1. INTRODUCTION

Each year, more than $1 billion is spent on wildfire suppression in the US. In spite of this spending and much effort going into fuel treatments, millions of acres are burned each year by wildland fires. In order to meet this considerable challenge, a proactive approach to wildland fire management is necessary. Change from reactive to proactive fire management requires decision-support products, forecast tools, and structured technology transfer processes informed by science-based knowledge.

According to the National Fire Plan (NFP) Research & Development 2002 Business Summary (USDA Forest Service, 2003), “a strong science foundation is key to managing the wildfire hazard and supporting management decisions in the most cost-effective and environmentally sensitive way. Supported by scientific knowledge, decisionmakers are better equipped to more reliably forecast or prevent damaging fires and to understand the consequences of the decisions for society and for forest and rangeland health.” The NFP 2002 Business Summary and an executive summary from the recent Joint Fire Science Program March-April 2003 workshops on the collective needs of fire managers and applied fire researchers conclude that effective technology transfer was an essential need for bridging the worlds of fire managers and researchers.

Climate impacts on regional wildland fire incidence, size and intensity are a growing concern to both the public and federal fire and land management agencies. Over a decade’s worth of research has demonstrated strong relationships between wildland fire, persistent climate patterns, such as El Niño-Southern Oscillation, and fuel moisture (Simard et al., 1985; Swetnam and Betancourt, 1990; Brenner, 1991; Jones et al., 1999; Hess et al., 2001). There is strong evidence that some of the general characteristics of the fire season can be forecast several months in advance, especially where fuel load buildups are high and climate patterns have been shown to contribute to wildfire regimes. This is readily seen from statistical relationships between antecedent moisture and summer fire activity. These relationships are driven chiefly through the build up of fuels and fuel moisture due to antecedent seasonal climate anomalies raising or lowering the potential for wildfire activity (Westerling et al. 2003; 2002). Moreover, climate forecasts and drought monitoring have improved rapidly based on advances in understanding the long-term circulation of the ocean-atmosphere system. As climate forecasts have improved and become more available, the need to develop forecasts that “matter” to specific sectors and interests (Stern and Easterling, 1999) has taken on greater importance. Federal agency fire managers stand to benefit from advances in climate forecasts, particularly when forecasts are tailored to their needs, effectively translated and communicated, properly interpreted, and synthesized in a systematic fashion.

In this paper we describe the development and implementation of a multi-agency partnership and technology transfer process designed to improve information available to fire management decision makers, and improve the prospects for proactive management decisions. We describe the products of the process, and we evaluate the process — a week-long workshop that brought together fuels specialists, fire managers, fire meteorologists, fire behavior analysts, and climatologists — in terms of its success in building capacity within organizations and improving the dialogue and trust between management and researchers, fire specialists and climatologists. We also provide recommendations from the workshop participants, and a brief summary of key improvements to be applied to future workshops.

2. SYNERGISTIC THINKING AND PARTNERSHIPS

2.1 Background and Impetus for the Workshop

The workshop spawned in response to events, such as the very active La Niña-driven fire year of 2000, and as a result of fortuitous interactions between bridge-building individuals at several organizations with the mandate to improve the use of climate information in resource management.

The National Fire Plan established Predictive Service units at the National Interagency...
The overarching objective of the workshop process was to improve information available to fire management decision makers for allocation of firefighting resources at local, regional, and national scales. The NSAW, which took place during the week of February 25-28, 2003, was explicitly designed with the goal of bringing together operational climate forecasters and fire specialists to utilize climate history, long-range climate forecasts and up-to-date fuels assessments in preseason fire outlook reports. The NSAW and the process leading to the development of the NSAW was designed (a) to foster communication and cooperation, e.g., between climate forecasters and GACC specialists, workshop organizers and participants; (b) to enhance collaboration and innovation, e.g., between climate forecasters; and (c) to develop a sustained partnership between organizations in order to ensure continued technology transfer, collaboration, innovation, and productive work output. Additional goals addressed further needs for improved communication and cooperation between the GACCs, in order to: (a) improve national fire danger outlook “edge-matching” in adjacent regions, through sharing information about regional fuels and climate/weather patterns, and (b) enhance the capacity of the GACCs to share methods, techniques and information useful for producing their own seasonal outlooks.

A little more than one year prior to the workshop, individuals from the aforementioned institutions began to develop an initial concept for the workshop. The fundamentals of workshop process concept development and multi-institution collaborative project management included a commitment to sustained interaction between partnering institutions, equality in partnership, and clear partnership responsibilities. NICC guided the concept development process, took the lead on communication with project advisors and participants, and took responsibility for the fuels assessment activity; CLIMAS developed the formal concept proposal, presented the concept to participants, and took responsibility for workshops logistics; and CEFA took responsibility for the consensus climate forecast activity and for ensuring that forecast information was communicated in a clear and effective manner by climatologists to fire specialists.

Over a period of months, the workshop concept was designed and refined in great detail. While the aforementioned is not remarkable or unusual in the course of a technology transfer initiative, it was done in a manner that emulated some of the goals of the workshop, i.e., to maximize participation, input, a sense of ownership of and investment in the process, and information flow. The concept was reviewed by an advisory committee, including potential workshop participants, and then presented to the potential workshop participants at a business meeting approximately four months prior to the NSAW. A result of interactions during the aforementioned concept development period was the development of a tentative workshop process, structure, and protocols. Thus, prior to the workshop, and with input from workshop participants, a preliminary set of standards, procedures and protocols for producing
multi-timescale fire danger outlooks was developed. The protocols were established in a manner that facilitates the easy update of seasonal outlooks as needed. At the NSAW, these standards were finalized and put to immediate use by each geographic area as they created region-specific, comprehensive, seasonal fire danger outlooks, incorporating information about climate and fuels conditions.

The NSAW was structured to provide opportunities for the climate forecasters to interact personally with fire management professionals. This allowed forecasters to improve their understanding of the needs of the fire management community and, ultimately, to improve the format and content of climate and weather forecast products in order to address management needs.

3. WORKSHOP STRUCTURE AND FLOW

The NSAW agenda was structured to minimize the time participants spent passively listening to research presentations and to maximize the time spent (a) working on outlook reports, (b) consulting with climatologists and other geographic area personnel, (c) reporting progress, getting clarification, and providing feedback to the meeting organizers and other geographic area personnel. The physical meeting space was selected to provide an environment conducive to dialogue and discussion.

The first full day of the meeting provided participants with important background talks and information, including national climate forecasts and regional fuels assessments. During the first day of the NSAW, participants also

- gave final feedback on the aforementioned protocols and report format
- clarified the goals and process of composing the outlooks
- agreed on a basic layout style, outline and format, document length, mechanism for updates and forecast coordination between adjacent geographic areas.

Climate forecasters prepared the national consensus climate forecast for spring and summer 2003. Forecasters compared the results of various forecast models and examined historical probabilities of above and below-average temperature and precipitation based on analogue configurations of the ocean-atmosphere system. Based on their intimate knowledge of the strengths and weaknesses of the models and historical data, they determined the regions of maximum agreement. The forecasters clarified forecast probabilities for problematic regions and assigned no forecast confidence to regions where conflicts between forecast tools could not be resolved.

During the second day of the NSAW, the consensus climate forecast was reported and participants were given the opportunity to question climate forecasters regarding the regional details of the forecast. Participants then spent the next two days of the workshop in breakout work sessions divided up by geographic area. Individual breakout rooms were located along a common hallway at the conference venue. This allowed geographic areas the privacy necessary to concentrate on work and at the same time the logistical convenience necessary to facilitate communication between the geographic areas. All geographic area workgroups reconvened once each day in order to discuss progress, problems, and the content and distribution of a workshop synthesis volume.

One of the outstanding highlights of the workshop was the degree of coordination, communication, and cooperation within and between geographic area workgroups. The workshop provided an opportunity for fuels, fire behavior, and fire weather specialists, often dispersed throughout large multi-state geographic areas, to meet face-to-face in order to discuss on the ground and forecast conditions throughout the broader geographic area. The two California geographic areas collaborated on a single assessment representing both northern and southern parts of the state; similarly, the eastern and western Great Basin geographic areas worked together to prepare an integrated outlook. Geographic area fire weather program managers were especially heartened to receive firsthand fuels information from the far reaches of their geographic areas. The workshop served to lay the groundwork for sharing information on fuels assessments among the geographic areas.

The geographic areas worked together to build on each other's strengths and share expertise. The workshop participants expressed satisfaction with and enthusiasm for bringing together all 11 geographic areas for one national preseason outlook meeting. The flow of information between geographic areas was particularly impressive with regard to forecasts and assessment methodologies. Participants noted that collective knowledge and expertise from each of the 11 geographic areas, along with a healthy sense of friendly competition, resulted in enhancements to geographic area reports that would not be possible in isolation. Moreover, they shared information regarding how their regions have been affected by vast areas of forest mortality due to drought stress and insect infestation — information which was of particular interest to climate forecasters.

Climate forecasters expressed an appreciation for the consensus forecast process, which allowed them to compare notes and weigh the strengths and weaknesses of individual forecasts. However, the
resulting forecast was probably conservative due to the nature of the consensus process; at the same time, confidence in the geographic extent of forecast probability anomalies was probably strengthened by the process. An important outcome is that climate forecasters were sensitized to the forecast and data needs of particular geographic areas, such as Alaska (the geographic area with the greatest number of wildland acres burned in 2002).

4. WORKSHOP PRODUCTS

The tangible products of the NSAW included the following:

- 2003 consensus climate forecasts for wildland fire management
- Geographic area wildland fire outlook reports
- N ICC preseason national wildland fire outlook
- Standardized protocols for producing long-range fire danger outlooks
- Frameworks for future multiagency cooperation

4.1 Consensus Climate Forecast

Under the guidance of CEFA, climate forecasters merged climate predictions into a consensus forecast for the 2003 fire season. This new climate decision-support tool, along with regional fire and fuels assessments prepared in advance of the workshop, provided the foundation for the seasonal fire danger outlooks.

Seasonal forecasts of two-category probabilistic temperature and precipitation anomalies were produced for the contiguous United States and Alaska as significant input into the geographic area wildland fire seasonal outlooks. Forecast consensus was reached by combining several monthly and seasonal forecasts produced at the International Research Institute for Climate Prediction, the Scripps Institution of Oceanography Experimental Climate Prediction Center, the NOAA/NCEP/NWS Climate Prediction Center, and the NOAA/CIRES Climate Diagnostics Center. The primary purpose of the consensus forecast was three-fold, as follows:

- to produce seasonal climate forecasts for use in developing a national seasonal wildfire outlook
- to determine whether or not additional probabilistic information could be provided for areas where individual forecasts showed little confidence
- to directly integrate climate forecast information into specific geographic area decision-making.

The forecast periods were March-May (MAM) and June-August (JJA) 2003. A combination of dynamical and statistical models from the respective organizations, and forecaster judgment were incorporated in producing the forecasts. A newly developed statistical model and analysis of precipitation forecasts in the southwest U.S., as well as historical climate information based on averages of ENSO-related precipitation and temperature for MAM and JJA during rapidly declining El Niño phases, were consulted. These objective forecasts were then combined with forecaster judgment including model forecast skill, temperature versus precipitation correlations, and current opinions regarding the state of ENSO.

The forecasts were produced via a round-table forum during the workshop. The discussions were characterized by collegiality between participants, and enhanced communication between forecasters. Forecast discussion lead to determining regions of warm/cool and dry/wet, and assigning a consensus probability. Since the forecasts were comprised of only two categories, the probabilities simply represent the chance of above or below average conditions.

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Figure 1. March-May 2003 Consensus Climate Forecast for Fire Management.
Figure 1 shows the 2003 seasonal U.S. consensus forecasts for MAM temperature and MAM precipitation, respectively. The primary highlights of these maps are increased likelihoods of above normal temperature for large portions of the West during MAM and JJA (not shown), and above normal precipitation for the Southwest during MAM. The seasonal outlook of wildfire potential, which was developed in part from these figures, is available at the NICC website: http://www.nifc.gov/news/intell_predserv_forms/season_outlook.html.

This is only the second effort to produce a consensus forecast by combining forecasts from different organizations (see Brown et al. 2002). Thus, estimates of quantitative skill cannot be offered at this time. The skill has been established for most of the inputs, and it is likely that the consensus forecast skill would be equal to or slightly larger than individual forecasts, depending on the region and the number of inputs that were in agreement.

4.2. National and Geographic Area Wildland Fire Outlooks.

The preseason fire danger outlooks were produced by the coordinated efforts of GACC fire meteorologists, fuels analysts, fire behavior analysts, and other regional fire specialists. Outlooks followed an agreed-upon format and set of protocols for content; participants also consulted a comprehensive list of climate and fire history products and forecast tools. Fire danger predictions were expressed in terms of best-case/most likely/worst-case scenarios.

Each geographic area wildland fire outlook covered the following content:

- executive summary (including a specific forecast statement and a statement about forecast confidence)
- caveats regarding the use of the report
- current climate and fuel conditions (including comparison with historical records)
- climate and weather outlooks
- fire occurrence and resource outlooks (including estimated number of fires and expected resource needs)
- future scenarios and probabilities (including Fire Family Plus analyses, sub-regions of concern, season ending event probabilities)
- management implications and concerns
- summary and recommendations

The complete pre-season fire danger outlooks for each of the 11 geographic areas, as well as a national wildland fire outlook can be found on the NICC Predictive Services website (http://www.nifc.gov/news/nicc.html). For several of the geographic areas (e.g., Alaska, California, Great Basin, Rocky Mountain), the NSAW reports were considered as preliminary assessments of potential fire danger. These regions are subject to significant variability in late winter/early spring precipitation; hence, conditions could change substantially prior to the onset of the fire season. Seasonal fire danger outlooks were designed to be updated as needed prior to and during the fire season for each of the geographic areas. The aforementioned website can be checked for updates.

5. RECOMMENDATIONS

In addition to daily sessions devoted to providing feedback and course adjustment during the workshop, participants were given ample time during a working lunch on the final day of the workshop to convey constructive criticism of the workshop process. Critiques were designed to address what worked and how to maintain or improve it, and what did not work and how to improve or change it.

Workshop participants expressed satisfaction with the breakout group organization. Some geographic areas, such as Southern California, mentioned that future seasonal assessment workshops would be enhanced by greater participation of state fire management agencies.

A key success was the design of breakout session and report writing activities. Participants supported and were enthusiastic about cooperative work in a “work retreat-style” atmosphere, away from offices, routines, and interruptions. Participants found the following:

- individual breakout rooms facilitated concentrated work within groups
- close proximity between breakout rooms aided interaction between groups
- taking time out from individual work sessions in order to gather in large group feedback sessions during the course of the breakout report writing activity was productive and informative
- communication with and/or feedback from other geographic areas enhanced the quality and completeness of their reports.

Workshop participants were enthusiastic about producing a joint technical note on the analytical techniques used to produce preseason outlooks. All participants valued innovation and the sharing of techniques. When questioned about what they would like to see in a post-fire season assessment and evaluation meeting, participants mentioned the need for talks on climate diagnostics (i.e., analyses of past climate behavior). Climate forecast evaluation and review was also a subject of keen interest to workshop participants. Particular topics of interest included the following:
workshop participants. Moreover, through pre-
and an impressive degree of cooperation between
atmosphere of collegiality, openness, enthusiasm
structured workshop process successfully created an
in a focused and productive manner. The carefully
participants and climate forecasters worked together
pre-season fire danger outlooks. Workshop
personnel to an operational process for producing
methodology and evaluation. All of the
excellent opportunity for forecasters and workshop
specialists more time to interact directly with climate
organizers to provide training on climate forecast
background, this would provide an
aforementioned would allow geographic area fire
participants more time to interact directly with climate
forecasters during collective question-and-answer
and individual breakout sessions on the first day of
the workshop.
Finally, participants recommended that workshop
organizers, as well as participants, need to better
prepare workshop materials in advance of the
meeting. Better preparation includes:
• providing comprehensive checklists of data
and analyses needed by geographic areas
• priority access to NICC online databases
• the creation of rough draft outlooks by the
geographic areas prior to future workshops.

6. CONCLUSIONS AND FUTURE DIRECTIONS

The NSAW marked a turning point in the
progression from dialogue and exchange of ideas
between climatologists and fire management
personnel to an operational process for producing
pre-season fire danger outlooks. Workshop
participants and climate forecasters worked together
in a focused and productive manner. The carefully
structured workshop process successfully created an
atmosphere of collegiality, openness, enthusiasm
and an impressive degree of cooperation between
workshop participants. Moreover, through pre-
workshop communication and feedback, participants
rapidly adopted outlook protocols and the method of
presenting outlooks.
In retrospect, workshop success hinges on
maximizing opportunities for participant interaction. In
post-workshop evaluations, workshop participants
placed exceedingly high value on interaction, and the
sharing of data and forecast expertise. Face-to-face
contact between individuals helped to build bridges
on several levels:
• between forecasters and fire specialists
• between fire specialists and fire managers
• between workshop organizers and
participants
Direct interactions between the various organizers
and workshop participants, a cornerstone of
successful technology transfer (USDA Forest
Service, 2003), fostered trust and increased
commitment to the workshop process. Moreover,
sustained, iterative interaction between workshop
organizers increased commitment to the project, and
improved multi-institutional coordination.
In terms of human resources, several lessons were
learned. Workshop organizers will need to ensure the
participation of all parties necessary for producing the
outlooks, including non-GACC partners in geographic
areas where state fire management personnel play
key roles in overall fire management and planning.
Workshop organizers need to work harder to secure
the participation of multiple participants from each
geographic area. We found that in the cases where
the GACC participant did not have an established
rapport with his/her non-GACC collaborator, high
levels of synthesis were not realized. Workshop
organizers also realized the importance of employing
the services of a professional technical writer, as was
done in the highly successful 2003 Joint Fire Science
Program regional workshops, in order to facilitate the
rapid turnaround of workshop reports.
In addition, workshop organizers need to put further
effort into securing a higher level of commitment and
more resources from climate forecast entities; a
greater level of time and commitment by the climate
forecasters is key to improving fire and climate
outlooks, increasing understanding of the methods
and analyses produced by climate forecasters, and
engendering greater trust and understanding
between the climate research and fire operations
communities.
A key indicator of the success of the workshop was
the enthusiastic support of workshop participants for
future workshops, and collaboration on a technical
note. Workshop participants expressed strong
support for training on forecast and climate
assessment techniques, and the construction,
interpretation, and use of the national climate
forecasts. The aforementioned training, which has
the potential to improve forecast skill and build capacity within the GACCs, has been incorporated into the NICC Predictive Services calendar; a medium-range forecast training has been scheduled for winter 2003, and the three institutions responsible for organizing the NSAW are in the process of developing a long-range climate forecast training, in conjunction with NOAA’s Climate Services Division.

In conclusion, carefully structured workshop organization and a collegial environment generated an unexpected level of enthusiasm and cooperation between participants, as well as learning and sharing of expertise. The workshop process provided a model and mechanism for moving the entire Predictive Services organization forward to meet its goals of integrating climate, weather, situation, resource status and fuels information into products that will enhance the ability of wildland fire managers to make proactive short- and long-range decisions for strategy development and resource allocation, and to improve efficiency and firefighter safety. NSAW organizers are now planning a 2004 NSAW, for the western U.S. and Alaska, as well as a separate eastern U.S. workshop.

References


