DEPOSITION FLUXES OF ACIDIFYING COMPOUNDS ON THE TERRITORY OF BELARUS

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Introduction

In Belarus monitoring of precipitates (by the BAPMON methodology, monthly samples) started 1962. Till 1980 sampling was conducted at one site (Berezino); since 1981 measurements started at the site Berezinsky Reserve (BR). In 1990-1991 precipitates collection began at 12 sites (located mainly in cities). Main components (SO_4^{2-}, NO_3^-, Cl^-, HCO_3^-, NH_4^+, Ca^{2+}, Na^+, K^+, Mg^{2+}, H^+) and conductivity are monitored.
Results of monitoring were used for analysis of dynamics of acidifying compounds deposition on the territory of Belarus in 90th and for revealing of their connections to emissions.

Methods

Intensity of weighted average daily wet deposition fluxes for every site was calculated as a function of monthly compound concentration in precipitates, monthly volume of precipitates and month length.
Intensity of daily wet deposition for region was calculated as a weighted average daily wet deposition fluxes for every site.

Trend analysis included:

- simple time-series review
- non-parametric Seasonal Kendall Test (SKT) for trend detection and measurement
- 12-month moving average of monthly acidity and deposition data was used for visualisation of existing trends

Results

Trend in Acidity of Precipitates

For the majority of stations reaction of precipitates is close or higher the equilibrium value (5.7). This is stipulated by the location of the most stations in cities. In background conditions precipitates are acid. This is especially characteristic to the BR (mean pH for 1990-99 – 5.1).
Trend of acidity is significant for the most of sites (8 from 14). But sites are heterogeneous in acidity trend: for 5 of them it is positive, and for 3 – negative. There is no certain regularities in location of sites with positive and negative trend of acidity.

Trend in Sulphur Wet Deposition

Analysis of dynamics of wet deposition fluxes for the period 1990-1999 revealed the distinct downwards trend of sulphur deposition (its average fluxes reduced from 3.4 kg/km^2 day in 1992-1993 to 2.5 kg/km^2 day in 1997-1999). This trend has statistically approved significance for 10 sites. Only one site has positive trend (Mozyr), but statistically not different from zero. 12-month moving average is rather monotonous

Trend in Oxidized Nitrogen Wet Deposition

Oxidized nitrogen fluxes have significant downwards trend for 11 sites. Upwards trend is only for Berezino (not significant). In spite of SKT analysis 12-month moving average has not revealed monotonous downwards slope.
Sharp reduction of nitrates deposition detected in period from 1994 to 1996. Its reasons are obscure.

Trend in Reduced Nitrogen Wet Deposition

For reduced nitrogen deposition levels fluctuations are typical which can hardly been explained now

though some tendency to reduction can be detected.

Described tendencies are in common confirmed by model calculations of the MSC-West. According to them, total sulphur depositions on the territory of Belarus reduced from 275.1 thous. tonnes in 1991 to 153 thous. tonnes in 1997 – approximately 44%. During the same period oxidized nitrogen fluxes decreased 26% (from 81.3 thous. tonnes to 59.9 thous. tonnes), reduced nitrogen fluxes decreased slightly (from 162.4 thous. tonnes to 151.5 thous. tonnes).

Emissions

In continuation of the most part of 80th SO_2 emission on the territory of Belarus was stable. Reduction started in 1988, and rapid reduction – in 1992. During the period from 1992 to 1998 SO_2 emission reduced 3.4 times. This was stipulated mainly by total industry output decrease and by changes in fuel balance (natural gas share have increased).

Nitrogen oxides emission increased from 1980 to 1990 (maximum – 285 thous. tonnes); in 1992 steady reduction began (in 1998 – 164 thous. tonnes).

In the most of cities with precipitates sampling emission of SO_2 in 90th reduced a few times. Nitrogen oxides emission reduction also typical but not so sharp.

But correlation analysis of SO_2 emission with SO_4^{2-} content in precipitates and NO_x emission with NO_3^- content on the territory of the same city did not reveal reliable relations for no one station.

On the whole deposition fluxes of sulphur and oxidized nitrogen has more close relation to total SO_2 emission levels as on the territory of Belarus, so on territory of Europe rather than to emission on the territory of a certain city with precipitation monitoring. This is due to characteristic feature of Belarus – prevalence of transboundary sulphur and oxidized nitrogen in depositions. Accordingly to model calculations, the share of transboundary sulphur in depositions on the territory of Belarus makes 84-86%, oxidized nitrogen – 89-94%, reduced nitrogen – 28-65%.

Conclusions

Trend of acidity of precipitates in 90th was heterogeneous across the territory of Belarus and can hardly been described by averaged slope values.

Absence of expressed correlation between acidity of precipitates and the content of main acidifying compounds in depositions is characteristic.

For the 90th the significant trend of sulphur wet deposition reduction was revealed. The intensity of deposition of nitrates also showed downwards trend for the most of sites but it is not monotonous.

Level of depositions of sulphur and oxidized nitrogen on the territory of Belarus slightly dependent from the emission in limits of precipitates allocation sites. So considerable reduction of SO_2 and NO_x emission in Belarusian cities did not lead to adequate reduction of fluxes of these compounds. But averaged depositions correlate with emissions on the territory of Belarus as a whole and European. This is due to prevalence of transboundary component in the structure of atmospheric depositions on the territory of Belarus.

It should be stressed that in 2001 EMEP station Vysokoje (daily sampling) has resumed its work.

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