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Performance of the line-by-line radiative transfer model (LBLRTM) for temperature and species retrievals: IASI case studies from JAIVEx

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Abstract. Presented here are comparisons between the Infrared Atmospheric Sounding instrument (IASI) and the "Line-By-Line Radiative Transfer Model" (LBLRTM). Spectral residuals from radiance closure studies during the IASI JAIVEx validation campaign provide insight into a number of spectroscopy issues relevant to remote sounding of temperature, water vapor and trace gases from IASI. In order to perform quality IASI trace gas retrievals, the temperature and water vapor fields must be retrieved as accurately as possible. In general, the residuals in the CO_2 v_2 region are of the order of the IASI instrument noise. However, outstanding issues with the CO_2 spectral regions remain. There is a large residual ~−1.7 K in the 667 cm^{-1} Q-branch, and residuals in the CO_2 v_2 and N_2O/CO_2 v_3 spectral regions that sample the troposphere are inconsistent, with the N_2O/CO_2 v_3 region being too negative (warmer) by ~0.7 K. Residuals on this lower wavenumber side of the CO_2 v_3 band will be improved by line parameter updates, while future efforts to reduce the residuals reaching ~−0.5 K on the higher wavenumber side of the CO_2 v_3 band will focus on addressing limitations in the modeling of the CO_2 line shape (line coupling and duration of collision) effects. Brightness temperature residuals from the radiance closure studies in the v_2 water vapor band have standard deviations of ~0.2–0.3 K with some large peak residuals reaching ±0.5–1.0 K. These are larger than the instrument noise indicating that systematic errors still remain. New H_2O line intensities and positions have a significant \mbox{impact} on the retrieved water vapor, particularly in the upper troposphere where the water vapor retrievals are 10% drier when using line intensities compared with HITRAN 2004. In addition to O_3, CH_4, and CO, of the IASI instrument combined with an accurate forward model allows for the detection of minor species with weak atmospheric signatures in the nadir radiances, such as HNO_3 and OCS.

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