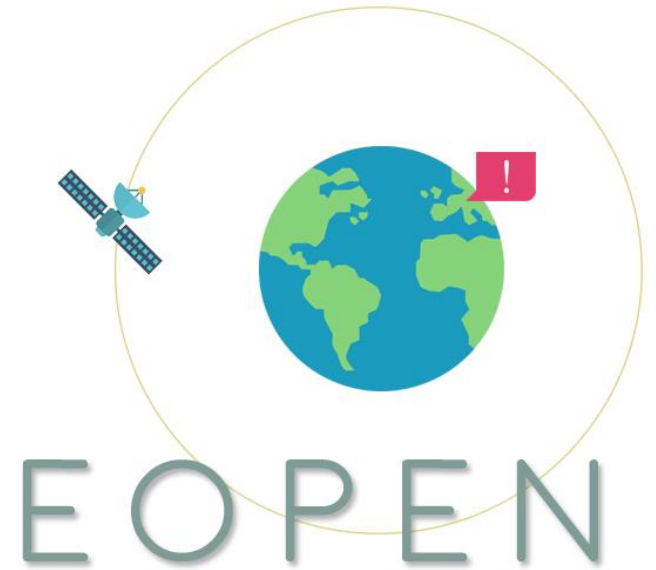EOPEN External Advisory Board Seminar
February 28, 2020

EOPEN – A PLATFORM FOR DEVELOPING DISTRIBUTED APPLICATIONS

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Space Applications Services
Platform Development and Integration Lead

Overview

▷ EOPEN, a Framework for Interoperability

▷ Application development cycle

▷ Core capabilities and extensions

▷ EOPEN End-User Portal

▷ EOPEN Pilot Use Cases

▷ Live Demonstration

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EOPEN, a Framework for Interoperability

▷ The **EOPEN Platform** provides

- Integrated tools allowing to develop, test and share services and applications, and visualise the results.
- Generic re-usable processes for data transfer, transformation and storage, messaging, …
- Extensions for supporting specific data sources (e.g. tweets) in the workflows.

▷ Three **Pilot Use Cases** demonstrate the capabilities of the platform by addressing crucial contemporary issues: Flood risk assessment and prevention, food security, and climate change.

Support to Service and Application Developers

▷ EOPEN Supports the development cycle:

1. Import user algorithms
2. Integrate the algorithm in a workflow
3. Select and execute the workflow
4. Analyse the performances and the resulting products
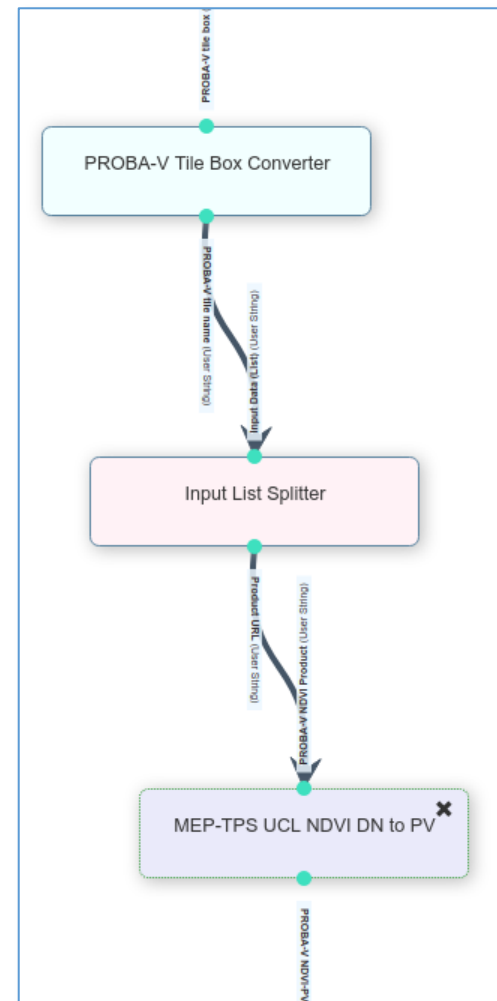5. Share / publish the workflow as an application

▷ Supports this with

- Core capabilities
- EO and non-EO data processing extensions

EOPEN Platform – Deployment and Operation

▷ Core layer running at SpaceApps:

- Controller node
- Process images registry
- Centralized datastore

▷ Worker nodes running at SpaceApps and in DIAS platforms

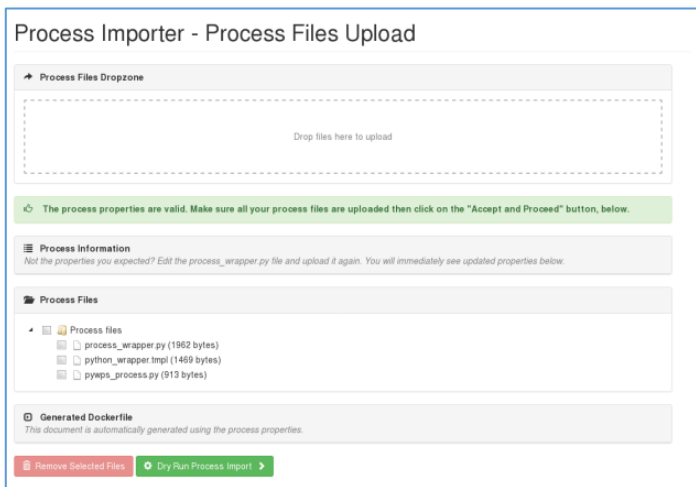▷ Compute node available in HPC and HPDA at HLRS
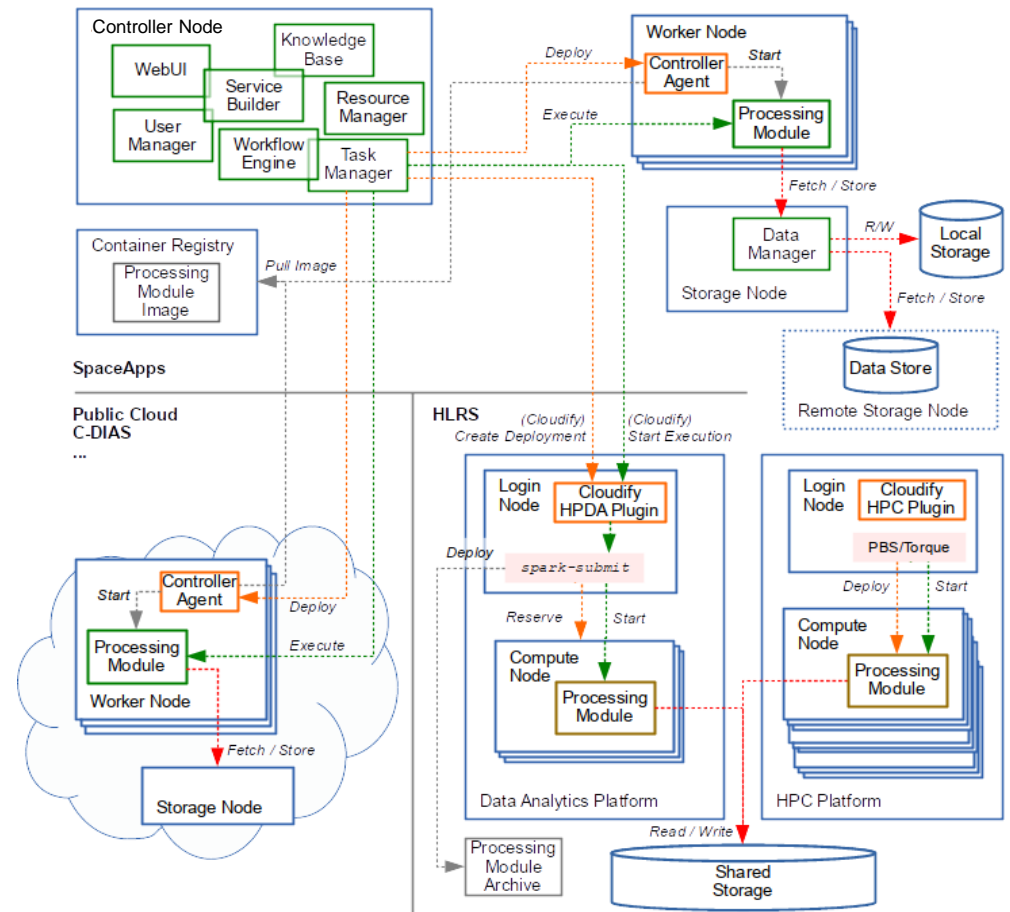
Main Technical Concepts

- A **Workflow** is an application defined by inter-connected **Processes**.

  - The Platform includes a graphical **Workflow Editor** for creating workflows interactively.
  - Workflows can be executed on-demand, scheduled or externally triggered.
  - **Parameterization forms** are automatically generated.
  - Interfaces are included for monitoring and control, reporting and data access.

- A **Process** is a unit of execution.

  - A Process is implemented as a Dockerised **Algorithm**.
  - A Process has (typed) input and output parameters.
  - The Platform includes a tool for that automates the packaging and the registration of custom processes.
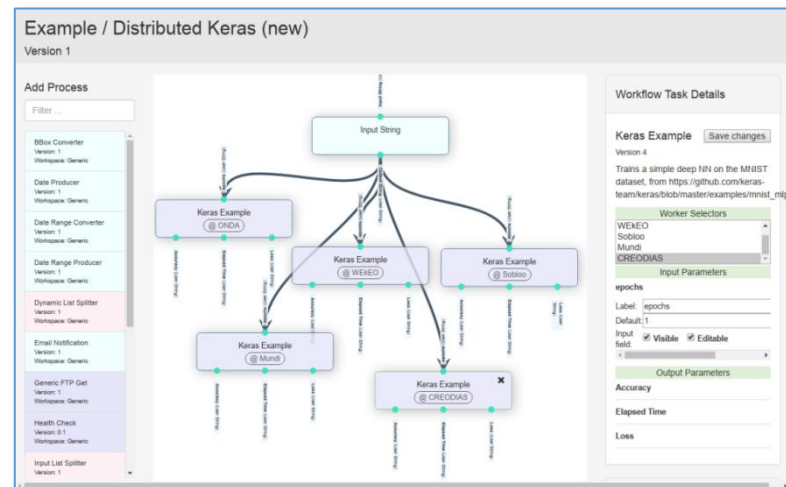
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EOPEN Core Capabilities

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EOPEN Core Capabilities

Process Importer
Package and register user processes

Workflow Editor
Graphical configuration of workflows including target processing environment selection

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EOPEN Core Capabilities

Parameterisation Forms
dynamic generated
based on unresolved
workflow inputs
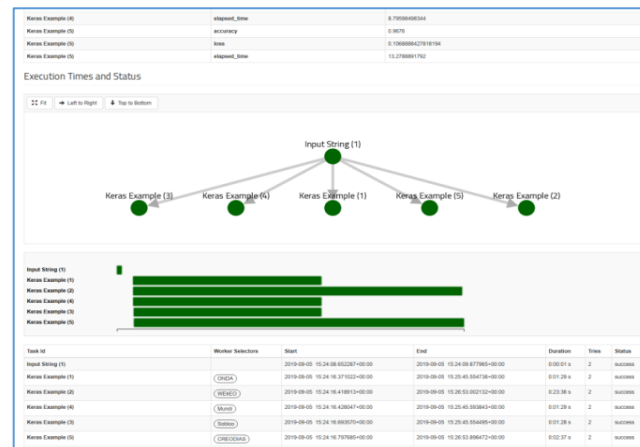
Execution monitoring and
reporting
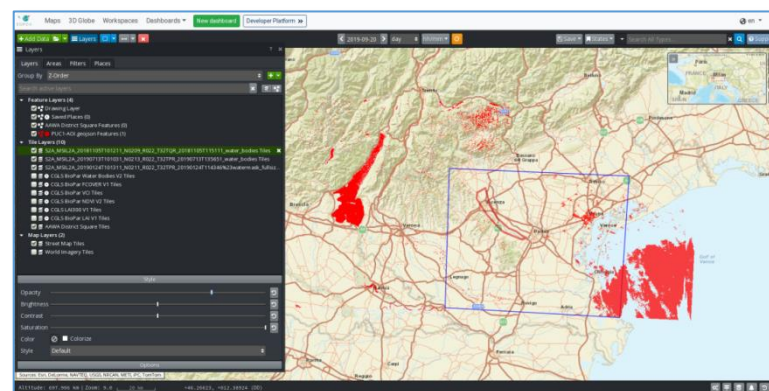
Visualisation of execution results

EOPEN Core Capabilities

Unattended Workflow Executions
- Single future execution
- Repeated executions at fixed interval
- Executions at specific month days

Resources Sharing
Based on the concept of workspaces

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EOPEN Extensions
(support to application developers)

▷ Sentinel missions product catalogue

▷ Water body mask generation

▷ Social media crawling, filtering

▷ Event detection in social media

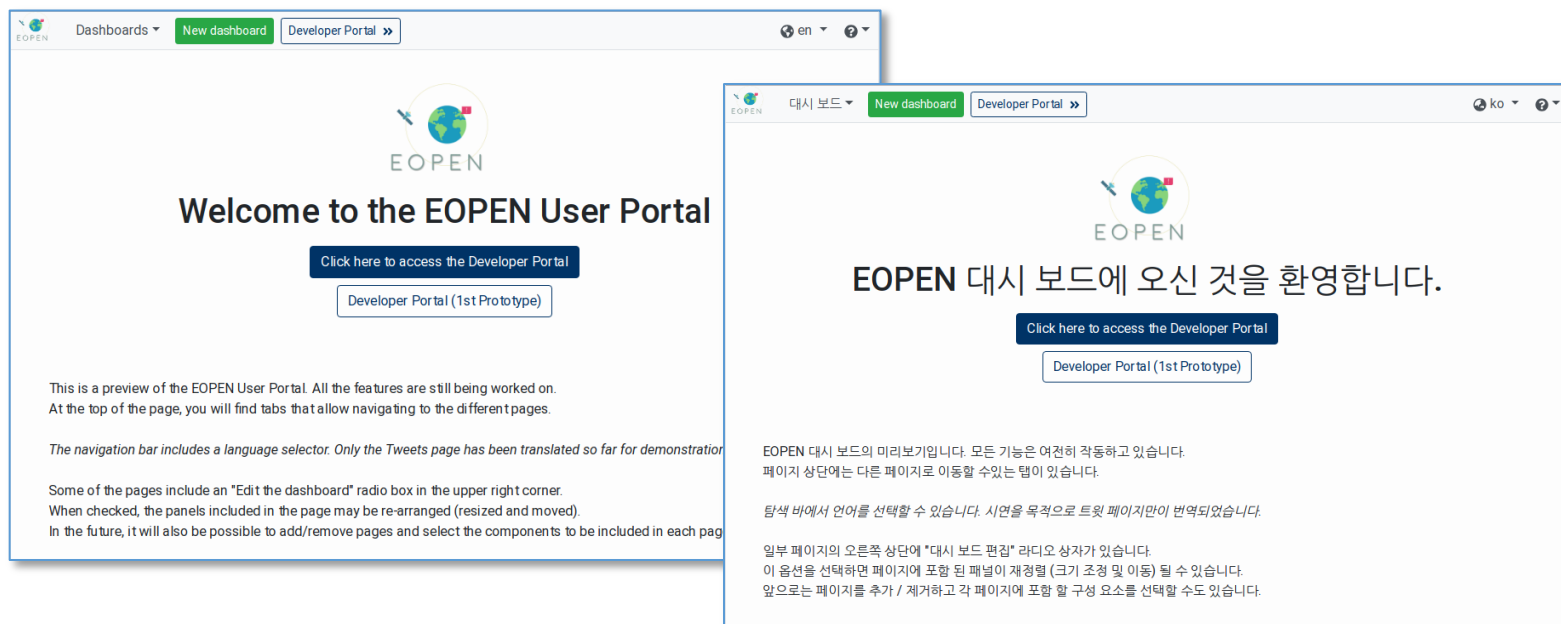▷ Community detection and topic identification
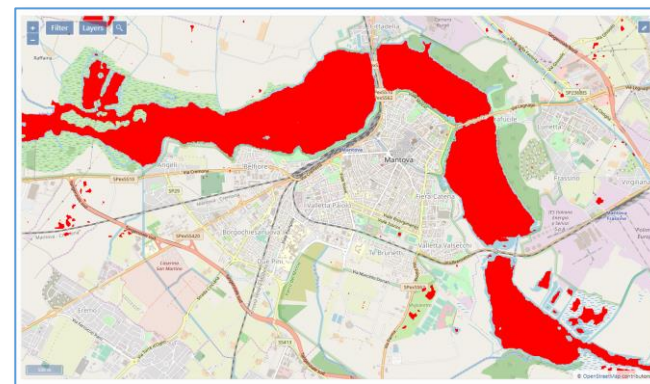
Water body mask
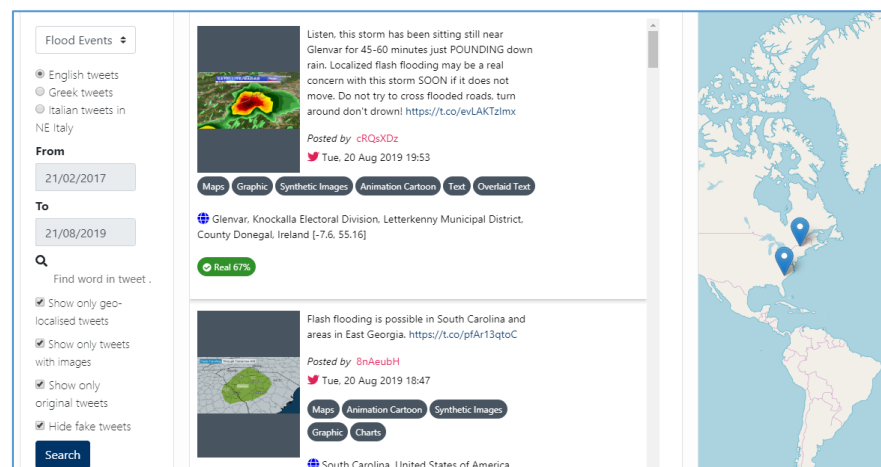
Tweets filtering, visualisation and geo-localisation

EOPEN End-User Portal

EOPEN End-User Portal

A Customisable Web-Portal

- New dashboard pages can be created and populated with available visualisation components

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Visualisation of generated outputs – GIS Clients

- Geo-temporal data may be published in GIS Server (e.g. GeoServer)

- Visualisation in OGC compliant GIS Client (e.g. QGIS, OpenSphere)
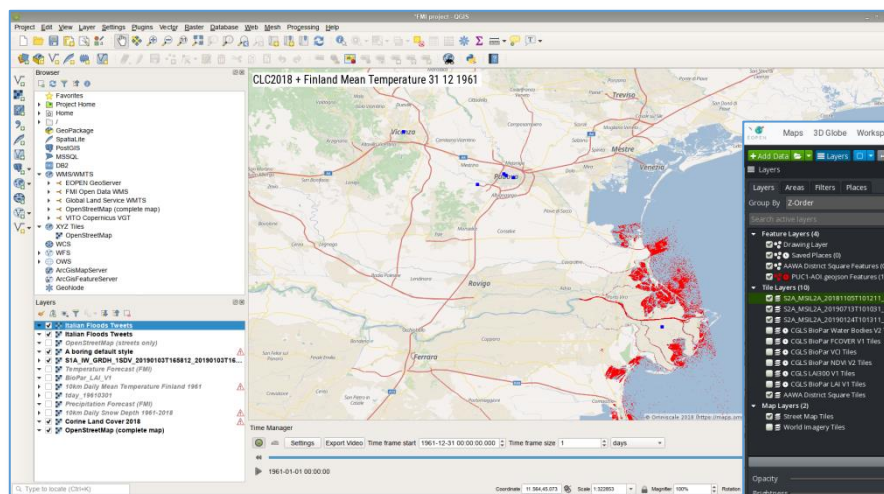
QGIS (Desktop Client)
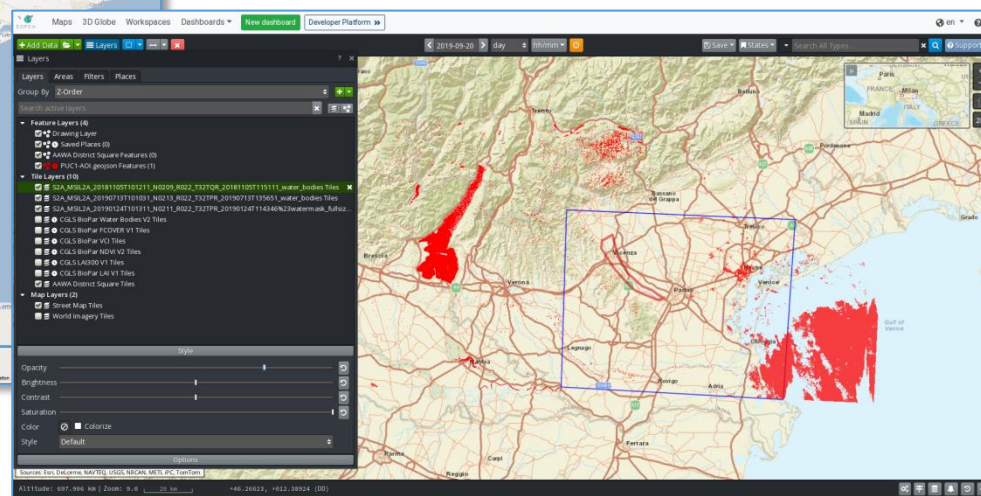
OpenSphere (Web Client)

EOPEN Pilot Use Cases

- PUC1: Flood Risk Assessment and Prevention
- PUC2: Food Security
- PUC3: Climate Change Impact in Finnish Lapland

PUC1: Flood Risk Assessment and Prevention

Background: Floods in Italy
The average annual precipitation is
highly variable with increasing trend
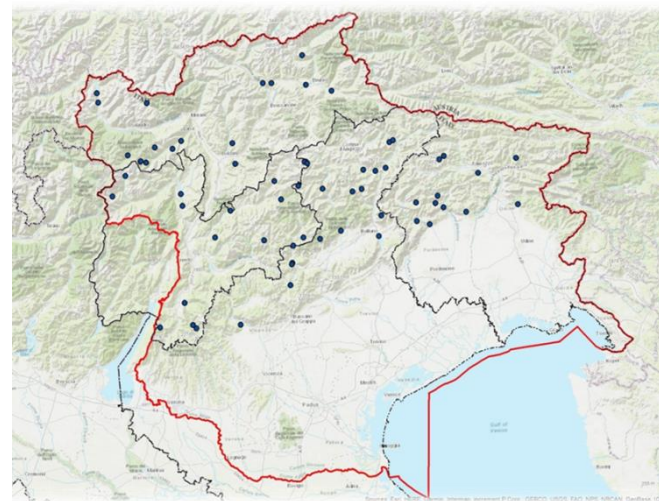
Eastern Alps river basin district
AAWA is the Authority competent
for a district covering an area of
over 37,000 km^2.

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PUC1: Precipitation Levels Warning System

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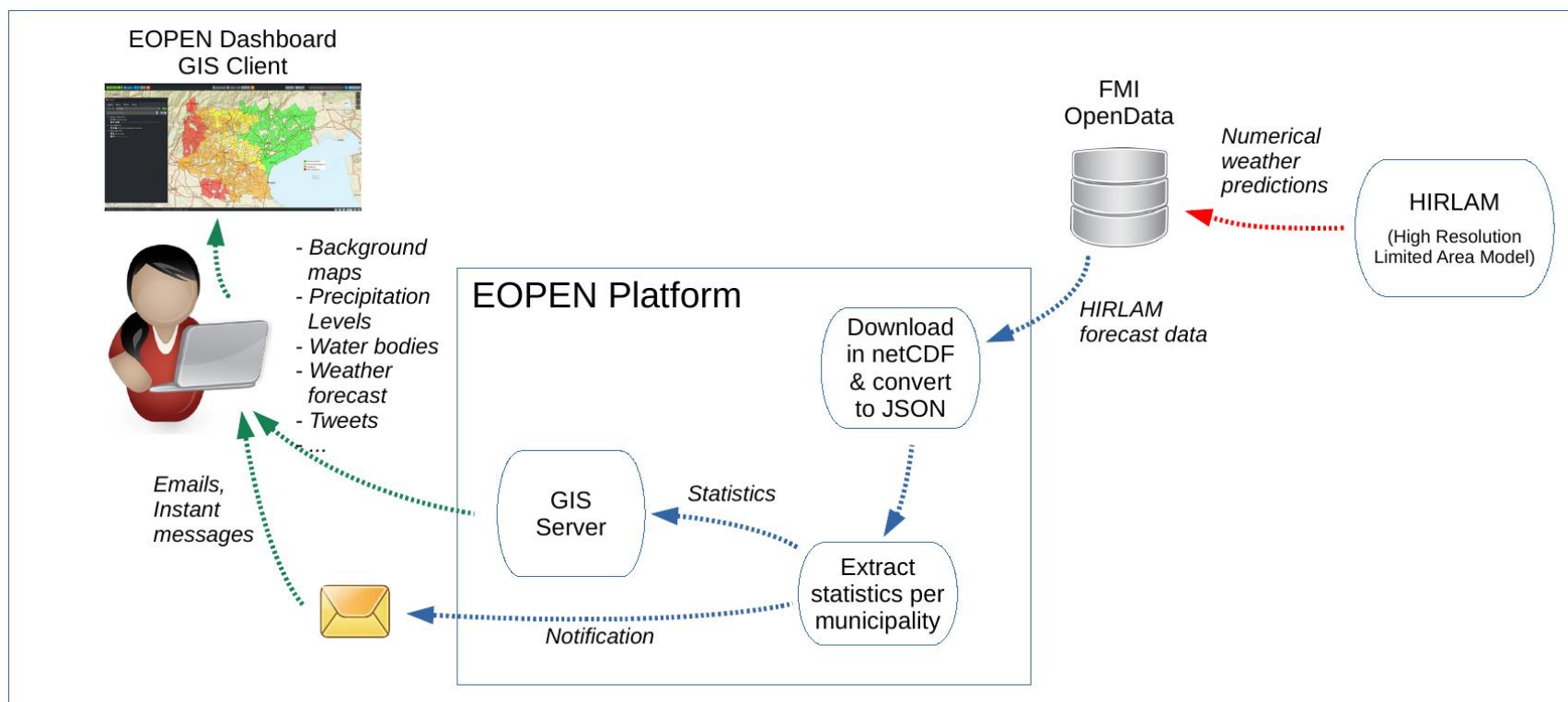
PUC1: Flood Risk Assessment and Prevention
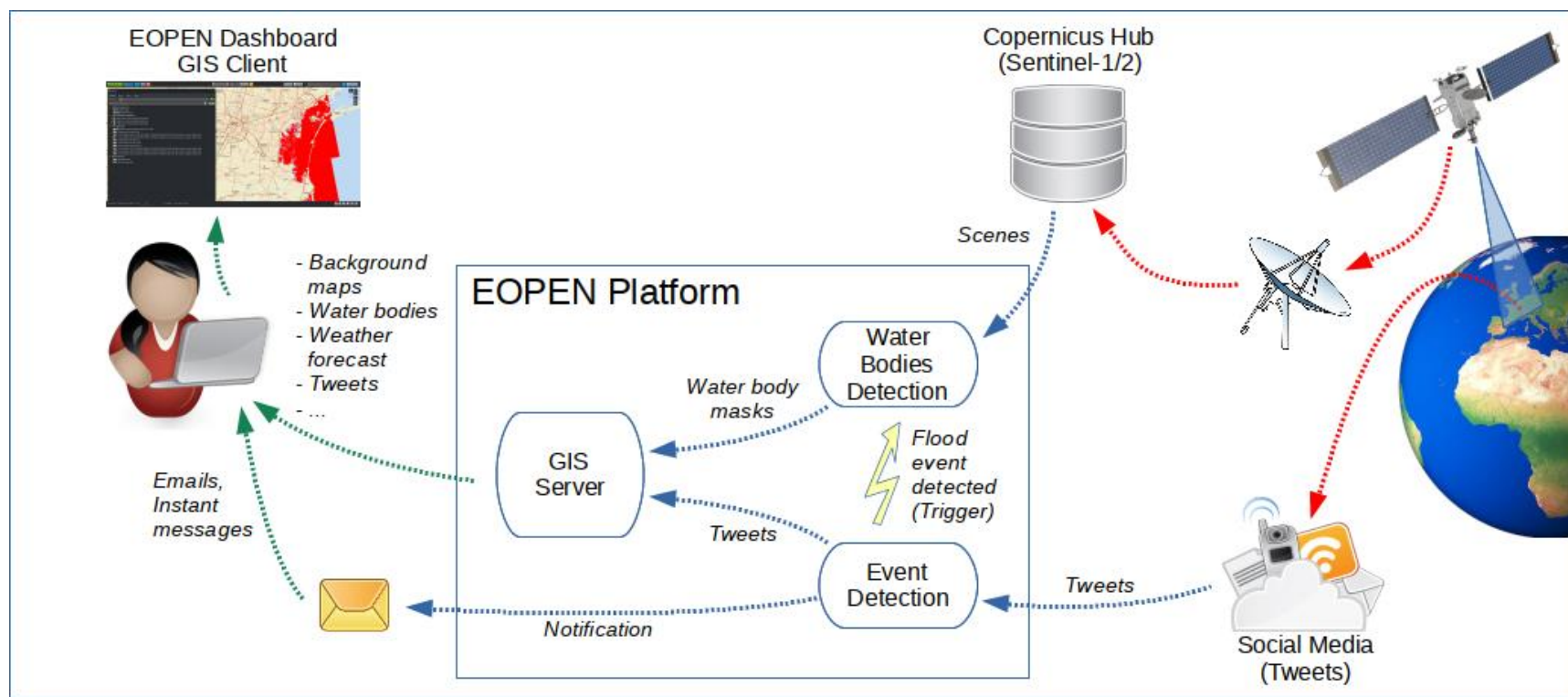
PUC1: Hydrological model for flood prediction

Planned interactions to provide information for flood risk reduction

EOPEN

Copernicus Land Service maps

AAWA EWS

HIRLAM weather forecast

Check the forecast total rain on sub-basins

Hydrological model

Less than threshold ➡ Do nothing

Over threshold ➡ Alarm to AAWA, creation of EVENT in EOPEN

Setup of Basement simulation

Run in EOPEN (on-demand)
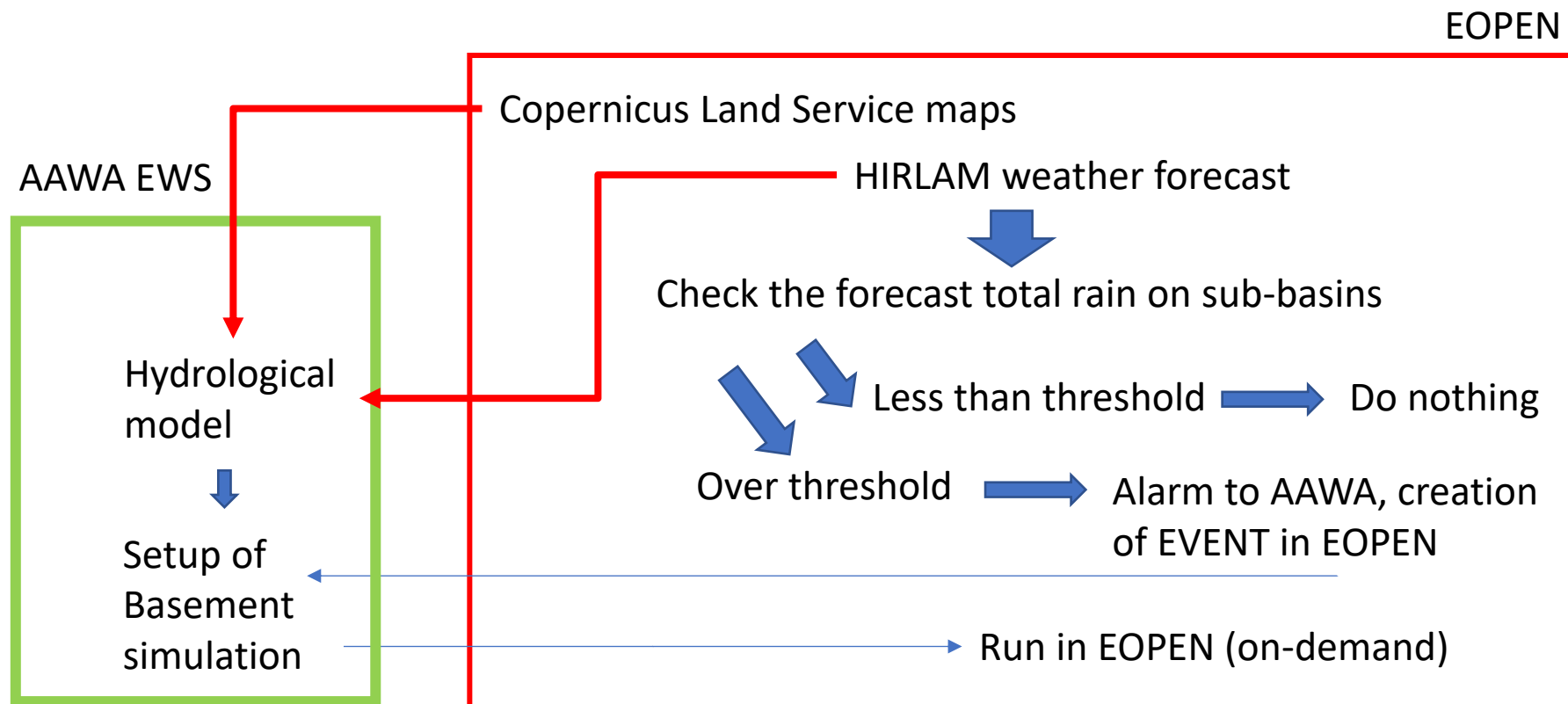
PUC2: Food Security

Rice Paddy Detection using Machine Learning

▷ Based on Sentinel-1 SAR data

▷ Rice paddy fields classification using RNN

▷ Rice yield estimation on time series

▷ Visualisation on the EOPEN platform interface (GIS client)

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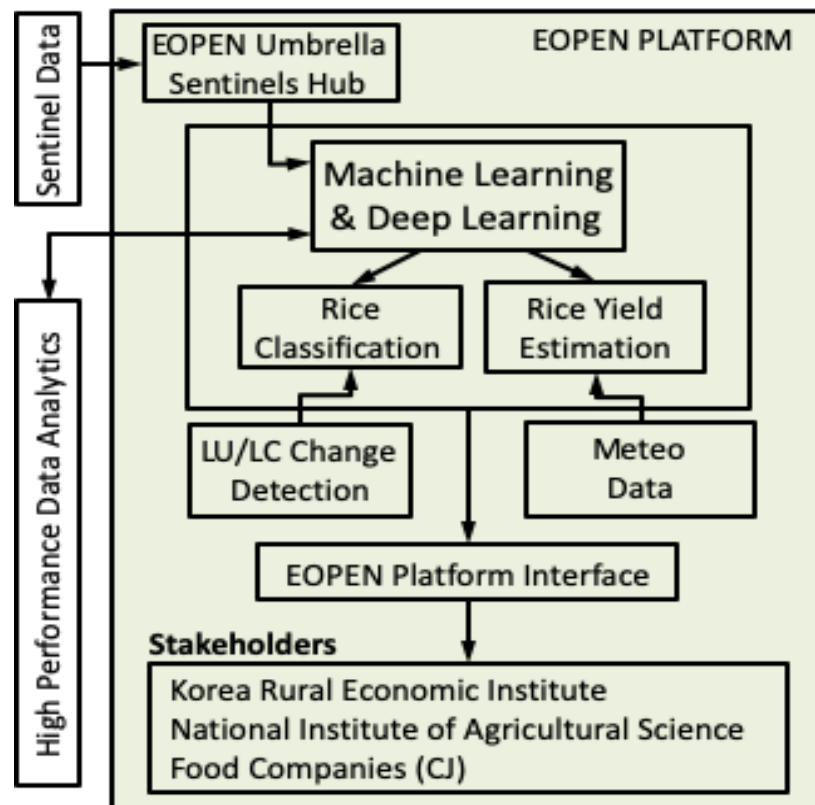
PUC2: Food Security

Rice Paddy Detection (RNN) Workflow:

- "*Monthly_mosaic*" corresponds to a mask for selecting a year and a shape and produces monthly mean composite images.

- "*Time_series_list*" generates a regular expression for a list of input data .

  Example: re_path = './PUC_2/*_', Month_list = '4, 5_1'

  Images to be searched = './PUC_2/*_4.tif' and './PUC_2/*_5_1.tif'

- "*rp_detection*" performs the rice pad detection over a list of images.
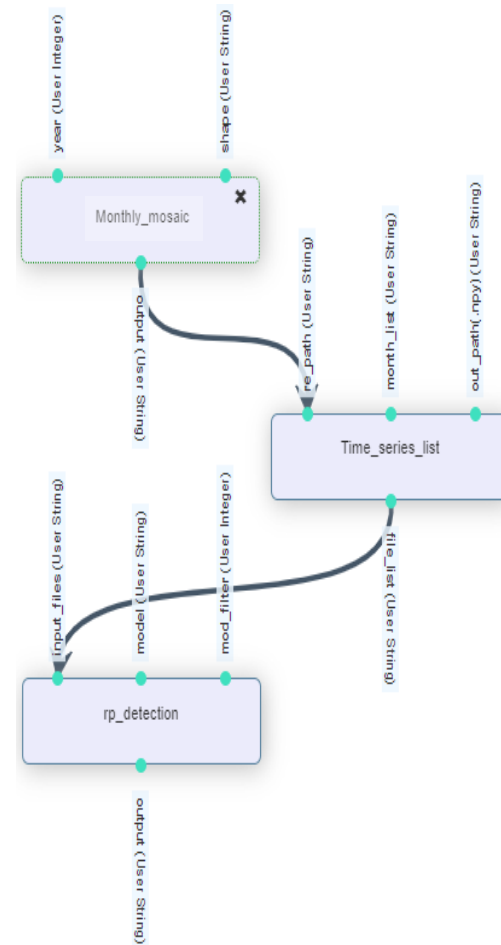
PUC2: Food Security

Rice Paddy Fields detected using:

- Machine Learning / RNN (KUEGIRS) (left)
- K-means (NOA) (right)
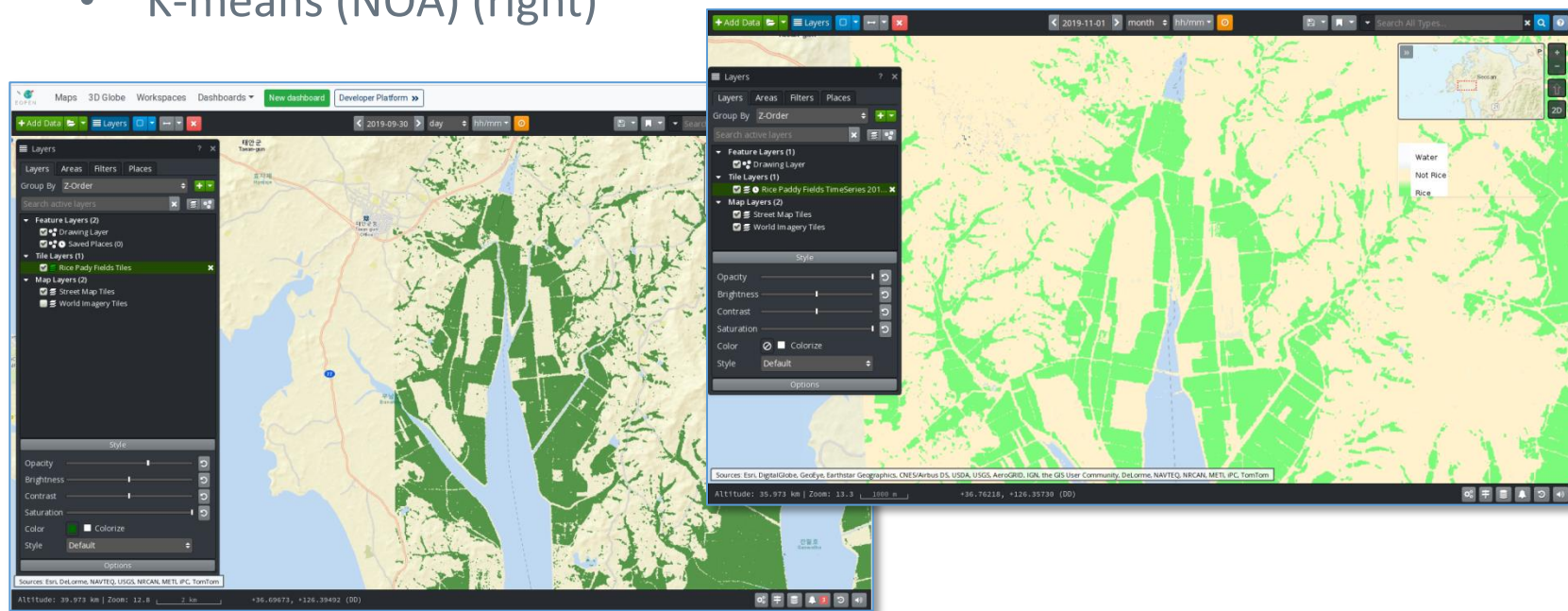
PUC3: Impact of Climate Change in Finnish Lapland

▷ Impact on the reindeer herding livelihoods, infrastructure and transportation.

▷ The herders' livelihood depends directly on the environmental and seasonal variation in snow cover, snow depth, temperature and the start of snow melting.

▷ EOPEN provides
  - Historical data of both air temperature and snow depth in Finland.
  - Weather forecasts.
  - FMI GlobSnow and Freeze/Thaw products for monitoring purposes.
  - Tools to plot the data and estimate both temporal/areal statistics.

PUC3 – Example Product in GIS Viewer

▷ Snow depth animation in reindeer herding areas during late Spring
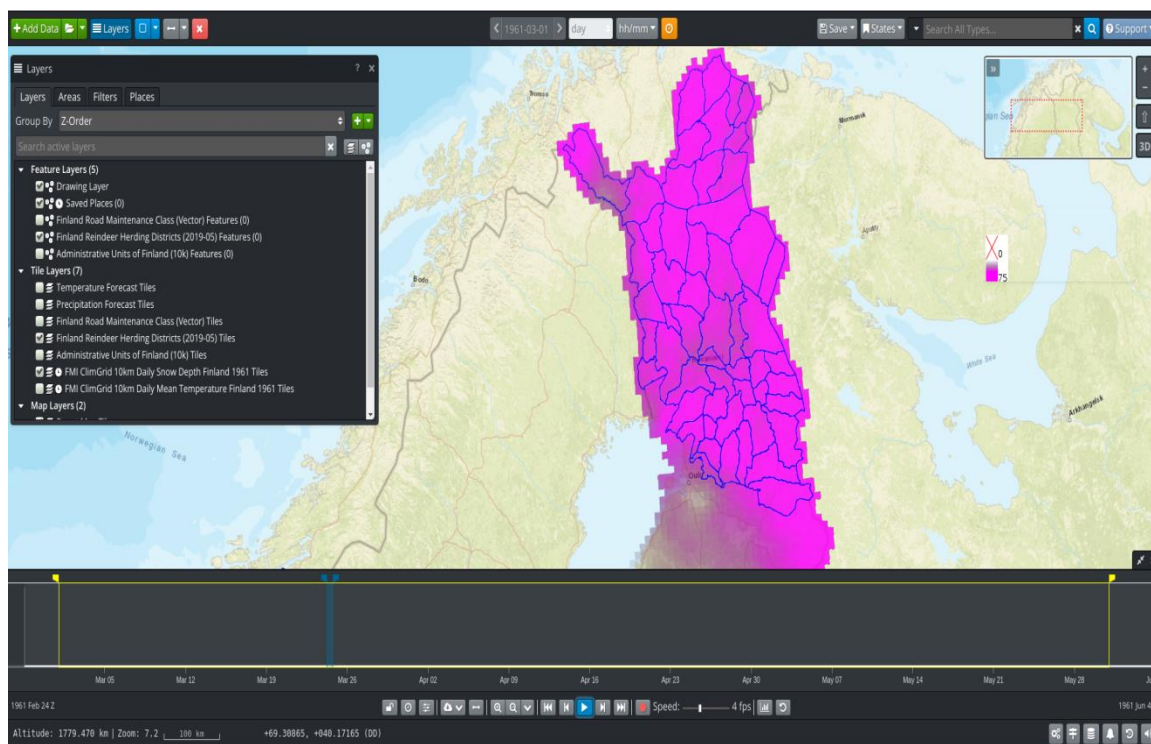
Animation shows the occurrence of snow melting in different reindeer herding areas over Northern Finland. This information is important both for the herders and researchers.
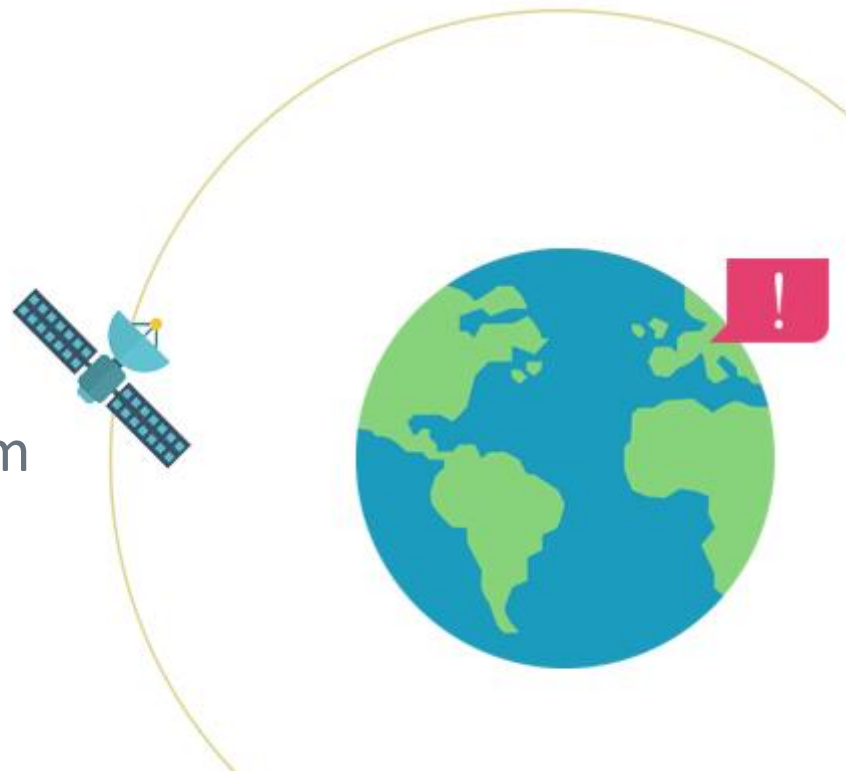
Live Demonstration

- Developer Portal:
  End-to-end walkthrough from algorithm development to workflow execution and access to the results.

- Dashboard:
  Configuration of new pages with existing components.
  Visualisation of geospatial data.

- Pilot Use Cases
  Presentation of the key workflows and visualisation of the results.

Thanks you!

Any questions?

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Backup slides

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