Updating and extending the "dimming" and "brightening" over Spain

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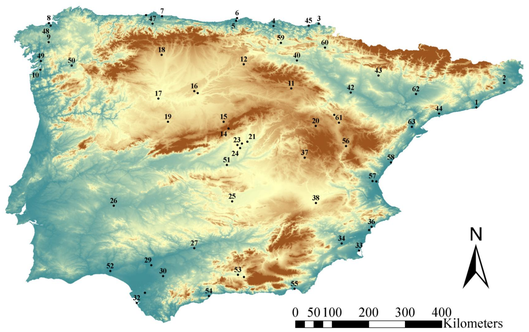
Introduction

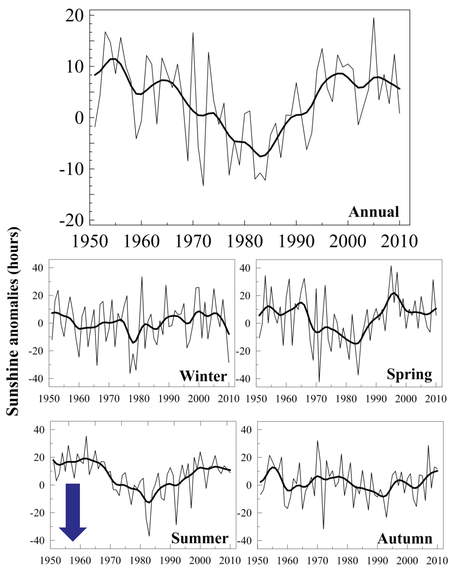
In this work we present an update of a previously published sunshine duration data set (Sanchez-Lorenzo et al., 2007) for the peninsular Spain. In addition, in order to complete the analysis to cover all Spanish areas, the data set has been extended using series from the Canary Islands (partially studied in Sanroma et al., 2010) and the Balearic Islands.

With the aim of studying the direct effect of the anthropogenic aerosols on sunshine duration records, we also show the sunshine duration mean series for clear-sky and overcast conditions for the peninsular Spain, extending previous analysis (Sanchez-Lorenzo et al., 2009).

1. Updating SUNDUIB data set (2005-2010)

- Updated 63 of the 72 sunshine series in the peninsular Spain published in Sanchez-Lorenzo et al. (2007).
- No evidence of "brightening" during the 2000s, although future attention needed for a possible effect of the sunshine measurements automatization (see Box 3).

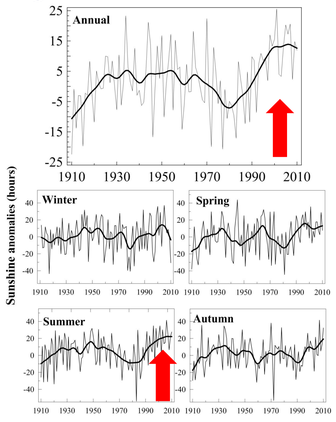




Updated from Sanchez-Lorenzo et al. (2007)

2. 100-years of sunshine data in Tortosa

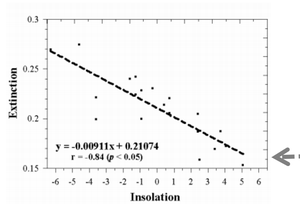
- The longest series is Tortosa (NE Iberia), starting in 1910.



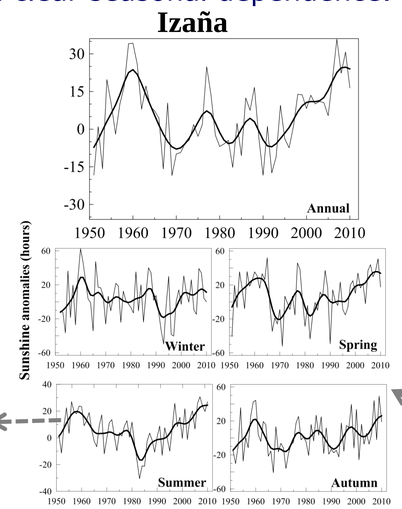
Updated from Curto et al. (2009)

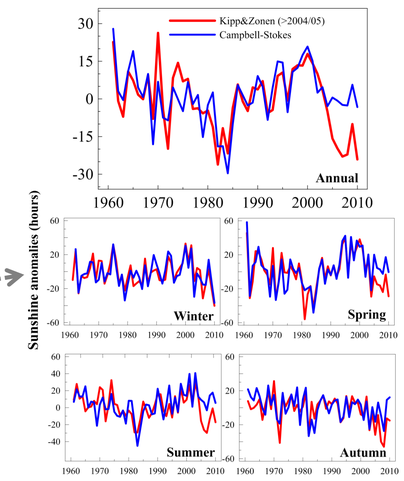
3. Which are the trends in the Balearic and Canary Islands

- Only 4 and 5 series available in each area with data before the 1970s.
- Similar trends to the peninsular Spain. Remarkable the JJA series at Izaña station in Tenerife (2371 m a.s.l.) → sig. correlated with atmospheric extinction measurements.
- Important bias in the 2 Balearic series with automatic Kipp&Zonen instruments measurements (started after 2004/05), with a clear seasonal dependence.



Sanroma et al. (2010)



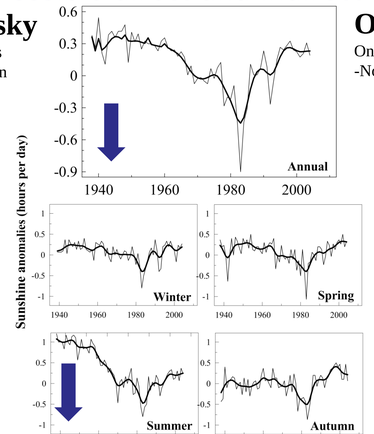


More details in Guijarro (2007)

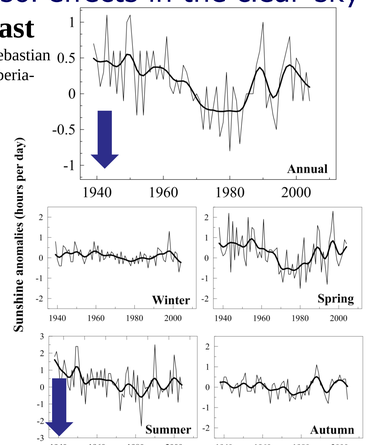
4. Sunshine under clear-sky and overcast conditions

- Cloud-free sunshine series showed in Sanchez-Lorenzo et al. (2009) are extended in the past up to >1938. Sunshine duration trends under overcast conditions are also analyzed.
- Possible direct and indirect aerosol effects in the clear-sky and overcast series, respectively.

Clear-sky
Only 4 series
San Sebastian
Valencia
Castellon
Alicante



Overcast
Only San Sebastian
-Northern Iberia-



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