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Limb temperature observations in the mesosphere with OMPS

Molecular scattering (Rayleigh scattering) has been extensively used from the ground with lidars and from space to observe the limb, thereby deriving vertical temperature profiles between 30 and 80 km. In this study, we investigate how temperature can be measured using the new Ozone Mapping and Profiler Suite (OMPS) sensor, aboard the Suomi NPP and NOAA-21 satellites. The OMPS consists of three instruments whose main purpose is to study the composition of the stratosphere. One of these, the Limb Profiler (LP), measures the radiance of the limb of the middle atmosphere (stratosphere and mesosphere, 12 to 90 km altitude) at wavelengths from 290 to 1020 nm.

This new data set has been used with a New Simplified Radiative Transfer Model (NSRTM) to derive temperature profiles with a vertical resolution of 1 km. To validate the method, the OMPS-derived temperature profiles were compared with data from four ground-based lidars and the ERA5 and MSIS models.

The results show that OMPS and the lidars are in agreement within a range of about 5 K from 30 to 80 km. Comparisons with the models also show similar results, except for ERA5 beyond 50 km. We investigated various sources of bias, such as different attenuation sources, which can produce errors of up to 120 K in the UV range, instrumental errors around 0.8 K and noise problems of up to 150 K in the visible range for OMPS. This study also highlighted the interest in developing a new miniaturised instrument that could provide real-time observation of atmospheric vertical temperature profiles using a constellation of CubeSats with our NSRTM.

Topic

Current and past limb and occultation instruments: algorithms, products, validation

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