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The role of dynamics in rapid changes in surface ozone on the Arctic Ocean

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Episodic depletions of tropospheric ozone in late winter / early spring have been studied at arctic research stations since the mid-1980s. However, measurements in the marine surface layer over the frozen ocean are still rare. Existing data suggest that ozone concentrations near zero are actually the norm out over the ice, interrupted by the occasional entrainment of free tropospheric air with higher ozone concentrations. The "Out On The Ice (OOTI) 2004" study on the ocean north of Alert, Nunavut, encountered and documented drastic changes in surface meteorological conditions and ozone concentrations on time scales of minutes. The rapid increase of surface ozone concentration with the onset of high winds was explained through the entrainment of air from the free troposphere, at the point where the kinetic energy of the flow just above the stable surface layer (at 200m) was sufficient to overcome the potential energy stored in the stable surface layer. The drop of ozone concentrations at the end of the high wind episode, just as rapid as the increase at the beginning, was a result of the replacement of the mixed boundary layer by the stable arctic marine boundary layer through advection, characterized by a spatially tightly confined frontal interface. Further measurements of ozone gradients, heat fluxes, BrO concentrations and meteorological variables are planned north of Barrow, Alaska, in March 2005. Results from both the 2004 and 2005 studies will be presented.