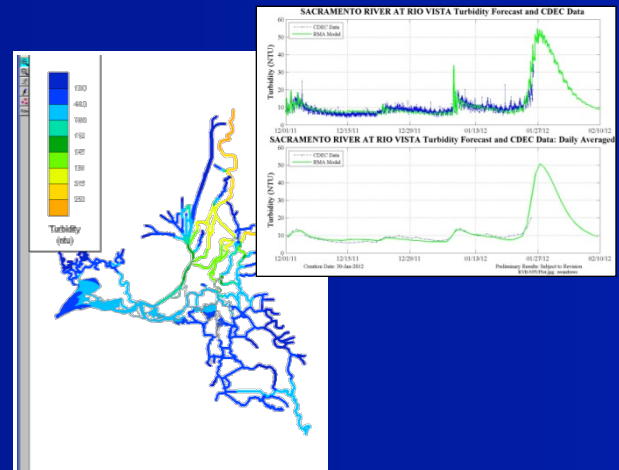


Forecasting Turbidity in the Sacramento-San Joaquin Delta

John DeGeorge, Ph.D.,
Marianne Guerin, Ph.D.
Richard Rachiele
Stephen Andrews, Ph.D.
Stacie Grinbergs, P.E.

Resource Management Associates, Inc.



Acknowledgements

- Funding provided by the Metropolitan Water District of Southern California (MWD)
- Collaborative effort with:
 - Chuching Wang and Paul Hutton, MWD
 - Joel Herr and Scott Sheeder, Systech Water Resources, Inc.
 - Dave and Amye Osti and their staff, 34 North and DeepBlu
- Special thanks to Jon Burau and the USGS for managing the new turbidity monitoring network

Forecasting Objectives

- Use recent observed data, DWR and CNRFC forecasts, and watershed model output to generate three week forecasts of EC, Turbidity, and adult delta smelt (particle) distribution
- Provide weekly forecasts for MWD, Fish and Wildlife Service, Smelt Working group, and others between December and March
- Provide tools for evaluating alternate operations
- This is the third year of the real-time modeling effort

Data Sources

- California Data Exchange Center (CDEC)
 - Recent monitoring data
- California-Nevada River Forecasting Center (CNRFC)
 - 5-day flow forecast
- DWR Operations and Maintenance (O&M) group
 - DSM2 3-week forecast input files
- CIMIS meteorological data
 - Daily and hourly data received weekly

Models and Tools

- WARMF –Watershed Analysis Risk Management Framework (WARMF) Central Valley developed and operated by Joel Herr and Scott Scheeder, Systech
- HEC-DSS Tools for Time Series Management
- RMA Delta Model – Hydrodynamics, EC, Turbidity
- RMA Adult Delta Smelt Particle Model
- Information Dissemination through Bay Delta Live developed and managed by Dave Osti and staff, 34North

Process

■ Thursday Afternoon

■ Friday

■ Monday Morning

Receive DWR DSM2 forecast files
Receive WARMF forecast results



QA and Merge recent monitoring data
with forecast information



Delta Simulation Model
RMA2 (hydrodynamics)
RMA11 (transport)
Adult smelt model (particle tracking)



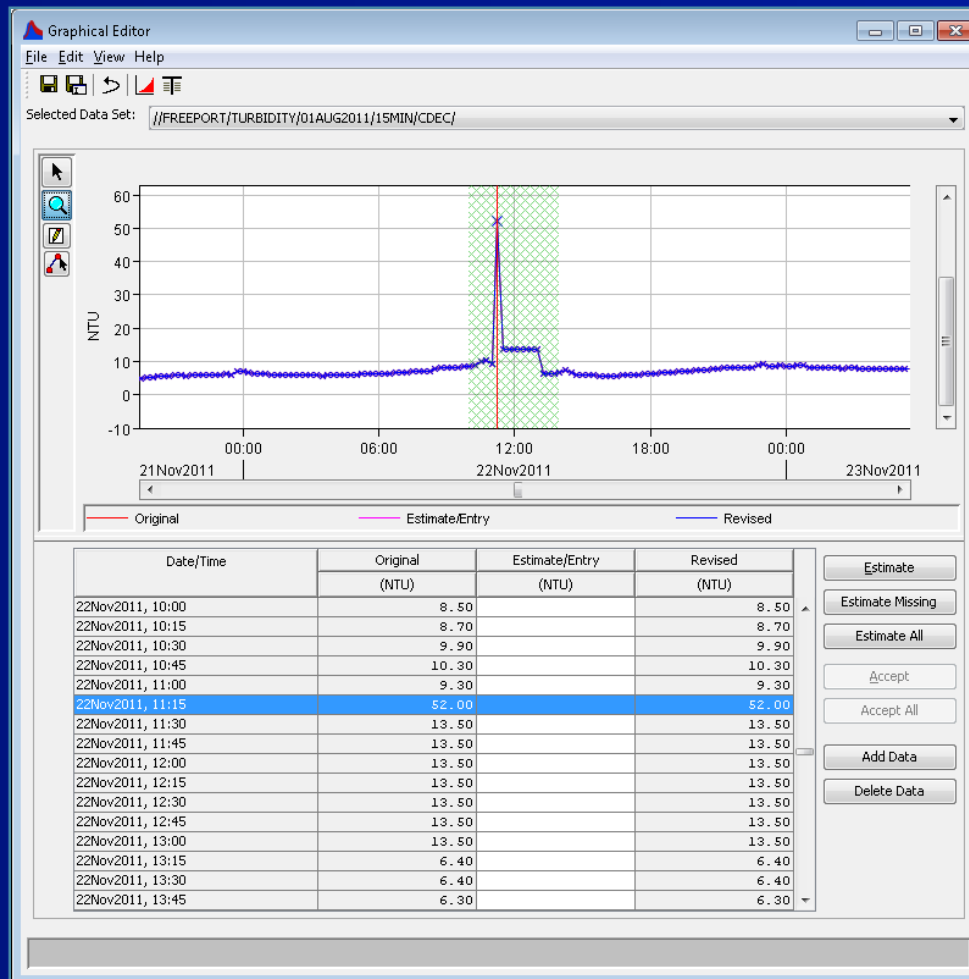
Review Results
Post results to Bay Delta Live
Prepare and submit forecast Summary

Managing Time Series

- Time Series stored in HEC-DSS format
- Automated download from CDEC web site through “plug-in” utility in HEC-DSSVue*
- QA with HEC-DSSVue Graphical Editor
- Merging of Time Series records with custom software tool
- RMA is a lead software development contractor for the USACE Hydrologic Engineering Center and has contributed extensively to the development of HEC-DSSVue

*<http://www.hec.usace.army.mil/software/hec-dss/hecdssvue-dssvue.htm>

DSSVue Graphical Editor



Merging Time Series

Merge Time Series Generator

File Edit Help

DSS Prev-Forecast Input File: C:\work\Real-Time\WY_2012_Forecasting\Compile\Hindcast\Step1\Feb02_2012EC.dss

DSS Obs Data-CDEC Input File: C:\work\Real-Time\WY_2012_Forecasting\Compile\Hindcast\Step1\Hindcast_BC_Long.dss

DSS CNRFC Input File: C:\work\Real-Time\WY_2012_Forecasting\Compile\Hindcast\Step1\Mar08_2012_CNRFC_And_I-St_rating_table.dss

DSS Forecast-WARMF Input File: C:\work\Real-Time\WY_2012_Forecasting\Compile\Hindcast\Step1\forecast.dss

Stations File: C:\work\Real-Time\WY_2012_Forecasting\Compile\Hindcast\Step1\FlowStationsForMerging.csv

Output DSS File: C:\work\Real-Time\WY_2012_Forecasting\Compile\Hindcast\DW\Mar09\final_merged_Mar05_2012.dss

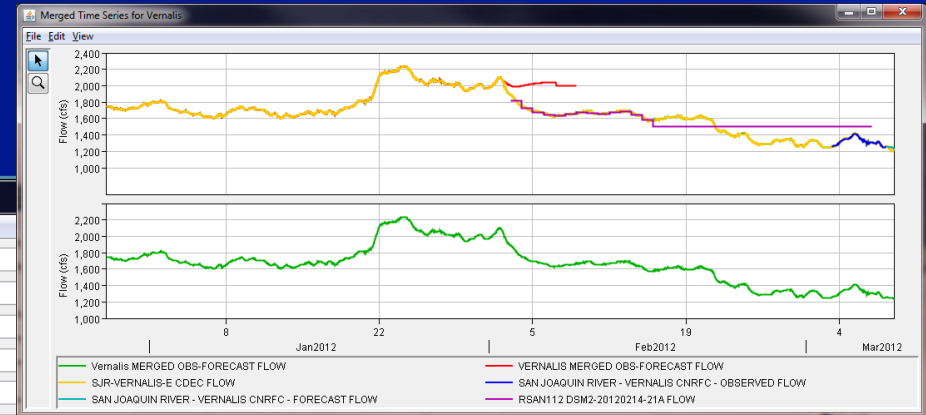
Start Date: 28Dec2011 Start Time: 0000 03MAR2012 09MAR2012

End Date: 08Mar2012 End Time: 2400

Parameter: FLOW

Select	Station Name	Prev-Forecast ID	Obs Data/CDEC ID	CNRFC ID	Forecast/WARMF ID	Merge Option	Time Shift (hrs)	Forecast Fill
<input type="checkbox"/>	Freeport	FREEPORT	CLEANED+FILED/FREEPORT	SACRAMENTO RIVER - SACR...	FORE+CHAN/RSAC155		0.0	
<input checked="" type="checkbox"/>	Vernalis	VERNALIS	CLEANED+FILED/SJR-VERN...	SAN JOAQUIN RIVER - VERN...	FORE+CHAN/RSAN112		0.0	
<input type="checkbox"/>	Yolo	YOLO	CLEANED+FILED/YOLO-LIS...	YOLO BYPASS - LISBON	FORE+CHAN/BYLO040		0.0	
<input type="checkbox"/>	Cosumnes	ALL-OBSERVED/COSUMNES		COSUMNES RIVER - MCCON...	FORE+CHAN/RCSM075		0.0	
<input type="checkbox"/>	Mokelumne	MOKELUMNE			FORE+CHAN/RMKL070		0.0	
<input type="checkbox"/>	Calaveras	CALAVERAS	CLEANED+FILED/MORMON...		FORE+CHAN/RCAL009		0.0	

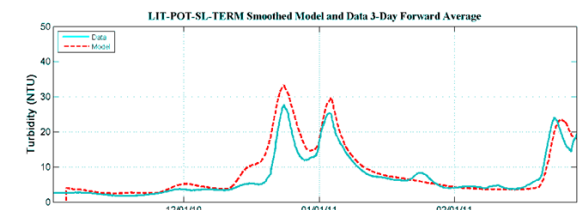
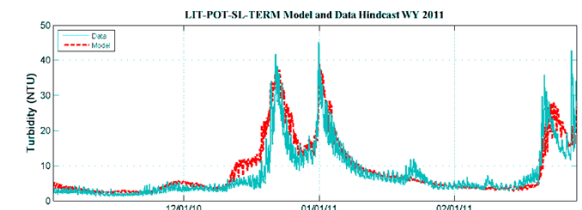
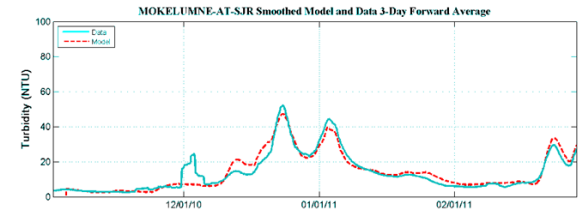
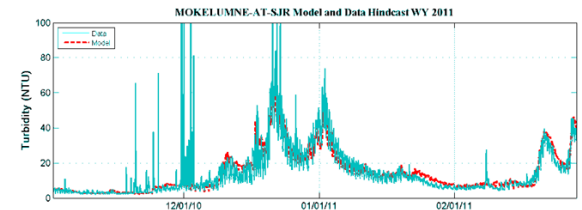
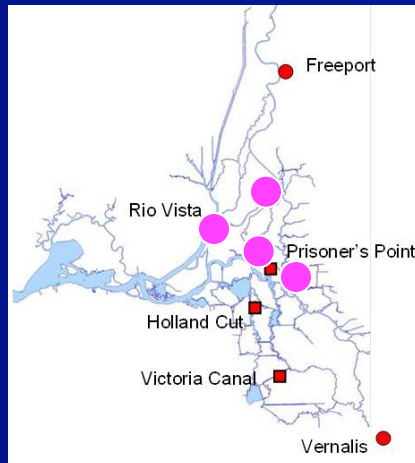
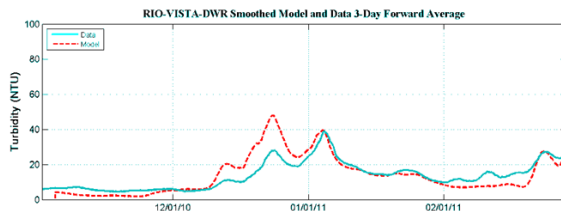
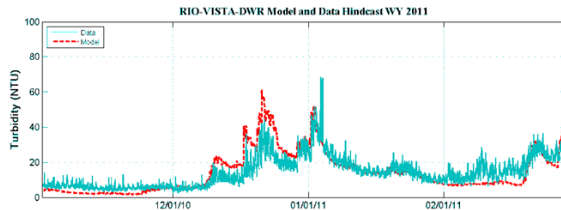
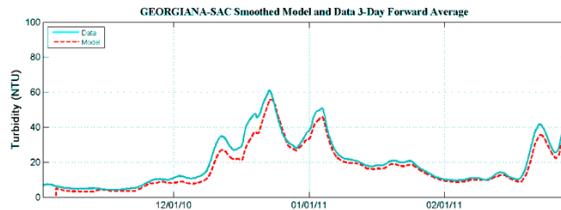
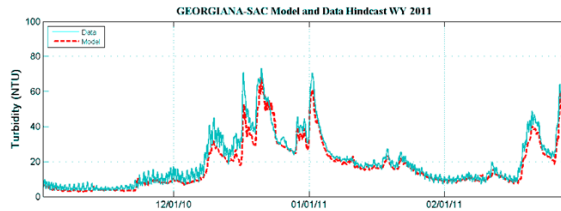
Select All Deselect All Plot Station Time Series Output Merged TS File



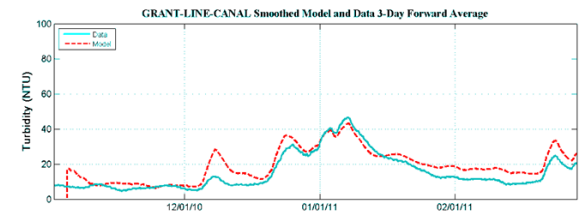
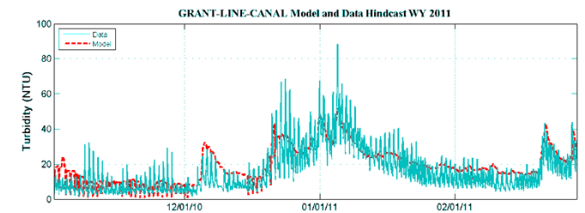
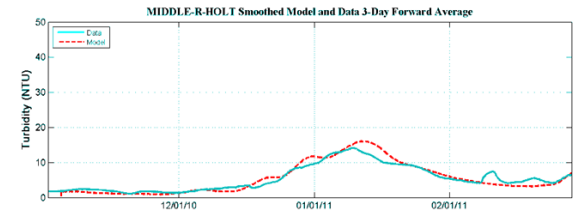
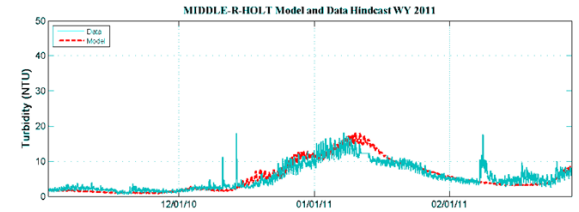
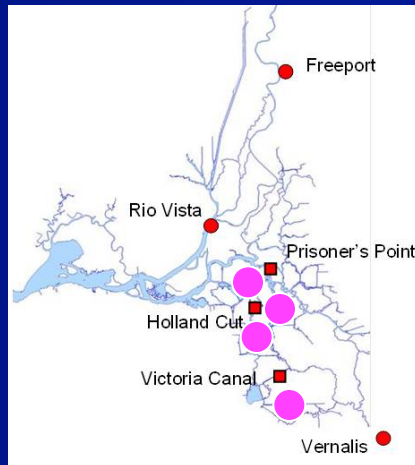
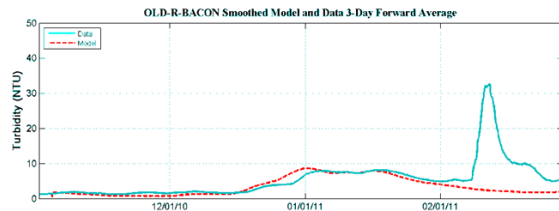
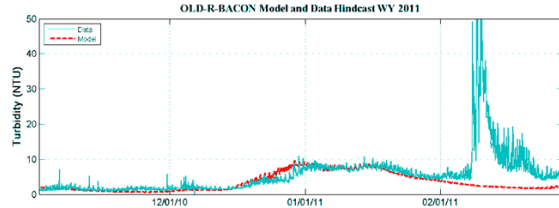
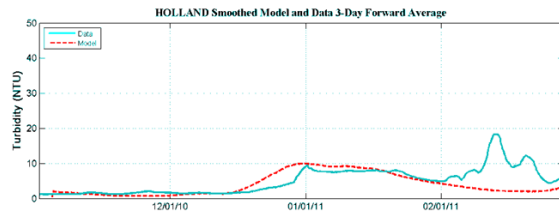
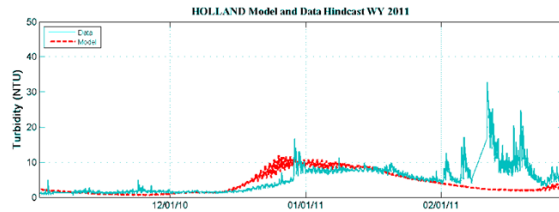
Turbidity Model

- Simulation of turbidity in the Delta as a function of tributary loading
- Uses a simple first order decay to represent averaged deposition/resuspension of suspended sediments or decay of organics
- An interim approach until a full sediment model is available (work is underway)
- Originally calibrated for 2007 conditions, updated for 2011 conditions
 - Project Reports: Resource Management Associates, Inc. (RMA), 2008. “San Francisco Bay-Delta Turbidity Modeling”, and Resource Management Associates, Inc. (RMA), 2011. Turbidity and Adult Delta Smelt Forecasting with RMA 2-D Models: December 2010 – February 2011, prepared for Metropolitan Water District of Southern California.

2011 Turbidity Hindcast Results



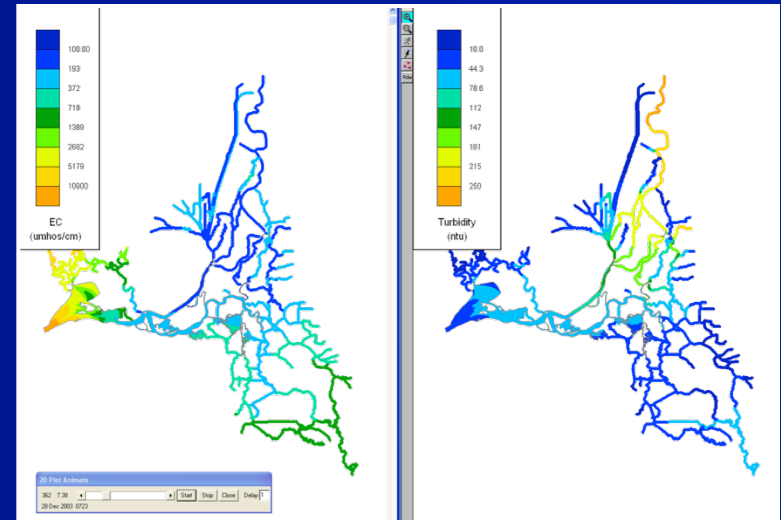
2011 Turbidity Hindcast Results



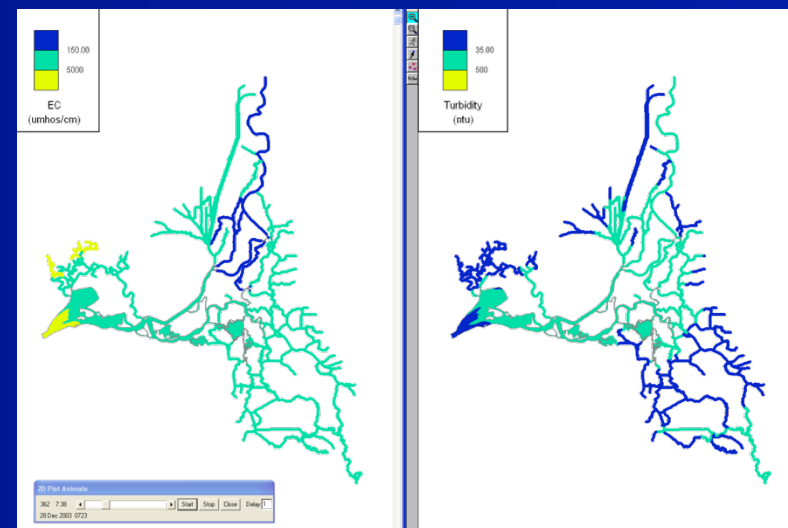
Adult Delta Smelt Particle Model

- All movement is accomplished by “surfing” the tidal flows
- Move away from high EC (representing desire to move upstream)
- Move toward higher (favored) turbidity
- Randomly explore region of acceptable habitat
 - Project Report: Resource Management Associates, Inc. (RMA), 2009a “Particle Tracking and Analysis of Adult and Larval/Juvenile Delta Smelt for 2-Gates Demonstration Project”, prepared for Metropolitan Water District of Southern California.

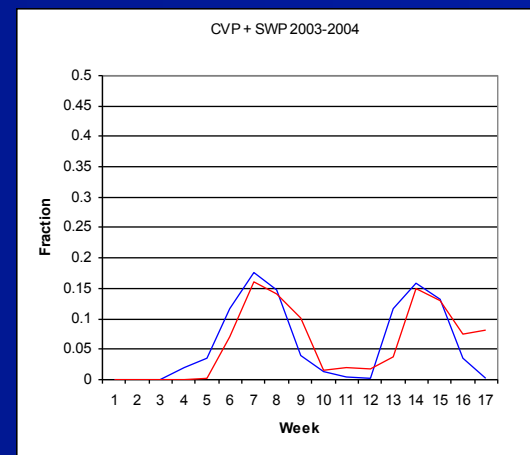
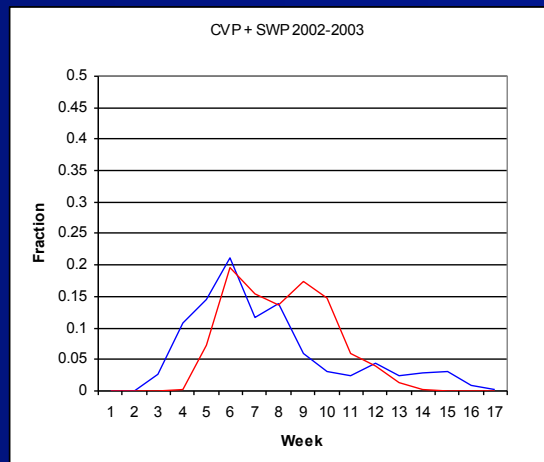
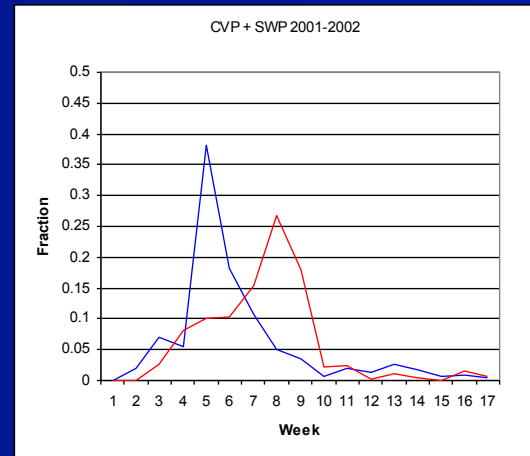
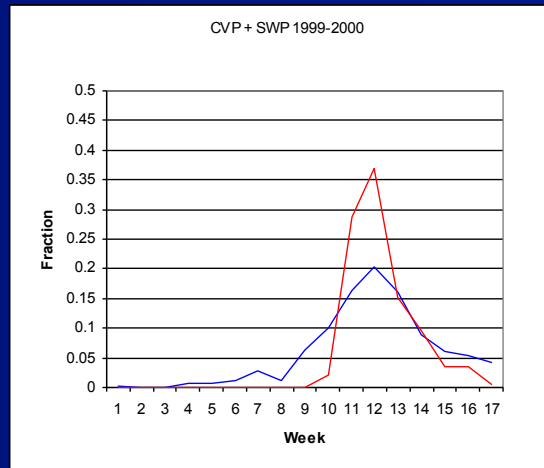
EC and Turbidity Distribution



Favored Range



Comparison of Adult Delta Smelt Particle Entrainment (CVP +SWP) to Observed Salvage (Normalized Weekly counts)



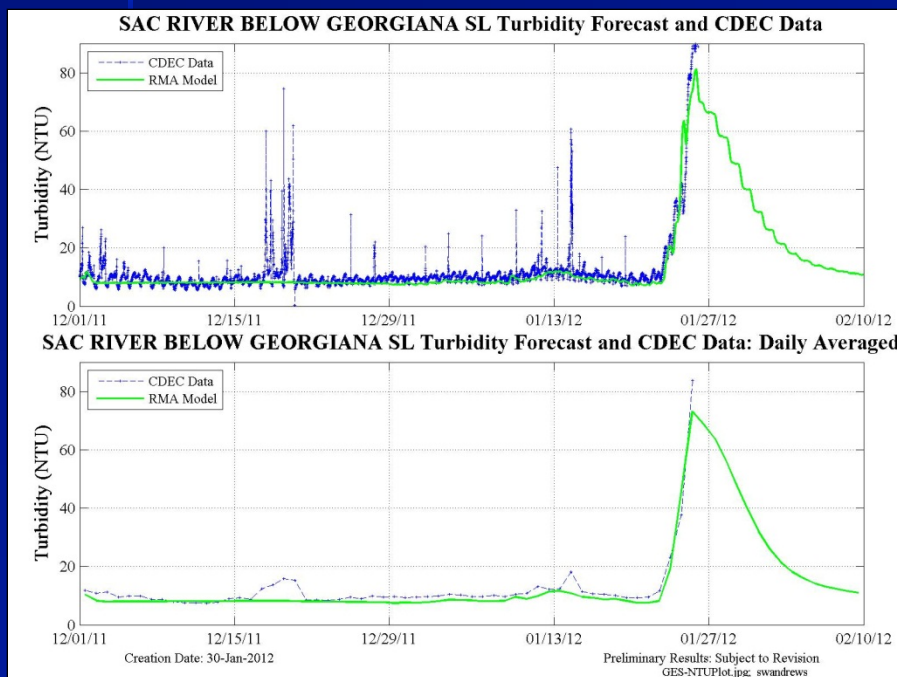
— Predicted — Observed

Forecast Products

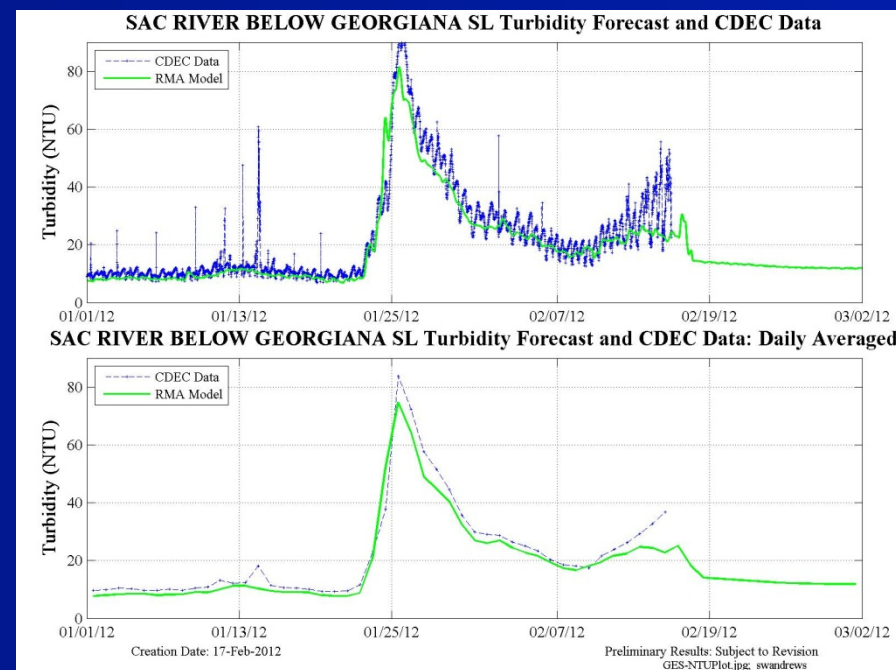
- Summary Assessment
 - Pre-Forecast
 - Turbidity 3-Stations Performance and Summary
 - Smelt (Particle) Movement Summary
- Forecast Boundary Conditions
 - Tributary Inflows and Turbidity
 - Exports
 - Tidal Boundary
- Simulation Output
 - Turbidity time series at 3 compliance stations, SWP, and other in-Delta locations
 - Smelt (particle) distribution at three times during simulation period and time series of estimated particle entrainment at SWP/CVP

Turbidity Forecast Results

Sac River below Georgiana Sl.

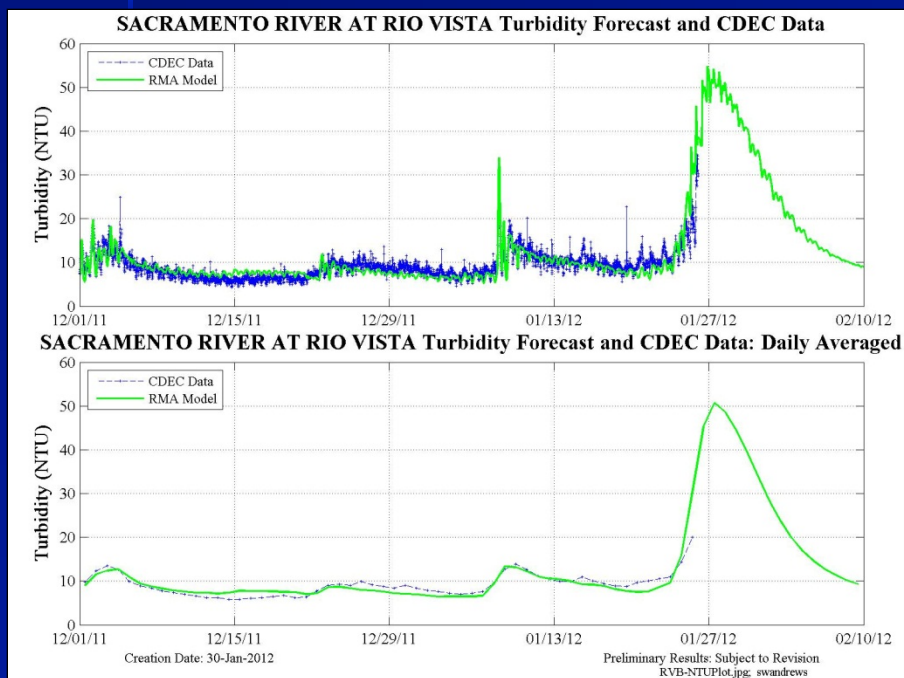


January 26, 2012 Forecast

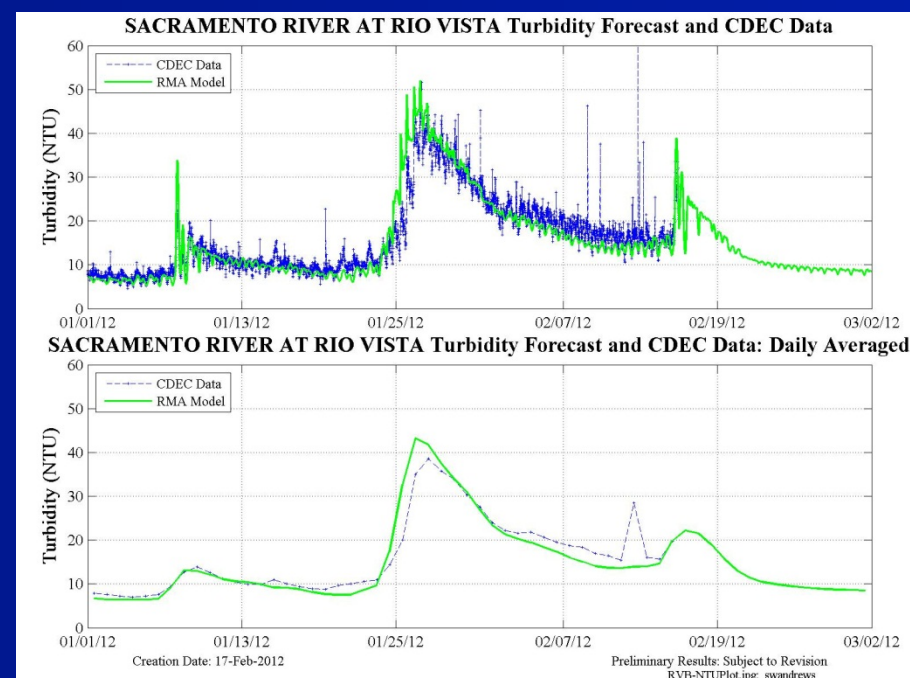


February 16, 2012 Forecast

Turbidity Forecast Results Sac River at Rio Vista

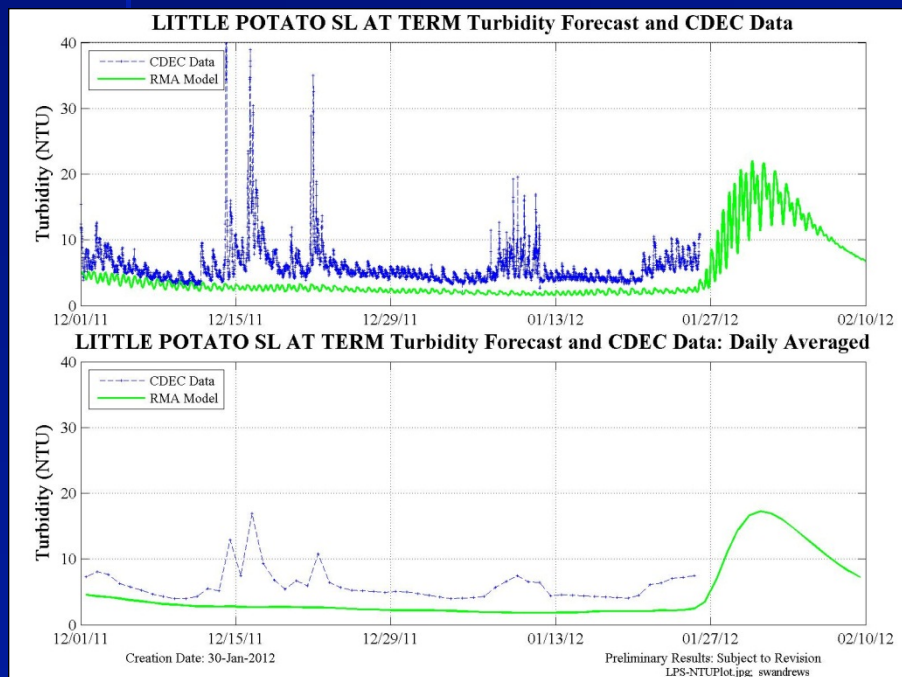


January 26, 2012 Forecast

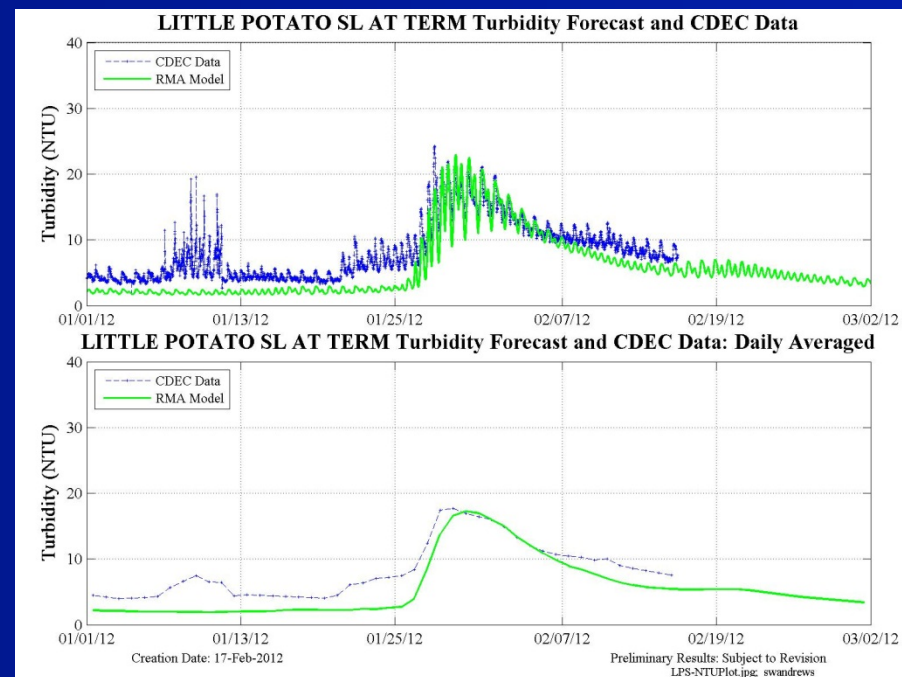


February 16, 2012 Forecast

Turbidity Forecast Results Little Potato Sl. At Terminous

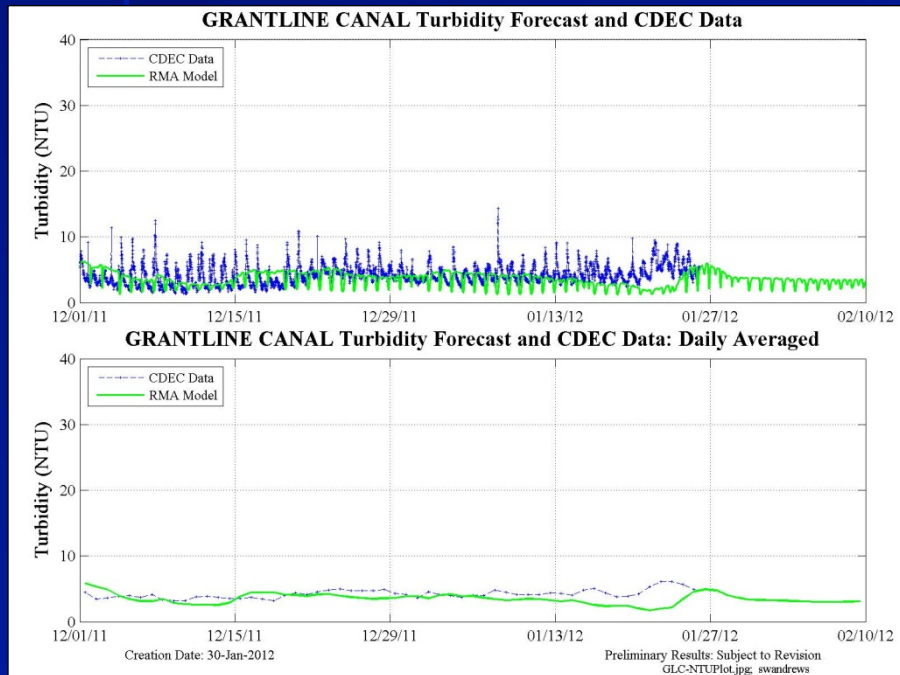
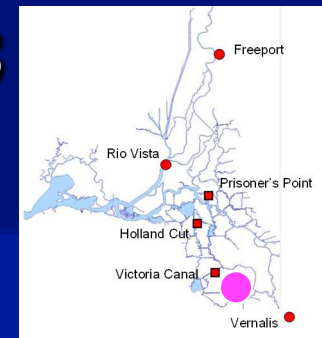


January 26, 2012 Forecast

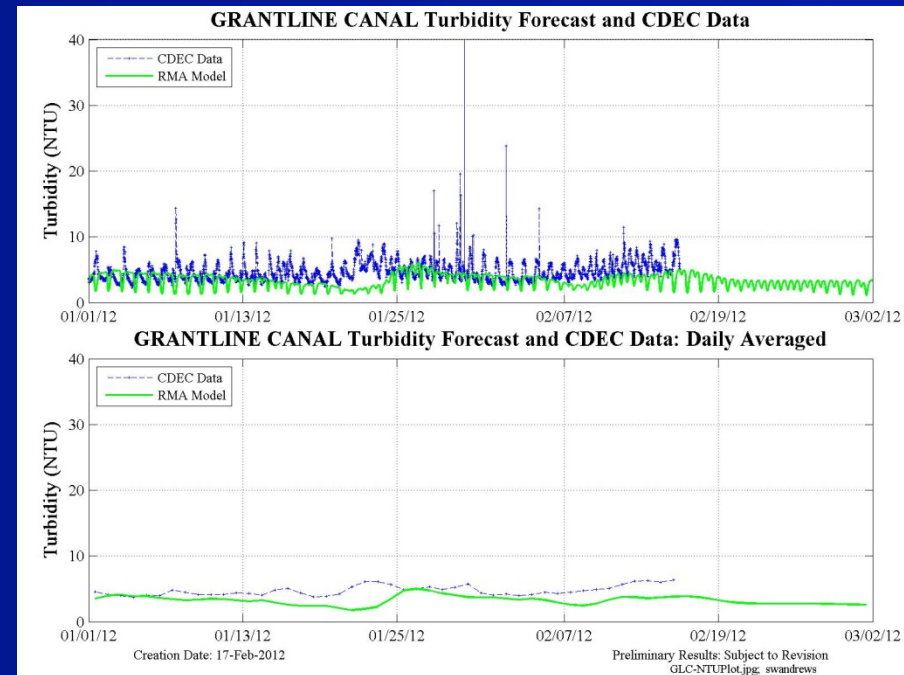


February 16, 2012 Forecast

Turbidity Forecast Results Grant Line Canal

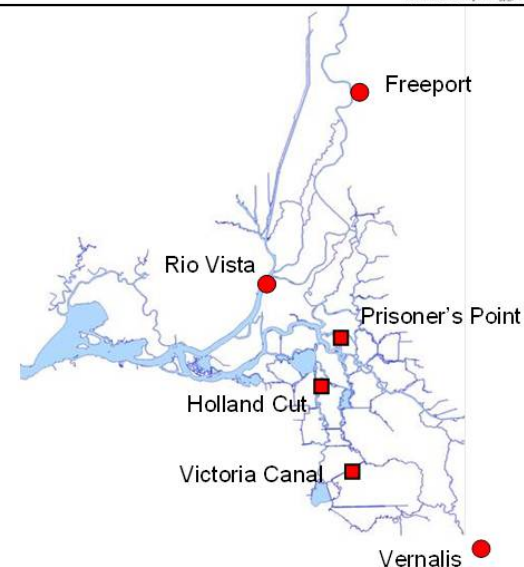
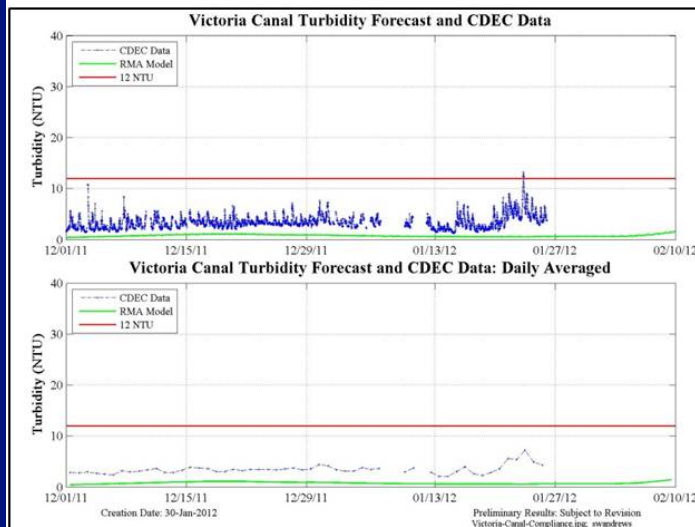
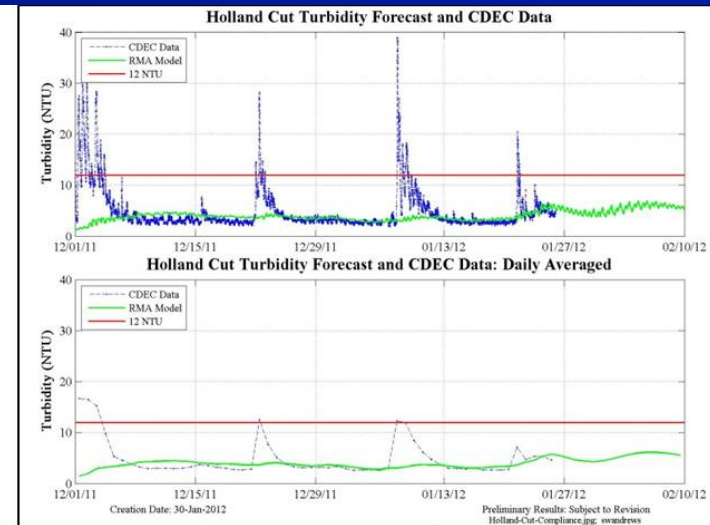
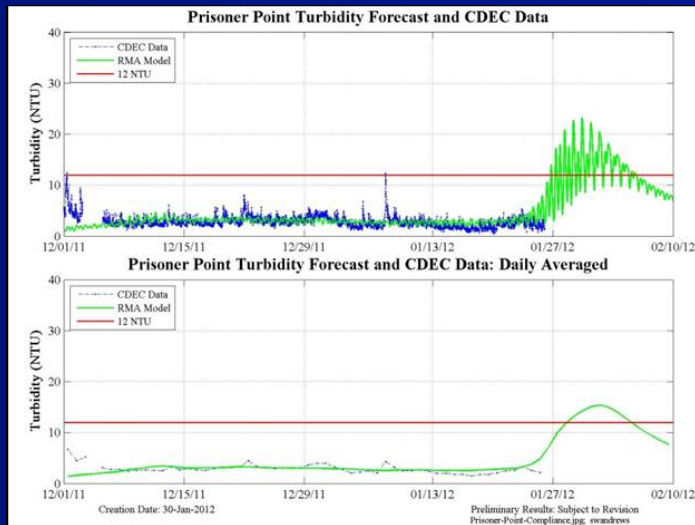


January 26, 2012 Forecast

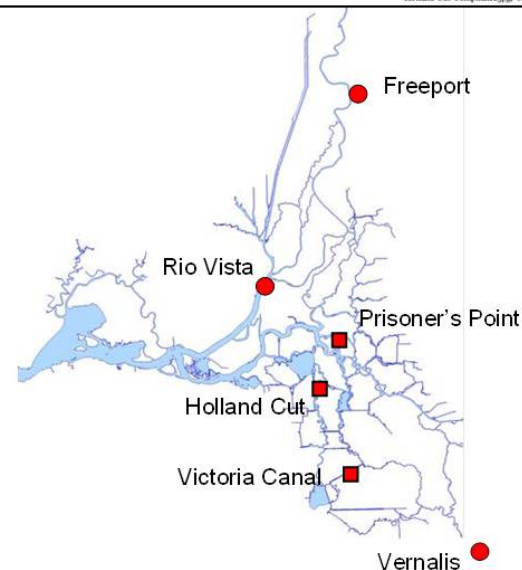
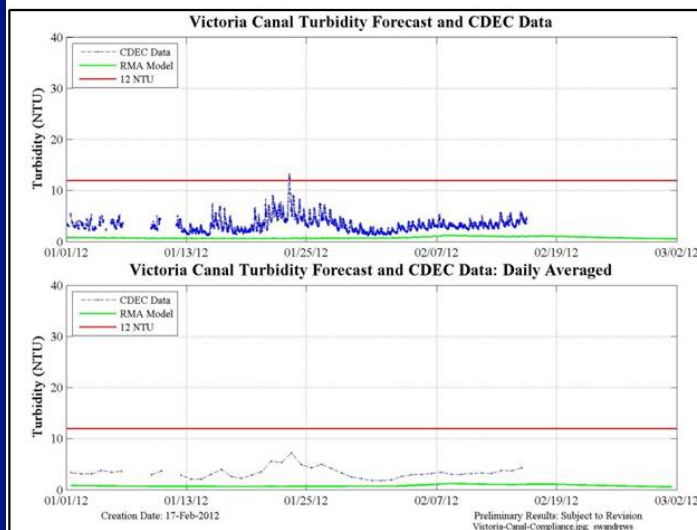
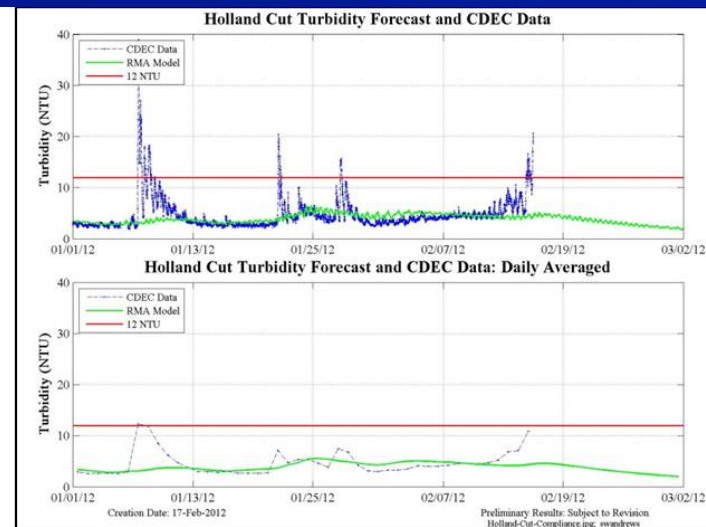
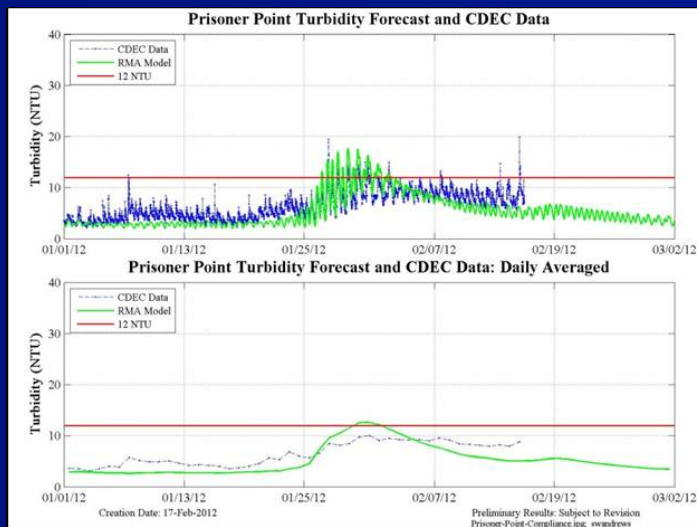


February 16, 2012 Forecast

Turbidity Forecast Results Three Compliance Locations



Turbidity Forecast Results Three Compliance Locations



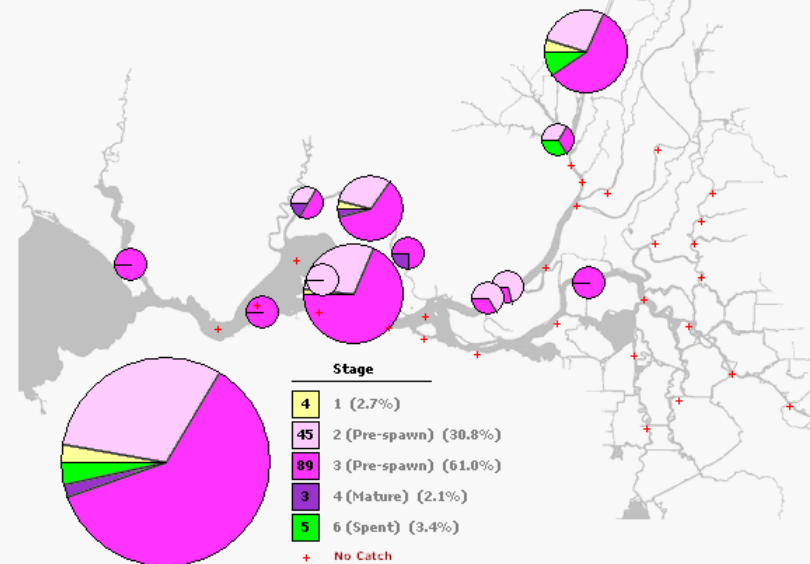
Kodiak Trawl Survey and Particle Distribution Maps

Delta Smelt Distribution Maps

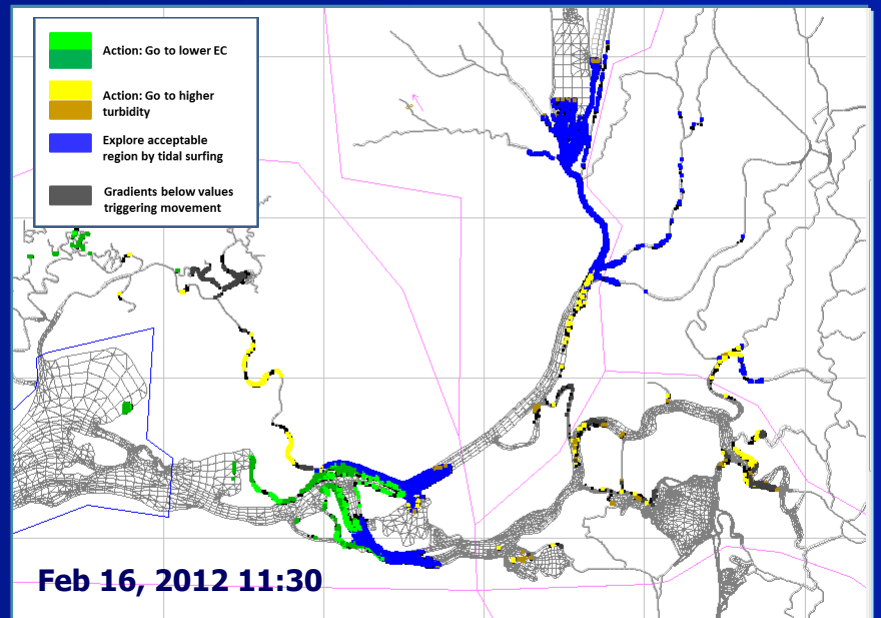
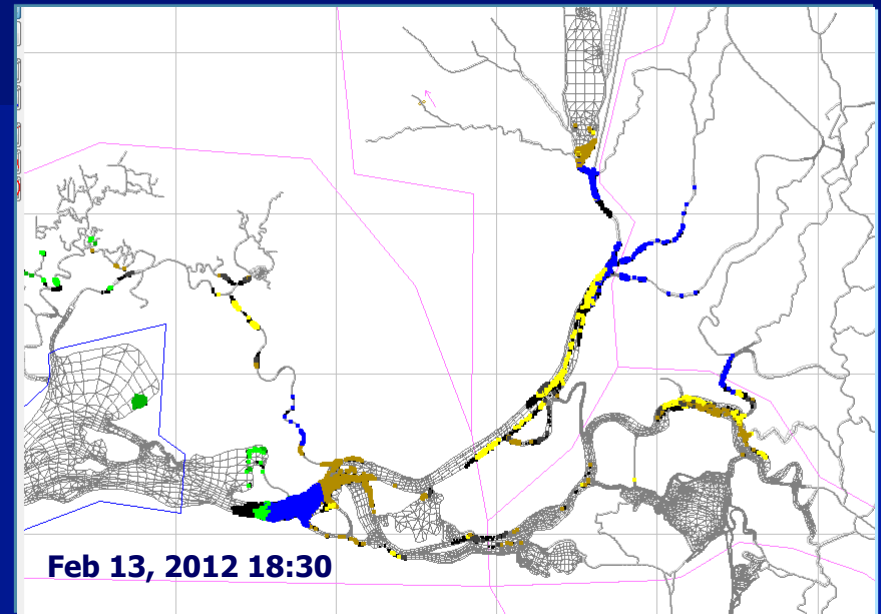
Year	Survey	Report Type	Show	Zoom	
2012	2	Females	Normal	1x (Normal)	Display Map

To view station details, move mouse over center of pie chart.

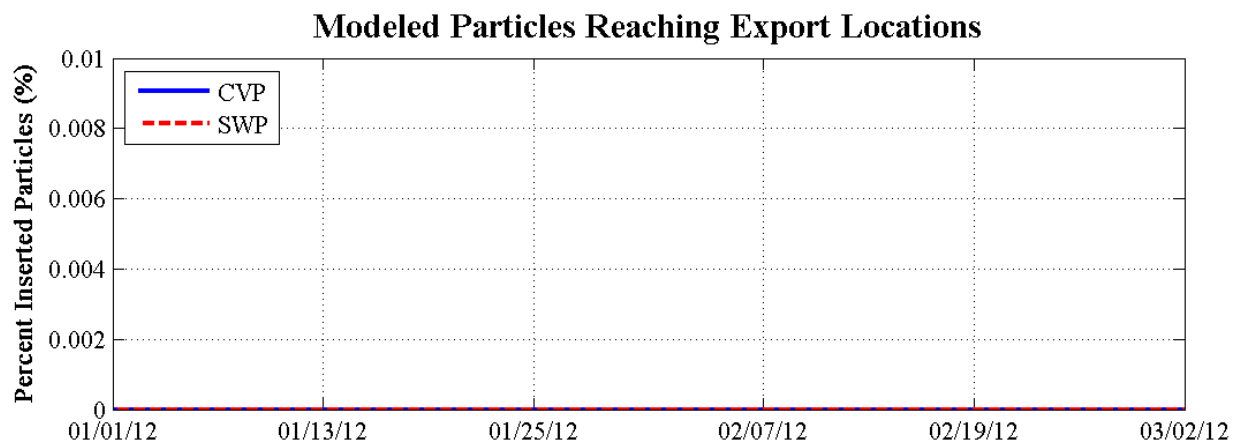
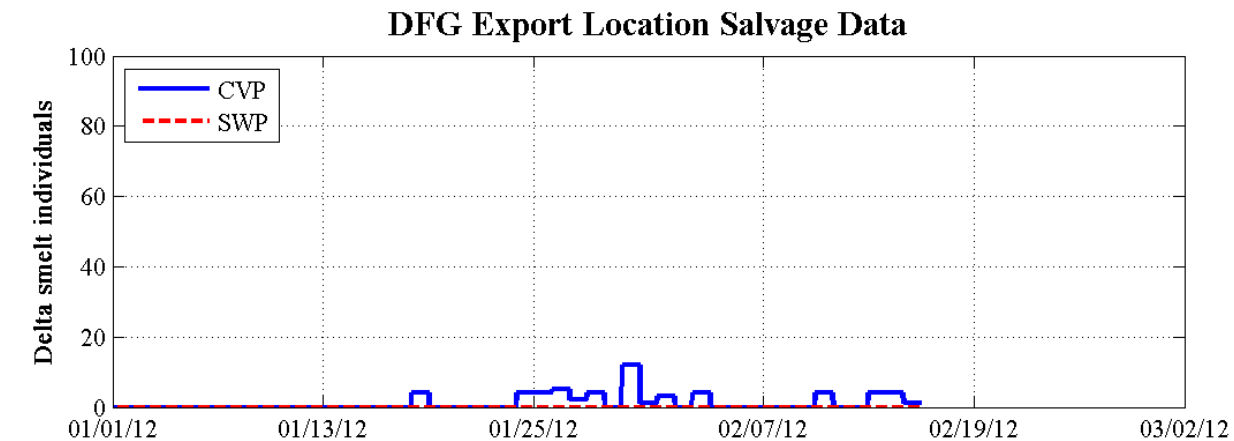
Spring Kodiak Trawl Survey #2 of 2012 Distribution of Female Delta Smelt (2/13/2012 - 2/16/2012)



www.dfg.ca.gov/delta/data/skt/DisplayMaps.asp



Comparison of DFG export salvage data and simulated particle entrainment

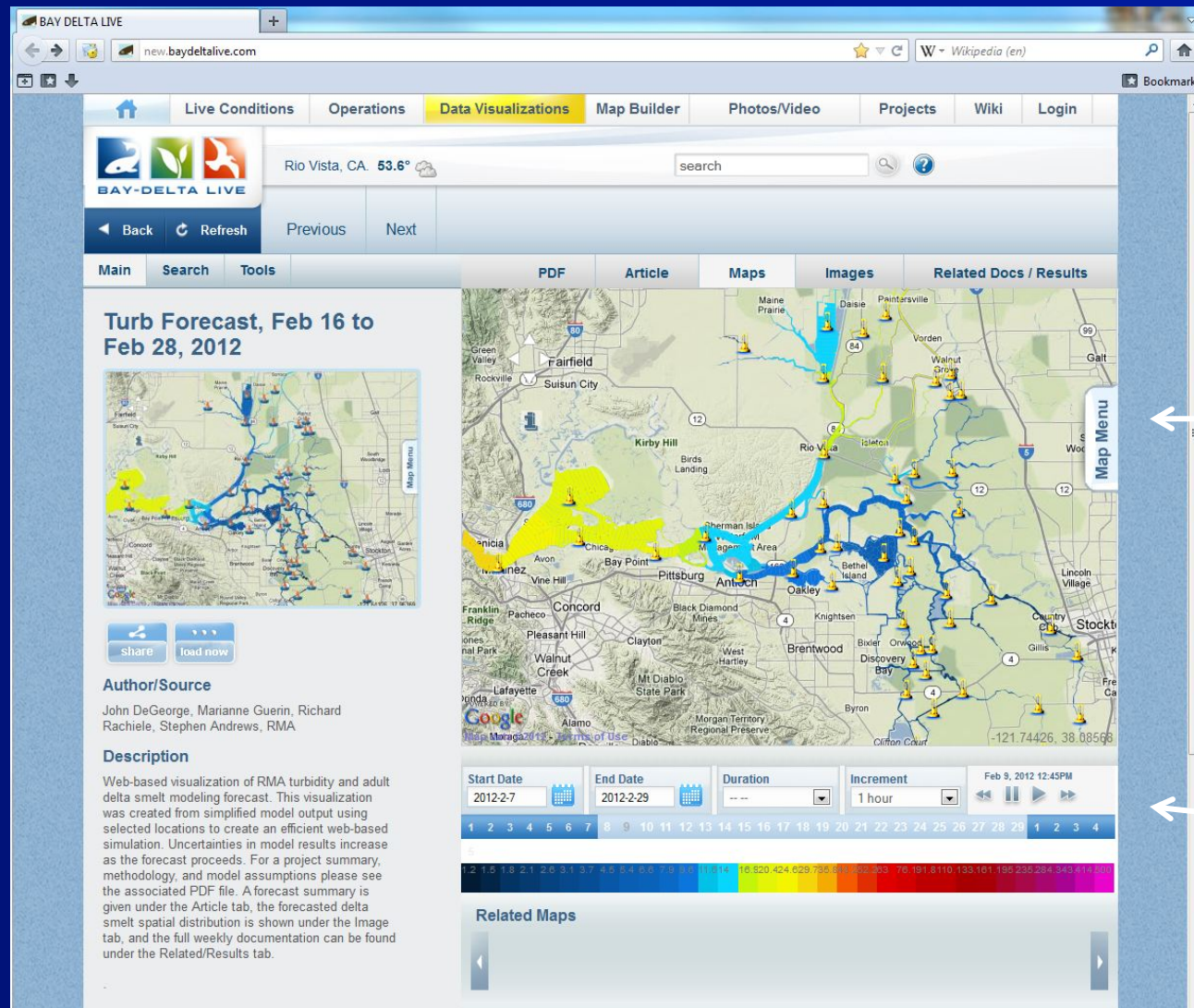


Creation Date: 17-Feb-2012

Preliminary Results: Subject to Revision
part-Results.jpg, swandrews

Bay Delta Live – Color Contour Map Display

www.baydeltaalive.com



Map Controls

Animation Controls

Bay Delta Live – Supporting Documents

www.baydeltalive.com

The screenshot shows the Bay Delta Live website interface. The top navigation bar includes links for Live Conditions, Operations, Data Visualizations (highlighted), Map Builder, Photos/Video, Projects, Wiki, and Login. Below this is a search bar and a secondary navigation bar with links for Main, Search, Tools, PDF, Article, Maps, Images, and Related Docs / Results. The main content area displays a document titled "RMA Turbidity and Adult Delta Smelt Behavioral Model Covering the Forecast Period February 16, 2012 to March 1, 2012". The document includes a date of February 17, 2012, and lists authors: Chuching Wang, Paul Hutton, Marianne Guerin, and Steve Andrews. It also features a summary assessment and a forecast summary. On the left side of the document, there is a map of the Delta region showing turbidity and smelt distribution, and a section for the author/source information.

BAY DELTA LIVE

Rio Vista, CA. 53.6°

search

Back Refresh Previous Next

Main Search Tools PDF Article Maps Images Related Docs / Results

Turb Forecast, Feb 16 to Feb 28, 2012

share load now

Author/Source

John DeGeorge, Marianne Guerin, Richard Rachiele, Stephen Andrews, RMA

Description

Web-based visualization of RMA turbidity and adult delta smelt modeling forecast. This visualization was created from simplified model output using selected locations to create an efficient web-based simulation. Uncertainties in model results increase as the forecast proceeds. For a project summary, methodology, and model assumptions please see the associated PDF file. A forecast summary is given under the Article tab, the forecasted delta smelt spatial distribution is shown under the Image tab, and the full weekly documentation can be found under the Related/Results tab.

RMA Turbidity and Adult Delta Smelt Behavioral Model Covering the Forecast Period February 16, 2012 to March 1, 2012

Date: February 17, 2012

To: Chuching Wang, Senior Engineer, Metropolitan Water District
Paul Hutton, Senior Engineer, Metropolitan Water District

From: Marianne Guerin, Senior Water Resources Specialist
Steve Andrews, Water Resources Engineer

Subject: Results of Recent Forecasting Work

Summary Assessment

PERIOD: The Delta turbidity and adult delta smelt forecast was produced this week, and this documentation covers the forecast period February 16, 2012 to March 1, 2012 plus a period of historical conditions.

PRE-FORECAST SUMMARY: Apart from the rain event the week of January 30, 2012, the earlier pattern of a general lack of significant precipitation has resumed in this forecast period. As a consequence, turbidity in the Delta decreased below 20 NTU at most locations in the model results during the forecast period.

TURBIDITY 3-STATIONS PERFORMANCE & SUMMARY EVALUATION: Forecast turbidity remained below compliance values at the three compliance locations during the two week forecast period. During the recent historical period, including the rain and turbidity event, modeled daily average turbidity at Prisoner Point, the northernmost compliance location, exceeded compliance values (12 NTU) briefly. Observed CDEC data exceeded compliance values at Holland Cut four times in January and February, due to resuspended sediment from wind events.

SMELT MOVEMENT SUMMARY: Under the influence of turbidity from the Sacramento River turbidity pulse associated with the rain event last week, many of the delta smelt particles that had moved up the Sacramento River and into the Northern and Central Delta remained in those regions during the forecast period.

COMMUNITY COMMENTS

There are currently no comments.

Model
Methodology
And
Assumptions

Model
Calibration
Report
Links

Smelt
Distribution
Map

Forecast
Summary
(shown)

Conclusions

- Successfully implemented a near real-time forecasting procedure for flow, EC, turbidity, and particle distribution
- Excellent progress integrating with the WARMF model for improved forecasting
- Produced weekly reports and results for dissemination through the Bay Delta Live web site
- Future efforts
 - Working toward transition to sediment modeling for turbidity simulation
 - RMA has performed temperature modeling with DSM2 and RMA Delta model for BDCP that could be included as part of real-time work

Contact Information

- John DeGeorge, Ph.D.
- Resource Management Associates, Inc.
- 4171 Suisun Valley Road, Suite J
- Fairfield, CA 94534
- 707 864-2950
- jfdegeorge@rmanet.com
- www.rmanet.com