Data Drought:

An Assessment of Global Hydrological Monitoring Systems

Convened by:
Duke University / The Aspen Institute /
University of Oxford / Xylem

Xylem: At a Glance

WE ARE AN INDUSTRY LEADER WITH GLOBAL REACH …

- Leading global water technology provider
- Unrivaled product portfolio with leading brands and solutions
- Approximately 16,000 global employees
- 300+ global locations; doing business in 150+ countries
- $4.5 billion* in annual revenues
- Provide solutions across the entire water cycle

…UNIQUELY POSITIONED TO SOLVE OUR CUSTOMERS' CHALLENGES

xylem

Data Drought: Agenda

I. Overview of the Data Drought Challenge

Albert Cho
Vice President, Strategy & Business Development, Xylem

II. Water Data System Gaps Analysis

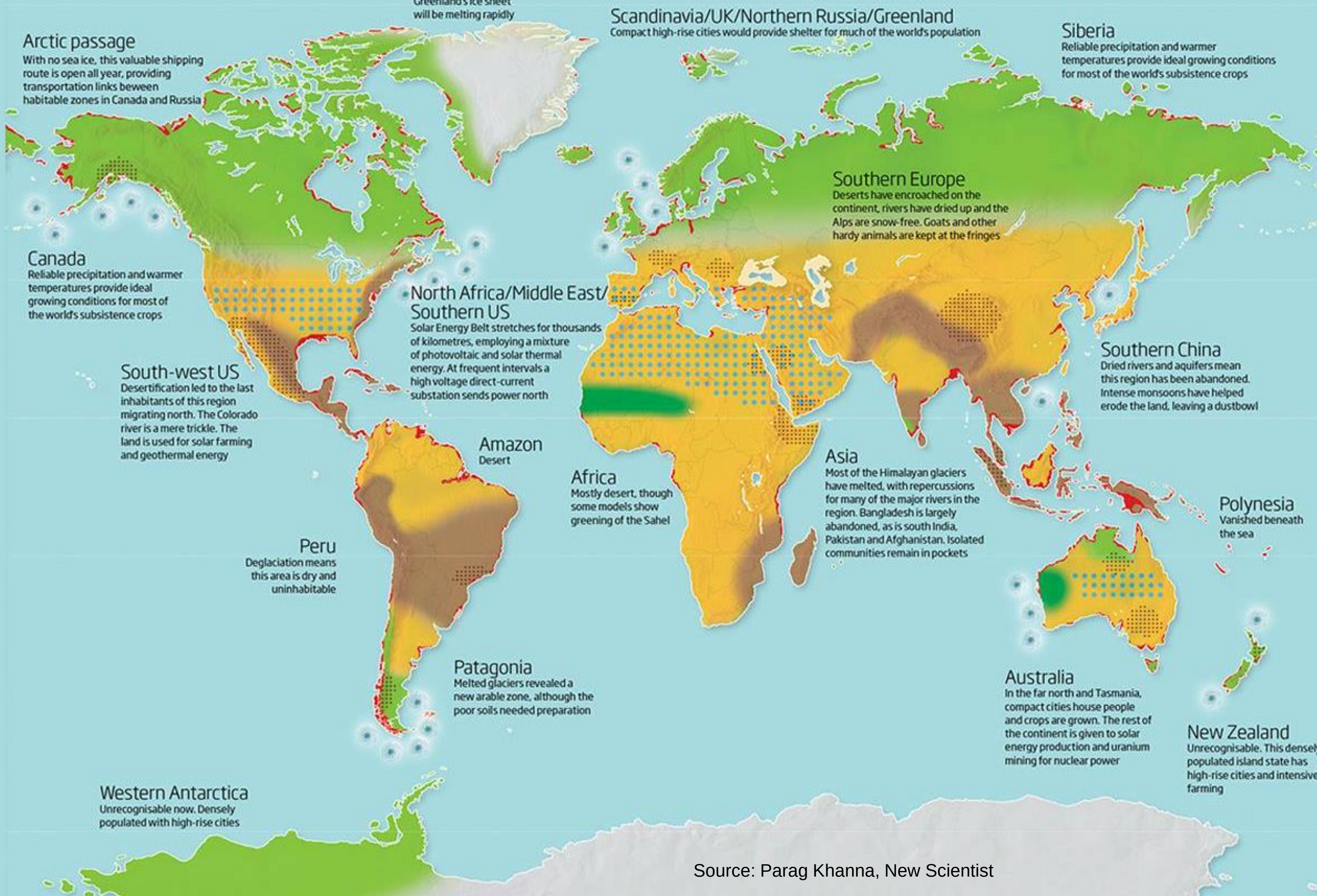
Alex Fischer
University of Oxford

III. Estimated Benefits from Investment in Water Data Systems

Martin Doyle
Nicholas Institute for Environmental Policy Solutions at Duke University and The Aspen Institute

IV. Panel Discussion

V. Q&A



Source: Parag Khanna, New Scientist

A robust water data system supports vital decisions

	Water Supply				Water Demand			
	1	2	3	4	5	6	7	8
Energy production	■	■			■			
Food production	■	■	■		■			■
Flood protection	■	■		■	■	■		
Insurance		■	■	■	■	■	■	
Water storage planning	■	■	■		■	■	■	■
Climate resilience	■	■	■	■	■	■	■	■
Water quality for human health		■	■		■	■	■	
Water quality for ecosystem health		■	■	■	■	■		■
Wastewater treatment		■				■	■	■
Infrastructure design	■	■	■	■	■	■	■	■

Legend:
1. Atmospheric, 2. Surface water, 3. Subterranean,
4. Oceanic, 5. Agricultural, 6. Industrial,
7. Domestic, 8. Environment

A robust water data system is vital to SDG 6

Targets for SDG 6	Water Supply				Water Demand			
	1	2	3	4	5	6	7	8
6.1: universal and equitable access to safe and affordable drinking water for all							■	
6.2: access to adequate and equitable sanitation and hygiene for all							■	
6.3: improve water quality globally		■	■	■				■
6.4: substantially increase water-use efficiency across all sectors		■			■	■	■	
6.5: implement integrated water resources management at all levels	■	■	■	■	■	■	■	■
6.6: protect and restore water-related ecosystems		■	■	■				■
6.a: expand international cooperation and capacity building support	■	■	■	■	■	■	■	■
6.b: strengthen local communities for improving water and sanitation management	■	■	■	■	■	■	■	■

Legend:
1. Atmospheric, 2. Surface water, 3. Subterranean,
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The Value of Water Information

Do we have the right public water data infrastructure to support resilience and adaptation to a changing world?

Change drivers

- Climate change
- Population growth and urbanization
- Economic growth
- Aging infrastructure

Data needs

- Dense
- Discoverable
- Accessible
- Reliable

Global Water Information

Is the global network of rain, river and water quality in situ measurement stations sufficient for public data benchmarking?

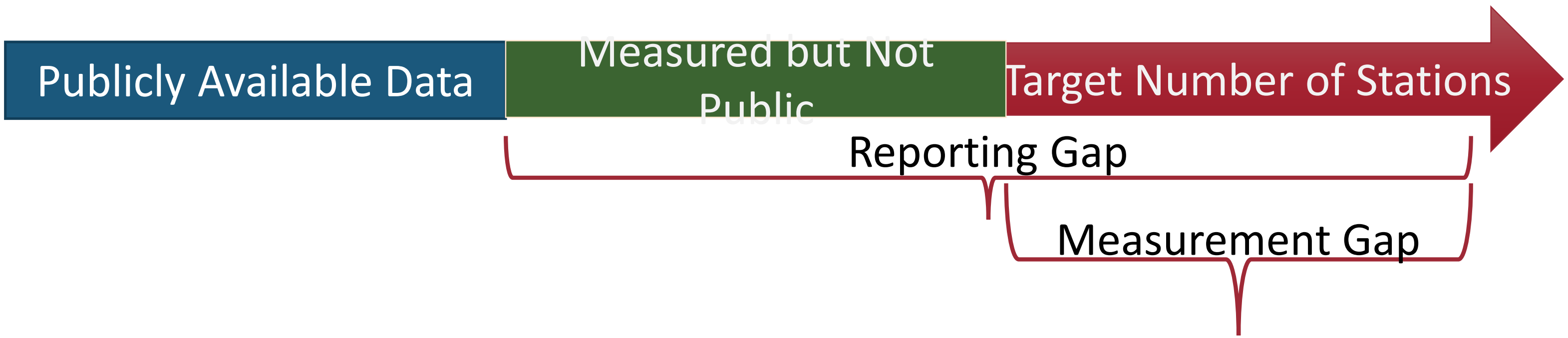
What do we know about global monitoring?

Scientists, industry experts, and policy makers repeatedly state that there is an **insufficient and declining** availability of water information.

The exact gaps, reported decline and minimum target density for in situ monitoring stations have not been clearly defined.

Global and standardized databases for rain/climate, streamflow and water quality provide an initial basis for estimating global station coverage.

How big is the gap?



- Reporting Gap:
  - The difference between the recommended stations defined by the 2008 WMO Guidelines and the number of stations being actively reported into the global databases.

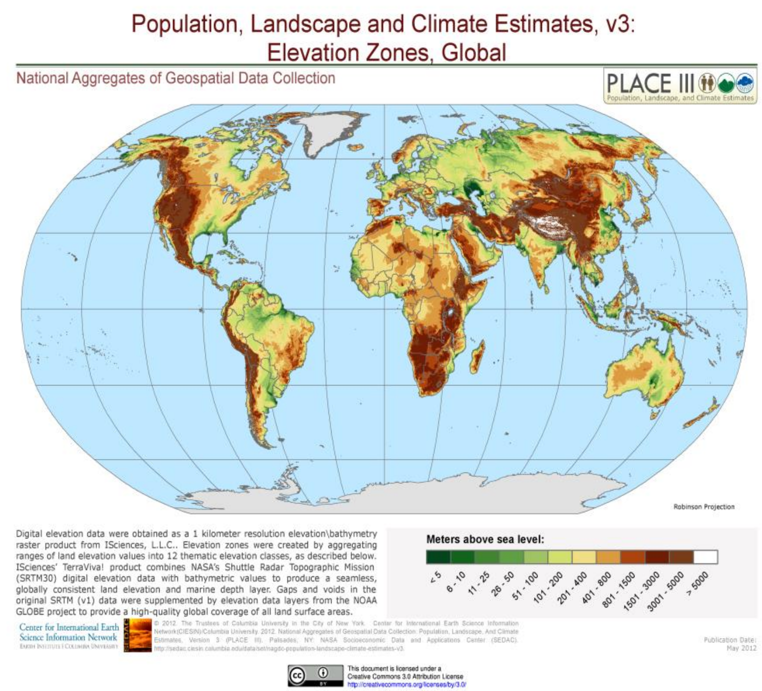
- Measurement Gap:
  - The difference between the recommended station density defined by the 2008 WMO and the number of station estimated to be active through statistical models.

Benchmarks for Minimum Station Density

WMO's recommended minimum densities of hydrological stations

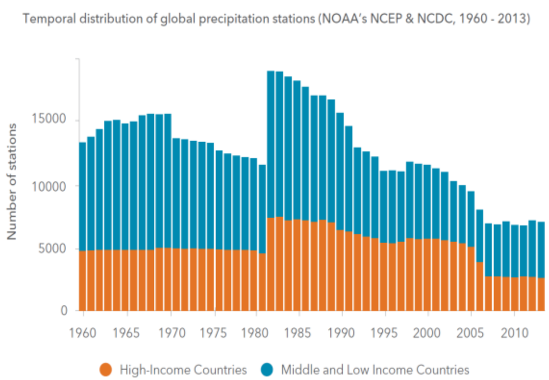
Physiographic unit	Description	Precipitation (Area in km² per station)	Streamflow (Area in km² per station)
Small islands	Island states or territories with area 500km² or less.	250	300
Coastal	Areas within 100km from the coastline.	9,000	2,750
Arid / Polar	Areas classified as 'Dry system' or 'Polar system' by the Köppen-Geiger climate classification system	100,000	20,000
Mountainous	Areas with elevation of 1,500m or greater.	2,500	1,000
Interior plains	Areas with elevation of 200m or less.	5,750	1,875
Hilly / Undulating	Total area not classified as Coastal, Mountainous, or Interior plains.	5,750	1,875

Source: WMO 2008.

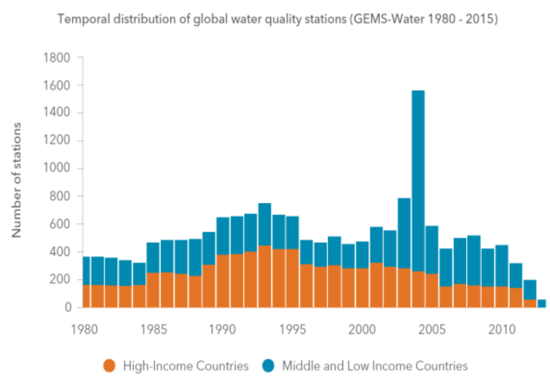


Trends From Public Global Databases | Declining Reporting

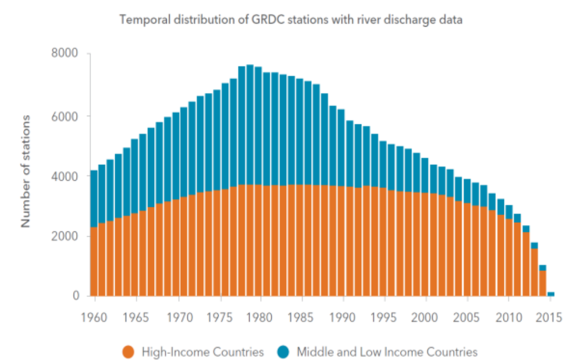
Precipitation



Water Quality



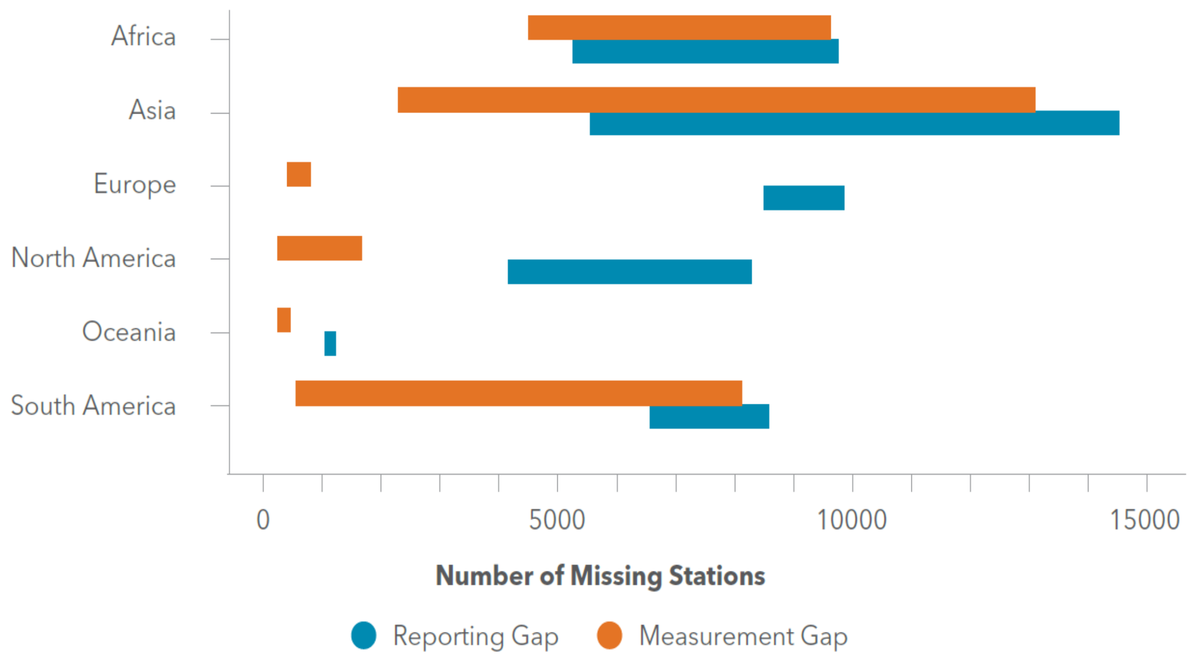
Streamflow



Reporting Gaps Assessment

	Station Reporting	Country Reporting	Reporting Gap
Streamflow (GRDC)	By 2010, stations decline 40% since peak reporting in 1979	Declined from 142 countries in 1979 to less than 40 after 2010	Gap of 30,938 to 52,058 in current global data base
Precipitation (NOAA)	By 2010, stations decline 31% since peak reporting in early 1980s	Over 180 countries reporting since the mid-1800s	Gap of 6,416 to 14,773 in current aggregated database
Water Quality Stations (GEMS)	By 2010, stations decline 41% since peak reporting in 1993	Total of 83 countries reporting since 1965, but only 16 after 2010	Not calculated as no targets by parameter.

Measurement Vs Reporting Gaps for Streamflow Stations



Global Reporting Gap: Maximum of 52,000 stations.
Potential Global Measurement Gap: Maximum of 33,000 stations

Key Findings

Reporting Gaps

- Continued declines in voluntary reporting and inconsistent temporal coverage of stations.
- Precipitation databases have the largest network of reported in situ stations.
- Water quality has the fewest reported number of stations.
- Reporting gaps are high for all regions.

Measurement Gaps

- The gaps are smaller when estimating coverage of active stations.
- Measurement gaps remain most severe in low-income countries.
- Many climate and water quality stations are reported as existing but not sharing data.

Acknowledgements

This work was done in collaboration with Marc Levy and Paola Kim-Blanco at the Center for International Earth Science Information Network, Earth Institute at Columbia University.

The Value of Public Water Data

Benefits of Public Water Data

Agriculture – improving irrigation decisions
Energy production – improving planning and real-time decision-making
Forestry – optimize operational decisions for harvesting
Manufacturing – increase efficiency through optimized recycling/reuse
Transportation – optimize shipping/logistics; increased use of water traffic
Tourism – river/ski forecasts; weather forecasts
Public safety – disaster preparedness

All in addition to public health, water service providers, and ecosystems

Benefits of Public Water Data

The water sector—policy community, academia, private industry—has rarely quantified the economic benefits and costs of public water data

With unknown/unspecified and presumed benefits
public sector has under-invested in water data

ABOUT THE DIALOGUE SERIES

PURPOSE

The Dialogue Series focused on how to create a better water data infrastructure to access and connect publicly collected and reported sources for data starting with quantity, quality and use information.

PARTICIPANTS

The Dialogue Series brought together a select group of 30 water experts, managers, policy makers, regulators, and representatives from the private and social sectors.

PARTNERS

The Dialogue Series was convened by the Aspen Institute in partnership with the Nicholas Institute for Environmental Policy Solutions at Duke University and Redstone Strategy Group.

REDSTONE

THE ASPEN INSTITUTE

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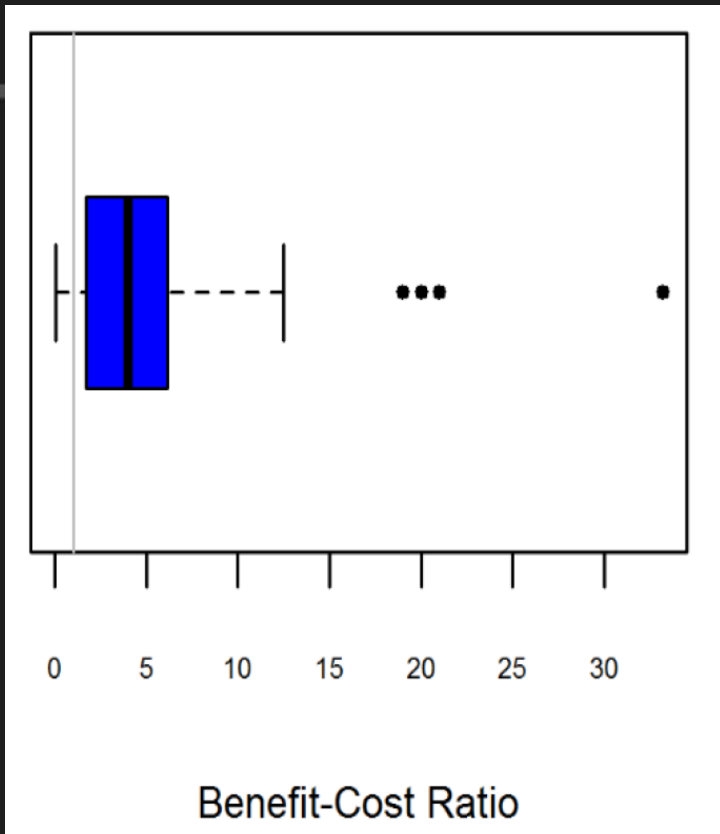
FOR ENVIRONMENTAL POLICY SOLUTIONS

Key Findings from the Dialogue Series

1 Water is undervalued, water data even more so. The value of open, shared, and integrated water data has not been widely quantified, documented, or communicated.

2 Watershed management decisions are being made without adequate data. Making existing public water data open is a priority. There has to be data available for there to be sharing and integration.

3 The internet shares information between entities across the world, revolutionizing society. Similarly, developing an “Internet of Water” – a network of interconnected data producers, hubs, and users – could revolutionize how water is managed.



- 29 published studies of benefit-cost ratio of public water data
- Ranged up to 35
- Median benefit-cost ratio ~4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Working Paper
NI WP 17-05

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www.nicholasinstitute.duke.edu

Estimating the Value of Public Water Data

John Gardner,* Martin Doyle,*,** and Lauren Patterson**

Dialogue Recommendations

ACTION 1

Articulate a Vision for Why Open Water Data are Needed

ACTION 2

Enable Open Water Data

ACTION 3

Create an Internet of Water

Value of Water Data

We didn't know the potential value of digital road infrastructure data
Until Google Maps, Waze, ….

If 'traditional' water data has 4:1 value, what might be value of 21st century version of water data?

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Thank you