**Reviewer 3**

The predictability of the atmospheric tropical belt is investigated by exploring the emergence of chaos in reduced-order model off the vorticity equation under the weak temperature gradient hypothesis. It is shown that the emergence of chaos depends on the aspect ratio (the length scale of the forcing), the forcing amplitude and its symmetry properties. There is an unusual increase in the number of positive Lyapunov exponents that should be the core of the paper; unfortunately, this is postponed for future works.

I am left with a taste of "so, what"? The authors have an interesting model, come with interesting questions but postpone the core of the work for future works… So, let see what they will do with this. They did not explain sufficiently the key aspect (for instance, when n = 20, what is the corresponding length scale?, the role of the dissipation rate r, the implication of the two components of the forcing, etc.). Consequently, this manuscript appears as a preproject… This should be matured to become a paper to quote…

**Thank you very much for your feedback. Indeed the letter's intention is to propose a new research avenue to evaluate the predictability of the tropical atmosphere. To our knowledge, the tropical atmosphere has been studied for decades essentially with the vision that pure linear waves are the essential ingredients of the dynamics. Although we recognize that the source of predictability of processes in that region has always been related to the interaction with the surface, in the current program, we hypothesize that the ocean is not the only player. So we propose a systematic strategy for the analysis of this problem based on a hierarchy of models that can then be systematically explored using the dynamical systems theory. We further stressed that in the Introduction and conclusion.**

Other comments

Abstract

"This result contrasts with the idea of a predictable tropical atmosphere, and opens important questions on the effective origin of predictability in the Tropics." This sentence opposes two features that appear contradictory. Please, clarify.

**Thank you for pointing that out. We modified the sentence as**

***"This result contrasts with the idea of a predictable standalone tropical atmosphere and opens important questions on the effective source of predictability in the Tropics through interactions with the other components of the climate system."***

Introduction

The introduction is a little bit short… I don't understand why the problem of the atmospheric predictability can be resumed in knowing "whether the tropical atmosphere

is essentially slaved to its boundary conditions." Indeed, it is now well-known that very simple systems are not long-term predictable. Please, explain. I am rather surprised to read that the unpredictability results from "the uncertainty at the interface between the ocean and the atmosphere". What is exhibited, particularly by Lorenz, is that the unpredictability is inherent from the dynamics itself and does not result from uncertainties, and this is what quantify the Lyapunov exponents… Please, clarify.

**We understand your difficulty in capturing this point. In fact the ocean is very slow and therefore the properties of the dynamics of the atmosphere will slowly change as a function of the imposed boundaries. So authors usually focus on the slow boundary dynamics that are shaping the systems' attractor, while the sensitivity to initial conditions seems to play a secondary role. In other words, the intrinsic size of the atmospheric attractor would be rather small as compared with the imposed change to this attractor due to external forcing. This is precisely an aspect that we will address in the future, using a step by step approach with first the analysis of a pure atmospheric model with no changes of the surface boundary forcing. We have slightly changed the second paragraph of the Introduction accordingly.**

According to the authors, the question is therefore to know "whether the tropical atmosphere is essentially slaved to its boundary conditions". It is therefore surprising to use simplified equations for investigating this. How are preserved the boundary conditions in the simplified model here investigated? This is a key question to address the problem posed by the authors but it seems to be forgotten from the beginning… So, what? In the other hand, how inserting stochastic forcing can help in answering this problem? Please explain.

**In the current analysis, the impact of the boundary conditions is not taken into account as the forcing is frozen to a constant value. Those boundaries will affect the forcing and in future works, the intention is precisely to add new processes allowing for modifications of the divergence field.**

Section 2.3

If I well understand this manuscript, the authors use an integration of the model over 30 s to assess Lyapunov exponents leading a horizon prediction of 1 day… It seems strange to me…

**Thank you for pointing that out. We integrated the model for each experiment (each parameter value) for 100,000 time units, or 33,333 days. The time step, on the other hand, is fixed to 0.001 time unit, so about 30 seconds. We have clarified that in the manuscript in section 2.3.**

Section 3.1

How is selected n = 20? What is its influence on the results?

**The aspect ratio n is chosen in order to cover the whole tropical region over 40,000 km. We have added a sentence in the first paragraph of Section 3.1.**

Figure 1 shows that the Lyapunov dimension becomes greater than 3 very quickly. It would be interesting to investigate how is the transition from periodic to chaotic. It appears that the hyperchaos arises also very quickly after the first chaotic solution, a feature quite expected with large dimensional model.

**Thank you very much for this comment. Indeed, we are planning to investigate in detail the bifurcation diagram of this system in order to put on firm grounds the transitions between the different regimes. This is commented on in the conclusion.**

For regimes associated with a Lyapunov dimension greater than 9, how many Lyapunov exponents are null? This is indeed puzzling and this should be checked and explained since all the manuscript is devoted to Lyapunov exponents without further analysis. This cannot be postponed for future works because this could come from a mistake in computing Lyapunov exponents. Otherwise, what would be the interest of such a work? I had a look on the video, it seems rather surprising that these not so turbulent dynamics lead to so large Lyapunov dimension… A clear link could be made between these videos and the figures of the manuscript… This would help the reader…

**There is only one zero Lyapunov exponent. Please see below the Lyapunov spectrum obtained with an integration of 100,000 time units for parameter $\chi_2$=0.32, n=0.20 (corresponding to a Lyapunov dimension larger than 9). The Lyapunov spectrum has a quite classical shape, except that the number of positive exponents is large. We do not see any mistake in the computation of Lyapunov exponents.**

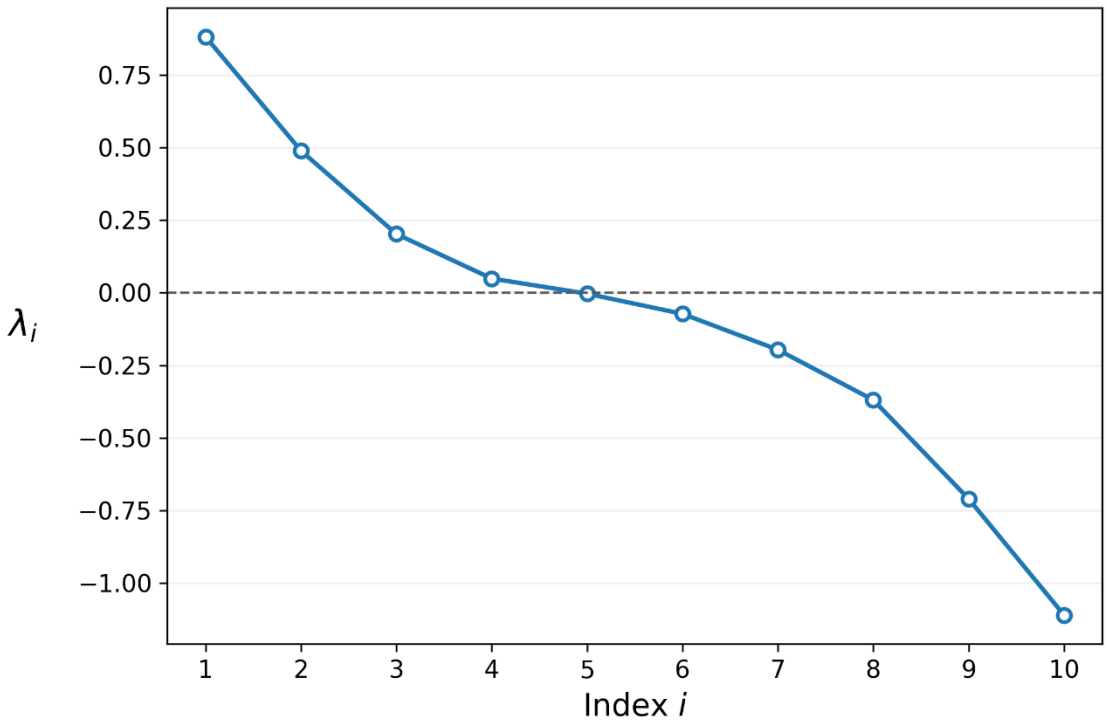



**Figure 1: Lyapunov spectrum for $\chi_2$=0.32 and $\chi_5$=0., r'=0.0028 and n=0.20. Four exponents are positive, one zero and the last five are negative. This result is obtained after an integration of 100,000 time units corresponding to 33,333 days.**

**Concerning the videos, the behavior becomes more erratic when we increase the values of the forcing amplitude. The discussion is slightly modified (in view of the size limit of the letter) in Section 3.1.**

When only $Xi_2$ or $Xi_5$ is reported, does it means that the second Xi_i is null ? Please, clarify.

**Thank you. This has been done in the figure captions.**

Since there is no state portrait, it is rather difficult to figure out which type of (hyper) chaos is actually observed. The influence of symmetric and asymmetric forcing is therefore difficult to assess. The Lyapunov exponents being a poor marker for the type of chaos actually observed.

**Thank you for the remark. This will be addressed in the future by making bifurcation diagrams. The current letter was focusing on the predictability of those systems.**