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Polar Stratospheric Clouds detection at Belgrano II Antarctic station from DOAS measurements

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Ground-based zenith DOAS (Differential Optical Absorption Spectroscopy) measurements have been used to detect and estimate the altitude of PSCs over Belgrano II Antarctic station during the polar sunrise seasons of 2018 and 2019. The method used in this work studies the evolution of the color index (CI) during twilights. The CI has been defined here as the ratio of the recorded signal at 520 and 420 nm. In the presence of PSCs, the CI shows a maximum at a given solar zenith angle (SZA). The value of such SZA depends on the altitude of the PSC. By using a spherical Monte Carlo radiative transfer model (RTM), the method has been validated and a function relating the SZA of the CI maximum and the PSC altitude has been calculated. Model simulations also show that PSCs can be detected and their altitude can be estimated even in presence of optically thin tropospheric clouds or aerosols. Our results are in good agreement with the stratospheric temperature evolution obtained through the ERA5 data reanalysis from the global meteorological model ECMWF (European Centre for Medium Range Weather Forecasts) and the PSCs observations from CALIPSO (Cloud-Aerosol-Lidar and Infrared Pathfinder Satellite Observations).

The methodology used in this work could also be applied to foreseen and/or historical measurements obtained with ground-based spectrometers such e. g. the DOAS instruments dedicated to trace gas observation in Arctic and Antarctic sites. This would also allow to investigate the presence and long-term evolution of PSCs.

Keywords: Polar stratospheric clouds; color index; radiative transfer model; visible spectroscopy.