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Keystone: Exploring the mesosphere and lower thermosphere

Keystone is a proposed upper atmospheric limb sounding mission that would provide a comprehensive measurement of the Mesosphere and Lower Thermosphere (MLT) composition, temperature and winds, and its variability (from a diurnal to a seasonal scale). It's currently in Phase-0 study as ESA's 12th Earth Explorer satellite.

The MLT is the upper atmosphere region which goes from 70km to 120km. The MLT is subject to high energy inputs from space as solar electromagnetic radiation and energetic particles. The resulting photodissociation, photo-ionisation and high-energy collisions generate radicals and ions, often with internal excitation.

The key science objective of the Keystone mission is to gain knowledge of geophysical parameters in the MLT that will allow a better understanding of its behaviour. Keystone will improve our understanding of space weather and climate change processes, particularly their impact on the MLT region. To do this, Keystone will measure the composition, gradients and variability of the neutral atmosphere, temperature profiles, and mesospheric winds.

The Keystone concept includes a comprehensive remote sensing payload, covering spectral windows in the Terahertz (THz), IR and UV-Vis regions of the electromagnetic spectrum in order to fulfil its science objectives.

The primary instrument foreseen for this mission is a supra-THz radiometer with high spectral resolution for the retrieval of vertical distribution profiles of trace gases between 1 THz and 5 THz, including—as a world first—the key MLT species atomic oxygen, for which no global, time resolved measurements exist. The THz instrument will also retrieve temperature profiles, and mesospheric winds (through Doppler shift).

To date, atomic oxygen can only be inferred indirectly from IR and UV-Vis measurements, a process that is heavily reliant on model assumptions. Collocated measurements of atomic oxygen from the THz instrument, combined with heritage IR and UV-Vis instruments, will allow us to resolve decades old uncertainties in these photochemical models.

Topic

Upcoming Earth observation limb and occultation instruments

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