

Quantifying the variability of the annular modes: Reanalysis uncertainty vs. sampling uncertainty

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This a very useful study in the sense that it elegantly illustrates which Reanalysis datasets and during which time periods the Northern Annular Mode (NAM) and Southern Annular (SAM) are well represented. It is not surprising that the most recent Reanalysis datasets are excellent for examining the NAM and the SAM, but it is very helpful to know that pre-satellite era data extending back to 1958 is still very useful for the NAM, but not the SAM, where the assimilation of satellite data is crucial. By comparing various Reanalysis datasets, including those that do and do not assimilate satellite data, and those constrained only by surface pressure, the authors are able to glean much insight into what factors determine the reliability of the NAM and SAM in these datasets. This type of information is very helpful for those scientists that investigate the NAM and SAM. For this reason, I recommend that this manuscript be accepted for publication after the minor comments below are addressed. One may perhaps criticize this study for providing little insight into the physical processes that drive the NAM and SAM, but that is not the aim of the study.

Minor Comments:

1. Page 3, line 30. There have been many different definitions of the annular mode in addition to the polar cap averaged geopotential height used in this study. Baldwin and Thompson (2009) compared different annular mode definitions. In analogy with Baldwin and Thompson (2009), it would be beneficial to briefly discuss the strengths and weaknesses of the particular annular mode used in this study.
2. Figure 3. How is the consistency determined? This does not appear to be clearly defined in either the text or the figure caption. Does the consistency correspond to the average of the six pairwise correlations between the four Reanalysis datasets?
3. Page 6, line 19. What is meant by conventional observations? In the abstract, the term conventional appears to correspond to surface observations which doesn't appear to be consistent with the rest of the paragraph. Since

on page 3, line 22, where it is indicated that JRA-55C data lacks satellite measurements, it appears that conventional in this paragraph corresponds to the exclusion of satellite measurements.

4. Page 7, line 6. It is stated that the NAM is consistently represented prior to the satellite era. However, this appears to be the case only for the troposphere. For the stratosphere, the ERA-20C, as indicated in the text, and the two versions of 20CR are much poorer?

5. Page 8, line 8. The relatively high R^2 value between the 20CR and ERA-20C is mentioned for the early half of the 20th century. This is taken to indicate that the NAM may be reasonably accurate during this time period. It is not indicated in this paragraph that this result applies only for 1000 hPa.

6. Page 9, line 11. It is stated that the strong vortex build up is less abrupt than its decay. I don't see this in Fig. 8.

7. Page 9, lines 25-31. I did not follow how the sampling uncertainty is determined. Was the standard deviation determined for all four modern Reanalysis datasets over the lag days? A little more detail would be helpful.

8. Page 11, line 12. To remove the interannual variability, one could simply apply a high pass filter to the data with a cutoff period shorter than one year and longer than the longest e-folding time scale in the raw data.