

REPORT 2019



Institut Català
de Recerca de l'Aigua
Instituto Catalán
de Investigación del Agua
Catalan Institute
for Water Research

Research institute attached to the University of Girona

Annual Report 2019

This new proposed Directive on the quality of water for human consumption shall protect human health from any adverse effects of any contamination of water intended for human consumption and should promote as well the universal access of such water in all EU. (Drinking Water Directive).





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Report 2019

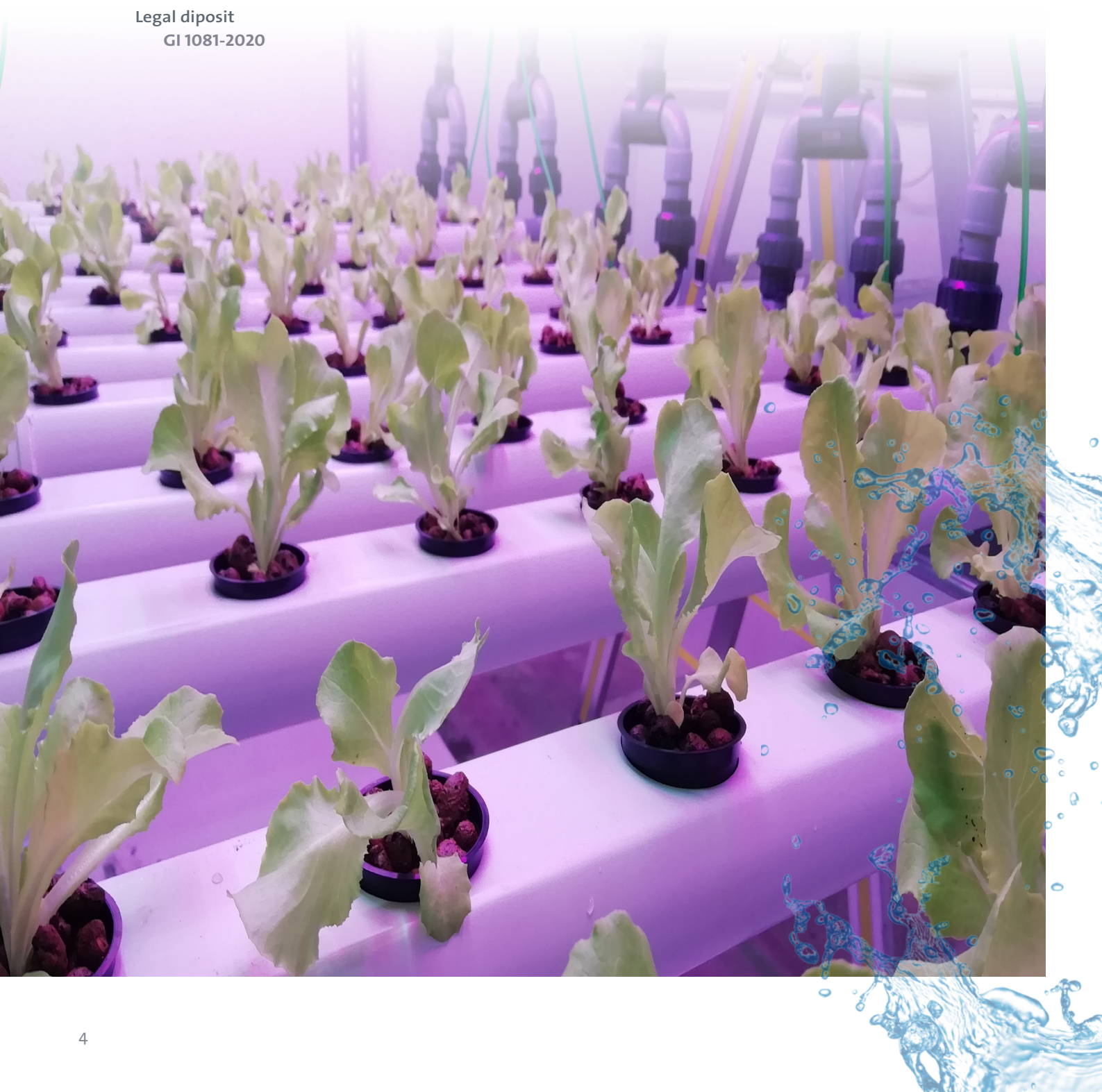
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CONTENTS

Annual Report 2019 ICRA

00	PRESENTATION	6
01	DESCRIPTION	8
02	ORGANISATION	10
	• BOARD OF TRUSTEES	12
	• COMMITTEES	14
	• DEPARTMENTS & STAFF	17
	DIRECTOR, DEPUTY DIRECTOR, GENERAL MANAGER & SECRETARY	17
	• R&D&I SUPPORT SERVICES	18
	ADMINISTRATION	18
	R&D&I OFFICE	19
	TECHNICAL-SCIENTIFIC PLATFORMS: SCT & PLANTEA	20
	• WATER FRAMEWORK DIRECTIVE PROJECT	26
	• HR EXCELLENCE IN RESEARCH AWARD	26
	• EQUALITY GENDER PLAN	27
03	RESEARCH AREAS	28
	• GENERAL INTRODUCTION	29
	• AREA I – RESOURCES AND ECOSYSTEMS	30
	• AREA II – WATER QUALITY	36
	• AREA III – TECHNOLOGIES AND EVALUATION	47
04	PUBLICATIONS & CONGRESSES	56
05	PROJECTS	72
06	CONTRACTS	80
07	AGREEMENTS	84
08	OTHER DISSEMINATION ACTIVITIES	88
09	AWARDS	106
10	FINANCING	108
11	ICRA IN THE NEWS AND PRESS	110





00

PRESENTATION

Once again, this year, I have the honour of introducing ICRA's Annual Activity Report. 2019 marked the 10th anniversary of the inauguration and occupation of the H2O building. Ten years ago, as we watched the structure of what was to be ICRA's headquarters emerge, enthusiastic and impatient to move in and fulfil our patrons' commitment to creating a centre of excellence for water research, we felt full of determination and drive. A decade later, I'm delighted to report we're just as enthusiastic, and despite the obstacles we've encountered, the path for future progress is laid.

As you'll see later in this book, ICRA goes from strength to strength, year after year, with scientific research and dissemination activities that are both extensive and relevant, despite only having a small number of researchers. Its international contribution and recognition as a centre of reference can be seen in the number of projects completed and theses read, in the number of publications in major scientific journals such as **Science, Trends in Ecology and Evolution, Science Advances, Trends in Microbiology**, and its contributions to networks and conferences... among other things.

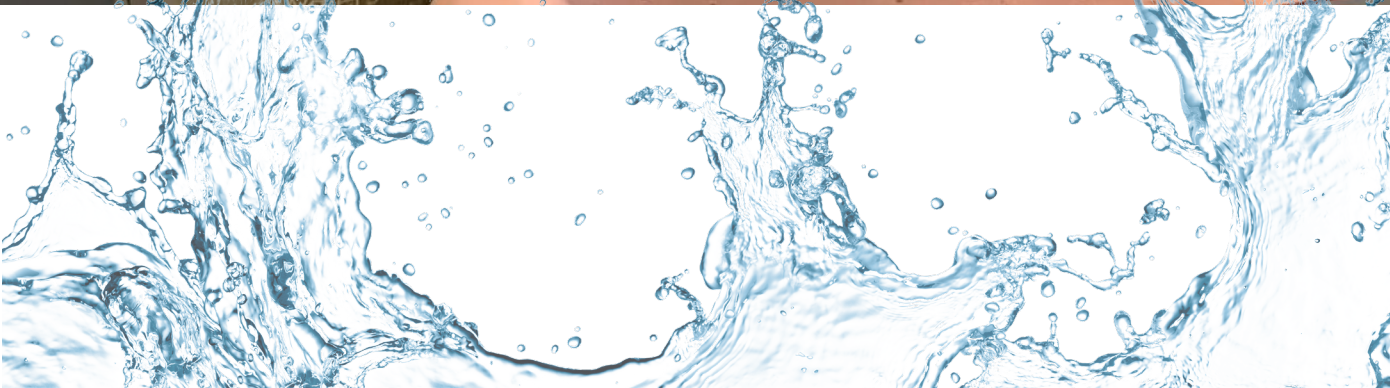
Furthermore, our work has evolved to consolidate new lines of research in response to the ever-changing demands and needs of society. These complement the initial lines proposed in the last Strategic Plan and include research into the impact of microplastics, the control of pollutants in drinking water and water management in the circular economy. The new research areas have given rise to projects such as **PLAS-MED** (*Microplastics and microcontaminants in the Mediterranean coast: Toxicity and environmental and human health impacts*), **SEWAGENE** (*Acumulación, dispersión y eliminación de resistencias a antibióticos en colectores de agua residual [Accumulation, dispersion and elimination of antibiotic resistance in wastewater collectors]*), **CLEaN-TOUR** (*Circular economy to facilitate urban water reuse in a touristic city: centralised or decentralised?*), **NDMA- Predict** (*Evaluación del potencial de formación de nitrosaminas (específicamente N-Nitrosodimetilamina -NDMA- como consecuencia de la cloraminación, y desarrollo de herramientas analíticas de prevención y alerta temprana en embalses de canal de Isabel II gestión [Evaluation of the potential for nitrosamine formation - specifically N- Nitrosodimethylamine -NDMA- as a consequence of chloramination, and the development of analytical tools for prevention and early warning in reservoirs managed by Canal Isabel II]*), and **HYDROUSA** (*Demonstration of water loops with innovative regenerative business models for the Mediterranean region*).

I want to end by thanking all the personnel at ICRA, once again, for their enthusiasm, hard work and dedication.

Read and enjoy!

Regards,

Damià Barceló
DIRECTOR



01

DESCRIPTION

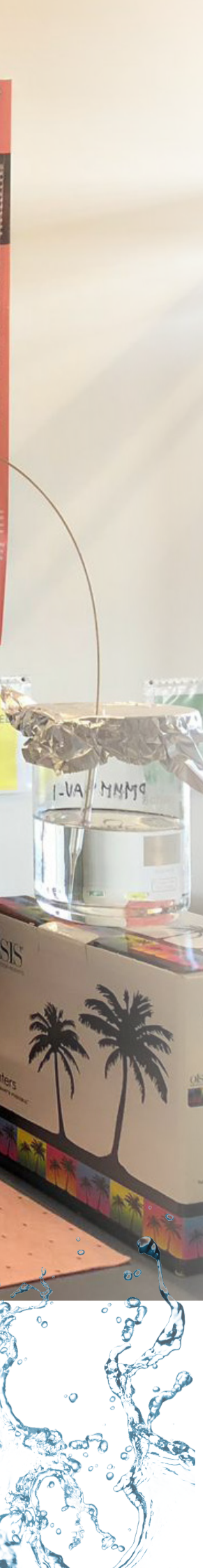
The Government of Catalonia established the Catalan Institute for Water Research (ICRA), within the framework of its **Catalan Research Centres Programme (CERCA)**, on the 26th of October 2006. **ICRA forms part of the CERCA programme.**

ICRA is supported by its trustees: **the Catalan Ministry of Business and Knowledge (DECO), the Catalan Water Agency (ACA) and the University of Girona (UdG).**

ICRA is a **multidisciplinary water research centre**, covering the complete water cycle. Research at the Institute deals with a range of topics, including the availability of **water resources**, the importance of **biodiversity**, assessing **water quality** (chemical, microbiological, ecological, etc.) and the development and evaluation of **treatment technologies**, as well as the **transfer of this knowledge** to the wider society, industry and the business network.

ICRA's mission is to be a point of **reference for water science and technology in the Mediterranean**. Its research, therefore, focuses on **the rational use and effects of human activity on water resources and aquatic ecosystems**, based on the importance of water as a fundamental resource for both natural systems and human needs.

ICRA's headquarters are located at the **H2O building at the University of Girona's Science and Technology Park**, inaugurated on the 7th of October 2009. The H2O building is equipped with cutting-edge facilities and technologies that are used to carry out national and international research projects. The Institute's scientific equipment was co-financed by the **Ministry of Economy and Competitiveness (MINECO)** and the European Regional Development Fund (ERDF), within the framework of the **ERDF Operational Programme for Catalonia 2007-2013**. Furthermore, between 2010 and 2011, and within the framework of the **2010 Spanish budget (MICINN, now MINECO)** ICRA was awarded a nominal subsidy to purchase the equipment required to commission artificial river facilities.





02

ORGANISATION



BOARD OF TRUSTEES

COMMITTEES

DEPARTMENTS & STAFF

- DIRECTOR, DEPUTY DIRECTOR, GENERAL DIRECTOR, GENERAL MANAGER & SECRETARY

R&D&I SUPPORT SERVICES

- ADMINISTRATION
- R&D&I OFFICE
- TECHNICAL-SCIENTIFIC PLATFORMS: SCT & PLANTEA

WATER FRAMEWORK DIRECTIVE PROJECT

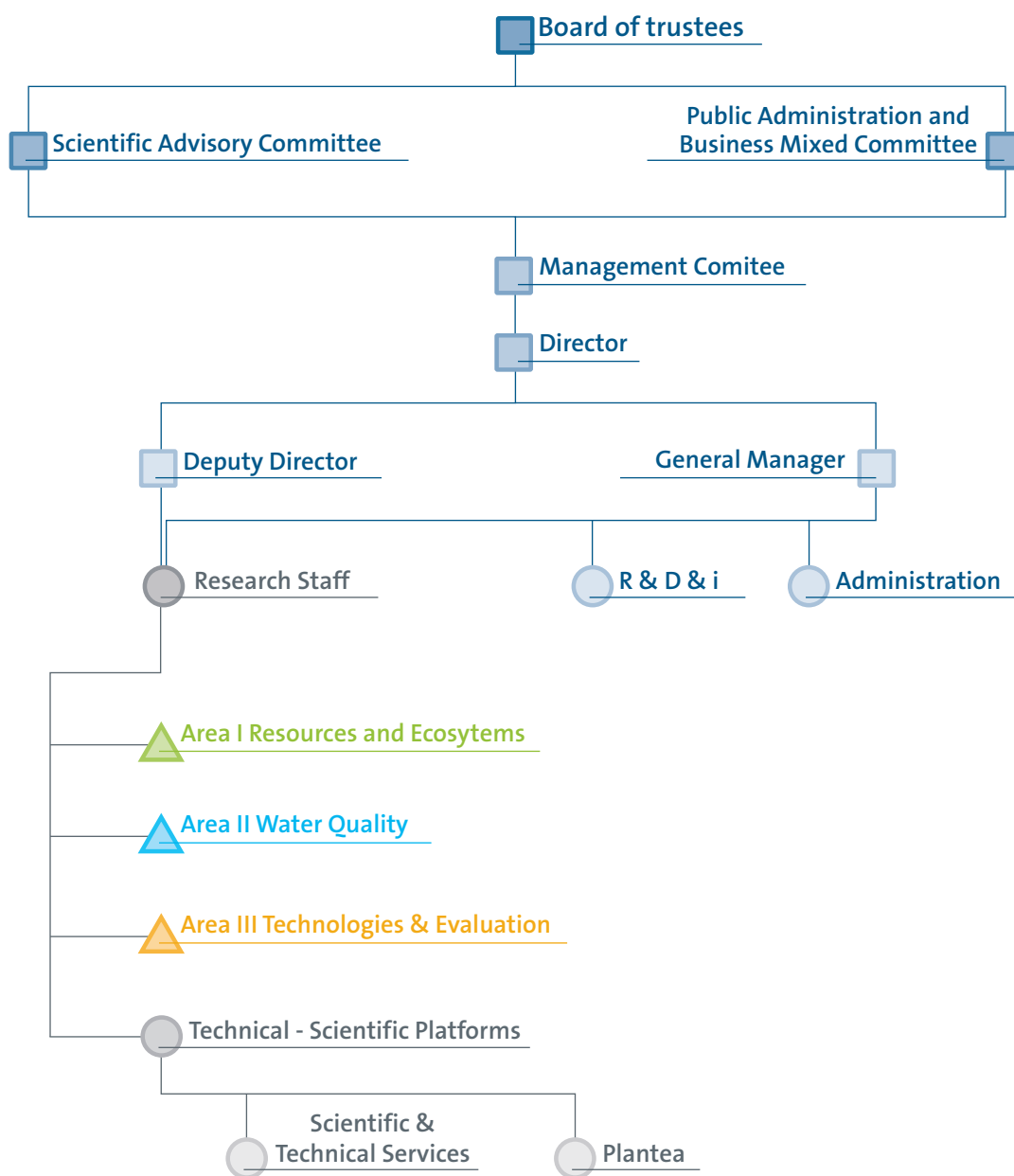
HR EXCELLENCE IN RESEARCH AWARD

EQUALITY GENDER PLAN

BOARD OF TRUSTEES

The Board of Trustees is ICRA's highest governing body. The trustees are the Catalan Regional Government's Ministry of Business and Knowledge (DECO), the Catalan Water Agency (ACA) and the University of Girona (UdG).

In 2019, the ICRA Board of Trustees met in an ordinary session on the 25/06/2019, and an extraordinary session on the 21/10/2019 (at the H2O building). This meeting was followed by a further extraordinary session on the 13/12/2019, which approved the new agreement with ICREA.



MEMBERS

CHAIR

M. Àngels Chacon i Freixes
Minister for Business and Knowledge
Ministry of Business and Knowledge
Regional Government of Catalonia

DEPUTY CHAIR

Joaquim Salvi
Rector
University of Girona

MEMBERS

Francesc Xavier Grau i Vidal
Secretary for Universities and Research
Secretariat for Universities and Research
Ministry of Economy and Knowledge
Regional Government of Catalonia

Joan Gómez Pallarès
Managing Director of Research
General Directorate of Research
Ministry of Economy and Knowledge
Regional Government of Catalonia

Anna Albar
Managing Director
Science and Technology Park
University of Girona

Josep Calbó
Vice-Rector for Strategic Projects
University of Girona

Lluís Ridao
Director of the Catalan Water Agency
Catalan Water Agency
Ministry of Territory and Sustainability
Regional Government of Catalonia

TRUSTEE SECRETARY

Lluís Rovira
Director of CERCA (Catalan Research Centres)
General Directorate of Research
Ministry of Business and Knowledge
Regional Government of Catalonia

NON-TRUSTEE DEPUTY SECRETARY

Josep M. Alcoberro
Legal Department of CERCA (Catalan Research
Centres)
Ministry of Business and Knowledge
Regional Government of Catalonia



COMMITTEES

SCIENTIFIC ADVISORY COMMITTEE

The **Scientific Advisory Committee** is appointed by the Board of Trustees and includes an unspecified number of scientists of acknowledged repute and expertise in the field of water and all other related areas of science. This Committee's membership represents the ICRA's different priority areas of research. One of its most significant tasks is to ensure the quality of the research carried out at the ICRA. Accordingly, it acts as an advisory body for all issues relating to the scientific activities submitted for its consideration and, when requested, it will also act as an evaluating body for these activities.



Bernd Bilitewski

Chair of the Scientific Advisory Committee. Emeritus Professor of the Institute for Waste and Pollutant Management, Dresden University of Technology (DE)



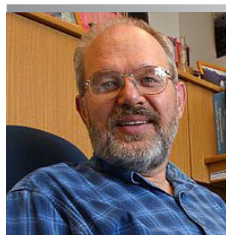
Inmaculada Ortiz Uribe

Head of the research group in Advanced Separation Processes. Faculty member of the Department of Chemical Engineering and Inorganic Chemistry, University of Cantabria, Santander (ES)



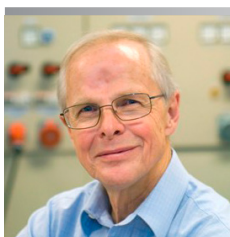
Clifford Dahm

Emeritus Professor of Department of Biology, University of New Mexico, Albuquerque (USA)



Edward Furlong

Head of the Methods Research & Development Program, National Water Quality Laboratory, US Geological Survey, Denver Federal Center, Denver, CO (USA)



Gustaf Olsson

Emeritus Professor of Industrial Automation, Department of Industrial Electrical Engineering and Automation (IEA), Lund University, Lund (SE)



Amadeo Rodríguez Fernández-Alba

Head of the European Reference Laboratory for Pesticides. Faculty member of the Department of Hydrogeology and Analytic Chemistry, University of Almería, Almería (ES)



Jeanne Garric

Director of the Ecotoxicology Laboratory, Aquatic Ecosystems Biology Unit, Department of Water Quality and Pollution Prevention, IRISTEA (FR)



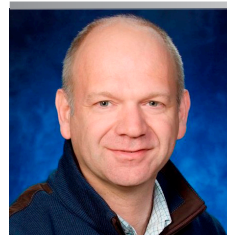
Maria Reis

Full Professor in Environmental Biotechnology, Department of Chemistry, Sciences and Technology Faculty, University Nova of Lisbon (UNL), Portugal (PT)



Emilio Custodio Gimena

Emeritus Professor of the Department of Geotechnical Engineering and Geosciences, Groundwater Research Team of the Polytechnic University of Catalonia, Barcelona (ES). Correspondent member of the Royal Spanish Academy of Sciences. President of the Advisory Committee of the Fundación Centro Internacional de Hidrología Subterránea (FCIHS)



Peter Vanrolleghem

Holder of the Canada Research Chair on Water Quality Modeling (modelEAU) and Professor of the Department of Civil Engineering and Water Engineering, Université Laval, Quebec, Canada (CA)



Georg Teutsch

Scientific Managing Director of the Helmholtz - Centre for Environmental Research (UFZ) at Leipzig, Germany (DE), Full Professor in Hydrogeology at the same centre, Member of the National Committee for Global Change Research, Member of the German Commission on Water Research



Paola Verlicchi

Professor in Environmental and Sanitary Engineering, Engineering Faculty, Department of Engineering, University of Ferrara, Italy (IT)



Jörg Overmann

Director of the Leibniz-Institute German Collection of Microorganisms and Cell Cultures (DSMZ) and Head of the Department Microbial Ecology and Diversity Research, Leibniz, Germany (DE)



Susan D. Richardson

Arthur Sease Williams Professor of Chemistry, Department of Chemistry & Biochemistry, University of South Carolina (USA)



Peter-Dietrich Hansen

Director of the Department of Ecological Impact Research and Ecotoxicology, Berlin Institute of Technology (BIT), Germany (DE)



Stan Gregory

Emeritus Professor, Department of Fisheries & Wildlife, Oregon State University (USA)

PUBLIC ADMINISTRATION AND BUSINESS MIXED COMMITTEE

The Public Administration and Business Mixed Committee is the body for business participation in the Foundation. It may be consulted by the Board of Trustees and by the Director and may issue recommendations for guidance.

The functions of the Public Administration and Business Mixed Committee are:

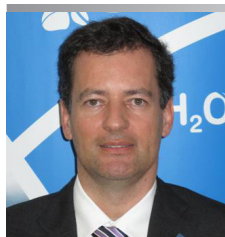
- Assisting in detecting industry needs and suggesting specific business proposals
- Identify attractive technology development opportunities
- Promote participation in joint research projects and facilitate access of the Foundation to public and private resources
- Assist in the creation of spin-offs
- Participate in activities related to the Foundation's objectives



Xavier Tristán Prat

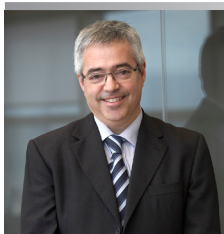
Chair of the Business Committee

Acting Manager of the Costa Brava Consortium (CCB) and Head Engineer for Technical Services at the CCB. Member of the Advisory Council for the Sustainable Development of Catalonia (CADS).



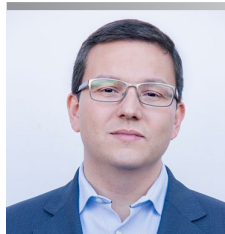
Sergi Martí Costa

Managing Director of STENCO, AQUA AMBIENT IBÉRICA and TRAINING INDUSTRIAL.



Jaume Carol Pañach

Managing Director of FLUIDRA. President of the Catalan Water Partnership (CWP), the Catalan Water Cluster and member of the Catalan Sports Cluster Board (INDESCAT).



Carlos Montero

Managing Director of CETaqua.



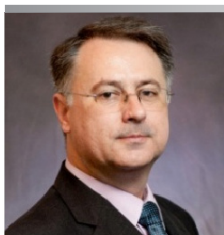
Jesús Gómez del Blanco

Managing Director of RECIPHARM Parets S.L.U., the Spanish subsidiary of RECIPHARM AB (Sweden)



Antonio Ordóñez

Director of Research, Development and Innovation - GS INIMA Environment, S.A.



Jorge Juan Malfeito Sánchez

Director of R&D&I at ACCIONA Agua S.A.



Valentin Garcia

Director of Hydraulic Public Works, National and International, at SOIL AGUAS, SOIL Group.

DEPARTMENTS & STAFF



DIRECTOR

Damià Barceló

Research Professor of the Institute of Environmental Assessment and Water Studies (IDAEA), of the Spanish National Research Council (CSIC)



DEPUTY DIRECTOR

Sergi Sabater

Full Professor of Ecology at the University of Girona. Head of ICRA's Resources and Ecosystems Research Area



GENERAL MANAGER

Iván Sánchez

General Manager



EXECUTIVE SECRETARY

Olga Corral

Executive Secretary, Director's Office

EDIFICI H₂O
Parc Científic i Tecnològic de la UdG

In 2019,
100 people contributed to ICRA's R&D&I activities

- 83** Research personnel
- 12** Management/ Administration personnel
- 4** R&D&I personnel
- 1** Framework Directive Project personnel



R&D&I SUPPORT SERVICES

The General Manager of ICRA is responsible for all the basic services that provide support for R&D&I:

- ADMINISTRATION
- R&D&I OFFICE
- TECHNICAL AND SCIENTIFIC PLATFORMS:
 - > Scientific and Technical Services (SCT)
 - > PLANTEA

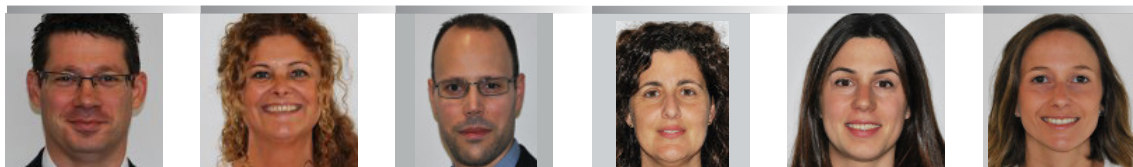
ADMINISTRATION

In 2019, the active administrative services that performed specific functions within each field of activity were:

- Human Resources
- Purchasing and Procurement (Outsourcing)
- Finance and Accounting
- Information Technologies
- Communication, Image and Promotion
- Quality and Environment
- General Services

The **Outsourcing Service** has managed 3 types of contract: services, supplies and construction, with the objective of providing ICRA's 3 research areas and the SCT with both basic and special scientific equipment.

This equipment has been 50% co-financed by the EU's European Regional Development Fund (ERDF) under the Catalan ERDF Operative Programme 2007-2013 and it also received funding from MINECO (the Spanish Ministry of Economy and Competitiveness), directly and through the Third Additional Provision (DA3^a) of the Catalan Statute of Autonomy.



Iván Sánchez

General Manager

Olga Corral

Executive Secretary,
Director's Office

David López

Human Resources
Head

Susana Roca

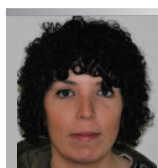
Eco-Fin Head

Neus Fàbrega

Accounting and
Support to Research
(until March)

Janina Manrique

Accounting and
Support to Research



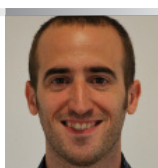
Laura Sancho

Administration
Technician



Esther Llorens

RDI Technician



Rubén Díaz

IT



Pere Royo

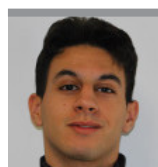
Reception



Sandra Monleon

Reception

VISITING STUDENTS



Achraf Aloui

Internship Student,
Montilivi HS
(Girona)



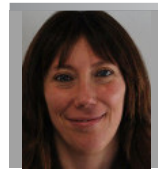
Jenifer Avila

Internship Student,
Montilivi HS
(Girona)

R&D&I OFFICE



Jaume Alemany
R&D&I Office Manager



Laura Bertolini
European and
International
Project Officer



Rina Weltner
Project Manager



Arnau Mulla
Administration Technician
(until February)

Objectives and activities of the R&D&I Office

The purpose of the R&D&I Office is to enhance the capacity of ICRA to scale research and gain international prestige by attracting external funding and partnerships. The operational objective of the Office's activities is therefore to increase the participation of the ICRA's research groups in nationally and internationally funded basic and applied research projects and to increase industry connections through the application of research results.

The Office assists ICRA's researchers in the definition and implementation of a strategy for participation in research-grant funding initiatives at the local, national and international level. We also offer our researchers full support for calls search and proposal preparation and presentation, as well as advice on all proposal-related financial and legal issues. Finally, we provide full support for the administrative and financial management of successful grants and technology transfer contracts with local and international enterprises.

In 2019 ICRA presented around 30 European proposals either as coordinator (9) or participant. So far we received notice of 4 successful proposals: 1 Marie Curie Skłodowska Action Individual Fellowships (MICROWATER), 1 Marie Curie Skłodowska Action Innovative Training Network in which ICRA performs as coordinator (NOWELTIES) and 2 H2020 Societal Challenge collaborative projects (DRYVER and EMERGE), for a total of more than €1.5M. 8 proposal are still pending of evaluation.

At the moment, the European and international projects unit is managing a total of 17 projects, 7 of which coordinated by ICRA for a total of almost €6M.

Our aim for 2020 is to work intensively with interna-

tional consortia in order to prepare and present at least 20 European proposals as we did in 2019. Apart from the last H2020 calls, we will be working to actively participate in the WATER JPI and the new Partnership on Research and Innovation in the Mediterranean Area (PRIMA) calls. ICRA will also participate in the forthcoming calls issued by the ERC Starting, Consolidator, and Advanced Grants, as well as the ENI CBC MED and by water/climate-related ERA-NET Initiatives.

The Next Framework Programme (*Horizon Europe*) will be launched in 2021. In 2020 the unit will also be engaged in the process of understanding what went into the Commission's new Framework Programme and preparing participation strategies for the period 2021-2027.

ICRA is also participating in 2 COST actions: Science and Management of Intermittent Rivers and Ephemeral (SMIRES) and Circular City Re.Solution (Circular City).

In terms of national funding, during 2019 a total of 33 proposals were submitted to Spanish and Catalan funding agencies; 6 of which have been awarded for a global amount of €275,000 and 7 proposals are still pending resolution for a global amount of €750,000.

In 2019, the National Projects Unit has managed 14 research projects, 12 funded by the Spanish National Funding Agency and Spanish Ministry of Science, Innovation and Universities (AEI-MCIU), 1 project funded by Catalan Government through Eurodistrict collaboration programme and 1 project funded by the Catalan Agency for Competitiveness (ACCIÓ) and ERDF; 22 Fellowship Grants (12 funded by AEI-MINECO and 10 by the Catalan Agency for Management of Universities and Research Grants - AGAUR) and 2

networking projects funded by AGAUR.

As for the Knowledge and Technology Transfer (KTT) Unit, a total of 6 collaborative contracts have been signed with private companies and public entities during 2019 for a global amount of €215,145. Although the number of projects decreased compared to 2018 (-1), their global amount increased (+26%)

because there has been a clear rise in individual budgets reflecting higher commitment from companies.

On IPR management, 6 assets emerging from research results have been evaluated in collaboration with researchers (inventors) for protection and possible future commercialisation.

TECHNICAL AND SCIENTIFIC PLATFORMS

Since one of the objectives of ICRA is to transfer knowledge and provide practical solutions, the Scientific and Technical Services (SCT) provide analytical services and PLANTEA for scaling up processes to pilot plant scale.

In 2019, the technical and scientific platforms have been consolidated to provide a quality scientific and technical support service to researchers.

The SCT has also carried out continuous training and specialisation of technicians.



Sara Insa Aguilar
ICRA Head of SCT



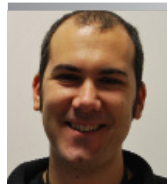
Marta Villagrasa Giménez
ICRA Head of SCT



Olga Montojo Jordan
ICRA Research Technicians



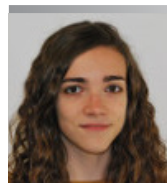
Mireia Núñez Marcé
ICRA Research Technicians



Àlex Sánchez Melsió
ICRA Research Technicians



Natàlia Serón Mallo
ICRA Research Technicians



Maria Simón Font
ICRA Research Technicians

These platforms are the following:

Platform (PLANTEA)

- SCIENTIFIC AND TECHNICAL SERVICES (SCT)
- WATER SCIENCE AND TECHNOLOGIES RESEARCH PLATFORM (PLANTEA)

SCIENTIFIC AND TECHNICAL SERVICES (SCT)

The Scientific and Technical Services (SCTs) of the ICRA constitute a fundamental element in the development of the activities programmed by the Institute. Throughout 2019, SCTs have not only focused on conducting a wide range of chemical and microbiological analyses on environmental matrices, but also have been actively involved in the implementation of numerous research projects in the field of support and advice.

The most significant actions carried out during 2019 are framed in the provision of multiple analysis services in aqueous matrices of diverse origin (residual, natural, consumption, etc.) for both internal users and external entities, thus consolidating an analytical catalogue that adapts to the needs that are originating. As a particularly relevant contribution, it should be noted the contribution of the SCTs in the second edition of the Water Framework Directive project (WFD), promoted by the Catalan Water Agency (ACA), where apart from applying methodologies for studying the ecological status of different water bodies, new protocols for pesticide determination have been developed.

Many of the analytical services offered by the SCTs have materialised through the incorporation of new analytical parameters, contributions to congresses, manuscripts published in high-impact international journals, and/or represent the starting point for applications for new research projects or collaborations with other agencies.

The rigour and quality of the results obtained are explained by the experience and qualification of the team members of the SCTs, along with the dedication to the maintenance of scientific facilities and equipment, which are regularly subject to verification and calibration in order to guarantee its proper operation. It is precisely the commitment to cutting-edge instrumentation that has led to different procedures for the hiring of new equipment during 2019. At the same time, the accreditation has been obtained by the Radioactive Activity Coordination Service for the opening of the ICRA Radioactive Installation (IRA).

Aware of the vital importance of ensuring occupational safety in accordance with current regulations, the preparation of the procedure for the acquisition of suitable infrastructures for the handling of compounds with special

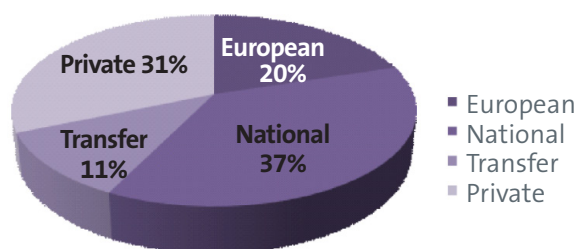
requirements due to their toxicity has been encouraged.

In line with the continuous improvement and global growth of the ICRA, various seminars have been organised coordinated with researchers and companies related to spectrometric techniques. At the same time, it has invested in data processing software to offer a more competitive and efficient service. The training task has been completed with the training, mentoring and supervision of undergraduate, masters, doctoral students and other academic profiles.

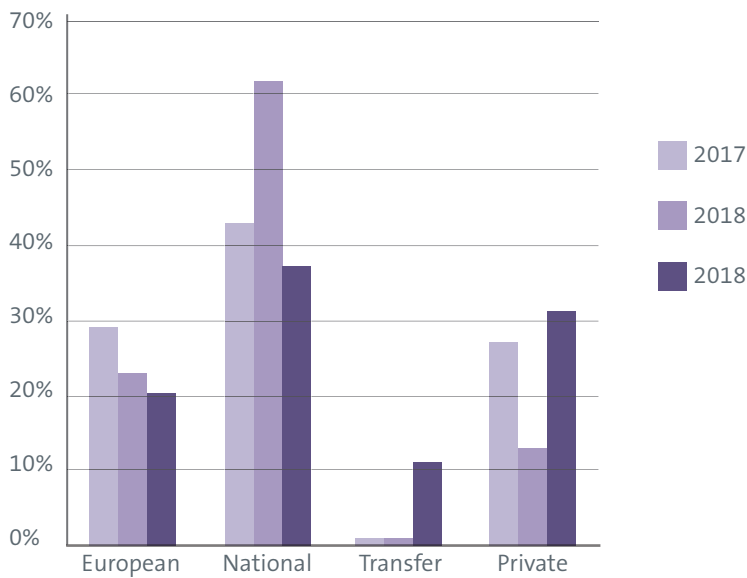
Finally, the SCTs have shown a desire to maintain environmental responsibility in their roadmap by reviewing activities and replacing those determinations associated with toxic waste reagents by others that minimise their impact.

TECHNOLOGY TRANSFER

Focusing on the analytical work of the SCTs, which is endowed with different types of projects (national, European, private and transfer), we conclude that 2019 has been very successful in terms of knowledge outsourcing because, and as shown in the following figure, almost half of the revenue received is from external sources (31%) and associated with technology export collaborations (11%).

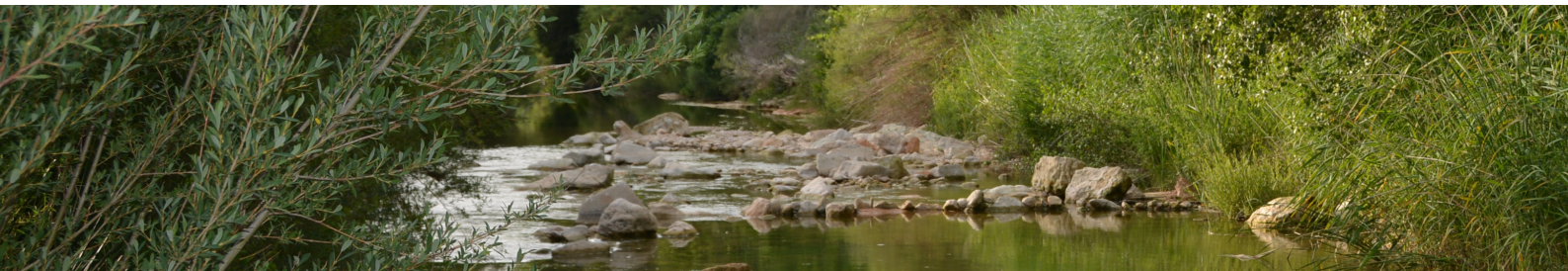


In retrospect, comparing the funding allocations of the SCTs over the last three years shows a slight decrease in funding for national and European projects. On the other hand, the increased analytical offer has been rewarded with a substantial increase in investments derived from the transfer of knowledge, the attraction of new clients and the loyalty of satisfied SCT users.



ICRA Head of SCT:
 - Sara Insa Aguilar
 - Marta Villagrasa Giménez

ICRA Research Technicians:
 - Olga Montojo Jordan
 - Mireia Núñez Marcé
 - Àlex Sánchez Melsió
 - Natàlia Serón Mallol
 - Maria Simón Font



WATER SCIENCE AND TECHNOLOGIES RESEARCH PLATFORM (PLANTEA)

The Catalan Institute for Water Research (ICRA) is the home of the Water Science and Technologies Research Platform (PLANTEA).

The Water Science and Technologies Research Platform (PLANTEA) is a space where research and industrial development projects can be carried out with pilot plants of different sizes (up to semi-industrial scale).

These pilot plants make it possible to carry out research projects on advanced treatment of both wastewater and treated water or water that can be made potable, and on projects for monitoring, eliminating and evaluating the effects of contaminants in water, as well as studies that require large-scale equipment.

This facility has been 50% co-financed by the EU's European Regional Development Fund (ERDF) under the Catalan ERDF Operative Programme 2007-2013 and also received funding from MINECO (Spanish Ministry of Economy and Com-

petitiveness) directly and through the Third Additional Provision (DA3ª) of the Catalan Statute of Autonomy.

SCIENTIFIC-TECHNICAL PLATFORMS

The PLANTEA test platform currently provides ICRA with benchmark facilities for carrying out three different aims:

- The study of wastewater transport and treatment systems in conditions as similar as possible to the real world (pilot plants).
- The study of the response of fluvial ecosystems in different conditions thanks to the installation of an experimental stream facility (ESF).
- An artificial aquatic mesocosm ecosystem that makes it possible to carry out studies on exposing organisms such as mussels and/or fish to chemical contaminants.

LAB AND PILOT SCALE PLANTS AT PLANTEA UNIT (LABORATORY L06)

During 2019 there have been several pilot plants in operation in the PLANTEA platform to mimic real wastewater transport and treatment systems. Regarding the in-sewer research, in 2019 efforts have been focused in studying the presence and mobility of antibiotic resistance genes during wastewater transport. These activities were part of a project funded by the Spanish Government that finished in December (SEW-AGENE).

Also, a forward osmosis unit was constructed to concentrate real municipal wastewater. Several tests were conducted during the year to optimise this novel technology to treat real wastewater. The concentration of different compounds present in the wastewater (nutrients, pharmaceuticals, etc.) have been assessed during the filtration process. The concentrate produced has been treated with an anaerobic lab-scale membrane bioreactor (AnMBR) and the amount of biogas production has been assessed.

Novel advanced oxidation processes (UV/persulphate, UV/HOCl) were studied in a pilot plant employing low-pressure mercury lamps in the context of the INVEST project to degrade pharmaceutical compounds in secondary effluent.

Three technologies have been operated and compared for the treatment and reuse of grey-water in the context of the circular economy (CLEaN-TOUR project): a) semi-industrial scale low energy requirement membrane bioreactor (Smart Air MBR); b) forward osmosis membranes and c) hydroponic-constructed wetlands. With regard to this last point, one system is installed at Hotel Samba (Lloret de Mar) with ornamental and edible plants and a new one is being built and operated under controlled conditions in the PLANTEA platform.

All these installations are fully monitored and controlled by different PLC systems connected to a SCADA program, allowing real-time control of the processes taking place in each of the pilot plants. This is possible thanks to the numerous monitoring systems in PLANTEA facilities such as dissolved oxygen, pH, redox, nitrate and hydrogen sulphide sensors connected to the SCADA system.

Finally, the PLANTEA laboratory has a direct connection to a sewage pumping station that collects the wastewater from local neighbourhoods. This greatly facilitates the use of real wastewater for the experiments conducted in the PLANTEA pilot plants.



The Experimental Streams Facility makes it possible to simulate the response of fluvial ecosystems to different environmental conditions.

TITLE:

Assessing the relative roles of frequency and duration of the non-flow period on stream biofilm communities

DATES:

18 artificial streams, acclimation phase (7 days, from 4/09 to 10/09/2019) and experimental phase (84 days, from 11/09 to 4/12/2019)

OBJECTIVE:

- Study the effects (impact and recovery) of duration (28 vs 56) and frequency of non-flow periods (1, 2 or 4) on river biofilm communities in experimental streams

EXPERIMENTAL DESIGN:

6 different treatments were performed using a total of 18 artificial stream channels, with two levels of duration (28 vs 56 days of non-flow) and 3 levels of frequency (1, 2 and 4 non-flow periods). Biofilm samples were collected at 4 different times during the experiment: at the beginning, before the last flow period, after 7 days of the last flow period and at the end of the experiment (Fig. 1).

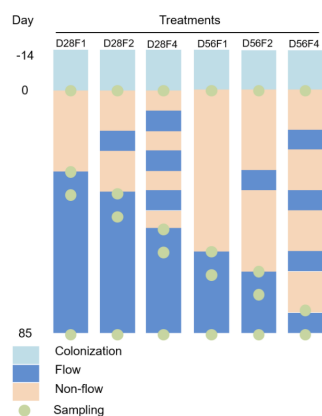


Figure 1 – Experimental design of the treatments used in the experiment

Sediment and cobbles biofilm samples (Fig. 2) were collected to analyse the bacterial and meiofauna community composition, live and dead bacteria, metabolism, community respiration (Resazurin technique) and the photosynthetic parameters using the Diving PAM. Finally, water samples to analyse the nutrient balance during 48h after the non-flow periods were also collected.

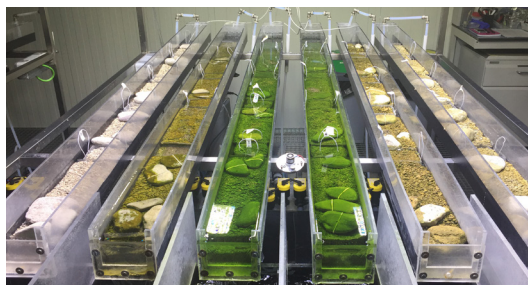


Figure 2. Picture of the artificial streams used in the experiment

PRELIMINARY RESULTS:

Results of this experiment showed that both duration and frequency of non-flow periods alter biofilm communities. Although epilithic biofilm was greatly affected in all the treatments, no significant differences were observed between the duration and frequency of non-flow periods. On the contrary, the epipsamic biofilm showed significant differences between treatments. One of the reasons of this finding could be linked to the nature of the substrate, as sands could keep the moisture in the interstitial space, creating a different humidity gradient between treatments. By contrast, in the cobbles, this gradient does not exist and in few hours or days the surface of the cobbles was completely dry, impacting quickly and similarly the biofilm community among treatments.

Regarding the epipsamic biofilm, higher impact was observed after 56 days, especially in the autotrophic compartment (decreased photosynthetic efficiency and gross primary production) in contrast to 28 days. Moreover, higher frequency of non-flow periods decreased the impact on the autotrophic and heterotrophic biofilm compartment (i.e. high ratio of live/dead bacteria, high algal biomass, and high community respiration).

Results of this experiment are being analysed. Three publications are planned for high-impact scientific journals, one covering all the results, one detailing the results of the bacterial community and another one focusing on the meiofauna results.

Under the scope of the project PLAS-MED, the fluvial mesocosms of the Experimental Streams Facility (ESF) of ICRA have been used to perform exposure experiments with river biofilms using microplastics and emerging contaminants. Two studies were conducted to understand the impact of microplastics on the toxicity,

bioaccumulation and biotransformation of other emerging contaminants on river biofilms.

Artificial mesocosms were used to perform two short-term exposure experiments (72h), using as model contaminants polyethylene microplastics and the antibiotic clarithromycin (experiment 1) and the bactericide triclosan (experiment 2). In the experimental setup, 5-week-old biofilm, previously grown on glass tiles in artificial stream channels, was exposed to 4 different conditions: a) polyethylene microplastics only; b) emerging contaminant only; c) emerging contaminant + polyethylene microplastics; d) control experiment with no addition of contaminants (Figure 1).

ARTIFICIAL AQUATIC ECOSYSTEM

An artificial aquatic ecosystem has been set up at ICRA's facilities. It consists of two 400 L aquarium systems, which can be used to recirculate salt water and fresh water.

The system is equipped with protein skimmers, biological and chemical filtration, temperature control and aeration, simulating the characteristics of both marine and freshwater environments. The mesocosm is thus available to perform research studies where aquatic organisms such as mussels and/or fish are exposed to chemical contaminants to study the impact of environmental pollution on these organisms and evaluate the possible implications for human consumption.

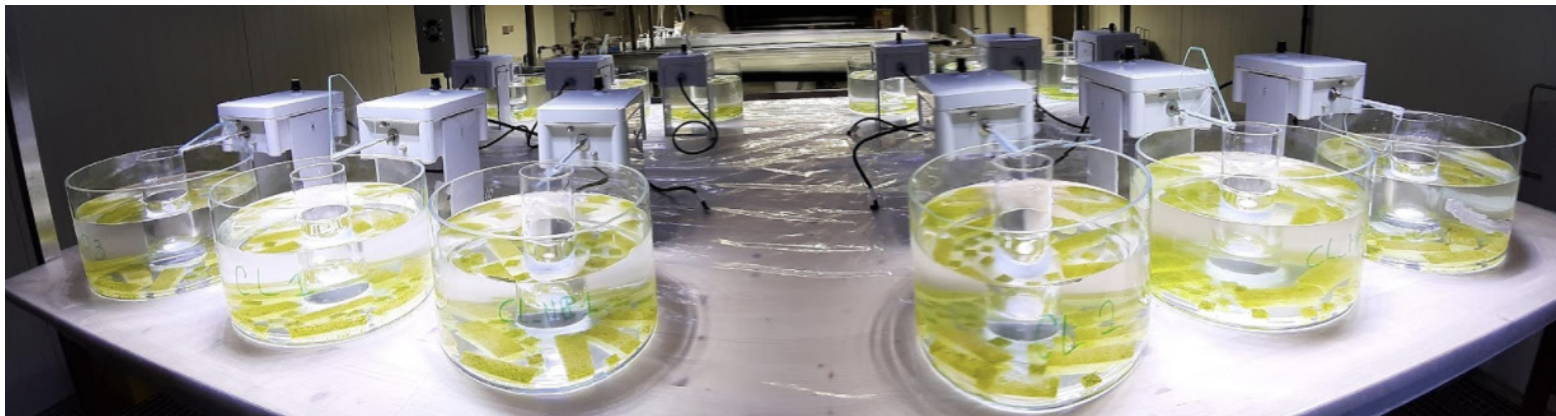


Figure 1 – Artificial mesocosms used for the exposure experiment of river biofilms to microplastics and clarithromycin

The preliminary results of both experiments showed that microplastics were not highly toxic for river biofilms; however, their presence may impact the availability and bioaccumulation of the selected emerging contaminants (Figure 2).

Experiment 1 showed that clarithromycin caused a pronounced decrease in photosynthetic efficiency and net metabolism relative to the control and exposure to polyethylene microplastics alone. The co-exposure to clarithromycin and polyethylene microplastics showed a more pronounced reduction in chlorophyll-a concentration and the activity of the enzyme leucine aminopeptidase than single exposure scenarios. In experiment 2, triclosan also affected the photosynthetic efficiency, either alone or in combination with polyethylene microplastics, relative to the control. Triclosan did not show significant changes on other studied toxicological parameters. Complementary studies using omics techniques will be further performed to elucidate possible changes in the community at the structural and functional levels.

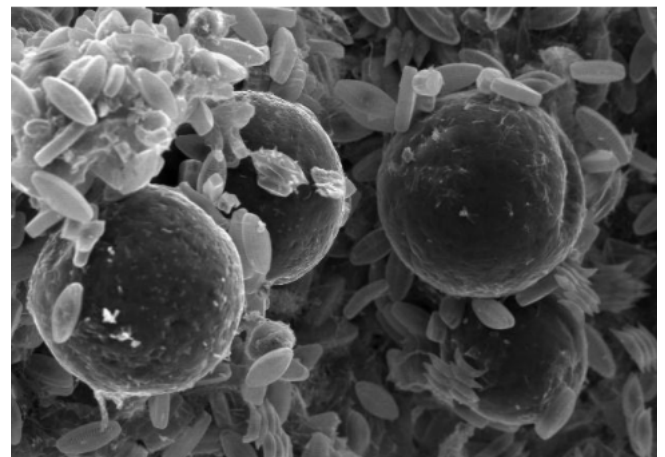


Figure 2 – Interaction of polyethylene microplastics with river biofilm (experiment 2)

FRAMEWORK DIRECTIVE PROJECT

COMPLEMENTARY ACTIONS OF THE WATER FRAMEWORK DIRECTIVE PROJECT:

Strategic project on knowledge acquisition regarding the obligations from the Water Framework Directive

The European Commission has been adopting and publishing new legislation and requirements for monitoring and control programmes since the Water Framework Directive was published. One of its objectives is improving knowledge of the chemical state of water bodies, especially for those organic pollutants about which little is known. Accordingly, ICRA undertook the strategic **WATER FRAMEWORK DIRECTIVE PROJECT**. Its main objective was the determination of the appearance of priority substances and new emergent pollutants in the Catalan water bodies in order to provide new tools for the improvement of their chemical state. The project has continued with the monitoring of some sampling points detected as problematic. This has led to the need to develop new analytical methods. These **COMPLEMENTARY ACTIONS OF THE WATER FRAMEWORK DIRECTIVE PROJECT** started at the end of 2018. In this stage ACA collaborated doing the sampling campaigns and providing the samples.

Throughout 2019 analytical methods were developed, optimised and set up for the following contaminants: 1) glyphosate, AMPA, glufosinate, and carbendazim for the groundwater matrix; 2) diclofenac and Watch List compounds for the freshwater matrix; and 3) VOCs, OCPs, PAHs, dichlorvos, and endosulfans for the marine water matrix.

Then 192 samples coming from the Catalan water bodies were analysed and a total of 254 compounds were studied in 5 matrices.

The results obtained have made it possible to carry out a more accurate chemical assessment of the Catalan water bodies as well as a more precise risk assessment study of the chemical compounds in relation to the thresholds established by the Water Framework Directive and related legislation.

Biota (fish)		Freshwater
PCDDs, PCDFs, PCB-DLs	PBDEs	PFASs
PCBs	Dicofol	HBCDDs
DDXs	PFASs	Diclofenac
Marine water		Watch List
HBCDDs	OCPs	Chloroalkanes
PFASs	PAHs	Groundwater
VOCs	Pesticides	Pesticides
River sediments		
HCHs	NPEOS (n=0, n=1, n=2)	PAHs

Project manager – **Esther Llorens**

HR EXCELLENCE IN RESEARCH AWARD

In December 2015, the Catalan Institute for Water Research (ICRA) received the “HR Excellence in Research” award from the European Commission.

This award and its logo recognises that ICRA endorses the policies and practices of The *Human Resources Strategy for Researchers (HRS4R)*, established by the European Commission to implement principles of the European Charter for Researchers and the Code of Conduct for the Recruitment of Researchers (Charter & Code).

In December 2018, ICRA performed Internal Review for Interim Assessment to HRS4R.



HR EXCELLENCE IN RESEARCH

Work is also being done on integration of the OTM-R Policy (Open, Transparent and Merit-based Recruitment of Researchers) into ICRA's HR Policy.

GENDER EQUALITY PLAN

Pursuant to Act 3/2007 of 22 March on effective equality between women and men, ICRA and the Standing Committee on Equality have executed the Gender Equality Plan with the aim of establishing and developing policies that integrate equal treatment and opportunities between women and men.

The Standing Committee on Equality is a multidisciplinary team composed of 4 people from different areas and groups at ICRA. Questions or concerns on this matter can be addressed to the Standing Committee.





03

RESEARCH AREAS

ICRA's Research Plan is structured in three main research areas, each with a mission and a vision aligned with those of ICRA.

The ICRA's areas and respective lines of research are as follows:

AREA I RESOURCES AND ECOSYSTEMS

LINES

- AI1 Hydrological Processes
- AI2 Lacustrine and Reservoir Systems
- AI3 Fluvial Systems
- AI4 Modelling of Ecosystems and Basins

AREA II WATER QUALITY

LINES

- AI11 Chemical Contamination of Water Bodies
- AI12 Contaminants in Wastewater
- AI13 Quality and Microbial Diversity
- AI14 Ecotoxicological Response of Biota to Contaminants

AREA III TECHNOLOGIES AND EVALUATION

LINES

- AI111 Water Supply and Advanced Treatment
- AI112 Wastewater Treatment, Reuse and Resource Recovery
- AI113 Modelling and Management Systems
- AI114 Unit Operations



Area I

RESOURCES AND ECOSYSTEMS

THE LINES OF RESEARCH OF THE RESOURCES AND ECOSYSTEMS AREA ARE:

- ▷ A11 HYDROLOGICAL PROCESSES
- ▷ A12 LACUSTRINE AND RESERVOIR SYSTEMS
- ▷ A13 FLUVIAL SYSTEMS
- ▷ A14 MODELLING OF ECOSYSTEMS AND BASINS





17 RESEARCHERS IN THE AREA

- 1 Research Professor (UdG associated) and group leader
Sergi Sabater
- 1 Research Professor (UdL associated)
Ramon J. Batalla
- 1 Research Professor (UdG associated)
Josep Mas-Pla
- 2 Research Scientists
Vicenç Acuña • Rafael Marcé
- 1 Postdoc Researcher
Carme Font
- 1 Postdoc Researcher
Núria Catalán
- 1 Postdoc Researcher
Anna Freixa
- 1 Postdoc Researcher
Perujo Buxeda, Núria
- 1 Postdoc Researcher
Didac Jordà
- 5 Predoc Researchers
**Miriam Colls • Elias Munthali •
Juan David González • Oriana Lucía Llanos •
Duygu Tolunay**
- 2 Research Technicians
Julio César López • Daniel Augusto Mercado

Area I

RESOURCES AND ECOSYSTEMS

The activities of ICRA's Resources and Ecosystems Area have been developed through several projects now reaching their final stages, as much as through the commencement of new projects with companies and public bodies. During 2019, eight postdoctoral researchers (Drs J.C. López, D. Jordà, C. Font, E. Tornés, A. Freixa, D. Mercado, J. Castellà, and N. Perujo) have contributed to the research performed in the R&E Area. During this period two PhD students of the Area finished their theses (Jordi-René Mor and Ferran Romero).

Research on the sustainable use of water resources in the face of global change was conducted through the project HIDSOS, completing the setup of a monitoring network of suspended sediments and nutrients in the Pyrenees, and collaborated in several programmes conducted by the Catalan Water Agency (ACA) in both applied and scientific products.

National projects such as SPACESTREAM have triggered intense research related to flow intermittency, carbon dynamics and ecosystem services. This project has provided relevant and refreshing perspectives on river ecosystems and hydrological basin dynamics, regarding both the implications for water resources quantity and quality, within the framework of global change. The national project PACE-IMPACT started in 2018 to look for the

occurrence of pharmaceutical products and residence impacts in the groundwater microbiome in different hydrogeological environments, as a basis for addressing groundwater pollution cases.

ERANET projects within the ERA4CS call (CLIMALERT and WATEXR) have added a new perspective by linking global and regional climate models to ecological research. Both projects deal with climate services, and on how to mitigate the adverse effects of extreme climate events when we have advance knowledge of their occurrence (4-5 weeks before seasons).

Participation in European and international network projects has also been relevant during the reported period. R&E researchers have continued their contribution to the COST Action SMIRES; whereas the NCEAS-SNAPP project and the ISIMIP Lake Sector network have expanded their research networks beyond European borders.

All these projects have resulted in a better understanding of the effects of climate change on hydrological systems, whether in surface water or groundwater. They depict and describe the complex relationship between water flow intermittency and biodiversity, including the effect of emerging pollutants as ecological stressors, and the availability of water resources for human use.

▶ LINE I.1 HYDROLOGICAL PROCESSES

The team has completed the monitoring tasks related to flow discharge, sediment transport and nutrient loads in the river Noguera Pallaresa within the frame of the Research Contract 'Sustainability of Water Resources under Global Change' HIDSOS-IV. The whole set of data is now being fully processed as is key to the calibration and validation of the TETIS® distributed model results, which have led to the implementation of global change scenarios in this representative basin of the Southern Pyrenees. As a central focus in 2019, the team continued the monitoring of streamflow at the Vernagà hydrometric station (Gavarres Massif) to obtain hydrological data from this intermittent stream, with

the general objective of assessing the foreseen impacts of flow reduction and the increase in drought severity on invertebrate community. The site was re-equipped with water-stage and air-pressure sensors and lapse-time cameras, and it will also be used to test latest-generation flow sensors (task already underway).

The team has continued publishing research on hydro-geomorphological processes, as well as participating in national and international congresses and research stays (e.g. The Austral University of Chile), which, together with the research previously reported, help to transfer and internationalise the research conducted by the Resources and Ecosystems Area.

▶ LINE I.2 LACUSTRINE AND RESERVOIR SYSTEMS

2019 has been the year of the consolidation of the research activities related to forecasting water quality in lakes. The tasks related to the WATExR project (JPI Climate ERA4CS, “Integration of climate seasonal prediction and ecosystem impact modelling for an efficient adaptation of water resources management to increasing climate extreme events”) have brought the project to the doors of real case seasonal prediction in the different case studies. In the case of the Sau Reservoir, a hydrological model for the Ter River and a lake model for the Sau-Susqueda system were created, and both are already running in a testing operational mode. The prediction system is now in beta version, ready to be used as a QGIS plug-in. All these progresses, as in most of the other case studies around Europe, are conducted in a co-creation framework with the stakeholders, such as ATLL and ACA.

Also supported by WATExR, the ISIMIP Lake Impact sector has experienced a spectacular increase, with more than 60 research teams contributing to the impact simulations. The ISIMIP Lake Sector has become a hub for collaborations in the lake-water quality arena and is already a well-known instrument for the lake-water quality modelling community. ICRA has decisively contributed to the network coordinating all activities related to the Lake Sector.

In the context of the MANTEL project (H2020 ITN, “Management of climatic extreme events

in lakes and reservoirs for the protection of Ecosystem Services”), the ITN student E. Munthali has settled on new methodologies to detect extreme events in historical water quality data series using historical records from the Sau Reservoir. He has also started the analysis on how those events affect water quality in the reservoir, using an innovative approach based on the causality in quantiles methodology. He also conducted a series of experiments and field assessments on the impact of natural organic matter on the formation of disinfection by-products, a topic of interest for ATLL. All these results are already in writing phase.

Moreover, research into the fate of sedimentary carbon in dried-out lakes through the C-HYDROCHANGE (Excelencia) project is progressing well after the incorporation of D. Tolunay as a PhD student. Most of the data from the 2018 campaign have been processed, and the first papers should come out soon. We expect the results from this field expedition to be a turning point in our understanding of the fate of organic carbon in the sedimentary deposits of vanishing lakes. In the same project, we studied how the decommissioning of dams modifies the carbon cycle of these systems, using the unique example of the Artikutza reservoir, in cooperation with the University of the Basque Country.

▶ LINE I.3 FLUVIAL SYSTEMS

During this reporting period, we have pursued our research lines on the effects of flow intermittency on (i) the stream biota and biogeochemistry, (ii) the integration of ecosystem services in freshwater ecosystems management, (iii) the effects and fate of emerging contaminants in freshwater ecosystems; and (iv) the use of nature-based solutions in the urban water system. As a product of our continued research on the effect of multiple stressors on river ecosystems, the edited book “Multiple Stressors in River Ecosystems. Status, Impacts and Prospects for the Future” was completed with the contribution of several R&E researchers.

Most of the research into the effects of flow intermittency on freshwater ecosystems has been carried out through the SPACESTREAM (CGL2017-88640-C2-1-R) and CLIMALERT (PCIN-2017-068) projects. The SPACESTREAM project started in January 2018 and will last for 36 months, while the CLIMALERT project finishes at the end of 2020. During 2019, the tasks related with the hydrological characterisation and the seasonal surveys for the characterisation of organic matter dynamics have been completed, and several measurements related to the biota response to flow intermittence have started. Thus, river flow measurements have been taken at 16 sites on the Algars River since April 2018. Seasonal surveys took place between November 2018 and July 2019, including samples on

organic matter storage, transport and processing, as well as dissolved nutrients and emerging contaminants. Through the SMIRES COST Action (CA15113) ICRA researchers are leading one of the working groups on eco-hydrology and ecosystem services.

The research line on the integration of ecosystem services in water management has continued during 2019, mainly focused on the development of a socio-environmental process-based model at the sub-basin scale. This model is implemented at the Algars River basin, in the Ebro basin, where data on hydrology, climate, water uses, pollution, services demand and perception have been gathered. This work, although still underway, has allowed us to gain insights into the complex modelling of socio-environmental systems, and we have submitted and achieved a research proposal on the last PRIMA call.

Finally, we have been working on the use of nature-based solutions in the urban water system within the framework of an international expert project; the NCEAS-SNAPP. A two-tier decision-support system has been developed, with one tier based on expert knowledge and one on a review of evidence. The first one is currently published online (<https://sannat.000webhostapp.com/>), whereas the second will be terminated soon.

▶ LINE I.4 MODELLING OF ECOSYSTEMS AND BASINS

Research into the occurrence of pharmaceuticals in groundwater has developed under the PACE-IMPACT project. Groundwater samples have been gathered from springs in the Osona hydrogeological system to provide a field-based insight into the processes that control the transport of pharmaceutical compounds in the upper part of the aquifer. Microbiological monitoring evaluates antibiotic resistance in spring water. This project is a collaboration with researchers of the Water Quality Area. Statistical analysis associates antibiotic data with the lack of a spatial correlation to several explanatory variables in the Baix Fluvià aquifer, including geological, hydrological and land-use parameters, to provide management strategies which deal with the occurrence of these emerging contaminants in groundwater.

Climate change issues on stream discharge have been evaluated in collaboration with the ODYSSEUS project, conducted with the University of Girona. This collaboration has benefited from previous methodologies developed at ICRA, adopted to simulate stream-flow intermittency in future climate scenarios. Moreover, this methodology also evaluates nitrate pollution under hydrologically changing conditions.

Water management research is the focus of an international collaboration with the University of Pavia (Italy) on the study of nitrate evolution in a part of the Lombardy aquifer. This collaboration involves the development of a numerical flow and transport model for this hydrogeological system that, using a socio-hydrogeological approach, can be applied to support governance processes.

TECHNOLOGY TRANSFER

Sabater, S., Batalla, R.J., Sostenibilidad de recursos hídricos bajo el cambio global (HIDSOS-IV). Contract appointed by ENDESA 2017-2019.

Mas-Pla, J. Groundwater exploitation and pollution risk assessment for a natural water bottled facility nearby Girona. Contract under confidentiality requirements.

Acuña V. SCI SNAPP Water sanitation and nature. Contract appointed by “The Nature Conservancy” (SCI-SNAPP_ICRA_190123).

AI- PHD DISSERTATIONS

Ferran Romero (University of Girona). “Multiple stressor effects on river biofilm communities: from community composition to ecosystem processes using experimental mesocosms”. Supervised by Sergi Sabater and Vicenç Acuña.

Jordi-René Mor Roy (University of Girona). “Flow alteration and wastewater inputs effects on freshwater communities in Mediterranean rivers”. Supervised by Sergi Sabater and Isabel Muñoz.

Olatz Pereda (Universidad del País Vasco, EHU). “Effects of urban pollution on stream ecosystem functioning”. Supervised by Arturo Elosegi and Sergi Sabater.

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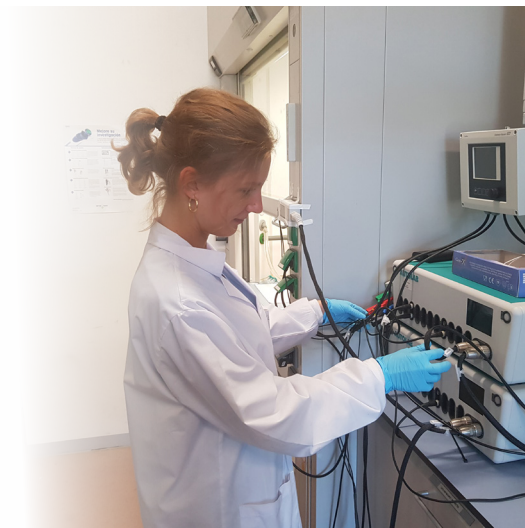
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Pham, Vuong – CA’FOSCARI UNIVERSITY

Rincón Palau, Katterine Johanna – UNIVERSIDAD NACIONAL DE COLOMBIA

Romero Pérez, Sandra – UNIVERSITAT DE GIRONA (UDG).



Area II

WATER QUALITY AREA

THE WATER QUALITY AREA LINES OF RESEARCH ARE:

- ▷ AII1 CHEMICAL CONTAMINATION OF WATER BODIES
- ▷ AII2 CONTAMINANTS IN WASTEWATER
- ▷ AII3 QUALITY AND MICROBIAL DIVERSITY
- ▷ AII4 ECOTOXICOLOGICAL RESPONSE OF BIOTA TO CONTAMINANTS

25 RESEARCHERS IN THE AREA

1 ICREA Research Professor and group leader
Mira Petrovic

1 Research Professor (CSIC associated)
Damià Barceló

1 Research Professor (UdG associated)
Carles Borrego

1 Research Scientist
José Luis Balcázar

1 Research Scientist (Ramon y Cajal)
Sara Rodríguez-Mozaz

1 Research Scientist (Ramon y Cajal and IIF)
Maria Jose Farre

8 Postdoc Researchers
Lucia Helena Moreira • Pablo Gago • Meritxell Gros • Josep Angel Sanchis • Rubén Gil • Ana Carolina Magahna • Natalia Ospina • Ivan Senta

6 Predoctoral Researchers
Jose María Castaño • Marc Castaño • Mira Celic • Adrián Jaén • Albert Serra • Barbara Topolovec

4 Research Technicians
Mireia Fillol • Elisa García • Elissavet Kassotaki • Ferran Romero

1 RDI Technician
Miyako Nitta

Area II

WATER QUALITY

Research in the Quality Area follows three main lines: *i*) Chemical contamination of water bodies; *ii*) Pollutants in wastewater; and *iii*) Effects of anthropogenic pollution on aquatic microbial communities. The main activities and results obtained in 2019 within these three lines of research are summarised below.

▶ LINE II.1 CHEMICAL CONTAMINATION OF WATER BODIES

Evaluation of alternative treatment strategies for the elimination of emerging pollutants from wastewater

Fungal biodegradation has become a promising approach among wastewater treatment technologies to remove emerging micropollutants due to the nonspecific ligninolytic enzymatic system of fungi, which targets the degradation of both biological and xenobiotic compounds. The project *H2PHARMA "Fungi, algae and bacteria degrading pharmaceuticals. Hospital effluent treatment by fungi"* (MINECO-CTM2013-48545-C2-2-R) proposes the development of a treatment process for hospital wastewater using lignolytic fungi. During 2019, and as a follow up of the project, we have tested the efficiency of these treatment technologies alone and also coupled to advanced oxidation processes (AOPs) for the removal of emerging pollutants in hospital wastewater. Special attention was paid to the study of generation of transformation products from target pollutants such as benzotriazoles and pharmaceuticals along with treatment processes and their potential environmental impact. The performance of other biodegrading microorganisms such as algae was also evaluated regarding the removal of antibiotics from wastewater. These eco-friendly systems open up the possibility of reuse by industry or agriculture of effluent treated with these alternative treatments.

Bioaccumulation and Impact of emerging pollutants in aquatic organisms and in the spread of antibiotic resistance

The impact of the contaminants in the aquatic environment can be evaluated by assessing selected toxicological effects and/or by measuring the bioaccumulation of the target pollutants in aquatic organisms. In 2019, we completed work, in collaboration with colleagues in Latin America, on the presence of pharmaceutical compounds in aquatic biota on that continent. In addition, as a follow up of the project *SEA-on-a-CHIP "Real time monitoring of sea contaminants by an autonomous Lab-on-a-Chip Biosensor"*, FP7-OCEAN-2013 (GA No.614168), we have finished our study on the bioconcentration, metabolism and impact of antibiotics on mussel species (*Mytilus galloprovincialis*). The relevance of antibiotics in the spread of antibiotic resistance was also considered in this study, and other studies were carried out in collaboration with other European researchers, through the framework of projects such as StARE "Stopping Antibiotic Resistance Evolution" EU, 2013, Water JPI and the NEREUS Cost Action (ES1403-NEREUS). These studies were published in 2019.

Evaluation of the effect of microplastics and nanoparticles in the impact of organic micropollutants on aquatic organisms

New emerging pollutants such as microplastics and nanoparticles can act as carriers of organic contaminants and alter their impact on aquatic organisms. In the project *NANOTRANSFER*, “Transfer of carbon based manufactured nanomaterials in the aquatic environment: An assessment of their fate and effects, bioaccumulation, food web transfer, Trojan horse effects, and green applications” (ERA SIINN PCIN-2015-182-Co2-02) the results of mesocosm experiments with aquatic macroinvertebrates and biofilm as model organisms were published. The impact of fullerene carbon nanoparticles on the bioaccumulation and biotransformation of selected contaminants (venlafaxine, diuron and triclosan) in river biofilms was thus reported in 2019. In addition, the project *PLAS-MED* “Microplastics and micropollutants in the Mediterranean coast: Toxicity and impact in the environment and human health” (MINECO CTM2017-89701-C3-2-R) started in 2018 with the aim of studying the role of microplastics in the transference, bioaccumulation and toxicity of pharmaceuticals and other emerging pollutants in aquatic organisms. Besides laboratory experiments, a monitoring campaign in coastal areas in Spain (Ebro estuary and in the Mar Menor lagoon in Murcia) was carried out in Spring 2019, where water, sediments and biota were collected for the assessment of the presence of selected emerging pollutants and microplastics. A metabolomics approach, a powerful tool to better evaluate the ecotoxicological response of aquatic organisms in areas impaired by the presence of such contaminants, was applied to mesocosm and field samples.

Study of occurrence and fate of disinfection by-products and their precursors in drinking and recycled water

Disinfection by-products (DBPs) and their precursors are studied within the frame of **ND-MA-Predict** (*How to predict and minimise NDMA formation in potable and recycled water through advanced analytical techniques*), a project funded by AEI-MICIU. The main objective of this project is to investigate N-Nitrosodimethylamine (NDMA) precursors with advanced high-resolution mass spectrometry techniques. Dr Josep Sanchís, a new postdoc, has joined the team to provide capacity on non-target analysis and organic matter molecular fingerprinting. First results of this work have been published in 2019. Additionally, the group has successfully obtained, through a public tender process issued by the Canal de Isabel II, funding to investigate nitrosamines and their precursors in the drinking water treatment plants of central Spain, where chloramines are used for disinfection processes.



▶ LINE II.2 CONTAMINANTS IN WASTEWATER

Study into the elimination of emerging contaminants in advanced water treatment processes

Within the H2020 MSCA ITN-EJD project **NOWELTIES** - Joint PhD Laboratory for New Materials and Inventive Water Treatment Technologies. Harnessing resources effectively through innovation, the group is involved in studying the elimination of recalcitrant organic micropollutants (OMPs) in advanced AOP treatments such as non-thermal plasma. Non-thermal plasma in liquid and gas-liquid environments generates in situ oxidising species, such as hydroxyl radicals, ozone, hydrogen peroxide, peroxyxynitrites etc., capable of degrading OMPs from the solution relatively quickly, and even using low power discharges. However, the oxidative breakdown is influenced by the scavenging capacity of matrix components, resulting in the accumulation of transformation products (TPs) rather than complete mineralisation. Knowledge regarding the degradation mechanisms of the investigated chemical compounds under plasma conditions and the evolution of reaction by-products is crucial for the practical application and optimisation of treatment time and power discharges. Therefore, the main objective of this project is to elucidate the transformation pathways of selected OMPs (WFD Watch List compounds recalcitrant to biological treatment) using advanced analytical methodologies based on high-resolution mass spectrometry (Orbitrap MS), and to identify those TPs posing the highest risk to aquatic environments if discharged, or to humans, in the case of reusing treated water for potable purposes. The effect of process modifications (the addition of catalysts or combination of plasma with ozonation) on the formation of TPs and their persistence will be evaluated. In the first part of this study, perfluorinated compounds (GenX, Perfluorooctanoic acid (PFOA), Heptadecafluorooctanesulfonic acid (PFOS), Undecafluorohexanoic acid (PFHxA), Tridecafluorohexane-1-sulfonic acid (PFHxS), Perfluorobutyric acid (PFBA), Nonfluorobutane-1-sulfonic acid (PFBS) are selected as target compounds, and their elimination in plasma treatment is studied.

Evaluation of wastewater treatment processes using advanced methodologies for comprehensive characterisation of dissolved organic matter (DOM) in wastewater

Continuing the research line initiated within the framework of the H2020 MSCA ITN-EJD project TreatREC (*Interdisciplinary concepts for municipal wastewater treatment and resource recovery. Tackling future challenges*), the group further optimised and applied advanced methodologies for the characterisation and fingerprinting of DOM in wastewater using a statistical non-targeted analysis of liquid chromatography high-resolution mass spectrometry (LC-HRMS) data.

Within the frame of 2020 MSCA EF project **SMART-WORKFLOW** (*Development of a smart workflow based on high-resolution mass spectrometry for the assessment of the performance of wastewater treatment technologies*), we have focuses on integrating the latest advances in high-resolution mass spectrometry (HRMS) and statistical analysis of data to develop and optimise a smart methodology (workflow) for the assessment of the overall efficiency of wastewater treatment using different technological approaches, focusing on innovative treatments. The generated workflow is understood as a procedural sequence for data acquisition, data processing and data mining and it will be applicable to both already-known and new wastewater treatments, providing a rapid assessment on their performance regarding the removal of polar organic compounds and generated transformation products (TPs).

During 2019 the research has focused on the development of new computational tools that allow the transformation of raw HRMS data into peak lists and also in molecular formulas. These tools are being used to evaluate changes at a molecular level in various innovative water treatments based on advanced oxidation processes. The potential addition of sulphur in the transformation products generated, the addition of halogens and the general oxidation state are being evaluated in collaboration with researchers from T&E Area. Changes at the molecular level have also been evaluated in the treatment of contaminated soils by electrochemical treatment and other innovative techniques in collaboration with researchers from the Swedish University of Agricultural Science.

Suspect screening and risk assessment of wastewater derived emerging contaminants in receiving riverine and coastal areas

A suspect screening methodology was applied for the identification of organic pollutants and their transformation products as potential markers of wastewater contamination in riverine and coastal ecosystems. An exact mass compound database, based on the list developed by the Catalan Water Agency (ACA), was constructed. It includes more than 400 compounds, covering different groups of MPs, in addition to a large number of relevant transformation products (~100). Extensive data processing is performed using the “Compound Discoverer v2.1” software with the “m/z Cloud”, “m/z Vault” and “Chem Spider” databases for compound identification. A comprehensive screening of organic pollutants was performed in the Ebro Delta area, and the identified compounds can be considered markers of wastewater contamination. The suspect screening strategy identified several pollutants, such as mass-consumption pharmaceuticals used in Catalonia, illegal drugs, pesticides, biocides etc., and their occurrence was followed along the wastewater-recipient water chain until they reached estuaries and the Mediterranean sea. Results from this screening allowed for the identification and quantification, for the first time, of mass-consumption MPs and transformation products (TPs), as well as providing new knowledge about their fate and behaviour in freshwater and coastal ecosystems.

As some of these substances have been detected in concentrations ranging from high ng L⁻¹ to µg L⁻¹, and for some of them, information about their potential toxic effects is still sparse or unknown, it is becoming increasingly apparent that a comprehensive environmental risk assessment study is advisable. This evaluation allowed us to predict the potentially toxic effects of the compounds selected as contamination markers, which, in turn, helped us prioritise compounds of primary ecological concern that could be used as significant indicators of wastewater contamination in coastal environments. An environmental risk assessment was, therefore, performed in collaboration with the Environmental and Sanitary Research Group led by Prof. Paola Verlicchi, from the Department of Engineering at the University of Ferrara (Italy), which has extensive expertise on risk assessment studies and prioritising emerging organic contaminants. Several environmental risk assessment approaches for water and sediments were used, such as the calculation of hazard quotient ratios, which are the ratio between the measured environmental concentration (MEC) and the predicted no-effect concentration (PNEC), among others.

Fate and environmental risks of organic contaminants in agroecosystems

Within the framework of the H2020-MSCA-IF, we are involved in project **RESOURCE** (*Groundwater quality assessment in areas with intensive livestock: is manure recycling a major source of pollu-*

tion and dissemination of antibiotic resistance genes?), together with researchers from the Microbiology unit (see next section) and from R&E. In 2019, we completed the groundwater monitoring programmes started in 2018. In these studies, samples were collected in areas with intensive livestock production for the analysis of veterinary antibiotics, antibiotic resistance genes (ARGs) and the characterisation of dissolved organic matter (DOM). Tetracycline and sulfonamide antibiotics were found at concentrations ranging from ng L⁻¹ to µg L⁻¹, with substantial variability between sampling events. Genes conferring resistance to these antibiotic classes were also found (values from 4×10² to 5×10⁶ copy numbers/L water). DOM analysis revealed that most formulas were CHO compounds, with a small percentage containing nitrogen and sulphur (~15-20%, respectively). The use of Van Krevelen diagrams (plots of H/C versus O/C atomic ratios) showed that samples were dominated by molecules falling in the lignin-like region, exhibiting potential correlations with antibiotics.

Other research activities carried out in 2019 include, *i)* a collaboration between the São Paulo State University (UNESP) in Brazil and ICRA to assess the potential of vinasse reuse (a by-product of ethanol production used as fertiliser in sugarcane crops) as a source of groundwater pollution, and *ii)* a collaboration between the Beta Technological Centre at the University of Vic (CTBeta) and ICRA to evaluate livestock waste treatment technologies that can reduce antibiotic loads.

Wastewater-based assessment of human exposure to chemical pollutants

Within the framework of the H2020-MSCA-IF, we started the project **SCHEME** (*Sewage Chemical Information Mining - development of a novel concept for the assessment of human exposure to pollutants through wastewater analysis*) in collaboration with researchers from T&E. The project is focused on the development and validation of a comprehensive analytical methodology for the determination of biomarkers of human exposure to chemicals from personal care and household products in wastewater. The applicability of the developed approach will be verified in 4 European cities as case studies (Girona, Platja d'Aro, Zagreb, Uppsala). In the selected cities, human exposure to chemical pollutants will be assessed and compared with other epidemiological data.

In 2019, the pharmacokinetic and other related literature was studied to create a list of the most suitable target biomarkers (parent compounds and/or metabolites) for more than 30 chemicals, which will be included in the method development. The list includes biomarkers of exposure to parabens, UV filters, triclosan, phosphorous flame retardants, bisphenols, phthalates and alternative plasticisers, as well as oxidative stress biomarkers.

▶ LINE II.3 QUALITY AND MICROBIAL DIVERSITY

The sewer resistome and its response to chemical treatments

We have continued the research started in 2017 on the characterisation of the sewer resistome and its response to chemical treatments (Project **SEWAGENE** (*Accumulation, Spread and Removal of Antibiotic Resistance In Sewer Systems, Ref. CTM2016-75653-R*) funded by the Spanish Ministry of Economy and Competitiveness).

We carried out an analysis of metagenome datasets obtained from biofilm samples collected in a full-scale sewer in L'Escala (Alt Empordà) before and after the nitrate dosage was added by sewer managers. Results from this metagenomic analysis revealed that the relative abundance of both antibiotic resistance genes (ARGs) and mobile genetic elements (MGEs) increased in biofilm samples collected after 15 days of nitrate exposure. Besides quantification of the fold change in the copy number of ARGs, transcripts showed a significant increment after nitrate addition for genes *intl1*, *sul1*, *ermB*, *qnrS*, *tetW* and *bla_{TEM}*. These results are indicative of a clear response from the wastewater microorganisms inhabiting the sewer biofilms to the oxidative stress caused by nitrate. Results from the full-scale sewer agree with those obtained on a smaller scale under laboratory conditions (bio-reactors), thus suggesting that nitrate addition has severe consequences for gene expressions and mobility.

In 2019, we also set up a mid-scale sewer pipe (pilot plant) at the ICRA to assess the potential removal of antibiotic-resistant bacteria (ARB) and ARGs through exposure to nitrate treatment. After a colonisation and maturation phase that lasted from November 2018 to April 2019, we carried out a laboratory experiment to evaluate the effect of nitrate dosage (30 mg/L) on the resistome and mobilome of the sewer biofilms. Samples of RNA and DNA were collected in triplicate at different time intervals and sent to our sequence provider to carry out a shotgun metagenomic sequencing. These data will be valuable for the analysis of potential variations in the resistome and mobilome in response to oxidative stress.

Role of migratory birds in the dissemination of antibiotic resistance genes

Birds can disperse plants, invertebrates, parasites, pathogens, and even pollutants over long distances. Migratory birds, in particular, may play a fundamental role in the dispersal of bacteria and antibiotic resistance genes in the environment. In 2019, we collaborated with Dr Marta Sánchez (University of Seville) and Dr Andy Green (CSIC - Doñana Biological Station) to investigate the prevalence and abundance of ARGs in four species of birds: storks (*Ciconia ciconia*), seagulls (*Larus fuscus*), geese (*Anser anser*) and cranes (*Grus grus*), which all differ in their migratory and feeding habits. DNA from freshly voided faeces collected from 60 individuals (15 of each species) was extracted and further analysed by qPCR to assess the abundance of several biomarker genes, namely: the 16S rRNA as a proxy for bacterial abundance; the *intl1* as a proxy for anthropogenic pollution and gene mobilisation; *sul1* (resistance to sulfonamides), *bla_{TEM}* and *bla_{KPC}* (resistance to beta-lactams and carbapenems, respectively); *tetW* (resistance to tetracyclines); *qnrS* (resistance to fluoroquinolones), and *mcr1* (resistance to colistin). Results showed that faeces from birds feeding on anthropised habitats (seagulls and storks) contain a significantly higher abundance of ARGs (*intl1*, *sul1*, *bla_{TEM}* and *tetW*) than those from birds inhabiting natural systems (geese and cranes). Moreover, genes conferring resistance to last-resort antibiotics such as carbapenems (*bla_{KPC}*) and colistin (*mcr1*) were only observed in faeces from seagulls, a species that feeds on landfills and rests in polluted water bodies. In fact, differences in the species' habitat usage explain 72% of the total variation when samples were ordered according to their overall ARG content. Our results draw attention to the role of migratory waterbirds in the dispersal of antibiotic resistance into the environment.

Assessment of the effect of wastewater discharges on streambed communities and their resistance profile through a manipulative experiment

To assess the impact of chronic discharges of WWTP effluents on the composition of bacterial communities and the abundance of ARGs, researchers usually compare control and impact sites located upstream and downstream from the discharge point, respectively. This approach is subject to a significant limitation because the upstream site is not as pristine as expected and the actual effect of pollution is difficult to evaluate. To overcome this limitation, we collaborated with colleagues from the University of the Basque Country (Prof. Arturo Elósegui and his group) to conduct a BACI (Before-After, Control-Impact) design experiment in the field, in order to assess the effects of a WWTP effluent on streambed bacterial communities that had never previously been exposed to such an impact. Streambed biofilm samples from both reaches (control/impact) and periods (before/after the diversion of the WWTP effluent into the stream) were collected every two months, subjected to DNA extraction and examined for changes in the composition of streambed biofilm communities and abundance of ARGs. We observed clear changes in the composition of bacterial communities and their resistance profile immediately after the diversion (May) and lasting until Autumn (October). The streambed bacterial communities had increased levels of the microorganisms characteristic of WWTPs (i.e. *Microthrix*) and significantly, an increase in the absolute and relative abundance of genes *int1*, *sul1*, and *ermB*. These results demonstrate that discharges of WWTP effluents have a clear effect on streambed bacterial communities although its magnitude depends on both the dilution factor of the effluent on the receiving stream and the climatic conditions (temperature, rainfall) in the system.



Antibiotics and antibiotic resistance genes as tracers of agricultural contamination

In collaboration with Dr Meritxell Gros, we analysed the concentration of several ARGs in water from several natural springs located in Osona (Catalonia) and representing four distinct hydrogeological settings. The springs were selected based on their nitrate concentrations, which were attributed to livestock waste fertilisation. Springwater was collected and analysed for hydro-chemical and isotopic evidence, as well as for its concentration of antibiotic residues and ARGs. The latter were monitored as a response of the groundwater microbiota to antibiotic pollution and as a way to measure their persistence effects on groundwater quality. We detected genes *sul1* (conferring resistance to sulfonamides), *tetW* (conferring resistance to tetracyclines), and *int1* (a proxy for anthropogenic pollution) in most of the springs although concentrations never exceeded 104 gene copies/L. Results from chemical and microbiological analyses suggested that the pollution in these groundwater resources is low but has considerable seasonal variability.

Effect of disinfection by-products on the dissemination of antibiotic resistance genes

Previous studies have suggested that stressful conditions such as extreme pH, nutrient limitation, high salinity, oxidation, or chlorine exposure may favour horizontal gene transfer events, thereby allowing bacterial populations to acquire resistance to antibiotics. In 2019, we established a multidisciplinary collaboration with Dr María José Farré and Dr Sara Rodríguez-Mozaz to explore whether exposure to disinfection by-products may promote the horizontal transfer of plasmid-mediated ARGs in bacteria. A *qnr*-positive *Escherichia coli* was chosen as the donor, whereas an azide-resistant *E. coli* strain J53 was used as a recipient for the assessment of gene transfer frequency. Donor and recipient bacteria were exposed to several disinfection by-products (such as *N*-nitrosodimethylamine [NDMA], *N*-nitrosodiethylamine [NDEA], *N*-nitrosodi-*n*-propylamine [NDPA], and *N*-nitrosodiphenylamine [NDPhA]), at different concentrations. While the results are preliminary, exposure to NDMA caused a slight increase in gene transfer frequency.

Exploring the contribution of bacteriophages to the emergence and spread of antibiotic resistance in environmental settings (ENVIROSTOME)

Although antibiotic resistance has become a global public health concern, the contribution of bacteriophages (viruses that infect and replicate within bacterial cells) to the acquisition and spread of ARGs in the environment has not been extensively studied. In order to overcome these limitations, Dr Ana de Almeida has recently joined our research group as a Marie Skłodowska-Curie fellow. Her research activities are mainly focused on the contribution of bacteriophages to the horizontal transfer of ARGs in aquatic environments, as well as the prevalence of ARG-carrying phages under conventional wastewater treatments and novel disinfection processes. In order to reach these goals, untreated and treated wastewater samples, including activated sludge, have been collected from a local WWTP. Although the proposed activities are ongoing, over 70 temperate and lytic bacteriophages infecting two *E. coli* strains have been isolated, particularly from the activated sludge samples. These preliminary findings warrant further studies to determine the extent to which bacteriophages contribute to the mobilisation of ARGs. This work also entails a secondment with the water business intelligence company Blue-Tech Research, in Ireland. To date, this industry connection has significantly contributed to improving research design, exploring market applications and the legislative impact of the project outcomes.

Effects of global warming on the methane emissions of freshwater sediments

In 2019, we began a collaboration with the Microbial Ecology group at the Cavanilles Institute of Biodiversity and Evolutionary Biology at the University of Valencia, lead by Prof. Antonio Camacho, to study the effect of temperature on methane emissions from freshwater sediments. Sediments from 20 lagoons differing in their trophic status and limnological conditions were incubated at different temperatures (4 °C, 14 °C and 25 °C) for a month, and end-point samples were collected to quantify the concentration of transcripts of archaeal genes 16S rRNA and *mcrA*, the latter

involved in methanogenesis. Concentrations of methane were also measured in the experimental microcosms to relate their values with the abundance of *mcrA* transcripts as a function of temperature. In parallel, DNA and RNA samples were subjected to amplicon-targeted sequencing to characterise the bulk (DNA) and active (RNA) fractions of archaeal communities in the microcosms. Results will provide a better insight into how the increase in temperature affects methanogenic archaeal communities in sediments and their activity. Overall, this project will shed light on how global warming affects the expected increase of methane emissions from inland waters.

TECHNOLOGY TRANSFER

Collaboration with the Beta Technological Centre (CTBeta) in the demonstration project “*Demostració de la capacitat d’eliminació d’antibiòtics en tecnologies de tractament de purins (File no. 56 30027 2018 5C)*” funded by the Catalan Ministry of Agriculture, Livestock, Fisheries and Food (DARP).

A transference contract with the Beta Technological Centre (CTBeta) was established for the “*analysis of veterinary pharmaceuticals and antibiotics in samples from a livestock waste treatment plant*”.

Within the framework of the DANTE project, funded by the Formas non-toxic environment grant, a transference contract with the Swedish University of Agricultural Science (SLU) was established to investigate the occurrence and fate of micropollutants in relation to water quality when using recycled wastewater in the production of drinking water.

2019-2022. Study of NDMA and its precursors in drinking water treatment plants. Contract no88/2018 Canal de Isabel II. Public tender: ICRA. PI: Maria José Farré. Budget: 100,347€

RESOLUCIÓ TES/2442/2018, Projects for the Catalan Water Agency (ACA). Desenvolupament d’eines per al suport en la implementació i gestió de la reutilització - “SUGGEREIX”. PI: Wolfgang Gernjak. Budget for ICRA: 50,000€

Analyses of NDMA for commercial laboratories (Labacua). PI: Maria José Farré.

All- PHD DISSERTATIONS

Vicent Pau Gimeno (University of Girona) “Environmental and socio-economical assessment of measures for the reduction of pharmaceuticals in rivers”.

Yaroslav Verkh (University of Girona) “Characterization of dissolved organic matter in wastewater using liquid chromatography-high resolution mass spectrometry”.

Daniel Lucas (Autonomous University of Barcelona (UAB) “Fungal treatment for the elimination of pharmaceutical compounds from wastewater: Chemical, Microbiological and Ecotoxicological evaluation”. January 2019.

VISITING SCIENTISTS

Prof. Ajit Sarmah, from The University of Auckland, New Zealand, “Removal of emerging contaminants using carbon like materials including graphene in wastewater”, (November-December 2019).

Dr Patricia Giovanella, from São Paulo State University (UNESP) – Rio Claro/Brasil, (November 2019-July 2020).

Dr Carolina Salgado, from La Plata National University (Argentina) (May-July 2019).

Palacios, Carmen, Perpignan Univeristy

Previsic, Ana, Univeristy of Zagreb

Rozman, Marko, Univeristy of Zagreb

VISITING STUDENTS

Camarasa Gallego, Mireya, University of Girona (UDG)

Castillo Boukhchtaber, Dina, Royal Netherlands Institute for Sea Research (Nioz)

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Coll Soler, Duna, IES Pla Estany

Da Silva, Josiel Jose, Sao Paulo State Univeristy

Gein Daria, Rhine-Waal Univeristy

Grgic, Ivana, Ruder Boskovic Institute

Jarma, Dayana, University of Cadiz

Miralles Lorenzi, Javier, Univeristy of Valencia

Moix Fernandez, Ivan, Univeristy of Girona (UDG)

Moura, Leonardo, Federal Univeristy of Rio de Janeiro

Noyer, Megane, Perpignan University

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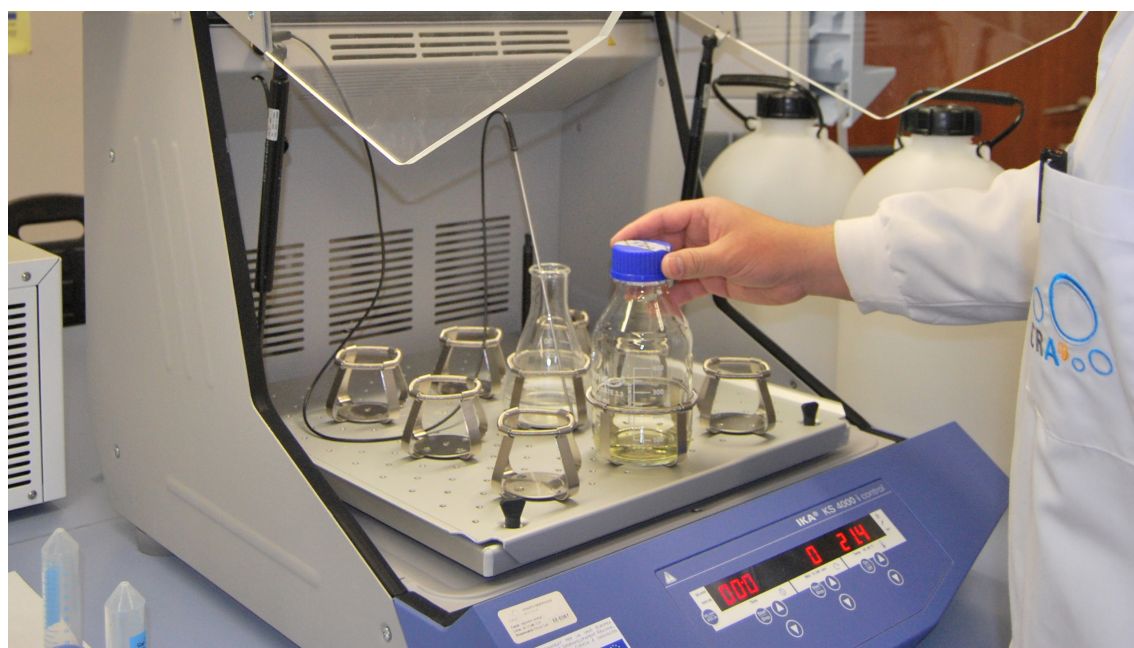
Rodríguez Tamayo, Erika Andrea, University of Antioquia

Schroeter, Nicole Simone, University of Amsterdam

Sorengard, Mattias, Swedish university of agricultural science

Tornabell Noguera, Eric, University of Girona (UDG)

Turón Bas, Anna, University of Girona (UDG)

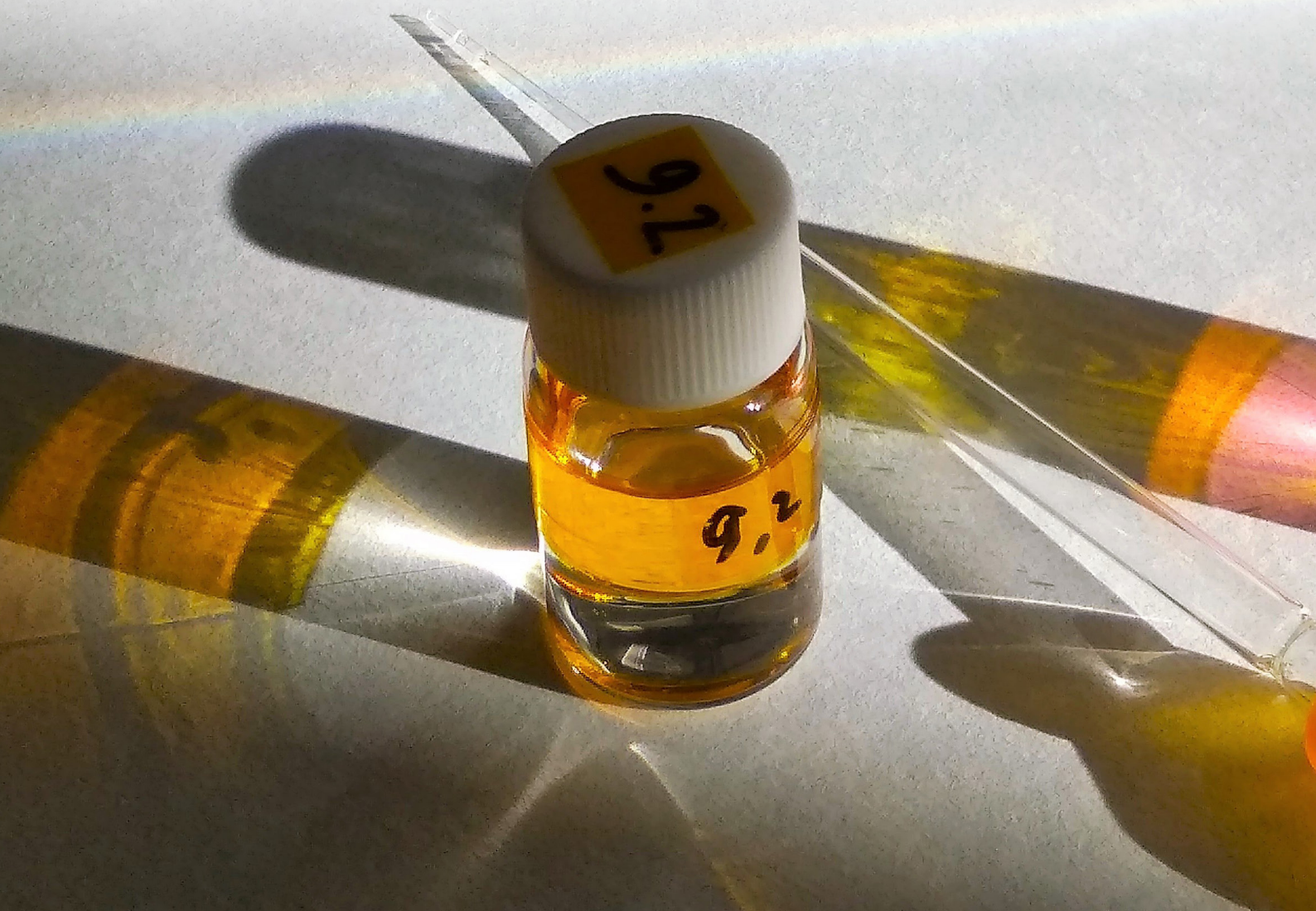


Area III

TECHNOLOGIES AND EVALUATION

THE TECHNOLOGIES AND EVALUATION AREA'S LINES OF RESEARCH ARE:

- ▷ AIII1 WATER SUPPLY AND ADVANCED TREATMENT
- ▷ AIII2 WASTEWATER TREATMENT, REUSE AND RESOURCE RECOVERY
- ▷ AIII3 MODELLING AND MANAGEMENT SYSTEMS
- ▷ AIII4 UNIT OPERATIONS





32 RESEARCHERS IN THE AREA

1 Research Professor (UdG associated) and group leader

Ignasi Rodríguez-Roda

1 Research Professor (UdG associated)

Joaquim Comas

1 ICREA Research Professor

Wolfgang Gernjak

1 ICREA Research Professor

Jelena Radjenovic

1 Research Scientist

Maite Pijuan

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4 Postdoc Researchers

Luis Miguel Baptista • Oriol Gutiérrez • Oksana Udovyk • Soraya Zahedi

9 Predoctoral Researchers

José Miguel Albahaca • Nick Duinslaeger • Federico Ferrari • Natalia Sergienko • Aleksandra Kaminska • Esther Mendoza • Giannis Florjan Norra • Ponzelli Michele • Nikoletta Tsiarta

12 Research Technicians

Morgan Abily • Lluís Maria Bosch • Silvia Busquets • Laura Castañares • Joana America Castellar • Monica Escolà • Lucia Gusmaroli • Anastasya Kravtchenko • Dante Maschio • Adrià Riu • Marc Sauchelli • Anna Valls

Area III

TECHNOLOGIES AND EVALUATION

This year we celebrated the tenth anniversary of ICRA. It's an excellent time to take stock, not only of 2019's activities and results but also, and especially, the Institute's growth, evolution and consolidation over the last ten years, which have undoubtedly placed it at the forefront of international research excellence. The Technology and Evaluation Area is proud to be part of the Institute's history, and to have contributed to the knowledge and results it has achieved through the projects detailed in the subsequent sections and corresponding to each of the three lines of work in the area.

The Technology and Evaluation Area has made an effort to spearhead the technology transfer strategy. Our diverse collaborations with companies and institutions in the sector have resulted in several products and patents. We foster a clear "give-them-a-go" attitude, either through marketing or by evaluating the viability of a business plan for a spin-off. Product creation is essential to generate new ideas and test solutions developed in the area, and also to encourage the incorporation of young students and researchers who are trained at the Institute, into the labour market.

We would like to highlight the impact that recognition, as a consolidated research group at AGAUR (2017024_SGR17-19_ICRA-TECH), has had on the area. In our second year, we have been able to execute consolidation actions at all levels of the human group, as well as initiate small dissemination projects in society, particularly for the little ones. The visibility of the work carried out at the Institute is very important, as is the cohesion of the working team, although this not directly reflected in the research indicators. We have organised in-house discussions to talk about water issues featured in the media and of concern to the broader society, and we have written simple opinion articles that have been published on networks and blogs. We have also visited schools to explain the importance of water, recycling and resource conservation through play, and in doing so, we encountered a generation aware of environmental issues, committed to the future of the planet and genuinely concerned about the effects of climate

change. Environmental education will be key to ensuring the planet's sustainability, and fortunately, it seems that awareness is increasing among the younger generation.

The importance of multidisciplinary projects and networking cannot be overstated. We are great fans of collaboration; with other areas of the Institute, with other institutes and local and international research groups, with companies, with business associations, with public and private administrations, with neighbourhood associations, etc. Water management is complex. We still need more knowledge about the mechanisms that regulate the behaviour of water resources, as well as how to develop technologies to treat and recover those resources through existing solutions (and those to come). Water problems can only be addressed if we work together with geographers, economists, artificial intelligence specialists, sociologists, architects, etc. And that is our mission here at the Technology and Evaluation Area.

Finally, I would like to highlight the permanent appointment of Dr Lluís Corominas, who works in the incredibly important field of Modelling and Management Systems. The position has been awarded to him following years of hard work and leadership at the Institute, in the areas of digitalisation, monitoring, modelling and control of the complete water cycle. We are embarking on a year full of exciting projects and challenges, and we are delighted to present our progress from the previous year. That progress comprises work ranging from the most ambitious European projects to that of undergraduates, master's, doctoral theses, etc., through to collaborations with companies and personal participation in various cooperation projects.



▷ LINE III.1 WATER SUPPLY AND ADVANCED TREATMENT

This research line has two overarching themes: the development of novel processes and treatment trains, mostly focused on physical-chemical treatments, and water quality management in these processes. These strategies are applied to increase water supply diversity by amending the quality of challenging traditional and alternative water sources contaminated mainly with organic pollutants but also inorganic ones such as nitrate.

In the scope of the ERC Starting Grant *ELECTRON4water* led by ICREA professor Jelena Radjenovic, the following progress has been made:

- We demonstrated electrochemical oxidation of sulphide and its separation from the waste stream in the form of sulphur using low-cost carbon-based porous materials, activated carbon felt, and graphite felt. However, their application was limited by the
- low regeneration efficiency of the electro-deposited sulphur, and research efforts were reoriented towards using more catalytically active coatings based on manganese oxides - MnOx. This work is being conducted by Natalia Sergienko (PhD student).
- We developed a methodology for the synthesis of completely uniform TiO₂ nanotube array (NTA) of mesh geometries, thus enabling the application of Ti/TiO₂-NTA/SnO₂-Bi electrodes in bench-scale flow-through reactors. These reactors have been successfully applied for the electrochemical removal of poly- and perfluoroalkyl substances (PFASs) from water. This work is being conducted by Nick Duinslaeger (PhD student).
- We developed a graphene sponge for the electrocatalytic removal of persistent organic contaminants from water, overcoming

a major limitation of the existing electrode materials – the formation of toxic by-products due to the oxidation of halides. Our experiments show that these electrodes do not oxidise chloride, and therefore there continues to be no chlorine, chlorate or perchlorate production. At the same time, the system removed the organic contaminants. In addition, we have observed up to a 4-log removal of *E. coli*, thus suggesting their potential for chlorine-free disinfection. Graphene sponge is comprised of either reduced graphene oxide (RGO) or RGO doped with B, N and hBN (hexagonal boron nitride). This work is conducted by Dr Luis Pires (post-doc fellow) and Giannis Florjan-Norra (PhD student).

- Removal of persistent organic contaminants from wastewater by packed-bed electrochemical reactor, based on: 1) granular activated carbon (GAC) and 2) RGO, MnOx and RGO/MnOx coatings. By using granular material with conductive and/or catalytic coating placed inside the electric field, the reactor performance for the elimination of persistent contaminants from water can be drastically enhanced compared to a conventional plate-and-frame reactor. This work is being conducted by Giannis Florjan-Norra (PhD student).

In 2019, we also initiated a Marie Curie ITN project, Nowelties, (coordinated by Mira Petrovic, ICRA AII) in the scope of which four students began their PhD thesis:

- Michele Ponzelli (supervisor: Jelena Radjenovic) initiated his PhD on the topic: Design of hybrid nano-engineered bioprocesses for wastewater treatment. This thesis is co-supervised by Prof. Jurg Drewes from TU Munich, Germany. We have so far observed that the addition of graphene oxide (GO) to an anaerobic system leads to its microbial reduction to biologically reduced GO (bioRGO). BioRGO enhanced the transformation of some of the persistent halogenated contaminants investigated (e.g., iodinated contrast media), and we are currently working on the elucidation of the underlying mechanisms.

- Nikoletta Tsiarta (supervisor Wolfgang Gernjak, co-supervisor Lidija Ćurković, U. Zagreb) commenced her PhD thesis on catalytic ozonation using modified ceramic membranes, with the aim of achieving increased micropollutant degradation and decreased membrane fouling.

- Two more PhD students, Amit Kumar (co-supervised by Wolfgang Gernjak) and Camilo Sánchez Tobón (co-supervised by Jelena Radjenovic) commenced their respective PhD projects on plasma reactor development and Au/TiO₂/graphene oxide photocatalyst synthesis in their primary host institutions and will begin working at ICRA in 2020.

Another PhD is being carried out in collaboration with Wetsus in the Netherlands (www.wetsus.nl), where PhD student Nimmy George Kovoovoor (principal supervisor, Wolfgang Gernjak, ICRA) aims to develop novel AOPs making use of the 185 nm and the 254 nm component simultaneously emitted by low-pressure mercury lamps. Besides targeting an understanding of the chemistry of the process, this PhD project has a strong emphasis on computational fluid design modelling as well as reactor design.

In 2019 Marc Sauchelli successfully concluded and defended his PhD thesis on the impact of the draw solute and reverse solute flux in forward osmosis (FO) for the mass transport of contaminants through the membrane and fundamental aspects of membrane fouling in FO, specifically how pressure and transmembrane flux govern the build-up of the foulant cake.

The water quality and supply management aspects within the research line include a strategic co-operation with the company s::can Messtechnik GmbH from Austria and its Spanish subsidiary s::can Iberia S.L. In 2017, Mireia Plà Castellana commenced an Industrial Doctorate co-funded by the Generalitat of Catalonia to work on chemometric methods for enabling contaminant detection using optical spectroscopic sensors. Other activities include collaborations on developing algorithms for mixing of sources in complex water supplies with the University of Girona.

Recently, the ACA funded SUGGEREIX project was also approved and will commence in early 2020. The project is a collaboration between EURECAT, CETAQUA and the Catalan Water Partnership. One of ICRA's responsibilities will be to develop a decision support system for the selection of appropriate treatment technology for the fit-for-purpose generation of reclaimed water.

The line is also involved in other projects led by different lines and areas of the Institute, which are described in the corresponding section of this report.

▶ LINE III.2 WASTEWATER TREATMENT, REUSE AND RESOURCE RECOVERY

Research conducted under this line aims to improve current technologies and develop novel tools for treating wastewater and reusing it in centralised and decentralised systems, including nature-based solutions, in the context of circular economy. Achieving better treatment performance, recovering energy and nutrients and reducing detrimental emissions including organic micropollutants are the goals of this line. The experimental approach ranges from fundamental to applied research, with most of the projects involving strong involvement and participation by industry partners and water utilities.

The main activities focus on the following themes:

- Resource recovery through wastewater treatment
- Monitoring organic micropollutants in the environment and biodegradation/ removal by means of several treatment technologies
- The Circular economy and nature-based solutions for optimal and safe closed water cycle in the Mediterranean region and in tourist facilities.

The first block of activities conducted during 2019 focused on recovering resources from wastewater. Within this line, the research funded by the EU Water Works call (Water JPI) via the WATINTECH project focused on improving methane production through the anaerobic digestion of concentrated wastewater via a forward osmosis process. This work is part of the ongoing PhD thesis of Federico Ferrari. During 2019, a forward osmosis system was developed with the help of Dr Gaetan Blandin (UdG, Eurecat) and operated to obtain real concentrated wastewater which is treated by an anaerobic membrane bioreactor. Also, during 2019, Dr Soraya Zahedi was incorporated to the research team via a Juan de la Cierva fellowship. She has been exploring the effect of different wastewater concentrates produced through FO on the anaerobic digestion process, assessing its potential methane production as well as the occurrence of pharmaceutical compounds and their associated resistance genes.

In October 2019, a pilot plant based on an innovative electrochemical system was installed in the wastewater treatment plant (WWTP) of Girona. The pilot system is part of the NEWBIES project awarded within the LIFE17 ENVINL call and coor-

inated by WETSUS (The Netherlands), a European centre of excellence for sustainable water technology. The pilot plant aims to recover 1 Kg of nitrogen per day from the digestate produced in the anaerobic digesters of the WWTP.

The second research topic deals with organic micropollutants (pharmaceutical, endocrine disrupting compounds and Watch List compounds) to expand knowledge of their removal/biodegradation mechanisms. In particular, within the framework of Lucia Gusmaroli's PhD thesis, which she submitted in 2019, tests were conducted to consider those emerging compounds not sufficiently evaluated, such as Watch List compounds, and their fate in conventional activated sludge systems. Additional studies, in collaboration with the water quality area, were performed to identify transformation products of a specific micropollutant (metoprolol). Moreover, tailored studies on the presence and removal of micropollutants in greywater (using hydroponic technologies and other biologically based technologies like wire hose cover as biological carriers) and in swimming pool water (by an advanced disinfection technology) have been performed and the results published. Finally, as part of TreatRec and micropollutants removal, the research fellow Luca Sbardella has processed the results from a biological-activated carbon filter and in sulphate radical-based oxidation experiments. His work concluded with the brilliant defence of his Doctoral Thesis "Evaluation and comparison of advanced treatment technologies to enhance the removal of pharmaceutical active compounds from WWTP secondary effluent", supervised by Dr Joaquim Comas, Dr Ignasi Rodriguez-Roda, and Alessio Fenu (Aquafin).

Following the expertise achieved on water reuse (in particular the demEAUmed project, 2014-2017) and nutrients recovery, the fourth research topic within this line is expanding its activities towards the circular economy concept and nature-based solutions with the HYDROUSA and CLEaN-TOUR projects, in the context of Mediterranean areas and tourist installations, and the COST action Circular City Re.Solution.

With regard to circular economy and nature-based solutions, the H2020 project HYDROUSA "Demonstration of Water Loops with Innovative Regenerative Business Models for the Mediterranean Region" has been evaluating innovative, nature-based

water management solutions for Mediterranean islands and coastal areas for wastewater treatment and nutrient recovery, supplying fresh water from non-conventional water sources and also for agricultural purposes. The goal is to establish the water-energy-food-employment nexus, creating jobs, boosting the economy and making sure that both the community and stakeholders are engaged.

In addition, The RETOS project CLEaN-TOUR (2018-2020) “Circular Economy to Facilitate Urban Water Reuse in a Tourist City: Centralised or Decentralised?” is being conducted in collaboration with the AIII3 line and within the framework of Esther Mendoza’s PhD thesis. The aim is to demonstrate the safety of regenerated water for irrigation and other uses, thus taking a step towards the circular econ-

omy in tourist areas. It is analysing centralised and decentralised systems (segregating different types of water) to address: *i)* the elimination of micro-contaminants and some pathogens, *ii)* the evaluation of the possible risks posed by water reuse, and *iii)* the difficulties in selecting the most suitable scenario (centralised or decentralised) with innovative treatment technologies such as osmotic membrane bioreactors and hydroponic technologies for greywater treatment with edible plants.

Finally, ICRA is also active in the Circular City Re.solution project (Implementing Nature-Based Solutions for Creating a Resourceful Circular City) COST action (2018-2022), with Gianluigi Buttigliero as MC for Spain and many other ICRA researchers involved.

▶ LINE III.3 MODELLING AND MANAGEMENT SYSTEMS

The main focus of research line AIII3 is on the development of tools and methodologies to support urban water system (UWS) management. Line III.3 seeks the integration of subsystems (e.g. sewer systems, wastewater treatment plants and receiving water bodies) and the planning of smart and sustainable cities.

The main activities focus on the following three themes:

- **Digitalisation of the water sector**
- **Planning of sustainable cities including Nature-Based Solutions**
- **Integrated management of urban wastewater systems**

Digitalisation of the water sector

AIII.3 established a cooperation with the Water Quality research area (Sara Rodriguez-Mozaz, Mira Petrovic, Carles Borrego and Pablo Gago) which will bring together technology and imagination to mine socio-economic information from different neighbourhoods through the chemical and microbiological analysis of their citizens’ sewage, the so-called “sewage sociology”. Lluís Corominas is leading the ICRA contribution on the H2020 SCOREwater project (<https://www.scorewater.eu/>), which aims at mining socio-economic information from sewage samples. SCOREwater relies on several complementary Catalan partners (ICRA, BCASA, s::can iberia, IERMB and Eurecat) who are collaborating on the Barcelona case-study, where

three of the city’s neighbourhoods will be monitored over the period of a year. Considerable progress has been made during the first eight months of SCOREwater’s Barcelona case-study; the neighbourhoods to be monitored have been carefully selected, the water quality/quantity monitoring stations have been designed, data has been collected from the local authority to develop a data-driven model for enhanced sewer system maintenance, and one preliminary campaign has been executed to kick-off the analytical work. Mònica Escolà and Nicole Schröter (under the main supervision of Pablo Gago) have contributed to these achievements.

The H2020 project “Leading Urban Water Management to its Digital Future” (DWC) (<https://www.digital-water.city/>) started in 2019. The main objective of DWC is to create linkages between the physical and digital world by developing 15 advanced digital solutions to address water-related challenges. The solutions are being tested and demonstrated in five major European cities to show how they can contribute to achieving three main objectives: improved water system performance, increased citizen involvement in urban water management and better protection of citizens’ health. Traditionally there has been a lack of reliable data and information on the occurrence of CSO’s. The AIII.3 contribution to DWC is led by Dr Gutierrez and Dr Corominas with participation from Silvia Busquets; the team will deploy a network of low-cost sensors (SENVES, see description

below) in the sewer systems of Sofia (Bulgaria) and Berlin (Germany) to improve knowledge on CSO emissions and develop operational strategies to minimise its effects. The solution provides a robust and straightforward method for CSO detection, reduces CAPEX and OPEX for CSO monitoring and allows utilities to monitor their extensive networks.

All3 has been very active in the field of urban wastewater system digitalisation. The team, formed by Dr Lluís Corominas, Dr Oriol Gutierrez, Sílvia Busquets, Lluís Bosch and Adrià Riu, has been working on three projects-actions that have successfully developed smart solutions to cope with the current and future needs of water utilities. Starting small, with the invention of low-cost combined-sewer-overflow detectors, then integrating those sensors in proactive management tools and finally working on their incorporation into the digitalisation of the urban water cycle. The following is a description of two of the main tools developed:

SENVES (Development of a low-cost sensor for combined sewer overflow monitoring). Combined sewer overflow (CSO) events produced in sewer systems during wet weather conditions are a threat for the receiving water bodies. Legislation obliges the monitoring of such events (i.e. in Spain, Royal Decree 1290/2012). In 2012, Dr Corominas, Dr Acuña and Dr Gutierrez (during the EcoMaWat project) led the development of a new methodology which aims to characterise the occurrence and duration of CSO events using low-cost temperature sensors. The method has been patented and rigorously validated in 4 European cities. The cost of the proposed solution is five times lower than that of current technologies. The first prototype (called SENVES) of this low-cost method was later deployed and validated in the Gestor project. An enhancement of the prototype is now being deployed in the H2020 Digital Water City project (DWC) which will finally bring the new sensor to the market.

GESTOR (Decision support tool for the proactive management of sewer systems). Together with two companies (FACSA and ABM) T&E-ICRA has developed the GESTOR tool which helps to predict potential sewer problems such as combined sewer overflows, infiltration/exfiltration or life-span reduction through corrosion, allowing us to detect/solve them before they become critical and even more costly. The tool has been tested in the municipality of Peñíscola (Spain) and is ready to be applied in other sites. The GESTOR platform reduces the maintenance costs of urban water infrastructure management, and its proactive protection diminishes the risk of infrastructure failure. Despite being a recently created tool, several municipalities have enquired about its application, and FACSA is already using it in a municipality in Northern Spain.

SAD-nitrates (Decision support system to select nitrate treatment technologies). In 2019, the Decision Support System (DSS) for selecting the most suitable treatment technology for nitrate removal in groundwater, which was developed in cooperation with the Catalan Water Agency (ACA) and the Catalan Water Partnership, was finalised. The DSS incorporates updated information on the most effective treatment technologies for nitrate removal and is freely available through the ACA website (<http://aca.gencat.cat>) to support local authorities dealing with polluted groundwaters. The project was led by Prof. Comas and the DSS was developed by Adrià Riu.

Planning of sustainable cities including Nature-Based Solutions

AIII.3 cooperates with AI.3 in the Sanitation for and by Nature project (SANNAT) as part of the Science for Nature and People Partnership (SNAPP). The team is led by Dr Acuña, with contributions from Prof. Comas, Dr Corominas and Mrs Castañares. ICRA has been compiling scientific evidence on the use of nature-based solutions (NBS) in urban wastewater systems all around the world. ICRA is developing a web-based decision support system (DSS) based on expert knowledge and the collected scientific evidence, to provide recommendations on using NBS for sanitation. At the end of 2019, ICRA presented the first prototype of the web-based DSS in a SNAPP workshop organised in Girona. During 2020, the DSS will be validated by experts and expanded to provide preliminary design outcomes for the selected NBS.

In 2019, AIII.3, in collaboration with the Resources and Ecosystems Area, has intensified its work on the H2020 project EdiCitNet (<http://www.edicitnet.com>), which aims to foster the systemic use of nature-based solutions for food production as a major step towards more sustainable, liveable and healthier cities. ICRA is leading the development of the tools (online catalogue and educational game supported by a database) to support public and private stakeholders in NBS learning and implementation. During 2019, ICRA researchers (Dr Castellar, Dr Acuña, Dr Corominas, Dr Rodríguez-Roda and Dr Comas) have led the conceptualisation and co-design of the tools and prepared the data and knowledge acquisition steps. A web-based survey has been developed collaboratively and inclusively, to act as a long-term data gathering and knowledge sharing tool. Furthermore, we have just started exploring the data and functionalities required to develop an educational game for participatory urban planning. This year, we have intensified our contacts with NBS-sister projects to look for synergies and amplify the project's impact.

Integrated management of urban wastewater systems

The State Research Agency (AEI) funds the INVEST project that commenced in 2019. In this project, research professor Wolfgang Gernjak, and research scientist Lluís Corominas, are at-

tempting to establish a framework that can be used to make investment decisions that contribute to achieving the implementation of the Water Framework Directive goals under different global change scenarios. Prof. Ignasi Rodríguez-Roda (ICRA-UdG), Manel Poch (UdG) and Morgan Abily (ICRA, postdoctoral researcher) complete the core project team.

The company “Aigües de Catalunya” provided the funding for AIII.3 to develop Ecoadvisor, an app for wastewater treatment plants (WWTPs). The app aims to adapt their operation to protect freshwater ecosystems while minimising costs. At ICRA, the working team is composed by Dr Corominas, Dr Acuña, Mrs Castañares, Mr Bosch and Prof. Comas. Ecoadvisor offers “Aigües de Catalunya” an advantage in tenders for the management of UWWTUs. “Aigües de Catalunya” has included the deployment of Ecoadvisor in two tenders relating to the management of wastewater treatment plants; the contracts have not yet been awarded. Three phases were programmed for EcoAdvisor, and two of them were successfully completed by the end of 2019. EcoAdvisor makes it possible to model different scenarios for a comprehensive range of WWTP treatments (i.e., primary treatment, nitrification, denitrification and phosphorus removal) and to evaluate how the discharge is affecting the receiving water body. The models that EcoAdvisor uses have been validated by expert knowledge and experimental campaigns in two real systems.

In 2019, AIII.3 continued working on the development of an educational game in cooperation with GILAB (University of Girona). Dr Corominas led the development of an educational game to educate primary school students about the urban water cycle (from the tap to freshwater ecosystems) in collaboration with GILAB (University of Girona). The educational game was an output from the EcoMaWat project. It's already in use at schools and is being continuously expanded to incorporate new scenarios under the umbrella of the SCOREwater project. During this process, ICRA engaged several schools to test and validate the game. Two primary schools have been involved with the project: Escola Pericot (Girona) and Bosch de la Pabordia (Girona). So far, the educational game has been tested on 125 students from four schools. Anna Suarez contributed to the definition of new scenarios as part of her BsC final project.



AIII- PHD DISSERTATIONS

Ignasi Aymerich (University of Girona) Integrated Assessment of Wastewater Treatment Plants and their Receiving River Systems in a Global Change Context.

Marc Sauchelli Toran (University of Girona) Mass Transport and Fouling of Novel TFC Forward Osmosis Membranes.

Pau Juan García (University of Girona) Resilience of Water Resource Recovery Facilities: a framework for quantitative model-based assessment.

Luca Sbardella Evaluation and Comparison of Advanced Treatment Technologies to Enhance the Removal of Pharmaceutical Active Compounds from WWTP Secondary Effluent. Luca Sbardella. Co-supervised by Ignasi Rodríguez-Roda, Joaquim Comas and Alessio Fenu (AQUAFIN) May 2019.

VISITING SCIENTISTS

Klai, Nouha (Western University)

Lant, Paul (University of Queensland)

Sedlak, David Louis (University of California)

VISITING STUDENTS

Oriol Canal (University of Girona-UDG)

Erik Fernández (University of Girona-UDG)

Joan Ferriol (University of Girona-UDG)

Abdelhalim Fetimi (University of Bejaia)

Erwann Franssen (ENSCL)

Mónica Izquierdo (University of Girona-UDG)

Gemma Quílez (University of Girona-UDG)

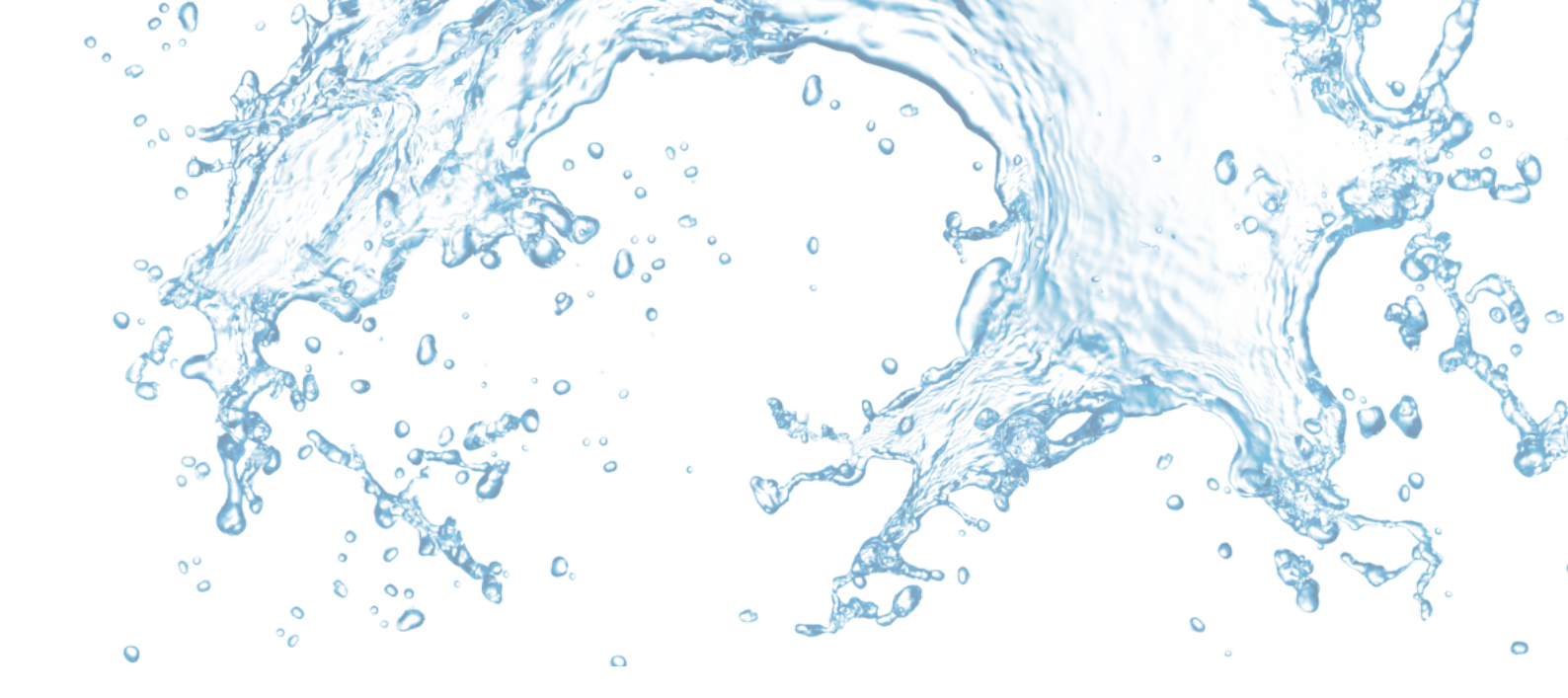
Ruggero Rapisarda (University of Catania)

Nonito Ros Berja (University of Girona-UDG)

Ana Suárez (University of Girona-UDG)

AIII – STAYS ABROAD

Gianluigi Buttiglieri at UNIVPM, **Department of Materials, Environmental Sciences and Urban Planning**, (Ancona, Italy) with Prof. Francesco Fatone and Dr Anna Laura Eusebi in the period 10th September - 8th October 2018.



WATER 5.0
A new paradigm
in the context of
circular economy



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Quim
Alexandre
Lluís
Hèctor



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WATER SOLUTIONS

ICRA

Institut Català
de Recerca de l'Aigua
Institut Catalán
de Investigación del Agua
Catalan Institute
for Water Research

04

PUBLICATIONS & CONGRESSES

TOTAL PUBLICATIONS:
118



SCI PUBLICATIONS (SCIENCE CITATION INDEX 2018)

(Publications ordered alphabetically)

Álvarez-Muñoz D, Rambla-Alegre M, Carrasco N, Lopez de Alda M, Barceló D. 2019. **Fast analysis of relevant contaminants mixture in commercial shellfish.** *Talanta* 205. IF=4,916 Q1

Arce MI, Mendoza-Lera C, Almagro M, Catalán N, Romani AM, Martí E, Gómez R, Bernal S, Foulquier A, Mutz M, Marcé R, Zoppini A, Gionchetta G, Weigelhofer G, del Campo R, Robinson CT, Gilmer A, Rulik M, Obrador B, Shumilova O, Zlatanović S, Arnon S, Baldrian P, Singer G, Datry T, Skoulikidis N, Tietjen B, von Schiller D. 2019. **A conceptual framework for understanding the biogeochemistry of dry riverbeds through the lens of soil science.** *Earth-Science Reviews* 188:441-453. IF=9,530 Q1

Attermeyer K, Andersson S, Catalán N, Einarsdottir K, Groeneveld M, Székely AJ, Tranvik LJ. 2019. **Potential terrestrial influence on transparent exopolymer particle concentrations in boreal freshwaters.** *Limnology and Oceanography* 64:2455-2466. IF=4,325 Q1

Aznar-Alemany Ò, Sala B, Plön S, Bouwman H, Barceló D, Eljarrat E. 2019. **Halogenated and organophosphorus flame retardants in cetaceans from the southwestern Indian Ocean.** *Chemosphere* 226:791-799. IF=5,108 Q1

Aznar-Alemany Ò, Yang X, Alonso MB, Costa ES, Torres JPM, Malm O, Barceló D, Eljarrat E. 2019. **Preliminary study of long-range transport of halogenated flame retardants using Antarctic marine mammals.** *Science of the Total Environment* 650:1889-1897. IF=5,589 Q1

Barbieri MV, Postigo C, Guillem-Argiles N, Monllor-Alcaraz LS, Simionato JI, Stella E, Barceló D, López de Alda M. 2019. **Analysis of 52 pesticides in fresh fish muscle by QuEChERS extraction followed by LC-MS/MS determination.** *Science of the Total Environment* 653:958-967. IF=5,589 Q1

Barbieri MV, Postigo C, Monllor-Alcaraz LS, Barceló D, López de Alda M. 2019. **A reliable LC-MS/MS-based method for trace level determination of 50 medium to highly polar pesticide residues in sediments and ecological risk assessment.** *Analytical and Bioanalytical Chemistry* 411:7981-7996. IF=3,286 Q1

Barceló D, Knepper T. 2019. **Analysis, fate and effects of microplastics in the environment: Preface to article collection.** *TrAC - Trends in Analytical Chemistry* 121. IF=8,428 Q1

Barceló D, Kostianoy AG. 2019. **Series preface.** *Handbook of Environmental Chemistry* 77:IX-X. IF=1,310 Q3

Barceló D, Kostianoy AG. 2019. **Series preface.** *Handbook of Environmental Chemistry* 73:ix-x. IF=1,310 Q3

Barceló D, Kostianoy AG. 2019. **Series preface.** *Handbook of Environmental Chemistry* 71:ix-x. IF=1,310 Q1

Barceló D, Kostianoy AG. 2019. **Series preface.** *Handbook of Environmental Chemistry* 79:IX-X. IF=1,310 Q3

Barceló D, Kostianoy AG. 2019. **Series preface.** *Handbook of Environmental Chemistry* 72:IX-X. IF=1,310 Q3

Barceló D, Kostianoy AG. 2019. **Series preface.** *Handbook of Environmental Chemistry* 66:ix-x. IF=1,310 Q3

Barceló D, Kostianoy AG. 2019. **Series preface.** *Handbook of Environmental Chemistry* 68:ix-x. IF=1,310 Q3

Barreto A, Luis LG, Pinto E, Almeida A, Paíga P, Santos LHMLM, Delerue-Matos C, Trindade T, Soares AMVM, Hylland K, Loureiro S, Oliveira M. 2019. **Effects and bioaccumulation of gold nanoparticles**

in the gilthead seabream (*Sparus aurata*) – Single and combined exposures with gemfibrozil. *Chemosphere* 215:248-260. IF=5,108 Q1

Barreto A, Luis LG, Pinto E, Almeida A, Paíga P, Santos LHMLM, Delerue-Matos C, Trindade T, Soares AMVM, Hylland K, Loureiro S, Oliveira M. 2019. **Genotoxicity of gold nanoparticles in the gilthead seabream (*Sparus aurata*) after single exposure and combined with the pharmaceutical gemfibrozil.** *Chemosphere* 220:11-19. IF=5,108 Q1

Bilal M, Ashraf SS, Barceló D, Iqbal HMN. 2019. **Biocatalytic degradation/redefining “removal” fate of pharmaceutically active compounds and antibiotics in the aquatic environment.** *Science of the Total Environment* 691:1190-1211. IF=5,589 Q1

Bilal M, Iqbal HMN, Barceló D. 2019. **Mitigation of bisphenol A using an array of laccase-based robust bio-catalytic cues – A review.** *Science of the Total Environment* 689:160-177. IF=5,589 Q1

Bilal M, Iqbal HMN, Barceló D. 2019. **Persistence of pesticides-based contaminants in the environment and their effective degradation using laccase-assisted biocatalytic systems.** *Science of the Total Environment* 695. IF=5,589 Q1

Blandin G, Rosselló B, Monsalvo VM, Batlle-Vilanova P, Viñas JM, Rogalla F, Comas J. 2019. **Volatile fatty acids concentration in real wastewater by forward osmosis.** *Journal of Membrane Science* 575:60-70. IF=7,015 Q1

Blöschl G, Bierkens MFP, Chambel A, Cudennec C, Destouni G, Fiori A, Kirchner JW, McDonnell JJ, Savenije HHG, Sivapalan M, Stump C, Toth E, Volpi E, Carr G, Lupton C, Salinas J, Széles B, Viglione A, Aksoy H, Allen ST, Amin A, Andréassian V, Arheimer B, Aryal SK, Baker V, Bardsley E, Barendrecht MH, Bartosova A, Batelaan O, Berghuijs WR, Beven K, Blume T, Bogaard T, Borges de Amorim P, Böttcher ME, Boulet G, Breinl K, Brilly M, Brocca L, Buytaert W, Castellarin A, Castelletti A, Chen X, Chen Y, Chiffard P, Claps P, Clark MP, Collins AL, Croke B, Dathe A, David PC, de Barros FPJ, de Rooij G, Di Baldassarre G, Driscoll JM, Duethmann D, Dwivedi R, Eris E, Farmer WH, Feicabrino J, Ferguson G, Ferrari E, Ferraris S, Fersch B, Finger D, Foglia L, Fowler K, Gartsman B, Gascoin S, Gaume E, Gelfan A, Geris J, Gharari S, Gleeson T, Glendell M, Gonzalez Bevacqua A, González-Dugo MP, Grimaldi S, Gupta AB, Guse B, Han D, Hannah D,

Harpold A, Haun S, Heal K, Helfricht K, Herrnegger M, Hipsey M, Hlaváčiková H, Hohmann C, Holko L, Hopkinson C, Hrachowitz M, Illangasekare TH, Inam A, Innocente C, Istanbuluoglu E, Jarihani B, Kalantari Z, Kalvans A, Khanal S, Khatami S, Kiesel J, Kirkby M, Knoben W, Kochanek K, Kohnová S, Kolehkina A, Krause S, Kreamer D, Kreibich H, Kunstmann H, Lange H, Liberato MLR, Lindquist E, Link T, Liu J, Loucks DP, Luce C, Mahé G, Makarieva O, Malard J, Mashtayeva S, Maskey S, Mas-Pla J, Mavrova-Guirguinova M, Mazzoleni M, Mernild S, Misstear BD, Montanari A, Müller-Thomy H, Nabizadeh A, Nardi F, Neale C, Nesterova N, Nurtaev B, Odongo VO, Panda S, Pande S, Pang Z, Papacharalampous G, Perrin C, Pfister L, Pimentel R, Polo MJ, Post D, Prieto Sierra C, Ramos MH, Renner M, Reynolds JE, Ridolfi E, Rigon R, Riva M, Robertson DE, Rosso R, Roy T, Sá JHM, Salvadori G, Sandells M, Schaeffli B, Schumann A, Scolobig A, Seibert J, Servat E, Shafiei M, Sharma A, Sidibe M, Sidle RC, Skaugen T, Smith H, Spiessl SM, Stein L, Steinsland I, Strasser U, Su B, Szolgay J, Tarboton D, Tauro F, Thirel G, Tian F, Tong R, Tussupova K, Tyrallis H, Uijlenhoet R, van Beek R, van der Ent RJ, van der Ploeg M, Van Loon AF, van Meerveld I, van Nooijen R, van Oel PR, Vidal JP, von Freyberg J, Vorogushyn S, Wachniew P, Wade AJ, Ward P, Westerberg IK, White C, Wood EF, Woods R, Xu Z, Yilmaz KK, Zhang Y. 2019. **Twenty-three unsolved problems in hydrology (UPH)—a community perspective.** *Hydrological Sciences Journal* 64:1141-1158. IF=2,180 Q3

Bodmer P, Attermeyer K, Pastor A, Catalán N. 2019. **Collaborative Projects: Unleashing Early Career Scientists’ Power.** *Trends in Ecology and Evolution* 34:871-874. IF=15,236 Q1

Brack W, Ait-Aissa S, Backhaus T, Birk S, Barceló D, Burgess R, Cousins I, Dulio V, Escher BI, Focks A, van Gils J, Ginebreda A, Hering D, Hewitt LM, Hilscherová K, Hollender J, Hollert H, Köck M, Kortenkamp A, de Alda ML, Müller C, Posthuma L, Schürmann G, Schymanski E, Segner H, Sleuwaert F, Slobodnik J, Teodorovic I, Umbuzeiro G, Voulvoulis N, van Wezel A, Altenburger R. 2019. **Strengthen the European collaborative environmental research to meet European policy goals for achieving a sustainable, non-toxic environment.** *Environmental Sciences Europe* 31. IF=5,878 Q1

Calero-Cáceres W, Balcázar JL. 2019. **Antibiotic resistance genes in bacteriophages from diverse marine habitats.** *Science of the Total Environment* 654:452-455. IF=5,589 Q1

- Calero-Cáceres W, Ye M, Balcázar JL. 2019. **Bacteriophages as Environmental Reservoirs of Antibiotic Resistance.** *Trends in Microbiology* 27:570-577. IF=11,974 Q1
- Carvalho L, Mackay EB, Cardoso AC, Baattrup-Pedersen A, Birk S, Blackstock KL, Borics G, Borja A, Feld CK, Ferreira MT, Globevnik L, Grizzetti B, Hendry S, Hering D, Kelly M, Langaas S, Meissner K, Panagopoulos Y, Penning E, Rouillard J, Sabater S, Schmedtje U, Spears BM, Venohr M, van de Bund W, Solheim AL. 2019. **Protecting and restoring Europe's waters: An analysis of the future development needs of the Water Framework Directive.** *Science of the Total Environment* 658:1228-1238. IF=5,589 Q1
- Castaño-Ortiz JM, Jaspers VLB, Waugh CA. 2019. **PFOS mediates immunomodulation in an avian cell line that can be mitigated via a virus infection.** *BMC Veterinary Research* 15. IF=1,792 Q1
- Ćelić M, Gros M, Farré M, Barceló D, Petrović M. 2019. **Pharmaceuticals as chemical markers of wastewater contamination in the vulnerable area of the Ebro Delta (Spain).** *Science of the Total Environment* 652:952-963. IF=5,589 Q1
- Cojocariu C, Postigo C, Richardson SD, Barcelo D, Silcock P. 2019. **Discovery of emerging disinfection by-products in water using gas chromatography coupled with orbitrap-based mass spectrometry.** *Brazilian Journal of Analytical Chemistry* 6:98-105. IF=0,815 Q1
- Colls M, Timoner X, Font C, Sabater S, Acuña V. 2019. **Effects of Duration, Frequency, and Severity of the Non-flow Period on Stream Biofilm Metabolism.** *Ecosystems* 22:1393-1405. IF=4,555 Q1
- Díaz-Cruz MS, Molins-Delgado D, Serra-Roig MP, Kalogianni E, Skoulikidis NT, Barceló D. 2019. **Personal care products reconnaissance in EVROTAS river (Greece): Water-sediment partition and bioaccumulation in fish.** *Science of the Total Environment* 651:3079-3089. IF=5,589 Q1
- Ekowati Y, Ferrero G, Farré MJ, Kennedy MD, Buttiglieri G. 2019. **Application of UVOX Redox® for swimming pool water treatment: Microbial inactivation, disinfection byproduct formation and micropollutant removal.** *Chemosphere* 220:176-184. IF=5,108 Q1
- Espa P, Batalla RJ, Brignoli ML, Crosa G, Gentili G, Quadroni S. 2019. **Tackling reservoir siltation by controlled sediment flushing: Impact on downstream fauna and related management issues.** *PLOS ONE* 14. IF=2,776 Q1
- Farré MJ, Jaén-Gil A, Hawkes J, Petrovic M, Catalán N. 2019. **Orbitrap molecular fingerprint of dissolved organic matter in natural waters and its relationship with NDMA formation potential.** *Science of the Total Environment* 670:1019-1027. IF=5,589 Q1
- Ferrari F, Balcázar JL, Rodríguez-Roda I, Pijuan M. 2019. **Anaerobic membrane bioreactor for biogas production from concentrated sewage produced during sewer mining.** *Science of the Total Environment* 670:993-1000. IF=5,589 Q1
- Ferrari F, Pijuan M, Rodríguez-Roda I, Blandin G. 2019. **Exploring submerged forward osmosis for water recovery and pre-concentration of wastewater before anaerobic digestion: A pilot scale study.** *Membranes* 9. IF=2,020 Q1
- Font C, Bregoli F, Acuña V, Sabater S, Marcé R. 2019. **GLOBAL-FATE (version 1.0.0): A geographical information system (GIS)-based model for assessing contaminants fate in the global river network.** *Geoscientific Model Development* 12:5213-5228. IF=5,154 Q1
- Gago-Ferrero P, Bletsou AA, Damalas DE, Aalizadeh R, Alygizakis NA, Singer HP, Hollender J, Thomaidis NS. 2019. **Wide-scope target screening of >2000 emerging contaminants in wastewater samples with UPLC-Q-ToF-HRMS/MS and smart evaluation of its performance through the validation of 195 selected representative analytes.** *Journal of Hazardous Materials*. IF=7,650 Q1
- Ginebreda A, Sabater-Liesa L, Barceló D. 2019. **Quantification of ecological complexity and resilience from multivariate biological metrics datasets using singular value decomposition entropy.** *MethodsX* 6:1668-1676. IF=1,349 Q2
- Giulivo M, Stella E, Capri E, Esnaola A, López de Alda M, Diaz-Cruz S, Mandaric L, Muñoz I, Bellin A. 2019. **Assessing the effects of hydrological and chemical stressors on macroinvertebrate community in an Alpine river: The Adige River as a case study.** *River Research and Applications* 35:78-87. IF=1,954 Q1

- González-Trujillo JD, Petsch DK, Córdoba-Ariza G, Rincón-Palau K, Donato-Rondon JC, Castro-Rebolledo MI, Sabater S. 2019. **Upstream refugia and dispersal ability may override benthic-community responses to high-Andean streams deforestation. Biodiversity and Conservation.** IF=3,295 Q1
- Gros M, Marti E, Balcázar JL, Boy-Roura M, Busquets A, Colón J, Sánchez-Melsió A, Lekunberri I, Borrego CM, Ponsá S, Petrovic M. 2019. **Fate of pharmaceuticals and antibiotic resistance genes in a full-scale on-farm livestock waste treatment plant. Journal of Hazardous Materials** 378. IF=7,650 Q1
- Gros M, Mas-Pla J, Boy-Roura M, Geli I, Domingo F, Petrovic M. 2019. **Veterinary pharmaceuticals and antibiotics in manure and slurry and their fate in amended agricultural soils: Findings from an experimental field site (Baix Empordà, NE Catalonia). Science of the Total Environment** 654:1337-1349. IF=5,589 Q1
- Gusmaroli L, Buttiglieri G, Petrovic M. 2019. **The EU watch list compounds in the ebro delta region: Assessment of sources, river transport, and seasonal variations. Environmental Pollution** 253:606-615. IF= 5,714 Q1
- Iroumé A, Zingaretti V, Vericat D, Tenny J, Llena M, Batalla RJ. 2019. **Fluvial responses following volcanic eruptions: The Blanco-Este river, Southern Chile C3 - WIT Transactions on Ecology and the Environment.** 234:21-29. IF=0,21 Q4
- Jaén-Gil A, Buttiglieri G, Benito A, Gonzalez-Olmos R, Barceló D, Rodríguez-Mozaz S. 2019. **Metoprolol and metoprolol acid degradation in UV/H₂O₂ treated wastewaters: An integrated screening approach for the identification of hazardous transformation products. Journal of Hazardous Materials** 380. IF=7,650 Q1
- Jaén-Gil A, Castellet-Rovira F, Llorca M, Villagrasa M, Sarrà M, Rodríguez-Mozaz S, Barceló D. 2019. **Fungal treatment of metoprolol and its recalcitrant metabolite metoprolol acid in hospital wastewater: Biotransformation, sorption and ecotoxicological impact. Water Research** 152:171-180. IF=7,913 Q1
- Jordà-Capdevila D, Gampe D, Huber García V, Ludwig R, Sabater S, Vergoñós L, Acuña V. 2019. **Impact and mitigation of global change on freshwater-related ecosystem services in Southern Europe. Science of the Total Environment** 651:895-908. IF=5,589 Q1
- J. Rodríguez-Chueca, S. Varella, J. Rocha, T. Fernandes, C. Pablos, A. Encinas, D. Barceló, S. Rodríguez-Mozaz, C.M. Manaia and J. Marugán. **“Assessment of full-scale tertiary wastewater treatment by UV-C based-AOPs: Removal or persistence of antibiotics and antibiotic resistance genes?” Science of the Total Environment**, 652 (2019), 1051-1061. IF=5,589 Q1
- Kassotaki E, Pijuan M, Rodríguez-Roda I, Buttiglieri G. 2019. **Comparative assessment of endocrine disrupting compounds removal in heterotrophic and enriched nitrifying biomass. Chemosphere** 217:659-668. IF=5,108 Q1
- Ker Rault PA, Koundouri P, Akinsete E, Ludwig R, Huber-Garcia V, Tsani S, Acuna V, Kalogianni E, Luttik J, Kok K, Skoulikidis N, Froebrick J. 2019. **Down scaling of climate change scenarii to river basin level: A transdisciplinary methodology applied to Evrotas river basin, Greece. Science of the Total Environment** 660:1623-1632. IF=5,589 Q1
- Kiecak A, Sassine L, Boy-Roura M, Elsner M, Mas-Pla J, Le Gal La Salle C, Stumpp C. 2019. **Sorption properties and behaviour at laboratory scale of selected pharmaceuticals using batch experiments. Journal of Contaminant Hydrology** 225. IF=2,650 Q1
- Köck-Schulmeyer M, Postigo C, Farré M, Barceló D, López de Alda M. 2019. **Medium to highly polar pesticides in seawater: Analysis and fate in coastal areas of Catalonia (NE Spain). Chemosphere** 215:515-523. IF=5,108 Q1
- Letsinger S, Kay P, Rodríguez-Mozaz S, Villagrasa M, Barceló D, Rotchell JM. 2019. **Spatial and temporal occurrence of pharmaceuticals in UK estuaries. Science of the Total Environment** 678:74-84. IF=5,589 Q1
- Limberger R, Birtel J, Peter H, Catalán N, da Silva Farias D, Best RJ, Brodersen J, Bürgmann H, Matthews B. 2019. **Predator-induced changes in dissolved organic carbon dynamics. Oikos** 128:430-440. IF=3,468 Q2
- Llorca M, Castellet-Rovira F, Farré MJ, Jaén-Gil A, Martínez-Alonso M, Rodríguez-Mozaz S, Sarrà M, Barceló D. 2019. **Fungal biodegradation of the N-nitrosodimethylamine precursors venlafaxine and O-desmethylvenlafaxine in water.**

Environmental Pollution 246:346-356. IF= 5,714 Q1

López-Doval JC, Freixa A, Santos LHMLM, Sanchís J, Rodríguez-Mozaz S, Farré M, Barceló D, Sabater S. 2019. **Exposure to single and binary mixtures of fullerenes and triclosan: Reproductive and behavioral effects in the freshwater snail *Radix balthica***. *Environmental Research* 176. IF= 5,714 Q1

López-García E, Postigo C, Barceló D, López de Alda M. 2019. **The value of wastewater-based epidemiology in the estimation of alcohol consumption**. *Current Opinion in Environmental Science and Health* 9:19-25. IF=4,258 Q1

López-Pacheco IY, Carrillo-Nieves D, Salinas-Salazar C, Silva-Núñez A, Arévalo-Gallegos A, Barceló D, Afewerki S, Iqbal HMN, Parra-Saldívar R. 2019. **Combination of nejayote and swine wastewater as a medium for *Arthrospira maxima* and *Chlorella vulgaris* production and wastewater treatment**. *Science of the Total Environment* 676:356-367. IF=5,589 Q1

López-Pacheco IY, Salinas-Salazar C, Silva-Núñez A, Rodas-Zuluaga LI, Donoso-Quezada J, Ayala-Mar S, Barceló D, Iqbal HMN, Parra-Saldívar R. 2019. **Removal and biotransformation of 4-nonylphenol by *Arthrospira maxima* and *Chlorella vulgaris* consortium**. *Environmental Research* 179. IF= 5,714 Q1

López-Pacheco IY, Silva-Núñez A, Salinas-Salazar C, Arévalo-Gallegos A, Lizarazo-Holguin LA, Barceló D, Iqbal HMN, Parra-Saldívar R. 2019. **Anthropogenic contaminants of high concern: Existence in water resources and their adverse effects**. *Science of the Total Environment* 690:1068-1088. IF=5,589 Q1

López-Serna R, García D, Bolado S, Jiménez JJ, Lai FY, Golovko O, Gago-Ferrero P, Ahrens L, Wiberg K, Muñoz R. 2019. **Photobioreactors based on microalgae-bacteria and purple phototrophic bacteria consortia: A promising technology to reduce the load of veterinary drugs from piggy wastewater**. *Science of the Total Environment* 692:259-266. IF=5,589 Q1

López-van Oosterom MV, Casas-Ruiz JP, Gampe D, López-Robles MA, Ludwig R, Núñez-Marcé A, Muñoz I. 2019. **Responses of a native and a recent invader snail to warming and dry conditions: the case of the lower Ebro River**. *Aquatic Ecology* 53:497-508. IF=2,235 Q2

Mandaric L, Kalogianni E, Skoulikidis N, Petrovic M, Sabater S. 2019. **Contamination patterns and attenuation of pharmaceuticals in a temporary Mediterranean river**. *Science of the Total Environment* 647:561-569. IF=5,589 Q1

Marcé R, Obrador B. 2019. **Reuniting biogeochemistry with ecology and evolution**. *Science* 366:805-806. IF=41,063 Q1

Marcé R, Obrador B, Gómez-Gener L, Catalán N, Koschorreck M, Arce MI, Singer G, von Schiller D. 2019. **Emissions from dry inland waters are a blind spot in the global carbon cycle**. *Earth-Science Reviews* 188:240-248. IF=9,530 Q1

Mas-Pla J, Menció A. 2019. **Groundwater nitrate pollution and climate change: learnings from a water balance-based analysis of several aquifers in a western Mediterranean region (Catalonia)**. *Environmental Science and Pollution Research* 26:2184-2202. IF= 5,714 Q1

Mekni S, Barhoumi B, Aznar-Alemany Ò, Touil S, Driss MR, Barceló D, Eljarrat E. 2019. **Occurrence of halogenated flame retardants in sediments and sea urchins (*Paracentrotus lividus*) from a North African Mediterranean coastal lagoon (Bizerte, Tunisia)**. *Science of the Total Environment* 654:1316-1325. IF=5,589 Q1

Menció A, Mas-Pla J. 2019. **Assessing the influence of environmental factors on groundwater antibiotic occurrence by means of variation partitioning**. *Water Research (Switzerland)* 11. IF=7,913 Q3

Menéndez M, Abril M, Colls M, Quintana XD. 2019. **Decomposition processes in coastal lagoons and their implications for the assessment of ecological health**. *Aquatic Conservation: Marine and Freshwater Ecosystems* 29:450-460. IF=4,555 Q1

Mir-Tutusa JA, Parladé E, Villagrasa M, Barceló D, Rodríguez-Mozaz S, Martínez-Alonso M, Gaju N, Sarrà M, Caminal G. 2019. **Long-term continuous treatment of non-sterile real hospital wastewater by *Trametes versicolor***. *Journal of Biological Engineering* 13. IF=2,667 Q2

Mor JR, Dolédec S, Acuña V, Sabater S, Muñoz I. 2019. **Invertebrate community responses to urban wastewater effluent pollution under different hydro-morphological conditions**. *Environmental*

Pollution 252:483-492. IF= 5,714 Q1

Nilsen E, Smalling KL, Ahrens L, Gros M, Miglioranza KSB, Picó Y, Schoenfuss HL. 2019. **Critical review: Grand challenges in assessing the adverse effects of contaminants of emerging concern on aquatic food webs.** *Environmental Toxicology and Chemistry* 38:46-60. IF=3,421 Q2

Padró R, Marco I, Font C, Tello E. 2019. **Beyond Chayanov: A sustainable agroecological farm reproductive analysis of peasant domestic units and rural communities (Sentmenat; Catalonia, 1860).** *Ecological Economics* 160:227-239. IF=4,281 Q2

Park J, Batalla RJ, Birgand F, Esteves M, Gentile F, Harrington JR, Navratil O, López-Tarazón JA, Vericat D. 2019. **Influences of catchment and river channel characteristics on the magnitude and dynamics of storage and re-suspension of fine sediments in river beds.** *Water Research (Switzerland)* 11. IF=7,913 Q3

Pärnänen KMM, Narciso-Da-Rocha C, Kneis D, Berendonk TU, Cacace D, Do TT, Elpers C, Fatta-Kassinos D, Henriques I, Jaeger T, Karkman A, Martinez JL, Michael SG, Michael-Kordatou I, O'Sullivan K, Rodriguez-Mozaz S, Schwartz T, Sheng H, Sørum H, Stedtfeld RD, Tiedje JM, Giustina SVD, Walsh F, Vaz-Moreira I, Virta M, Manaia CM. 2019. **Antibiotic resistance in European wastewater treatment plants mirrors the pattern of clinical antibiotic resistance prevalence.** *Science Advances* 5. IF=12,804 Q1

Pastor A, Freixa A, Skovsholt LJ, Wu N, Romani AM, Riis T. 2019. **Microbial Organic Matter Utilization in High-Arctic Streams: Key Enzymatic Controls.** *Microbial Ecology* 78:539-554. IF= 3,611 Q1

Peña-Angulo D, Nadal-Romero E, González-Hidalgo JC, Albaladejo J, Andreu V, Bagarello V, Barhi H, Batalla RJ, Bernal S, Bienes R, Campo J, Campo-Bescós MA, Canatario-Duarte A, Cantón Y, Casali J, Castillo V, Cerdà A, Cheggour A, Cid P, Cortesi N, Desir G, Díaz-Pereira E, Espigares T, and all, Zorn M. 2019. **Spatial variability of the relationships of runoff and sediment yield with weather types throughout the Mediterranean basin.** *Journal of Hydrology* 571:390-405. IF=4,405 Q1

Pereda O, Acuña V, von Schiller D, Sabater S, Elosegi A. 2019. **Immediate and legacy effects of urban pollution on river ecosystem functioning:**

A mesocosm experiment. *Ecotoxicology And Environmental Safety* 169:960-970. IF=4,527 Q1

Pham HV, Sperotto A, Torresan S, Acuña V, Jorda-Capdevila D, Rianna G, Marcomini A, Critto A. 2019. **Coupling scenarios of climate and land-use change with assessments of potential ecosystem services at the river basin scale.** *Ecosystem Services* 40. IF=5,572 Q1

Picó Y, Barceló D. 2019. **Analysis and prevention of microplastics pollution in water: Current perspectives and future directions.** *ACS Omega* 4:6709-6719. IF=2,584 Q2

Pico Y, Belenguer V, Corcellas C, Diaz-Cruz MS, Eljarrat E, Farré M, Gago-Ferrero P, Huerta B, Navarro-Ortega A, Petrovic M, Rodríguez-Mozaz S, Sabater L, Santín G, Barcelo D. 2019. **Contaminants of emerging concern in freshwater fish from four Spanish Rivers.** *Science of the Total Environment* 659:1186-1198. IF=5,589 Q1

Pistocchi A, Dorati C, Aloe A, Ginebreda A, Marcé R. 2019. **River pollution by priority chemical substances under the Water Framework Directive: A provisional pan-European assessment.** *Science of the Total Environment* 662:434-445. IF=5,589 Q1

Previšić A, Rožman M, Mor JR, Acuña V, Serra-Compte A, Petrović M, Sabater S. 2019. **Aquatic macroinvertebrates under stress: Bioaccumulation of emerging contaminants and metabolomics implications.** *Science of the Total Environment.* IF=5,589 Q1

Radinja M, Comas J, Corominas L, Atanasova N. 2019. **Assessing stormwater control measures using modelling and a multi-criteria approach.** *Journal of Environmental Management* 243:257-268. IF=4,865 Q1

Radinja M, Comas J, Corominas L, Atanasova N. 2019. **Multi-criteria Evaluation of Sustainable Urban Drainage Systems C3 - Green Energy and Technology.** 269-274. IF= / Q4

Reche C, Viana M, Querol X, Corcellas C, Barceló D, Eljarrat E. 2019. **Particle-phase concentrations and sources of legacy and novel flame retardants in outdoor and indoor environments across Spain.** *Science of the Total Environment* 649:1541-1552. IF=5,589 Q1

Rede D, Santos LHMLM, Ramos S, Oliva-Teles F, Antão C, Sousa SR, Delerue-Matos C. 2019. **Individual and mixture toxicity evaluation of three pharmaceuticals to the germination and growth of *Lactuca sativa* seeds.** *Science of the Total Environment* 673:102-109. IF=5,589 Q3

Ribera-Guardia A, Bosch L, Corominas L, Pijuan M. 2019. **Nitrous oxide and methane emissions from a plug-flow full-scale bioreactor and assessment of its carbon footprint.** *Journal of Cleaner Production* 212:162-172. IF=6,395 Q2

Rizzo L, Malato S, Antakyali D, Beretsou VG, Dolic MB, Gernjak W, Heath E, Ivancev-Tumbas I, Karaolia P, Lado Ribeiro AR, Mascolo G, McArdell CS, Schaar H, Silva AMT, Fatta-Kassinos D. 2019. **Consolidated vs new advanced treatment methods for the removal of contaminants of emerging concern from urban wastewater.** *Science of the Total Environment* 655:986-1008. IF=5,589 Q1

Rodríguez-Chueca J, Varella della Giustina S, Rocha J, Fernandes T, Pablos C, Encinas Á, Barceló D, Rodríguez-Mozaz S, Manaia CM, Marugán J. 2019. **Assessment of full-scale tertiary wastewater treatment by UV-C based-AOPs: Removal or persistence of antibiotics and antibiotic resistance genes?** *Science of the Total Environment* 652:1051-1061. IF=5,589 Q1

Rojo M, Álvarez-Muñoz D, Dománico A, Foti R, Rodríguez-Mozaz S, Barceló D, Carriquiriborde P. 2019. **Human pharmaceuticals in three major fish species from the Uruguay River (South America) with different feeding habits.** *Environmental Pollution* 252:146-154. IF= 5,714 Q1

Romero F, Acuña V, Font C, Freixa A, Sabater S. 2019. **Effects of multiple stressors on river biofilms depend on the time scale.** *Scientific Reports* 9. IF=4,011 Q1

Romero F, Sabater S, Font C, Balcázar JL, Acuña V. 2019. **Desiccation events change the microbial response to gradients of wastewater effluent pollution.** *Water Research* 151:371-380. IF=7,913 Q1

Romero-Güiza M, Zahedi S, Monsalvo V, Icaran P, Pijuan M. 2019. **Nitrite and free nitrous acid sludge pre-treatments to enhance methane production in continuous anaerobic digestion: Comparing process performance and associated costs.** *Waste*

Management 95:526-534. IF=5,431 Q1

Sabater-Liesa L, Montemurro N, Font C, Ginebreda A, González-Trujillo JD, Mingorance N, Pérez S, Barceló D. 2019. **The response patterns of stream biofilms to urban sewage change with exposure time and dilution.** *Science of the Total Environment* 674:401-411. IF=5,589 Q1

Sala B, Giménez J, de Stephanis R, Barceló D, Eljarrat E. 2019. **First determination of high levels of organophosphorus flame retardants and plasticizers in dolphins from Southern European waters.** *Environmental Research* 172:289-295. IF=5,714 Q1

Santana MVE, Cornejo PK, Rodríguez-Roda I, Buttiglieri G, Corominas L. 2019. **Holistic life cycle assessment of water reuse in a tourist-based community.** *Journal of Cleaner Production* 233:743-752. IF=6,395 Q2

Santos LHMLM, Freixa A, Insa S, Acuña V, Sanchís J, Farré M, Sabater S, Barceló D, Rodríguez-Mozaz S. 2019. **Impact of fullerenes in the bioaccumulation and biotransformation of venlafaxine, diuron and triclosan in river biofilms.** *Environmental Research* 169:377-386. IF=5,714 Q1

Santos-Clotas E, Cabrera-Codony A, Comas J, Martín MJ. 2019. **Biogas purification through membrane bioreactors: Experimental study on siloxane separation and biodegradation.** *Separation and Purification Technology*. IF=5,107 Q1

Sbardella L, Velo-Gala I, Comas J, Rodríguez-Roda Layret I, Fenu A, Gernjak W. 2019. **The impact of wastewater matrix on the degradation of pharmaceutically active compounds by oxidation processes including ultraviolet radiation and sulfate radicals.** *Journal of Hazardous Materials* 380. IF=7,650 Q1

Schirinzi GF, Llorca M, Seró R, Moyano E, Barceló D, Abad E, Farré M. 2019. **Trace analysis of polystyrene microplastics in natural waters.** *Chemosphere* 236. IF=5,108 Q1

Sergienko N, Irtem E, Gutierrez O, Radjenovic J. 2019. **Electrochemical removal of sulfide on porous carbon-based flow-through electrodes.** *Journal of Hazardous Materials* 375:19-25. IF= 7,650 Q1

- Serra-Compte A, Álvarez-Muñoz D, Solé M, Cáceres N, Barceló D, Rodríguez-Mozaz S. 2019. **Comprehensive study of sulfamethoxazole effects in marine mussels: Bioconcentration, enzymatic activities and metabolomics.** *Environmental Research* 173:12-22. IF=5,714 Q1
- Serra-Compte A, Sánchez-Melsió Á, Álvarez-Muñoz D, Barceló D, Balcázar JL, Rodríguez-Mozaz S. 2019. **Exposure to a Subinhibitory Sulfonamide Concentration Promotes the Spread of Antibiotic Resistance in Marine Blue Mussels (*Mytilus edulis*).** *Environmental Science and Technology Letters* 6:211-215. IF=6,934 Q1
- Silva A, Stawinski W, Romacho J, Santos LHMLM, Figueiredo SA, Freitas OM, Delerue-Matos C. 2019. **Adsorption of Fluoxetine and Venlafaxine onto the Marine Seaweed *Bifurcaria bifurcata*.** *Environmental Engineering Science* 36:573-582. IF=1,575 Q3
- Smeti E, Kalogianni E, Karaouzas I, Laschou S, Tornés E, De Castro-Català N, Anastasopoulou E, Koutsodimou M, Andriopoulou A, Vardakas L, Muñoz I, Sabater S, Skoulikidis NT. 2019. **Effects of olive mill wastewater discharge on benthic biota in Mediterranean streams.** *Environmental Pollution* 254. IF=5,714 Q1
- Smeti E, von Schiller D, Karaouzas I, Laschou S, Vardakas L, Sabater S, Tornés E, Monllor-Alcaraz LS, Guillem-Argiles N, Martinez E, Barceló D, López de Alda M, Kalogianni E, Elosegi A, Skoulikidis N. 2019. **Multiple stressor effects on biodiversity and ecosystem functioning in a Mediterranean temporary river.** *Science of the Total Environment* 647:1179-1187. IF=5,589 Q1
- Subirats J, Di Cesare A, Varela della Giustina S, Fiorentino A, Eckert EM, Rodríguez-Mozaz S, Borrego CM, Corno G. 2019. **High-quality treated wastewater causes remarkable changes in natural microbial communities and intl1 gene abundance.** *Water Research* 167. IF=7,913 Q1
- Timoner X, Colls M, Salomón SM, Oliva F, Acuña V, Sabater S. 2019. **Does biofilm origin matter? Biofilm responses to non-flow period in permanent and temporary streams.** *Freshwater Biology (Ecology)*. IF=3,404 Q2
- Tolboom SN, Carrillo-Nieves D, de Jesús Rostro-Alanis M, de la Cruz Quiroz R, Barceló D, Iqbal HMN, Parra-Saldivar R. 2019. **Algal-based removal strategies for hazardous contaminants from the environment – A review.** *Science of the Total Environment* 665:358-366. IF=5,589 Q1
- Tombola R, Buttiglieri G, Auset M, Gonzalez-Olmos R. 2019. **Recycled corrugated wire hose cover as biological carriers for greywater treatment in a sequential batch biofilm reactor.** *Journal of Environmental Management* 240:475-484. IF=4,865 Q1
- Vázquez-Tarrío D, Batalla RJ. 2019. **Assessing controls on the displacement of tracers in gravel-bed rivers.** *Water Research (Switzerland)* 11. IF=7,913 Q3
- Velo-Gala I, Farré MJ, Radjenovic J, Gernjak W. 2019. **N-Nitrosodimethylamine (NDMA) Degradation by the Ultraviolet/Peroxodisulfate Process.** *Environmental Science and Technology Letters* 6:106-111. IF=6,934 Q1
- von Schiller D, Datry T, Corti R, Foulquier A, Tockner K, Marcé R, García-Baquero G, Odriozola I, Obrador B, Elosegi A, Mendoza-Lera C, Gessner MO, Stubbington R, Albariño R, Allen DC, Altermatt F, Arce MI, Arnon and all. 2019. **Sediment Respiration Pulses in Intermittent Rivers and Ephemeral Streams.** *Global Biogeochemical Cycles* 33:1251-1263. IF=5,733 Q1
- Watson K, Farré MJ, Knight N. 2019. **Comparing three Australian natural organic matter isolates to the Suwannee river standard: Reactivity, disinfection by-product yield, and removal by drinking water treatments.** *Science of the Total Environment* 685:380-391. IF=5,589 Q3
- Zraunig A, Estelrich M, Gattringer H, Kissler J, Langergraber G, Radtke M, Rodríguez-Roda I, Buttiglieri G. 2019. **Long term decentralised greywater treatment for water reuse purposes in a tourist facility by vertical ecosystem.** *Ecological Engineering* 138:138-147. IF=3,406 Q2

BOOKS

Ecuaciones y cálculos para el tratamiento de aguas, Editorial Paraninfo, 2019, ISBN 13: 9788428341523. Coord: Mario Díaz, <https://www.paraninfo.es/catalogo/9788428341523/ecuaciones-y-calculos-para-el-tratamiento-de-aguas>. Capítulo 2: Problemática de los recursos hídricos. Gestión de cuencas, Manel Poch, Ignasi Rodríguez-Roda, Joaquim Comas, Lluís Corominas.

BOOKS CHAPTERS

Carlos Escudero-Oñate, Sara Rodríguez-Mozaz, and Laura Ferrando-Climent. "Tamoxifen: Occurrence, Fate, Transformation Products, and Non-Conventional Treatment Technologies" In the book "Fate and Effects of Anticancer Drugs in the Environment". Editors: Ester Heath; Marina Isidori; Tina Kosjek and Metka Filipic. Springer

OTHER BOOKS AND JOURNALS

Porro J, De Mulder C, Amerlinck Y, Torfs E, Balemans S, Weijers S, Nopens I, Rodríguez-Roda I, Comas J. 2019. Building an integrated AI and mathematical modeling framework for online supervision and control of water resource recovery facilities C3 - 91st Annual Water Environment Federation Technical Exhibition and Conference, WEFTEC 2018.4025-4028.

Moura de Salles Pupo, M., Albahaca Oliva, J.M., Barrios Eguiluz, K.I., Salazar-Banda, G.R., Radjenovic, J. 2020. Characterization and comparison of Ti/TiO₂-NT/SnO₂-SbBi, Ti/SnO₂-SbBi and BDD anode for the removal of persistent iodinated contrast media (ICM), *Chemosphere* 253: 126701.

Khalifa, O., Banata, F., Srinivasakannan, C., Radjenovic, J., Hasan, S.W. 2020. Performance tests and removal mechanisms of aerated electrocoagulation

in the treatment of oily wastewater, *J. Water Process Eng.*, in press

Sergienko, N., Radjenovic, J. 2020. Manganese oxide-based porous electrodes for rapid and selective (electro)catalytic removal and recovery of sulfide from wastewater, *Appl. Catal. B. Environ.*, 267: 118608.

Sergienko, N., Irtem, E., Gutierrez, O., Radjenovic, J. 2019. Electrochemical removal of sulfide on porous carbon-based flow-through electrodes, *J. Hazard. Mater.* 375: 19-25. 4/52, JIF: 7.65.

Velo-Gala, I., Farré, M.J., Radjenovic, J., Gernjak, W. 2019. N-Nitrosodimethylamine (NDMA) Degradation by the Ultraviolet/Peroxodisulfate Process, *Environ. Sci. Technol. Lett.* 6(2), 106-111.

EDITORIAL BOARDS OF BOOKS AND SCIENTIFIC JOURNALS

M. Petrovic, editor in chief TrEAC – *Trends in Environmental Analytical Chemistry*, Elsevier (impact factor 5.57 (2018)).

S. Rodriguez-Mozaz, editor in HAZMAT – *Journal of Hazardous Materials* (impact factor 7.65 Since September 2019).

J.L. Balcázar. Associate Editor, *BMC Microbiology (BioMed Central)*. Since 2013 to present.

J.L. Balcázar. Review Editor, *Frontiers in Microbiology (Frontiers)*. Since 2016 to present.

J.L. Balcázar. Member of the Editorial Board, *Environmental Science and Pollution Research (Springer)*. Since 2016 to present.

J.L. Balcázar. Member of the Editorial Board, *Journal of Applied Microbiology and Letters in Applied Microbiology (Wiley)*. Since 2016 to present.

Barceló, D. Associate Editor. *Environment International* (Elsevier, The Netherlands) 2009 to present.

Barceló, D. Associate Editor. *Trends in Analytical Chemistry* (Elsevier, The Netherlands) 1993 to present. IF=8,428 Q1

Barceló, D. Co-Editor. *Handbook of Environmental Chemistry*, book series (Springer-Verlag, Germany) 2007 to present. IF=1,310 Q3

Barceló, D. Co-Editor-in-chief. *Science of the total Environment* (Elsevier, The Netherlands) 2012 to present.

Barceló, D. Editor. *Wilson & Wilson Comprehensive Analytical Chemistry*, book series (Elsevier, The Netherlands) 1997 to present.

Barceló, D. Member of the Editorial Board. *Analytical and Bioanalytical Chemistry* (Springer Verlag, Germany) 2002 to present.

Buttiglieri, G. is member of the scientific committee

of the journal “*Ingegneria dell’Ambiente (IDA)*”.

Comas, J. is member of the *Editorial Board of the open access journal Global Challenges* and *Water*.

Corominas, Ll. is member of the editorial board of the journal *water practice and technology from the International Water Association Publishing*.

Pijuan, M. is member of the editorial board of the journal *Nature Scientific Reports*.

Marcé, R., Associate Editor of *Limnetica*

Acuña, Vicenç, Associate Editor of *Aquatic Sciences*

Sabater, Sergi, Editorial Board Member of *The Science of the Total Environment*; Editorial Board Member of *Acta Biológica Colombiana*; Associate Editor of *Freshwater Science* (specialty section of Frontiers in Environmental Science).

Radjenovic Jelena, editor of the *Journal of Hazardous Materials Letters* (Elsevier)



PRESENTATION AT CONGRESSES

ORAL PRESENTATIONS

M. Petrovic, M. Gros, M. Celic, Y. Verkh. Monitoring of pharmaceutical residues in the environment: from target analysis, suspect screening to non-target analysis. Limitations and pitfalls, 2nd International Conference on Risk Assessment of Pharmaceuticals in the Environment, Barcelona 28-29 November 2019. Invited key note.

Gago-Ferrero P., Alygizakis N.A., Velo-Gala I., Sbardella L., Gernjak W., Petrovic. *Evaluation of innovative water treatments at molecular level based on high resolution mass spectrometry and advanced statistical analysis tools.* 16th International Conference on Environmental Science and Technology. Rhodes (Greece), 2019. Invited talk.

Gago-Ferrero P. *New environmental analytical tools towards a comprehensive understanding of organic pollutants in the environment.* Conferences in Environmental Sustainability INGURU-DOK 2019. Basque Country University, (EHU) Bilbao (Spain). Closing invited lecture.

Gago-Ferrero P. "Suspect and non-target strategies to evaluate source water, water treatment and the formation of transformation products". School on SMART treatment water treatment July 2019. University of Ferrara (Italy). Invited lecture.

José LuíB Balcázar. *Implicación de los bacteriófagos en la adquisición y diseminación de resistencia a antibióticos en el medio ambiente.* XXVII Spanish National Congress on Microbiology (XXVII SEM Congress), Málaga, 2-5 July 2019. Jaime Ferrán Award invited lecture.

Damià Barceló, Silvia Díaz-Cruz, Ethel Eljarrat, H.K. Karapanagioti, Marta Llorca, Josep Sanchis, Marinella Farre, Diana Alvarez-Muñoz, Sara Rodriguez-Mozaz, Yolanda Pico. "Contaminantes químicos en el medio marino- PFASs, FRs, UV-filters, fármacos y microplásticos" Agua y Mundo. Aigües de Sabadell, Sabadell (Spain) June 13th 2019.

Damià Barceló, The EU Globaqua "Project on multiple stressors in rivers under water scarcity and global change: a reconnaissance study in selected

European river basins and the water-energy-food nexus", Global Consortium for Sustainability Outcomes Workshop 2018. King's College London (UK) January, 2019

Damià Barceló, Canvi climatic, sequera i contaminants emergents: reptes en la gestió dels rius". Jornadas: III Jornades + Ciencia. : Planetari, Castello de la Plana (Spain) February 2019.

Damià Barceló. "Occurrence of emerging contaminants and microplastics in several hot spots of Saudi Arabia: Bioaccumulation and plant uptake from wastewaters used in agriculture". Jornadas: DSFP-King Saud University-College of Science, Botany and Microbiology. KSU, Riyadh February 2019.

Damià Barceló, "The EU Globaqua Project on multiple stressors in rivers under water scarcity and global change: a reconnaissance study in selected European river basins and the water-energy-food nexus", invited conference, College of Biosystems in Engineering and Food Science. Zhejiang University, Hangzhou, (China). March 2019.

Damià Barceló, "Emerging contaminants: risk and challenges for water quality in Iberian river basins and plant uptake. Solutions with advanced treatment technologies" invited conference in Zhejiang Agricultural and Forestry University (ZAFU), Hangzhou (China) March 2019.

Damià Barceló, "Emerging contaminants and Microplastics in Water Reuse and Plant Uptake". Invited conference in Zhejiang University of Technology ZUT, Hangzhou, (China) March 2019.

Damià Barceló, M Farré, M. Petrovic, MJ Lopez de Alda, Y. Picó. "LC-MS-MS Analysis of Emerging Contaminants (EDCs, PPCPs and PFAs) Nanomaterials and Polymers (Microplastics) in the Aquatic Environment", Pittcon 2019. : Philadelphia, PA, USA. March 2019.

Damià Barceló. "Analysis, Occurrence and Removal of Microplastic Pollution in Water: Current Perspectives and Future Directions". Invited conference

Zhejiang University of Technology. ZUT, Hangzhou, (China). April 2019.

Damià Barceló. "Analysis, Occurrence and Removal of Microplastic Pollution in Water: Current Perspectives and Future Direction". JRC-Ispra (Italia). May 2019.

Damià Barceló, Y.Pico, N.Montemurro, S.Perez: "High Resolution MS the best choice for emerging contaminants discovery in wastewater reuse and plant uptake". 15th Annual LC-MS/MS Workshop on Environmental and Food Safety. Miami, Fl, USA. May 2019.

D. Barceló, Y.Pico, N. Montemurro, S.Perez. "QTOFMS the best choice for emerging contaminants discovery in wastewater reuse and plant uptake" 67th Conference on Mass Spectrometry and Allied Topics. Atlanta, Georgia USA. June 2019.

D. Barceló, B.Zonja, A.Ginebreda, M Vila, S Perez, N.Montemurro. "MALDI-TOF MS Imaging and LC-HRMS: New tools for degradation studies of polymer probes exposed to different wastewater contaminants". 67th Conference on Mass Spectrometry and Allied Topics. : Atlanta, Georgia USA. June 2019.

Damià Barceló. "Coupling of UV/H₂O₂ and biological treatment for the removal of the pharmaceuticals metropolol and metropolol acid from hospital wastewater". American Chemical Society Fall 2019 National Meeting and Exposition. Division of Environmental Chemistry. San Diego, CA, USA. August 2019.

Damià Barceló. "Analysis, occurrence and removal of microplastic pollution in water (and soil): current perspectives and future directions." Environmental Sciences Special Seminar- University of California Riverside. Riverside, CA, USA. August 2019.

Damià Barceló. "Emerging Contaminants: Risk and Challenges for Water Quality, Water Reuse and Plant Uptake. Solutions using advanced treatment technologies in Europe." 16th International Conference on Environmental Science & technology. Rhodes, Greece. September 2019.

Damià Barceló. "MALDI-TOF MS Imaging and LC-HRMS: New tools for degradation studies of polymer probes exposed to different wastewater environments: Linking chemical transformations and

potential microbial consumers (DNA + Proteomic analysis)". 16th International Conference on Environmental Science & technology. Rhodes, Greece. September 2019.

Damià Barceló. "Emerging Contaminants and Microplastics in treated wastewaters in agriculture". 1st International Conference on Semi-Arid Mountain Environment. Abha, Saudi Arabia. September 2019.

Damià Barceló. "MALDI-TOF MS Imaging and LC-HRMS: The best choices for Emerging Contaminants Discovery and Proteomic Analysis in Wastewaters". 4th International Mass Spectrometry School. Sitges, Barcelona. September 2019.

Damià Barceló "Emerging Contaminants and Microplastics in water reuse and plant uptake: solutions using advanced treatment technologies". Invited conference Nanjing- Institute of Soil Science, Chinese Academy of Sciences. Nanjing, China. October 2019.

Damià Barceló. "Analysis, occurrence and removal of microplastic pollution in water (and soil): current perspectives and future directions". Invited conference Shanghai East Normal University-School of Resources and Environmental Engineering. Shnagai, China. October 2019

Damià Barceló. "Emerging Contaminants and Microplastics: Risk and Challenges for Water Quality, Water Reuse and Plant Uptake. Solutions using advanced treatment technologies". 3rd International Water and Health Congress. Antalya, Turkey. November 2019.

Damià Barceló. "Occurrence of Emerging Contaminants and Microplastics in several hot spots of Saudi Arabia. Bioaccumulation and plant uptake from wastewaters used in agriculture." 12th International Conference on Sustainable Energy & Environmental Protection SEEP 2019. University of Sharjah, Emirates. November 2019.

Damià Barceló. "L'impacte de la qualitat de l'aigua, medicaments i plàstics amb el canvi climàtic". Residència d'Investigadors del CSIC- Conferències. L'Ordre Nacional del Merit (Barcelona). November 2019.

Damià Barceló. "Membrane technologies, eco-friendly fungal treatment and advanced oxidation

processes for efficient removal of pharmaceuticals in urban and hospital wastewaters". 2nd Conference on Green Technologies for Sustainable Water. Ho Chi Minh City, Vietnam. December 2019.

Damià Barceló. "Microplásticos". I Jornadas AN-TROPOCEN-Los Contaminantes Emergentes en el Parque Natural de l'Albufera. Facultat de Farmacia, Valencia. December 2019.

Rodríguez-Mozaz, S. "Contaminantes en las aguas: retos de calidad ambiental" Ciclo de Conferencias Instituto de Estudios Altoaragoneses. Huesca (Spain), 28th March 2019.

Rodríguez-Mozaz, S. "Projecte H2020 HYDROUSA: economia circular, destí dels contaminants emergents i avaluació de la seguretat alimentària"; III Congreso del Agua en Cataluña. Barcelona, 20–21 March 2019.

Rodríguez-Mozaz, S. "Bioaccumulation and impact of emerging contaminants in aquatic organisms in laboratory and field studies". October 15th 2019. Invited webinar by the "Alberta Environment and Parks" (Canada) <https://albertagov.app.box.com/s/64no3bp520n4e7g54d0dpb11tr8wuzl7>

Rodríguez-Mozaz, S. "Eliminación o persistencia de antibióticos y genes de resistencia a antibióticos durante el tratamiento de aguas residuales" II Jornada Científico-Técnica CÁTEDRA DAM "El agua residual como fuente de recursos", December 3rd, Valencia (Spain). Invited oral presentation.

Maria José Farré gave an invited lecture as part of the "SMART Drinking Water Treatment" course in Ferrara (Italy), 1st-5th of July 2019.

Maria José Farré, Chair of the session "Removal of contaminants" 8th International Conference on Swimming Pool and Spa. March 2019, Marseille (France).

Gernjak, W. Lamp driven advanced oxidation processes. At: 6th European Conference on Environmental Applications of Advanced Oxidation Processes (EAAOP6). Invited plenary presentation. 26-30 June 2019. Portoroz, Slovenia.

J. Radjenovic, Electrochemical systems for the treatment of contaminated water: limitations, challenges and prospective. Keynote. 8th de Nora R&D Symposium, Milan, Italy, 2019.

J. Radjenovic, Prospects of electrochemical technology in water and wastewater treatment. Keynote. Workshop on electrochemistry for the environment. Montpellier, France, 2019.

J. Radjenovic, Using electrons to clean the water: are electrochemical systems the future of water treatment? Keynote. ACS National Meeting, Orlando, FL, 2019.

J. Radjenovic, Electrochemical systems for water and wastewater treatment. Invited talk at the Helmholtz Centre for Environmental Research (UFZ), Leipzig, Germany, 2019.



PATENTS/PILOT PLANTS

Note: Both patents were in force. From the 26/12/19 when the European one is dropped.

Spanish Patent: ES2490065

Title: *Sistema de monitorització de desbordaments en xarxes de tubèries.*

Application date: 27/02/2013 -- **Grant date:** 09/06/2015

Holder: Fundació Institut Català de Recerca de l'aigua (ICRA)

Inventors: Oriol Gutierrez García-Moreno; Lluís Corominas Tabares; Vicenç Acuña Salazar

European patent application: EP16382307.
(Requested)

Title: Method for operating a membrane bioreactor of a water treatment system and corresponding membrane bioreactor and water treatment system.

Holder: University of Girona and the Catalan Institute for Water Research (ICRA).

Inventors: Blandin, Gaetan, Rodríguez-Roda Layret, Ignasi, Comas i Matas, Joaquim.





05

PROJECTS

**RESOURCES AND ECOSYSTEMS
RESEARCH AREA**

WATER QUALITY RESEARCH AREA

**TECHNOLOGIES AND EVALUATION
RESEARCH AREA**

ICRA

RESOURCES AND ECOSYSTEMS RESEARCH AREA

PROJECT

Managing the effects of multiple stressors on aquatic ecosystems under water scarcity (GLOBAQUA)

Funding agency: European Commission FP7-ENV-2013 (603629)

Duration: 2014-2019

Coordination: Consejo Superior de Investigaciones Científicas (CSIC)

Leader researcher: Sergi Sabater

Amount for ICRA: €637,551

PROJECT

Integration of climate seasonal prediction and ecosystem impact modeling for an efficient adaptation of water resources management to increasing climate extreme events (ERA4CS_WATExR)

Funding agency: MINECO

Duration: 2017-2020

Coordination: ICRA

Leader researcher: Rafael Marce Romero

Amount for ICRA: €148,000

PROJECT

Science and Management of Intermittent Rivers and Ephemeral Streams (COST_SMIREs)

Funding agency: European Union – Cost Action

Duration: 2016-2020

Coordination: Institut National de Recherche en sciences et technologies pour l'environnement et l'agriculture (IRSTEA).

Leader researcher: Vicenç Acuña Salazar

Amount for ICRA: €0

PROJECT

Climate Alert Smart System for Sustainable Water and Agriculture (ERA4CS_CLIMALERT)

Funding agency: MINECO

Duration: 2017-2020

Coordination: University of Minho

Leader researcher: Sergi Sabater

Amount for ICRA: €97,445

PROJECT

Management of Climatic Extreme Events in Lakes Reservoirs for the Protection of Ecosystem Services (MANTEL)

Funding agency: European Commission H2020-MSCA-ITN-2016 (722518)

Duration: 2017-2020

Coordination: Centre for Freshwater and Environmental Studies (IRL)

Leader researcher: Rafael Marce Romero

Amount for ICRA: €247,872.96

PROJECT

Intermitencia espacial y temporal del flujo en sistemas fluviales: efectos en la estructura, funcionamiento, y servicios ecosistémicos (Retos17_SPACESTREAM)

Funding agency: Ministerio de Economía and Competitividad (MINECO) and ERDF.

Duration: 2018-2020

Coordination: ICRA

Leader researcher: Vicenç Acuña Salazar

Amount for ICRA: €96,800

PROJECT

Dinámica del carbono en lagos y embalses frente a una hidrología cambiante: implicaciones para el metabolismo del ecosistema, flujos de gases y sumideros (Excel17_C-HydroChange)

Funding agency: Ministerio de Economía y Competitividad (MINECO) and ERDF.

Duration: 2018-2020

Coordination: Universidad de Málaga

Leader researcher: Rafael Marce Romero

Amount for ICRA: €48,400

PROJECT

Assessing the fate of a long-term C sink: organic carbon LOSS in lake SEDiments as a consequence of recurrent and permanent drying (CLOSED) (BP2016_NCatalan)

Funding agency: AGAUR

Duration: 2018-2019

Coordination: ICRA

Leader researcher: Rafael Marce Romero

Amount for ICRA: €92,000

PROJECT

Impacto de la contaminación de origen agrícola en la calidad hidroquímica (nitratos, antibióticos) y microbiológica (genes de resistencia) (Retos17_IMPACT)

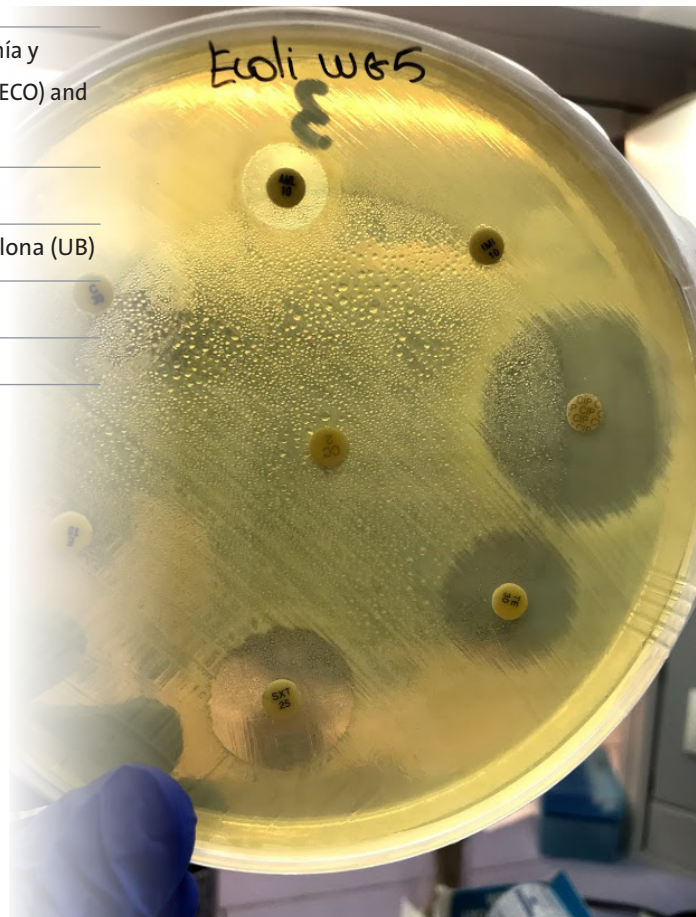
Funding agency: Ministerio de Economía y Competitividad (MINECO) and ERDF.

Duration: 2018-2021

Coordination: Universitat de Barcelona (UB)

Leader researcher: Josep Mas-Pla

Amount for ICRA: €104,665



WATER QUALITY RESEARCH AREA

PROJECT

Acumulación, dispersión y eliminación de resistencias a antibióticos en colectores de agua residual (SEWAGENE-16)

Funding agency: Ministerio de Economía and Competitividad (MINECO) and ERDF.

Duration: 2016-2019

Coordination: ICRA

Leader researcher: Carles Borrego Moré

Amount for ICRA: €154,880

PROJECT

MicroPLASTicos y Microcontaminantes en la costa MEDiterranea. Toxicidad e Impacto ambiental y en la salud humana (Retos17_PLAS_MED)

Funding agency: Ministerio de Economía and Competitividad (MINECO) and ERDF.

Duration: 2018-2020

Coordination: CSIC (Marinella Farré)

Leader researcher: Sara Rodríguez Mozaz

Amount for ICRA: €159,720

PROJECT

Groundwater quality assessment in areas with intensive livestock: is manure recycling a major source of pollution and dissemination of antibiotic resistance genes?"(RESOURCE)

Funding agency: European Commission H2020-MSCA-IF-2016 (750104)

Duration: 2017-2019

Coordination: ICRA

Leader researcher: Meritxell Gros, Supervisor Mira Petrovic

Amount for ICRA: €170,121.6

PROJECT

Emerging contaminants in freshwaters: deciphering impact on aquatic macroinvertebrate metabolic response and ecosystem transfer (UKF_Croacia)

Duration: 2017-2019

Coordination: University of Zagreb

Leader researcher: Mira Petrovic

Amount for ICRA: €0

PROJECT

Como predecir y minimizar de la formación de NDMA en agua potable y reciclada mediante técnicas analíticas avanzadas (Retos17_NDMA_PREDICT)

Funding agency: Ministerio de Economía and Competitividad (MINECO) and ERDF.

Duration: 2018-2020

Coordination: ICRA

Leader researcher: Maria Jose Farre Olalla

Amount for ICRA: €171,094

PROJECT

SMART-WORKFLOW

Funding agency: European Commission H2020-MSCA-IF-2016

Duration: 2018-2020

Coordination: ICRA

Leader researcher: Mira Petrovic

Amount for ICRA: €158,121.60



TECHNOLOGIES AND EVALUATION RESEARCH AREA

PROJECT

Smart decentralized water management through a dynamic integration of technologies (JPI_Water2014_WATINTECH)

Funding agency:	Ministerio de Economía y Competitividad (MINECO)
Duration:	2016-2019
Coordination:	ICRA
Leader researcher:	Ignasi Rodriguez-Roda Layret
Amount for ICRA:	€220,000

PROJECT

Three-dimensional nanoelectrochemical systems based on low-cost reduced graphene oxide: the next generation of water treatment systems (ELECTRON4WATER)

Funding agency:	European Commission ERC-2016-STG (714177)
Duration:	2017-2022
Coordination:	ICRA
Leader researcher:	Jelena Radjenovic
Amount for ICRA:	€1,493,733.12

PROJECT

Desarrollo de una herramienta avanzada de Gestión preventiva y para la Eficiencia de recursos hídricos en infraestructuras de Saneamiento uRbano (GESTOR)

Funding agency:	Ministerio de Economía y Competitividad (MINECO) and ERDF
Duration:	2016-2019
Coordination:	Sociedad Fomento Agrícola Castellonense SA (FACSA)
Leader researcher:	Oriol Gutierrez Garcia Moreno
Amount for ICRA:	€221,445.48

PROJECT

ARC-Grant-WGE_Toxic metal removal from wastewater sludge

Funding agency:	INSTITUCIÓN PÚBLICA
Duration:	2017-2019
Coordination:	Australian Research Council
Leader researcher:	Wolfgang Gernjak
Amount for ICRA:	€0

PROJECT

Economía circular para facilitar la reutilización de agua urbana en una ciudad turística: gestión centralizada o descentralizada? (Retos17_CLEaN-TOUR)

Funding agency:	Ministerio de Economía y Competitividad (MINECO) and ERDF
Duration:	2018-2020
Coordination:	ICRA
Leader researcher:	Joaquim Comas Matas
Amount for ICRA:	€181,500

PROJECT

Nitrogen Extraction from Water By an Innovative Electrochemical System (life NEWBIES)

Funding agency:	European Commission LIFE17 ENV/NL/000408
Duration:	2018-2021
Coordination:	WETSUS
Leader researcher:	Maite Pijuan Vilalta
Amount for ICRA:	€97,307

PROJECT

HYDROUSA

Funding agency:	European Commission CIRC-02-2017 (776643)
Duration:	2018-2022
Coordination:	National Technical University of Athens
Leader researcher:	Gianluigi Buttiglieri
Amount for ICRA:	€474,300

ICRA

PROJECT

Institut Català de Recerca de l'Aigua - Tecnologies i avaluació del cicle integral de l'aigua (ICRA-TECH) – Grups de recerca consolidats (GRC) (SGR2017-19)

Funding agency:	AGAUR
Duration:	2017-2020
Coordination:	ICRA
Leader researcher:	Ignasi Rodriguez Roda Layret
Amount for ICRA:	€36,000

PROJECT

Institut Català de Recerca de l'Aigua - Qualitat, dinàmica i funció dels ecosistemes aquàtics continentals (ICRA-ENV) – Grups de recerca consolidats (GRC) (SGR2017-19)

Funding agency:	AGAUR
Duration:	2017-2020
Coordination:	ICRA
Leader researcher:	Mira Petrovic
Amount for ICRA:	€60,216



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06

CONTRACTS

TOTAL AMOUNT 2019:
€448,634.50

CONTRACT:

HIDSOS-IV (Sostenibilidad de Recursos Hídricos Bajo el Cambio Global - HIDSOS IV (2016-2017))

Contracting Entity: ENDESA S.A.

Duration: 2016-2019

Leader researcher: Sabater Cortes, Sergi

CONTRACT:

Canal_NDMA-2017 (monitorización de formación de n-nitrosodimetilamina (ndma) en plantas de tratamiento del canal de Isabel II Gestión)

Contracting Entity: Canal Isabel-II Gestión

Duration: 2018

Leader researcher: Farre Olalla, Maria Jose

CONTRACT:

FACSA_Nules (Estudio de la utilización de rechazos de potabilización ricos en NO3 para el control de olores, toxicidad y corrosión en redes de saneamiento)

Contracting Entity: FACSA

Duration: 2018 -2019

Leader researcher: Gutierrez Garcia Moreno, Oriol

CONTRACT:

H2S_Torredembarra (Contracte amb ACA per eliminació olors en Sistemes de sanejament Torredembarra – Creixell)

Contracting Entity: Agència Catalana de l'Aigua

Duration: 2018 -2019

Leader researcher: Gutierrez Garcia Moreno, Oriol

CONTRACT:

NEIKER_Antifungicos (Monitoreo del impacto agudo de la adición de antifúngicos en el control de l banda en Pinus radiata sobre los ecosistemas fluviales)

Contracting Entity: NEIKER

Duration: 2019-2020

Leader researcher: Sabater Cortes, Sergi

CONTRACT:

Sulfelox_RU (Scientific collaboration between ICRA and Ryerson University (RU) to test the effectiveness of the Sulfelox product developed by RU)

Contracting Entity: University Ryeson

Duration: 2019

Leader researcher: Gutierrez Garcia Moreno, Oriol

CONTRACT:

NILSA (evaluación de propuestas de mejora para los ríos receptores de efluentes de aguas residuales tratadas en la comunidad foral de navarra)

Contracting Entity: NILSA

Duration: 2019-2020

Leader researcher: Sabater Cortes, Sergi

CONTRACT:

EcoAdvisor (Desarrollo de una plataforma web y App para la asistencia a la operación EDARs, basada en criterios ambientales y ecosistémicos (EcoAdvisor for Wise Leadin Water Management))

Contracting Entity: Aigües de Catalunya

Duration: 2018-2020

Leader researcher: Corominas Tabares, Lluís

CONTRACT:

STARNIT (Seguimiento mediante herramientas de biología molecular FISH y pirosecuenciación de las poblaciones presentes en los reactores de nitrificación parcial y anammox en el proyecto STARNIT “Nueva estrategia de control de poblaciones basada en el FNA para procesos integrados de nitrificación parcial-Anammox”)

Contracting Entity: ACCIONA AGUA S.A.

Duration: 2019-2020

Leader researcher: Pijuan Vilalta, Maite

CONTRACT:

NDMA_Licitacio (Servicios de investigación, presencia y eliminación de precursores de NDMA en ETAP)

Contracting Entity: Canal de Isabel II S.A.

Duration: 2019 - 2022

Leader researcher: Farre Olalla, Maria Jose

CONTRACT:

TRAGSATEC_licitacio (Servicio de Asesoramiento Experto Senior en Limnología Aplicada Para La Revisión de Las Condiciones de Referencia de Las Masas de Agua de La Categoría Ríos y Lagos.)

Contracting Entity: TRAGSATEC

Duration: 2019-2023

Leader researcher: Sabater Cortes, Sergi

CONTRACT:

AUDITORIES ENAC (Auditories ENAC)

Contracting Entity: ENAC

Duration: 2015- until term

Leader researcher: Sabater Cortes, Sergi

CONTRACT:

Convenio marco de colaboracion entre la Fundación Institut Català de Recerca de l’Aigua-ICRA y Soil Tratamiento de Aguas Industriales, S.L.

Contracting Entity: SOIL Agua S.A.

Duration: 2014-2019

Leader researcher: Oriol Gutierrez Garcia Moreno

CONTRACT:

Desarrollo de una plataforma web y App para la asistencia a la operación EDARs, basada en criterios ambientales y ecosistémicos (EcoAdvisor for Wise Leadin Water Management) (EcoAdvisor)

Contracting Entity: Aigües de Catalunya

Duration: 2018 - 2020

Leader researcher: Lluís Corominas Tabares

CONTRACT:

Contracte amb ACA per eliminació olors en Sistemes de sanejament Torredembarra – Creixell (H2S_Torredembarra)

Contracting Entity: Agència Catalana de l’Aigua

Duration: 2018-2019

Leader researcher: Oriol Gutierrez Garcia Moreno

CONTRACT:

Estudio de la utilización de rechazos de potabilización ricos en NO3 para el control de olores, toxicidad y corrosión en redes de saneamiento (FACSA_Nules)

Contracting Entity: FACSA

Duration: 2018- 2019

Leader researcher: Oriol Gutierrez Garcia Moreno



07

AGREEMENTS



26/01/2019

UNIVERSITY OF GIRONA

Renewal of the research agreement for Dr Joaquim Comas in ICRA's Technology and Evaluation area.

11/03/2019

Ministry of Education, Culture and Sport

Extension of the agreement to provide aid management to the Training and Mobility sub-programmes of the State Programme for Talent Promotion and employability (mobility of university students and professors).

21/03/2019

RYERSON UNIVERSITY - Toronto, Canada

Scientific collaboration agreement, within the framework of research work assigned to ICRA, on the effectiveness test of a product developed by RU.

27/09/2019

University of Santiago de Compostela, and others

Framework collaboration agreement within the framework of the NOWELTIES European Joint Doctorate Project, for the regulation and coordination of doctoral programmes for NOWELTIES students. (University of Santiago de Compostela - Spain, Technical University of Munich - Germany, Rwth Aachen University- Germany, University of Zagreb- Croatia, University of Belgrade- Serbia, University of Girona- Spain, University of Ferrara- Italy).

01/07/2019

CSIC and others

Consortium agreement, specifically for the regulation of the INWAT project, between the participating institutions. CSIC- Spain, University of Mohamed Seddik- Algeria, University of Duisburg-Essen- Germany, University of Montpellier- France, University of Bari Aldo Moro- Italy, CERTE- Tunisia.

20/08/2019

TRAGSATEC

Contracting of ICRA services, via tender TEC00005102, "Asesoramiento experto senior en limnología aplicada para la revisión de la condiciones de referencia en masas de Agua" (RP Sergi Sabater).

01/09/2019

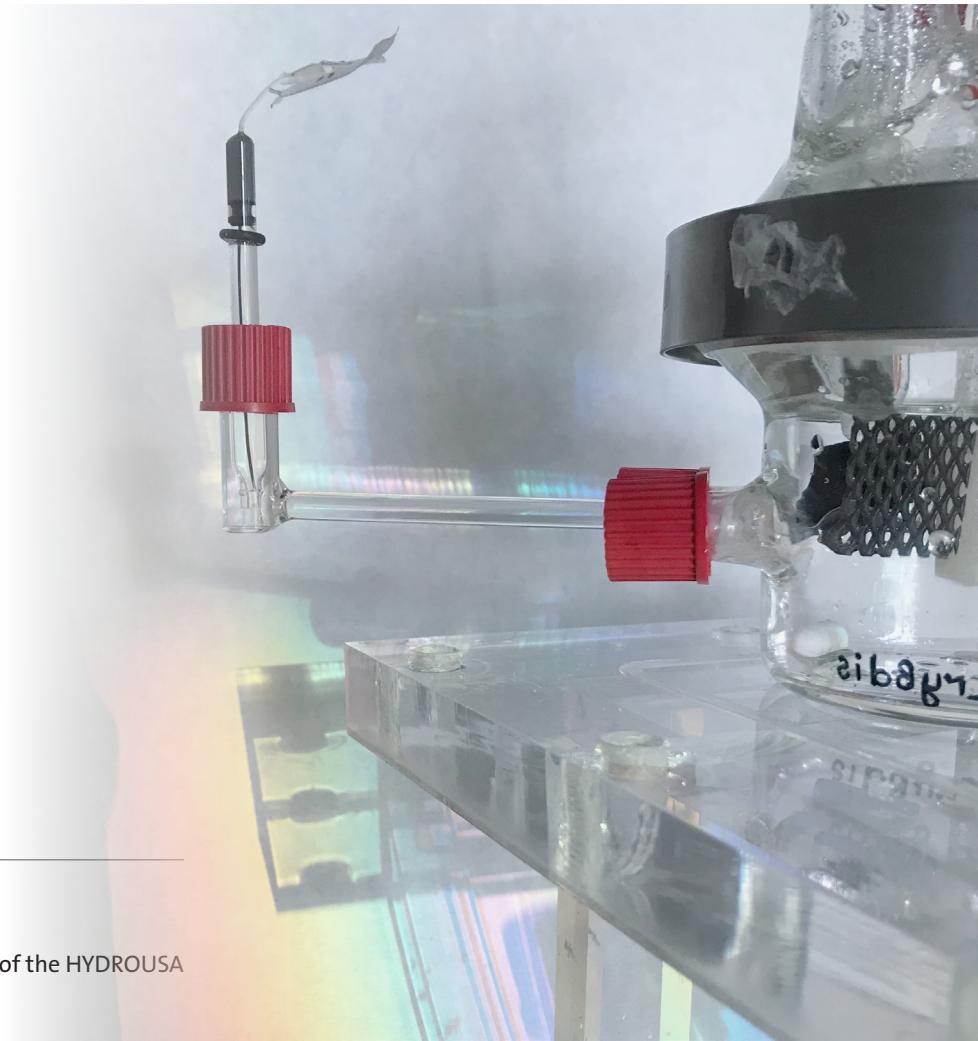
University of Lleida

Renewal of the scientific collaboration agreement between UdL and ICRA, within the framework of developing the Hydrological Processes research line in the Resources and Ecosystems Area.

25/09/2019

UdG- NIOO-KNAW-WU

Specific collaboration agreement for the organisation and coordination of doctoral theses developed within the framework of the MANTEL project. University of Girona (UdG)- Spain, Netherlands Institute of Ecology (NIOO-KNAW) - The Netherlands, Wageningen University (WU)- The Netherlands.



25/10/2019

CET Auditors

Contract to oversee the audit of the HYDROUSA project.

30/10/2019

University of Zagreb

Scientific collaboration contract with the University of Zagreb, for coordination and collaboration on the project “Effects of Multiple Stressors on Freshwater Biodiversity and Ecosystem Functioning” led by Dr Mira Petrovic.

25/11/2019

CANAL ISABEL II

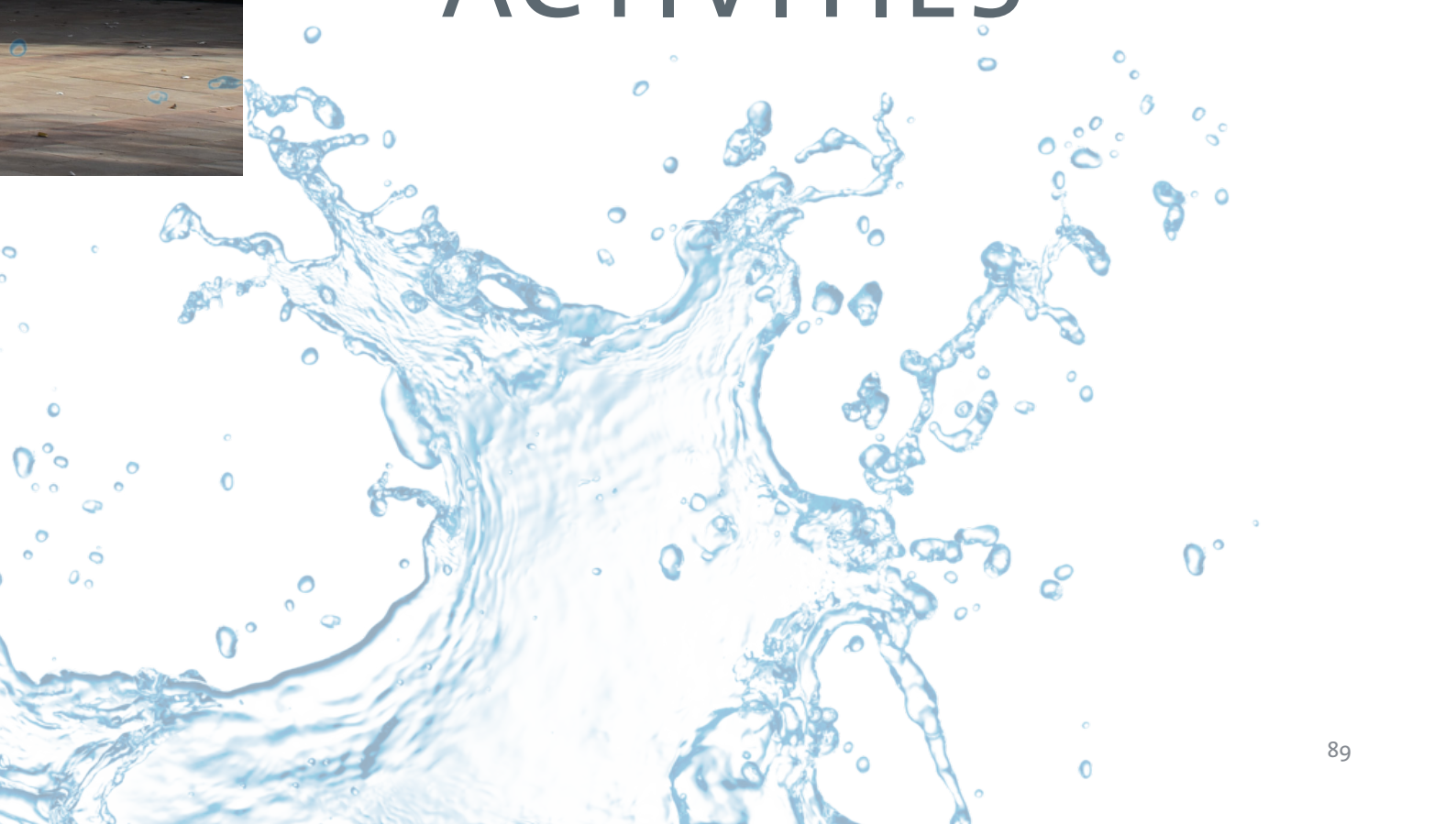
Scientific collaboration contract with CANAL ISABEL II, within the framework of tender 88/2018, to carry out research projects on the elimination of NDMA precursors in ETAP. Run by Dr M. Jose Farré.





08

OTHER DISSEMINATION ACTIVITIES



21/01/2019

Doctoral thesis defence: Environmental and socio-economical assessment of measures for the reduction of pharmaceuticals in rivers. Vicent Pau Gimeno

ICRA

Abstract: Pharmaceuticals are inherently biologically active substances and ubiquitous water contaminants that have been proven to have a detrimental effect on aquatic organisms at low concentrations. The presence of pharmaceuticals in rivers is beginning to be regulated through both European and global environmental legislation. Countries, therefore, are starting to plan and implement measures (Wastewater treatment plant (WWTP) upgrades and source control) to reduce pharmaceutical concentrations in rivers. Decision-makers use models to predict the fate, removal and transport of pharmaceuticals in rivers and to evaluate the effectiveness of measures for the reduction of pharmaceutical concentrations at catchment level. However, there is still considerable uncertainty around the processes driving the fate, removal and transport of pharmaceuticals in rivers, which compromises decision-making. Moreover, the cost of implementing WWTP upgrades at a catchment or national level can be daunting, hence the need to develop tools that can optimise upgrading costs. Furthermore, there is little scientific information on the effectiveness of source control measures for the reduction of pharmaceutical concentrations at the catchment level.

Thus, this thesis aims to provide decision-makers with modelling tools to evaluate measures (WWTP upgrades and source control) to reduce pharmaceutical concentrations in rivers. The modelling tools include uncertainty throughout the decision-making process.

The first section describes the development and calibration of a Microcontaminant Fate and Transport model for the estimation of pharmaceutical concentrations in rivers, including uncertainty. The model was successfully calibrated, and the uncertainty in the concentrations decreased after using Bayesian inference and taking measurements of diclofenac concentrations in WWTPs and rivers.

The second section deals with the influence that the model uncertainty has on the selection of WWTP upgrades designed to decrease pharmaceutical concentrations (i.e. diclofenac) in rivers. For this purpose, we evaluated different scena-

rios of model uncertainty and WWTP diclofenac removal efficiencies using the model developed in the first section. We concluded that the installation of tertiary treatments results in apparent reductions of diclofenac concentrations regardless of the uncertainty. However, apparent reductions after upgrading secondary treatments require lower uncertainty.

The third section shed light on the relationship between the proposed Environmental Quality Standards (EQS) for pharmaceuticals (i.e. diclofenac), and the optimal cost of WWTP upgrades at catchment level. For this purpose, we optimised the number of WWTPs requiring an upgrade for different EQS and uncertainty levels using multi-objective genetic algorithms and the model calibrated in the first section. We used cost minimisation and total EQS exceedance as the objective functions. We found that there is a non-linear relationship between EQS and the costs; hence there is an optimal EQS that balances costs and ecosystem protection.

The fourth section illustrates the effect that source control measures (i.e. substitution of diclofenac with naproxen) have on the required WWTP upgrades for the reduction of pharmaceuticals in rivers. For this purpose, we optimised the number of WWTP upgrades for different levels of diclofenac and naproxen consumption, different EQS and uncertainty levels. We found that apparent reductions in the number of WWTP upgrades are achieved only when more than half the diclofenac consumed is substituted by naproxen. However, we conclude that any substitution of pharmaceuticals requires a model-based evaluation because the change may be harmful to the environment under specific EQS.

Finally, we discussed the factors that influence the selection of measures for the reduction of pharmaceuticals: uncertainty in pharmaceutical concentration estimates, EQS setting, hydrological conditions and consumption of pharmaceuticals. We, therefore, recommend that decision-makers apply the adaptive management of pharmaceuticals at catchment level in response to the variables that influence the selection of measures.

22/01/2019

Doctoral thesis defence: Integrated assessment of wastewater treatment plants and their receiving river systems in a global change context. Ignasi Aymerich

ICRA

28/01/2019

Doctoral thesis defence: Characterization of dissolved organic matter in wastewater using liquid chromatography-high resolution mass spectrometry, Yaroslav Verkh

ICRA

Abstract: Individual hazardous chemicals and substance mixtures with synergistic toxicity effects occur in the dissolved organic matter (DOM) of wastewater and negatively impact human health. Yet a large number of chemicals and their treatment by-products in wastewater makes the tracking of individual compounds nearly impossible and calls for new analytical strategies. The thesis describes the development and evaluation of non-targeted and suspect analysis methods aimed at the transformation of DOM and micro-contaminants of interest during wastewater treatment using liquid chromatography-high-resolution mass spectrometry (LC-HR-MS) data. This data analysis revealed that the secondary treatment removed 67% of detected DOM signals, while 24% of new signals appeared relative to the influent DOM. The number of large molecules (> 450 Da) decreased, and the number of unsaturated molecular features of the effluent organic matter (OM) increased. Van Krevelen plots revealed the distribution of unsaturation and heteroatoms. This thesis also approached the transformation of chemicals in wastewater DOM by analysing micro-contaminants and their confirmed, as well as tentative, transformation products (TPs) to supplement the developed non-targeted analysis.

04/02/2019

Doctoral thesis defence: Resilience of water resource recovery facilities: a framework for quantitative model-based assessment. Pau Juan García

ICRA

Summary: The water sector is entering a period of uncertainty, as stressors such as climate change pose unknown risks to its infrastructure. Utilities need to build resilience to handle unpredictable changes, but the field of resilience in water management is still in its infancy. This thesis will first examine the state of the art of resilience implementation in water resource recovery facilities (WRRF) and identify challenges to its implementation. Secondly, a framework to measure resilience using modelling techniques is proposed. Thirdly, a WRRF model is calibrated and validated at full scale using state of the art dynamic aeration modelling, to be used to validate the framework with two stressors: stormwater and power outage.

05/02/2019

2019 International Year of the Periodic Table of Chemical Elements

Institute of Catalan Studies (IEC)- Barcelona

The United Nations General Assembly (UN) proclaimed 2019 the International Year of the Periodic Table of Chemical Elements (A/TP 2019), to celebrate the genesis and development of the



periodic table since it was created by Dmitri Mendeléeiev, one hundred and fifty years ago.

The celebration also aims to raise the awareness of chemistry's role in finding solutions to global challenges, such as sustainable development, the future of clean energy, food and health.

Catalonia has a powerful, developed and internationalised chemical sector, and is a point of reference for chemistry in southern Europe, combining industrial impetus with cutting-edge research and development in its universities and research centres.

The Catalan Society of Chemistry, a subsidiary of the Institute of Catalan Studies, together with the co-organising entities, sought to take advantage of AITP 2019 to make Catalan society more aware of the importance of chemistry in our daily lives. For this reason, they promoted and organised activities intended, primarily, to reach children and young people, to attract young talent to chemistry, incorporate more women into the scientific community, and foment the next generation of scientists, engineers and innovators in this field.

To publicise and disseminate information about the events and activities organised to mark AITP 2019, a website and several social network accounts were created (Twitter, Facebook and Instagram). The accounts allowed us to promote the celebration and bring it to the attention of Catalan citizens.

The website also provides educational material for teachers and scientific articles aimed at a wide range of audiences.

07/02/2019

Career Guidance Sessions for students (JOP 2019)

University of Girona

On the 7th and 8th of February 2019, the University of Girona's Faculty of Sciences organised Career Guidance Sessions for students (JOP 2019). The objective of the Career Guidance Sessions is to bring Faculty of Science students closer to the world of research and work. JOP 2019 was divided into three blocks: TOOLS, RESEARCH AND BUSINESS.

The Deputy Director of ICRA, Sergi Sabater, presented ICRA at the afternoon session on the 7th.

28/02/2019

Seminar: Occurrence of emerging contaminants and microplastics in several hot spots of Saudi Arabia: Bioaccumulation and plant uptake from wastewaters used in agriculture. Dr Damià Barceló

King Saud University, Saudia Arabia

Seminar: Occurrence of emerging contaminants and microplastics in several hot spots of Saudi Arabia: Bioaccumulation and plant uptake from wastewaters used in agriculture. Dr Damià Barceló

Thursday 28 Feb. 2019 College of Science, Botany & Microbiology Department.



05/03/2019

ICRA Seminar: Drinking water contaminants and health: Current knowledge and research needs. Dr Cristina Villanueva, Associate Research Professor, ISGLOBAL

ICRA

07/03/2019

III Forum on Innovation in the Water Sector - Organised by the CWP

Barcelona

The CWP organises the III Forum on Innovation in the Water Sector to promote the transfer of knowledge around the most relevant technological and R&D innovations for the sustainable use of water in Catalonia.

Inaugural Conference: "Competitiveness in the Catalan economy and business sector: Current situation, perspectives and the role of innovation" by Oriol Amat, Professor and Dean of the Barcelona School of Management at Pompeu Fabra University (UPF).

15/03/2019

ICRAseminar: Lessons learned from nanogeosciences for engineered nanoparticles and microplastic research. Prof. Dr Thilo Hofman, Centre for Microbiology and Environmental Systems Science, University of Vienna

ICRA

Thilo Hofmann Centre for Microbiology and Environmental Systems Science, University of Vienna
Lessons learned from nanogeosciences for engineered nanoparticles and microplastic research
Professor Thilo Hofmann received his Ph.D. in aquatic geochemistry from Bremen University in 1998. From 1999 he was first a post-doctoral scholar, and then Assistant Professor at Mainz University. Since 2005 Prof. Hofmann has been Full Professor and Chair for Environmental Geosciences at the University of Vienna. His group works in nanogeosciences, environmental impact of nanotechnology, and investigates trace contaminants and sorption to carbonaceous materials and microplastic, and in hydrogeology, including vulnerability analysis. Prof. Hofmann ser-

ved as Vice Dean of the Faculty for Earth Sciences, Geography and Astronomy from 2006 to 2012 and then as Dean of the Faculty until 2016. He is the director of the University of Vienna's Environmental Research Network, which he established in 2014; the network includes more than 130 scientists from the natural sciences, the social sciences, the humanities, law, and economics, aiming to tackle today's environmental challenges. In March 2019 he was one of the founding members of the new Centre for Microbiology and Environmental System Sciences at the University of Vienna.

Prof. Hofmann has published more than 150 peer-reviewed papers. He has received awards from the German Academic Scholarship Foundation, Berlin Technical University (the Erwin-Stephan Prize), and the German Water Chemical Society. In 2017 he was appointed Adjunct Full Professor in the Department of Civil and Environmental Engineering at Duke University (US). In 2018 he was honoured as Guest Professor at the College of Environmental Science and Engineering at Nankai University, Tianjin (China).

Talk: My talk will address natural (NPs), engineered (ENPs), and microplastic (nano)particles (MPs). Globally, surface and groundwater resources are the most important sources for drinking water supply. Surface waters and groundwater resources are, however, prone to threats from emerging contaminants, including nanoparticles. The production and use of emerging contaminants, engineered nanoparticles and microplastic (nano)particles inevitably lead to their release into aquatic environments, among many others. Concerns, therefore, arise over the possibility that ENPs and MPs might also pose a threat to drinking water supplies. Investigations into the vulnerability of drinking water supplies to ENPs and MPs are hampered by the absence of suitable analytical methods capable of detecting and quantifying them in complex aqueous matrices. Even though many concepts have been developed in nanogeosciences for natural particles, they are seldom used for ENPs and MPs. Analytical data concerning the presence of ENPs and MPs in drinking water supplies is scarce. The eventual fate of ENPs and MPs in the natural environment and in processes that are important for drinking water production is currently being investigated through laboratory-based experiments and modelling. Although the information obtained from these studies may not, as yet, be sufficient to allow a comprehensive assessment of the complete life-cycle of ENPs and MPs, it does provide a valuable starting point for predicting their relevance.

This talk will address specific aspects concerning the detection and prediction of nanoparticle fate, including natural, engineered and microplastic particles. It will focus on both new analytical concepts and “old” knowledge from nanogeoscience, which might be of importance for research into MPs.

20/03/2019

III CATALONIA WATER CONGRESS: Evolution of uses, reuse, circular economy and new technologies

Barcelona, Spain

22/03/2019

ICRA participated in the joint event organised by the UdG’s Water Campus and Girona City Council to commemorate World Water Day

Girona

The UdG and Girona City Council raise awareness about plastic pollution on World Water Day

The University of Girona’s Water Campus and Girona City Council joined forces to commemorate World Water Day, on the 22nd of March, with informative workshops and a round table to raise public awareness of the problems caused by the presence of plastics in the environment.

In 30 years, there will be more plastic than fish in the sea. This is the United Nation’s forecast should the current trend, in which plastic already accounts for 90% of the existing waste in the oceans, is not reversed. Faced with this situation, the University of Girona (UdG) and Girona City Council joined forces for World Water Day on Friday the 22nd of March, to help raise awareness of this serious issue.

World Water Day aims to inform and raise awareness about this and other issues related to the use and management of water. Plastic pollution was the focus of 2019’s day, which contributes to the United Nations’ proposed “Nobody left behind” motto, in highlighting the difficulties that billions of people around the world experience in accessing drinking water.

Informative workshops and debate in Girona

In the city of Girona, the UdG Water Campus and the City Council joined forces to organise a day of

informative scientific workshops aimed at family audiences and a debate open to all, which took place between 4 pm and 8 pm. The Catalan Government’s Girona headquarters (Plaça Pompeu Fabra, 1) hosted a range of workshops where participants learned about Catalonia’s native fish species, discovered how a treatment plant works and sampled the different tastes that water can have. The workshops were led by researchers from UdG research groups such as LEQUIA, GRECO and Geocamb. The environmental projects and activities cooperative, La Copa, and the Sorellona Association also contributed to the day with storytelling and informative workshops.

At six o’clock in the evening, experts from different fields related to water and waste participated in a round table discussion on the effects and primary issues caused by the presence of plastics in the environment and our lives. The debate was moderated by Margarida Castañer, the researcher for UdG’s Department of Geography. Wolfgang Gernjak and Anna Freixa, researchers for the Catalan Institute of Water Research (ICRA), contributed to the table, as did the researcher for the University of Barcelona (UB) Anna Sànchez, and the environmental technician for UdG’s Social Commitment Unit, Pep Juandó.

Only 0.007% of water is available, and only 3% of all water on Earth is fresh. Of this, less than 2% is in the form of ice on glaciers and polar caps. If we subtract atmospheric water, the water that forms part of living things and water in soil composition, only 0.007% of the water on the planet is available to humans. The presence of plastics and their derivatives, especially microparticles and nanoparticles, has a major impact on the functioning of aquatic ecosystems, beyond the damage caused by the mere presence of these elements in the natural environment.

The Water Campus represents the UdG’s strategic commitment to proactively facilitating the relationship between companies, institutions and the university in the field of water. It brings together 30 research groups; research institutes the Catalan Institute for Water Research and the Spanish National Research Centre for Advanced Studies at Blanes (CSIC); around one hundred Catalan, national and international companies, and is advised by a council made up of recognised sector professionals.

Its mission is to connect the University of Girona with other parts of the Catalan territory, promoting and maintaining a continuous relationship through a personalised dialogue, and encourag-



ing the transfer of technology and knowledge. It focuses on the management and quality of water resources and the natural environment, the development of technologies for the improvement of the integral water cycle, and the design of tools for the management and optimisation of 0020 processes.

10/05/2019

ICRA Seminar: Exploiting Nanotechnology and Nature to build novel materials

ICRA

16/05/2019

ICRA Seminar: Water innovation and phage research: industry and academia working together to fight antimicrobial resistance

ICRA

Dr Ana de Almeida, Marie Curie IF Research Fellow, Quality Area

Ana de Almeida shares ideas and insights gained from over 10-years experience of working in innovation and R&D in both industry and academic sectors. Ana will also introduce the **Envirostome project**, designed to help tackle the global antimicrobial resistance crisis, alongside the water industry.

The project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement n. 792686, acronym ENVIROSTOME.

04/06/2019

Ionic Chromatography Seminar. Presented by Vertex Technics

ICRA

05/06/2019

WORKSHOP ON FINANCING RESEARCH THROUGH COMPANIES AND INSTITUTIONS - INDUSTRIAL DOCTORATES

ICRA

- "The Industrial Doctorates programme as a tool for knowledge transfer: 2019 tender"

Presented by Joan Francesc Córdoba and Ainhoa Gaudes

- "An Industrial Doctorate experience: Development of chemometric tools for the detection of different compounds and development of new indices in water matrices"

Presented by Oriol Gutiérrez Garcia-Moreno/Wolfgang Gernjak

07/06/2019

ICRA Seminar: Viral markers assessing fecal contamination in Quito urban rivers (Ecuador). Dr Laura Guerrero Latorre (Biodiversity, Environment and Health study group (BIOMAS), University of the Americas, Quito, Ecuador

ICRA

11/06/2019

ICRA Seminar: Interactions between marine bacteria and anthropogenic dissolved organic matter. Dr Maria Vila-Costa, Institute of Environmental Assessment and Water Research (IDAEA-CSIC)

ICRA

13/06/2019

WATER AND THE WORLD 19th CONFERENCE CYCLE: Pollution in rivers, seas and oceans

Sabadell

13/06/2019

Novedar Symposium: Presence and elimination of microcontaminants in water

Santiago de Compostela

Dr Ignasi Rodriguez Roda and Dr Damià Barceló, will give lectures at this symposium.

18/06/2019

ICRA Seminar: Next Generation Electrode Materials for Water Treatment Applications. Prof. Brian P. Chaplin, Associate Professor Dept. of Chemical Engineering (University of Illinois at Chicago)

ICRA

Next Generation Electrode Materials for Water Treatment Applications

Abstract: Electrochemical advanced oxidation processes (EAOPs) have emerged as promising water treatment technologies for the elimination of a broad range of organic contaminants and the inactivation of pathogens. Progress has been facilitated by the development of stable, novel electrode materials that efficiently generate high yields of hydroxyl radicals. However, key challenges still remain, including toxic by-product formation, low electro-active surface area, and costly electrode materials. In this talk, I will discuss our ongoing research efforts aimed at advancing EAOPs, which includes the synthesis of selective electrodes for the minimisation of by-product formation and the development of inexpensive, high surface area, porous electrodes for enhanced electrochemical activity. A combination of

electrochemical reactivity experiments, electrochemical characterisation, and density functional theory modelling was used to develop a mechanistic understanding of the interactions of contaminants with these novel electrode materials. Results from this work are being used to develop more efficient and compact treatment technologies, including 'self-cleaning' membranes and multi-functional point-of-use water treatment devices.

Short Biosketch

Dr Brian P. Chaplin is an Associate Professor of Chemical Engineering at the University of Illinois at Chicago (UIC). His postdoctoral training was in the area of electrochemistry at the University of Arizona and he obtained his PhD from University of Illinois at Urbana-Champaign in Environmental Engineering. Prof. Chaplin also holds B.S. and M.S. degrees from the University of Minnesota in Civil Engineering. Research and educational activities in his Echem Lab at UIC are focused on novel electrochemical and catalytic processes for water treatment, with an emphasis on developing technologies that promote water sustainability. He is a recipient of the 2015 National Science Foundation Early CAREER Development Award, the 2019 Environmental Science and Technology Early Career Scientist Award, and the 2018 Environmental Science and Technology best paper award in the Environmental Technology Area.

20/06/2019

ICRA Seminar: Innovations in potable reuse: Two online water quality monitoring technologies. Prof. Takahiro Fujioka Department of Advanced Engineering, Graduate School of Engineering, Nagasaki University

ICRA

Abstract: Management of chemical and microbiological risks is essential to ensure the safety of recycled water for potable reuse. However, the credibility of reverse osmosis (RO) membrane for the removal of trace organic chemicals (TOCs), particularly N-nitrosodimethylamine (NDMA), and pathogens remains low, because of the low separation capability of the RO process and the limited availability of water quality monitoring technologies for a continuous assurance of their removal. My presentation will cover the development and pilot-scale demonstrations of two innovative online monitoring technologies—NDMA analyser and real-time bacteriological counter—for improving the credibility of the RO process for



removal in potable reuse. Our research goal is to improve the value of the RO process by providing high-rejection RO membranes and online monitoring technologies to ensure membrane integrity. By the end of this presentation, the audience will be able to: (a) explain the benefits of online monitoring of NDMA and bacterial counts; (b) evaluate the potential benefits and limitations of online water quality monitoring strategies at both pilot and full-scale levels, and (c) develop a monitoring approach using the online water quality monitoring technologies.

Biography: Taka has over 5 years of experience as a project manager for ozone systems in the water industry. He received his MEng, MSc, and PhD degrees from Hiroshima University, UNESCO-IHE (Netherlands), and University of Wollongong (Australia), respectively. Taka was also a board member (secretary role) of Membrane Society of Australasia from 2013 to 2015. Taka started working as Associate Professor at Nagasaki University in 2015. His research interests focus on reverse osmosis membrane treatment for potable reuse.

04/07/2019

Closing event of the 53rd International Groundwater Hydrology Course (2019)

SUPERIOR TECHNICAL SCHOOL OF ROAD ENGINEERS- Barcelona

Closing lecture of the 2019 academic year, given by Dr Josep Mas-Pla, Professor of the Department of Environmental Sciences - University of Girona, and researcher attached to the Catalan Institute for Water Research

Entitled "Data and Reflections on the Presence of Pharmaceuticals in Groundwater"

18/07/2019

Thesis Defence: Mass Transport and Fouling of Novel TFC Forward Osmosis Membranes, PhD Marc Sauchelli Toran

ICRA

19/09/2019

Doctoral thesis defence: Flow alteration and wastewater inputs effects on freshwater communities in Mediterranean rivers, Jordi-René Mor

ICRA

26/09/2019

ICRA Seminar: Old and emerging pollutants in the light of high throughput (omics) technologies and complex bioinformatic analyses. Dr Lukasz Dziewit, Institute of Microbiology, Faculty of Biology, University of Warsaw, Poland

ICRA

30/09/2019

ICRA Seminar: The Four Drinking Water Crises of the Twenty-First Century. Prof. Dr David Sedlak, University of California at Berkeley

ICRA

As a result of population growth, climate change, and a greater understanding of the health risks posed by contaminants, the world's drinking water supplies are under considerable stress. As pressure on water supplies grows, members of the public and decision-makers look to engineers and scientists for solutions to their water crises. Over the past four decades, we have created an array of technologies that allow us to detect and remove contaminants from water. Advanced technologies have helped solve some of the world's water crises, but there is still room for improvement. This talk will provide insight into four distinct crises that society faces and the technological challenges associated with providing safe, affordable and reliable drinking water.

Biographical Details

David Sedlak is the Plato Malozemoff Professor in the Department of Civil & Environmental Engineering at UC Berkeley, Co-Director of the Berkeley Water Centre and Deputy Director of the NSF engineering research centre for Reinventing the Nation's Urban Water Infrastructure (RENUWI). Sedlak is a member of the US National Academy of Engineering, recipient of the NSF CAREER Award, the Paul Busch Award for Innovation in Applied Water Quality Research and the Clarke Prize for Excellence in Water Research. Sedlak is the author of *Water 4.0: The Past, Present and Future of the World's Most Vital Resource* and serves as editor-in-chief of the American Chemical Society journal, *Environmental Science & Technology*.

01/10/2019

Descobert a Girona 2019- October 2019 conference series

GIRONA

ICRA participated in the "Descobert a Girona" (Discovered in Girona) conference series, whose main objective is to bring research carried out by the University of Girona's Department of Biology to Girona society. The public can find out more about the research being carried out and how it is done. The cycle consisted of three sessions to explain the findings of all the Department's research areas and a closing presentation by a guest researcher of international prestige who presented a strategy for guaranteeing food security despite global warming.

Programme:

01/10/2019 DESCOBERT A GIRONA (I)

Fluvial Sepsis: An Environmental Perspective on Antibiotic Resistance

Dr Carles Borrego. Full Professor at the University of Girona and researcher for the Catalan Institute for Water Research (ICRA), Microbial and Molecular Ecology Group.

Targeted Photochemotherapy - A New strategy for Cancer Treatment

Dr Anna Massaguer. Associate Professor, University of Girona, Biochemical Cancer Group.

08/10/2019 DESCOBERT A GIRONA (II)

Strategies to Enhance Memory: Diet and Intracranial Stimulation, Treatments that Affect the Brain Cell Structure

Dr Gemma Huguet

Full Professor, University of Girona, Cellular and Molecular Neurobiology Group.

Using Transgenic Potatoes to Understand how Plants are Nourished and Protected

Dr Olga Serra

Associate Professor, University of Girona, Cork Laboratory.

Environmental DNA as a Tool for Species Monitoring

Dr Núria Sanz

Associate Professor, University of Girona, Genetic Ichthyology Laboratory.

15/10/2019 DESCOBERT A GIRONA (III)

Apoptin: A Cancer-Fighting Viral Protein

Dr Antoni Benito

Full Professor, University of Girona, Protein Engineering Group.

Intestinal Microbiota and Health: Myths and Realities

Dr Jesús Garcia-Gil

Professor, University of Girona, Intestinal Microbiology and Infectious Disease Group.

Conversations In Utero: The Dialogue between the Endometrium, Paternal Factors and the Embryo as a

Formula for Success in Reproduction

Dr Beatriz Fernández

Postdoctoral researcher, Marie Skłodowska-Curie programme, University of Girona, Reproductive Biology Group.

22/10/2019 - CLOSING LECTURE

Food Crisis Solutions in the Face of Climate Change

Dr Ana I. Caño-Delgado

Professor and coordinator of the “Plant Signaling and Development” Programme at the Centre for Agrigenomic Research (CRAG).

- to develop a roadmap for future stakeholder engagement and eventual policy adaptation.

Workshop language is English. The format of the workshop entails several introductory talks from national and international experts followed by an expert panel discussion, intended to be highly interactive with the audience, and a networking lunch. A conclusion statement will be prepared by the workshop moderators and circulated after the workshop to the attendants.

04/10/2019

Workshop: International experiences in potable reuse – what and how can we best learn?

ICRA

Metropolitan areas are increasingly adopting potable water reuse in water-scarce regions across the globe. The south-west of the United States has the greatest experience of Indirect Potable Reuse projects. They are generally well accepted with clear regulatory guidelines for their usage. California has even self-imposed an obligation to develop a regulatory framework for Direct Potable Reuse in the near future. This regulatory initiative has been supported by the California Direct Potable.

Reuse Initiative.

Recently, Europe has, for the first time, adopted a centralised approach to Water Reuse regulation by issuing a “proposal for a regulation of the European Parliament and of the Council on minimum requirements for water reuse (2018/337 final)”. Nevertheless, neither this new European regulation nor the existing Spanish regulation (RD 1620/2007) contemplates any form of potable reuse despite the overwhelming evidence that potable reuse can be safely executed.

The goal of this workshop is:

- to contrast international and recent local experiences.
- to identify needs and opportunities for knowledge adaptation including technology, monitoring and risk management.

26/11/2019

ICRA Congress: Water research in perspective: beyond 2020

ICRA

ICRA celebrates its ten years in the H2O building with the organisation of different conferences and round tables on research related to water, climate change, and the situation in the Mediterranean. Throughout the day, different researchers from the centre, as well as guests presented their experiences. The day ended with a joint discussion between all participants entitled “Beyond Science: How to Synchronise Research, Management and Policy”, guided by Dr Richard Elelman (Eurecat). The conference was attended by the University of Girona’s Rector and the Director of the Catalan Water Agency.

28/11/2019

ICRAPHE 2nd International Conference on Risk Assessment of Pharmaceuticals in the Environment

Barcelona

This International conference on Risk Assessment of Pharmaceuticals in the Environment (ICRAPHE) is a follow-up of the First ICRAPHE international conference organised in Paris, September 8-9, 2016 by Prof. Yves Levi. This conference aims to capture outstanding examples of active research in this field and to draw the attention to future research needs. For those interested to submit a full manuscript, it is expected that a Virtual Special Issue will be planned in one of the Elsevier journals.

17/12/2019

Technical workshop: Reduction of Antibiotics Using Manure Treatment Technologies, with the participation of ICRA

Vic (Osona)

20/12/2019

Doctoral thesis defence, Ferran Romero. Multiple stressor effects on river biofilm communities: from community composition to ecosystem processes using experimental mesocosms

ICRA

Abstract: Human activity worldwide exposes aquatic ecosystems to multiple anthropogenic stressors. Freshwater ecosystems are of particular concern because of their notable sensitivity to stressors and relevance for global biodiversity and human well-being. Among the many stressors that threaten freshwater ecosystems, those derived from land-use change include the release of many pollutants into rivers and streams flowing through urban and agricultural areas. Also, climatic stressors such as warming, and others related to human activities, such as hydrological stress, affect river ecosystems on a global scale by modi-

fyng biodiversity patterns and ecosystem functioning. Among the many organisms exposed to multiple stressors in freshwater ecosystems, those attached to river and stream sediments play a crucial role in virtually all major ecosystem processes and are frequently used as sentinels when assessing stressor impacts on freshwater ecosystems. This thesis aims to identify the single and multiple-stressor effects of warming, hydrological stress and pollutant exposure on river biofilms. To that end, I used several experimental approaches, consisting of glass crystallisers and artificial streams to expose river biofilms to single and multiple-stressor scenarios under controlled conditions. I tested the river biofilm response both at the structural and the functional scale, employing response variables that ranged from photosynthetic and enzymatic activity to gene expression and bacterial community composition. I detected that hydrological stress was the most influential stressor, especially impairing the biofilm community growing on cobbles. Water warming had lesser effects, mostly affecting bacterial activity due to the dependence of metabolic activity on temperature, but showed limited effects on bacterial community composition. Pollutant exposure had conflicting results depending on the nature of the pollutant used. The results presented in this thesis show that single and multiple stressors affect both biofilm community structure and function, and emphasise that river biofilms show an adaptive nature when facing multiple-stressor scenarios.

SEMINARS ORGANISED BY ICRA AS PART OF THE SCIENCE DISSEMINATION PROGRAMME

15/01/2019

Seminar: Occurrence, fate and effects of nanomaterials and other emerging environmental risks

ICRA

IDr Josep Àngel Sanchís, PostDoc Researcher, Water Quality Area.

Dr John Copp, Primodal Inc.: Wastewater Treatment Modelling Specialists (Hamilton, Canada).

15/02/2019

Seminar: Lessons learned from nanogeosciences for engineered nanoparticles and microplastic research

ICRA

Prof. Dr Thilo Hofmann, Centre for Microbiology and Environmental Systems Science, University of Vienna

Lessons learned from nanogeosciences for engineered nanoparticles and microplastic research

05/02/2019

Seminar: Over 20 years of experience in water and wastewater treatment modelling, process design, control and monitoring

ICRA

Professor Thilo Hofmann received his PhD in aquatic geochemistry from Bremen University in 1998. From 1999 he was first a post-doctoral scholar, and then Assistant Professor at Mainz University. Since 2005 Prof. Hofmann has been Full Professor and Chair for Environmental Geosciences at the University of Vienna. His group works in nanogeosciences, environmental impact of nanotechnology, and investigates trace contaminants and sorption to carbonaceous materials and microplastic, and in hydrogeology, including vulnerability analysis. Prof. Hofmann served as Vice Dean of the Faculty for Earth Sciences, Geography and Astronomy from 2006 to 2012 and then as Dean of the Faculty until 2016. He is the director of the University of Vienna's Environmental Research Network, which he established in 2014; the network includes more than 130 scientists from the natural sciences, the social sciences, the humanities, law, and economics, aiming to tackle today's environmental challenges. In March 2019 he was one of the founding members of the new Centre for Microbiology and Environmental System Sciences at the University of Vienna. Prof. Hofmann has published more than 150 peer-reviewed papers. He has received awards from the German Academic Scholarship Foundation, Berlin Technical University (the Erwin-Stephan Prize), and the German Water Chemical Society. In 2017 he was appointed Adjunct Full Professor in the Department of Civil and Environmental Engineering at Duke University (US). In 2018 he was honoured as Guest Professor at the College of Environmental Science and Engineering at Nankai University, Tianjin (China). Talk: My talk will address natural (NPs), engineered (ENPs), and microplastic (nano)particles (MPs). Globally, surface and groundwater resources are the most important sources for drinking water supply. Surface waters and groundwater resources are, however, prone to threats from emerging contaminants, including nanoparticles. The production and use of emerging contaminants, engineered nanoparticles and microplastic (nano)particles inevitably lead to their release into aquatic environments, among many others. Concerns, therefore, arise over the possibility that ENPs and MPs might also pose a threat to drinking water supplies. Investigations into the vulnerability of drinking water supplies to ENPs and MPs are hampered by the absence of suitable analytical methods capable of detecting and quantifying them in complex aqueous matrices. Even though many concepts have been developed in nanogeosciences for natural particles, they are seldom used for ENPs and MPs. Analytical data concerning the presence of ENPs and MPs in drinking water supplies is scarce. The eventual fate of ENPs and MPs in the na-

tural environment and in processes that are important for drinking water production is currently being investigated through laboratory-based experiments and modelling. Although the information obtained from these studies may not, as yet, be sufficient to allow a comprehensive assessment of the complete life-cycle of ENPs and MPs, it does provide a valuable starting point for predicting their relevance. This talk will address specific aspects concerning the detection and prediction of nanoparticle fate, including natural, engineered and microplastic particles. It will focus on both, new analytical concepts and "old" knowledge from nanogeoscience, which might be of importance for MPs research.

10/05/2019

Seminar: Exploiting Nanotechnology and Nature to build novel materials

ICRA

Dr Anna Laromaine

Group of Nanoparticles and Nanocomposites

Abstract: The need to provide eco-friendly materials to reduce the costs and risks associated with waste echoes in many fields as the European Commission strengthens the substitution of plastics and petroleum-based materials. In this context, raw materials of natural origin and in particular natural biopolymers like cellulose play an important role. Cellulose (C) and nanocellulose (NC) based materials have emerged as interesting candidates for industries, governments and consumers as green, sustainable and natural materials for the fabrication of advanced complex composites.

Additionally, nanoparticles (NPs) can be chemically and structurally tuned to influence their interaction with different materials. Hundreds of NPs have been proposed in diverse fields. However, the lack of a time and batch-efficient method to evaluate NPs and processes prevents the establishment of general fundamental principles and is impeding their usage, particularly, as future drugs and therapies unless high throughput methods advance.

The possibility of combining materials of raw origin, like cellulose, with nanoparticles opens new avenues in the development of novel materials that harness nanotechnology and nature.

In this context, we will present our latest development on novel stimuli-responsive materials for a variety of applications. In addition, we will

demonstrate how to evaluate those biomaterials on the *in vivo* *Caenorhabditis elegans*, which has emerged as a test-bed for the multiparametric optimisation of nanomaterials.

Biography: Anna Laromaine is a chemist from the University of Girona (UdG), PhD in Chemistry from the Materials Science Institute of Barcelona (ICMAB) and the Autonomous University of Barcelona (UAB) with extensive international scientific experience. Her PhD focused on the molecular synthesis of carboranes for catalysis and medical therapy. As postdoctoral researcher at Imperial College London (UK) in the group of Prof. Molly M. Stevens, she developed a colorimetric sensor for the detection of proteases based on gold nanoparticles and peptides. She studied the replication of surfaces with DNA and peptides using supramolecular interactions at MIT (USA) in the group of Prof. Francesco Stellacci. They developed new methodologies for the production of cell cultures in three-dimensional structures on paper and the combination of the use of *C. elegans* and microfluidic chips for innovative biological assays at Harvard University (USA) in the group of Prof. George Whitesides. She is currently Investigadora Distinguida at the ICMAB where she combines materials science, chemistry and biology for biological applications. She focuses on the use of cellulose materials and nanoparticles to create multifunctional composites and responsive material. The interaction of those novel materials is evaluated in cells within 2D and 3D cell cultures and using the animal *C. elegans*. They optimise the physico-chemical properties of the novel multifunctional materials using biocompatible approaches that are economical and have low environmental impact. She actively participates and has experience in scientific divulgation activities and technology transfer.

16/03/2019

Seminar: Water innovation and phage research: industry and academia working together to fight antimicrobial resistance

ICRA

Dr Ana de Almeida, Marie Curie IF Research Fellow, Quality Area

[Ana de Almeida shares ideas and insights gained from over ten years experience of working in innovation and R&D in both industry and academic sectors. Ana will also introduce the Envirostome project, designed to help tackle the global antimicrobial resistance crisis, alongside the water industry].

30/03/2019

Seminar: Research and management of temporary rivers: principles, methods and utilities of the TREHS software

ICRA

[Francesc and Maria will talk about the free software tool **TREHS (Temporary Rivers' Ecological and Hydrological Status)**, which has been developed by the LIFE+ TRivers project and designed to adequately implement the Water Framework Directive in temporary rivers. Based on a predictive model of the evolution of a river's characteristics over time, TREHS will detect if temporariness is due to the natural characteristics of the river or to human impact. It is also expected to help managers select appropriate sampling dates and use the right methods to determine ecological status.

04/06/2019

Ionic Chromatography Seminar

Vertex Technics Presentation

ICRA

07/06/2019

Seminar: Viral markers assessing faecal contamination in Quito urban rivers (Ecuador)

ICRA

Dr Laura Guerrero Latorre (Biodiversity, Environment and Health study group (BIOMAS)), University of the Americas, Quito, Ecuador.

11/06/2019

Seminar: Interactions between marine bacteria and anthropogenic dissolved organic matter

ICRA

Dr Maria Vila-Costa, Institute of Environmental Assessment and Water Research (IDAEA-CSIC).

18/06/2019

Next Generation Electrode Materials for Water Treatment Applications

Prof. Brian P. Chaplin, Associate Professor Dept. of Chemical Engineering (University of Illinois at Chicago)

ICRA

Abstract: Electrochemical advanced oxidation processes (EAOPs) have emerged as promising water treatment technologies for the elimination of a broad range of organic contaminants and the inactivation of pathogens. Progress has been facilitated by the development of stable, novel electrode materials that efficiently generate high yields of hydroxyl radicals. However, key challenges still remain, including toxic by-product formation, low electro-active surface area, and costly electrode materials. In this talk, I will discuss our ongoing research efforts aimed at advancing EAOPs, which includes the synthesis of selective electrodes for the minimisation of by-product formation and the development of inexpensive, high surface area, porous electrodes for enhanced electrochemical activity. A combination of electrochemical reactivity experiments, electrochemical characterisation, and density functional theory modelling was used to develop a mechanistic understanding of the interactions of contaminants with these novel electrode materials. Results from this work are being used to develop more efficient and compact treatment technologies, including 'self-cleaning' membranes and multi-functional point-of-use water treatment devices.

Short Biosketch: Dr Brian P. Chaplin is an Associate Professor of Chemical Engineering at the University of Illinois at Chicago (UIC). His postdoctoral training was in the area of electrochemistry at the University of Arizona and he obtained his Ph.D. from University of Illinois at Urbana-Champaign in Environmental Engineering. Prof. Chaplin also holds B.S. and M.S. degrees from the University of Minnesota in Civil Engineering. Research and educational activities in his Echem Lab at UIC are focused on novel electrochemical and catalytic processes for water treatment, with an emphasis on developing technologies that promote water sustainability. He is a recipient of the 2015 National Science Foundation Early CAREER Development Award, the 2019 Environmental Science and Technology Early Career Scientist Award, and the 2018 Environmental Science and Technology best paper award in the area of Environmental Technology.

20/06/2019

Innovations in potable reuse: Two online water quality monitoring technologies

ICRA

Prof. Takahiro Fujioka Department of Advanced Engineering, Graduate School of Engineering, Nagasaki University

Abstract: Management of chemical and microbiological risks is essential to ensure the safety of recycled water for potable reuse. However, the credibility of reverse osmosis (RO) membrane for the removal of trace organic chemicals (TOrcs), particularly N-nitrosodimethylamine (NDMA), and pathogens remains low, because of the low separation capability of the RO process and the limited availability of water quality monitoring technologies for a continuous assurance of their removal. My presentation will cover the development and pilot-scale demonstrations of two innovative online monitoring technologies—NDMA analyser and real-time bacteriological counter—for improving the credibility of the RO process for removal in potable reuse. Our research goal is to improve the value of the RO process by providing high-rejection RO membranes and online monitoring technologies to ensure membrane integrity. By the end of this presentation, the audience will be able to: (a) explain the benefits of online monitoring of NDMA and bacterial counts; (b) evaluate the potential benefits and limitations of online water quality monitoring strategies at both pilot and full-scale levels, and (c) develop a monitoring approach using the online water quality monitoring technologies.

Biography: Taka has over 5 years of experience as a project manager for ozone systems in the water industry. He received his MEng, MSc, and PhD degrees from Hiroshima University, UNESCO-IHE (Netherlands), and University of Wollongong (Australia), respectively. Taka was also a board member (secretary role) of Membrane Society of Australasia from 2013 to 2015. Taka started working as Associate Professor at Nagasaki University in 2015. His research interests focus on reverse osmosis membrane treatment for potable reuse.

21/06/2019

Seminar: Research opportunities for maturing membrane technologies in the water and wastewater industry and water reuse

ICRA

Dr Pierre Le-Clech, UNESCO Centre for Membrane Science and Technology, School of Chemical Engineering, UNSW, Sydney, Australia

Abstract: Conventional membrane processes such as micro-, ultra-, nano-filtration, reverse osmosis and membrane bioreactors are now considered treatments-of-choice for water and wastewater. Notwithstanding all the important process improvements and optimisations obtained through recent academic and industry research activities, the full maturity of those membrane processes is expected to be reached only after the development of standardised strategies for design, operation, maintenance and replacement. Future research efforts are expected to focus on the challenges faced by membrane practitioners in delivering a set of new, more appropriate and practical tools. This presentation will propose a range of “out-of-left-field” research topics, some of them conducted at UNSW Sydney, aiming to deliver a more simplified implementation and operation of membrane processes for the industry.

27/06/2019

Seminar: Emerging metallic contaminants: Environmental aspects and future trend

ICRA

Dr Natalia Ospina-Alvarez, Beatriu de Pinós Research Fellow ICRA, Water Quality Area

[This presentation draws on Dr Ospina-Alvarez's experience during the last ten years working on the biochemistry of trace elements in coastal and marine systems. She will introduce the state of the art on Emerging Metallic Contaminants and a vision about future trends of research]

16/07/2019

Seminar: Industrial applications of wastewater treatment plant models

ICRA

Xavier Flores-Alsina, PhD Process and Systems Engineering Center (PROSYS) DTU Chemical and Biochemical Engineering

Abstract: Practical applications of wastewater treatment plant modelling studies, particularly industrial cases, have been relatively limited. This could potentially be explained by the fact that commercial software applications (e.g. GPS-X, WEST-DHI, SUMO, BIOWIN, EFOR, SIMBA) including state-of-the-art implementations (ASM1, ADM1) were originally developed to predict the performance of urban wastewater systems treating domestic wastewater, and therefore fail to represent specific industrial processes properly. Industrial wastewaters have very diverse dynamics (compared to urban wastewater), which is a result of different production schemes/schedules within the factory. Variable pH, influent biodegradability and non-standard N:COD and P:COD ratios might challenge traditional biological processes. In some cases, high S loads decrease methane/biogas production (and potential energy recovery). Metals and some inorganic/organic compounds can inhibit microorganism growth and/or have severe toxicity effects. The high content of cations and anions promotes the formation of precipitates at different locations in the reactor (granules, pipes), which can have detrimental (decrease of methanogenic activity) or catastrophic (cementation) effects on reactor performance. The seminar will show how some of these (hostile) phenomena may be included within mathematical models describing industrial wastewater and several case studies as a result of the collaboration between DTU Chemical Engineering and the Biotech industry, Water Utilities and Biogas companies within the Scandinavian region.

19/07/2019

Seminar: UHPLC-HRMS metabolomics approaches for food classification and nutrition

ICRA

Ruben Gil (Postdoc Researcher ICRA, WQ Area)

Seminar: Development and application of environmental stress indicators to be used as sensitive diagnostic tools for renewable natural resource conservation and preservation programmes

Carolina Salgado (Centre for Environmental Research, Chemistry Department, Faculty of Exact Sciences, UNLP-CONICET).

21/08/2019

Seminar: Interactions of microplastics with organic compounds in the environment - influence of particle aging on sorption and desorption

ICRA

Dr Thorsten Hüffer, Senior Scientist, Research Faculty, Deputy Head of Department. University of Vienna (Centre for Microbiology and Environmental Systems Science)

Award, the Paul Busch Award for Innovation in Applied Water Quality Research and the Clarke Prize for Excellence in Water Research. Sedlak is the author of Water 4.0: The Past, Present and Future of the World's Most Vital Resource and serves as editor-in-chief of the American Chemical Society journal, Environmental Science & Technology.

26/09/2019

Seminar: Old and emerging pollutants in the light of high throughput ('omics') technologies and complex bioinformatic analyses

ICRA

Dr Lukasz Dziewit, Institute of Microbiology, Faculty of Biology, University of Warsaw, Poland

14/10/2019

ICRA seminars: "THE ENERGY POVERTY CRISIS – ENERGY FOR THE MANY"

Prof. Paul Lant, Professor of Chemical Engineering at The University of Queensland

Abstract: In this seminar, Paul Lant will continue David Sedlak's reflections on personal and global crises. After many years of working as a researcher, educator and consultant in the wastewater field, Paul's 'personal crisis' led him to wonder about global decarbonisation and energy issues. Thus, he funded a research group (with several more intelligent colleagues) focused on 'energy for the many', and focused on the global energy poverty crisis. In this seminar, Paul will introduce you to the energy poverty crisis, present some recent research findings, and reflect on the many analogies between global energy challenges and global water challenges. **WARNING:** This seminar is not about technology development, it will not include any water chemistry, and it may even include a four letter word – coal!

Paul Lant is a Professor of Chemical Engineering at the University of Queensland. His research interests are in urban water systems, energy poverty, food waste, bioplastics and risk. He is on sabbatical at ICRA from Sept-Dec 2019.

30/09/2019

Seminar: The Four Drinking Water Crises of the Twenty-First Century

ICRA

Prof. Dr David Sedlak, University of California at Berkeley

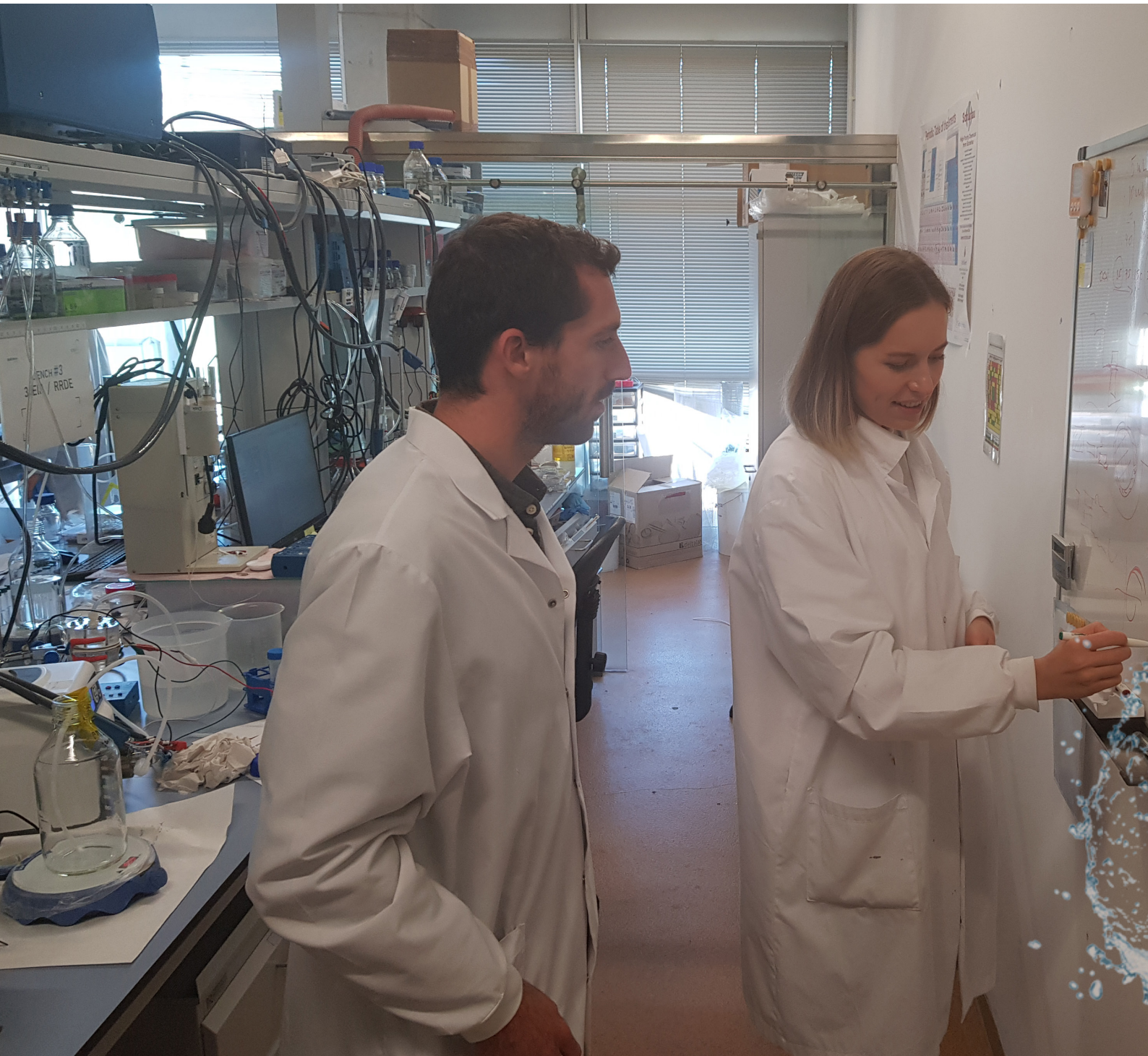
As a result of population growth, climate change and greater understanding of health risks posed by contaminants, the world's drinking water supplies are under considerable stress. As pressure on water supplies grows, members of the public and decision-makers look to engineers and scientists for solutions to their water crises. Over the past four decades, we have created an array of technologies that allow us to detect and remove contaminants from water. Advanced technologies have helped solve some of the world's water crises, but there is still room for improvement. This talk will provide insight into four distinct crises that society faces and the technological challenges associated with providing safe, affordable and reliable drinking water.

"RESULTS OUTSIDE SPECIFICATIONS, IN THE CONTEXT OF THE PHARMACEUTICAL INDUSTRY"

"RESULTS OUTSIDE SPECIFICATIONS, IN THE CONTEXT OF THE PHARMACEUTICAL INDUSTRY" Mr Jordi Algaba, Head of the Esteve Group's Stability Lab - Stability Lab Manager for generic and third-party products. New products. Head of the Finished Product Laboratory (API), intermediates and raw materials.

Biographical Details

David Sedlak is the Plato Malozemoff Professor in the Department of Civil & Environmental Engineering at UC Berkeley, Co-Director of the Berkeley Water Center and Deputy Director of the NSF engineering research center for Reinventing the Nation's Urban Water Infrastructure (ReNUWIt). Sedlak is a member of the US National Academy of Engineering, recipient of the NSF CAREER





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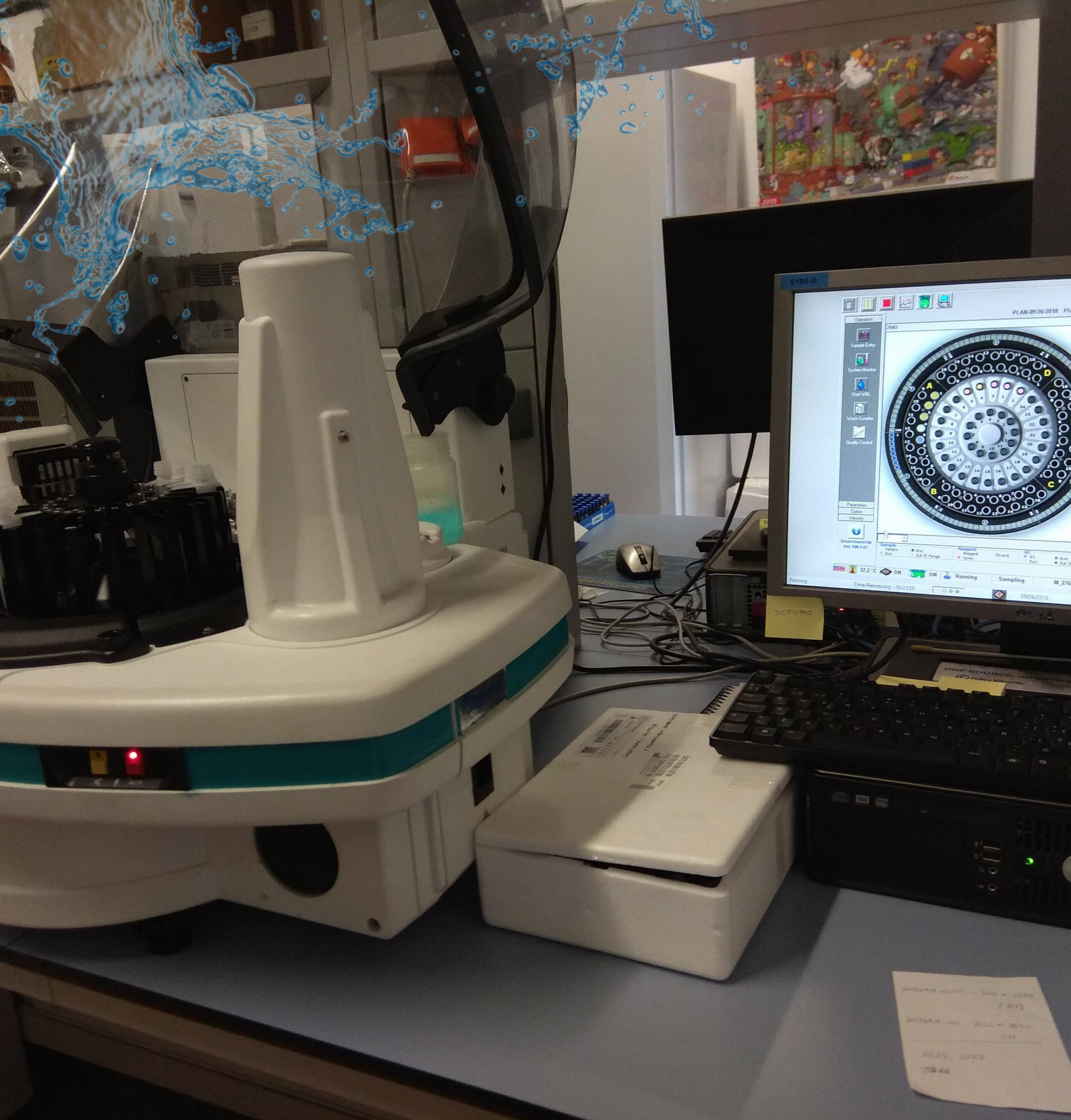
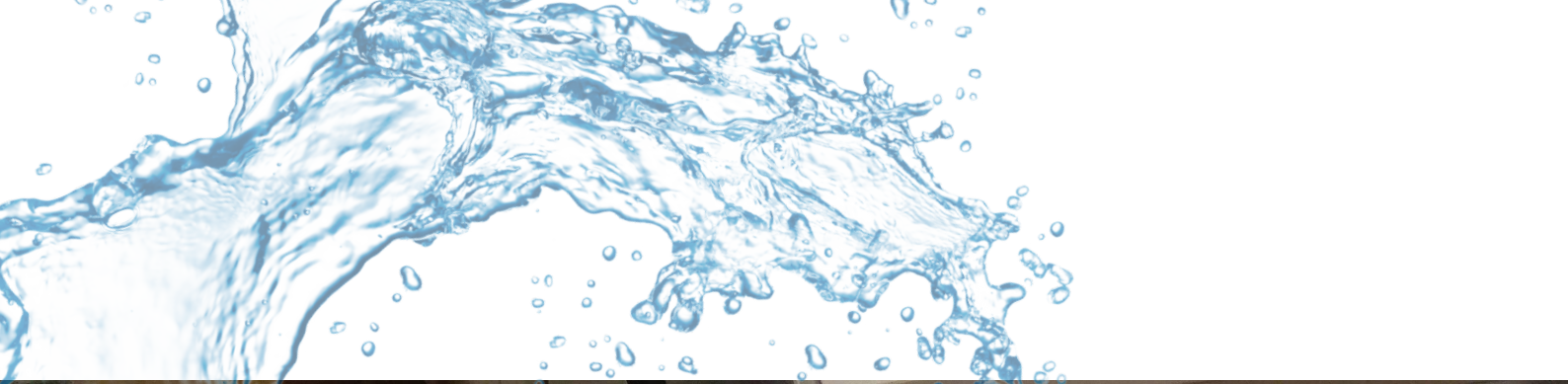
AWARDS

Jaime Ferrán Award to José Luís Balcázar Rojas for his excellent Research career in Microbiology

XXVII National Microbiology Congress (XXVII SEM Meeting). Malaga, 2-5 July 2019.

Best Student Poster Award

In the 2nd *International Conference on Risk Assessment of Pharmaceuticals in environment (ICRAPHE, November (2019), Barcelona, Spain)* to **Mira Čelić**, Meritxell Gros, Paola Verlicchi, and Mira Petrović. Risk assessment based prioritisation of pharmaceuticals of major concern in the Ebro Delta.



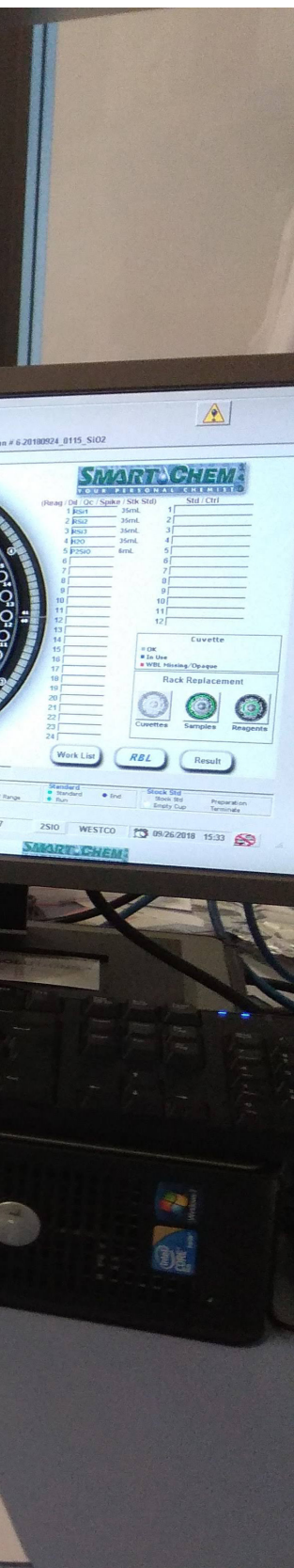
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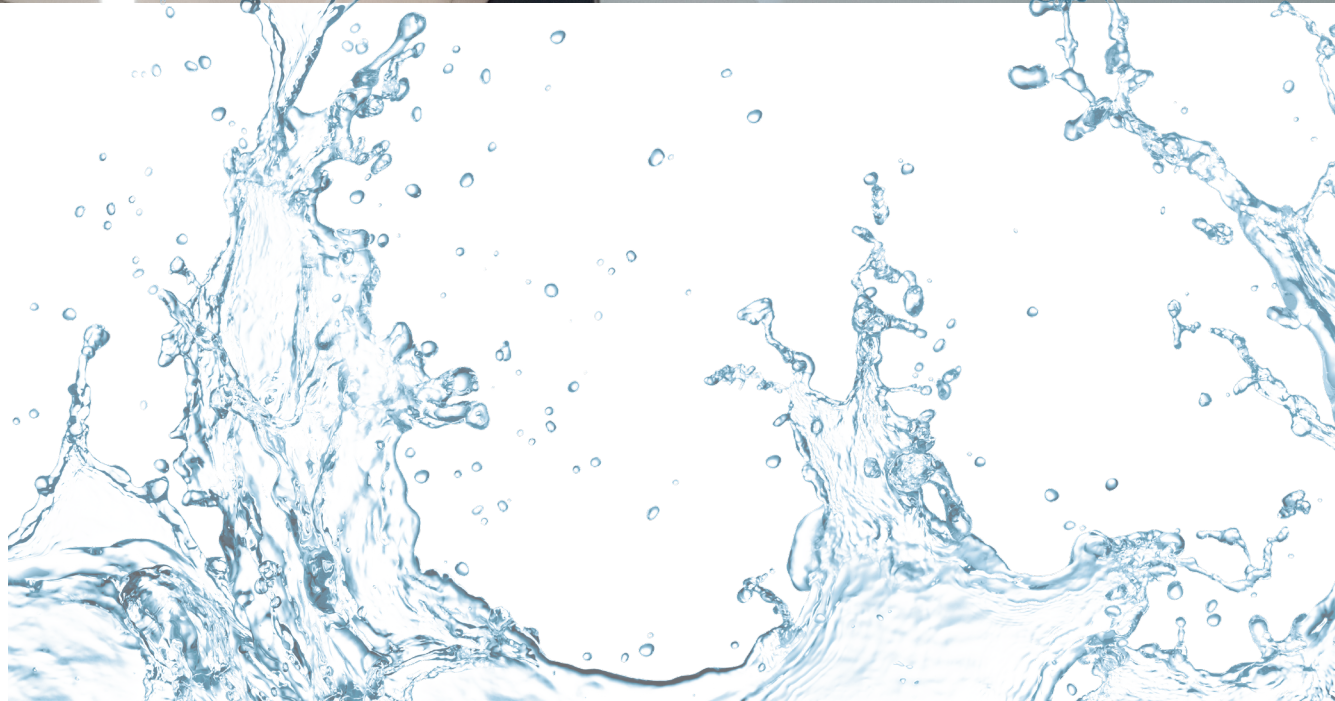
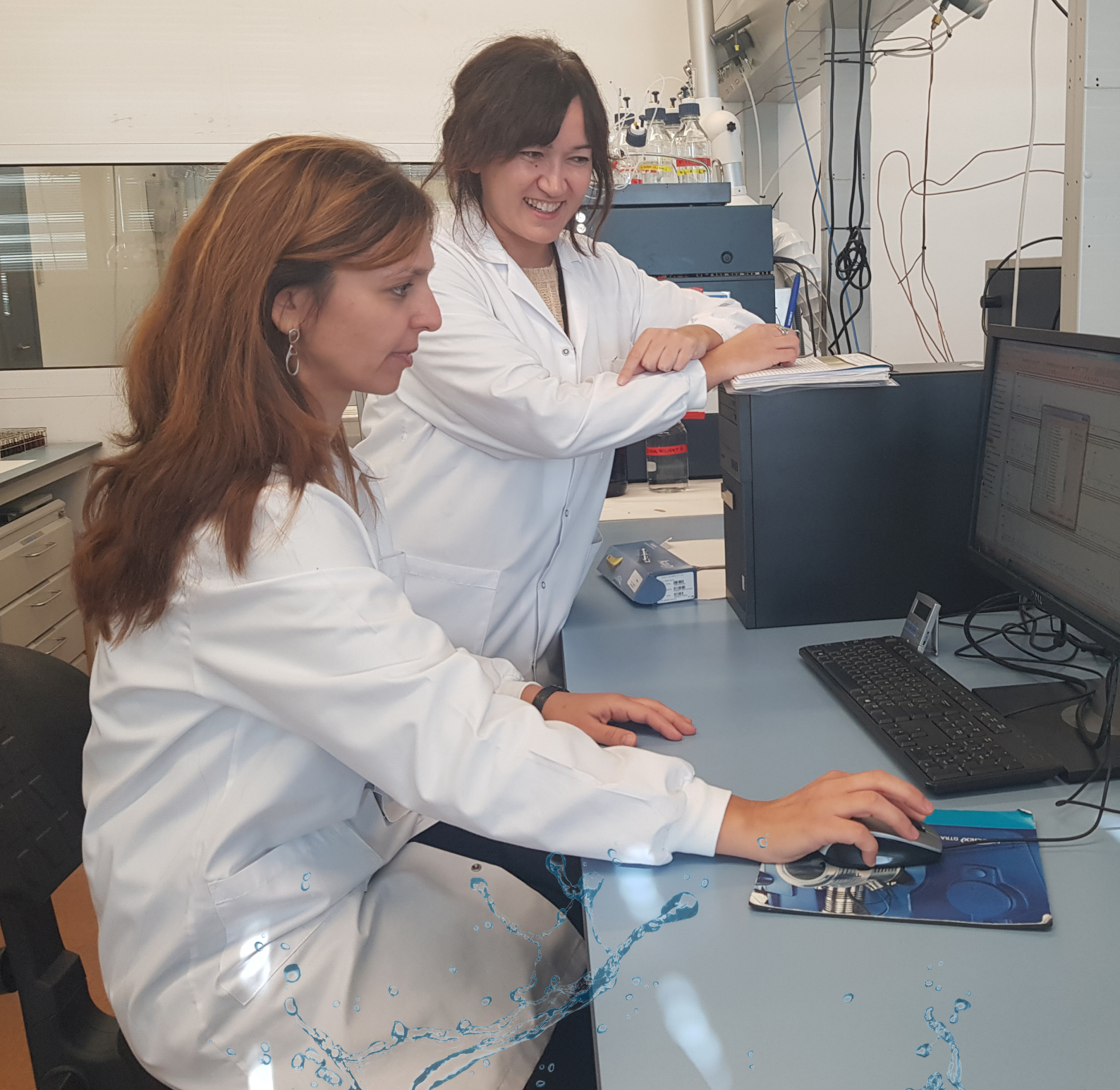
FINANCING

Contribution of the Regional Government of Catalonia

Ministry of Business and Knowledge (DECO)	€1,861,900.00
Catalan Water Agency (ACA)	€400,000.00
<u>Competitive projects</u>	
Regional Government of Catalonia	€197,674.97
Ministry of Economy and Competitiveness	€814,012.76
European Union	€984,069.27
<u>Transfer projects</u>	
Knowledge Transfer Technology (KTT)	€166,794.97
Financial income	€48.07
Other income	€2,858.82
TOTAL INCOME	€4,427,358.86

The **University of Girona** as ICRA Trustee annually consolidates its non-monetary contribution to ICRA from the transfer of the researchers assigned to its investigation, which is financially measured by the UdG in the amount of €299,629.04 for 2019.

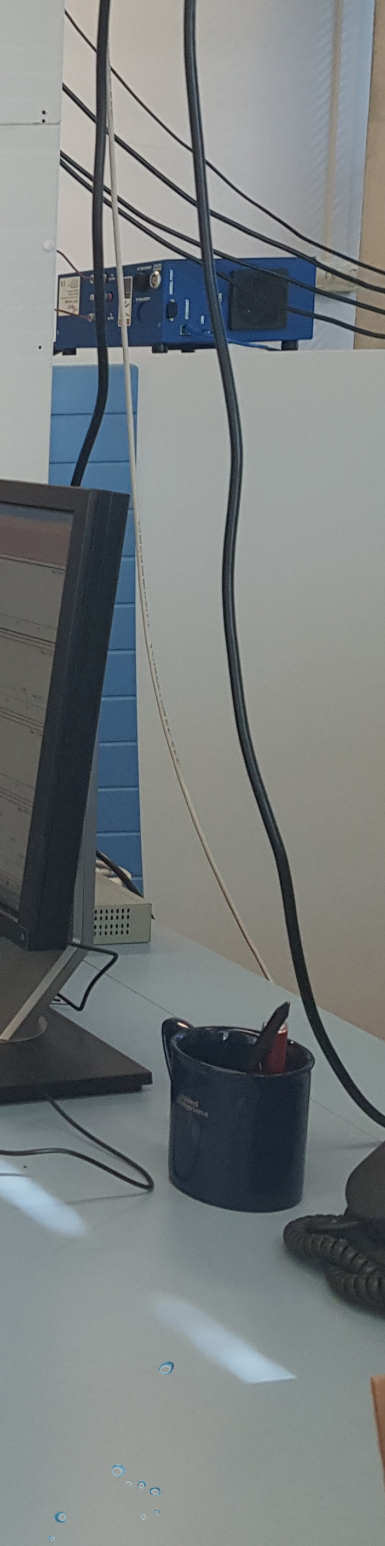




11

ICRA IN THE NEWS & PRESS

The activity of communicating the work that has been done both to the scientific community and to society in general over the last year resulted in 204 news items appearing in the media (187 in digital media, 9 in printed press, 5 on TV and 3 on radio).



ICRA has also committed to social networks over this last year. On Twitter (@icrawater) it now has 395 more followers, reaching 1,368 followers in December 2019, a total of 791 likes and 233 retweets to its tweets.

During 2019, ICRA uploaded to its YouTube channel a self-created video entitled "ICRA 10 anys" that achieved 64 views. and the video "Celebració 10è aniversari ICRA. Festa familiar" that was published in hidden mode.

Moreover the video "Eko perspektive: Prof. Mira Petrovic" was shared and added to the list "L'ICRA als mitjans de comunicació" and the video "Presentación de ICRA Tech - Institut Català de Recerca de l'Aigua" was added to the list "Projectes i grups de recerca ICRA".

PRESS RELEASES

30/05/2019

Intel·ligència Atifical i Big Data aplicades al clavagueram de Barcelona a fi de generar informació sobre la personalitat dels barris

[https://press.clipmedia.cat/notas/intel%**c2%b7**lignencia-artificial-i-big-data- aplicades-al- clavegueram-de-barcelona-a-fi-de-generar-informacio-sobre-la- personali-tat-dels-barris/](https://press.clipmedia.cat/notas/intel%c2%b7lignencia-artificial-i-big-data- aplicades-al- clavegueram-de-barcelona-a-fi-de-generar-informacio-sobre-la- personali-tat-dels-barris/)

Inteligencia Artificial y Big Data aplicadas al alcantarillado de Barcelona a fin de generar información sobre la personalidad de los barrios.

<https://press.clipmedia.cat/notas/inteligencia-artificial-y-big-data-aplicadas-al-alcantarillado-de-barcelona-a-fin-de-generar-informacion-sobre-la-personalidad-de-los- barrios/>



NOTA DE PREMSA 30/05/2019

Intel·ligència Atifical i Big Data aplicades al clavagueram de Barcelona a fi de generar informació sobre la personalitat dels barris

- L'objectiu és generar informació objectiva, immediata i agregada a nivell de barri de l'estat de vida i dels hàbits diaris dels ciutadans.
- Aquesta informació s'obté a partir de l'anàlisi química, microbiològica i de cabals de les aigües residuals en el clavagueram i l'aplicació d'Intel·ligència Artificial i Big Data.
- Aquesta informació serà clau en el futur immediat per dissenyar campanyes de conscienciació ciutadana en els àmbits de gestió de residus a les llars i d'hàbits de salut i fer un seguiment de la seva eficàcia.
- 5,8 M€ és la xifra d'SCOREwater, el projecte europeu destinat a la transformació digital del sector de l'aigua durant els propers quatre anys.
- L'Institut Català de Recerca de l'Aigua (ICRA), el centre tecnològic Eurecat, el Consorci Institut d'Estudis Regionals i Metropolitans de Barcelona (IERMB), la pime fabricant de sensors on-line Bacta i l'operador públic municipal de l'aigua, Barcelona Ciutat de l'Aigua (BCASA) participen en el projecte.

El projecte SCOREwater està finançat pel programa Horizon 2020 de la Unió Europea dins de l'àmbit de la digitalització del sector de l'aigua per tal d'accelerar l'assoliment dels Objectius de Desenvolupament Sostenible (ODS). El projecte, que s'ha posat en marxa aquest mes de maig i es perllongarà durant quatre anys, compta amb un pressupost de 5,8 milions d'euros i desenvoluparà tres laboratoris socials "living labs" a les ciutats de Barcelona, Göteborg (Suecia) i Amersfoort (Holanda).

El "living lab" de Barcelona permetrà generar informació objectiva i immediata sobre la personalitat dels barris. Exemples de la informació que es generarà són els hàbits de gestió de residus a les llars, incidents i inadequada gestió dels olis i dels greixos i de les tovalloletes humides, o els hàbits de consum de productes farmacèutics, com els antibiòtics. Aquesta informació s'obté a partir de l'anàlisi química, microbiològica i de cabals de les aigües residuals en el clavagueram i amb l'aplicació d'Intel·ligència Artificial i Big Data.

L'Institut Català de Recerca de l'Aigua (ICRA), el centre tecnològic Eurecat, el Consorci Institut d'Estudis Regionals i Metropolitans de Barcelona (IERMB), la pime fabricant de sensors on-line Bacta i l'operador públic municipal de l'aigua, Barcelona Ciutat de l'Aigua (BCASA) participen en el projecte europeu SCOREwater, que té la finalitat de contribuir a la transformació digital del sector de l'aigua mitjançant diferents casos d'estudi, un dels quals es centrarà a Barcelona, on s'aplicarà Intel·ligència Artificial i Big Data per generar informació sobre la personalitat dels barris.

18/06/2019

L'ICRA crea un 'laboratori' europeu de doctorands amb 3,5M€ per millorar la innovació tecnològica en el tractament d'aigües

<https://press.clipmedia.cat/notas/licra-crea-un-laboratori-europeu-de-doctorands-amb-3-5me-per-millorar-la-innovacio-tecnologica-en-el-tractament-daigues/>

El ICRA crea un 'laboratorio' europeo de doctorandos con 3,5M€ para mejorar la innovación tecnológica en el tratamiento de aguas

<https://press.clipmedia.cat/notas/el-icra-crea-un-laboratorio-europeo-de-doctorandos-con-3-5me-para-mejorar-la-innovacion-tecnologica-en-el-tratamiento-de-aguas/>



NOTA DE PREMSA 18/06/2019

L'ICRA crea un 'laboratori' europeu de doctorands amb 3,5M€ per millorar la innovació tecnològica en el tractament d'aigües

- L'iniciativa forma part del projecte NOWELTIES de la UE per promoure la innovació tecnològica i la formació en el tractament d'aigües residuals.
- Es tracta del major programa de doctorands coordinat des de Catalunya en aquesta matèria: 14 tesis, amb 3 a ICRA, 2 a Santiago de Compostela, 3 a Alamyria, 2 a Sarbja, 2 a Cracòvia i 1 a Itàlia.

L'Institut Català de Recerca de l'Aigua (ICRA), amb seu a Girona, acaba de crear a través del projecte europeu NOWELTIES un 'laboratori' de doctorands per a la recerca de nous materials i tecnologies innovadores en l'àmbit del tractament d'aigües residuals.

La necessitat de fer front a les conseqüències del canvi climàtic, i als cada vegada més freqüents períodes d'escassetat d'aigua, comporta un notable increment de la demanda de solucions tecnològiques per al sector del tractament d'aigües i la descoberta de nous professionals capacitats i interdisciplinats que puguin fer front als futurs desafiaments d'aquest sector i aplicar a la pràctica les directives relacionades amb aquest àmbit.

Amb aquest objectiu ICRA ha desenvolupat el projecte NOWELTIES, dins del programa Maria Skłodowska Curie, una plataforma (European Joint Doctorate) que ofereix oportunitats de formació d'avantguarda per a experts en tractament d'aigües del futur i, al seu torn, inclou un programa de recerca per al desenvolupament de nous materials i tecnologies (tractaments biològics avançats, processos d'oxidació innovadors, sistemes híbrids) que permetin satisfer les diverses demandes de tractament d'aigües residuals.

Aquestes tecnologies permetran controlar la contaminació per microcontaminants orgànics, com són els pesticides, fàrmacs, hormones, composts perfluorats o disruptors endocrins, que actualment no són eliminats per les estacions depuradores d'aigües residuals (EDARs) en el procés de recuperació de l'aigua.

"Amb el tractament convencional de tractament d'aigües residuals l'eliminació d'aquests contaminants emergents és baixa i insuficient" explica la Dra. Mira Petrovic, responsable de la línia de recerca de Contaminants en Aigües Residuals de ICRA i investigadora principal del projecte NOWELTIES. "El projecte ajudarà a acabar amb les mancances tecnològiques i les necessitats de coneixement existents en aquest àmbit. S'aprofitaran eficaçment els recursos per a la cerca de nous materials i tecnologies i es crearà una plataforma que ofereix oportunitats d'estudis d'avantguarda per a la formació dels experts en tractament d'aigües del futur" -afegia la Dra. Petrovic.

01/10/2019

Girona, centre de debat internacional sobre l'ús d'aigües regenerades per a consum humà

<https://press.clipmedia.cat/notas/girona-centre-de-debat-internacional-sobre-lus-daigues-regenerades-per-a-consum-huma/>

Girona, centro de debate internacional sobre el uso de aguas regeneradas para consumo humano

<https://press.clipmedia.cat/notas/girona-centro-de-debate-internacional-sobre-el-uso-de-aguas-regeneradas-para-consumo-humano/>



CONVOCATORIA DE PRENSA 30/09/2019

Girona, centro de debate internacional sobre el uso de aguas regeneradas para consumo humano

- El workshop se enmarca en el programa de actividades del 10º aniversario del ICRA



La jornada tendrá lugar en el edificio H2O del ICRA, en Girona

Con el título "International experiences in potable reuse. What and how can we best learn?" el encuentro, que se estructura en formato de charlas y una mesa redonda, mostrará, por una parte, casos prácticos de reutilización de agua potable en regiones con escasez de agua en todo el mundo. Y por otra ayudará a determinar las necesidades y oportunidades de actualización de los conocimientos, en cuestiones tecnológicas, económicas, legales, de bienestar, etc. ofreciendo a los participantes.

¿Es seguro regenerar agua para consumo humano?, ¿es viable económicamente?, ¿lo aceptará la población? Internacionalmente el uso del agua regenerada para uso potable ha aumentado considerablemente estos últimos años como una práctica que, correctamente gestionada, puede ser implementada de un modo seguro y contribuir sustancialmente al sistema de abastecimiento de recursos hídricos en ciudades en todo el mundo con climatologías semejantes a España. Pero sin embargo su utilización en nuestro país todavía no se contempla en la legislación correspondiente.

Científicos y expertos nacionales e internacionales del sector del agua se reunirán, el próximo viernes 4 de octubre en la sede del Institut Català de Investigació del Aigua (ICRA), en Girona, para exposar y revisar los desarrollos que existen, en este ámbito, así como los beneficios que se pueden obtener, implementando proyectos de reutilización potables –término derivado de la terminología anglosajona.

18/11/2019

Commemoració del 10è aniversari de l'ICRA a Girona

<https://press.clipmedia.cat/notas/dimarts-26-de-novembre-commemoracio-oficial-del-10e-aniversari-de-licra-a-girona/>



CONVOCATORIA 18/11/2019

Damià Barceló,
director de l'Institut Català de Recerca de l'Aigua (ICRA), es compliu a convidar-vos a

Commemoració del 10è aniversari de l'ICRA a Girona

que tindrà lloc el dimarts 26 de novembre de les 10.00h a les 16.30h, a l'edifici H₂O (Emili Grahit, 101, 17001 Girona), seu de l'ICRA, i a l'atenció a mitjans que es farà a les 9.30h.

El 2009 es va inaugurar l'edifici H₂O, seu de l'Institut Català de Recerca de l'Aigua (ICRA) ubicada al Parc Científic de la UdG. Un equipament que naixia amb la missió d'esdevenir un pol de referència nacional i internacional en l'àmbit de la recerca de l'aigua, amb els seus més de 6000m² i 20 laboratoris destinats a la investigació i transmissió del coneixement.

L'ICRA ha volgut commemorar la seva creació a l'edifici H₂O de les milers d'aigües que han fet possible la seva creació.

21/11/2019

Dos investigadors de l'Institut Català de Recerca de l'Aigua, entre els científics més citats del món

<https://press.clipmedia.cat/notas/dos-investigadors-de-linstitut-catala-de-recerca-de-laigua-entre-els-cientifics-mes-citats-del-mon/>

Dos investigadores del Instituto Catalán de Investigación del Agua, entre los científicos más citados del mundo

<https://press.clipmedia.cat/notas/dos-investigadores-del-instituto-catalan-de-investigacion-del-agua-entre-los-cientificos-mas-citados-del-mundo/>



NOTA DE PREMSA 07/10/2019

L'Institut Català de Recerca de l'Aigua commemora el seu 10è aniversari amb un centre de recerca de referència en el sector de l'aigua

- Comença el compte enrere per a la celebració de l'acte oficial d'aniversari



Girona, 7 d'octubre de 2019.- Tal dia com avui ara fa deu anys es va inaugurar l'edifici H₂O, seu de l'Institut Català de Recerca de l'Aigua (ICRA) ubicada al Parc Científic de la UdG. Un equipament que naixia amb la missió d'esdevenir un pol de referència nacional i internacional en l'àmbit de la recerca de l'aigua, amb els seus més de 6000m² i 20 laboratoris destinats a la investigació i transmissió del coneixement.

"En 10 anys s'ha fet molta feina i són moltes les fites assolides en camps com la reutilització de l'aigua de consum de boca, temes de contaminació química i microbiològica o l'estat dels rius... explica Damià Barceló, director de l'ICRA-. Tot i que el procés de recerca és lent, ja que cada projecte pot durar entre 3 i 4 anys, són molts els avenços aconseguits en l'última dècada. Avui dia, per exemple, es té molta més informació sobre l'estat de l'aigua i els contaminants emergents que hi podem trobar com són els perfluorats, els micropàstics, pesticides o antibiòtics."

L'objectiu de l'ICRA és respondre d'una manera global, eficient i competitiva als problemes actuals vinculats al cicle integral de l'aigua i transmetre el coneixement cap a les empreses i les administracions responsables de la seva gestió. És el cas, per exemple, del programa de recerca PLAS-MED que, actualment, és portat a terme per un equip d'investigadors de l'ICRA i en el qual s'avaluen els riscos alimentaris i per a la salut que poden tenir els micropàstics.



Un dels laboratoris de l'edifici H₂O

26/11/2019

L'ICRA es posiciona en el seu 10è aniversari com un referent intercontinental i un model d'èxit de país en investigació de l'aigua

<https://press.clipmedia.cat/notas/licra-es-posiciona-en-el-seu-10e-aniversari-com-un-referent-intercontinental-i-un-model-dexit-de-pais-en-investigacio-de-laigua/>

El ICRA se posiciona en su 10o aniversario como un referente intercontinental y un modelo de éxito de país en investigación del agua

<https://press.clipmedia.cat/notas/el-icra-se-posiciona-en-su-10o-aniversario-como-un-referente-intercontinental-y-un-modelo-de-exito-de-pais-en-investigacion-del-agua/>



NOTA DE PREMSA 26/11/2019

L'ICRA es posiciona en el seu 10è aniversari com un referent intercontinental i un model d'èxit de país en investigació de l'aigua

- El caràcter interdisciplinari de biòlegs, enginyers, químics i d'altres especialitats marquen el gran potencial de l'ICRA que es veu reflectit en les seves àrees: 12.632.090,85 € de Fons Compartits destinats a projectes de recerca; 250 projectes gestionats; 1.438 treballs científics impulsats; 60 persones dedicades a recerca.



L'Institut Català de Recerca de l'Aigua (ICRA) ha celebrat aquest matí els seus 10è aniversari de l'edifici H₂O a Girona, amb la participació dels representants institucionals, personal tècnic i investigador que l'han vist créixer i convertir-se en un centre de recerca de referència nacional i internacional.

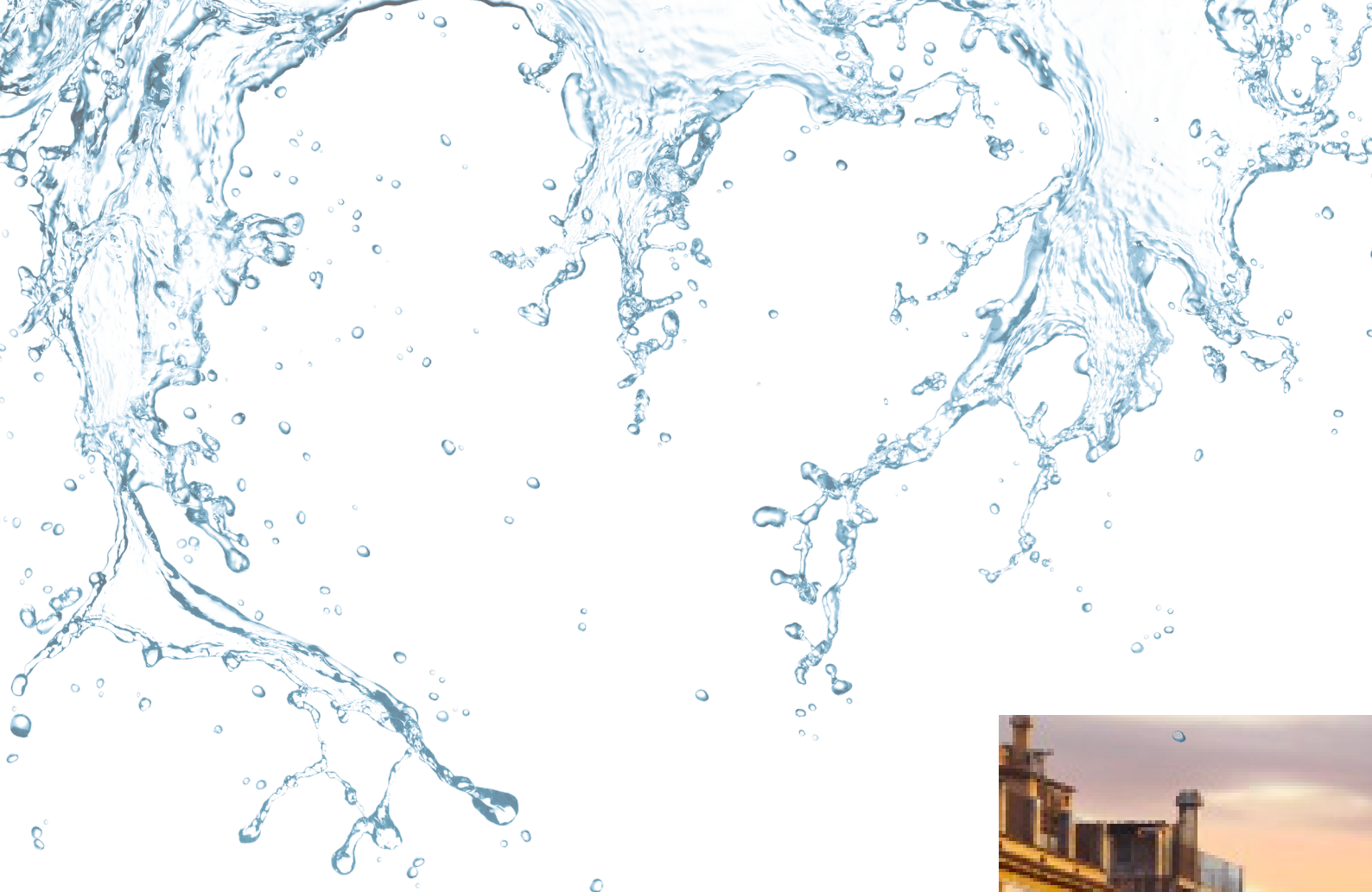
Durant tota una dècada l'ICRA ha desenvolupat recerca de qualitat, mitjançant l'atracció del talent, per situar-se a l'avantatge dels millors centres en el seu àmbit. A hores d'ara, ha esdevingut un punt de trobada entre tots els agents, públics i privats, que treballen en l'àmbit de l'aigua, i un forat de relació entre la recerca que es desenvolupa i la societat.

La creació de l'ICRA es va aprovar el 26 d'octubre de 2009 pel govern de la Generalitat de Catalunya, en el marc del Programa de Centres de Recerca de Catalunya (CERCA), i es va constituir la Fundació de l'Institut Català de Recerca de l'Aigua, amb el Patronat: Generalitat, Universitat de Girona (UdG) i Agència Catalana de l'Aigua (ACA). Tres anys després, quan va ocupar la seva seu a l'edifici H₂O al Parc Científic i Tecnològic de la UdG, va comptar amb l'estructura interna necessària per desenvolupar tot el seu contingut estratègic. Des del mes de juliol de 2018 és també un institut universitari de recerca adscrit a la Universitat.

Tal com ha recordat el director de l'ICRA, Damià Barceló, durant les seves paraules de benvinguda: "En aquests deu anys, l'ICRA ha aconseguit situar-se en el mapa mundial com a centre de



Prosserger a dreta: Lluís Ribot, Damià Barceló i Quim Salvà

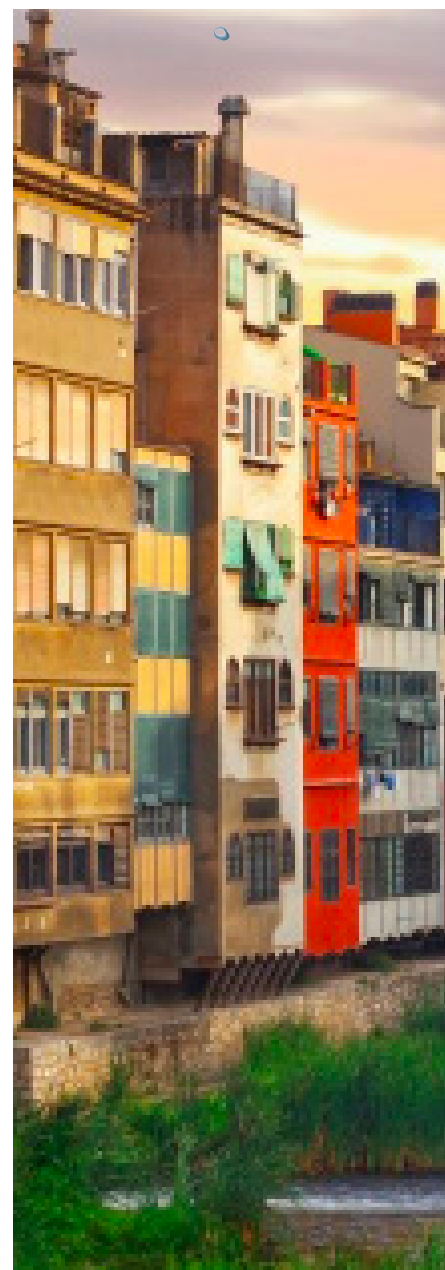


www.icra.cat

Catalan Institute for Water Research

**H₂O Building
Scientific and Technological Park
of the University of Girona**

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The logo for ICRA, featuring the letters 'ICRA' in a bold, sans-serif font. The 'I' and 'C' are dark grey, while the 'R' and 'A' are blue. The 'R' has a small orange square with a white 'R' inside its top curve. To the right of the text are three blue circles of varying sizes, and two more blue circles of varying sizes are positioned below the 'A' and 'R'.





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