

A Majorca case study of daily extreme temperatures homogenization

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10th EMS / 8th ECAC (Zürich, 13-17/Sep., 2010)

Case description

- ▶ 3 consecutive anomalies detected in the monthly mean maximum and minimum temperature series of Sóller (Majorca) at the beginning of 1961.
- ▶ Metadata indicate that a defective thermometer was used for about 3 months.
- ▶ Questions:
 - ▶ Exact days of the beginning and end of the wrong observations?
 - ▶ Corrections to be applied to the daily extreme temperature data?

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Methodology

- ▶ All available Majorca's daily extreme temperature data were collected for a whole year enclosing the problem period: 1-Sep-1960 to 31-Aug-1961, from 6 stations.
- ▶ The R contributed package *Climatol* was used for the processing of the data.
 - ▶ The 6 daily series were deseasonalized by a Fourier adjustment to mean daily values of all of them (after a first homogenization).
 - ▶ Then the shifts in the mean were detected by a test of difference of means between running samples of 60 daily values.
 - ▶ A binary split was applied to the detected significant shifts, and the homogenization function reconstructed the resulting series, allowing to compute the temperature difference involved in the shifts.
- ▶ This process was applied to the daily maximum, minimum and mean temperature series.

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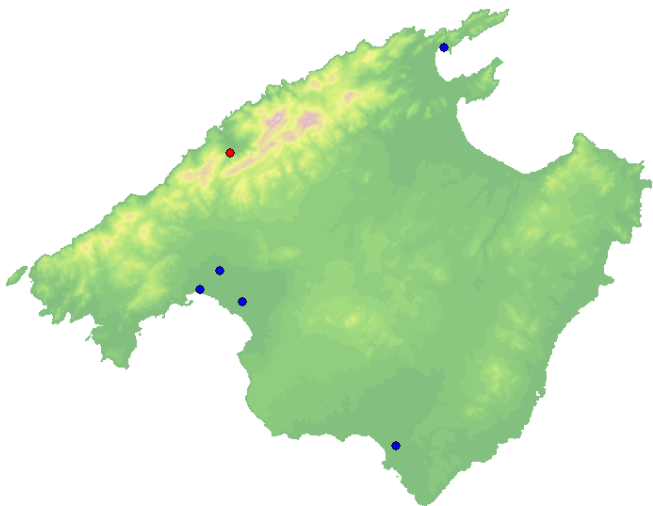
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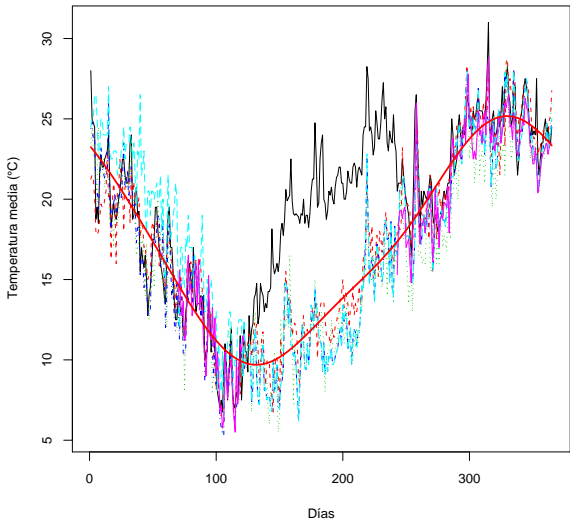
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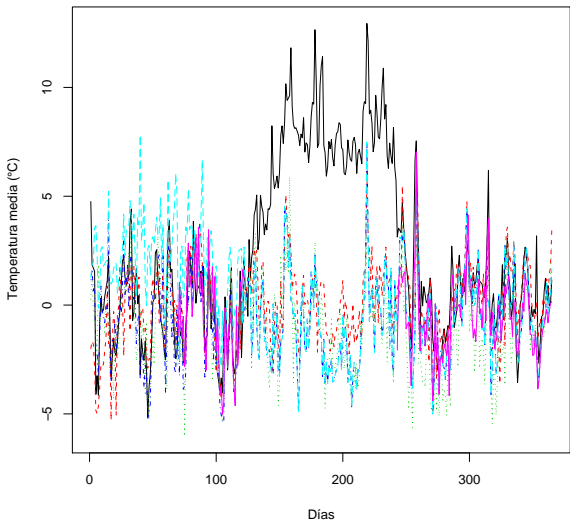
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Problem (red dot) and reference (blue dots) stations

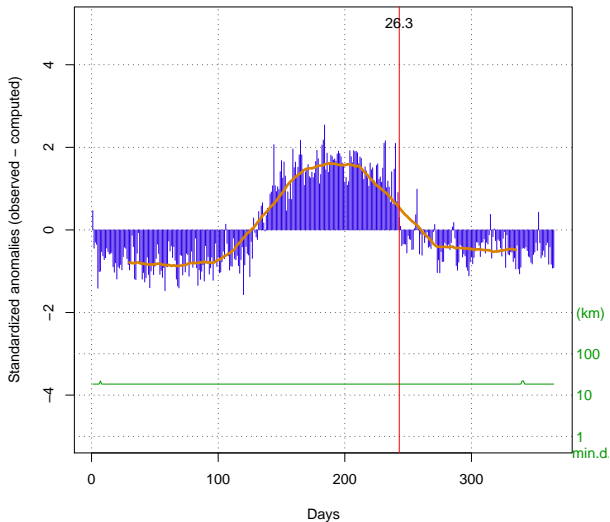


Mean daily temperatures from 1-Sep-1960 to 31-Aug-1961



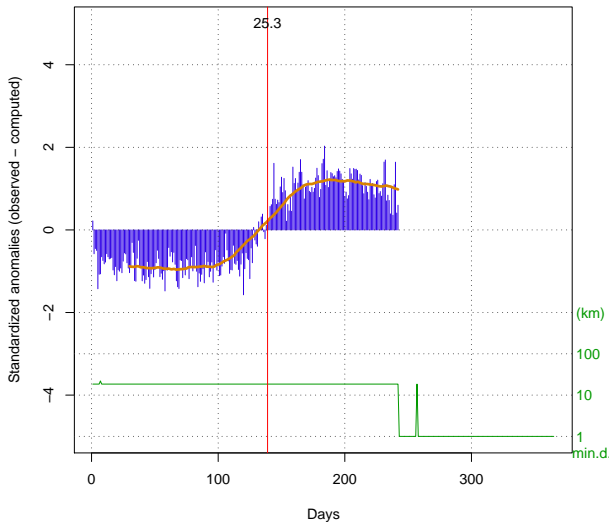
Mean deseasonalized daily t., 1-Sep-1960 to 31-Aug-1961

t at B061(1), Sóller



Most significant shift in Sóller mean t. anomalies

t at B061(1), Sóller



Second most significant shift in Sóller mean t. anomalies

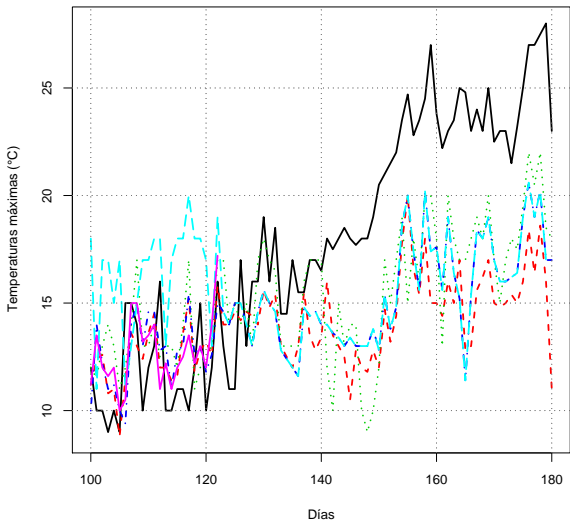
Results

Shift temperature increments computed as difference of the average (ave.) and median (med.) of the split series:

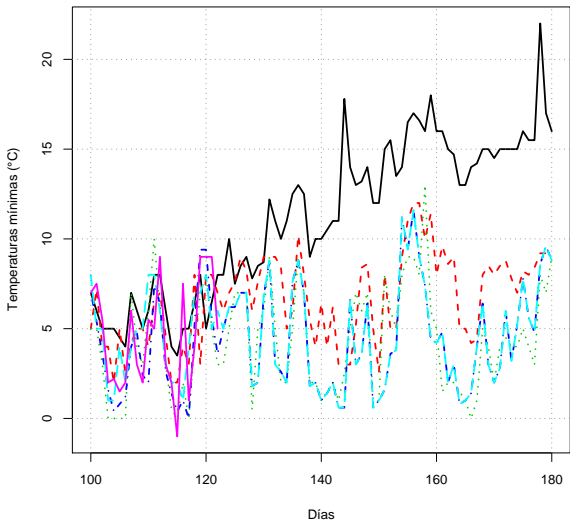
	Date	First shift		Second shift		
		Δt ($^{\circ}\text{C}$) (ave.)	Δt ($^{\circ}\text{C}$) (med.)	Date	Δt ($^{\circ}\text{C}$) (ave.)	Δt ($^{\circ}\text{C}$) (med.)
Maximum	19-Jan	+8.75	+8.93	1-May	-6.95	-7.04
Minimum	17-Jan	+6.77	+7.00	3-May	-7.36	-7.70
Mean	17-Jan	+7.77	+7.79	3-May	-7.19	-7.22

The absolute values of the 12 corrections have a mean of 7.54°C , a median of 7.29°C , and a standard deviation of 0.69°C .

⇒ A constant correction value of -7°C can be applied to the wrong data, though a linear adjustment between 7.835 and 7.243°C is also a good, less conservative, choice.



Max. temp. around the first thermometer change



Min. temp. around the first thermometer change

Conclusions

- ▶ Detected dates of the wrong observations period: from 19th of January to 30th of April (1961)
- ▶ Correction to be applied: Either a (conservative) constant value of -7°C , or a linear adjustment between 7.835 and 7.243°C
- ▶ Further analysis should be made to confirm or refine this corrections.

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