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Air mass origin during tropospheric ozone depletion events at Arrival Heights, Antarctica

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Surface ozone (O_3) measurements made between 1997 and 2003 at Arrival Heights, Antarctica (77.8˚S, 166.7˚E), show sudden decreases in O_3 mixing ratios during Antarctic springtime. These low O_3 events were often correlated with elevated concentrations of bromine oxide (BrO) indicating that similar processes of halogen activation, involving sea ice surfaces as proposed for Arctic and other Antarctic regions, also take place at Arrival Heights.

The air mass origin during these O_3 depletion events was investigated by calculating 5-day backwards trajectories. Trajectory analysis revealed that air masses had either contact with sea-ice, which was correlated with enhanced BrO columns, or were transported across the Antarctic continent, which led to O_3 depletion events without elevated BrO concentrations.

Mainly changes in wind velocities lead to the correlation of ENSO and sea ice coverage of the Ross Sea. BrO measurements at Arrival Heights were below average during the El Niño years 1997-1998 when sea ice coverage in the Ross Sea region was heavier than usual. In contrast 2 and 3 high BrO events were observed in the La Niña years 1999-2000, when sea ice coverage was below average.

Low O_3 events in September 2000 showed no elevated BrO columns. However, 7-day back trajectories linked high BrO concentrations in the Weddell Sea with the transport of O_3 depleted air masses across the Antarctic continent. Measurements of O_3 and BrO at the German Antarctic Base Neumayer, which is located in the Weddell Sea sector, showed high BrO columns and O_3 destruction 6 days prior to observed O_3

depletion events at Arrival Heights. We speculate that a quasi Lagrangian experiment was performed and that the same air mass was probed once at Neumayer and 6 days later at Arrival Heights.