Heavy rainfall events in Portugal over the 1783-1787 period based on instrumental and documentary sources

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Outline

1. Motivation and objectives
2. Data, sources and methods
3. Results
   - Interannual variability of precipitation during the 80’s of the 18th century
   - Evidences of extreme rainfall events

Conclusions

Motivation

• contribute for the understanding of the climatic variability of the eighteenth century (firstly, with a focus on the 80’s)
• gathering new evidences of climatic and meteorological conditions from documentary sources

Objectives

• To summarize the main aspects of the precipitation anomalies of the cycle of rainy years initiated in 1783 until the late 80’s;
• To find additional documentary evidences related with the impacts of these excessive rainy conditions
2. Data, sources and methods

80’s of the 18th century:
Two networks organised by European scientific societies...
and... a large number of private observers were recording daily meteorological observations

Reconstruction of daily weather maps based on quantitative instrumental data

J. Kington (1988) – The weather of Europe in the 1780’s over Europe

Data: observations by J. Assunção Velho, 1783-1787 in Mafra

- Velho provided the most valuable metadata, such as detailed references about station site, instruments and measurements methods
- Velho used calibrated instruments (produced in London) and positioned outside as it was advised in the end of 18th century.
- Velho made three daily observations on air pressure, temperature and precipitation, as well as related to the "state of the sky" (nebulosity) and wind direction and speed (inferred from cloud and smoke movement)

Example:
Table with October 1784 Observations

- Temperature: degrees Farenheit;
- Precipitation records are in divisions of the French king foot (French System): inches (27.069646 mm)
  lines (0.2255803 mm) and tenths of lines (0.02255803 mm)

(Taborda et al 2004)

Data: descriptions on extreme weather conditions in the periodic (weekly) "Gazeta de Lisboa"

- The periodic with more continuous publication in the 18th century;
- Numbers published in the 80’s, contain some information related with meteorological conditions, thus contemporary of the Pretorius, Schulze and Velho observations.

Mafra Royal Monastery (in 1853, lithograph)

Example: table with October 1784 Observations

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(Taborda et al 2004)
“on the afternoon of the 26th May occurred in this city an horrible storm (...) followed by an impetuous hurricane together a copious hail...”

“the long lasting rainfall that has been occurring and that, principally in the 2nd January caused extraordinary floods in this city...”

**Results**

**Interannual rainfall variability** (annual scale)

A cycle of rainy years from 1783 until the late 80’s

(Winds and precipitation in Mafra) 2/3 of the precipitation in Mafra was related with SW, S and SE winds

**Results**

**Interannual rainfall variability** (daily scale)

The top seven heavy rainfall events at daily scale were winter episodes (not exceeding 60 mm)

<table>
<thead>
<tr>
<th>Year</th>
<th>Month</th>
<th>Total (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1783</td>
<td>December</td>
<td>27</td>
</tr>
<tr>
<td>1783</td>
<td>January</td>
<td>29</td>
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<td>December</td>
<td>24</td>
</tr>
<tr>
<td>1785</td>
<td>September</td>
<td>23</td>
</tr>
<tr>
<td>1785</td>
<td>June</td>
<td>27</td>
</tr>
</tbody>
</table>

**Methods**

- Data conversion into current units
- Descriptive statistics of the daily climatic data set provided by J. Assunção Velho (1783-1787)
- Analysis of selected daily weather maps from the Kington catalogue
- Deductive (interpretative) analysis from descriptions from the periodic publication “Gazeta de Lisboa” (1783-1787) on meteorological and/or climatic evidences
• Extraordinary persistence of rainfall in March and April “extraordinária continuação das chuvas”

- Late December / beginning January: heavy rainfall period (270 mm in 16 days, Mafra)

- Three storms responsible for shipwrecks in Lisbon region are mentioned in the descriptions coinciding with heavy rainfall days in Mafra

- 2nd January: Severe floods in Lisbon; Very rainy Spring 1786
- May: Floods in Mondego river (Central Portugal)

Conclusion

• With regard precipitation data, our perception after this study is that JA Velho records represent an historic-instrumental data set with excellent quality;
• The “Gazeta de Lisboa” is, undoubtedly, a valuable source on climatic and meteorological conditions for the late 18th century;
• In a general assessment, we found a good correspondence between the instrumental records and the documentary descriptions with regard the main extreme rainfall events
References


• Taborda, JP; Alcoforado, MJ and Garcia, JC (2004) O Clima do Sul de Portugal no Século XVIII, Centro de estudos Geográficos, Área de de Investigação de Geo-Ecologia, relatório nº 2