

Quasi-global view of methanol, formic acid and PAN distributions obtained from IASI with neural networks

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Methanol (CH₃OH) is one of the major Volatile Organic Compound (VOC) in the Earth's atmosphere. Formic acid (HCOOH) is the dominant carboxylic acid in the global troposphere, with an important influence on precipitation chemistry and acidity. Peroxyacetyl nitrate (CH₃C(O)O₂NO₂ or PAN) is considered to be the largest reservoir for nitrogen oxide radicals (NO_x = NO + NO₂) and contributes to their redistribution from source to remote regions. These VOCs have various primary and/or secondary sources, including terrestrial vegetation, oceans, biomass burning, anthropogenic emissions, and the oxidation of VOCs. However, large uncertainties in their budget estimates still exist, mainly because their sources and sinks remain poorly constrained. The paucity of VOC observations, in particular in remote and tropical regions, strongly contributes to those uncertainties.

In this work, a quasi-global view of CH₃OH, HCOOH and PAN distributions is obtained using satellite observations from the Infrared Atmospheric Sounding Interferometer (IASI) operating on the MetOp platforms since 2007. IASI has been shown capable of measuring CH₃OH and HCOOH in previous works, although with a simplified scheme. Here, an innovative methodology, relying on hyperspectral indices and neural networks, is applied to overcome the limitations from the earlier methods by better accounting for the dependence on, e.g., meteorological parameters. Furthermore, this methodology allows to provide more sensitive and better characterized data. The retrievals above oceans are in particular optimized. The method is applied to produce new CH₃OH and HCOOH distributions, and to produce PAN data for which distributions have not yet been obtained.

The retrieved distributions are analysed to give insight into the source regions and types, role of transport, seasonality and inter-annual variability. The columns with their associated errors can also serve models to provide updated CH₃OH, HCOOH and PAN budget.