The impact of climate change on the water balance in the North-East of Spain: from downscaling of climate models to droughts.

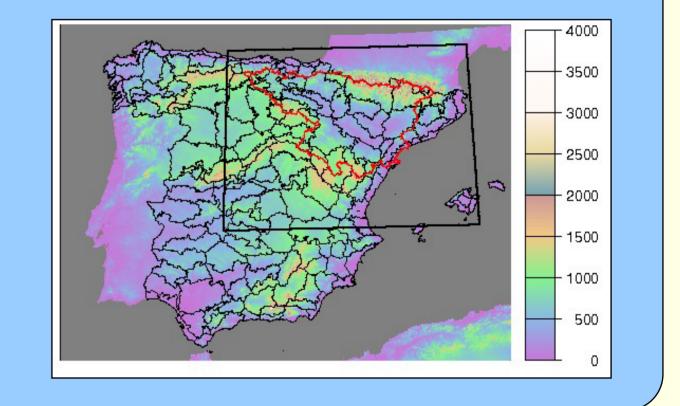Marco Turco [1], Maria del Carmen Llasat [1], Pere Quintana Seguí [2]
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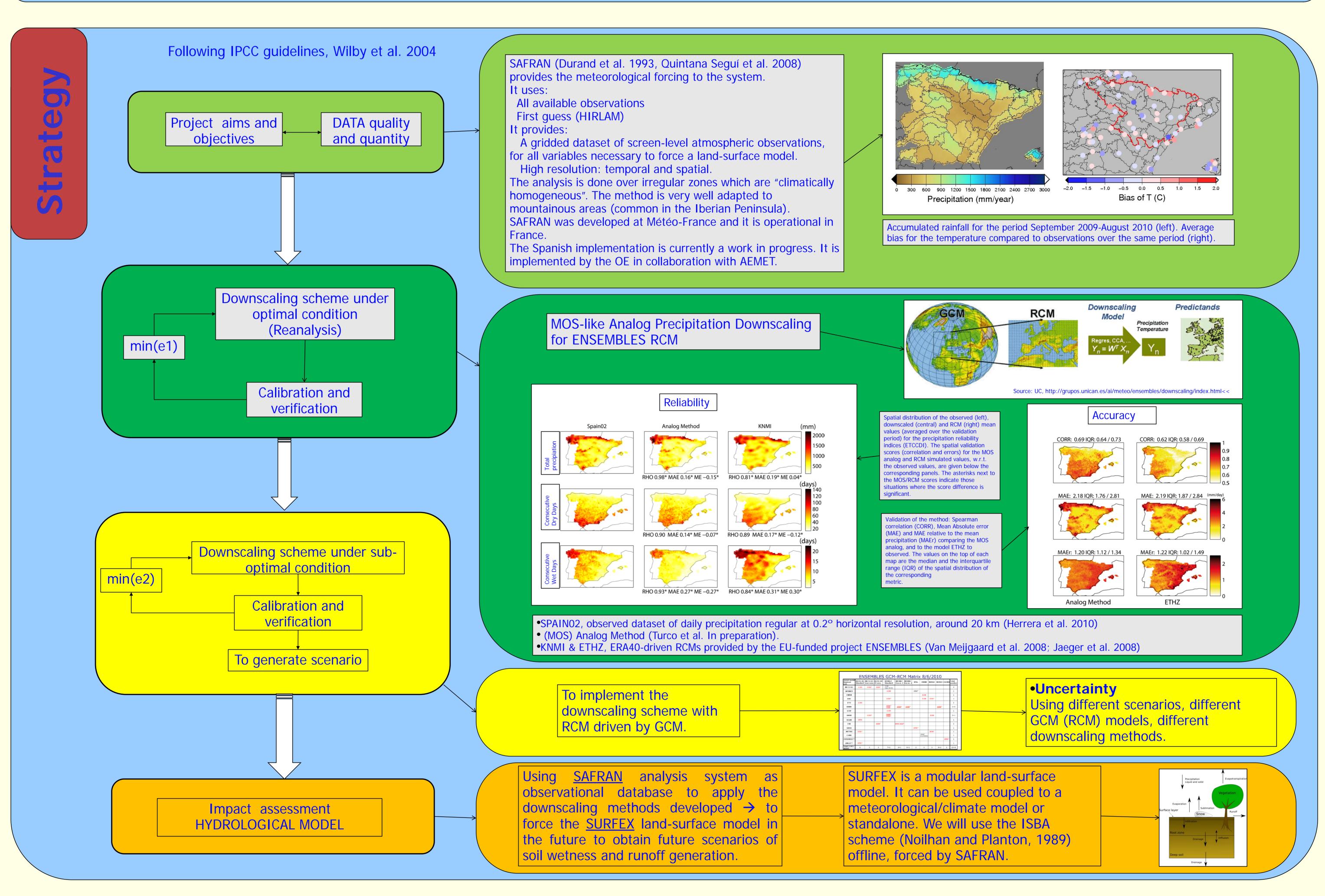
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Objective

To analyze the impact of climate change on the water balance of North-East of Spain, including on soil moisture.

How: to generate regional climate scenarios using statistical downscaling→ SAFRAN database will be used as observational database to apply the downscaling methods developed → to force SURFEX in the future and obtain future scenarios evapotranspiration, soil wetness and runoff generation.

Strategy

Following IPCC guidelines, Wilby et al. 2004

Project aims and objectives → DATA quality and quantity

SAFRAN (Durand et al. 1993, Quintana Seguí et al. 2008) provides the meteorological forcing to the system.
It uses:
  All available observations
  First guess (HIRLAM)
It provides:
  A gridded dataset of screen-level atmospheric observations, for all variables necessary to force a land-surface model.
  High resolution: temporal and spatial.
The analysis is done over irregular zones which are "climatically homogeneous". The method is very well adapted to mountainous areas (common in the Iberian Peninsula).
SAFRAN was developed at Météo-France and it is operational in France.
The Spanish implementation is currently a work in progress. It is implemented by the OE in collaboration with AEMET.

Accumulated rainfall for the period September 2009-August 2010 (left). Average bias for the temperature compared to observations over the same period (right).

Downscaling scheme under optimal condition (Reanalysis)

min(e1)

Calibration and verification

MOS-like Analog Precipitation Downscaling for ENSEMBLES RCM

Source: UC, http://grupos.unican.es/ai/meteo/ensembles/downscaling/index.html<<

Reliability

Accuracy

Spatial distribution of the observed (left), downscaled (central) and RCM (right) mean values (averaged over the validation period) for the precipitation reliability indices (ETCCDI). The spatial validation scores (correlation and errors) for the MOS analog and RCM simulated values, w.r.t. the observed values, are given below the corresponding panels. The asterisks next to the MOS/RCM scores indicate those situations where the score difference is significant.

Validation of the method: Spearman correlation (CORR), Mean Absolute error (MAE) and MAE relative to the mean precipitation (MAEr) comparing the MOS analog, and to the model ETHZ to observed. The values on the top of each map are the median and the interquartile range (IQR) of the spatial distribution of the corresponding metric.

- SPAIN02, observed dataset of daily precipitation regular at 0.2° horizontal resolution, around 20 km (Herrera et al. 2010)
- (MOS) Analog Method (Turco et al. In preparation).
- KNMI & ETHZ, ERA40-driven RCMs provided by the EU-funded project ENSEMBLES (Van Meijgaard et al. 2008; Jaeger et al. 2008)

Downscaling scheme under sub-optimal condition

min(e2)

Calibration and verification

To generate scenario

To implement the downscaling scheme with RCM driven by GCM.

- Uncertainty
Using different scenarios, different GCM (RCM) models, different downscaling methods.

Impact assessment HYDROLOGICAL MODEL

Using SAFRAN analysis system as observational database to apply the downscaling methods developed → to force the SURFEX land-surface model in the future to obtain future scenarios of soil wetness and runoff generation.

SURFEX is a modular land-surface model. It can be used coupled to a meteorological/climate model or standalone. We will use the ISBA scheme (Noilhan and Planton, 1989) offline, forced by SAFRAN.

Conclusions

SAFRAN analysis has been established on the north east of Spain. An analysis of the period September 2009-August 2010 was made by comparison to observations and analysis of surface AEMET SPAN. The long term goal is the simulation of surface water budget with SURFEX, then coupling with a hydrological model. This work is a contribution to the HyMeX project.

The MOS analog method improves the mean, the frequency and the extremes of precipitation for all RCMs, regardless of the region and the model reliability (including relatively low-performing models), while preserving the daily accuracy.

Next steps: (1) To calibrate the AM under sub-optimal conditions; (2) To generate the multi-scenarios; (3) To use SAFRAN as an observation database and to force SURFEX with the downscaled scenarios on the NE of Spain.
This data will be very useful to study different drought indices and prepare future scenarios of drought conditions.

References

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