



Estimate of the outgoing far-infrared irradiance with FORUM

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In November 2017 the European Space Agency selected FORUM (Far-infrared Outgoing Radiation Understanding and Monitoring) as one of the two instrument concepts to be developed further and to compete to be the ninth Earth Explorer mission. FORUM will be a Fourier Transform Spectrometer measuring the upwelling spectral radiance emitted by the Earth across the most relevant infrared part of the electromagnetic spectrum from satellite. In particular, the instrument will cover the spectral range from 100 to 1600 cm^{-1} (from 100 to 6.25 microns in wavelength), covering the Far InfraRed (FIR), between 100 and 667 cm^{-1} , which has never been done from space before.

Idealized model simulations suggest that between one quarter and one third of the total clear-sky long-wave cooling of the Earth to space occurs within the FIR spectral region. An even larger fraction of this cooling is predicted to occur in the FIR under all-sky conditions, because the presence of clouds causes lower emitting temperatures, and hence a shift to longer wavelengths of the peak of the black-body curve. For this reason, a detailed study of the Earth's radiation budget requires accurate, frequent, and global-coverage measurements of the total upwelling irradiance. In this paper we show that FORUM measurements will permit to obtain a very accurate estimate of the upwelling FIR irradiance. The achieved accuracy will be much better than that achievable with state-of-the-art forward model calculations of the FIR spectrum, based on the water vapor distribution determined from operational Mid- Infra-Red measurements, such as those from the Infrared Atmospheric Sounding Interferometer (IASI) on Met-Op satellites. For simplicity reasons the presented study is limited to clear-sky. In cloudy conditions, due to the large uncertainties in cloud composition, forward model simulations are expected to be even less accurate.