ICT4WATER cluster online meeting

Intelligent and Smart Systems AG meeting

19 October 2022

Topic overview & relevant projects

Action Group Intelligent and Smart Systems

Focus identified from the “Digital Water Action Plan”:
1) Reinforce better utilization and effective deployment of new technology enablers
2) Improve efficiency and circularity in digitalisation of water use and re-use
3) Smartening of the water system

Short term actions radar

- **Update the DSS marketplace based on new survey** (include new projects, update on included projects) Consider Water Europe market place (https://mp.watereurope.eu/)
- **Digital twins** : *definitions, boundary conditions, experience, lessons learned*

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Digital action plan (1/2)

#	Action	Activities	Timeline
ISS_1	**Deployment of smart water sensors with IoT enablers and data models**	• Activity 1 : Utilisation of IoT platforms and context brokers • Activity 2 : Promote the development of smart sensors supporting interoperable IoT-compatible water data models from DS. • Activity 3 : Create and promote a library of IoT data models in public domain (e.g. FIWARE)	2022-2025
ISS_2	**Use of trustworthy AI-techniques for big data analytics to help explain decisions (XAI), learn models, diagnostics etc., for the water sector**	• Activity 1: Promote the use of advanced AI techniques for data analytics and decision making (e.g. deep reinforcement learning, supervised/unsupervised learning, semantic reasoning) • Activity 2 : Create collections of “virtual sensor” methods for the monitoring and detection of substances through surrogate metrics (e.g. temperature, pressure) using AI methodologies. • Activity 3: Create a library and repository of AI models and algorithms related to water (as reference applications, with the objective promoting implementation at other utilities and by SMEs/developers)	2022-2026 2026-2032
ISS_3	**Digital twins for real/near time operational management of water systems**	• Activity 1: Promote the developments of digital twins for various types of water systems, including predictive and prospective twins for designing and training (e.g. longer-term developments and stress scenarios) • Activity 2: Promote the use of advanced and innovative visualisation techniques for water system management • Activity 3: Collection of use cases on Digital Twin and benchmarks	2022-2026

Digital action plan (2/2)

#	Action	Activities	Timeline
ISS_4	**Expand research on system dynamics to improve efficiency, nexus and circularity in water use and re-use**	• Activity 1: Continue supporting and boosting smart city, smart agriculture and smart water/waste water system techniques and practices. Create synergies with smart activities in other domains (e.g. agriculture and energy) to promote circularity. Collection of case studies • Activity 2: Collection of methodologies and applications on system dynamics/systems thinking (e.g. using Fuzzy pattern recognitions, agent based modelling, hybrid simulation)	2022-2026
ISS_5	**Enabling long-term decision-making taking into account uncertainties (and deep uncertainty) for climate change adaptation for the water sector**	• Activity 1: Promote the development and use of uncertainty simulation techniques (e.g. probabilistic, long-term etc) for DSS for the water sector and methods under deep uncertainty. • Activity 2: Seek and promote the synergies with stakeholders in the formulation and simulation of uncertainties due to climate change, but also to other types of extreme events (e.g. pandemics) and take them into account in DSS for climate change adaptation.	2022-2032

Special challenges/topics for discussion relevant

ISS_3	**Digital twins for real/near time operational management of water systems**	• Activity 1: Promote the developments of digital twins for various types of water systems, including predictive and prospective twins for designing and training (e.g. longer-term developments and stress scenarios) • Activity 2: Promote the use of advanced and innovative visualisation techniques for water system management • Activity 3: Collection of use cases on Digital Twin and benchmarks

- From Smart to Intelligent: How can we proceed from Smart to Intelligent Water Systems through AI

- From Digital Twins to Decision Support Systems : what are the transition challenges (eg for waste water treatment, stormwater/rainwater, raw drinking water and drinking water distribution and supply)?

Be solution oriented & Illustrate by use cases

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Special challenges/topics for discussion relevant

- From Smart to Intelligent: How can we proceed from Smart to Intelligent Water Systems through AI
- E.g. How capable is your data acquisition?
- What type of equipment are you using?
- What sort of data, handling and storage are you using? What techniques do you use to fuse and interrelate the data from multiple sources
- What modelling techniques are you using to interpret the dynamics of you system? Knowledge & Intelligence
- Please give specific examples from use cases

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Special challenges/topics for discussion relevant

- From Digital Twins to Decision Support Systems : what are the transition challenges

➢ Give examples of the models that have been developed to capture dynamics of water systems

➢ Type of models

➢ How have you validated and verified these models

  - Please give specific examples from use cases

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AG: Intelligent and Smart Systems

What happened in 2021 (activities and publications)

- Finalised the systemic review on Decision Support Systems for sustainable water management systems
- Completed our DSS roadmap and DSS marketplace that can go live (excel)

Project	ID	Name of DSS	Type of DSS	Water Value Chain	Main aim of the DSS	Problem(s) addressed	Challenge Addressed	How?	SDGs contribution	Tool scope	Decision-making level	Stakeholders	Decision orientation (how it supports decision making)	Spatial Coverage	Temporal Coverage	IoT enablers
ICATCH	1	DSS	Data-driven	Source/Ecosystems (freshwater resources i.e. rivers)	Strategies for the investigative monitoring of surface water quality and Catchments management. Identification of pollution sources and mitigation measures.	Detect and address water quality changes in freshwater resources	Water degradation (Point-source pollution and non-point source pollution)	ICT technologies to facilitate monitoring Obtain real time water quality data	Goal 6 - Clean water and sanitation	Environmental monitoring	Tactical and Operational	Community, Environment agencies, NGOs	"Diagnostic analysis tool" to detect likely causes of water quality change "Scenario Analysis" to identify and suggest water quality improvement	Catchment		Autonomous and radio controlled boats, sensors and DNA test kits, cloud-based data management platform
WC	2	Interoperable DSS and real-time control algorithms for stormwater management	Data-driven and model-driven	Source/Ecosystems (bathing water, river)	Machine-learning based Early Warning System for bathing/river water quality	Assess water and contamination risk			Goal 6 - Clean water and sanitation; Goal 9 - Industry, innovation and infrastructure	Early warning (bathing,river water quality)	Operational	Health / Environmental authorities, water utilities, public	The early warning system is an open source software interface that enables real-time bathing water quality assessment. Based on ML and/or statistical modelling, it predicts bacterial concentration in specific river sections using a set of local data such as rainfall, river flow, temperature and water quality.	Urban	Day - weeks	Sensors, weather data
BathWater	3	DSS	Data-driven	Source/Ecosystems (bathing water, water pollution) considering CSOs (untreated rainwater leakages), spillages (i.e. solid, plastic etc.) and rain pollution	Enabling monitoring strategies to minimise discharges from the unit system (DSU) and untreated-rainwater leakages + reduce the presence of solid, plastic and fibre spillages + determine the concentration of substances that are harmful to human health in bathing water (Local level). Strategies for operational management (with information from the global network, i.e. operational strategies to detect and alert CSOs) and bathing; such as determining bathing flags (Global level)	Reduce the impact of untreated rainwater on natural aquatic systems	Water degradation (Point-source pollution and non-point source pollution)	SCADA systems; online tools; ext. tools; panels/platforms. Monitoring strategies and management strategies considering the source of pollution	Goal 6 - Clean water and sanitation	Operation and Control (Human intervention required)	Operational	Wastewater operators/managers, wastewater utilities, water utilities, agriculture, chemical industry, construction sector	The DSS uses automated reasoning and learning techniques for recommending efficient strategies on the monitoring of rainwater deposits and management of bathing areas.	Urban, city		
que3S	4	Integrated platform	Data-driven, knowledge-driven, and communication driven	Source/Ecosystems (lakes, rivers and sea water), water distribution	Water crisis events Assessment and classification; crisis severity level identification during pre-emergency and emergency crisis phases	Water quality and water supply, Identify the areas with high crisis severity level to help authorities prioritize their actions	Water safety (point-source pollution and non-point source pollution, terrorist attacks, spills, emerging pollutants) and water security (leakage detection); Water degradation (Point-source pollution and non-point source pollution, terrorist attacks, spills, emerging pollutants)	Data-driven and ICT based monitoring; early detection of pollution and hydrological modelling of the evolution of the events, crisis management scenarios and prioritization of actions	Goal 6 - Clean water and sanitation; Goal 9 - Industry, innovation and infrastructure	Environmental monitoring	Operational	Water authorities, water utilities, emergency responders	The DSS detects, locates, and prepares mitigation actions to leakage and water contamination. A 'Recommeder' tool aiming at detecting and assessing the crisis severity level	Local (Urban areas)	Real-time for sensors, depends on data provided for simulations	Sensors, UAVs, satellites and social media data
rimeWater	5	Forecast model	Data-driven, model-	Source/Ecosystems (lakes,	Forecasting (at different time	Increase situational awareness	Water degradation (due to weather extremes and algae blooms)	Help prepare for forthcoming	Goal 12 -	Environmental monitoring	Tactical and	water utilities, water				

List of DSS tools - new version | Sheet1 | Categories

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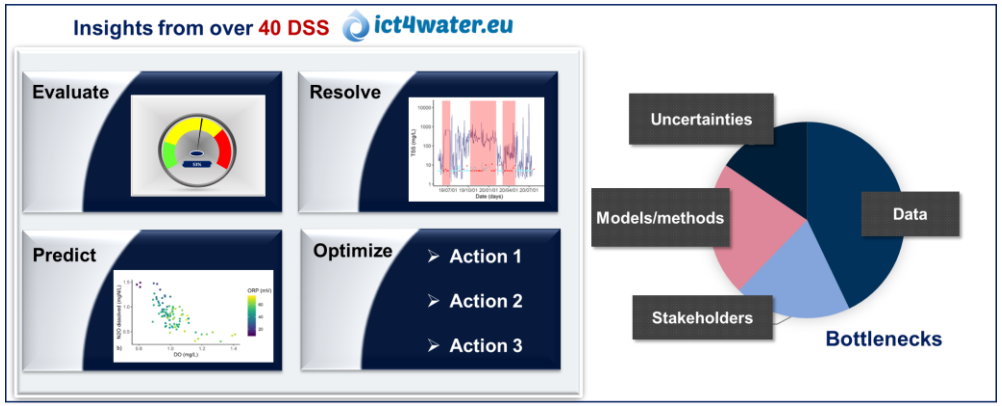
AG: Intelligent and Smart Systems

What happened in 2021 (activities and publications)

- Submitted a journal paper (awaiting review)



- Made connection to SWAN Forum's Digital Twins working group (coordinated by Gigi Karmous) on collaboration on Digital Twins actions of the AG.

Actions in ICT4WATER action plan

ISS_1	Deployment of IoT enablers and data models for smart sensors and data collection	**Activity 1** Utilisation of IoT platforms (e.g. FIWARE) and context brokers **Activity 2** Promote the development of IoT compatible water data models **Activity 3** Create and promote a library of IoT data models in public domain (e.g. FIWARE)	2022-2025	• HE and following Funding Schemas • Current funded activities • Synergies among currently funded projects • Synergies with data sharing AG
ISS_2	Use of AI techniques for big data analytics for the water sector	**Activity 1** Promote the use of advanced AI techniques for data analytics and decision making (e.g. deep reinforcement learning) **Activity 2** Create a library and repository of AI models and algorithms related to water	2022-2026 2026-2032	• HE and following Funding Schemas • Current funded activities • Synergies among currently funded projects • Cross-synergies with other sectors
ISS_3	Digital twins for real/near time operational management of water systems	**Activity 1** Promote the developments of digital twins for various types of water systems **Activity 2** Promote the use of advanced and innovative visualisation techniques for water system management	2022-2026	• HE and following Funding Schemas • Current funded activities • Synergies among currently funded projects

Actions in ICT4WATER action plan

ISS_4	Improve efficiency and circularity in water use and re-use	**Activity 1** Continue supporting and boosting smart city, smart agriculture and smart water/waste water system techniques and practices **Activity 2** Create synergies with smart activities in other domains (e.g. agriculture and energy) to promote circularity **Activity 3** Promote public private partnership to leverage risks and opportunities	2022-2026	• HE and following Funding Schemas • Current funded activities • Synergies among currently funded projects • Synergies with other sectors • National funding schemes
ISS_5	Taking into account uncertainties (and deep uncertainty) for climate change adaptation for the water sector	**Activity 1** Promote the development and use of uncertainty simulation techniques (e.g. probabilistic, long-term etc) for DSS for the water sector **Activity 2** Seek and promote the synergies with stakeholders in the formulation and simulation of uncertainties due to climate change, but also to other types of extreme events (e.g. pandemics) and take them into account in DSS for climate change adaptation.	2022-2032	• HE and following Funding Schemas • Synergies among AG • Synergies with CLIMA projects and initiatives • Synergies with MISSION calls/actions

AG action plans

What we are planning for 2022

- **Update the DSS marketplace based on new survey** (include new projects, update on included projects)

- Start to work on next deliverables.
  - ISS3 _ Digital Twins

    Digital Twins – definitions, boundary conditions, experience, lessons learned

  - Digital Water Innovation Hubs

    What is the role of Digital Innovation Hubs, what hubs are in place, what are limiting factors to success of DIHs

  - ***Expand DSS survey to include DT and DIH questions to collect information simultaneously.***

Topic for discussion today

- Are the actions defined in the action plan (ISS1-5) the highest priority actions for ICT4WATER and EU policy concerning Intelligent and Smart Systems for water? Do we need more or less (less is preferred)

- Which of these actions should receive highest priority, acknowledging at AG can not work on more than 1 (max. 2) actions simultaneously.

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Thank you for your attention

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