Variability in Boundary Layer Stability Across Antarctica

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Often the Antarctic boundary layer is described in terms of persistent, strong temperature inversions and strong static stability but some studies have highlighted the fact that weaker stability can occur frequently, even during the austral winter. Here, we analyze multiple years of radiosonde observations from three coastal (McMurdo, Syowa and Neumayer) and two continental interior (South Pole and Dome C) sites to characterize the range of boundary layer stability present on a seasonal basis across the Antarctic continent.

The artificial neural network data analysis technique known as self-organizing maps (SOMs) is used to objectively identify 30 boundary layer potential temperature profiles, at each site, that span the range of stability conditions observed. The results from this analysis reveal that strong stability dominates at the interior sites while coastal sites experience a wider range of stability conditions. This analysis also reveals that weaker stability near the surface is often capped by enhanced stability aloft, above the boundary layer.

Based on the SOM-identified potential temperature profiles thresholds of potential temperature gradient were selected to classify near surface stability ranging from near neutral to extremely strongly stable and stability aloft ranging from weakly stable to extremely strongly stable. These thresholds were then used to identify 20 stability regimes defined by both the near surface and aloft stability. These thresholds were applied consistently to all five study sites allowing for a direct comparison of the frequency of different boundary layer stability regimes on a seasonal basis and across the continent. Finally, near surface wind speed and downwelling longwave radiation were compared across all of the stability regimes to identify wind and radiation conditions associated with varying stability. A comparison of the stability regime frequencies across the five study sites and the wind and radiation associated with each stability regime will be presented.