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An in-flight blackbody calibration source for the GLORIA interferometer on board an air-borne research platform

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The Gimballed Limb Observer for Radiance Imaging of the Atmosphere (GLORIA) is a prototype of an imaging Fourier Transform Spectrometer for a candidate Earth Explorer mission by ESA. GLORIA is deployed on board different research aircraft like the Russian M55 Geophysica or the German HALO. The instrument shall provide a detailed picture of the upper troposphere/lower stratosphere (UTLS) region, which plays a crucial role in the climate system. GLORIA uses a two-dimensional detector array for infrared limb-observations and therefore it needs large-area radiation sources (126 mm x 126 mm) for calibration with an absolute accuracy of 0.1 K as well as a spatial homogeneity of better than 0.1 K in order to meet the uncertainty requirements for atmospheric temperature and trace gas retrieval. Since the instrument is exposed to the hostile environment of the tropopause with mutable low temperature and pressure, the in-flight calibration sources have to be carefully designed to cope with those adverse circumstances. The GLORIA in-flight calibration system consists of two identical high-precision blackbodies, which are independently controlled at two different temperatures. The two point calibration should be in the range of the observed atmospheric radiance with 10 K below ambient temperature and 30 K above ambient temperature, respectively. Thermo-Electric Coolers are used to control the temperature of the blackbodies offering the advantage of avoiding cryogens and mechanical coolers. We will present the design and performance of the GLORIA in-flight calibration system. The system has been comprehensively characterized for its spatially (full aperture) and spectrally (5 μm to 14 μm) resolved radiation properties in terms of radiation temperature traceable to the international temperature scale (ITS-90) at the national metrology institute of Germany (PTB).