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

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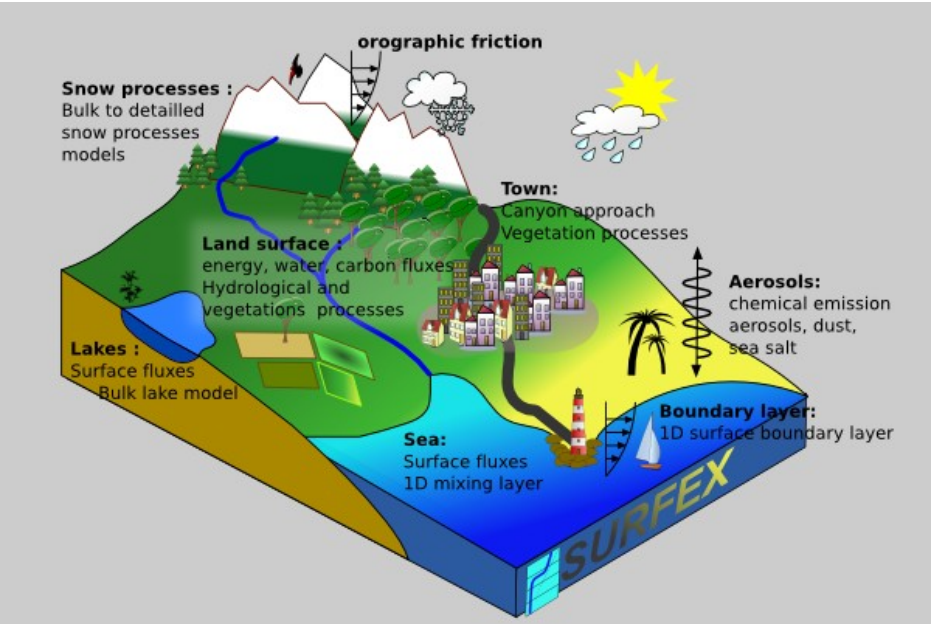
Introduction

- The physical simulation of the land surface is very important in many areas study such as climate, meteorology, hydrology.
- In Spain:
  - **land-surface – atmosphere coupling:** transition between wet and dry regimes.
  - **Water resources, droughts, floods**.
- A high quality gridded dataset of meteorological variables is necessary.
- A new gridded dataset of screen-level meteorological variables has been created.

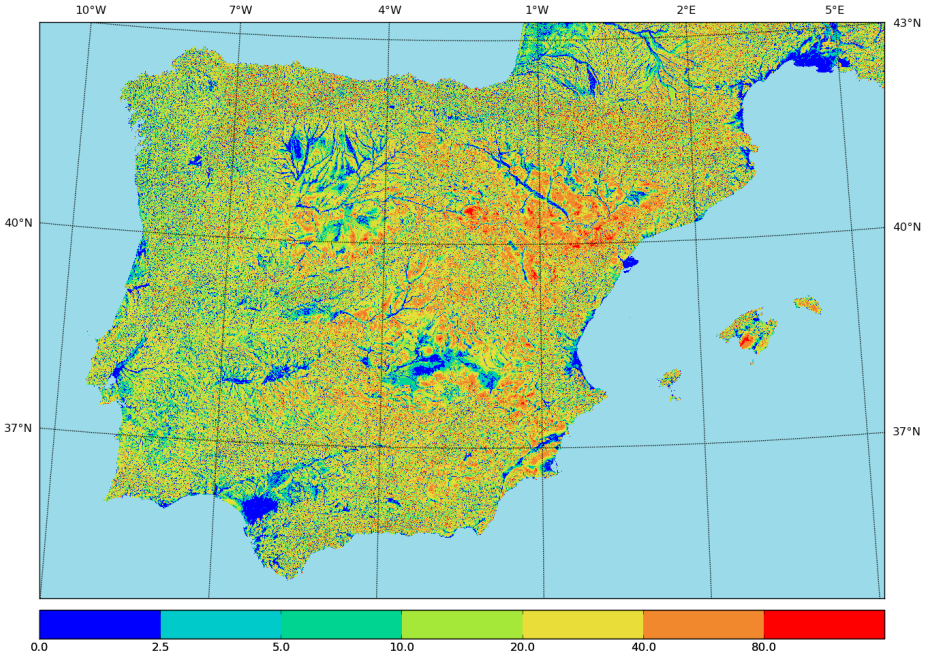


The SURFEX LSM.
http://www.cnrm.meteo.fr/surfex/

Land-surface and underground water coupling

- eartH2Observe (FP7) Spanish Case Study.
- Drought risk is important in Spain.
- Non linearity between meteorological and hydrological droughts.
  - Underground water adds memory to the system.
- Coupling between underground water and the land surface processes.
- Objectives:
  - improve 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.
- A good meteorological gridded forcing dataset is needed to perform these simulations.

Equilibrium Water Table (m)



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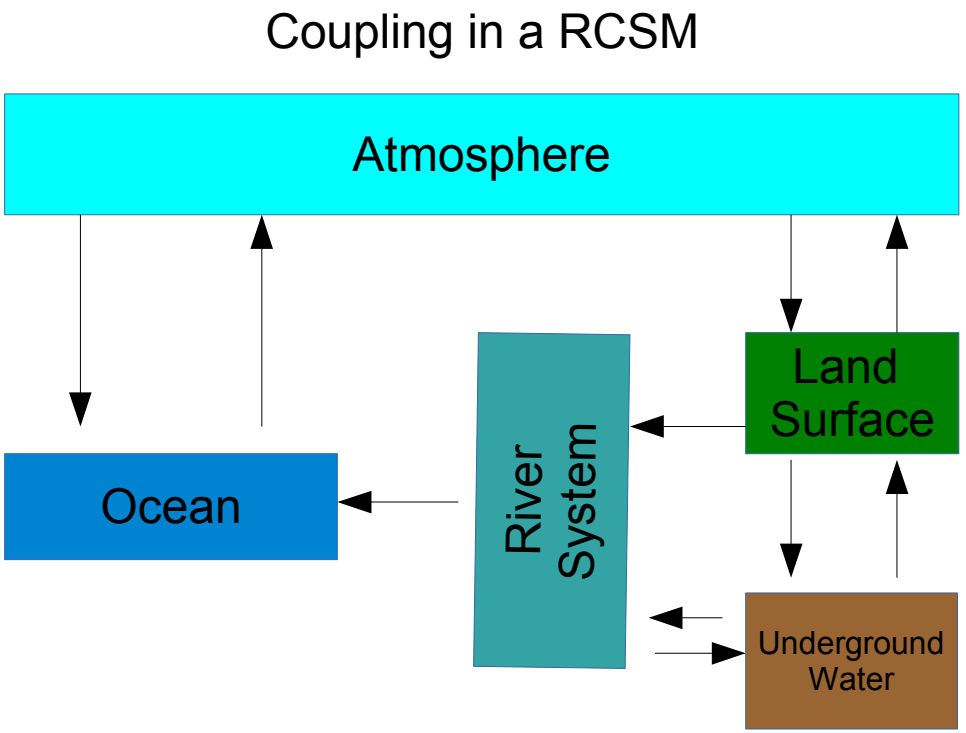
Land-surface and coupled regional climate modeling

- MARCO project (Spain) is working on improving the next geneartion of RCMs.
  - Contribution to the international HyMeX program
- RCM models are evolving rapidly:
  - Regional Climate System Model (RCSM).
- 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 used in order to improve LSMs.
- A good gridded meteorological forcing dataset is needed to perform these simulations.

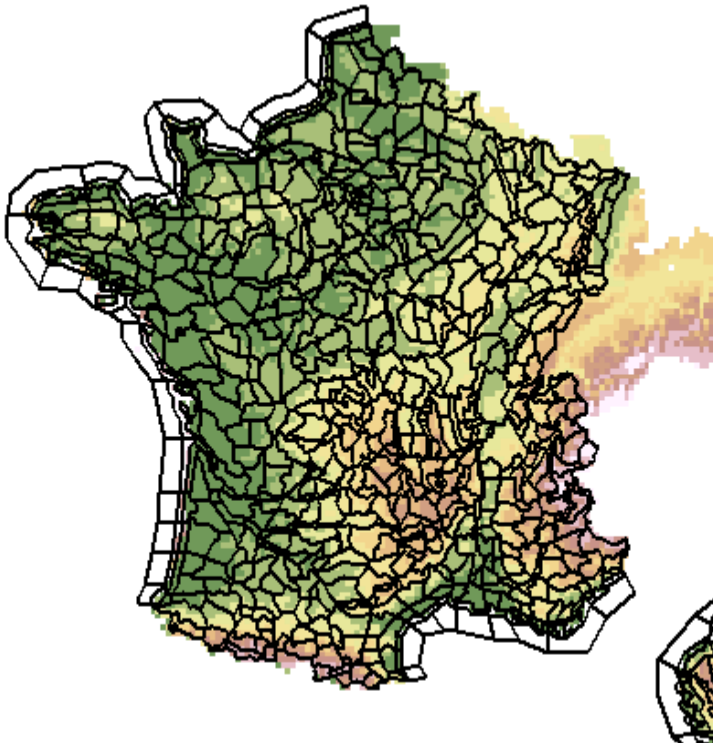


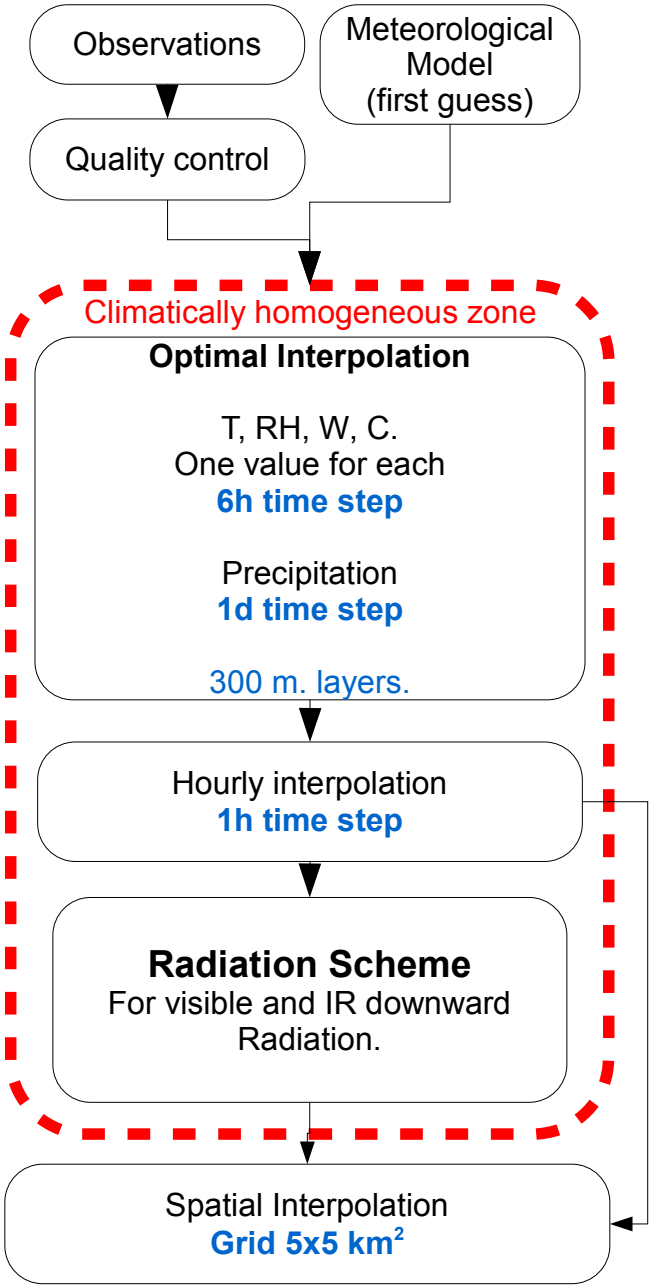
Available meteorological forcing datasets for LSM simulation in Spain

Product	Available in Spain	Sufficient Spatial resolution	Long period?	Enough variables
ERA-Interim, WFDEI, etc.	Yes. Global.	No	Yes	Yes
E-OBS	Yes. Europe	No	Yes	No
Spain02	Yes. Spain.	No	Yes	No
MESAN	No. Sweden	Yes	No	Yes
SAFRAN	No. France	Yes	In France	Yes ++
MESCAN	Yes. Europe	Yes	No	Yes
SPAN (HIRLAM)	Yes. Spain	Yes	Maybe	Yes

SAFRAN meteorological analysis system

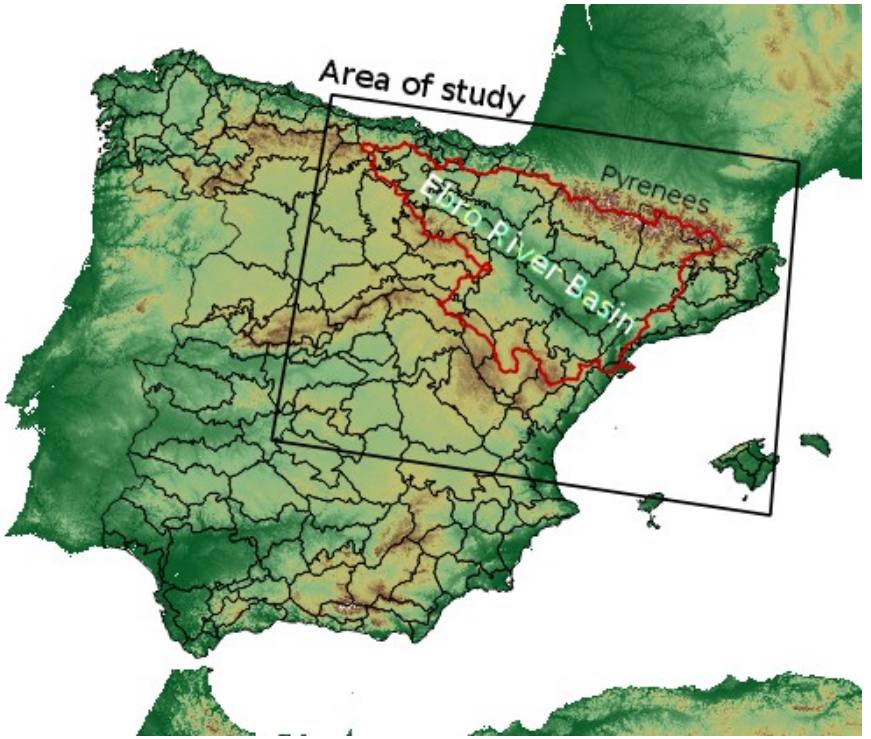
- CNRM-Météo France.
- Durand et al. 1993, 1999.
- Validated in France by Quintana-Seguí et al. (2008), Vidal et al. (2010).
- A 70 year analysis is available in France with many users and applications.

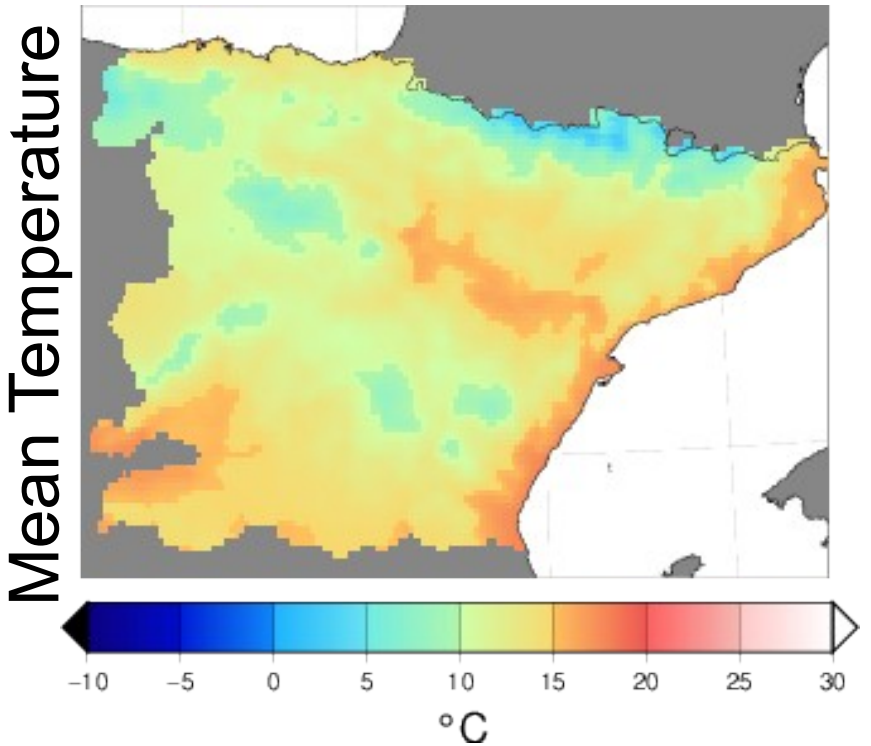




SAFRAN analysis in NE Spain.

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





SAFRAN analysis in NE Spain

Bias

	SAFRAN Analysis	HIRLAM Model
T (°C)	-0.2	-0.8
W (m ·s^{-1})	-0.2	0.5
HR (pp)	0.1	-0.4
C (oktas)	-1.4	-1.0
P (mm d^{-1})	0.0	0.2

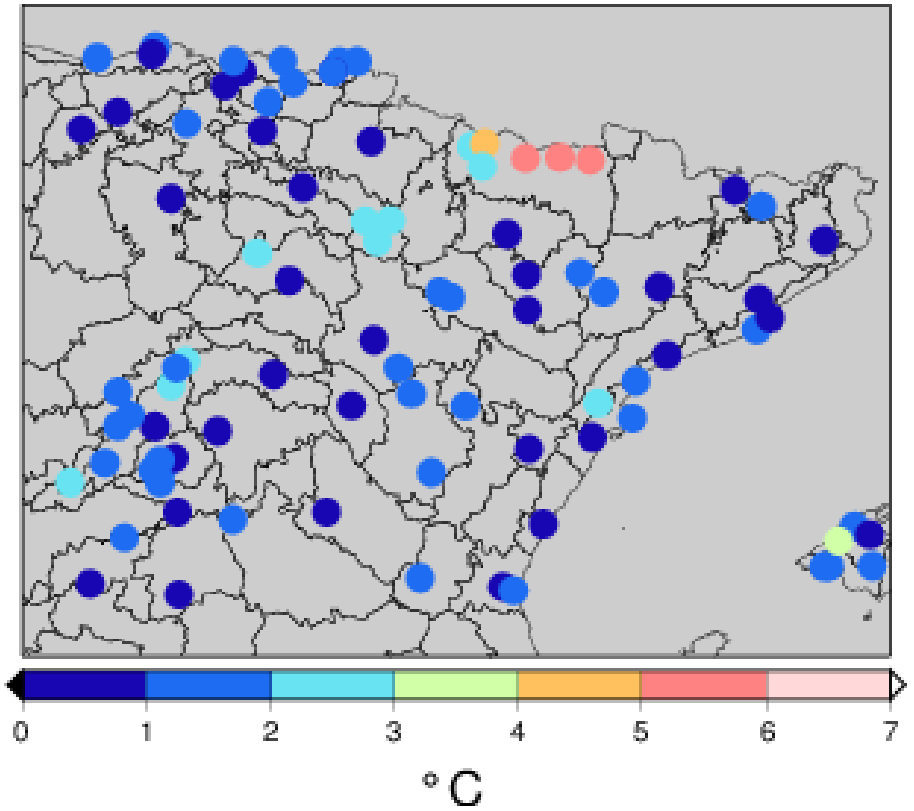
RMSD

	SAFRAN Analysis	HIRLAM Model
T (°C)	1.4	2.2
W (m ·s^{-1})	1.3	2.0
HR (p.p.)	8.6	12.6
C (oktas)	3.0	3.2
P (mm d^{-1})	3.2	6.8

- Good performance in general.
- Performance in Spain, close to the performance in France.
- Improvements needed for cloudiness.

Temperature and wind error maps

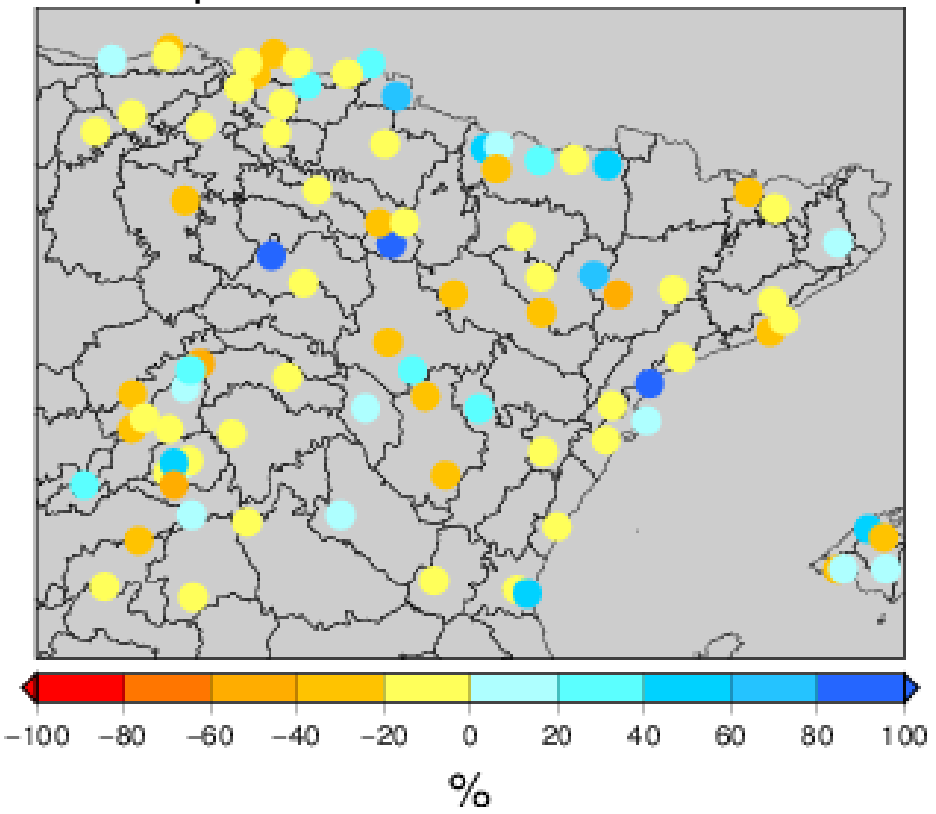
Temperature. RMSD.



RMSD of mean annual temperature (°C) between SAFRAN and the dependent stations.

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

Wind Speed. Bias.



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.

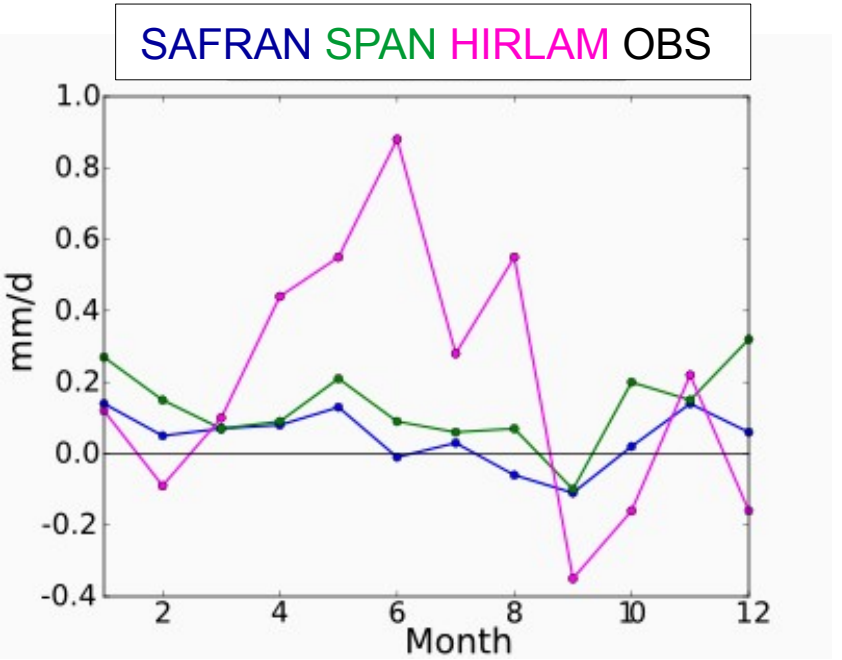
Validation of precipitation

SAFRAN, compared to SPAN and HIRLAM

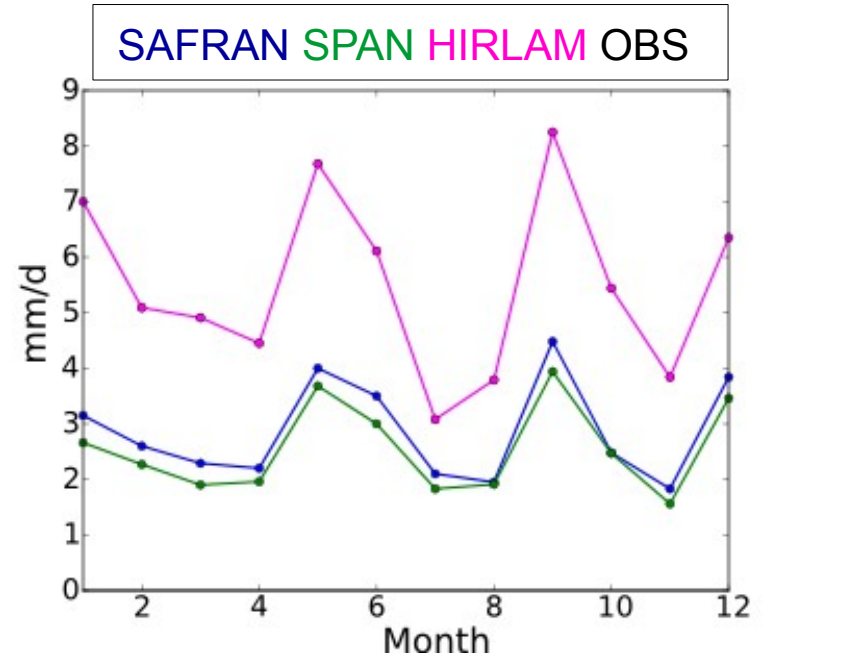
- Validation of SAFRAN and SPAN with independent data.
- Both SAFRAN and SPAN are close and much better than HIRLAM HNR.

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

Bias

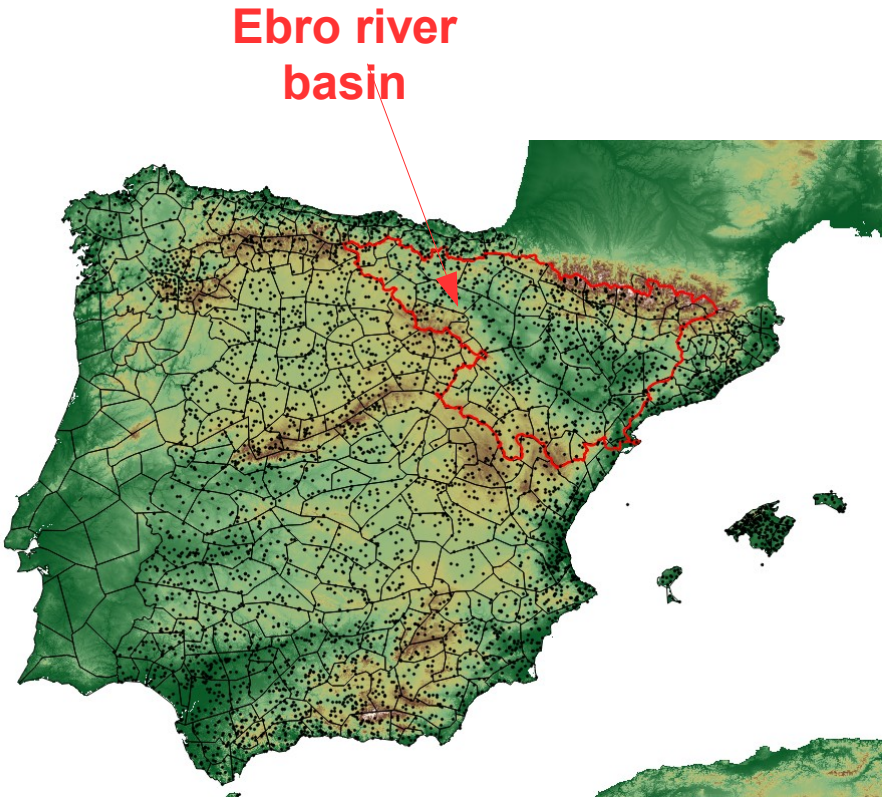


RMSE



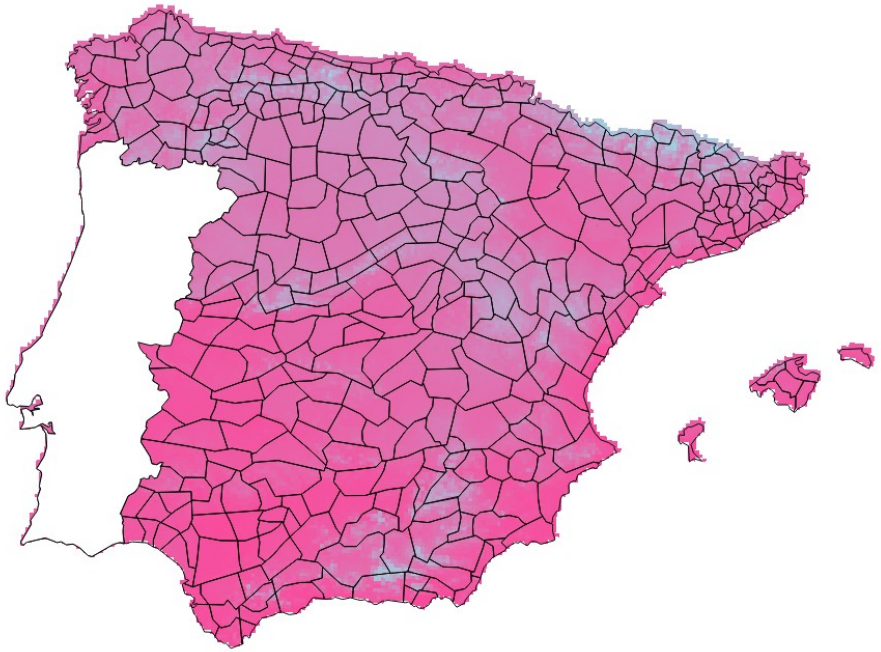
Extending SAFRAN to the Iberian Peninsula and the Balearic Islands

- 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 performend in the MARCO project.



- Precipitation station network (AEMET).
- Climatically homogeneous zones.

Extending SAFRAN to the Iberian Peninsula and the Balearic Islands



Mean temperature 2005/2006

Total precipitation 2005/2006

- SAFRAN also analyzes wind speed, relative humidity and cloudiness.
- It also simulates downward IR and VIS radiation.
- 12 year period in production (1995-2007). eartH2Observe project.
- 30 year period will be produced within the MARCO project.

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 proceses 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 longuer 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

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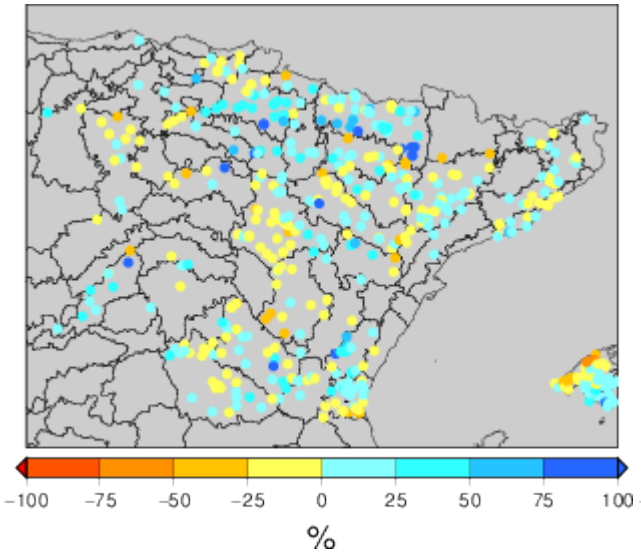
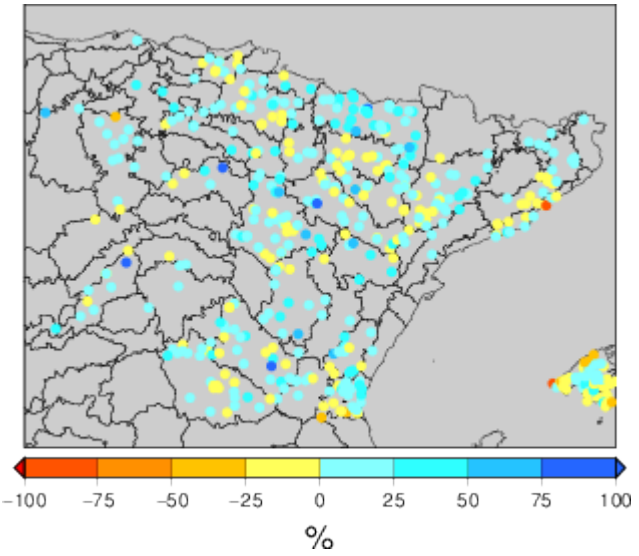
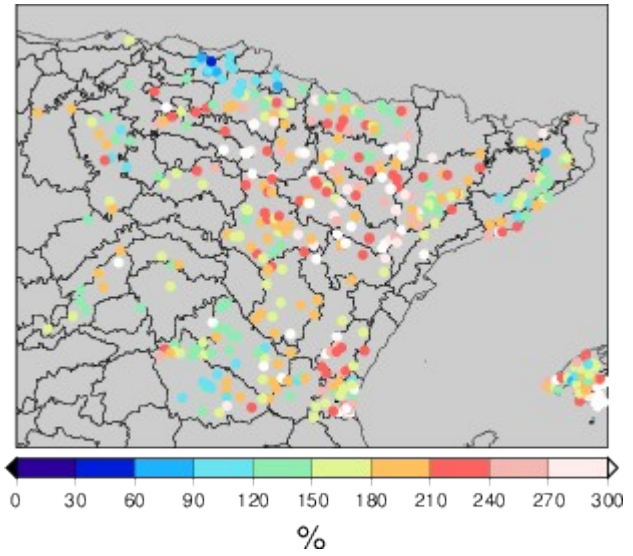
Validation of precipitation



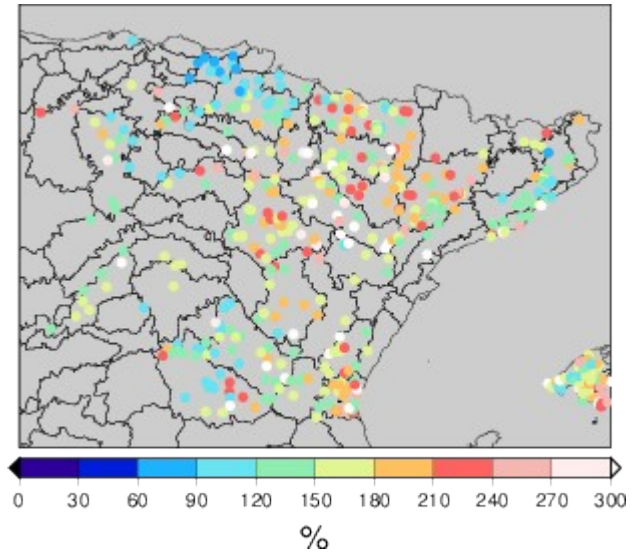
Rel. Bias. SF



Rel. Bias. SP



Rel. RMSE SF



Rel. RMSE SP

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