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CAIRT - the Changing-Atmosphere Infra-Red Tomography Explorer

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Abstract: CAIRT, a candidate for ESA's Earth Explorer 11 mission, will observe the Earth's limb with an imaging Fourier-transform spectrometer. It will provide global observations of ozone, temperature, water vapour and key halogen and nitrogen compounds.

The Changing-Atmosphere Infra-Red Tomography Explorer (CAIRT) has been selected by ESA as one of four candidates for the upcoming Earth Explorer 11 mission. CAIRT will observe the Earth's limb with an imaging Fourier-transform spectrometer. Vertical spatial coverage extends from 5 km to 115 km altitude and spectral coverage reaches over the infrared spectral domain from 4.5 µm to 13.9 µm wavelength in two bands. The current timeline foresees a launch of Earth Explorer 11 in 2031–2032.

CAIRT will improve our knowledge of the coupling of atmospheric circulation, composition and regional climate change, and will provide the urgently needed observations of the on-going changes and processes involved. By observing simultaneously the atmosphere from the troposphere to the lower thermosphere CAIRT will provide global observations of ozone, temperature, water vapour, as well as key halogen and nitrogen compounds. The latter will help to better constrain coupling with the upper atmosphere, solar variability and space weather. Observation of long-lived tracers will provide information on transport, mixing and circulation changes. CAIRT will deliver essentially a complete budget of stratospheric sulfur, as well as observations of ammonia and ammonium nitrate aerosols. Biomass burning and other pollution plumes and their impact on ozone chemistry in the UTLS region will be detected from observations of HCN, CO and a suite of volatile organic compounds. The potential to measure water vapour isotopologues will help to constrain water vapour and cloud processes and interactions at the Earth's surface. The high-resolution measurements of temperature will provide the momentum flux, phase speed and direction of atmospheric gravity waves. CAIRT thus will provide comprehensive information on the driving of the large-scale circulation by different types of waves. These scientific goals will be enabled by tomographic retrievals, which will provide temperature and trace gas profiles at a much higher horizontal resolution and coverage than achieved from space so far.

Flying in formation with the Second Generation Meteorological Operational Satellite (MetOp-SG) will enable combined retrievals with observations by the New Generation Infrared Atmospheric Sounding Interferometer (IASI-NG) and Sentinel-5, resulting in consistent atmospheric profile information from the surface up to the lower thermosphere.