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Synoptic and terrain influences on transitory accumulation of cold air on the Antarctic Plateau

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Early studies of the stable atmospheric boundary layer at the South Pole, on the high Antarctic Plateau, revealed the strong control of the surface inversion layer and winds by synoptic scale disturbances in addition to the effect of terrain slope. When upper level winds shifted from northwest to southeast periodically, the downslope, inversion-layer flow was either aided or opposed by the large scale pressure gradient. This resulted in periods of several days at a time when winds were light and the surface inversion strong. Recent studies of snow-gas exchange at the South Pole have suggested that this phenomena is also critical to the occurrence of high surface-layer concentrations of nitrogen oxide that arise from the photodenitrification of the snow and outgassing into thin boundary layers. In recent years, more detailed topographic maps have become available for the area upwind of the South Pole. These suggest a large area (along 90 degrees E) of much lower slope than the remainder of the plateau where cold air can accumulate under appropriate synoptic conditions. In this study we examine these flows in more detail using detailed boundary layer observations at the South Pole together with automatic weather stations (AWS) located 100 km along 0 degrees and 90 degrees E from the South Pole. Because of the continuing accumulation of snow at the AWS sites, care must be used in interpreting surface wind speeds over extended periods of time. However, in a number of the cases analyzed, surge-like events can be identified by the time delay in wind direction shifts between upslope locations and the South Pole. Implications for enhanced katabatic flow from the continent will be discussed briefly.