Exploring the impact of changes in observation times on the homogeneity of temperature series: rainfall day vs. calendar day

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OVERVIEW

- **Background and motivation of the experiment**
- **Methodology**
- **Homogeneity analysis: ACMANT V4**
- **Conclusions**

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BACKGROUND AND MOTIVATION OF THE EXPERIMENT

Ensuring quality and homogeneity in climate series is a crucial step to be undertaken when analyzing climate trends and variability.

Several sources of inhomogeneity are well known and documented (Aguilar et al. 2003):

- Station relocation
- Instrumental exposure
- Change of instrumentation
- Environmental changes in station surroundings
- Observing practices: change of observer, maintenance routines, **observing times**

Most of the breaks in temperature series are associated to the first four sources, while little evidences are found for the last one.

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BACKGROUND AND MOTIVATION OF THE EXPERIMENT

In recent years, AWS emerge as the main source of surface climate data, and gradually manned stations are replaced by them.

IMPACT

- Change of instrumentation (largest one)
- Relocation (in some cases)
- **Change in observing times: rainfall days (8h – 8h) vs. calendar days (0h – 24h)**

Size of the breaks is not large enough?
Homogeneity testing/procedure is not sensitive enough?

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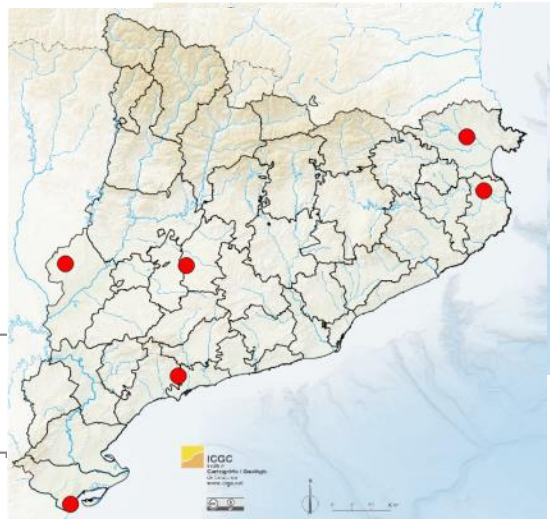
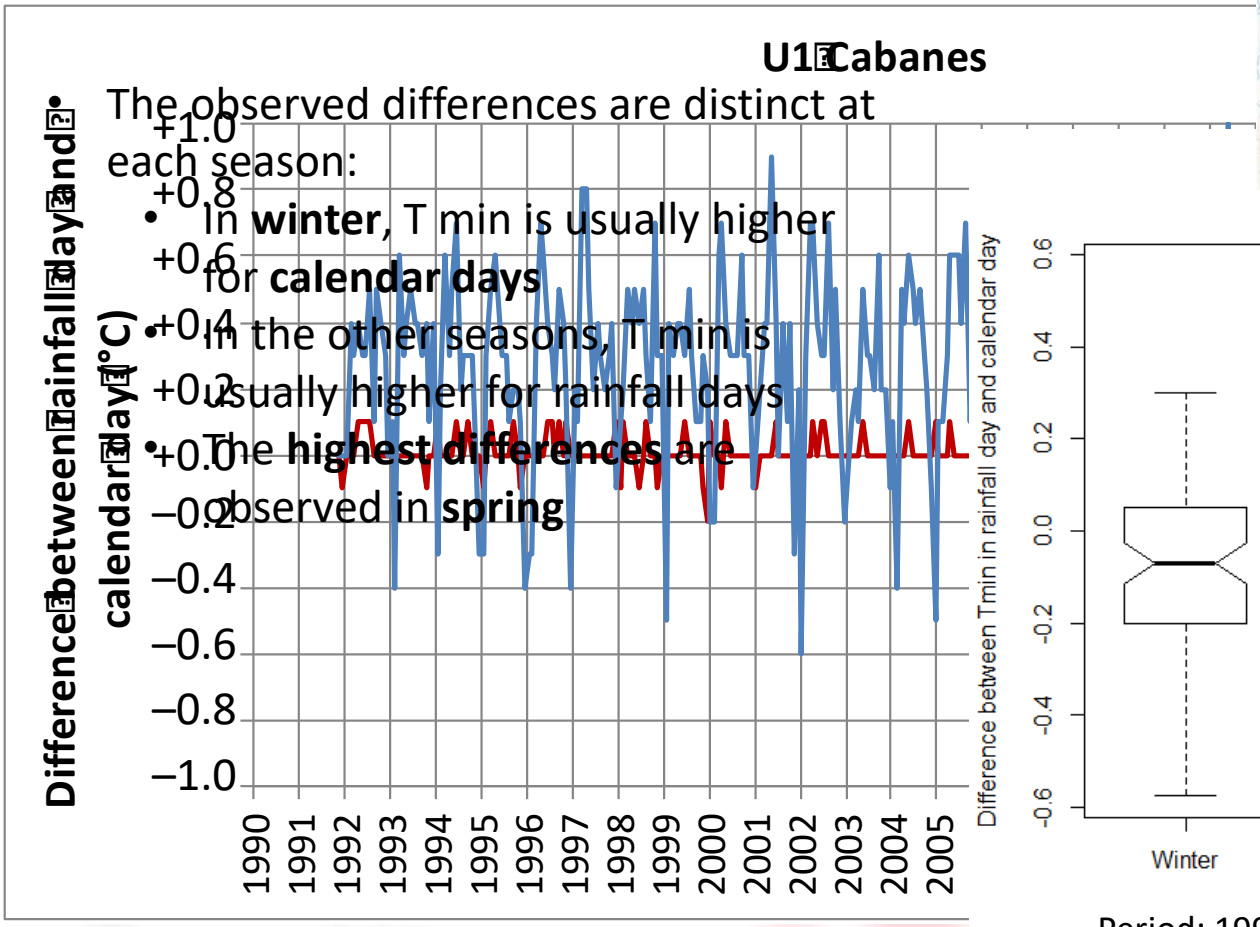
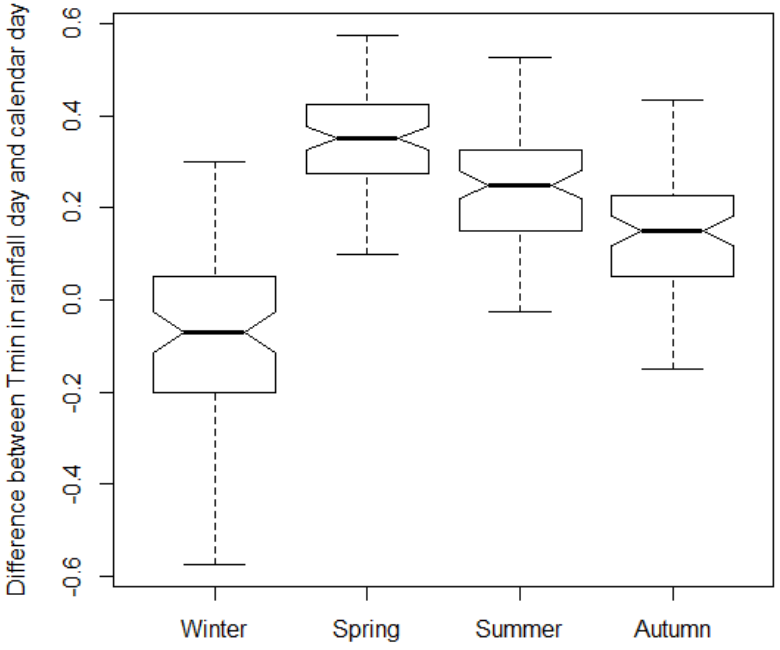
BACKGROUND AND MOTIVATION OF THE EXPERIMENT





The observed differences are distinct at each season:

- In **winter**, T min is usually higher for **calendar days**
- In the other seasons, T min is usually higher for rainfall days
- The **highest differences** are observed in **spring**



Period: 1992-2018; Number of stations: 6

Monthly mean differences in temperature

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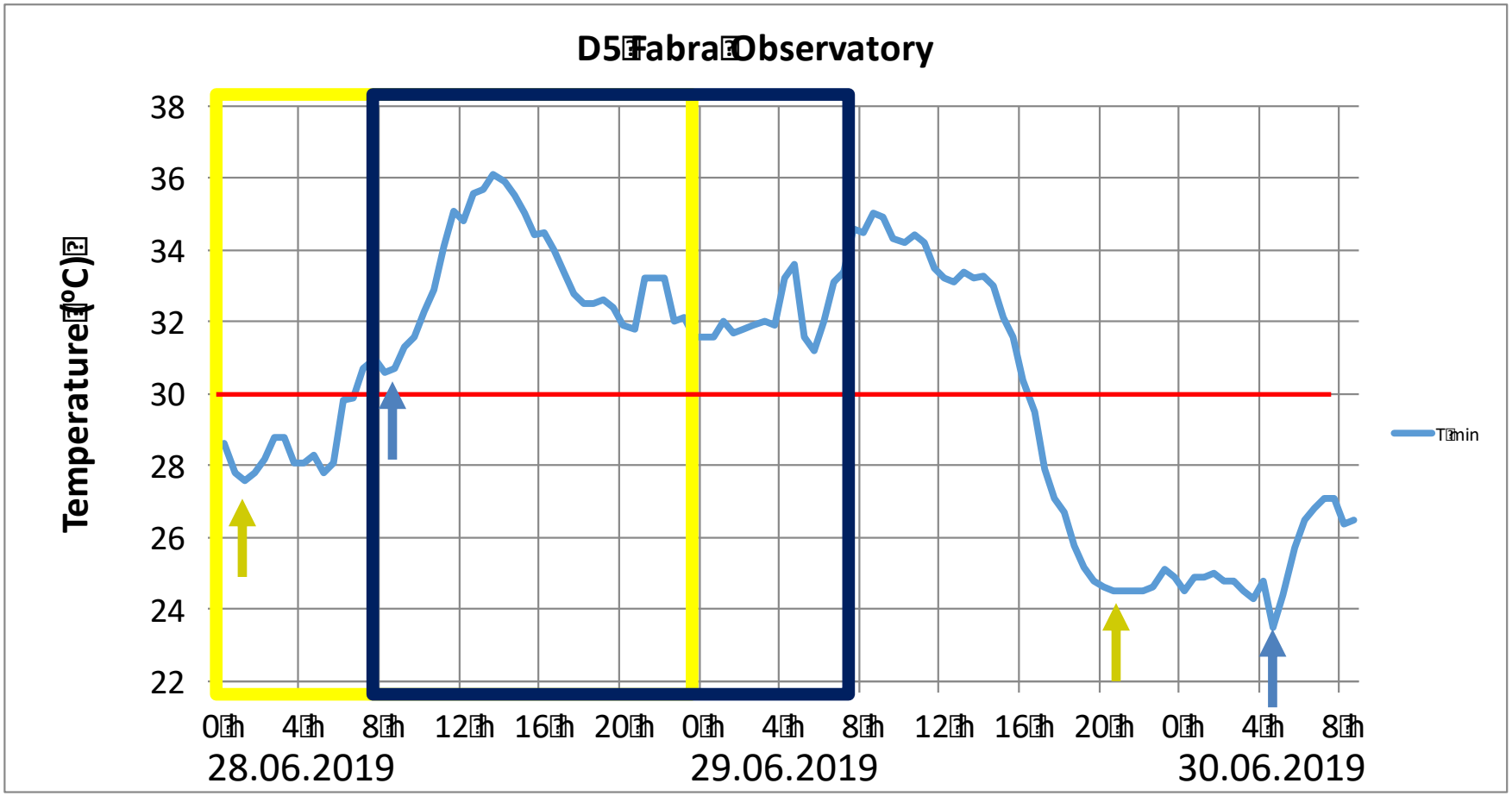
BACKGROUND AND MOTIVATION OF THE EXPERIMENT

T min	Rainfall day (8h-8h)	Calendar day (0h-24h)
28.06.2019	30.6	27.6
29.06.2019	23.5	24.5



Hourly minimum temperature

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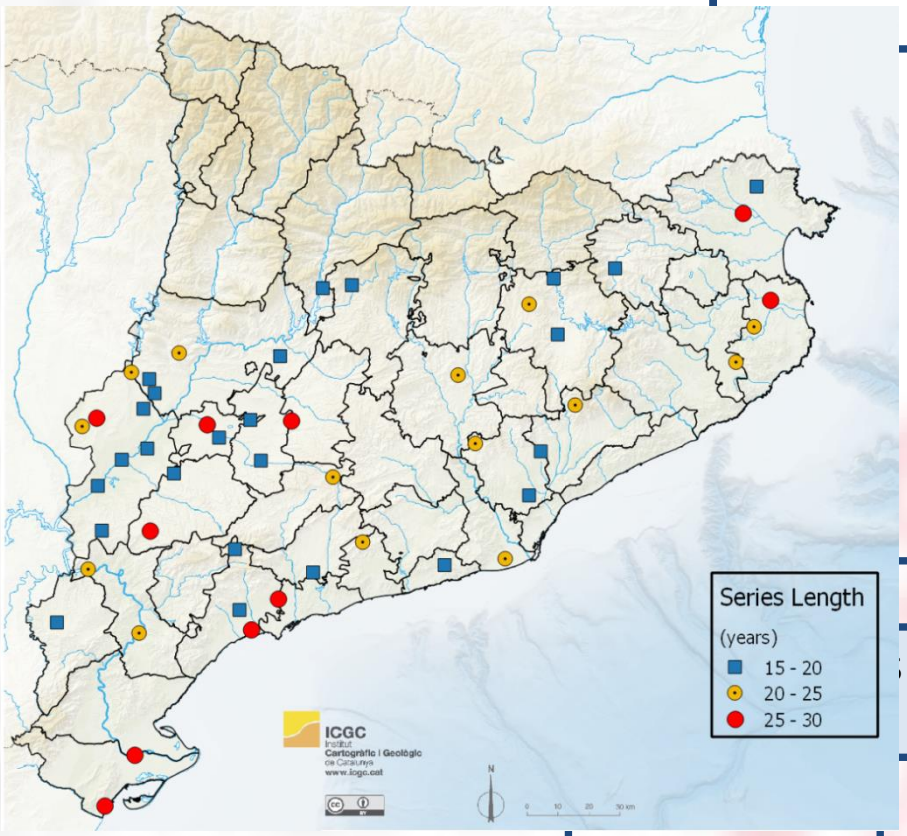
METHODOLOGY

Selection of 76 hourly T series (1988-2018)



T max & T min daily series rainfall day (8h – 8h)

ACMANT (v4)

Selection of 49 **original** series

24 **reference** series (length > 20 years) rainfall day (8h – 8h)

9 series:
1st half calendar
2nd half rainfall day

16 series:
1st half rainfall
2nd half calendar day

2 approaches ...

ACMANT (v4)

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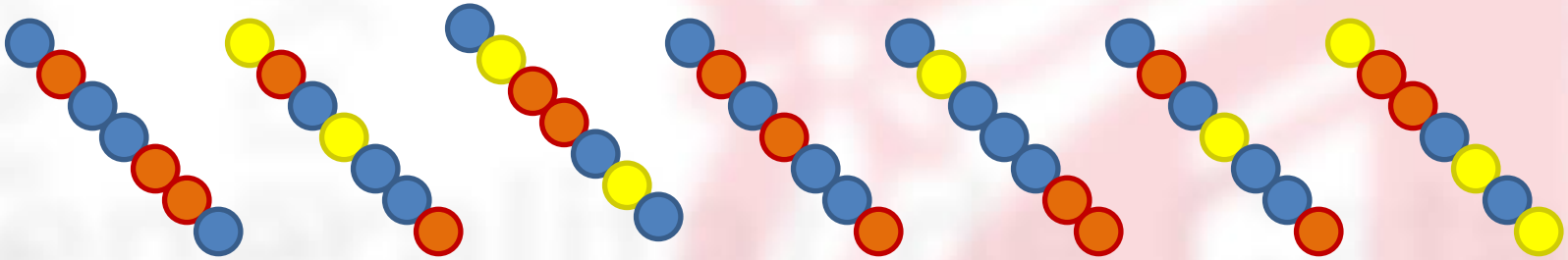
METHODOLOGY

- Introduction of 1 artificial change in the middle of the series period for the series with less than 20 years
- 64% of the modified series have the temperature of the rainfall day in the 1st part of the period and temperature of the calendar day in the 2nd part. The other 36% start with calendar day and end with rainfall day

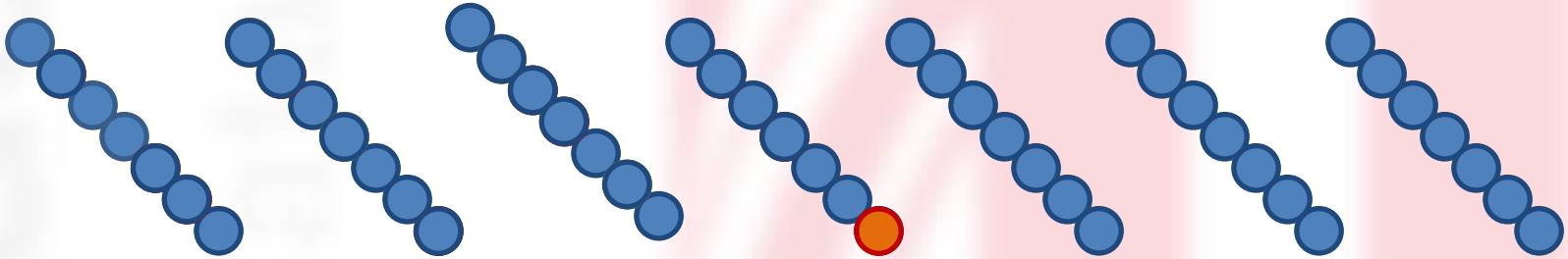
Temperature in rainfall day (8h-8h)
Transition from calendar to rainfall day
Transition from rainfall to calendar day

Execution of ACMANT in 2 approaches:

A. 1 execution with the whole set of 25 modified series + 24 unmodified series



B. 25 independent executions with only 1 modified series + 48 reference series



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Homogeneity analysis: ACMANT V4

T max: none of the forced transitions are detected

T min: some of the forced transitions are detected both for approach A and B

A. (49 series)	Inserted transition (25 series)	Rainfall day T min (24 series)
Detected	6	5
Not detected	19	19

- Critical success index: CSI=6/(6+5+19) = 0.20
- Probability of detection: POD=6/(6+19) = 0.24
- False alarms: FAR=5/(6+5) = 0.45

B. (25 series)	Inserted transition
Detected	6
Not detected	19

Detected inserted transiton	A.	B.
Rainfall to calendar (16)	3	4
Calendar to rainfall (9)	3	2

	A. Detected transition (6 series)	B. Detected transition (6 series)	Detected transition rainfall day (49 series)
Nº of breaks	6	6	78
Nº of negative breaks	0	1	39
Minimum magnitude	0.17	0.06	0.01
Mean magnitude	0.39	0.36	0.44
Maximum magnitude	0.69	0.64	1.65

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CONCLUSIONS

- Change in observing times has an important effect in monthly temperature, especially in mean minimum temperature, that follows an annual cycle
- The process of homogenization is slightly affected by the presence of periods with different observing times
- Detection of inhomogeneities caused by changing observing times is extremely difficult: forced transitions could be detected when the magnitude of the break was sufficient and it was not masked by other inhomogeneities.
- The size of the break for a transition from manned to automatic weather station are of moderate magnitude and they can be masked by other sources of inhomogenities.

Future work:

- Creation of different benchmarks: analysis of multibreak detection
- Homogeneity check by HOMER
- Correction analysis and trend impact

Mange tak!