Review of "An empirical model of global climate-Part1 : reduced impact of volcanoes upon consideration of ocean circulation"

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The same acronyms as those defined in the paper are used here.

1 General Comments

This paper uses a Multiple Linear Regression (MLR) to decompose the global surface temperature anomaly ΔT (global or only land surface) into several parts related to anthropogenic radiative forcing (GHG RF and NAA RF), volcanic eruptions, solar radiation, ENSO, the AMO, the PDO, the IOD, and the increase in the upper 700m oceanic heat content due to increasing GHG. The aim is to find the impact of volcanic eruptions onto ΔT. The model used follows the previous work of Lean and Rind (2008) Kopp and Lean (2011), but differs in several manners, and in particular it takes into account in the MLR the AMO, PDO, and IOD. They find almost no contribution of the PDO and IOD to ΔT, while the AMO appears to have a large contribution depending on how this index is detrended, resulting in a smaller impact of volcanic eruptions on ΔT than estimated in previous studies. The authors consider the AMO as a proxy of the AMOC, and conclude that the impact of volcanoes is reduced when considering oceanic circulation. Even if they underline the caveat that the AMO may not be a perfect proxy of the AMOC, they use indistinctly AMOC/oceanic circulation for AMO in the title and several times in the manuscript.

Assessing the impact of volcanic eruptions on the global mean temperature is a relevant scientific question, and the introduction of variability modes (AMO, PDO, IOD) in the decomposition of ΔT is interesting. However, I find two main problems in the paper :

- The interpretation of the AMO as the AMOC is problematic, since it is the key point of how they interpret their results.
  However, as already commented by D. Zanchettin, AMO and AMOC

are not permutable, especially in the presence of volcanic forcing (see references given in the interactive comment of D. Zanchettin). The Atlantic SST and thus the AMO is indeed influenced by short time scales weather fluctuations, the ENSO ([Alexander et al, 2002], [Brönnimann, 2007]), and ocean dynamics that are not directly related to the AMOC. There are also links at low frequencies between the North Atlantic SST and the Pacific decadal variability ([Enfield and Mestas-Nunez, 1999], [Orgeville and Peltier, 2007], [Müller et al, 2008], [Guan and Nigam, 2009]).

- The lack of discussion about the significance of the MLR model (see Specific comments below).

I would thus recommend major revisions.

2 Specific Comments

The AMO is not the AMOC The title of the paper should be modified and the AMO should not be used indistincly for the AMOC or the oceanic variability (as in part 4.4 for instance). The AMO should not be considered only as a proxy of the AMOC variability, since North Atlantic SST are not only influenced by the AMOC (cf above). I would thus recommend to modify the interpretation of the results in regard of what represents the AMO.

MLR model More statistical investigations of the MLR model should be added. The authors consider the reduced chi-squared as an indicator of the model to the observations, but do not apply a F-test, neither compute confidence intervals for the regression parameters (e.g. [von Storch and Zwiers, 2002], chapter 8.4). They do not discuss the possibility of multicolinearity between the regression variables (which could be detected using variance inflated factor).
Besides, the use of a MLR model itself should be discussed. Indeed, it has been shown than ENSO could not be properly filter out using only a regression (see for instance [Penland and Matrosova, 2006]). [Thompson et al, 2009] used a simple thermodynamic model of the global atmospheric-oceanic mixed layer response to anomalous heating to estimate the impact of ENSO and volcanic eruptions onto the global mean temperature anomaly.

Definition of regression variables The origin of the ENSO, PDO and IOD indices is given, but how the indices are computed and from which dataset they are derived should be added.

3 Technical corrections

- in the abstract, use of the acronyms WWI and WWII without introducing them
- p.23835, l.8 : "an SST"

References

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