Using DSM2 in Support of Delta Smelt Life Cycle Modeling

CHANDRA SEKHAR CHILMAKURI, CH2M HILL

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Outline

Delta Smelt Life Cycle Model

Applications of DSM2 – Tidal Data

Applications of DSM2 – Movement Probabilities

DSM2 Historical Model (pre-1990 conditions)

Wrap up

Delta Smelt Life Cycle Model

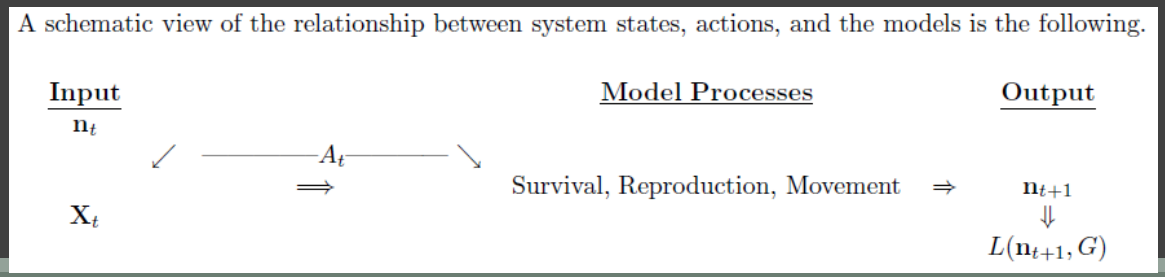
Currently in development by Ken Newman at USFWS.

Model to help evaluate the potential effects of various water management actions on the delta smelt population.

A monthly state-space hierarchical model with spatially explicit state and observation models.

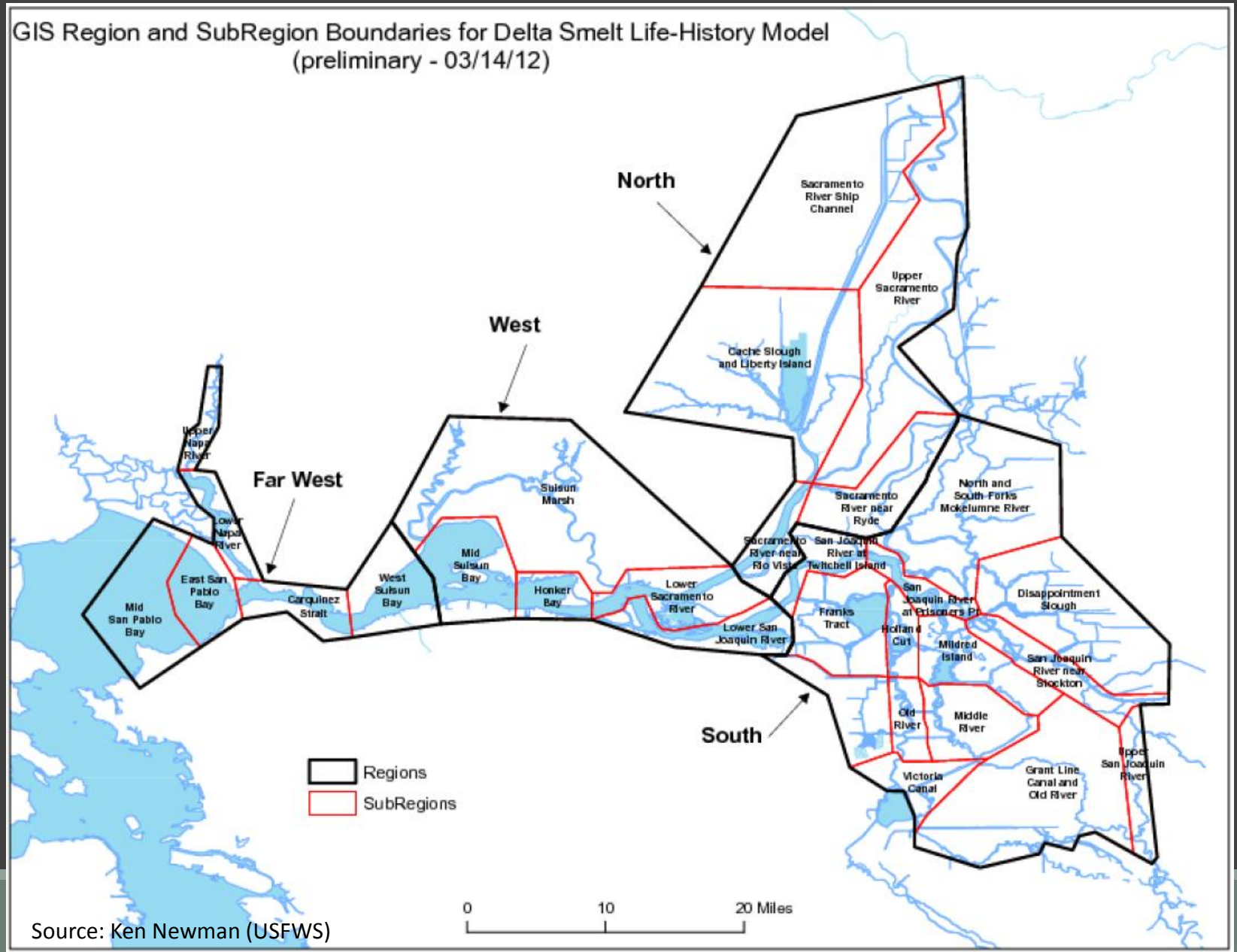
The state model characterizes the population dynamics by considering processes such as survival, movement, and reproduction.

The observation model links the delta smelt catch sample data to the underlying population abundances.



Source: Ken Newman (USFWS)

Delta Smelt Life Cycle Model – Spatial Domain



Source: Ken Newman (USFWS)

Delta Smelt Life Cycle Model

Movement process is considered to be of three types:

- Larval – fish movement is generally flow dictated
- Juvenile – fish prefer and move towards water in the Low Salinity Zone
- Maturing Adult – fish move up estuary toward fresher water

Estimating potential larval smelt movement within the Delta under the influence of historical flow and tidal conditions is necessary to explain larval/post-larval movement dynamics across the regions.

The probability of fish being present in a sampling location is affected by the tidal condition[1] at the time of sampling, and affects the Observation Model.

Delta Simulation Model (DSM2) was used to simulate:

- The tidal hydrodynamics corresponding to the sampling times and locations.
- The potential larval Delta Smelt movement within the Delta channels.

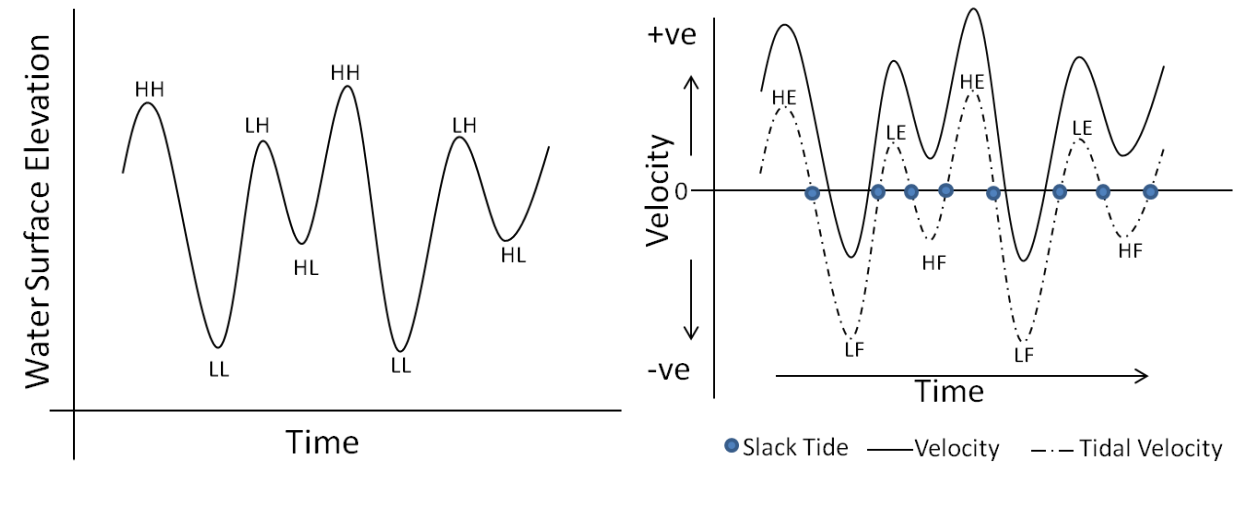
[1] Burau, J. (2013). The Hydrodynamics of Position Maintenance and Upmigration of Delta Smelt. 2013 IEP Workshop

Application of DSM2 – Tidal Data

Historical flows, tides and gate operations used to simulate hydrodynamics using DSM2 from 1990 to 2010 period.

DSM2 stage and velocity results processed to determine the tidal state at a given sampling location at a given time.

A database with water level, velocity and other tidal information compiled for all the delta smelt surveys within the DSM2 model domain.



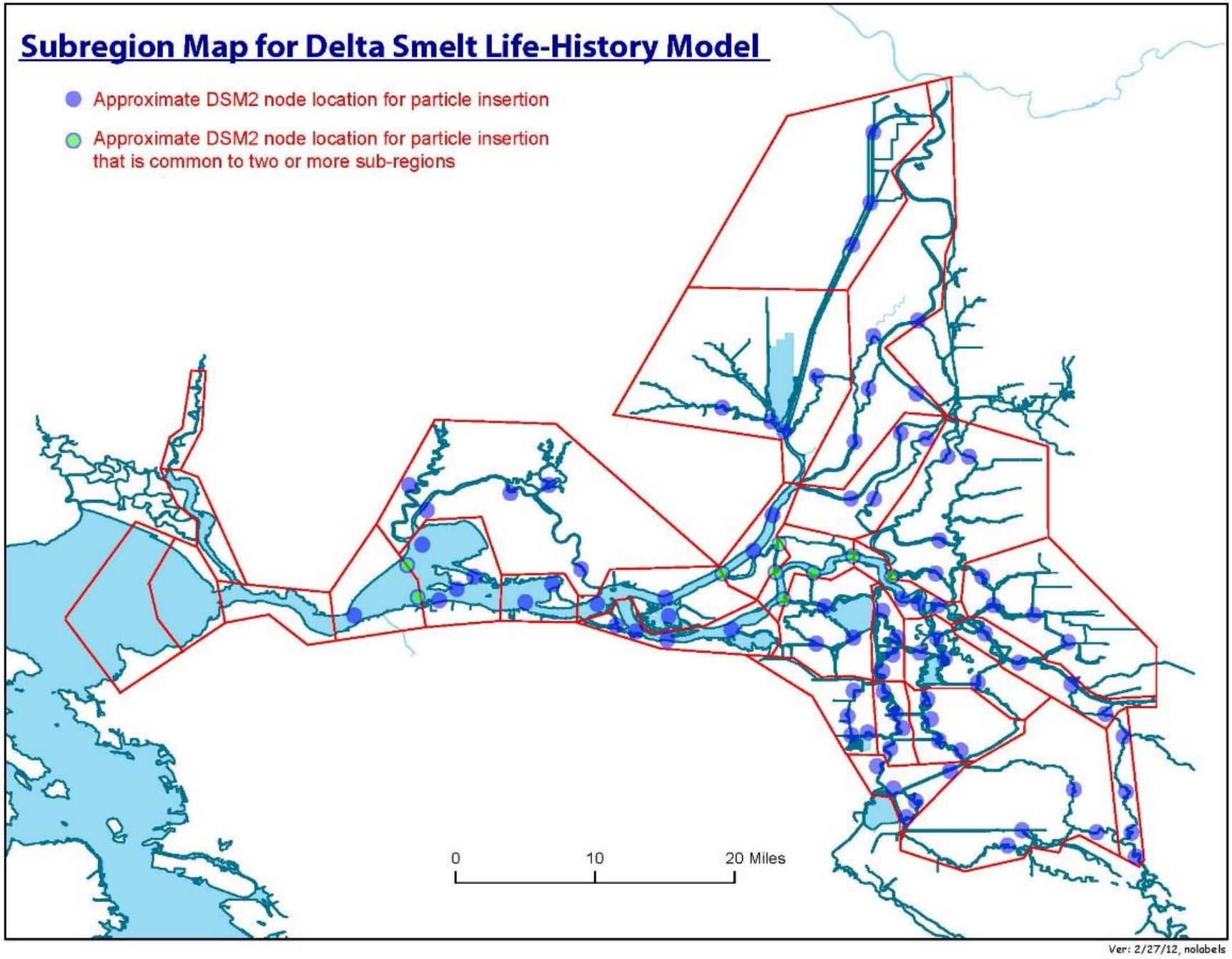
Application of DSM2 – Movement Probabilities

DSM2 PTM was simulated to estimate movement probabilities from one region to another.

The regions were divided into sub-regions for PTM simulations. A total of 25 sub-regions were identified within the boundaries of the DSM2.

DSM2 channels and open water areas within each sub-region were “grouped”.

Up to six DSM2 nodes were identified within each group for particle release such that the nodes are uniformly distributed across the sub-region.


Subregion Map for Delta Smelt Life-History Model
Approximate DSM2 node location for particle insertion
Approximate DSM2 node location for particle insertion that is common to two or more sub-regions
0
10
20 Miles
Ver: 2/27/12, nolabels

Application of DSM2 – Movement Probabilities

PTM runs were simulated for March, April, May and June months in each year from 1990 to 2010 under historical flows, tides and gate operations.

For each selected PTM simulation period, 4000 particles were released on the 1st day of the month, uniformly over 24.75-hour period and across all the nodes in each sub-region.

For each release period one PTM run was performed for each Delta sub-region.

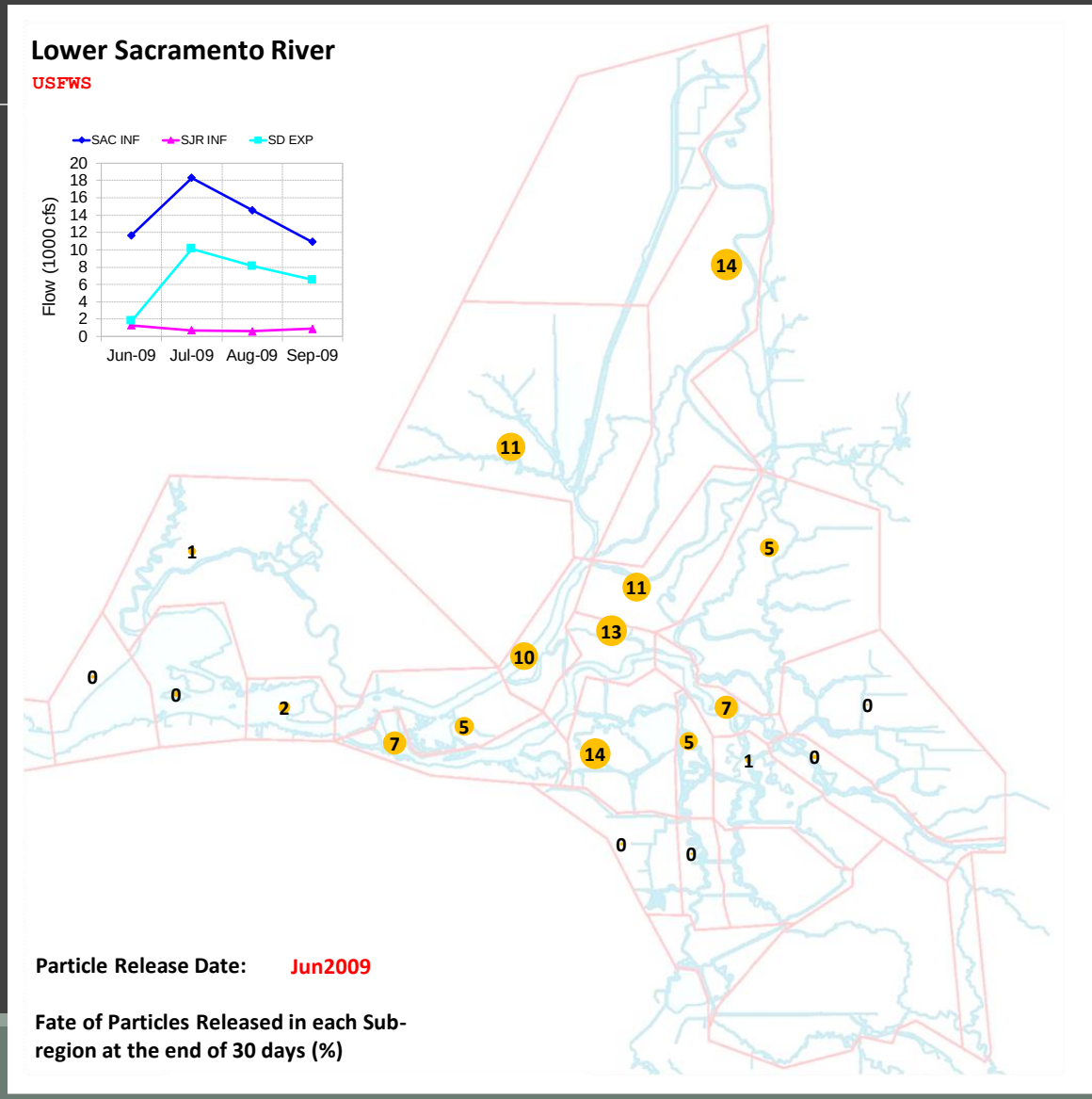
Particles were tracked for 30 days from the date of release. At the end of 30 days, the total particles releases were tallied across all the sub-regions, and various boundary points (e.g. DICU, exports etc.).

A database with percentage of particles ending up in the various sub-regions of the Delta at the end of 30 days from the date of release from one sub-region of the Delta.

Application of DSM2 – Movement Probabilities

A spreadsheet tool was developed to spatially visualize the results for each release period from this PTM analysis.

For each sub-region, percent of particles ended up at exit points or other sub-regions (e.g. Lower Sacramento River), can be plotted.



DSM2 Historical Model (pre-1990 conditions)

Extending the historical DSM2 simulation to 1962

Covering period of available delta smelt survey results

Includes major historical levee breach events

Validation with historical EC data (obtained from IEP database)

Coordinating with DWR

DSM2 Historical Model (pre-1990 conditions)

Constructed boundary conditions database based primarily on DAYFLOW for back to 1955

Reviewed historic data sources to catalogue historic levee failures and include major events in simulation

Generated DSS files with gate operations

- Delta Cross Channel from 1953
- Clifton Court Forebay from May 1, 1971

Modifications to DSM2

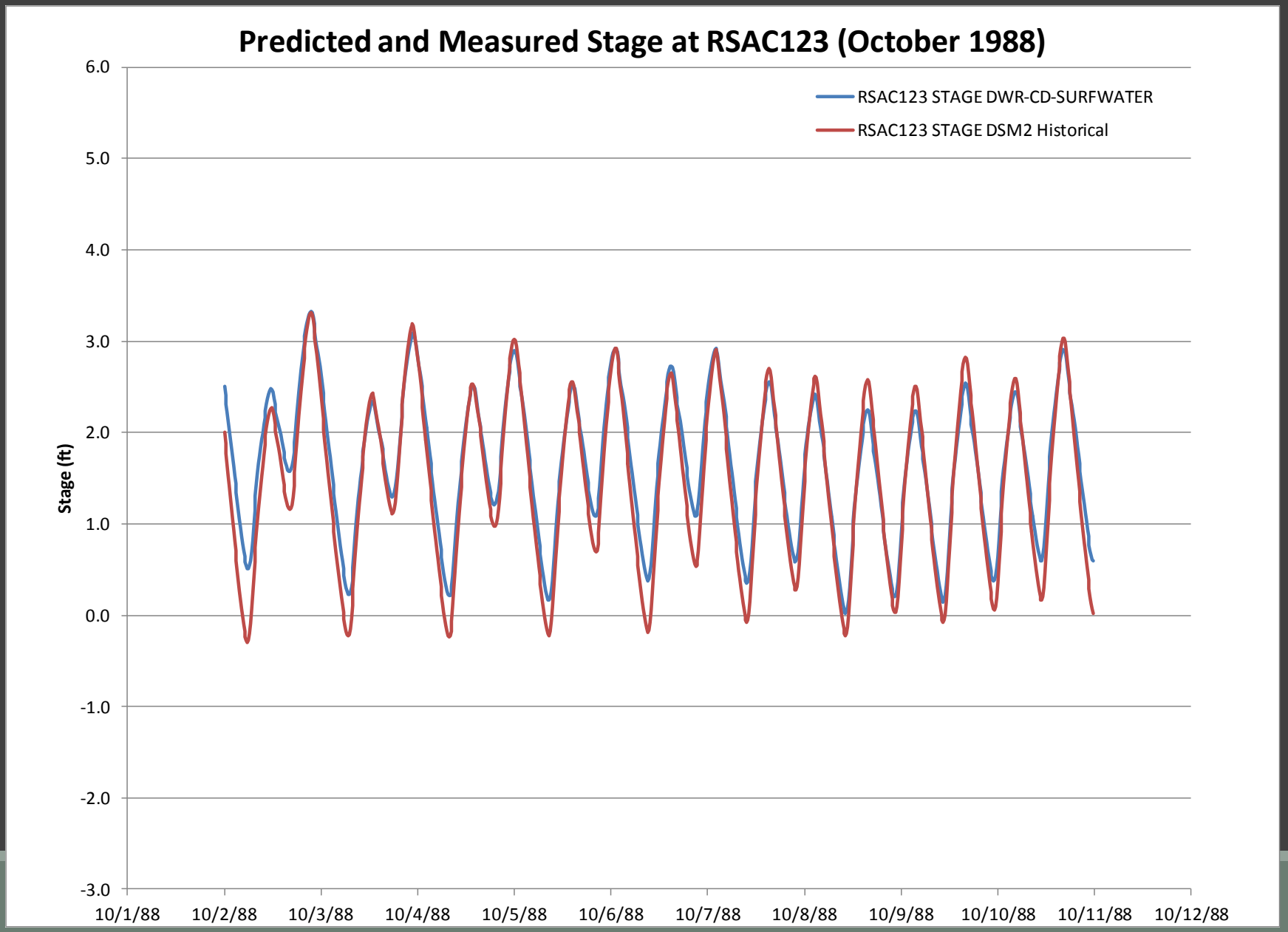
Clifton Court online in 1971, SWP and BBID diversions moved to Old River prior to 5-1-71

Minor channel modifications to avoid channel drying (Thomas Paine Slough / Paradise Cut)

Levee breaches simulated with gates on reservoirs that open with breach and close when levee was restored.

Nodal inflow included to account for dewatering of flooded islands.

Preliminary Verification Simulation



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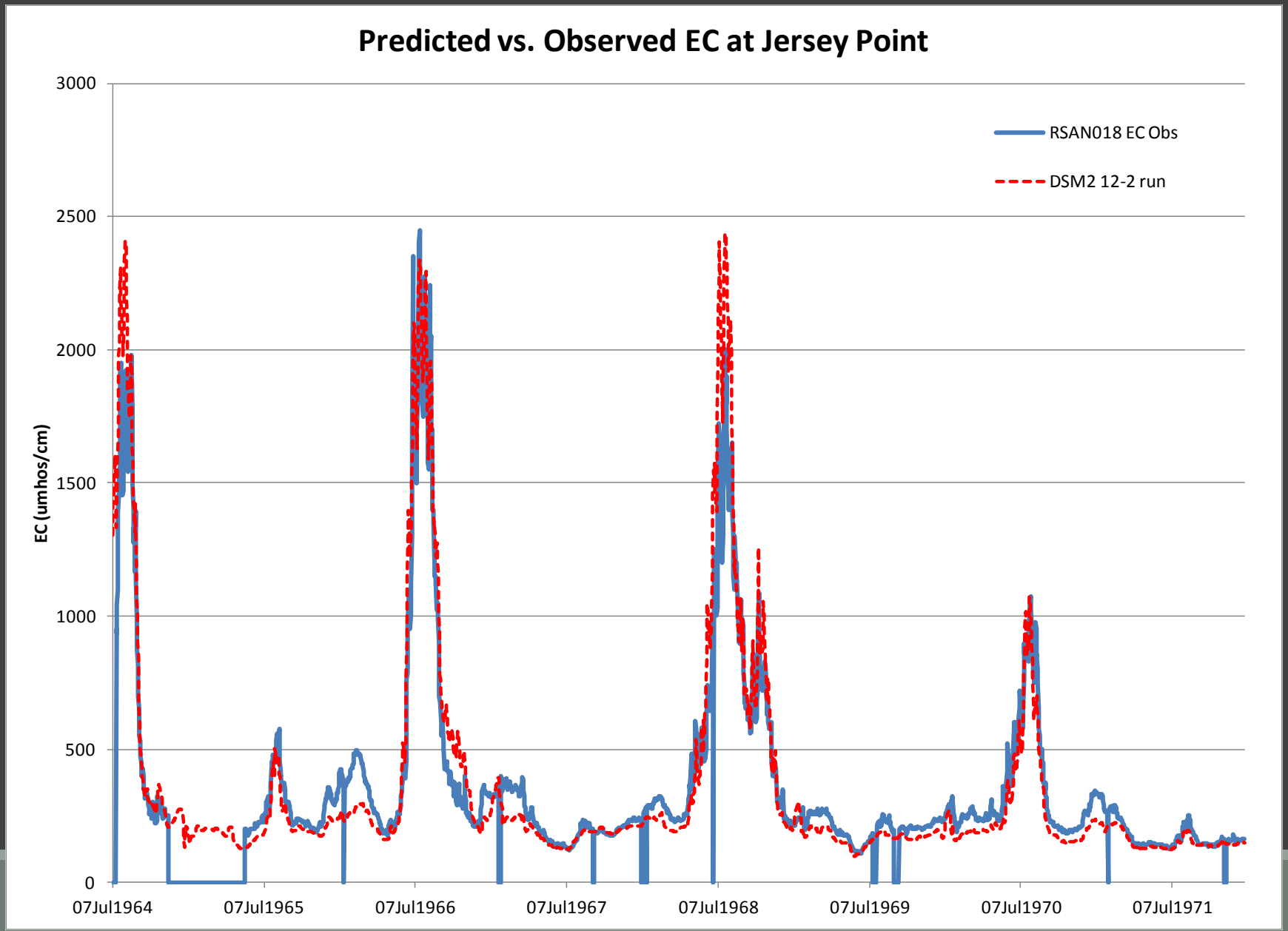

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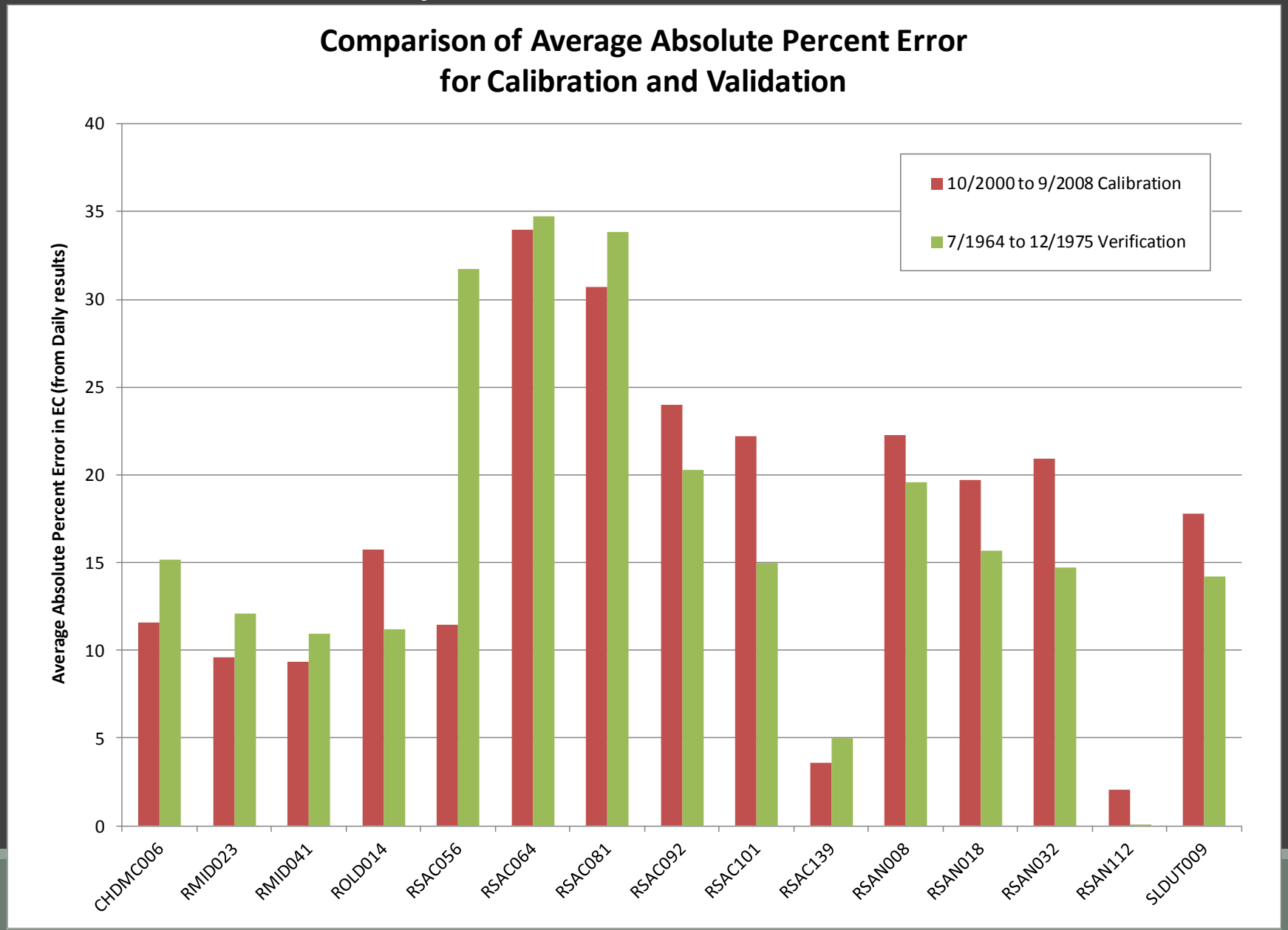

Wrap Up

Process tidal data at each sampling location for various sampling time prior to 1990.

Perform PTM simulations to extend movement probabilities database to 1962.

If interested in delta smelt life cycle model:

Recent Developments in a State-Space Model for Delta Smelt Population Dynamics – Ken Newman (USFWS)

On **Wednesday, February 26 1:20 pm (Sierra Ballroom)**