Evidence of changes in daily climate extremes of precipitation and temperature over mainland Portugal

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Motivation and Objectives

→ *Human activities and the related increment of greenhouse gases have increased the risk of some extreme weather events, such as the 2003 and 2010 heat waves in Europe (Barriopedro et al., 2011), and the severe drought 2004/2005 in the Iberian Peninsula (Trigo et al., 2013). The implications of changes in climate variables such as temperature and/or precipitation might have great socio-economic impacts at the regional and local scales.*

→ *This study summarizes some of the key findings by the authors in the last years when assessing variations in the intensity, frequency and duration of extreme precipitation and temperature events in mainland Portugal (e.g. Ramos et al., 2011; de Lima et al., 2013; Santo et al., 2013).*

Dataset and Methods

*Trends in selected specific indices are calculated from daily precipitation data from 57 and temperature data from 23 stations scattered across the territory (**Fig. 1**). Selected indices:*

***R10** - Number of days per year with RR > 10mm*
***R20** -Number of days per year with RR > 20mm*
***R95p** -Precipitation on very wet days (Precipitation amount above the 95 percentile)*
***PrectTot** - Annual total precipitation from days > 1mm*
***TN20** - Number of days with daily minimum temperature > 20°C*
***TX25 / TX35** -Number of days with daily maximum temperature > 25°C (35ºC)*
***TX90** - Number of days with maximum temperature > 90th percentile reference period*
***TN10** - Number of days with minimum temperature < 10th percentile reference period*

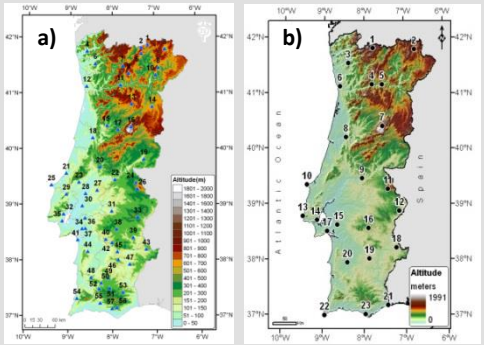

Figure 1. Weather stations used (a) precipitation and (b) temperature.

Results Precipitation

Table 1. Fractions (in percentage) of the 57 precipitation stations that have statistically significant (p < 5%) and non-significant trends for seasonal precipitation indices over mainland Portugal (period 1941-2007). Positive (+) indicates significant wetting trends and negative (-) indicates significant drying trends;

		R10	R20	R95p	PrecTot
Spring	–	68.4	59.6	40.4	75.4
	+	0.0	0.0	0.0	0.0
	n.s	31.6	40.4	59.6	24.6
Autumn	–	0.0	0.0	0.0	0.0
	+	12.3	17.5	17.5	24.6
	n.s	87.7	82.5	82.5	75.4
Winter	–	1.8	5.3	5.3	1.8
	+	0.0	0.0	0.0	0.0
	n.s	98.2	94.7	94.7	98.2

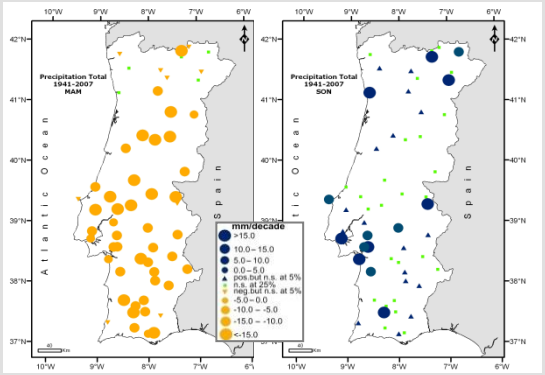

Figure. 2. Trends per decade in seasonal total precipitation in the 1941-2007 period.

Results Temperature

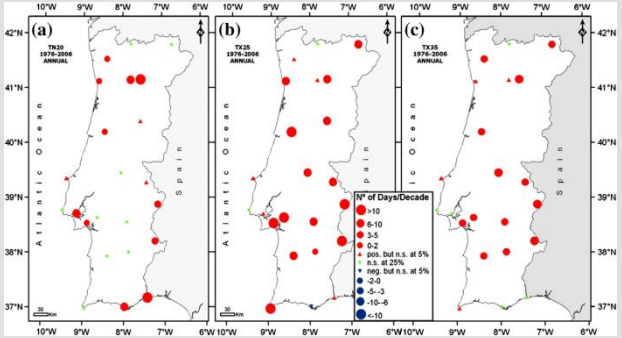

Figure 3. Trends for the period 1976–2006: (a) Tropical nights (TN20 index); (b) summer days (TX25 index); (c) extremely hot days (TX35 index).

Table 2. Number of stations with positive (+) and negative (-) seasonal trends for percentile indices. Corresponding number of significant trends (Sig) at 5% level are also shown (bold).

	1976-2006			
TX90	+	+ sig	-	- sig
MAM	23	**19**	0	0
JJA	23	**19**	0	0
SON	13	**1**	10	0
DJF	21	**8**	2	0

	1976-2006			
TN10	+	+ sig	-	- sig
MAM	1	0	22	**17**
JJA	0	0	23	**17**
SON	2	**1**	21	**12**
DJF	5	**1**	18	**1**

Conclusions

→ Precipitation exhibits significant decreasing trends in spring, while extreme heavy precipitation events, have become more pronounced in autumn.

→ Trend analyses of temperature extremes since mid-1970s indicate a wide-spread increase of warm extremes particularly in spring and summer. At the same time a decreasing trend in cold extremes is found in all seasons.

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