

WARMF and Its Potential Application to San Joaquin River TMDL Analysis

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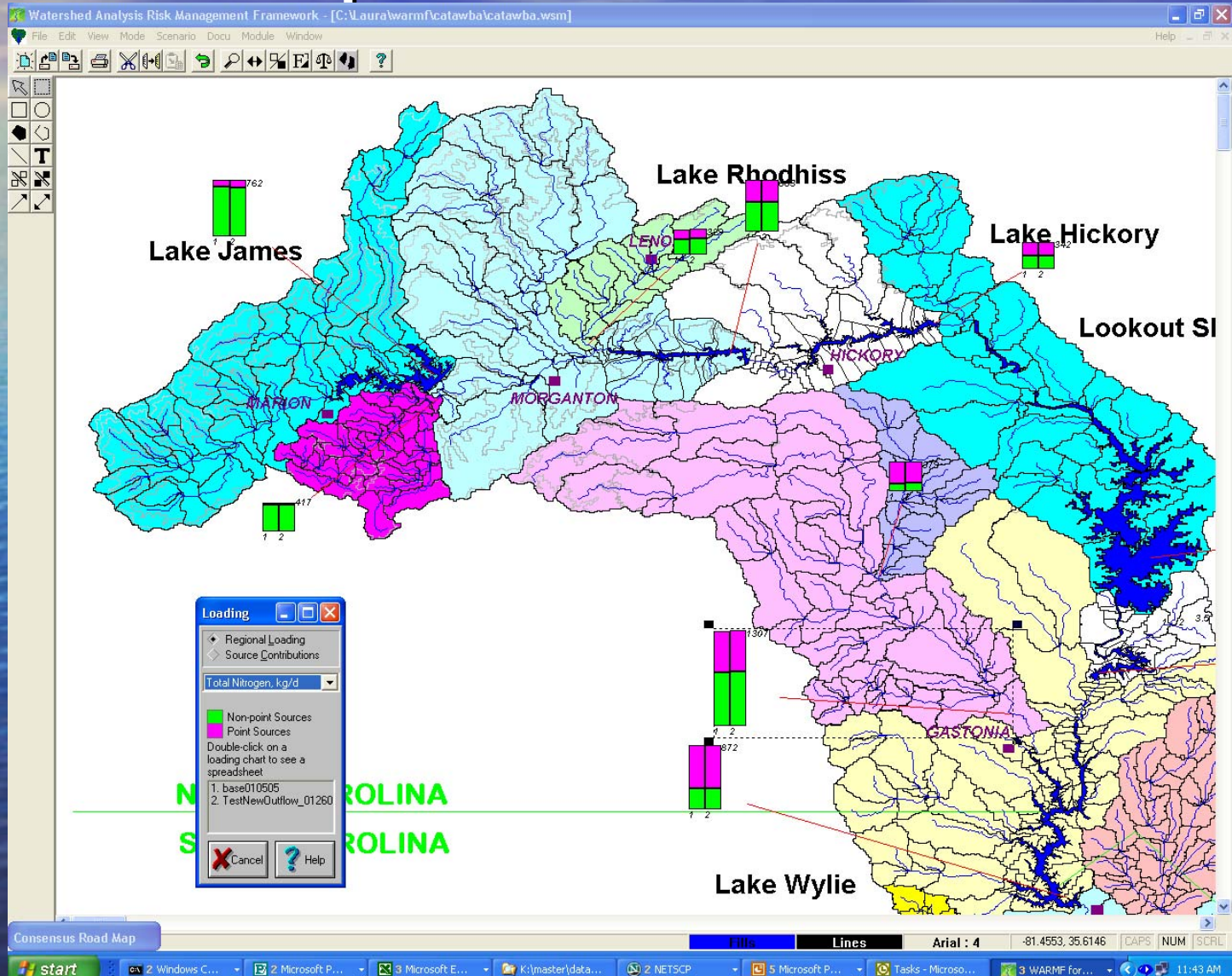
Joel W. Herr

Systech Engineering, Inc.

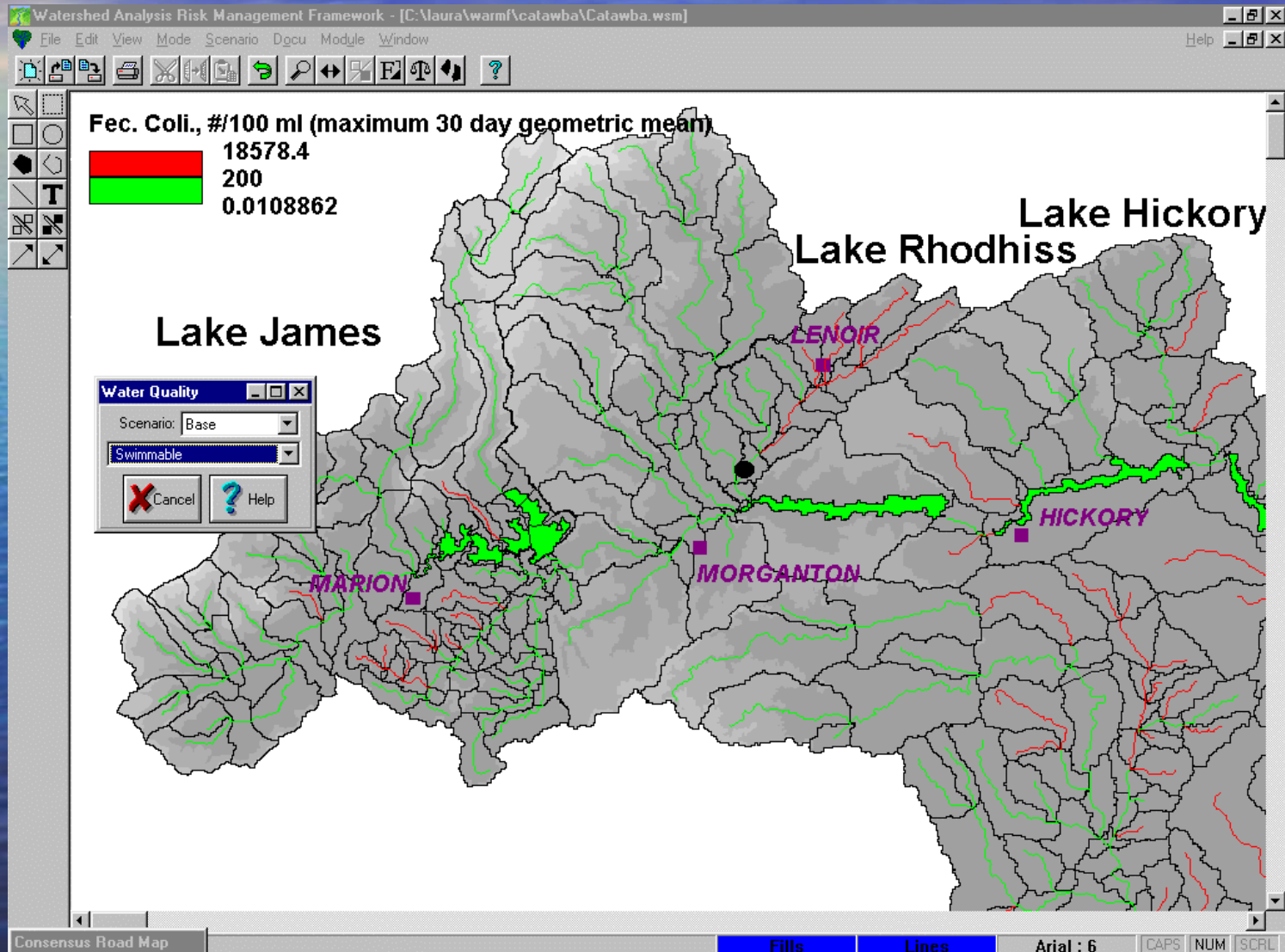
GIS Based Watershed Model

- Divides a complex river basin into a net work of interconnected reactors (vegetation, land surface, and soil layers, river segments, lakes), which allow water and pollutants to move from one to another.
- Applies precipitation and irrigation water to land and simulate surface runoff, soil hydrology, groundwater lateral flows, stream flows, and nonpoint source loads from each land use.
- Accepts point source loads
- Calculates hydrology and water quality in stream segments and lake water layers.

Regional pollution loads for the source of pollution



Water quality consequence of pollution in red or green



History and Future of WARMF

- Developed over 10 years with funding from Electric Power Research Institute.
- Applied to fourteen river basins throughout the United States.
- Analyzed TMDLs of coliform, sediment, nutrients, acid mine drainage, and mercury.
- Transferred to USEPA for free distribution as a public domain software.

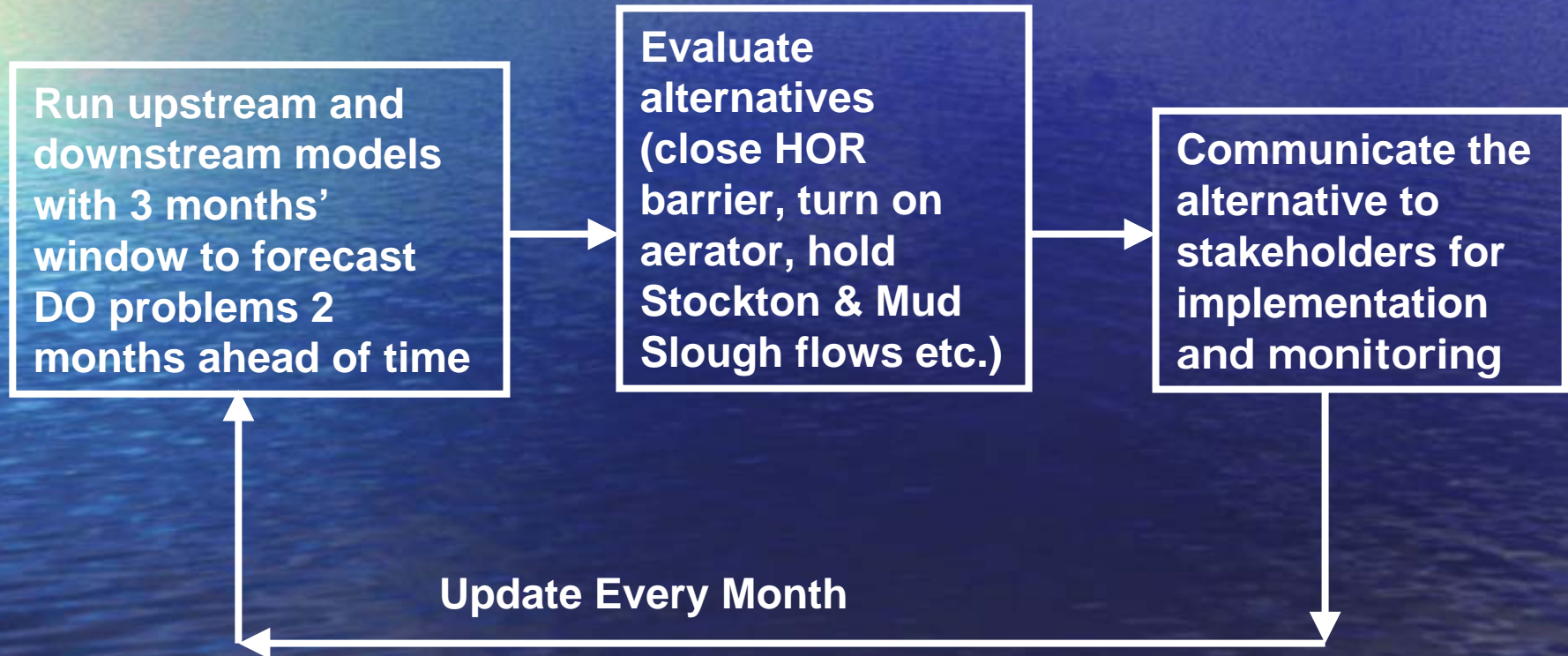
Potential Application to San Joaquin River TMDL Analysis

- Adaptation of WARMF GUI to DSM2 for real time water quality management
- Potential to simulate runoff and nonpoint loads for input to DSM2.
- Complete implementation of WARMF to the Upper San Joaquin River
- Use WARMF for the TMDLs of DO, nutrients, TDS, pesticides, etc.

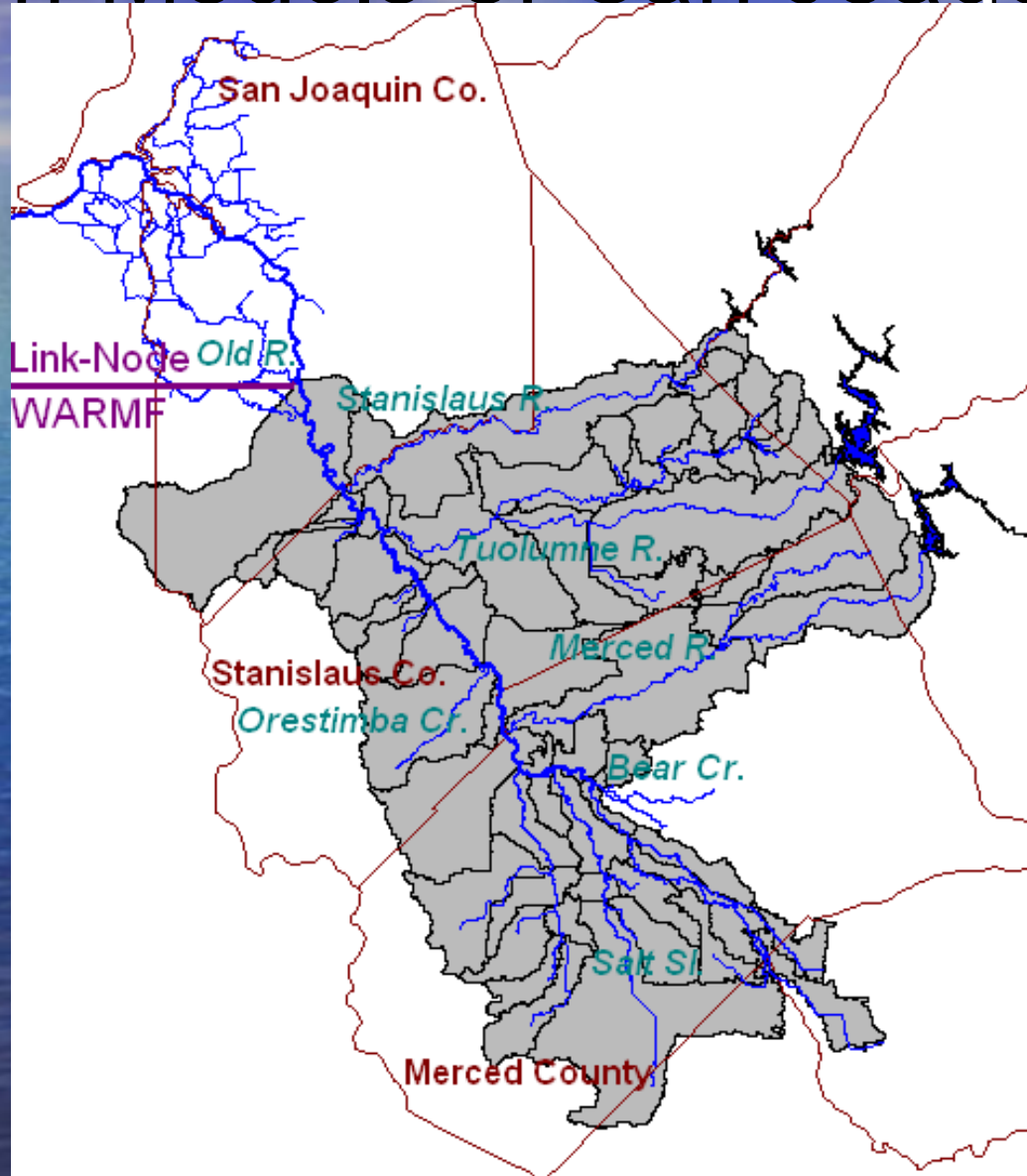
Real Time Adaptive Water Quality Management of San Joaquin River



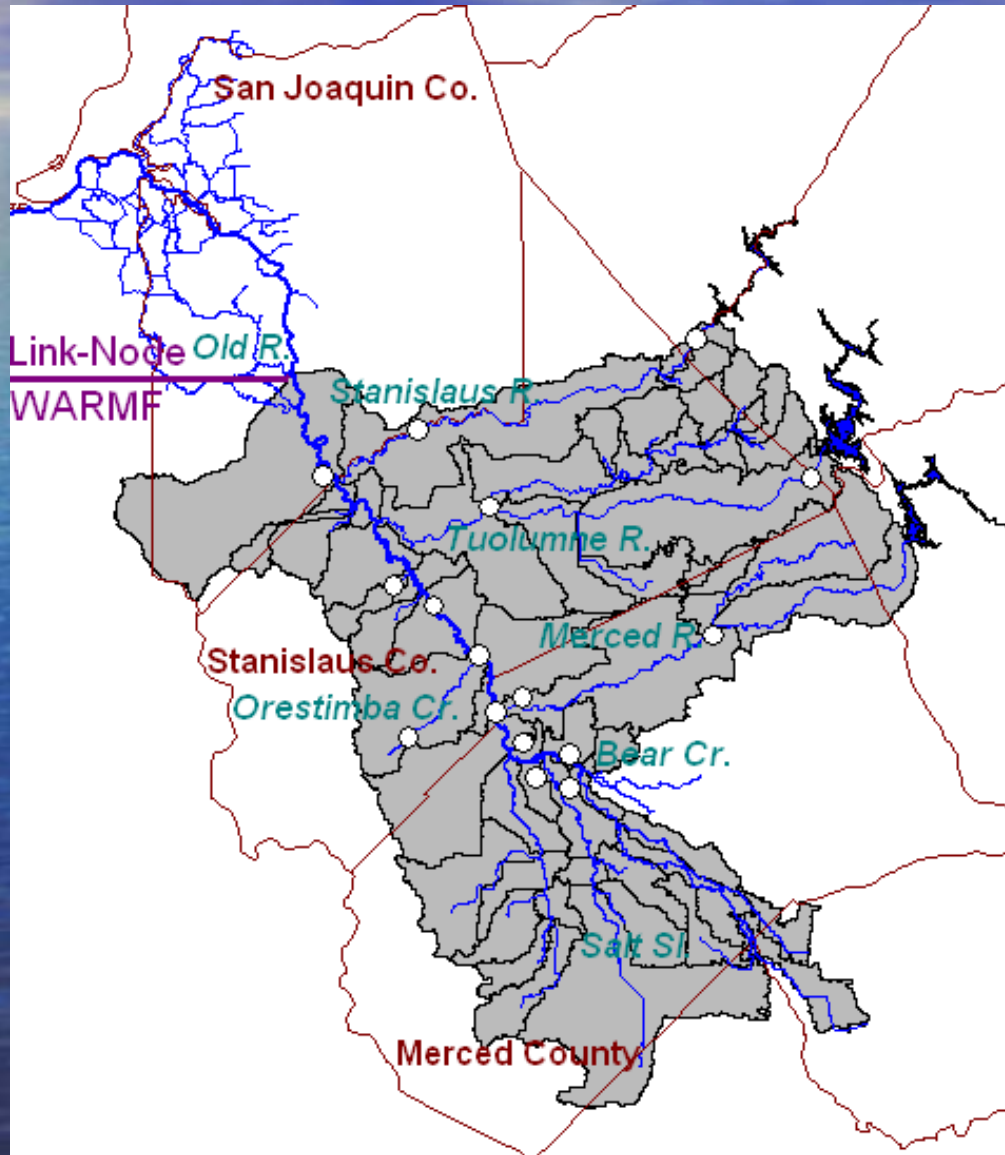
Procedure for Real Time Adaptive Water Quality Management



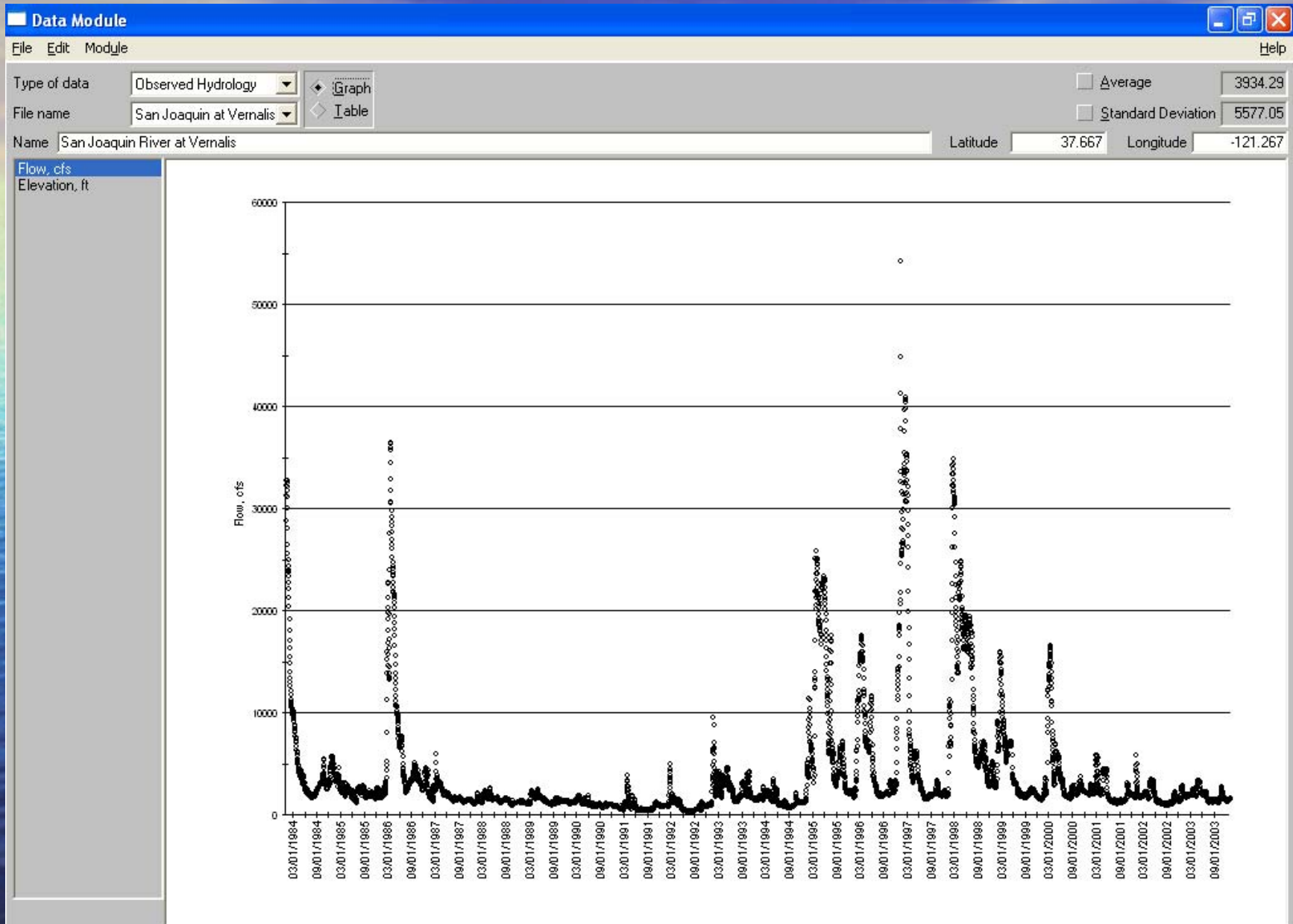
Integration of Upstream and Down Stream Models of San Joaquin



Gaging Stations in Upper San Joaquin River



Capability of Data Module



Capability of Data Module

Data Module [Window Title Bar]

File Edit Module Help [Menu Bar]

Type of data: Observed Hydrology [Dropdown] Graph [Button] Add Blank Rows to End of File [Button]
File name: San Joaquin at Vernalis [Dropdown] Table [Button] Insert or Delete Rows: Select Rows, Ctrl+Ins or Ctrl+Del [Text]

Name: San Joaquin River at Vernalis [Text] Latitude: 37.667 [Text] Longitude: -121.267 [Text]

Date	Time	Flow cfs	Elevation ft	Data Source
01/01/1984	00:00	28900	25.78	SJR Data Atlas
01/02/1984	00:00	31400	26.94	SJR Data Atlas
01/03/1984	00:00	32400	27.5	SJR Data Atlas
01/04/1984	00:00	32800	27.79	SJR Data Atlas
01/05/1984	00:00	32800	27.88	SJR Data Atlas
01/06/1984	00:00	32800	27.89	SJR Data Atlas
01/07/1984	00:00	32600	27.89	SJR Data Atlas
01/08/1984	00:00	32200	27.84	SJR Data Atlas
01/09/1984	00:00	31900	27.67	SJR Data Atlas
01/10/1984	00:00	31800	27.47	SJR Data Atlas
01/11/1984	00:00	31200	27.35	SJR Data Atlas
01/12/1984	00:00	30100	27.08	SJR Data Atlas
01/13/1984	00:00	28100	26.51	SJR Data Atlas
01/14/1984	00:00	26600	26.09	SJR Data Atlas
01/15/1984	00:00	25700	25.91	SJR Data Atlas
01/16/1984	00:00	25100	25.76	SJR Data Atlas
01/17/1984	00:00	24500	25.6	SJR Data Atlas
01/18/1984	00:00	24100	25.52	SJR Data Atlas
01/19/1984	00:00	24000	25.53	SJR Data Atlas
01/20/1984	00:00	23800	25.5	SJR Data Atlas
01/21/1984	00:00	23400	25.37	SJR Data Atlas
01/22/1984	00:00	22900	25.25	SJR Data Atlas
01/23/1984	00:00	22200	25.08	SJR Data Atlas
01/24/1984	00:00	21400	24.86	SJR Data Atlas
01/25/1984	00:00	20500	24.42	SJR Data Atlas
01/26/1984	00:00	19300	23.91	SJR Data Atlas
01/27/1984	00:00	18100	23.27	SJR Data Atlas
01/28/1984	00:00	17100	22.83	SJR Data Atlas
01/29/1984	00:00	16400	22.37	SJR Data Atlas

Live demonstration of WARMF

- Show GUI and its user friendliness.
- Explain GUI help transfer water and pollutants from land to river and from river to lakes.
- Show gaging stations, precipitation stations, pictures
- Show spreadsheet for input and plot for visualization of input data.
- Show list of water quality parameters simulated
- Show time series of predicted and observed data to facilitate calibrations.
- Show HELP menu
- Show TMDL module for TMDL analysis
- Show Consensus module for implementation plan