Preliminary Validation of the Seasonal Forecasting Systems included in the SPECS-EUPORIAS Data Portal: The ECMWF System4 Hindcast

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\section{Abstract}

Different activities in the EU FP7 projects SPECS and EUPORIAS require seasonal predictions to feed different impact models, to serve as input to different downscaling techniques, or to test different validation methodologies. Typically, precipitation and surface temperatures are used for this purpose. The ECMWF System4 seasonal forecasting system has been selected in these projects as the initial model to undertake these activities. The available System4 hindcast covers the period 1981-2010, and several variables have already been included in the SPECS-EUPORIAS data portal (https://www.meteo.unican.es/trac/meteo/wiki/SpecsEuporias). This information is available for downloading through a THREDDS server for the SPECS-EUPORIAS community, both directly and through an R-package for transparent data access.

A key task in this framework is to assess worldwide the forecast skill of the data included in the SPECS-EUPORIAS data portal, so appropriate decisions can be made based on the model skill. This document shows the results of a preliminary validation of the “System4 seasonal range (15 members)” dataset for the whole hindcast period 1981-2010. This allows identifying the most suitable regions for impact applications on seasonal time-scales. This document will be updated in the coming months to include the validation results for further seasonal forecasting systems to be included in the SPECS-EUPORIAS data portal (for instance the CFS from NCEP).

\section{1 Introduction}

The climate impact activities on seasonal timescales planned in SPECS (http://www.specs-fp7.eu) and EUPORIAS (http://www.euporias.eu) projects require the use of different data sources; mainly seasonal forecasts, reanalysis, and observations. These activities include the calibration, downscaling, and modelling of sector-specific indices in agriculture, energy, health, etc., building on meteorological information. Typically, only a reduced subset of variables is required for these activities. The SPECS-EUPORIAS Data Portal has been established by the Santander Meteorology Group (UC-CSIC) to gather the relevant information from existing datasets in order to provide a unique, homogeneous access to data for the SPECS and EUPORIAS partners —in particular for impact-users—.

Currently the data portal includes information from a single seasonal forecasting system, the ECMWF System4 model\textsuperscript{1}. Seasonal predictability strongly varies from region to region —with higher skill typically in the tropics—and from season to season (see, e.g., van Oldenborgh, 2004; Doblas-Reyes et al., 2010). Therefore, a key task is to properly evaluate the forecast skill worldwide and seasonally. Since surface temperature and precipitation are, typically, the main variables of interest for end-users and the best observed, they are good candidates for an initial evaluation. For this purpose, a number of validation scores have been proposed in the literature, each covering different aspects of a forecast relevant to users (Jolliffe and Stephenson, 2003). This document shows the results of a preliminary validation of the “System4 seasonal range (15 members)” dataset for the whole hindcast period

\footnote{\url{http://www.ecmwf.int/products/changes/system4}}
Most of the validation studies reported so far for these variables and for this model have been conducted for specific seasons and/or over limited areas of the world, such as the Northern Hemisphere winter (Kim et al., 2012a) or the Asian summer monsoon (Kim et al., 2012b). Note that the ECMWF provides public information of the previous seasonal forecasting system (System3), but the verification site for System4 is still in progress. Therefore, the main goal of this report is to provide a preliminary worldwide validation of the System 4 model focusing on seasonal precipitation and temperature using standard validation scores: bias, correlation and ROC Skill Area (ROCSS) for tercile-based predictions.

2 Data

On the one hand, data from System4 were obtained from the System4 seasonal range (15 members) dataset, accessible through the SPECS-EUPORIAS data portal. Visit https://meteo.macc.unican.es/trac/meteo/wiki/SpecsEuporias for further information. On the other hand, observational datasets widely used for verification purposes have been considered to validate the model. For precipitation, GPCC v5 at 1° resolution was used. For maximum temperature, we considered CRU ts 3.10 on a 0.5° regular grid. In both cases, the System4 was bi-linearly interpolated from its native 0.75° resolution to the resolution of the observations.

3 Validation Results

This preliminary analysis of the skill is performed considering the four seasons DJF, MAM, JJA, and SON, and one-month lead forecasts for the whole 15-member ensemble hindcast period (1981-2010). The ensemble mean is considered for the deterministic scores (bias and correlation), whereas the tercile frequencies/probabilities given by the 15 ensemble members have been validated using the probabilistic ROC Skill Score (ROCSS). The latter score is recommended by the WMO Lead Centre for the SVS-LRF, as a simple, intuitive and easy to interpret score, thus providing a reasonable first choice for communicating skill to decision-makers.

Figure 1 shows the seasonal bias (mean error) for precipitation (top) and maximum temperature (bottom). Positive and negative biases alternate in different regions of the world for precipitation, whereas negative maximum temperature biases are predominant in all regions (except North America and East Asia).

Figure 2 shows the results for the interannual seasonal Pearson correlation. The skill for precipitation is mostly concentrated in the tropical regions, in agreement with previous results analyzing different seasonal forecasting systems (see, e.g. van Oldenborgh et al., 2005). Note that in the case of temperatures, trends can lead to artificial skill and, therefore, an alternative analysis for the detrended series is also given in Fig. 3) series. Again, the skill of the detrended series is mostly concentrated in the tropical regions.

Figure 4 shows the ROCSS for the dry (left) and wet (right) terciles of precipitation. The most skillful regions are Northern South America (all seasons), the Malay archipelago and Oceania (during JJA and SON), South Africa (during DJF) and Middle East (during SON). There are also some spots of skill in Africa, in the Gulf of Guinea (in DJF) and Sahel - East Africa (JJA and SON), but the spatial significance of these results should be further analyzed.

Finally, Fig. 5 shows the ROCSS for the cold (left) and warm (right) terciles of daily maximum temperature for the detrended series. Note that in this case the skillful regions cover broad regions particularly in South America, Africa, Middle East and India.
Figure 1: Seasonal bias of the ensemble mean for the whole hindcast period (1981-2000) for precipitation (validated against GPCC v5) and maximum temperature (validated against CRU ts 3.10).

References


Figure 2: As Fig. 1, but for seasonal interannual correlation using Pearson correlation.

Figure 3: As Fig. 2 bottom, but for the detrended series. Significant trends after a Mann-Kendall test (at a 5% level) are removed both from System4 and CRU ts 3.10 for the computation of correlations.
Figure 4: Seasonal ROCSS for the dry and wet terciles for the whole hindcast period 1981-2000. Precipitation from System4 has been validated against GPCC v5. Only statistically significant (at a 5% level) ROCSS are shown. Blue points indicate gridboxes where the corresponding tercile category has never been observed during the hindcast period.
Figure 5: As Fig. 4 but for detrended maximum temperature. Significant trends after a Mann-Kendall test (at a 5% level) are removed both from System4 and CRU ts 3.10 for the computation of correlations.