Fire and Smoke Initiative Brief

Bill Sjoberg/Andy Edman

Representing the Fire and Smoke Initiative Team

19 July 2017
Outline

• JPSS PGRR Background including Fire and Smoke Initiative
• Key Organizations in Fire Weather Support
• Fire Event Questions
• How Satellites Help
• What is Happening Now?
• What is Going on in the Future?
• Model Validation
• Discussion
JPSS PGRR Background Definitions

- **Proving Ground**
  - Demonstration and utilization of data products by the end-user operational unit, such as a NWS Weather Forecast Office or Modeling Center.
  - Promote outreach and coordination of new products with the end users, incorporating their feedback for product improvements

- **Risk Reduction**
  - Development of new research and applications to maximize the benefits of JPSS satellite data
    - Example - use of Day Night Band for improved fog and low visibility products at night, benefiting transportation industry.
  - **Encourages fusion of data/information from multiple satellite, models and in-situ data**
  - **Encourages use of satellite data to improve model forecast**
JPSS PGRR Background

RFP Timelines

2012 CFP
40+ Projects

2014 CFP
Initiative Focus

Proposed 2017 CFP
User Focus
JPSS PGRR Background

Success of PGRR Initiatives

- Successful Transition of Products to Operations
- Initiative Teams
- Individual PGRR Projects

Joint Polar Satellite System

Bill Sjoberg – Global Science & Technology Contractor
JPSS PGRR Background

PGRR Initiatives List

- Ocean and Coastal
- Severe Weather/NWP/Data Assimilation
- Arctic
- River Ice and Flooding

- Sounding
- Hydrology

- Fire and Smoke

May 2013

May 2014
JPSS PGRR Background
Best Practices

- Clear Objectives
- Transition to Operations
- Frequent Meetings
- Key Milestones
- Working Groups

Joint Polar Satellite System
Bill Sjoberg – Global Science & Technology Contractor
JPSS PGRR Background
F&S Initiative Initial Objectives

- Organize a forum to allow stakeholders supporting Fire and Smoke products development to interact with key users of the capabilities.

- Understand the current use of geostationary and polar orbiting satellite capabilities in support of Fire and Smoke detection and forecasting mission

- Identify current SNPP/JPSS and new GOES-R Fire and Smoke data and capabilities with the potential to improve support to this mission

- Establish methodologies and procedures for the operational demonstrations of these capabilities

- Following these operational demonstrations, identify the satellite capabilities whose operational impacts are sufficient to warrant transition from research to operations

- Determine required actions for an effective transition of these capabilities to operations that can be maintained over the long term.

- As the Initiative Team met over the months and years, actions were taken to implement these objectives, and new objectives were identified and worked.
# JPSS PGRR Background

**Telecon Participants**

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<tr>
<th>Name</th>
<th>Organization</th>
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<tbody>
<tr>
<td>Tim Barker</td>
<td>NWS</td>
<td>Valerie Mikles</td>
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<td>Nazmi Chowdhury</td>
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<td>Tony Mostek</td>
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<td>Ivan Csiszar</td>
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<td>Andy Edman</td>
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<td>Susan O’Neill</td>
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<td>Evan Ellicott</td>
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<td>Mitch Goldberg</td>
<td>JPSS</td>
<td>Julie Price</td>
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<td>Robyn Heffernan</td>
<td>NWS</td>
<td>Katherine Rowden</td>
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<td>Amy Huff</td>
<td>Penn State</td>
<td>Bill Sjoberg</td>
<td>JPSS</td>
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<td>Eric James</td>
<td>ESRL/GSD</td>
<td>Eric Stevens</td>
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<td>Shobha Kondragunta</td>
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<td>Scott Lindstrom</td>
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<td>Jorel Torres</td>
<td>JPSS Training Liaison</td>
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<td>Mark Loeffelbein</td>
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Key Organizations in Fire Weather Support

- National Weather Service (WFOs, IMETs)
- National Interagency Fire Center
- National Interagency Coordination Center
- Bureau of Land Management
- US Forest Service
- US Fish and Wildlife Service
- National Park Service
- The National Wildfire Coordinating Group
- Regional Geographic Area Coordination Centers
- Air Quality Organizations
HRRR-SMOKE 08/11/2017 (06:00) - Experimental

VIIRS Fire Radiative Power (MW)
Both the city lights (blue circles) and visible light energy from active wildfires (red circles) were visible early this morning on the #VIIRS day/night band. Even think it shows a few possible new fire starts too (yellow circles).
Wildland fire smoke health effects on wildland firefighters and the public
Issues

FRP is not always provide consistent behavior

Fire pulse and evolve – but there are detection issues with FRP that need further work

Similar comments from WFOs
BC Fires Aug 12

http://rammb-slider.cira.colostate.edu/?sat=goes-16&sec=mesoscale_02&x=901&y=460&z=2&im=60&ts=2&st=0&et=0&speed=130&motion=loop&map=1&lat=0&p%5B0%5D=20&opacity%5B0%5D=1&hidden%5B0%5D=0&pause=0&slider=-1&hide_controls=0&mouse_draw=0&s=rammb-slider
Fort McMurray Fire
Suomi NPP IMAGERY - Before the fire

Ft. McMurray city lights
Tar Island gas flares
Border between Canadian Provinces

Alberta, Canada
Saskatchewan, Canada

Clouds

Joint Polar Satellite System
Bill Sjoberg – Global Science & Technology Contractor
Suomi NPP Imagery of Ft McMurray Wildfire
7 May at 0930 UTC

- Emitted light from the fire
- Clouds
- Fire Perimeter Line
- Active fires along the Perimeter Line
- Clouds/Smoke
Suomi NPP Imagery of Ft McMurray Wildfire
18 May at 0915 UTC
COMPARISON BETWEEN ESTIMATED FIRE PERIMETER AND NCC IMAGERY

NCC Imagery 17 May 2016 at 0929Z (i.e., 05:29 a.m. ET)
RealEarth Image May 04, 2016
VIIRS Fire Detection and True Color Composite
Fort McMurray Wildfire Smoke Plume
RealEarth Image May 04, 2016
VIIRS Fire Detection, True Color composite and AOD
Fort McMurray Wildfire smoke plume
IDEA-I High resolution (NAM 3km) Trajectory Forecast
Fort McMurray Wildfire
May 04, 2016

- **IDEA-I high resolution trajectory forecast colored by initial AOD**

- **Upper panel** shows NAM 600mb heights and precipitation (purple)

- **Lower panels** show longitude and latitude cross sections

- **Only AOD>0.5 initialized**
May 05, 2016 VIIRS AOD shows plume along MN/WI and IA/MO boarders

IDEA-I high resolution trajectory forecast predicts southern extent too far east
Smoke from Fort McMurray Wildfire
Mount Horeb, WI (South Central WI)
7:30pm Central May 05, 2016
questions
UW-Madison SSEC Aeronet AOD
May 5, 2016

U_of_Wisconsin_SSEC, N 43°04'19", W 89°24'39", Alt 330 m,
PI: Brad_Pierce, brad.pierce@noaa.gov
Level 1.5 AOT; Data from 5 MAY 2016

AOT_1640 : <0.019>
AOT_1020 : <0.037>
AOT_070 : <0.040>
AOT_675 : <0.057>
AOT_500 : <0.085>
AOT_440 : <0.096>
AOT_340 : <0.115>
AOT_300 : <0.121>
Fire Event Questions

• **Weather (General Conditions)**
  • What are the high/low temperature ranges across the fire area for today?
  • How low will the humidity be today and will it change over the wester part of the AOR?
  • What are the wind direction, speed and gusts over the northern ridge?
  • When will the thunderstorms breakout this afternoon and will they be severe?
  • How strong will the cold front be as it moves through tomorrow? When will it exit the area?
  • When will this high temperatures and low humidity pattern break?
  • Will the valley drainage winds be as strong tomorrow morning as they were today?

• **Operational (Weather Impact on Specific Decisions)**
  • With the forecast wind change, the fire may threaten Forward Camp Bravo. How confident are you in the timing?
  • The aircraft with the fire retardant just had a weather cancel due to high winds. How soon will the winds die down?
  • Will we be able to get the smoke jumpers in the air this afternoon and what are the conditions in the landing zone?
  • Will we have to close the interstate due to low smoke visibility? How close will the fire be to the interstate?
  • Will the smoke be elevated or near the ground tomorrow in Bozeman MT?
  • How soon will we have to declare a health alert due to smoke?
Discussion

• How do we make weather organizations aware of the Satellite data and products available to them?

• How do we ensure these capabilities are consistently available when needed?

• We need to work with current and future users to maximize benefit of these products.

• We need to have training available in ways that the user can fit it into their busy schedule.

• We need to maintain a process to capture user feedback and adjust products to better serve them
How Satellites Help

- Satellites are part of an integrated observation system for decisionmakers supporting remotely through WFOs, NWS regions, and NCEP Centers.
  - WFO ASOS surface observations and upper air soundings
  - Ground based lightning systems
  - Radar
  - Remote Automated Weather Stations (RAWS)
  - Weather information from deployed fire personnel (ground and aviation)
  - Forecast, fire weather and other specialized models

- Satellite data and products are available to deployed IMETS
  - Use the AWIPS Thin Client to get access to observations, models, and satellite products
  - Can access websites for supplemental information (HRRR)
  - Reach back to supporting WFOs for assistance and more detailed analysis

- Satellite Capabilities Impact
  - What is happening now?  Geostationary and Polar-Orbiting imagery for weather, fire, and smoke, Day-Night-Band, and VIIRS NUCAPS Soundings in convective environment
  - What is going to happen in the future?  VIIRS Fire Radiative Power as input to smoke models
  - Are the models handling things well?  JPSS validate model forecasts to give confidence in future model output
The Real-Time HRRR-Smoke Web-Site
(rapidrefresh.noaa.gov/HRRRsmoke)

HRRR Model Fields - Experimental
Model: HRRR-smoke (Experimental)  Area: NW  Date: 14 Sep 2016 - 06Z

*** Experimental, Not for Official Guidance *** - see description.  Alaska Version

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The Fire Radiative Power (FRP) data are processed during HRRR-Smoke initialization by processing FRP for the model domain detected during previous 24 hours by VIIRS. Then the model simulates fire emissions and plume rise using the static FRP fields for 36 hours of smoke forecast. The following plot shows processed FRP values from VIIRS for the model grid cells (each size of 3x3 km) containing fires for 6Z September 14th, 2016 experimental smoke forecast.
This plot shows simulated fire emitted fine particulate matter (PM2.5 or fire smoke) concentrations at the first model level (~8m above ground). The following plot shows forecast of near-surface fire smoke for Sep 14th, 8pm EDT over the CONUS domain. This forecast is based on the model simulation of 18 hours from the model initialization time, which is 2am EDT, Sep. 14th.
This plot shows simulated total PM2.5 mass within vertical columns over each model grid cell (or fire smoke). These columns reach as high as ~25 km above ground. The purpose of showing such plots is to display the effect of fire smoke load which includes smoke in boundary layer as well as aloft, illustrating the integral effect of fire smoke throughout the atmosphere. The following plot shows a forecast of vertically integrated fire smoke for Sep 14th 8pm EDT.
Validation of Models