MESOSPHERIC TEMPERATURE AND OZONE SOUNDING BY THE SMAS SOLAR OCCULTATION SENSOR

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We present a fast forward model and a temperature and ozone retrieval algorithm for processing data of the planned Sun Monitor and Atmospheric Sounder (SMAS) instrument. The SMAS sensor concept employs the solar occultation technique and is primarily aiming at mesospheric profiles while also furnishing thermospheric ones. SMAS can provide, based on high-precision photodiode sensors, self-calibrated transmission data in 14 UV channels within 1-250 nm (6 EUV channels within 1-130 nm, 8 MUV channels within 180-250nm) and in one 300-700 nm VIS broadband channel. While the 6 EUV channels allow to obtain profiles of N2, O2, O, and temperature in the thermosphere (> 100 km), the 8 MUV channels allow to accurately retrieve O3 and temperature (via O2) profiles in the mesosphere.

We concentrate on the 8 MUV channels, each of 5 nm width with channel centers at 184/190/195/200/205/210/224/246 nm, which cover the Schumann-Runge absorption bands and the Herzberg absorption continuum of O2 and the Hartley absorption band of O3, respectively. Sensible approximative modeling of the limb transmission within 180-250 nm is necessary, especially due to the complicated and temperature-dependent Schumann-Runge cross section structure to achieve an efficient and accurate forward model and retrieval algorithm. We discuss two SMAS forward model variants for the five channels affected by the Schumann-Runge band, which require a prohibitive number of 3000 monochromatic transmission calculations per channel: i) an optimal random-selection approximation furnishing sufficient transmission precision (< 0.3%) with 100 monochromatic bins already and ii) a piecewise-integration approximation involving piecewise spectrally averaged cross sections, which leads to sufficient precision with 300 bins. The Hartley band channels (210/224/246 nm) require, due to the smoothness of cross sections over the channel width and the independence of temperature, up to 5 transmission calculations per channel only.

Temperature and ozone retrieval algorithms are developed in two versions: i) sequential inversion of transmission data via O2 and O3 columnar content profiles (spectral inversion) to O2 and O3 number density profiles (inverse Abel transform) and, based on O2 profiles, to pressure and temperature (hydrostatic integration, equation of state), and ii) optimal estimation retrieval of temperature and ozone profiles involving the fast SMAS forward model and using climatological profiles and associated uncertainties as prior information. First preliminary results on retrieved temperature and ozone profiles are shown.