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Differences in Arctic and Antarctic PSC occurrence as observed by lidar in Ny-Ålesund (79° N, 12° E) and McMurdo (78° S, 167° E)

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Abstract. The extent of springtime Arctic ozone loss does not reach Antarctic ``ozone hole'' dimensions because of the generally higher temperatures in the northern hemisphere vortex and consequent less polar stratospheric cloud (PSC) particle surface for heterogeneous chlorine activation. Yet, with increasing greenhouse gases stratospheric temperatures are expected to further decrease. To infer if present Antarctic PSC occurrence can be applied to predict future Arctic PSC occurrence, lidar observations from McMurdo station (78° S, 167° E) and NyÅlesund (79° N, 12° E) have been analysed for the 9 winters between 1995 (1995/1996) and 2003 (2003/2004). Although the statistics may not completely cover the overall hemispheric PSC occurrence, the observations are considered to represent the main synoptic cloud features as both stations are mostly situated in the centre or at the inner edge of the vortex. Since the focus is set on the occurrence frequency of solid and liquid particles, the analysis has been restricted to volcanic aerosol free conditions. In McMurdo, by far the largest part of PSC observations is associated with NAT PSCs. The observed persistent background of NAT particles and their potential ability to cause denoxification and irreversible denitrification is presumably more important to Antarctic ozone chemistry than the scarcely observed ice PSCs. Meanwhile in Ny-Ålesund, ice PSCs have never been observed, while solid NAT and liquid STS clouds both occur in large fraction. Although they are also found solely, the majority of observations reveals solid and liquid particle layers in the same profile. For the Ny-Ålesund measurements, the frequent occurrence of liquid PSC particles yields major significance in terms of ozone chemistry, as their chlorine activation rates are more efficient. The relationship between temperature, PSC formation, and denitrification is nonlinear and the McMurdo and Ny-Ålesund PSC observations imply that for predicted stratospheric cooling it is not possible to directly apply current Antarctic PSC occurrence to the Arctic stratosphere. Future Arctic PSC occurrence, and thus ozone loss, is likely to depend on the shape and barotropy of the vortex rather than on minimum temperature alone.

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