Coupled Quantitative Precipitation Estimation and Distributed Hydrologic Modeling: Case Study for the Russian-Napa Rivers, CA

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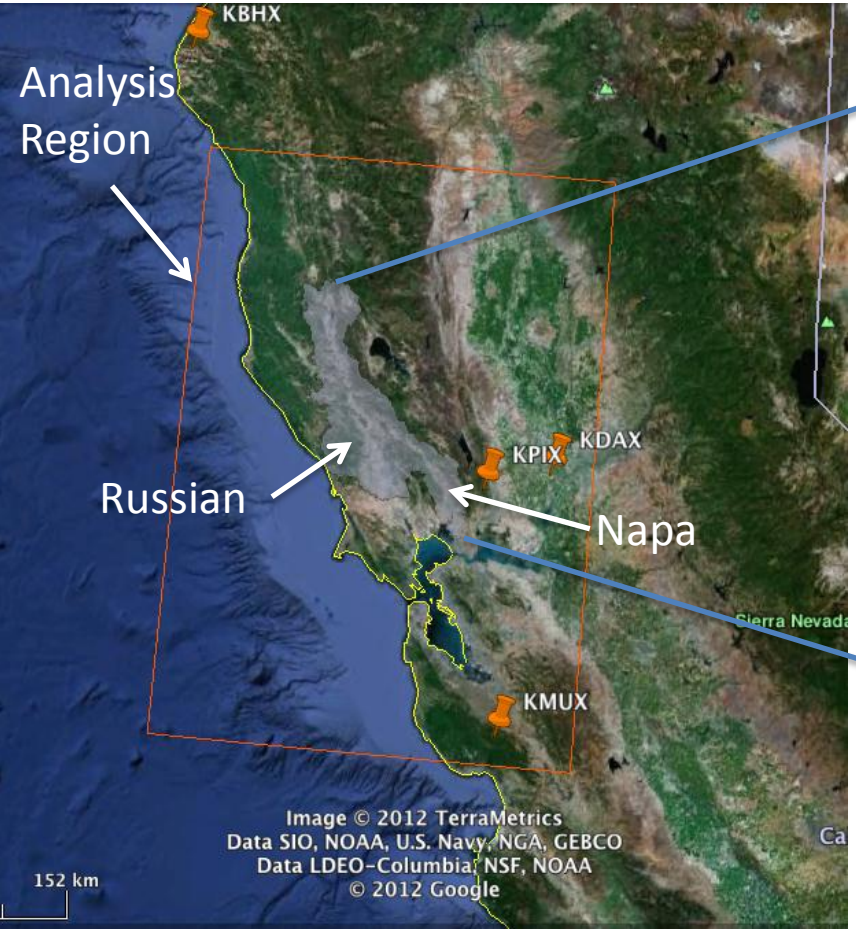
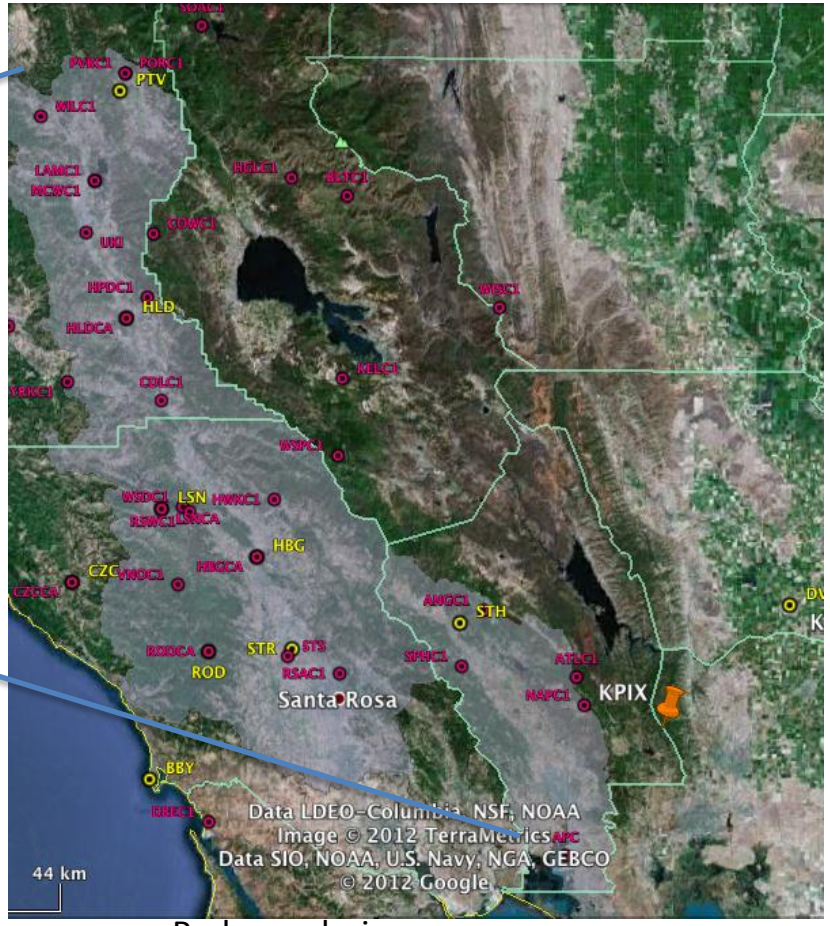
HMT Russian River Precipitation-Hydrology Activities

- HMT is engaged in a Proof of Concept demonstration with Sonoma County Water Agency
  - Improved precipitation monitoring and forecast products are needed for mitigating flood impacts and informing water management decisions
  - Distributed hydrologic modeling could be used in combination with precipitation information to better manage tradeoffs between water supplies, endangered fisheries, and flooding
- Major Objectives of PoC
  - Evaluate the impact of commercial TV radar (KPIX) on precipitation monitoring performance
    - *NWS operational network is inadequate to monitor precipitation in Russian River*
  - Determine the best combination of radar and rain gauge data to monitor precipitation in the Russian
    - *Use this method to validate precipitation forecasts in this region*
  - Evaluate the efficacy of distributed hydrologic modeling in the Russian
    - *Sensitivity to spatial resolution and precipitation inputs*
    - *Ability to represent both flood peaks and base flow*

Precipitation-Hydrology Evaluation Region

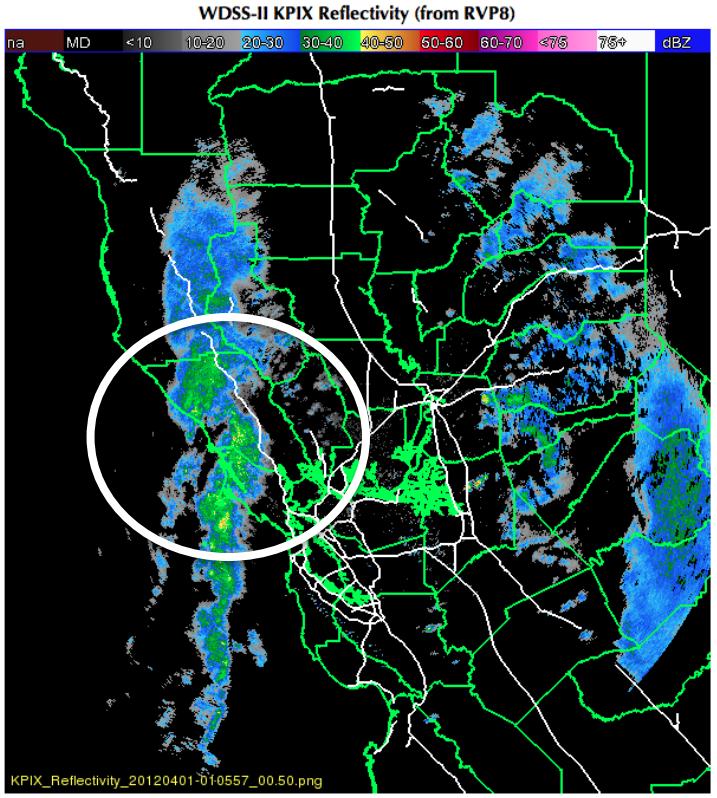




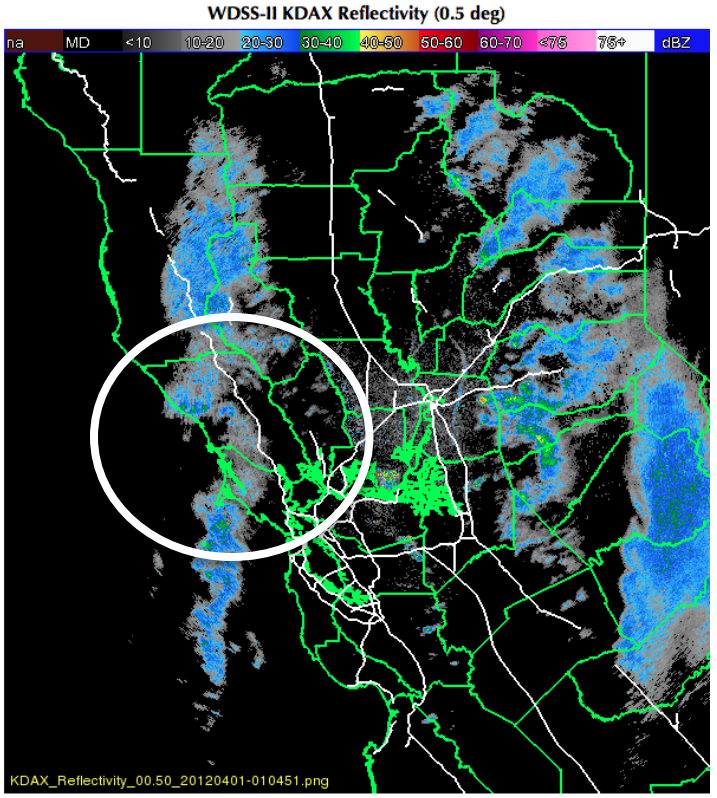
Red – analysis gauges
Yellow – independent gauges

Radar Coverage in Russian River Basin

KPIX TV



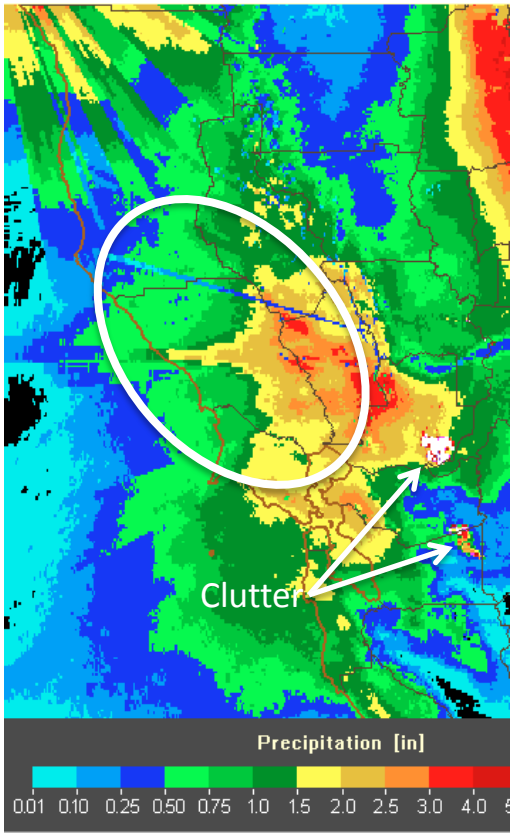
KDAX NEXRAD



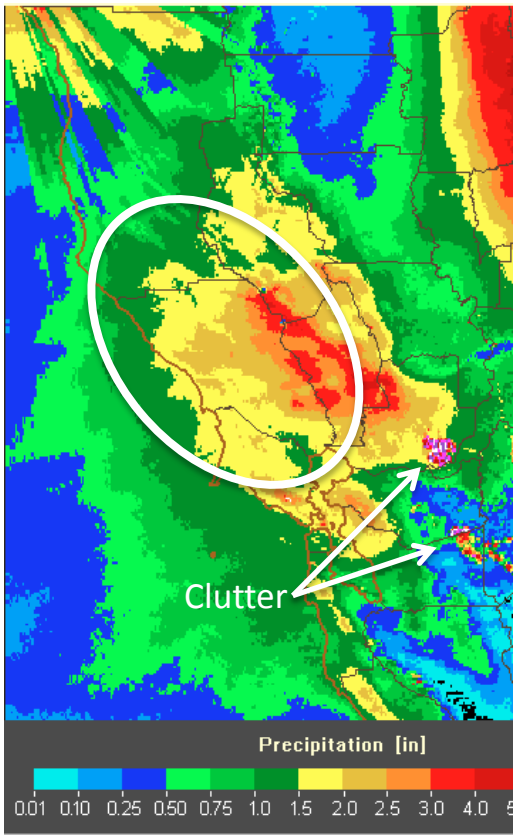
- KPIX provides better coverage over lower Russian River Basin

Rainfall Total Comparison

3-Day Rain Total Without KPIX

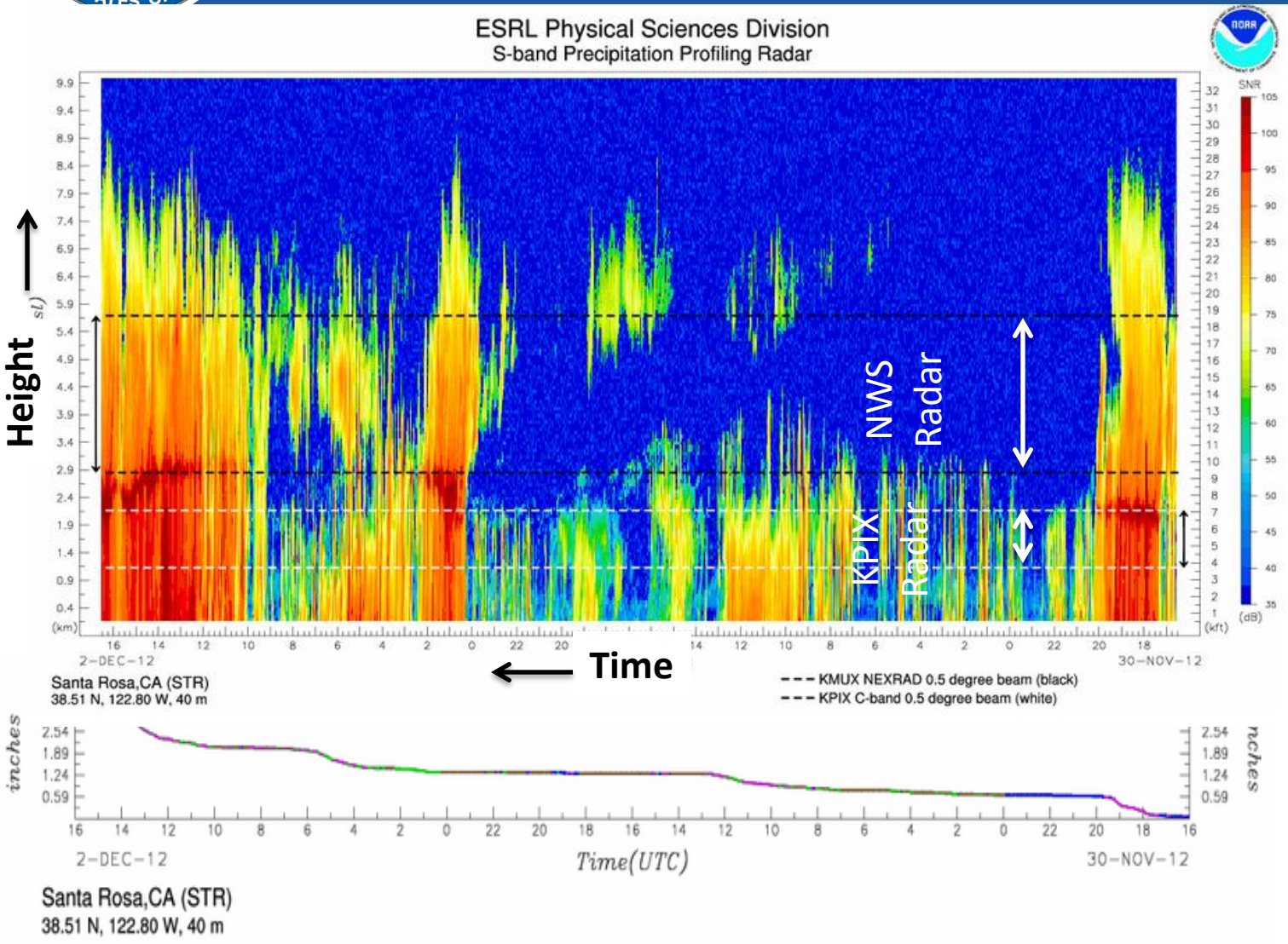


3-Day Rain Total With KPIX



- KPIX produces more realistic precipitation patterns and amounts

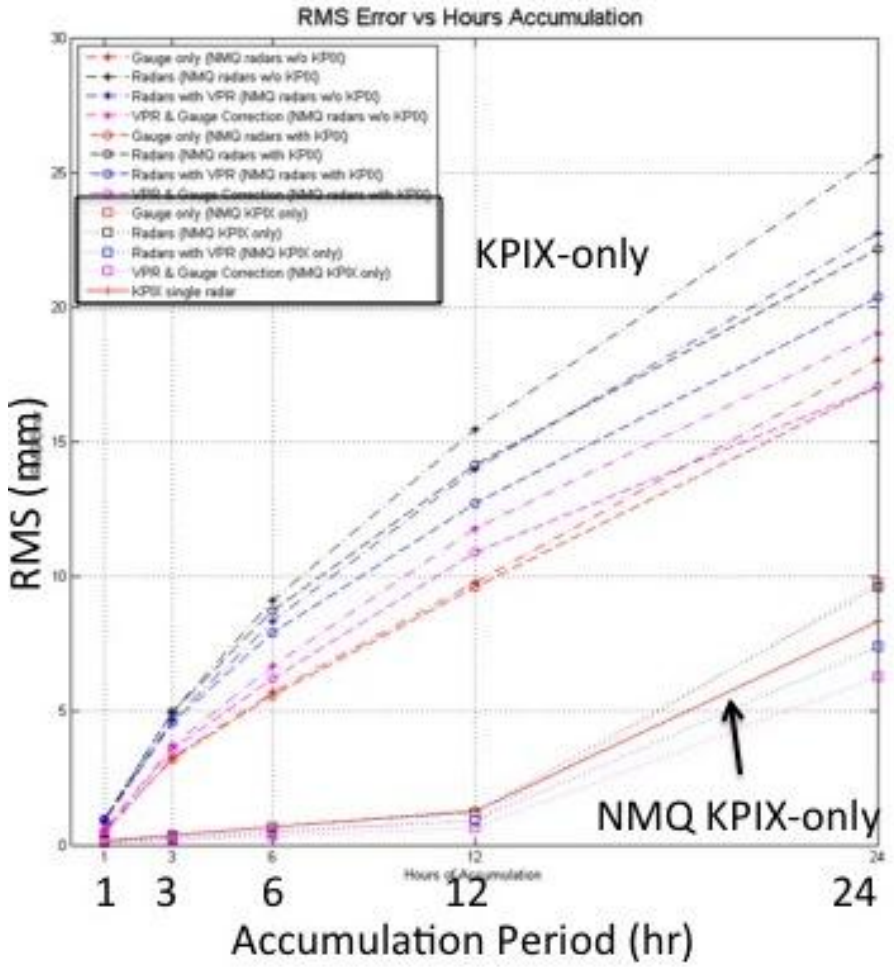
Importance of KPIX Radar Data



- KPIX can see the rain better than the NWS radar

KPIX QPE Evaluation: March 2012

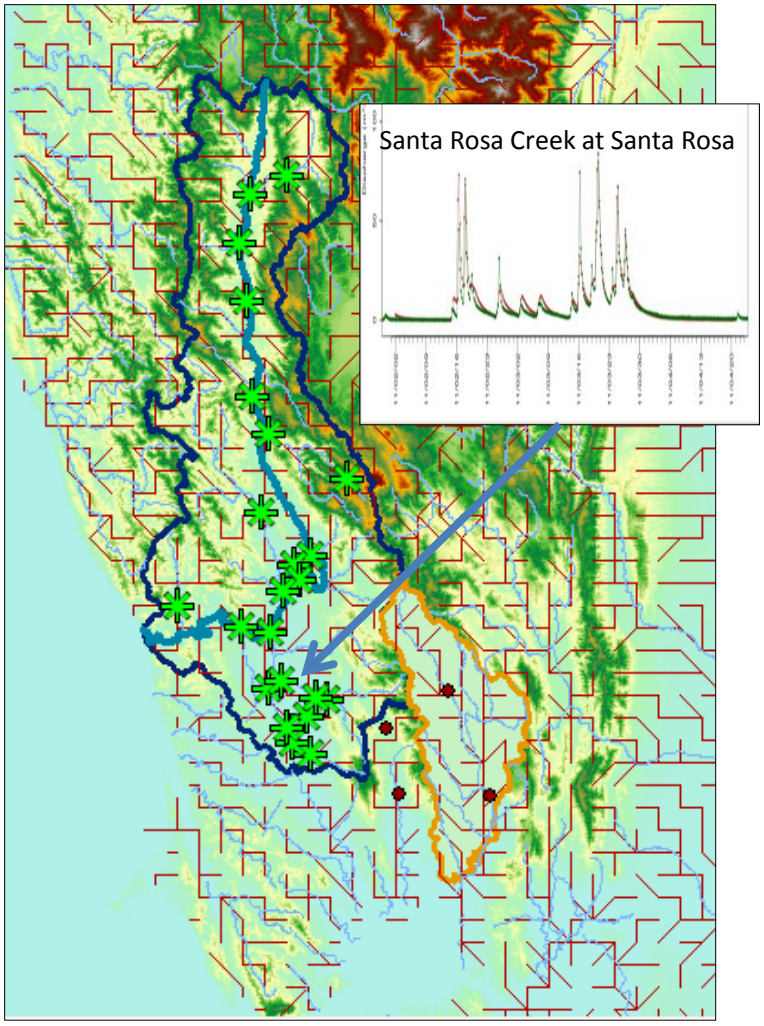
RMS Error: NMQ/KPIX QPE



RMS errors are reduced relative to other QPE methods when using KPIX-only data

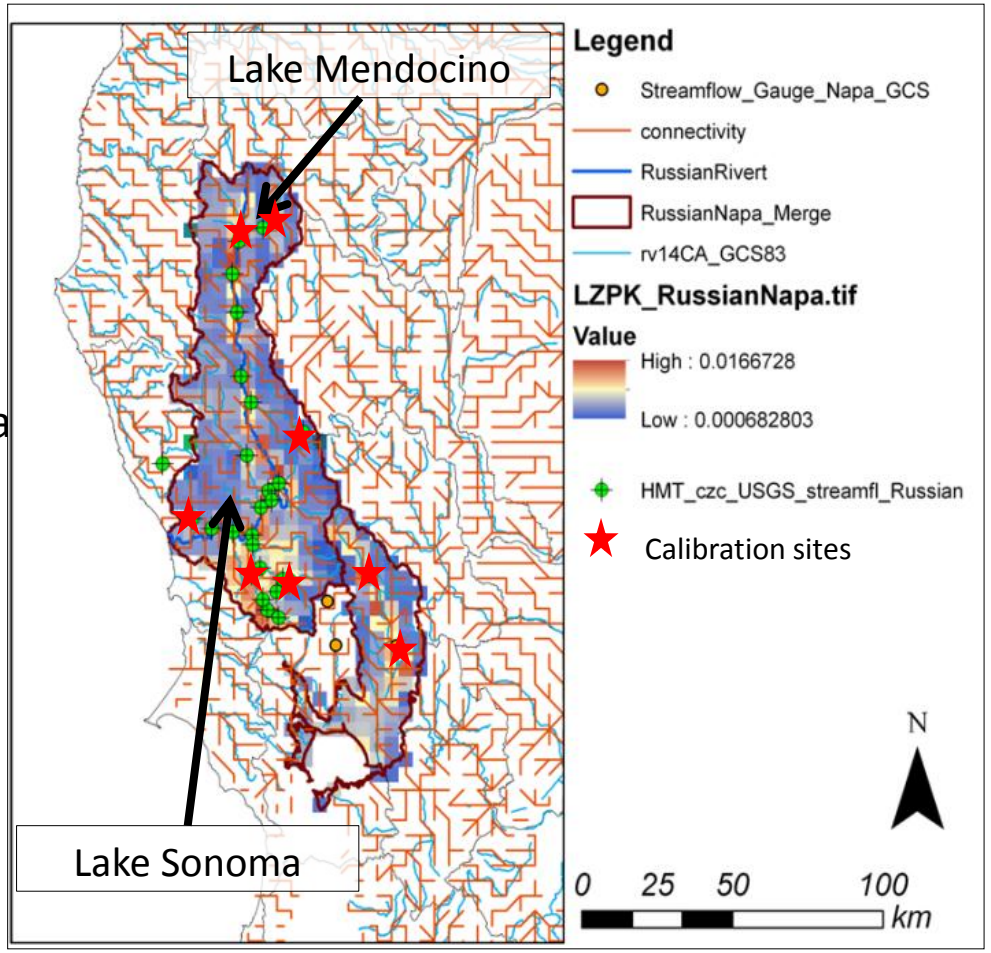
Russian-Napa Basins 2-D Hydro Model

- 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
    - ~1 km side
  - 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

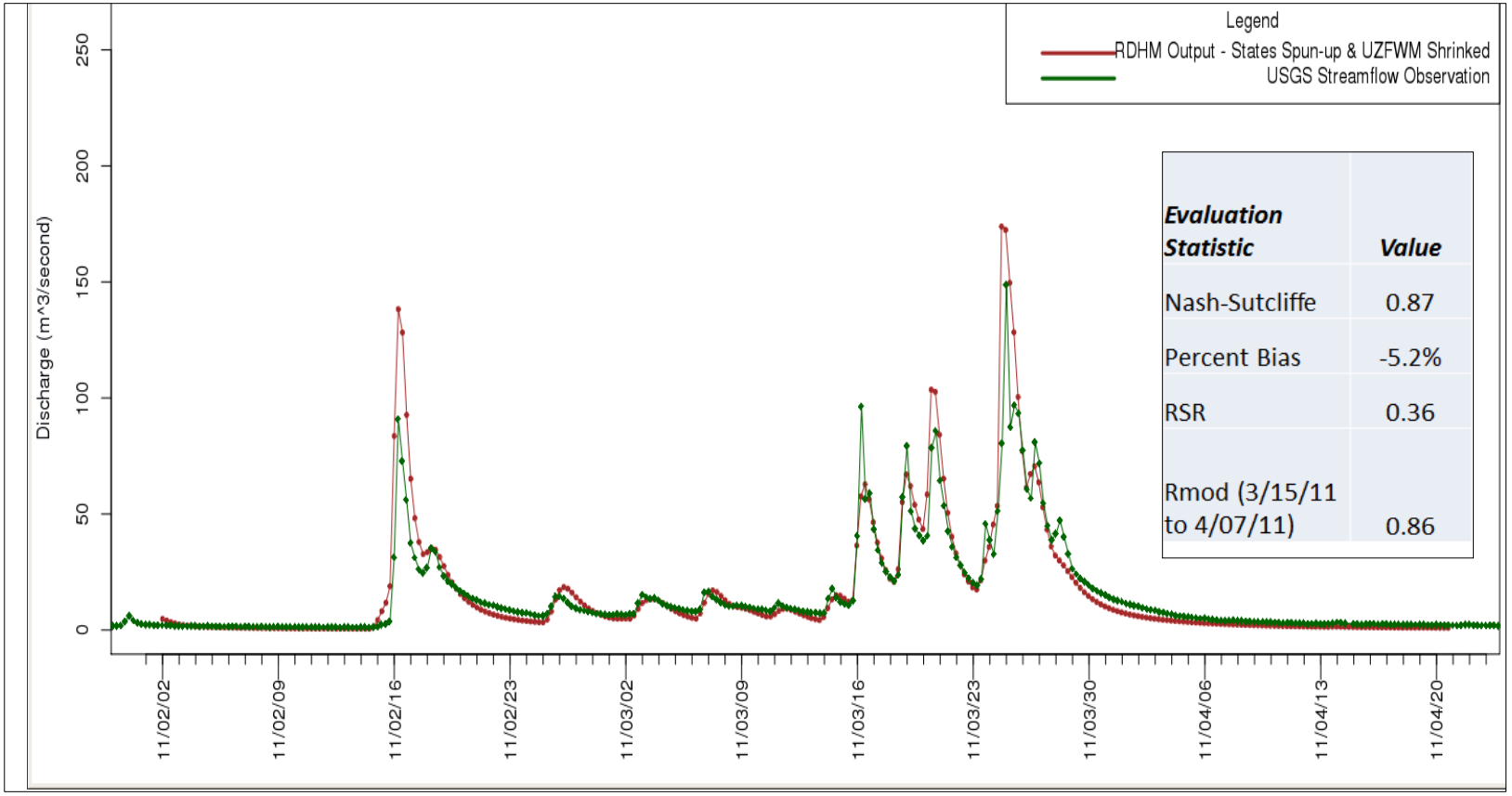


Calibration Sites on Unregulated Tributaries

- Managed flow issues on main stem Russian River
- 1) Austin Creek nr Cazadero
- 2) Russian River near Ukiah
- 3) EF Russian R nr Calpella
- 4) Big Sulfur Creek nr Cloverdale
- 5) Santa Rosa Creek at Santa Rosa
- 6) Laguna de Santa Rosa near Sebastopol
- 7) Napa River near Napa
- 8) Napa River near St. Helena

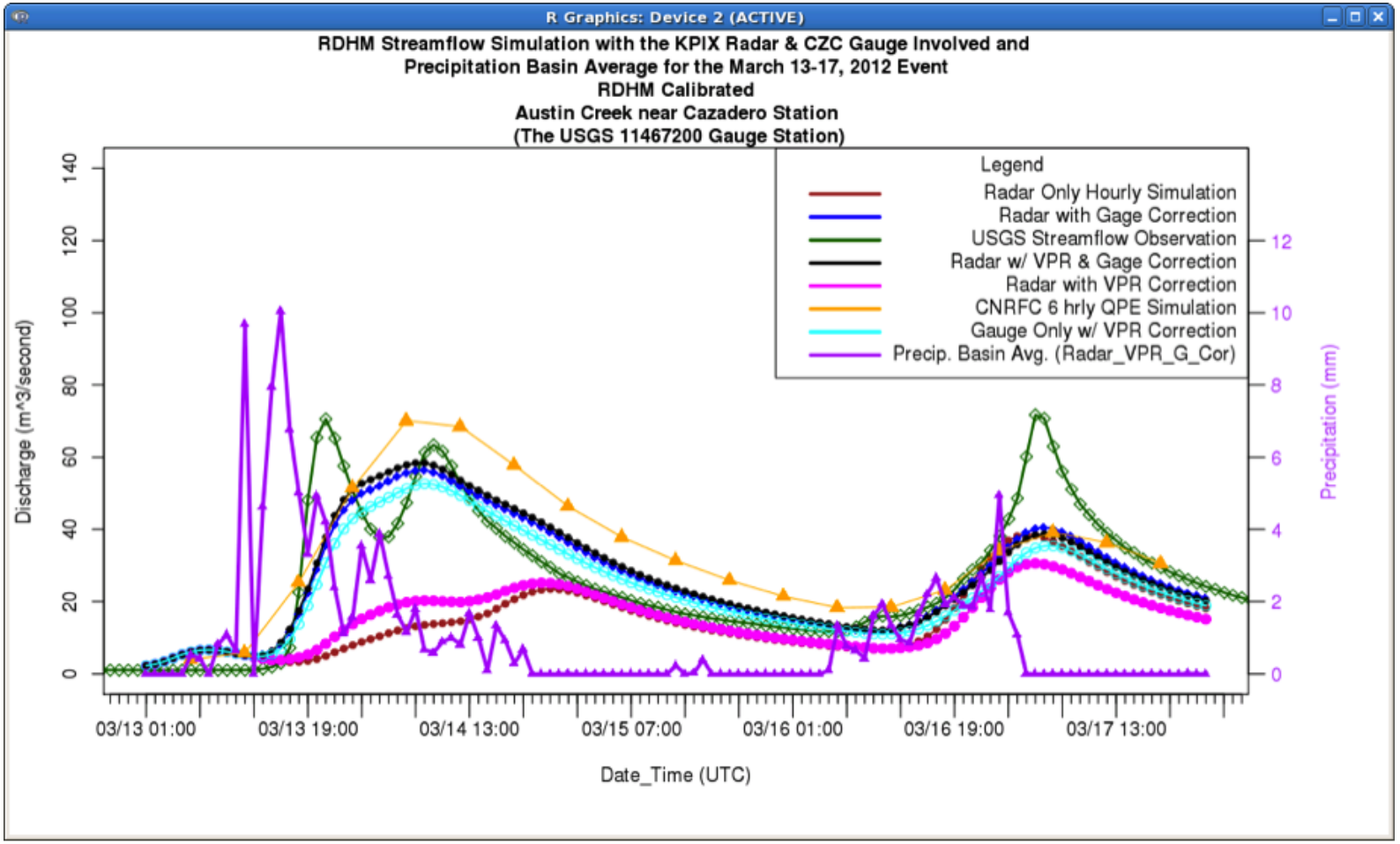


Russian River near Ukiah



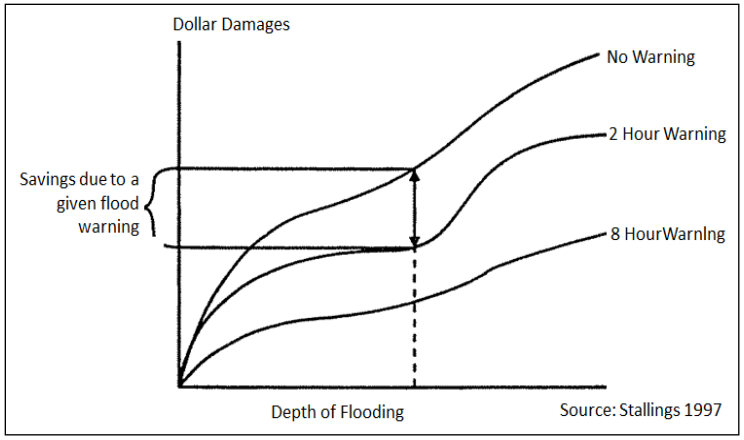
Evaluation Statistic	*Value*
Nash-Sutcliffe	0.87
Percent Bias	-5.2%
RSR	0.36
Rmod (3/15/11 to 4/07/11)	0.86

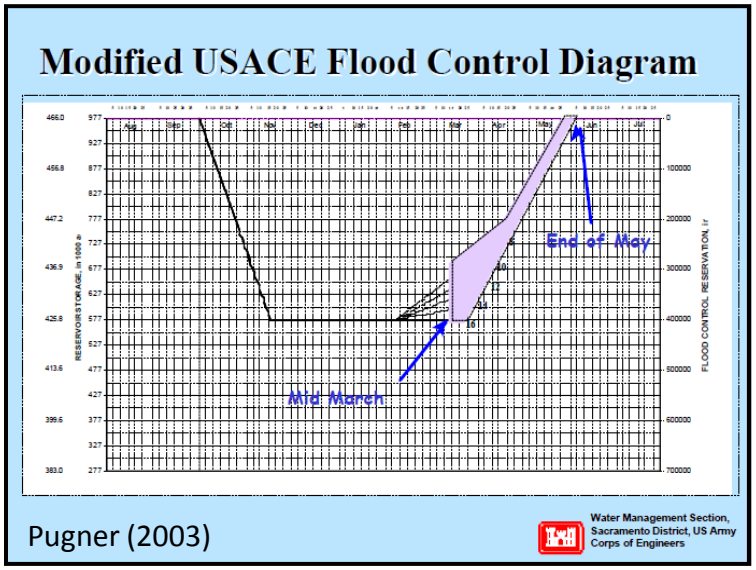
RDHM Simulation: March 2012



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 $25/AF is $750,000/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

Future Directions

- Continue prototyping high resolution QPE and hydrological model in Russian-Napa
  - Firm up best QPE methodology
  - Have system hosted at one or more WFOs
    - Replicate system developed at AKRFC for HI
    - Effort leverages FFG provided by CNRFC
- Acknowledgements
  - National Severe Storms Laboratory and Office of Hydrologic Development