

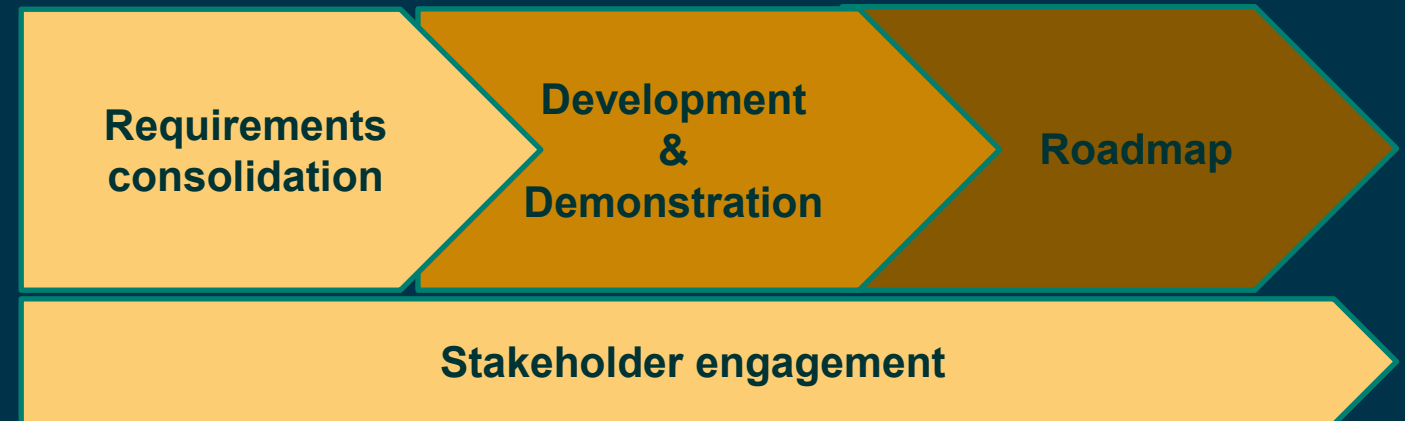
# ESA HPC Demonstrators

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After a wide consultation at the Phi week, DTE Precursors ITT was launched to foster a fast reaction in the community and bring together different expertise and emerging capabilities in ESA MSs to explore some of the main scientific and technical challenges to realise the Digital Twin Earth vision...

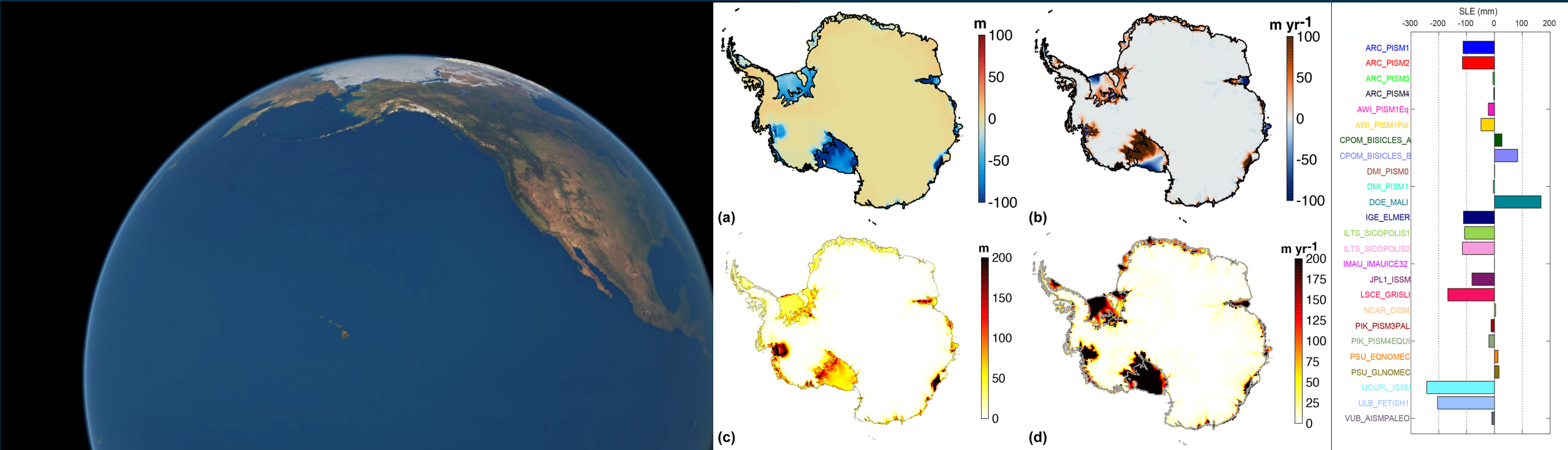
Based on an effective integration of advanced data, models, AI and computing capabilities, Digital Twins shall offer high precision digital replicas of the Earth system boosting our capacity to monitor the planet and simulate its potential evolution under different “what-if” scenarios serving a wide set of users...

- 6 Activities have been selected addressing different aspects of the Earth system and dedicated sectorial application domains;
- All activities aims at prototyping an “instance” of DTE that..:
  - may capitalise on the outputs from the initial DestinE DTs: e.g., dedicated additional user modules...
  - or establish the basis for potential future DTs: e.g., future DTs focused on specific aspects of the Earth system and/or application sectors.



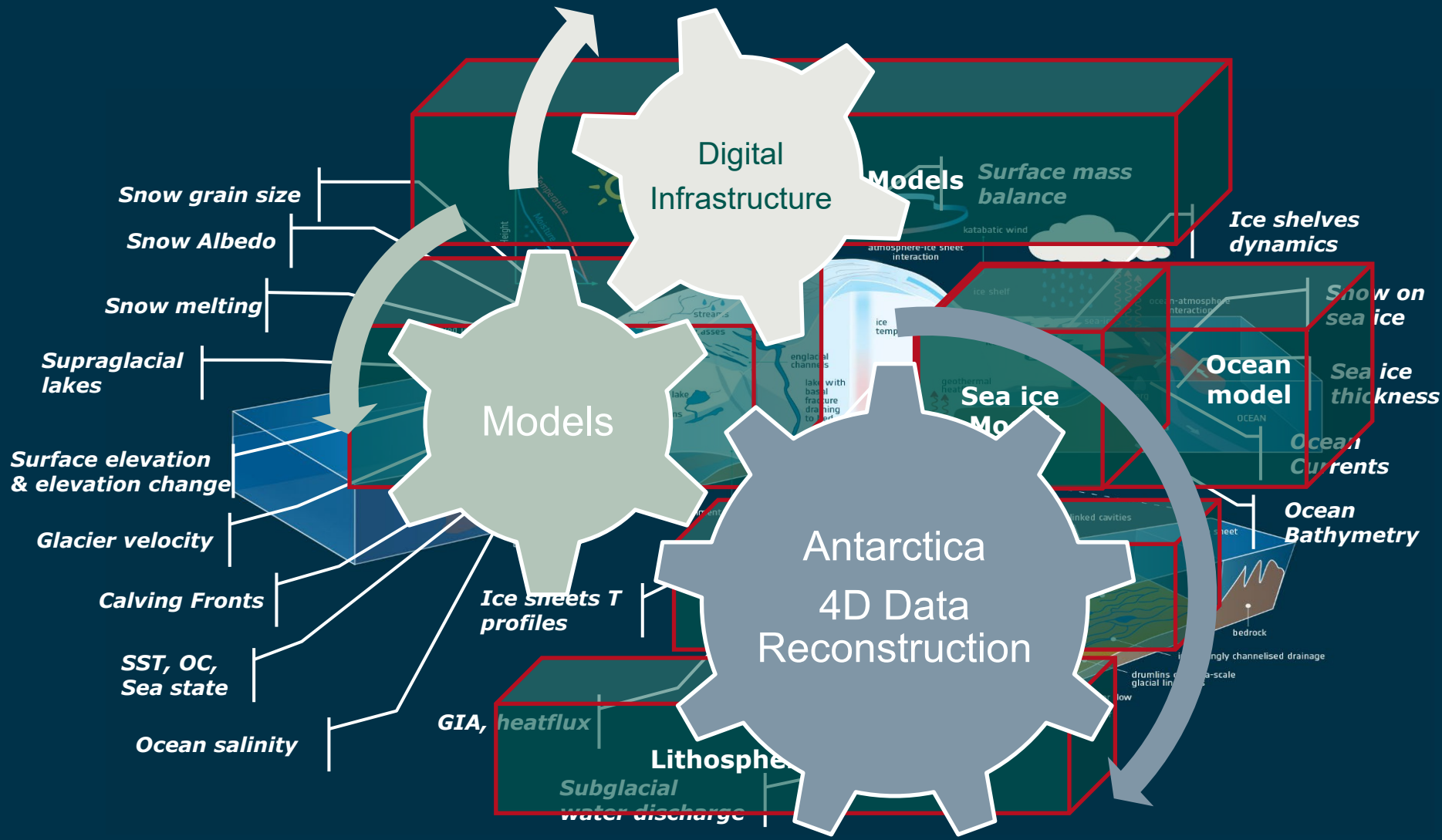
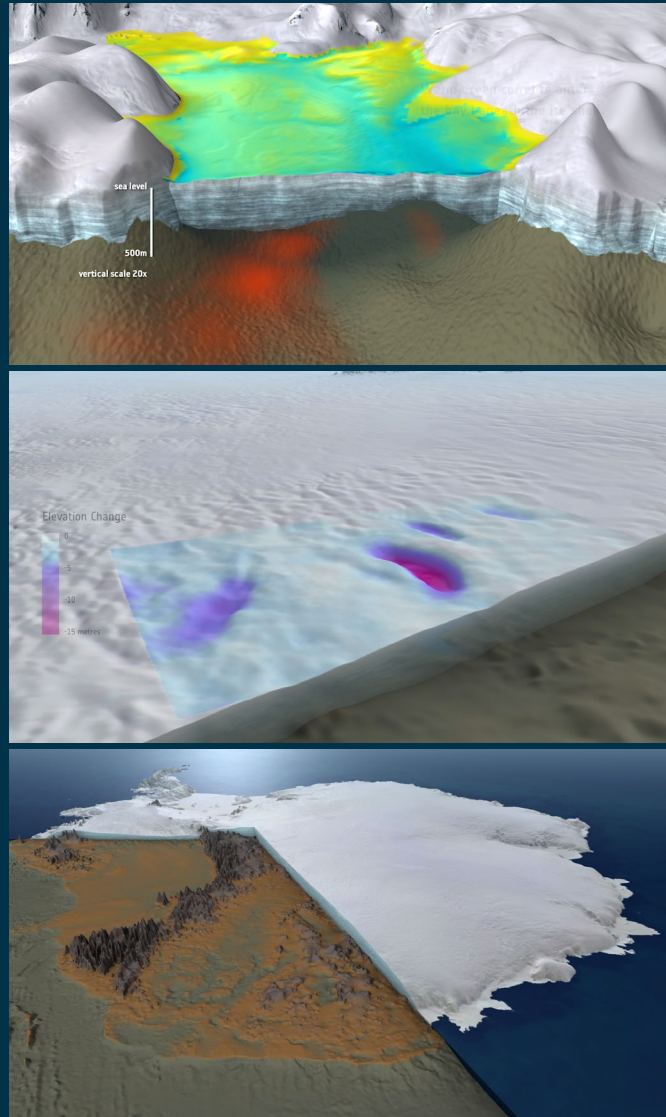
# An example: The case of Antarctica

- Antarctica is the major reservoir of freshwater in the world with a huge potential to contribute to SLR in the future...
- Current Ice sheets models present major differences: Standard deviations among models are greater than the signals. Strong variability particularly in most unstable areas (poor characterization of ice shelf–ocean interactions).
- DTE Antarctica aims at realize the best possible reconstruction of the Antarctic system bridging together the state of the art 4D dynamic data-driving reconstruction of the Antarctic system (from the lithosphere to the ice-sheet surface) together with models (regional climate, ocean, ice sheet, water routing) into a single Open science interactive “replica”...



Seroussi, 2019 & 2020

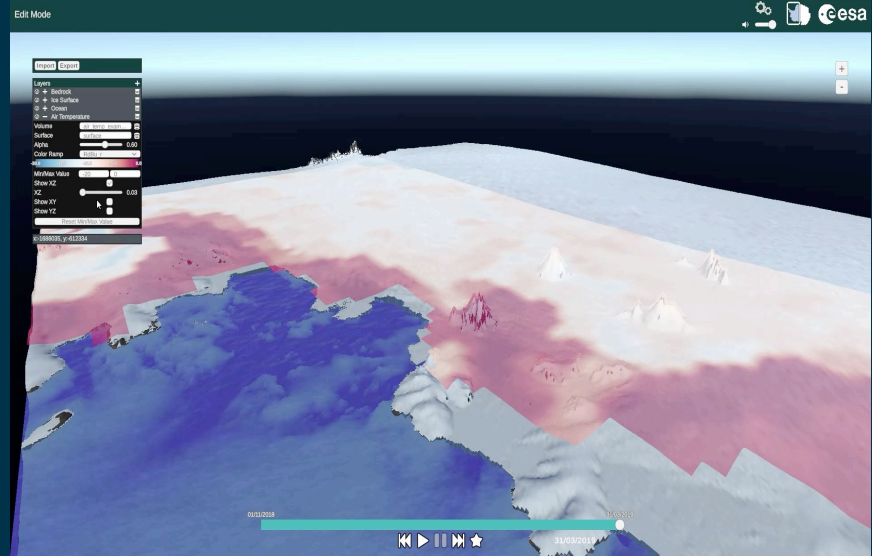
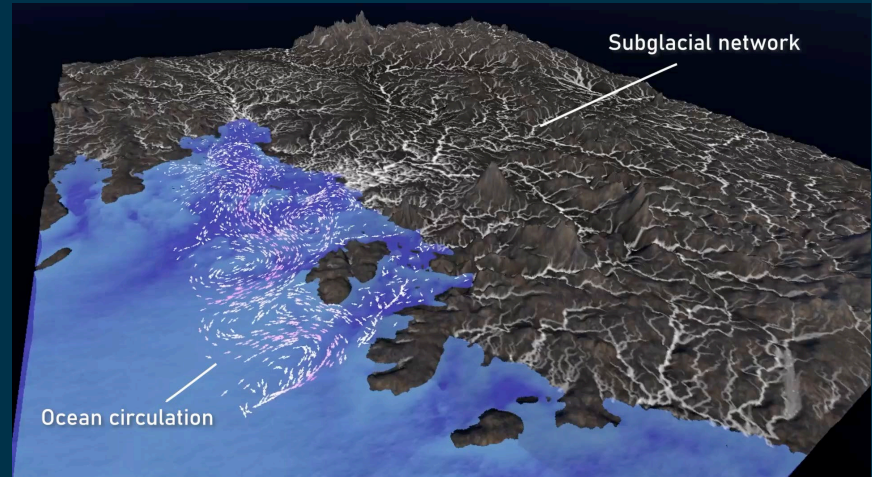
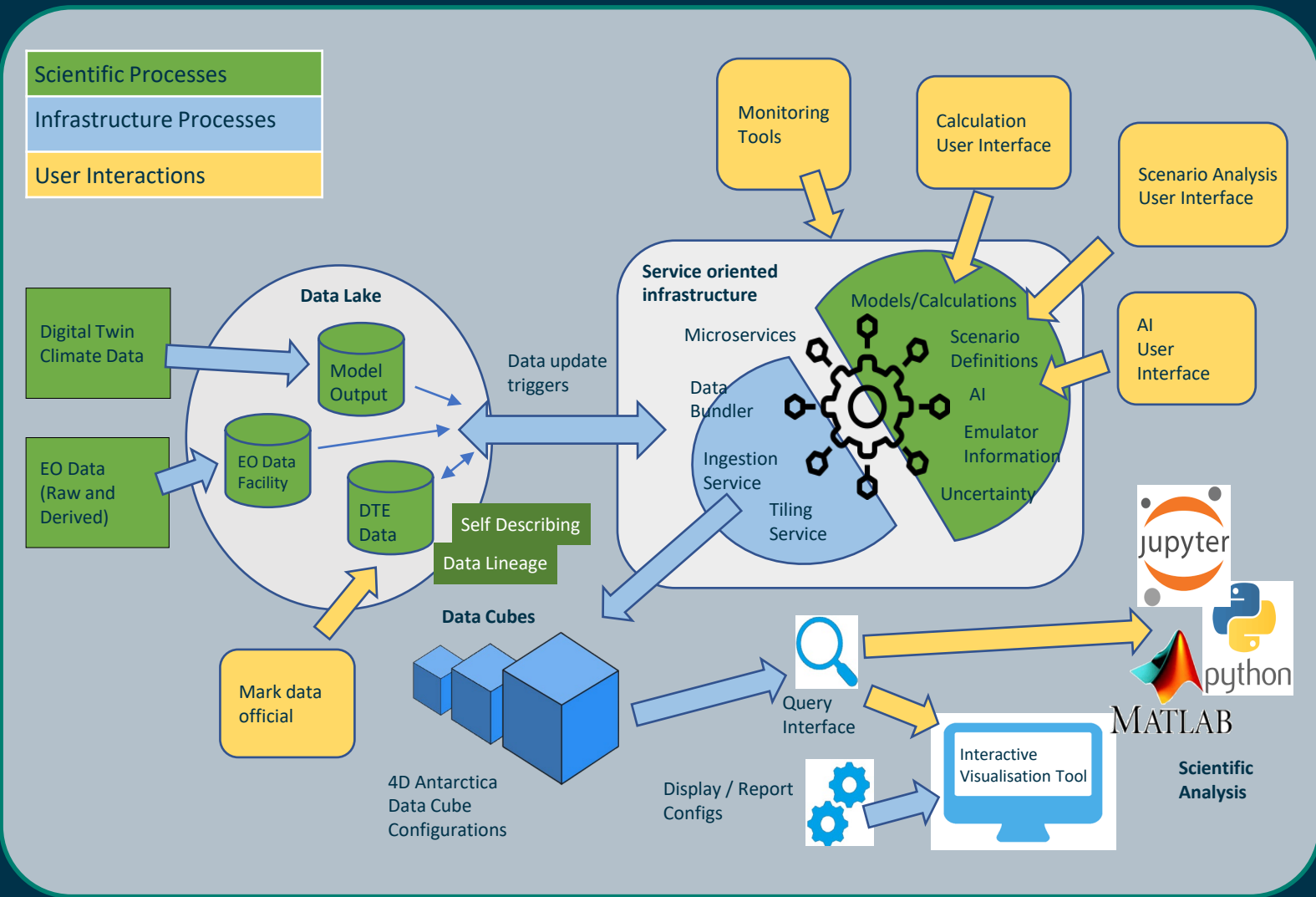
# An example: Digital Twin Antarctica



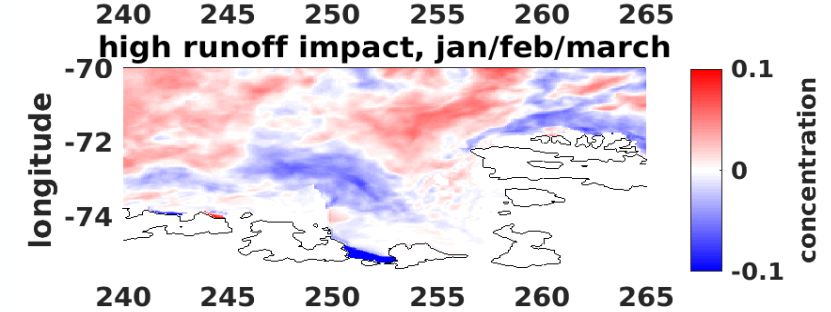
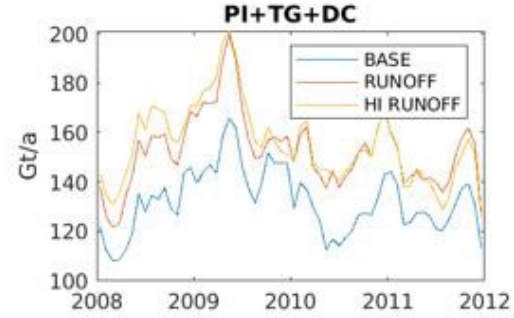
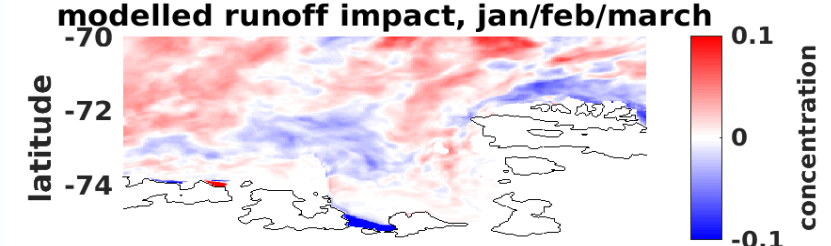
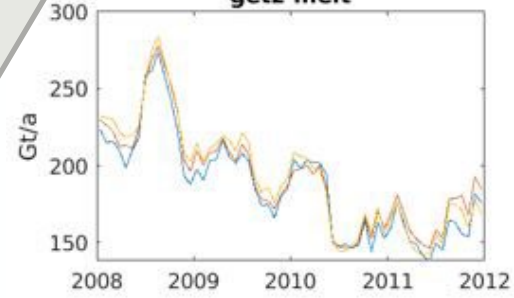
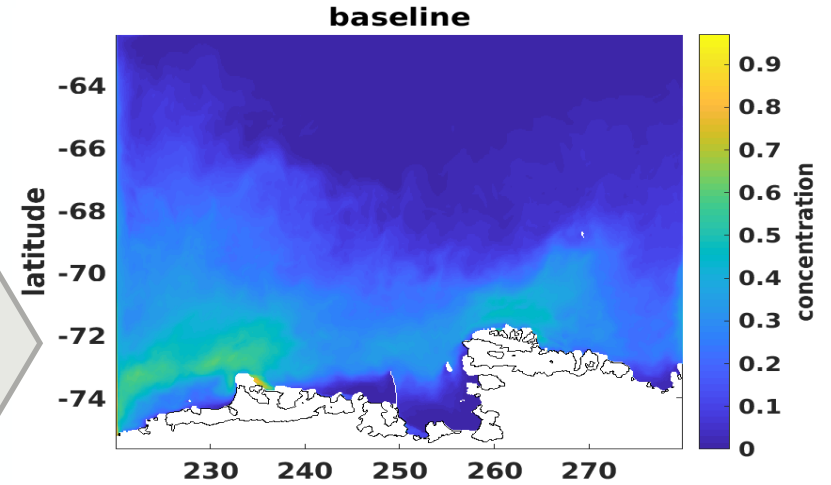
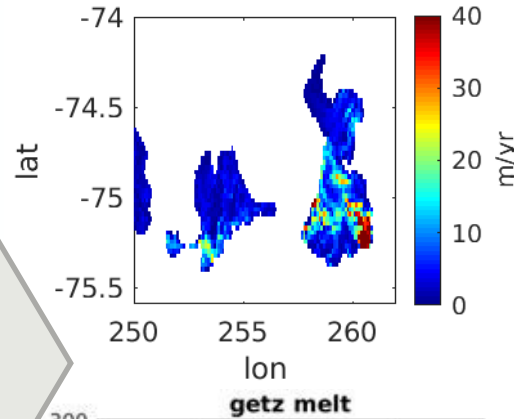
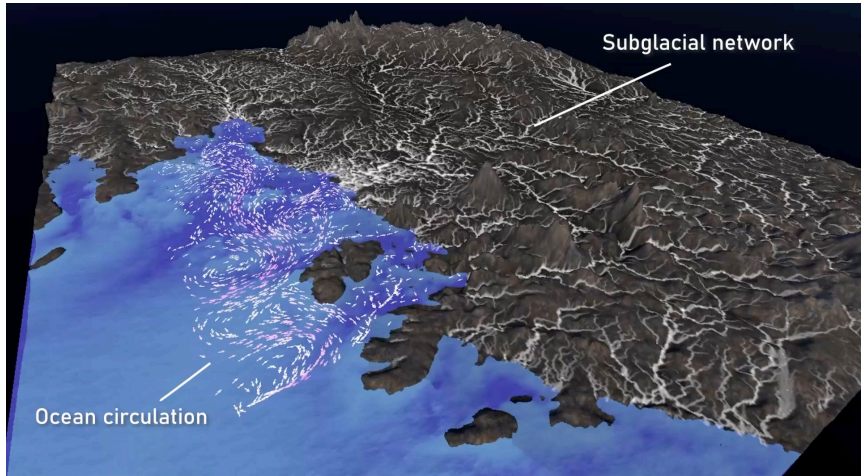
ESA UNCLASSIFIED – For Official Use



# An example: Digital Twin Antarctica



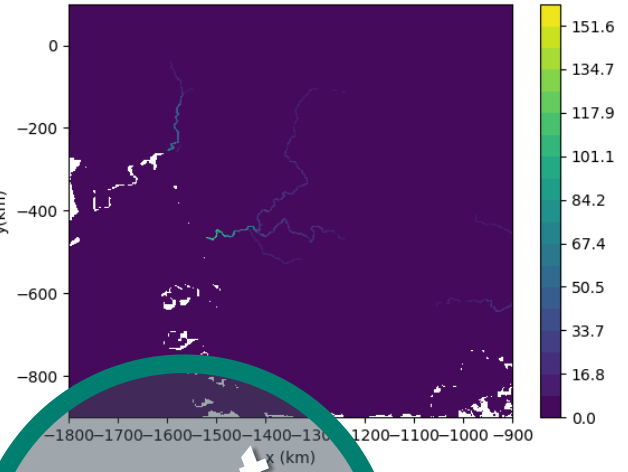
# Connecting dots: data, models, what if scenarios



**Assessment:** Subglacial flux (run-off) calculated from basal inversion of satellite based velocities and heat-flux

**What-if:** Doubled basal dissipation simulating a high run-off.

Time series of melt under major ice shelves



What if?

# DTE Hydrology

## Italy – Flash Floods and Landslides After 250mm of Rain in 12 Hours

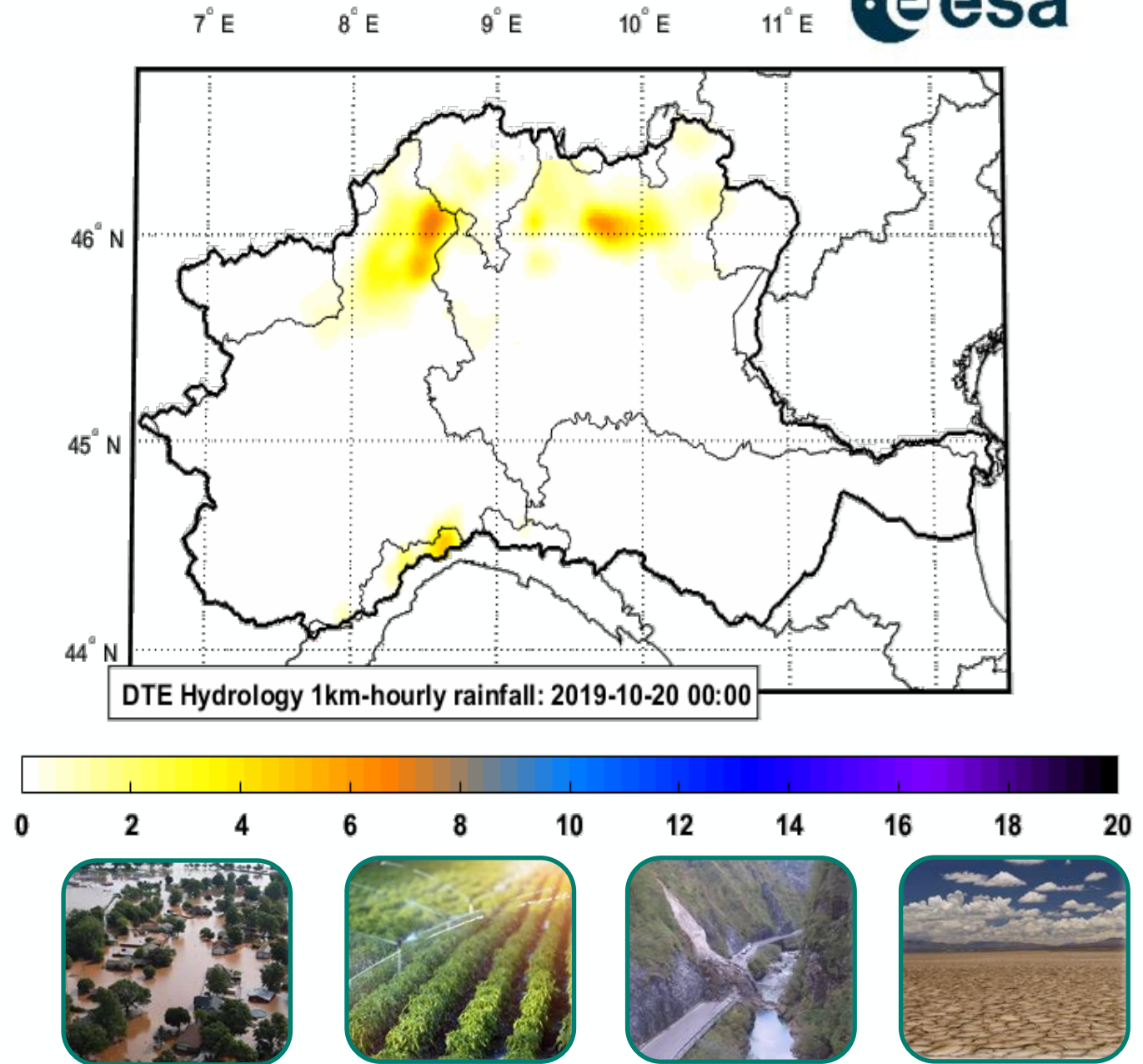
22 OCTOBER, 2019 BY FLOODLIST NEWS IN EUROPE, NEWS

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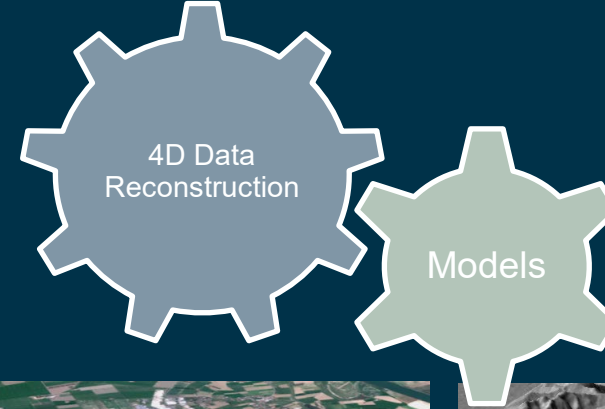
Heavy rain in northern Italy has caused floods and landslides in the regions of Lombardy, Piedmont and Liguria.



Heavy rain triggered landslides in northern Italy, 20 to 22 October 2019. Photo: Vigili del Fuoco



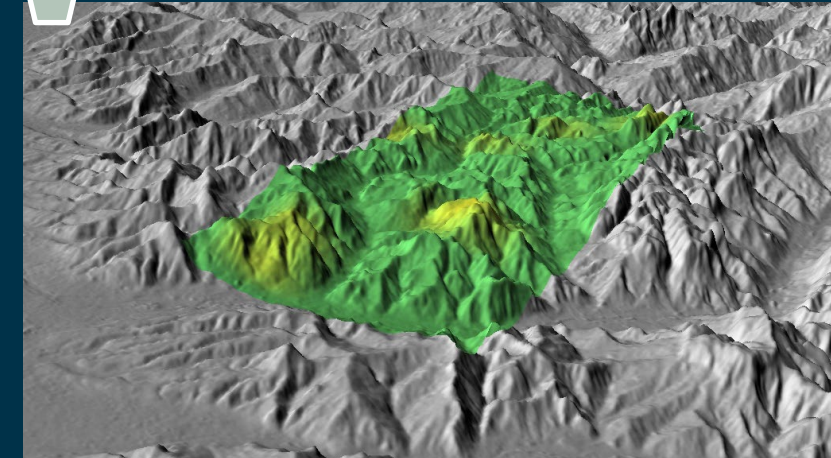
## PAST, PRESENT AND FUTURE



**Water management:** New 1Km Datasets and model results are used together for *water resources management at basin scales, drought risk and agriculture.*



**Flood Risk:** Modelled river discharge is used as input for *flood modelling* and hence for *flood risk*. Satellite river discharge (and flooded areas) are used for calibration and testing *flood modelling*.



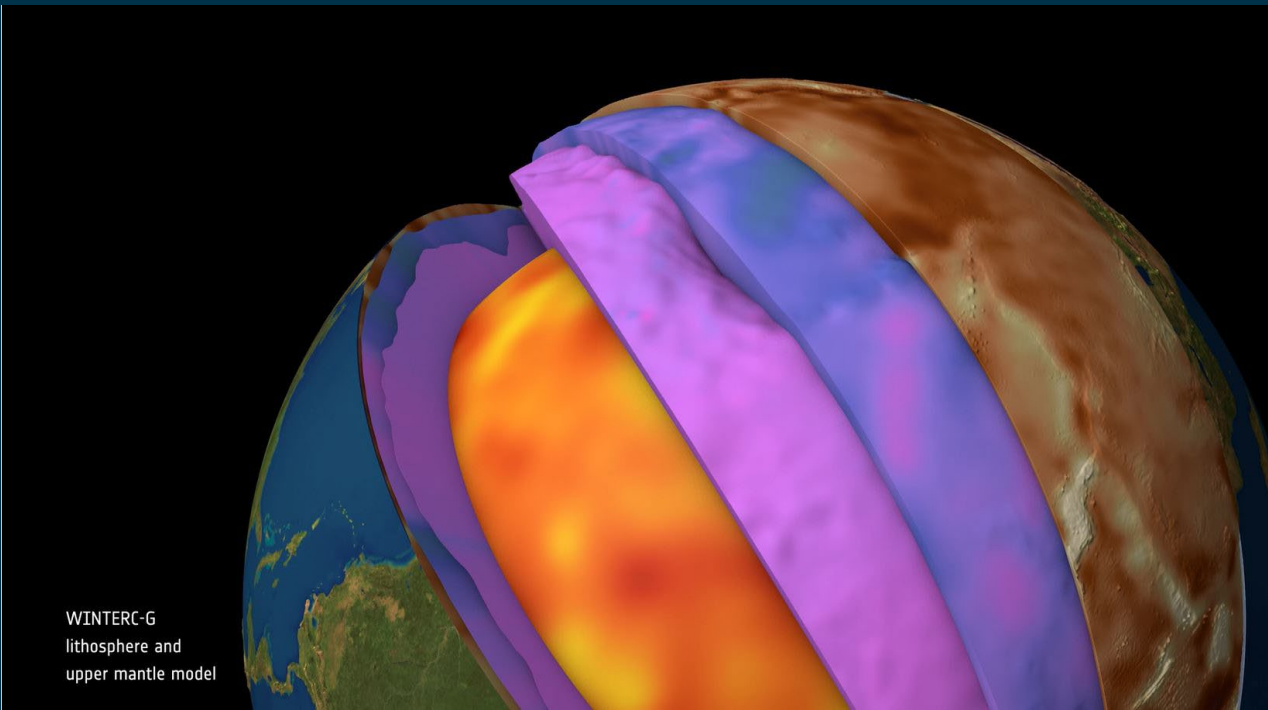
**Landslide risk:** Modelled soil moisture together with satellite soil moisture and precipitation are used for *landslide modelling* and hence *landslide risk*.

<https://www.youtube.com/watch?v=lke70Hnip5Q>

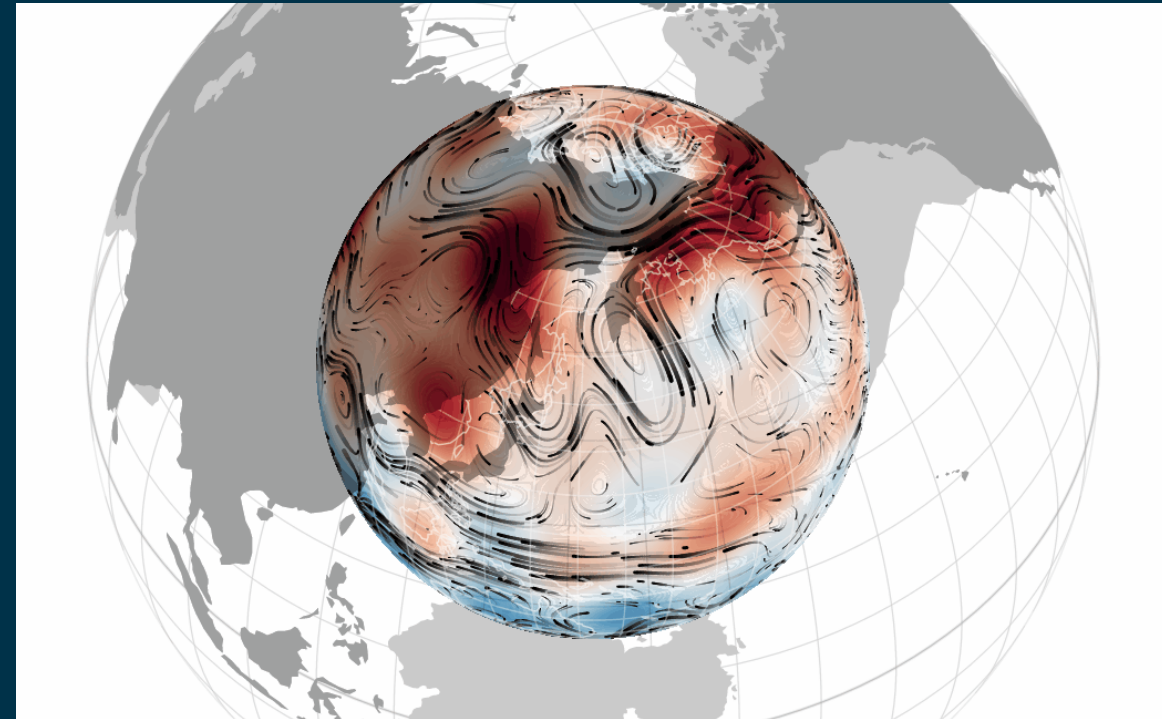
Video from Po basin authority on recent draught in Northern Italy. Data from IRPI (DTE Hydrology) used.



# Looking at the future.....



ESA 4DEarth activities represent also a precursor of a dynamic replica the solid Earth and, in the future, its connections with geo-hazards



4DEarth Deep-Earth connects the dynamic Earth core flow with the Earth geo-magnetic field and the ionosphere