Delivering Digital Water: Global Case Studies

07 NOVEMBER 2024

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AGENDA

- Introduction
  Oliver Grievson, AtkinsRealis/Chair IWA DWP
- Developing Digital Twins of the Wastewater System
  Yufeng Guo, Three Gorges Smart Water Technology/ Member IWA DWP
- Digital Water and Resillience – a case study from Brazil
  Marina Batalini de Macedo, UNIFEI/ Member IWA DWP
- Q&A Panel Discussion
  All speakers and moderator
- Close
  Oliver Grievson, AtkinsRealis/Chair IWA DWP

WEBINAR INFORMATION

- This webinar will be **recorded and made available "on-demand"** on the IWA Connect Plus platform and IWA Network website, with presentation slides, and other information.
- The **speakers** are responsible for **securing copyright permissions** for any work that they will present of which they are not the legal copyright holder.
- The opinions, hypothesis, conclusions or recommendations contained in the presentations and other materials are the **sole responsibility of the speaker(s)** and do not necessarily reflect IWA opinion.

WEBINAR INFORMATION

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- **'Chat' box**: please use this for general requests and for interactive activities.
- **'Q&A' box**: please use this to send questions to the panelists.
  (We will answer these during the discussions)

***Please Note:** Attendees' microphones are muted. We cannot respond to 'Raise Hand'.*

ABOUT THE DIGITAL WATER PROGRAMME

- The Digital Water Programme aims to act as a catalyst for innovation, knowledge, and best practices around digitalisation for the water industry, provide a platform to share experiences and promote leadership in transitioning to digital water solutions, and consolidate lessons to guide the natural evolution from the ‘business as usual’ to achieving a digital water utility.

- The Programme is driven by end users (e.g., utilities, regulators) as well as solution providers (e.g., technology companies, software companies, researchers, academia) at the forefront of emerging technologies to solve urgent and costly operational problems to deliver water services.

- The overall goal of the Programme is to facilitate utility’s access to knowledge that enhances the rate of success of their digital initiatives and prowess. The objectives of the Programme ensure this goal can be achieved.

The DWP Steering Committee

The Steering Committee guides the Programme, ensuring the goal and objectives are consistently achieved.

The 2023 – 2025 Steering Committee was recently announced, with 55% being female, and 50% representing low- and middle-income countries.

The Steering Committee is led by Oliver Grievson.

The DWP Goal

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Goal

To facilitate embedding digital at the core of the water profession to address challenges and create value

Objectives

Suggested Tools

Collate body of knowledge and insights from members

- Webinars
- Blogs & podcasts
- Videos
- Zoom interviews

- White papers
- Case studies
- Surveys
- Book series

To empower members with a unified terminology and standards

- Elevator pitch
- Good practice guides
- Workshops

Enabling sharing between members

- Library of case studies

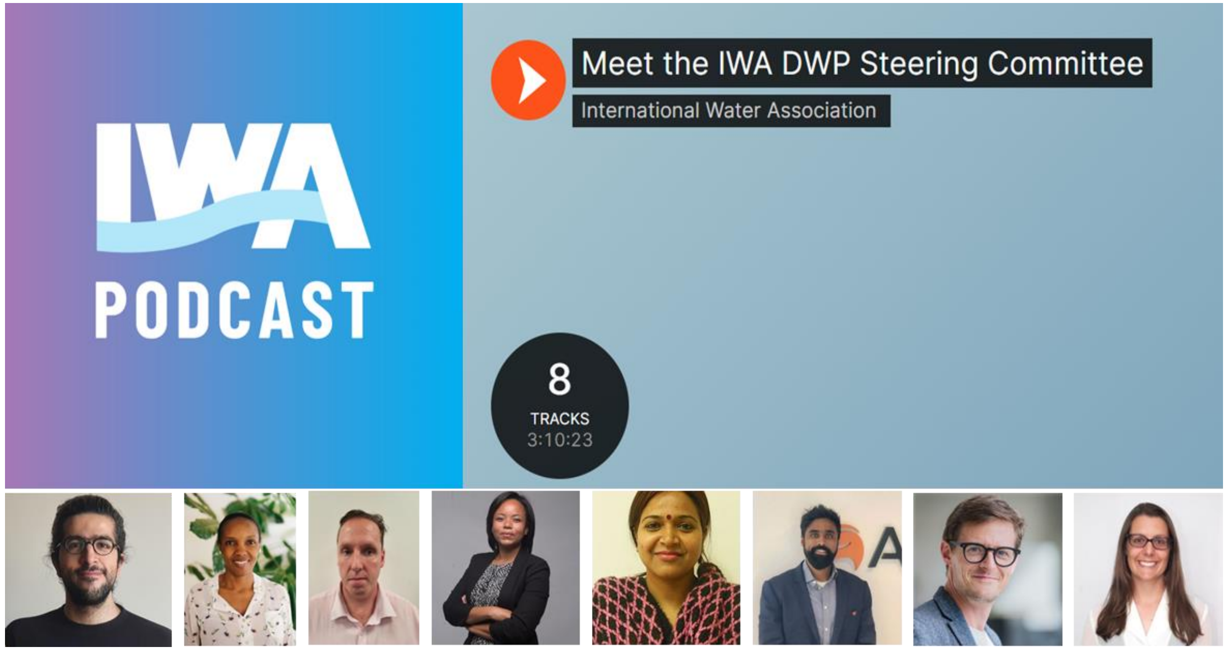
Creating a focal point in IWA for Digital Water

- Annual Meeting (DWS)
- Subgroups working on different topics

The DWP Outputs

Publications

Podcasts, webinars, online meetings and more!



MODERATORS & SPEAKERS

Oliver Grievson
Associate Director, AtkinsRealis, UK

Marina Batalini de Macedo
Adjunct Professor, UNIFEI, Brazil

Yufeng Guo
Deputy General Manager, Three Gorges Smart Water Technology, China

Developing Digital Twins of the Wastewater System

A CASE STUDY OF DIGITAL WATER TRANSFORMATION IN CHINA

Dr Yufeng GUO

Three Gorges Smart Water Technology Co., Ltd.

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OUTLINE

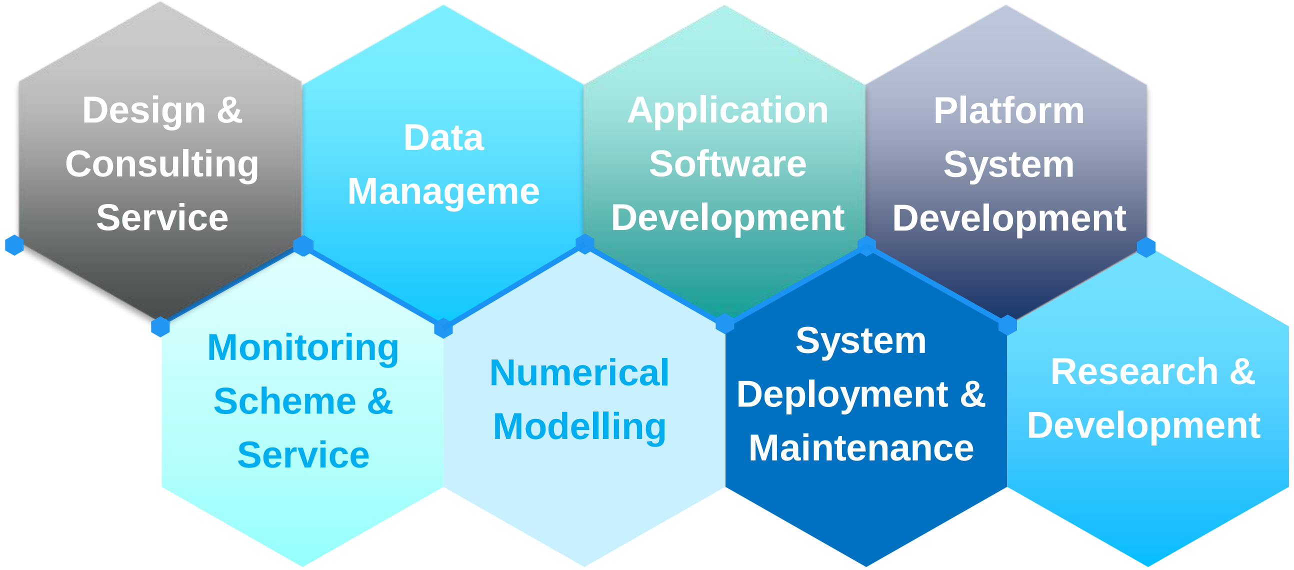
- Background Introduction
- Framework & Methodology
- Practices of Digital Twins in Jiangjiu City
- Achievements of The Project

COMPANY BACKGROUD

Three Gorges Smart Water Technology Co. Ltd.

- A subsidiary of **China Three Gorges Group**
- Two offices: **Shanghai** & **Wuhan**
- Founded in **October 2021**

中国三峡
China Three Gorges Corporation

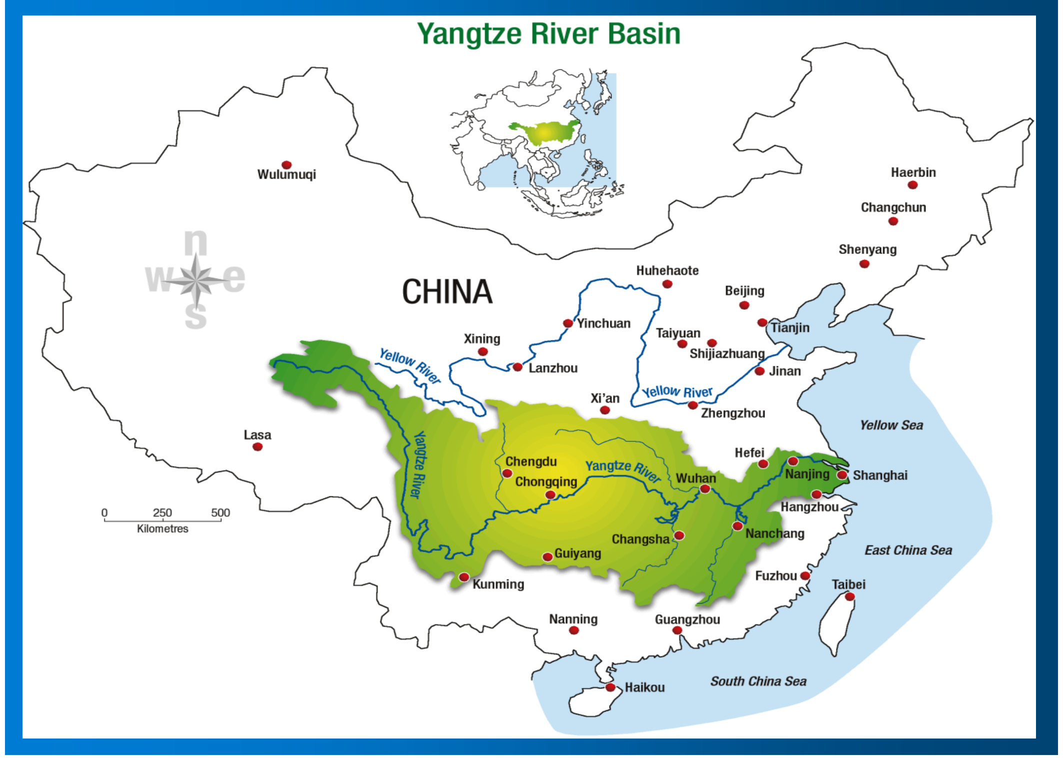


GREAT PROTECTION OF THE YANGTZE RIVER

Aim to vigorously protect and improve the ecology and environment of the Yangtze River Basin

Contributions from Three Gorges Group on urban water management & environment protection

- Promote **Urban Smart Water Steward** in China embracing water resources, raw water transportation, water treatment and distribution, wastewater collection and treatment, drainage network, sludge treatment, and open water.
- A total investment of **28.7 billion** $
- Over **660** WWTPs or treatment works, with a total treatment capacity of **4.5 million** m^3/day
- Rehabilitation & new constrution of over **50,000** km drainage pipes
- Implement digital water transformation and smart water solutions



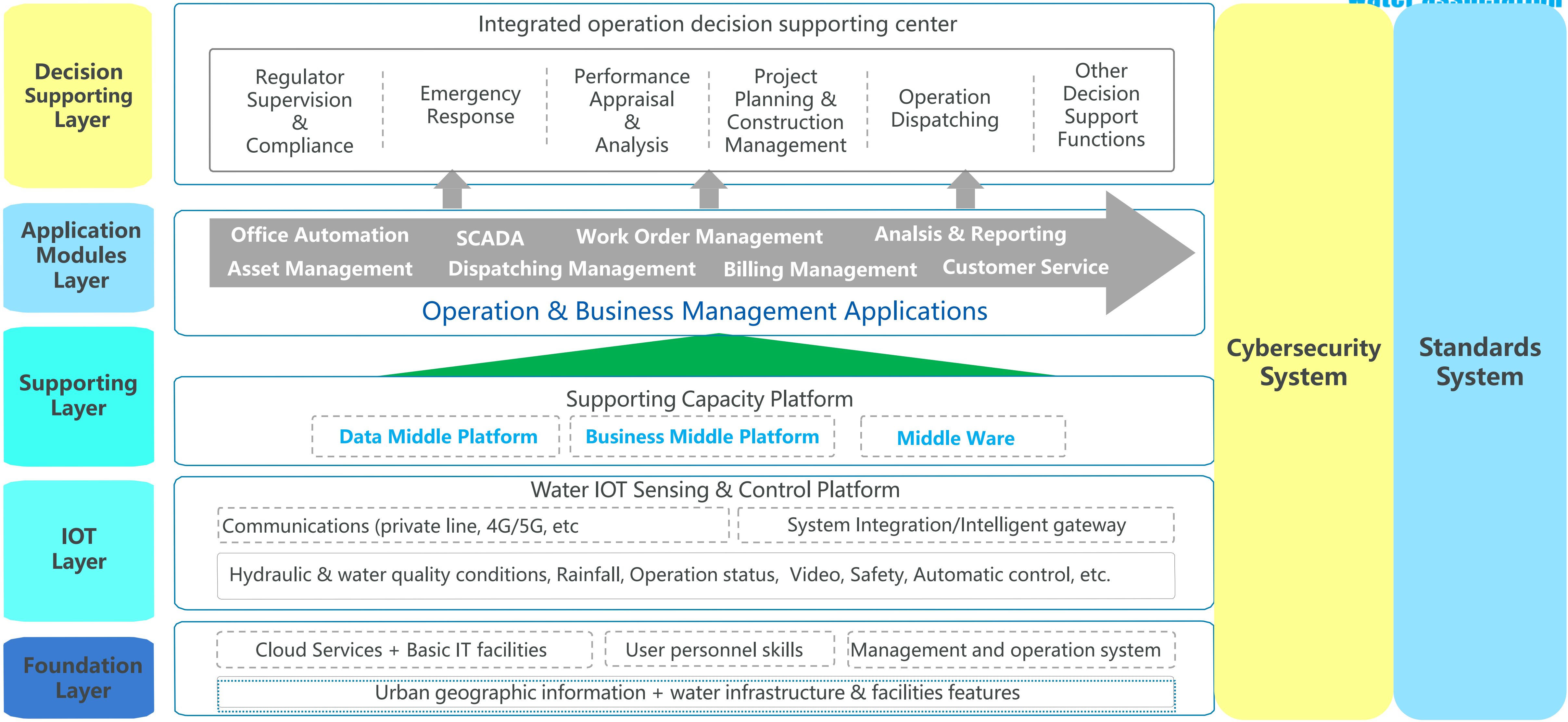
- The largest river in China with diverse habitats and ecosystems
- Pass through nine provinces and several metropolitan areas
- Its watershed accounts for 21 % of China's total area and >40 % of gross domestic product (GDP)

CASE STUDT IN JIUJIANG CITY

Covers all drainage facilities in the central area (around 80 km²) of Jiujiang City

- **6** wastewater treatment plants
- Over **40** sewer pumping stations
- **1862** km of drainage pipe networks
- **1** sludge treatment plant
- **6** regulating reservoirs
- Rivers and lake facilities
- Sevice population: **2.89** million

FRAMEWORK OF SMART WATER SYSTEM



SMART WATER MANAGEMENT SYSTEM

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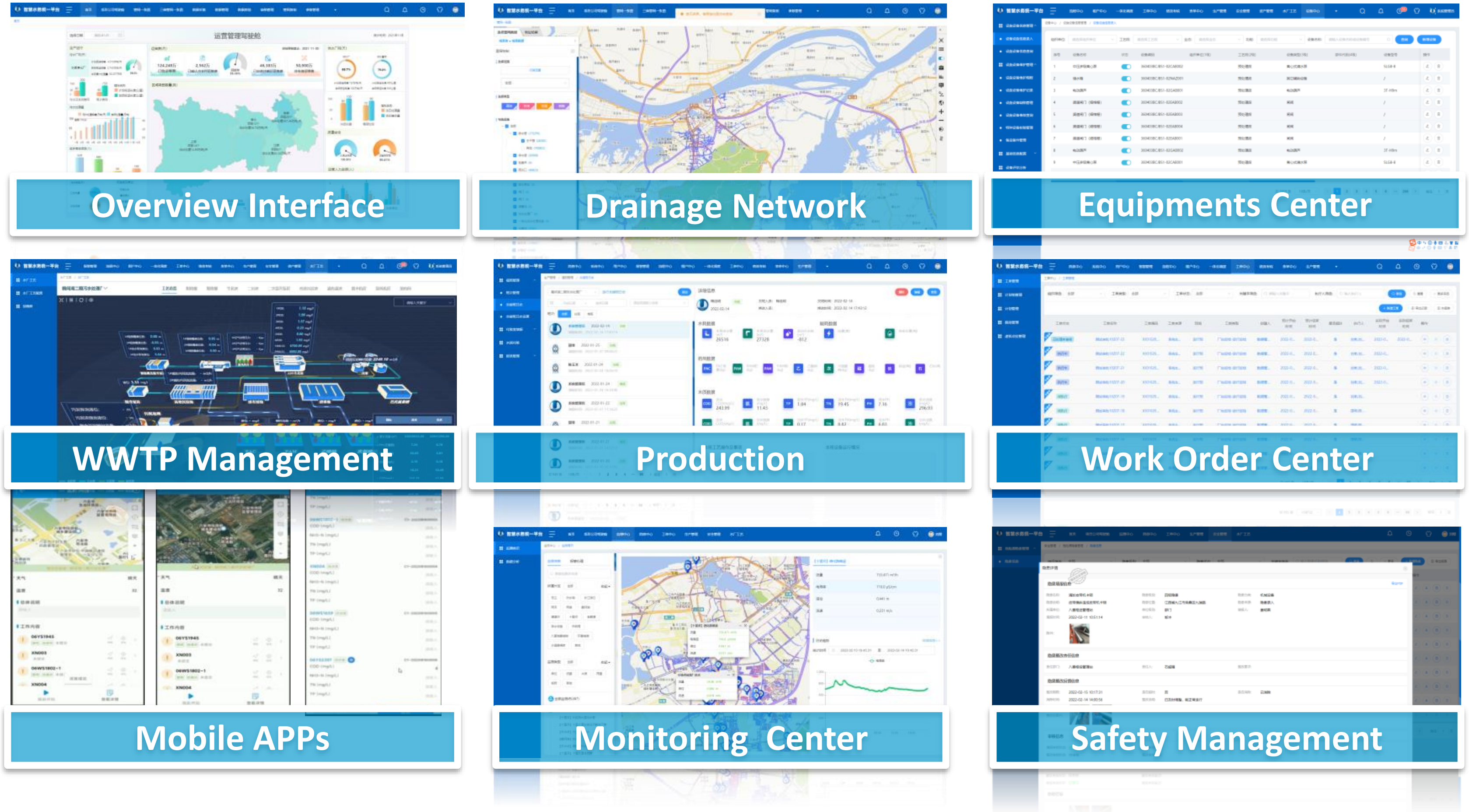
SMART WATER MANAGEMENT SYSTEM

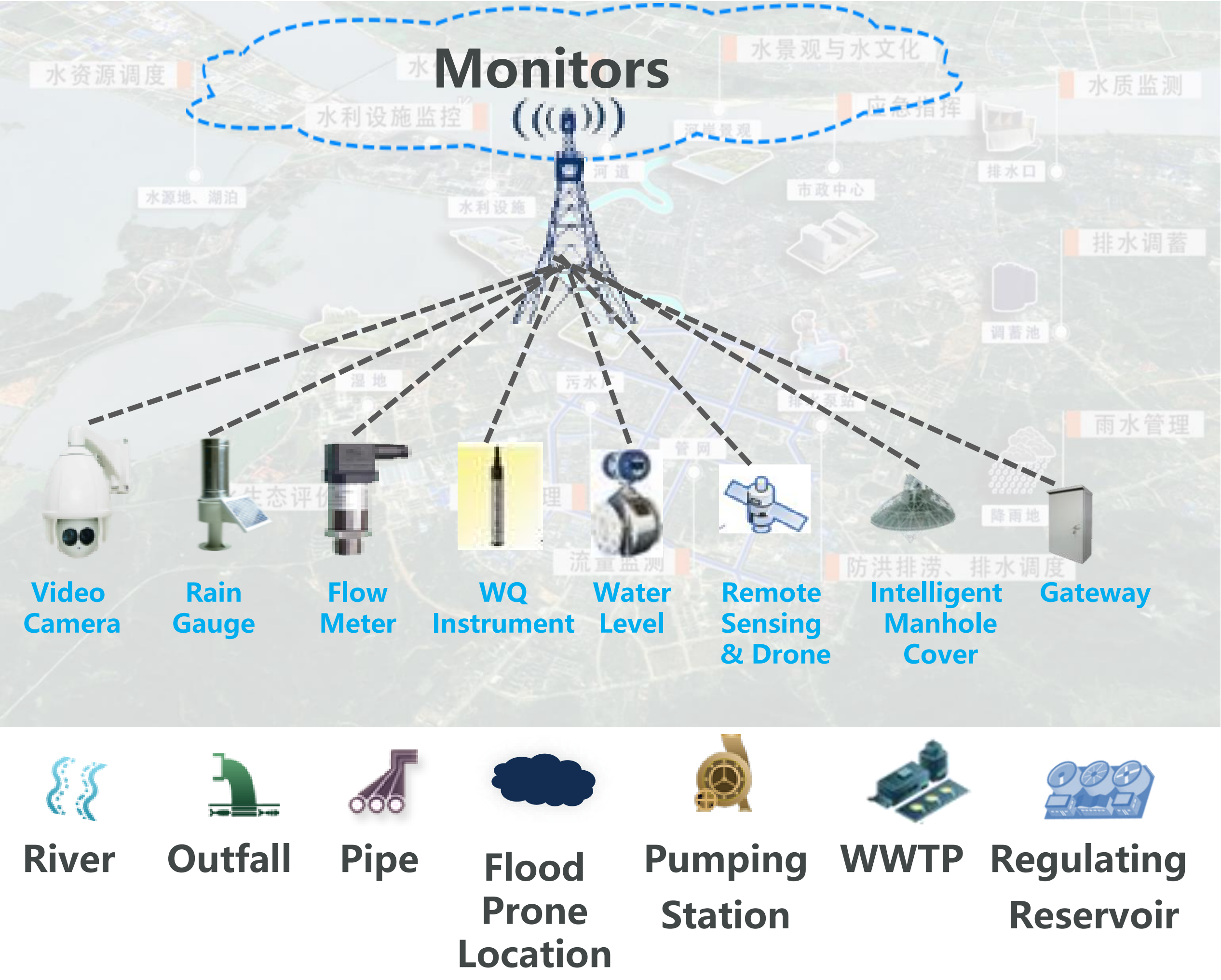
Develope a smart water management system to support daily operation management



- **Over 80 function modules** sewerage & stormwater drainage network, sewage treatment, industrial wastewater, rivers and lakes, flood control, water environment, sponge city, sludge treatment & control, raw water, water supply, water saving, recycled water, etc.
- **Over 300 user accounts**
- **Over 1400 standarised reports** (daily, weekly & monthly)
- Daily operation and management data records exceed **49,600** entries

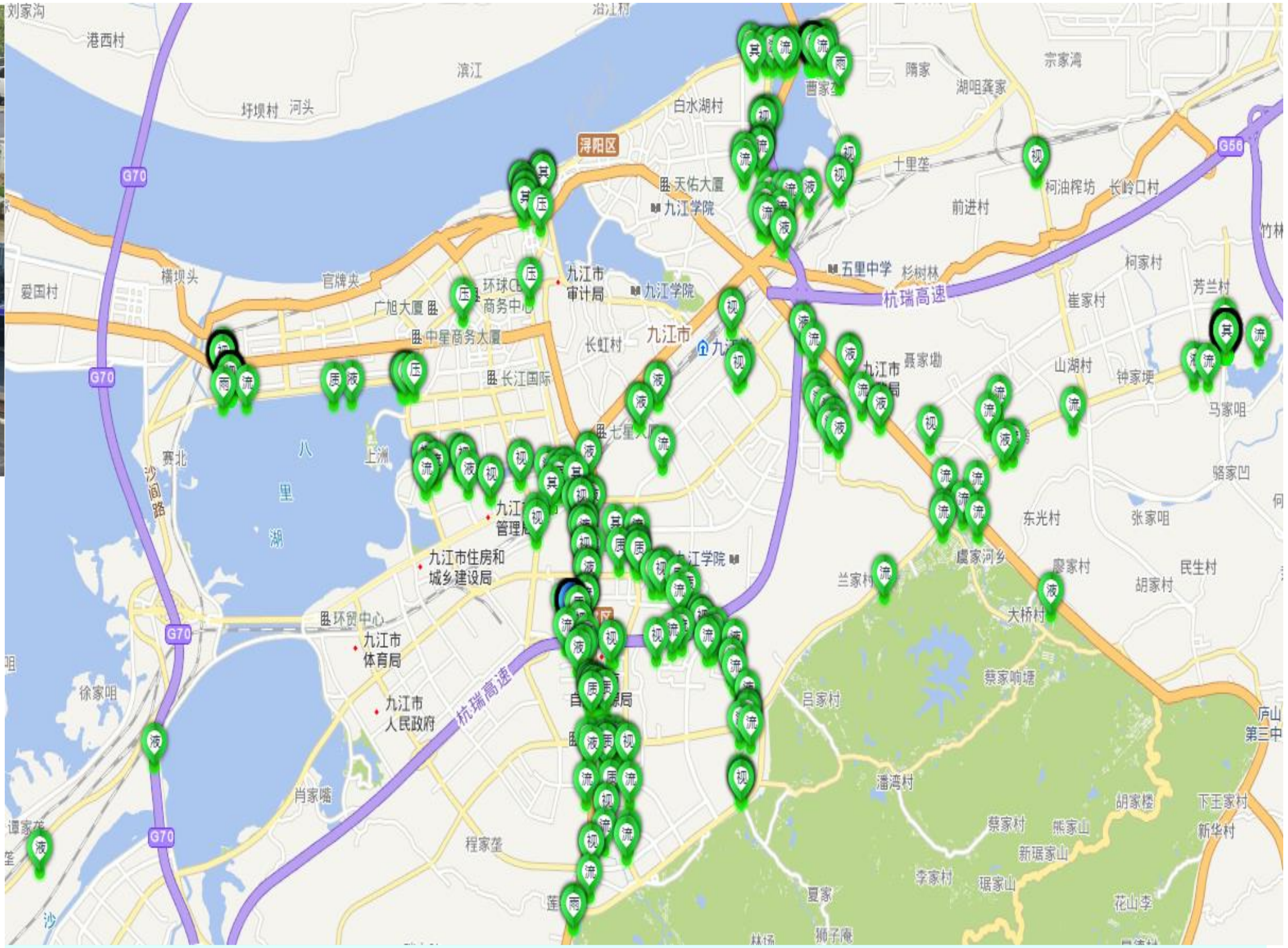
MONITORING SYSTEM

Deploy monitors across the newtork to being well aware of operational status



No.	Instrument type	Quantity
1	Flow rate	87
2	Water level	53
3	Pressure	4
4	uvCOD	19
5	Total Suspended Soilds	9
6	Conductivity	9
7	Oil	9
8	Rainfall	5
9	Portable multi-parameter water quality	4
10	Integrated laser water level gauge	20
11	HD camera	32
12	Intelligent manhole cover alarm	40

MONITORING SYSTEM



Layout Map of Monitors within the System

Intelligent manhole cover alarm

Video surveillance

Online monitor

DATA MANAGEMENT

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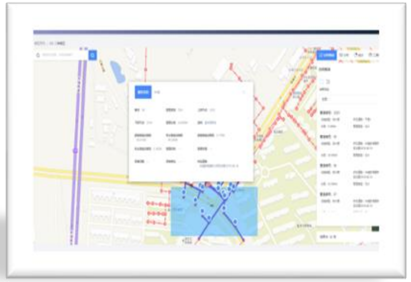
Collect data from various sources, including operations, workforce, water assets, work processes, monitoring data, numerical models and aggregate into a centralised data platform on cloud

Design drawings

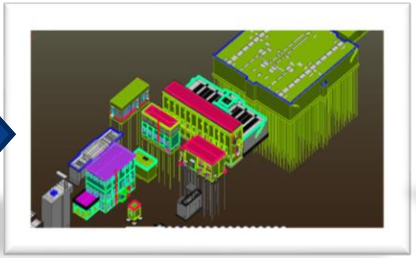
Numerical models



Importing

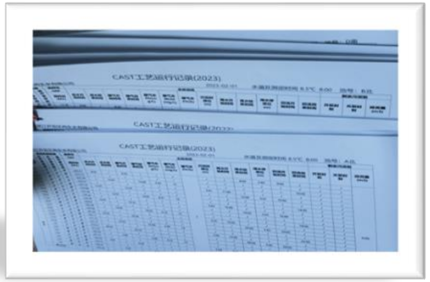
Photos & Videos

BIM models

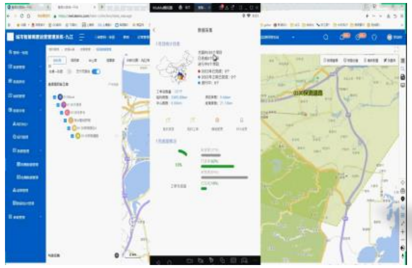


Processing

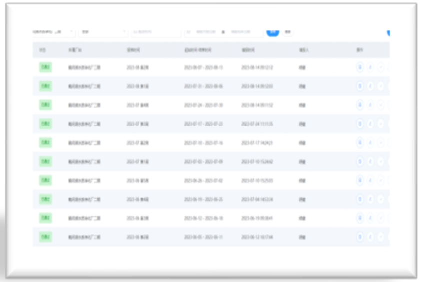
3D Visulisation



Data records & reports



GIS



Digitalisation

Data Acquisition

Data Assembing

Data Processing

Data Analysis

Data Application

TOOLS FOR ASSET DATA MANAGEMEMT

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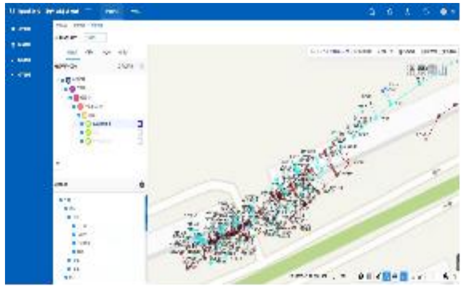
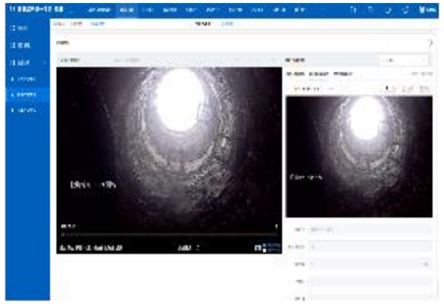
Develope digital tools for the whole life cycle management of pipe network

Phases	Existing	Planning & Design	Construction	Commissioning	Operation
Functions	Layout map of water facilities Defect identification Condition anslysis & assessment	Design process database Transfer plan and design drawings Reliabl data supporting plan & design	Database for construction processes Digitalisation of construction progress, quality & schedule control BIM models	Project delivery diagnostic report Completed drawing Reporting & analysis	System visualisation Digital Tiwn Operation & maintenance Performance appraisal

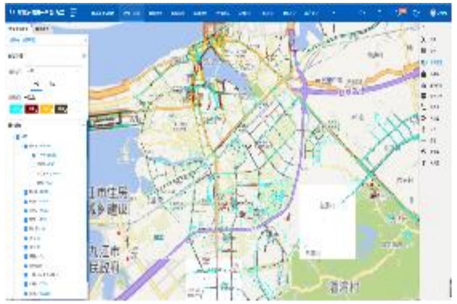
Digital Tools



Survey data management

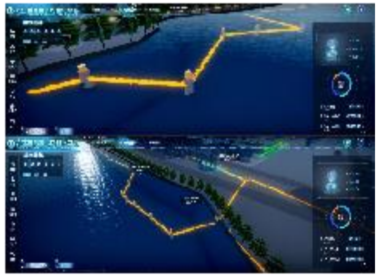


Inspection image & video interpretation



Construction management

Monitoring and diagnosis system



Operation management system

MODELLING OF DRAINAGE NETWORKS

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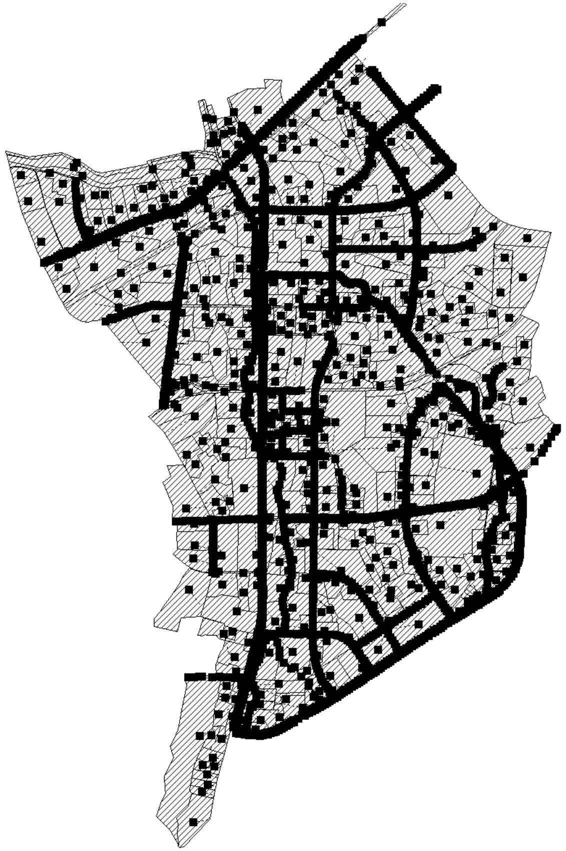
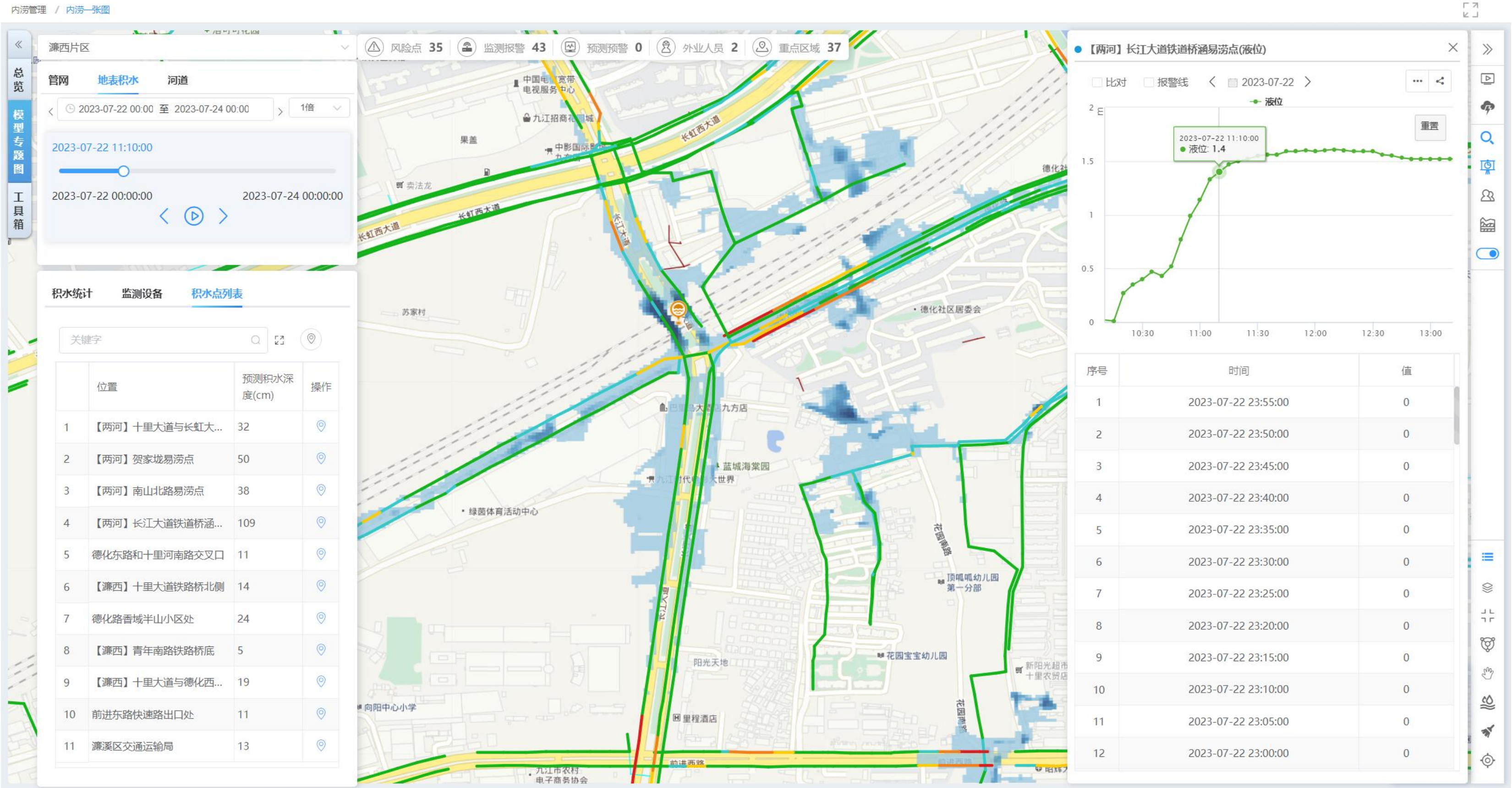


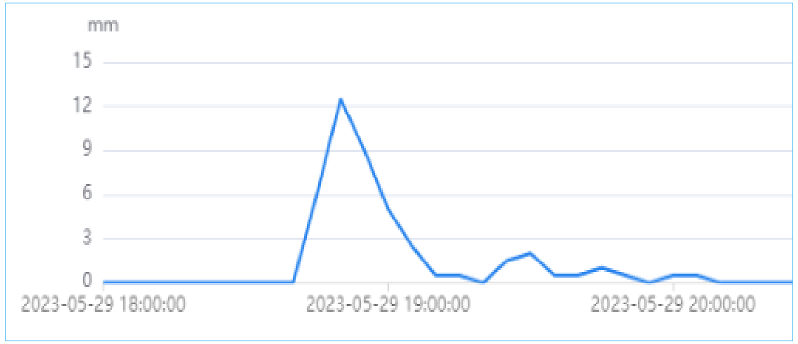


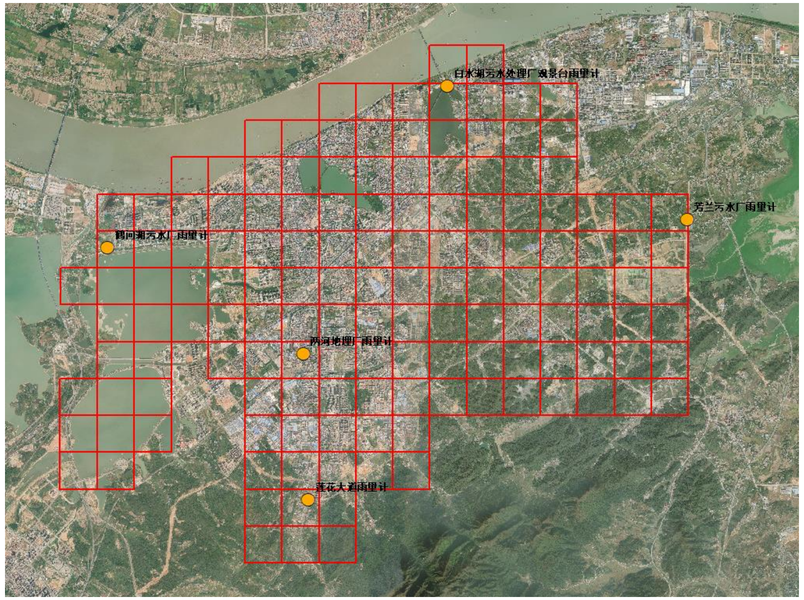
	位置	预测积水深度(cm)	操作
1	【两河】十里大道与长虹大...	32	
2	【两河】贺家垅易涝点	50	
3	【两河】南山北路易涝点	38	
4	【两河】长江大道铁道桥涵...	109	
5	德化东路和十里河南路交叉口	11	
6	【濂西】十里大道铁路桥北侧	14	
7	德化路香域半山小区处	24	
8	【濂西】青年南路铁路桥底	5	
9	【濂西】十里大道与德化西...	19	
10	前进东路快速路出口处	11	
11	濂溪区交通运输局	13	

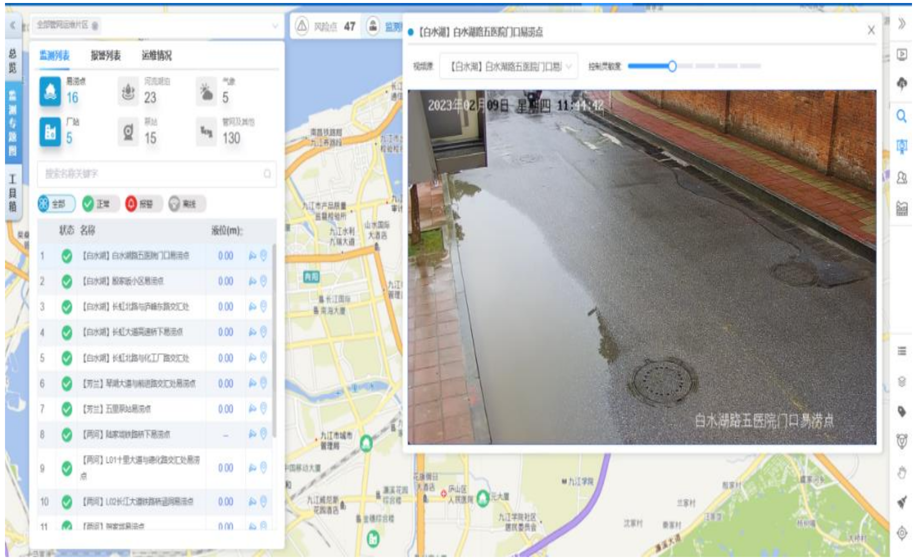
序号	时间	值
1	2023-07-22 23:55:00	0
2	2023-07-22 23:50:00	0
3	2023-07-22 23:45:00	0
4	2023-07-22 23:40:00	0
5	2023-07-22 23:35:00	0
6	2023-07-22 23:30:00	0
7	2023-07-22 23:25:00	0
8	2023-07-22 23:20:00	0
9	2023-07-22 23:15:00	0
10	2023-07-22 23:10:00	0
11	2023-07-22 23:05:00	0
12	2023-07-22 23:00:00	0

- Model Simulation Engines: SWMM + LISFLOOD
- Consecutive online simulation + data assimilation with latest monitoring & operation data

MODELLING OF DRAINAGE NETWORKS





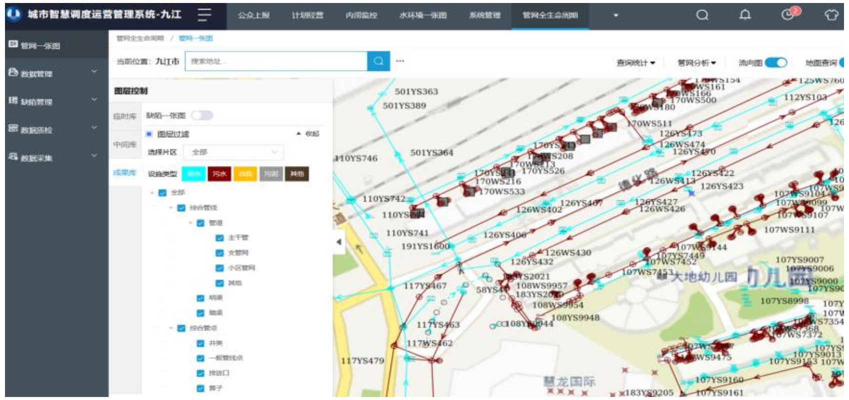


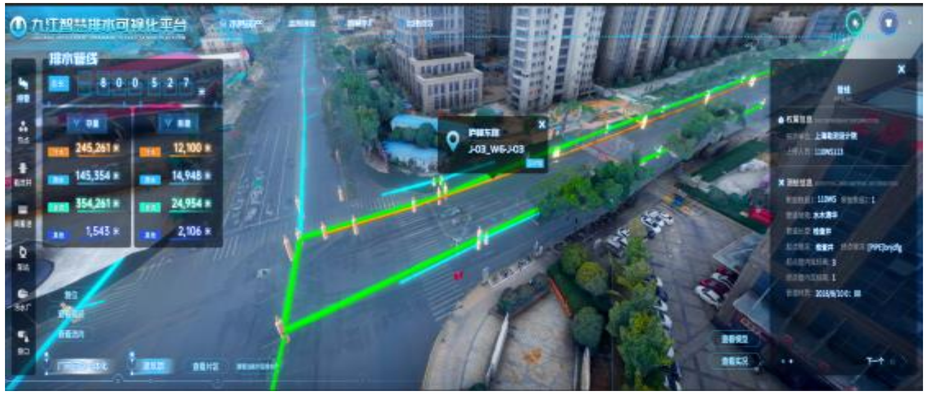
Rainfall Observation & Forecasting

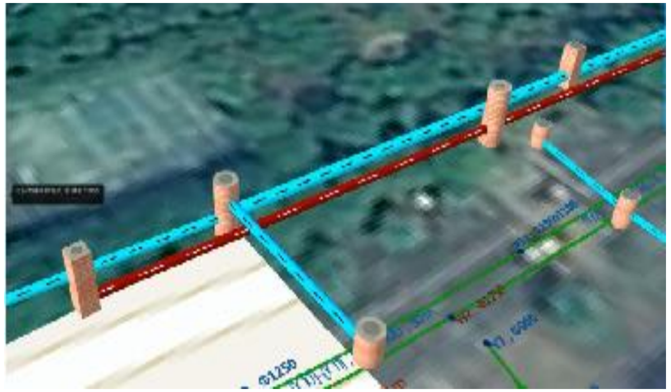
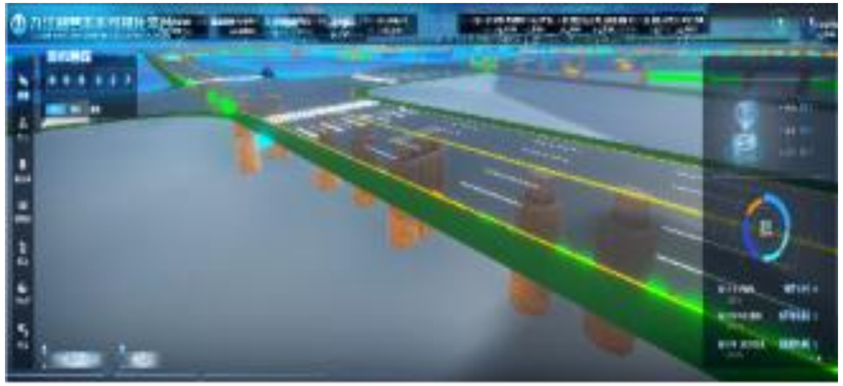
Modelling results vs observation & video records

Proactive dispatching

DIGITAL TWIN OF DRAINAGE NETWORK



DIGITAL TWIN OF WASTEWATER TREATMENT PLANT

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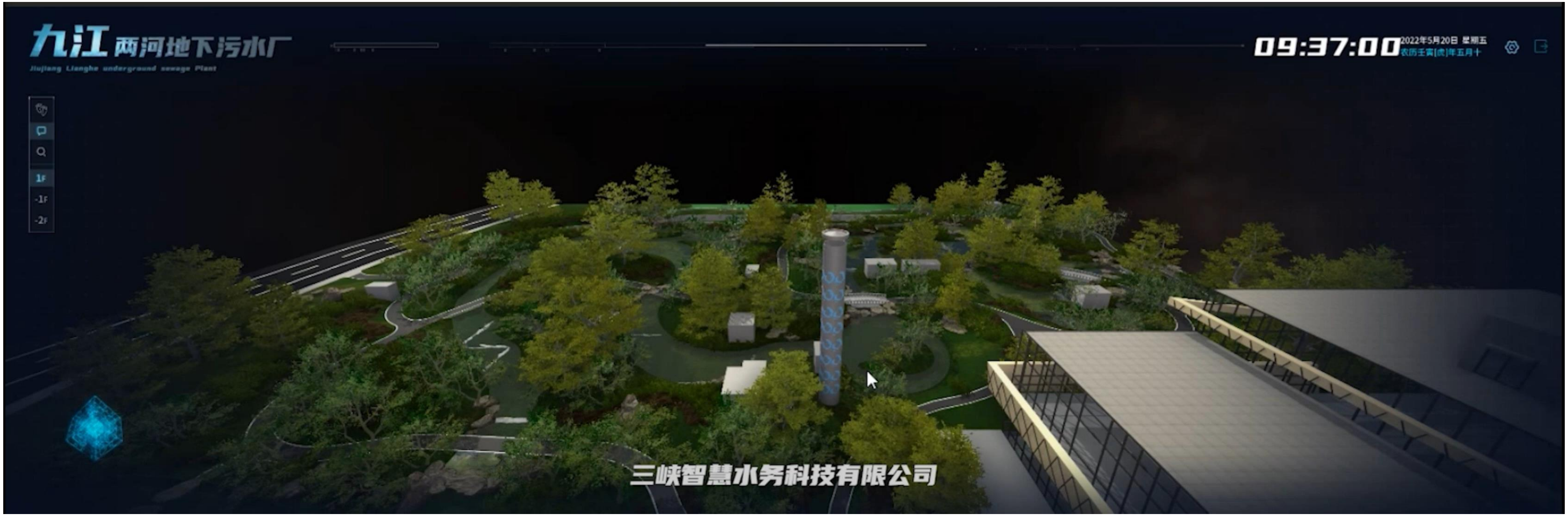
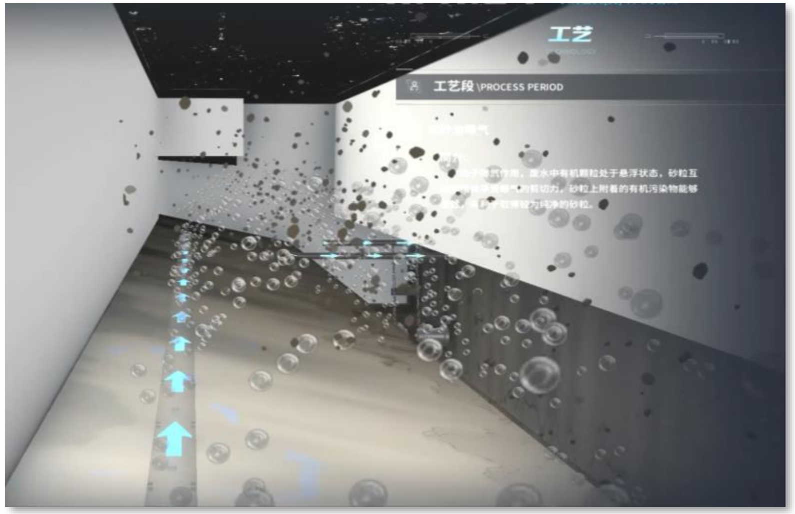
Lianghe Underground Wastewater Treatment Plants, JiuJiang City, Jiangxi Province

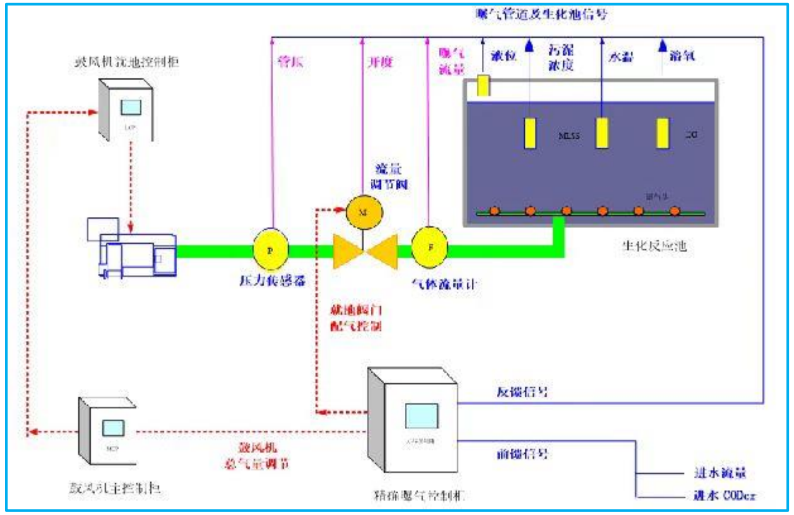


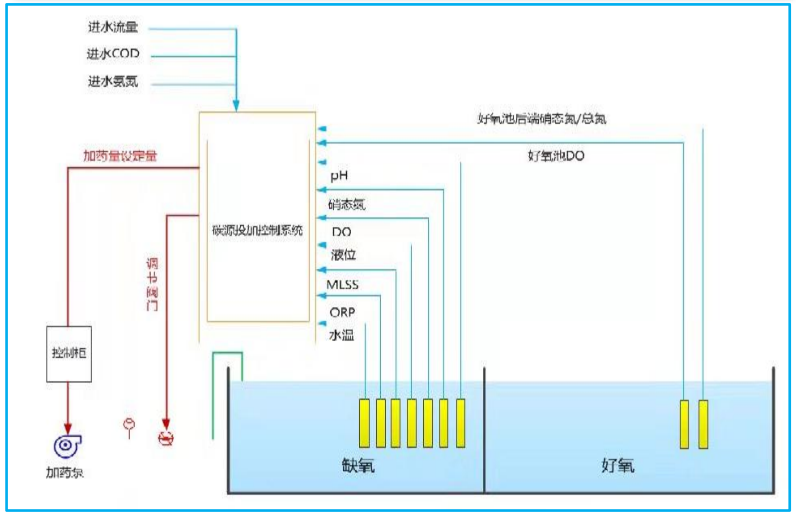
- **Area：** the total area covered by the plant is about **32,670**m^2
- **Design Capacity:** **30,000** m^3/day
- The project **started on April 25, 2019** and be completed and **accepted on May 31, 2021**

APPLICATIPNS UNDER DIGITAL TWIN OF WWTP

Intelligent Aeration	Intelligent Chemical Dosing

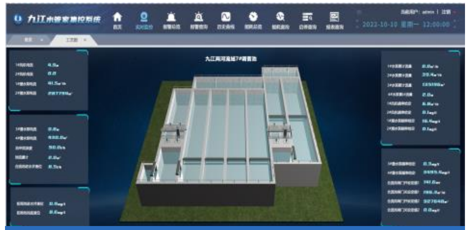






CENTRALISED CONTROL

WWTP



Regulating Reservoir

Pumping Stations

Alarm Query

Enery Consumption

ACHIEVEMENTS OF THE PROJECT

- **38%** improvement in operational and maintenance efficiency
- **26%** improvement in energy efficiency
- **60%** reduction in maintenance failure rates
- **80%** of process operations and safety training are based on the digital twin application technology
- **6** successful cases for pollution source tracing and source pollution control
- An educational resource for future generations of water engineers, attracting over **100** visits each year from a variety of stakeholders
- More than **10** patents and over **40** software copyrights

Thank You！

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Digital Water and Resillience: a case study from Brazil

DRA. MARINA BATALINI DE MACEDO – FEDERAL UNIVERSITY OF ITAJUBÁ

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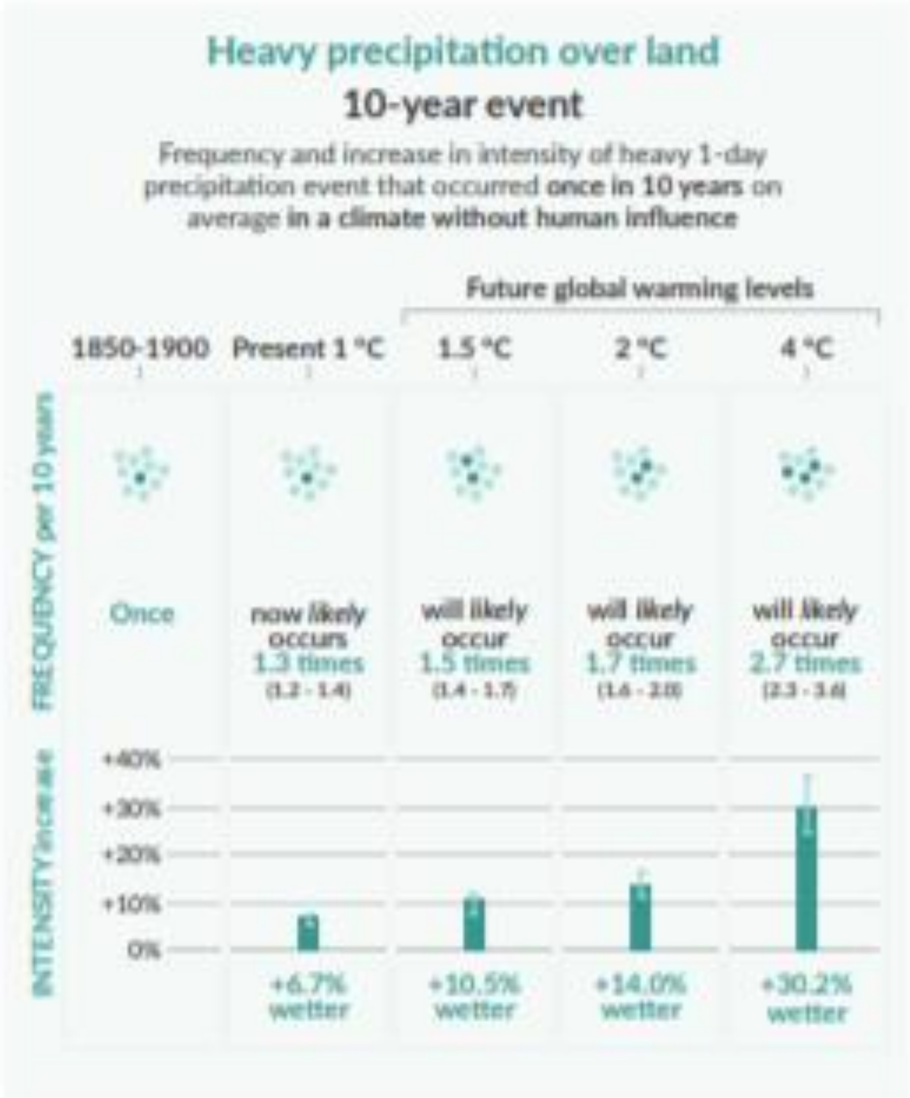
DIGITAL TOOLS TO IMPROVE FLOOD RESILIENCE



- The new IPCC report AR6 projects a **1.5-fold increase in heavy storms (return period = 10 years)** across the globe, even under scenarios of a more conservative rise in temperatures of 1.5°C (IPCC, 2021).
- Given that 55% of the world's population lives in urban environments (UN DESA, 2019), there is an urgent need to strengthen the urban resilience of water, sanitation, and stormwater drainage infrastructure.

DIGITAL TOOLS TO IMPROVE FLOOD RESILIENCE

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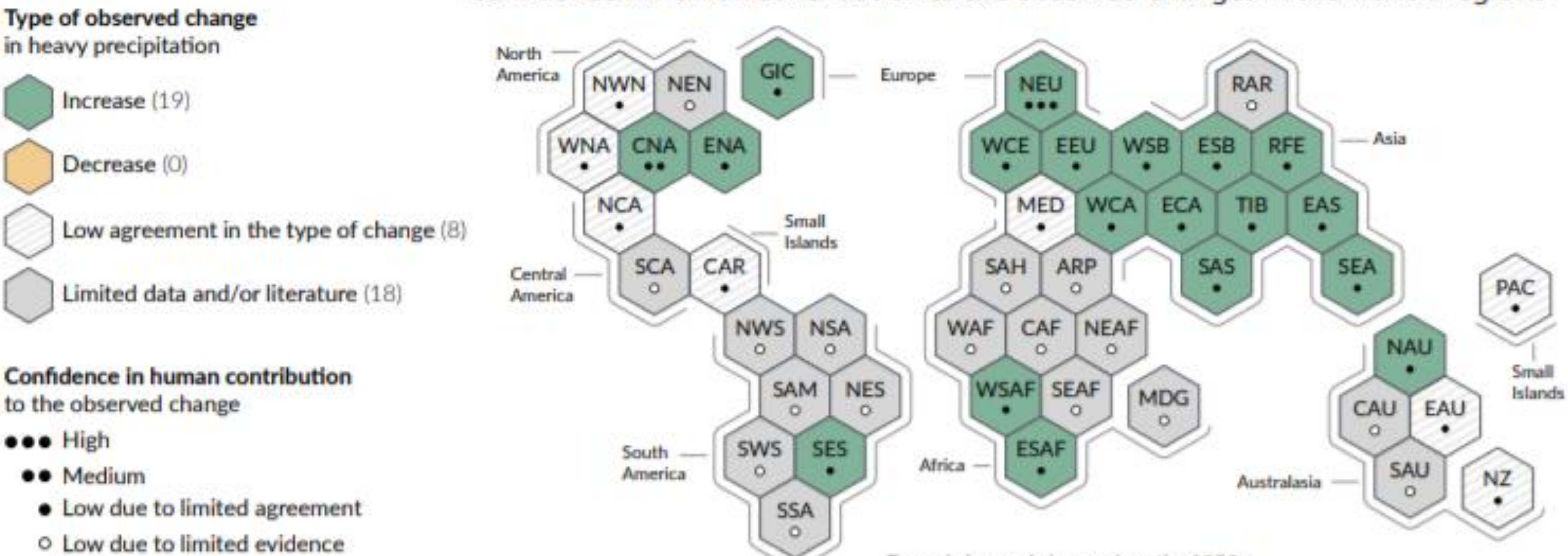
b) Synthesis of assessment of observed change in **heavy precipitation** and confidence in human contribution to the observed changes in the world's regions



Type of observed change since the 1950s

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Enchentes na Alemanha deixam mais de 100 mortos; 1.300 estão desaparecidos

Consideradas as mais intensas em 100 anos, chuvas torrenciais atingiram cidades e vilas, deixando casas destruídas, pessoas ilhadas e sem energia elétrica

Um terço do Paquistão está submerso pelas piores inundações da história do país

Maior lago de água doce do país foi invadido pelas autoridades com o intuito de impedir que áreas próximos sejam atingidas pela água das enchentes

DIGITAL TOOLS TO IMPROVE FLOOD RESILIENCE

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Spain floods mapped: Where are weather alerts in force as death toll hits 217?

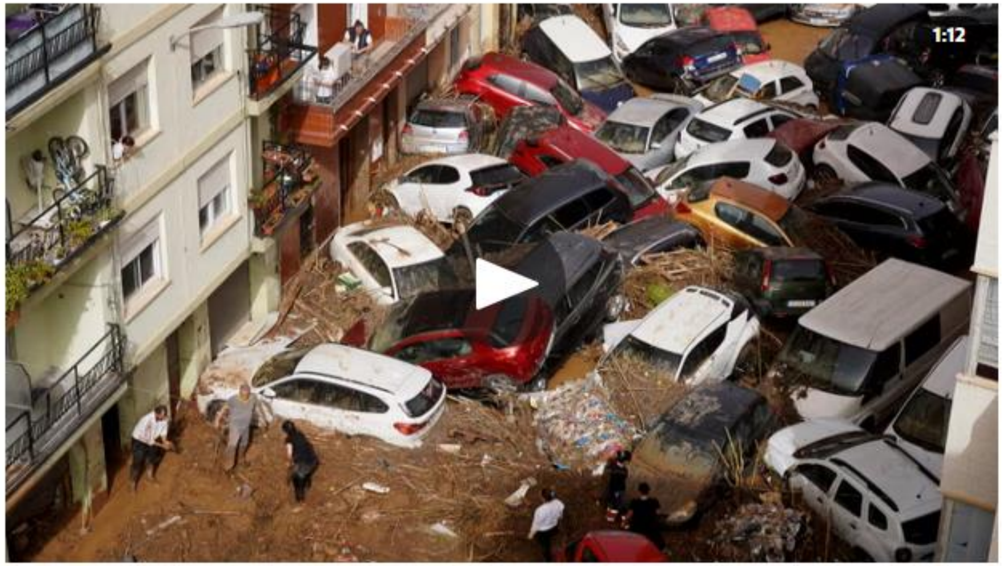
New weather warnings issued in areas in Spain as prime minister warns devastation from flooding is 'not finished'

Andy Gregory, Rachel Hagan • 1 day ago • 5 Comments

People in Valancia carry water and shovel mud after flooding hit large parts of the country *(Getty)*

At least 95 people dead in Spain's worst floods in three decades

Soldiers aid search for dozens still missing as prime minister warns extreme weather may not be over



Rescues as torrential rain brings flash flooding to Spain – video

Sul da Bahia vive a pior enchente dos últimos 35 anos

Imagens aéreas gravadas na quinta-feira (9) mostram o município de Jucuruçu debaixo d'água

Imagem: Reprodução/Prefeitura de Jucuruçu no Facebook

Litoral de SP foi atingindo por 'evento extremo', com recorde de chuvas e elevação do mar

Inundações e deslizamentos na região deixaram ao menos 40 mortos, 1.730 desalojados e 766 desabrigados, segundo o governo estadual.

Destruição na região de Juquehy, em São Sebastião, após a enchente do fim de semana — Foto: SEBASTIÃO MOREIRA/EPA-EFE/REX/SHUTTERSTOCK via BBC

DIGITAL TOOLS TO IMPROVE FLOOD RESILIENCE

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Milhares de atingidos na maior enchente da história do RS

3 de maio de 2024

Facebook Twitter WhatsApp +

Rio Taquari transbordou e subiu mais de 30 metros alagando dezenas de cidades. Vista aérea da cidade de Encantado, tomada pela enchente. Foto: REUTERS/Diego Vara

"Uma dor terrível", relata moradora afetada pela forte enchente no Rio Grande do Sul

IN GERAL, MEIO AMBIENTE

White paper

The Digitalisation Journey of Urban Climate Resilience: case studies on flood management and resilience

Marina Batalini de Macedo (Federal University of Itajubá, Brazil), Jyoti Gautam (Netaji Subhas University of Technology, Delhi, India), Sheilla de Carvalho (Royal Haskoning DHV, Singapore), Pilar Conejos (Idrica and Universitat Politècnica de València, Spain)

DIGITAL TOOLS TO IMPROVE FLOOD RESILIENCE

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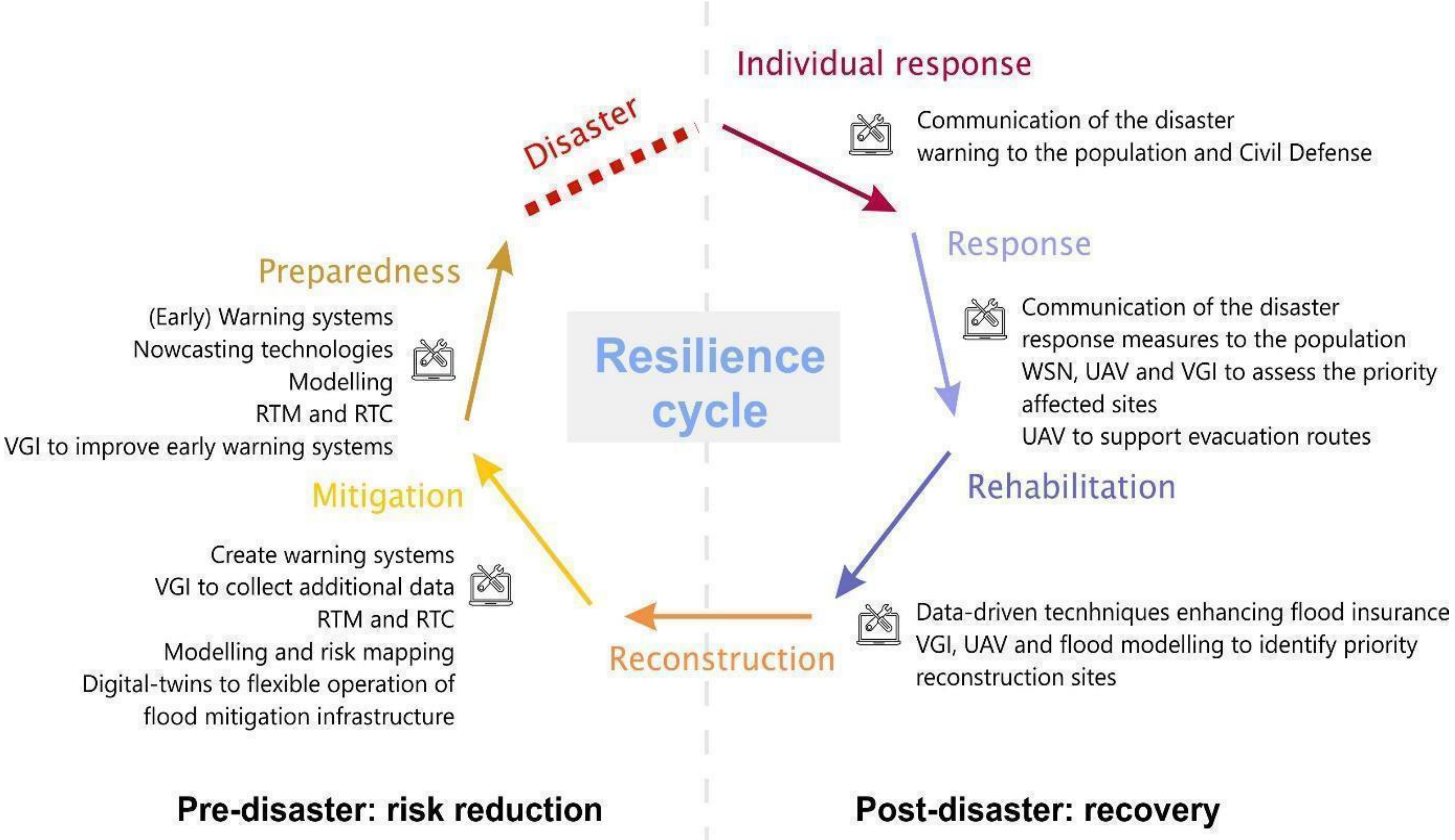
- What is resilience? How do we define it?
- UNDRR – Sendai Framework:
  - Resilience means the ability of a system, community or society exposed to hazards to resist, absorb, accommodate to and recover from the effects of the hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions.
- Urban resilience and urban sustainability (Zhang and Li, 2018):
  - Urban resilience is the passive process of monitoring, facilitating, maintaining and recovering a virtual cycle between ecosystem services and human wellbeing through concerted effort under external influencing factors,"
  - "Urban sustainability is the active process of synergetic integration and co-evolution between the subsystems making up a city without compromising the possibilities for development of surrounding areas and contributing by this means towards reducing the harmful effects of development on the biosphere.

DIGITAL TOOLS TO IMPROVE FLOOD RESILIENCE



Abbreviations.
RTM: Real-time Monitoring;
RTC: Real-time control;
VGI: Volunteered Geographic Information;
WSN: Wireless Sensor Networks;
UAV: Unmanned Aerial Vehicles.

CASE STUDY FROM BRAZIL: ASTHON TEC.

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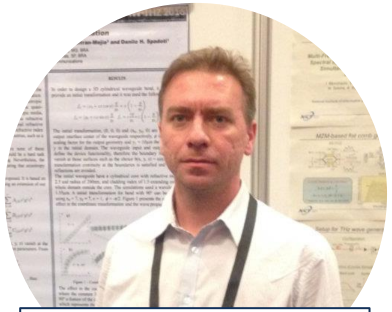
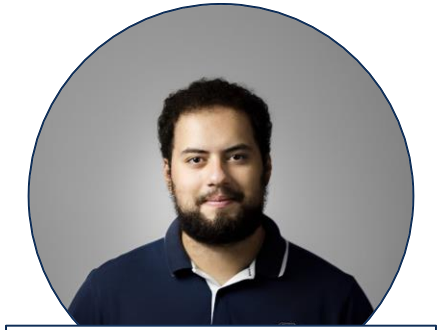
Flood monitoring and warning system in urban areas based on a Long Range Wide Area Network: case study for the city of Itajubá, Brazil

Benedito C. da Silva

Vitória J. Baratella



Danilo Spadoti



Caio T. B. da Costa

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UNIVERSIDADE FEDERAL DE ITAJUBÁ

CASE STUDY FROM BRAZIL: ASTHON TEC.

Flood monitoring and warning system in urban areas based on a Long Range Wide Area Network: case study for the city of Itajubá, Brazil

The challenge addressed in this case study is to develop a **monitoring and alert system for urban areas** based on **compact measuring stations**, with **low construction cost**, **minimum energy consumption**, **simple maintenance** and that **communicates measured data** to the user in an objective manner and in accessible language.

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the international water association

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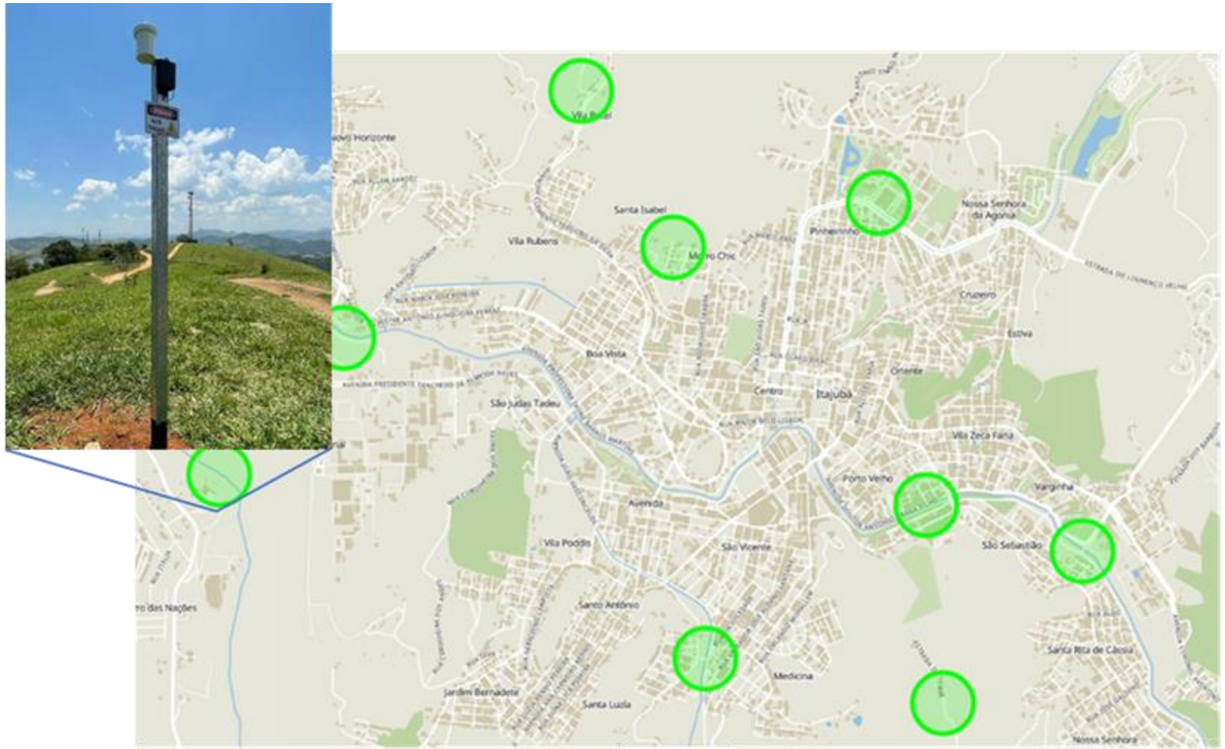
Monitoring and alert system for urban areas

Hydrological study of the basin to choose the better and strategic spots in terms of monitoring.

- Where can we install rain gauges that would be able to provide the best response in terms of spatial variation in the basin and in terms of hydrological response?

- Where do we need to install flow/depth meters to be able to catch the flood wave? Specially in terms of flash floods.



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Compact measuring stations

Compact stations to avoid problems of spatial availability in urban areas and to avoid thefts.

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Low construction cost, **minimum energy consumption**, **simple maintenance**

Urban areas require different temporal scales (usually < 10min), which requires a lot of memory and energy consumption, hence, high costs.

Flow and depth meters are usually costly and have “closed” communication.

Strategic places for rain gauges can sometimes be out of coverture range for 3g.

The high costs of installation, operation and maintenance are a barrier to small and medium cities to adopt this systems.

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Low construction cost, **minimum energy consumption**, **simple maintenance**

The main digital component developed by ASTHON was the data reception and transmission module via LoRaWAN.

- MARLIN: this module consists of a digital circuit board where sensors are connected, and data is received and sent to LoRaWAN receivers.

Extremely compact and with low energy consumption, it requires a small battery whose charge can last for months, without needing a solar panel for recharging.

The sensors used are preferably nationally manufactured and low cost.

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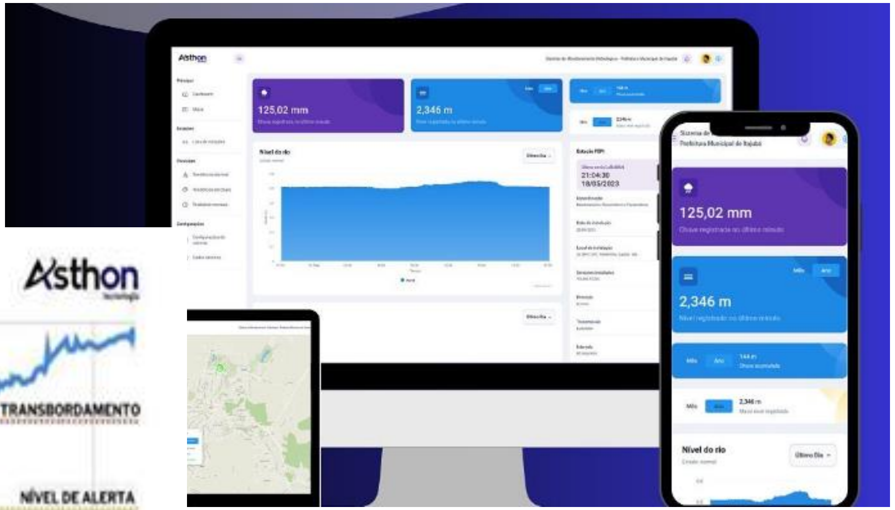
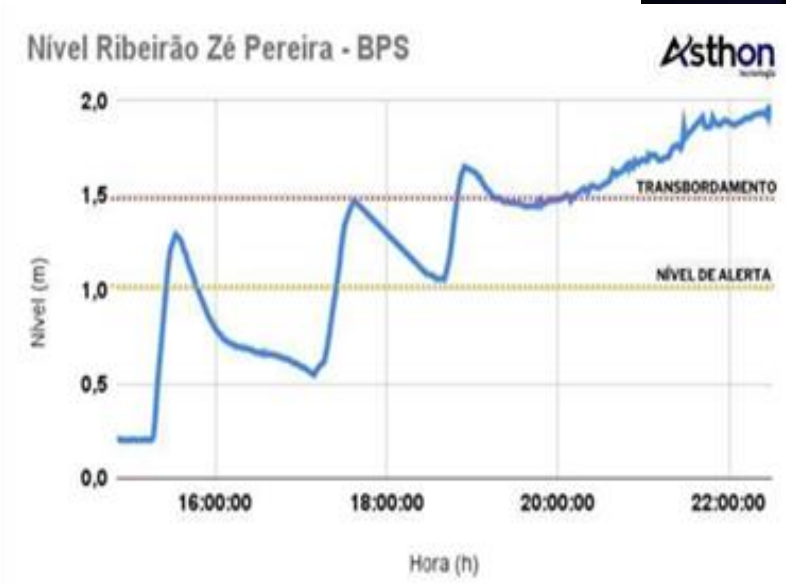
Communicates measured data

Board to communicate the data to the user.

Data visualisation is graphical and uses colour scales, with indication of alert thresholds (Normal, Attention, Emergency).

It is possible to set the viewing period and access numerical data as well.





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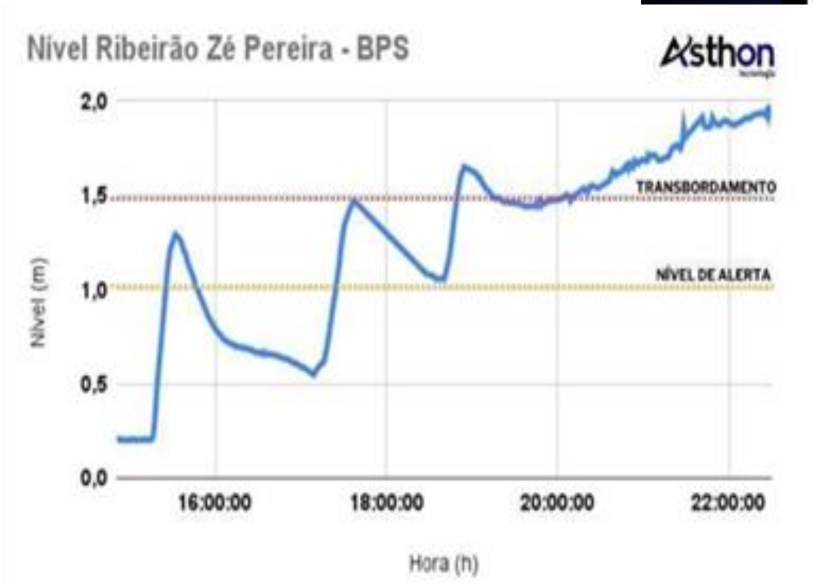
Communicates measured data

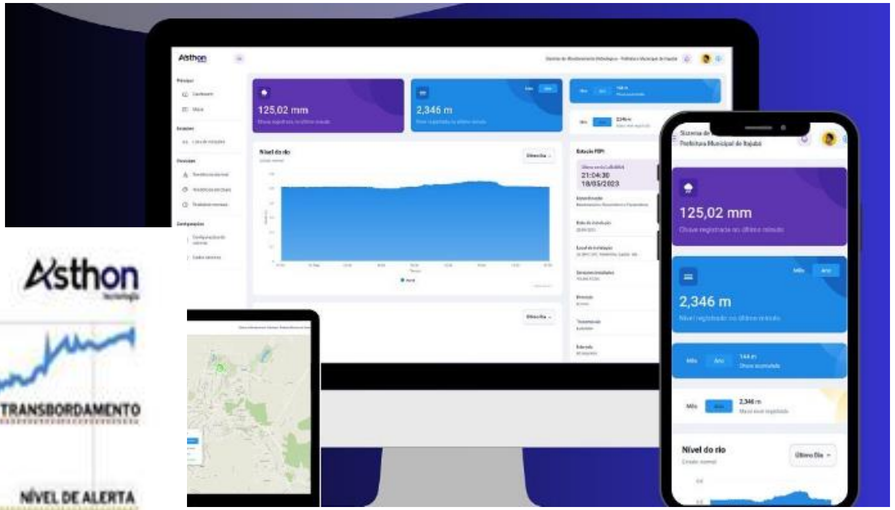
The alert thresholds are defined by hydrological studies and modelling:

- MGB
- HEC-HMS

And according to the information of the civil defense in the location.

As the system collects data and learn with it, AI models are trained to improve the prediction.





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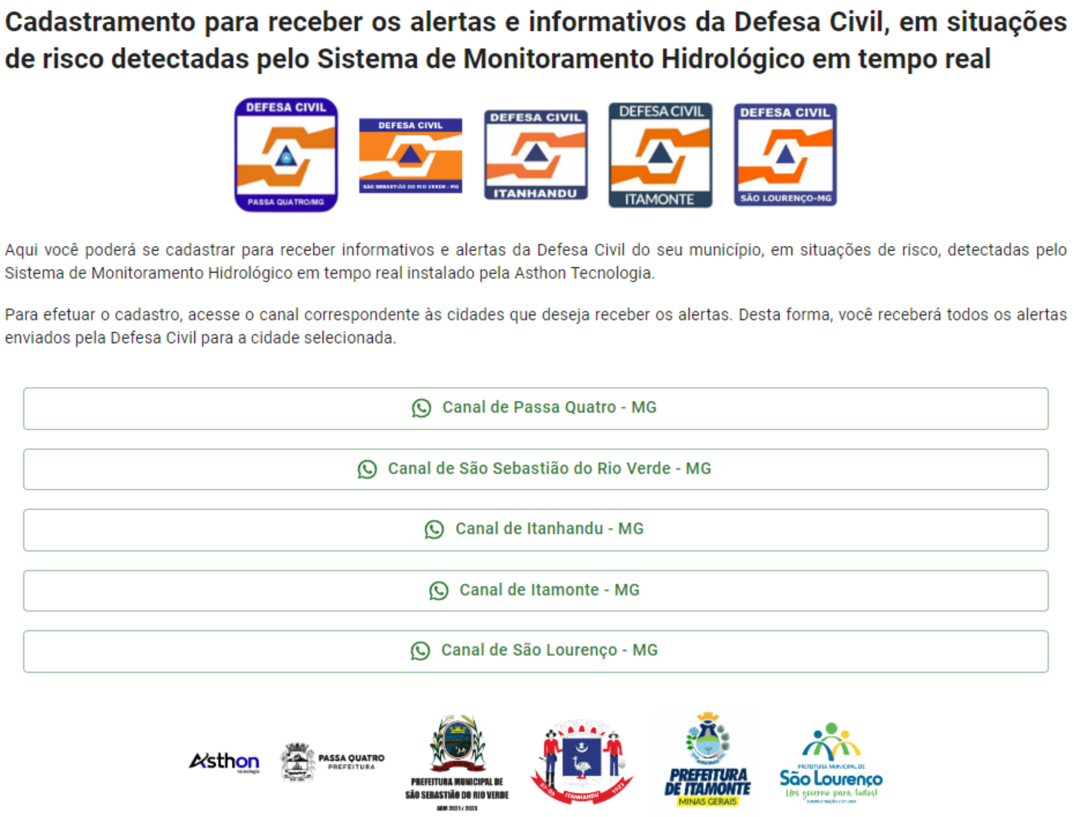
Communicates measured data



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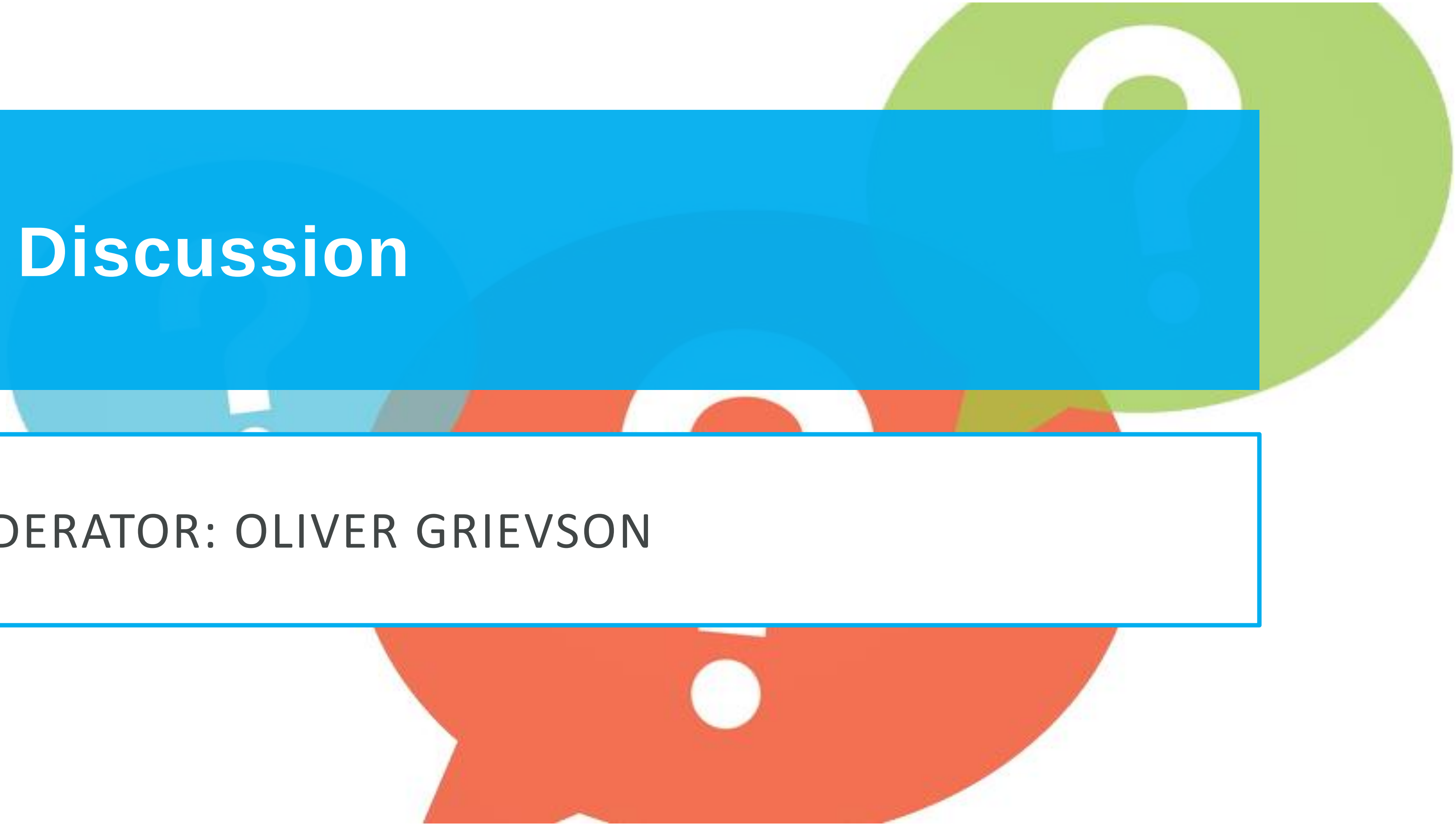
The entire development of the system is based on several years of **cooperation between team members and municipal civil defence teams**.

This experience made it possible to identify the municipality's deficiencies and needs in relation to the occurrence of extreme hydrological events. This way, it was possible to build a system tailored to these needs.

However, it is a tool that requires continuous improvements, the success of which depends heavily on the collaboration and trust of civil defence teams and other agents involved.

As important as using the best technology available is listening to and incorporating the experience of people who work on the front lines of preventing and combating extreme events.



Q&A Discussion

MODERATOR: OLIVER GRIEVSON

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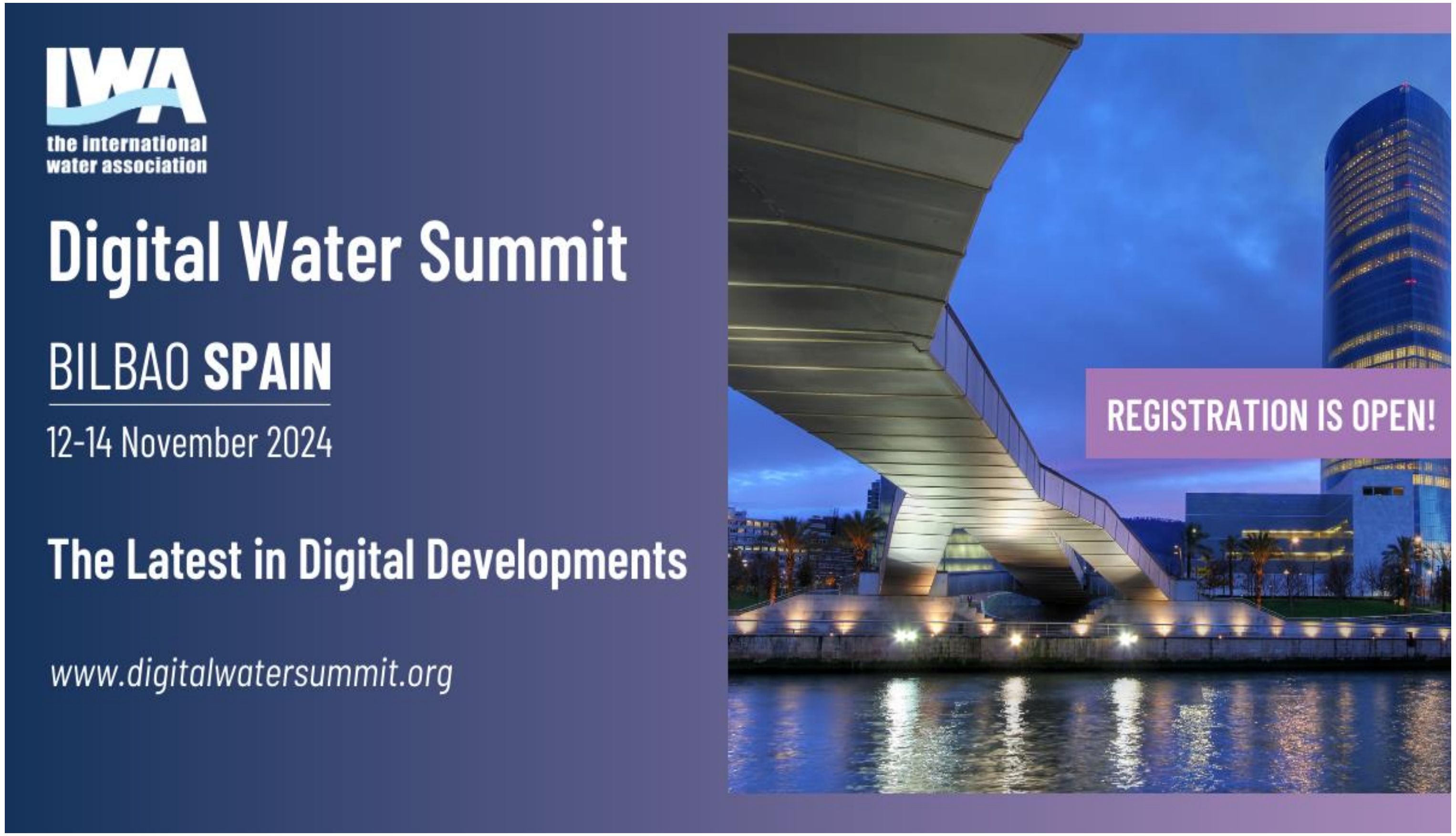

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