

A high resolution hydrodynamic simulation of Lesvos semi - enclosed embayment Kalloni Gulf: Preliminary results

I. Mamoutos, S. Petalas, A. Sampatakaki, A. A. Dimitrakopoulos,
V. Zervakis

Department of Marine Sciences, School of Environmental Sciences University of the Aegean, Mytilene, Greece



Επιχειρησιακό Πρόγραμμα
Ανάπτυξη Ανθρώπινου Δυναμικού,
Εκπαίδευση και Διά Βίου Μάθηση

Ειδική Υπηρεσία Διαχείρισης

Με τη συγχρηματοδότηση της Ελλάδας και της Ευρωπαϊκής Ένωσης



Introduction

description of Kalloni Pilot

- A pilot system for monitoring the circulation and functioning of embayments in coastal areas of Greece.
- Use, for first time in Greek seas, of an underwater communications cable to estimate the flux with the open sea.
- Developing a pre – operational high resolution state of the art hydrodynamic model including tides and fully coupled with a wave model.
- Extensive collection of *in situ* data using CTD, ADCP and drifters.



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ανάπτυξη - εργασία - αλληλεγγύη

Material and Methods

Model setup

- ROMS 3.7.
- 120 meters resolution in both horizontal directions.
- 15 vertical sigma levels.
- GLS vertical mixing scheme.
- 1st run with 4th order AKIMA (Shchepetkin and McWilliams 2003) for horizontal and vertical advection of tracers.
- 2nd run with 3rd order sign preserving, recursive scheme (Smolarkiewicz *et al.* 1998) for horizontal and vertical advection of tracers.
- Preliminary run from 1st of January to 31st of December 2004.

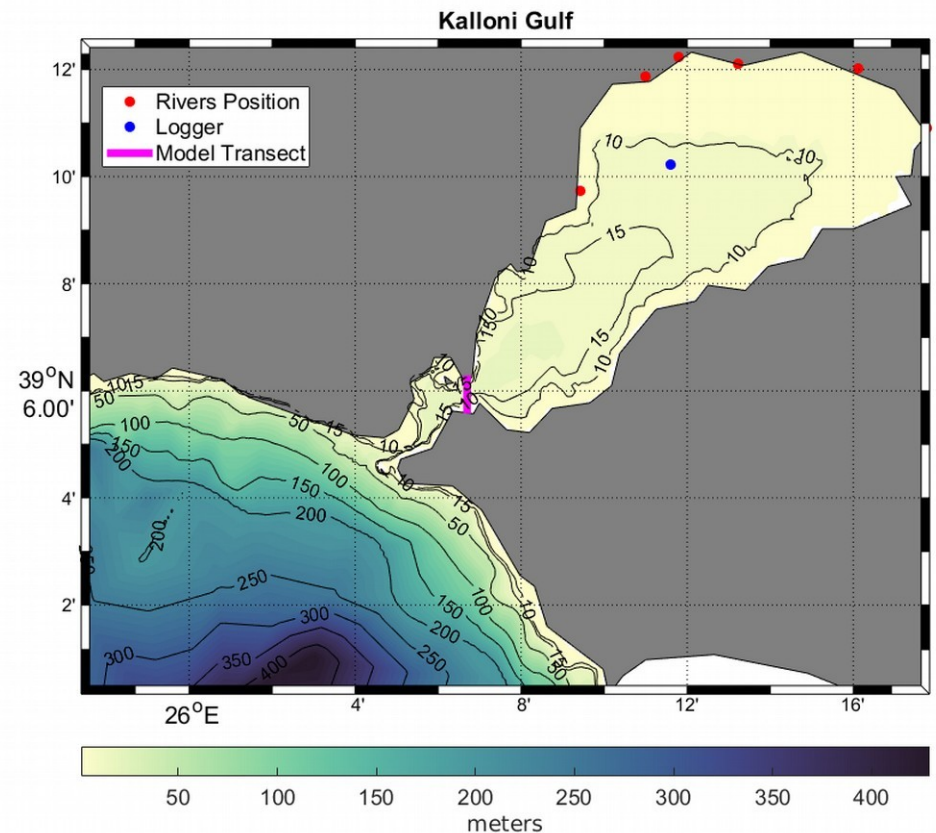
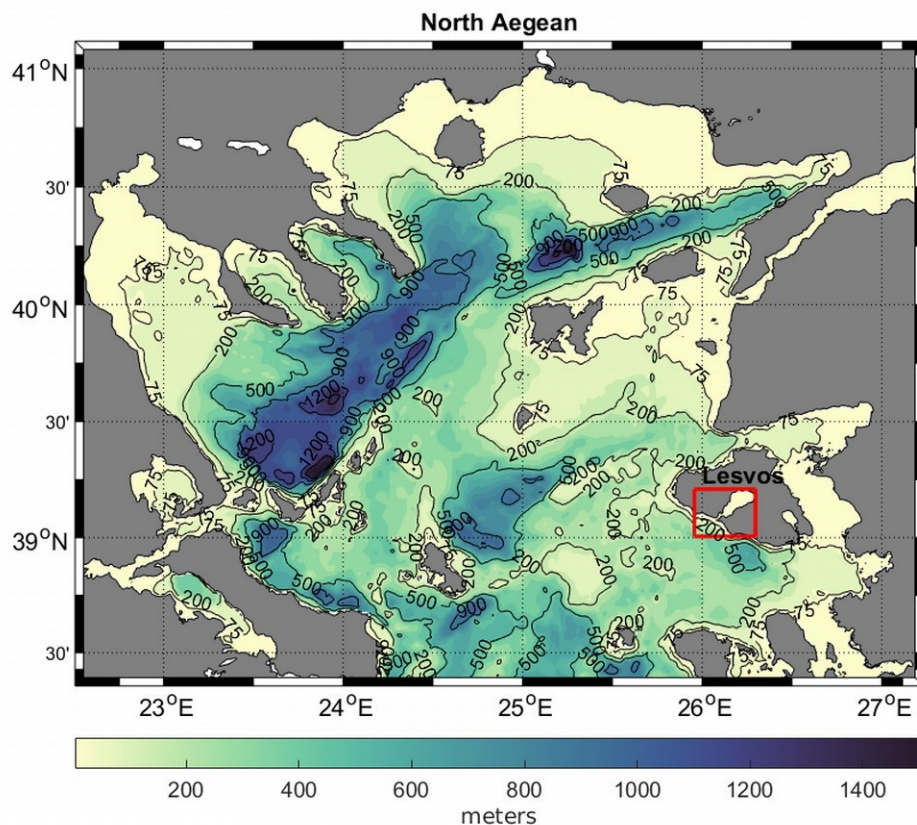
Input data

- High resolution bathymetry from digital naval map.
- Initial and boundary conditions from high resolution North Aegean historical hind cast (Mamoutos *et al.* 2018).
- Atmospheric forcing from ECMWF ERA – Interim and ERA5 reanalysis datasets.
- 5 major rivers and streams from a hydrological model (Sumaya *et al.* 2016; Chalazas *et al.* 2017).
- 9 Tidal constituents from Oregon State University Global Inverse Tidal Model (Egbert *et al.* 2002).



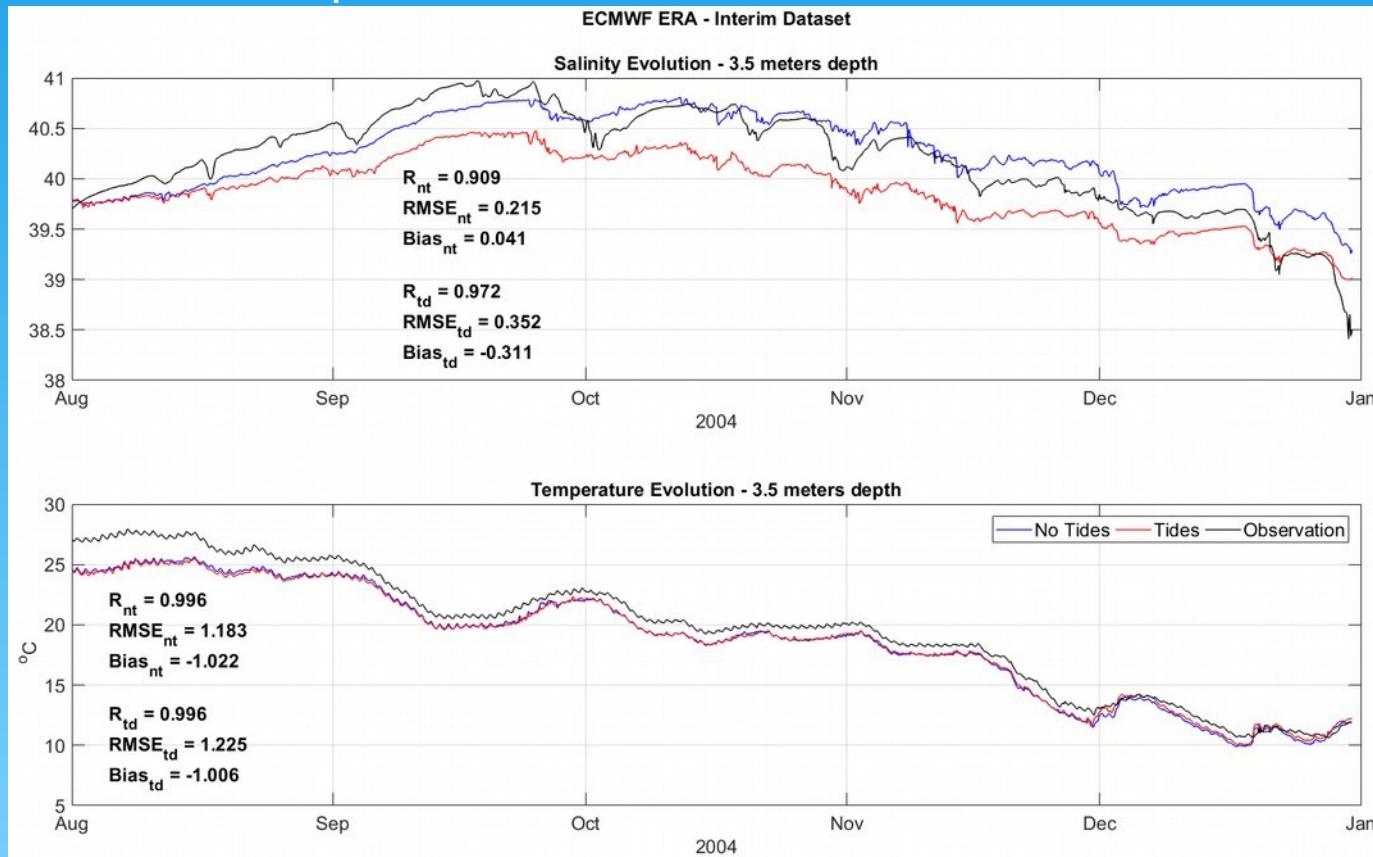
Materials and Methods

Model domain



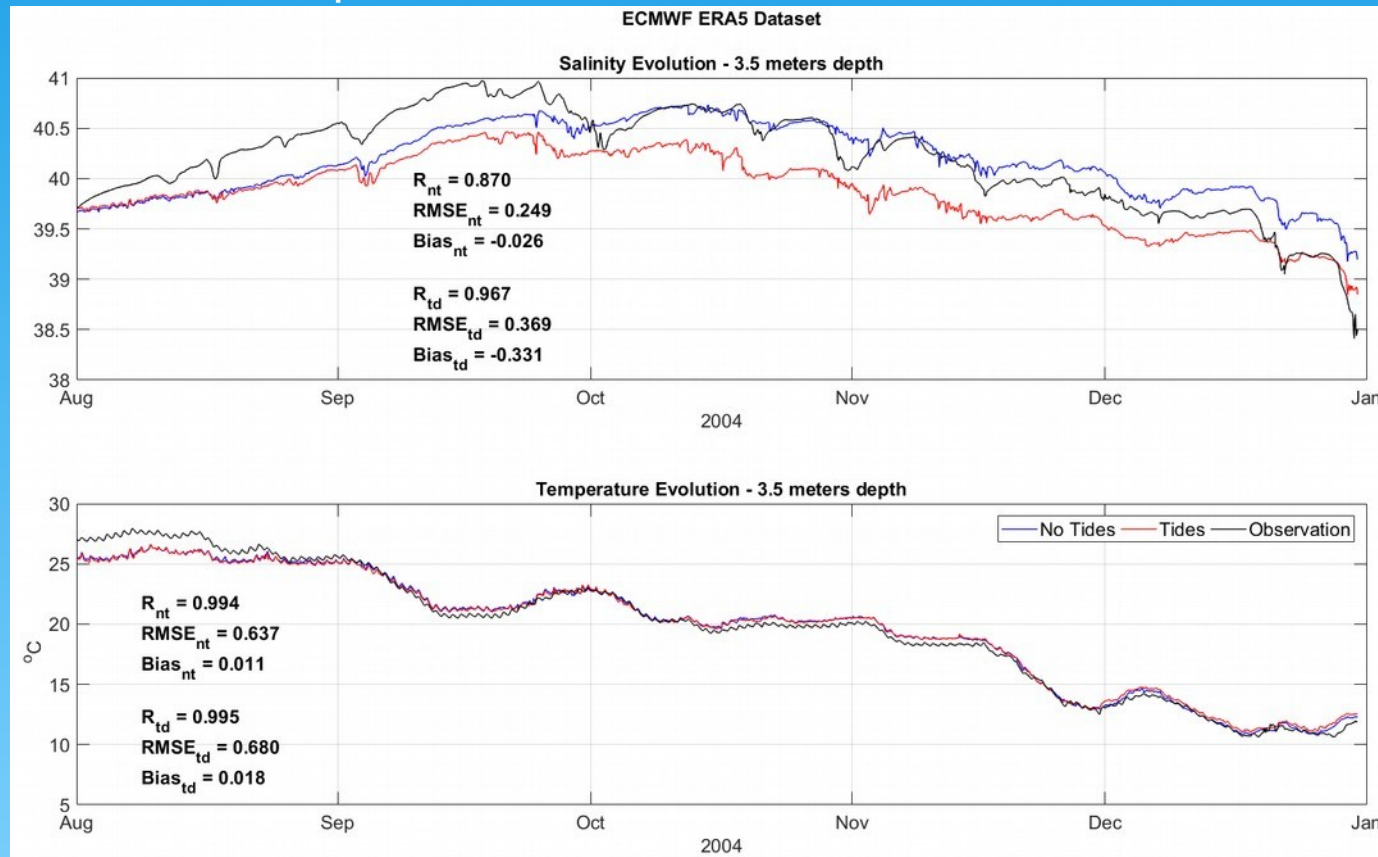
Results

Sensitivity tests – Impact of different atmospheric input – MPDATA advection scheme



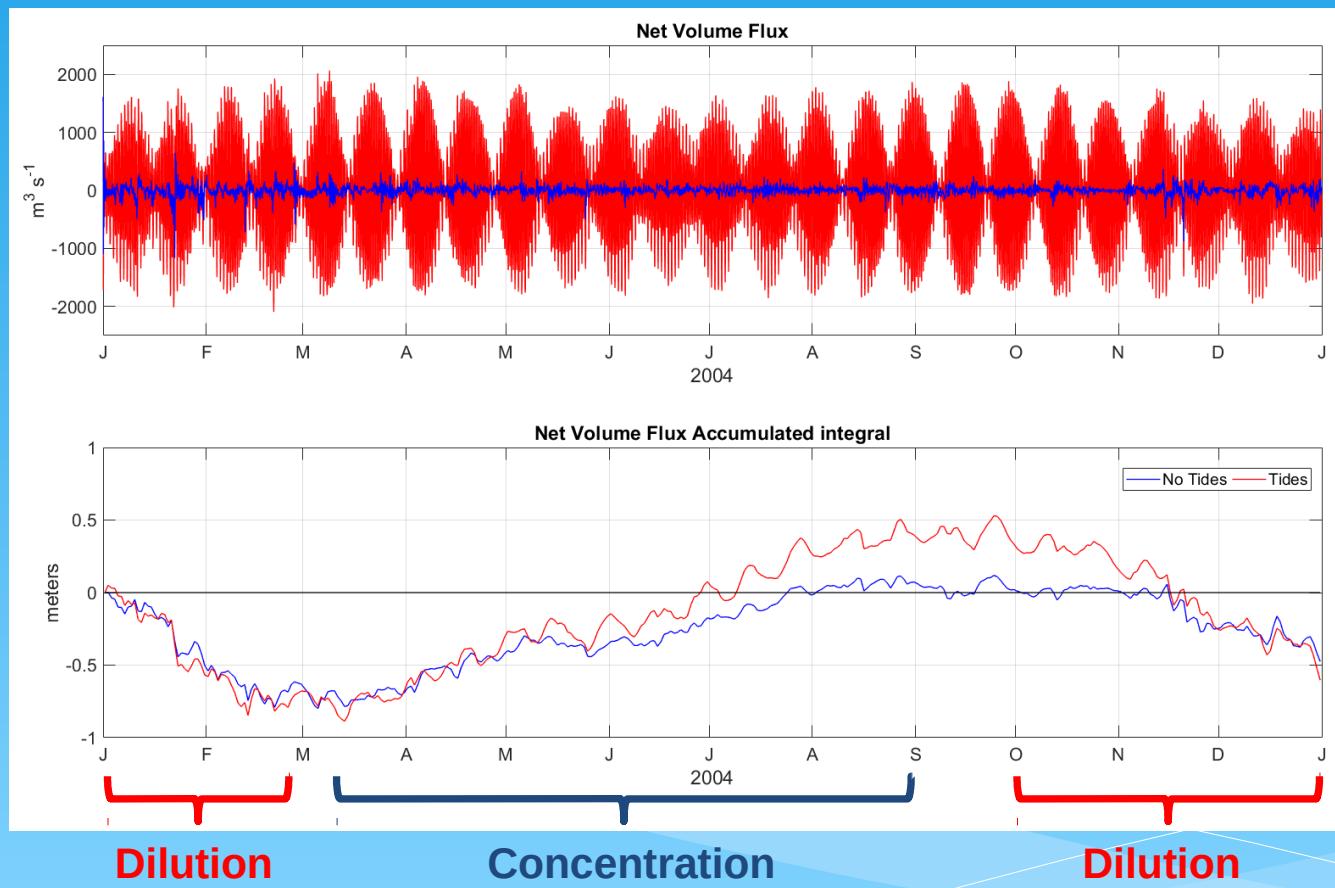
Results

Sensitivity tests – Impact of different atmospheric input – MPDATA advection scheme



Results

Sensitivity tests – Impact of different advection scheme for tracers (T, S) – AKIMA case



Ευρωπαϊκή Ένωση
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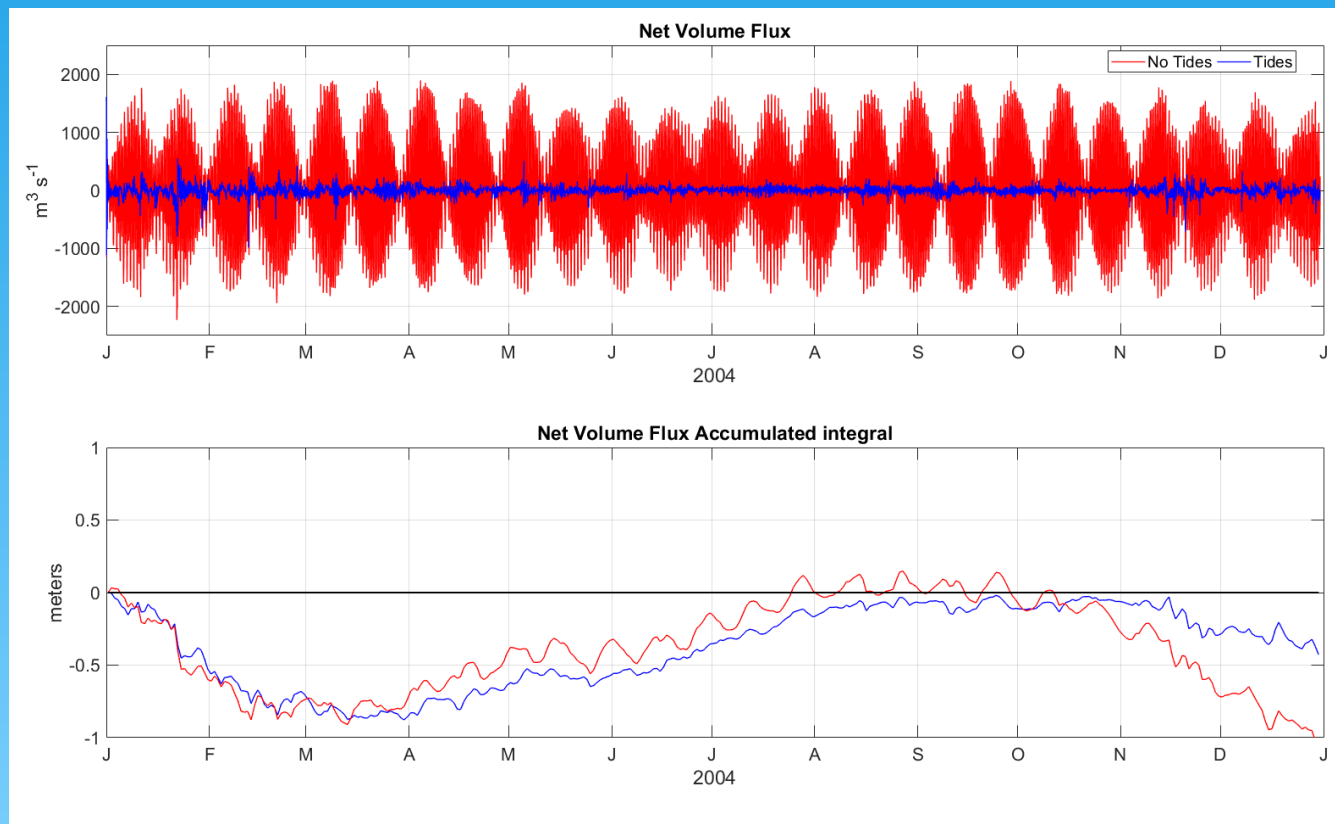
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ανάπτυξη - εργασία - αλληλεγγύη

Results

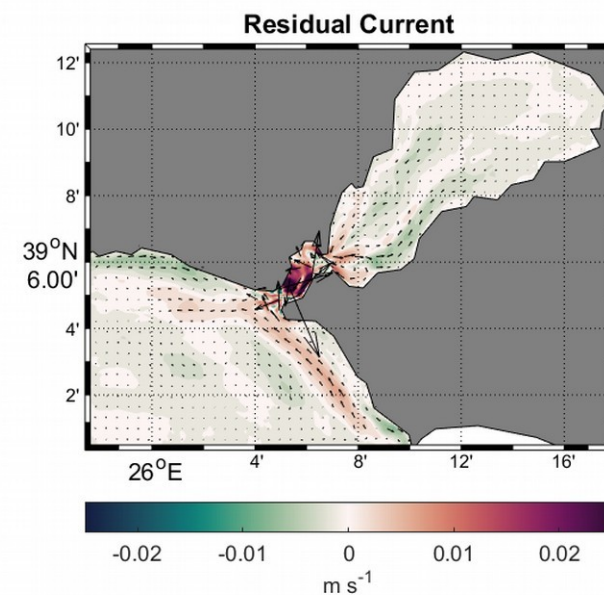
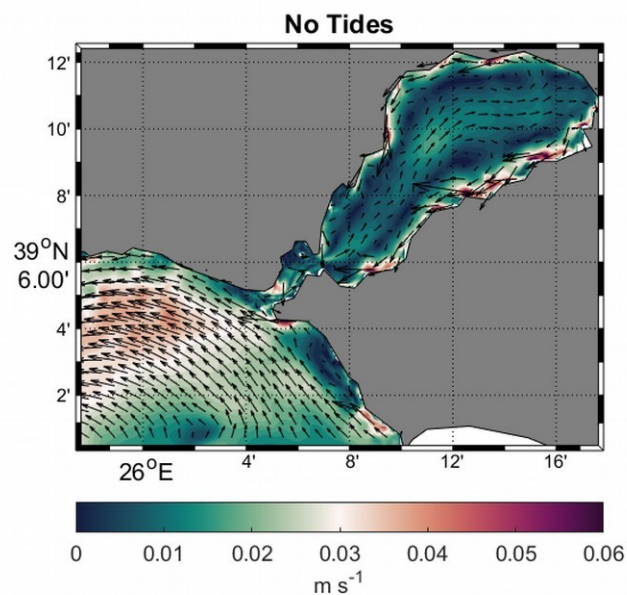
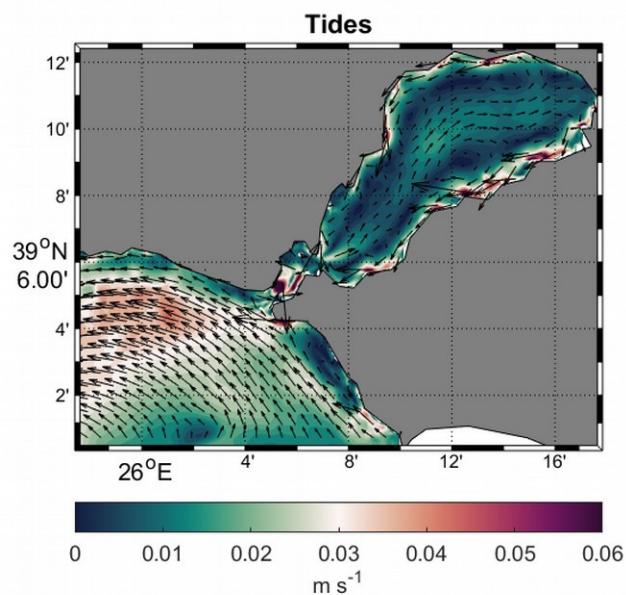
Sensitivity tests – Impact of different advection scheme for tracers (T, S) – MPDATA case



Results

Mean circulation with and without tidal forcing

Mean Velocity Field



Results

Residence times estimation

T/S Advection scheme	4 th order AKIMA	3 rd order MPDATA
Tidal case	22.7 days	22.9 days
Non Tidal case	34.6 days	36 days



Discussion

Conclusions

- Our preliminary results suggest that the model reproduces the dynamics and the thermohaline functioning of the bay in an adequate way.
- Kalloni Bay exhibits a dual behavior, dictated mainly by the water budget:
 - wet season (October – March): dilution basin
 - dry (April – September): concentration basin.
- Residence times of the waters are small, of the order of 20 days.
- Tides have a significant role in enhancing the exchange with the open sea.
- The model on it's current form underestimates the mixing inside the Kalloni Gulf.



Discussion

Future improvements/plans

- Rerun using new high spatial resolution (2.5 km) atmospheric forcing.
- Couple the hydrodynamic model with a wave model (SWAN).

