

**Co-analysis of coniferous forest state
parameters and atmospheric deposition data
series obtained by ICP IM and EMEP at
European part of Russia**



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ICP IM and EMEP Russian network



 **ICP IM
station**

 **EMEP
station**

ICP IM and EMEP research parameters

ICP IM

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

EMEP

Concentration in precipitation	K⁺
Daily sampling	Na⁺
	Ca²⁺
Analysis were carried out by methods of ion and liquid chromatography	Mg²⁺
	NH₄⁺
	NO₃⁻
	NO₃⁻
	SO₄²⁻
	Cl⁻

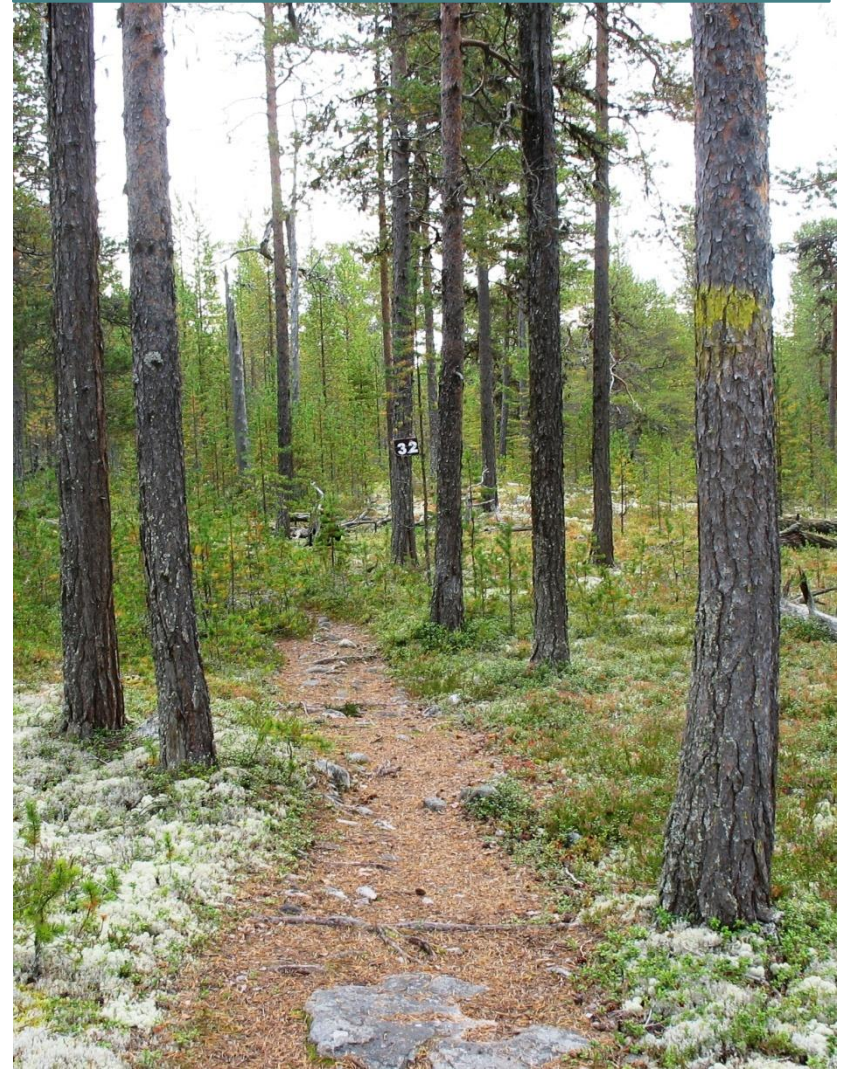
Stands

White Sea Biological Station

fir-wood



pinery



Stands

Oka-Terrace Biosphere Reserve

fir-wood



pinery



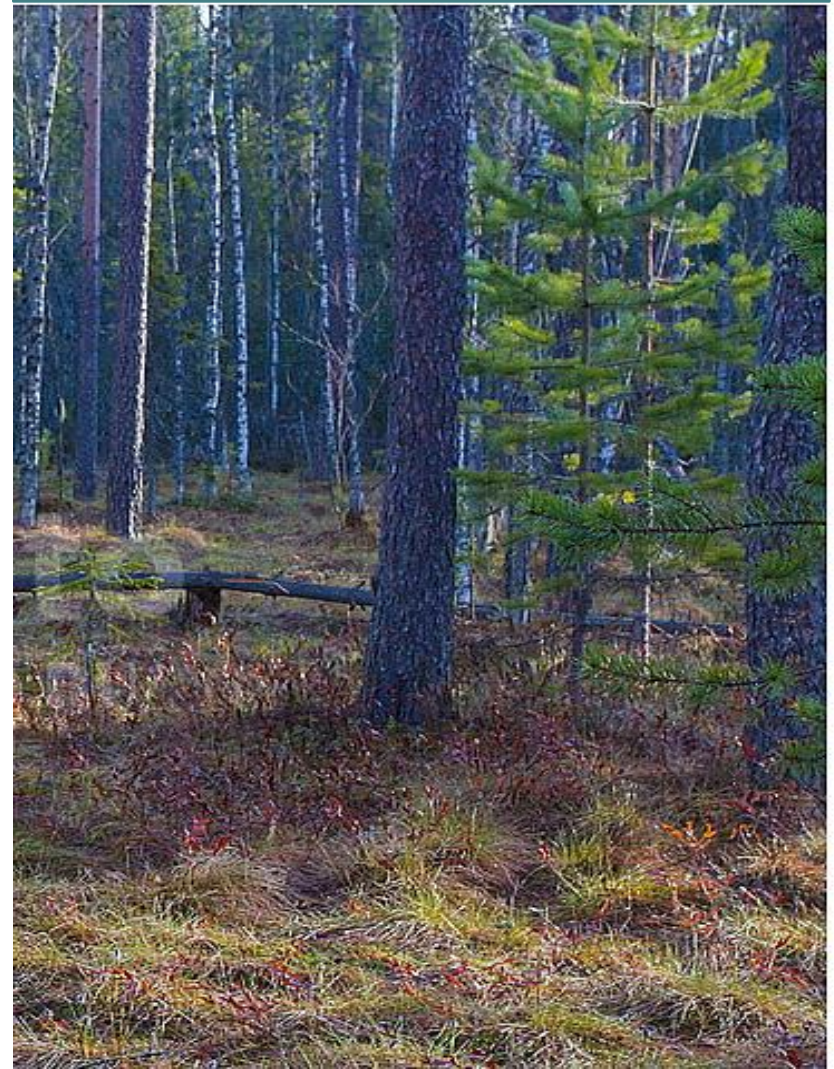
Stands

Central-Forest Biosphere Reserve

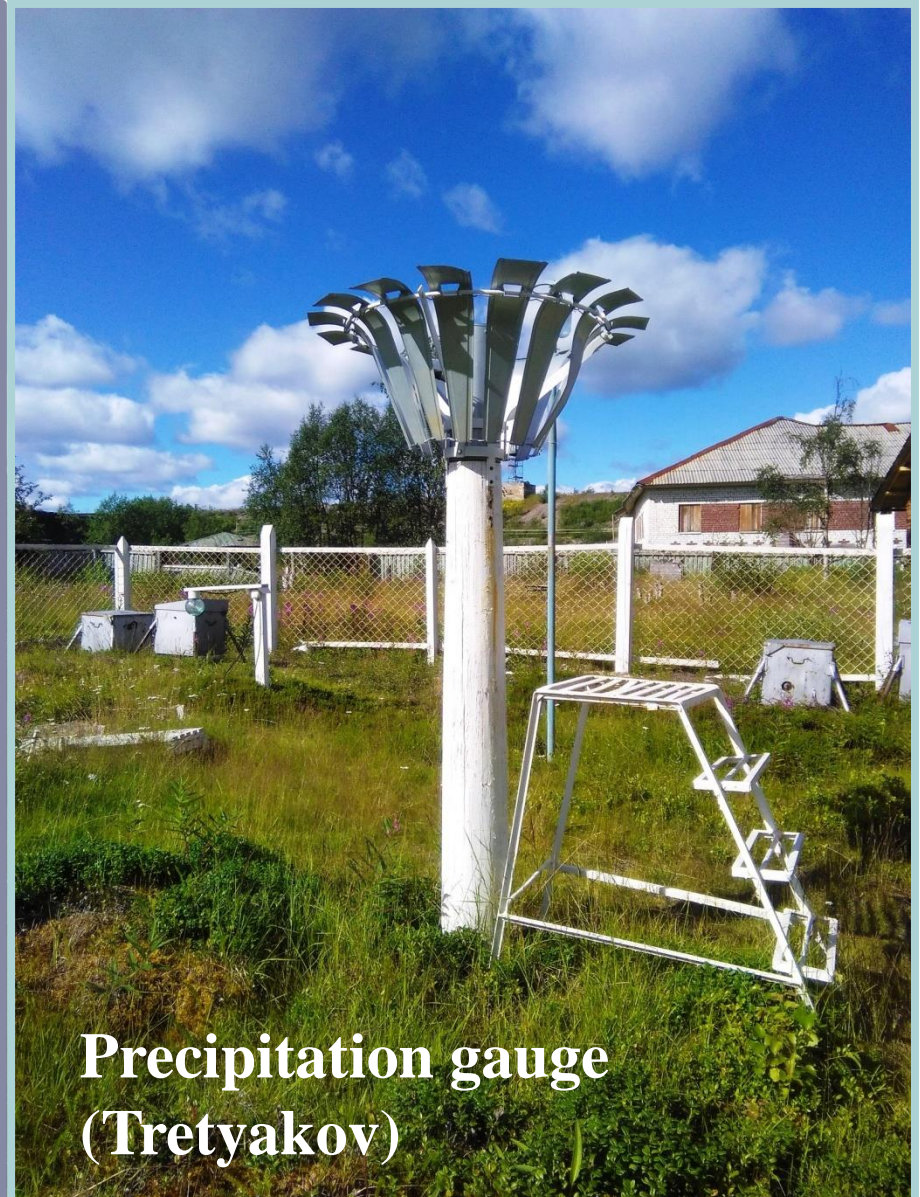
fir-wood



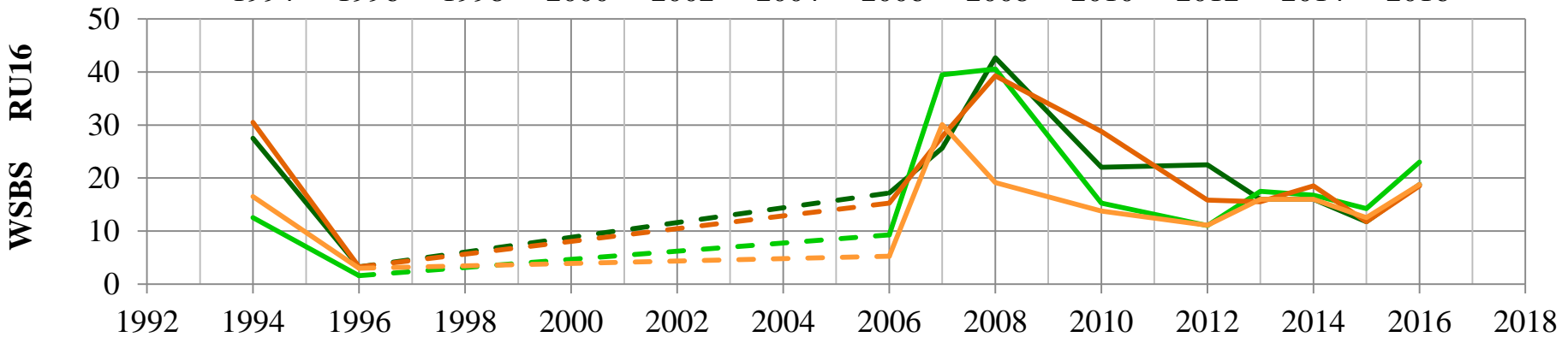
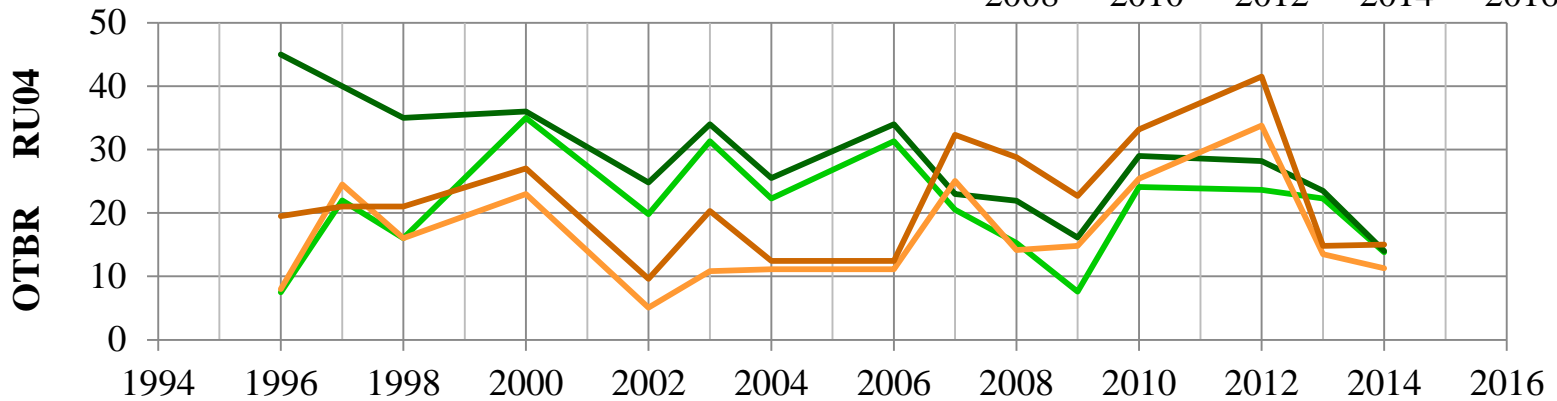
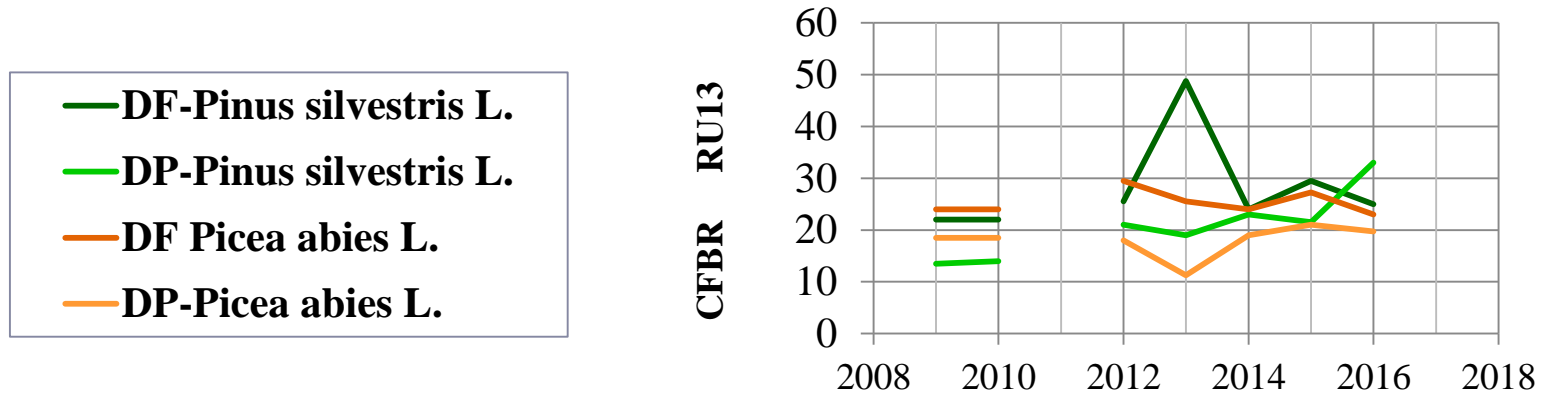
pinery



EMEP station



Interannual fluctuations of defoliation(%) and depigmentation(%) in stands of Scots pine (*Pinus sylvestris*) and spruce (*Picea abies*) .



Defoliation and depigmentation in pine and spruce stands changed unidirectionally for RU16 and RU04

Correlation coefficients ($p = 0.05$)			
RU04		RU16	
R(DF&DP)	R(DF&DP)	R(DF&DP)	R(DF&DP)
Picea abies	Pinus sylvestris	Picea abies	Pinus sylvestris
0,861	0,698	0,649	0,748

There is no the same correlations for RU13

Tab. 1 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	SO ₄ (S)	NO ₃ (N)	NH ₄ (N)	Na	Mg	Ca	Cl	K
Pinus sylvestris L.	DF			-0.63C; 0.63P;					-0.63C;
Picea abies L.	DF						0.58C;		
Pinus sylvestris L.	DP	-0.94C; -0.73P;			-0.68C; -0.60P;	- 0.73C;		-0.64C; -0.66P;	-0.73C; -0.63P;
Picea abies L.	DP			-0.59P;					

Tab. 2 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	SO ₄ (S)	NO ₃ (N)	NH ₄ (N)	Na	Mg	Ca	Cl	K
Pinus sylvestris L.	DF	-0.69P;	0.67C;						-0.61C;
Picea abies L.	DF	-0.65C;							
Pinus sylvestris L.	DP		0.55P;	0.73P;			0.59C;	-0.58P;	
Picea abies L.	DP	0.58P;		0.74C;					

Tab. 5 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	SO ₄ (S)	NO ₃ (N)	NH ₄ (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. 6 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	SO ₄ (S)	NO ₃ (N)	NH ₄ (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;	

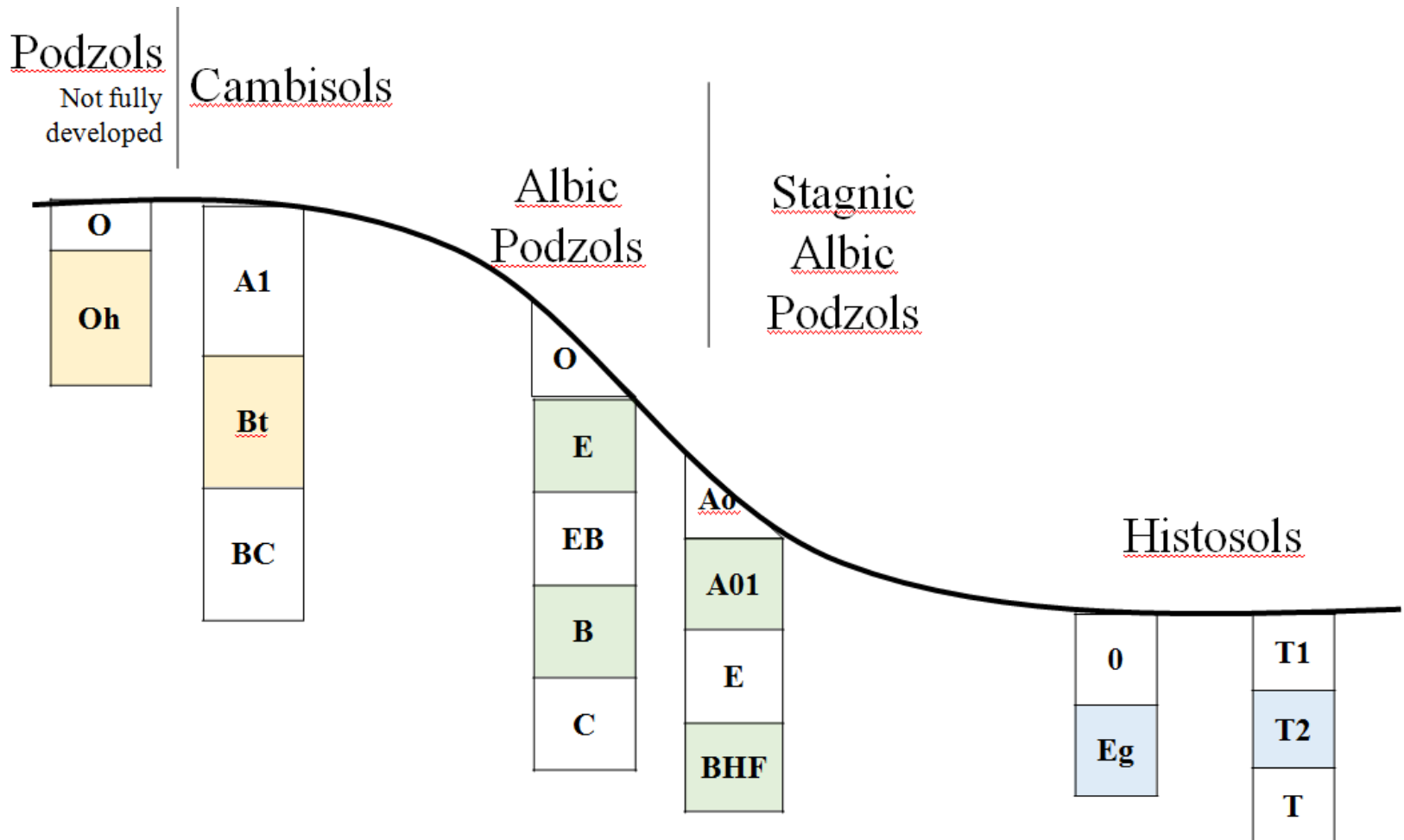
WSBS**&****Table. 7 Coefficients of correlations between the parameters of coniferous stands and total wet deposition of pollutants for current(C) and previous(P) year. (p = 0.05)**

Stands	Parameter	SO ₄ (S)	NO ₃ (N)	NH ₄ (N)	Na	K	Ca
Pinus sylvestris L.	DF	0,59 C;		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;

Table. 8 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	SO ₄ (S)	NO ₃ (N)	NH ₄ (N)	Na	K	Ca
Pinus sylvestris L.	DF		-0,63C; -0,48 P;	0,62C;	0,57C; 0,66 P;	0,65C;	0,62C; 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;		

The distribution of soils at White Sea Biological Station



Conclusions

- Defoliation and depigmentation of pine and spruce changed unidirectionally for RU16 and RU04
- For all territories, discovered the significant correlations between the state of the forest and annual fluctuations of pollutants
- Coniferous forests of the North are more sensitive to fluctuations in pollutants
- Nitrogen compounds act as fertilizers for the territories of the far North
- We assume that the results of this research, could be used for verification models of the atmospheric pollutants transport for Northern area



Thank you