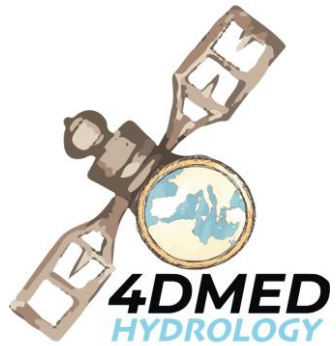
4DMED-Hydrology - a 4D reconstruction of the terrestrial Mediterranean water cycle (2021-2023)

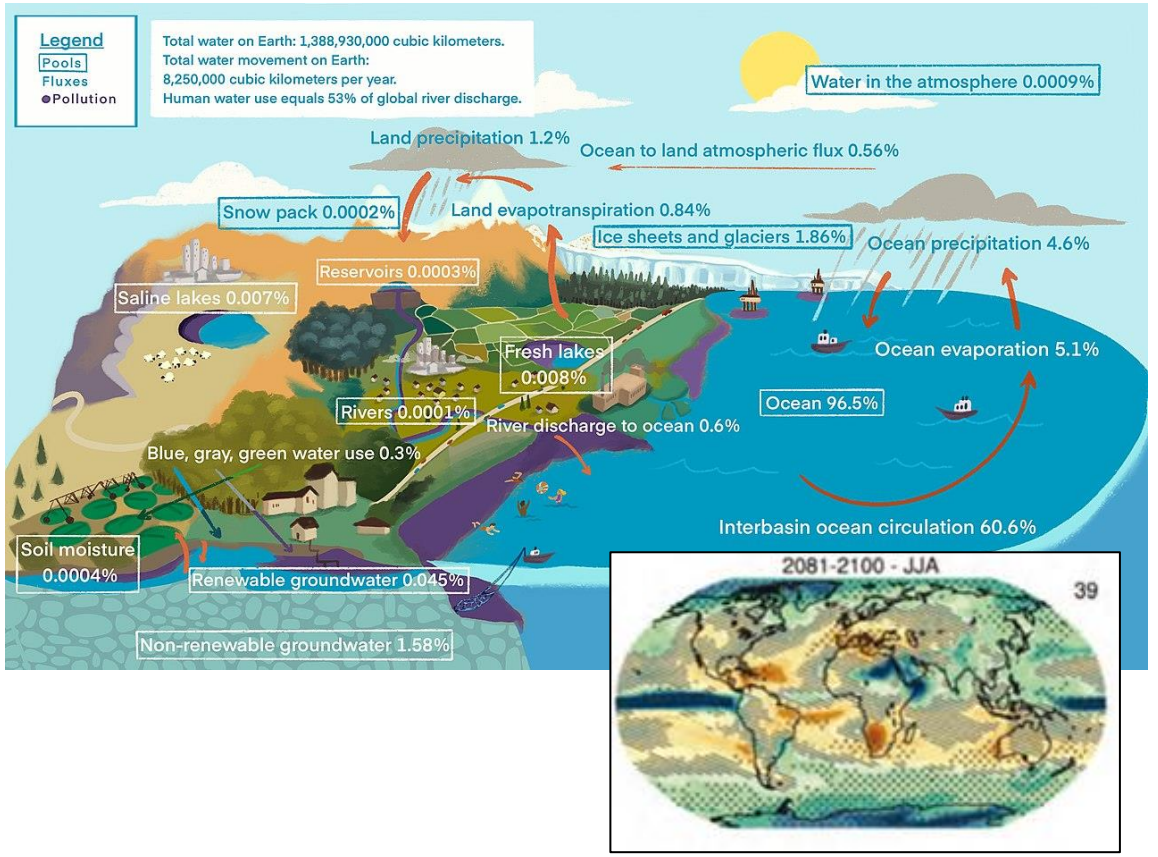


Why the Mediterranean

1. Mediterranean has a **unique character** (complex topography, high climate variability, high human pressure) – > it is a hot spot of climate change (Giorgi et al. 2006).

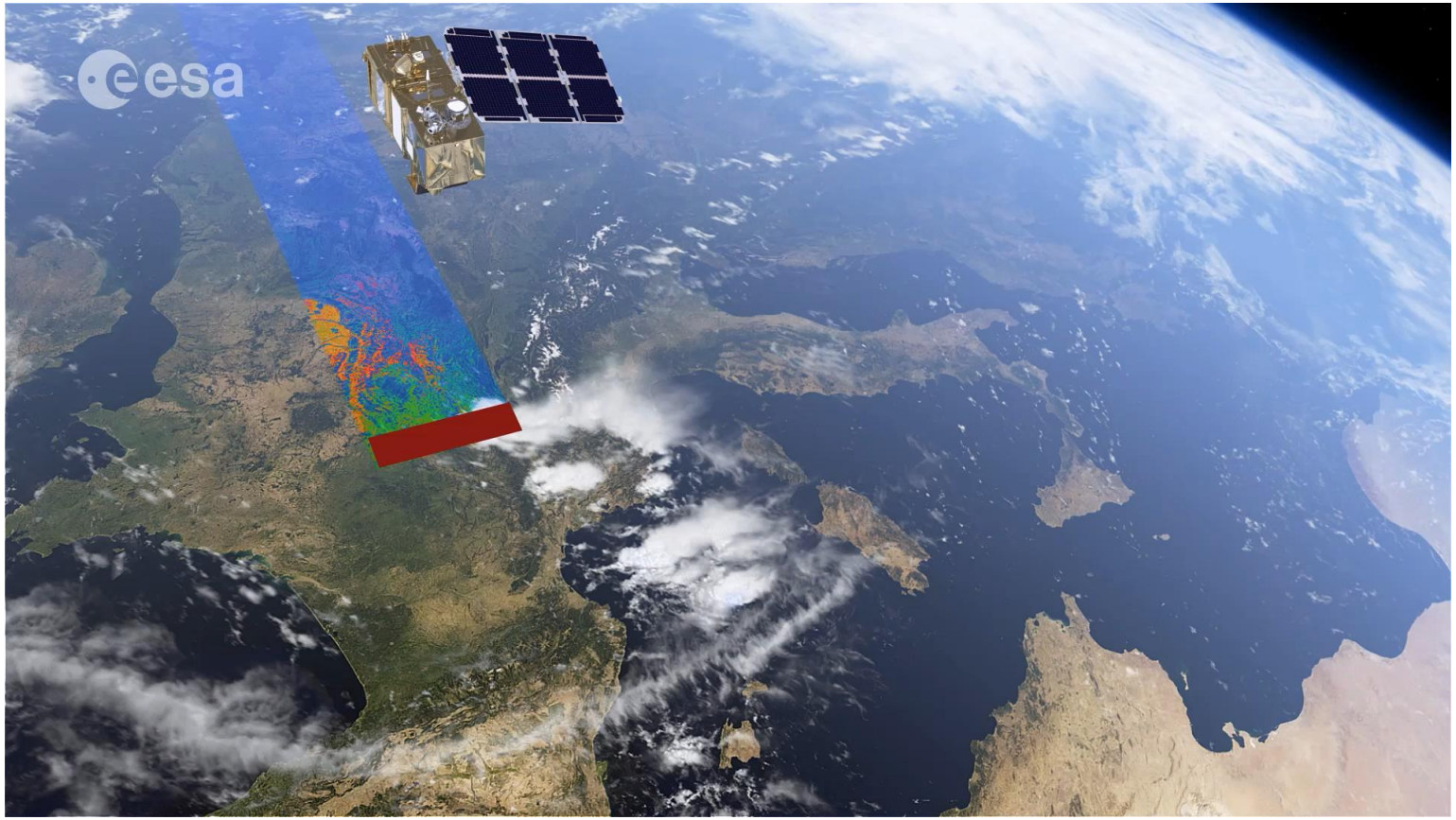
2. Mediterranean is an exposed region to intense **hydro-meteorological extremes** (floods, droughts, landslides)

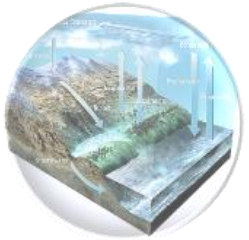
3. Mediterranean has strong non-linear interactions between **fine scale processes and anthropogenic pressure → observation gap at these scales**



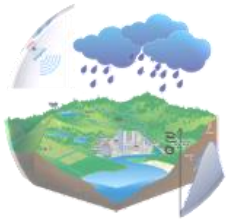
High-resolution Earth observation data are then very important to support water cycle research and disaster risk reduction activities.

4DMED-Hydrology objective





Water cycle reconstruction



Advancing Earth system Science

Solutions for society

Consiglio Nazionale delle Ricerche

eurac research

cima RESEARCH FOUNDATION

TU WIEN

Observatoire de l'Eau

GHENT UNIVERSITY

HSM

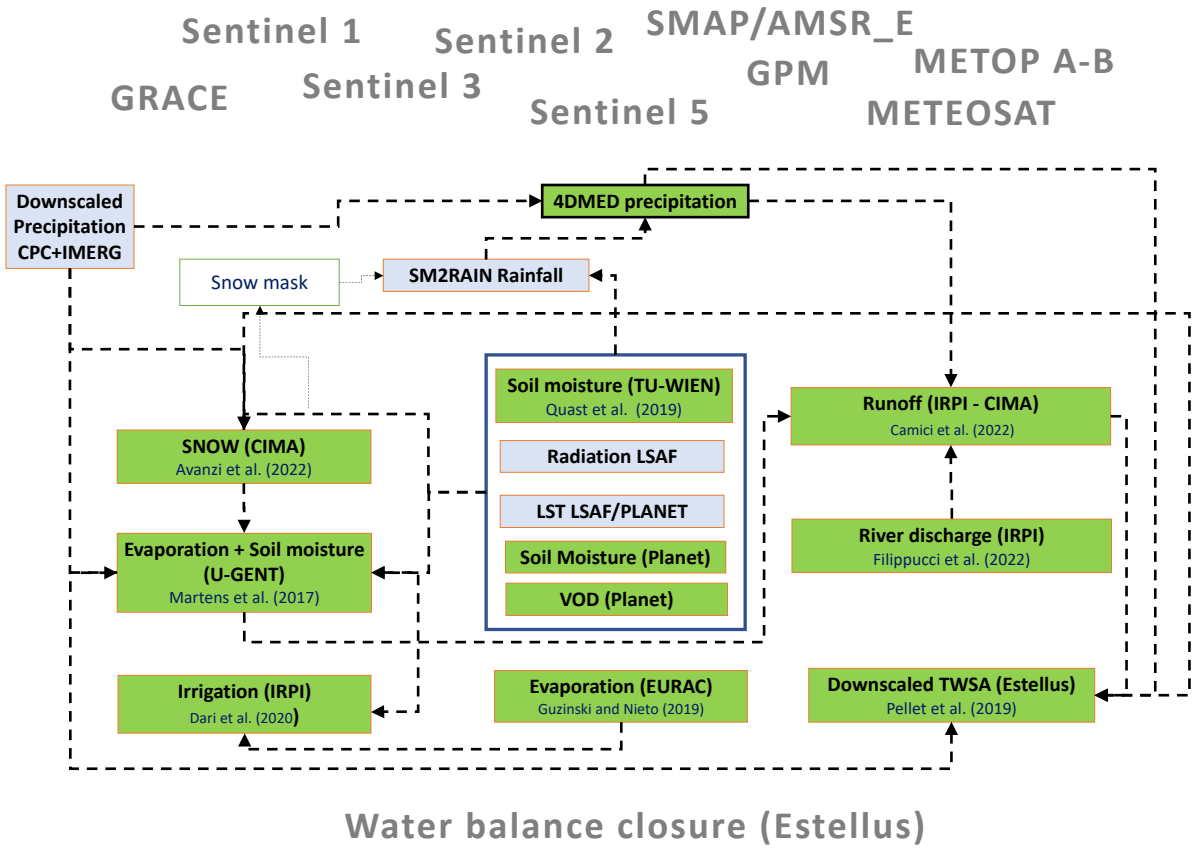
VanderSat

KU LEUVEN

Estellus

The 4DMED-Hydrology project aims to develop an advanced, high-resolution, and consistent reconstruction of the Mediterranean terrestrial water cycle, by highlighting the potential of high-resolution ESA satellite products (i.e., Sentinel missions)

Products from the exploitation of data from Sentinel missions



- 1 km Precipitation (CNR-IRPI)
- 1 km Snow water equivalent (CIMA, KU-Leuven)
- 1km Active surface soil moisture (TU-Wien)
- 1km Passive Surface soil moisture and LST (Planet)
- 1km GLEAM evaporation (U-GENT)
- 100 Sen-ET evaporation (EURAC)
- 1km irrigation (CNR-IRPI)
- 1km runoff (CIMA – CNR-IRPI)
- 1km TWS (Estellus)
- Satellite river discharge (CNR-IRPI)

Science

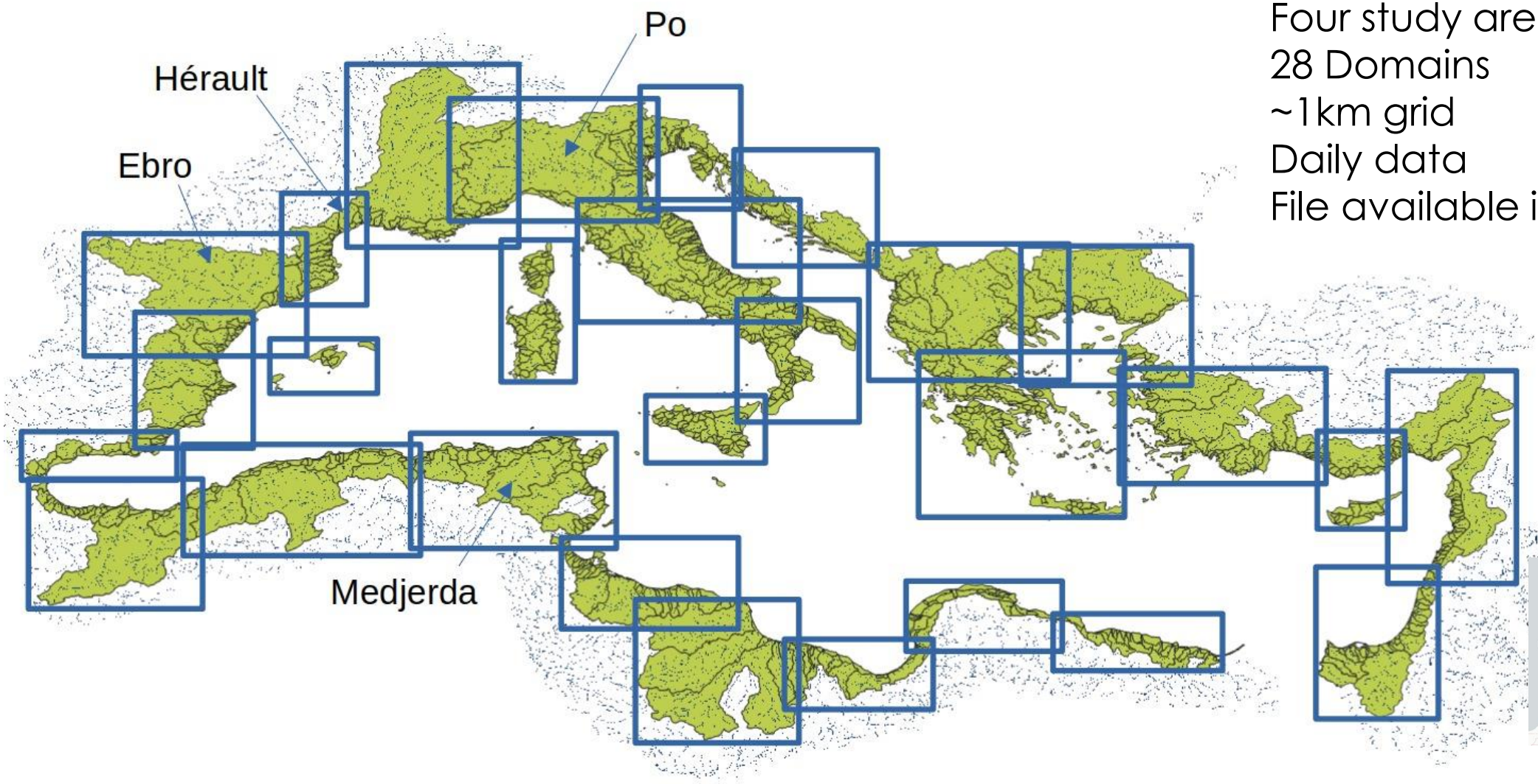
Snow in the Mediterranean
Human impact water cycle
Groundwater
Land atmosphere interactions

4DMED HYDROLOGY

Solution for society

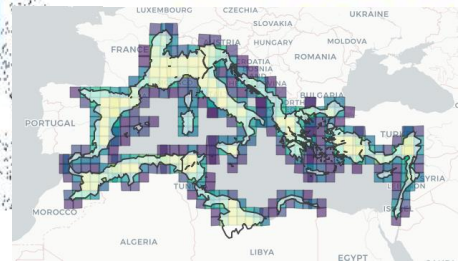
Floods
Landslides
Water resource management
Droughts

4DMED-Hydrology domain



Four study areas
28 Domains
~1km grid
Daily data
File available in netcdf files

NoR



Use of the Network of Resource (1)

April 2022: request for NoR
June 2022: signature from ESA

The main goals of the NoR are:

- to create a **common working environment** for all project partners with demanding processing needs
- **co-organize the data generation**
- **sharing** of all required **input**, intermediate and **results** collectively in one infrastructure

EODC hosts the infrastructure

Resources availability

For a duration of 18 month:
- 64 CPU cores
- 256 GB RAM
- 2TB of SSD Storage
- 10 TB of HDD EO Storage

For a duration of 5 month:
- 96 CPU cores
- 384 GB RAM
- 2TB of SSD Storage

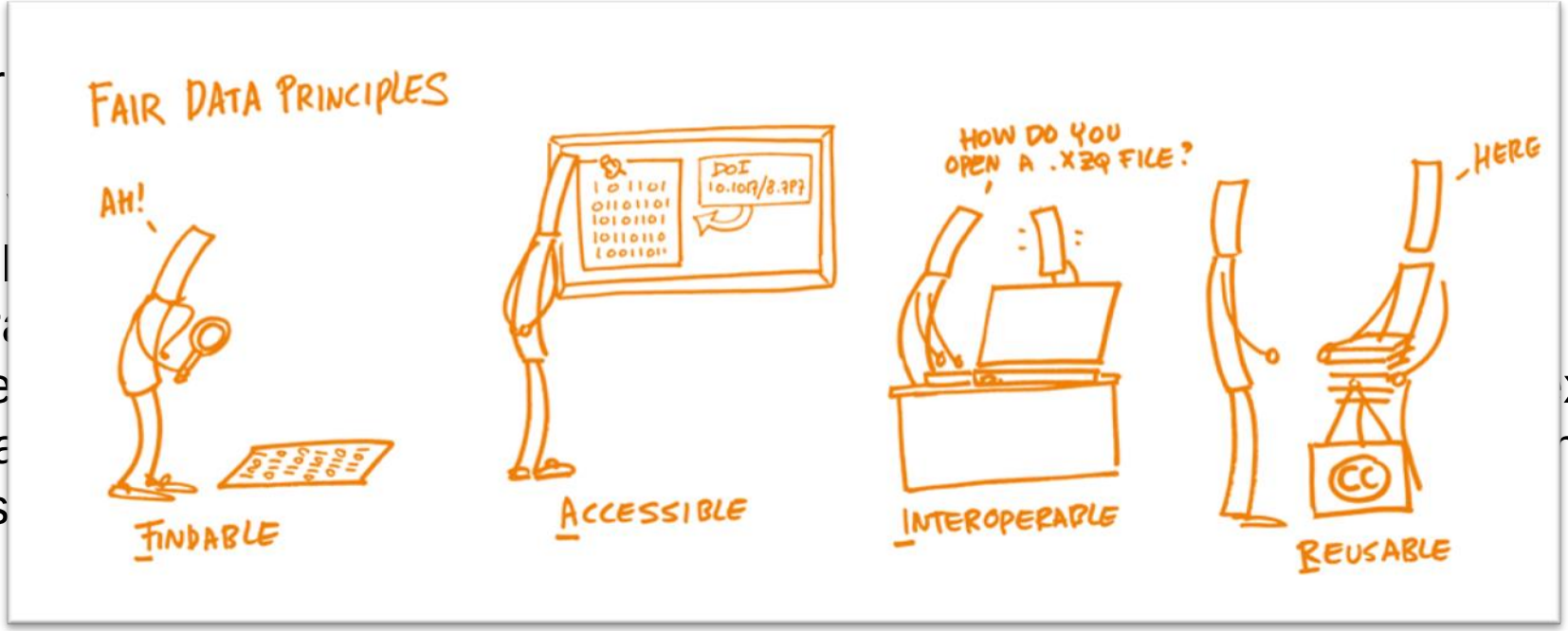
Use of the Network of Resources (2)

The EO-based results (i.e., experimental datasets, EO products) are available in an Open Science catalogue hosted on the openEO platform by EODC.

In particular

- Findable
- Accessibl
- Interopera
- Reusable

xtents or request la n federation members



This approach can be valuable both for the scientific output of the project and to speed up the research process while simultaneously improving our confidence in those results.

A large dataset for validating the products

https://edp-portal.eurac.edu/cdb_doc/4dmed/

4DMED project - Hydrological datasets

4DMED-Hydrology project aims at achieving this objective by developing and validating a novel and advanced set of EO-based products that together with additional information (in-situ data, model results) may provide an accurate reconstruction of the Mediterranean Land "Earth system", its land-atmosphere interactions and relevant processes (also human activities) based on the latest advances in EO technology (4DMed-Hydrology dataset). Further information can be found on the official website: https://www.4dmed-hydrology.org/.
The data have been collected by the partners responsible for each site and organized in a project database to be shared among the team members, ensuring that all of them can work on the same data versions. The database contains observations concerning the following variables: river discharge, in situ soil moisture, actual ET from eddy covariance stations, snow depth and snow water equivalent, groundwater and irrigation measurements.

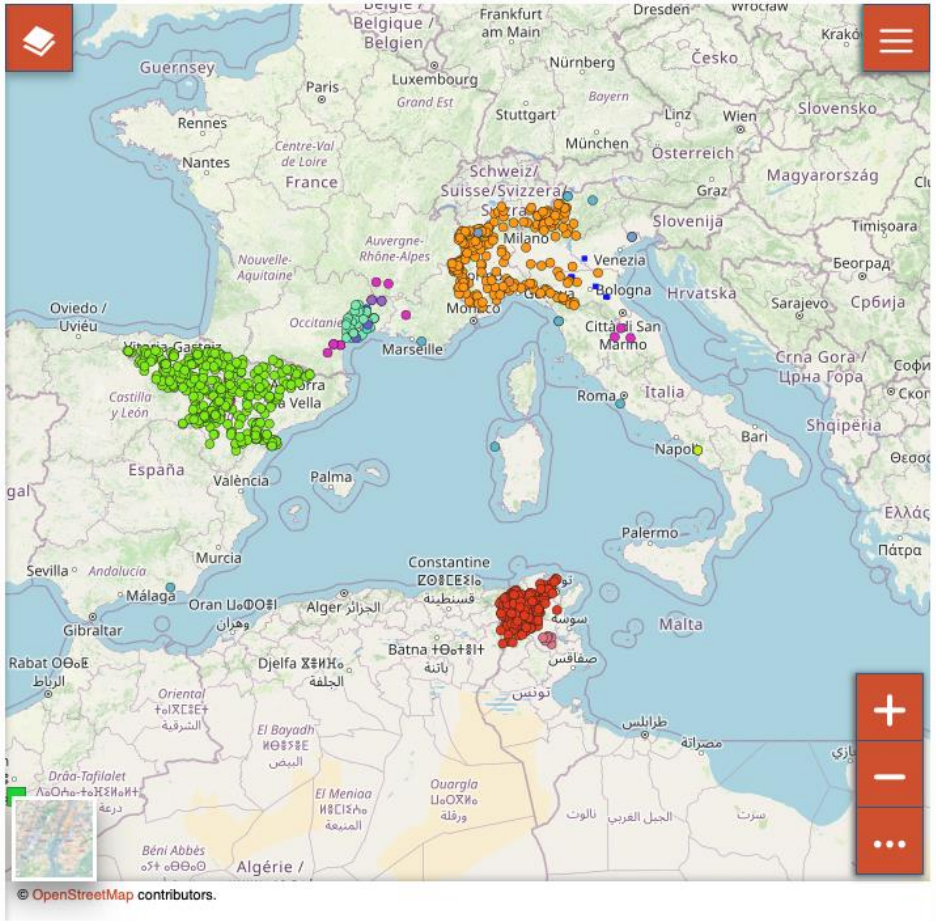
Data sources

The 4DMED-Hydrology project involves a consortium led by CNR-IRPI and comprises the following organizations:

- Vienna University of Technology (TU Wien), hereinafter TUWIEN;
- Ghent University (Ghent University) hereinafter UGent;
- CIMA Research Foundation (CIMA RESEARCH FOUNDATION), hereinafter CIMA;
- Estellus (ESTELLUS SAS), at Paris Observatory, hereinafter ESTELLUS;
- Universitat Ramon Llull, Observatori de l'Ebre (OBSERVATORI DE L'EBRE), hereinafter OBSEBRE;
- KULeuven, Department of Earth and Environmental Sciences, Division Soil and Water Management (KATHOLIEKE UNIVERSITEIT LEUVEN), hereinafter KULeuven;
- VanderSat (VANDERSAT B.V.) hereinafter VANDERSAT;
- Eurac Research, Institute for Earth Observation (EURAC RESEARCH - ACCADEMIA EUROPEA DI BOLZANO), hereinafter EURAC;
- HydroSciences Montpellier (INSTITUT DE RECHERCHE POUR LE DÉVELOPPEMENT), hereinafter HSM.

Web Map Service

Station's location is visible by means of a spatial layer that can be accessed by a GIS client (or R) to compose maps using the WMS service, with the keyword "4dmed" to filter the layer list.
A preview about stations location is provided here or by opening this MAP.



When clicking on each point, a small window will appear listing some useful information about the selected station.

Data distribution and visualization

stac-fastapi

Browse | Search

Description

stac-fastapi

Catalogs 36 — Tiles | List | Ascending | Descending

Filter catalogs by title

Daily evaporation product Ebro basin

Daily evaporation data are produced from Two-Source Energy Balanced (TSEB) model driven by ESA Sentinel (both Sentinel-2 MSI and Sentinel...

1/1/2017, 12:00:00 AM UTC - 12/31/2021, 12:00:00 AM UTC

E_GLEAM_1km_2015-2021_D12_Dalmatia

Daily land evaporation (mm/day) estimated from a fully satellite driven evaporation model GLEAM v3. E is calculated as a sum of interception loss...

1/1/2015, 12:00:00 AM UTC - 12/31/2021, 12:00:00 AM UTC

Daily evaporation product Herault basin

Daily evaporation data are produced from Two-Source Energy Balanced (TSEB) model driven by ESA Sentinel (both Sentinel-2 MSI and Sentinel...

1/1/2017, 12:00:00 AM UTC - 12/31/2021, 12:00:00 AM UTC

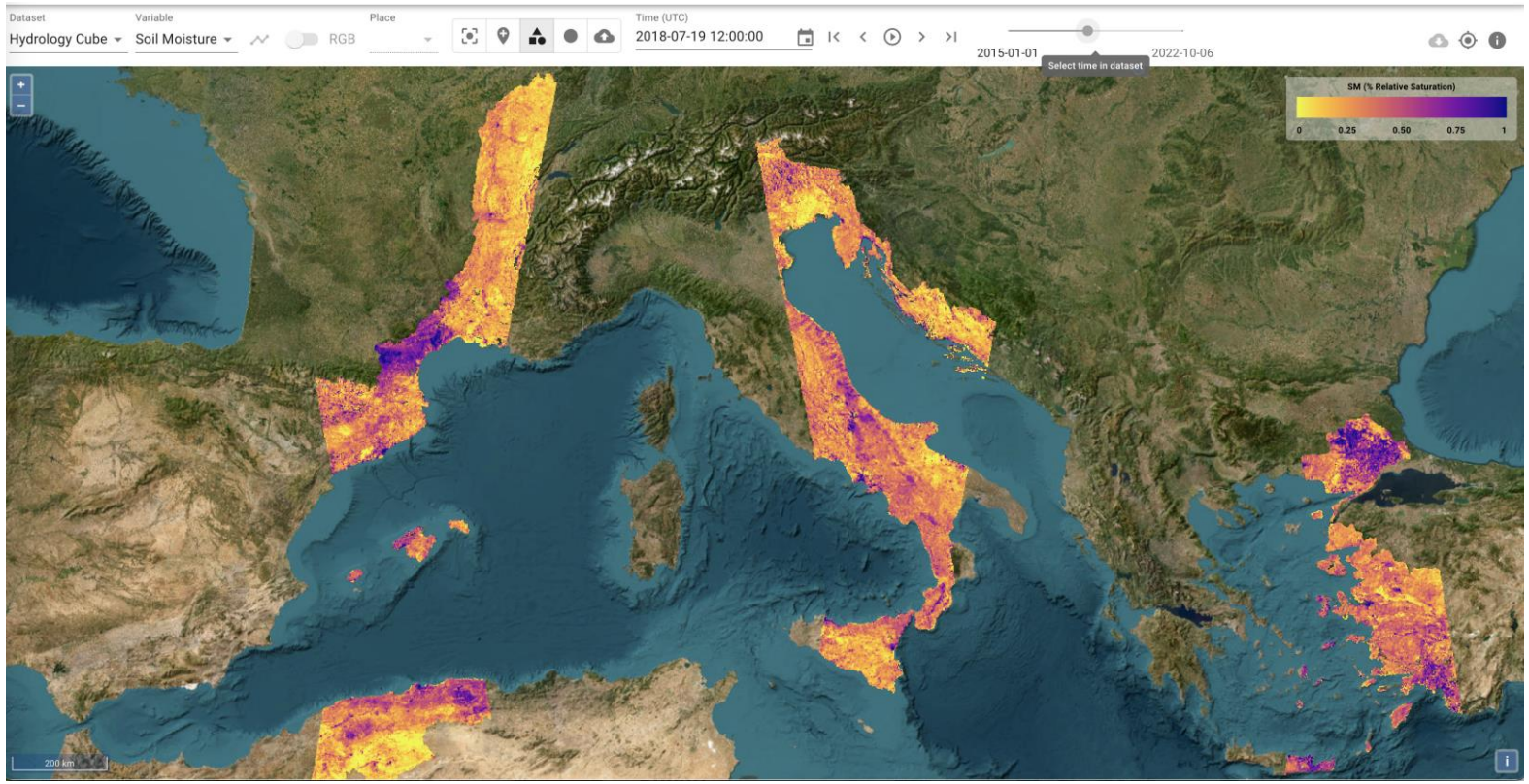
E_GLEAM_1km_2015-2021_D13_Epirus

Daily land evaporation (mm/day) estimated from a fully satellite driven evaporation model GLEAM v3. E is calculated as a sum of interception loss...

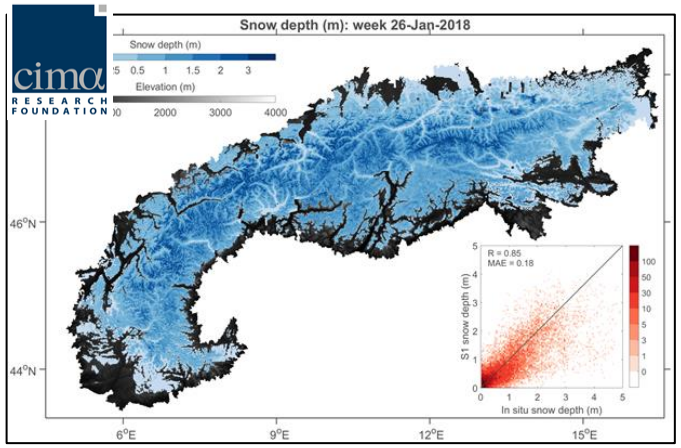
1/1/2015, 12:00:00 AM UTC - 12/31/2021, 12:00:00 AM UTC

https://stac.eurac.edu:8080/?.language=it

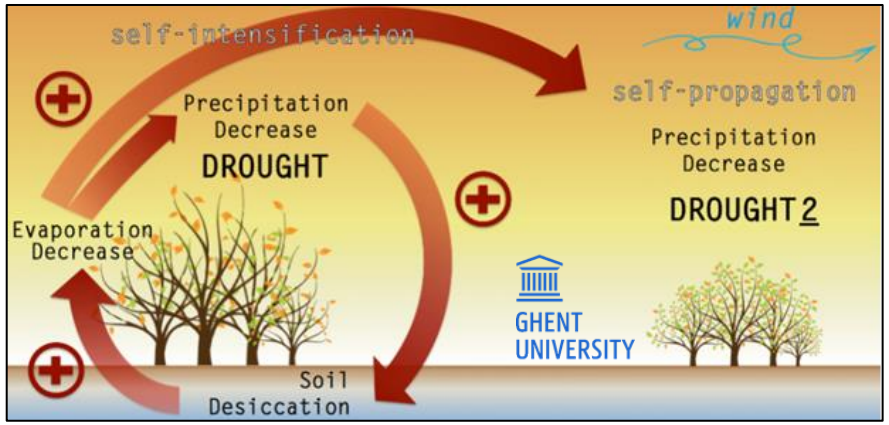
https://viewer.earthsystemdatalab.net/?dataset=hydrology



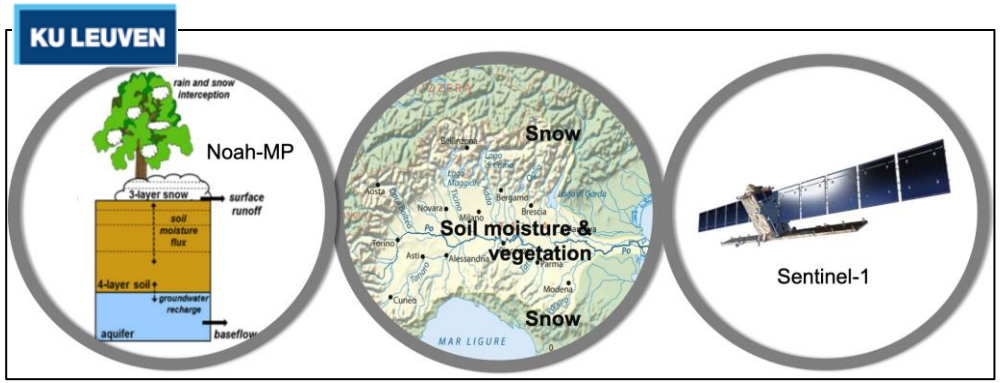
How we are advancing the Earth System Science



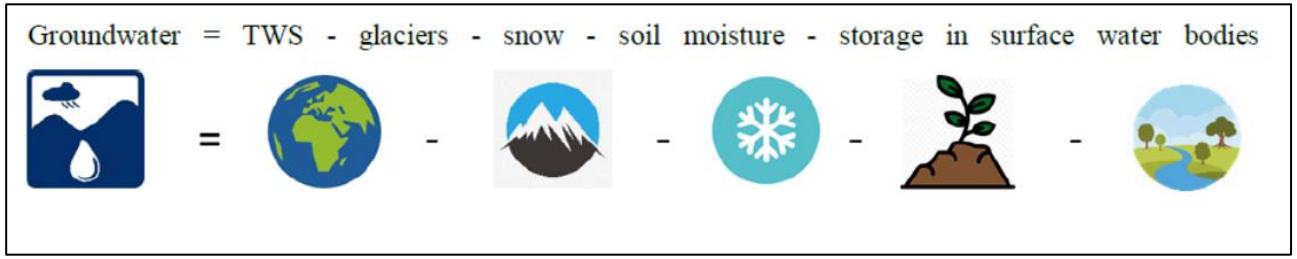
How much snow is there in the Mediterranean region? (S1-based snow data - 4DMED-Hydrology Snow dataset)



Land-atmosphere interactions in the Mediterranean region (S1, S2, S3, S5P data (4DMED-Hydrology high resolution ET and precipitation datasets)



Human impact on the water cycle – S-1 data assimilation of radar backscatter and snow height



TECHNISCHE UNIVERSITÄT WIEN

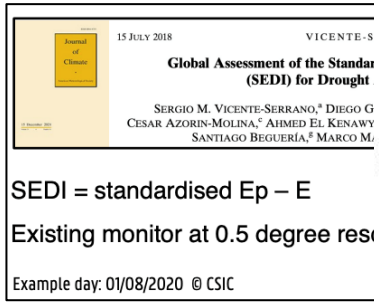
Informed attribution of irrigation water sources from surface and groundwater bodies (S1, S2, S3, S5P) – Multiple 4DMED datasets

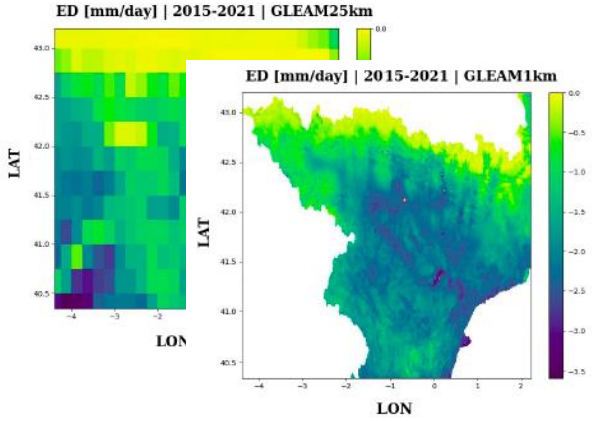
(papers in preparation)

EO to find solutions for society

Agricultural drought monitoring over the Mediterranean

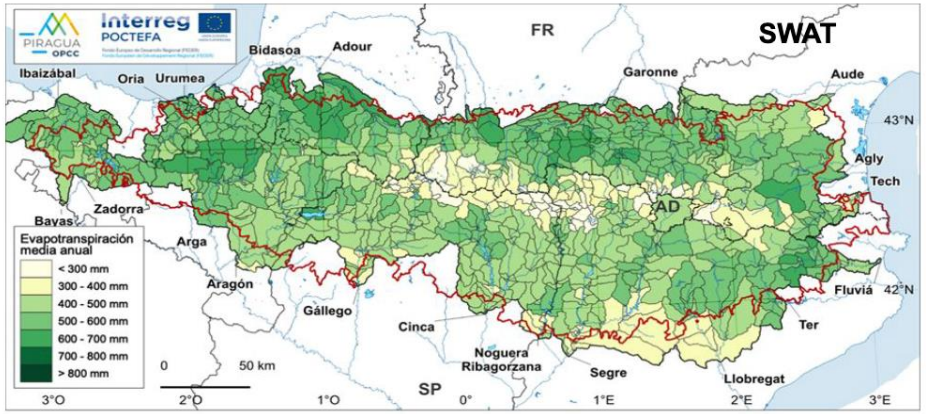
GHENT UNIVERSITY

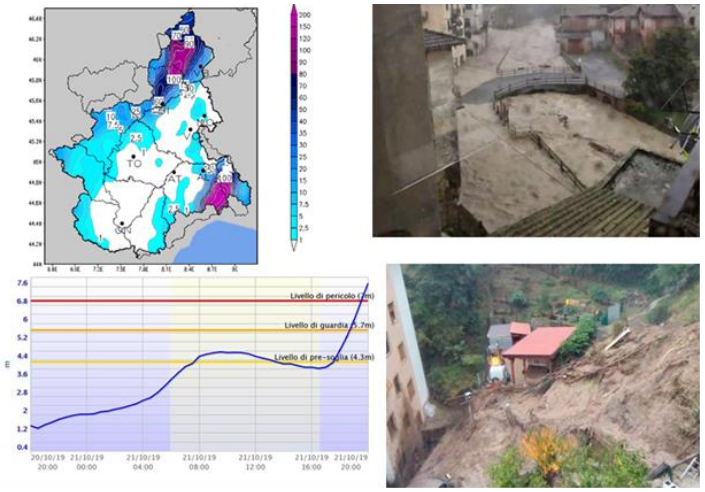




Water resource management in the Ebro River basin

Observatorio de l'Ebre



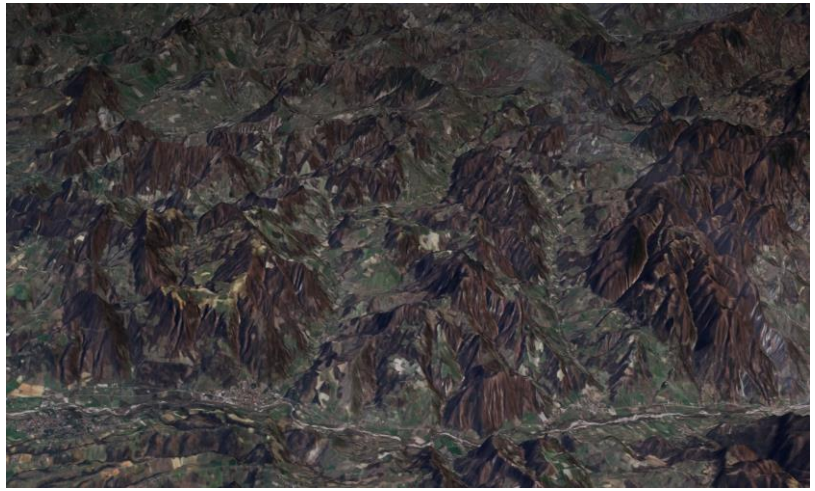


HSM

CNR irpi

Landslide modelling with precipitation, snow and multiple soil moisture 4DMED-Hydrology datasets

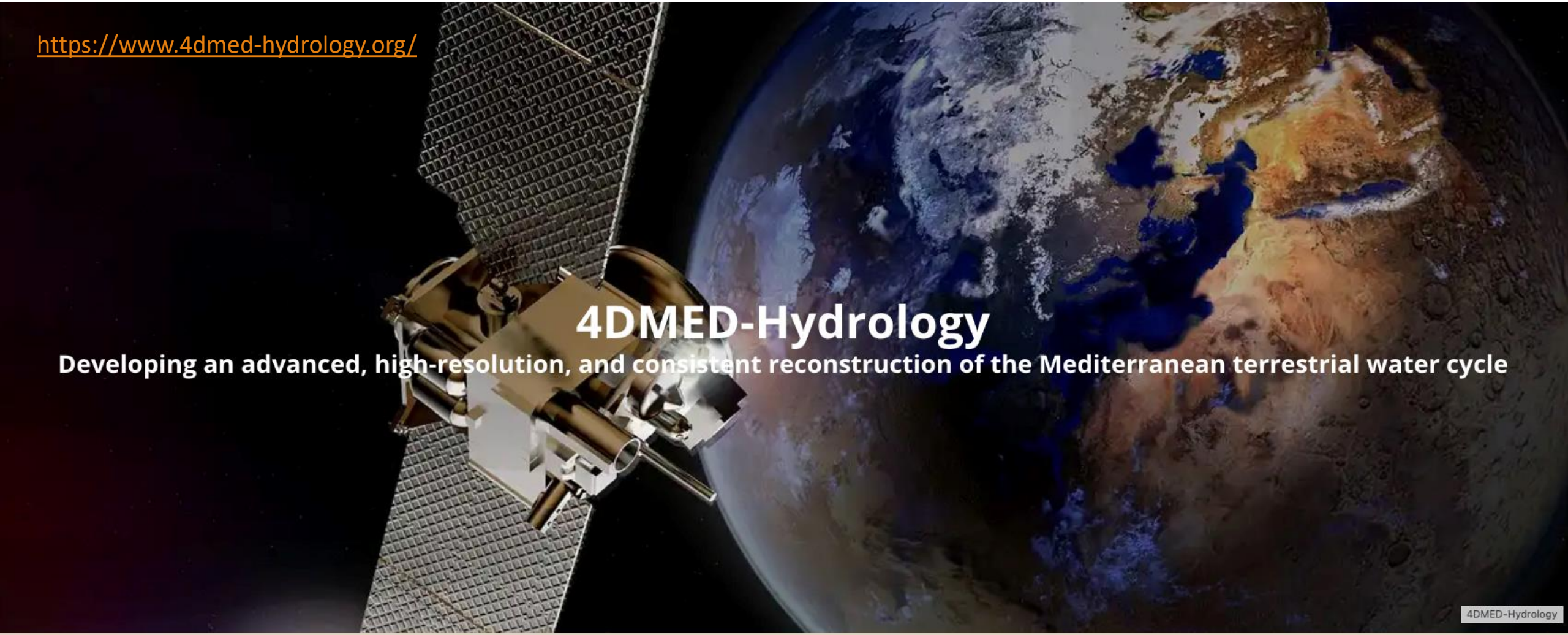
CNR irpi



Flood modelling with 4DMED-Hydrology precipitation and soil moisture

(papers in preparation)

Our website: it contains a list of publications



For more info write me: christian.massari@cnr.it