SMOS Sea Surface Salinity contribution to the Land-Marine Boundary Development and Analysis (LAMBDA) project

E. Olmedo, F. Campuzano. A. Turiel, P.B. Oliveira and M.M. Angélico

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Lambda project

The LAMBDA project aims to improve the CMEMS MFCs thermohaline circulation in coastal areas by a better characterisation of the land-marine boundary conditions, with special regard to the salinity fields, through exploring the capacities of watershed numerical modelling and its coupling to mesoscale regional ocean models. New Earth Observation sea surface salinity products and experts groups will evaluate the project products impact on ocean salinity fields..

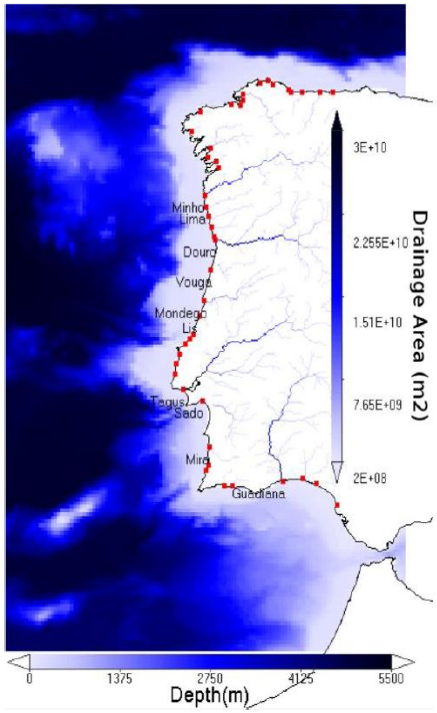

Figure 3. Modelling grids for the PCOMS regional ocean model and the MOHID Land water lines. In the map the main river courses for Western Iberia are represented and the dots indicate the location of the rivers discharges from the MOHID Land and the names of the main rivers discharging in Portuguese territory.

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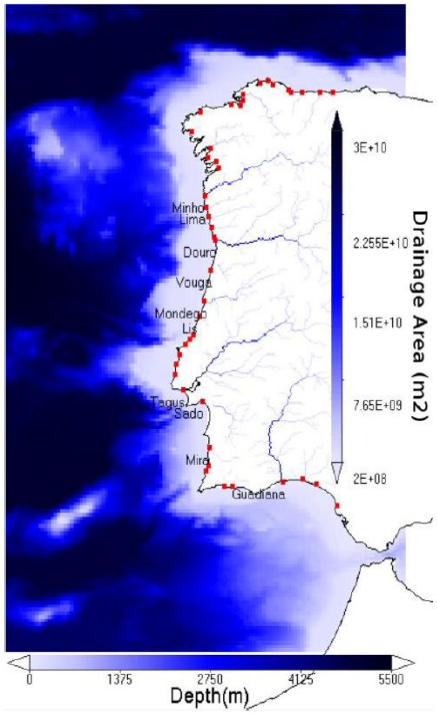

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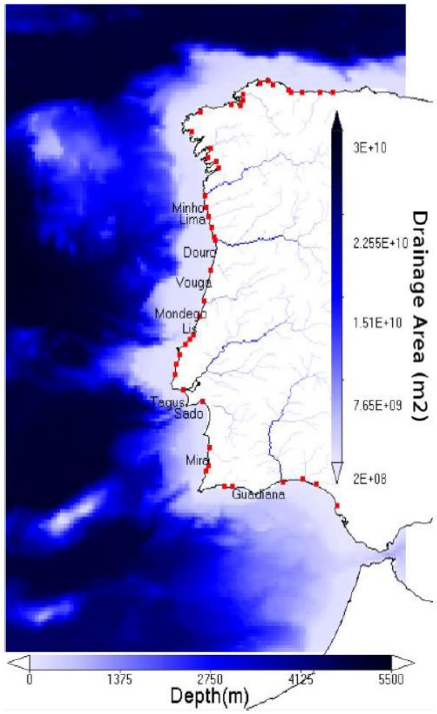

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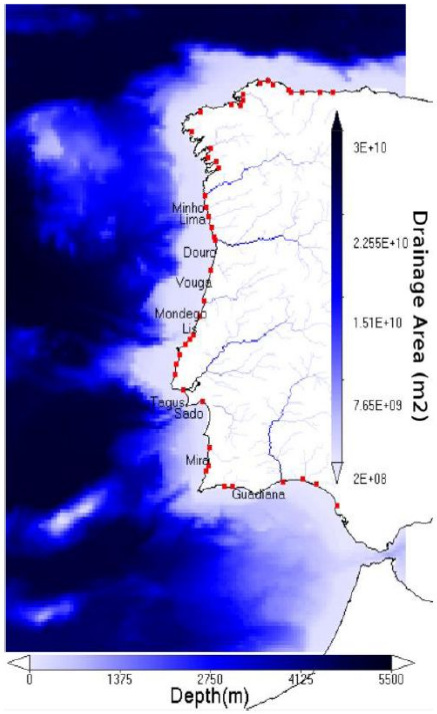
Activity 4-Remote sensing validation by EO CMEMS prdocuts and novel EO salinity products development.

The impact of river runoff on those regional ocean CMEMS products will be evaluated by comparing the obtained salinity fields from each LAMBDA river flow scenario with the current forcing results. Since, in-situ measurements close to the coast are scarce and unreliable, innovative SMOS SSS products produced by BEC-ICM for this project can provide a robust source of salinity information for validation.



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SMOS SSS

The North Atlantic and the Mediterranean sea a have been identified as a hot-spot of climate change

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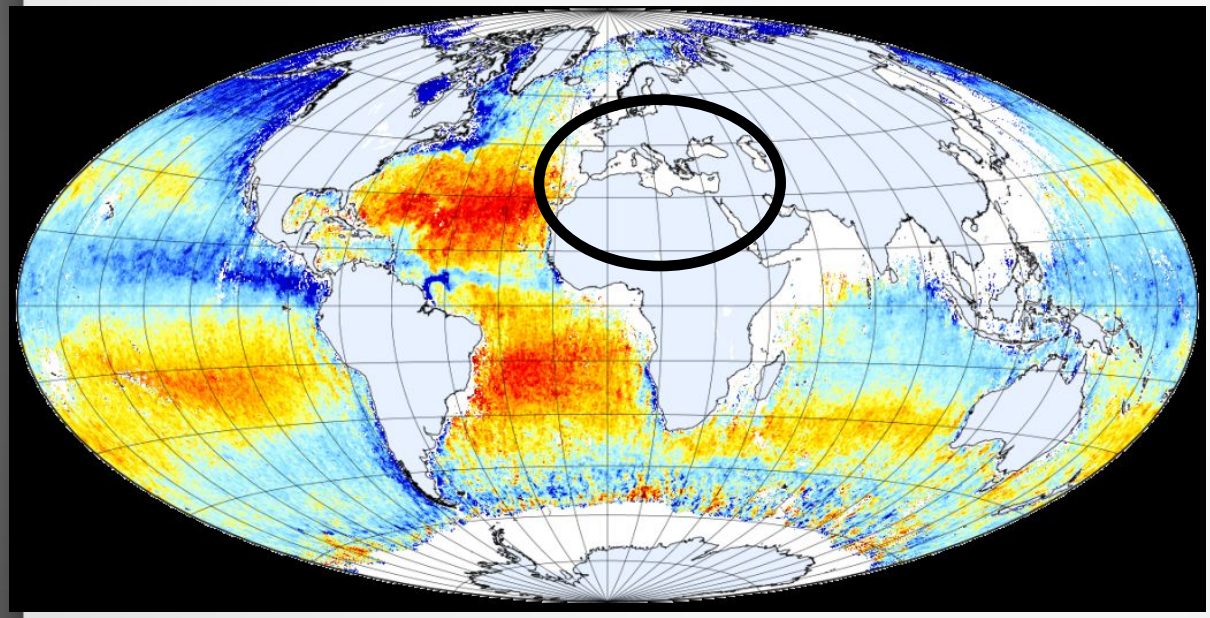

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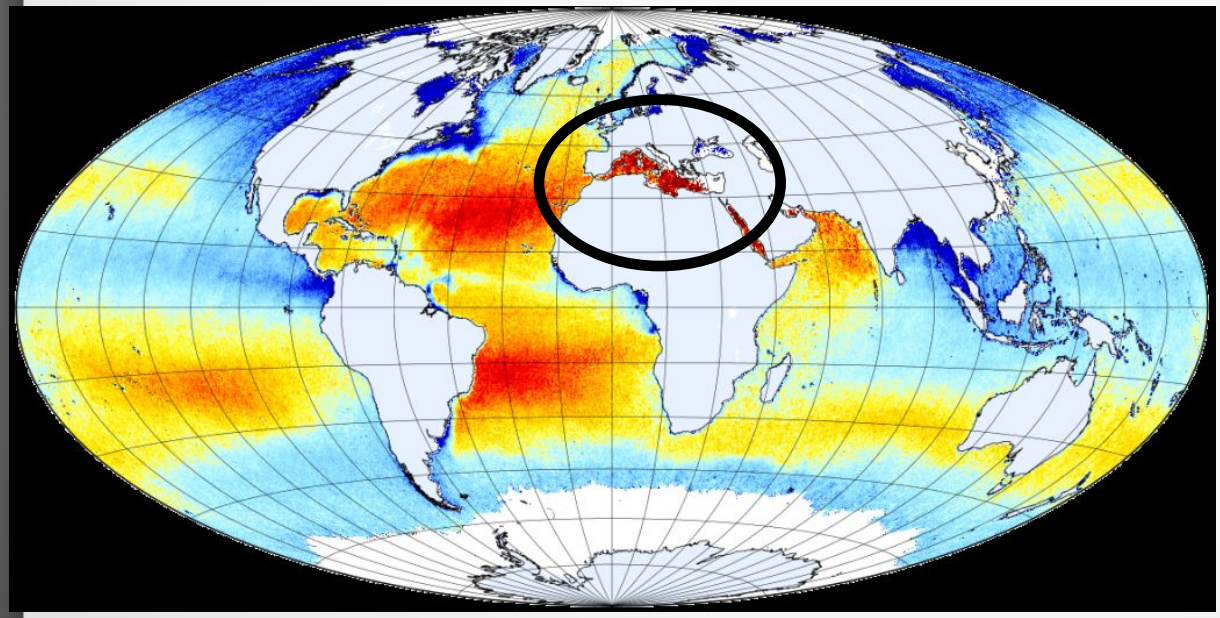

Olmedo E. et al (2017) Remote Sensing of Environment

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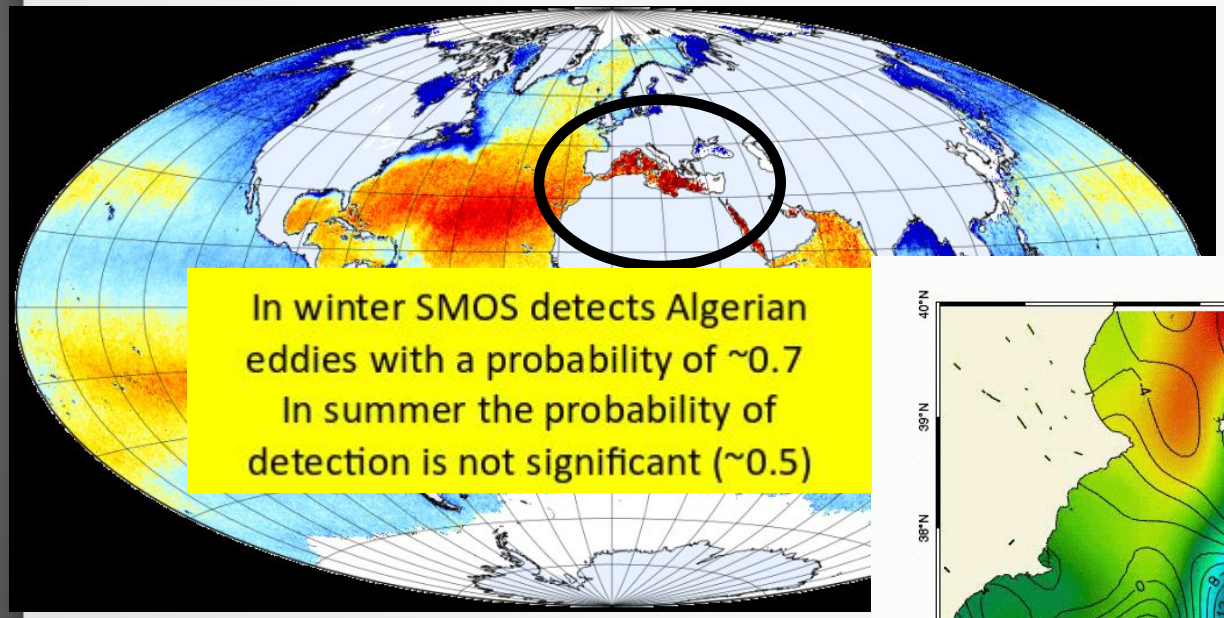

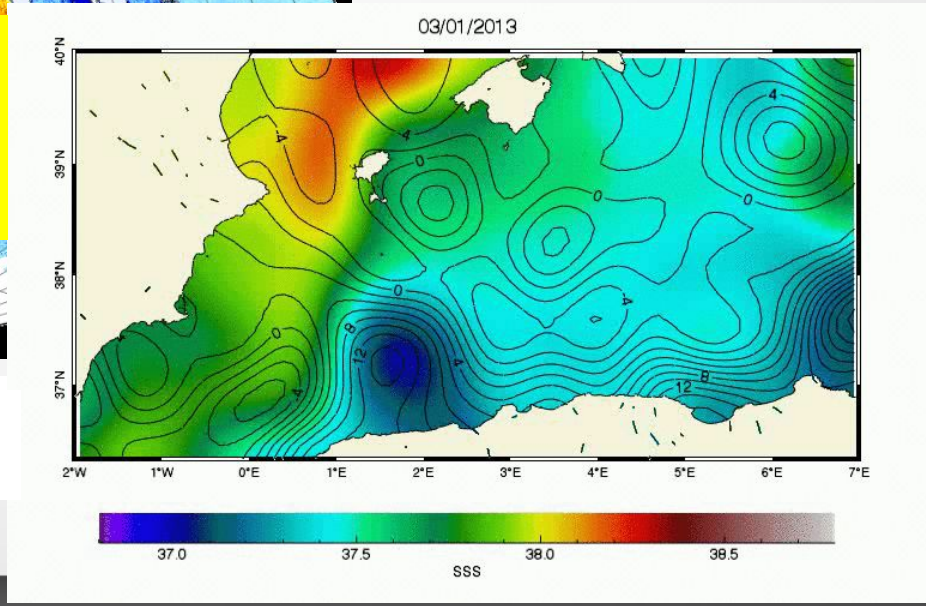

Isern-Fontanet, J.. et al (2016) Geophysical Research Letters

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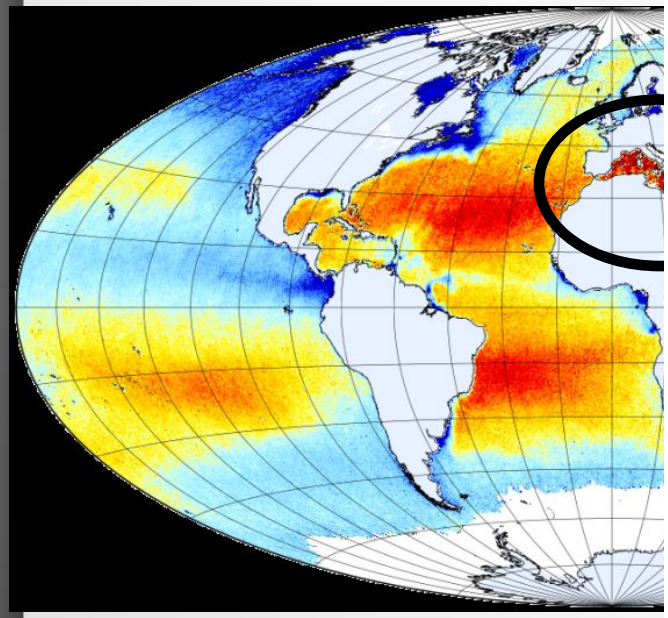
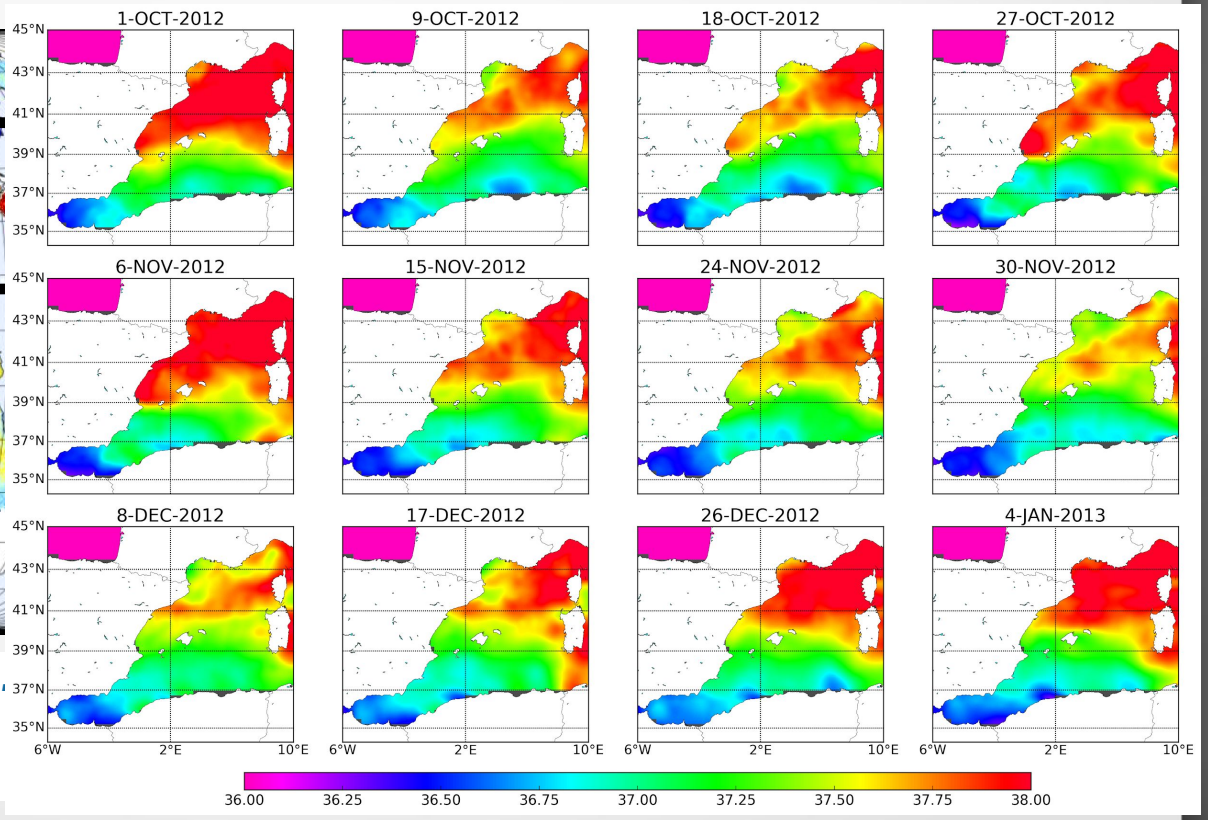




Olmedo, E. et al (2018) Remte Sensing

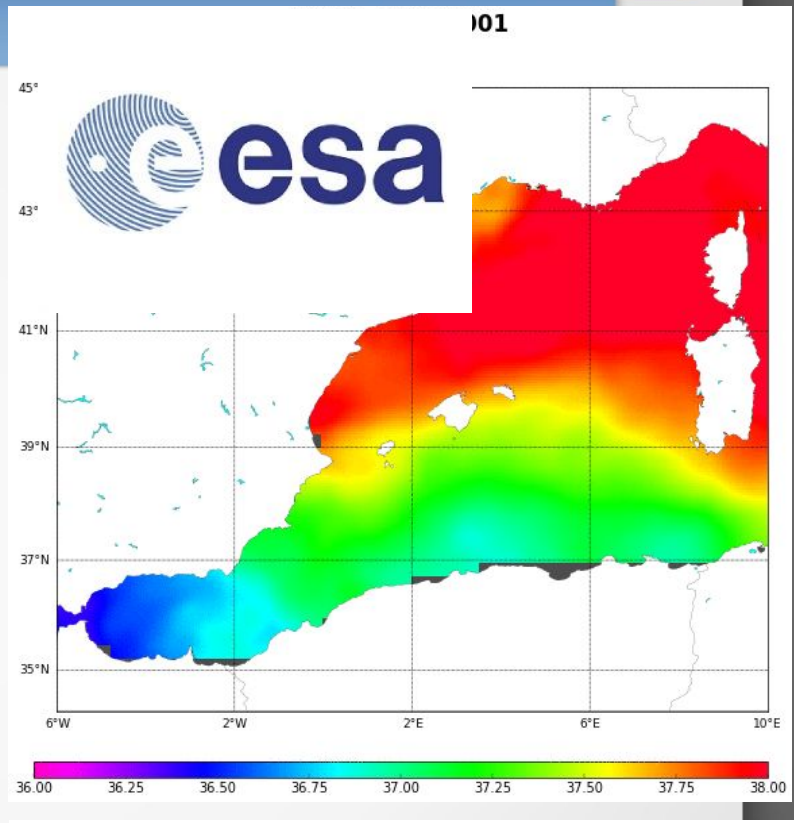
SMOS SSS

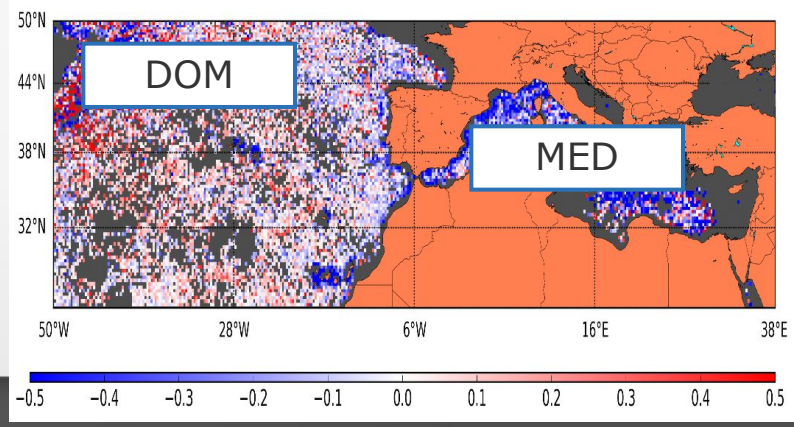
The combination of several recent methodologies (in the SMOS context) has been used to obtain Sea Surface Salinity (SSS) fields over the North Atlantic Ocean and the Mediterranean Sea:

- **Debiased non-Bayesian** mitigates the systematic biases (constant on time) and improves the coverage.
- **DINEOF decomposition** allows the characterization of the time-dependent biases: seasonal and particular events
- **Multifractal fusion** improves the description of the mesoscale structures

The new **products improves the accuracy with respect to the previous products that were produced at the BEC**:

- RMSE SMOS-ARGO:
  - DOM: 0.26 (new) vs 0.41 (old)
  - MED: 0.39 (new) vs 0.70 (old)





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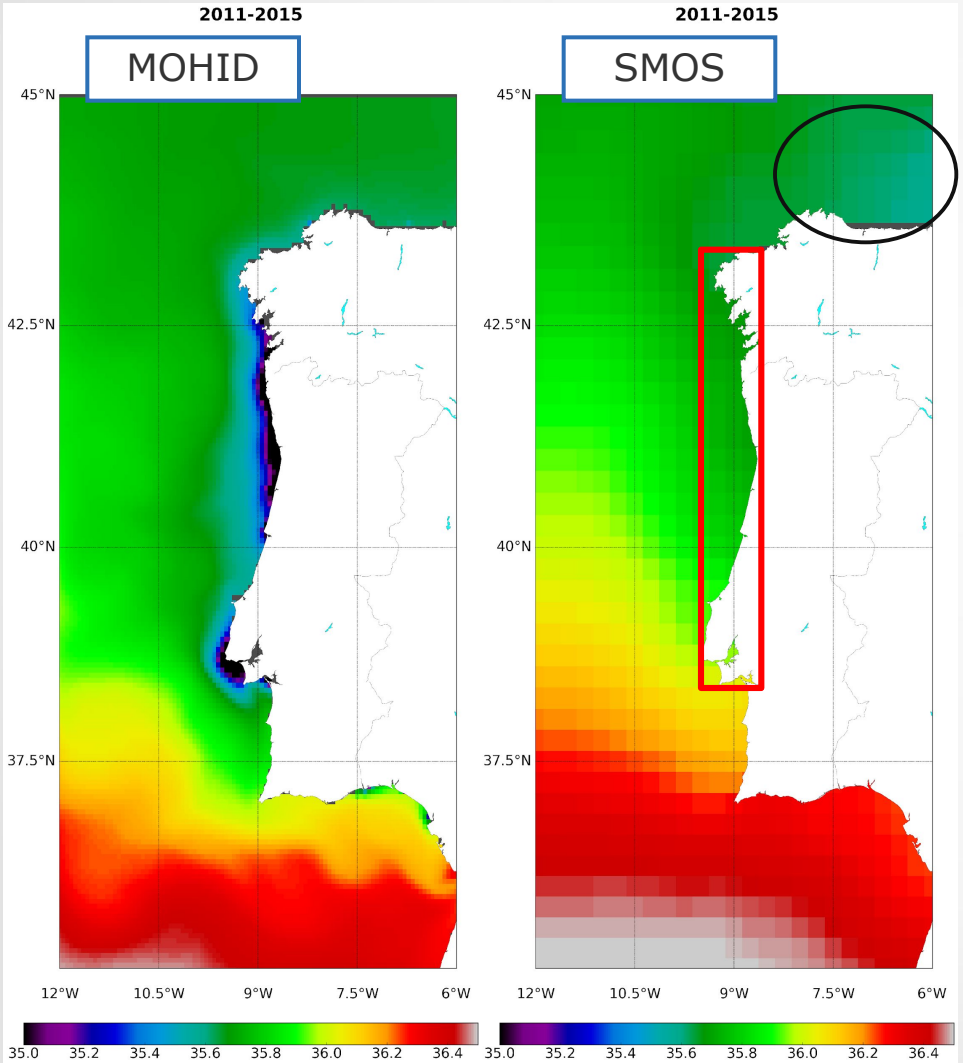
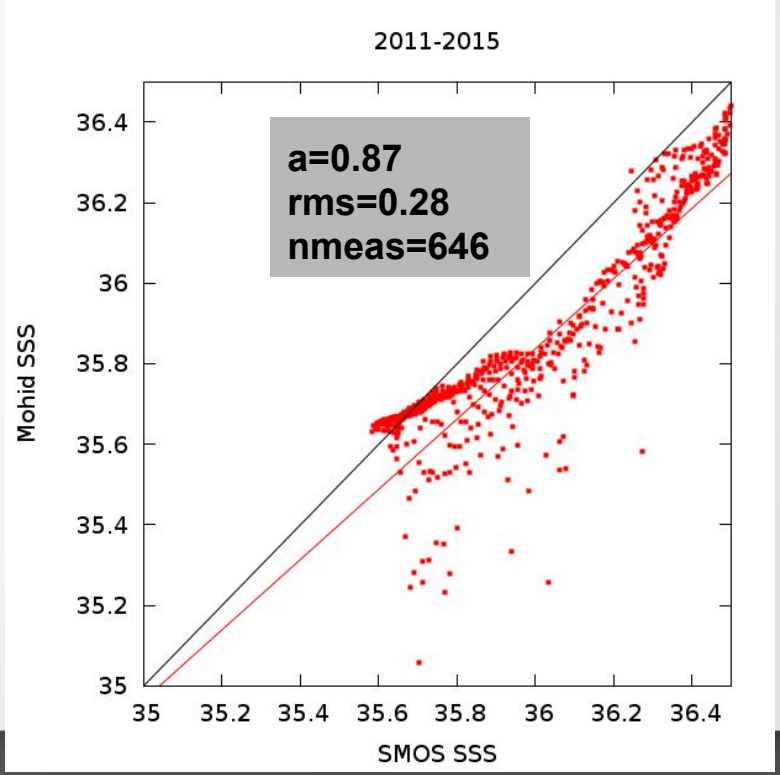
SMOS vs model: 2011-2105



Current SMOS products cannot capture the salinity gradient in pixels too close to Portuguese coast.

Fresher salinity in the Cantabrian coast in SMOS products

Differences in meridional salinity gradients.



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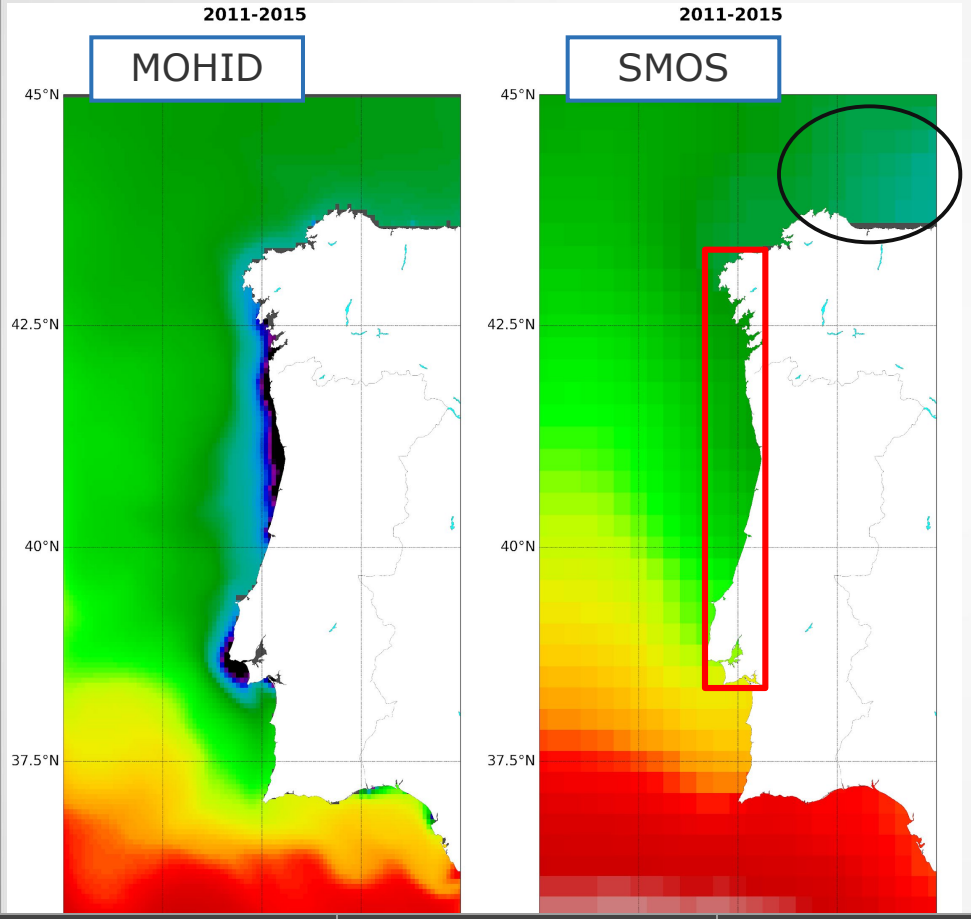
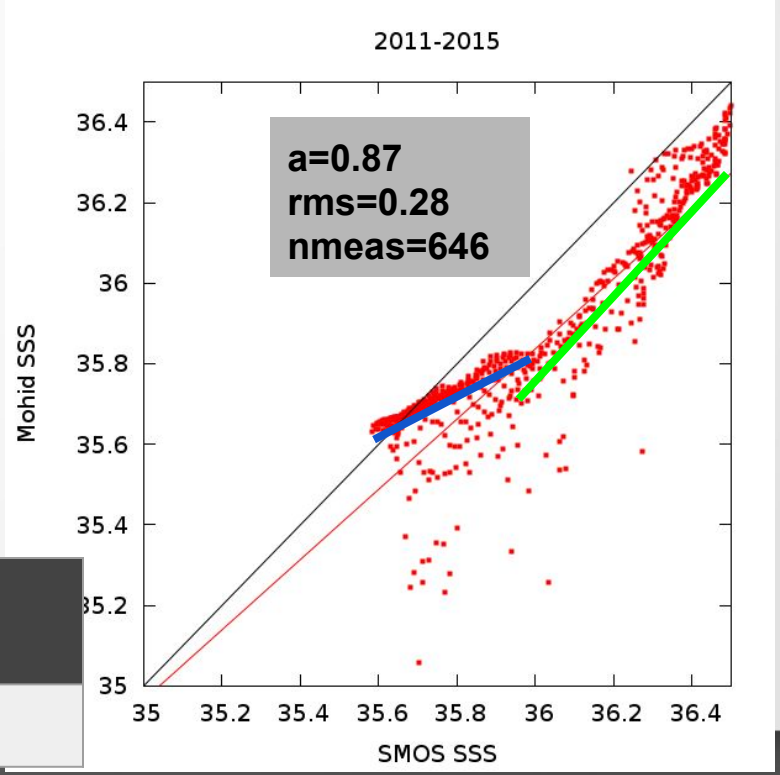


Scatter plot shows two different regimes:

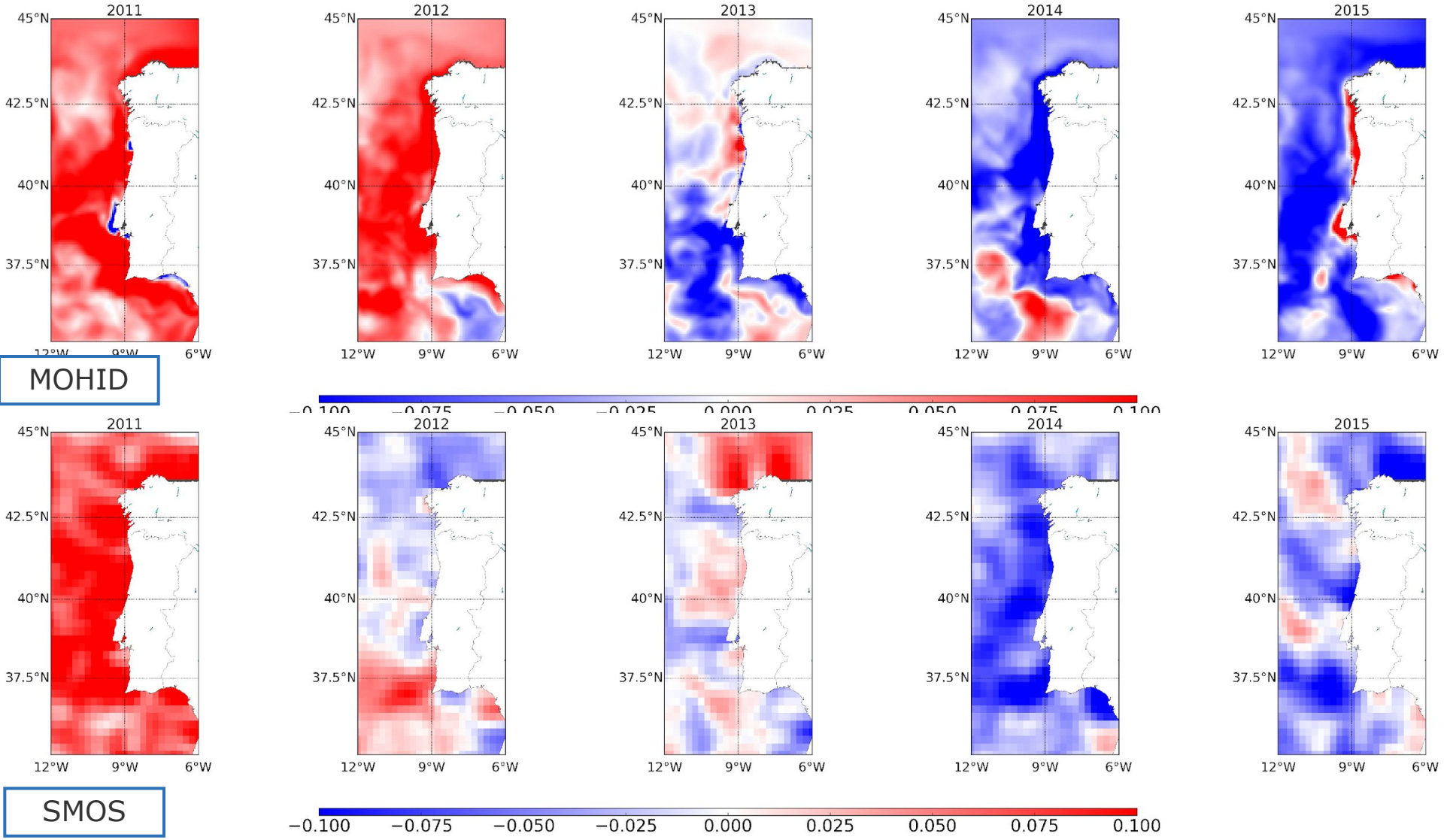
a) Green line: with trend close to one (good correlation) and a bias between SMOS and model (SMOS SSS> MOHID SSS)

b) Blue line: with trend very different from one and SMOS SSS fresher than MOHID SSS. This regime corresponds to region of SSS in the Cantabrian Sea



MEAN (SMOS-MOHID)	STD (SMOS-MOHID)	CORR
0.16	0.28	0.68

SMOS vs model: interannual variability



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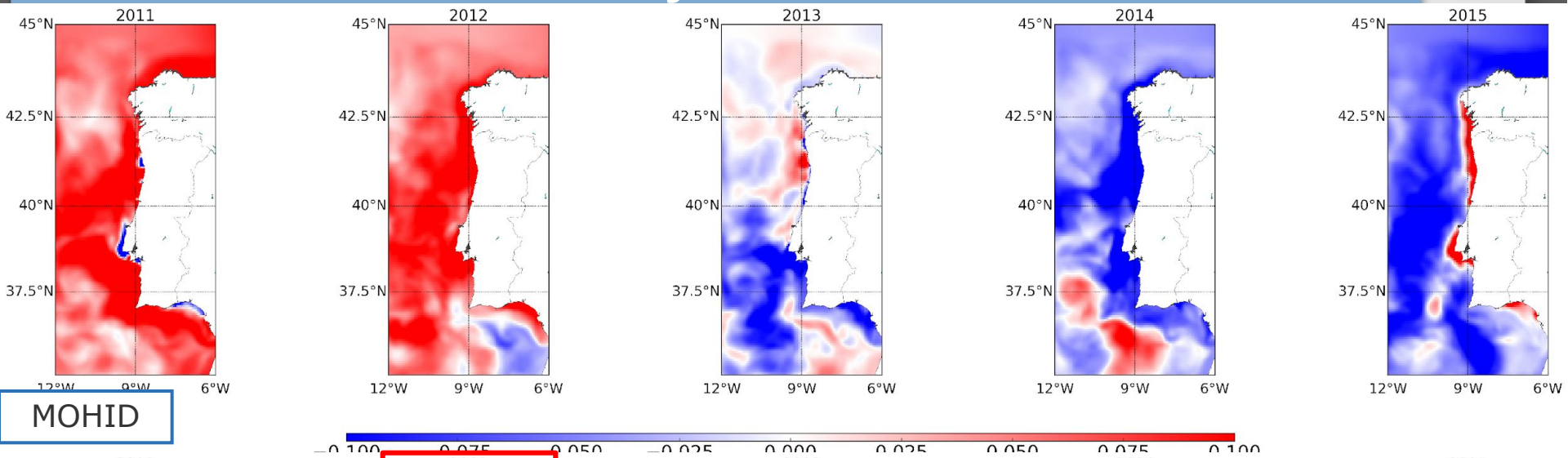
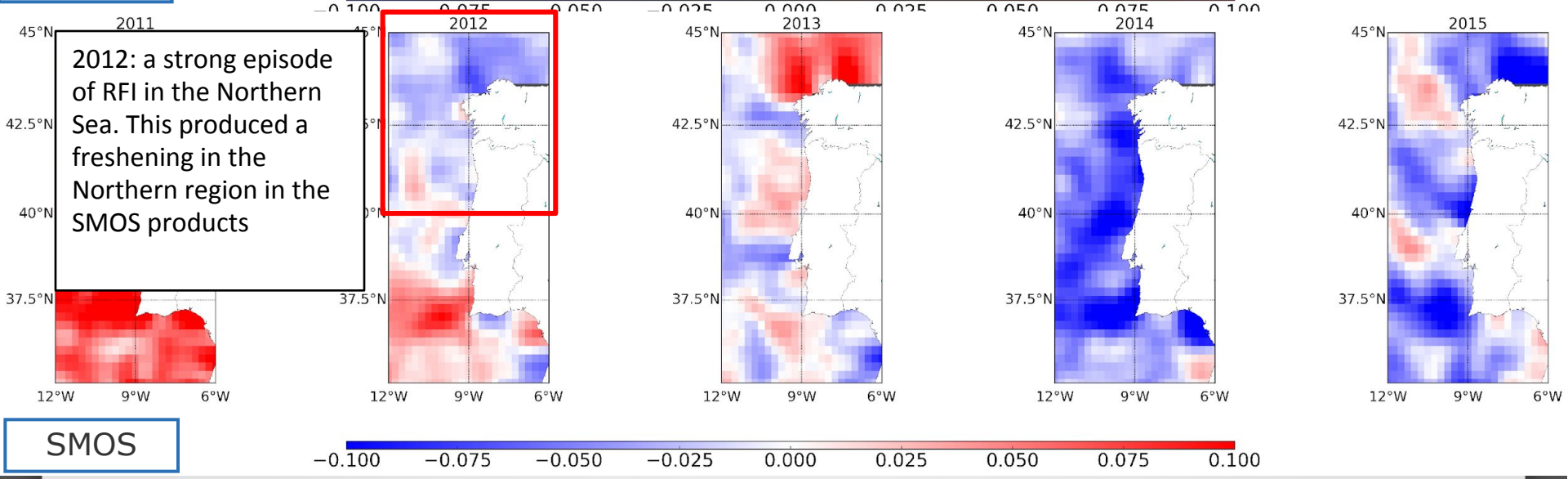


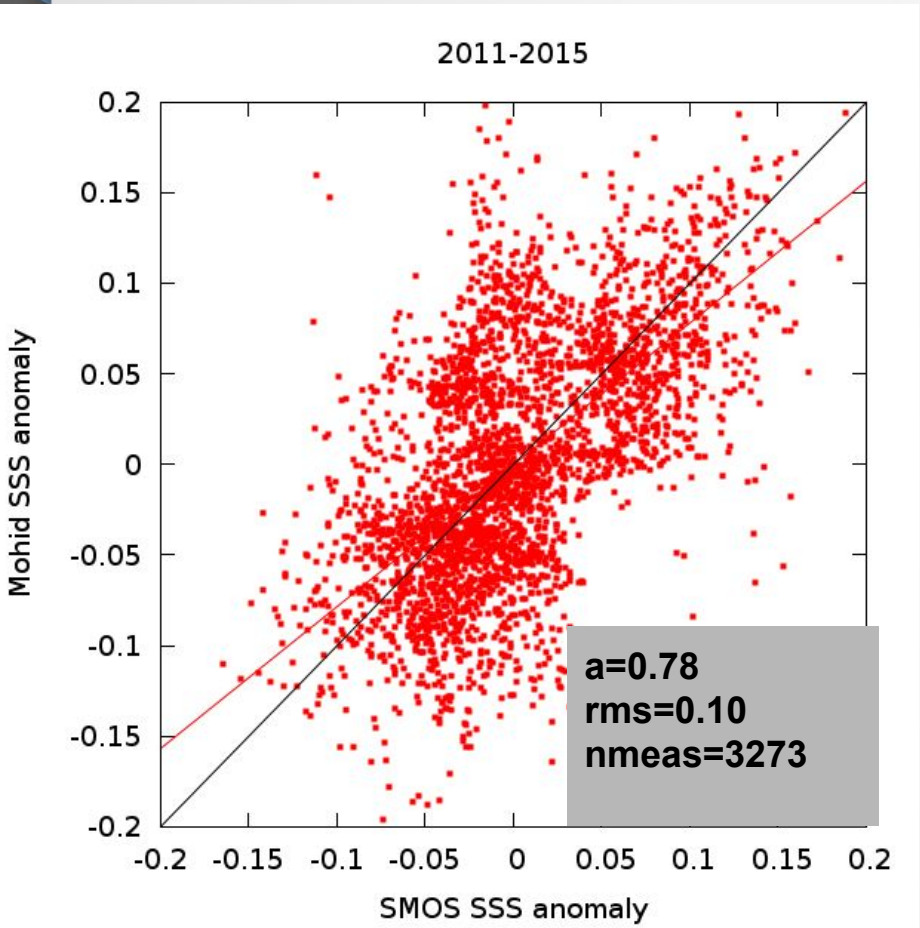
MOHID

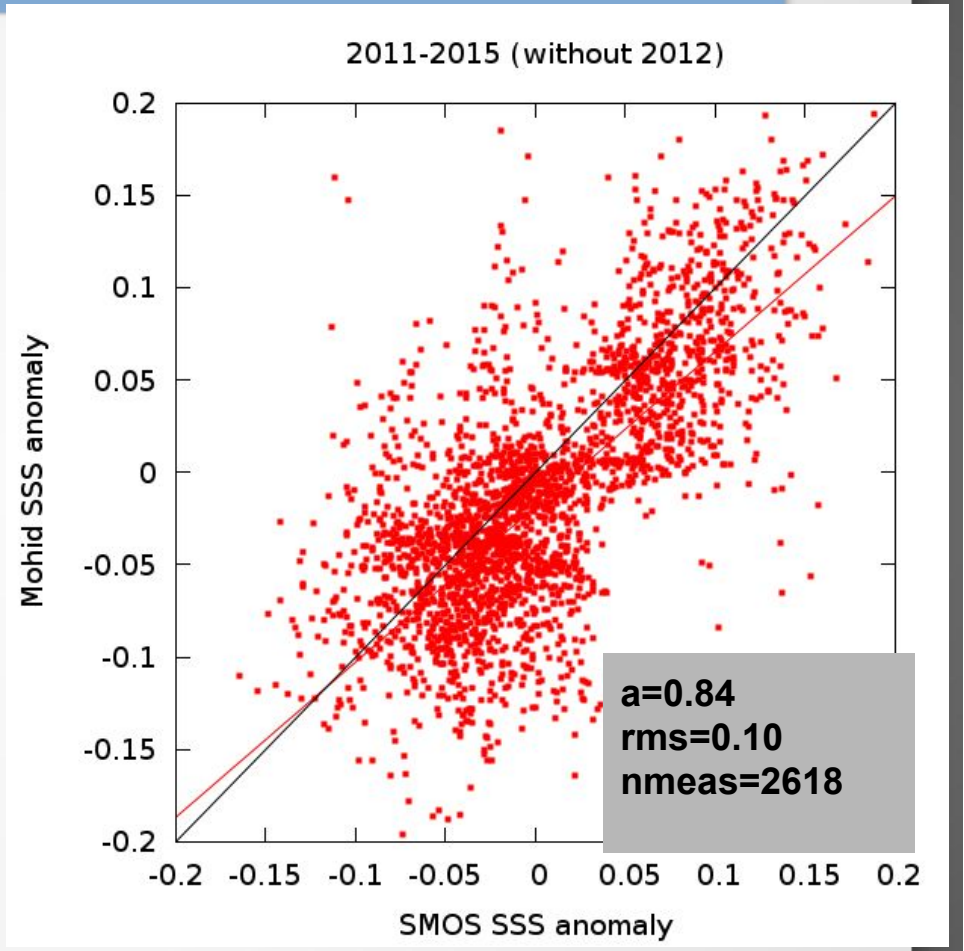


2012: a strong episode of RFI in the Northern Sea. This produced a freshening in the Northern region in the SMOS products

SMOS

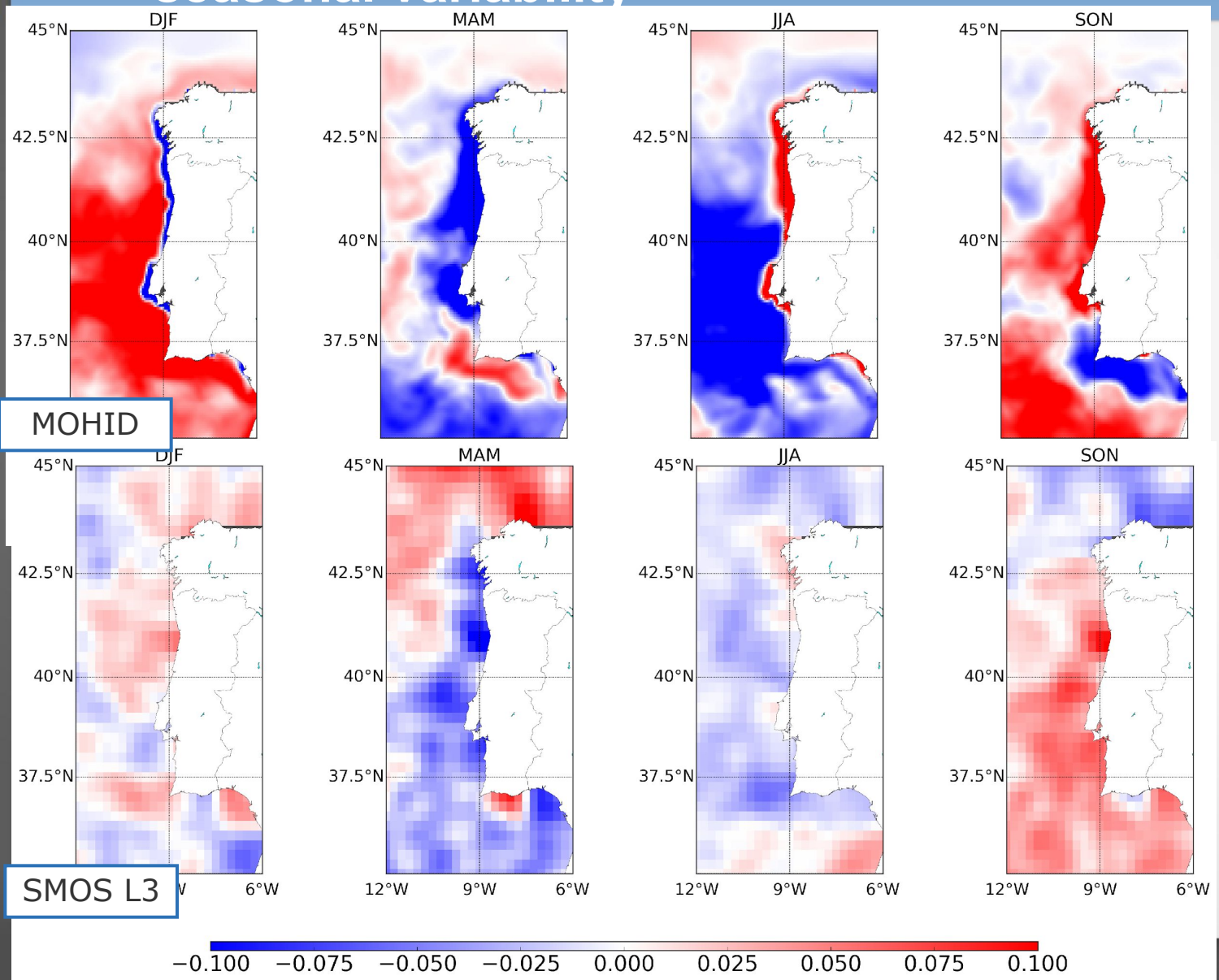
SMOS vs model: interannual variability





MEAN (SMOS-MOHID)	STD (SMOS-MOHID)	CORR	MEAN (SMOS-MOHID)	STD (SMOS-MOHID)	CORR
0.00	0.11	0.39	0.02	0.10	0.47

SMOS vs model: seasonal variability



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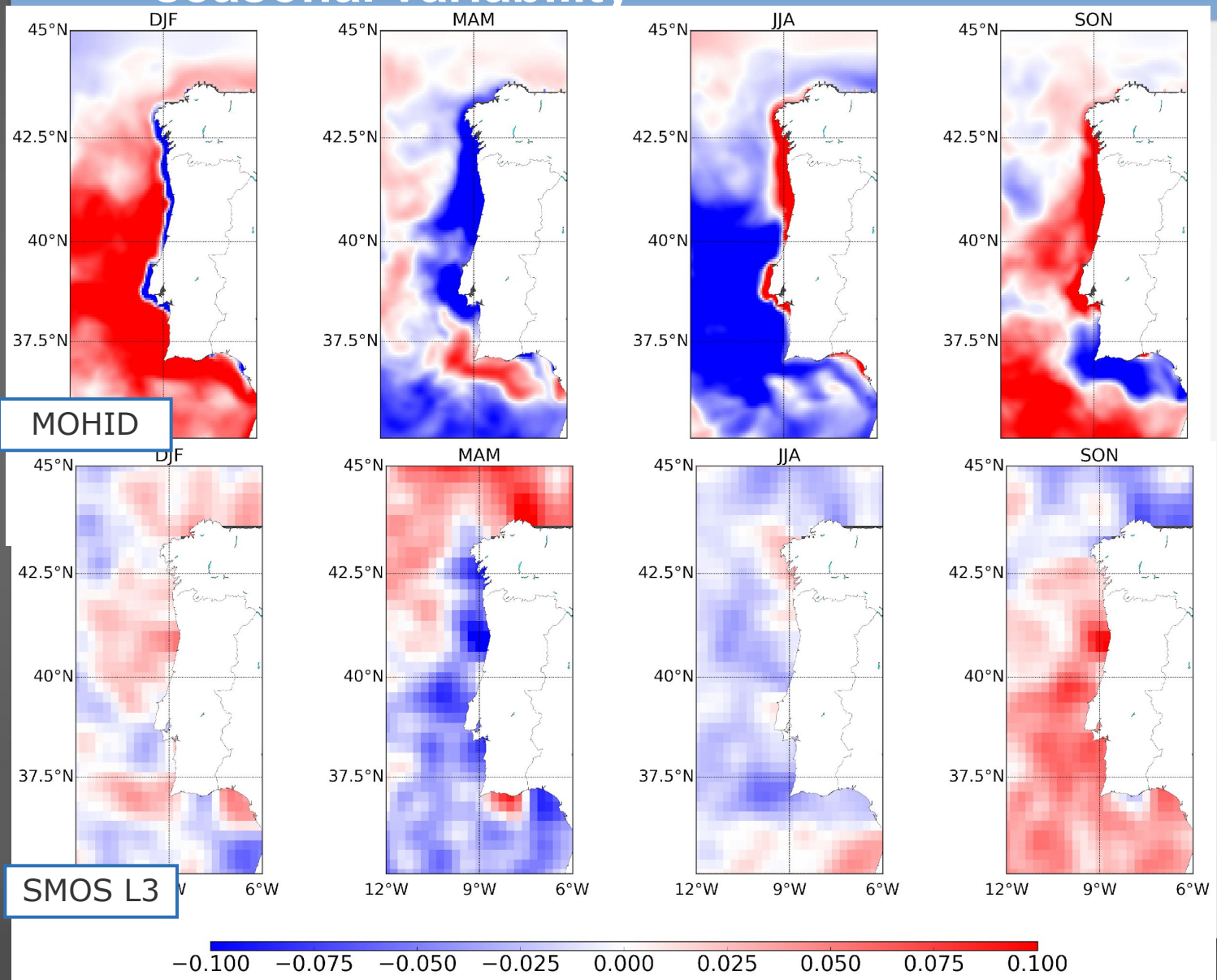
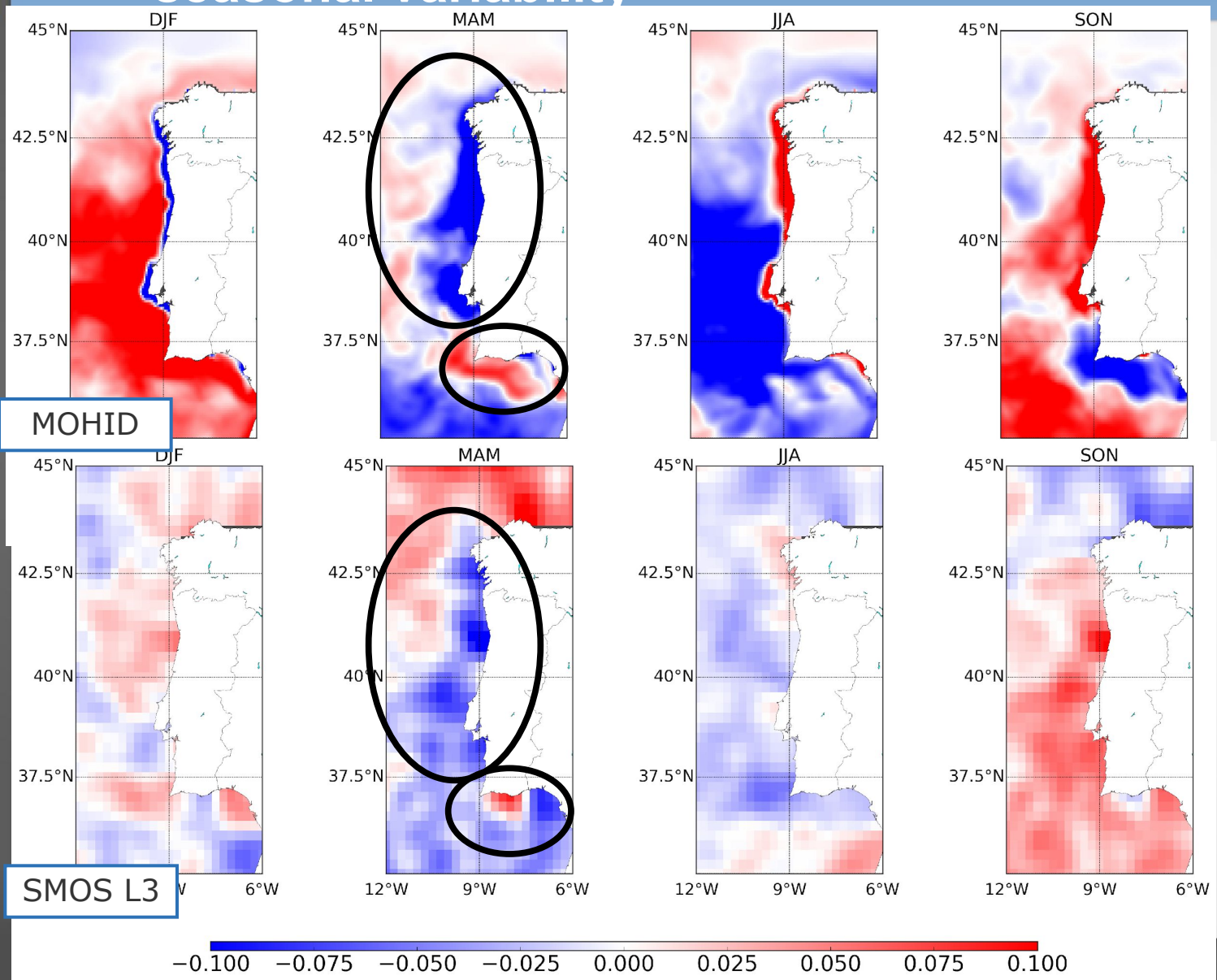


Differences in the DJF season.

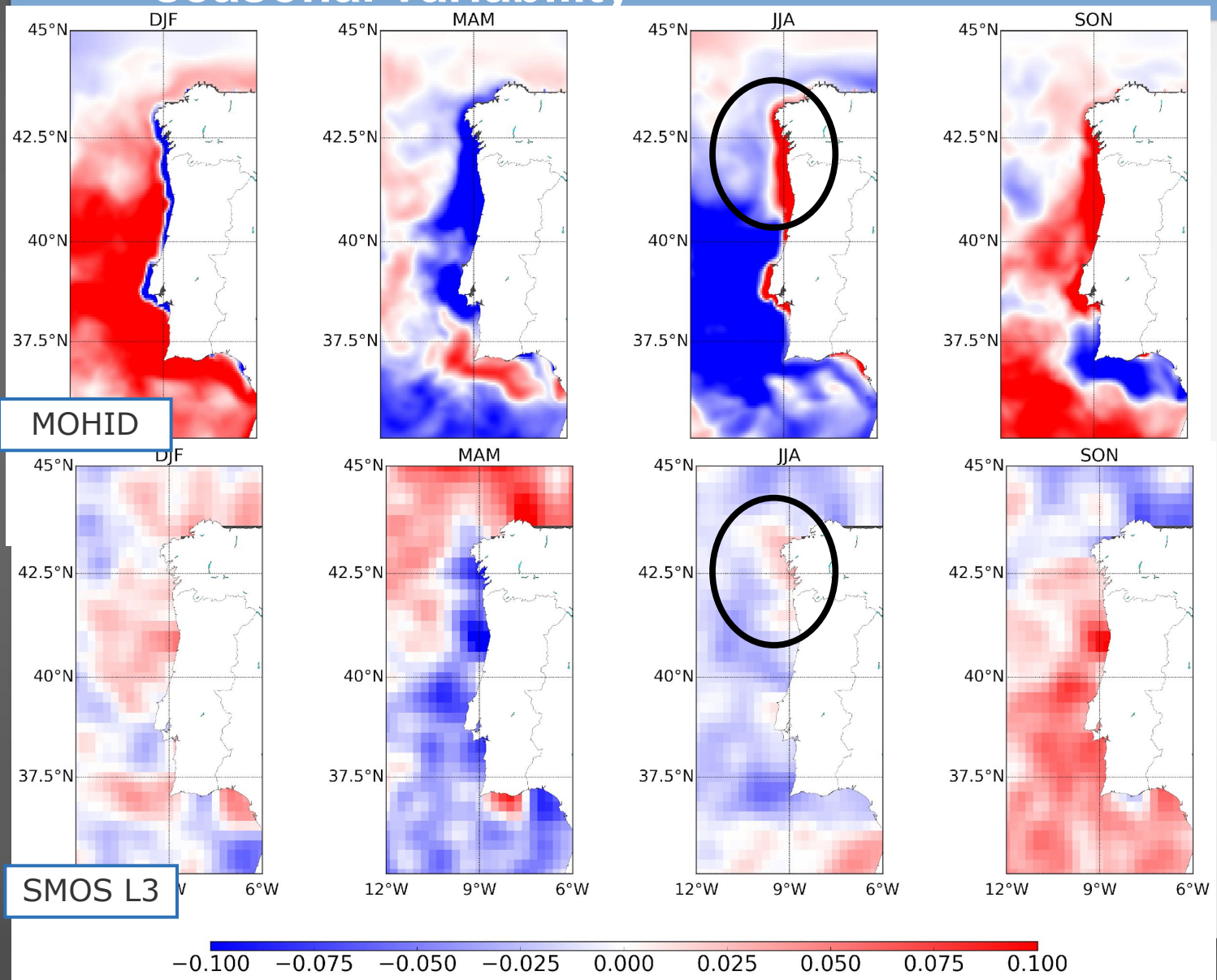
SMOS vs model: seasonal variability



Differences in the DJF season.

Good agreement in the MAM season. Larger salty anomaly displayed by MOHID in the Gulf of Cadiz

SMOS vs model: seasonal variability



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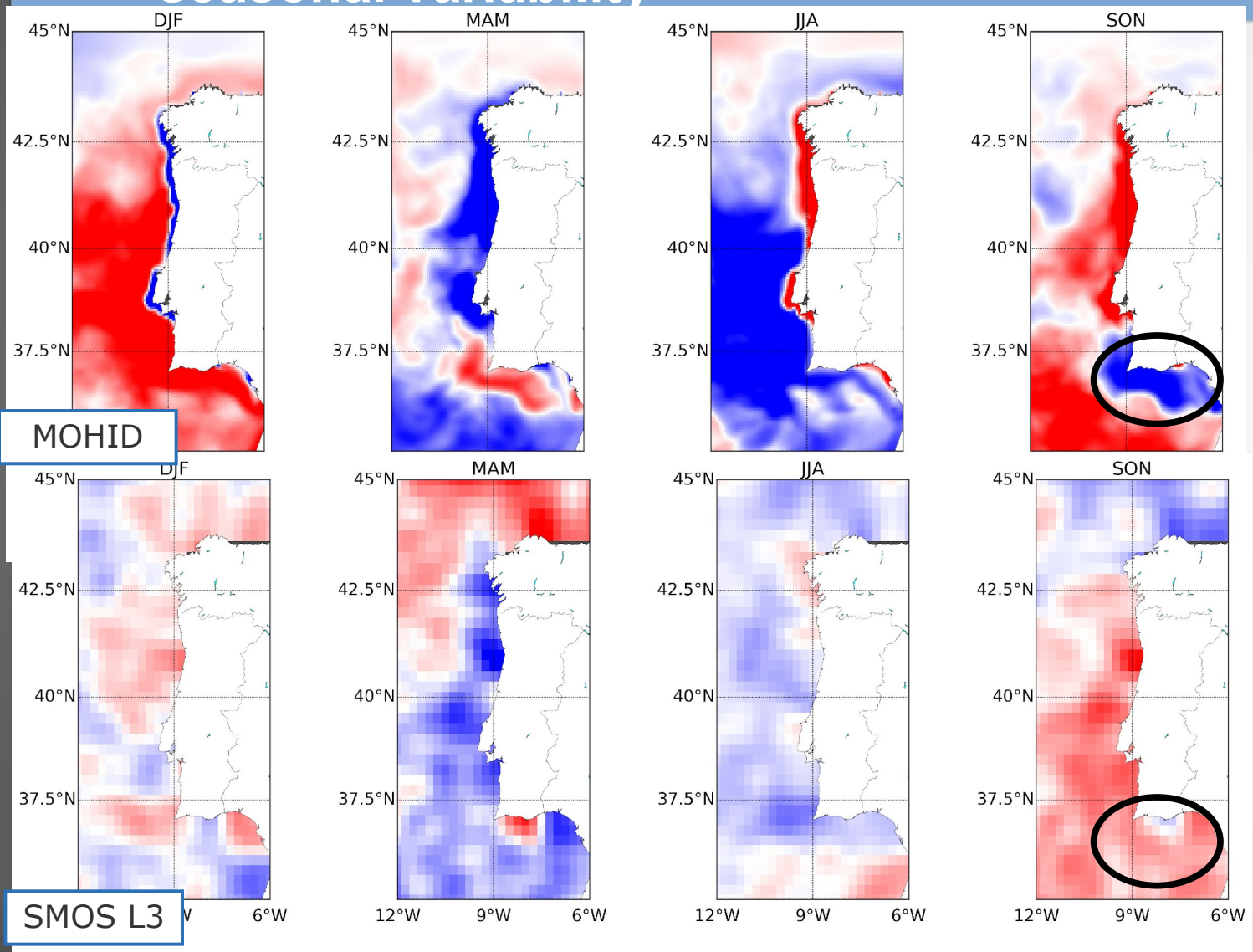
Salty anomalies close to the coast in both salinity products in JJA season

SMOS vs model: seasonal variability



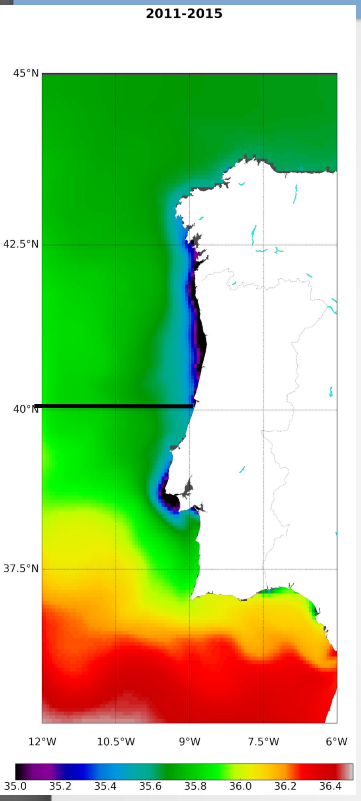
Differences in the DJF season.

Good agreement in the MAM season. Larger salty anomaly displayed by MOHID in the Gulf of Cadiz

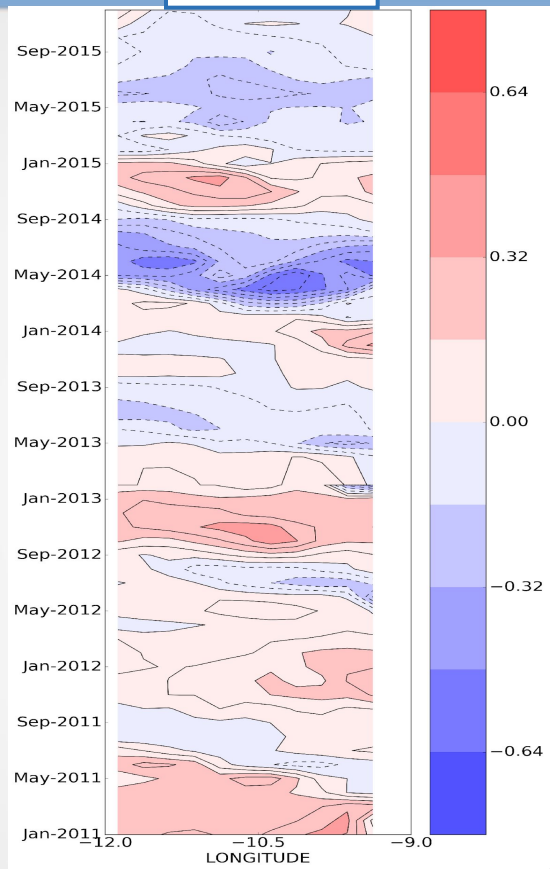
Salty anomalies close to the coast in both salinity products in JJA season

In SON, fresh anomalies in the southern coast in both salinity products, but larger in Mohid.

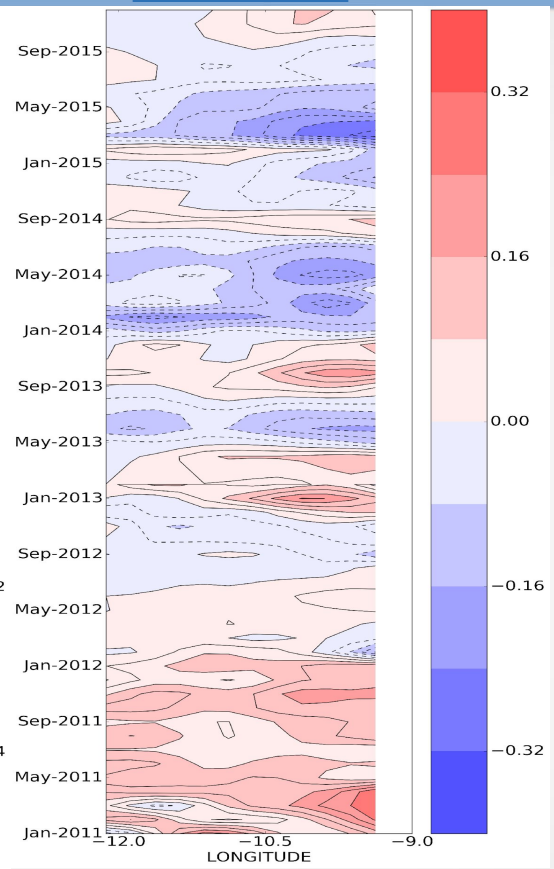
SMOS vs model: Hovmoller



MOHID

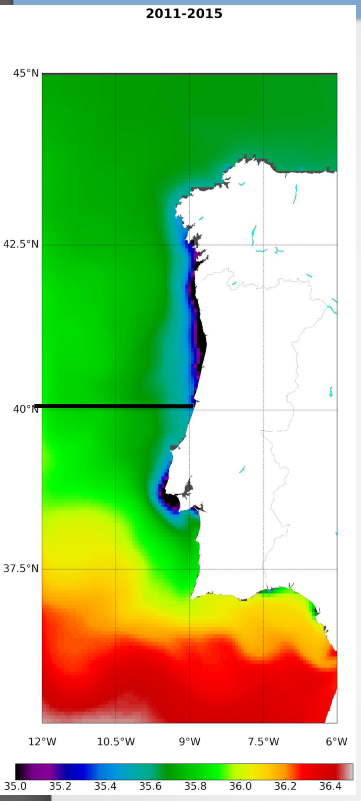


SMOS



Lat = 40.5ºN

SMOS vs model: Hovmoller



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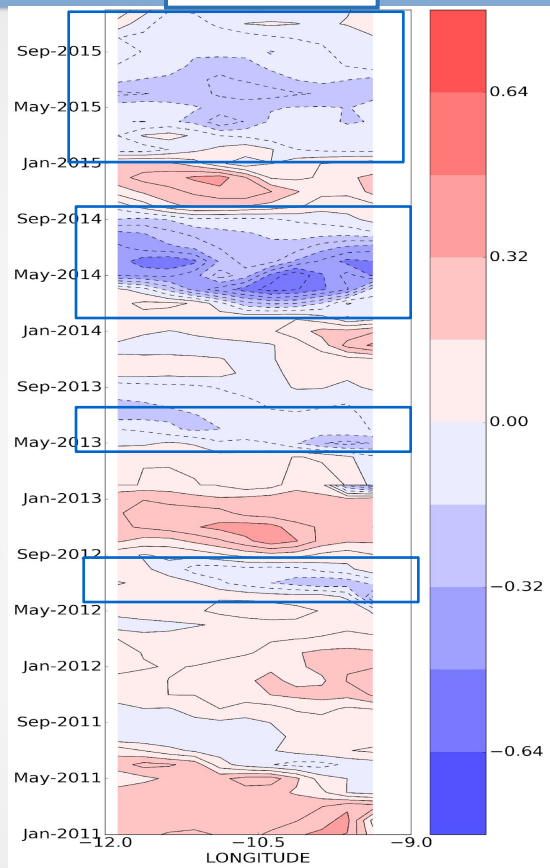
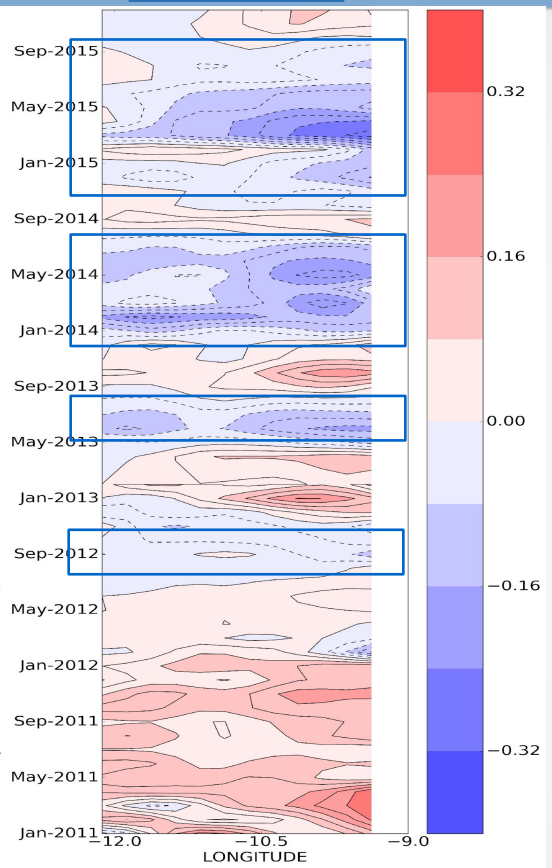


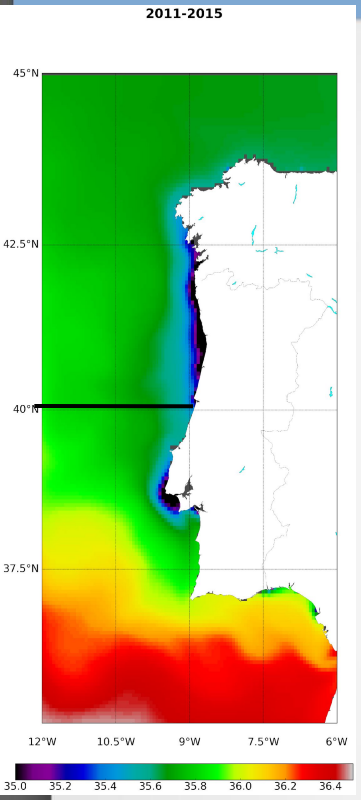
SMOS

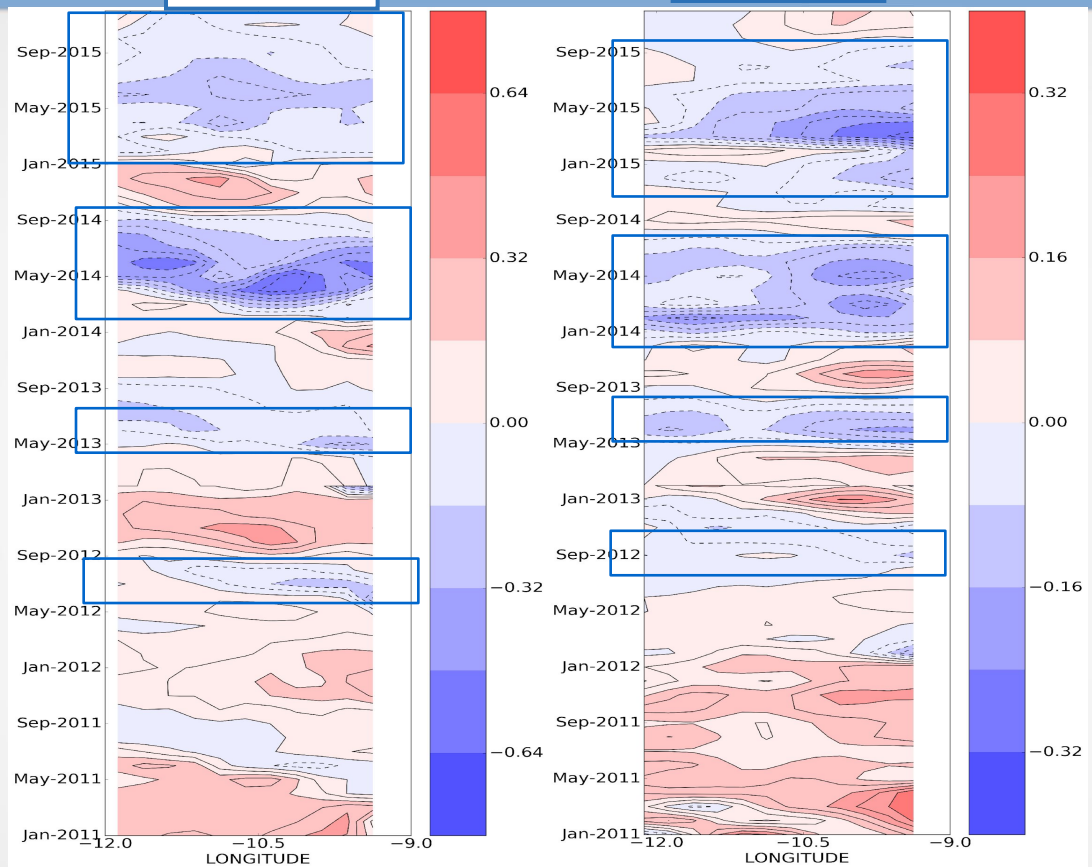


Lat = 40.5ºN

Fresh anomalies, consistent in model and SMOS but they not always happen at the same time

SMOS vs model: Hovmoller





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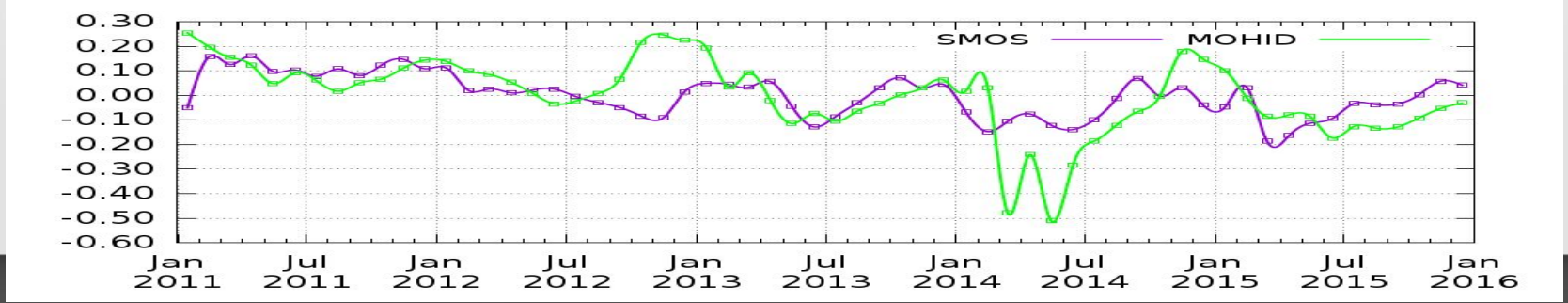
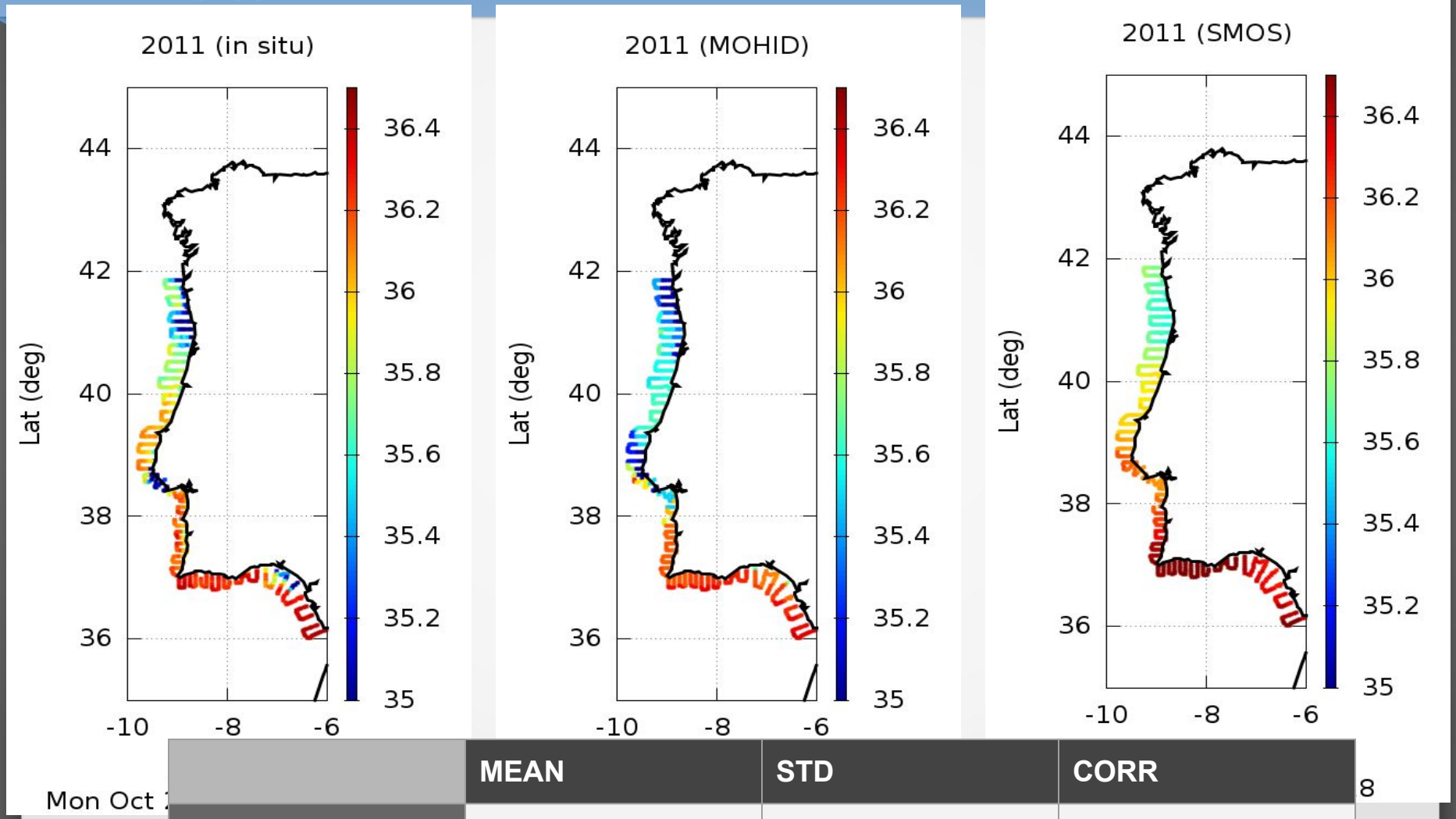
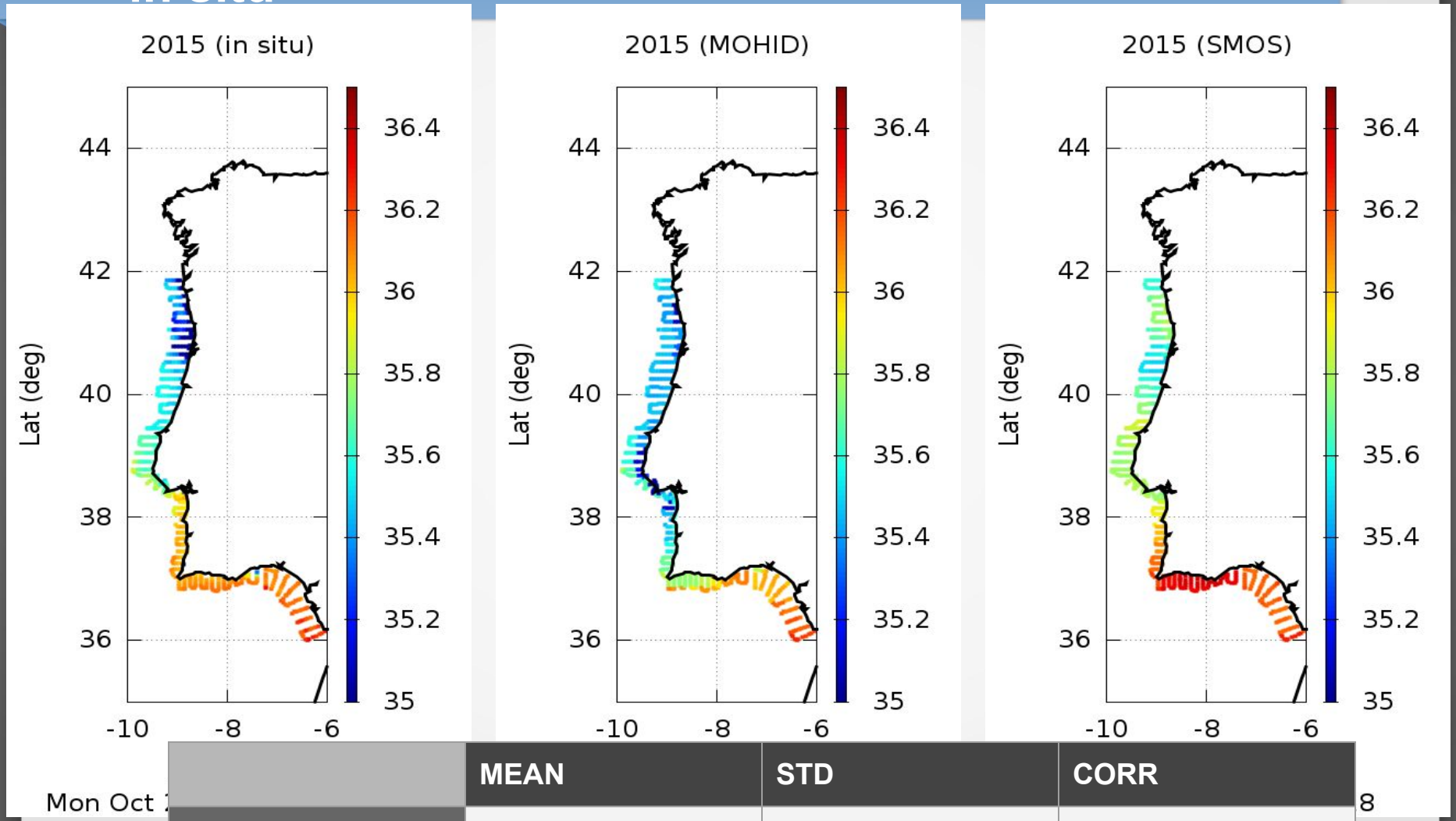


Assessment with in situ



	MEAN	STD	CORR
SMOS	0.31	0.69	0.46
MOHID	-0.04	0.69	0.50

Assessment with in situ



	MEAN	STD	CORR
SMOS	0.20	0.33	0.68
MOHID	-0.10	0.35	0.63

Conclusions

SMOS and MOHID SSS are in **good agreement in the major features of the salinity dynamics**:

- Current **SMOS SSS does not capture the dynamics of the most coastal pixels**
- **Global SSS of both data sets are in good correlation**.
- **Good agreement in the interannual variability**:
  - 2012 SMOS is affected by strong RFI episode.
- **Good agreement in the seasonal variation**s.
  - The largest differences in winter.
  - Model displays wider river plumes than SMOS, specially in the Gulf of Cadiz.
- **Good agreement between the fresh anomaly structures evolution**
- Comparison with in situ:
  - SMOS captures the major features of the spatial and temporal salinity gradients.
  - Model shows coastal dynamics, but it presents differences with in situ in some spatial features
  - **SMOS and model present similar std and corr w.r.t in situ**.

Conclusions

Future improvements:

- Improving the SMOS SSS close to the coast.
  - Reduction of correlation radii
  - Application of alternative image reconstruction methods to reduce noise
- Improving the Model
  - Improvement of the Land-marine boundary conditions

Analysis of some cases of study:

Capabilities of SMOS and MOHID of resolving river flows scenarios in the Portuguese coast will be analyzed.

lambda

Thank you!

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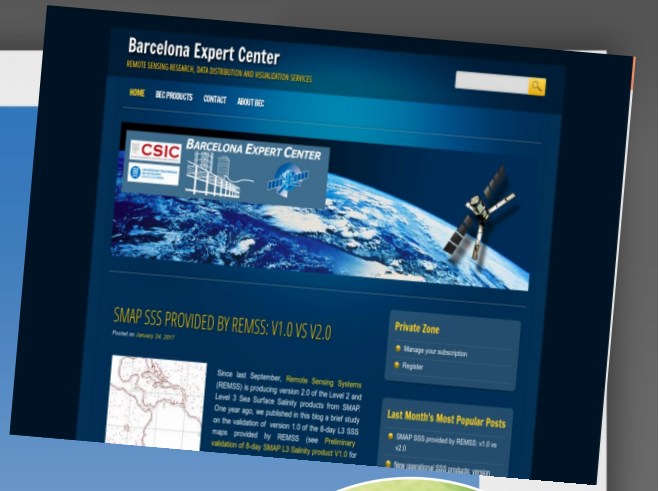

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