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BrO clouds and blizzards – a novel view on ODE drivers

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Ozone depletion events (ODEs) are well-documented phenomena that are observed in both polar regions during spring. Boundary layer ozone values can drop rapidly from background levels to instrumental detection limits and remain suppressed for several days. Their occurrence is driven by halogen chemistry, predominantly involving bromine. The source of bromine atoms is likely to be a condensed phase associated with the sea ice zone. Several candidates have been identified including sea salt aerosol, frost flowers and first year sea ice rich in sea salts. For such surfaces, the build up of BrO and depletion of ozone is favoured by low wind speeds, and indeed ODEs are frequently observed under such quiescent conditions. However, here we present observational evidence that shows an intense storm over the Weddell Sea region of Antarctica during which BrO columns were significantly enhanced and ozone depleted. Meteorological fields from the European Centre for Medium-Range Weather Forecasting (ECMWF) as well as ground-based observations from the British Antarctic Survey station Halley show that wind speeds were high during this event. Such conditions are synonymous with significant amounts of blowing snow within the boundary layer. We explore this event using a qualitative model of the effect of blowing snow, built by combining the contribution from the depth of the boundary layer with the magnified accessible snow surface area within blowing snow. The model offers a conceptual framework, and suggests that there could be a bi-modal maximum in ODE depth as a function of wind speed and that, at high wind speeds, blowing snow itself could act as a bromine atom source.