CEFA Chronicle

January 2003

From the Director

Greetings,

This is the first edition of what is planned to be a bi-annual update of CEFA activities. Not sure what CEFA is or never heard of it? Then please check out page 16. But briefly, CEFA is the Desert Research Institute (DRI) Program for Climate, Ecosystem and Fire Applications (CEFA) and resides within DRI's Division of Atmospheric Sciences. We started about five years ago to work with wildland fire management agencies, in particular the Bureau of Land Management, to perform applied studies and decision-support product development for agency on-the-ground use. Since our conception, we have grown to a small group of DRI faculty, students and visitors working with a number of federal, state, and county agencies across the U.S.

What is the purpose of the chronicle? It is meant to serve as a narrative report of CEFA business, but not necessarily abiding by the strict definition of chronicle – a detailed account in prose or verse of historical events, presented in chronological order, without authorial interpretation, and sometimes including legendary material. We can hope that maybe some projects will become legendary. In the meantime, the chronicle will provide a snapshot of CEFA projects – information pieces taken from reports and papers along with newsletter specific script. You are invited to review the full-text documents or visit the CEFA web site for more detail.

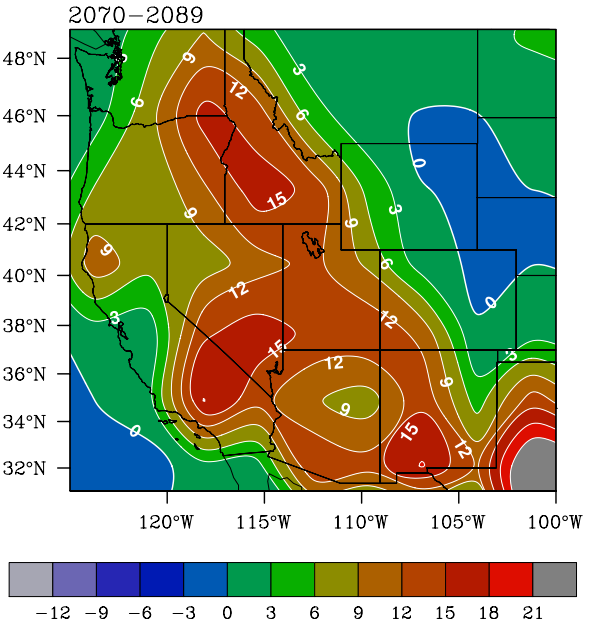
The organization of the chronicle will consist of several sections, including completed projects, continuing projects, new projects, CEFA's history and mission, a list of CEFA partners, and a list of presentations and publications. Of course I would say that all of the projects are good, but my picks for this issue would be "Climate Prediction and Fire Danger" and "California Hourly Fire Danger". But check out the whole issue to sense the variety of things we do. So as they say on the airlines, sit back, relax and enjoy the flight. Hopefully you are in a more comfortable seat though.

Western Regional Climate Center

(CAP)

Climate Prediction and Fire Danger

CEFA collaborated with the Scripps Institution of Oceanography (Drs. Dan Cayan, Tim Barnett, and Tony Westerling) on the Department of Energy Accelerated Climate Prediction Initiative project. CEFA's role was to incorporate climate model predictions for the period 1975 through 2089 in the National Fire Danger Rating System (NFDRS) and assess how fire danger in the western U.S. might change in response to regional climate change during the 21st Century. The results of this study are expected to apppear in the scientific journal *Climatic Change*.

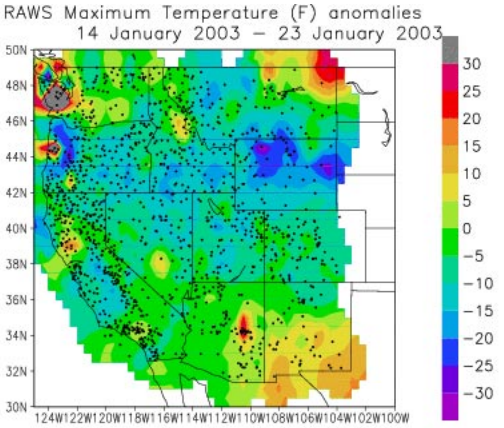


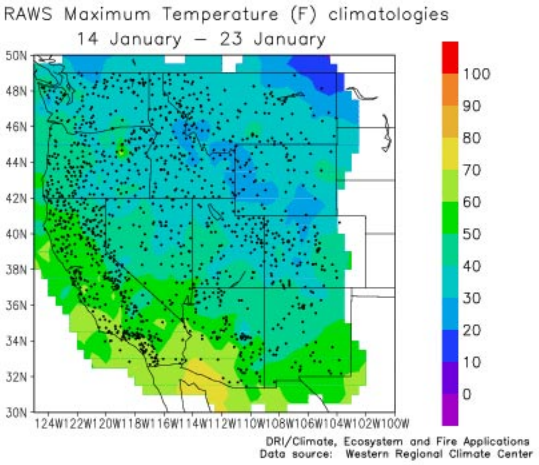
Meteorological output from the National Center for Atmospheric Research (NCAR) Parallel Climate Model (PCM) was used to assess changes in wildland fire danger across the western United States due to climatic changes projected in the 21st Century (e.g., temperature and precipitation trends). A "business-as-usual" climate scenario incorporating changing greenhouse gas and atmospheric aerosol concentrations until the year 2089 was compared to a historically observed period 1975-1996. Results show that changes in relative humidity, especially a drying pattern over much of the West, are projected to increase the number of days of high fire danger (based on the energy release component (ERC)) at least through the year 2089 in comparison to the base period. The regions most affected are the northern Rockies, Great Basin and the Southwest – regions that have already experienced significant fire activity early this century. In these regions starting around the year 2070, when the model climate carbon dioxide (an important element in global warming) has doubled from present-day, the increase in the number of days that ERC (fuel model G) exceeds a value of 60 is as much as two to three weeks. The Front Range of the Rockies and the High Plains regions do not show a similar change. For those regions where change is predicted, new fire management strategies and policies may be needed to address these added climatic risks, by changes in suppression and fuel treatment approaches, while also accommodating the complex and changing ecosystems and increasing human stresses and considerations on the region.

The graphic provides a map of the change in the number of days with an energy release component (ERC) value greater than 60 for the final 20-year period in comparison to the 1976-1995 base period. Red colors indicate areas of increased number of extreme ERC days by 2-3 weeks.

Near Real-Time Climate Monitoring

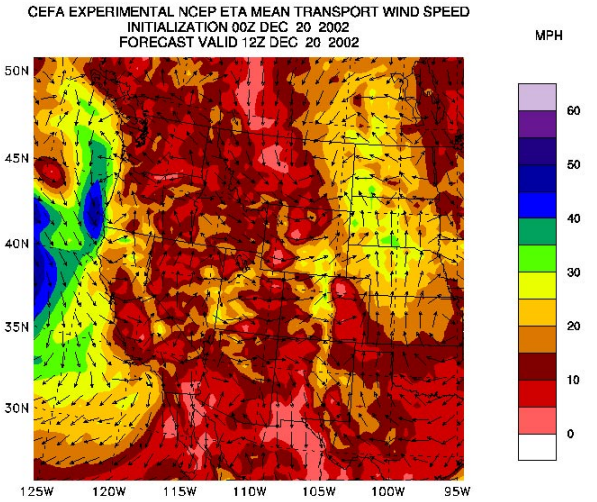
The Western Regional Climate Center (WRCC) receives Remote Automatic Weather Station (RAWS) data in near-real time from the National Interagency Fire Center (NIFC). WRCC also maintains a historical archive of RAWS observations. CEFA extracted historical data for all western U.S. RAWS that have at least seven years of records and computed a daily climatology of maximum and minimum temperature and relative humidity for each RAWS. This serves as the basis for computing anomalies, or departures from average. A computer program is run once daily that computes the most recent 10- and 30-day average of maximum and minimum temperature and relative humidity, and then the 10- and 30-day climatological average is subtracted from this value to produce departures from average for the respective periods. The departure values are color coded and plotted on a map made available at the CEFA web site in the assessment section. Shown here are example relative humidity maps.





Similar type maps are also being generated for upper-atmosphere or pressure level elements. In particular, 500 and 600 mb 10- and 30-day relative humidity anomaly maps are being produced, along with 500 and 850 mb streamlines. The streamlines show wind flow patterns that have occurred for the respective period. The NCEP/NCAR reanalysis pressure level data are being provided to CEFA by the NOAA/CIRES Climate Diagnostics Center in Boulder, Colorado.

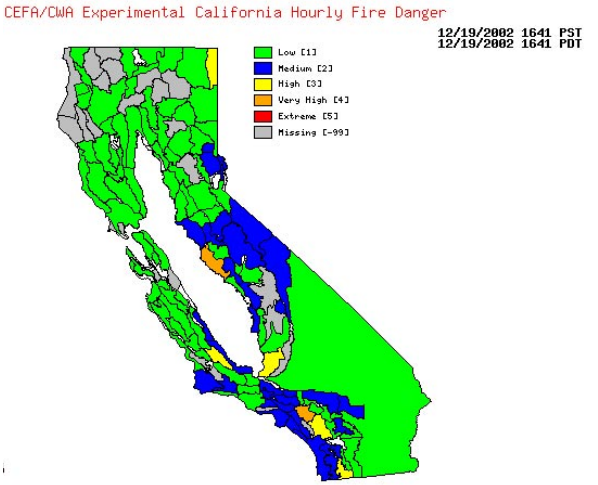
Lightning anomaly information for 10- and 30-day periods are also being provided in near-real time. Once a day, three maps are produced for the respective time period showing what was observed, the departure from average and the climatological average for the period. These data are provided by Vaisala-GAI, Inc. and are proprietary. Therefore, only federal fire agencies associated with the national lightning data contract have access to this information. Near real-time maps are also being produced for the southwest monsoon region Arizona, New Mexico, Colorado, and Utah. Visit this webpage at www.cefa.dri.edu/Assessment_Products.



Mixing Height and Transport Wind Forecasts

Based on research work from former CEFA graduate student Matt Fearon, a method for estimating the mixing height was developed. The method is being used operationally at CEFA in the production of real-time forecasts of mixing height and associated transport winds utilizing National Centers for Environmental Prediction Eta model forecasts. The forecasts are 6-hourly out to 48 hours. Maps of both the western and eastern U.S. are provided on the CEFA web site. Special digital forecast information is forwarded to the California Geographic Area Cooordination Centers (GACC) where it is implemented into their operational smoke management forecasts. In southern California, a clickable web site has been developed where users can click on an air basin to obtain the forecast information. Visit our website at www.cefa.dri.edu/Operational_Products.

California Hourly Fire Danger -Phase One -

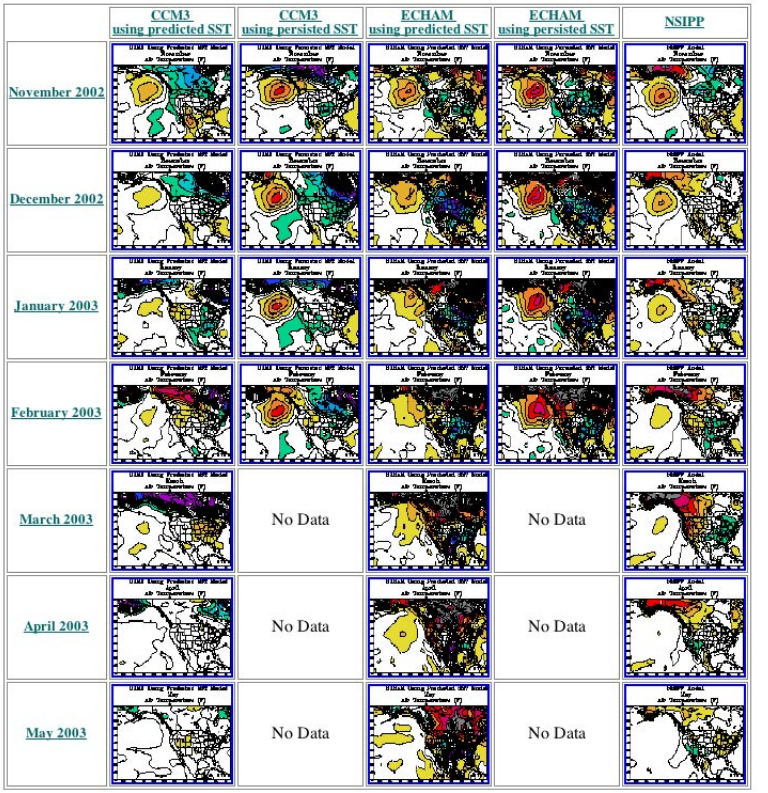


Over the past couple of years and in conjunction with several California wildfire agencies, CEFA has been developing a prototype and experimental system for calculating and displaying hourly fire danger in California. Using hourly RAWS from WRCC and NFDRS algorithms provided by Larry Bradshaw at Missoula Fire Sciences Laboratory, fire danger indices are computed for each fire danger rating area across the state, and a fire adjective class calculated on an hourly basis. California wildfire agency personnel are currently evaluating the product. Before the prototype system can be considered official, extensive evaluation is required in order to determine that the adjective classification is computed correctly and as expected by users, and that the system is producing reasonable hourly values given that NFDRS was originally designed for once daily calculations. The figure above shows an example map from the prototype system.

Monthly Climate Forecasts

CEFA receives over 3,500 forecasts per month from the International Research Institute for Climate Prediction. These include monthly predictions from three different climate models. For two of the models, persisted and predicted sea surface temperatures are used as the primary physical forcing of the models. There are between 9 and 20 ensemble (variations of the model initialization that produces slightly different forecast outcomes, but when combined produces an overall forecast) forecasts of temperature and precipitation out to 4 to 6 months (depending on the particular model). Using model climatology, CEFA computes temperature and precipitation anomalies for each forecast month and generates maps that are posted on the CEFA web site. Also, probabilities of monthly below or above average temperature and precipitation are computed and displayed. Additionally, some forecasts of wind and 500 mb height are made available. Though each forecast is considered experimental, CEFA makes them available to the fire community for decision support use in monthly outlooks and assessments. The forecasts that CEFA receives from IRI are based on models developed at several worldwide climate research institutions including the National Center for Atmospheric Research in the United States, the Max Plank Institut fur Meteorolgie in Germany, and at NASA's Goddard Space Flight Center. The models that produce the forecasts are quite complicated as they link together the physical processes and interactions of the land, ocean and atmosphere. Global sea surface temperatures are a major component in producing monthly and seasonal climate predictions. CEFA also produces and makes available forecast maps covering the Australian/New Zealand region for their fire weather communities. Visit out website at www.cefa.dri.edu/Assessment_Products.

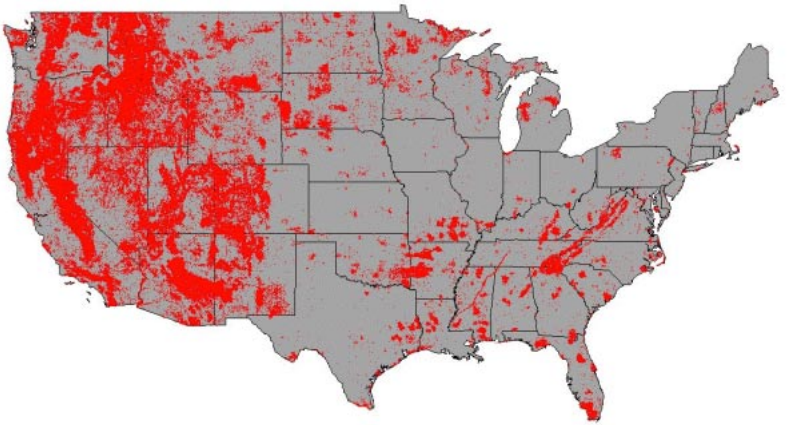
Air Temperature Anomalies



Completed Projects

Coarse Assessment of Federal Wildland Fire Occurrence Data

CEFA has prepared a report that provides a coarse assessment of western U.S. historical federal wildland fire occurrence records. These records are from USDA Forest Service (USFS), and the Department of Interior (DOI) agencies Bureau of Indian Affairs (BIA), Bureau of Land Management (BLM), U.S. Fish and Wildlife Service (FWS) and National Park Service (NPS). Our initial purpose in assessing these data was to provide an inventory and quality control of occurrence records for subsequent analyses in several wildland fire research projects at CEFA. But it was soon recognized that describing the results of our assessment might be beneficial to other academic researchers, wildland fire personnel (e.g., fire specialists, fuels specialists, meteorologists, etc.) and database managers where the records originated. Thus, the report describes our initial efforts of working with federal wildland fire occurrence data, and is offered to the National Wildfire Coordinating Group (NWCG) for information and reference. The report began distribution in early January 2003 and is available on the CEFA site in the publications web section. Maps and plots from the report are available by CEFA in the educational web section.



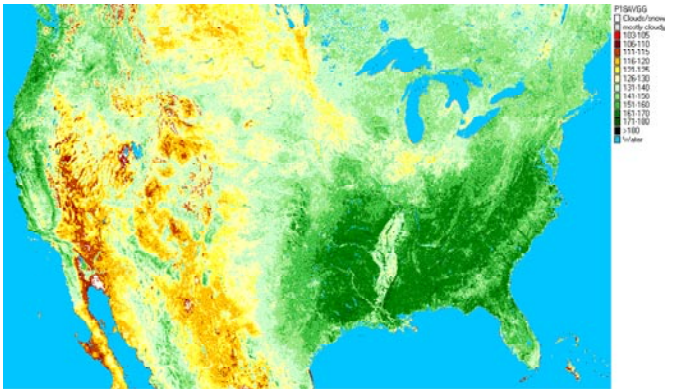
Point locations of coarse quality controlled U.S. wildland fires (red symbols) from the federal fire occurrence database for the period 1970-2000.

Continuing Projects

Estimating green-up parameters in the National Fire Danger Rating System

Paul Schlobohm, a BLM/NIFC fire management specialist currently residing at DRI, is working on a Master's thesis project to utilize satellite imagery to determine live fuel conditions for NFDRS. More specifically, weekly maximum composite values of 1-km Normalized Difference Vegetation Index (NDVI) derived from multispectral NOAA satellite imagery capture the changes in fuel condition that are known as the greenup date and the length of greenup in the NFDRS (1978 version). These events can be identified both in the historical record and operationally as the year progresses. Currently NFDRS relies on the fire

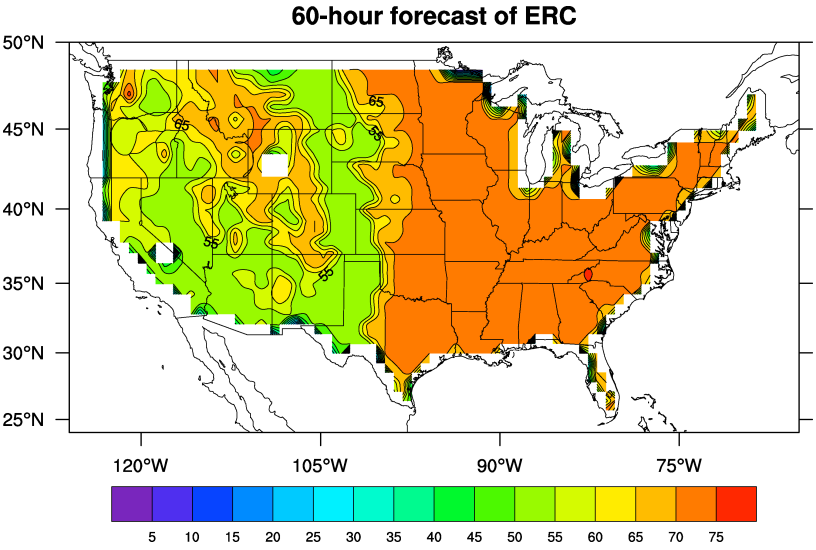
manager to estimate the initial timing of greenup (greenup date), and the length of greenup is a predetermined fixed number of days based on the climate of the area (represented by climate class). Paul`s proposal is that a method for determining greenup based on NDVI will provide greenup parameters at an appropriate spatial scale and temporal variability for the next generation of NFDRS. The focus of this work will be to determine the utility of NDVI for identifying the start and end of greenup. Completion of this work is anticipated during summer 2003.



Climatology map of NDVI greenness for appproximately the beginning of May.

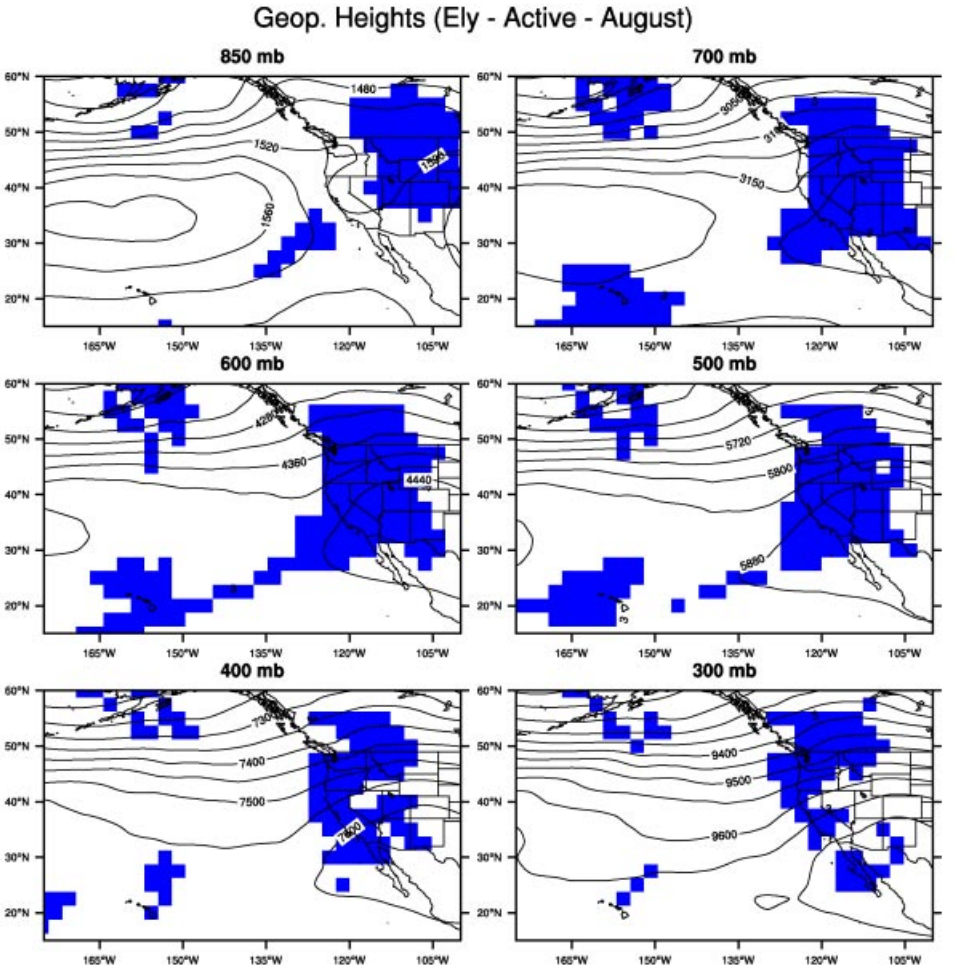
Development of U.S. Operational Fire Danger 15-Day Forecasts

The overall goal of the project is to develop a prototype system of producing operational forecasts of fire danger daily out to fifteen days. It incorporates national needs at the National Interagency Coordination Center with operational forecast products produced by the National Centers for Environmental Prediction. A national map of standardized energy release component (ERC) daily forecasts out to 15 days will be produced on an operational basis. A U.S. 8 km grid climatology of ERC using fuel model G is currently being produced by the Missoula Fire Sciences Laboratory. This will be used in conjunction with NFDRS and the NWS GFS meteorology model to produce ERC fire danger forecasts. The prototype product is anticipated to begin evaluation in spring 2003. The example map shows a prototype forecast of ERC using all NFDRS fuel models.



Utilization and Evaluation of Climate Information and Forecasts for Fire Management

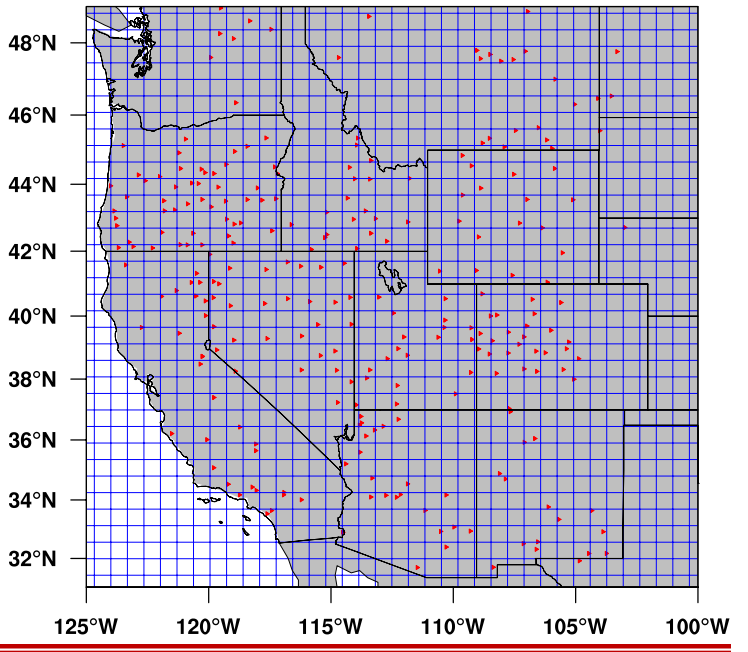
The goal of this project is to develop climate forecast products and information that can be utilized for wildfire, prescribed fire and fire use strategic planning and decision-making. In collaboration with the Scripps Institution of Oceanography (SIO) Experimental Climate Prediction Center (ECPC), SIO California



Applications Program (CAP) and the International Research Institute (IRI) for Climate Prediction, the project has several components to develop and evaluate climate forecasts. The applied research aspects include a new method for identifying critical fire climate patterns and the evaluation of prediction skill of ECPC weekly to seasonal climate forecasts.

The main goal of the fire climate pattern analysis was to develop a comprehensive and objective statistical method to assess pressure level weather elements that can potentially be associated with natural fire occurrence. A method to determine upper-air (pressure) level patterns in association with periods of low and high fire start activity was developed. The method utilizes median map composites accounting for variance, statistical significance via randomization, and an assessment of predictability using contingency table analysis. Composite cases that are statistically significant provide information for fire weather meteorologists regarding pressure level patterns and anomalies associated with low and high levels of fire start activity over a region. Thus, confidence in a forecast of these patterns or anomalies yields a more confident forecast of fire start activity. The example 6-panel plot to the left highlights areas satisfied by all the tests in the methodology at six mandatory pressure levels. These are areas where fire climate patterns are significant for high fire activity in the Ely BLM district during the month of August. Contour lines indicate median composite geopotential heights. Results of this study are currently being documented for publication.

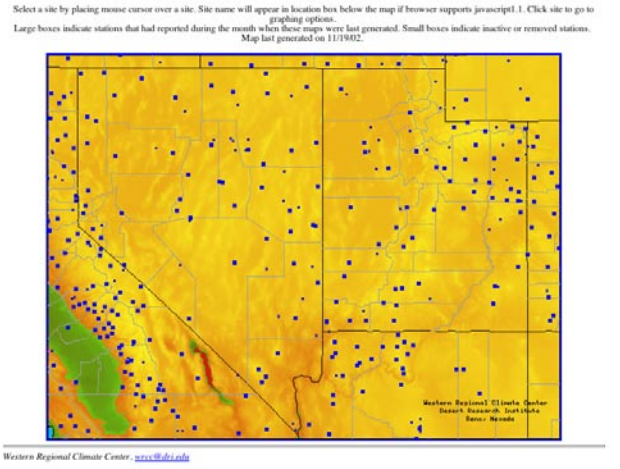
ECPC produces forecasts of several atmospheric elements, many of which are directly related to fire. These include temperature, precipitation, relative humidity and wind speed. In addition to these elements, forecasts of NFDRS fire danger indices are also produced. However, the skill and accuracy of these forecasts for fire management purposes has not been quantified, and therefore it is highly desired to assess the quality and uncertainty associated with the forecasts. During this first year phase of the project, the primary emphasis has been on running and archiving model forecasts that will be used in a skill analysis. Also, a number of RAWS locations have been identified that can be used to evaluate climate forecasts. The map shows the forecasts assessment domain and grid along with the RAWS site locations used in the analysis.



Web Access to RAWS Data and Products

This project is being accomplished within the Western Regional Climate Center (WRCC) using CEFA as a project and collaboration conduit. The primary project objective is to build upon recent efforts to rebuild the internal storage and access system for RAWS data and initiate system-wide improvements.

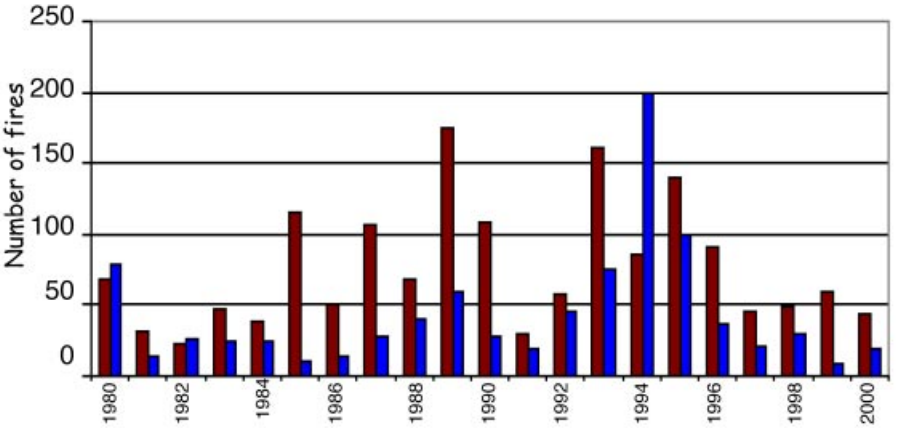
The primary tasks were the creation of an internal database of all historical RAWS data and associated metadata. The result of this data organization and conversion process will allow users to extract requested information via the WRCC RAWS web site. Metadata display graphs were developed to allow WRCC internal personnel to quickly monitor and assess the historical archive for a particular RAWS, and to provide external users with relevant metadata information about a selected station. A web based user interface system for query and acquisition of RAWS has been built, and some limited user testing has taken place. Changes will likely be implemented based upon user comments over the coming months as the system becomes publicly available. Some value-added products based on the historical RAWS data has been created. WRCC has developed several web clickable maps for specific regions of interest per agency requests. For example, WRCC was requested to develop and make accessible a Cerro Grande region RAWS access map following the large fire event in 2000. This concept has been extended to other regions (see the WRCC web site at http://www.wrcc.dri.edu for current active regions).



During the summer of 2002, BLM provided equipment funding to WRCC to acquire high-end web server software in conjunction with this RAWS project. This will allow for faster accessibility to the database and value-added products. It is anticipated that the database will be generally accessible in early calendar year 2003. The example map shows RAWS point locations for the Nevada/Utah region. The points can be mouse clicked on to obtain RAWS information.

Analysis of the Southwest Monsoon in Relation to Fire Danger Characteristics

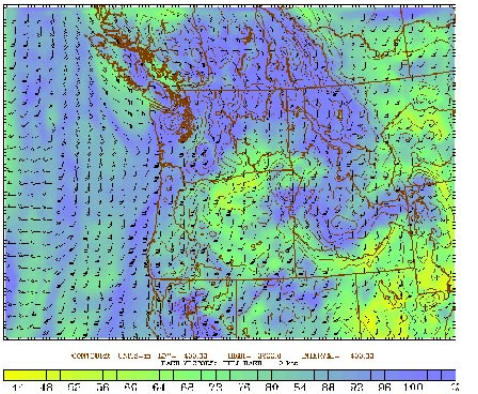
The goal of this project is to identify quantitative relationships between Southwest monsoon climate and weather elements and subsequent links with impacts on fire danger and fire occurrence. The products derived from the project will provide information for decision-making related to resource allocations and prescribed fire and fire use activities. The primary analysis includes applying



spatial and temporal statistical methods to determine monsoon weather and climate patterns over both space and time. This will include analyses to determine monsoon and fire threshold values over the monsoon region, and analyses to quantify and describe year-to-year patterns. One of the questions to be resolved in this study is what is the climatological threshold for atmospheric moisture (e.g., dew point, relative humidity) and other weather and NFDRS indices that relates large fire occurrence and the monsoon over the region. The primary study region includes Arizona, New Mexico, Colorado, Utah, eastern Nevada and southeastern California. Data for the period 1980-2000 is being used in the analysis. The first year emphasis on this project has been the collection, quality control, analysis of fire occurrence data, and development of RAWS database for the Southwest monsoon region. The second year focus will be on the statistical analyses and linking the relationships between the monsoon and fire activity. It is anticipated that the results of this study will be beneficial to fire weather meteorologists, fire management, fuels specialists, and fire behavior analysts among others. The plot above indicates the number of large fires that occurred before (red) and after (blue) the monsoon onset date as determined by the Tucson dew point standard. For most years, there is a greater number of large fires prior to monsoon onset than afterwards. Final results are anticipated in summer 2003.

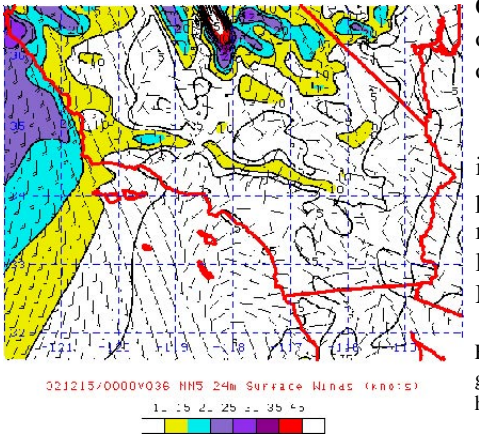
Development and Implementation of the CEFA Operational Forecast Facility

In October 2001, a concept proposal was submitted to the California and Nevada Wildfire Agencies to develop and implement an operational mesoscale meteorology forecast facility for smoke and fire management to be referred to as the CEFA Operational Forecast Facility (COFF). The purpose of the facility is to provide high-spatial resolution weather forecasts and value-added products for federal, state, county, and local fire and smoke management agencies in California and Nevada. These forecasts will be made available on a grid covering all of California and Nevada at 36, 12 and 4 km spatial resolution, and 6-hourly out to 72 hours for the larger grids. Products from COFF will enhance and improve forecasts of smoke dispersion and transport, fire danger and fire behavior in addition to providing general meteorological forecast information over the two state area. Meteorologists from the Geographic Area Coordination Centers, air regulatory agencies, and the National Weather Service are the primary intended recipient of the meteorological products and information. However, users with knowledge of meteorological output will find value in many of the products, as well as other numerous value-added products.



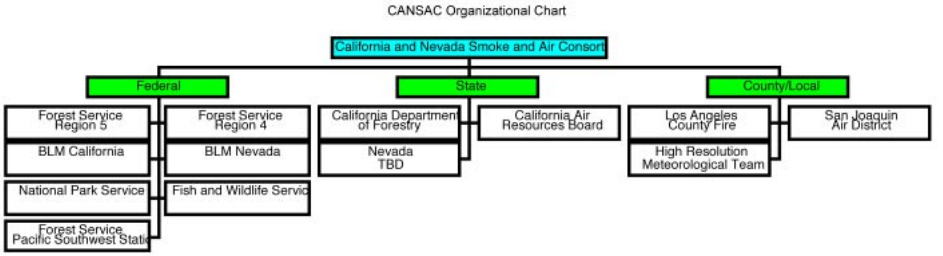
Example map graphic taken from the Pacific Northwest MM5 web site:
http://www.atmos.washington.edu/mm5rt/etainit.html

The California Firescope Weather Working Group approved the concept proposal in 2001, and subsequently formed the California and Nevada Smoke and Air Committee (CANSAC) currently comprising thirteen federal, state, county and local agencies (see CANSAC organization chart). The committe is comprised of a governing board, a technical advisory committee, and an operational applications group.



The USFS Pacific Southwest Research Station (PSW) is a member of CANSAC , and is also an important research partner with COFF. PSW represents one of five USFS regional modeling consortia to support the National Fire Plan, thus linking COFF to the Fire Consortia for Advanced Modeling of Meteorology and Smoke (FCAMMS).

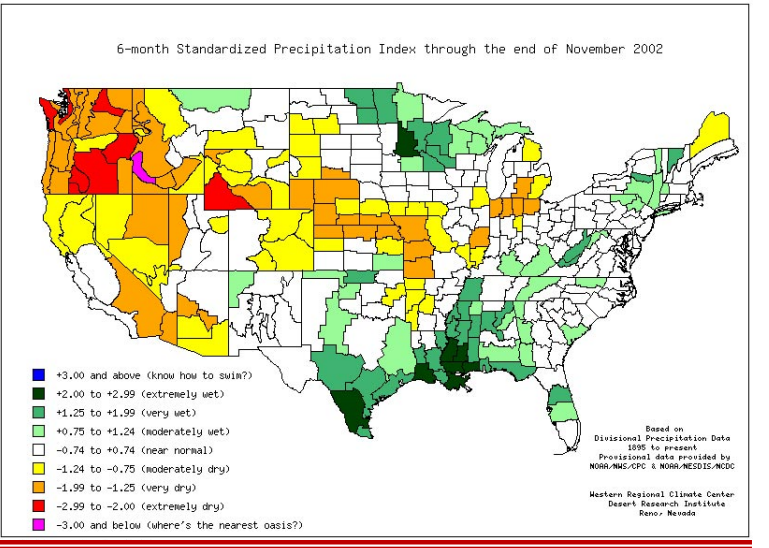
Example map graphic taken from the Naval Postgraduate School MM5 web site:
http://www.weather.nps.navy.mil/~dkmiller/



Much of the first year will be devoted to building the computing infrastructure, putting in place required personnel, establishing product requirements and specifications, testing the MM5 model, and developing a real-time verification system. Once COFF becomes operational, the primary deliverables will include meteorological model forecast output and web based application products as defined by the CANSAC committees. Visit the CANSAC website at http://cefa.dri.edu/COFF. See also http://www.fs.fed.us/fcamms for more information regarding FCAMMS regional activities.

A Comparison of Precipitation/Drought Indices Used in Fire Management

The primary focus of this project is to assess the strengths and weaknesses of the standardized precipitation index (SPI), the Palmer drought severity index (and its derivatives), and Keetch-Byram drought index in the context of fire management decisions. This will include discussing the indices in the context for which they designed, a comparison of indices for various applications, and discussion of usage for fire management. Results will be presented in the form of an interagency report, a scientific journal article, and presentation at relevant meetings, workshops and scientific conferences.



CAP and CLIMAS Interactions

CEFA has an established partnership with Scripps Institution of Oceanography California Applications Program (CAP) and the University of Arizona, Institute for Studies of Planet Earth, Climate Assessment for the Southwest (CLIMAS) project. Both CAP and CLIMAS are NOAA Regional Integrated Science and Assessment (RISA) programs. One objective of the RISAs is to improve integration between science and users of scientific information. The CAP interactions, along with ECPC collaboration, have involved developing products jointly with California wildfire agencies. Examples include climate forecasts, the formation of CANSAC/COFF, and the California hourly fire danger project. CAP information can be found at: http://meteora.ucsd.edu/~meyer/caphome.html.

Collaboration with CLIMAS has involved co-organizing the 2002 Fire and Climate Workshop during March. This workshop brought together national and regional climate scientists, fire managers, and fuel and fire specialists to discuss the utilization of climate information in fire business. One of the key products of this meeting was the development of a consensus seasonal climate forecast for the U.S. with emphasis of climate impacts on fire. CEFA and CLIMAS participated with the Southwest GACC in producing a southwest area seasonal outlook of climate and fire conditions that was distributed from the Southwest GACC. The forecast of continued dry conditions and high fire danger, along with extensive fire activity, verified quite well during the season. CLIMAS information is available at:
http://www.ispe.arizona.edu/climas/index.html.

Other Important Partnerships

In the fall of 1999, Paul Schlobohm, BLM Fire Management Specialist at the National Interagency Fire Center (NIFC), was stationed at Reno, Nevada to work specifically with CEFA, and to serve as the liaison between BLM and CEFA for a minimum of three years. Approximately one year after Mr. Schlobohm's arrival, the national AA was put into place formalizing the partnership between the two organizations.

Since its inception, CEFA has developed partnerships and collaboration with a host of federal, state and academic agencies and institutions:

Bureau of Land Management

California Interagency Fire and Forecast Warning Units

Scripps Institution of Oceanography
-- California Applications Program
-- Experimental Climate Prediction Center

National Oceanic and Atmospheric Administration
-- Office of Global Programs

U.S. Fish and Wildlife Service

U.S. Forest Service

California Department of Forestry and Fire Protection

University of Arizona
-- Climate Assessment for the Southwest

National Park Service

Western Regional Climate Center

Presentations and Training (Fall 2001 - Summer 2002)

October 22-25 (San Diego, CA): NOAA Climate Prediction Center Climate Diagnostics Workshop (T. Brown).
October 30 (Sacramento, CA): California Fire Weather Working Group meeting (T. Brown and B. Hall).
November 6-7 (Minneapolis, MN): GACC meteorologist fall meeting (T. Brown).
November 13-15 (Reno, NV): American Meteorological Society 4th Symposium on Fire and Forest Meteorology. T. Brown also co-program chair of symposium (T. Brown, B. Hall, and P. Schlobohm).
January 8-9 (Austin, TX): NWCG Fire Danger Working Team meeting (T. Brown).
January 15-17 (Minneapolis, MN): Eastern Area Coordination Center meeting (T. Brown).
January 23 (Boise, ID): NIFC science meeting (T. Brown and P. Schlobohm).
February 21 (Tucson, AZ): NARTC Advanced Fire Danger Rating System course lecture (T. Brown).
February 28-March 1 (Washington, D.C.): NOAA Office of Global Programs (T. Brown).
March 5-8 (Tucson, AZ): ISPE/CLIMAS Fire and Climate 2002 workshop. T. Brown also co-organizer of workshop (T. Brown).
March 20 (Los Angeles, CA): Association of American Geographers annual meeting (T. Brown).
March 22-28 (Tucson, AZ): Fire and Climate History international workshop (T. Brown).
April 10-11 (Fort Collins, CO): GACC meteorologist Spring meeting (T. Brown).
April 23 (Sacramento, CA): California Fire Weather Working Group meeting (T. Brown and B. Hall).
May 20 (Sacramento, CA): CANSAC meeting (T. Brown).
June 25-27 (St. Petersburg, FL): Southeast Climate and Fire Workshop (T. Brown).

Reports and Publications

Brown, T.J., B.L. Hall, and G.D. McCurdy, 2002: Quality Control of California Historical RAWS Data. Report prepared for the California Firescope Weather Working Group, CEFA Report 02-01, March 2002, 27 pp.

Brown, T.J., 2002: 2002 Seasonal Consensus Climate Forecast for Wildland Fire management. Report prepared for Interagency Fire Management, CEFA Report 02-02, March 2002, 5pp.

Brown, T.J., A. Barnston, J.O. Roads, R. Tinker, and K.E. Wolter, 2002: 2002 Seasonal Consensus Climate Forecasts for Wildland Fire Management. Experimental Long-Long Forecast Bulletin, Center for Land-Ocean-Atmosphere Studies, University of Maryland, March 2002.

Westerling, A.L, A. Gershunov, D.R. Cayan, and T.J. Brown, 2002: A western United States fire climatology. *Bulletin of the American Meteorological Society* (Accepted).

Brown, T.J., B.L. Hall, A.L. Westerling, 2002: The impact of twenty-first century climate change on wildland fire danger in the western United States: an applications perspective. Submitted to the journal Climatic Change.

Brown, T.J., B.L. Hall, C.R. Mohrle, H.J. Reinbold, 2002: Coarse assessment of federal wildland fire occurrence data, CEFA Report 02-04, December 2002, 31pp.

CEFA was established in October 1998 under a BLM Nevada State Office Assistance Agreement (AA). The primary mission of CEFA was defined under this AA and is also being applied under a new BLM national Office of Fire and Aviation agreement established in November 2001. Current specific mission statements are as follows:

- *Perform studies and applied research to improve the understanding of relationships between climate, fire and natural resources.*
- *Serve as a liaison between the decision-maker (user) and the scientific research community by providing product training, education, assisting in technology/knowledge transfer and eliciting user feedback.*
- *Provide climate and weather information directly for fire and ecosystem decision-making and strategic planning.*
- *Improve operational fire weather forecasting using new knowledge of climate and meteorology.*
- *Develop decision-support tools for fire applications.*

Contact CEFA

Dr. Tim Brown, Director; 775-674-7090; tbrown@dri.edu
Beth Hall, Research Scientist, 775-674-7174; bhall@dri.edu
Charlie Mohrle, Graduate Research Student; 775-673-7390; cmohrle@dri.edu
Hauss Reinbold, Graduate Research Student; 775-673-7386; reinbold@dri.edu
Paul Schlobohm, BLM/NIFC Fire Specialist; 775-674-7170; pschlobo@dri.edu

http://cefa.dri.edu

Desert Research Institute
2215 Raggio Parkway
Reno, NV 89512-1095
Fax: 775-674-7016