

## ***Interactive comment on “Using synoptic type analysis to understand New Zealand climate during the Mid-Holocene” by D. Ackerley et al.***

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This manuscript presents a very interesting methodology applied to the important and difficult task of model-data comparison, to understand past climate variability in New Zealand. Overall the paper is well structured, the methodology is well applied, and figures illustrate well the results. However, I have a number of questions and suggestions, which should be addressed before publication. Therefore, I recommend publication after minor revisions.

First, Rojas and Moreno (RM) have published a paper in *Climate Dynamics* in 2010, that analyses the PMIP2 Mid-Holocene simulations in the Southern Hemisphere, with emphasis in Patagonia and New Zealand (Rojas, M. and P.I. Moreno, 2010: Atmospheric circulation changes and Neoglacial conditions in the Southern Hemisphere

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mid-latitudes: insights from PMIP2 simulations at 6 kyr. *Climate Dynamics*, DOI 10.1007/s00382-010-0866-3). Some of the discussion of your results should reference that work. There are some coherent results in both papers, and others not. This should be addressed.

I will now go through the paper, with questions, comments, typos, etc:

Abstract: \*Include in line 13: ..,we find at 6000 BP, increased.....

1) Introduction: \*Change in line 26: This model-proxy model intercomparison is an essential test to establish the ability of a climate model ... \*page 1306, line23: you might want to use the word "robust" ?

2) Models, data and method \*I think the model description can be shortened with a table.

2.5) EOF procedure for synoptic classification (typo in procedure)

I am not sure I understand how the regimes were calculated and the precipitation and temperature composites for those regimes. From the text, it seems that you used "1000hPa geopotential height" for the regimes (1972-2009?), but for the temp. and precip. composites you calculated again 3 regimes with daily SLP ? Please clarify. Are the models "forced" to match one of the 12 Kidson's synoptic types? Couldn't you just calculate the with a cluster analysis 12 clusters (freely in the models) and compare those to the 12 clusters in the reanalysis? Maybe I am not understanding well here! Also, I believe that it would be useful to actually show the precipitation and temperature composite for each of the 3 regimes (not separated by season, just 1 more figure 3 panels, or 6 panels if you include the models composites). How are the climatological precip and temp fields in the models? Might the difference between the relative occurrence of the regimes in models versus reanalysis explain any observed biases in the model?

Finally, my main problem is with the discussion, which is somewhat contradictory with

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your own results and sometimes contradictory with my results. In Rojas and Moreno we used 11 models, so part of the differences can be related to this, however robust results in both papers should agree. This should be conciliated.

3 Results comments on discussion in 3.1-3.5: From table 1 I see that in most seasons the increase/decrease of events in the through regime is compensated by decrease/increase in the zonal regime, but you choose to comment on 1 of them only depending on season. For example significant increase in through regime in MAM is mentioned, but not the also significant decrease in zonal regime during the same season. Because I don't have a clear picture how the regimes project on precipitation and temperature, it is not clear to me what to expect from those changes in terms of precipitation and temperature. Why is the increase in zonal regime in SON (also seen in RM) related to decreased precipitation in NZ? Or are the colours in WSI positive? (I can't distinguish the colour scale around zero, in figures 7 and 8)

3.5 Summary \*line 8: increase in zonal types in JJASON. The PMIP model mean shows decreased westerlies in JJA, and increased only in SON.

4.1 \*page 1316: typo: resoution \*page 1317, discussion on the temperature changes forced by insulation changes versus regime changes. You should comment on the MAM in the Northern Island, which shows an important warming! \*page 1318, line 1.4: this reduced seasonally is also shown in figure 7 of RM (except in the southern part of SI).

5 Conclusions page 1322, line 19: figure 2 of RM indicates cooler temperatures in all seasons, except SON.

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