



Climate impacts of El Niño phenomenon in South America: The 1877-1878 episode (Alexander von Humboldt Medal Lecture)

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Extreme climate anomalies took place in many regions of the world during 1877 and 1878 in connection with the occurrence of a major El Niño episode (EN78/79). The large magnitude of the global disturbance is revealed by the impressive positive anomaly in surface air temperature during the boreal 1877-78 winter semester (October 1877 - March 1878), which according to some estimations exceeded +3.0 standard deviations with respect to the 1870-1900 mean.

After describing some regional climate anomalies related to EN78/79, mainly the intense droughts in Asia, the maritime continent between Australia and Asia, and Africa, the impacts of this phenomenon in South America will be described focusing in those areas where ENSO-related interannual climate variability has been well established through studies performed in recent decades. These areas are the northern portion of the continent (Colombia, Venezuela, Guyana, Suriname, French Guiana and neighboring regions in northern Brazil), the Brazilian Nordeste and the central Andes (Altiplano) where El Niño occurrences are associated with rainfall deficit or drought; and the coastal areas of southern Ecuador and northern Perú, the SE portion of the continent (SESA: southern Brazil, eastern Paraguay, Uruguay and NE Argentina) and the extratropical West coast of the continent (central Chile), where flooding conditions typically occur during El Niño events. According to information derived from the analysis of historical rainfall records and various documentary sources (newspapers, technical reports, scientific papers, etc.) it was concluded that all these climate anomalies did occur during 1877 and 1878.

The most dramatic climate disturbance was the severe drought in the Brazilian Nordeste starting at the beginning of 1877. When it finished in 1879 at least 500.000

people had died from starvation and related diseases, and the regional economy had collapsed. Regarding other regions along the northern portion of the continent not much evidence was found about the rainfall regime during EN77/78. However, a 20% deficit in annual precipitation during 1877 calculated for Bogotá (Colombia), plus references to a severe drought occurring in the Curazao island (off the coast of Venezuela) during 1877 and in Suriname, from September 1877 to March 1878, suggest that the typical ENSO signal on the rainfall regime in northern South America did show up during EN77/78. Regarding the central Andes (Altiplano), from the review of previous studies and the analysis of documentary sources in Peru and Bolivia it was established that rainfall deficit and drought occurred during the 1876-77 and 1877-78 rainy seasons (October - March) leading to famine and starvation in Bolivia.

No direct meteorological information was found for the coastal region of Southern Ecuador and Northern Perú during 1877 and 1878, but from the analysis of historical reports and other documentary sources it was concluded that floods occurred during the rainy seasons coinciding with the growing stage of the El Niño episode in 1877 and after the phenomenon had reached its mature stage in 1878. Furthermore, floods were severe on the plains of Northeast Argentina during the first semester of 1878 due to the increased discharge of the Parana River. It is estimated that the flooding was similar in magnitude to that associated to the 1997-98 El Niño episode, but considerably less intense than the flooding of 1983 during the major 1982-83 El Niño event. Consistent with the current knowledge about ENSO related rainfall anomalies in South America, an anomalous wet condition prevailed along the extratropical West coast of the continent (central Chile) during the 1877 austral winter (JJA) producing considerable damage to public infrastructure.

In the context of the growing awareness of global climate change and its potential impact it is interesting to bear in mind the 1877-78 El Niño episode and the associated climate disturbances leading to severe environmental crisis in many areas of the world.

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