Advancements in CrIS Data Assimilation

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In Collaboration With

NCEP/EMC, NCEP/NCO, NESDIS/JPSS, NESDIS/STAR, NESDIS/ASPB, NASA/GMAO, NASA/NCCS, STC, JCSDA



Outline

- RARS/EARS Direct Broadcast Status
- CrIS Modifications in NCEP's Gridpoint Statistical Interpolation (GSI) software.
- Transition to CrIS-FSR

RARS/EARS/DB -> DBNet Status

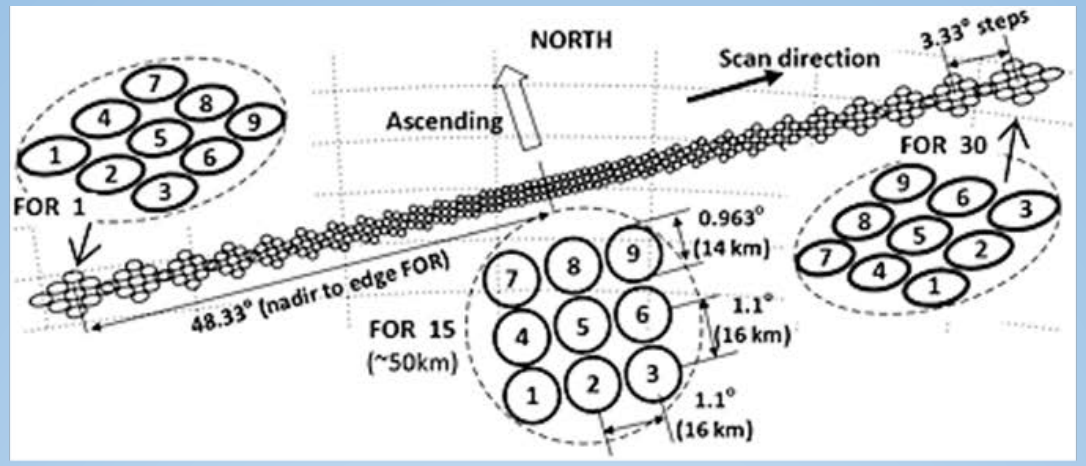
- Direct Broadcast available from SSEC
- Regional ATOVS Retransmission Services (RARS) available via GTS
- Available Instruments:
  - CrIS (399), ATMS, IASI (500), AMSU, MHS, (HIRS)
- Latest NCEP Global Forecast System included:
  - RARS – IASI (500), AMSU
  - DB – CrIS (399), ATMS, IASI (500)
- RAP & HRRR parallel testing all instruments available from DB and RARS
- Need to validate / test CrIS-FSR (431 subset)

CrIS Modifications to the GSI

- Designed to work with the current CrIS and CrIS-FSR
- Exploits new GSI features (bias correction, removal of channel subset restrictions)
- Exploits VIIRS cloud height and amount information in the CrIS BUFR
- Is part of NCEP's software management system.
  - Currently under review by NCEP
  - To be reviewed by the GSI Review Committee (NASA, DTC, ESRL)

Scan Angle Modifications

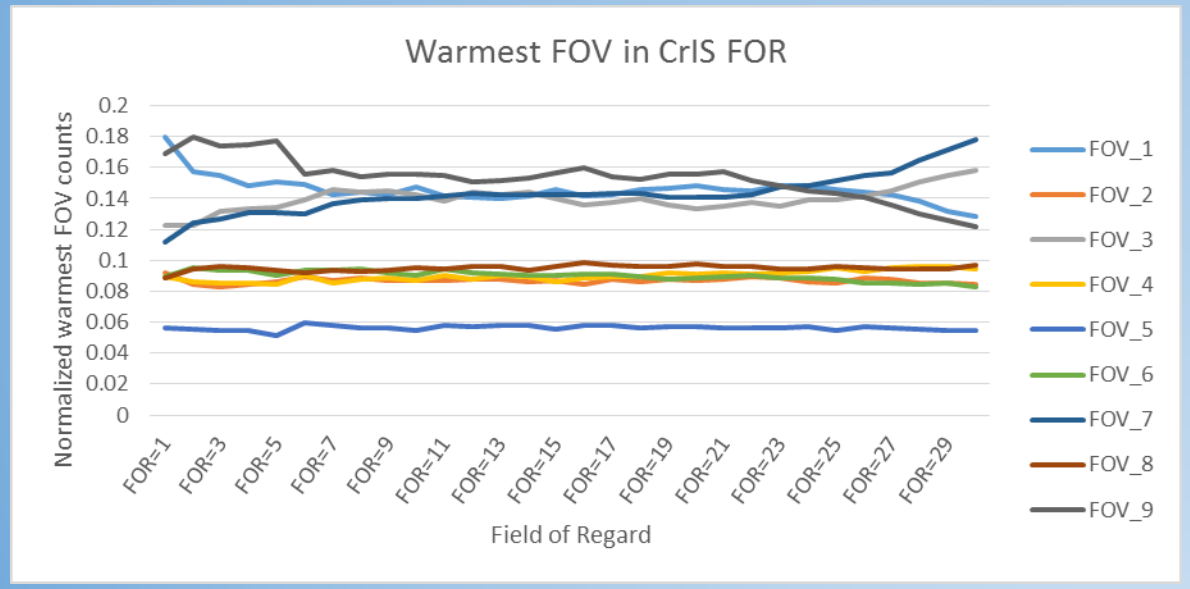
- New bias correction routine able to accommodate non-fixed scan angles.
- Scan angle is computed for all FOVs within all FORs, vice FOV=5 only.
- Counterclockwise rotation of FOVs is accounted for.
- Using all FOVs increased the number of thinning boxes.

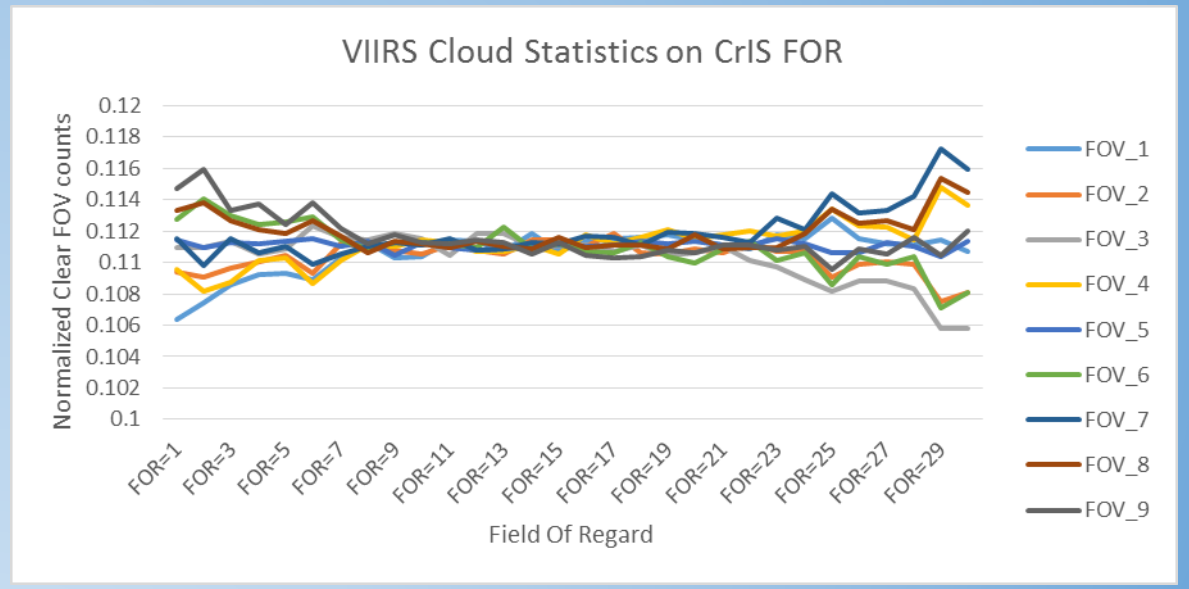


Journal of Geophysical Research: Atmospheres
Volume 118, Issue 22, pages 12,734-12,748, 25 NOV 2013 DOI: 10.1002/2013JD020344
http://onlinelibrary.wiley.com/doi/10.1002/2013JD020344/full#jgrd50972-fig-0003

VIIRS Cloud Information

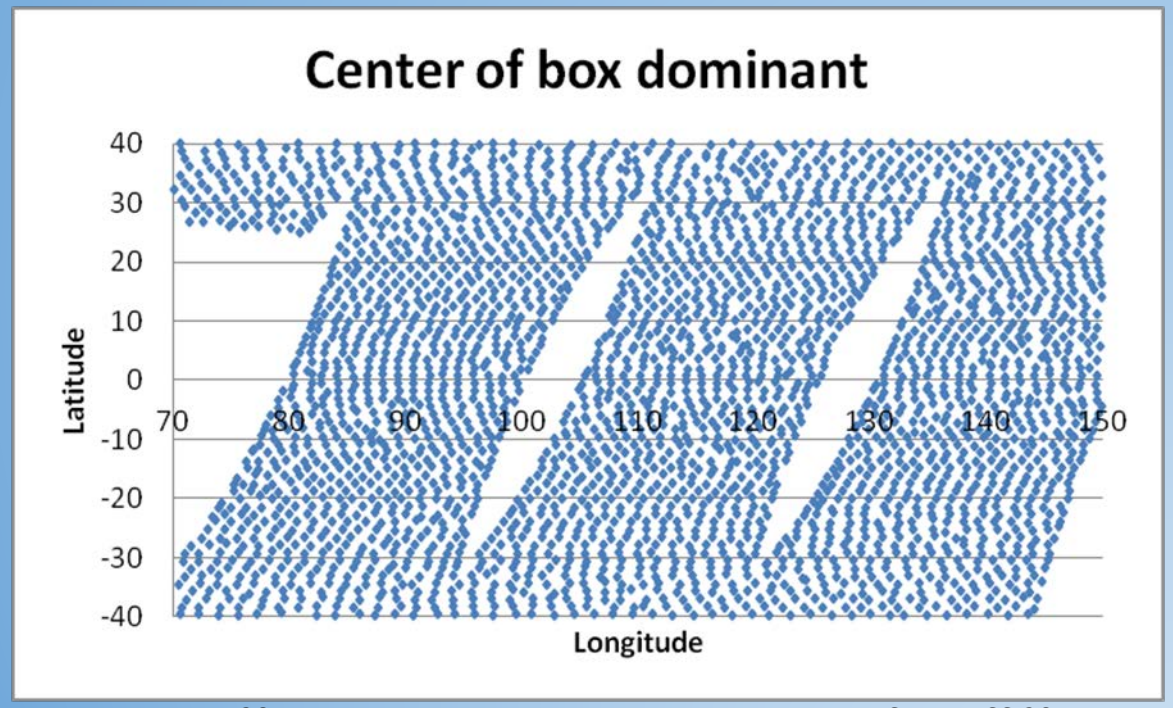
- VIIRS cloud information now in BUFR files
- Use cloud height and cloud amount to determine clearest FOV in thinning box
- Improves “normal” distribution of observations.
- Defaults to warmest FOV when cloud information is missing.

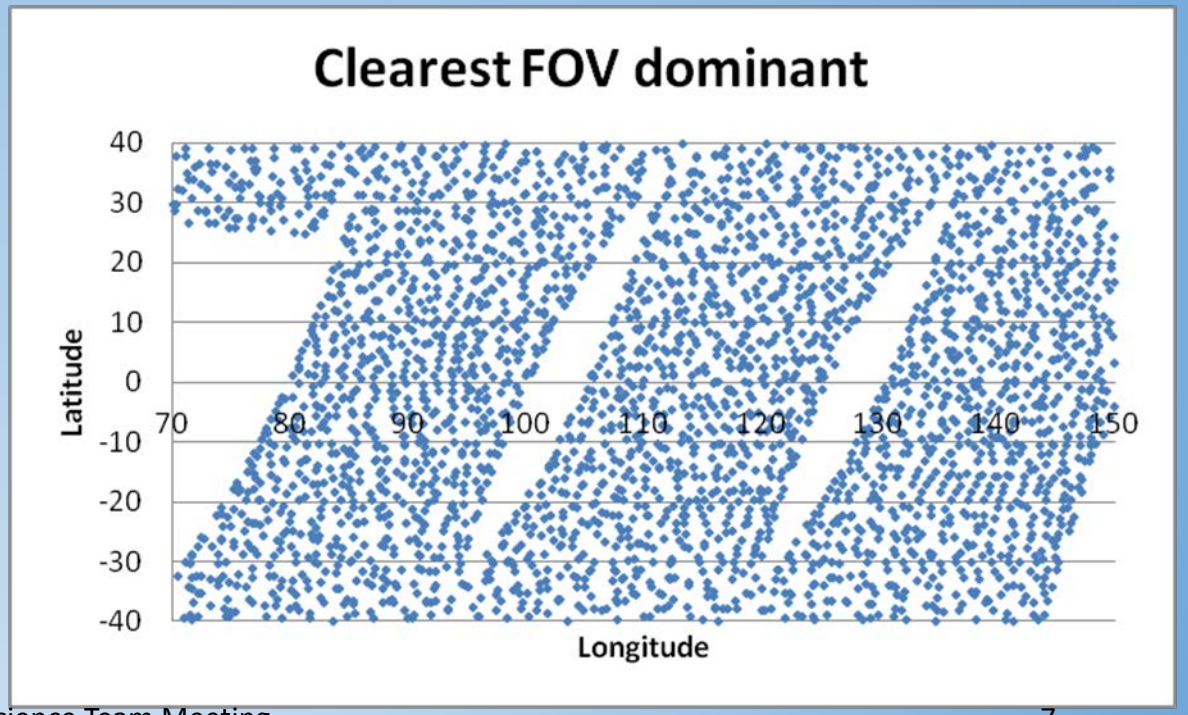




Center of Box Criteria

- Relaxed “distance from center of thinning box” criteria
- Used only when more than one FOV is clear.
- Was most dominant constraint.
- Has the largest increase in observations used.





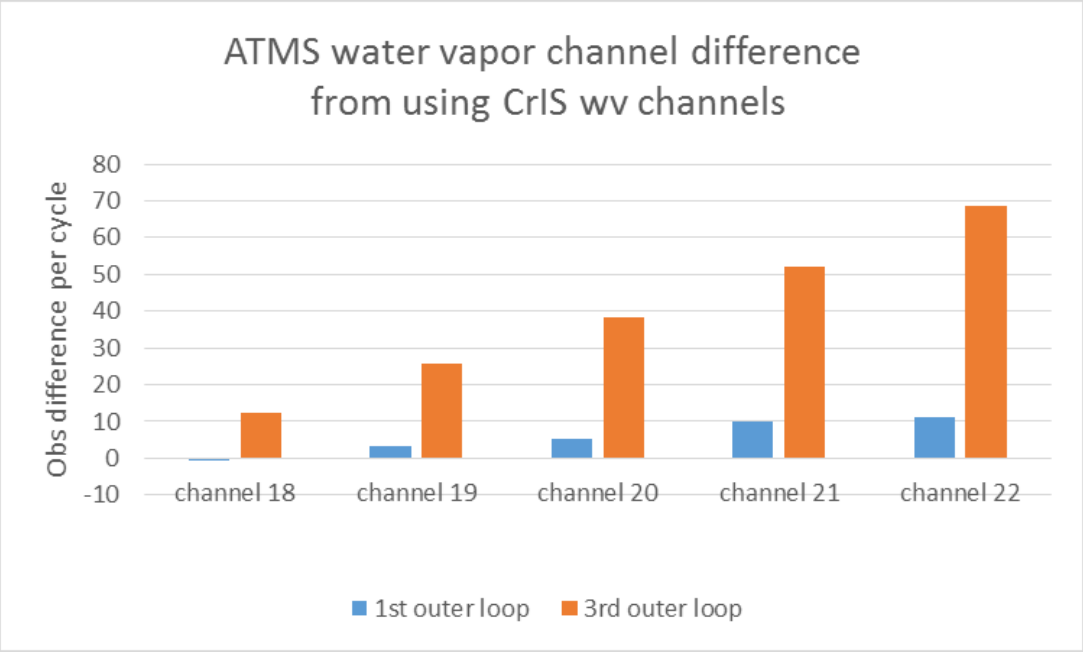
Transition to CrIS-FSR

- 431 channel subset derived by Andrew Collard and Antonia Gambacorta and was reviewed by several NWP centers.
- CrIS BUFR template was revised to contain a “FSR” flag and the 12 guard channels (Tom King, Yi Song, Jeff Ator, Dennis Keyser).
- DBNet will distribute CrIS-FSR 431 subset.
- Retrospective CrIS-FSR data were made available by Yong Han, Tom King, Yangrong Ling.
- NCEP’s initial plans are to use 2211 channel data from NESDIS/OSPO and 431 subset from DBNet.

Transition to CrIS-FSR Cont'd

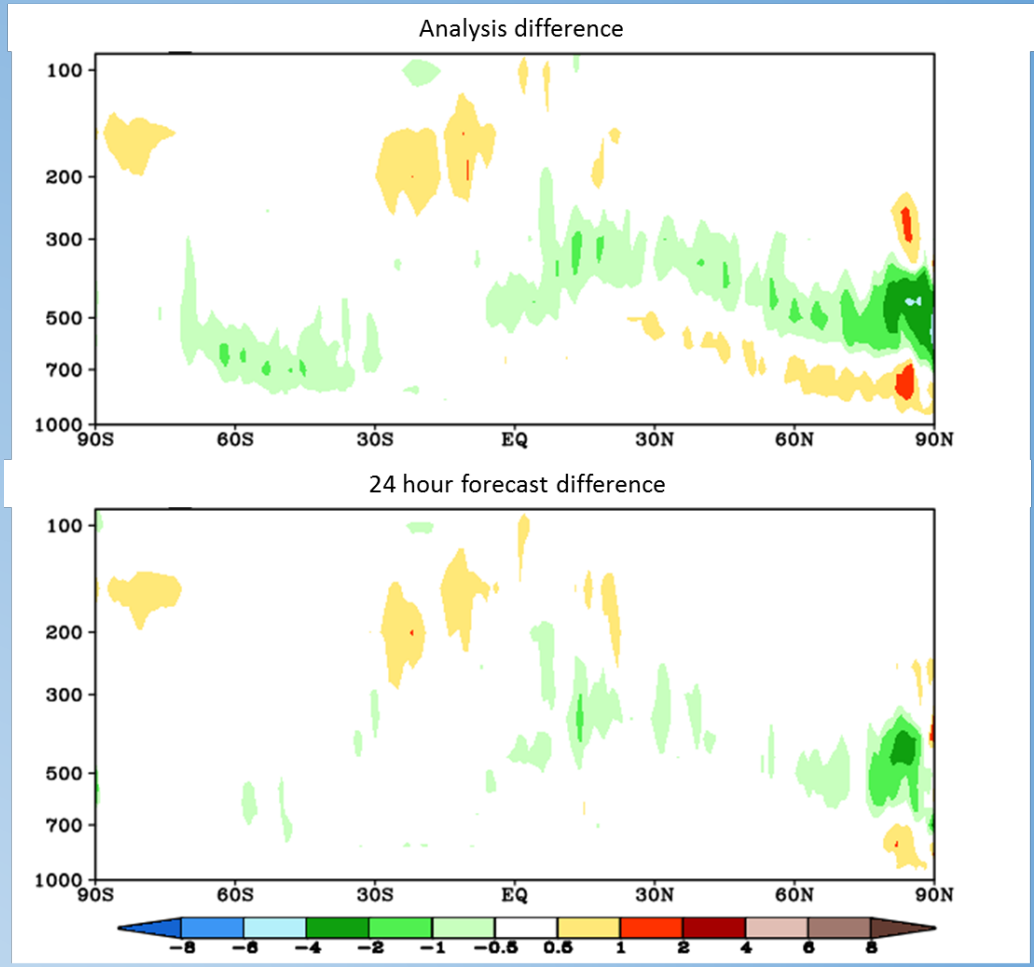
- VIIRS enterprise cloud information is only available after 1 May 2017.
- Used a low resolution (T670,254) version of the 4DEnsVAR Global Forecast System.
  - Operational framework, updated analysis software.
  - Scan angle, cloud information and distance relaxation is used in both control and experiment (**only testing channel selection**)
- Control uses current (82) CrIS channels and assimilation weights but from CrIS-FSR data set.
- Experiment uses 94 temperature and 8 water vapor channels with modified assimilation weights.

Water Vapor Statistics



Increased use of ATMS water vapor channel observations when using CrIS-FSR water vapor channels.

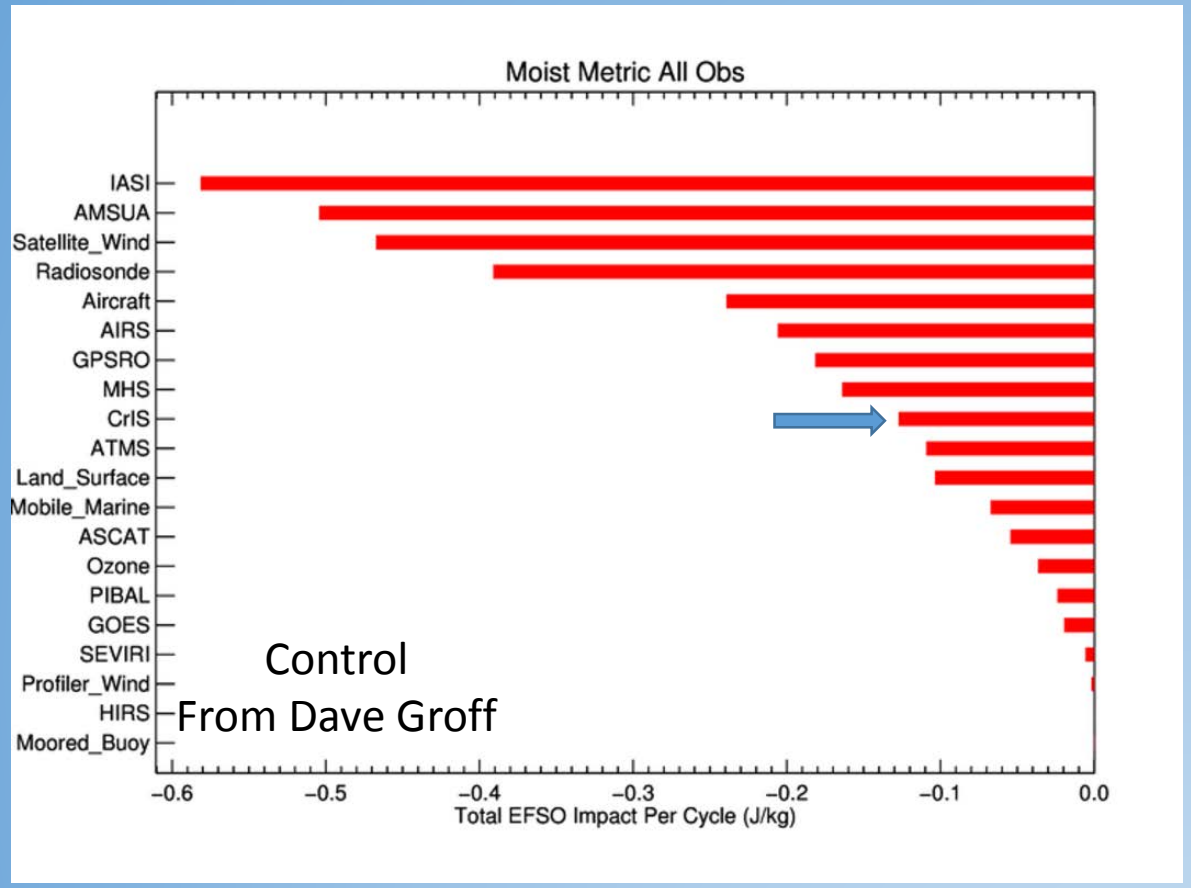
Blue – more observations pass initial QC
Gold – more channels used during assimilation.

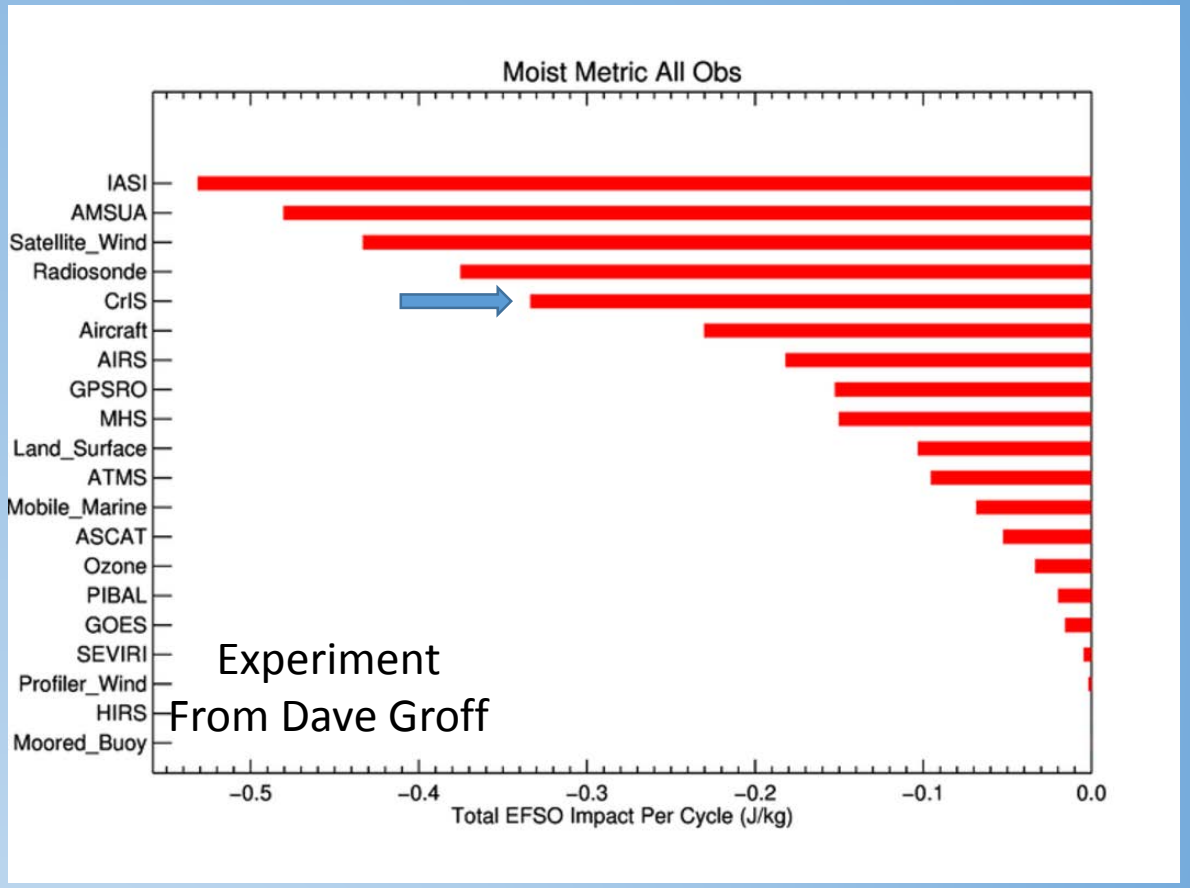


Average Relative Humidity difference from last 10 days.

Changes are evident in the analysis and forecasts out to 24 hours.

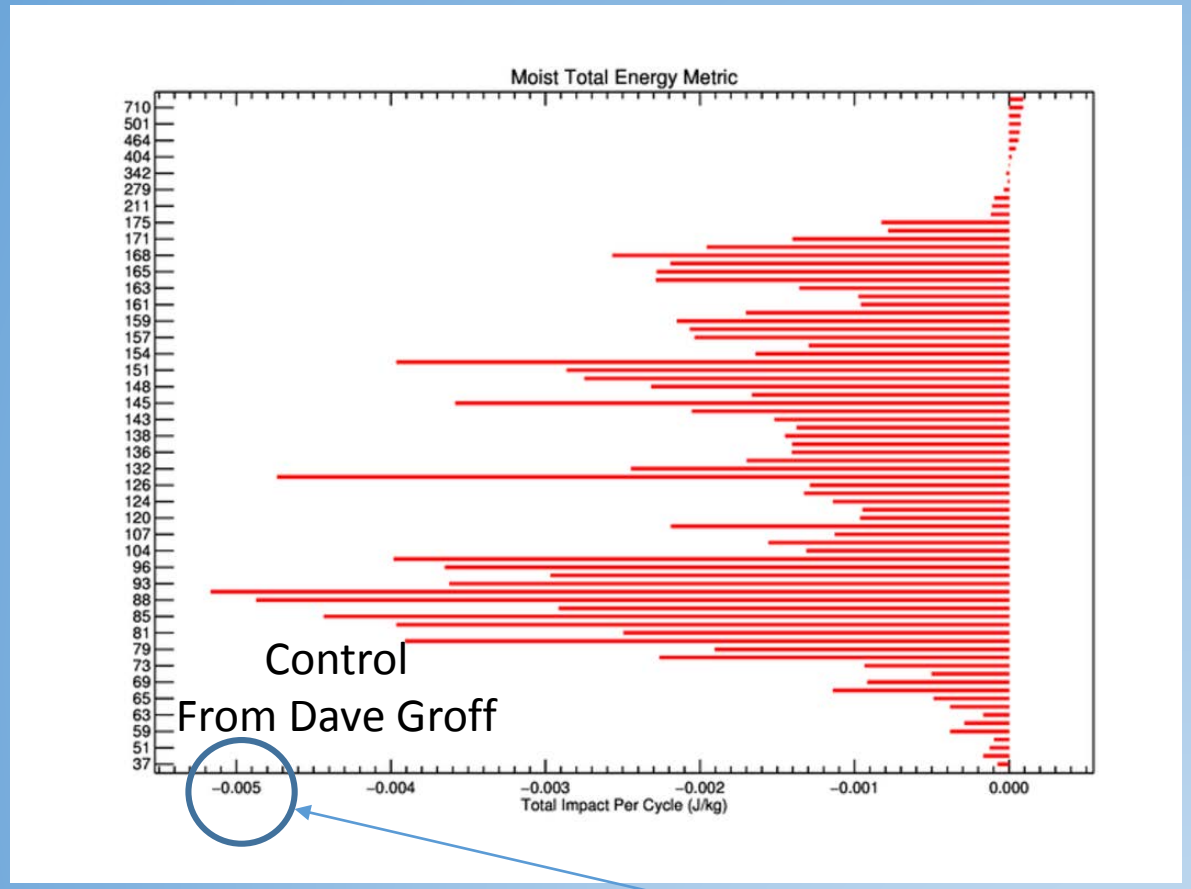
Forecast Sensitivity Observation Impact (FSOI)
Total Moist Energy

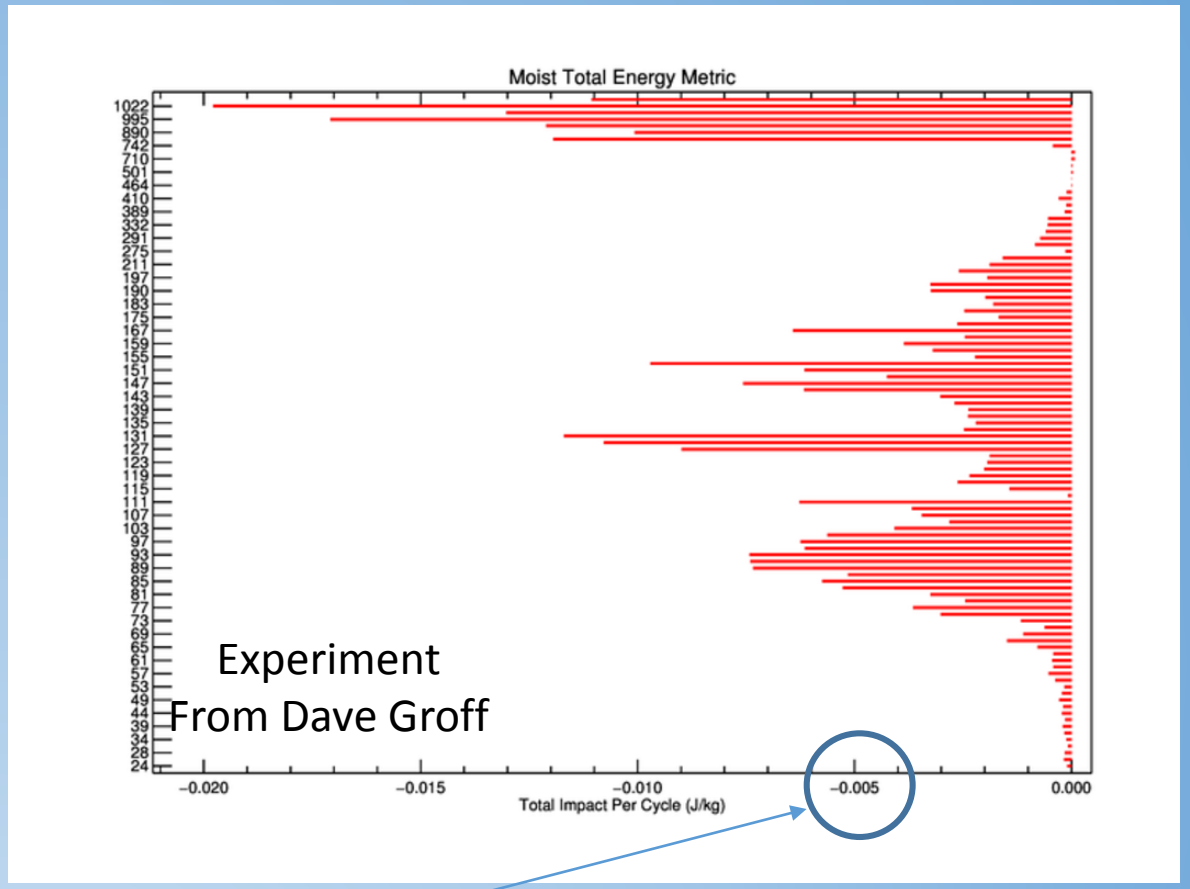




Adding 20 channels and adjusting assimilation weights moved CrIS from 9th to 5th

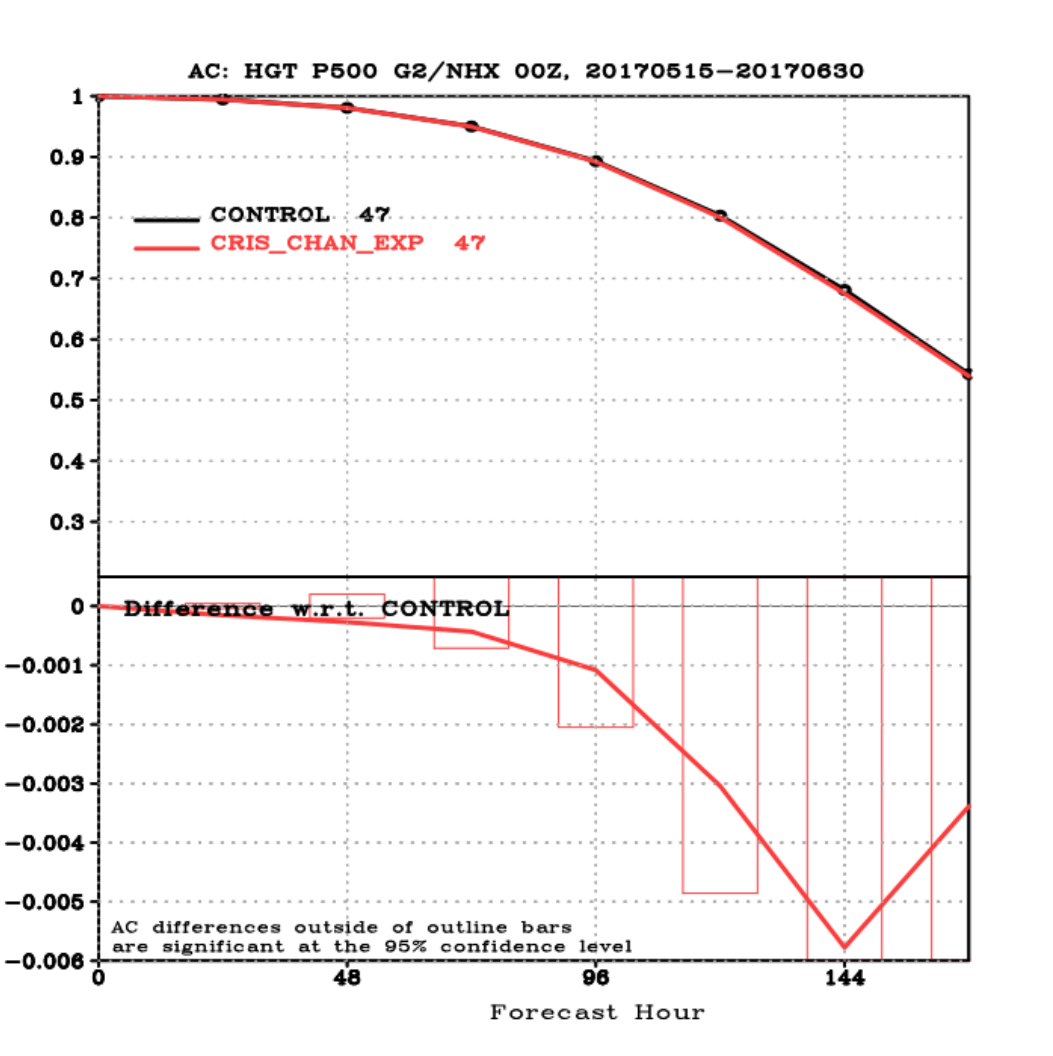
Forecast Sensitivity Observation Impact (FSOI)
Total Moist Energy per CrIS Channel

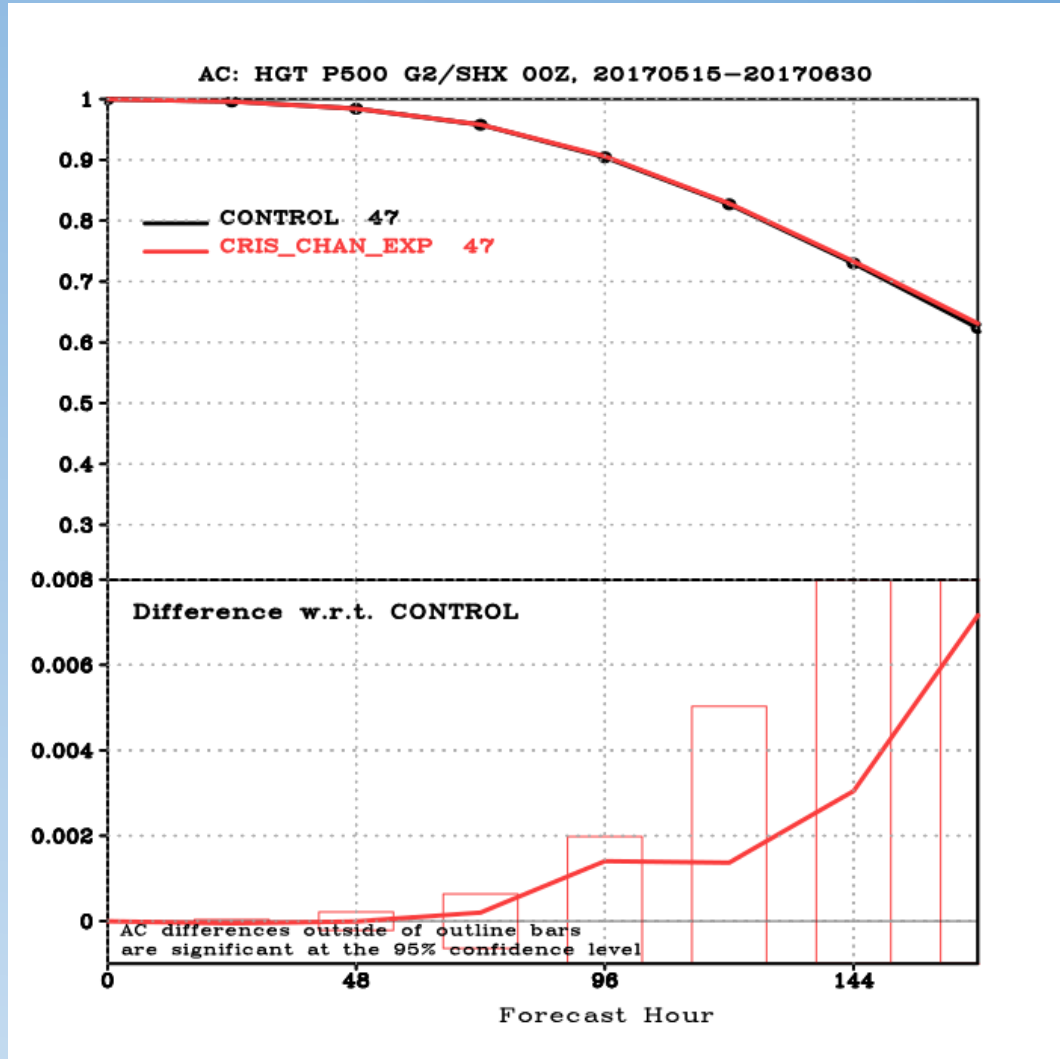




Different channels
Different scale
New Water Vapor Channels Dominate

500 hPa anomaly correlations for the Northern and Southern Hemisphere





Summary

- Using all FOVs (instead of FOV=5)
- Using VIIRS cloud information
- Relaxing distance from center of thinning box
- First attempt at a new channel selection has 94 temperature and 8 water vapor channels.
- Adjusted assimilation weights/observation errors.
- Increased number of total observations from ~250,000 to ~500,000
- Improvements in humidity field
- CrIS FSOI ranking moved from 9th to 5th
- Minimal changes in 500 hPa anomaly correlations

Added ~ 100,000 observations

Added ~ 150,000 observations

Questions?

Jim.Jung@noaa.gov



Cal/Val and Assimilation of satellite data at ECMWF

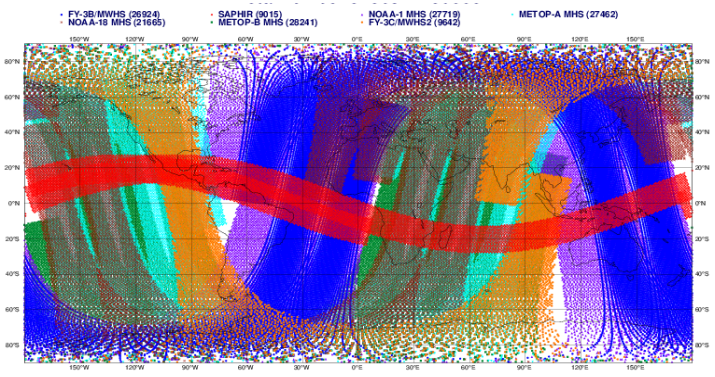
Heather Lawrence, Reima Eresmaa, Niels Bormann, Peter Weston, Bruce Ingleby, Stephen English

Thanks to: Fabien Carminati, Bill Bell, Stuart Newman

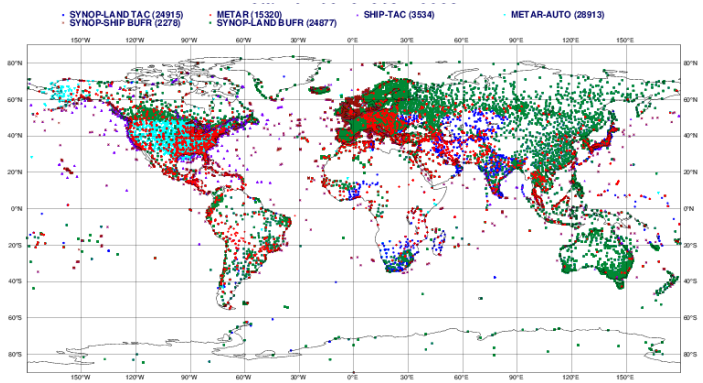
UK Met Office

Using NWP short-range forecasts to evaluate satellite data

MHS/MWHS-2/SAPHIR/MWHS



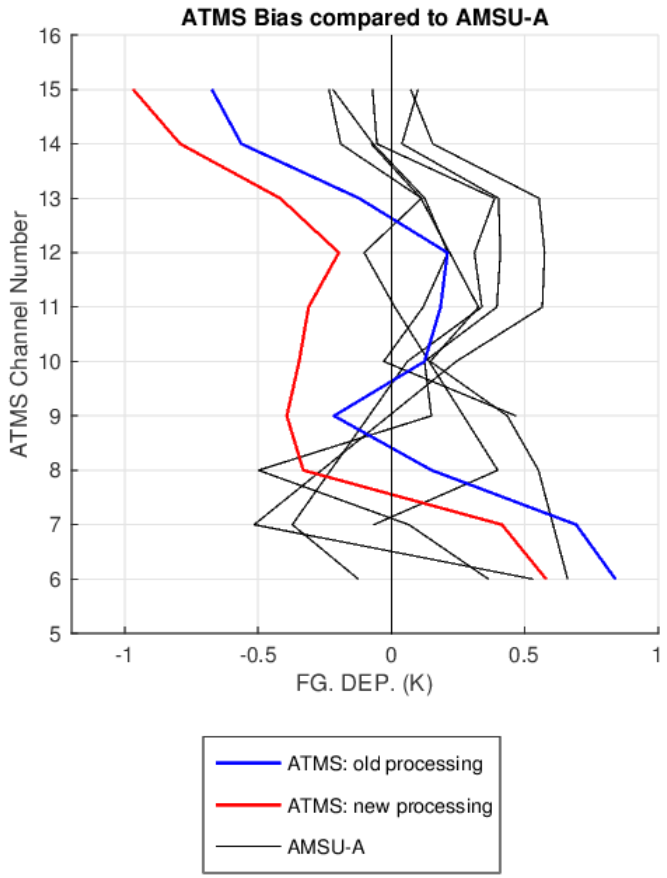
SYNOP



NWP Data Assimilation:

- Optimal combination of many observations past and present
- High accuracy temperature and humidity analyses

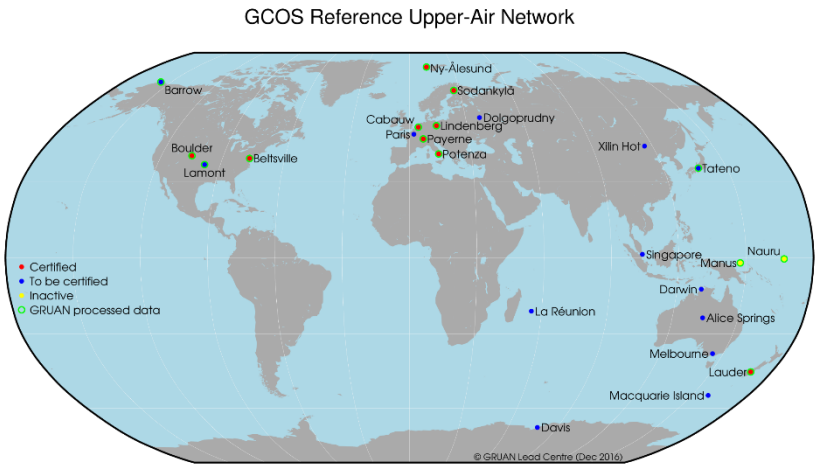
ATMS operational change – March 2017

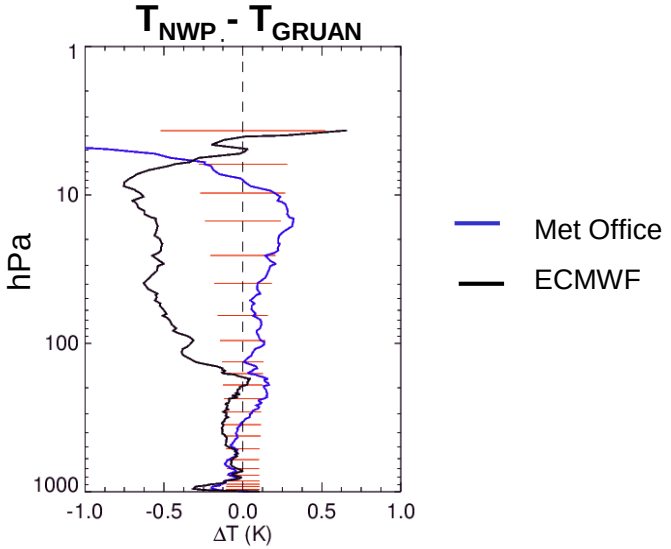


- Biases are now more different to AMSU-A
- But magnitude still similar

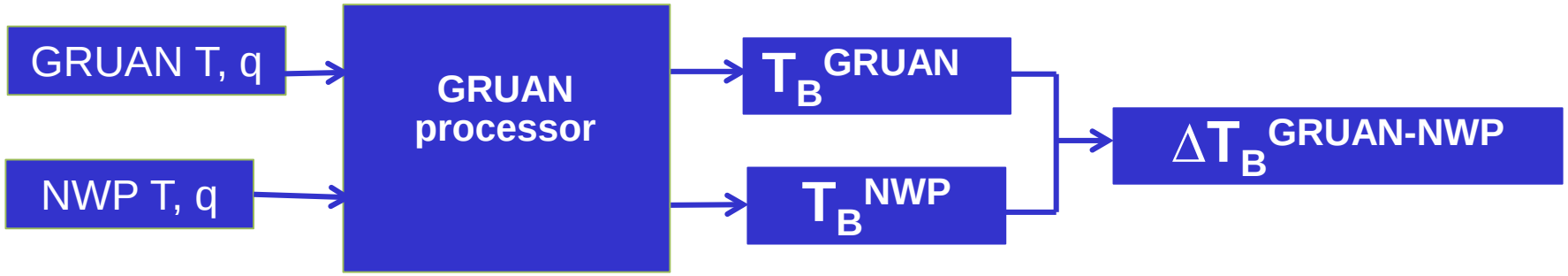
What are the forecast biases?

GRUAN processor from the GAIA-CLIM project



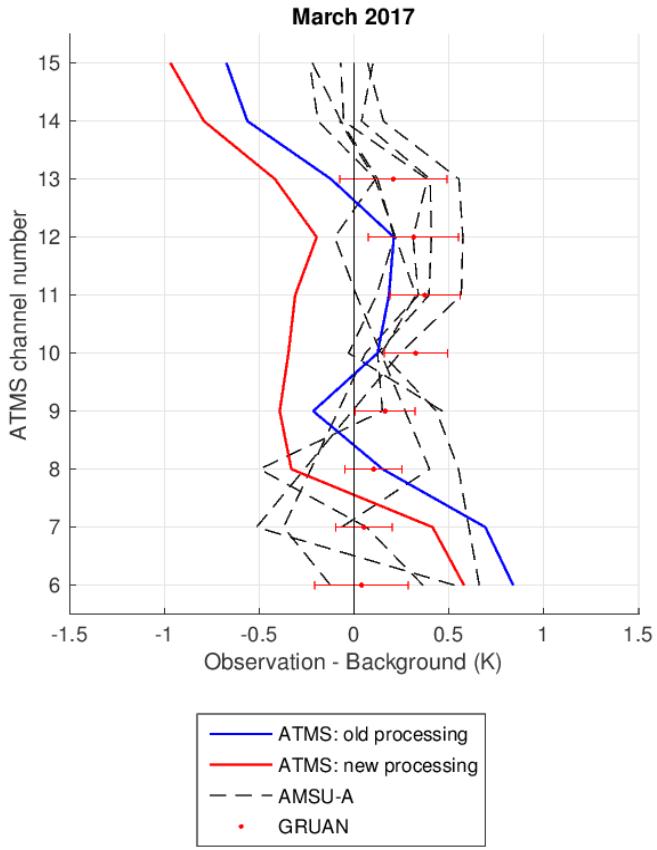


Met Office GRUAN Processor (F. Carminati):



Evaluating ATMS bias change

ATMS calibration change



But….

Error bars should be increased for:

- Radiative transfer uncertainty
- Representivity
- Vertical interpolation uncertainty…
- Correlations?

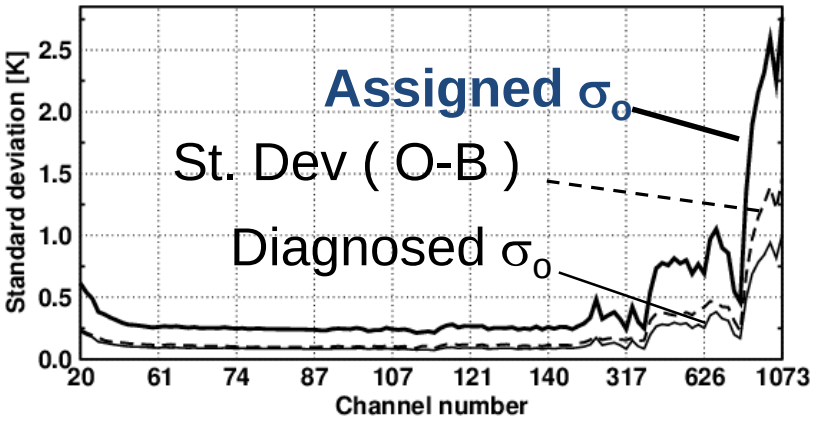
Are the number of GRUAN sites enough?

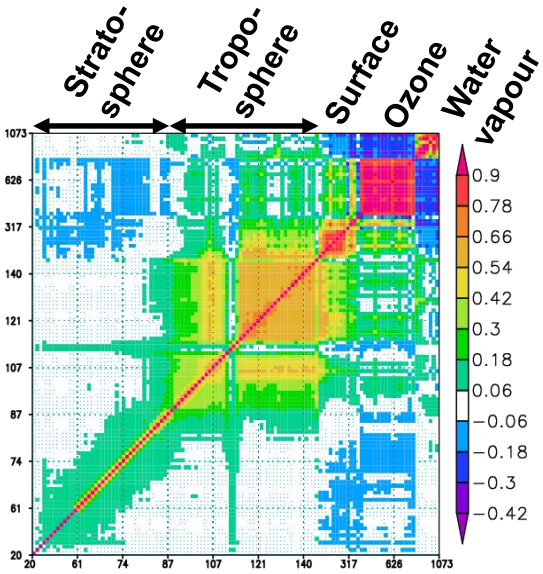
Ongoing work…

Assimilation of CrIS and ATMS

Assimilating CrIS: Reima Eresmaa

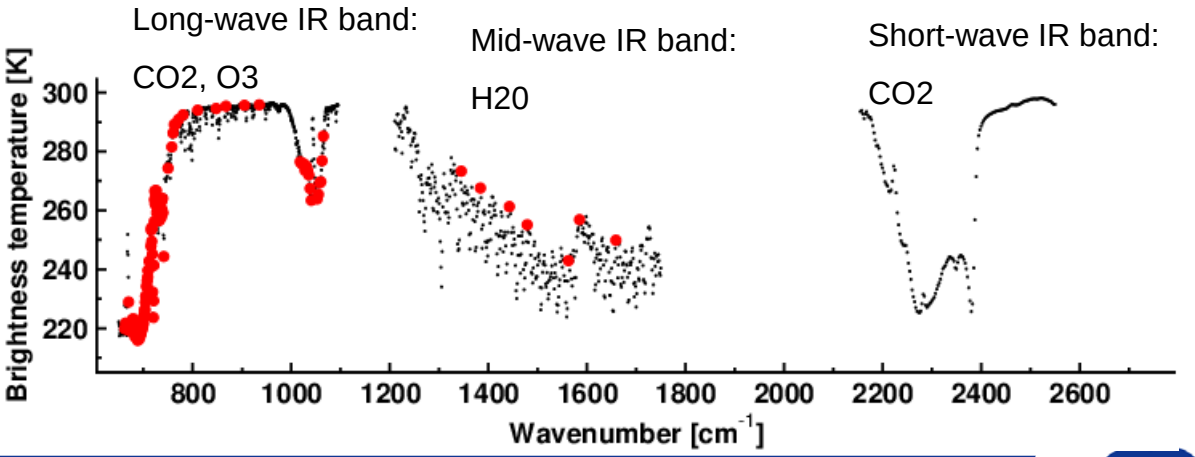
1. New Observation Errors





Error correlation

2. Increased number of channels used (118 channels):

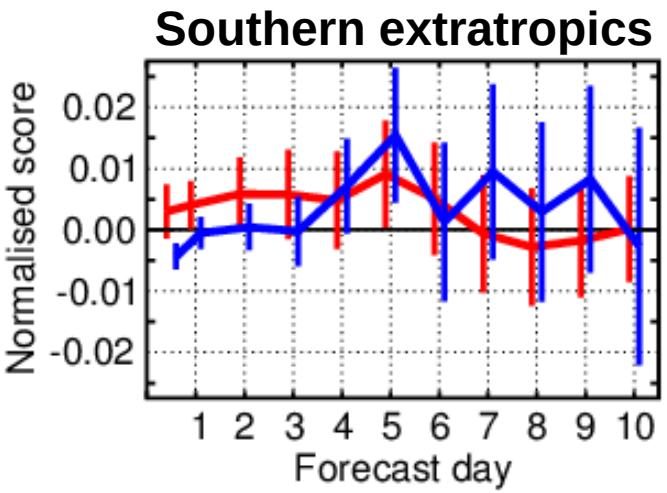


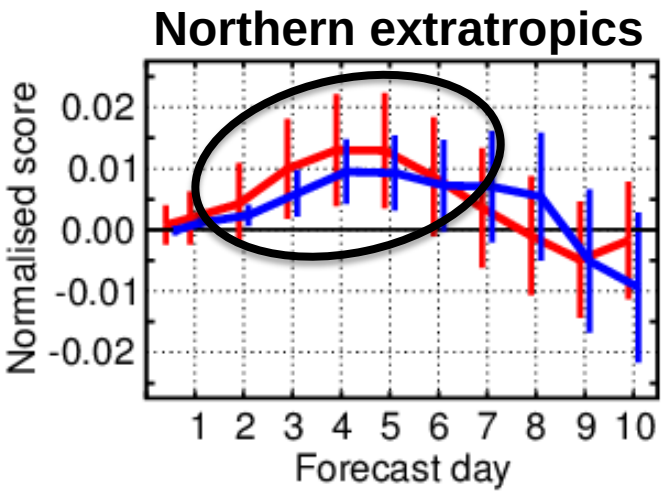
ECMWF

Assimilating CrIS: Reima Eresmaa

Z500

RMSE





Own analysis verification

Radiosonde verification

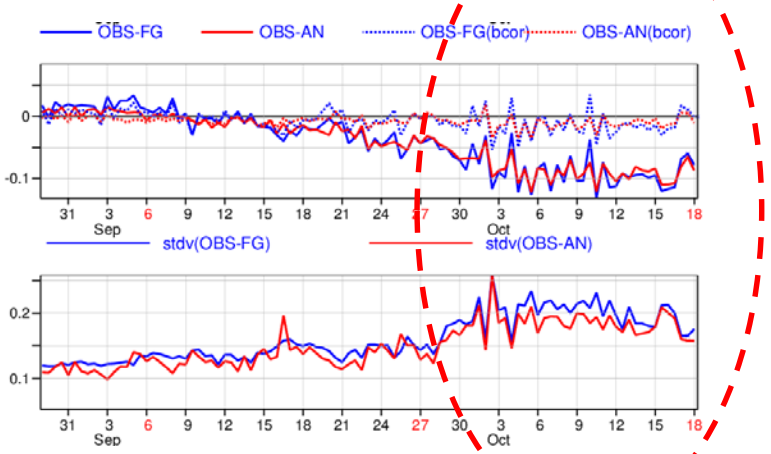
Future Plans:

- Start using a large number of tropospheric channels over land (to become operational in 2018 Q1)
- Assimilation of JPSS-1 CrIS
- Working on making the observation error situation-dependent e.g. intersatellite differences

ECMWF

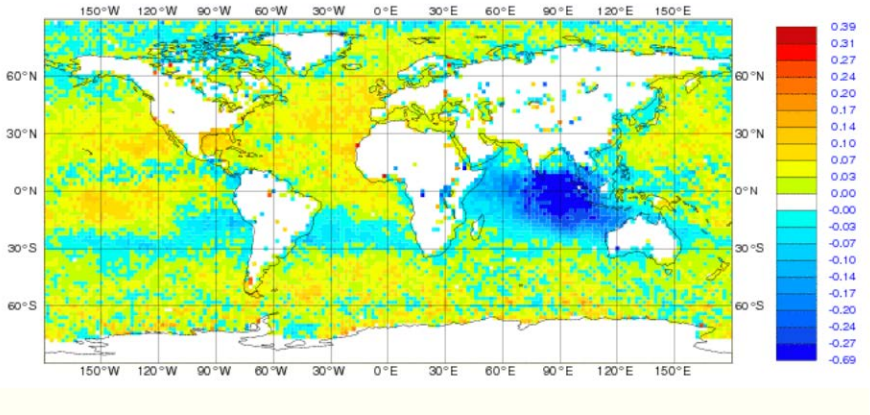
CrIS monitoring: HCN event identified

CrIS channel 101



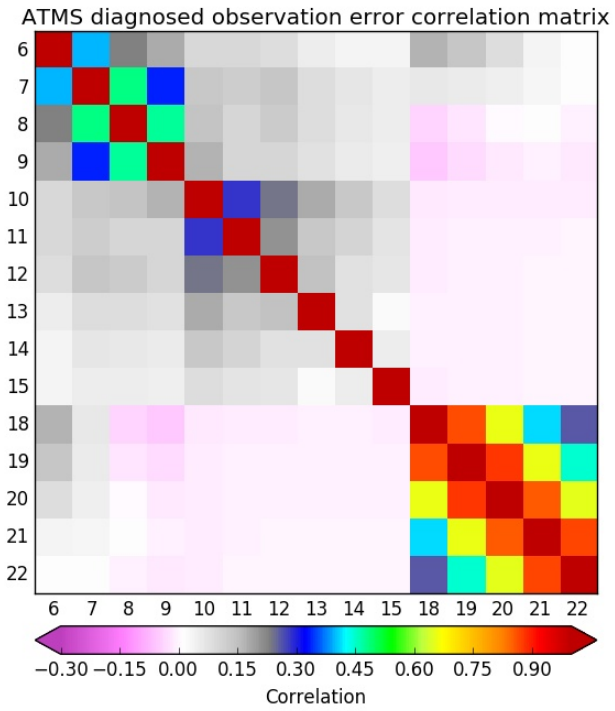
50 mK – 0.1 K

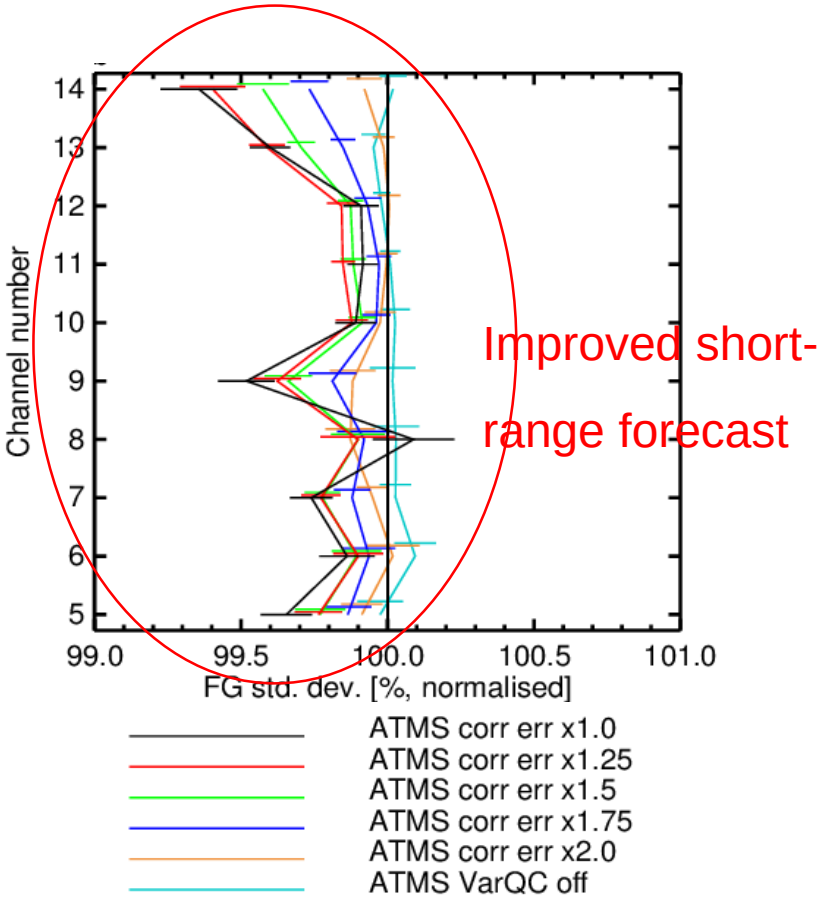
change identified



Assimilating ATMS: Peter Weston

Improve the use of ATMS with Correlated observation errors:





Improved short-range forecast

Summary

- NWP forecasts are very powerful for assessing new satellite data

- There is ongoing work to assess the uncertainties of NWP in the GAIA-CLIM project

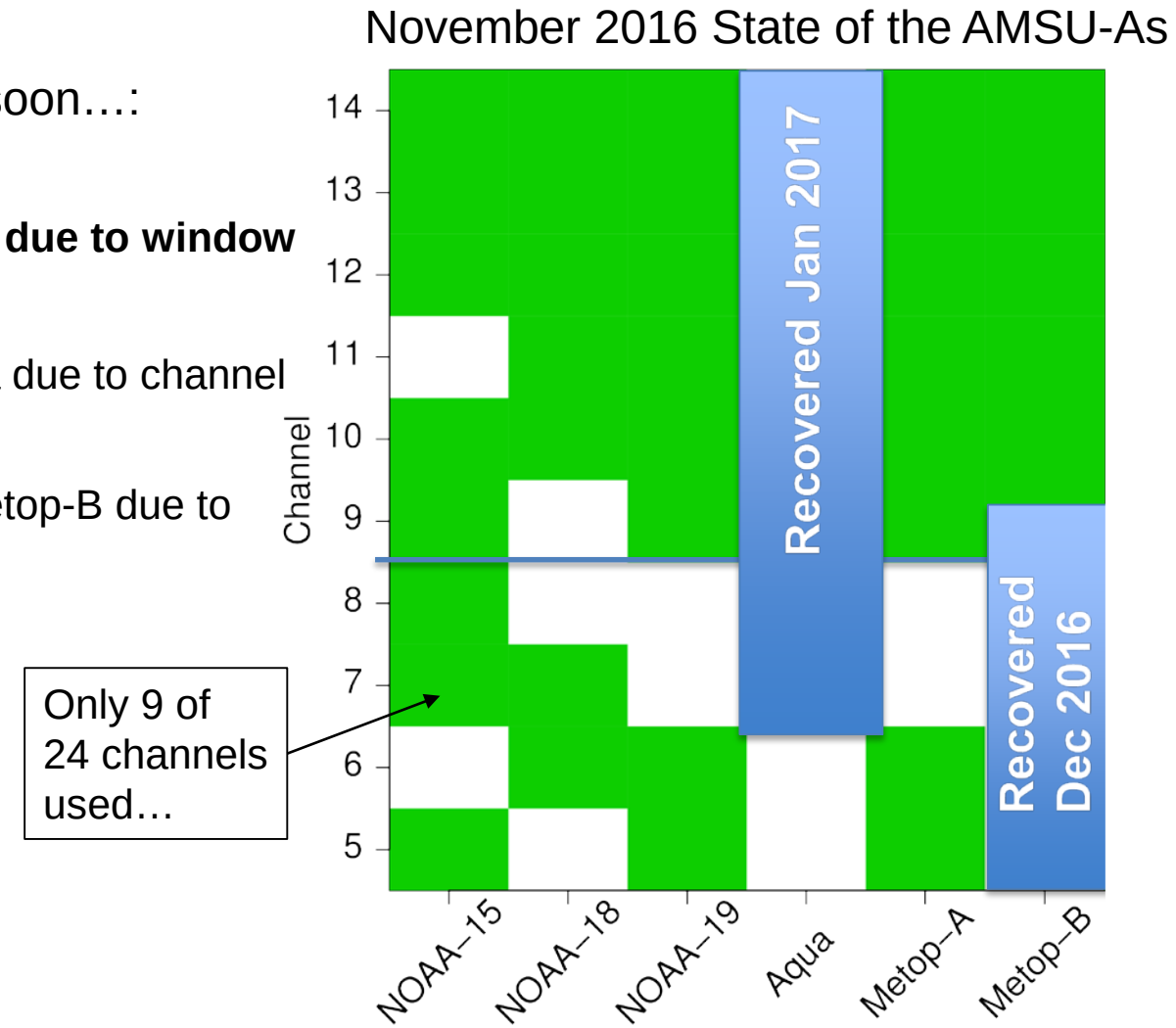
- Improved use of CrIS and ATMS at ECMWF, especially accounting for observation error correlation

Eresmaa, R., Letertre-Danczak, J., Lupu, C., Bormann, N. and McNally, A., 2017: *The assimilation of Cross-track Infrared Sounder radiances at ECMWF*, submitted to QJRMS

Future work: New data from JPSS-1

Keen for new data soon…:

- **2016 AMSU-A losses due to window channel failures:**
  - 24 September: Aqua due to channel 1 & 2 failure
  - 17 Oct – 29 Nov: Metop-B due to channel 15 failure



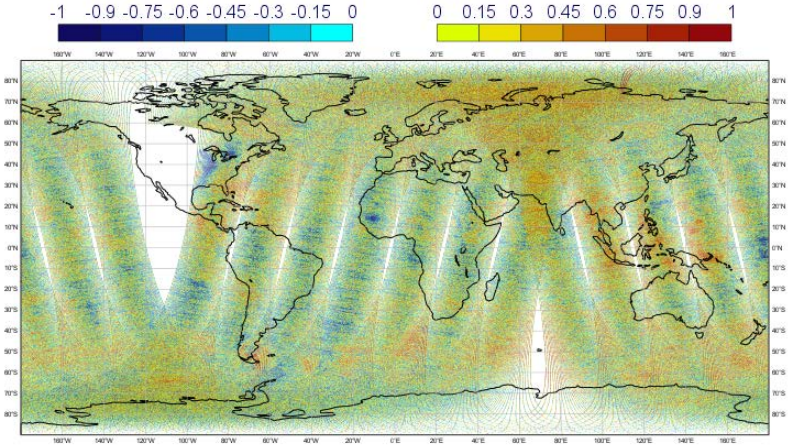
Thank you for listening..

Extra slides

Evaluating biases in satellite data

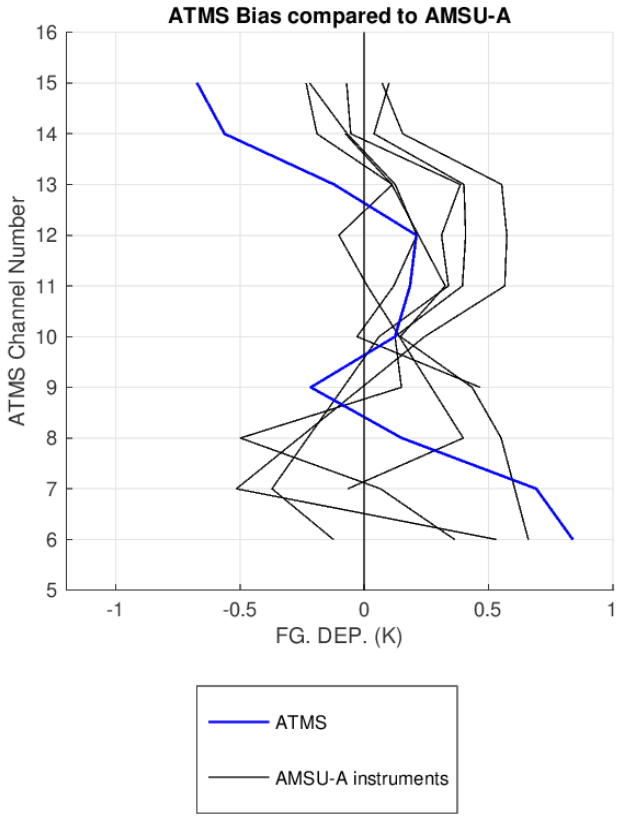
Striping noise:

ATMS channel 10

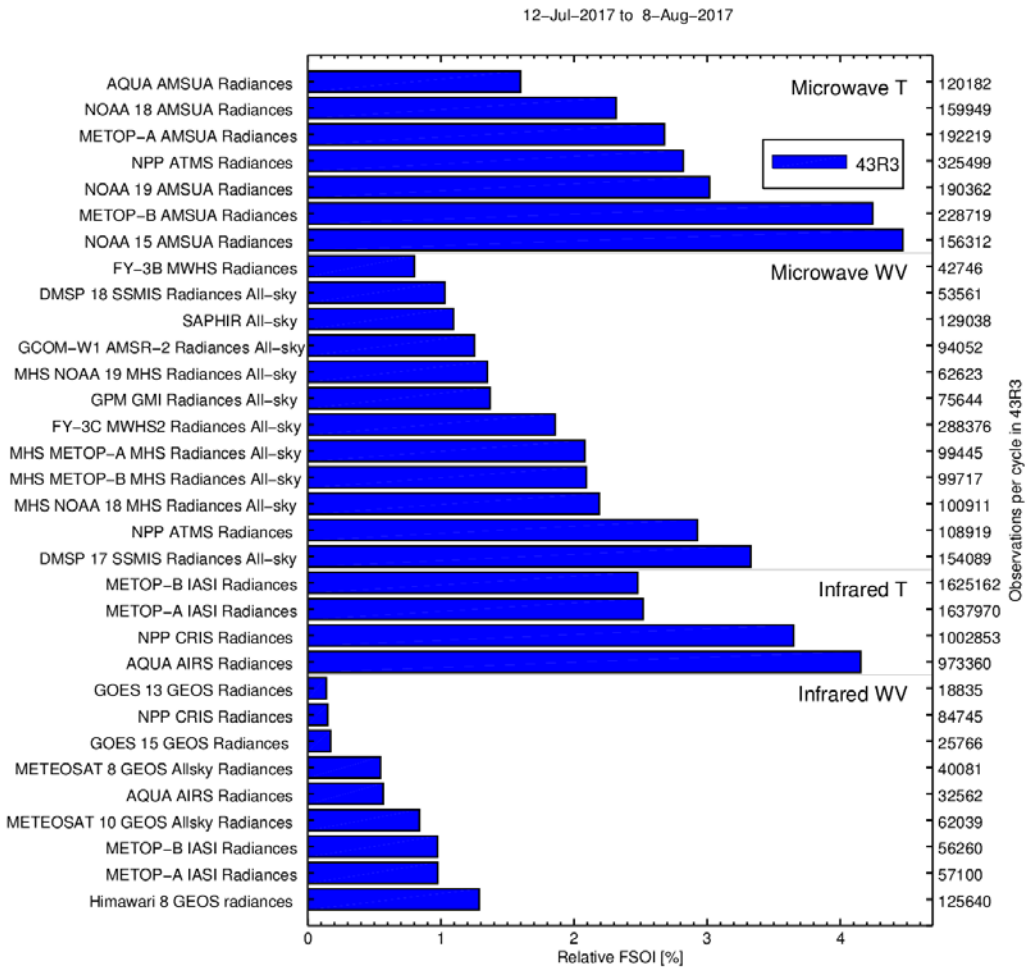


(Data are successfully assimilated despite the striping)

Global biases per channel:



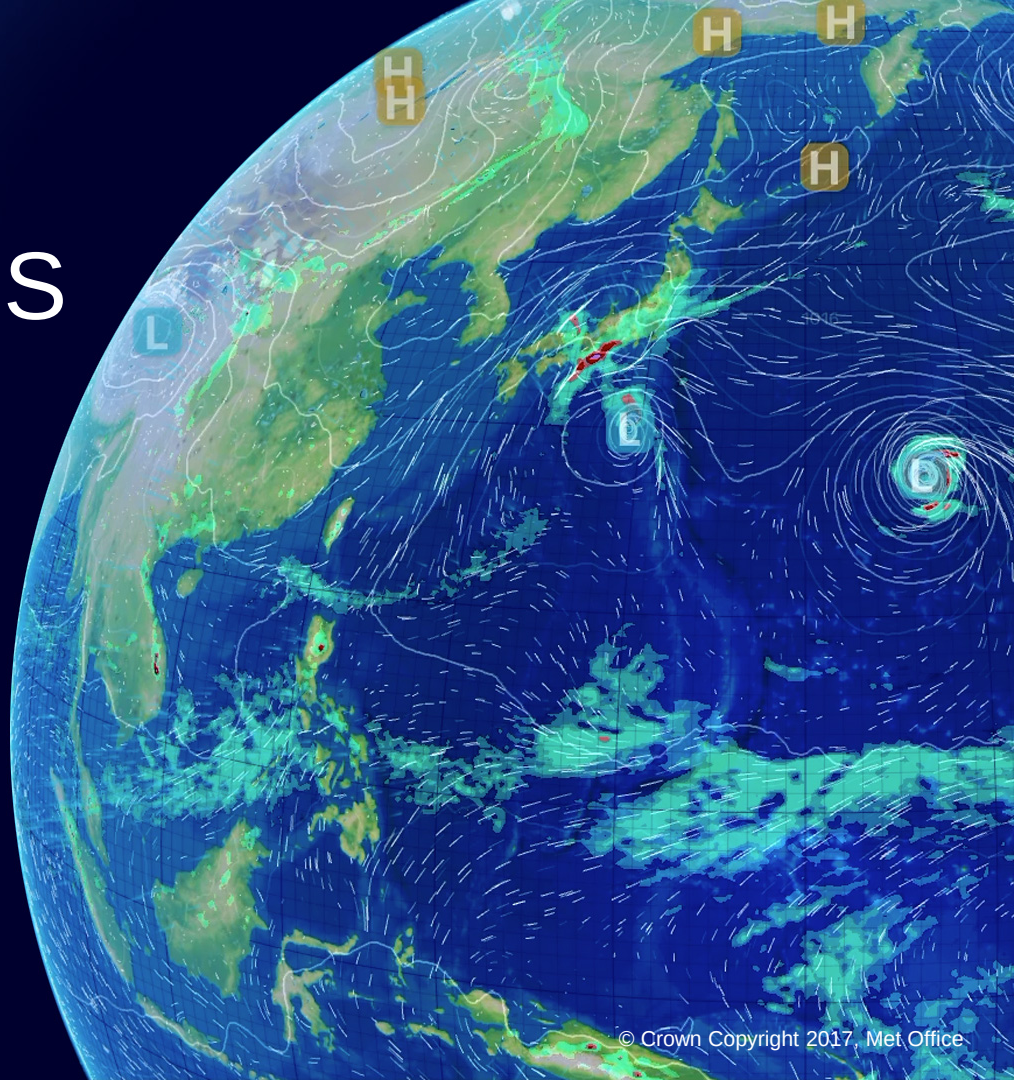
43R3 FSOI


12–Jul–2017 to 8–Aug–2017
AQUA AMSUA Radiances
NOAA 18 AMSUA Radiances
METOP–A AMSUA Radiances
NPP ATMS Radiances
NOAA 19 AMSUA Radiances
METOP–B AMSUA Radiances
NOAA 15 AMSUA Radiances
FY–3B MWHS Radiances
DMSP 18 SSMIS Radiances All–sky
SAPHIR All–sky
GCOM–W1 AMSR–2 Radiances All–sky
MHS NOAA 19 MHS Radiances All–sky
GPM GMI Radiances All–sky
FY–3C MWHS2 Radiances All–sky
MHS METOP–A MHS Radiances All–sky
MHS METOP–B MHS Radiances All–sky
MHS NOAA 18 MHS Radiances All–sky
NPP ATMS Radiances
DMSP 17 SSMIS Radiances All–sky
METOP–B IASI Radiances
METOP–A IASI Radiances
NPP CRIS Radiances
AQUA AIRS Radiances
GOES 13 GEOS Radiances
NPP CRIS Radiances
GOES 15 GEOS Radiances
METEOSAT 8 GEOS Allsky Radiances
AQUA AIRS Radiances
METEOSAT 10 GEOS Allsky Radiances
METOP–B IASI Radiances
METOP–A IASI Radiances
Himawari 8 GEOS radiances
Microwave T
43R3
Microwave WV
Infrared T
Infrared WV
120182
159949
192219
325499
190362
228719
156312
42746
53561
129038
94052
62623
75644
288376
99445
99717
100911
108919
154089
1625162
1637970
1002853
973360
18835
84745
25766
40081
32562
62039
56260
57100
125640
Observations per cycle in 43R3
0
1
2
3
4
Relative FSOI [%]

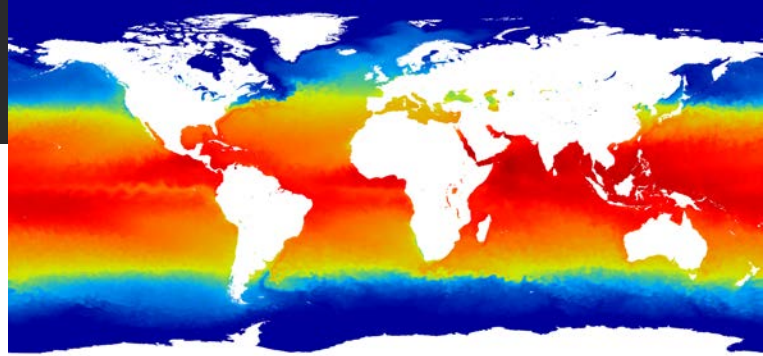
Use of ACSPO VIIRS L3U SST in the OSTIA system

The OSTIA team: Simon Good, Emma Fiedler, Chongyuan Mao, Rebecca Reid

August 17, 2017



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Introduction

OSTIA is the Met Office Operational SST and Ice Analysis system

- L4 (global, gap-free analysis), produced daily at 1/20^{o} grid resolution
- Foundation SST (uses all nighttime observations and daytime observations only when wind speed >6 m s^{-1} to remove diurnal warming effects)
- Validates well against other analyses (compared to independent near-surface Argo observations)
- Available from http://marine.copernicus.eu/services-portfolio/access-to-products/?option=com_csw&view=details&product_id=SST_GLO_SST_L4_NRT_OBSERVATIONS_010_001

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SST data used in OSTIA

- ACSPO VIIRS
- AMSR2 (from Remote Sensing Systems)
- NOAA-18 and -19 AVHRR (from NAVO)
- MetOp AVHRR (from OSI SAF)
- SEVIRI (from OSI SAF)
- GOES-E (from OSI SAF)
- In situ (ships, drifters, moored buoys) (from GTS)

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Change in the last year

OSTIA performs a bias-correction of satellite data to a reference dataset of all in situ data and high-quality satellite data

- Prior to November 9, 2016, the reference satellite data was a subset of MetOp-A AVHRR (nighttime, max satellite zenith angle 48 degrees, QL4+)
- From November 9, 2016 onwards the reference satellite data was ACSPO VIIRS nighttime data

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Prior testing of the impact of the change

Before proceeding with the change, testing was carried out. Two runs were conducted for the period 09 Dec 2015 – 11 Jan 2016:

- Control: MetOp-A AVHRR (nighttime, max satellite zenith angle 48 degrees, Q4+) used as the reference dataset
- VIIRSG_ref: Nighttime VIIRS QL5 data used as the reference dataset

Validation used Argo observations (shallowest observations between 3-5 m depth have been shown to be representative of foundation temperature and they are not used in the analysis) from the Met Office Hadley Centre EN4 database (www.metoffice.gov.uk/hadobs)

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Met Office

Near-surface Argo minus OSTIA analysis statistics for a test period of 9 Dec 2015 – 11 Jan 2016

Region (CMEMS definitions)	Mean diff to Argo (K)		RMS diff to Argo (K)	
	control	VIIRSG_ref	control	VIIRSG_ref
Global	0.12	0.06	0.45	0.40
North Atlantic	0.22	0.05	0.48	0.42
Tropical Atlantic	0.17	0.11	0.28	0.24
South Atlantic	0.08	0.08	0.46	0.44
North Pacific	0.20	0.09	0.51	0.45
Tropical Pacific	0.08	0.07	0.26	0.22
South Pacific	0.03	0.07	0.32	0.30
Indian Ocean	0.03	0.09	0.29	0.28
Southern Ocean	0.07	0.04	0.45	0.42

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Results from prior testing

- Sizable improvement of 0.05 K global RMS difference to Argo using VIIRS as a reference and improvements in RMS consistent across all regions
- Similar results were seen for a second test period of 01 to 31 May 2016
- Improvements of mean difference to Argo in most ocean regions
  - Largest magnitude decrease of 0.16 K in North Atlantic
  - Smallest magnitude decrease of 0.01 K in Tropical Pacific
  - Detriments to mean difference seen in South Pacific (0.04 K) and Indian Ocean (0.06 K)

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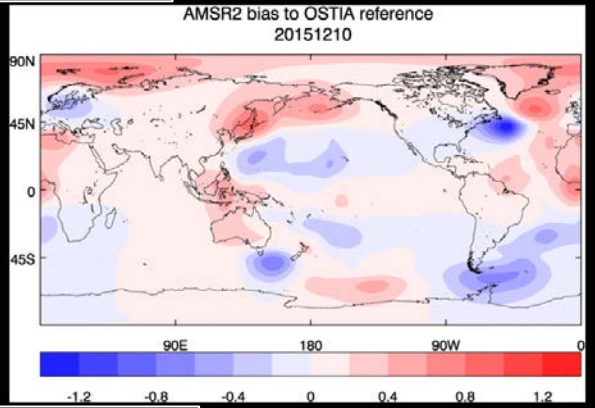
Met Office

Animations of daily bias fields:

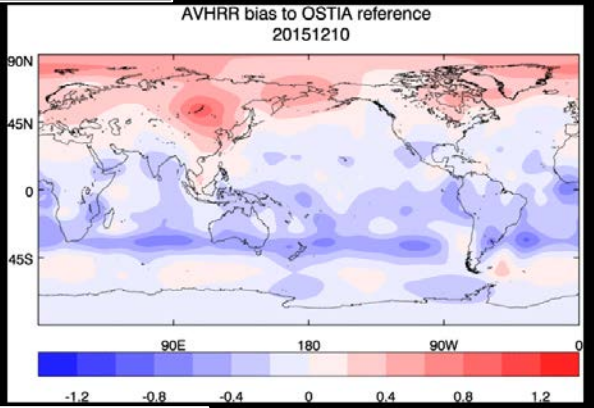
REMSS AMSR2 and NOAA -18 and -19 AVHRR minus the two reference datasets, control (MetOp-A AVHRR) and VIIRS

Observations have already been filtered to remove daytime measurements where wind speed < 6 m s^{-1}, and SSES biases have been removed

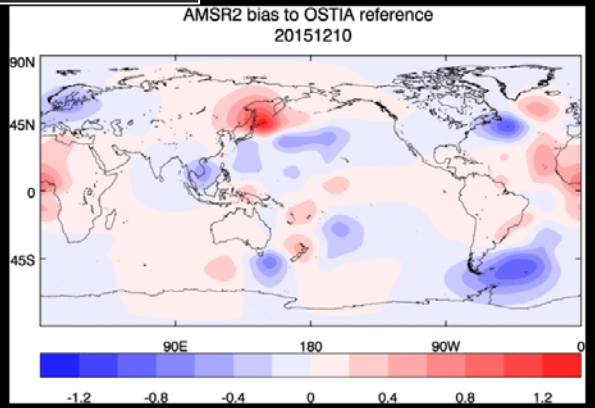
Control



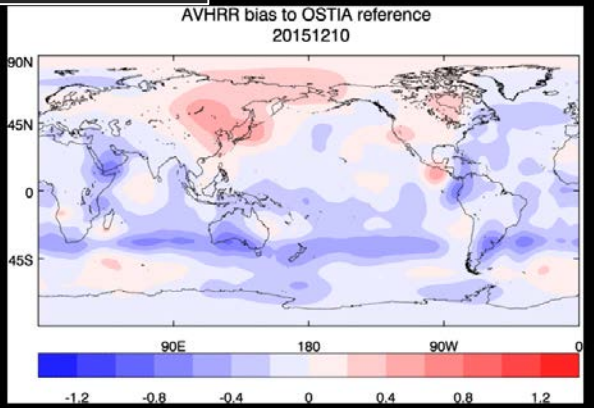
Control



VIIRS_ref



VIIRS_ref



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Results from prior testing

- The bias fields show the magnitude of the correction removed from the observations by the OSTIA system
- The run using VIIRS as a reference has eliminated the warm bias seen in the Arctic, so this “correction” is no longer being applied to the data
- The magnitude of the biases is generally smaller for the run using VIIRS as a reference, meaning the observations are in closer agreement with the reference data
- Note the unusual band of cold bias for combined NAVO AVHRR-18 and -19 along 30-40S compared to both reference datasets

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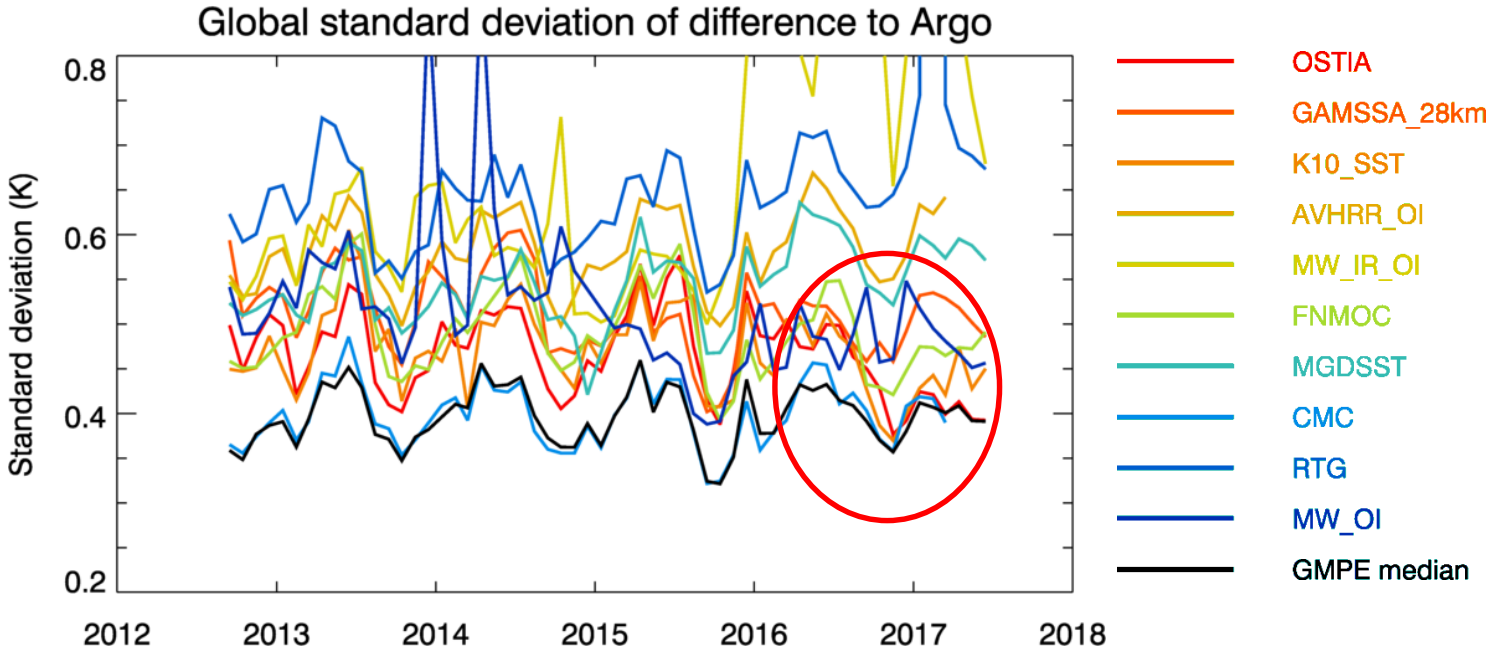
Impact on the operational system - GMPE

- Near-surface temperature observations from Argo profiling floats are used to validate various global SST analyses and their daily ensemble median, known as the GMPE (GHRSST Multi-Product Ensemble) median product
- These statistics are updated on the first of the month for the previous-but-one month using Argo data from the Met Office Hadley Centre EN4 database
- Plots can be seen at http://ghrsst-pp.metoffice.com/pages/latest_analysis/sst_monitor/argo/
- GMPE data are available from http://marine.copernicus.eu/services-portfolio/access-to-products/?option=com_csw&view=details&product_id=SST_GLO_SST_L4_NRT_OBSERVATIONS_010_005

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Impact on the operational system - GMPE

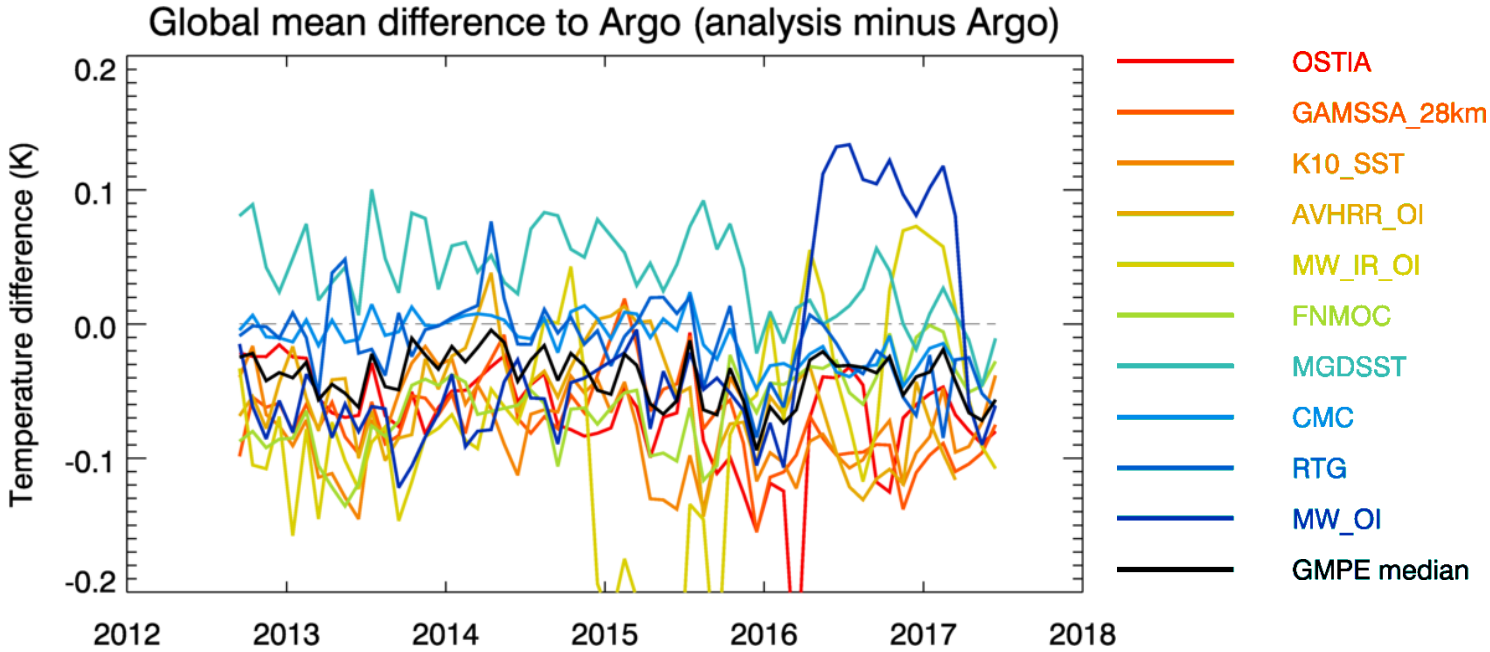
There is a clear improvement in standard deviation of differences from the time of the upgrade



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Impact on the operational system - GMPE

However, global mean differences are variable and do not show a clear change



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Summary

- OSTIA is a near real time, operational SST analysis run daily at the Met Office
- In November, the system was upgraded to use nighttime ACSPO VIIRS data as the reference used to correct for biases in other satellite data
- Prior testing indicated that this change should improve mean and standard deviation of differences to reference Argo data
- Monitoring since the upgrade has shown a clear improvement to standard deviation of differences; however this is not clear in mean differences

- Thanks for making your excellent data available!

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Ocean Color Data Applications for Water Quality in Coastal Areas

William J Hernandez, Ph.D.
Post Doctoral Researcher
CCNY-NOAA CREST
UPRM









2017 STAR JPSS Annual Science Team Meeting (SJASM)
College Park, MD
August 14, 2017

Water Quality

Land based sources of pollution (LBSP) are a major threat to corals:

- Cause disease and mortality
- Disrupt critical ecological reef functions that impede growth and reproduction and larval settlement.

Innovations in Monitoring and Assessment.

- Connecting Coasts, Estuaries, and Freshwater Ecosystems.
- Identifying and Assessing Emerging Risks.
- Measuring Effectiveness of Water Management Actions.



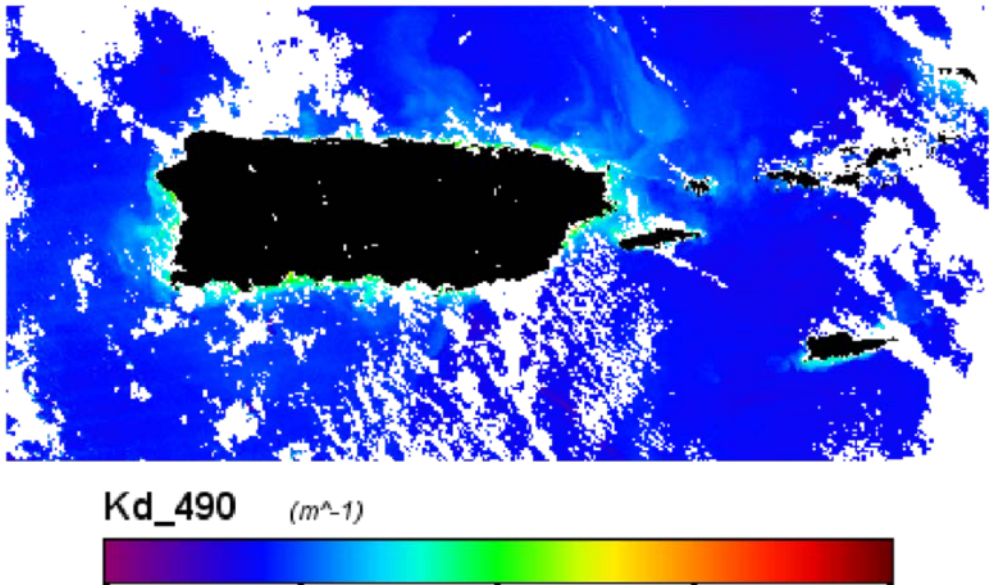
Honokahua Bay, West Maui. Credit: Bill Rathfon.



Guanica Bay, Puerto Rico Credit: NOAA

VIIRS

- **Chlorophyll-*a* (Chl-*a*)**
  - Monitoring phytoplankton biomass.
  - Nutrient status (*i.e.* **productivity**).
  - Index of water quality.
- **Kd(490)**
  - Diffuse attenuation coefficient at 490nm.
  - **Turbidity** (measure of the total organic and inorganic matter held in solution and suspension).
  - Index of water quality.



VIIRS Kd(490) product image for Puerto Rico and the USVI after a precipitation event (August 26, 2014).

Why use VIIRS for Water Quality?

- The color of coastal water is related to water quality.
- Satellite ocean color data provide a synoptic view of water quality.
- Continuous monitoring
- Ocean color tools that managers and stakeholders can use to:
  - Track water quality near their reefs
  - Evaluate effect in the coastal water due to changes in the watershed. (“Ridge to Reef”).

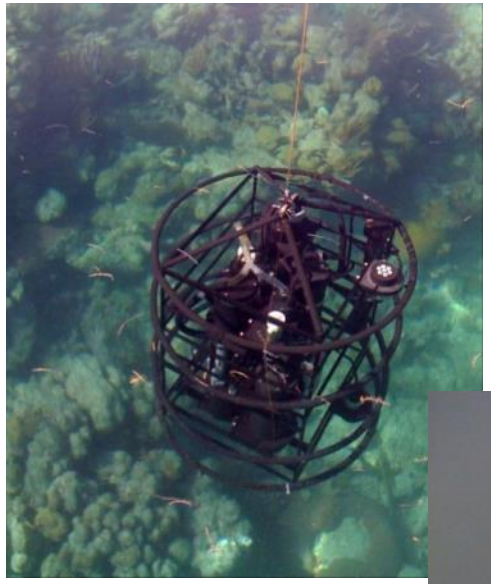




Image credit: Bio-optical oceanography Lab, UPRM

Study Area

U.S. Coral Reef Task Force priority watershed sites:

- Ka’anapali (West Maui, Hawai'i)
- Faga'alu (American Samoa)
- Guánica Bay (Puerto Rico).



Image credit: NOAA/NESDIS/STAR/CRW

Study Area

Guánica and La Parguera Area (Puerto Rico).



Water Quality Products from VIIRS

<u>Matching large rainfall events to satellite derived measurements.</u>

- **Chlorophyll-*a* (Chl-*a*)**
- **Kd(490)**

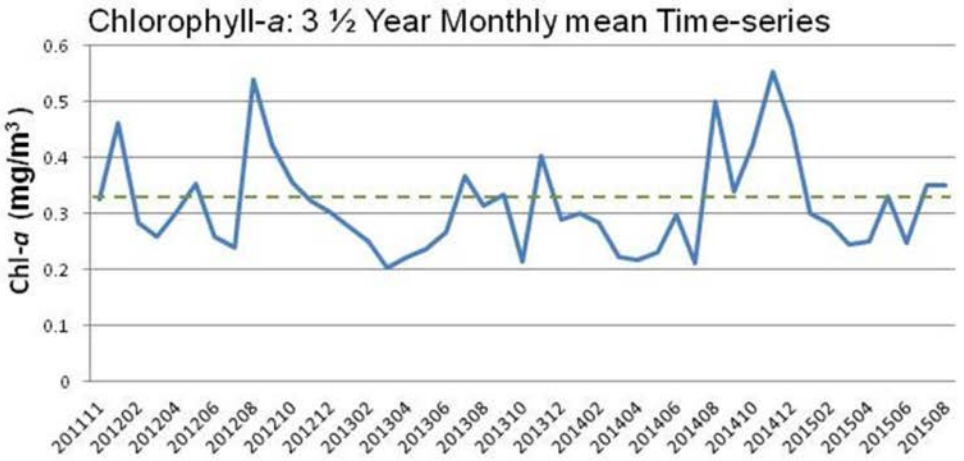
“Virtual Areas”

- Establishing virtual areas around watersheds will enable calculation of plume statistics such as:
  - Maximum and average levels of Chl-*a* and Kd(490)
  - Monthly climatologies
  - Variations from “normal” levels through time. (Anomalies).

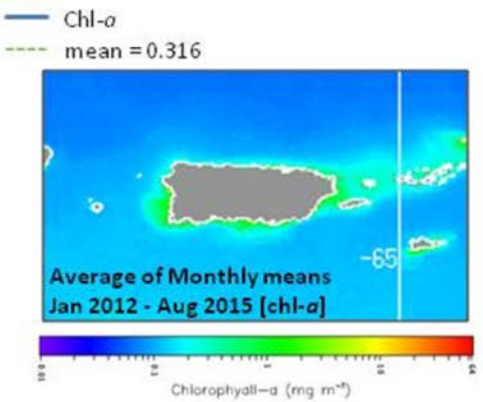
Results VIIRS (Monthly)

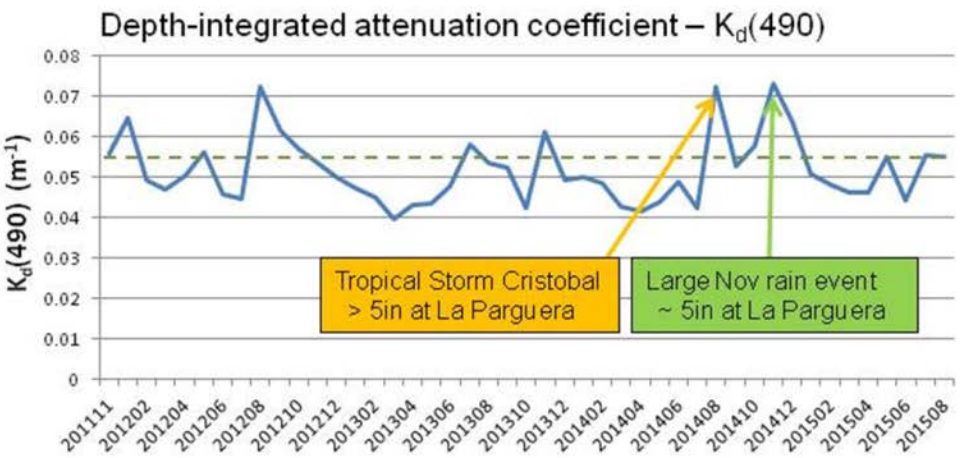
10 km around Point A (17.92347 °N, 66.90108 °W)

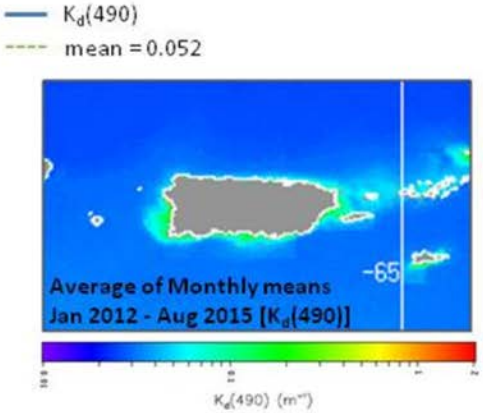
Target Site: Guánica watershed discharge site, Puerto Rico







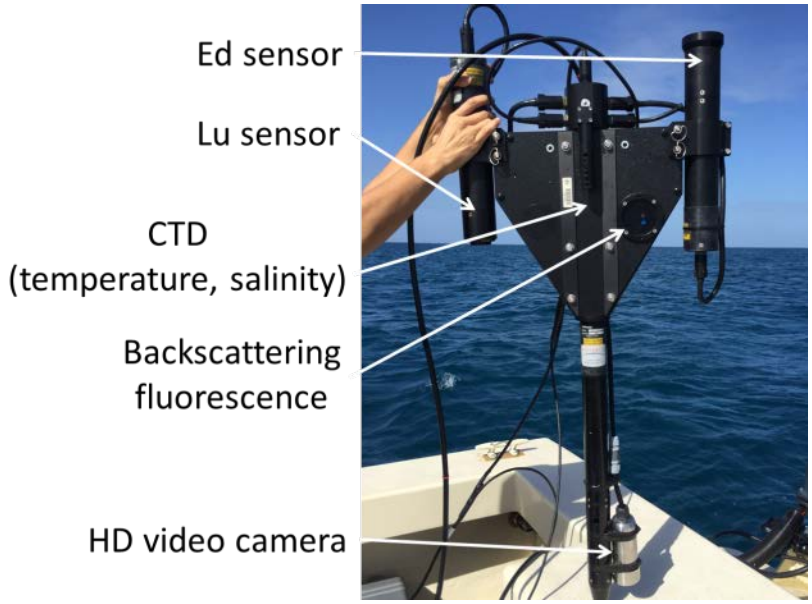




Images credit: NOAA/NESDIS/STAR/CRW

Field Sampling

- Simultaneous with Landsat 8 OLI image capture
- Instruments
  - **Satlantic Hyperpro Profiling radiometer (Lu, Ed, Rrs, Lw, Kd)**
  - GER 1500 Spectro-radiometer (Lw, Ed, Rrs)
  - SolarLight Datalogging Radiometer (PAR)
  - Hydroscat-6 (backscattering, flourescense)
  - YSI EXO (CHL, TSS, CDOM, CTD)
  - Water quality samples
    - CHL, TSS, CDOM





Hydroscat-6

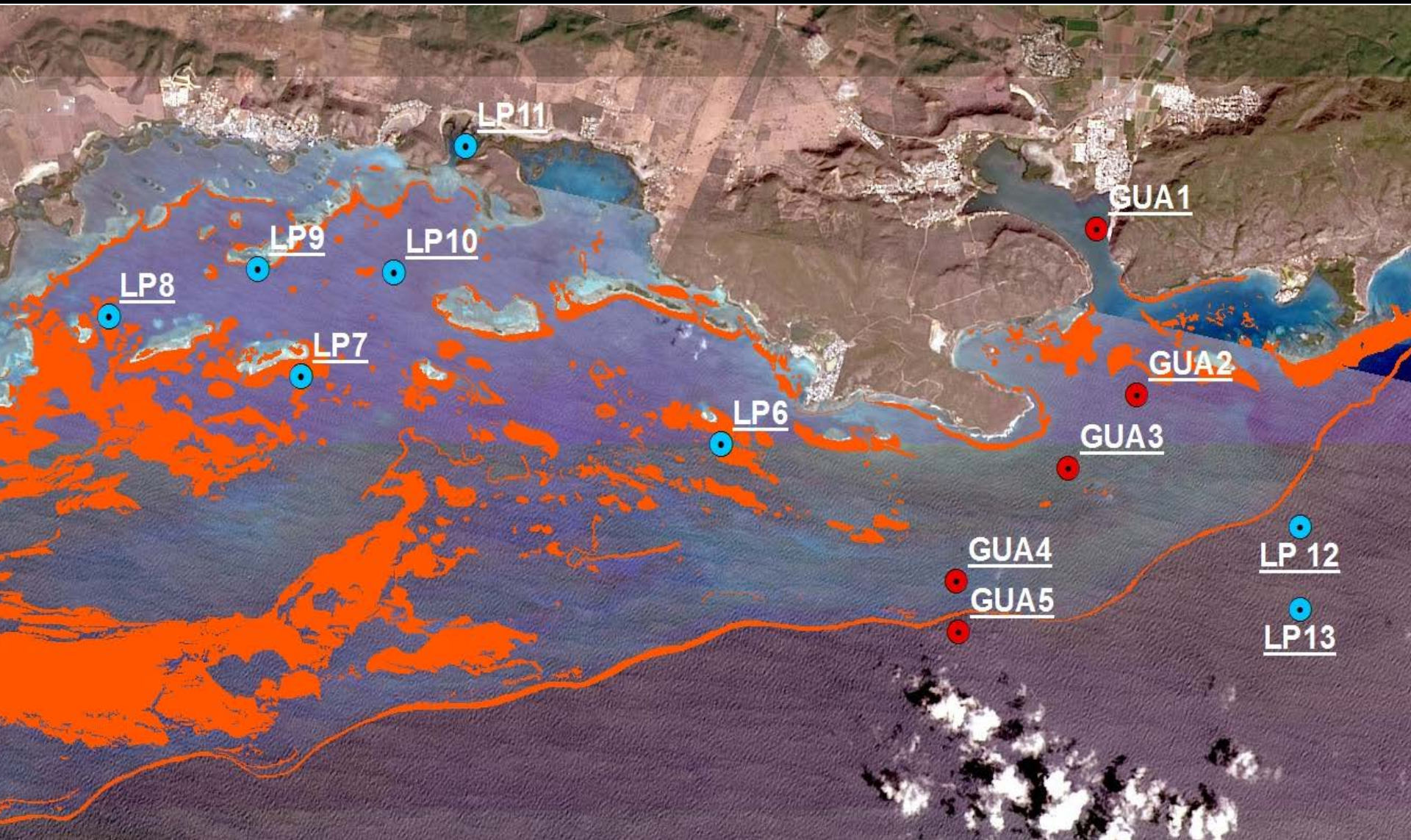


GER1500

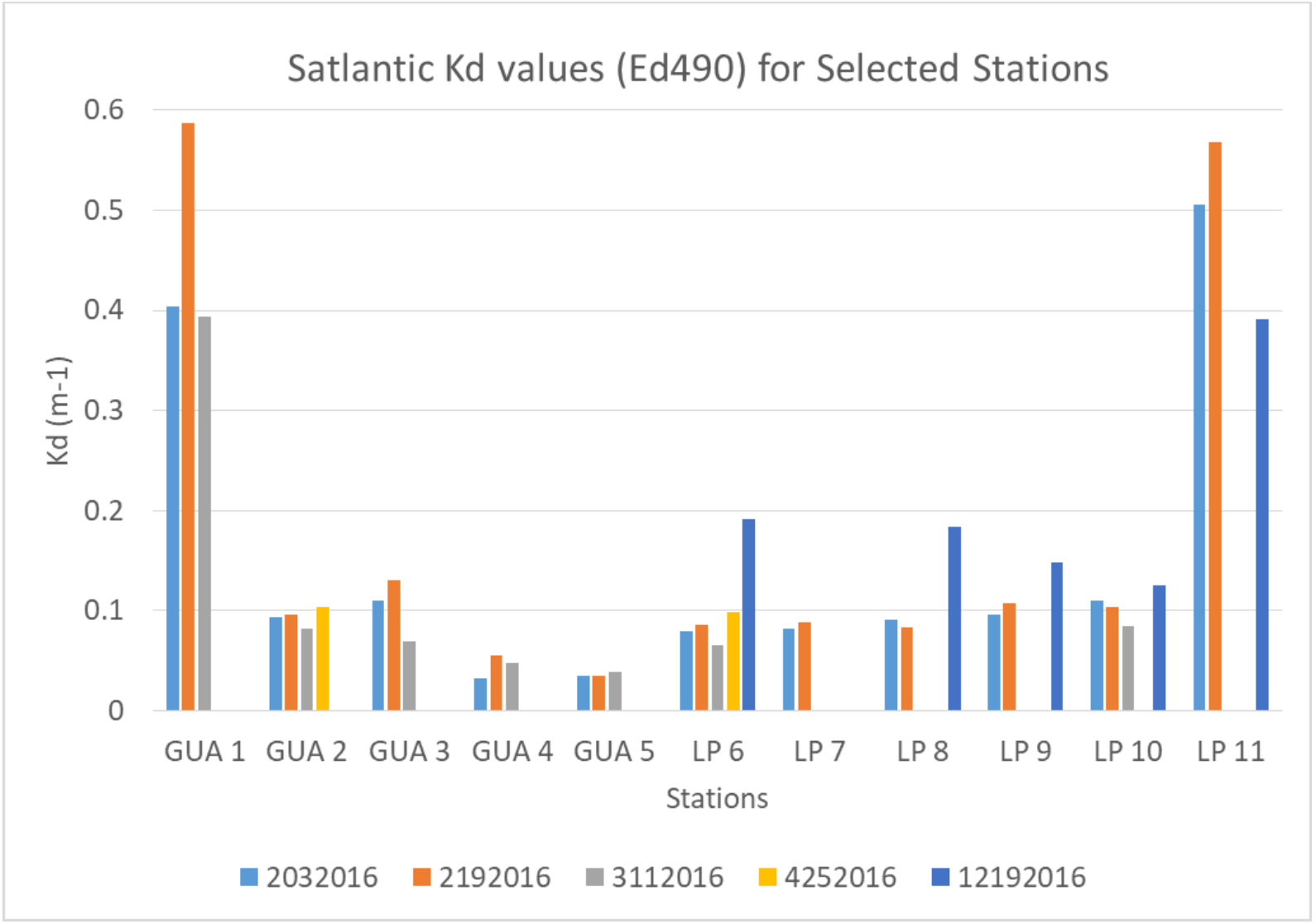


YSI EXO

Field Sampling

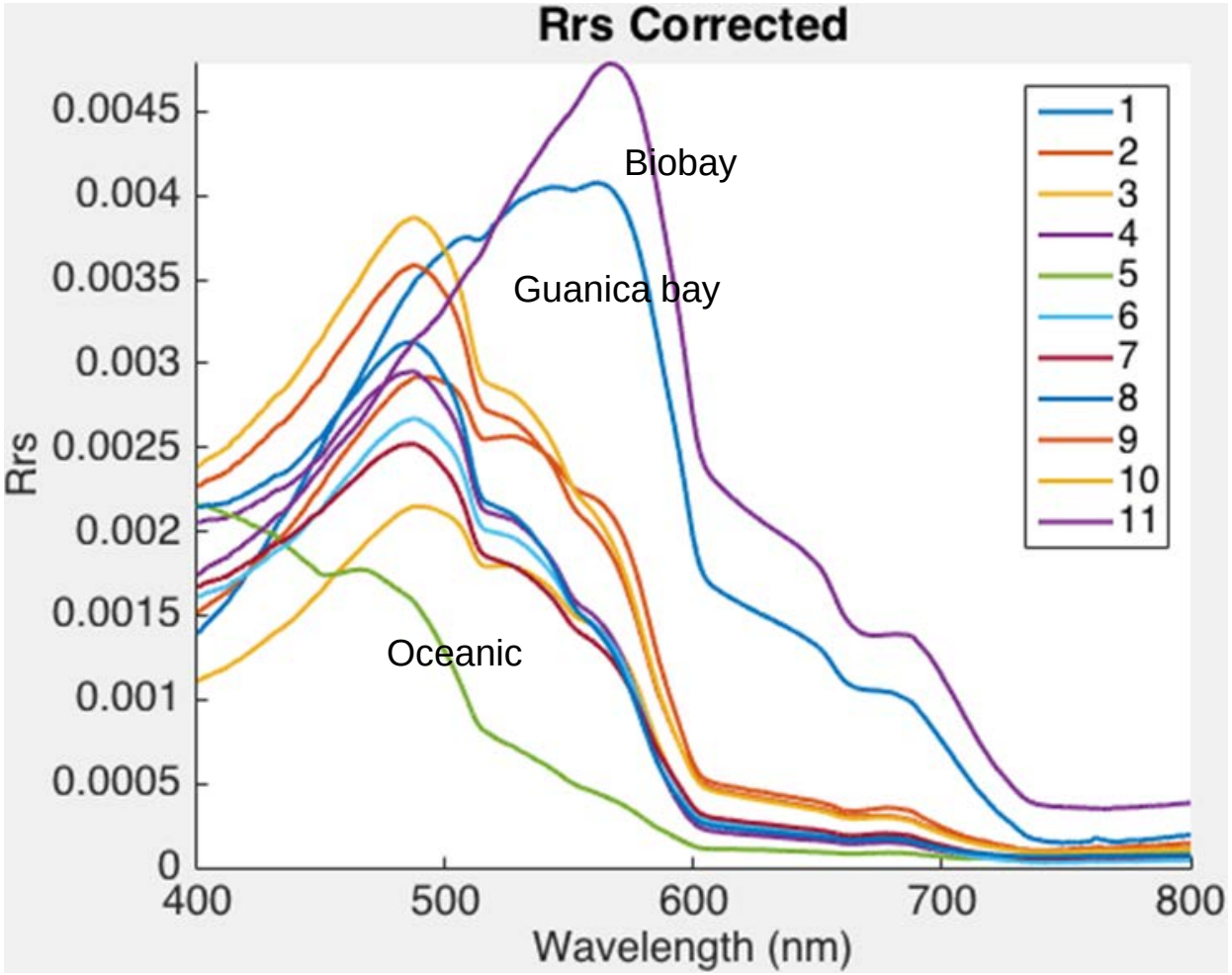


Kd 490

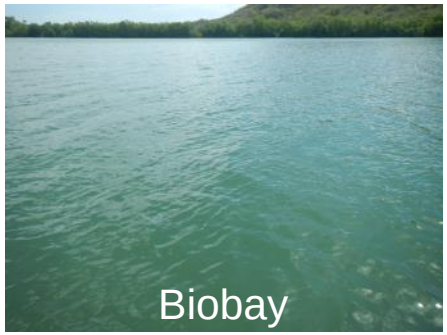

Satlantic Kd values (Ed490) for Selected Stations
Kd (m-1)
0.6
0.5
0.4
0.3
0.2
0.1
0
GUA 1
GUA 2
GUA 3
GUA 4
GUA 5
LP 6
LP 7
LP 8
LP 9
LP 10
LP 11
Stations
2032016
2192016
3112016
4252016
12192016

Field Sampling - Rrs

GER1500 surface remote sensing reflectance







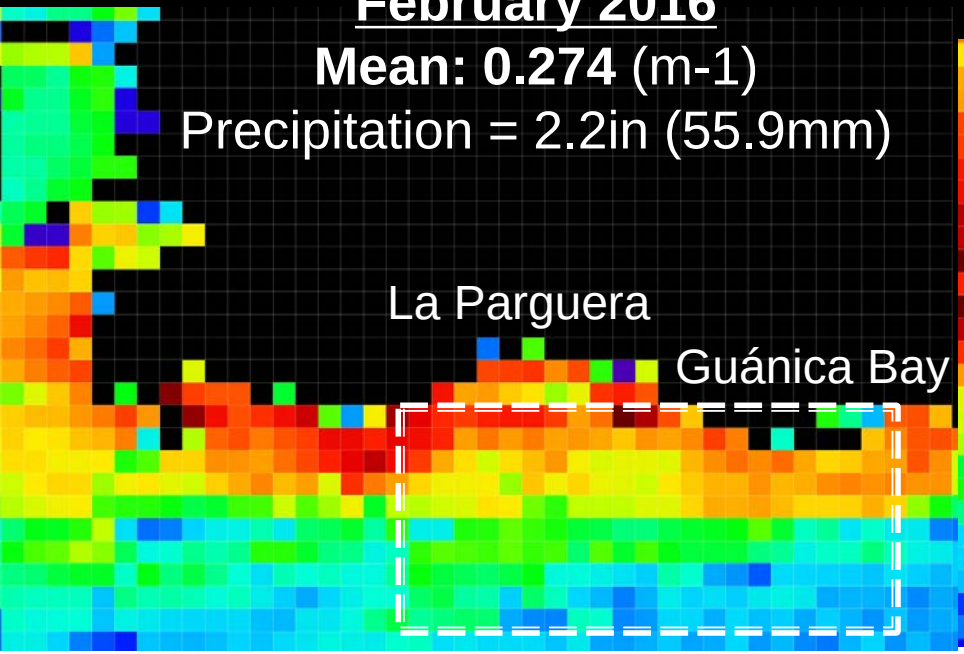


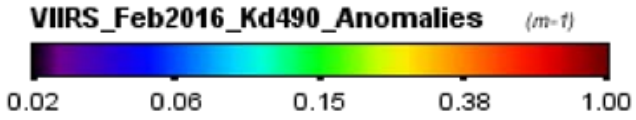
VIIRS Monthly Anomalies Kd(490)

February 2016

Mean: 0.274 (m-1)

Precipitation = 2.2in (55.9mm)



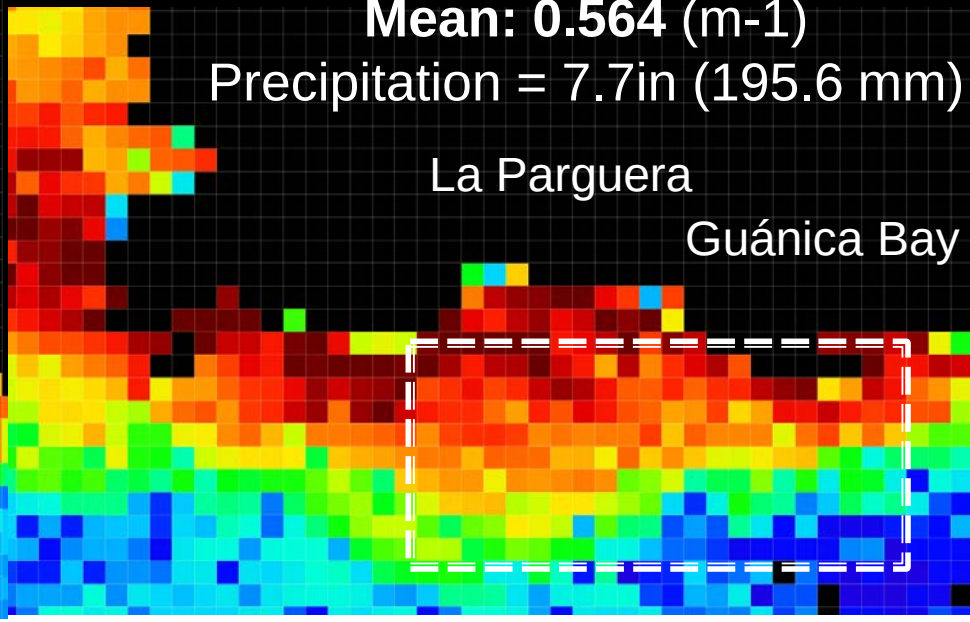


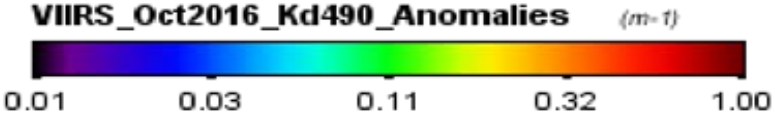


October 2016

Mean: 0.564 (m-1)

Precipitation = 7.7in (195.6 mm)







High Resolution Sensors

Landsat 8 Operational Land Imager (OLI)

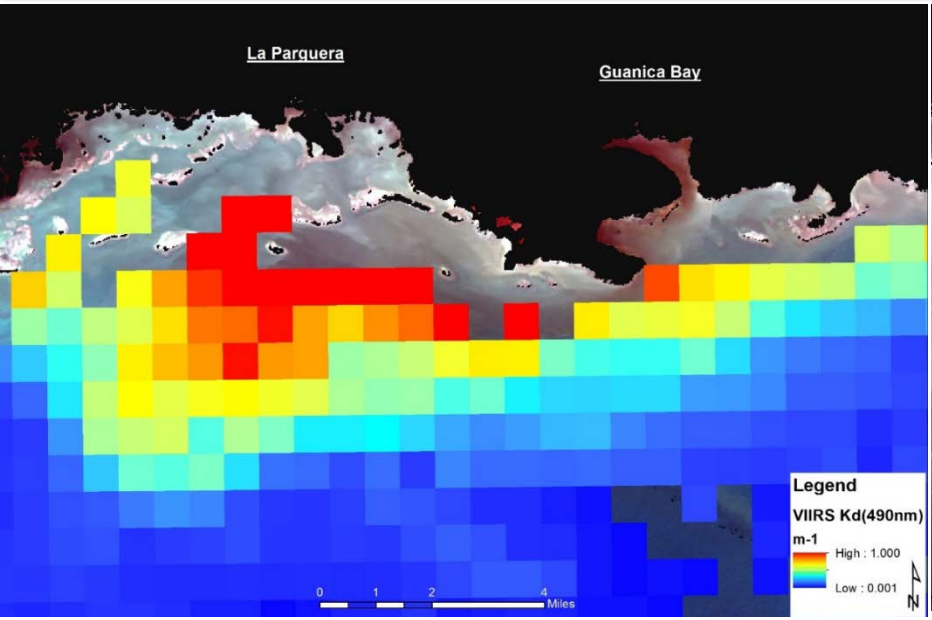
Sentinel 2A/B MultiSpectral Instrument (MSI)

- Supplements VIIRS in very near shore with higher resolution
- Morning pass (~11:00am) less clouds.
- Water quality products can be obtained.
- Other products like benthic maps and land cover can created from imagery.

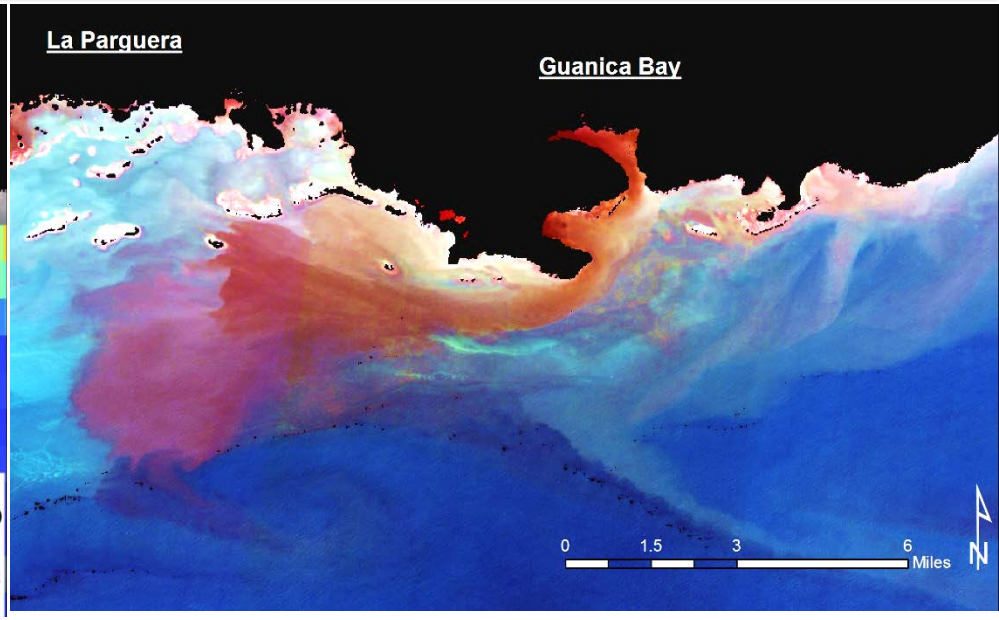


Sentinel-2 Guánica Bay
February 17, 2017

VIIRS / Landsat 8 Showcase



VIIRS image of turbidity, Kd (490 nm) wavelength (Level 2 Science Quality) averaged for November 11-13 at 750m.



Landsat 8 OLI False Color (3,2,1) image (with landmask) for November 12, 2014 showing plume from Guánica Bay

**6.0 inches precipitation event

Aerial/Drone Photos



Aerial photo of the Guánica Bay after a rain event of approximately 5.5 inches in late August 2014 (Photo credit: Protectores de Cuencas Inc.).

Next Steps…

- Continued data collection for PR and HI
  - Shared experiences for HI and PR.
- Web mapping application for watershed managers that can include:
  - Watershed layers
  - Benthic habitat/land cover maps.
  - Water quality from satellites (VIIRS, Landsat/Sentinel).
  - *In situ* water samples results.
  - Layers from watershed managers.

UPRM Sample



http://arcg.is/1QpyIL7

Collaborators

- NOAA
  - Alan E. Strong, NOAA/NESDIS/STAR, GST Inc.
  - Robert A. Warner, NOAA/NOS/NCCOS
  - Erick F. Geiger, NOAA/NESDIS/STAR, GST Inc.
  - C. Mark Eakin, NOAA/NESDIS/STAR.
  - Menghua Wang, NOAA/NESDIS/STAR.
- NGO/Universities
  - Protectores de Cuencas Inc.
  - West Maui Ridge 2 Reef
  - University of Hawaii Maui College
  - University of Puerto Rico Mayaguez

Bio-Optical Oceanography Laboratory Team Members

- Dr. Roy Armstrong -Director
- Dr. Yasmin Detres - Researcher
- Suhey Ortiz, Maria Cardona, Myrna Santiago, Jenniffer Perez, Omar Lopez -Graduate Students
- Luis Lugo - Staff





QUESTIONS?



Contact:
william.hernandez@upr.edu

MDWG Overview: Floods

STAR JPSS

2017 Annual Science Team Meeting

FEMA

14 August 2017

Agenda

- Modeling and Data Working Group (MDWG)
- Flood Decision Support/Guidance Documents
  - Flood Decision Support Architecture (HDSA) and Executive Decision Support Guide
  - MoDI Scenario Analysis for Flood Response
  - Geospatial Framework (21 Standard GIS Products)
- Modeling Capabilities and Lessons Learned
  - Defining the Impacts: Flood
  - Recent Highlights
    - 2016 Louisiana Flooding
    - Hurricane Matthew
    - Superstorm Sandy
  - Flood Incident Journal

Modeling and Data Working Group: Overview

Overview:

- **An interagency working group** appointed by the Emergency Support Function Leadership Group (ESFLG) in 2012

Mission: Information Gathering

- Assess the current state of **modeling systems**
- **Identify consistent, reliable, authoritative models and datasets** to enable response planning and operational decision making

Goals:

- **Assess the current modeling systems** in use or under development
- Identify state-of-the-art capabilities to incorporate into response operations
- Maintain the **Model and Data Inventory (MoDI)**
- Identify gaps and recommend solutions

Modeling and Data Working Group: Status Update

Accomplishments to Date:

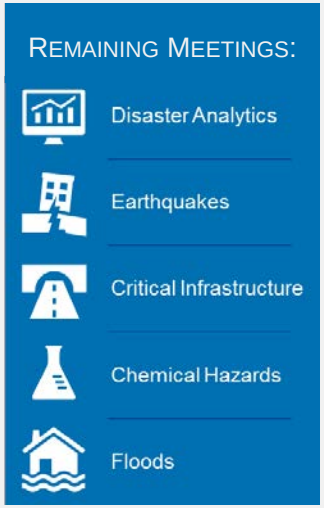
- **2012 – 2016:** Completed interviews, analyses, reports and SOPs for hurricanes, earthquakes, INDs, flooding, and biological hazards
- **2016:** Expanded initiative to include Recovery-related data and tools
- **Created the Model and Data Inventory (MoDI),** a central repository for modeling and data resources



https://gis.fema.gov/Model-and-Data-Inventory/

2017 Efforts:

- **Monthly meetings focused on incident- and capability-specific requirements**
- Expand MoDI to include **Chemical Hazards**



- **Follow-on Issue Papers**
  - Identify major findings, areas for improvement, and proposed path forward
- **MoDI Updates**
  - Maintain up-to-date information on tool uses, POCs, and access
  - Incorporate new data sets, models, and resources

MDWG Flood Summit: Nov 15, 2017

USGS Headquarters, Reston, VA

Goals:

- Review state-of-the-art **flood modeling software** and identify datasets and models critical for responding to flooding events.
- Evaluate the response and recovery timeline following a flood and work to integrate the S&T community with the operational response.
- Review the current flood information in the Model and Data Inventory (MoDI) to ensure the content is up-to-date and inclusive of the latest modeling tools available.

Anticipated Program Updates:

- DHS S&T Flood Apex Program
- NOAA/NWS/National Water Center and Office of Water Prediction
- FEMA Risk Mapping, Assessment, and Planning (Risk MAP)

For more information:

- **Contact FEMA-MDWG@fema.dhs.gov**

MDWG Coordination Efforts

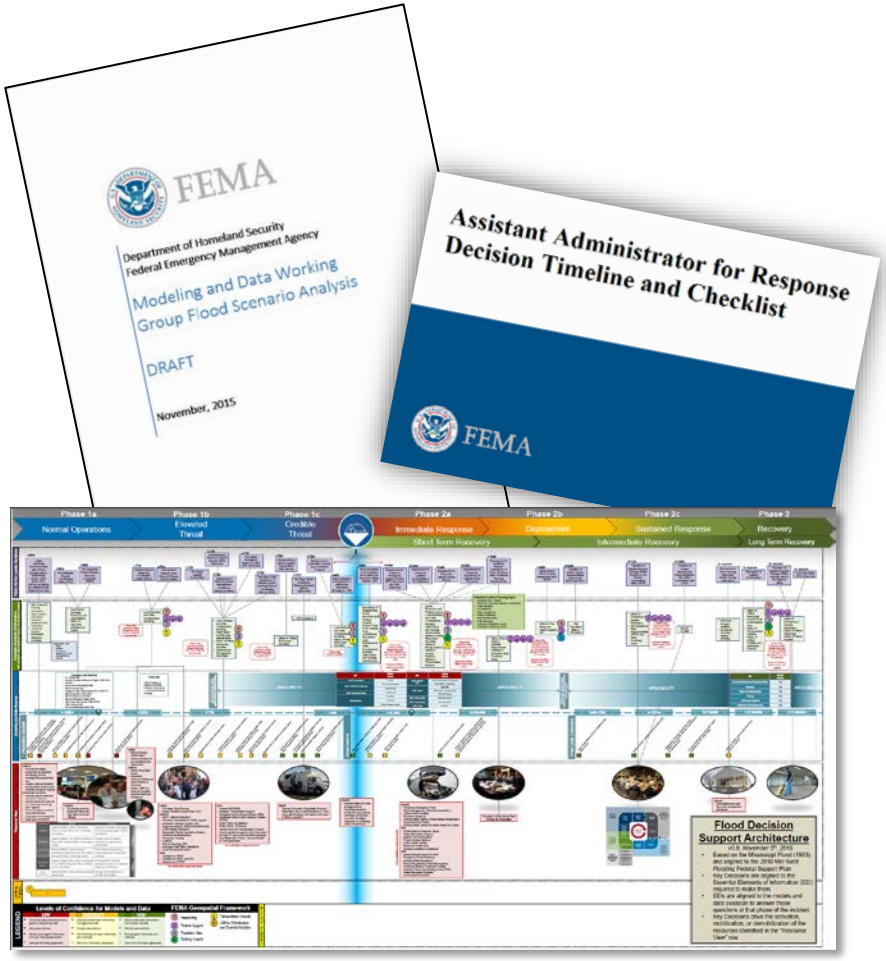
- **MDWG holds incident- and capability-specific monthly meetings**
  - Journal and app development leverages MDWG research and findings
  - GIS training familiarizes staff with process/products and prepares them for response operations

MDWG	Damage Assessments	IND	Power Outages	Tornado	Debris	Hurricane	Disaster Analytics	Earthquake	Critical Infrastructure	Chemical	Flood		
				Gotham Shield ★									
Journal Development	December	January	February	March	April	May	June	July	August	September	October	November	December	January
	Application Maintenance • ArcGIS Upgrade • Template Updates • Data Refresh • Begin Migration to National GeoPlatform			**Damage Assessment App** • Creation of new Damage Assessment application for existing journals based on DMWG	**IND Journal** • Create new IND Journal based on existing framework	**Power Outage App** • Create Power Outage app for existing journals based on MDWG 	**Tornado Journal** • NOAA Data • Create new Tornado Journal based on existing framework 	**Debris App** • Creation of new Debris Model application for existing journals based on the research of the MDWG	**Hurricane Journal** • Update Journal based on recent improvements • Deploy to National GeoPlatform 	**App Maintenance** • Upgrade all journals to latest templates • Update data to latest sources & releases	**Earthquake Journal** • USGS ShakeMaps • Create new Quake Journal based on framework 	**Critical Infrastructure** • Enhancement to Critical Infrastructure model based on research of the MDWG	**Chemical Journal** • Create new Chemical Journal in existing framework based on new and research of the MDWG	**Flood Journal** • Create new Flood Journal based on new model and research of the MDWG 
Training	**Kickoff** • GTG/Skills review concept	**Tutorial** • GeoAnalytics	**Technical** • IND • 2-day Seminar	**Tutorial** • Remote Sensing	**Technical** • Tornado	**Debrief** • STLL • Hurricane	**Tutorial** • TBD	**Technical** • Earthquake	**Debrief** • STLL • Flood					

Agenda

- Modeling and Data Working Group (MDWG)
- **Flood Decision Support/Guidance Documents**
  - **Flood Decision Support Architecture (HDSA) and Executive Decision Support Guide**
  - **MoDI Scenario Analysis for Flood Response**
  - **Geospatial Framework (21 Standard GIS Products)**
- Modeling Capabilities and Lessons Learned
  - Defining the Impacts: Flood
  - Recent Highlights
    - 2016 Louisiana Flooding
    - Hurricane Matthew
    - Superstorm Sandy
  - Flood Incident Journal

Flood Decision Support



- **Flood Decision Support Architecture**
  - Also know as the response timeline or "**whiteboard**"
  - Links critical decisions with analytics products
- **Decision Timeline and Checklist**
  - **Flip-book format** for notice and non-notice incidents
  - Condensed version of the Executive Decision Support Guide and the HDSA, **highlighting key decision points**
- **MoDI Scenario Analysis for Flood Response**
  - Provides a framework for response operations, with a **focus on the models and datasets** for a major flood, and includes:
    - The time frame for when models are applicable
    - How model results meet emergency response data requirements
    - Model/data access information

Flood Decision Support Architecture

Flood planning, response and recovery activities are organized over time by:

FEMA HQ Key Leader Decisions

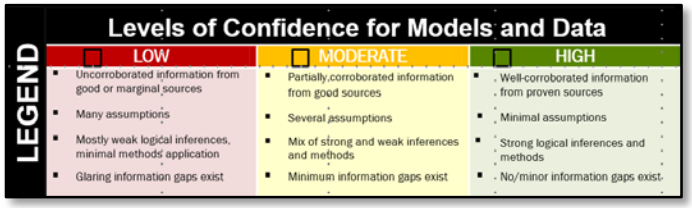
Key Decisions are aligned to the EEIs required to make them

Essential Elements of Information (EEI)

EEIs are aligned to the models and data available to answer, and denoted with the respective map product from the Geospatial Framework

Modeling and Data Sources

Data sets and models are mapped to their "Level of Confidence"



Resource View

Highlights resources for activation, mobilization, and demobilization

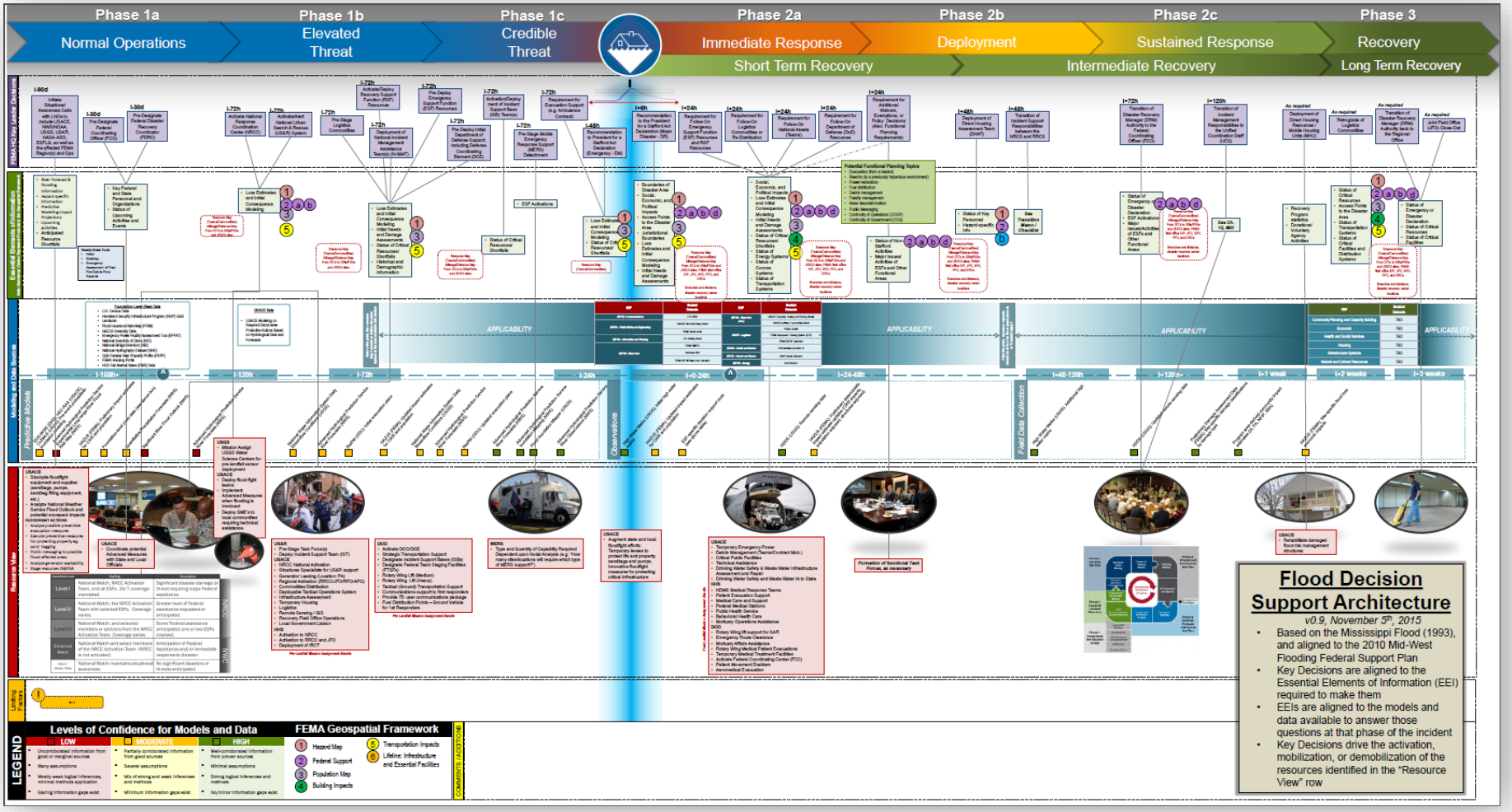
Limiting Factors

GEOSPATIAL FRAMEWORK

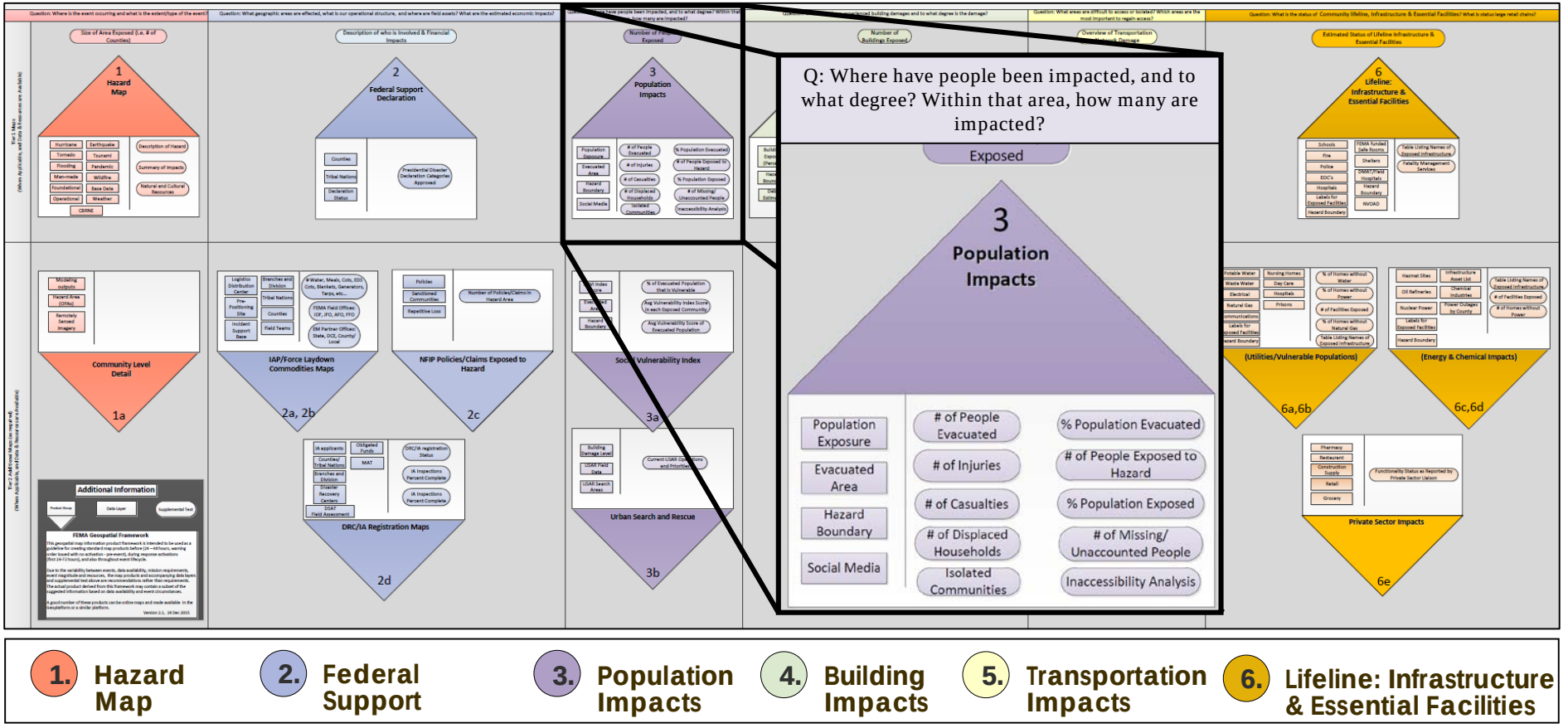
- The GeoFramework is intended to be used as a guideline for creating standard map products throughout the event lifecycle.
- Includes a baseline list of 21 geospatial products for disaster response, which fall into 6 categories:

1. Hazard Map
2. Federal Support
3. Population Impacts
4. Building Impacts
5. Transportation Impacts
6. Lifeline: Infrastructure and Essential Facilities

Flood Decision Support Architecture



Geospatial Framework



1. Hazard Map
2. Federal Support
3. Population Impacts
4. Building Impacts
5. Transportation Impacts
6. Lifeline: Infrastructure & Essential Facilities

Agenda

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    - **2016 Louisiana Flooding**
    - **Hurricane Matthew**
    - **Superstorm Sandy**
  - **Flood Incident Journal**

Defining the Impact: Floods

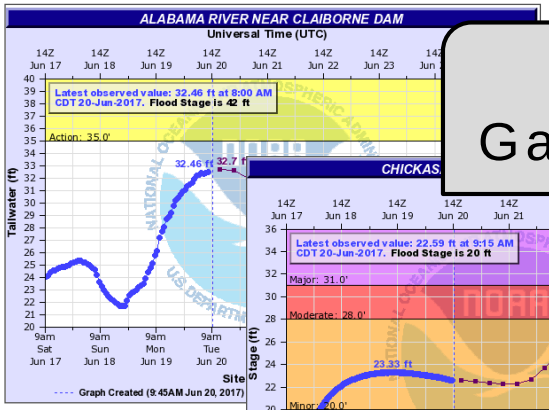
Stream Gauge Data

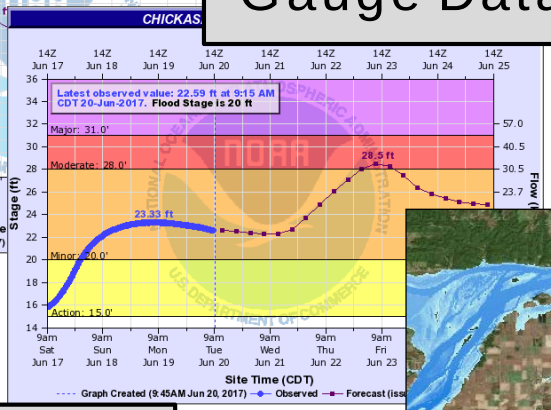
Remote Sensing Data

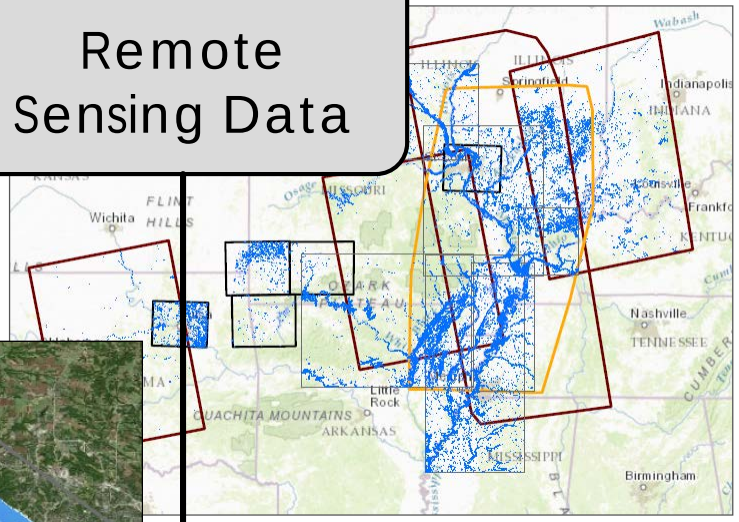
Structural Dataset

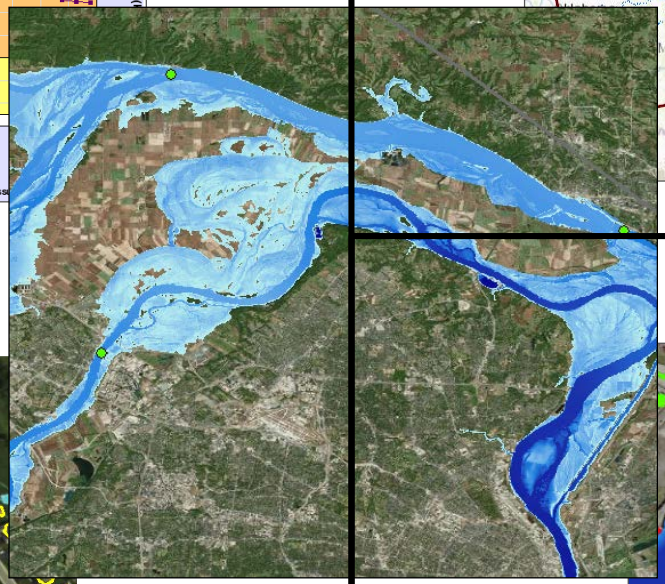
Flood Extent/ Depth Grid

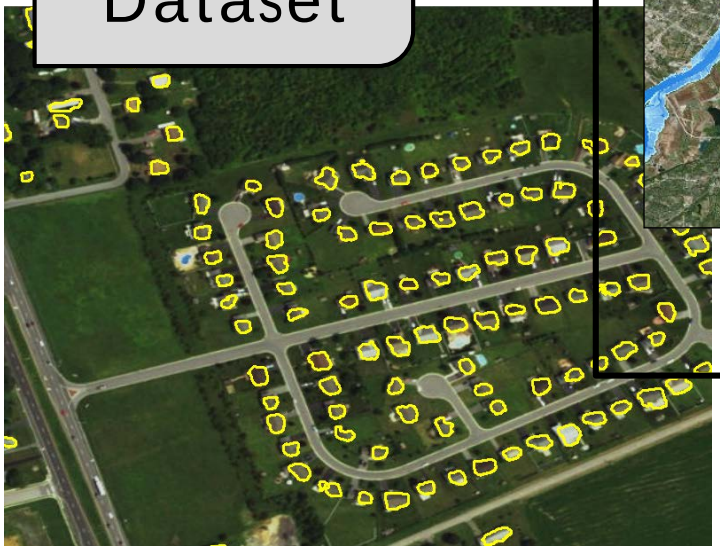
Modeled Impacts

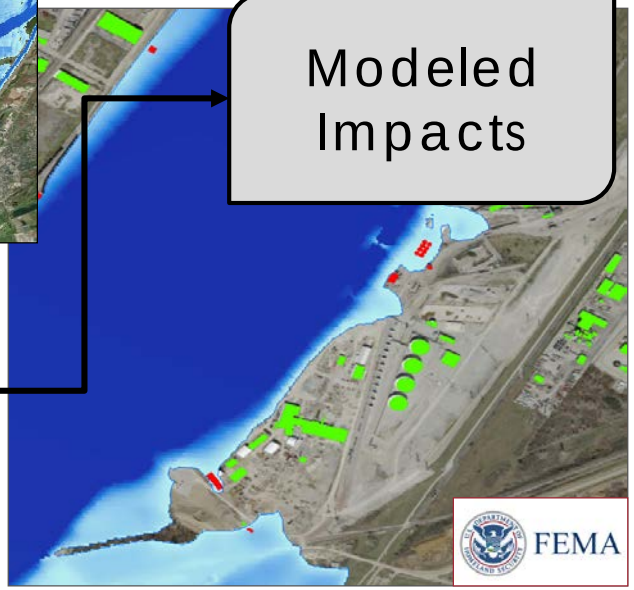






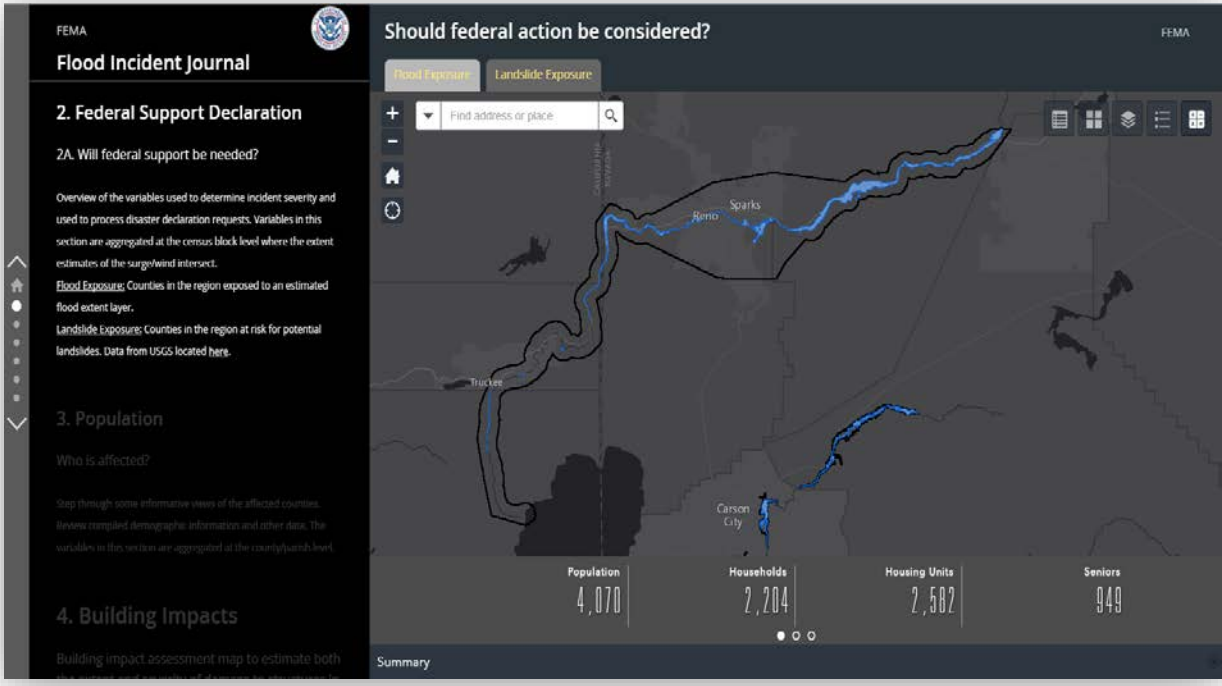




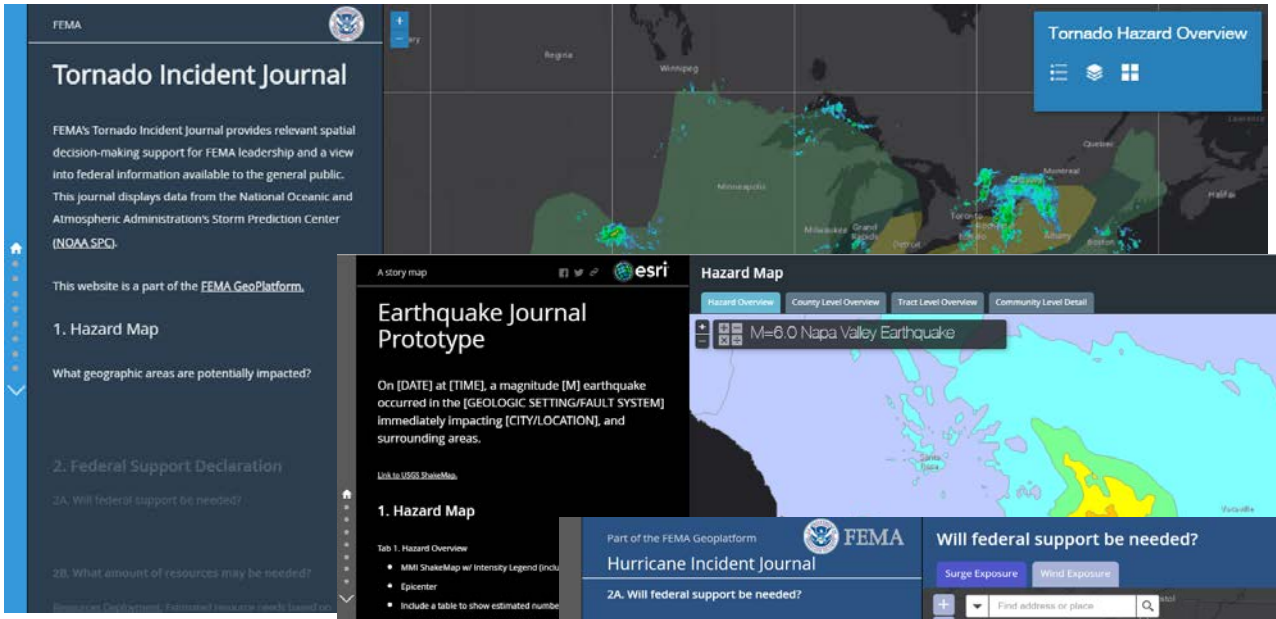


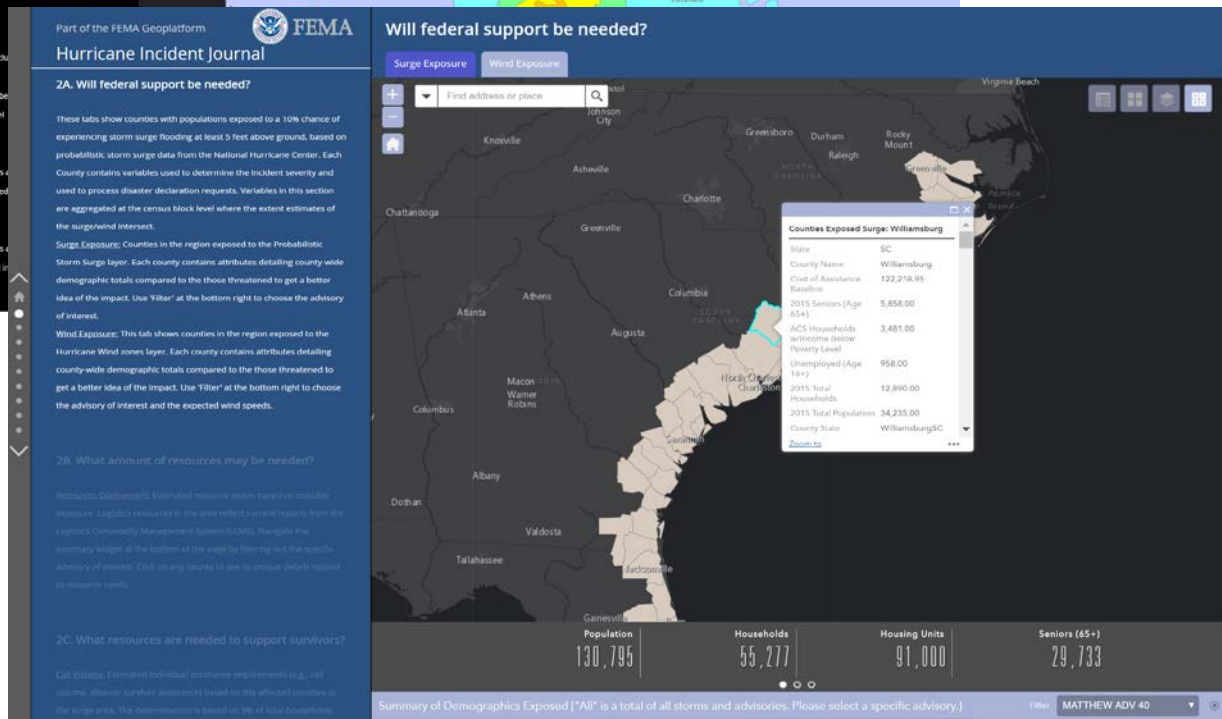
Flood Incident Journal

- **Models and Data Used**
  - NWS Watches & Warning
  - Census Data
  - HIFLD Data
  - FEMA Planning Factors
- **Goals**
  - Support Key Federal Decisions
  - Automate analysis
  - Improve response
- **Challenges**
  - Data
  - Dissemination
  - Consumption



Other Incident Journals





Recent Highlights:

Geospatial Successes

- **Louisiana Floods**
  - 92% of claims were located inside the modeled flood extent, which was delivered within days of impact
  - >$10.5m in expedited rental assistance grants provided to >12,500 disaster survivors

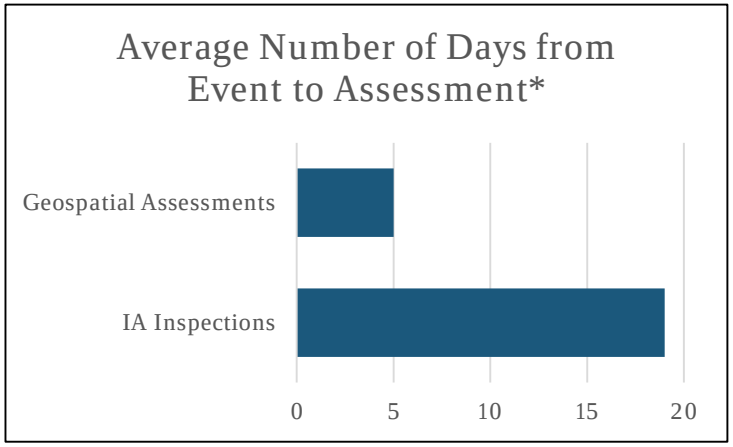


*Figure: LA Flood, Aug 2016 Comparative Analysis

- **Hurricane Mathew**
  - Statewide assessments delivered ~24hrs after landfall
  - For NC and SC, geospatial assessments were within 1'-2' of IA HWMs

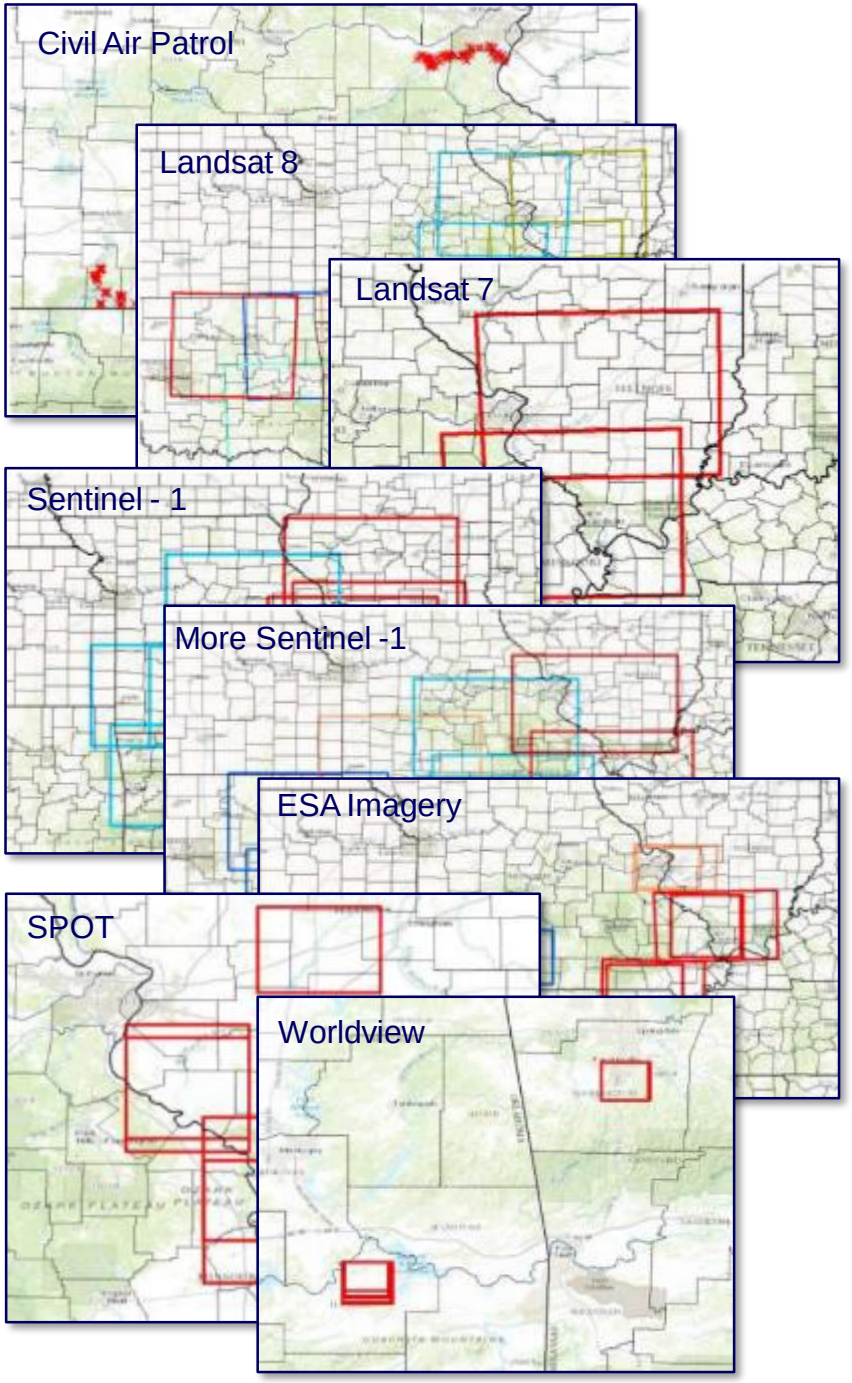
Actionable geospatial analysis is typically delivered within days. Conventional approaches may take months.

- **Superstorm Sandy**
  - Expedited $130m in rental assistance to 44k applicants with 99% accuracy
  - Analysis of NFIP policy exposure and loss potential was used to increase the borrowing limit by $9.7B

Backup Slides

Case Study

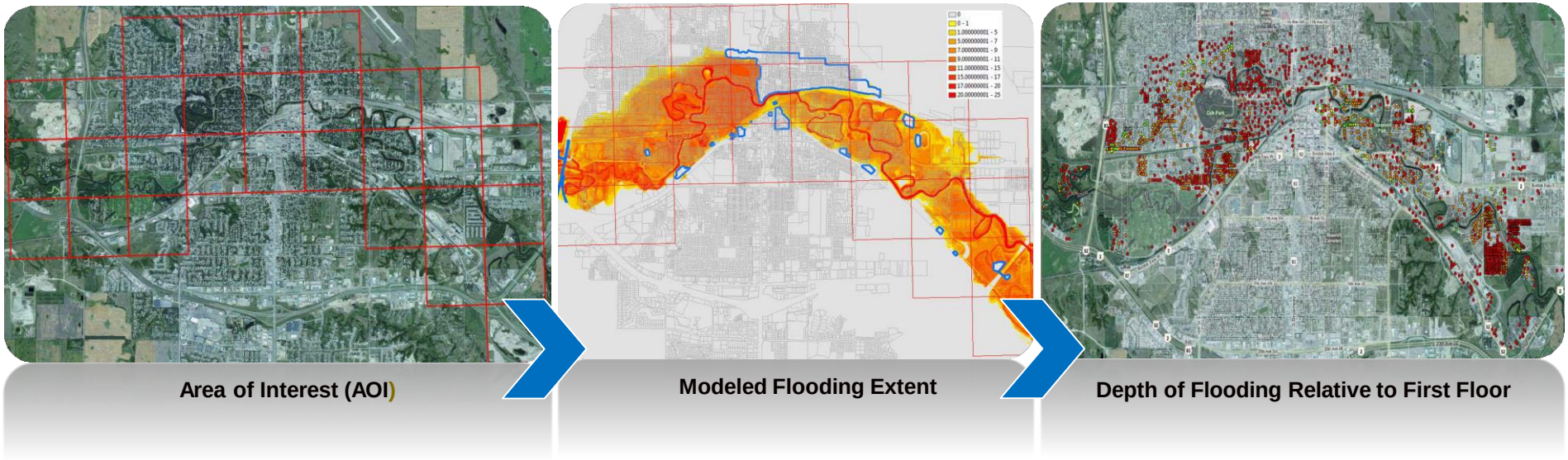
- Spring Flooding in central US
- Nearly 1000 images collected by May 6
- 715 are high resolution, aerial photos from Civil Air Patrol



Example:
Automated or Modeled Change Detection

- With relatively minimal post processing of the pre & post event imagery - ‘automated’ change detection can reveal impacts not immediately apparent to the naked eye over broad areas (below)

2011 Minot, ND Floods (cont…)



Area of Interest (AOI)

Modeled Flooding Extent

Depth of Flooding Relative to First Floor

Damage Classification Case Study

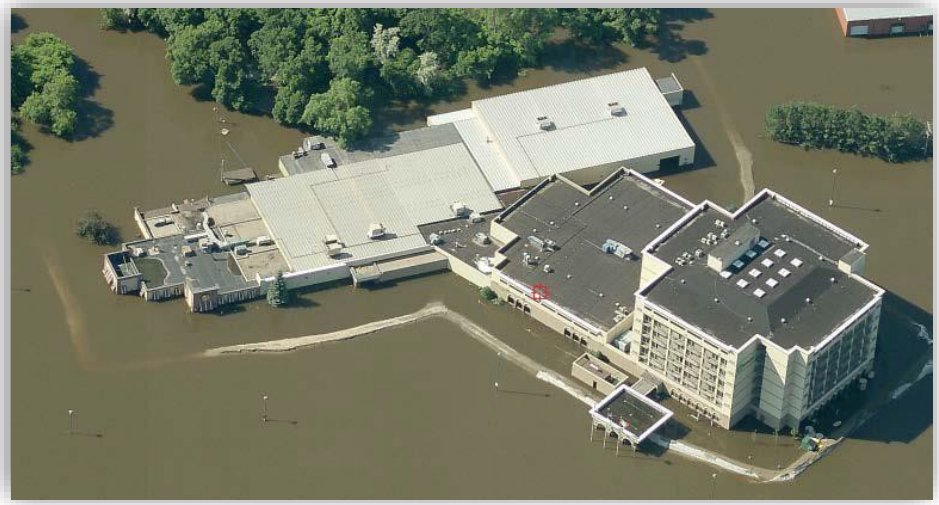
2011 Minot, ND Floods:

- FEMA Funded Contractor Analysis
- Priority Area of Oak Park
- 12 Priority Structures Identified for Detailed In-Depth Assessment
- Used Pre-Post Imagery w/ Parcel Info
- Google Earth, Bing Maps, Pictometry



Example of Priority Structure:

- Facility: **Holiday Inn**
- Description: 7 story hotel with a connection ballroom, indoor pool and entertainment casino area.
- Square Footage: 1) Hotel 109,203 2) Warehouse 12,460 3) Casino 22,425. Total 144,088
- Water depth at first floor: 2-5 feet





How does FEMA use Imagery?

Remote Sensing Product	Example of FEMA Uses		Flood	Hurricane	Tornado	Earthquake	IND
Flood Extent	• Flood depth grid	• Damage estimation	X	X			
Debris Detection	• Damage estimation • Debris detection	• Debris volume estimation • Debris removal planning	X	X	X	X	X
Debris Volume Estimation	• Debris volume estimation	• Debris removal planning	X	X	X	X	X
Soil Moisture	• Flood forecasting • Landslide prediction	• Wildfire mitigation	X	X			
Potential Shelter Locations	• Temporary shelter planning	• Relief supplies distribution planning	X	X	X	X	X
NDVI (Normalized Difference Vegetation Index)	• Wet debris estimation (several weeks post-event)		X	X			
Identify Displaced Persons Camps	• Support/relief planning	• Rescue efforts	X	X	X	X	X
Damage Assessment	• Damage assessment		X	X	X	X	X
Ground Deformation	• Damage assessment	• Debris estimation				X	
Landslide Detection	• Landslide prediction	• Landslide detection	X	X		X	
Radiation Detection	• Response planning operations						X
Identify Isolated Areas	• Response planning operations		X	X	X	X	X
Routing Map	• Response planning operations		X	X	X	X	X
Hot Spot/Thermal Mapping	• Fire rescue					X	X

Barriers & Challenges to Success

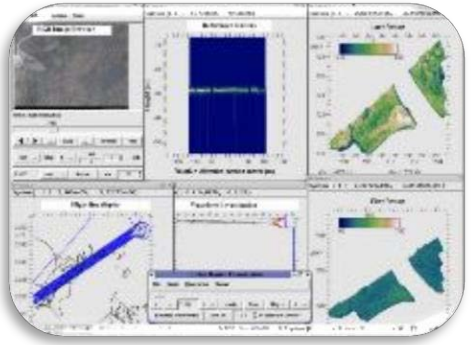
- Emergency management is a time dominant regime – Acquiring and using imagery can be time intensive.
- Cloud cover and environmental conditions can impact airborne (collection)
- Satellite revisit times and aircraft mobilization maintenance can impact needed timelines
- Resource and processing intensive (software, server/disk space, expertise etc.)



Cloud Covered Satellite Image



Aircraft Maintenance



Processing Software



Sufficient Imagery

- Every major event initiates imagery collections plan to ensure sufficient imagery is collected in a timely manner.

- Interagency groups in situ telecons works to ensure all national, international, research and commercial resources are appropriately coordinated and brought to bear, given available resources.

Hurricane Incident Journal

Operational Uses:*

- **Updates automatically** with every National Hurricane Center advisory
- Estimates **call volumes** and staffing needs
- Estimates **shelter, food, and water** requirements
  - Note: Planning factors correspond to the Decision Support Tool (DST)
- Reports **demographics** of impacted areas
- Estimates building impacts
- Logs IA applications
- Provides **live traffic** updates
- Current weather events

> *Our GIS staff have **plowed new ground in the creation of the Map Journal** that will likely **change the way we do business** in the future and the products provided…they are the central resource for data and request for information that **keeps us consistent and quickly meets the needs of both internal and external requirements.***
>
> ~ Federal Coordinating Officer
> DR-4285-NC

Ongoing Efforts:

- **Socialization** of the journal's format, capabilities, and uses
- Sr. Leadership feedback
- Community feedback at the MDWG

* The Hurricane Incident Journal has only been used operationally for (1) Hurricane Hermine and (2) Hurricane Matthew.

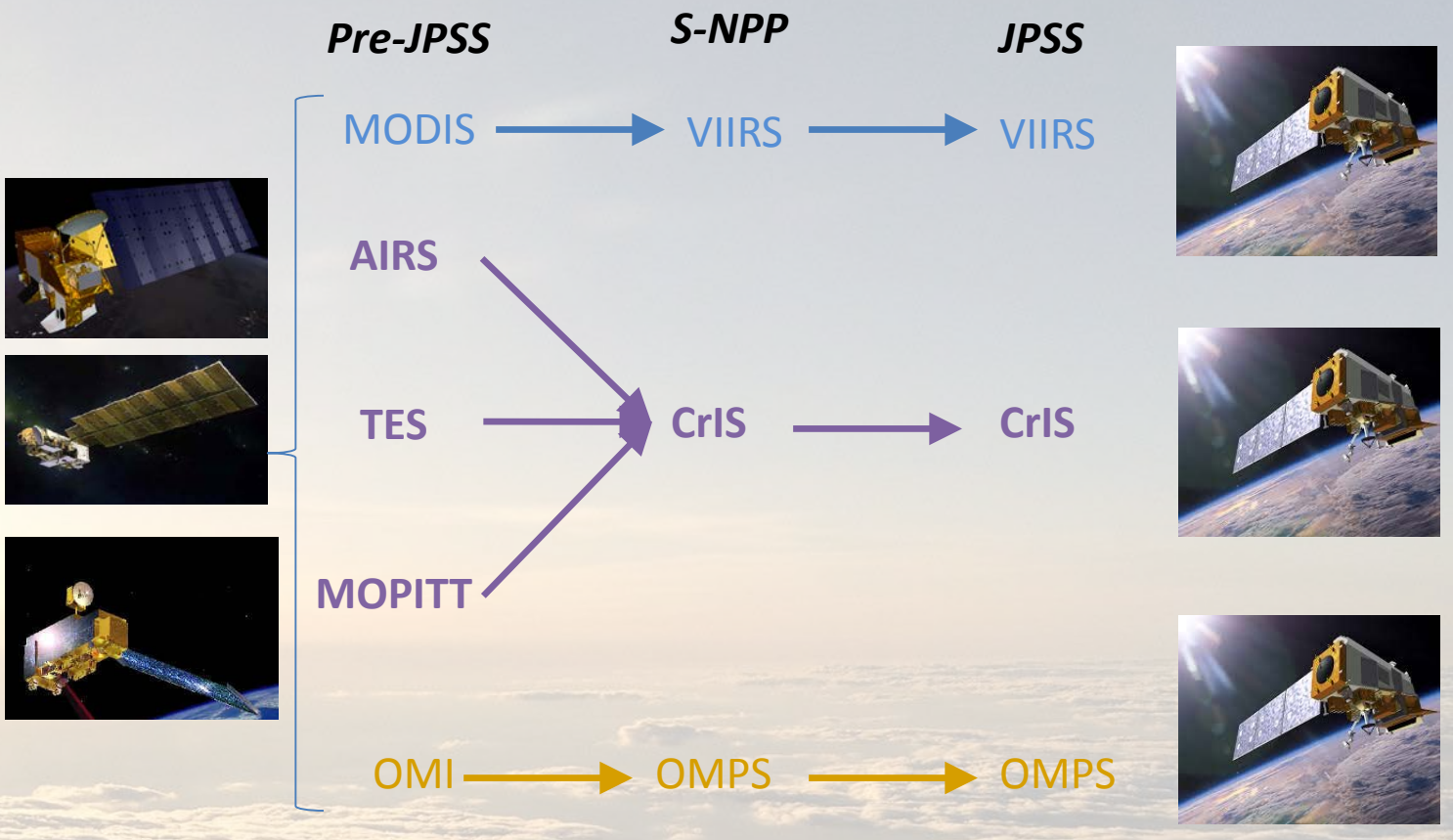
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Atmospheric chemistry products from JPSS and their applications

Monika Kopacz
NOAA/OAR Climate Program Office
AC4 Program Manager

JPSS Science Team Meeting
August 14, 2017

JPSS instrument legacy
(in atmospheric chemistry)



NOTE: **VIIRS**, **OMPS and CrIS** all provide or can provide data relevant to atmospheric chemistry

Atmospheric chemistry products from JPSS: current and future

- CrIS: CO, CO_2, ozone, methane, ammonia, SO_2, *N_2O, PAN, isoprene*…
- OMPS: ozone, NO_2, *formaldehyde*…
- VIIRS: burned area, AOD, other fire products

See Thursday session on Trace Gases for more details

Sources: JPSS standard products, PGRR, NOAA/AC4 funded, NASA

NOAA (OAR/CPO/AC4) effort so far

- **2013**: FY13 FFO funded ammonia product development and validation
- **2014**: FY14 FFO funded further development of ammonia product; CrIS workshop gathers potential (research) users
- **2015**: FY15 FFO funded ammonia product application in GFDL Earth System Model; CrIS workshop report released
- **2016-17**: FY16 FFO funded CrIS/OMPS ozone product development
- **2017**: FY18 FFO solicits for new (BVOC) product development (e.g. isoprene, formaldehyde)

How did we contribute? Mostly through FFO…

More progress: CrIS workshop recommendations (2015)

Scientific community uses TIR satellite observation, so far provided by NASA and EUMETSAT from **MOPITT, TES, AIRS and IASI**. All are past expiration and there are no plans to replace them.

Recommendation 1: Need data

- Provide calibrated radiances Level 1b data at full spectral resolution.

Recommendation 2: Special needs for atmospheric chemistry

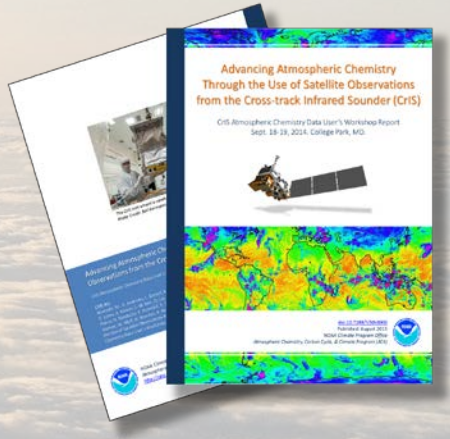
A. Provide reduced file size (like TES "lite) with retrievals for individual trace gases and their observation operators at a reduced vertical resolution.
B. Provide essential information: a priori, averaging kernels, estimated retrieval error.
C. Allow rapid multi-file download from CLASS

Recommendation 3: Validation

A. Coordinate validation with upcoming field campaigns (e.g. FIREX)
B. More frequent ESRL flights to validate trace gases
C. Plan additional field campaigns with retrieval and user communities

Recommendation 4: Future

A. Explore the possibility of new species/products
B. Close spectral gap
C. Reduce noise and increase resolution for future instruments



Most apply to all of JPSS!

What are the applications?

- Improved understanding of atmospheric composition
- NOAA Climate/Earth System Model (GFDL) development and validation
- Air quality forecasting
- NGGPS
- Monitoring of air pollution and greenhouse gases

Note: substantial NASA effort continues

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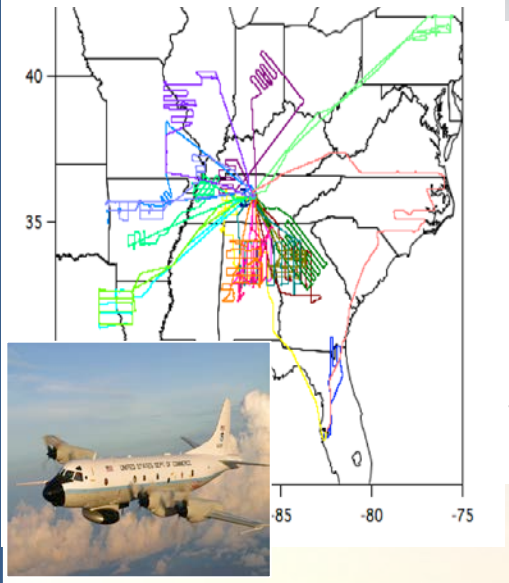
Note: substantial NASA effort continues

Understanding Emissions and Tropospheric Chemistry using NUCAPS and VIIRS

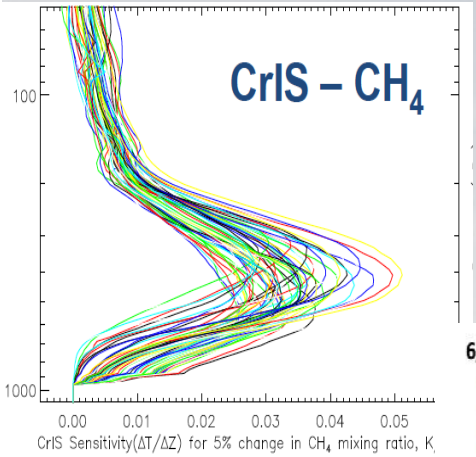
G. Frost, S. McKeen, S.-W. Kim, R. Ahmadov, M. Trainer, Y. Cui, W. Angevine, T. Ryerson, J. Roberts, C. Warneke, C. Granier, K. Rosenlof, J. Brioude; R. B. Pierce; C. Barnet, N. Smith, A. Gambacorta; C. Elvidge

JPSS Proving Ground/ Risk Reduction Program

SENEX 2013 NOAA WP-3 flights

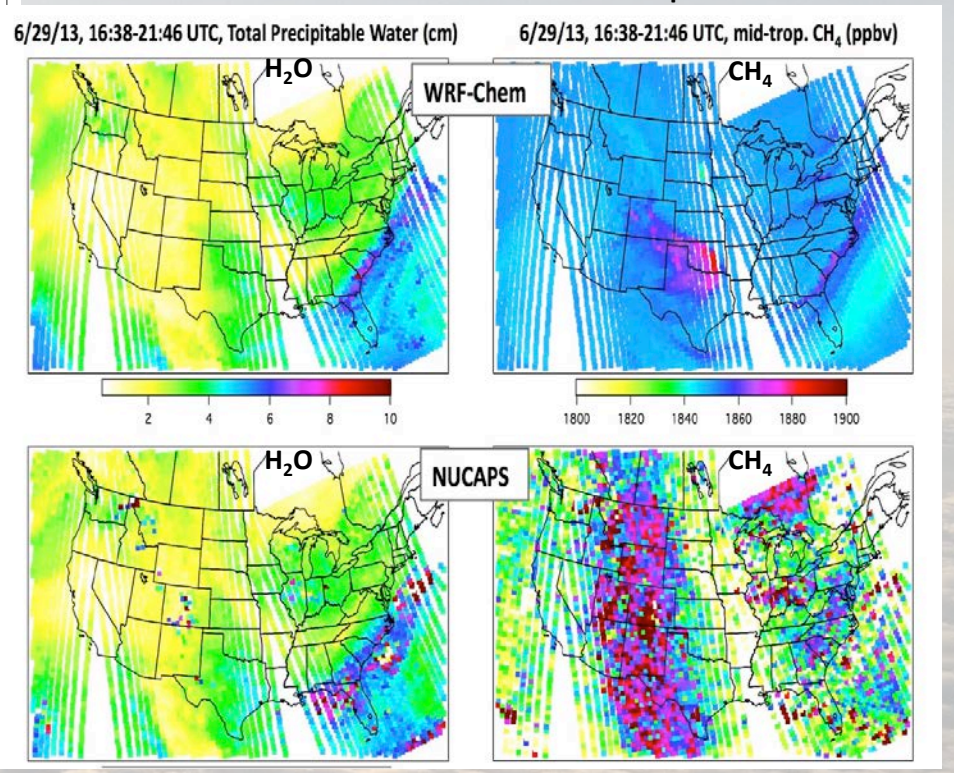


CrIS CH_4 Vertical Sensitivity



- Evaluate NUCAPS (CrIS+ATMS) CH_4 and CO retrievals with aircraft data and aircraft-validated atmospheric model simulations
- Quantify CH_4 and CO spatial-temporal variability with aircraft, models, and NUCAPS

NUCAPS vs. WRF-Chem Model Comparison



Validate NUCAPS retrievals by comparing to aircraft observations and model output

Determining the quality of satellite retrievals when aircraft data for comparison are sparse

Characterize true signals vs. noise with variance scaling using Fourier spectral analysis

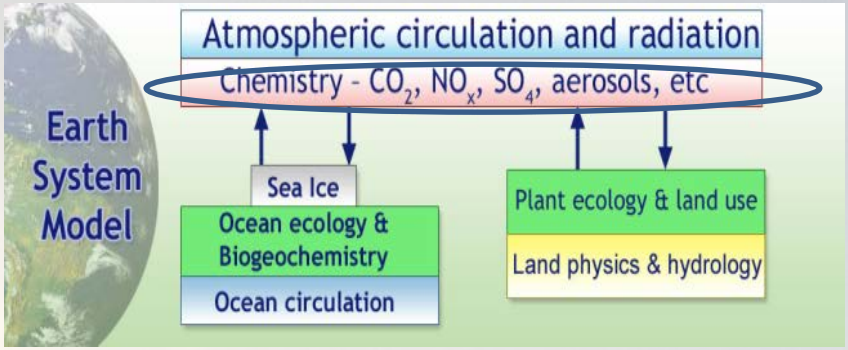
Slide courtesy of G. Frost and B. Pierce

http://www.esrl.noaa.gov/csd/projects/senex/

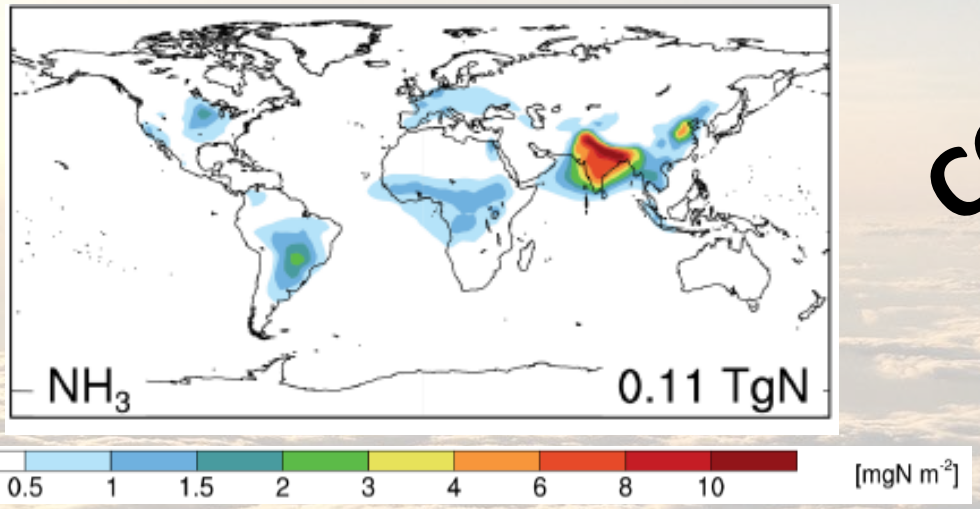
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NOAA GFDL model development and validation

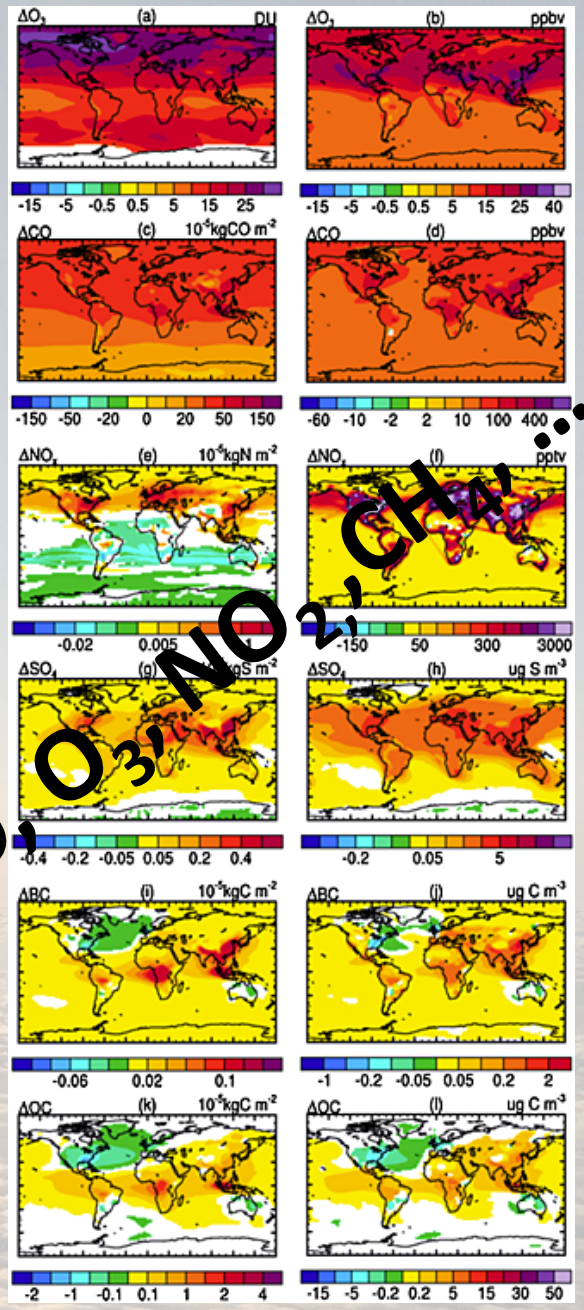


Ammonia in GFDL AM3 model



Paulot et al. 2016

User potential: High latency operational user



Naik et al. 2013

What are the applications?

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National Air Quality Forecast Capability

End-to-End Operational Capability

Model: Linked numerical prediction system

Operationally integrated on NCEP's supercomputer

- *NOAA NCEP mesoscale numerical weather prediction*
- *NOAA/EPA community model for air quality: CMAQ*
- *NOAA HYSPLIT model for smoke and dust prediction*

Observational Input:

- *NWS weather observations; NESDIS fire locations; climatology of regions with dust emission potential*
- *EPA emissions inventory!!!!*



Gridded forecast guidance products

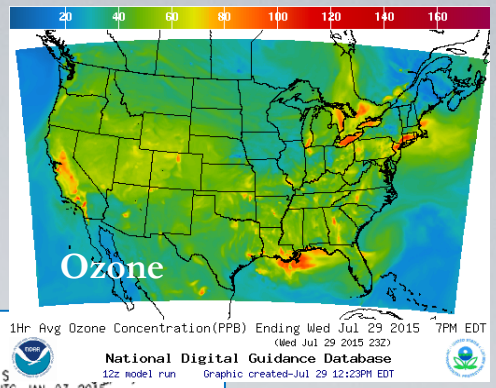
- *On NWS servers: airquality.weather.gov and ftp-servers (12km resolution, hourly for 48 hours)*
- *On EPA servers*
- *Updated 2x daily*

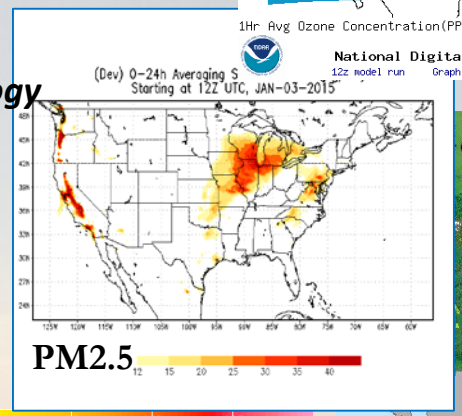
Verification basis, near-real time:

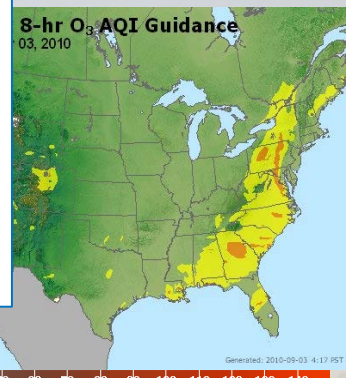
- *Ground-level AIRNow observations surface ozone and PM2.5*
- *Satellite observations of smoke and dust*

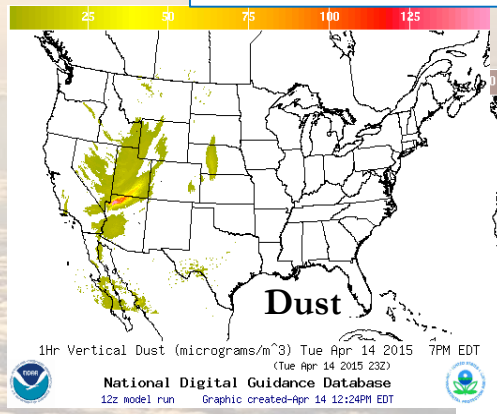
Customer outreach/feedback

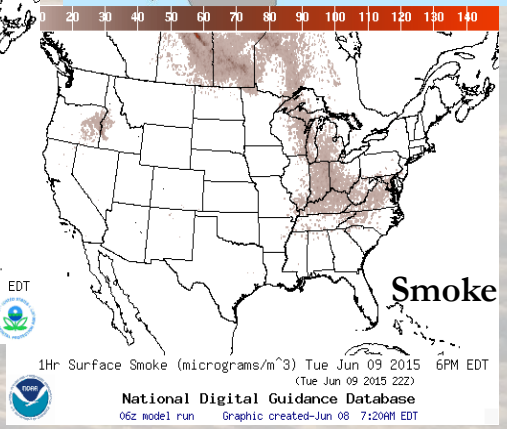
- *State & Local AQ forecasters coordinated with EPA*
- *Public and Private Sector AQ constituents*











Slide from Ivanka Stajner, NOAA/NWS

What are the applications?

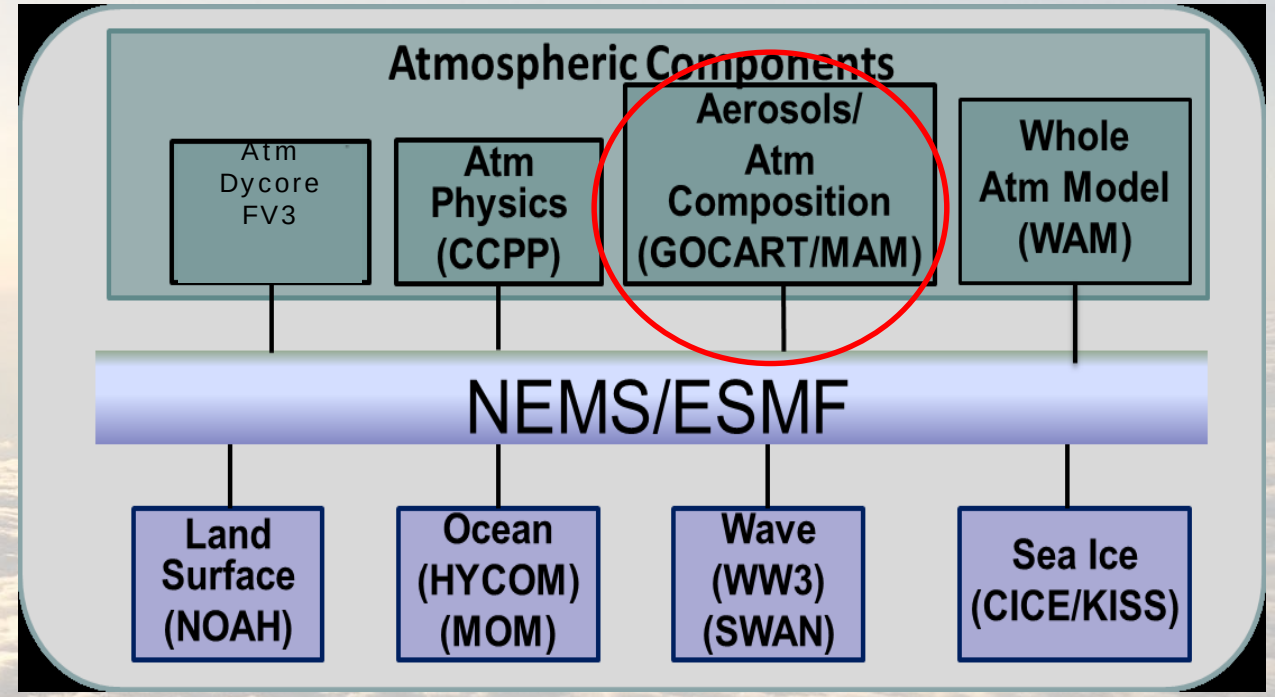
- Improved understanding of atmospheric composition
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Applications: NOAA NGGPS

Next Generation Global Prediction System (NGGPS) will be a multi-scale unified modeling system that will eventually replace the current GFS, GFS ensemble, and Climate Forecast System (CFS)

Predicting the whole **Earth System**, not just weather!

NGGPS structure

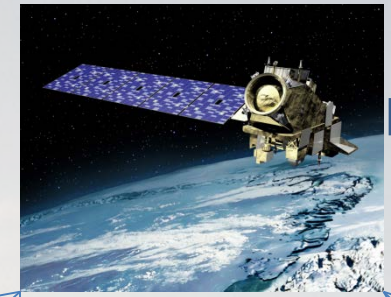


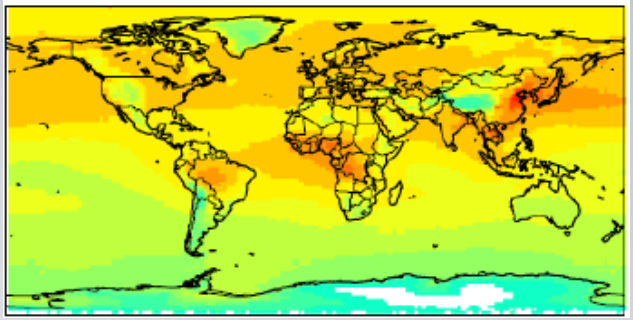
What are the applications?

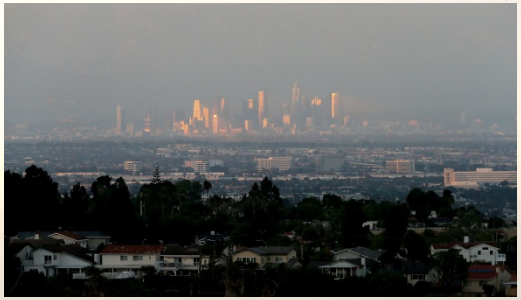
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Atmospheric composition monitoring from space: “air pollution”

Daily global maps







Urban smog



Smoke composition



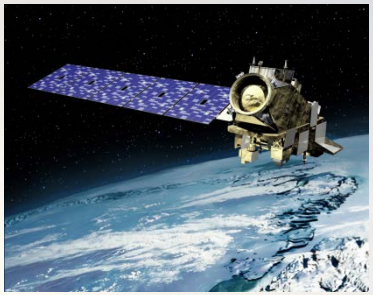


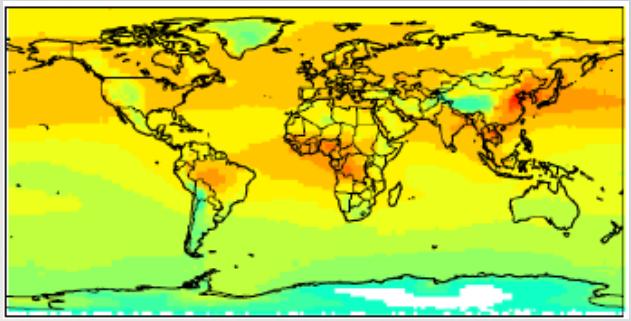
Other, including new sources (e.g. oil & gas extraction)

NYTimes, 8/9/17, “We’re choking on smoke in Seattle”

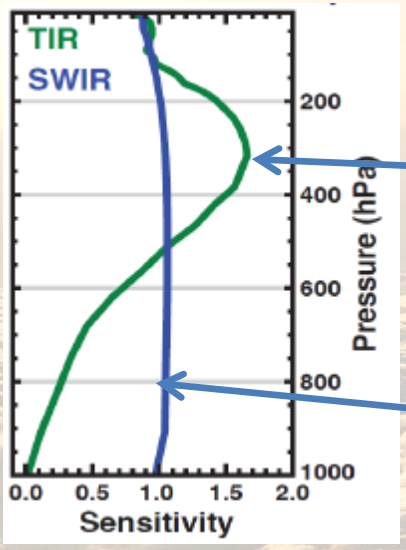
Atmospheric composition monitoring from space: CO_2

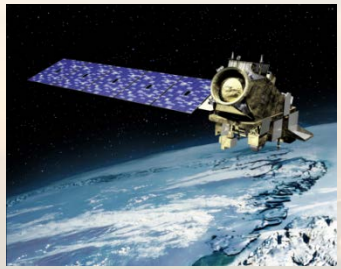
Daily global maps.









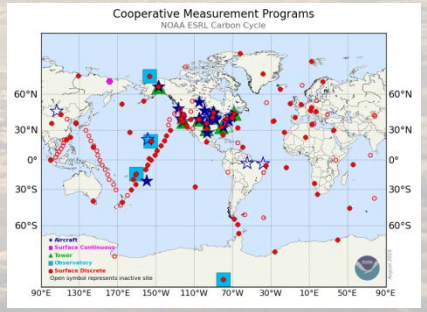


JPSS

JPSS/CrIS could provide background CO_2 to help estimate very small surface enhancement



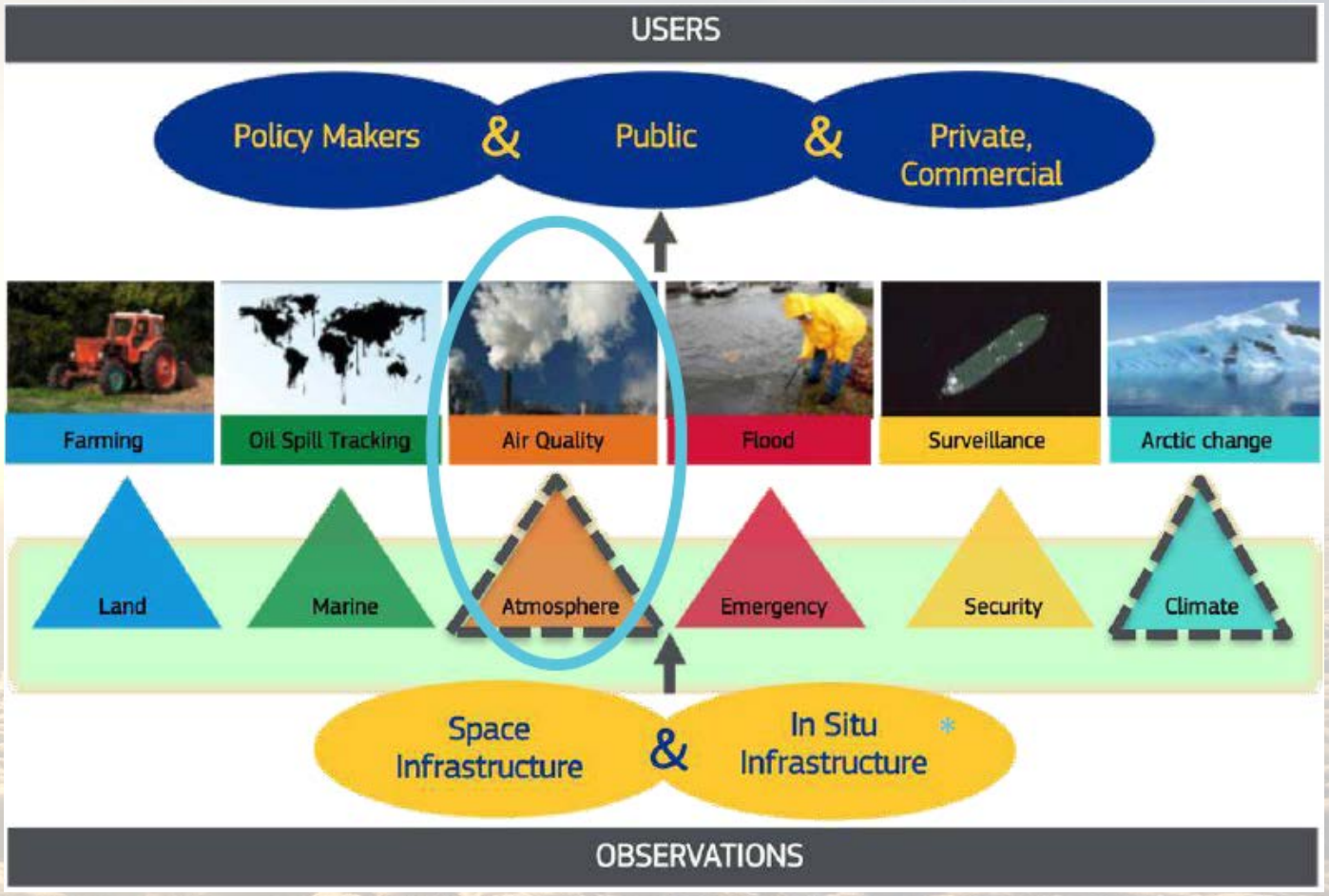
OCO-2



Complement to surface station monitoring by ESRL/GMD!

Air quality services: Can we keep up with Copernicus?





"The service provides near-real-time analysis and 4-day forecasts, as well as reanalysis, of the **European air quality**, thus enabling a permanent assessment of the air we breathe."

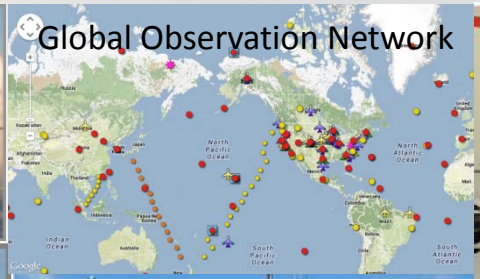
http://atmosphere.copernicus.eu/services/air-quality-atmospheric-composition

Figure courtesy of Mark Parrington and Vincent-Henri Peuch, ECMWF

OAR in situ and modeling capabilities

Validation with all the aircraft data, including and especially FIREX/FIRE-Chem field campaign





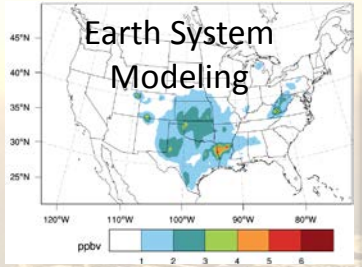






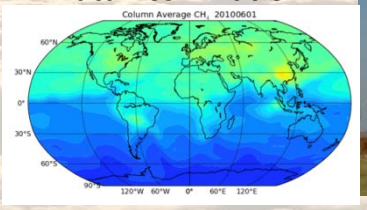
















Observing the atmosphere at multiple spatial and temporal scales with a suite of complementary approaches

State-of-the-art earth system modeling and data analysis

http://www.esrl.noaa.gov

Slide from G. Frost and B. Pierce

Vegetation Health Applications in USDA

Mark D. Brusberg
Deputy Chief Meteorologist
USDA Office of the Chief Economist / World Agricultural Outlook Board

Presented to the

STAR JPSS

2017 Annual Science Team Meeting

August 14, 2017

1972 Soviet Grain Purchases

Former National Security Advisor Henry Kissinger had this to say about record July 1972 Soviet grain purchases from the United States:

- "Our intelligence about Soviet needs was appalling.
- Our knowledge of what was happening in our markets was thin.
- The U.S. Government was simply not organized at the time to supervise or even monitor private grain sales as a foreign policy matter."

WASDE Report



World Agricultural Outlook Board

waob

ISSN: 1554-9089

World Agricultural Supply and Demand Estimates

United States Department of Agriculture

Office of the Chief Economist | Agricultural Marketing Service, Farm Service Agency | Economic Research Service, Foreign Agricultural Service

WASDE - 510 | Approved by the World Agricultural Outlook Board | September 12, 2012

WHEAT: The 2012/13 U.S. wheat balance sheet is unchanged this month; however, small by-class adjustments are made to projected exports and stocks. Projected exports for Hard Red Winter wheat are lowered 25 million bushels with Hard Red Spring and White wheat exports raised 15 million bushels and 10 million bushels, respectively. Corresponding changes are made to projected ending stocks for these three classes. The proje
price is lowered to $7.50 to $8.70 per bushel con
Prices reported for the summer months, when pr
remained well below cash bids and futures prices
producers earlier in the year.

Global wheat supplies for 2012/13 are projected
production in Russia. An increase in foreign beg
ton reduction in world wheat output. Beginning s
for Argentina. Production for Russia is reduced
reduced yields as harvest results confirm additio
spring wheat crops. Production is also lowered
experienced the same adverse drought and heat
in the central and eastern growing regions of Rus
mostly reflecting lower expected yields in the Uni
million tons based on higher reported yields. Pro
mostly on higher reported area.

Global wheat consumption for 2012/13 is lowere
residual use in Russia and Kazakhstan. Food us
additional reductions projected for food use in Eg
Afghanistan, Iran, and Libya.

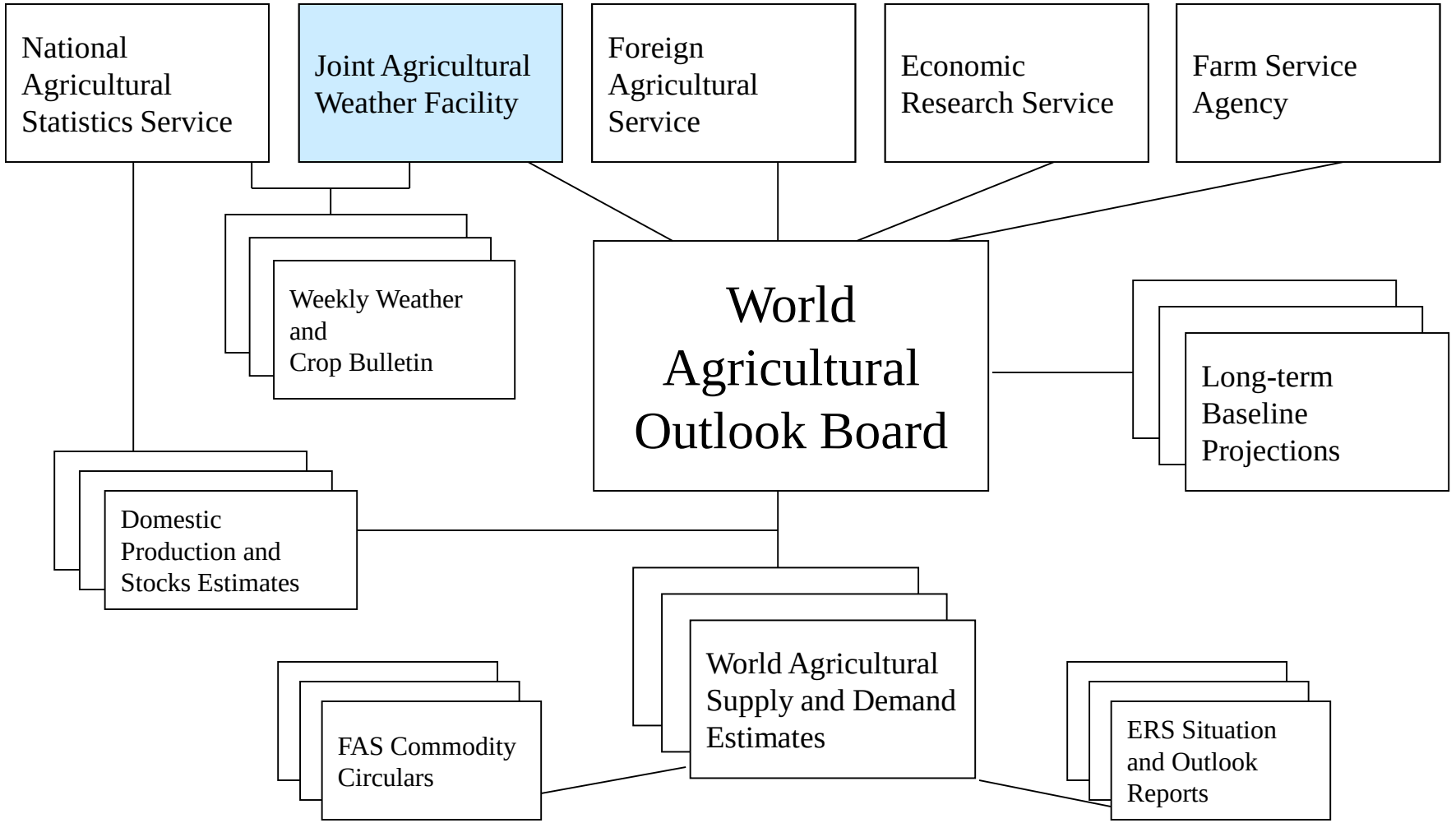
Global wheat trade for 2012/13 is lowered slightl
EU-27, Israel, and Nigeria. Import increases for
Exports are reduced 2.0 million tons for Ukraine
government officials and grain traders to limit shi
domestic supplies. Higher expected exports for
Ukraine reduction.

World ending stocks for 2012/13 are projected 0.5 million tons lower with changes to a number of countries. The largest declines in stocks are for Russia, EU-27, China, Brazil, and Argentina. The largest increases are for Ukraine, Canada, Iran, and Turkey.

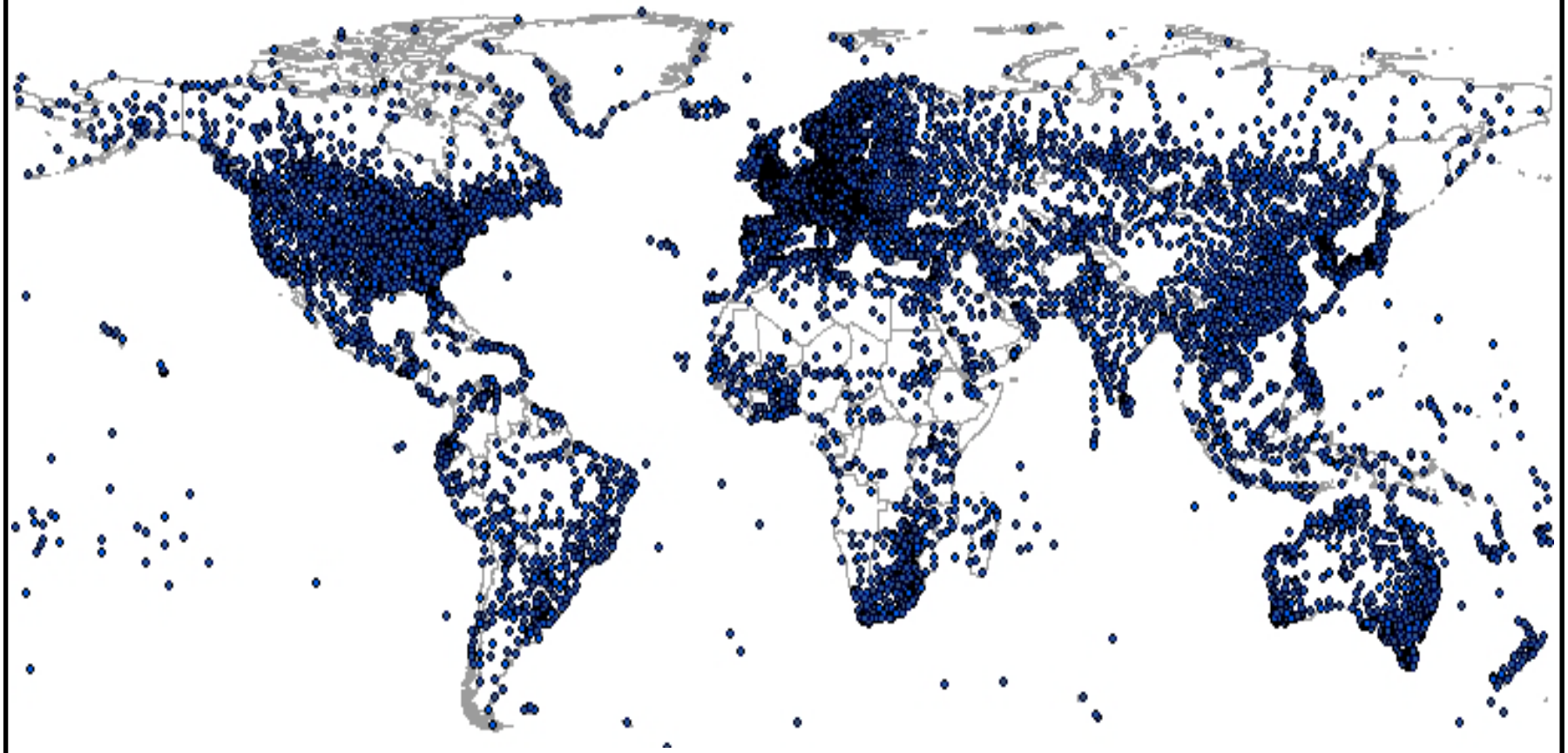
COARSE GRAINS: U.S. feed grain supplies for 2012/13 are projected higher this month with a reduction in forecast corn production more than offset by higher projected corn carryin. U.S. corn production is lowered 52 million bushels with the national average yield forecast 0.6 bushels per acre lower at 122.8 bushels. Lower yields and production in the Corn Belt and Central Plains are partly

Global wheat supplies for 2012/13 are projected 3.1 million tons lower mostly due to lower expected production in Russia. An increase in foreign beginning stocks partly offsets the projected 4.1-million-ton reduction in world wheat output. Beginning stocks are raised for Canada and Egypt, but lowered for Argentina. Production for Russia is reduced 4.0 million tons with lower reported area and reduced yields as harvest results confirm additional drought and heat damage to both the winter and spring wheat crops. Production is also lowered 0.5 million tons for adjoining Kazakhstan, which experienced the same adverse drought and heat during July and August that affected spring wheat in the central and eastern growing regions of Russia. EU-27 production is lowered 0.5 million tons mostly reflecting lower expected yields in the United Kingdom. Ukraine production is raised 0.5 million tons based on higher reported yields. Production for Afghanistan is raised 0.4 million tons mostly on higher reported area.

USDA's Economic Intelligence System



* Random sampling of available daily weather data

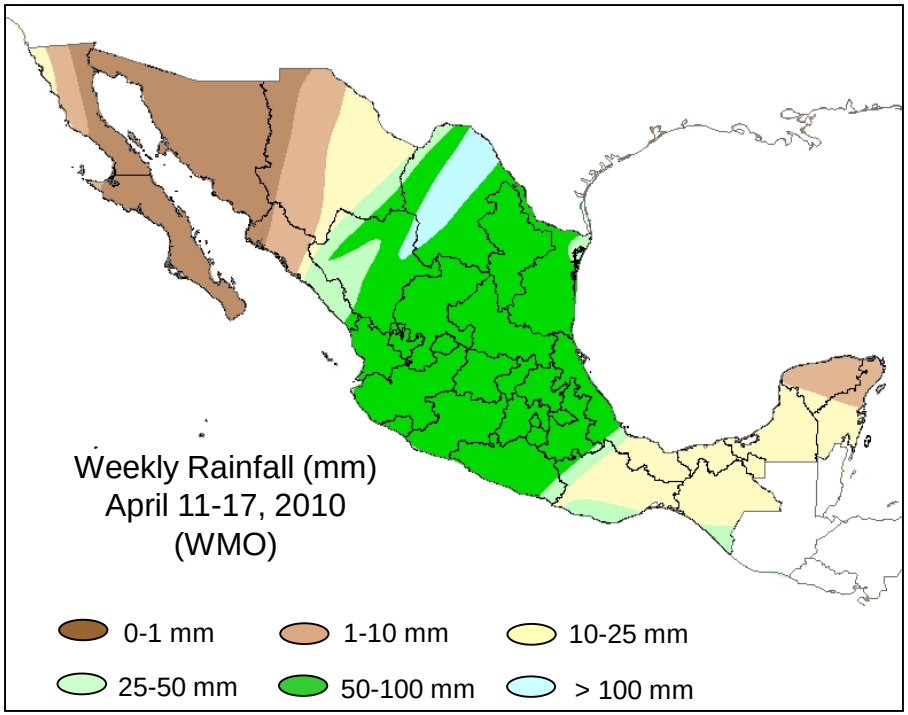


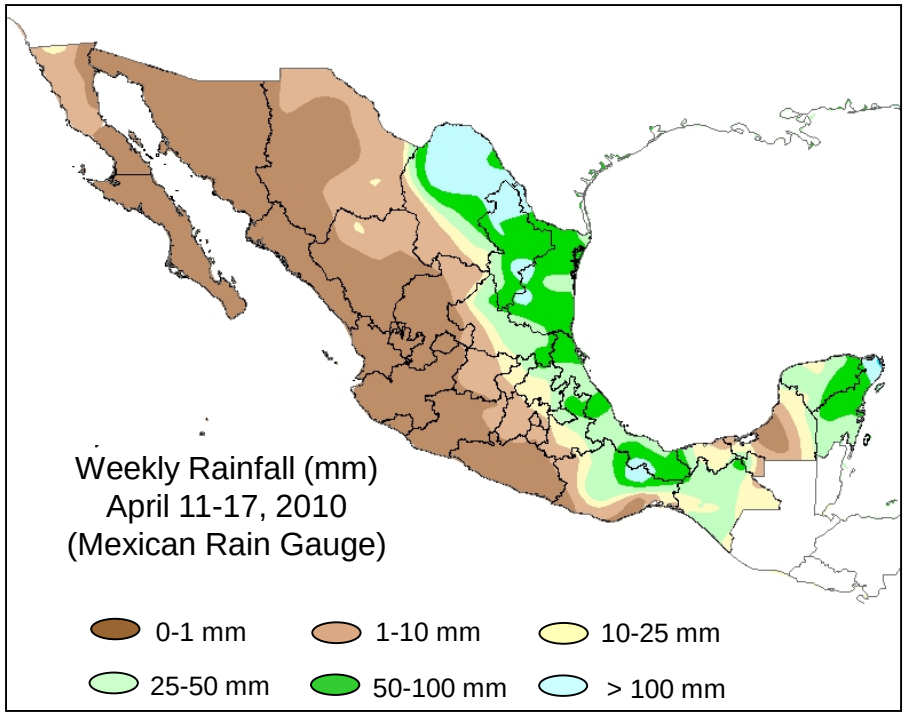
* Most have data since at least 1982
(many with normals)

Location of weather stations
received daily via the WMO[1]

[1] United Nations World Meteorological Organization

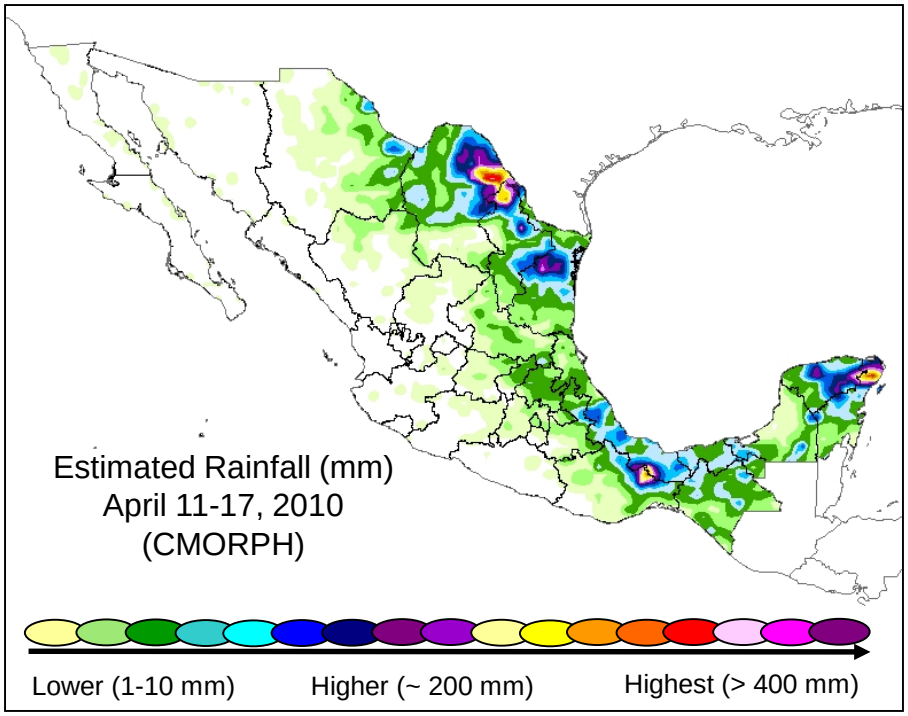
Secondary sources of weather data

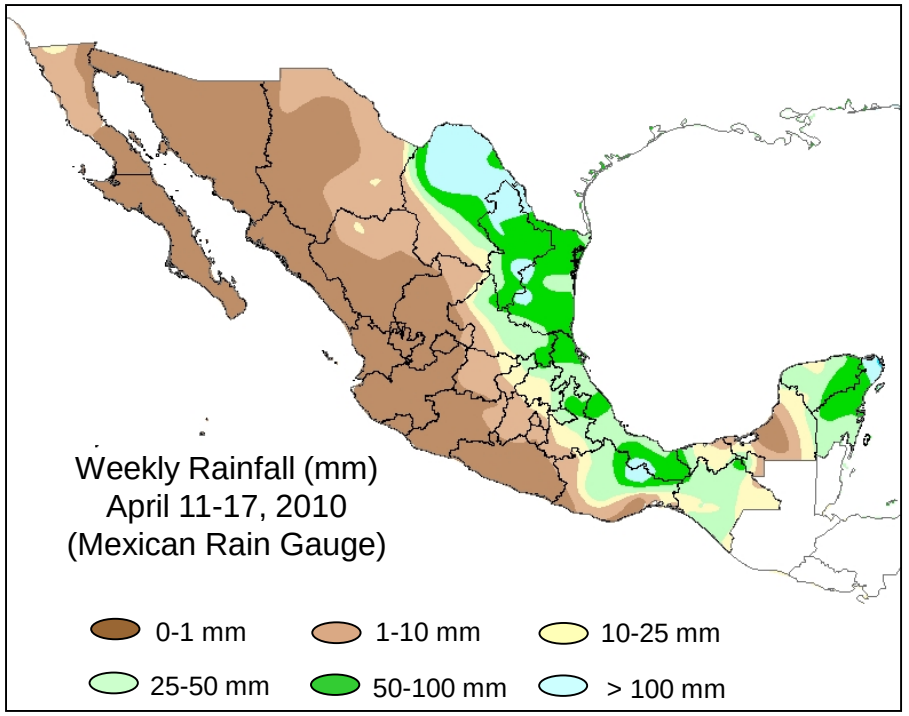




The maps above highlight the differences that arise using WMO data, which are sparse in coverage, versus the supplemental rain gauge data, which provides a denser network of stations and a better representation of rainfall.

Secondary sources of weather data





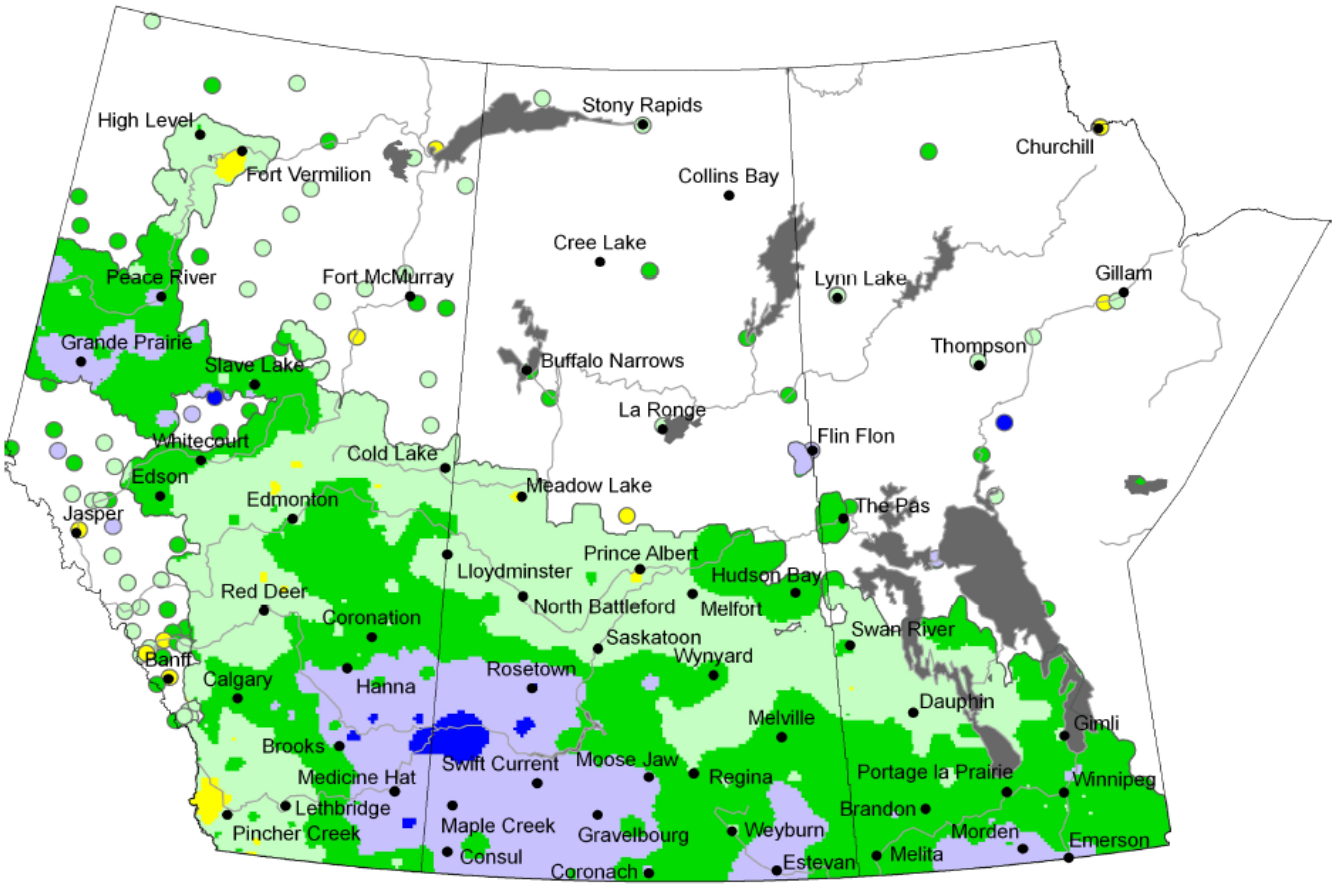
Comparison with other sources of information, including satellite derived estimates (CMORPH), support the rain gauge analysis.

Agriculture and Agri-Food Canada | Agriculture et Agroalimentaire Canada

Canada

Percent of Average Precipitation (Prairie Region)

April 1, 2016 to August 8, 2016





- < 40%
- 40 - 60%
- 60 - 85%
- 85 - 115%
- 115 - 150%
- 150 - 200%
- > 200%
- Extent of Agricultural Land
- Lakes and Rivers

Produced using near real-time data that has undergone initial quality control. The map may not be accurate for all regions due to data availability and data errors.

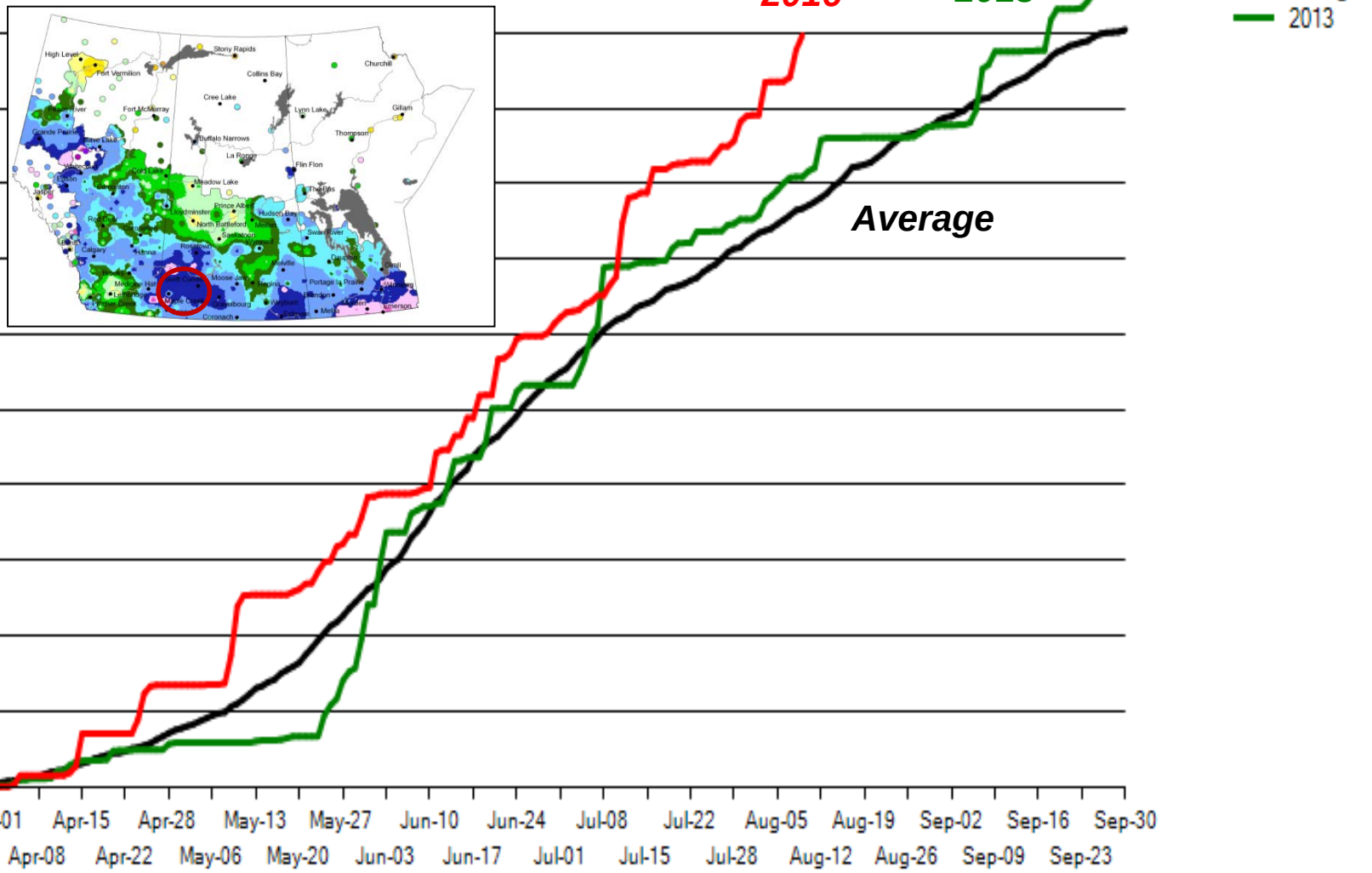
Copyright © 2016 Agriculture & Agri-Food Canada

Prepared by Agriculture and Agri-Food Canada's National Agroclimate Information Service (NAIS). Data provided through partnership with Environment Canada, Natural Resources Canada, and many Provincial agencies.

Created: 08/09/16
www.agr.gc.ca/drought

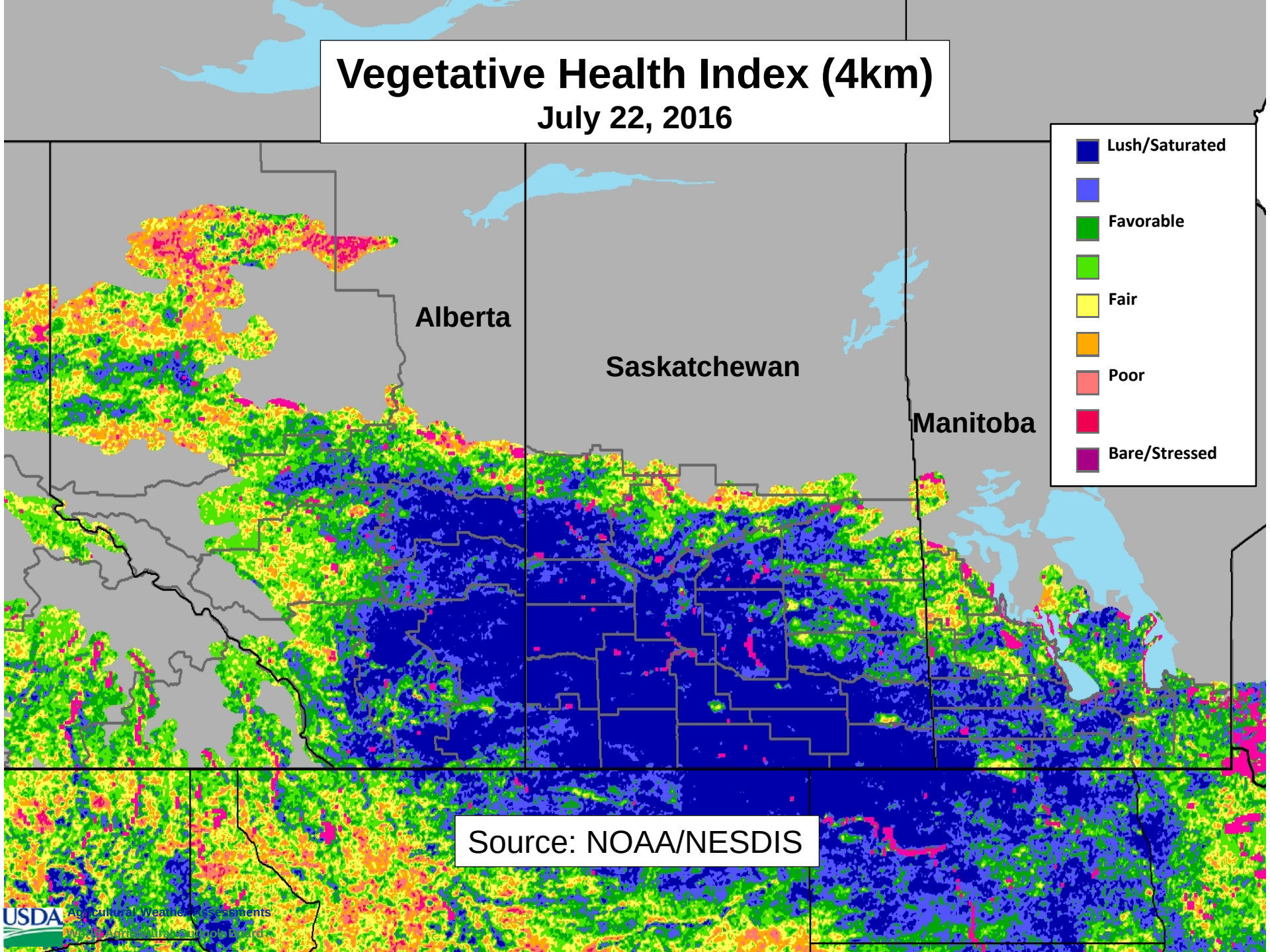
9 - SASKATCHEWAN - SOUTHWEST

Cumulative Precipitation

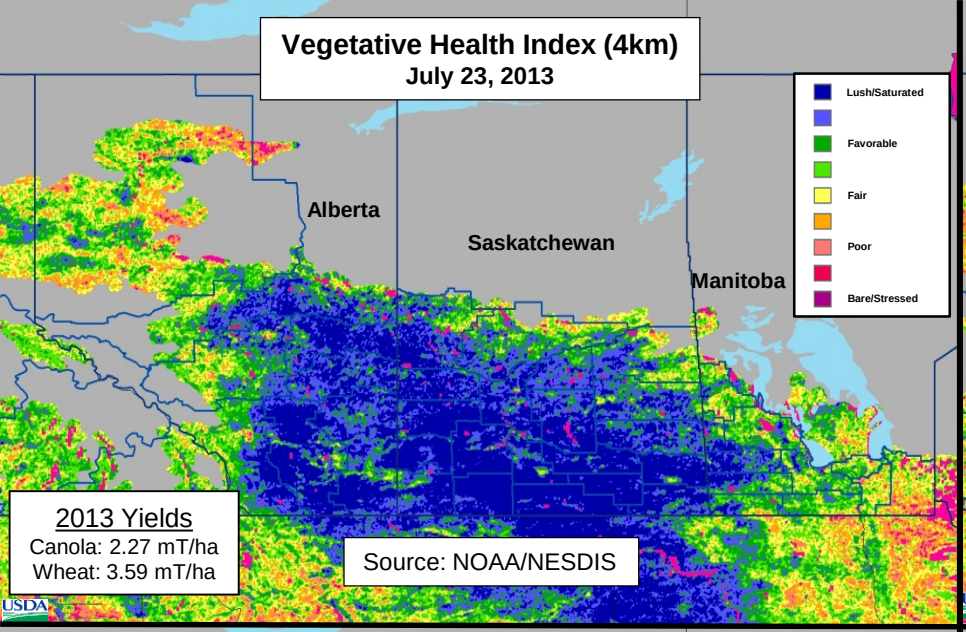


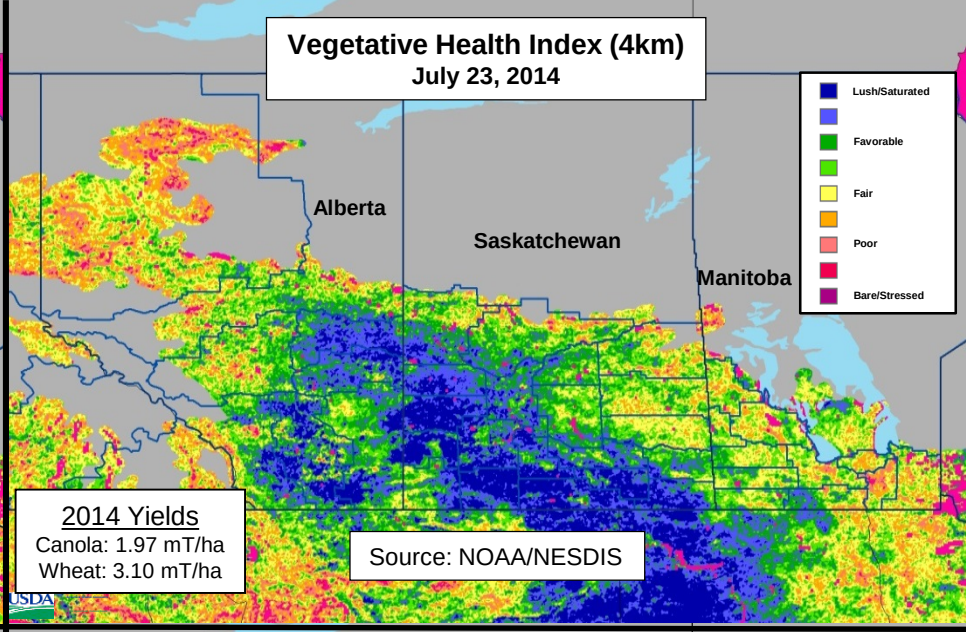
Vegetative Health Index (4km)

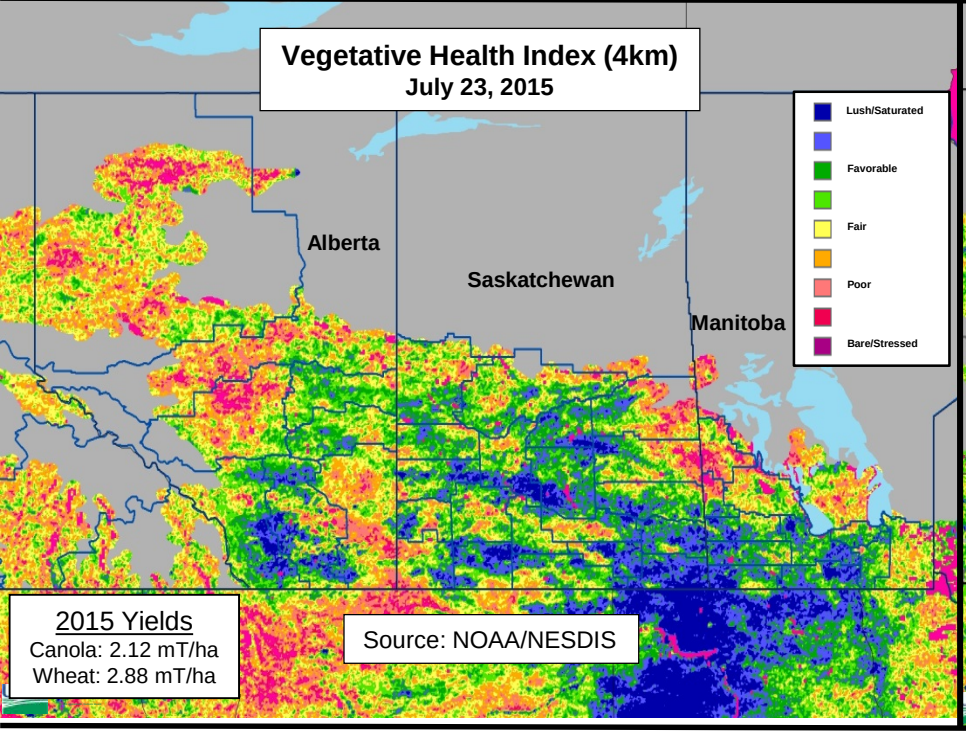
July 22, 2016

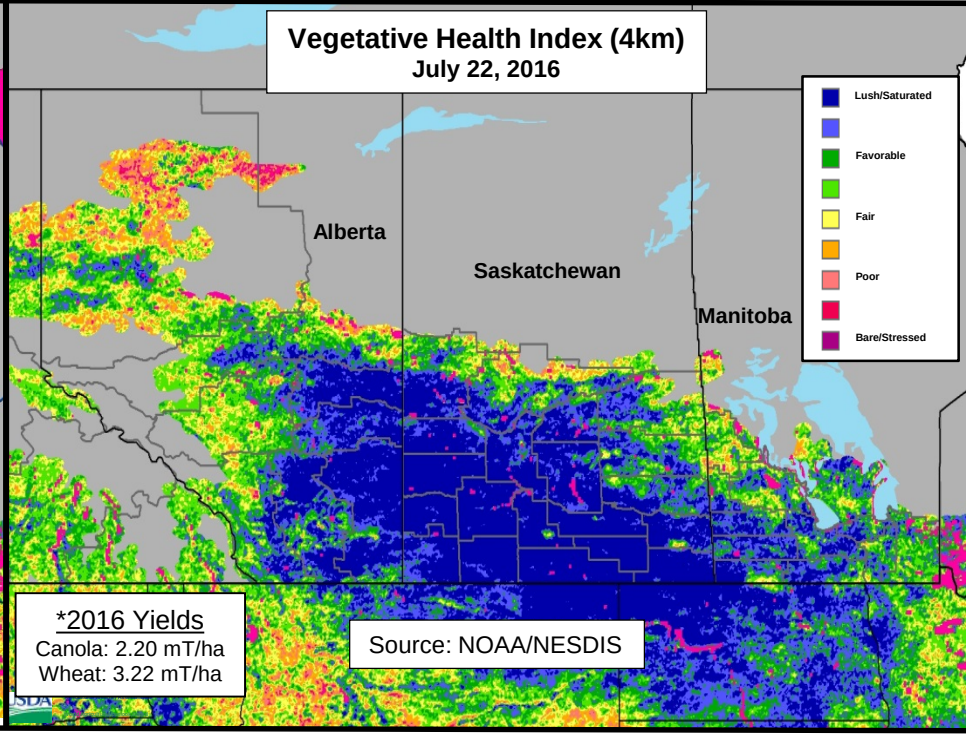


USDA Agricultural Weather Assessments







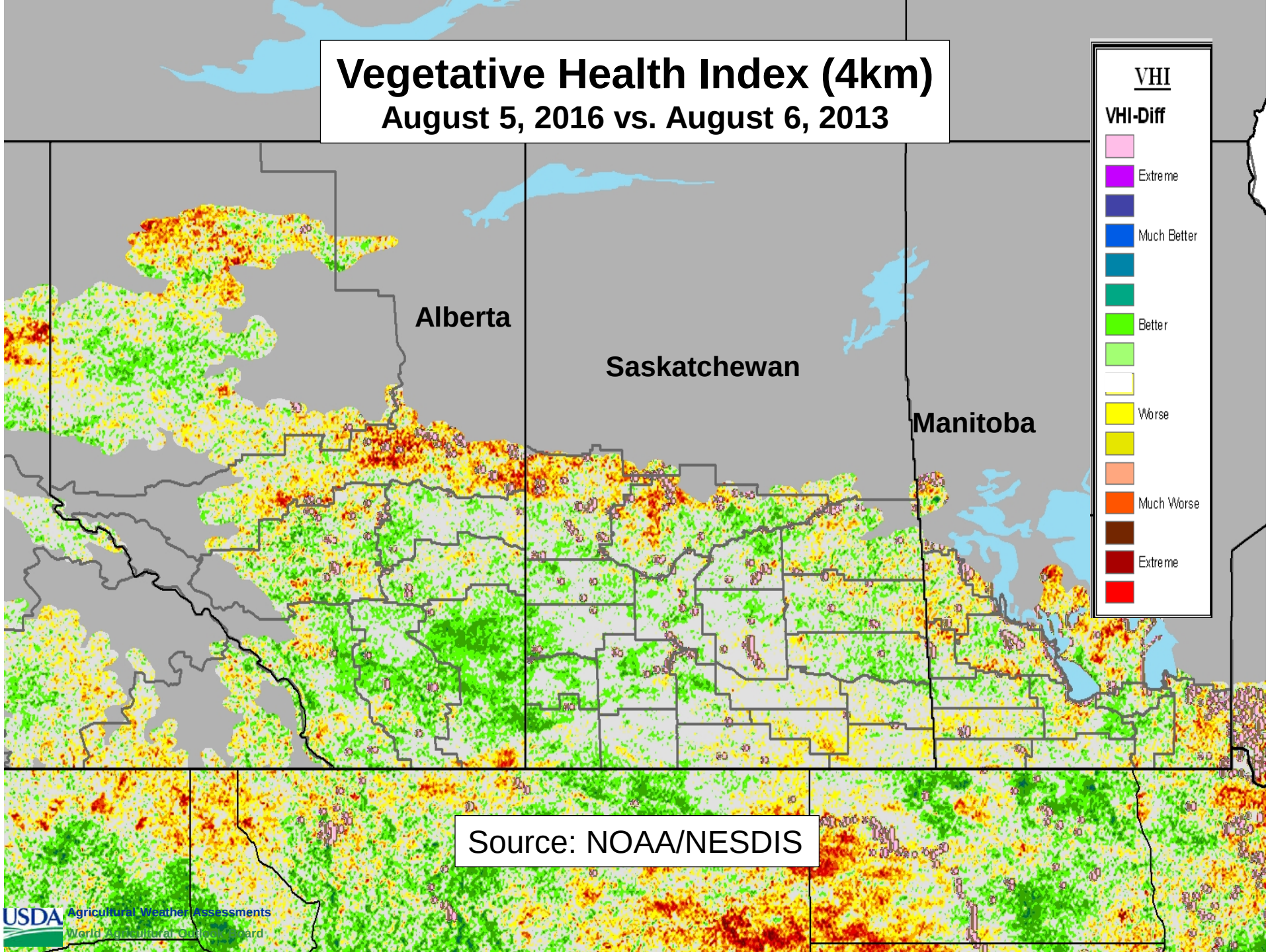


USDA Agricultural Weather Assessments
World Agricultural Outlook Board

*** Current Proposed Yields**

Vegetative Health Index (4km)

August 5, 2016 vs. August 6, 2013

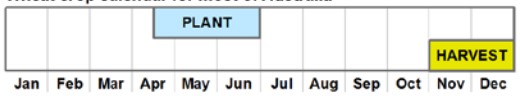


Source: NOAA/NESDIS

Australia: Wheat

United States Department of Agriculture

Wheat crop calendar for most of Australia



Major Crop Area

Minor Crop Area

34

7

17

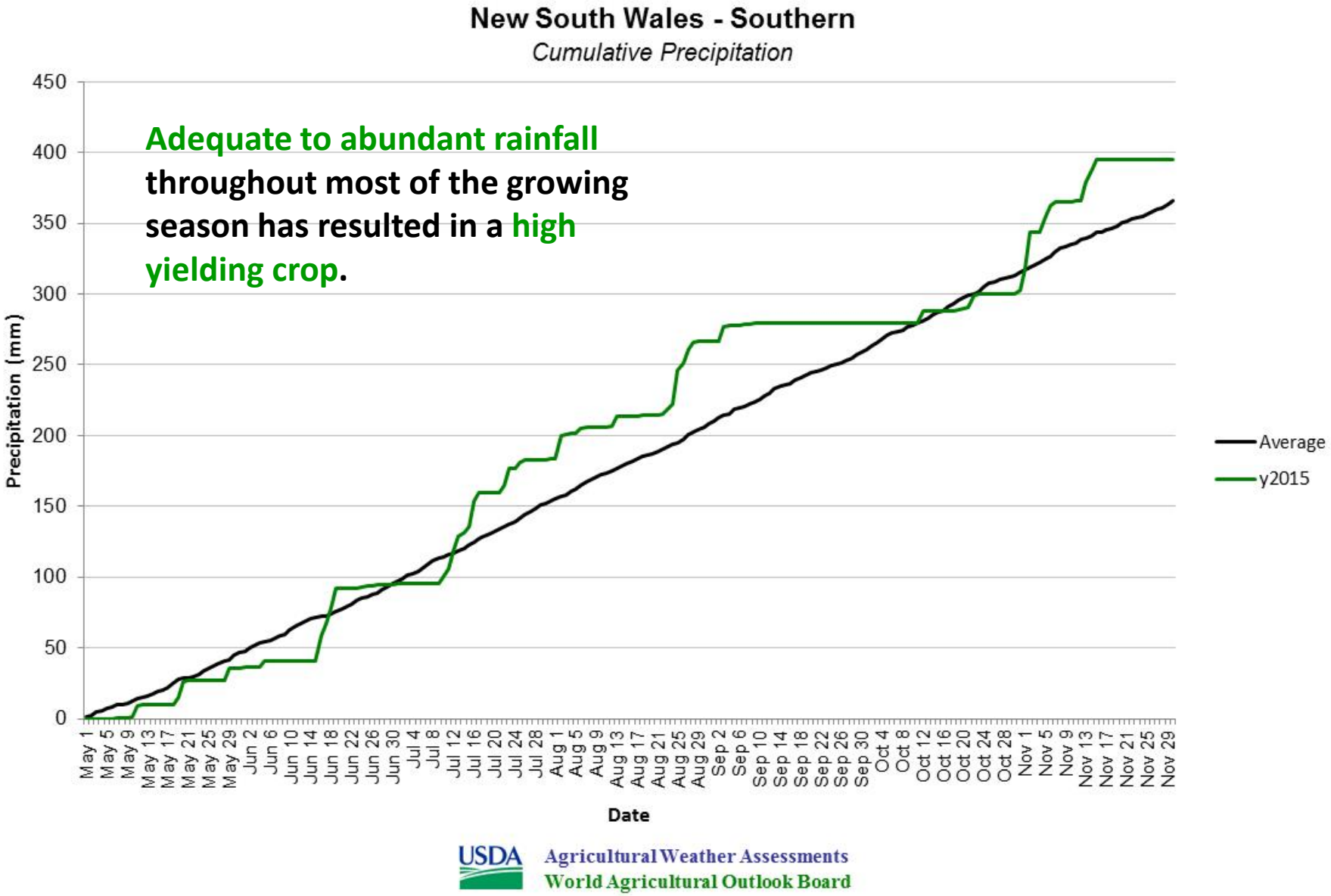
30

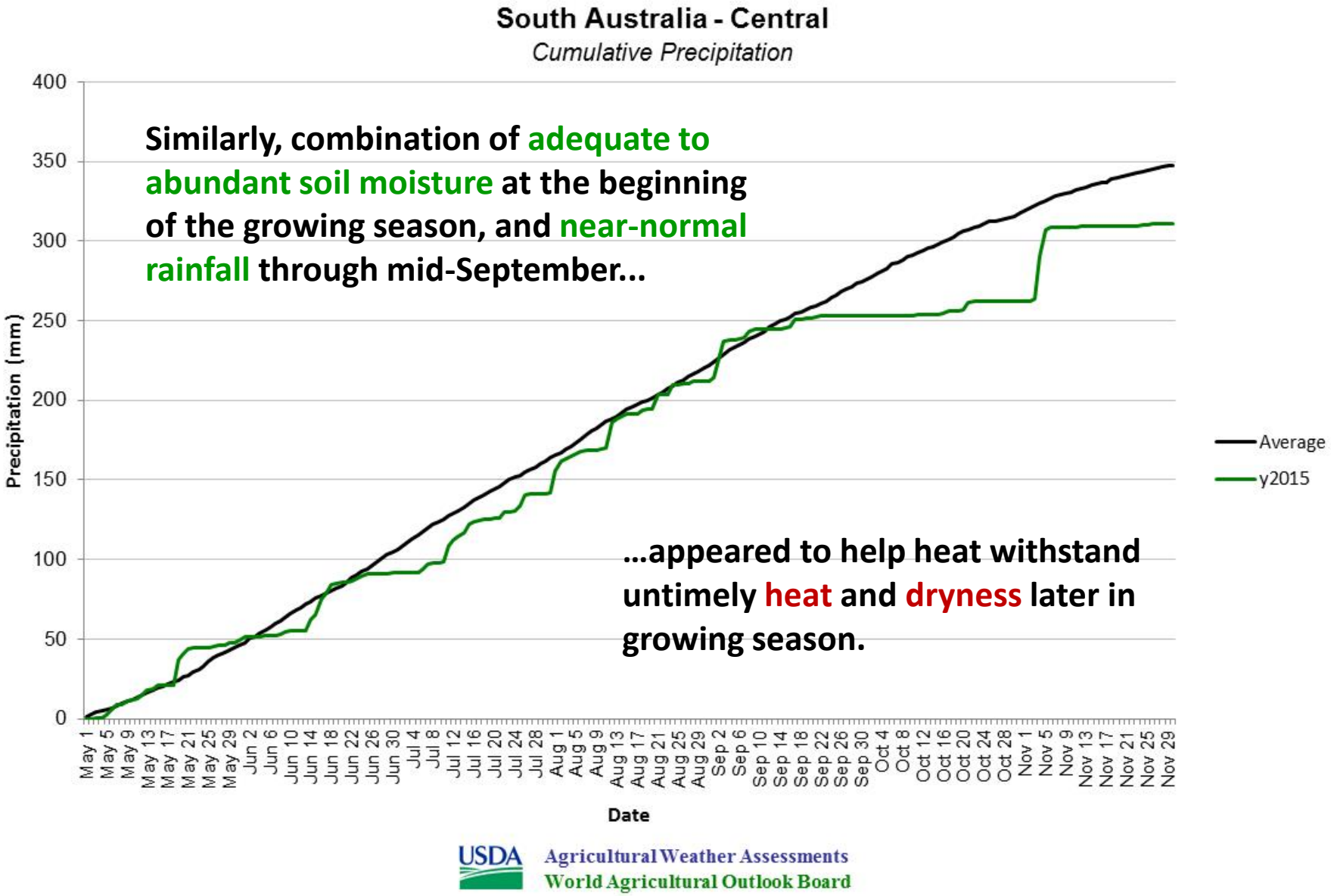
13

- Yellow numbers are percentages, representing the average annual contribution of each state to the total national production. States not numbered contribute less than 1% to the national total.
- Major crop areas combined account for approximately 75% of the total national production annually.
- Major and minor crop areas combined account for approximately 99% of the total national production annually.

Source: Major and minor agricultural areas and state percentages are derived from 2010-11 Agricultural Census data, obtained from the Australian Bureau of Statistics (ABS), and data obtained from the Australian Bureau of Agricultural and Resource Economics and Sciences (ABARES).

This product was developed by the USDA Office of the Chief Economist (OCE) World Agricultural Outlook Board (WAOB).

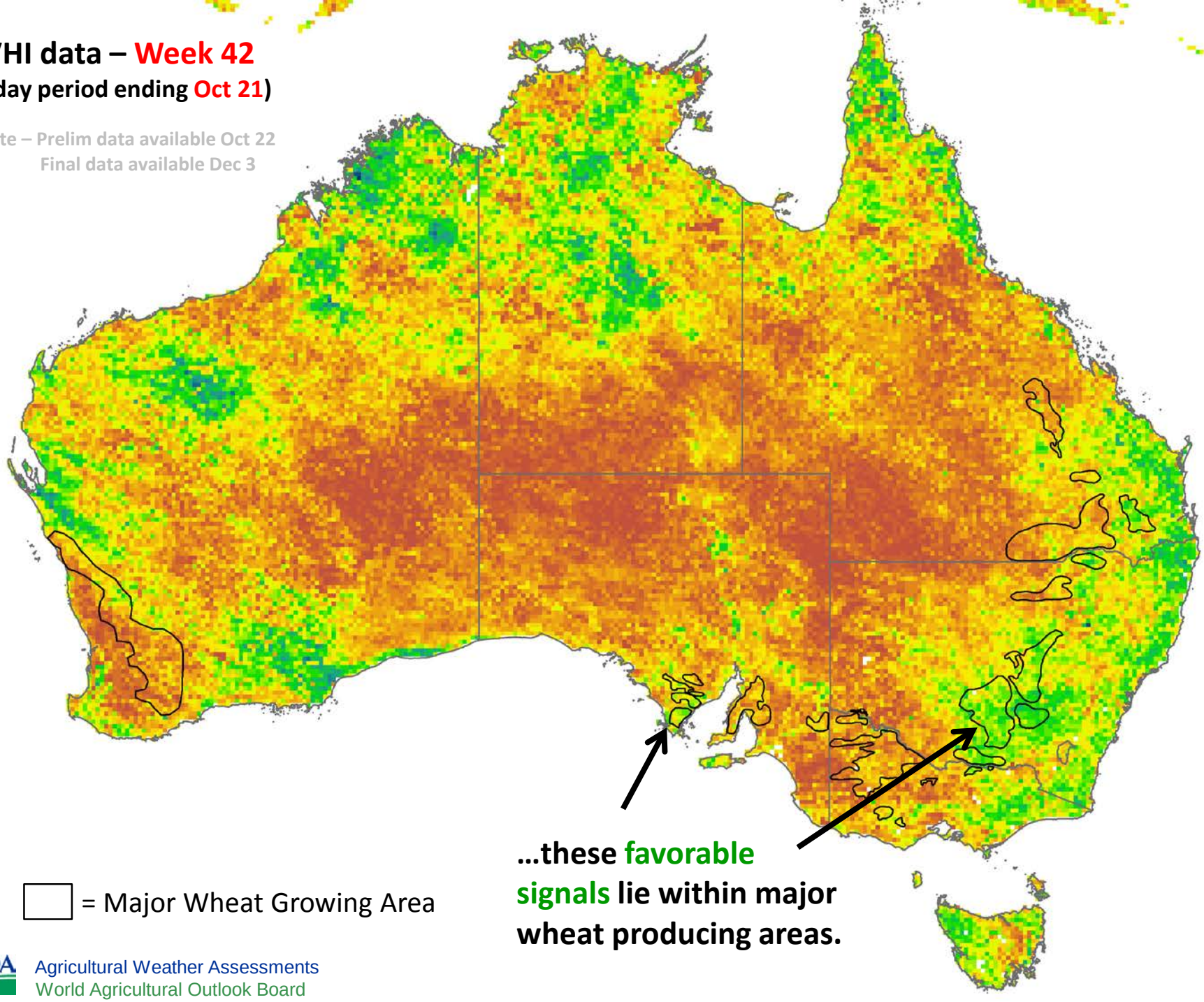

New South Wales - Southern
Cumulative Precipitation
Adequate to abundant rainfall throughout most of the growing season has resulted in a high yielding crop.
Precipitation (mm)
450
400
350
300
250
200
150
100
50
0
May 1
May 5
May 9
May 13
May 17
May 21
May 25
May 29
Jun 2
Jun 6
Jun 10
Jun 14
Jun 18
Jun 22
Jun 26
Jun 30
Jul 4
Jul 8
Jul 12
Jul 16
Jul 20
Jul 24
Jul 28
Aug 1
Aug 5
Aug 9
Aug 13
Aug 17
Aug 21
Aug 25
Aug 29
Sep 2
Sep 6
Sep 10
Sep 14
Sep 18
Sep 22
Sep 26
Sep 30
Oct 4
Oct 8
Oct 12
Oct 16
Oct 20
Oct 24
Oct 28
Nov 1
Nov 5
Nov 9
Nov 13
Nov 17
Nov 21
Nov 25
Nov 29
Date
Average
y2015
USDA
Agricultural Weather Assessments
World Agricultural Outlook Board


South Australia - Central
Cumulative Precipitation
Similarly, combination of adequate to abundant soil moisture at the beginning of the growing season, and near-normal rainfall through mid-September...
…appeared to help heat withstand untimely heat and dryness later in growing season.
Precipitation (mm)
400
350
300
250
200
150
100
50
0
May 1
May 5
May 9
May 13
May 17
May 21
May 25
May 29
Jun 2
Jun 6
Jun 10
Jun 14
Jun 18
Jun 22
Jun 26
Jun 30
Jul 4
Jul 8
Jul 12
Jul 16
Jul 20
Jul 24
Jul 28
Aug 1
Aug 5
Aug 9
Aug 13
Aug 17
Aug 21
Aug 25
Aug 29
Sep 2
Sep 6
Sep 10
Sep 14
Sep 18
Sep 22
Sep 26
Sep 30
Oct 4
Oct 8
Oct 12
Oct 16
Oct 20
Oct 24
Oct 28
Nov 1
Nov 5
Nov 9
Nov 13
Nov 17
Nov 21
Nov 25
Nov 29
Date
Average
y2015
USDA
Agricultural Weather Assessments
World Agricultural Outlook Board

VHI data – Week 42

(7 day period ending Oct 21)

Note – Prelim data available Oct 22
Final data available Dec 3



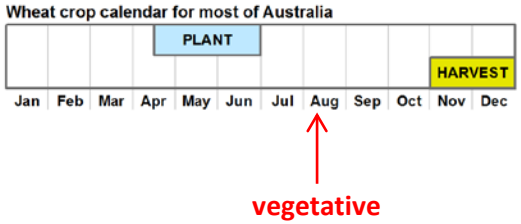
= Major Wheat Growing Area

…these favorable signals lie within major wheat producing areas.

USDA Agricultural Weather Assessments
World Agricultural Outlook Board

Vegetation Health Index vs. Wheat Yields

South Australia



VHI data – Week 32

(7 day period ending Aug 12)

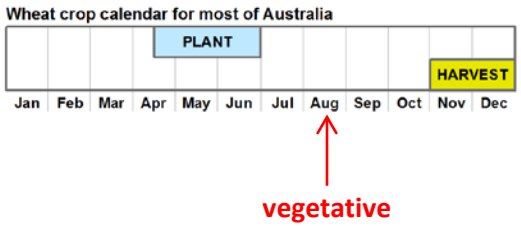
Note – Prelim data available Aug 13
Final data available Sep 24

$R^2 = 0.10$

Based on 13 years of data (2002-2014)

Vegetation Health Index vs. Wheat Yields

South Australia



VHI data – Week 33

(7 day period ending Aug 19)

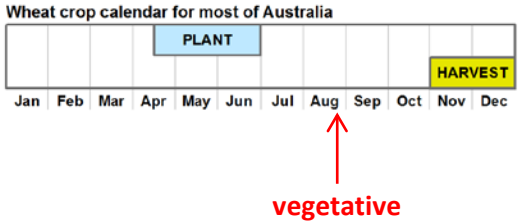
Note – Prelim data available Aug 20
Final data available Oct 1

$R^2 = 0.19$

Based on 13 years of data (2002-2014)

Vegetation Health Index vs. Wheat Yields

South Australia



VHI data – Week 34

(7 day period ending Aug 26)

Note – Prelim data available Aug 27
Final data available Oct 8

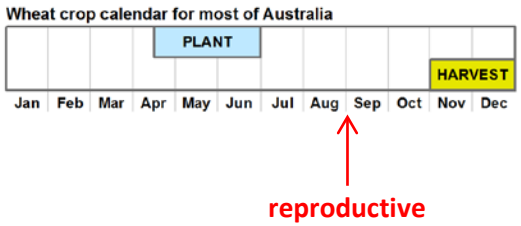
$R^2 = 0.35$

Based on 13 years of data (2002-2014)

USDA Agricultural Weather Assessments
World Agricultural Outlook Board

Vegetation Health Index vs. Wheat Yields

South Australia



VHI data – Week 35

(7 day period ending Sep 2)

Note – Prelim data available Sep 3
Final data available Oct 15

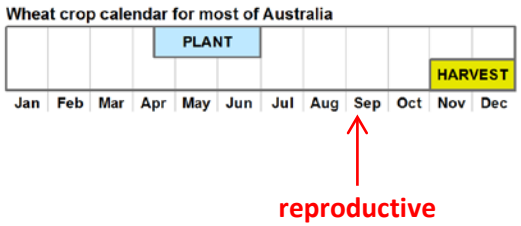
$R^2 = 0.49$

Based on 13 years of data (2002-2014)

USDA Agricultural Weather Assessments
World Agricultural Outlook Board

Vegetation Health Index vs. Wheat Yields

South Australia



VHI data – Week 36

(7 day period ending Sep 9)

Note – Prelim data available Sep 10
Final data available Oct 22

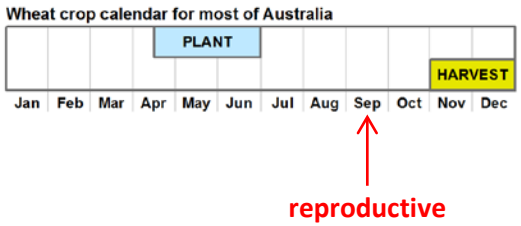
$R^2 = 0.61$

Based on 13 years of data (2002-2014)

USDA Agricultural Weather Assessments
World Agricultural Outlook Board

Vegetation Health Index vs. Wheat Yields

South Australia



VHI data – Week 37

(7 day period ending Sep 16)

Note – Prelim data available Sep 17
Final data available Oct 29

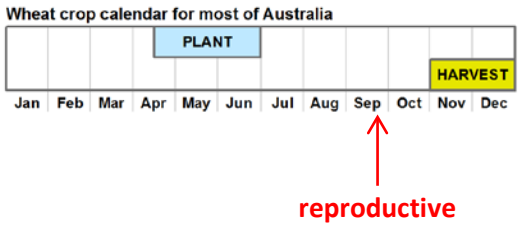
$R^2 = 0.74$

Based on 13 years of data (2002-2014)

USDA Agricultural Weather Assessments
World Agricultural Outlook Board

Vegetation Health Index vs. Wheat Yields

South Australia



VHI data – Week 38

(7 day period ending Sep 23)

Note – Prelim data available Sep 24
Final data available Nov 5

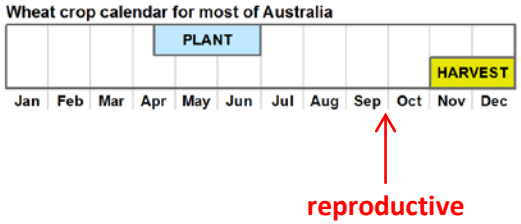
$R^2 = 0.84$

Based on 13 years of data (2002-2014)

USDA Agricultural Weather Assessments
World Agricultural Outlook Board

Vegetation Health Index vs. Wheat Yields

South Australia



VHI data – Week 39

(7 day period ending Sep 30)

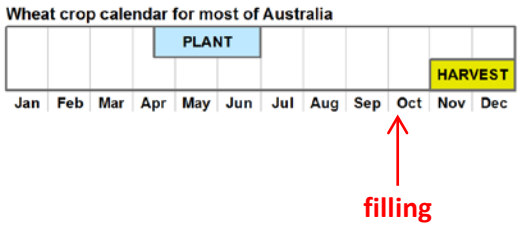
Note – Prelim data available Oct 1
Final data available Nov 12

$R^2 = 0.88$

Based on 13 years of data (2002-2014)

Vegetation Health Index vs. Wheat Yields

South Australia



VHI data – Week 40

(7 day period ending Oct 7)

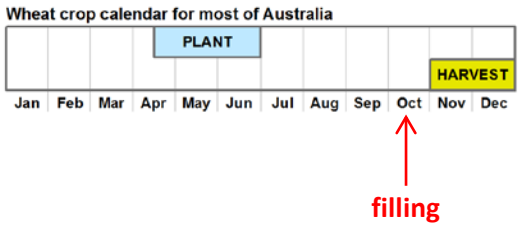
Note – Prelim data available Oct 8
Final data available Nov 19

$R^2 = 0.91$

Based on 13 years of data (2002-2014)

Vegetation Health Index vs. Wheat Yields

South Australia



VHI data – Week 41

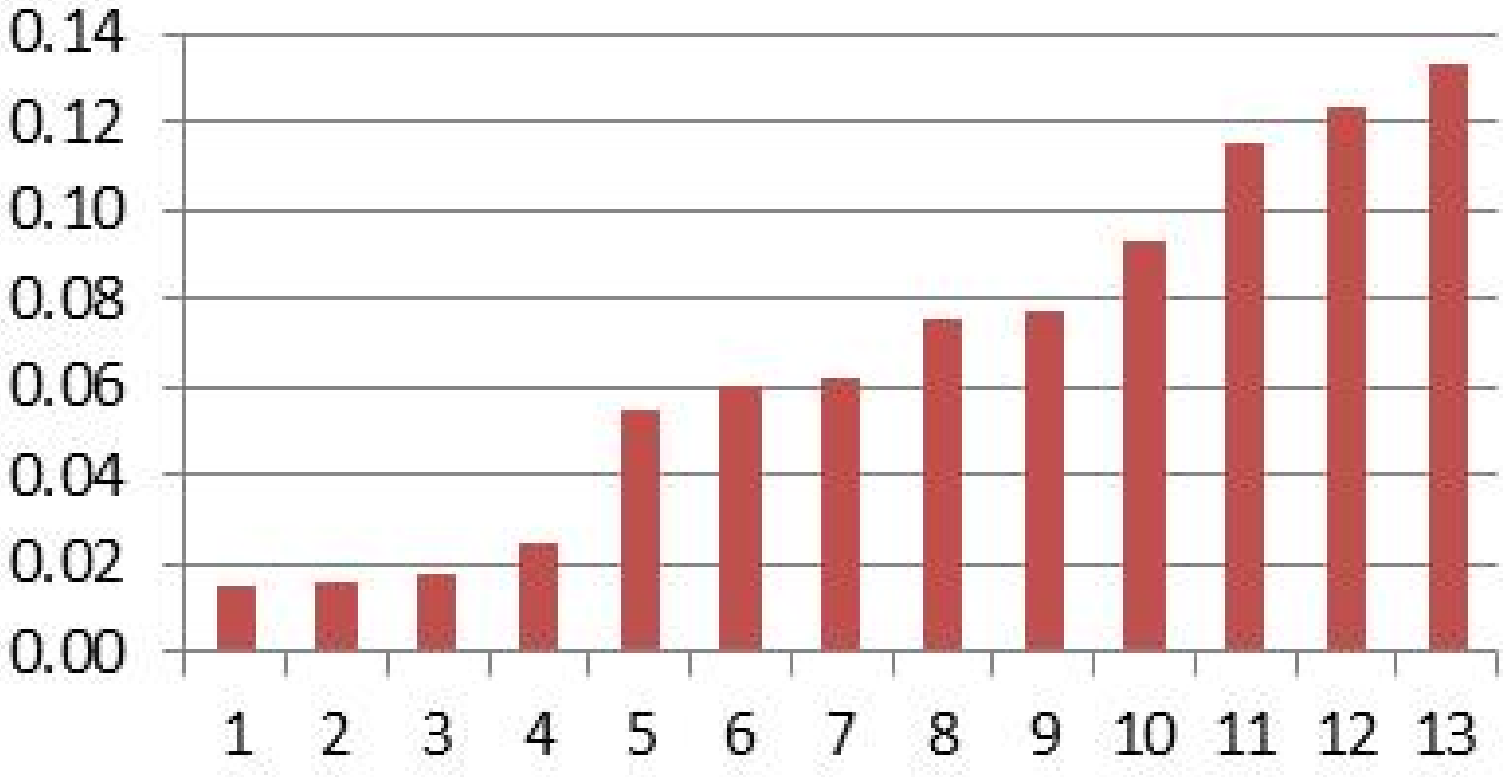
(7 day period ending Oct 14)

Note – Prelim data available Oct 15
Final data available Nov 25

$R^2 = 0.92$

Based on 13 years of data (2002-2014)

Difference between VHI-based and final yield estimates



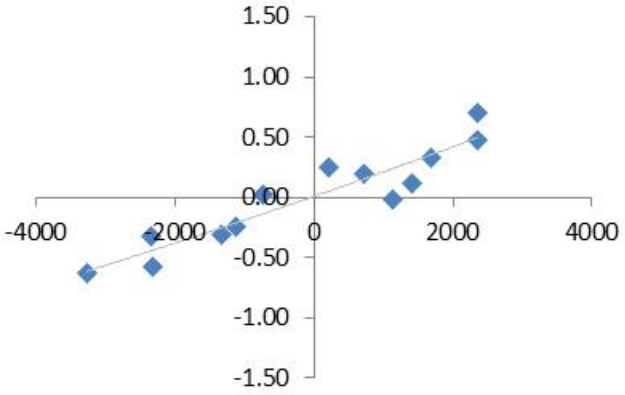
Diff ≤ 0.02 t/ha, 31% (4/13 years)
Diff ≤ 0.08 t/ha, 70% (9/13 years)
Diff ≤ 0.13 t/ha, 100% (13/13 years)

Current VHI-based estimate = 1.87 t/ha

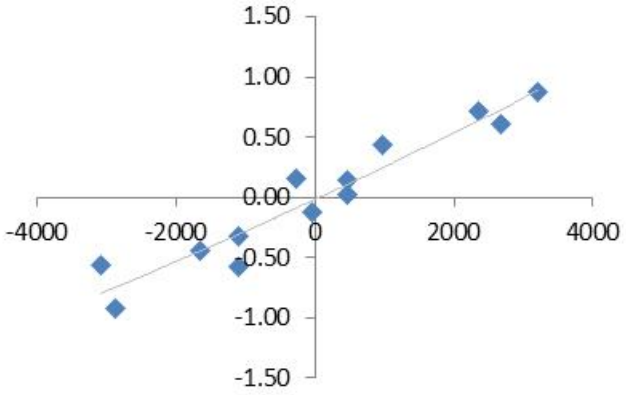
Vegetation Health Index vs. Wheat Yields

The relationship between VHI and wheat yields is strong in these states as well…

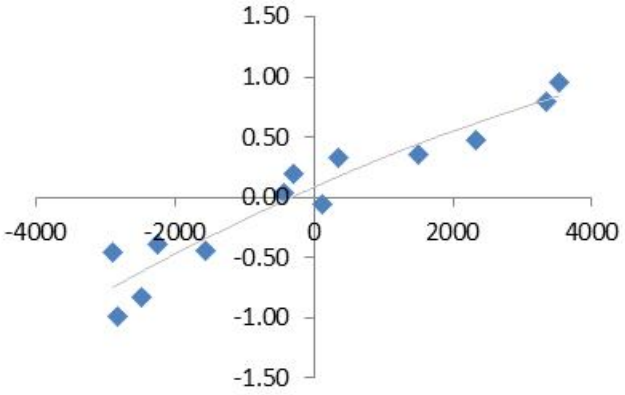
Western Australia: $R^2 = 0.87$ (week 44)



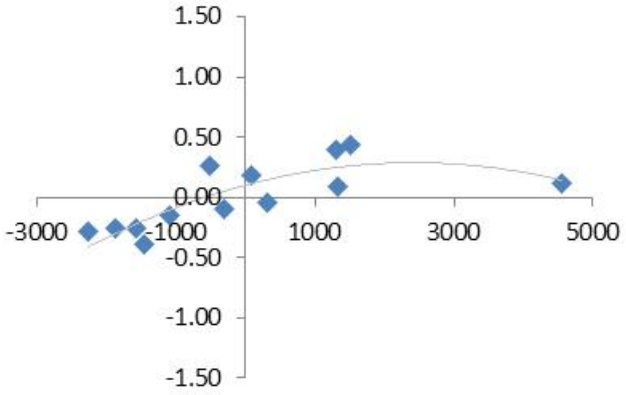
Victoria: $R^2 = 0.92$ (week 42)



New South Wales: $R^2 = 0.91$ (week 42)



Queensland: $R^2 = 0.70$ (week 42)



VHI-derived and ABARES Yield Estimates

Winter Wheat

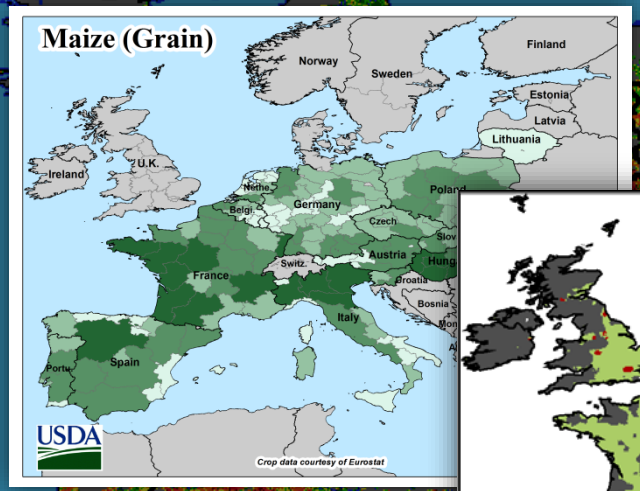
	ABARES area (ha)	VHI yield (t/ha) prod (Mt)	ABARES yield (t/ha) prod (Mt)
Western Australia	5,150,000	**1.71** 8.8	**1.69** 8.7
South Australia	2,360,000	**2.09** 4.9	**1.85** 4.4
Victoria	1,625,000	**1.61** 2.6	**1.54** 2.5
New South Wales	3,900,000	**2.08** 8.1	**1.82** 7.1
Queensland	750,000	**1.69** 1.3	**1.67** 1.3
National Estimate	13,785,000	***1.87*** 25.7	***1.74*** 24.0

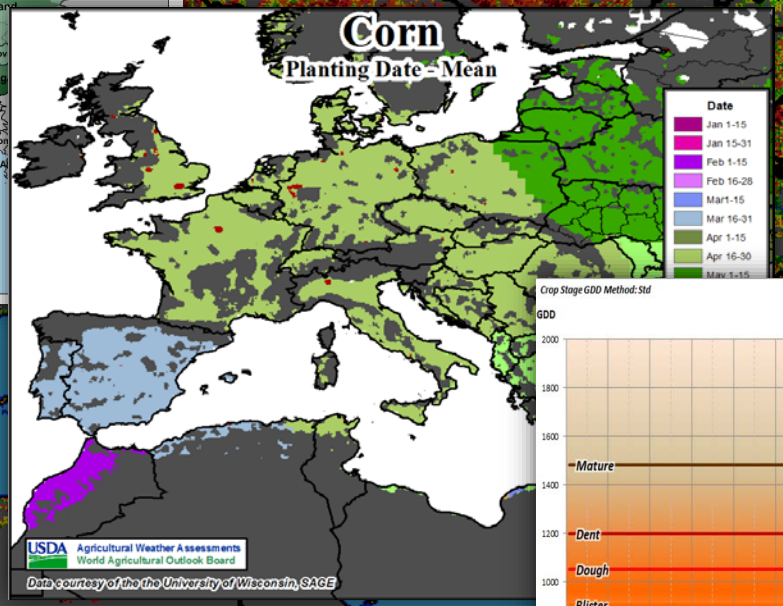
USDA **Agricultural Weather Assessments**
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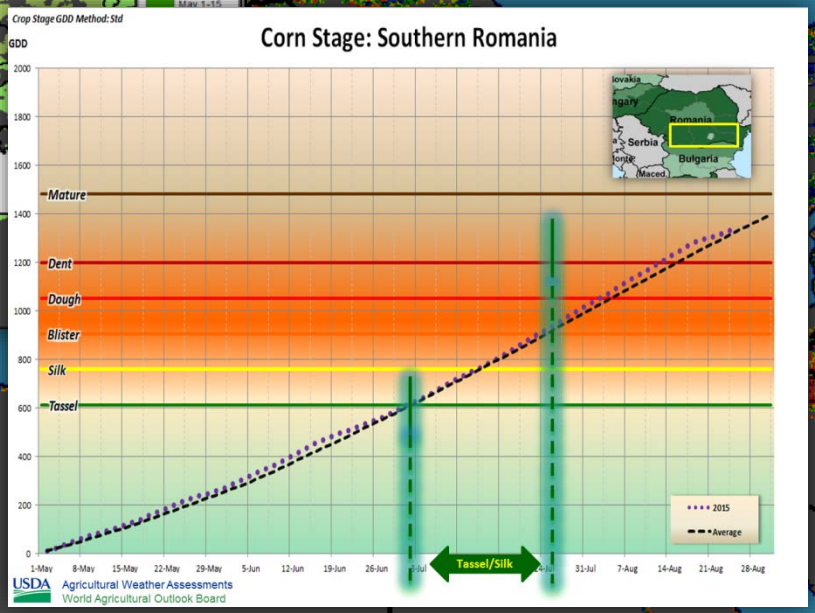
Vegetation Health Index

August 13, 2015

In order to accurately interpret satellite-derived imagery, it is imperative to know the crop-growing regions, crop calendars, and development stage.
WAOB meteorologists have acquired crop-production data, planting dates, and proven GDD-based methodology to assist this effort.







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Vegetation Health Index

June 17, 2017

Russia

Central

Volga

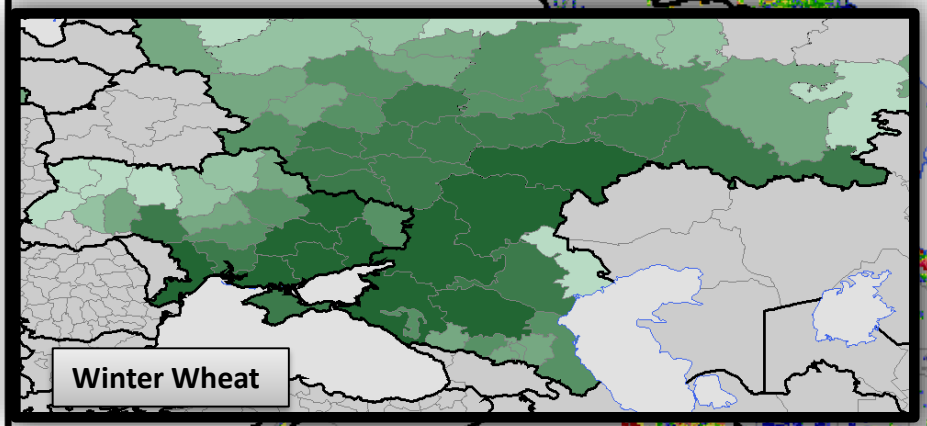
Ukraine

Southern

N. Caucasus

From the August 2017 Lockup:

"In mid- to late –June, as the crop was flowering (north) to filling (south), the VHI supported excellent – perhaps even record-setting – winter wheat yields for a second straight year."



VHI Value

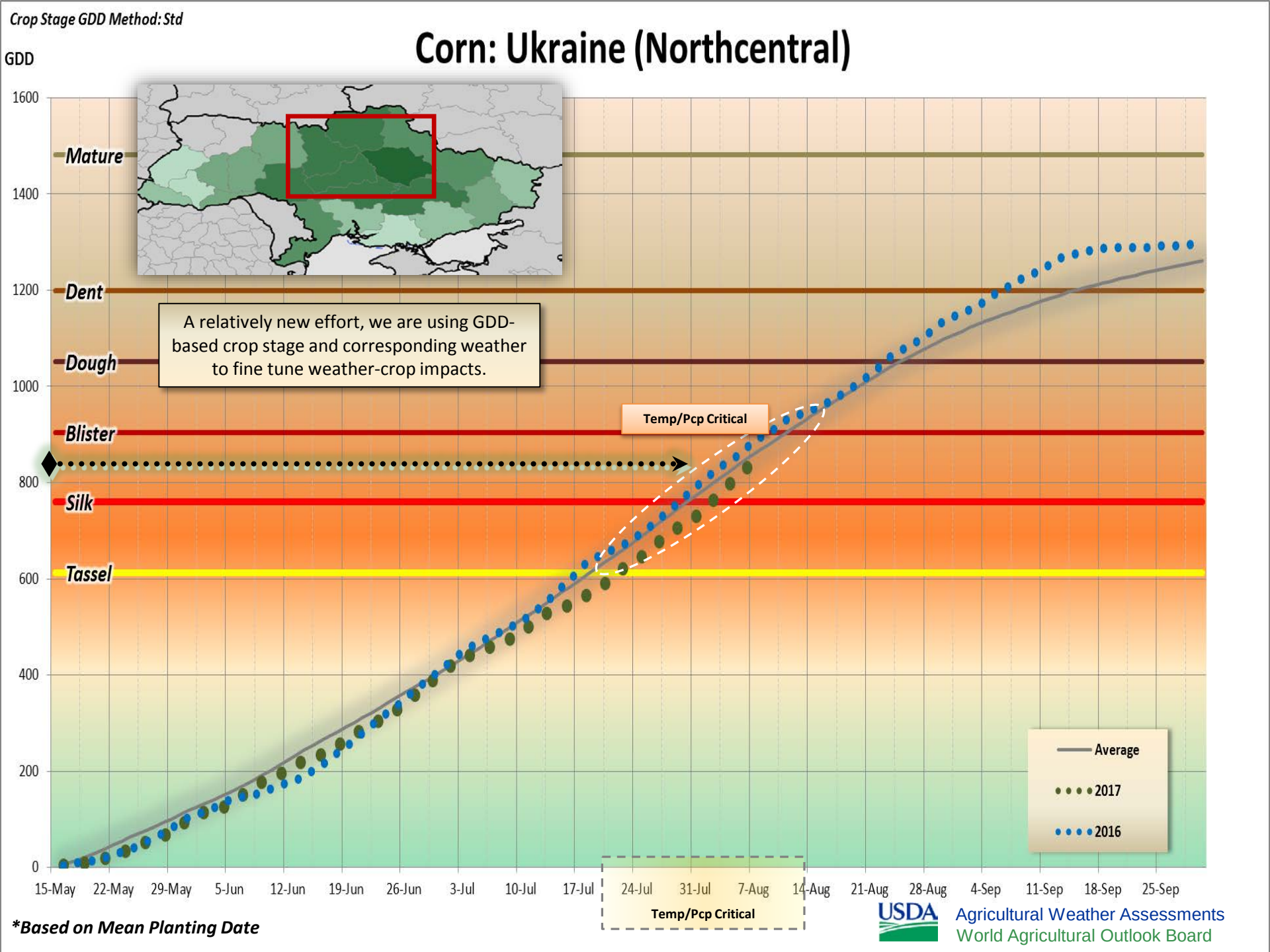
85 - 100	Better
73 - 84	
61 - 72	
49 - 60	
37 - 48	
25 - 36	
13 - 24	
7 - 12	
1 - 6	Worse

Crop areas are unmasked

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Crop Stage GDD Method: Std

Corn: Ukraine (Northcentral)

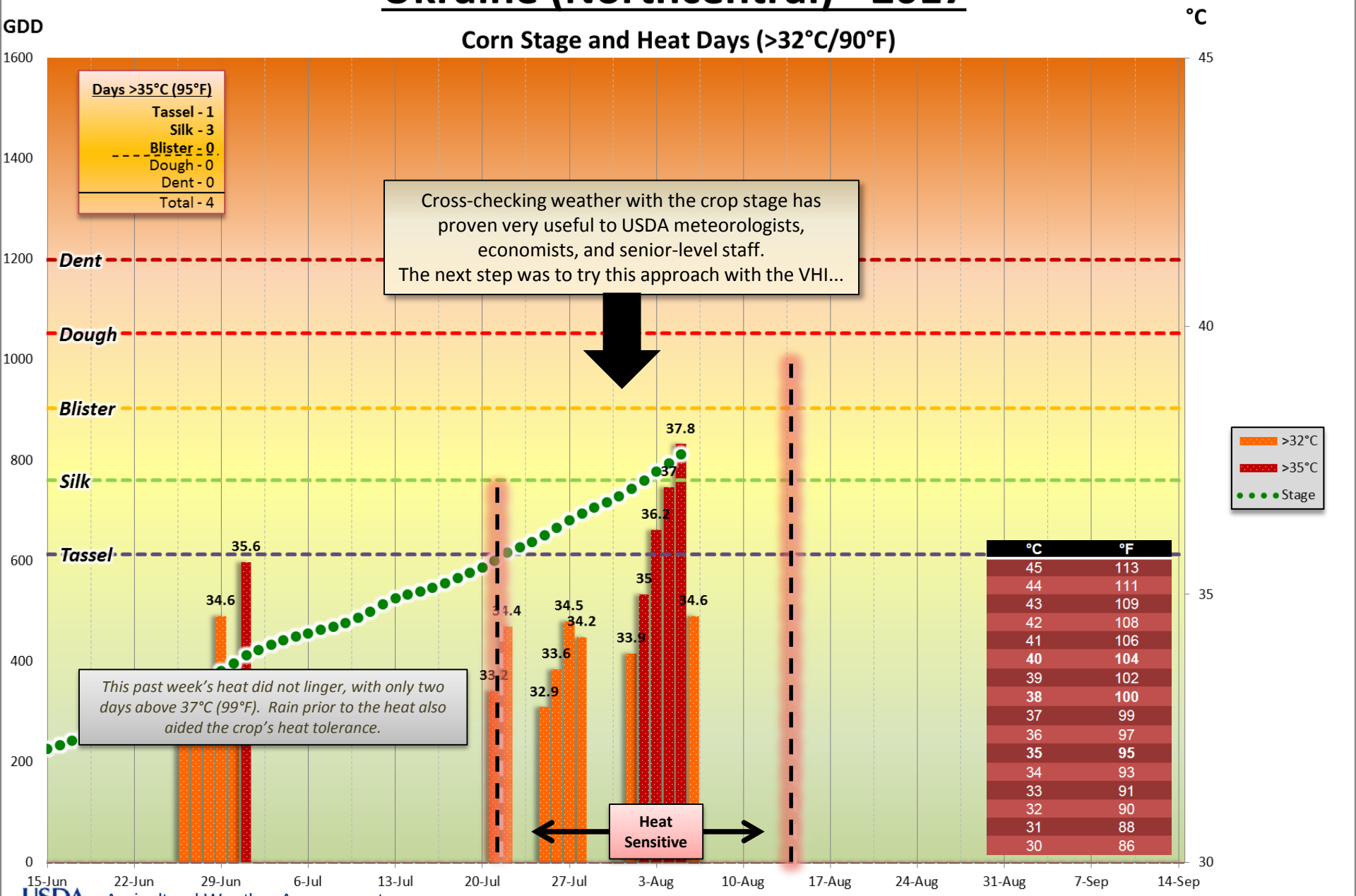


***Based on Mean Planting Date**

USDA Agricultural Weather Assessments
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Crop Stage GDD Method: 0

Ukraine (Northcentral) - 2017



°C	°F
45	113
44	111
43	109
42	108
41	106
40	**104**
39	102
38	**100**
37	99
36	97
35	**95**
34	93
33	91
32	90
31	88
30	86

GDD data
NC Ukraine

Date	2017	Average	2016	2015	2014	2013	2012	2011	2010	2009	2008	2007	2006	2005	2004	2003	2002	2001	2000	1999	1998	1997	1996	1995	1994
Years Back >			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
15-May-17	0.0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16-May-17	4.5	5.9	4.4	1.9	11.2	11.2	10.2	5.6	9.5	2.2	4.1	9.9	3.4	5.3	0	9.5	6.8	5.2	5.7	1.7	1.7	11.9	10	0	6.2
17-May-17	0.1				23.1	22.4	17.7	11.5	16.4	6.8	11.1	20	9	12	1.4	12.3	12.6	12	7.8	2.2	6	13.6	20.8	1.4	14.5
18-May-17	1				33.1	33.6	25.2	18.8	18.1	10.1	15.1	25.1	12.7	20.5	2.8	18.1	18.1	20	13.6	2.2	11.7	24.3	31.8	5.3	25.7
19-May-17	1				44.9	45	31.8	24.4	25.2	12.9	19.2	29.9	16.1	25.4	4.2	23.6	19.8	26.8	21.1	3	17.8	30.9	43.5	10.9	37.6
20-May-17	1				55.8	56.9	38.9	30.3	31.9	15.7	23.3	34.9	19.5	30.8	5.6	29.9	19.8	30.5	25.3	7.6	24.2	40	55.9	18.3	49.1
21-May-17	1				66.9	68.1	46.7	36.4	38.3	18.6	27.4	39.8	22.8	36.2	6.9	35.4	20	33.4	31.1	11.1	28.9	46	68.3	24.8	58.6
22-May-17	2				77.8	77.8	53.7	42.4	44.7	21.5	31.6	44.7	26.2	41.6	8.3	41.2	22.5	35.8	34.2	16.2	34.3	53.7	71.1	32.3	63.4
23-May-17	28.7	53.1	32	51.8	89.9	86.9	60.8	48.5	51.1	24.4	35.8	49.6	29.9	46.9	9.7	46.9	27.9	35.8	39.9	22.1	34.8	63	73.7	39.1	65.7
24-May-17	37.9	59.8	38	62.7	103.2	98	67.8	54.5	57.4	27.3	40	54.5	33.5	52.1	11.1	52.4	35.5	36.5	46	28.5	34.8	65	77.4	49.7	71.5
25-May-17	45.5	66.5	45	73.8	116.7	106.2	74.8	60.6	63.7	30.2	44.2	59.4	37.1	57.4	12.5	57.9	45.4	43	52.9	36.1	37.3	65.3	82.2	58.5	76.3
26-May-17	52.5	73.2	53.3	86	130.1	114.3	81.8	66.7	69.9	33.1	48.3	64.3	40.8	62.8	13.9	63.4	55	49.2	58.9	43.9	39.8	67.2	86.9	67.4	80.9
27-May-17	58.9	80.1	62.4	97.1	142.8	124	88.9	72.8	76.2	36.1	52.4	69.2	44.4	68.2	15.3	68.9	64.8	55.8	65.1	51.8	42.3	69.1	91.5	76.3	85.5
28-May-17	65.4	87.3	72.2	104.2	155.1	130.4	95.9	78.9	82.5	39.1	56.5	74.1	48.1	73.6	16.8	74.5	75.2	61.4	71.2	59.8	44.8	71.1	95.9	85.2	90.1
29-May-17	74.8	94.5	82.4	109.3	166.2	137.3	102.9	84.9	88.8	42.1	60.7	79.1	51.8	79.1	18.2	80.1	84	67.1	77.4	67.8	47.3	73.1	100.3	94.1	94.8

VHI data (Poltava)

YEAR	VEE	SMN	SMT	VCI	TCI	VHI
1981	35	0.238	291.57	11.48	2238:14:24	52.37
1981	36	0.244	291.61	19.94	82.23	51.08
1981	37	0.25	291.4	31.42	66.43	48.92
1981	38	0.254	290.75	43.65	54.65	49.15
1981	39	0.254	289.5	53.91	46.28	50.1
1981	40	0.249	287.54	62.42	42.35	52.39
1981	41	0.243	285.98	68.64	43.66	56.65
1981	42	0.233	284.49	73.24	51.42	62.33
1981	43	0.197	278.33	74.28	56.38	65.33
1981	44	0.168	274.71	70.1	56.26	63.18
1981	45	0.135	270.2	60.35	63.15	61.75
1981	46	0.11	266.14	53.81	67.08	60.44
1981	47	0.091	262.73	49.77	68.47	59.12
1981	48	0.079	260.21	49	69.83	59.41
1981	49	0.069	257.97	46.06	72.3	59.18
1981	50	0.063	256.36	46.99	70.76	58.87
1981	51	0.057	255.15	47.33	69.52	58.43
1981	52	0.049	254.76	46.37	66.55	56.46
1982	1	0.044	255.31	46.66	61.44	54.05
1982	2	0.042	257.37	45.34	51.39	48.37
1982	3	0.041	259.08	43.25	45.76	44.5
1982	4	0.039	260.68	41.6	41.89	41.74
1982	5	0.037	261.76	37	41.55	39.27

Tassel	Silk	Blister	Dough	Dent	Mature
		GDD Cutoffs			
613	760			1199	1482

Expanding on this technique, we are using Wx data & corresponding GDD-based **crop stage** in conjunction with VHI admin-level ascii data and extracting a **stage-specific VHI**.

	A	B	C	D	E	F	G	H	I	J	K
1	Date	2017	Avg	2016	2015	2014	2013	2012	2011	2010	2009
2	Years Back >			1	2	3	4	5	6	7	8
3	Week @ Stage	32	33	32	32	31	31	31	32	30	32
4	VHI @ Stage	#N/A	#N/A	71.22	68.63	51.43	56.32	43.58	70.75	38.03	57.39
5	SumPcp @ Stages	1854.80	15529.49	9943.40	8197.00	10601.20	8490.70	6733.30	13816.90	5593.70	9571.70
6	AvgPcp @ Stages	109.11	218.73	194.97	167.29	216.35	139.19	143.26	255.87	164.52	159.53
7	AvgTmax @ Stages	33.02	27.22	31.00	31.82	31.33	28.49	32.09	29.92	36.02	28.53
8	AvgTmin @ Stages	15.38	10.71	12.95	12.43	12.93	11.84	14.16	13.06	17.88	11.27
9	QC			8/14	8/8	8/10	8/5	8/5	8/1	8/6	7/29	8/11
10	QC			33	32	32	31	31	31	32	30	32
11	QC - VHI @ Stage (prev Row)	#N/A	#N/A	71.22	68.63	51.43	56.32	43.58	70.75	38.03	57.39
12	QC Week# (Compute via GDD!)	32	33	32	32	31	31	31	32	30	32

Stage-specific VHI & Wx

Select VHI Stage

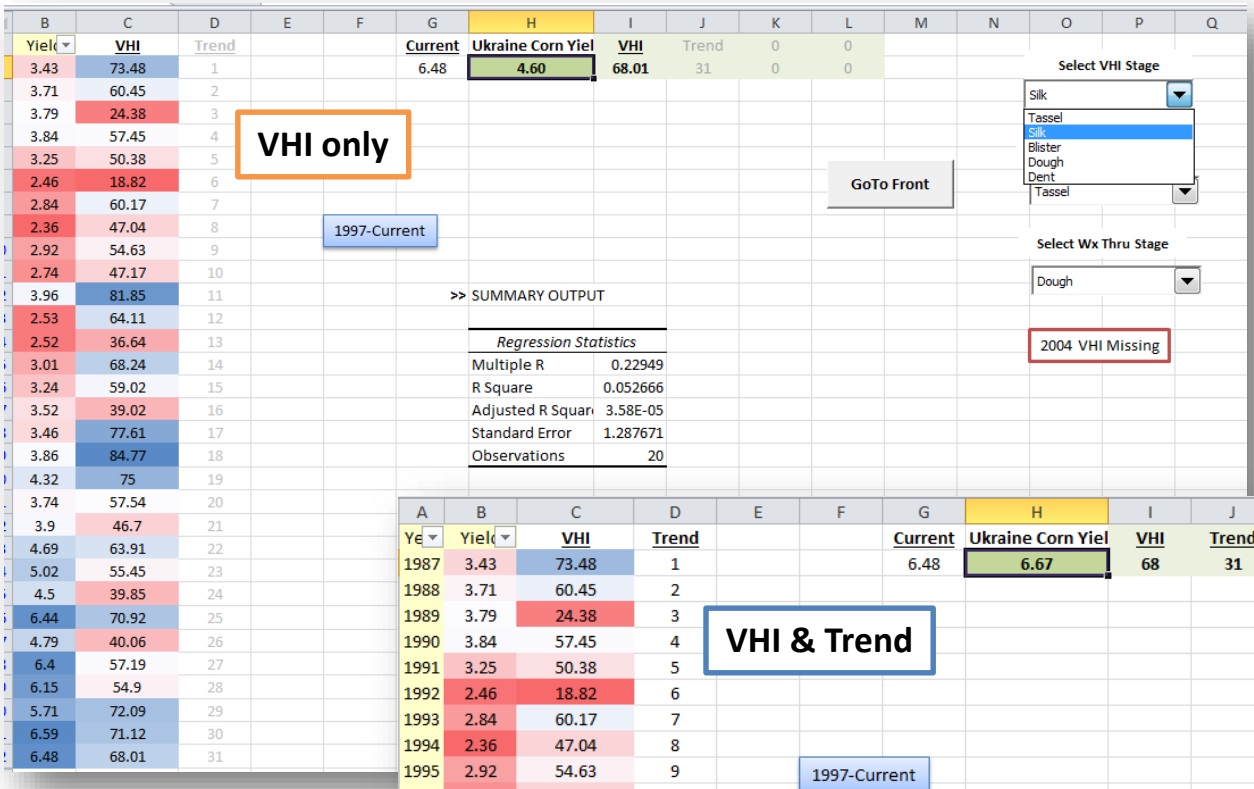
Blister

Tassel
Silk
Blister
Dough
Dent

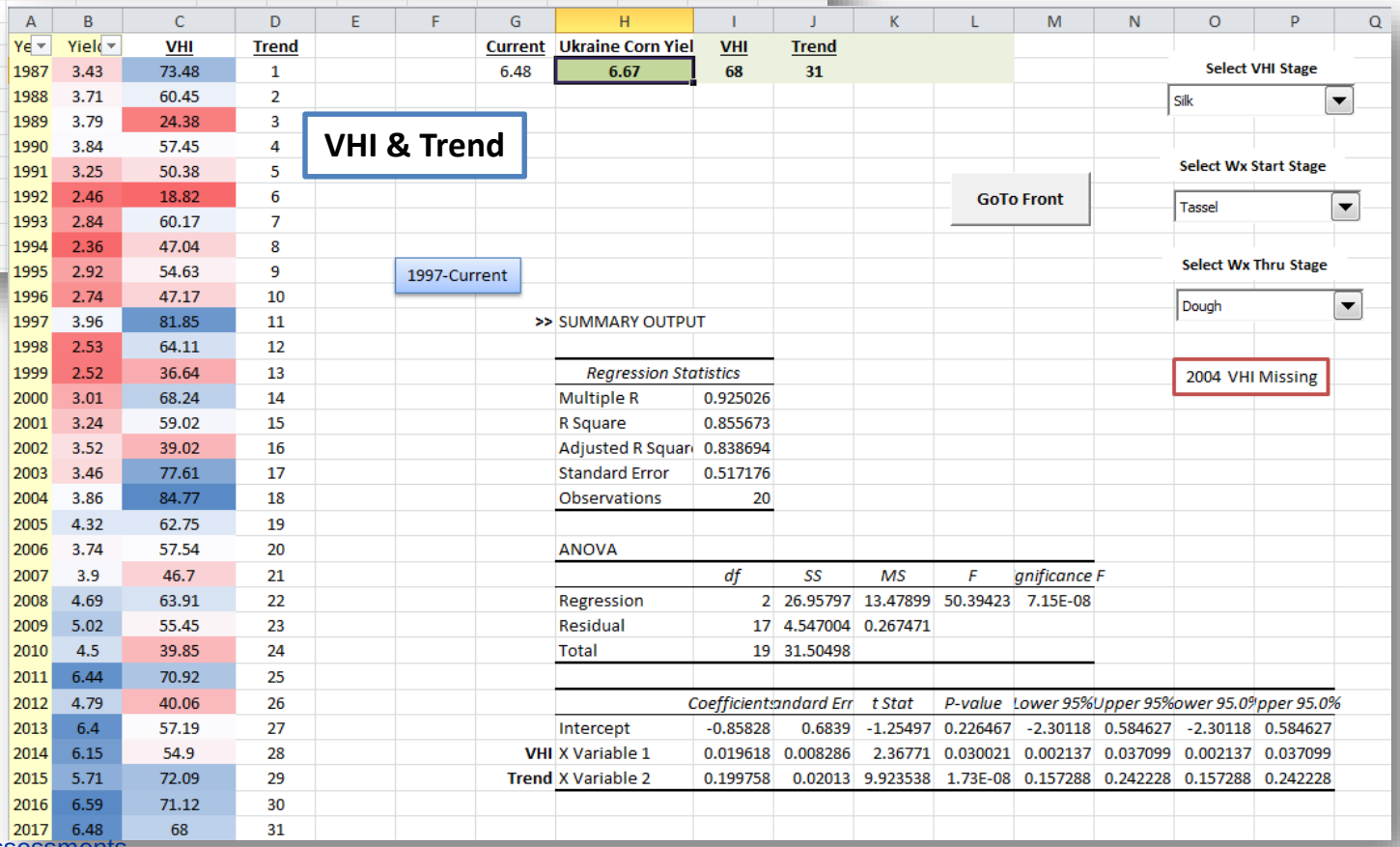
Tassel

Select Wx Thru Stage

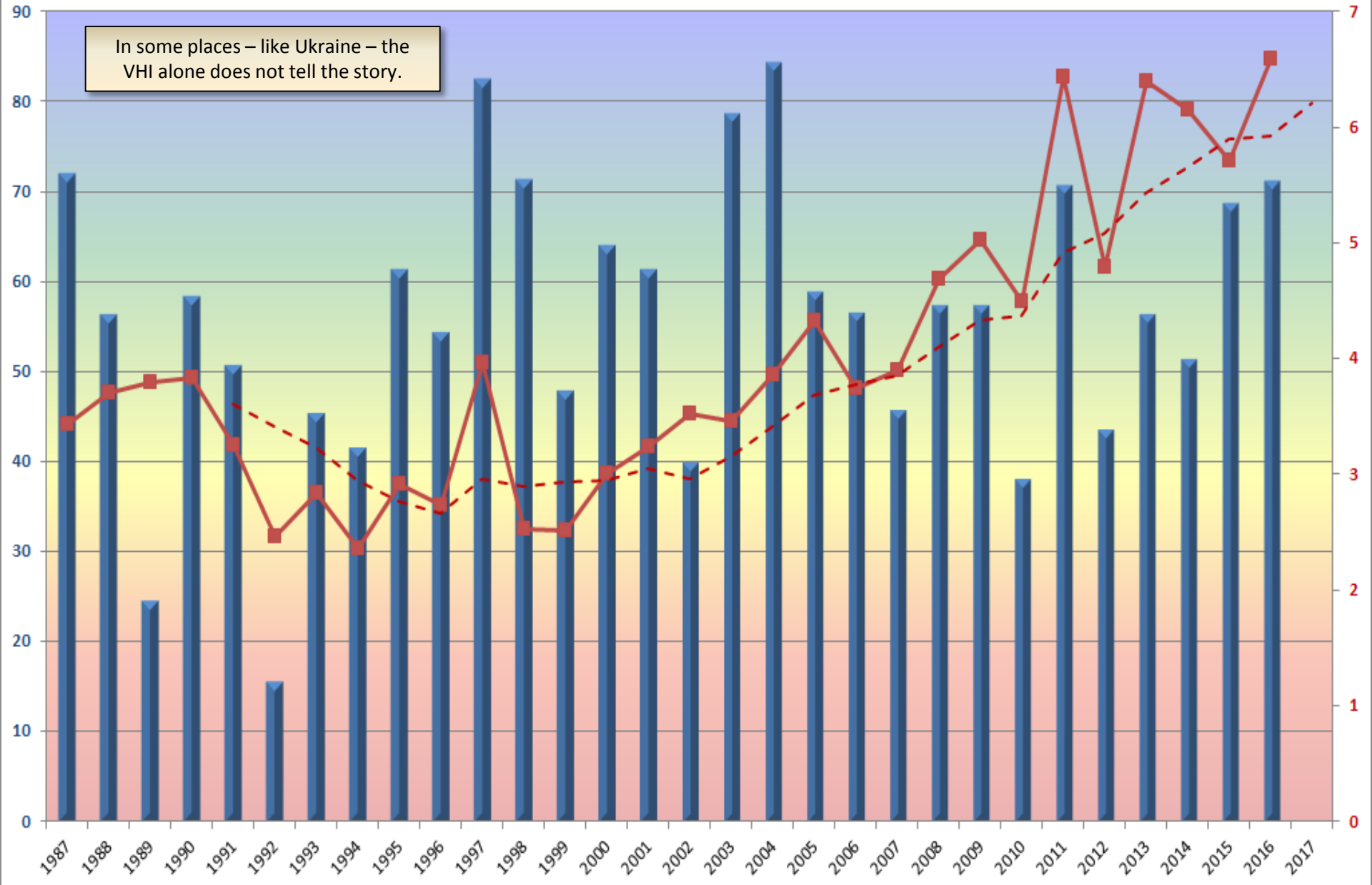
Dough



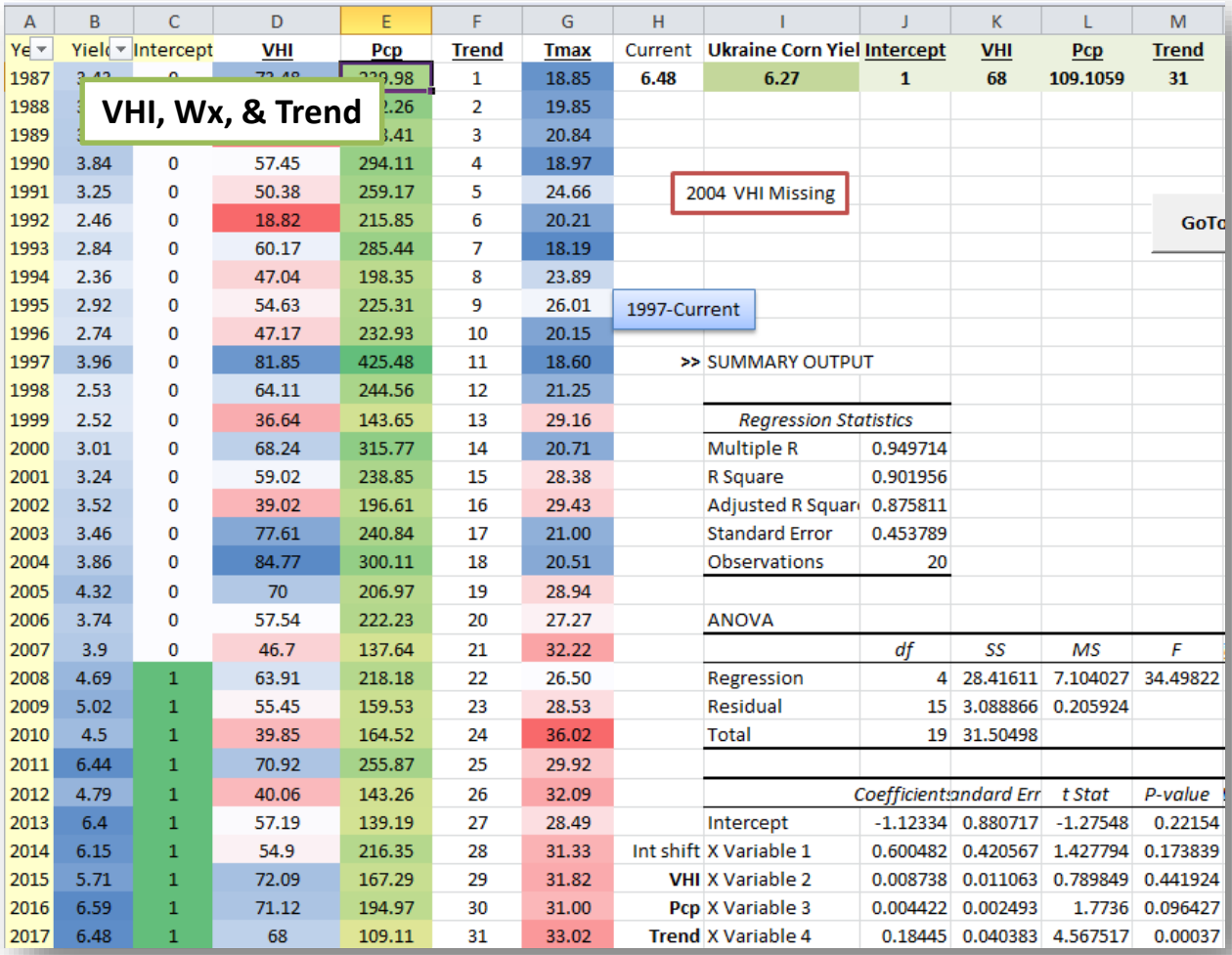
Scenarios (VHI @ various crop stages) are tested, looking for the best fit. In the case of Ukraine, the VHI alone (left) does not score well, but when paired with trend (below) it scores very high at Silk and Blister.



Ukraine VHI for Corn @ Blister



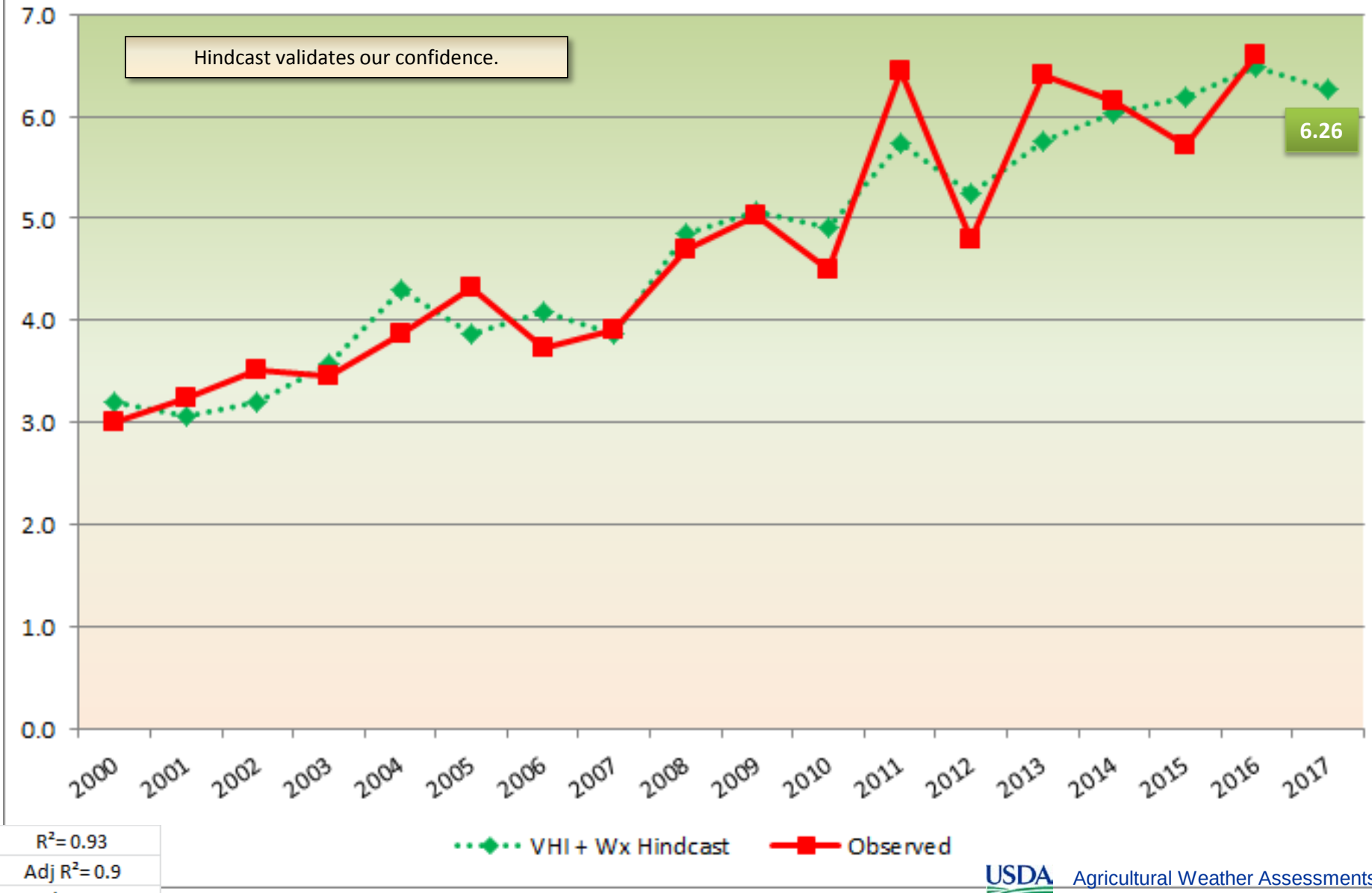
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Ye	Yield	Intercept	VHI	Pcp	Trend	Tmax	Current	Ukraine Corn Yiel	Intercept	VHI	Pcp	Trend
1987	[illegible]	0	[illegible]	[illegible]98	1	18.85	6.48	6.27	1	68	109.1059	31
1988	[illegible]	0	[illegible]	[illegible].26	2	19.85						
1989	[illegible]	0	[illegible]	[illegible].41	3	20.84						
1990	3.84	0	57.45	294.11	4	18.97						
1991	3.25	0	50.38	259.17	5	24.66						
1992	2.46	0	18.82	215.85	6	20.21						
1993	2.84	0	60.17	285.44	7	18.19						
1994	2.36	0	47.04	198.35	8	23.89						
1995	2.92	0	54.63	225.31	9	26.01						
1996	2.74	0	47.17	232.93	10	20.15						
1997	3.96	0	81.85	425.48	11	18.60						
1998	2.53	0	64.11	244.56	12	21.25						
1999	2.52	0	36.64	143.65	13	29.16						
2000	3.01	0	68.24	315.77	14	20.71						
2001	3.24	0	59.02	238.85	15	28.38						
2002	3.52	0	39.02	196.61	16	29.43						
2003	3.46	0	77.61	240.84	17	21.00						
2004	3.86	0	84.77	300.11	18	20.51						
2005	4.32	0	70	206.97	19	28.94						
2006	3.74	0	57.54	222.23	20	27.27						
2007	3.9	0	46.7	137.64	21	32.22						
2008	4.69	1	63.91	218.18	22	26.50						
2009	5.02	1	55.45	159.53	23	28.53						
2010	4.5	1	39.85	164.52	24	36.02						
2011	6.44	1	70.92	255.87	25	29.92						
2012	4.79	1	40.06	143.26	26	32.09						
2013	6.4	1	57.19	139.19	27	28.49						
2014	6.15	1	54.9	216.35	28	31.33						
2015	5.71	1	72.09	167.29	29	31.82						
2016	6.59	1	71.12	194.97	30	31.00						
2017	6.48	1	68	109.11	31	33.02						

The VHI (@ onset of Blister) paired with Wx, Trend, as well as an adjustment for a technology shift ~ 2007, shows significant skill.

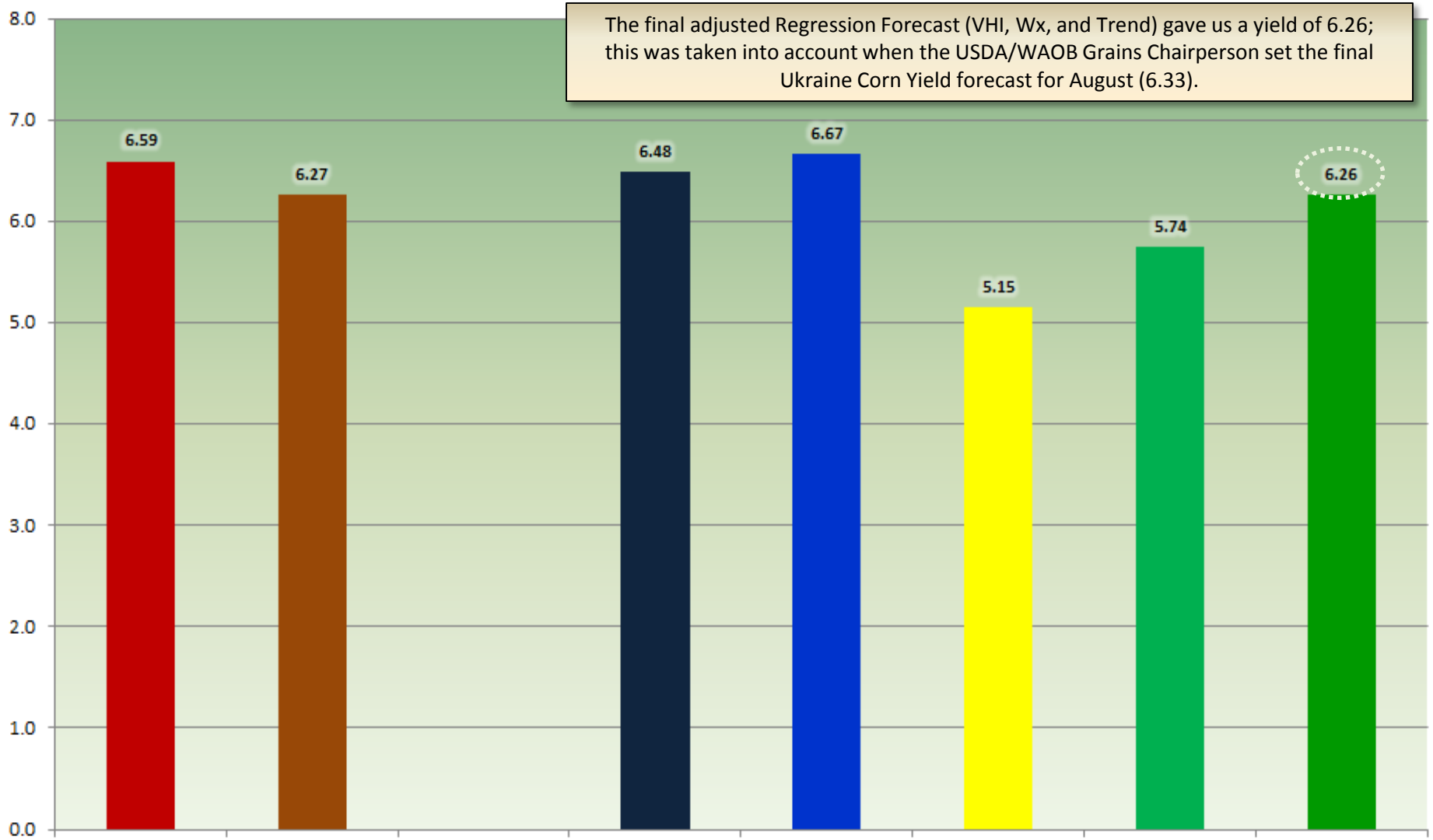
Regression: VHI & Wx (Intercept Adjustment)



$R^2 = 0.93$
Adj $R^2 = 0.9$
+/- 0.41

Ukraine Corn Yield

The final adjusted Regression Forecast (VHI, Wx, and Trend) gave us a yield of 6.26; this was taken into account when the USDA/WAOB Grains Chairperson set the final Ukraine Corn Yield forecast for August (6.33).



*Includes Trend

Thank You !

mbrusberg@oce.usda.gov

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

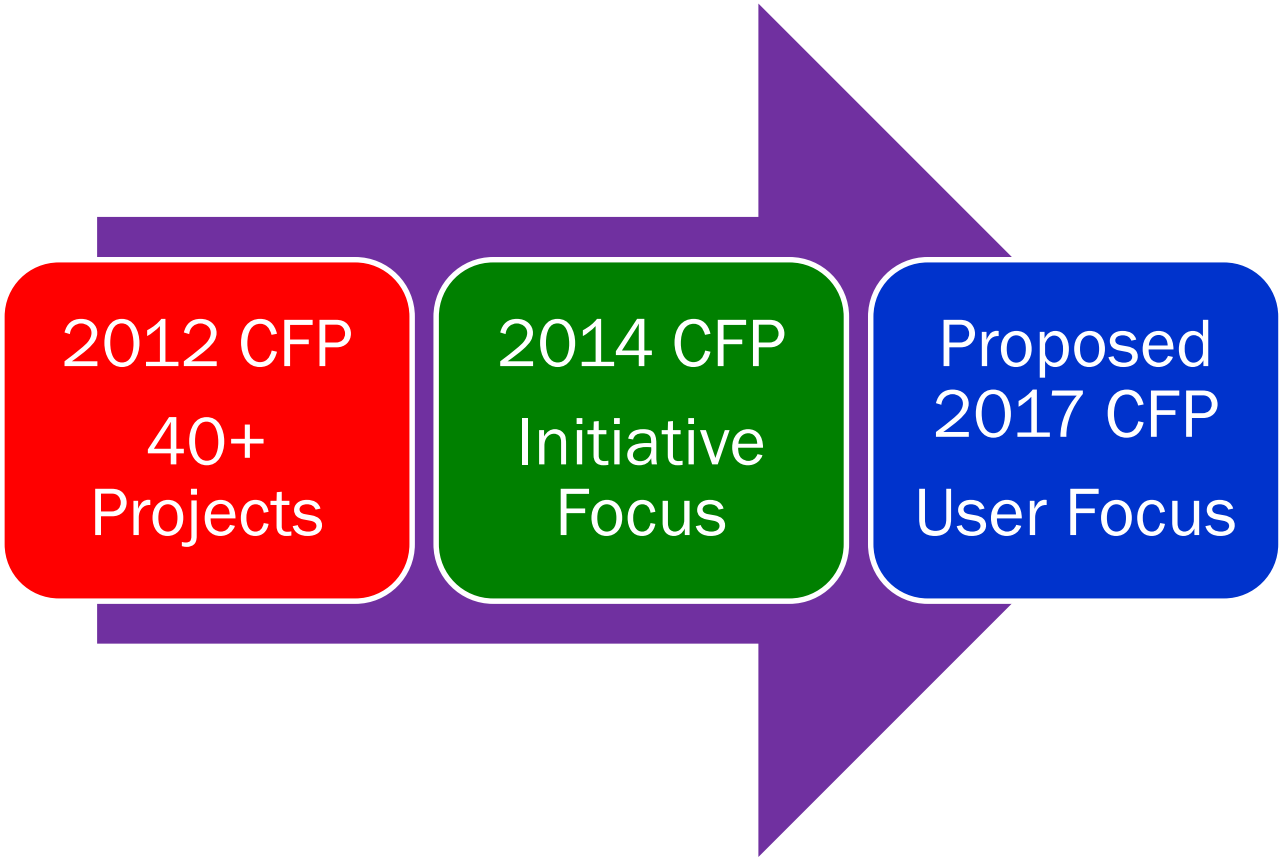
- **Proving Ground**
  - Demonstration and utilization of data products by the end-user operational unit, such as a NWS Weather Forecast Office or Modeling Center.
  - Promote outreach and coordination of new products with the end users, incorporating their feedback for product improvements

- **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**

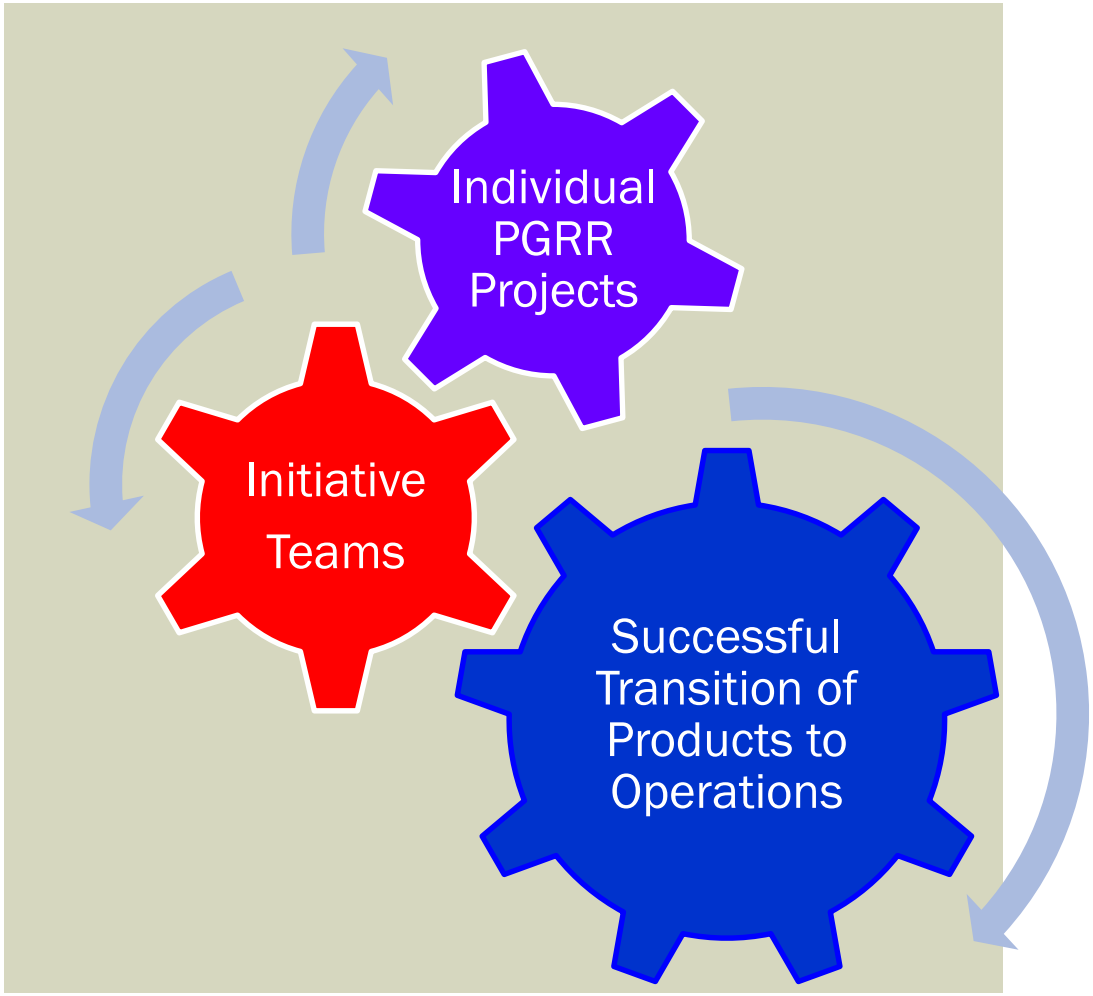
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JPSS PGRR Background
RFP Timelines



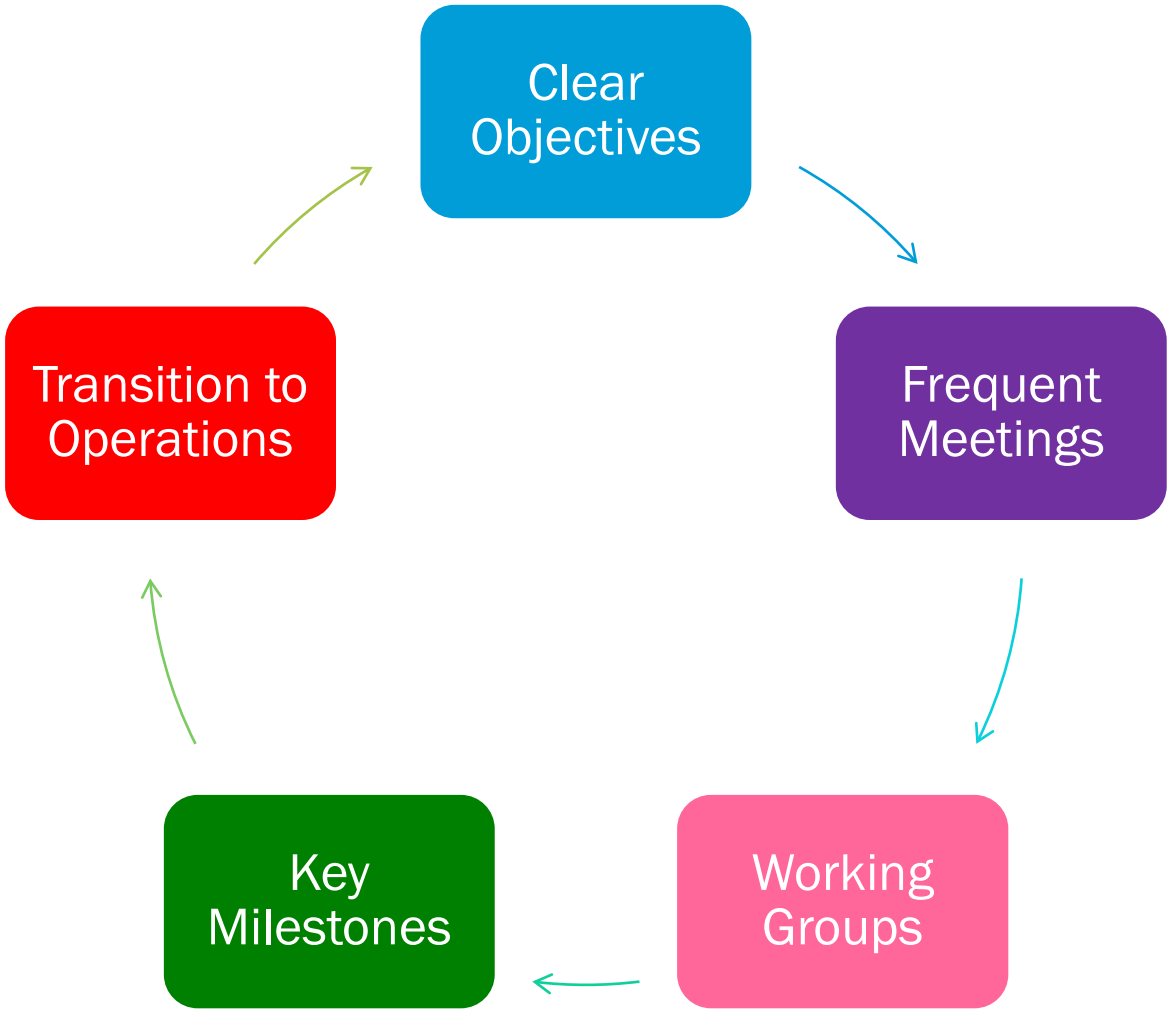
JPSS PGRR Background
Success of PGRR Initiatives



JPSS PGRR Background
PGRR Initiatives List



JPSS PGRR Background Best Practices



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

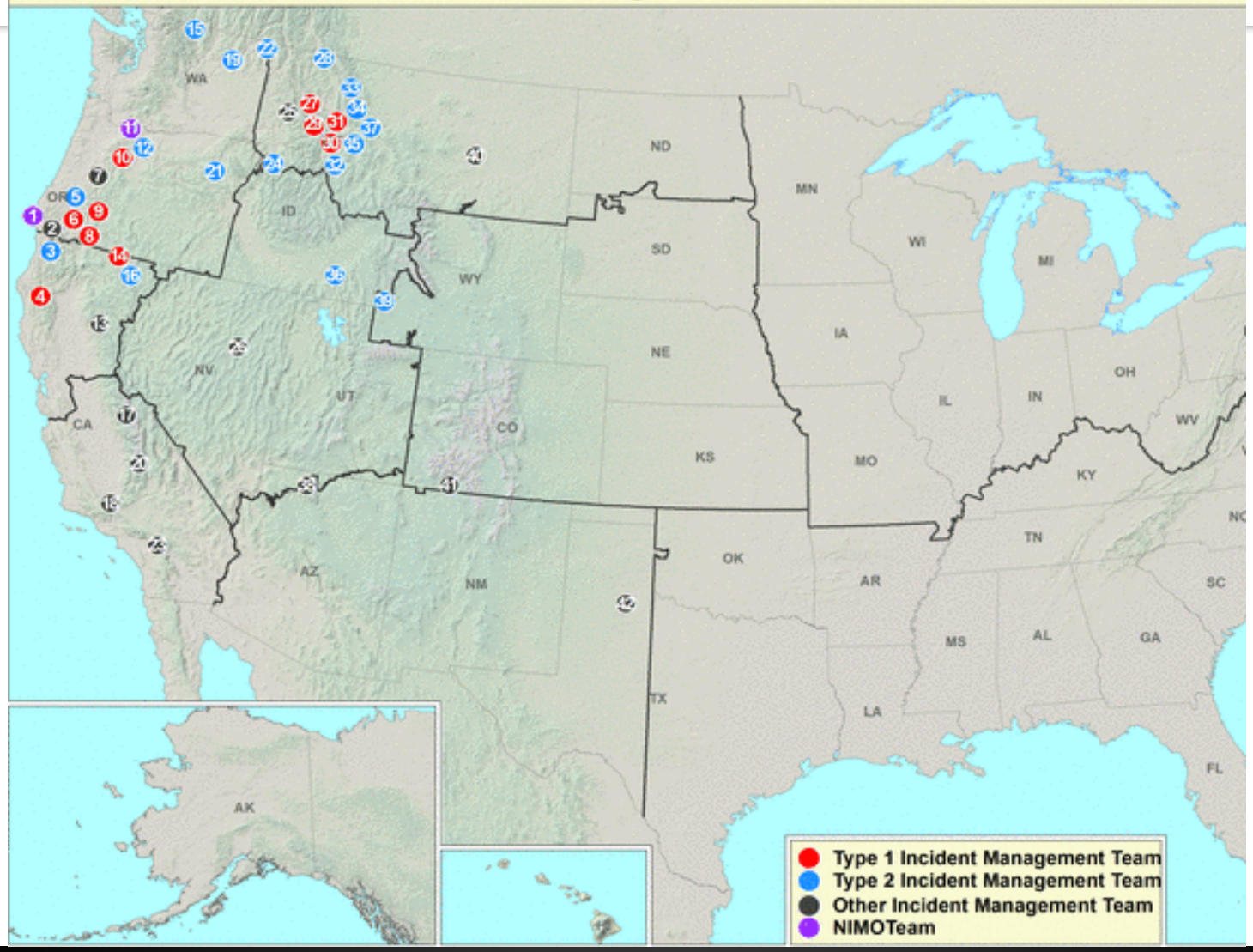
Name	Organization	Name	Organization
Tim Barker	NWS	Valerie Mikles	STAR
Nazmi Chowdhury	JPSS	Tony Mostek	NWS
Ivan Csiszar	STAR	Brian Motta	NWS
Andy Edman	NWS	Susan O'Neill	USDA Forest Service
Evan Ellicott	U of MD	Brad Pierce	STAR
Mitch Goldberg	JPSS	Julie Price	JPSS
Robyn Heffernan	NWS	Katherine Rowden	WFO Spokane Hydrologist
Amy Huff	Penn State	Bill Sjoberg	JPSS
Eric James	ESRL/GSD	Eric Stevens	GINA
Shobha Kondragunta	STAR	William Straka	CIMSS
Scott Lindstrom	CIMSS	Jorel Torres	JPSS Training Liaison
Mark Loeffelbein	NWS	Christine Waigl	UAF
Jeff McQueen	STAR		

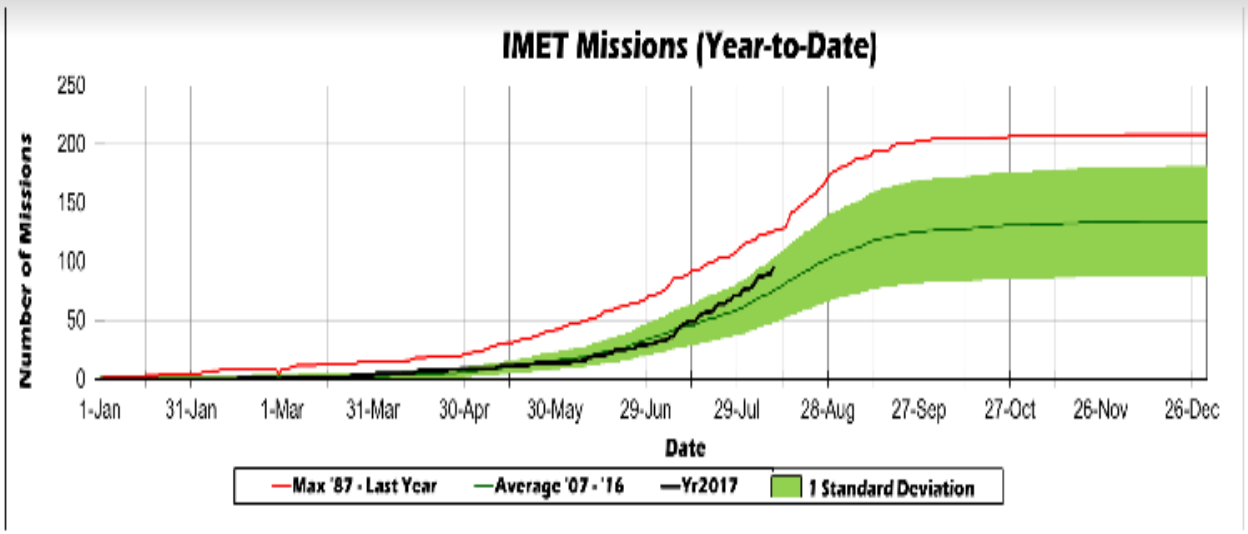
Key Organizations in Fire Weather Support

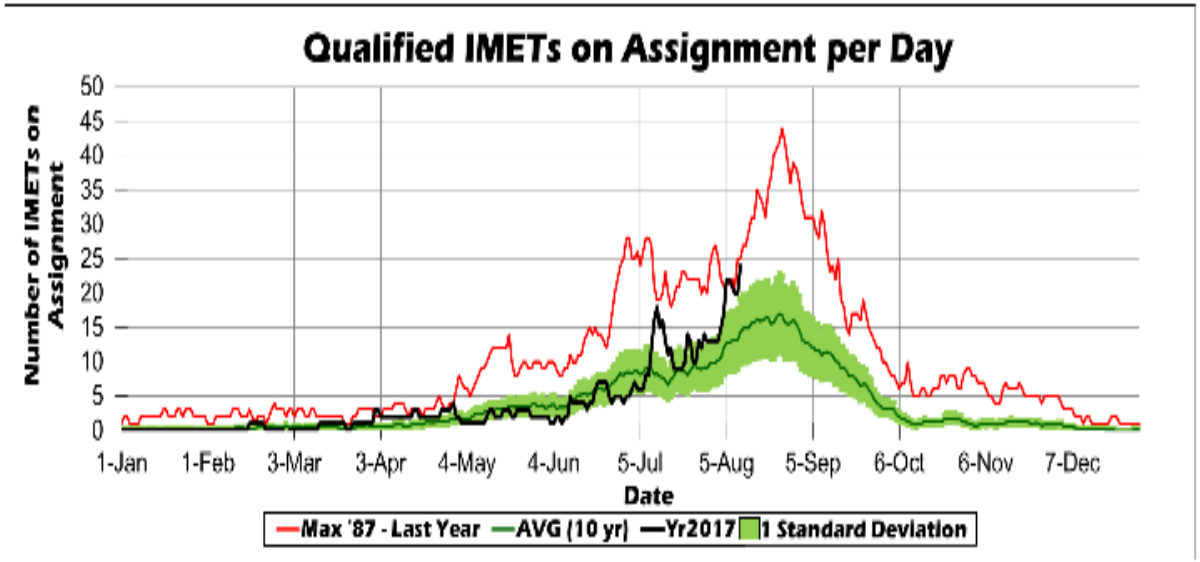
- National Weather Service (WFOs, IMETs
- National Interagency Fire Center
- National Interagency Coordination Center
- Bureau of Land Management
- US Forest Service
- US Fish and Wildlife Service
- National Park Service
- The National Wildfire Coordinating Group
- Regional Geographic Area Coordination Centers
- Air Quality Organizations

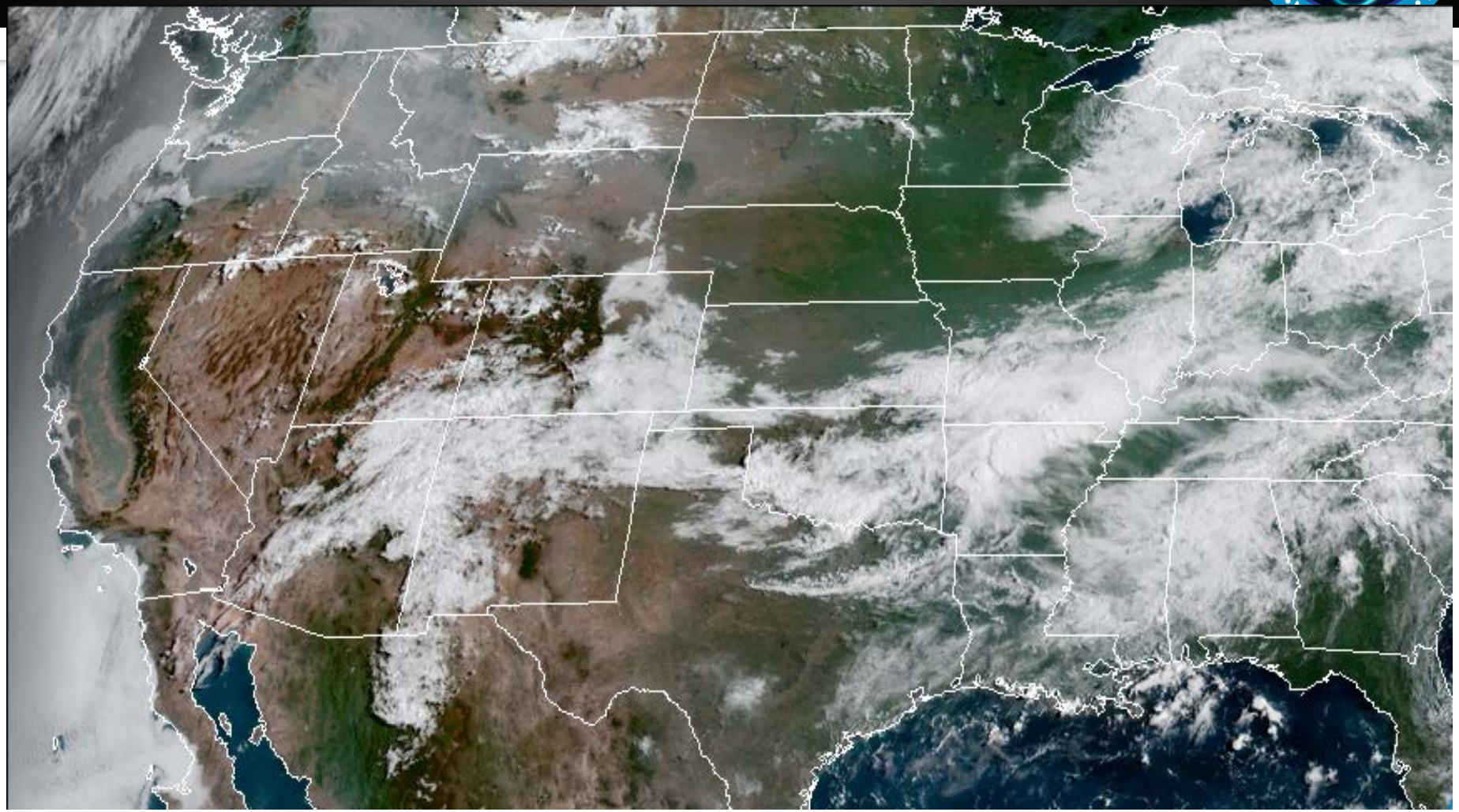
Current Large Incidents

August 12, 2017



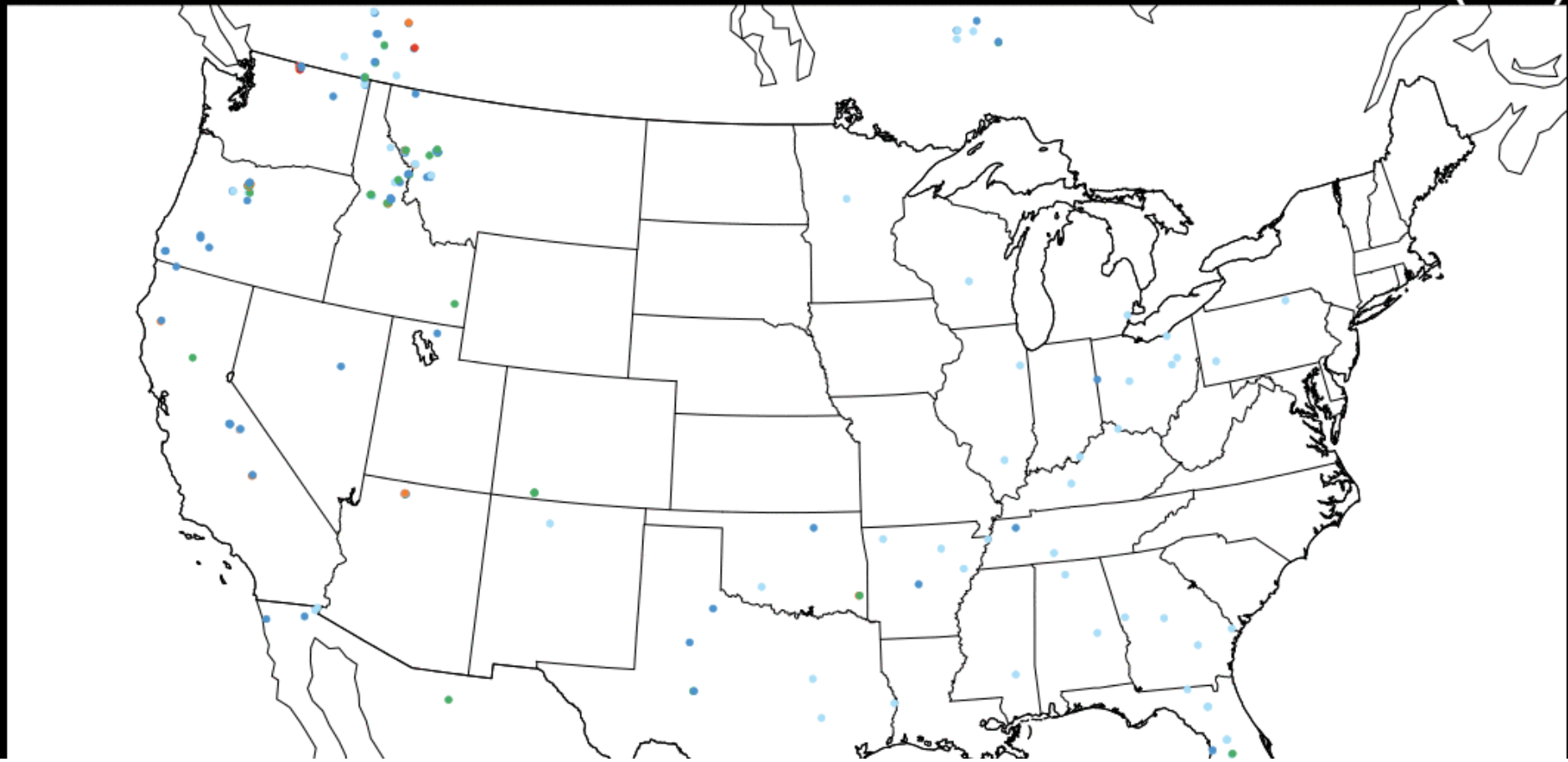

IMET Missions (Year-to-Date)
Number of Missions
250
200
150
100
50
0
1-Jan
31-Jan
1-Mar
31-Mar
30-Apr
30-May
29-Jun
29-Jul
28-Aug
27-Sep
27-Oct
26-Nov
26-Dec
Date
Max '87 - Last Year
Average '07 - '16
Yr2017
1 Standard Deviation

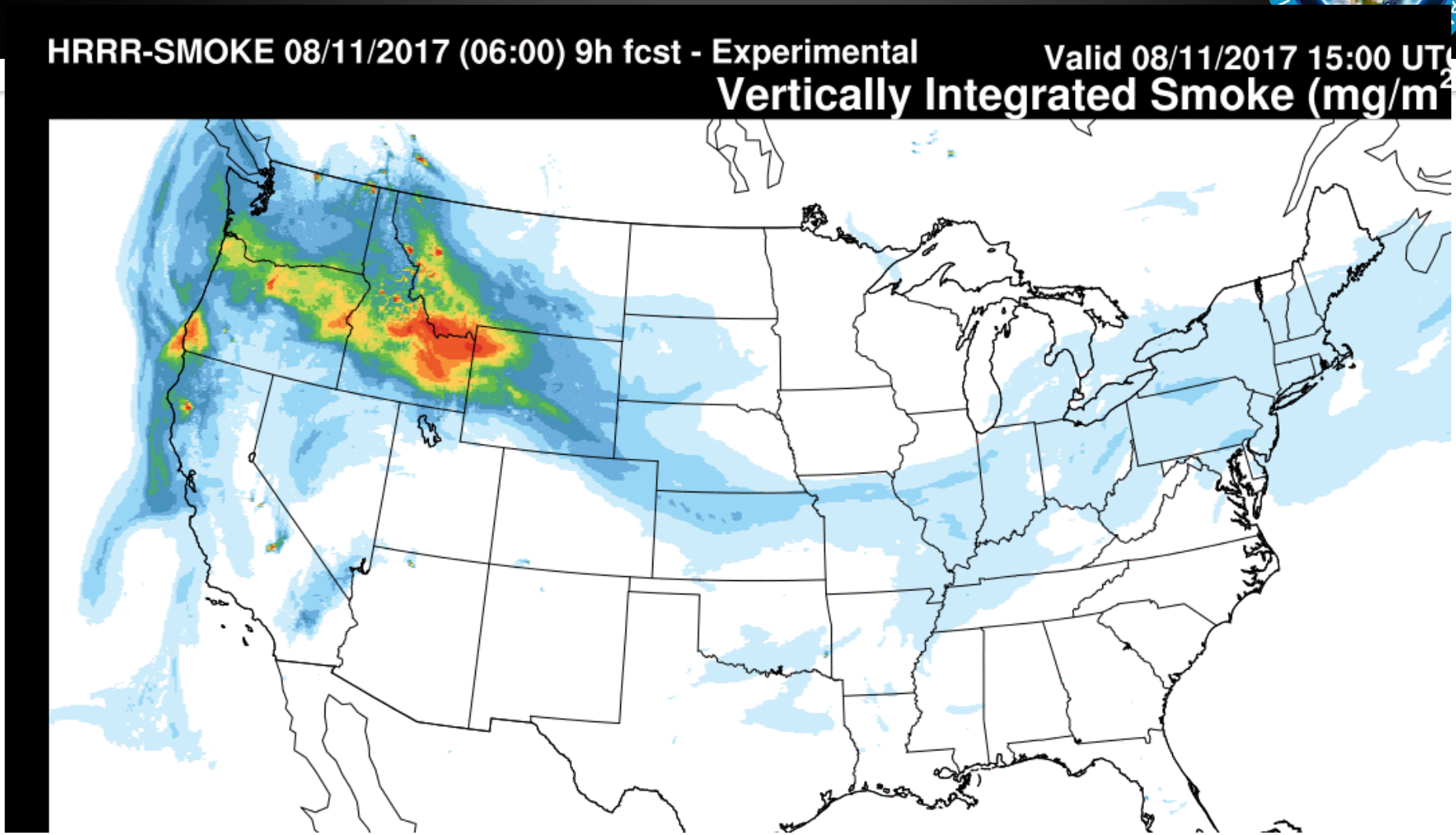

Qualified IMETs on Assignment per Day
Number of IMETs on Assignment
50
45
40
35
30
25
20
15
10
5
0
1-Jan
1-Feb
3-Mar
3-Apr
4-May
4-Jun
5-Jul
5-Aug
5-Sep
6-Oct
6-Nov
7-Dec
Date
Max '87 - Last Year
AVG (10 yr)
Yr2017
1 Standard Deviation

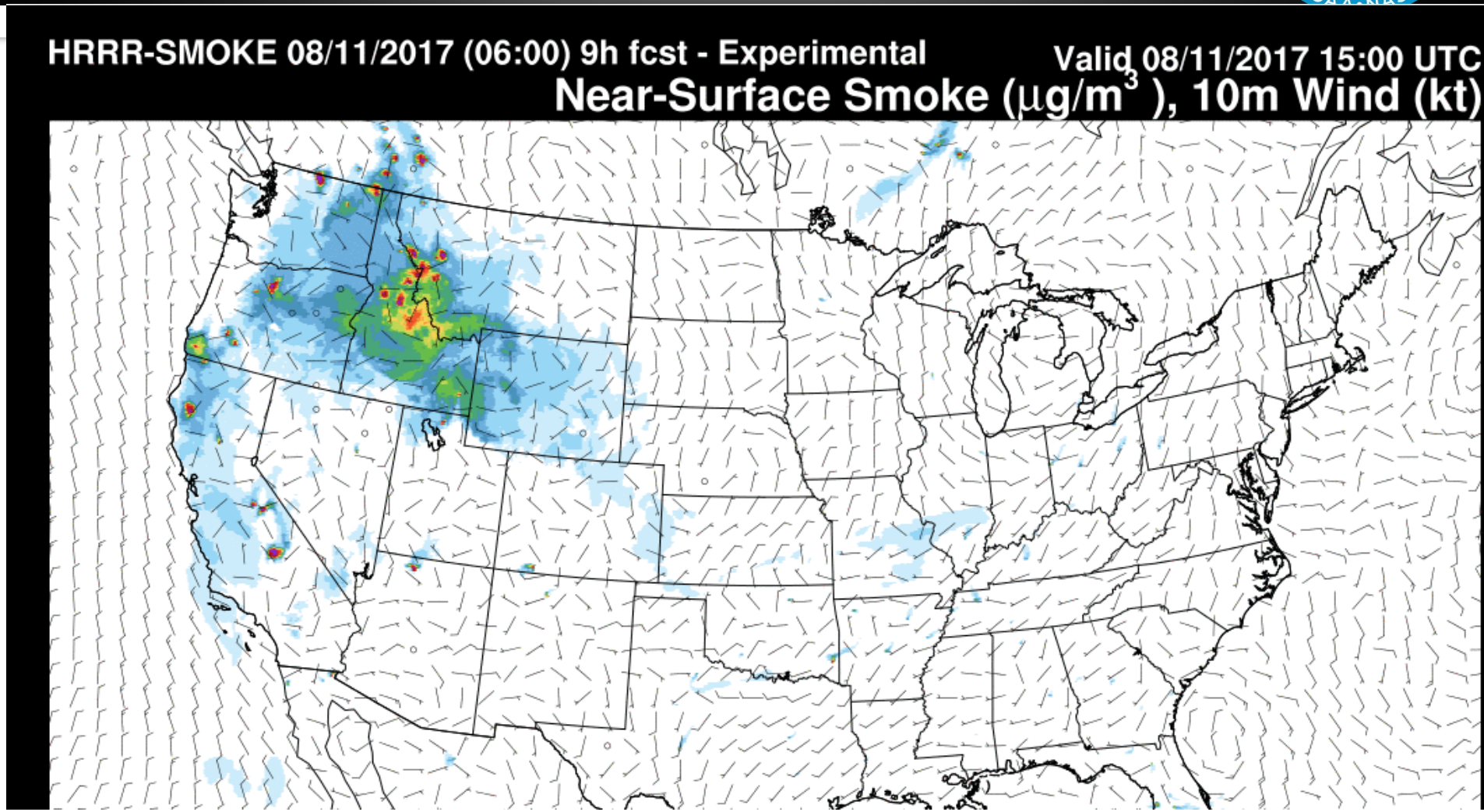


HRRR-SMOKE 08/11/2017 (06:00) - Experimental

VIIRS Fire Radiative Power (MW)



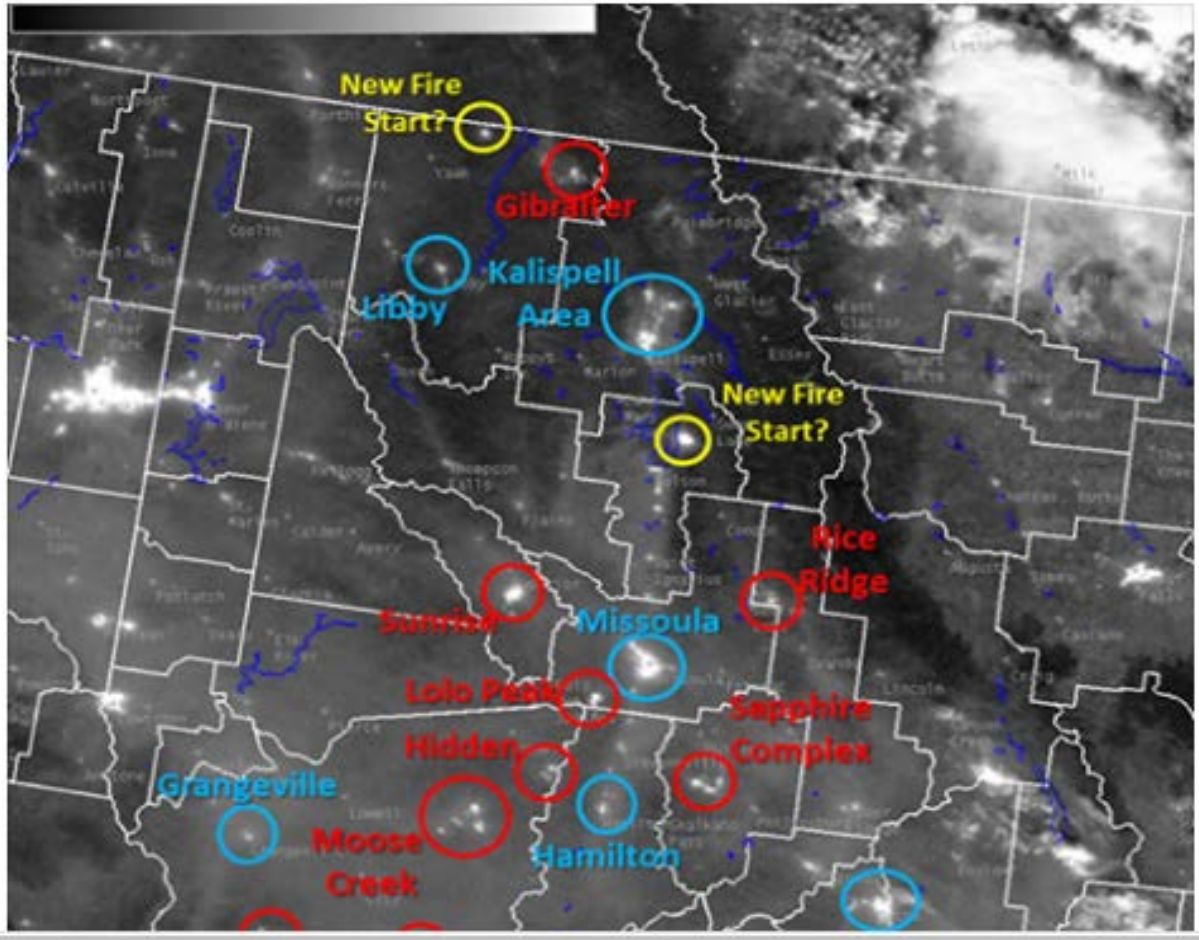

HRRR-SMOKE 08/11/2017 (06:00) 9h fcst - Experimental
Valid 08/11/2017 15:00 UT
Vertically Integrated Smoke (mg/m


HRRR-SMOKE 08/11/2017 (06:00) 9h fcst - Experimental
Valid 08/11/2017 15:00 UTC
Near-Surface Smoke (μg/m3), 10m Wind (kt)

US National Weather Service Missoula Montana

Yesterday at 5:59am

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).



FIRESCIENCE.GOV

Research Supporting Sound Decisions

Facebook Twitter Website LinkedIn Email

Wildland fire smoke health effects on wildland firefighters and the public



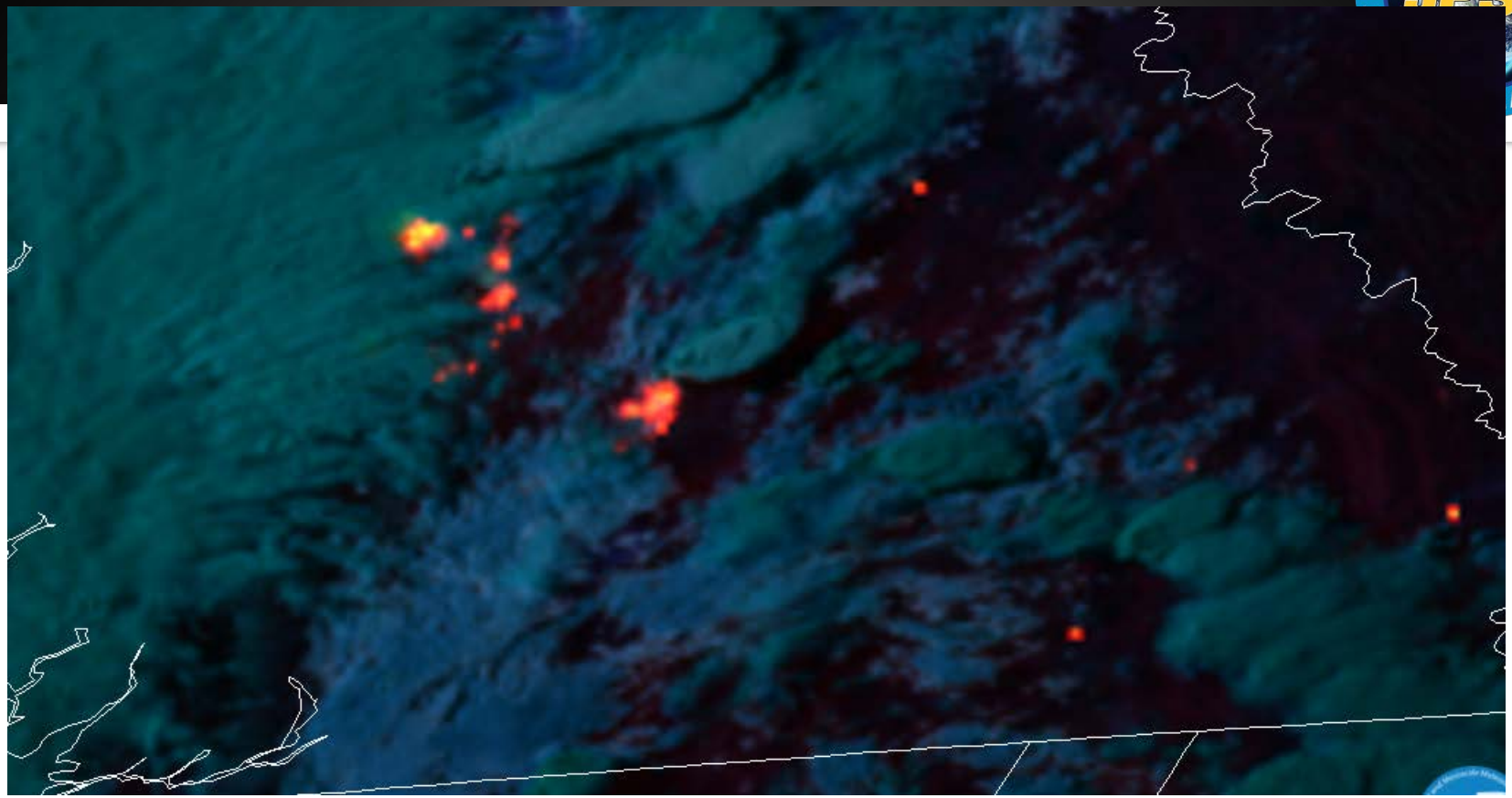
Issues

FRP is not always provide consistent behavior

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

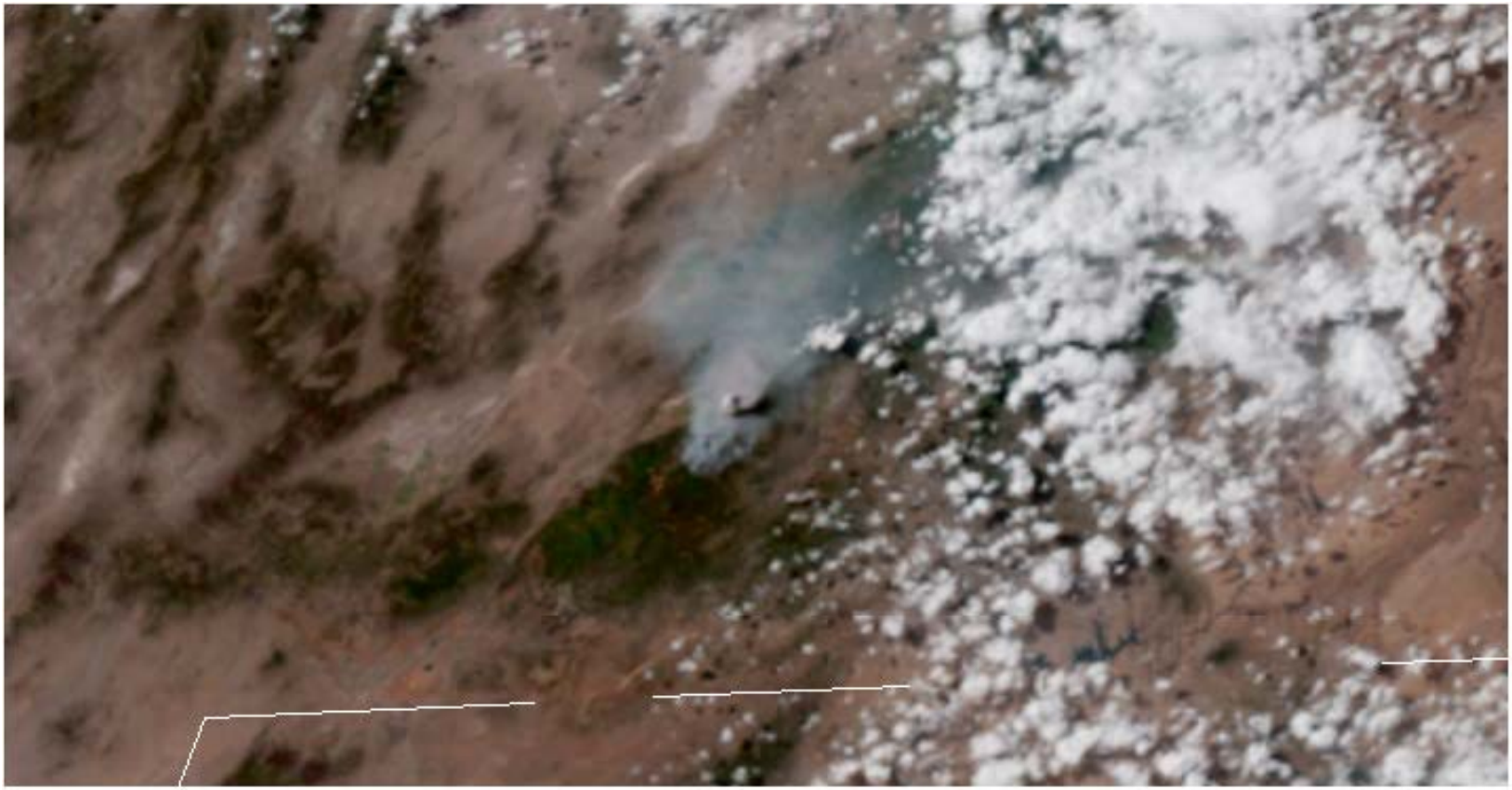
Similar comments from WFOs

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

Cedar City Fire Jun 26 2016



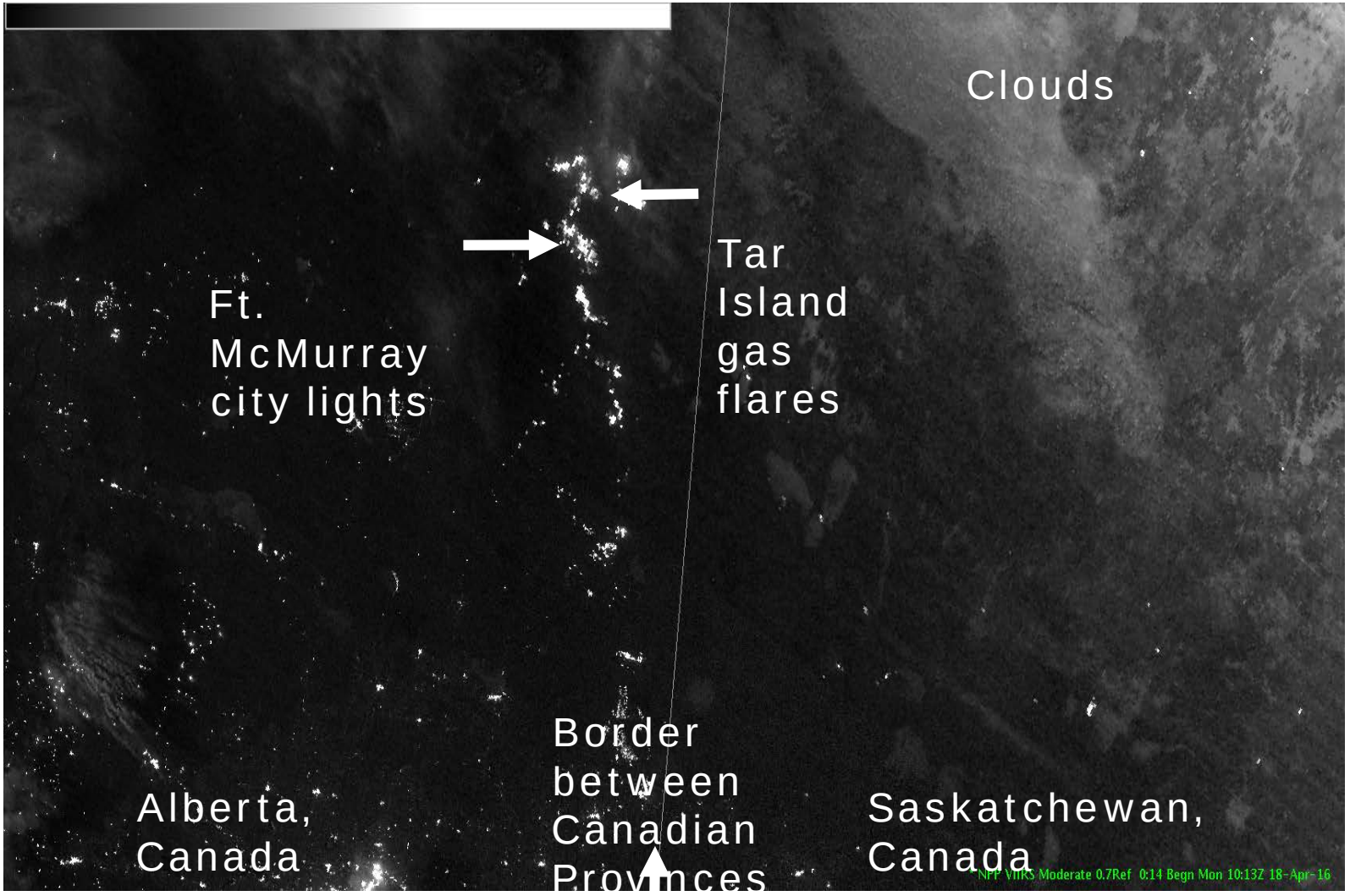
Fort McMurray Fire



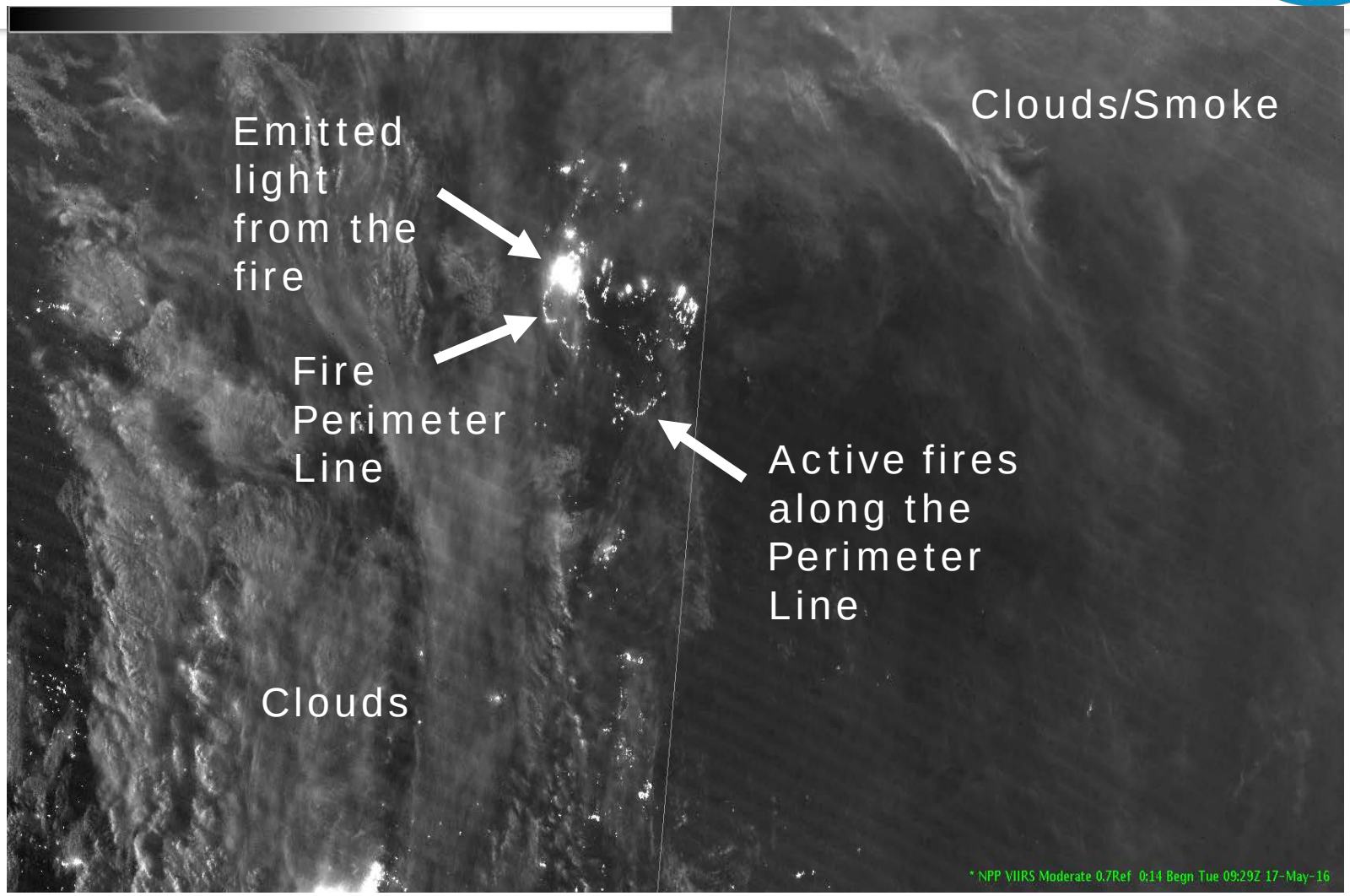




Suomi NPP IMAGERY - Before the fire

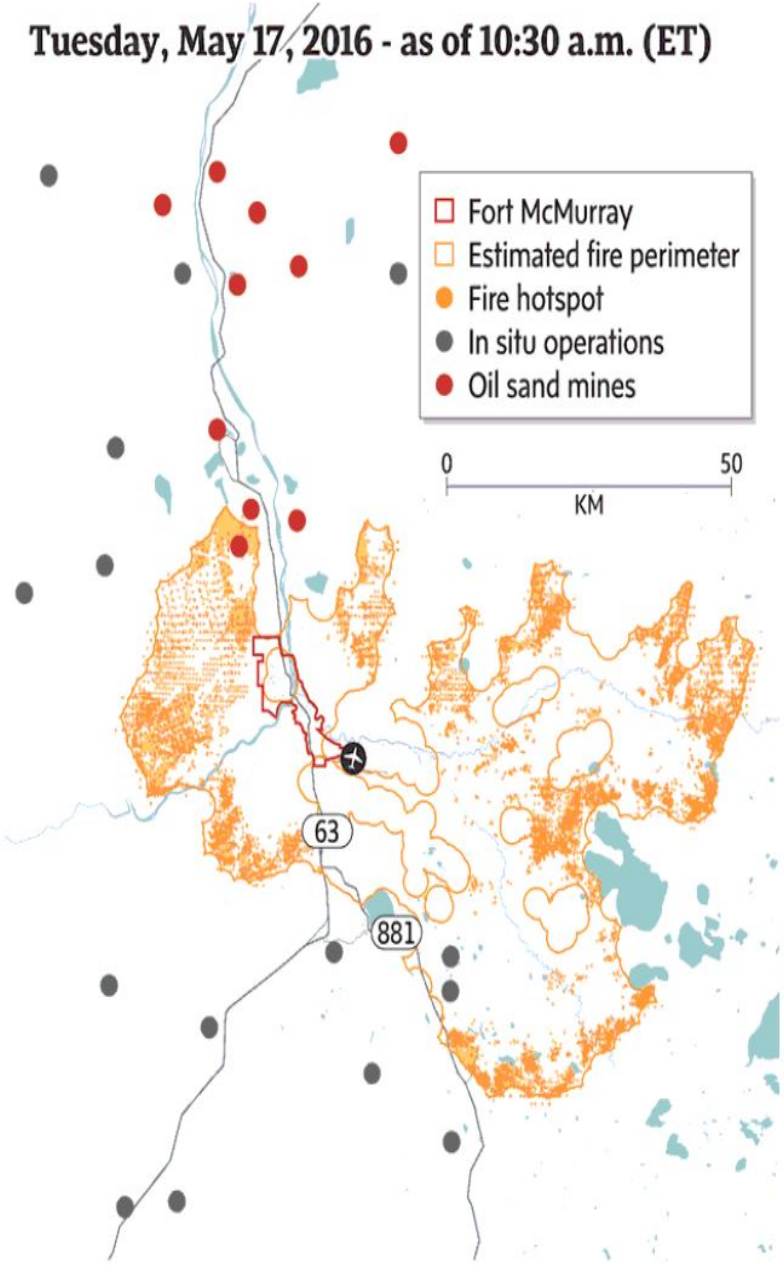


Suomi NPP Imagery of Ft McMurray Wildfire
7 May at 0930 UTC

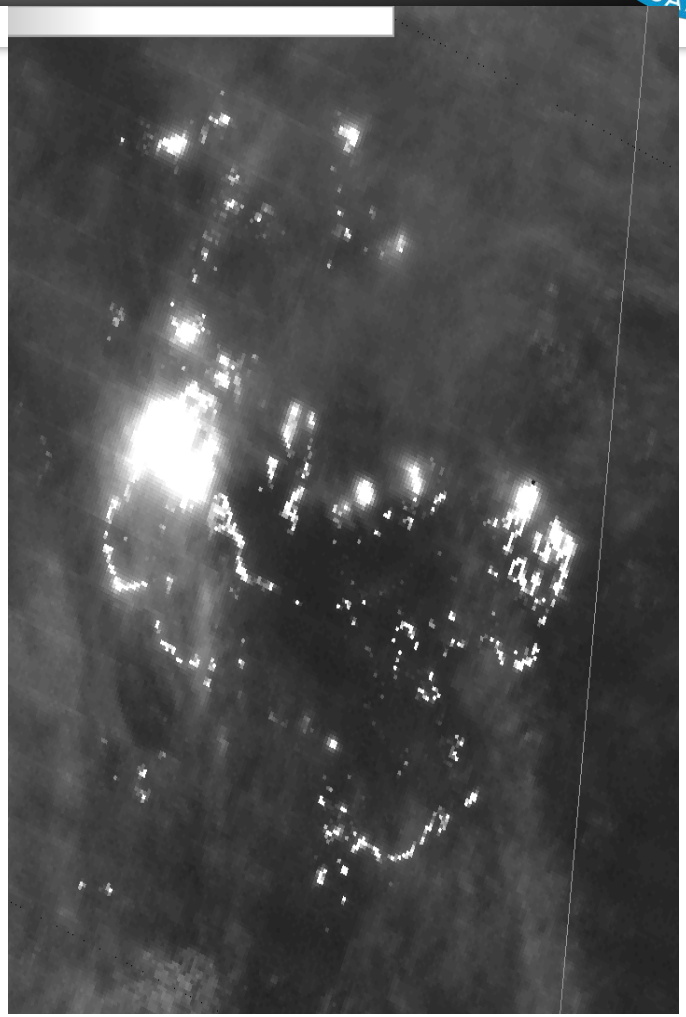


Suomi NPP Imagery of Ft McMurray Wildfire
18 May at 0915 UTC



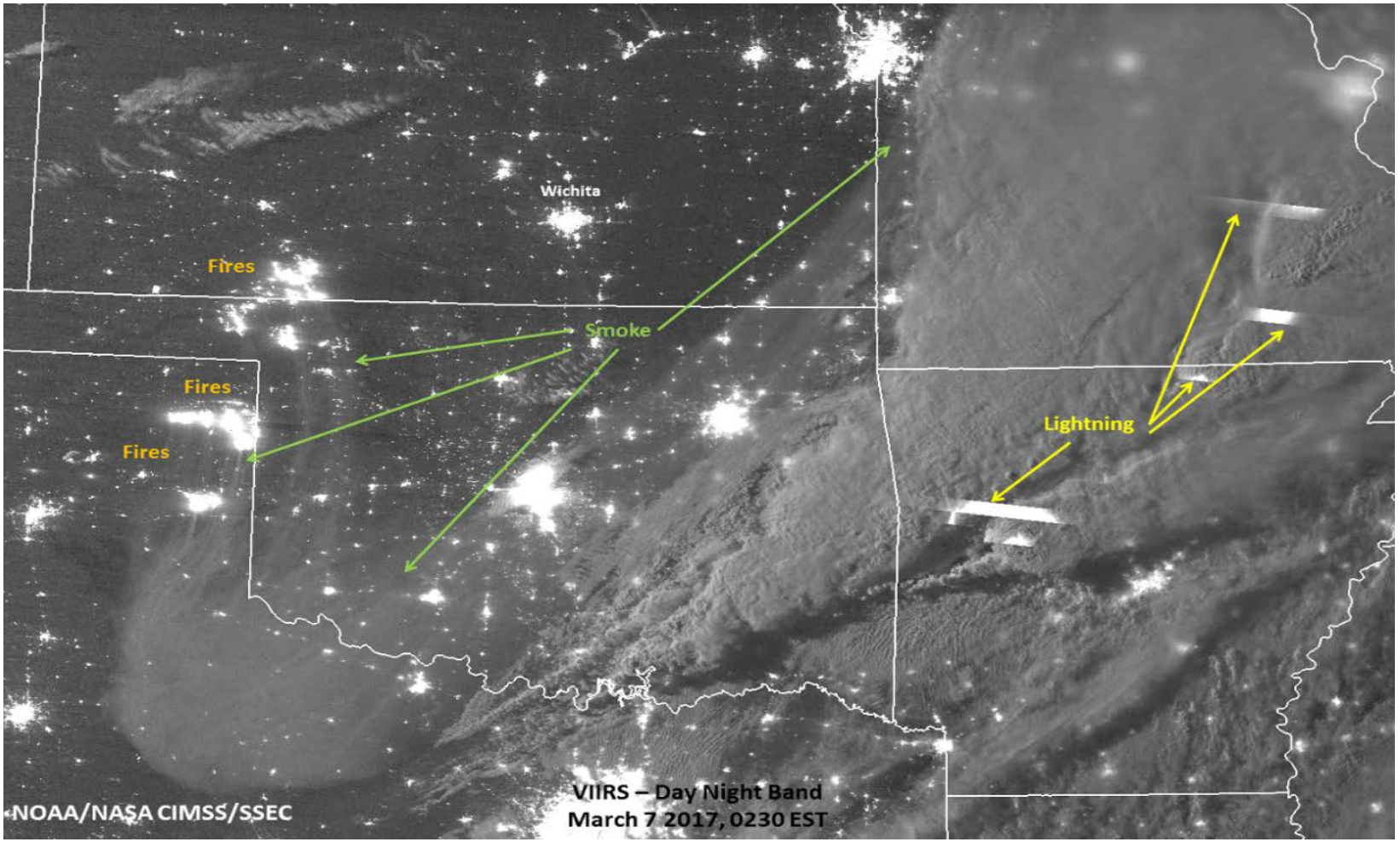


NCC Imagery 17 May 2016
at 0929Z (i.e., 05:29 a.m. ET)

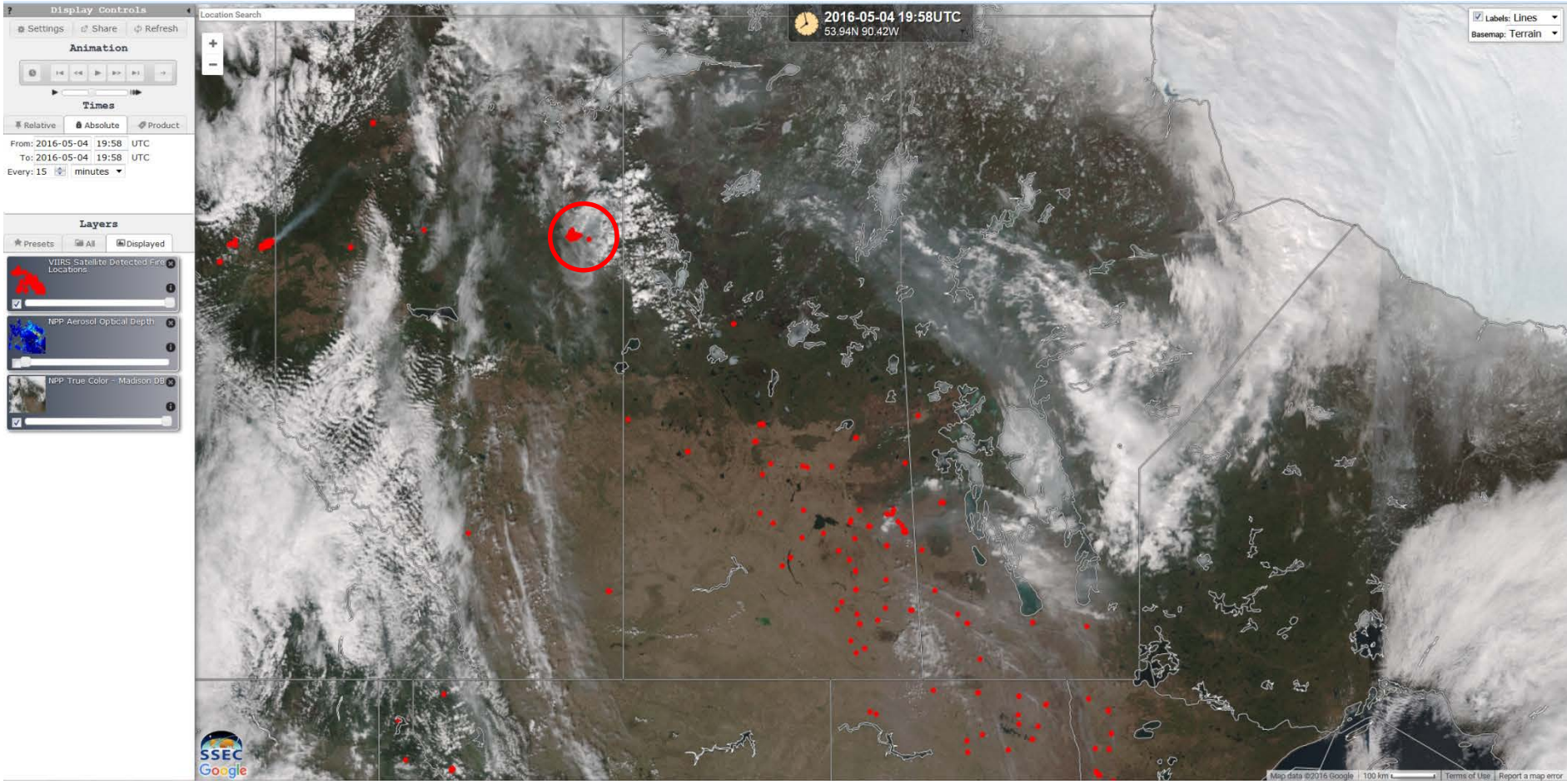


COMPARISON BETWEEN ESTIMATED FIRE PERIMETER AND NCC IMAGERY

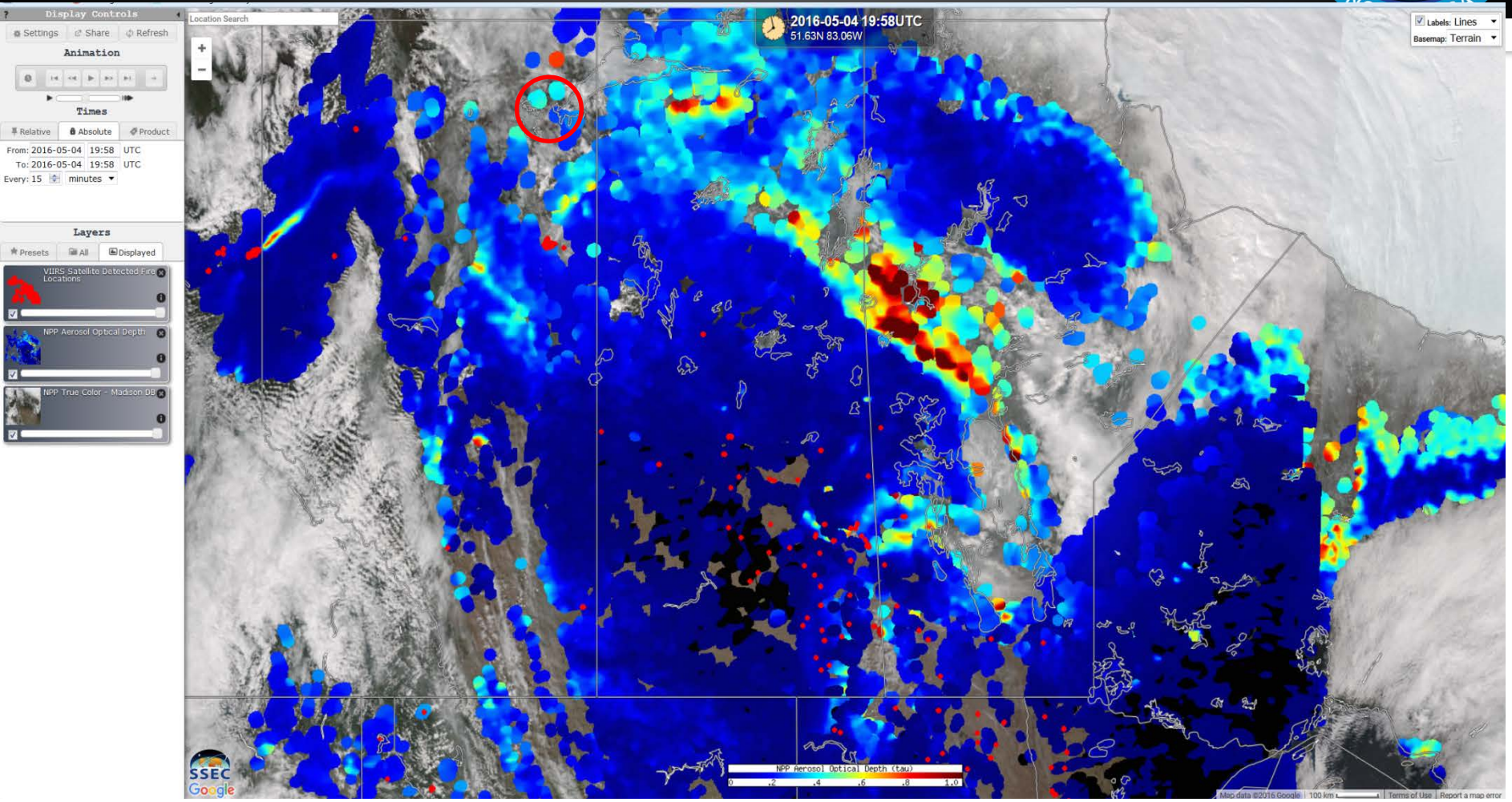
OK Fires – 7 Mar 2017



RealEarth Image May 04, 2016
VIIRS Fire Detection and True Color Composite
Fort McMurray Wildfire Smoke Plume

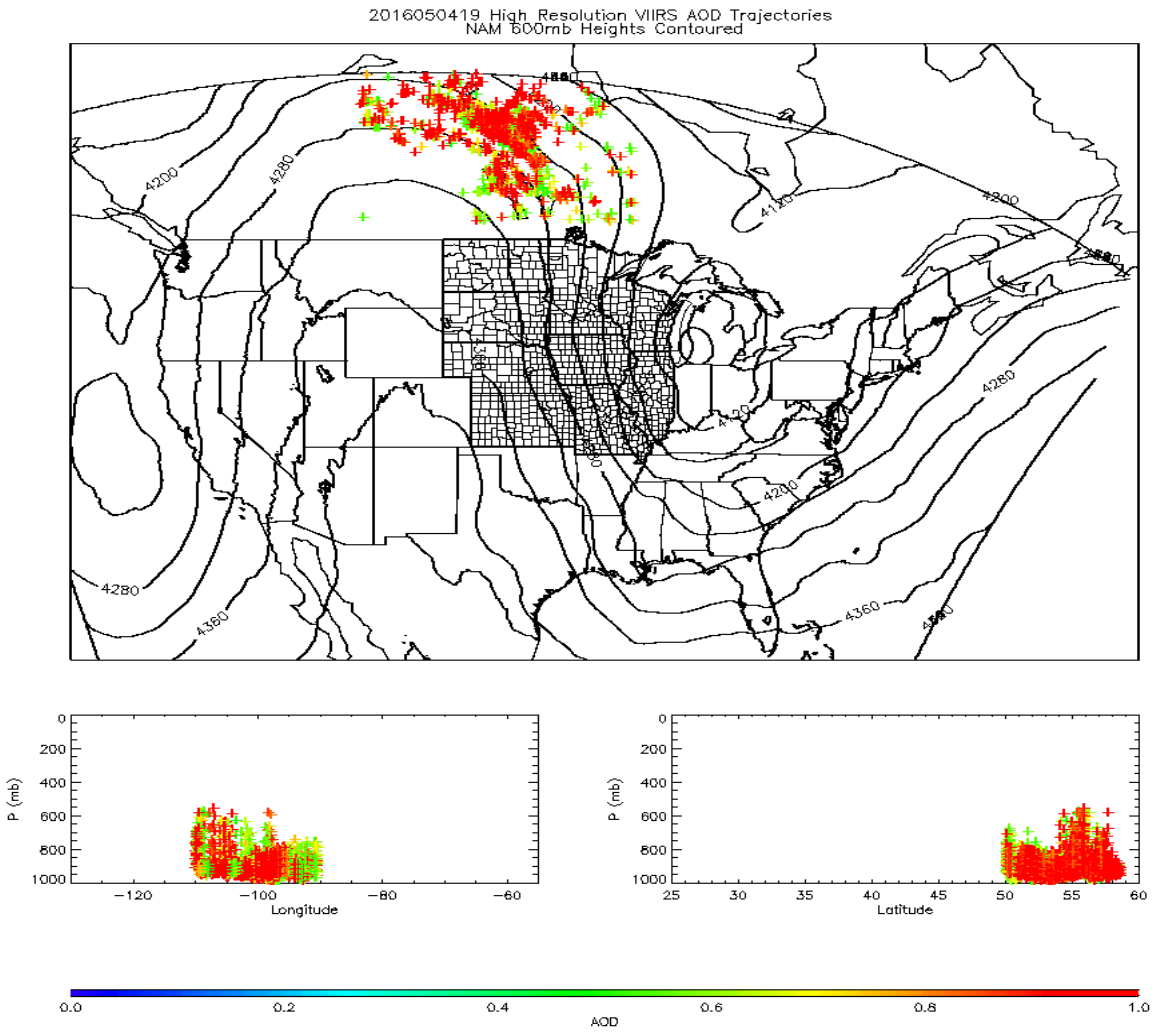


RealEarth Image May 04, 2016
VIIRS Fire Detection, True Color composite and AOD
Fort McMurray Wildfire smoke plume

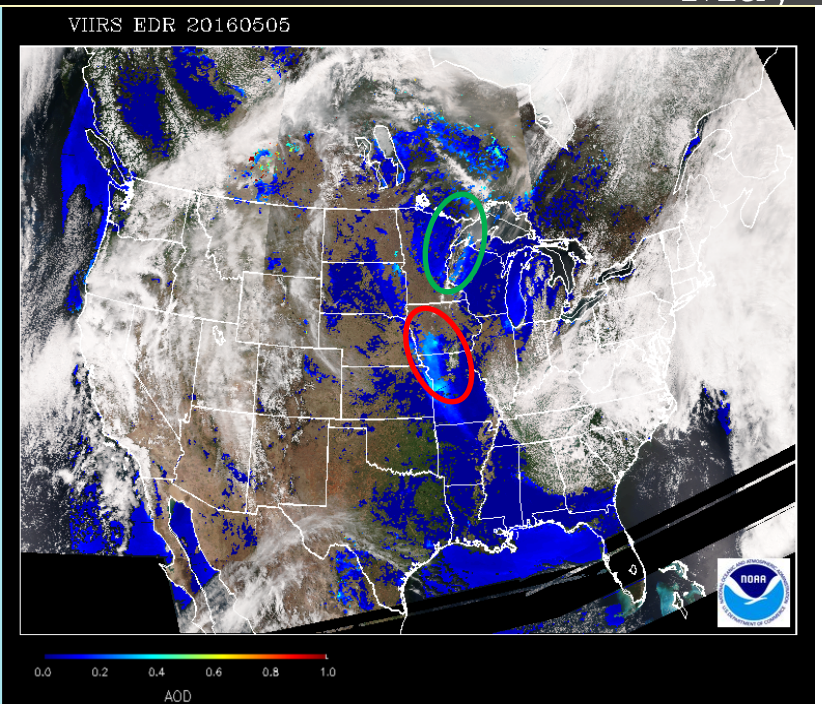


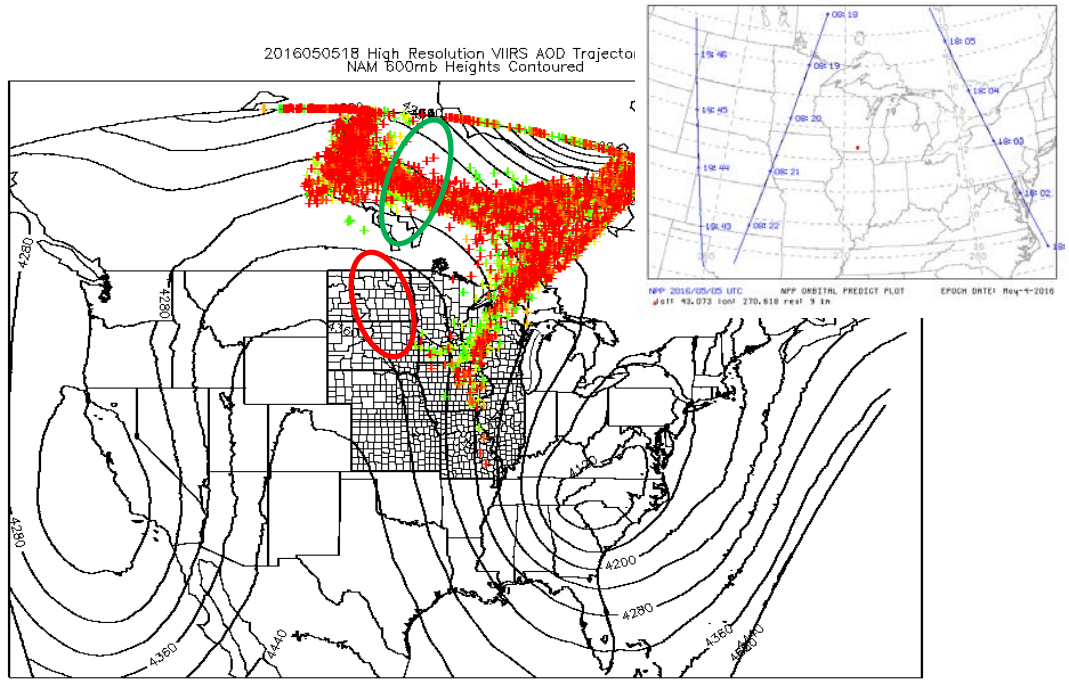
IDEA-I High resolution (NAM 3km) Trajectory Forecast
Fort McMurray Wildfire
May 04, 2016

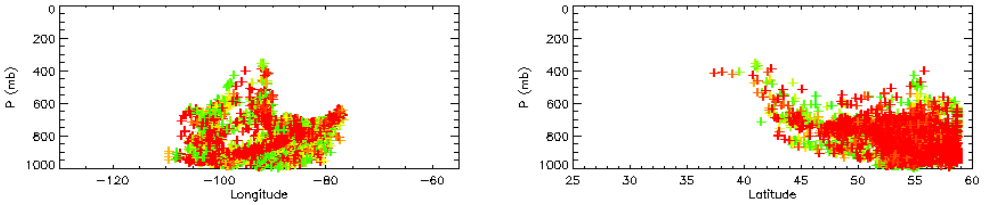
- IDEA-I high resolution trajectory forecast colored by initial AOD
- Upper panel shows NAM 600mb heights and precipitation (purple)
- Lower panels show longitude and latitude cross sections
- Only AOD>0.5 initialized



IDEA-I High resolution (NAM 3km) Trajectory Forecast
Fort McMurray Wildfire
May 05, 2016









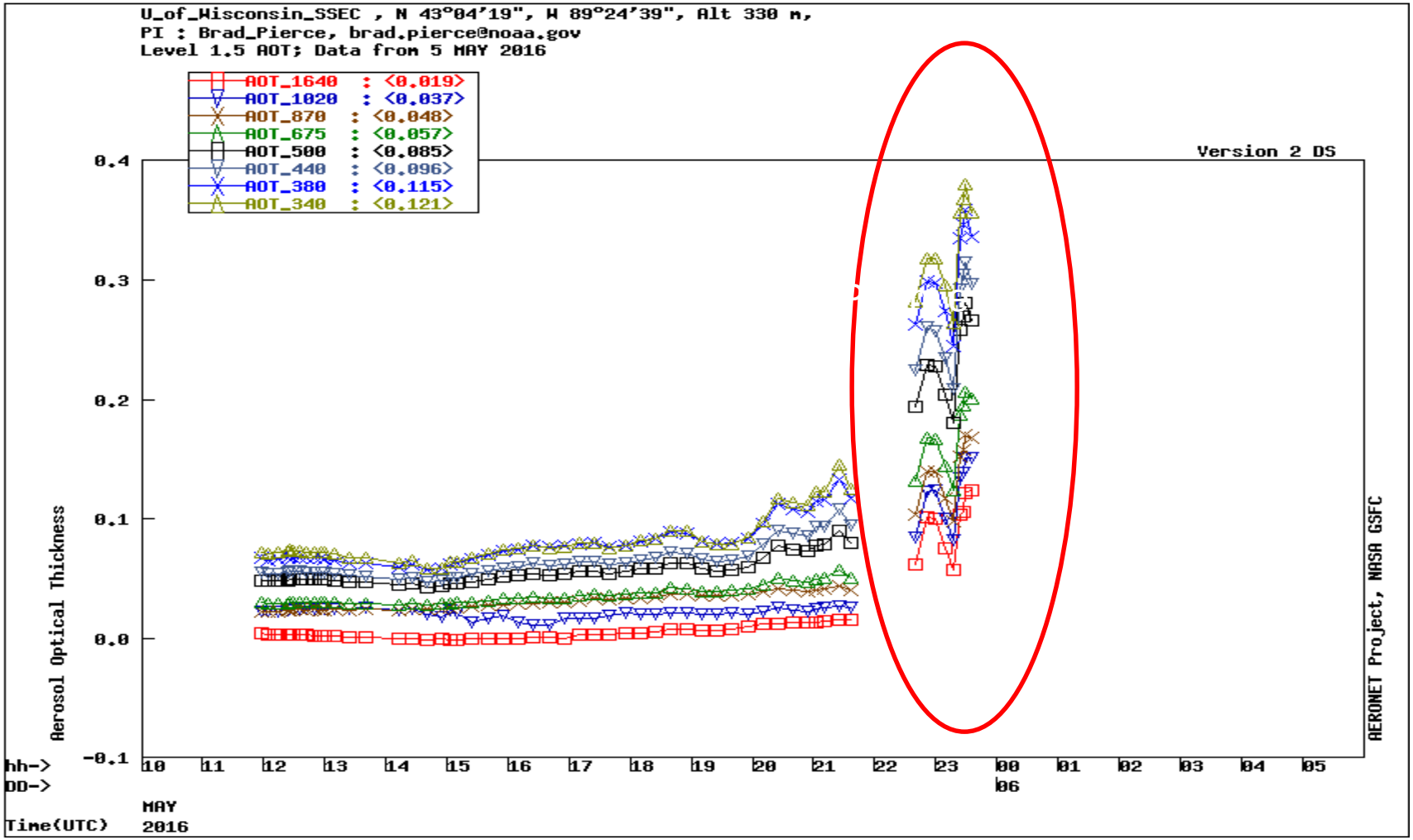
- May 05, 2016 VIIRS AOD shows plume along MN/WI and IA/MO boarders
- IDEA-I high resolution trajectory forecast predicts southern extent too far east

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



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

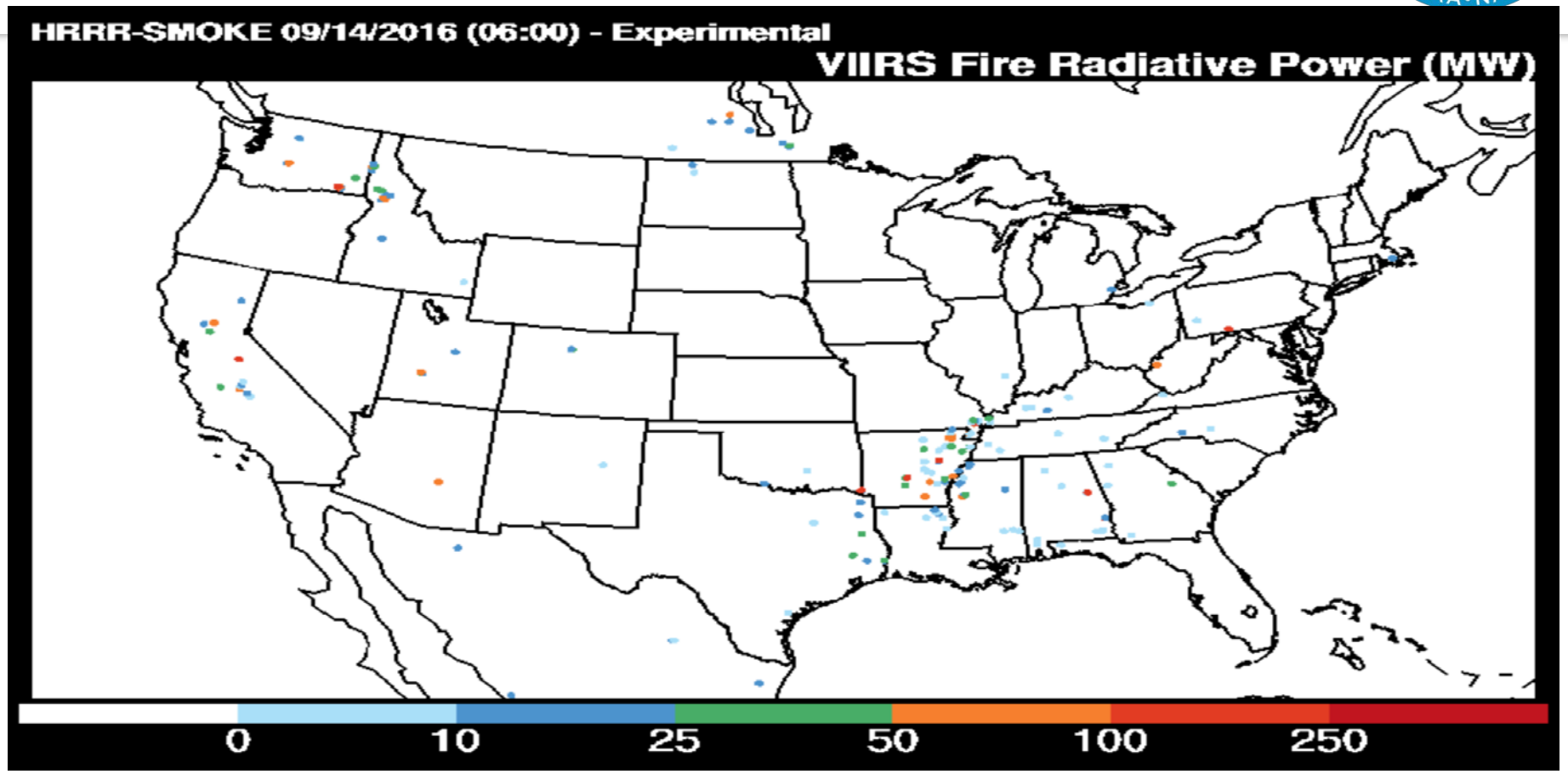
*** Experimental, Not for Official Guidance *** - see description. Alaska Version

Model: HRRR-smoke (Experimental) **Domain:** NW **Date:** 14 Sep 2016 - 06Z

CONUS
NW
NC
NE
SW
SC
SE
Great Lakes
NE CO
SEA
SFO
MKX
OKX
IAD
MIA
ATL

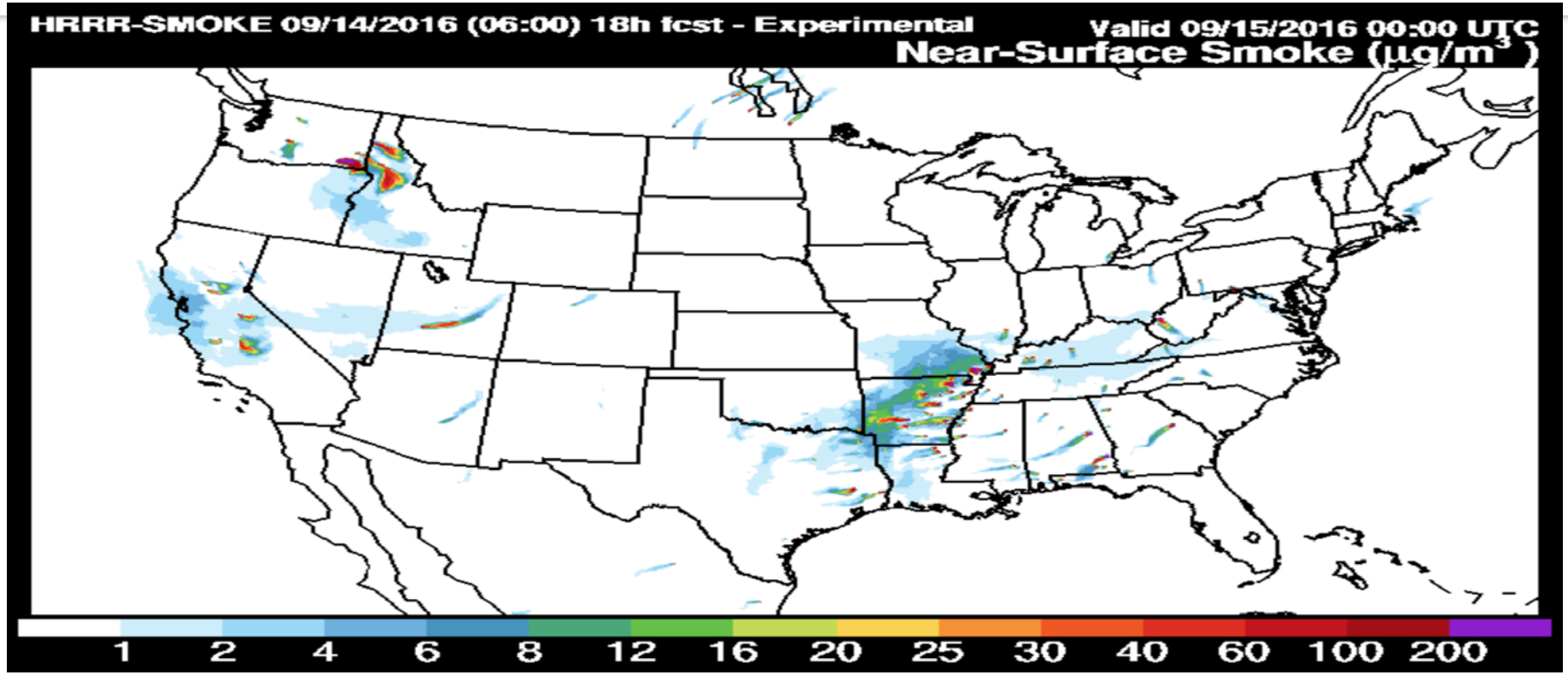
	All times	Loop	Wed 06	Wed 07	We 08	ed 11	Wed 12	Wed 13	Wed 14	Wed 15	Wed 16	Wed 17	Wed 18
			00	01	02	05	06	07	08	09	10	11	12
all fields			00	01	02	05	06	07	08	09	10	11	12
fire radiative power	✔	✔	00	01	02	05	06	07	08	09	10	11	12
near-surface smoke	✔	✔	00	01	02	05	06	07	08	09	10	11	12
vertically integrated smoke	✔	✔	00	01	02	05	06	07	08	09	10	11	12

The Real-Time HRRR-Smoke Web-Site (rapidrefresh.noaa.gov/HRRRsmoke)



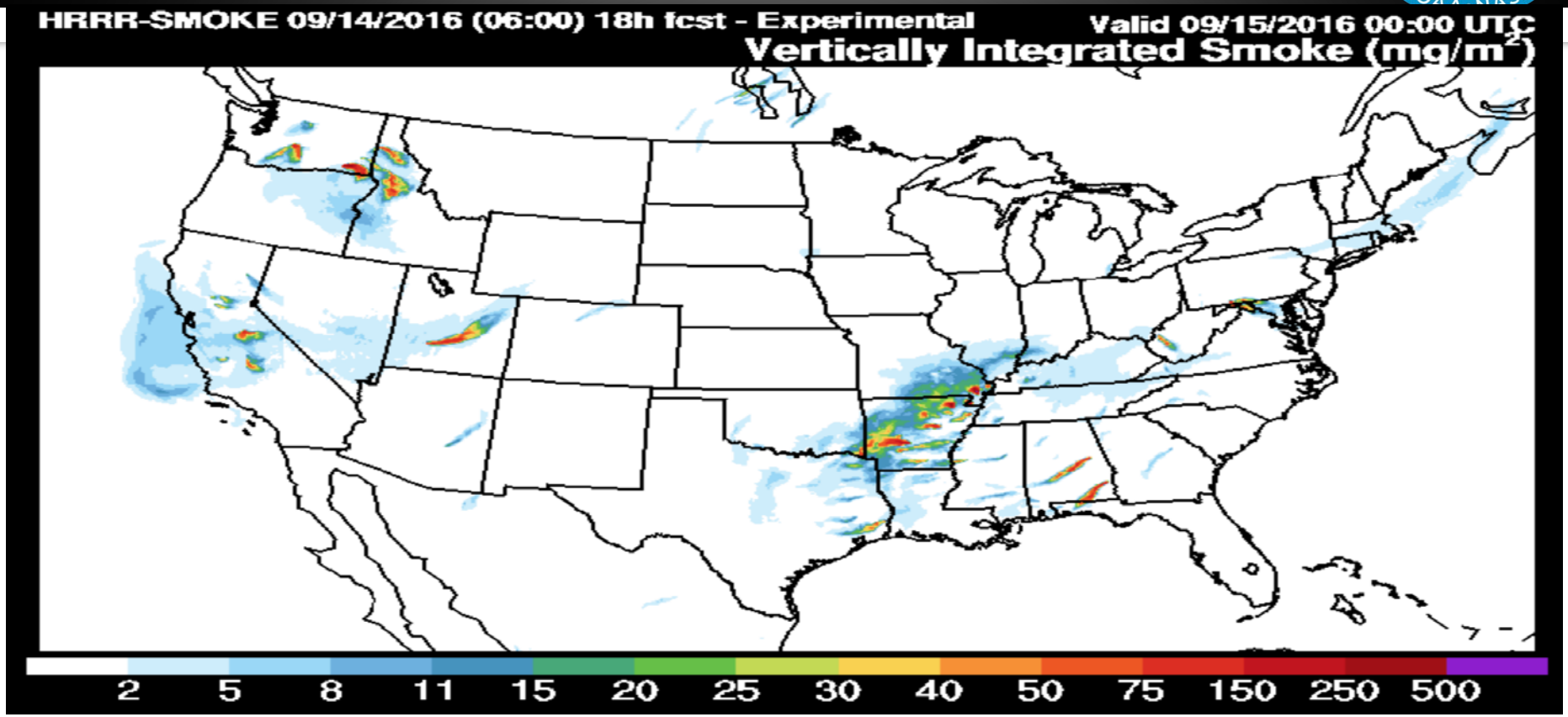
The Fire Radiative Power (FRP) data are processed during HRRR-Smoke initialization by processing FRP for the model domain detected during previous 24 hours by VIIRS. Then the model simulates fire emissions and plume rise using the static FRP fields for 36 hours of smoke forecast. The following plot shows 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.

The Real-Time HRRR-Smoke Web-Site (rapidrefresh.noaa.gov/HRRRsmoke)



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.

The Real-Time HRRR-Smoke Web-Site (rapidrefresh.noaa.gov/HRRRsmoke)



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

Atmospheric Rivers over the Western United States:

Comparing the Cool-Season Events of 2016/17 to the 1980-2017 Mean

Jon Rutz (jonathan.rutz@noaa.gov)

With acknowledgements to Ben Hatchett (DRI),
Andy Edman (NWS) and Brian Kawzenuk (UCSD)

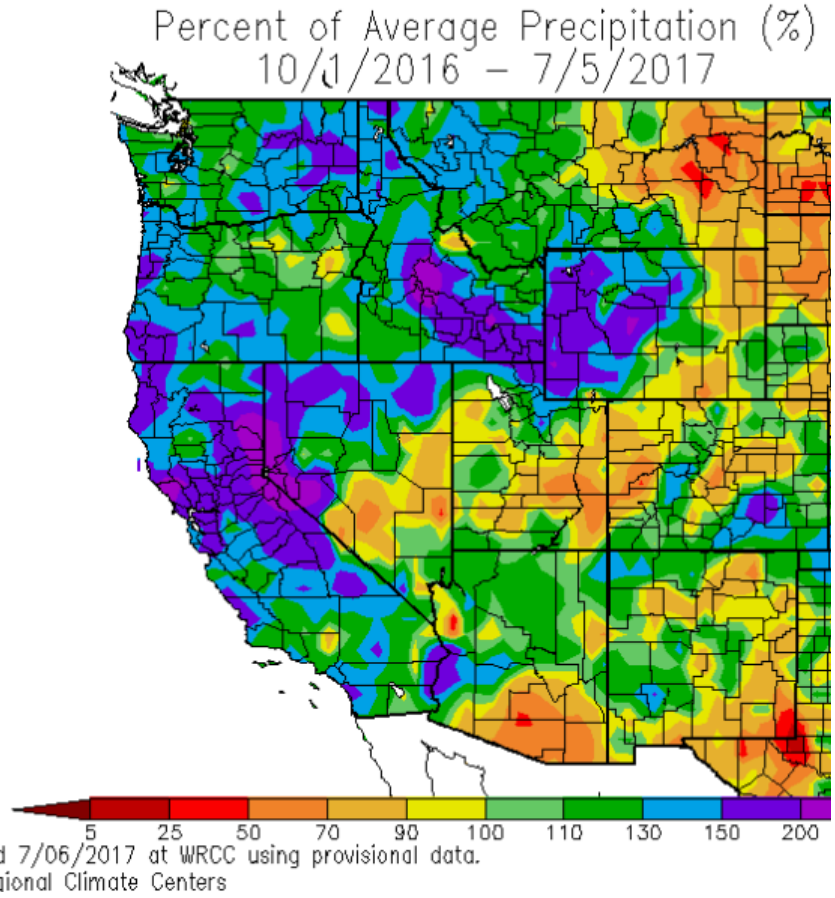
Weather Prediction Center Seminar
NOAA Center for Weather and Climate Prediction – July 17th, 2017

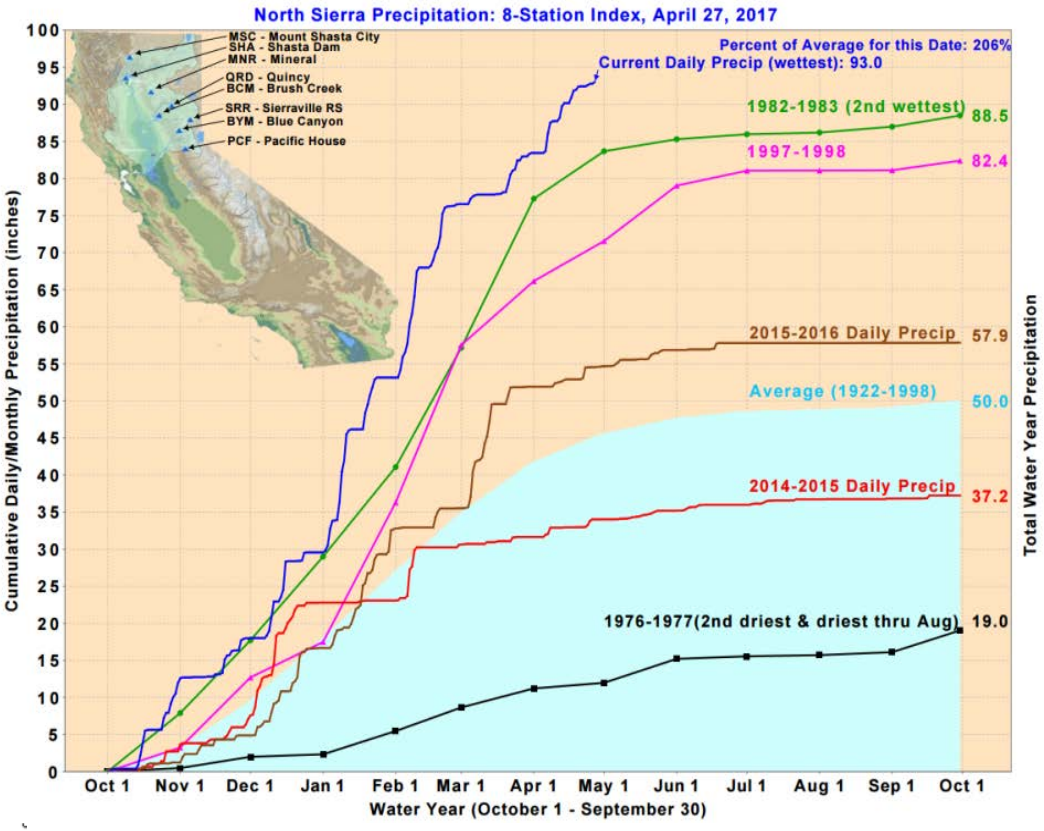
Outline

- Motivation
- Atmospheric Rivers
  - What are they and why do we care?
- Data and Methods
- Results
  - Statistics over the western U.S.
  - ARs and Precipitation
  - Statistics at Selected Points

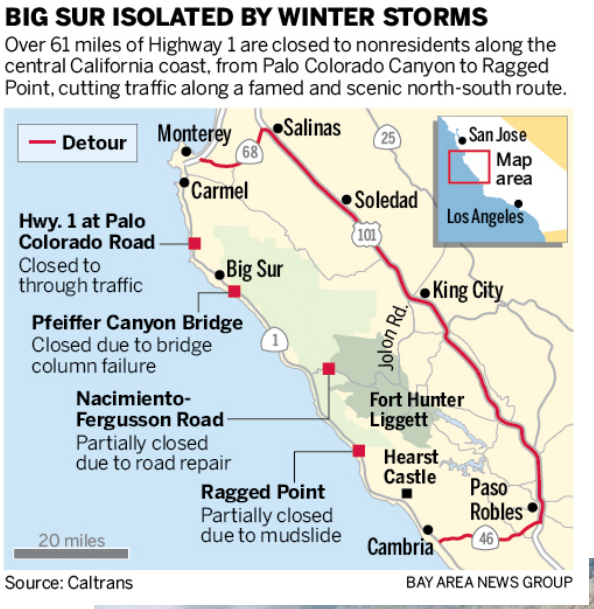
Motivation – Hazards

Incredibly wet and snowy year for the western U.S.





Motivation – Hazards

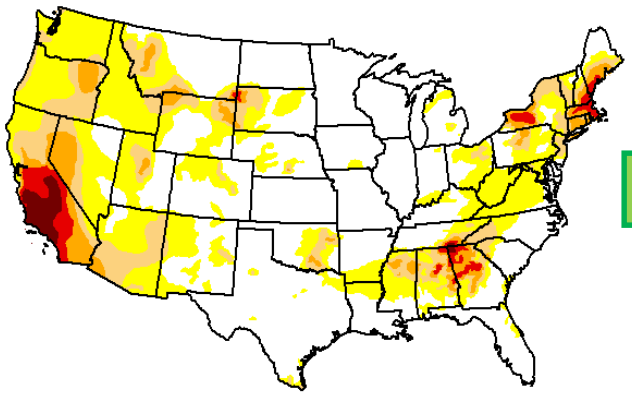



Mammoth Mountain Resort, CA (Jan 2017)

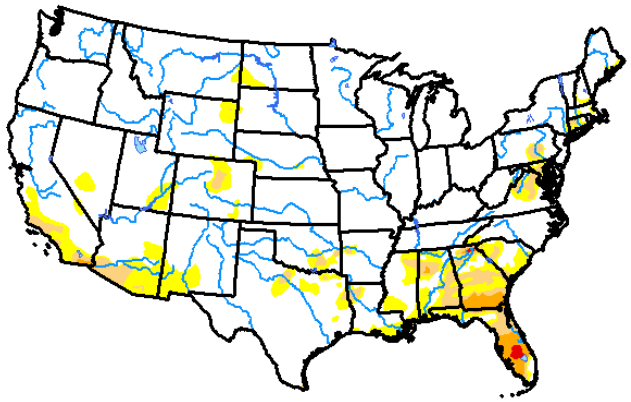

Big Sur, CA (May 2017)


Oroville Dam Spillway, CA (Feb 2017)

Motivation – Benefits



2016/17 Cool Season



September 27, 2016
(Released Thursday, Sep. 29, 2016)
Valid 8 a.m. EDT

Drought Conditions (Percent Area)

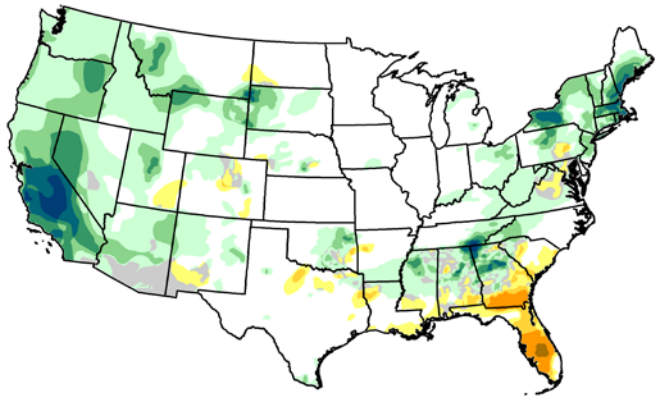
	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	53.60	46.40	18.96	8.10	3.20	1.16
Last Week 9/20/2016	54.97	45.03	18.82	7.76	2.94	1.11
3 Months Ago 6/28/2016	56.61	43.39	16.18	5.43	2.36	1.11
Start of Calendar Year 12/29/2015	66.99	33.01	18.74	11.56	6.28	2.70
Start of Water Year 9/29/2015	44.91	55.09	31.36	20.09	11.45	3.00
One Year Ago 9/29/2015	44.91	55.09	31.36	20.09	11.45	3.00

Intensity:

- D0 Abnormally Dry
- D1 Moderate Drought
- D2 Severe Drought
- D3 Extreme Drought
- D4 Exceptional Drought

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

U.S. Drought Monitor Class Change - CONUS
Start of Water Year



May 2, 2017
compared to
September 27, 2016

May 2, 2017
(Released Thursday, May. 4, 2017)
Valid 8 a.m. EDT

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	85.69	14.31	4.98	1.30	0.13	0.00
Last Week 04-25-2017	78.33	21.67	6.11	1.07	0.03	0.00
3 Months Ago 01-31-2017	68.02	31.98	14.55	3.83	0.41	0.00
Start of Calendar Year 01-03-2017	53.89	46.11	22.53	8.63	3.15	0.96
Start of Water Year 09-27-2016	53.60	46.40	18.96	8.10	3.20	1.16
One Year Ago 05-03-2016	66.11	33.89	14.56	5.46	3.44	1.11

Intensity:

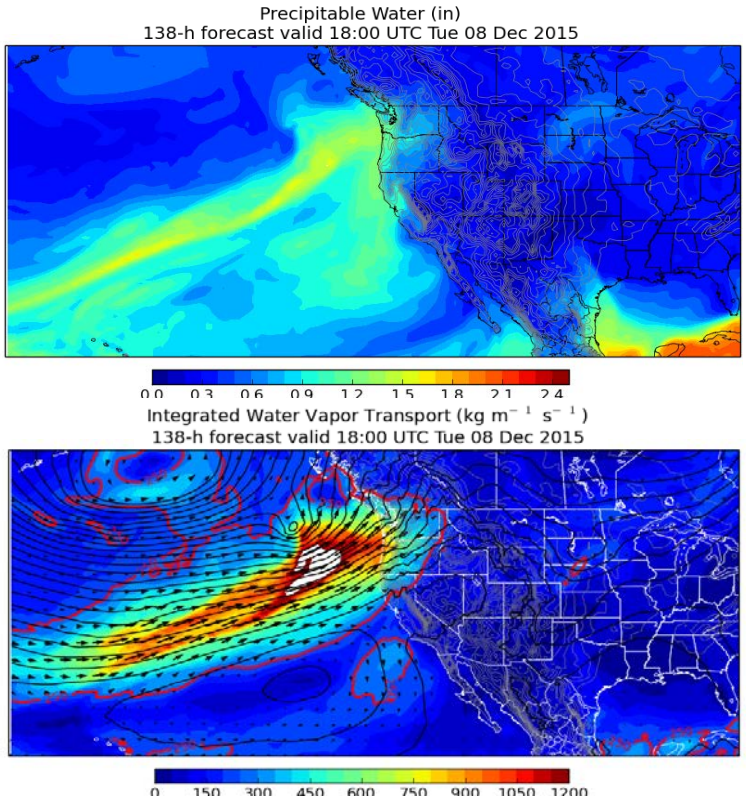
- D0 Abnormally Dry
- D1 Moderate Drought
- D2 Severe Drought
- D3 Extreme Drought
- D4 Exceptional Drought

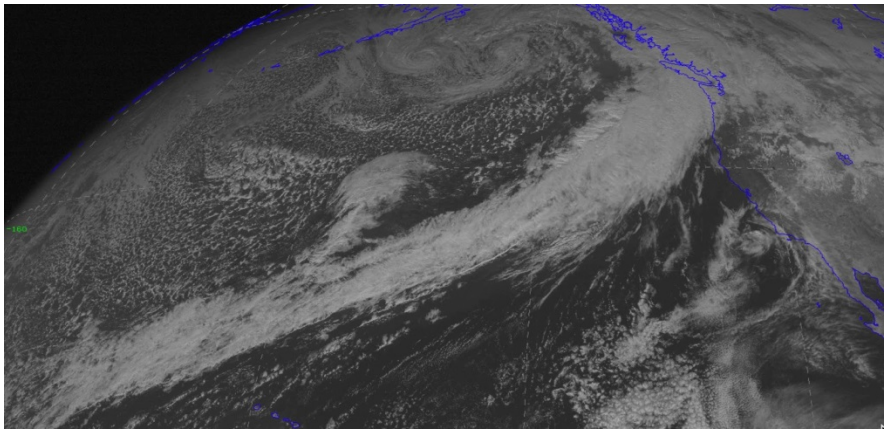
The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

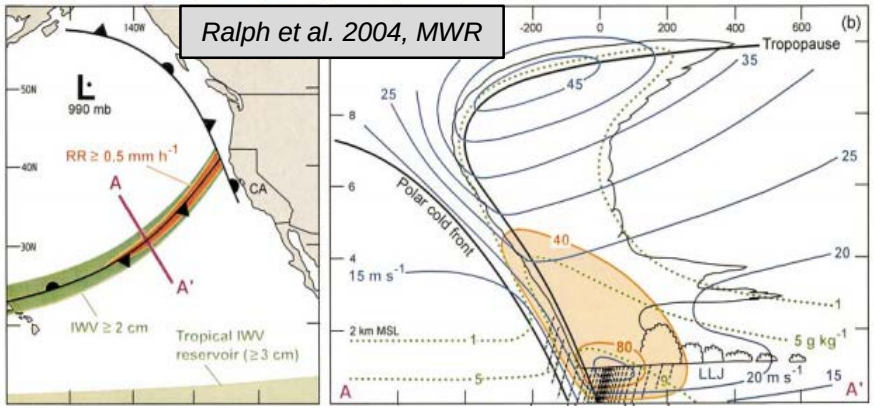
Atmospheric Rivers – What Are They?

- Atmospheric rivers (ARs): elongated regions of intense vertically integrated water vapor transport (IVT). They are…
  - **Long (> 2000 km)**
  - **Narrow (< 1000 km)**
  - **Large IVT (> 250 kg m^{-1} s^{-1})**

→ **Length/Width > 2/1**



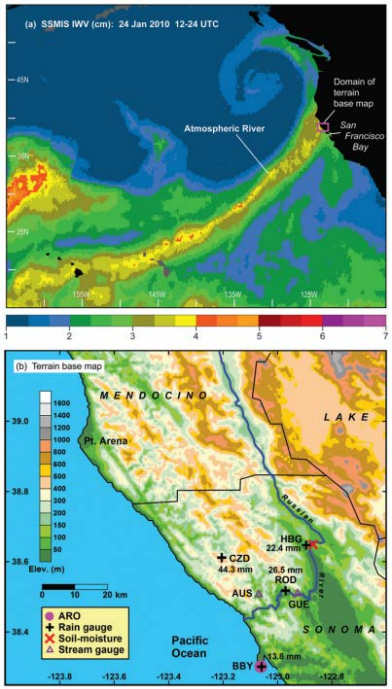


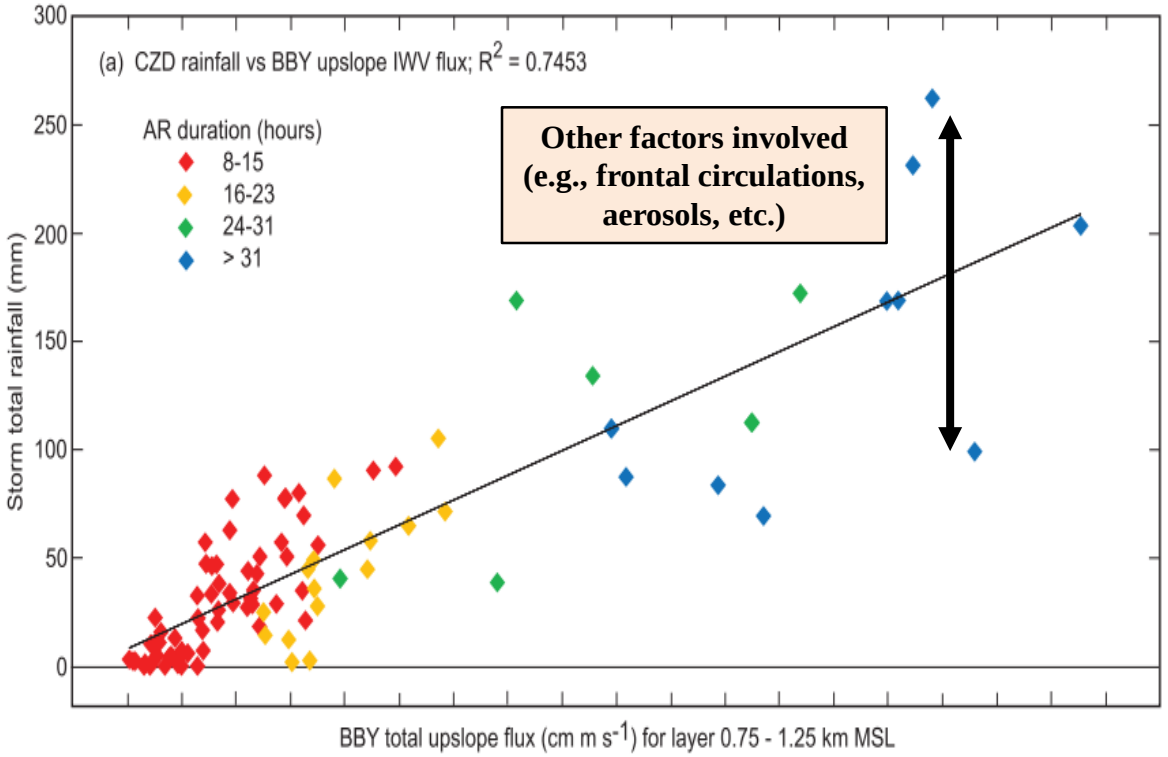


Atmospheric Rivers – Why Do We Care?

Observed impacts of duration and seasonality of atmospheric-river landfalls on soil moisture and runoff in coastal northern California

Ralph, F. M., T. Coleman, P. J. Neiman, R. Zamora, and M. D. Dettinger, J. Hydrometeorology, 2013





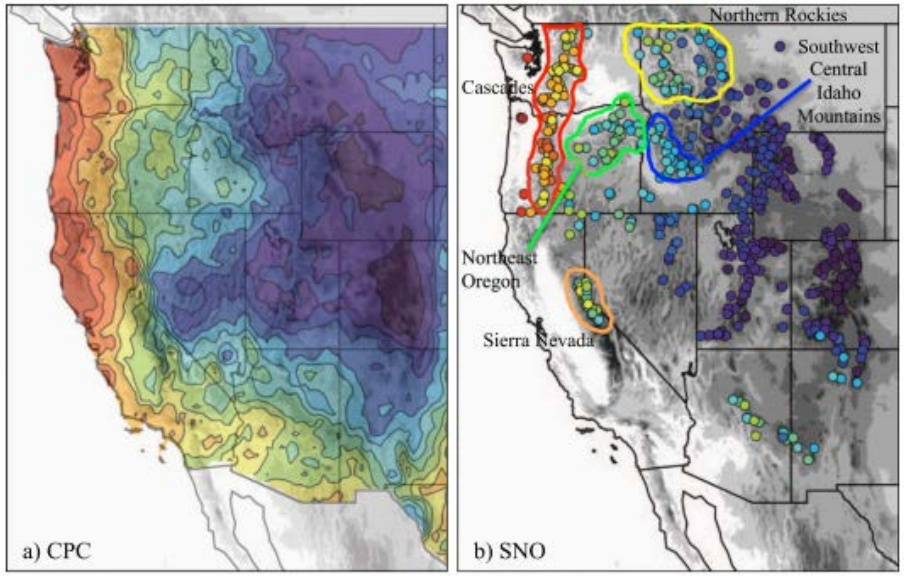
The greater the precipitation

The greater the AR strength and duration

Atmospheric Rivers – Why Do We Care?

Climatological characteristics of atmospheric rivers and their inland penetration over the western United States

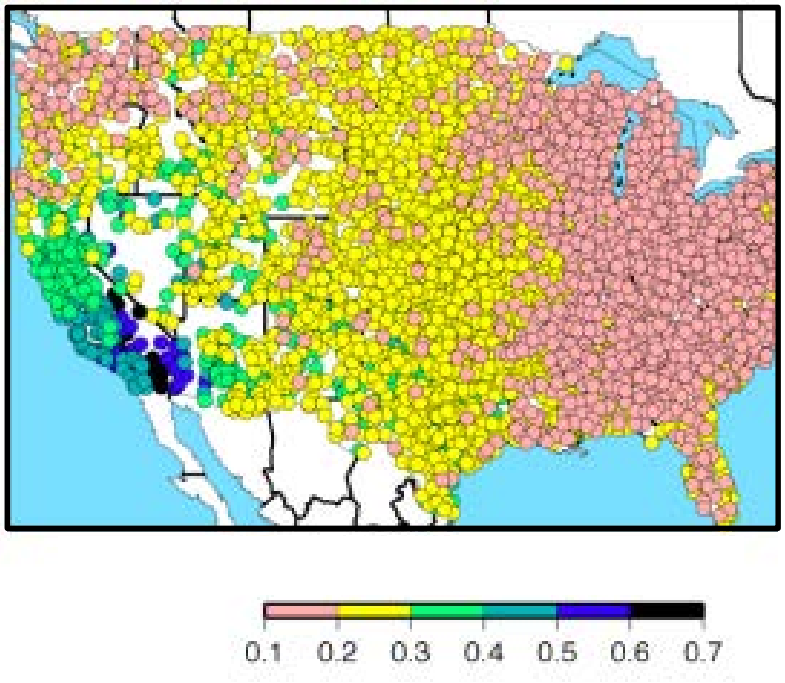
Rutz, J. J., W. J. Steenburgh, and F. M. Ralph, Mon. Wea. Rev., 2014



Fraction of cool-season (Nov – Apr) precipitation attributable to ARs based on (left) CPC analysis and (right) SNOTEL data

Atmospheric rivers, floods, and the water resources of California

Dettinger, M. D., F. M. Ralph, T. Das, P. J. Neiman, and D. R. Cayan, Water, 2011



Coefficient of variation for annual precipitation

Key Science Questions for 2016/17

- ***How*** was 2016/17 different from average?
  - Were there simply more AR events?
  - Were they longer-lived AR events?
  - Were they more intense AR events?
  - Or maybe all 3?

- ***What*** was the relationship between ARs and precipitation during the 2016/17 cool season?

- ***Why*** was 2016/17 different from average?
  - More on this at the end

Data and Analysis

- MERRA v2 Reanalysis used to calculate IVT and ARs from **Jan 1980 – Apr 2017**
  - 0.5°×0.625° horizontal grid
  - 25 hPa from 1000-700 hPa
  - 50 hPa from 500-200 hPa
  - 3-hour time steps
  - Most of CONUS and AK
  - example shown at right

123.125°W, 38.5°N

yyyy	mm	dd	hh	AR?	new AR?	AR duration	ivt
2017	2	5	9	0	0	0	182.80
2017	2	5	12	0	0	0	177.52
2017	2	5	15	0	0	0	196.64
2017	2	5	18	1	1	3	268.17
2017	2	5	21	1	0	6	350.94
2017	2	6	0	1	0	9	462.30
2017	2	6	3	1	0	12	531.89
2017	2	6	6	1	0	15	325.53
2017	2	6	9	1	0	18	274.47
2017	2	6	12	1	0	21	279.71
2017	2	6	15	1	0	24	302.33
2017	2	6	18	1	0	27	279.04
2017	2	6	21	1	0	30	366.22
2017	2	7	0	1	0	33	420.16
2017	2	7	3	1	0	36	474.17
2017	2	7	6	1	0	39	717.14
2017	2	7	9	1	0	42	766.54
2017	2	7	12	1	0	45	680.94
2017	2	7	15	1	0	48	800.43
2017	2	7	18	1	0	51	486.54
2017	2	7	21	1	0	54	353.27
2017	2	8	0	1	0	57	297.10
2017	2	8	3	0	0	0	208.20
2017	2	8	6	0	0	0	234.37
2017	2	8	9	1	1	3	395.92
2017	2	8	12	1	0	6	563.81

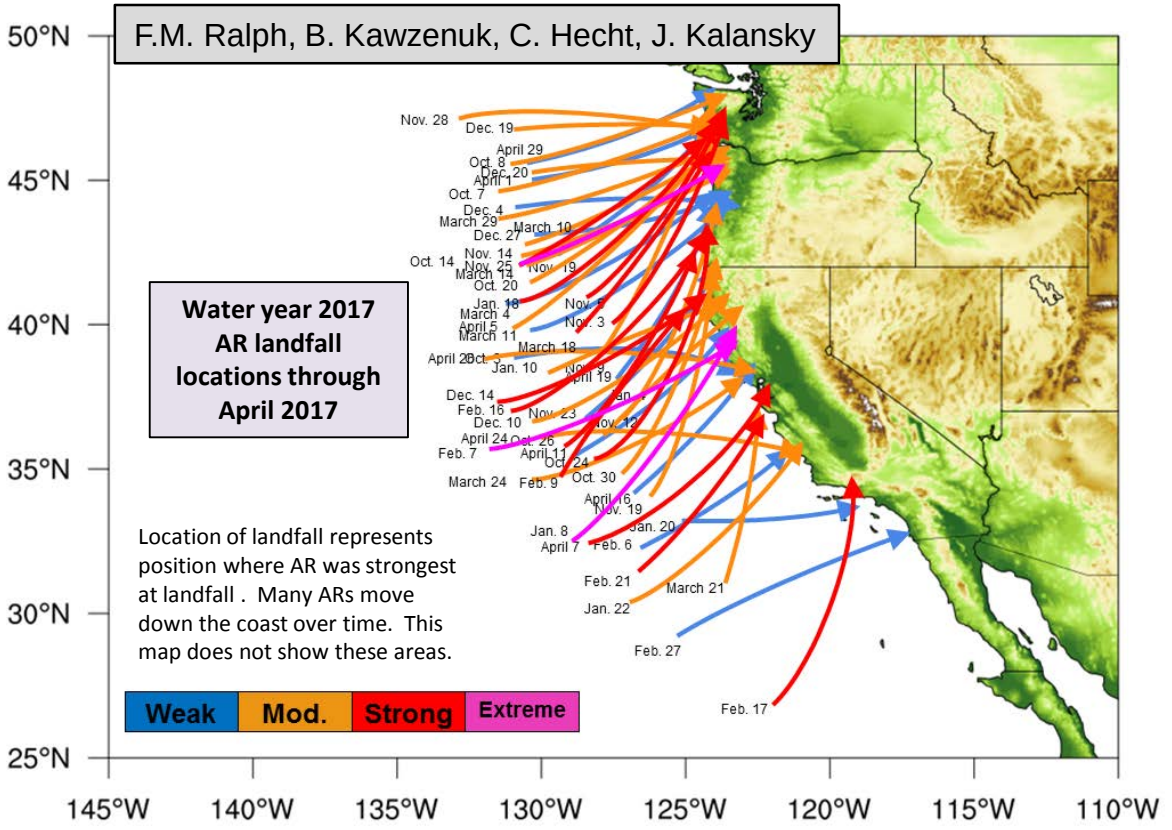
Data Available at: http://www.inscc.utah.edu/~rutz/ar_catalogs/

2016/17 Cool Season ARs

Ralph/CW3E AR Strength Scale

- Weak: IVT=250–500 kg m^{-1} s^{-1}
- Moderate: IVT=500–750 kg m^{-1} s^{-1}
- Strong: IVT=750–1000 kg m^{-1} s^{-1}
- Extreme: IVT>1000 kg m^{-1} s^{-1}

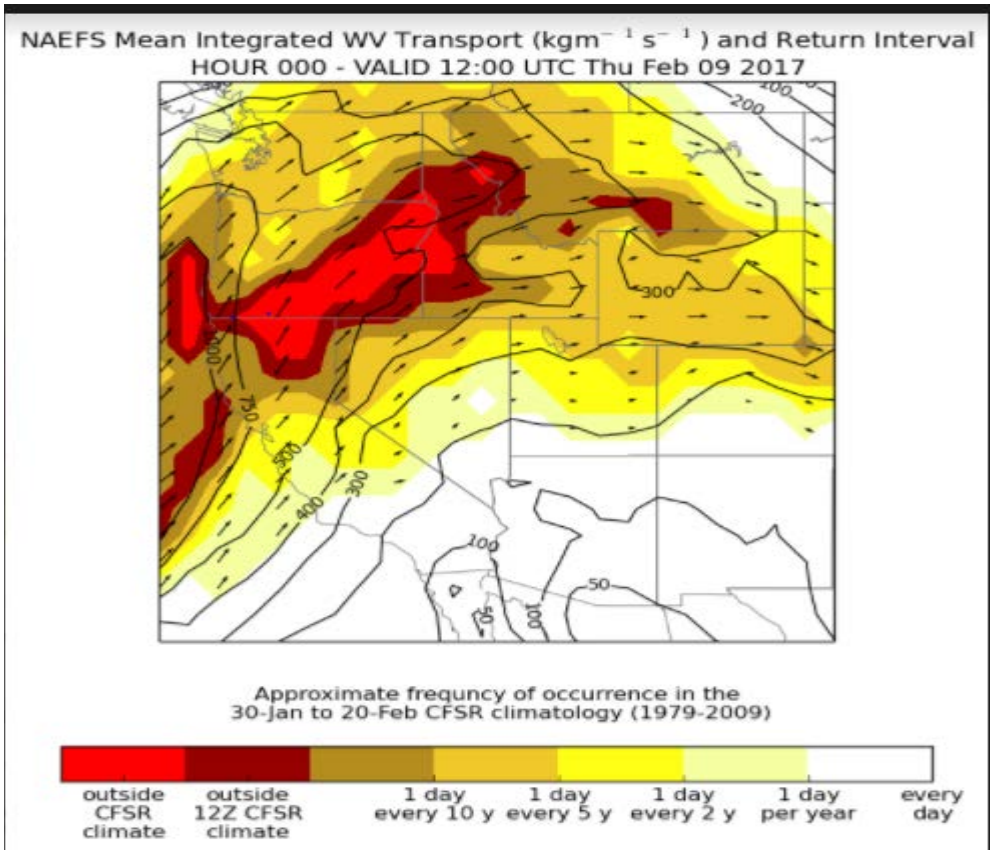
AR Strength	AR Count*
Weak	15
Moderate	23
Strong	13
Extreme	3



*Radiosondes at Bodega Bay, CA indicated the 10–11 Jan AR was strong (noted as moderate based on GFS analysis data) and 7–8 Feb AR was extreme (noted as strong)

- 54 ARs have made landfall on the West Coast thus far during the 2017 water year (1 Oct. – 1 May 2017)
- This is much greater than normal
- 1/3 of the landfalling ARs have been “strong” or “extreme”

AR Examples

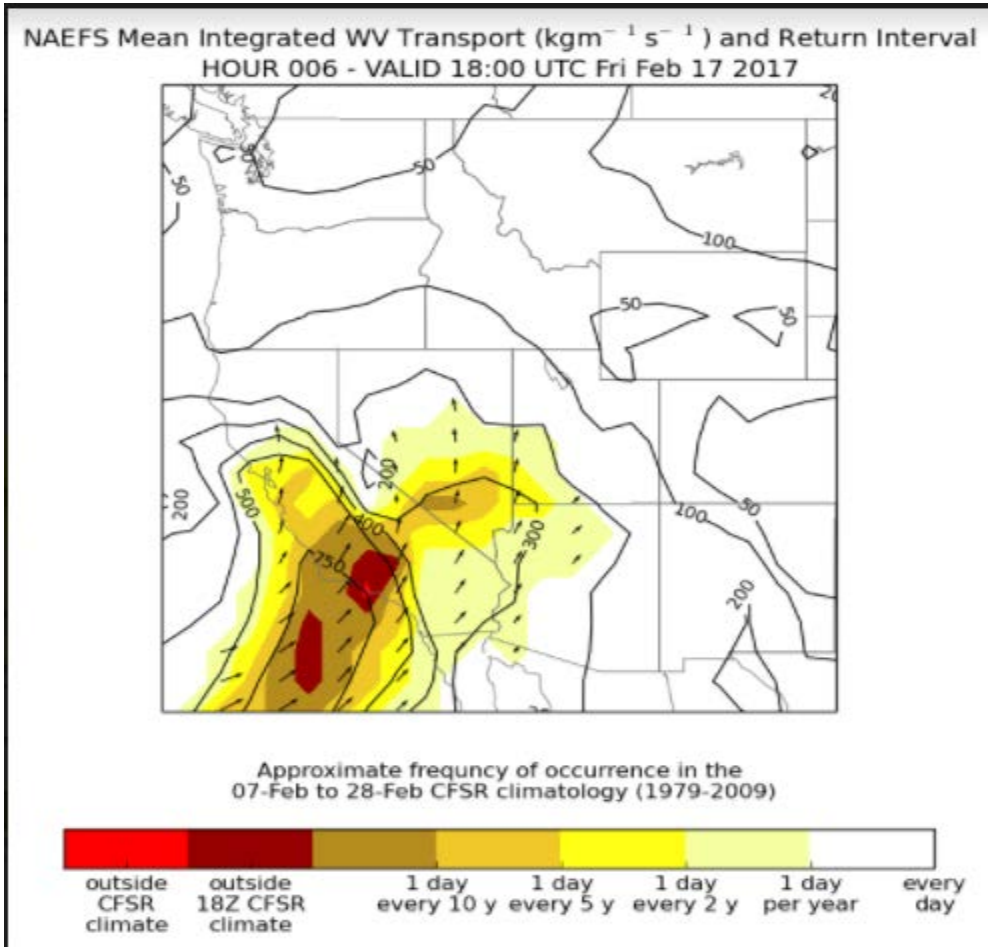


MIMIC TPW
ftp://ftp.ssec.wisc.edu/pub/ssec/edman1
Courtesy of Anthony Wimmers/Chris Veldon - UW – Jon Rutz WR/STID

Feb 6-10, 2016

- 12" over the Feather River Basin led to the Oroville Dam crisis
- ftp://ftp.ssec.wisc.edu/pub/ssec/edman1/mimic_epac0207-0211.gif

AR Examples



MIMIC TPW

ftp://ftp.ssec.wisc.edu/pub/ssec/edman1

Courtesy of Anthony Wimmers/Chris Veldon - UW – Jon Rutz WR/STID

Feb 17-18 2016

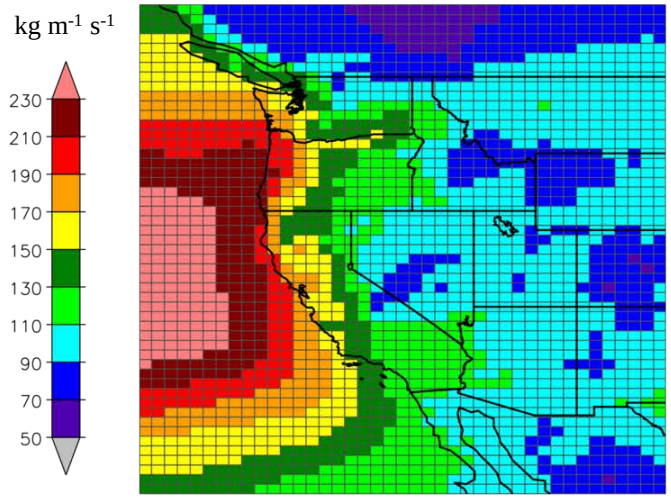
- Much more quickly progressing AR, but heavy rain and landslides in the LA and surrounding mountains... talking to folks at Oxnard and San Diego... probably most significant SoCal event since 2010/11.12" over the Feather River Basin led to the Oroville Dam crisis
- ftp://ftp.ssec.wisc.edu/pub/ssec/edman1/mimic_epac0214-0218.gif

AR Examples

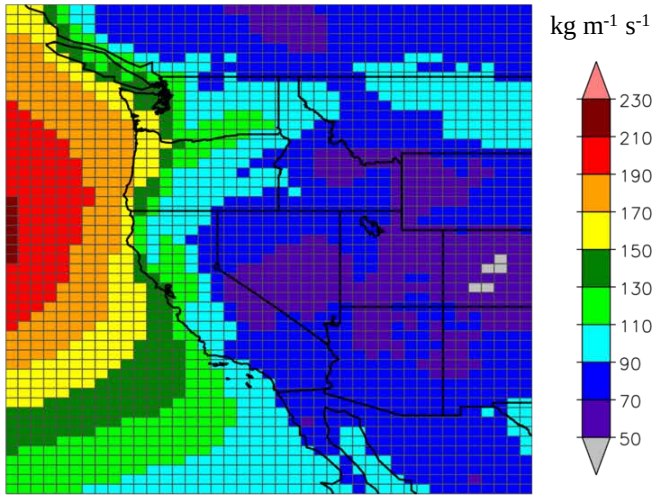
- Early Jan AR event
  - ftp://ftp.ssec.wisc.edu/pub/ssec/edman1/170106-11_mimic_tpw_EPAC_CA_anim.gif

- Early Season Trpoical Transition
  - ftp://ftp.ssec.wisc.edu/pub/ssec/edman1/161010-15_mimic_tpw2_Songda_to_PacNW_anim.gif

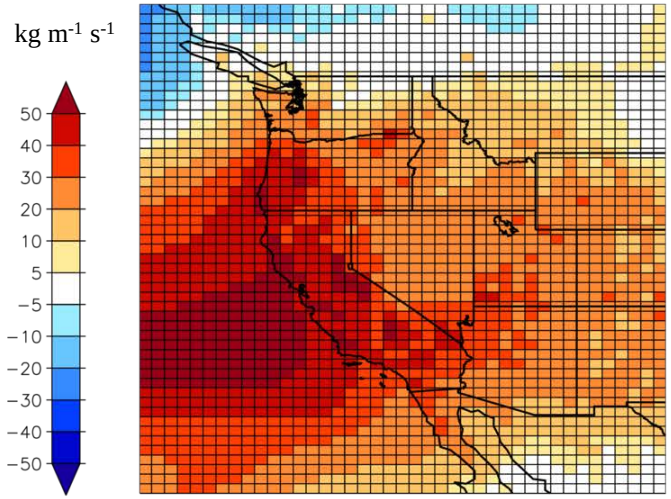
Integrated Water Vapor Transport (IVT)



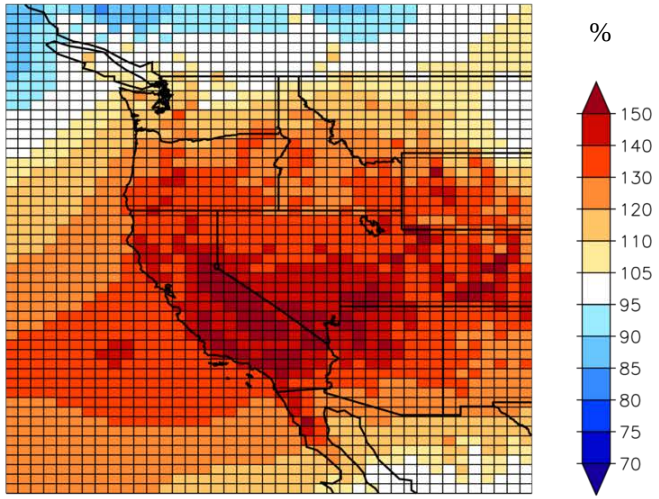
2016/17 Cool Season



1980-2017 Cool Season Mean

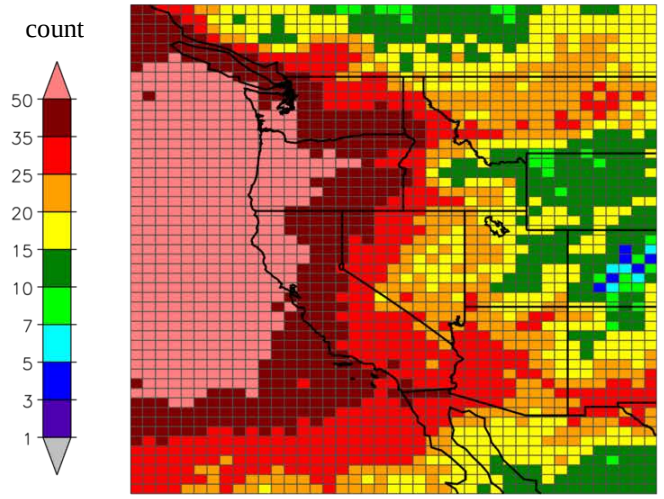


Difference (2016/17 – Mean)

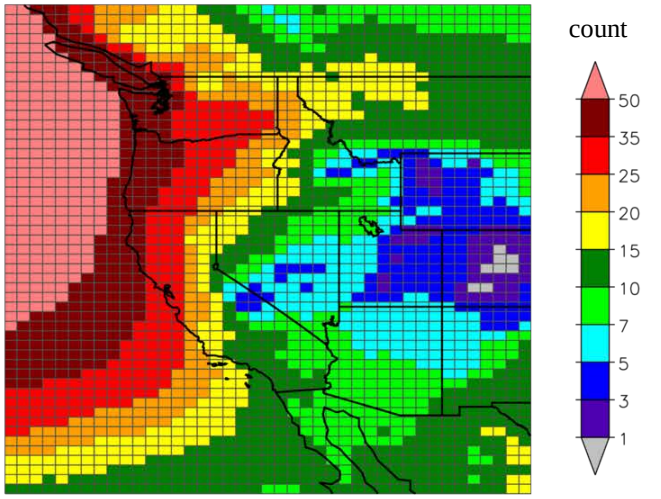


Percentage (2016/17 ÷ Mean)

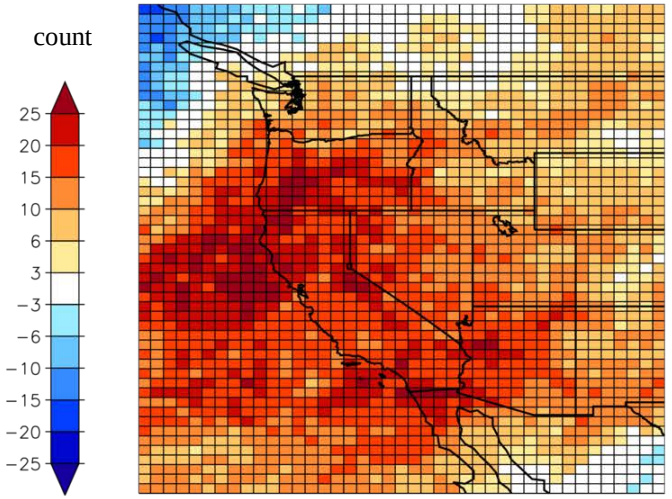
Atmospheric River Events (IVT ≥ 250)



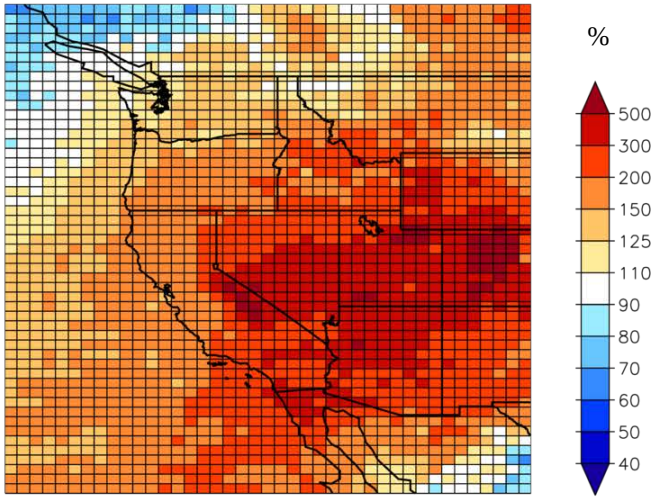
2016/17 Cool Season



1980-2017 Cool Season Mean

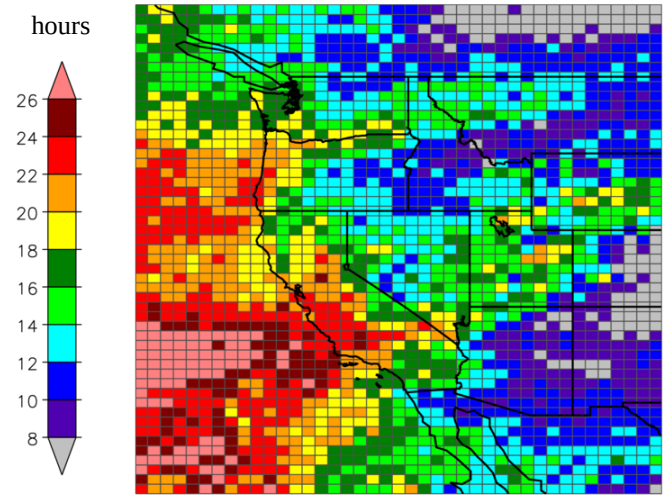


Difference (2016/17 – Mean)

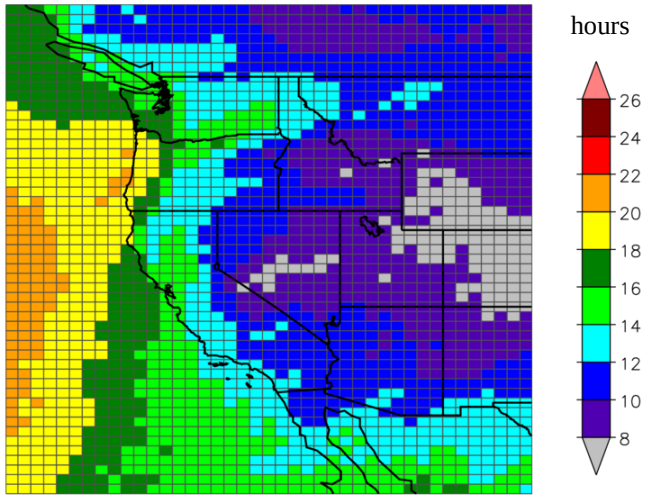


Percentage (2016/17 ÷ Mean)

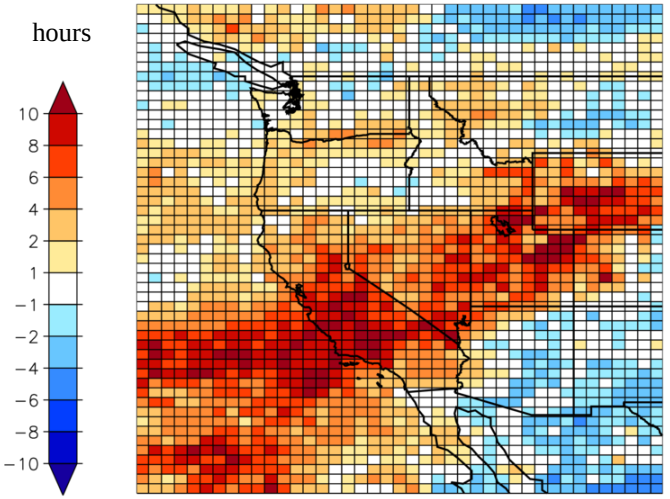
Atmospheric River Mean Duration



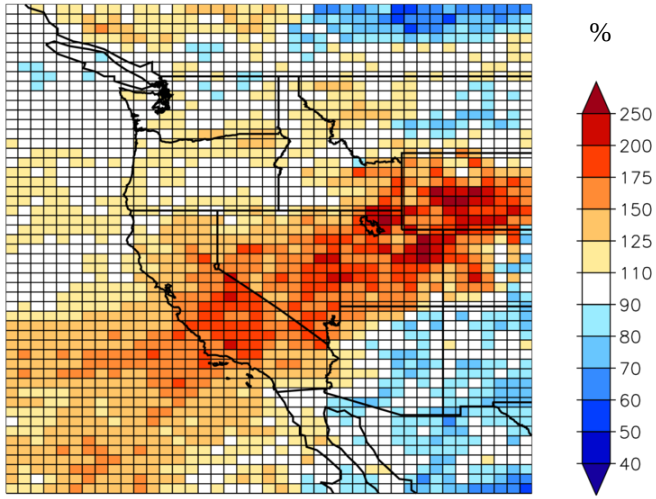
2016/17 Cool Season



1980-2017 Cool Season Mean



Difference (2016/17 – Mean)

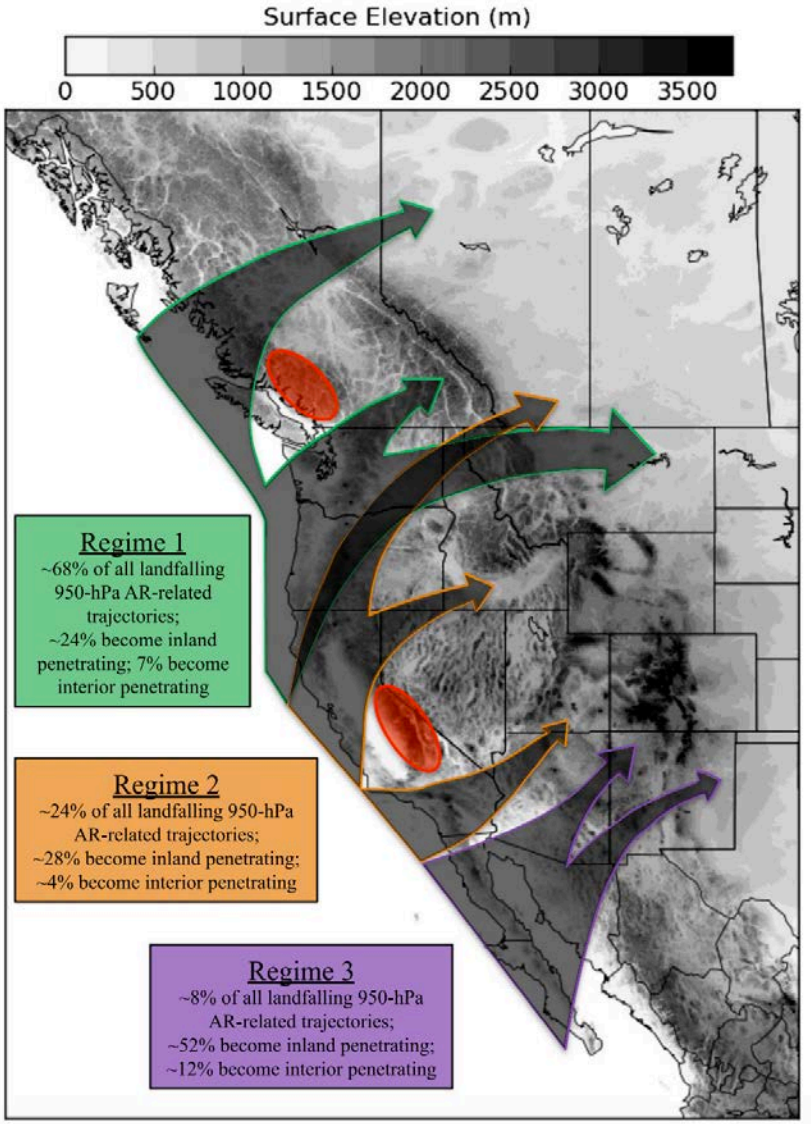


Percentage (2016/17 ÷ Mean)

What Explains Great Basin Anomalies?

Typically, the high Sierra are strongly conducive to AR decay via water vapor depletion, as well as flow blocking and deflection (Rutz et al. 2015 Mon. Wea. Rev.; Swales et al. 2016 Geophys. Res. Lett.; Hudson et al. in prep).

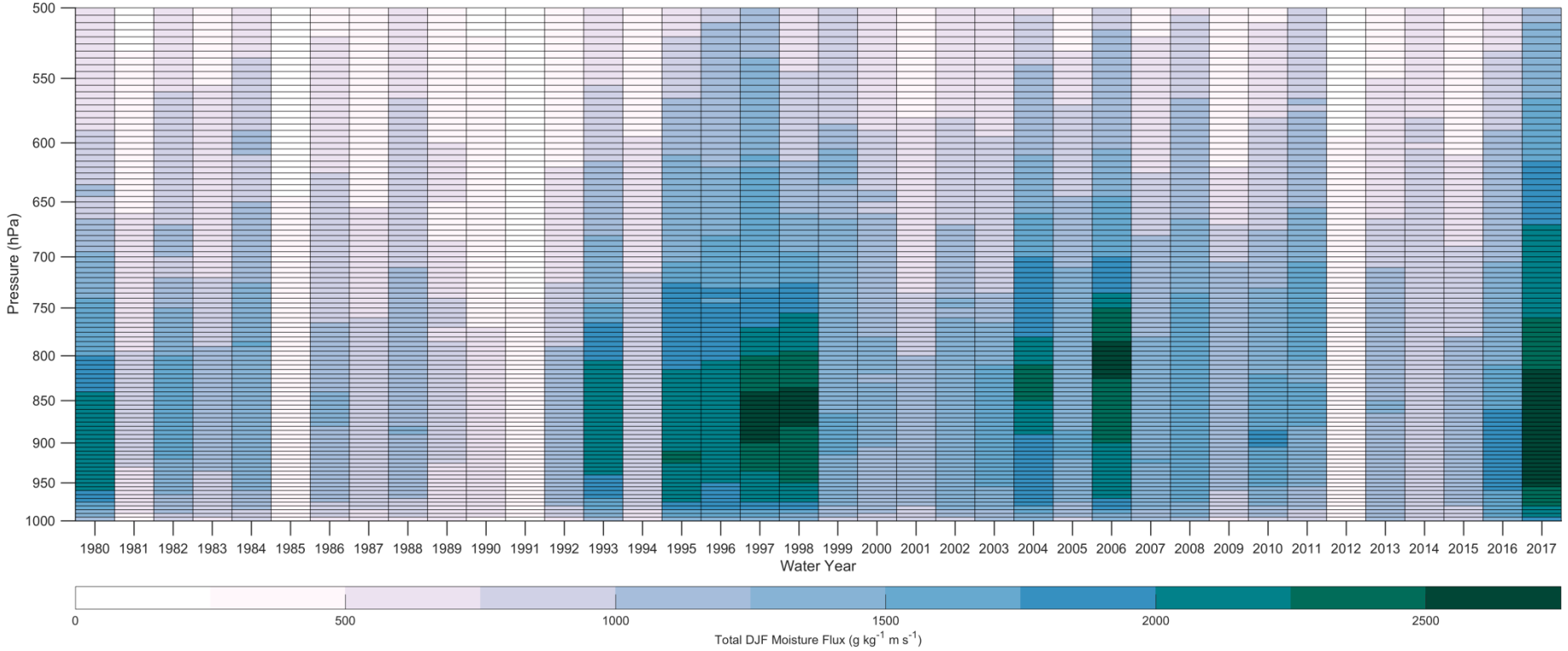
So what explains the huge anomalies over the Great Basin?



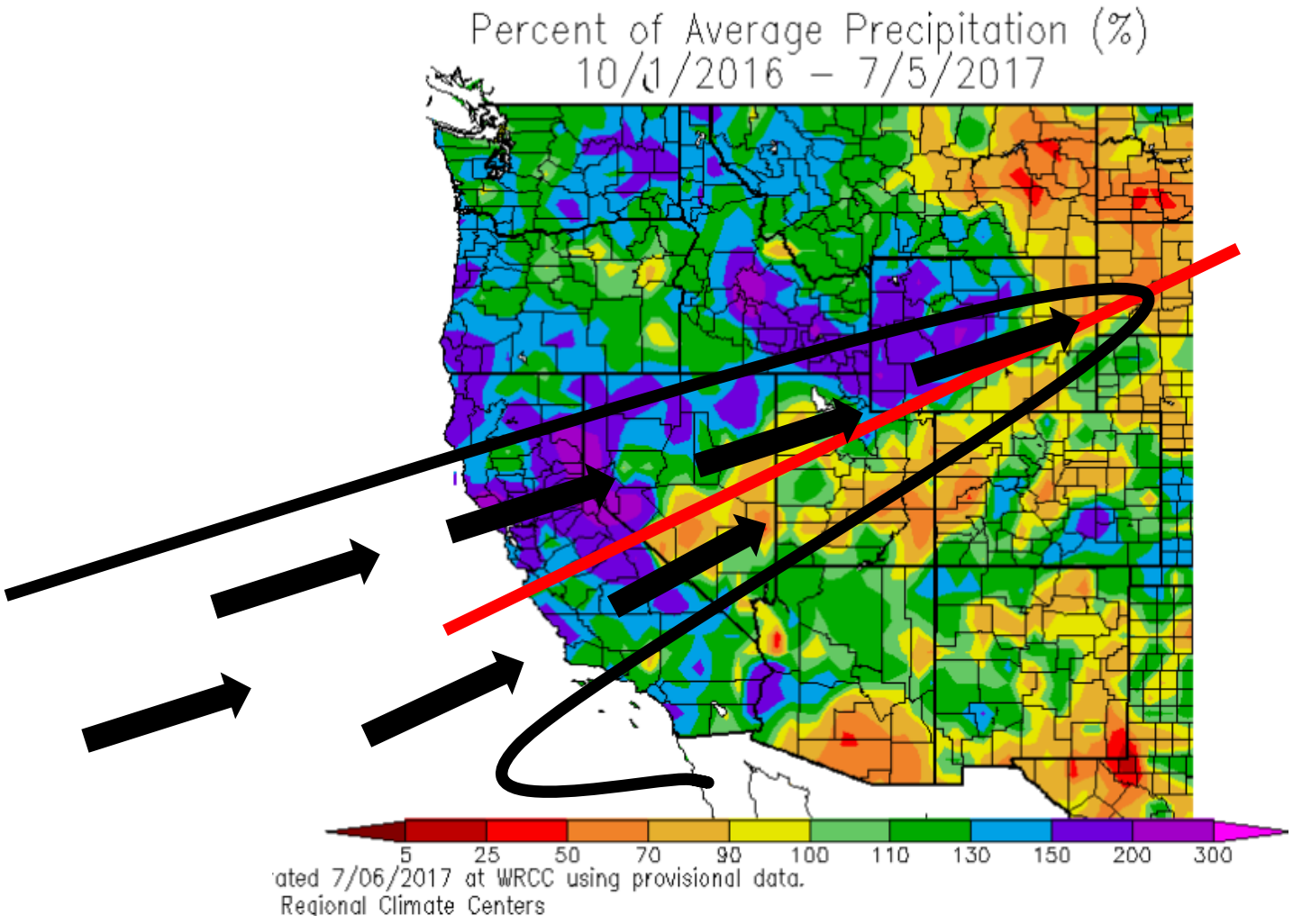
Mid-Level Moisture Transport

One strong candidate is mid-level moisture transport (Kaplan et al. 2012 J. Hydromet.); also the frequency and intensity of landfalling ARs.

Moisture Flux at Oakland For DJF (caveat: some 1980s years missing or suspicious)

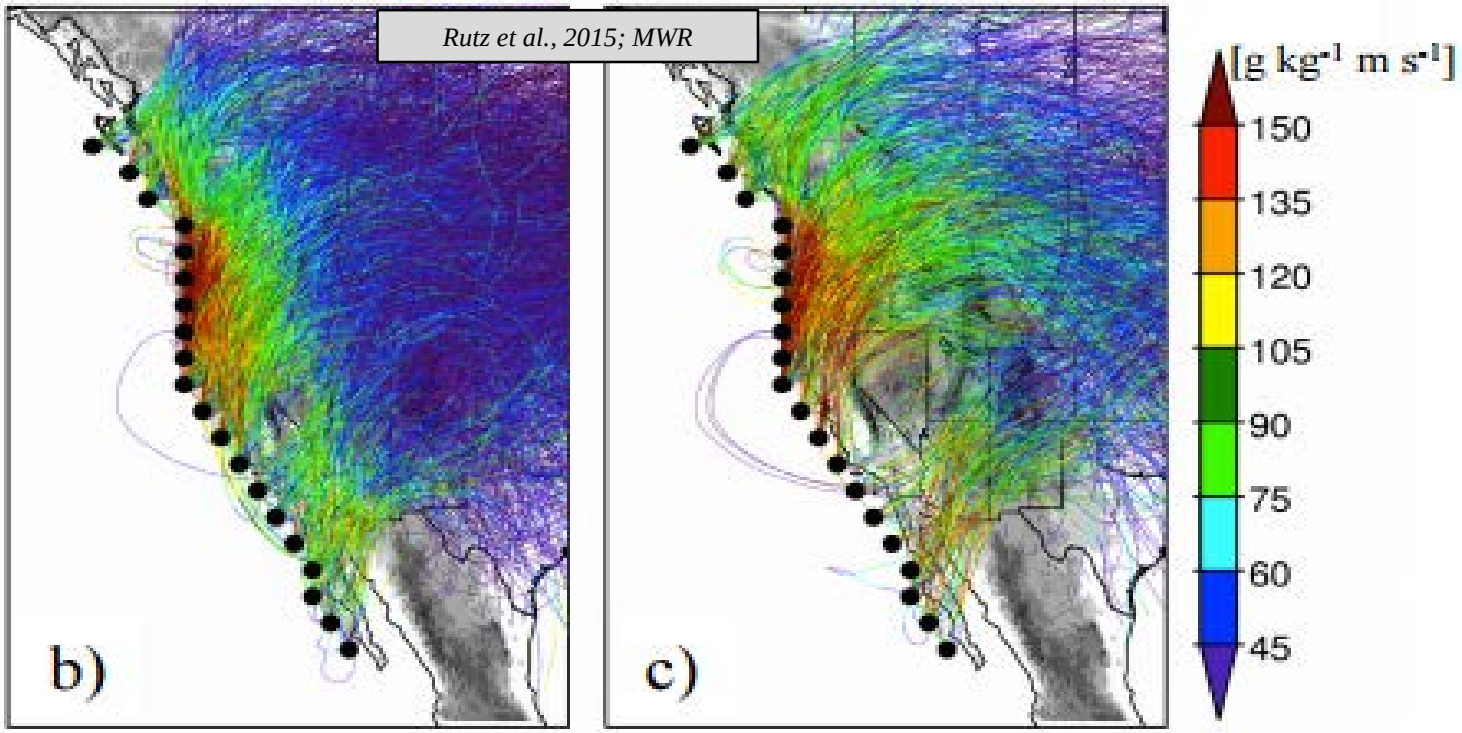


ARs and Precipitation

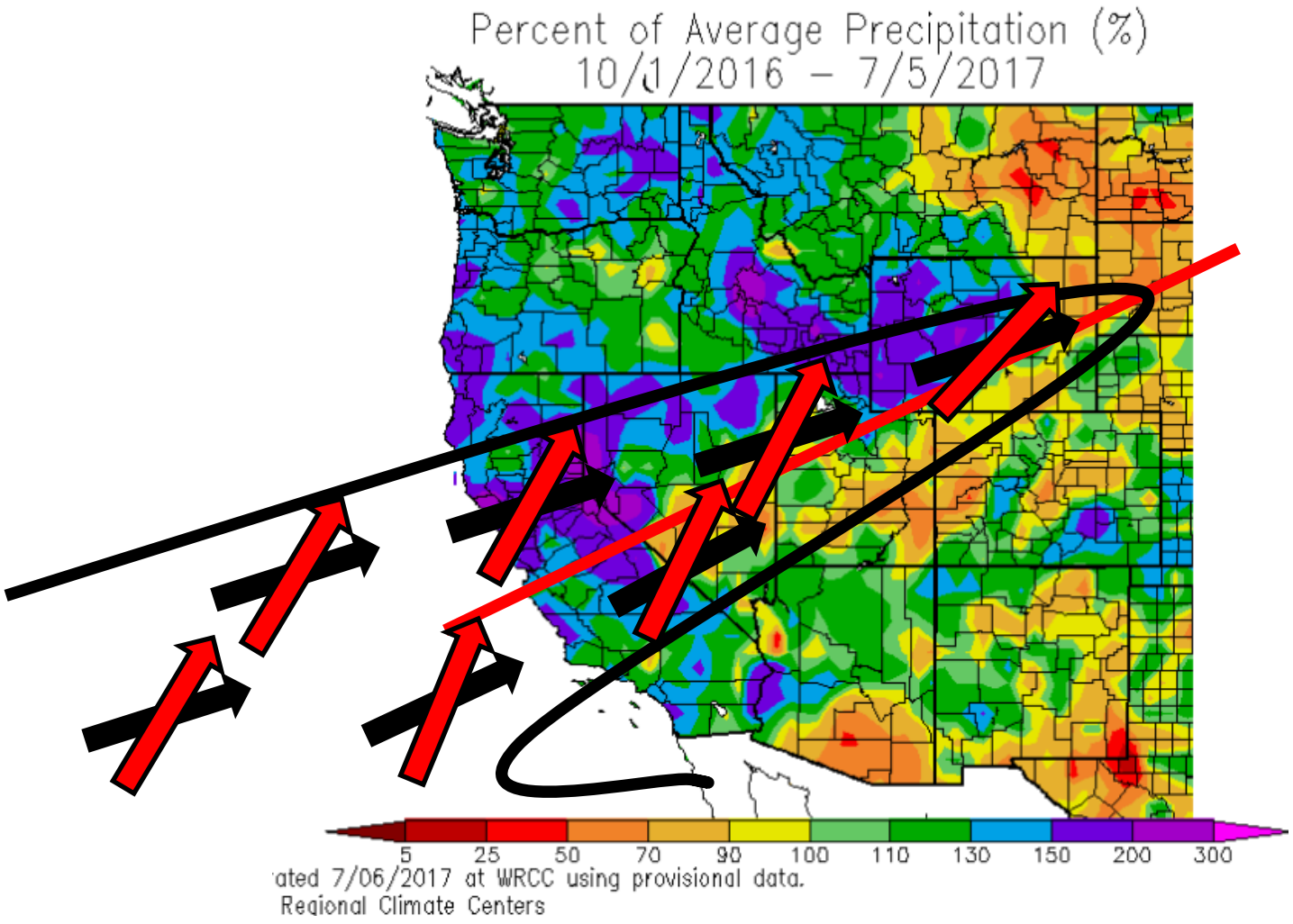


ARs and Precipitation

Transport within ARs is much more poleward than parallel to the AR, especially at lower levels where greater moisture is present.

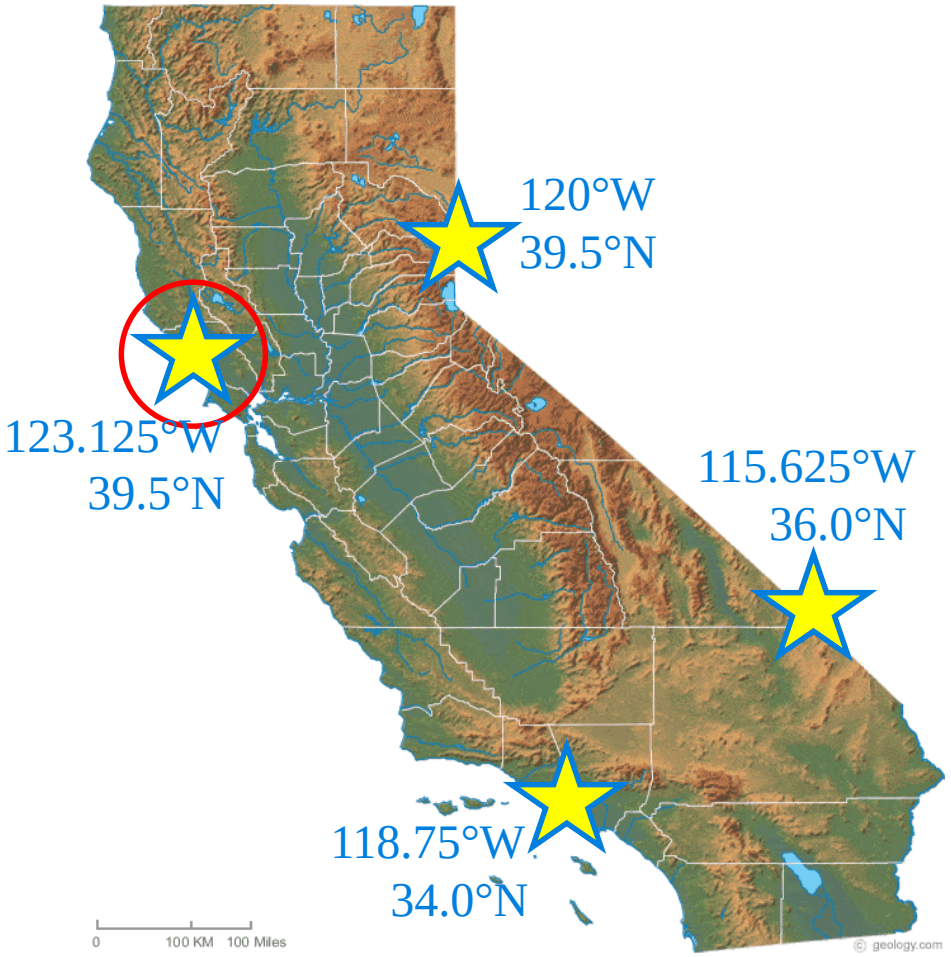


ARs and Precipitation



And Now For A Closer Look…

- Using MERRA v2 Catalogs
- Compare AR climatology of 2016-2017 cool season to the 1980-2017 mean
  - 2 locations along CA coast
  - 2 location at CA/NV border
- I can quickly provide data and graphics for other locations



AR Timeseries 1980–2017

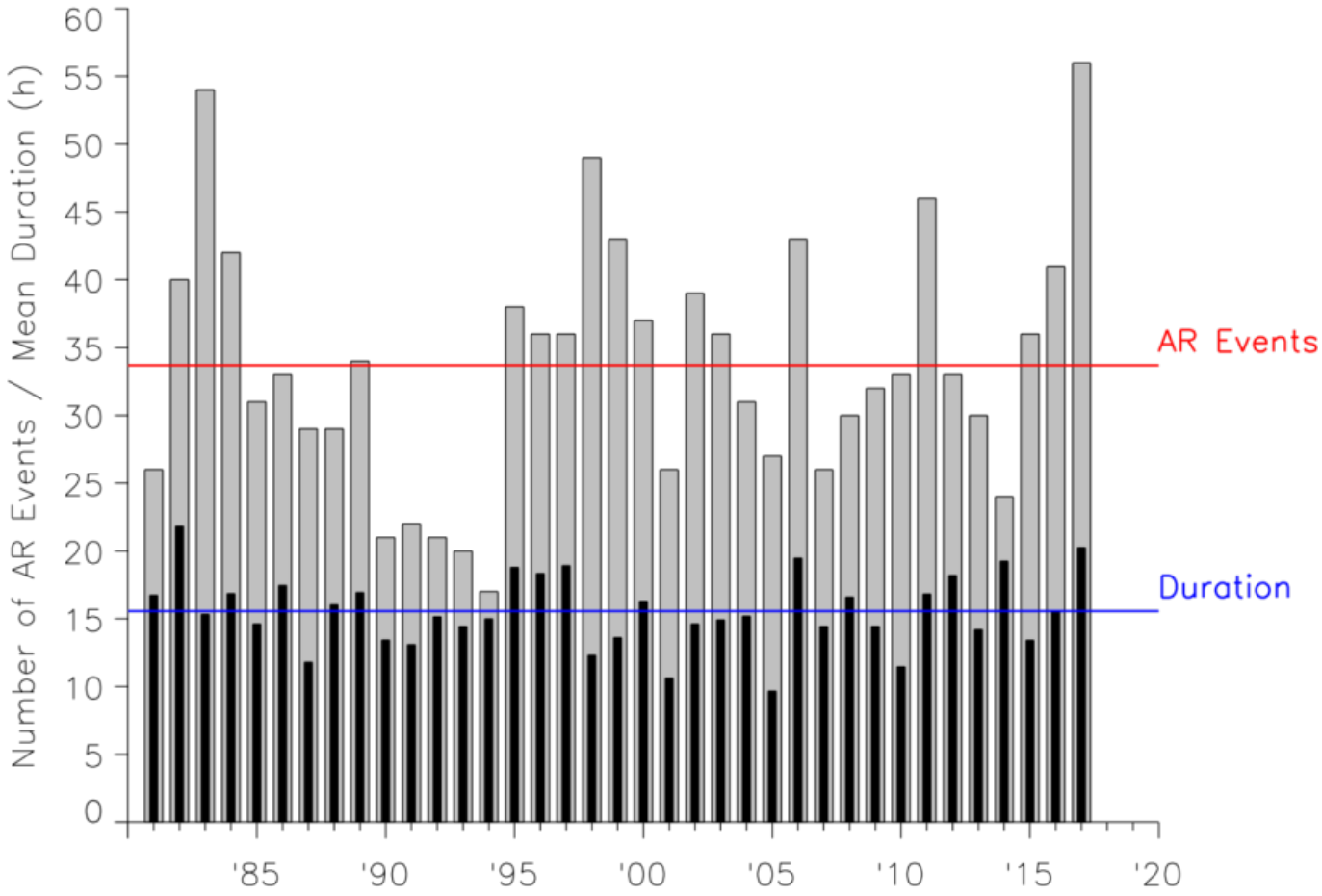


Figure Description: Number of AR events (grey) and mean annual duration (black).

AR Timeseries 1980–2017

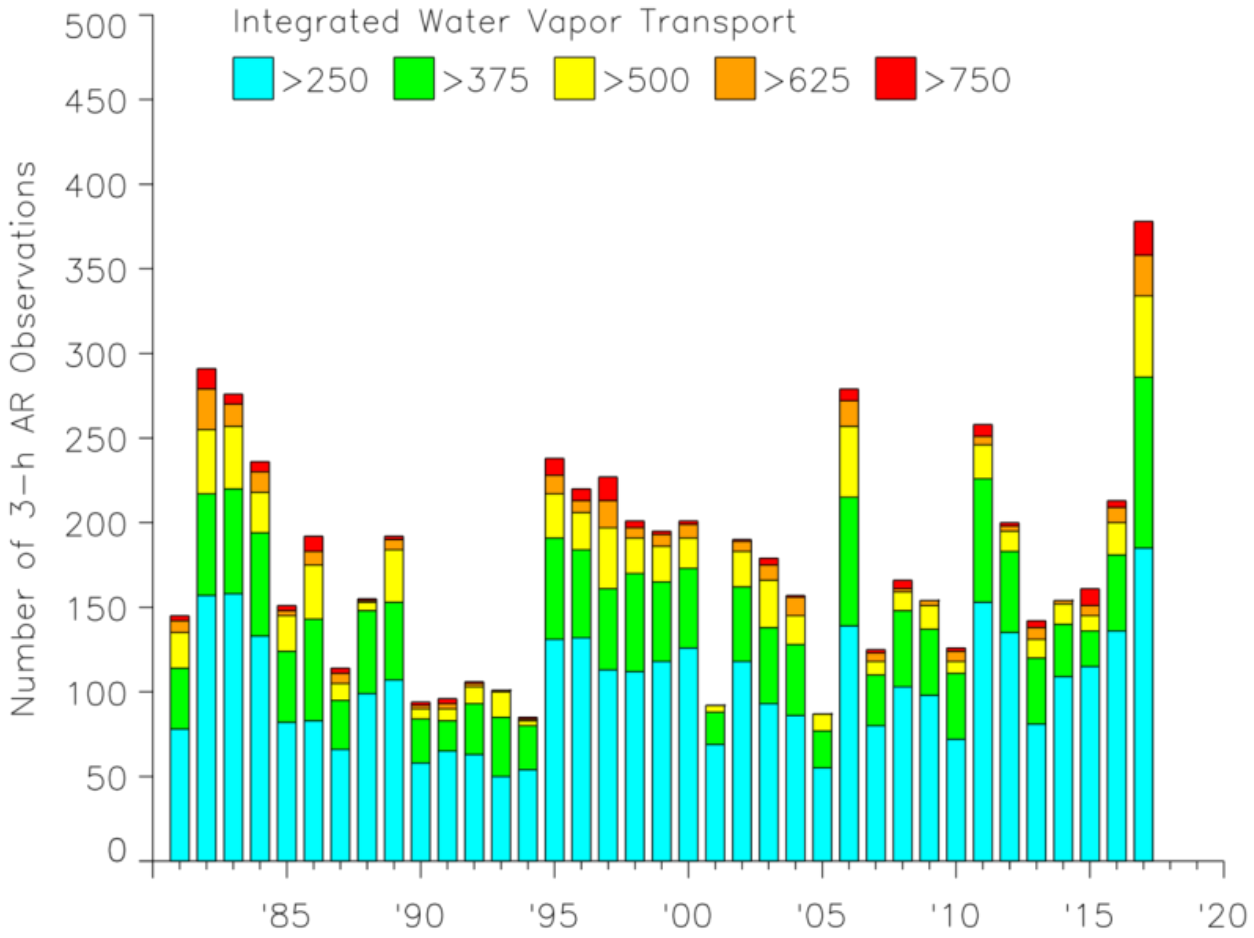


Figure Description: AR Observations as a function of IVT (solid fill).

AR Intensity by Month

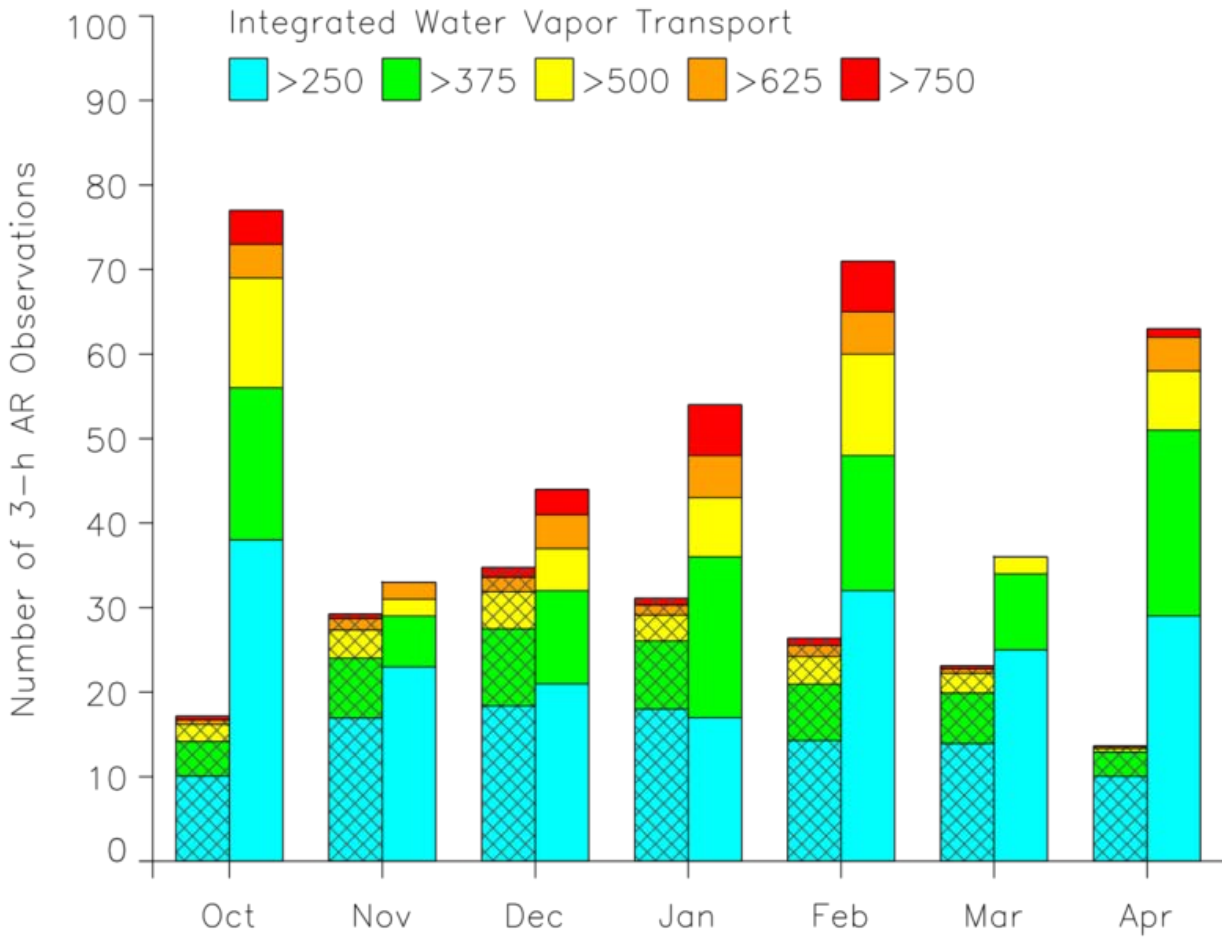


Figure Description: 2016/17 AR Observations as a function of IVT (solid fill) and 1980-2017 mean (cross hatched).

Inland Impacts – Feb/Mar 2017



Marsh Creek near Inkom, ID (16 Feb 2017)



Cottonwood, ID (3 Mar 2017)



Southern ID (11 Feb 2017)

Summary

- The 2016/17 cool season saw widespread impacts – both hazardous and beneficial – across the western U.S.
  - Landslides, flooding, emergency dam releases, drought reduction

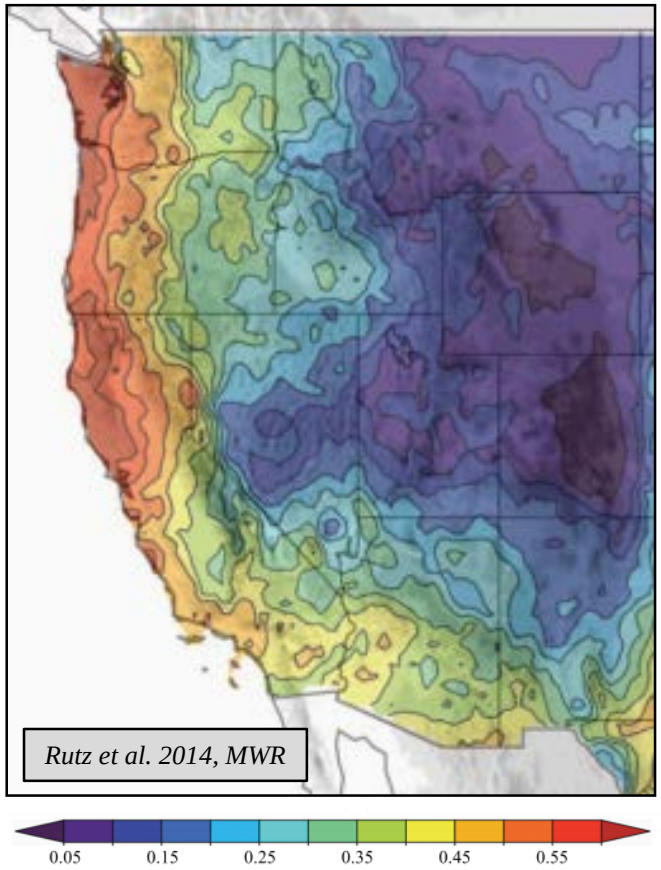
- During this time, atmospheric rivers (ARs) were ***more frequent***, ***longer-lived***, and ***more intense*** than the 1980–2017 average
  - Although other years can compete on one or two of these metrics, none can compete on all three
  - These ARs and their impacts were not limited to coastal regions, but extended (and were actually most anomalous) further inland

Ongoing Work

- ***Why*** were the climatological characteristics of ARs so extreme during 2016/17?
  - Corresponding w/ group at ESRL working to answer this question

- Can forecast skill be improved at various lead times?

- Did the greater frequency, duration, and intensity of ARs during the 2016/17 cool season actually alter the relative contribution of ARs to precipitation?

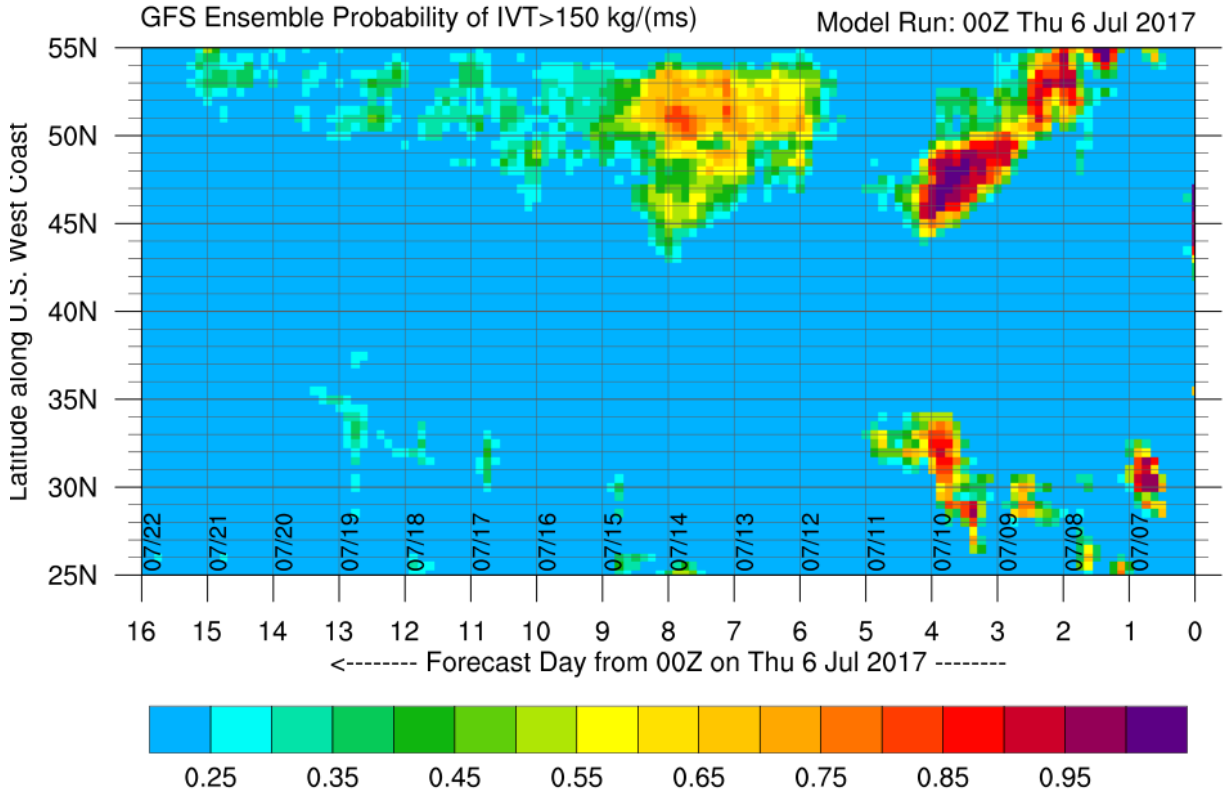


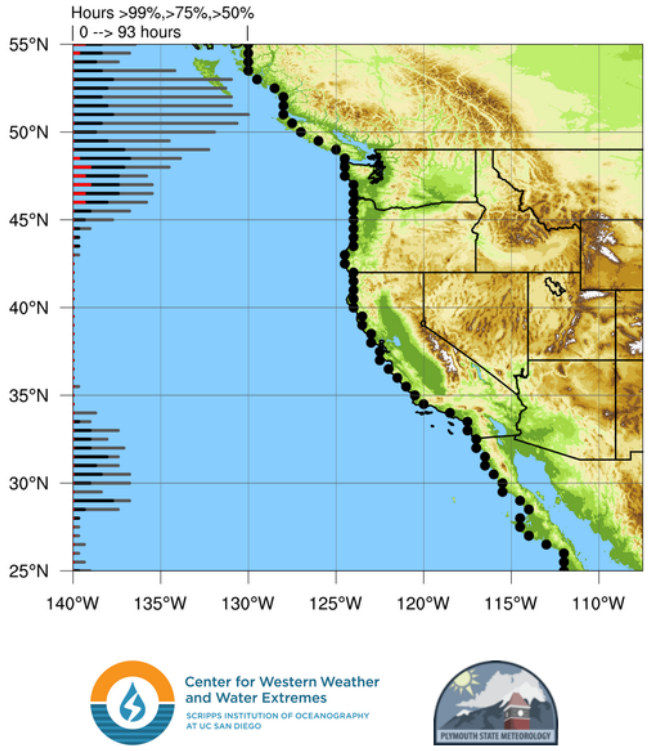
Atmospheric River Forecast Tools

Atmospheric River Forecast Tools

UCSD / Scripps / CW3E

http://cw3e.ucsd.edu/iwv-and-ivt-forecasts/





Center for Western Weather and Water Extremes
SCRIPPS INSTITUTION OF OCEANOGRAPHY AT UC SAN DIEGO

PLYMOUTH STATE METEOROLOGY

Atmospheric River Forecast Tools

NWS Situational Awareness Tables

http://esatqa.ncep.noaa.gov/

ENSEMBLE SITUATIONAL AWARENESS TABLE ARCHIVE
NOAA / NATIONAL WEATHER SERVICE

Verification

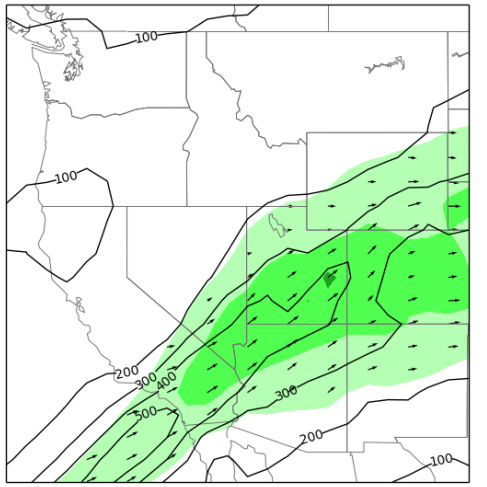
Type: NAEFS Standardized Anomaly | Recent Cases | Historic Cases | Date: 02/08/2017 | 12Z | Region: Western U.S. | View Table

Fcst Hr: 72 Valic

Western U.S. Table Feb 8, 2017 00Z Run

			Z	T	U	V	WSP	SLP	Q	PW	IVT
0	Wed 8th	00Z	-2.0	2.7	4.1	-2.7	4.3	-2.3	3.9	4.3	5.8
6		06Z	2.0	2.9	4.3	-2.7	4.5	-1.9	3.3	3.5	5.8
12		12Z	2.1	2.7	3.5	-2.9	3.7	-1.4	3.1	3.2	4.1
18		18Z	2.2	2.4	3.7	-2.9	3.6	-1.4	3.2	3.3	4.3
24	Thu 9th	00Z	2.4	2.5	3.8	2.3	3.8	-1.7	3.2	3.2	4.9
30		06Z	2.4	2.5	3.6	2.9	3.8	-2.1	3.5	3.3	5.6
36		12Z	-2.5	2.5	3.9	3.4	3.6	-2.5	3.8	3.3	5.8
42		18Z	-2.7	2.8	4.3	3.6	4.6	-2.7	4.1	3.6	6.3
48	Fri 10th	00Z	-2.8	2.7	4.6	3.7	5.1	-2.6	4.3	3.7	6.2
54		06Z	-2.7	2.6	4.3	3.2	3.7	-2.5	4.1	3.7	6.3
60		12Z	2.6	2.8	4.5	2.9	4.1	-2.5	4.1	3.6	5.7
66		18Z	2.6	2.6	4.3	2.6	4.1	-2.2	3.9	3.4	6.1
72	Sat 11th	00Z	2.5	2.6	4.2	2.5	4.1	-1.9	3.4	3.1	6.2
78		06Z	2.3	2.3	3.9	2.3	4.2	-1.7	3.3	3.0	5.9
84		12Z	2.2	2.3	3.7	2.3	4.2	-1.6	3.1	2.6	5.1
90		18Z	2.0	2.2	2.5	2.2	2.7	1.5	2.6	2.5	4.2
96	Sun 12th	00Z	1.8	2.1	1.6	2.1	1.8	1.6	2.3	2.2	3.2
102		06Z	1.7	2.2	-1.9	2.1	1.7	1.9	2.1	2.1	2.1
108		12Z	1.8	1.8	-2.0	-2.2	2.2	1.9	2.0	1.8	1.3
114		18Z	1.9	-1.8	-3.0	-2.2	2.4	2.0	-2.0	1.4	1.2
120	Mon 13th	00Z	2.0	-1.8	-3.0	-2.3	2.0	2.0	1.9	1.3	1.5
126		06Z	2.1	-1.8	-2.8	-2.4	2.2	1.8	2.0	1.7	1.5
132		12Z	2.1	1.8	-2.7	-2.1	2.0	1.7	2.3	1.7	1.1
138		18Z	1.9	1.9	-2.6	-2.2	2.1	1.7	2.0	1.5	0.8
144	Tue 14th	00Z	1.8	-1.7	-2.0	-2.0	0.9	1.6	-1.9	1.3	0.9
150		06Z	1.9	1.6	-1.6	-1.7	1.0	1.3	1.9	1.4	0.9
156		12Z	2.0	1.7	-1.6	-1.5	0.9	1.3	1.9	1.5	0.8
162		18Z	2.0	1.8	-1.5	-1.4	0.6	1.0	1.7	1.3	0.8
168	Wed 15th	00Z	2.2	1.8	-1.6	-1.3	0.8	0.9	-1.6	0.9	0.8
174		06Z	2.3	1.9	-1.6	1.4	1.0	0.9	1.9	1.3	1.4
180		12Z	2.4	2.0	-1.6	1.5	1.3	1.1	2.6	1.7	1.9
186		18Z	2.4	2.0	-1.5	1.9	1.7	0.7	2.8	2.1	2.7
192	Thu 16th	00Z	2.5	2.0	-1.6	1.9	1.6	0.7	2.5	2.1	2.5
198		06Z	2.5	2.1	-1.6	2.0	1.8	0.9	2.6	2.1	2.5
204		12Z	2.5	2.1	-1.6	2.0	1.7	-1.0	2.5	2.1	2.2
210		18Z	2.4	2.1	-1.7	1.9	1.3	-1.1	2.7	2.2	1.8

NAEFS Mean Integrated WV Transport ($kgm^{-1}s^{-1}$) and Standardiz
HOUR 072 - VALID 00:00 UTC Sat Feb 11 2017



Relative to the 31-Jan to 21-Feb 1979-2009 CFSR climatology



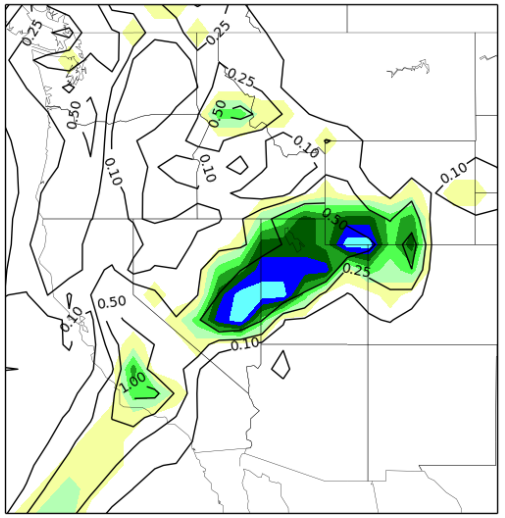
ENSEMBLE SITUATIONAL AWARENESS TABLE ARCHIVE
NOAA / NATIONAL WEATHER SERVICE

Type: GEFS M-Climate QPF | Recent Cases | Historic Cases | Date: 02/08/2017 | 12Z | Region: Western U.S. | View Table

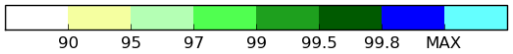
Western U.S. Table Feb 8, 2017 12Z Run

			6-h	12-h	24-h	48-h	72-h
6	Wed 8th	18Z	99.0				
12	Thu 9th	00Z	99.8	99.6			
18		06Z	MAX	99.9			
24		12Z	MAX	MAX	MAX		
30		18Z	MAX	MAX	MAX		
36	Fri 10th	00Z	MAX	MAX	MAX		
42		06Z	99.9	99.9	MAX		
48		12Z	99.9	MAX	MAX	MAX	
54		18Z	MAX	MAX	MAX	MAX	
60	Sat 11th	00Z	MAX	MAX	99.9	MAX	
66		06Z	MAX	MAX	MAX	MAX	
72		12Z	MAX	MAX	MAX	MAX	MAX
78		18Z	MAX	MAX	MAX	MAX	MAX
84	Sun 12th	00Z	99.4	99.8	MAX	MAX	MAX
90		06Z	96.8	98.9	MAX	MAX	MAX
96		12Z	98.6	98.1	99.4	MAX	99.9
102		18Z	99.3	99.5	98.9	MAX	MAX
108	Mon 13th	00Z	MAX	MAX	99.7	MAX	MAX
114		06Z	98.1	99.8	99.9	99.8	MAX
120		12Z	96.6	97.7	99.9	99.5	MAX
126		18Z	93.4	97.9	99.6	99.8	MAX
132	Tue 14th	00Z	93.8	93.8	97.7	99.7	MAX
138		06Z	<90	93.1	97.7	99.6	99.7
144		12Z	91.3	90.1	96.0	99.6	99.4
150		18Z	91.0	93.9	97.1	98.9	99.5
156	Wed 15th	00Z	<90	<90	94.1	98.8	99.5
162		06Z	93.7	90.0	91.7	98.1	99.4
168		12Z	<90	<90	<90	96.7	99.4
174		18Z	98.1	94.4	<90	95.1	98.6
180	Thu 16th	00Z	99.2	99.2	95.3	91.8	98.1

GEFS Mean QPF (in) and M-Climate percentile
48-72-h forecast valid
12Z Fri Feb 10 2017 to 12Z Sat Feb 11 2017



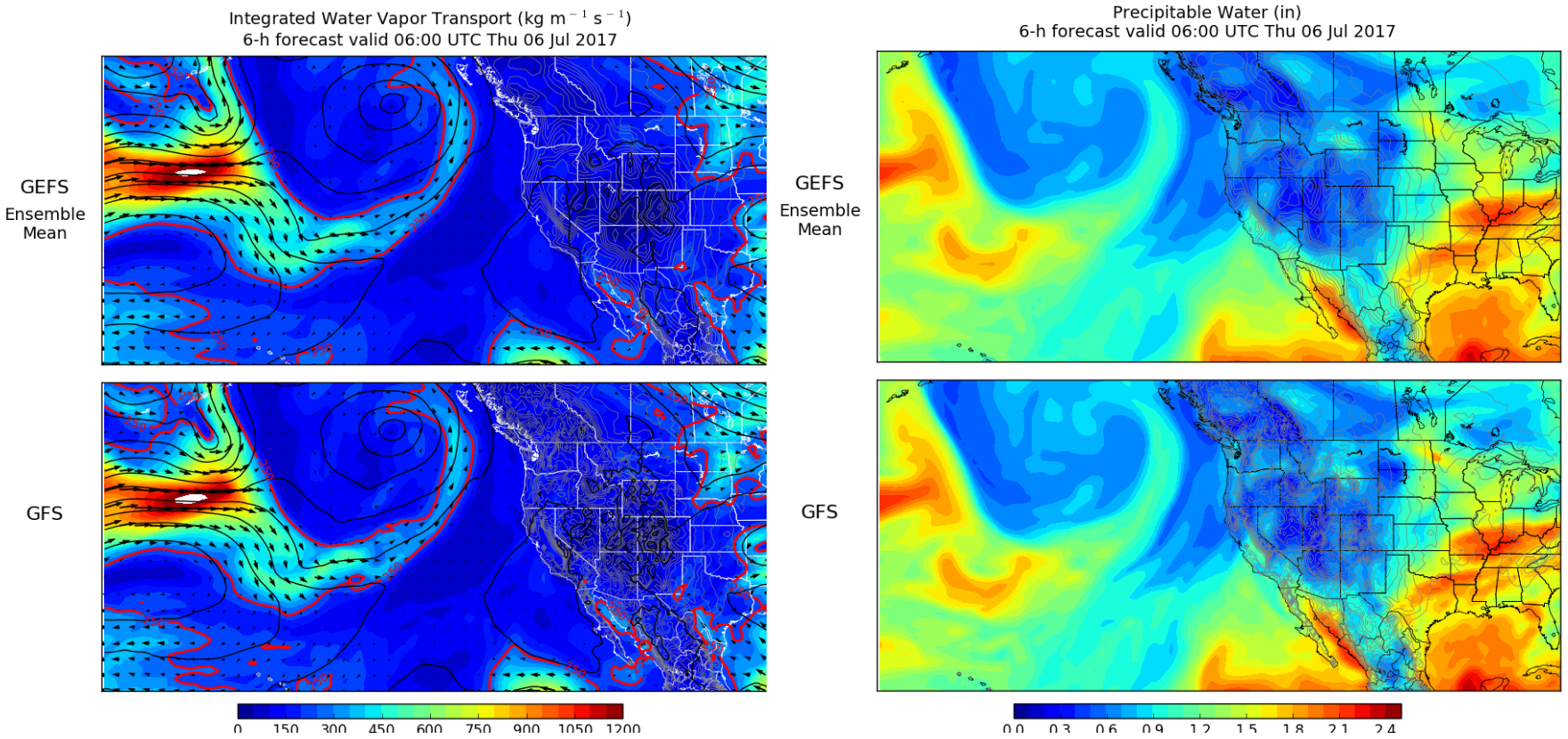
relative to GEFS reforecasts initialized
25-Dec to 25-Mar (1985-2012)



Atmospheric River Forecast Tools

NWS WRHQ

http://ssd.wrh.noaa.gov/naefs/?type=ivtw

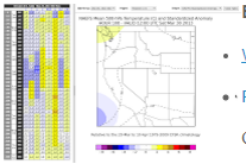


Atmospheric River Forecast Tools

NWS WRHQ "Forecast Confidence Toolkit"

https://sites.google.com/a/noaa.gov/nws-wr-stid/projects/forecast-confidence

Large-Scale Pattern Tools

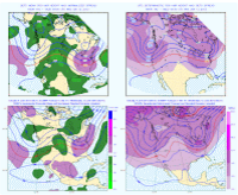


Ensemble Situational Awareness Table

- WR Version | NCEP Version (w/ECens Data)
- Penn State Anomaly Page

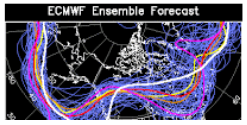
Contact/training: Randy Graham

- Provides a framework for quickly identifying significant events in the forecast.
- NAEFS ensemble mean fields are compared to the 1979-2009 CFSR reanalysis climatology to highlight potentially significant features in the forecast.
- The NAEFS ensemble consists of a control run and 20 perturbed members from each of the Canadian and GEFS models.
- Only presents the ensemble mean-- no explicit confidence information.
- Large anomalies in an ensemble mean at long lead times suggest a higher likelihood of significant events, but not if the model is underdispersive or "overconfident"
- See the Projects Page for more details.



STID Ensemble Graphics

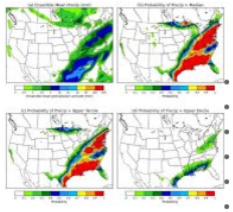
- GFS/GEFS 500mb Heights
- Contact/training: Trevor Alcott
- Gathers several confidence tools (normalized spread, GFS deterministic versus GEFS ensemble, model climate QPF, ensemble IVT) in one place.
- Normalized spread is especially tricky, and can highlight strong gradients or pattern changes rather than low predictability.



ECMWF Ensemble Graphics

- HPC Spaghetti Plots
- ECMWF Normalized Spread Maps

Impact Probabilities and Forecast Analogs

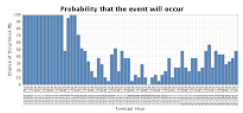


GEFS Reforecast V2 & Climatology-Calibrated Precipitation Analysis

- ESRL SA Table
- QPF Analogs and EFI
- High-Res QPF Analogs
- Extreme Percentile Plots
- Z500/T850/T2
- Teleconnections

Contact/training: Trevor Alcott
Data outages: Reforecast Admin

- Reforecast analogs are used to calibrate the real-time GEFS forecast, which shows considerable skill over raw ensemble probabilities.
- Uses a GEFS reforecast dataset covering 1984 to 2012 at ~50km (~70 km) resolution for days 1-8 (8-16).
- Precipitation forecasts are subject to the quality of the NARR reanalysis precipitation (32-km resolution).



NCEP / EMC Ensemble Tools

- NAEFS / GEFS / SREF Graphics
- NOMADS Probability Tool

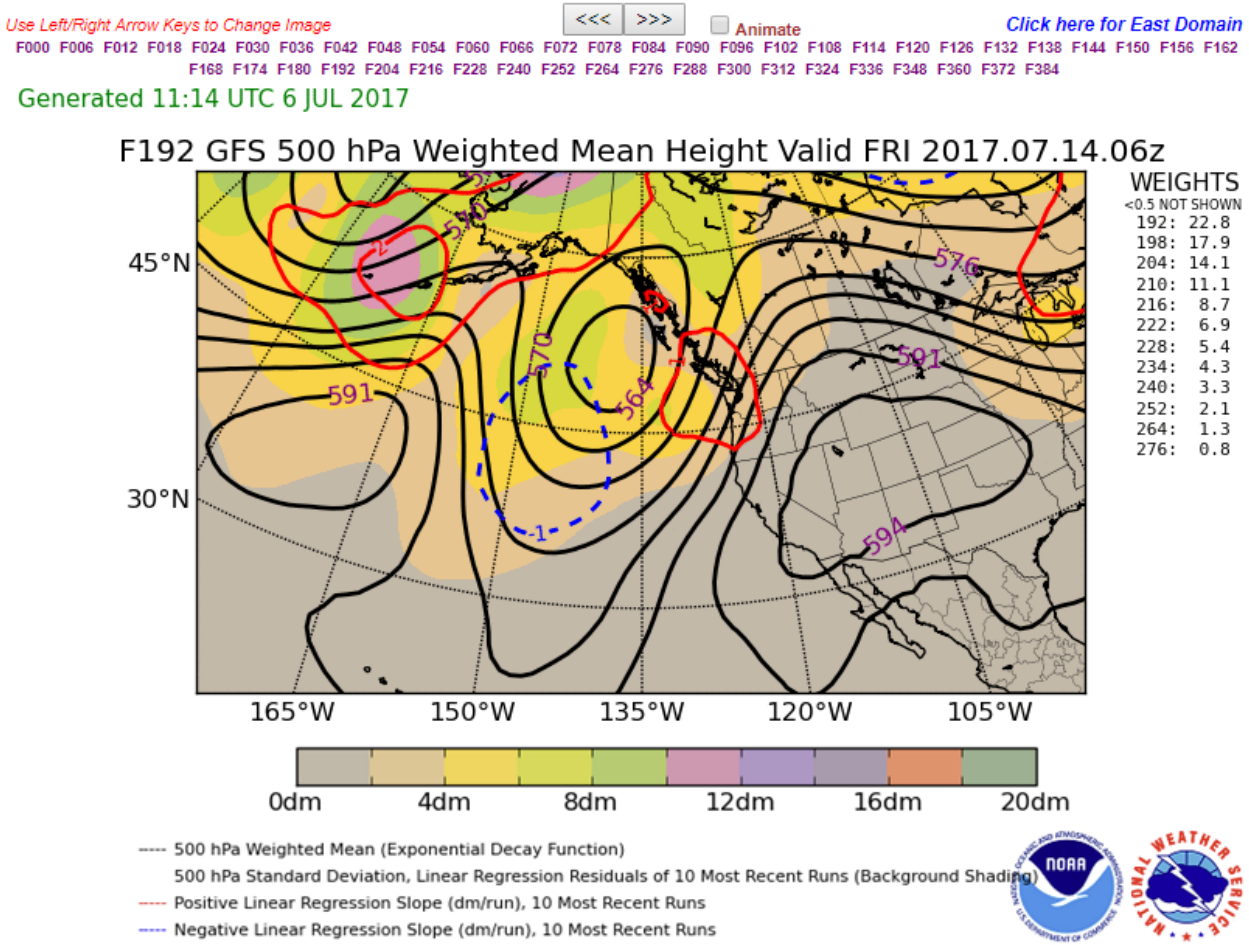
Contact/training: JJ Brost

- Show the raw probability of exceeding various thresholds (% of 21 GEFS members).
- Point-based and plan view graphics available. One-stop shop for raw ensemble mean/spread data and probabilities.
- Use raw ensemble probabilities at your peril. Particularly for high precipitation thresholds, these uncalibrated values are unreliable in complex terrain.

Atmospheric River Forecast Tools

"ModTrend" Tool

http://www.wrh.noaa.gov/hnx/modTrend/



Questions or comments?