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Sulphur atmospheric deposition in areas with different anthropogenic loads in Belarus

Elena V. Sanets*, Vera N. Chuduk

Institute for Problems of Natural Resources Use and Ecology, National Academy of Sciences of Belarus, Belarus

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Abstract

This article presents some results of an investigation of sulphur atmospheric deposition in areas with different anthropogenic loads in Belarus. Through sampling and chemical analysis of precipitation, new data about sulphate concentrations in precipitation and atmospheric deposition of sulphur in different conditions, including regional background conditions, a large industrial city and a zone affected by point source of sulphur emission, were obtained. Comparison of the chemical composition of precipitation at three sampling locations has shown that the local emission of sulphur compounds has a minor influence on local sulphur deposition. This data points to the dominant role of transboundary transfer of sulphur in contamination and acidification of the environment in Belarus.

Keywords: Precipitation; Sulphur; Atmospheric deposition; Transboundary pollution; Belarus

1. Introduction

Investigation of the chemical composition and dynamics of atmospheric deposition is very important in environmental studies. First, the chemical composition of precipitation characterises the contamination of the lower layer of the atmosphere.

* Corresponding author. Fax: +375 17 264 24 13.
E-mail address: elena-sanets@yandex.ru (E.V. Sanets).

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Second, it reflects the direction and the level of influence of atmospheric fluxes of pollutants on the environment. Third, data about the chemical composition and the temporal and spatial scale of atmospheric deposition are used in modelling to predict the transfer of pollutants from one area to another (e.g. transboundary and regional transfer).

Sulphates are one of the main components of atmospheric deposition in industrialised areas as well as in so-called "background conditions", i.e. far from any anthropogenic sources of sulphur emission. Sulphur atmospheric deposition causes acidification of soils and surface waters and damages buildings and other constructions in many countries all over the world (Gorham et al., 1984; Byron et al., 1991; Europe's Environment, 1995). Despite measures for the reduction of sulphur emissions, acidification remains a serious problem in many European countries (Trends in Impacts. . . , 1999).

Acidification is closely related to transboundary pollution. Due to their long residence time in the atmosphere, sulphates can be transferred by air fluxes over long distances. Transboundary fluxes of sulphur cause acid deposition hundreds or thousands of kilometres away from sources of emission (ApSimon and Warren, 1996; Straten, 1996). Therefore, great attention is given to the estimation of the contribution of transboundary transfer to total deposition. At present, this contribution is estimated on the basis of a variety of modelling techniques (Alcamo et al., 1987, 1990; Shaw et al., 1988; Operational EMEP. . ., 1999). However, these models give just an approximate reflection of reality and have some drawbacks. That is why it is very important to use a combination of different methods and techniques to assess the contribution of different sulphur emission sources to total atmospheric deposition.

On one hand, concentrations of sulphate ion in precipitation and sulphur atmospheric deposition can be used as indicators of anthropogenic effects on ecosystems. On the other hand, comparing the data on conditions which are subjected exclusively to regional (i.e. within the borders of the country) or transboundary transport with those which are characteristic of areas affected by industrial emissions can help us to estimate the possible contribution of local sulphur emissions to total atmospheric deposition.

Data on the chemistry of precipitation and on sulphur atmospheric deposition are widely available for Western and Central Europe while they are scarce in the case of the countries of the Former Soviet Union. The main attention to acidification problem in these countries was given in 1980s and most of investigations on the chemistry of precipitation belong to that period. In Belarus, all recent investigations on precipitation chemistry dealt with an evaluation of trends of precipitation acidity and deposition of acidifying compounds in 1990s on the basis of data of State Precipitation Monitoring Network (Kakareka, 1995, 2001).

This article presents the results of experimental investigation of sulphur atmospheric deposition in areas subject to different anthropogenic loads in Belarus. Sulphur atmospheric deposition in industrialised areas is compared to the level of deposition that is subjected exclusively to regional or transboundary transport of sulphur compounds. The possible contribution of the local and transboundary sources of sulphur emission is estimated as well. This study was performed within the framework of an investigation on sulphur atmospheric fluxes' influence on ecosystems in Belarus.