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# Employing simulated cloud parameters for the MAX-DOAS profile retrieval

Ilya Bruchkouski (1,2), Siarhei Barodka (1), Leonid Katkovsky (2), Hleb Litvinovich (2), Alexander Svetashev (1), Leonid Turishev (1), Aliaksandr Krasouski (1), and Yang Wang (3)

(1) National Ozone Monitoring Research and Education Center (NOMREC), Belarusian State University (Minsk, Belarus) (bruchkovsky2010@yandex.ru), (2) Institute of Applied Physical Problems of Belarusian State University, Minsk, Belarus, (3) Satellite group, Max Planck Institute for Chemistry, Mainz, Germany

Cloud cover has a significant impact on the radiation transfer in the atmosphere, which in turn affects the quality of ground-based optical observations, including the Multi-axis differential optical absorption spectroscopy (MAX-DOAS) observations of aerosols and trace gases. In recent years, active attempts have been made to parameterize and classify clouds in order to qualify the sky and cloud conditions. For extremely cloudy sites application of cloud screening methods can remove up to 65% of measured data. For instance, in Minsk, Belarus, we have near 85% of cloudy days a year, so proper representation of cloud parameters for MAX-DOAS observations processing is very desirable.

The aim of this work is to evaluate the possibilities of using simulated cloud parameters from a numerical atmospheric model for better representation of clouds in MAX-DOAS observation processing. Our main objective is to include the simulated cloud data in radiation transfer modelling for vertical profile retrieval.

The automated self-built instrument (MARS-B) based on the ORIEL MS257 spectrograph with a Peltier-cooled CCD-array detector Andor Technology DV-420 OE (number of active pixels is 1024×256, working temperature is -40 ºC) is in operation as our MAX-DOAS instrument. The instrument records the spectra of scattered sunlight in the range of elevation angles 0º – 90º in one azimuth direction within angular FOV of 1.3º in UV spectral range (340-400 nm) with FWHM = 0.32 and is working without mechanical shutter. Radiation input system is made without optical fiber and spectrograph unit has open-air design, spectrograph unit is temperature-stabilized at level 40±0.5 ºC. The MARS-B instrument successfully participated in MAD-CAT (2013) and CINDI-2 (2016) international inter-comparison campaigns.

To obtain improved cloud parameters and other related atmospheric characteristics for MAX-DOAS observations we perform a series of mesoscale simulations with the Weather Research and Forecasting (WRF) modelling system, focusing on a high resolution grid for the region surrounding our measurement site and considering available meteorological observational data for the time periods of interest. Furthermore, we are using the PriAM algorithm, which is based on optimal estimation method and the SCIATRAN radiation transfer model, for vertical profile retrieval. Finally, we discuss the connections between the spatial geometry of MAX-DOAS measurements and different approaches to representation of the simulated meteorological fields from the mesoscale atmospheric model in radiative transfer calculations.