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Polar stratospheric ice clouds within CLaMS

Ines Tritscher (1), Jens-Uwe Grooß (1), Reinhold Spang (1), Michael C. Pitts (2), and Rolf Müller (1)
(1) Forschungszentrum Jülich, IEK-7, Jülich, Germany, (2) NASA Langley Research Center, Hampton, Virginia, USA

Polar ozone loss in late winter and early spring is caused by enhanced concentrations of active chlorine. The surface necessary for heterogeneous reactions activating chlorine species is provided by cold stratospheric aerosols and by polar stratospheric clouds (PSCs). Moreover, sedimentation of PSC particles changes the chemical composition of the lower stratosphere and alters the ozone depleting process by irreversible redistribution of nitric acid and water vapor.

The Chemical Lagrangian Model of the Stratosphere (CLaMS) allows PSC particles to nucleate, grow, sediment, and evaporate along individual trajectories. Particles consisting of nitric acid trihydrate (NAT) were the focus of previous work and are known for their potential to denitrify the polar stratosphere. We carried this idea forward and introduced the formation of ice PSCs and related dehydration within the sedimentation module of CLaMS.

We show results from the Arctic winter 2009/2010, which is already well characterized because of the RECONCILE campaign and connected work. CLaMS simulations from the Antarctic winter 2011 complete this study and demonstrate the model's performance over an entire PSC season in the Southern hemisphere. For both winters, we present CLaMS results in comparison to PSC observations from the Cloud-Aerosol Lidar with Orthogonal Polarization (CALIOP) and the Michelson Interferometer for Passive Atmospheric Sounding (MIPAS). Moreover, we face CLaMS simulations of water vapor with vortex-wide Microwave Limb Sounder (MLS) observations. Observations and simulations are compared on season-long and vortex-wide scales as well as for single PSC events. The simulations reproduce well both the timing and extent of PSC occurrence inside the entire vortex and also the PSC classification of single measurements.