Projects presentations on Topic 2- Strengthening Socio-economic Approaches to Water Management
(15 min presentation+5 min for questions and answers)

FG members: Budds, Becker, Covaliova*, Schirmer*, Suzenet
*absent

NATWIP

Nandita Singh

Water JPI 2018 Joint Call

Mid-term evaluation meeting
19-20 April 2021 Online

Scientific and technological results

1. Review of international experiences to identify barriers, lessons learned & challenges vis-à-vis NBS for water in periurban **(WP1):**
   - Systematic literature review (SLR) of 1288 PR articles - completed
   - Key expert interviews - ~20 interviews in different partner countries - completed
   - Additional activities:
     - SLR on co-benefits, and Global North-South insights – almost complete
     - Review of the status, changing practices and policy on NBS in India – completed

2. Methodological/Assessment framework (ASF) to analyze potentials, content & benefits of NBS in the peri-urban **(WP2)** – completed

Scientific and technological results (contd.)

3. Apply the ASF to selected *case studies* in partner countries to compare situations and draw generalizations **(WP3)** – in progress
   - Case study briefs being prepared
   - Above ASF finalized for application to the case studies
   - Case study data on indicators in the ASF available from Brazil, Norway, S. Africa, Spain and – currently being processed
   - Data collection for case studies in India, S. Africa, and Sweden ongoing

4. Creating a common narrative for implementing NBS for water in peri-urban areas **(WP4)** - work started:
   - Dependent on results of WPs 1, 2, 3
   - Short workshop organized during the Mid-Term project meeting on 25 Sep 2020
   - Online half-day workshop scheduled for May 19

Collaboration, coordination, mobility, synergies

- Excellent **collaboration** and **coordination** within the Consortium
- Activities under each WP designed by the leader, subjected to multi-partner discussion and review, leading to a collaborative multi-disciplinary effort
- **Transnational** nature of project – though data is country-based, the synthesis is transnational, knowledge to be applicable at global scale
- All project partners actively involved – funded, associated and self-funded/in-kind:
  - Södertörn University, Stockholm, Sweden
  - Technical University of Catalonia (UPC), Barcelona, Spain
  - Norwegian Geotechnical Institute, (NGI), Oslo, Norway
  - Stellenbosch University, Stellenbosch, S. Africa
  - KTH Royal Institute of Technology, Stockholm, Sweden
  - IIS-Rio, Rio de Janeiro, Brazil
  - Anugrah Narayan College (A.N. College), Patna, India
- **Mobility**: Originally planned towards end of WP3 (Jul 2021) as study visit in Sweden – now postponed indefinitely due to Covid-19

Stakeholder engagement

- Successful stakeholder engagement involving:
  - public sector (government/municipal/local authorities)
  - academia
  - civil society and NGOs
  - private sector
- WP1 - through interviews with them as 'key experts' in NBS – their different narratives are being drafted in a scientific paper
- WPs 2 - involvement of different actors helped in achieving the WP objective
- WPs 3 & 4 – two-way communication with stakeholders closely connected to the case studies – ongoing in every partner country
- Cooperation with stakeholders positively influenced project outcome(s):
  - WP1- brought practical region-based experiences on NBS, which otherwise remained uncaptured through the SLR
  - WP2 - helped define the main aspects of the ASF and to prepare list of indicators
  - WP3 – double benefit – to learn more thoroughly about concerned NBS and support future positive action through knowledge-dissemination

Impact and knowledge output

- Strengthen socio-economic approaches to water management by:
  - developing and sharing knowledge on NBS in peri-urban areas – research articles, conference presentations, project website, etc.
  - proposing management tools and best practices guidelines – WP2 (ASF), WP3+WP4 outputs (forthcoming)
  - defining ways and means for enhancing their acceptance within policy and action – continuous two-way communication with stakeholders
- Develop supporting tools for sustainable integrative water management through:
  - creation of a framework for assessing and verifying different aspects of NBS - ASF
  - case studies in partner countries that will provide information for adoption in regions beyond – WP3 + 4
- Already available knowledge outputs – WP1 report, 1 published article, project website, conference presentations
- Outputs in preparation - 1 reviewed article, 5 articles in manuscript, 9 case study briefs, conference presentations + more planned
- 60-min Session at the ***World Water Week*** *(August 2021)*, where all the findings of NATWIP will be presented to a diverse group of global water stakeholders

Continuation of the work in the future

3 ways:

- Additional co-authored scientific presentations and publications
- Partners continue to work on the theme independently
- Apply for newer collaborative project funding – e.g. Horizon Europe

Any comments?

Water JPI

Nudges For Economics of Water Tariffs
NEWTS

Michel PAUL (CEMOI – University of La Reunion Island)

Water JPI 2018 Joint Call

Mid-term evaluation meeting

19-20 April 2021 Online

Scientific and technological results

- Academic production : 6 scientific papers published or under review in international academic journals and 10 communications in national and international academic congresses.

- Methodological advances concerning the measurement of overconsumption and the proper calibration of social incentive IBTs.

- Development of the Newts-Run1 micro-simulation model (prototype) for assessing the socio-economic performance of water tariffs

-- Econometric estimation of household water demand functions for Cap Town (making use of historic Census data from 2011) and Tunisia (with preliminary results, at the district level)

- Cost benefit analysis for the large-scale behavioral nudges campaigns implemented in Cape Town in 2015/2016

Collaboration, coordination, mobility, synergies

- Several working meetings, seminar and workshops (in remote connection since 2020) organized by the coordinators of Experimental Unit and Econometric Unit

- Preferential collaborations with GAEL / OEG (deploying the lab-tested nudges in the field with the Spanish case study) and EPRU / OEG (strong support concerning the econometric work)

- Sharing outputs with computer programs, (Spanish) database for pre-testing, and survey questionnaires relating to the household data production phase (micro-simulation model Newts-Run1 is on the agenda)

- Mobility is currently frozen (COVID-19 pandemic). A workshop and related research stays are scheduled for October 2021 in Reunion Island.

Stakeholder engagement

- Very strong (except for Tunisia) because of the involvement of stakeholders in the research program with many work meetings, one public consultation (Reunion Island, 60 people), and regular participation to workshop and on line seminars

- Local stakeholders took part to scientific work relating to nudge design (with participation to nudge units)

- Local water companies (*i*) provide data from subscriber files and (*ii*) are involved in the implementation of the project (operational aspects), construction of the data management plans and possibly on financial level for some additional funding

Remark Implementation of the project for the SA study site concerning the impacts of BIs (carried out in Cap Town in 2016) on the water demand functions of the Households and the related performance of water pricing policy requires updated data. The related survey work is called into question due to the COVID-19 crisis (with the City of Cap Town that gives priority to the management of its COVID-19 response).

Impact and knowledge output

- NEWTS project has not yet produced its main results … but several stakeholders are involved in the research program from the start.

It follows :

- capacity building

- knowledge sharing

- a real interest and some expectation concerning BIs, field experiments and the micro-simulation model

what is fully in line with the general objective of the project ("to break boundaries between services valuation [...] and the use of economics and social science“).

Continuation of the work in the future

Many opportunities with in particular :

(1) designing a nudge on willingness to pay for water and sanitation in Reunion Island

This work involves a collaboration between CEMOI and EPRU with 14 research stays funded by the Protea program (the funding of the related nudge campaign will be funded by specific local resources)

(2) a thesis project (in collaboration with Reunion Island Water Office) aimed at scaling up the micro-simulation model

It is to provide more macroscopic information on the various tariff policies that are implemented at territory scale, for allowing institutional bodies such as water agencies to have a mapping of DSM policy performance at their level of competence and action.

(3) SEMIDE / EMWIS (involved in the NEWTS project) is working on the development of a project closed to the NEWTS project, and involving members of the Newts research consortium and some national and international stakeholders from the southern Mediterranean area.

Any comments?

Sustainable technology for the staged recovery of an agricultural water from high moisture fermentation products (RECOWATDIG)

Halina Pawlak-Kruczek
(Name of the Coordinator)

Water JPI 2018 Joint Call

Mid-term evaluation meeting
19-20 April 2021 Online

THE CONSORTIUM

RECOWATDIG

UNIVERSITY OF TWENTE.

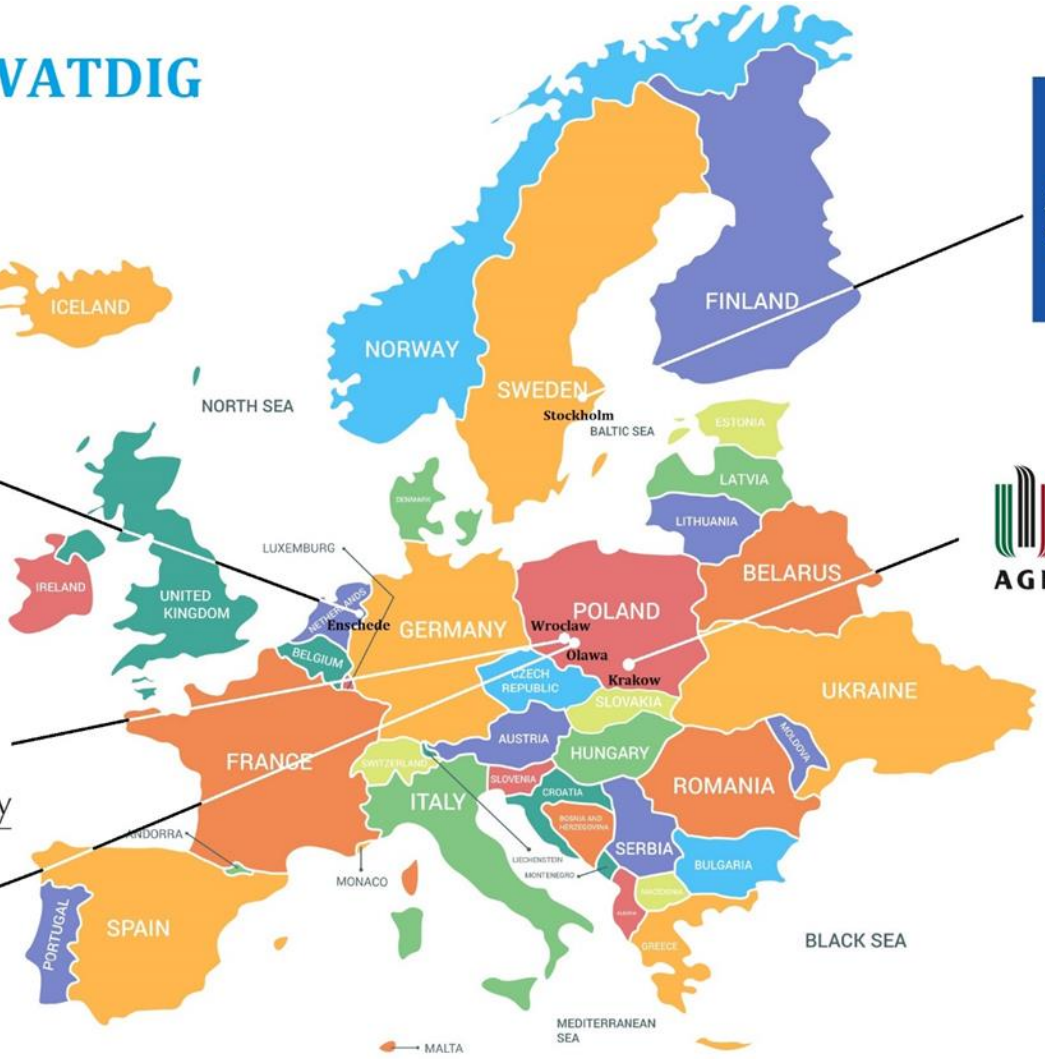
HOST BIO-ENERGY INSTALLATIONS

KTH VETENSKAP OCH KONST

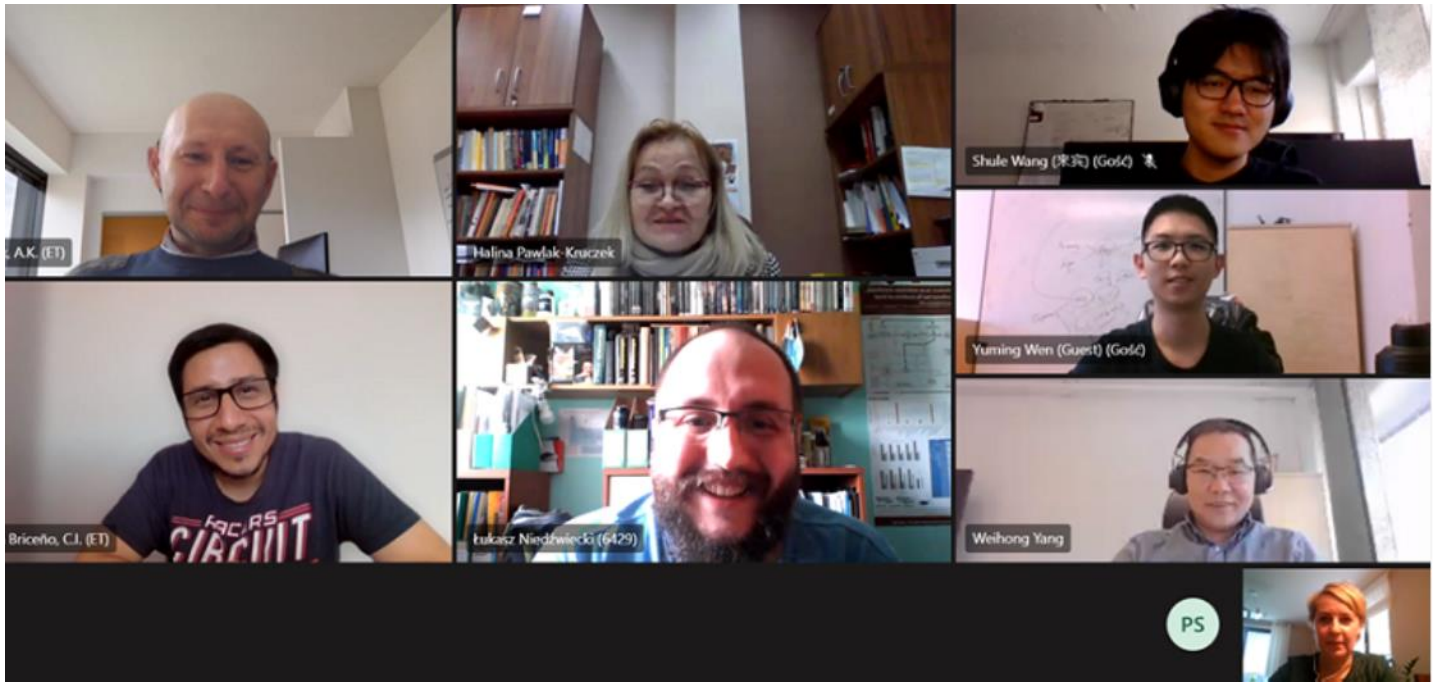
AGH UNIVERSITY OF SCIENCE AND TECHNOLOGY

Wrocław University of Science and Technology

ZGO GAĆ



PROJECT MANAGEMENT



Project meetings:
14.04.2019 – Kick-off meeting, Stockholm, Sweden
23.09.2019 – Wrocław, Poland
09.04.2020 – on-line
01.10.2020 – on-line
14.04.2021 – on-line
Next … hopefully face-to-face once again

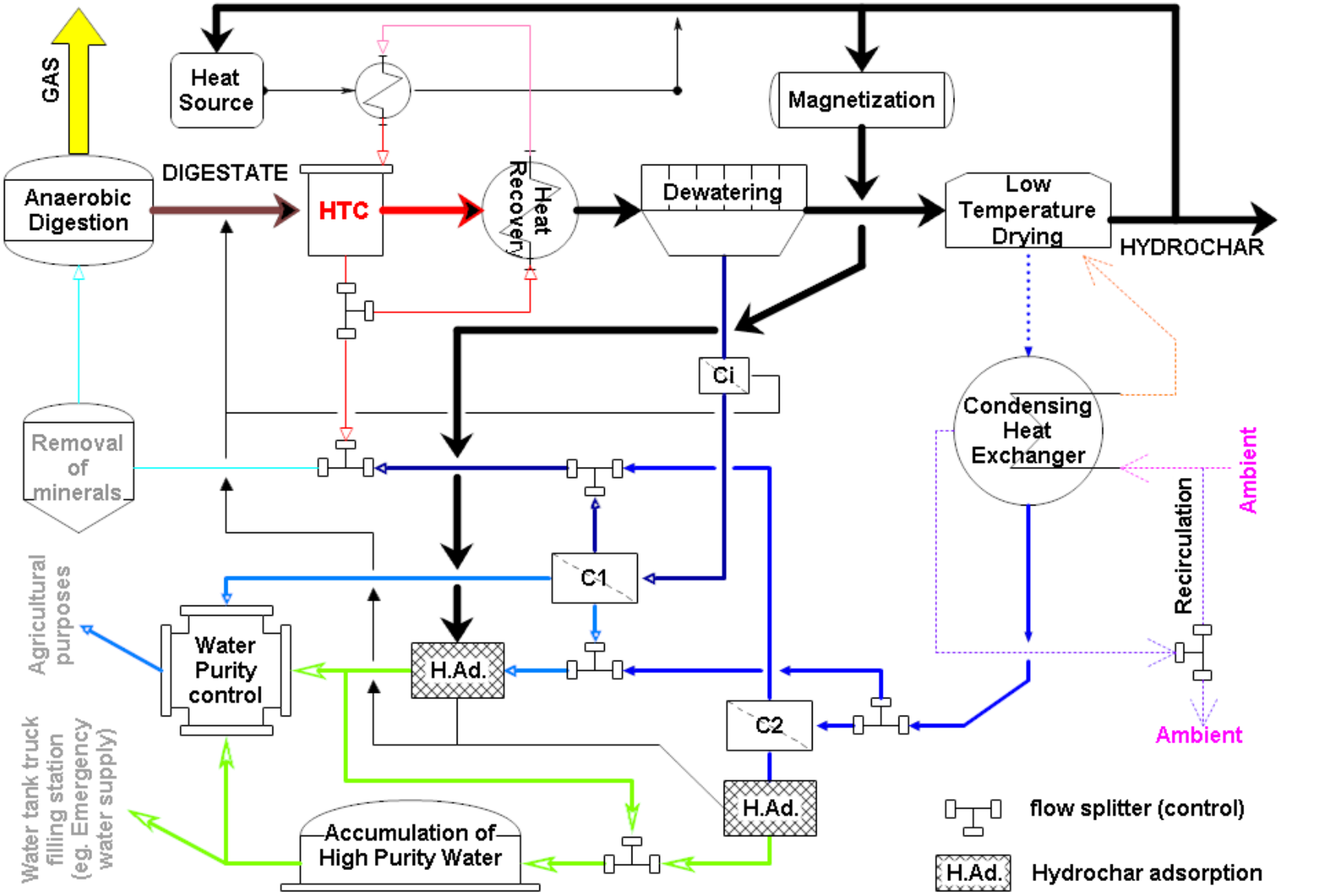
Digestate from Biogas Plant – neglected resource of the agricultural water

- Moisture content of approximately 90% in anaerobic digestion reactor
- Mechanical dewatering allows to decrease this moisture content to approx. 55% – 60%.
- Storage of liquid requires large sizes of specially prepared lagoons (typically 8 ha/MW of installed el. power of a biogas plant).
- This can be sprayed on the fields, however, not everything at once.
- This leads to losses caused by evaporation.
- Potential sources of recovery:
  - Increased mechanical dewatering,
  - Drying of the digestate followed by recovery of water and latent heat by condensation.

Potential SYNERGY

- ✓ Climate change influences magnitude and frequency of droughts
- ✓ Increased biogas production = increased share of renewable energy in energy mix
- ✓ Increased generation of renewable energy = decreased anthropogenic influence
- ✓ Elimination of lagoons = decreased loss through evaporation

CONCEPT OF THE INSTALLATION



Ci – initial filtration
C1 – pressurized membrane processes/forward osmosis
C2 – nanofiltration

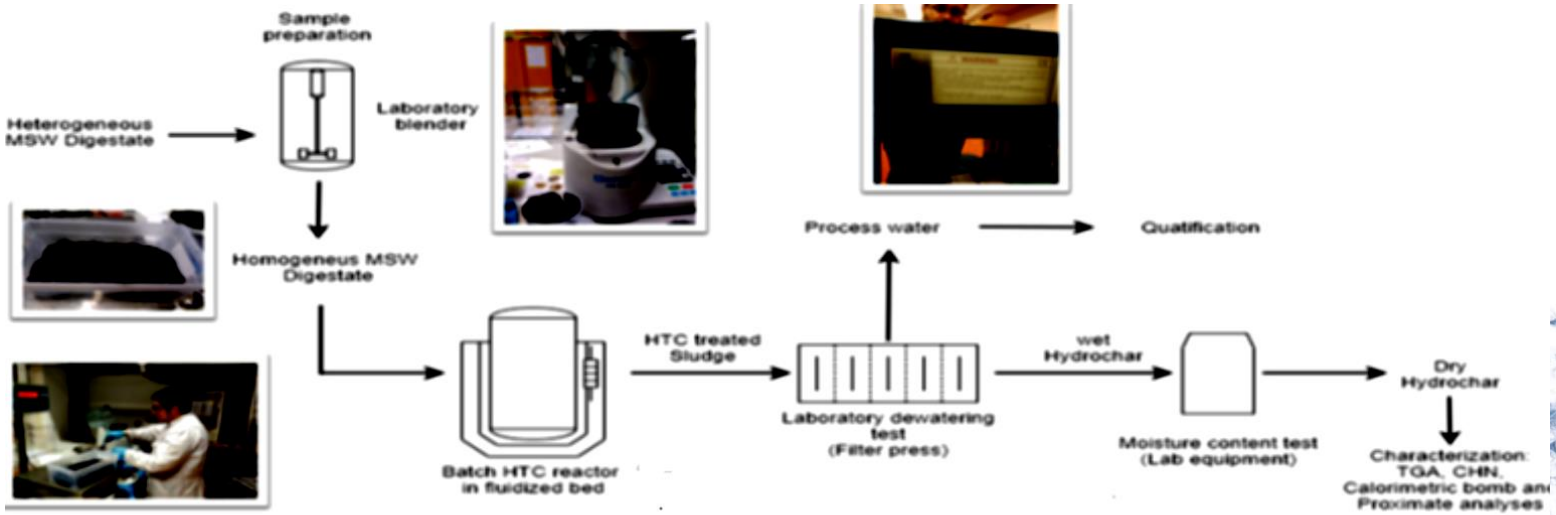
Optimum HTC parameters

UNIVERSITY OF TWENTE.

Main Goal

Determine the optimum HTC process conditions to recover water from the Municipal Solid Waste Digestate (MSWD) based on the mass and energy balances.

Methodology



Optimum HTC parameters

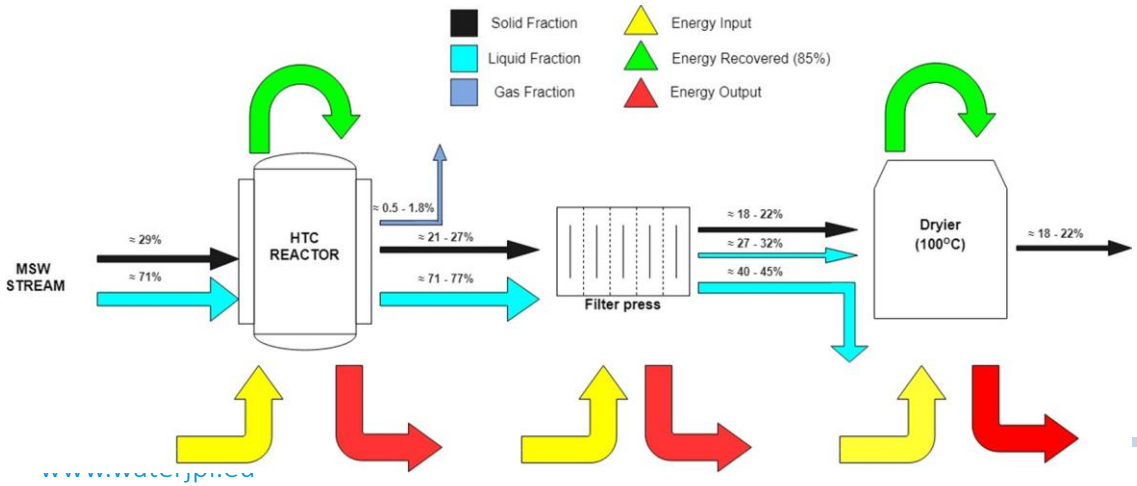
UNIVERSITY OF TWENTE.

Results

Hydrochar Properties

Sample	Ultimate analysis				HHV (MJ kg^{-1})	Energy densification (MJ kg^{-1})	Energy Yield
	C (%)	H (%)	N (%)	O[a] (%)			
MSW Digestate RAW	19.97 ± 0.85	2.37 ± 0.13	1.20 ± 0.15	13.13 ± 0.93	6.17 ± 0.23	-	-
HTC MSW Digestate							
180 °C- 30min-10 bar	20.46 ± 0.88	2.43 ± 0.16	1.40 ± 0.51	14.57 ± 1.19	8.24 ± 0.14	1.34 ± 0.02	96.82% ± 1.69%
180 °C- 60min-10 bar	20.67 ± 0.53	2.39 ± 0.06	1.48 ± 0.34	12.66 ± 0.78	7.43 ± 0.15	1.21 ± 0.02	88.45% ± 1.79%
180 °C- 120min-10 bar	22.21 ± 0.80	2.64 ± 0.21	1.45 ± 0.24	13.57 ± 1.07	7.03 ± 0.09	1.14 ± 0.01	89.61% ± 1.16%
200 °C- 30min-17 bar	21.90 ± 0.88	2.50 ± 0.12	1.51 ± 0.28	14.20 ± 0.87	8.20 ± 0.25	1.33 ± 0.04	94.05% ± 2.88%
200 °C- 60min-17 bar	25.67 ± 0.97	3.03 ± 0.05	1.67 ± 0.32	6.73 ± 1.22	8.36 ± 0.29	1.36 ± 0.05	100.48% ± 3.60%
200 °C- 120min-17 bar	20.67 ± 0.91	2.41 ± 0.12	1.24 ± 0.24	11.93 ± 1.05	9.24 ± 0.19	1.50 ± 0.03	106.00% ± 2.18%
230 °C- 30min-27 bar	24.31 ± 1.04	2.73 ± 0.20	1.79 ± 0.11	8.27 ± 0.74	7.94 ± 0.11	1.29 ± 0.02	92.47% ± 1.29%
230 °C- 60min-27 bar	22.51 ± 0.50	2.62 ± 0.06	1.75 ± 0.06	12.78 ± 0.60	8.94 ± 0.05	1.45 ± 0.01	97.32% ± 0.57%
230 °C- 120min-27 bar	23.01 ± 0.58	2.59 ± 0.09	1.68 ± 0.07	17.91 ± 0.65	9.22 ± 0.18	1.50 ± 0.03	96.04% ± 1.91%

Mass and Energy Balance Diagram

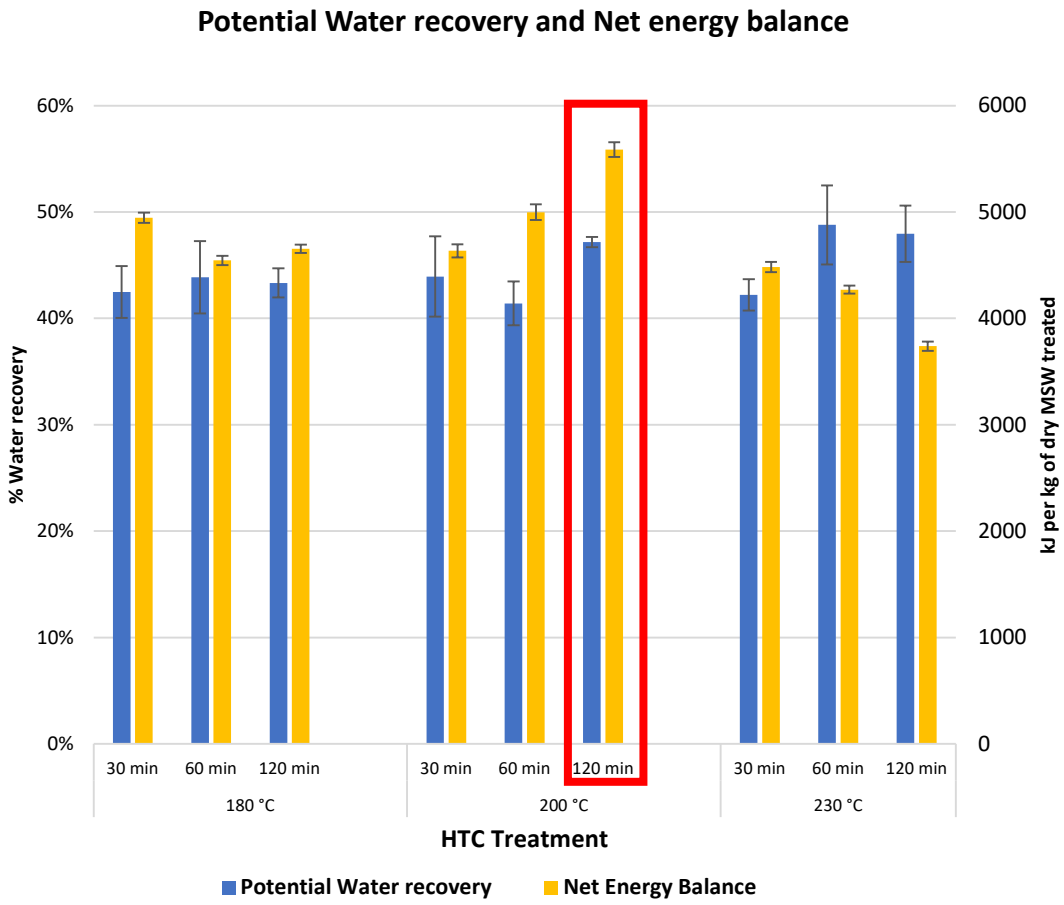


- The solid product yield (hydrochar) of the system ranged from 64.21 to 78.60%.
- HTC treatment promoted carbon densification in the solid fraction of the MSW digestate from 20 to 25%.
- 200°C-60min treatment was found to have the highest carbon densification (25.67%).
- After HTC treatment the HHV of the solid fraction increased after HTC treatment up to 49%.

Optimum HTC parameters

UNIVERSITY OF TWENTE.

Results



- HTC treated MSW digestate showed higher potential water recovery during the dewatering (40 - 48%) compared with the original feedstock (18%)
- The net energy balance for the different scenarios showed a positive energy production if the potential energy coming from hydrochar is included.
- The HTC treatment of 200°C with a residence time of 120min showed to be the most suitable treatment for the MSW Digestate considering water recovery (47.2%) and net energy balance(5.6 MJ).

membranes

MF membranes

Membrane symbol	Material	Nominal thickness	Porosity
0.02 µm	polypropylene	25.4 µm	60%
0.2 µm			38%

UF membranes

Membrane symbol	Membrane material	MWCO, kDa	Mean pore radius, nm	Contact angle, °	Polarity, %	Effective filtration surface, cm^2
PES 10	polyethersulphone	10	2.04	50.01	44.27	45.3
PES 30		30	8.38			
C 10	regenerated cellulose	10	5.01	54.76	49.92	
C 30		30	12.55			

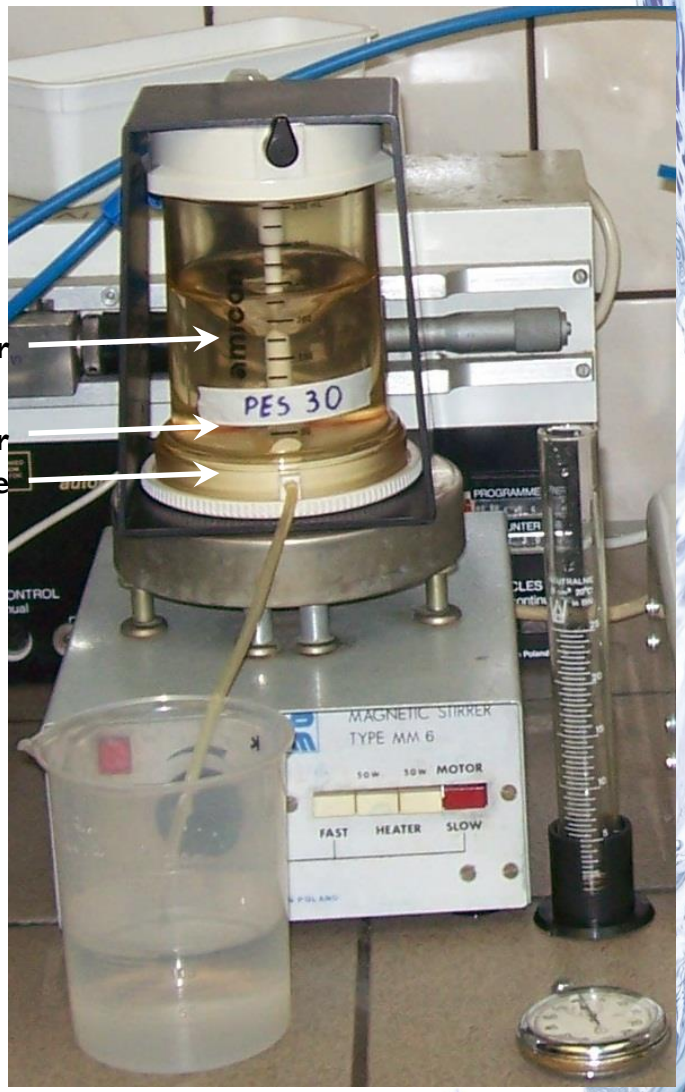
NF membranes

Membrane type	Membrane material	Na_2SO_4 retention	MWCO, kDa	Max temp., °C	pH range	Effective filtration surface, cm^2
NP010P	polyethersulfone	25 - 40 %	1040 – 1400	95	0 - 14	45.3
NP030P		80 - 95 %	520 – 700			

Experimental setup

Amicon 8400 →

dead-end micro/ultra/nanofiltration with the use of polymeric membranes



Coagulation / chemical precipitation

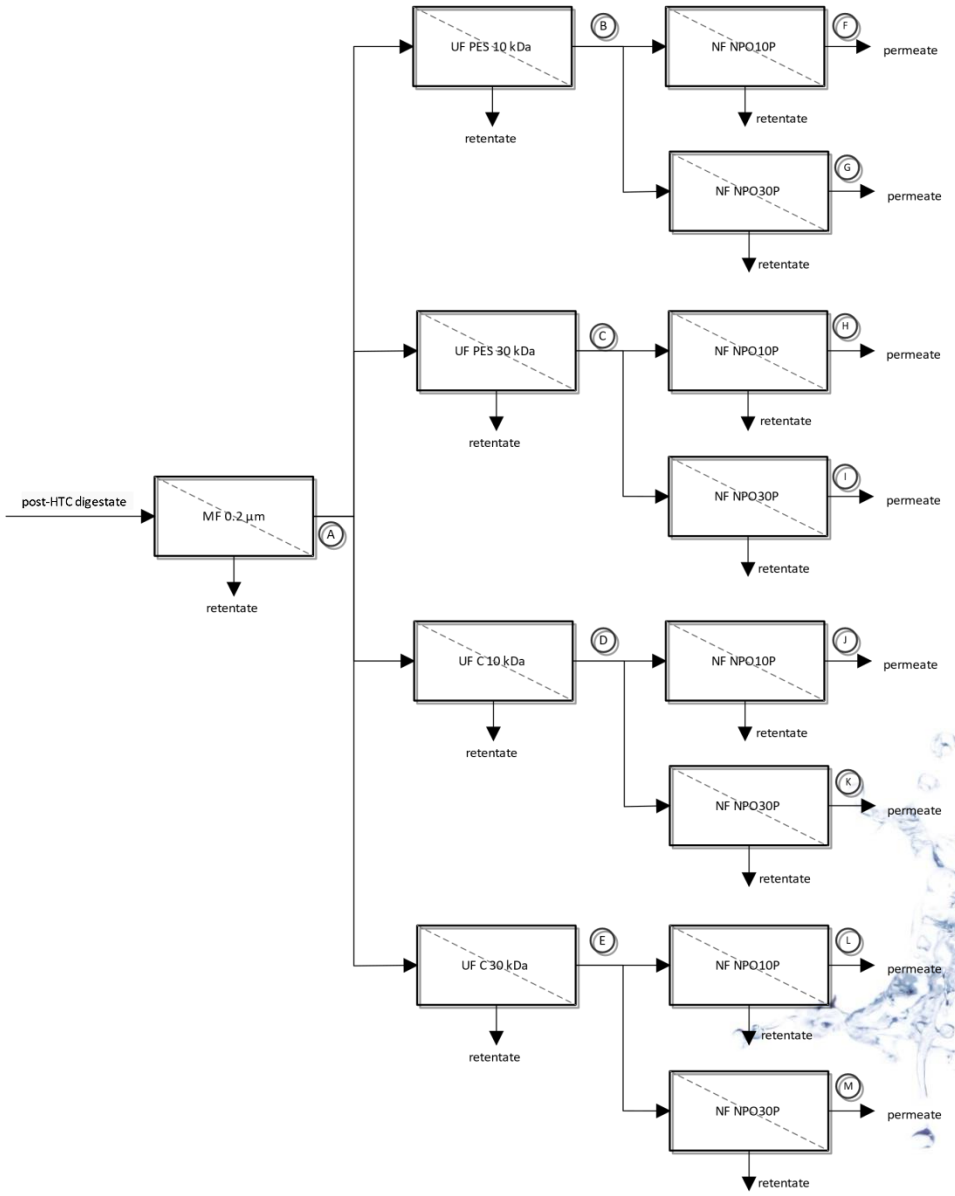
Analysis of the liquid fraction after digestate dewatering and post-condensation water after drying of the solid digestate fraction

SAMPLEs

	Liquid digestate fraction from the municipal waste biogas plant	Liquid digestate fraction from the municipal waste biogas plant after HTC	Liquid digestate fraction from the rural biogas plant after HTC
pH	6.2	7.17	7.2
Conductivity, mS/cm	8.13	25.2	14.95
Total suspended solids, mg/dm³	254	670	3,950
Chemical oxygen demand (COD), mg O_2/dm³	8,980	29,360	38,595
Biochemical oxygen demand (BOD), mg O_2/dm³	9,520	8,690	12,320
Dissolved organic carbon (DOC), mg C/dm³	2,995	8,650	23,070
Na, mg/dm³	293.6	487.2	521.3
K, mg/dm³	688.9	1678.4	1,966.5
Ca, mg/dm³	28.2	89.2	104.7
Mg, mg/dm³	449.7	672.2	101.9
Fe, mg/dm³	2.2	6.2	15.9
Mn, mg/dm³	3.9	4.4	1.5
Cu, mg/dm³	0.096	0.230	0.545
Zn, mg/dm³	0.630	1.434	3.977
Hg, mg/dm³	0.0036	0.0040	0.0029
Co, mg/dm³	0.137	0.156	0.069
Ni, mg/dm³	0.270	0.320	0.147

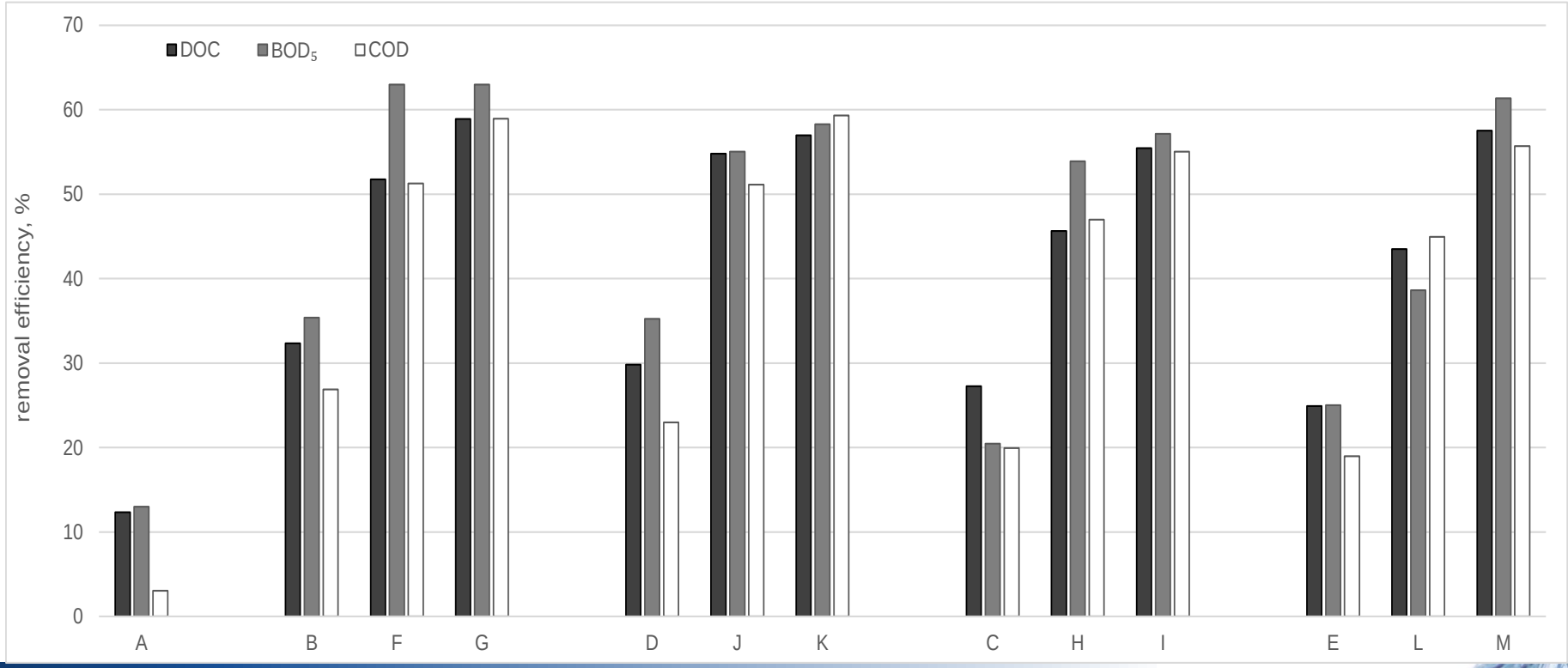
Application of pressurized membrane processes such as microfiltration (MF), ultrafiltration (UF) and nanofiltration (NF) for the purification of the liquid fraction of digestate

- **Goal**:
  - evaluation of the efficiency of sequential purification of liquid digestate fraction using pressurized membrane processes



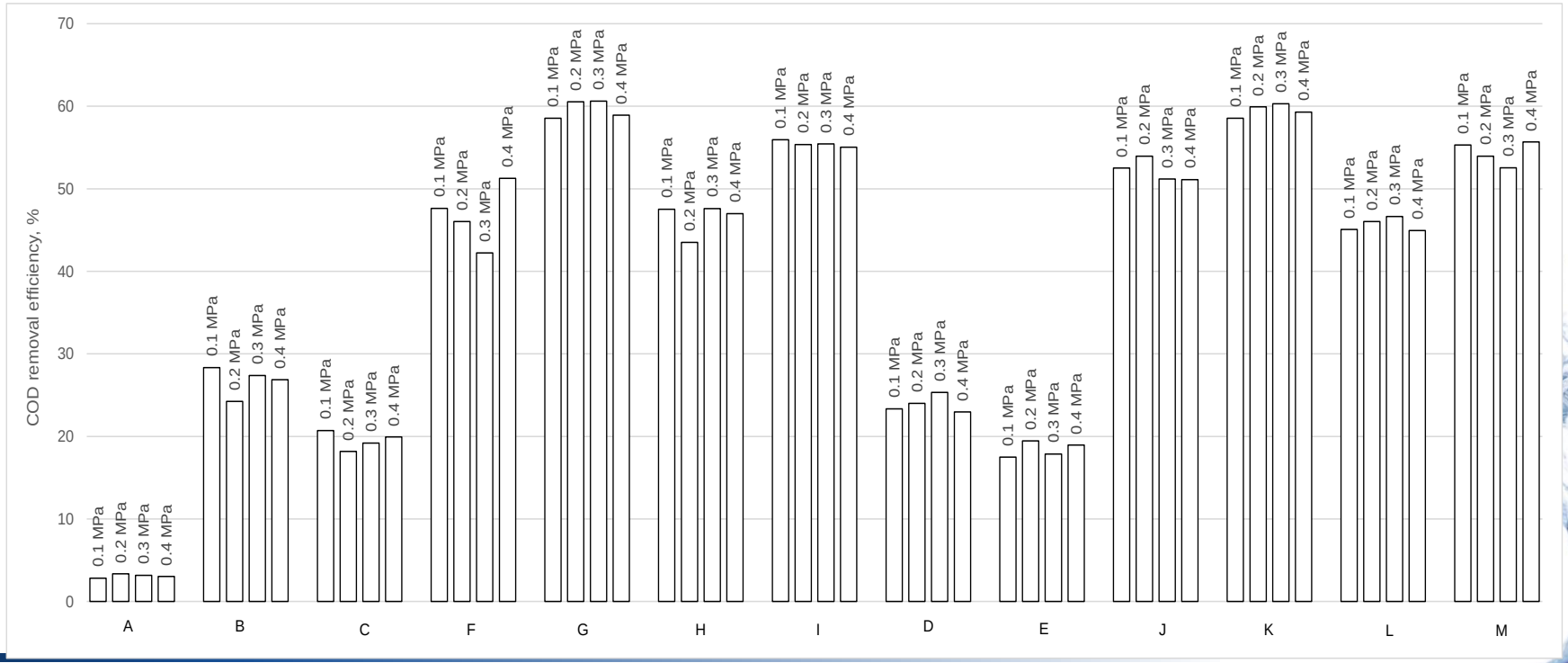
Application of pressurized membrane processes such as microfiltration (MF), ultrafiltration (UF) and nanofiltration (NF) for the purification of the liquid fraction of digestate

- **Results**:
  - the final quality was determined by the combination of separation properties of individual membranes. The combination of MF, UF and NF allows for a significant increase in the effectiveness of the purification of the raw solution compared to the effects obtained for independent membrane processes
  - the best results were obtained by conducting sequential treatment of the solution in the following variant: MF 0.2 μm → UF PES 10 → NF NPO30P



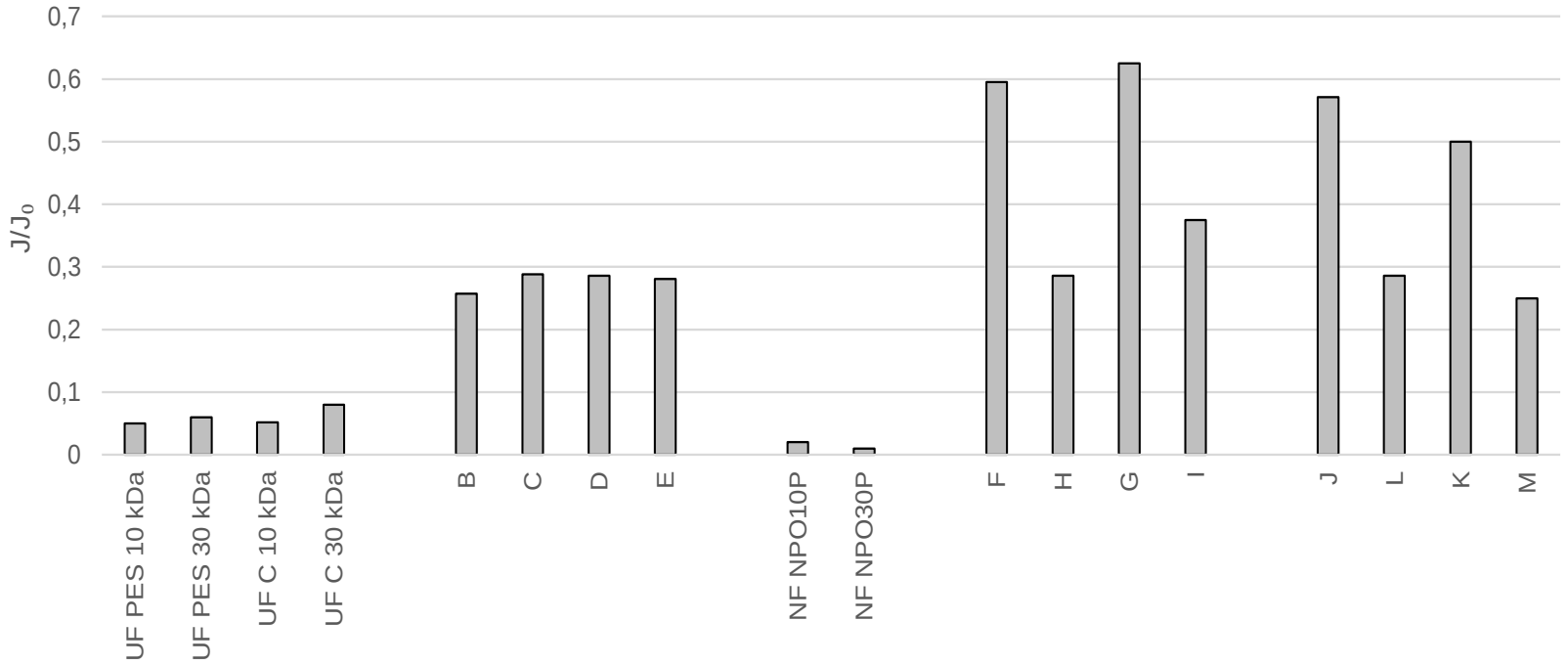
Application of pressurized membrane processes such as microfiltration (MF) ultrafiltration (UF) and nanofiltration (NF) for the purification of the liquid fraction of digestate

- **Results**:
  - the transmembrane pressure value has no significant influence on the efficiency of removing organic compounds from the analysed liquid, both in the case of application of single (for MF) and sequentially successive membrane processes
  - in the analysed range of transmembrane pressures from 0.1 MPa to 0.4 MPa the DOC, BOD5 and COD retention coefficients were practically at the same level (differences did not exceed 10%)

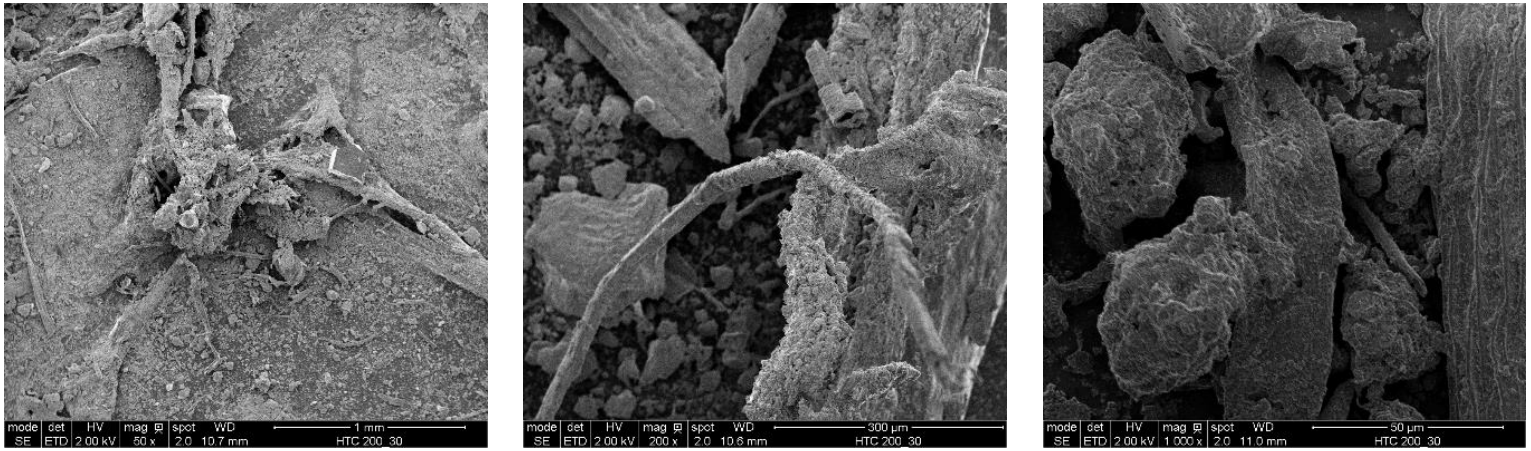


Application of pressurized membrane processes such as microfiltration (MF) ultrafiltration (UF) and nanofiltration (NF) for the purification of the liquid fraction of digestate

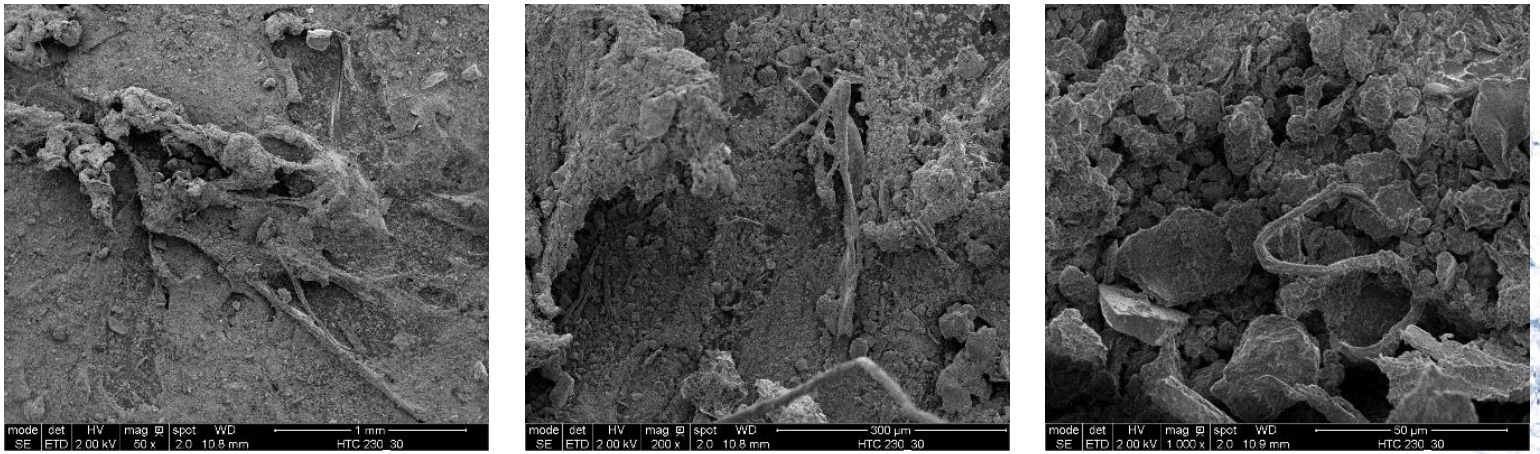
- **Results**:
  - although the applied membrane sequence allows for a very significant removal of organic compounds from the solution, there are still considerable amounts of low molecular weight substances remaining in the permeate, which may limit the direct use of the obtained water for agricultural purposes
  - the application of a sequence of the analysed membrane techniques has partially reduced the problem of membrane fouling



SEM analysis of hydrochars

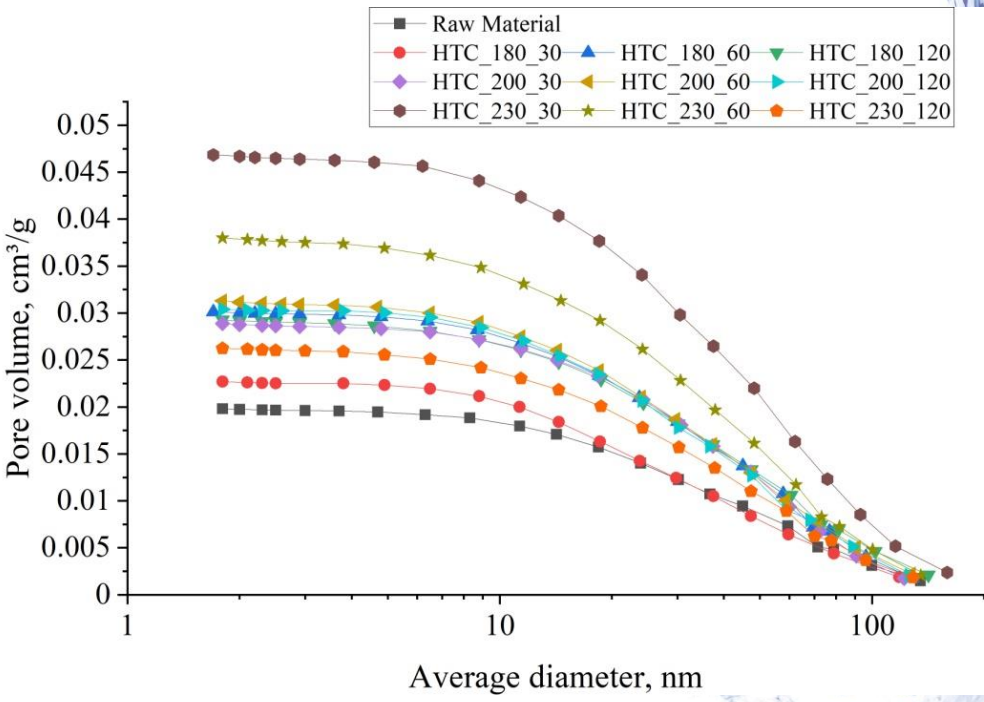


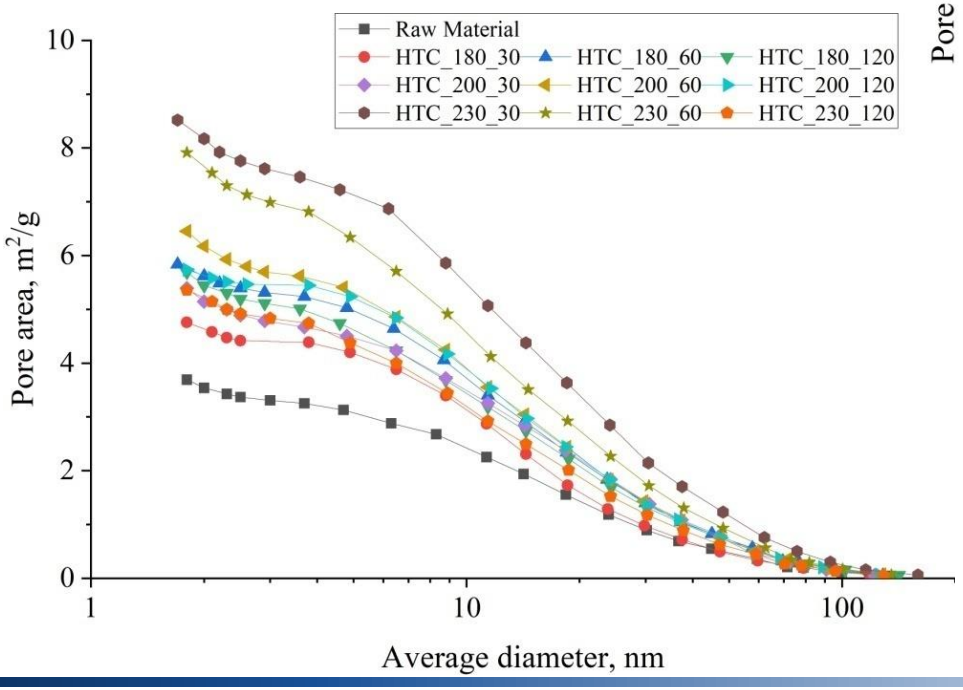
Microstructural images of hydrochar HTC_200_30 (200 °C, residence time of 30 min)



Microstructural images of hydrochar HTC_230_30 (230 °C temperature, residence time of 30 min)

Analysis of hydrochars – porosity, BJH desorption method



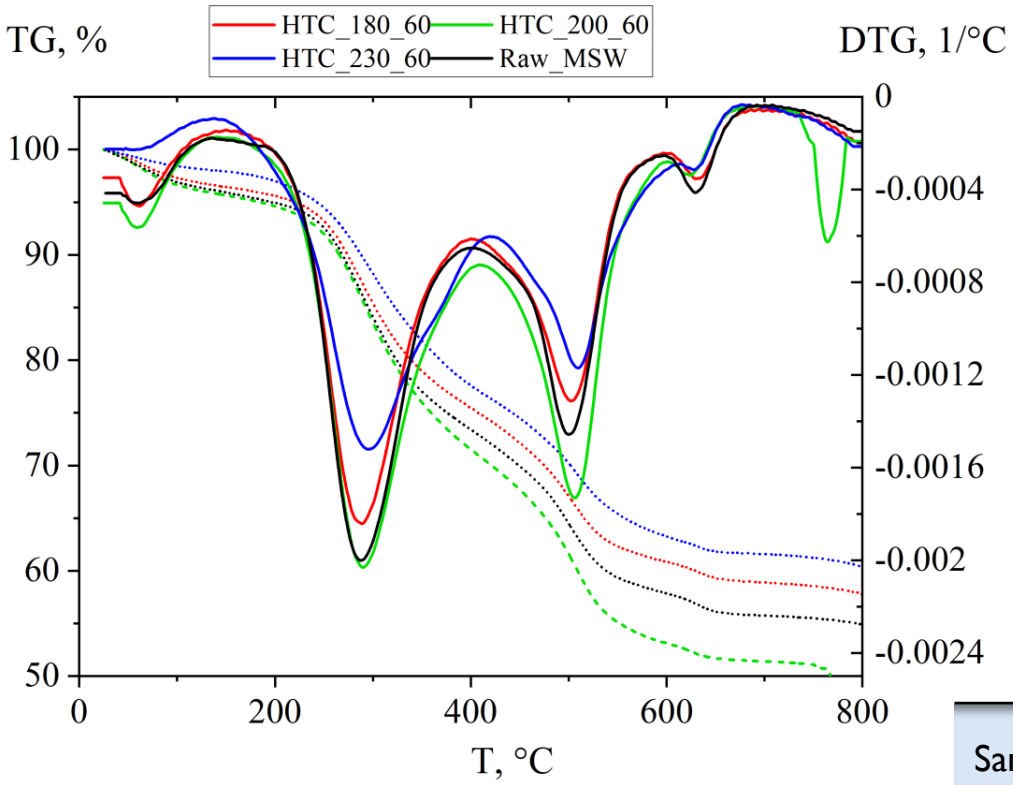


Proximate and ultimate analysis of hydrochars

Proximate and ultimate analyses, contents of: ash (A), volatile matter (VM), fixed carbon (FC), carbon (C), hydrogen (H) and nitrogen (N) contents (wt.%).

Sample	A, %	VM, %	FC, %	C, %	H, %	N, %
Raw MSW	68.05	25.79	4.99	20.07	2.42	1.13
HTC_180_30	66.91	25.38	6.37	20.49	2.38	1.17
HTC_180_60	66.09	25.48	7.19	20.37	2.43	1.17
HTC_180_120	66.03	25.33	7.25	22.39	2.65	1.29
HTC_200_30	64.80	25.73	8.48	22.43	2.574	1.32
HTC_200_60	64.72	25.84	8.56	25.55	3.04	1.50
HTC_200_120	65.50	25.68	7.78	21.43	2.53	1.16
HTC_230_30	64.88	25.97	8.40	23.80	2.83	1.84
HTC_230_60	65.12	25.84	8.16	27.92	3.22	2.18
HTC_230_120	65.94	25.86	7.34	22.75	2.64	1.63

Analysis of hydrochars – thermal analysis



$$D_i = \frac{DTG_{max}}{t_p \cdot t_i}$$ Ignition index

$$S = \frac{DTG_{max} \cdot DTG_{mean}}{T_i^2 \cdot T_f}$$ Combustion index

$$D_f = \frac{DTG_{max}}{\Delta t_{1/2} \cdot t_p \cdot t_f}$$ Burnout index

Thermal behaviour of studied hydrochars (TG and DTG curves) during the combustion – the impact of temperature (60 min residence time).

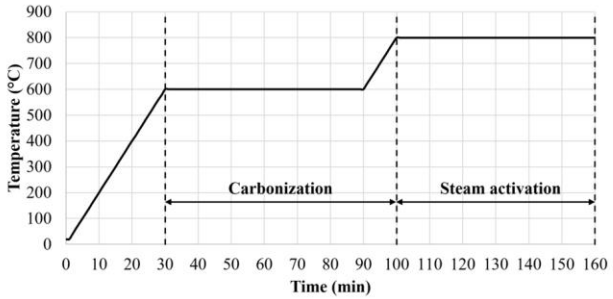
Sample	D_i wt. %/min^3	D_f, wt. %/min^4	S min^{-2}·°C
Raw MSW	0.0041	6.42E-05	3.28E-08
HTC_200_60	0.0042	6.17E-05	5.19E-08
HTC_200_120	0.0036	5.30E-05	3.04E-08
HTC_230_60	0.0028	4.67E-05	2.02E-08
HTC_230_120	0.0031	5.30E-05	2.31E-08

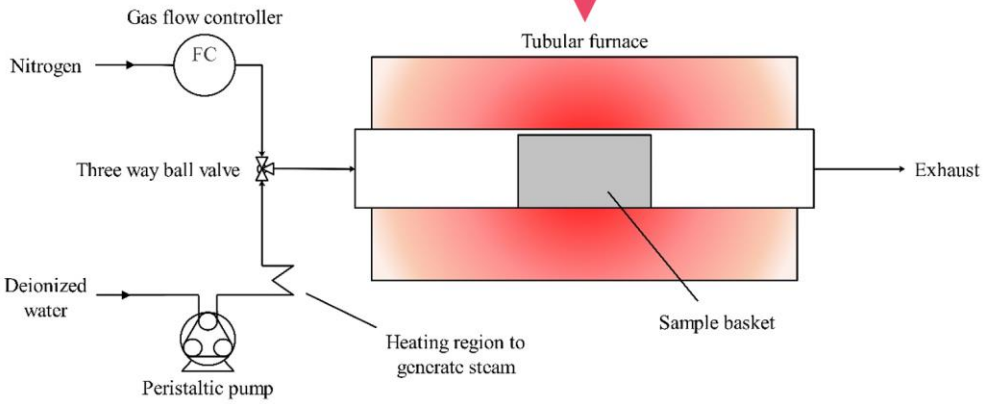
MAC- Adsorption of impurities in the wastewater by

the magnetic activated carbon

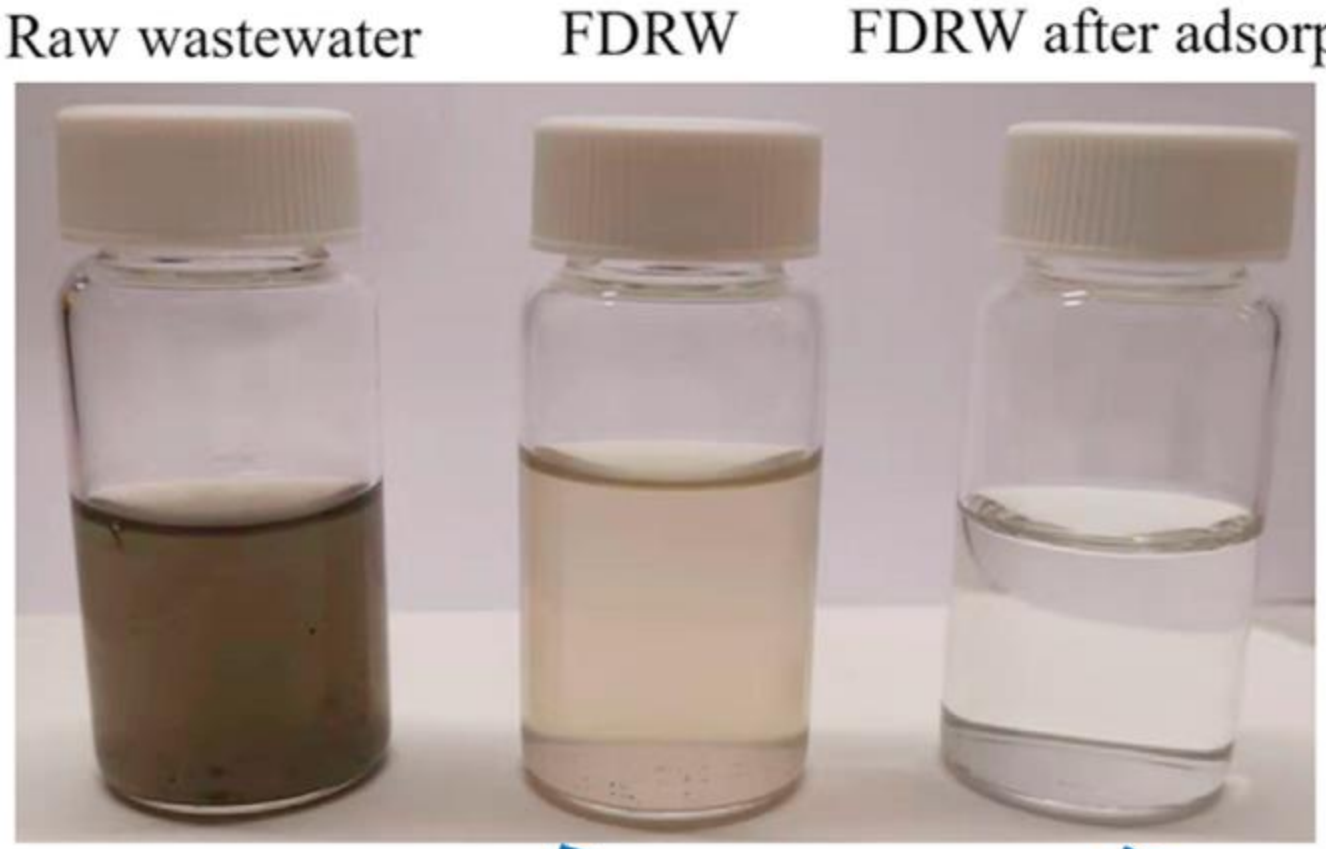
1. Previous work has used lignin to produce the magnetic activated carbon (MAC) and the process parameters have been investigated to optimize its phosphorous adsorption capacity. (https://doi.org/10.1016/j.chemosphere.2021.129561)

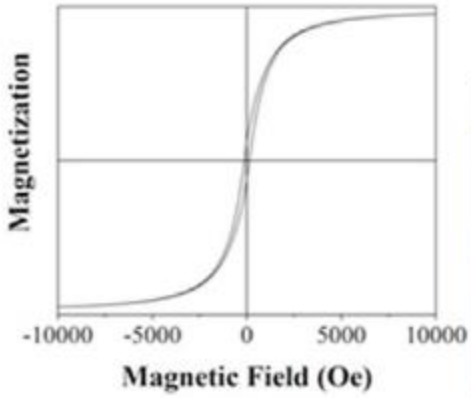
2. The produced agricultural digestate hydrochar were used to prepare the MAC followed the optimizing process parameters in the previous work. The characterization of the produced MAC and its phosphorous adsorption capacity would be investigated.





ADSORPTION AFTER MAGNETIZATION

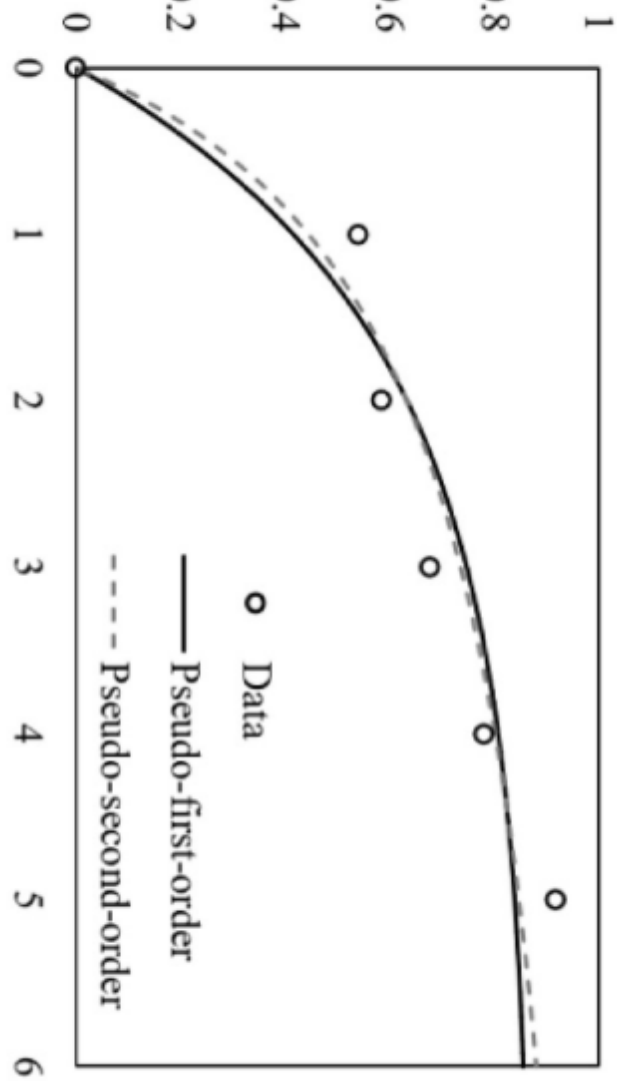




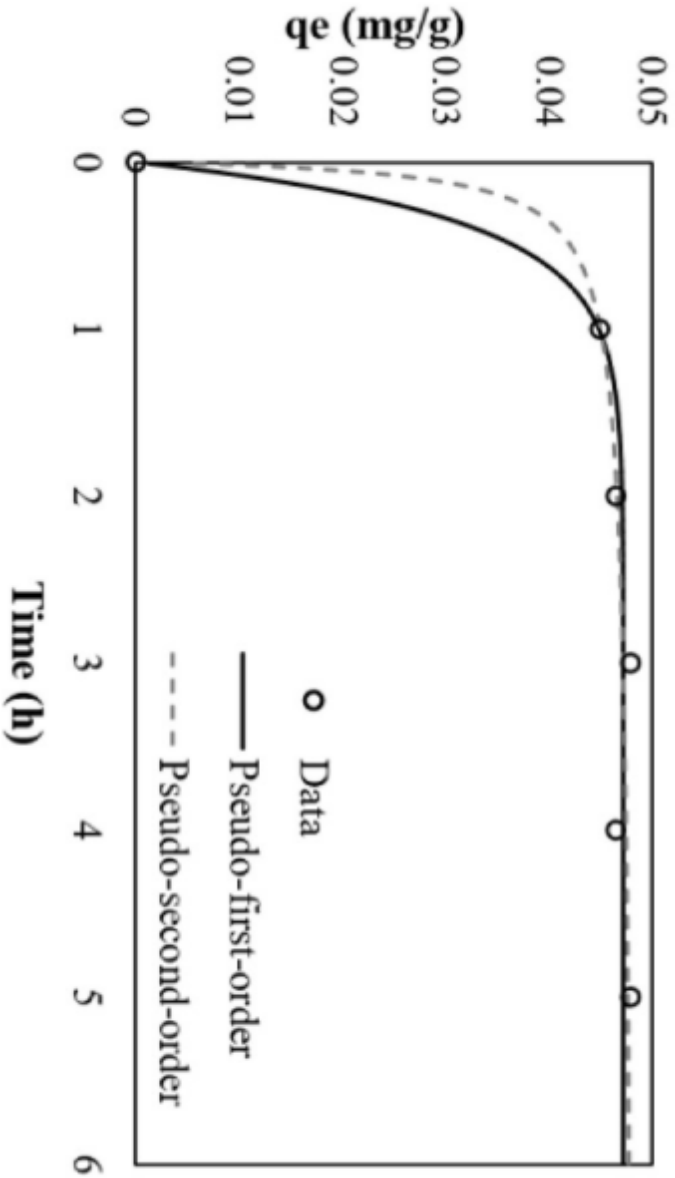
P SORPTION ISOTHERMS

Real wastewater from two different treatment stages have been collected from **Stockholm Vatten och Avfall AB**

filtered raw domestic wastewater



treated domestic wastewater



Cited papers

Urbanowska et al. „Treatment of liquid by-products of Hydrothermal Carbonization (HTC) of agricultural digestate using membrane separation" Energies, 2020 (13), 1; DOI: 10.3390/en13010262

Web of Science: 4 Scopus:4 (* autocitations not included)

- ✓ Atallah et al. „Hydrothermal carbonization of spent mushroom compost waste compared against torrefaction and pyrolysis" **Fuel Processing Technology** 2021 (216); DOI: 10.1016/j.fuproc.2021.106795;
- ✓ Wang, W and Lee, DJ „Valorization of anaerobic digestion digestate: A prospect Review" **Bioresource Technology** 2021 (323); DOI: 10.1016/j.biortech.2020.124626
- ✓ Kim et al. „Influence of Ammonia Stripping Parameters on the Efficiency and Mass Transfer Rate of Ammonia Removal" **Applied Sciences** 2021 (11), 1;DOI: 10.3390/app11010441
- ✓ Delahaye et al. „Experimental and Computational Evaluation of Heavy Metal Cation Adsorption for Molecular Design of Hydrothermal Char" **Energies** 2020 (13), 16; DOI: 10.3390/en13164203

Cited papers

Pawlak-Kruczek et al. „Hydrothermal carbonization of agricultural and municipal solid waste digestates – Structure and energetic properties of the solid products" Fuel 2020 (275); DOI: 10.1016/j.fuel.2020.117837

Web of Science: 5 Scopus: 4 (* autocitations not included)

- ✓ Lu et al. „Integration of Biomass Torrefaction and Gasification based on Biomass Classification: A Review" **Energy Technology** 2021, DOI: 10.1002/ente.202001108
- ✓ Parra-Orobio et al. „Physicochemical, microbiological characterization and phytotoxicity of digestates produced on single-stage and two-stage anaerobic digestion of food waste" **Sustainable Environment Research** 2021 (31), 1; DOI: 10.1186/s42834-021-00085-9
- ✓ Wang, W and Lee, DJ „Valorization of anaerobic digestion digestate: A prospect Review" **Bioresource Technology** 2021 (323); DOI: 10.1016/j.biortech.2020.124626
- ✓ Cesaro, A „The valorization of the anaerobic digestate from the organic fractions of municipal solid waste: Challenges and perspectives" **Journal of Environmental Management** 2021 (280); DOI: 10.1016/j.jenvman.2020.111742
- ✓ Zhao et al. „Upgrading Solid Digestate from Anaerobic Digestion of Agricultural Waste as Performance Enhancer for Starch-Based Mulching Biofilm" **Molecules** 2021 (26), 4; DOI: 10.3390/molecules26040832

Cited papers

Urbanowska et al. „Characteristics of Changes in Particle Size and Zeta Potential of the Digestate Fraction from the Municipal Waste Biogas Plant Treated with the Use of Chemical Coagulation/Precipitation Processes" Energies, 2020 (13), 1; DOI: 10.3390/en13225861

Web of Science: 2 (* autocitations not included)

- ✓ Zhao et al. „Upgrading Solid Digestate from Anaerobic Digestion of Agricultural Waste as Performance Enhancer for Starch-Based Mulching Biofilm." **Molecules** 2021, (26), 832; DOI: 10.3390/molecules26040832
- ✓ Warguła et al. „Impact of Compressed Natural Gas (CNG) Fuel Systems in Small Engine Wood Chippers on Exhaust Emissions and Fuel Consumption." **Energies** 2020, 13, 6709; DOI: 10.3390/en13246709

Pawlak-Kruczek et al. „Industrial process description for the recovery of agricultural water from digestate" Journal of Energy Resources Technology 2020 (142), 7; DOI: 10.1115/1.4046141

Web of Science: 1 (* autocitations not included)

- ✓ Wang, W and Lee, DJ „Valorization of anaerobic digestion digestate: A prospect Review" **Bioresource Technology** 2021 (323); DOI: 10.1016/j.biortech.2020.124626

Recent published work and work under review

- Urbanowska et al. " Treatment of municipal waste biogas plant digestate using physico-chemical and membrane processes." **Desalination and Water Treatment** 2021, (214), 214 – 223, DOI: 10.5004/dwt.2021.26661
- Wen et al. "Magnetic bio-activated carbons production using different process parameters for phosphorus removal from artificially prepared phosphorus-rich and domestic wastewater" **Chemopshere** 2021, (271), DOI: 10.1016/j.renene.2021.02.109
- Aragón-Briceño et al. "Hydrothermal carbonization of wet biomass from nitrogen and phosphorus approach: A Review." **Renewable Energy** 2021, Volume 171, Pages 401-415, DOI: 10.1016/j.renene.2021.02.109
- Urbanowska et al. "Recovery of water and chemical energy from liquid by-products of the agricultural digestate HTC using a cascade membrane system." – submitted to **Energies**, under review
- Magdziarz et al. "Multiphase analysis of hydrochars obtained by anaerobic digestion of municipal solid waste organic fraction." – submitted to **Renewable Energy**, under review
- Aragón-Briceño et al. "Integration of Hydrothermal carbonization treatment for water and energy recovery from organic fraction of municipal solid waste digestate." – submitted to **Renewable Energy**, under review

Conference publications

1. International Conference on Advances in Energy Systems and Environmental Engineering (ASEE19), 9th – 12th of June **2019,** Wrocław, Poland; Urbanowska et al.. *"Hydrothermal carbonization of the digestate as an innovation way for recovery of the water for agricultural purposes"* **Oral presentation**
2. 44th International Technical Conference on Clean Energy (Clearwater2019), 16th – 21st of June **2019,** Clearwater, Florida, USA; H. Pawlak-Kruczek et al.. *"Hydrothermal carbonization of the digestate as an innovation way for recovery of the water for agricultural purposes"* **Oral presentation**
3. 32nd International Conference on Efficiency, Cost, Optimization, Simulation and Environmental Impact of Energy Systems (ECOS2019), 23rd –28th of June **2019,** Wrocław, Poland; H. Pawlak-Kruczek et al.. *"Structural and energetic properties of hydrochars obtained from agricultural and municipal solid waste digestates"* **Oral presentation**
4. XXIV International Symposium on Combustion Processes (ISCP2019), 23rd – 25th of September **2019,** Wrocław, Poland; Urbanowska et al. *"Membrane separation as an innovative way of water separation from liquid by-products of wet torrefaction of agricultural digestate"* **Poster**
5. XXIV International Symposium on Combustion Processes (ISCP2019), 23rd – 25th of September **2019,** Wrocław, Poland; Bramer et al. *"Influence of the HTC treatment on fast pyrolysis of agricultural biomass"* **Poster**
6. 6th International Conference on Contemporary Problems of Thermal Engineering (CPOTE 2020), 21st – 24th of September **2020**, Poland (on-line); Aragon-Briceño et al. *"Influence of the wet torrefaction treatment on the organic fraction of municipal solid waste digestate"* **Oral presentation**
7. 6th International Conference on Contemporary Problems of Thermal Engineering (CPOTE 2020), 21st – 24th of September **2020**, Poland (on-line); Magdziarz et al. *"Multiphase analysis of hydrochars from anaerobic digestion of municipal solid waste organic fraction"* **Oral presentation**
8. 6th International Conference on Contemporary Problems of Thermal Engineering (CPOTE 2020), 21st – 24th of September **2020**, Poland (on-line); Urbanowska et al. *"Separation of water from liquid by-products of the agricultural digestate HTC"* **Oral presentation**

Any comments?

Water JPI

Sense and Purify (SPy)

Robert J. Forster, DCU, Ireland

Water JPI 2018 Joint Call

Mid-term evaluation meeting
19-20 April 2021 Online

CONSORTIUM DESCRIPTION

Prof. Robert Forster, **Wireless electrochemistry, Electrocatalysis, Sensing**

UNIVERSITÉ DE NANTES

Prof. Yann Pellegrin. **Electro- and photo-active materials.**

UNIVERSITY of the WESTERN CAPE

Prof. Emmanuel Iwuoha, **(bio)chemical sensing, bipolar electrochemistry**

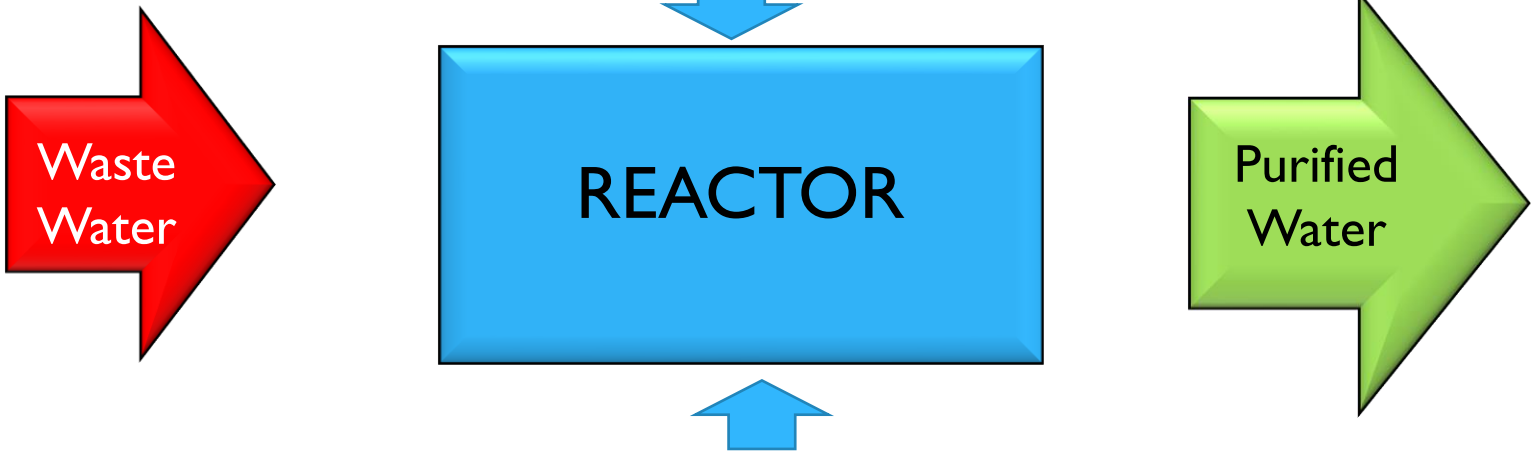
UNIVERSITAT ROVIRA I VIRGILI

PI: Prof. Ciara O'Sullivan, **Chemical, biological and pathogen sensing.**

OJECT OVERVIEW

WWT:
PHARMACEUTICALS
FOOD
MUNICIPAL

WP3 Integrated Reactor



- Specific organics
- Recalcitrant Organics
- Bacteria

WP2 BDD Particles for AOP

- Pure, sterile water
- Impurities mineralised to carbon dioxide, water, ammonia

WP1 Sensors

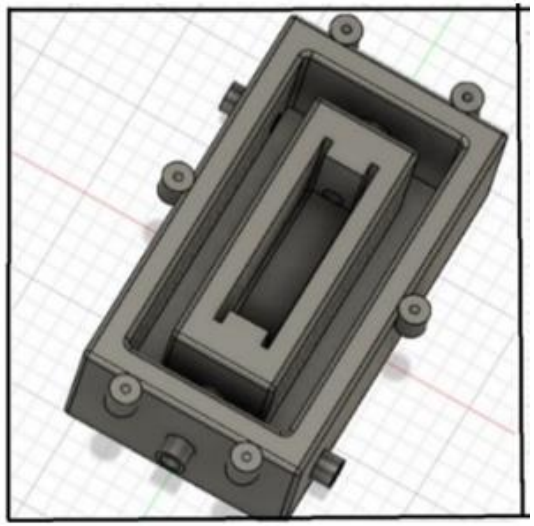
WP1 Sensors

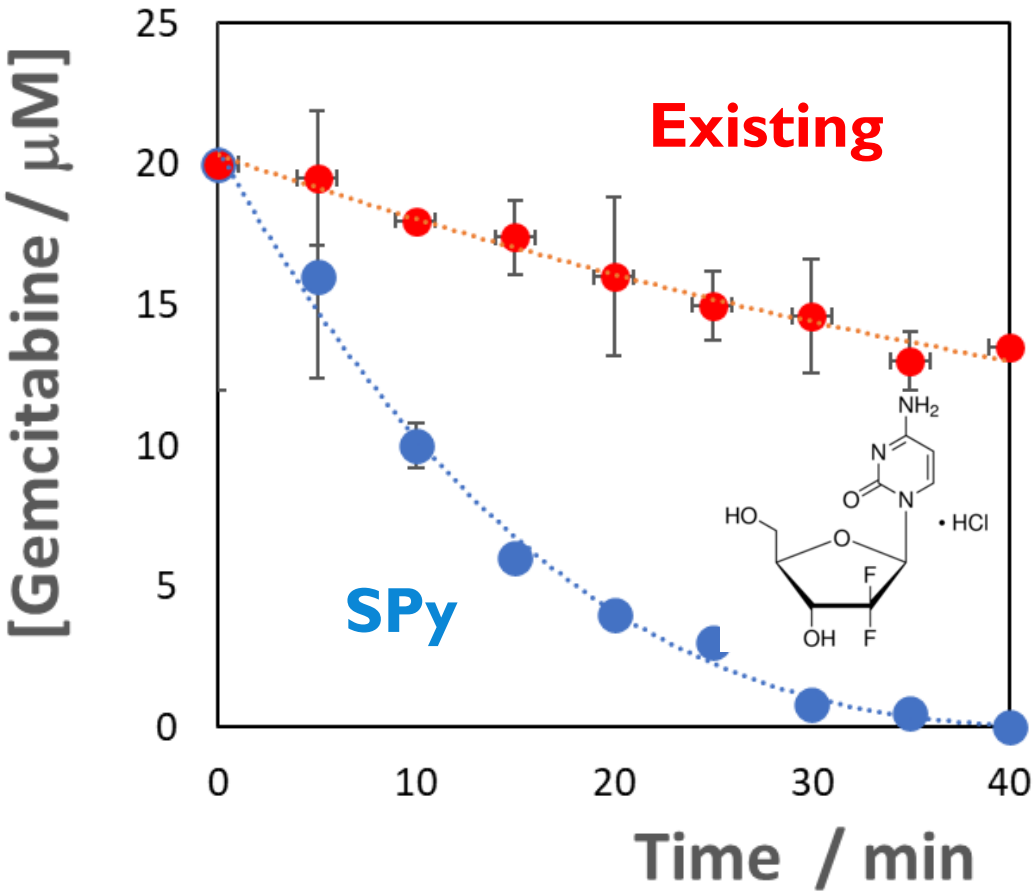
WP4 Real World Wastewater Testing

1. Scientific and Technological Results

Summary of Progress

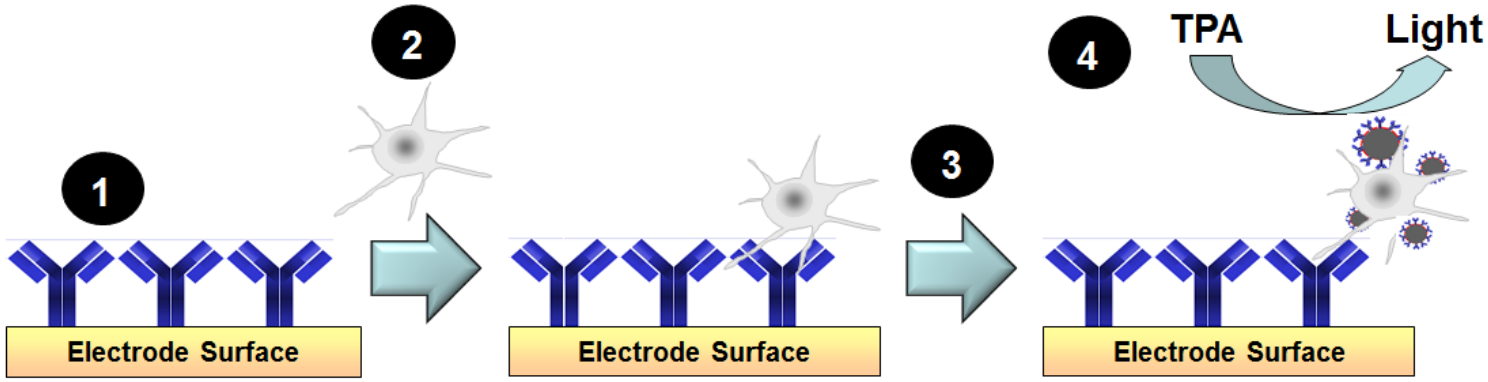
IPSEN
Innovation for patient care





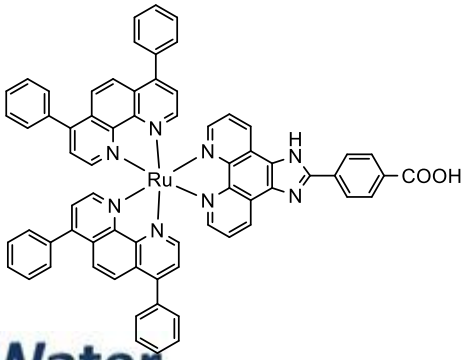
UN SDG Goal 6: Ensure access to water and sanitation for all.

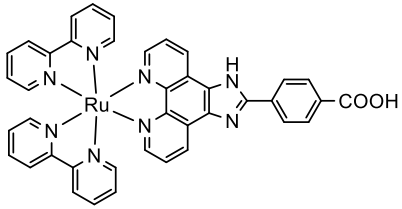
WP1: SENSORS FOR WASTE WATER

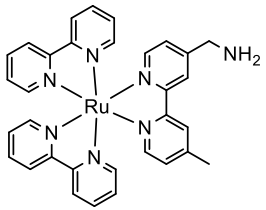


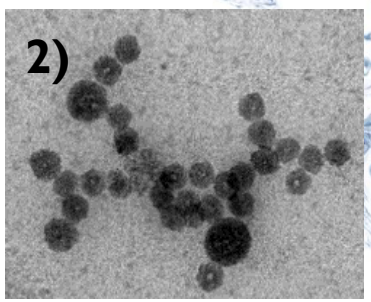
High Performance ECL Luminophores (NU)

1) Molecular complexes with high luminescence quantum yield



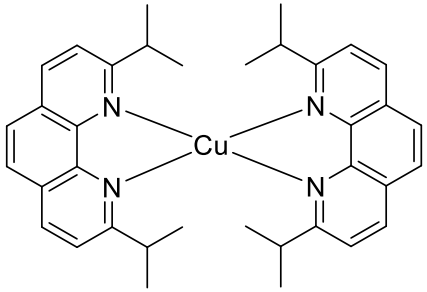


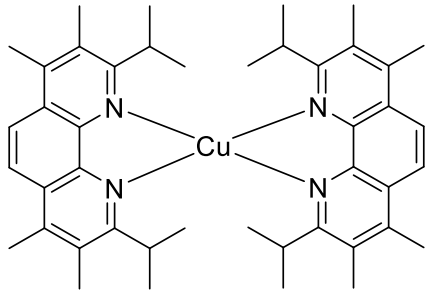


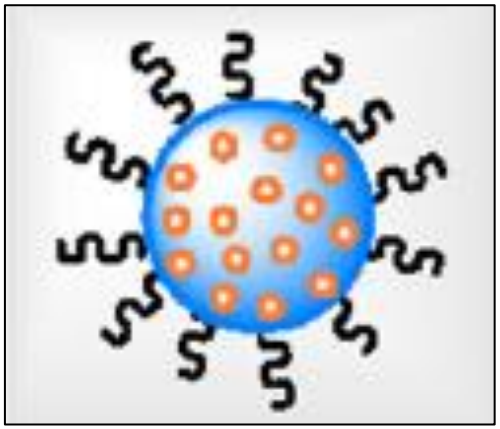


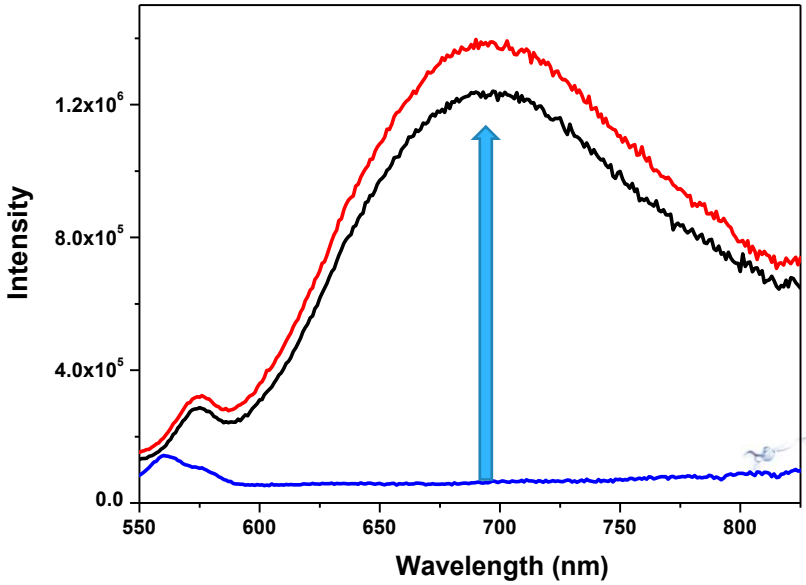
High Performance ECL Luminophores

3) Cu-based luminescent silica nanoparticles

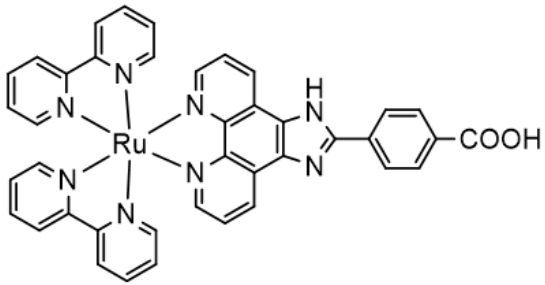


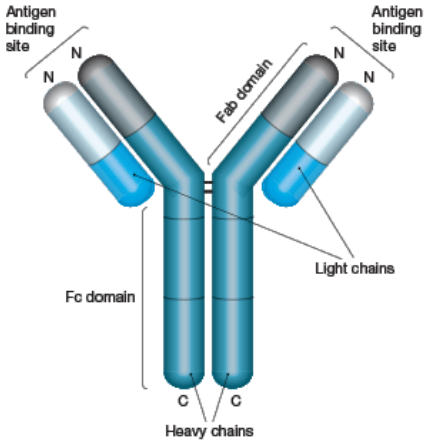


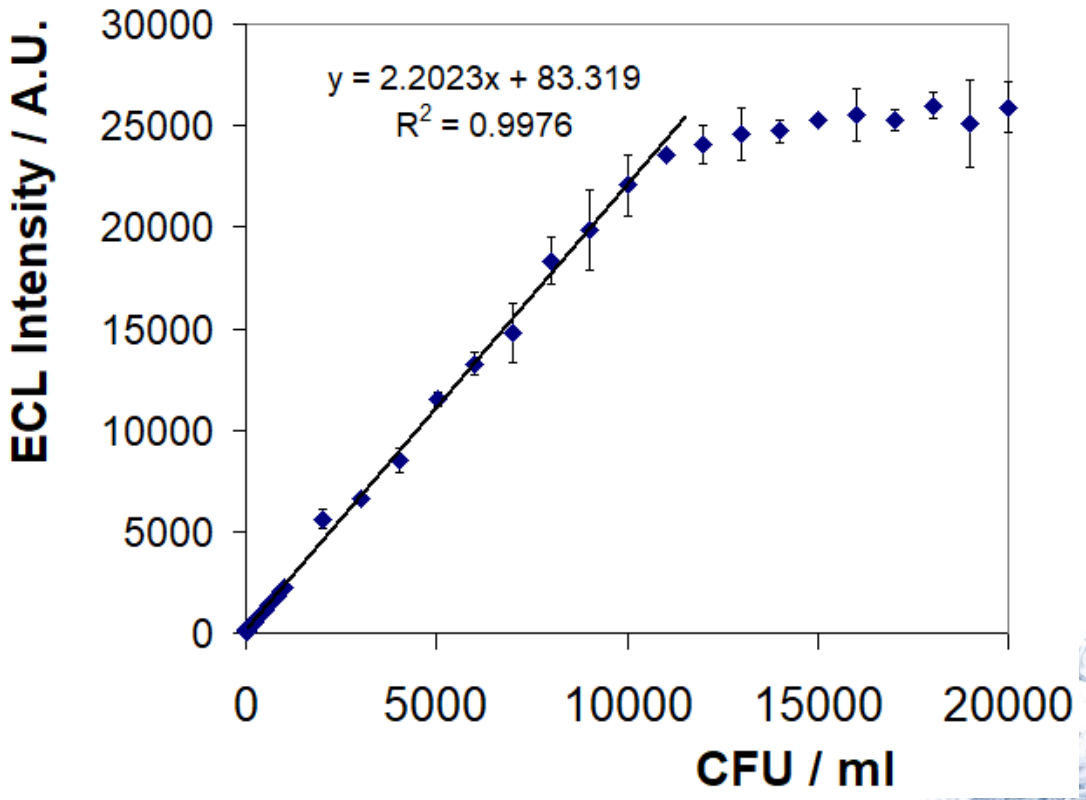




Highly Sensitive Detection of E. coli

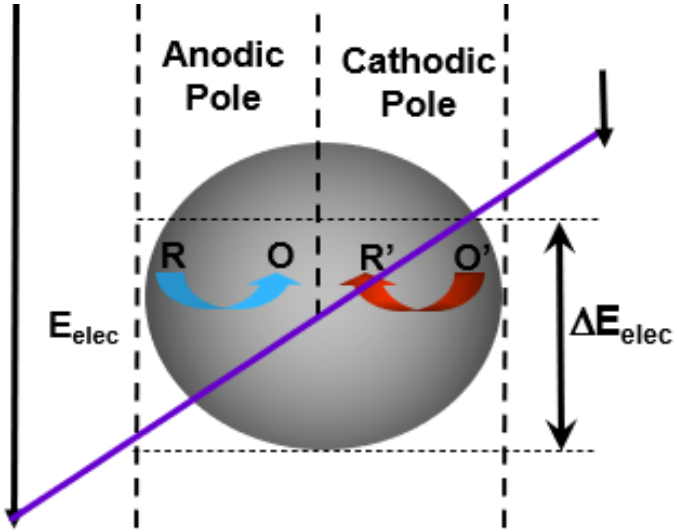


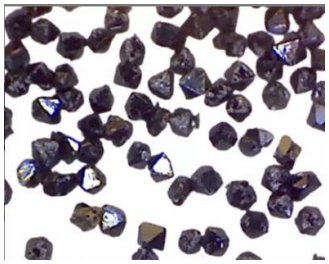


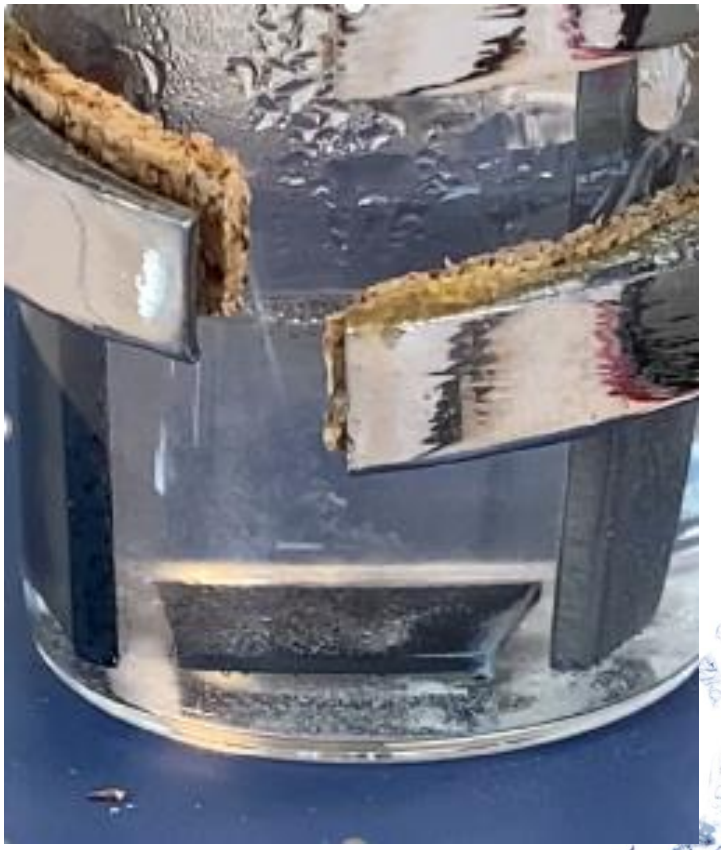


Dependence of the ECL intensity on the concentration of E. coli in a wastewater sample.

WP2: OPTIMISED PARTICLES FOR WASTEWATER TREATMENT

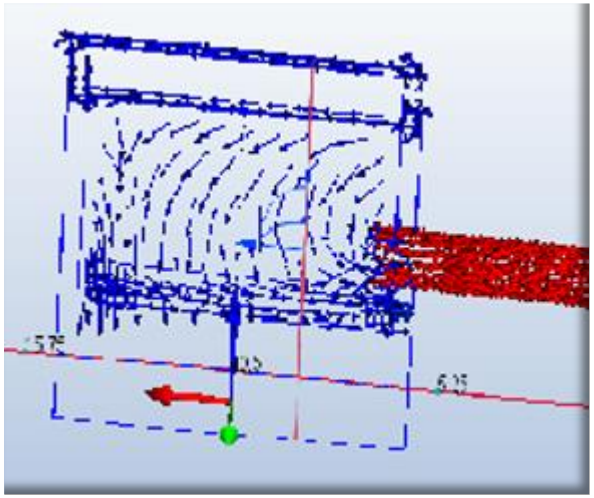


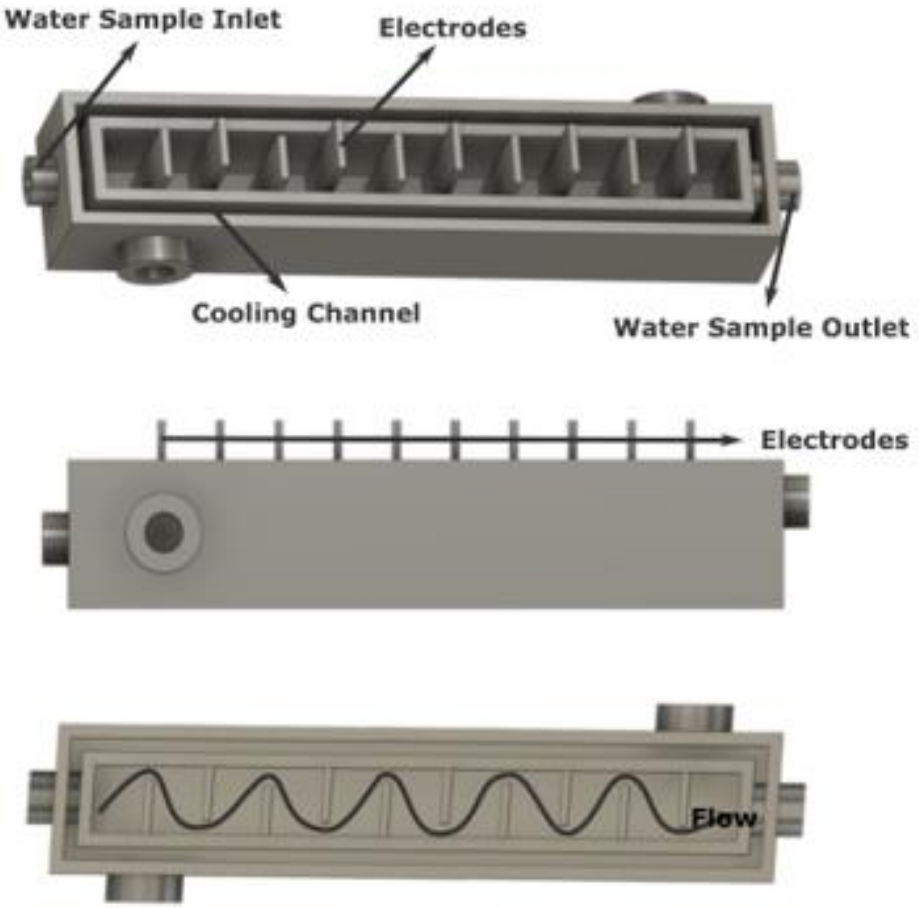




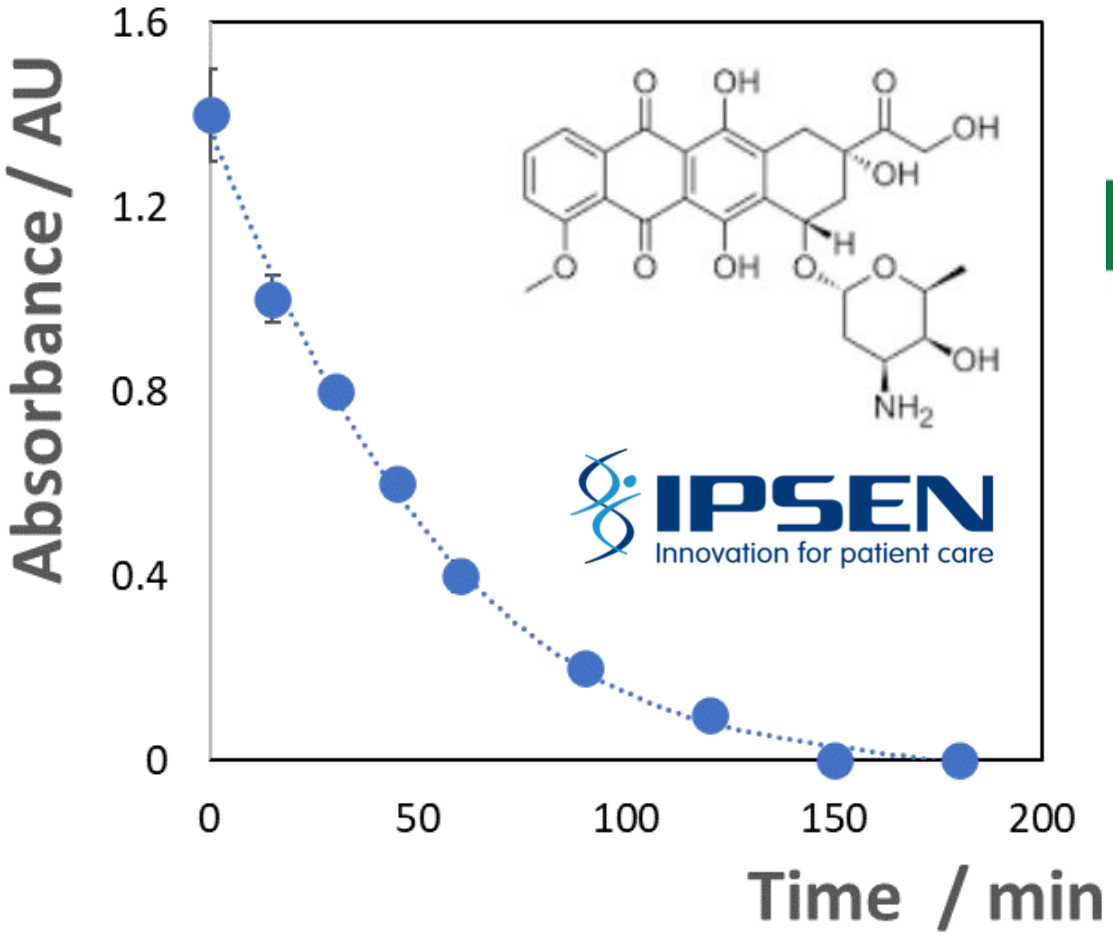
Boron Doped Diamond (BDD) Particles for hydroxyl radical generation.

WP3 INTEGRATED REACTOR





WP4 REAL WASTEWATER TREATMENT



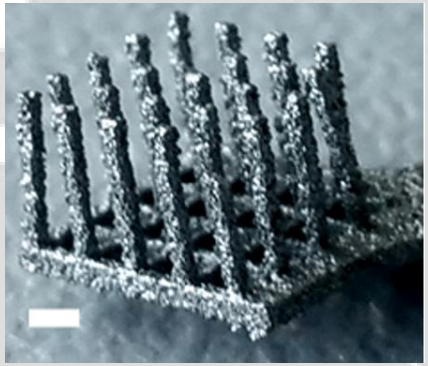
Fleury Michon

2. Collaboration, Coordination, Mobility, Synergies

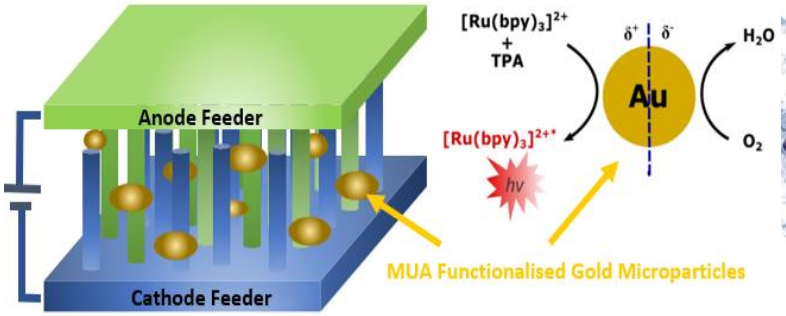
Collaboration

COMPLETED COLLABORATIVE PROJECTS

1. Electrochemiluminescence at 3D Printed Titanium Electrodes. **(DCU, UWC) Accepted in *Frontiers in Chemistry***.

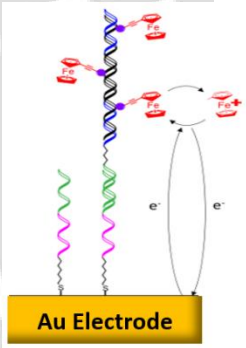


2. Wireless Electrochemiluminescence at Functionalised Gold Microparticles Using 3D Titanium Electrode Arrays. **(UWC, DCU, NU) Accepted in *Chemical Communications*.**



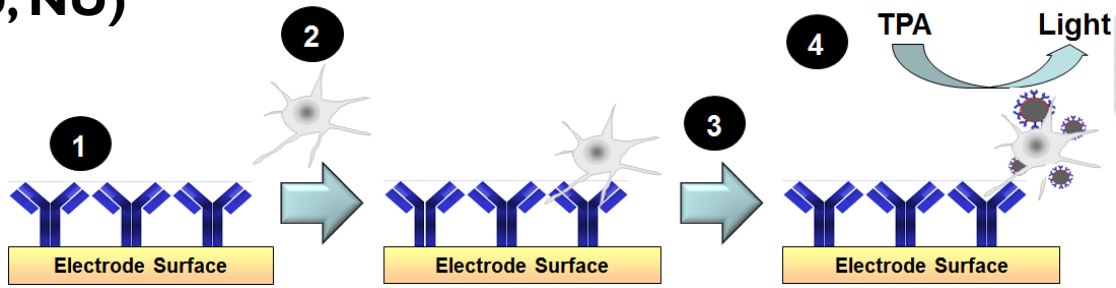
Collaboration

3. Ferrocene Containing DNA Monolayers: Influence of Electrostatics on the Electron Transfer Dynamics. **(URV, DCU) Published in Langmuir, 2021, 37, 11, 3359–3369.**



TO BE COMPLETED COLLABORATIVE PROJECTS

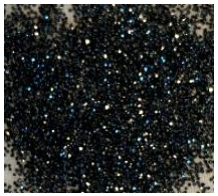
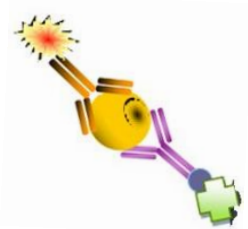
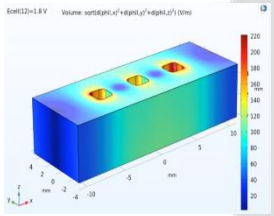
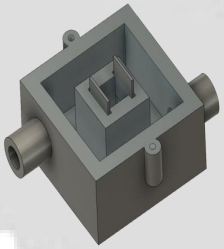
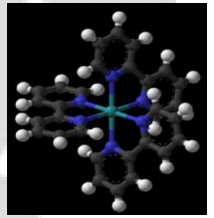
Highly sensitive pathogen assay using high brightness Ru-based nanoparticles **(URV, DCU, NU)**



Collaboration

EXPERTISE EXCHANGE

Optimisation of boron doped diamond : South Africa→ Ireland
Biosensor development : Spain → Ireland
Electric field modelling : Ireland → South Africa; Ireland → Spain
Reactor Design : Ireland → South Africa
ECL luminophore properties for assays : Ireland → France, Spain → France

MATERIALS EXCHANGE

ECL Luminophores : France → Ireland; France → Spain
3D Titanium Feeder Electrodes : Ireland → South Africa
Microfluidic Platforms: Spain → Ireland
Bioreceptors: Spain → Ireland
Biosensors: Spain → Ireland
Wastewater Samples : France → Ireland

Management Coordination

Management Committee Meetings: PI team meets regularly -in Dublin June 2019 and virtual since March 2020. The Coordinator prepared the **Consortium Agreement**, **Mid-Term Report**, oversees sequencing and scheduling of tasks, communicates the project's progress to team members and other stakeholders and liaises with the **Project Manger** and the Commission.

Virtual Company. DCU recruited a team of four MBA students to work with the two DCU researchers to carry out preliminary work on Business and Commercialisation plans. The other SPy researchers will join this process in 2021.

Workshop. We are canvassing industrial and academic interest in attending a workshop on wireless electrochemical methods and advanced oxidation processes for wastewater treatment.

Website: https://data-spy.com/

Social Media: Twitter **@PurifySense** - please follow us!

Mobility

PI Visits: Prof. Iwuoha visited DCU in May, 2019. Prof. O'Sullivan and Dr. Pellegrin visited DCU in June 2019.

Researchers: Dr. Bacem Zribi (DCU) worked for three weeks with Prof. Emmanuel Scorsone CEA, Gif Sur Yvette, France developing expertise on the uses of Raman spectroscopy to characterise BDD particles and a further 3 weeks on optimising the boron composition of the BDD particles with Dr. Michel Bouyssie, CEA SACLAY DF/SFT.

Ivan Magriñá Lobato, researcher (URV) spent 6 weeks in DCU training in ultrafast electrochemistry.

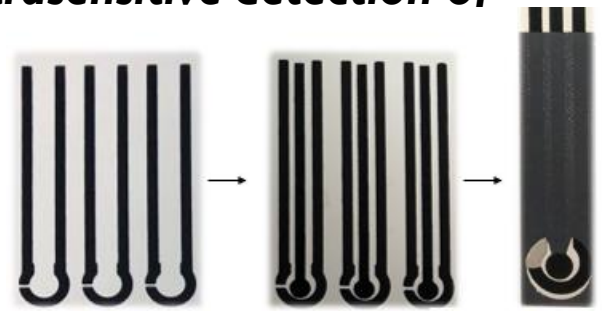
PI Exchanges Planned: Coordinator plans to spend 3 weeks in both Tarragona, Spain (Nov./Dec. 2021) and Nantes, France (Spring 2022). Dr. Pellegrin (NU) and Prof. O'Sullivan (URV) will visit DCU in autumn 2021. Prof. Iwuoha will visit URV and DCU in 2022.

Ms. Melinato (NU) will visit DCU in autumn 2021 to train on assay development.
Ms. Mokwebo (UWC) will visit DCU in spring 2022 to train on ECL and reactor design.

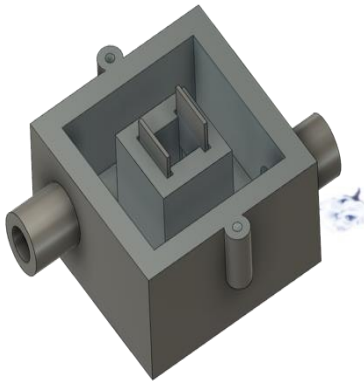
Synergies

Seamless collaboration covering electrode materials (DCU, UWC), bioreceptors (URV), labels (NU), 3D rapid prototyping and microfluidics (DCU, URV, UWC).

1. Sample to answer microfluidic devices for the ***ultrasensitive detection of pathogens***.



2. Novel advanced oxidation process for the ***destruction of micropollutants*** that resist breakdown using conventional approaches.



3. Stakeholder Engagement

Citizen Science

- Engagement and advice to **local groups** on managing greywater resources.

Science Week Ireland (DCU):

- 2019 "***Removing Pollutants in Water with Sustainable Electricity***"
- "***Destroying Micropollutants in Water : From SARS COV2 to your Personal Care Products!***"

- NU organised a "**Science Fair**" and participated in "**scientific popularisation conferences**".

- All partners: **Round Table Discussions** and **Post It Parades.**

Industry Advice

Advisory Committee

Oonagh Monaghan, Alpha Omega Consultants
Brian Coffey, Environmental Protection Agency
Greg Beechinor, Environmental Scientist,
Paul Butler, Enterprise Ireland, Commercialisation Specialist Engineering
Edmond O'Reilly, Wastewater Asset Planning at Irish Water
Declan Moran, Vice President, Ipsen

Meets every six months to review programme progress and advise on next steps to **maximise impact**.

4 Impact and Knowledge Output

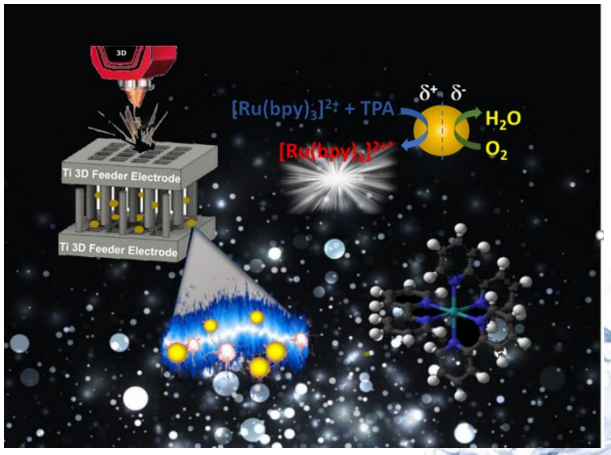
Publications

1. Ferrocene Containing DNA Monolayers: Influence of Electrostatics on the Electron Transfer Dynamics. **(URV, DCU) Published in Langmuir, 2021, 37, 11, 3359–3369.**

2. A radical and portable solution to purify water, **(NU, DCU) The conversation,** https://theconversation.com/une-solution-radicale-et-portative-pour-purifier-leau-145120)

3. Electrochemiluminescence at 3D Printed Titanium Electrodes. **(DCU, UWC) Accepted in *Frontiers in Chemistry***.

4. Wireless Electrochemiluminescence at Functionalised Gold Microparticles Using 3D Titanium Electrode Arrays. **(UWC, DCU, NU) Accepted in *Chemical Communications*.** Under consideration as Front Cover.



5. Sensing and Degradation of Organics Using Hydroxyl Radicals Electrogenerated at Boron Doped Diamond Electrodes, **(DCU) submitted to Electrochimica Acta.**

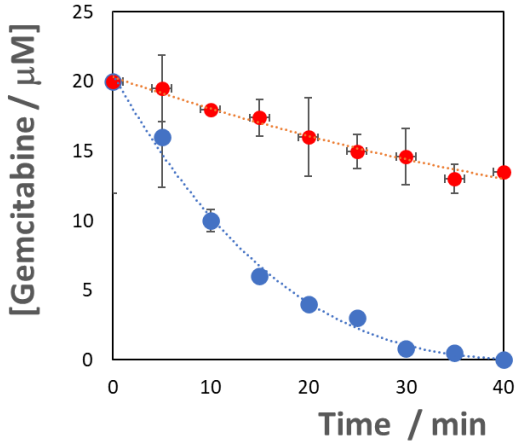
Training

1. Four researchers, who have been employed on the Sense and Purify Project, have received **interdisciplinary training** in i) **Electrochemical sensor** development, ii) synthesis of high brightness **ECL luminophores**, iv) **wireless electrochemistry**, v) **electric field modelling**, vi) **WWT treatment** using wireless AOP and vii) **reactor design** and rapid prototyping.

2. An additional **12 PhD candidates**, funded from other sources, and 10 UG students have received training in aspects of these areas.

Industry Impact

DCU: Collaborations with Ipsen and Mylan to treat pharmaceutical production process water.



NU: Fleury Michon (food industry): processing of used cooking water samples.

Societal Impact

Water Syndicate : NU working with Atlantic'eau, Nantes, France, supporting the provision of cost effective, quality water to 600,000 inhabitants. Provision of effluents from Nantes city local areas for wireless WWT.

Schools: DCU has made 6 visits to schools in the greater Dublin area to rasie awareness of water conservation and treatment as well as promoting careers in science.

General Public: Communication to the general public through animations in science fair events, e.g., "village des sciences de Nantes", Oct. 2019 and Oct. 2020.

5. Continuation of the Work in the Future

Work Packages

DCU salary support now exhausted. Other resources will focus on the reactor and **testing the technology using real wastewater samples**.

NU Full characterisation of the **first silica nanoparticles doped with copper(I)** complexes. First implementation of **ECL with copper based luminescent nano-objects**.

UWC Assay development for bacterial and molecular targets. Electrochemistry using **BDD Electrodes**.

URV Not funded by JPI. Continued provision of **bioreceptors** and input on **sensor design and fabrication**.

Follow-On Funding Applications:

i) **DCU** Enterprise Ireland Feasibility Application submitted for support of a Business Consultant.

ii) **NU** EIC Pathfinder being developed with DCU.

Any comments?

Water JPI

Simulating tourism water consumption with Stakeholders (SIMTWIST)

Bas Amelung

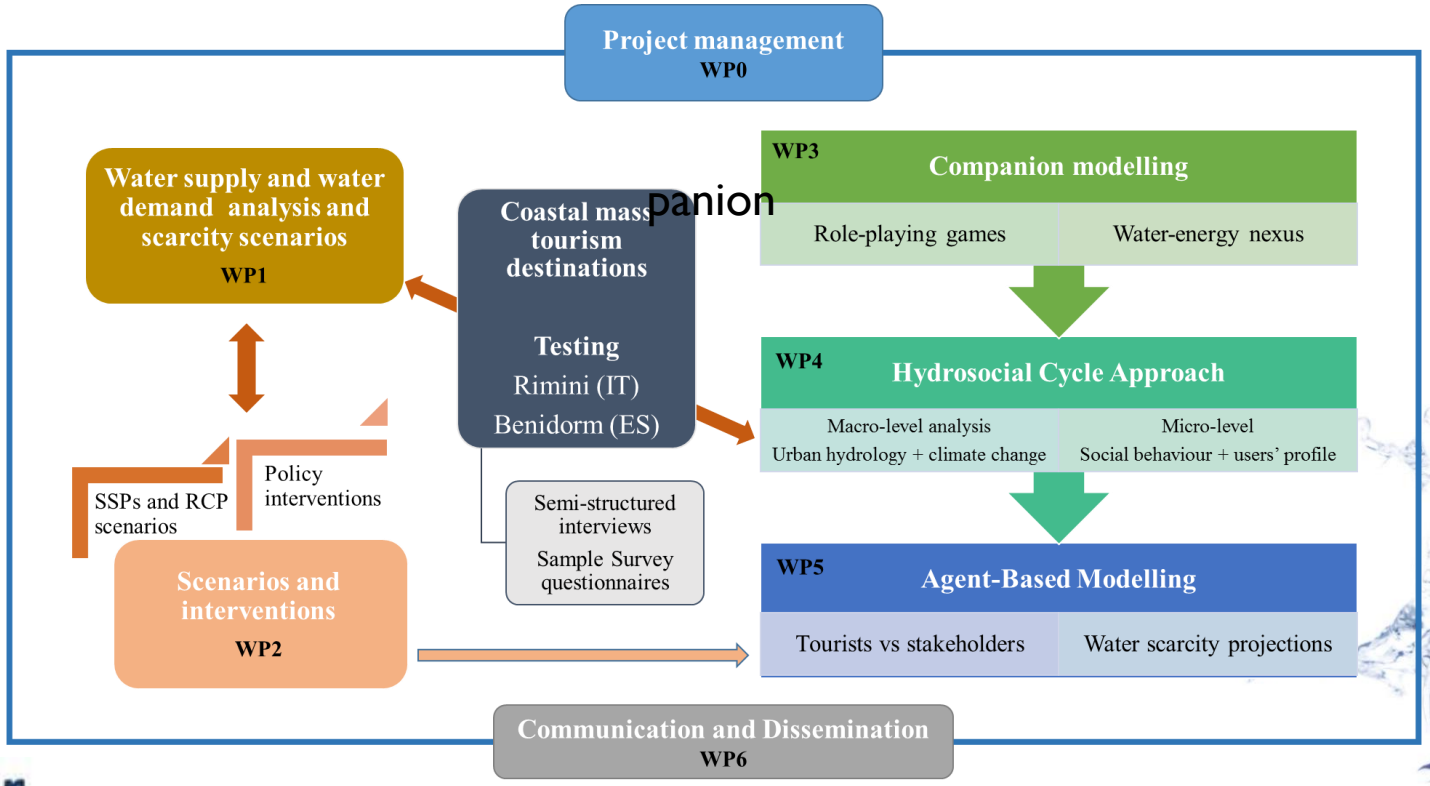
Water JPI 2018 Joint Call

Mid-term evaluation meeting
19-20 April 2021 Online

SIMTWIST: overview

General objective:

To improve the understanding of the tourism water footprint and to help reduce tourism stakeholders' water consumption by informing public and private decision-makers about the effectiveness of different types of interventions.

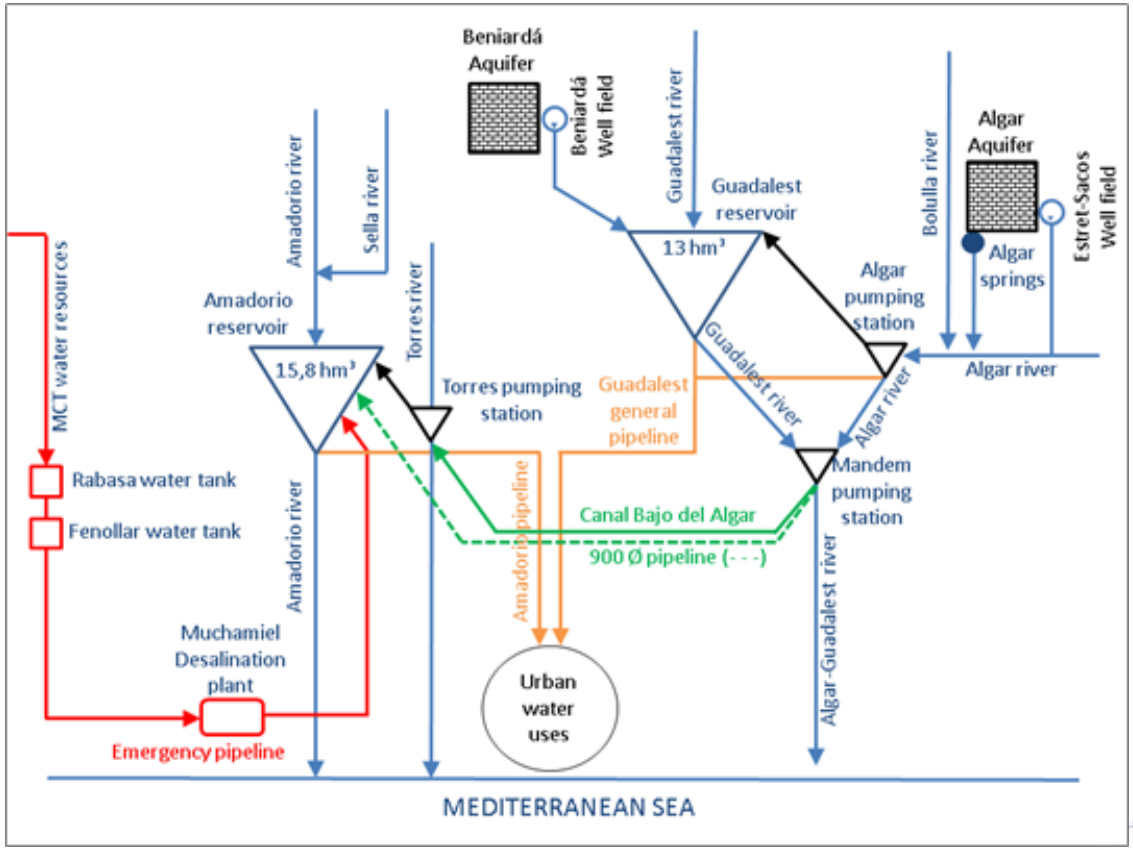


SIMTWIST: Consortium

- Wageningen University, Netherlands (Maria Reyes, PI: Bas Amelung)
  - Project leader
  - Participatory modelling
  - Agent-based modelling
- University of Alicante, Spain (Rubén Villar, Sandra Ricart, María Hernández, PI: Antonio Rico)
  - Coordination of the Benidorm case study
  - Hydrosocial cycle analysis
- University of Bologna (Mattia Neri, Cristiana Bragalli, PI: Elena Toth)
  - Coordination of the Rimini case study
  - Hydrological analysis

Scientific and technological results

1. Description of the water supply systems of Benidorm and Rimini

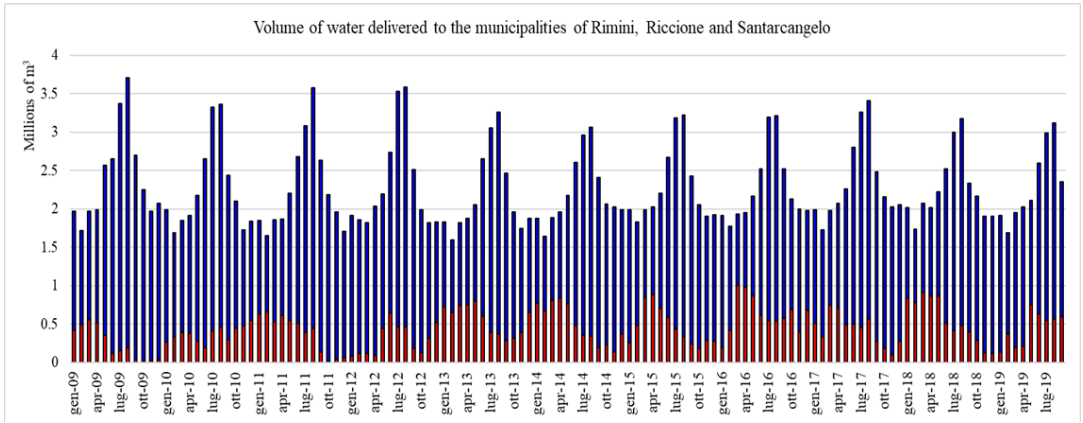


Scheme of Marina Baja Water Consortium's water supply system

Scientific and technological results

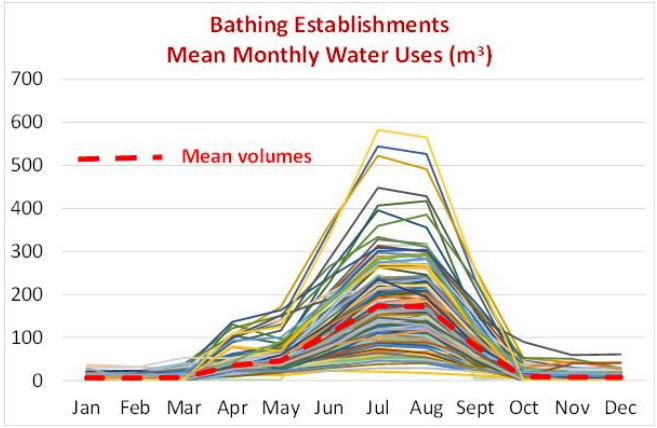
2. Collection, validation and analysis of the water supply and demand data

Monthly inflows to the distribution network by supply source



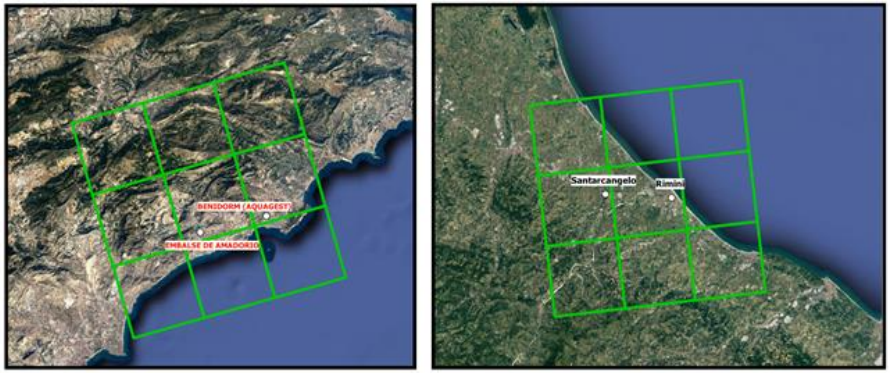
Inflows to the distribution network from surface and groundwater sources (Rimini)

Mean monthly water demand in the bathing establishments (Rimini)

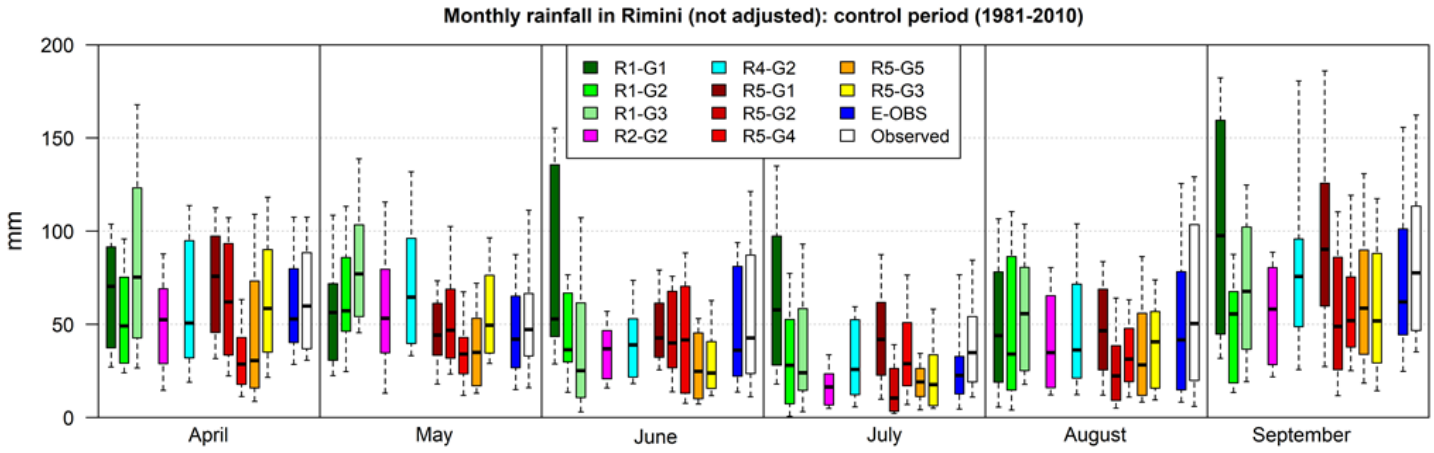


Scientific and technological results

3. Analysis and validation of existing climate scenarios in the case study areas



Re-oriented local domain for E-OBS and CORDEX grids
(left: Benidorm, right: Rimini)



Monthly rainfall in Rimini: climate models output vs observations over the control period

Scientific and technological results

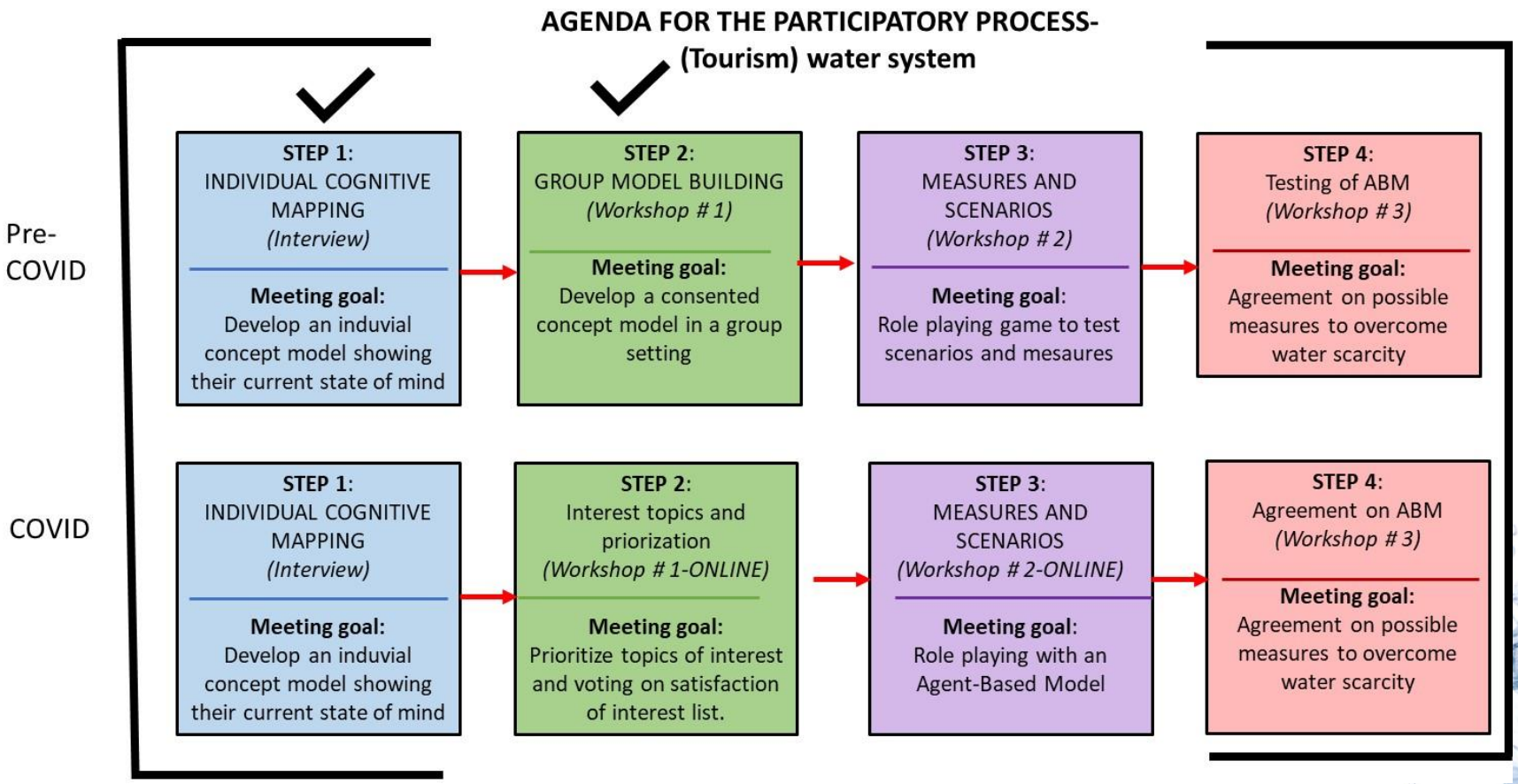
4. Identification and description of intervention options

Example of interventions (Benidorm):

Measure's type and scale	Intervention option
Technical (hotel)	Installation of water-saving devices; water-efficient irrigation systems and/or irrigation programmers
	Installation of desalting plants to treat brackish water from private wells; rainwater harvesting systems
	Use closed system for water treatment in swimming pools; Use salt water
Management (hotel)	Promote environmental awareness on water consumption; Employee/Staff involvement in water efficiency protocols; Voluntary environmental management systems (ISO, EMAS); irrigation schedules
Management (Public administration/ Water utility)	Water-saving awareness-campaigns (Guest-centered strategies); Drought management plans and mandatory measures; Requirement to use non-conventional water resources for green areas of more than 1,000 m²
Management (Tourist sector/Public administration/Farmers)	Agreements between tourist sector and farmers to exchange treated wastewater for freshwater; institutional cooperative mechanism between stakeholders with common objectives
Economic (public administration/Water utility)	Design of new water tariffs structures to reduce water consumption; Eco tax to be charged for all tourists and visitors

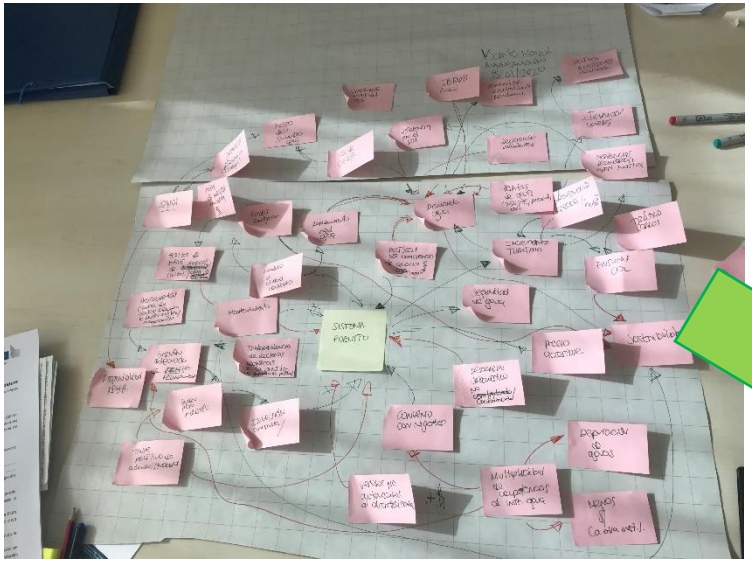
Scientific and technological results

5. Participatory modelling: process

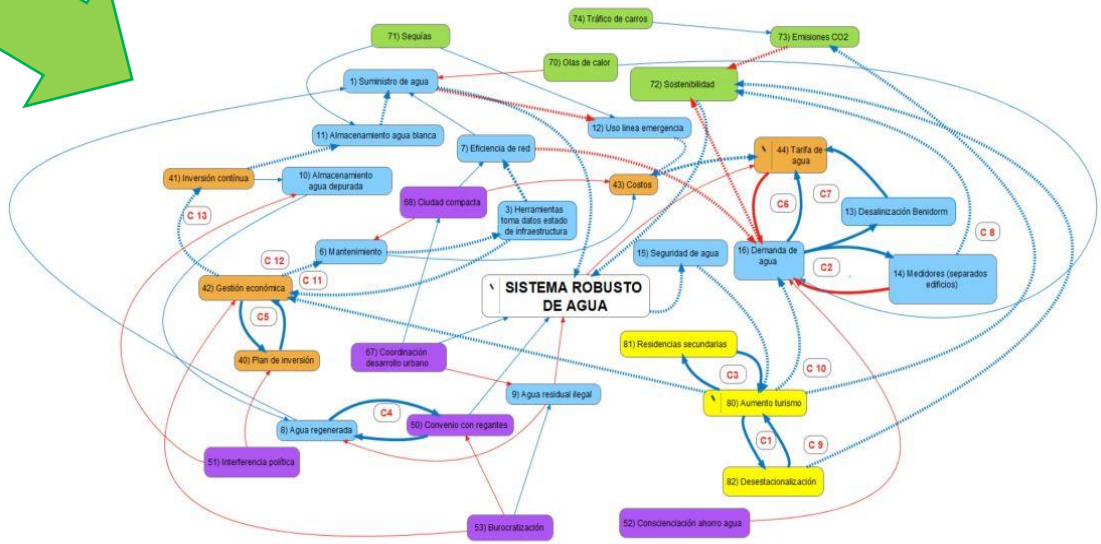


Scientific and technological results

5. Participatory modelling: analysis



- A concept map was developed during the interview
- The map was cleaned up and further analysis of data was done



Scientific and technological results

5. Participatory modelling: topics of interest

- During the 2st workshop, a list of topics of interests was presented, based on the frequency and the number of stakeholders that named it
- Stakeholders had to prioritize this list, from more to less important.

BENIDORM

Temas de interés
1) Calidad del agua regenerada
2) Caudales ecológicos
3) Control de vertidos de agua residual
4) Tecnologías para uso eficiente y ahorro de agua
5) Concienciación de ahorro de agua
6) Cambio climático

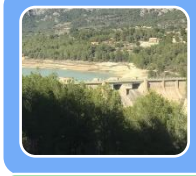
RIMINI

Temi di interesse
a. Pianificazione preventiva
b. Investimenti e tariffe
c. Continuità collaborazione stakeholder
d. Premio / Label ambientale per operatori turistici
e. Cambiamento climatico
b. Investimenti e tariffe

Prioritized topics after workshop

Scientific and technological results

6. Hydrosocial Cycle analysis: data collection



Water supply stakeholders

- Benidorm city council(BEN)
- Júcar River Basin Authority (JUCAR)
- Marina Baja Water Consortium (CAMB)
- Sanitation and Wastewater Regional Public Entity (EPSAR)
- Hidraqua (Benidorm water utility) (HIDRA)

Irrigators

- Irrigation Community and users of Callosa d'en Sarrià (CALLOSA)
- Irrigation Community of Canal Bajo del Algar (ALGAR)
- Irrigation Community of La Vila Joiosa(LAVILA)

Tourism sector

- HOSBEC (Benidorm and regional hotel association) (HOSBEC)
- Tourism planning regional department (GENTOU)
- Urban planning regional department (GENURB)

Data collection:

Face-to-face **semi-structured interviews** (January 2020) and **recurring virtual meetings** → Iterative process

Hydrosocial Cycle analysis questionnaire: 11 questions to identify 3 key aspects (relevance, representativeness and collaboration) to uncover power relations (collaboration):

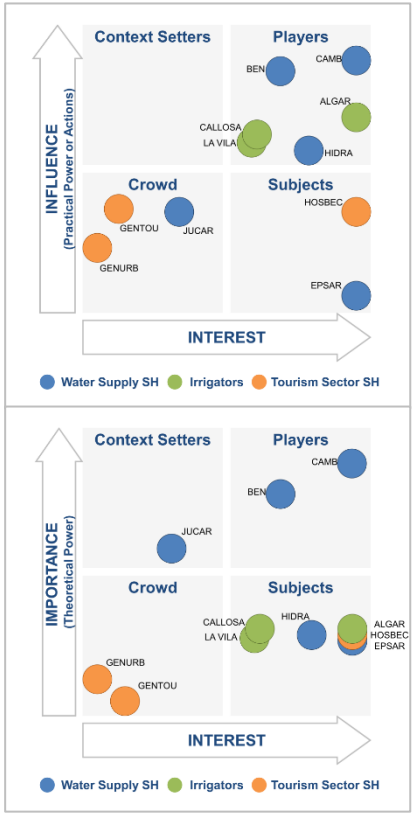
Data analysis:

- **Relevance**: Interest-Power matrices and stakeholder categorization
- **Representativeness**: **Descriptive analysis** of Likert responses and stakeholder perceptions (what do they understand by "feeling represented and which factors explain underrepresentation).
- **Recognition:** Identification of bilateral responses about importance or theoretical power and influence or practical power).
- **Collaboration**: Identification of bilateral responses about current or potential agreements and factors which benefit/difficult them.

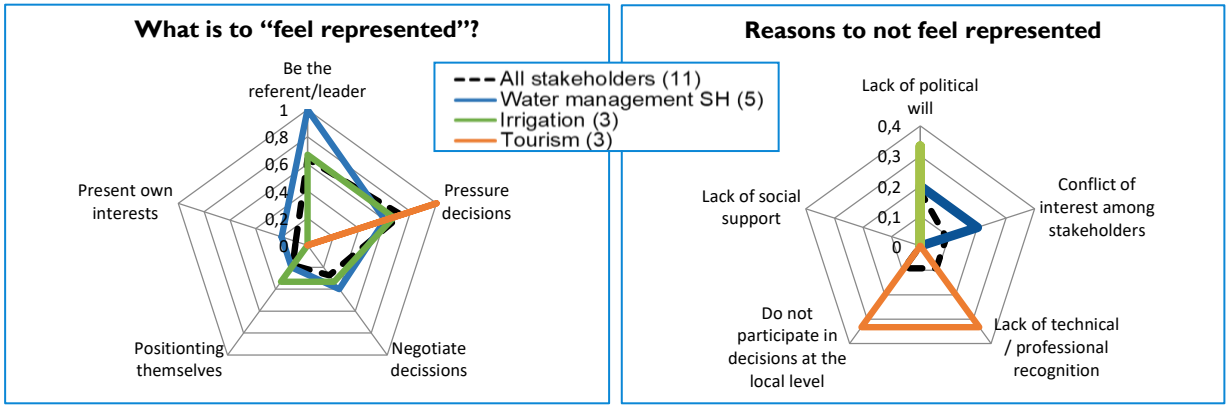
Scientific and technological results

6. Hydrosocial Cycle analysis: preliminary results

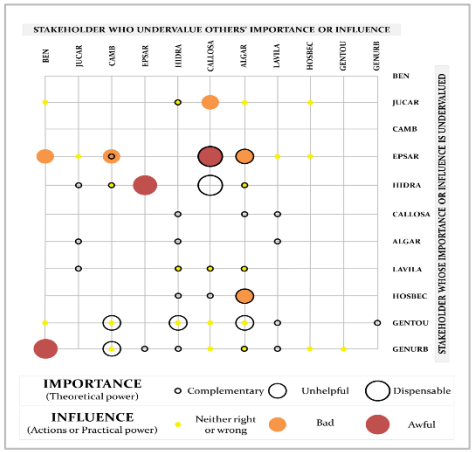
Relevance



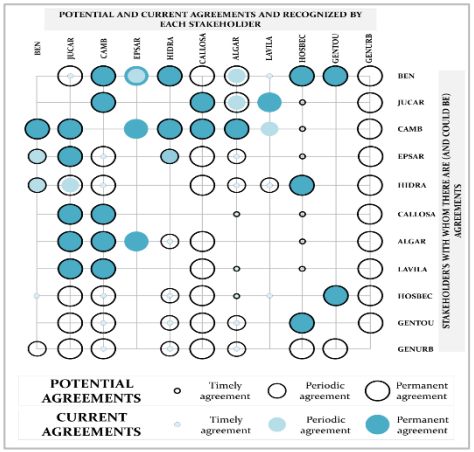
Representativeness



Recognition



Collaboration



Scientific and technological results

7. Tourist surveys

Goals:

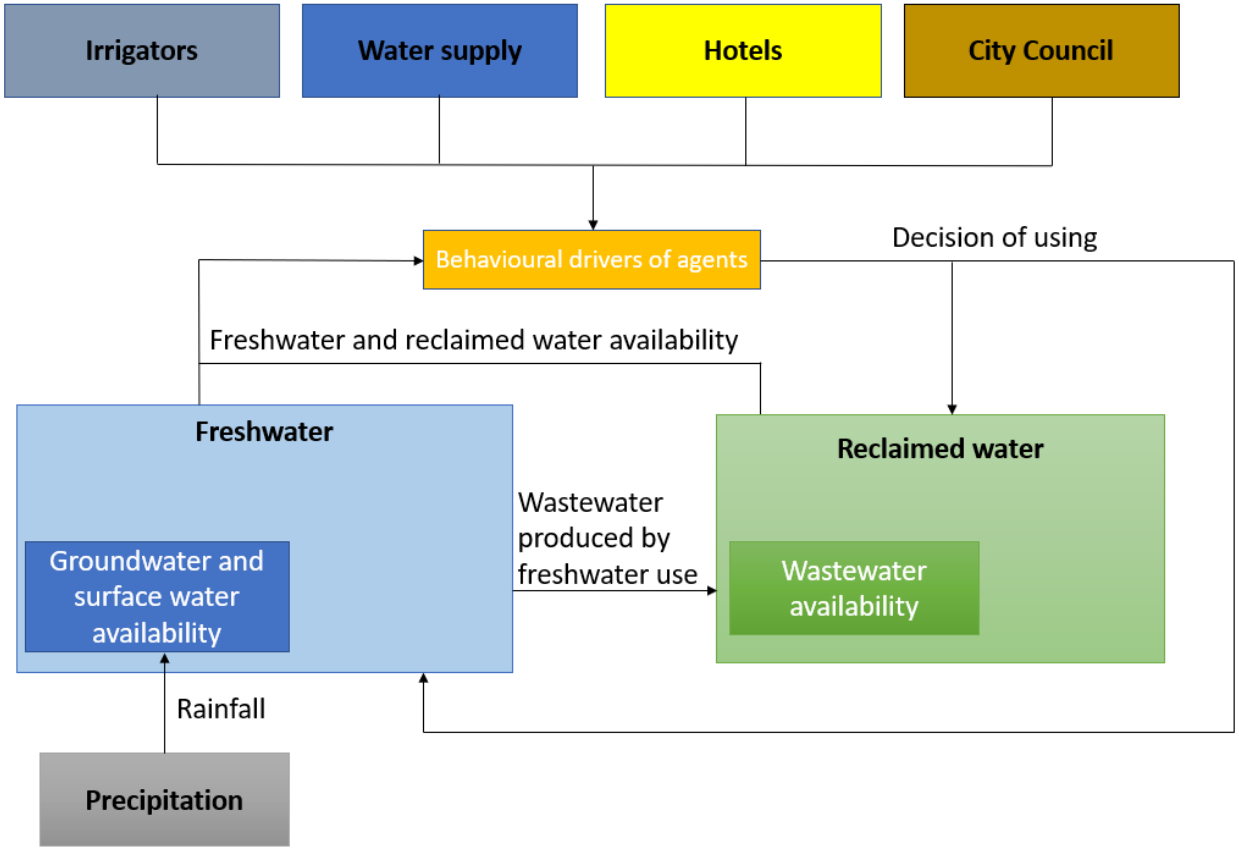
- Identify **tourist profiles** based on **water consumption behaviour** in hotels and **environmental awareness**.
- Evaluate the **tourist's perception** of possible **intervention measures** for saving water.
- Check the **changes** that **Covid-19** has produced in the **habits of tourists** (in water consumption, choice of tourist destination, and hotel stay).

Approach:

- Survey developed
- **Face-to-face surveys** in hotels previously contacted (2021 summer and 2022, if necessary)
- **Main hotel typologies** (3 and 4-star hotels).
- Guarantee the **representativeness** of the **sample** of tourists (age, nationality and gender based on 2019 data).

Scientific and technological results

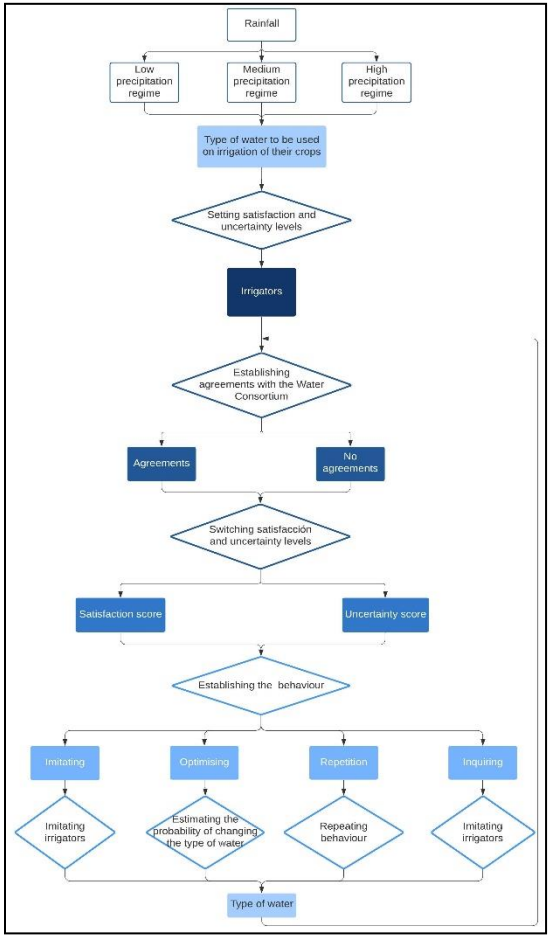
8. ABM development



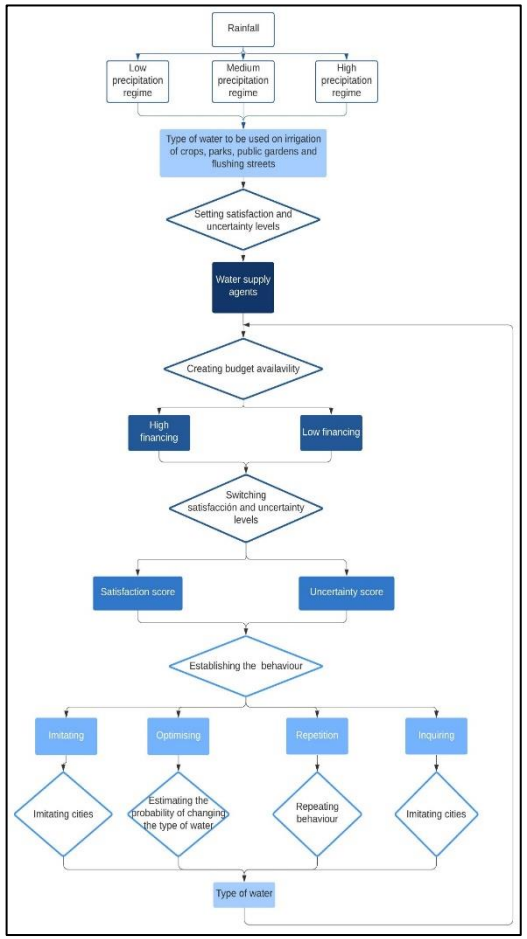
Preliminary conceptual map of the entities and relationships in the ABM.

Scientific and technological results

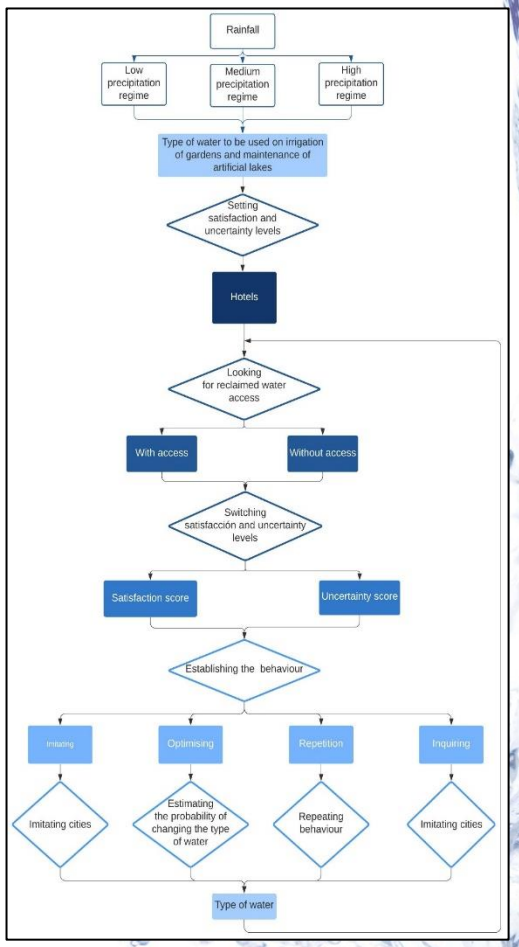
8. ABM development



Decision tree of irrigators SH to use reclaimed or freshwater.



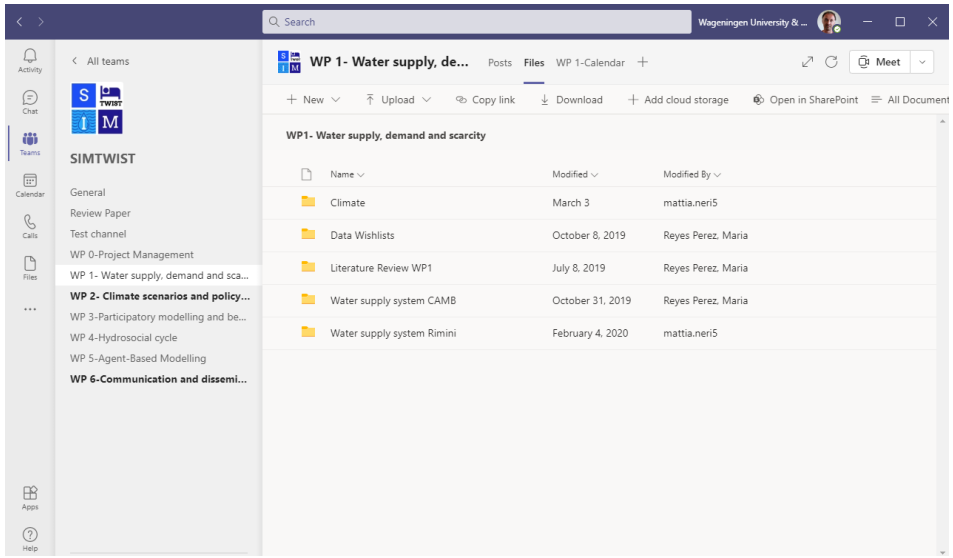
Decision tree of water supply SH to use reclaimed or freshwater.



Decision tree of hotels to use reclaimed or freshwater.

Collaboration, coordination, mobility, synergies

- Funding issues for the Spanish and Italian partners
- Close collaboration between partners: main investigators and also team of post-docs
- Kick-off in Wageningen in June 2019
- Monthly online meetings
- Annual meeting in June 2020 (online)
- MSc and BSc supervision



Collaboration, coordination, mobility, synergies (2)

- Mobility events:
  - Maria Reyes (WUR): visit to James Hutton Institute at the end of 2019
  - Bas Amelung WUR): visit to University of Alicante in November of 2019
  - Maria Reyes (WUR): visit to University of Alicante for fieldwork in January/February of 2020
  - Sandra Ricart UA): invited visit to Wageningen University to work on the project and contribute to a MOOC

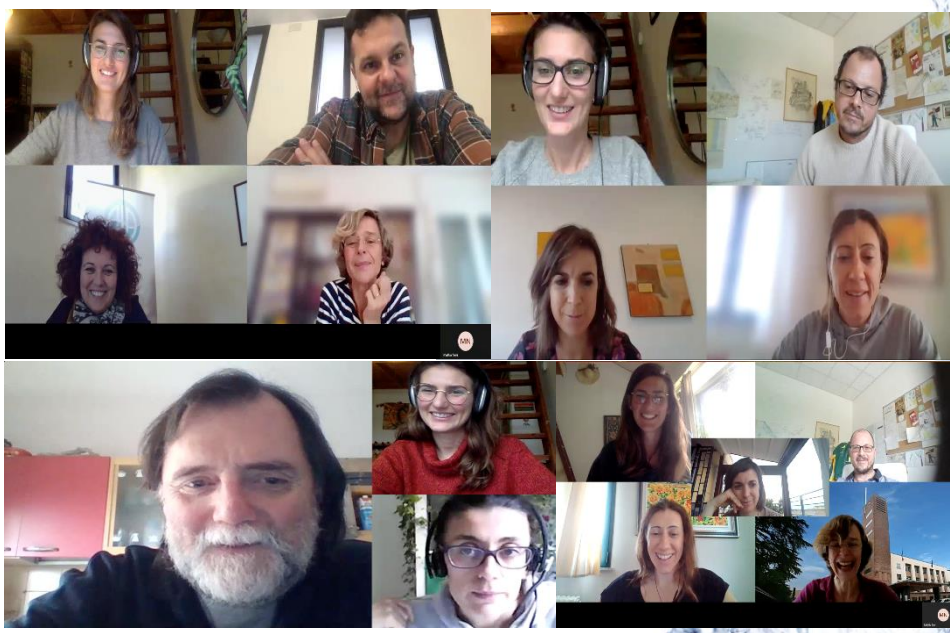
Sandra Ricart

Maria Reyes

Stakeholder engagement

- Interviews with stakeholders
  - Benidorm: water sector, tourism sector, irrigators (11 interviews)
  - Rimini: water sector, tourism sector (7 interviews)
- Output: draft individual concept maps for each stakeholder

In-person interviews with Benidorm stakeholders

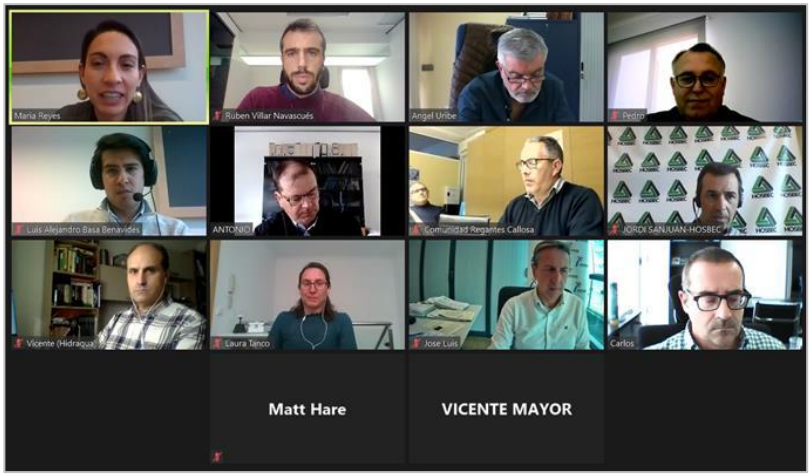


Online interviews with Rimini stakeholders

Stakeholder engagement (2)

- Individual concept maps refined in iterative process
- Workshop to compare and discuss the individual concept maps and identify the main topics of interest

- Stakeholder engagement and in particular workshops is greatly appreciated by stakeholders: good platform to discuss important issues



Benidorm's workshop (November 24th, 2020)

Rimini's workshop (April12th, 2021)

Impact and knowledge output: publications

Publications

- Ricart S., Villar R., Rico-Amorós A.M. (2021). Water exchange and wastewater reuse to achieve SDG 6: How to reduce water scarcity and water pollution? Learnings from Benidorm (Spain). In Cissé G. (Ed.): Transitioning to clean water and sanitation. MDPI Books: Switzerland.
- Ricart S., Villar-Navascués R., Hernández-Hernández M., Rico-Amorós A.M., Olcina-Cantos J., Moltó-Mantero E. (2021). Extending natural limits to address water scarcity? The role of non-conventional water fluxes in climate change adaptation capacity: A review. *Sustainability* 13(5): 2473.
- Ricart S., Arahuetes A., Villar R., Rico, A.M., Berenguer J. (2020). More water exchange, less water scarcity? Driving factors from conventional and reclaimed water swap between agricultural and urban–tourism activities in Alicante, Spain. *Urban Water Journal* 16(10): 677-686.
- Ricart S. (2020). Water governance and social learning: Approaches, tools, and challenges. In: Leal Filho W., Azul A.M., Brandli L., Lange Salvia A., Wall T. (Eds.): *Clean Water and Sanitation. Encyclopedia of the UN Sustainable Development Goals*. Springer: Cham.
- Villar R., Arahuetes A. (2020). The hydrosocial cycle: Understanding water as a socionatural production. In: Leal Filho W., Azul A.M., Brandli L., Lange Salvia A., Wall T. (Eds.): *Clean Water and Sanitation. Encyclopedia of the UN Sustainable Development Goals*. Springer: Cham.
- Sattler, C., Rommel, J., Chen, C., Llorente M., Briceño I., Prager K., Reyes, M., Schröter B., Schulze C., van Bussel, L., Lasse, L., Matzdorf, B., Kelemen, E. (2021). Participatory Research in times of COVID-19 and Beyond: Adjusting your Methodological Tool Kits. Accepted in One Earth Journal.

Conferences papers

- Toth E., Bragalli C., Neri M. (2020). Urban water demand in a mass-tourism destination: analysis of touristic water uses in Rimini (Italy). In American Geophysical Union Fall Meeting (AGU2020), Dec 1-17th, online, San Francisco, USA. https://agu.confex.com/agu/fm20/webprogram/Paper758665.html
- Toth E., Bragalli C., Neri M. (2021). Characterization of hotels and bathing establishments water uses for understanding urban demand in touristic cities. In European Geosciences Union General Assembly (vEGU2021). April 19-30th, online, Vienna, Austria. https://meetingorganizer.copernicus.org/EGU21/EGU21-13470.html
- Villar-Navascués R., Ricart S., Rico-Amorós A., Hernández-Hernández M. (2021). Adapting hydrosocial framework to Mediterranean coastal tourism environments: How to achieve water governance from stakeholders' perceptions and power relationships? In American Association of Geographers Annual meeting (AAG 2021). April 7-11th, online, Seattle, United States. American Association of Geographers.

Continuation of the work in the future

- Smart meter campaign among accommodations in Rimini and Benidorm
- This summer: tourist survey in hotels with smart meters
- Development of ABM based on ODD (Overview, Design, Details)
- Scenario analysis of future water availability (based on climate scenarios) and water demand (based on socio-economic and tourism scenarios)

Publications in progress

- Villar-Navascués R., Ricart S., Reyes M., Rico-Amorós A.M., Hernández-Hernández M., Amelung B., Toth E., Neri M, Bragalli C. (2021). Nudging tourism-water research in the right direction: a review of approaches and methods. Current Issues in Tourism

Upcoming conferences

- Villar-Navascués R., Ricart S., Rico-Amorós A., Hernández-Hernández M. (2021). Is scientific research on water-tourism nexus responding to the challenges identified by stakeholders and policy-makers? The case of Benidorm, Spain. In European Geosciences Union General Assembly (EGU 2021). April 19-30th, online. European Geosciences Union.
- Ricart S., Rico-Amorós A.M., Villar-Navascués R. (2021). Facing agricultural water scarcity through water reuse: Driving factors in Southern Spain. In *Pathways to extend sustainable water reuse practices in Europe*. May 18-19th, online. SUWANU EUROPE project

Any comments?

Group discussion

Coffee / Snack break

Projects presentations on Topic 1- Enabling Sustainable Management of Water Resources
(15 min presentation+5 min for questions and answers)

FG members: Budds, Becker, Covaliova*, Schirmer*, Vehanen
*absent

Managed Aquifer Recharge: Addressing the Risks of Recharging Regenerated Water (MARadentro)

Coordinator: M. Silvia Diaz-Cruz (IDAEA-CSIC, Spain)

Water JPI 2018 Joint Call
Mid-term evaluation meeting
19-20 April 2021 Online

Water Works 2017

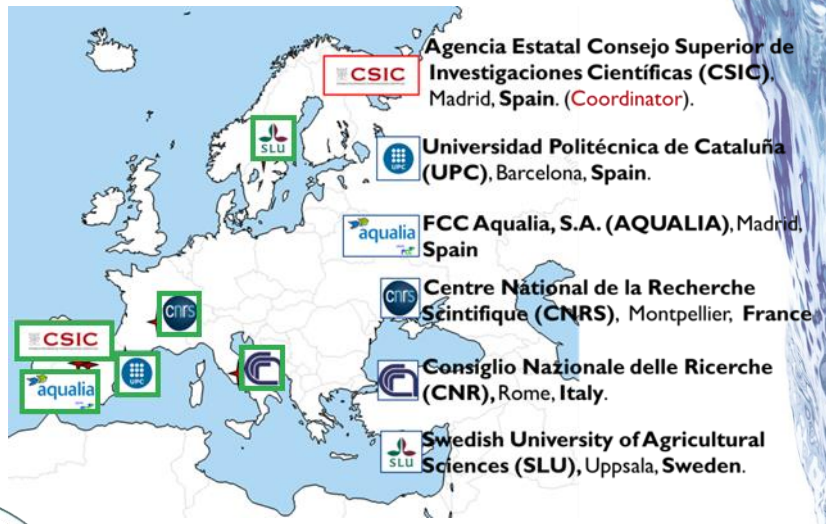
CSIC
Consejo Superior de Investigaciones Científicas

idaea
Institut de Diagnosi Ambiental i Estudis de l'Aigua

Excelencia Severo Ochoa

Water JPI

Scientific and technological results



Data mining - D2.1.

- Batch
- Column

Laboratory testing

Pilot MAR

- Reactive barriers

- Site selection

Field MAR

Modelling

Functional analysis

http://www.maradentro-jpi.eu

Scientific and technological results

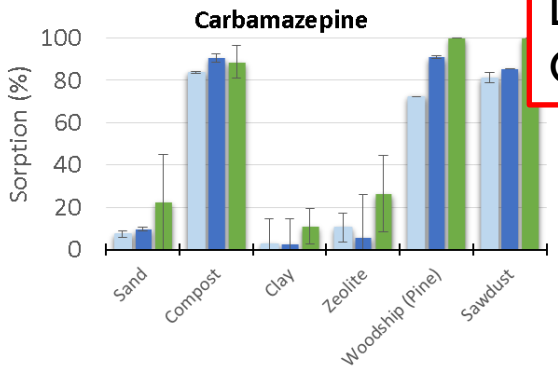
- Batch
- Column

Laboratory testing

- CNRS and CSIC selected the contaminants to be tested:

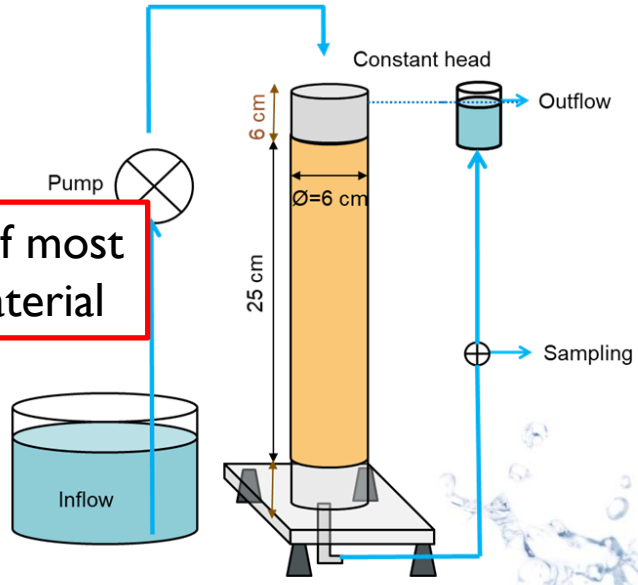
❖ Batch experiments:

11 sustainable materials
16 pharmaceuticals and personal care products
3 Water/soil ratio
4 contact time: 30 min, 60 min, 6h, 24h
2 grain size fractions
2 water types (MilliQwater and synthetic wastewater)
➔ **In total, 240 batch experiments**



Done!: excellent sorption of most CECs to organic barrier material

❖ Column experiments:



- **Selection of the most sustainable materials to design reactive barriers**
- **Impact of physico-chemical properties of CECs (pKa, log Dow, …) and materials (%MO, pH, …)**

Valhondo et al., in prep - 2021

- **Experiments in progress (Spring and summer 2021)**
- **Tracer test to obtain the residence time distribution**
- **Reactive tests to determine the effectiveness of the designed barrier (selected based on batch results)**

Scientific and technological results

- Reactive barriers

Pilot MAR

- Barriers compositions
- Several infiltration periods testing: plants, flow regime……
- Autopsy – samplings

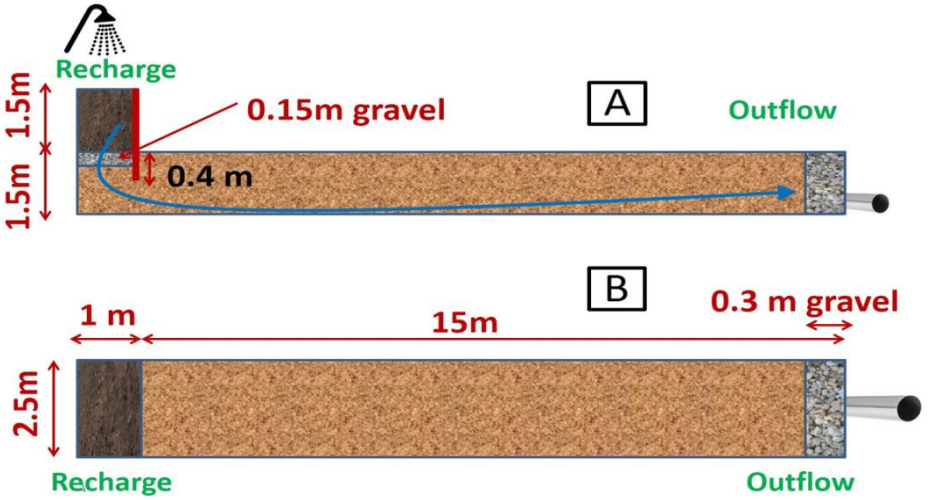
WWTP Palamós (Girona, Spain)

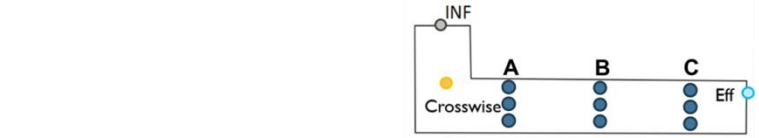
Scientific and technological results

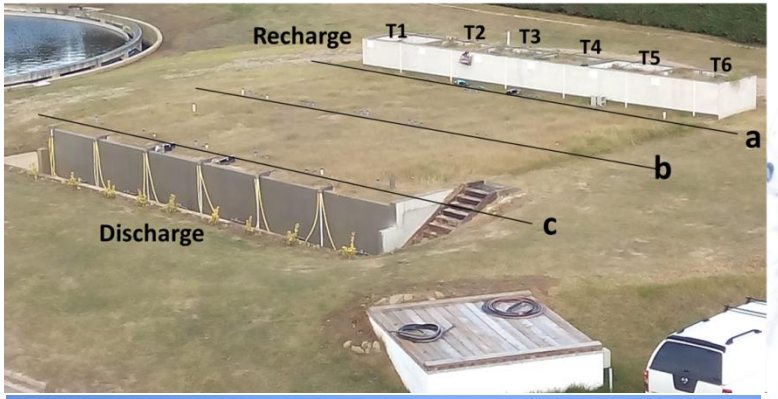
- Reactive barriers

Pilot MAR

Reactive Barrier General Scheme







	T1	T2	T3	T4	T5	T6
	n.p.	REF	het	RB1	RB2	het
	RB 1 -	REF Sand Plants	RB 1 Plants	RB 1 Plants	RB 2 Plants	RB 1 Plants
	Sand	Sand	Sand+ gravel	Sand	Sand	Sand+ gravel

Scientific and technological results

- Tracer tests
- Plants
- Long recharge events (3 m
- Pulse recharge tests
- Benzophenone-3 dynamic a (degradation/adsorption)

• Reactive barriers

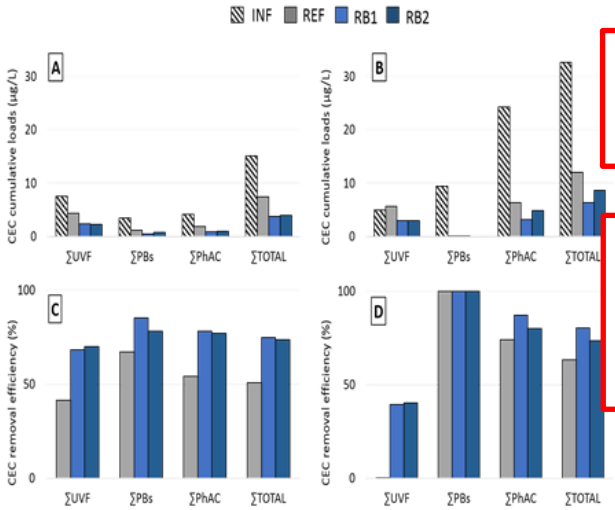
Pilot MAR

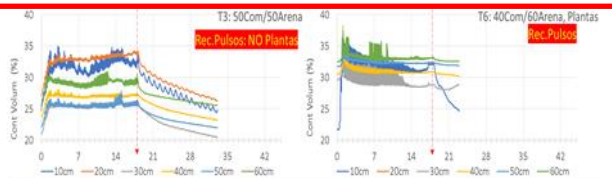
Barriers with plants have worked with virtually no maintenance for almost two years

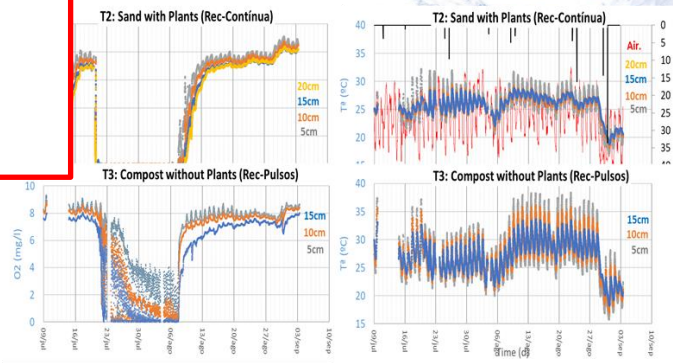
High removal of emerging contaminants

High removal of pathogens, but we want better!

We want to improve. New barriers. But, before, autopsy of the old ones







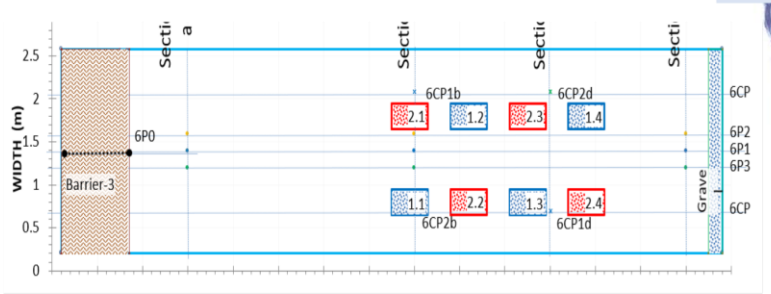
Scientific and technological results

Barriers' autopsy

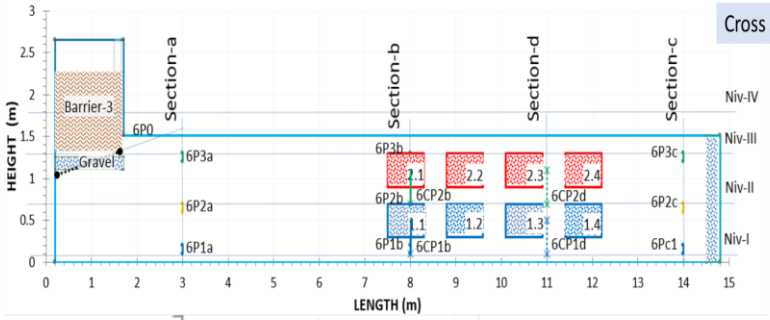
(extensive monitoring during disassembly)

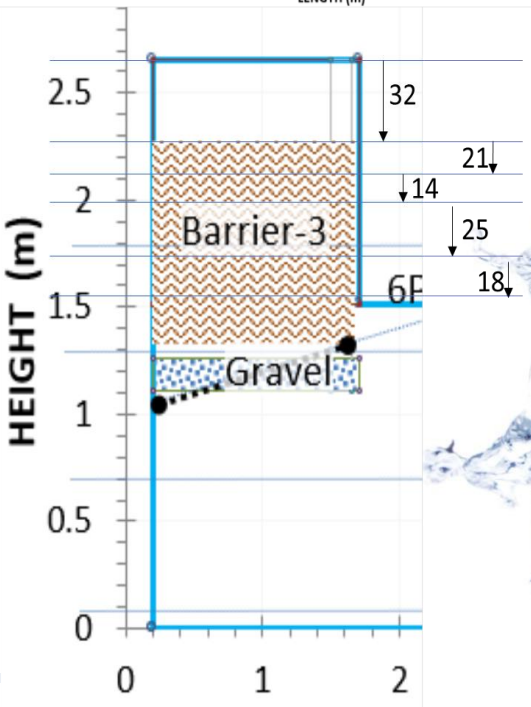
Barrera T6: 49% compost vegetal + 49% arena + 2% arcilla

Plan View



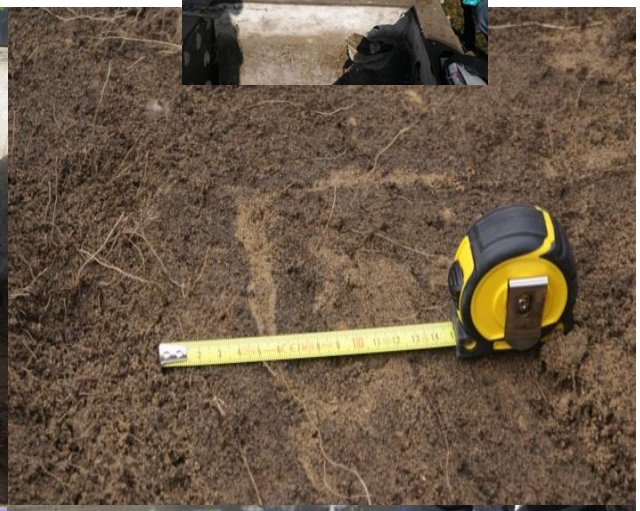
Cross Section

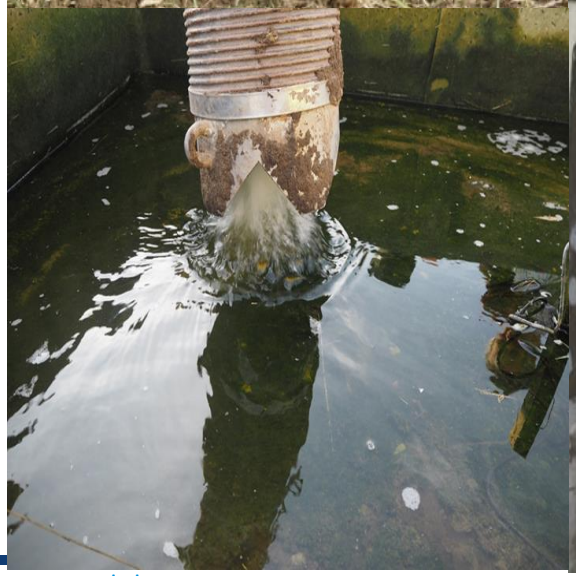




Scientific and technological results

Barriers' autopsy





Scientific and technological results

Sampling

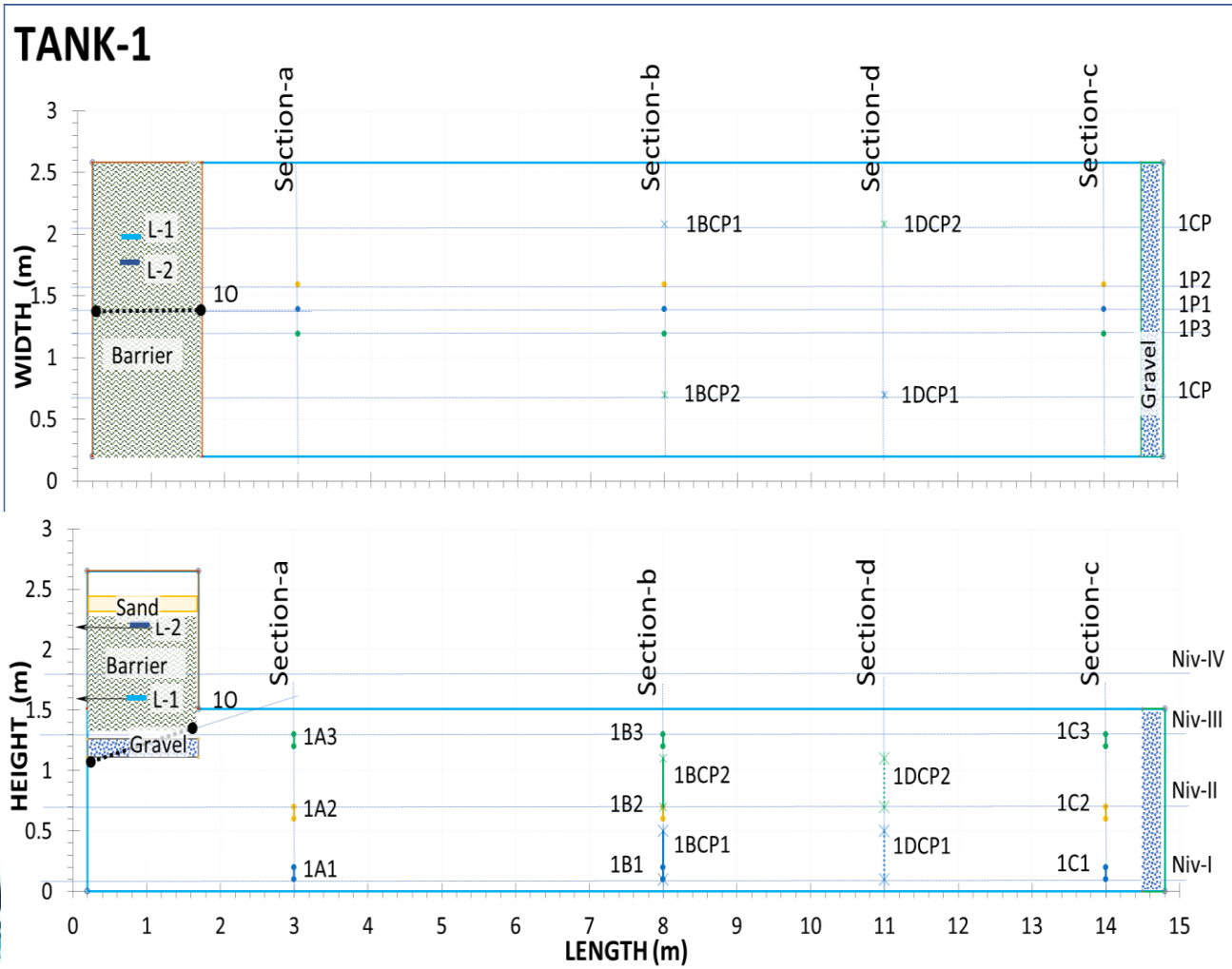





Scientific and technological results

- Reactive barriers
- Pilot MAR

Des-2020 → RB2020 New barriers



AQUIFER:
- Homogeneous

Base BARRIER:
- Sand 50%
- OM (Compost+WC) 50%

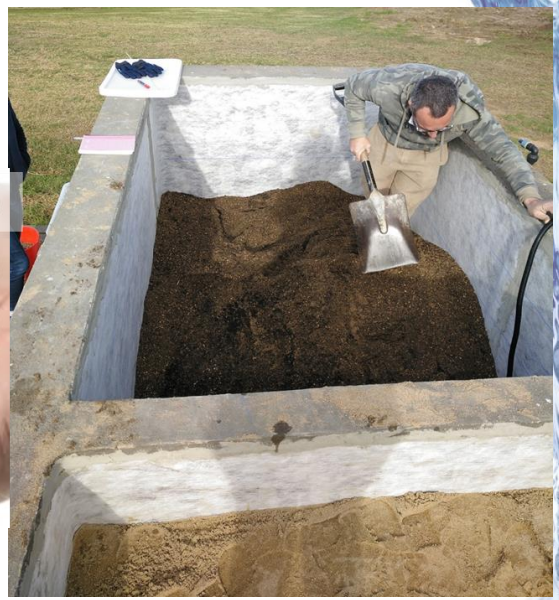
PLANTS:
YES

PIEZOMETERS:
Basic control:
- Position 1(deep) to 3 (shalow)
- Sections a, b and c
- O under the barrier
- L Lysimeter

Caotic Pump:
-CP1 and CP2 at Sections b and d.

Piezometer identification:
Tank-Section-Position

Scientific and technological results



Scientific and technological results

WWTPs initially considered but inadequate:
Lleida, Huesca , and Cadiz.

In Nov. 2020 site finally selected: WWTP **Medina del Campo**.

Adequate characteristics for the implantation: the land is autochthonous without modification and is far from the nearby river so as not to be a flood zone.

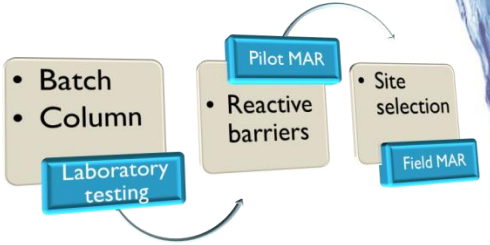
The acting administration responsible for the WWTP facilities and for whom Aqualia provides its management services is the Medina del Campo **City Council.**

Presentation of the project to obtain the preliminary permits to carry out the necessary surveys prior to the drafting of the construction project with which to request official permits for the execution. We get the permission (**January 2021**).

Geotechnical study and soil composition analysis:

Zone 1: inadequate characteristics of the soil,
Zone 2: affection to a collector.
Zone 3: Adequate

Scientific and technological results



***Functional analysis* (SLU)**

Palamós pilot MAR in 2018 and 2019 campaigns

- Analysis of the **functionality of the systems**: **water chemistry, nitrogen removal** and abundances of **key players involved in transforming inorganic nitrogen** compounds.
- Preliminary results, based on the relative abundances of functional groups responsible for transformation of nitrogen compounds, showed that the **assemblages differ between the reactive barrier material itself and the water passing through**.
- The **reactive barrier material** did not affect the assemblage of functional groups.
- The passage of the **water** through the sand in the tank did **not change** the nitrogen cycling assemblages.
- SLU has also **developed a method for DNA extraction from woodchips**, by combining and modifying existing commercial kits.

Development and application of modelling tools (UPC)

- Produced the **basis of the numerical models** by constructing and verifying the conceptual model using data available prior to MARadentro.
- Constructed three **model evaluating:** (1) **the impact of the compost material** added in the reactive barrier **on the carbon and nitrogen cycle,** (2) **for redox processes**, and for the (3) **role of biomass as a sorbent of organic pollutants**.
- Performed a **mechanistic model of sorption of a set of UV-filters** demonstrating, for the first time that **biofilm play an important role in the sorption** of these compounds in the porous media. The particular case of **BP3 was further experimentally tested in the Pilot MAR, Palamós.**

Collaboration, coordination, mobility, synergies

- Some **laboratory and field tasks** were designed to be carried out by **students from every partner**, which has been **realized in the sampling campaign** during the long-period recharge event in spring-summer 2019. Other student exchange were not possible by the COVID-19 pandemic mobility restrictions.
- **Virtual meetings** substituted face to face meetings.
- **Transnational nature:** MAR studies at a **laboratory scale** are performed **in France** by CNRS. The **pilot MAR system** (managed by CSIC and UPC) and the **field-scale MAR** (managed by the industrial partner, Aqualia) are located in **Spain**, where chemical analysis is also performed. **Microbial communities' studies** (SLU), as well as **microbiological analysis** (IRSA-CNR), are carried out in **Sweden and Italy**, respectively.
- A close collaboration was established **among all the partners** to help CNR in the writing of **Deliverable 2**.1.
- Since February 2020 **a PostDoc of CSIC** is participating during a stay in the batch and column laboratory studies carried out by **CNRS in Montpellier.**
- Particular collaborations between **Aqualia and CSIC** to design/implement the **field MAR prototype**.
- MARadentro is connected with the **Spanish project ROUSSEAU** (http://rousseauproject.es). Both projects are Coordinated by Dr. Diaz-Cruz and thus, a smooth collaboration was established from the beginning of MARadentro. The ROUSSEAU project aims to fill in current knowledge gaps in the reuse of regenerated water in agricultural irrigation . In the project the regenerated water produced in MARadentro is used to irrigate vegetables grown in agricultural plots located next to the MAR pilot , Palamós.
- Collaboration also occurs with **Catalonian project RESTORA** (https://restora.h2ogeo.upc.edu/), whose coordinator is also part of the CSIC team of MARadentro, Dr. Jesús Carrera. This project focuses on the use of organic substrates to accelerate water renaturalization in MAR. emphasising research on antibiotic resistance genes (ARG) and chaotic mixing.

Stakeholder engagement

Thanks to the **visibility of MARadentro achieved through the End-users meeting** (Barcelona, Dec. 2019), we have established cooperation with several water agencies and actors in the field, not only in EU but also in Africa.

- The **Catalan Water Agency** (ACA) funded the project RESTORA - *Managed recharge of aquifers and use of Organic Substrates to Accelerate water renaturalization* (Ref. ACA210/18/00040, https://restora.h2ogeo.upc.edu), installed at the same site and in connection with the MAR pilot system. CSIC and UPC are involved.
- Formal documented agreement with **Consorcio Costa Brava** (CCB) supporting the execution of MARadentro within the Palamós WWTP.
- **Medina del Campo City Council** provides strong support demonstarting its high interest in the MARadentro prototype installation in the urban WWTP.
- A Research Technical Support contract signed between CSIC and **Consorci Besós-Tordera** (CBT) a management of integrated water cycle company.
- Performed two sessions of virtual meetings to show the achievements of MARadentro to the **Consorcio Costa Brava (12 Januari 2021)** and **Tarragona Regional Water authorities and the Public Health Department of the Catalonia Government (8 March 2021).**
- Involvement of **Comaigua S.L**, a management of integrated water cycle company as the Coordinator in the project proposal *LIFE-REMAR - Reactive barriers for water renaturalization during managed aquifer recharge in the Baix Camp region (Spain)*) in close connection with MARadentro. The private company **Mejoras Energéticas S.A.** is also involved as an industrial partner. The 2nd Step proposal was submitted in February 2021.
- CSIC team of MARadentro is the Coordinator of a PRIMA project proposal, RESOLWE - *Recovery of Soil and Landscape through Water Recharge Enhancement.. As partners we have a stakeholder from Morocco:* **L'Agence du Bassin Hydraulique de la Miulouya.** We have also the support of **stakeholders from Tunisia and Egipt.**

Impact and knowledge output

- The performed studies on water quality improvement processes at **laboratory and at pilot MAR scales**, has allowed us to select the **most appropriate materials for reactive barriers to increase pollutants degradation**.

- On the basis of the knowledge gained on MAR results from the lower scales, we are **successfully progressing towards the design of the field MAR prototype**, implemented with reactive barriers.

- **Pilot MAR tests** (tracers, flow regime, etc), **functional analysis, and analysis of pollutants** indicated that the **system is robust allowing a sound reduction in pollution** and that **reactive barrier material** and the passage of the **water** through the tank **do not affect the assemblage of microbial functional groups** and do **not change** the nitrogen cycling assemblages either.

- **Modeling development** provided **the first tools to predict behavior and environmental risk** to quantify the processes taking place **in MARadentro pilot and field scale**, allowing **estimate impacts in scenarios different** from those tested in our project.

Impact and knowledge output

Other outputs produced in this period are:

- Publications: 6 published and 6 in preparation,
- Popular conferences and mass media: 4 activities
- Contributions in Conferences: 4 oral + 3 posters.
- 3 Master Thesis + 6 PhD Thesis on-going.

Webs
Diumenge, 18 abril 2021

EL PUNT AVUI+

Identifica't Subscriu-te
Cercar

SECCIONS EDICIÓ IMPRESA MÉS

PORTADA LOCAL SOCIETAT SUCCESSOS POLÍTICA ECONOMIA CULTURA EUROPA-MÓN COMUNICACIÓ OPINIÓ ESPORTS

INFRAESTRUCTURES I SERVEIS GIRONA - 10 març 2021 2.00 h

Acord de col·laboració entre el Consorci d'Aigües Costa Brava Girona i el CSIC

- Els científics podran utilitzar les instal·lacions del CACBGi per a projectes de recerca en l'àmbit de l'aigua
- Es farà un estudi a la depuradora de Palamós

CATALUÑA

Carga artificial de acuíferos: mimos al subsuelo y almacén de agua ante el calentamiento

El Consorcio de Aguas Costa Brava Girona y el CSIC desarrollan en Palamós un plan que combate los efectos del cambio climático en materia hídrica.

22 marzo, 2021 - 03:29

EN AGUA CAMBIO CLIMÁTICO CATALUÑA CSIC GIRONA INNOVACIÓN MEDIO AMBIENTE

J. Arnau

El cambio climático tiene múltiples efectos negativos, pero todavía no tiene todas las soluciones necesarias para erradicarlos. Por suerte, la **innovación, la investigación y la puesta en marcha de proyectos experimentales** ayudan a que, al menos algunos de estos problemas, puedan empezar a solventarse.

Uno de estos **efectos negativos** es el que tiene que ver con los problemas que causa el calentamiento global en los acuíferos.

Noticias relacionadas

- La recuperación 'azul' tras la pandemia: así cuida Coca-Cola el ciclo del agua
- La calamitosa consecuencia del cambio climático de la que nadie te había
- Esta es la zona de España que enfrenta un mayor riesgo de hundimiento del suelo

- Organization of an End-users meeting (Dec. 2019) and 2 virtual meetings with Water and Public Health authorities in Catalonia, Spain (January and March 2021).
- Lectures on MAR in, two Official University Master programs (UPC and UB) (2019-2021).

Continuation of the work in the future

- Results from the column experiments at lab scale
- Testing in the new reactive barriers at pilot scale
  - Water, barrier and tank materials, and biofilm análisis (emerging contaminants, microplastics, EPS, bacterial density, N, anions and cations, heavy metals,…
  - Bacterial growing tests
  - Reactive materials combination
  - Microbial community and ARGs identification
  - Tomography
  - Chaotic flow tests
- Performance of the developed models to reproduce experimental data.
- Scale-up, field MAR prototype: construction and fucntioning.
- Economimal analysis.
- Recommendations for good MAR practices and public aceptance.
- Dissemination activities (Publications, conferences, meetings, PhD, Masters, mass media….)

Any comments?

Water Harmony

Closing the Water Cycle Gap with
Harmonised Actions for
Sustainable Management of Water Resources

Harsha Ratnaweera, Coordinator/Presenter

Water JPI 2018 Joint Call

Mid-term evaluation meeting
19-20 April 2021 Online

Water Harmony – Objectives and sub objectives

Objective: Closing the water cycle gap by **harmonising global good practices** of sound and **smart water management** concepts that address **emerging challenges** and **mobilise stakeholders.**

- Demonstration of sound and adaptive **approaches to modern water management** concepts that use BigData and technological advancements
- Validation of **innovative technologies** that enable safer, secure and economically more feasible use and reuse of water
- **Increase public engagement** to sustainably address the water challenges that connect sciences and society;
- **Facilitate policy decisions** favouring actions that rapidly close the demand-supply gap in the water sector by providing scientific backgrounds.

Norwegian University of Life Sciences, ***Norway*** *(NMBU), IVL Swedish Envi. Research Institute,* ***Sweden*** *(IVL)*
Stichting Deltares, ***Netherlands*** *(Deltares), University of Warmia and Mazury in Olsztyn,* ***Poland*** *(UMW)*
Technical University of Iasi, ***Romania*** *(TUIASI), Ben-Gurion University of the Negev,* ***Israel*** *(BGU),*
ACSA Obras e infraestructur as SAU, ***Spain*** *(ACSA), MARCOR,* ***Poland*** *(MARCOR)*
Qingdao Technological University, ***China*** *(QTU), University of Technology Sydney,* ***Australia*** *(UTS)*
Michigan State University, ***USA*** *(MSU), National University of Singapore,* ***Singapore*** *(NUS)*

Scientific and technological results

Topic	Progress/status	✓P/🕒
Reduction of pollution at the source by preventing sewer overflows (NMBU, NO).	Development of virtual sensors for sewer systems Monitoring of stormwater discharge systems	😐😐
Dynamic water source mgmt (IVL, SE).	Development of Models & control of surface and groundwater balance Development of sensors for the sites- soon deploy	😐😐
Implementing water conservation practices in a catchment (UWM, PL).	Hydrochemical monitoring of Łyna catchment Electrochemical Degradation of Industrial Dyes Tech solutions: coagulation dosing control/ automatic WQ analysis	☺😐
Rehab. of river water quality (TUIASI, RO).	Stakeholder workshop, agreed for automated WQM on a ship Early warnings related to the potential algal blooms	☺😐
Electrospun nanofibers for micropollutants removal (ACSA, ES)	Selected suitable nanofibers (PVDF-TiO2 and PAN-Ag) for the different targeted pollutants	☺😐
Ceramic membranes mobilising fenton reaction and photocatalysis (BGU, IL)	Galvanic cells into the process of electrochemical degradation of pigmentsLab scale tests started with ceramic membranes	😐😐
Dual membrane - GAC adsorption hybrid system (UTS, AU)	Adsorption pre-treatment: enhance MF treated WW nanofiltration for DOC & OrgMicroPoll.. Combined GAC+NF rejected >90% all OMP	☺😐
Zero Liquid Discharge with RO and electrocoagulation (NUS, SG)	Progress with Capacitive Deionisation to reduce membrane fouling in RO/desalination	😐😐
Enhancing reuse capacities with coagulation preteratment (MARCOR, UWM PL)	Reuse of dairy ww using membrane processes; Membrane fouling reduction in boiler water	😐😐
Hybrid reverse osmosis with Fenton oxidation (QUT, CN)	Completed tests on producing ultra-pure water from domestic wastewater for the Beijing 2022	☺😐
Natural coagulants w/membranes (MSU, US)	Lab scale tests continue with moringa. Reduction of membrane fouling in NOM removal	😐😐
Information management and realising the power of BigData (Deltares, NL)	Data tools and platforms for joint presentations In dialogue with the subproject owners Wflow in PL site	😐😐

Collaboration, coordination, mobility, synergies

- Sstarted with high enthusiasm for a strong collaboration, (breadth/depth of the knowledge/experience partners)
- Several partners met for the first time, and the kick-off workshop in May 2019 was a success
- Met in Zaragoza, Spain in Dec2019 /EIP Water conf.
- Collaborative efforts: Site visits/innovation camps delayed
- US, AU, SG, CN: own funding
- Additional funds: AU, CN, RO, PL, NO (3 EEA/Erasmus projects)

Stakeholder engagement

- 2 main activities planned: innovation camps in ES+IL and in Romania (RO carried out the stakeholder meeting without other partners)
- Several stakeholder meetings in Sweden
- EIP Water 2019 event
- Stakeholder activities limited to local events

Impact and knowledge output

- All severely delayed due to COVID-19
- Swedish partner: got their patent application approved
- Norwegian partner dialogue with TTOffice on IPR
- Spanish partner: commercial product defined
- Polish partners: drafting patent documents
- >7 peer reviewed publications, >7 conf presentations

Plans

- At the first possibility, we must hold the innovation camp. Probably first in Spain then in Israel
- Virtual project review meetings in April/May 2021
- Need to pick up physical meetings/visits
- Virtual meetings- intensify
- Uncertainty with the extension is a challange

Water JPI

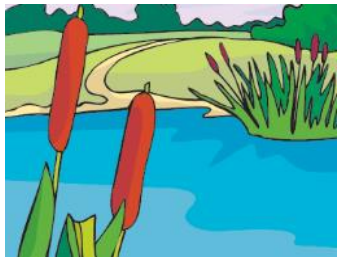
Research-based Assessment of Integrated approaches to Nature-based SOLUTIONS (RainSolutions)

DProf. DProf. Prof. Prof. Dr Dr Miklas Scholz

Water JPI 2018 Joint Call

Mid-term evaluation meeting
19-20 April 2021 Online

RainSolutions Members



RainSolutions

1. Scientific and Technological Results 1

Lund University

- Research focused on the impact of climate change on wetland systems and receiving waters.
- Four climate chambers simulating four different climate scenarios including current climate, RCP 2.6, RCP 4.5 and RCP 8.5 are operated.
- Carbon dioxide flux from wetlands are evaluated.
- Water level management helps to protect receiving watercourses and reduces greenhouse gases
- A mixed-effect model was applied to analyse for significant differences and to investigate how different factors might significantly affect the systems.

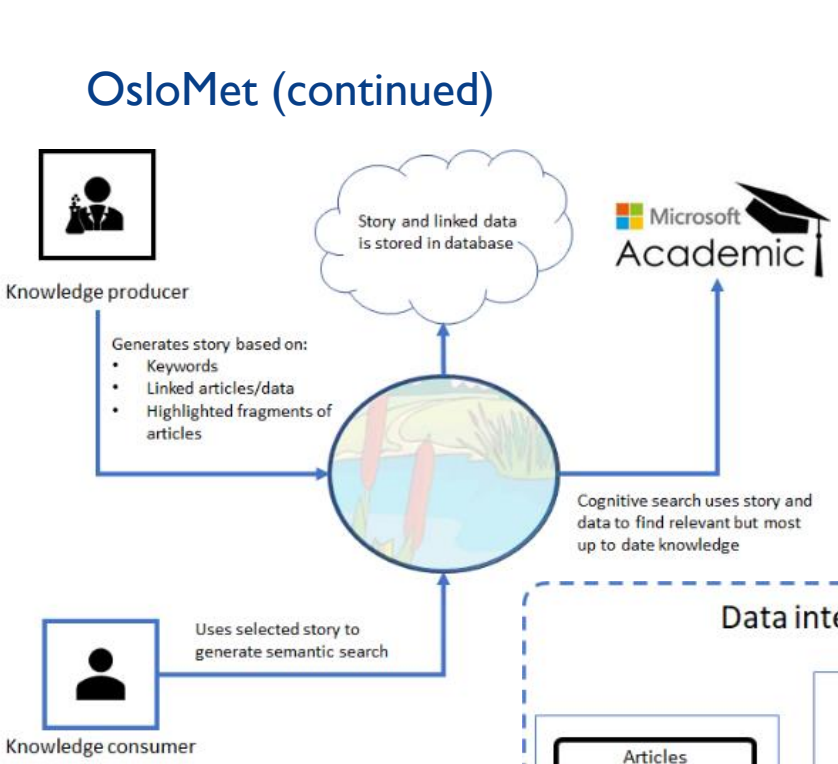
1. Scientific and Technological Results II

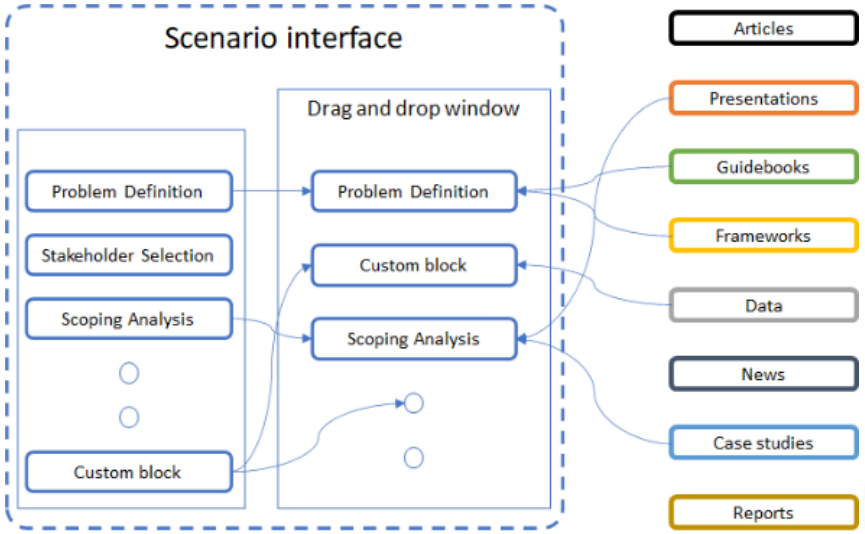
OsloMet

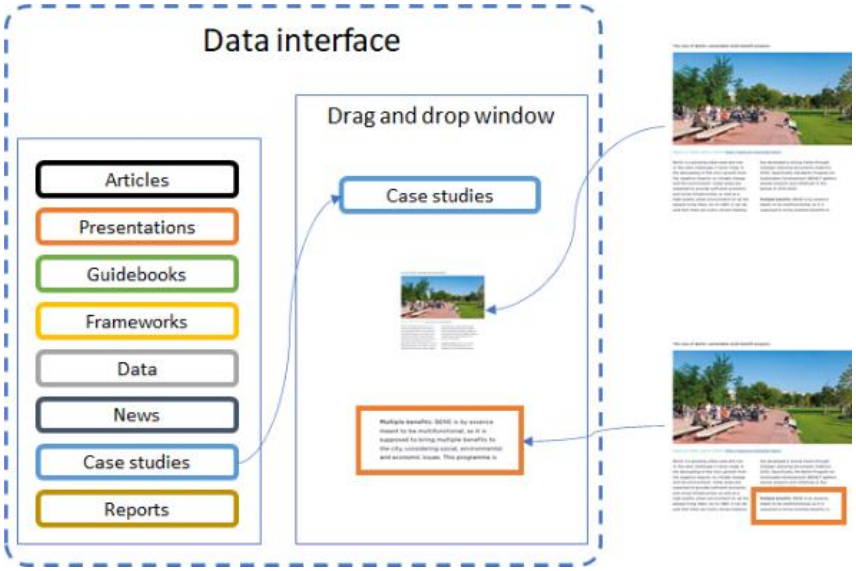
- Development of a decision support tool for nature-based solutions.
- The support tool will be implemented in a form of knowledge-shearing platform based on cloud services.
- The concept of the tool was prepared, but the technical architecture is under development.
- A toolbox for carbon dioxide prediction in wetlands and peatlands was prepared.
- The toolbox contains five modules for data processing and prediction: data import, cleaning, statistics calculation, machine learning fitting and neural fitting.
- A feature selection and classification module is under development.
- The performance is verified on data provided by Lund University.

1. Scientific and Technological Results III

OsloMet (continued)







1. Scientific and Technological Results IV

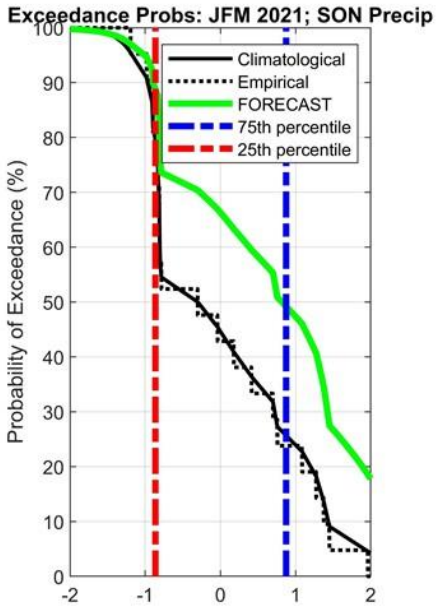
University of Pretoria

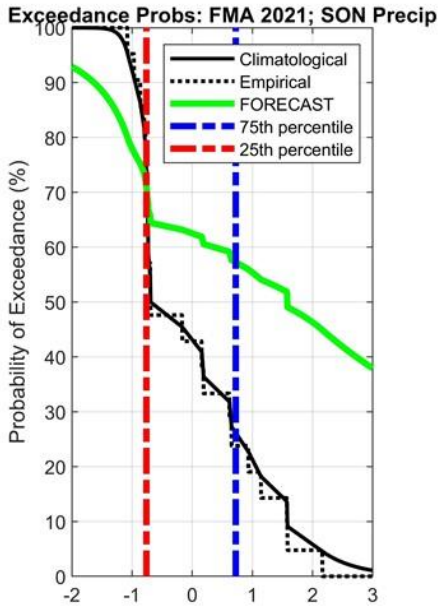
- An operational downstream flow forecasting product for the Vaal Dam has been developed.
- Seasonal downstream flow forecasts have been produced operationally since November 2020.
- The forecasts are all predicting enhanced probabilities of high downstream flow volumes.

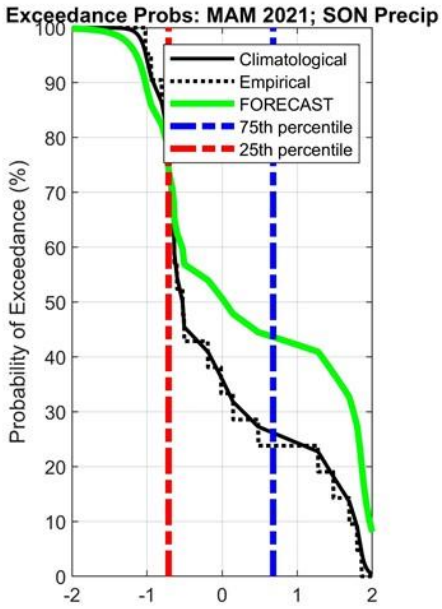
1. Scientific and Technological Results V

University of Pretoria (continued)

Current Project, administered by the WRC: *RainSolutions*







Vaal Dam Downstream Flow Predictions

1. Scientific and Technological Results VI

University of Tartu

- Water and greenhouse gas measurements at the Estonian case-study (Vända treatment wetlands) have been performed.
- Report summarising the state-of-the-art and gaps in knowledge regarding international case studies.
- MDPI Sustainability Special Issue (Editors: Dr Kasak, Prof. Scholz, Prof. Mander).

Wageningen University & Research

- An urban storm water model to simulate rainfall associated run-off and the drainage system has been developed at a prototype level.
- The model has been applied to a neighbourhood in Amsterdam that has problems with pluvial flooding and degraded surface water quality.
- The model outcome will be hydrographs revealing the probability of pluvial flooding and pollutant loads allowing to evaluate nature-based solution mitigation capacity.
- The model development involved various disciplines: environmental technology, geo-information science, landscape architecture design and civil engineering.

I. Scientific and Technological Results VII

Wageningen University & Research (continued)

1. Scientific and Technological Results VIII

VESI International

- A detailed photogrammetry survey of Kilbogget Park, County Dublin, was carried out.
- The survey will be used as a tool for community engagement, awareness raising and education.
- Surface water monitoring programs were established, examining nutrient and microbial removal efficacies in Kilbogget Park and Tolka Valley Park, County Dublin.

I. Scientific and Technological Results IX

Danube Delta National Institute for R&D

- Assessment of the perception of authorities and local communities on the aspects related to nature-based solution implementation in Romania,
- The focus is on the rehabilitation and reconstruction of urban lakes.
- Assessment of the perception of authorities and local communities on the aspects related to nature-based solution implementation in Romania,
- The focus is on the rehabilitation and reconstruction of urban lakes.
- The research focused on three urban lakes, the analysis of recreational value and the availability of civic involvement of local communities in monitoring the effects on water quality and biodiversity generated by the implemented solutions.
- Analyses of watercourse data gathered from National Administration of Romanian Waters surveys.

1. Scientific and Technological Results X

Federal University of Technology – Paraná, Brazil

- Research activity focusing on nature-based solutions for stormwater management, protection and restoration of an urban lake.
- Study of the extreme rainfall probability distribution to estimate large events and their probability of occurrence in the lake drainage area.
- Water Quality Index assessment under various rainfall intensities.
- Quantifying the impacts of land use/land cover change on the runoff generation at the basin-scale.
- Definition of a hydrological models to predict the impacts of nature-based solutions on runoff generation (Storm Water Management Model) .

Collection of water samples

2. Collaboration, Co-ordination, Mobility and Synergies I

Lund University

- Good collaboration with OsloMet has been established.
- Our data are used by OsloMet for machine learning modelling purposes.

OsloMet

- Collaborations with Lund University (see above), the University of Tartu and VESI International were established.
- Both universities and the company will provide a large database regarding their case studies (constructed wetland) with descriptions and a scientific database.
- Collaboration with WUR was initialized.

University of Tartu

See above.

Wageningen University & Research

- The Amsterdam Institute of Advanced Metropolitan Solutions (AMS-institute) and Amsterdam Rainproof (part of Waternet) provide in-kind support.
- Waternet has provided data for building the model prototype and co-organized one knowledge exchange meeting.

2. Collaboration, Co-ordination, Mobility and Synergies II

Wageningen University & Research (continued)

- The AMS-institute has also co-organised one knowledge exchange event, and they will contribute to data collection and stakeholder facilitation.

Danube Delta National Institute for R&D

Good exchange of information and collaboration for the Deliverable reports 1 and 2.

Federal University of Technology – Paraná

- Collaboration with partners on methods for allocating monetary values on deliverable environmental services.
- We will provide data regarding the urban lake case study; parameters for monitoring and evaluation as well as cost-benefit assessment of nature-based solutions.

3. Stakeholder Engagement I

OsloMet (supported by all partners)

- An Advisory Board with terms of references has been established.
- External board members are (in no particular order):

  Doina Cioaca (Ministry of Environment, Romania)
  Pere Malgrat (City Council of Barcelona, Spain)
  Daniel Goedbloed (Amsterdam Rainproof, The Netherlands)
  Nan Su (Dutch Sino Business, The Netherlands)
  Rasheed Aleem (Sharjah Electricity and Water Authority, United Arab Emirates)
  Zoran Kapelan (Delft University of Technology, The Netherlands)
  Christopher Pain (Imperial College London, UK)
  Bjørn Kløve (Oulu University, Finland)
  Frans van de Ven (Delft University of Technology, The Netherlands)
  Thurai Rahulan (The University of Salford, UK)
  Yali Woyessa (Central University of Technology, South Africa)

- The VEAS wastewater company got involved by organizing a Digital VEAS hackathon 2020. A follow-up activity will utilize the RainSolutions decision support tool.
- The Crayon (representative of Microsoft) company got involved to participate with the knowledge transfer platform development.

3. Stakeholder Engagement II

University of Tartu

Successful cooperation with local project companies such as Alkranel LCC, which designed the treatment wetlands.

Wageningen University & Research

- WUR has acquired several valuable data sets from Waternet; e.g., surface water monitoring data from 1970 until 2020 as well as geographical information service maps of land use and sewer systems in Amsterdam.
- The model development has drawn attention from other Dutch municipalities like Breda and Nieuwegein.
- Engagement with Suzhou and Xiamen, China.

3. Stakeholder Engagement III

Federal University of Technology – Paraná

- The National Water Agency provided all hydro-climatic data as well as additional rain gauges for the drainage area of Lake Igapó and the training for Water Quality Index measurements.
- Londrina's government secretary (City Hall) opened an exclusive communication channel to supply the information need for the project.
- Londrina Institute for Urban Research and Planning is the body responsible for the integrated planning of urban growth in the municipality. It created a permanent forum for monitoring and discussing nature-based solution applications in public projects that are being planned.

Stakeholder meeting

4. Impact and Knowledge Output I

Lund University and Danube Delta National Institute for R&D

- Salimi S., Almuktar S., and Scholz M. (2021), The Impact of Climate Change on Wetland Ecosystems: A Critical Review of Experimental Wetland Mesocosms. Journal of Environmental Management. 286, 112160.
- Salimi S. and Scholz M. (2021), Impact of Future Climate Scenarios on Peatland and Constructed Wetland Water Quality under Water Level Management: a Mesocosm Experiment within Climate Chambers. Journal of Environmental Management. 289, 112459.
- Scholz M., Török L., 2019, Research-based Assessment of Integrated approaches to Nature-based Solutions (RainSolutions). IN: Deltas & Wetlands (Book of abstracts), vol 6, 30 pp, Tulcea, Romania.
- Scholz M., Török L., Research-based Assessment of Integrated approaches to Nature-based Solutions (RainSolutions), poster, The 27th Symposium 'Deltas and Wetlands', 05 - 09 June 2019, Tulcea, Romania.

Wageningen University & Research

Modelling tools to support optimal planning of nature-based solutions.

4. Impact and Knowledge Output II

Danube Delta National Institute for R&D

- 2019, Construind în baza a ceea ce cunoaștem, 78 pagini. Raport Etapa 1 / decembrie/ 2019, proiect RainSolutions (coord. Liliana TÖRÖK), contract nr. 108/ 2019 / UEFISCDI, executant: INCDDD Tulcea, România.
- 2020, Evaluarea Soluțiilor Bazate pe Natură pentru o planificarea urbană integrată și o abordare ecologică coerentă 78 pagini. Raport Etapa 2 / decembrie/ 2020, proiect RainSolutions (coord. Liliana TÖRÖK), contract nr. 108/ 2019 / UEFISCDI, executant: INCDDD - Tulcea. Tulcea, România.

5. Continuation of the Work in the Future I

Lund University (supported by all partners)

- Organization of a conference in collaboration with the EU Horizon 2020 consortia WATERAGRI and OBTAIN.
- Targeted knowledge products will be developed for different audiences informing them about the benefits of nature-based solutions and the evidence-based framework.
- A reference framework for future solutions will be deployed, facilitating the growth of small businesses providing technologies and services, and creating new local green jobs.
- Creation of further innovations to reduce the risk of flooding and droughts whilst restoring urban ecosystems and adding to the amenity value of the urban environment.

Wageningen University & Research

- Model validation and upscaling.
- Receiving advice from further Dutch municipalities on future planning schemes, supporting the effectiveness of nature-based solutions.

5. Continuation of the Work in the Future II

Federal University of Technology – Paraná

- Continuation of the collection of water samples to calculate the Water Quality Index under dry conditions.
- Calibration and validation of the hydrological model for the drainage area and simulation of nature-based solution application scenarios.
- Map the land use/cover in the drainage area, using Pleiades satellite constellation imagery with very high-resolution (50 cm).
- Creation of a pixel-based map of indicators (based on high-resolution land cover mapping) ranking the efficiency of nature-based solutions.
- Presentation of nature-based solutions suitable for stormwater management and discussion of strategies for including them in future projects (including financing).

Any comments?

Water JPI

Evidence based assessment of NWRM for sustainable water management (EviBAN)

Herman Helness

Water JPI 2018 Joint Call

Mid-term evaluation meeting
19-20 April 2021 Online

General situation

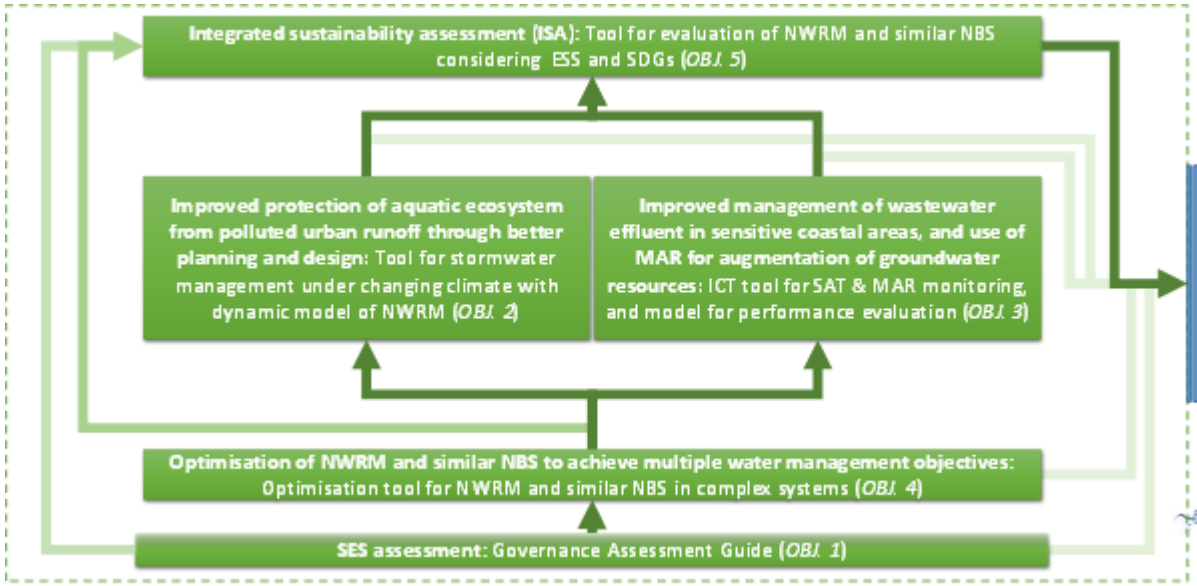
- Overall EviBAN is delayed compared to original time schedule
- Main cause is COVID-19
- Different effect for the different partners and for different activities
- Direct effects e.g., related to change of personnel
- Indirect effects following from delays in other activities
- Activities involving collaboration/co-development with stakeholders more affected than activities performed by researchers without direct involvement of stakeholders in the execution of the activity.
- Expected delay of activities according to countries: SAF < FRA < NOR < FIN
- SINTEF as coordinator will stay in the project until the end
- According to our understanding partners will apply for extension individually, but EviBAN in total would like to have an extension of 9 months (end of 2022).
- Clarification on possible extension of the project period urgently required.

Scientific and technological results

Presentation based on mid-term report (Oct. 2020) + developments since

Work package 2 – toolbox development (WP1 is coordination)

- Structure changed => optimisation tool to be used for screening
  - Offers more flexibility in workflow and level of detail in the assessments as illustrated by the arrows in the figure below.



Scientific and technological results

Work package 2 – toolbox development

Governance assessment tool

- Framework for systematic assessment of the governance context
  - Assess conducive and unconducive factors that will affect the scope for NWRM/NBS
- To be tested first in the Norwegian case, thereafter on other cases

- Onward schedule will be adapted to possibility for stakeholder interaction

Optimisation tool

- Optimal combination of solutions in an area/a catchment
  - Stormwater management
  - MAR

- Since October 2020
  - Excel + Python; two modes of use: stormwater and MAR
  - Documentation included in D2.1 "Report: documentation of toolbox components and guide for use"

- Under testing by Finnish partner for stormwater; planned in South Africa for MAR
  - Testing in South Africa will be adapted to possibility for travel

Scientific and technological results

Work package 2 – toolbox development

Stormwater tool

- Stormwater Management Model (SWMM) and PHREEQ-C
  - SWMM supports catchment applications of precipitation-runoff processes at different scales.
  - PHREEQ-C is the physics-based tool for assessing the geochemical processes in stormwater filter systems that are relevant for understanding their long-term behaviour.

- EviBAN case studies provide references to their parameterisation in the urban hydrology and stormwater context.

- Since October 2020:
  - Documentation included in D2.1 "Report: documentation of toolbox components and guide for use"
  - PhD returned to home county – need to replace with a post.doc.

- Plan for remaining activity and onward schedule will be adapted to possible extension of the project period.
  - Post. doc candidate identified, but %-position and duration to be finalised

Scientific and technological results

Work package 2 – toolbox development

MAR-SAT tool

- DDS-tool to enable a WWTP manager to determine the relevance of implementing MAR-SAT
  - Antea Group to use own software, NORRMAN, in the basin area Loire-Bretagne + Seine-Normandie
    - Preparatory phases have been carried out, implementation remaining
  - BRGM to implement a Soil Aquifer Treatment (SAT) module
    - Conceptual model to explain water quality developed, hydrodynamic and hydro-dispersive flow modelling
    - Further work: removal of contaminants of environmental concern (CEC), the geochemical processes
    - To be used in Agon-Coutainville to validate CECs transfer and degradation.
- Since October 2020:
  - Draft documentation included in D2.1 "Report: documentation of toolbox components and guide for use"

Scientific and technological results

Work package 2 – toolbox development

ISA tool

- Integrates the results from the other tools in the toolbox in a holistic assessment of sustainability
  - Objectives for each sustainability dimension → Criteria to assess compliance
  - Co-developed with stakeholders
  - Spreadsheet with accompanying documentation
- To be tested first in the Norwegian case, thereafter on other cases
- Since October 2020:
  - Partial testing in Norway – collaboration with KLIMA 2050 spin-off project
  - Draft documentation included in D2.1 "Report: documentation of toolbox components and guide for use"
- Onward schedule will be adapted to possibility for travel and stakeholder interaction

Scientific and technological results

Work package 2 – toolbox development

Work package 2 – deliverables (Month 24)

- D2.1 Report: documentation of toolbox components and guide for use
  - Draft version in preparation

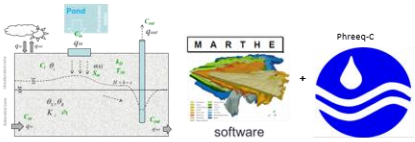
- D2.2 Manuscript for scientific paper on ISA
- D2.3 Toolbox components available on the project website
  - Delayed pending completion of D2.1 and publication

Scientific and technological results

Work package 3 – case studies

French case study

- MAR-SAT site established in previous project
- 2 stakeholder workshops (1 after Oct 2020)
- Sampling/measurements campaign
- Six new observation wells w/instrumentation
- Dissemination: Book chapter and conference
- Contribution to D3.2 (Report on MAR, month 24)



South African case study

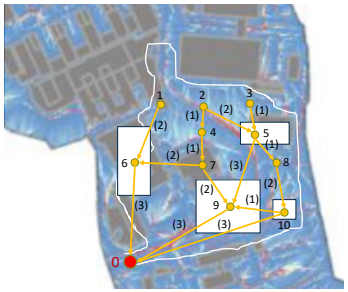
- 2 stakeholder workshops (1 after Oct 2020)
- 3 weather stations installed in catchment
- Data gathering and catchment delineation
- Since October 2020:
  - Model setup for runoff modelling (Pitman)
  - Stakeholder interviews by questionnaire
- Lead contribution to D3.2 (Report on MAR, month 24)

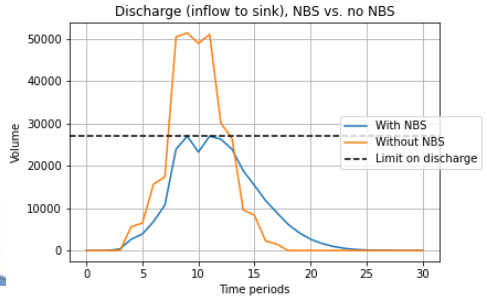
Scientific and technological results

Work package 3 – case studies

Norwegian case study

- 1 stakeholder workshop
- Setup of assessment tools and initial testing of optimisation and ISA
- Since October 2020:
  - Calibration of optimisation tool





Finnish case study

- 1 stakeholder workshop + annual meeting
- Measurements and data collection campaigns at road runoff site
- Modelling of performance (PHREEQ-C)
- Since October 2020:
  - Recruitment of post.doc. for replacement of PhD that left the project
  - Testing of optimisation tool (MSc)
  - D3.1 (Scientific article manuscript about NWRM in stormwater management, month 24)

Scientific and technological results

Work package 3 – case studies

Work package 3 – deliverables (Month 24)

- D3.1 Scientific article manuscript about NWRM in stormwater management
  - Manuscripts competed, further editing pending reviews for publication
- D3.2 Technical report or article manuscript about MAR solutions
  - In preparation, draft version for internal discussion available

Collaboration, coordination, mobility, synergies

Collaboration

- EviBAN – KLIMA 2050, common workshop in NOR
- Stakeholder meetings organised in all participating countries

Coordination:

- PMT meetings and bilateral meetings as required (Handling og COVID-19; Follow-up in FIN and FRA)

Mobility

- PhD's mobility from Aalto University to SINTEF in Trondheim
  - Interrupted because of the global COVID-19 in March 2020.
- Planned PhD mobility between SAF and FRA
  - Not realized due to COVID-19

Synergies between EviBAN partners

- NOR – FIN: Stormwater management (mutual participation in local workshops; ISA input, testing opt. tool)
- NOR – SAF: SES mapping exercise, ISA input, appl. of opt. tool (local workshops – f2f and virtual)
- SAF – FRA: methods/models (common MAR report)
- NOR – FRA: ISA input (local workshop)

Stakeholder engagement

- Annual workshops in each country
  - FRA and SAF: 2 completed to date
  - NOR and FIN: 1 completed, second planned
- Annual project meeting organised as a virtual event by Finnish partner
  - Participation from Finnish stakeholders
- Collaboration with other projects in Norway included workshops with participation of wider stakeholder groups
  - KLIMA 2050
  - DRENSTEIN

Impact and knowledge output

Impacts through stakeholder interactions

- SAF: Water supply problems and health of river
- FIN: Participation cities of Espoo and Vantaa - potentially impact from future use of results
- FRA: Plans for improvement of current system
- NOR: Stakeholder's ability to assess sustainability of solutions

Impacts through exploitation

- French industry partner preparing plan for exploitation of NORRMAN tool (D4.4 has been drafted)

Outputs/dissemination

- 1 book chapter:
  - Picot-Colbeaux Géraldine, et al. (2020): Case Study 16: Soil Aquifer Treatment system to protect coastal ecosystem in Agon-Coutainville (Normandy), France, in Zheng, Y., Ross, A., Villholth, K.G. and Dillon, P. (eds.). Managing Aquifer Recharge: A Showcase for Resilience and Sustainability. A UNESCO-IAH-GRIPP Publication. No: 4500386254 (in press).
- 1 conference presentation:
  - Guillemoto Q., et al. (2019) Numerical modelling: a tool for Managed Aquifer Recharge and Saturated Aquifer Treatment system in coastal area. AGU, San Francisco, USA.
- 2 manuscripts for scientific publications:
  - Koivusalo, et al.: Scientific article manuscript 1 on NWRM in stormwater management: Performance of sand and mixed sand-biochar filters for road runoff treatment
  - Dubovik et al.: Scientific article manuscript 2 on NWRM in stormwater management: Long-term performance of sand and biochar-amended roadside stormwater filtration systems

Continuation of the work in the future

Continued work in the remaining project period

- Discussed by the PMT in December 2020
  - Tentative scheduling of workshops and project meetings virtual and f2f
  - Collaborative activities connected to case studies
  - Dependent on COVID-19 and possibility for extension
- Plan for completion will be finalized when possibility of extension has been decided.

Continued work after end of EviBAN

- General good collaboration between the partners point to continued collaboration in future projects
- SUWI and SINTEF in proposal for new project
  - Partly building on EviBAN ISA-method – to be further developed for other application
- French stakeholders positive to plans for continued studies of the MAR-SAT system at Agon-Countainville

Any comments?

Water JPI

Group discussion

Q&A

Researchers and Funding Agencies

Water JPI

Reflections and wrap-up

Miguel Ángel Gilarranz,
Water JPI Vice-Chair
AEI, Spain

Thanks to all!

See you…