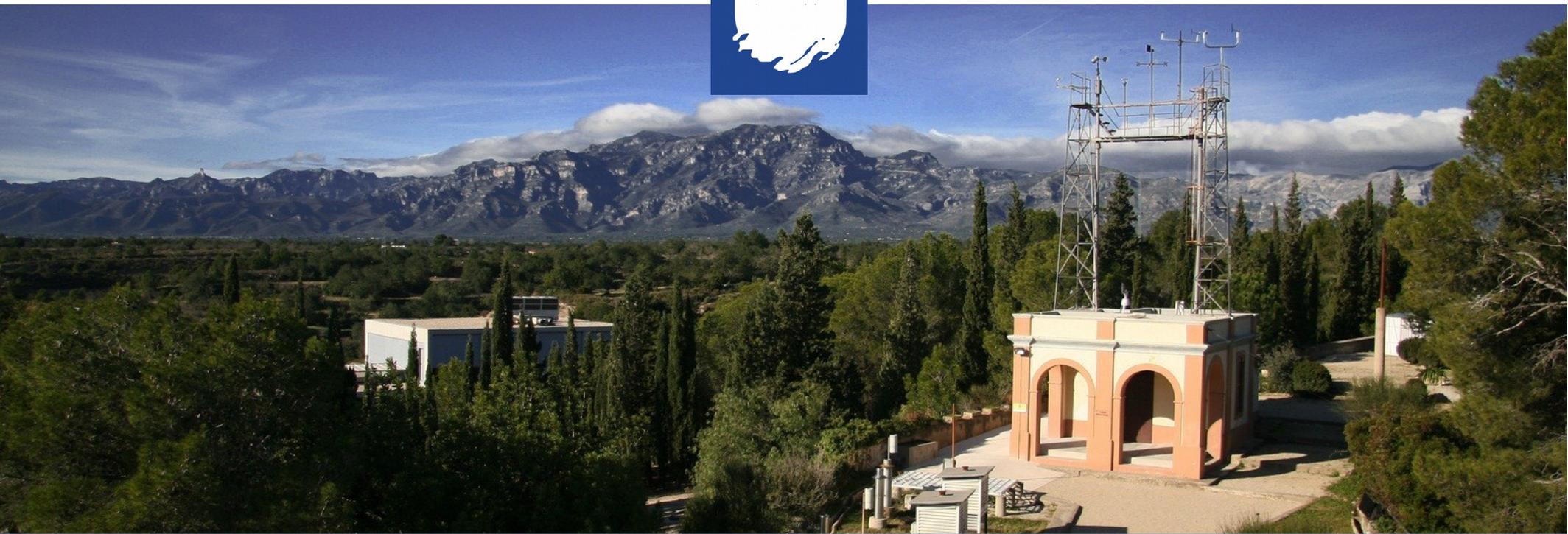
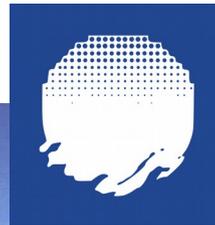


# Extending the SAFRAN meteorological analysis system to the Iberian Peninsula and the Balearic Islands. Analysis of its performance and applications.

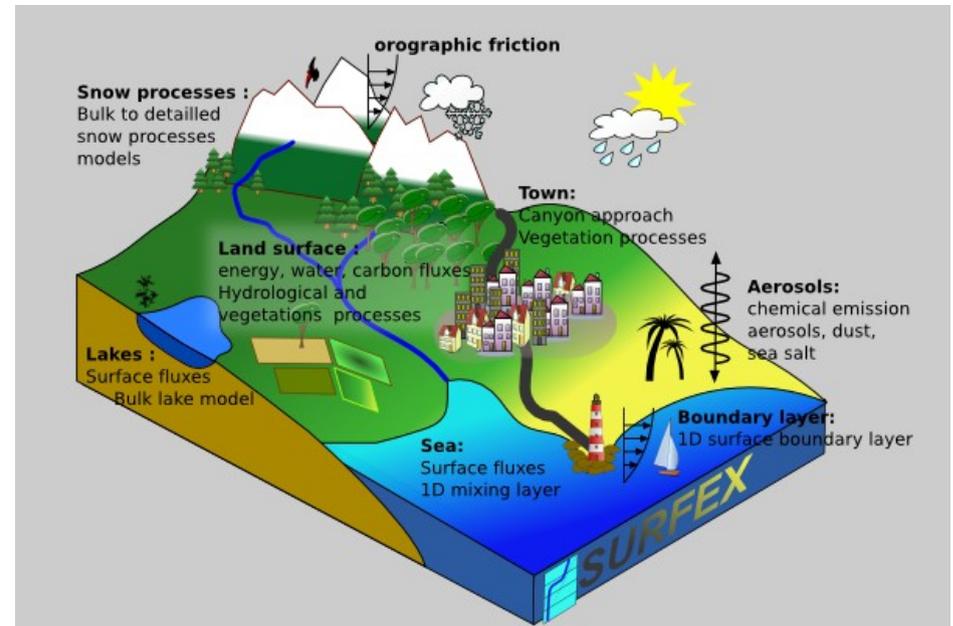
Pere Quintana Seguí (Observatori de l'Ebre, Universitat Ramon Llull - CSIC)  
Gonzalo Míguez Macho (Universidad de Santiago de Compostela)  
María del Carmen Llasat (Universitat de Barcelona)



The Ebro Observatory (1905) is located in Roquetes, near Tortosa.  
It's climate data series starts in 1880.

# Introduction

- A proper simulation of the land surface is very important in many areas such as: climate, meteorology, hydrology, etc..
- Thus, research on land-surface models (LSM) has an impact in many areas of research.
- In our Spanish and Mediterranean context, this is especially true:
  - land-surface – atmosphere coupling is relevant in areas that lay in the transition zone between the wet north and the dry south.
  - Water resources, droughts, floods.

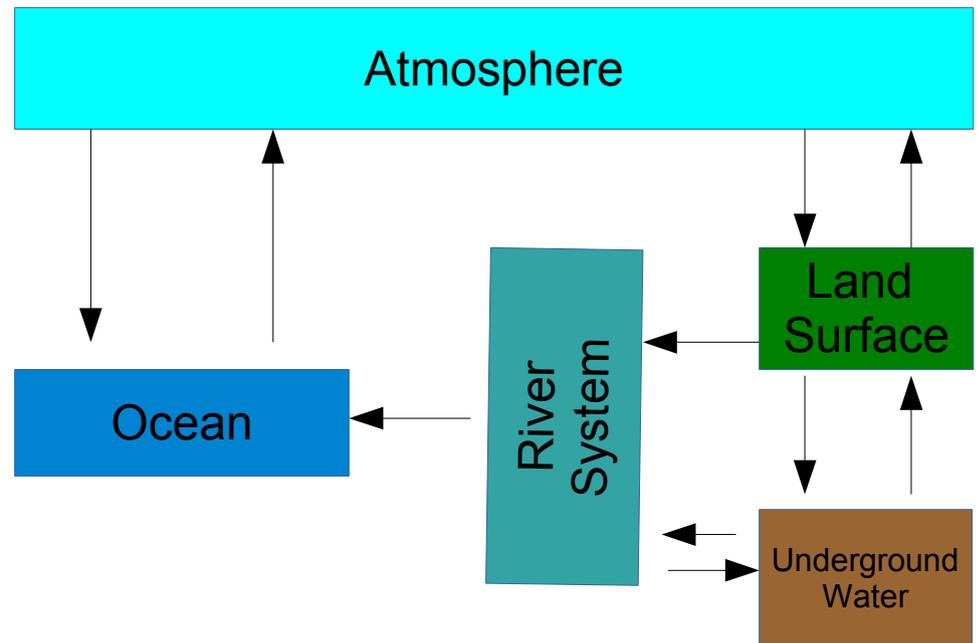


The SURFEX LSM.

<http://www.cnrm.meteo.fr/surfex/>

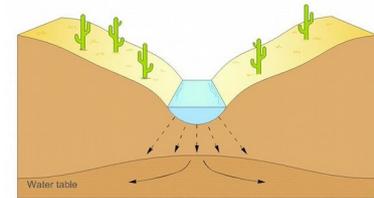
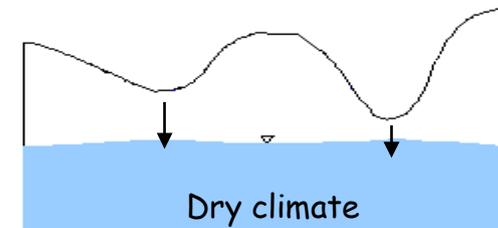
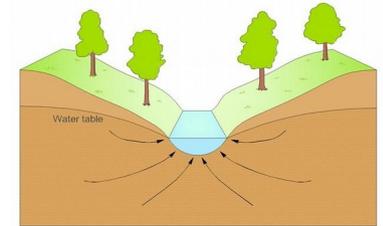
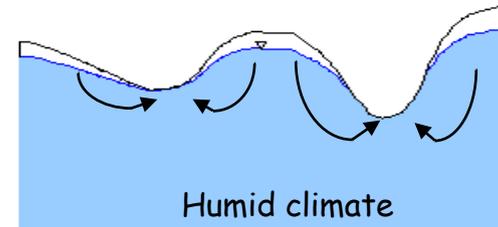
# Land-surface and coupled regional climate modeling

- RCM models are evolving rapidly:
  - Regional Climate System Model (RCSM).
  - Resolutions are increasing.
- Coupling: Each part of the system must be well represented, including the interactions with the other components.
- Land-Surface models must be improved.
- Offline high-resolution simulations are necessary.
- LSM simulations cannot be good if they are forced with meteorological forcing data of insufficient quality and/or resolution.
- The international HyMeX program is studying the Mediterranean coupled system.
- The MARCO project (*plan estatal*) is working on improving the next generation of RCMs.

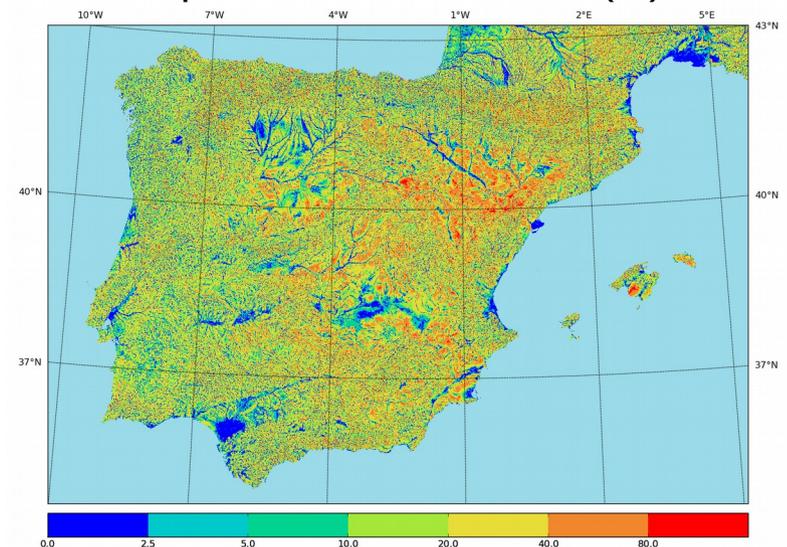


# Land-surface and underground water coupling

- Drought risk is important in Spain.
- Non linearity between meteorological and hydrological droughts.
- Underground water plays a double role.
  - It adds memory to the system.
- Few models take the water table into account.
- **The earthH2Observe (FP7) Spanish Case Study aims at**
  - improving LSMs in order to better simulate the coupling between the land-surface and the water table.
  - Understand the role of underground water during droughts in Spain.
- **LSM simulations cannot be good if they are forced with meteorological forcing data of insufficient quality and/or resolution.**



Equilibrium Water Table (m)



# Available meteorological forcing datasets for LSMs

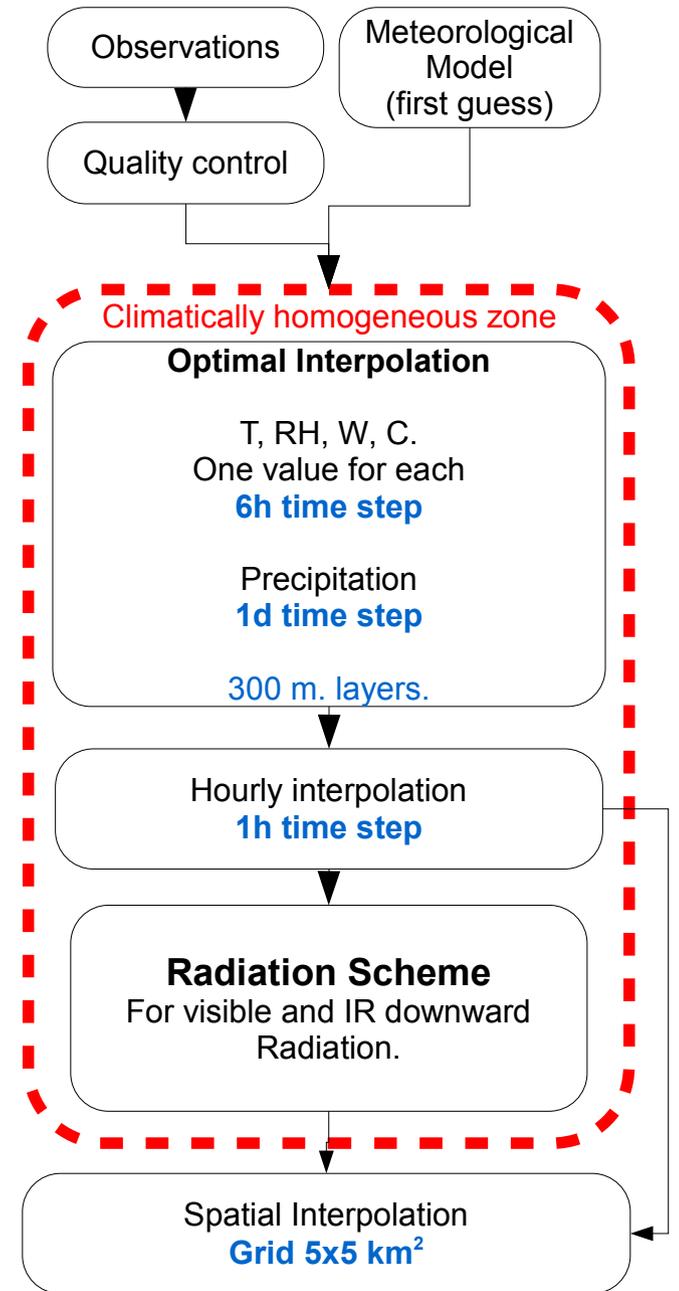
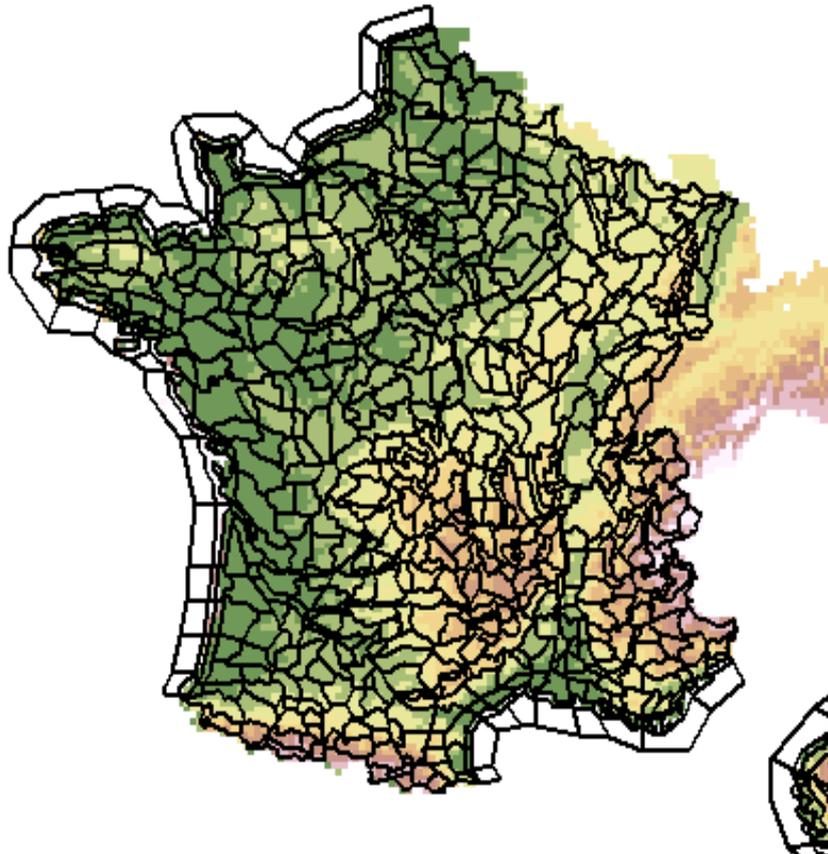
Some data products that could be used to force a LSM.

Product	Available in Spain	Sufficient Spatial resolution	Sufficient Temporal resolution	Long period?	Enough variables
ERA-Interim, WFDEI, etc.	Yes	No	Yes	Yes	Yes
E-OBS	Yes	No	Yes	Yes	No
Spain02	Yes	No	Yes	Yes	No
MESAN	No	Yes	Yes	No	Yes
MESCAN	Yes	Yes	Yes	No	Yes
SPAN	Yes	Yes	Yes	Only for precipitation.	Yes
SAFRAN	No, but we can do it.	Yes	Yes	No, but we can do it.	Yes ++

We decided to use SAFRAN to force the SURFEX LSM in our experiments.

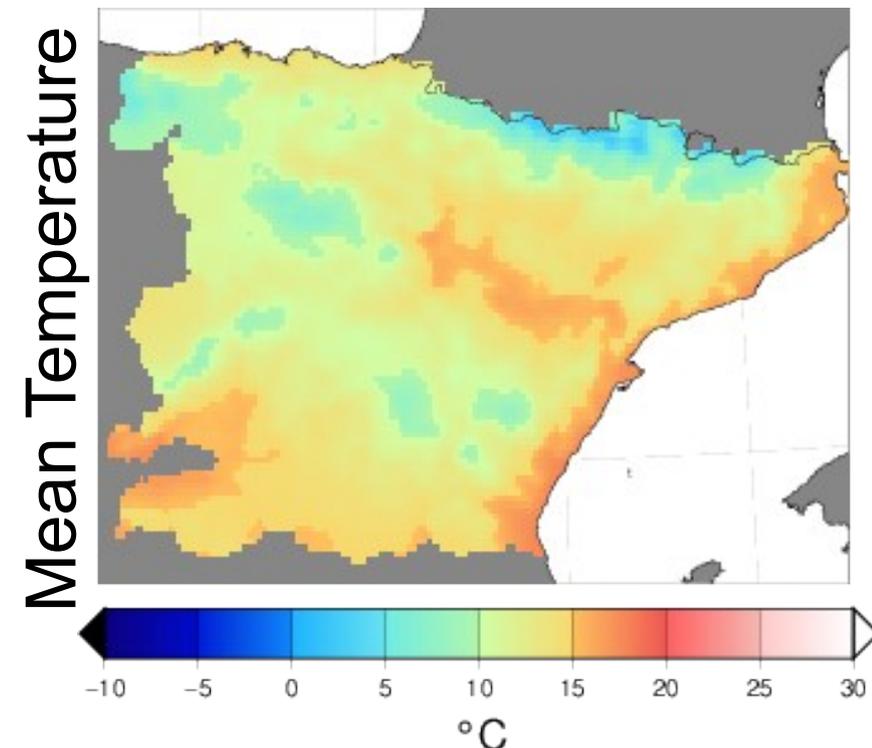
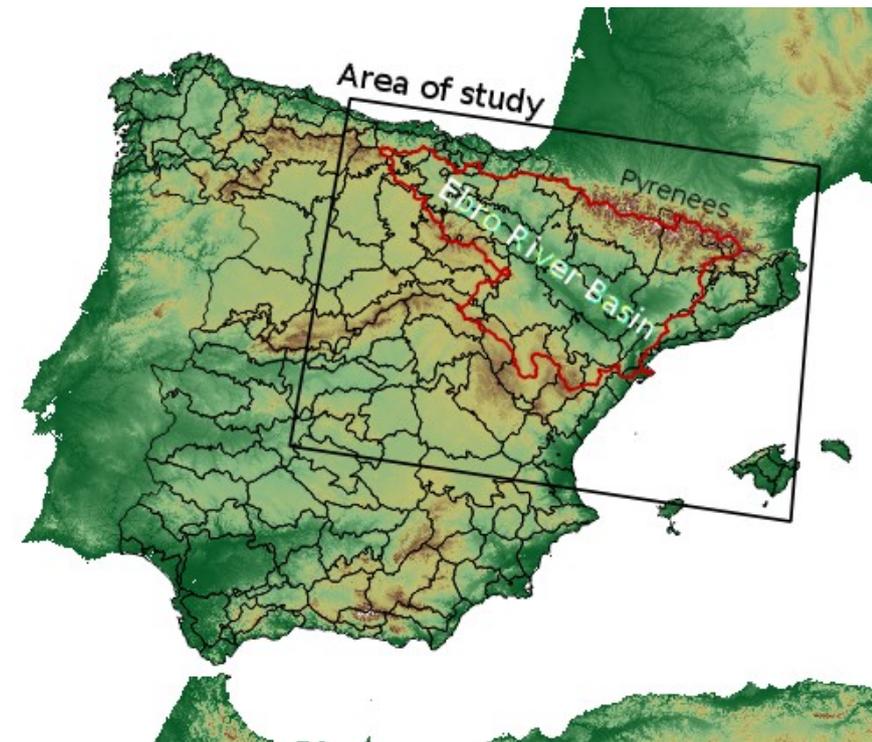
# SAFRAN meteorological analysis system

- Specifically designed to force LSMs.
- Created by Durand et al. 1993, 1999.
- Validated in France by Quintana-Seguí et al. (2008), Vidal et al. (2010).
- 70 year analysis in France with many users.



# SAFRAN analysis in NE Spain.

- Pilot study.
- 1 year of data: 2009/10.
- First guess: AEMET  
HIRLAM HNR (5km).
- Observations: AEMET.
- Comparison with SPAN  
(precipitation) and HIRLAM.
- Zones: meteorological alert  
zones.



# SAFRAN analysis in NE Spain

## Bias

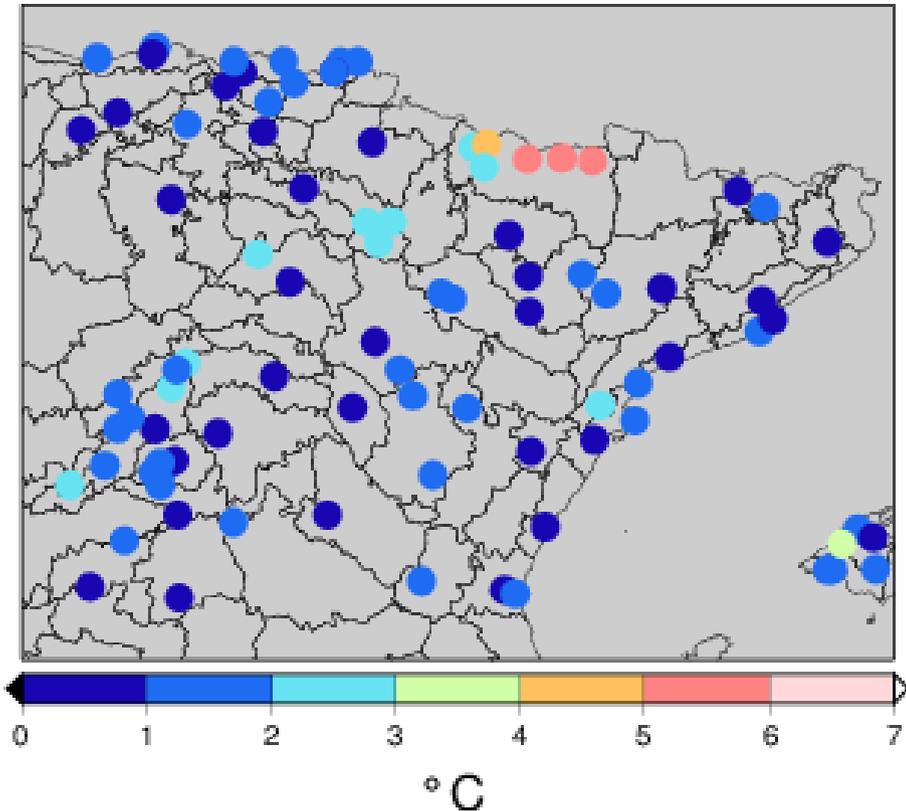
	SF	HIR
T (°C)	-0.2	-0.8
W (m · s <sup>-1</sup> )	-0.2	0.5
HR (pp)	0.1	-0.4
C (oktas)	-1.4	-1.0
P (mm · d <sup>-1</sup> )	0.0	0.2

## RMSD

	SF	HIR
T (°C)	1.4	2.2
W (m · s <sup>-1</sup> )	1.3	2.0
HR (p.p.)	8.6	12.6
C (oktas)	3.0	3.2
P (mm · d <sup>-1</sup> )	3.2	6.8

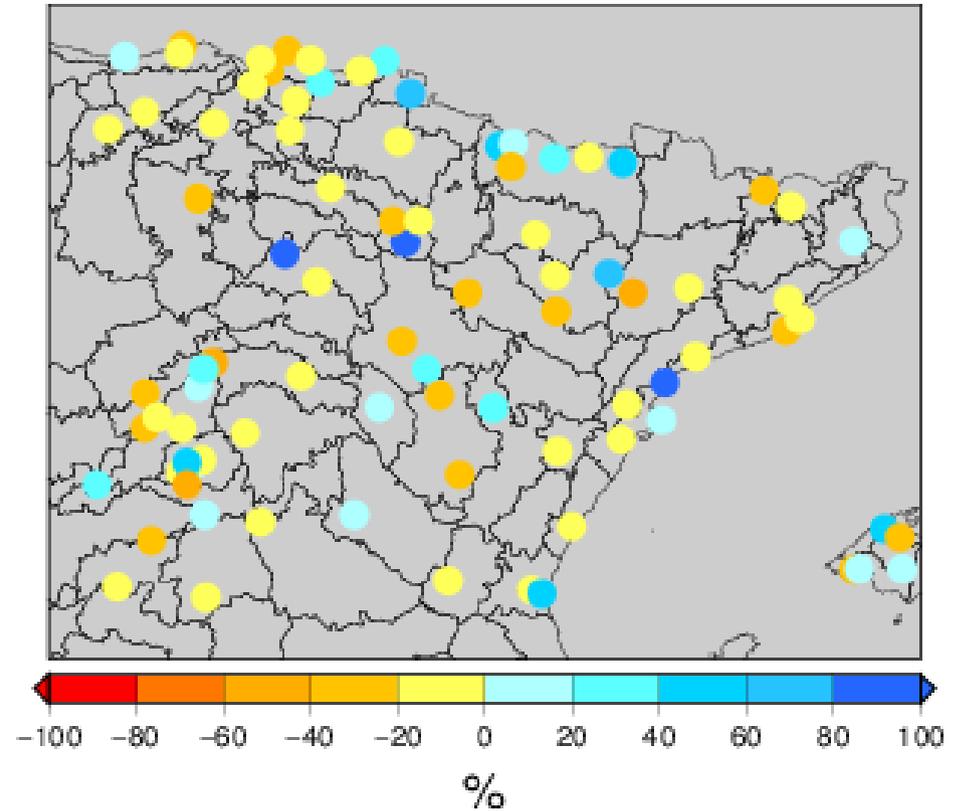
In general, good performance, very similar to its performance in France.  
Cloudiness is not very good.

# Temperature and wind error maps



RMSD of mean annual temperature ( $^{\circ}\text{C}$ ) between SAFRAN and the dependent stations.

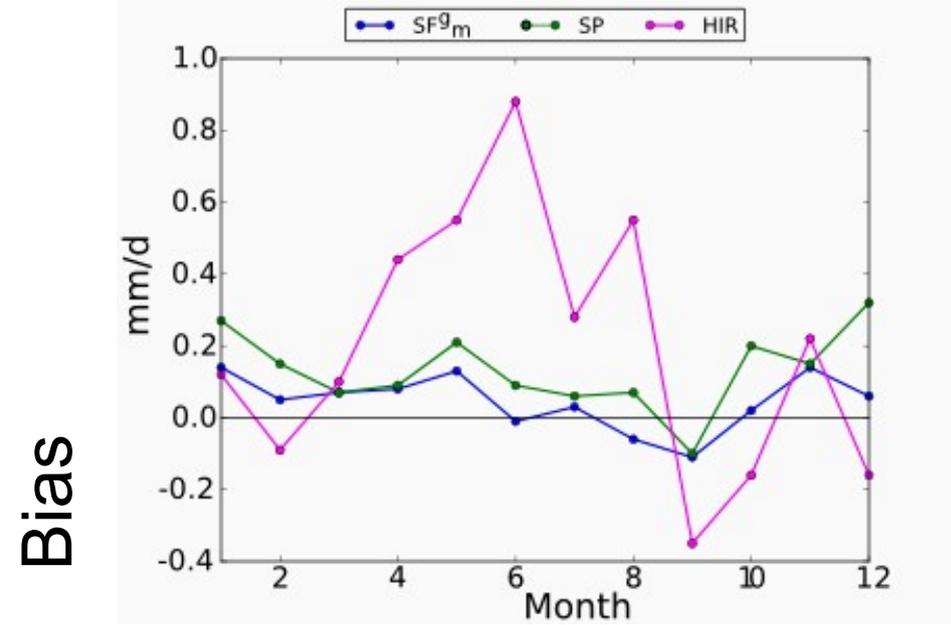
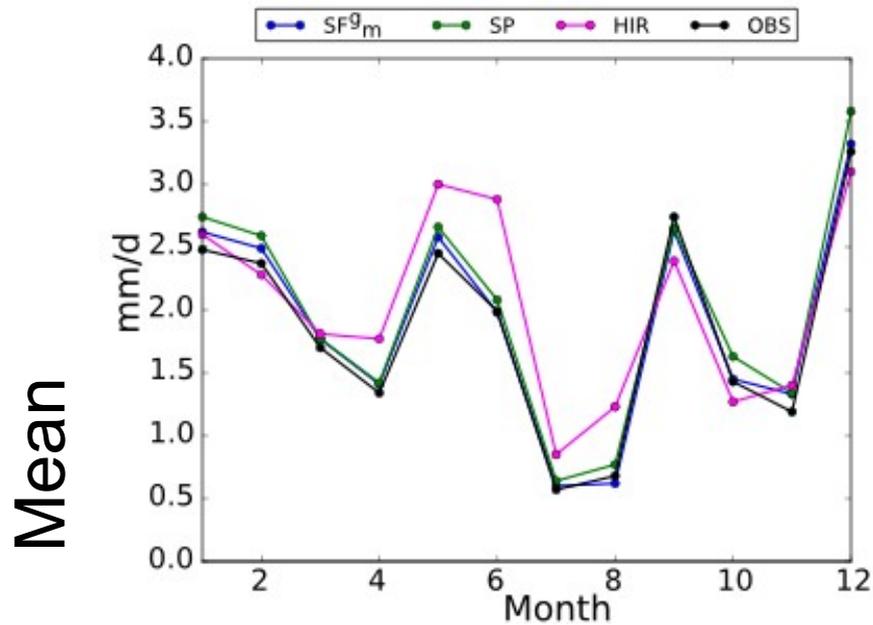
- Temperature errors are low and very homogeneous except on the mountain areas.



Relative bias of mean annual wind speed (%) between SAFRAN () and the dependent stations.

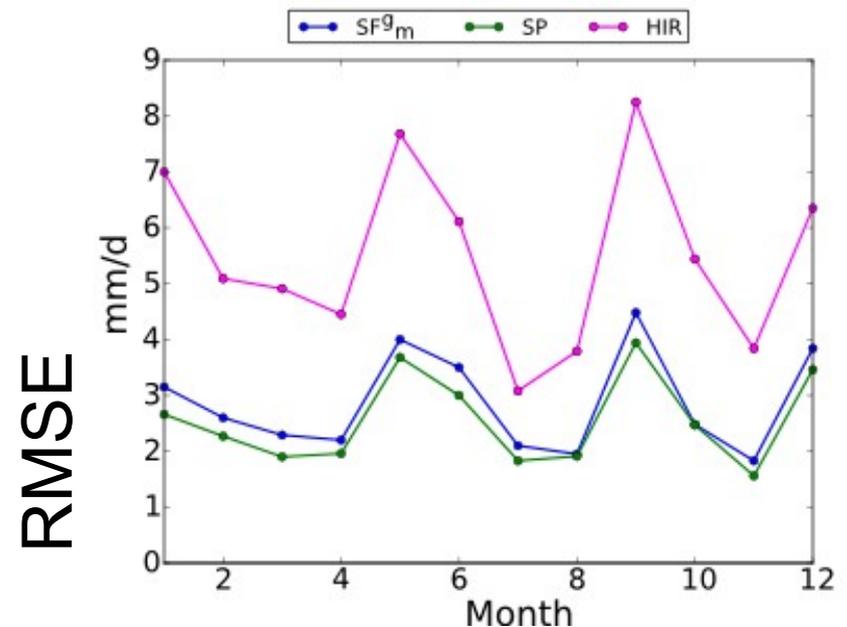
- Wind bias is negative in general, with exceptions. Strong contrasts in some close stations.

# Validation of precipitation



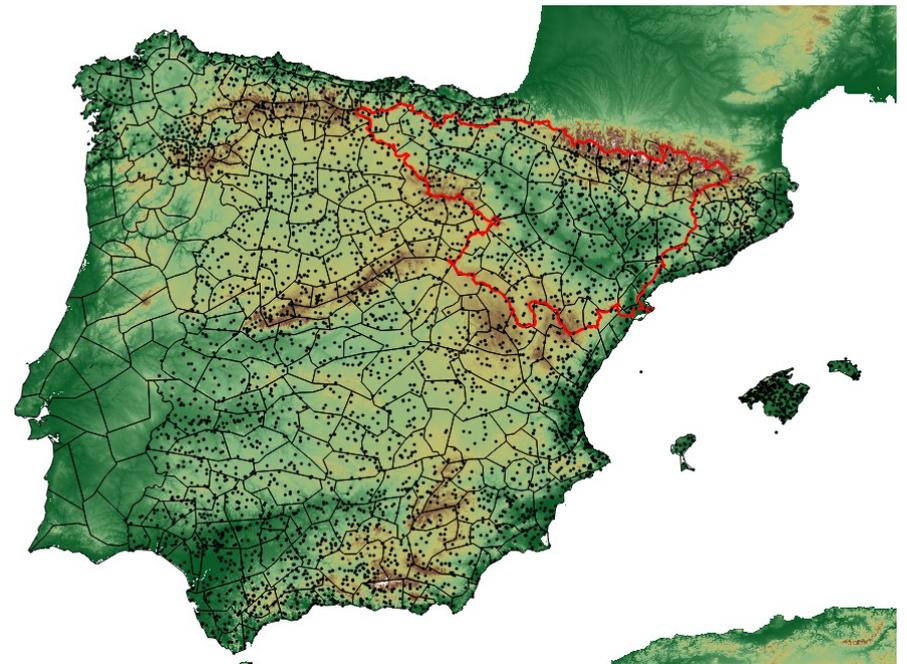
- Validation of SAFRAN and SPAN with independent data.
- Both SAFRAN and SPAN are close and much better than HIRLAM HNR.

Quintana Seguí et al. , *Meteorological analysis systems in north-east Spain. Validation of SAFRAN and SPAN*. Journal of Environmental Informatics. In Review.



# Extending SAFRAN to the Iberian Peninsula and the Balearic Islands

- First guess: ERA-Interim.
- Observations: AEMET.
- New zone set.
  - Smaller zones, closer in area to the French ones.
  - It would be possible to extend the analysis to Portugal.
- Period:
  - 12 year period already analyzed, it will be ready in a few months (earth2Observe).
  - 30 year period to be performed in the MARCO project.



# Extending SAFRAN to the Iberian Peninsula and the Balearic Islands



Mean temperature 2005/2006



Total precipitation 2005/2006

# Conclusions

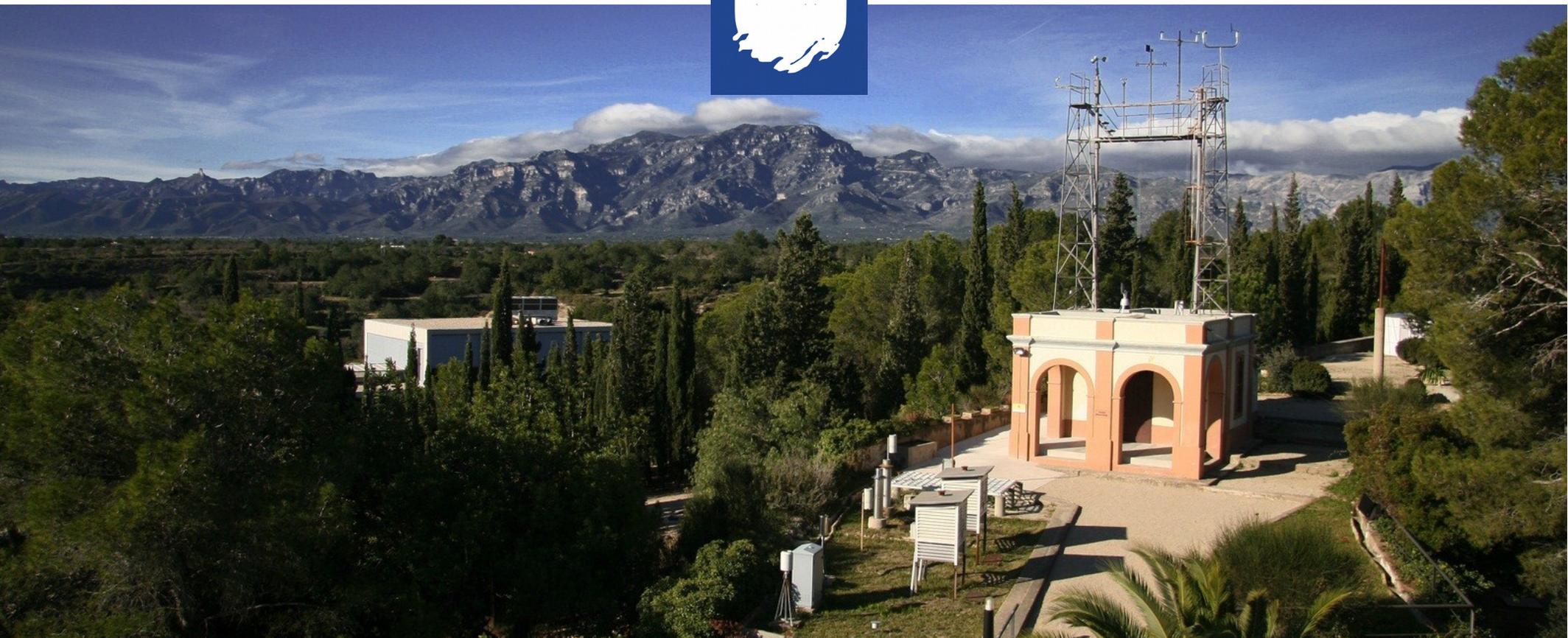
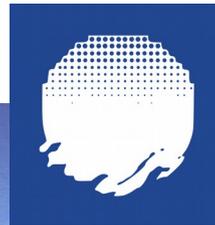
- A high resolution (5 km) analysis has been produced.
- To date, it is the only high resolution product that provides all necessary variables to force a LSM in Spain.
- A 1 year pilot implementation has been validated.
- SAFRAN's scores in Spain are close to those of SAFRAN in France.
- SAFRAN and SPAN perform similarly (precipitation).
- SAFRAN has some known limitations (biased wind, errors at the zone borders).
- Mountain areas, which are critical for hydrological processes in Spain, are more difficult.
- The analysis is being extended to the Peninsula and the Balearics.
- The zone map has been redefined.
- A longer period will be produced.
- We plan to compare SAFRAN to other similar products such as Spain02 and SPAN on the longer period.
- The database will be shared to the scientific community.
- We want to thank Candelas Peral and Isabel Martínez Marco (AEMET) for their help with SPAN and Eric Martin (Météo-France) for his help with SAFRAN.

# Thank You

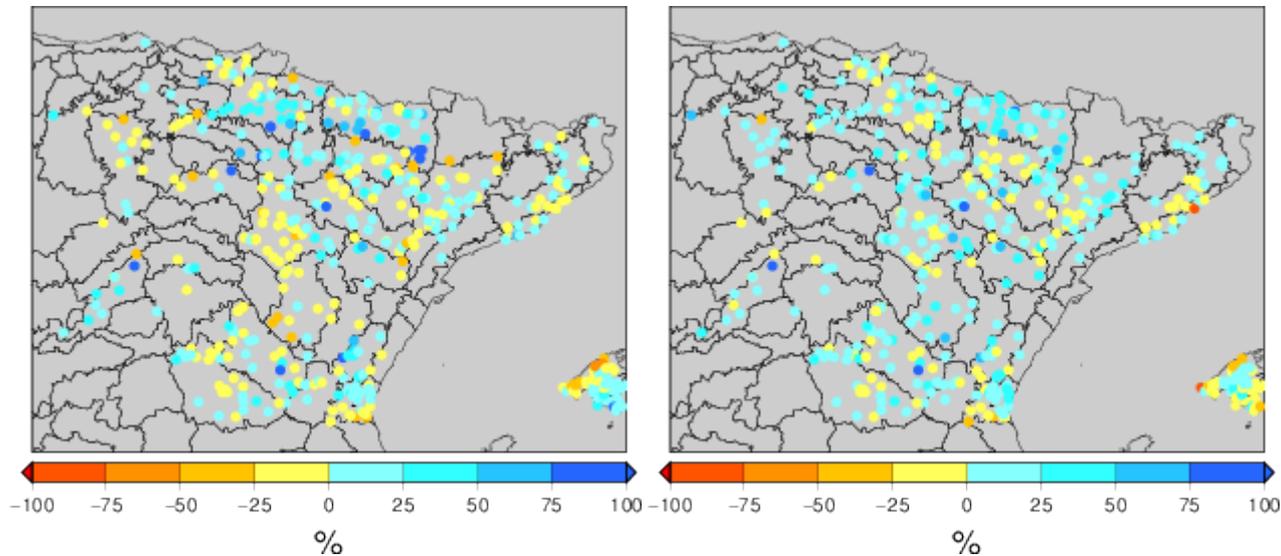
[pquintana@obsebre.es](mailto:pquintana@obsebre.es)

<http://www.obsebre.es>

<http://pere.quintanasegui.com>

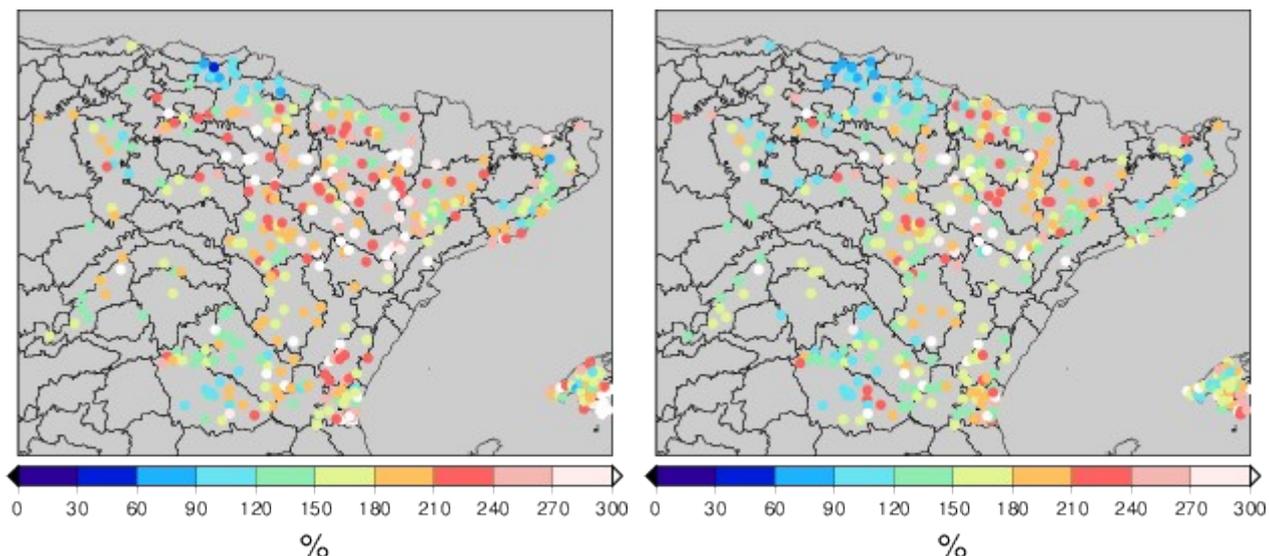


# Validation of precipitation



Rel. Bias. SF

Rel. Bias. SP



Rel. RMSE SF

Rel. RMSE SP

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*Meteorological analysis  
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