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statistical estimation of stratospheric cloud size distribution by combining microphysical and optical modelling and lidar measurements

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We will describe a retrieval method for stratospheric cloud size distributions. The information is provided by a microphysical and optical model (assuming that the particles are spherical) and multi-wavelength lidar backscatter coefficients. The errors on the lidar backscatter coefficients are explicitly taken into account in the statistical estimation. In order to discard model-simulated outliers resulting from the strong non-linearity of the model, a 1σ-filter is applied to the solution cluster. Within the filtered solution cluster, the retrieval algorithm minimizes a cost function of the misfit between measurements and model simulations. Two validation cases are presented on two polar stratospheric cloud (PSC) detected above ALOMAR (69°N - Norway). The clouds were also observed with a balloon-borne optical particle counter. In non-depolarizing regions of the clouds (i.e. spherical particles), the parameters of the size distribution are successfully retrieved, especially the mode radius and the geometrical standard deviation. Other results highlight the importance of taking into account the non linearity of the model together with the lidar errors, when estimating the size distribution parameters from lidar measurements. The retrieval algorithm is then applied to another PSC event at ALOMAR that lasted about 5 hours. The results show that multi-wavelength lidar data integrated over short time intervals and coupled to both Rotational Raman Technique (RRT) temperatures and the size distribution retrieval method described above can provide very useful information for the identification of PSC types and on the temporal evolution of the size distribution parameters.