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mFUND
Das Startkapital für die Mobilität 4.0

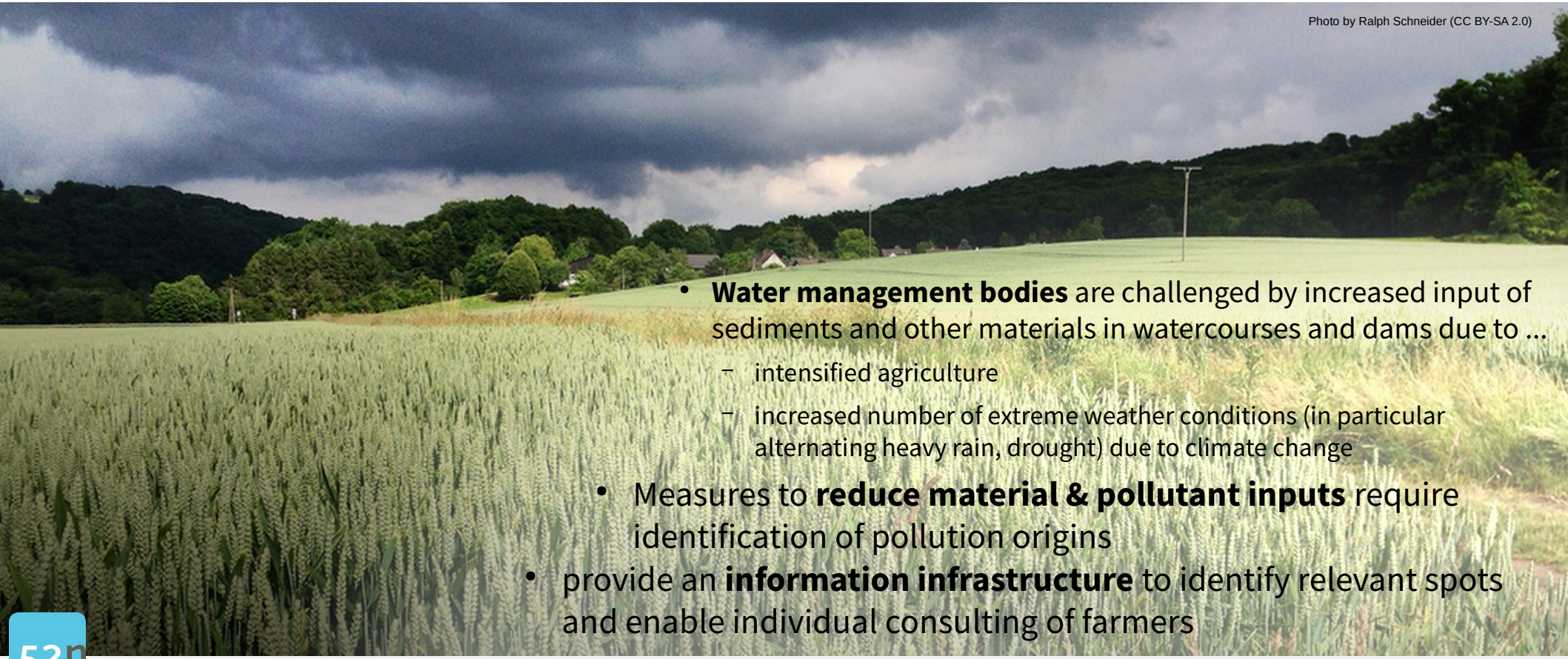
Federal Ministry
of Transport and
Digital Infrastructure

Automated Creation of Earth Observation Products for Water Resource

Matthes Rieke

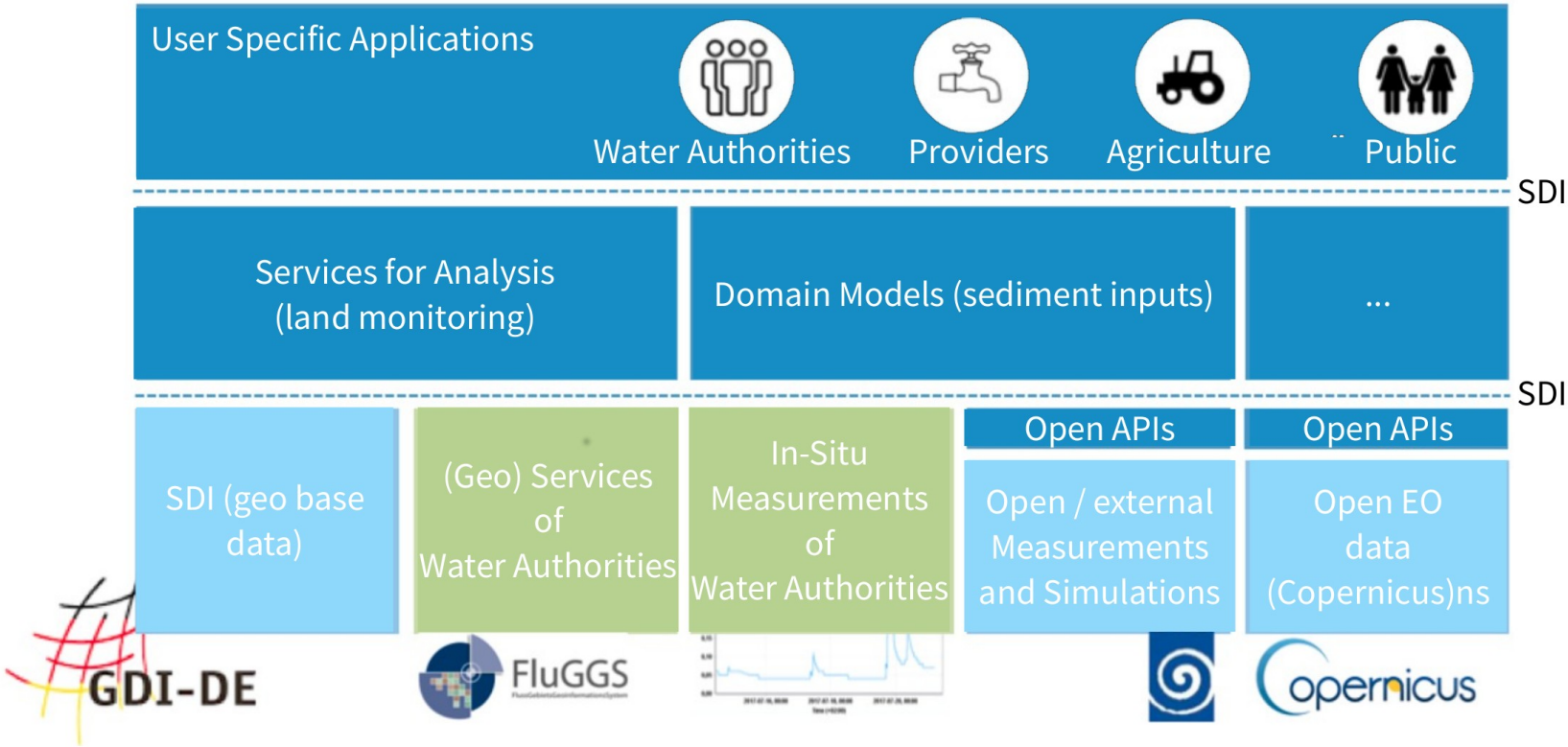
EGU General Assembly 2019, Vienna – ESSI1.16 Session, 2019-04-09

MOTIVATION



- **Water management bodies** are challenged by increased input of sediments and other materials in watercourses and dams due to ...
  - intensified agriculture
  - increased number of extreme weather conditions (in particular alternating heavy rain, drought) due to climate change
- Measures to **reduce material & pollutant inputs** require identification of pollution origins
- provide an **information infrastructure** to identify relevant spots and enable individual consulting of farmers

CONCEPTUAL OVERVIEW



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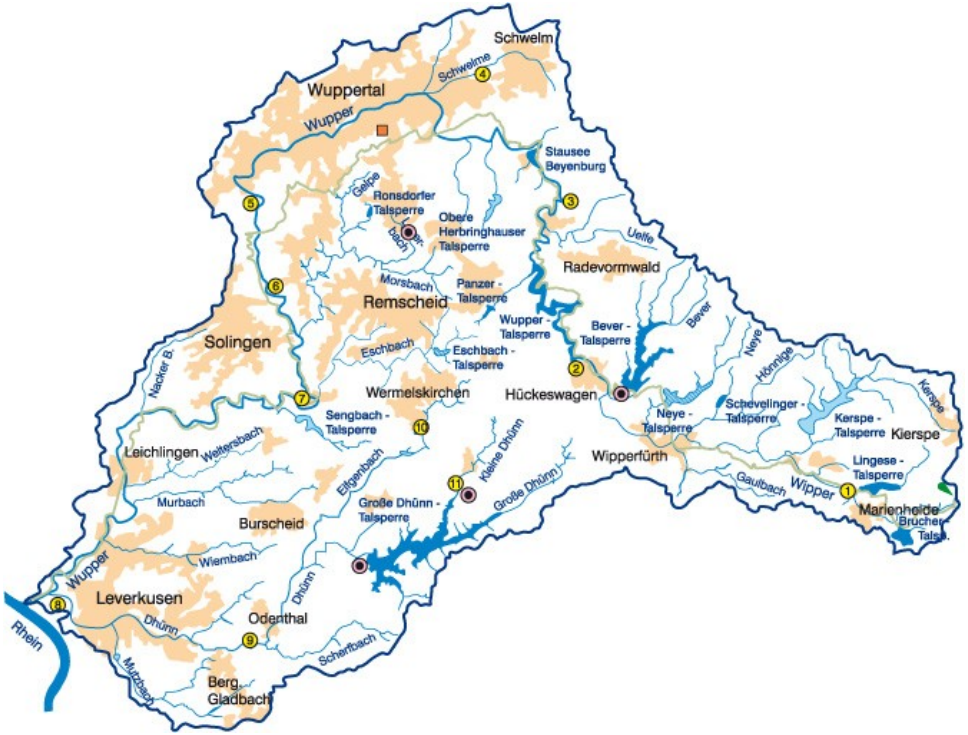
PROJECT OVERVIEW



- Wupper region in North-Rhine Westfalia, Germany
- Wupperverband is the responsible water authority
  - Operation of river dams, clarification plants
  - Water network monitoring (gauges, temperature, precipitation)

Hochschule Bochum
Bochum University of Applied Sciences

WUPPERVERBAND
für Wasser, Mensch und Umwelt

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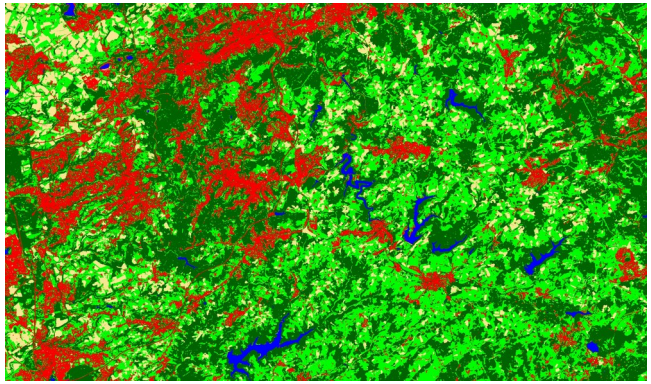
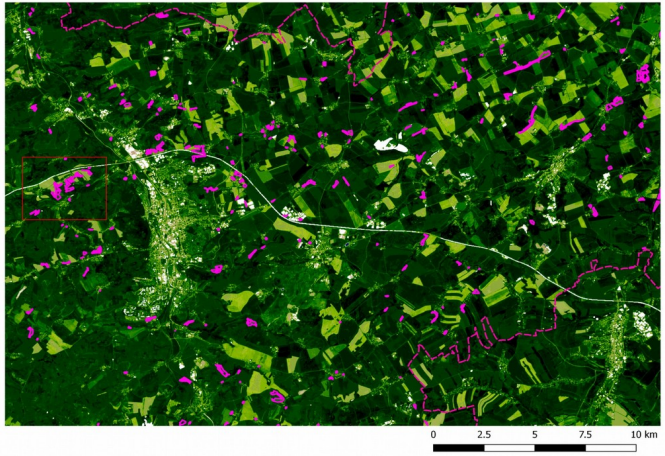
PRODUCTS FROM EARTH OBSERVATION

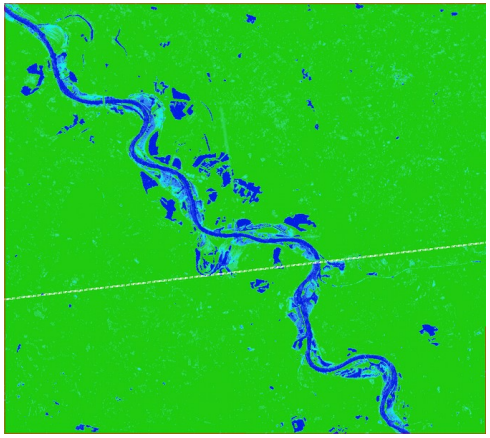
- Overall goal: Increasing the efficiency of environmental monitoring by **combining** various **geo- and sensor** data and **model components** for
  - Structure of a dynamic land register (vitality of the vegetation, actual crop rotations, types of sealing and use etc.)
  - Optimized modeling of **inputs in rivers and reservoirs**
  - Quantification and localization of **sediment and pollutant inputs**



Detailed land use classification



Intra-annual monitoring of agriculture



Change of water-land borders

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PRODUCTS FROM EARTH OBSERVATION

Group	Product
Land use classification	- Differentiation of sealed and unsealed surfaces - Detailed classification of land use - Intra-annual change analysis of land cover / use
Monitoring of vegetation	- Determination of the vegetation density - Intra-annual monitoring of grassland and field grasslands - Determination of forest damage / vitality caused by pests - Analysis of vitality changes of woodlots
Water vegetation monitoring	- Detection of Macrophyte Hotspots (in shallow waters) - Identification of vegetation structures in rivers
Water network monitoring	- Observing the change of water-land borders - Monitoring the water level of reservoirs
Damage monitoring	- Determination of forest damage (wind break, snow break) after storms

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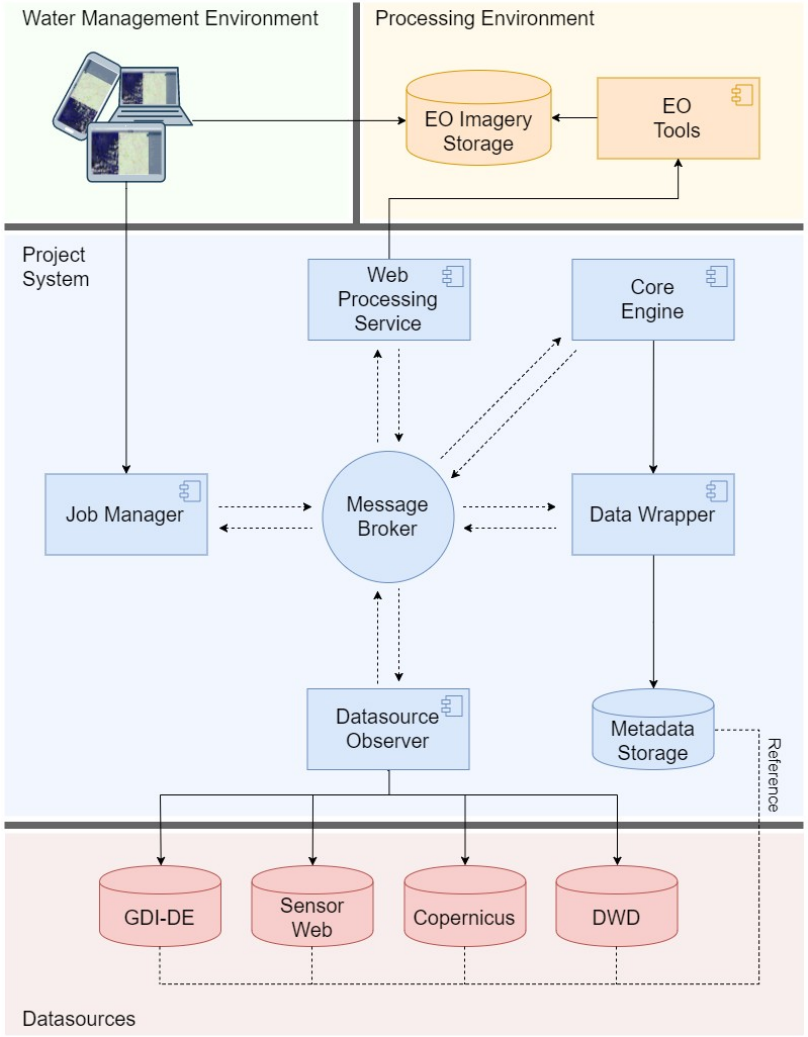
DESIGN APPROACH

- **Problem:** EO data to be used for processing must fulfill certain requirements
  - Minimal cloud coverage
  - High percentage of spatial overlap
  - Available as “time series” (e.g for training or intra-annual monitoring)
- **Approach:** Offering EO products “***on availability***”
  - Integration of models for sediment and pollutant inputs into river systems and dams
  - Information processing as soon as required data becomes available

    → event-driven processing of **EO data, in-situ measurements** etc.
  - Re-use of existing EO processing tools
    - Remote use of proprietary services
  - Deployment in “Copernicus Cloud Environments” (e.g. DIAS platforms, national infrastructures such as CODE-DE)

SYSTEM ARCHITECTURE

- Publish/Subscribe architecture
  - Start a process when new data is available
- Dedicated components **observe the data centres**
  - Sensor Web, Copernicus Open Access Hub, DWD
- Two-layered approach
  - Integrate **legacy EO tools via WPS**
  - Use state of the art processing
  - based on **Spark, Geotrellis**
  - Assess **Machine Learning** algorithms
  - for specific tasks (e.g. land classification)

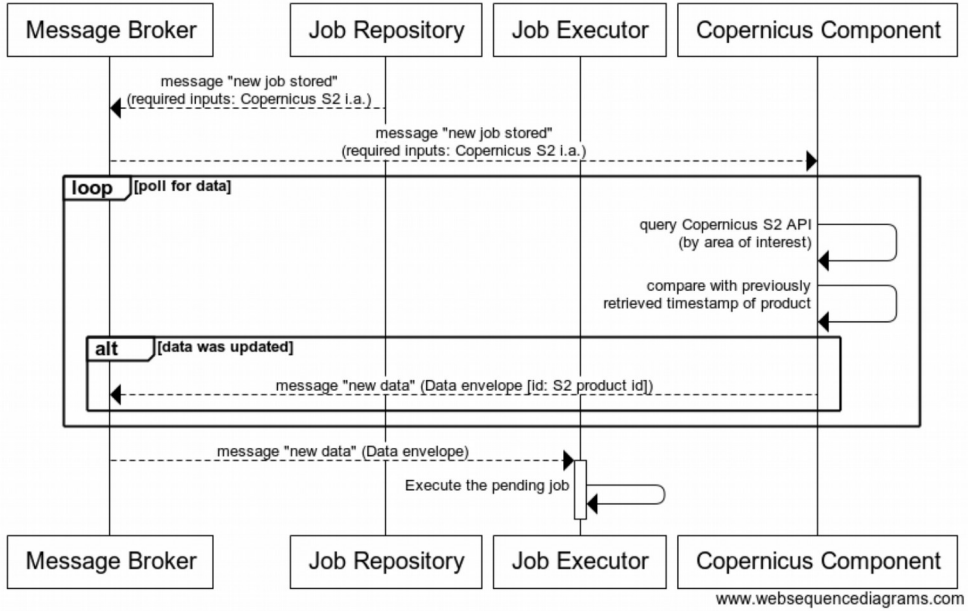


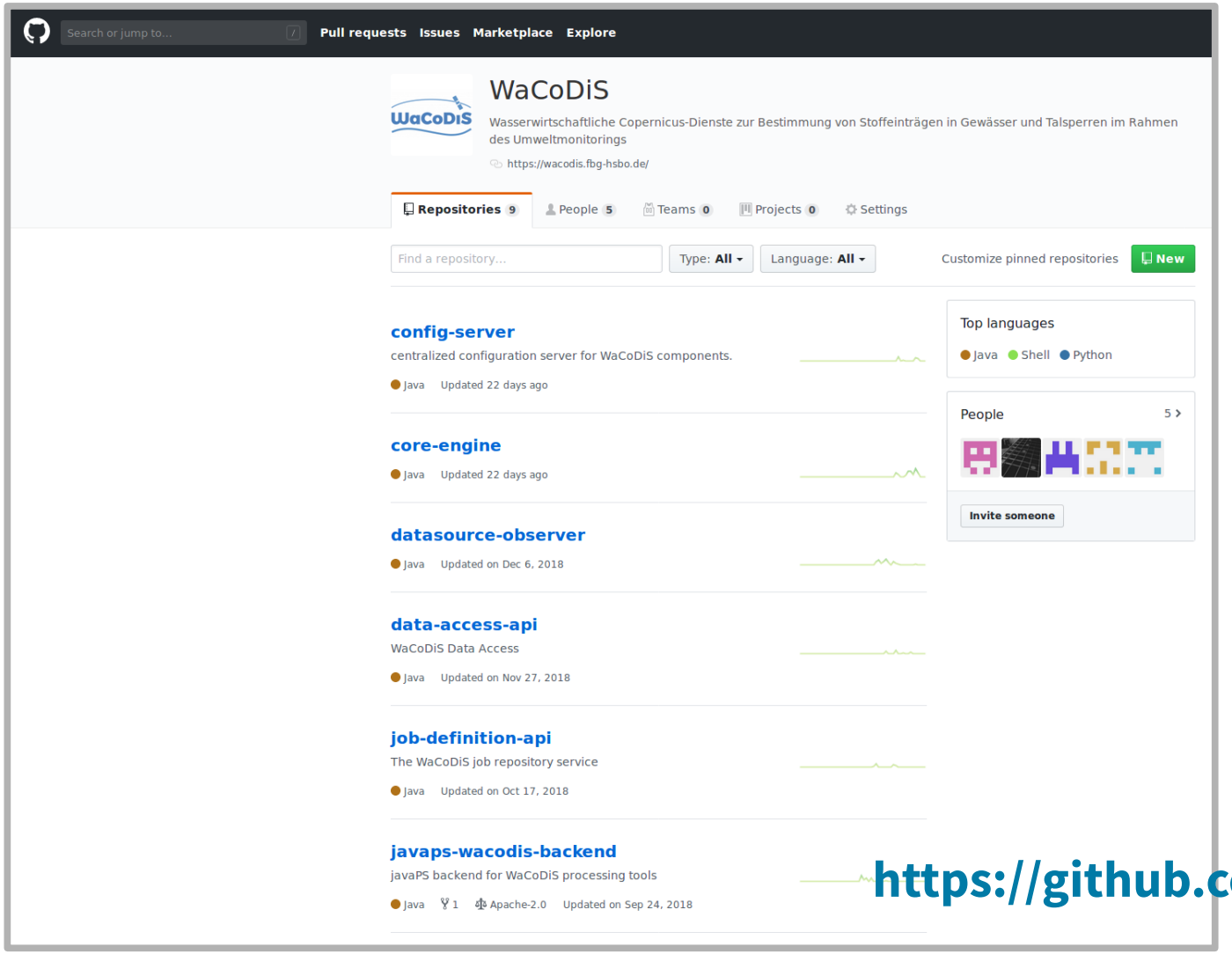
APPROACHING INTEROPERABILITY

- OGC Web Processing Service 2.0
  - Standardized interface for synchronous and asynchronous **processing jobs**
  - Allows the definition of **inputs** and **outputs**, and processing **parameters** (e.g. output resolution)
- WPS is used for
  - Wrapping of already existing EO processing tools
  - Execution environment for newly developed tools
- Standardized interface allows the lightweight introduction of additional tools → flexible and **extensible architecture** with broad processing capabilities

EVENT-DRIVEN WORKFLOWS

- The system is designed to **observe data centres** (Sentinel Hub, Sensor Web of Wupperverband, …)
  - Configurable observation cycles (e.g. every hour)
- Data of interest is identified
  - **Metadata** (by a specific domain data model) is published on the internal Message Broker
  - Interested components (e.g. the Job Execution) catch up
  - Achieves **automatic execution**





https://github.com/wacodis

OUTLOOK

- Implementation of first prototype planned for mid 2019
  - Components ready (as seen in the architecture overview)
  - Integration of one EO tool (for intra-annual land use classification)
- Feedback round with special departments of Wupperverband
- Product storage
  - As-is storage (e.g. GeoTIFFs) vs. Raster-optimized services (e.g. WCS)
- Development of a system dashboard
  - When did an EO tool execute? Where was the product stored?
  - Management of Jobs
- Investigation on the deployment options
  - DIAS (e.g. Mundi Web Services, Sobloo, WEkEO, …)
  - CODE-DE
  - Distributed components (e.g. WPS and tools running remotely)

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Thanks for your attention!

m.rieke@52north.org

Matthes Rieke

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Deadline extended!

Geospatial Sensing – from sensing to understanding our world

Submission Deadline: April 28th

https://52north.org/conference

This project received funding from:

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