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Radiative transfer modelling of mesospheric and thermospheric scattering, absorption, and emission in the O_2 A-band

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One of the brightest radiance features measurable in the visible and near-infrared region of the airglow spectrum is due to oxygen molecule (O_2) emission. This emission, found between 758 nm and 770nm, is known as the Oxygen Atmospheric Band or A-Band. Radiance measurements above 70 km and well into the thermosphere clearly depict this emission feature, making it a useful phenomenon for satellite observation. These measurements can typically be used with a photochemical emission model to retrieve desired parameters of the atmospheric state such as temperature. However, A-band emission measurements taken in the altitude range near and above polar mesospheric clouds (PMCs) require absorption and scattering characteristics be included in the radiative transfer calculation. SASKTRAN is an existing radiative transfer model developed for analysis of limb radiance measurements made by the OSIRIS (Optical Spectrograph and Infra-Red Imager System) satellite instrument. The publicly released version of SASKTRAN currently includes many absorption and scattering features, but no capability for modelling photochemical emission. This work details the inclusion of a photochemical model for the O_2 A-band emission as a source term in the SASKTRAN calculation. The resulting modeled limb spectra include effects of emission, self-absorption, and multiple scattering, and demonstrate a robust comparison to those measured by OSIRIS throughout mesospheric and lower thermospheric tangent altitudes.