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Methods for measuring HONO concentration and flux between soil and atmosphere: an overview

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Gaseous nitrous acid (HONO) significantly contributes to atmospheric hydroxyl radical (OH·) and also influences atmospheric oxidation capacity and air quality. Comparison of HONO concentrations measured in field campaigns and by modeling showed a large unknown HONO source during daytime. Studies have shown that the unknown HONO source can be attributed to soil emissions, a major source of atmospheric HONO. Here, we introduce the techniques of HONO concentration and flux measurements between soil and atmosphere. HONO can be detected by spectroscopic and wet chemistry methods, such as Differential Optical Absorption Spectroscopy (DOAS), Tunable Diode Laser Absorption Spectroscopy (TDLAS), Incoherent Broad Band Cavity Enhanced Absorption Spectroscopy (IBBCEAS), LOng Path Absorption Photometer (LOPAP), and High-Performance Liquid Chromatography (HPLC). Among these methods, LOPAP is the most commercial instrument with low detection limits, but also high maintenance cost. Labeling 15N isotopic method in HO15NO was also developed by combining with LOPAP and HPLC, while the natural abundance of 15N in HONO was recently detected by annular denuder system (ADS) and Isotope Ratio Mass Spectrometer (IRMS). The isotope methods enable a new approach of studying the formation pathways of HONO, and its role for atmospheric chemistry (e.g., ozone formation), and environmental tracer studies on the formation and conversion of gaseous HONO. Flux of HONO between land and atmosphere has been widely studied in field and laboratory. In general, flux-gradient (FG) and relaxed eddy accumulation (RED) methods were used in field campaign, and dynamic chamber method was used in laboratory studies. Both results from field and laboratory showed that soil HONO emissions can account for the missing HONO source during day time. The impacting of HONO emissions from soil on chemistry within the atmospheric boundary layer, nitrogen use efficiency, and climate change should be further quantified and included in regional and global models of atmospheric chemistry and air quality.