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"Making Water Transparent"

Innovative Water Monitoring Networks to Support Water Managers in Quickly Developing Economies

A Global Perspective

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The Global Perspective - Why Online Monitoring ?

USA

- Very strict new limits for nutrients with focus on coastal areas
- Drinking water protection “Homeland Security”

Canada

- Drinking water protection in very remote areas (First Nations project)
- Mining: Monitoring of mining activities and oil production from oil sand, and fracking

Europe

- Optimization of use of energy and chemicals in water treatment plants
- Centralized management of water infrastructure
- To guarantee excellent drinking water quality at consumer tap; EU Water Safety Plan

China, India, South-East Asia, Lat. Am.

(quickly developing economies)

- River monitoring for protection of drinking water intakes from toxic spills
- Detection and identification of toxic spills in industrial effluents
- Building protection: Drinking water monitoring in important buildings in China

Examples of existing s::can „Big Data“ WQM Networks

- Thames Water, UK, waste water plants: 250 stations centrally monitored
- Canal Isabel, Spain, waste water plants: 80 stations
- Vienna, Austria, drinking water: 70 stations
- Canada: 80 stations in a network operated by First Nations (drinking water)
- US “Homeland Security”: Boston, New York, Cincinnati, San Francisco, Dallas, and many more invested into drinking water network monitoring
- River monitoring projects active with up to 100 stations in India (Ganga), Mexico (Atoyac), China, South-East Asia …
- Several other projects under discussion with 50 – 500 stations in India, China, South-East Asia, Latin America, Europe, Middle East, ….

Which type of technology is needed to be successful in such large, highly resolved monitoring networks ?

WQM Networks – how to make them smart

Simplicity – of sensors

Simplicity – of software

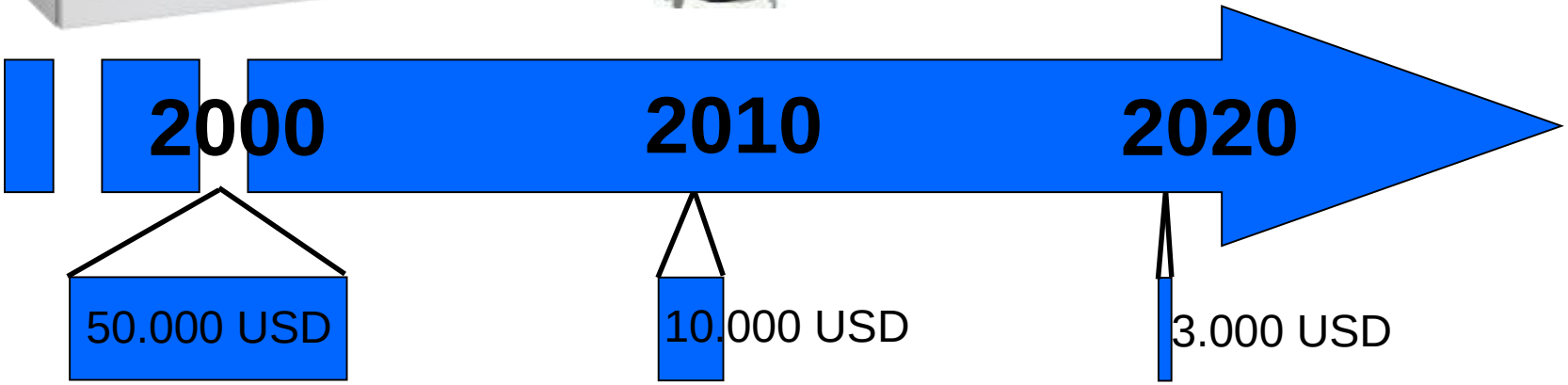
Simplicity – of operation

- **Avoid** reagents, consumables, pumps, filters, any moving parts
  - Solid state / optical / sensors always preferred
    - Submersed or In-pipe … if possible
    - Autonomy, intelligence, self-diagnosis
  - Factory-calibrated “out-of-the-box” measurements
  - Data Supply & Service Contracts by professionals

WQM Networks – how to make them really smart

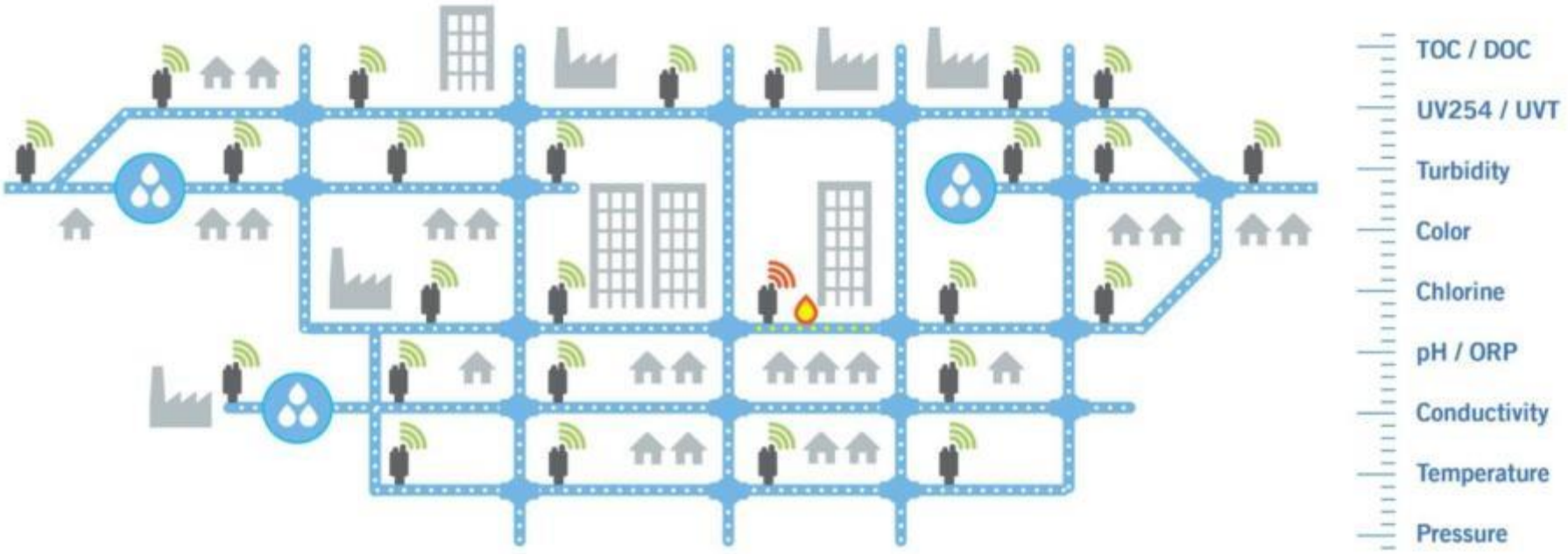
Change of 3 Measurement Paradigms:

1) From the laboratory to the field
2) From single measurement to real-time monitoring
3) From local display to internet / cloud connection



WQM Networks – how to make them really smart

Drinking Water Network Monitoring



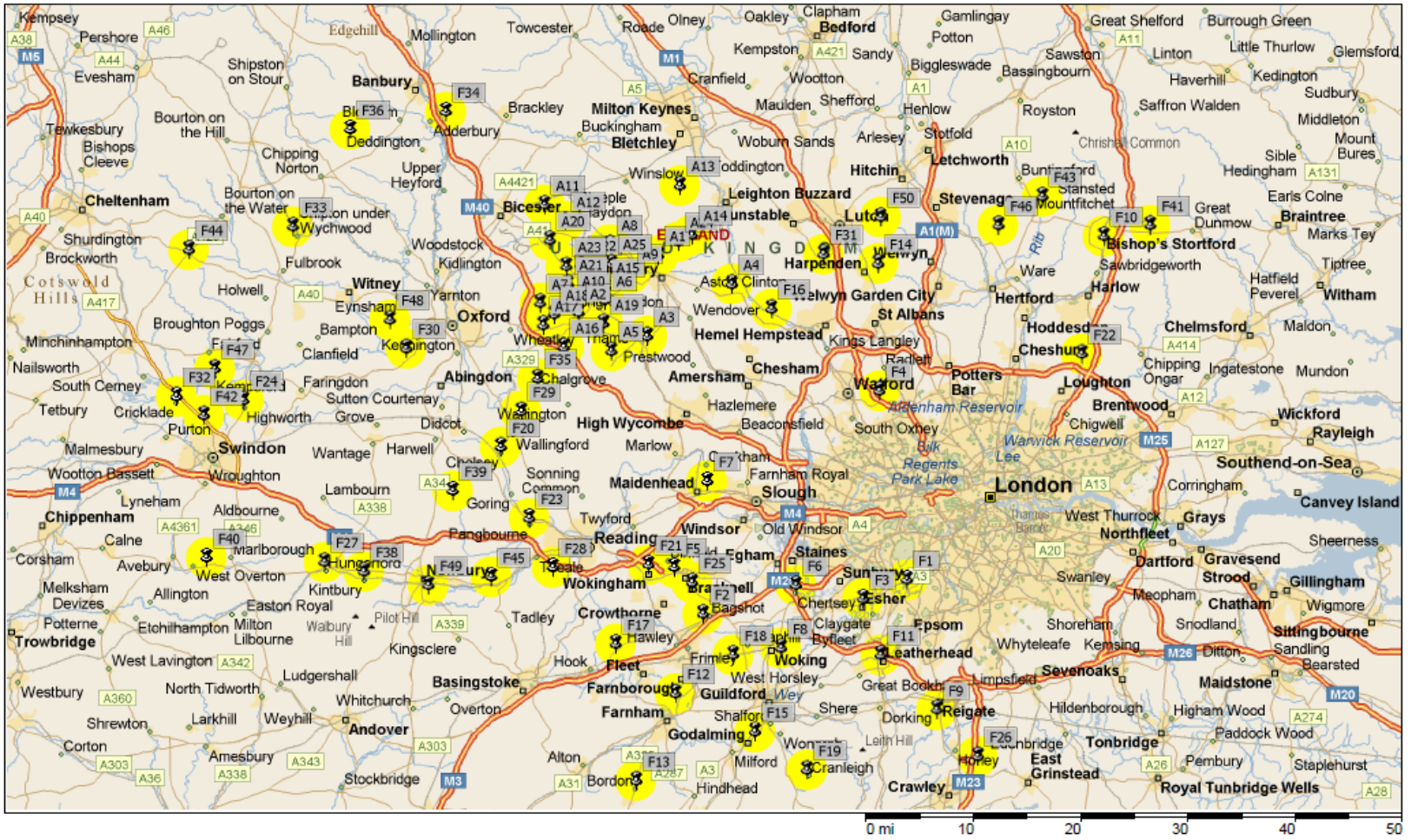
Multiple pipe::scans are the ideal - and only - solution to monitor all drinking water parameters at any point in the network.

UK - Waste Water

Centralised WWTP Management

Thames Water, UK

- 250 WWTPs (of 500) monitored and managed from one central place



UK - Waste Water

Centralised WWTP Management

Thames Water, UK

- Monitoring COD, TSS, NO3, NH4, pH, and Temperature by just two small sensors; instead of building a large monitoring container full of equipment.

Traditional Water Quality Monitoring Station

- Miniaturized laboratory
- Takes a lot of space
  (10 x Smart Station)
- Expensive
  (10 x Smart Station)
- Energy inefficient
- Toxic emissions
- Difficult to maintain
- Typical data availability only 50%
- 24/7 babysitter needed

The Smart Station

- Super-compact format.
- All reagent-less online sensors.
- Minimum space, no extra property needed.
- Cost efficient.
- Energy efficient, battery- or solar powered.
- Zero emission.
- Easy to maintain (1 x month)
- Data availability >90%

- Can be installed completely hidden, e.g. in a man hole, to protect against vandalism.

River monitoring goes Big Data

Two examples

The key to improvement is

TRANSPARENCY

Ganga Action Plan 1985

Trying to rejuvenate an aging river …. and goddess … and mother

- Ganga - river, goddess, mother for all Hindus
- Ganga - a trans-boundary river: India – Bangladesh
- Third largest river of the world by discharge
- Ganges basin covers approx. 25% India‘s total geographic area
- 500 mio. people in 11 states -> largest basin in the world by population
- Since 1985 financial support from World Bank and individual countries
- Several bio. USD spent in 3 investment rounds into water infrastructure
- Unclear outcome
  - Most sewage systems / plants never worked properly
  - Positive effect on Ganga water quality can not be proven
  - But lack of data for verification, reports are always in dispute

Lesson learned: The World Bank wants better data as a basis for least cost / best effect allocation of future investments, and for the measurement of success.

NEW: Namami Ganga Programme 2014

Government Objectives

1. Creating Sewerage Treatment Capacity
2. Creating River-Front Development
3. River Surface Cleaning
4. Bio-Diversity Conservation
5. Afforestation
6. Public Awareness
7. Industrial Effluent Monitoring
8. Ganga Gram – sanitation development of all 4470 villages along the River

Namami Ganga Programme 2014

Meeting with the Indian Water Minister

Namami Ganga Programme 2014

Ganga Water Monitoring Project

- 36 river monitoring stations along 2500 km built; 60 more planned
- 34 fixed stations and 2 profiling stations; all sensors submersed
- Up to 17 parameters monitored p. station
- QA/QC system and protocol in place to continuously validate data
- Central data management and remote access system (CDMS)
- 5 years “Data-as-a-Service” contract with India government
- 5 years of continuous monitoring (March 2017 till 2022)

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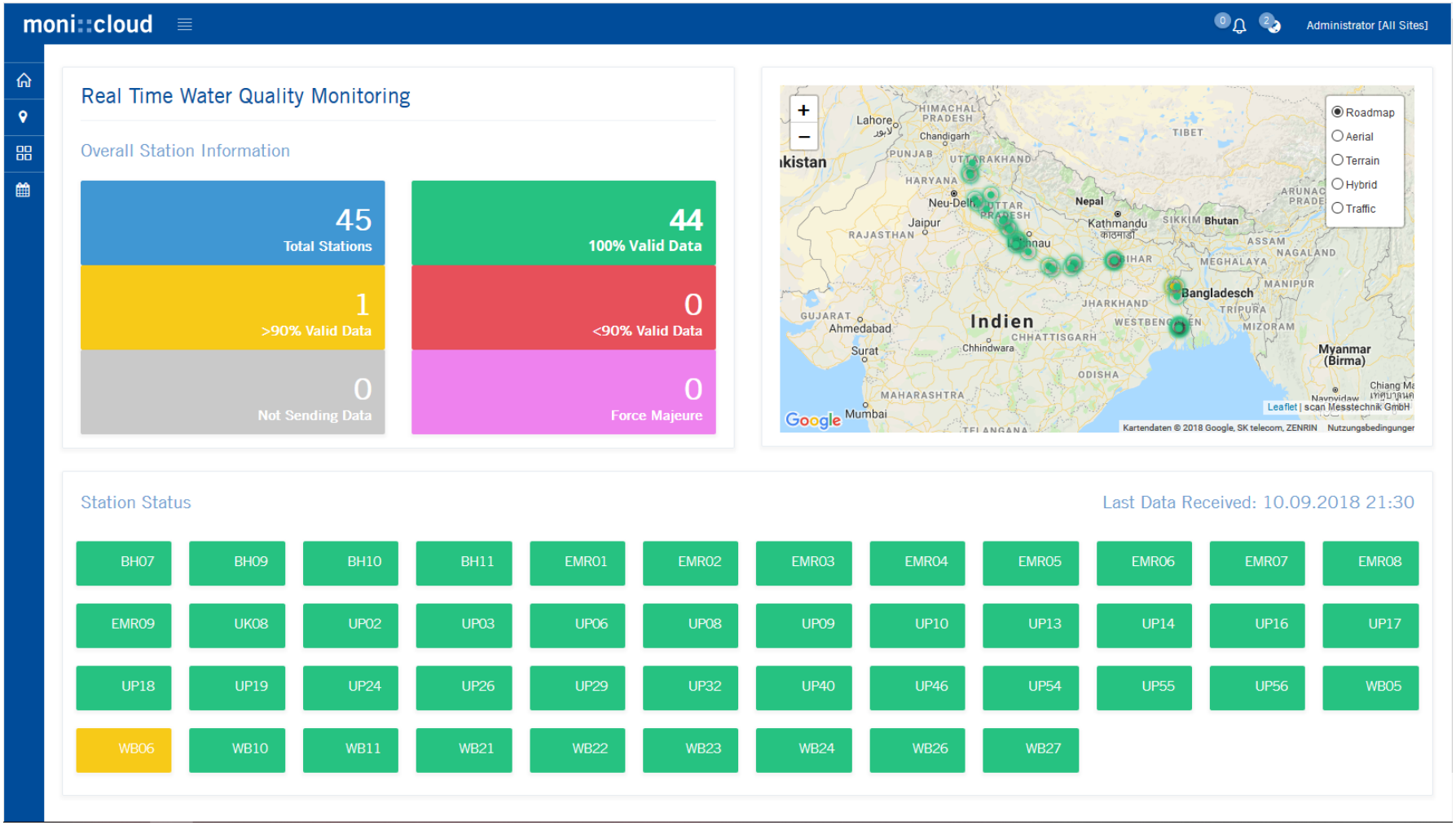
Namami Ganga Programme 2014

moni::cloud Central Data Management System

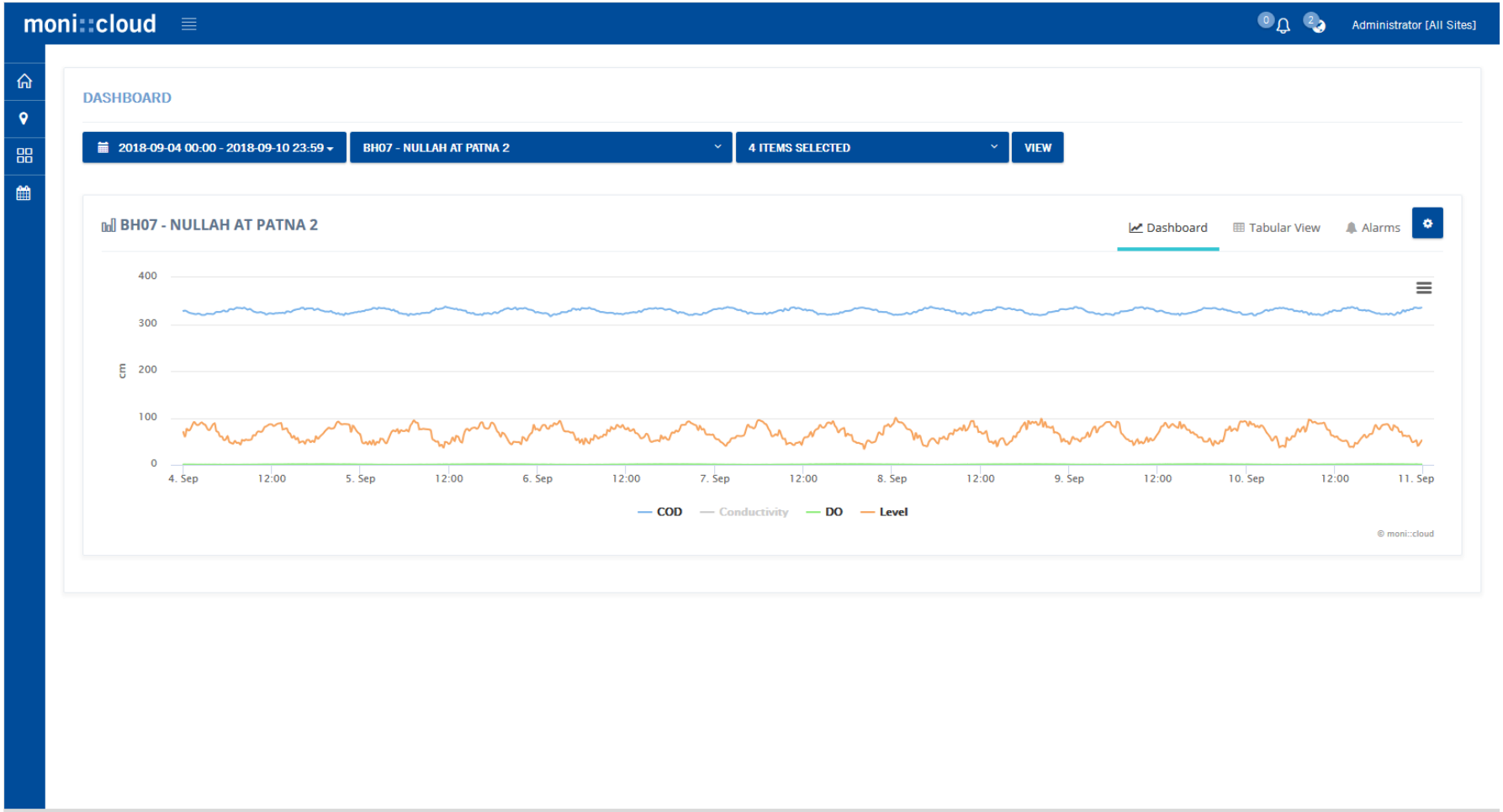


Namami Ganga Programme 2014

moni::cloud Central Data Management System

Namami Ganga Programme 2014

moni::cloud Central Data Management System



Namami Ganga Programme 2014

Station design

- Type A - „Fixed Station“

Namami Ganga Programme 2014

Station design

- Type B - „Profiling Station“ = Boat mounted

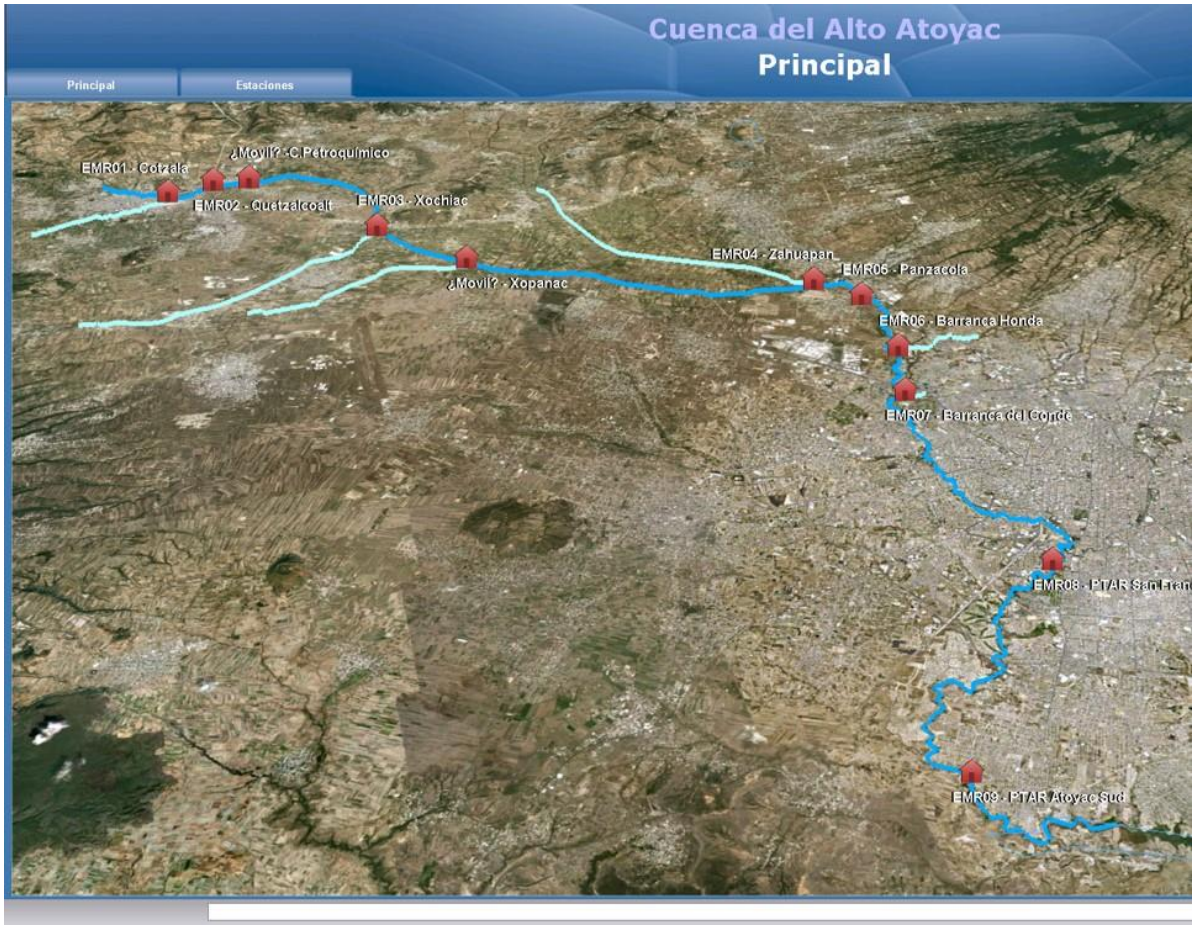
Namami Ganga Programme 2014

Station design

- Type C - „Floating Station“

Atoyac River Monitoring, Mexico

- One of the most polluted rivers in the world
- Installed and operate 12 monitoring systems along the river
- To catch industrial polluters in real-time



Transparent Rivers in Asia

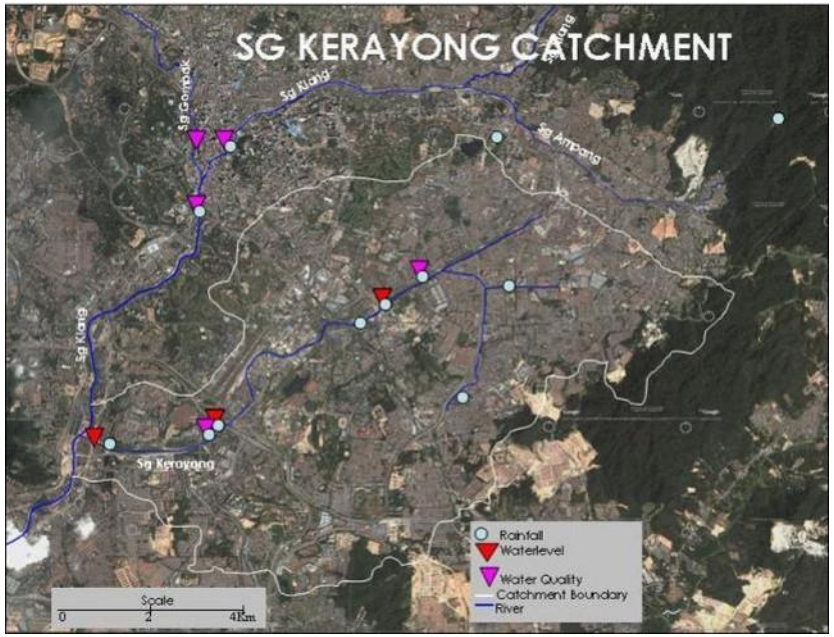
River Monitoring Singapore

- Rochor Channel Monitoring
- RTU with solar power and GPRS data upload to online PUB website

Transparent Rivers in Asia

River Monitoring Malaysia

- DIDM flood forecasting
- 5 Parameters: TSS, COD, BOD, NH4, pH



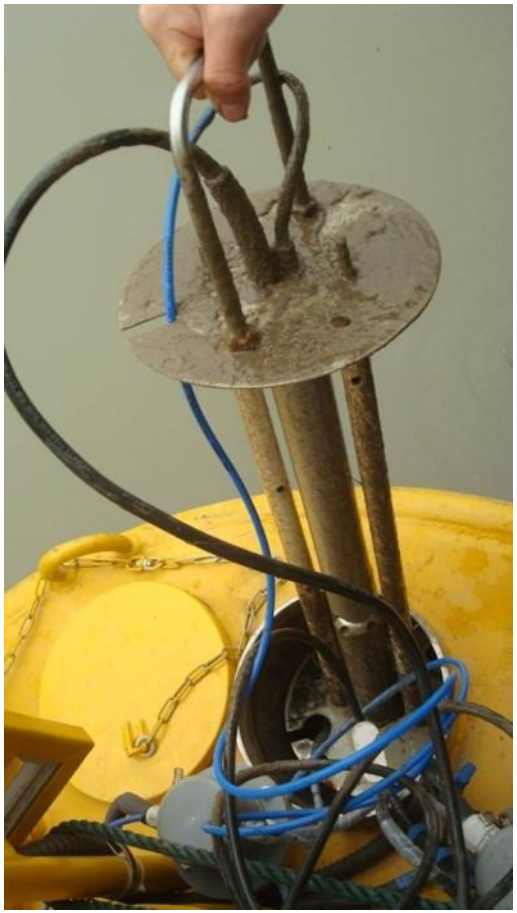
Transparent Rivers in Asia

River Monitoring China / Chengdu EPA

- River monitoring throughout Chengdu city
- 7 Parameters: TSS, COD, BOD, NH4, DO, EC incl. spectral alarms

Transparent Rivers in Asia

China buoy installation



Smart WQM Networks – how to make them work

Conclusions - Technology

- Use the simplest, most reliable, and multi-proven technologies only.
- Avoid reagents, consumables, filters, moving parts, pumps etc. in the field.
- If possible, use submersed installation.
- Preferred are optical technologies as they are the most stable and robust.
- Validation is important, but Calibration should be the rare exception.
- All complex analysis should remain in the lab.

Smart WQM Networks – how to make them work

Conclusions - Implementation

- Focus on comparability and standardization, at least within your organization, country or project.
- Plan enough time and resources for diligent implementation.
- Establish a QA/QC protocol and use software and central data management to control services and enforce the involved procedures.
- Data-as-a-Service contracts (-> purchasing data instead of equipment) put the risk on service provider side, minimizes the risk on employer side, can significantly reduce costs, and will greatly improve data quality.
- Service provider professionals are better trained, experienced, and focused to successfully install and operate water quality monitoring equipment.
- The Ganga monitoring tender could be a blueprint for many projects.

THANK YOU FOR YOUR ATTENTION !

Any questions ?

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