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3D tomography of a Rossby wave breaking event with GLORIA IR limb imager

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The Gimballed Limb Observer for Radiance Imaging of the Atmosphere (GLORIA) is an aircraft-based Fourier transform spectrometer with a 2D detector array jointly developed by Forschungszentrum Jülich and Karlsruhe Institute of Technology. Air temperature and volume mixing ratios of various trace gases are retrieved from the measured IR spectra. GLORIA can be panned between 45° and 135° w. r. t. the flight direction. Using this capability and/or flight paths that encircle the observed atmospheric region, multiple measurements of the same air mass are performed, allowing for 3D tomography of the atmosphere with a vertical resolution down to 250 m and horizontal resolution of around 25 km.

GLORIA instrument flew on the German HALO research aircraft during the Wave Driven Isentropic Exchange (WISE) measurement campaign held in Ireland in September/October 2017. Among other phenomena, Rossby-wave breaking events were observed on multiple flights, some of them showing a lot of stirring, filamentation, strong tropopause inversion layers and wet air masses lifted to high altitudes by warm conveyor belts. We present some of the data products, including HNO_3, O_3, and water vapour volume mixing ratios both as 2D curtains and 3D tomographic retrievals. The abundances of these gases are used to identify air masses of stratospheric and tropospheric origin, investigate their spatial distribution and hence quantify the length scales of filamentation. Tracer-tracer correlations are then employed to identify the location and spatial extent of mixing regions. Several cross-sections of some filaments were recorded over the course of the two flights carried out two days apart, allowing for analysis of their development timescales as well as identification of possible transport pathways. We compare our results with model data from ECMWF ERA5 and a Lagrangian model CLAMS, developed in Forschungszentrum Jülich and driven by ERA-Interim. We also briefly introduce some recent improvements in GLORIA 3D tomographic retrieval techniques: irregular grids and improved regularisation algorithms.