A **M**ultidisciplinary **A**nalysis of **C**limate change indicators in the **M**editerranean **A**nd **P**olar regions

10th MONGOOS Workshop, 26-28 October 2021

The MACMAP Project an inter-disciplinary contribution to the study of the present changing climate

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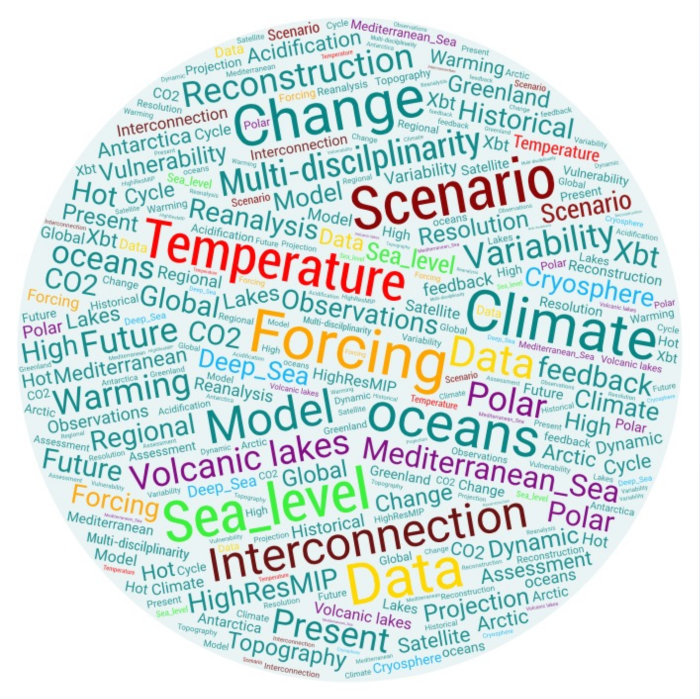
Thinking behind

INGV launched a **call for proposal for Strategic Projects** in late 2019 to fund a maximum of **1 Million Euros** for each of the three Departments (Earthquakes, Volcanos and Environment) The topic for **Environment was Climate Change**

Widely **comprehensive** project

Scientific **multidisciplinary** integration

Polar and **Mediterranean** regions



Main Objectives and Methods

Analysis and integration of **new data** from models and measurements

Analysis and integration of **existing data** from models and measurements

- **Clime evolution studies** in the **Mediterranean** and Polar regions to contribute to the comprehension of:
  - ✓ Climate change in the medium **past and future** time scales (1950-2100)
  - ✓ **Its effects** on the **interactions** amongst atmosphere, ocean, hydrosphere, cryosphere and solid earth
- **Support** the Earth System **monitoring infrastructures**
- Launch of **multidisciplinary** internal **collaborations**

New and more accurate **assessment** of the main **climate change indicators**

Historic information from a **qualitative** point of view

Themes of study

A highly **integrated approach** will allow the project to **contribute** to improve our **knowledge** on still debated open issues such as:

the **impact** of global warming on the **ocean circulation and acidification**

the **impact** of **atmospheric** forcing on the **cryosphere** which is strongly changing in response to global warming

the evolution of **sea level rise** from the recent past to the near future

how climate change affects the **deep ocean processes**

how climate change affects the **isotope composition** of meteoric water

the relation between the **ionized atmosphere** and **global warming**

Project Structure

WP 0 – Coord&Dissem

WP 1 – Data Management

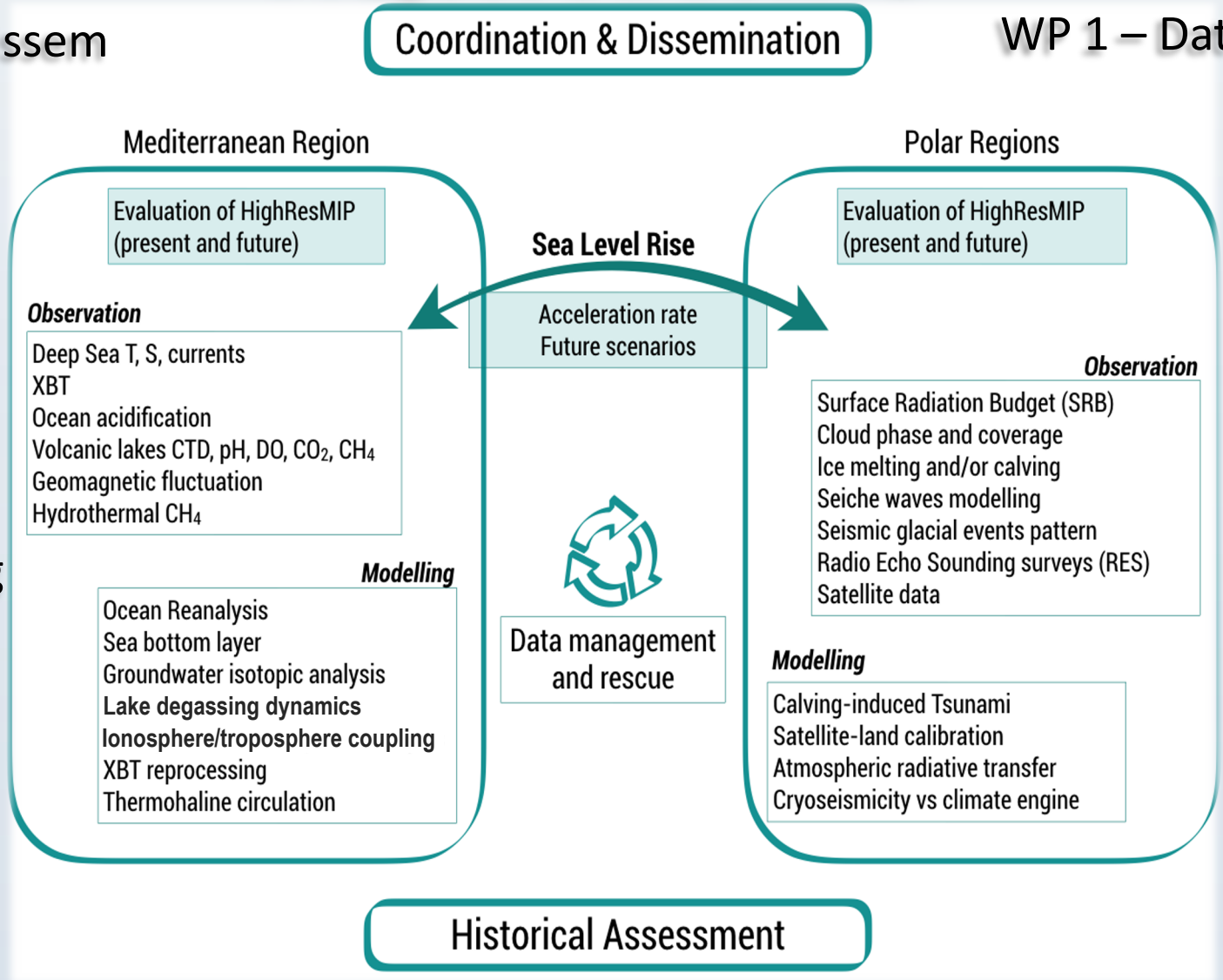
WP 2 – Sea Level

WP 3 – Observations

WP 4 – Modelling

WP 5 – Ice Studies

WP 6 – Hystorical studies

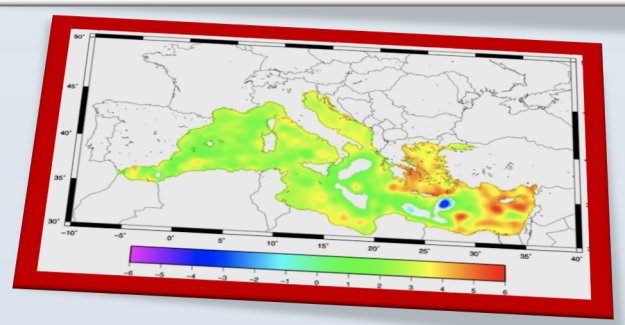


WP 2 – Quantitative sea-level change study

Study of sea level variations from altimetry to understand more accurately the **current rates and accelerations** of global and regional rise and to formulate **realistic scenarios of SSH at 2100,** including modeling considerations related to phenomena of Glacio-Isostatic Adjustment

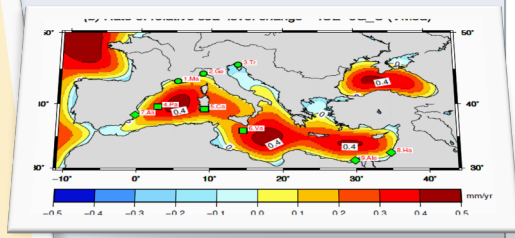
Task 2.1- Analysis of Altimetry data

- SL data analysis to determine updated **evolution rates and acceleration of SLR at regional scale**;
- Identify the **RCP mostly representative** of the actual SLR;



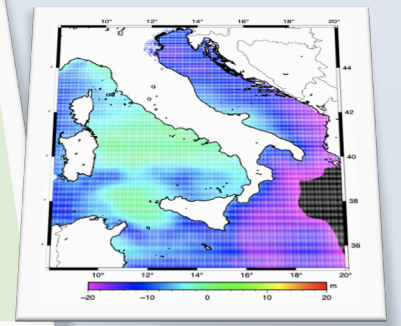
Task 2.2 – GIA Models

- Development and improvement of **GIA models** and **error quantification**;
- **Mini-ensemble approach for probabilistic** considerations;



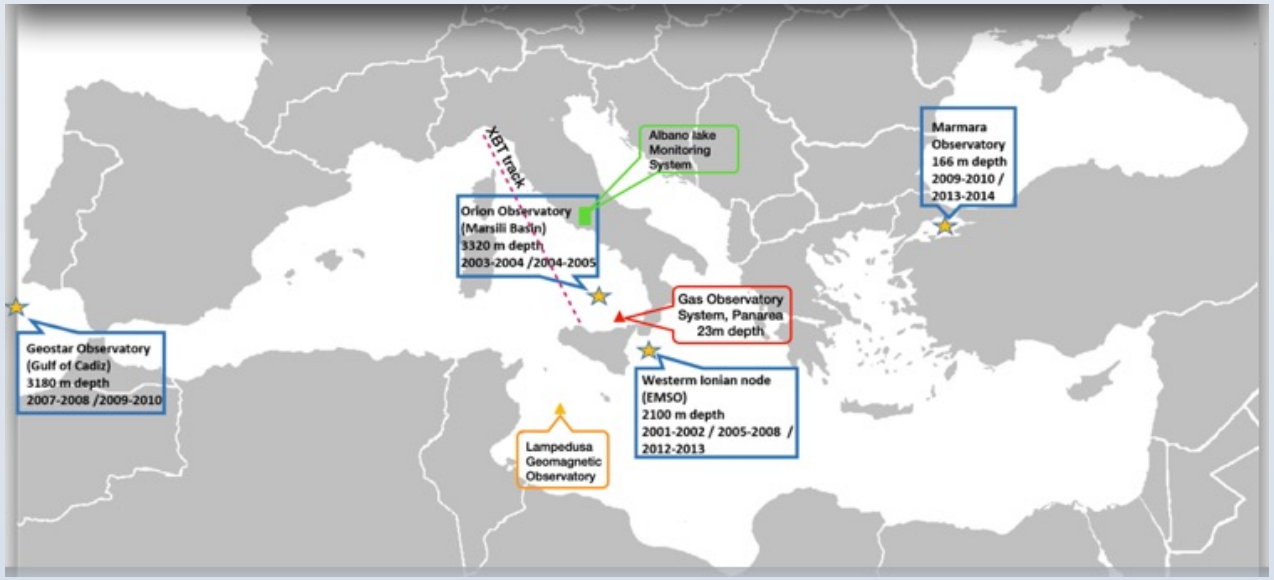
Task 2.3 - Geodetic Models

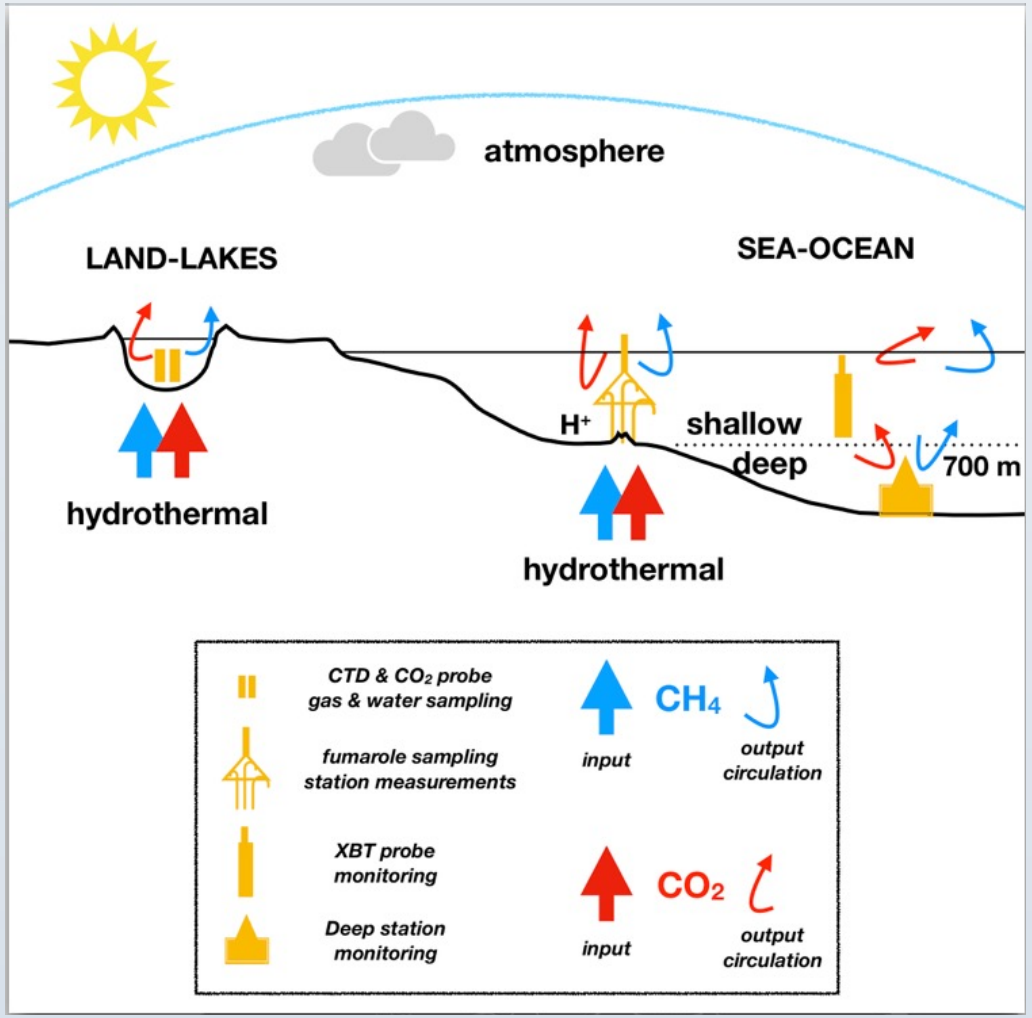
- Assessment of the geoid ondulations based on high res **DTMs;**
- **Estimate of a new MDT for the italian seas** with high resolution models for the bottom and data from GRACE and GOCE missions



WP3- Mediterranean regional observational studies

Study of the mechanisms influencing the **Mediterranean climatic variability** through the **monitoring** of **different essential parameters** such as T, S, pH, CO_2, CH_4, and geomagnetic components, in different marine and lake sites

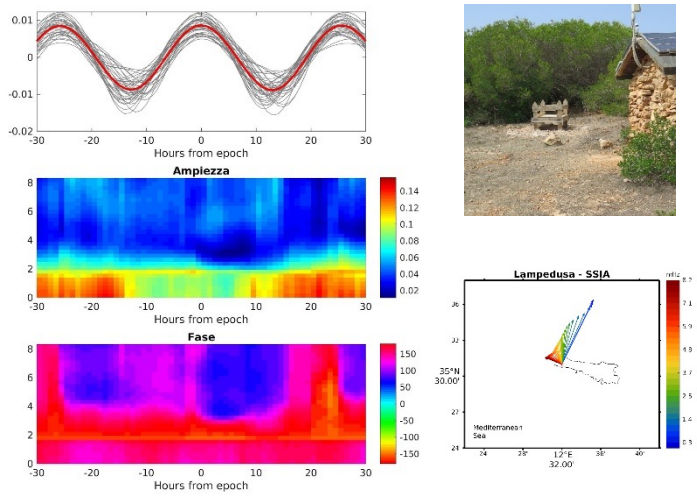




WP3- Mediterranean regional observational studies

TASK 3.1	TASK 3.2	TASK 3.3	TASK 3.4	TASK 3.5
				
Impact of deep ocean processes on Mediterranean circulation and climate variability	Long-term monitoring and assessment of the Tyrrhenian and Ligurian Sea	Mediterranean Sea acidification (Hydrothermal system of Panarea)	CO2 liberation at Lago Albano and Lago Nemi (Overturning processes)	Analysis of coastal geomagnetic observation to reconstruct sea level

WP 3 – Mediterranean regional observational studies

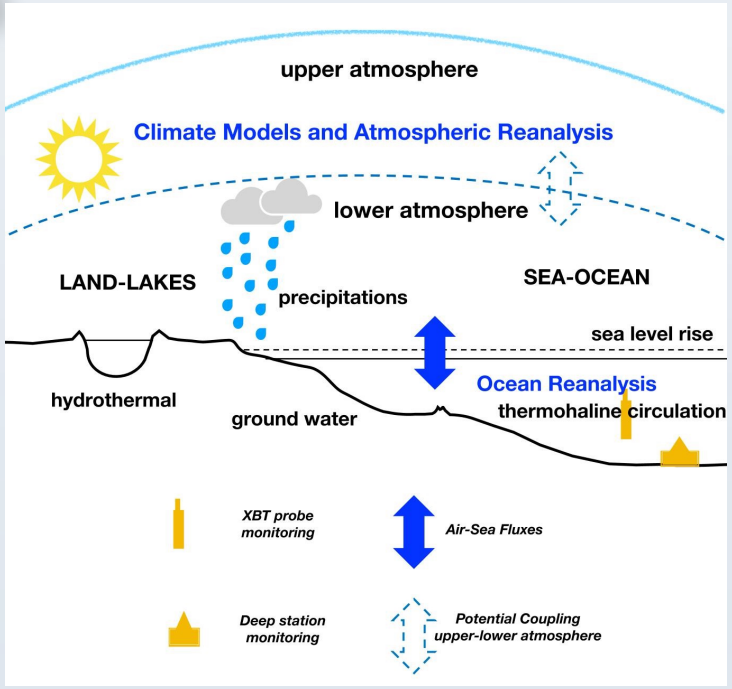


Identification of a correlation between the **anomaly** of the **geomagnetic** field and the **evolution of the sea level**

WP4- Mediterranean region climate evaluation: models and reanalysis

Study of the **average climate of the Mediterranean region** and its variability through the analysis of data from **climate models** and **reanalysis** of the **atmosphere** and **ocean** for the **period 1950-2050**. The integration with climate modeling will allow additional studies on:

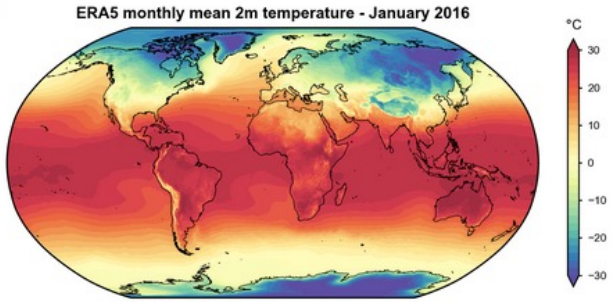
- the coupling processes between low and high atmosphere;
- the evolution of dynamics linked to degassing in lake areas;
- of the variation of the isotopic composition of rainwater

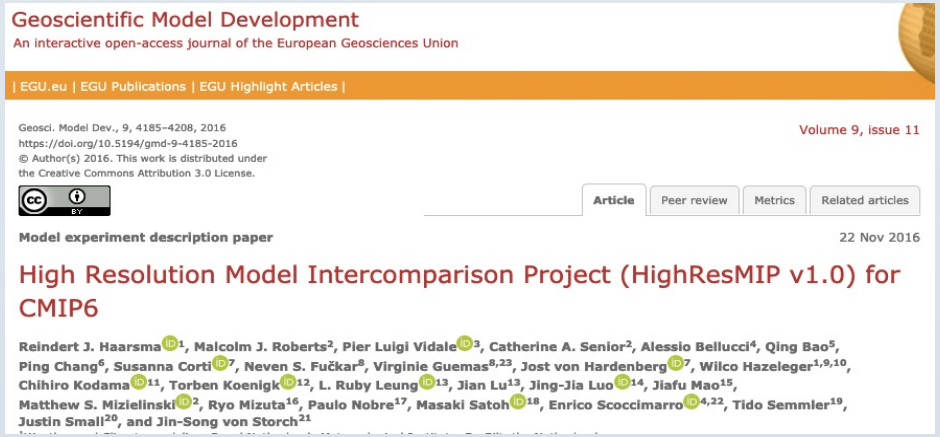


ERA5

ERA5 is the latest climate reanalysis produced by ECMWF, providing hourly data on many atmospheric, land-surface and sea-state parameters together with estimates of uncertainty.

ERA5 data are available in the Climate Data Store on regular latitude-longitude grids at 0.25° x 0.25° resolution, with atmospheric parameters on 37 pressure levels.

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Geosci. Model Dev., 9, 4185–4208, 2016
https://doi.org/10.5194/gmd-9-4185-2016
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Model experiment description paper

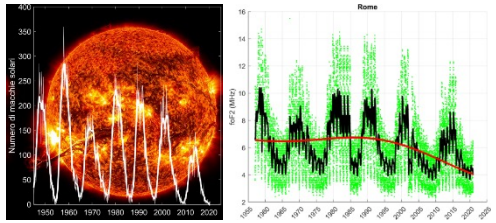
22 Nov 2016

High Resolution Model Intercomparison Project (HighResMIP v1.0) for CMIP6

Reindert J. Haarsma[1], Malcolm J. Roberts[2], Pier Luigi Vidale[3], Catherine A. Senior[2], Alessio Bellucci[4], Qing Bao[5], Ping Chang[6], Susanna Corti[7], Neven S. Fučkar[8], Virginie Guemas[8,23], Jost von Hardenberg[7], Wilco Hazeleger[1,9,10], Chihiro Kodama[11], Torben Koenigk[12], L. Ruby Leung[13], Jian Lu[13], Jing-Jia Luo[14], Jiafu Mao[15], Matthew S. Mizielinski[2], Ryo Mizuta[16], Paulo Nobre[17], Masaki Satoh[18], Enrico Scoccimarro[4,22], Tido Semmler[19], Justin Small[20], and Jin-Song von Storch[21]

T4.1 climate models atm reanalysis

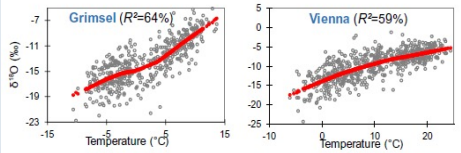
T4.2 coupling upper/lower atm



analysis of **tropospheric variables** (temp. and atmo. composition) to study **potential correlations** of the **ionized atmosphere and climate change**

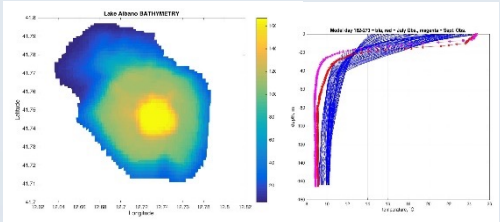
T4.3 ground water composition

Vystavna et al. 2021



study of **atmospheric properties** to assess the evolution (past and future) of the isotopic composition of rainwater (**effects on groundwater recharge**)

T4.4 lake dynamics



- **Lake dynamics** evolution related to **degassing** phenomena
- **Future scenario** projections to assess the hazard linked to **lake overturning**

T4.5 ocean reanalysis

T4.6 assessment and CC indicators

- new reanalysis **of the Mediterranean Sea** forced by the best realistic atmospheric and climatic reanalysis (T4.1) to cover the period 1950-2050
- **Production** of the main **OMI**

WP6 - Climate change from historical data and information

Since 2008 INGV curates the conservation and valorization of **214 volumes** of historical oceanography, **dated between 1494 and 1799**

Histoire physique de la mer
L.F. Marsili, (1725)

Mundus subterraneus, Kirker, (1665)

- Outline a picture of **the perception of climate change** in the past centuries (focusing the 17˚-18th centuries);
- Find new **data useful** for the scientific community to be the **basis for future studies** and analysis;
- Collect information through the **interpretation of scientific data, images and tables**;
- **validate them and make them digitally available** to be used in order to research, modeling and scientific dissemination;
- After a biblio survey the sea level in the Mediterranean seemed the most appropriate issue: **Histoire physique de la mer** (**Marsil,** 1725) ⟶ **bathymetric data**, **coastal profiles**, **marine physical parameters**

WP 1 – Data Management

Objective

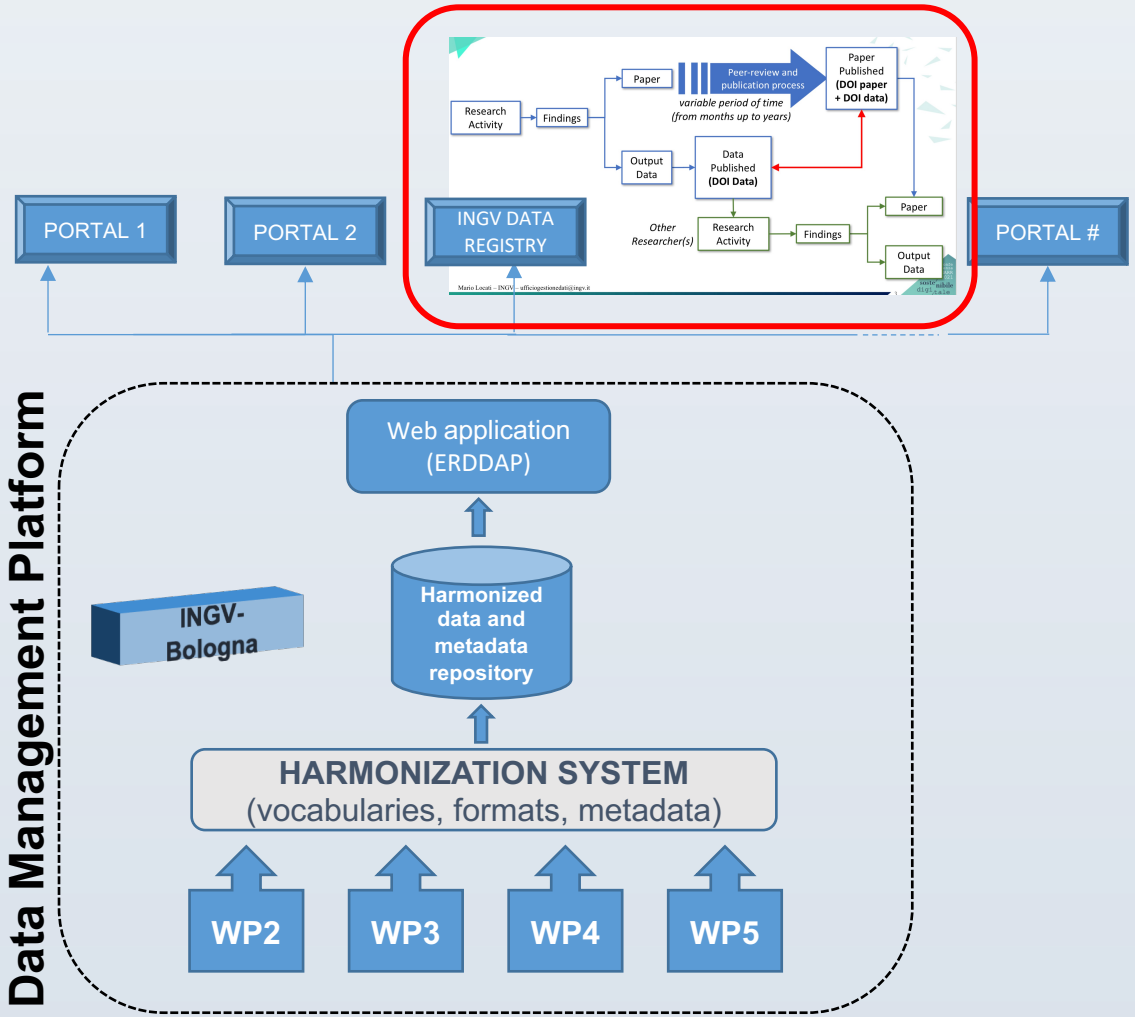
*«… WP1 will ensure that data from different WPs will be made **available**, in a **readily usable** format, with sufficient **information** attached in the form of **metadata** in primis within the project and in future to the wider science community and stakeholders in climate change and more broadly environment fields»*

DATA MANAGEMENT

Protocols and standards

FAIR principles

Open Access



MACMAP
https://progetti.ingv.it/it/progetti-dipartimentali/ambiente/macmap

Landing Page

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