Studying atmospheric composition by satellite measurements

Erkki Kyrölä [1]

[1] ***Finnish Meteorological Institute***
P. O. Box 503, 00101 Helsinki, Finland)

Satellite measurements are essential for monitoring changes in the distribution of ozone and other trace gases in the troposphere, stratosphere and mesosphere. Both the natural variation and anthropogenic change of trace gases are strongly dependent on altitude and latitude. The best global measurements of these changes can be obtained from space using limb viewing instruments. In this presentation we focus on ESA's GOMOS instrument and Canadian OSIRIS instrument. Finnish scientists and industry have participated for preparation and operations of both these instruments.

OSIRIS (Optical Spectrograph and Infrared Imager System) is one of the two instruments on board the Swedish Odin satellite, launched in February 2001. The spectrograph part of the instrument measures limb-scattered solar light (radiance) in the wavelength region of 280–800 nm with around 1 nm spectral resolution. Odin scans toward the Earth's limb from 7 to 110 km through a controlled nodding motion. The effective Field of View (FOV) is 1–2 km. In turn, the FOV is sampled discretely with 1–3 km vertical spacing. OSIRIS is the first dedicated satellite instrument to measure continuously the vertical composition of the atmosphere using the limb scatter technique and by recording the full spectrum from UV to visible wavelengths with a good spectral resolution.

GOMOS (Global Ozone Monitoring by Occultation of Stars) on board ESA's ENVISAT satellite measures attenuation of stellar light in occultation geometry. Daytime measurements also record scattered solar light from the atmosphere in the same way as OSIRIS. The wavelength regions are the ultraviolet-visible band 248–690 nm and two infrared bands at 755–774 nm and at 926–954 nm. From UV-Visible and IR spectra the vertical profiles of O_3, NO_2, NO_3, H_2O, O_2 and aerosols can be retrieved. In addition there are two 1 kHz photometers at blue 473–527 nm and red 646–698 nm wavelengths. Photometer data are used to correct spectrometer measurements for scintillations and to retrieve high resolution temperature profiles as well as gravity wave and turbulence parameters. Measurements cover altitude region 5–150 km. Atmospherically valid data are obtained in 15–100 km. GOMOS measured nearly one million ozone profiles during its ten years of operation 2002-2012.