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Atmospheric precursors and assessment of the extreme rainfall responsible for the Madeira flashfloods on 20 February 2010

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On February 20, 2010, the Madeira island (Portugal) was hit by torrential rains that triggered catastrophic flash floods, accounting for 43 deaths and 8 missing people. The regional authorities estimated that the total losses exceeded 1 billion of euros resulting from the destructive damages, which were very harmful in Funchal, the capital of the region, where 22 persons died. This paper aims to analyse and discuss two main issues related with the exceptionality of this event. The first part deals with the atmospheric context associated with the rainfall episode, which occurred embedded in a very rainy winter season on this subtropical Atlantic region. Large scale atmospheric controls will be analysed, taking into consideration the low phase conditions of the North Atlantic Oscillation (NAO) that remained overwhelmingly negative between late November 2009 and early April 2010. The role of positive sea surface temperatures anomalies in the subtropical Atlantic region during the prevous weeks will be also investigated. Furthermore, the discussion will be focused on the meteorological precursors of the 20 February rainstorm, using synoptic weather charts and sub-daily reanalysis data and analysing appropriate variables, such as, SLP, geopotential height, instability indices, precipitable water, and others atmospheric parameters.

The second section of this work is devoted to the evaluation of the exceptionality of the rainfall records related with this event. In Funchal (Observatory station), the precipitation amount registered during February 2010 was 458 mm, exceeding by seven times (!) the average monthly precipitation, constituting the new absolute record, since 1865, when this meteorological station began its activity. The daily rainfall on 20 February in the same location was 132 mm, which is the highest daily amount since 1920. Return periods of this daily amount will be estimated for the two stations with the longest period available of daily precipitation, Funchal Observatory and mountain peek Areeiro. Daily, sub-daily, hourly and sub-hourly rainfall data will be also analysed using the available information from the modern automated raingauge network of the island. Among the several notable rainfall amounts, it should be highlighted the daily amounts between 300 and 350 mm reached in different locations on the southern flanks of the mountains above the 500 m height and six hours rainfall exceeding 200 mm at the upper parts of the slopes in the Funchal area.