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VOC measurements reveal a strong fog-induced biomass burning feedback to air quality in the megacity of Delhi

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We present the first ambient measurements of thirteen VOCs for investigations of emissions and air quality during fog and non-fog wintertime conditions at a tower site (28.57° N, 77.11° E, 220m amsl) in the megacity of Delhi. Measurements of acetonitrile (biomass burning (BB) tracer), isoprene (biogenic emission tracer in daytime), toluene (a traffic exhaust tracer) and benzene (emitted from BB and traffic), together with soluble and reactive oxygenated VOCs such as methanol, acetone, acetaldehyde were performed during the winters of 2015-16 and 2016-17, using proton transfer reaction mass spectrometry in 183 whole air samples sampled thrice a day. Upwind industries, forests and traffic plumes were responsible for extremely high acetone and acetaldehyde (> 90ppb), isoprene (>7ppb) and toluene (>30ppb) spikes, respectively. Remarkably, ambient VOC composition changes during fog were not governed by solubility. While acetaldehyde and acetone decreased (by 40%), acetonitrile and benzene showed significant increases. It appears that during the fog, lower temperatures induce an emission feedback from enhanced open BB within Delhi for warming, releasing both gaseous and aerosol pollutants with consequences for fog chemistry, sustenance, and intensity. Current emission parametrizations in models will need to incorporate this feedback for more accurate air quality and fog forecasts.