CALIBRATION AND COMBINATION OF SEASONAL FORECASTS OVER SOUTHERN EUROPE

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1.- Introduction

This poster poses the very relevant question of the skill of state-of-the-art operational seasonal forecast models depending on different land domains within the Mediterranean region, on different seasons and on different variables. We have also applied the Bayesian calibration and combination method described by Stephenson et al. (2005) with different settings in an attempt to improve the scores of direct model outputs from individual seasonal forecasting systems.
From a purely operational point of view, the main objective of this paper is to gain knowledge about the skill of the here considered models as a function of the season, variable and region in order to improve the operational seasonal forecast activities in the Mediterranean region. For each region is crucial to evaluate the skill of seasonal forecasts and identify windows of opportunity or circumstances with higher skill. These windows of opportunity may be linked to certain teleconnections, seasons, variables or specific forecast systems. The windows of opportunity can be produced by signals from several processes interacting constructively, but the reasons how and why this occurs is still unclear.

2.- Data

Hindcasts of the following seasonal coupled atmosphere-ocean models have been used for their verification at seasonal time scales: ECMWF System 4 (S4), Météo-France System 3 (MF3), Met Office System 3 (UKMO3) and National Center for Environmental Prediction (CFSv2).
The E-OBS gridded dataset from the EU-FP6 project ENSEMBLES (http://ensembleseu.metoffice.com) has been used for the observational data (Haylock et al. 2008). The E-OBS (version 6.0) gridded dataset provides daily surface temperature and precipitation at 0.5º x 0.5º latlon horizontal resolution (for the ENSEMBLES European domain) from 1950 up to now. The dataset is based on daily station data available from the ECA&D website (http://www.ecad.eu) together with additional (restricted) data obtained by the STARDEX and ENSEMBLES projects.
From the original data, three monthly averaged anomaly values of temperature and precipitation upscaled to 1º x 1º horizontal resolution were computed to verify seasonal models outputs. These derived data were also used by the Bayesian method applied for calibrating and combining seasonal forecasts.

3.- Methodology

The Forecast Assimilation (FA) is a Bayesian method which has been used to calibrate and combine the four forecast systems here analyzed (Stephenson et al. 2005). The FA method is a consistent probabilistic approach that can be used for combining historical (climatological) information with dynamical model ensemble mean forecasts. The FA method, as any other Bayesian method, is firmly based on rigorous probability theory and so can provide well-calibrated probability forecasts.
We use as prior distribution the climatology from the E-OBS v6.0 observational database. As numerical forecasts, we have alternatively applied each of the four dynamical models here analyzed and also a combination equally weighted of the four models. The anomalies of the different prediction systems, computed as the difference between the forecasted and climatological values for each system, are obtained by cross-validated forecasts on data not used in the estimation, i.e., the year to be forecast is removed from the dataset. Cross-validation is also used for the calibration/combination FA method. We have used as common calibration period 1988-2008 covered by the hindcasts of the four systems here analyzed.

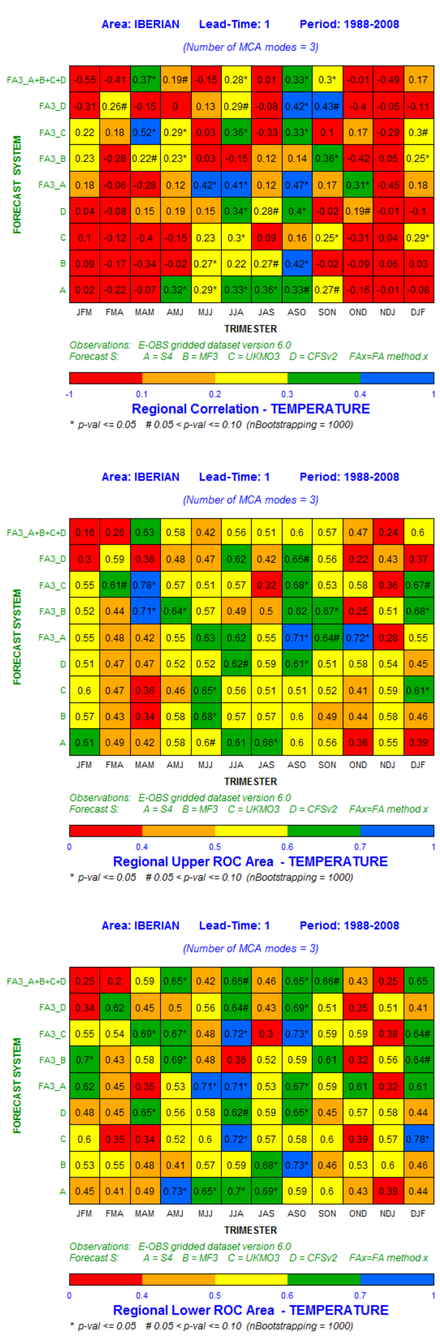
4.- Verification

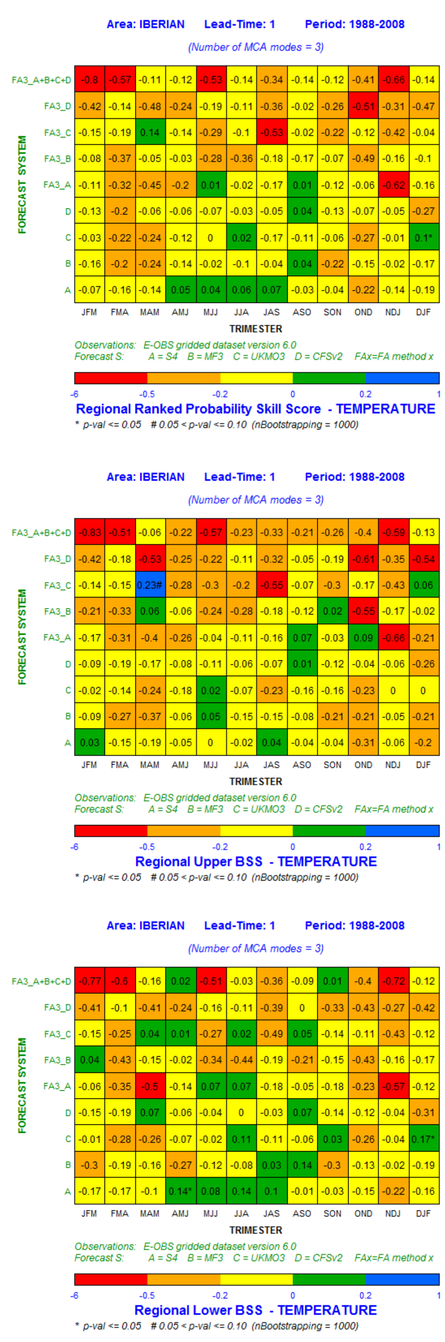
Seasonal forecasts of temperature and precipitation obtained with the different forecasting systems here considered are verified using both deterministic and probabilistic skill scores. Statistical significance of all computed scores has been quantified by the p-value estimated using a bootstrapping non-parametric method. The following skill scores (Wilks 1995) have been computed over different Mediterranean domains (although only the Iberian Peninsula domain is shown here) for 12 different three-month periods and for different lead times (only lead time 1 is shown here)

- Correlation between predicted and observed mean value of anomalies
- Ranked Probability Skill Score (RPSS) for terciles
- Lower/Upper Relative Operating Characteristic (ROC) area
- Lower/Upper Brier Skill Score (BSS)

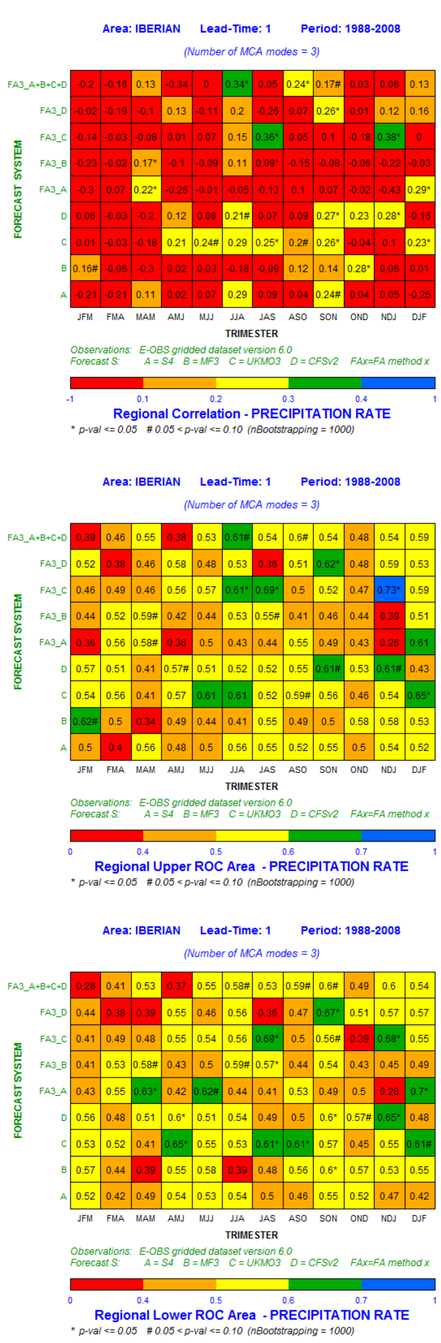
Skill scores are computed using 3 MCA modes and FA is applied making use of averaged three month standardized values computing the prior function using the extended period (1960 – 2010) for each of the individual four dynamical models here analyzed and for the combination of all of them.
Several alternative FA settings were also explored (not shown here).

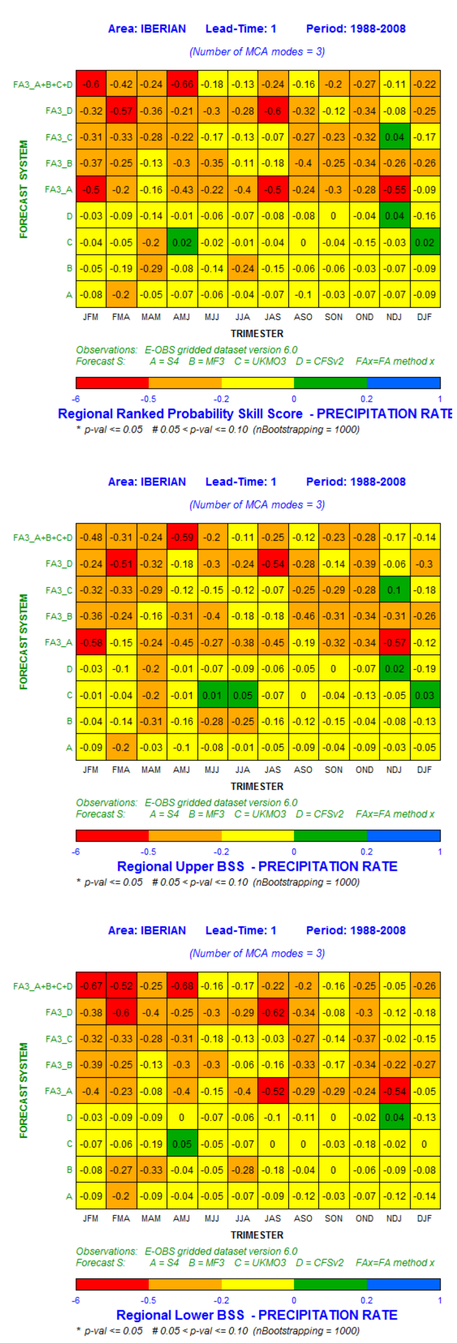
Temperature





Precipitation





Conclusions

•Tables above show windows of opportunity associated to certain seasons/variables/models, e.g., correlation for summer temperature over the Iberian Peninsula have higher skill in terms of correlation. Windows of opportunity are also highly dependent on the particular skill scores. The potential of calibration/combination based on FA is also shown.
• Improvement associated to the FA calibration and combination is more noticeable for certain models/seasons/variables/scores. FA jointly applied to the 4 models is not always the best strategy. FA does not show any improvement when there is no (or very low) skill.
• The FA algorithm here applied making use of averaged three month standardized values computing the prior function using the extended period (1960 - 2010) seems to give better results than other explored alternatives (e.g.,using anomalies of averaged three month values).
• Need to evaluate skill of all available sources of seasonal forecast information before their operational use and analize the ability of calibration/combination algorithms (like FA) to enhance skill.

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