

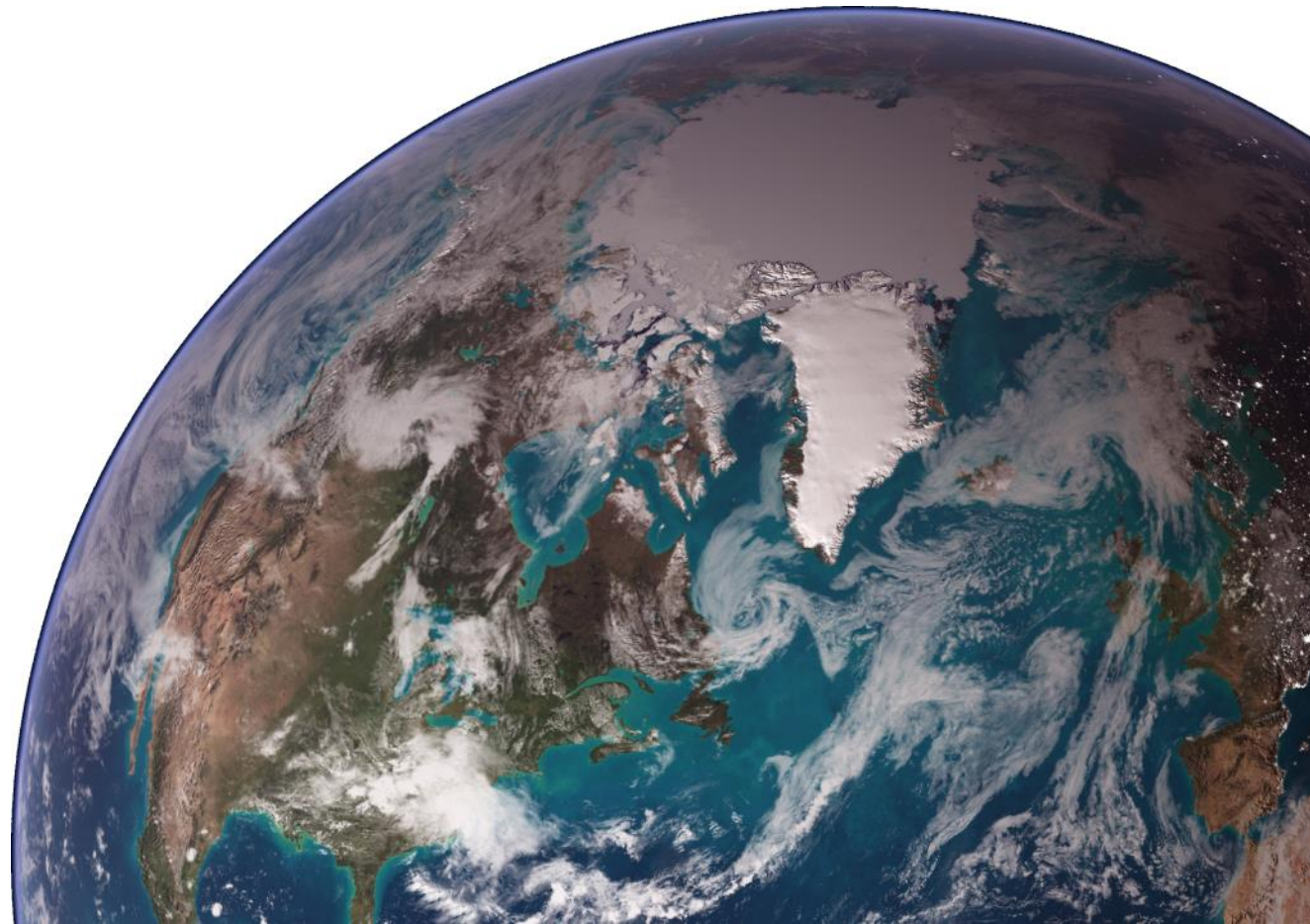


NOAA RESEARCH • ESRL • PHYSICAL SCIENCES DIVISION

A "Sea to Summit to Sea" Approach to Improve Management of Water Resources

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Science Review
12-14 May 2015
Boulder, Colorado



A "Sea to Summit to Sea" Approach to Improve Management of Water Resources

- San Francisco Bay Area Stakeholders and Collaborators
- Sea-to-Summit-to-Sea Integrated Monitoring, Analysis, and Prediction System
- Water Management Interfaces
 - Reduce Flood Damages With Increased Lead Time
 - Enhance NWS WFO Flash Flood Warning Services With Distributed Hydrologic Model
 - Enhance Water Supply With Reservoir Forecast-based Operations (FBO)
 - Reduce Combined Sewer Discharges With Advanced Precipitation Forecasting
 - Enhance Endangered Fisheries Habitat With Coupled Water Management Modeling
- Forecast Benefits Assessment

Stakeholders and Collaborators

• Federal

- National Weather Service
 - California-Nevada River Forecast Center
 - San Francisco – Monterey Weather Forecast Office
 - NWS National Water Center
- National Marine Fisheries Service
- National Ocean Service
- US Army Corps of Engineers
- US Geological Survey
- Federal Emergency Management Agency

• State and Local

- California Department of Water Resources
- Sonoma County Water Agency
- Scripps Center for Western Weather and Water Extremes
- Mendocino County Russian River Flood Control District
- San Francisco Public Utilities Commission
- Santa Clara County Water Agency
- Bay Area Flood Protection Agencies Association
- San Francisco Estuary Partnership



TIME FRAMES AND WATER MANAGEMENT PURPOSES

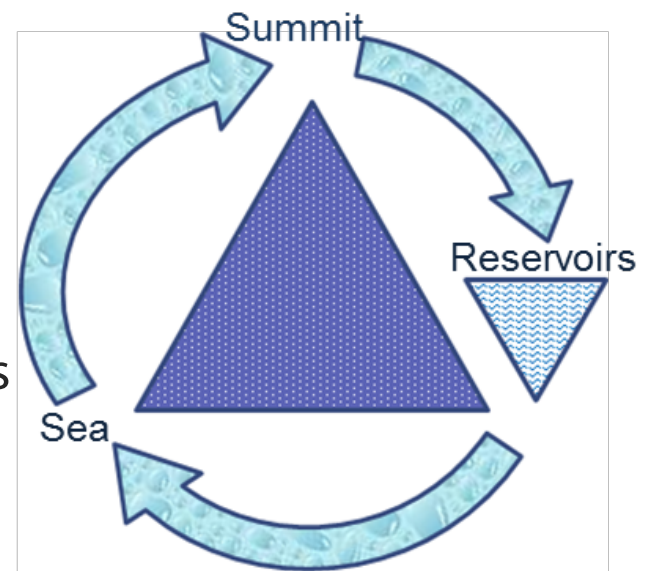
Time Frame / Purpose	Nowcast (0 min – 6 hrs)	Near Real-time (6 hr – 1 day)	Short-term (1 day – 1 week)	Near-term (1 wk – 3 mon)	Mid-term (6 mon – 2 yrs)	Long-term (5 years+)
Flood Mitigation	Flood status assessment	FF warning; Response deploy; System opt.	Flood warning; Response deploy; Reservoir FBO	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

PSD HMT Focus
<http://hmt.noaa.gov/>

Sea to Summit to Sea

Integrated Monitoring, Analysis, and Prediction System

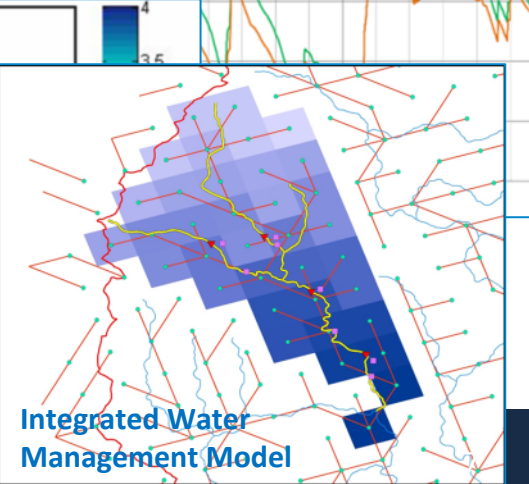
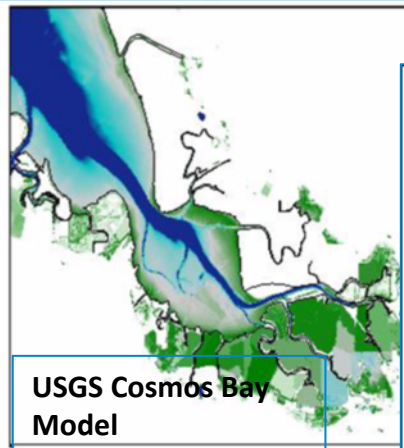
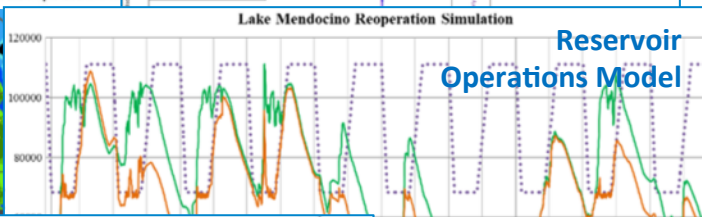
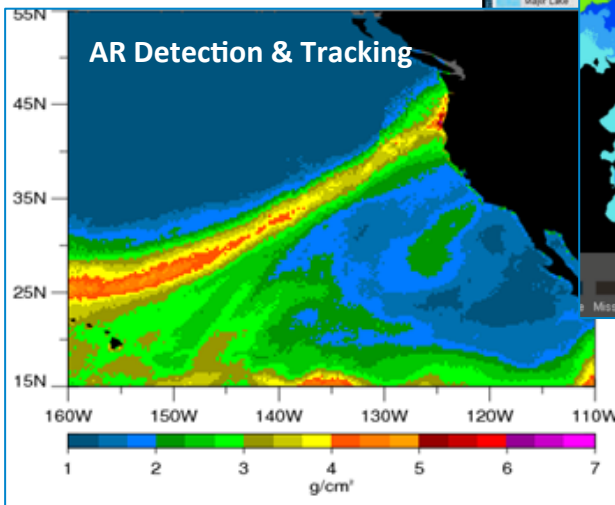
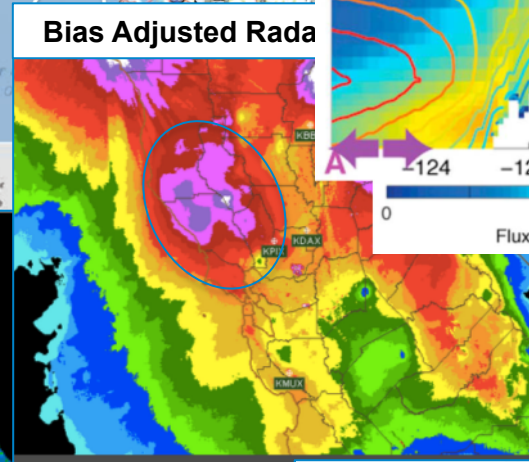
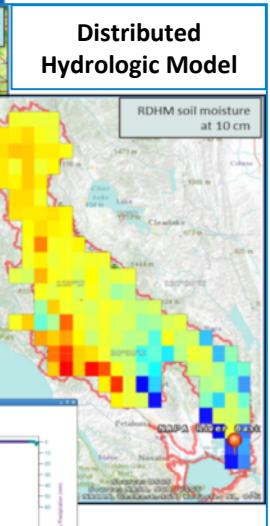
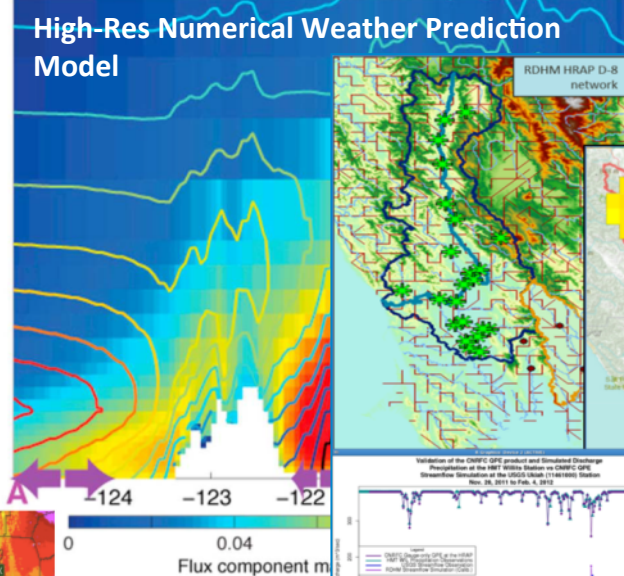
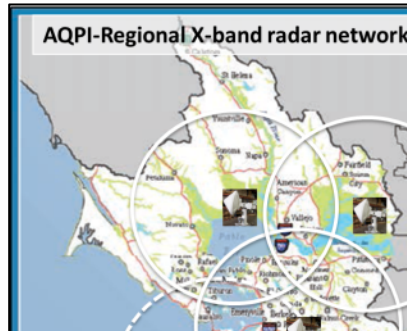
- Sea
 - Offshore storm detection and tracking
 - Numerical weather prediction models
- To Summit
 - Gap-filling radars
 - Rain, weather and soil moisture observations
 - Numerical weather prediction models
- To Sea
 - Stream flow observations
 - Hydrological models – “Natural flows”
 - Water management – “Managed flows”



San Francisco Bay Area R2O Projects

- Russian River Basin
 - Pilot for ESRL PSD HMT
 - Pilot for Integrated Water Resources Science and Services (IWRSS)
 - Pilot for National Integrated Drought Information System
 - Pilot for NOAA Habitat Blueprint Habitat Focus Area
- SF Bay Advanced Quantitative Precipitation Information (AQPI) System
- SF Bay Integrated Hydrologic and Shoreline Flood Model

Sea to Summit to Sea Integrated Monitoring, Analysis, and Prediction System



Enhance Flash Flood Warning Services With Distributed Hydrologic Model

• Purpose:

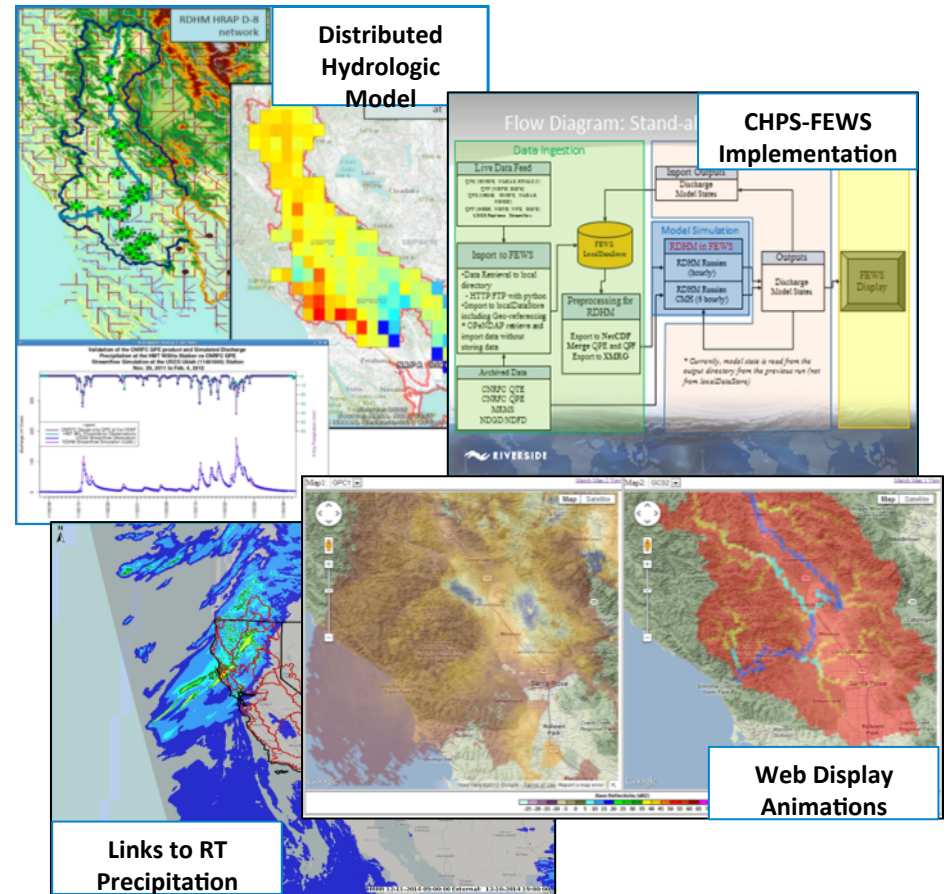
- Account for spatial distribution of rain, topography, soils, land use and runoff
- Tool to assess QPE/QPF products
- Prototype for flash flood forecasting at ungaged sites

• Research Distributed Hydrologic Model (RDHM)

- Developed by NWS-OHD for nation-wide deployment
- 2-D using HRAP grid (~4.1 km side; also ~1 km)
- Gridded precipitation and surface temperature (6-hr, 1-hr time steps)
- Soil moisture linked to observations

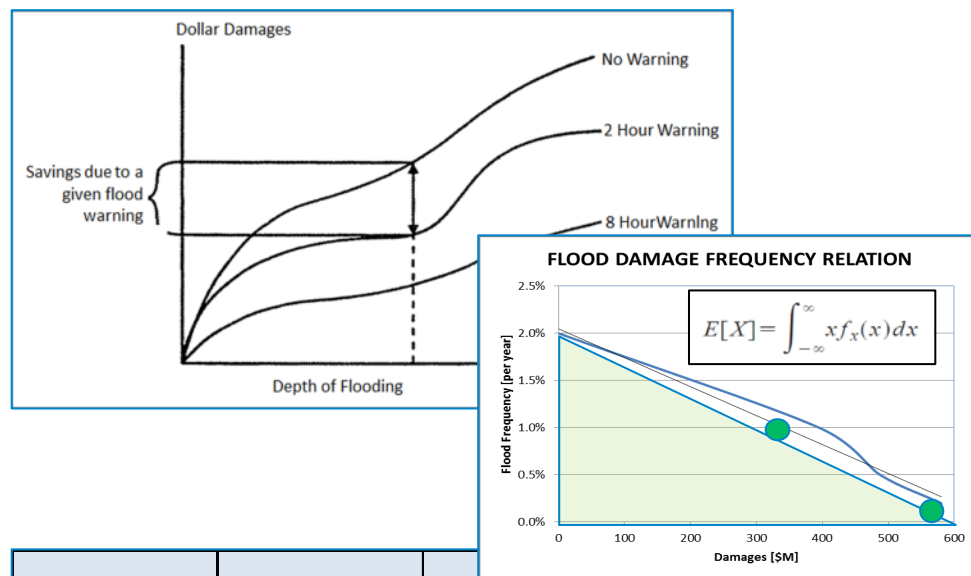
• Implemented in CHPS-FEWS

- Prototype real-time operations
- Links to real-time precipitation fields
- Web display of animations



Reduce Flood Damages With Increased Lead Time

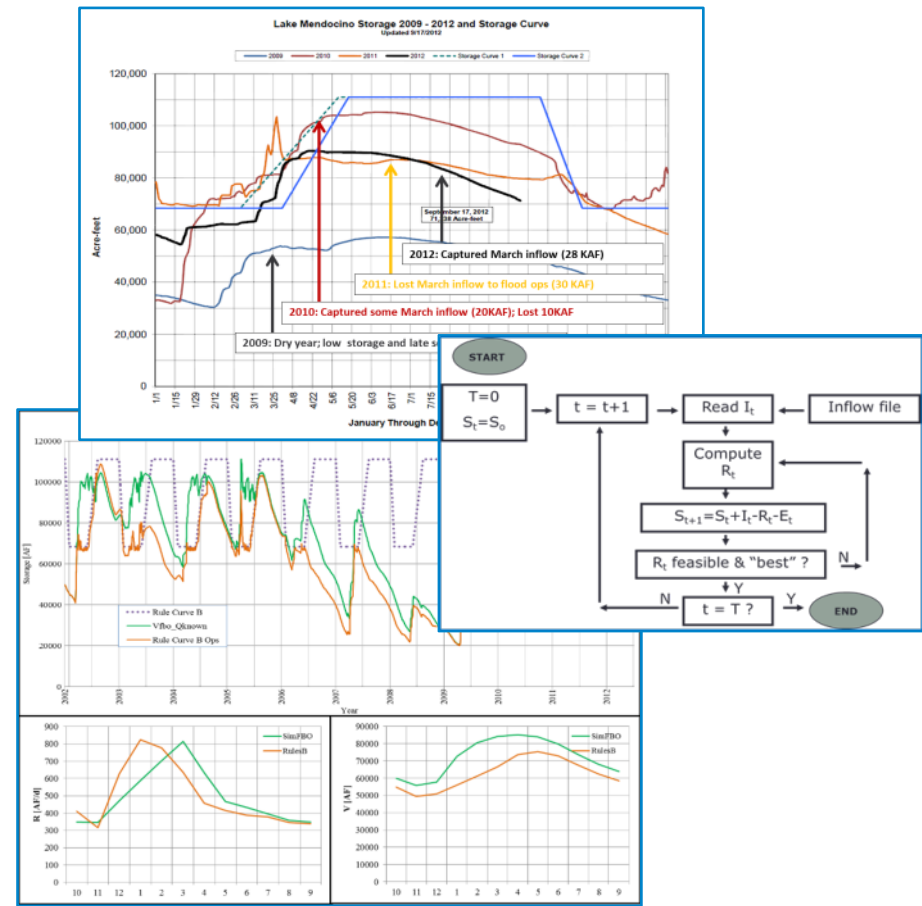
- Flood damage frequency relation
- Expected annual damage reductions with 12 hr lead time
 - Household contents value
 - 5% - 10% gross estimate
 - \$240M per year
 - AQPI 1% - 2% incremental estimate
 - \$62M per year



County	Structures in 100-yr Floodplain	Structures in 500-yr Floodplain	Exp. Annual Contents Damages [\$M/yr]
Alameda	10,100	38,500	\$11.5
Contra Costa	15,300	25,300	\$11.7
Marin	13,300	22,100	\$10.2
Napa	4,900	6,500	\$3.5
San Francisco	0	0	\$0.0
San Mateo	30,300	44,700	\$22.2
Santa Clara	37,100	201,600	\$52.9
Solano	7,200	23,100	\$7.5
Sonoma	7,900	11,600	\$5.8
Total	126,100	373,400	\$125.3

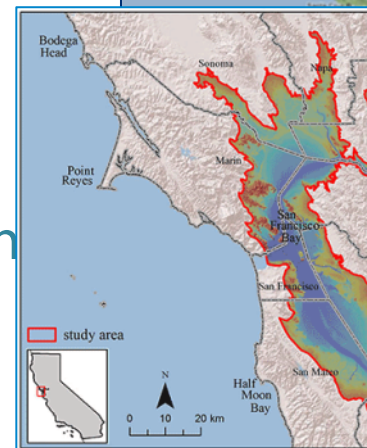
Enhance Water Supply With Reservoir Forecast-based Operations (FBO)

- Fixed rule curve operations lose water by ignoring forecasts
- FldOps simulation model
 - Rule curves relaxed for a) flood pre-release if large rain forecast, and b) flood zone capture and hold if no rain forecast
 - 10-day inflow volume look ahead
- Overall increase in storage levels
 - ~ 10 KAF/yr potential additional capture
 - Increase release flows to later in Spring and Summer
 - @\$1K/AF get \$10M/yr benefit



Reduce Combined Sewer Discharges With Advanced Precipitation Information

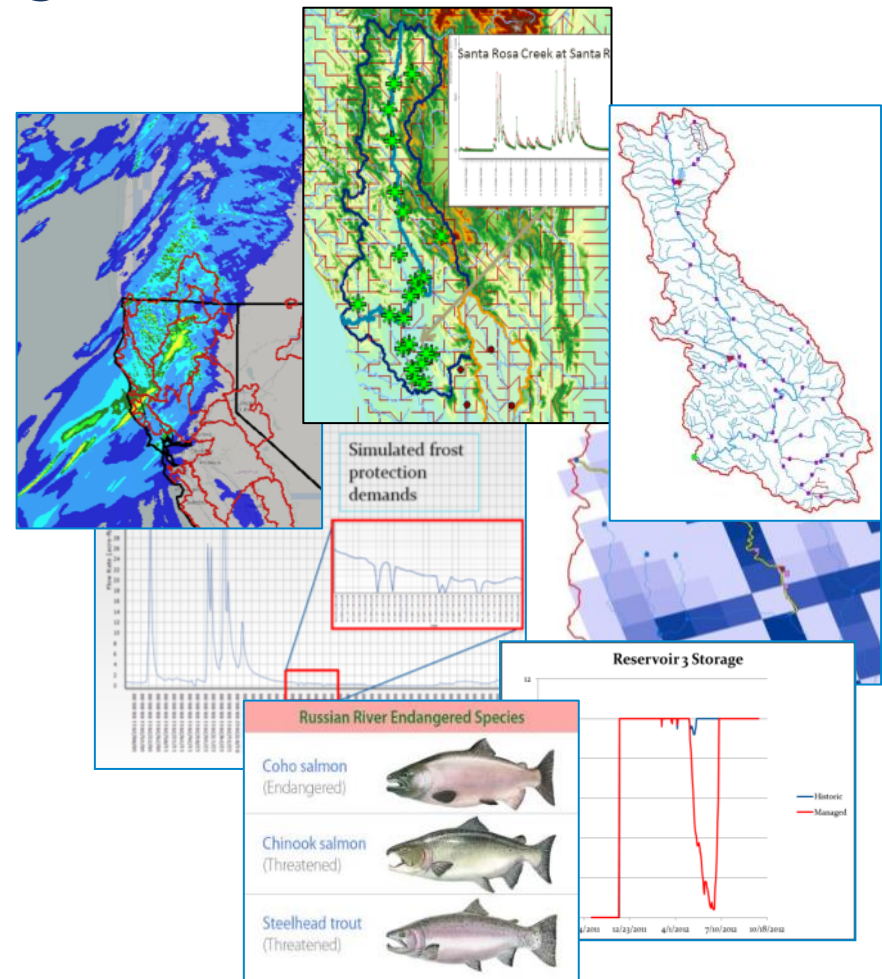
- CASA, C-band, rain gauge network scalable to regional requirements
- Hi-res QPE, nowcasting and QPF (HRRR)
- Compatible with storm water models across region
- SFPUC interested to optimize combined sewer tank operation
- Integrated SF Bay storm inundation forecast
- Regional partners – shared benefits and costs –
 - CA DWR, SF Bay Counties
 - USGS, CNRFC, NOS



San Francisco combined sewer system transport and storage boxes (from San Francisco 2030 Sewer System Master Plan 2011)

Enhance Endangered Fisheries Habitat With Coupled Water Management Modeling

- Gridded precipitation forecasts coupled to gridded hydro model (GHM)
- GHM generates gridded streamflow
- GHM coupled to water management model (WMM)
- Frost forecast model (FFM) used to generate vineyard frost protection water demands
- WMM evaluates pond storage to sustain fish flows



AQPI BENEFITS SUMMARY

• Overall

- Total Wx Benefits (\$240M/yr; \$34/person)
- Incremental AQPI Benefits (\$62M/yr; \$9/person)

• By Category

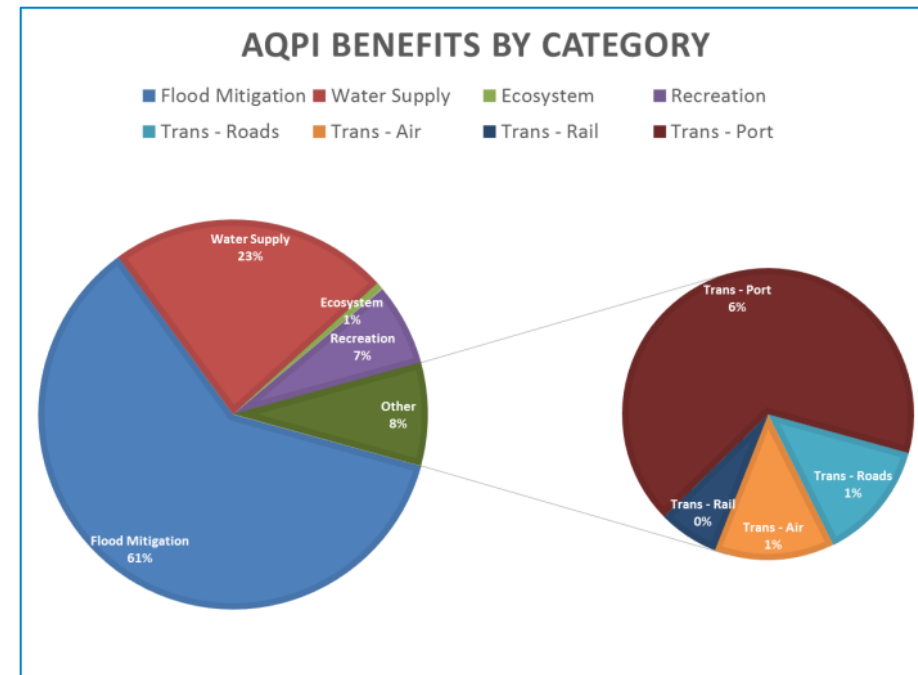
- Flood Mitigation (61%)
- Water Supply (23%)
- Ecosystem Services (8%)
- Transportation (8% (Ports 6%))

• By County

- Santa Clara (Flood Mitigation)
- Sonoma (Water Supply)

• Benefit/Cost Estimates

- Best Estimate – 5:1
- Optimistic – 13:1
- Pessimistic - 2:1



Thanks

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