

Inter-annual variability of air mass and acidified pollutants transboundary exchange in the north-eastern part of the EANET region

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Anthropogenic emissions, be it exhaust gases or aerosols, stem from multitude of sources and may survive long-range transport within the air masses they were emitted into. So they follow regional and global transport pathways varying under different climatological regimes. Transboundary transfer of pollutants occurs this way and has a significant impact on the ecological situation of the territories neighbouring those of emission sources, as found in a few earlier studies examining the environmental monitoring data [1]. In this study, we employ a relatively facile though robust technique for estimating the transboundary air and concomitant pollutant fluxes using actual or climatological meteorological and air pollution monitoring data. Practically, we assume pollutant transfer being proportional to the horizontal transport of air enclosed in the lower troposphere and to the concentration of the pollutant of interest. The horizontal transport, in turn, is estimated using the mean layer wind direction and strength, or their descriptive statistics at the individual transects of the boundary of interest.

The domain of our interest is the segment of Russian continental border in East Asia spanning from 88°E (southern Middle Siberia) to 135°E (Far East at Pacific shore). The data on atmospheric pollutants concentration are available from the Russian monitoring sites of the region-wide Acid Deposition Monitoring Network in East Asia (EANET, <http://www.eanet.asia/>) Mondy (Baikal area) and Primorskaya (near Vladivostok). The data comprises multi-year continuous measurement of gas-phase and particulate species abundances in air with at least biweekly sampling rate starting from 2000. In the first phase of our study, we used climatological dataset on winds derived from the aerological soundings at Russian stations along the continental border for the 10-year period (1961-1970) by the Research Institute of Hydrometeorological Information – World Data Centre (RIHMI-WDC) [3]. This dataset provides comprehensive monthly statistics on the wind meteorological regime at the stations of interest in a given range of altitudes. Based on long-term source observational data, the dataset is assumed being representative up to date, which allowed us to estimate monthly pollutant fluxes for the years 2006-2008 over segments of the Russian border and its whole [4]. In the current phase of our study, we calculate the inter-annual variations in the transboundary pollutant fluxes for 2000-2012 using longer-term EANET data and transient changes in air mass fluxes derived from the meteorological wind fields from ERA INTERIM re-analysis [5]. We gauge similar average air transport terms and dynamics from the statistical and reanalysis data, which bolsters our earlier findings. The reanalysis data, being naturally more variable, convolutes the variations in net air fluxes and pollutant concentrations into several episodes we emphasise, in addition to the integral pollutant transfer terms we estimate. At last, we discuss on the possibility of climate change effect on the flux strength and dynamics together with regional air quality tendencies in North-East Asia countries.

References:

1. Izrael, Yu.A., *et al.*: Monitoring of the Transboundary Air Pollution Transport. Gidrometeoizdat, Leningrad, 303 p., 187 (in Russian).
2. Akimoto H., *et al.*: Periodic Report of the State of Acid Deposition in East Asia. Part I: Regional Assessment. EANET-UNEP/RRC.AP-ADORC, 258 p., 2006.
3. Brukhan, F.F.: Aeroclimatic Characteristics of the Mean Winds over USSR (ed. Ignatjushina E.N.). Gidrometeoizdat, Moscow, 54 p., 1984 (in Russian).
4. Gromov S.A., *et al.*: First-order evaluation of transboundary pollution fluxes in areas of EANET stations in Eastern Siberia and the Russian Far East. *EANET Science Bulletin*, vol. 3, pp. 195-203, 2013.
5. Dee, D. P., *et al.*: The ERA-Interim reanalysis: configuration and performance of the data assimilation system, *Quart. J. Royal Met. Soc.*, **137**, 553-597, doi: 10.1002/qj.828, 2011.