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FTIR time series of tropospheric HCN in eastern China and source attribution

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We analyzed seasonality and interannual variability of tropospheric HCN column amounts in densely populated eastern China for the first time. The results were derived from solar absorption spectra recorded with ground-based high spectral resolution Fourier transform infrared (FTIR) spectrometer at Hefei (117°10'E, 31°54'N) between 2015 and 2018. The tropospheric HCN columns over Hefei, China showed significant seasonal variations with three monthly mean peaks throughout the year. The magnitude of the tropospheric HCN column peak in May > September > December. The tropospheric HCN column reached a maximum of (9.8 ± 0.78) × 10^{15} molecules/cm^2 in May and a minimum of (7.16 ± 0.75) × 10^{15} molecules/cm^2 in November. In most cases, the tropospheric HCN columns at Hefei (32°N) are higher than the FTIR observations at Ny Alesund (79°N), Kiruna (68°N), Bremen (53°N), Jungfraujoch (47°N), Toronto (44°N), Rikubetsu (43°N), Izana (28°N), Mauna Loa (20°N), La Reunion Maido (21°S), Lauder (45°S), and Arrival Heights (78°S) that are affiliated with the Network for Detection of Atmospheric Composition Change (NDACC). Enhancements of the tropospheric HCN columns were observed between September 2015 and July 2016 compared to the counterpart measurements in other years. The magnitude of the enhancement ranges from 5 to 46% with an average of 22%. Enhancement of tropospheric HCN (ΔHCN) is correlated with the coincident enhancement of tropospheric CO (ΔCO), indicating that enhancements of tropospheric CO and HCN were due to the same sources. The GEOS-Chem tagged CO simulation, the global fire maps and the PSCFs (Potential Source Contribution Function) calculated using back trajectories revealed that the seasonal maxima in May is largely due to the influence of biomass burning in South Eastern Asia (SEAS) (41 ± 13.1%), Europe and Boreal Asia (EUBA) (21 ± 9.3%) and Africa (AF) (22 ± 4.7%). The seasonal maxima in September is largely due to the influence of biomass burnings in EUBA (38 ± 11.3%), AF (26 ± 6.7%), SEAS (14 ± 3.3%), and Northern America (NA) (13.8 ± 8.4%). For the seasonal maxima in December, dominant contributions are from AF (36 ± 7.1%), EUBA (21 ± 5.2%), and NA (18.7 ± 5.2%).The tropospheric HCN enhancement between September 2015 and July 2016 at Hefei (32°N) were attributed to an elevated influence of biomass burnings in SEAS, EUBA, and Oceania (OCE) in this period. Particularly, an elevated fire number in OCE in the second half of 2015 dominated the tropospheric HCN enhancement in September – December 2015. An elevated fire number in SEAS in the first half of 2016 dominated the tropospheric HCN enhancement in January – July 2016.