Institute of Global Climate and Ecology Roshydromet and RAS

Co-analysis of coniferous forest state parameters and atmospheric deposition data series at European part of Russian Arctic

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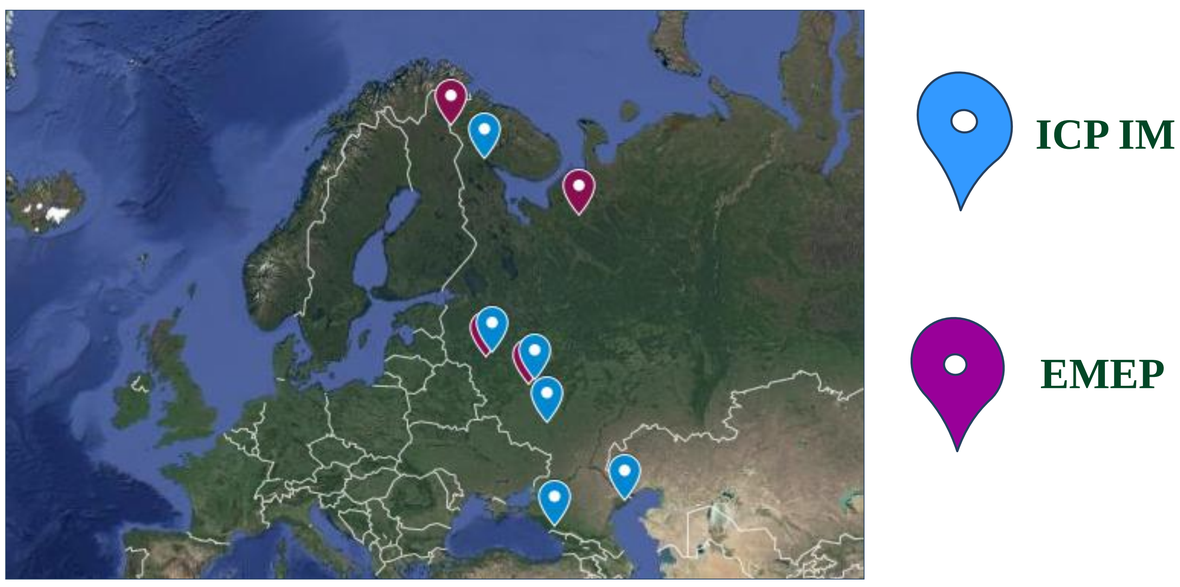
Introduction

The problem of air pollution is one of the greatest global challenges faced by humanity. In this regard, special importance takes the assessment of connection between the bioindication parameters and air pollutants, especially for background areas.
The Russian Federation participates in realization of a number of international monitoring programmes of the environment, working under Convention on Long-range Transboundary Air Pollution (CLRTAP). Some of them included monitoring on the background territories.
In this research the European Monitoring and Evaluation Programme (EMEP) and International Cooperative Programme on Integrated Monitoring of Air Pollution Effects on Ecosystems (ICP IM) data series were used. The study of forest stands state was carried out according to the routine measurements ICP IM "Forest damage".
Observations were carried out on permanent sample plots at the territory of the reserve “Polar circle”. Data on the content of pollutants in precipitation were obtained from the observations of the EMEP station located on the territory of Janiskoski and Pinega reserves (northern territories(fig. 1.)). The statistic analysis was used the Openoffice Calc.
The main purpose of this study was to identify the relationship between the measured values of the parameters (features) of coniferous forest stands, and the concentrations of pollutants from wet atmospheric deposition on the background territory of reserve “Polar circle”. Objectives of the study also included assessment of evaluation of the changes of state of forest stands defoliation (DF) and discoloration (DC) and assessment of the response of the forest on the flow of sulfate, nitrate, chloride and ammonium compounds, as well as sodium, magnesium, calcium and potassium, with precipitation (Table 1,2) .

Fig.1 Russian stations of EMEP and ICP IM



Objects and methods

The study of the trees state was carried out using visual assessment methods. Precipitation was studied by liquid chromatography

Tab. 1. ICP IM Forest damage parameters

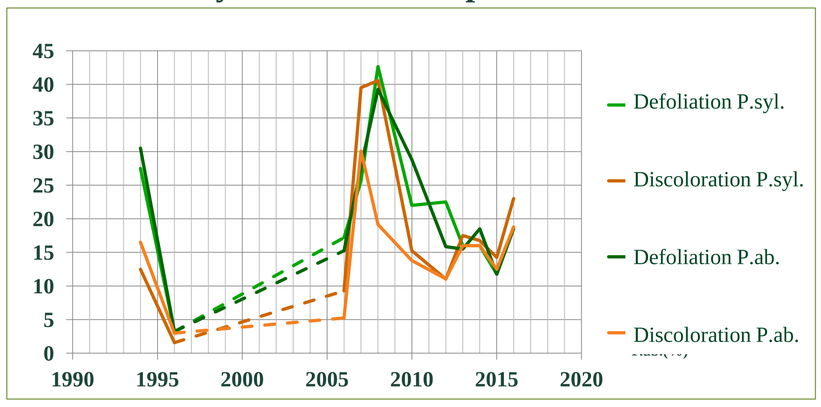
Coniferous stands	
Annual sampling	Defoliation (%)
Analysis were carried out by visual assessment	Discoloration (%)

Tab. 2. EMEP parameters

Concentration in precipitation	K^+
	Na^+
	Ca^{2+}
Daily sampling	Mg^{2+}
	NH_4^+
Analysis were carried out by methods of ion and liquid chromatography	NO_3^-
	NO_3^-
	SO_4^{2-}
	Cl^-

Defoliation and discoloration of coniferous stands

Fig.1 Variability of Picea abies L. and Pinus sylvestris L. state parameters



Tab. 3. Correlation coefficients (R) (p=0,01)

Defoliation P.ab.; Defoliation P.syl.	**0,94**
Defoliation P.syl.; Discoloration P. syl.	**0,75**
Defoliation P.ab.; Discoloration P.ab.	**0,65**
Discoloration P.ab.; Discoloration P. syl.	**0,86**

Life condition of forest stands

Fig. 3. Life condition of *Picea abies L.* stands

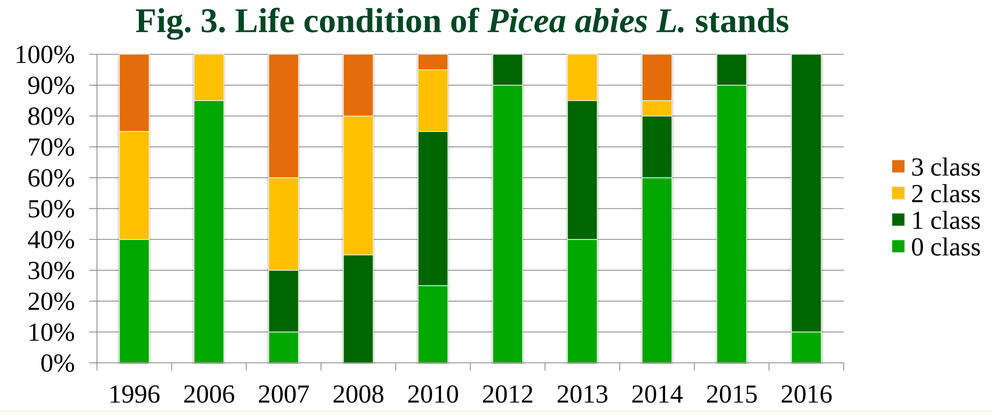
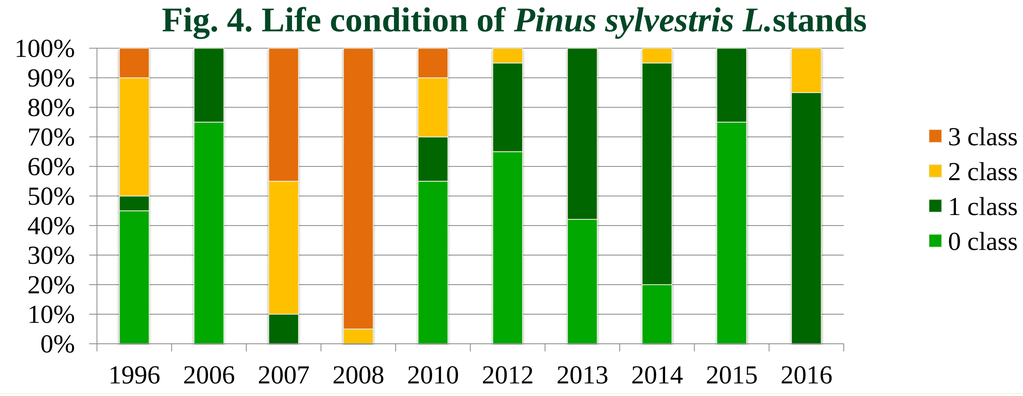


Fig. 4. Life condition of *Pinus sylvestris L.*stands



*0 meens healthy trees

Significant correlation coefficients

WSBS & Janiskoski

Tab. 4 Coefficients of correlations between the parameters of coniferous stands and total wet deposition of pollutants for current(C) and previous(P) year. (p = 0.05)

Stands	Parameter	SO4(S)	NO_3(N)	NH4(N)	Na	K	Ca
Pinus sylvestris L.	DF	0,59C;		0,61C;	0,79C;	0,69C;	0,69C;
Picea abies L.	DF		-0,65 C; -0,48 P;		0,63C; 0,72 P;	0,46C; 0,57P;	0,50C; 0,59P;
Pinus sylvestris L.	DP			0,62 C;	0,83C;	0,77C;	0,80C;
Picea abies L.	DP				0,48C;	0,53C;	0,58C;

Tab. 5 Coefficients of correlations between the parameters of coniferous stands and concentration pollutant in precipitation for current(C) and previous(P) year. (p = 0.05)

Stands	Parameter	SO4(S)	NO_3 (N)	NH4(N)	Na	K	Ca
Pinus sylvestris L.	DF		-0,63C; -0,48 P;	0,62C;	0,57C; 0,66 P;	0,65C;	062C; 0,48 P;
Picea abies L.	DF		-0,79C;		0,91 P;	0,75 P;	0,76 P;
Pinus sylvestris L.	DP		-0,58C;	0,63C;	0,77C; 0,62 P;	0,74C;	0,71C;
Picea abies L.	DP	0,47 P;	-0,59C;		0,53 C;		

WSBS & Pinega

Tab. 6 Coefficients of correlations between the parameters of coniferous stands and total wet deposition of pollutants for current(C) and previous(P) year. (p = 0.05)

Stands	Parameter	SO4(S)	NO_3(N)	NH4(N)	Na	Mg	Ca	Cl	K
Pinus sylvestris L.	DF				0,87C; 0,55P;	0,87P;	0,52P;	0,74C; 0,55P;	0,73P;
Picea abies L.	DF			-0,59P;	0,79C; 0,69P;	0,72P;		0,70C; 0,63P;	0,59P;
Pinus sylvestris L.	DP	0,71C;	0,52C; -0,51P;	-0,79P;	0,92C;	0,68C; 0,53P;	0,52P;	0,92C;	0,65C;
Picea abies L.	DP	0,72C; -0,59P;	0,48C; -0,70P;		0,71C;	0,86C;	0,53C;	0,87C;	0,84C;

Tab. 7 Coefficients of correlations between the parameters of coniferous stands and concentration pollutant in precipitation for current(C) and previous(P) year. (p = 0.05)

Stands	Parameter	SO4(S)	NO_3 (N)	NH4(N)	Na	Mg	Ca	Cl	K
Pinus sylvestris L.	DF	0,51C;			0,73C; 0,64P;	0,93P;		0,89C; 0,52P;	0,75 P;
Picea abies L.	DF	0,61C;		-0,61P;	0,86P;	0,76P;	-0,55C;	0,83C; 0,64P;	0,62 P;
Pinus sylvestris L.	DP		-0,48P;	-0,67P;	0,65C; 0,55 P;	0,74P;	0,75 P;	0,94C; 0	0,73 P;
Picea abies L.	DP			-0,54P;			0,88P;	0,75C;	

Conclusions

In the studies was revealed that:

- Defoliation and discoloration of pine and spruce changed unidirectionally (fig.1, tab.3)
- There were no detectable significant trends of deterioration or improvement in the status of coniferous forest stands (both in the case of the use of trend analysis and in the analysis of stands by class(fig.2,fig.3))
- Discovered the significant correlations between the state of the forest and annual fluctuations of pollutants (tab. 4, tab. 5, tab. 6, tab. 7). mainly increasing the concentration of pollutants in the atmosphere has a negative impact on the state of stands. Exceptions are nitrogen compounds (presumably, because of the poverty of the far north soils nitrogen compounds act as fertilizers for the territories).

Thus, thpredominantly e negative impact of pollutants fluctuations on the stands state on the background territory of "Polar circle" reserve, was recorded. To verify the assumption of the value of nitrogen as a fertilizer, it is necessary to conduct soil studies of the territory.

References

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2.Manual for Integrated Monitoring / Compiled by the ICP IM Programme Centre Finnish Environment Institute, Helsinki, Finland // International Cooperative Programme on Integrated Monitoring of Air Pollution Effects on Ecosystems URL: http://www.environment.fi/default.asp?node=6329&lan=en

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