

## ***Interactive comment on “Annual and semiannual cycles of midlatitude surface temperature and baroclinicity: reanalysis data and AOGCMs simulations” by Valerio Lembo et al.***

### **Anonymous Referee #3**

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The paper is generally well written and with a clear strategy. It contains some potentially interesting outcomes on the skills of global datasets (Renalysis and AOGCMs as well) in reproducing the most relevant harmonics (annual/semiannual) of some parameters of interest for mid-latitude synoptic variability such as 2 meter temperature and mean baroclinicity (mostly related to the Available Potential Energy ). However, I think that some points could be better addressed before considering it for a final publication.

1) In several parts of the paper more explanations , comments and interpretations are needed. There are too many vague statements that should be better assessed and figures not adequately commented. In the specific comments below some examples are reported

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2) In the context of the main objectives of this paper I have found the jump between the reanalysis and AOGCMs too large. One possible question is if the discrepancies observed in the representation of the first harmonics in the climate models are due to a lack in the description of main atmospheric processes or, alternatively, to the coupling with oceanic components. So, I strongly suggest to add to the present analysis some AMIP runs forced by observed SST. One possible candidates could be the AMIP runs recently produced in the ERA-CLIM project (Hersbach et al. 2015). Moreover, in order to have a longer reference dataset, the authors could also analyse the centennial reanalysis ERA-20C (Poli et al 2015) Hersbach, H., Peubey, C., Simmons, A., Berrisford, P., Poli, P. and Dee, D. (2015), ERA-20CM: a twentieth-century atmospheric model ensemble. Q.J.R. Meteorol. Soc.. doi: 10.1002/qj.2528 Poli P, Hersbach H, Berrisford P, Dee D, Simmons A. and Laloyaux P. (2015) ERA-20C Deterministic. ECMWF ERA Report Series 20, ECMWF, Shinfield Park, Reading

3) The quality of the figures should be improved to add readability to this work (see specific comments below).

Specific comments: Sec.2.1 As far as I know, in a recent paper Di Biagio et al (2014) have applied the same metrics introduced in Lucarini et al 2007 (here cited) on CMIP5 models. I suggest that this work should be here considered and the main outcomes should be taken into account, especially concerning the CMIP5 models analysed. Di Biagio, V., S. Calmanti, A. Dell'Aquila, and P. M. Ruti (2014), Northern Hemisphere winter midlatitude atmospheric variability in CMIP5 models, Geophys. Res. Lett., 41, doi:10.1002/2013GL058928.

Sec 3.1 In fig.1 a legend for the different lines should be added. Moreover, additional explanations (or even just references) about the relevant features of SH (for instance the october relative minimum in the meridional geopotential gradient) are here required I have found fig.2-3 almost useless. I suggest to remove them or alternatively to merge fig. 2 and fig 3, as already done in Fig.4, to better highlight the differences in phase between T2m and the index of baroclinicity. However, the periodic features have been

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already highlighted in Fig.1, so the authors should better explain the motivation of those figures, if they want to keep them further. Similarly, I suggest to modify Fig.4 reporting for each model only the standardised mean seasonal cycle of the two indicators (as in Fig.1). Also some additional comments about the different skills of the models are here needed.

Sec. 3.2 Why the authors have chosen the integer values  $p=3$  and  $K=5$  in the MTM method, and 7 degrees of freedom for the Chi-squared distribution? Could the authors add some details and explanations on that point? Fig-5-9: To improve the readability of the figures I suggest to report in x-axis the period (in months) instead of frequency Fig. 6-9 Please add the considered variable in the title of each figures The spectral analysis for the CMIP3/5 models is applied to 100 years instead of 36 years for Era-Interim. To be consistent, records with the same length should be considered. I suggest to re-run this analysis by considering records with comparable sizes. To have a longer record for the reanalysis, I would suggest, as already mentioned, the adoption of ERA-20C centennial reanalysis In this section, an additional analysis considering AMIP runs could be quite appealing to check if the discrepancies here arisen in CMIP3/5 models are due to the use of coupled models.

Sec.4 " Present findings contribute to better characterize the cyclic response of current global atmosphere-ocean models to the external solar forcing that is of particular interest for seasonal forecasts". Here some additional comments about seasonal forecast, or even just some references, are required

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