Impacts of the straits on the hydrodynamic circulation and sedimentology of the Corinth Gulf

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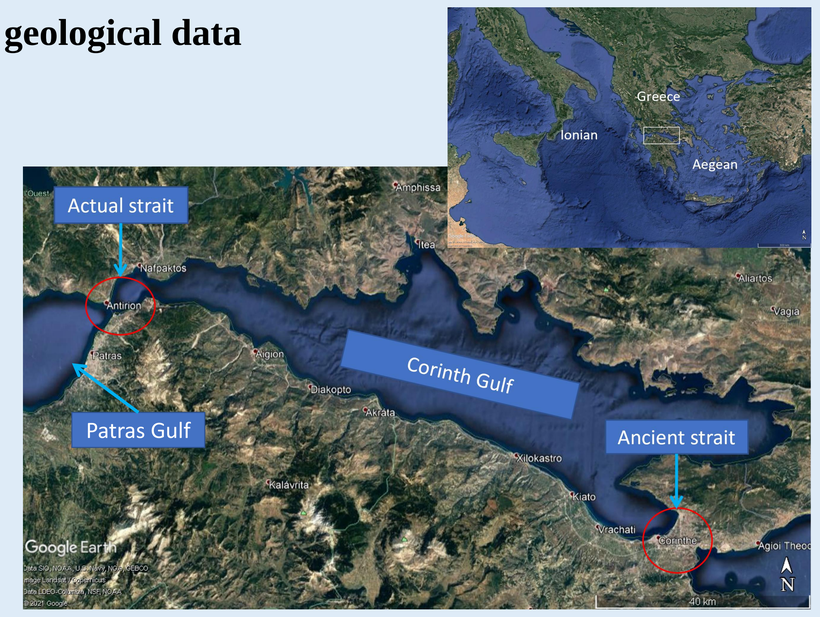
Introduction & Settings: A lack of marine data in the Gulf of Corinth despite a large amount of geological data

Marine data :

- Few data on the **circulation** between the **Corinth Gulf** and the **Ionian Sea** since the 80's (Papailiou, 1982; Friglios *et al.*, 1985; Lascaratos *et al.*, 1989; Poulos *et al.*, 1996)
- In the **Patras** Gulf: Information through numerical **models** (Fourniotis and Horsch, 2015)
- In of the **Corinth** Gulf: "**no data**"; a few CTD profiles, some gyres observations and 1 current velocity data (< 8 cm/s)
- Recently acquired data based on seismic profiles and ADCP measurement (Beckers *et al.*, 2015; Rubi *et al.*, 2022)

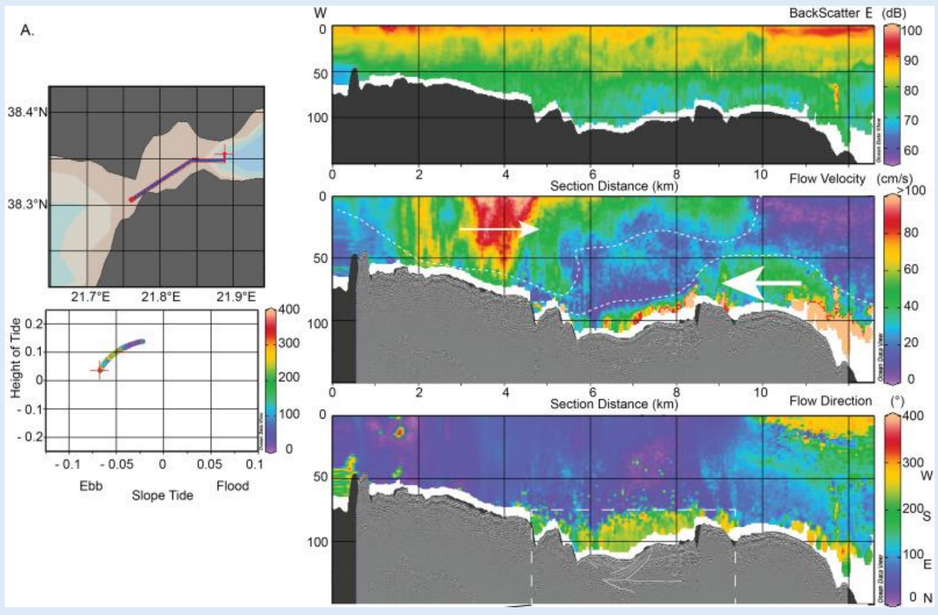
Geological features:

- Data on sedimentological morphologies in the Gulf through **seismic profiles** (Beckers *et al.*, 2016; Rubi *et al.*, 2022)
- Some **sedimentological morphologies** cannot be explained yet due to the paucity of oceanographic data.
- Evidence of an **ancient strait** in the Corinth Canal location (**Caterina** *et al.*, 2022)



What is known: Internal tide/wave & ancient strait

- **SST** information with **satellite** data (CMEMS) : waters from Patras & **Corinth** are **colder** than the waters from the **Ionian** Sea
- **Stratification** in the Corinth Gulf leading to an **internal tide/wave** with a higher frequency than the astronomic tide (2 times faster; Rubi *et al.*, 2022)
- **High velocities** (up to 6 m/s) reached at the **bottom** of the Rion-Antirion strait (modern strait)



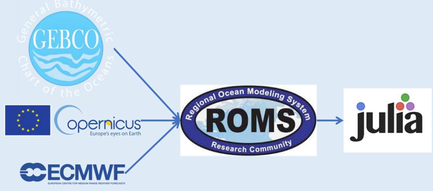
*West-East longitudinal section along the Rion-Antirion strait during **ebb** tide with back scatter, current velocity and current direction on the right, and on the left the location of the profile and the slope tide vs height of tide. The **internal tide/wave** is visible in the strait sill(Rubi et al., 2022).*

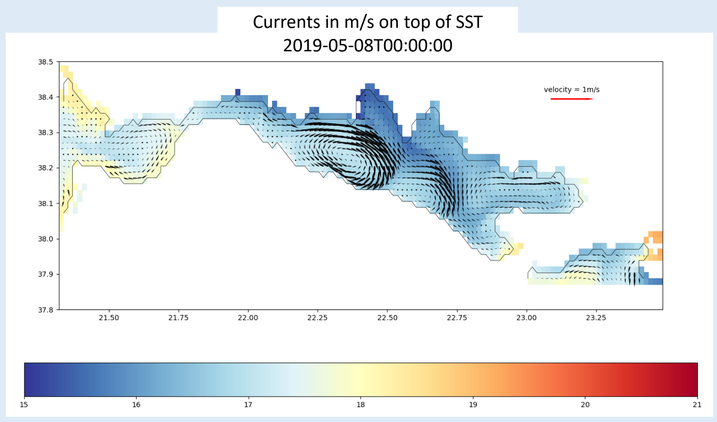
- Presence of an **ancient tidal strait** in the Corinth Canal area, displaying conglomeratic bedded dunes → **high energy currents** (~ > 2 m/s; **Caterina** *et al.*, 2022)
- **Connection** with the **Aegean** Sea ~300 ka ago → paleo-hydrodynamism

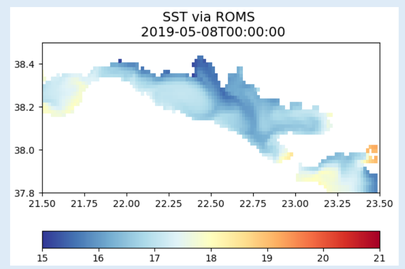
*Conglomeratic compound bedded dune in the Corinth Canal area. To build such dunes, **asymmetric tidal currents** of at least 2 m/s are needed. This type of current is commonly reported in **straits** (**Caterina** et al., 2022).*

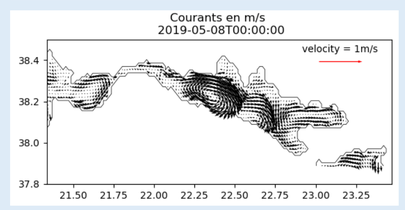
What is already done: SST models and current velocity

- Using **ROMS** to **model the actual hydrodynamism**; inputs are currently : GEBCO **bathymetry**, CMEMS **satellite** data, ECMWF **atmospheric** forcings
- Results are interpreted using **Julia**/Python to display evolution maps
- Simulation over 1 month (where some field data are available to **validate** the model)





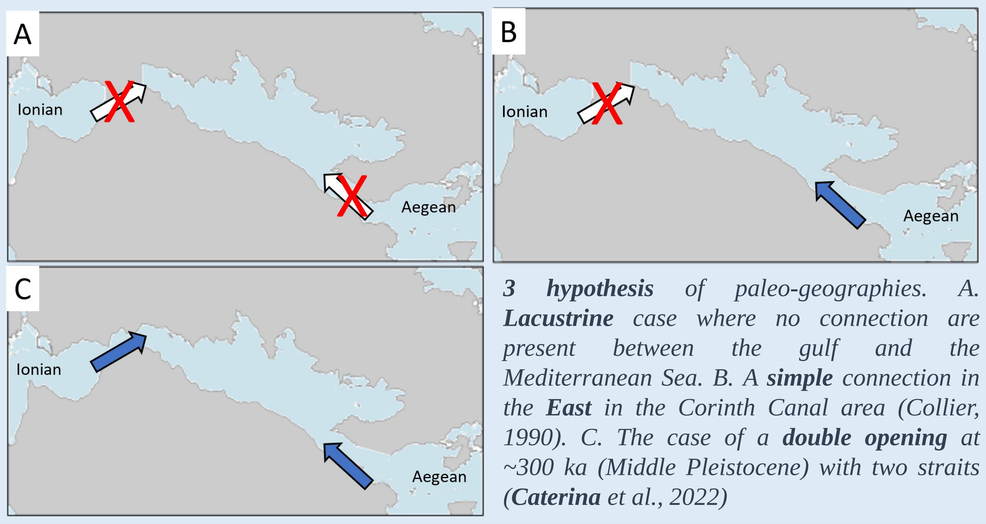




ROMS outputs mapped as SST map, current velocity and direction map and combined map for the Gulf of Corinth during the month of May 2019. On this day, two gyres can be seen in the center of the Gulf as well as the outgoing waters from Corinth to Patras through the strait.

What remains to be done: Tides, stratification & paleo-geographies

- To complete the actual model, **tides** and **stratification forcings** must be added to better **image the bottom currents** and clarify the **role** of the **modern strait**
- Modelling of some **paleo-geographies** with the hypothesis of 0, 1 or 2 **connections** between the Gulf of Corinth and the Mediterranean Sea
- The **sediment record** both at the bottom of the sea or outcropping on the margins of the Corinth Gulf will constrain the model, either as **inputs** or **validation**



***3 hypothesis** of paleo-geographies. A. **Lacustrine** case where no connection are present between the gulf and the Mediterranean Sea. B. A **simple** connection in the **East** in the Corinth Canal area (Collier, 1990). C. The case of a **double opening** at ~300 ka (Middle Pleistocene) with two straits (**Caterina** et al., 2022)*

Conclusions: Modelling to compensate the lack of data

Using **models** and **remote sensing** tools such as satellite data is a good way to get information where the **lack of data is a problem**. In the Gulf of Corinth where there are only a few oceanographic data, it became very handy to get SST or current velocities information through other means. In this case, the **paucity of oceanographic** data cannot explain the sedimentary structures that are observed on the sea floor. But through 1) the modelling of the **actual hydrodynamism**, 2) the modelling of **some paleo-geographies** and their oceanic circulations and 3) the **acquisition of new data** (either **oceanographic** or **sedimentological**) to validate the models, it would be possible to improve our understanding of the crucial **role of straits** in the **hydrodynamism** and **sedimentological** characterization of the Gulf of Corinth.

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