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Measurements of Atmospheric Dynamics from Space: SOVA-S, an ESA SCOUT mission candidate

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For many decades, hydroxyl (OH) airglow has been used to study atmospheric dynamics on different scales from infrasound and gravity waves to tides and planetary waves. These measurements refer to the upper mesosphere/lower thermosphere; they are mostly ground-based and only performed at night. In recent years, equivalent space-based measurements, i.e. nadir and off-nadir measurements, have also been carried out by instruments such as Suomi/VIIRS (Visible Infrared Imaging Radiometer Suite) and AWE (Atmospheric Wave Experiment).

Unlike ground-based measurements, satellite-based instruments can provide global or nearly global information depending on the orbit. However, nadir and off-nadir space-based measurements are subject to additional unwanted background signals. The main sources of this background radiation are moonlight reflected by clouds and the Earth's surface, as well as emissions from artificial lights on the ground. Whether the background radiation omits the analysis of space-based OH-airglow data with respect to atmospheric waves depends on the strength of the background signal and of its spatial and temporal variations compared to the dynamically-induced variations of the OH airglow.

Suomi/VIIRS operates in a spectral range that is not ideal for OH-airglow observations and does not utilise a dedicated background channel; OH-airglow measurements are only possible on moonless nights against a dark background. This limitation could be reduced by measuring the strongest OH-airglow emissions in the infrared, and by using a background channel. SOVA-S is one such concept. It was selected as one of four projects for the consolidation phase in the second ESA SCOUT cycle in 2025, focusing on OH(3-1) Q-branch measurements.

The measurement concept of SOVA-S is briefly introduced, along with the differences to AWE — an OH airglow mission in the infrared with an onboard background channel on the ISS. The conditions, under which atmospheric wave analyses should be possible with SOVA-S with regard to cloud cover, moon phase and surface albedo, are outlined; the underlying analyses were performed using the radiative transfer model SCIATRAN. Potential applications of these data in the context of applied research (e.g. the influence of middle atmospheric dynamics on the GNSS signal integrity) are presented.