Experimental Monthly to Seasonal Fire Danger Forecasts

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1. Introduction

Predictions of potential fire ignition and spread are operational requirements for seasonal fire planning. The National Interagency Coordination Center (NICC), which is the US support center for wildland firefighting, currently makes these seasonal firedanger forecasts subjectively, using standard seasonal forecasts of temperature and precipitation, available routinely from the National Centers for Environmental (NCEP).

By contrast, automatic nowcasts of fire danger potential are provided routinely by the US Forest Service (USFS) National Fire Danger Rating System (NFDRS; see Burgan 1988), which incorporates not only a more extensive weather description (i.e. relative humidity, windspeed, etc.) but also topography and fuels or vegetation.

A goal of our collaborative NCEP / US Forest Service (USFS) / Experimental Climate Prediction Center (ECPC) work has been to demonstrate that these USFS NFDRS fire danger indices (FDIs) can be usefully and skillfully predicted with a dynamical seasonal prediction model. Below we describe the NCEP global to regional seasonal forecast system we are currently evaluating, and then we provide a preliminary assessment of the skill of the initial forecasts.

2. Methodology

2.1 NCEP CFS/RSM Forecasts

The NCEP 64-level Climate Forecast System (CFS) currently starts from the NCEP operational atmospheric and ocean analysis and uses a coupled model comprised of the NCEP Global Forecast System (GFS) for the atmosphere and the Modular Ocean Model (MOM3) for the ocean, for the coupled seasonal forecast. Corresponding climatology runs start from the NCEP/Dept. of Energy atmospheric reanalysis II and historical MOM3 ocean analyses. In collaboration with NCEP, we are now nesting a 28-level NCEP Regional Spectral Model (RSM; Juang et al. 1997) within a 28 level Global Spectral Model (GSM) for an experimental US regional seasonal forecast (7-months each month). The GSM/RSM use the CFS physics but the RSM operates over the US with 50 km resolution, in contrast to the coarser scale (200 kms) global CFS and GSM. The GSM and RSM forecasts are run at the same time, using the CFS forecast sea surface temperature anomalies.

This experimental NCEP/USFS/ECPC CFS/RSM seasonal forecast archive began Oct. 2004. 10 forecasts starting on 5 different days at 0000 and 1200 UTC are made. In addition, three 7-month hindcasts are made for the same month for each year from 1982 to 2004 in order to develop a model climatology. Also, a continuous 1-day forecast run from Jan. 1982-present has now been developed. This continuous run, along with observed precipitation (Higgins et al. 2000), was required to initialize the fire danger code, which depends on current as well as past conditions, as well as to provide the forecast validation (see Roads et al. 2005).

2.2 NFDRS

The NFDRS (Burgan 1988) describes the potential for fire danger, given the conditions of fuel, topography, and weather. The basic inputs to the NFDRS include precipitation, temperature, relative humidity, cloud cover and wind speed as well as fuels and slope. The standard weather input to the NFDRS comes from weather station data, which is assumed to apply to a large area surrounding each weather station; vegetation (fuel) types and slope are also defined for each weather station. The Wildland Fire Assessment System (WFAS; http://www.wfas.us/) constructs maps of FDIs based on weather station observations.

In contrast to the WFAS station based FDIs, gridded fuels, weather forecasts and topography data are used here. The fuels and orography (slope) data were initially defined at 1km spatial resolution and then the nearest 1km grid point was used for the NFDRS 25km grid. Observed precipitation (25 kms) and forecast model output (50 kms) are similarly interpolated to the NFDRS grid. NFDRS gridded fuels and slopes are also used for these calculations. Slope is important in assessing fire danger because fire generally burns faster spreading upslope than on flat ground. Vegetation type, quantity and structure are also important for describing fire danger. Sixteen of the twenty NFDRS fuel models are being used to represent the vegetation types across the U.S., (Burgan 1988) defining fuel characteristics such as depth, load by live and dead classes, heat content, fuel particle size, etc. Each fuel model in the fire danger rating system must necessarily represent a rather broad range of vegetation types.

Roads et al. (2005) provide a summary description of the FDIs being examined here, which include the: Spread Component (SC), Energy Release Component (ER), Burning index (BI), Ignition Component (IC), Keetch-Byram Drought index (KB), and Fosberg Fire Weather index (FWI). The FWI is not a standard FDI, but because of its simplicity, it can be used globally.

3. Preliminary Results

The RSM provides a reasonable simulation of the validating firedanger indices**. Fig. 1** shows the anomaly correlations of MJJAS FDI forecasts, beginning Mar. 1, with FDI validations. Note that the correlation is high over the US West. This skill is presumably related to forecast skill of relative humidity, which has a strong influence on the FDIs. What is perhaps even more important is the correlation of the various indices with the fire characteristics such as fire counts and acres burned, not shown. These comparisons, as well as assessments of the additional skill that may be obtained from additional forecast ensemble members, as well as the additional skill the RSM adds to the downscaled GSM and to the persistent initial state, are underway.

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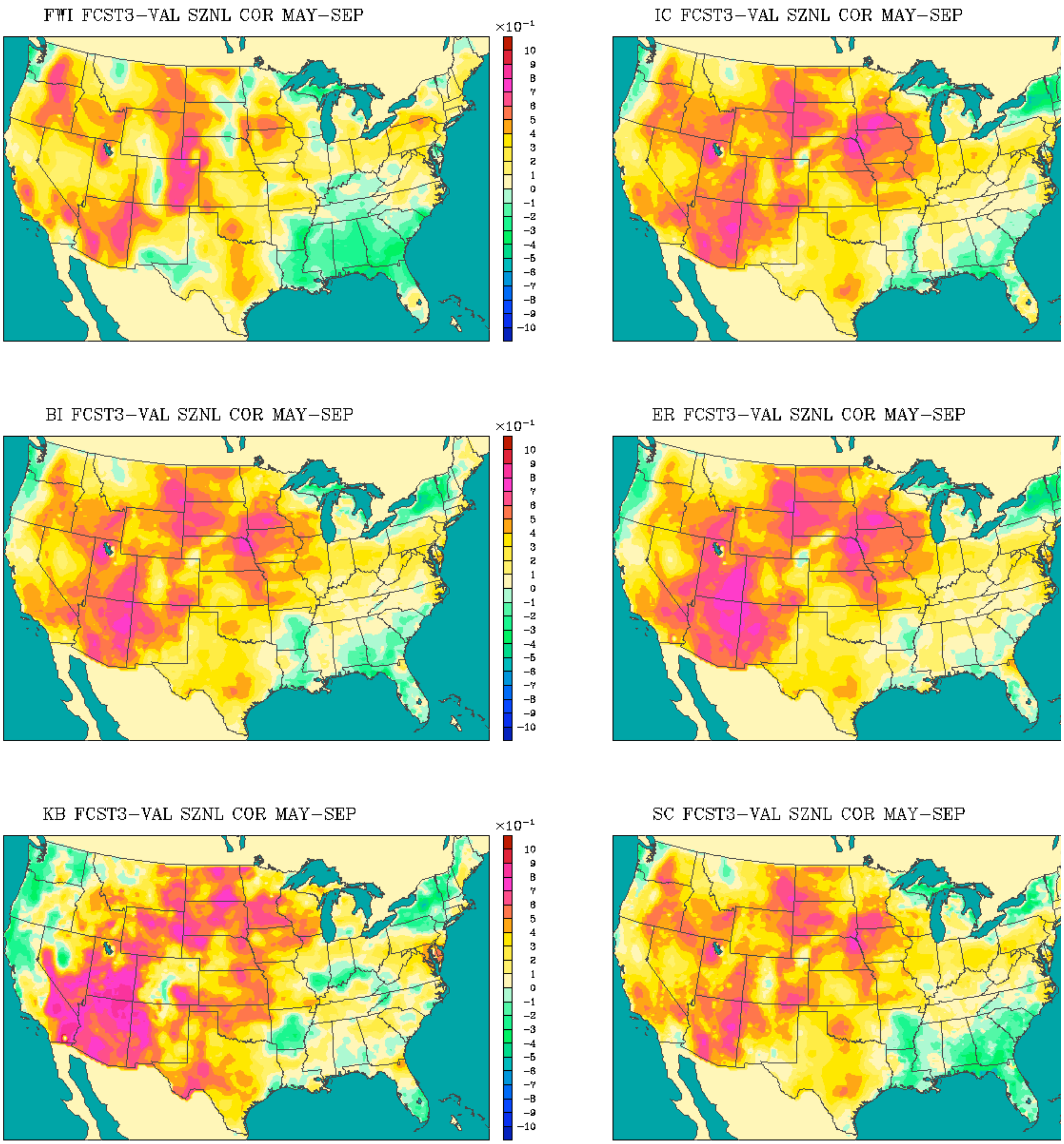

Fig. 1 Correlations of MJJAS forecasts beginning Mar. 1 with FDI validations.