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A new high-resolution zoom over the North-East Atlantic based on NEMO 4.2 (IMMERSE) version

Demonstrating impact on CMEMS systems

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Configuration description

Configuration : eNEATL36 + AGRIF108 zoom (“IBI prototype like”)

- **NEMO 4.2 (post-IMMERSE)**

- **Parent configuration : eNEATL36**
  - 1/36° resolution (~2-3km)
  - 150s time step
  - Realistic forcing at boundaries

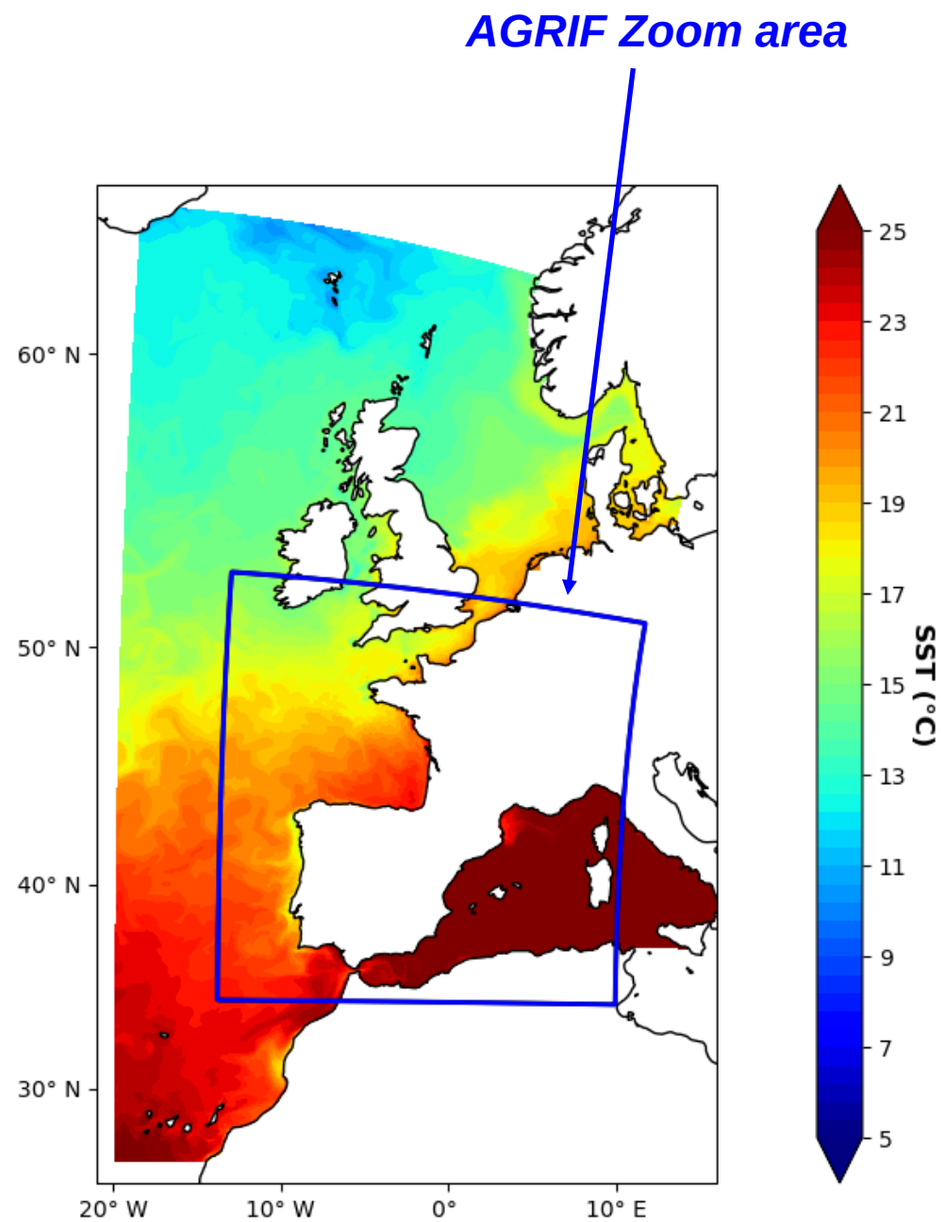
- **High resolution nest (AGRIF) :**
  - 1/108° resolution (~1km)
  - 50s time-step

- **Two-way nesting between the parent and the child configuration**

- **Free simulation from January 2017 to July 2018 : NEST**

- **Objectives**
  - Validation of the simulation (Macroscopic)
  - Impact on the ocean dynamics

  => Comparison with observations and with a twin simulation with no nest : TWIN



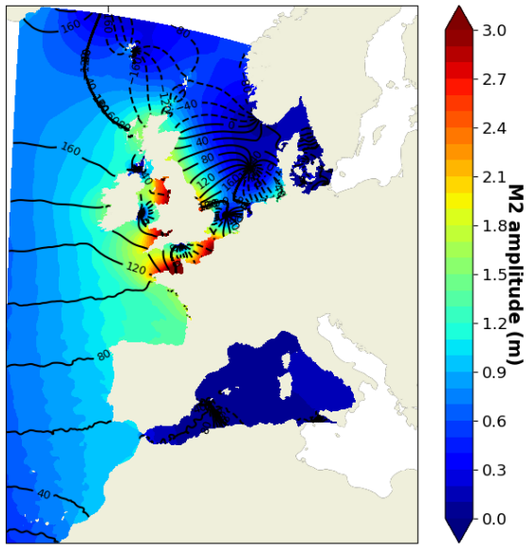
Averaged SST over 2018 on the eNEATL36 domain
Futur zoom is indicated with the blue squarre

Macroscopic validation

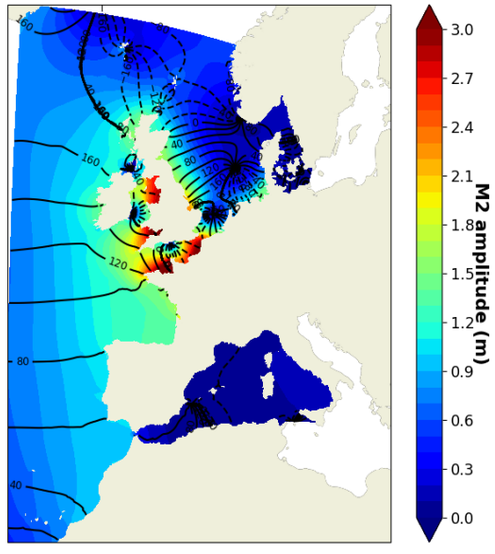
➢ **Tides : validation with FES2014**

- Continuous tidal solution
- Same order of magnitude of the difference NEST – FES and Maraldi et al. (2013)
- Differences mostly related to a drag boost in NEST

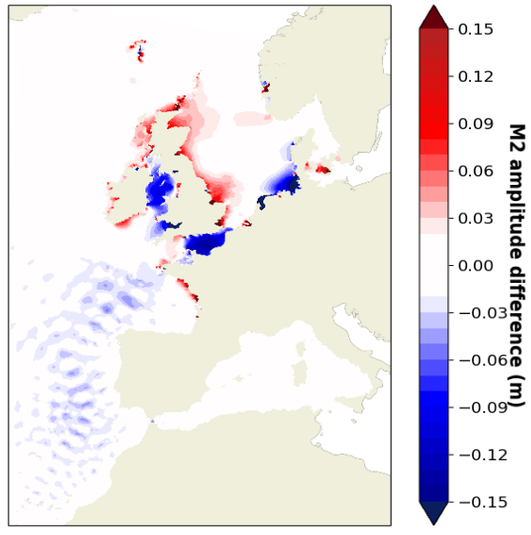
NEST



FES

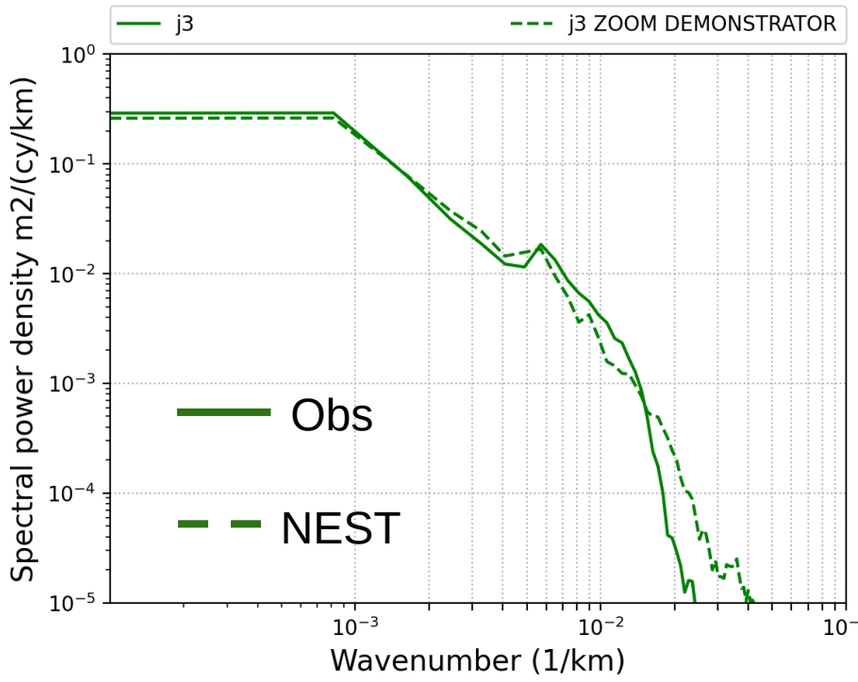


NEST - FES



➢ **SLA along satellite tracks (Jason 3)**

- Unfiltered from tides
- Good agreement with satellite SLA for scales > 100-50km (=satellite effective resolution)



➢ **T & S : Similar differences with observations with a twin simulation with no nest (see annexes)**

Two-way nesting : realistic and continuous large scale solution across the nest boundary

Two-way nesting

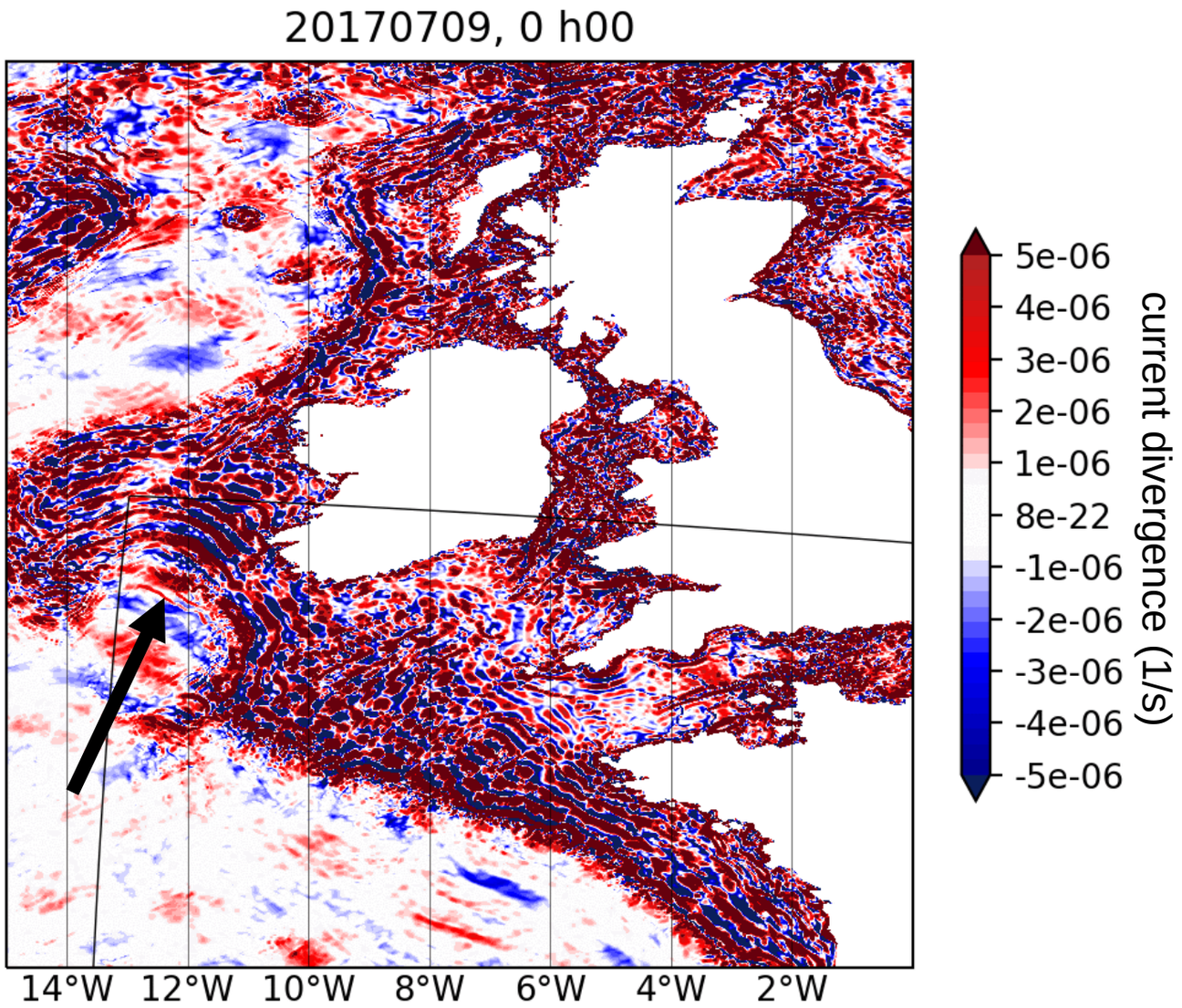
Internal waves (ITW) crossing the nest boundaries

- A well known issue in nested configurations (e.g : Debreu et al. 2008) :
  - ITW information should be transmitted across the nest boundaries
  - ITW should not be reflected by the boundaries

- ITW generated over the continental shelf

- ITW information transmitted through the nest boundaries

- No wave reflection



1st baroclinic mode current divergence (1/s)

Two way nesting enables internal wave information to be transmitted across the nest boundaries

Impact on ocean dynamics

- **Comparison with a twin simulation with no nest (TWIN)**

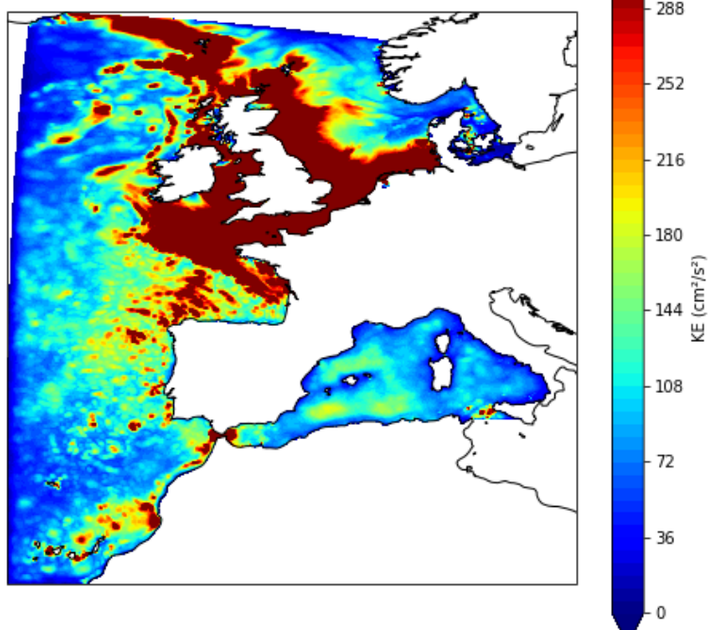
Subdaily KE :

- Smaller in the Manche and North sea => Reduced tides in NEST
- Increase of KE due to internal waves (Biscay)
- Increase of KE on the continental slope

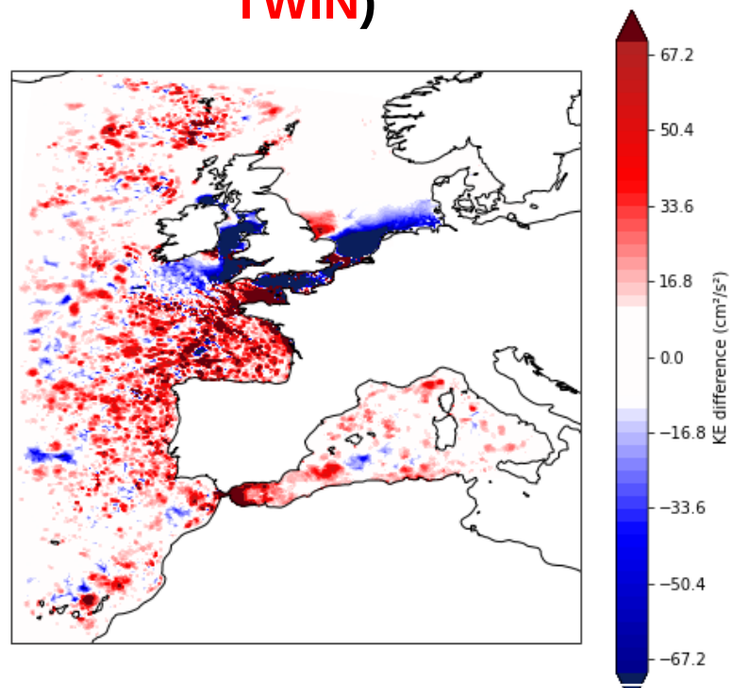
Submonthly KE :

- Mediterranean sea = small Rossby radius
- Mediterranean mesoscale structures better resolved in NEST => increase in KE

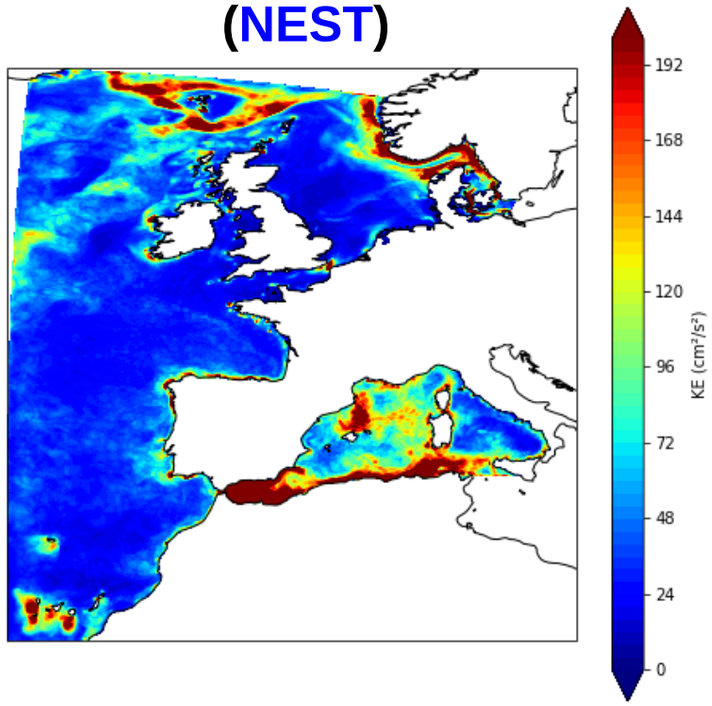
Sub-daily KE (NEST)



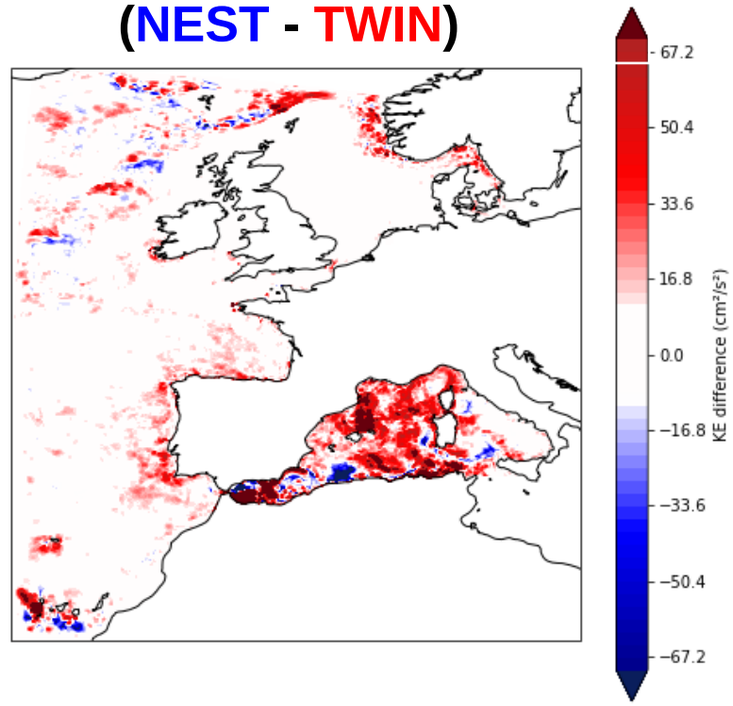
Sub-daily KE diff (NEST - TWIN)



1 day -> 1 month KE (NEST)



1 day -> 1 month KE diff (NEST - TWIN)



Conclusion & perspectives

Conclusions :

- The nest's model solution is realistic at large scale

- Two-way nesting:
  - enables a continuous model solution across the nest boundaries
  - allow internal wave information to be transmitted across the nest boundaries

- The high-resolution nest increase the KE signature of ITW in the north-east Atlantic and of mesoscales structures in the Mediterranean Sea

Perspectives :

- Validation of small scales with observations (IMMEDEA, CMCC)

- Additional tests over the nested configuration :
  - Increase the vertical resolution
  - Tests with an atmospheric boundary layer model
  - Wetting & drying

Additionnal comments :

- The configuration namelists are available on the IMMERSE github : https://github.com/immerse-project/eNEATL36-AGRIF_Demonstator

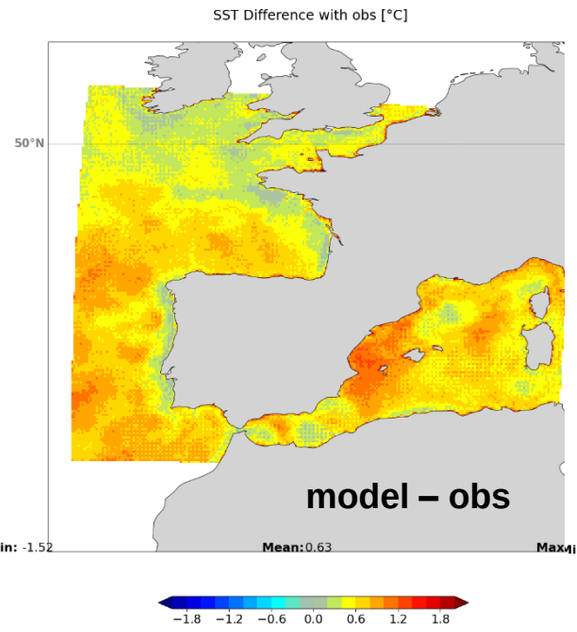
- The data will soon be available on a thredds server at Puertos del Estado

Annexe 1: SST validation

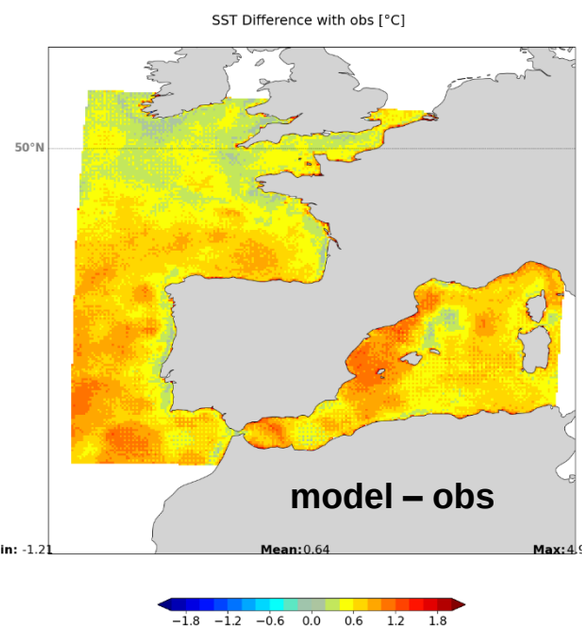
SST : comparison with ODYSSEA SST

- Slight differences at small scales between NEST and TWIN.
- Not much change at large scales
- Slight improvement of the SST in the alboran sea in NEST.
- Warm bias, stronger in summertime

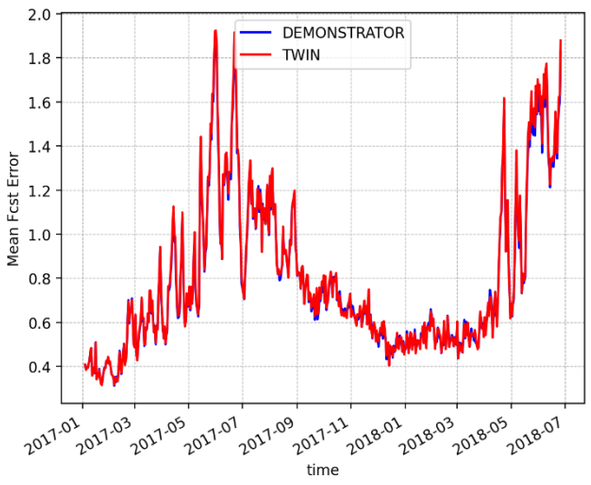
NEST.



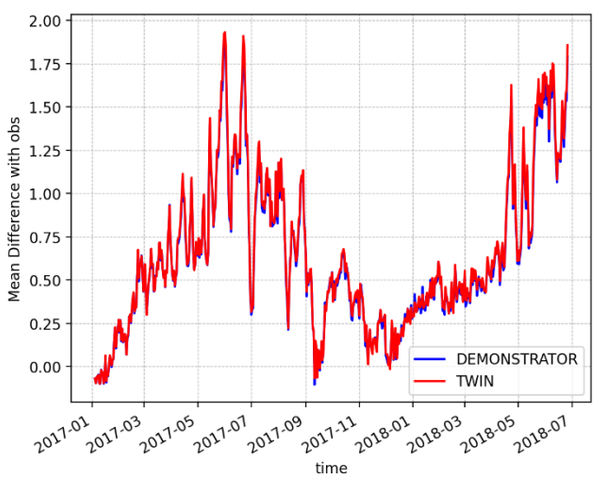
TWIN



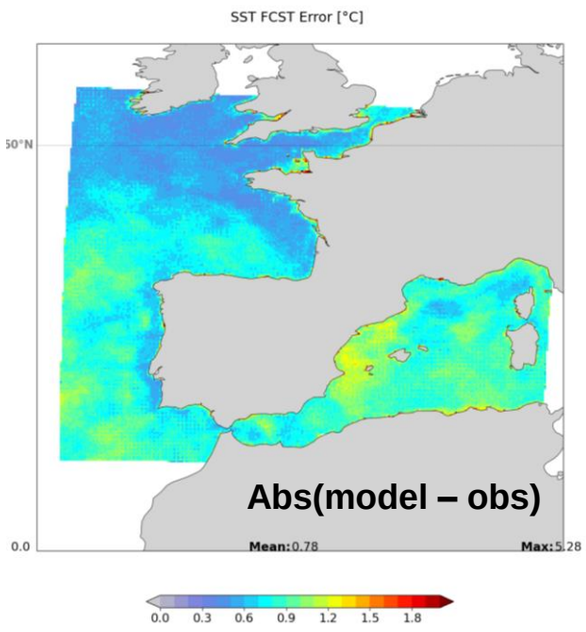
Abs(model – obs)

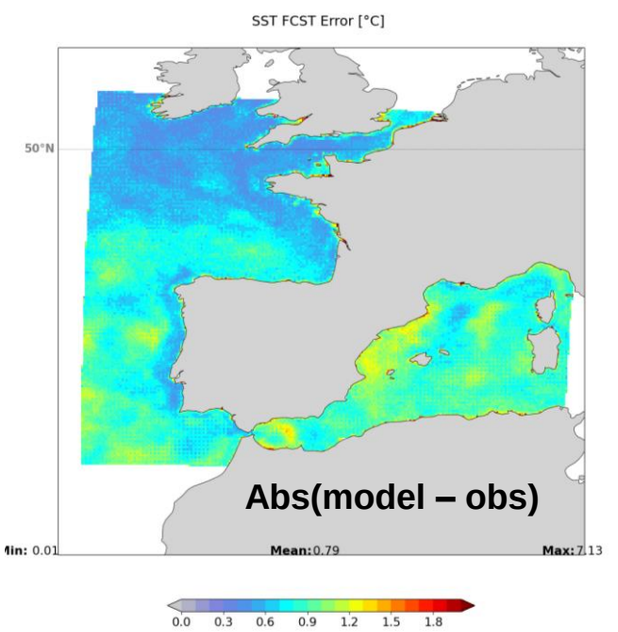


model – obs



NEST **TWIN**



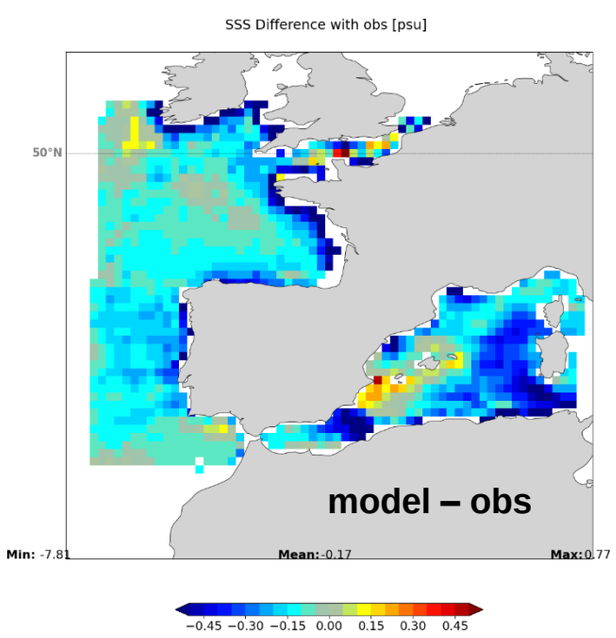


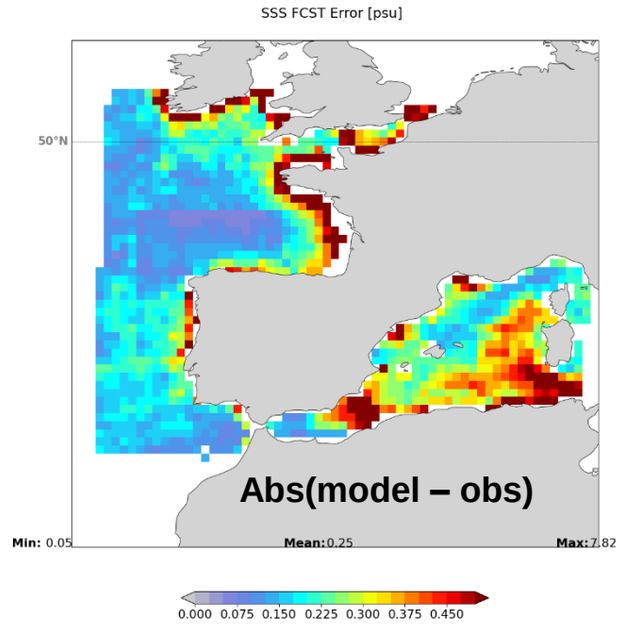
Annexe 1: SSS validation

SSS : comparison with ESACCI SSS

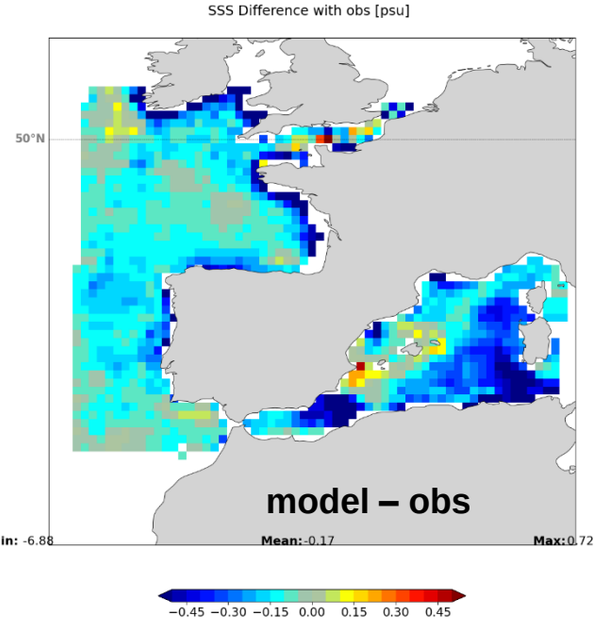
- Slight differences at small scales between NEST and TWIN.
- Fresh bias in the Mediterranean sea and near coasts
- But strong incertitude on the satellite SSS data near coasts !
- Good agreement with obs over the Atlantic
- NEST / TWIN : Not much change at large scales

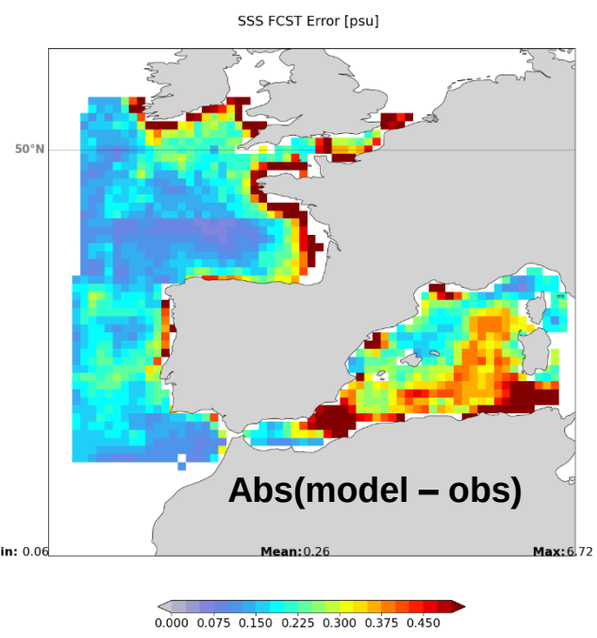
NEST



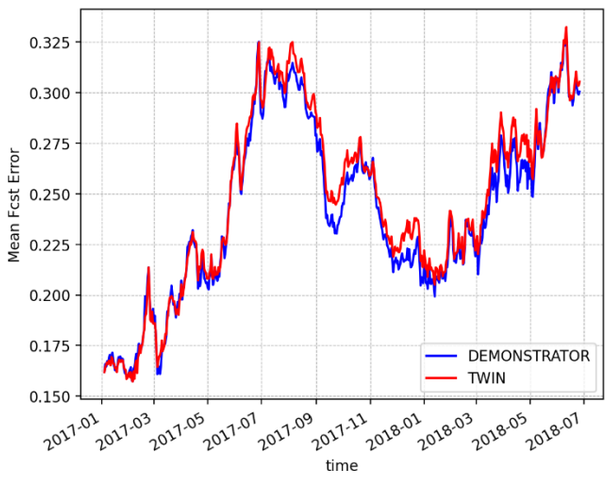


TWIN

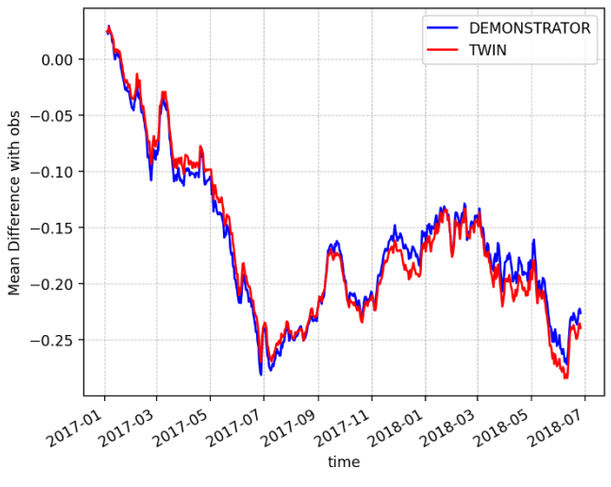




Abs(model – obs)



model – obs

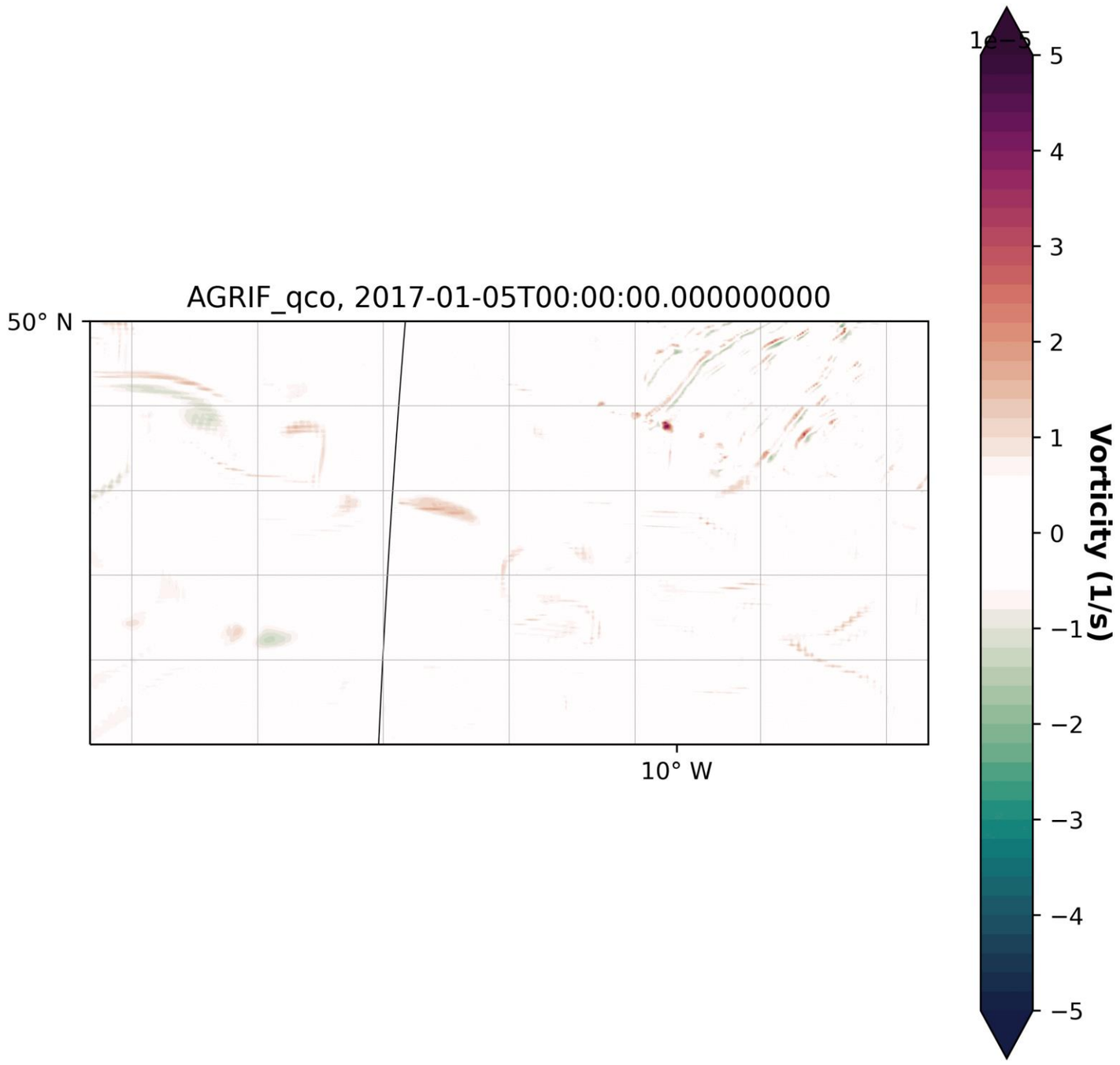


NEST **TWIN**

Annexe 5: Vorticity structures and two-way nesting

Nest boundaries

- 2 way nesting, so we need to check if the structures are consistent inside and outside the nest
- Vorticity structures crossing the nest boundary
- Vorticity structures are consistent inside and outside the AGRIF domain

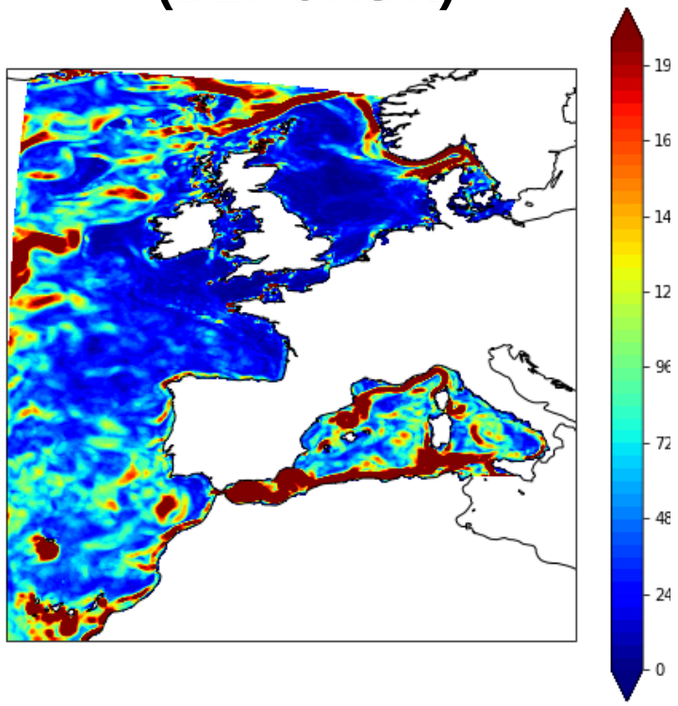


Annexe 4: Impact on monthly KE

Monthly KE :

- Mostly, changes in the position of long-lasting eddies.
- Slight increase of monthly KE over zoom
- Mediterranean sea : reduction of the Algerian current, and increase of the Mediterranean northern current

Monthly KE (DEMONST.)



Monthly KE diff (DEMONST. - TWIN)