SenSituMon

Improving Methods and Technologies for the Large-Scale Monitoring of Open Surface Water
Albert Remke, Arne de Wall - 52°North
Background: Copernicus uptake - NRW
(Results of a Survey: GeoIT Round Table NRW - Workshop 2017-06-23)

Today, the potential of Copernicus is not sufficiently exploited in practice.
What are the reasons?

- **Lack of knowledge** ..understanding the data, processing methods, technologies, applications and benefits ..,, *Lack of Best Practice Information*
- **Complexity and Costs** ..technical complexity and related costs: data volume, infrastructure costs, cloud-readiness, *lack of ready-to-use information products*
- **Market structures** ..structure of the GeoIT industry (from niche market services to mainstream GeoIT); Copernicus is a ‘can-do” not a ‘must do’; *lack of coordination & cooperation*
Objectives

● Fully automated large-scale monitoring of open surface water in near real-time
  ○ actual extent of water bodies
  ○ NRW (test site), Germany, Europe

● Based on Copernicus satellite data and various in situ open data sources such as water gauges, weather radar, terrain data, land use data.

● Considering requirements from insurance industry, disaster management, agriculture and water management

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Challenges

- Which quality level can be achieved in a fully automated process
- How to scale up from a regional (NRW) to the national and European level
- How to cope with the volume, variety and velocity of the data in near real-time
  - Integration of in situ sensor data sources
  - Time-critical provision of data products
  - Efficient processing
- How to make use of existing Copernicus data hubs
  (e.g. CODE DE, DIAS nodes)
Methodical Approaches

- Calculation of flood masks
  - Based on Sentinel 1, DTM and land cover data
  - Thresholding of S1 backscatter intensities, Support Vector Machines, RF classifiers

- Use of in-situ data
  - Spatio-temporal demarcation of high water events based on the classification of precipitation and water level data (RADOLAN, Pegel-Online, HYGON, WV)
  - Completing the picture - providing information on the meteorological and hydrological context (visual exploration)
Fundamental Technical Concepts

- **Cost-efficient, cloud-based processing**
  - Scalable and elastic processing environment adapting to varying workloads and omitting idle resources

- **Stream Processing Paradigm** (Keep Data Moving)
  - Stream-based integration and reactive, on-the-fly processing of data sources without preceding storage (As Soon As Possible)

- **Extensible and loosely coupled architectural style**
  - The integration of new data sources should be as easy as possible in order to allow to scale up from a regional to the national and european level

- **Standardized access to data products**
System Architecture
(Conceptual, Simplified)

- Message-driven, reactive system architecture based on intermediate Queues and **Message Brokers** (Publish&Subscribe pattern).

- **Stream processors** consume input data from one or more input queues.

- **Connectors** ingest data and write processing results into datastores.
Technology View

InSitu & Raster Processing

- **Stream Processing with Apache Kafka and Spark Streaming:**
  - Scalable open source technologies allowing for real-time streaming analytics
  - Development of streaming pipelines for InSitu and raster data

- **Raster Processing with GeoTrellis:**
  - Distributed processing of spatial and spatio-temporal raster data on Apache Spark
  - e.g. used for the classification of Sentinel 1&2 Data and RADOLAN aggregations.
Deployment @ Open Telekom Cloud

- Leverages the OTC IaaS offer powered by OpenStack.
- Static: Always accessible machines that run the Esri Enterprise Stack. These services are accessible from the outside.
- Dynamic: Utilizes Container Management based on Docker and Kubernetes, which provide automated failover and autoscaling mechanisms.

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Current Status & Next Steps

- V0 (technical) prototype by end of 2018
  - Production environment on the OTC is up and running
  - Ingestion of Sentinel, RADOLAN and PegelOnline data
  - Demarcation of HW events
  - Processing chain for flood masks based on S1 data

- Next iterations in 2019
  - Tuning the methodical and technical approaches
  - Validation
Thanks for your attention!

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