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The abundance, shape and chemical composition of non-volatile particles in the Arctic winter Stratosphere and their potential activation by Polar Stratospheric Cloud elements.

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Earlier studies showed elevated fractions of non-volatile particles of up to 75 % in the Arctic vortex stratosphere between 400 - 500 K potential temperature (Θ) compared to $\sim$ 25 % outside of the vortex (Curtius, J., et al., Atmos. Chem. Phys., 2005), or elsewhere (Borrmann, S., et al., Atmos. Chem. Phys., 2010). It was assumed that refractory smoke material from meteoritic burn-up, accumulated in the mesosphere (Strelnikova, I., PhD thesis, University Rostock, 2009), enters the polar vortex with subsiding air over the winter pole (Curtius, J., et al., Atmos. Chem. Phys., 2005).

Aerosol measurements with the COPAS Condensation Particle Counters (CPCs) (Weigel, R., et al., Atmos. Meas. Tech., 2009) were performed on board the research aircraft M-55 "Geophysica" during the RECONCILE mission (funded under the EC Seventh Framework Program), in- and outside the Arctic vortex, during spring 2010. COPAS measures ambient particle number concentrations from nucleation mode size up to a few μm in diameter (d_p) – one COPAS channel measures downstream of a heated (250°C) aerosol line the number of non volatile particles. Additionally, particles were sampled with a miniaturized dual-stage impactor (Kandler, K., et al., Atmos. Environ., 2007) for offline single particle analysis using Environmental Scanning Electron Microscopy and Energy Dispersive X-ray analysis methods. One impactor sample per flight (size range $0.15 < d_p < 4$ μm) was taken over 20 minutes, respectively, generally at altitudes between 420 K $< \Theta <$ 520 K.

Elevated concentrations of non-volatile particles within the Arctic vortex were found again during RECONCILE. The analyses of collected aerosols show non-volatile particles with $d_p < 500$ nm to be dominated by soot, casually with lead particles attached. Particles with $d_p > 500$ nm are categorized into: 1) Alloy particles (containing Al, Cr, Mn, Fe, Ni in different abundance), mostly of spherical (globule-kind) shape. 2) Silicates, of crystalline (50 %) and of spherical shape (50 %), 3) Iron oxides, mostly agglomerates of smaller globules, 4) Carbon-rich, mostly with silicon compounds. 5) Calcium-rich, mostly as Ca SO_4. The globule shape of a fraction of collected particles indicates that they have been exposed to temperatures exceeding the melting point of identified materials.

On 25 January 2010, at 18.5 – 19 km altitude, the aerosol sampling took place while the M-55 "Geophysica" was penetrating Polar Stratospheric Clouds (PSCs) which were characterized by elevated cloud particle densities and backscatter ratio as well as by a decline of the NO_y mixing ratio which indicates the uptake of nitrate compounds in this PSC. PSC elements were potentially collected with the impactor, and non-volatile residues (category 2, 4 and 5 were found in this case) could give a hint concerning the chemical composition of PSC-activated particles.

We will present our studies concerning the origin of non-volatile particles in the Arctic vortex stratosphere by comparing physico-chemical characteristics of sampled aerosol inside and outside the polar vortex, also in the context of previous findings. Furthermore, investigations concerning the chemical composition of likely PSC-activated non-volatile nuclei will be discussed.