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A satellite based study of tropospheric bromine explosion events and their linkages to polar cyclone development

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Intense, cyclone-like shaped plumes of tropospheric bromine monoxide (BrO) are regularly observed by the UV-vis satellite instruments GOME-2/MetOp-A and SCIAMACHY/Envisat over Arctic and Antarctic sea ice in polar spring. The plumes are associated with an autocatalytic chemical chain reaction involving tropospheric ozone depletion and initiated by the release of bromine from cold brine-covered ice or snow to the atmosphere. This influences atmospheric chemistry as it affects the oxidising capacity of the troposphere through OH production and may also influence the local weather/temperature of the polar atmosphere, as ozone is a major greenhouse gas.

Here, we make combined use of satellite retrievals and numerical model simulations to study individual BrO plume cases in the polar atmosphere. In agreement with previous studies, our analysis shows that the plumes are often transported by high latitude cyclones, sometimes over several days despite the short atmospheric lifetime of BrO. Moreover, general characteristics of bromine explosion events linked to transport by polar weather systems, such as frequency, spatial distribution and favourable weather conditions are derived based on a new detection method. Our results show that BrO cyclone transport events are by far more common in the Antarctic than in the Arctic.