



The impact of resolution on the air-sea interaction in the Agulhas current region



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Ocean is not a **passive element**, affected by the variable atmospheric system: it acts as a memory for the coupled air-sea system, allowing **positive feedback** in the air sea interactions.

$$\frac{dT_a}{dt} = \alpha(T_o - T_a) - \gamma_a T_a + N_a,$$
$$\frac{dT_o}{dt} = \beta(T_a - T_o) - \gamma_o T_o + N_o,$$

Bishop, S. P., Small, R. J., Bryan, F. O., & Tomas, R. A. (2017)

Two regimes can be recognised:

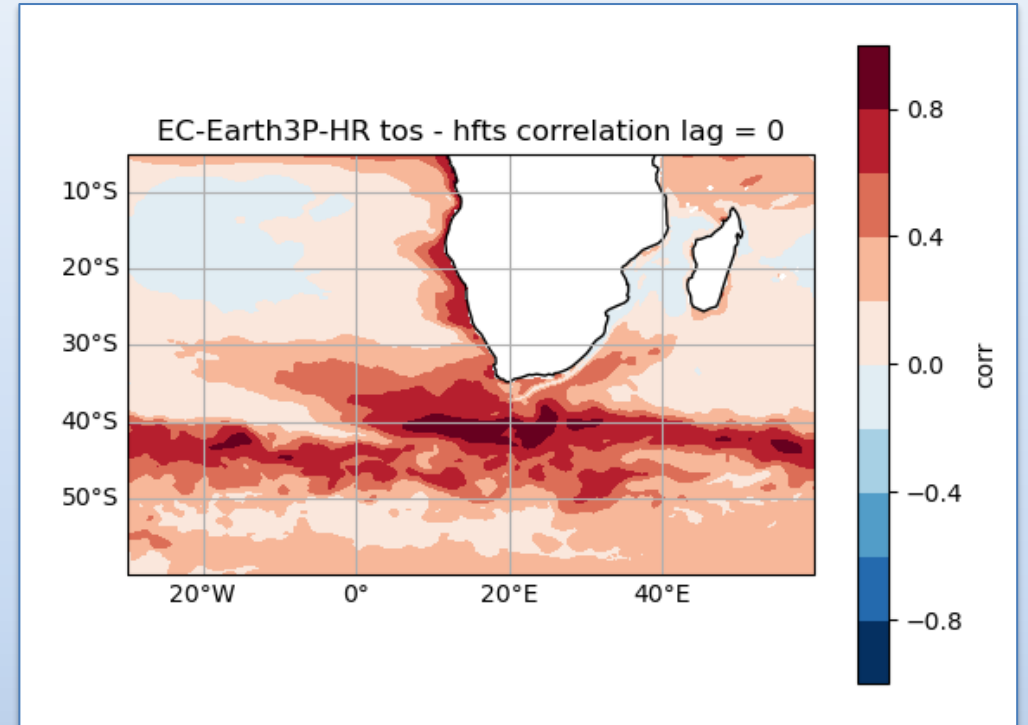
- **Atmosphere-driven regime:** high frequency varying atmospheric quantities drive changes in oceanic properties, such as SST (tos).
- **Ocean-driven regime:** ocean dynamics intrinsically causes variation in the atmospheric system, such as heat fluxes (hfts).

Why the Agulhas System

Agulhas Current is the WBC that flows along the South-Eastern coasts of the African continent carrying warm waters poleward.

It has a strong impact on the heat and salt **feedback processes** between *Indian* and *Atlantic* Ocean.

Agulhas System is characterized by **turbulence** and non - linearity effects caused by *bathymetry influence, meandering events, Southern Hemisphere Westerlies, Kelvin waves etc.*

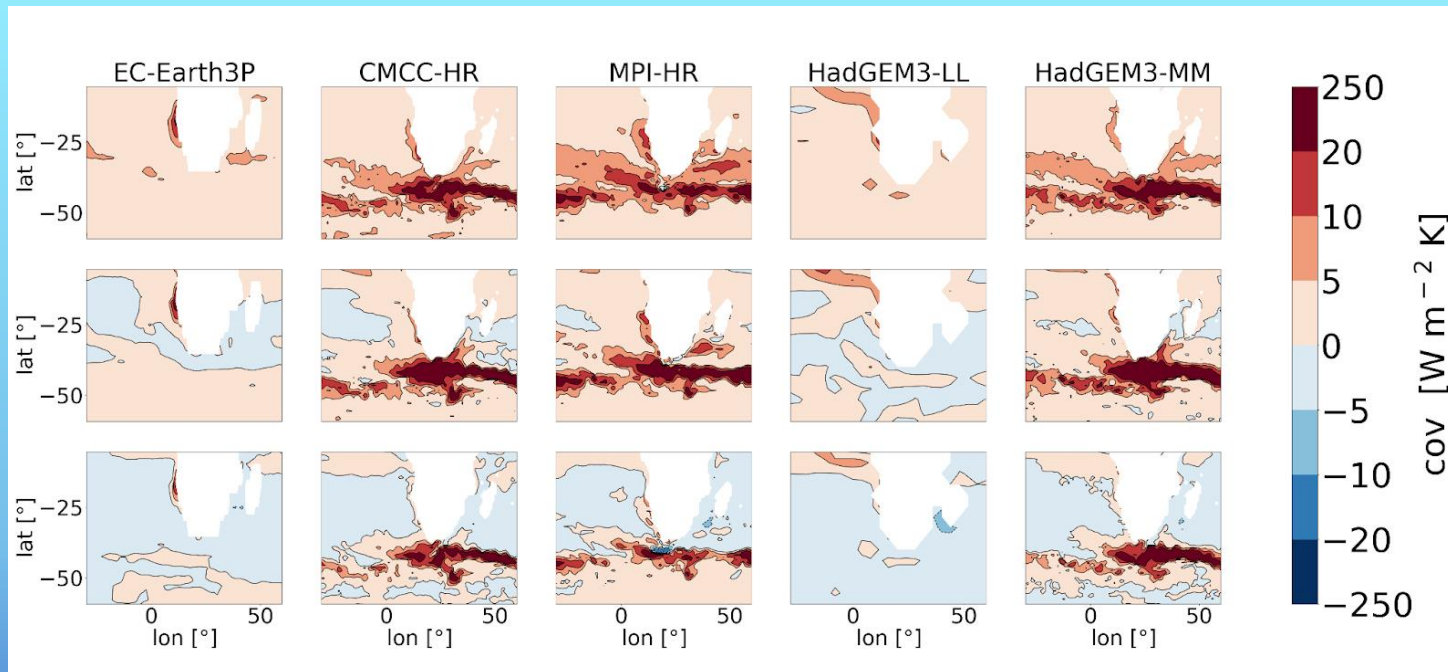


Datasets: Numerical results belong to the “hist-1950” experiment in the CMIP6 environment. Observations are from JOFURO and OAFlux

MODELS:	CMCC-VHR	CMCC-HR	EC-Earth-HR	EC-Earth	HadGEM-HH	HadGEM-HM	HadGEM-MM	HadGEM-LL	MPI-XR	MPI-HR	JOFURO	OAFUX
Ocean	25km	25km	25km	100km	10km	50km	50km	250km	50km	50km	25km	100km
Atm	25km	100km	50km	100km	50km	50km	100km	250km	50km	100km	25km	100km

Results

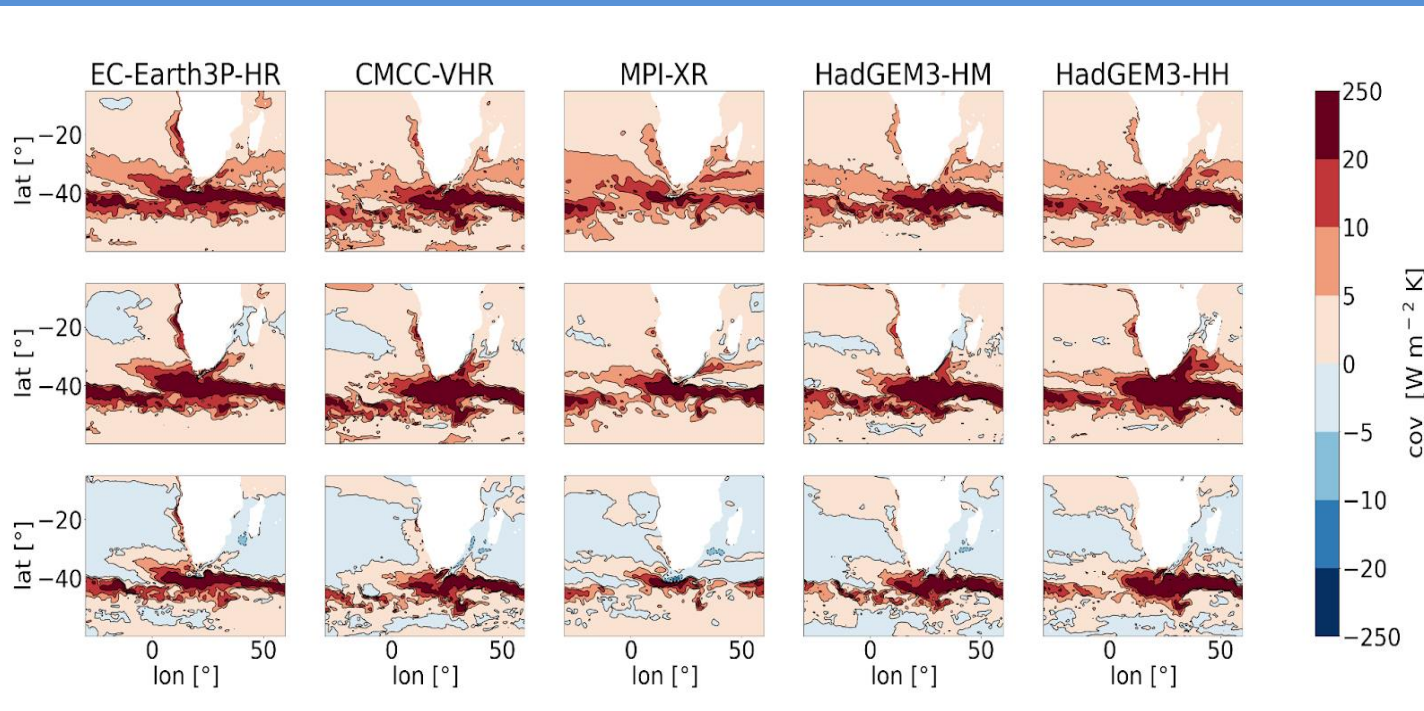
Low resolution SST-THF covariance patterns for lag = (-1 0 1)



- In the **Agulhas system**, high covariance appear (ocean driven regime);
- **2 models** do not reconstruct that signal.

Results

High resolution SST-THF covariance patterns for lag = (-1 0 1)



- Increasing **spatial resolutions**, covariance values rise;
- **Ocean driven regime signal** is reproduced in the ensemble.

Conclusions

- Reproducing physical interactions between ocean and atmosphere is strictly related to the **spatial resolution**.
- Lead – lag correlation functions allow to analyse the quality of the **symmetry** of the signals.
- Some models need **higher resolution** to obtain the expected behaviour.
- Ocean driven regime signals can be removed (or similarly, it persist) using the proper **spatial filter**.



THANK YOU FOR THE ATTENTION!

Any question is gladly welcome!

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