Digital Water Approach for Smarter Water Management in Cities

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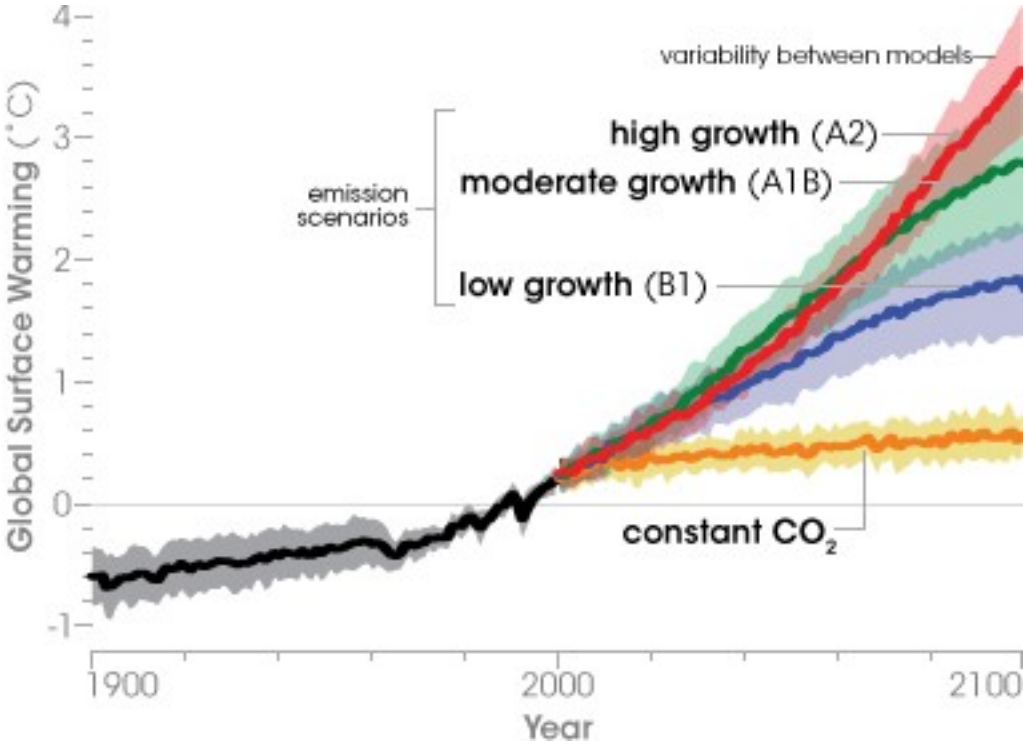
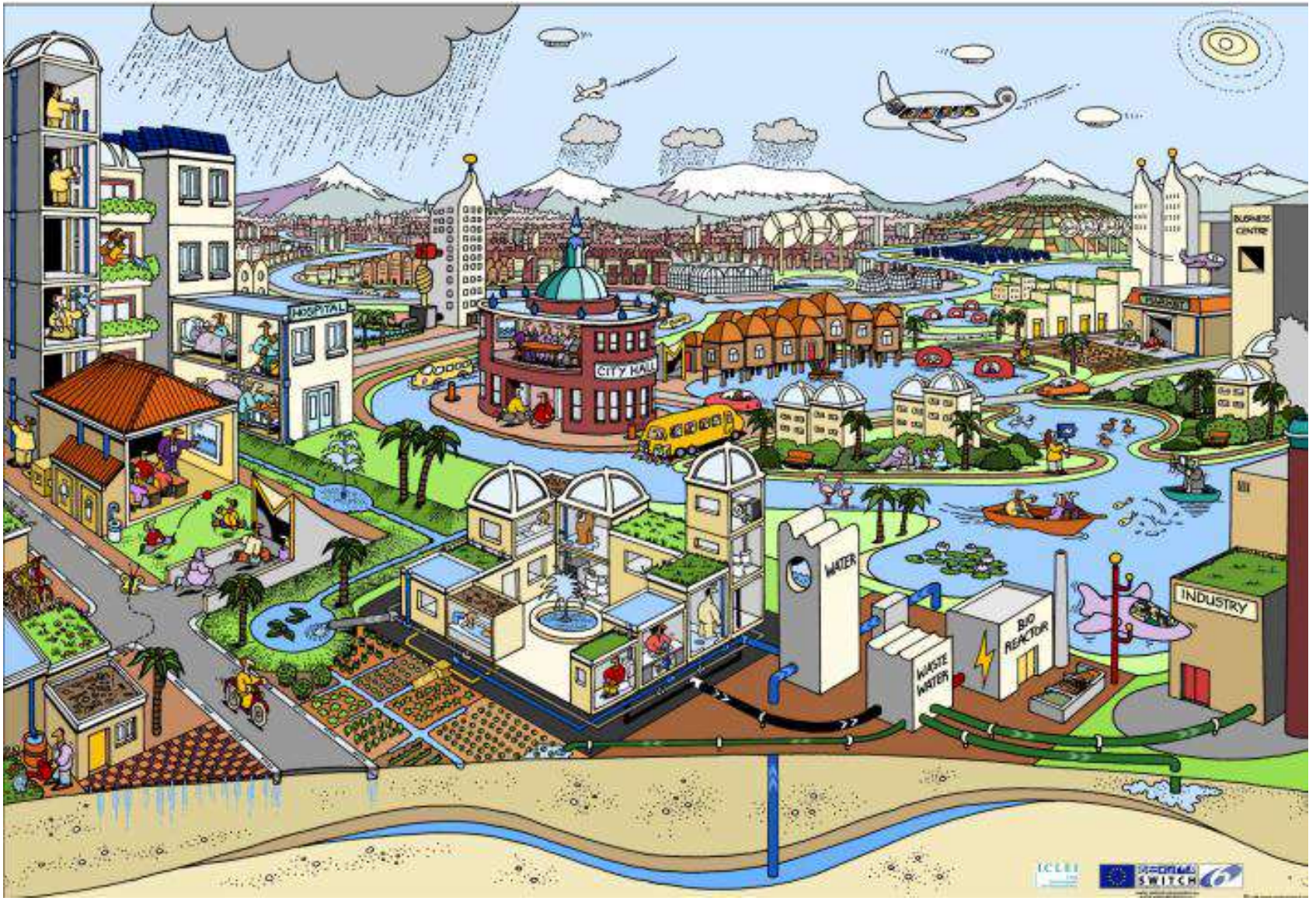
Pressures/Drivers in the Water Sector

- Population growth and urbanisation
- Climate change
- Sustainability concerns
- Environmental issues
- Infrastructure deterioration
- Increased consumer expectations
- Other



Smart/Digital Water City



Smart Water and Wastewater Systems

- Better understand network performance / state
- Better utilise water, energy and other resources under normal operating conditions
- Detect/predict events and intervene before (catastrophic) failure occurs
- Improve asset management and customer service
- Other

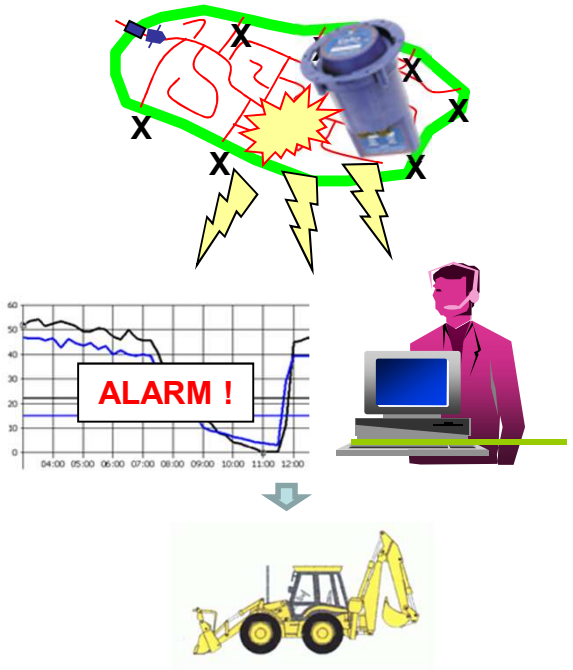
Source: SWAN Forum

Digital Water Technology Example #1:

Real-time Detection and Location of Failure Events in Water Distributon Systems

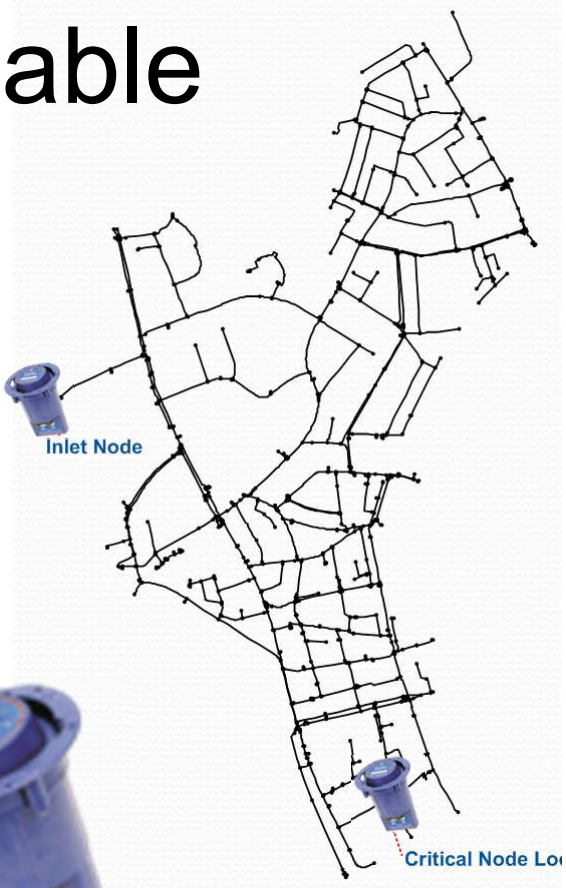
Real-time Detection and Location of Pipe Bursts/Leaks

- Challenge: use pressure and flow sensor data to detect and locate bursts and other events and raise alarms in real-time
- Data analytics type technology – no hydraulic or any other model
- Enables more proactive approach

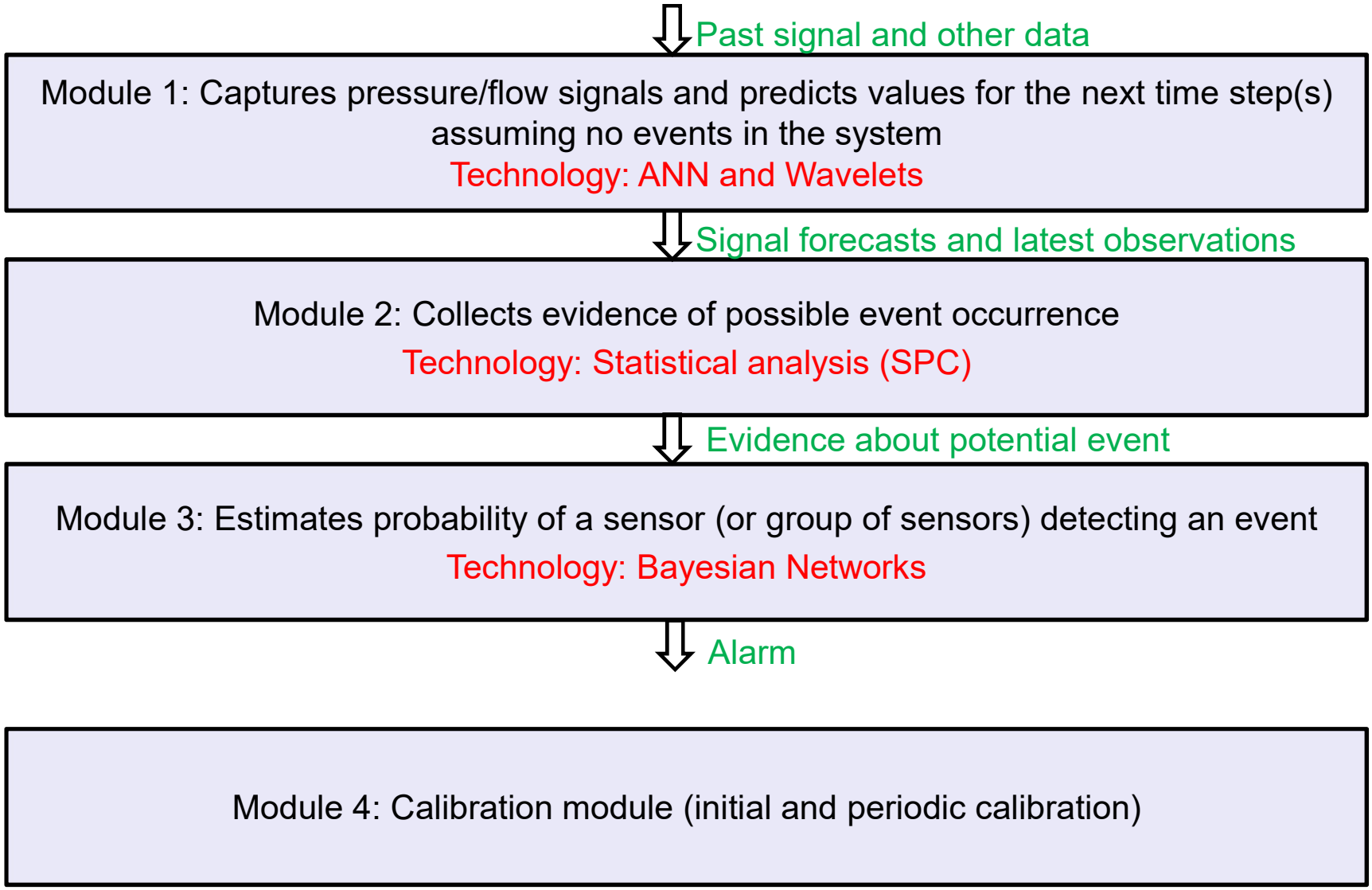


(Big) Data Available

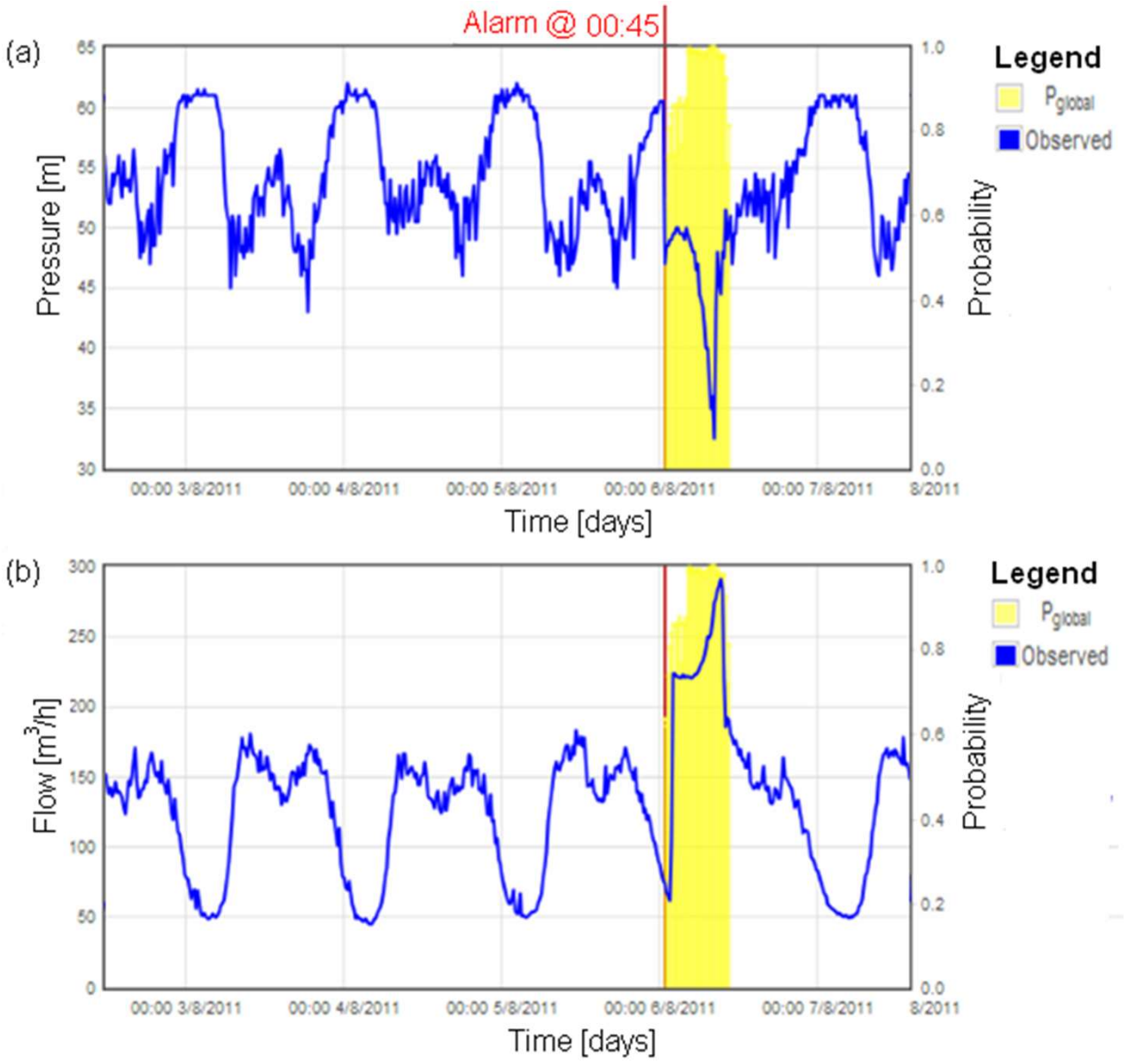
- Sensor data:
  - Pressures and flows at DMA sources and import/export points
  - Pressures at critical/other points
  - Logging every 15 minutes
  - Other (e.g. SCADA data)
  - Lots of sensors in large UK companies
- Other data:
  - Network/asset data
  - Customer bills and contacts
  - WMS/mains repair data
  - Other (e.g. smart demand metering)
- Current situation: DRIP



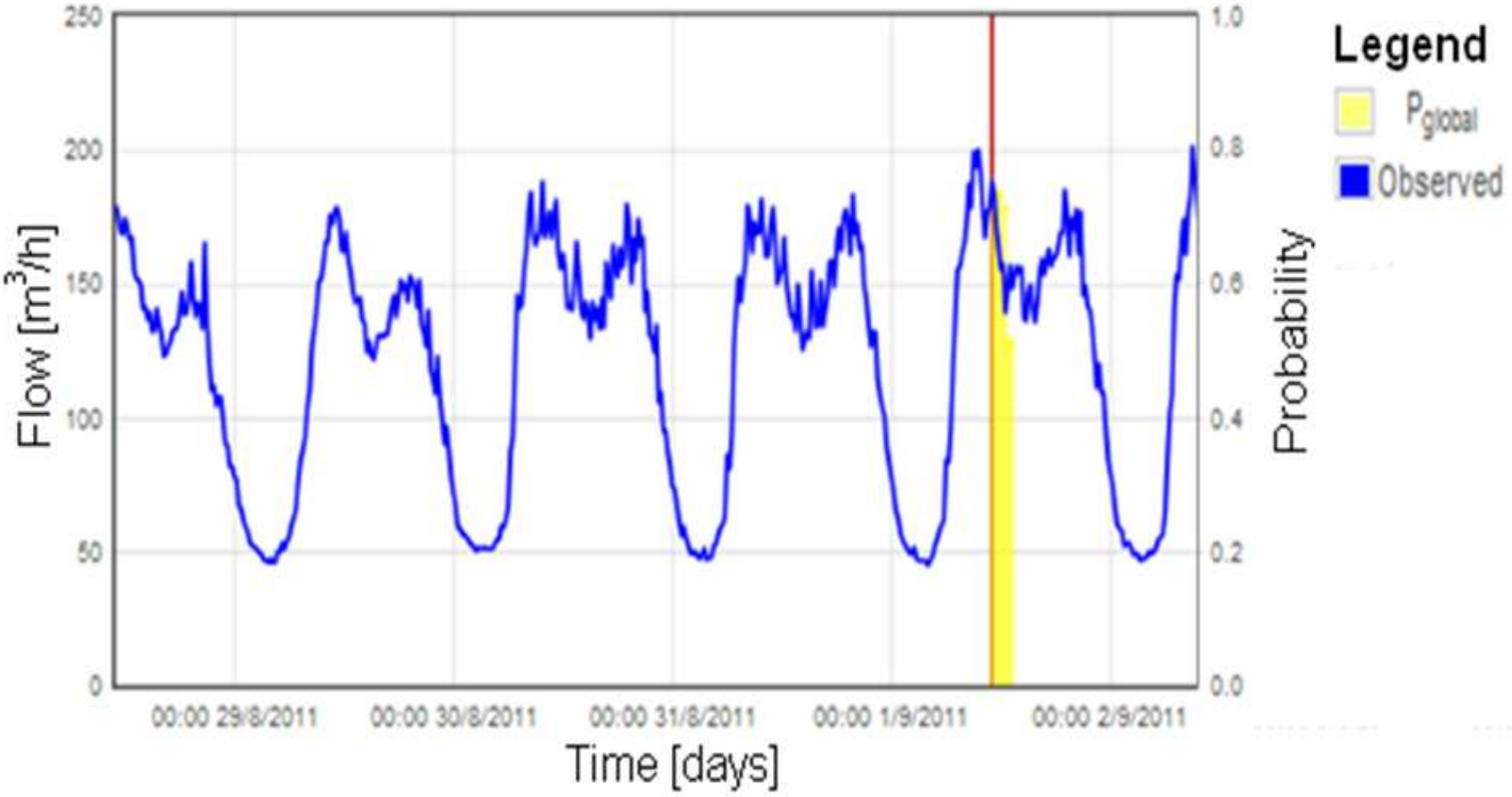
Event Detection System



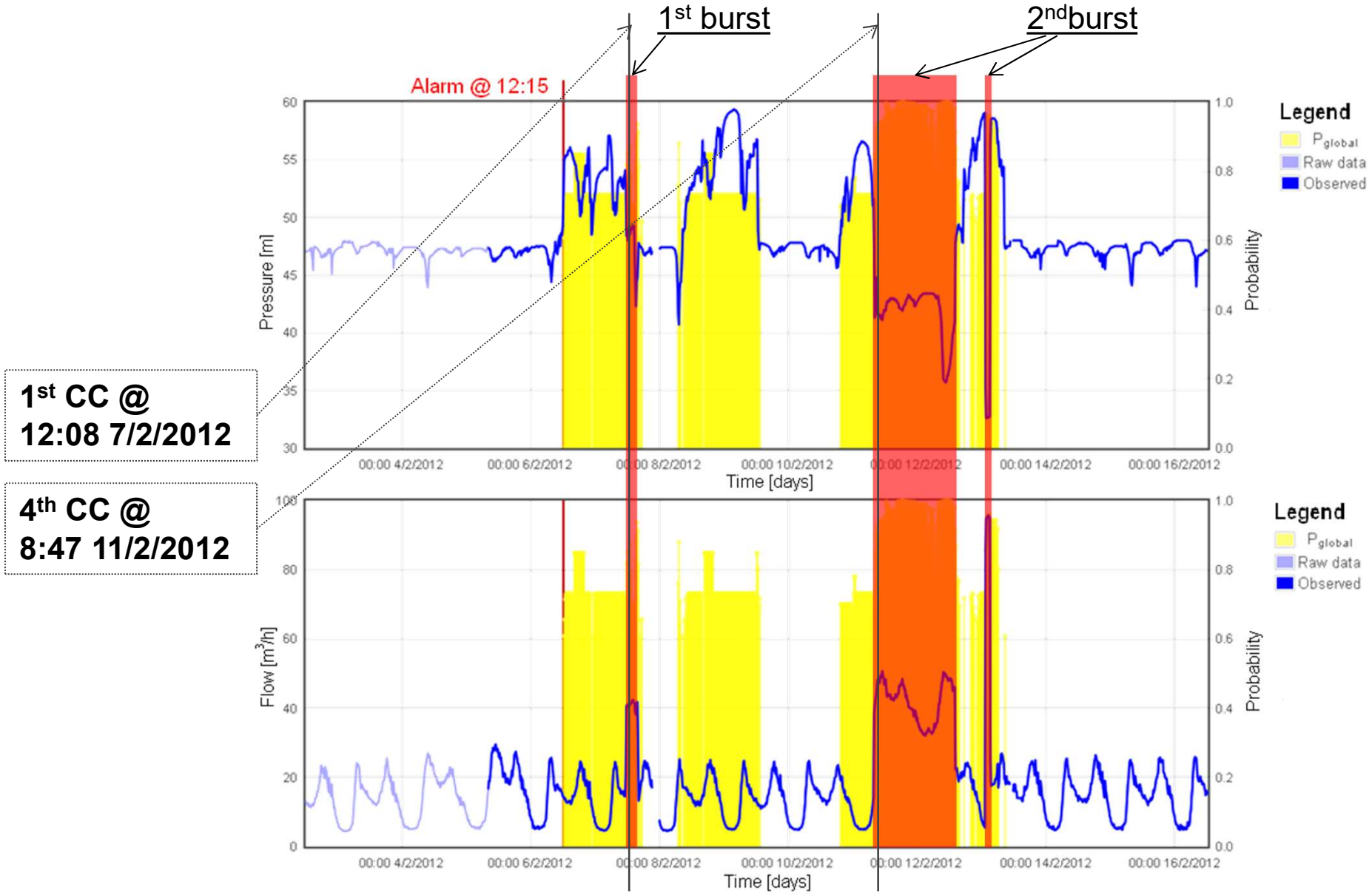
Example: Large Burst



Example: Small Burst



Example: PRV Failure



1st CC @ 12:08 7/2/2012

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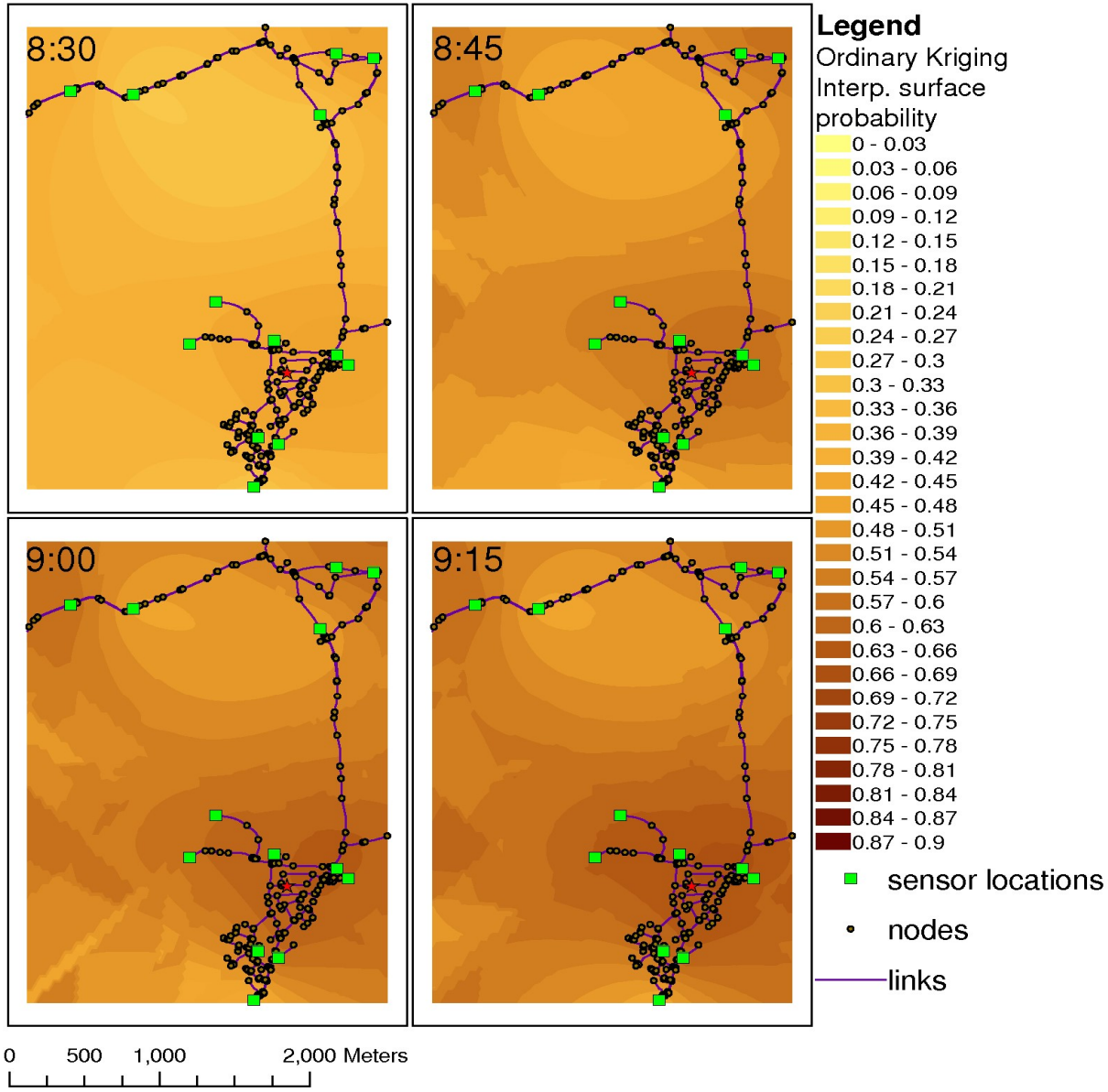
Event Detection Technology

- Successfully tested and validated on historical data, engineered events and real-life events
- Enables fast and reliable detection of different type events at the sensor/DMA level
- ERS used companywide in a large UK water utility since 2015 resulting in major operational cost savings

Event Location

first event
interpolation surface for successive time steps



Digital Water Technology Example #2:

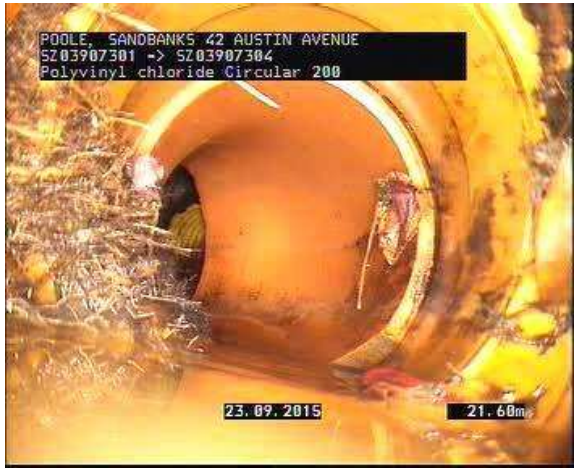
Machine Learning based Automated Asset Condition Assessment

Motivation

CCTV used to survey most sewer /urban drainage pipes

- Commonly collected using ‘PIG’ or ‘push rods’
- Footage is time consuming to collect
- Requires trained engineers
- Prone to human error and subjectivity

AIM: Automatically detect and identify faults in CCTV sewer surveys



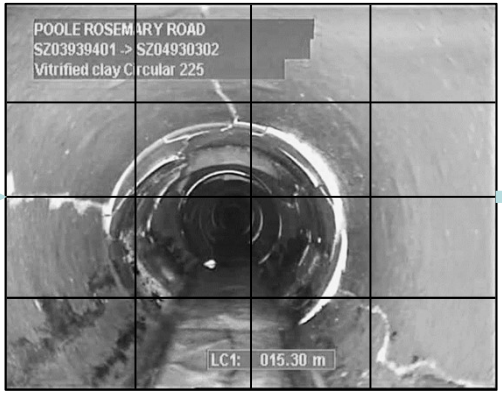
Intruding Roots

Collapsed Pipe

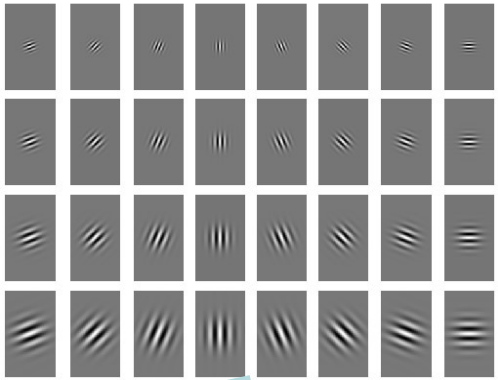
Fault Detection Methodology

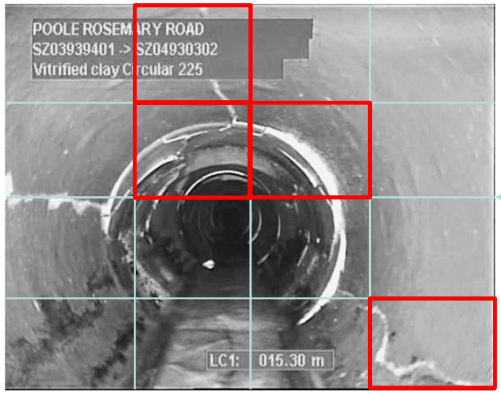
Frame Extraction

Pre-processing

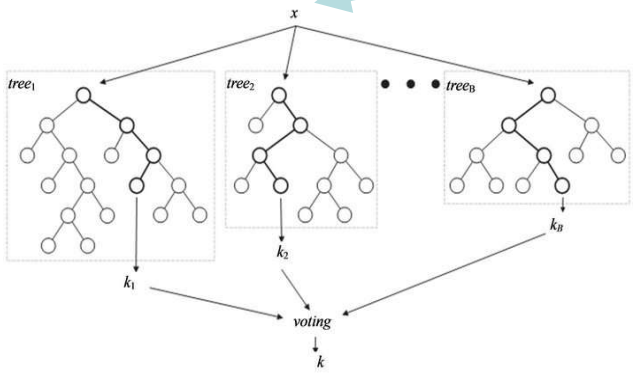


Feature Extraction





Annotate Fault



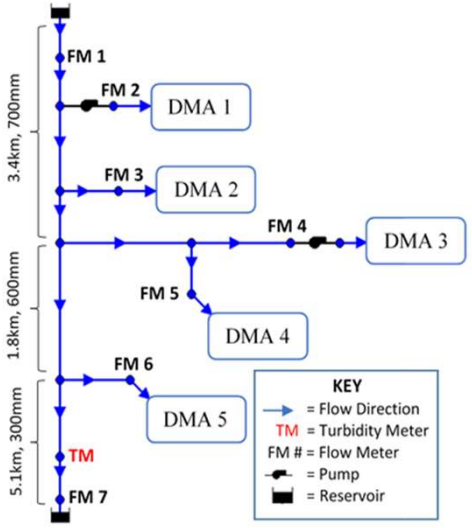
Classification for detection

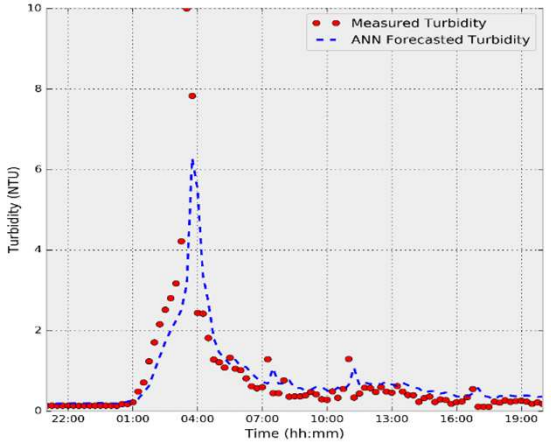
Results

- Applied to unseen CCTV sewer surveys achieved the detection accuracy of 90% with low false alarm rate
- Validated so far on CCTV data from UK, Finland and Australia
- Ultimate goal is to incorporate this technology into a decision support type tool used by a technician
- Currently being commercialised

Other Examples of Digital Water Technologies

- Early warning for discolouration issues
- Detection of events at treatment works
- Sensor data validation
- Real-time system state estimation via data assimilation (online modelling)
- Adaptive demand forecasting
- Pump scheduling for energy cost and water quality
- Flood forecasting
- Many objectives optimisation of water systems
- Other





Take Home Messages

- Digital water solutions work and can lead to substantial cost savings, benefits and improved service

- Digital water solutions have great potential to address a wide range of real challenges in the water sector

- AI and machine learning is not sufficient of its own, it needs to be combined with engineering knowledge and adopted by people who can use it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