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Monitoring of the Polar Stratospheric Clouds formation and evolution in Antarctica in August 2007 during IPY with the MATCH method applied to lidar data

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The project ORACLE-O3 ("Ozone layer and UV RAdiation in a changing CLimate Evaluated during IPY") is one of the coordinated international proposals selected for the International Polar Year (IPY). As part of this global project, LOLITA-PSC ("Lagrangian Observations with Lidar Investigations and Trajectories in Antarctica and Arctic, of PSC") is devoted to Polar Stratospheric Clouds (PSC) studies. Indeed, understanding the formation and evolution of PSC is an important issue to quantify the impact of climate changes on their frequency of formation and, further, on chlorine activation and subsequent ozone depletion.

In this framework, three lidar stations performed PSC observations in Antarctica during the 2006, 2007, and 2008 winters: Davis (68.58°S, 77.97°E), McMurdo (77.86°S, 166.48°E) and Dumont D'Urville (66.67°S, 140.01°E). The data are completed with the lidar data from CALIOP ("Cloud-Aerosol Lidar with Orthogonal Polarization") onboard the CALIPSO ("Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observation") satellite.

Lagrangian trajectory calculations are used to identify air masses with PSCs sounded by several ground-based lidar stations with the same method, called MATCH, applied for the first time in Arctic to study the ozone depletion with radiosoundings. The evolution of the optical properties of the PSCs and thus the type of PSCs formed (supercooled ternary solution, nitric acid trihydrate particles or ice particles) could thus be linked to the thermodynamical evolution of the air mass deduced from the trajectories. A modeling with the microphysical model of the Danish Meteorological Institute allows assessing our ability to predict PSCs for various environmental conditions. Indeed, from pressure and temperature evolution, the model allows retrieving the types of particles formed as well as their mean radii, their concentrations and could also simulate the lidar signals.

In a first step, a case in August 2007 around 17-18 km, involving the three ground-based lidar stations and CALIOP has been selected. Trajectories with different models (gscf and ecmwf), grids and initializations have been computed to test the robustness of the MATCH. Then the DMI model has been used with these different trajectories to test its ability to reproduce the observations. For a same case, the temperature differences (~2-3 K) between the trajectories have a strong impact on the number density of the particles formed (factor 1000). This case is presented here in detail and a statistical comparison is planned with the numerous MATCH cases identified during the three winters and which involve most of the time two ground-based lidar stations with CALIOP.