

Trends, variability & predictive skill of the ocean heat content in the North Atlantic: An analysis with the EC-Earth3 model

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Main Goals

Investigate **trends** of the upper ocean heat content (OHC) in the **North Atlantic** basin.

$$OHC(t) = \sum_{i=0}^h T(t)_i c_p \rho_0 \Delta x \Delta y \Delta z_i$$

How do **internal & forced variability** contribute to **local trends**? What is their role on **local prediction skill**?

Reanalyses:

ECDA3.1
ORAS4
ORAS5

To explore the **observational uncertainties**

EC-Earth3 Experiments:

Decadal PRED
HIST

(10 members each)
To disentangle **Forced vs internal climate variability**

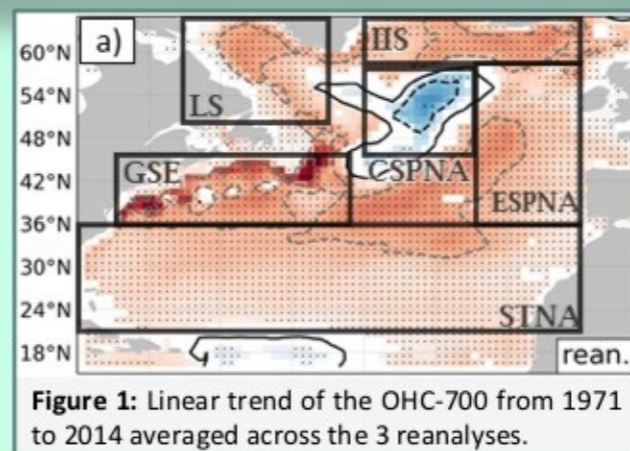
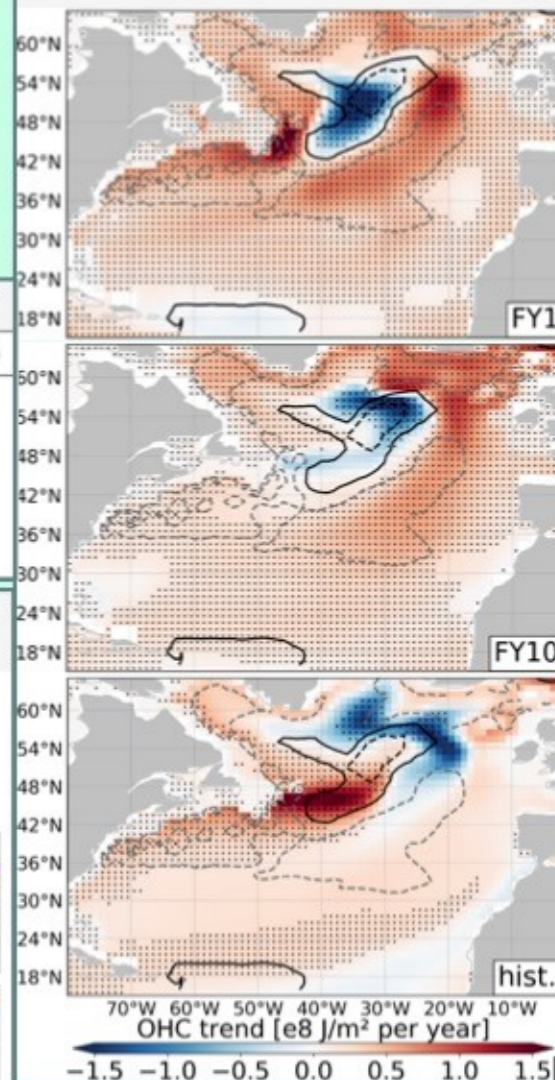


Figure 1: Linear trend of the OHC-700 from 1971 to 2014 averaged across the 3 reanalyses.

Figure 4: Spatial pattern of the OHC-700 linear trends in 1971-2014 as forecasted in PRED in forecast years 1 and 10, and as represented by the historical ensemble



Reanalysed linear trends of the regional OHC-700 in 1971-2014

Region	ECDA	ORAS5	ORAS4	Multi Reanalysis Mean
NA	3.82 (0.77)	2.27 (0.67)	3.10 (0.85)	3.06 (0.79)
IIS	5.46 (0.39)	4.70 (0.31)	4.08 (0.36)	4.74 (0.37)
ESPNA	3.03 (0.51)	4.24 (0.64)	3.71 (0.57)	3.66 (0.59)
CSPNA	3.82 (0.28)	-7.26 (0.54)	0.19* (<0.01)	-1.08* (0.04)
LS	4.97 (0.49)	1.30 (0.11)	4.37 (0.52)	3.55 (0.44)
GSE	5.13 (0.59)	5.05 (0.67)	6.56 (0.67)	5.58 (0.68)
STNA	3.66 (0.81)	3.26 (0.72)	3.04 (0.81)	3.32 (0.82)

Figure 4: Predicted and reanalysed trends of the regional OHC-700 in 1971-2014

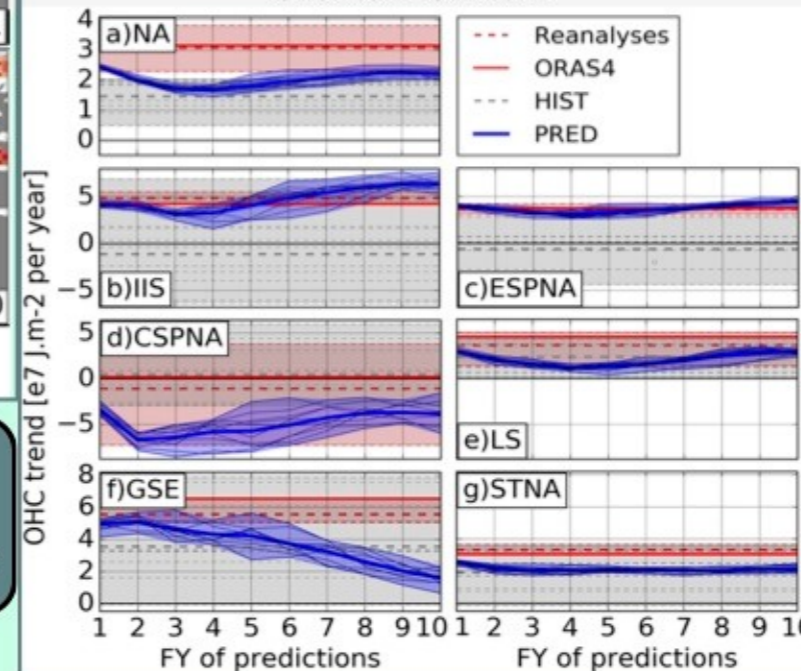
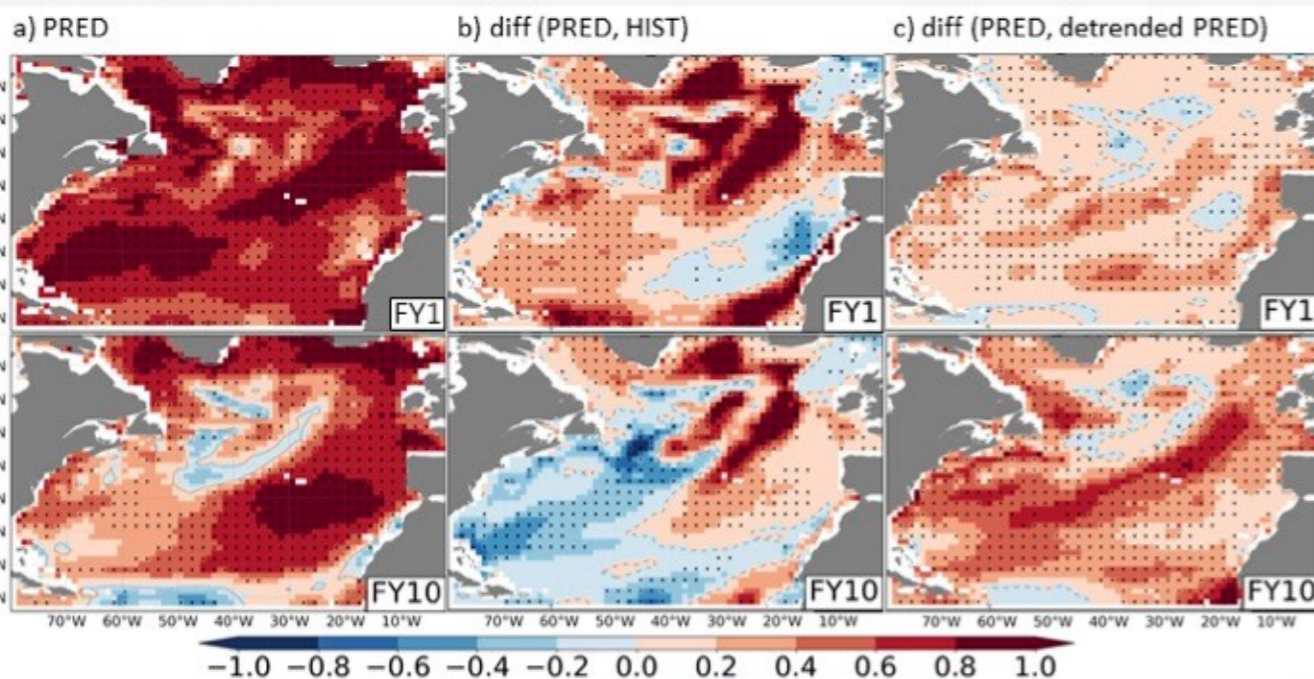


Figure 2 - Left: Anomaly correlation coefficient (ACC) for the OHC-700 in the initialised decadal predictions (PRED) at forecast years 1 and 10. Middle: ACC difference between PRED and the historical experiments (HIST), at the same forecast times. Right: ACC difference between PRED and the linearly-detrended PRED, at the same forecast times.



Results

Large observational & modeling uncertainties affect the trends & interannual variability in the CSPNA, the only region with a cooling trend. Internal variability is essential to understand the spatial pattern of North Atlantic OHC trends; External forcing affects predictive skill & trends in SW most regions (GSE, STNA) whereas internal variability plays a larger role in N-E areas (LS, IIS, ESPNA).

Further details can be found in a paper recently accepted for publication in *Climate Dynamics*