
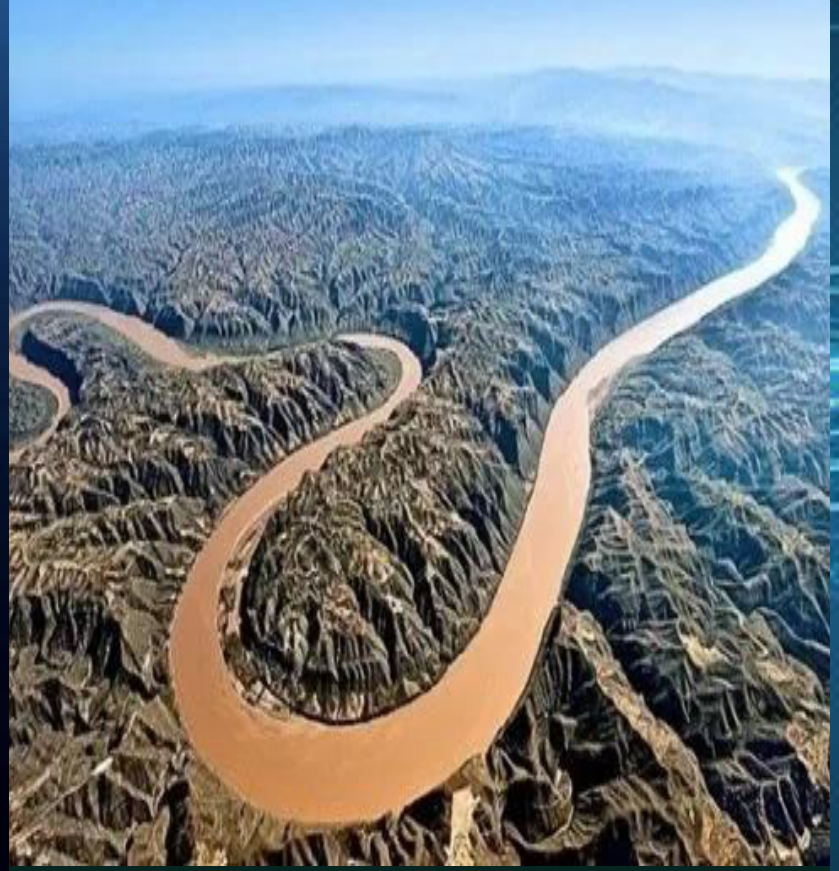


Water security & Hydroinformatics: challenges & opportunities

Prof. Philippe Gourbesville
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IAHR AIRH International Association for Hydro-Environment Engineering and Research

Hosted by Spain Water and IWHR, China

IWHR

Flash Flood Program

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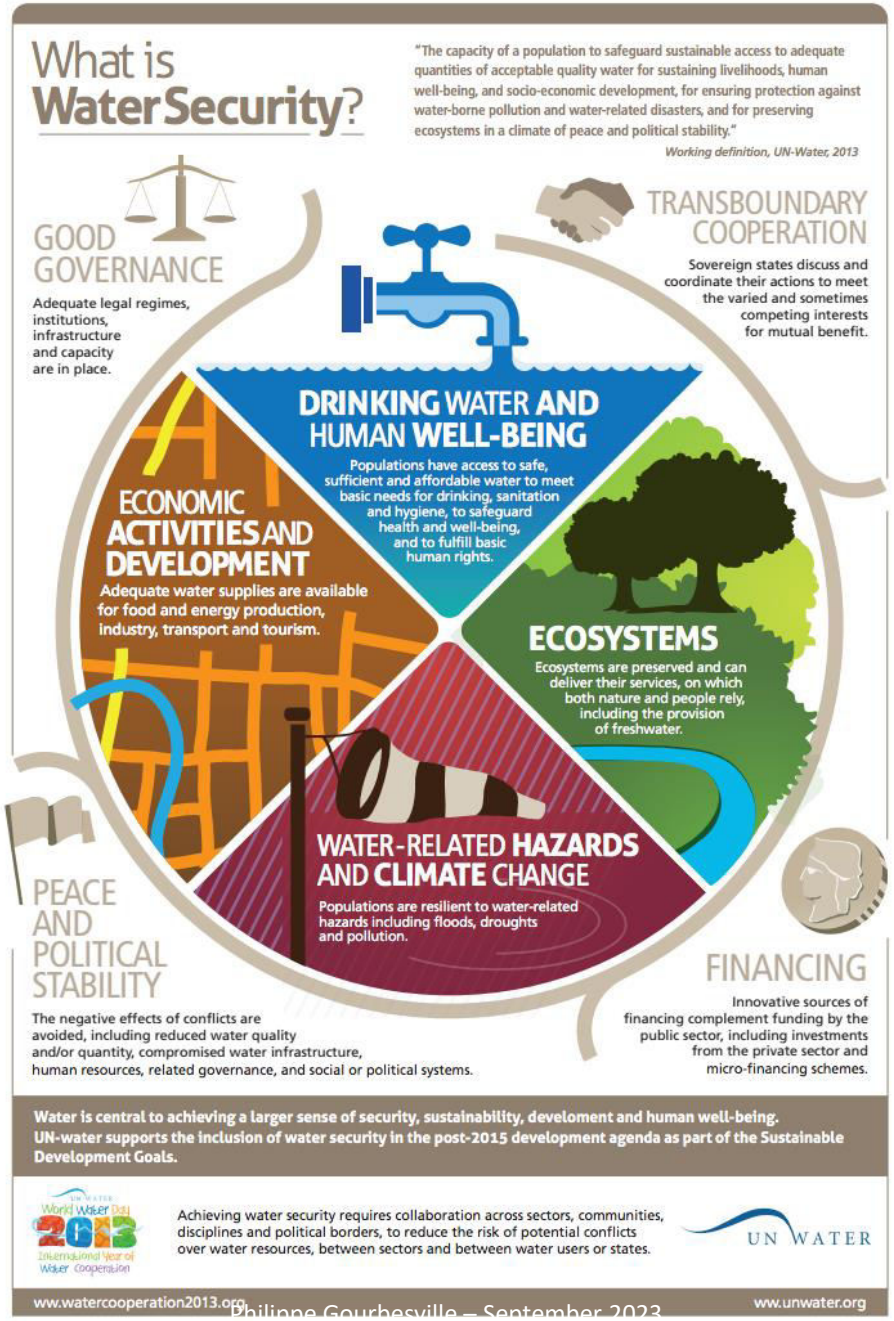
UN Water (2013) first definition for water security concept:
"Water security is defined as the capacity of a population to safeguard sustainable access to adequate quantities of acceptable quality water for sustaining livelihoods, human well-being, and socio-economic development, for ensuring protection against water-borne pollution and water-related disasters, and for preserving ecosystems in a climate of peace and political stability."



What are the water challenges? Ensure strategic needs & uses

Philippe Gourbesville – September 2023

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What are the water challenges? Mitigate natural hazards and promote resilience to reduce impact on populations

Indonesia 2021

What are the water challenges? Mitigate natural hazards and promote resilience to reduce impact on populations

Pakistan 2022

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Water security & Hydroinformatics

What are the water challenges? Preserve natural environment and water as key resources

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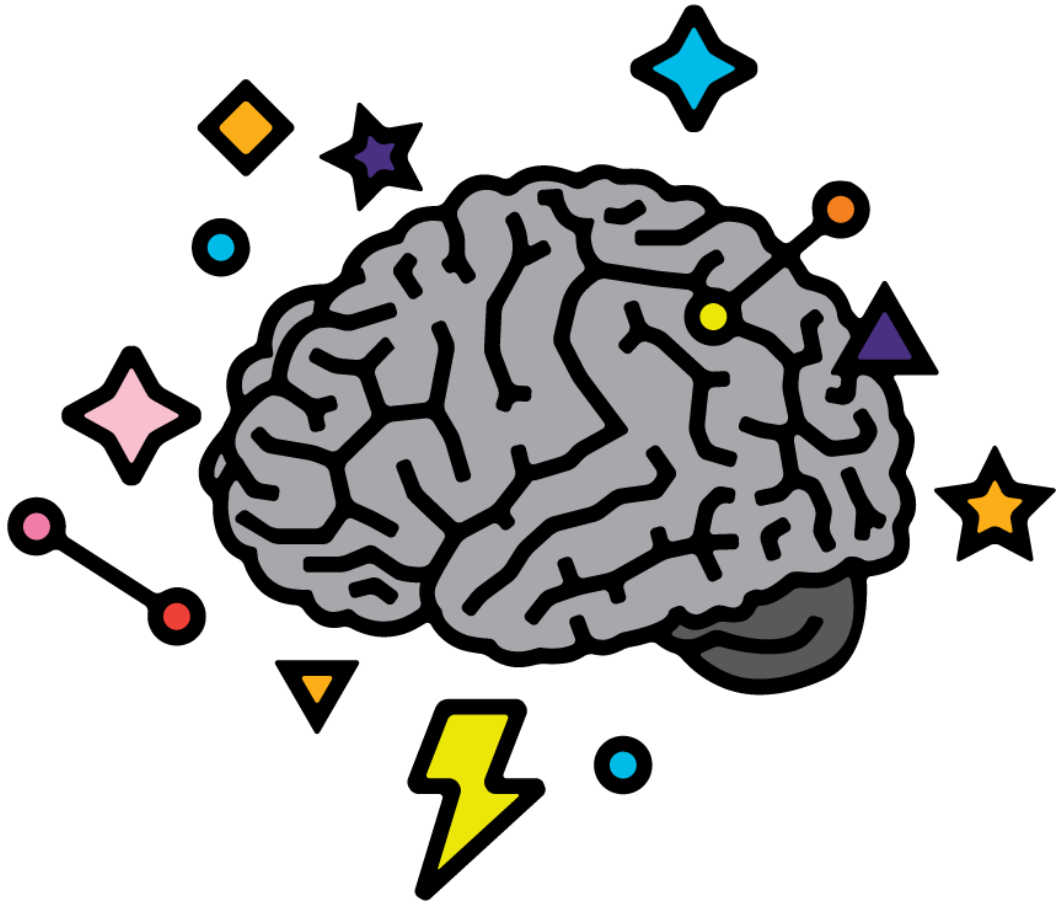
Situation becomes too complex to ensure the right decision on all subjects… Competitions among uses, need to ensure energy & food nexus, need for exposure & vulnerability management …

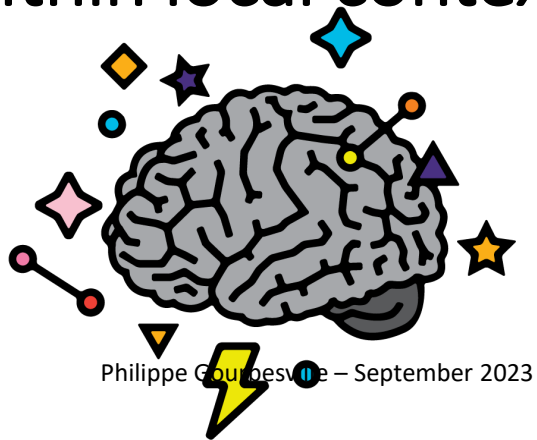
How to address complexity ?



Situation becomes too complex to ensure the right decision on all subjects… Competitions among uses, need to ensure energy & food nexus, need for exposure & vulnerability management …

How to address complexity ?

- Develop a holistic approach integrating various aspects within a relevant legal framework (vision + roadmap)
- Mobilize available technologies (field data + models+ simulations + forecasts) for Decision Support Systems
- Manage implementation of tailored solutions within local context
- Build consensus on observations and facts
- Harmonize uses & manage sustainability



Situation becomes too complex to ensure the right decision on all subjects… Competitions among uses, need to ensure energy & food nexus, need for exposure & vulnerability management …

Why Hydroinformatics?

- *Hydroinformatics is defined as the study of the flow of information and the generation of knowledge related to the dynamics of water in the real world, through the integration of modelling, information technologies and artificial intelligence considering sustainability and social implications for decision support and smart management of water-based systems.*

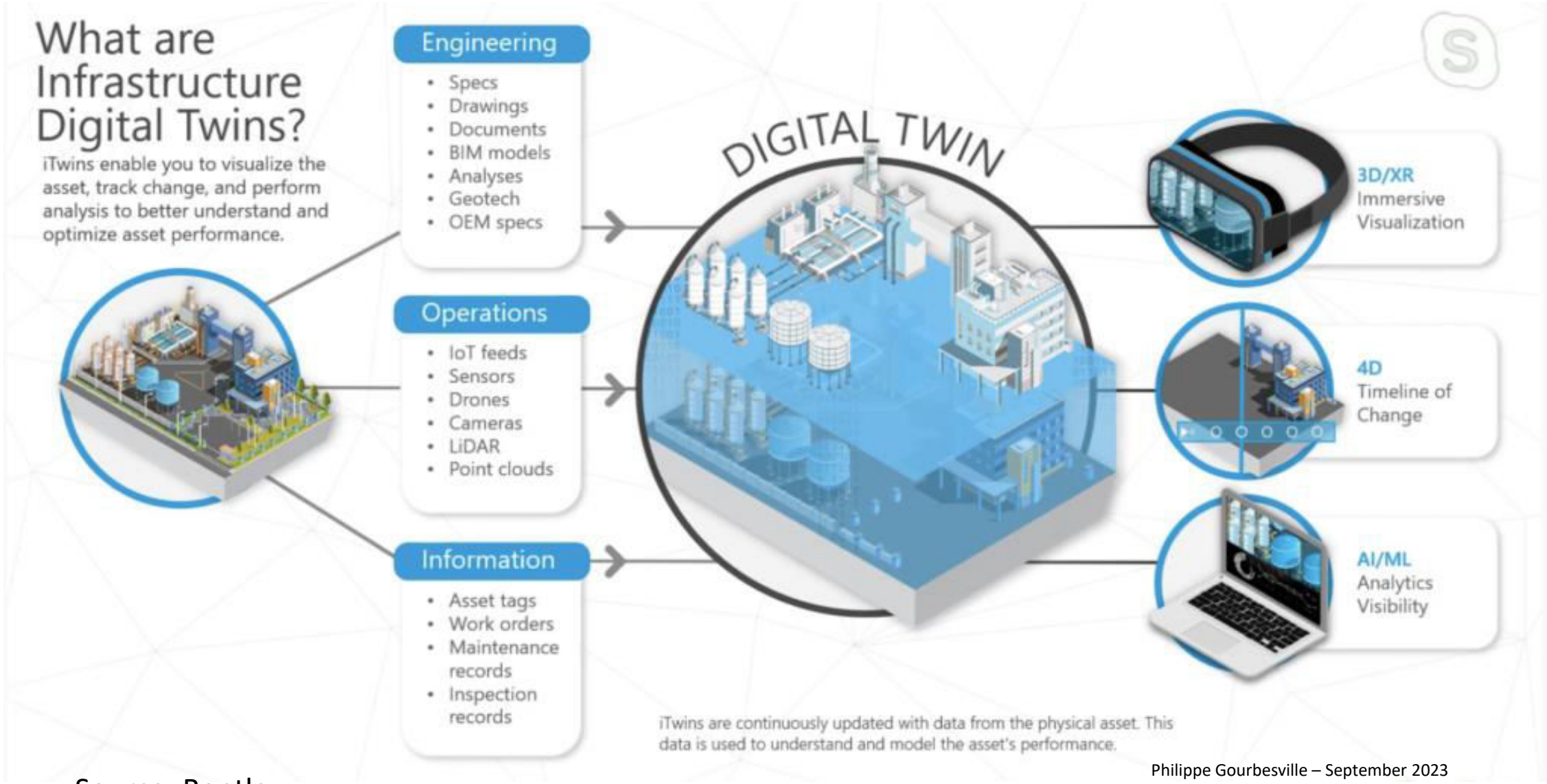
Situation becomes too complex to ensure the right decision on all subjects… Competitions among uses, need to ensure energy & food nexus, need for exposure & vulnerability management …

Hydroinformatics and associated concepts:

- Smart Water (water supply & sanitation)
- Digital Twins (water supply & sanitation, catchments, …)
- …

Need for integration into Information Systems (IS) encompassing not only water systems at city, regional, national & international scale

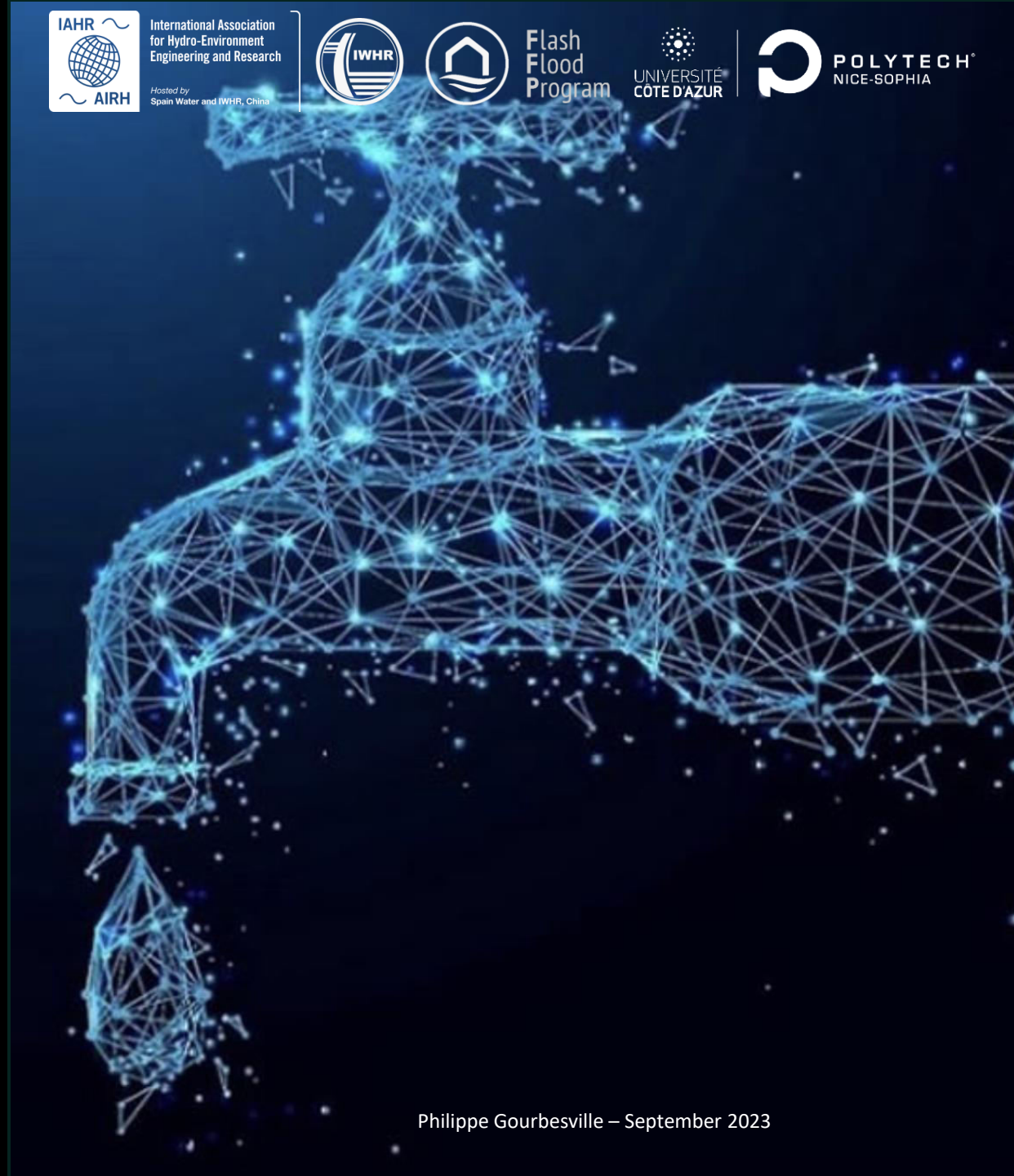
Emerging concept of digital twin…



Source: Bentley

Water security & Hydroinformatics

How Hydroinformatics can better address water issues and support SDG 6?



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6 CLEAN WATER AND SANITATION

ENSURE AVAILABILITY AND SUSTAINABLE MANAGEMENT OF WATER AND SANITATION FOR ALL

Five accelerators are proposed:

- Finance
- Data and information
- Capacity development
- Innovation
- Governance

6 CLEAN WATER AND SANITATION

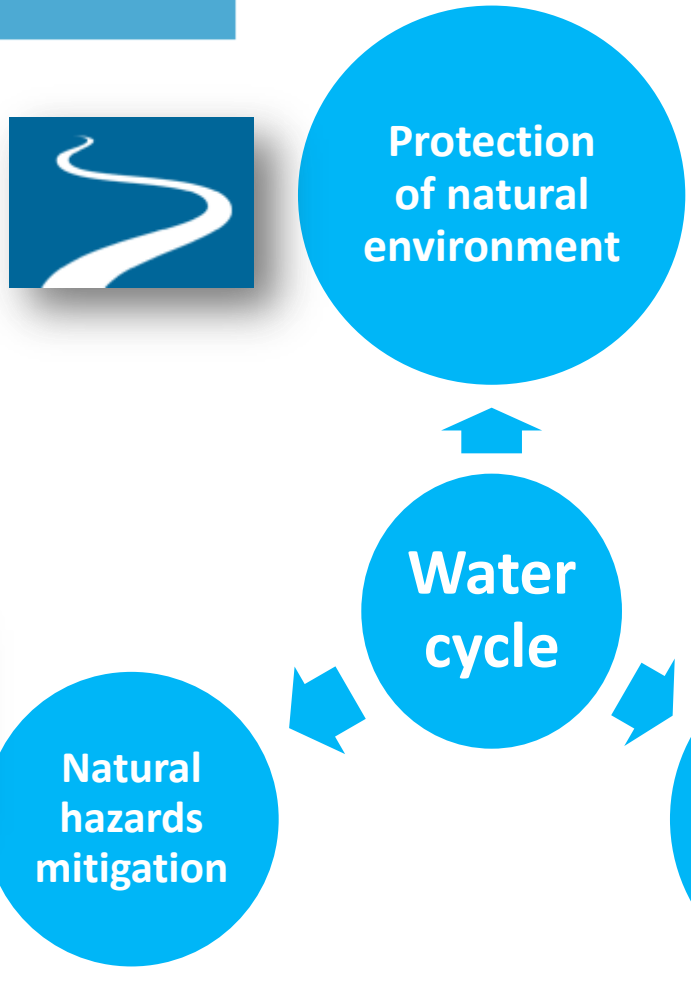
ENSURE AVAILABILITY AND SUSTAINABLE MANAGEMENT OF WATER AND SANITATION FOR ALL

Smart Solutions & Water domains:

- Water uses & services
- Natural hazards mitigations
- Protection of natural environment

Invariant activities:

- Investigating
- Monitoring
- Designing
- Building & Decommissioning
- Operating



Smart Water for Water Utilities

Safety

- **Forecast** natural or accidental events (floods and pollution)
- **Improve reliability of operations** on a daily basis and during a crisis
- **Comply** with regulatory requirements
- **Secure** the drinking water supply

Environment

- **Reduce** water losses
- **Preserve** the quality of the natural environment
- **Commit** to an energy performance

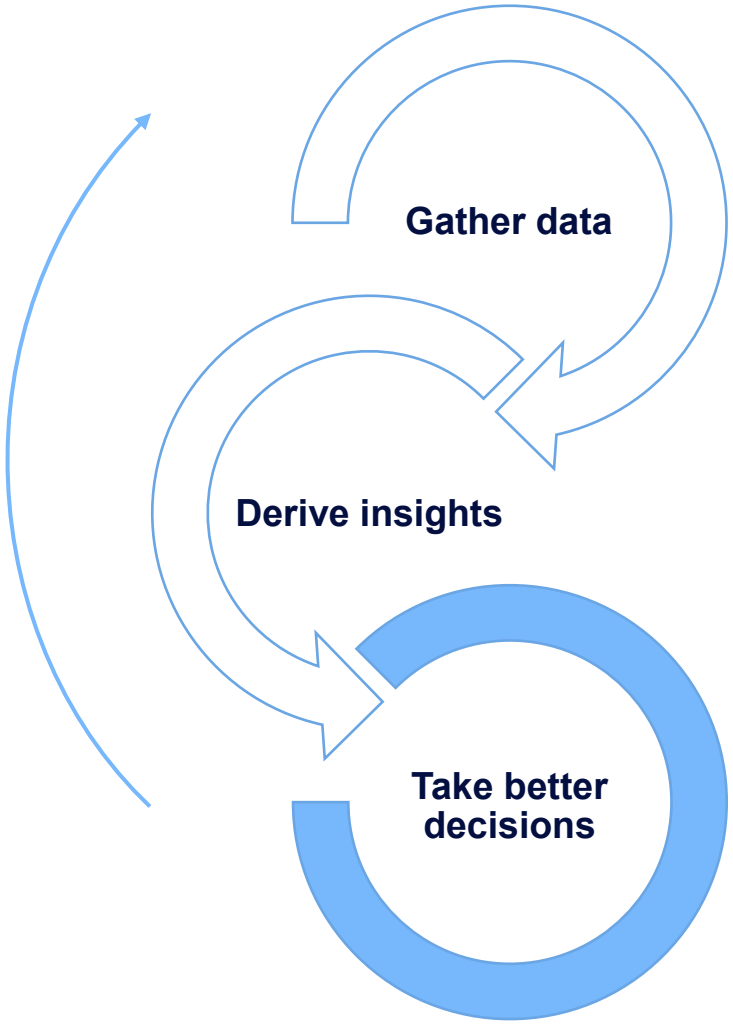
Information

- **Communicate** and inform stakeholders in real time
- **Improve** the understanding of on-going operations
- **Reinforce** control over operator commitments

Economy

- **Optimise** the output from plants or network installations
- **Rationalise** operational costs and investments
- **Increase the value** of existing assets

Smart Water requires data and technologies, but value comes from operations transformation



Sensors, operational data…

AI, digital twin, early warning, dashboards…

Transform workflows

Share anywhere, anytime

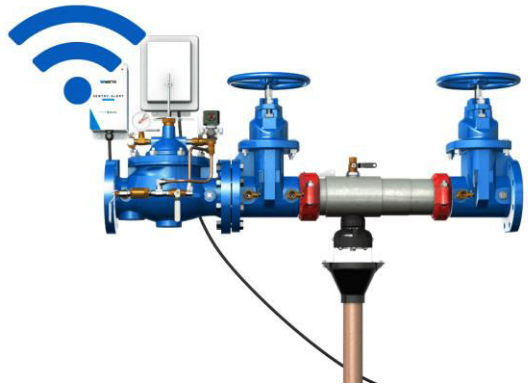
Accelerate

- Performance
- Resilience
- Cost Savings
- Compliance

Smart Water solution – a wide range of use cases

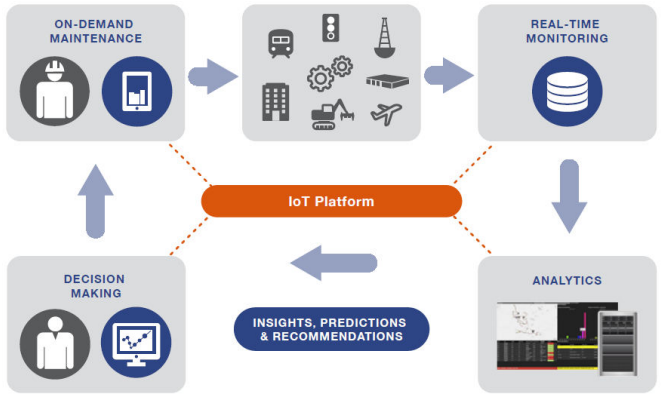
1. Throughout the water cycle

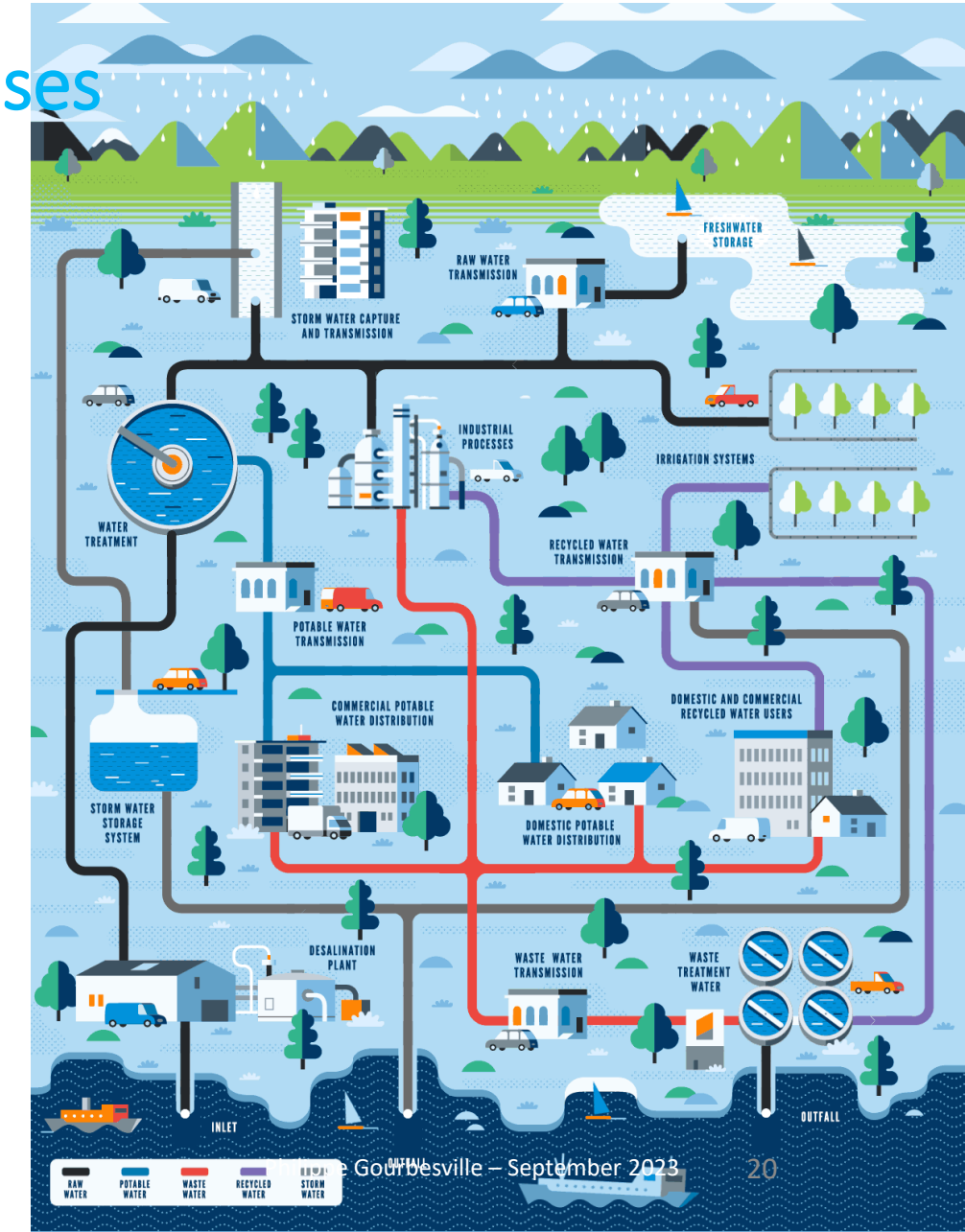
- Plants
- Water networks
- Wastewater networks
- Stormwater networks
- Receiving bodies
- Groundwater and wells



2. At different time scales

- Real-time Operations
- Maintenance
- Infrastructure



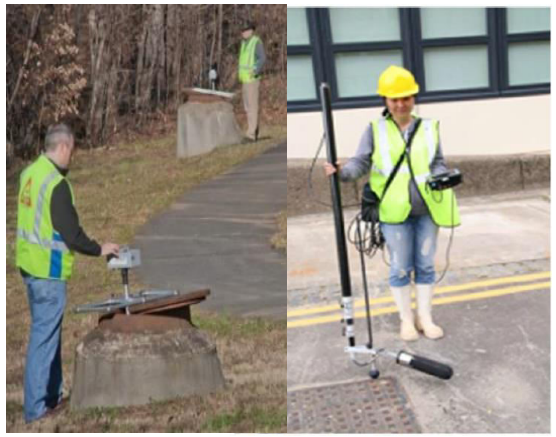


Sewer maintenance digital transformation

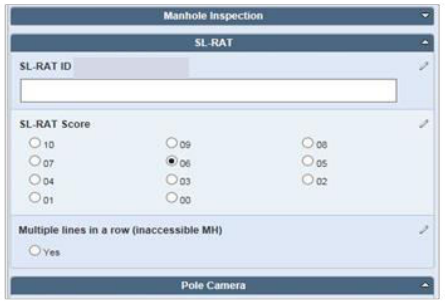
Acoustic test & Pole Cameras	Database Records	Evaluate clogging risk	Planning for inspection, cleaning or other operations

Gather data

Derive Insight



Provide a score between 0 and 10
0 = blocked 10 = clear



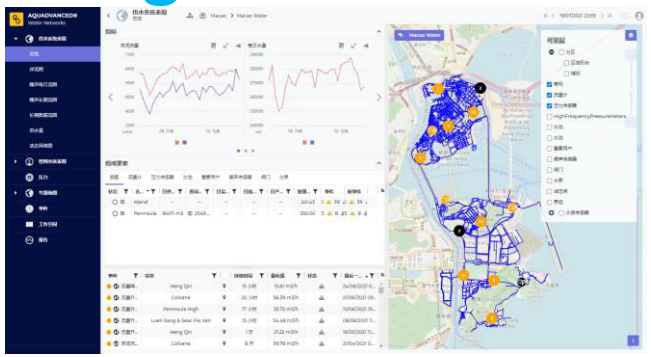
Heavy Cleaning

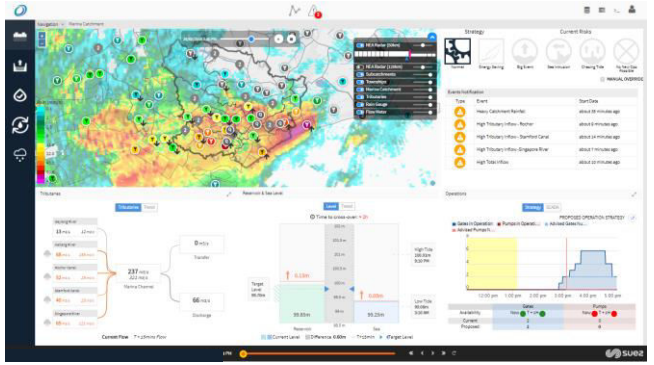
CCTV

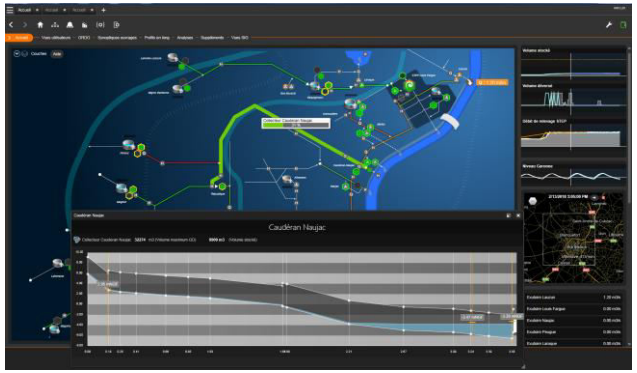
Root treatment

Source: adapted from Suez

Real-time systems: different levels of complexity & operational benefits depending on data maturity







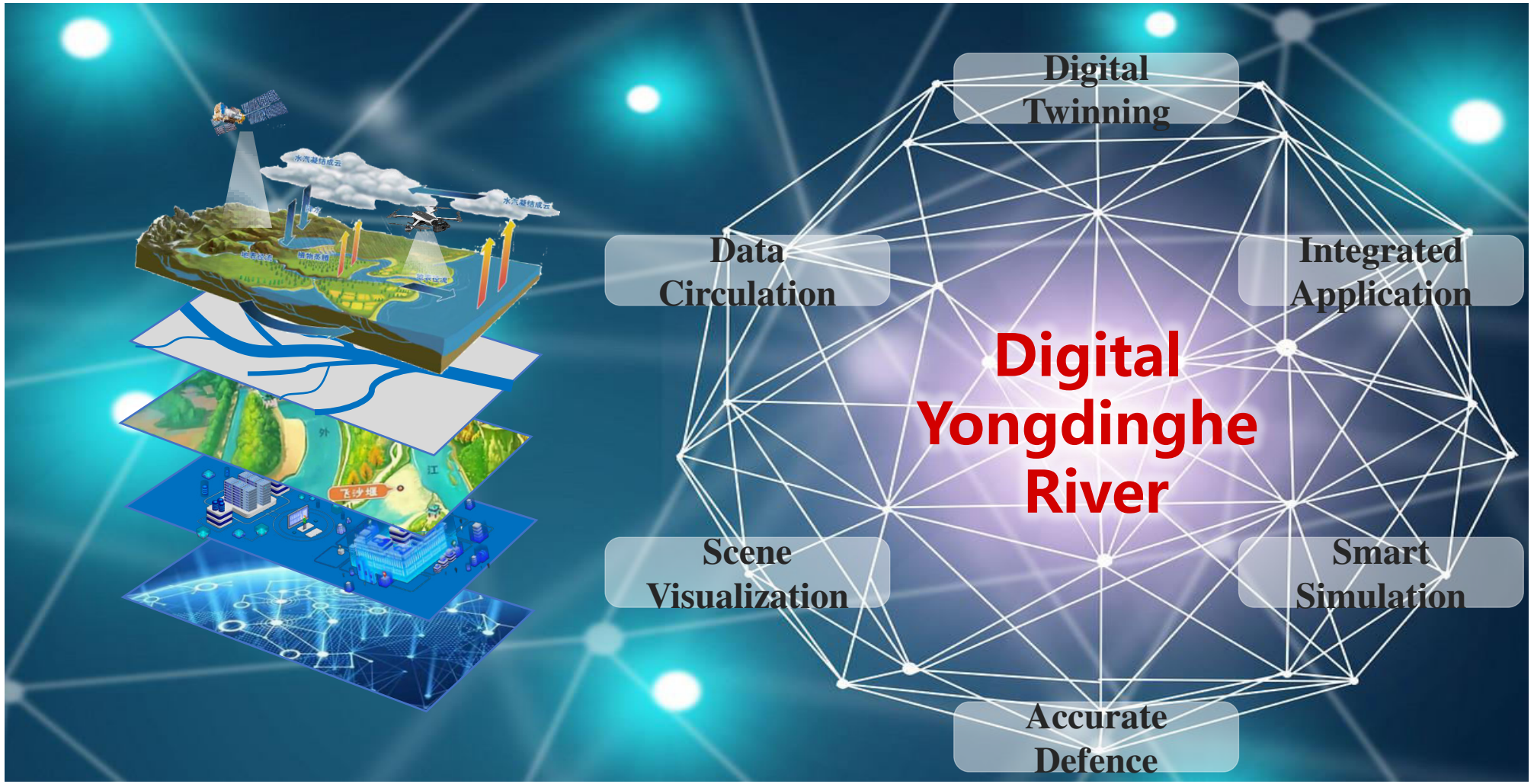
Past | Now | Future

Monitoring → **Anticipation** → **Predictive control**

- Real-time dashboards
- Anomaly detection
- Early warning using models (physical, data-driven, or hybrid)
- Risk prediction
- Proposition of operational strategies
- Automatic application of proposed strategies

Source: adapted from Suez

Yongdinghe River: part of Haihe River catchment (43,000 km²)



Source: IWHR

Yongdinghe River: part of Haihe River catchment (43,000 km²)

System design

Sub-system development

Modular connection

Digital Scenario

Smart Simulation

Accurate Decision

Forecast

Early Warning

Rehearsal

Reserve plan

Core module

Rainfall forecast

Hydrology Simulation

Hydraulic Simulation

2D Flood Simulation

Hydrology/Hydraulic Coupling Simulation

Source: IWHR

Yongdinghe River: part of Haihe River catchment (43,000 km²)

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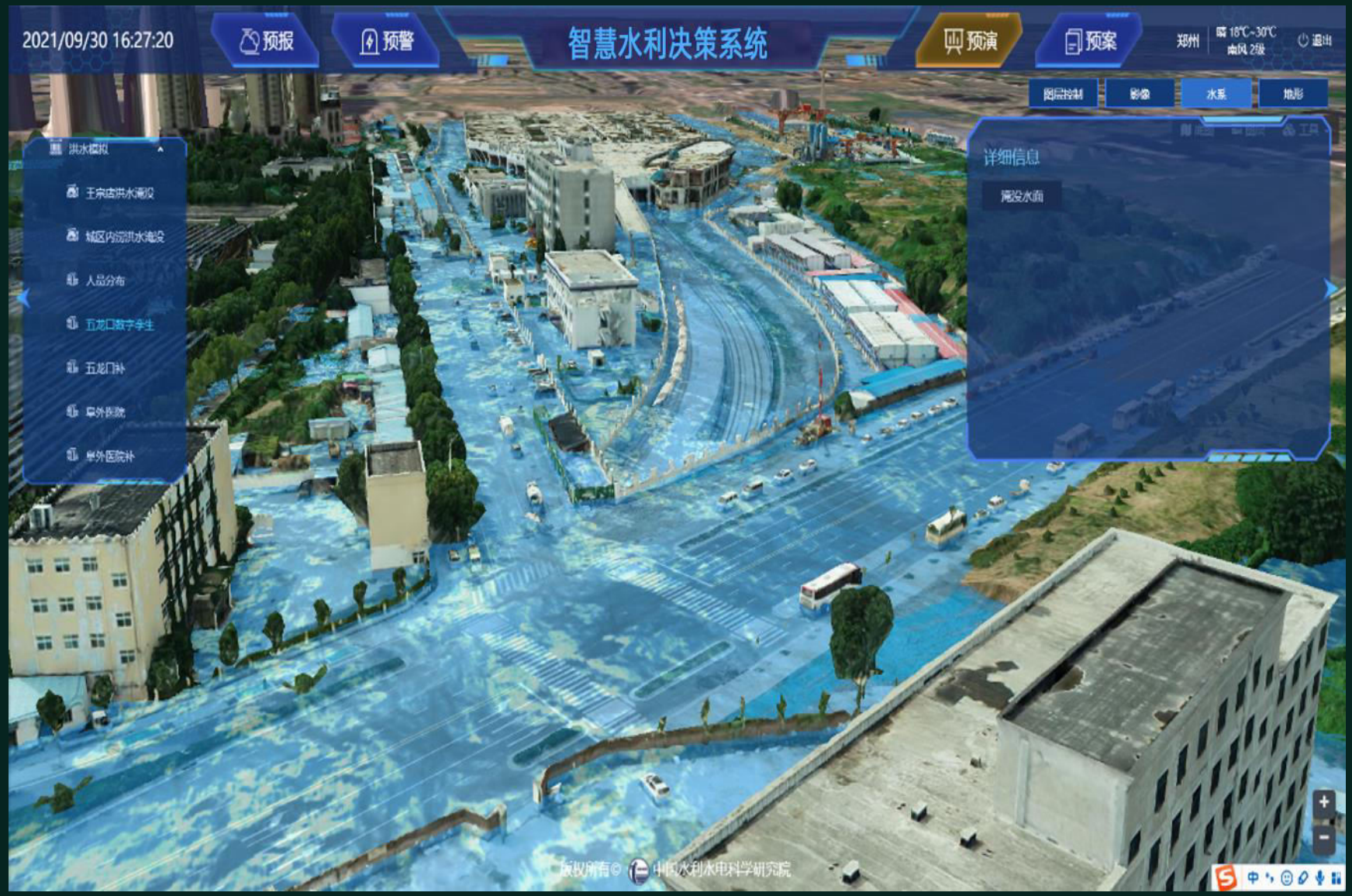
Yongdinghe River: part of Haihe River catchment (43,000 km²)



Yellow river catchment: a continuous management over centuries…

Flood protection works in 17th century for Yellow River floods

Yellow river: a continuous management over centuries…

Today priorities (from Yellow River Commission):

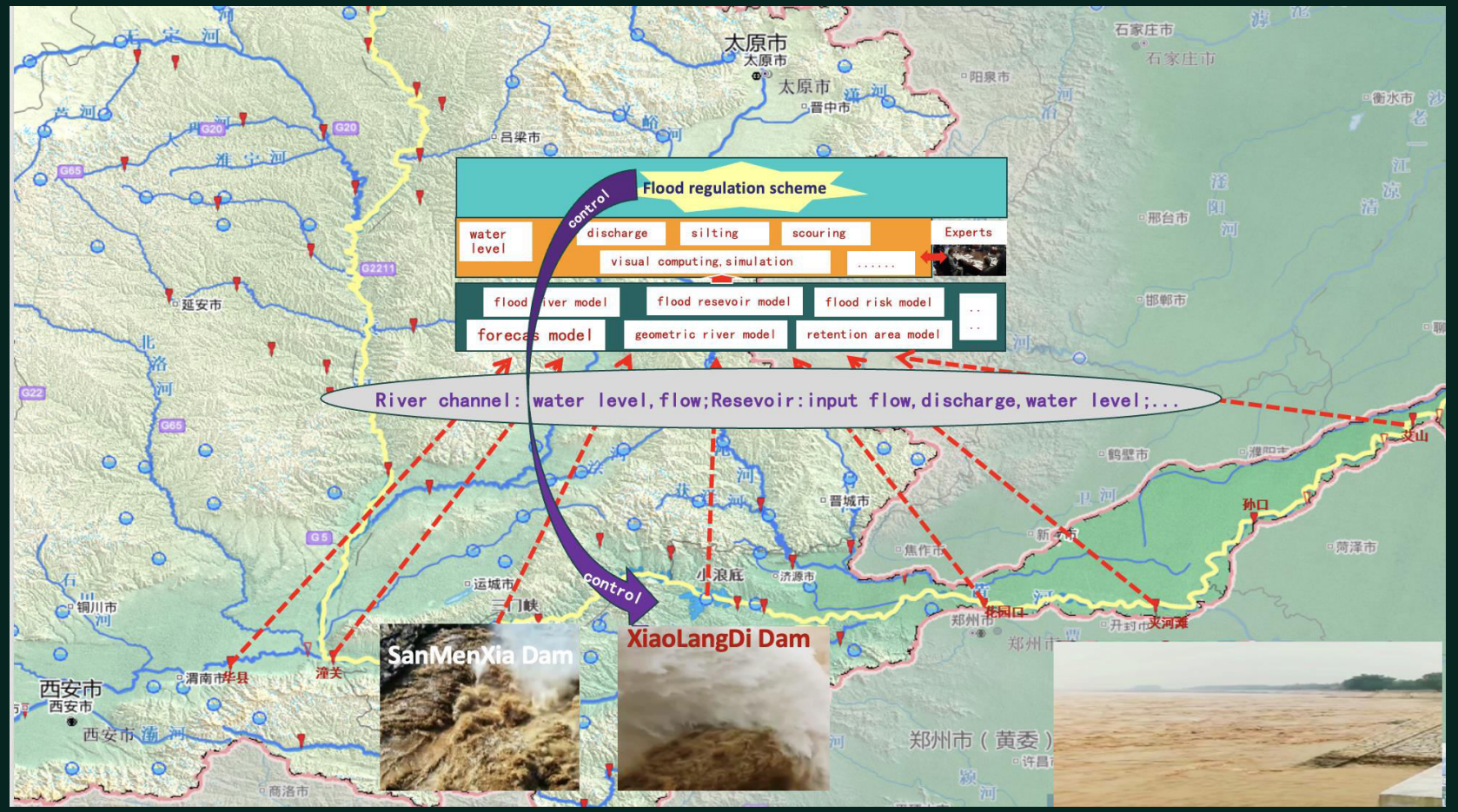
- Maintain harmonious co-existence between man, river and ecology
- Assure healthy status of the river
- Provide water security for agriculture and industries
- Mitigate floods and extreme draughts

Measures:

- Strengthen enforcement of legal framework to limit massive water consumption and pollution
- Carry out education program for water conscience and ecological values
- Implement digital twin of the Yellow river

Yellow River: digital twin for efficient management

- high fidelity digital twin for key objectives
- mapping the basin within the virtual space in real time
- carry out simulation analysis, prediction and early warning for major problems, scientific framework for protection and management.



Access to reliable data: the key challenge …

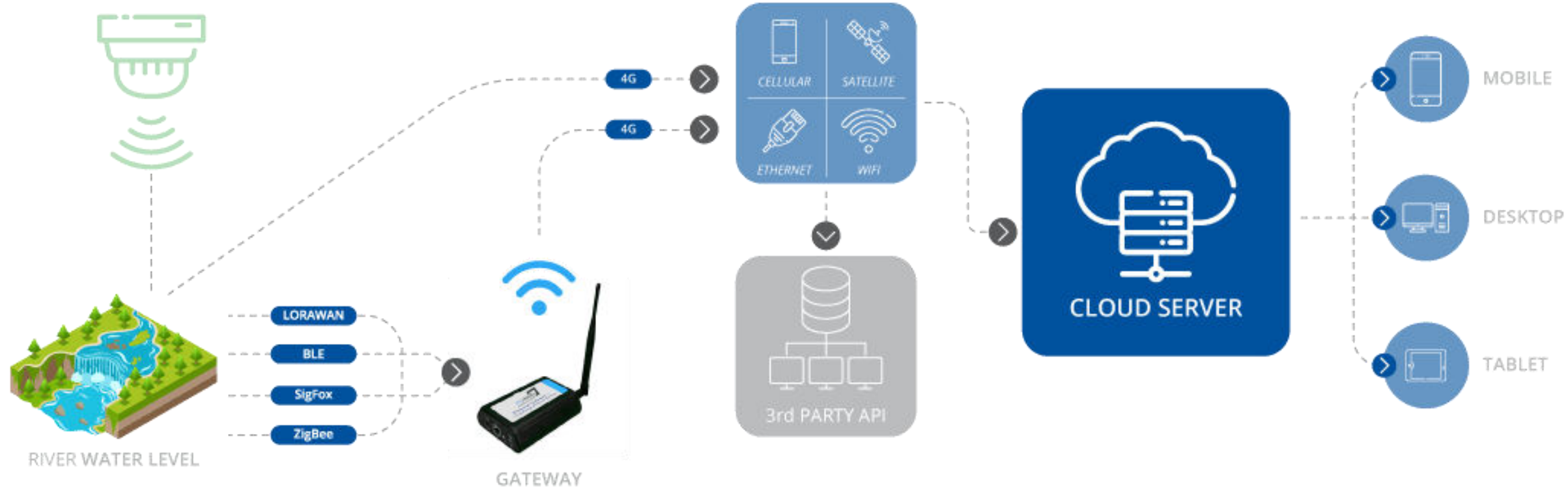
Hydro Informatics Institute (HII) https://www.hii.or.th/en/homepage/

National Hydroinformatics Data Center (NHC) - Thailand initiative

Access to reliable data: the key challenge …
National Hydroinformatics Data Center (NHC) - Thailand initiative

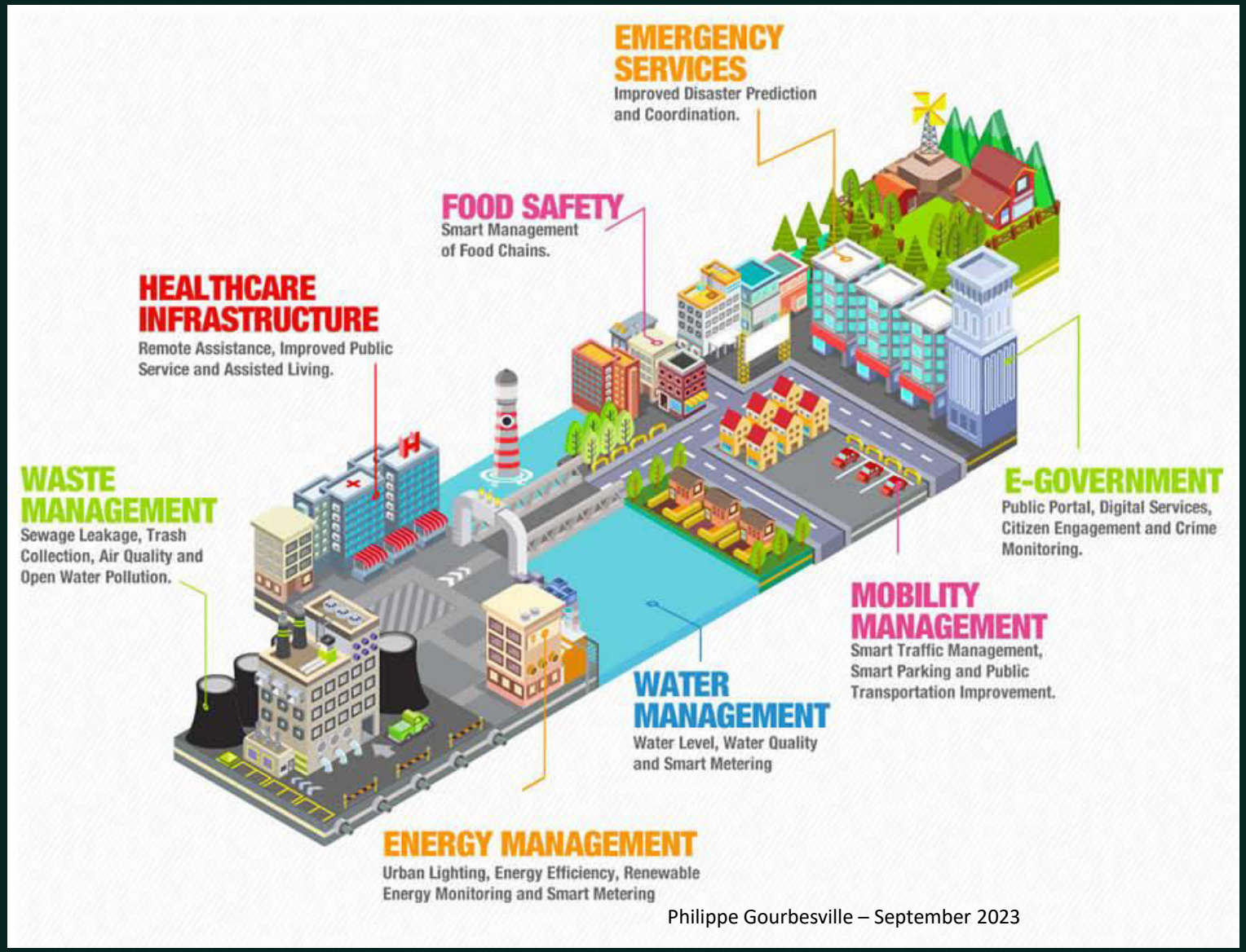
https://www.hii.or.th/en/homepage/

Key message 1: Reliable and affordable technology is available for developing Informatios Systems in all countries



Key message 2: Technology is great but … no success without vision, strong legal framework, commitment from local operating teams and endorsement by population

Key message 3: Integrate solutions at catchment scale



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IWA the international water association

IWHR

HIC 2024

15th International Conference on Hydro-informatics

From Nature to Digital Water: Challenges and Opportunities

May 27-31, 2024 Beijing, China

Please visit: www.hic2022.org

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Thank you for your attention!

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