EGU General Assembly 2020

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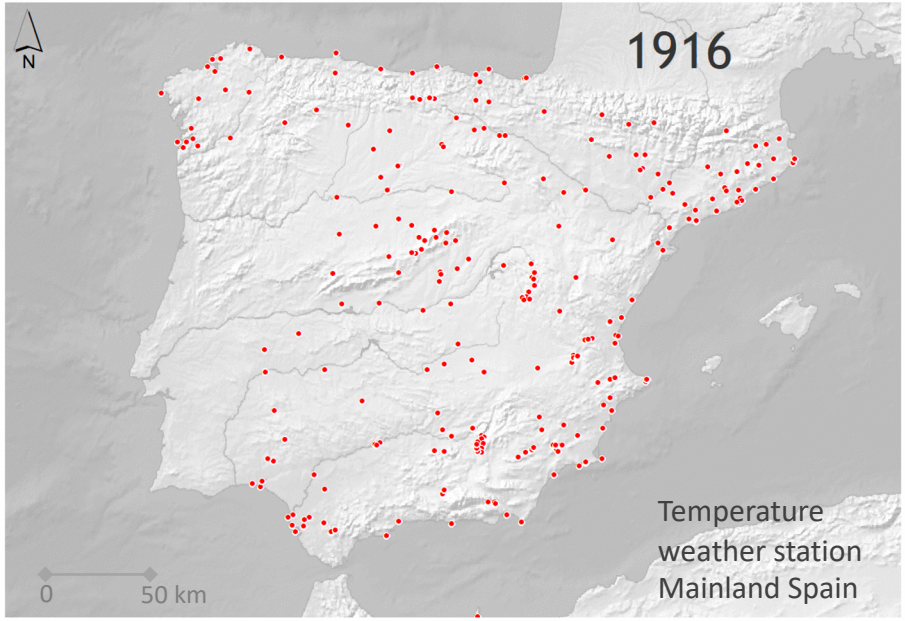


MOTEDAS Century Database

Part 1: Temperature Evolution in Spanish Mainland (1916-2015).

Dhais Peña-Angulo [1], Leire Sandonís-Pozo [2], Miquele Brunetti [3], Santiago Beguería [4], José Carlos González-Hidalgo [2]

CLICES Project (CGL2014-83866-C3-1-R, CGL2014-83866-C3-3-R).
Ministry of Economy and Competitiveness of Spain.

(1) Instituto Pirenaico de Ecología, CSIC, Zaragoza, SPAIN
(2) Department of Geography, University of Zaragoza, Zaragoza, Spain
(3) Institute of Atmospheric Sciences and Climate (ISAC-CNR), Italy
(4) Estación Experiemental Aula Dei, CSIC, Zaragoza, Spain

Motivation

- Climate variations have important impacts on the natural and anthropic environment. Understanding these variations is an important goal.

- The climatic databases with high spatial resolution and long temporal coverage allow us to know the spatio-temporal variability of climate variables.

- In order to have climatic databases with high spatial resolution and long temporal length, we need to obtain all the information available from different sources.

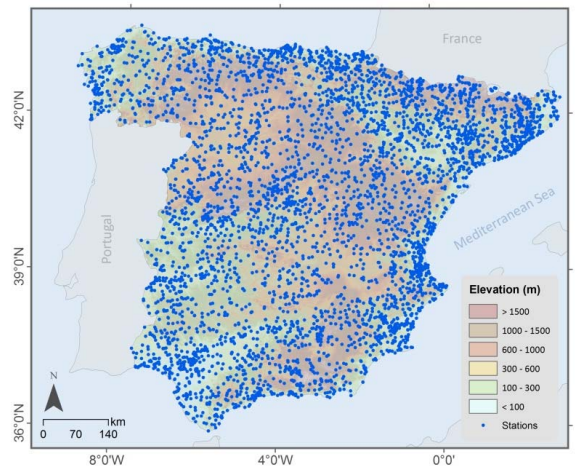
Objectives

- To create a new database of monthly maximum and minimum temperatures in mainland Spain to 1916-2015 period.

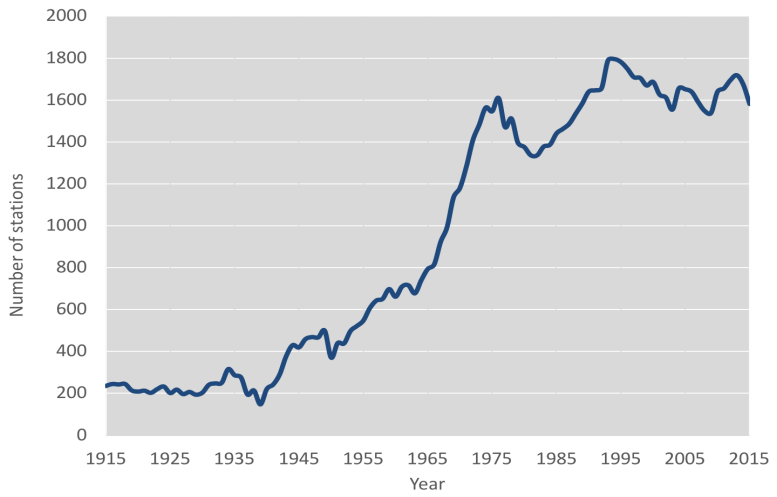
- To analyse the temporal evolution of the monthly maximum and minimum temperatures for a period of 100 years and along the mainland Spain.

Introduction

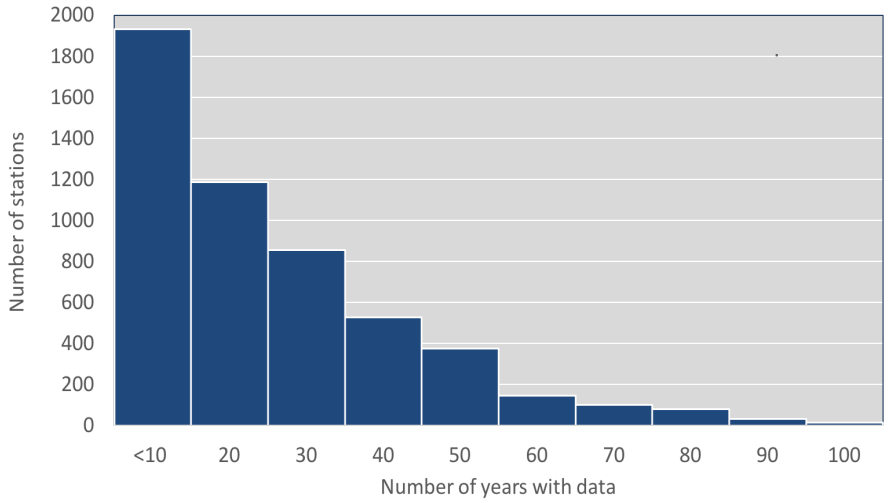
- The number of stations increase along the time for the study period.
- Many stations only have data of short periods, and it is not possible to generate reference series.
- The weather stations have a uniform distribution of the space.



Spatial distribution of the temperature weather stations in mainland Spain



Temporal distribution of the temperature weather stations in the study period



Temporal length of the temperature weather stations in mainland Spain

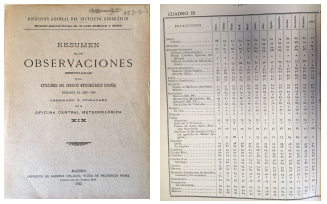
Methodology

1. Data rescue and digitization
2. Merge sources of information
3. Generation of temporal series using spatial reconstruction
4. Evaluation of the database
5. Trend analysis

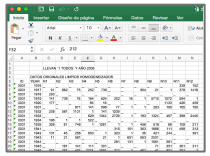
Methodology

1 Data rescue and digitization

"Annual summaries" Books



Digitized alphanumeric information



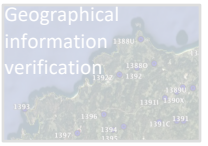
2 Merge sources of information

Rescued data (Digitalized)

Historical records AEMet

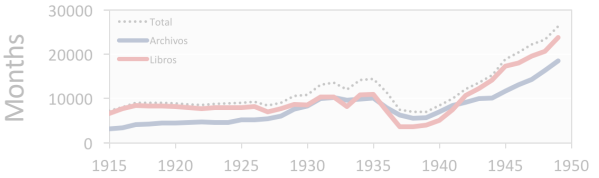
Source of information

Source of information



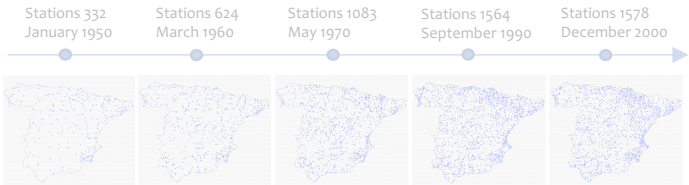
Information sources

Rescued data | Historical records



One data is selected for each year/month

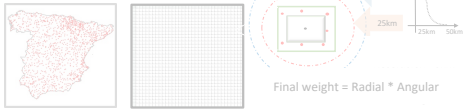
3 Generation of temporal series using spatial reconstruction



Different number of stations in each year and each month

Database of monthly temperature: Creation of the temporal series from of spatial reconstruction with an interpolation method

Brunetti et al., 2016



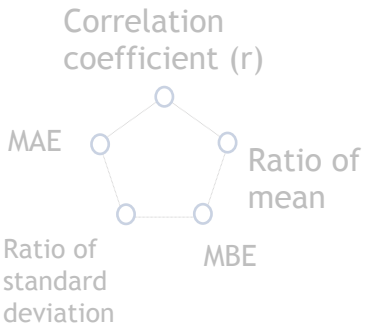
4 Evaluation of the database

Spatial reconstruction

Leave One Out Validation

Temporal reconstruction

Compare the temporal series from other databases



5 Trend analysis

Mann Kendall test

Significance (p value < 0.05)

Signal (positive -> increase, negative –> decrease)

Methodology

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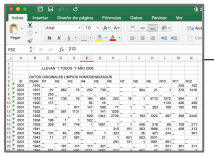

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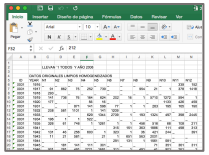
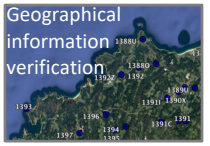
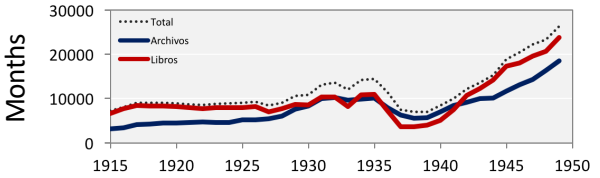




Information sources

Rescued data | Historical records



One data is selected for each year/month

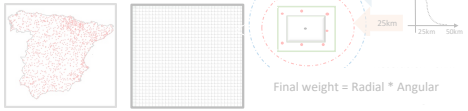
3 Generation of temporal series using spatial reconstruction

Stations 332 January 1950 | Stations 624 March 1960 | Stations 1083 May 1970 | Stations 1564 September 1990 | Stations 1578 December 2000

Different number of stations in each year and each month

Database of monthly temperature: Creation of the temporal series from of spatial reconstruction with an interpolation method

Brunetti et al., 2016



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Spatial reconstruction

Leave One Out Validation

Temporal reconstruction

Compare the temporal series from other databases

Correlation coefficient (r)

MAE | Ratio of mean | MBE | Ratio of standard deviation

5 Trend analysis

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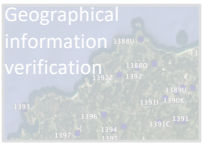

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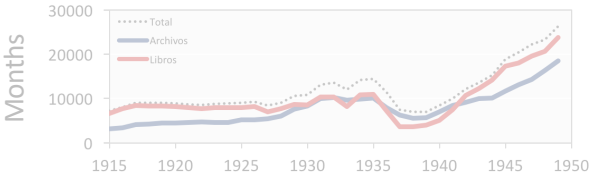

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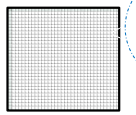

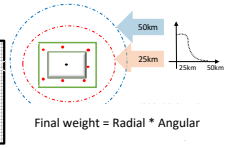

Final weight = Radial * Angular

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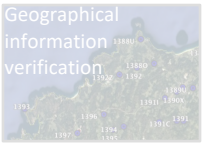
Geographical information verification



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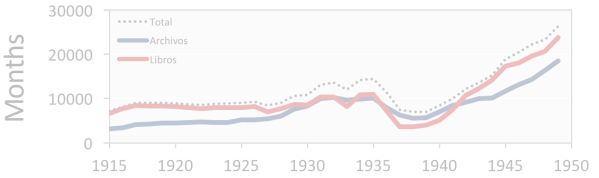

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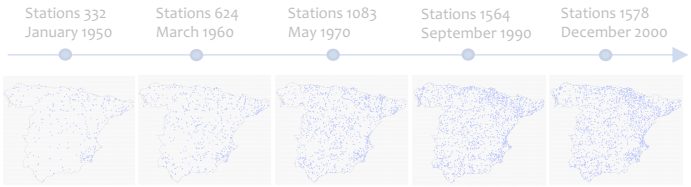

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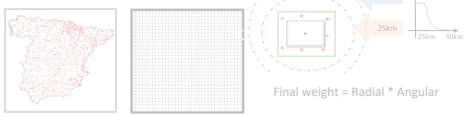

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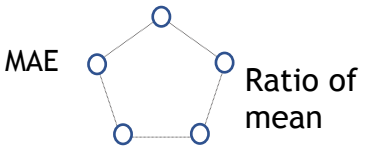

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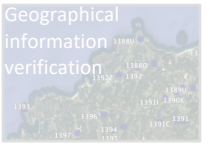

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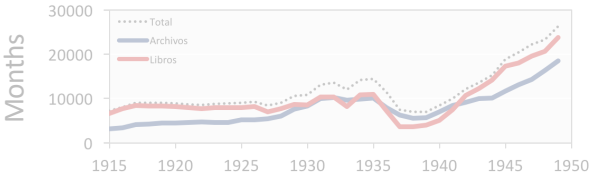

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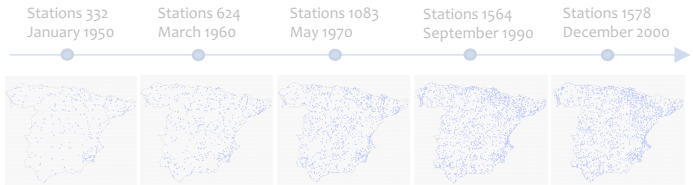

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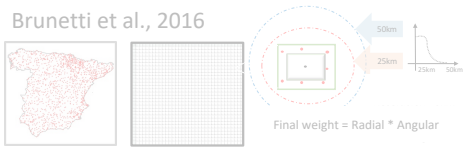

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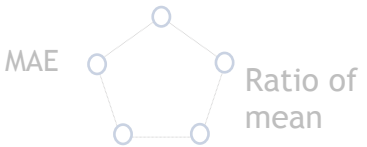

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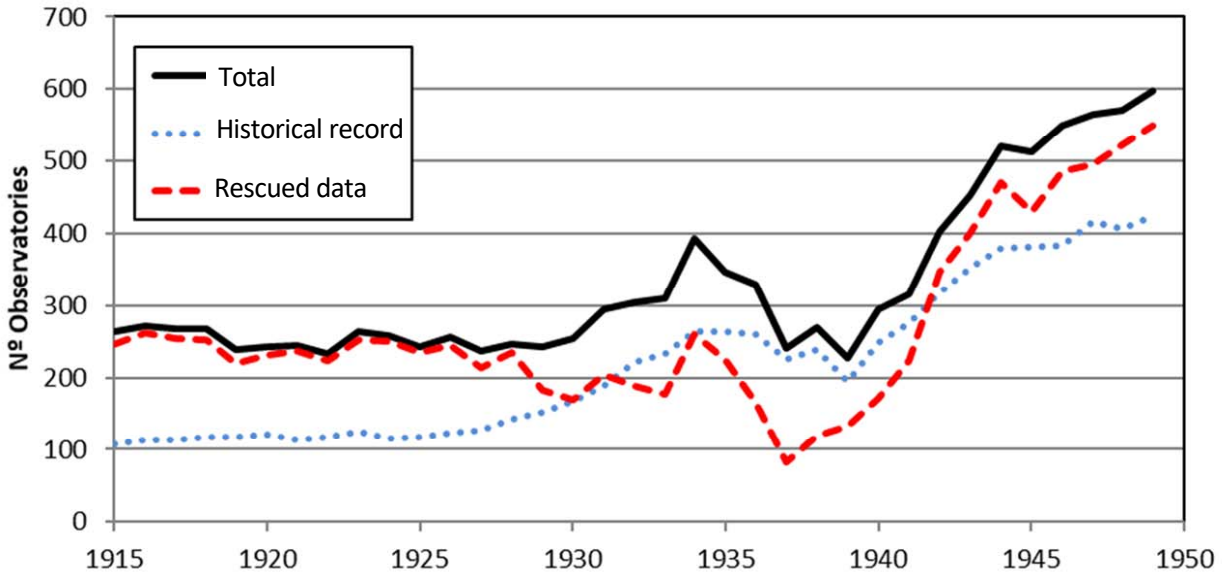
Results

Data rescue and merge sources of information

- The number of station of “rescued data” exceed the number of stations of “historical record” of the State Meteorological Agency.

- This is an example of how important is the old data rescue.



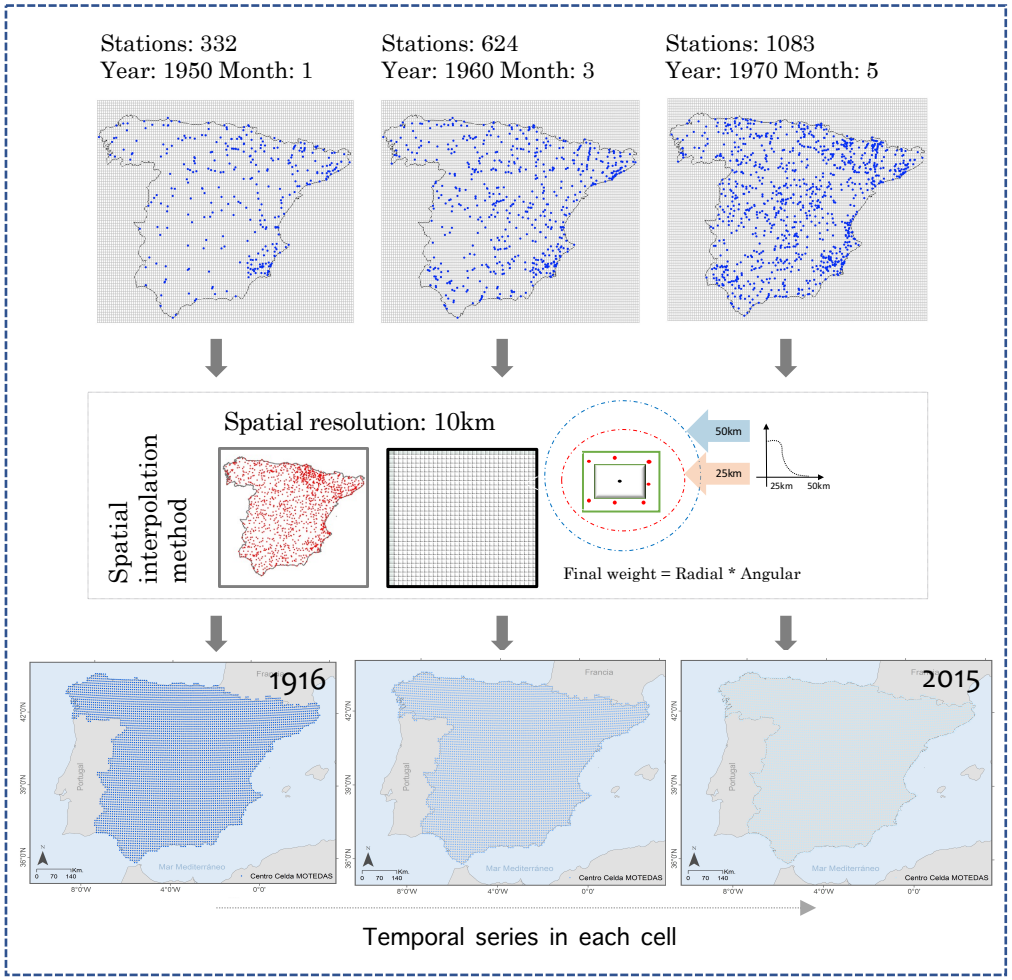
Number of temperature weather stations per year

Results

MOTEDAS Century database

- We obtained a monthly grid applying spatial interpolation in each year with all the available information.
- We chose the spatial interpolation method with the “Leave One Out” validation technique.
- Grid of the monthly maximum and minimum temperature of mainland Spain in the 1916-2015 period (resolution 10*10km).

Generation of temporal series using spatial reconstruction

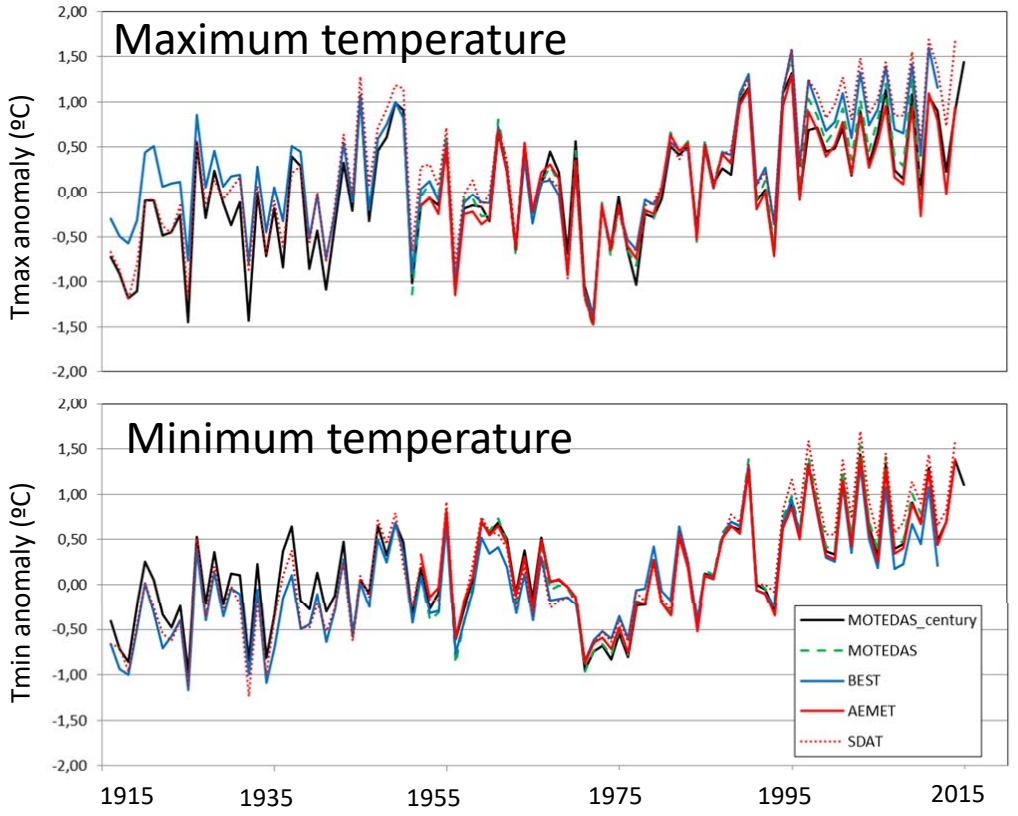


Results

Evaluation of the database

- The national series of the annual mean, maximum and minimum temperature agrees with other databases.

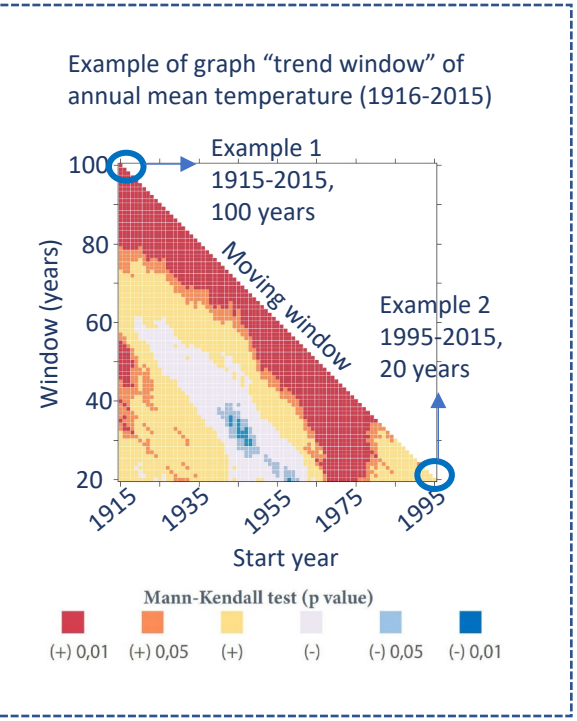
- Others databases:
  - MOTEDAS (González-Hidalgo et al., 2015)
  - Best (Rohde et al., 2013)
  - SDAT (Sigro et al., 2015)
  - AEMet (Guijarro, 2013)

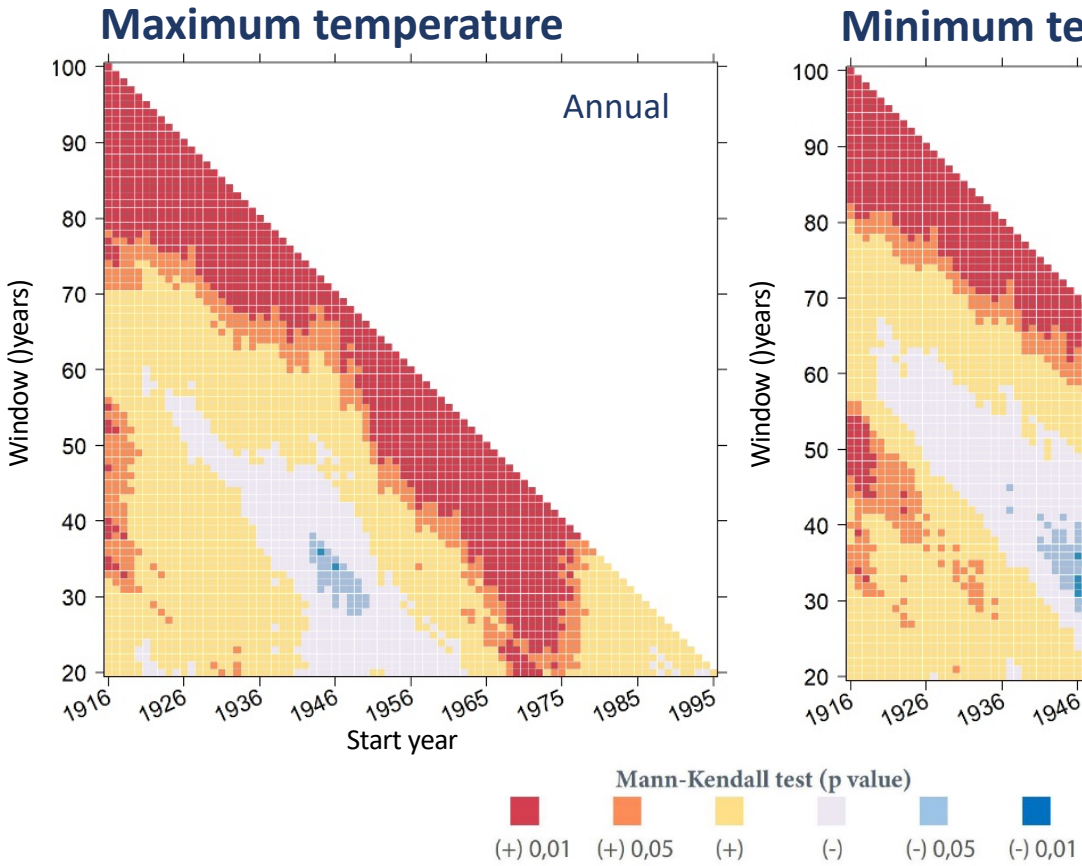


Results

Trend analysis

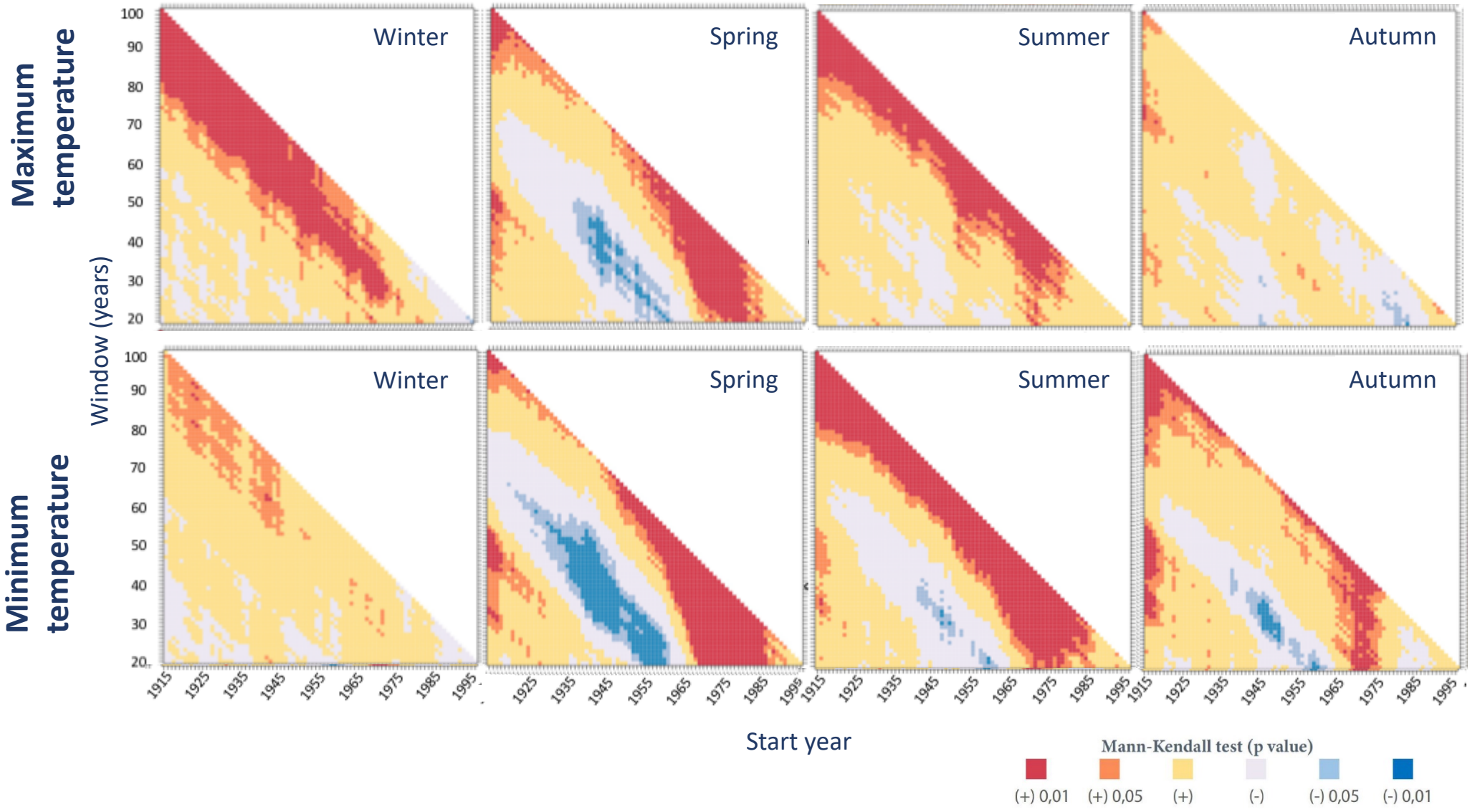
- Trend analysis of the national series of the annual and seasonal maximum and minimum temperature in mainland Spain (1916-2015).





Results

Seasonal trend analysis



Summary

- There is a large amount of climate data that has not yet been recovered and that is a source of information of great interest.
- The temporal series reconstruction of climate data based on spatial interpolation allows us to benefit from all the available information and it can be updated easily.
- The analysis of the trend indicates the monthly maximum and minimum temperatures have risen in mainland Spain for 1916–2015 period.
- The trend of the monthly maximum and minimum temperatures in mainland Spain shows great differences between them, which affect to the Diurnal Thermal Range.
- There are important seasonal differences in the trends of the monthly maximum and minimum temperature in mainland Spain.

Gonzalez-Hidalgo, J.C., Peña-Angulo, D., Beguería, S., Brunetti, M. (2020). MOTEDAS century: A new high-resolution secular monthly maximum and minimum temperature grid for the Spanish mainland (1916–2015) International Journal of Climatology DOI: 10.1002/joc.6520

Thanks for your attention!

CLICES Project

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EGU General Assembly 2020

Departamento de Geografía y Ordenación del Territorio
Universidad Zaragoza

EEAD Estación Experimental de Aula Dei

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Facultat de Geografia i Història