Water information services supporting water governance: Opportunities and challenges for the next generation water experts.

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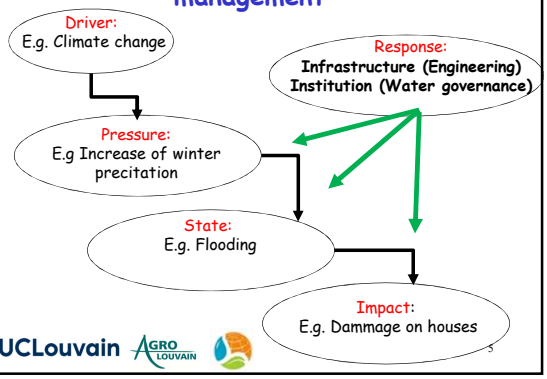
The role of information for water governance and engineering

Water governance

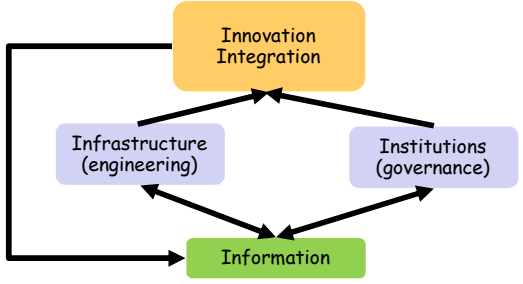
"Water governance refers to the political, social, economic and administrative systems in place that influence water's use and management. Essentially, who gets what water, when and how, and who has the right to water and related services, and their benefits"

www.watergovernance.org

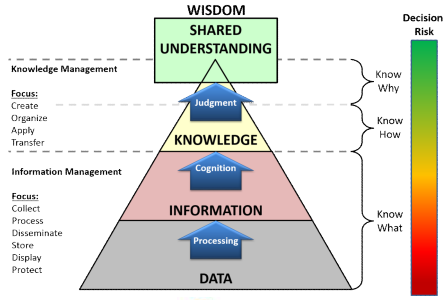
Engineering and governance supporting management



The 5 I's of water management



Data ≠ Knowledge: The Cognitive pyramid



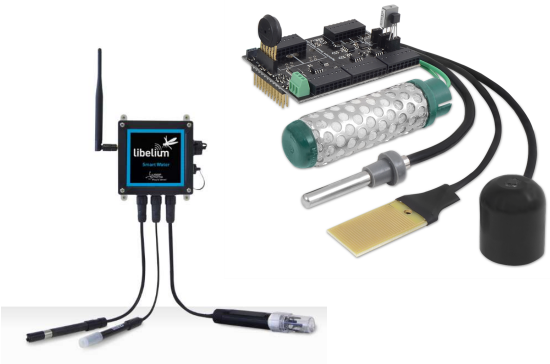
Data, information, knowledge on …

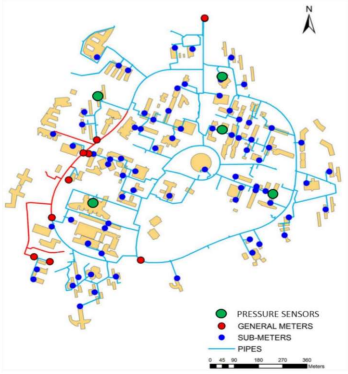
- Physical attributes
- Social attributes
- Economical attributes

Opportunities

Opportunities

- Data collection
  - IoT
  - Remote sensing
  - Citizen science
- Big open water data infrastructure
- From data to water knowledge: data mining.



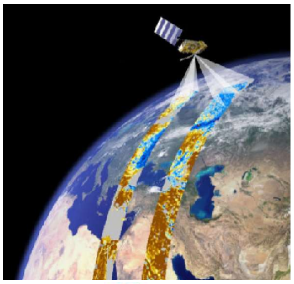


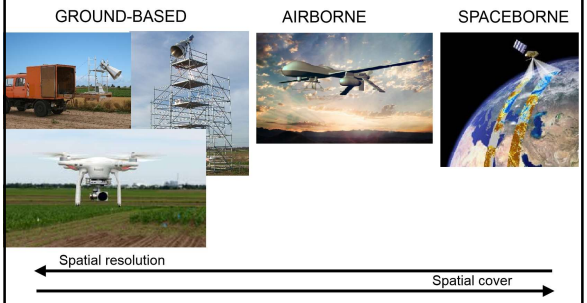
Source: Saab, 2018

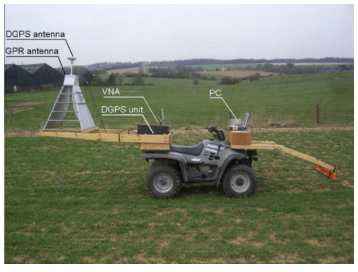
Category	Savings as Percentage of Baseline Cost		Description
Leakage and Pressure Management	2.3 - 4.6	(3.5%)	Reduction in leakage levels by precise detection of leaks; Predictive modeling to estimate potential future leaks and pressure management
Strategic Capital Expenditure Prioritization	3.5 - 5.2	(12.5%)	Improved dynamic assessment, maintenance, replacement, planning and designing of network to optimize spending on infrastructure needs
Water Quality Monitoring	0.3 - 0.6	(0.4%)	Automatic water sampling, testing and quality monitoring; Reduction in costs from labor and truck rolls for manual sample collection
Network operations And Maintenance	1.0 - 2.1	(1.6%)	Real-time, automated valve/pump shutoff to facilitate flow redirection and shutoffs; more efficient and effective workflow planning
Total Smart Water Savings Opportunity	**7.1 – 12.5**	**(7.4%)**	

Source: Saab, 2018

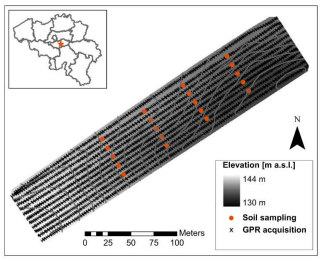
Remote sensing



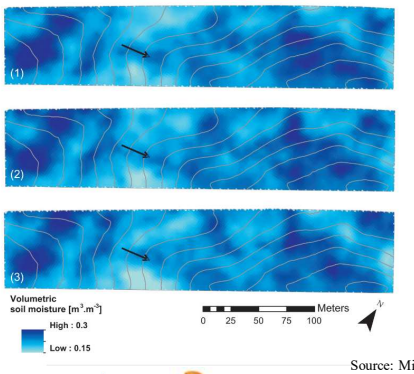




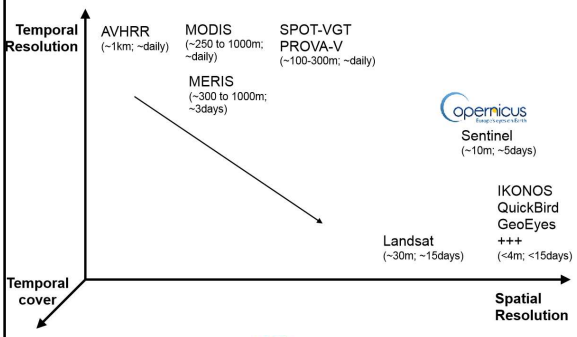
Source: Minet et al, 2008



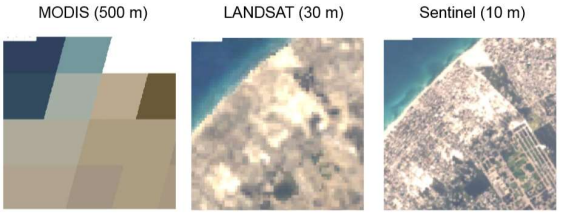
Source: Minet et al, 2018



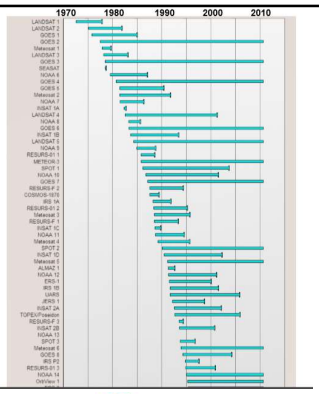
Source: Minet et al, 2018



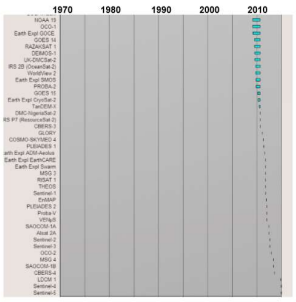
Source: Alonso & Vanclooster, 2017



Source: Alonso & Vanclooster, 2017

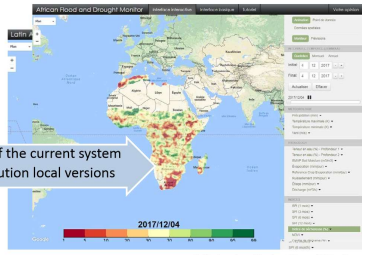


Source: NASA



Source: NASA

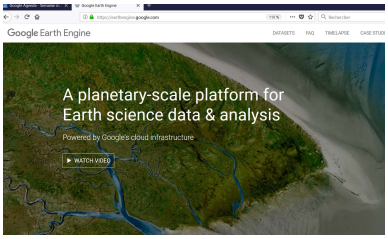
From scientific to operational EO



Latin American Flood and Drought Monitor
African Flood and Drought Monitor

Source: Verbist, K, 2017

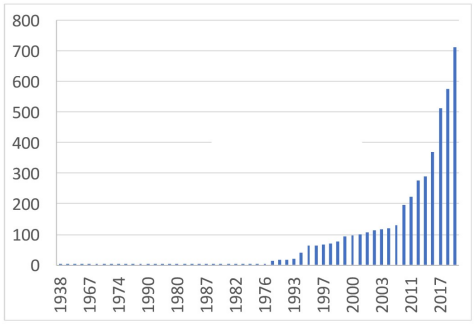
From expert base to open source…



Citizen science

citizen SCIENCE

Number of papers in Web of Science with *Citizen Science* in the topic



Source: Alonso & Vanclooster, 2017

Together4Water

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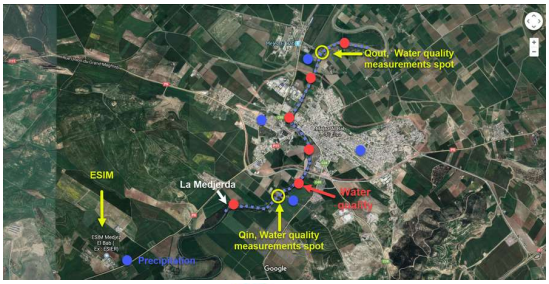
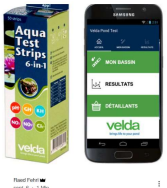


Together4Water



Big open water data infrastructure

- Portal of water data portals: https://www.cuahsi.org/data-models/portals/P15

USGS Water Data for the Nation

WISE Water Information System for Europe

CUAHSI

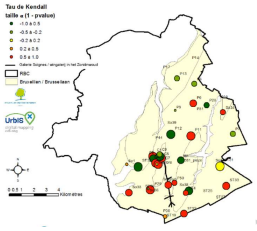
SCIENTIFIC DATA

Big open water data infrastructure

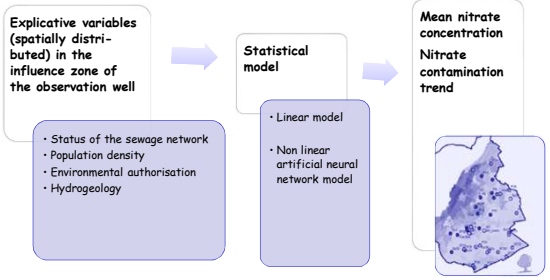
- Institutional measures:
  - EU: Directive Inspire
  - California: California's 2016 Open and Transparent Water Data Act

From data to water information: Data mining

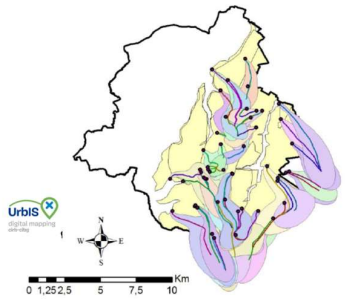
- Physical based modelling
- Machine learning
- Hybrid approaches



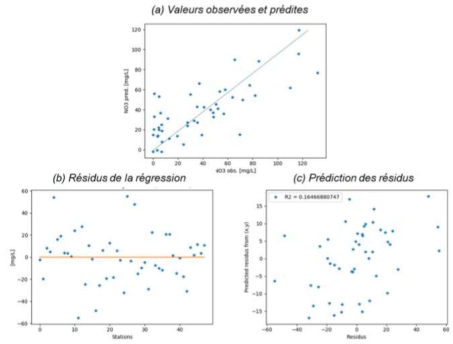
Source: Petit et al, 2018



Source: Petit et al, 2018



Source: Petit et al, 2018



Source: Petit et al, 2018

From data to water information: Modelling platforms

- Google compute engine
- Google cloud computing
- GoGrid
- MicroSoft Azure
- Amazone Elastic Compute Cloud
- Open Cloud Consortium

Bottlenecks

"Currently, California's water data fall far short of the fundamental goal of being complete, accessible, and usable—that is, readily available in formats that suit users' needs, at relevant spatial and temporal resolutions that are useful for making the decisions at hand. Data sources are incomplete and inconsistent. Fragmented data systems often cannot exchange data with one another. Existing data are frequently difficult to access or use. "

Cantor et al., 2018

The Big Data V's Bottlenecks

- Volume
- Variety
- Veracity
- Validity
- Volatility
- Versioning
- Vulnerability
- Value

Recommendations

Water data infrastructure - recommandations

(Conclusion from Californian study, Cantor et al., 2018)

- To ensure relevance, an understanding of the way data are used in decision making should guide the development of data systems
- A wide variety of data must be easily accessible and highly interoperable to serve many different user needs
- Data gaps take a variety of forms and will need to be filled in distinct ways
- For California water, an integrated data system will need to connect data from multiple sources, while maintaining the autonomy of those independent systems
- A water data system must address needs for data at multiple spatial and temporal resolutions, and in multiple, distinct forms and formats.
- A water data system must enable the production of new information (data is not information)
- Engagement between data system developers and end users is, ideally, an ongoing and iterative process
- Basing water data on principles of usability and stakeholder engagement requires robust cyberinfrastructure, good governance, and stable funding.

Take home message

- Data play an important role in decision making in the water sector.
- Technological revolutions in ICT (IoT, Citizen science, EO) offers a broad set of opportunities to consolidate the cognitive pyramid supporting water governance and decision making, in particular with respect of the physical attributes of the water system (a bit less for socio-economical attributes).
- Yet, there are considerable bottlenecks associated with this digital revolution, mainly related to poor capacity to consider water systems in a holistic way.