Cooperation with Parties to the Convention – Russia

Assessment of heavy metal pollution levels in the EMEP region requires information about emissions, monitoring data and modelling. Coverage of the EMEP region with monitoring data as well as emission reporting by countries is not uniform. In particular, evaluation of heavy metal pollution levels in Russia is hampered by scarce monitoring data. Besides, official emissions have not been reported to CEIP during several recent years. Nevertheless, information about monitoring data on lead and cadmium air concentrations at Russian measurement stations have been presented at recent TFMM meeting held in May, 2017 in Prague, the Czech Republic. This section is focused on brief analysis of modelled and observed concentrations at Russian stations for 2014.

Background monitoring of heavy metal pollution in Russia is carried out at four stations located in biosphere reserves (BR) of European Part of Russia: Prioksko-Terrasny (PTR), Voronezhsky (VBR), Kavkazsky (KBR) and Astrakhansky (ABR). Concentrations of lead and cadmium observed at Russian stations are mostly comparable with the values observed at EMEP stations (Fig. 1). The exceptions are measurements of lead at Prioksko-Terrasny BR and cadmium at Astrakhansky BR, which are relatively higher than the EMEP measurements.

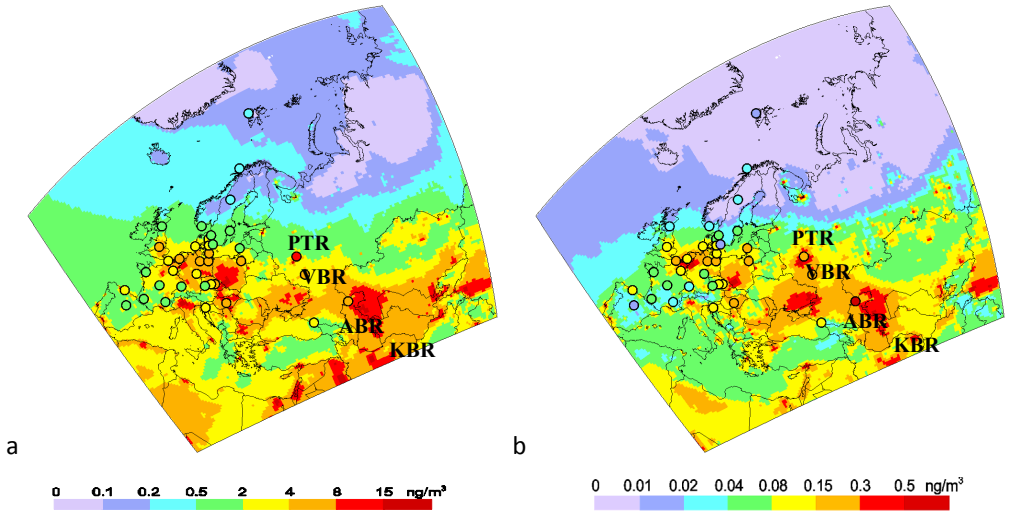

Fig. 1. *Modelled and observed annual mean concentrations of lead (a) and cadmium (b) in the EMEP region in 2014*

Annual mean modelled concentrations of lead and cadmium in air are compared with the concentrations observed at stations of Russian monitoring network. Agreement between modelled and measured levels differs significantly among stations. At stations located in the central regions of European part of Russia, such as Prioksko-Terrasny and Voronezhsky Biosphere Reserves, the modelled concentrations of lead are below, and the concentrations of cadmium are above the observed ones (Fig. 2). In Caucasus region (Kavkazsky Biosphere Reserve) the model tends to underestimate the observed concentrations of both lead and cadmium. In the south-eastern part of European Russia the model produces lead levels higher than the observed, and cadmium levels lower than the observed at the station Astrakhansky Biosphere Reserve.

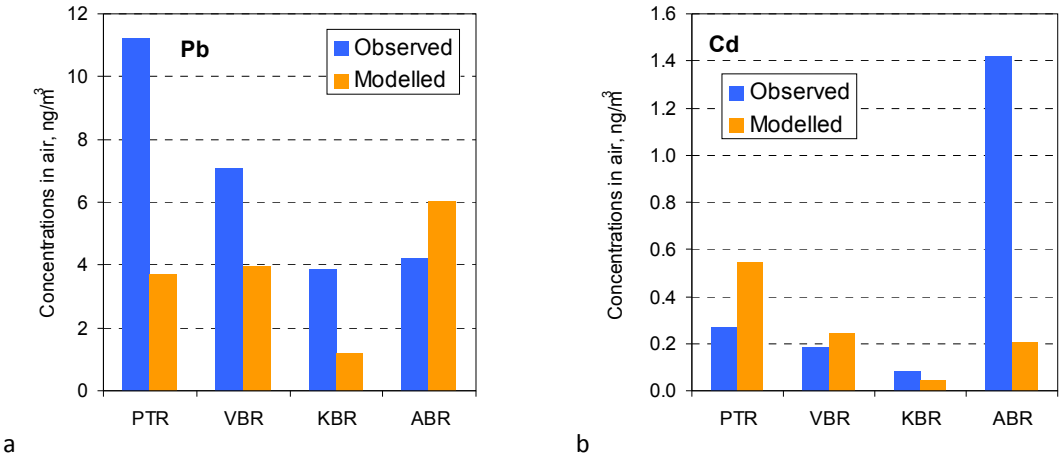

Fig. 2. *Annual mean modelled and observed concentrations of lead (a) and cadmium (b) at stations of Russian monitoring network in 2014*

Measurements at Russian stations are carried once per three days. Time series of air concentrations with this frequency are compared in order to identify periods of higher or lower discrepancies between modelled and observed values. Besides, the modelled values are presented as a sum of contribution of anthropogenic, secondary and non-EMEP emission sources.

Observed concentrations of lead at station Prioksko-Terrasny Biosphere Reserve are the highest both among measured values of Russian and EMEP stations (Fig. 1a). Probably, these high levels are caused by the influence of motorway with heavy traffic, passing by the station in several kilometres. This fact can explain the significant difference between modelled and observed concentrations of lead at this station.

Time series for station Voronezhsky Biosphere Reserve are shown in Fig. 3. As seen, the model better reproduces lead levels in the beginning (January-April) of 2014 than in the other part of the year. For the first four month average modelled (4.7 ng/m^3) and observed (5.3 ng/m^3) levels are similar. Besides, a number of observed peak concentrations are captured by the model. From May to December the difference between average values of modelled (3.6 ng/m^3) and observed (7.9 ng/m^3) concentrations is higher. According to current model calculations, the main contribution to the observed levels at this station is made by secondary sources (87%), while the anthropogenic sources contribute 12%, and non-EMEP sources – 1%. It is important to note that in a number of episodes the model overestimates the observed levels because of predominant contribution of secondary sources.

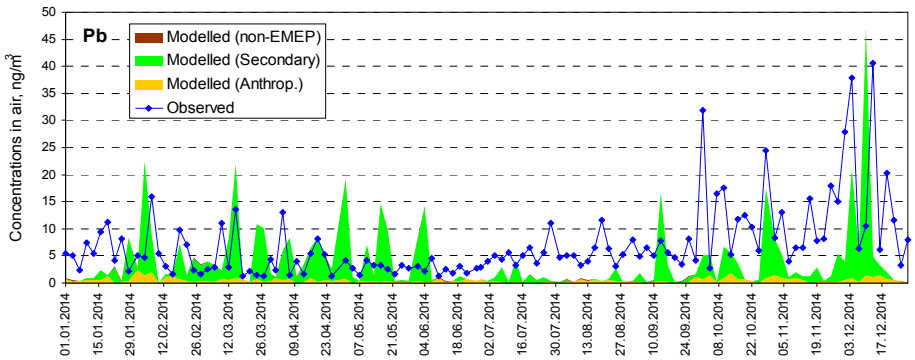

Fig. 3. *Time series of modelled and observed concentrations of lead in air at station Voronezhsky Biosphere Reserve*

Opposite situation is noted for cadmium concentrations at station Prioksko-Terrasny Biosphere Reserve. At this station modelled concentrations exceed the observed ones two-fold. The main contribution to modelled levels is made by anthropogenic emission sources (Fig. 4.4), and secondary sources contribute less than 10% to the annual mean calculated concentrations. A number of observed peak concentrations are captured by the model, e.g., for the periods of the middle of September and middle of October. Both the model and observations demonstrate peak concentrations on January, 22, but the model exceeds the observed levels more than 4-fold.

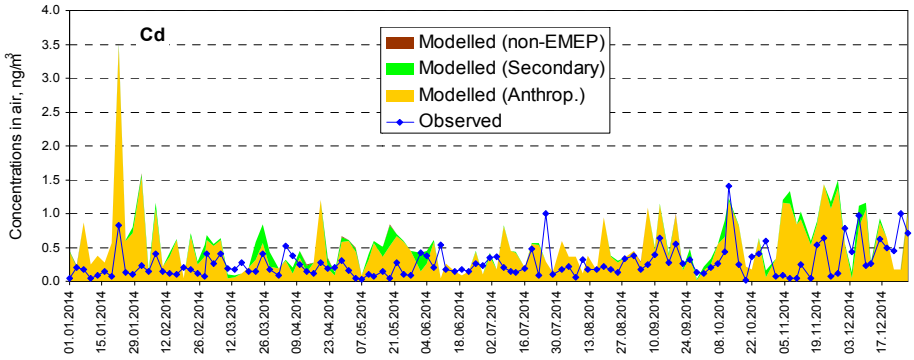

Fig. 4. *Time series of modelled and observed concentrations of cadmium in air at station Prioksko-Terrasny Biosphere Reserve*

According to the available gridded emission data, there are few grid cells with large cadmium emission within distance of 50 – 100 km from the station (Fig. 5a). Analysis of back trajectories demonstrates that high modelled concentrations are associated with episodes of air mass passing over these areas of large emissions. For example, in the period from 01st – 28th of November the modelled concentrations are higher than the observed ones by an order of magnitude (Fig. 5). In this period the back trajectories arrive to the station mostly from the south-western or south-eastern direction, i.e., from regions with high emission values (Fig. 5b).

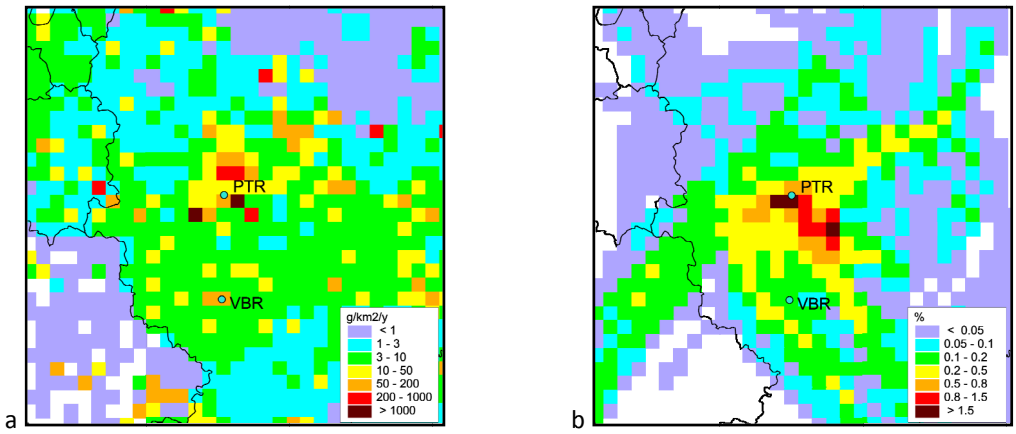

Fig. 5. *Annual emission of cadmium (a) and HYSPLIT-based back trajectories (expressed as frequencies of trajectory presence in gridcells) for station Prioksko-Terrasny Biosphere Reserve for 01st – 28th of November*

Unlike other Russian stations, modelled concentrations of lead at station Astrakhansky Biosphere Reserve are higher than the observed levels. There are several episodes, when the modelled concentrations are much higher than the observed ones, e.g., in the middle of February, April, May, in the beginning of December (Fig. 6). Some of these peaks correspond to the observed concentrations. These peaks are caused by influence of wind re-suspension of lead from regions of Central Asia.

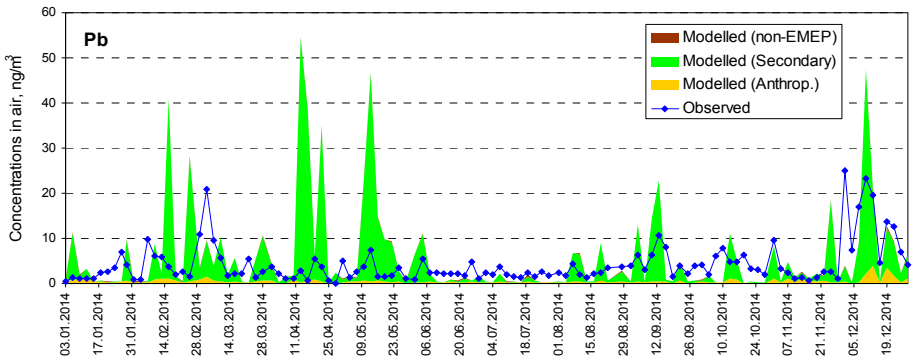

Fig. 6. *Time series of modelled and observed concentrations of lead in air at station Astrakhansky Biosphere Reserve*

Observed cadmium concentrations in air at the station Astrakhansky Biosphere Reserve are the highest among other available measured concentrations at Russian stations. These levels are not typical for measurements in background regions either in Russia or in other European countries (Fig. 2). These levels may be caused by influence of unaccounted emission sources or monitoring issues.

Brief analysis lead and cadmium levels demonstrated that for a number of episodes modelled and observed concentrations agree relatively well, while in other episodes the discrepancies between modelled and observed values are considerable. The analysis revealed that the noted discrepancies can be caused by various reasons. First of all, anthropogenic emissions of heavy metals from Russia are not officially reported to CEIP. Lack of national emission data may cause uncertainties in the emission data used in the modelling. It, in turn, can lead to underestimation or overestimation of the observed levels. Another reason is evaluation of re-suspension of heavy metals from desert regions of Central Asia. In Chapter 1 it is demonstrated that secondary sources may significantly affect pollution levels in the EMEP courtiers. Transition from old to new EMEP grid will require adaptation of wind re-suspension scheme of heavy metals. Detailed measurement data from Russian stations can be very important for further evaluation of re-suspension fluxes in the Central Asian region. Finally, quality of measurement data at some stations may need special attention.

Cooperation between the EMEP centres (MSC-E, CEIP, CCC) and national experts from Russia is needed to tackle the identified issues. In particular, special country-specific study aimed at investigation and assessment of heavy metal pollution levels in Russia can facilitate deeper understanding of factors affecting pollution levels in Russia.

References: EMEP Status Report 2/2017