

Extreme drought conditions over NE Iberia in early 19th century (1813-1827) and its possible relationship to major volcanic eruptions

M. Barriendos (1)*, M. Prohom (2), A. Sanchez-Lorenzo (3)

(1) Department of Modern History, University of Barcelona, Catalonia, Spain

(2) Meteorological Service of Catalonia (SMC), Catalonia, Spain

(3) Climate Research Laboratory, Barcelona Science Park, Catalonia, Spain

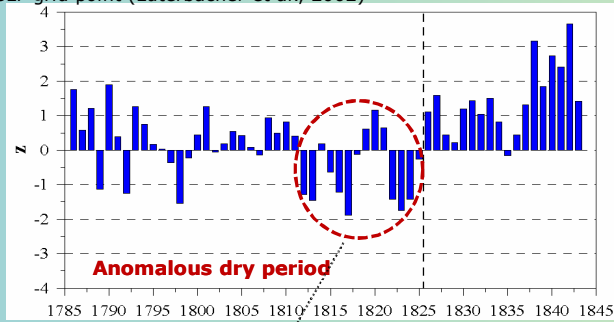
* Mariano Barriendos Vallvé (<http://www.clioclim.cat>); e-mail: mbarriendos@ub.edu

OBJECTIVE and DATA

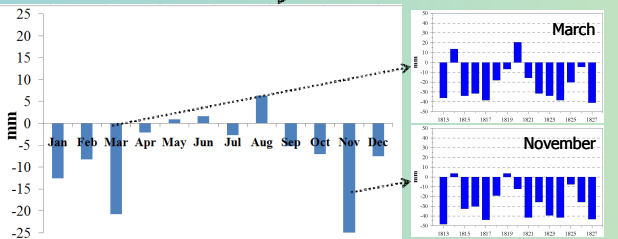
- Objective:** Analysis of a mega-drought over NE Iberia in early 19th century is made using two climatic information sources: instrumental and proxy data from historical documentary sources
- Data:** I) Monthly rainfall series of Barcelona covering the period 1786-1842; II) Rogation ceremonies records in six locations over Catalonia for the period 1800-1825; III) Monthly reconstruction of Sea Level Pressure (SLP) fields over the eastern North Atlantic and Europe during the 1786-1842 period (Luterbacher et al., 2002)

1. Barcelona rainfall series (1786-1842)

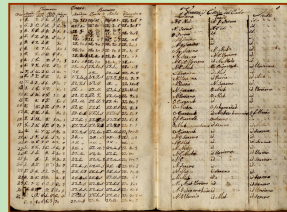
Observers → Dr. Francesc Salvà (1786-1825) and Pere Vieta (1826-1842). Gap filled with multiple regressions, independent variables: number of days with precipitation and highest correlated SLP grid point (Luterbacher et al., 2002)



Standardized annual rainfall series in Barcelona during the 1786-1842 period with respect to the 1786-1825 period

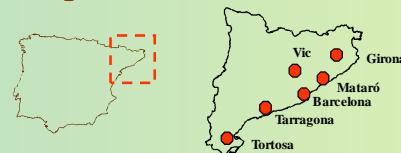


Left: Monthly rainfall anomalies during the 1813-1825 period; right: March (top) and November (bottom) anomalies time evolution during the 1813-1827 period



Original sources: manuscript of the original readings made by Salvà (left) and front page of the "Diario de Barcelona" where Salvà and Vieta observations were published (right)

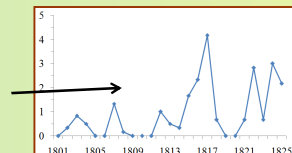
2. Rogation ceremonies in Catalonia



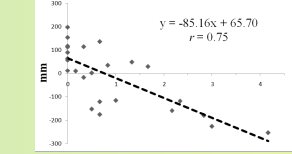
Location of the 6 cities with rogation ceremonies



Example of rogation ceremonies levels for rain in Barcelona (Pro pluvia rogations)

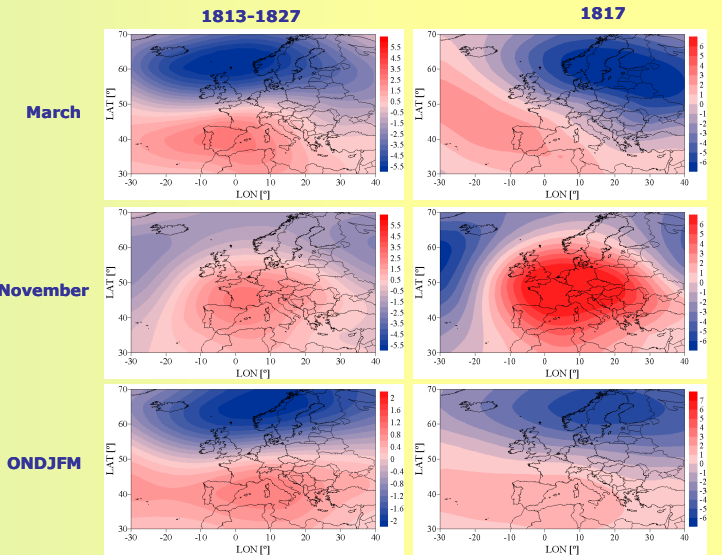


Mean rogation index series in Catalonia during the 1801-1825 period



Relationship between SONDJFM rainfall anomalies in Barcelona (mm) and the mean rogation index

3. SLP anomalies over Europe



March (top), November (middle) and ONDJFJ (bottom) reconstructed SLP anomalies (hPa) for the 1813-1827 period (left) and 1817 (right) with respect to the 1786-1842 reference period.

Large tropical volcanic eruptions (i.e. Tambora, 1815) increases Equator-Pole temperature gradient and makes jet-stream (polar vortex) stronger, amplifying "Arctic Oscillation" circulation pattern. This pattern is associated to main rainfall deficits over southern Europe, especially in winter



CONCLUSIONS

- Both, early instrumental and documentary proxy data (rogation ceremonies) confirm major rainfall deficits during the 1813-1827 period, being the coldest months of the year those most affected
- Great equatorial volcanic eruptions are a well-known forcing source of positive Arctic Oscillation mode in winter. The coincidence of the most important volcanic event of the 19th century (Tambora, 1815) with remarkable negative rainfall anomalies over NE Iberia, should be considered as a likely cause-and-effect relationship
- Homogeneity analysis of rainfall instrumental data should be considered in the future, in order to confirm these preliminary findings

Luterbacher et al. (2002): Reconstruction of Sea Level Pressure fields over the eastern North Atlantic and Europe back to 1500. *Climate Dynamics*, 18, 545-561
Trigo et al. (2009): Iberia in 1816, the year without a summer. *International Journal of Climatology*, 29, 99-115

Acknowledgments: This research was supported by the "Salvà-Sinobas project" (MMAMRM 200800050083542) funded by the Ministry of the Environment and Rural and Marine Affairs