NOAA Hydrometeorology Testbed (HMT)

Research on Extreme Precipitation Supporting Water Resources in a Changing Climate

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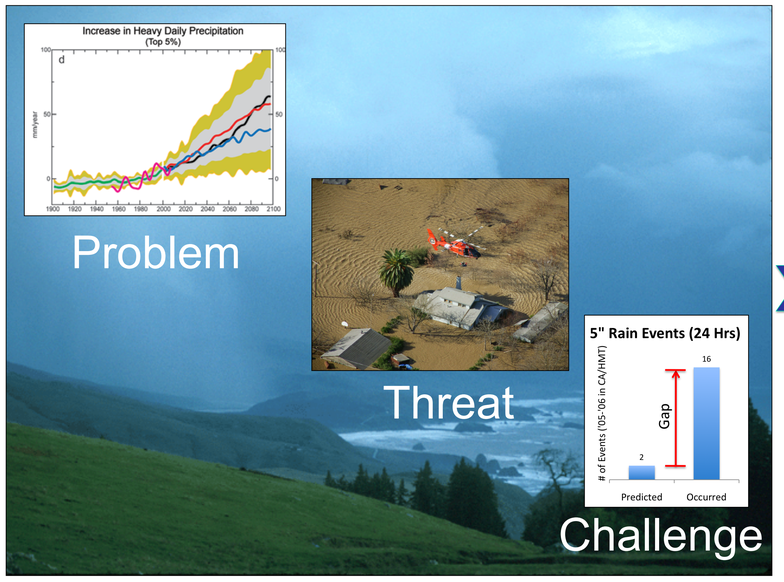
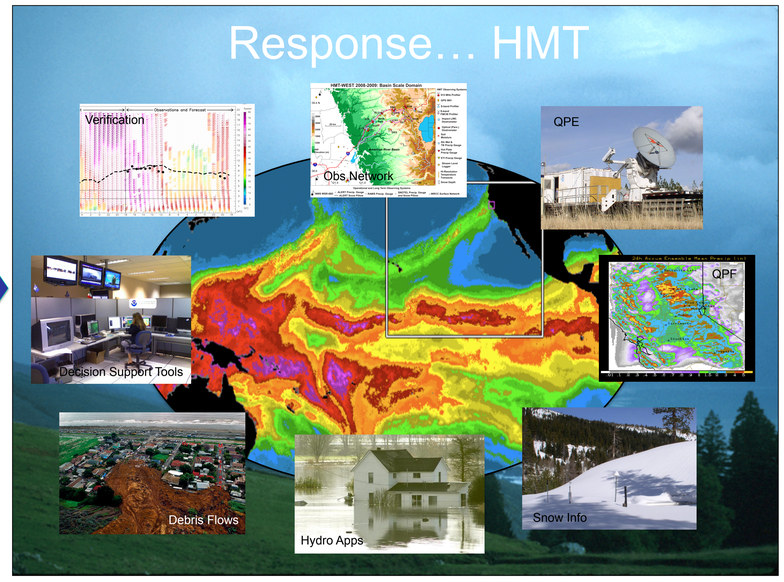


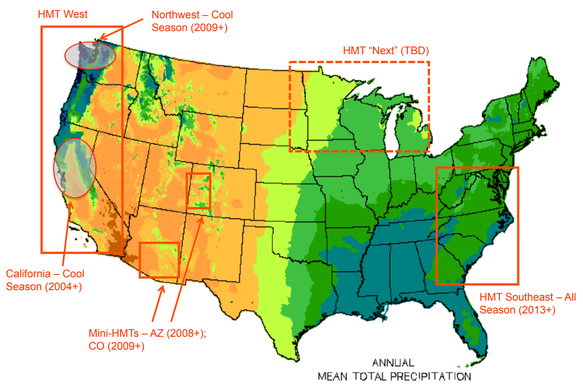
Water and a Changing Climate...

"Within the United States, extensive climate-related changes have been documented over the last century. These include increases in continental-average temperatures, rising sea levels in many coastal locations, an increased frequency of extreme heavy rainfall events, lengthening of the growing season, earlier snowmelt, and altered river flow volumes. Water is an issue in every region, but the nature of the potential impact varies. Drought is a serious problem in many regions, especially in the West and Southeast; and floods and water quality problems are likely to be amplified by climate change in most regions."

– Dr. Jane Lubchenco, NOAA Administrator



A National Testbed Strategy



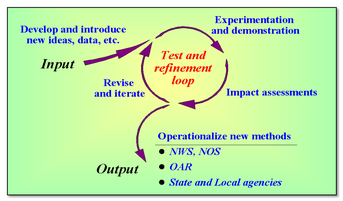
Partnerships on Research, Demonstration, Evaluation & Impact Assessment

NOAA Research:
- ESRL – PSD
- ESRL – GSD
- NSSL

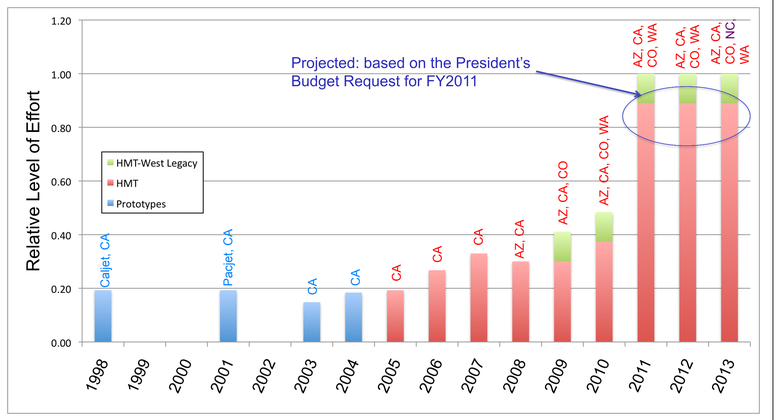
National Weather Service:
- OHD
- NCEP/HPC
- OCWWS/NOHRSC
- Western Region HQ
- Eastern Region HQ
- Southern Region HQ
- River Forecast Centers: California-Nevada; Colorado Basin; Southeast
- Weather Forecast Offices: Eureka, Monterey, Sacramento, Reno, Seattle, Raleigh-Durham

NESDIS
- STAR

- Federal Agencies
  - NASA; USGS; US-ACE
- State Agencies
  - CA-DWR; NC-RENCI
- Local Agencies
  - SAFCA
- Academic
  - CU; CSU; UW; UCSD/Scripps; NCAR



Timeline & Overall Effort

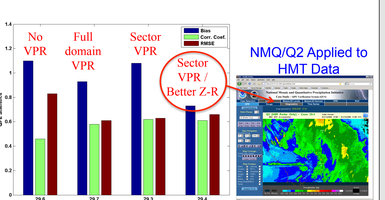


Select Accomplishments and Plans

Quantitative Precipitation Estimates

- FY09: ESRL-NSSL collaboration established
  - Improved VPR algorithms in NMQ/Q2. "Sector VPR" correction provides better QPE from a spatial structure standpoint, but not necessarily from a statistical standpoint
  - Improved Z-R relations in NMQ-Q2
- FY10: Delivery of "best possible" QPE fields for DMIP-2 project at NWS-OHD
  - Forcing for distributed hydrologic model intercomparison studies

HMT Improvements to NMQ/Q2



NMQ/Q2 Applied to HMT Data

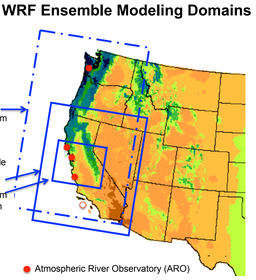
Quantitative Precipitation Forecasts

- FY09: Studies of WRF ensembles lead to insights into how to configure ensembles
  - Forcing at lateral boundary conditions is critical for accurate spatial distribution of QPF
  - Use of multiple microphysical schemes resulted in variability in QPF amount
- FY10: Expanded ensemble modeling plans
  - Ensembles driven by 8 different sets of lateral boundary conditions
  - Domain expanded to entire West Coast, in support of five HMT Atmospheric River Observatories

HMT-West 2010: WRF Ensemble Modeling Domains

Single Deterministic Run
- 12 hour forecast; 1 hr/10 km resolution

Nested, 8-Member Ensemble Run for Probabilistic Forecasts
- 120 hour forecast; 6 hr/9 km
- 12 hour forecast; 6 hr/3 km resolution

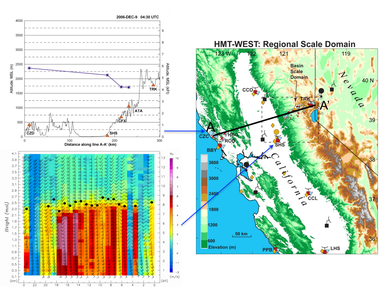


Atmospheric River Observatory (ARO)

Snow Information

- FY09: Low-cost "snow level radar" invented
  - Prototype developed and tested
  - Two field-ready units built
- FY10: Deploy 2 permanent snow level radars
  - Colfax, CA (American River Basin) & Shasta Lake Reservoir, CA
  - Apply data to snow level verification studies

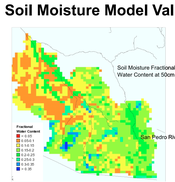
Snow Level Varies Significantly in Space & Time



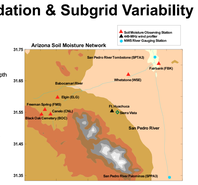
Hydrologic Applications & Surface Processes

- FY09:
  - Gauge-only (baseline) QPE data sets prepared for the American River Basin
  - First year of operation of the soil moisture network in southern Arizona
- FY10:
  - Apply state of the art QPE to distributed hydrologic model simulations in the American River Basin
  - Use the HMT soil moisture observations in the San Pedro Basin to verify the predicted soil moisture values generated by the SAC-HT model (w/CB-RFC)

Soil Moisture Model Validation & Subgrid Variability



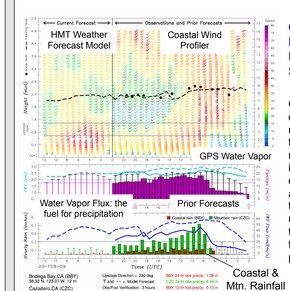
Prototype 4-km gridded soil moisture product for the San Pedro & Santa Cruz River Basins. Shown is the fractional water content at a depth of 50cm for 2 October 2008.



Location of HMT PSD soil moisture and wind profiler sensors in the San Pedro River Basin, AZ

Decision Support Tools

- FY09:
  - The Coastal Atmospheric River Monitoring & Early Warning System was created and evaluated (e.g. displayed on plasma display at the Monterey WFO, providing "critical short-term forecast guidance" for flash flooding and debris flow
  - ALPS workstation performance enhanced; deployed to 3 WFOs and 1 RFC in HMT
- FY10:
  - Begin to assess performance of operational and research forecast products for QPF & snow level
  - Develop and evaluate tools in the MET tool (a community-wide verification package)



Coastal Atmospheric River Monitoring & Early Warning System

Combines HMT observations and numerical model forecasts to detect, monitor, and predict the impacts of ARs on extreme precipitation. It also allows forecasters to judge how well models are representing the atmospheric river forcing and the resulting precipitation.

Publications

Phenomena	Paper	HMT Major Activity Area: QPE	QPF	SI	HA	V/DST	DF
Atmospheric Rivers (8)	Bao'06		✓		✓	✓	
	Junker'09		✓			✓	
	Neiman'08a	✓	✓	✓	✓	✓	
	Neiman'08b	✓	✓	✓	✓	✓	
	Ralph'06		✓		✓	✓	
	Ralph'05a		✓			✓	
	Ralph'04		✓		✓	✓	
	Wick'08		✓		✓	✓	
Warm-Rain Processes (4)	Kingsmill'06	✓	✓			✓	
	Martner'08	✓	✓		✓	✓	
	Neiman'05	✓	✓		✓	✓	
	White'03	✓	✓		✓	✓	
Orographic Effects (7)	Neiman'10	✓				✓	
	Neiman'06		✓				
	Neiman'04		✓			✓	
	Neiman'02		✓		✓	✓	
	Nuss'01		✓			✓	
	Smith'10		✓			✓	
	Ralph'03	✓	✓		✓	✓	
Observing Systems (15)	Dabberdt'05	✓	✓		✓	✓	
	Gourley'09	✓			✓	✓	
	Lundquist'09	✓		✓	✓		
	Lundquist'08a			✓	✓		
	Lundquist'08b			✓	✓		
	Martner'07	✓			✓		
	Matrosov'10	✓		✓		✓	
	Matrosov'09	✓		✓			
	Matrosov'08	✓		✓		✓	
	Matrosov'07	✓		✓			
	Matrosov'05	✓				✓	
	Matrosov'04	✓		✓			
	Neiman'09		✓	✓	✓	✓	
	White'02			✓	✓	✓	
	White'00	✓		✓			
Precipitation Forecasting (6)	Jankov'09		✓			✓	
	Jankov'07		✓				
	Junker'08		✓			✓	
	Moras'07	✓	✓		✓	✓	
	Ralph'05b	✓	✓	✓	✓	✓	
	Yuan'08		✓			✓	
Physical Processes (7)	Andrews'04		✓		✓		
	Coplen'08	✓					
	Jorgensen'03	✓	✓		✓		
	Persson'05		✓		✓	✓	
	Restrepo'08	✓				✓	✓
	Richiardone'09					✓	
	Wilczak'07					✓	

47 peer reviewed papers since 2000

Appearing in Journals:
- Monthly Weather Review
- J. Hydrometeorology
- J. Atmos. & Oceanic Tech.
- Bull. Amer. Meteor. Soc.
- Geophys. Res. Let.
- *Proc. Institution of Civil Engineers* – Water Resource Res.
- Weather & Forecasting
- IEEE Trans. on Geosci. & Rem. Sens.
- J. Appl. Meteor. & Climatology
- J. Climate
- Nonlin. Proc. in Geophys.
- Prog. in Oceanography
- Water Management

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