Distribution and fate of select oxygenated organic species in the troposphere and lower stratosphere over the Atlantic

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J. Geophys. Res, in press, 1999.

Abstract

A large number of oxygenated trace species (peroxyacylnitrates, alkyl nitrates, acetone, formaldehyde, methanol, methylhydroperoxide, acetic acid, and formic acid) were measured during the 1997 SONEX [SASS (Subsonic Assessment) Ozone and NOx Experiment] airborne field campaign over the Atlantic. In this paper we present a first picture of the distribution of these oxygenated organic chemicals (Ox-organic) in the troposphere and the lower stratosphere, and assess their source and sink relationships. In both the troposphere and the lower stratosphere, the total atmospheric abundance of these oxygenated organics (SUM Ox-organic) nearly equals that of nonmethane hydrocarbons (SUM NMHC), which have been traditionally measured, in both the troposphere and lower stratosphere. A sizable fraction of the reactive nitrogen (10-30%) is present in its oxygenated organic form. Comparison of observations with the predictions of the Harvard 3-D global model suggests that in many key areas substantial differences between measurements and theory are present and must be resolved. In the case of CH_3OH, there appears to be a large mismatch between atmospheric concentrations and estimated sources, indicating the presence of major unknown removal processes. Instrument intercomparisons as well as disagreements between observations and model predictions are used to identify needed improvements in key areas. The atmospheric chemistry and sources of this group of chemicals are poorly understood even though their fate appears to be intricately linked with upper tropospheric NO_x and HO_x cycles.