Influence of Initialization Method on the Quality of Decadal Climate Predictions

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Introduction

Methodology

Results

Discussion

Project's purpose

Improvement of the quality and the reliability of decadal climate predictions.

First Step

Estimate of the initial condition using data assimilation methods.

LOVECLIM Model

- 3D Earth system model of intermediate compexity.
- Made up of 5 interacting components.
- Reasonable computational time

  ➜ large number of experiments can be performed.

Data Assimilation (DA)Methods

- Particle Filter with Resampling

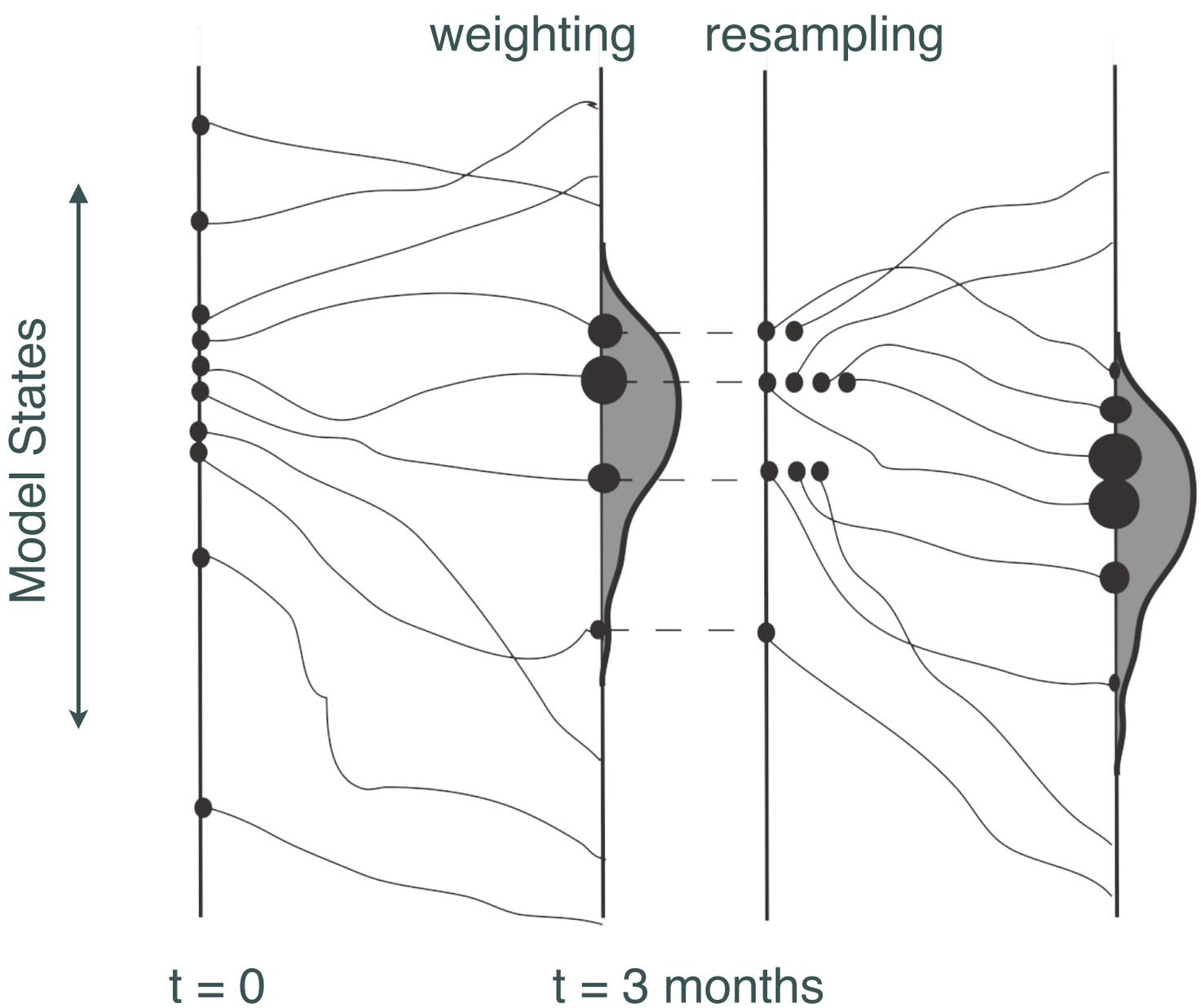
  ➡Seasonal DA of the surface temperature, over 2D box spanning northward of 30°N.

➡Propagation of a 96 particles ensemble.

➡Every 3 months, calculation of a weight (~ likelihood) for each particle.

Data Assimilation (DA)Methods

- Particle Filter with Resampling



Data Assimilation Methods

- Nudging

$$- k(T_{mod} - T_{obs})$$

is added to the heat flux between the atmosphere and the ocean (for each grid point of the ocean free of see ice).

T_{mod} = surface temperature calculated by the model
T_{obs} = observed surface temperature
k = relaxation coefficient (~ relaxation time of 6 months)

Nudging limited to a maximum flux of 50 Wm^{-2}.

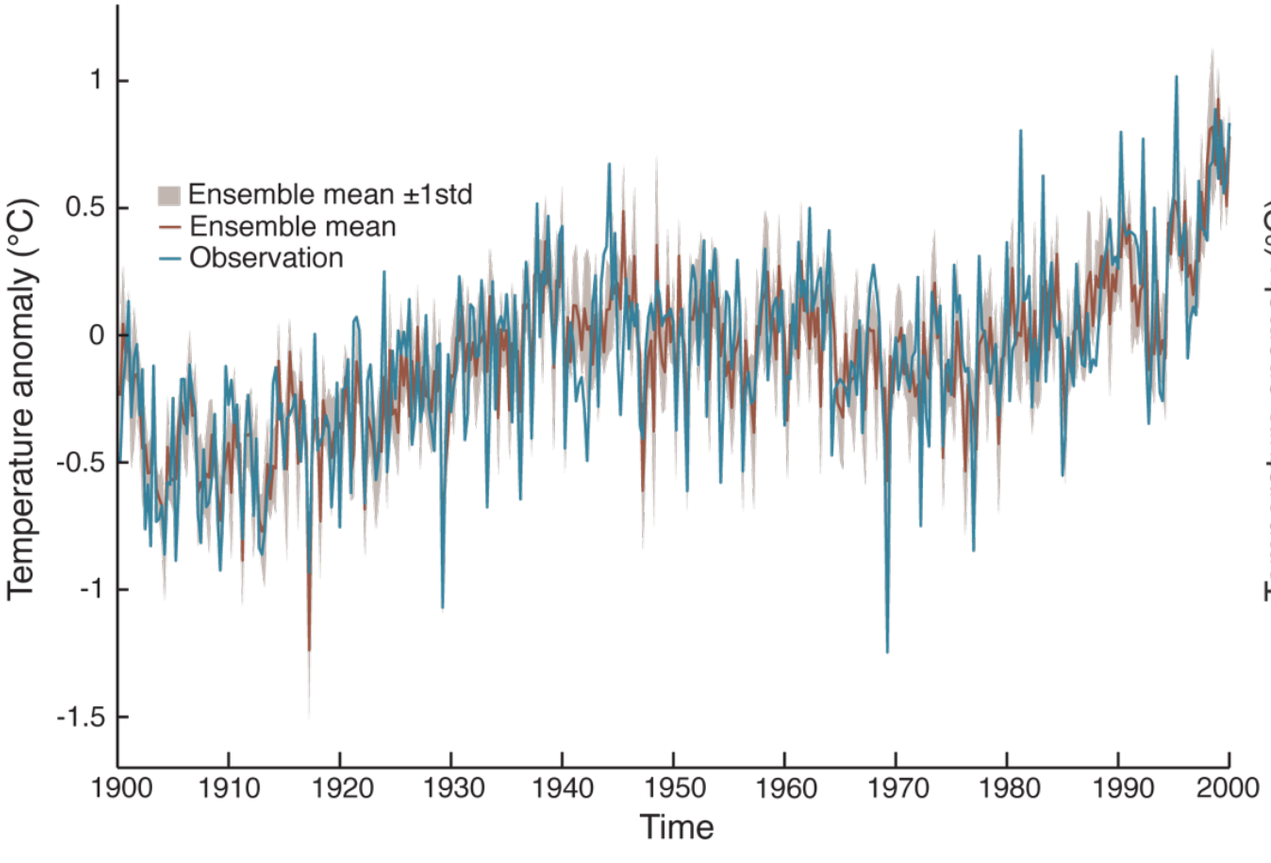
Hindcast Experiments

10-years period ensemble simulations start in January every 5 years from 1940 to 2000.

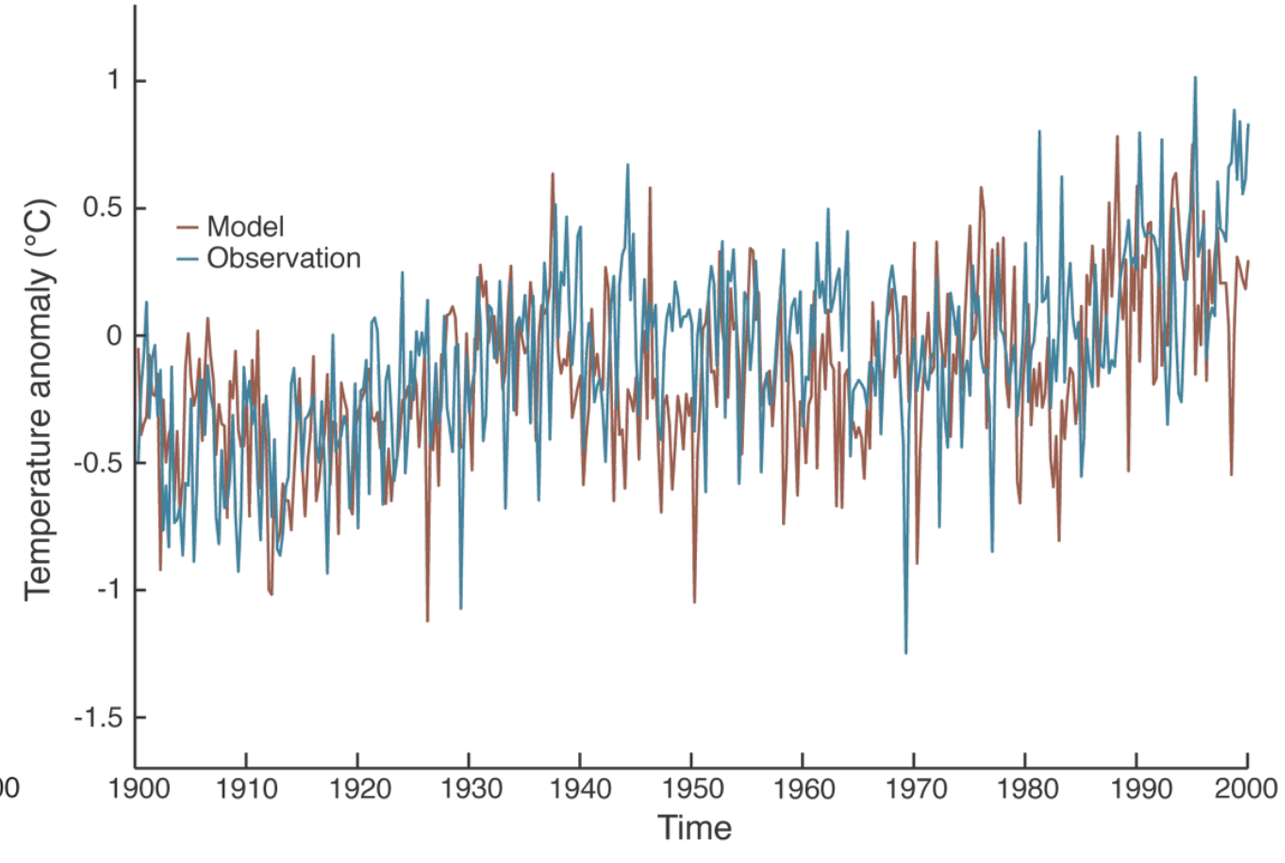
Reconstruction of the Surface Temperature between 1900 and 2000

Seasonal mean of the surface temperature anomaly averaged over the area northward of 30°N

Particle Filter + Nudging

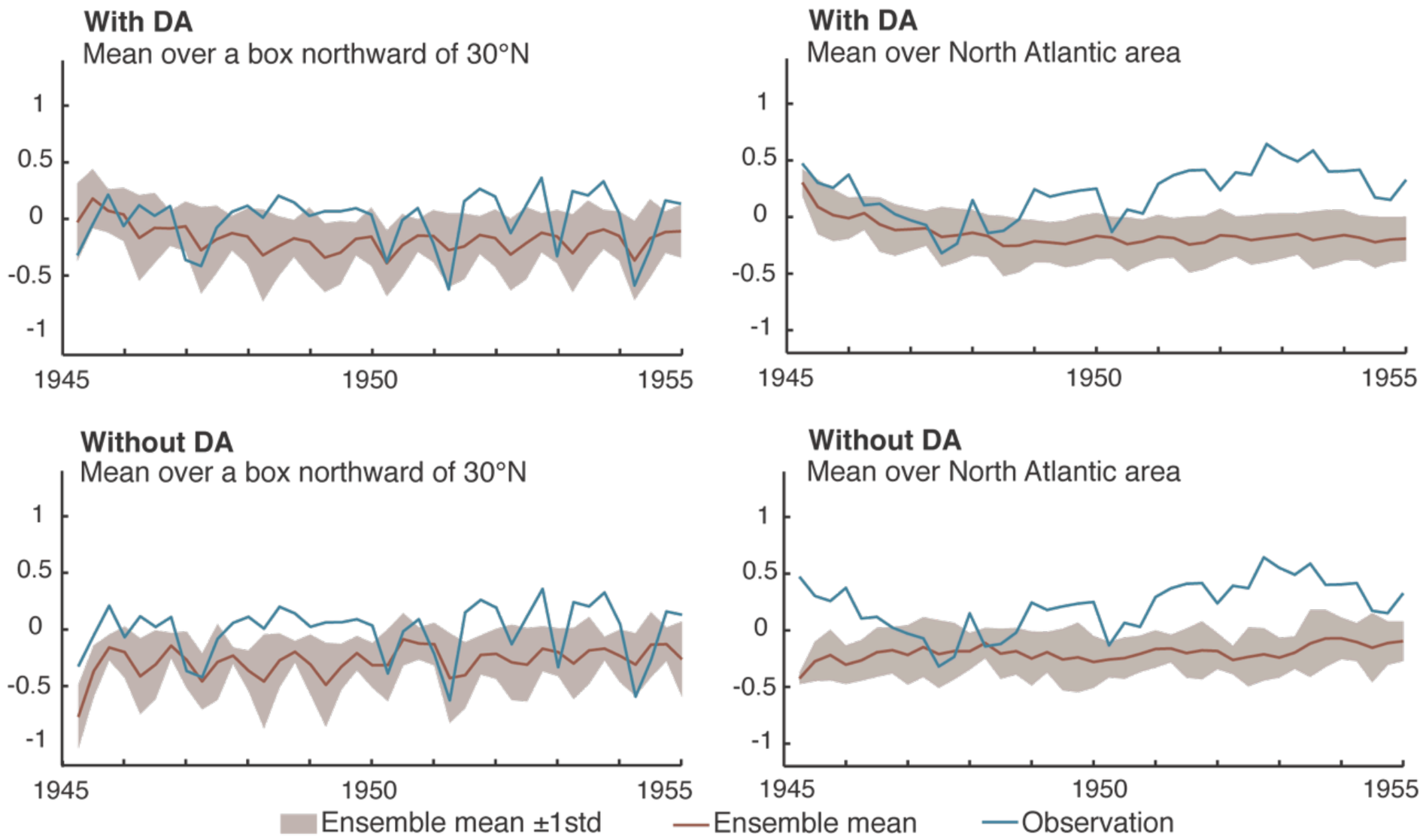


Without Data Assimilation



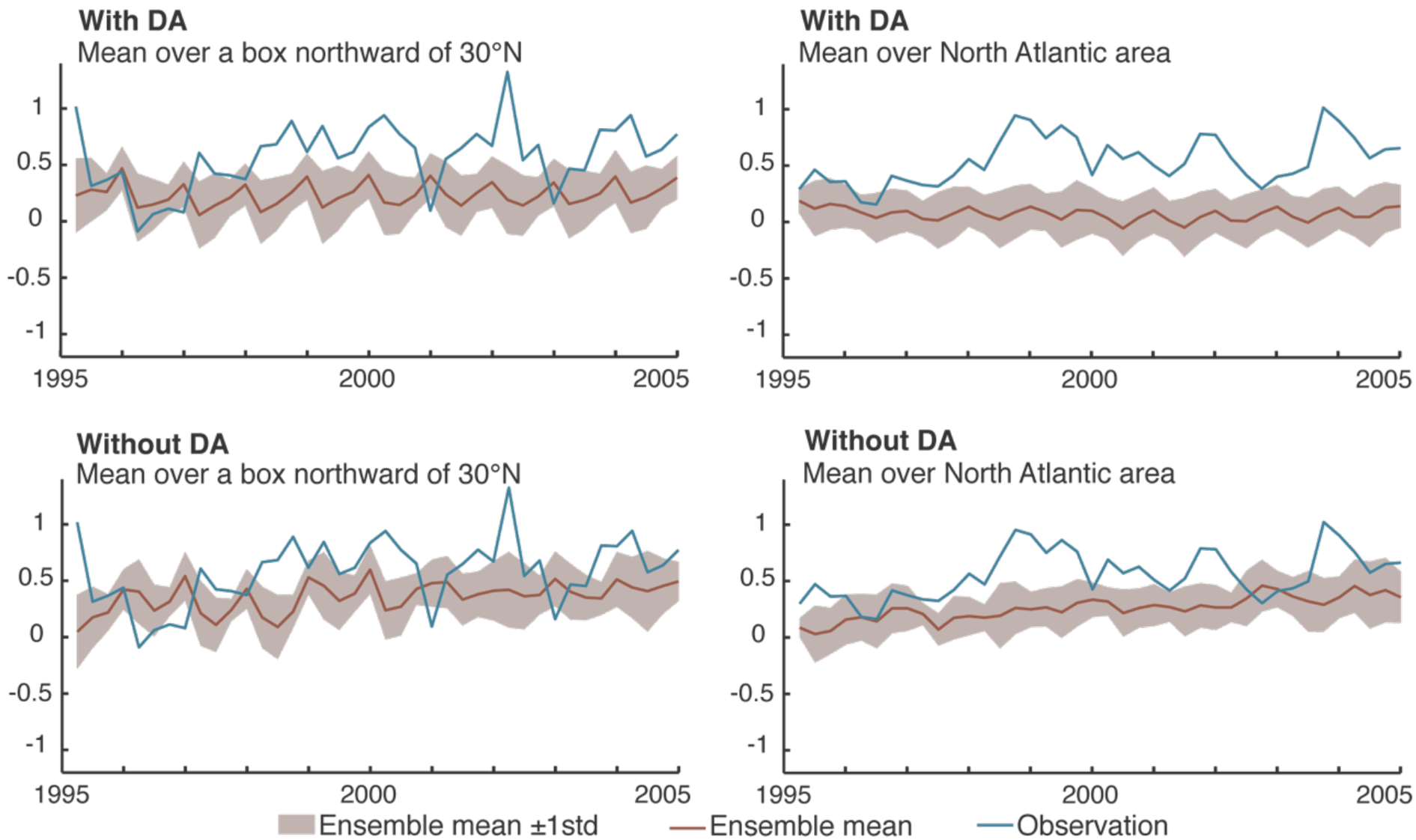
Hindcasts Experiments

1945 - 1955 hindcast for the surface temperature anomaly (°C)



Hindcasts Experiments

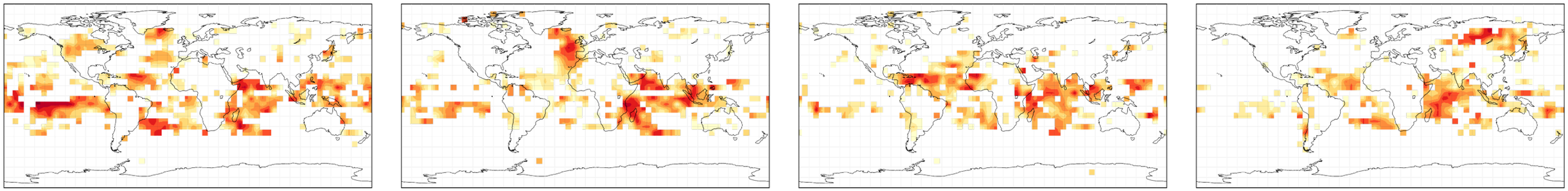
1995 - 2005 hindcast for the surface temperature anomaly (°C)



Spatial Distribution of the Correlation between Observations and Hindcasts

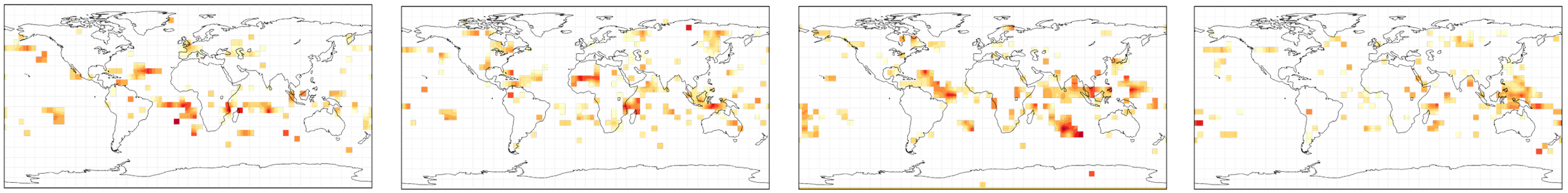
- **With DA**

Season 1 Season 2 Season 3 Season 4



- **Without DA**

Season 1 Season 2 Season 3 Season 4



- Quality of the predictions performed with LOVECLIM using initial conditions obtained thanks to the assimilation of observed surface temperature is not very high.
- Hindcasts perfomerd with these initial conditions show that the model tends to drift toward its climatology and its dynamics is not able to create anomalies such as those appearing in the observations.

Next Steps

- Improvement of the data assimilation method.
- Assimilation of 3D temperature in the ocean.

Thank you for your attention!