SYMPOSIUM OP'24 — ADVANCING OCEAN PREDICTION SCIENCE FOR SOCIETAL BENEFITS

From the Delta to the Sea: Challenges in modelling the Danube-Black Sea continuum

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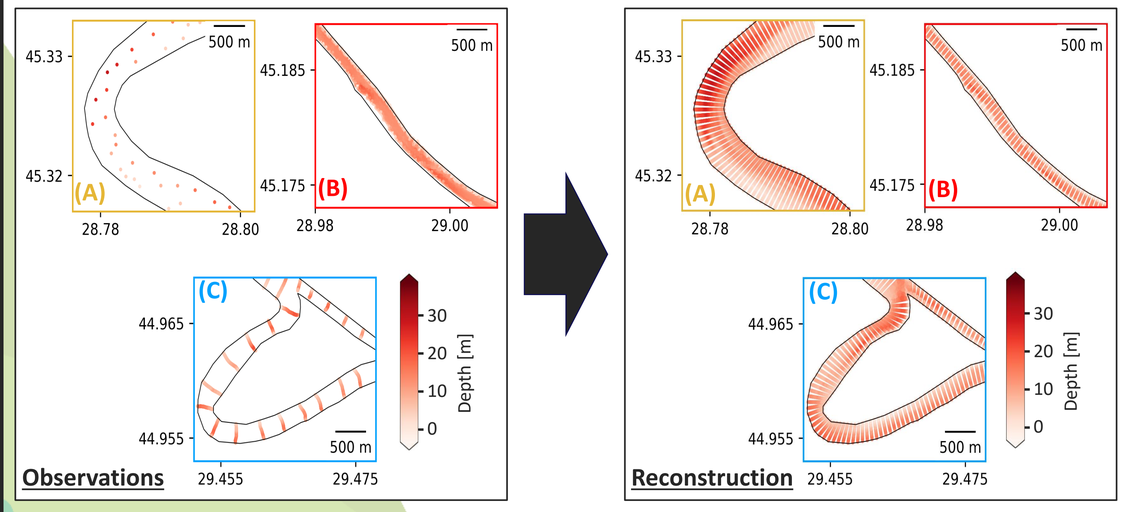
1. Why model this continuum?

The Danube is the second longest river in Europe, and the Danube Delta plays a buffering role between the river and the Black Sea. An excess of nutrients discharged into the river has caused **eutrophication** at its mouth since the 1970s [1]. Most of present models are unable to correctly represent this phenomenon because of the **difference in scales** of the processes involved. By using the **unstructured hydrodynamical model SLIM**, we aim to represent these phenomena and evaluate the **present and future risks of eutrophication** on the coastal area of the Black Sea.

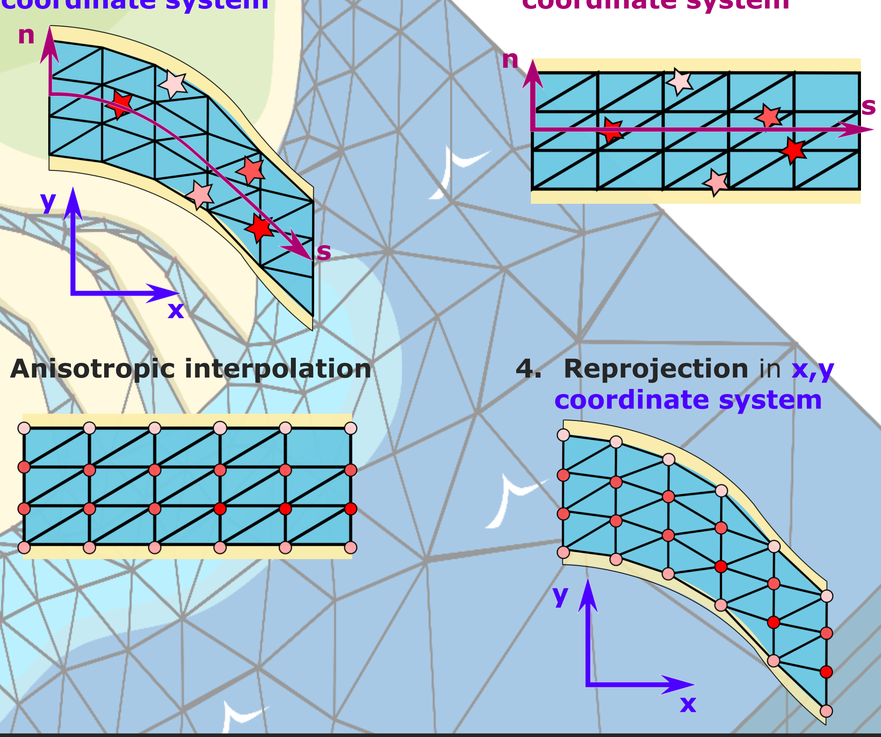
2. Reconstruct the bathymetry

An **accurate representation of the bathymetry** is very important in an hydrodynamical model [2]. The lack of data in the Danube Delta made the task particularly complicated. We had to **reconstruct a comprehensive bathymetry** for the Delta's three branches.



The problem was twofold:

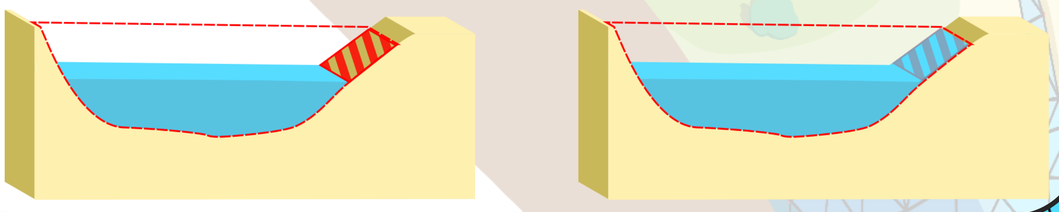
- Finding **bathymetry data**:
  Three different sources were needed to cover the delta
- **Interpolating** the bathymetry on the **mesh**:
  1. Bathymetry points in **x,y coordinate system**
  2. **Reprojection** in **s,n coordinate system**
  3. **Anisotropic interpolation**
  4. **Reprojection** in **x,y coordinate system**



3. Wetting and drying for seasonal flooding

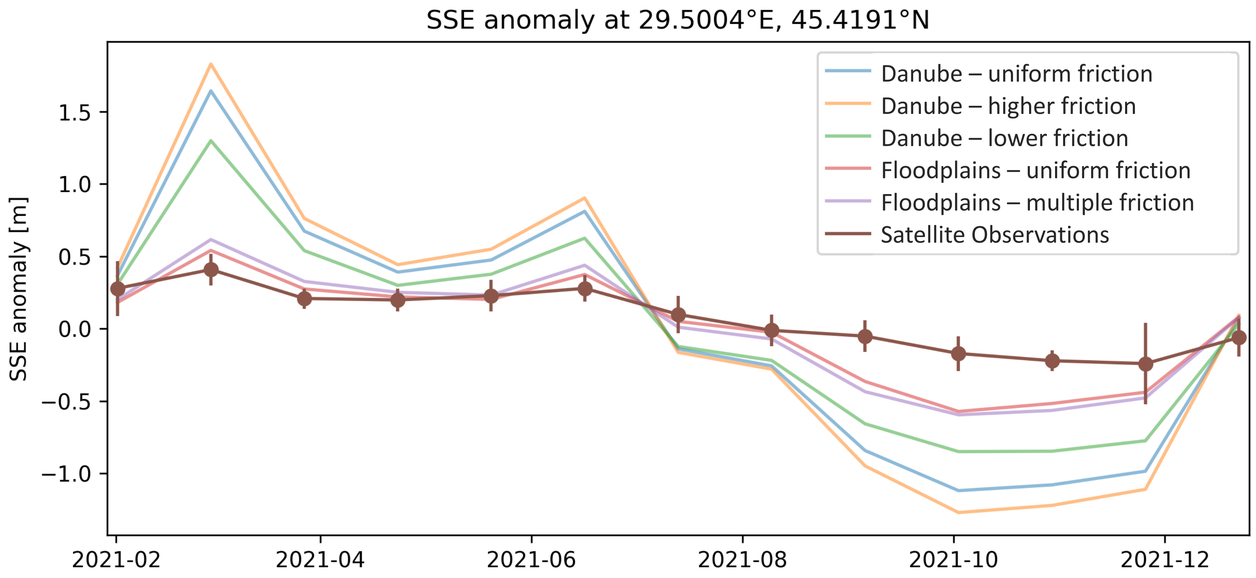
The Danube Delta is subject to **seasonal flooding**. These important changes in the water height can cause the **model to crash when water height becomes equal to 0** on some parts of the domain.

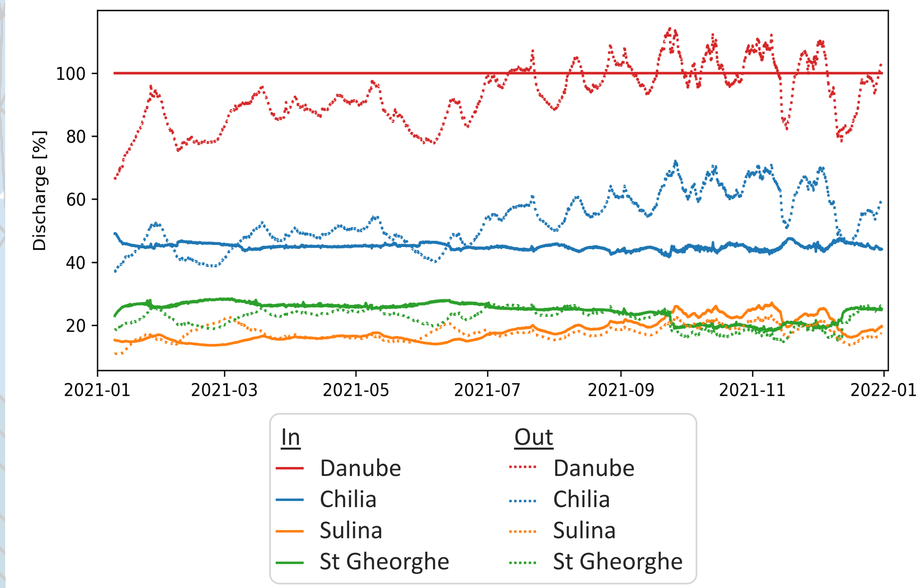
The **solution** is to use a wetting and drying algorithm, in this case a **thin-film wetting and drying algorithm**.



4. Preliminary results show the importance of floodplains

We managed to model **one year** of hydodynamic in **2D** on the Danube-Black Sea continuum





The **repartition of the modelled discharge**, in the three branches of the Danube's Delta follows what is reported in the literature [3].

[1] Berlinskyi et al., Eutrophication and pollution development in the Danube River and coastal marine zone system, 2020
[2] Dey et al., Assessing the effect of different bathymetric models on hydraulic simulation of rivers in data sparse regions, 2019
[3] Romanescu et al, Alluvial transport processes and the impact of Anthropogenic intervention on the Romanian littoral of the Danube Delta, 2013

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