Evaluation of nitrous oxide retrievals from IASI/Metop A

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Nitrous oxide (N_2O), with a lifetime of approximately 120 years, is the third most significant greenhouse gas following carbon dioxide (CO_2) and methane (CH_4), contributing substantially to global warming. Its global warming potential is 300 times that of CO_2 over a 100-year period. Currently, N_2O emissions are not regulated by the Montreal Protocol. Although covered by the Kyoto Protocol, the observed annual increase of ~0.25% in N_2O levels over the past decade is expected to persist until 2100. N_2O emissions involve both biotic (living organisms) and abiotic (environmental factors such as water, soil, and air) processes, with 60% being natural and 40% anthropogenic. In 2019, the average annual concentration of N_2O in the atmosphere was approximately 332 ppbv.

Despite its significance, global measurements of tropospheric N_2O and surface emissions remain understudied, with limited surface observations available. Nevertheless, sparse FTIR/NDACC instruments monitor N_2O profiles, and satellite observations in the thermal infrared (TIR) from IASI (Ricaud et al., 2009; Chalinel et al., 2022), AIRS, and GOSAT (Kangah et al., 2017) provide valuable global data. GOSAT-2/TANSO-FTS-2, which has some sensitivity to lower tropospheric N_2O, offers potential for comparisons on a global scale at lower levels in the troposphere.

This study evaluates IASI N_2O observations from the TN_2OR (Toulouse N_2O retrieval) tool, a joint effort by LAERO and CNRM. The reliability of IASI N_2O measurements in the troposphere is assessed through comparisons with ground-based NDACC N_2O profiles, aircraft data, and satellite observations from GOSAT-2/TANSO-FTS-2 across various periods, in particular 2019.

References:

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