

living planet symposium

BONN
23–27 May
2022

TAKING THE PULSE
OF OUR PLANET FROM SPACE



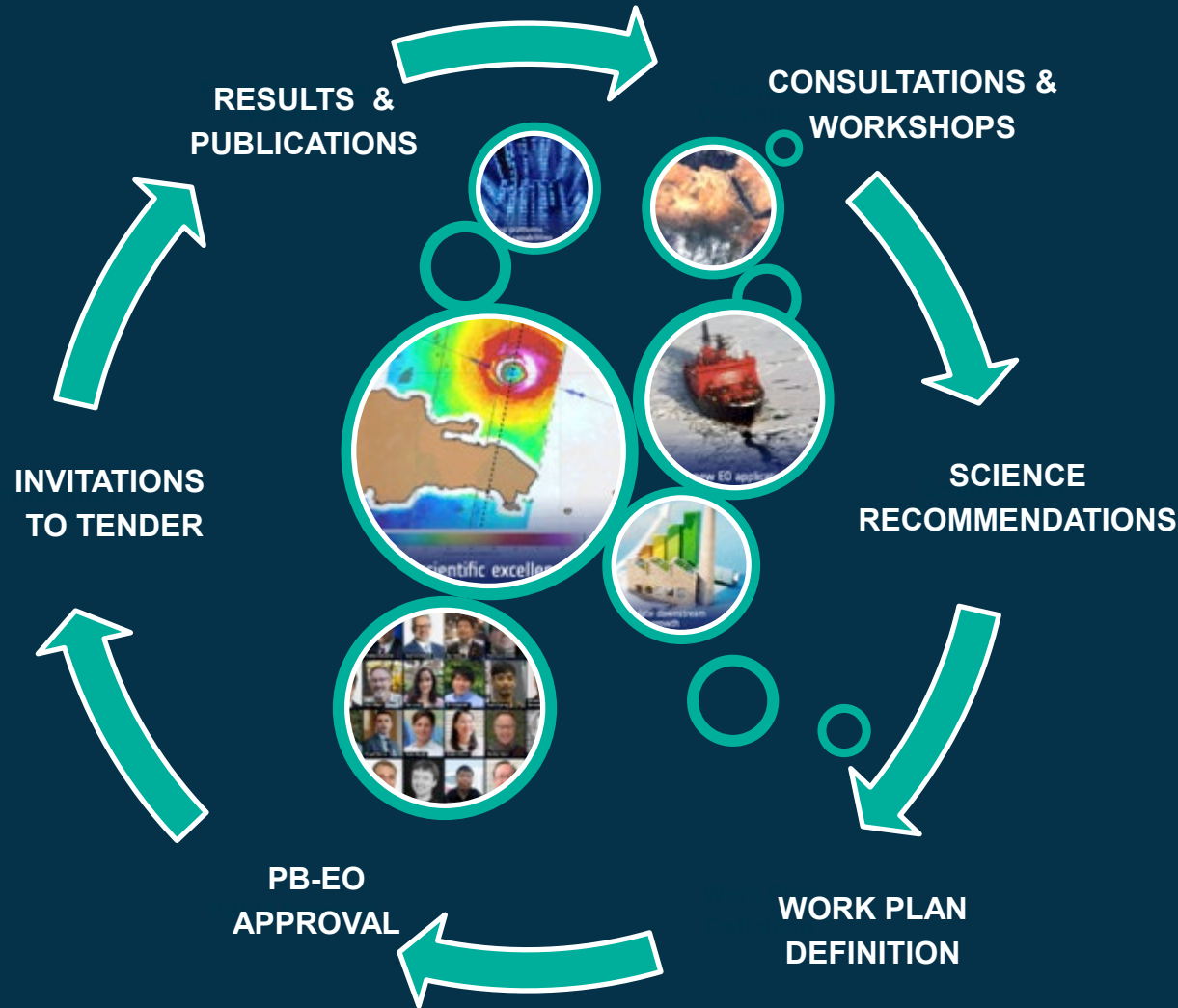
ESA Water Science Activities

Espen Volden, Jérôme Benveniste, Diego Fernandez

26 May 2022

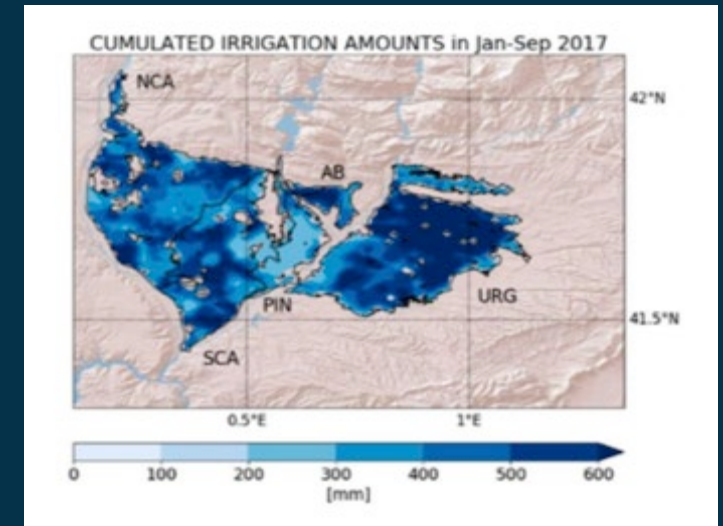
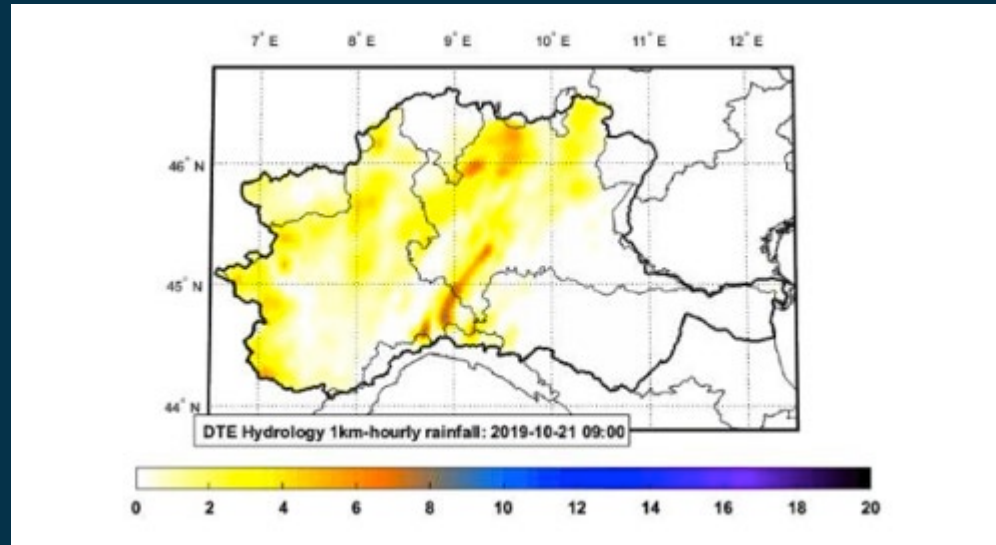
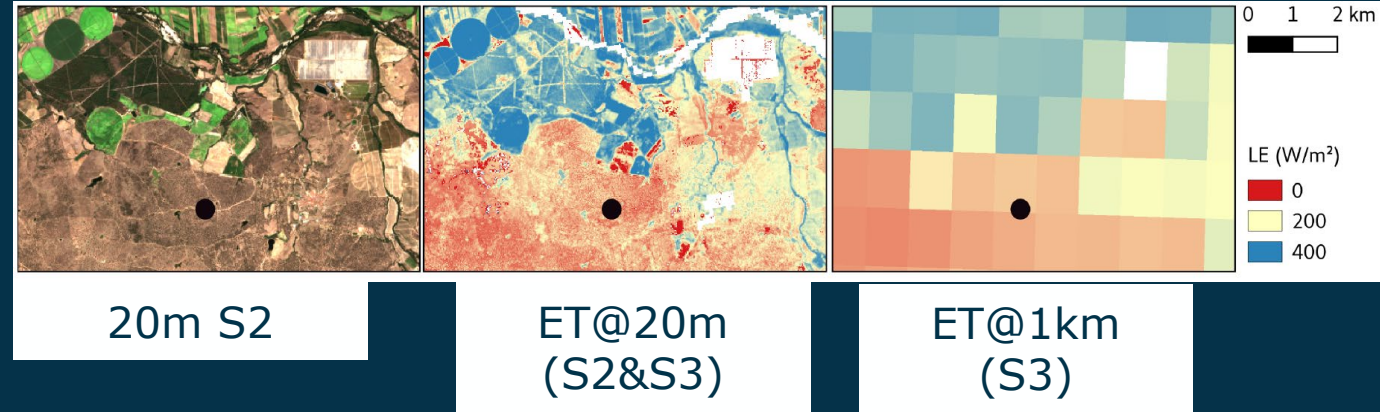
HOW WE WORK?

Interaction and animation of the user community



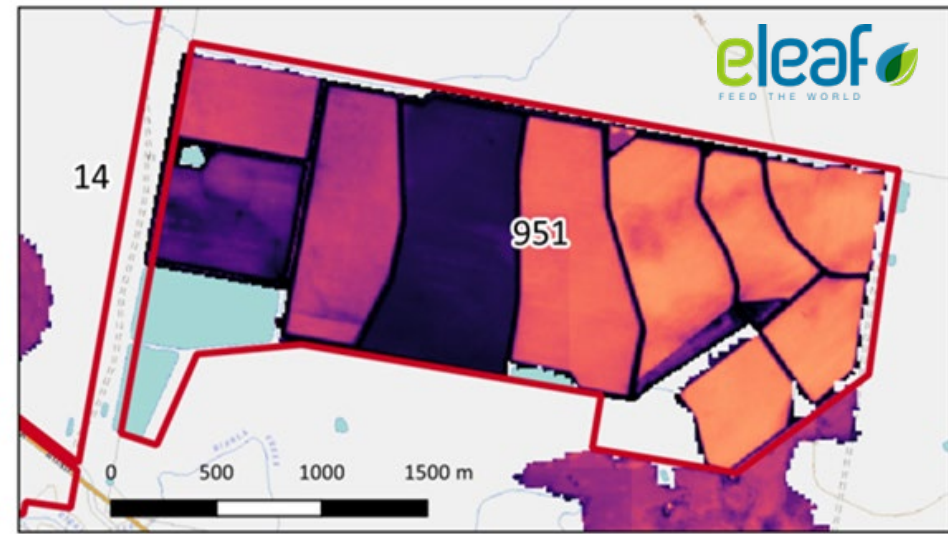
Development of new high-resolution products

- Evapotranspiration
- Soil moisture
- Precipitation
- Snow parameters
- Irrigation
- Runoff
- River discharge

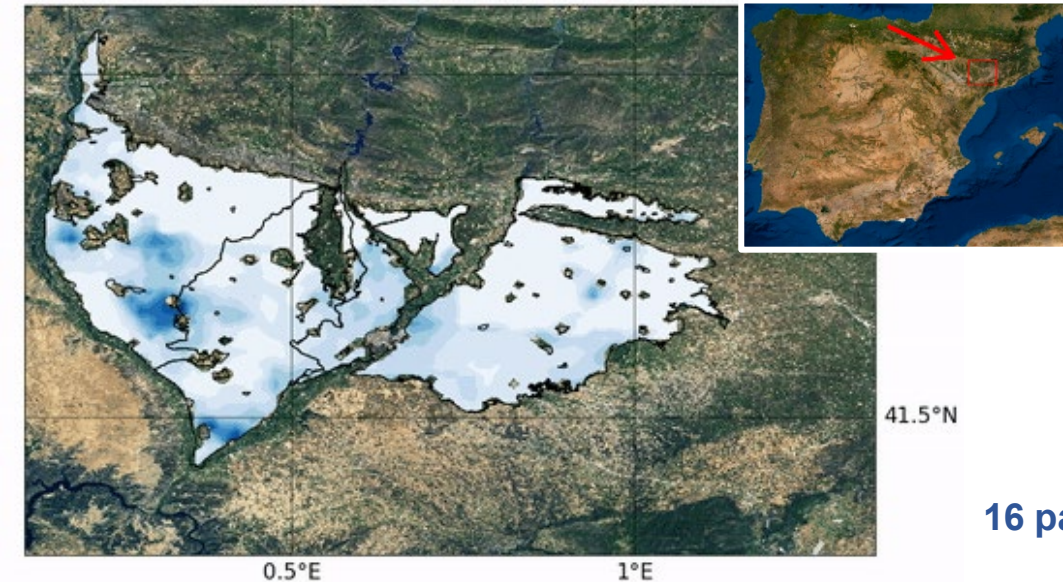


IRRIGATION+

The IRRIGATION+ ESA project aims to explore, develop and validate advanced EO-based algorithms and techniques for irrigation mapping, quantification and detection from field to regional/global scale

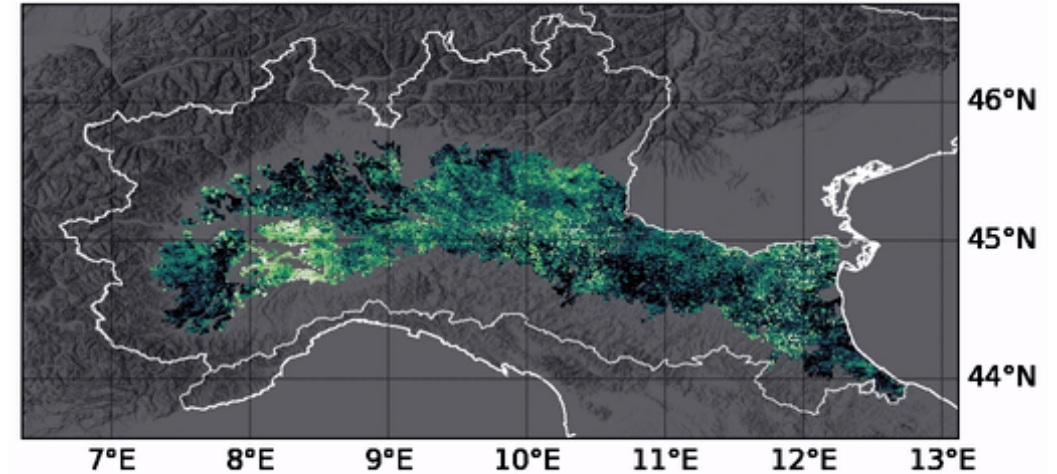


2011-01-16



16 papers published!

ESTIMATED IRRIGATION - SEASON 2016



Brocca et al. 2018 (JAG)
Dari et al. 2021 (JoH), 2022 (AWR)



Satellite based Runoff Evaluation and Mapping and River Discharge Estimation (STREAMRIDE)

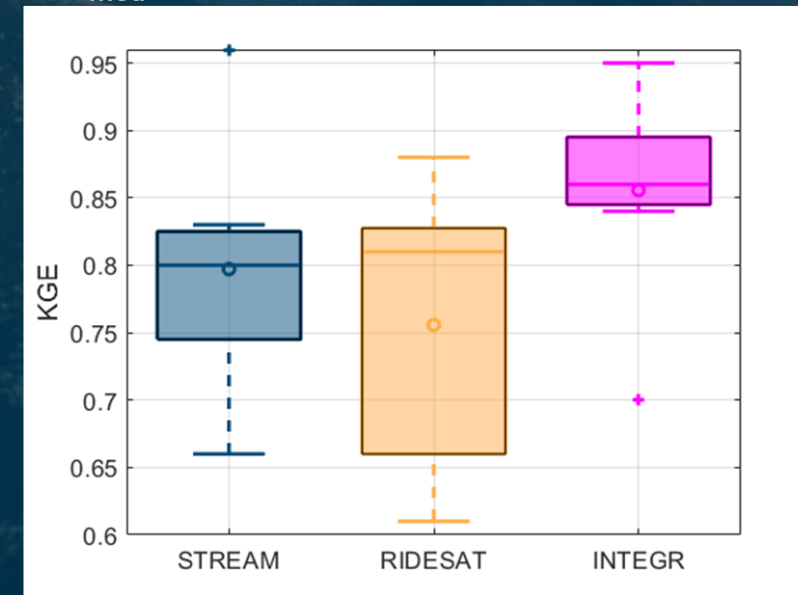
MAIN OBJECTIVES

- The **STREAM** model is a conceptual hydrological model that uses observations of precipitation, air temperature, soil moisture and terrestrial water storage anomalies to simulate continuous daily runoff and river discharge time series
- The **RIDESAT** algorithm is based on the jointly use of the water level from radar altimetry and reflectance index calculated from the images in NIR band
- The purpose of **STREAMRIDE** project is to improve the reliability of **STREAM** and **RIDESAT** approaches over specific case studies (e.g. mountainous basins, basins with high anthropogenic impact, basins with presence of morphological discontinuity along the river) where they individually fail to reproduce accurately the runoff and river discharge

MAIN RESULTS

- Successful estimation of river discharge through STREAM model and RIDESAT algorithm over critical areas identified in the Mississippi and Amazon river basins
- Enhancement of river discharge estimates through integration of STREAM and RIDESAT river discharge time series; the integration allowed to compensate for errors and missing data of their parent products, providing very accurate river discharge time series

KGE_{med} 0.80 0.81 0.86



MAIN OBJECTIVES

- Exploitation of the Synthetic Aperture (SAR) mode measurements of **CryoSat-2**, **Sentinel-3A** and **Sentinel-3B**, and Synthetic Aperture Interferometric (SARin) mode of CryoSat-2 in the coastal and inland water domains, along with optical and microwave imaging sensors, supporting the **UN Ocean Science Decade** and the **Sustainable Development Goal #6, Water**, and the societal benefit of a better understanding of **interaction processes between River Discharge and the Coastal Zone Sea Level**.

BACKGROUND

The junction between the coastal zone and inland waters is a boundary between

- Different science domains (hydrology and oceanography)
- Different satellite measurement regimes
- Region of high variability in small spatial and temporal scales

AIM

enhance understanding of

- Interactions at this boundary
- The small-scale processes that govern these interactions
- Exchanges with the ocean and the impact on regional sea-level changes

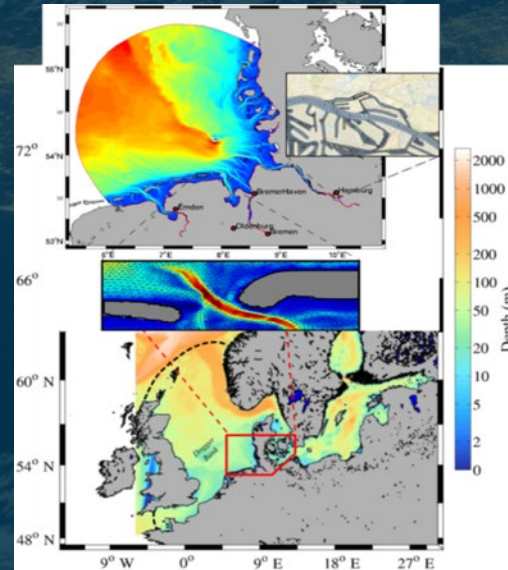


Image courtesy of U Bonn: German Coast of the North Sea and the Elbe Estuary

OUTPUTS

State of the art review paper on SAR Radar Altimetry.

Initial SAR / SARin satellite altimeter L2, L3 and L4 test data set over 18 Regions of Interest.

Descriptions of processing algorithms and products.

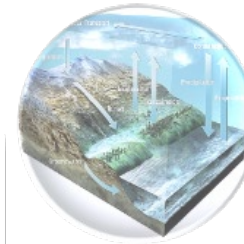
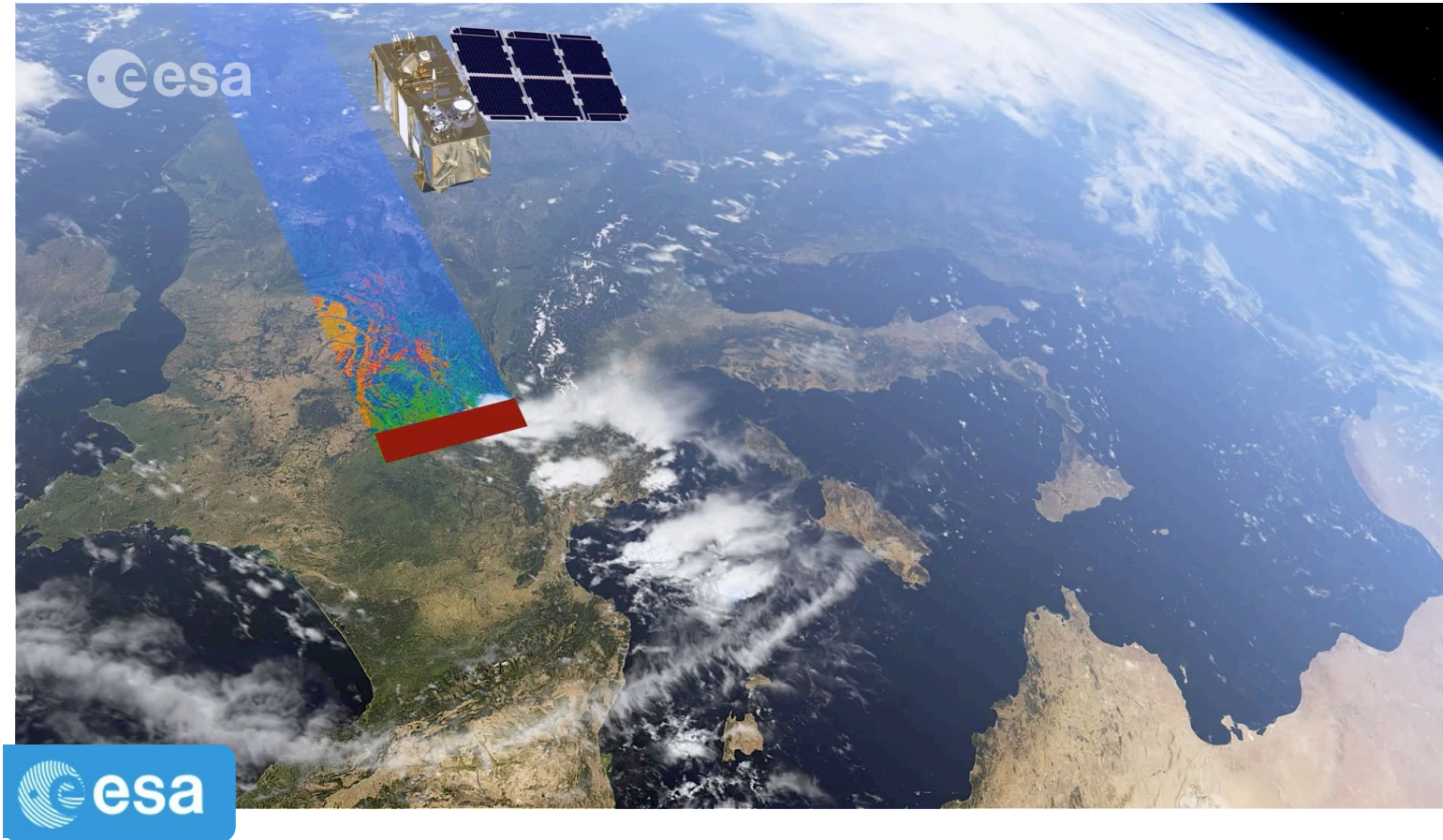
Global Products:

- Global L2 coastal & inland water SAR altimeter data set.
- Time series (L3) and river discharge (L4) data sets for medium to large rivers

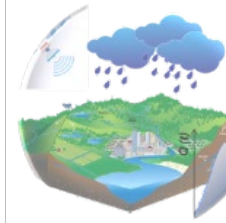
Scientific Road Map for further developments, implementations and research for SAR altimetry

<https://www.satoc.eu/projects/hydrocoastal>

4DMED-HYDROLOGY – monitoring the full Mediterranean terrestrial water cycle with High-Resolution Earth observation data



Water cycle reconstruction



Advancing Earth system Science



Solutions for society



Consiglio Nazionale delle Ricerche

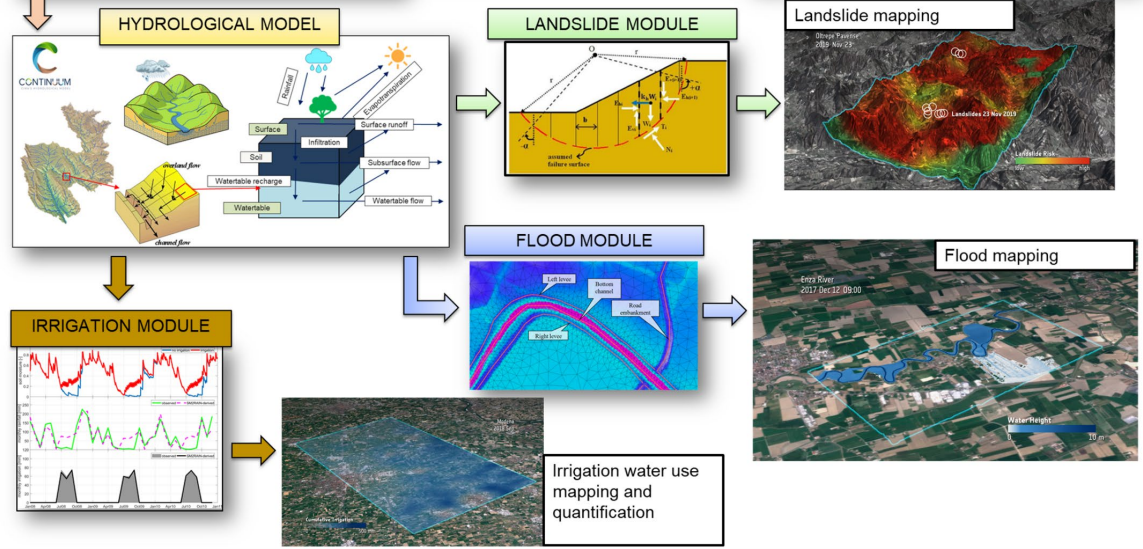
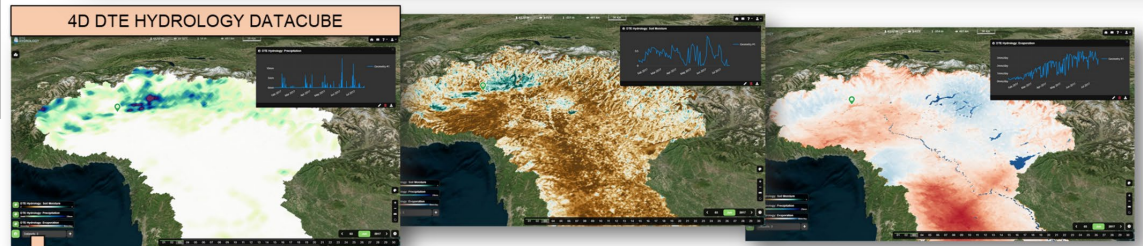
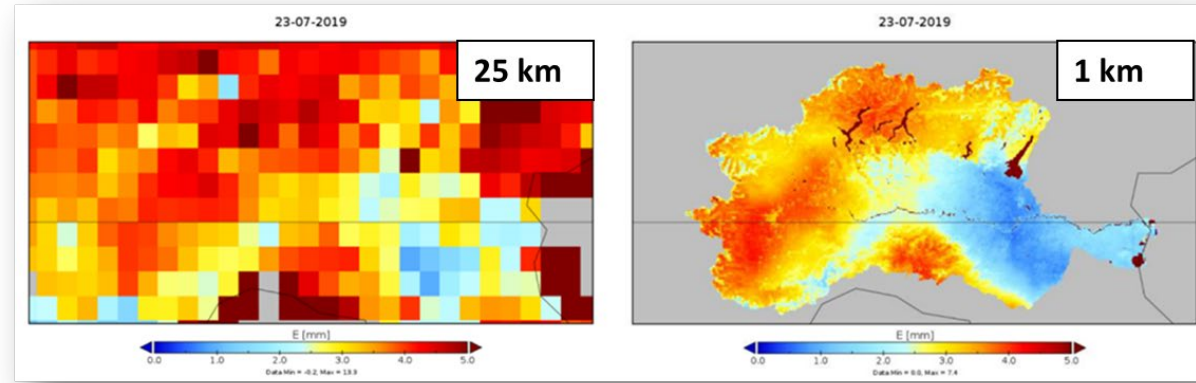
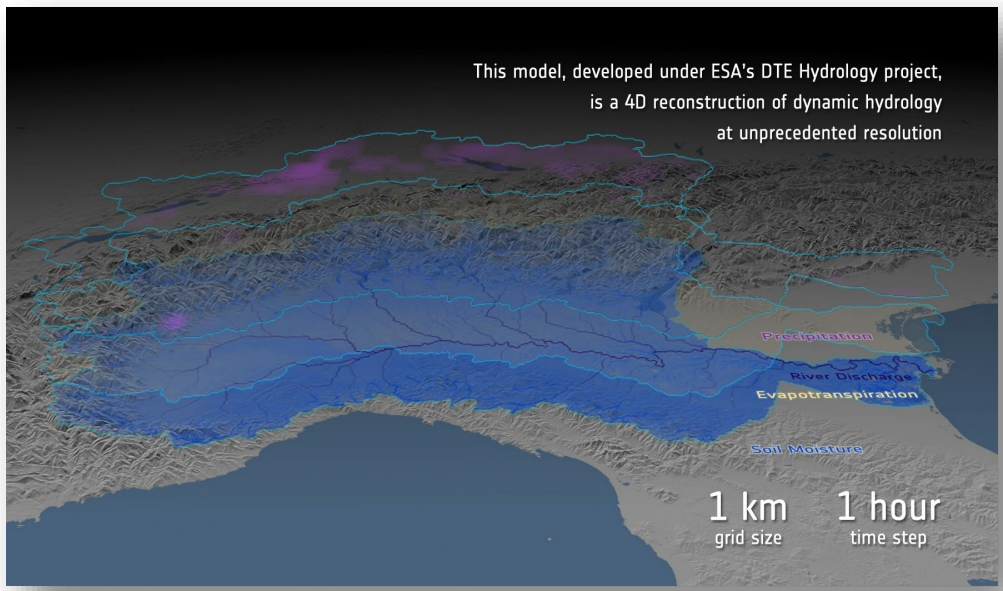
eurac research



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)

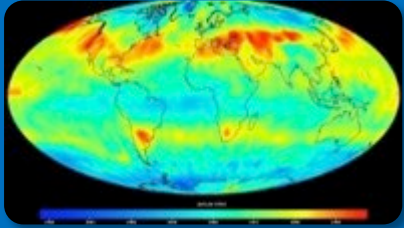
DTE HYDROLOGY

The DTE HYDROLOGY ESA project aims to develop 4D reconstruction of the water cycle at the decision making scale (1 km, 1 hour) with applications for extreme events prediction and water resources management



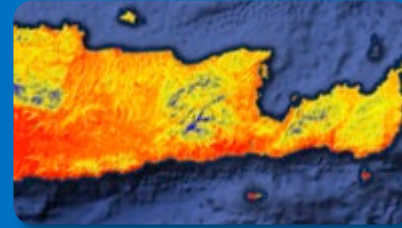
Copernicus: Sentinel Expansion Missions

CO2M - Anthropogenic CO₂ Monitoring



Causes of
Climate Change

LST – Land Surface Temperature Mission



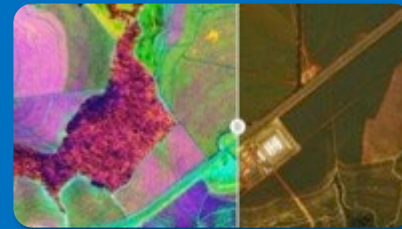
Agriculture & Urban
Management

CRISTAL – Polar Ice & Snow Topography



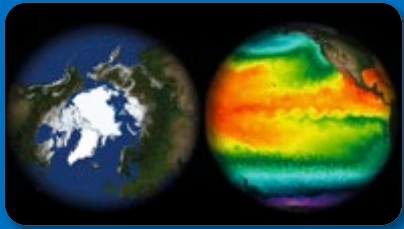
Effects of
Climate Change

CHIME – Hyperspectral Imaging Mission



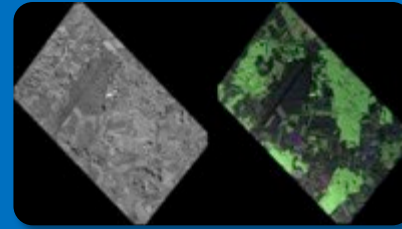
Food Security, Soil,
Minerals, Biodiversity

CIMR – Passive Microwave Radiometer



Sea: Surface Temp.
& Ice Concentration

ROSE-L – L-band SAR Mission



Vegetation & Ground
Motion & Moisture

1. ITT Hyper-resolution Hydrology June
2. Planning 2023-24 activities, including with DG RTD
3. Official launch of science cluster Q4
4. New ITTs from 2023 onwards
5. Visiting scientists in the Science Hub in ESRIIN