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Sources of Nitrous Acid, Formaldehyde, and Hydroxyl Radical in Doha, Qatar.

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One of the most important species in the atmosphere is the hydroxyl radical (OH), due to its role controlling the oxidizing capacity of an air shed. The main formation processes of OH include the photolysis of ozone (O_3), nitrous acid (HONO), formaldehyde (HCHO), and the ozonolysis of alkenes. Still, the sources of HONO in the atmosphere are not sufficiently well known, with indications that heterogeneous reactions on surfaces may contribute to the observed concentrations. The city of Doha in Qatar presents a unique opportunity to explore photochemical processes including the effects of high particulates concentrations under extreme weather conditions (high temperatures and humidity) and complex emission sources.

Two Intensive Observational Periods (IOP) were conducted in Doha in 2016, one during the winter and the other during the summer. These consisted of meteorological measurements, ozone (O_3), nitrous acid (HONO), formaldehyde (HCHO), nitrogen monoxide (NO), direct nitrogen dioxide (NO_2), sulfur dioxide (SO_2), carbon monoxide (CO), as well as particulate matter with an aerodynamic diameter $\leq$ 10 μm and 2.5 μm (PM_{10} and $PM_{2.5}$). In addition photolysis rates of HONO, HCHO, NO_2, and singlet oxygen (O^1D) were measured.

The photostationary state concentration of OH was calculated from its known sources and sinks. The maximum hourly average concentration of OH was determined to be around 1.1 ppt for summer and 0.5 ppt for winter IOP. For the 24-hr average, the photolysis of HONO was the main precursor for OH production with 54.3 % and 72.7 % (summer and winter IOP), while the photolysis of O_3 was responsible for 23.8 % and 19.7 % and the photolysis of HCHO accounted for 21.9 % and 7.6 % (summer and winter IOP, respectively). In this study we present source apportionment analysis for the radical precursors HONO and HCHO during the winter and summer IOP and its diurnal variation and elucidate their impact on OH production. We also infer NO_x vs VOC limitation of O_3 production from NO_2 and HCHO observations.