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Intraregional links between the trends in air pollutants observed at the EANET network sites for 2000-2014

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Recent changes in economic development tendencies and environmental protection policies in the East Asian countries raise hopes for improvement of regional air quality in this vast region populated by more than 3 billion people. To recognize anticipated changes in atmospheric pollutants levels, deposition rates and impact on the environment, the Acid Deposition Monitoring Network in East Asia (EANET, http://www.eanet.asia/) is regularly operating region-wide since 2000 in 13 countries. The network provides continuous monitoring data on the air quality and precipitation (including gas-phase and particulate chemistry) at 55 monitoring sites, including 20 remote and 14 rural sites. Observation of soil and inland water environments are performed at more than 30 monitoring sites [1].

In this study we focus on 1) the data quality assessment and preparation and 2) analysis of temporal trends of compositions observed at selected 26 non-urban EANET stations. Speciation includes gas-phase (SO_2, HNO_3, HCl, NH_3) and particulate matter (SO_4^{2-}, NO_3^-, Cl^-, NH_4^+, Na^+, K^+, Mg^{2+}, Ca^{2+}) abundances analysed in samples collected using filterpack technique with sampling duration/frequency of one-two weeks. Data quality assessment (distribution test and manual inspection) allowed us to remove/repair random and operator errors. Wrong sample timing was found for 0.37% (severe) and 34% (mild inconsistency) of the total of 7630 samples regarded. Erroneous data flagging ($e.g.$ missing or below the detection limit) was repaired for 9.3%, respectively. Some 1.8% of severely affected data were corrected (where possible) or removed. Thus refined 15-year dataset is made available for the scientific community. For convenience, we also provide data in netCDF format (per station or in an assembly).

Based on this refined dataset, we performed trend analysis using several statistical approaches including quantile regression which provides robust results against outliers and better understanding of trend origins. Our calculations indicate that about half of the median trends at EANET stations are significant, derived either for the entire observational period or for a given season, however not for the same species. The proportions of decreasing and increasing trends are comparable. The latter is the case for SO_2, HCl, Cl^-, NO_3 (except for Russia), while marked decrease in K^+ abundances is prevailing at all stations. Most unsystematic trends are seen for nitrogenated compounds, particularly HNO_3, which calls for deeper data quality analysis. Interestingly, about the same statistic (half of significant trends) is obtained for the upper (0.9) quantile of the dataset, suggesting that trends pertain to the upper part of the data distribution usually linked to emission dynamics ($i.e.$ bearing winter/spring compositions). We further apply an ad hoc cluster analysis to infer spatial patterns and colocation of the trends across the East Asian region. Finally, we provide a brief comparison of results with an evaluation of changes in major acidic compounds over EMEP region for the 1990-2012 provided by EMEP in its trend assessment for the UN ECE CLRTAP earlier this year [2].

References:

1. EANET: Data Report 2014. Network Center for EANET (ACAP), November 2015, 314 p. (http://www.eanet.asia/product/datarep/datarep14/datarep14.pdf)

2. EMEP: Air Pollution Trends in the EMEP region between 1990 and 2012. WMO/EMEP TFMM Trend Assessment Report. UN ECE Convention on LRTAP, 2016, 54 p.