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A Climatology of Polar Stratospheric Cloud Types by MIPAS-Envisat

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For Chemistry Climate Models (CCM) it is still a challenging task to properly represent the evolution of the polar vortices over the entire winter season. The models usually do not include comprehensive microphysical modules to evolve the formation of different types of polar stratospheric clouds (PSC) over the winter. Consequently, predictions on the development and recovery of the future ozone hole have relatively large uncertainties. A climatological record of hemispheric measurement of PSC types could help to better validate and improve the PSC schemes in CCMs.
The Michelson Interferometer for Passive Atmospheric Sounding (MIPAS) instrument onboard the ESA Envisat satellite operated from July 2002 to April 2012. The infra-red limb emission measurements compile a unique dataset of day and night measurements of polar stratospheric clouds up to the poles. From the spectral measurements in the 4.15–14.6 microns range it is possible to select a number of atmospheric window regions and spectral signatures to classify PSC cloud types like nitric acid hydrates, sulfuric ternary solution droplets, and ice particles. The cloud detection sensitivity is similar to space borne lidars, but MIPAS adds complementary information due to its different measurement technique (limb instead of nadir) and wavelength region.
Here we will describe a new classification method for PSCs based on the combination of multiple brightness temperature differences (BTD) and colour ratios. Probability density functions (PDF) of the MIPAS measurements in conjunction with a database of radiative transfer model calculations of realistic PSC particle size distributions enable the definition of regions attributed to specific or mixed types clouds. Applying a naive bias classifier for independent criteria to all defined classes in four 2D PDF distributions, it is possible to assign the most likely PSC type to any measured cloud spectrum. Statistical Monte Carlo test have been applied to quantify uncertainties and the sensitivity to a priori information of the approach.
The processing of the complete MIPAS data set of almost 10 years of PSC observations with a first version of the new classification approach is completed. Results for various northern and southern hemisphere winters will be presented. The temporal evolution of the PSC types with respect to the temporal development of the meteorological conditions of the polar vortex as well as comparison with space and ground based lidar measurements will be investigated.