What Processes Determine Surface Ozone in Polar Regions?

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Recent research in polar regions has demonstrated that chemical and physical interactions between snowpack and the overlaying atmosphere have a substantial impact on the composition of the polar lower troposphere. Scavenging of gases and aerosols by precipitating snow as well as dry deposition to the snowpack result in the accumulation of a chemical reservoir that subsequently, under conditions of increasing temperature and solar irradiance, can turn into a photochemically active reactor. Snow-photochemical reactions result in the formation and release of radicals and secondary products into the atmospheric surface layer, which consequently influence concentrations and budgets of important tropospheric trace gases. Furthermore, ozone deposition and photochemical formation appear to be influenced by these snow photochemical processes. Observations of photochemical depletion of ozone in firn air, diurnal ozone trends in the surface layer, and tethered balloon vertical profile data all imply that ozone deposition to the snowpack depends on a multitude of parameters including chemical snow composition, solar irradiance, and snow temperature. Ozone surface deposition is more complex and overall appears to be larger than current considerations in global atmospheric models. Current research investigates the processes governing atmospheric trace gas dynamics, in particular ozone, in the Arctic boundary layer through a combination of data analyses and modeling studies. Different Arctic data sets are analyzed, including surface observations, tethered balloon data, and ozonesonde data from the World Meteorological Organization (WMO) ozone-monitoring network. This presentation focuses on surface ozone from CMDL polar monitoring programs including Barrow, Alaska, and Summit, Greenland (Figure 1); and McMurdo and South Pole, Antarctica. The analysis and comparison of these data sets reveals information on sources, sinks, and transport of ozone in the polar planetary boundary layer.

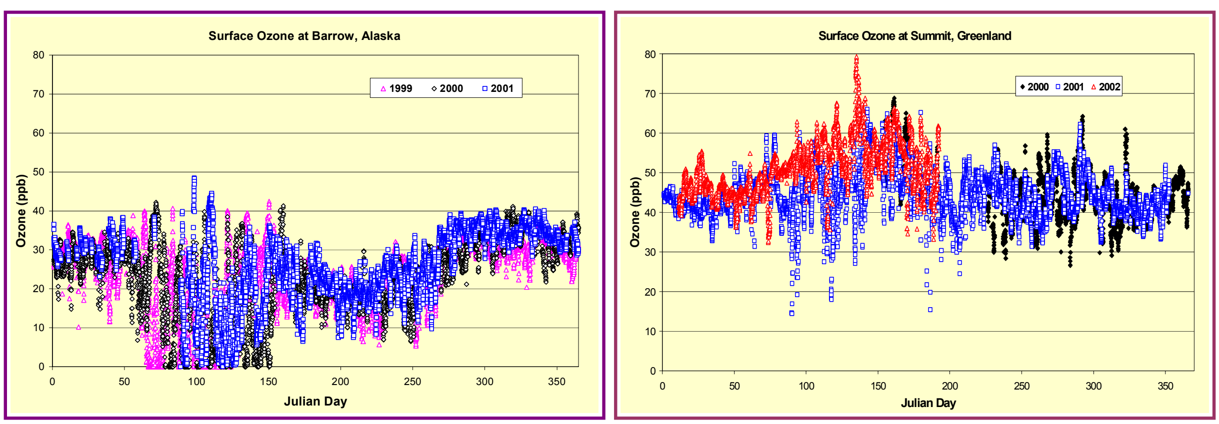

Figure 1. Three years of recent surface ozone data from Barrow, Alaska, and Summit, Greenland.