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*Supplement of*

## **Global sensitivity analysis of the climate–vegetation system to astronomical forcing: an emulator-based approach**

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# Global sensitivity analysis of the climate-vegetation system to astronomical forcing: an emulator-based approach

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## Abstract

This supplementary material provides further information on experiments 20 and 27, for which more sensitive dependence to initial conditions was found than for the other members of the experiment design. It is shown that the difference between the two initial condition bears the typical signature of a change in North Atlantic Overturning circulation, particularly visible in exp. 20 and which has not been anticipated by the emulator.

## 1 Explanation

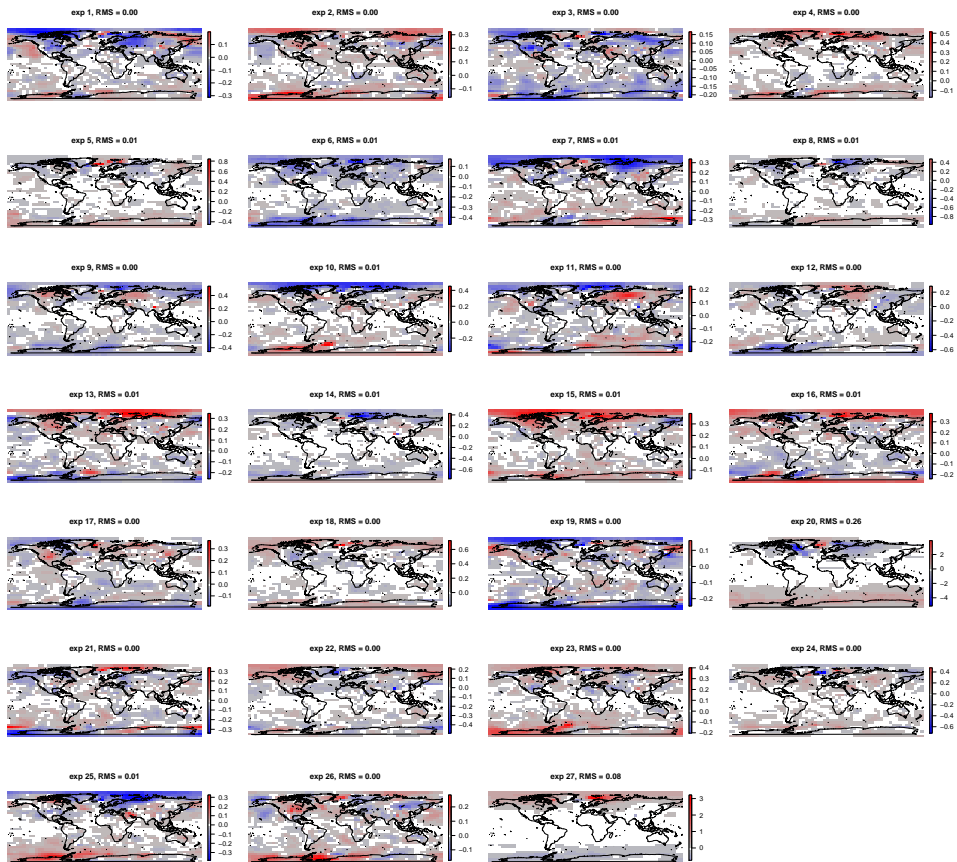
Among the 27 experiment performed, only two experiments appear to show dependence to the choice of initial conditions: experiment 20 and experiment 27, experiment 20 being by far the one showing the largest dependency (Figure 1).

PCA emulators were calibrated on both designs, and Figure 2 shows some validation plots, namely, the barplot similar to already seen in the main article, except that all experiments were duly taken into account, and prediction errors associated with experiments 20 and 27.

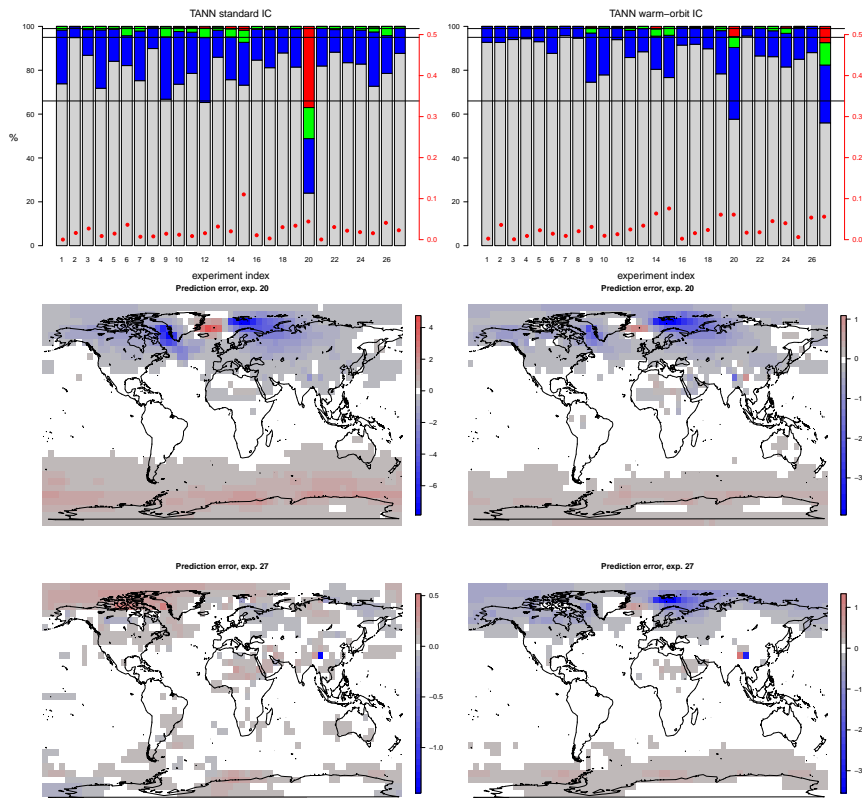
The error pattern on experiment 20 clearly reveals the signature of a weakening or shut-down of the North Atlantic Overturning Cell, associated with coolings over North Atlantic convection sites and warming in the Southern Ocean, visible from both designs, but stronger on the default initial condition set. Only the warm initial condition design presents a clearly structured error pattern on experiment 27, which seems here to be associated with a weakening of the Norwegian Sea convection pattern.

It is unclear whether these patterns reveal distinct attractors of the ocean circulation states, reached from the different initial condition sets, or whether they correspond to weakly connected regions of the attractors that have randomly been sampled from the 500-year sampling and averaging procedure use for output processing.

## 2 Figures



**Fig. 1.** Difference in annual mean temperature associated with the different initial conditions, along with the root-mean-square of the difference.



**Fig. 2.** Barplots showing, for each of the 27 experiments, the number of grid points correctly predicted within one, two, three or more standard deviations, for two experiment designs : (left) standard initial conditions provided in the LOVECLIM package, (right) initial conditions obtained from exp. 2 of the initial set, corresponding to a so-called 'warm orbit' (high obliquity and precession). The figures below show the emulator prediction errors (observe that color scales are optimised for each figure).