Description of the bias introduced by the transition from Conventional Manual Measurements to Automatic Weather Station through the analysis of European and American parallel datasets. (+ Australia, Israel & Kyrgyzstan)

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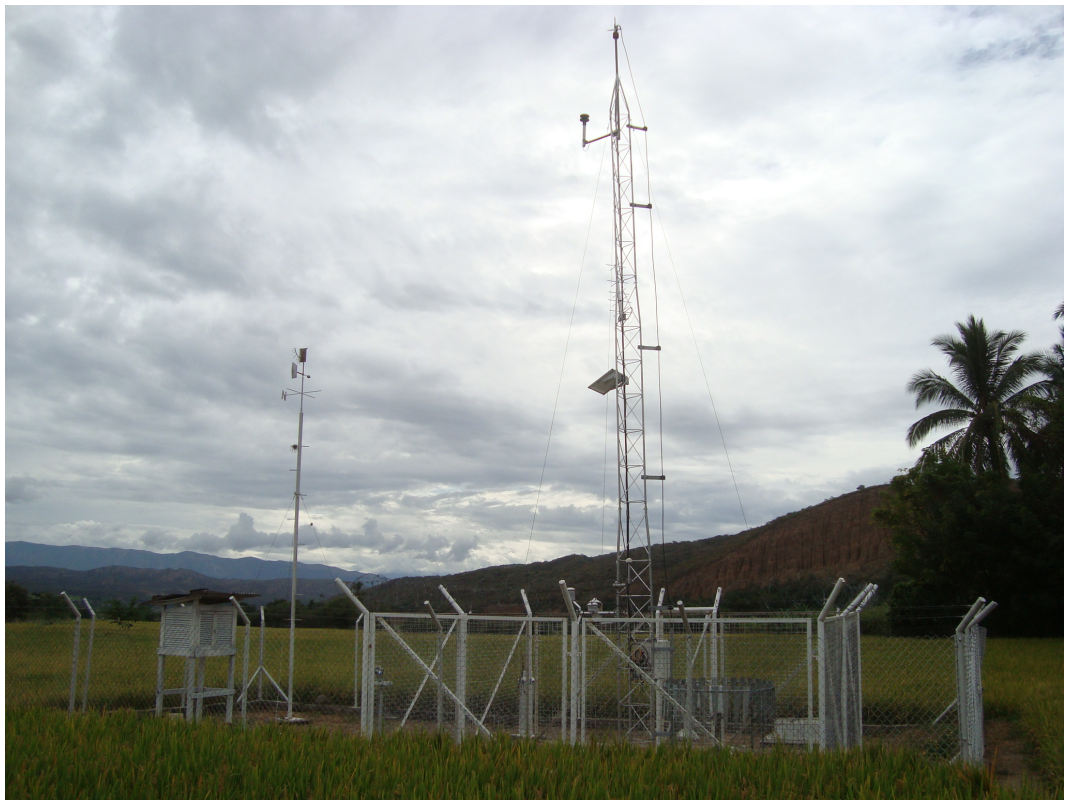
October-2015. Saint-Gallen.

IN THIS TALK

- Motivation.
- POST & the AWS-Manual transition dataset.
- Results: networkwide; per country; some particular cases.
- Summary, further work.



Jaen Station (Peru)

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MOTIVATION

- We have inhomogeneities.
- Daily data homogenization needs to be improved.
- Parallel measurements help us to empirically compare the effect of transitions between systems.
- Their analysis contributes to : create realistic benchmarks; validate homogenization; evaluate uncertainty.

PARALLEL OBSERVATIONS SCIENTIFIC TEAM (POST)

- This talk AWS-Manual temperatures < POST-AWS < POST < ISTI
- **POST is a Working Group of the International Surface Temperature Inititative (ISTI)**, which intends to contribute to the creation and delivery of reliable climate services produced with an open and transparent procedures: www.surfacetemperatures.org
- POST works to **create a global parallel dataset** to enable the **study of systematic biases** in the national, regional and global records of different Essential Climate Variables (ECVs).

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NUMBER OF STATIONS FOR EACH DATASET (TEMPERATURE, TX, TN, TM, DTR)

COUNTRY	STATIONS	DETAILS ON AWS STATIONS
Argentina	9	No info available at this point
Australia	13	Stevenson shelters; AWS are relocations
Brazil	4	AWS sensors in Young screens
Israel	5	AWS Campbell/Rotronic (repl. 2005) in Stevenson
Kyrgyztan	1	Vaisala HMP45C in non-stevenson shelter
Peru	31	AWS sensors in multiplate shelters
Slovenia	3	iButton probes in same Stevenson Screen than LIG
Spain	35	Mixture of Stevenson and non-Stev. (Young type)
Sweden	8	AWS in multiplate screens (Young Type)
USA	6	AWS in fan aspirated solar radiation shields

- POST is preparing a metadata template to distribute to partners

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QUALITY CONTROL

- More than 300,000 values checked.
- Set to **error**: |t| $>$ 60º, |AWS-CON| $>$ 10ºC , value of |t| $>$ 40Cº & |AWS-CON| $>$ 5, TX $>$ TN.
- Set to **very suspect**: outliers in temperature and difference (4 IQR).
- Set to **suspect**: outliers either in temperature or difference (4 IQR).

	1	2	3	4	9
tx	1.19	0.01	0.02	97.80	0.98
tn	0.60	0.02	0.02	98.59	0.77

Percentage of values flagged during QC.

1.- Error; 2.- Very Suspect ; 3.- Suspect ; 4 Passed QC; 9 NA.

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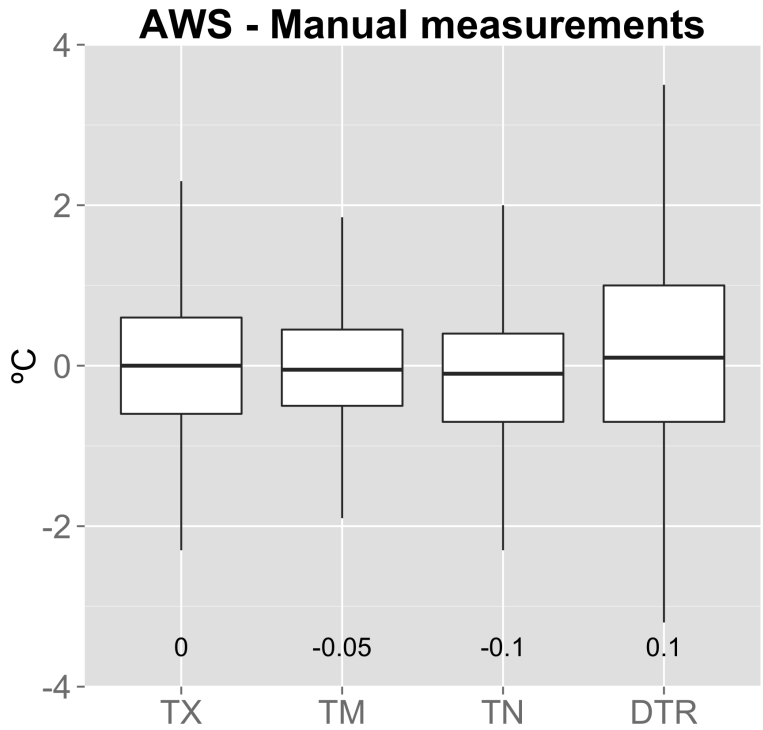
BIAS ANALYSIS. FULL DATASET

- This analysis is run using all the data which was not labelled as error in QC (level > 1).
- The median bias in TX and TM is 0.0ºC, meanwhile it is -0.1 in TN and +0.1ºC in DTR.
- Wishkers indicate spread (1.5 times IQR).



- Even though these results are not representative (different years, different number of values, uneven area coverage, etc.), they show to some extent the cancellation exerted by different sign biases.

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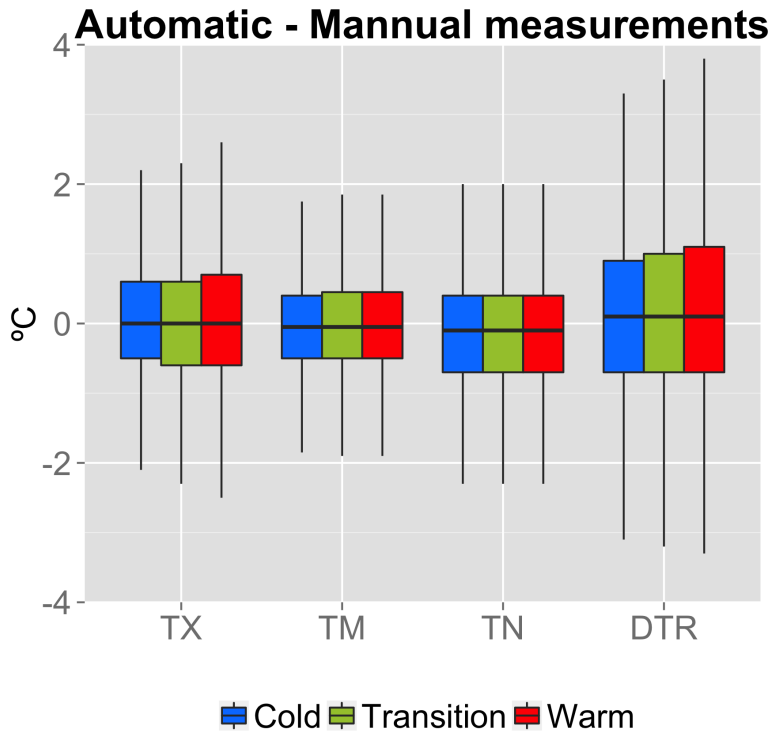
BIAS ANALYSIS. FULL DATASET. SEASONS

- **Cold** and **Warm** seasons have been adapted to each hemisphere (DJF for HS, JJA for HN).
- MAM and SON are labelled as **Transition**.



- Values are **similar to** those found for the **year-round** analysis.
- **Warm season** shows slightly **larger dispersion**.

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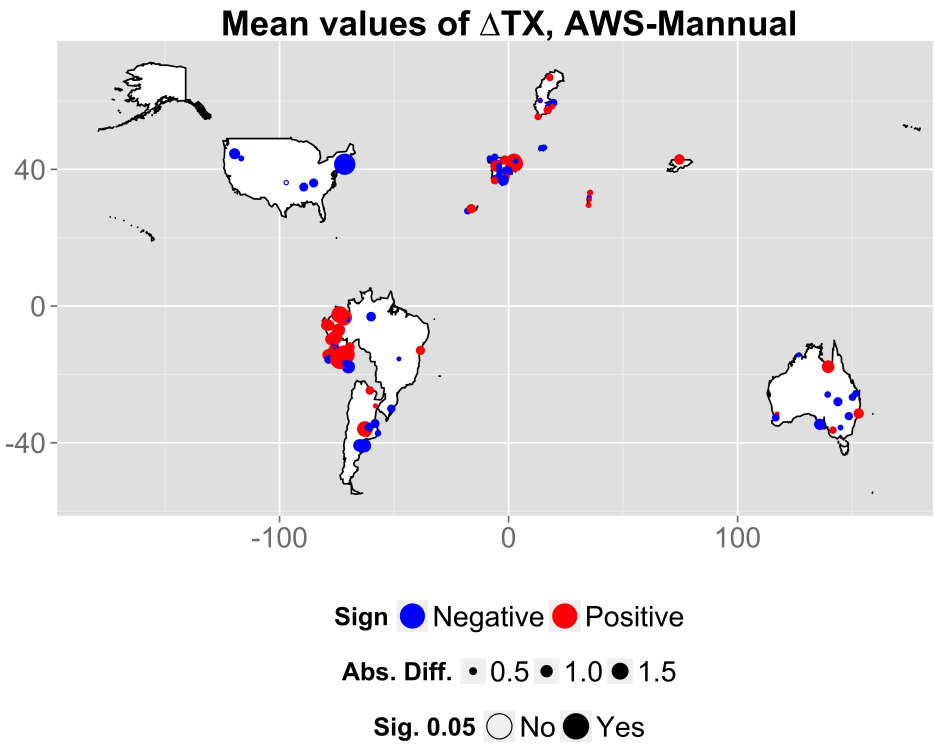
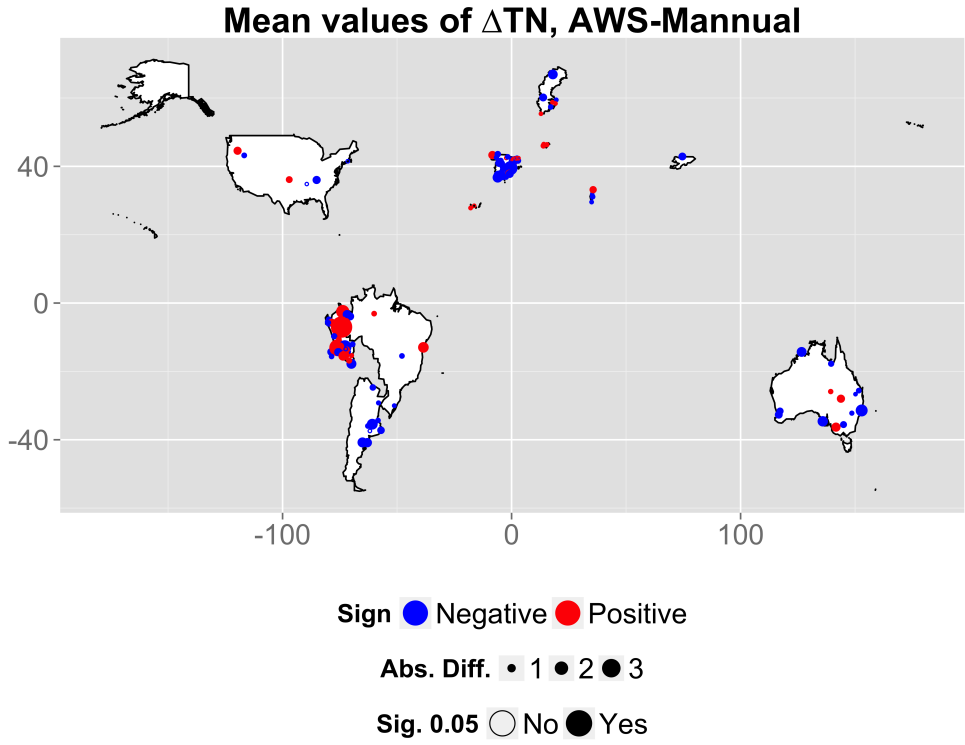
MEAN BIAS (AWS-Manual) PER STATION. TX, TN.





	Negative	Positive
No	3	4
Yes	51	58

Significance and Sign

	Negative	Positive
No	6	5
Yes	70	35

Significance and Sign

- Most diff. **significant**. In **TN** 2/3 of the series show **cooler AWS**.

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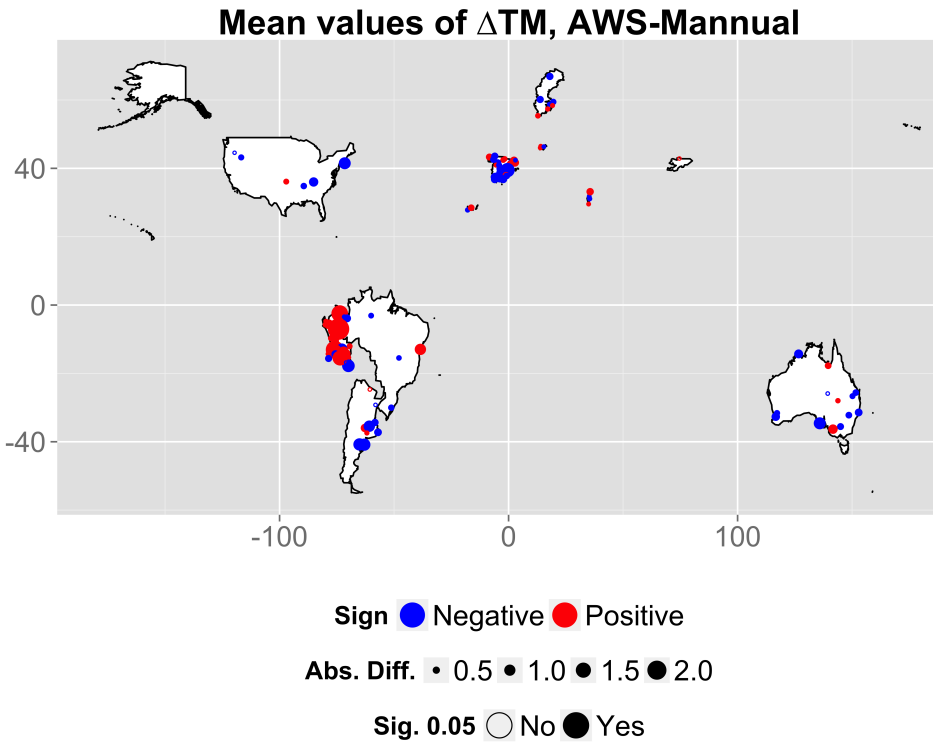
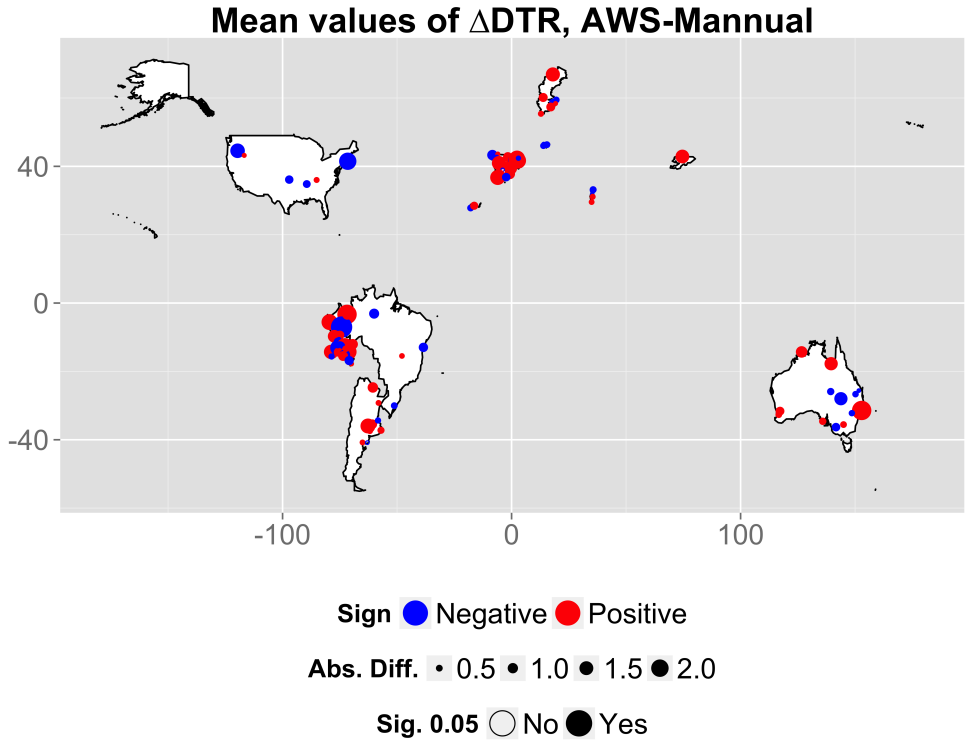
MEAN BIAS (AWS-Manual) PER STATION. TM and DTR





	Negative	Positive
No	5	2
Yes	55	54

Significance and Sign

	Negative	Positive
No	5	2
Yes	41	68

Significance and Sign

- Most diff. **significant**. More than 60% of **AWS show larger DTR**.

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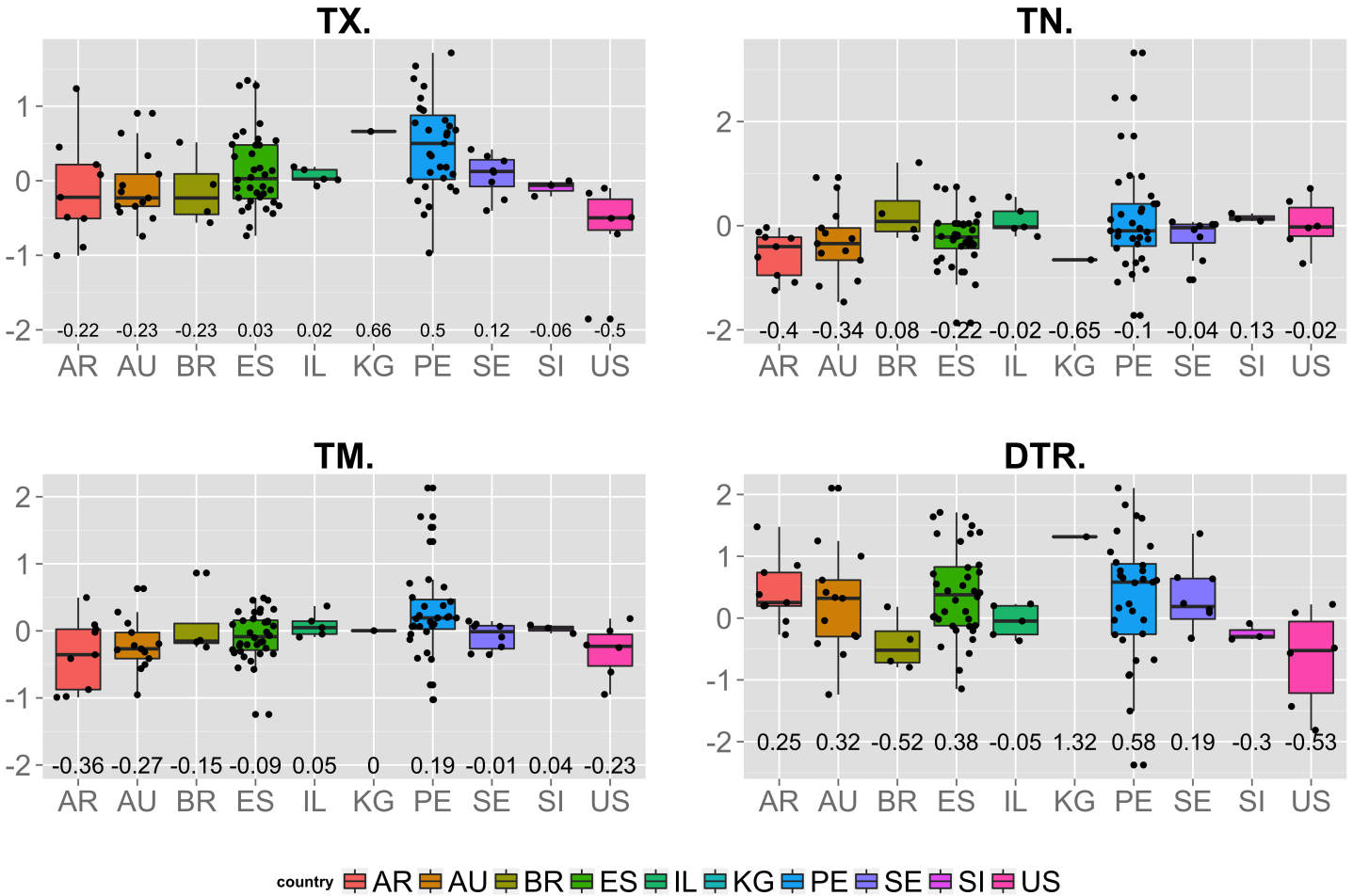
BIAS (deg. C) AWS-MANUAL PER COUNTRY



- **Different countries = different results**. Eg. Peru shows larger bias in Tx than other countries and Irael shows no bias in DTR.
- **More data is necessary** to reach more solid conclusions.

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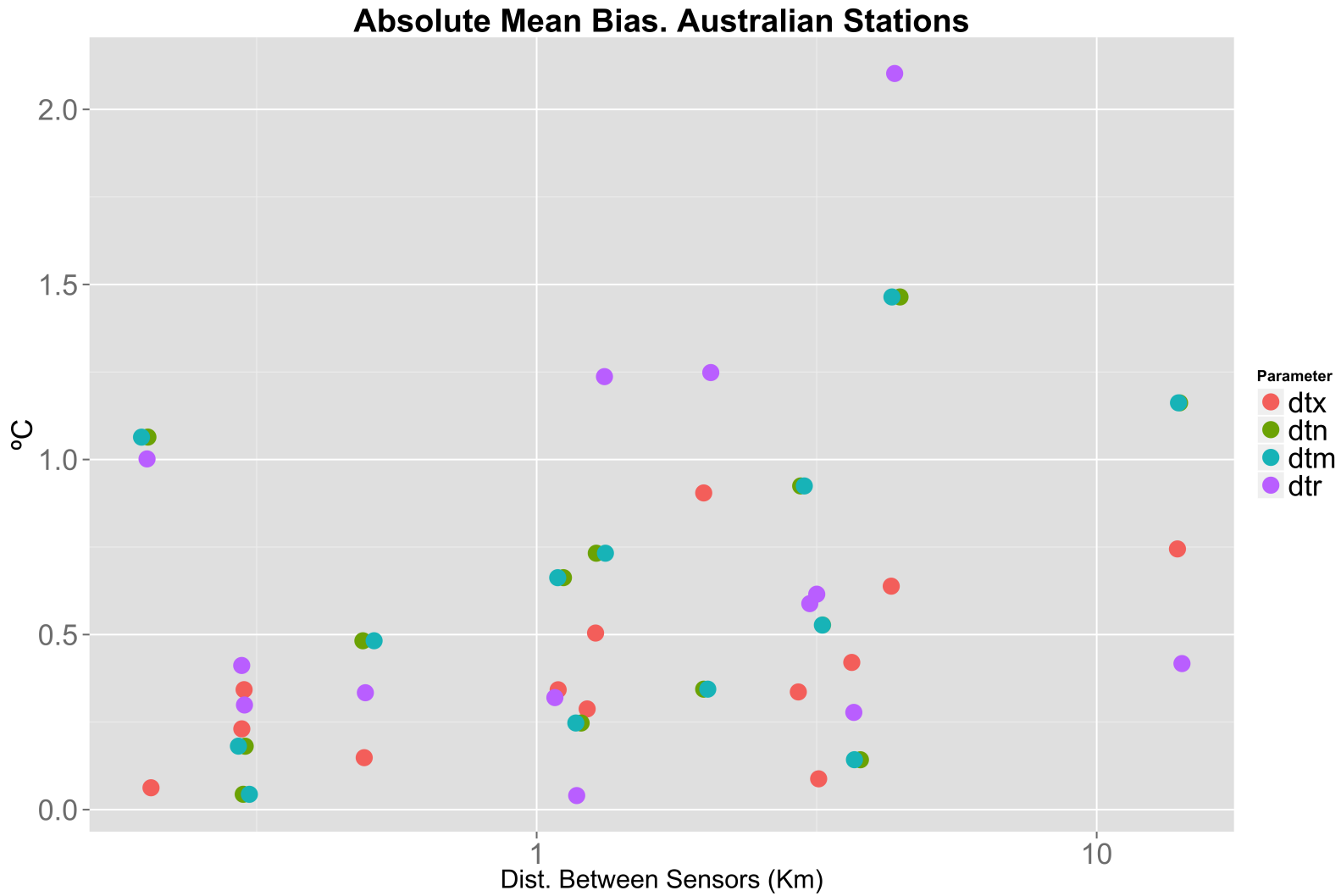
INFLUENCE OF OTHER FACTORS. **AUSTRALIA** .



- The plot shows a tendency of the **absolute mean bias to grow with increasing distance** between sensors.

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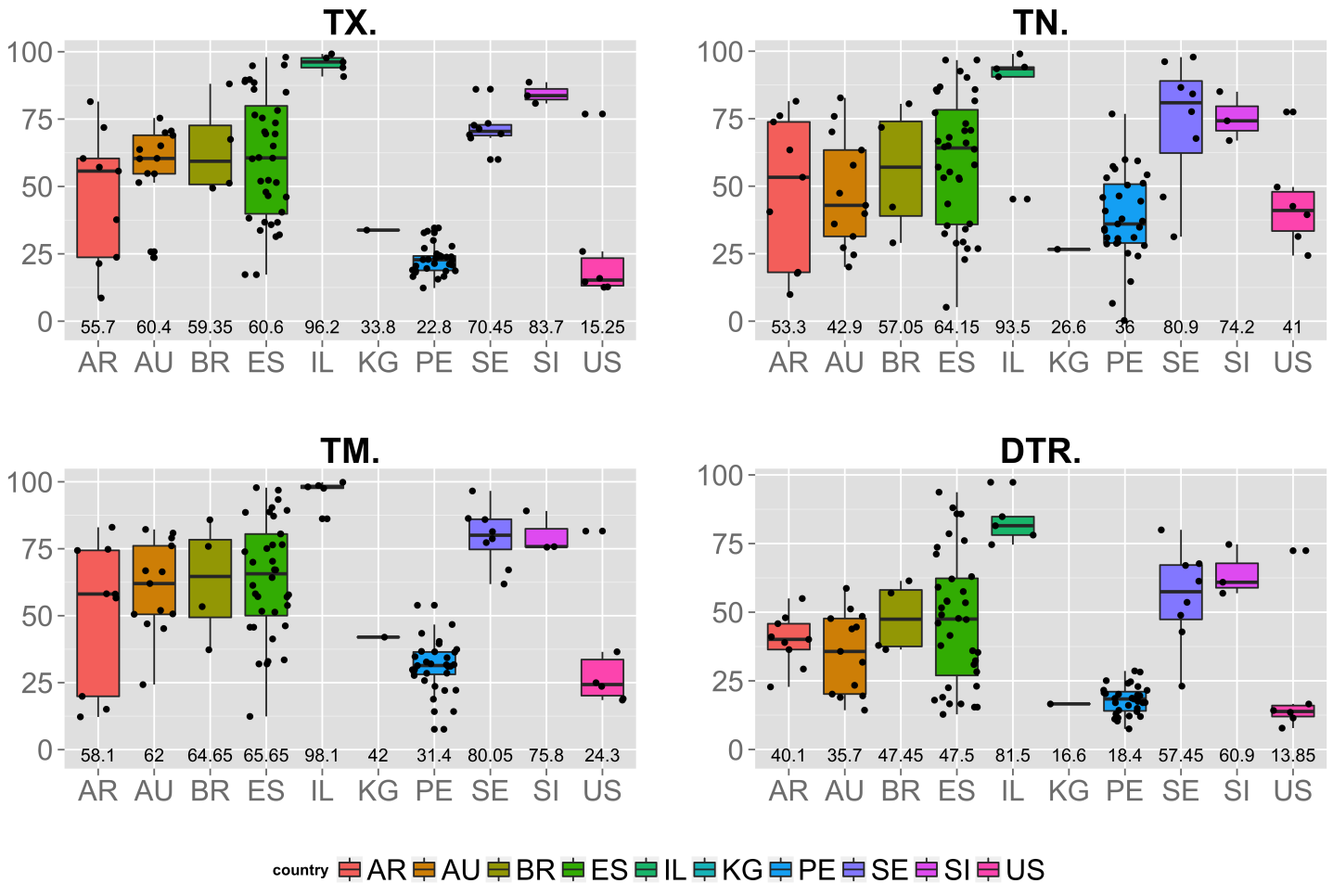
PERCENTAGE ABS. AWS-MANUAL < 0.5



- **Israel** (nearly 100%), **Slovenia and Sweden** show the larger % of diffs in a $|0.5|$ range. Notice **larger spread in TN, specially Sweden and Peru**.

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EFFECT OF INTERNAL INHOMOGS. **ISRAEL** (METADATA)

Israel made available detailed metadata:

Station	Code Man/AWS	Parallel Period	AWS Type
Eilat	9972/9974	01/05/2001-08/07/2002	Campbell 107
Eilat	9972/9974	09/07/2002-31/05/2008	Rotronic-MP101
Zefat	4640/4642	01/02/2003-30/06/2008	Rotronic-MP101
Jerusalem	6770/6771	01/01/1996-31/08/2005	Campbell 107
Jerusalem	6770/6771	01/09/2005-29/02/2008	Rotronic-MP101
Kefar Blum	8471/8472	01/07/2005-31/03/2009	Rotronic-MP101
Sedom	9570/9571	01/01/2003-30/04/2009	Rotronic-MP101

- Even more detailed information and pictures was made available by Israel Meteorological Service.

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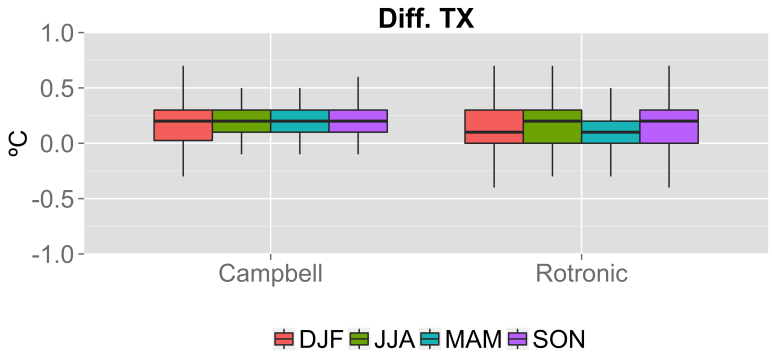
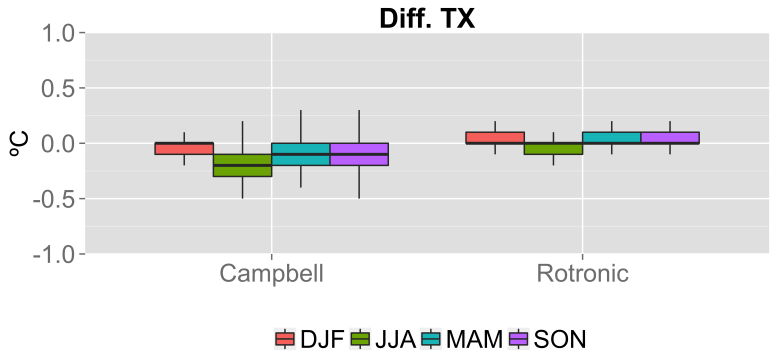
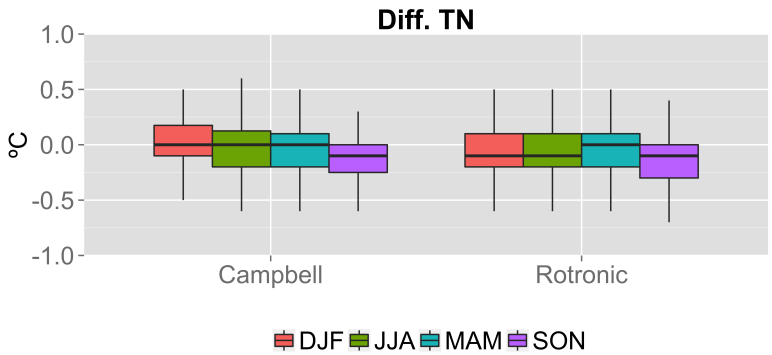
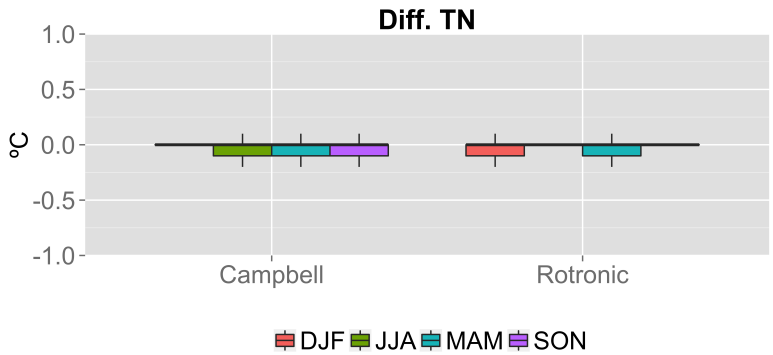
EFFECT OF INTERNAL INHOMOGS. EILAT (left), JERUSALEM (right), **ISRAEL**









- The effect of the sensor change is relatively small in absolute magnitude.
- But some seasons (eg. Eilat, winter, DTN) reverse sings of the median difference after the replacement.

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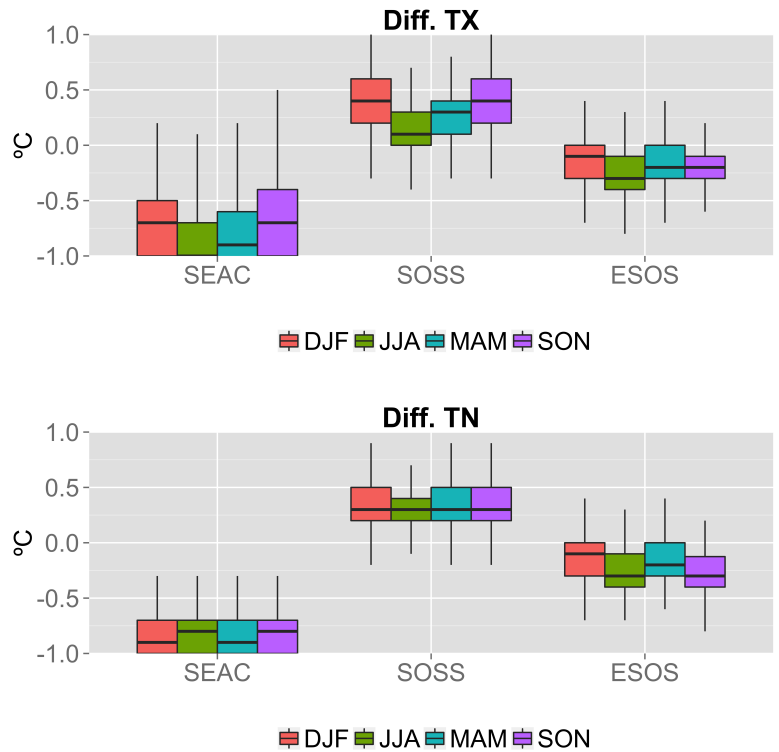
INTERNAL INHOMOGENEITIES. OBSERVATORIO-EBRO, **SPAIN**

- The **Observatorio del Ebro, near Tortosa (Tarragona, Spain) is the longest paralell record** we have available for Spain.
- The AWS sensors are **always located inside the same Stevenson Screen** of the LIG manual measurement.
- DTX and DTN bias changes **up to 1ºC, reverses sign and alters seasonality** with sensor changes



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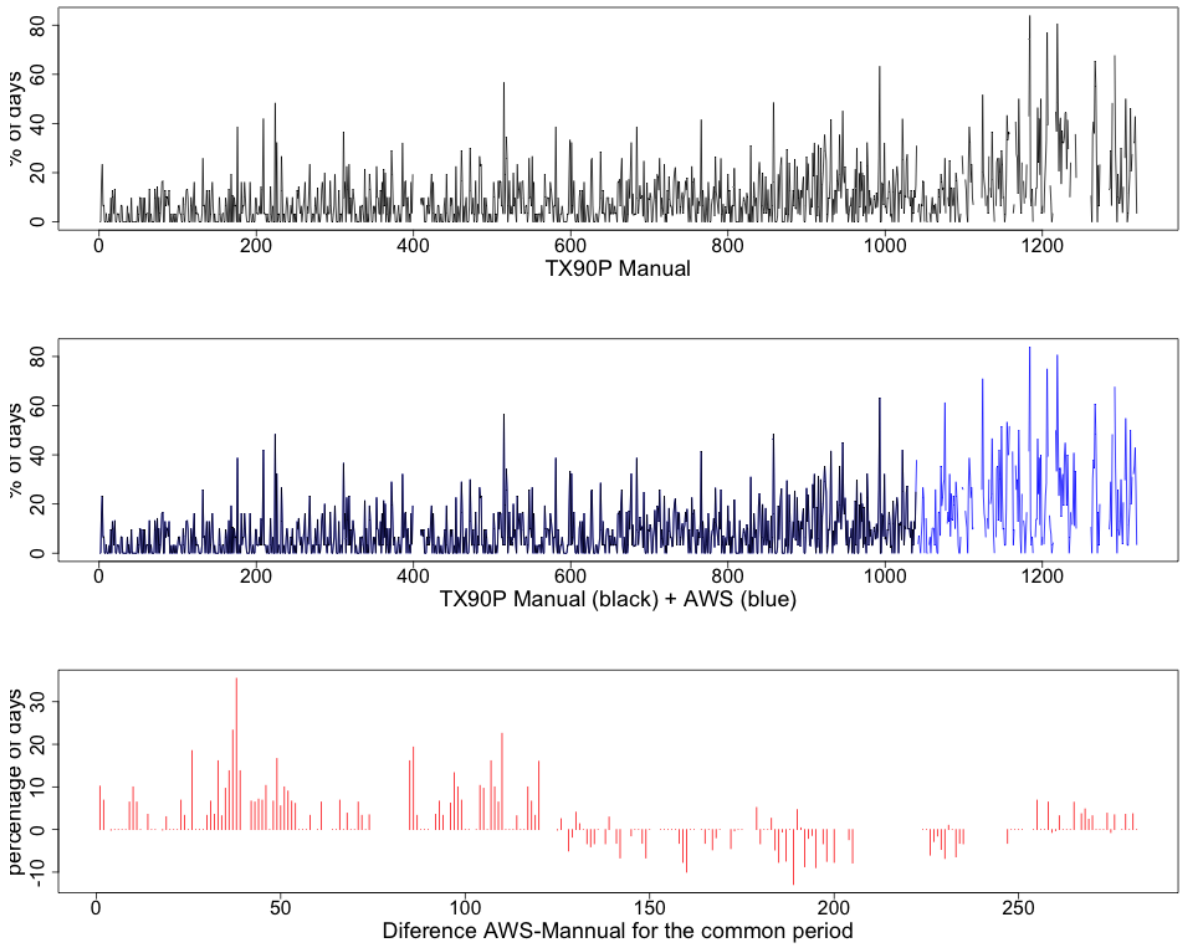
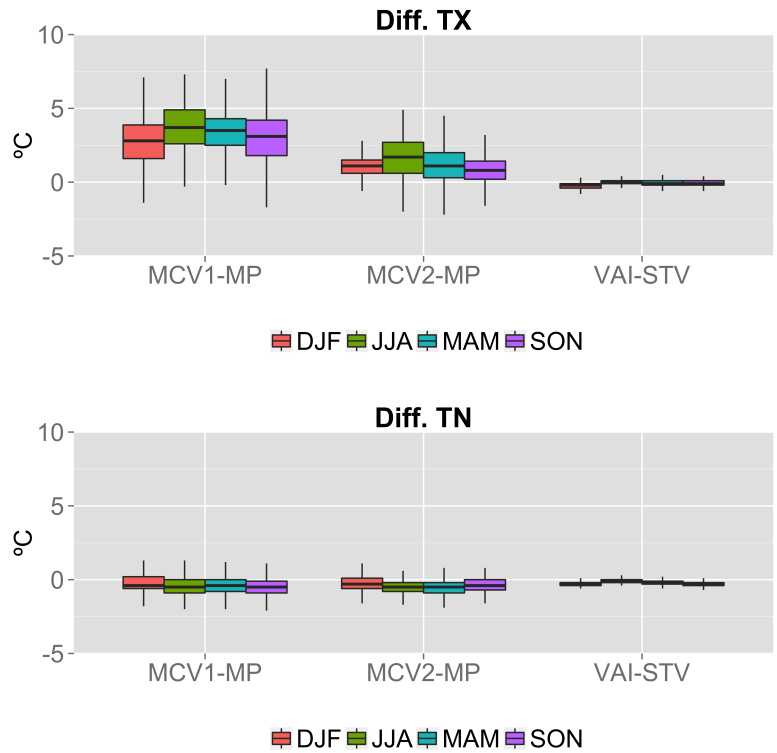
EFECT OVER ETCCDI INDICES.TX90p. OBSERVATORIO-EBRO, SPAIN

- Introduction of AWS affects mean values and also ETCCDI indices. Sensor changes are evident.



INTERNAL INHOMOGENEITIES. BARCELONA-FABRA, **SPAIN**

- Internal changes in Fabra station have a **strong effect in the relation between the AWS and the Manual** measurements, specially in DTX. (Notice the change in y-axis scale)
- 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.



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STRATIFICATION OF THE DIFFERENCES WITH OTHER VARIABLES IN BARCELONA-FABRA

Median differences AWS-CON for the third period (AWS in Stevenson)

	TX	TN
sun <= 03 hours	-0.2	-0.2
sun >= 10 hours	0.0	-0.2
wind sp. <= 2 m/s	-0.2	-0.3
wind sp. >= 6 m/s	0.0	-0.2
precip <= 1 mm	-0.1	-0.1
precip >= 5 mm	-0.2	-0.2

- We intend, if data is available, to stratify the results with other variables / weather types.

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SUMMARY

- We have presented a dataset of temperature observations for the study of the transition between AWS and Manual observations.
- Although averaged biases over the whole dataset are not remarkable, most individual stations show significant differences.
- These differences vary much between countries and within countries.
- Differences affect not only the mean, but also extremes and ETCCDI indices.
- Instrumentation and sheltering plays a very important role, easily identificable.
- At this point we cannot determine whether different climates imply different biases.
- Other factors such as internal inhomogeneities and distance between the parallel measurements must be taken into account.
- The more data we have, the more solid conclusions we will be able to reach.

ACKNOWLEDGEMENTS AND FURTHER WORK

- This study has been possible thanks to the kind contributions of many coauthors and their institutions.

- It will continue under the guidance of POST.
- POST intends compile the largest possible dataset of transition (including AWS - Manual) to understand their effect on climate series.
- POST is your playground. Come and play!

- More info about POST: `http://tinyurl.com/ISTI-Parallel`.
- Interested in joining us? Contact chair, Victor Venema, after EMS at `Victor.Venema@uni-bonn.de`.

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Thanks for your atention and thanks to:

Universitat Rovira i Virgili, Center for Climate Change, C3, Tarragona, Spain, Global Change Research Centre,Czech Academy of Sciences, Brno, Czech Republic, Czech Hydrometeorological Institute, Brno Regional Office, Brno, Czech Republic, University of Bonn, Meteorological Institute, Bonn, Germany, University of Bern, Institute of Geography, Bern, Switzerland, Instituto Nacional de Meteorologia, INMET, Brazil, Swedish Meteorological and Hydrological Institute, Norrköping, Sweeden, Main Hydrometeorological Administration, Bishkek, Kyrgizstan, Agencia Estatal de Meteorología, AEMET, Madrid, Spain, Servicio Nacional de Meteorología e Hidrología del Perú(SENAMHI), Lima, Perú, Servei Meteorològic de Catalunya, Barcelona, Spain, Universidad de Cantabria, Santander, Spain, Slovenian Environment Agency, Ljubljana, Slovenia, Israel Meteorological Service, Tel-Aviv, Israel and Servicio Meteorológico Nacional, Buenos Aires, Argentina, Bureau of Meteorology, Australia for their contributions in terms of data and human resources.

With the support of Grant **CGL2012-32193**, Ministerio de Economía y Competitividad, **MINECO**, España and FP7-SPACE-2013-1 grand 607193, Uncertainties in Ensembles of Regional Reanalyses (UERRA).

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