

MILLENNIAL ANALYSIS OF THE RECONSTRUCTED CLIMATE IN THE CARPATHIAN BASIN ON THE BASE OF CODED WRITTEN SOURCES



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ABSTRACT

Written sources can be used to evaluate the occurrence and duration of past climate events when there is lack or only scarce instrumental time series are available. This is the case before approximately the 1800s when regular and reliable instrumental meteorological observations started. Therefore, in order to analyze the climate during the earlier centuries, historical documentary data is one of the main climate information sources.

For the Carpathian Basin (located in Central/Eastern Europe) Antal Réthly (1879-1975) – the Hungarian meteorologist, professor and director of the former National Meteorological and Earth Magnetism Institute – collected historical documents containing meteorology-related information into the 2500-page-long book series titled 'Meteorological Events and Natural Disasters in the Carpathian Basin'.

In order to facilitate the detailed analysis of this documentary collection, a special code system using hierarchical subclasses has been defined (Bartholy et al., 2004). Three main categories of climate information have been distinguished: temperature, precipitation, and wind related events, containing about 3800, 10000, and 1300 information items, and classified into 14, 32, and 15 groups, respectively. Among the temperature related documents, reports on cold conditions dominate (65%), while in case of wind most of the archive records mention the strength. Precipitation information takes 66% of the total collection and the most often reported event is the 'rain', which can be explained by the source types (many estate records and account rolls) and by the agricultural importance of water. Other frequent classes of precipitation are 'thundersstorms', 'hail', 'flood', and 'drought'. Besides the event classification, the coded database contains full geographical information about the location of the meteorological events (settlement name, geographical longitude and latitude coordinates, and subregion identification).

Spatial and temporal distribution of precipitation, temperature, and wind related climate events have been investigated using both settlement and subregional scales. Decadal, annual, and seasonal reconstructed time series have been analyzed for the Carpathian Basin region.

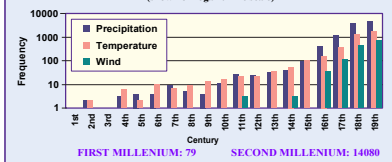
GEOGRAPHICAL LOCATION OF THE TOTAL COVERAGE OF THE RÉTHLY COLLECTION (1962, 1970, 1998, 1999)



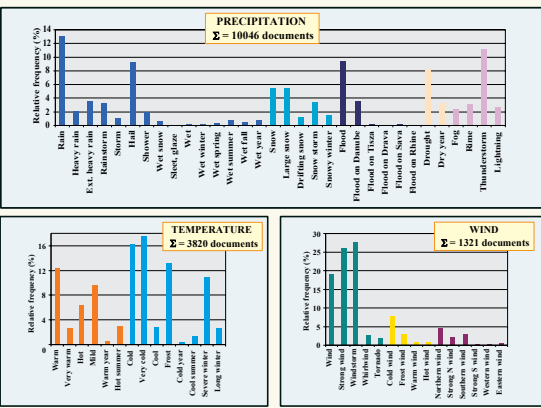
EXAMPLE FOR THE DERIVED CODE TABLE CONTAINING HISTORICAL DOCUMENTARY SOURCES

Main class	Starting year		Ending year		Settlement	Geographical latitude (°N)	Geographical longitude (°E)	Subregion number	Event	Note	Consequences
	Starting month	Ending month	Starting month	Ending month							
2	1267	0	1268	0	319	47.5	19.1	22	61	0	0
2	1346	0	0	0	15	46.2	21.3	24	67	0	0
3	1526	11	0	0	224	49.0	20.7	44	82	0	0
2	1561	0	0	0	361	47.7	16.6	12	67	0	17
1	1684	2	0	0	409	47.2	20.2	23	21	0	55
2	1718	6	0	0	56	47.5	19.0	15	66	0	70
2	1812	13	0	0	77	47.5	21.6	25	45	2	0
1	1821	2	1821	3	56	47.5	19.0	15	20	0	0
2	1833	5	0	0	197	46.7	23.6	33	40	2	0
1	1866	5	0	0	454	47.8	19.1	21	23	1	1423

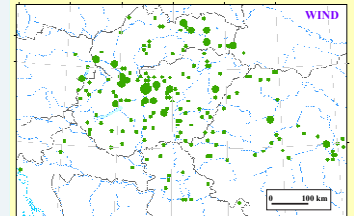
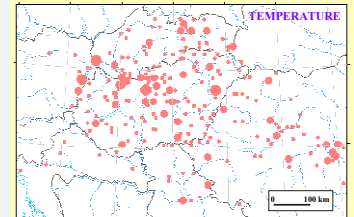
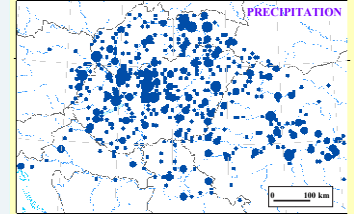
THE NUMBER OF COLLECTED DOCUMENTS IS INCREASING (shown on logarithmic scale)



FREQUENCY DISTRIBUTION OF CLIMATE RELATED HISTORICAL DOCUMENTS WITHIN THE MAIN CLASSES (TEMPERATURE, PRECIPITATION, WIND)



GEOGRAPHICAL DISTRIBUTION OF TEMPERATURE, PRECIPITATION, AND WIND-RELATED DOCUMENTARY SOURCES IN THE RÉTHLY COLLECTION

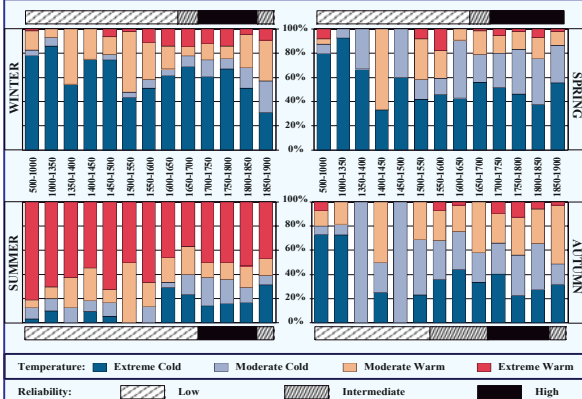


The total number of documents containing climate-related information are indicated by the size of the circles using the following three categories:

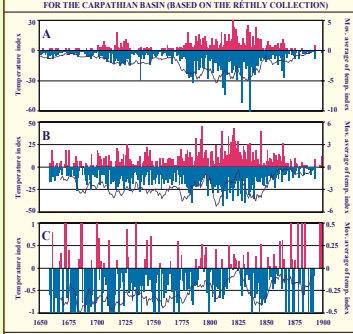
- > 100
- 10 - 100
- 1 - 10

Seasonal comparison of 50-year relative distribution of extreme and moderate temperature conditions in the Carpathian Basin based on annual scale data.

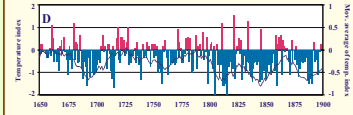
Reliability index represents the number of total data in a given 50 year period



ANNUAL RECONSTRUCTED TEMPERATURE TIME SERIES FOR THE CARPATHIAN BASIN (BASED ON THE RÉTHLY COLLECTION)



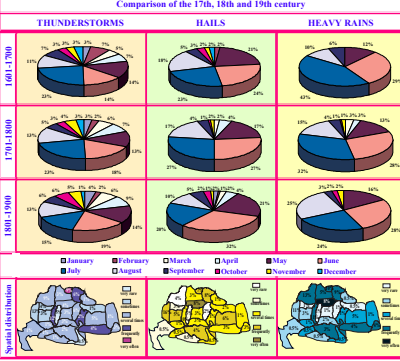
ANNUAL RECONSTRUCTED TEMPERATURE TIME SERIES FOR SWITZERLAND (PFISTER, 1993)



Historical annual temperature indices and the 20-year moving averages for 1650-1900.

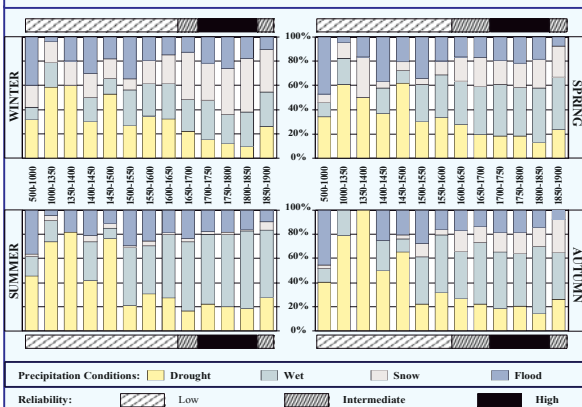
- A: Frequency values of documents from the Réthly collection reporting warm and cold temperature events from the Carpathian Basin.
- B: Adjusted temperature index using intensity values for the recorded warm/cold events.
- C: Normalised temperature index taking into account the total annual number of temperature related historical data.
- D: Graduated temperature index for Switzerland (Pfister, 1993).

ANNUAL AND SPATIAL DISTRIBUTION OF EXTREME PRECIPITATION EVENTS Comparison of the 17th, 18th and 19th century



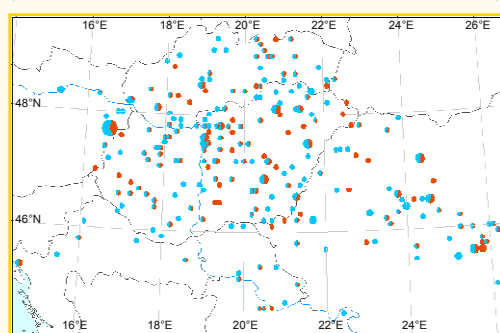
Seasonal comparison of 50-year relative distribution of different precipitation conditions in the Carpathian Basin based on annual scale data.

Reliability index represents the number of total data in a given 50 year period



Spatial distribution of temperature related documentary information based on the Réthly collection

(Circles indicate both the number of total records and the ratio of the cold and warm conditions)



Number of temperature related historical records: >300, 200-300, 100-200, <100. Warm conditions (orange), Cold conditions (blue). Lambert Conic Projection, Mapsource: ESRI.

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