



Generalitat de Catalunya
Departament de Recerca
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**Barcelona
Supercomputing
Center**
Centro Nacional de Supercomputación



Comparing the seasonal predictability of Tropical Pacific variability in EC-Earth3 at two different horizontal resolutions

19 April 2024

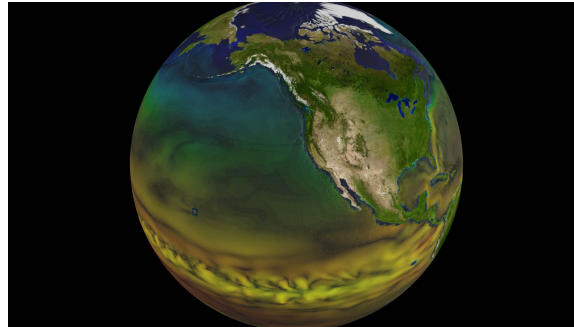
Carreric et al., in prep.

Forecast systems: 2 horizontal resolutions

Standard resolution (SR):

- EC-Earth 3.3.3.1
- IFS T255L91 (~80 km)
- ORCA1 (~100 km)

eddy-parameterized

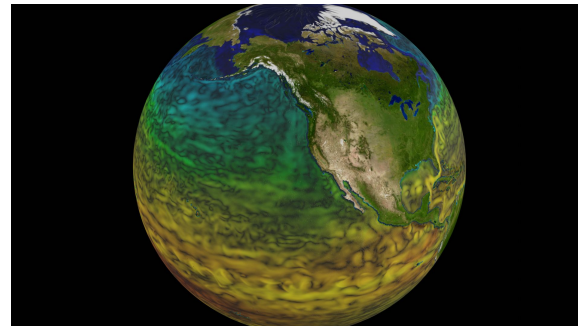


ORCA grid 1°

High resolution (HR):

- EC-Earth 3.3.4
- IFS T511L91 (~40km)
- ORCA025 (~25km)

eddy-permitting



ORCA grid 0.25°

Courtesy of O. Tinto

Hindcast period:

1990-2015

Ensemble:

20 members

Initialisation:

May and November
every year

Same initialization protocol

Atmospheric Reanalysis
ERA5

- interpolation to the corresponding grid
- perturbation of the 3D air temperature forcing field

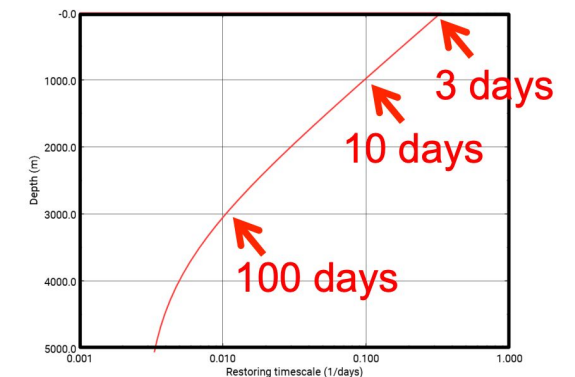
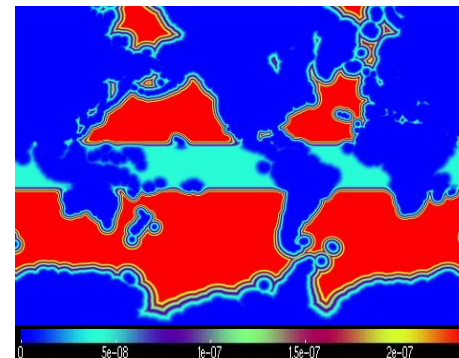
Ocean Reconstruction

- ERA5 surface fluxes*
- ORAS5 restoring at the surface
- EN4 v4.2.1 nudging in the subsurface
 - 5 difference initial conditions

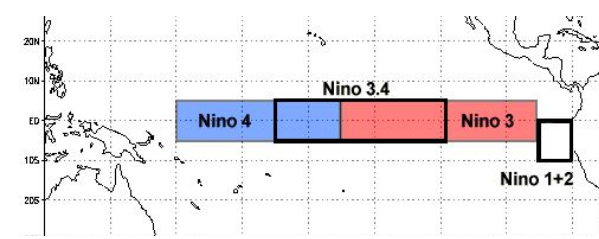
- Atmospheric forcing: tas^* , heat fluxes*, humidity, precipitation, surface winds

- Surface restoring coefficients $\gamma_T = -200 \text{ W/m}^2/\text{K}$
 $\gamma_S = -750 \text{ kg/m}^2/\text{s/psu}$

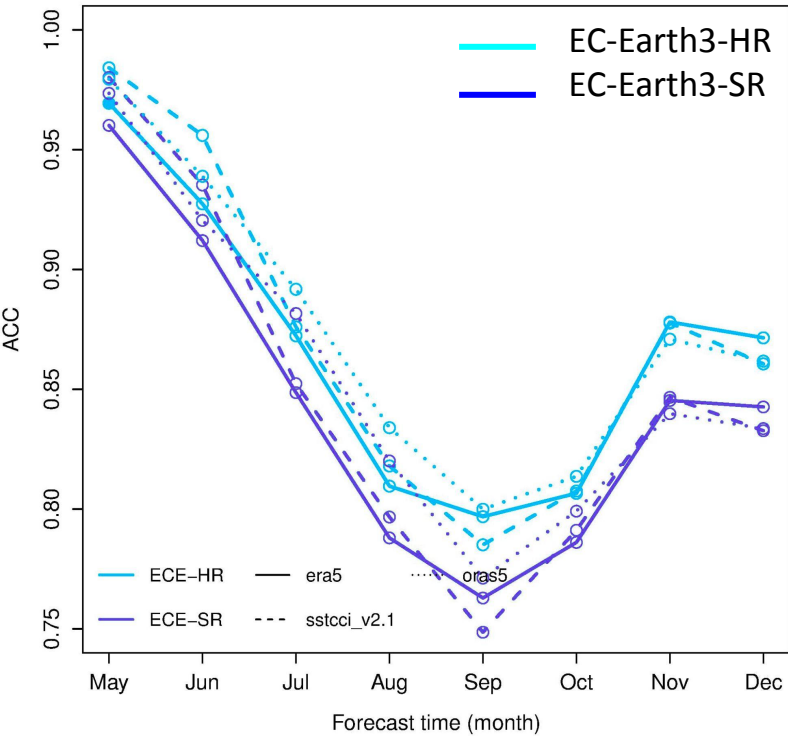
- 3D nudging (temperature and salinity)



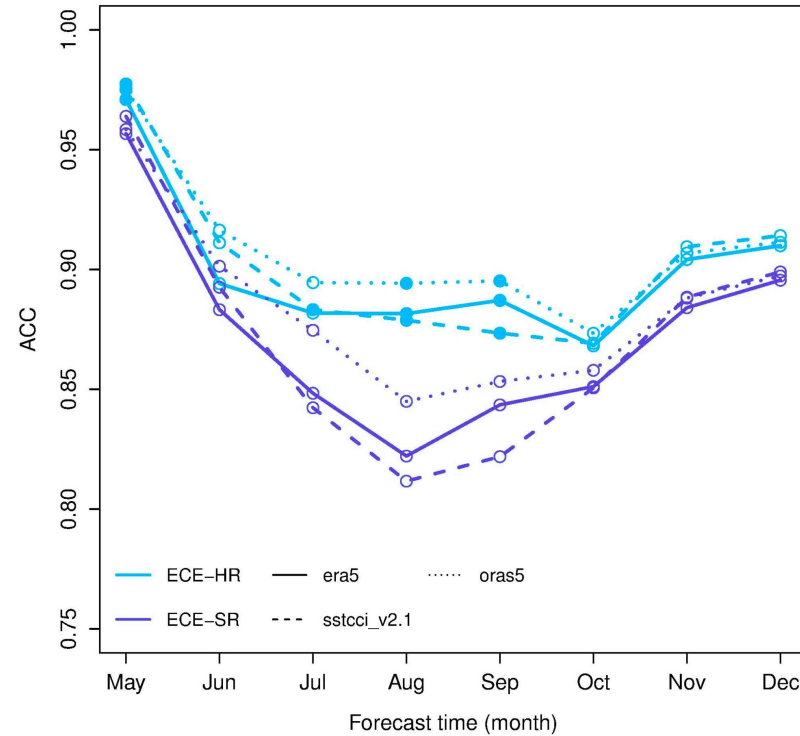
SST ACC timeseries - Niño regions



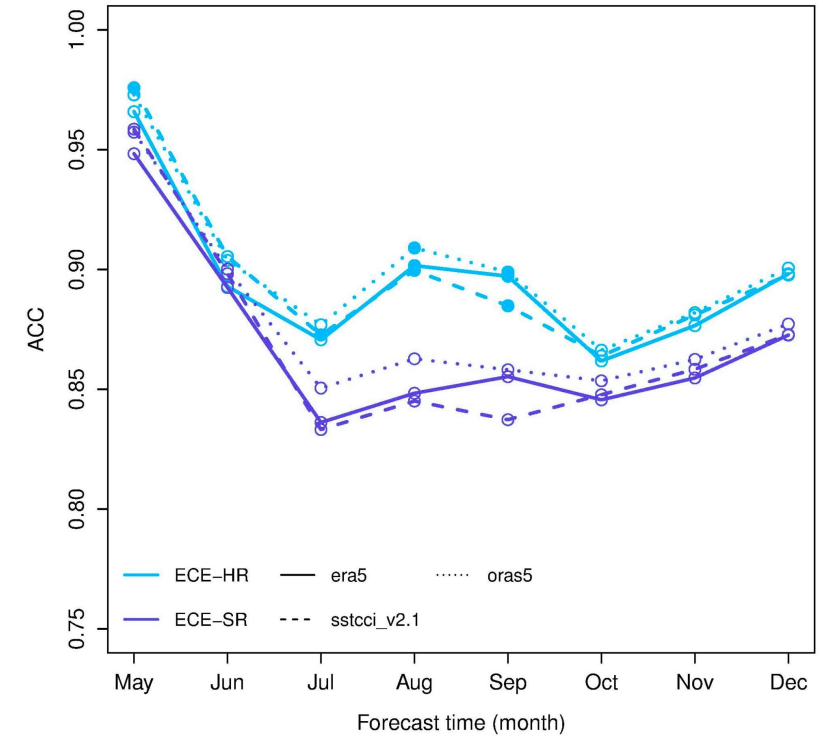
Niño4



Niño3.4



Niño3



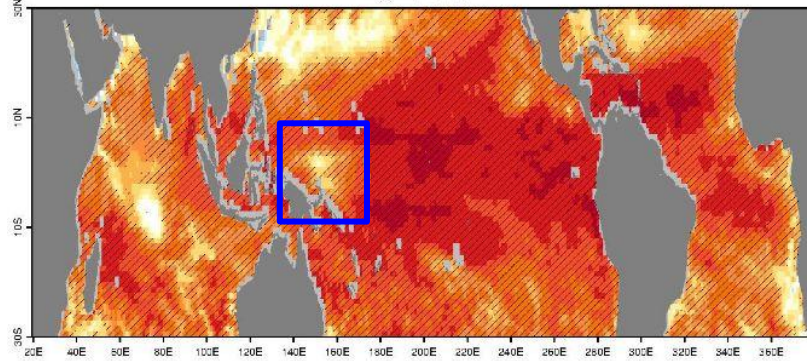
Higher skill in the HR system, statistically significant in summer in the central-eastern equatorial Pacific

Predictive skill in the tropics

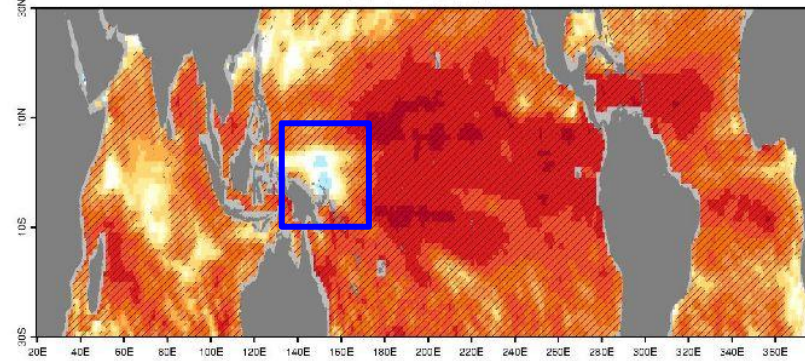
Sea surface temperature (SST)

Reference: SSTCCI v2.1

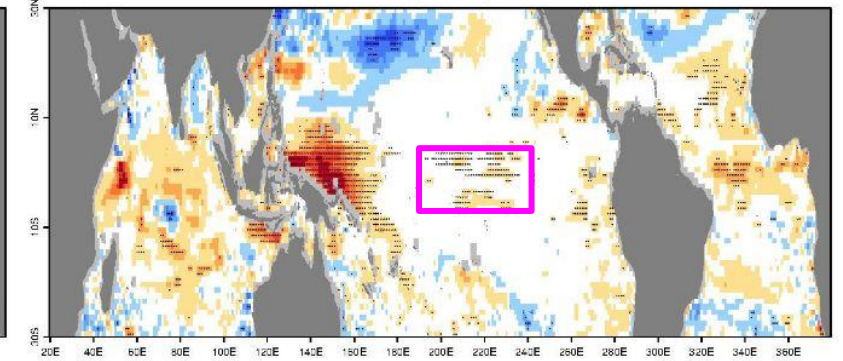
JJA High Resolution



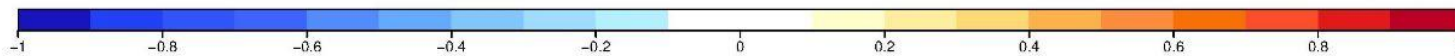
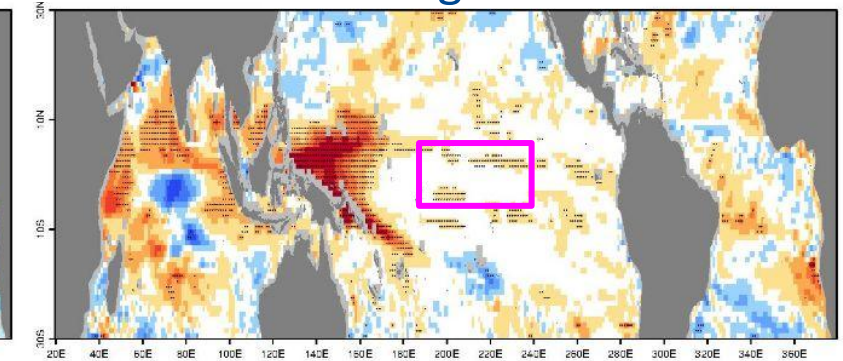
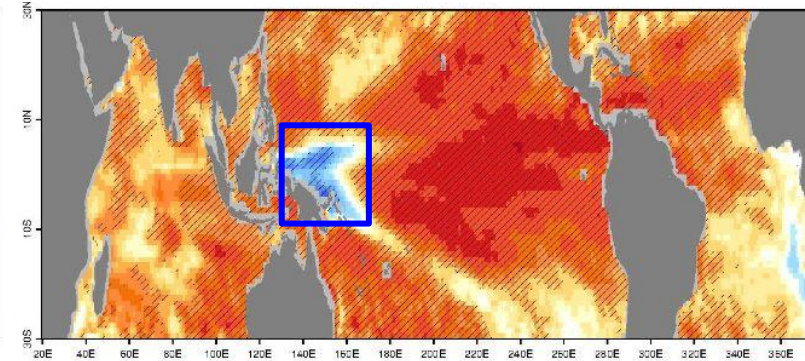
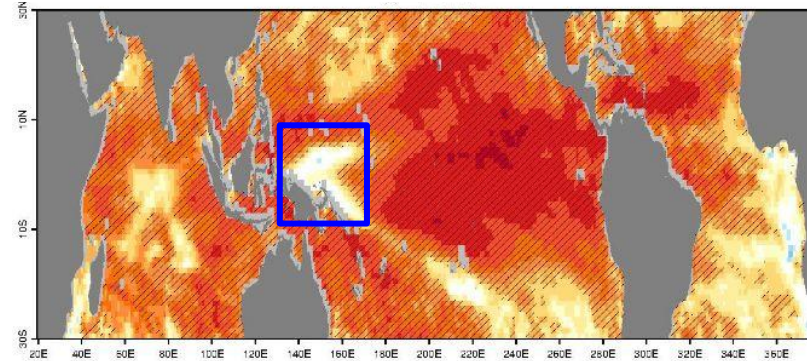
Standard Resolution



Correlation differences



SON



red: improvement
blue: degradation

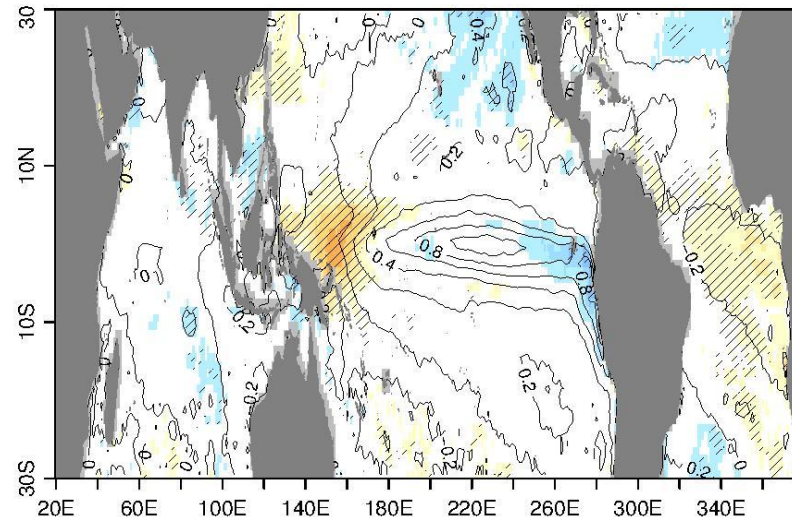
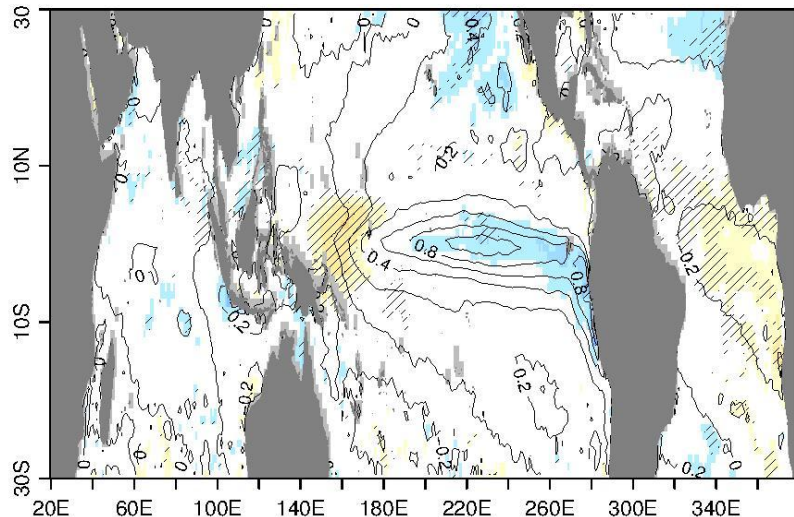
Lower ENSO-related errors in ECE3-HR

SST

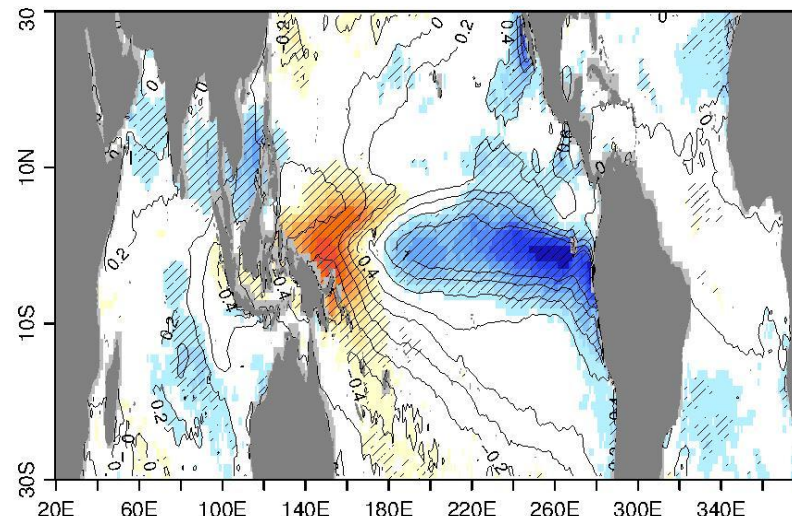
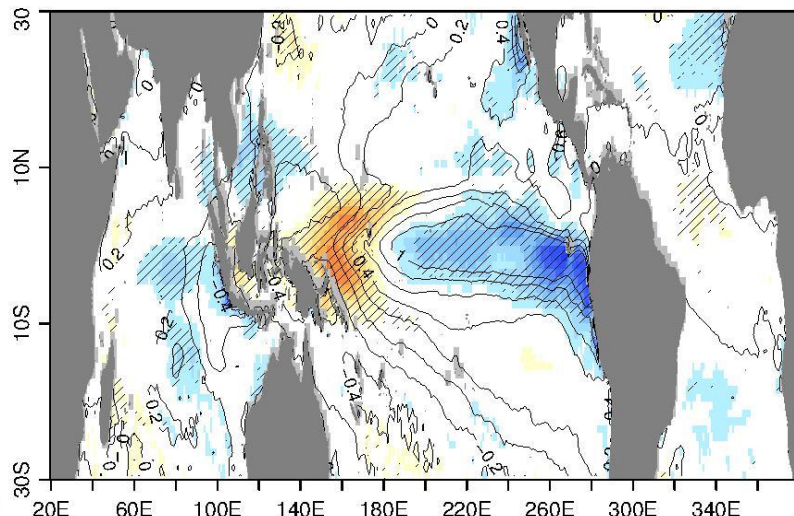
High Resolution

Standard Resolution

JJA



SON

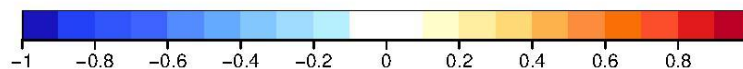
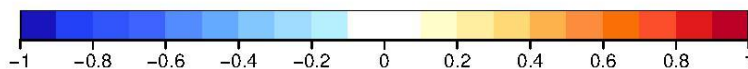


*ENSO-related errors
(Beverley et al. 2023)*

Common ENSO-related biases:

- cold bias in the cold tongue region
- westward extension of ENSO-related SST anomalies

Biases not present in the coupled SR historical simulations



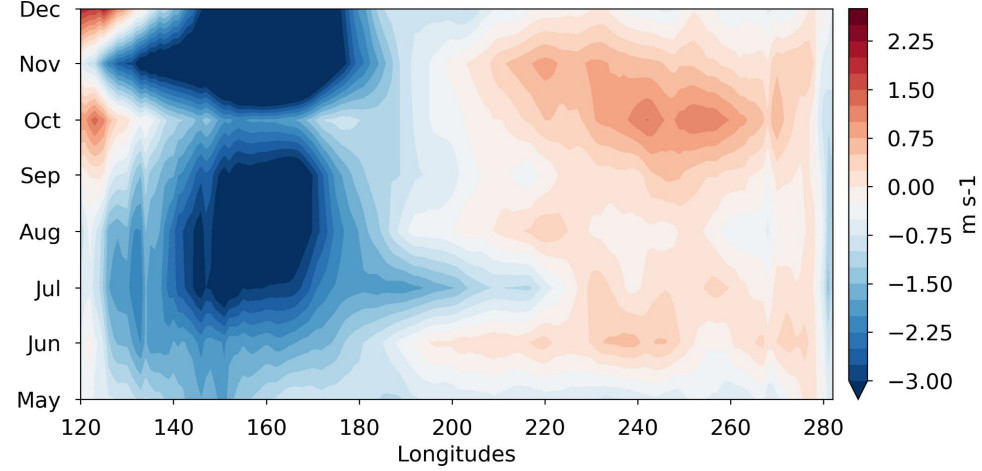
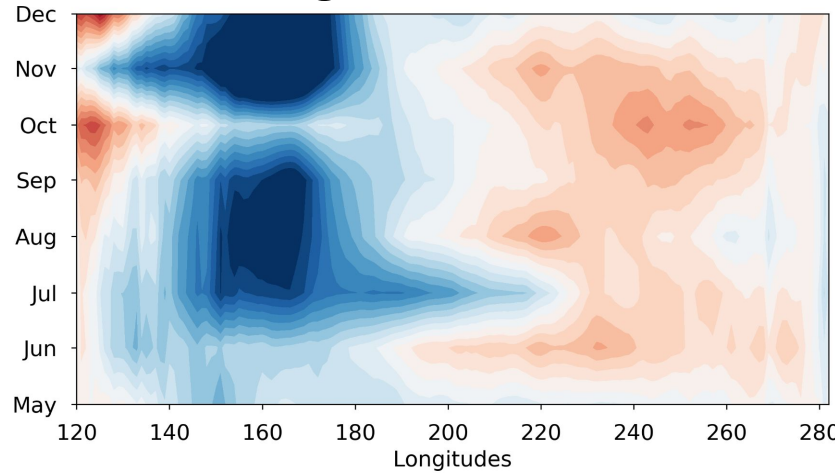
Importance of the Niño4 region processes

UAS

High Resolution

Standard Resolution

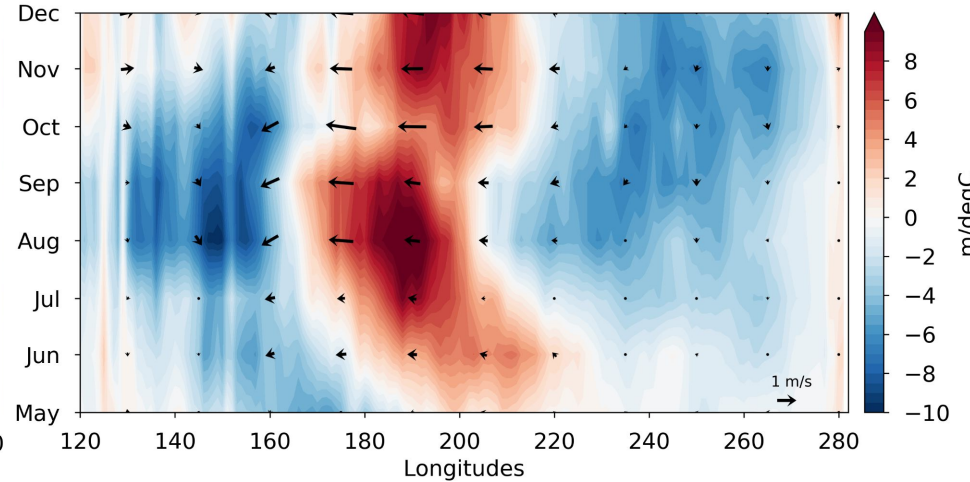
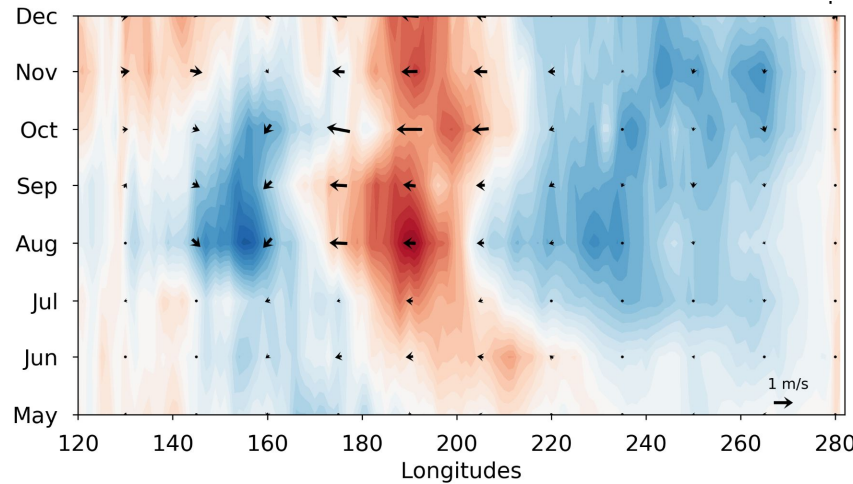
Mean state bias



Wind bias inherent in the model:
too strong easterlies in the west Pacific

MLD

ENSO-related errors



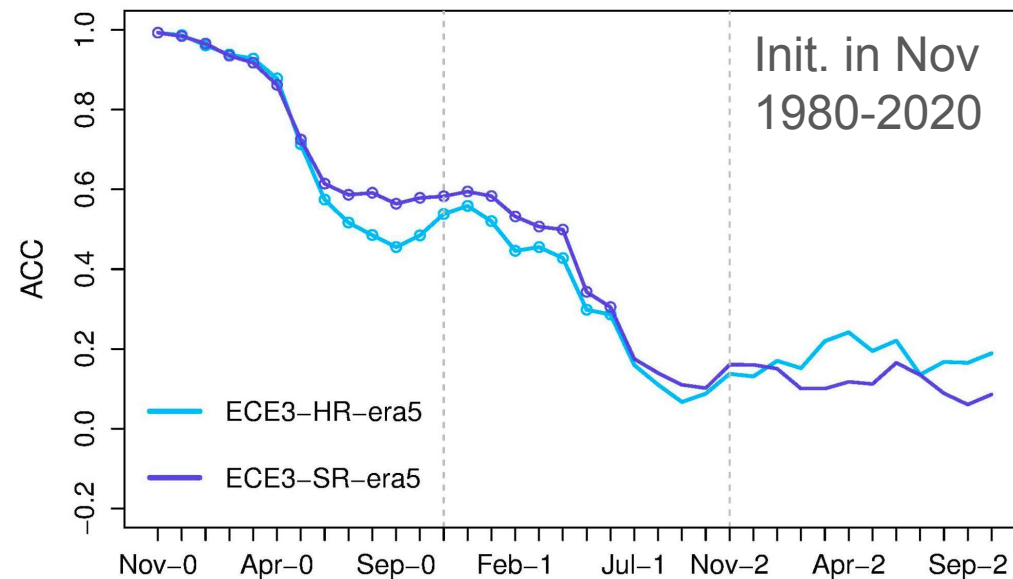
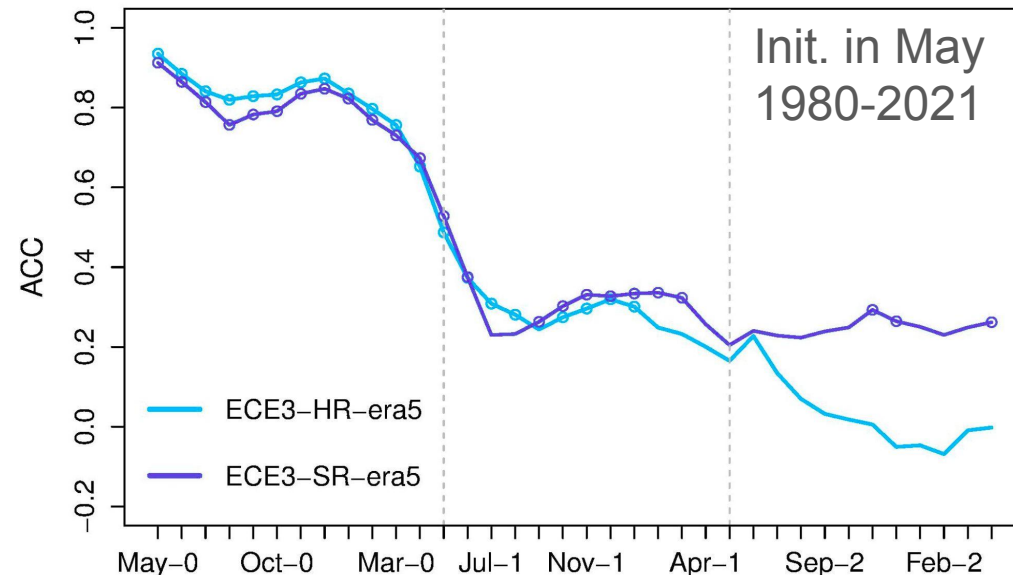
Initialisation errors:
anomalous downwelling → anomalous vertical mixing of cold water feeding the cold tongue bias

Spatial mean at the Equator (5S-5N)

Multi-year prediction system

Multi-year prediction systems	
Standard res.	High res.
2 init. per year: Nov.: 1960-2021 May: 1980-2021 (every yr)	2 init. per year: Nov.: 1960-2021 May: 1980-2021 (every yr)
20 members	15 members
3 forecast yrs	3 forecast yrs
TOTAL: 6240 yrs	TOTAL: 4680 yrs

Niño 3.4 - 15 members





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i Universitats**

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**Any questions?
Thanks for your attention**

aude.carreric@bsc.es



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