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Assessment of the uncertainties in air mass and pollutants transboundary exchange over the continental part of the EANET region

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In this study, we attempt to quantify the uncertainties in air mass exchange in the lower troposphere across two regions of the Russian border in Eastern Siberia and the Russian Far East in 2000-2015. We use meteorological data from long-term air sound data (ASD) on mean layer winds [1] and from the ERA INTERIM re-analysis (EIR) project [2]. Using a transboundary exchange model, we estimate the total and net amounts of air crossing the boundary segments around Irkutsk (IR) and Vladivostok (VL) aerological stations. We compare transport terms derived (i) from the long-term wind statistics based on both ASD and EIR data, and (ii) from integrating 6h meteorological winds from EIR directly over the border segments cells. We find similar wind direction statistics in both meteorological datasets, however EIR favours stronger westerly winds at VL in summer, which results in more often air export from China to Russia in the Far East. There is less agreement on the wind strengths than wind directions between the datasets, with EIR often providing slower wind speeds.

The resulting climatic (ASD) and directly (from EIR 6h terms) calculated non-equilibrium (net) transport terms are comparable in orders (tens of million km^3/month), however may differ substantially in temporal evolution or/and magnitude. Thus, EIR net transport over the IR segment has similar annual dynamics but is higher by a factor of $\sim$4 (maxima of 3.6 *vs.* 12 of 10^6 km^3/month in December, respectively). An opposite ratio is derived for the VL segment (average $\sim$6 *vs.* 13 of 10^6 km^3/month), with a distinct seasonality in the ASD but not in the EIR data. We attribute this discrepancy to the variations in wind direction with altitude, which cannot be resolved in the model fed with the ASD data. Calculated transport in the boundary layer (BL, provided by the EIR) supports this inference. Thus, the BL net transport temporal dynamics differ substantially from that within the 3 km layer, owing to the BL diurnal dynamics that favour non-equilibrium air transport mostly at daytime. The BL transport reaches at most $2{\cdot}10^6$ km^3/month in April-May during air export from Russia at the IR segment and re-import from China at the VL, respectively. A non-negligible BL air import from China into Russia occurs also over the IR segment throughout winter (at a 0.7-1.5 of 10^6 km^3/month rate).

Using the data from the stations of the Acid Deposition Monitoring Network in East Asia (EANET, www.eanet.asia), we estimate the transboundary pollution fluxes of S- and N-bearing gaseous compounds (SO_2, NO_x, *etc.*) and particulate matter (SO_4^-, ammonia nitrate). The co-occurrence of the high pollutants load and significant non-equilibrium air exchange renders pollutant net transport a rather non-linear problem. We derive the uncertainties associated with different assumptions on plum vertical location ($i.e.$, in the BL-only vs. free troposphere). Finally, we derive the transient record of pollution transport for 2000-2015 for the IR and VL transboundary segments.

References:

1. Brukhan, F.F.: Aeroclimatic Characteristics of the Mean Winds over USSR (ed. Ignatjushina E.N.). Gidrometeoizdat, Moscow, 54 p., 1984 (in Russian).Izrael, Yu.A., *et al.*: Monitoring of the Transboundary Air Pollution Transport. Gidrometeoizdat, Leningrad, 303 p., 187 (in Russian).

2. 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.