NITROUS ACID AND NITRITE IN THE ATMOSPHERE

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Introduction:

Why is nitrous acid important as an atmospheric trace gas? It is present in very small quantities, typically up to a few parts in 10^9 by volume (ppbV), and usually makes up only a small fraction of the total amount of gaseous nitrogen oxides present in the atmosphere. One reason for an increasing number of recent studies into the chemistry of HNO2 is the increasing importance of nitrogen oxides as atmospheric pollutants. Unlike the emissions of sulphur dioxide, which have been decreasing markedly in recent years in Europe and North America, if not in the developing world, the emissions of nitrogen oxides are far from decreasing.

In developed countries the major source of nitrogen oxides is vehicle traffic, and the steadily increasing number of cars and car journeys more than compensate, in many cases, for emission reduction measures. On a global scale the importance of NOx pollutants (= NO + NO2 ) is on the rise, too, as man produces these trace gases directly from a range of activities (e.g. fossil fuel combustion in the energy sector, biomass burning in the context of agriculture), or enhances natural sources (e.g. soil NO emission following fertilization with nitrogen).

The global significance of the nitrogen oxides in the atmosphere is in determining the production and consumption of the highly reactive hydroxyl and hydroperoxy radicals, HOx (= OH + HO2). The OH radical is the most important trace species in tropospheric chemistry, and its abundance governs the oxidation and eventual removal of most trace gases from the atmosphere. It is in this respect that HNO2 shows its importance as a trace gas; on photolysis (< 310 nm) HNO2 directly produces OH. This OH source is of greatest importance during the early morning, when HNO2 concentrations may be high after night-time accumulation, and when OH production rates from other sources (photolysis of ozone and formaldehyde) are slow. Concentrations of OH radicals later in the day are also influenced by HNO2.

Apart from its role in tropospheric chemistry, nitrous acid is of toxicological relevance. It is suspected to be a precursor of carcinogens (nitrosamines) under atmospheric conditions. Despite this importance, nitrous acid is one of the least researched species in inorganic tropospheric chemistry. Why is this so, and why do we know so little of its major sources and sinks? The aim of this review is to unravel the puzzle of HNO2 occurrence in the atmospheric boundary layer close to the earth's surface, as far as present knowledge allows, by investigating evidence from both laboratory and field studies.