

## ***Interactive comment on “A 24-variable low-order coupled ocean–atmosphere model: OA-QG-WS v2” by S. Vannitsem and L. De Cruz***

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Review of A 24-variable low-order coupled ocean-atmosphere model: OA-QG-WS v2.  
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Reviewer: Anna Trevisan

General comments

In the low-order coupled model presented in this paper, the shallow-water ocean is forced by wind stress produced by the atmospheric component, a 20-variable system of equations representing planetary and baroclinic scale dynamics. The attractor of the atmospheric model (Reinhold and Pierrehumbert, 1982) has two distinct regimes, not located near any of the stationary equilibria. This model belongs to the category of toy

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models that contain the essential dynamical ingredients to reproduce some aspects of the observed phenomenology and can be a very useful tool for the investigation of basic physical mechanisms. I therefore recommend the paper for publication in Geoscientific Model Development of the EGU.

### Specific comments

1. The low-order coupled models and the results obtained in previous works could be discussed in more detail. This would help the reader understand better the improvements that can be obtained with the present model in terms of the ability to reproduce and interpret important realistic mechanisms.

2. With the same values of parameters and scaling of variables of the original 1982 paper, the typical residence time in one regime is 800 units (about 90 days) and the system has two positive Lyapunov exponents, the leading one, .0094, corresponding to an e-folding time of 12.3 days (Trevisan et al., 2001: Ensemble prediction in a model with flow regimes. Quart. J. Roy. Meteor. Soc., 127, 343-358.) Is the the difference in the value of the leading exponent in the present manuscript due to a different scaling of the variables?

Fig. 6 shows the Lyapunov exponents and the Kolmogorov-Sinai entropy as a function of the coupling parameter for three different values of the forcing. In all three cases the values of the exponents increase with the coupling parameter and are larger in the coupled system than they are for the atmospheric component by itself. This result is worth being investigated, being in contrast with the results of Nese and Dutton (1993) and with the intuitive notion that the presence of the ocean has the effect of increasing the predictability.

One could try to understand how the coupling with the ocean can increase the intensity of baroclinic instability by inspecting the structure of the Lyapunov vectors.

3. It would be interesting to look at the time record of the local leading Lyapunov

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exponent to see if there is any relation with the temporal evolution of the modes (Fig.1) showing the decadal variability induced by the atmospheric chaotic wind forcing.

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