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Stratospheric and upper tropospheric measurements of long-lived tracers and photochemically active species of the nitrogen, chlorine, and bromine families with GLORIA-B

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The Gimbaled Limb Observer for Radiance Imaging of the Atmosphere (GLORIA) is a limb-imaging Fourier-Transform spectrometer (iFTS) providing mid-infrared spectra with high spectral sampling (0.0625 cm^{-1} in the wavelength range $780\text{--}1400\text{ cm}^{-1}$). GLORIA, a demonstrator for the Changing-Atmosphere Infra-Red Tomography Explorer (CAIRT, one of the remaining two candidates for the ESA Earth Explorer 11 mission) was deployed on the Russian M55 Geophysica and is still being deployed on HALO, the German high-altitude research aircraft. In order to enhance the vertical range of GLORIA to observations in the middle stratosphere albeit still reaching down to the middle troposphere, the instrument was adapted to measurements from stratospheric balloon platforms. GLORIA-B performed its first flight from Kiruna (northern Sweden) in August 2021 and its second flight from Timmins (Ontario/Canada) in August 2022 in the framework of the EU Research Infrastructure HEMERA.

The objectives of GLORIA-B observations for these campaigns have been its technical qualification and the provision of a first imaging hyperspectral limb-emission dataset from 5 to 36 km altitude. Further, scientific objectives, which are, amongst many others, the diurnal evolution of photochemically active species belonging to the nitrogen (e.g. N_2O_5 , NO_2), chlorine (e.g. ClONO_2), and bromine (BrONO_2) families are discussed.

In this contribution we demonstrate the performance of GLORIA-B with regard to level-2 data of the flight in August 2021, consisting of retrieved altitude profiles of a variety of trace gases. We will show examples of selected results together with uncertainty estimations, altitude resolution as well as long-lived tracer comparisons to accompanying in-situ datasets. In addition, diurnal

variations of photochemically active gases are compared to simulations of the chemistry climate model EMAC. Calculations largely reproduce the temporal variations of the species observed by GLORIA-B.