

6<sup>th</sup> Study Conference on BALTEX  
Międzyzdroje, Island of Wolin, Poland, 14 to 18 June 2010

# Frequencies of spring floods in Belarus part of the Baltic Sea Basin related to the atmospheric circulation

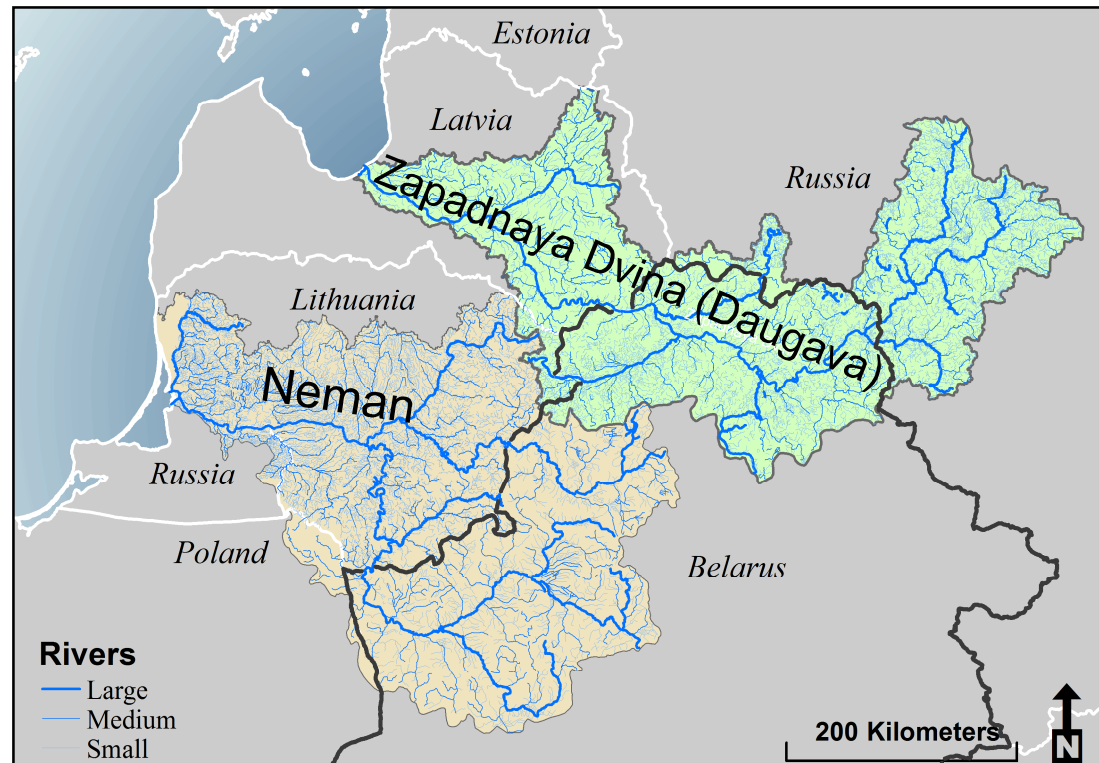
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## River network and water resources

Water resources of Baltic Sea basin within Belarus are formed the Zapadnaya Dvina, Neman, and Narev River basins with mean annual runoff of about 26 cubic kilometers.

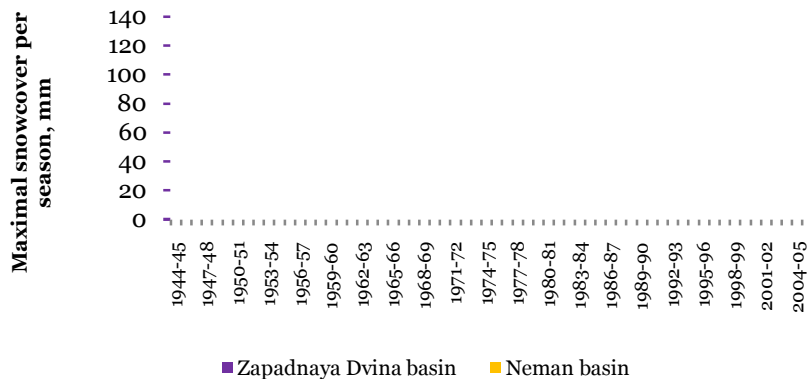
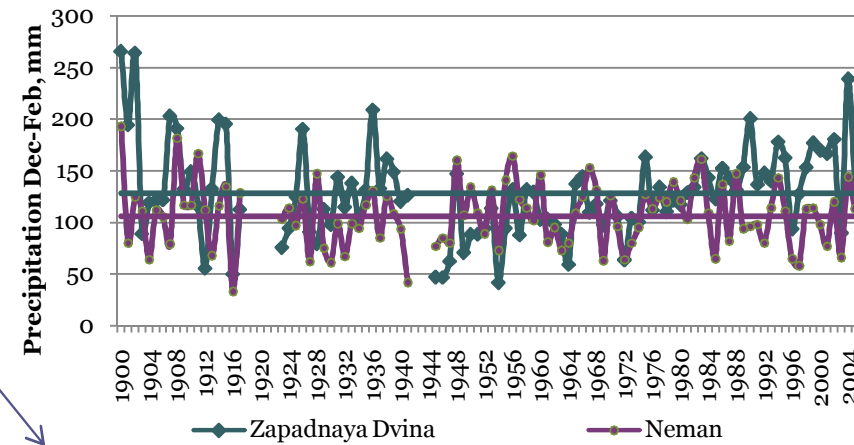
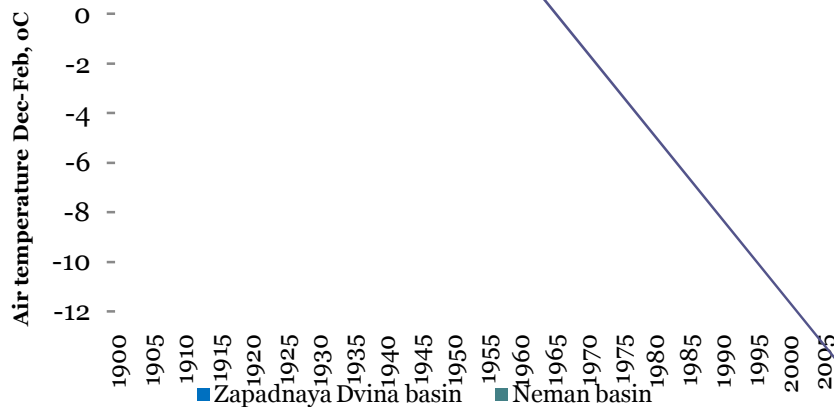
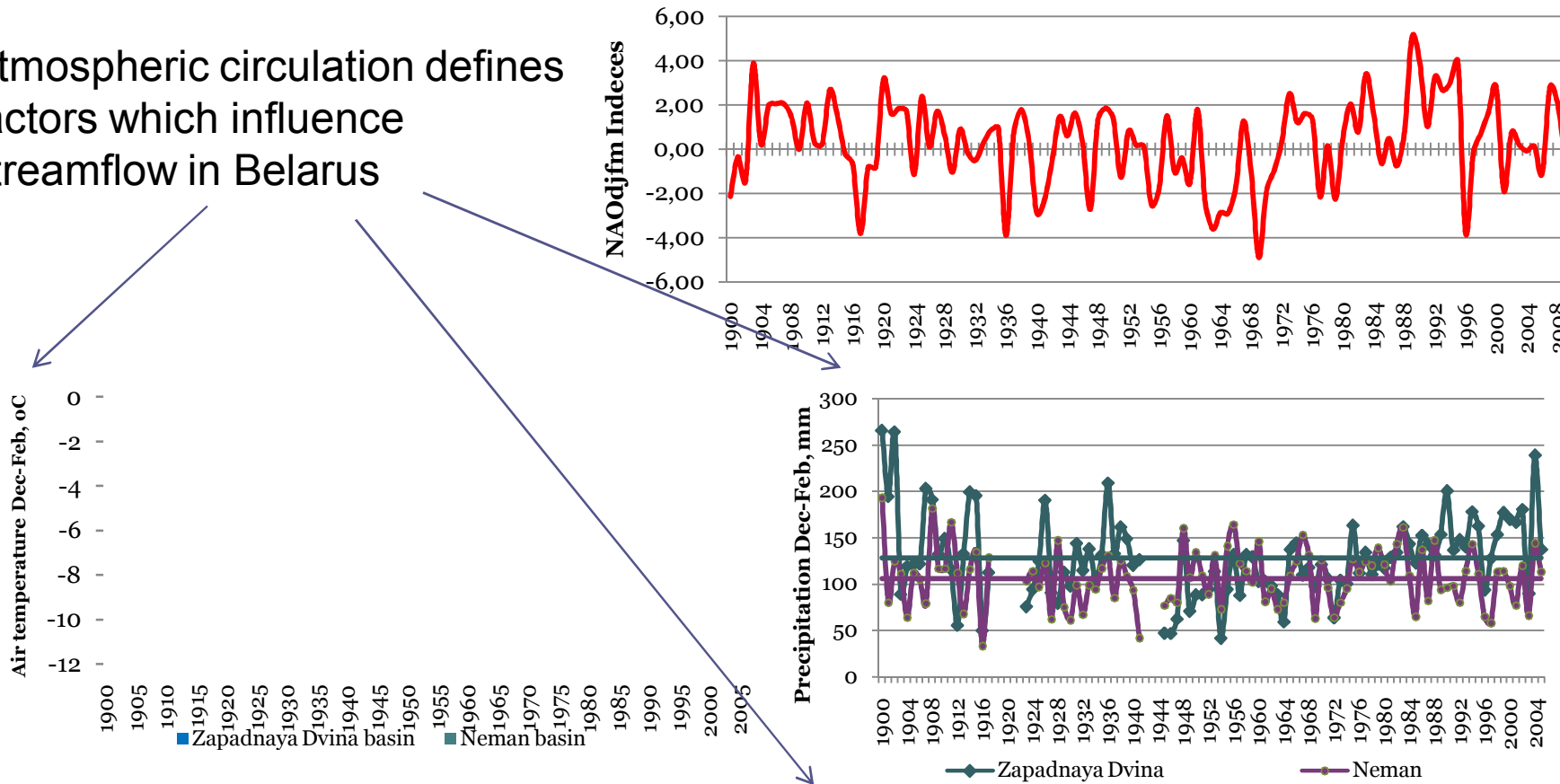
The annual outflow to the neighboring countries is on average 13.9 cubic kilometers to Latvia via the Zapadnaya Dvina River, 9 cubic kilometers to Lithuania via Neman and Viliya, and 3.1 cubic kilometers to Poland via Zapadny Bug and Narev.



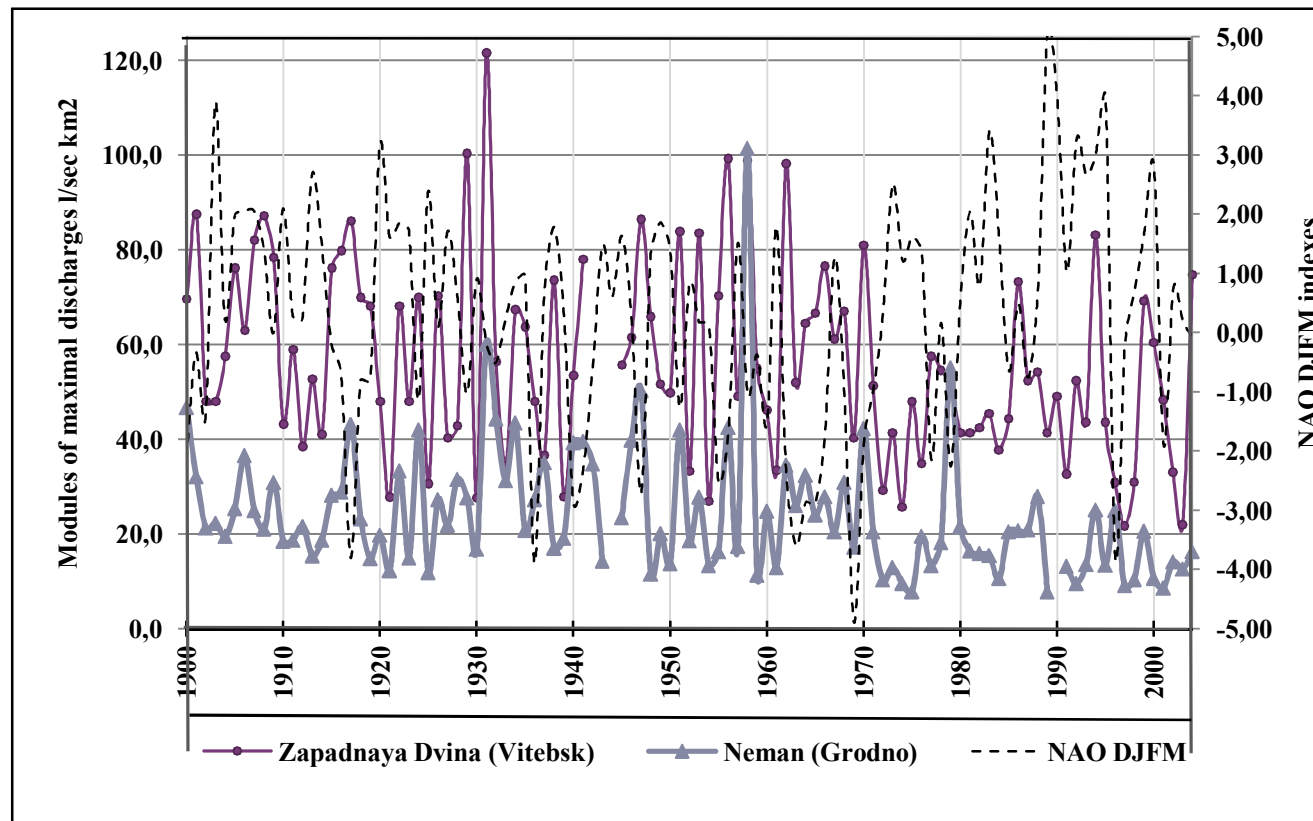
## List of stations used in the research

River-Station	Catchment, km <sup>2</sup>	Period of observation, years	Stability of series	
			Annual Discharges	Maximal Discharges
Zapadnaya Dvina - Vitebsk	27300	1877-1941, 1944 - 2010	All period	All period
Zapadnaya Dvina - Polotsk	41700	1936-1941, 1944 - 2010	- " -	- " -
Ulla - Bocheykovo	3330	1929-1939, 1945-2010	- " -	- " -
Polota - Yankovo	618	1927-1940, 1944-2010	- " -	- " -
Nacha - Nacha	240	1928-1931, 1936-1941, 1944-2010	- " -	- " -
Disna - Sharkovchina	4720	1945-2010	- " -	- " -
Berezovka - Sautki	567	1950-2010	- " -	- " -
Dryssa - Dernovichi	4580	1961-2010	- " -	- " -
Neman - Stolbtsy	3070	1922-1933, 1939, 1940, 1942, 1944-2010	- " -	- " -
Neman - Belitsa	16700	1925-33, 1944-2010	- " -	- " -
Neman - Mosty	25600	1951-2010	- " -	- " -
Neman - Grodno	33600	1877-2010	- " -	- " -
Shchara-Shchara	4860	1957-2010	- " -	- " -
Svisloch - S. Dolina	1720	1960-2010	- " -	- " -
Kotra - Sahkombinat	2000	1946-2010	- " -	- " -
Viliya - Steshitsy	1230	1951-2010	- " -	- " -
Naroch - Naroch	1480	1944-2010	- " -	- " -
Oshmyanka - V. Yatsyny	1480	1959-2010	- " -	- " -
Ryta - M. Radvanichi	968	1952-2010	1973-2010	1973-2010
Lesnaya - Kamenets	1920	1946-2010	1) 1946-1966 2) 1967-2010	1946-2010

Atmospheric circulation defines factors which influence streamflow in Belarus



## Dynamic of NAOdjfm indexes and modules of maximal discharges



# Analysis of the atmospheric circulation impact on river regime

NAO Index Data provided by the Climate Analysis Section, NCAR, Boulder, USA, Hurrell (1995).

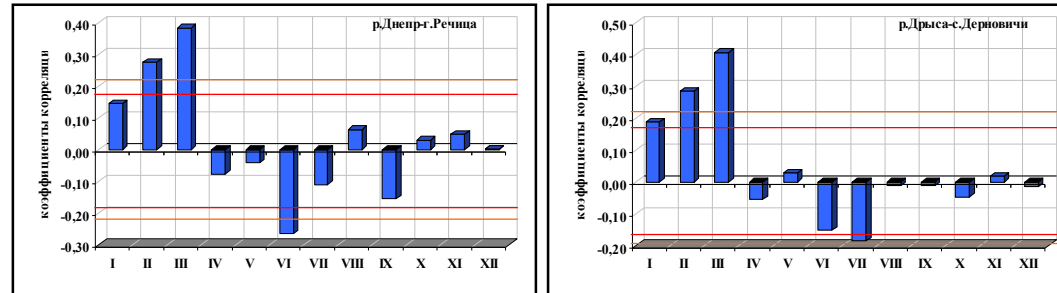
Winter (December through March) index of the NAO based on the difference of normalized sea level pressure (SLP) between Lisbon, Portugal and Stykkisholmur/Reykjavik, Iceland

The correlation coefficients were calculated between:

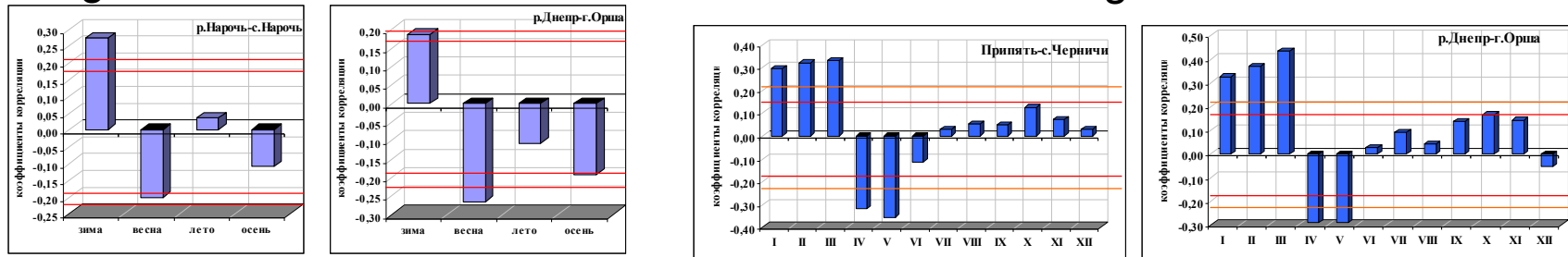
- a) monthly NAO indexes and monthly discharges
- b) seasonal NAO indexes and seasonal discharges
- c) NAOXII-III indexes and monthly, seasonal and annual discharges
- d) NAO indexes and monthly and annual discharges

# Results of correlation analysis

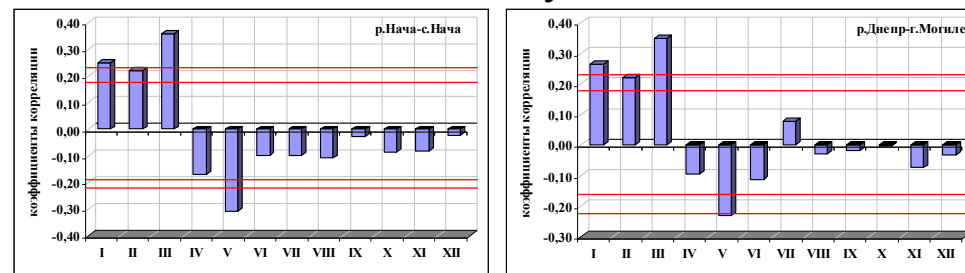
a) monthly NAO indexes and monthly discharges



b) seasonal NAO indexes and seasonal discharges c) NAOXII-III indexes and monthly, seasonal and annual discharges



d) annual NAO indexes and monthly and annual discharges



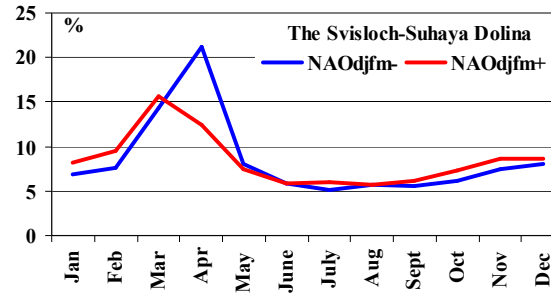
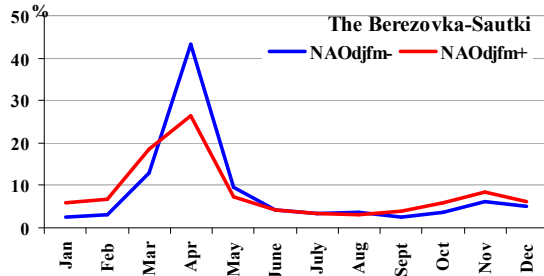
**Correlation coefficient between seasonal NAOdjfm indexes under different period of atmospheric circulation**

Period	1900-1928, 1996-2005	1929-1939, 1971-1995	1940-1948, 1949-1970
December- March	0,4...0,6	0,5...0,7	0,4...0,6
April- June	-0,3...-0,6	-0,4...-0,8	-0,4...-0,9
(Sig. 0.05-0.001)			

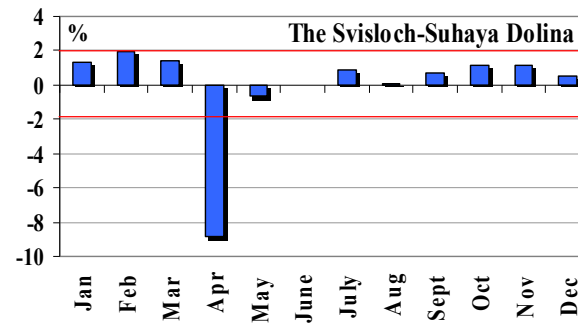
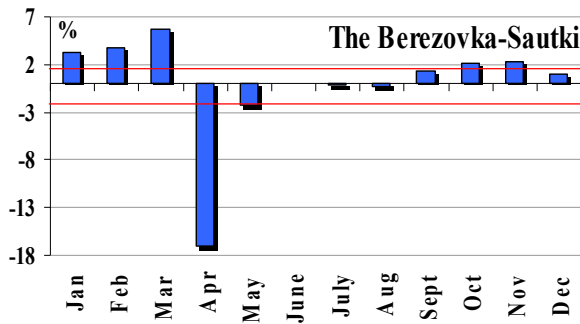
## The share of monthly runoff layers from longstanding means under opposite stages of North Atlantic Oscillation, %

River	Catchment, km <sup>2</sup>	Stage of NAO	Jan	Feb	March	Apr	May	Year
The Zapadnaya Dvina-Polotsk	41700	nao-	85	76	64	112	122	103
		nao+	110	115	122	94	87	98
The Obol-Obol	2520	nao-	76	63	62	119	120	103
		nao+	115	122	123	90	88	98
The Nacha-Nacha	240	nao-	73	63	74	126	119	102
		nao+	117	123	116	86	89	100
The Berezovka-Sautki	567	nao-	58	57	80	135	119	102
		nao+	126	126	113	81	89	99
The Neman-Grodno	33600	nao-	92	84	80	133	118	103
		nao+	105	110	112	82	90	98
The Neman-Stolbtsy	3070	nao-	94	82	89	139	116	105
		nao+	104	111	106	78	91	98
The Kotra-Sahkombinat	2000	nao-	89	79	82	131	112	100
		nao+	107	112	111	83	93	100
The Viliya-Mihalishki	10300	nao-	93	85	83	133	117	105
		nao+	104	109	111	82	91	98

## Monthly streamflow and difference under NAO>2 and NAO<-2, mm



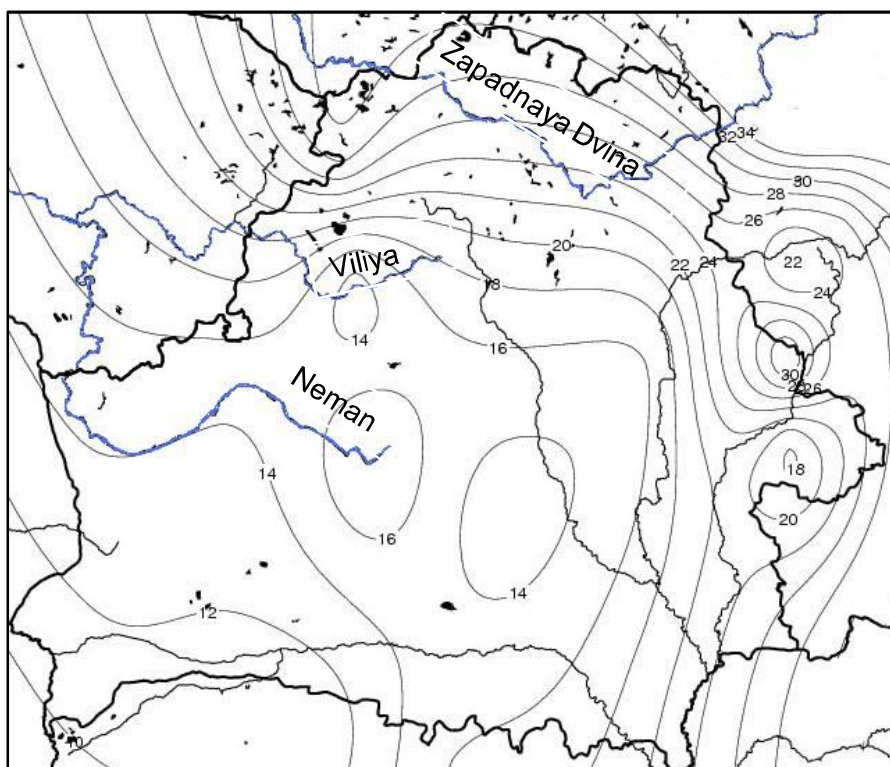
The intraannual distribution of runoff in the years under opposite stages of North Atlantic Oscillation



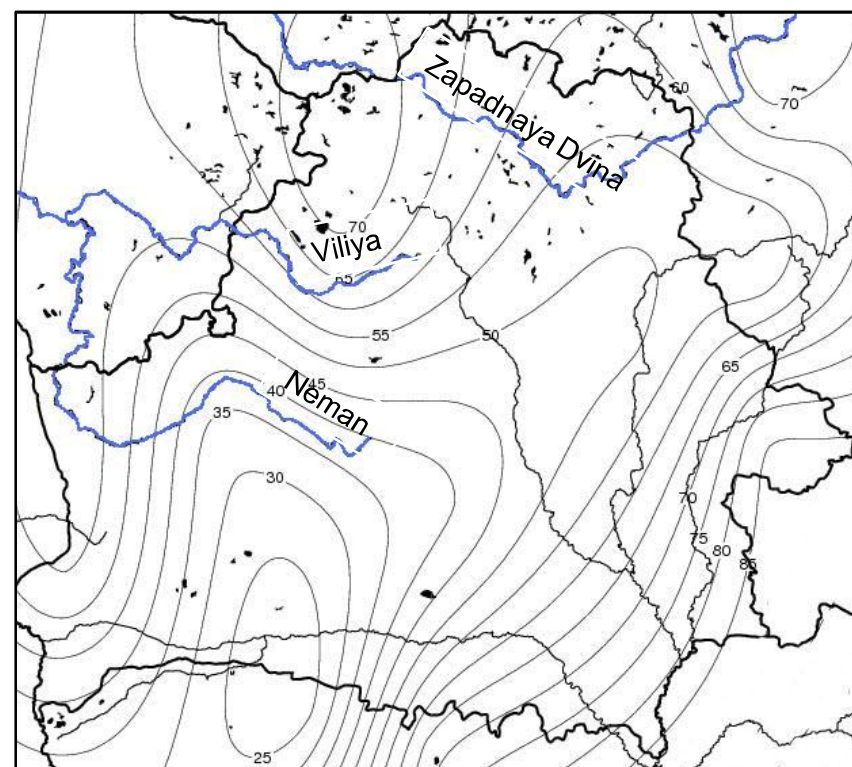
The differences between intraannual distribution of runoff in the years under opposite stages of North Atlantic Oscillation

## Distribution of maximal discharges under different atmospheric processes (opposite stage of NAO)

NAO+



NAO-



## Years with floods

River - Station		Floods characteristic		
		Catastrophical P<1-1%	Outstanding P1-2%	Large P3-10%
1	Zapadnaya - Dvina - Surazh		1929,1931,1956	1878,1895,1901,1908, 1915,1917, 1958,1962
2	Zapadnaya Dvina - Vitebsk	1931	1878,1929, 1956	1958,1962
3	Zapadnaya Dvina - Ulla	1931	1941,1951, 1956	
4	Zapadnaya Dvina - Polotsk	1931	1951,1956	1941,1953,1958,1962
5	Zapadnaya Dvina - Verhnedvinsk	1931	1956	1958,1962
6	Obol - Obol		1956	1938,1951,1953,1955, 1958,1962, 1965
7	Disna - Sharkovchina	1931	1951	1953,1956,1958
8	Neman - Stolbtsy		1958	1931,1932,1940,1947, 1956
9	Neman - Mosty	1958		1931
10	Neman - Grodno	1958	1931	
11	Shchara - Slonim	1958	1886	1888,1889,1895,1931, 1941,1970, 1979
12	Muhavets - Brest		1974,1979	1967,1970

## Frequencies of spring floods in Belarus part of the Baltic Sea Basin related to the atmospheric circulation

Periods with types of atmospheric circulation	1900-1928	1929-1939	1940-1948	1949-1970	1971-1995	1996-2009
Peculiarities of meteorological conditions in winter	Cold winters average precipitation and snow	Cold winters and large snow cover before floods	Coldest winter s during last 110 years	Cold winter and huge snow cover before floods	Cold winters and enough snow cover	Warm winters and small snow cover before floods
Years with floods	1908	1929, 1931, 1932	1940, 1941, 1947	1956, 1951, 1953, 1958, 1962, 1963, 1965, 1968	1970, 1974, 1975, 1979, 1981	
NAO <sub>djfm</sub> Indexes	1,44	-1.03, -0.16, -0.50	-2,86, -2,31, -2,71	-1,26, 0,18, -1,73, -1,02, -2,38, -3,60 -2,88, -1,04	-1,89, 1,23, 1,63, -2,25, 2,05	
Frequencies of floods	1 flood per 28 years	3 floods per 10 years	3 floods per 9 years	9 floods per 21 years	5 floods per 24 years	

Thank you for attention!