Wind as driver of sub-annual SLA on South Brazil and Patagonian shelf

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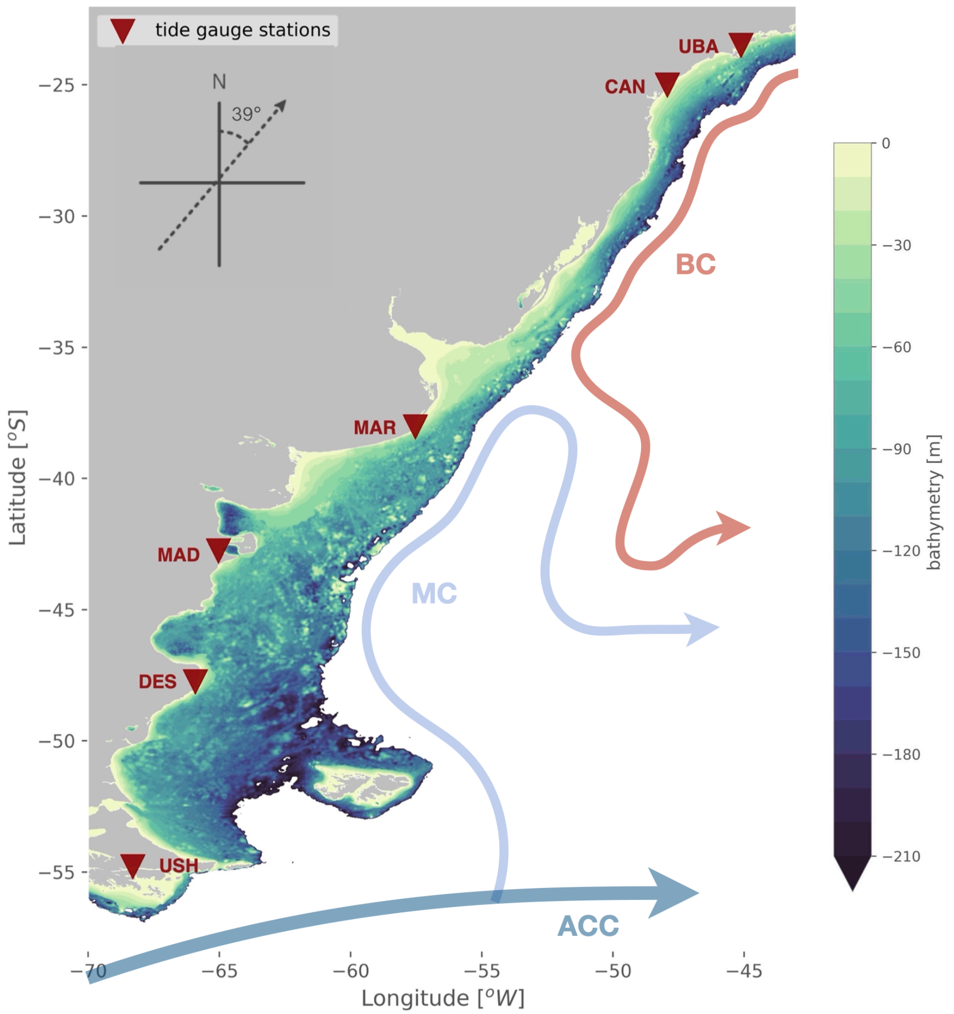
Motivation of the study

- Largest continental shelf in the southern hemisphere
- Previous studies showed that wind is an important driver of sea level anomalies (SLA) on parts of the Southwestern Atlantic Continental Shelf on annual scale
- For coastal and shelf regions shorter temporal timescales get more important



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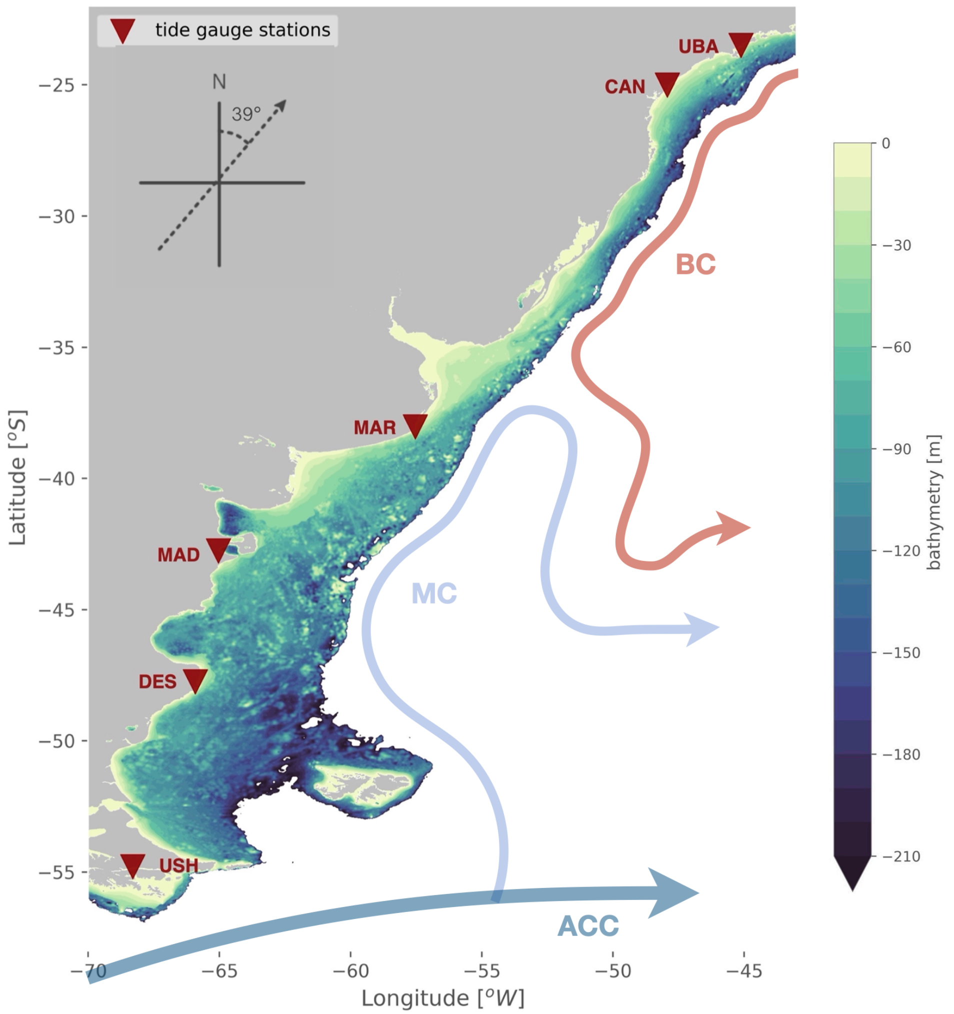
- Objectives:

1. Is high-frequency SLA variability driven by the wind?
   In which frequencies and regions?
2. To what extent can gridded altimetry reveal high-frequency SLA on the continental shelf?

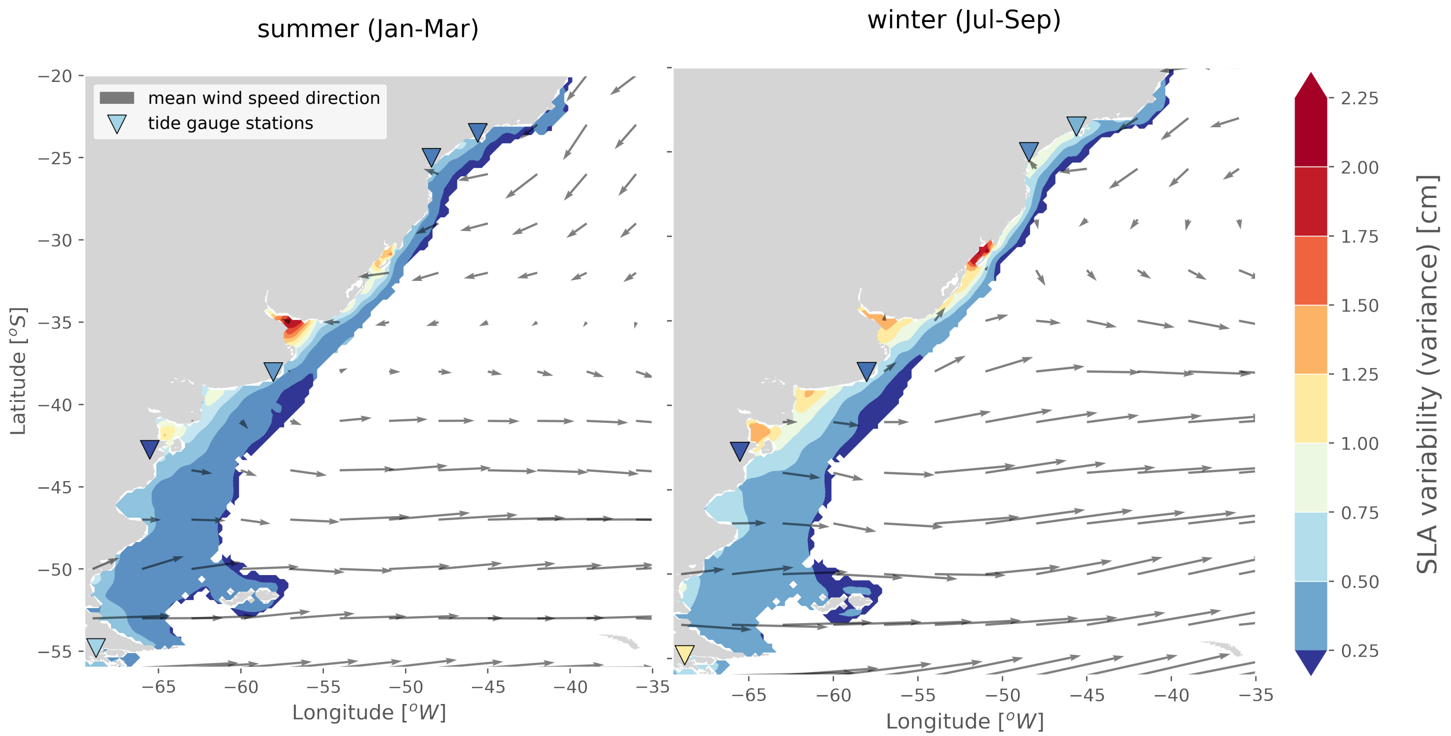


Data and Methods

Data:

- SLA: **gridded altimetry** (L4) and **numerical model** from CMEMS in daily resolution in 0.25° grid from 1993-2019 + derived geostrophic velocity

- Winds speed components (L4) from scatterometers in 6hr resolution over a 0.25° grid, daily averaged and modified in along/across-shore wind



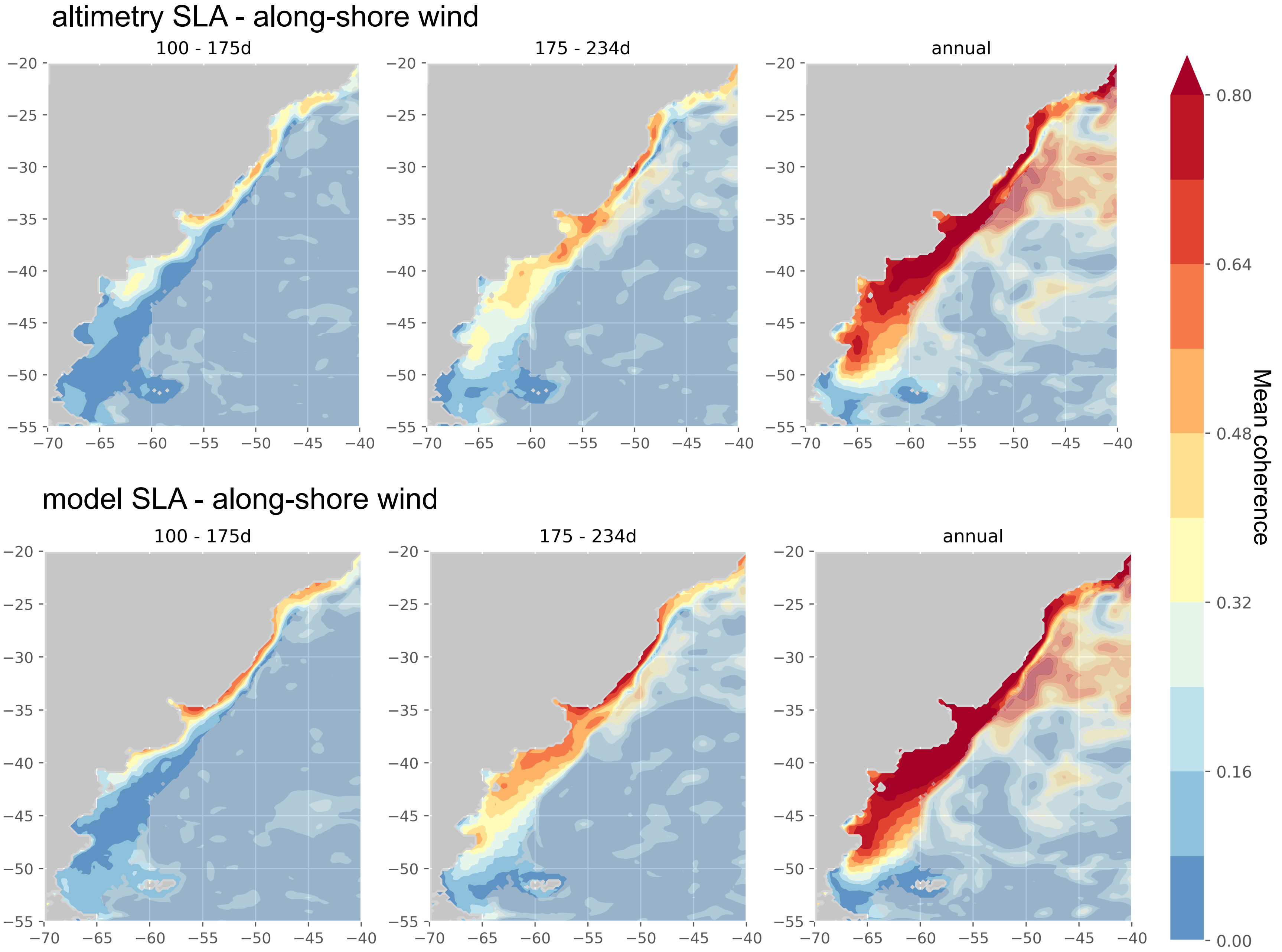
Method:

- Magnitude squared **coherence** to obtain agreement of two time series depending on frequency, EOF-analysis

Coherence between SLA and wind

100d to annual:

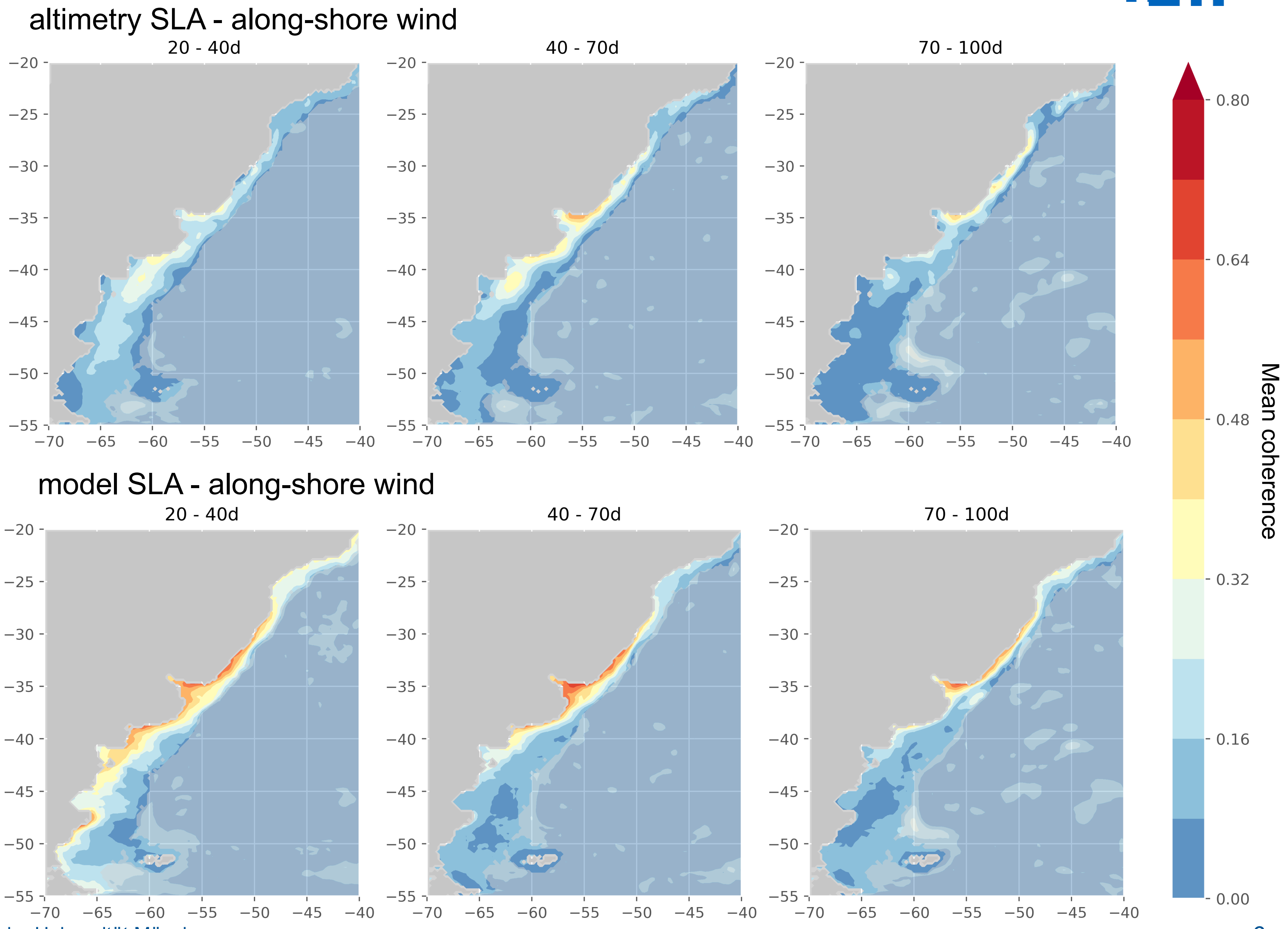
- Highest coherence on annual scale with good agreement between model and altimetry SLA
- Annual wind-driven SLA over whole shelf width (model and altimetry)
- <175d restricted towards the coast with stronger coherence for model SLA



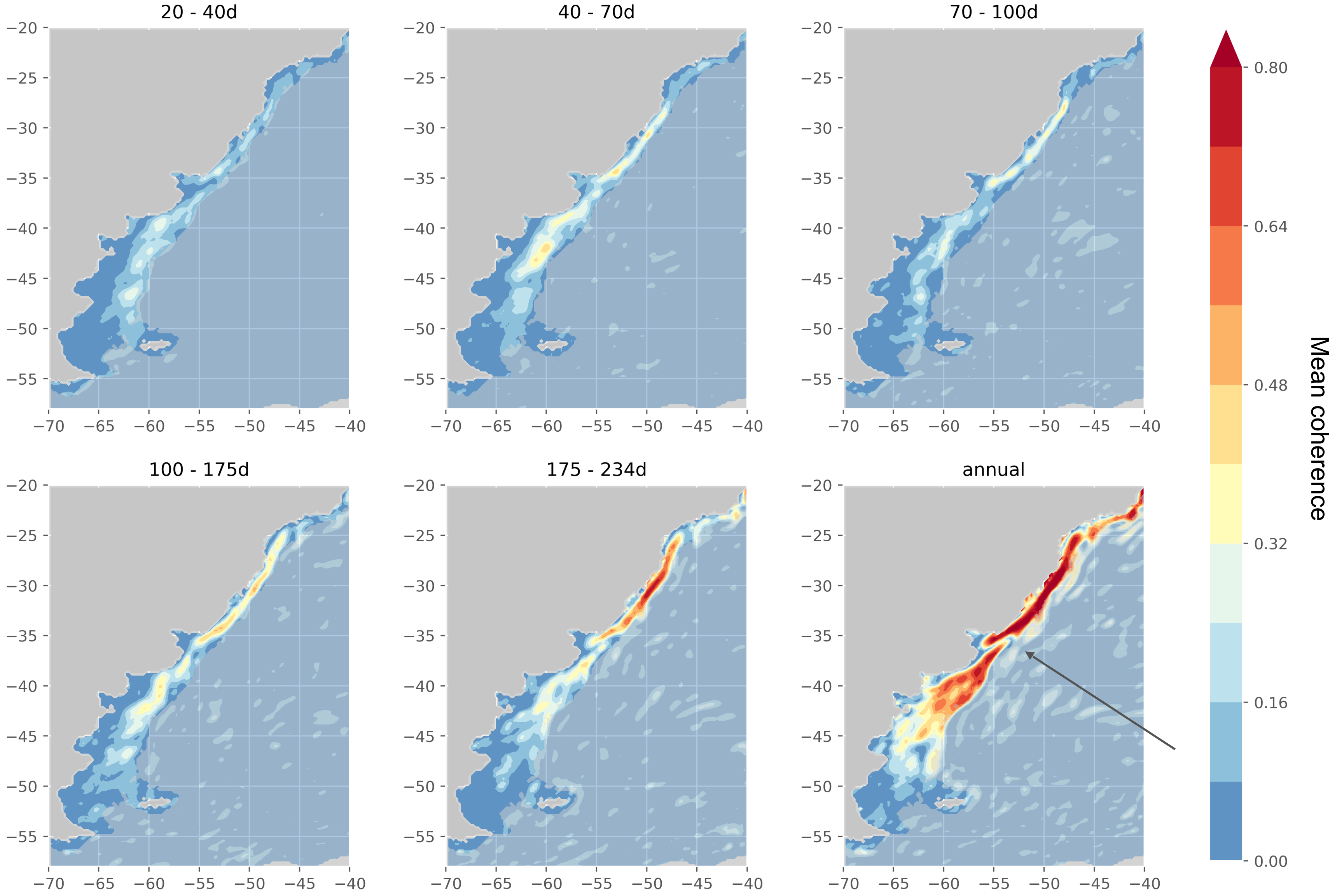
Coherence between SLA and wind

20 - 100d:

- Coherence smaller for higher-frequencies
- Still significant (>0.32) coherence in all periods
- Notable wind driven SLA along the Uruguayan and Brazilian coast



Coherence between wind and geostrophic velocity

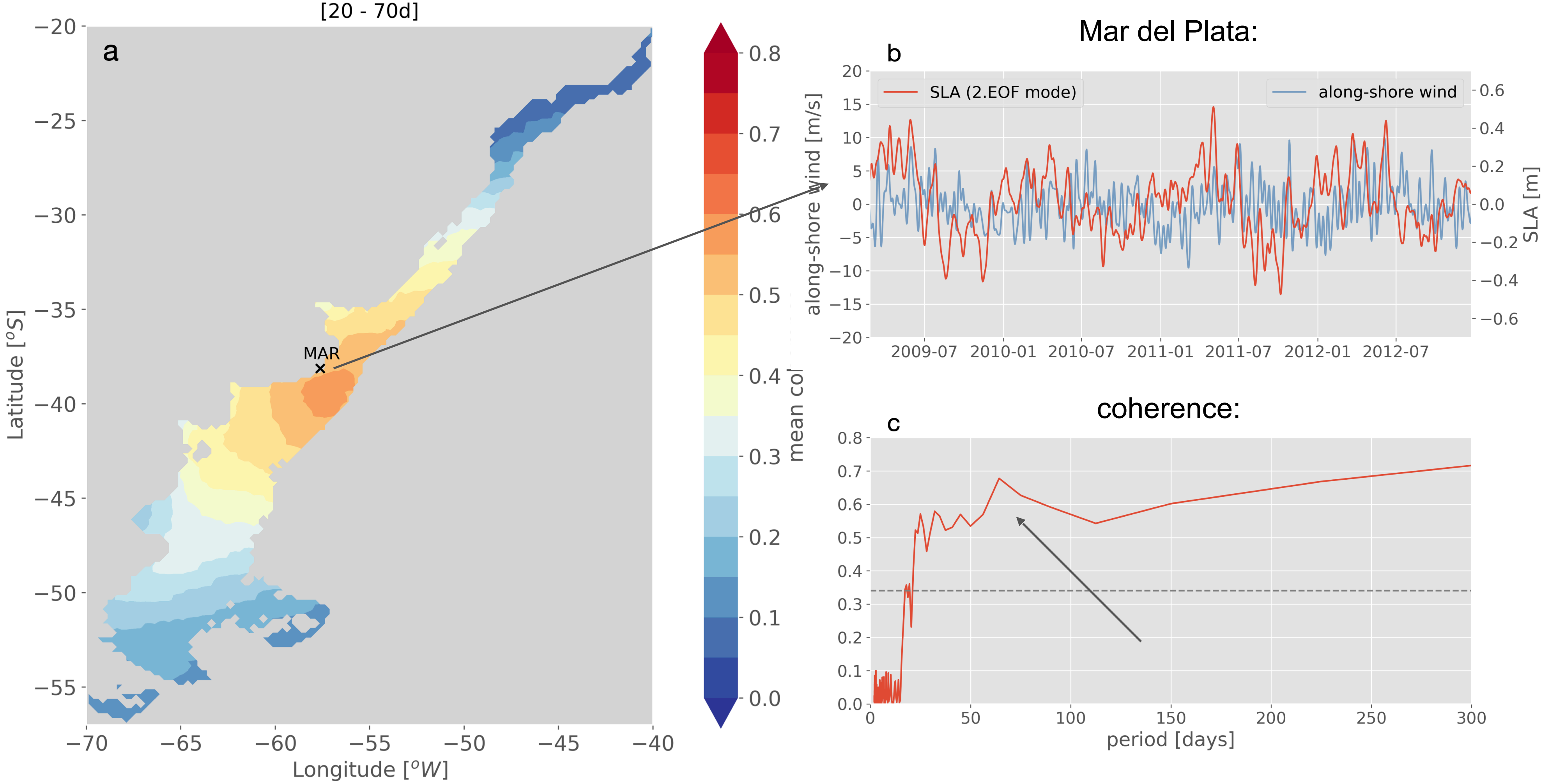


Along-shore geostrophic velocity and along-shore wind:

- Along shore wind drives across-shore ocean mass transport
- Pressure gradient causes geostrophic current velocity
- Part of shelf circulation driven by wind through geostrophic adjustment

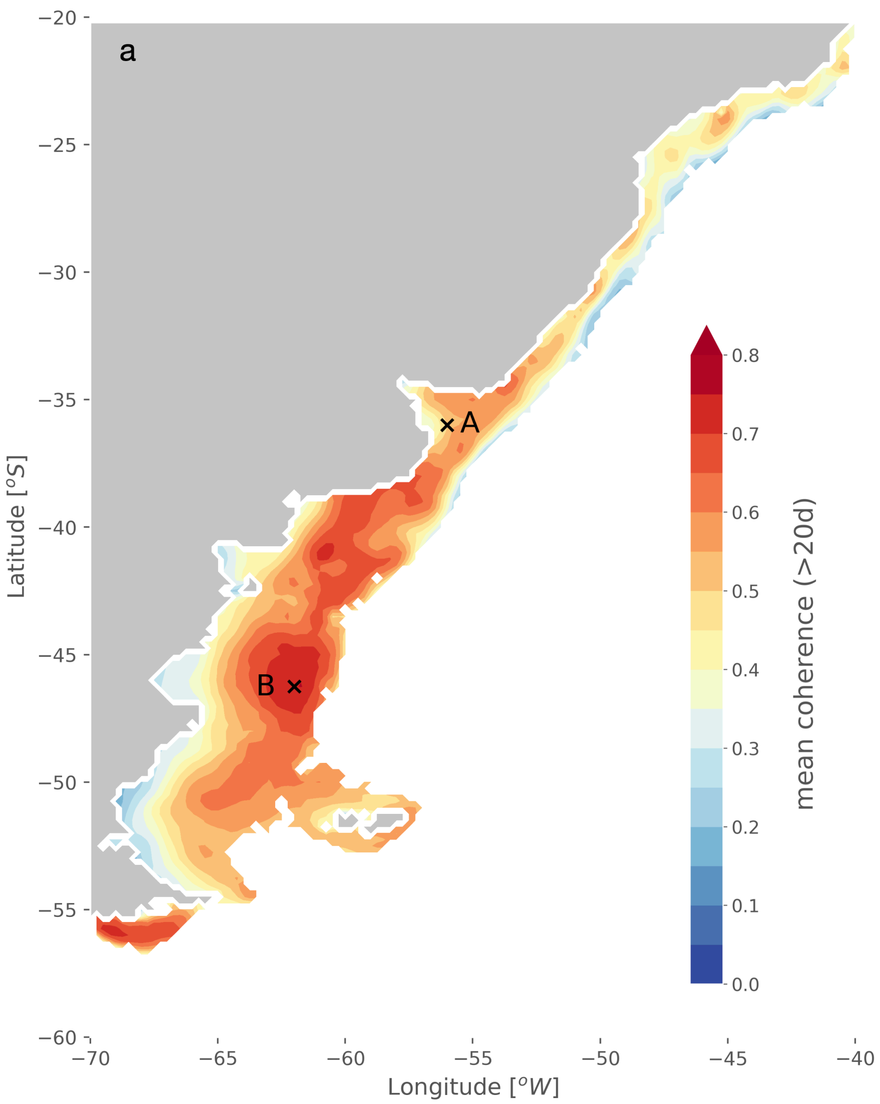
EOF-analysis

- decomposition of SLA into „modes of variability“

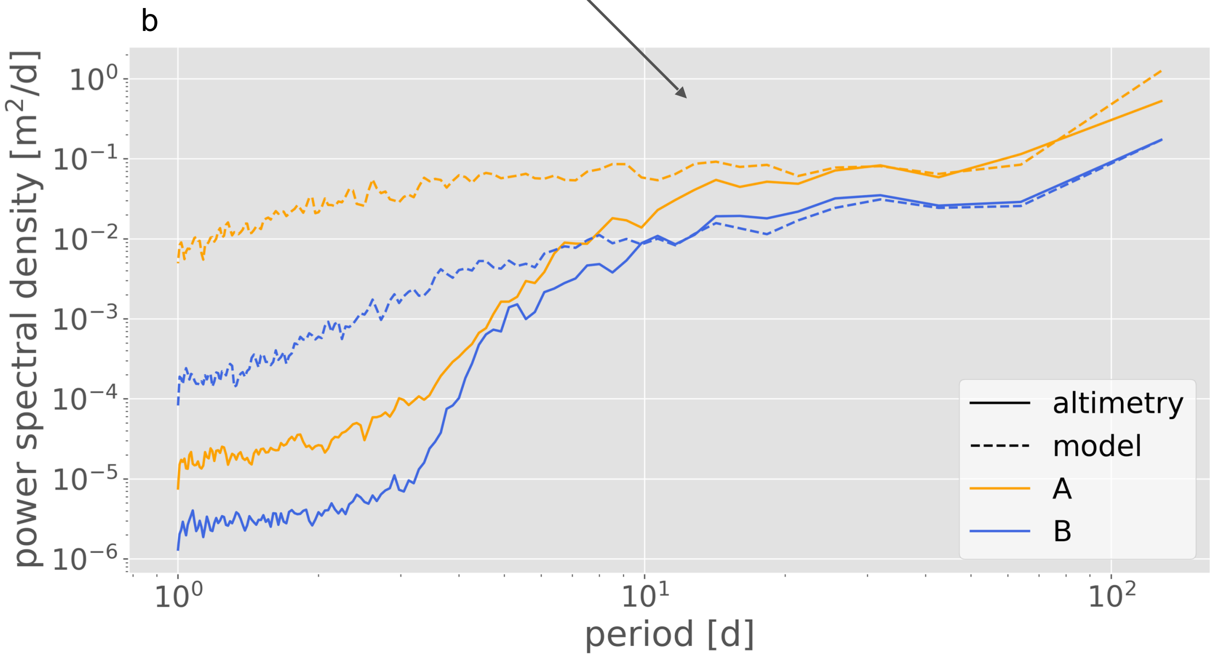


- 2. EOF SLA describe 10% of variability on the shelf
- Shows good agreement with along-shore wind (corr. 0.6)
- best agreement off the coast of Mar del Plata (spatial) and ~70d (temporal)

model vs. gridded altimetry SLA

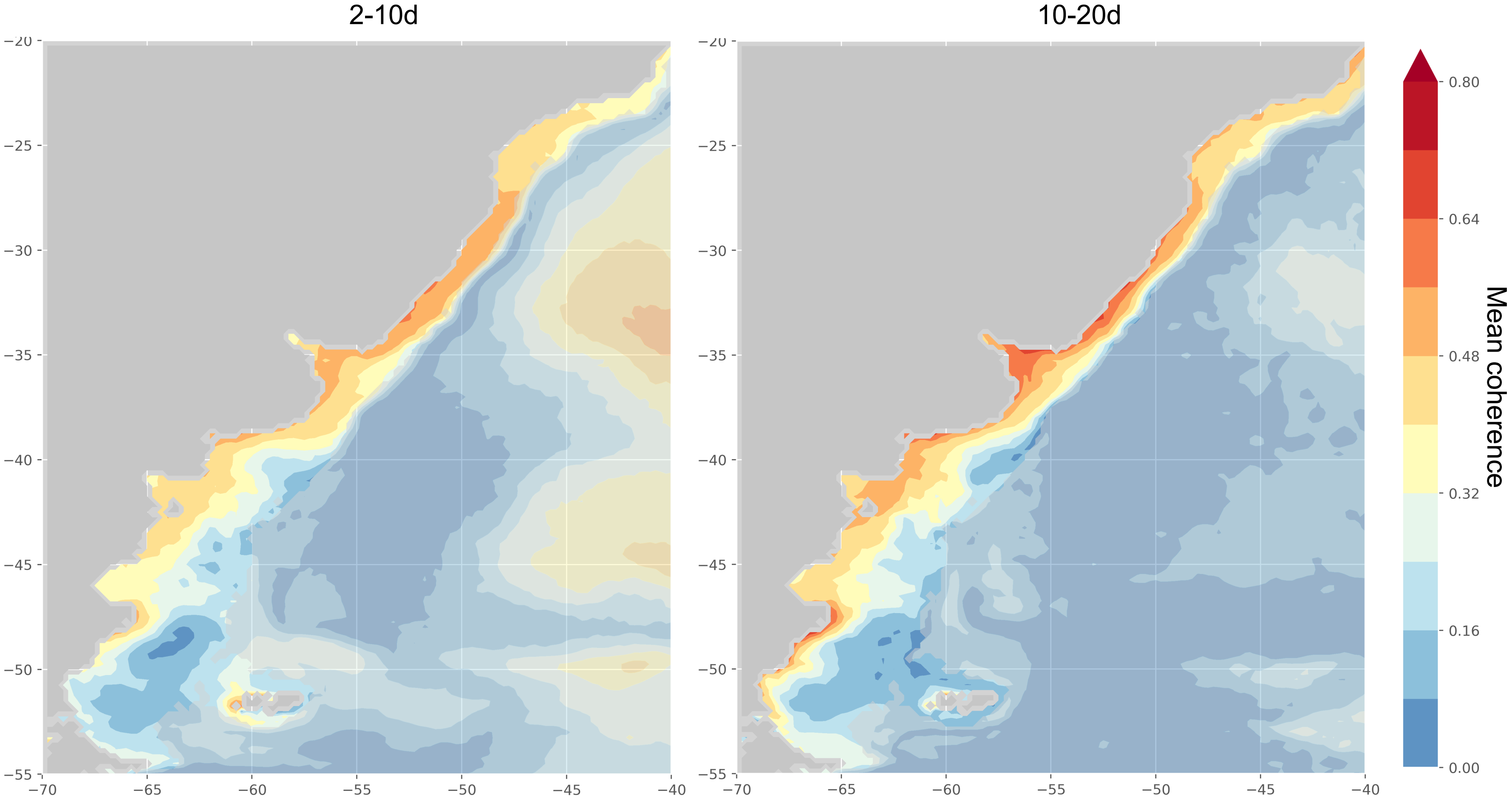


- Largest agreement on the mid shelf
- No correlation below 20d
- Power spectral density suppressed for gridded altimetry SLA



Model SLA below 20d:

- Model provides wind-driven SLA below 20d
- not catched by gridded altimetry, but shows that wind-driven SLA necessary to observe coastal and shelf processes



Conclusion

1. Is high-frequency SLA variability driven by the wind? In which frequencies and regions?

Yes, wind-driven SLA in all frequency bands (>1/20d), most notable along the Brazilian and Uruguayan coast and dominating annually.

2. What is the capability of gridded altimetry to show these high-frequency SLA on the continental shelf?

Coherence of with the wind is notable higher for model SLA than altimetry SLA for 20d to 100d. The wind-driven variability below 20d is fully suppressed in the gridded altimetry product.

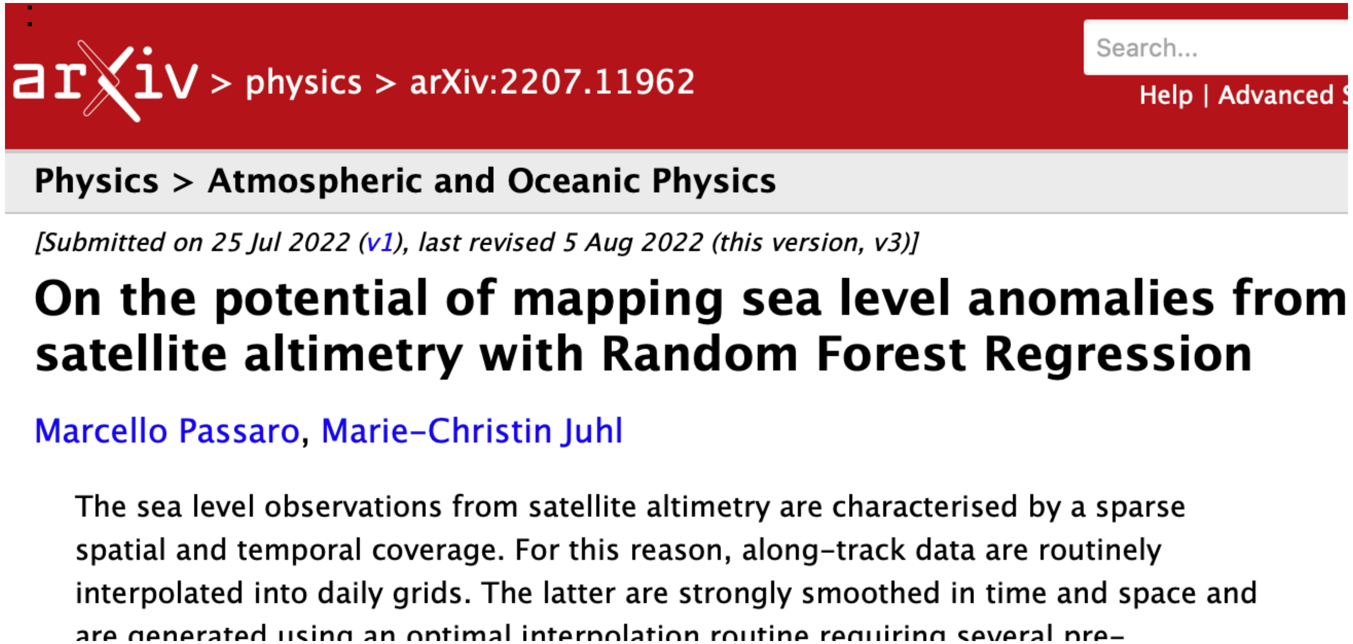
Outlook

Use this information for gridding!

E.g. within Machine learning approach* use of wind data during gridding for improved high-frequency signals

*see our paper „On the potential of mapping sea level anomalies from satellite altimetry with Random Forest Regression“ accepted for Ocean Dynamics

Preprint: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On the potential of mapping sea level anomalies from satellite altimetry with Random Forest Regression

Marcello Passaro, Marie-Christin Juhl

The sea level observations from satellite altimetry are characterised by a sparse spatial and temporal coverage. For this reason, along-track data are routinely interpolated into daily grids. The latter are strongly smoothed in time and space and are generated using an optimal interpolation routine requiring several pre-