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Observed cloud anomalies associated with the North Atlantic Oscillation, and their potential radiative feedback on internal circulation variability

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Clouds shape weather and climate by regulating the flow of radiative energy through the atmosphere. Recent modeling work highlighted the importance of cloud-radiative effects for the mean circulation of the present-day atmosphere and its long-term response to global warming. However, little research has been done regarding the impact of cloud-radiative effects on the internal variability of the extratropical atmospheric circulation on synoptic to subseasonal timescales. Here, we focus on how clouds and circulation in the North Atlantic region couple on timescales of days to weeks by analyzing correlations between cloud incidence and the North Atlantic Oscillation (NAO) index. An analysis of 5-day mean cloud incidence retrievals from the CloudSat/CALIPSO for 2006 to 2011 shows that a positive NAO is accompanied by increased upper-tropospheric cloud incidence along the storm track and in the subpolar Atlantic, and a decrease equatorward of the storm track and in the Labrador Sea. These correlations are most pronounced during the Northern Hemisphere winter and less pronounced during summer. The changes in clouds associated with the NAO lead to substantial changes in cloud-radiative effects. Vertically integrated atmospheric cloud-radiative effects calculated from CERES-EBAF and the Outgoing Longwave Radiation calculated from GERB/SEVIRI reveal a dipole of heating north and cooling south of the storm track. This suggests a possible negative feedback of cloud-radiative effects on the NAO. Furthermore, we will discuss implications from the perspectives of surface pressure and atmospheric temperatures, as well as lead-lag correlations between the cloud-radiative effects and the NAO.