

REVIEW: Atmospheric Blocking in an Aquaplanet and the Impact of Orography by Narinesingh et al.

Summary:

Scientific significance: good

Scientific quality: good

Presentation quality: good

I would like to thank the authors for considering my earlier comments. The manuscript is now more focused on the key questions that can be answered using the experiments and better uses previous work to explain the changes. Specially, the authors show that orography impacts the regional and hemispherically integrated statistics of blocking. The results could potentially explain differences in Northern versus Southern Hemisphere blocking and regional differences in Northern-Hemisphere blocking in reanalysis. Given the improvements, I recommend minor revisions before this paper can be published.

General comments:

1. Significance testing (section 2.5.4 and results): As I understand it, the authors use t-tests where the samples are taken from winter mean blocking frequencies. The t-test assumes the data are normally distributed, however, daily blocking events follow more of a Poisson distribution. Does averaging the events over one year produce normally distributed samples, either regionally or hemispherically integrated, as expected from the central limit theorem? I think it is important to confirm whether the statistical test is appropriate given that the changes in blocking statistics are modest and have large internal variability. Furthermore, have the authors tested whether the Northern versus Southern hemisphere statistics in reanalysis are statistically significant (L350-351)? Also I might be mistaken but I don't think the statistical significance mentioned on L493-494 was stated explicitly in the results section. I only found a mention of the regional blocking frequencies being significantly different on L385-390.
2. Results L279-282 and Fig. 3: I'm confused why the authors show Southern Hemisphere reanalysis results in Fig. 3a-c. I thought the idea behind the orography experiments was to mimic the configuration in the Northern-Hemisphere? I don't understand why the authors avoided 'regional variations' in Northern-Hemisphere blocking. Are the results different if Northern-Hemisphere blocks are shown? Furthermore, I'm confused why blocking events 'near the high-pressure anomaly of stationary waves' from the 3km mountain experiment was chosen. Are the results different if blocks from other regions are shown? If the authors need to be selective about which blocks to compare in the model and reanalysis, it suggests that the answer to question 1 in the Introduction is no.
3. Discussion and conclusion section: The results show modest changes in blocking statistics when comparing individual experiments to their control simulation and some of these changes are not statistically significant. The authors chose to emphasise the differences with the control simulation rather than the similarities. While I understand the reasoning for this choice, I think

the authors should also discuss the implications of the similarities, which are larger than the differences, which were mentioned in my earlier review. In particular, it could be that the model fails to capture the real effect of topography in reanalysis or that other processes, not included in the model, better explain the statistics in reanalysis.

Specific comments:

1. Abstract: I suggest including a sentence that states the knowledge gap in the literature to entice the reader. Its not clear why your results are important based on the abstract only.
2. L72-74: Questions 1 and 4 are similar. I suggest combining them. Also I suggest changing 'overall' in question 3 with 'hemispherically integrated' to be more concise.
3. L260 and other subsection titles: suggest using more descriptive titles. For example: 'Lifecycle of blocking in reanalysis and the idealized model' for section 3.1.
4. L296: Needs more explanation if the Danielson et al. 2005 citation is included.
5. L307-308: Citing the Woollings paper in the Introduction would be helpful to readers.
6. L395: For comparison, how high are the Rockies and Himalayas?
7. 418-419: Alternate explanation: other processes not included in the model could explain the differences.
8. L437-439: Instead of 'cautious suggestions', a more robust statement could be made that the differences are likely due to internal variability. The non-linear changes in duration in response to linear changes in topography support this interpretation.
9. L459-460: I don't understand what the citation is referring to here.
10. L475 'purely through eddy-eddy interactions': You haven't shown this. I would simply say that that blocks can be produced using a zonally symmetric model consistent with the role of eddy-eddy interaction generating blocks.
11. Conclusions and discussion: Since the authors have laid out specific questions in the Introduction, I think it would be useful for readers if you repeated them here before answering them.
12. Tables 2-3: It would help to have some measure of the year to year variability in these numbers to better understand the magnitude of the changes between experiments. For example, you could add 95% confidence intervals using ± 2 standard deviations next to each value in the tables. You could also include a star symbol to denote which experiments are statistically different than the control.
13. Fig. 2 and 3: Suggest presenting both figures in the same format to better compare.
14. Caption in Fig. 4: I think this may be wrong.
15. Fig. 8: It is difficult to compare different experiments because they overlap. I suggest splitting this plot into 4 panels, each with the control and 1 experiment with the mean and the spread. Why is the two mountain experiment left out?