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Project Identifier: **01.PNW.A.3,**

Seasonal prediction of national fire risks and impacts

Project Narrative

2003 Highlights, Accomplishments and Activities

The MAPSS team is web-publishing experimental 6-month fire risk forecasts that allow agencies to better anticipate firefighting needs, thus increasing fire preparedness.
http://www.fs.fed.us/pnw/corvallis/mdr/mapss/fireforecasts.htm
Actual weather observations since 1895 to the most recent month (currently through June 2003) have been gridded over the conterminous U.S. for use by a dynamic general vegetation and fire model, MC1. The model has demonstrated good skill in simulating the spatial and temporal distributions of observed fire activity in the United States over the last several years (Figure 1).

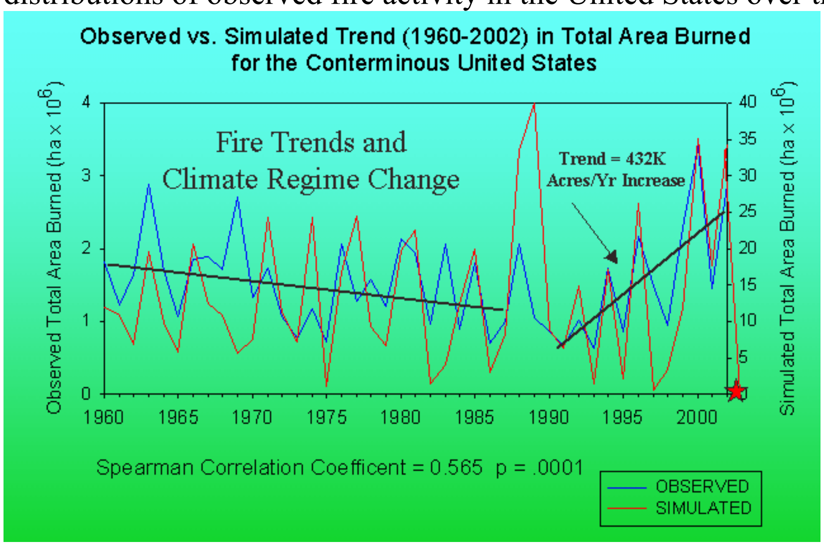


Figure 1. MC1 demonstrated a highly significant correlation between Observed vs. simulated trends in total annual area burned in the United States from 1960-2002. The observed area burned is an order of magnitude less than the simulated area due to fire suppression and other land use effects not yet accounted for in the model. An ocean-atmosphere climate regime shift occurred in 1988-89 and demonstrates that the recent increase in fire area is clearly related to climate, since the fire model does not as yet incorporate historical fire suppression.

The current consensus forecast for the 2003 fire season is based on three weather scenarios for the next 6 months and predicts a relatively low level of fire risk compared to recent years. Observed fire activity in the 2003 fire season is remarkably coincident with the simulated distribution of fire risk.

http://cefa.dri.edu/Assessment_Products/assess_index.htm

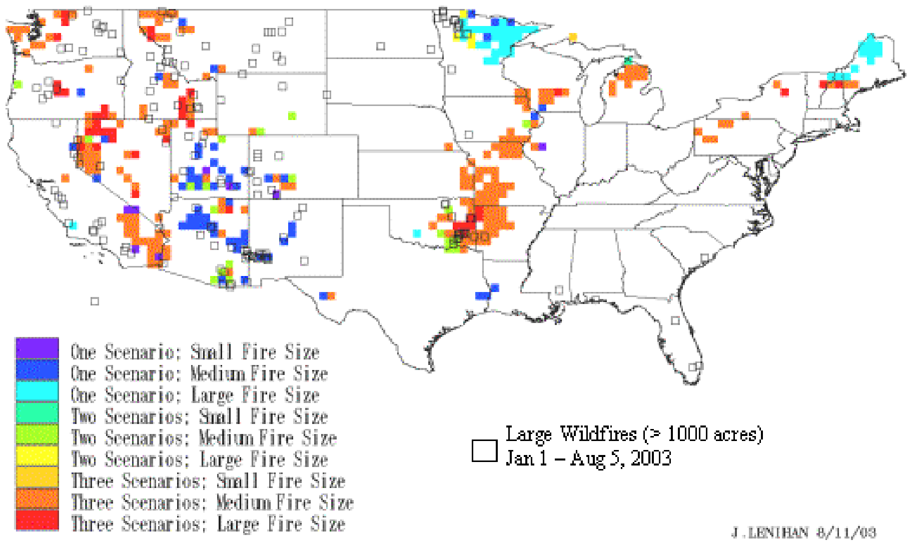
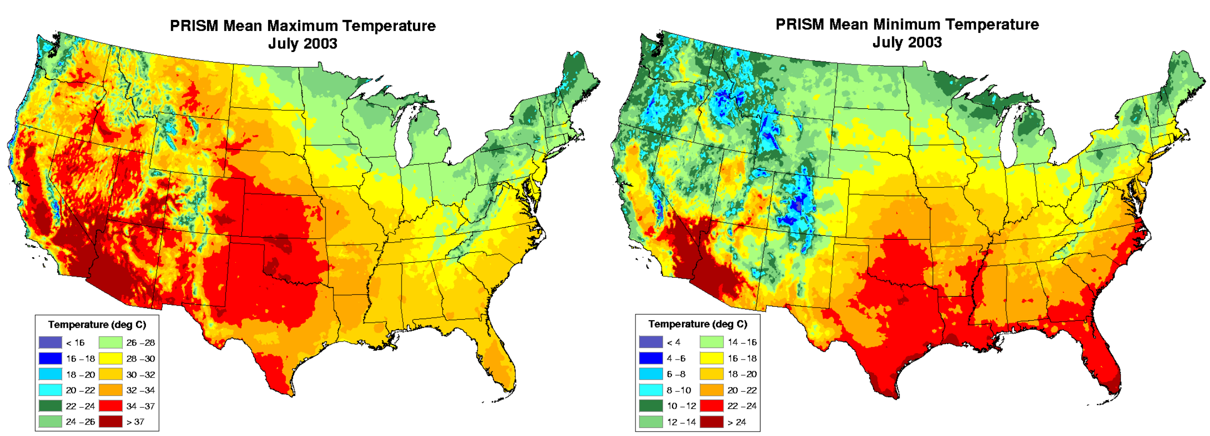


Figure 2. The fire risk consensus forecast for 2003 (as of August, 2003). The forecast is based on observed climate data up through June 2003, and three different 6-month weather scenarios up to December 2003. The redder colors indicate a greater probability of high fire risk. Hollow squares show the observed location of large fire events up to August 5, 2003.

The infrastructure necessary for operational historical and near-real-time climate mapping at fine temporal and spatial scales has been significantly improved with the development of a parallel computing system and enhanced storage by Oregon State University's Spatial Climate Analysis Service (SCAS). Monthly climate data sets are updated approximately 1 to 2 weeks after the end of each month and include updates of the past several months with new station observations as well as the most recent month. Baseline grid resolution is ~50 km, but recent advances have increased the resolution to ~4 km. The much finer resolution, near-real-time data grids require a highly rigorous quality control system, which is undergoing major research and development. MC1 requires high-resolution monthly climate grids for 'spinup', which were developed for the period January 1895-present. Unique algorithms were developed to extend all the required climate variables back to 1895 on the ~4 km grid, even though all variables, such as vapor pressure, were not directly measured. The ~4 km climate grids for recent months are the most accurate and detailed available anywhere (Figure 3).



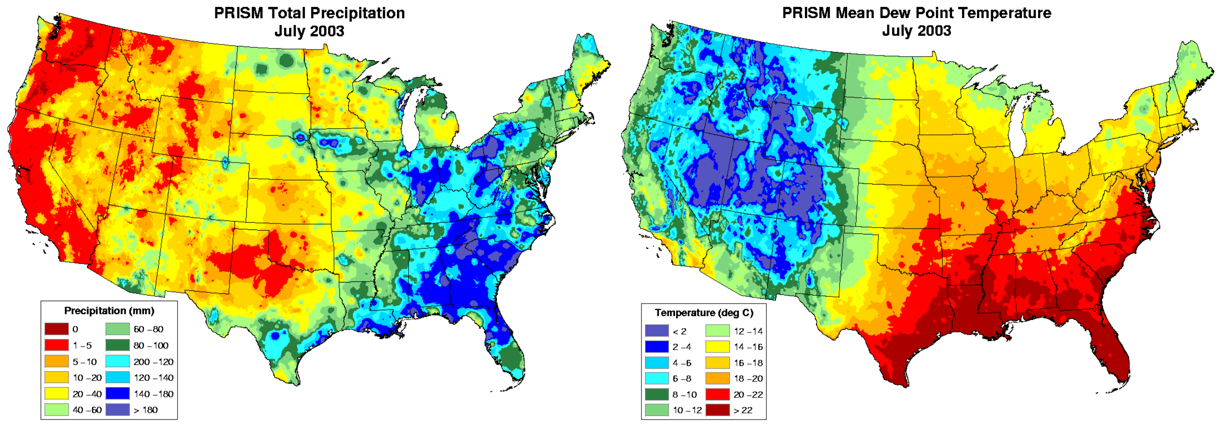


Figure 3. July 2003 gridded climate data from Oregon State University's Spatial Climate Analysis Service (SCAS) used by the MC1 model for fire forecasting.

The development of future climate scenarios requires the conversion of simulated future climate scenarios (General Circulation Model, GCM) into 'anomaly' maps of monthly deviations of future climate variables from long-term averages of those variables. The coarse grid anomalies from the GCMs must also be interpolated to the high-resolution grids (e.g. ~50km, or ~4km) for use by the fire-vegetation model, MC1. Considerable quality control must be uniquely developed for each GCM in order to insure proper 'downscaling' and anomaly interpretation of its future climate simulations (Figure 4).

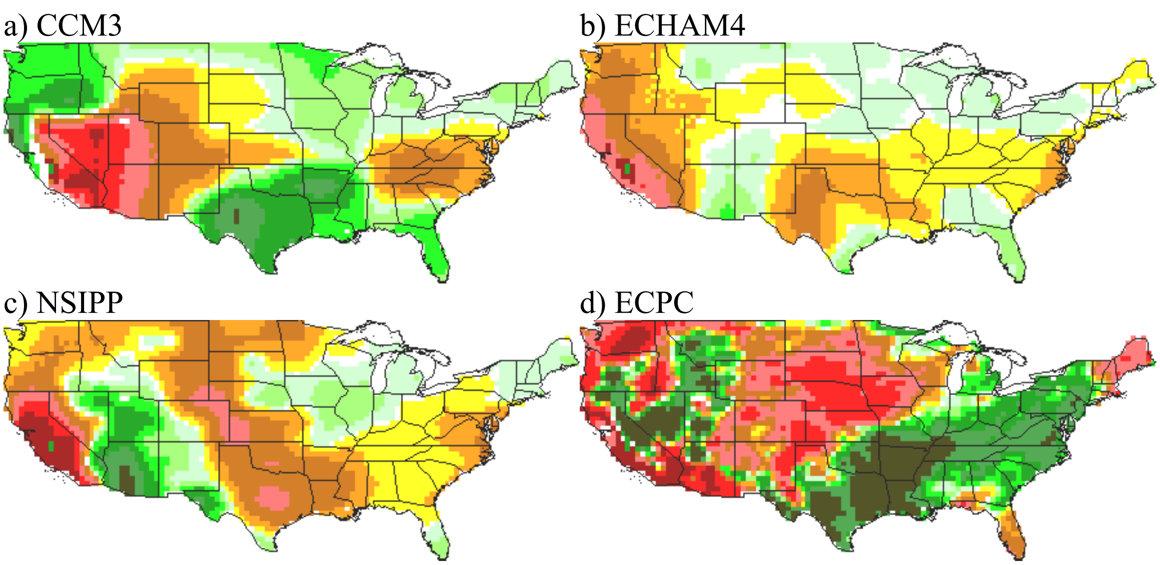


Figure 4. August, 2003, simulated precipitation anomalies from a) the Community Climate Model (CCM3) of the National Center for Atmospheric Research, b) the European Community - HAMburg (ECHAM) model, c) the Seasonal to Interannual Prediction Project (NSIPP) at NASA's Goddard Space Flight Center, and d) The Scripps Experimental Climate Prediction Center (ECPC) model. Greens are increases in forecast precipitation. Yellows to reds are decreases in forecast precipitation.

Accurately forecasting fire occurrence and magnitude requires accurate simulation of fuel buildup after each fire, which is one of the largest uncertainties in fire forecasting. Soil nitrogen dynamics can control the rate of re-growth following fire, but the rate of supply of nitrogen to the soils is not well understood. The MAPSS team in collaboration with Oregon State University has demonstrated through sensitivity analyses (Figure 5) that different assumptions about nitrogen supply can significantly alter both the frequency and magnitude of fire occurrence.

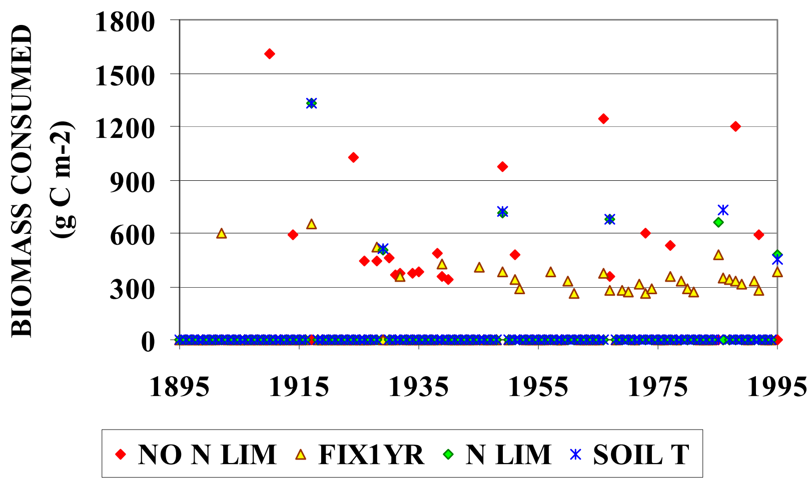


Figure 5. Each symbol represents an individual fire, simulated under different assumptions of nitrogen supply in an eastern Oregon forest. Unlimited supply of nitrogen (red diamonds) produces considerable woody growth, inhibiting ground fuel growth, with few, but larger fires. A single year of post-fire nitrogen fixation (yellow triangles) produces more grass growth with frequent small fires. Limited nitrogen supply from decomposition (green triangles and blue asterisks) produces moderate growth of both grasses and woody vegetation with intermediate fire return interval and intermediate fire size.

One journal paper was published in 2003 and one is in press:

Bachelet, D., R.P. Neilson, T. Hickler, R.J. Drapek, J.M. Lenihan, M.T. Sykes, B. Smith, S. Sitch, K. Thonicke. 2003. Simulating past and future dynamics of natural ecosystems in the United States. Global Biogeochemical Cycles 17(2):14-1 - 14-21.

Lenihan, J.M., D. Bachelet, R. Drapek and R.P. Neilson. In Press. Climate Change Effects on Vegetation Distribution, Carbon Stocks, and Fire Regimes in California. Ecological Applications (In Press).

Future goals for the MAPSS team's fire forecasting efforts are to:

1) Increase the resolution of fire forecasts from ~50km to ~4km;
2) Expand the scope of forecasting to Alaska
3) Increase the number of scenarios used for future forecasts;
4) Enhance algorithms for fire ignition, and
5) Improve our knowledge and simulation of nitrogen dynamics and fuels re-growth following fire.
6) Develop analyses of forecast 'skill'.