



DCPP-Component C

Protocol validation and results sensitivity to restoring

Christophe Cassou (CNRS-Cerfacs)
With the help of Saïd Qasmi



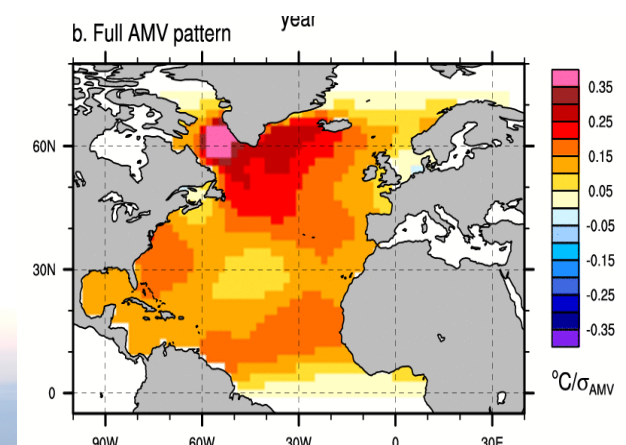
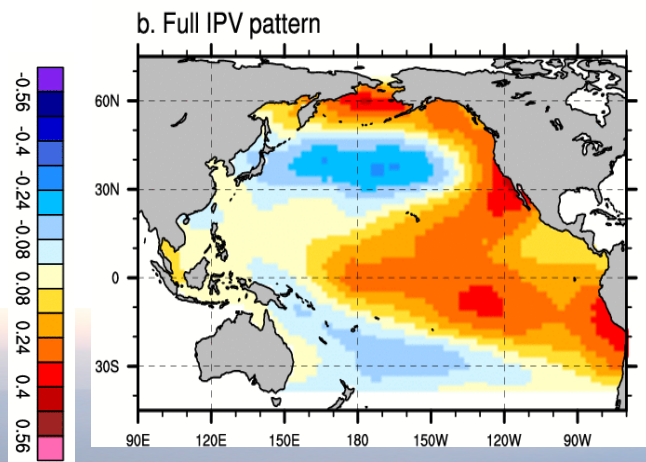
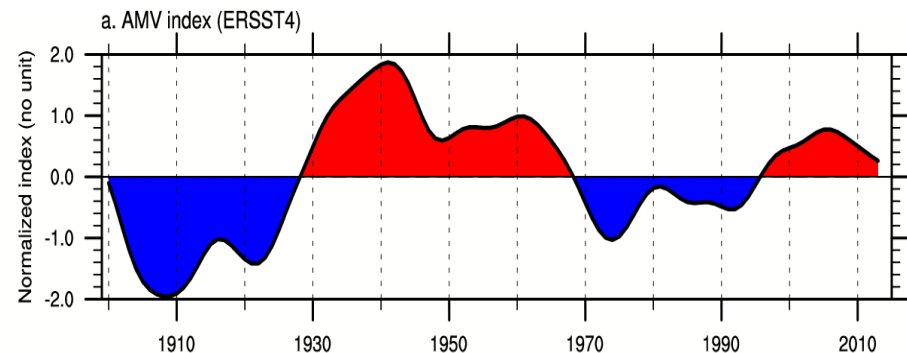
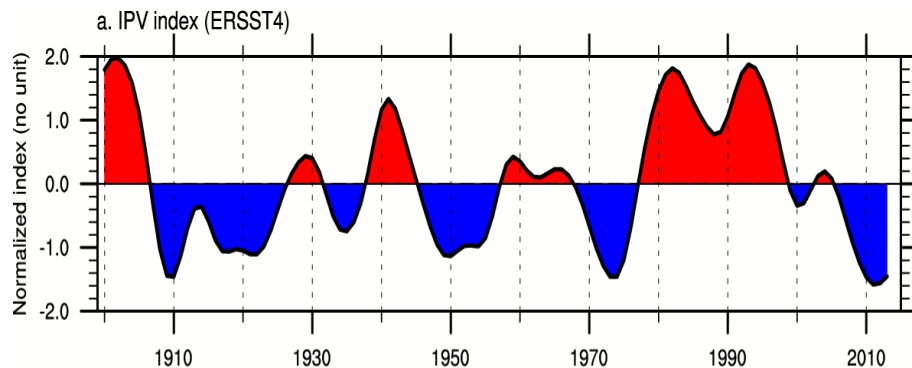
**Centre National
de la Recherche
Scientifique**

Exeter DCP meeting Oct. 2017

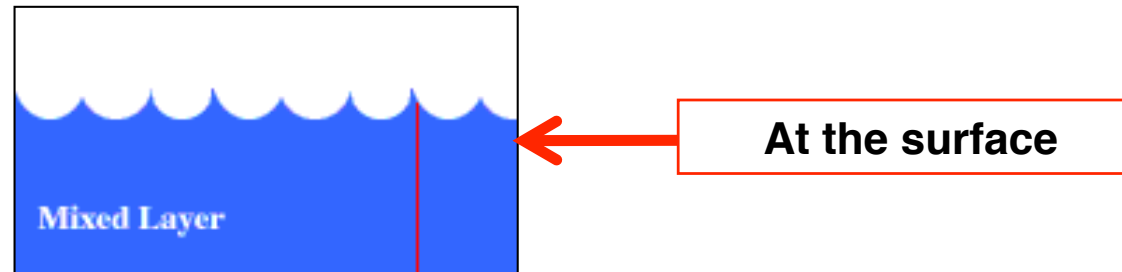
Motivation

Pacemaker experiments :

- ✧ **Goal:** constrain SST over a given basin/domain to anomalies that are representative of decadal variability (AMV, IPV, etc.)
- ✧ **Investigate :**
 - (i) the local atmosphere response to the constrained SST anomalies
 - (ii) the remote ocean-atmosphere response in the others oceanic basins that are not constrained



The surface restoring



Heat flux:

$$Q_{ns} = Q_{ns}^o + \frac{dQ}{dT} (T_{k=1} - SST_{obs})$$

*Nonsolar
Heat flux at
the surface*

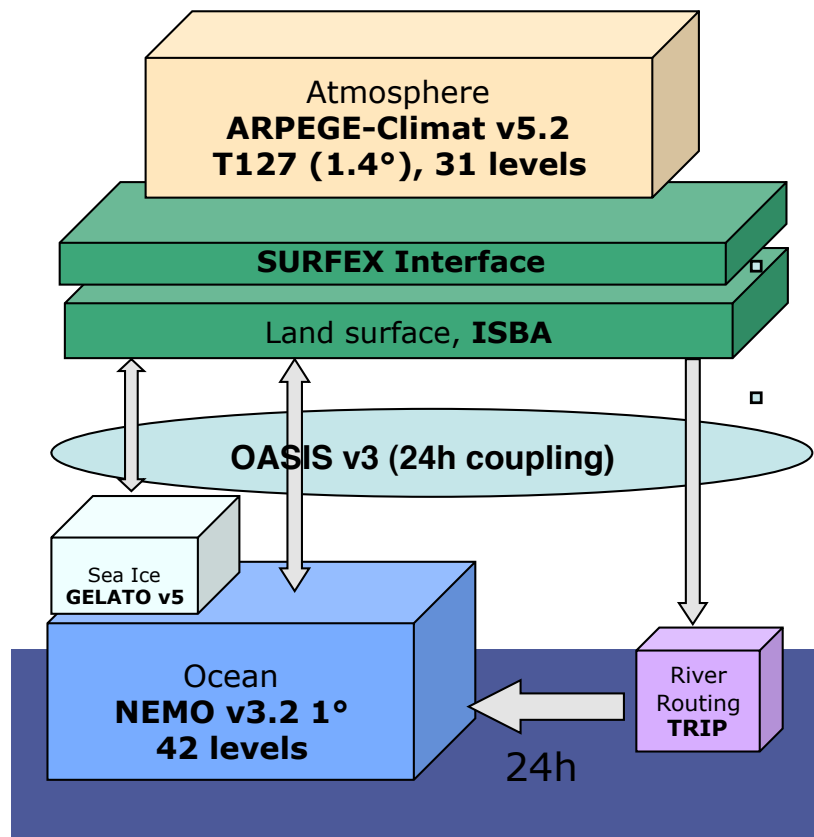
*Feedback term.
 SST_{obs} =
observations*

$\frac{dQ}{dT}$ *Feedback coefficient
acting as a restoring term*

Units: W/m²/K

- ✧ **Strong restoring:** $\gamma = -960 \text{ W/m}^2/\text{K}$, ~ equivalent of a 2-day restoring (H=50m depth)
- ✧ **Weak restoring:** $\gamma = -40 \text{ W/m}^2/\text{K}$, ~ equivalent of ~ 2-month restoring (H=50m depth)
- ✧ **Variable restoring:** $\gamma = f(\text{MLD})$ to set the restoring timescale equal to 2 months.

The simulations



The coupled model = CNRM-CM5
used for CMIP5

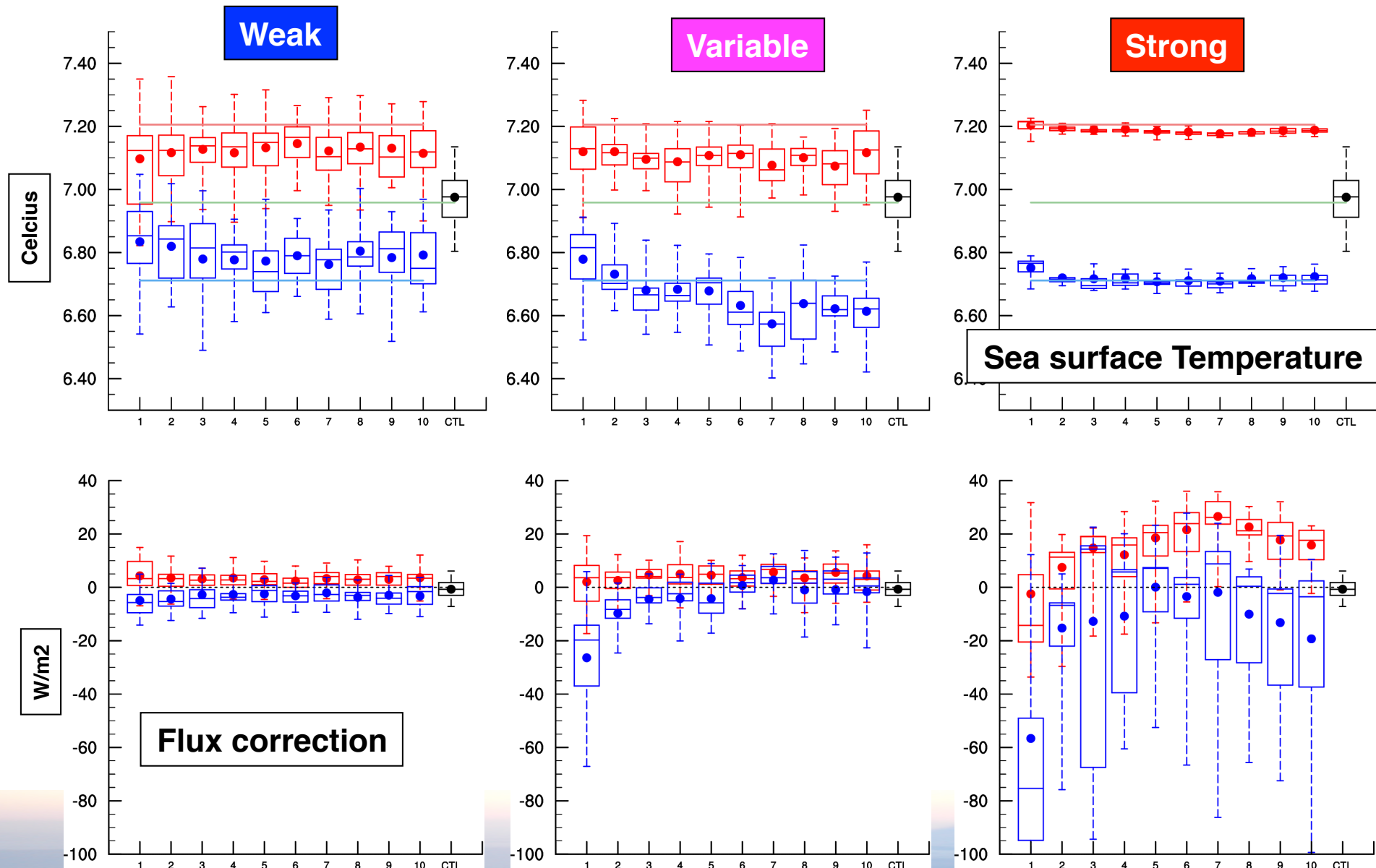
✧ **Strong restoring:** $\gamma = -960 \text{ W/m}^2/\text{K}$, \sim equivalent of a 2-day restoring ($H=50\text{m}$ depth)

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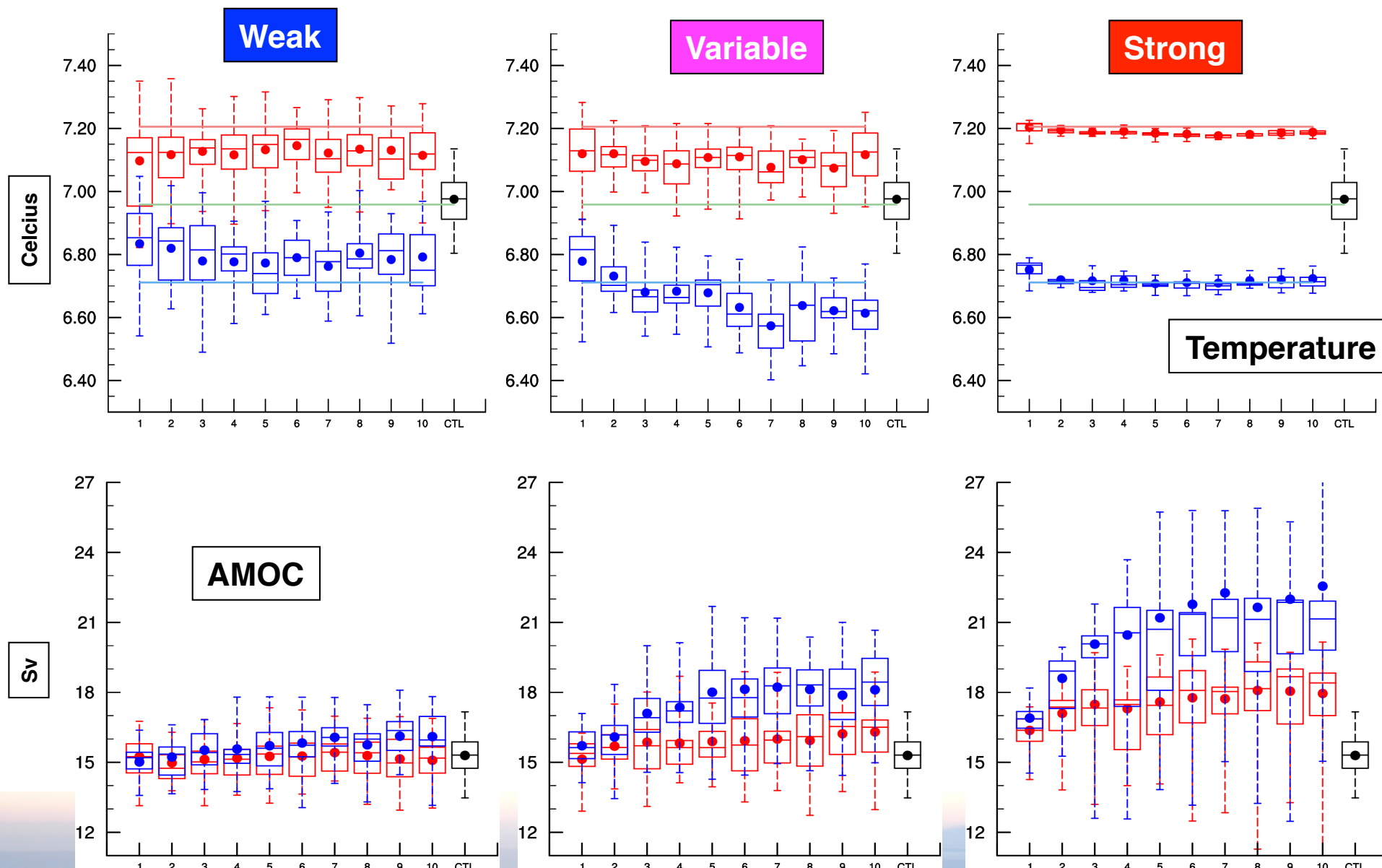
✧ **Variable restoring:** $\gamma=f(\text{MLD})$ to set the restoring timescale equal to 2 months.

Pacemaker Initial Conditions from
piControl simulation
30 members/10-year long

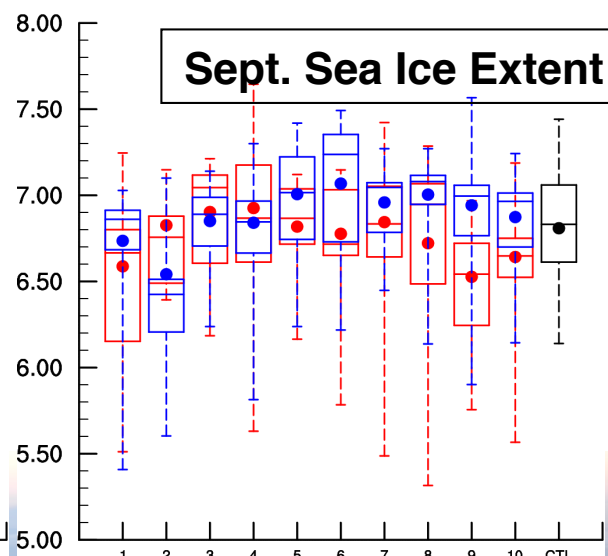
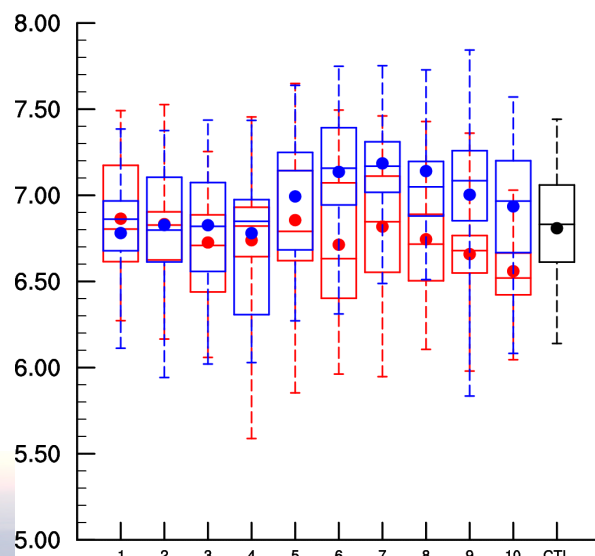
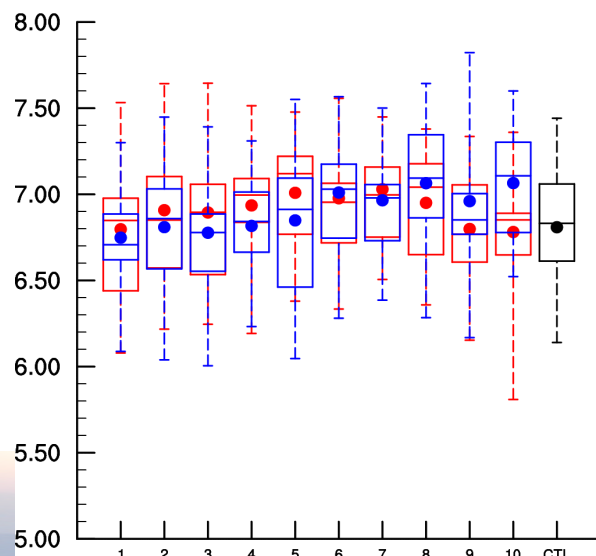
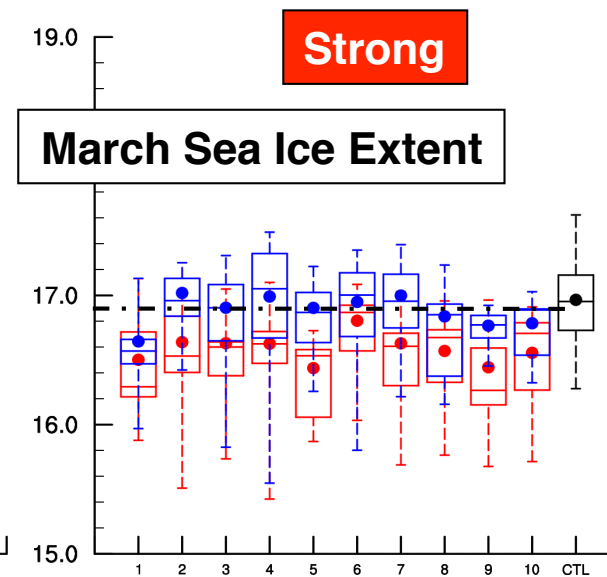
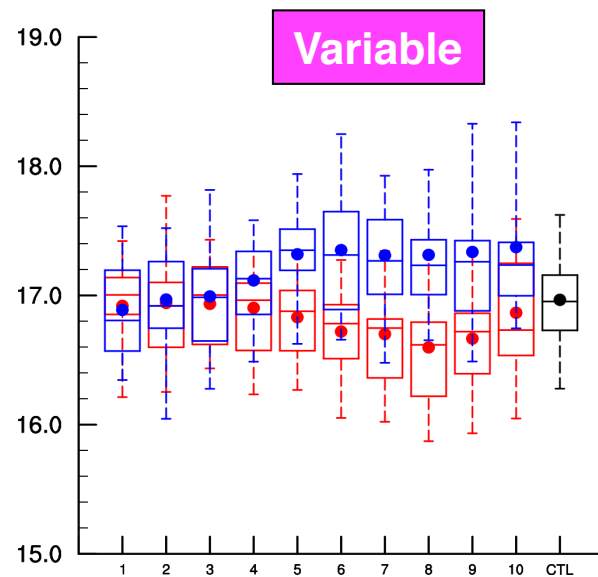
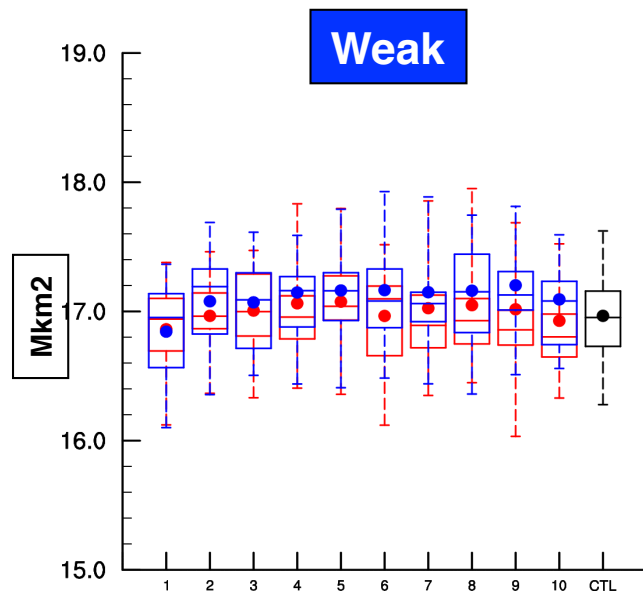
Over the supolar gyre



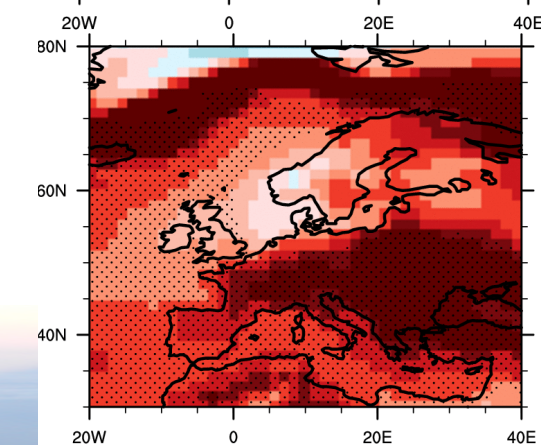
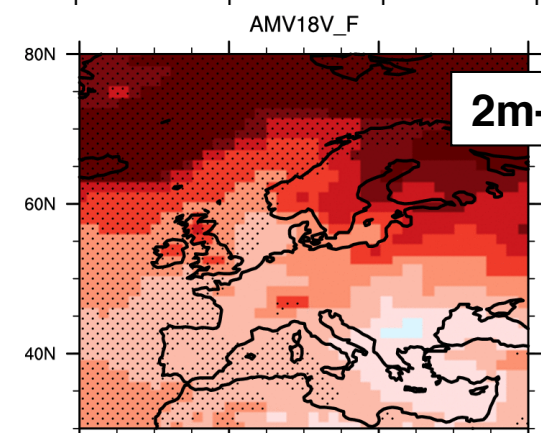
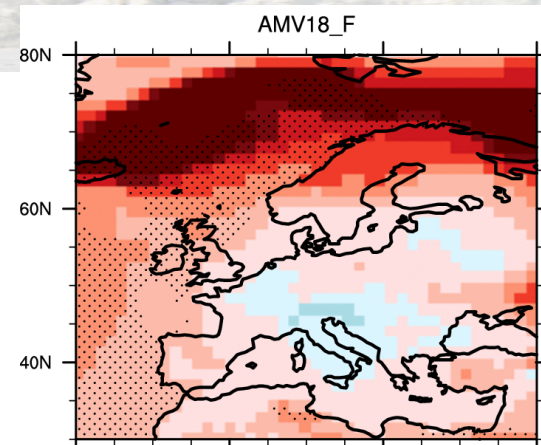
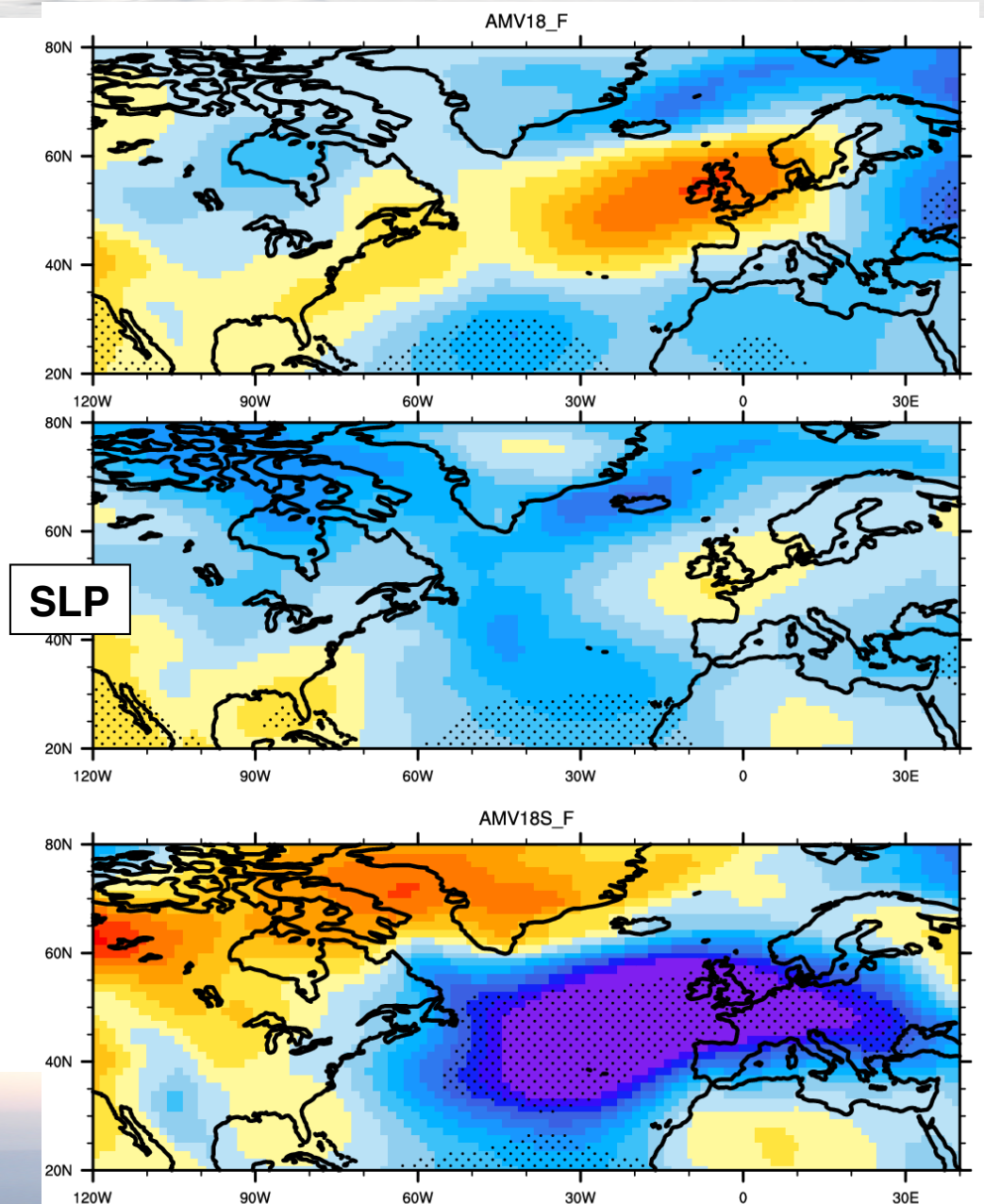
AMOC



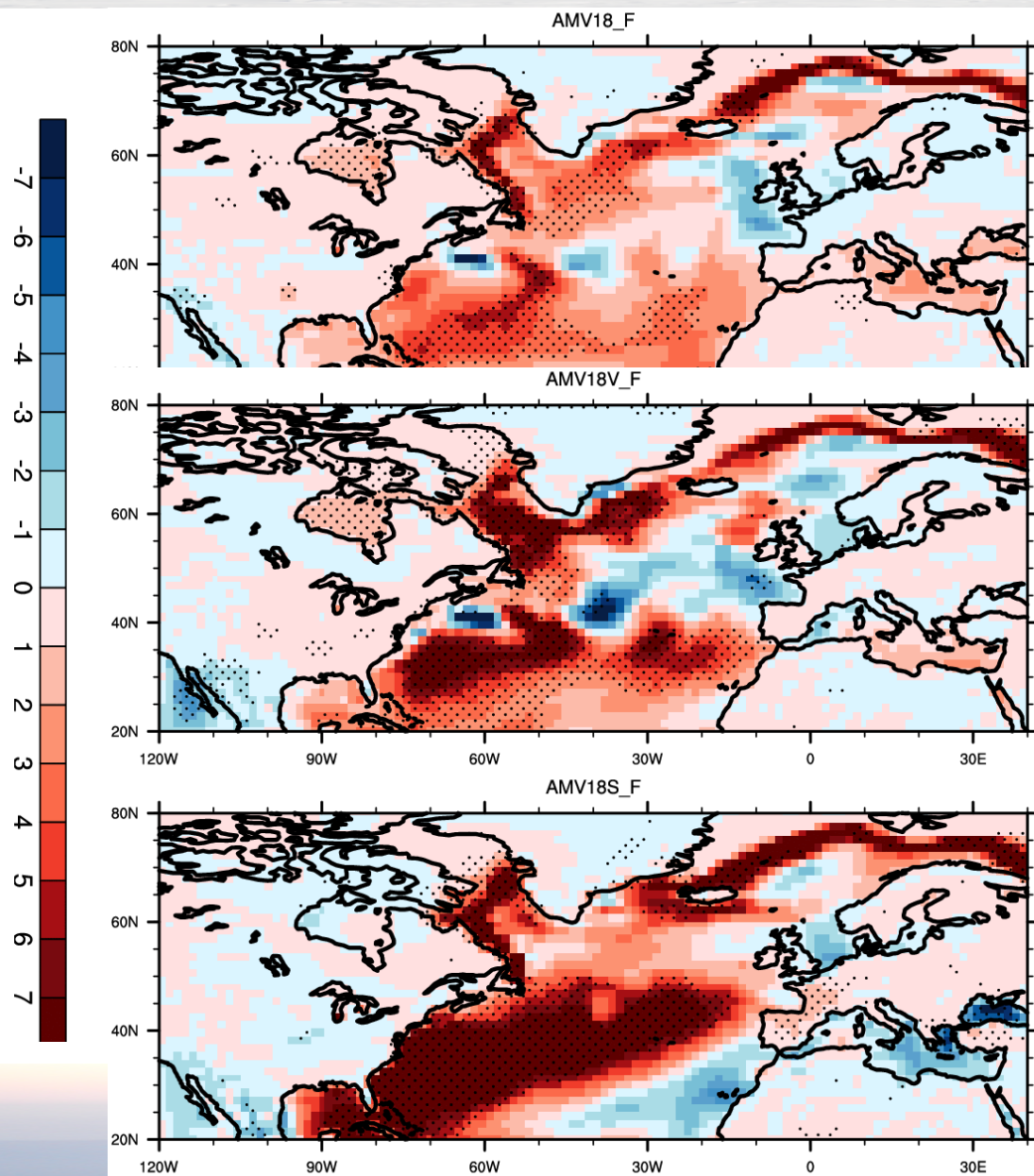
Arctic Sea Ice



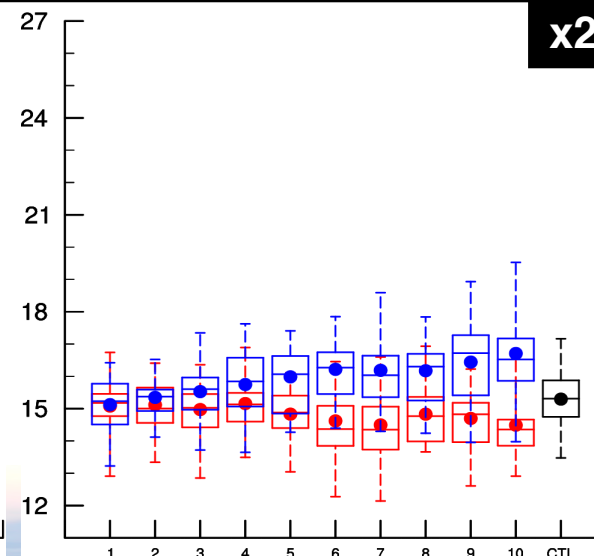
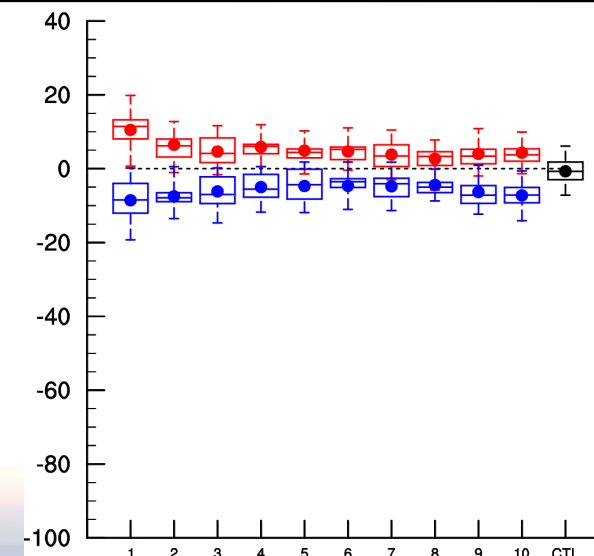
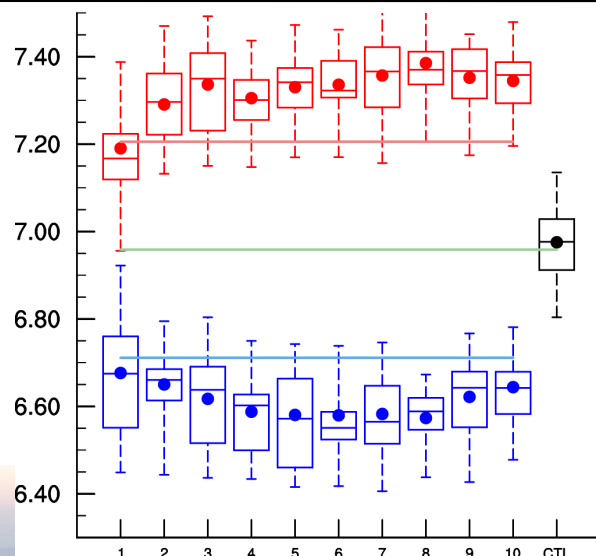
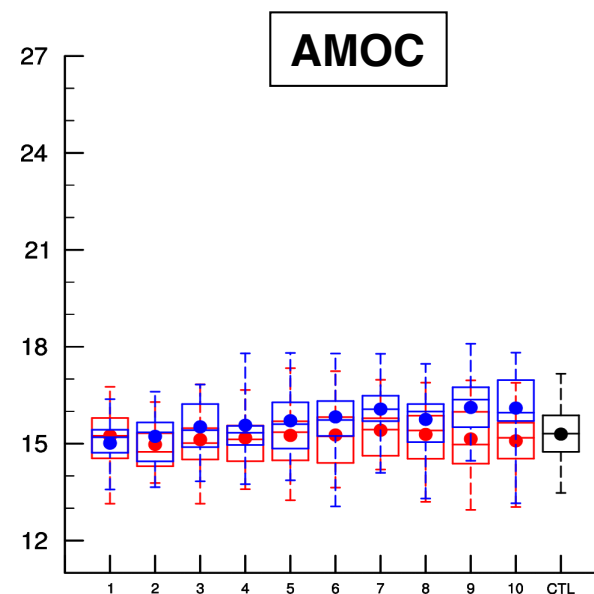
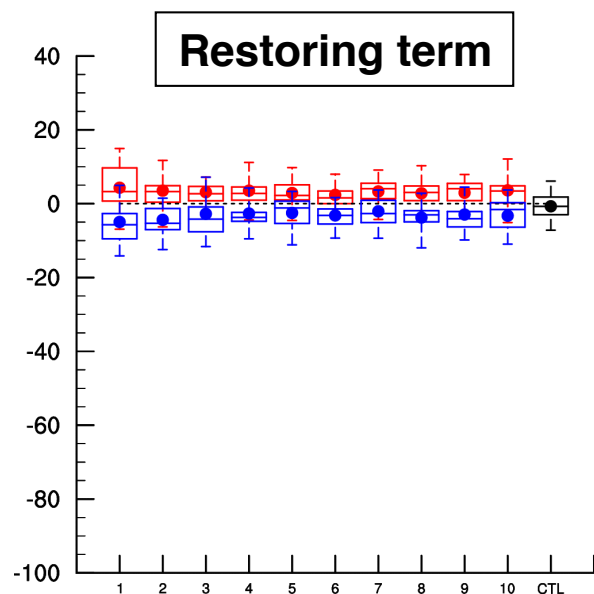
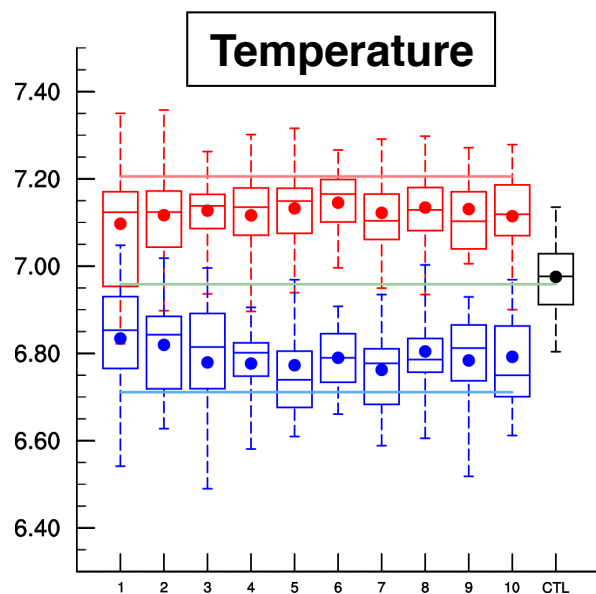
Circulation and temperature



Latent heat flux at the surface

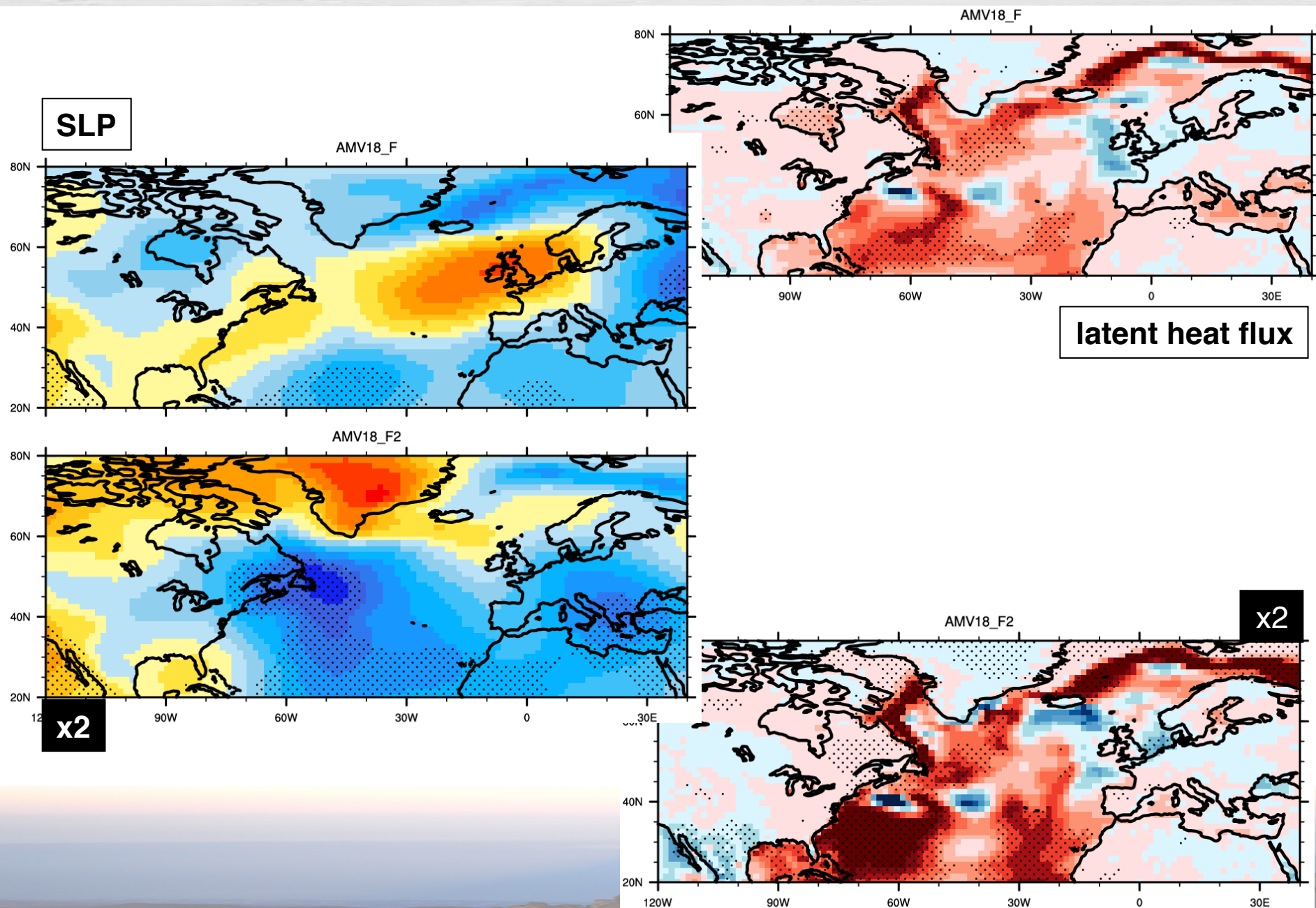


Doubling the SST anomalies



x2

Circulation and temperature



Methodology

Experimental protocol :

- ✧ **Easy in principle: Add a restoring term over a selected regional domain and set a buffer zone between restored and fully-coupled oceans**
- ✧ **Need some cautious though because :**
 - (i) the restoring term may create energy imbalance leading to spin-up of the coupled model
 - (ii) the restoring term may perturb local ocean dynamics that may remotely perturbed the entire system

Need to find a set of parameters that perturbs the least the equilibrium and the intrinsic physics of the coupled climate model, while controlling enough the temporal low-frequency changes

And, as usual... the devil is in the detail