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Ratios of atmospheric formic acid and acetic acid seen from space

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Formic acid (HCOOH) and acetic acid (CH3COOH) are ubiquitous atmospheric trace gases and the most abundant carboxylic acids in the global troposphere. They have a substantial impact on the atmospheric aqueous-phase chemistry and are major sources of cloud and precipitation acidity. Together, they account for > 60% of the rain-water acidity in remote regions (e.g., over tropical and boreal forests). Sources of formic and acetic acids include direct emissions (e.g., from biomass burning, fossil fuel, plants) and secondary production from sunlight-induced degradation of a suite of other volatile organic compounds. However, several investigations have pointed to large inconsistencies between measurements and model simulations, suggesting key gaps in our understanding of their sources and the likely existence of so far unidentified sources.

Here we use a neural network-based approach to retrieve total columns of formic and acetic acids from the IASI (Infrared Atmospheric Sounding Interferometer) satellite observations, and to produce daily global and regional pictures of both species. With this dataset we characterize their respective spatial distributions, seasonal variability as well as their transport patterns from emission sources. We focus on their emission regions to study the variability and evolution of the HCOOH-to-CH3COOH ratios. Their respective enhancement ratios with respect to CO total columns from IASI are also investigated in fire plumes. This study contributes to improving our understanding of the emission sources of these dominant carboxylic acids.