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The vertical distribution of cloud regimes and their radiative impact under active phases of the Arctic Oscillation

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The Arctic Oscillation (AO) is the leading natural mode of variability in the Northern Hemisphere (NH) and strongly influences weather and climate over mid- and high-latitudes. Although our understanding of the AO is improving, the insufficient description of clouds remains a major stumbling block in achieving the desired accuracy and confidence in forecasting and climate models over NH regions due to tight coupling of clouds with radiation and thermodynamics during the AO.

Previous studies argue that anomalies of the vertical distribution of clouds show a dipole structure that is centred around Greenland during the positive and negative phases of the AO, with different signs of dipole anomalies in the low and medium/high level clouds (Devasthale et al. 2012, and references therein). The net radiative impact of such dipole structure and its implications for local dynamics remains to be evaluated.

In that context, we investigate the following aspects.

1) How does the vertical distribution of various cloud regimes changes during the enhanced AO positive and negative phases and under which meteorological conditions?
2) What is the TOA, in-atmosphere and surface radiative impact of these cloud regimes during AO?
3) How sensitive the cloud radiative impact is to cloud microphysical properties during enhanced positive and negative phases of the AO?

We use the combined lidar and radar (CloudSat+CALIPSO) data from the A-Train constellation of satellites from 2006 through 2011 for analysis. Specifically, we use the 2B-CLDCLASS-LIDAR data for obtaining information on cloud regimes, 2B-GEOPROF-LIDAR for cloud boundaries, and 2B-FLXHR-LIDAR for the estimates of cloud radiative heating/cooling.

References:

Devasthale, A., Tjernström, M., Caian, M., Thomas, M. A., Kahn, B. H., and Fetzer, E. J.: Influence of the Arctic Oscillation on the vertical distribution of clouds as observed by the A-Train constellation of satellites, Atmos. Chem. Phys., 12, 10535-10544, doi:10.5194/acp-12-10535-2012, 2012.