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JURASSIC2 Retrieval Processing for the GLORIA Instrument

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The Gimballed Limb Observer for Radiance Imaging in the Atmosphere (GLORIA) is a new remote sensing instrument combining a Fourier transform infrared spectrometer with a highly flexible gimbal mount. GLORIA is a joint project of the research center Jülich (IEK-7, ZEL, ZAT), Karlsruhe Institute for Technology (IMK, IPE), and Wuppertal University. Measurements are made with uniquely high spatial and spectral resolution by a 2-D detector array. Mounted in the belly pod of an aircraft, the viewing direction of the GLORIA instrument is perpendicular to the flight direction, but may be varied by up to 45° forward and backward. By flying on a circular path, it is possible to generate images of an area of interest from a wide range of angles. These can be analyzed in a 3-D tomographic fashion, which yields superior spatial resolution along line of site. Usually limb instruments have a resolution of several hundred kilometers. In studies we have shown to get a resolution of 35km in all horizontal directions. For linear instead of circular flight tracks, resolutions of ≈70km can be obtained. GLORIA tomographic images can be used to observe features of the Upper Troposphere Lower Stratosphere (UTLS), where important mixing processes take place. Especially tropopause folds are difficult to image, as their main features need to be along line of flight when using common 1-D approach.

The GLORIA Michelson interferometer can run with a wide range of parameters. In the dynamics mode, spectra are generated with a medium spectral and a very high temporal and spatial resolution. Each sample can contain thousands of spectral lines for each contributing trace gas. In the JURASSIC retrieval code this is handled by using a radiative transport model based on the Emissivity Growth Approximation. Deciding which samples should be included in the retrieval is a non-trivial task and requires specific domain knowledge. To ease this problem we developed an automatic selection program by analyzing the Shannon information content. By taking into account data for all relevant trace gases and instrument effects, optimal integrated spectral windows are computed. This includes considerations for cross-influence of trace gases, which has non-obvious consequence for the contribution of spectral samples. We developed methods to assess the influence of spectral windows on the retrieval. While we can not exhaustively search the whole range of possible spectral sample combinations, it is possible to optimize information content using a genetic algorithm.