

EXTREME PRECIPITATION
MONTHS
IN BULGARIA AND
CIRCULATION PROCESSES

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Outline

- Introduction
 - actuality of the problem
 - objectives of the research
- Data and Methods
- Results:
 - Spatial and temporal variability in extreme precipitation months in Bulgaria during the period 1931-2007
 - Correlation between number of extremely dry and extremely wet months and atmospheric circulation indices
 - Spatial distribution of occurrence of extremely precipitation months
- Conclusion

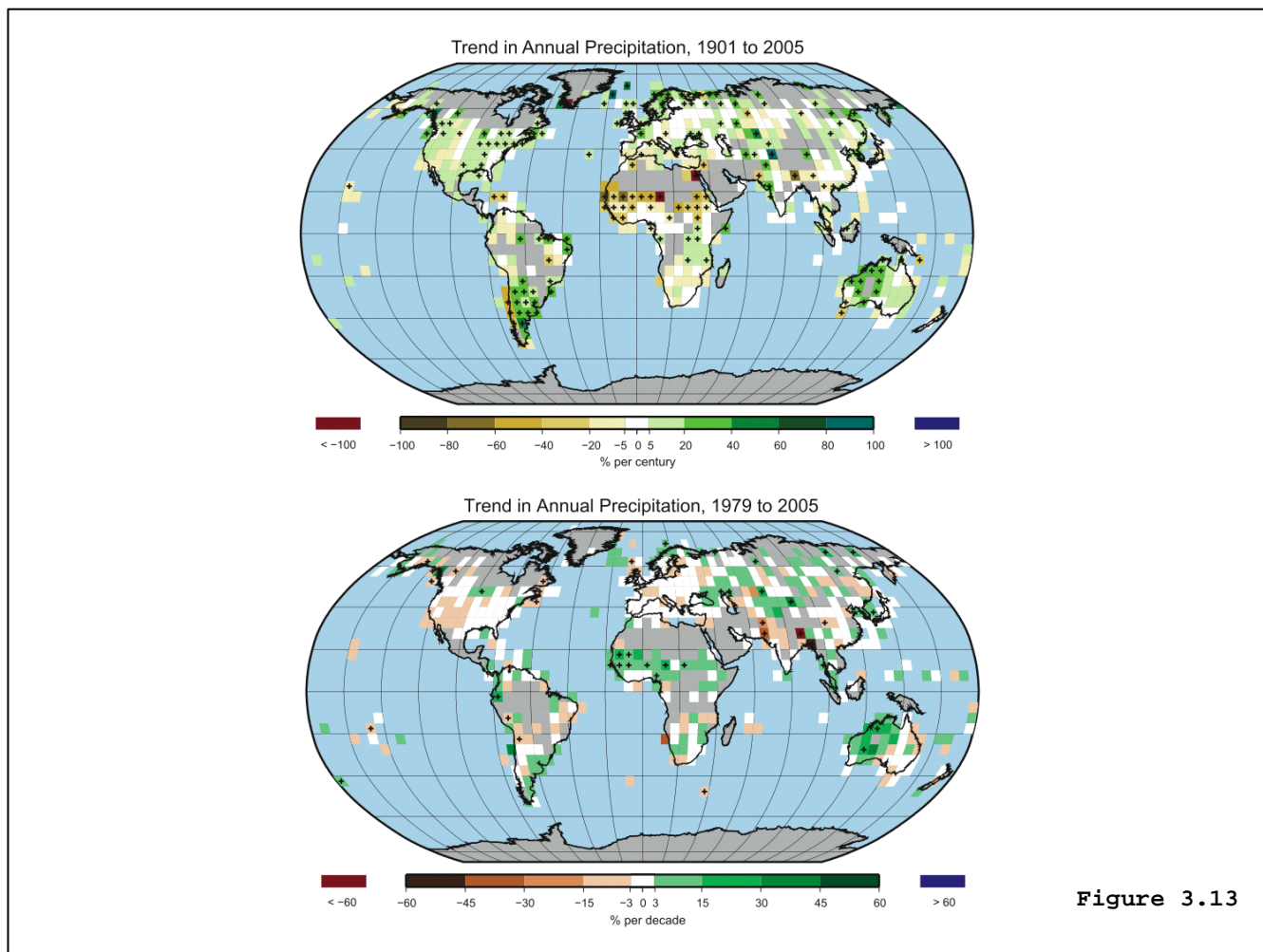
Introduction

Climate change is one of the most serious global threats for the environment. The main questions in many research works are:

- Does such a global threat as irreversible climate change really exist?
- Is anthropogenic activity the most important cause for climate change?
- What is the impact of natural processes for climate changes?

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Trend of annual land precipitation amounts for 1901 to 2005 (top, % per century) and 1979 to 2005 (bottom, % per decade)



IPCC, 2007: WG I, "The Physical Science Basis"

Figure 3.13

Challenges of climate change:

- ✓ Quantity of rainfall – increases and decreases in average up to 20%;
- ✓ Extremes – more intense floods and longer droughts;
- ✓ Frequency – extreme events will occur more often;

- The aims:
 - to give detailed information about temporal and spatial changes in extreme precipitation months
 - to show to what extent extreme precipitation months over Bulgaria are related with variations in large-scale circulation
- The tasks are:
 - study of extremely dry and wet months – spatial and temporal changes
 - investigation of relationship between precipitation variability and atmospheric circulation patterns.

Data

- Monthly data for precipitation from 19 meteorological stations

The main investigated period is 1931-2005

- NAO indices;
- East Atlantic pattern;
- Mediterranean Oscillation indices (MOI)

(Climate Prediction Center,

<http://www.cpc.noaa.gov/data/teledoc/telecontents.shtml>)

Methods

Selection of months with extreme precipitation total

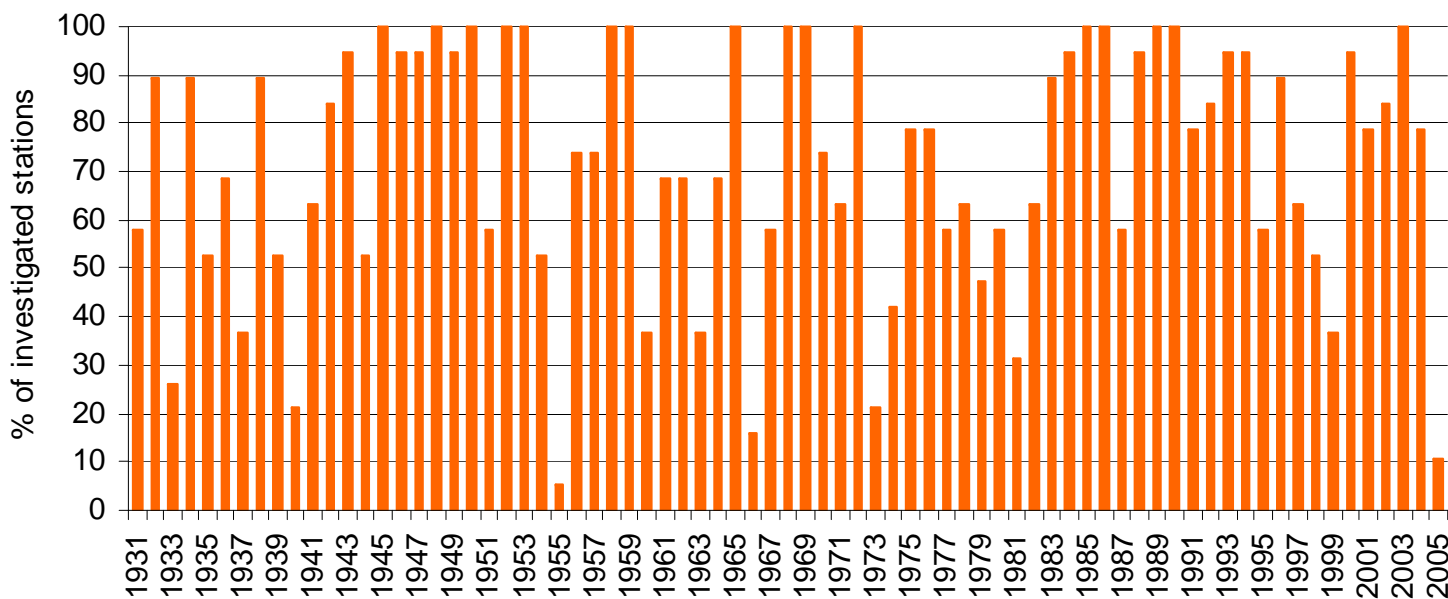
- ❑ Extreme wet months are defined as a months whose monthly precipitation total is higher than 90% percentiles of gamma distribution in the reference period 1961-1990. As extreme dry month we consider the month with precipitation total lower than 10% of gamma distribution.

- ❑ Cluster analysis – *for analyzing spatial changes in occurrence of extreme precipitation*
 - Complete linkage; Euclidean distances

- ❑ Correlation analysis

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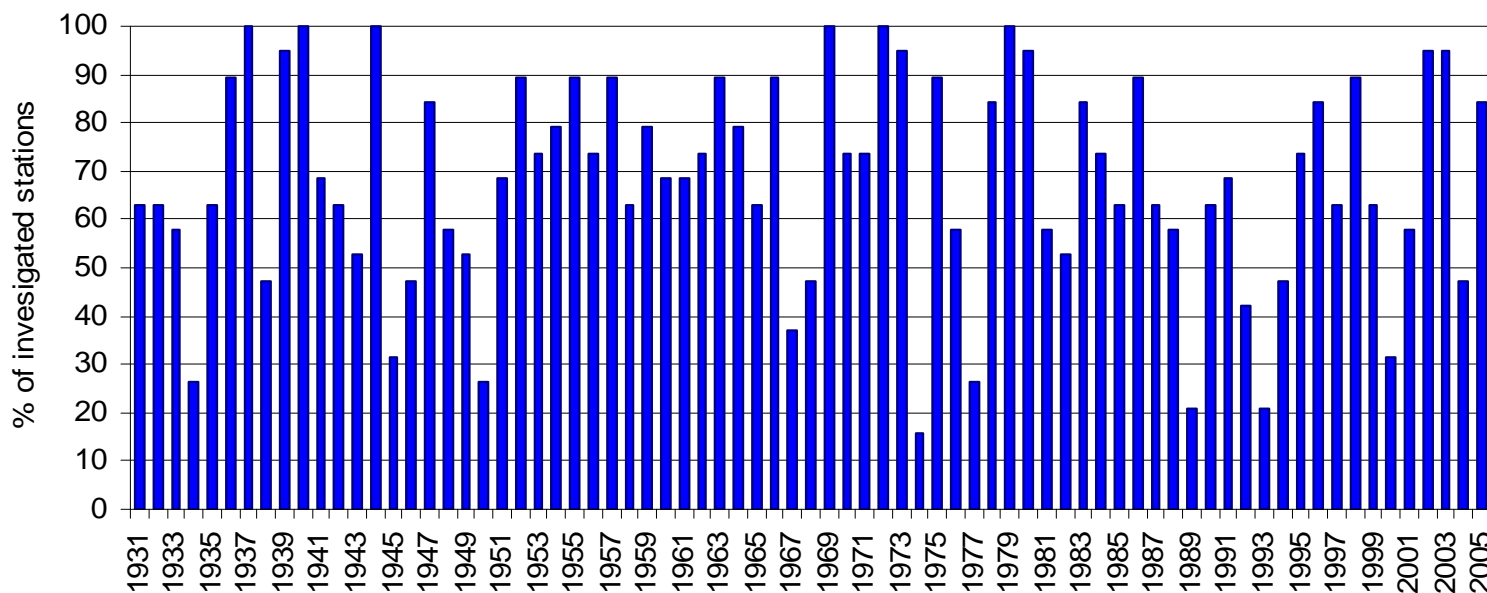
Results: Spatial and temporal variability in extreme precipitation months in Bulgaria during the period 1931-2005



**NUMBER OF STATIONS WITH AT LEAST ONE EXTREMELY DRY MONTH
(IN % OF ALL INVESTIGATED STATIONS)**

EXTREME PRECIPITATION MONTHS IN BULGARIA AND CIRCULATION PROCESSES

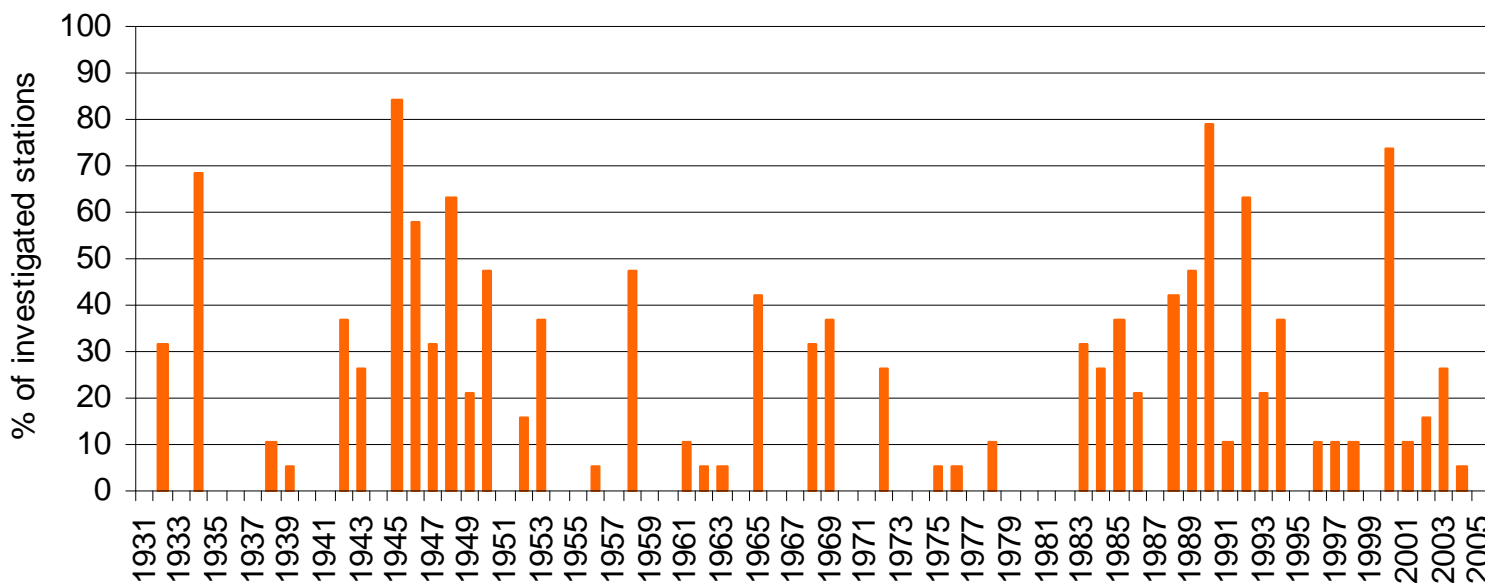
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**NUMBER OF STATIONS WITH AT LEAST ONE EXTREMELY WET MONTH
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EXTREME PRECIPITATION MONTHS IN BULGARIA AND CIRCULATION PROCESSES

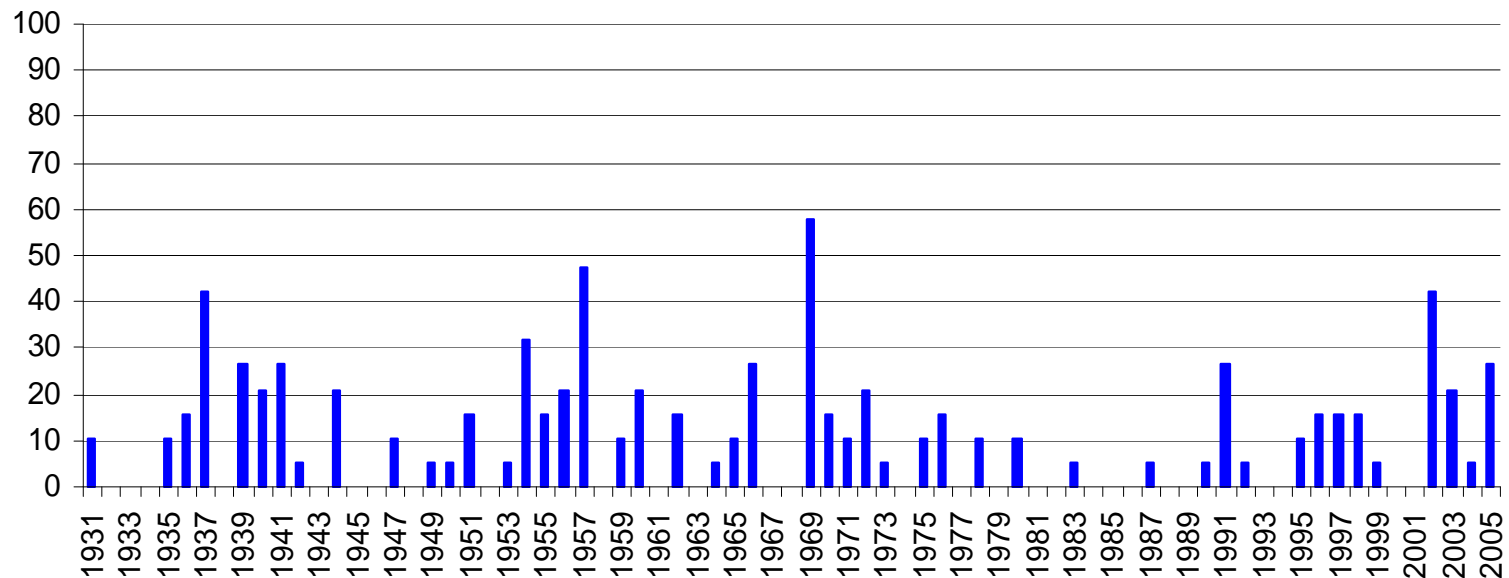
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**NUMBER OF STATIONS WITH THREE OR MORE EXTREMELY DRY MONTHS
(IN % OF ALL INVESTIGATED STATIONS)**

EXTREME PRECIPITATION MONTHS IN BULGARIA AND CIRCULATION PROCESSES

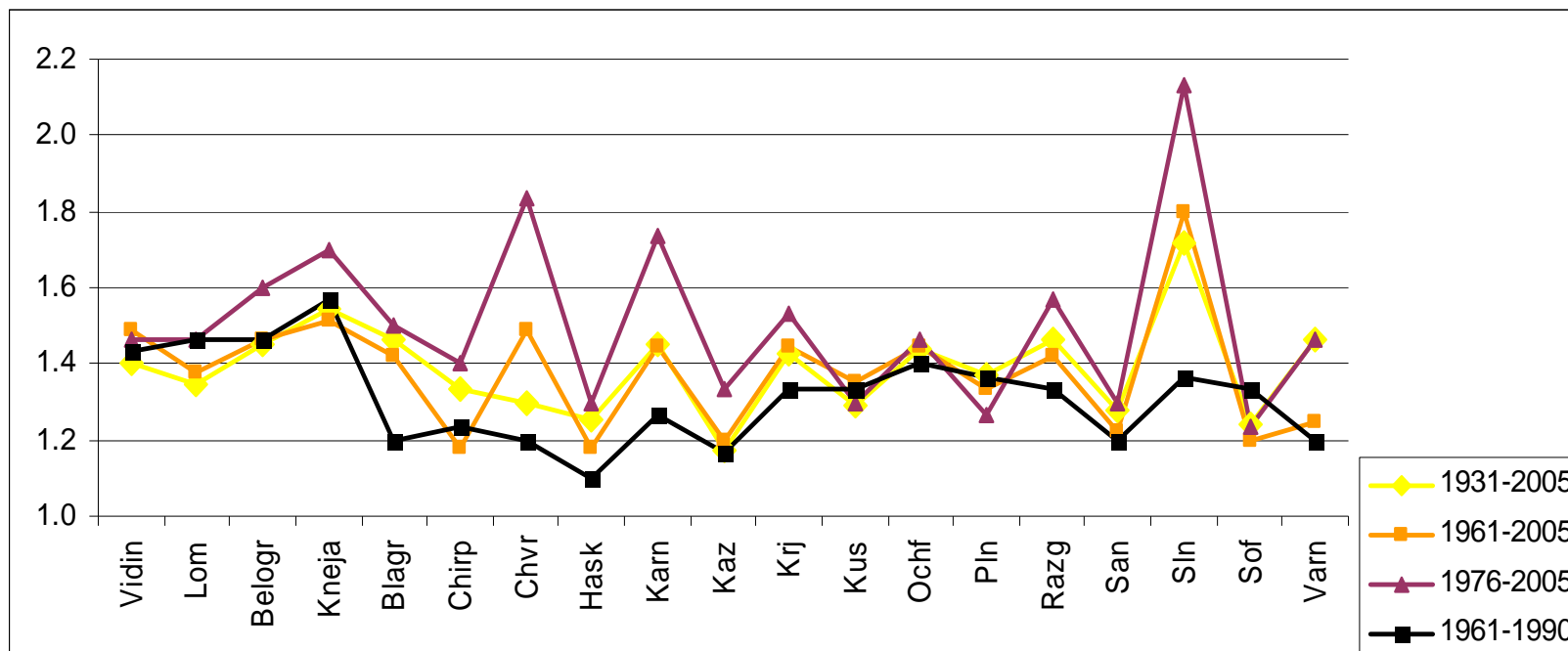
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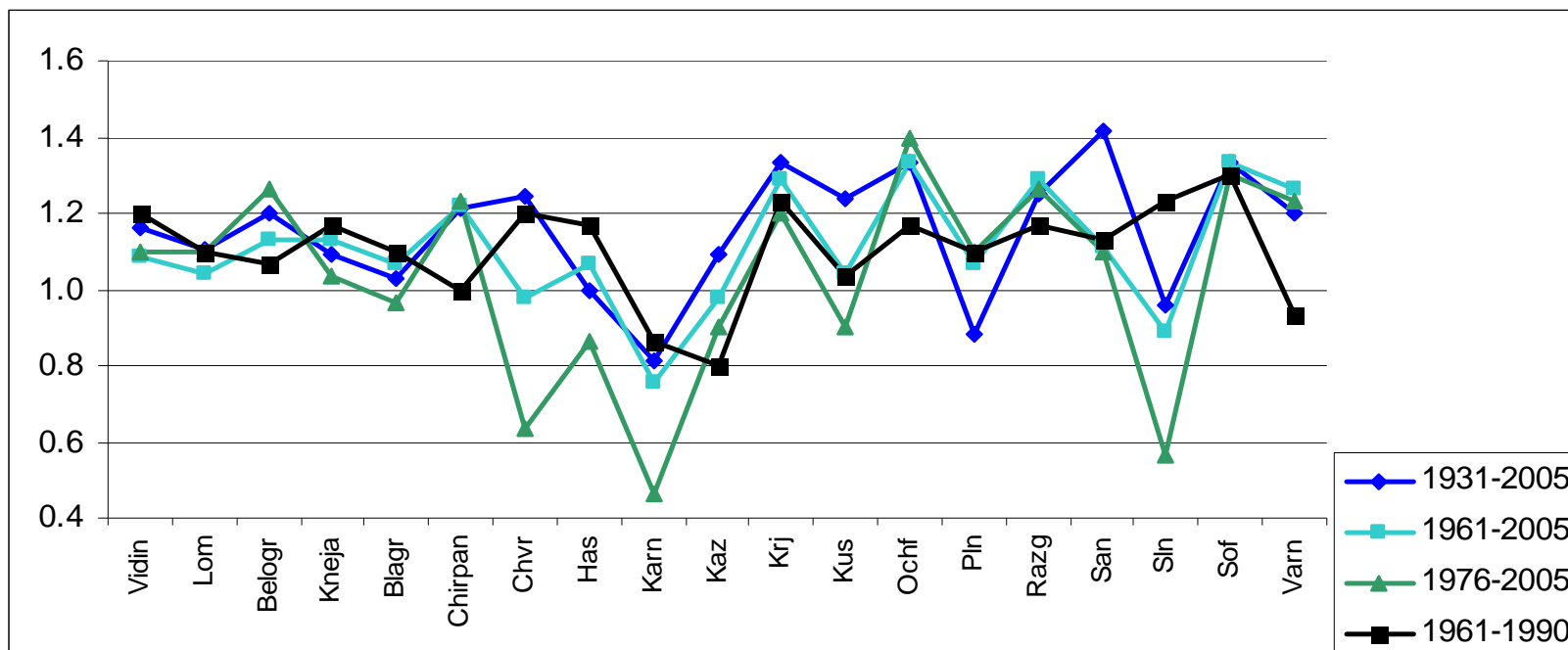
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MEAN NUMBER OF EXTREMELY DRY MONTHS FOR DIFFERENT PERIODS

EXTREME PRECIPITATION MONTHS IN BULGARIA AND CIRCULATION PROCESSES

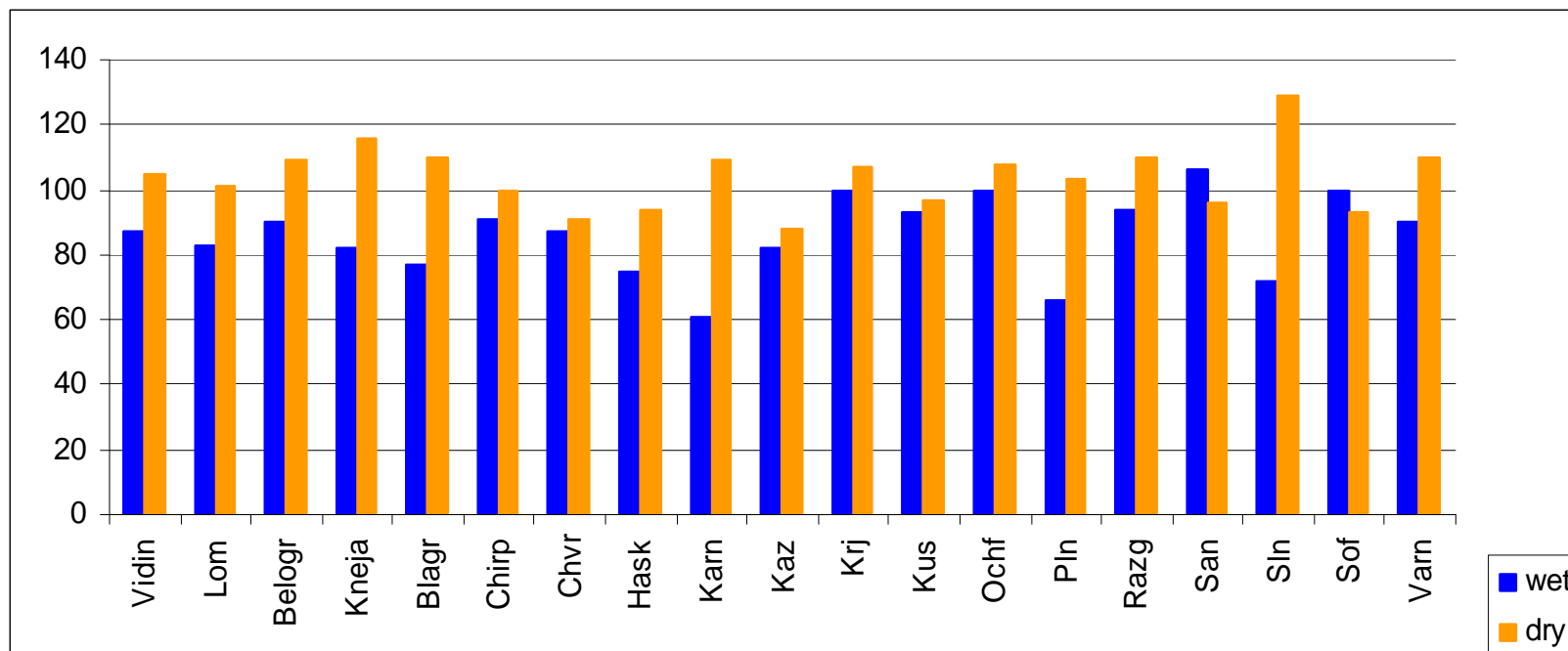
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MEAN NUMBER OF EXTREMELY WET MONTHS FOR DIFFERENT PERIODS

EXTREME PRECIPITATION MONTHS IN BULGARIA AND CIRCULATION PROCESSES

Results: Spatial and temporal variability in extreme precipitation months in Bulgaria during the period 1931-2005



NUMBER OF EXTREME PRECIPITATION MONTHS FOR THE PERIOD 1931-2005

EXTREME PRECIPITATION MONTHS IN BULGARIA AND CIRCULATION PROCESSES

Results: Correlation between number of extremely dry and extremely wet month and atmospheric circulation indices

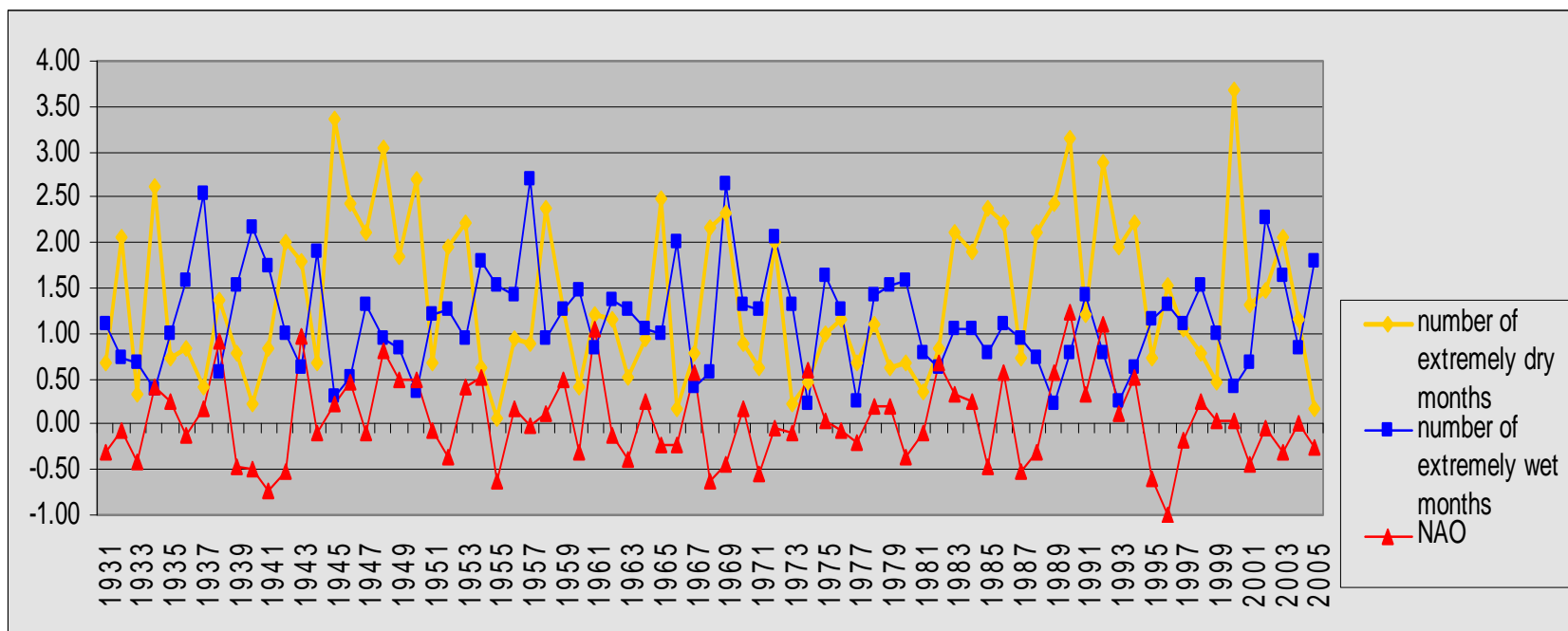
Correlation coefficients between averaged data for number of extreme precipitation months and NAOI

	1931-2005	1961-2005	1976-2005	1961-1990
Dry months	0.35*	0.24	0.43*	0.18
Wet months	-0.35*	-0.31*	-0.23	-0.34

* Marked values are statistically significant at $p < 0.05$

EXTREME PRECIPITATION MONTHS IN BULGARIA AND CIRCULATION PROCESSES

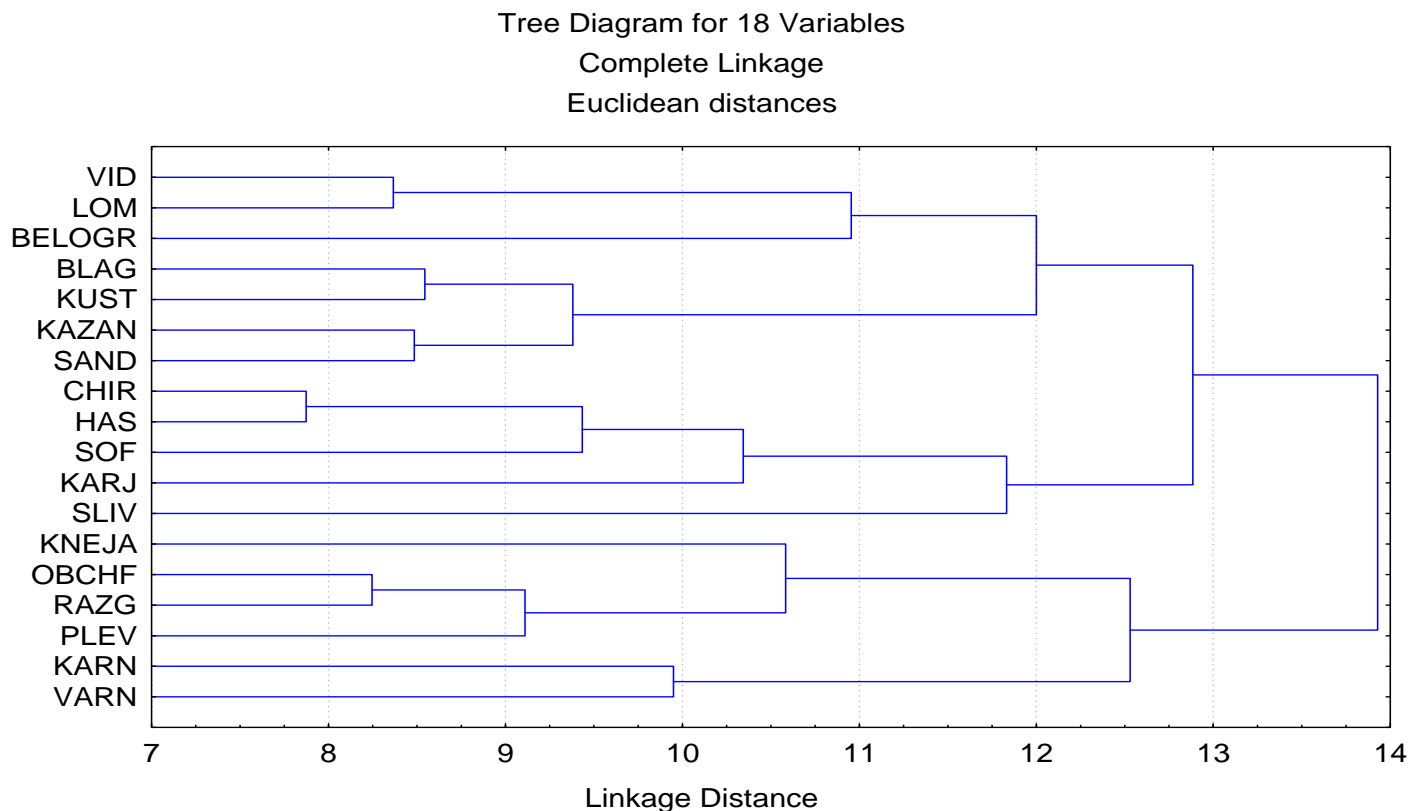
Results: Correlation between number of extremely dry and extremely wet month and atmospheric circulation indices



ANNUAL MEAN NUMBER OF EXTREME PRECIPITATION MONTHS AND NAOI

EXTREME PRECIPITATION MONTHS IN BULGARIA AND CIRCULATION PROCESSES

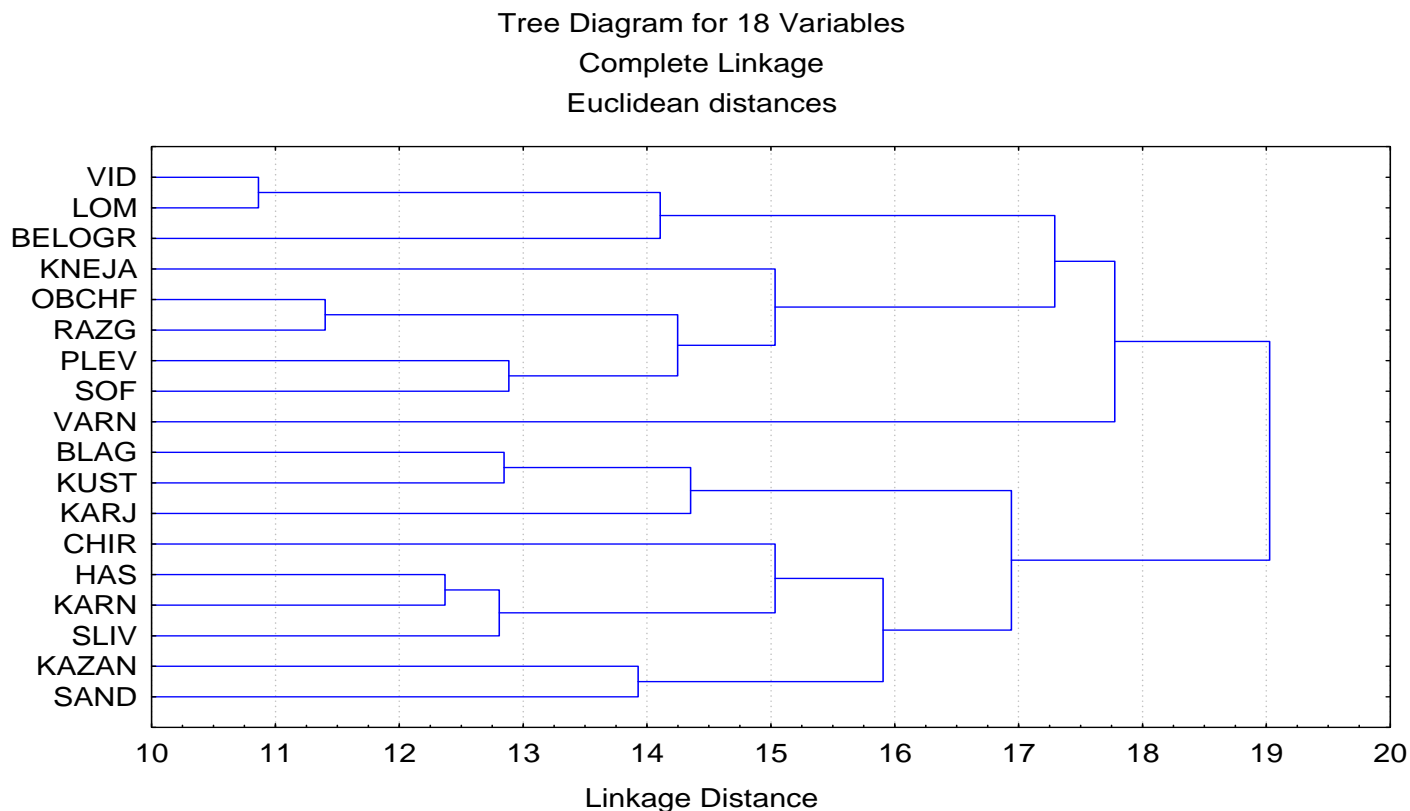
Results: Spatial distribution of occurrence of extremely precipitation months



CLUSTER ANALYSIS OF THE OCCURRENCE OF EXTREMELY DRY MONTHS
IN BULGARIA FOR THE PERIOD 1931-2005

EXTREME PRECIPITATION MONTHS IN BULGARIA AND CIRCULATION PROCESSES

Results: Spatial distribution of occurrence of extremely precipitation months



CLUSTER ANALYSIS OF THE OCCURRENCE OF EXTREME PRECIPITATION MONTHS IN BULGARIA FOR THE PERIOD 1931-2005

Conclusion

- ✓ During the period 1931-2005 extreme dry months have been observed more often than extreme wet months;
- ✓ In the recent years (1976-2005) the number of extreme dry months increase in comparison to the period 1961-1990;
- ✓ There are three clearly determined extreme dry periods in Bulgaria: 1942-1950; 1983-1994 and 2000- 2004;
- ✓ The good synchrony is established between the curves of NAOI and number of days wit extreme precipitation months and the correlation is better expressed for dry months during the period 1976-2005;
- ✓ By means of cluster analysis is established that the main factors for grouping meteorological stations in relation to occurrence of extreme precipitation months are geographical situation, relief and distance among the stations.

THANK YOU

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