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Influence of the stochastic sources in climate models

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The nonlinear nature of the climate system provokes that its reactions to unexpected perturbations could be different as the expected ones. In the nonlinear science it is recognized as a promising paradigm that stochastic fluctuations can generate order or other counterintuitive effects. Thus, noise sources, adequately coupled to a nonlinear system, may give rise to a rich new phenomenology not present in a deterministic noiseless scenario. Although the noise-induced transitions between different stable states are not yet completely understood, its study may play a crucial role. In this work we focus the attention on Thermohaline circulation (THC). The ocean's thermohaline circulation presents two modes of operation. One state corresponds to the active THC and the other corresponds to an inactive THC. Previous episodes of transitions between both states of the THC observed in the paleoclimate records have awakened the interest by the study of this transition. The possibility of a weakening or a collapse of this current in the context of actual global warming could trigger the onset of a new Younger Dryas.

In this work we prove that the introduction of stochastic forcing in key parameters as freshwater input or the equivalent salt flux both in a simple box-model and in an earth model of intermediate complexity provokes a weakening and even a shutdown of the THC.

These results reinforce the necessity to consider stochastic sources in climate models in an attempt to mimic the impacts of the unresolved processes and to model the unpredictable fluctuations of the short time-scale atmospheric variables in the climatic system. In this way we could improve the understanding of the climate system and the effects of the global warming on it.

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