Evaluation of the Impact over temperature series of the transitions between observation systems (IMPACTRON)

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Universitat Rovira i Virgili

Centre for Climate Change

IN THIS TALK …

- INTRODUCTION TO IMPACTRON, MEMBERS AND OBJECTIVES
- PRESENTATION OF OUR WORK
- OUR GOALS FOR THE NEAR FUTURE

EVALUATION OF THE **IMPAC**T OVER TEMPERATURE SERIES OF THE **TR**ANSITI**ON**S BETWEEN OBSERVING SYSTEMS, (IMPACTRON)

- Spanish Scientific network, coordinated by C3-URV and participated by AEMET, SMC, Observatori de l'Ebre, University of Cantabria, University of Zaragoza
- Links with Israel Met. Service, University of Goteborg, University of Bern, Universit of Bonn
- It is a spin-off of DAAMEC, a Spanish funded project which intended to describe and adjust the AWS-MAN Bias
- POST

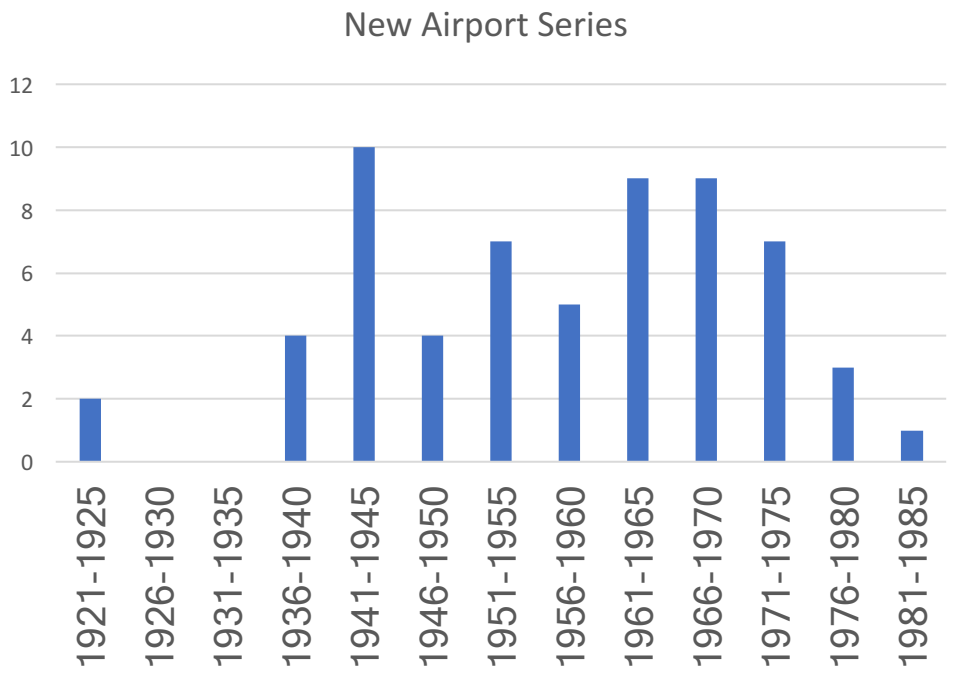
OBJECTIVES OF IMPACTRON

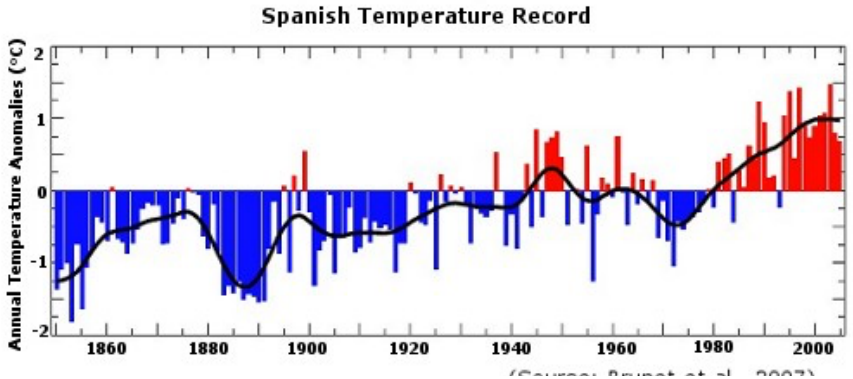
- Identify the most important transitions between observing systems in the Spanish long term network of temperatures
- Document each selected transition: when it happened, where it happened, metadata about old and new systems
- Create a database of parallel measurements for each transition. Interested in the daily scale ➔ most usual resolution
- Describe the associated biases
- Investigate adjustment approaches
- Promote and study new experiments and advocate for the continuation of existing ones.

IDENTIFIED TRANSITIONS:

- Three transitions have affected or are affecting a good part of the Spanish Net
  - From open stands to the Stevenson Screen
  - From the city center to the airports
  - From mannual records to AWSs

TRANSITION TO THE AIRPORTS





SPANISH DAILY ADJUSTED TEMPERATURE SERIES (SDATS) 1785

Table IV. Time intervals for each station, together with the INM local code, for which the QC procedures described have been applied

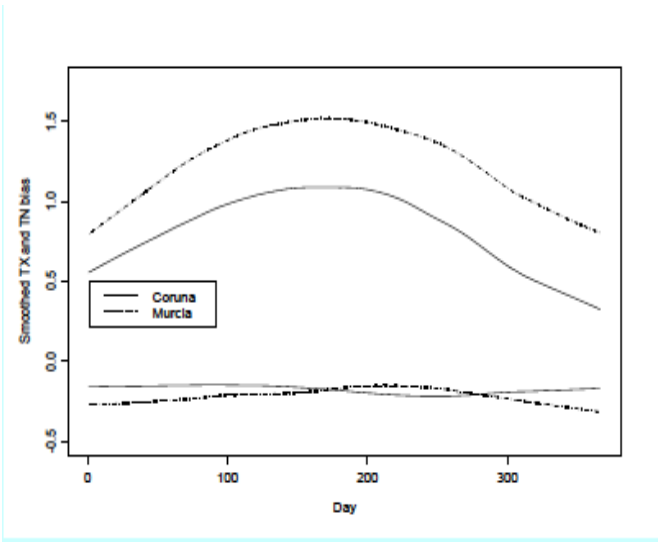
NAME	INM CODE	PERIOD	NAME	INM CODE	PERIOD
ALBACETE	8178	1893–1936	CADIZ	5972	1850–2003
ALBACETE	8175	1939–2003	MURCIA	7182C	1863–1950
ALICANTE	8025E	1894–1920	MURCIA	7182A	1951–1974
ALICANTE	8025G	1921–1938	MURCIA	7182	1976–2003
ALICANTE	8025	1939–2003	PAMPLONA	9262	1880–1974
BADAJOZ	4478	1864–1954	PAMPLONA	9263D	1975–2003
BADAJOZ	4452	1955–2003	SALAMANCA	2870D	1893–1944
BARCELONA	0201E	1885–1925	SALAMANCA	2867	1945–2003
BARCELONA	0200E	1926–2003	S. SEBASTIAN	1024D	1893–1900
BURGOS	2327	1870–1943	S. SEBASTIAN	1024E	1916–2003
BURGOS	2331	1944–2003	SEVILLA	5787D	1893–1932
CIUDAD REAL	4121C	1893–1970	SEVILLA	5790	1933–1950
CIUDAD REAL	4121	1971–2003	SEVILLA	5783	1951–2003
GRANADA	5515A	1893–1937	SORIA	2030	1893–2003
GRANADA	5514	1938–2003	VALENCIA	8416A	1863–1932
HUELVA	4605	1903–1984	VALENCIA	8416	1935–2003
HUELVA	4642E	1984–2003	VALLADOLID	2422C	1893–1923
HUESCA	9901F	1861–1943	VALLADOLID	2422F	1924–1940
HUESCA	9898	1944–2003	VALLADOLID	2422C	1942–1969
LA CORUÑA	1387	1882–2003	VALLADOLID	2422G	1970–1973
MADRID	3195	1853–2003	VALLADOLID	2422	1974–2003
MALAGA	6171	1893–1942	ZARAGOZA	9443D	1887–1950
MALAGA	6155A	1943–2003	ZARAGOZA	9434	1951–2003

- Working to identify and collect a set of simultaneous observations airport/city center (parallel does not strictly apply here) to describe the biases

TRANSITION TO STEVENSON SCREENS

Table VIII. Dates of Stevenson screen introduction in the Spanish meteorological network defining periods of application of the monthly adjustment factors for maximum temperature given in Table VII. In bold (italic) adjusted stations using Murcia (La Coruña) estimated monthly factors

Albacete	4/1915	**Alicante**	1/1909	**Badajoz**	1/1909	**Barcelona**	1/1901
Burgos	1/1905	**Ciudad Real**	1/1908	**Granada**	1/1909	**Huelva**	1/1909
Huesca	4/1912	*La Coruña*	6/1912	**Madrid**	1/1894	**Murcia**	1/1913
Pamplona	1/1916	**Salamanca**	1/1909	*S. Sebastian*	1/1901	**Sevilla**	5/1912
Soria	1/1914	**Valencia**	1/1901	*Valladolid*	10/1912	**Zaragoza**	4/1913



- Bias is described in Brunet et al (2011)
- Tmax bias has a seasonal cycle and can be adjusted using a regression model
- Tmin has a year-round bias better corrected by substracting 0.2
- The two experimental sites of Murcia and La Coruña continue recording as of today

Screen-11 (Montsouris-Stevenson)

Models for Tx Bias

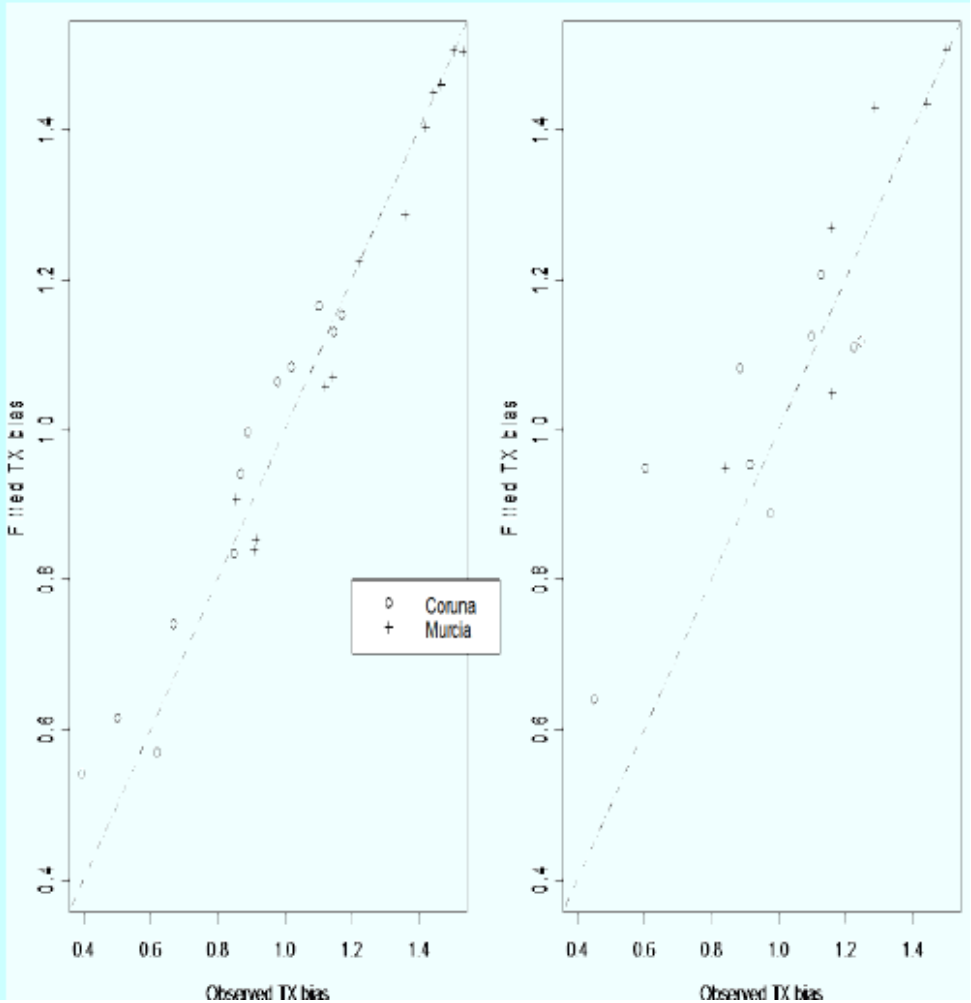
The regression depends on linear and quadratic terms in Tx and DTR.

Interactions with Fourier harmonics express the seasonal change in the effects of both predictors.

Figure: Monthly mean values observed and obtained from the model, in the estimation period (left) and validation period (right)

Explained variability is 49.7% for Murcia and 30.3% for La Coruña.

	Calibration period 2003-2007		Validation period 2008	
	R^2	s	R^2	s
All	0.517	--	0.387	
Murcia	0.497	0.258	0.436	0.264
Coruna	0.303	0.424	0.299	0.408



TRANSITION TO STEVENSON SCREENS.
Jesús Asín.

INTERCOMPARISON DESIGN

Montsouris (Mnt)

Stevenson (Stv)

Young (Yng)

Campus of the University of Alicante: 38º22'N 0º30'W, 91 m

Distance to the sea: 5.1 km – coastal site

Sensor: Thermistor probes 108

- Not the mercury-alcohol thermometers (automatic sensors have less radiation errors because their small size!).

- High-temporal resolution data (10-min) for understanding the reasons for the bias.

Datalogger: Campbell CR1000

TRANSITIONS

XIX → XX → XXI

Technician: Manuel Bañón (AEMET-Ciudad Jardín)

UNIVERSITY OF GOTHENBURG

Department of Earth Sciences

Regional Climate Group

TRANSITION BETWEEN DIFFERENT SCREENS. César Azorín

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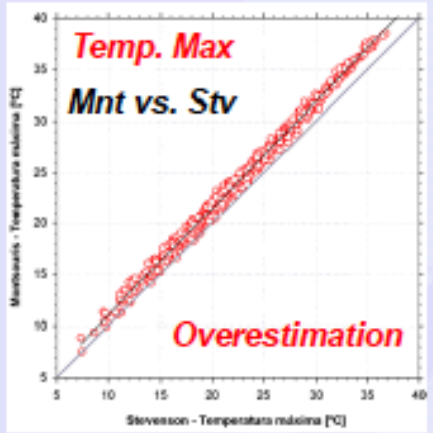
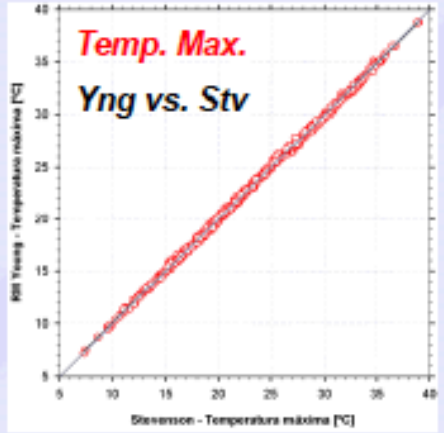
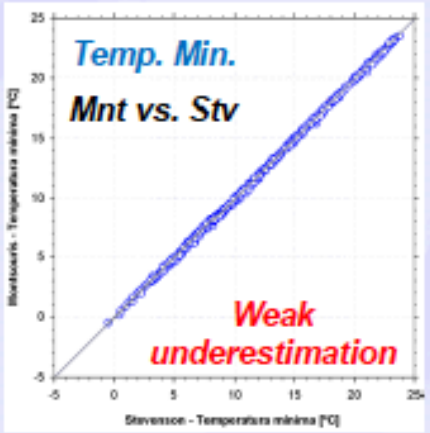
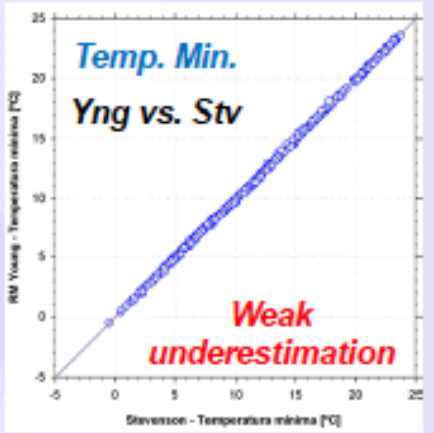








PRELIMINARY STATISTICS (Data from 30-Sep-2008 till 30-Abr-2010)

Diferences	Min.	1st Quartile	Mean	Median	3rd Quartile	Max
Mnt-Stv Máx.	0.0	1.2	1.6	1.7	2.0	3.0
Yng-Stv Máx.	-0.6	-0.1	0.0	0.0	0.1	0.6
Mnt-Stv Mín.	-0.6	-0.2	-0.1	-0.1	0.0	0.1
Yng-Stv Mín.	-0.4	-0.1	-0.1	-0.1	0.0	0.3

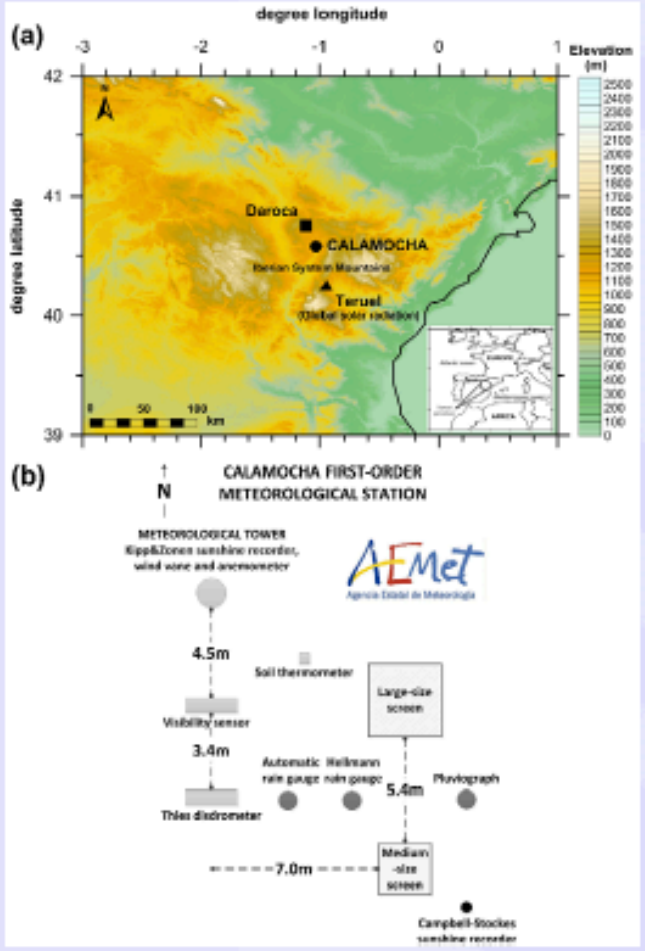
DATA AVAILABLE SINCE SEP-2008, but some shortcomings are found because some of the three thermistors failed.

Hopefully **~5-years of parallel air temperature measurements** can be rescued and analyzed.

TRANSITION BETWEEN DIFFERENT SCREENS.

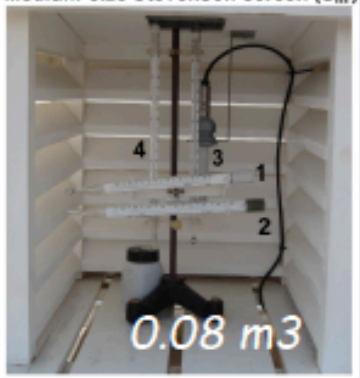
César Azorín

I.3. Stevenson medium *vs.* large size

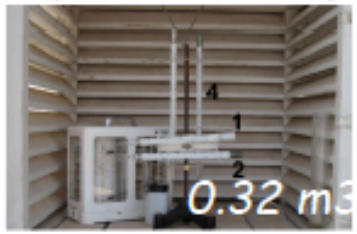


Objective: ***To report the air temperature difference between these two differently sized Stevenson screens used by the Spanish Meteorological State Agency.***

Medium-size Stevenson screen (S_m)



Large-size Stevenson screen (S_l)



(1) Maximum THIES mercury-filled thermometer
(2) Minimum THIES alcohol-filled thermometer
(3) THIES PT100 temperature sensor
(4) Psycrometer (dry-bulb -right side- and wet-bulb -left side- thermometers)

Overheat (0.54C) of daily max air temperatures by the medium-sized Stevenson screen, particularly in summer.

COMPARISON
BETWEEN
DIFFERENT
SCREENS.
César Azorín

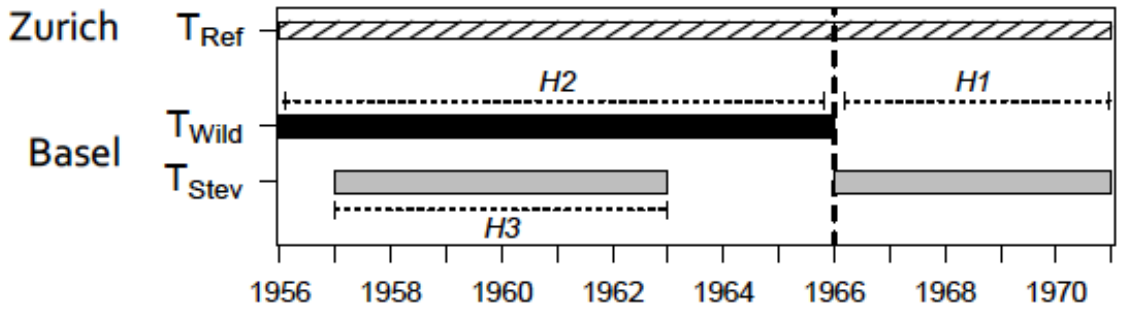
BUISAN, S. T., AZORIN-MOLINA, C., and JIMENEZ, Y., 2015: Impact of two different sized Stevenson screens on temperature measurements in Calamocha (Spain). International Journal of Climatology, 35(14), 4408-4416. doi: 10.1002/joc.4287.

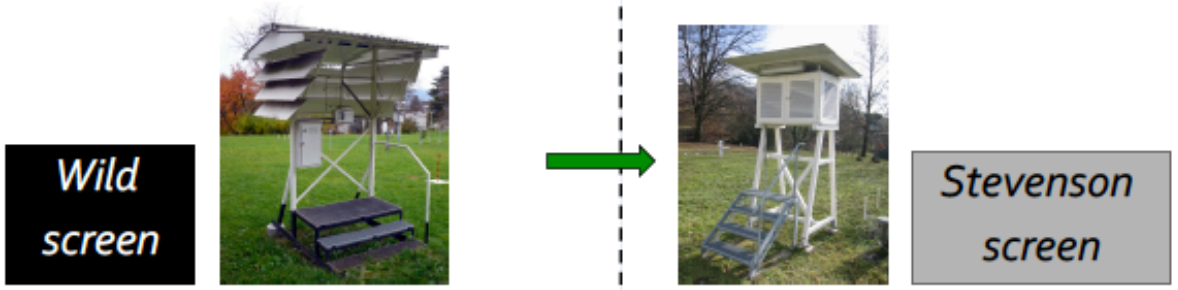
WILD-STEVENSON, by Auchmann

UNIVERSITÄT BERN
OESCHGER CENTRE CLIMATE CHANGE RESEARCH

Data

- Station Basel-Binningen (CH), 316 m a.m.s.l.
- Sub-daily temperature records: 6:00, 12:00, 20:00 UTC





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WILD-STEVENSON, by Auchmann

Conclusions

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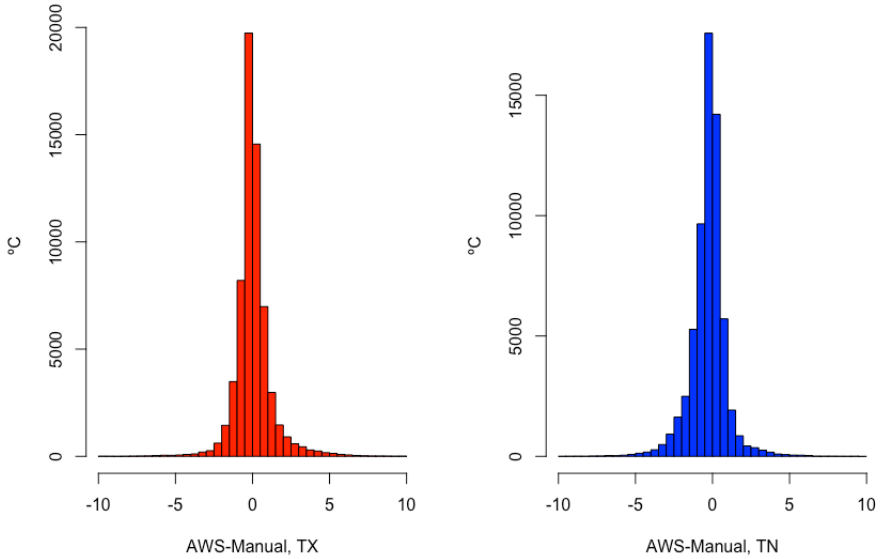
- for Wild – Stevenson transition parameters (and model) can be transferred within same regional climate
- statistical approaches (regression, annual spline with cloud cover) provide good alternative – simple, robust, but less variability
- physics-based correction for other types of breaks needs further attention

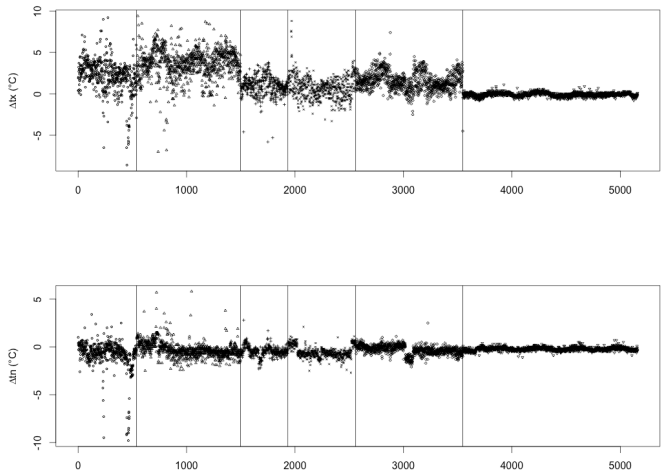
TRANSITION TO AWSs

- Working to collect the dates of official changes from MAN to AWS
- Large database collected: 46 parallel records, nearly 90.000 observations, contributed to POST
- Official transitions are not clear
- Metadata is not always complete. Most times, AWS in Stevenson screen. Some cases, platelike.

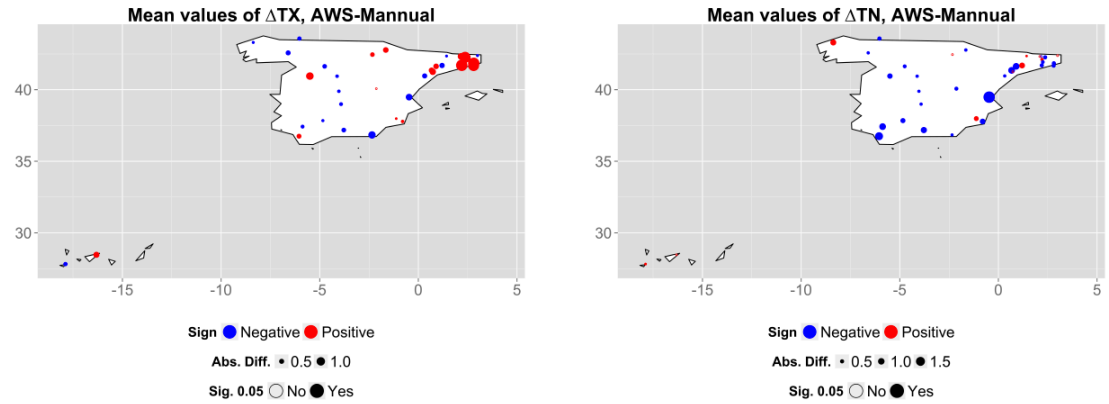


AWSs slightly warmer at day, sligthly cooler at night. Very different from station to station and from segment to segment

Fabra AWS-MAN



TRANSITION FROM TO AWSs

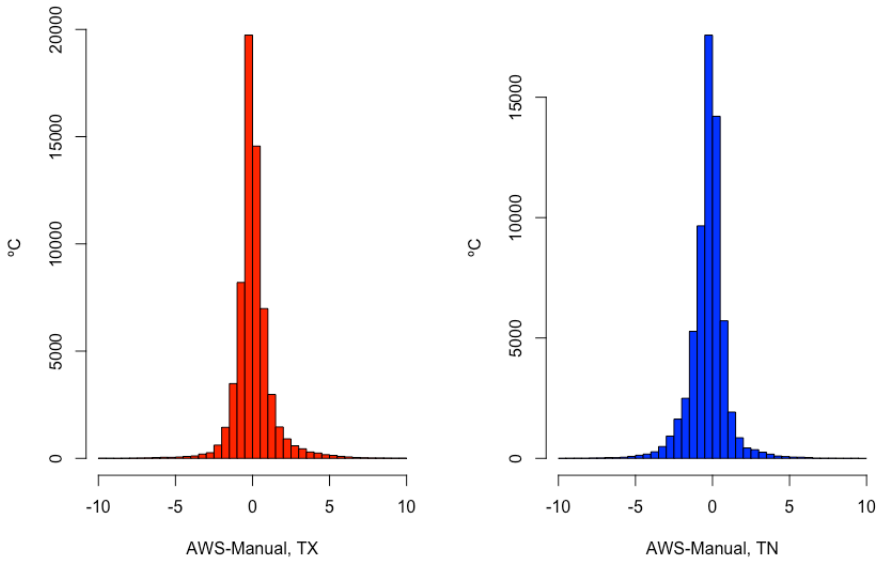


	Negative	Positive
No	0	1
Yes	17	18

Significance and Sign

	Negative	Positive
No	1	5
Yes	24	6

Significance and Sign



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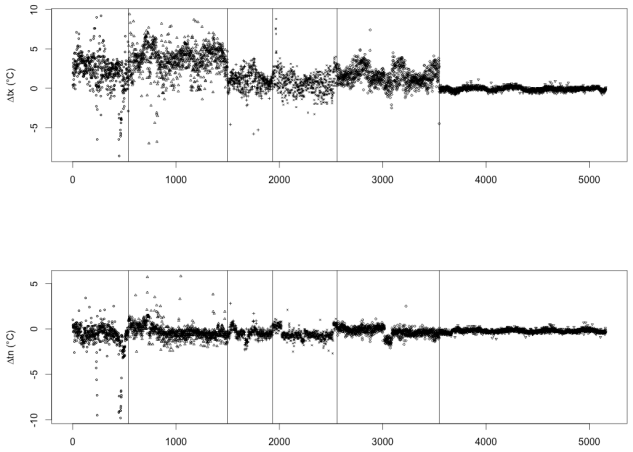
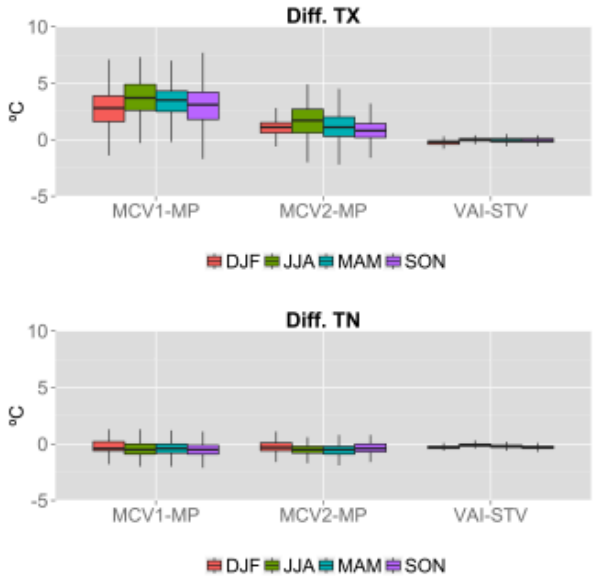
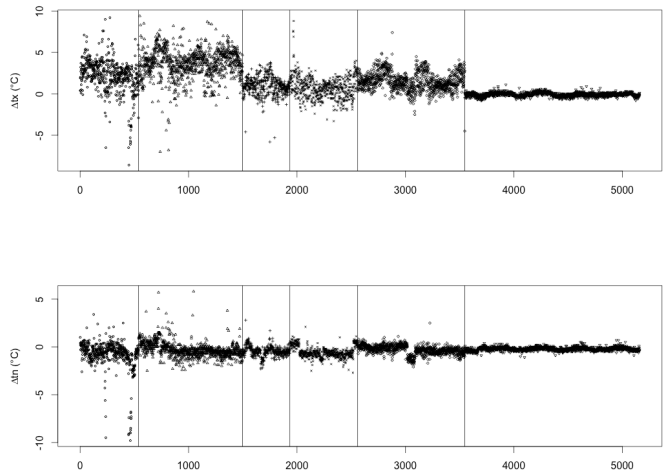


Fabra AWS-MAN

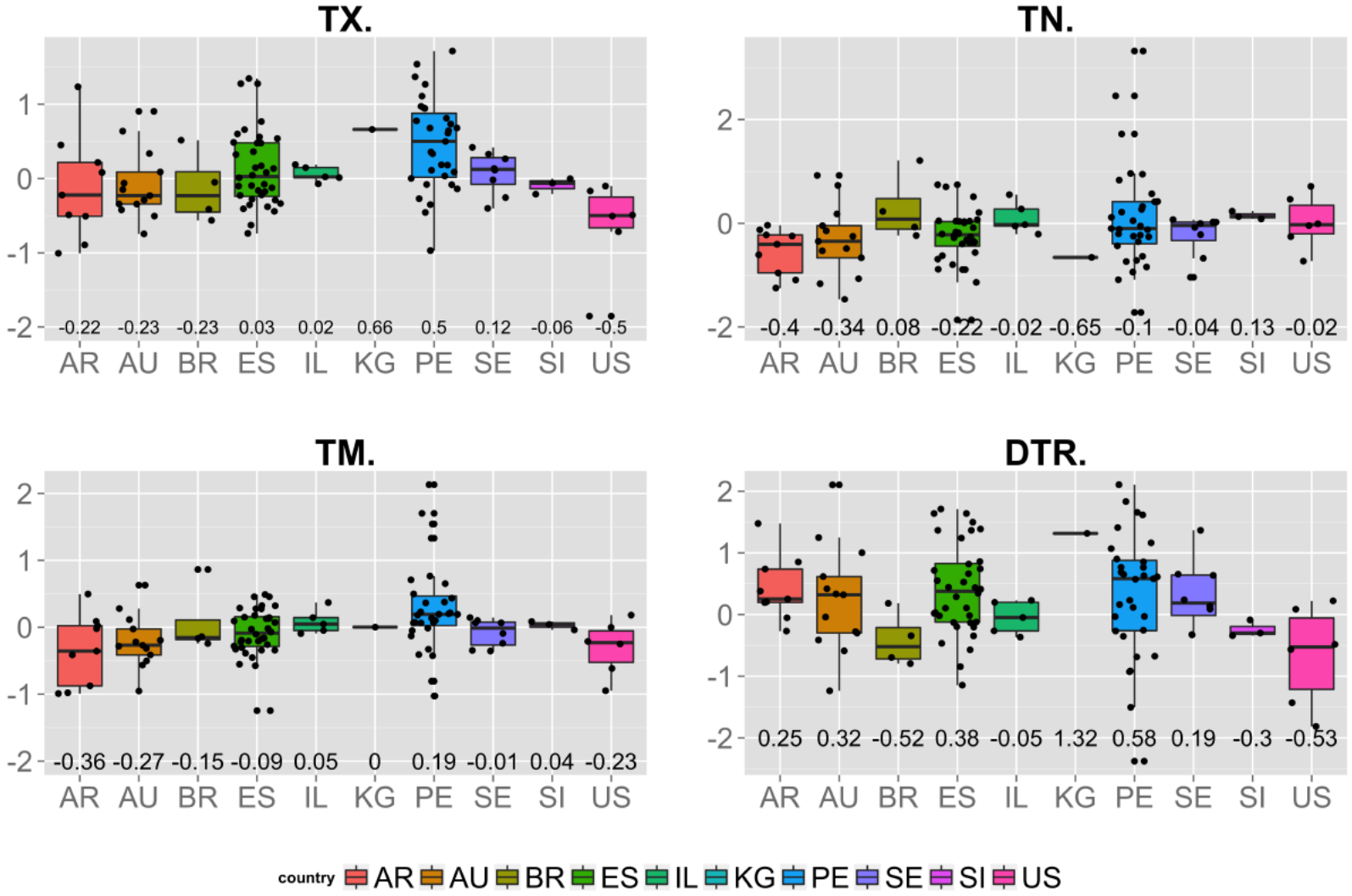
TRANSITION TO AWSs

- Internal changes in Fabra station have a **strong effect in the relation between the AWS and the Manual** measurements, specially in DTX.
- When the AWS sensor is sheltered inside the **Stevenson screen**, the **differences are much smaller** and even **reverse sign in DTX**.
- For **DTN, the changes are less dramatic** and do not imply a change in sign, but the dispersion of the difference series becomes much smaller.

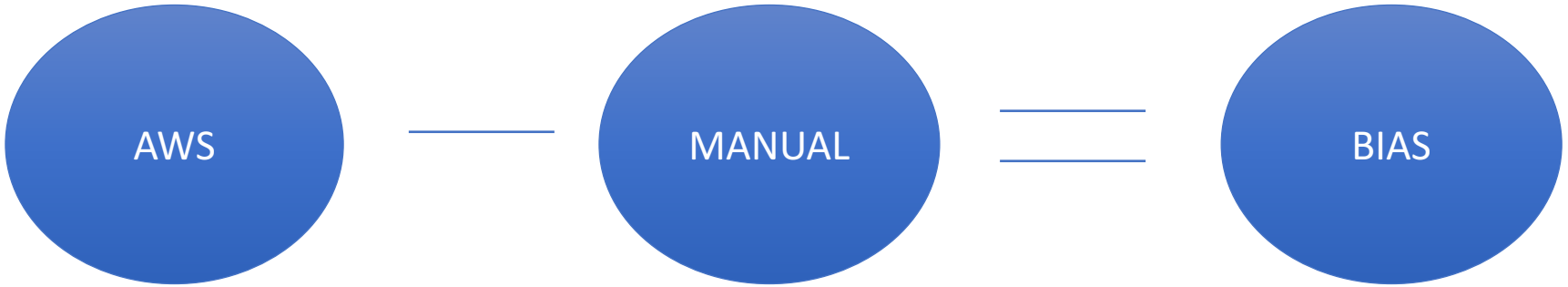




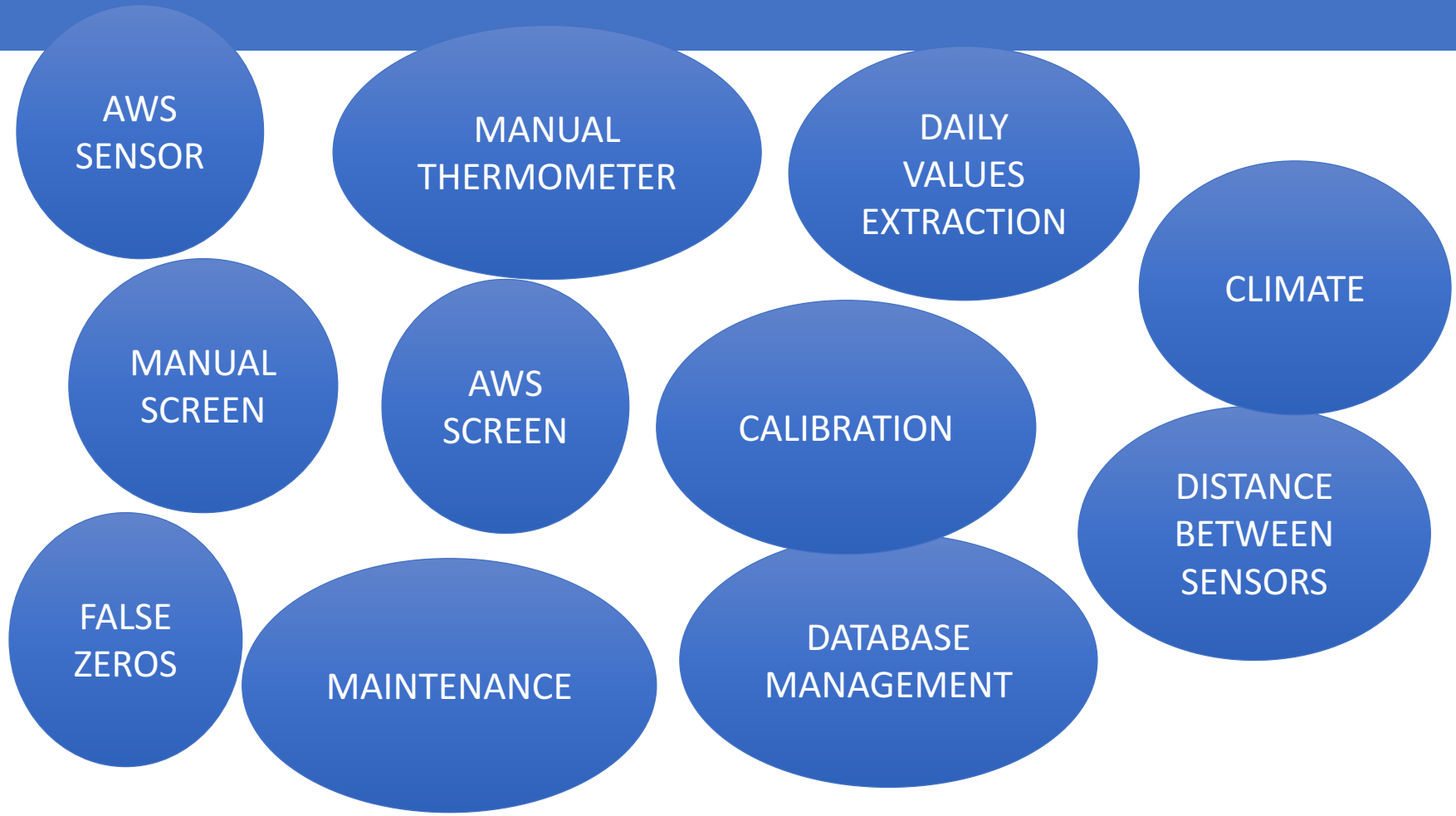
TRANSITION TO AWSs (POST)

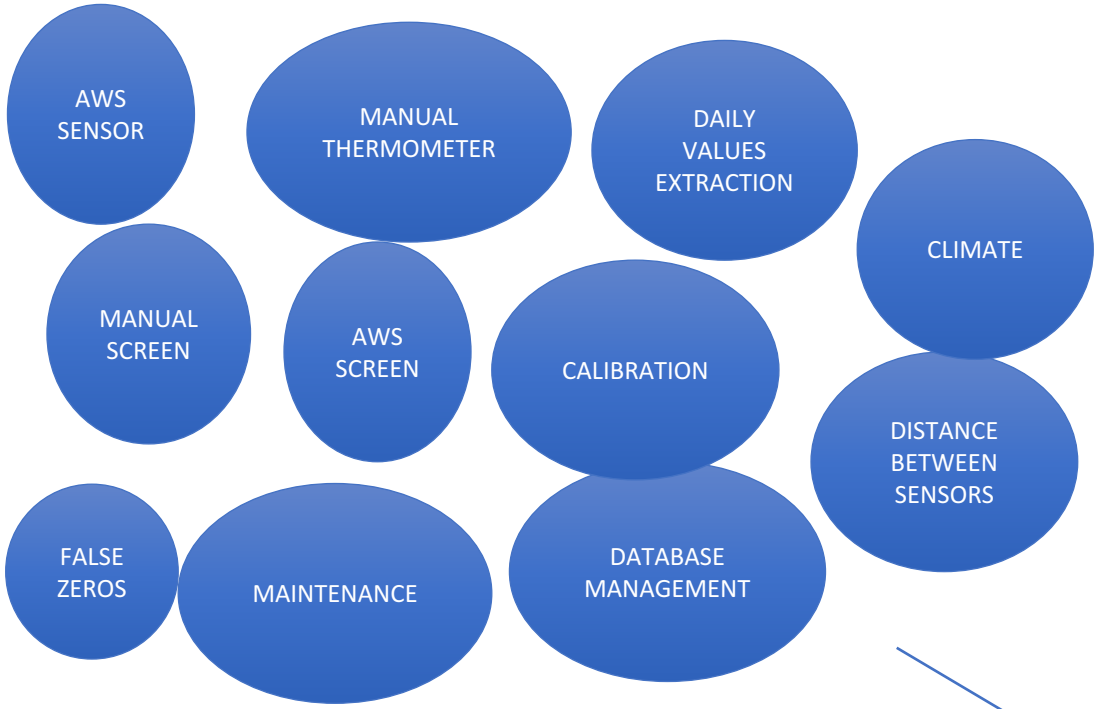


WHAT WE THOUGHT WE WERE LOOKING AT?



WHAT **ARE** WE LOOKING AT?




AWS SENSOR
MANUAL THERMOMETER
DAILY VALUES EXTRACTION
CLIMATE
MANUAL SCREEN
AWS SCREEN
CALIBRATION
DISTANCE BETWEEN SENSORS
FALSE ZEROS
MAINTENANCE
DATABASE MANAGEMENT

BIASES

ADJUSTMENT ATTEMPS. From Jesús Asín.

Discussion for Impactrón

Regression models are an option as procedure to **correct temperature bias,**

- it is a standard technique,

- to use the dependence respect to other availables variables,

- to reflect the seasonal behavior, if it exists, and the possible change of relationship of covariates and response to long the year,

It is not the 'universal' solution:

	Bias Tx	Bias Tn	Bias 10-minute temp
Screen (Stevenson-Montsouris)	39%-51%	39%-42%	--
Fabra (automatic-conventional) only temp covariates	29%	25.1%	--
Fabra (automatic-conventional) using also qfe and rh covariates	33.6%	25.2%	--
Villena (Young-Stevenson)	11.92%	5.8%	27%

STAGNATION INDEX

Data

- ERA INTERIM 1979-2015 (0,5ºx0,5º)
- ECAD gridded precipitacion (0,5ºx0,5º)

Criteria:

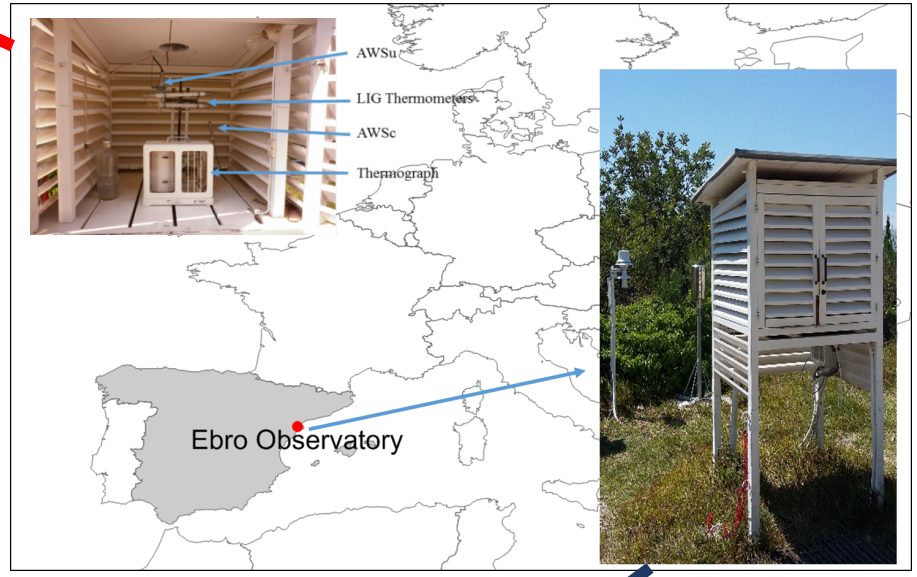
- Daily average surface wind < 4 m/s
- Daily average 500 hPa wind < 13,3 m/s
- Dry day < 1,0 mm

OBSERVATORI DE L'EBRE (Roquetes, Spain)
EXPERIMENT by Alba Gilabert and Germán Solé

Ebro Observatory field trials characteristics

- First step: AWSc-AWSu-MAN differences: from 6/2013
- Second step: Stevenson Screen – Young Screen: from 05/2016

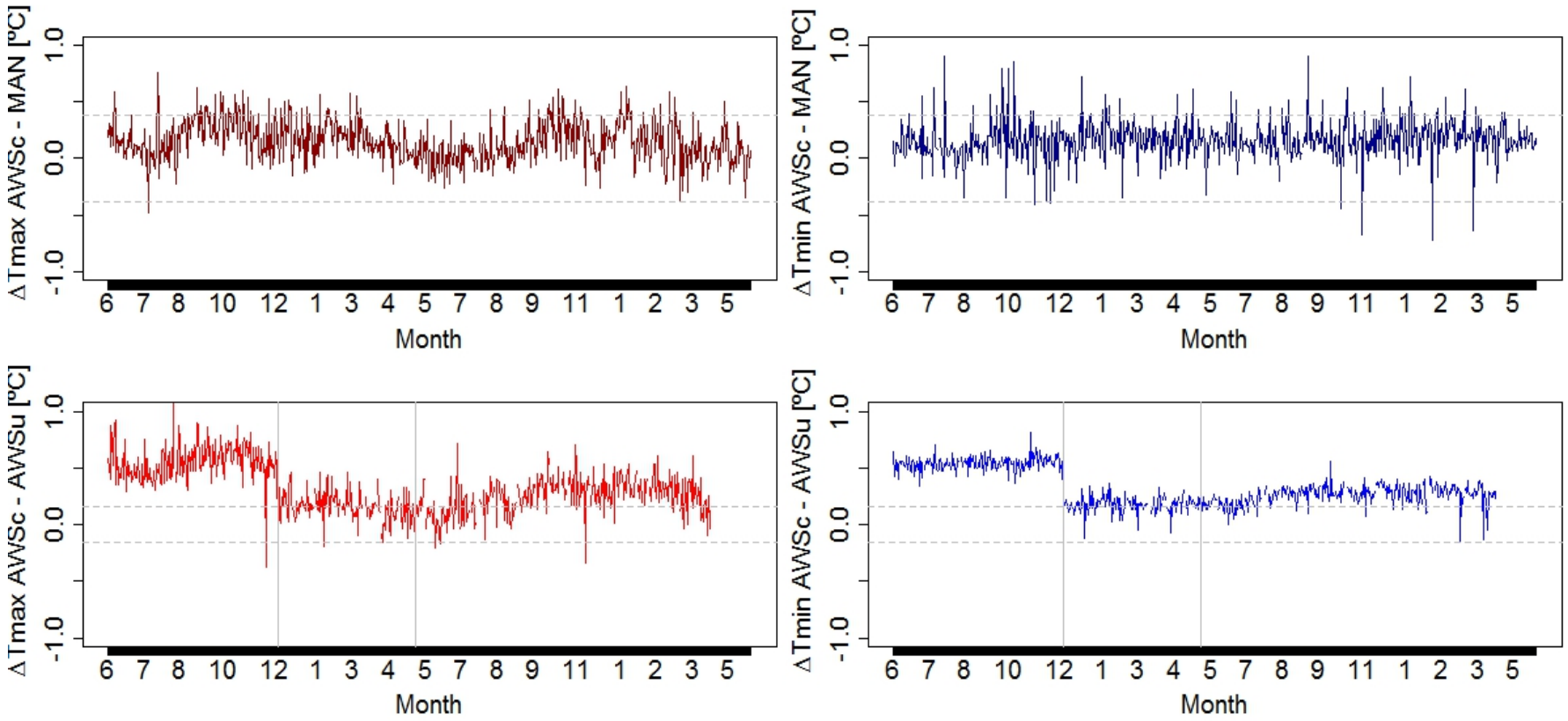
- The aim of the first experiment was the evaluation of the AWS bias plus the influence of the AWS calibration
- One sensor calibrated with metrological procedures (AWSc) was installed inside the same Stevenson screen and in the same relative position than the MAN and AWSu.
- Only following this specifications we can **assess the real differences AWSc-AWSu-MAN**



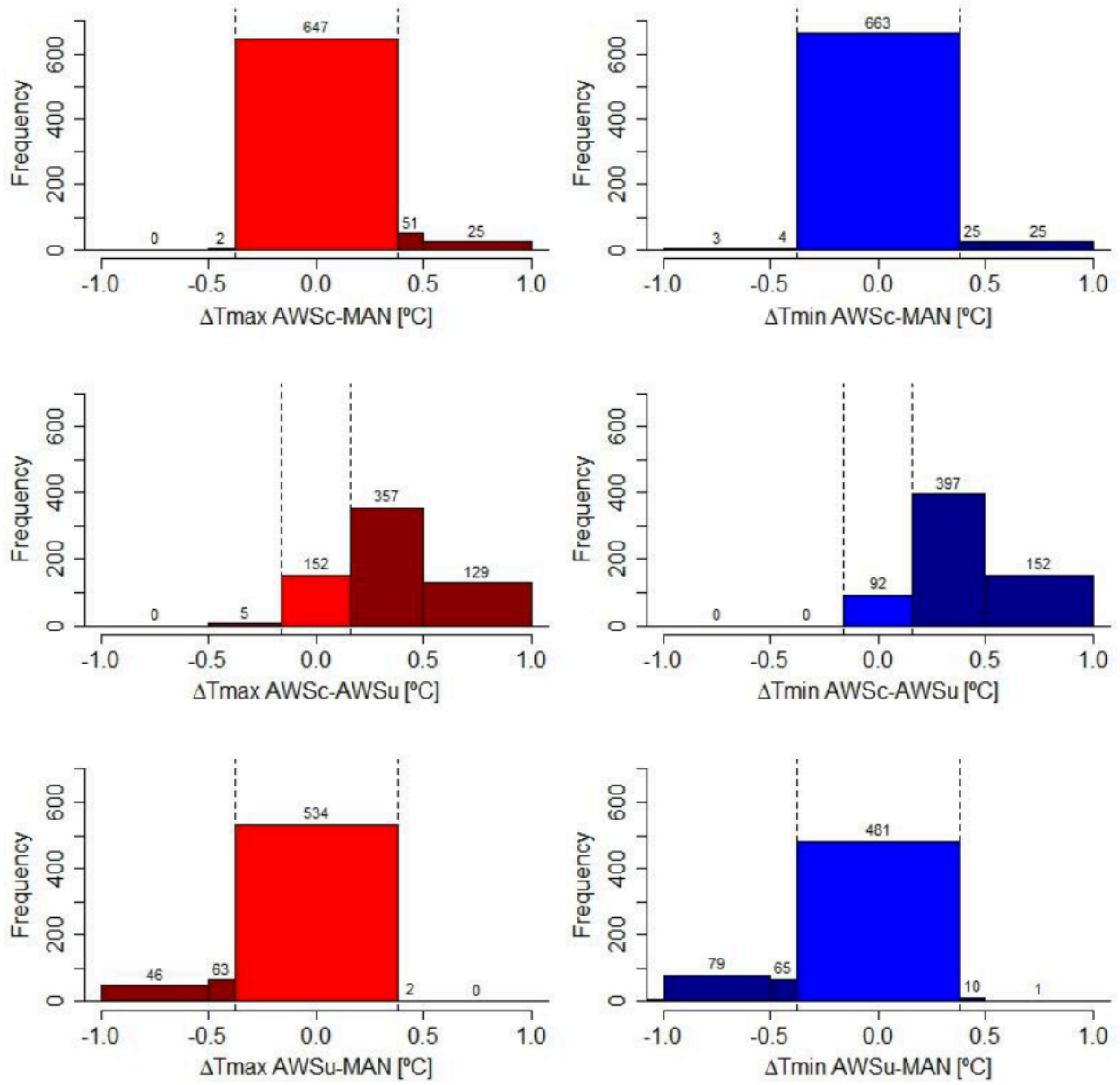
- The aim of the second experiment is the evaluation of the differences on the temperature measurement due to the different shelters: **Stevenson screen vs Young screen**
- Two **identical** sensors, calibrated regarding the same metrological standard procedures, in the same climatic chamber and the both signals are transmitted by the same system and processed with the same datalogger
- Only following this specifications we can be sure that **the differences are only due to the Stev. – Young screens**

1. AWSc-AWSu-MAN

- Using calibrated sensors in the comparisons, reduces the presence of internal inhomgoeneities.



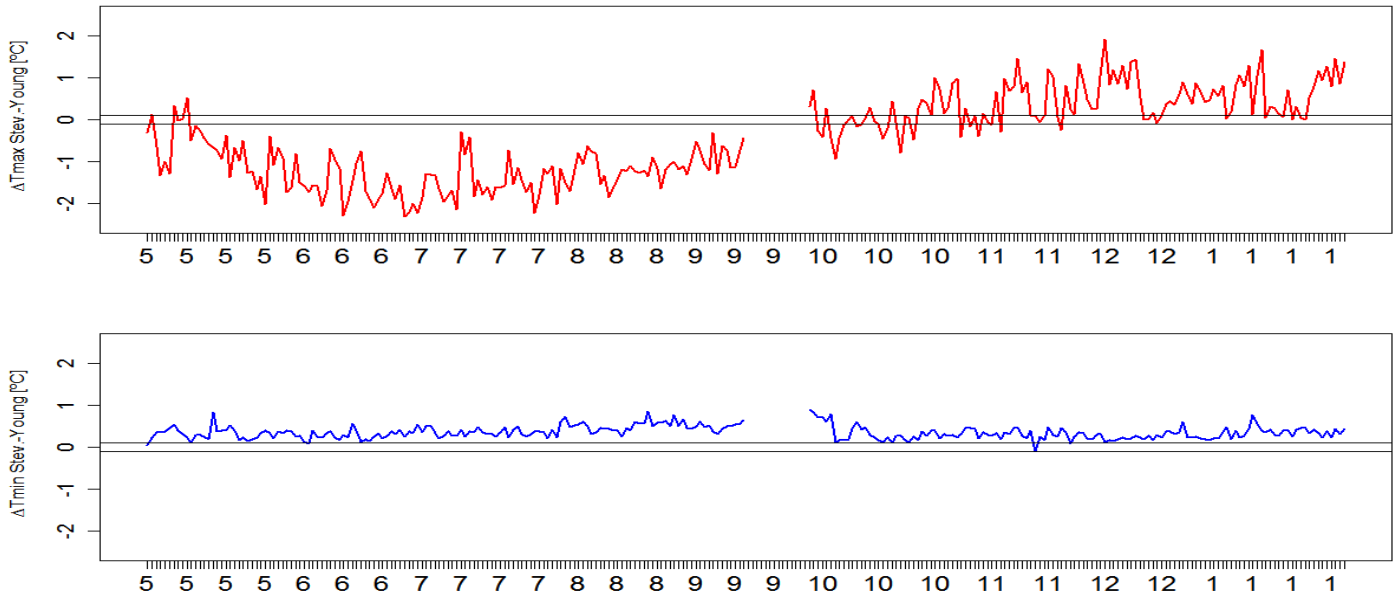
Paired ΔTmax (left) and ΔTmin (right) between AWSc – MAN (upper) and AWSc – AWSu (bottom). Horizontal gray lines the combined calibration uncertainty, vertical lines changes on AWSu due to comparison procedures



Calibration reduces the number of observations outside the uncertainty range.

2. Stevenson Screen – Young Screen

- Most part of the differences Stevenson – Young are outside the combined calibration uncertainty.



ΔTmax (upper) and ΔTmin (down) between Stevenson–Young. Horizontal lines represent the combined calibration uncertainty ± 0.1 ºC

	ΔTmax (ºC)		ΔTmin (ºC)	
	Mean	RMSD	Mean	RMSD
Year	-0.44	1.08	0.36	0.59
DJF	0.66	0.81	0.31	0.97
MAM	-0.69	0.90	0.32	0.36
JJA	-1.45	1.51	0.38	0.41
SON	-0.03	0.63	0.36	0.41

Mean and RMSD (Root-Mean Square Deviation) ***Stevenson – Young Screen*** *for all the observations, winter (DJF), spring (MAM), summer (JJA) and autumn (SON)-*

FABRA OBSERVATORY EXPERIMENTS, by Marc Prohom, Servei Meteorològic de Catalunya

1. Background and objectives

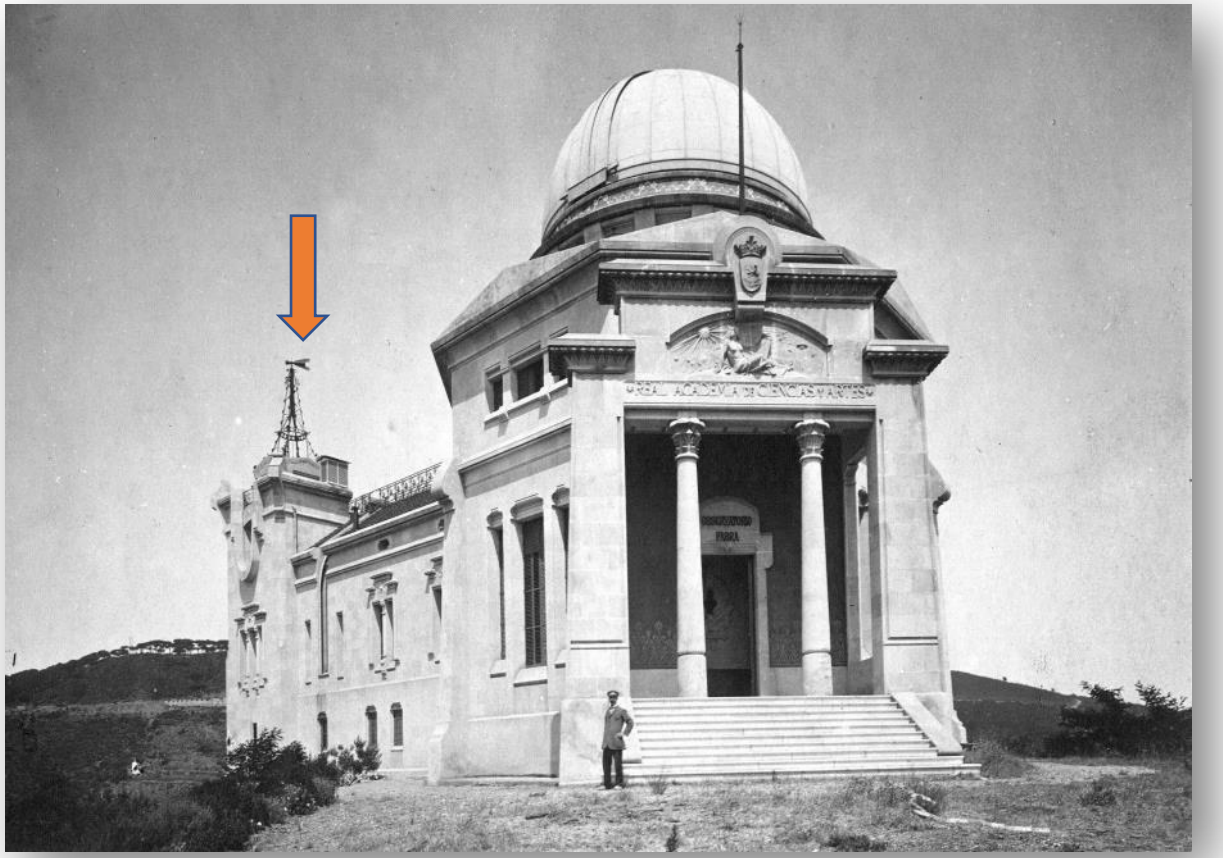
Fabra Observatory (in Barcelona, 412 m asl) has one of the longest, continuous and unchanged location series of Iberia.

Meteorological field at Fabra Observatory: 1920s (left image) – present day (right image)

For years it was believed that meteorological observations began in 1914. In 2012, evidence of previous observations appeared and the data and metadata was detected and recovered from the archives of the Royal Academy of Sciences and Arts of Barcelona.

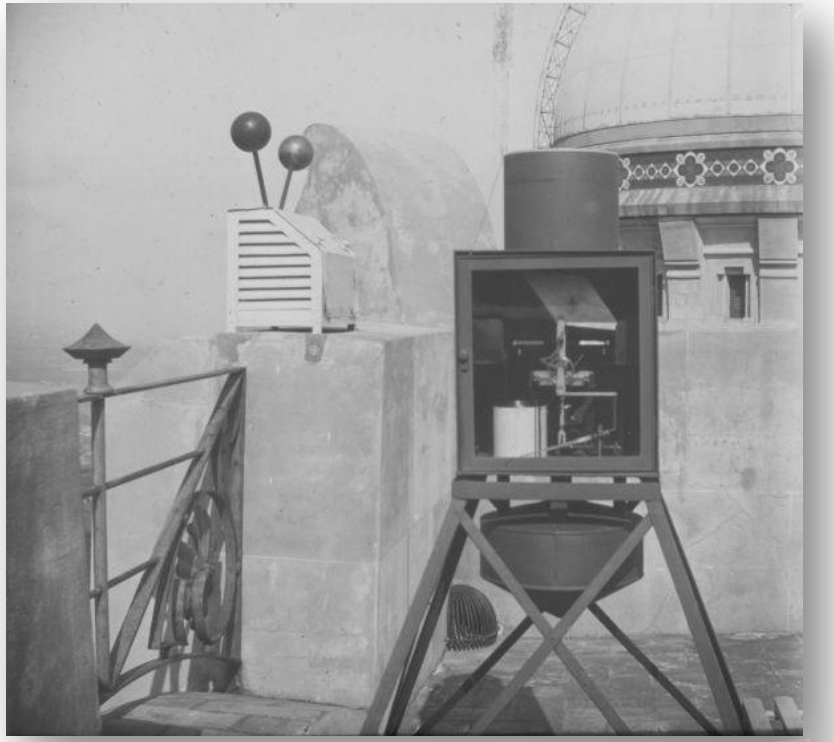
1. Background and objectives

- New data covered the period from 1904(Dec) up to 1914.
- Was recorded by weekly thermographs and pluviographs.
- The site was located at the roof of the observatory.

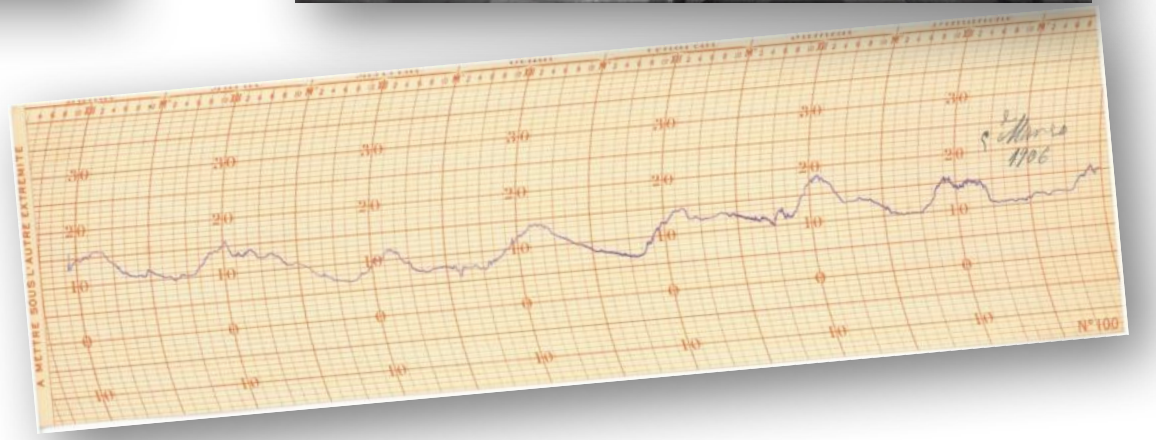


Location of the undocumented observatory

1. Background and objectives

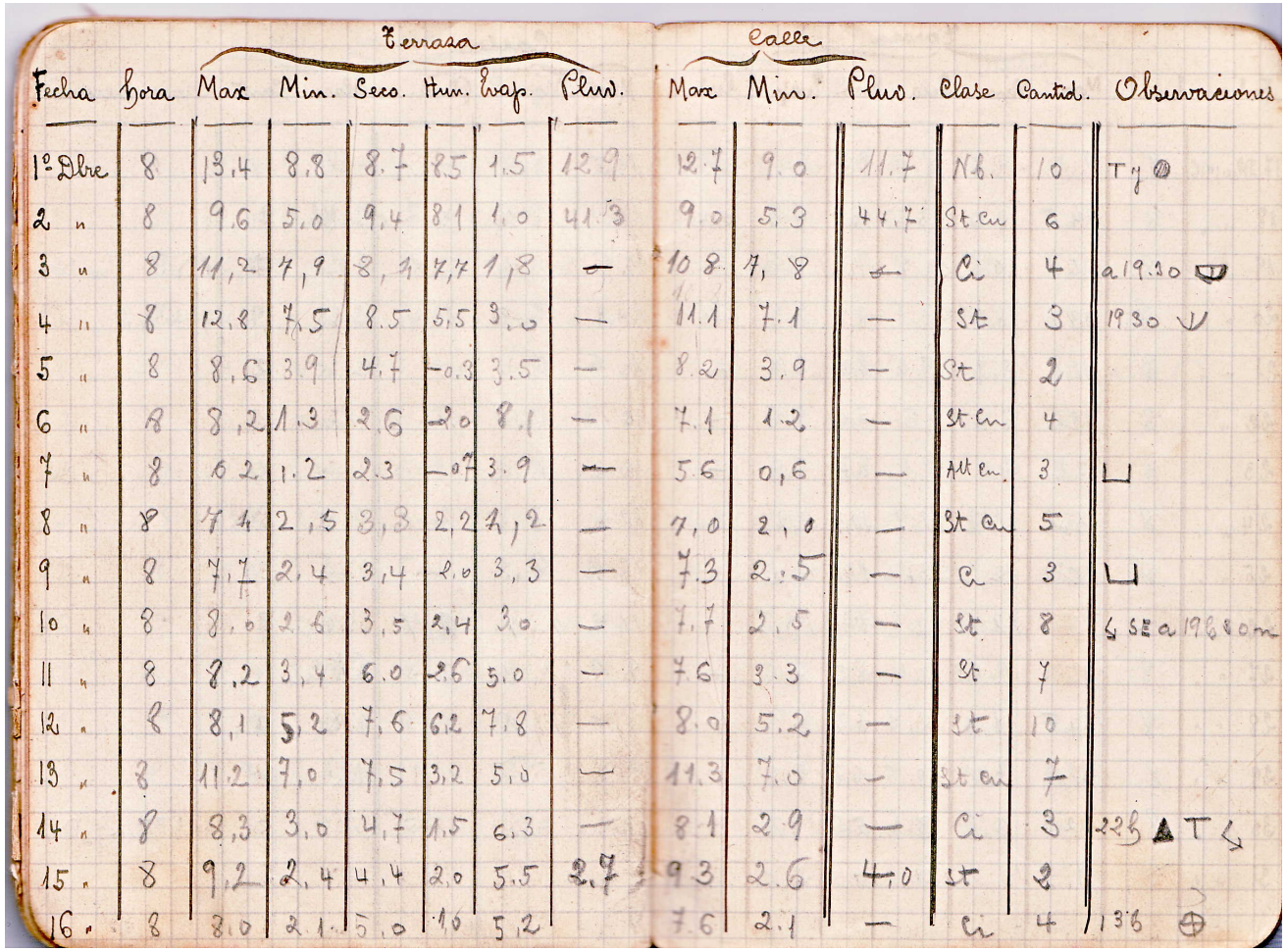


Weekly thermograph and tipping-bucked rain gauge, both Richard manufacturers



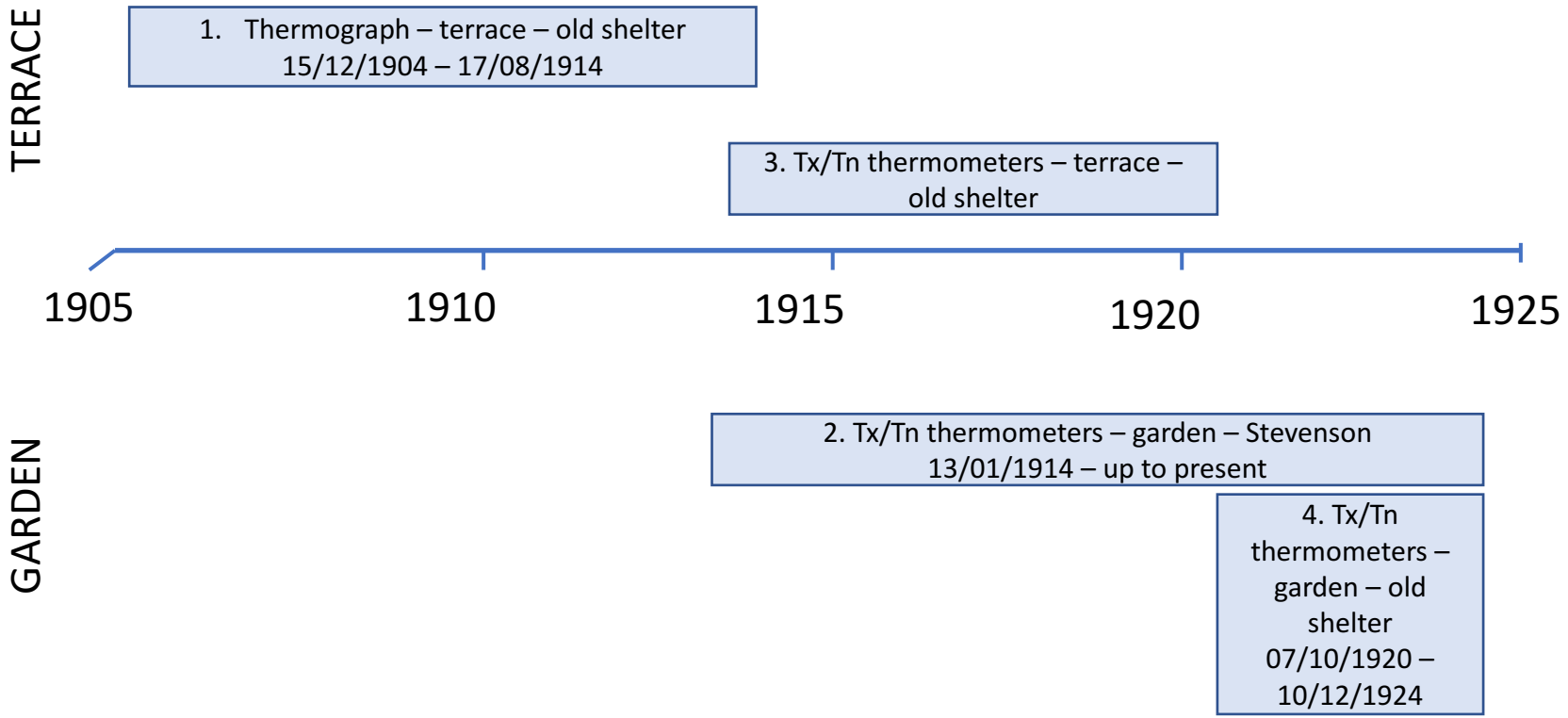
15/12/1904 up to 30/06/1914
97.9% data recovered for T and
100% for precipitation (hourly and daily)

7. New hopes…



		Terrasa						Calle					
Fecha	hora	Max	Min.	Seco.	Hum.	Evap.	Pluv.	Max	Min.	Pluv.	Clase	Cantid.	Observaciones
1º Dbre	8	13.4	8.8	8.7	85	1.5	12.9	12.7	9.0	11.7	Nb.	10	Ty
2 "	8	9.6	5.0	9.4	81	1,0	41.3	9.0	5.3	44.7	St cu	6	
3 "	8	11,2	7,9	8,1	7,7	1,8	—	10 8	7, 8	—	Ci	4	a 19.30
4 "	8	12.8	7.5	8.5	5.5	3.0	—	11.1	7.1	—	St	3	1930
5 "	8	8.6	3.9	4.7	-0.3	3.5	—	8.2	3.9	—	St	2	
6 "	8	8,2	1.3	2.6	-2.0	8.1	—	7.1	1.2	—	St cu	4	
7 "	8	6 2	1.2	2.3	-0.7	3.9	—	5.6	0,6	—	Alt cu	3	
8 "	8	7 1	2,5	3,3	2,2	2,2	—	7,0	2, 0	—	St cu	5	
9 "	8	7.7	2.4	3,4	2.0	3,3	—	7.3	2.5	—	Ci	3	
10 "	8	8.0	2.6	3.5	2,4	3.0	—	7.7	2.5	—	St	8	SE a 1986 m
11 "	8	8.2	3.4	6.0	2.6	5.0	—	7.6	3.3	—	St	7	
12 "	8	8,1	5,2	7.6	6.2	7.8	—	8.0	5.2	—	St	10	
13 "	8	11.2	7,0	7,5	3,2	5.0	—	11.3	7.0	—	St cu	7	
14 "	8	8,3	3.0	4.7	1.5	6.3	—	8 1	2 9	—	Ci	3	22h ▲ T
15 "	8	9.2	2.4	4.4	2.0	5.5	2.7	9 3	2.6	4.0	St	2	
16 "	8	8.0	2.1	5.0	1.6	5.2		7.6	2.1	—	Ci	4	13h

Parallel measurements were taken in the roof and the garden, from **January 1914 up to October 1920.**



TASKS

- Identifying more reference series (1905-1930) + dummy serie (Ebre Observatory)
- Apply HOMER to the composite series (1+2 / 1+3+2 / 1+3+4+2)
- Test VINCENT, SPLIDHOM (HOM), HOMAD, TREWIN, RHTEST, ACMANT 3.0

FABRA OBSERVATORY

Fabra Observatory (Barcelona). Three different sizes of Stevenson Screens. Experiment just starded, 1.5 years of observations guaranteed

NEXT STEPS FROM IMPACTRON

- Consolidate database:
  - Under MySQL
  - Using OwnCloud deployed over C3's Server
    - Open to use for other initiatives, specially POST
    - Allow basic queries, descriptive statistics and visualizations
- Improve data holdings
  - City vs airport
  - Transition dates for AWS-MAN
  - METADATA!!!
- Further inspect adjustment methods
- Final Workshop (next slide)

IMPACTRON'S FINAL WORKSHOP

- FORMAT: Small Seminar + training school
- TOPIC: Update on the use of parallel measurements for bias description and series adjustment.
- WHEN: Second half of November
- WHERE: Spain
- Some funding to support participants will be made available.
- Contact through the Homogenization list.

THANKS FOR YOUR ATTENTION