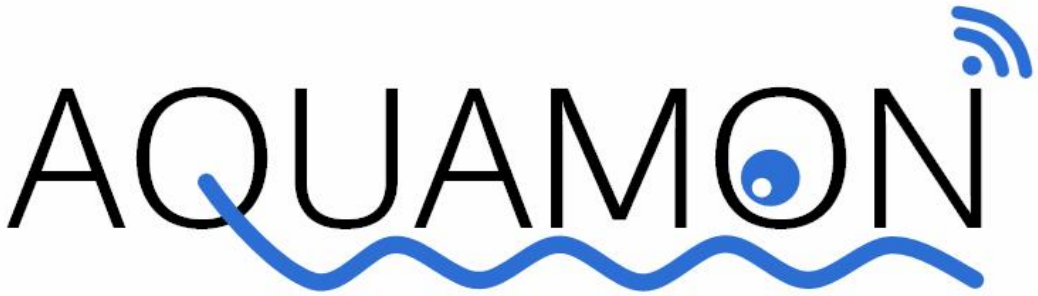

A dependable Monitoring Platform based on Wireless Sensor Networks for Water Environments

Ciências ULisboa

U.PORTO FEUP FACULDADE DE ENGENHARIA UNIVERSIDADE DO PORTO

LNEC LABORATÓRIO NACIONAL DE ENGENHARIA CIVIL

LASIGE driven by excellence

CISTER Research Center in Real-Time & Embedded Computing Systems

FCT Fundação para a Ciência e a Tecnologia MINISTÉRIO DA CIÊNCIA, TECNOLOGIA E ENSINO SUPERIOR

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Overview

- Motivation
- Objectives
- Case study
- Technical approach
- Questions and answers

Aquatic information systems

- Anticipate events of pollution and support the emergency response
- Support daily and long-term management actions to minimize the risks for public and ecosystems health
- Support activities in the water bodies (management and leisure)

Aquatic monitoring and forecast systems

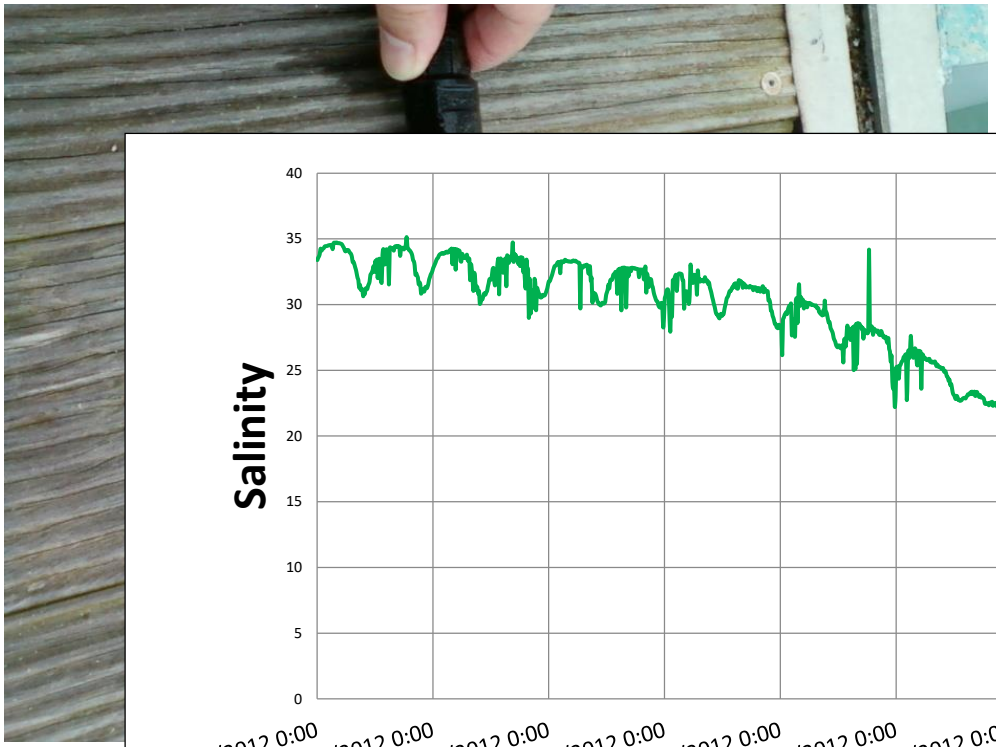
- The integrated use of wireless sensors and web-based decision support systems plays a main role in monitoring, controlling, relieving and assessing natural disasters

- Real-time aquatic monitoring, for water level, flow or precipitation values, is essential in losses prevention:
  - Confirm process-based model predictions
  - Support alerts issuing
  - Support decision-making (mitigation actions)

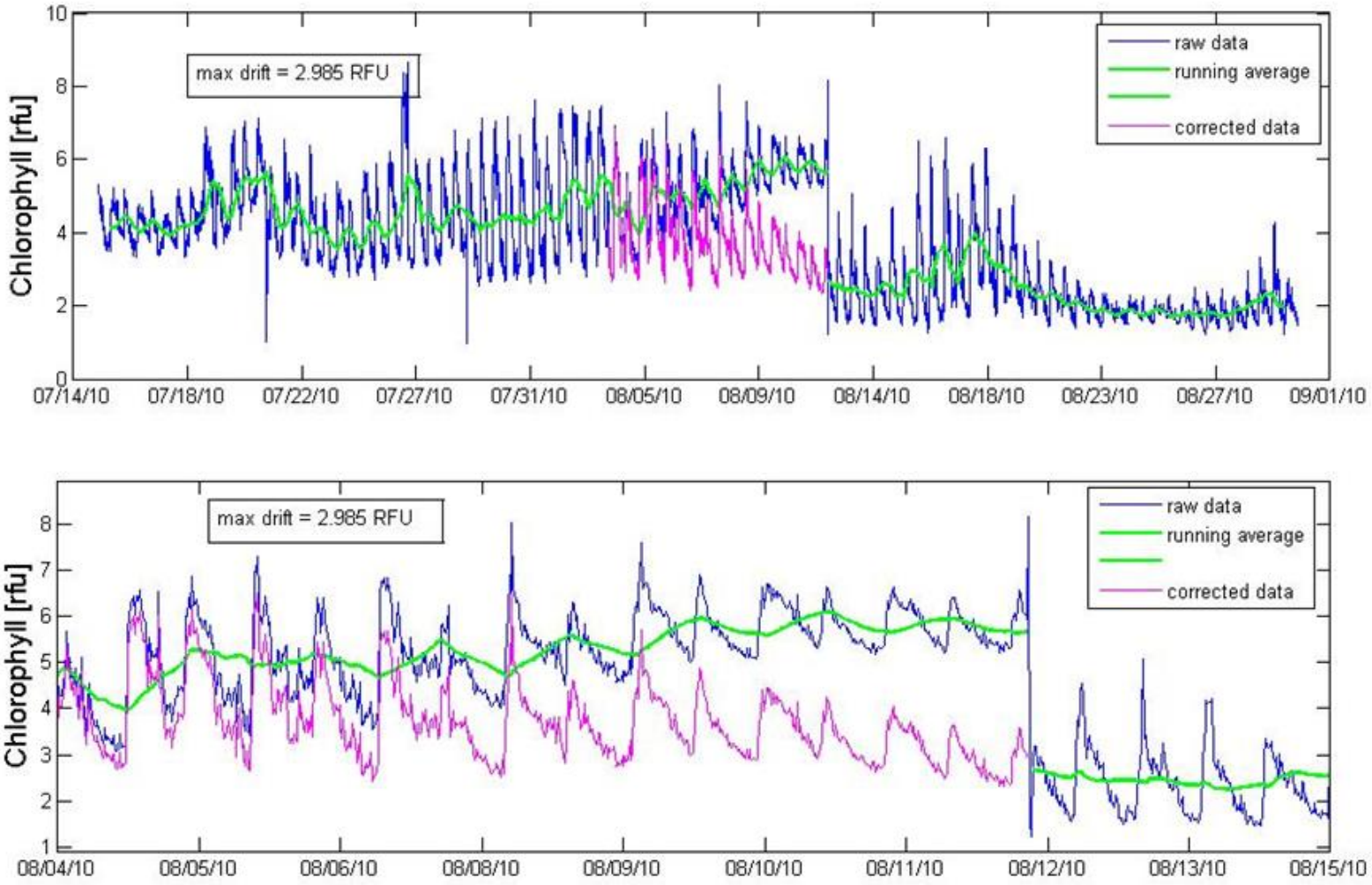
- The quality of the data that feeds these systems depends on the **quality of the measurements** that are used to continually validate the involved predictions

Faulty data in harsh environments

Faulty data in harsh environments



Failure detection and data correction



Objectives

- Develop a dependable monitoring platform for application in aquatic environments using wireless sensor networks
- Address data communication quality problems
- Demonstrate the results using a real-time hydrodynamic and water quality monitoring and forecast system of the Tagus estuary

Case Study – Baía do Seixal

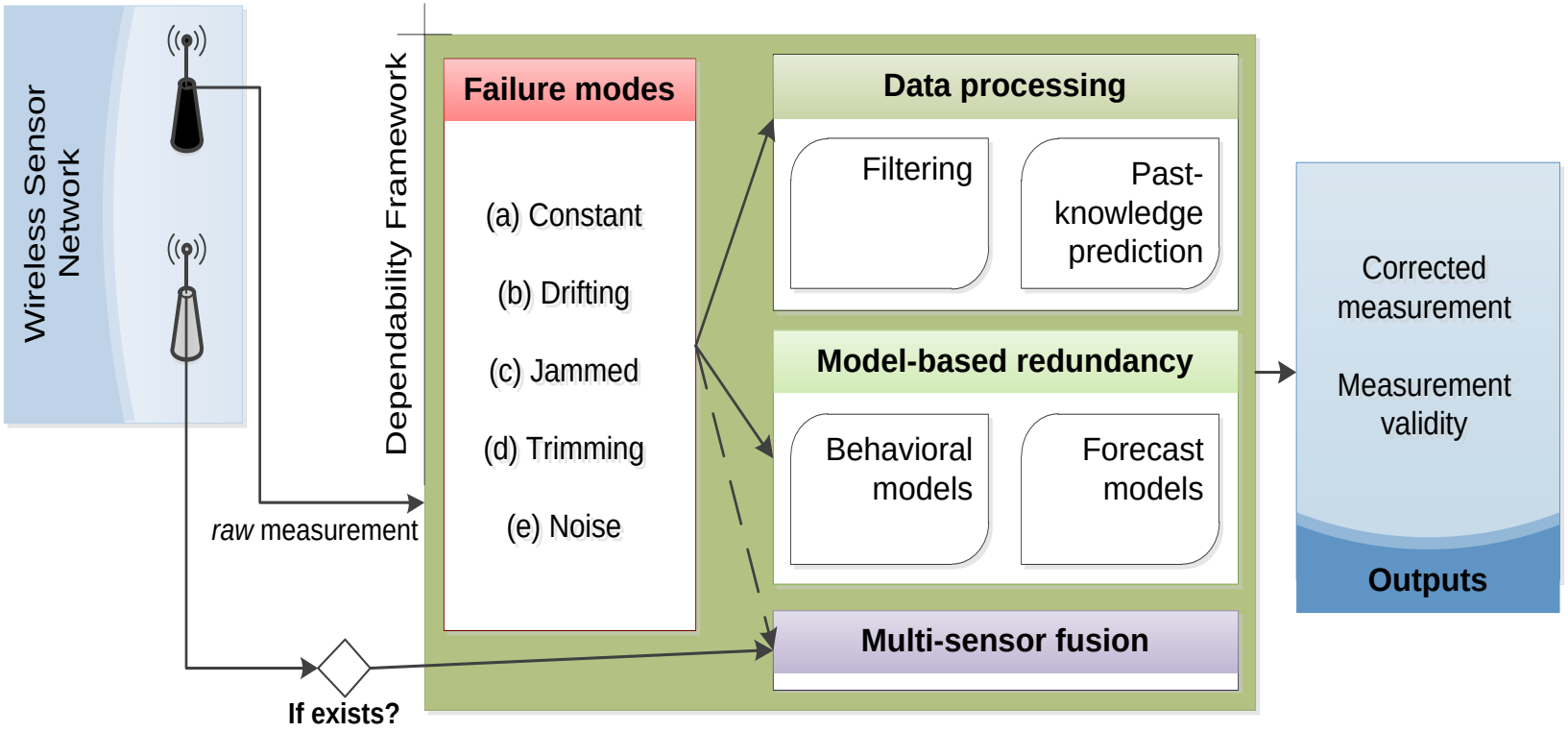
- Baía do Seixal - provides valuable services (e.g., recreational activities, inundation protection) for both the local population and economy, and the global ecological functioning of the Tagus estuary

- AQUAMON will produce daily forecasts (water levels, velocities, salinity and water temperature) and implement a real-time monitoring network - to continuously and dependably assess the environmental status of the bay

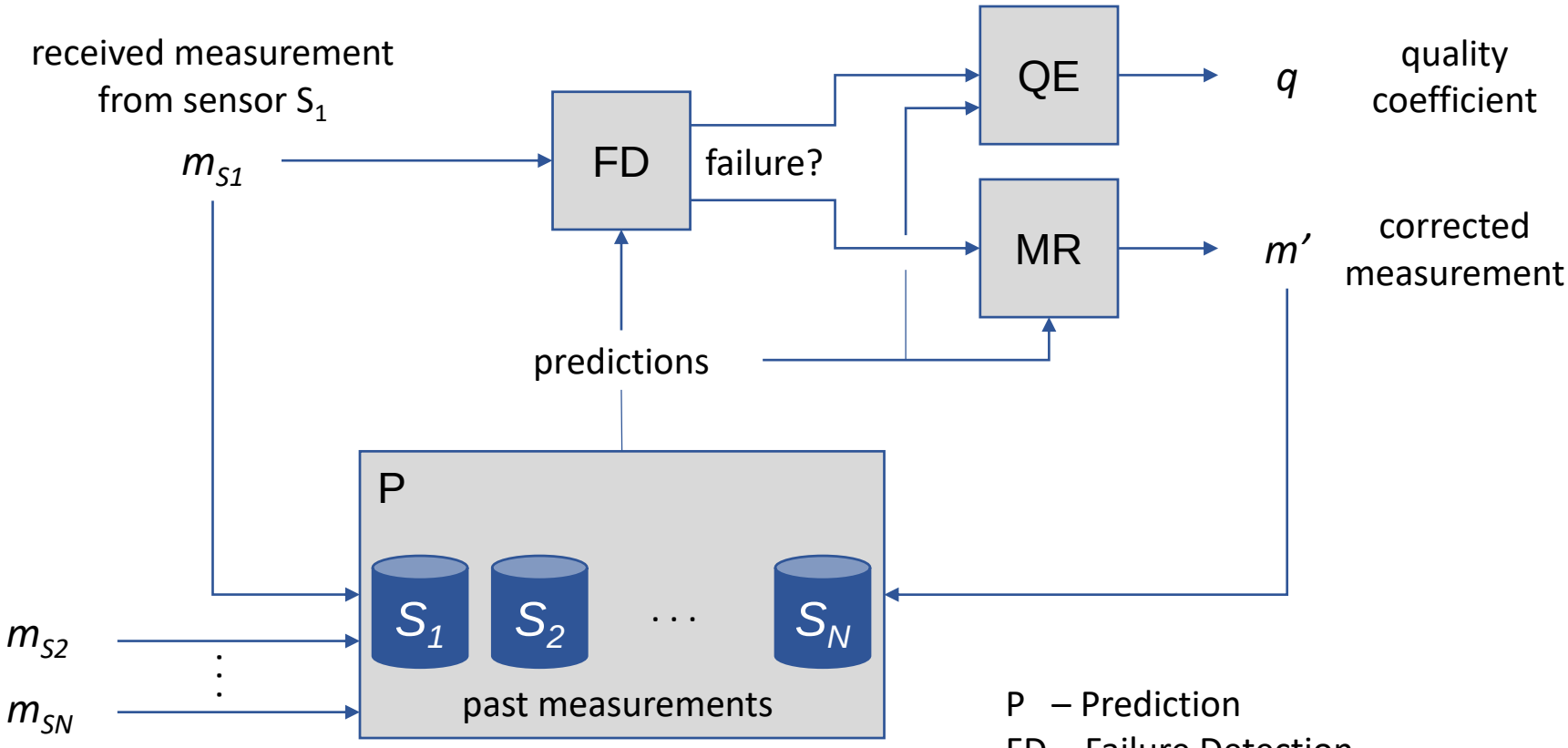
Dependable WSN-based communication

- Objectives
  - Evaluate existing technologies, namely high-power ZigBee, LoRA and NB-IoT
  - Define a low-level management interface for:
    - RF channel selection
    - Address configuration
    - Power management
    - Collection of performance data
    - Etc.
  - Experimentally characterize communication quality
    - In the demonstration deployment site
  - Develop a reliability strategy to mitigate communication problems (e.g. interference of water waves)

Dependable Monitoring Framework

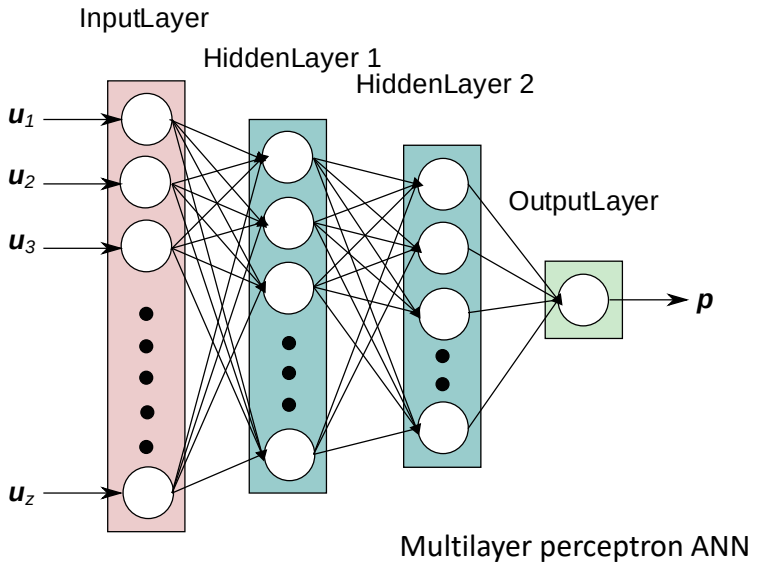


Data Processing



Prediction models

- Use **Artificial Neural Network** to predict the value of a sensor based on past measurements of that sensor and of neighbour sensors
- Depending on combinations, multiple predictions can be obtained
- Requires careful selection of sensors and features to be used
- Input vectors must include **data from about 12 hours (a complete tidal cycle)**



Multilayer perceptron ANN

Notes on training

- Training data representative of one entire year and fault free
- Several ANNs trained for each sensor output, exploiting different correlations:
  - Using only target sensor data
  - Using only neighbour sensor data
  - Using both target and neighbour sensor data

Questions?