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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Influence of the Arctic Oscillation on the vertical distribution of clouds as observed by the A-Train constellation of satellites" *by* A. Devasthale et al.

Anonymous Referee #2

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General comments:

The authors use A-Train data to analyze the spatial distribution of clouds during positive and negative polarity of AO, and report a cloud dipole pattern around Greenland. The paper is generally well-written and provides an updated view of cloud spatial distributions. My specific comments focus on the statistical significance of the results and the novelty of the principal finding.

Specific comments:

1. The statistical significance of the results needs to be assessed because the number of years available for analysis is limited. Tests will be performed at many spatial points,

so issues of multiplicity necessitate establishment of field significance as discussed in the following paper and references therein:

DelSole, T. & Yang, X. (2011) Field Significance of Regression Patterns. J. Climate, Journal of Climate, American Meteorological Society, 24, 5094-5107.

2. The manuscript seems to suggest it is the first to analyze the spatial distribution of clouds in the context of the AO or NAO (e.g., "for the first time"; line 20, page 10308). This may be the first study to use this suite of satellite data for this purpose, but much is known about the distribution of clouds under the AO or NAO, including what the authors refer to as the "Greenland cloud dipole anomaly". This result should be presented in the context of its appearance in various forms based on other data in the following and references therein:

Hurrell, J. W.; Kushnir, Y.; Ottersen, G. & Visbeck, M. (Eds.) (2003) The North Atlantic Oscillation: Climate Significance and Environmental Impact. Amer. Geophys. Union Geophysical Monograph Series (134), 279 PP. ISSN: 0065-8448; ISBN: 0-87590-994-9

Park, S., and C. B. Leovy (2000), Winter North Atlantic low cloud anomalies associated with the northern hemisphere annular mode, Geophys. Res. Lett., 27(20), 3357–3360, doi:10.1029/2000GL011609.

Previdi, M., and D. E. Veron (2007), North Atlantic cloud cover response to the North Atlantic oscillation and relationship to surface temperature changes, J. Geophys. Res., 112, D07104, doi:10.1029/2006JD007516.

Trigo, R. M., T. J. Osborn, and J. M. Corte-Real (2002), The North Atlantic Oscillation influence on Europe: Climate impacts and associated physical mechanisms, Clim. Res., 20, 9–17.

Wang, X. and JR Key (2003). Recent Trends in Arctic Surface, Cloud, and Radiation Properties from Space. Science, 299 (5613), 1725-1728. [DOI:10.1126/science.1078065]

3. The manuscript states that "there is no consensus on what forces the oscillations in the AO" (line 27, page 10307). Several studies published during the past decade convincingly agree that the AO and NAO arise from the dynamics of potential vorticity overturning (i.e., Rossby wave breaking and blocking). This should be noted with references to:

Benedict, J. J.; Lee, S. & Feldstein, S. B. (2004) Synoptic view of the North Atlantic Oscillation. J. Atmos. Sci., 61, 121-144.

Strong C, G Magnusdottir, 2008: Tropospheric Rossby Wave Breaking and the NAO/NAM. J. Atmos. Sci., 65, 2861–2876. doi: http://dx.doi.org/10.1175/2008JAS2632.1

Woollings T, B Hoskins, M Blackburn, P Berrisford, 2008: A New Rossby Wave–Breaking Interpretation of the North Atlantic Oscillation. J. Atmos. Sci., 65, 609–626. doi: http://dx.doi.org/10.1175/2007JAS2347.1

4. The text refers to the "trend in the AO" (line 23, page 10307) citing a paper from 2000. Since 2000, it has become clear that the observational record (1958-present) no longer evidences a trend in the AO, and this should be clarified in the text:

Cohen, Judah, Mathew Barlow, 2005: The NAO, the AO, and Global Warming: How Closely Related?. J. Climate, 18, 4498–4513. doi: http://dx.doi.org/10.1175/JCLI3530.1

Semenov, V. A., M. Latif, J. H. Jungclaus, and W. Park (2008), Is the observed NAO variability during the instrumental record unusual?, Geophys. Res. Lett., 35, L11701, doi:10.1029/2008GL033273.

5. The conclusions refer to differences in "energy and moisture transport" (line 5, page 10317), but no calculations were presented for "transport" per se.

6. The CPC's AO index in Fig. 1 has already been normalized by the standard deviation of the monthly index (1979-2000 base period) as detailed here:

http://www.cpc.ncep.noaa.gov/products/precip/CWlink/daily_ao_index/history/method.shtml Zero and +/- one on this index therefore have intrinsic meaning related to the mean and standard deviation of the AO index as defined by CPC. Basing the submitted analysis on defining an additional mean and standard deviation of the already normalized index (blue lines, Fig. 1) therefore appears awkward and unnecessary. This convention should be discussed and justified above and beyond the fact that the analysis period and AO base period differ.

7. It would be helpful to include a map view of the cloud differences (vertically integrated or sliced at a vertical level) for comparison to Fig. 8. Otherwise, the meridional averaging onto longitude-height axes limits spatial understanding of results.

Technical comments:

1. Vertical axes on the figures should be consistently km or hPa to facilitate comparisons.

2. The phrase "zonal vertical distribution" is not clearly defined (Abstract line 10; line 27, page 10316).

Interactive comment on Atmos. Chem. Phys. Discuss., 12, 10305, 2012.