Geophysical Research Abstracts
Vol. 14, EGU2012-10270, 2012
EGU General Assembly 2012

Modelling and Evaluation of Environmental Impact due to Continuous Emissions of the Severonickel Plant (Kola Peninsula)

A. Mahura (1), I. Gonzalez-Aparicio (2), R. Nuterman (1,3), and A. Baklanov (1)

(1) Danish Meteorological Institute, Research Department, Copenhagen, Denmark (ama@dmi.dk, +45-3915-7400), (2) TECNALIA Research and Innovation, Environmental Unit, Edificio 700 C/ Geldo 48160, Derio, Spain, (3) Tomsk State University, TSU, Lenin Ave., 36, 634050, Tomsk, Russia

In this study, evaluation of potential impact - through concentration, deposition and loadings patterns - on population and environment due to continuous anthropogenic emissions (on example of sulfates) of the Cu-Ni smelters of the Russian North is given. To estimate impact, the Danish Emergency Response Model for Atmosphere (DERMA) was employed to perform long-term simulations of air concentration, time integrated air concentration (TIAC), dry (DD) and wet (WD) deposition patterns resulting from continuous emissions of the Severonickel smelters located on the Kola Peninsula (Murmansk region, Russia). To perform such simulations the 3D meteorological fields (from the European Center for Medium-Range Weather Forecasts, ECMWF) for the year 2000 were used as input. For simplicity, it has been assumed that normalized releases of sulfates from smelters location occurred at a constant rate every day. For each daily release the atmospheric transport, dispersion, dry and wet deposition due to removal processes were estimated during 10 day interval. Output from these long-term simulations is an essential input for evaluation of impact, doses, risks, and short- and long-term consequences, etc.

Detailed analyses of simulated concentration and deposition fields allowed evaluating the spatial and temporal variability of resulted patterns on different scales. Temporal variability of both wet and dry deposition as well as their contribution into total deposition have been estimated. On an annual scale, the concentration and deposition patterns were estimated for the most populated cities of the North-West Russia. The modeled annual fields were also integrated into GIS environment as well as layers with population density (from the Center for International Earth Science Information Network, CIESIN) and standard administrative division of the North-West Russia and bordering countries. Furthermore, the estimation of deposited amounts (loadings) of sulfates for selected regions of Russia and border countries has been performed.

It has been found that for the “mild emission scenario” (i.e. approx. 31.6 ths. ton), for the Severonickel smelters, the annual average daily dry deposition value is 5.79 ton (with the highest – 10.4 ton - in September, and the lowest – 2.9 ton – in March). The annual average daily wet deposition is 22.7 tons, and a strong month-to-month variability is seen compared with dry deposition. The highest average WD (46.3 ton) is in January, and the lowest – 5.5 ton – in July. There are also differences in amount deposited in total from daily releases. On an annual scale, on average, 32.9% of emitted amount could be deposited at the surface during the considered duration (i.e. 10 days) of atmospheric transport. The highest deposited amount of 57.2% is observed in January and the lowest of 14.3% – in July. Taking into account actual annual (on example of year 2000) emissions of sulfur dioxide as 45.3 ths. ton (Severonickel smelters, city of Monchegorsk), the summary annual time integrated air concentration, dry and wet deposition were re-scaled and these have been estimated for most populated cities (Arkhangelsk, Petrozavodsk, Sankt-Petersburg, Syktyvkar, Pskov, and Vologda) of the North-West Russia. It was found that among these cities, the TIAC is the highest – 86 μg•h/m3 – for Arkhangelsk and the lowest – 4 μg•h/m3 – for Pskov. Both dry and wet depositions were also the highest for Arkhangelsk – 0.5 and 2.2 mg/m2, respectively.

Detailed analysis also showed that for regions surrounding the Kola Peninsula, on average (maximum), the total (dry plus wet) deposition was 0.6 (3.0), 1.8 (5.1), and 28.3 (122) mg/m2 for the territories of the Arkhangelsk, Karelia, and Murmansk regions of Russia. For border regions with Scandinavian countries, on average (maximum), the total deposition was 2.2 (6.7) mg/m2 in Finnmark (Norway); 0.2 (0.4) in Norrbotten and 0.03 (0.1) mg/m2 in Vsterbotten counties (Sweden); 0.6 (1.2) in Eastern Finland, 2.2 (7.2) in Lapland, and 1.4 (2.9) mg/m2 in Oulu provinces of Finland. For urban population living in the central and northern territories of the Kola Peninsula the yearly loading due to deposition of sulfates could be more than 40 kg/person. For bordering territories with the Murmansk region such loadings are less than 5 kg/person for the Eastern Finland, Karelia, and Arkhangelsk regions; and up to 15 kg/person – for the Northern Norway.