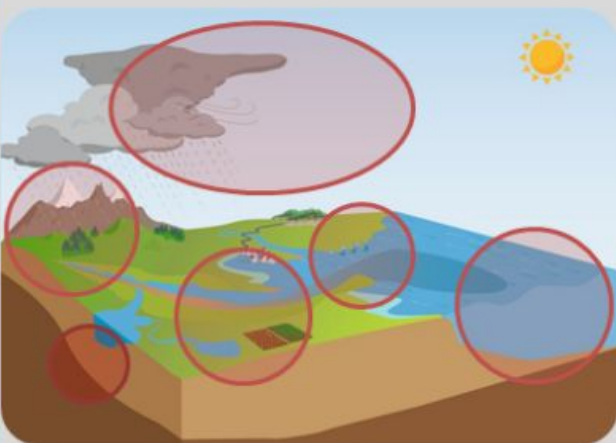# An integrative framework for data-driven investigation of environmental systems.

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DIGITAL
EARTH

Goal: Understand Systems

Current Situation

Data Science approach; exploration and fusion of observational & modelled data

Digital Earth

Development of methods and tools for integrated Earth System investigations

Earth System Modelling

Model-driven approach; coupling of simulation models and link to field data

Prospective Vision

Mostly separated views and investigations of specific Earth System compartments

Holistic view and compartment integrating approach for understanding the Earth System

Task

Investigating environmental systems with a data-driven research approach requires **linking** a variety of *data*, *analytical methods*, and *derived results*.

Challenges / Obstacles

- distributed and heterogeneous data sets
- **separated analytical tools**
- **discontinuous analytical workflows**
- **isolated views to data and data products**

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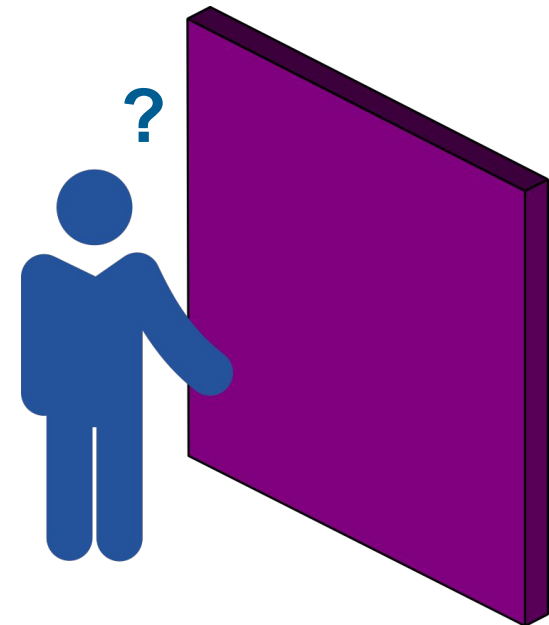
Digital Earth Approach

Our goal is to develop a framework (conceptual and technical) supporting the data-driven investigation of environmental systems.

Applied Concepts

1. *Component-based software framework* integrates **separated analytical tools and methods**
2. The *concept of digital workflows* allows for **seamless and continuous analytical workflows**
3. *Interactive visual interfaces with multiple linked views* provide **integrated views of data and data products**

Realizing the Approach

The combination of those three concepts from computer science allows us to create a digital research environment that enables scientists to investigate the initially mentioned links in a flexible way.

We ...

1. … developed a generic concept for our approach
2. … implemented a corresponding framework
3. … finally applied both to realize a "Flood Event Explorer" prototype supporting the comprehensive investigation of a flood system.

Implementing and Applying the Approach

- Implement digital workflow
  - → precisely define the workflow's requirements (methods and data)
  - → via informal interviews with domain scientists

- Software framework
  - → modularization (one front-end, multiple back-end modules
  - → connected via messaging system (pulsar)

  - → provides multiple generic visual front-end components
 - → create interactive linked views supporting the visual analysis of the workflow's data
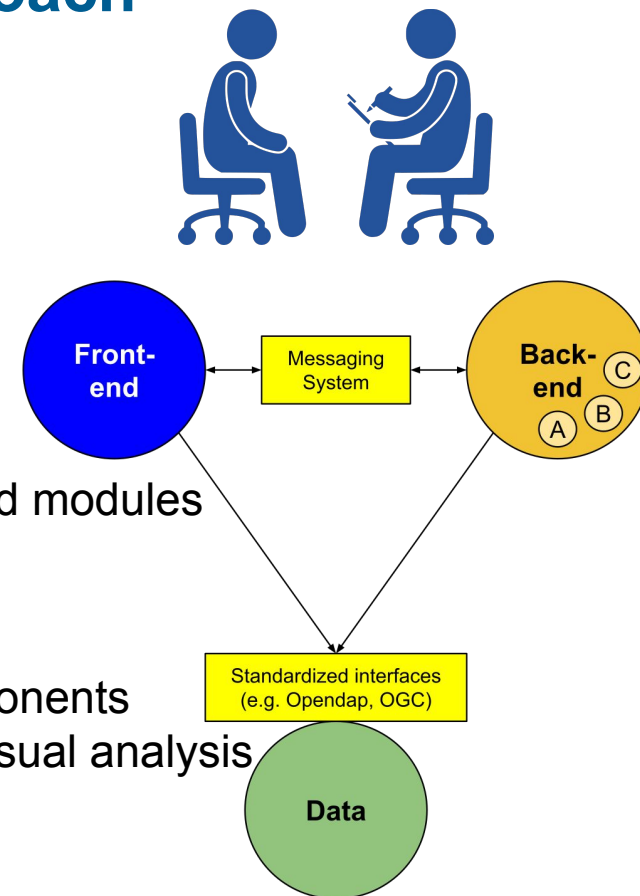
Scenario: System Flood

Scientists investigate the conditions, drivers and effects of flood events and the relations between them. We call the implemented prototype supporting the comprehensive investigation of a flood system "**Flood Event Explorer**".
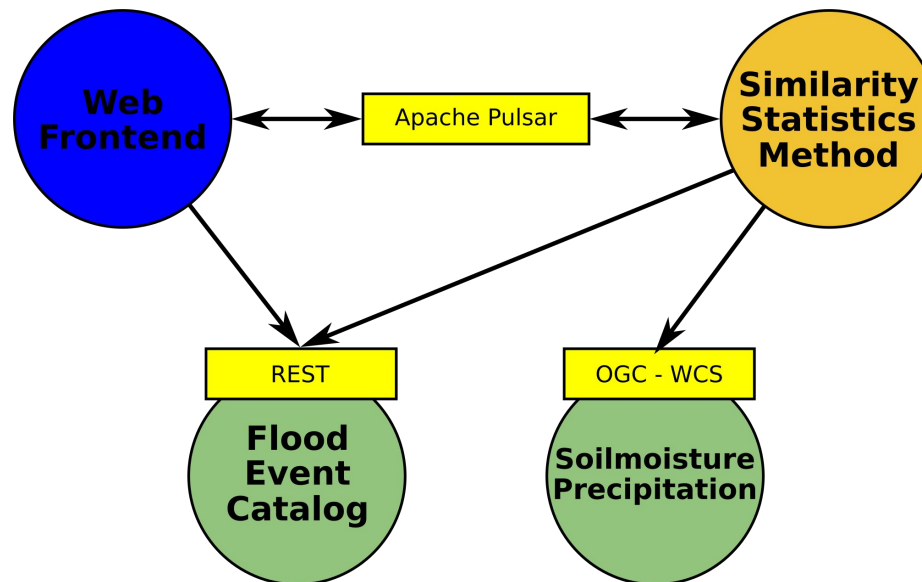
Applied Concept: Digital Workflows

Defined cross-compartment (atmo, terra and mare) workflows supported by the **Flood Event Explorer**:
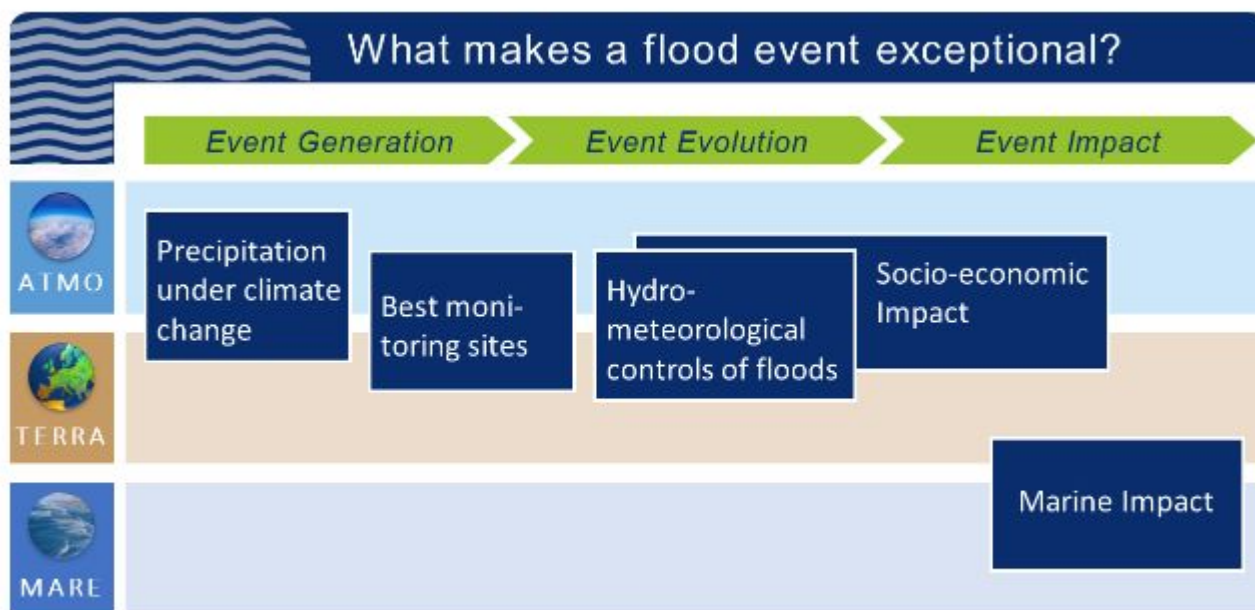
# Applied Concept: Component-based Software Framework

Generic web front-end components and analytical methods provided by standalone back-end modules connected via Apache Pulsar.

Applied Concept: Interactive Visual Interfaces with multiple linked views

Multiple linked visual components combined to support the defined analytical workflow tasks.
Example 1: Workflow - Hydro-meteorological controls of floods
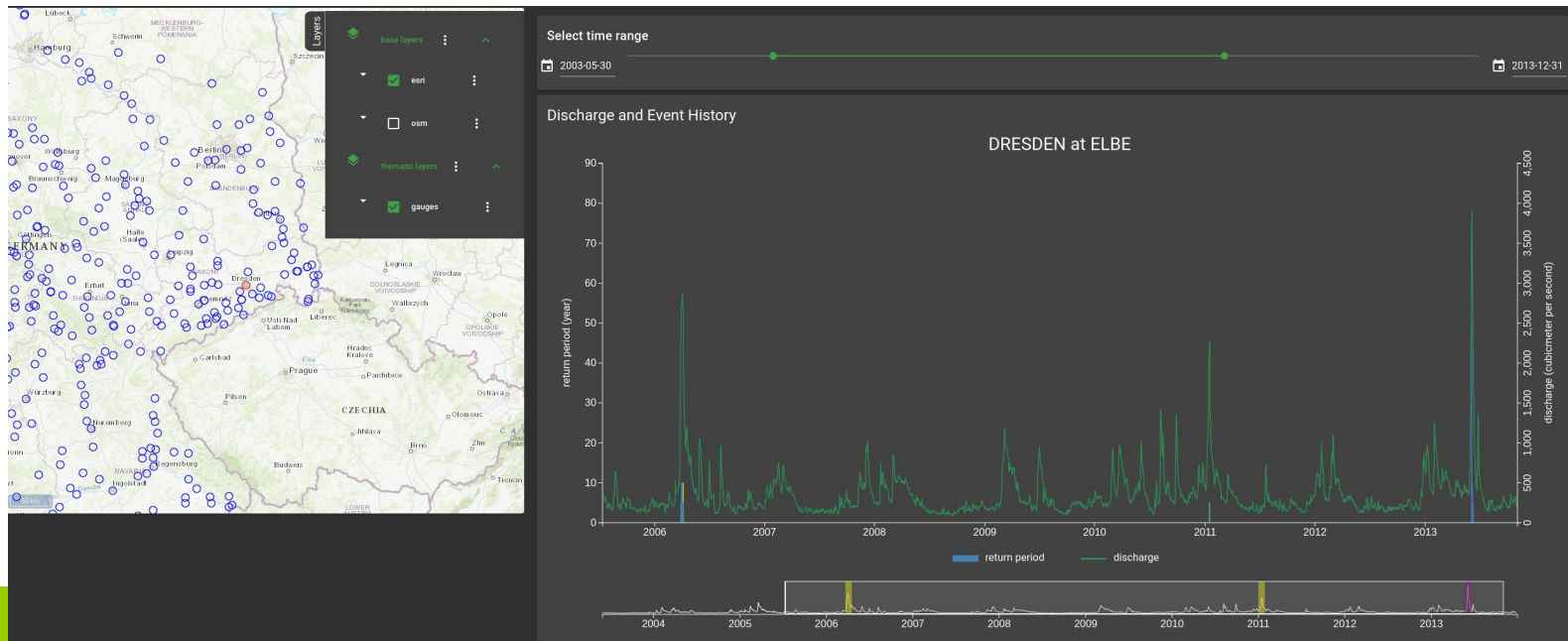
Applied Concept: Interactive Visual Interfaces with multiple linked views

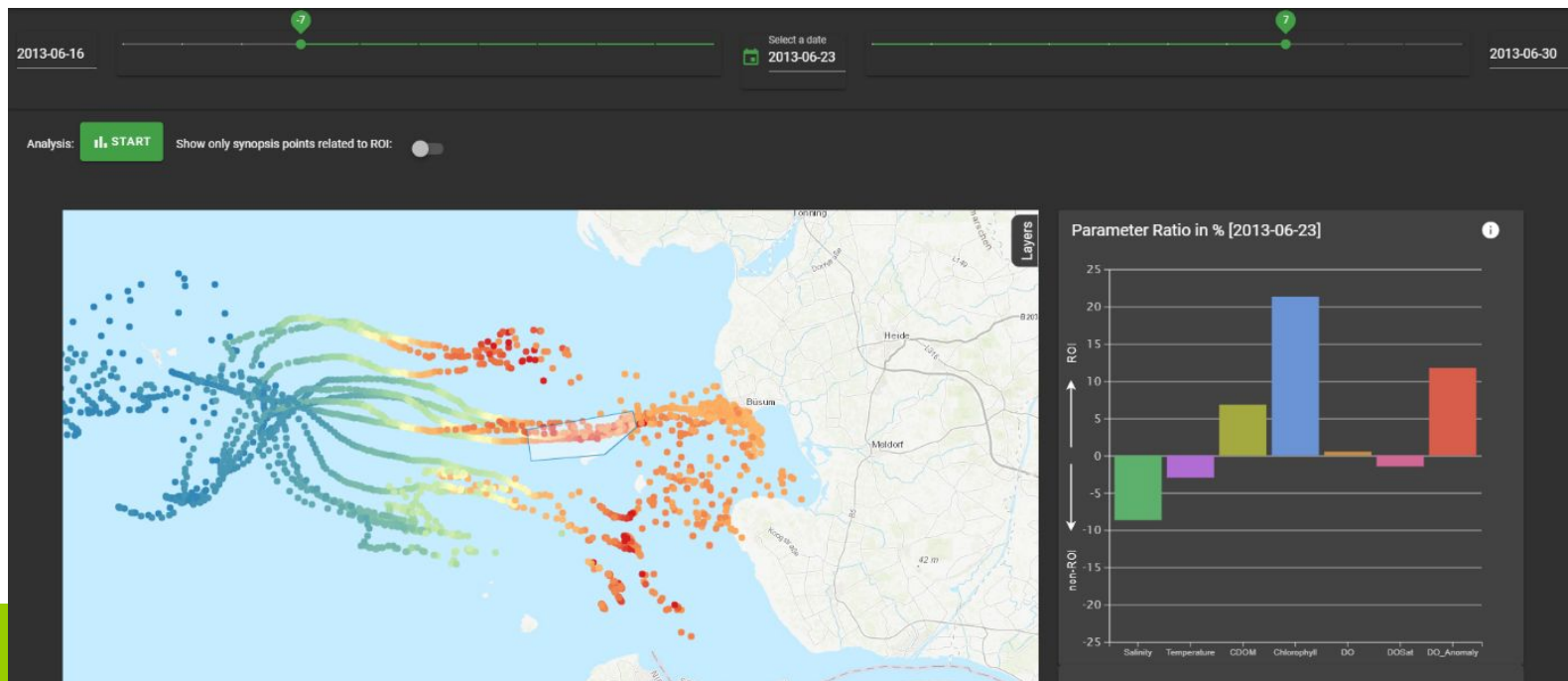Multiple linked visual components combined to support the defined analytical workflow tasks.

Example 2: Workflow - Marine Impact

Project and Contact Information

Digital Earth Project (https://www.digitalearth-hgf.de/)

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