

Hydrometeorology Testbed (HMT) Roundup

Allen White¹, Rob Cifelli¹, Dave Reynolds^{1,2},
Lynn Johnson^{1,3}, Ligia Bernardet^{1,2}, Kelly Mahoney^{1,2},
Dave Novak⁴, Faye Barthold⁴, Seth Gutman¹, and Rich Latatits¹

¹NOAA Earth System Research Laboratory, Boulder, CO

²Cooperative Institute for Research in Environmental Sciences, U. of Colorado, Boulder, CO

³Cooperative Institute for Research in the Atmosphere, Colorado State U., Ft. Collins, CO

⁴NOAA National Weather Service Weather Prediction Center, College Park, MD

Outline

- HMT Overview
 - Mission and organization
 - Why HMT? Ex: QPF skill in extreme events
 - HMT field experiment locations
- HMT-West Legacy
 - Observations
 - NWP
- HMT Southeast Pilot Study (HMT-SEPS)
- WPC-HMT Forecast Experiments
 - 2013 Flash Flood and Intense Rainfall (FFaIR) Experiment
 - 2013 Winter Weather Experiment
- HMT-related Programs
 - CalWater 2
 - Sonoma County Water Agency – Phase II
 - NOAA' Habitat Blueprint
- HMT publications
- Future work



NOAA Hydrometeorology Testbed (HMT)

The 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. 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

HMT Hydrometeorology Testbed

hmt.noaa.gov

New!

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



Tools for Water in a Changing Climate



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

April 1, 2014

Evaluating rainfall measurements over Sonoma County



March 17, 2014

New tool evaluates how well forecast models are predicting precipitation



February 28, 2014

Russian River Hydrologic Modeling Meeting



Major Activity Areas



Quantitative Precipitation Estimates

Developing and prototyping 21st Century methods for observing precipitation



Quantitative Precipitation Forecasting

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



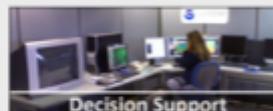
Snow Information

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



Hydrologic Applications

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



Decision Support

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.



Local forecast by "City, St" or Zip Code

City, St

Search WPC

WPC Home

HMT Home

R2O Goals

R2O Activities

Experiment Summaries

Papers and Presentations

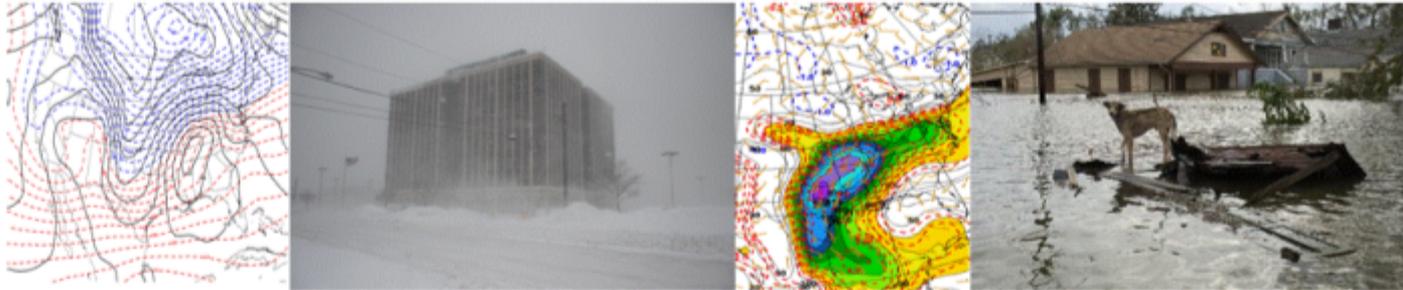
Annual Accomplishments

Partners

Staff



Hydrometeorological Test Bed at WPC



The Hydrometeorological Testbed (HMT) at the Weather Prediction Center (WPC) was established by the National Oceanic and Atmospheric Administration (NOAA) in order to accelerate the assessment and implementation of new technology, research results, and other scientific advancements from the research and development communities to enhance WPC products and services. The HMT-WPC is designed to enhance and extend forecast skill for high-impact weather, especially precipitation, by facilitating interactions among researchers, operational forecasters, and users. Ultimately, project proposals related to this mission will be solicited from both the meteorological and hydrological communities.

Please note that the Hydrometeorological Prediction Center (HPC) [changed its name](#) to the Weather Prediction Center (WPC) on March 5, 2013.

If you are a researcher and would like to work with the HMT-WPC, please read about our [research to operations \(R2O\) goals and objectives](#).

NOAA/ National Weather Service
National Centers for Environmental Prediction
Weather Prediction Center
5830 University Research Court
College Park, Maryland 20740
Weather Prediction Center Web Team
Page last modified: Tuesday, 05-Mar-2013 21:14:44 UTC

[Disclaimer](#)
[Credits](#)
[Glossary](#)

[Privacy Policy](#)
[About Us](#)
[Career Opportunities](#)



HMT Organization

Program Director
Allen White

Management

Science

Field

Transitions

Program Coordination
Richard Lataitis

Science Coordination
Rob Cifelli

Field Coordination
Clark King

Transition Coordination
David Reynolds

Major Activity Areas
(MAAs)

Stakeholder
Groups

Quantitative
Precipitation
Estimation
Rob Cifelli
Ken Howard

Quantitative
Precipitation
Forecasting
Ellen Sukovich
Zoltan Toth

Snow
Information
Allen White
Art Henkel

Hydrologic
and Surface
Processes
Lynn Johnson
Ed Clark

Decision
Support
Tools
MAA Co-Leads
Stakeholders

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)

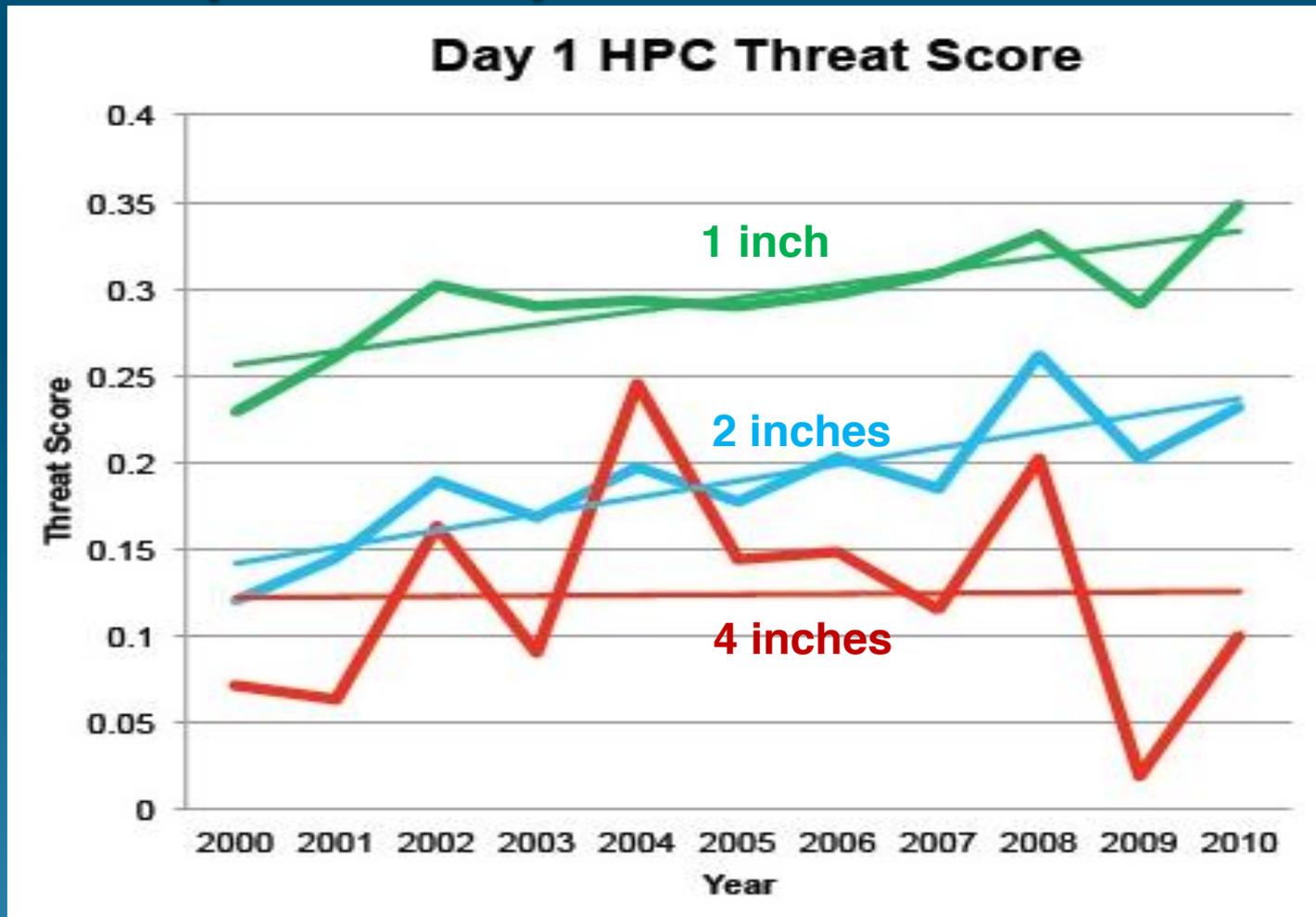
Allen White (OAR/PSD)
Art Henkel (NWS/CNRFC)

TBD

TBD

Why do we need HMT?

Example: Precipitation Forecast Skill

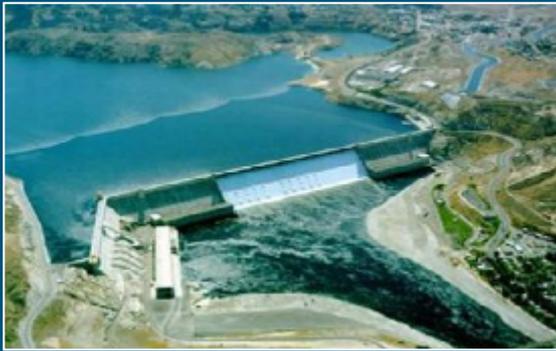


Courtesy Dave Novak, NOAA/NWS/WPC

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.

Who needs accurate and reliable QPFs?



Water Resource Managers



Public



Transportation



Emergency Management



Agriculture

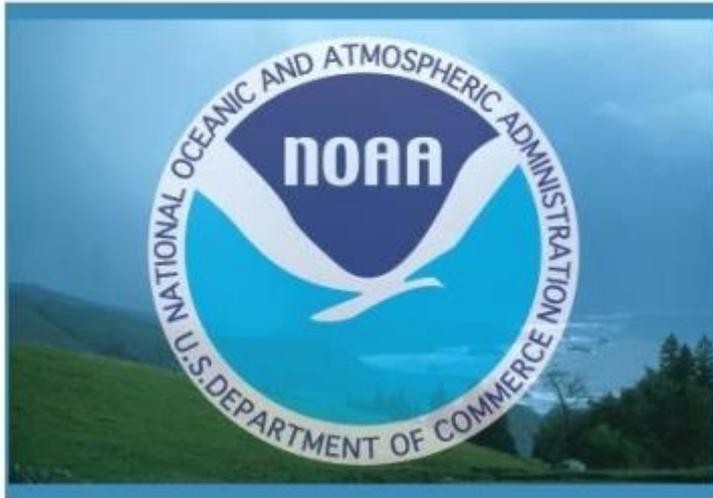
Water is One of NOAA's Five Grand Science Challenges

<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.

A collage of four publications related to water. From top-left to bottom-right: a Newsweek magazine cover titled "LIQUID ASSET" with a picture of a water tap; a National Geographic magazine cover titled "Water" with the subtitle "OUR THIRSTY WORLD" and a picture of a water tap; a Readers Digest magazine cover titled "How Safe Is Our Water?" with a picture of a water tap; and a book cover titled "UNQUENCHABLE" by Robert Glennon with a picture of a water tap. The book cover also has the subtitle "The New Economics of Water: Blue Gold, 'The New Oil'".

Growing Water Challenges

National Imperative

- Protect Life and Property
- Support Economic Security
- Protect Health and Environment
- Mitigate Escalating Risk

Triple Threat

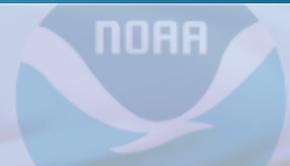
- **Population growth and economic development** are stressing water supplies and increasing vulnerability
- **Climate variability and change** is impacting water availability and quality, increasing uncertainty
- **Aging water infrastructure** is forcing critical, expensive decisions

The New Economics of Water: Blue Gold, "The New Oil"

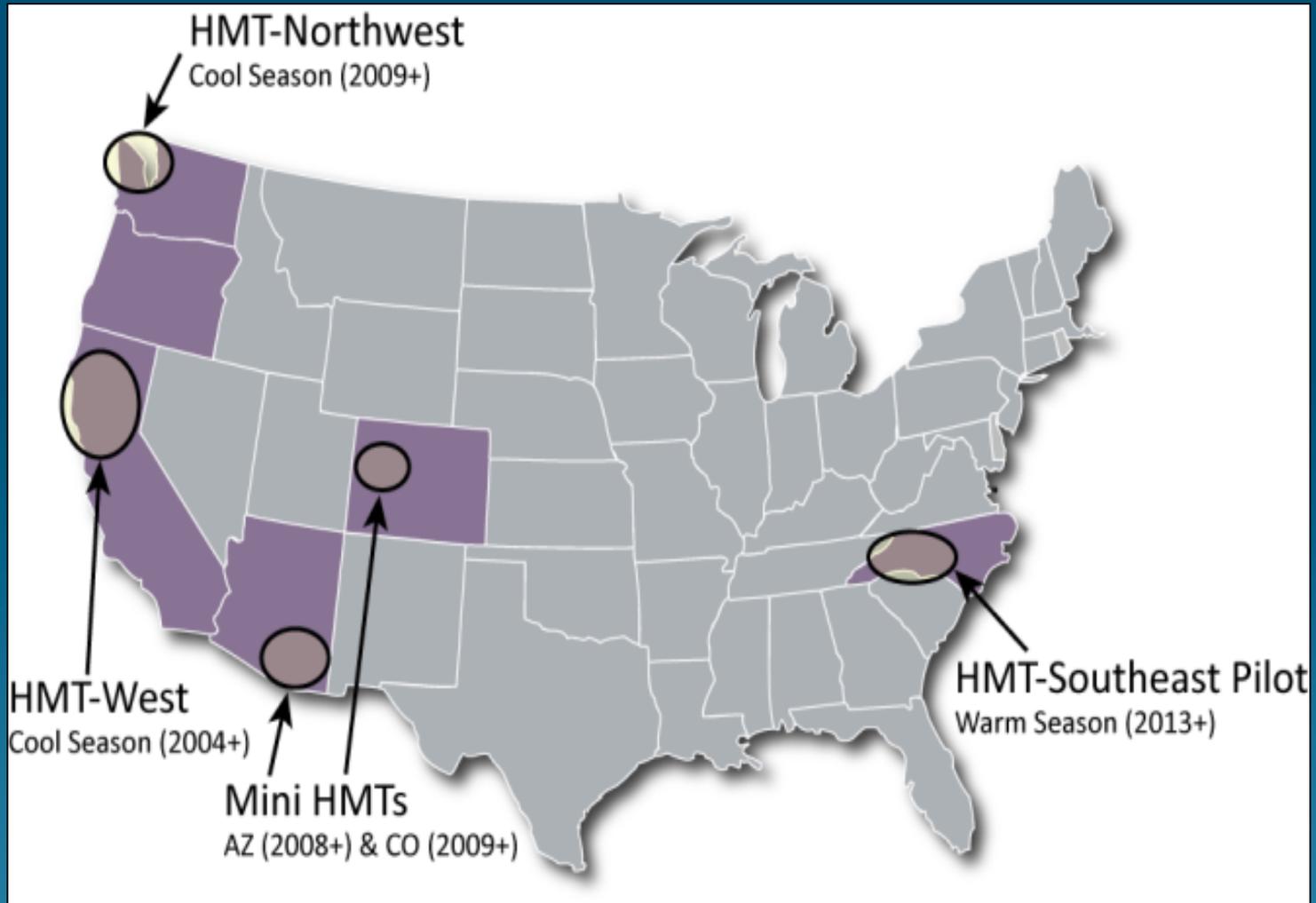
Examples of several key drivers for improved understanding and prediction of the water cycle. (Courtesy Don Cline)

HMT

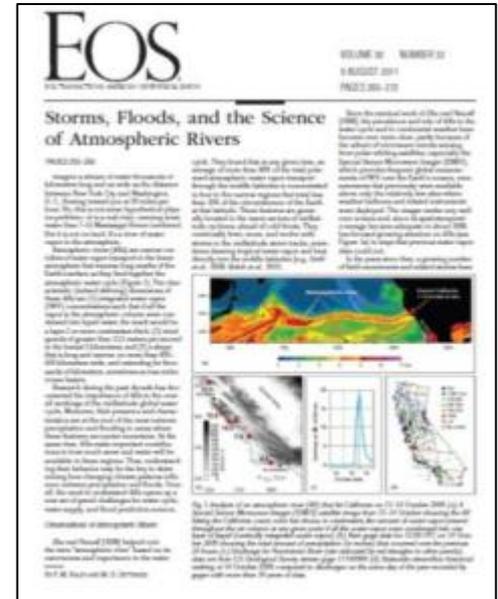
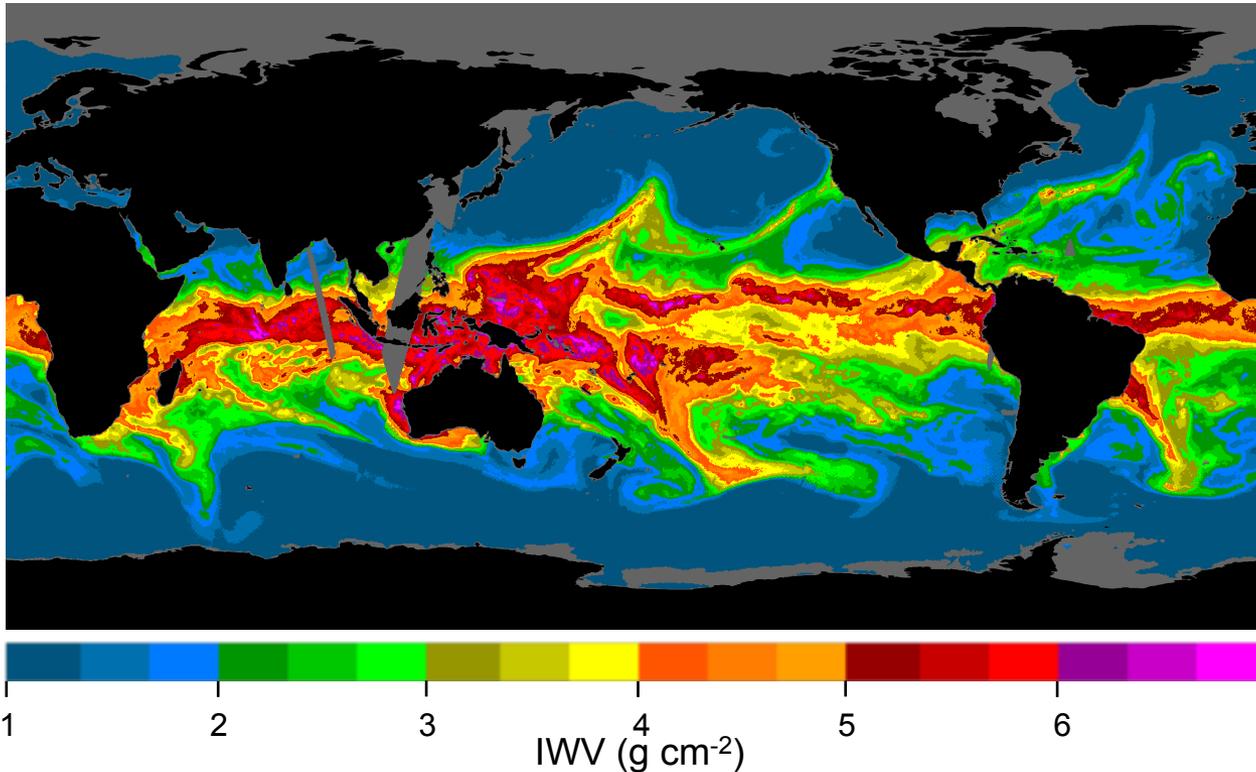
Hydrometeorology Testbed



HMT Field Program Locations



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



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.”

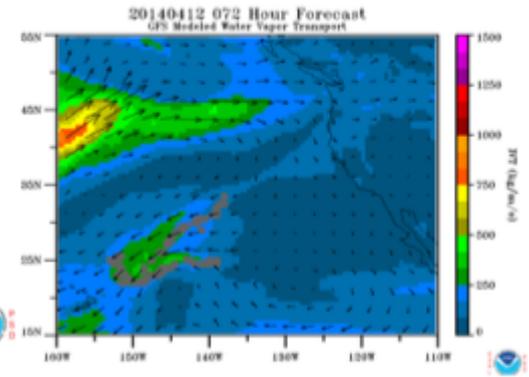
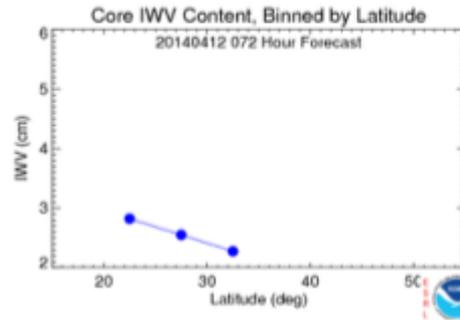
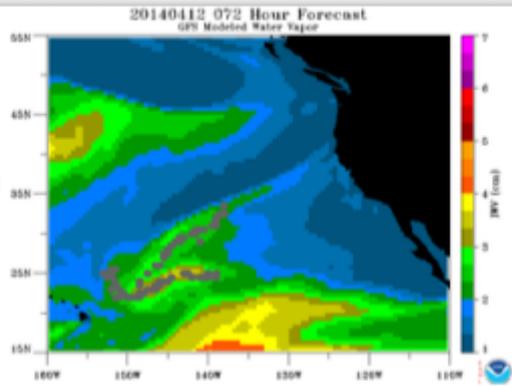
GFS analysis
time out to 7-
day forecast

HMT AR Detection Tool

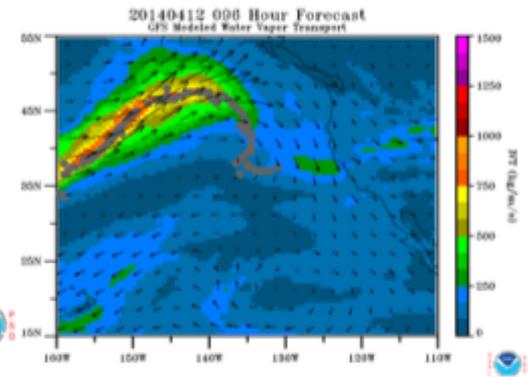
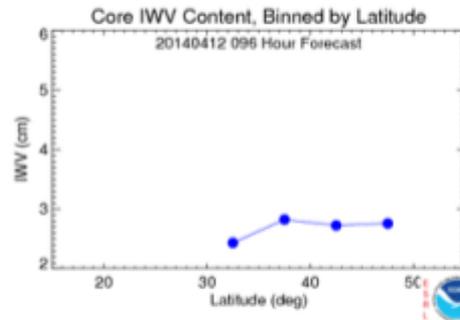
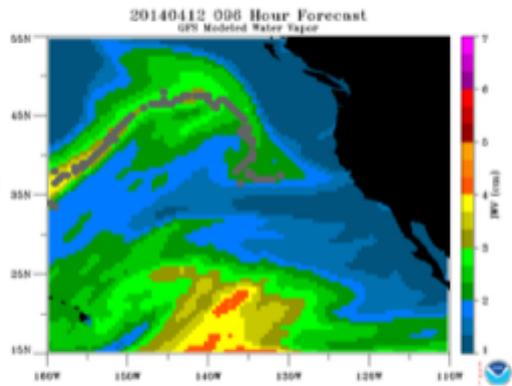
IWV (left)
IVT (right)

http://www.esrl.noaa.gov/psd/psd2/coastal/satres/data/html/ar_detect_gfs.php

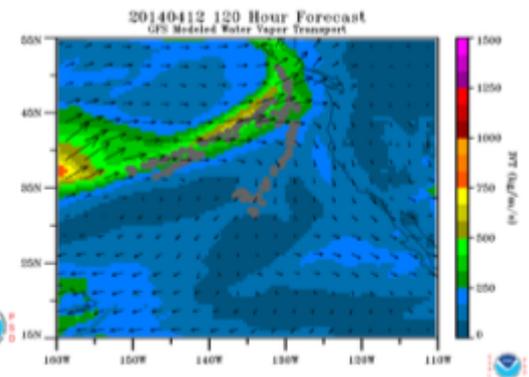
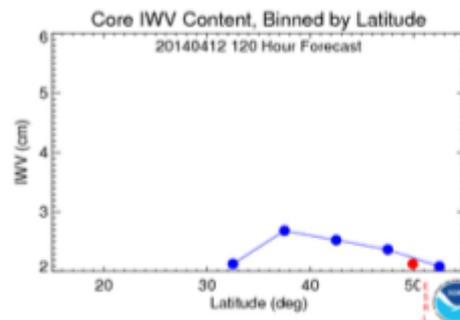
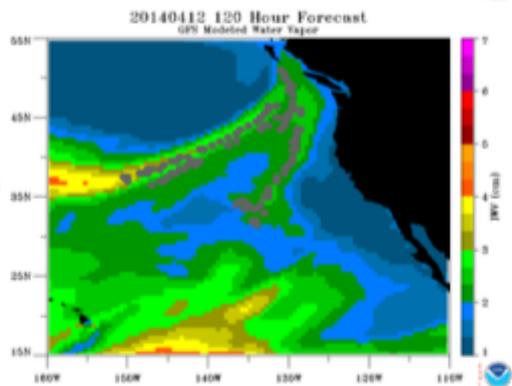
3-Day Forecast Valid
00 Z on 2014-04-15



4-Day Forecast Valid
00 Z on 2014-04-16



5-Day Forecast Valid
00 Z on 2014-04-17



20140412 144 Hour Forecast

See Thursday, 4:30-4:50

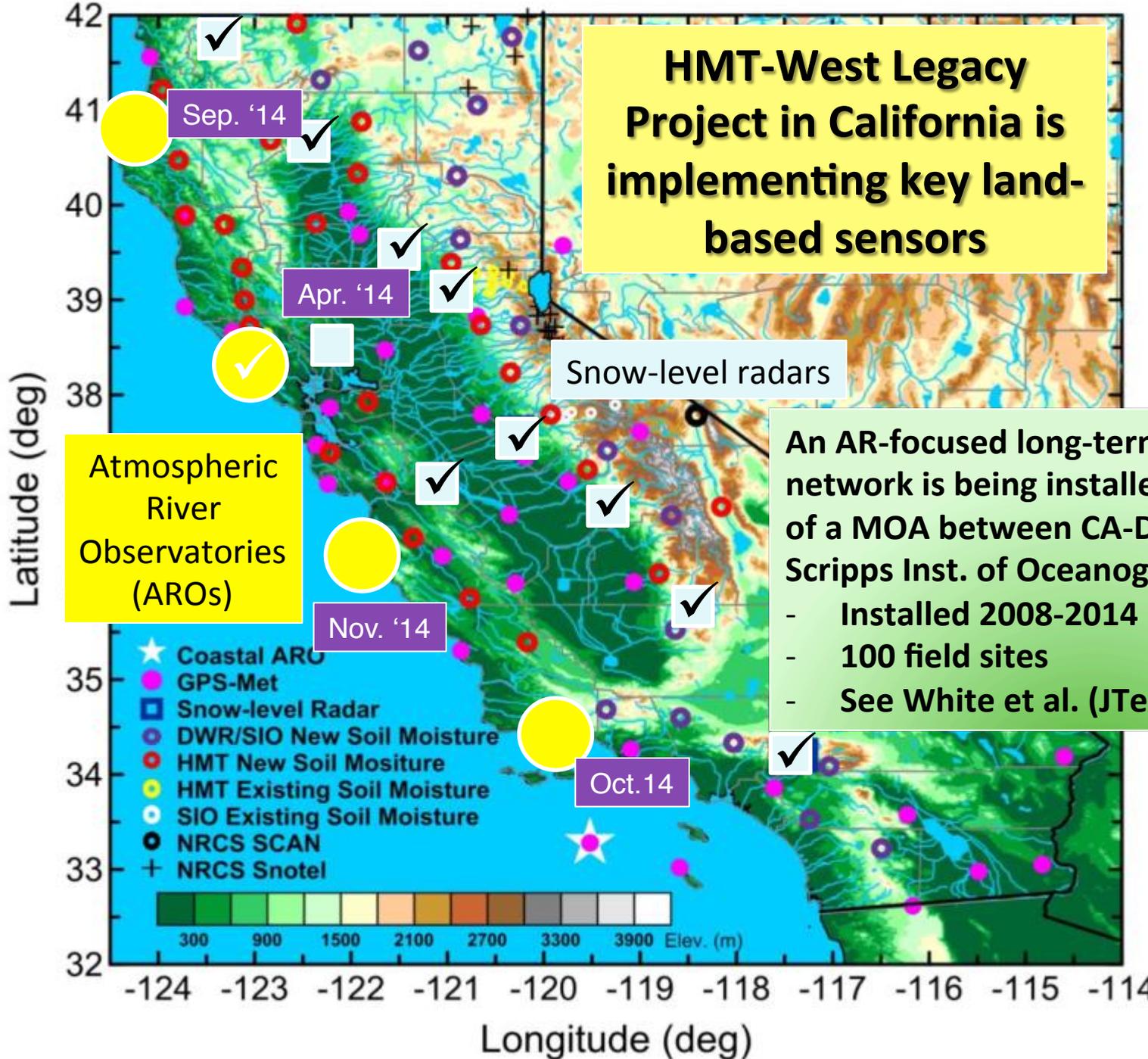
**Application and Extension of the Automated Atmospheric River
Detection Tool in HMT**

Gary A. Wick¹, Darren L. Jackson², and David Reynolds²

¹NOAA/ESRL/PSD, ²CIRES University of Colorado



HMT-West Legacy Project in California is implementing key land-based sensors



Atmospheric River Observatories (AROs)

Snow-level radars

An AR-focused long-term observing network is being installed in CA as part of a MOA between CA-DWR, NOAA and Scripps Inst. of Oceanography

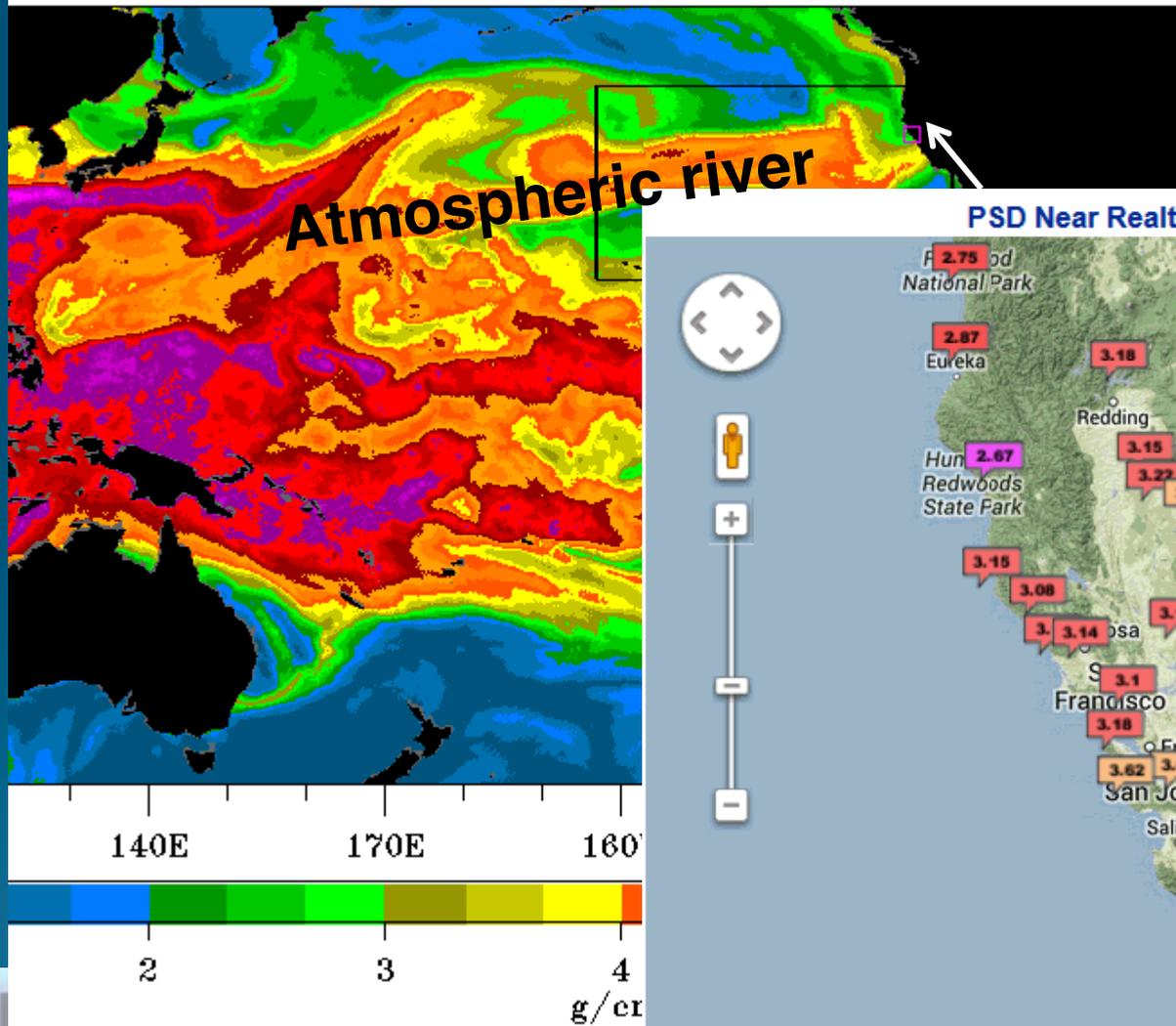
- Installed 2008-2014
- 100 field sites
- See White et al. (JTech, 2013)

HMT-Legacy Network Instrument Function

- **Land-based GPS Sensor** – measure the fuel (water vapor content) carried by the winds as the storm makes landfall.
- **Wind Profilers** – measure the rate at which the fuel is being supplied to generate heavy rain (fuel rate)
- **Snow-level Radar (S-band profilers)** – measure the depth of the atmosphere warmer than freezing. Deeper this layer more moisture is available and the higher the elevation snow will fall in the mtns. Higher snow level more runoff will occur.
- **Soil Moisture Sensor** – measure the moisture content of the soil and calibrate that to field capacity to determine runoff potential.

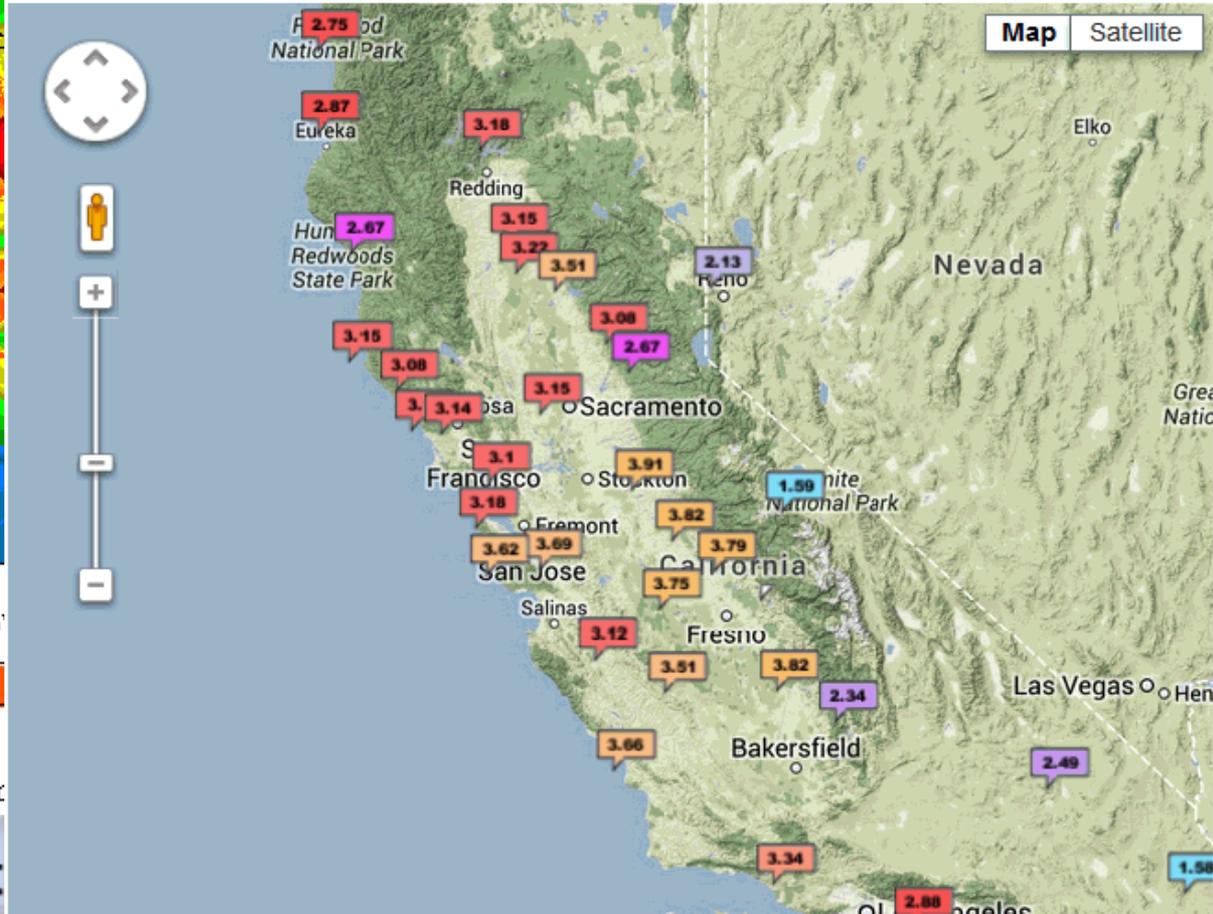
Google Map IWV from GPS Met Stations

June 24, 2013 1200 UTC Preceding 12 Hour
SSMIS Water Vapor (Wentz algorithm)

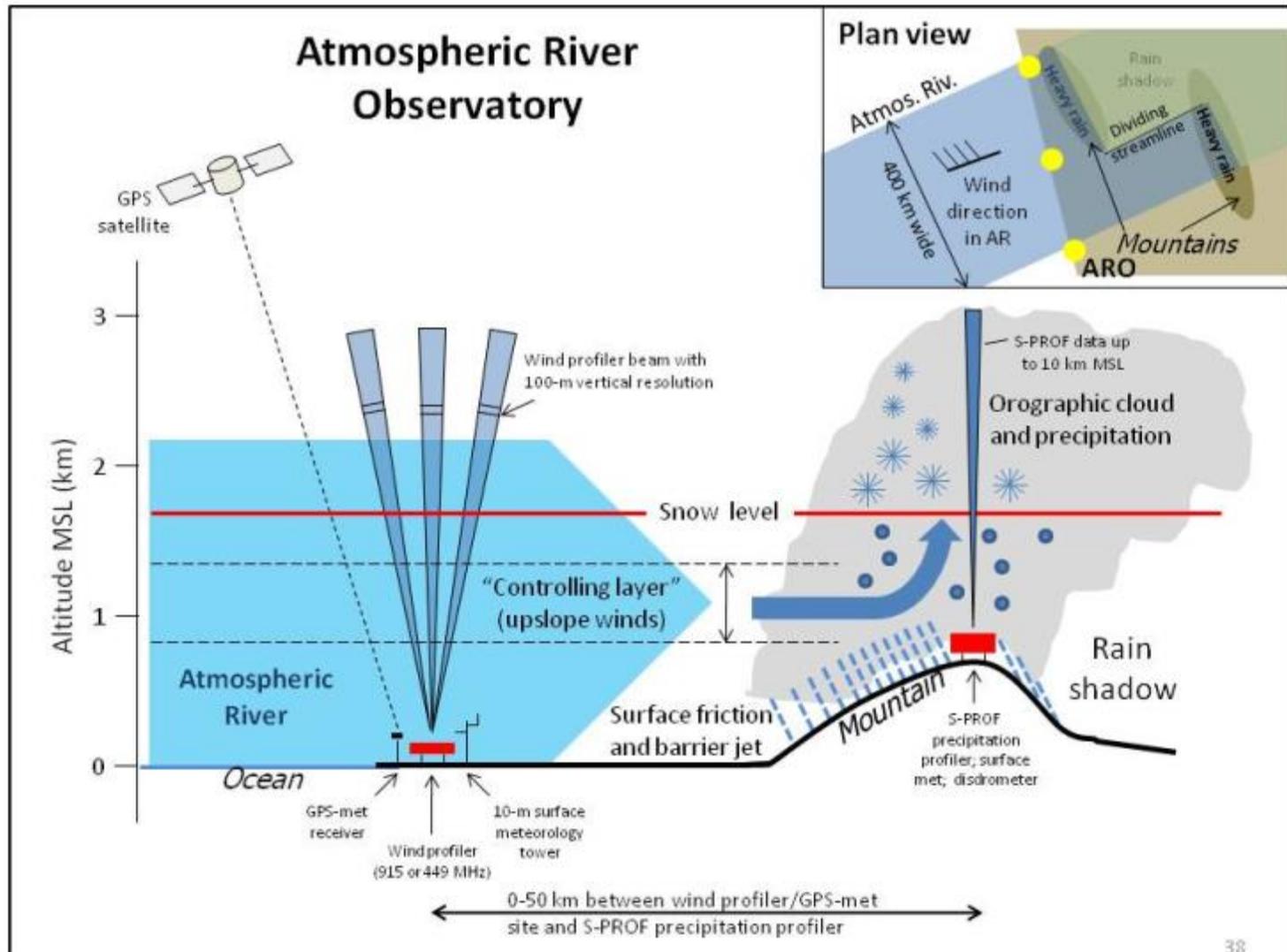


Water vapor obs.
onshore fill gap in
satellite observations

PSD Near Realtime Observations - Map



Atmospheric River Observatories Fill Largest Single Monitoring Gap

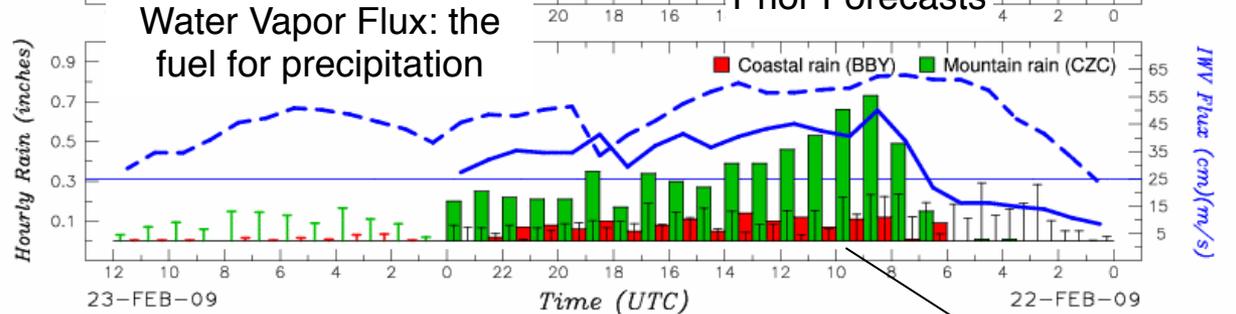
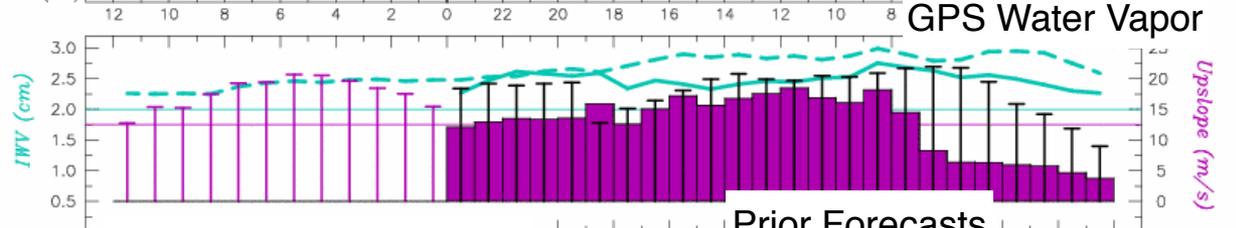
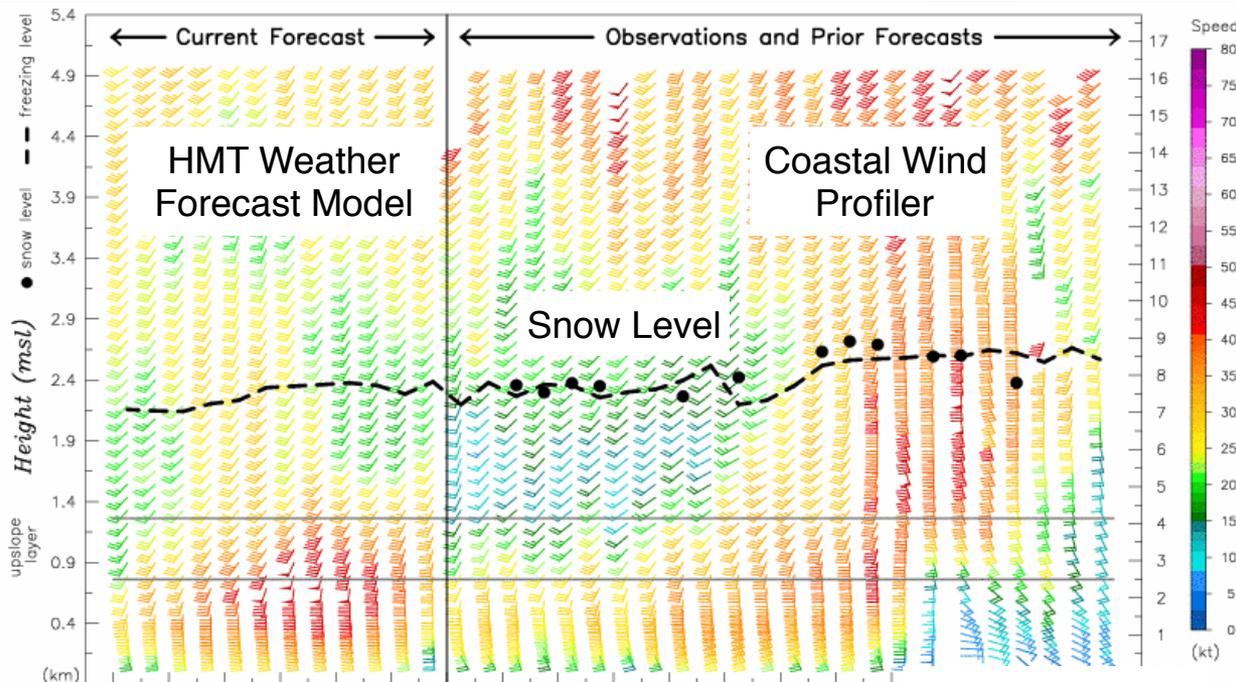


HMT-Legacy Network Atmospheric River Observatory

- ¼-scale 449-MHz wind profiler
- Radio acoustic sounding system
- 10-m surface met. tower
- GPS receiver



HMT Real-time Upslope Water Vapor Flux Tool Display



Bodega Bay, CA (BBY)
38.32 N, 123.07 W, 12 m
Cazadero, CA (CZC)
38.61 N, 123.22 W, 475 m

Upslope Direction = 230 deg
T and -- = Model Forecast
Obs/Fcst Verification: 3 hours
Fcst Init: 23-FEB-09 00 UTC

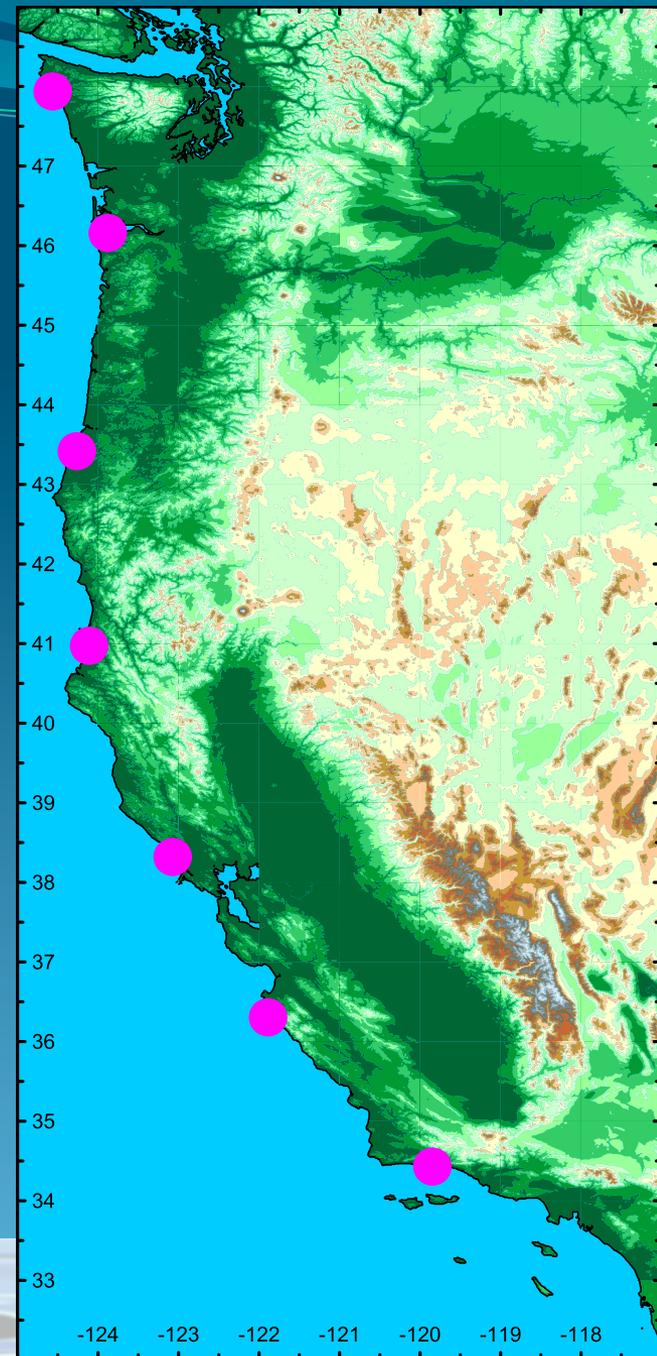
BBY 24-hr obs precip: 1.38 in
CZC 24-hr obs precip: 6.34 in
BBY 12-hr fcst precip: 0.13 in
CZC 12-hr fcst precip: 1.15 in

Coastal and Mtn. Rainfall

Providing forecasters with the critical observations to determine how ARs are impacting the area and how model forecasts are portraying the AR conditions and orographic precipitation enhancement.



CA-DWR and U.S. DOE are jointly supporting a coastal network of seven atmospheric river observatories. This “picket fence” will provide the first line of defense for winter storms that pound the West Coast each year. This network will be completed over the next two years.



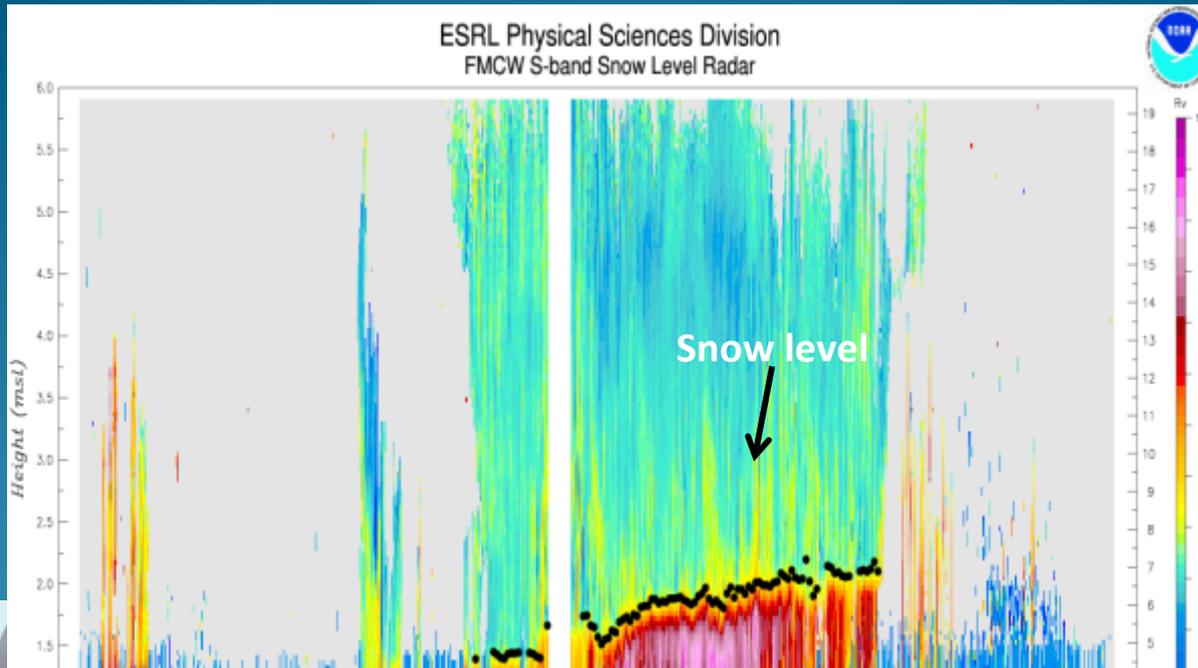
Colfax, CA
Elev. 636 m



Photo by P. Johnston

Snow-level Radar

- Provides proxy snow-level height during precipitation events
- Utilizes proven FMCW technology to substantially lower cost
- **Uses the patented ESRL automated snow-level detection algorithm proven in nationwide field experiments**
- Less than 8' diameter footprint
- Low-power requiring minimal infrastructure

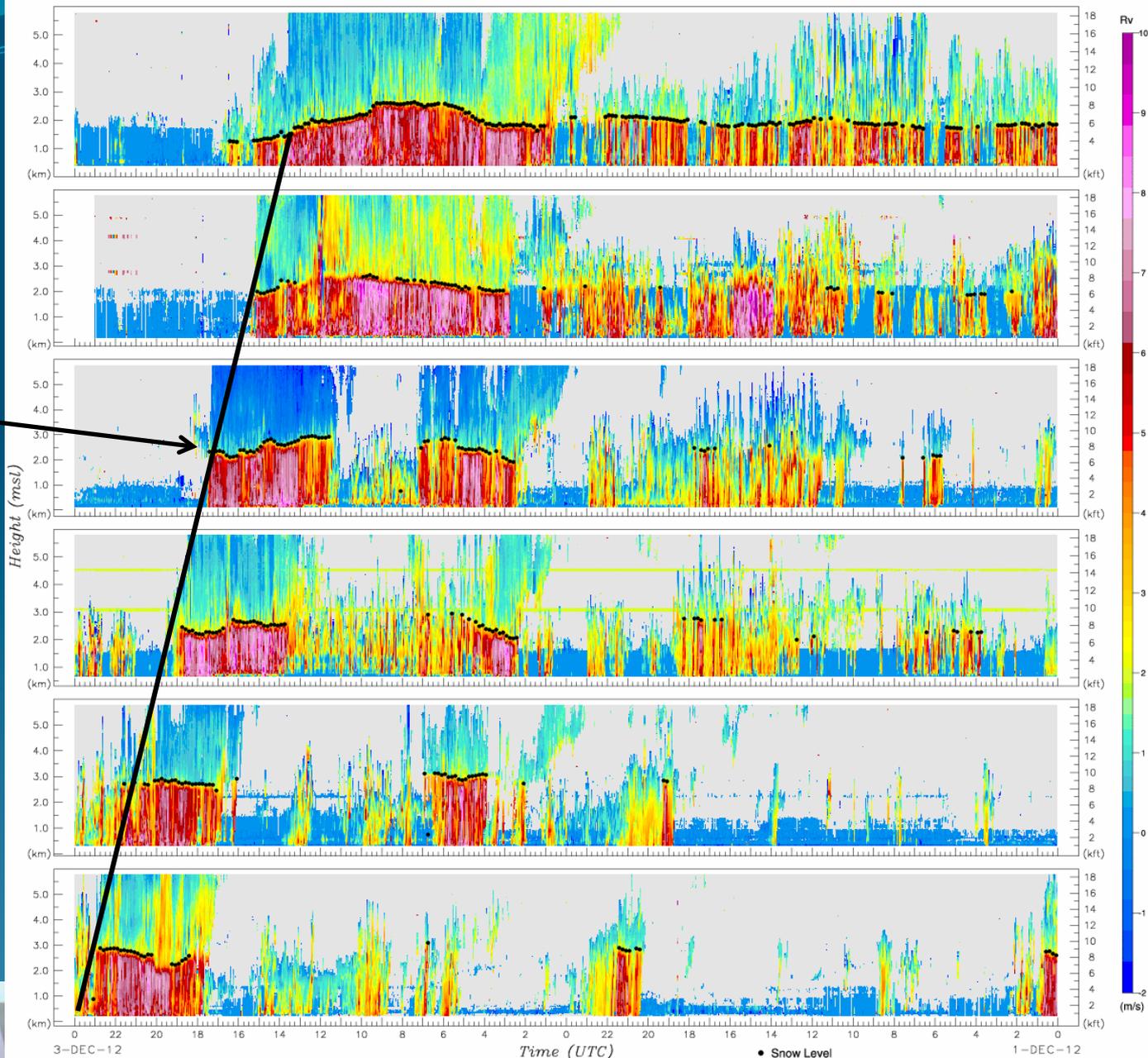


ESRL Physical Sciences Division
FMCW S-band Snow Level Radar



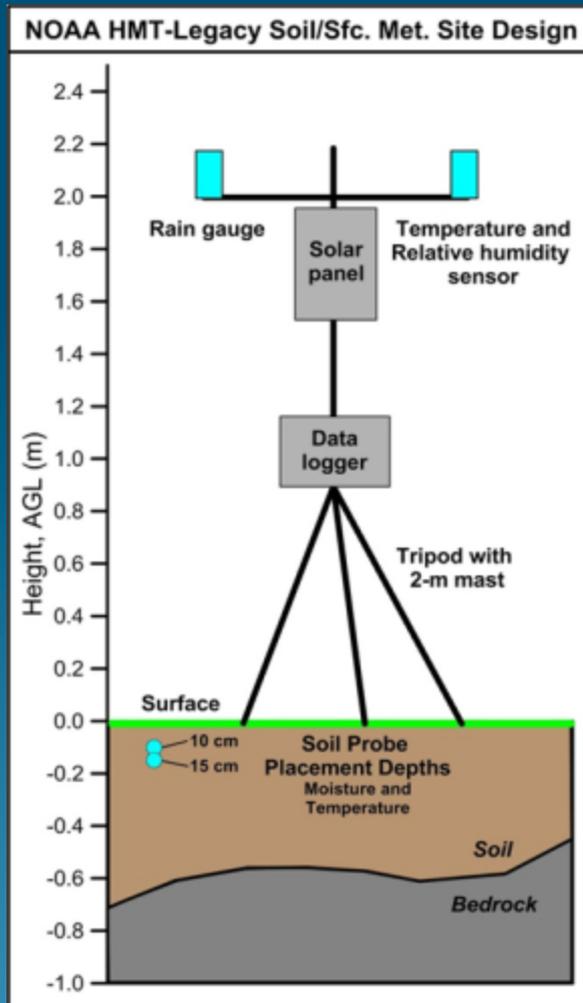
1-2
Dec
2012

~21 kt
motion
allows 3 to
12 hrs
lead time of
front and
cessation of
heavy rain



	Happy Camp, CA (HCP)	Shasta Dam, CA (STD)	Oroville, CA (OVL)	Colfax, CA (CFF)	New Exchequer, CA (NER)	Pine Flat Dam, CA (PFD)
From top to bottom :	41.79 N, 123.39 W, 366 m	40.72 N, 122.43 W, 183 m	39.53 N, 121.42 E, 114 m	39.08 N, 120.94 W, 644 m	37.60 N, 120.28 W, 274 m	36.83 N, 119.31 W, 184 m
Current snow level :	None	None	None	None	None	879 m / 2883 ft

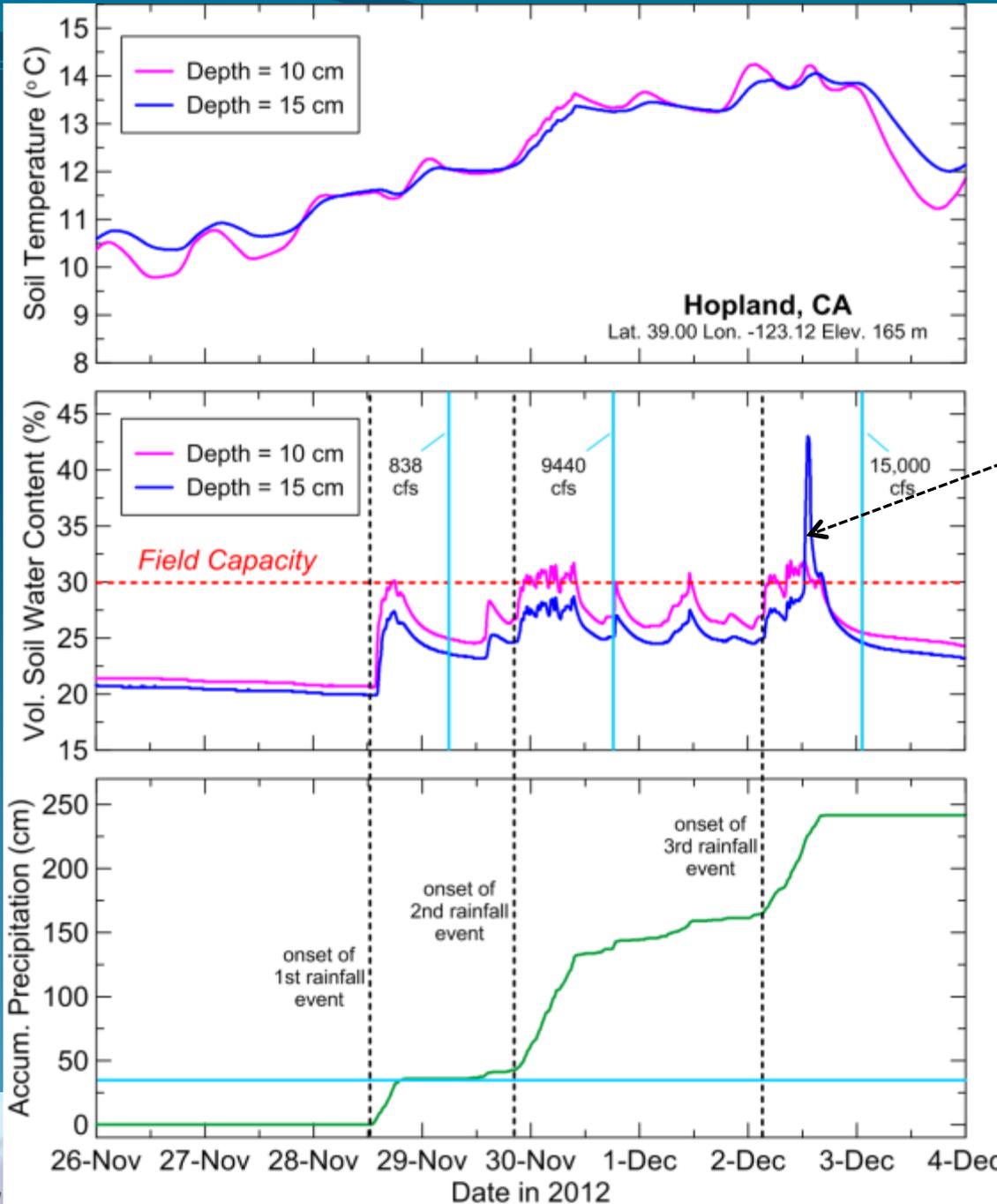
HMT-Legacy Network Soil/Sfc. Met.



- Russian River of NorCal was impacted by three separate precipitation events within a five day period in late Nov. to early Dec. 2012.

- Peaks in Russian River stream flow were observed each time the observed precipitation rate and amount kept the 10 cm soil at field capacity for a period longer than 3 h.

- The 15,000 cfs flow peak that occurred early on 3 Dec. was 0.42 m below flood stage for this location.



Saturation Excess Runoff

See Thursday Poster Session, 2:10-3:30

Using NOAA Hydrometeorological Testbed Soil Moisture Observations in Flood Forecasting

Robert Zamora¹; Rob Cifelli¹; Chengmin Hsu²; Lynn Johnson³; and Allen White¹

¹NOAA Earth System Research Laboratory, Physical Science Division, Boulder, Colorado, USA

²Cooperative Institute for Research in Environmental Sciences, University of Colorado Boulder / NOAA Earth System Research Laboratory, Physical Science Division, Boulder, Colorado, USA

³Cooperative Institute for Research in the Atmosphere, Colorado State University / NOAA Earth System Research Laboratory, Physical Science Division, Boulder, Colorado, USA



Benefit of Expanded Observation Networks Recent Past and Near Future

- Allowed us to begin a climate record of land-falling AR magnitude, duration, relationship to flooding, seasonality.
- Allowed us to define the spatial and temporal resolution needed to monitor extreme rainfall events
- Allowed us to define the critical observations that we need to properly model extreme events - gaps
- Test beds have provided the scientific credibility needed to bridge the research to operations gap - Sustainability – not just a research project...
- Expand capability to all areas in the west.

See Thursday, 12:50-1:10

WRF Microphysics Validation with HMT Observations: Simulations of Winter Storms Impacting the Complex Terrain of Northern California

David Kingsmill^{1,2}, Isidora Jankov^{3,4}, Evelyn Grell^{1,2}, Linda Wharton^{1,4}, Sara Michelson^{1,2}, and Brad Ferrier⁵

¹University of Colorado, Cooperative Institute for Research in Environmental Sciences, Boulder, CO

²NOAA Earth System Research Laboratory, Physical Sciences Division, Boulder, CO

³Colorado State University, Cooperative Institute for Research in the Atmosphere, Fort Collins, CO

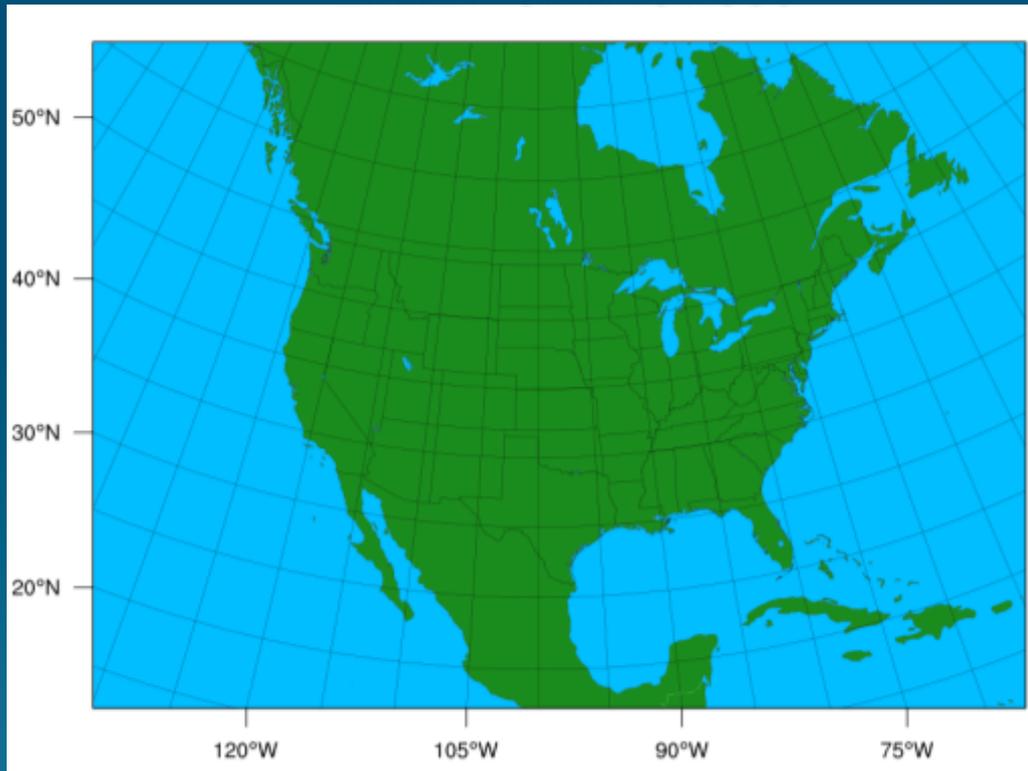
⁴NOAA Earth System Research Laboratory, Global Systems Division, Boulder, CO

⁵NOAA National Centers for Environmental Prediction, Environmental Modeling Center, and IMSG, College Park, MD



Experimental Regional Ensemble Forecast System (ExREF: www.esrl.noaa.gov/exref/)

NOAA ESRL/GSD has run an ensemble for HMT for various years
Since the 2012-2013 winter, the domain became North American

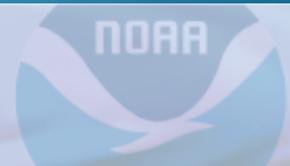


Experimental

- ExREF is a community resource for development and testing of new ensemble techniques
- Configuration can change in response to partners needs
- Runs are conducted on NOAA R&D machines (non-operational)

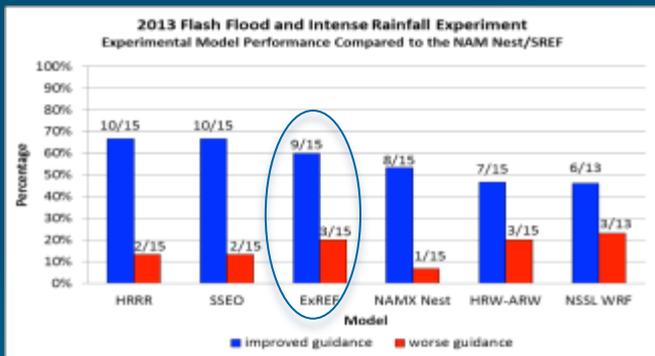
Distribution: STO WFO and CNRFC, WPC, Unidata THREDDS, and new... FirstEnergy Weather (private)

HMT
Hydrometeorology Testbed

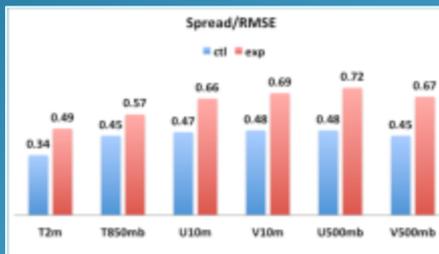
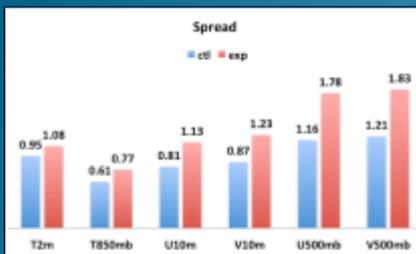


Accomplishments and plans

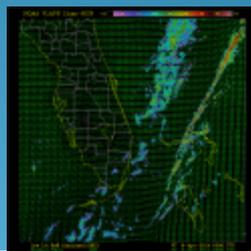
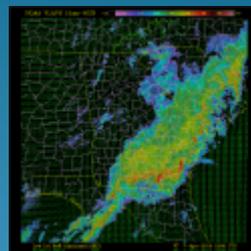
Participation in HMT-WPC Flash Flood and Winter Weather Experiments



Implementation of dynamically downscaled global perturbation in initial conditions



Plans: HIREs (High-Impact Relocatable Ensemble)



Pilot: Single member for HWT 2014 spring experiment

- $\Delta x = 1 \text{ km}$; 800×800

- AL/GA @ 4/7 13 UTC
- GA/FL @ 4/7 21 UTC
- FL @ 4/9 09 UTC

Will be deployed in HWT 2014 Spring Experiment

See Thursday Poster Session, 2:10-3:30

The Experimental Regional Ensemble Forecast System (ExREF)

Ligia Bernardet¹, Isidora Jankov¹, Steve Albers¹, Kirk Holub¹, David Reynolds², T. Workoff³, F. Barthold³, W. Hogsett³, and J. Du⁴

¹NOAA ESRL Global Systems Division, Boulder, CO

²NOAA ESRL Physical Science Division, Boulder, CO

³NOAA NCEP – Weather Prediction Center, College Park, MD

⁴NOAA NCEP – Environmental Prediction Center, College Park, MD

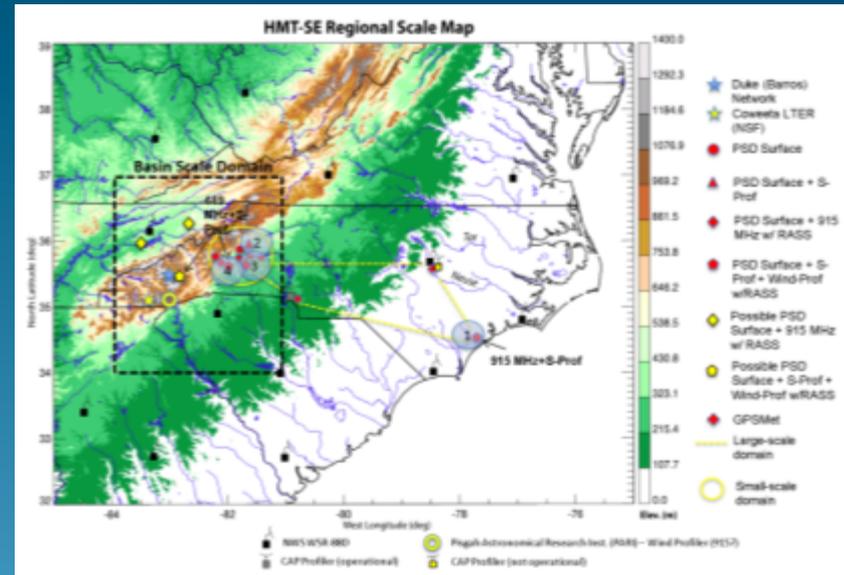


The NOAA Hydrometeorology Testbed Southeast Pilot Study (HMT-SEPS)

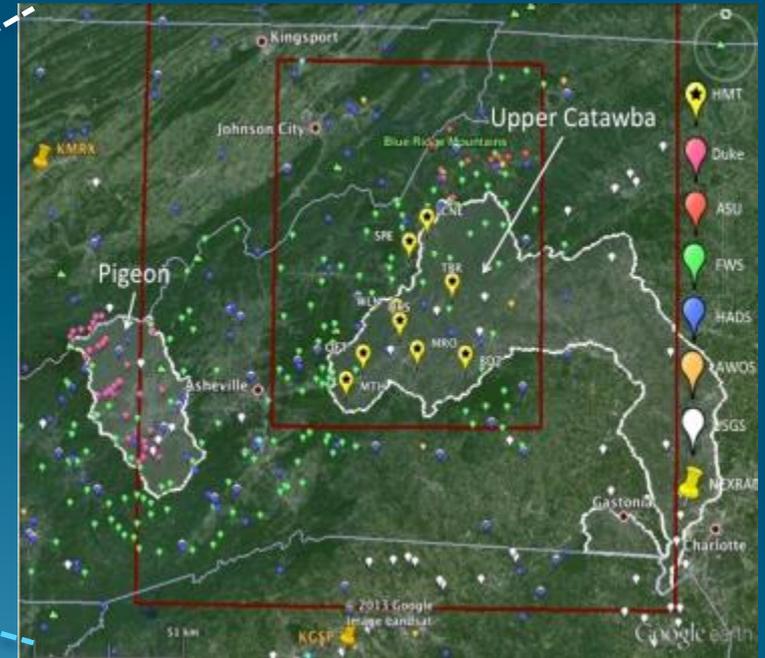
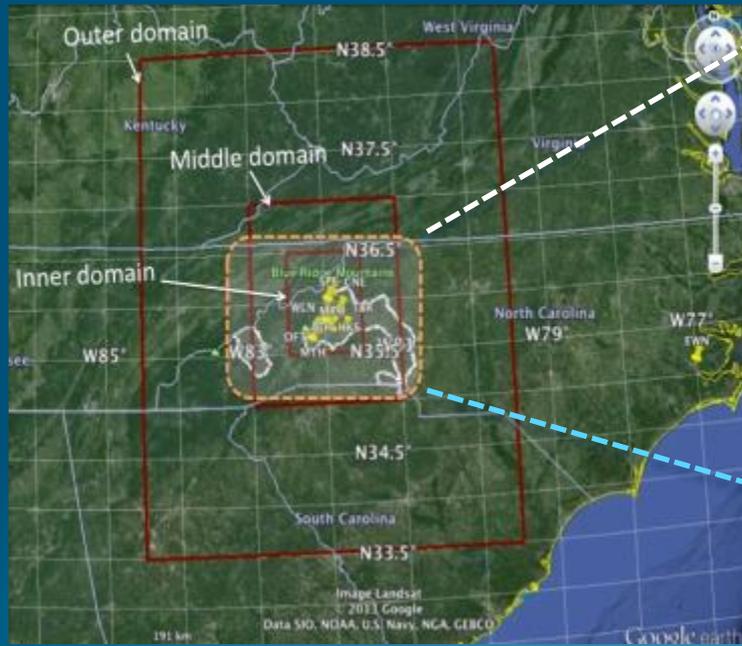


HMT-SEPS Overview

- Planned for May 2013 – September 2014 in western North Carolina (Upper Catawba watershed)
 - Operationally-oriented research on extreme precipitation and forecast challenge identification (QPE and QPF)
- NOAA instrumentation plus leverage additional assets from NASA ground validation campaign
 - (IPHEX) – May-June 2014
- “Pilot study”: Long-term plan, vision uncertain



HMT-SEPS Instrument Deployment



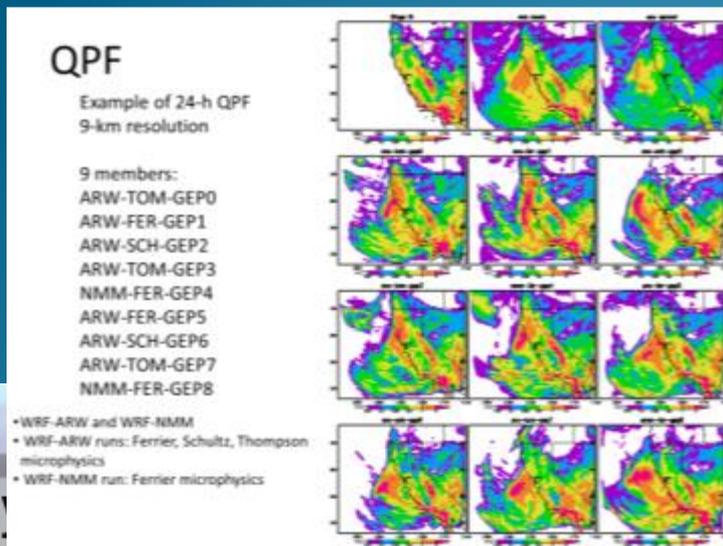
Site Name	Site ID	Elev (m)	449	915	RASS	S-band	Met	Soil Moisture	Parsivel
Brindletown	BDT	355					X	X	X
Crossnore	CNE	1008					X	X	X
Hankins	HKS	379				X	X		X
Marion	MRO	384		X	X		X		X
Mount Hebron	MTH	519					X	X	X
New Bern	EWN	3	X			X	X		X
Old Fort	OFT	421	X		X	X	X		X
Spruce Pine	SPE	833					X	X	X
Table Rock	TBR	356					X	X	X
Woodlawn	WLN	523					X	X	X

- 4 profiler sites and 6 surface meteorology sites
- Additional NASA precipitation gauge and disdrometer added to each surface site

HMT-SEPS QPF Modeling Efforts

- Working closely with the NOAA Global Systems Division HMT-Ensemble modeling system team to distribute increasing amounts of forecast information from their 9-member, 9-km North American Ensemble.
- Working with NWS Eastern, Southern Region Headquarters on what they'd like to use and how to most smoothly get it into AWIPS (and to rest of user community via NOMADS)
- Pursuing improving real-time verification capacity, visibility (of both HMT-Ensemble and operational models; focused on SE ideally)
- Also in planning stages of 3-km Southeast Ensemble Forecast System for FY14
- Open questions involve reliability, utility to forecasters, logistics of getting data to NWSFOs: Is it wanted at all, if so, how much data?

(Example of QPF from 2011 HMT-Ensemble)

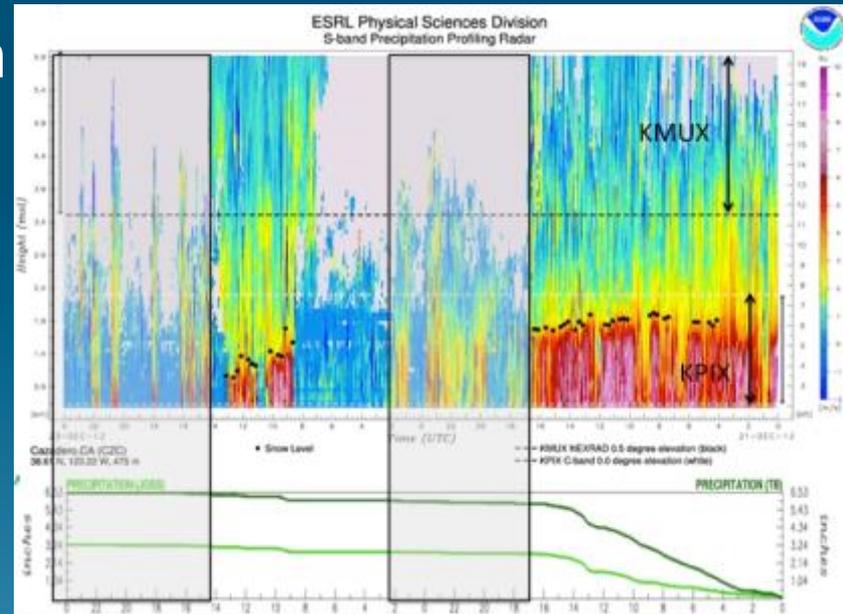


Real-time verification example



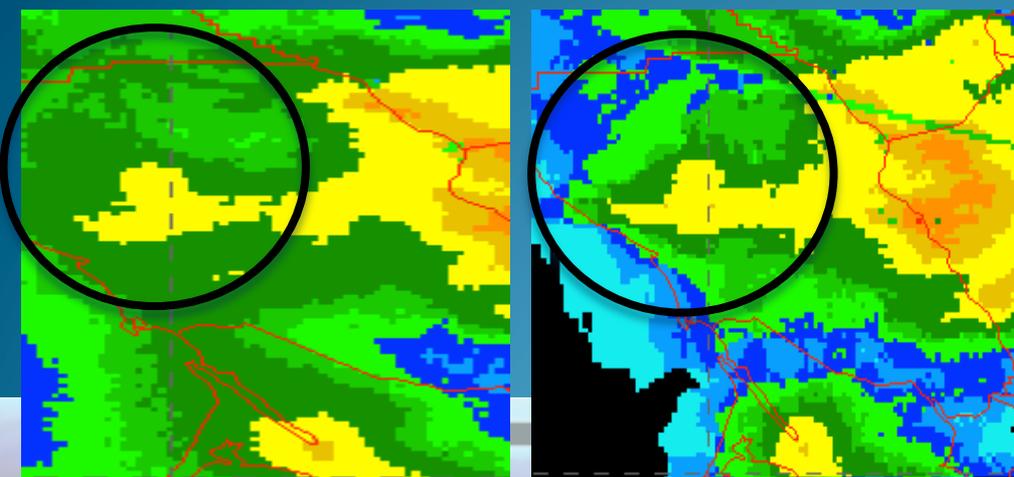
QPE Evaluation in HMT-SEPS

- Similar to QPE evaluation approach in HMT-West
- Gauge, radar, and satellite QPE
 - MRMS
 - MPE
 - SCaMPR
 - CMORPH
 - Others?
- Data fusion development and testing

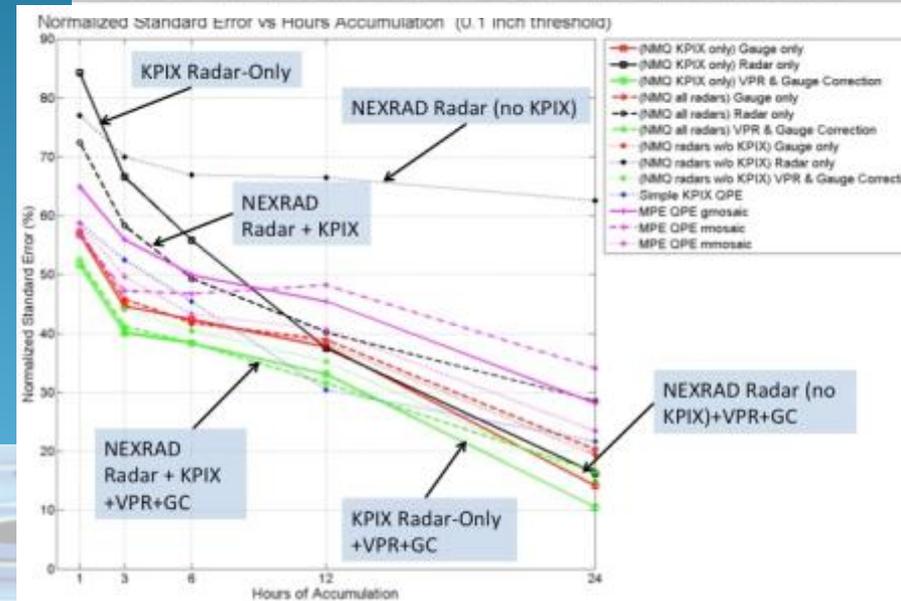


MRMS with KPIX radar

MRMS without KPIX radar



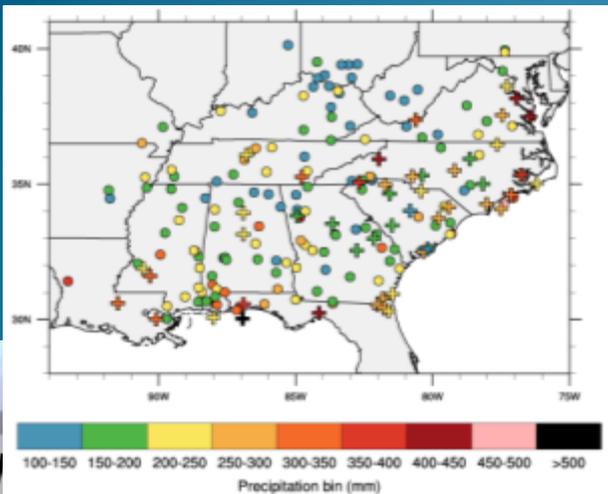
Hydrometeorology Testbed



HMT-SEPS QPF Research

- Extreme precipitation work is not regionally-bound to western NC
- Three main components to date:
 - Southeast US extreme precipitation climatology
 - Extreme event case studies, WRF model sensitivity studies
 - WPC (HPC) QPF verification; linking forecast metrics to event types from climo

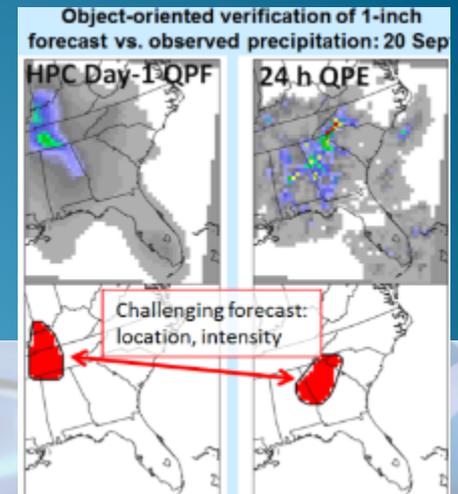
Extreme precipitation event climatology



Extreme precipitation event case studies



QPF verification



See Friday, 8:30-9:30

The NOAA GPM Proving Ground and Hydrometeorology Testbed Southeast Pilot Study

Rob Cifelli, Allen White, NOAA/OAR/ESRL

Ralph Ferraro, Bob Kuligowski, Chandra Kondragunta, NOAA/NESDIS

Pingping Xie, Yu Zhang, Mike Bodner, NOAA/NWS



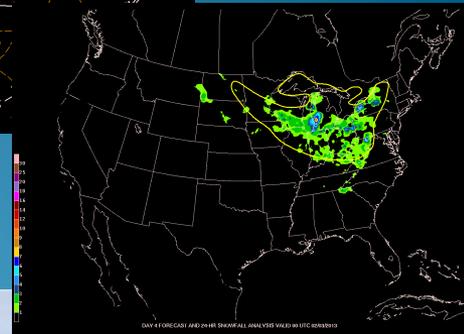
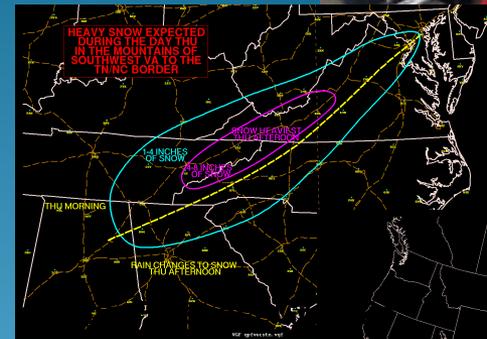
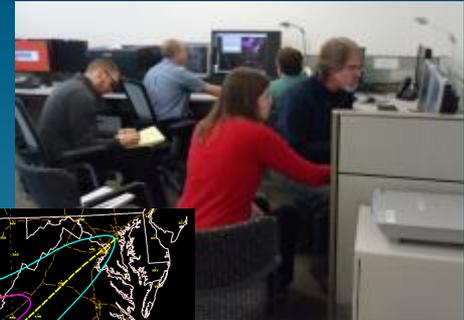
2013 HMT-WPC Winter Weather Experiment

January 15 – February 15, 2013

Explore the use of ensemble systems to better quantify and communicate uncertainty in winter weather forecasts

Explore new techniques for deriving snowfall accumulations from numerical models

- Experiment Activities
 - Probabilistic snowfall forecasts
 - Decision support briefing
 - Day 4-5 winter weather outlook
 - Subjective evaluation
- Lessons Learned
 - Winter weather outlook forecasts are an operational goal*
 - Communicating complex forecast information to Decision makers takes practice
 - Rime factor-modified snowfall accumulation technique appears promising*



See Thursday Poster Session, 2:10-3:30

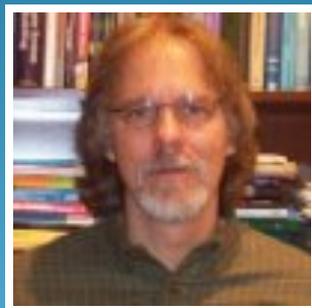
The Development and Testing of a Day 4-7 Probabilistic Winter Weather Forecast at the Weather Prediction Center

Michael J. Bodner¹, Thomas E. Workoff^{1,2}, Faye E. Barthold^{1,3}, Keith F. Brill¹,
Wallace A. Hogsett¹, David R. Novak¹

¹NOAA/NWS/Hydrometeorological Prediction Center, College Park, MD

²Systems Research Group, Inc., Colorado Springs, CO

³I.M. Systems Group, Inc., Rockville, MD

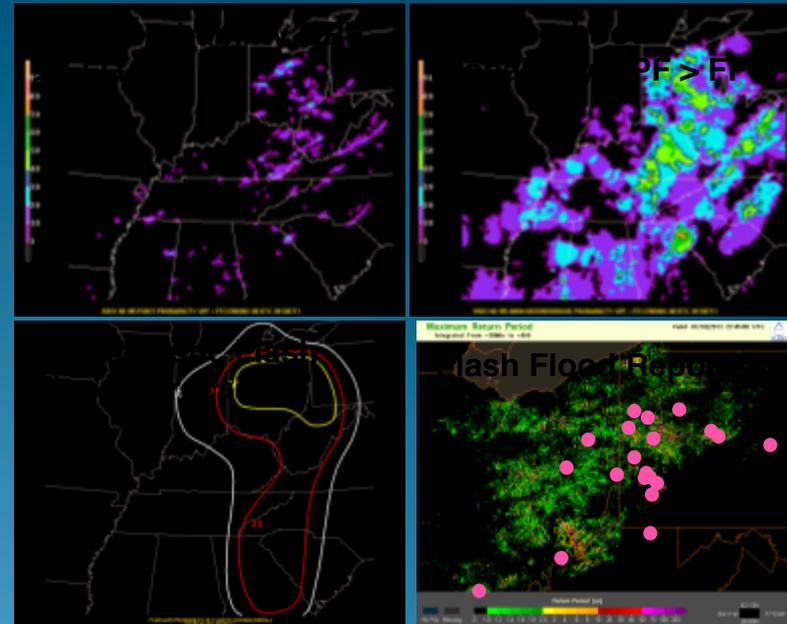


2013 Flash Flood and Intense Rainfall Exp.

July 8-26, 2013

Explore techniques to improve short-term QPF and flash flood forecasts in support of WPC's new MetWatch Desk

- Joint HMT-WPC, NSSL, and ESRL effort
- Experiment Activities
 - Probabilistic QPF and flash flood forecasts
 - Subjective evaluation
- Lessons Learned
 - High resolution convection-allowing guidance is a vital to evaluation of the flash flood threat
 - Gap in understanding exists between the meteorological and hydrologic aspects of flash flood forecasting
 - Neighborhood probabilities of $QPF > FFG$ provide valuable guidance



See Thursday, 1:30-1:50

The Flash Flood and Intense Rainfall Experiment: Lessons Learned and Future Plans

Thomas E. Workoff^{1,2}, Faye E. Barthold^{1,3}, David R. Novak¹, Wallace A. Hogsett¹, Ligia Bernardet⁴, J.J. Gourley⁵, Kelly Mahoney⁶

¹NOAA/NWS/Weather Prediction Center, College Park, MD

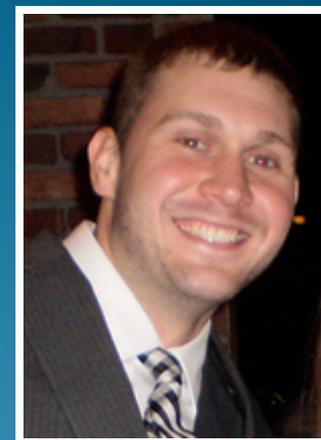
²Systems Research Group, Inc., Colorado Springs, CO

³I.M. Systems Group, Inc., Rockville, MD

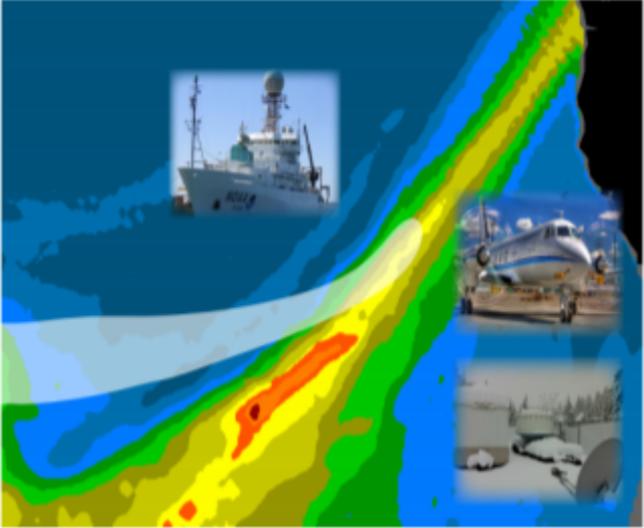
⁴NOAA Earth Systems Research Laboratory/Global Systems Division, Boulder, CO

⁵NOAA/National Severe Storms Laboratory, Norman, OK

⁶CIRES/University of Colorado/NOAA Earth Systems Research Laboratory, Boulder, CO



Key Documentation on CalWater 2



CalWater 2

Precipitation, Aerosols, and Pacific Atmospheric Rivers Experiment

A continuing effort to improve weather and climate prediction systems and develop better decision support tools for water resources management.

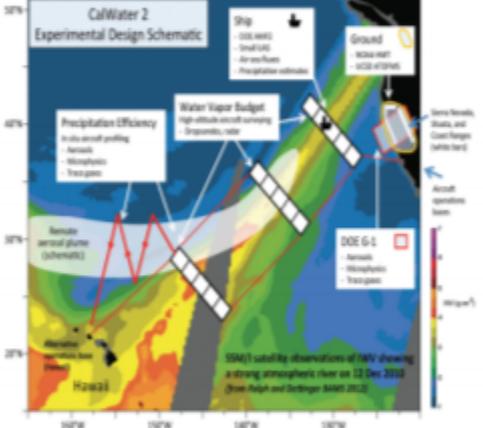
National Oceanic & Atmospheric Administration
U. S. Department of Energy

California Energy Commission
Scripps Institution of Oceanography

GEWEX Global Energy and Water Exchanges
NEWS

Vol. 23, No. 1 WCRP ICSU February 2013

CalWater 2: Impacts of Pacific Atmospheric Rivers and Aerosols on Extreme Precipitation Events



The CalWater 2 observational strategy shown above will employ high- and low-altitude aircraft platforms, a ship equipped with the ARM Mobile Facility 2, a ground-based network that includes the NOAA Hydro-meteorology Testbed assets, and the aerosol time-of-flight mass spectrometer from Scripps Institution of Oceanography. The experimental design is superimposed on SNOF satellite observations from a strong atmospheric river (AR) event discussed in Ralph and Dettiger (2012). An Asian aerosol plume is shown schematically in the context of the AR to conceptualize the sampling strategy for both the AR (structure and water vapor flux losses) and aerosol (profiling in the north and west of the AR) objectives. During such an AR event, the ship would be repositioned along an aircraft transect of an AR to coordinate the observations. As the parent storm moves to the east, the AR would move to the south and east (toward the G-1 research aircraft sampling region in the diagram). See article by Ryan Spangher et al. on page 5. Figure courtesy of Dr. M. Ralph, NOAA Earth System Research Laboratory.

Also Inside

- Commentary by K. Trenberth: *The New Normal* (Page 2)
- New GEWEX SSG Members: Rene Garreaud and Richard Anyah (Page 4)
- 1st GDAP Meeting Highlights Panel Results and Progress on the Integrated GEWEX Data Product (Page 11)

Now Available

Radiative Flux and Global Cloud Data Assessments

About (Page 6)
Results (Page 11)



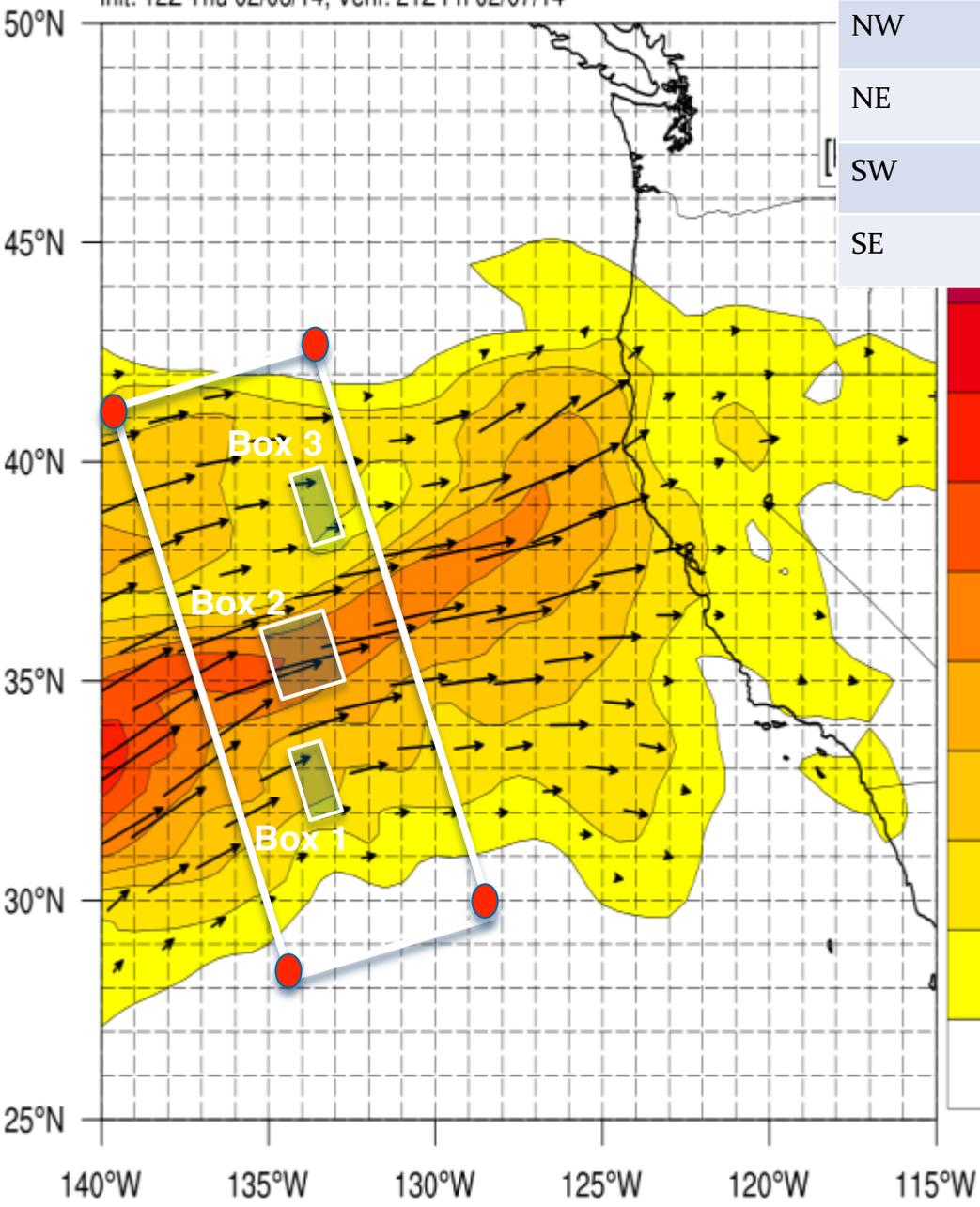
DRA

CalWater 2: Key Science Gaps

- **Evolution and structure of ARs**, including quantifying terms in the water vapor transport budget (air-sea flux, rainout, frontal convergence, entrainment from tropics)
- **Prediction of aerosol burdens and properties** during intercontinental transport from remote source regions to the U.S. West Coast
- **Aerosol interactions with ARs and the impact on precipitation**, including locally generated aerosol effects on orographic precipitation along the U.S. West Coast

NCEP GFS IVT and Vector

Init: 12Z Thu 02/06/14; Verif: 21Z Fri 02/07/14

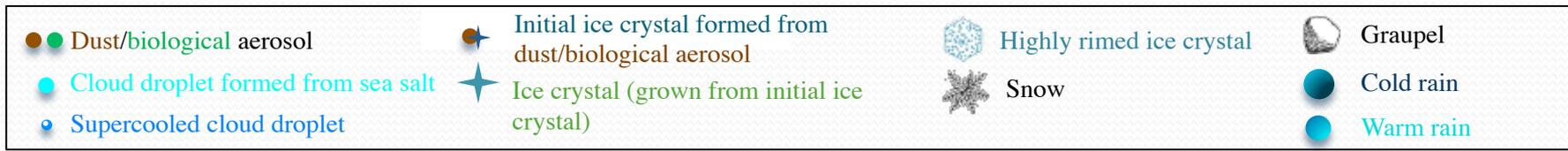
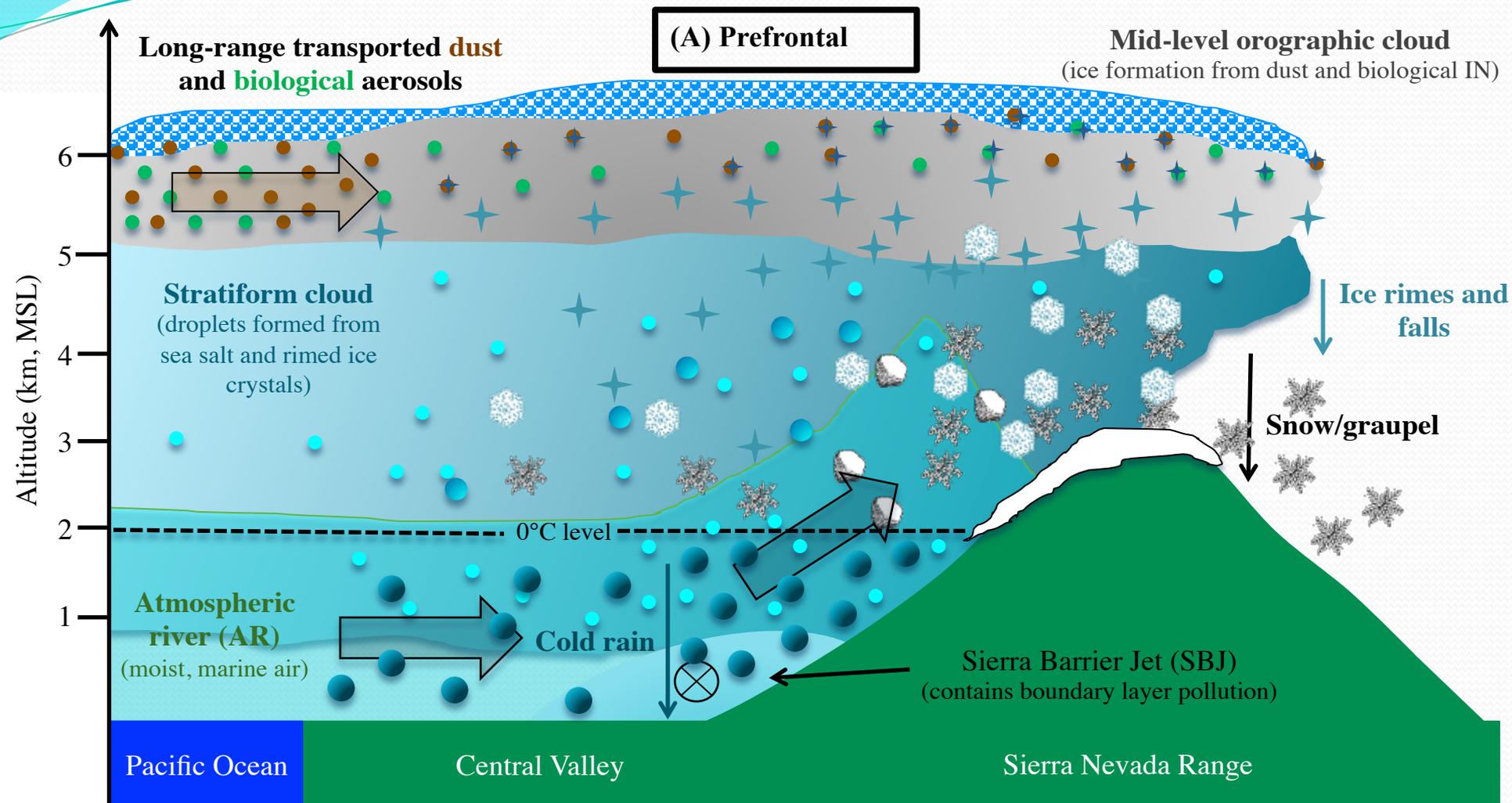


NOTAM Pt	Lat	Lon
NW	41	139
NE	43	133
SW	28	135
SE	30	129

Budget box	Lat	Lon
1 NE	33.6	133.3
1 SE	32.1	132.9
1 SW	31.8	133.9
1 NW	33.3	134.3
2 SW	34.5	134.7
2 NW	36.0	135.1
2 N center	36.3	134.15
2 S center	34.8	133.75
2 SE	35.1	132.8
2 NE	36.6	133.2
3 SW	38.2	133.9
3 NW	39.7	134.3
3 NE	40.0	133.3
3 SE	38.5	132.9

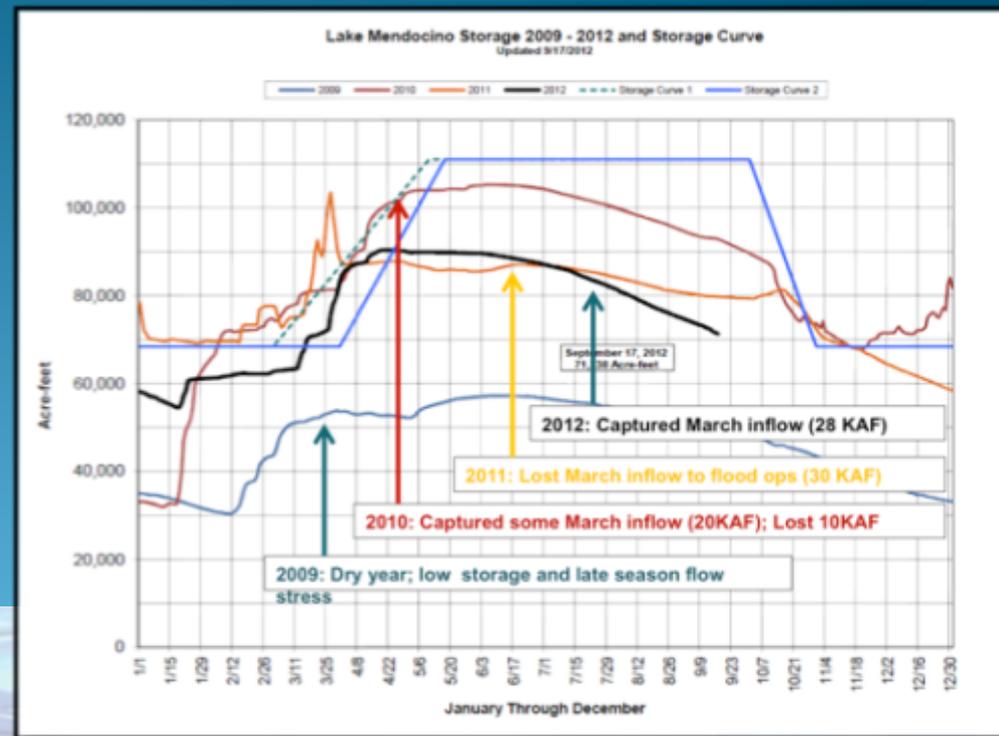
 50 nm X 100 nm box
 100 nm X 100 nm box





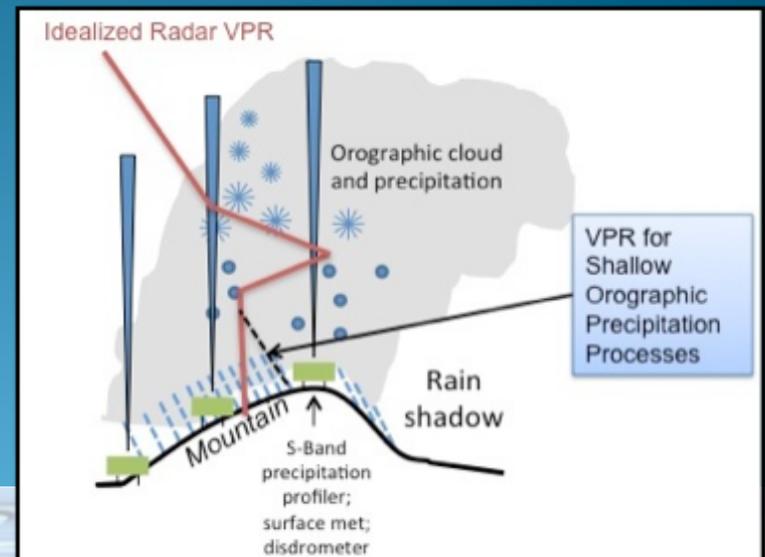
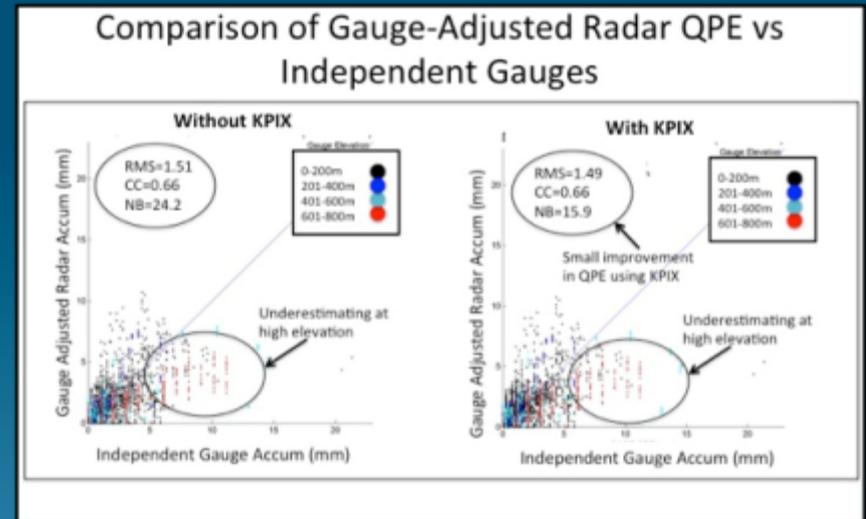
HMT and the Sonoma County Water Agency

- Reservoir operations and benefits
 - Lake Mendocino operated for flood control (winter) and water supply (summer)
 - Can forecast based operations provide increased storage for improved flows during summer time?



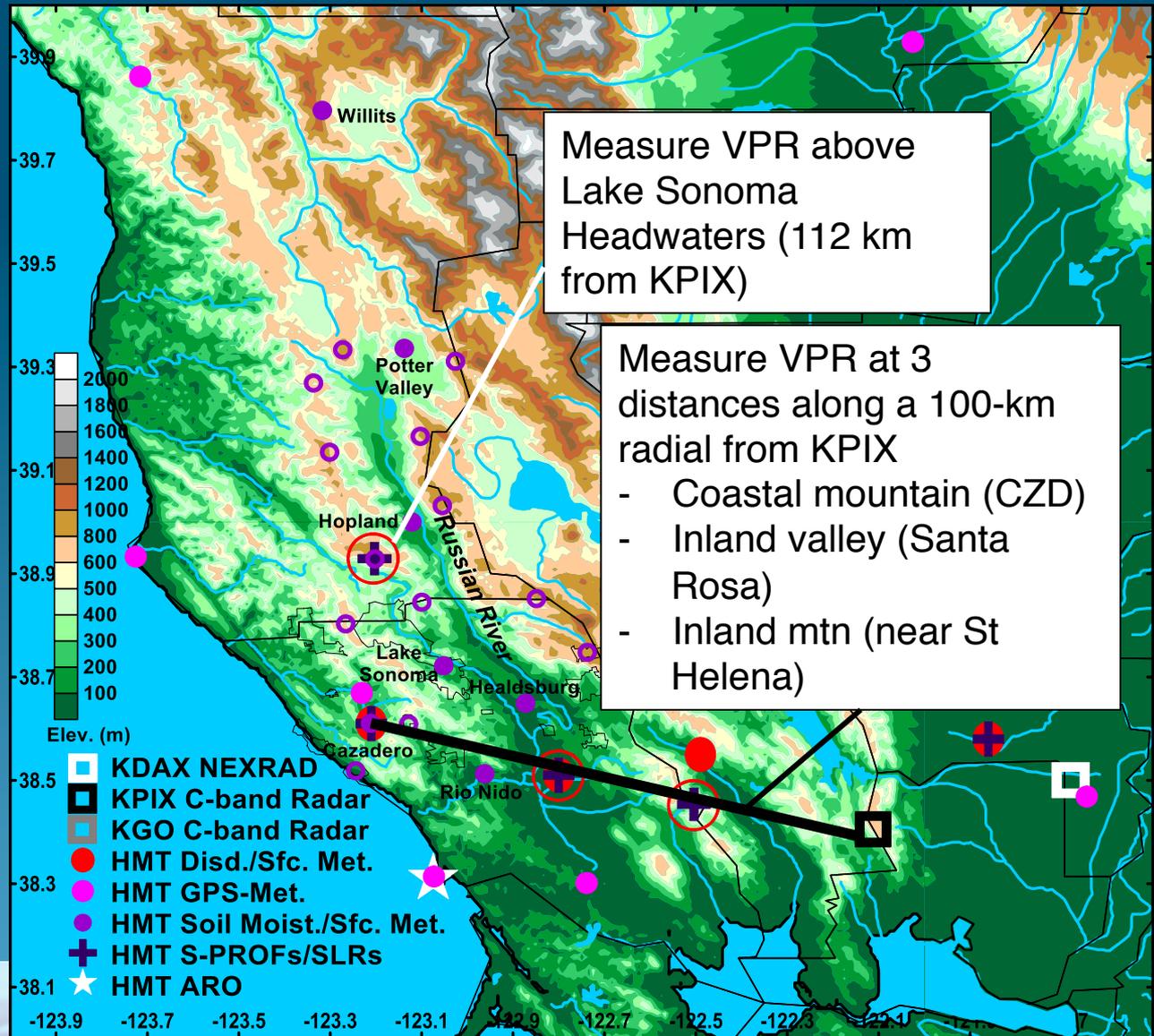
HMT and SCWA

- Quantitative precipitation estimation (QPE)
 - Evaluation of Mountain Mapper precipitation gradients
 - Adaptable vertical profile of reflectivity (VPR) correction in different terrain regions



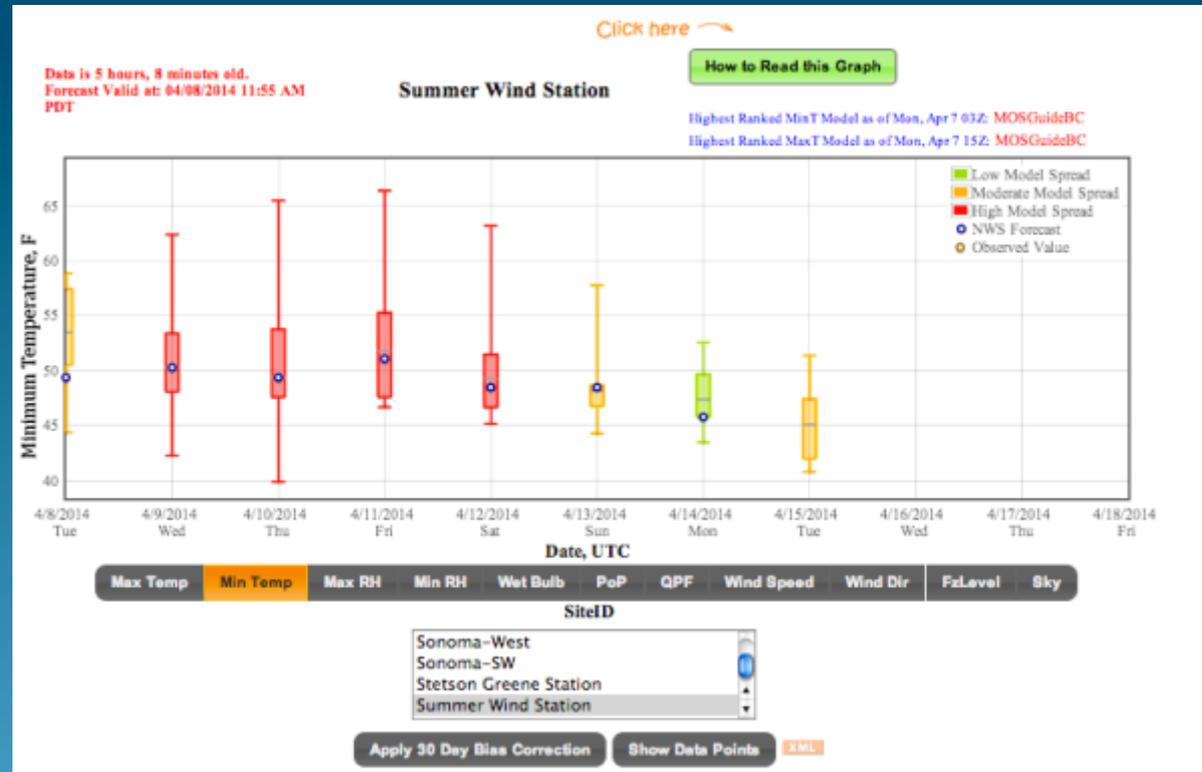
HMT and SCWA

- Observing system deployments
 - Characterization of soil moisture above Lake Mendocino
 - Rain gauge measurements to support Mt. Mapper evaluation
 - Precipitation profilers (S-PROFs) for VPR correction



HMT and SCWA

- Expand frost prediction network
 - Additional winery observations for model bias correction
 - DST development

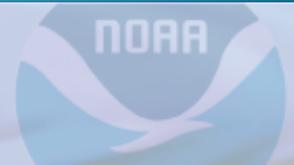


HMT and NOAA's Habitat Blueprint

- NOAA Habitat Blueprint
 - *A framework to improve habitat for fisheries, marine life, and coastal communities*
- California Russian River identified as first Habitat Focus Area
 - Objectives:
 - Rebuild endangered coho and threatened Chinook and steelhead stocks to sustainable levels through habitat protection and restoration.
 - Improve frost, rainfall, and river forecasts in the Russian River watershed through improved data collection and modeling.
 - Increase community and ecosystem resiliency to flooding and drought through improved planning and water management strategies.
 - Five collaboration projects
 - Involves NWS, NMFS, NOS, OAR + local/regional partners
- Russian also serves as a pilot demonstration for IWRSS and NIDIS
 - Ongoing NOAA, ACE, USGS, state, and local synergistic activities to address water resource management issues



HMT
Hydrometeorology Testbed



HMT leads 3 of 5 Top Tier Collaborative Projects

- Improve frost forecasting and protection methods
 - *Provide tool for vintners and water agency to better manage water demands during frost periods and provide more water for fisheries*
- Improve weather and river flow forecasting to maximize water captured for reservoirs and fisheries
 - *Explore benefits of implementing forecast-based operations to manage reservoir releases to support fisheries habitat*
- Characterize Russian River tributary water budget
 - *Develop collaborative hydrologic model to determine current and future flows in Russian tributaries and account for water management activities*



HMT Pulications (2013)

Creamean, J. M., D. J. Suski, D Rosenfeld, A. Cazorla, P. J. DeMott, R. C. Sullivan, A. B. White, F. M. White, P. Minnis, J. M. Comstock, J. M. Tomlinson, and K. A. Prather, 2013: Dust and biological aerosols from the Sahara and Asia influence precipitation in the Western US. *Science*, **339**, 1572-1578. [doi:10.1126/science.1227279](https://doi.org/10.1126/science.1227279)

Kim J., D. E. Waliser, P. J. Neiman, B. Guan, J.-M. Ryoo and G. A. Wick, 2013: Effects of atmospheric river landfalls on the cold season precipitation in California. *Clim. Dyn.*, **40**, 465-474. [doi:10.1007/s00382-012-1322-3](https://doi.org/10.1007/s00382-012-1322-3)

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.*, **141**, 2015-2036. [doi:10.1175/MWR-D-12-00277.1](https://doi.org/10.1175/MWR-D-12-00277.1)

Lim, S., R. Cifelli, V. Chandrasekar, and S. Y. Matrosov, 2013: Precipitation classification and quantification using X-band dual-Polarization weather radar: Application in the Hydrometeorology Testbed. *J. Atmos. Oceanic Technol.*, **30**, 2108-2120. [doi:10.1175/JTECH-D-12-00123.1](https://doi.org/10.1175/JTECH-D-12-00123.1)

Matrosov, S. Y., 2013: Characteristics of landfalling atmospheric rivers inferred from satellite observations over the Eastern North Pacific Ocean. *Mon. Weather Rev.*, **141**, 3757-3768. [doi:10.1175/MWR-D-12-00324.1](https://doi.org/10.1175/MWR-D-12-00324.1)

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. [doi:10.1175/JAMC-D-12-052.1](https://doi.org/10.1175/JAMC-D-12-052.1)

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. [doi:10.1175/JAS-D-12-0194.1](https://doi.org/10.1175/JAS-D-12-0194.1)

HMT Publications (2013, cont'd)

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 brightband height versus surface temperature data. *J. Hydrometeorol.*, **14**, 1139-1158. [doi:10.1175/JHM-D-12-035.1](https://doi.org/10.1175/JHM-D-12-035.1)

Neiman, P. J., M. Hughes, B. J. Moore, F. M. Ralph, and E. M. Sukovich, 2013: Sierra barrier jets, atmospheric rivers, and precipitation characteristics in Northern California: A composite perspective based on a network of wind profilers. *Mon. Weather Rev.*, **141**, 4211-4233. [doi:10.1175/MWR-D-13-00112.1](https://doi.org/10.1175/MWR-D-13-00112.1)

Neiman, P. J., F. M. Ralph, B. J. Moore, M. Hughes, K. M. Mahoney, J. M. Cordeira, and M. D. Dettinger, 2013: The landfall and inland penetration of a flood-producing atmospheric river in Arizona. Part I: Observed synoptic-scale, orographic, and hydrometeorological characteristics. *J. Hydrometeorol.*, **14**, 460-484. [doi:10.1175/JHM-D-12-0101.1](https://doi.org/10.1175/JHM-D-12-0101.1)

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.*, **14**, 443-459. [doi:10.1175/JHM-D-12-076.1](https://doi.org/10.1175/JHM-D-12-076.1)

Ralph, F. M., and coauthors, 2013: The emergence of weather-related test beds linking research and forecasting operations. *Bull. Amer. Meteor. Soc.*, **94**, 1187-1211. [doi:10.1175/BAMS-D-12-00080.1](https://doi.org/10.1175/BAMS-D-12-00080.1)

Wayand, Nicholas E., Alan F. Hamlet, Mimi Hughes, Shara I. Feld, Jessica D. Lundquist, 2013: Intercomparison of Meteorological Forcing Data from Empirical and Mesoscale Model Sources in the North Fork American River Basin in Northern Sierra Nevada, California. *J. Hydrometeorol.*, **14**, 677-699. [doi:10.1175/JHM-D-12-0102.1](https://doi.org/10.1175/JHM-D-12-0102.1)

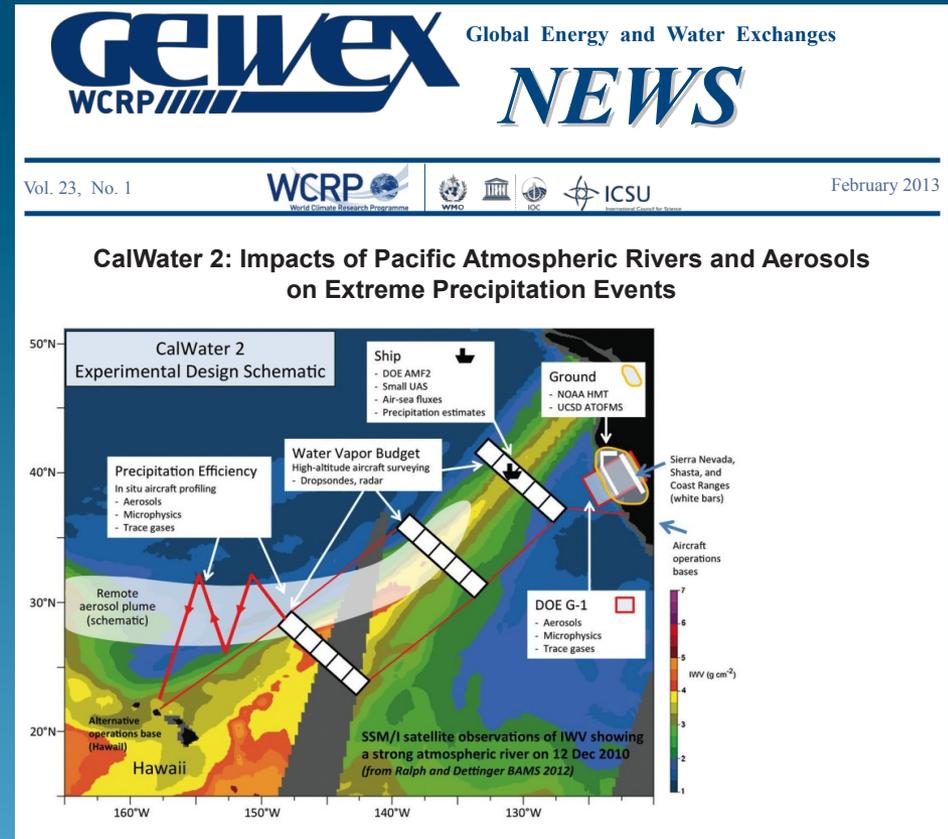
HMT Publications (2013, cont'd)

White, A. B., M. L. Anderson, M. D. Dettinger, et al., 2013: A Twenty-First-Century California Observing Network for Monitoring Extreme Weather Events. *J. Atmos. Oceanic Technol.*, **30**, 1585-1603. [doi:10.1175/JTECH-D-12-00217.1](https://doi.org/10.1175/JTECH-D-12-00217.1)

Wick, G. A., P. J. Neiman, F. M. Ralph, T. M. Hamill, 2013: Evaluation of Forecasts of the Water Vapor Signature of Atmospheric Rivers in Operational Numerical Weather Prediction Models. *Wea. Forecasting*, **28**, 1337-1352. [doi:10.1175/WAF-D-13-00025.1](https://doi.org/10.1175/WAF-D-13-00025.1)

HMT Future Work (FY14-15)

- 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
- Finish HMT-SEPS in North Carolina
 - NOAA component FY13-14
 - NASA component FY14
- Carry out 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 (FY15)
- Coordinate with NMFS on Russian River Habitat Blueprint projects



A blue-tinted landscape featuring a range of snow-capped mountains in the background and a forest of evergreen trees in the foreground. The sky is a clear, deep blue.

Thank you!

HMT
Hydrometeorology Testbed

