Spatial Cloud Structure over the Ross Ice Shelf

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The Ross Ice Shelf Air Stream (RAS) is a low-level jet over the western Ross Ice Shelf (RIS) partly driven by a barrier flow along the Transantarctic Mountains and reinforced by katabatic winds from the East Antarctic interior draining through glacial valleys. The RAS transports significant volumes of cold air from the Antarctic continent into the Ross Sea and is strongly linked to the Ross Sea Polynya – perhaps the most significant area of sea ice production in the Antarctic coastal region. Previous studies have examined cloud cover over both Antarctica and the RIS, though they generally focused on analysing very large-scale trends or specific case studies. Our aim is to investigate the relationship between cloud cover and synoptic conditions. In particular, we focus on the vertically integrated low-level cloud cover over the RIS for a period of six years in an effort to better understand and potentially further define RAS events, as well as to assist in targeting the upcoming deployment of SNOWWEB – a distributed network of environmental monitoring stations. To accomplish this, a synoptic classification scheme based on k-means clustering applied to surface-level wind data from the ERA-interim dataset over the general RIS/Ross Sea area was used to define 20 synoptic-scale patterns. Using six years of integrated LIDAR and RADAR information from the CALIPSO and CloudSat satellites, we composited vertically integrated low-level (< 2 km) cloud cover into grids linked to these 20 clusters. The grids were then used to investigate the effect that each synoptic situation has on the average low-level cloud cover over the RIS on a seasonal basis. Preliminary analysis shows clear two-dimensional cloud structure that differs both between clusters for a given season, and between seasons for a given cluster. There is also significant variability in cloud structure between clusters that belong to the same broad classification which indicates that identifying driving forces behind cloud formation will be non-trivial. Current analysis of clusters identified as representing RAS events shows that, while there is no single cloud structure that can be used to identify when a RAS is occurring, all RAS-related clusters display a lower probability of cloud compared to other clusters. Further investigation into cloud patterns with respect to the evolution of clusters over time is continuing.