

## **Extreme events analysis based on documentary evidence in Romania. Study case: floods from 1865**

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### **1 Introduction**

The ongoing and projected climate changes affect present-day biodiversity and the services it offers, as well as the functionality of our society and its capacity to mitigate and adapt to these changes (IPCC, 2018). It is expected that the regions most impacted by climatic changes are those where biomes and land-use have experienced different socio-economic and political regimes, for example, Southern and Central Eastern Europe. The link between climate and land is causal (e.g., the land influence the fluxes and energy, if there is any change among one of these, the fluxes will be altered (Dale, 1997)). In these regions, the interlinked changes in climate and biomes are superimposed on land use changes, thus the entire system will be affected. Instrumental data and climate projection derived from numerical simulation indicate significant variability and trends over the past decade to the millennia (IPCC, 2018). Further, numerical simulations of the CMIP5 (Coupled Model Intercomparison Project, Phase 5) for scenarios RCP2.6 and RCP8.5 predict that for the period between 2051 – 2100 there will be an increase in frequency and amplitude of dry spell and heavy rainfall (Jacob et al., 2014) and an decrease in the cold spells, especially over the southern and eastern part of Europe. The frequency of these extreme events is expected to increase in a warming world, which in turn will have important consequences on all environmental components (IPCC, 2014), concurrent with their impact on the human society (Bădăluță, 2019). For example, it is well documented that over the recent past, the Carpathian region have already experienced prolonged droughts (Ioniță et al., 2016), increased frequency of flash floods (Chendes et al., 2015) and harsh winters (Ionita et al., 2018; Bădăluță et al., 2019a). Among proxy data, one of the best candidate for reconstructing past variability of the climate are the documentary evidences. The aim of this study is the analysis of the main documentary sources, including the advantages and disadvantages, as well as the potential of their use for paleoclimatic and paleoenvironmental studies. Moreover, the main methods and a study case obtained from this type of historical investigations (historical climatology) for Romania will be presented.

### **2 Documentary evidence – data sources of extreme events**

Documentary evidence is an important source of information from a climatic, environmental, social, economic and political point of view. Also, these are the only archives that present the highest resolution (of the order of days, hours) of extreme events, which can have individual or institutional origin. The historical climate data are concentrated in particular on climate anomalies, natural disasters, synoptic interpretations, economic and social vulnerability or

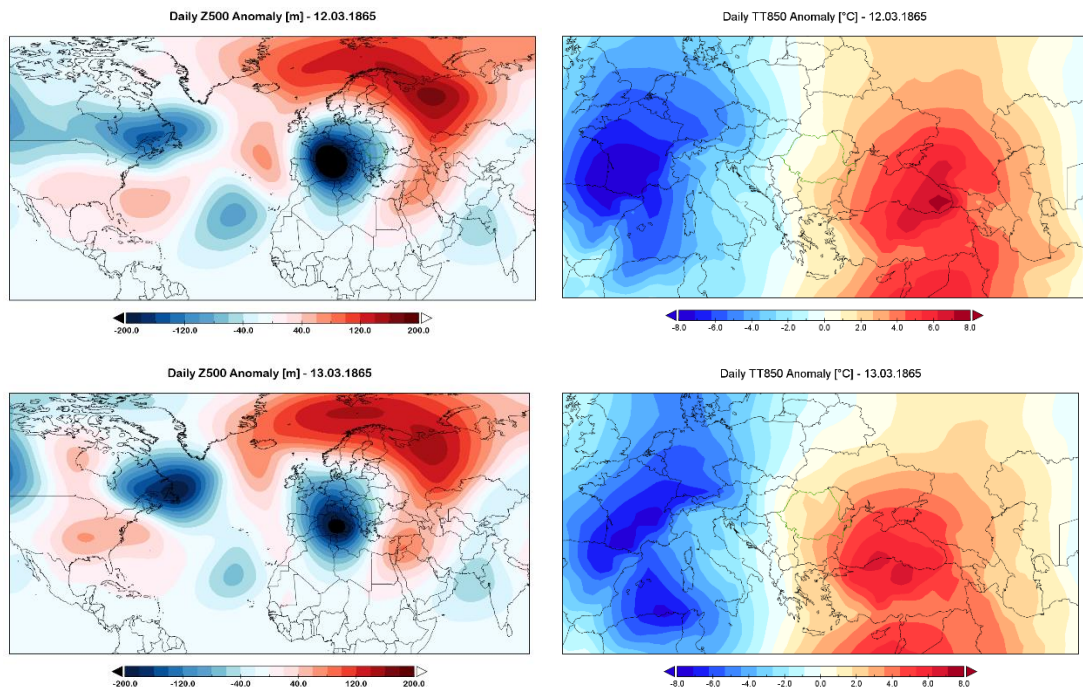
the outbreak of contagious diseases, these being exposed in the form of social images and representations of the past weather and climate (Brázdil, et al., 2005). The main sources of documentary evidences from Romania are: i) manuscript, annals, chronicles (e.g. *Călători străini în Țările Române*, *Letopisețul Moldovei*, *Analele Brasovului*), ii) Correspondence (letters), iii) old religious books; (e.g. *Apostol*, *Ceaslov*), iv) Official economic records, v) Newspapers (e.g. *România Liberă*, *Gazeta de Transilvania*, *Albina*), vi) Weather diaries (e.g. the diary of J.C. Klapa from Timișoara), vii) Epigraphic sources and/or viii) old photos.

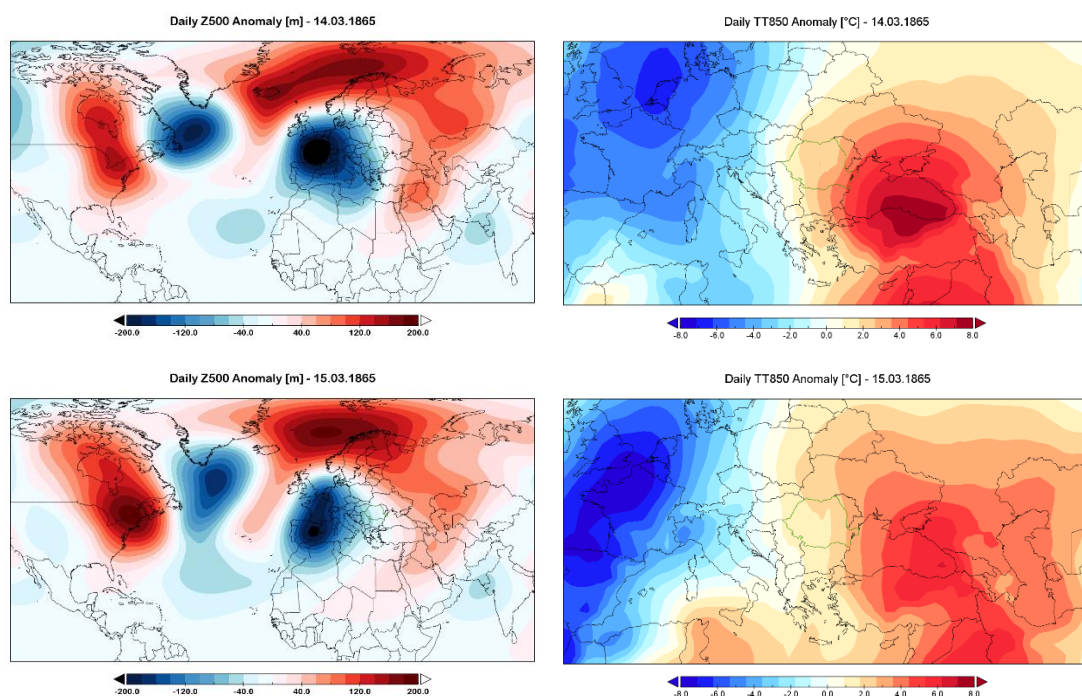
### 3 The March 1865 flood event

Floods are one of the most common extreme events on Earth, with negative effects on society and the economy. An eloquent example is the flood of March 1865, which is described by historical documents as the most disastrous flood of the nineteenth century, which affected all of Romania and especially the capital. Historical sources state that in Bucharest, the Dambovită River flooded the areas of Calea Rahovei, Radu Voda, Manuc's Inn (current locations). Moreover, in some areas the water would have reached the level of three meters and would have reached the hill where the National Theater was then (now the Novotel Hotel).

#### 3.1 The cause - large-scale atmospheric circulation

The flood event in March 1865 was triggered by the sudden melting of the snow in the vicinity of the Dambovită River, as a consequence of a very particular large-scale atmospheric circulation pattern (Fig. 1). Between 12 until 15th of March 1865, extreme precipitation events, which were triggered by a cyclonic circulation centered over the Mediterranean Sea and South Europe corroborated with the rapid melting of the snow, led to heavy flooding of Bucharest City. The rapid snowmelt was due to the advection of humid and warm air from the Mediterranean, which led to an increase in temperature, especially in southeastern part of Romania (Figure 1 – right column).

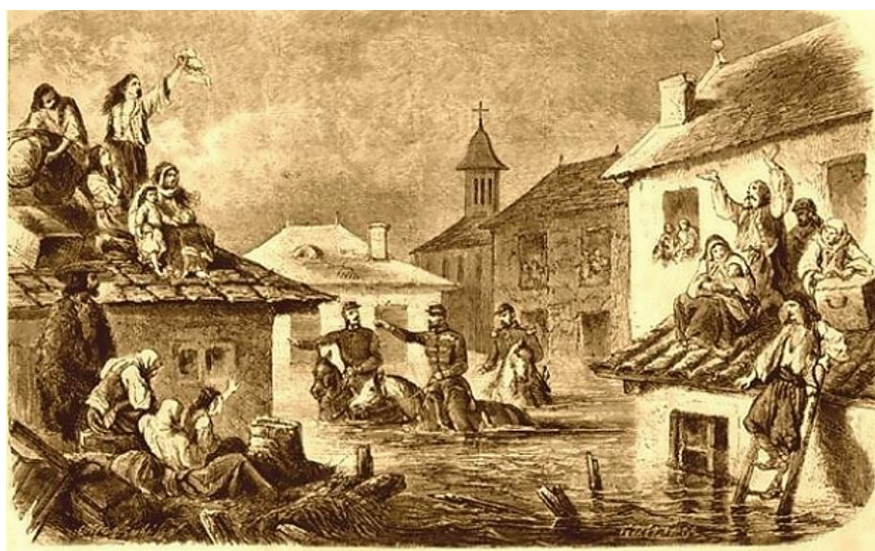




**Figure 1** Daily geopotential height at 500 hPa (Z500) and daily temperature at 850 hPa (TT850) for 12 -15 March 1865 June. Units: TT850 (°C) and Z500 (m).

### 3.2 Flood effects

The extreme flooding of Dambovită river had a high impact on social and economic sectors. The number of victims was very high and the traffic was disrupted. In addition, the supply of drinking water and food was difficult. The disaster of Bucharest was described in "The Illustrated London News" newspaper of London, England. Moreover, the flood is captured in an engraving with Prince Cuza (Fig. 2).



**Figure 2** Prince Cuza in the time of the 1865 flood event – engraving.

After this event, the government was accused of lack of measures to help the population and incompetence. Subsequently, the law was voted for the abolition of mills and dams on the water of Dîmbovița and the damming of the river.

## 4 Conclusion

Historical records represent the bridge between instrumental and palaeoclimate data, as they can provide a mechanism for extreme events (Wilhelm et al., 2018). The best advantage of these data is the reconstruction of the severity and the magnitude of extreme events, and therefore can help to improve climate models and prevent the risks associated with them.

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