SenSituMon

Improving Methods and Technologies for the Large-Scale Monitoring of Open Surface Water Albert Remke, Arne de Wall - 52°North Gefördert durch:



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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, <u>lack of ready-to-use information products</u>
- **Market structures** ...structure of the GeoIT industry (<u>from niche market services to</u> <u>mainstream GeoIT</u>); Copernicus is a 'can-do" not a 'must do'; lack of coordination & cooperation





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ür Wasser, Mensch und Umwelt



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Objectives

- Fully automated large-scale monitoring of open surface water in near real-time
 - o actual extent of water bodies
 - o 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











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)

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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.











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

Technology View

InSitu & Raster Processing

- 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 laaS 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
 - o Demarcation of HW events
 - o Processing chain for flood masks based on S1 data
- Next iterations in 2019
 - o tuning the methodical and technical approaches
 - o Validation





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exploring horizons



Thanks for your attention!

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