Hydrometeorology Testbed (HMT) Roundup

Allen White[1], Marty Ralph[1], Rob Cifelli[1], Dave Reynolds[1,2], Lynn Johnson[1,3], Tim Schneider[4], Zoltan Toth[1], Ligia Bernardet[1,2], Seth Gutman[1], Dave Novak[5], and Rich Lataitis[1]

[1]NOAA Earth System Research Laboratory, Boulder, CO
[2]Cooperative Institute for Research in Environmental Sciences, U. of Colorado, Boulder, CO
[3]Cooperative Institute for Research in the Atmosphere, Colorado State U., Ft. Collins, CO
[4]NOAA National Weather Service Office of Hydrologic Development, Silver Spring, MD
[5]NOAA National Weather Service Weather Prediction Center, College Park, MD

NOAA Testbed Workshop, 2-4 April 2013, College, Park, MD

Outline

- HMT Overview
  - Mission and organization
  - Why HMT? Ex: QPF skill in extreme events
  - HMT experiment locations
- HMT-West
  - Atmospheric Rivers and the ARRFEX
  - California's HMT-Legacy Project
    - Observations
    - NWP
  - HMT-Northwest: The Howard A. Hanson Dam Flood Risk Management Crisis
- CalWater
  - Atmospheric Rivers and Aerosols
- Collaborations with the Sonoma County Water Agency
  - Quantitative Precipitation Information (QPI)
  - Heat/Frost Information
- HMT Southeast Pilot Study (HMT-SEPS)
- HMT publications
- Future work

NOAA Hydrometeorology Testbed (HMT)

The Hydrometerology Testbed (HMT) conducts research on precipitation and weather conditions that can lead to flooding, and fosters transition of scientific advances and new tools into forecasting operations. HMT's outputs support efforts to balance water resource demands and flood control in a changing climate. HMT aims to:

- accelerate the development and prototyping of advanced hydrometeorological observations, models, and physical process understanding
- foster infusion of these advances into operations of the National Weather Service (NWS) and the National Water Center (NWC)
- support the broader needs for 21st Century precipitation information for flood control, water management, and other applications

Hydrometeorology Testbed

hmt.noaa.gov

Home | About | Field Programs | Data | Meetings | Publications | News | Resources | Transitions

New!

NOAA's Hydrometeorology Testbed (HMT) conducts research on precipitation and weather conditions that can lead to flooding, and fosters transition of scientific advances and new tools into forecasting operations. HMT's outputs support efforts to balance water resource demands and flood control in a changing climate. (Read more...)

What's New...

New items posted 2-4 times per month

March 15, 2013
A New Snow-Level Radar in Southern California Serves Dual Purposes

March 8, 2013
Four Coastal Atmospheric River Observatories to be Installed Along Central California Coast

February 28, 2013
New Study Finds Dust and Biological Particles Traveling from Sahara and Asia Influence Precipitation on West Coast

Major Activity Areas

Developing and prototyping 21st Century methods for observing precipitation

Addressing the challenge of extreme precipitation forecasting; from identifying gaps to developing new tools

Characterizing snow to address uncertainty in forecasting, flood control, and water management

Evaluating advanced observations of rain and snow, temperature, and soil moisture to provide best possible "forcings" for river prediction

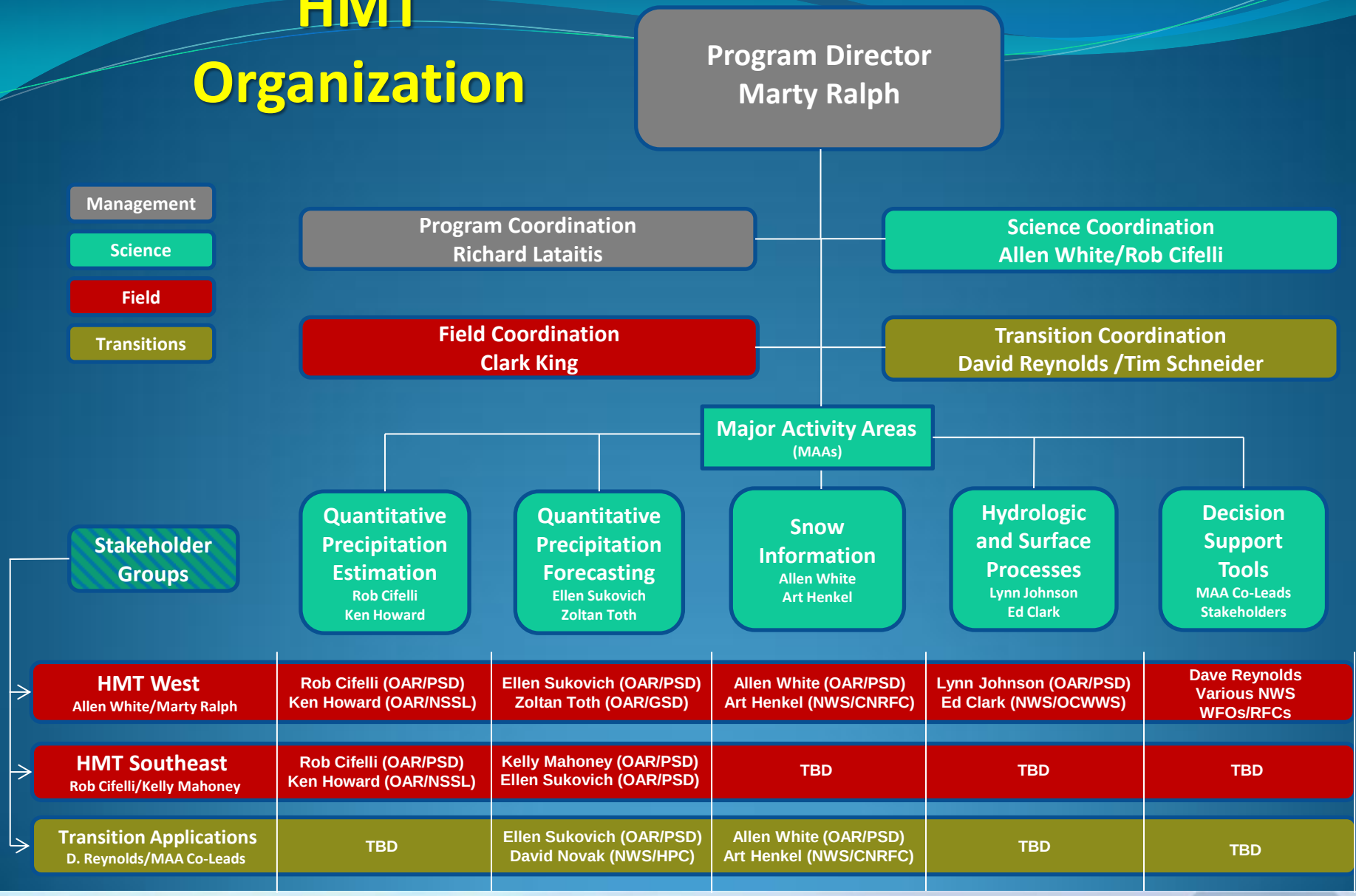
Developing tools for forecasters and users of extreme precipitation forecasts

HMT is led by the ESRL Physical Sciences Division
with partners across NOAA, other agencies, and universities.

NOAA Hydrometeorology Testbed
Contact: Dr. F. Martin Ralph
NOAA Earth System Research Laboratory
R/PSD2 : 325 Broadway : Boulder, CO 80305

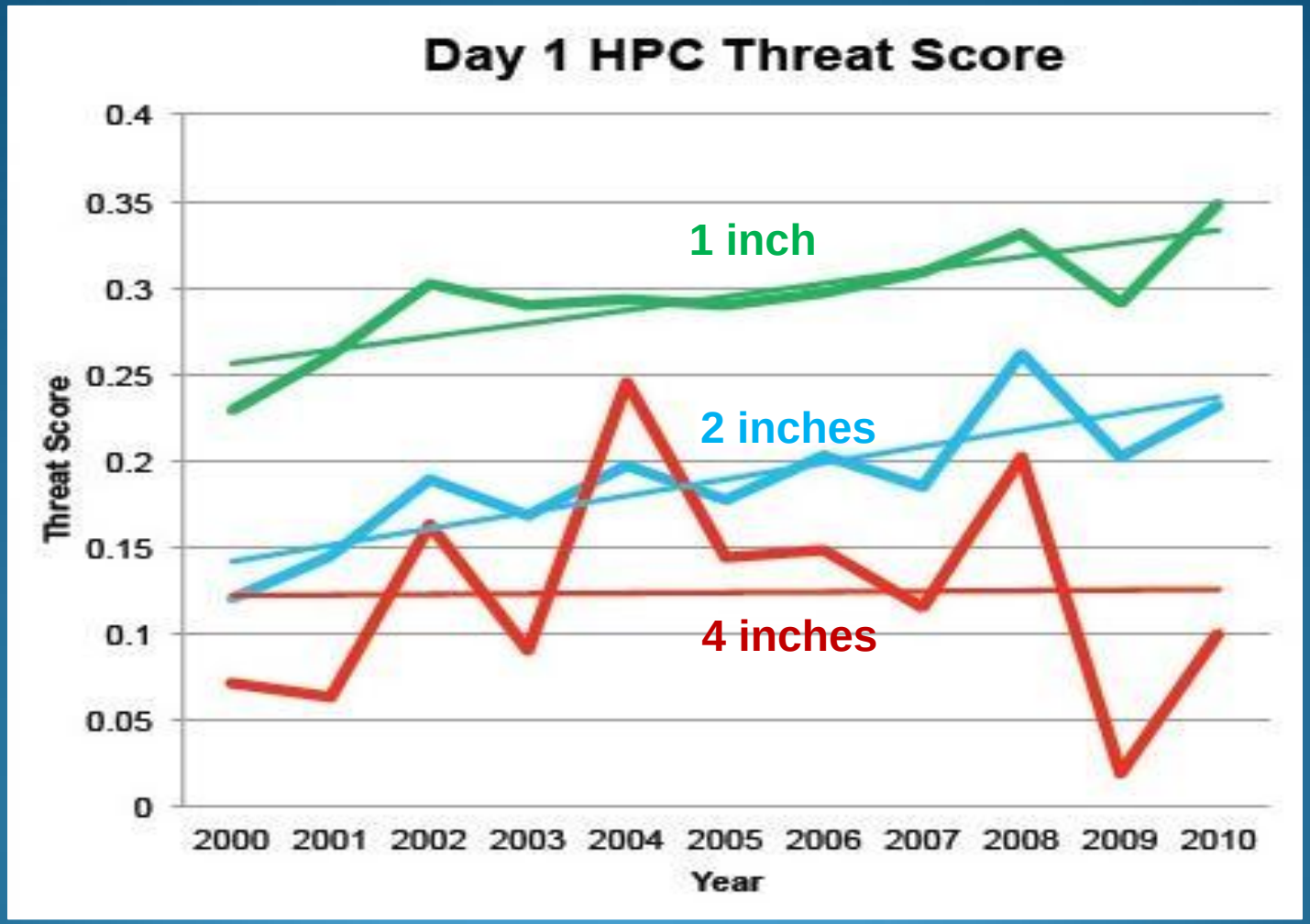
Hydrometeorology Testbed

HMT Organization



HMT West Allen White/Marty Ralph	Rob Cifelli (OAR/PSD) Ken Howard (OAR/NSSL)	Ellen Sukovich (OAR/PSD) Zoltan Toth (OAR/GSD)	Allen White (OAR/PSD) Art Henkel (NWS/CNRFC)	Lynn Johnson (OAR/PSD) Ed Clark (NWS/OCWWS)	Dave Reynolds Various NWS WFOs/RFCs
HMT Southeast Rob Cifelli/Kelly Mahoney	Rob Cifelli (OAR/PSD) Ken Howard (OAR/NSSL)	Kelly Mahoney (OAR/PSD) Ellen Sukovich (OAR/PSD)	TBD	TBD	TBD
Transition Applications D. Reynolds/MAA Co-Leads	TBD	Ellen Sukovich (OAR/PSD) David Novak (NWS/HPC)	Allen White (OAR/PSD) Art Henkel (NWS/CNRFC)	TBD	TBD

Why do we need HMT?
Example: Precipitation Forecast Skill



Courtesy Dave Novak, NOAA/NWS/WPC

Why Improve QPF?

Improving the amount, type, location and timing of quantitative precipitation forecasts (QPF) and probabilistic quantitative precipitation forecasts (PQPF) are key elements to enhance the information content and reliability of these forecasts.

Water Resource Managers

Emergency Management

Who needs accurate and reliable QPFs?

Public

See poster led by Ellen Sukovich on Wednesday afternoon:
Analyzing Extreme Quantitative Precipitation Forecast Performance

Transportation

Agriculture

Water is One of NOAA's Five Grand Science Challenges

http://nrc.noaa.gov/CouncilProducts/WhitePapers.aspx

Understanding the Water Cycle

Findings from NOAA's Water Cycle Science Challenge Workshop

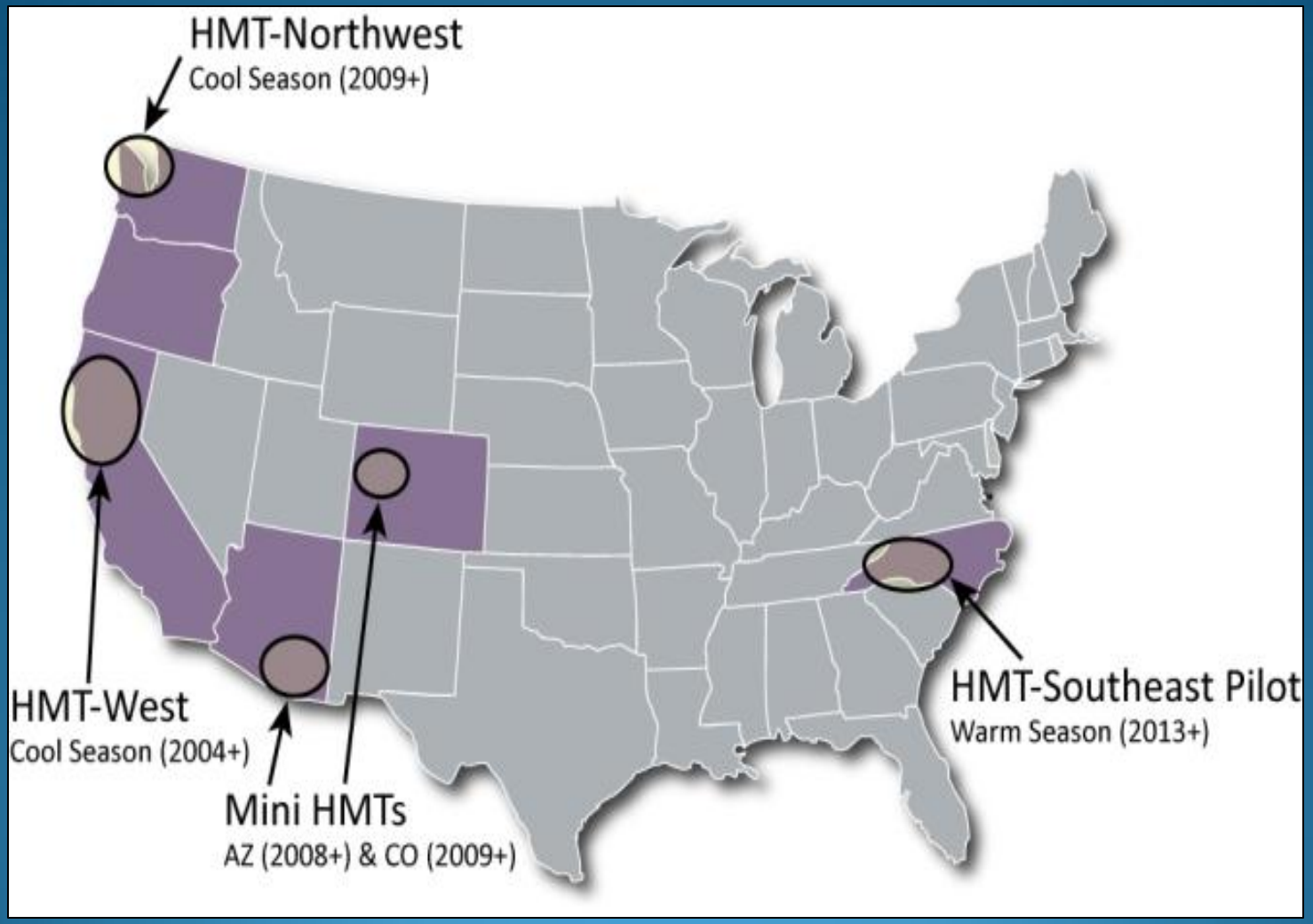
28 August – 1 September 2011, NOAA Earth System Research Laboratory, Boulder, Colorado

28 September 2012

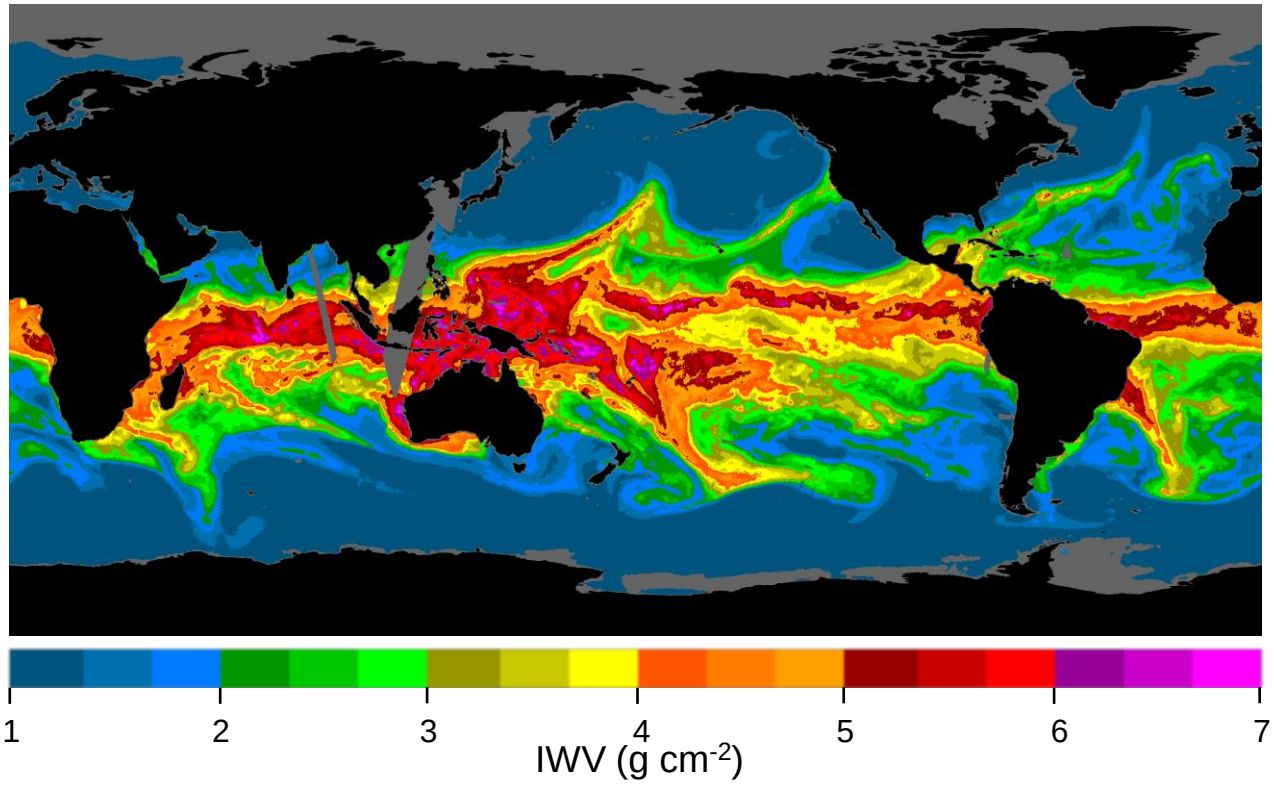
An Interagency Planning Workshop on **Water Cycle Science** for NOAA recommended several goals that HMT addresses and called for increased support and for coordination with other agencies.

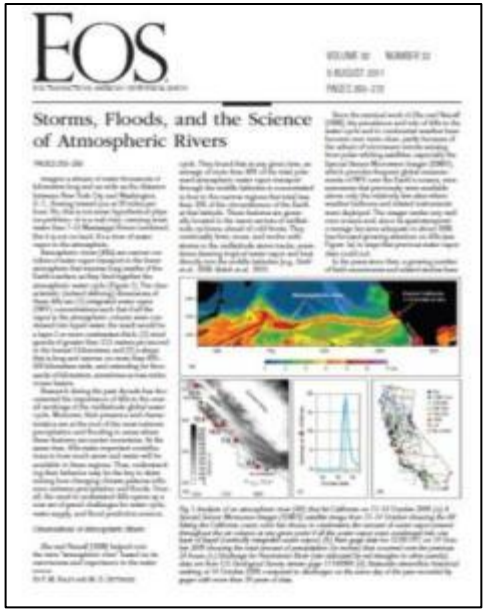
Examples of several key drivers for improved understanding and prediction of the water cycle. (Courtesy Don Cline)

HMT Locations



HMT-West Research has Identified Atmospheric Rivers (ARs) as the Primary Meteorological Cause of Extreme Precipitation & Flooding on U.S. West Coast




EOS

Storms, Floods, and the Science of Atmospheric Rivers

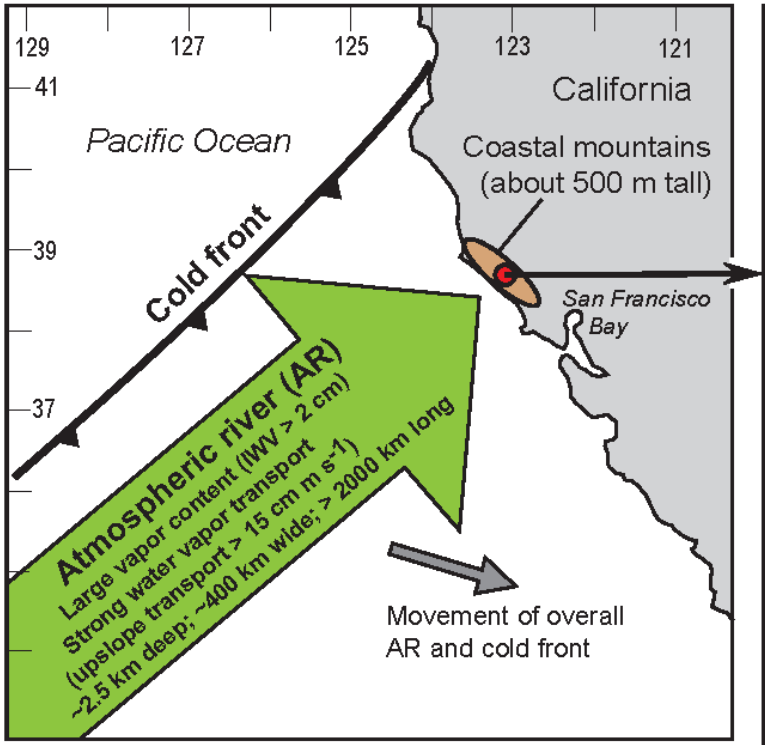
Ralph, F.M., and M.D. Dettinger, 2011: Storms, Floods and the Science of Atmospheric Rivers. *EOS, Transactions, Amer. Geophys. Union.*, **92**, 265-266.

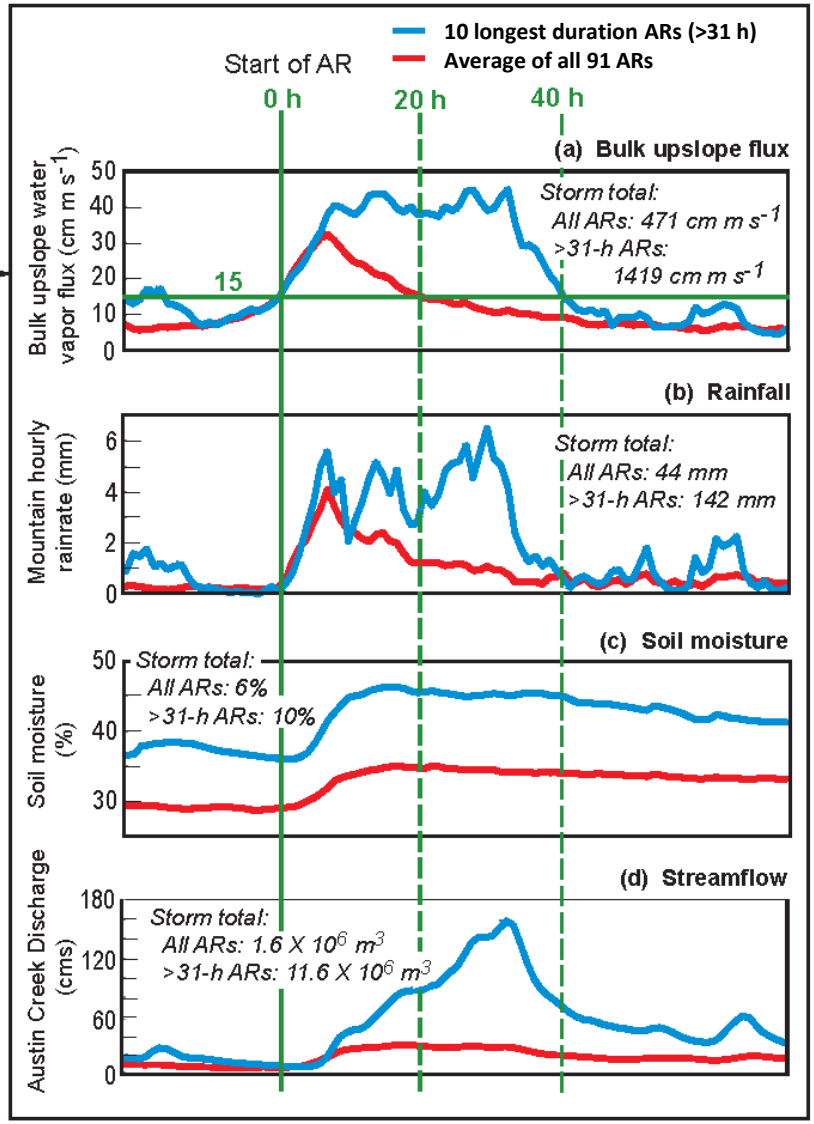
Atmospheric River Information Page: http://www.esrl.noaa.gov/psd/atmrivers/

"On average, about 30-50% of annual precipitation in the west coast states occurs in just a few AR events."

"A strong AR transports an amount of water vapor roughly equivalent to 7.5–15 times the average flow of liquid water at the mouth of the Mississippi River."

AR Duration is a Critical Component of Flooding





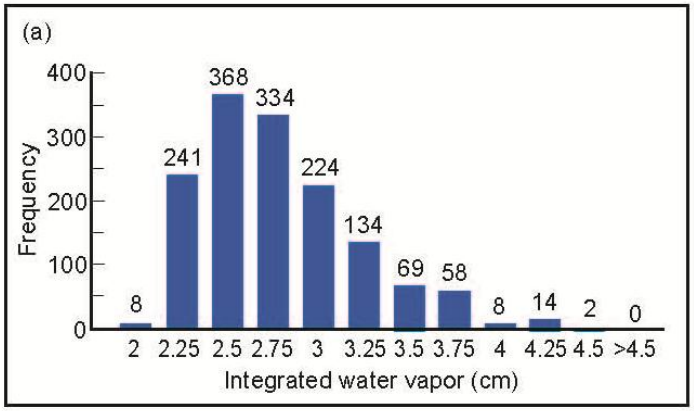
Key conditions during 91 ARs observed at the Earth's surface and aloft north of San Francisco, WY2005-2010

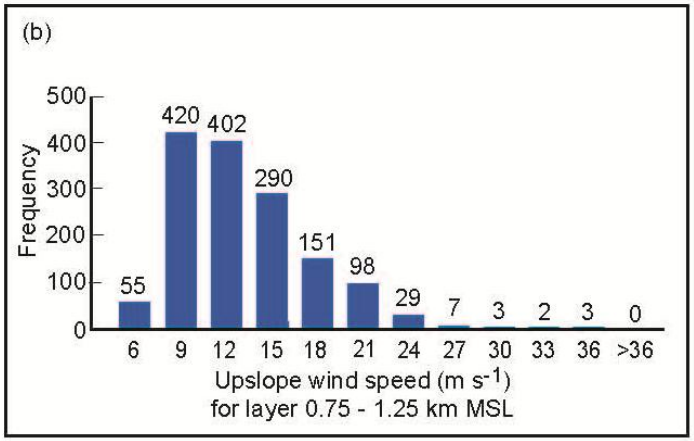
The following attributes characterize the 10 longest-duration ARs, which produced the most extreme rainfall and streamflow:

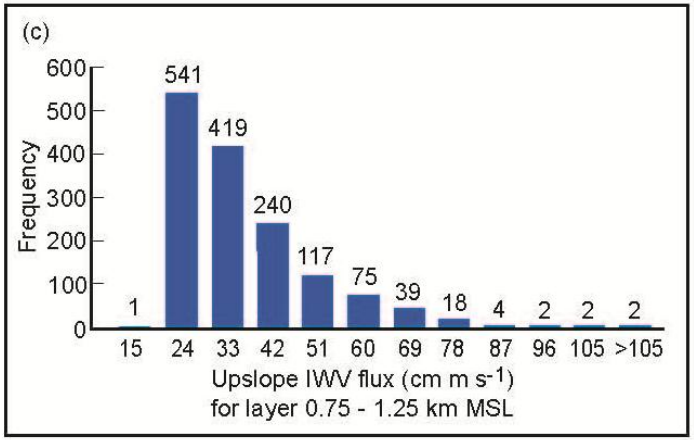
- AR conditions persisted for > 31 h
- Coastal rainfall averaged 140 mm during AR conditions
- Wind direction between 180° to 240° at about 1 km MSL
- Storm-total Bulk Upslope IWV flux was > 1000 units
- Precursor soil moisture was > 36%
- Heavy rain was in DJF and transition seasons (SON, MAM)
- Extreme runoff was in December, January, February (DJF)

Ralph et al. (2013), JHM (accepted)

91-case frequency distributions (hours) at BBY







Rankings of key characteristics

- Histograms showing the frequency distribution of hourly observations of
  - (a) IWV,
  - (b) upslope wind speed, and
  - (c) upslope IWV flux during the 1460 hours of AR conditions within the 91 AR events.
- This enables comparisons between current or predicted events to assess how extreme they are relative to past events.

Ralph et al. (2013), JHM (accepted)

HMT Atmospheric River Retrospective Forecasting Experiment (ARRFEX)

September 17-28, 2012

GOALS:

1) Evaluate operational and experimental datasets in forecasting West Coast heavy precipitation

2) Discuss ways to provide better forecast information to users in extreme events

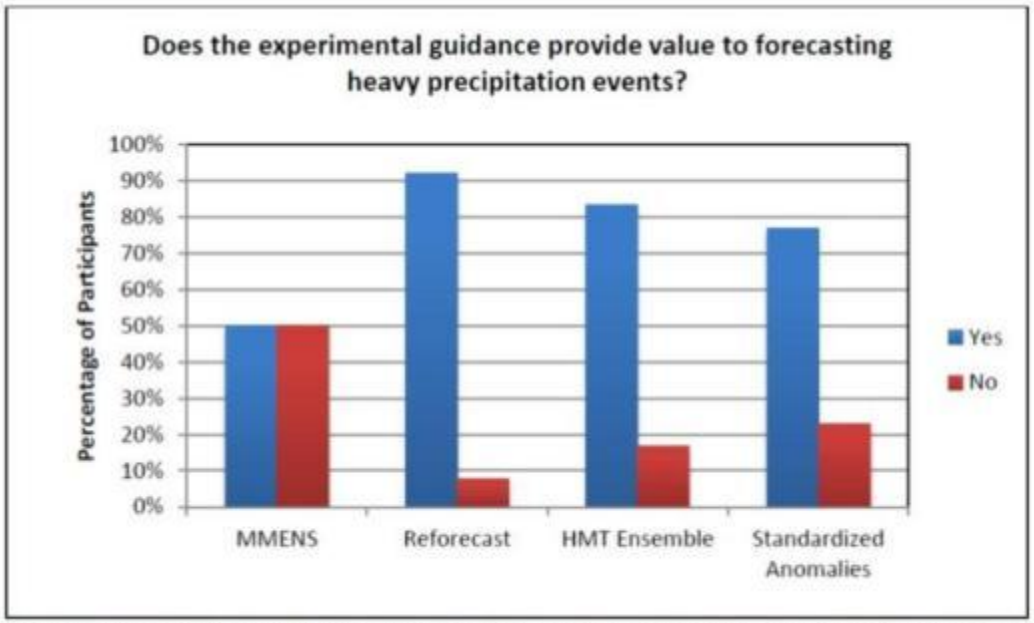
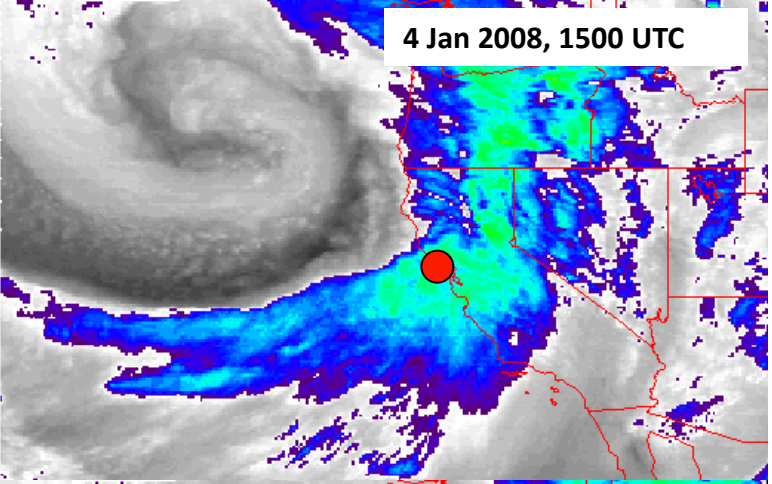
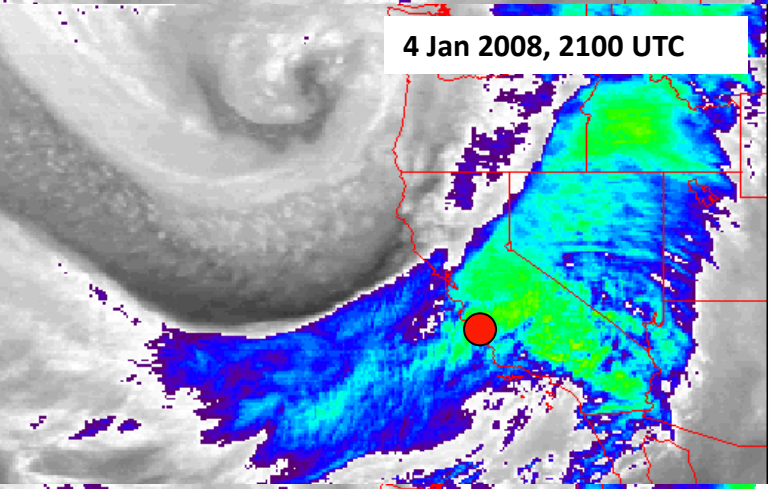
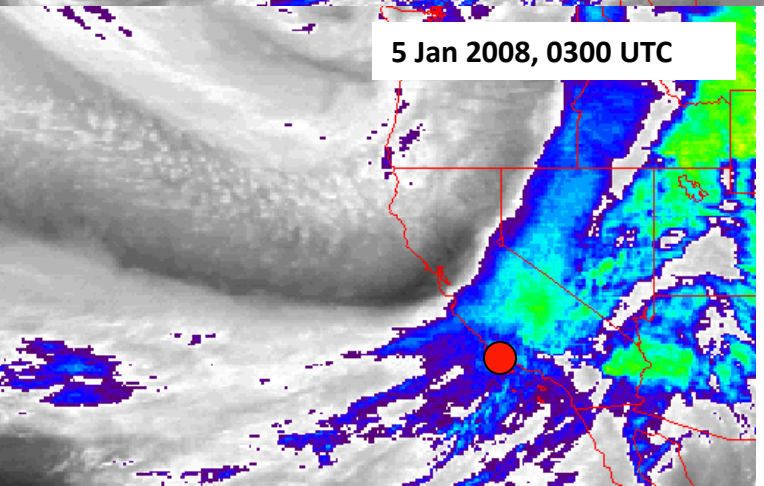


Figure 10) Participant feedback on the use and value of the experimental guidance systems featured in ARRFEX.

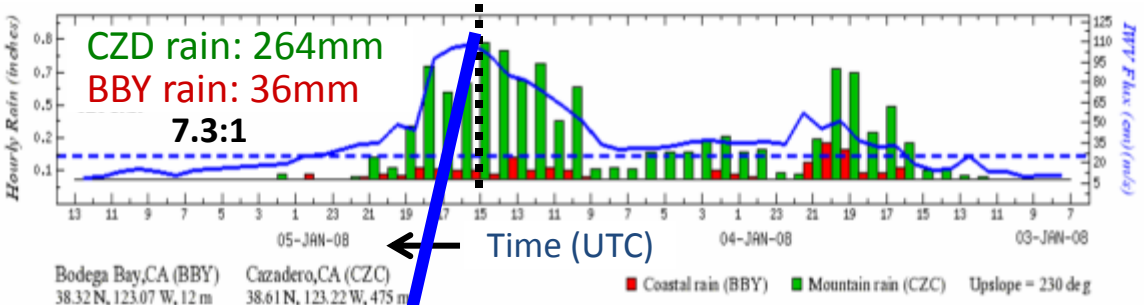
See talks by Tom Workoff and Faye Barthold on Wed. afternoon





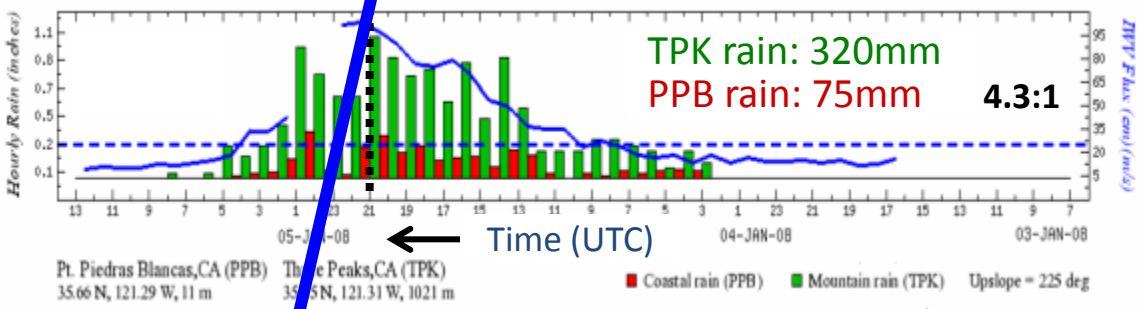


Time of max. IWV flux at BBY: 1500 UTC 4-Jan-08



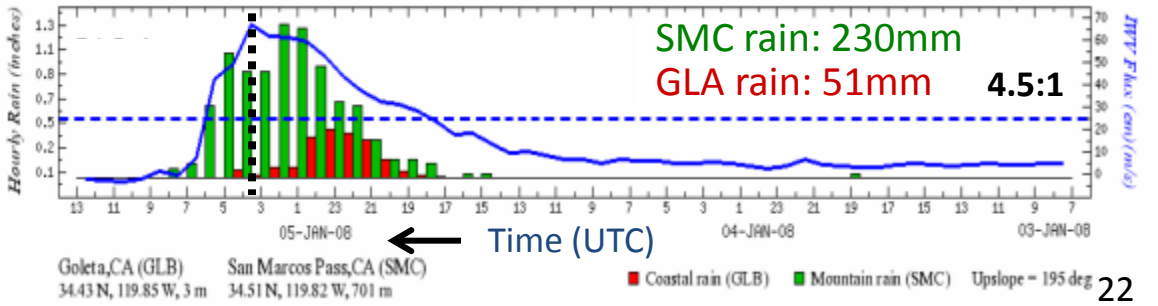
Max. IWV flux in AR highly correlated with max. mountain rainfall at each site

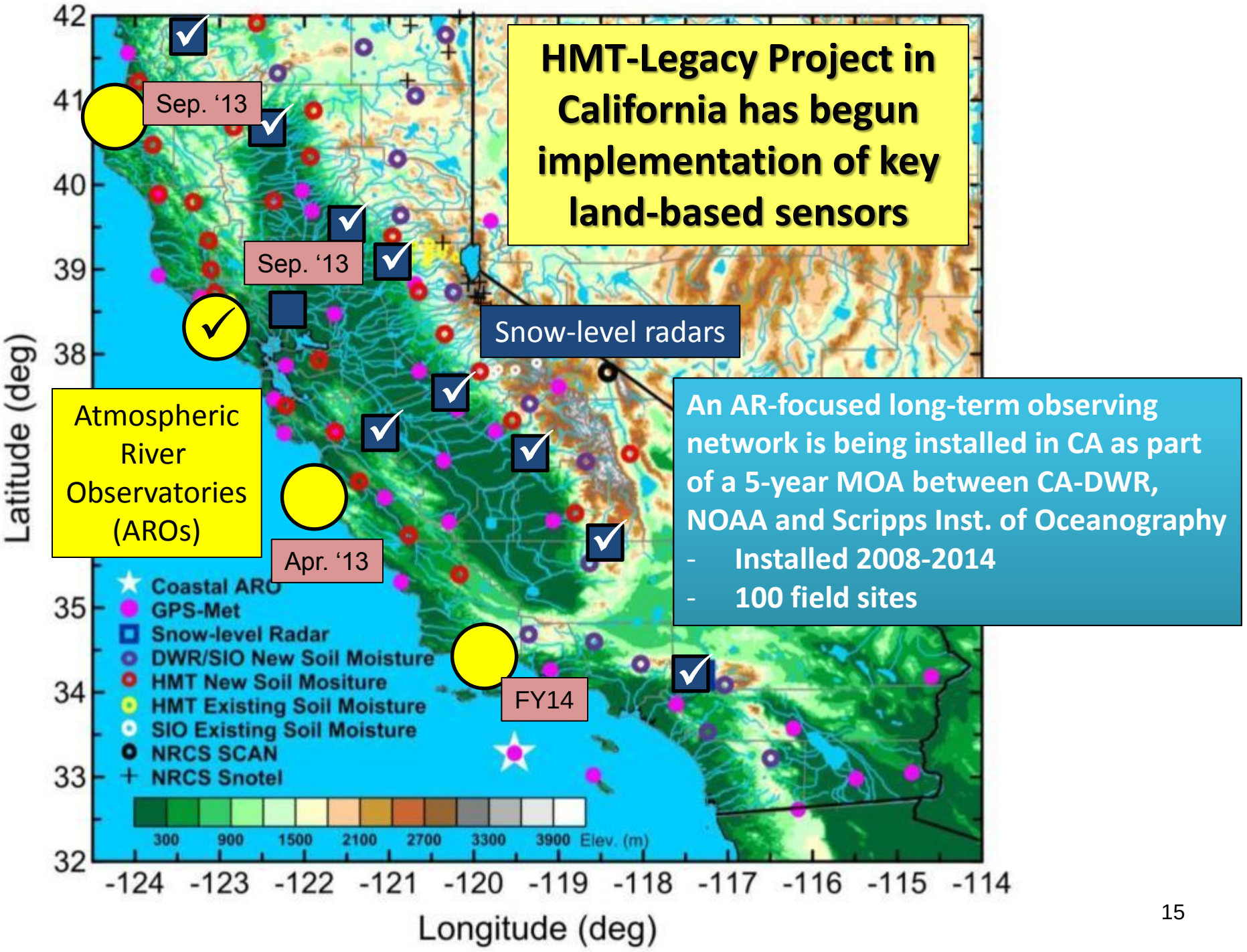
Time of max. IWV flux at PPB: 2100 UTC 4-Jan-08



AR Propagation: ~12 m s^{-1}. ½-day lead time for SoCal

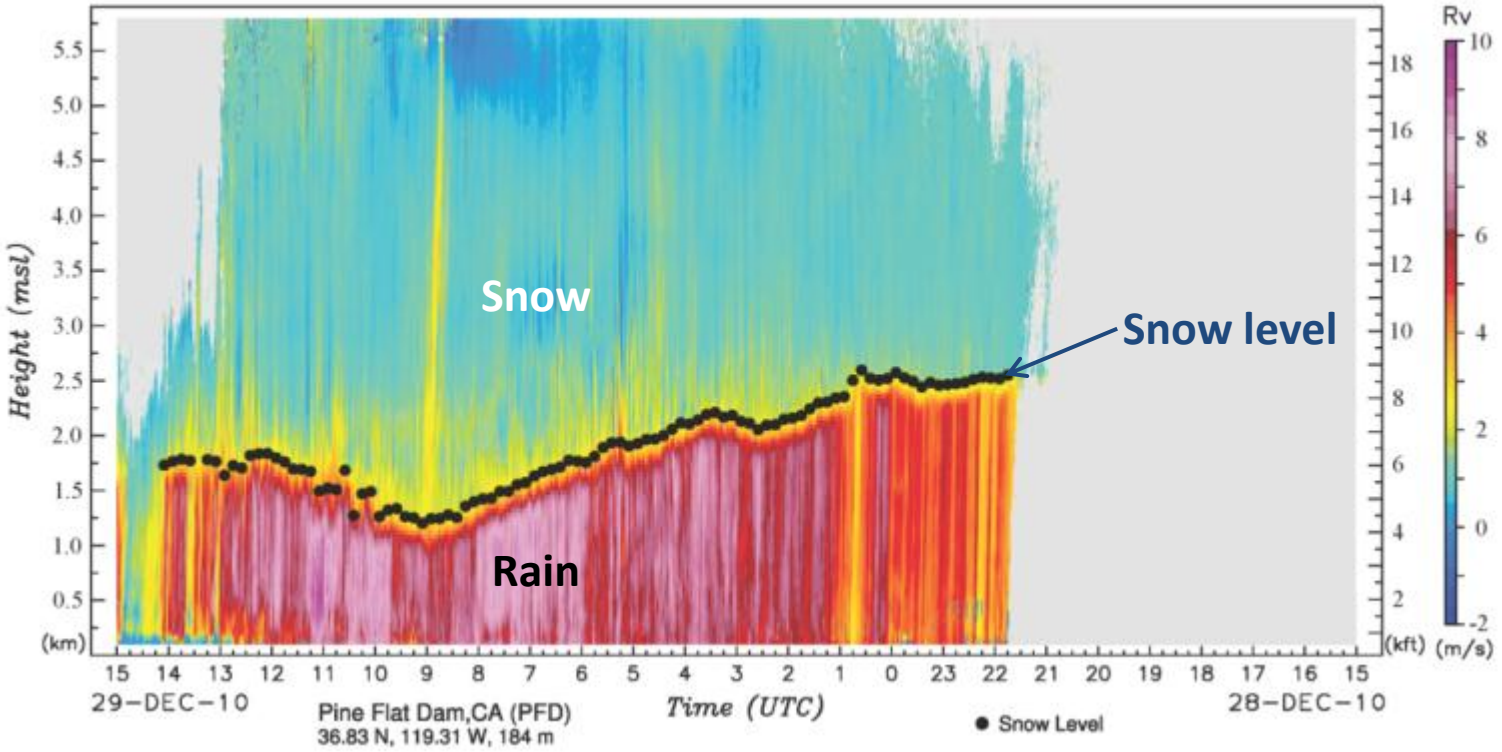
Time of max. IWV flux at GLA: 0300 UTC 5-Jan-08




HMT-Legacy Project in California has begun implementation of key land-based sensors
Sep. '13
Sep. '13
Snow-level radars
Atmospheric River Observatories (AROs)
Apr. '13
FY14
An AR-focused long-term observing network is being installed in CA as part of a 5-year MOA between CA-DWR, NOAA and Scripps Inst. of Oceanography
- Installed 2008-2014
- 100 field sites
Coastal ARO
GPS-Met
Snow-level Radar
DWR/SIO New Soil Moisture
HMT New Soil Mositure
HMT Existing Soil Moisture
SIO Existing Soil Moisture
NRCS SCAN
NRCS Snotel
300 900 1500 2100 2700 3300 3900 Elev. (m)
Latitude (deg)
Longitude (deg)
42 41 40 39 38 35 34 33 32
-124 -123 -122 -121 -120 -119 -118 -117 -116 -115 -114

SLR developers P. Johnston, D. Costa, and D. Carter win the 2011 CIRES Annual Award

A new award-winning Frequency Modulated-Continuous Wave (FM-CW) radar, a.k.a. Snow-level radar (SLR), was designed and built by NOAA Joint Institute staff for the HMT-Legacy Project. The SLR provides measurements of the snow-level every 10 minutes during precipitation events.



Data and Instrument Displays in Google Maps

SurfaceMet Data

- Temperature (F)
- Integrated Water Vapor (cm)
- Snow Depth (in)
- Wind Speed & Direction (mph)

Accumulated Precipitation (in)

Wind and Precipitation Radar Data

- Snow Level (kft msl)

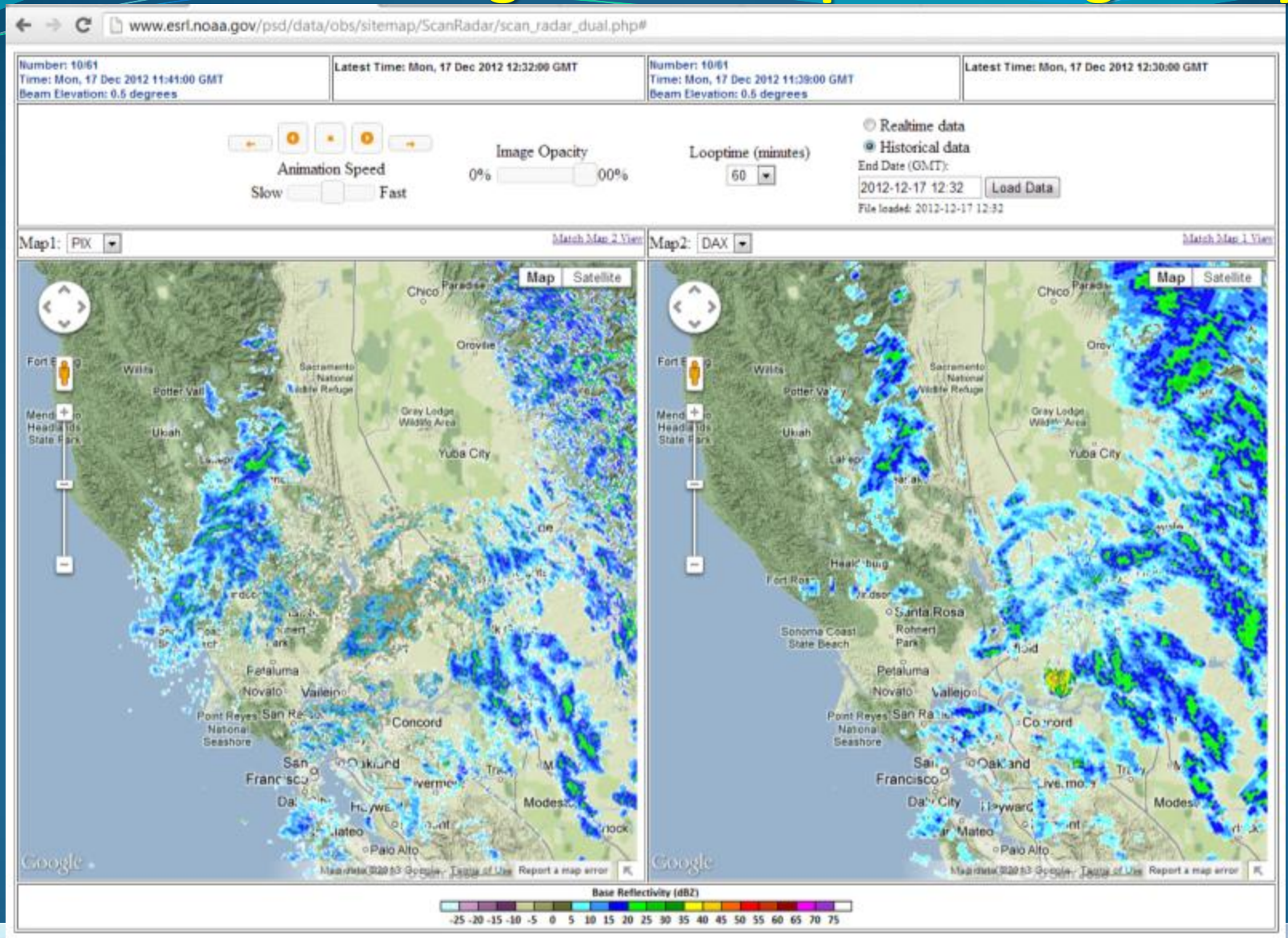
Integrated Water Vapor Flux (cm)(m/s)

Radar NEXRAD Data

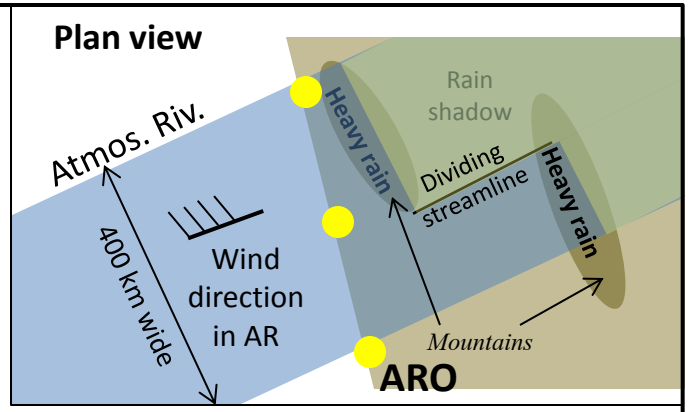
- Radar Relectivity Mosaic
- Radar 1 Hour Precip Mosaic

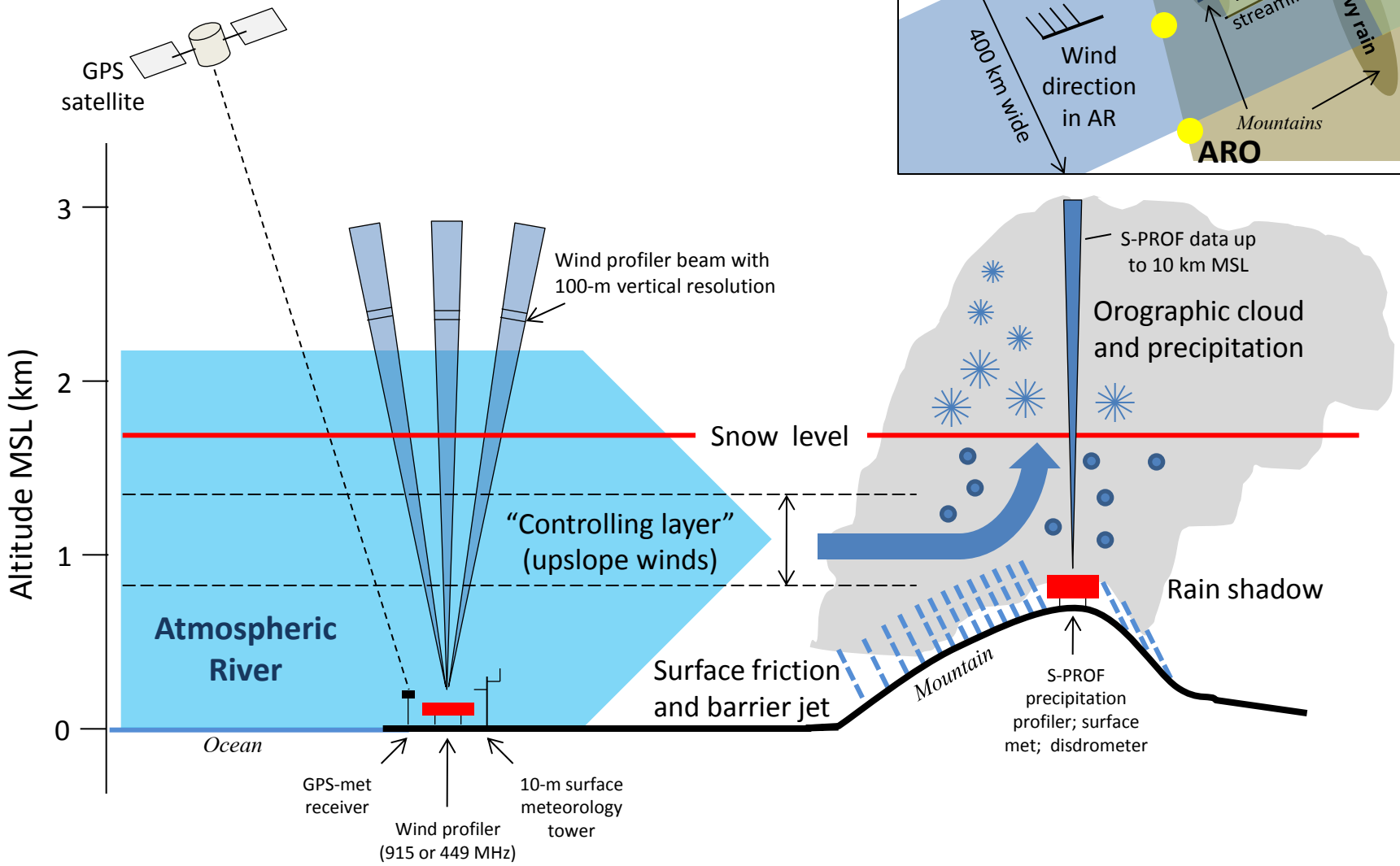
HMT-Legacy Project observational data are also being sent to MADIS, CDEC, and in SHEF-encoded format to NWS Western Region for distribution to WFOs and the RFC

HMT-West Scanning Radar Loops in Google Maps

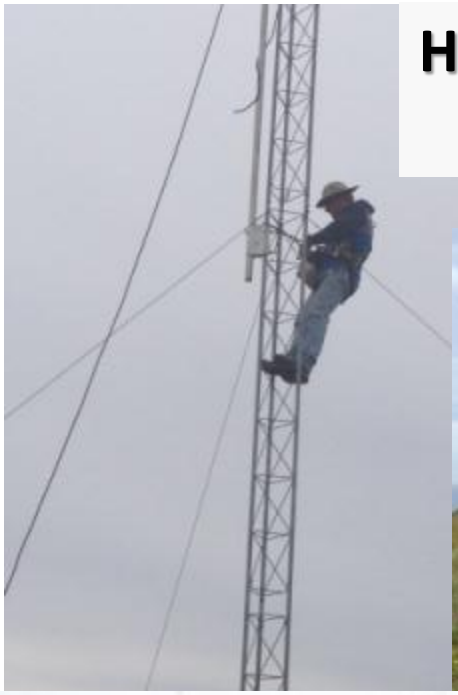


Atmospheric River Observatory (ARO)

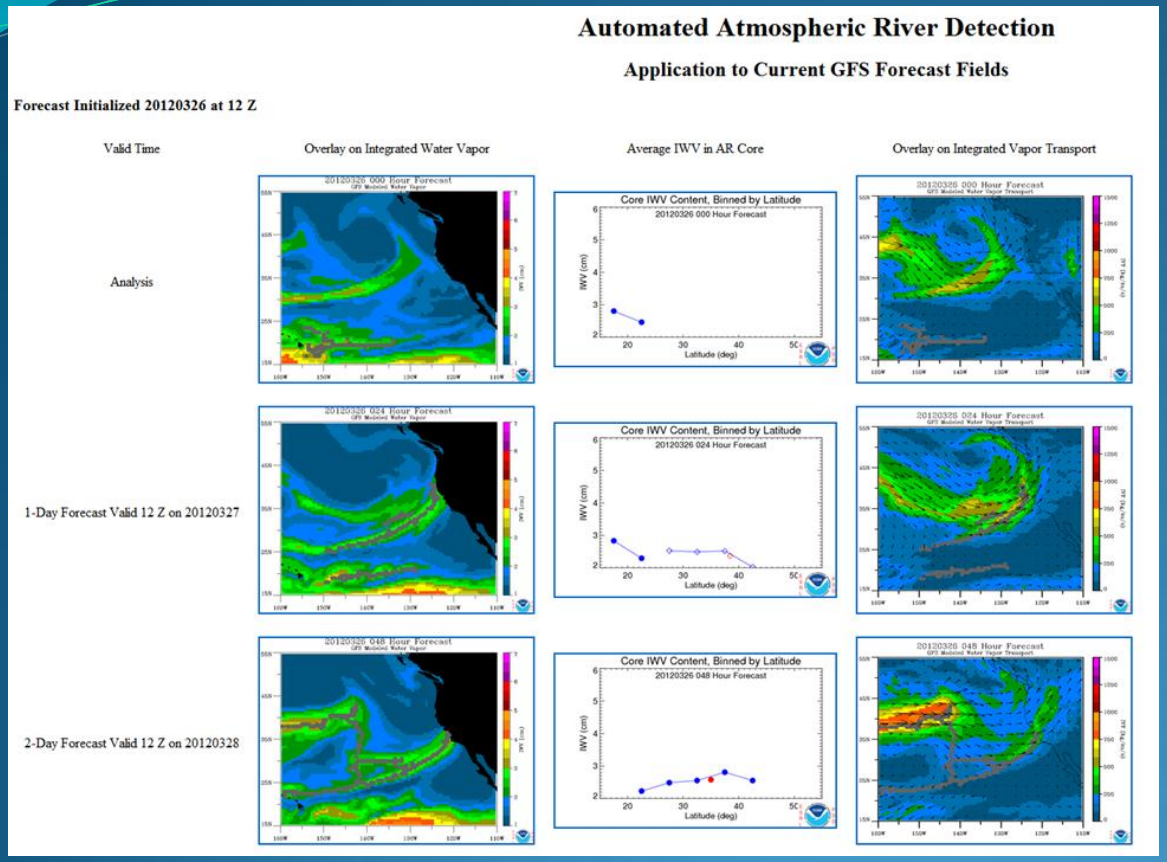




HMT Engineers Work Tirelessly to Install an ARO at Bodega Bay, CA the week of March 18th 2013



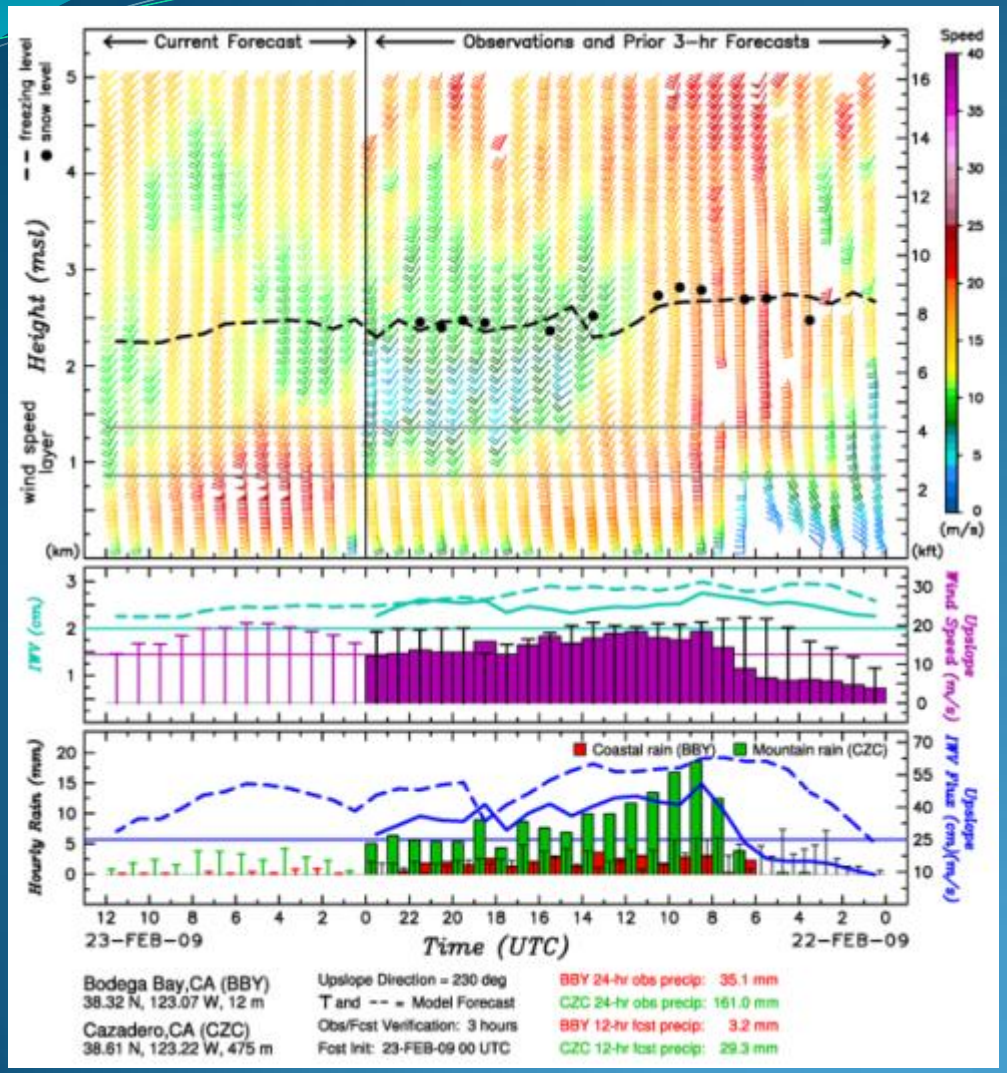
Western Region Spring 2012 Newsletter Highlights HMT



New Atmospheric River tools from OAR PSD:
OAR Physical Science Division (PSD) has developed an experimental set of tools to **identify atmospheric rivers (AR) and then combine these AR features with low level winds derived from the NCEP GFS to determine where the best cross-terrain flow will occur, and consequently, higher expected precipitation rates**. The tool is call Atmospheric River Flux and can be found at: http://www.esrl.noaa.gov/psd/psd2/coastal/satres/data/html/ar_detect_gfs.html

See poster led by Gary Wick on Wednesday afternoon: Evaluation of Forecasts of the Water Vapor Signature of Atmospheric Rivers in Operational NWP Models

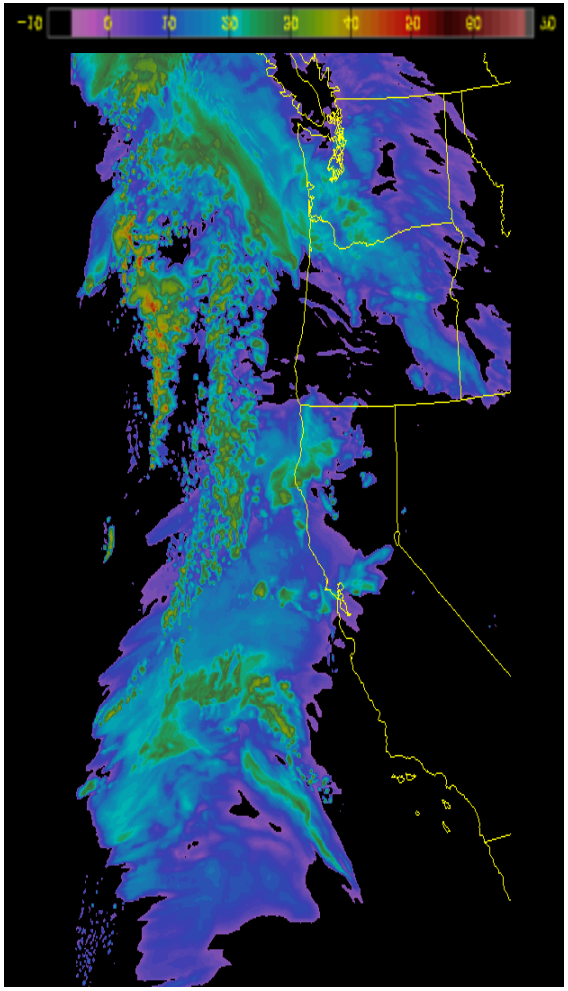
Western Region Spring 2012 Newsletter Highlights HMT



AR Observatory: A few sites have a number of sensors, which combined with the RUC, can be used to **provide a more integrated view of the atmosphere**. They are called AR Observatories and an example of the integrated model/data graphic is displayed below. All of the data can be found at:
http://www.esrl.noaa.gov/psd/data/obs/ - click on the sites with “vapor flux”.

2010 Dept. of Commerce Bronze Medal

The HMT High-Resolution Deterministic Model



Five-hour forecast of composite reflectivity (dBZ) initialized on 3/19/13, 08 UTC.

PRIMARY APPLICATION: input for the HMT flux tool

CONFIGURATION: WRF-ARW

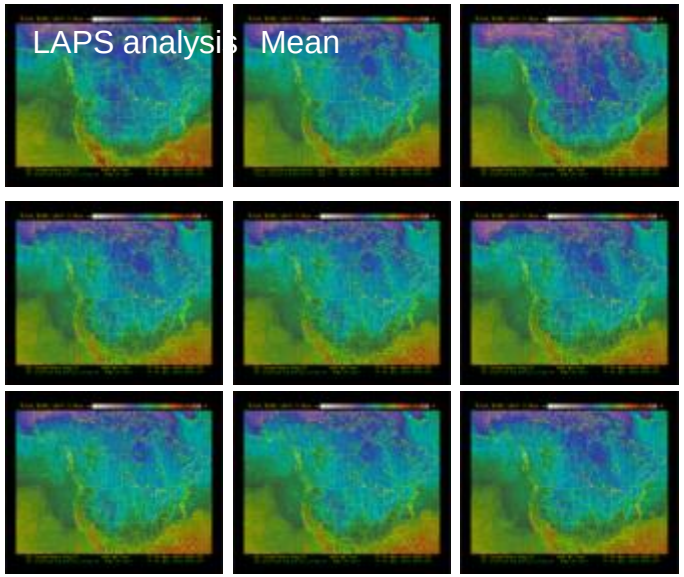
- 3-km grid spacing over west coast
- Initialized hourly; ran to 12 h
- Initialization: NAM + $LAPS_t$
- Boundary Conditions: NAM
- Microphysics: Thompson scheme

LAPS (Local Analysis and Prediction System)

- Blends a variety of in-situ and remote observations
- Has *hot start* capability to add clouds and vertical model at model initialization time
- $LAPS_t$: traditional (Barnes) analysis
- $LAPS_v$: multi-scale variational analysis

ExREF

Experimental Regional Ensemble Forecast system



Surface temperature, dewpoint, and winds analysis and 48-h forecasts (mean and members) initialized on 3/23, 00 UTC

<u>See poster led by Ligia Bernardet on Wednesday afternoon:</u>
The 2012-2013 Hydrometeorology Testbed Numerical Weather Prediction Suite

APPLICATIONS:

- Testing of new NWP techniques
- Collaboration with the Developmental Testbed Center to evaluate new techniques for possible transition to operational SREF
- Product dissemination to CA WFOs and WPC

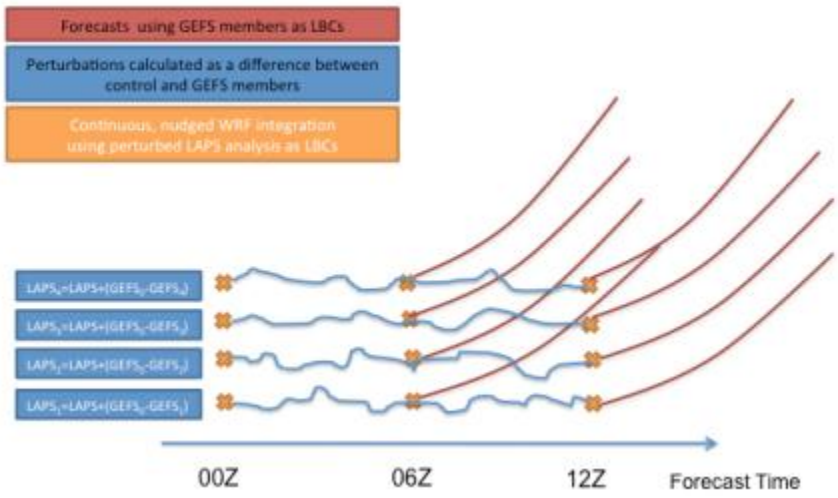
8 WRF-ARW members

- 9-km grid spacing over North America
- Initialized 4xday; ran to 84 h
- Ensemble encompasses uncertainty in physics and initial and boundary conditions

	IC	BC	MP
0	GFS	GFS	Thomp
1	GFS	GFS	Thomp
2	$LAPS_T$	$GEFS_1$	Ferrier
3	$LAPS_T$	$GEFS_2$	WSM6
4	$LAPS_T$	$GEFS_3$	Thomp
5	$LAPS_T$	$GEFS_4$	Ferrier
6	$LAPS_T$	$GEFS_5$	WSM6
7	$LAPS_v$	GFS	Thomp

Initial Conditions Testing

- ExREF is a tool for testing new generations of NWP systems
- If value is demonstrated, innovations can be transitioned to operations
- ExREF initial conditions are being upgraded to use dynamic downscaling of perturbations



Forecasts will be initialized from a blend of local analyses and perturbations (differences between GEFS control and members.

Local analyses will be produced by a model run nudged towards LAPS analysis. This approach makes LAPS analyses more consistent with WRF to reduce spin up.

<u>See poster led by Isidora Jankov on Wedensday afternoon</u>:
Initial Condition Perturbation Tests within Experimental Regional Ensemble Forecasting (ExREF) System for the purpose of Hydrometeorological Testbed

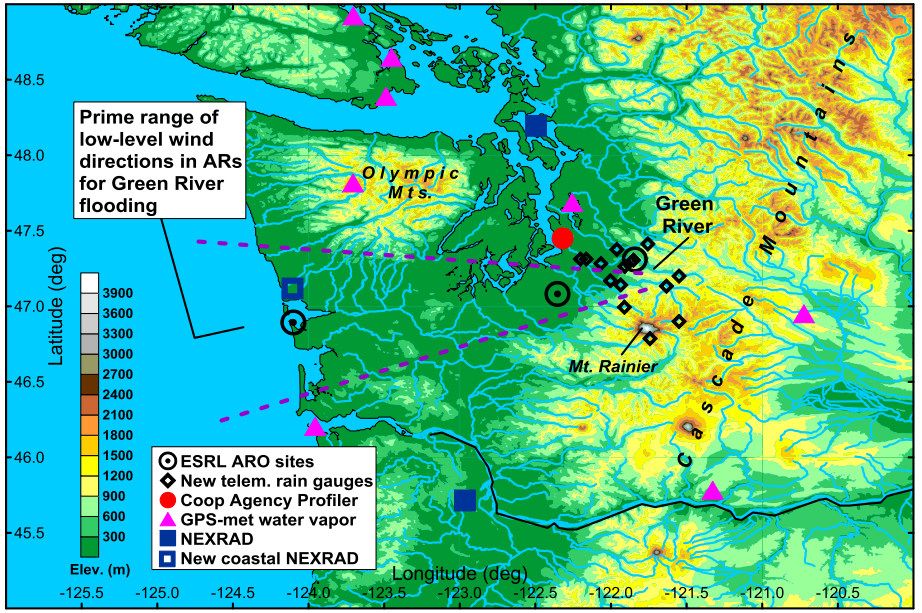
HMT-West Innovations were Key Elements in NOAA's Rapid Response to a Flood Risk Crisis

NOAA'S RAPID RESPONSE TO THE HOWARD A. HANSON DAM FLOOD RISK MANAGEMENT CRISIS

BY ALLEN B. WHITE, BRAD COLMAN, GARY M. CARTER, F. MARTIN RALPH, ROBERT S. WEBB, DAVID G. BRANDON, CLARK W. KING, PAUL J. NEIMAN, DANIEL J. GOTTAS, ISIDORA JANKOV, KEITH F. BRILL, YUEJIAN ZHU, KIRBY COOK, HENRY E. BUEHNER, HAROLD ORTZ, DAVID W. REYNOLDS, AND LAWRENCE J. SCHICK

NOAA operations and research personnel joined forces to better predict a possible flood and help calm public fears regarding reduced flood protection from a western Washington dam.

2012 Dept. of Commerce Bronze Medal



Basemap showing locations of newly telemetered rain gauges and AROs that were deployed for the Howard A. Hanson Dam project. A number of other forecast products, including a web page devoted to the Dam and Green River were made available to emergency managers and the public. For a full description of the project, see White et al. (February 2012; Bull. Amer. Meteor. Soc.)

Howard Hanson Dam Support

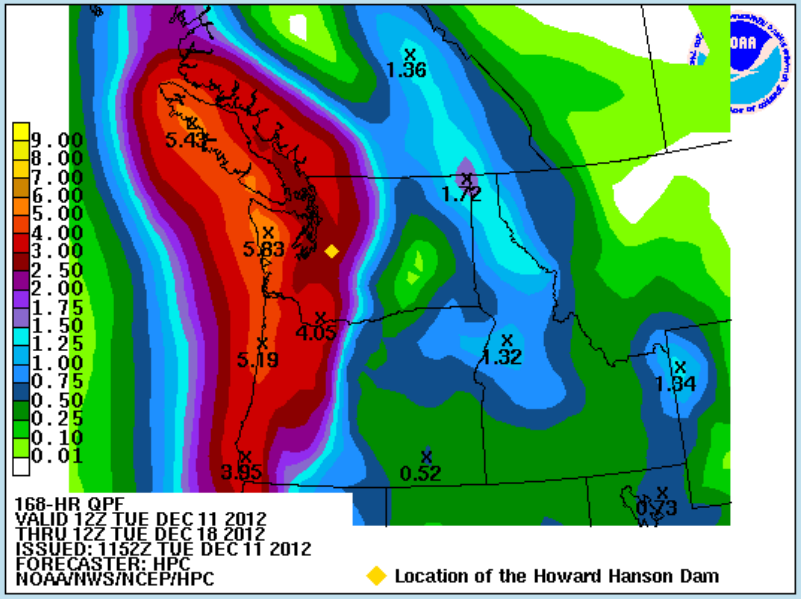
Built skill and familiarity with doing Day 6 and 7 QPF during 2009-2011

Preview of the 24-Hour and 7-Day Total Quantitative Precipitation Forecasts (QPFs)

QPF Preview 24 Hour and 7 Day Totals | 24 Hour QPFs | 24-Hour Probabilistic QPFs | 6 Hour QPFs | 6-Hour Probabilistic QPFs

24-hour and 7-Day Total QPFs

Forecast valid 12Z December 11, 2012 through 12Z December 18, 2012



Preview of Days 1-7

Day 1 | Day 2 | Day 3 | Day 4 | Day 5 | Day 6 | Day 7

7-Day Total

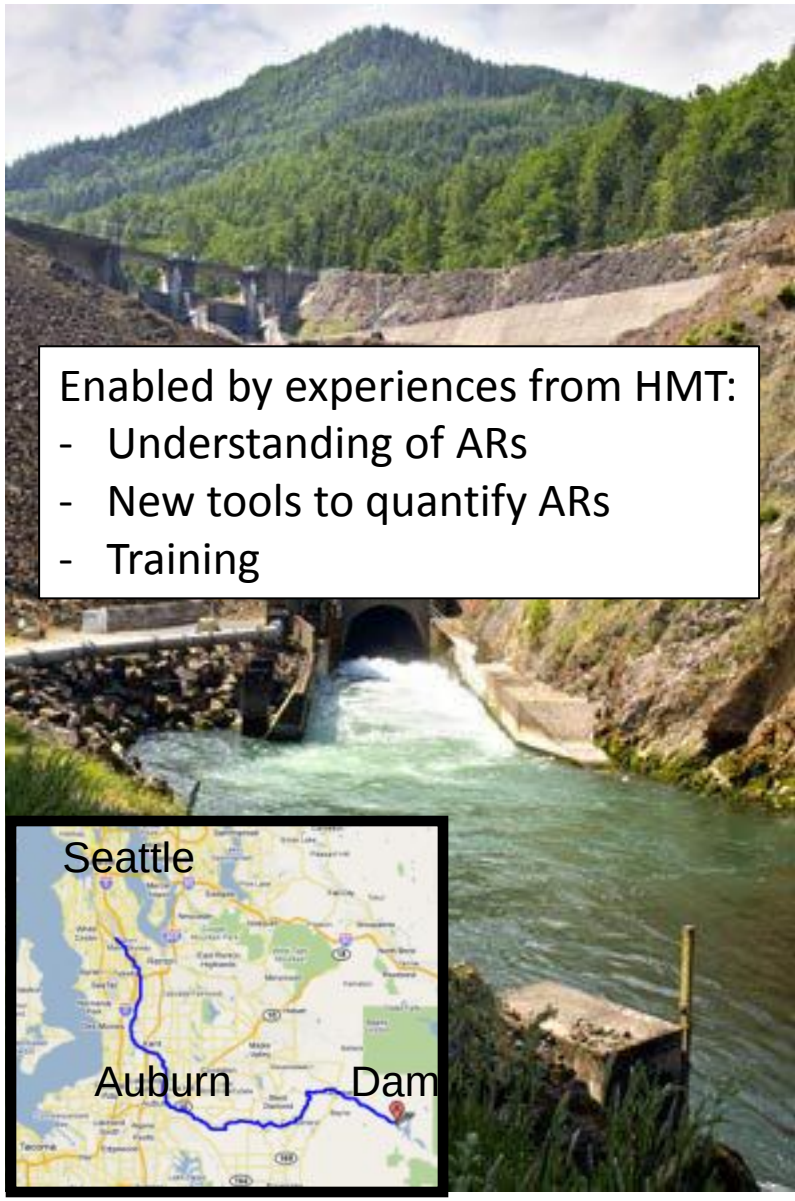
Help viewing QPF products on this page

Loop of all 24-hour QPFs for Days 1-7

Loop of all 6-hour QPFs for Days 1-7

Hanson Dam Precipitation Statement

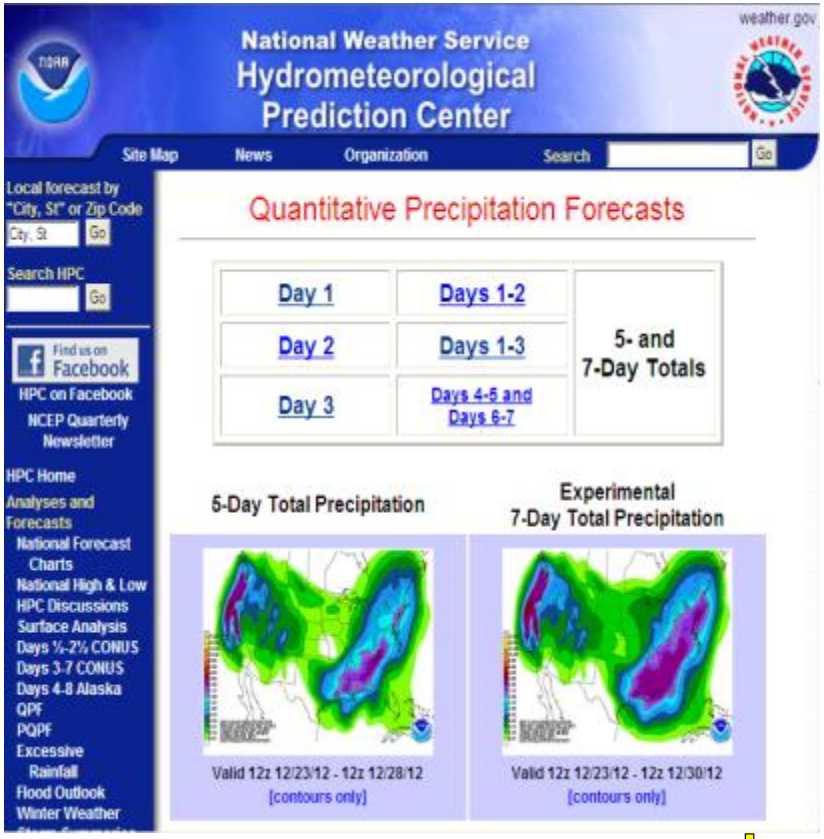
(Latest statement issued: 13:08Z March 05, 2013)



Enabled by experiences from HMT:

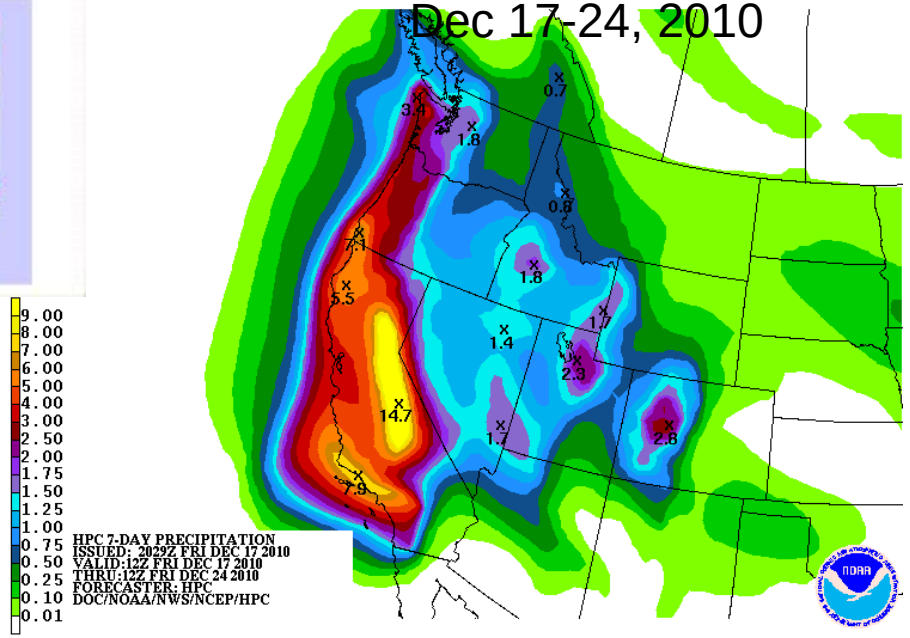
- Understanding of ARs
- New tools to quantify ARs
- Training

QPF out to Day 7



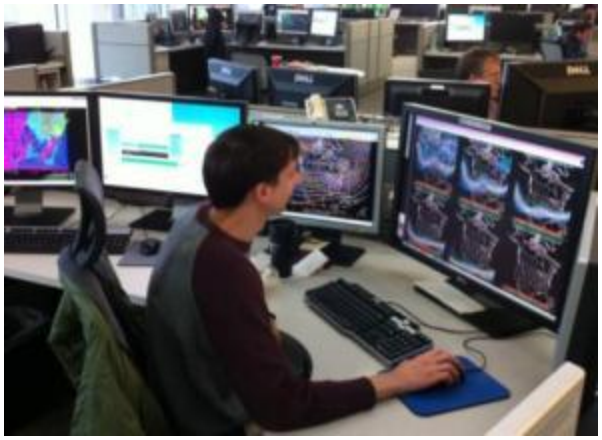
Building on technical and forecasting experience of the Howard Hanson Dam monitoring, Day 6-7 QPF was expanded to the CONUS on an experimental basis.

Soliciting comments through April 30, 2013



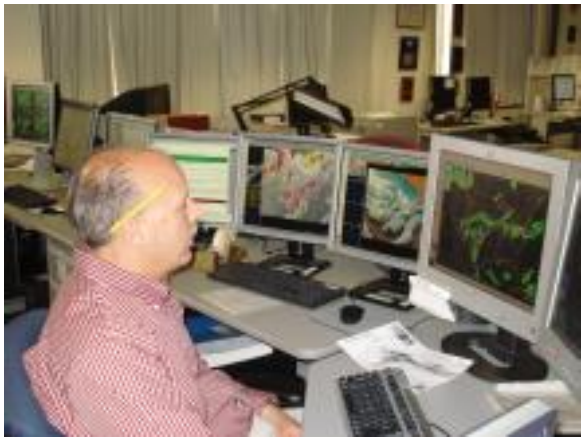
WPC QPF Services

Medium Range Desk



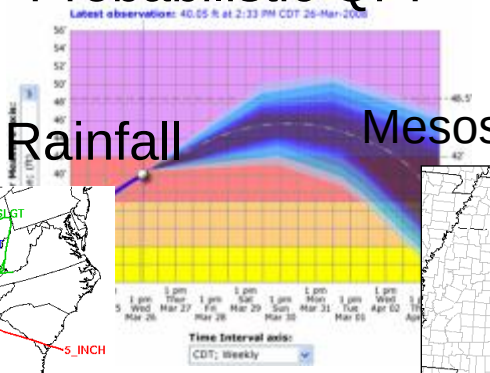
QPF Desk

MetWatch Desk

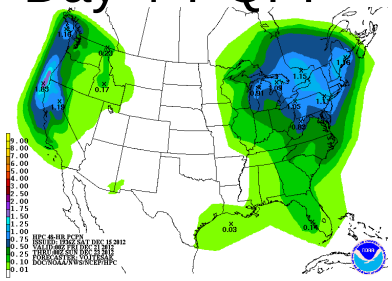


Deterministic QPF

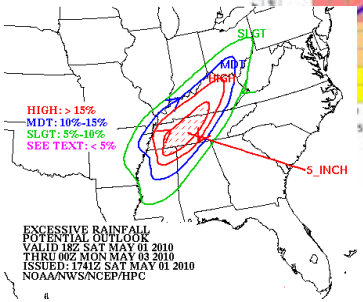
Probabilistic QPF



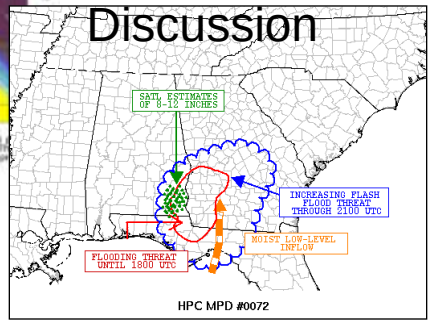
Day 4-7 QPF



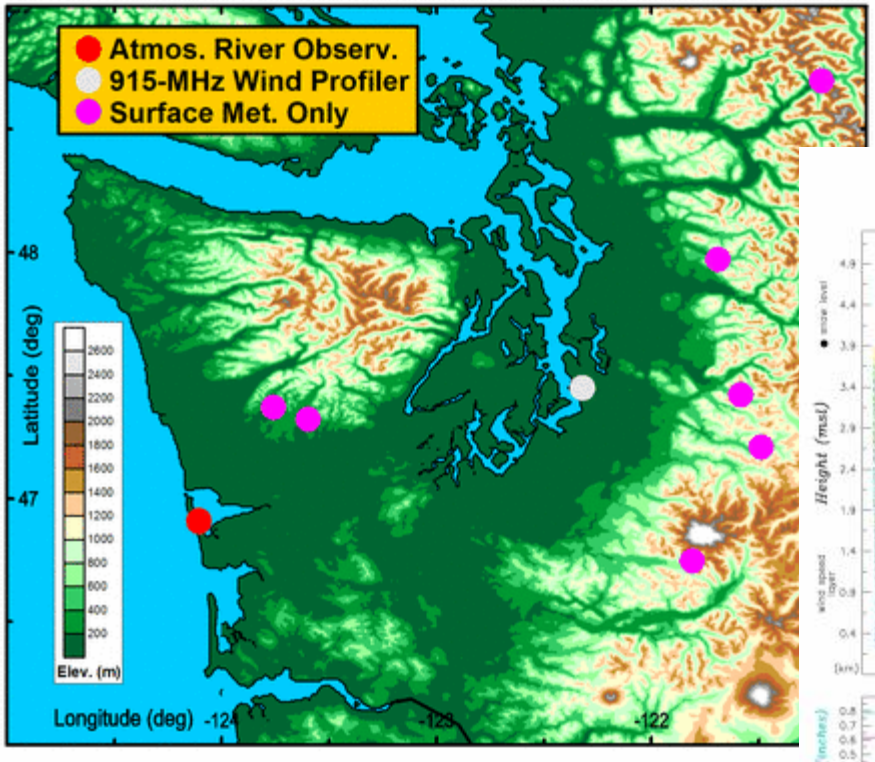
Excessive Rainfall



Mesoscale Precipitation Discussion

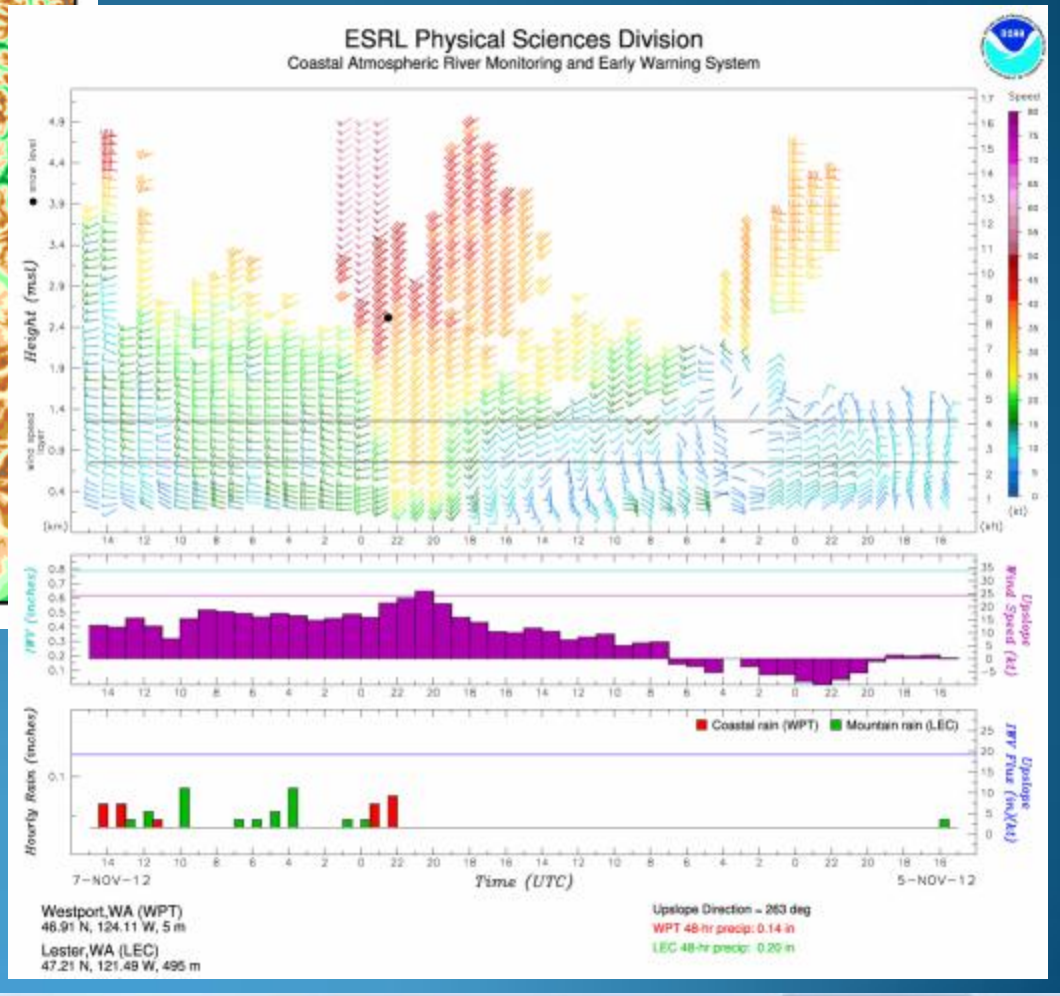


Multi-wind Direction Display for Westport ARO

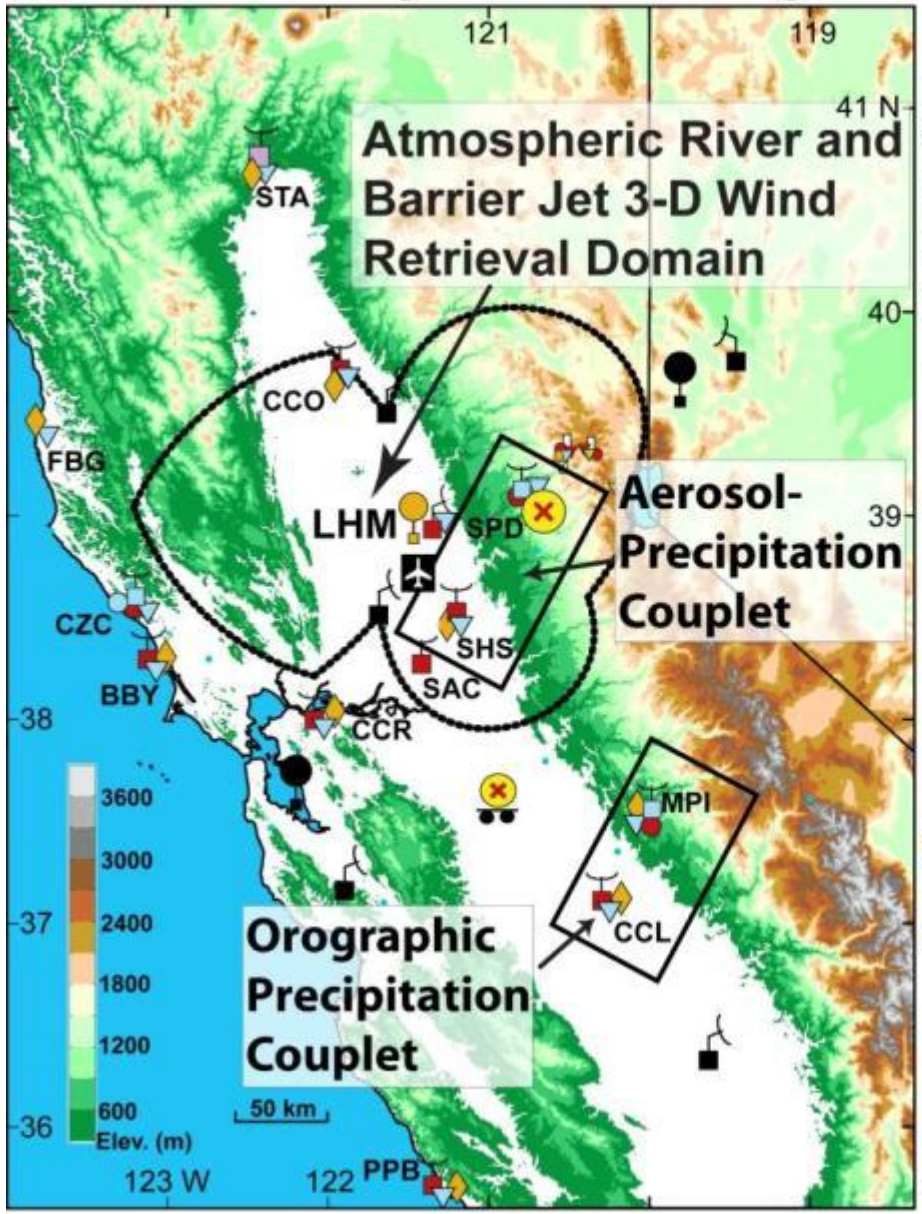


When Westport ARO S-PROF was interfering with the new coastal NEXRAD, we offered to move the ARO, but here's what the WCM from Seattle said: "The current site has some history now and its orientation to moisture moving into the interior of western Washington is excellent. We also would like to compare its output with the new radar data. So moving the ARO to another location....well, we'd really rather not."

New water vapor flux displays requested by Seattle WFO



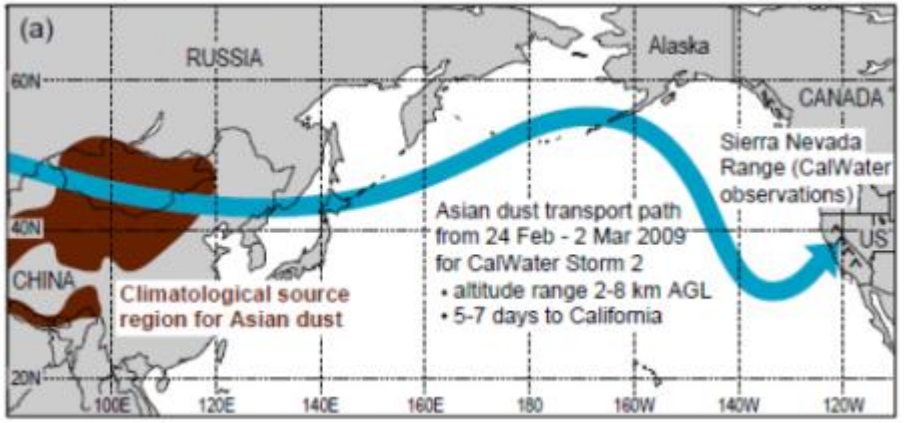
HMT-West infrastructure was the basis for development of a major field experiment – **CalWater** that ran from 2009-2011



CalWater generated $5 M of external funding that supported

- University PIs
- DOE scientists
- Cooperative Institutes
- NOAA/ESRL/PSD

A sample finding:
Asian aerosols were present in CA precipitation when an aerosol plume intersected the top of orographic clouds over the Sierras.
Ault et al. (2011, JGR)



Sciencexpress

Dust and Biological Aerosols from the Sahara and Asia Influence Precipitation in the Western U.S.

Jessie M. Creamean,[1]* Kaitlyn J. Suski,[1]* Daniel Rosenfeld,[2] Alberto Cazorla,[1] Paul J. DeMott,[3] Ryan C. Sullivan,[4] Allen B. White,[5] F. Martin Ralph,[5,6] Patrick Minnis,[7] Jennifer M. Comstock,[8] Jason M. Tomlinson,[8] Kimberly A. Prather[1,6]

[1]Department of Chemistry and Biochemistry, University of California, San Diego, La Jolla, CA 92093, USA.

[2]Institute of Earth Sciences, The Hebrew University of Jerusalem, Jerusalem 91904, Israel.

[3]Department of Atmospheric Science, Colorado State University, Fort Collins, CO 80523, USA.

[4]Center for Atmospheric Particle Studies, Carnegie Mellon University, Pittsburgh, PA 15213, USA.

[5]Physical Sciences Division, National Oceanic and Atmospheric Administration/Earth System Research Laboratory, Boulder, CO 80305, USA.

[6]Scripps Institution of Oceanography, University of California, San Diego, La Jolla, CA 92093, USA.

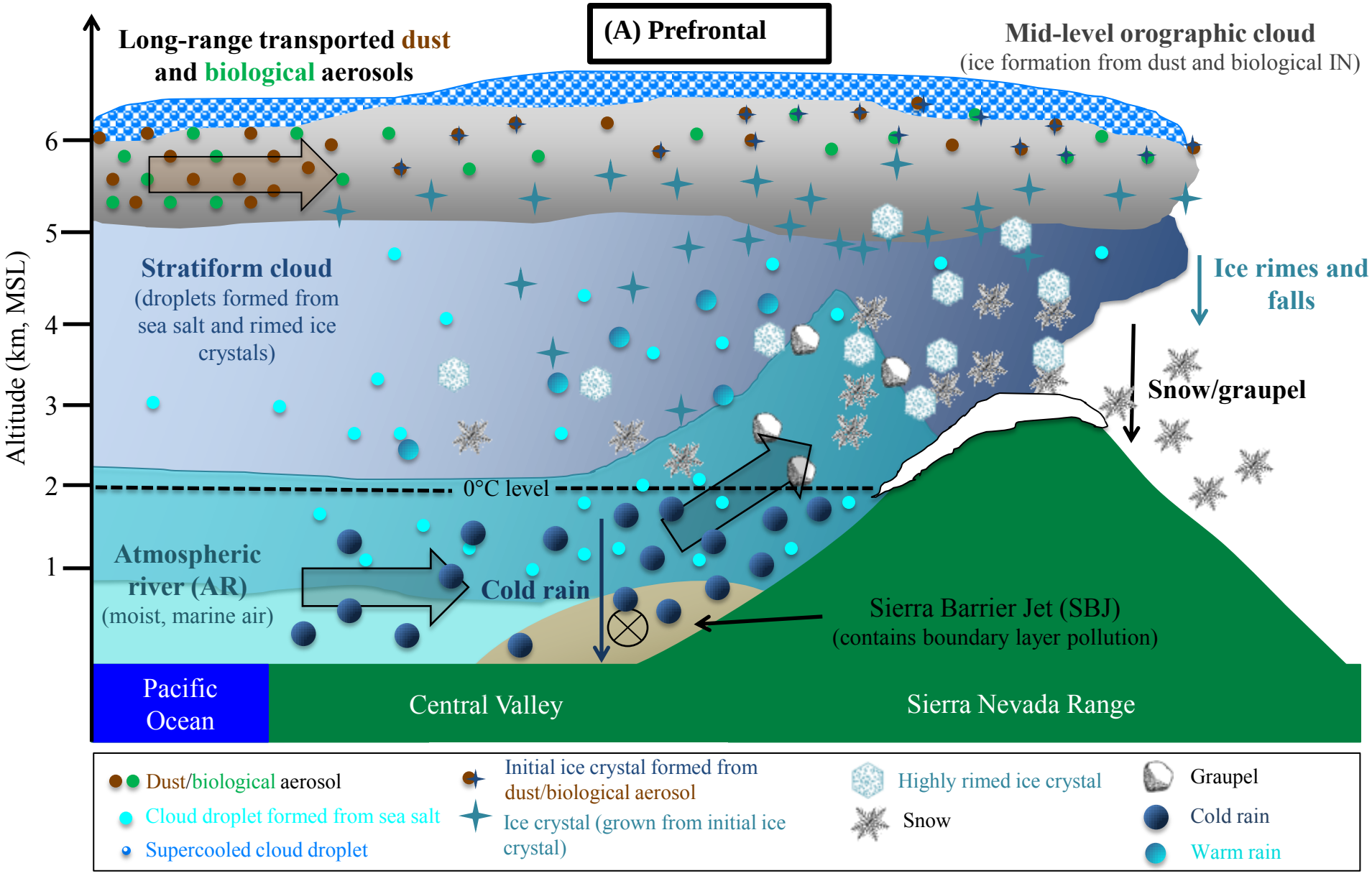
[7]NASA Langley Research Center, Hampton, VA 23681, USA.

[8]Atmospheric Sciences and Global Change Division, PNNL, Richland, WA 99352, USA.

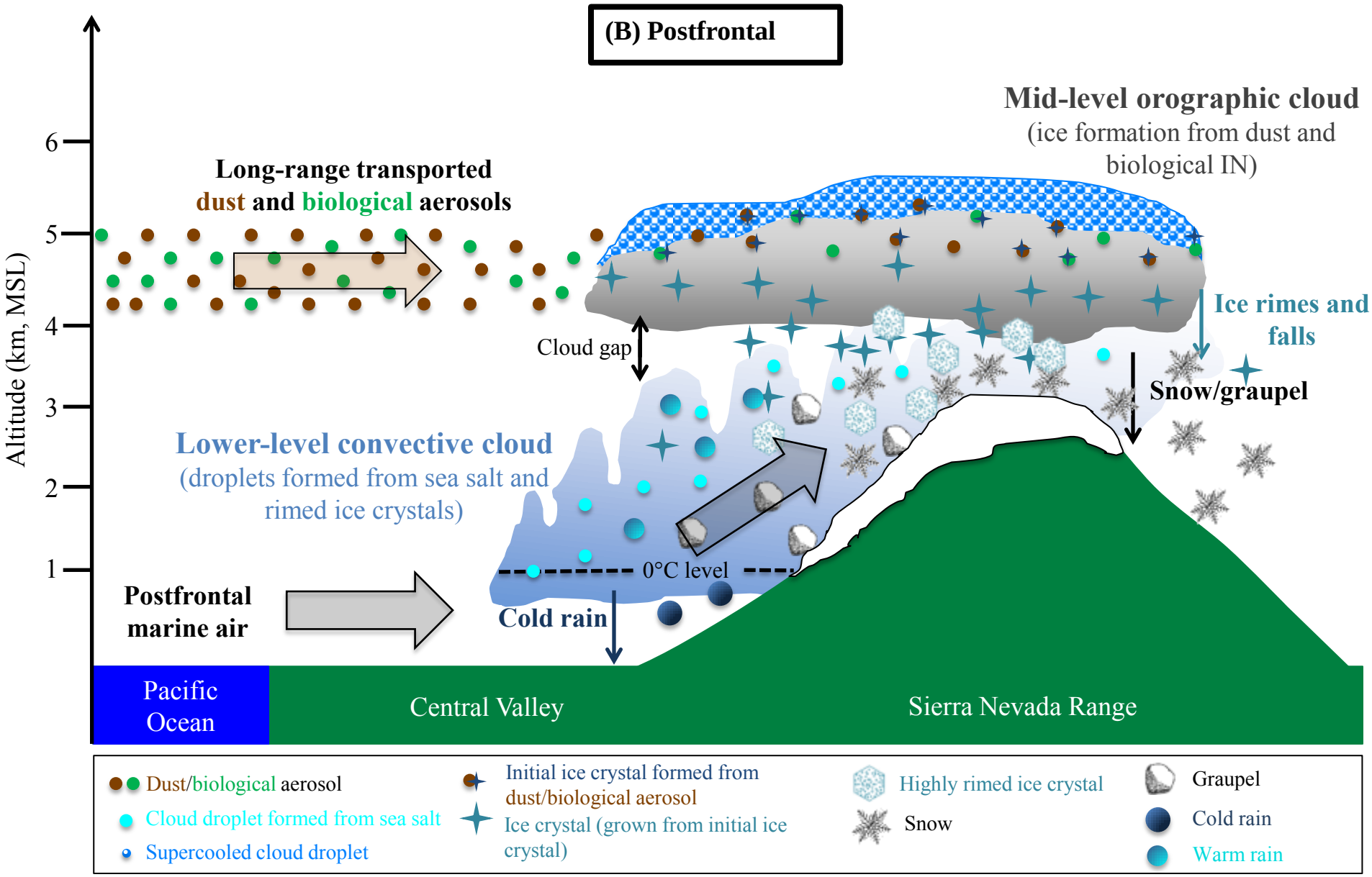
*These authors contributed equally to this work.

Published Online February 28 2013

Creamean et al. (2013, *Science*)



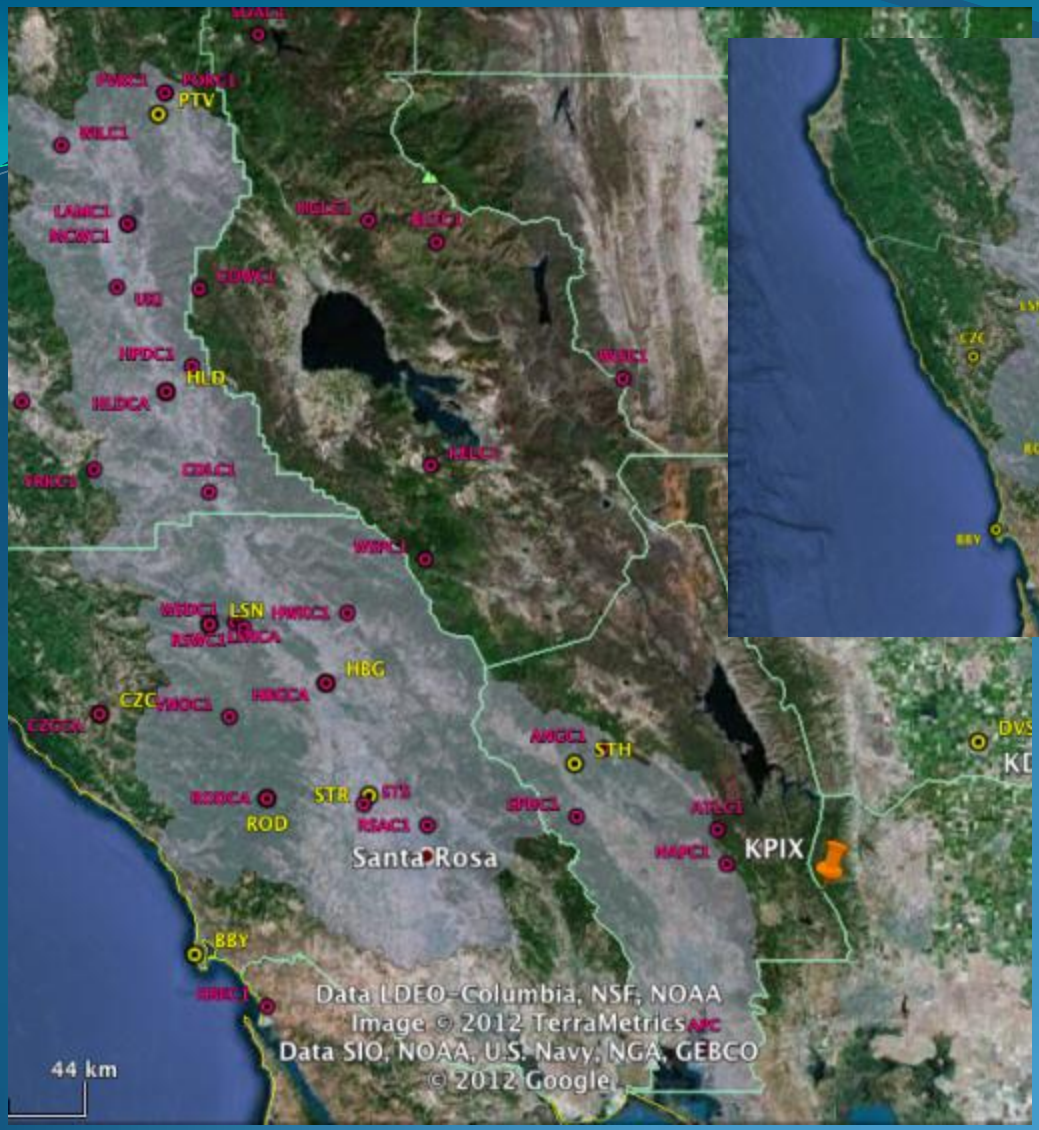
Creamean et al. (2013, *Science*)

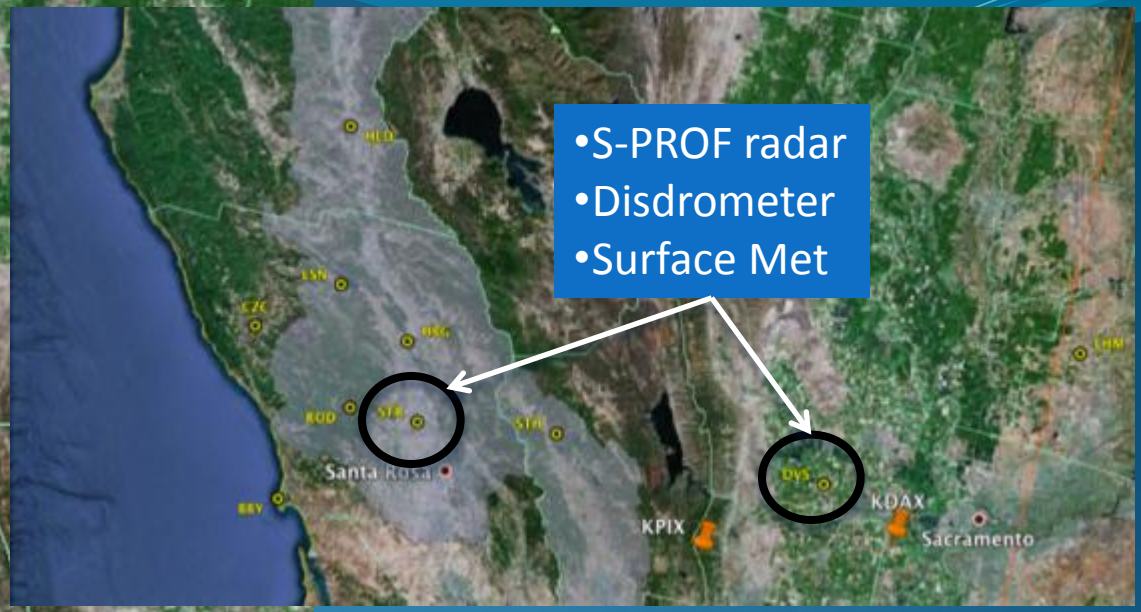


Phase I of Russian River Study with HMT and the Sonoma County Water Agency (SCWA):

- Improve Quantitative Precipitation Information (QPI) for the Russain River basin
  - Evaluate the benefit of TV radar (KPIX).
  - Determine best combination of radar and gauges to produce best possible QPE to drive hydro forecasts
- Provide high resolution temperature forecasts to mitigate Russian River draw down during frost and heat wave events

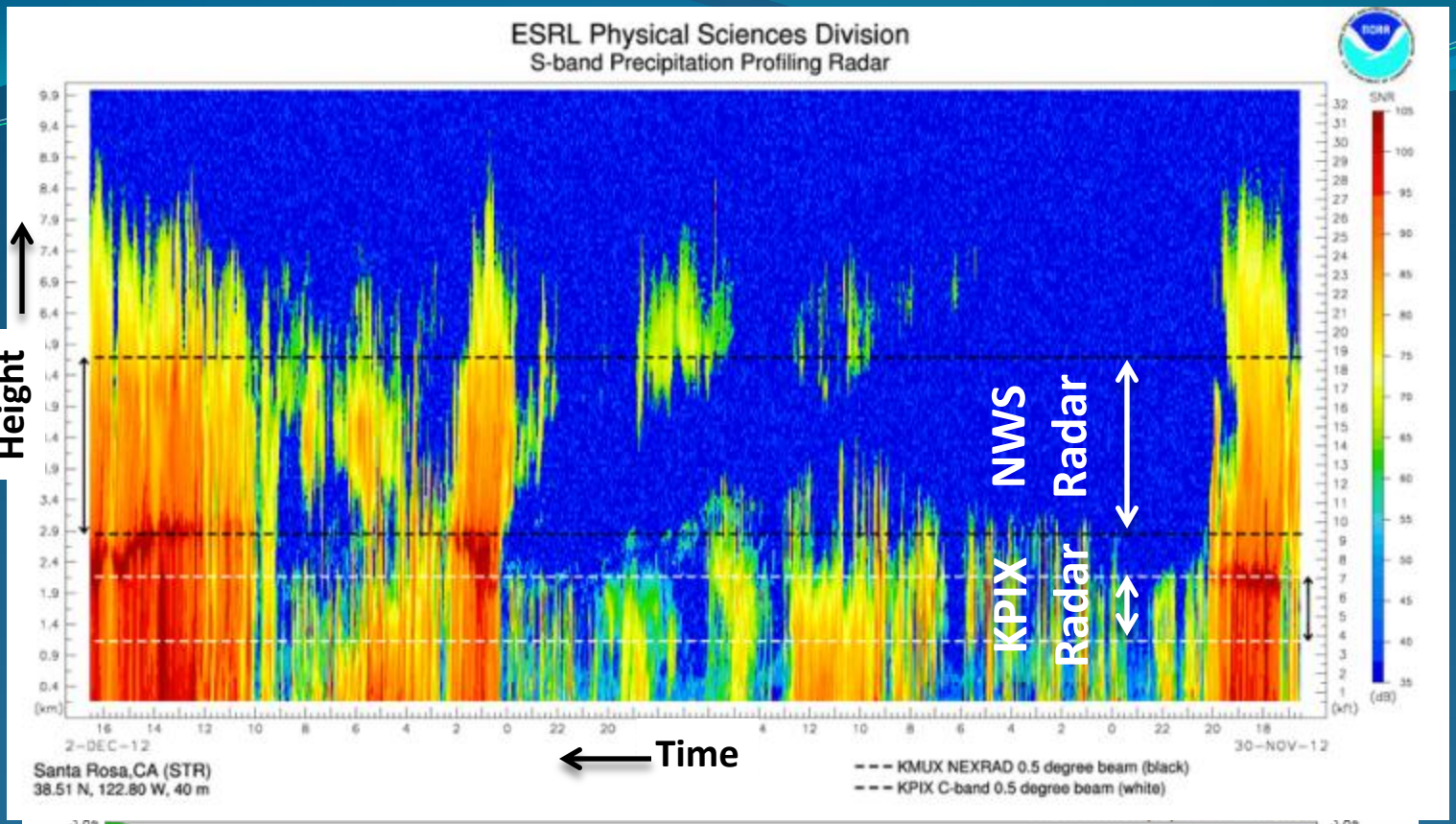
See talk by Rob Cifelli on Wed. afternoon

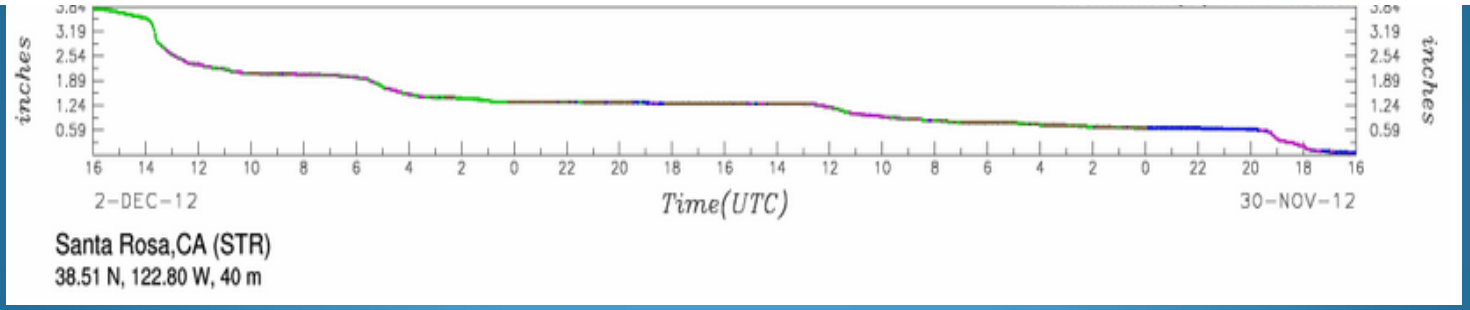




- S-PROF data used for Vertical Profile of Reflectivity (VRP) correction and to demonstrate spatial coverage of operational and TV radars
- Disdrometer data used to calibrate radars

Red – analysis gauges
Yellow – independent HMT gauges for verification

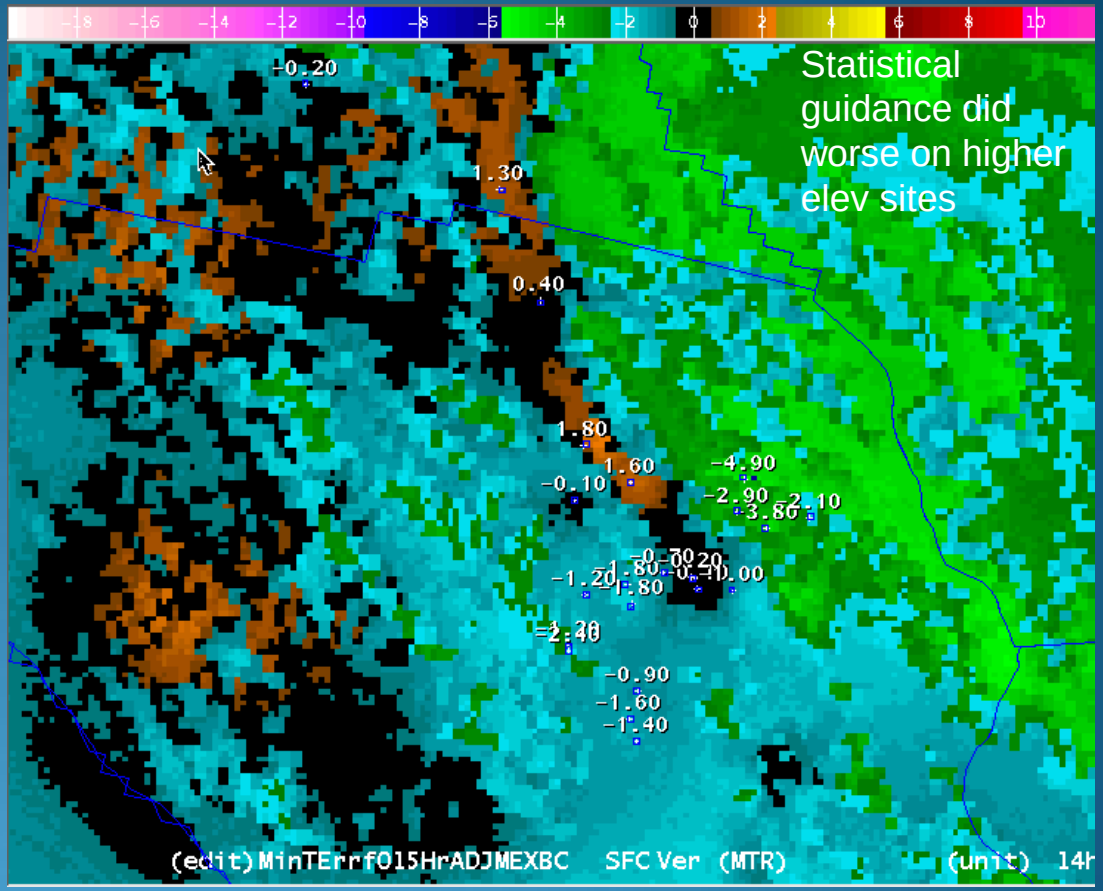




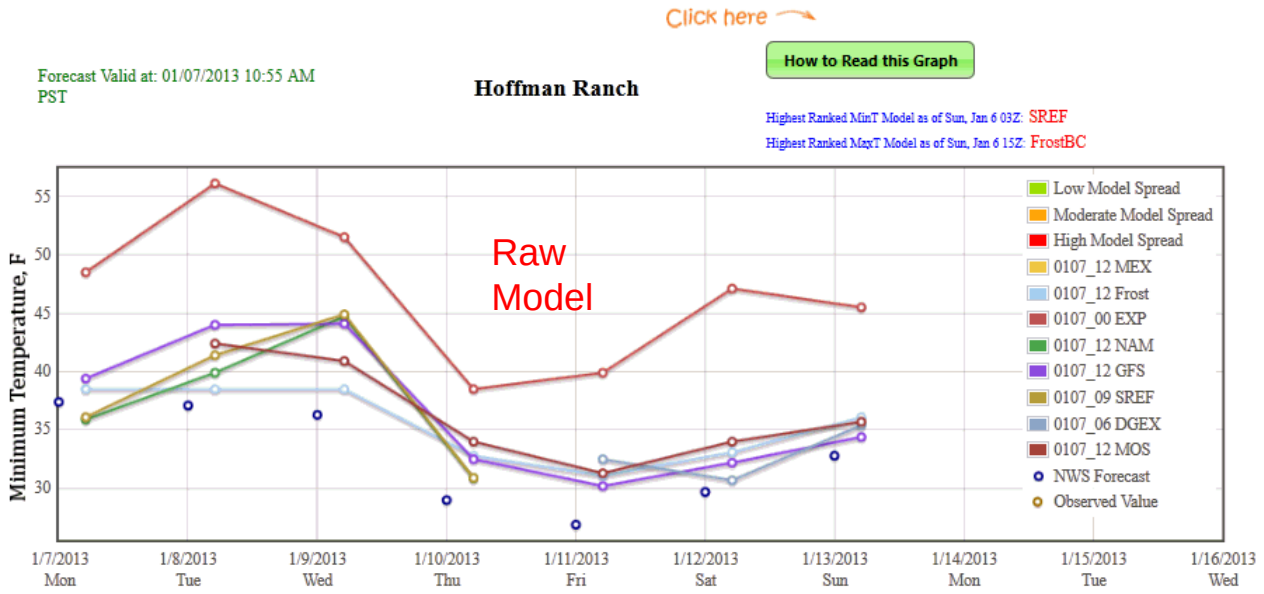
S-PROF shows improved coverage over Russian River Basin from KPIX as compared to KMUX

Frost/Heat Forecast Improvement

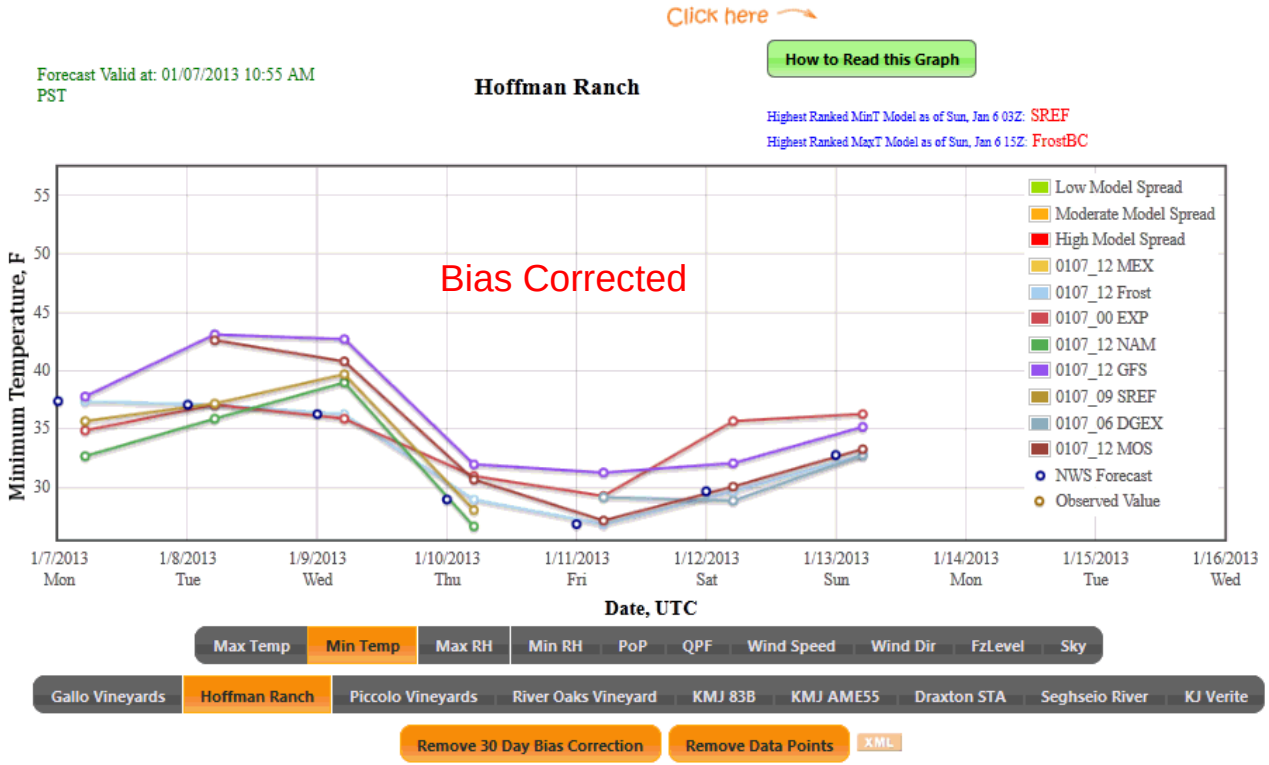
- Minimize Russian River drawdown during wine grape budding season – reduce fish kill
- Improve temporal and spatial forecasts to reduce hours of watering
- Increase lead time to allow early water releases increasing water in holding ponds days before frost to reduce flow impacts
- Disseminate to growers/water managers in form they can use to reduce impacts on river flows
- Obtain local observations critical for methodology proposed



15-hr forecast error for "Best Guidance" Jan 4 2013

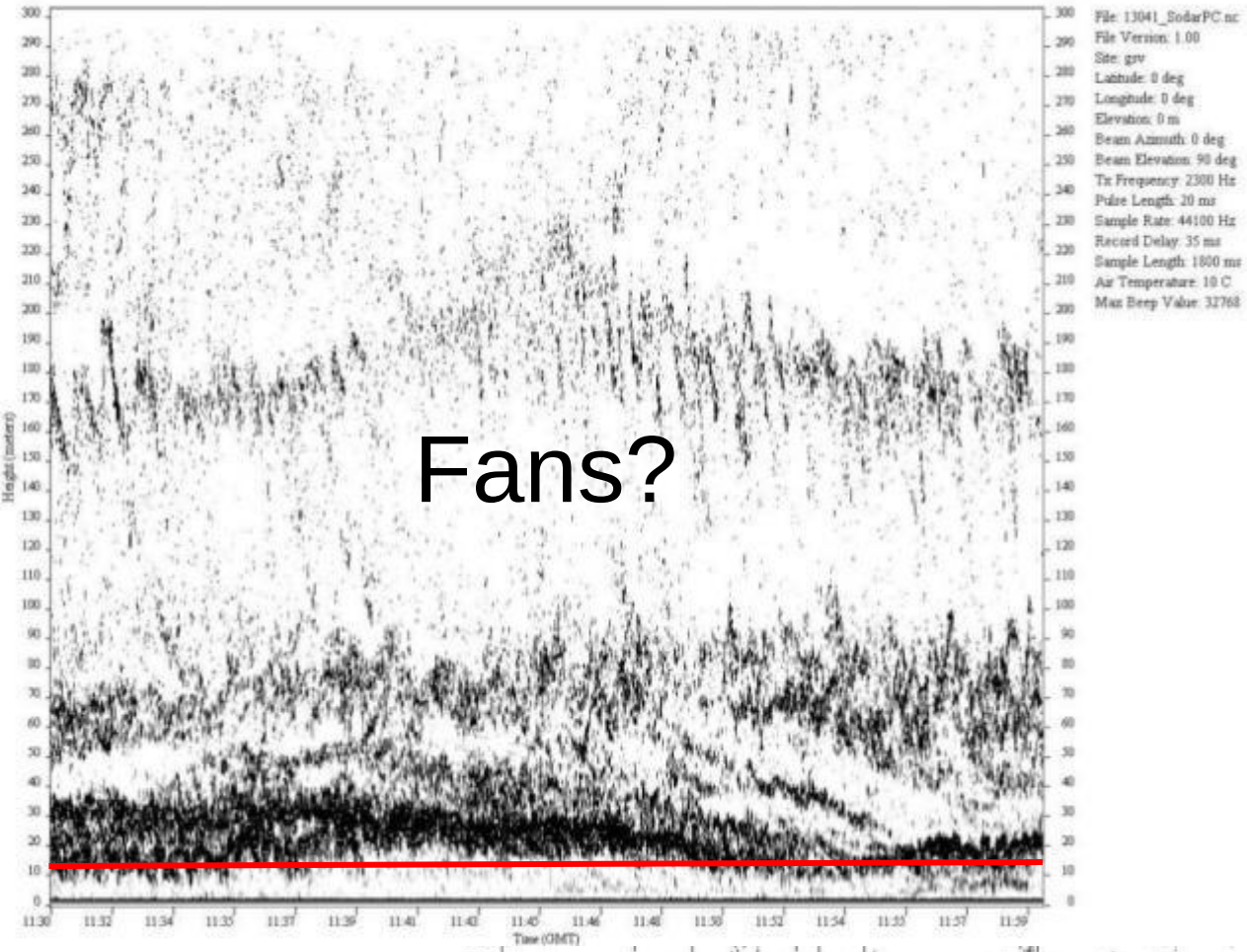


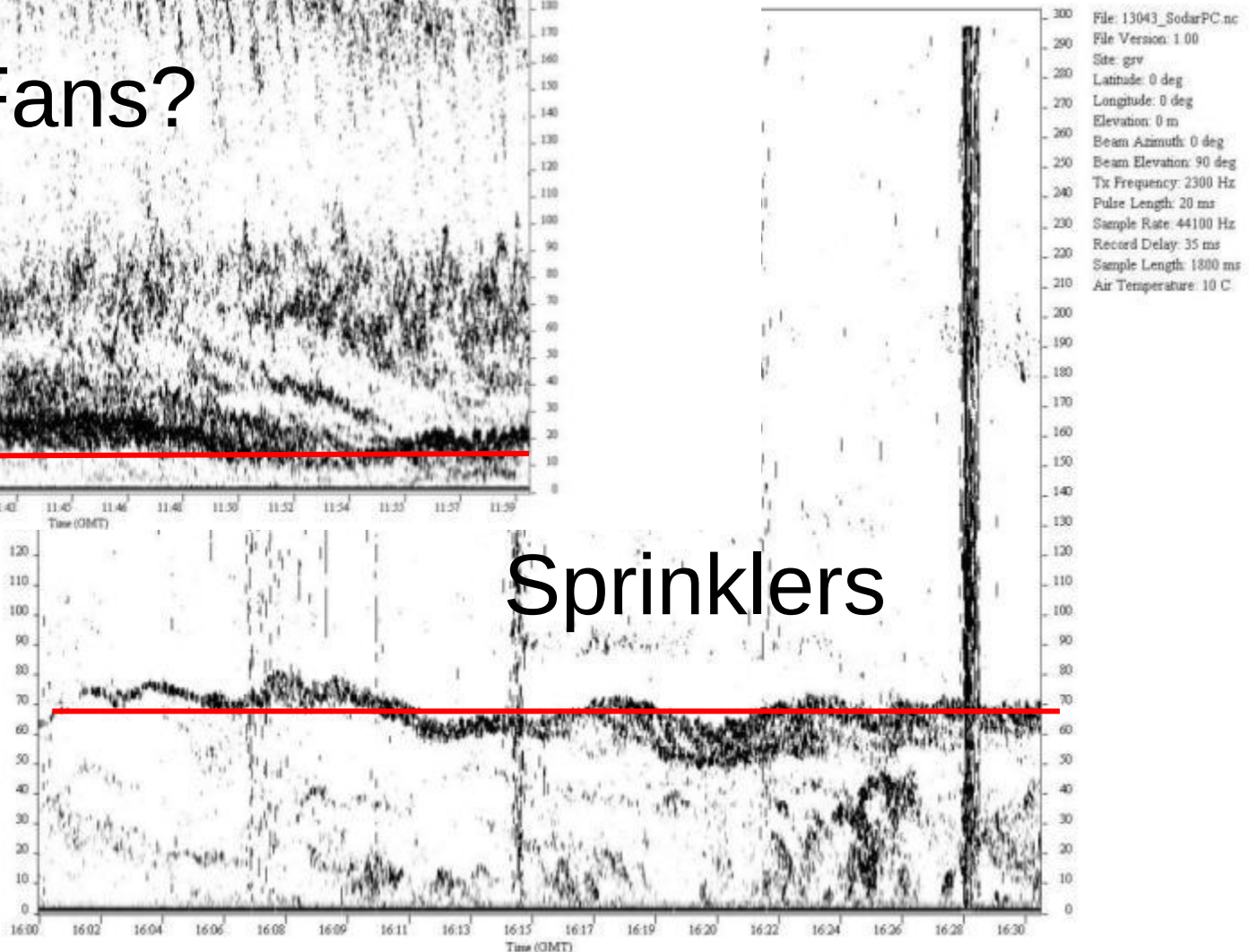
Model Spectrum web page showing plot of available numerical and statistical minimum temperature forecasts along with NWS “official” forecast.



Top is raw model forecasts and bottom shows forecasts after applying 10 day bias correction

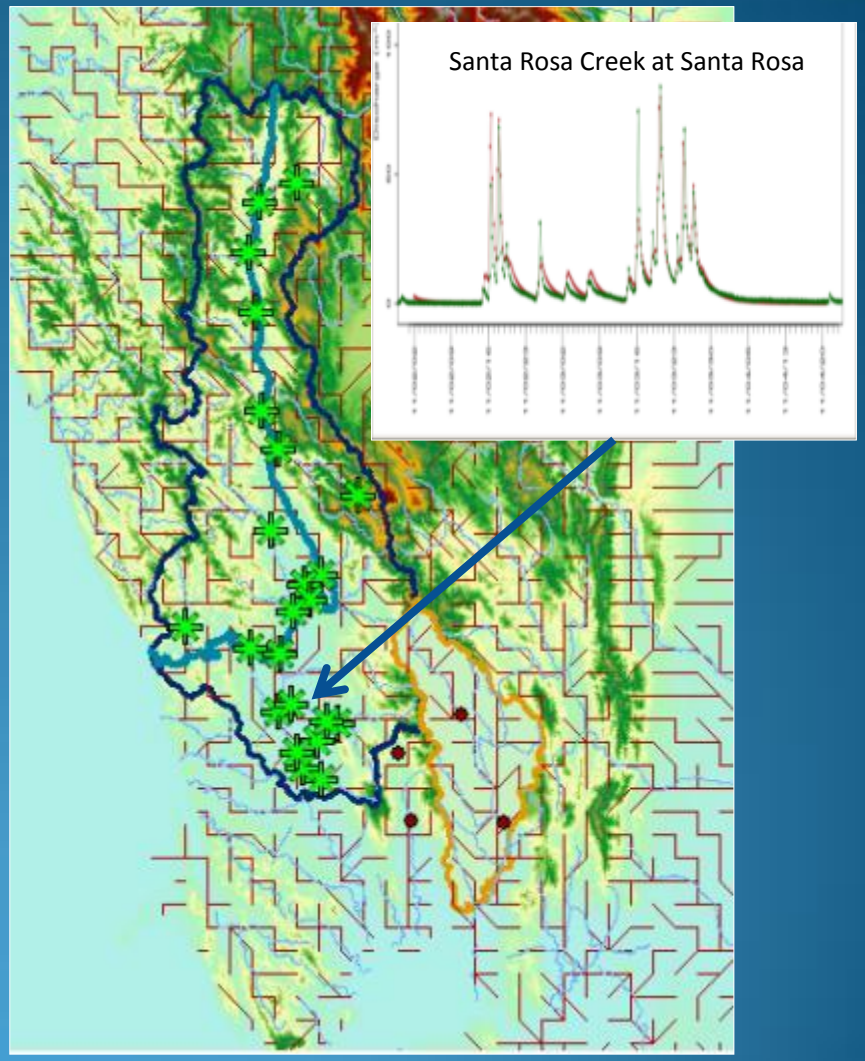
Geyserville SODAR





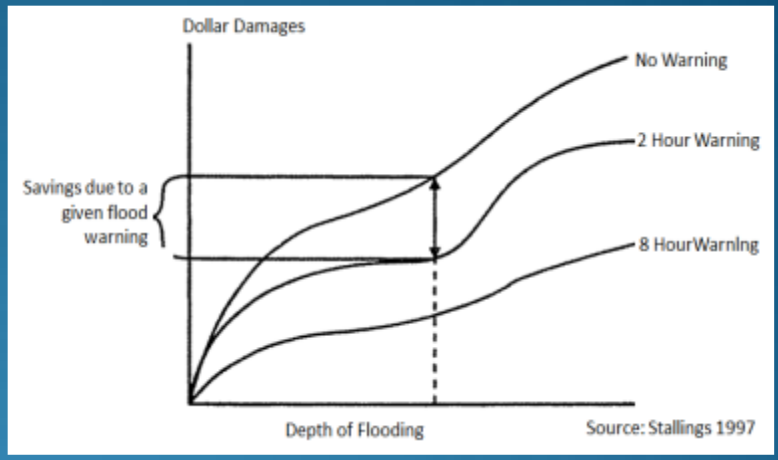
Russian-Napa Basins 2-D Hydro Model

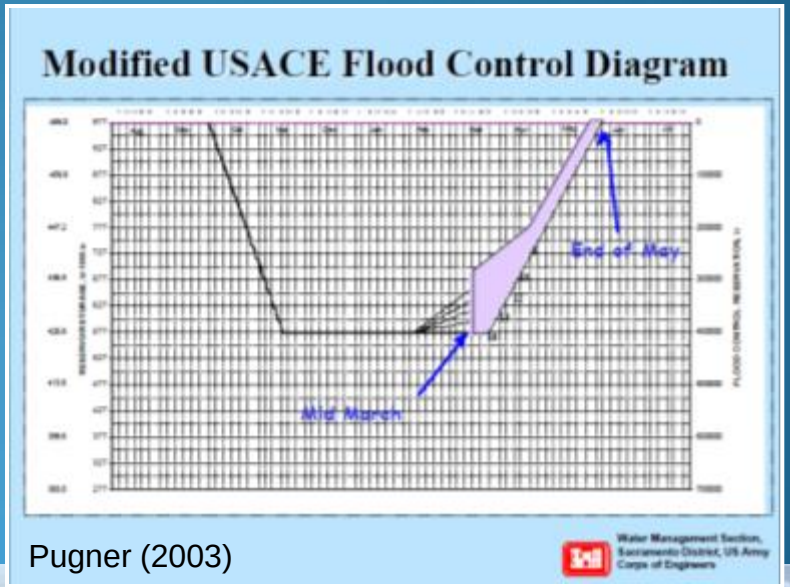
- Purpose:
  - Account for spatial distribution of rain, topography, soils, land use and runoff
  - Tool to assess QPE/QPF products
- Research Distributed Hydrologic Model (RDHM)
  - Developed by NWS-OHD for nation-wide deployment
  - 2-D using HRAP grid
    - ~4 km side, 6 hr
    - 1 km side, 1 hr
  - Gridded precipitation and surface temperature
  - Sacramento Soil Moisture Accounting Model (SAC-SMA) in each grid cell
  - Connectivity derived from DEM
  - Runoff (overland and channel) routed by kinematic wave equations
  - Soils parameters based on SSURGO
  - Channel routing based on USGS field measurements
  - Soil moisture linked to observations



SCWA Forecast Benefits

- Flood Mitigation
  - Lead time for moving residential contents (Day/Carsell)
  - 12-hr lead time, 5% reduced damages, $100K content value, 3000 residences, 80% efficiency
  - Value $12M for 2005 event
- Water Supply
  - Reservoir operations in March 2012 secured an extra volume of 30 KAF carried into the summer season
  - Potential FBO value for municipal water supply at $900/AF is $27M/yr
- Fishery Flows
  - Reservoir releases to sustain fisheries enabled by FBO captured water in March
  - Potential FBO value of 30 KAF at $125/AF is $3.75M/yr





Water Management Actions

Time Frame / Purpose	Nowcast (0 min – 6 hrs)	Near Real-time (6 hr – 1 day)	Short-term (1 day – 1 week)	Near-term (1 wk – 3 mon)	Mid-term (6 mon – 2 yrs)	Long-term (5 years+)
Flood Mitigation	Flood status assessment	FF warning; Response deploy; System opt.	Flood warning; Response deploy; Reservoir FBO	Flood warning; Response deploy; Reservoir FBO	Over-year storage allocation	Flood frequency; Capacity devel; Climate adapt.
Water Supply	Status assessment; Intake operations	Intake and outlet operations	Reservoir FBO; Emergency conservation	Delivery sched.; Reservoir FBO; Conservation	Over-year drought mit.; Conservation	Capacity devel; Demand mana; Climate adapt.
Hydro-Power	Release operations	Reservoir FBO	Reservoir FBO; Demand sched.	Reservoir FBO; Demand sched.	Over-year drought mit.	Capacity devel.; Climate adapt.
Ecosystem Enhancement	Status assessment	Threat assess; River & Reservoir FBO	Threat assess; River & Reservoir FBO	Threat assess; River & Reservoir FBO	Threat assess; Capacity devel; Drought mit.	Ecosystem & Capacity devel; Climate adapt.
Water Quality	Status assess; Real-time control	WW capture & treatment	Threat assess; Sys. optimize	Threat assess; Capacity devel; Sys. optimize	Threat assess; Capacity devel; Sys. optimize	Capacity devel; Climate adapt.
Recreation	Weather status; Warning	Event scheduling	Reservoir FBO	Reservoir FBO	Capacity development	Capacity development

HMT Focus

HMT Southeast Pilot Study (HMT-SEPS)

Management Structure

http://hmt.noaa.gov/field_programs/hmt-se/

Timeline-Location

- May 2013 – September 2014 in western North Carolina

Objectives

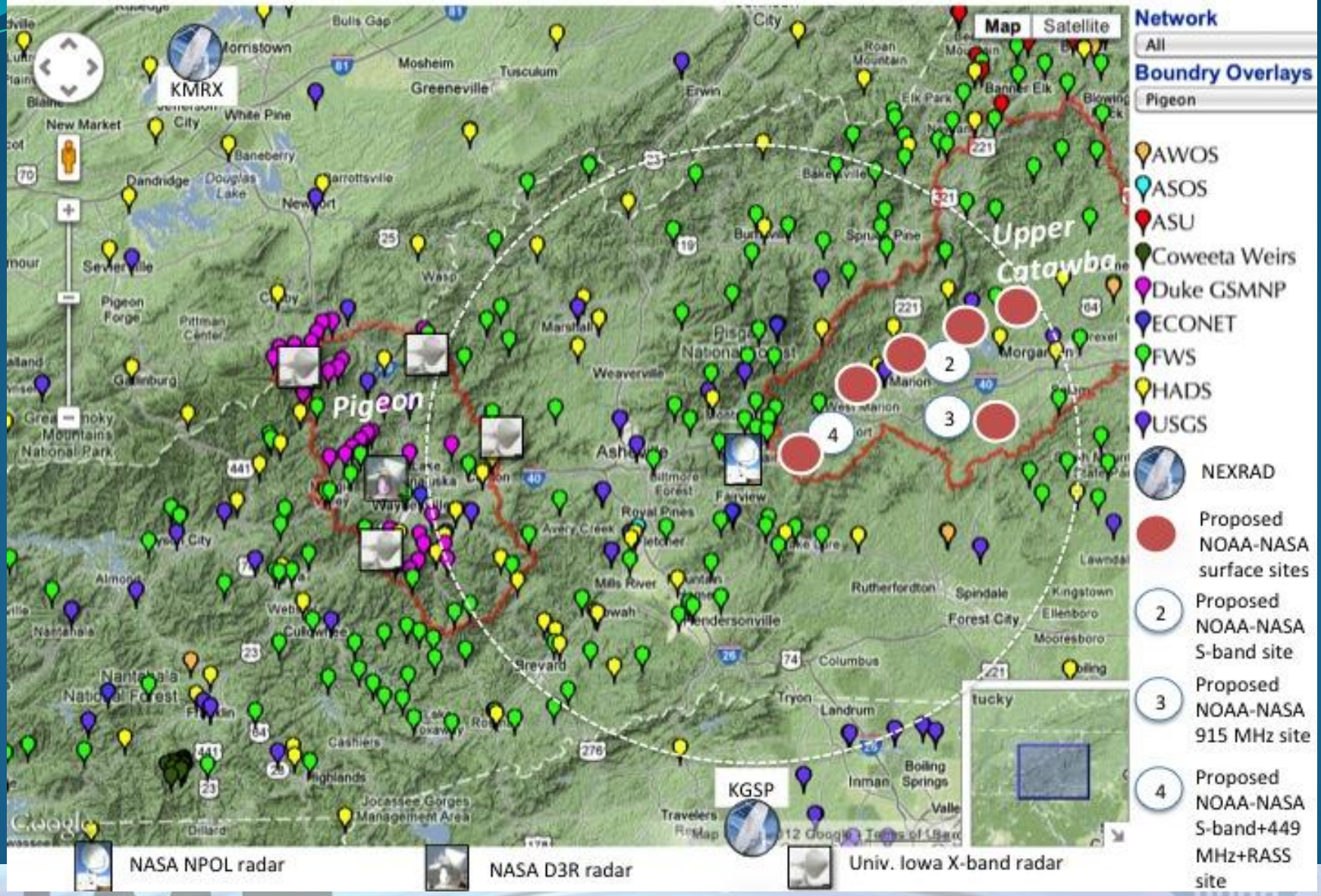
- Warm season QPE and QPF for extreme events
  - *Evaluation and improvement of QPE algorithms*
  - *Improved understanding of moisture sources and transport*

Partners

- NASA GPM
- NOAA GPM Proving Ground
  - NCEP CPC, NESDIS STAR, NWS OHD
- NWS Eastern & Southern Region & SERFC
- NC State, Duke, other Universities
- NSSL

Proposed NOAA-NASA Deployment Plan (Regional Scale)

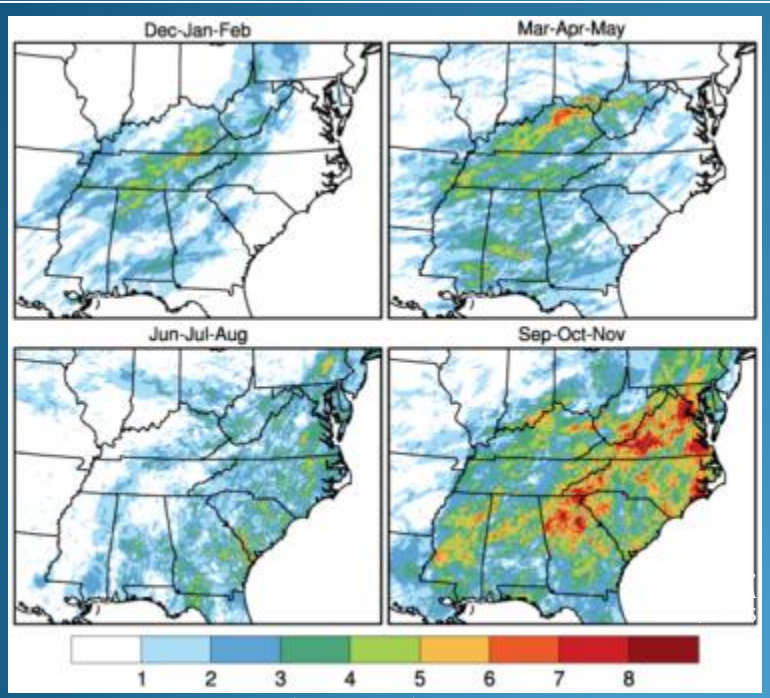
Proposed NOAA-NASA Deployment Plan (Basin-Scale)



HMT-Southeast Research

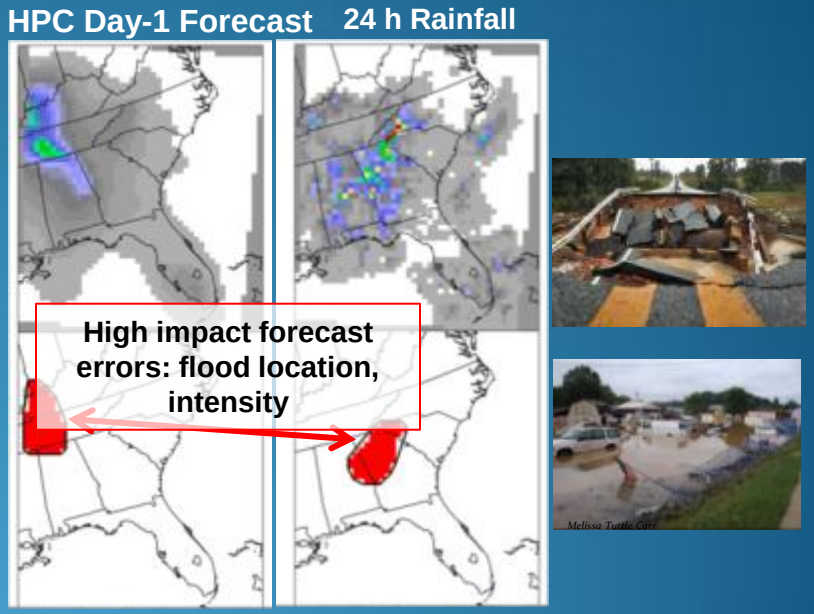
- Extreme precipitation climatology
- Identification of biggest forecast challenges

Extreme precipitation climatology: Southeast US experiences extreme rainfall across ALL seasons, weather system types



Number of days (2002–2011) on which precipitation exceeded 99th percentile threshold as part of extreme precipitation event; separated by season

High-impact forecast challenges:
Atlanta, GA devastating floods (Sept 2009)



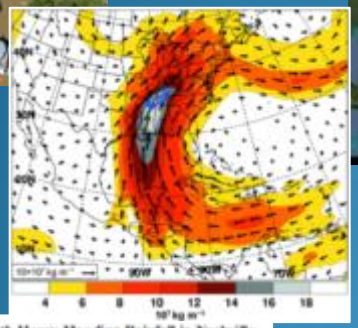
Object-oriented verification of 1-inch forecast vs. observed precipitation: 20 Sept 2009

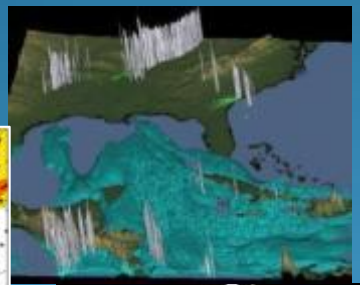
HMT-Southeast Research

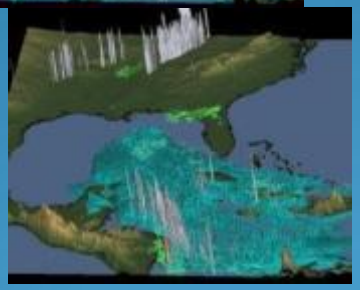
- High-impact event case studies
- Research-to-operations transitions

See poster led by Kelly Mahoney on Wednesday afternoon: Extreme Precipitation in the Southeast U.S.: HMT-Southeast's Specialized Observations and Modeling Focus on High-impact Forecast Challenges

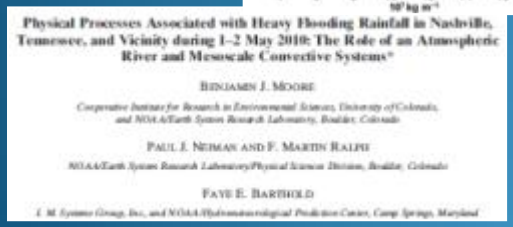
High-impact case studies: 2010 Nashville, Tennessee floods
Improve process understanding, forecast improvement







WRF model research highlighting role of Pacific moisture in Southeast extreme events (TN flood)



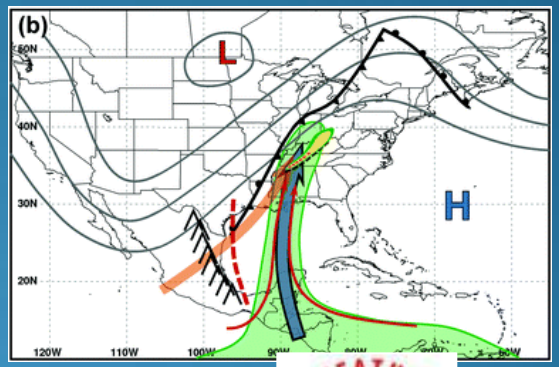
Physical Processes Associated with Heavy Flooding Rainfall in Nashville, Tennessee, and Vicinity during 1–2 May 2010: The Role of an Atmospheric River and Mesoscale Convective Systems*

BENJAMIN J. MOORE

PAUL J. NEIMAN AND F. MARTIN RALPH

FAYE E. BARTHOLD

Research-to-operations transitions: NWS forecaster training, NWS forecast office, headquarters collaboration



HMT Hydrometeorology Testbed

NOAA

HMT Publications (2012)

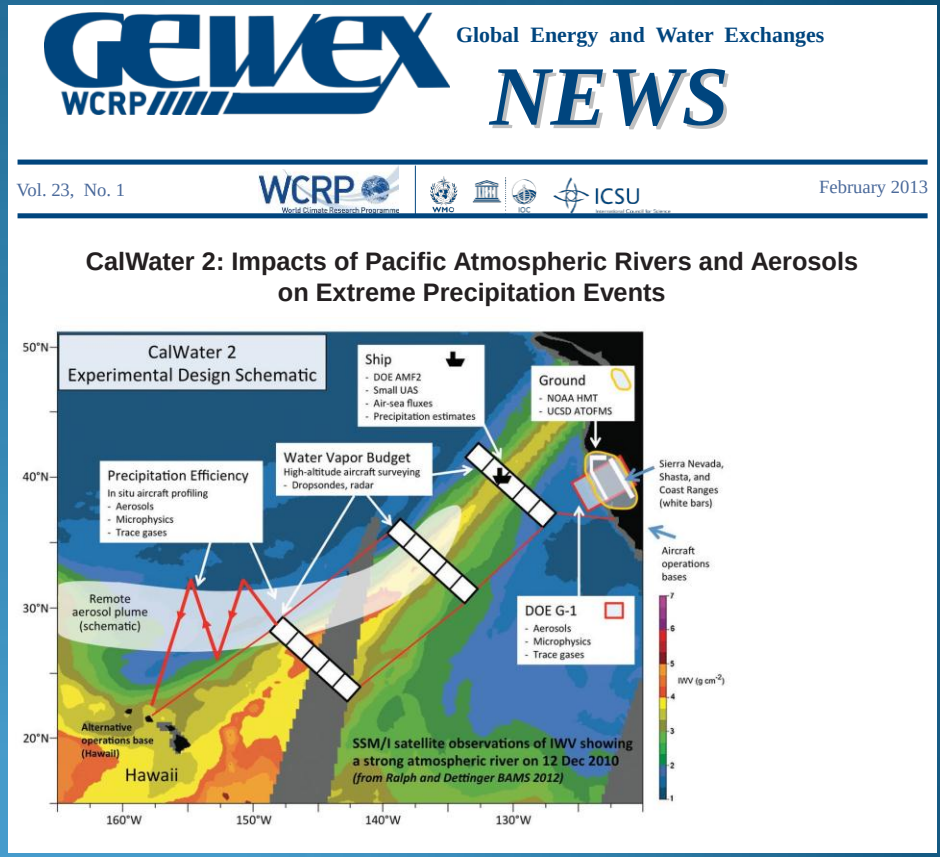
- Guan, B., D. E. Waliser, N. P. Molotch, E. J. Fetzer, P. J. Neiman, 2012: **Does the Madden–Julian Oscillation influence wintertime atmospheric rivers and snowpack in the Sierra Nevada?** *Mon. Weather Rev.*, **140**, 325-342.
- Matrosov, S. Y., 2012: **Observations of wintertime U.S. West Coast precipitating systems with W-Band satellite radar and other spaceborne instruments**. *J. Hydrometeorol.*, **13**, 223-238.
- Moore, B. J., P. J. Neiman, F. M. Ralph, and F. E. Barthold, 2012: **Physical processes associated with heavy flooding rainfall in Nashville, Tennessee, and vicinity during 1-2 May 2010: The role of an atmospheric river and mesoscale convective systems.** *Mon. Weather Rev.*, **140**, 358-378.
- Ralph, F. M., M. D. Dettinger, 2012 (June): **Historical and national perspectives on extreme West Coast precipitation associated with atmospheric rivers during December 2010.** *Bull. Am. Meteorol. Soc.*, **93**, 783-790.
- White, A. B., B. Colman, G. M. Carter, F. Martin Ralph, R. S. Webb, D. G. Brandon, C. W. King, P. J. Neiman, D. J. Gottas, I. Jankov, K. F. Brill, Y. Zhu, K. Cook, H. E. Buehner, H. Opitz, D. W. Reynolds, L. J. Schick, 2012: **NOAA's rapid response to the Howard A. Hanson Dam flood risk management crisis.** *Bull. Amer. Meteorol. Soc.*, **93**, 189-207.
- Zhang, J., Y. Qi, D. Kingsmill, and K. Howard, 2012: **Radar-based quantitative precipitation estimation for the cool season in complex terrain: Case studies from the NOAA Hydrometeorology Testbed.** *J. Hydrometeorol.*, **13**, 1836-1854.

HMT Publications (2013)

- Creamean, J. M., D. J. Suski, D Rosenfeld, A. Cazorla, P. J. DeMott, R. C. Sullivan, A. B. White, F. M. Ralph, P. Minnis, J. M. Comstock, J. M. Tomlinson, K. A. Prather, 2013: **Dust and biological aerosols from the Sahara and Asia influence precipitation in the Western US.** *Science*, Online release.
- Dettinger, M., and Ingram, L., 2013: **The coming megafloods.** *Scientific American*, **308**, 64-71.
- Kingsmill, D. E., P. J. Neiman, B. J. Moore, M. Hughes, S. E. Yuter, and M. Ralph, 2013: **Kinematic and thermodynamic structures of Sierra barrier jets and overrunning atmospheric rivers during a land-falling winter storm in northern California**. *Mon. Weather Rev.*, Online release.
- Matrosov, S. Y., R. Cifelli., and D. Gochis 2013 : **Measurements of heavy convective rainfall in presence of hail in flood-prone areas using an X-band polarimetric radar.** *J. Appl. Meteorol. Clim.*, **52**, 395-407.
- Minder, J. R., and D. E. Kingsmill, 2013: **Mesoscale variations of the atmospheric snow-line over the northern Sierra Nevada: Multi-year statistics, case study, and mechanisms.** *J. Atmos. Sci.*, **70**, 916-938.
- Mizukami, N., V. Koren, M. Smith, D. Kingsmill, Z. Xhang, B. Cosgrove, and Z. Cui, 2013: **The impact of precipitation type discrimination on hydrologic simulation - rain-snow partitioning derived from HMT-West radar-detected bright-band height versus surface temperature data.** *J. Hydrometeorol.*, Online release.
- Ralph, F. M., T. Coleman, P. J. Neiman, R. J. Zamora, and M. D. Dettinger, 2013: **Observed impacts of duration and seasonality of atmospheric-river landfalls on soil moisture and runoff in coastal northern California.** *J. Hydrometeorol.*, Online release.

HMT Future Work (FY13-15)

- Finish HMT-Legacy observing system deployments in California
- Formalize 2nd MOU with CA-DWR
  - Observing network O&M funding
  - Network optimization studies
  - Development of decision support tools
- Begin HMT-SEPS in North Carolina
  - NOAA component FY13-14
  - NASA component FY14
- Formalize amendment to MOU with SCWA
  - AR case studies for reservoir operations
  - Improved QPE for the Russian River Basin
  - Additional rain gauge/soil moisture monitoring sites
  - Benefits analysis
- Implement plans for CalWater 2




Thank you!
HMT
Hydrometeorology Testbed
NOAA