Synoptic and mesoscale flows conductive to hot summer events in Cantabria (Northern Spain)

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Coastal, western façade areas of the mid latitude continents are characterized by temperature and humid climates (Cfb or Cfc in Köppen's notation). One of their most recognisable attributes is the cool summers. The Northern Iberian Peninsula shares this kind of feature, although the climatological data used to characterize it are supplied by meteorological stations close to the coast. In the interior valleys and mountains, the continentality and the altitude transforms those generalized attributes, bringing near their characteristics to those of the close mediterranean regions. With this contribution, we want to make clear the different patterns of spatial distribution of hot days in Cantabria, to analyze the synoptic and mesoscale circulations associated with those events and to advance some of the possible mechanisms involved.

The atmospheric conditions conductive to those events were characterized by using several databases. First of all, surface, low- and mid-tropospheric meteorological variables were extracted from the NCEP/NCAR reanalysis data for a selected window (25W-15E and 25N-55N; Kalnay et al., 1996). Composite and anomaly fields were elaborated and tested using a two tailed t-test, to objectively highlight areas where climatic anomalies are significantly different from the climatology. Also, we used twice daily upper rawinsonde data from Santander and Madrid-Barajas to analyze the vertical structure of the atmosphere during those days at both sides of the Cantabrian Range. Finally, hourly surface data from automated meteorological stations (CIMA; Centro de Investigaciones Medioambientales, Consejería de Medio Ambiente, Gobierno de Cantabria) were also used to a finer characterization of those events.

A non rotated Principal Component Analysis (S-Mode) was applied to the raw maximum daily temperature data from June 15th to September 15th (summer season) in order to obtain the main modes of spatial and temporal variability in the data. Two components were selected, attending to the usual rules (Scree test, North et alĚ.); the principal one reproduces the regional magnitude of the temperature varability, while the second one discriminates the interior stations (mountain and valley observatories) from the coastal ones. A subset of days above the 90th percentile of the 1st principal component was selected, and from them, days below the 10th percentile and above the 90th percentile of the second component were extracted in order to analyze the mechanisms responsible of days with high temperatures but contrasted spatial patterns. From the synoptic scale point of view, the differences between those kinds of events are not

substantial. A southerly circulation between a ridge over the Iberian Peninsula and the Western Mediterranean basin, and an Atlantic low pressure area, conducts a hot and dry advection from Northern Africa through the Iberian Plateau. The most remarkable difference between the synoptic scale meteorological data is the most frequent southerly wind component and higher wind speeds at 850 hPa level during events with higher temperatures in the coast. At mesoscale, however, the characteristics of the atmosphere are completely different. A warm and dry downslope wind (southerly component), called “surada”, is responsible for warmer events in the coast; a breeze wind regime (northerly wind component) heads the advection of a maritime air mass which reduces the temperature in the coast observatories during the warmer events in the interior. This low level advection use to be shallow; a subsidence inversion (modal altitude: 400 m.a.s.l.) caps the maritime air mass from the upper continental advection. Finally, a hydraulic jump is proposed to explain the different thermal behaviour of those situations.