Fire Weather Research Report: Progress and Needs (June 2014)

A presentation to the Subcommittee on Disaster Reduction; Wildland Fire Science and Technology Task Force

NWS Office of Climate, Water & Weather Services
NWS Office of Science and Technology
June 17, 2014
Outline

- Purpose and Background
- Key Past Initiatives and Reports
- Progress Summary
- Transformation of Services
- Remaining Gaps
- Prioritized, un-met recommendations
- Other Examples of Success
- Desired Future Outcome; Best Chances for Success.
Purpose

• To provide an update on NOAA/NWS advancement of fire weather science:

  Based mainly on the 2008, NOAA Fire Weather Research Report

Also:

- Provide status on key initiatives since 2008.
- Illustrate remaining gaps and needs
- Discuss recent interaction with NWS leaders.
- Provide a desired outcome of activities.
• **NWS involvement in wildfire management**
  - The NWS provides all scales of fire planning forecasts.
  - Key Products; Planning Forecasts, Storm Prediction Center Outlooks, National Fire Danger Rating System Forecasts.
  - Special “spot” forecasts and Incident Meteorology (IMETs)

• **High-level attention continues**
  - California’s recent drought emergency
  - Western Governors’ Association (WGA)
  - Fire investigations
Past Initiatives and Reports

2000: National Fire Plan transitioned to

2005: WGA Policy Resolution 05-04:

“Operational fire managers need improved products and (weather) services...for fire operations decision making”

“NOAA should complete a national needs assessment for fire weather information and prescribed fire decision-making,...”

The 2008 NOAA Science Advisory Board Report

• NOAA concurred with all of the 2008 recommendations.

• Some progress has been made, but efforts were hindered by Federal fiscal cuts beginning in 2009.

• Plans need to be refined and resources identified.

Given budget limitations, must continue to identify highest priority items consistent with needed fire weather services.
• Who was involved?
  – Dr. John Snow (Dean of the College of Atmospheric and Geographic Science - University of Oklahoma).
  – Numerous Federal land managers.
  – Numerous private and fire agency wildland fire researchers.
  – University representatives.
  – The National Interagency Fire Center (NIFC).

• How was it reported to NOAA?
Progress to Date Summary

- The NWS mobile, on-site display platform is now operational (2014)
- A 2012 Fire weather research NOAA/USFS MOU is signed.
- There is a designated NWS fire weather research lead (OS&T).
- There are now 1.33km resolution fire weather model runs.
- Wildfire/structure and downscaling research from NIST, OAR/GSD.
- Coupled fire/atmosphere modeling research in Boulder, Colorado.
- Santa Ana wind research and mobile fire environment observation technology developed from UCLA and San Jose State University.
  - 2010 Improving fire weather forecasts
  - 2012 Spot forecast accuracy
NCAR and ESRL-GSD Work (Progress to Date)

- Historically, fire weather research efforts have originated from several key organizations (such as NCAR/UCAR, NIST, USFS, NOAA ESRL/GSD)

- The NCAR/GSD work is promising and output needs to be reviewed by users (e.g., IMETs, DOI and USFS) to clarify requirements and ensure necessary partnerships

- Those partnerships exist within the Fire Weather MOU team.

- NCAR and GSD have expressed willingness to share their work for user review.
NCAR and ESRL-GSD Work (Example)

WRF-SFIRE as an integrated system

- Ambient wind
- Fire area
- Fuel drying
- Fire-released heat
- Topography
- Max plume height
- Fuel wetting
- Smoke

WRF-SFIRE
Web Portal: Initiation and Monitoring of 12-hour Fire Forecast

NASA project #11-FIRES11-0038 submission

System status
- System: gss.ucdavis.edu
- Queue size: 3
- Total simulations: 7
- Active simulations: 0
- Free nodes: 12/12
- Status: ONLINE
- Last updated: 2013-06-29 23:01:58

Ignition control
- Ignition time: 2013-06-29 22:25:00
- Ignition latitude: 31.783198
- Ignition longitude: -116.4817
- Forecast length (hr): 12

Start fire

System messages
- Ignition time: 2013-06-29 22:25:00
- Ignition latitude: 31.783198
- Ignition longitude: -116.4817
- Forecast length (hr): 12

Fire simulation monitor
- Job status and control
- System messages

11
NCAR and ESRL-GSD Work (Example)
NEXT:

2008 SAB Vision still applies:

“NWS forecasters are equipped with a full suite of fire-scale weather and smoke prediction information from seasonal outlooks to short-term decision support, displayed, manipulated or delivered to any electronic device.”
Review of 2008 Identified Transformation Requirements:

• Fire weather and smoke modeling

• Research with and access to observed data

• Operational fire weather capabilities and services

• Organizational strategy for fire weather research
Gaps

Gaps still exist with respect to the 2008 vision:

- NOAA needs continued fire weather research to effectively:

  * Assist in pre-positioning of resources.
  * Downscale models to landscape scale.
  * Assist in smoke dispersion and transport forecasting.
SAB Key Recommendations:

- Assimilate output from all local observation resources (2.1)
- Explore use of remote sensing methods (2.2)
- Increase R&D of integrated fire weather modeling systems (3.1)
- Use assimilation from 2.1 to generate high res fire danger maps (5.1)
- Develop Intelligent Assistant tool for WFOs and deployed IMETs (8.1)
- Explore emerging communication and low bandwidth technologies (12.1)
- Collaborate with USGS on rainfall rate thresholds for debris flows (15.1)
- Designate lead NOAA/NWS lab for R&D, provide budget/authority (18.2)
- Team with land agencies to establish fire weather test bed (18.3)
IMET Upper Air Systems
(Success in Observation Capability)

- Currently the NWS has 24 IMET upper air kits.
- New upper air kits were used operationally in 2012 & 2013.
- These observations will be integrated into the current modeling suite.
VIIRS and Coupled Fire-Wx Models

- Trending fire management policies dictate improved mapping of fires
- Assimilate new remote sensing fire data into cutting-edge coupled fire-weather model

**Improved Satellite Mapping of Active Fires Achieved Using VIIRS I-bands**

**Coupled Fire-Weather Modeling**

Little Bear Fire, New Mexico June 2012

Wildfire in southern Brazil, March/2013

Coen and Schroeder (2013)
Best Chance for Success in Near Future

Recommendations:

- Assimilate output from all local observation resources (2.1)
- Use assimilation from 2.1 to generate high res fire danger maps (5.1)
- Develop Intelligent Assistant tool and explore emerging communication and low bandwidth technologies (8.1 and 12.1)
- Seek opportunities to contribute to interagency research priorities through the Joint Fire Science Program.
- Integrate VIIRS data into coupled fire-weather modeling (2.2 and 3.1)
- Support work underway at NCAR and GSD/ESRL (18.2 and 18.3)
Proposed Way Ahead

- **Short-term Field and Modeling Work**
  - Coordinate with partners on assessing fire weather research progress, applying R2O, and supporting research needs ➔ *Joint Fire Sciences Program partnership*
  - Allocate any available NWS and OAR funding resources to assist in obtaining local observations and conducting model validations, as well as to perform tasks under MOU umbrella
  - Utilize IMET upper air systems to *advance model initialization* and research-ready data sets
  - Integrate VIIRS into coupled fire-weather models being developed by UCAR/NCAR

- **Validation of 2008 SAB recommendations**
  - Can this Task Force help validate the top priorities for NOAA/NWS fire weather?
  - NWS must formalize a Fire Weather Research to Operations Plan.
  - Must explore links with U.S. Weather Research Program and other research partners.

  - Must all be done with the idea in mind of efficient resource allocation and responder safety.
Backup slides to Follow
Develop national databases of burn severity and fire perimeters for both wildland and wildland urban fire.

Establish methods to assess the adequacy of community resources for a successful response to a likely fire hazard.

Assess the benefits of fuel treatments, other preparedness activities, societal attitudes and decision making processes in reducing potential losses.

Understand why individuals evacuate or choose to stay.

More fully integrate across hazards to identify and illustrate interactions, including environmental benefits of natural fire.

Develop improved methods to assess the adequacy of community resources for a successful response to a likely fire hazard.

Integrate new process understanding into improved fire behavior models that incorporate complex fuels (including structures and ecosystem) and wildland-urban interface community design that incorporate rural-urban and wildland-urban effects, fire behavior, smoke transport, resource and social values; and wildland-urban interface community design that incorporate rural-urban and wildland-urban effects, fire behavior, smoke transport, resource and social values.

Understand why individuals evacuate or choose to stay.

Develop improved methods to assess the adequacy of community resources for a successful response to a likely fire hazard.

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Understand why individuals evacuate or choose to stay.

Develop improved methods to assess the adequacy of community resources for a successful response to a likely fire hazard.

Provide hazard and disaster information to where and when it is needed.

Develop an interagency coordinating group for wildland and wildland urban fire.

Develop national geospatial coverage and modeling systems for fuel types, fire regimes, and condition classes.

Develop common tools for assessing impacts of wildland fire as well as validated methods to enhance resilience to future fires.

Develop data and validated models to assess how well different community and landscape designs and post fire treatments work.

Develop improved systems to assist homeowners and communities to recover from impacts of wildland fire.

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Develop a web-based, geospatial and social media application to assist homeowners and communities to recover from impacts of wildland fire.

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Develop recovery strategies and tools for improving long-term preparedness and emergency response.

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<td>1.1</td>
<td>Fire Scale observations and field studies needed to verify downscaled weather models</td>
<td>Long-Term Unknown</td>
<td>Several JFSP research proposals. NOAA-NIST. UAV work</td>
<td>NOAA-OAR-GSD</td>
<td>OCWWS JFSP Program Universities Private Industry</td>
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<tr>
<td>1.2</td>
<td>Explore jointly-funded program of wildland fire-related weather research with all partners</td>
<td>Mid-Term Ongoing</td>
<td>Meetings coordinated with USFS. JFSP proposals. AMS Policy statement</td>
<td>NOAA-OAR-GSD</td>
<td>OCWWS USFS Desert Research Inst</td>
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<td>1.3</td>
<td>Matching of requirements to current and future satellite sensors</td>
<td>Long-Term</td>
<td>Discussions with NWS satellite team</td>
<td>NWS-OST</td>
<td>OCWWS USFS</td>
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<td>Perform model physics and data assimilation research to downscale existing models to sub 1-km</td>
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<td>3.1</td>
<td>Leverage NCAR modeling with NIST, OAR, USFS efforts in coupling</td>
<td>Mid-Term Ongoing</td>
<td>Ongoing work with NIST. Member of USFS Fire Sciences Research Team. Coord with GOES</td>
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<td>4.1</td>
<td>Establish fire incident archive and test bed for model research/verif. Started discussions with MIT Lincoln Lab about their testbed</td>
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<td>Expand use of downscaled wind forecasts in terrain and maintain forecast database</td>
<td>Short-Term Ongoing, incremental</td>
<td>Several JSFP proposals. HPCC Incubator proposal. Downscale wind training</td>
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<td>8.2</td>
<td>Prove usefulness-validity of uncertainty products and DSS tools used by IMETs. Also, perform model physics and DA research for downscaling to sub 1-km resolution</td>
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<td>9.1</td>
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<td>OCWWS</td>
<td>OST</td>
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<td>9.2</td>
<td>Provide improved lightning probability guidance including fuels state data and lightning climo</td>
<td>Short-Term 05/30/10</td>
<td>Second quarter milestone for SPC. Intent to implement in 2010</td>
<td>SPC</td>
<td>OCWWS Missoula WFO</td>
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<td>10.1</td>
<td>Participate in JFSP project to develop Smoke Science Plan, work with partner agencies</td>
<td>Mid-Term Ongoing</td>
<td>Coordinating WFO/user level survey of smoke science needs.  NWSEO</td>
<td>USFS</td>
<td>OCWWS</td>
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<td>Continue funding fire weather ops, equipment, training and provision of FX-Net data to IMETs</td>
<td>Short-Term Ongoing, each FY</td>
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<td>10.3</td>
<td>Collaborate with social scientists on best approaches to disseminate smoke, fire potential and debris flow information to public</td>
<td>Long-Term Unknown</td>
<td>Interacting with Jen Sprague of NWS. Drafted SOW and looking for funds</td>
<td>OCWWS</td>
<td>OST NWS/SPPO</td>
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<tr>
<td>11.1</td>
<td>Disseminate IMT spot forecasts from the field</td>
<td>Short-Term 04/30/11</td>
<td>Sharepoint server implemented at WFO Boise. HPCC Incubator proposal.</td>
<td>OCWWS</td>
<td>OST WFO ITO WG Predictive Services</td>
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<tr>
<td>11.2</td>
<td>Verify daily fire danger forecasts via the web and set fire weather element performance standards</td>
<td>Short-Term Ongoing</td>
<td>Verification branch already posting NFDRS info. System for Red Flags set up. JFSP proposals submitted</td>
<td>NWS Verification Branch</td>
<td>JFSP Program OCWWS NWS Regions</td>
</tr>
</tbody>
</table>
## 2008 SAB Report Recommendations

<table>
<thead>
<tr>
<th>SAB Ref</th>
<th>Current Action</th>
<th>Period/Completion</th>
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<th>Lead</th>
<th>Partners</th>
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</thead>
<tbody>
<tr>
<td>12.1</td>
<td>Expand capability to provide GIS-based product access via low-bandwidth technologies</td>
<td>Short-Term 04/30/11</td>
<td>Prototype hand-held distribution systems already implemented</td>
<td>NWS Western Region</td>
<td>NWS Regions NOAA-OAR-GSD</td>
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<tr>
<td>13.1</td>
<td>Develop and deploy improved 3-D weather visualization tools including GIS capability</td>
<td>Mid-Term Unknown</td>
<td>NOAA HPCC Incubator proposal submitted for Spot visualization tools</td>
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<td>13.3</td>
<td>Ensure NWS forecast products are compatible with Wildland Fire DSS (WFDSS)</td>
<td>Short-Term Ongoing, follow WFDSS versions</td>
<td>Ongoing changes, in consultation with USFS. Ingest of NDFD data</td>
<td>USFS WFDSS program developers</td>
<td>OCWWS</td>
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<td>14.1</td>
<td>Continue funding fire weather ops, equipment, training and provision of FX-Net data to IMETs</td>
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<td>15.1</td>
<td>Collaborate with social scientists on best approaches to disseminate smoke, fire potential and debris flow information to public</td>
<td>Long-Term Unknown</td>
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<td>15.2</td>
<td>Determine/refine concept of operations for USGS and NWS for debris flow warnings/forecasts</td>
<td>Long-Term Unknown</td>
<td>Started interactions with OHD about USGS-NWS involvement in debris flow</td>
<td>OCWWS</td>
<td>OST OHD</td>
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<td>16.1</td>
<td>Coordinate with DRI, Univ. of AZ, and NIDIS to better understand role of fire in climate system; improve fire weather outlooks</td>
<td>Mid-Term Ongoing</td>
<td>Ongoing work at seasonal assessment workshops (NOAA Climate Diag Ctr).</td>
<td>National Predictive Services (Robyn Hefferman)</td>
<td>NOAA CDC UA CLIMAS Program OST</td>
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<td></td>
<td>Verification field studies needed to transition algorithms for climate effects on fuels treatments</td>
<td>Long-Term Unknown</td>
<td>Unknown</td>
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<td>16.2</td>
<td>Use fire detections from NOAA satellites to develop fire climate data record</td>
<td>Mid-Term Unknown</td>
<td>Unknown</td>
<td>NOAA-NESDIS</td>
<td>OCWWS</td>
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<td>17.1</td>
<td>Formalize national and international exchange of operational and research personnel</td>
<td>Short-Term Ongoing</td>
<td>Consultation with Australian Bureau of Meteorology. Also, assessments with Mexico and Canada</td>
<td>OCWWS</td>
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<td>OCWWS Fire and Public Weather Branch will work for NWS; coord with MIT LL et al.</td>
<td>OCWWS</td>
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<td>Ongoing work in Boulder, involving NOAA/OAR and NIST. NOAA/OAR to take lead</td>
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<td>18.3</td>
<td>Establish fire incident archive and test bed for model research/verif. Started discussions with MIT Lincoln Lab about their testbed</td>
<td>Long-Term Unknown</td>
<td>Meetings with USFS. JFSP proposals submitted. Discussion on MOU for testbed</td>
<td>NOAA-OAR-GSD</td>
<td>OCWWS USFS JFSP Program MIT LL</td>
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<td>18.4</td>
<td>Increase NOAA Strategic Plan focus, designate “fire season”, ID fire weather research focus and test bed location. ID leveraging</td>
<td>Short-Term Unknown</td>
<td>OCWWS Fire and Public Weather Branch will work for NWS; coord with MIT LL et al.</td>
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<td>Lead a survey to identify leveraging opportunities</td>
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<td>19.3</td>
<td>Continue on NCWG’s Fire Environment Committee</td>
<td>Short-Term Ongoing</td>
<td>OCWWS and OST interacting with committees on many issues</td>
<td>OCWWS</td>
<td>Land Agency Partners</td>
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