The NOAA Hydrometeorological Testbed Program: Overview and Progress to Date

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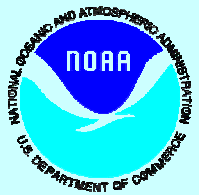


STIP Integrated Planning Team for Hydrologic Services (**September 2002)**

Key Information Gaps

- **Quantitative Precipitation Information (QPE & QPF)**

  Unbiased Precipitation Estimates with Reliability Information

  Reliable 0-6 Hour Precip. Nowcasts

  Longer-term, Unbiased Model QPFs

- **Hydrologic Forecasting**

  High-resolution Flash Flood Forecasts & Warnings

  Probabilistic River Forecasts Using 0-3 day QPF and Seasonal Precipitation Forecasts

STIP IPT for Hydrologic Services

Outstanding R&D Needs

- *Develop QPE Techniques That Optimally Blend Next-generation Radar, Satellite (e.g, GPM), and Rain Gauge Data*
- *Improve Short-Term Radar-Satellite Precipitation Nowcasting Techniques Blended with NWP Forecasts*
- *Develop High Resolution Hydrologic Forecast Models of Water Excess-Deficit at Ungauged Locations*
- *Develop Ensemble NWP and Hydrologic Model Forecasts with Associated Reliability Information*
- *Improve NWP Model Physics and Increase Assimilation of Existing Observational Datasets*
- *Implement Hydrometeorological Testbeds to Demonstrate & Evaluate Next-Generation Datasets, Forecast Techniques, & Models*

Hydrometeorological

Testbed Definition

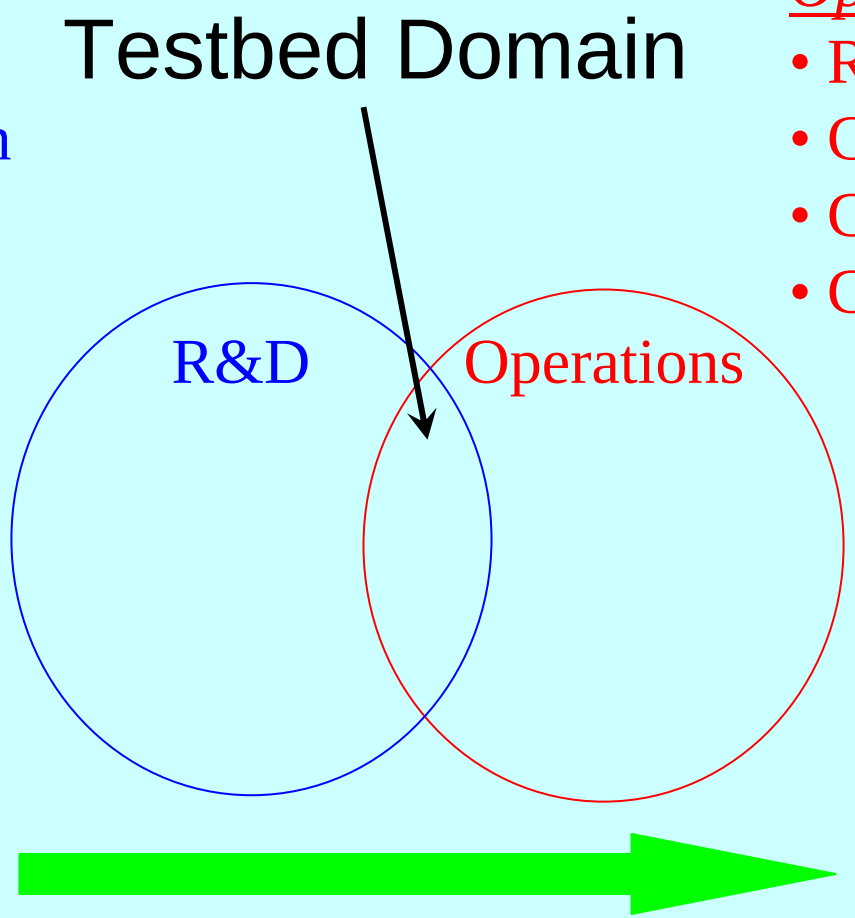
"A testbed is a working relationship in a quasi-operational framework among measurement specialists, forecasters, researchers, the private sector, and government agencies aimed at solving operational and practical regional hydrometeorological problems with a strong connection to the end users. Outcomes from a testbed are more effective observing systems, better use of data in forecasts, improved services, products, and economic/public safety benefits. Testbeds accelerate the translation of R&D findings into better operations, services, and decision-making. A successful testbed requires physical assets as well as long-term commitments and partnerships."

USWRP Mesoscale Observing Workshop, December 2003

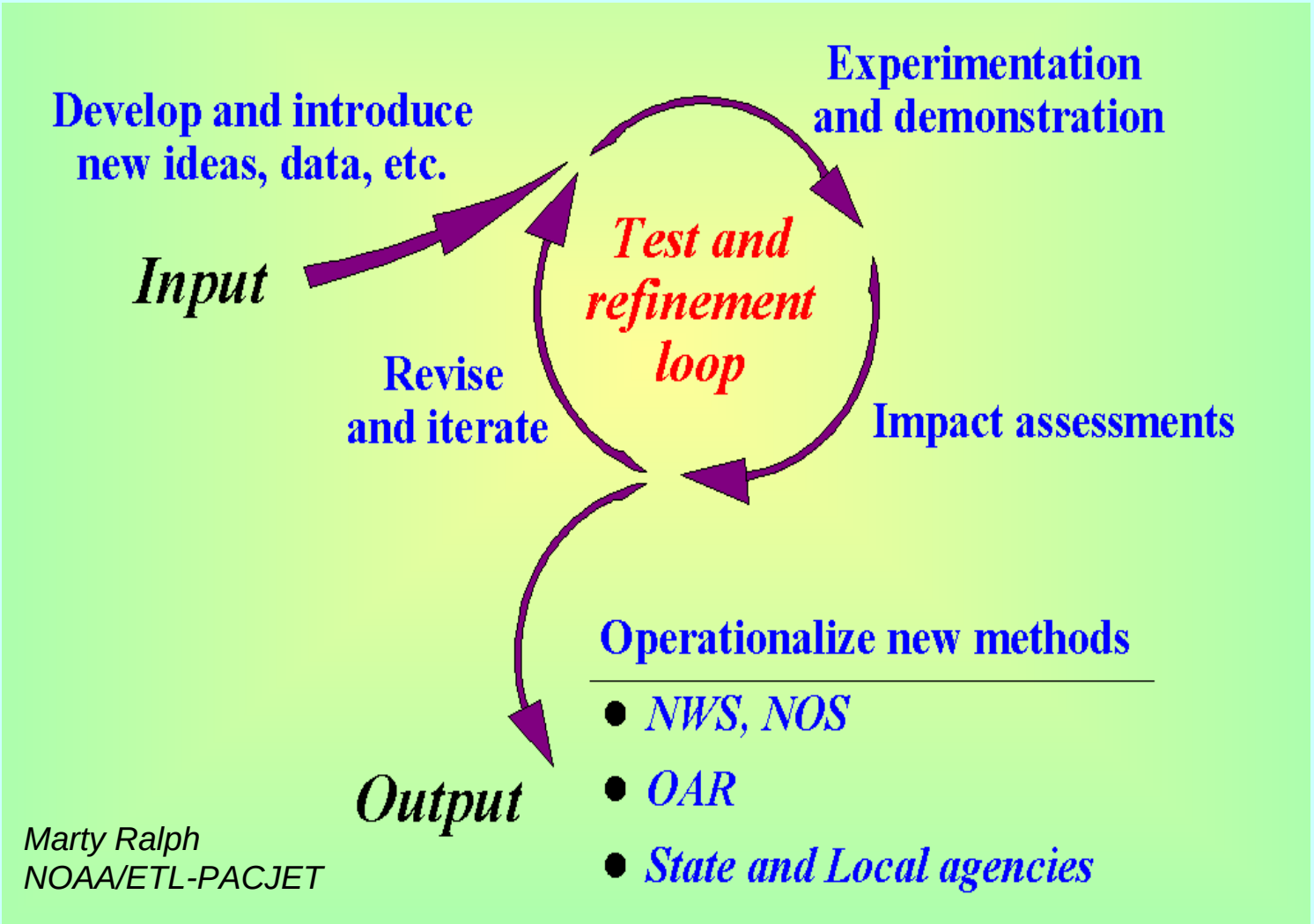
R&D and Operational Perspectives:
Observing Systems

R&D Priorities
- Exploratory
- Higher Resolution
- Multi-Sensor
- New Variables
- Publication

Operational Priorities
- Reliability
- Cost Effectiveness
- COTS (plug n' play)
- Continuity



Test bed concept



Marty Ralph
NOAA/ETL-PACJET

Hydrometeorology Testbed

A Broad Approach Is Required*

***i.e., There is no "Silver Bullet"**

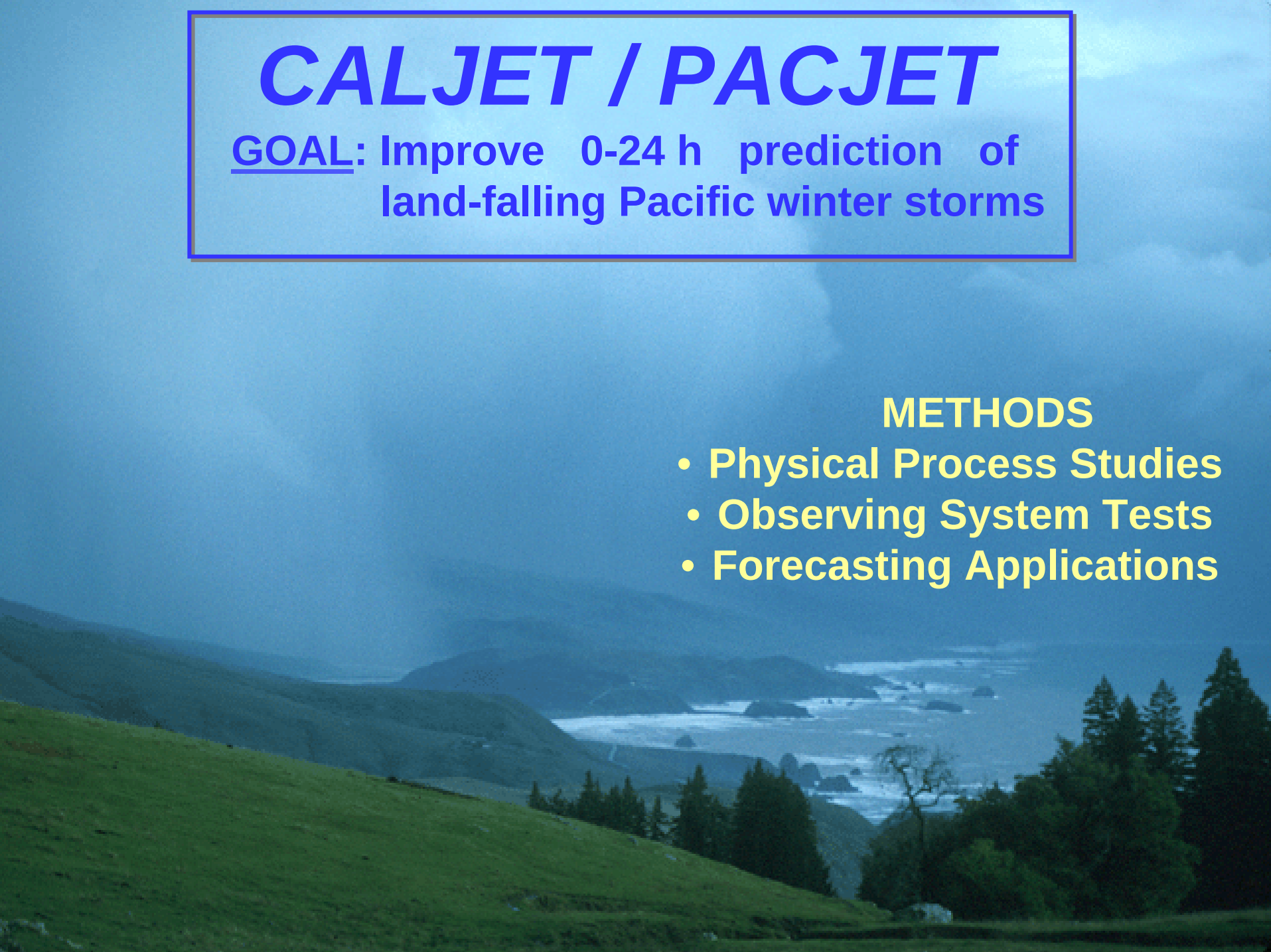
- Better numerical model guidance (i.e., QPF)
- Better observations for forecaster use and model assimilation and verification (i.e., QPE)
- Better physical understanding for parameterizations and conceptual models
- Better knowledge of capabilities and limitation of key tools

CALJET / PACJET

GOAL: Improve 0-24 h prediction of land-falling Pacific winter storms

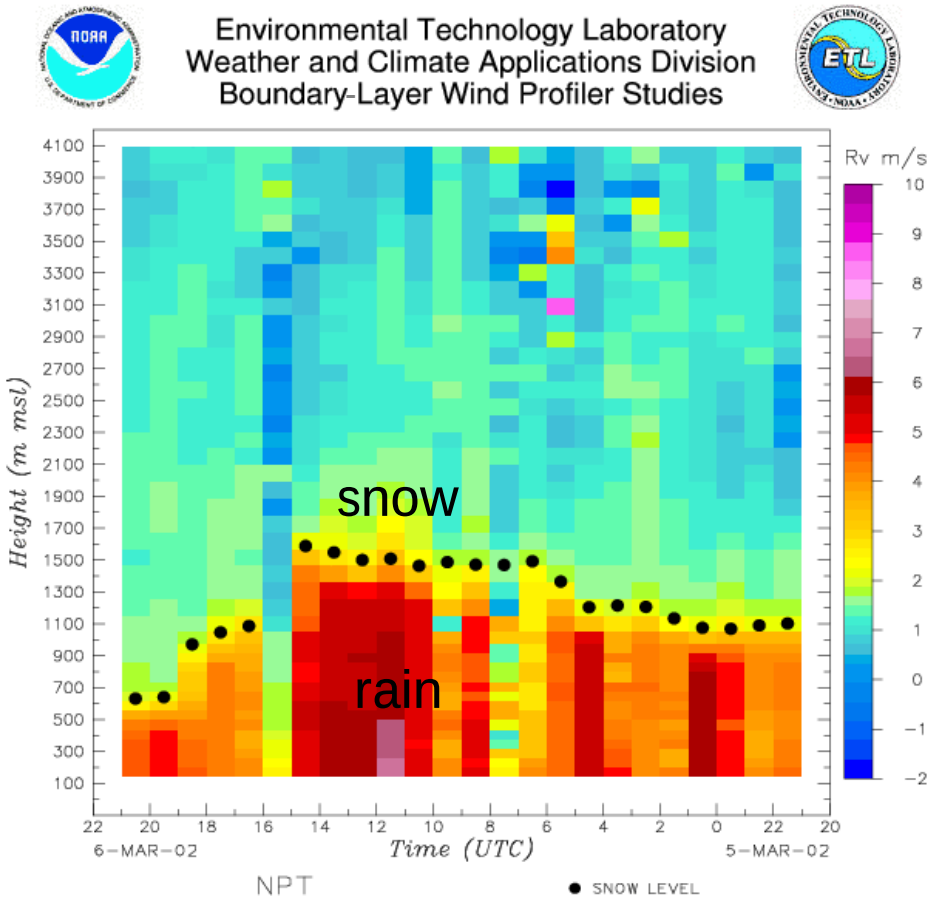
METHODS

- **Physical Process Studies**
- **Observing System Tests**
- **Forecasting Applications**



Profiler Snow-level Algorithm

Background field of consensus Doppler vertical velocity (Rv, positive downward) showing the transition from snow to rain. The snow-level estimates from the algorithm are indicated by the black dots. The table, which was added at the request of NWS weather forecasters, lists the snow level along with the surface temperature measured by a met station collocated with the wind profiler.



Time (UTC)	2030	1930	1830	1730	1630	1530	1430	1330	1230	1130	1030	0930
Snow Level (m)	631	640	971	1046	1086	none	1588	1548	1500	1508	1464	1487
Snow Level (ft)	2069	2099	3184	3430	3562	none	5208	5077	4919	4946	4801	4877
Sfc Temp (C)	6.02	6.18	6.24	5.97	6.31	6.87	7.23	7.43	9.44	9.92	10.04	10.14

Time (UTC)	0830	0730	0630	0530	0430	0330	0230	0130	0030	2330	2230	2130
Snow Level (m)	1471	1469	1492	1365	1204	1215	1206	1134	1075	1069	1090	1102
Snow Level (ft)	4824	4818	4893	4477	3949	3985	3955	3719	3525	3506	3575	3614
Sfc Temp (C)	10.02	7.28	7.25	7.36	7.31	7.30	7.80	8.41	8.55	8.13	8.72	9.06

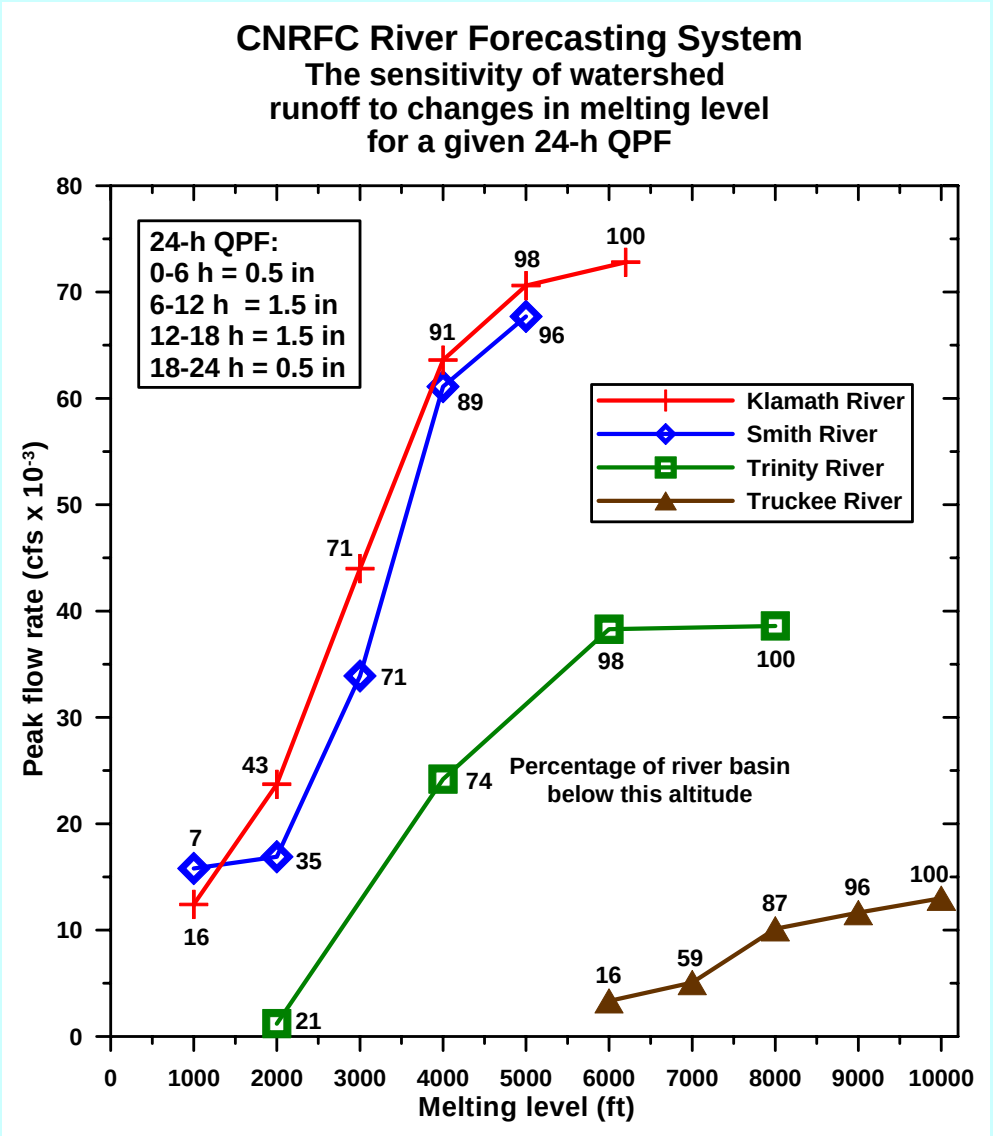
White et al., 2002 (JTech)

Profiler Snow-level Applications

River forecasting

- **The two most important factors influencing runoff forecasts for mountainous watersheds are the quantitative precipitation forecast and the melting level.**

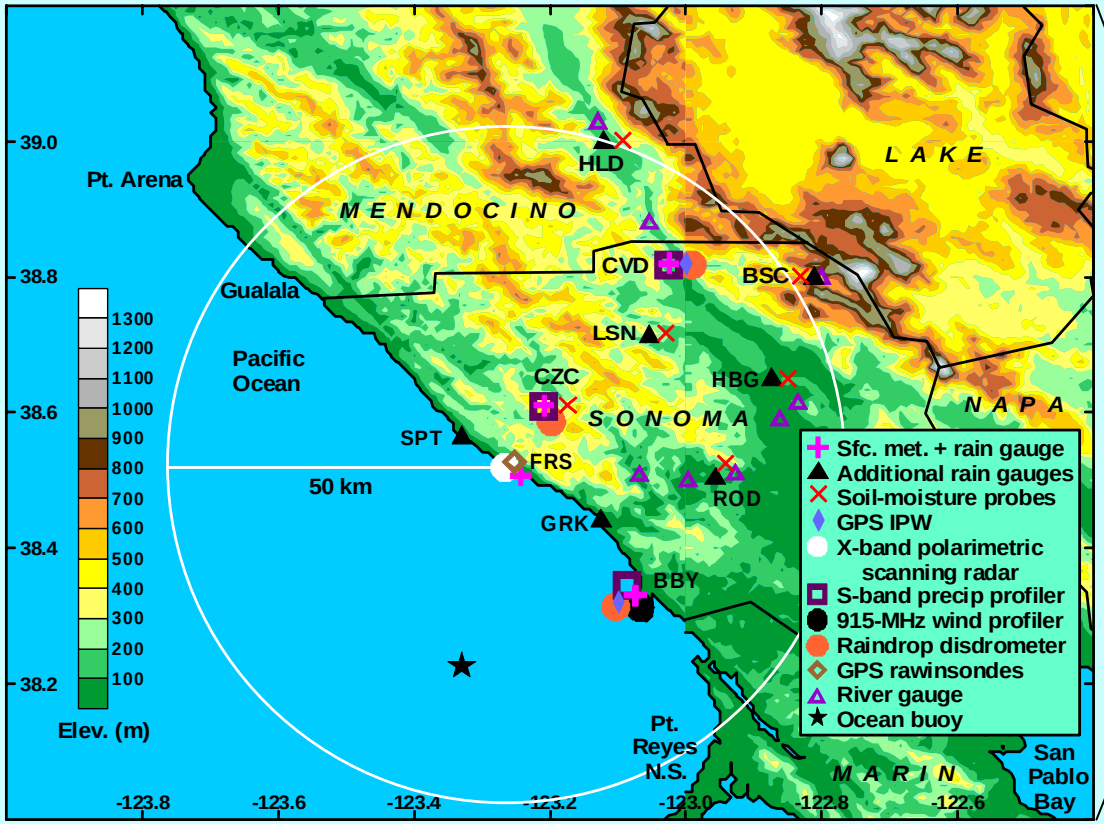
- **The model-based results shown to the right indicate that a 2000-ft increase in the melting level could triple the runoff in a watershed.**



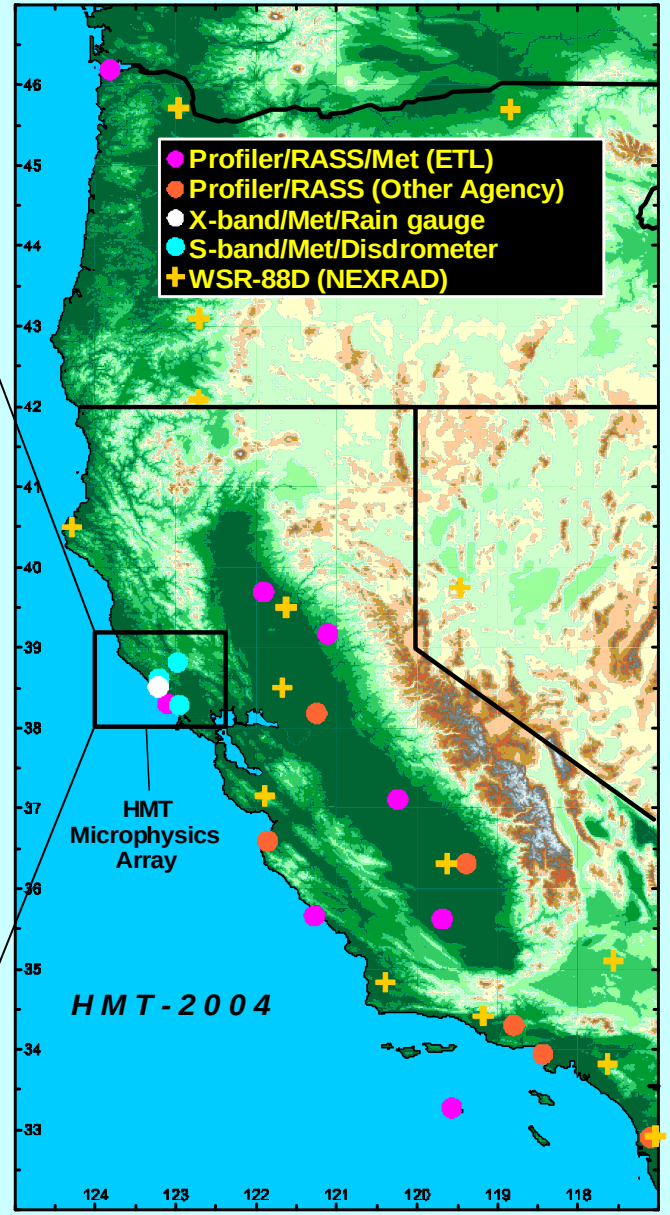
HMT-2004

A Hydrometeorological Testbed (HMT) for the Russian River Watershed

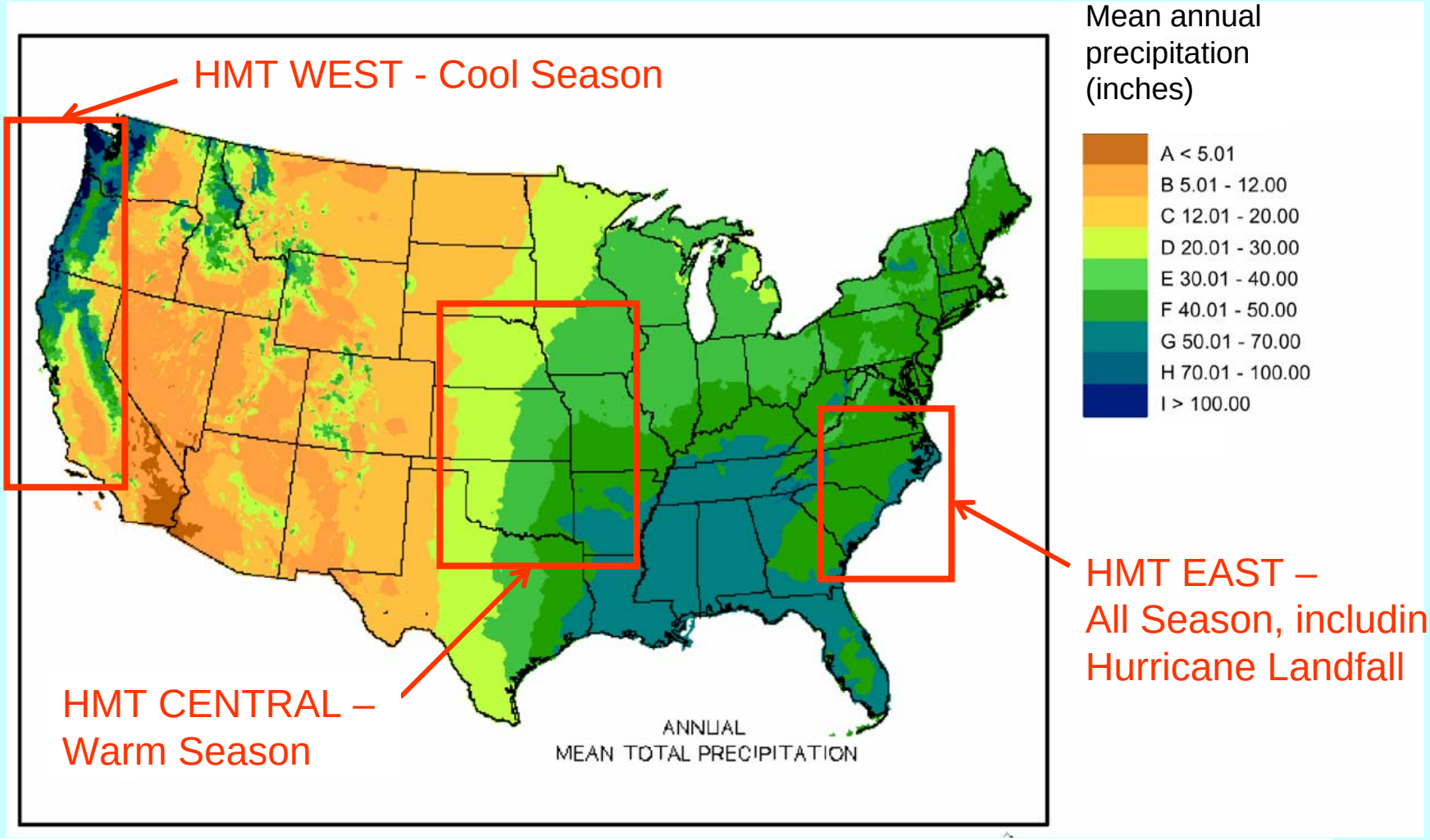
HMT-2004 Microphysics Array



BBY = Bodega Bay
BSC = Big Sulfur Creek
CVD = Cloverdale
CZC = Cazadero
FRS = Fort Ross
GRK = Goat Rock
HBG = Healdsburg
HLD = Hopland
LSN = Lake Sonoma
ROD = Rio Dell
SPT = Salt Point

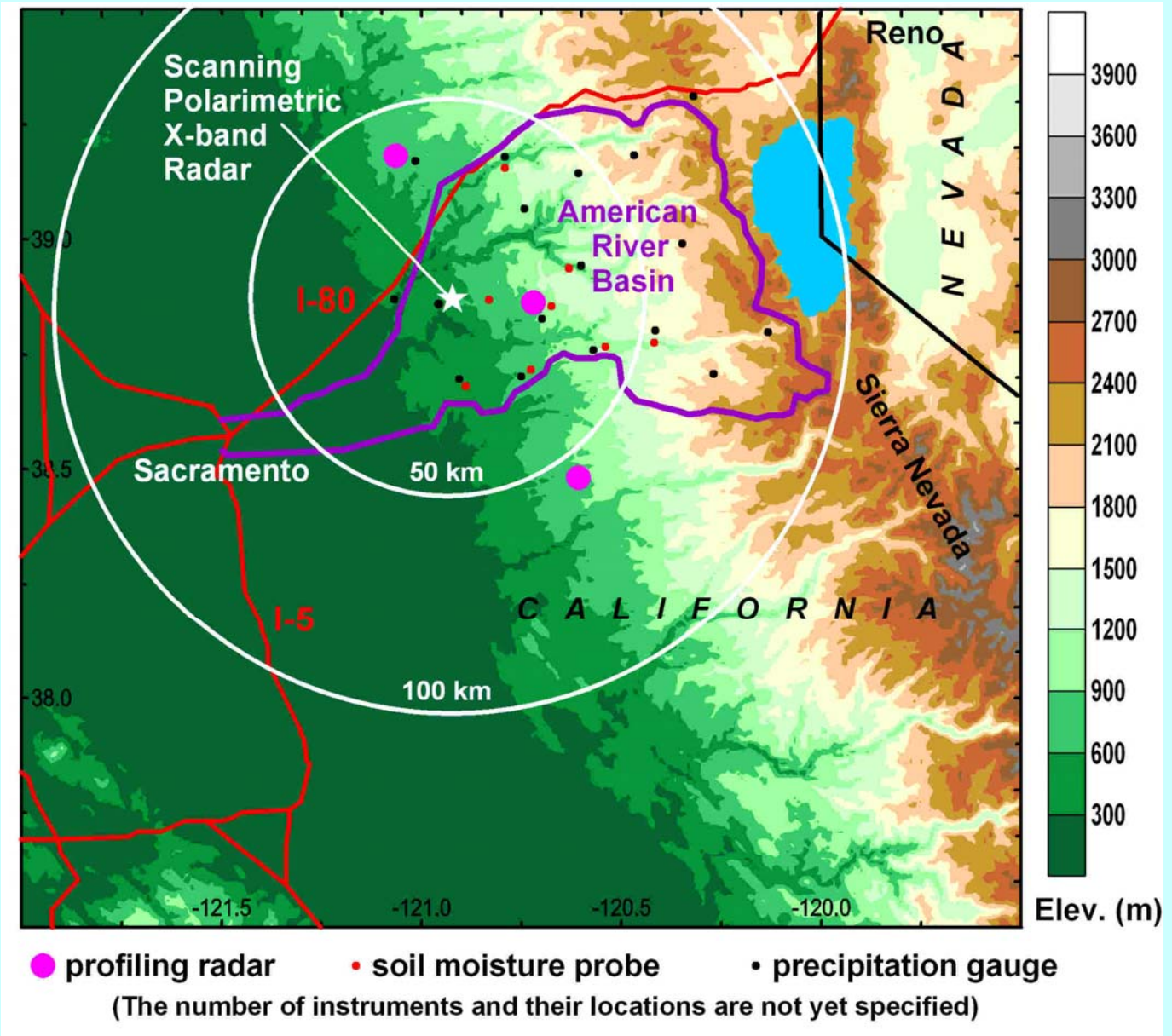


Regional Implementation Strategy



The national Hydrometeorological Testbed program will be implemented incrementally in different regions of the U.S.

HMT-WEST: American River Basin 2005-2009

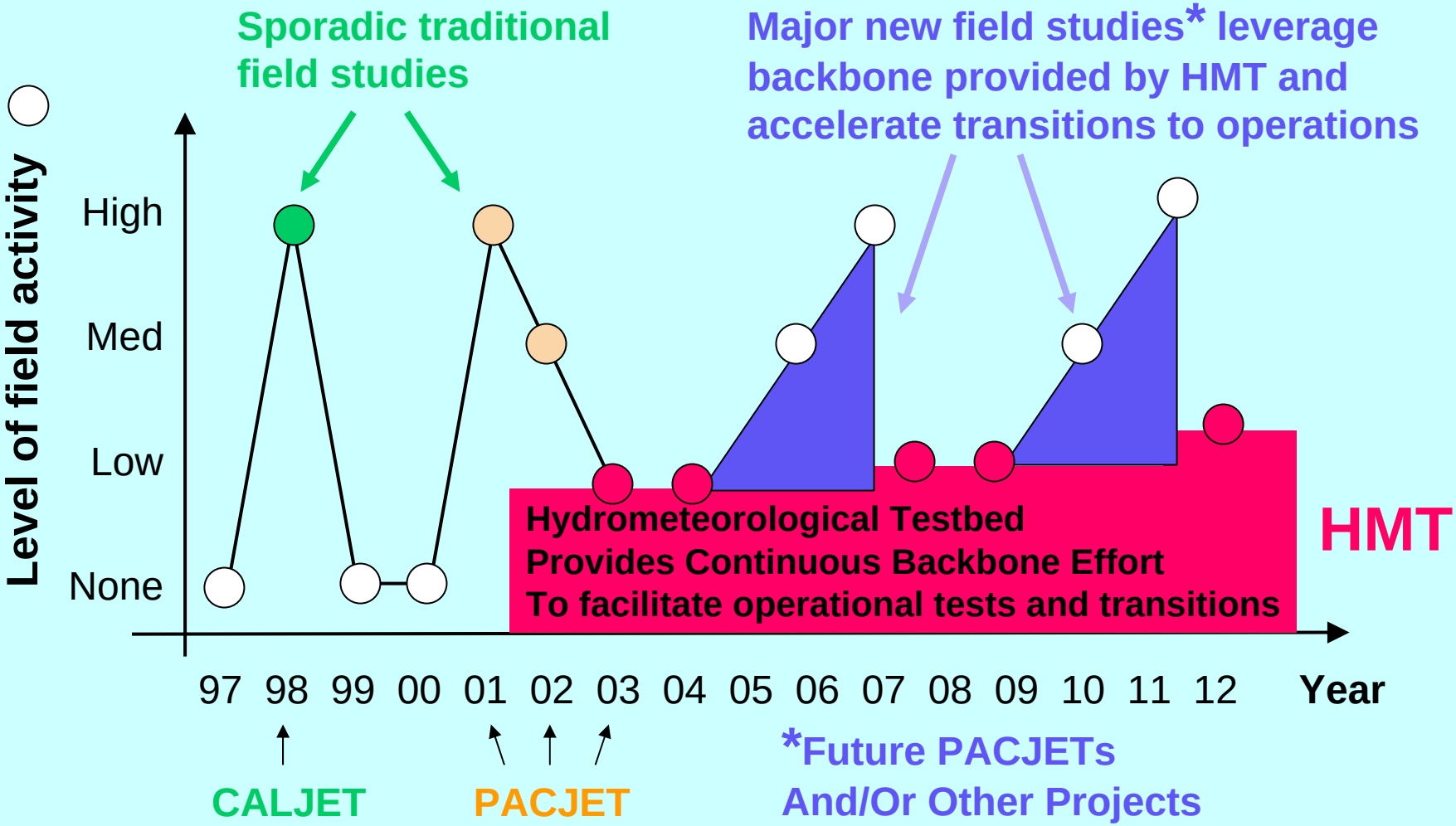


NOAA Hydrometeorology Testbed Program

- NOAA Partners Include:
  - ETL, NSSL, OHD, FSL, Region HQ's, FO's, RFC's, HPC, NOHRSC, CDC, STAR, AOML, EMC
- http://hmt.noaa.gov
- David.Kingsmill@colorado.edu

Back Up Material

CALJET to PACJET to HMT



Hydrometeorology Testbed

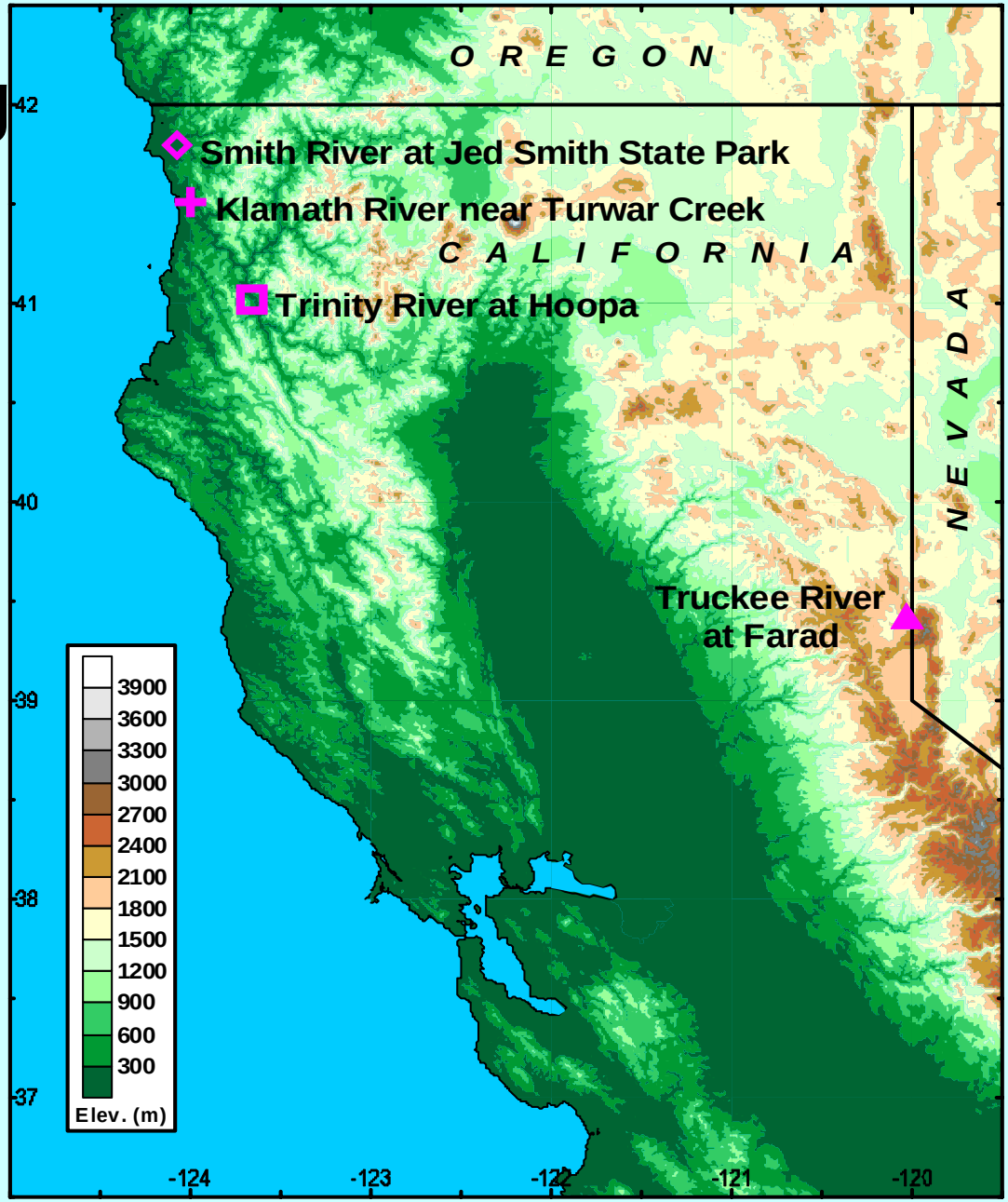
Primary Goals

- Systematically evaluate promising new methods that can influence both NWP and nowcasting using the man-machine mix forecasting paradigm.
- Assess their value in terms of improved regional performance on Flood/Flash Flood Warning and QPF GPRA measures.
- Use these results as an objective basis for decisions on transitions to operations both in the test region and nationally.

River forecasting

- Map of northern California showing the locations of four mountainous watersheds that are susceptible to flooding.

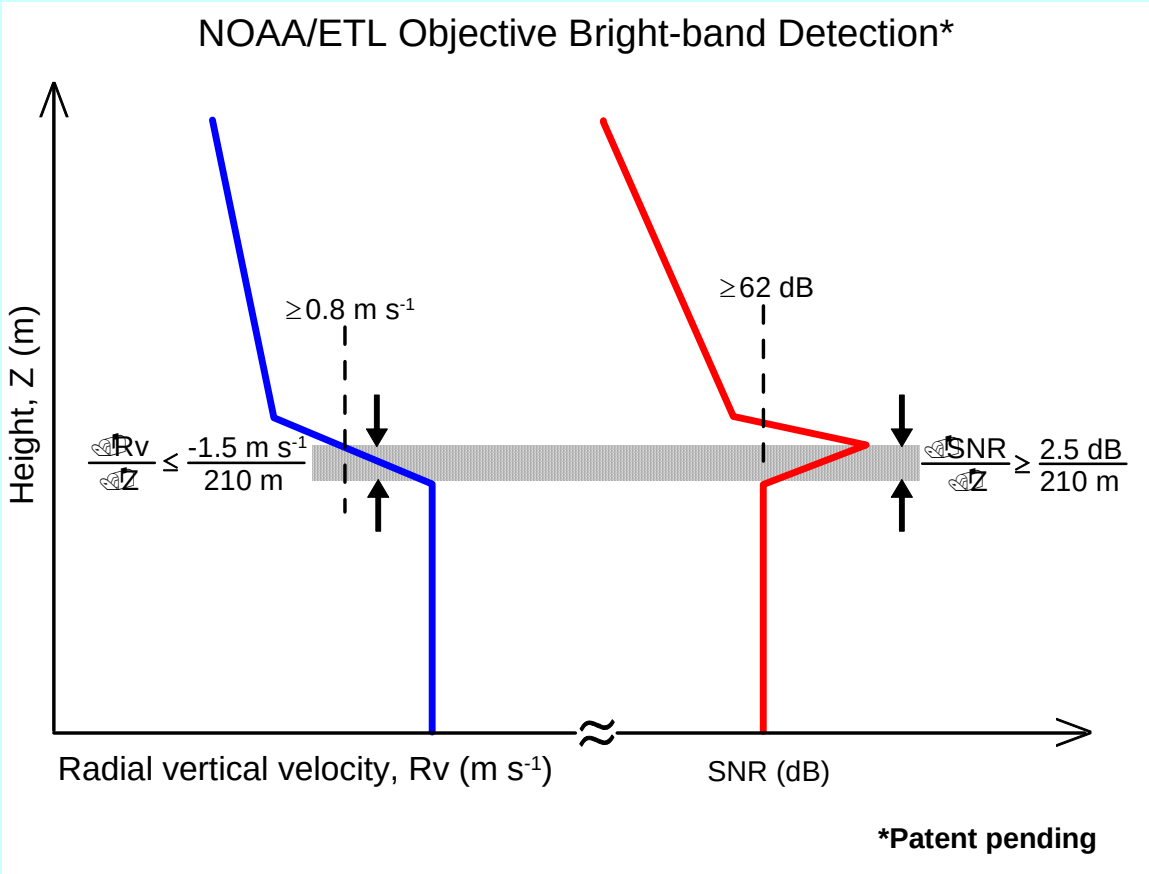
- The California-Nevada River Forecast Center modeled runoff in these watersheds using their operational river forecast modeling system to see the sensitivity of watershed runoff in the model to changes in the melting level of the atmosphere.



Profiler Snow-level Algorithm

- **Takes advantage of the fact the wind profilers measure Doppler vertical velocity in order to compute the three-dimensional wind vector, whereas many scanning precipitation radars do not adopt this strategy.**

- **The bright-band height is a better estimate of the snow level than the melting level (i.e. 0^{o} C isotherm) because of the time (or fall distance) required for ice particles to melt as they descend**



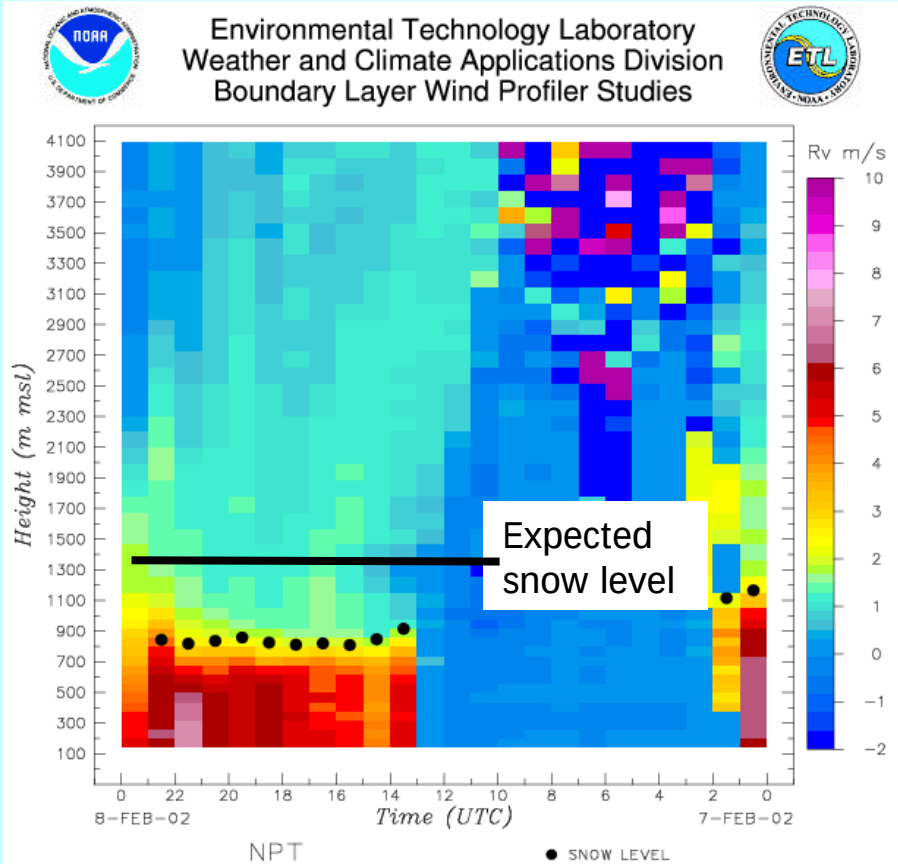
White et al., 2002 (JTech)

Winter Storm Warning Issued Based on PACJET-2002 Melting-Level Data

- Newport, OR profiler detected a lower snow level than had been expected (2700 ft vs 4000 ft).

- This caused Portland NWS to change from a Snow Advisory to a Winter Storm Warning.

White et al. (2002),
J. Atmos. Ocean. Tech.



Time (UTC)	2330	2230	2130	2030	1930	1830	1730	1630	1530	1430	1330	1230
Snow Level (m)	none	843	818	836	858	825	811	820	809	847	915	none
Snow Level (ft)	none	2765	2683	2742	2814	2705	2660	2689	2653	2778	3001	none
Sfc Temp (C)	4.00	4.74	5.42	6.02	6.21	6.46	6.52	6.95	7.25	7.30	7.93	8.70

Developing a Testbed Concept for Hydrometeorology in NOAA

Jointly organized by NWS (Rich Fulton of OHD**)** and **OAR** (Marty Ralph of ETL)

20 November 2002

Background

The testbed concept is gaining momentum within NOAA as a vehicle for accelerating transitions from research to operations and for fostering technology infusion to the National Weather Service. This is evidenced by the inclusion of testbeds as elements in a number of recent NOAA planning documents and programs, such as the NWS Science Technology Infusion Program (STIP). Most of these elements are associated with precipitation, water cycle and hydrology. Thus, the time for implementing a Hydro-Meteorology Testbed (HMT) may be approaching.