Analysis of near-surface atmospheric variables on the NE of the Iberian Peninsula

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Introduction

SAFRAN (Durand et al., 1995, Quintana-Seguí et al. 2008) is a mesoscale atmospheric analysis system for near-surface variables. It produces a meteorological analysis at the hourly time step by using all available ground data observations and the outputs of a meteorological model, by means of optimal interpolation. One of its main features is that it is based on climatically homogeneous zones (areas where spatial gradients of meteorological variables are not very relevant) and is able to reliably take vertical variations into account. Originally intended for mountainous areas, it was later extended to cover the whole of France (SAFRAN-F).

We have implemented SAFRAN on the NE of the Iberian Peninsula (SAFRAN/NEP). SAFRAN/NEP belongs to our effort to build a distributed hydrological model for this area, which is currently being developed within the context of HyMeX. This model is inspired by the French SIM (Habets et al., 2008).

Our objectives are to implement the analysis system, to validate it and to compare it to SPAN, which is a similar meteorological analysis system developed by AEMET (the Spanish meteorological office).

SAFRAN Meteorological Analysis

SAFRAN (Durand et al., 1993; Quintana-Seguí et al., 2008) provides the meteorological forcing to the system.

Inputs:
- Available observations
- First guess (meteorological model HIRLAM HNR)

Outputs:
- A gridded dataset of screen-level atmospheric observations:
  - all variables necessary to force a land-surface model.
- high resolution: temporal (hourly) and spatial (5 km).
- The analysis is done over irregular zones which are “climatically homogeneous”.
- Ideally, within each zone, the spatial gradients are only due to differences in topography (altitude). There must be observations within each zone.
- There is one analysis for each zone and level (there is a level every 300 m).
- The method is well adapted to mountainous areas (common in the Iberian Peninsula), as it deals very well with vertical gradients.
- Long and short wave radiation is calculated with a radiation scheme due to the lack of observations.

SPAN Meteorological Analysis

SPAN is part of the HIRLAM analysis and prediction system, but it can be used standalone to obtain an objective analysis of screen-level variables. Using optimal interpolation, at this very moment SPAN can analyze sea level pressure, wind speed, temperature and relative humidity. AEMET is currently extending it to also analyze precipitation.

SURFEX Land Surface Model

Our next step is to force the SURFEX land surface model with SAFRAN data.

SURFEX is a modular land-surface model. We will use the ISBA scheme (Noilhan and Planton, 1989) offline, forced by SAFRAN. ISBA calculates the water and energy balances. We will use the simple force-restore method with three layers (as shown in the figure). In the future we might use a multi-layer diffusion version.

ISBA was first developed as a scheme for meteorological models, but it has been improved for hydrological contexts (Quintana-Seguí et al. 2009).

Summary and conclusions

- SAFRAN has been successfully implemented on the NE of the Iberian Peninsula.
- Our results are still preliminary:
  - more data of precipitation is needed.
  - the validation was not done using independent data.
  - the choice of SAFRAN for this area of study is pertinent, as it performs similarly as it does in France, where it is operationally used in many contexts.
- The meteorological alert zones are generally homogeneous, nevertheless, our preliminary results show that the division in basins (evacuation) is better, mainly for precipitation, which is not a surprise from a hydrological perspective.
- The meteorological alert zones were not defined using an objective methodology, they were defined using the experience of AEMET’s forecasters. This study is an indirect validation of the homogeneity of the zones.
- We are at the beginning of the comparison between SPAN and SAFRAN. We already can see that there are differences in their respective spatial structures.
- We are at the right direction to build a model similar to the French SAFRAN-ISBA-MODCOUR (Huberts et al., 2008, Quintan Seguí et al., 2009).
- The availability of a good data set is usually the major difficulty to overcome before using a land-surface model.
- The SAFRAN gridded database which includes many atmospheric variables of interest) and the simulations of the water balance (in the present and future climate) will be very useful for research on hydrology (water resources, drought, etc.), agronomy, risk of forest fires, etc.

References


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