

MODULE: Real Time Geospatial Applications

LESSON: OGC Sensor Web Enablement (SWE)

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Contents / Learning Objectives

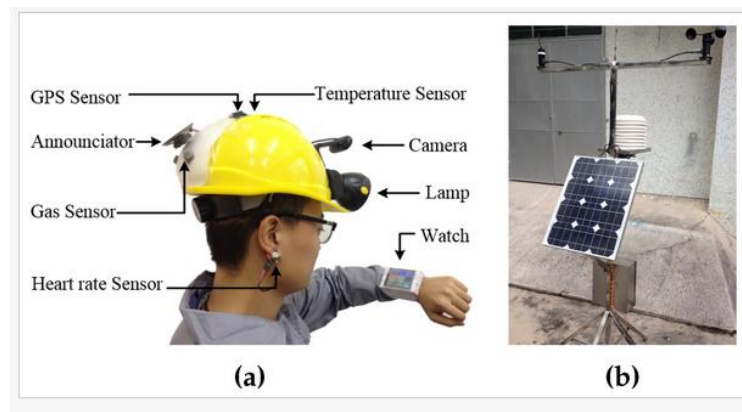
- Sensors, sensor system, sensor resource, sensor network
- Sensor web
- Open Geospatial Consortium (OGC) and OGC Sensor Web Enablement (SWE) description
- SWE information model
- SWE interface model

Sensor types

- Mobile sensor types (sensors in motion)
 - Remote sensors on orbiting satellites
- Fixed sensor types (stationary)
 - Flood gauges
 - Fixed air pollution
 - Noise pollution sensors
 - Fixed webcams



Thermometer



Anemometer

Source: Chen et al, 2016

Geosensors

- sensors delivering an observation with georeferenced location

Sensor system, sensor resource and sensor network

- Sensor systems:
 - Weather station
 - Water level monitoring station
- Sensor resource:
 - Abstract representation of sensors and sensor systems
- Sensor network

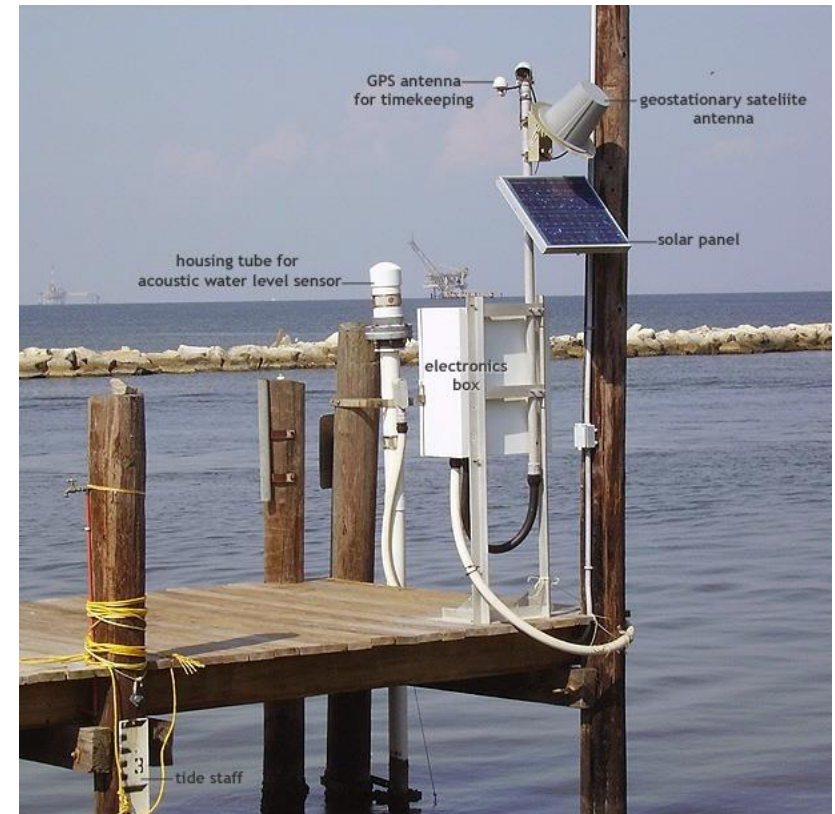
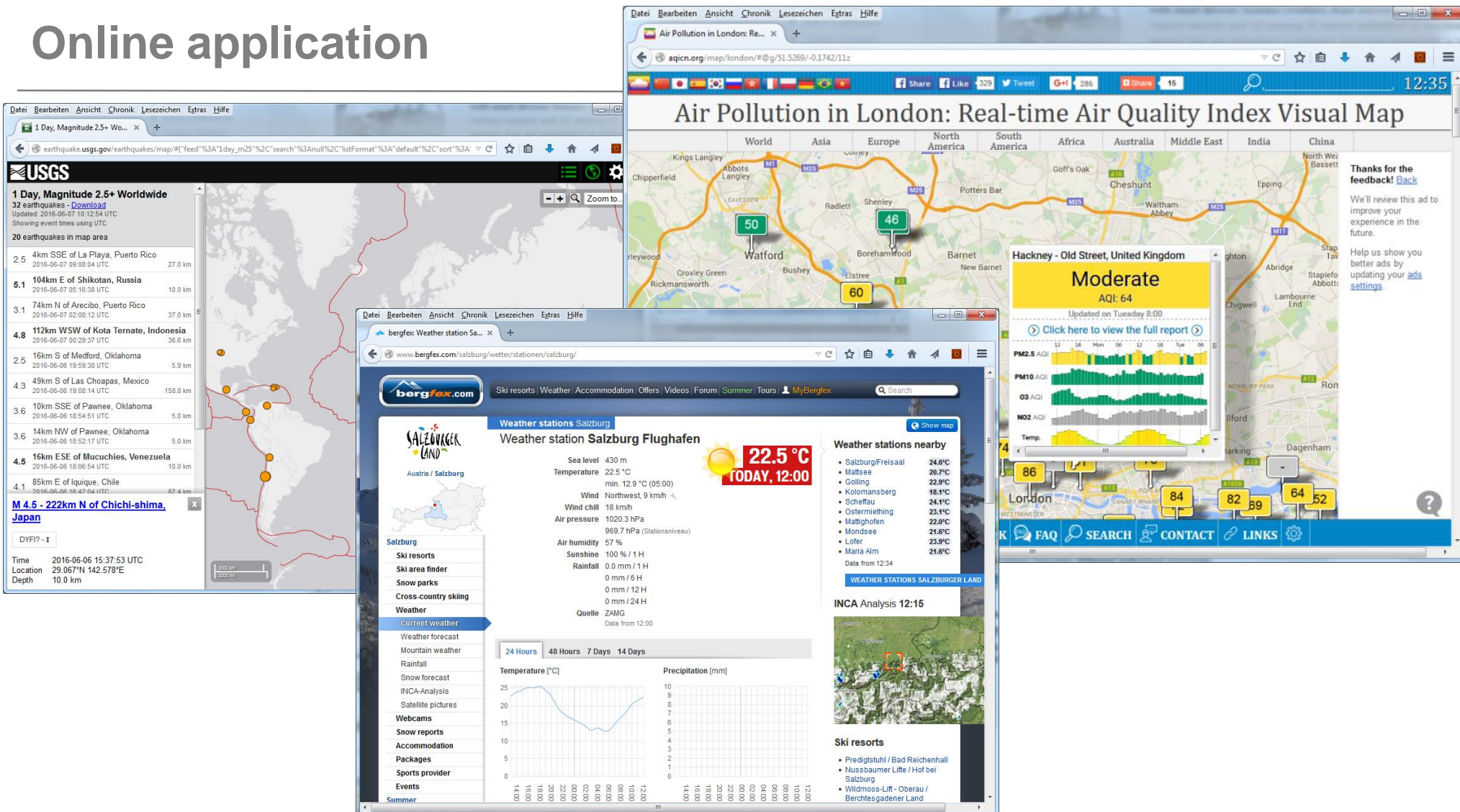


Figure: NOAA water level monitoring station
(Source: <https://goo.gl/NbDekp>)

Module: Real Time Geospatial Applications

Lesson: OGC Sensor Web Enablement (SWE)

Online application



Sensor Web

- ‚Sensor Web‘ concept originated at NASA/ Jet Propulsion Laboratory in the late 1990s
- Definition:
 - *“a **distributed**, global system of sensors, processed sensor observations, databases and simulations that can be dynamically configured to allow for information synthesis over a large spatial area and for tracking of dynamic phenomena”* (Delin et al 2005).



Need to develop standards for Sensor Web

- Different sensor protocols and interfaces
- Standalone applications integrating sensor resources through proprietary mechanisms
- Manual integration and linking sensor resources is expensive (time and financial resources)



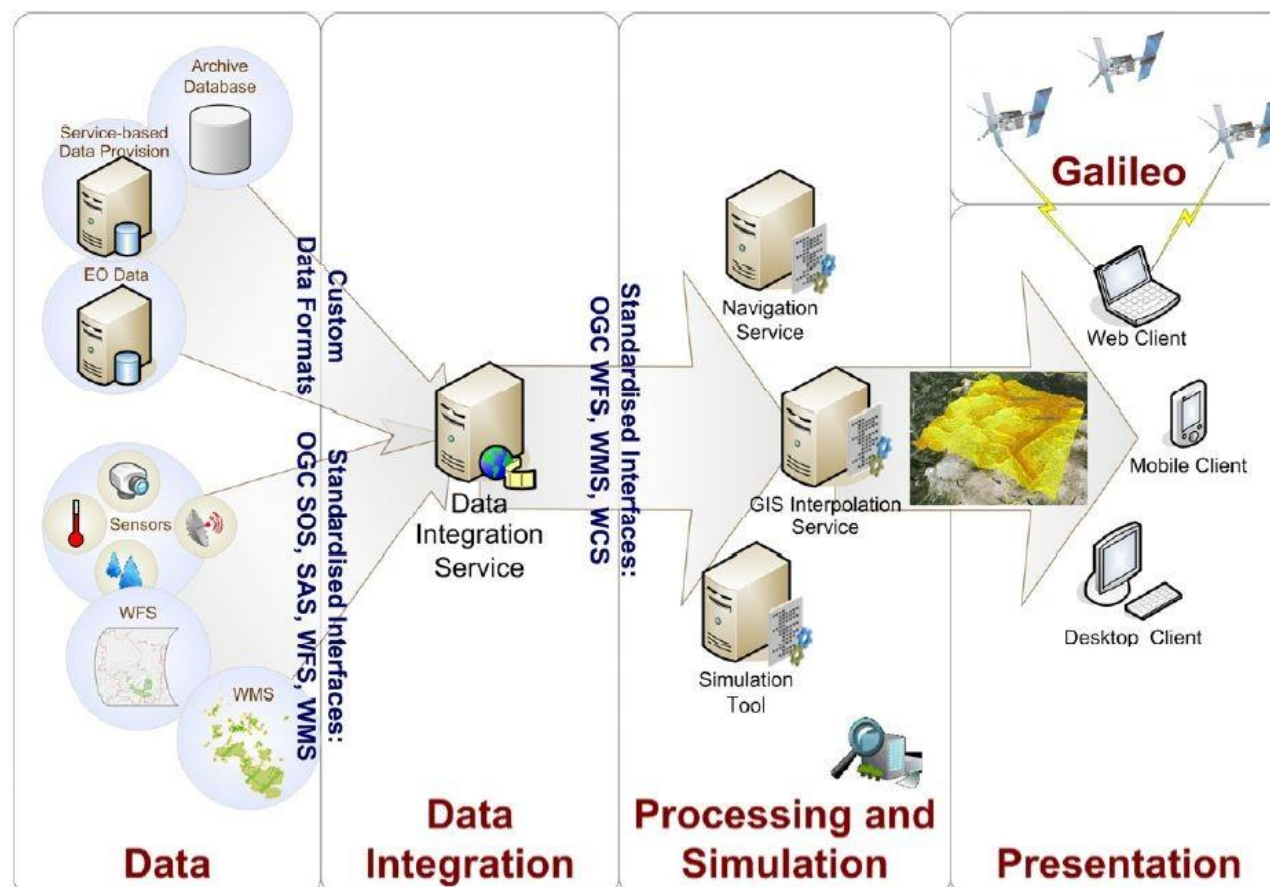
Open Geospatial Consortium (OGC)

- International not for profit organization
- Develop open standards for geospatial community, such as:
 - Geography Markup Language (GML3.0)
 - Keyhole Markup Language (KML)
 - Sensor Observation Service
 - Web Catalogue Service (CSW)
 - Web Coverage Service (WCS)
 - Web Feature Service (WFS)
 - Web Map Context (WMC)
 - Web Map Service (WMS1.3.0)
 -

Sensor Web Enablement (SWE)

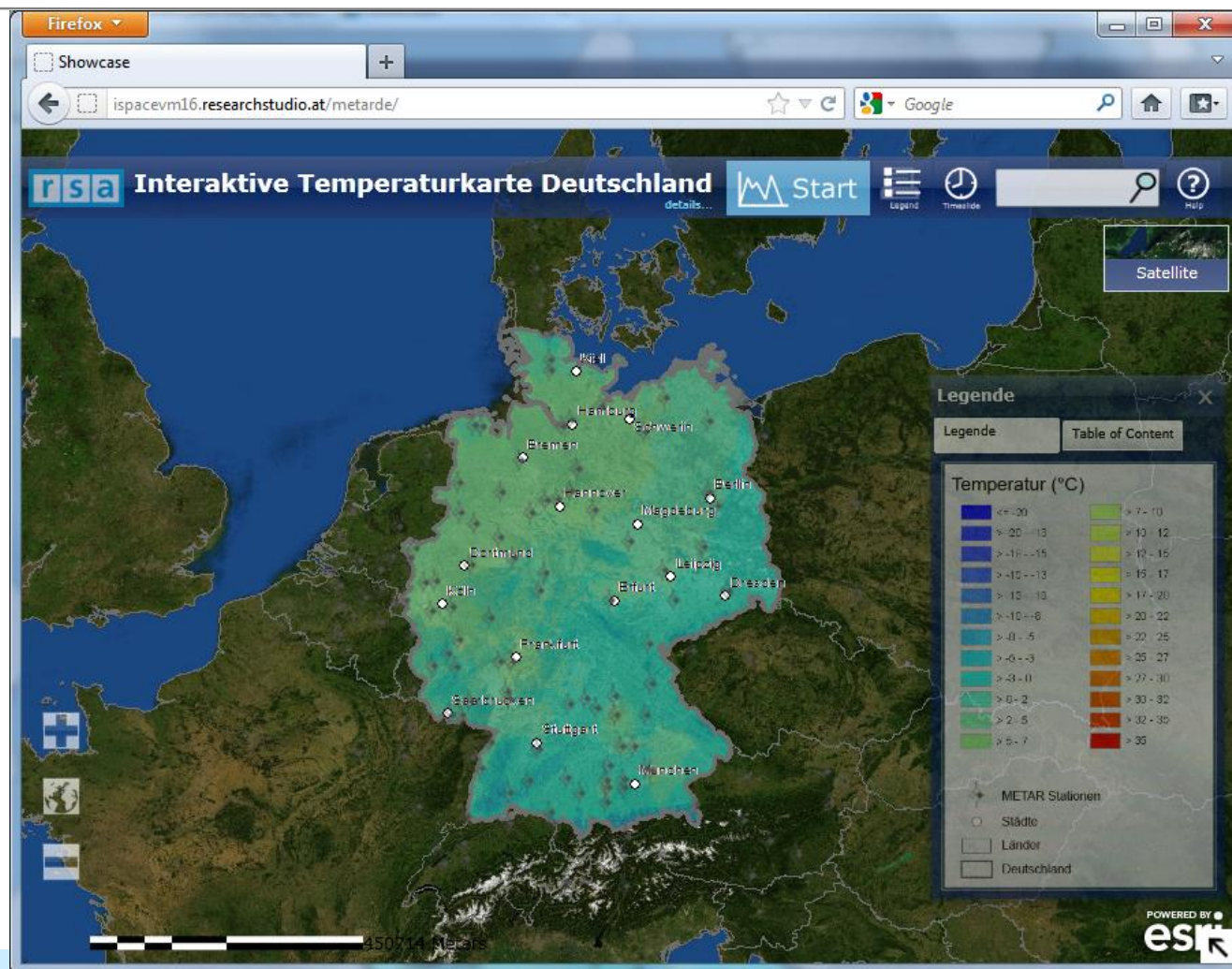
- Developed by OGC starting with 2003
- (new) definition of Sensor Web:
 - *Web accessible sensor networks and archived sensor data that can be discovered and accessed using standard protocols and application programming interfaces (Source: SWE standard)*
 - **Infrastructure** which enables an **interoperable** usage of **sensor resources** by enabling their **discovery**, **access**, **tasking**, as well as **eventing** and **alerting** within the Sensor Web in a **standardized** way (Source: SWE standard)

Sensor Web Enablement (SWE) deployment overview

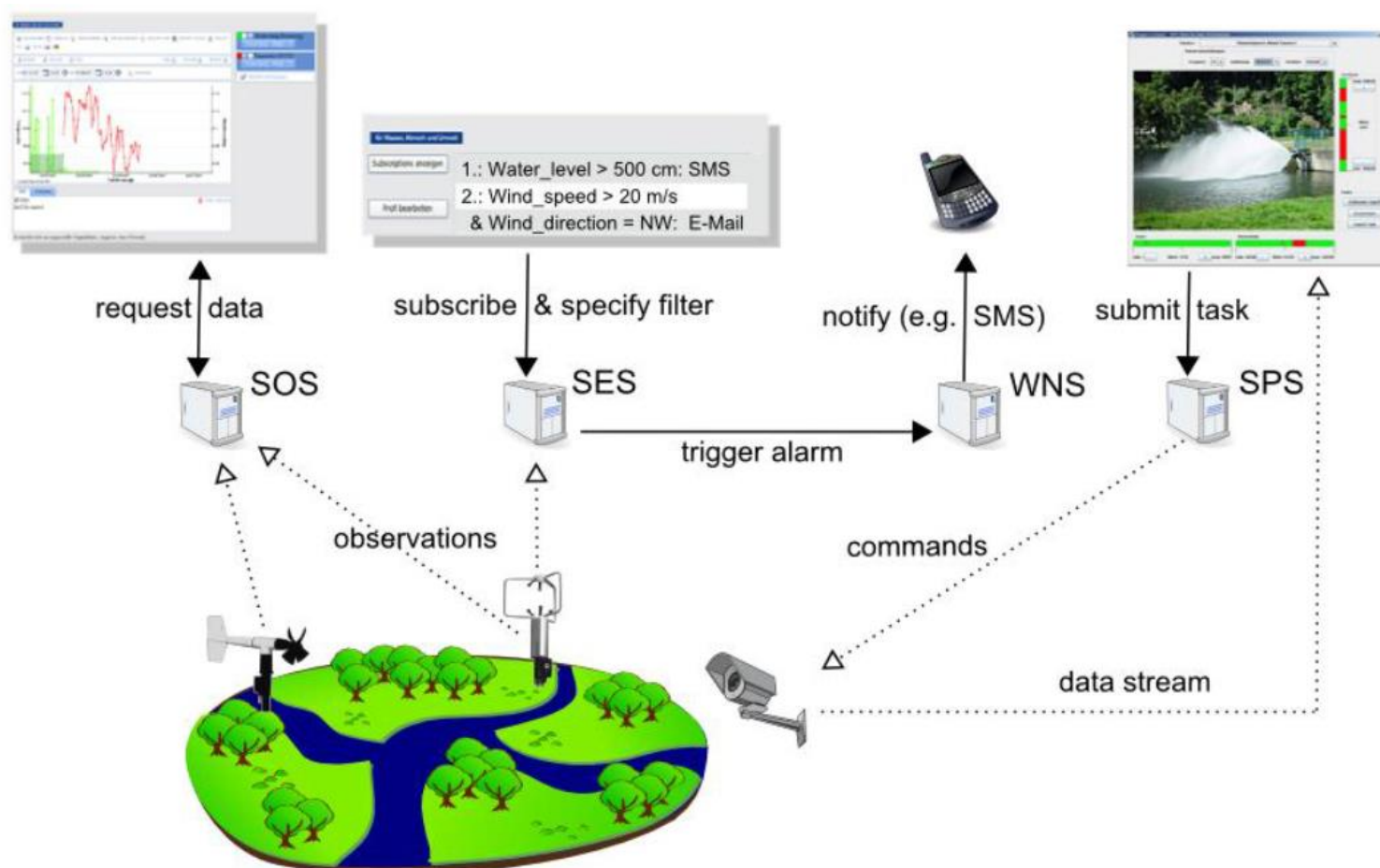


Source: Sagl et al, 2011

SWE deployment example 1

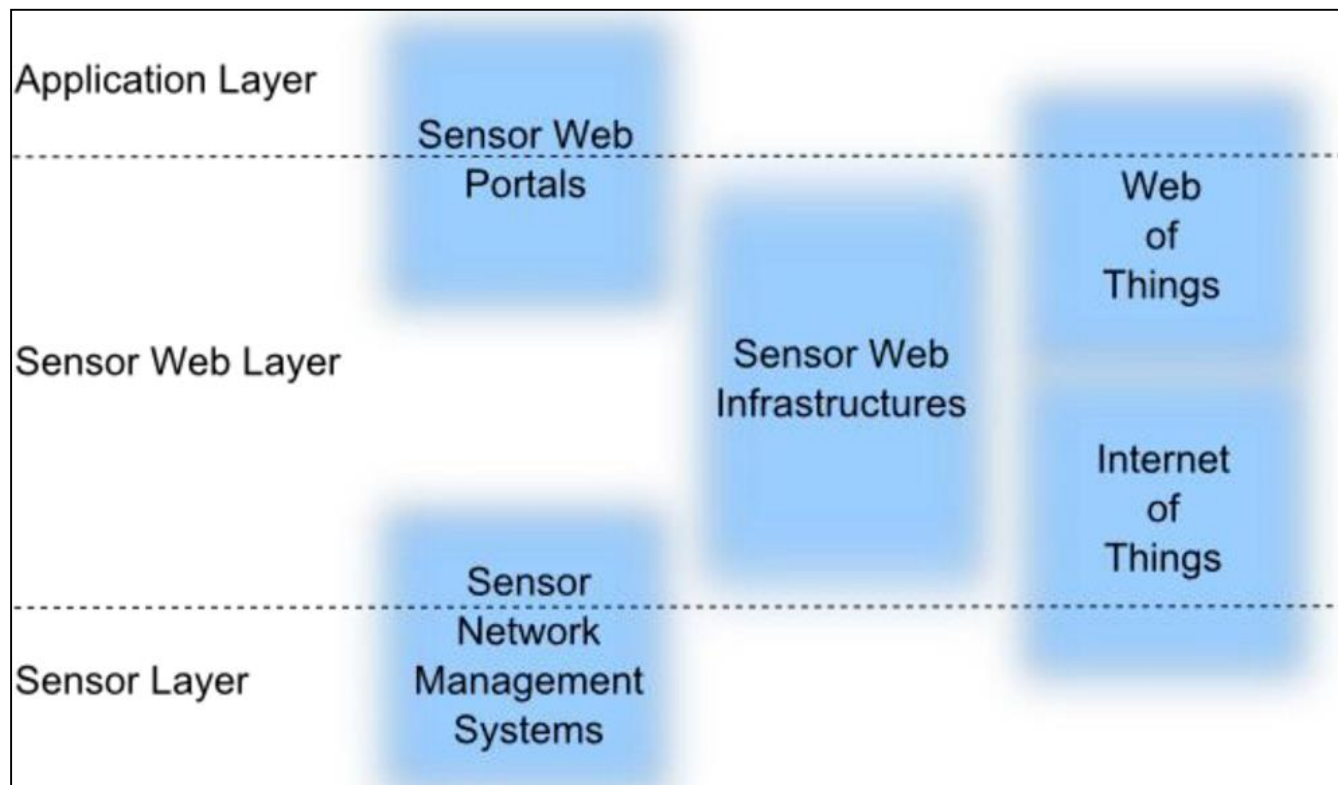


SWE deployment example 2



Source: Bröring et al., 2011

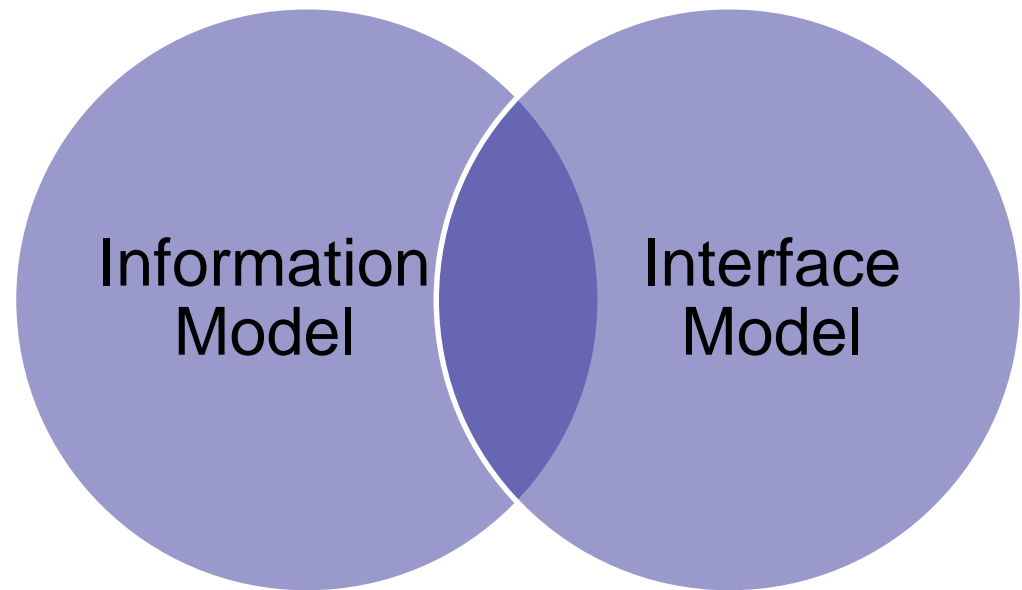
Sensor Web layer stack



Source: Bröring (2011)

SWE specifications

- Description of sensor data
- Description of sensor metadata
- Access to observations and sensor metadata
- Tasking of sensors
- Alerting
- Notification
- Eventing
- Discovery



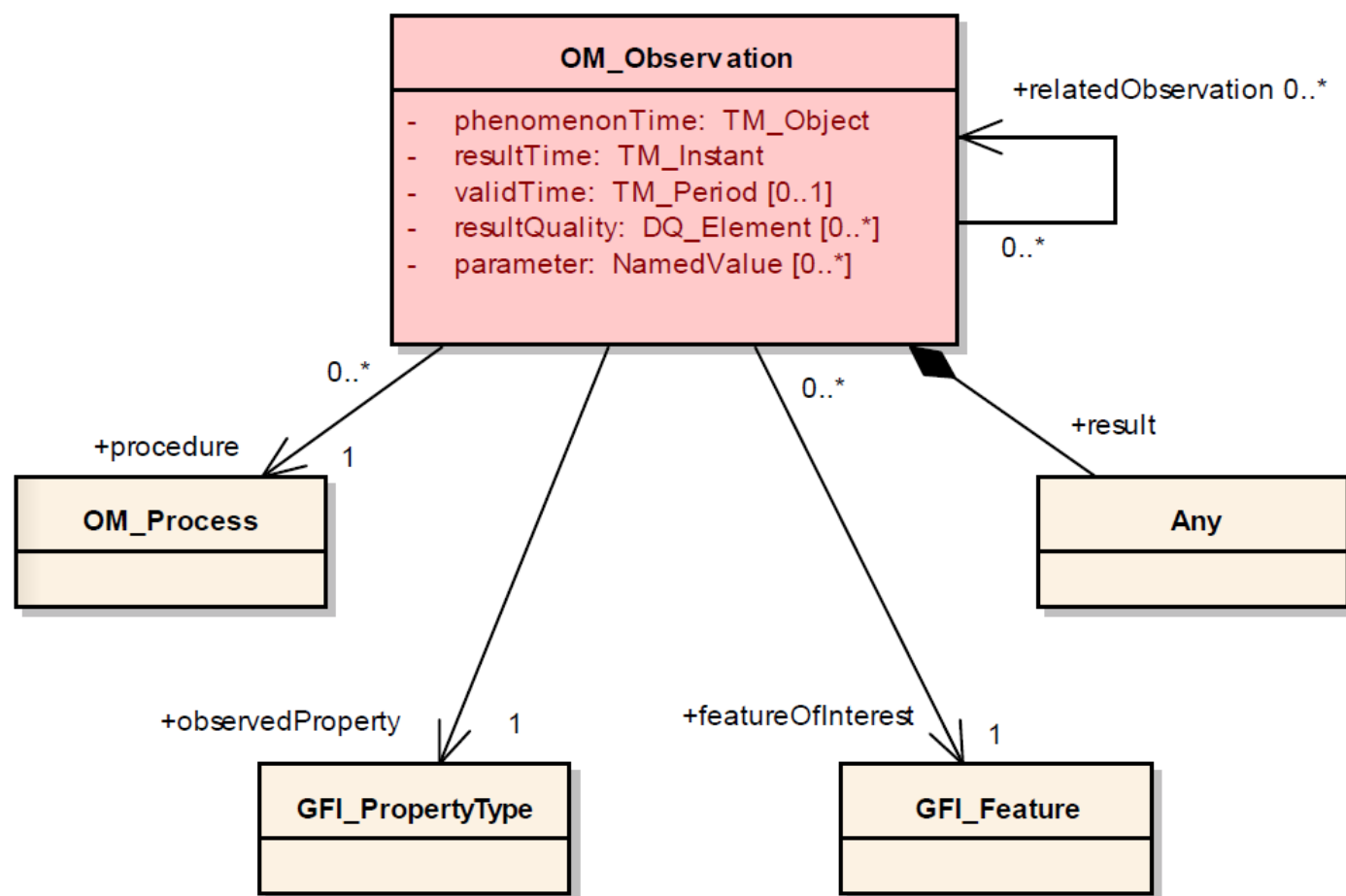
Sensor Observation Service (SOS) - operations

- Core operations
 - GetCapabilities, for requesting a self-description of a SOS instance
 - GetObservation, for requesting sensor observations encoded in O&M
 - DescribeSensor, for requesting information about the sensor itself encoded using SensorML
- Extensions:
 - RegisterSensor
 - InsertObservation
 - GetFeatureOfInterest

Sensor Observation Service (SOS) – data models

- Makes use of two data models:
 - Observations & Measurements (O&M):
 - modeling sensor observations and encoding them in XML
 - Sensor Model Language (SensorML):
 - modeling sensors and sensor systems for providing relevant metadata

Observations and Measurements (O&M)



Source: Bröring et al., 2011

SWE profiles

- WaterML profile:
 - Increase interoperability in the hydrology domain
 - Used to exchange many kinds of hydro-meteorological observations and measurements



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OGC® WaterML

- [1\) Overview](#)
- [2\) Documents and Downloads](#)
- [3\) Official Schemas](#)
- [4\) Related News](#)

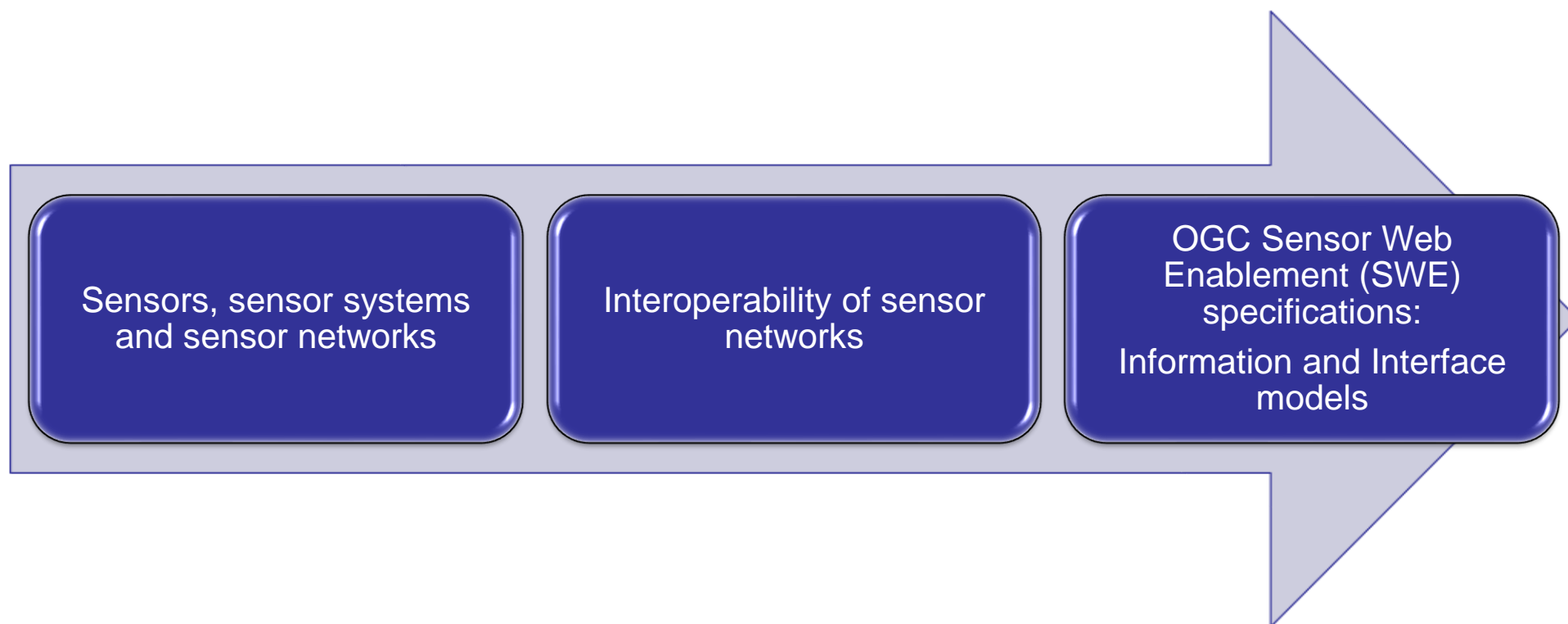
1) Overview

WaterML 2.0 is a standard information model for the representation of water observations data, with the intent of allowing the exchange of such data sets across information systems. Through the use of existing OGC standards, it aims at being an interoperable exchange format that may be re-used to address a range of exchange requirements, some of which are described later in this document.

▼ OGC® Standards

- [ARML2.0](#)
- [Cat: ebRIM App Profile: Earth Observation Products](#)
- [Catalogue Service](#)
- [CityGML](#)
- [Coordinate Transformation](#)
- [Filter Encoding](#)
- [GML in JPEG 2000](#)
- [GeoAPI](#)
- [GeoPackage](#)
- [GeoSparql](#)
- [Geography Markup Language](#)
- [Geospatial eXtensible Access Control](#)

Summary



Summary questions

- Why do we need to develop standards for integrating sensor observations into various applications?
- What are the main interfaces (or models) defined by the SWE specification?
- What are the main data models used by the SOS service to read and transmit sensor observations?

References

- Partners in ERASMUS+ Project 'GeoServices-4-Sustainability'



Xinjiang Institute of Ecology and Geography
Chinese Academy of Sciences



Palacký University
Olomouc



HNE
Eberswalde
Hochschule für nachhaltige Entwicklung



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- Please see full list of references in the notes section