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Polar stratospheric cloud and ozone observations in northern Finland

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Polar stratospheric clouds (PSCs) provide surface for heterogeneous reactions that are understood to be responsible for substantial chlorine activation and subsequent ozone depletion. Formation of PSCs is possible in the presence of very low stratospheric temperatures. These temperature conditions are found every winter in the polar stratosphere. However, the timing and duration of cold periods in the Arctic lower stratosphere has large inter-annual variability due to year-to-year variations in planetary wave forcing. In this study we focus on the PSC and ozone measurements at Sodankylä in northern Finland (67.4° N, 26.6° E) during the recent winters since 2000/01. We report PSC observations using data from aerosol backscatter sonde flights and ozone observations by Brewer and SAOZ instruments and by balloon borne ECC type ozone sondes. During three of the given winters PSC formation potential and ozone loss was much lower than average. However, during each winter there were several events when temperatures dropped below the threshold values of PSC formation. Balloon borne aerosol backscatter sonde measurements made during the cold events allowed detection of PSC layers together with simultaneous temperature measurements. In winter 2003/04 our PSC observations were limited to early December period due to unstable stratospheric vortex conditions. On Dec 2, 2003 we detected one kilometer thick layers of solid phase particles near the peak altitude of 26 km. Aerosol backscatter ratio at 940 nm channel reached 10.9, minimum temperature in the PSC layer was 188 K. During previous period, in January 2001, December 2001 and 2002 we observed events of PSC layers covering altitude range between 18 and 27 km. The observed PSCs composed of layers or mixtures of both solid and liquid particles. During January 2001 and December 2001 we also observed ice particle layers, a rare observation in Arctic stratosphere in contrast to Antarctic observations. As shown

by meteorological analysis using ECMWF data and mesoscale model simulations ice particle formation events were associated to gravity wave induced cooling under cold synoptic scale background conditions.