

Recent Analyses of the Historical DSM2 Temperature Model

Marianne Guerin

Stacie Grinbergs

Richard Rachiele

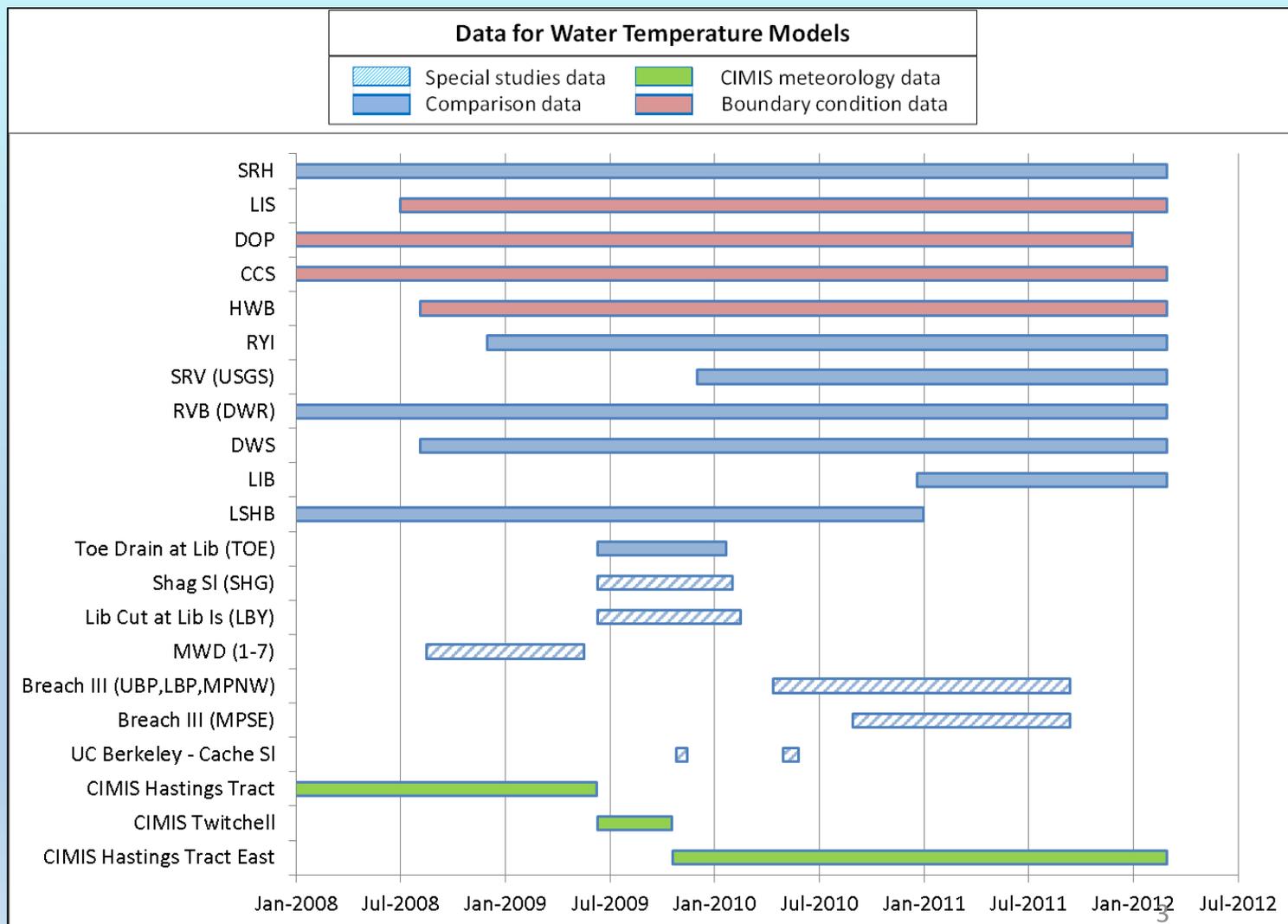
Motivation for Analyses

- My question about the sufficiency of DSM2's zero-dimensional representation of Liberty Island for water temperature (BDCP-concerns)
- Recent data collection in region and calibration of RMA's 2-D model for the Prospect Island project gave opportunity for comparison
- Analysis parameters in DSM2:
 - Variation of flow boundary conditions (BCs)
 - Variation of associated water temperature BCs
 - Variation of meteorological BCs
- NOTE – many graphics used from Prospect Island report (Richard)

Table 3 Observed water temperature data stations for model boundary conditions and model calibration/verification comparison.

Water Temp Station ID	Description	Data Source
For BCs:		
SRH	Sacramento River at Hood (Interal BC)	DWR-CDEC
LIS	Yolo Bypass Toe Drain at Lisbon	DWR-WDL
DOP	Barker Slough Doppler Station	SCWA
CCS	Upper Cache Slough	USBR
For Calibr./ Verification:		
HWB	Miner Slough at Hwy 84 Bridge	USGS Provisional Data
RYI	Cache Slough at Ryer Island	USGS Provisional Data
SRV	Sacramento River at Rio Vista	USGS Provisional Data
RVB	Sacramento River at Rio Vista	DWR-CDEC
DWS	Sacramento Deep Water Shipping Channel	USGS Provisional Data
LIB	Liberty Island @ Approx Cnter S End	USGS Provisional Data
LSHB	Lindsey Slough at Hastings Bridge	SCWA
CCS	Upper Cache Slough	USBR
TOE	Toe Drain at Liberty Island	USGS Liberty Island Study
SHG	Shag Slough at Liberty Island	USGS Liberty Island Study
LBY	Liberty Cut at Liberty Island	USGS Liberty Island Study
MWD (1-7)	Locations in and around Liberty Island	MWD
UBP	Liberty Island, Upper Beaver Pond	Breach III
LBP	Liberty Island, Lower Beaver Pond	Breach III
MPNW	Liberty Island, Main Pond North West	Breach III
MPSE	Liberty Island, Main Pond South East	Breach III
UCB	UC Berkeley, Cache Slough near Shag Slough	Cache Slough Study

Data range from Prospect Island study was extended to 03/12



RMA Grid

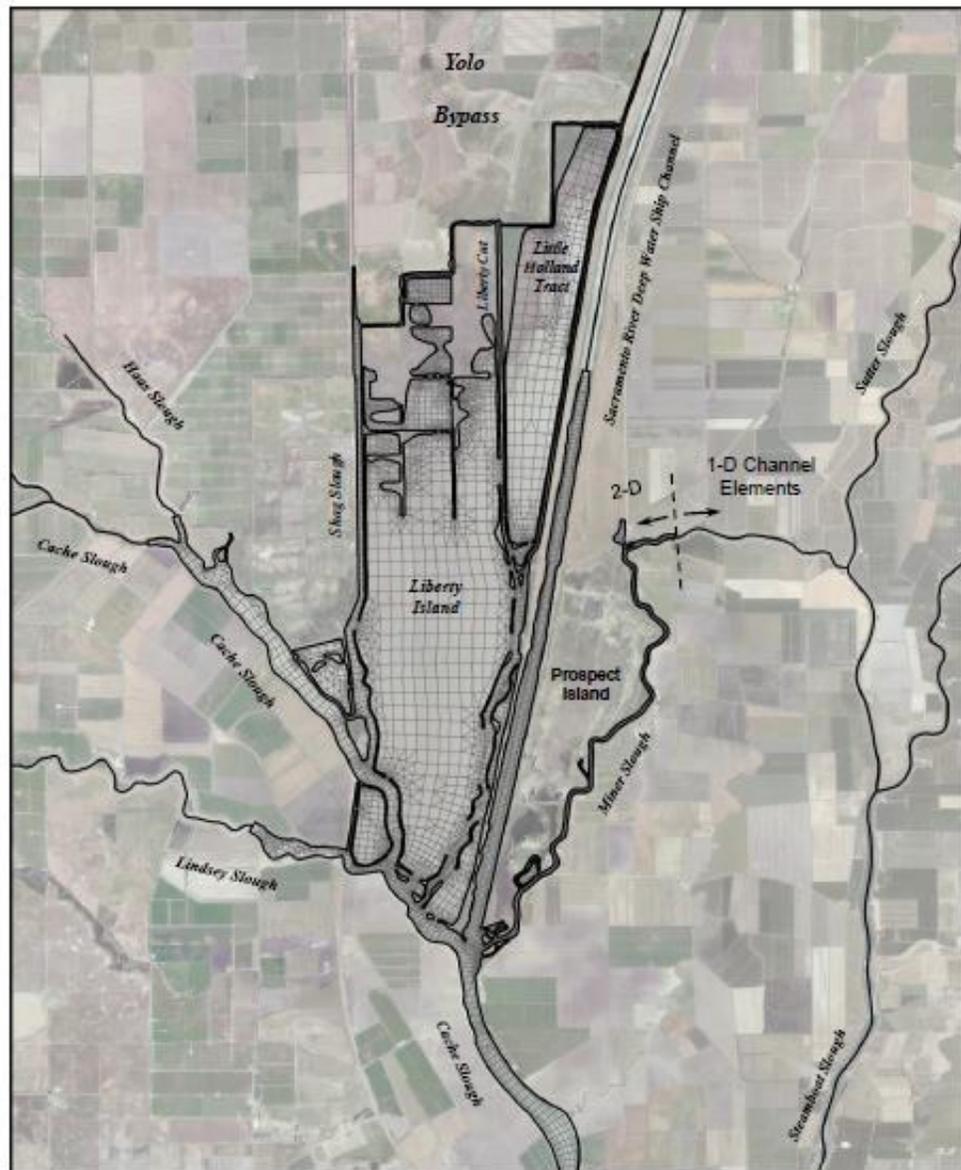
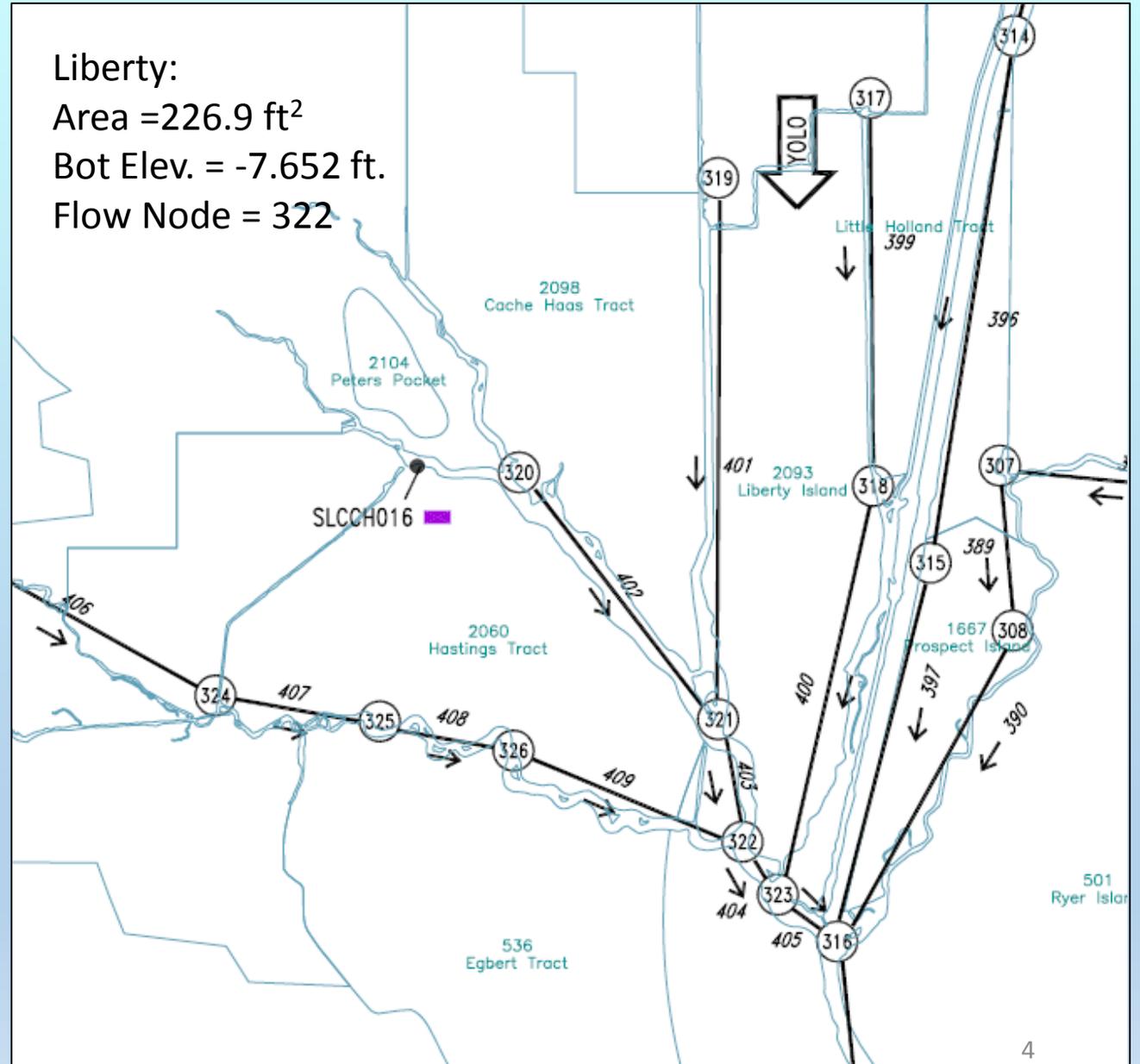


Figure 2 Detail view of model configuration in the Project area.

DSM2 Grid



Important Boundary Condition Locations

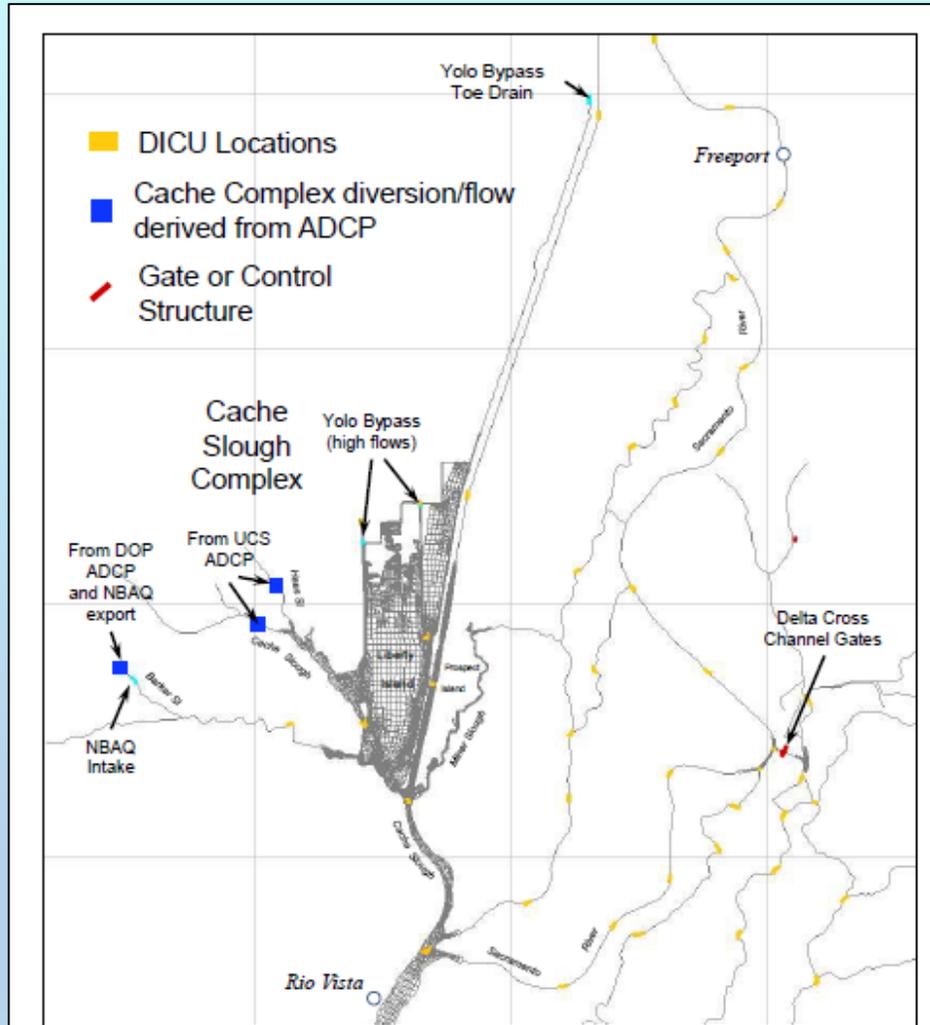
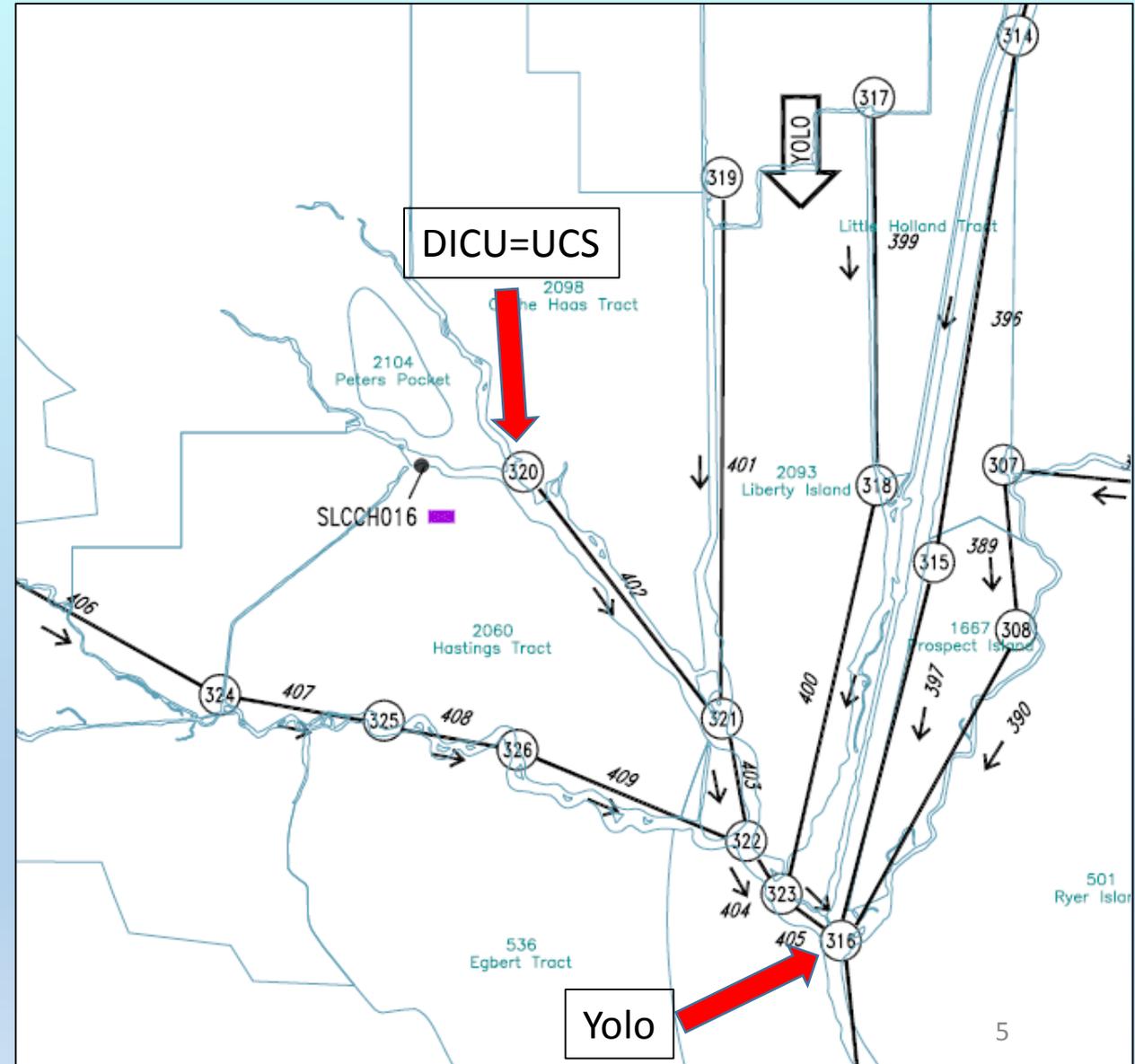


Figure 4 Flow boundary conditions for the Cache Slough Complex and DICU diversions and returns for the north Delta region near the Prospect Island site. DICU flows for Upper Cache Slough & Haas Slough, and Lindsey Slough are replaced with diversion flows computed from the long term ADCP stations UCS and DOP.



Water temperature data locations used for DSM2 or RMA comparisons

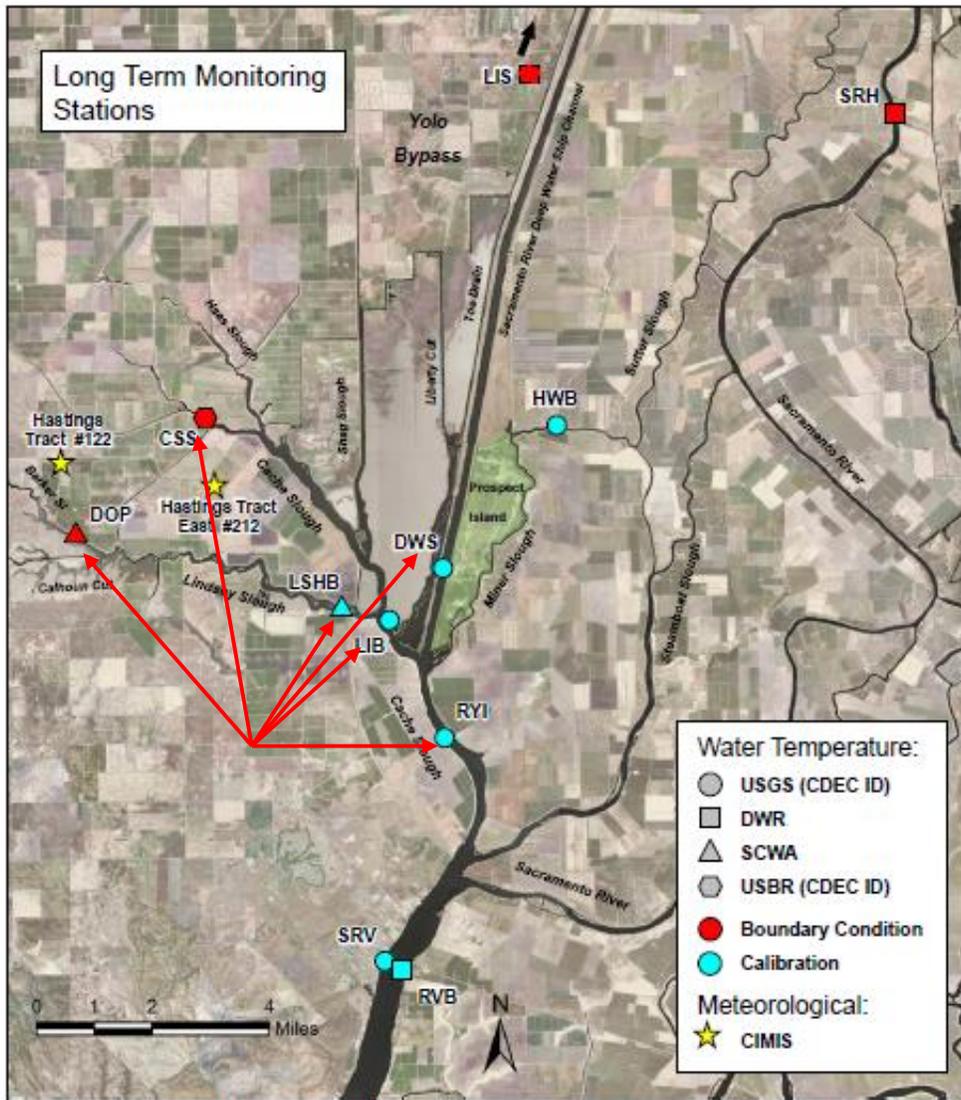


Figure 5 Location of long term north Delta water quality monitoring stations available for model water temperature boundary conditions or for observed data calibration sources. Weather data used for the model calibration/verification was collected at the CIMIS stations.

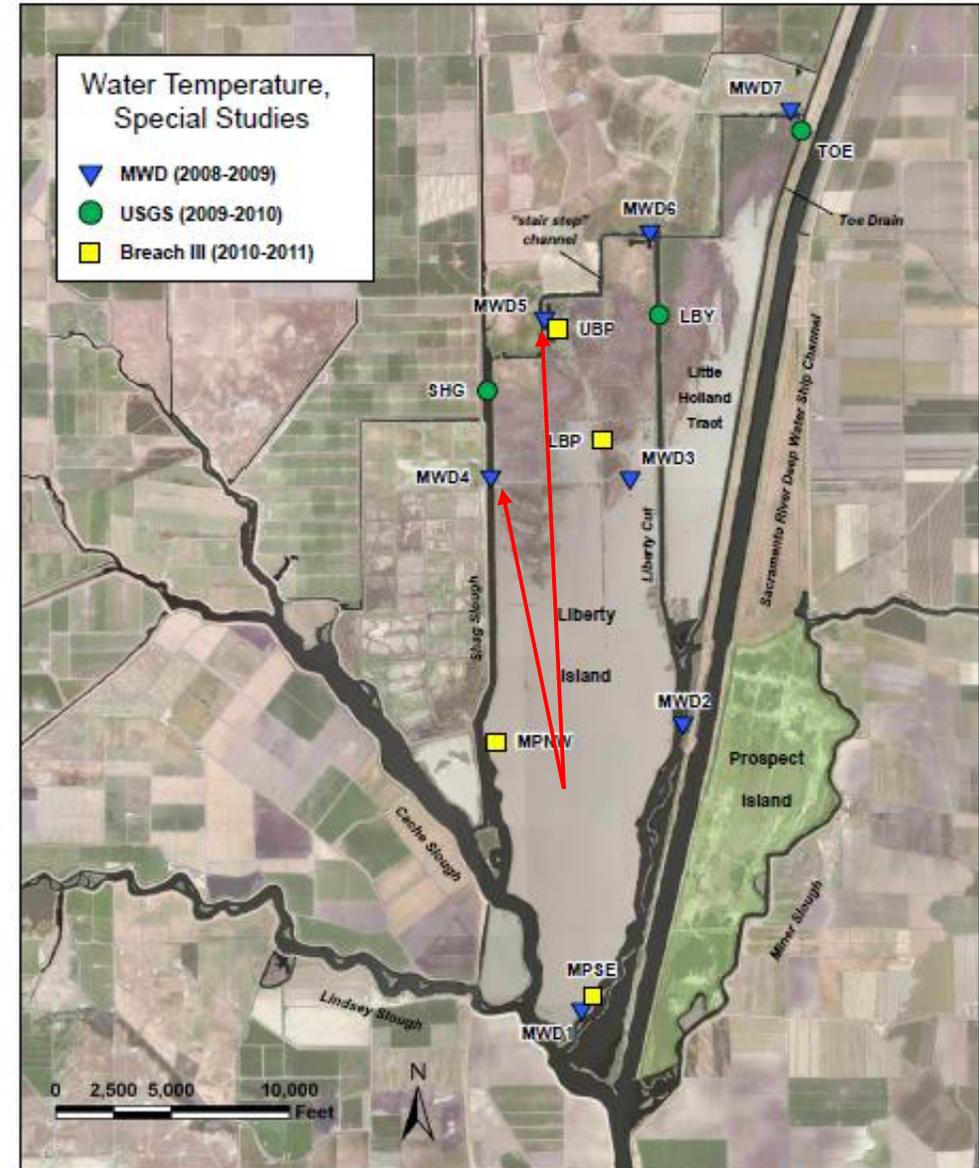
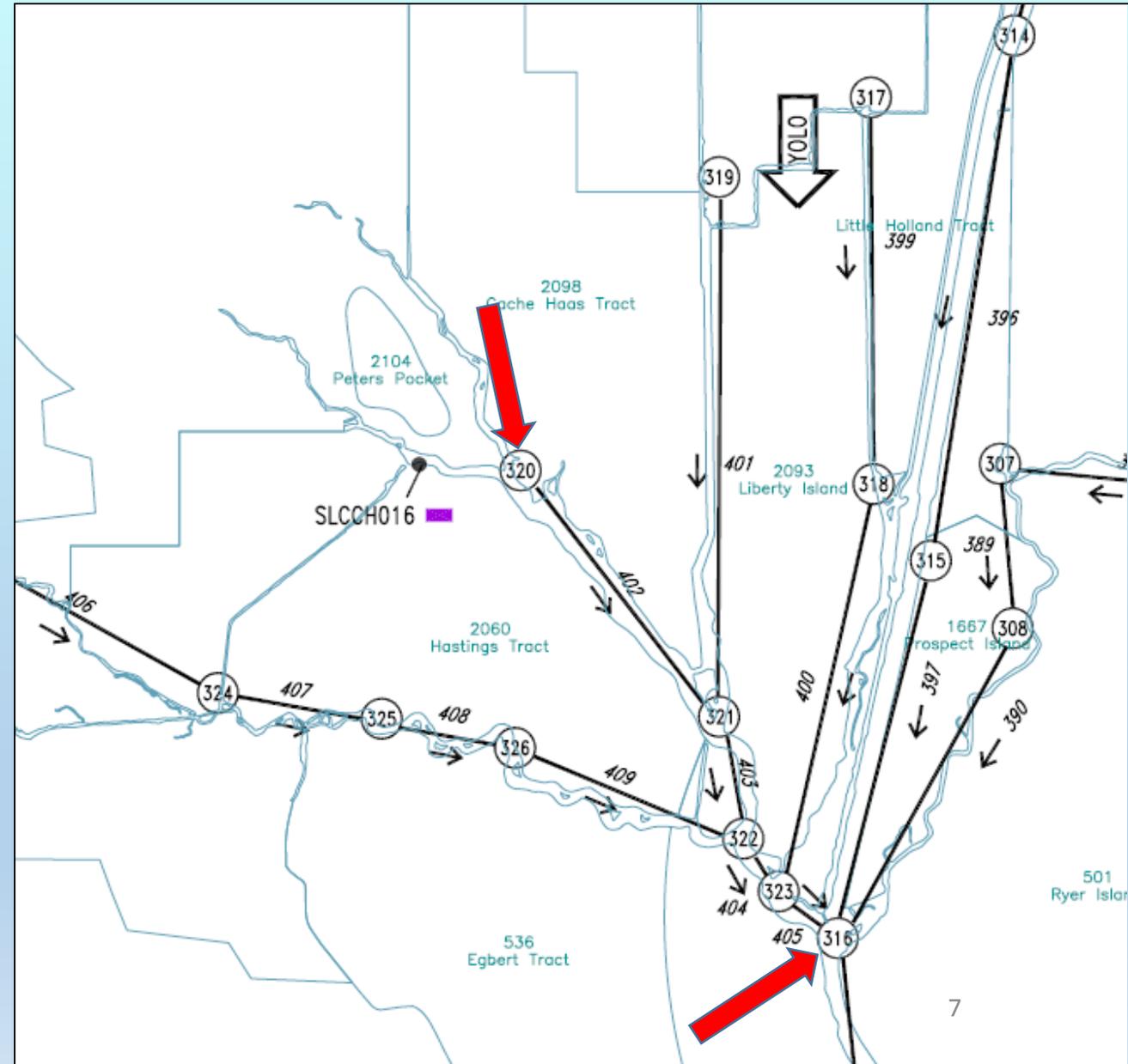


Figure 6 Locations of water temperature monitoring stations deployed on a temporary basis.

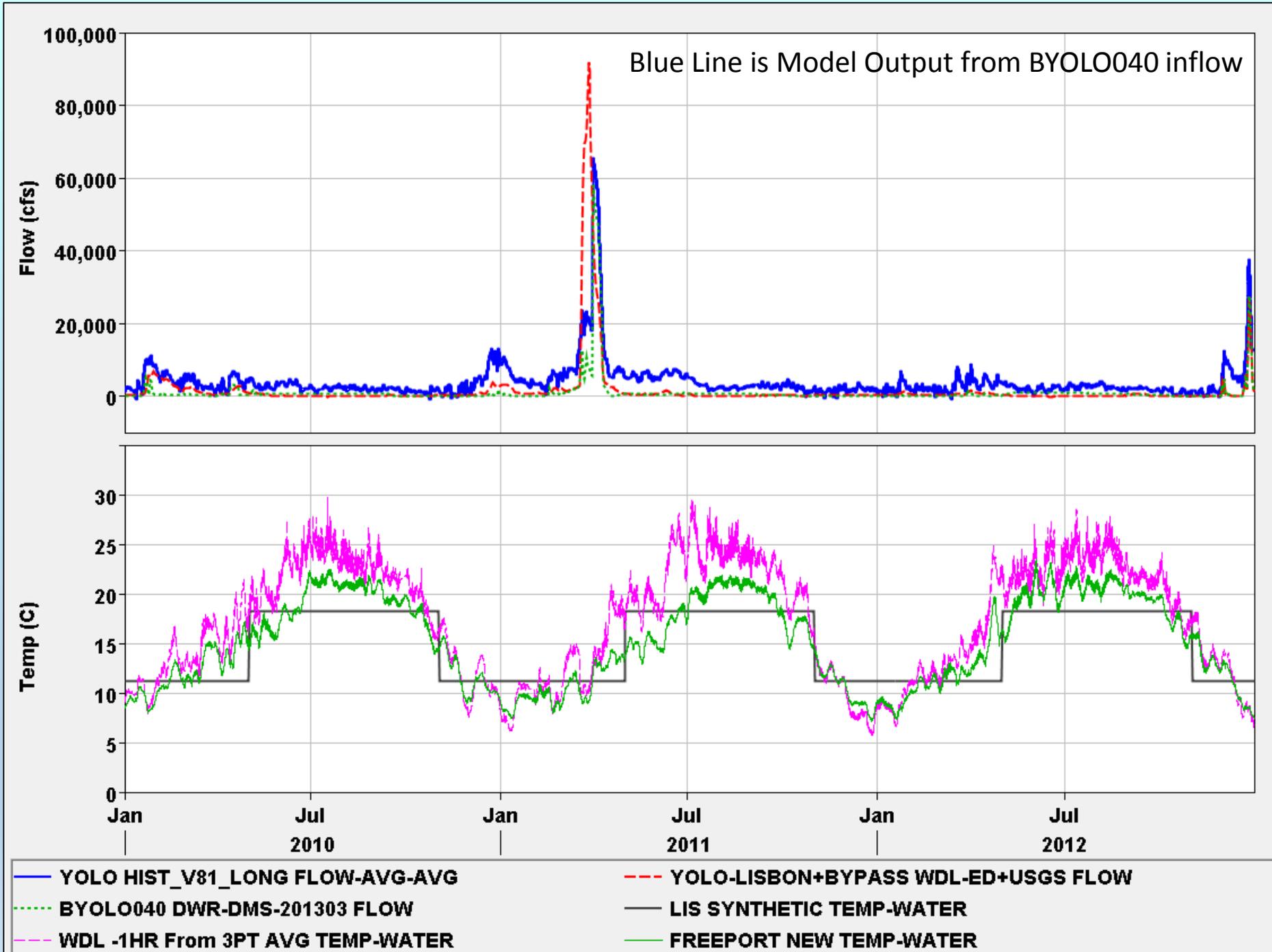
DSM2 Boundary Condition Simulations

- Yolo Flow (Node 316):
 - BYOLO040-DMS
 - Yolo-Lis-RMA
- Yolo Water Temp (Node 316)
 - Synthetic (pre-2009)
 - WDL Lisbon+CDEC or USGS Yolo
 - Freeport CDEC
- Meteorology
 - DSM2 calibration – CIMIS Lodi West
 - RMA calibration – CIMIS Hastings Tract
- DICU – water temperature
 - Monthly average repeating
 - Replace Node 320 w/UCS flow and water temp.

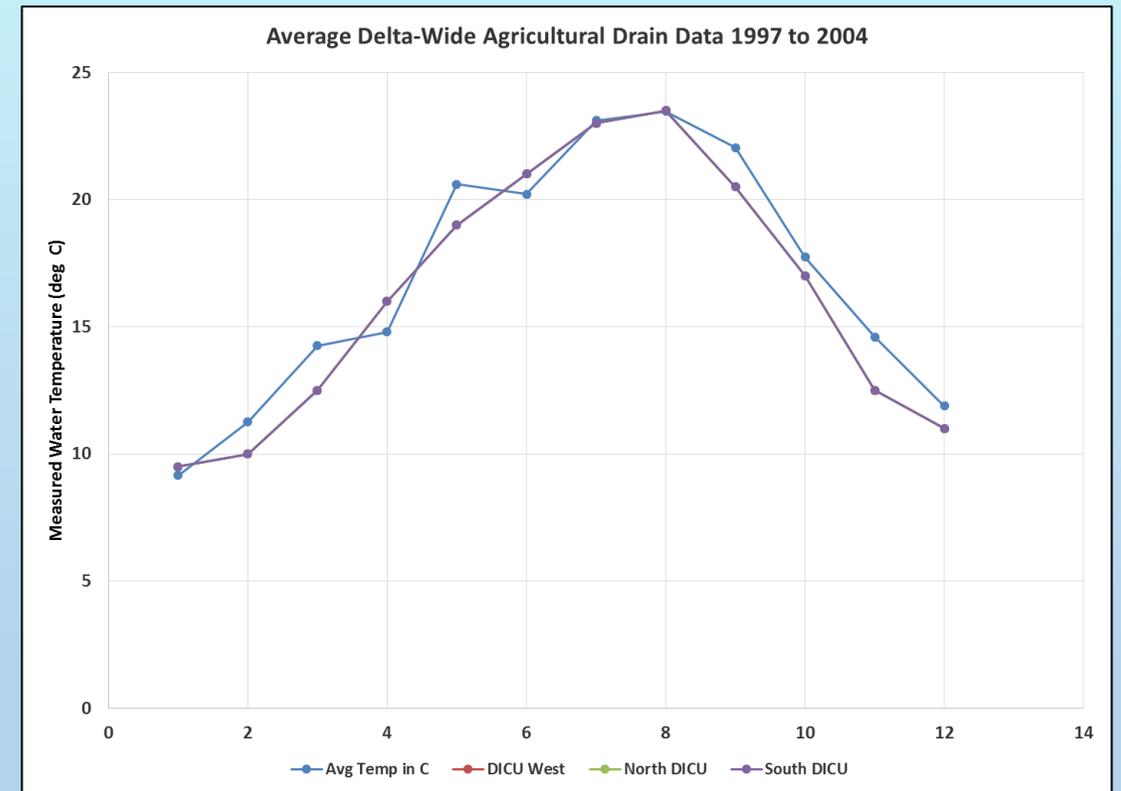
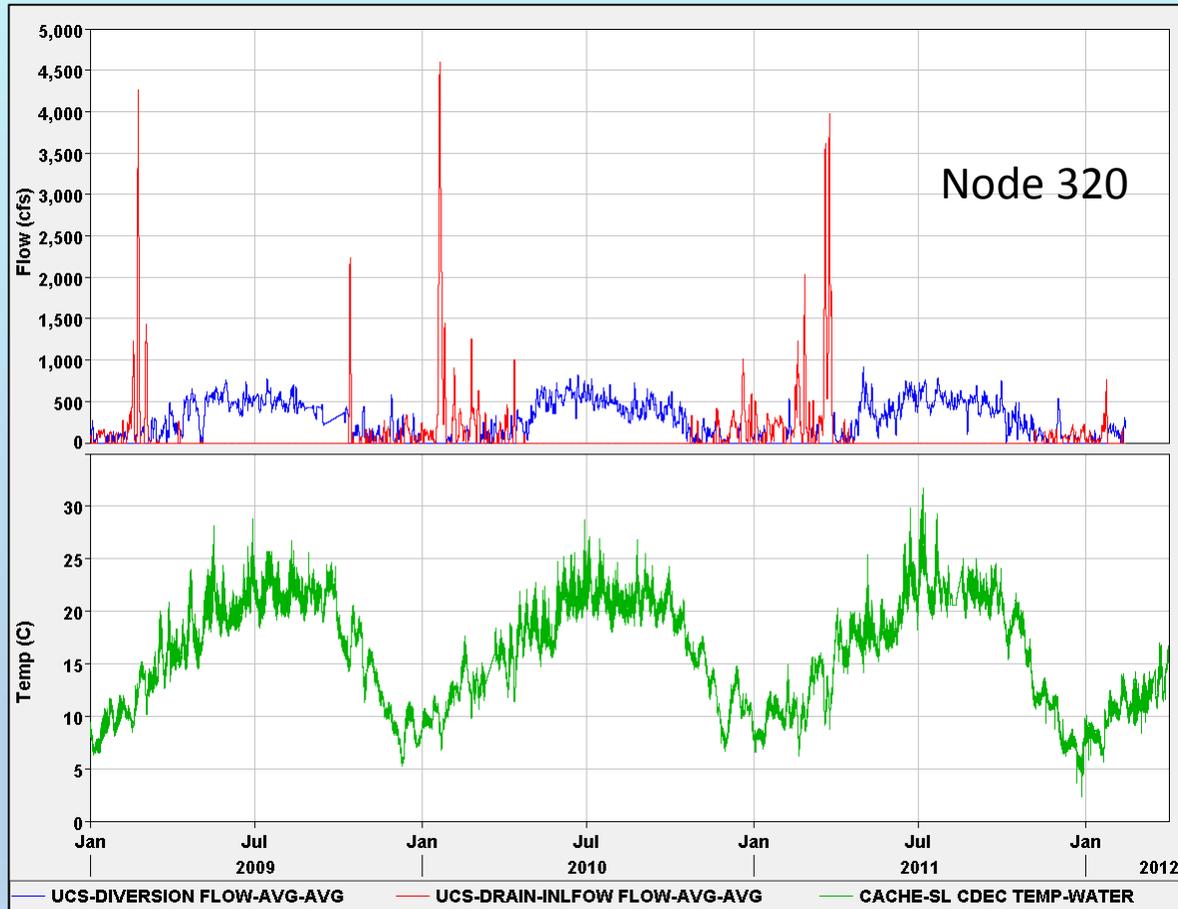


Conceptual Considerations

- RMA and DSM2 have the same fundamental set of equations with small differences:
 - RMA model has a term for exchange of temperature between water and the bed
 - The models use different units for meteorological BCs
- Calibration differences
 - DSM2 calibration/verification in select years 1990 – 2008, focused on Sacramento main stem
 - RMA calibration 03/10 – 10/10, verification 03/09 – 06/09, focused on Prospect region
- Differences in treatment of meteorology:
 - DSM2 calibration doubled wind speed April 15 – October 15 annually
 - RMA calibration decreased wind speed by a factor of 0.75
- DICU differences:
 - Inflow and outflow the same in general – UCS location special for some DSM2 simulations
 - DSM2 DICU water temperature is a monthly average
 - RMA DICU water temperature is specified as the ambient at DICU locations



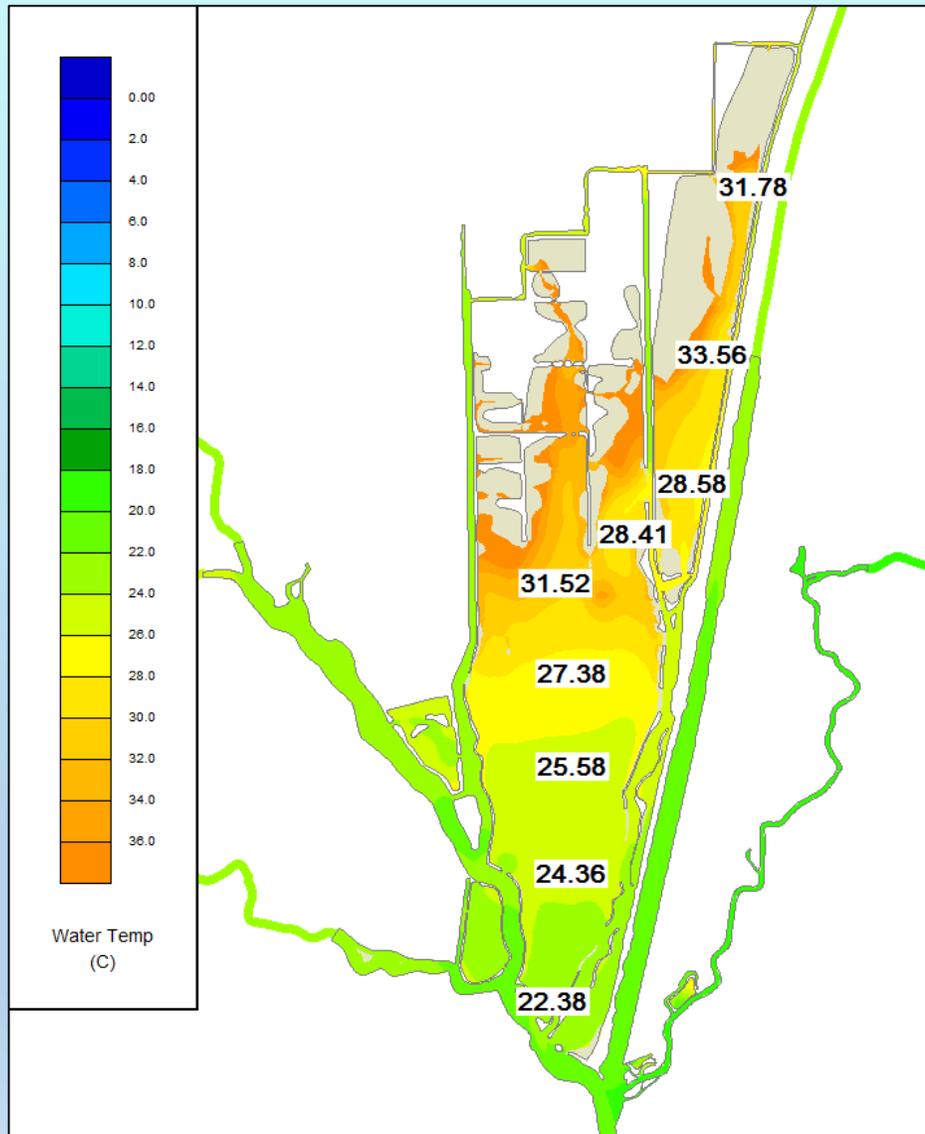
DICU Variations



Results Shown:

- Comparison of average temperature in Liberty Island - RMA and DSM2
 - July 2010, 2011 and December 2011 dates
- Daily average time series plots of RMA model and two DSM2 simulations:
 - DSM2 with “standard” BCs and calibration meteorology
 - DSM2 with RMA flow and water temperature BCs and RMA “massaged” meteorology
- Average monthly calculation for residual of daily averaged model results
 - Model – data
 - 5 locations

July 2, 2011 13:30



Liberty Island Comparison:

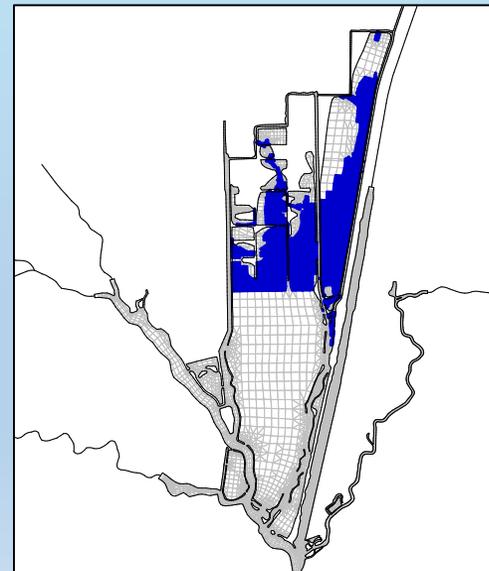
Deep – RMA avg. temperature 24° C, vol. fraction at MLW 0.83

Shallow – RMA avg. temp 29° C, vol. fraction at MLW 0.17

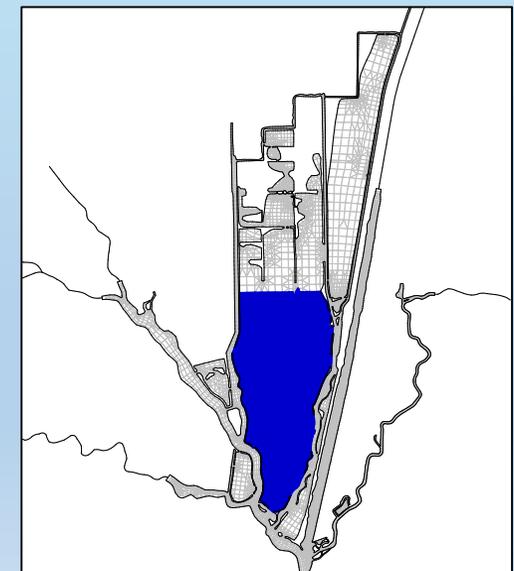
Rough Average RMA Liberty water temperature = 25° C

DSM2 hourly avg. = 22° C

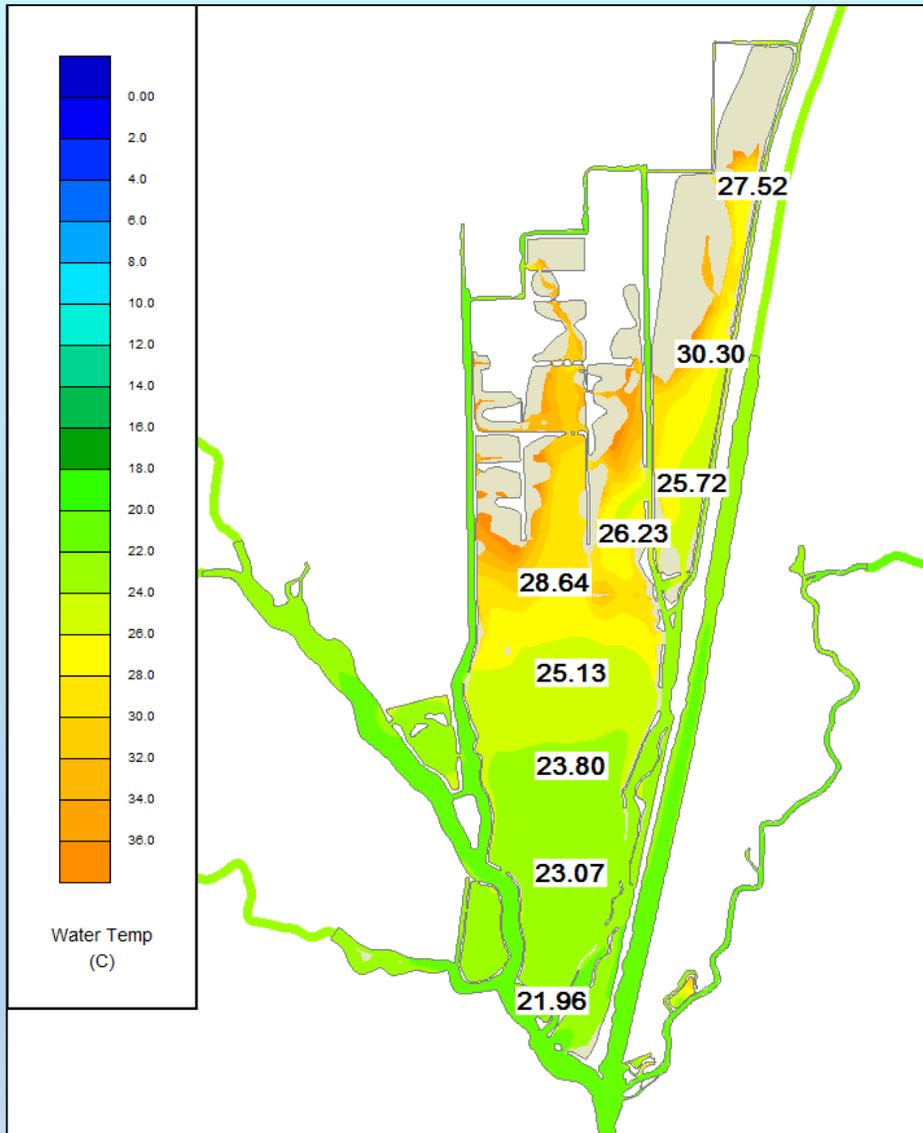
Shallow, < 1.5m



Deep >= 1.5 m



July 11, 2010 12:45



Liberty Island Comparison:

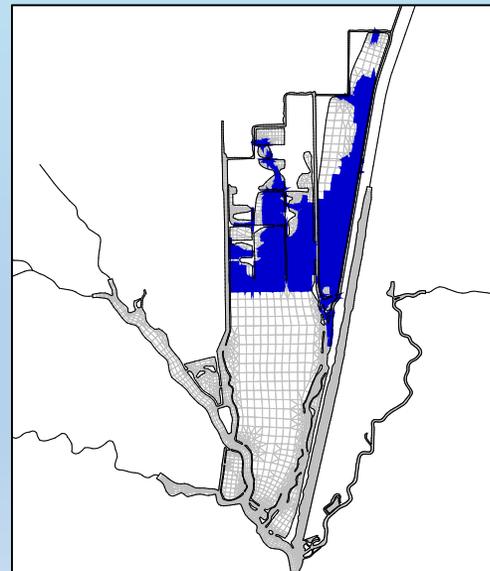
Deep – RMA avg. temperature 23° C, vol. fraction at MLW 0.83

Shallow – RMA avg. temp 27° C, vol. fraction at MLW 0.17

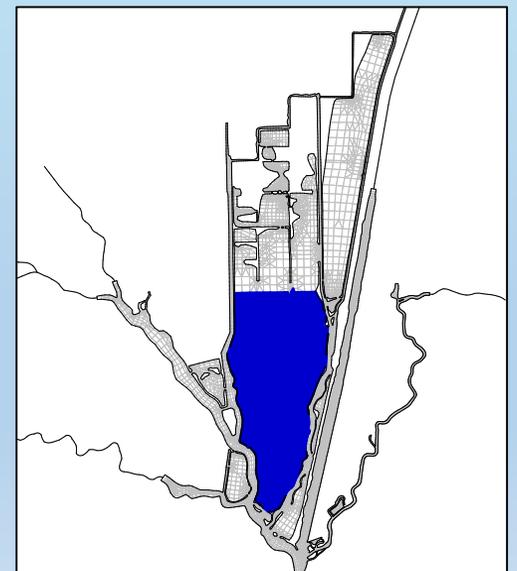
Rough Average RMA Liberty water temperature = 24° C

DSM2 hourly avg. = 23° C

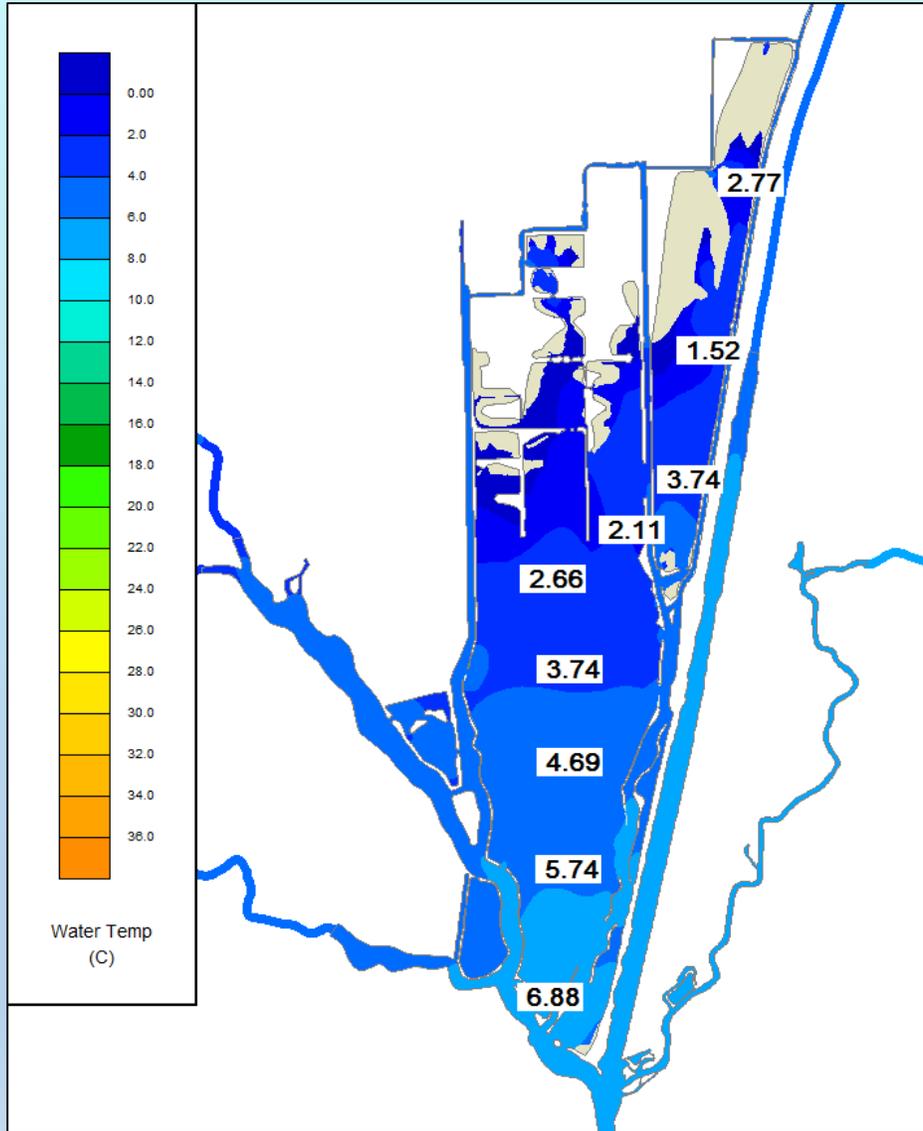
Shallow, < 1.5m



Deep >= 1.5 m



Dec. 24, 2011 04:00



Liberty Island Comparison:

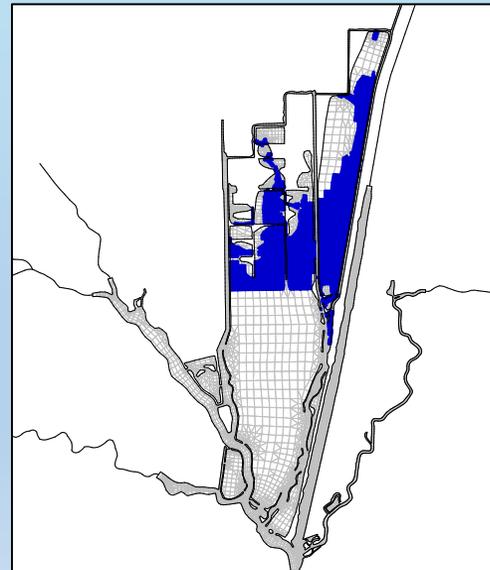
Deep – RMA avg. temperature 5.5° C, vol. fraction at MLW 0.83

Shallow – RMA avg. temp 3° C, vol. fraction at MLW 0.17

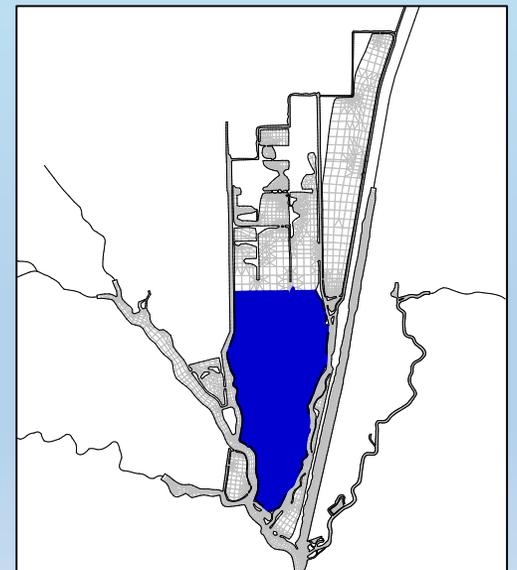
Rough Average RMA Liberty water temperature = 5° C

DSM2 hourly avg. = 6° C

Shallow, < 1.5m

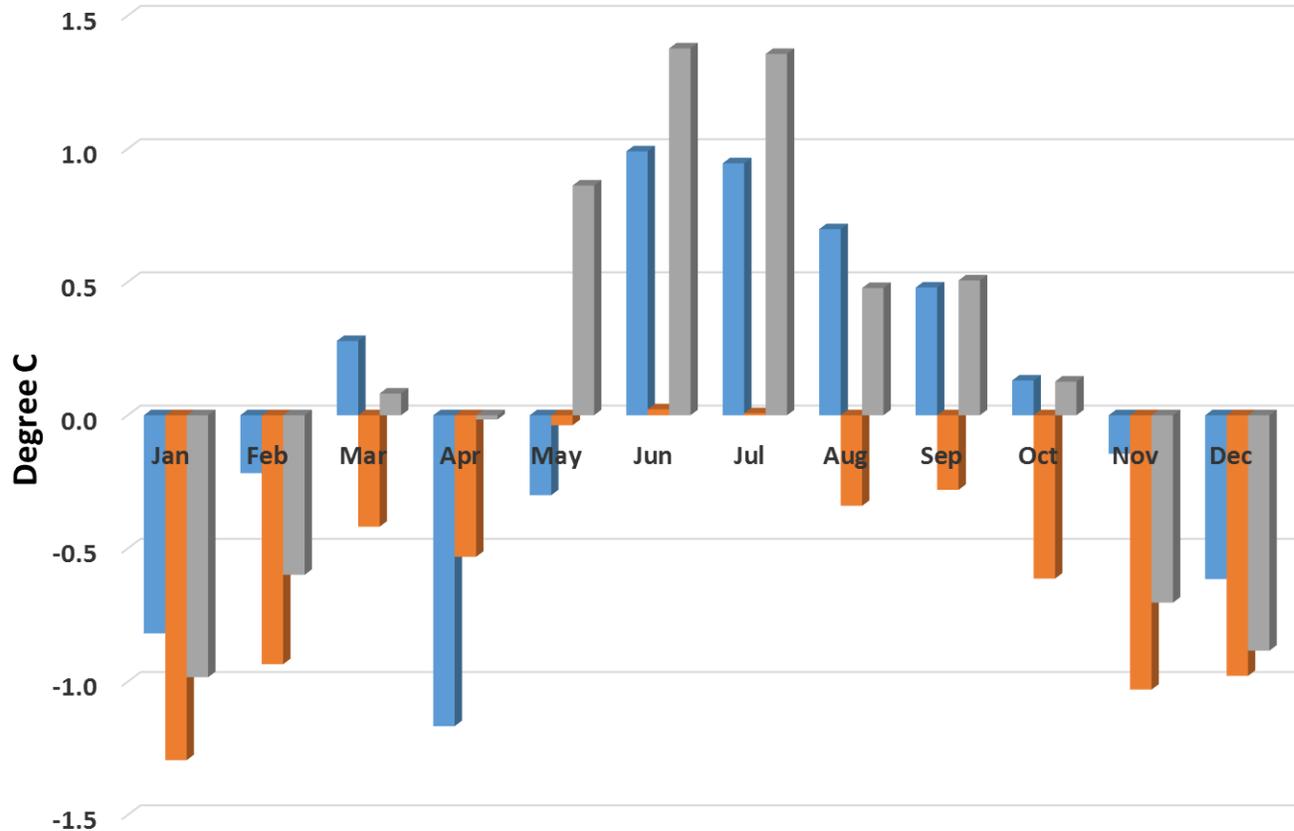


Deep >= 1.5 m



Average Daily Temperature Difference at Liberty S. End Dec. 2010 - Feb. 2011: Model - Data

DSM2 RMA DSM2 w/RMA Met

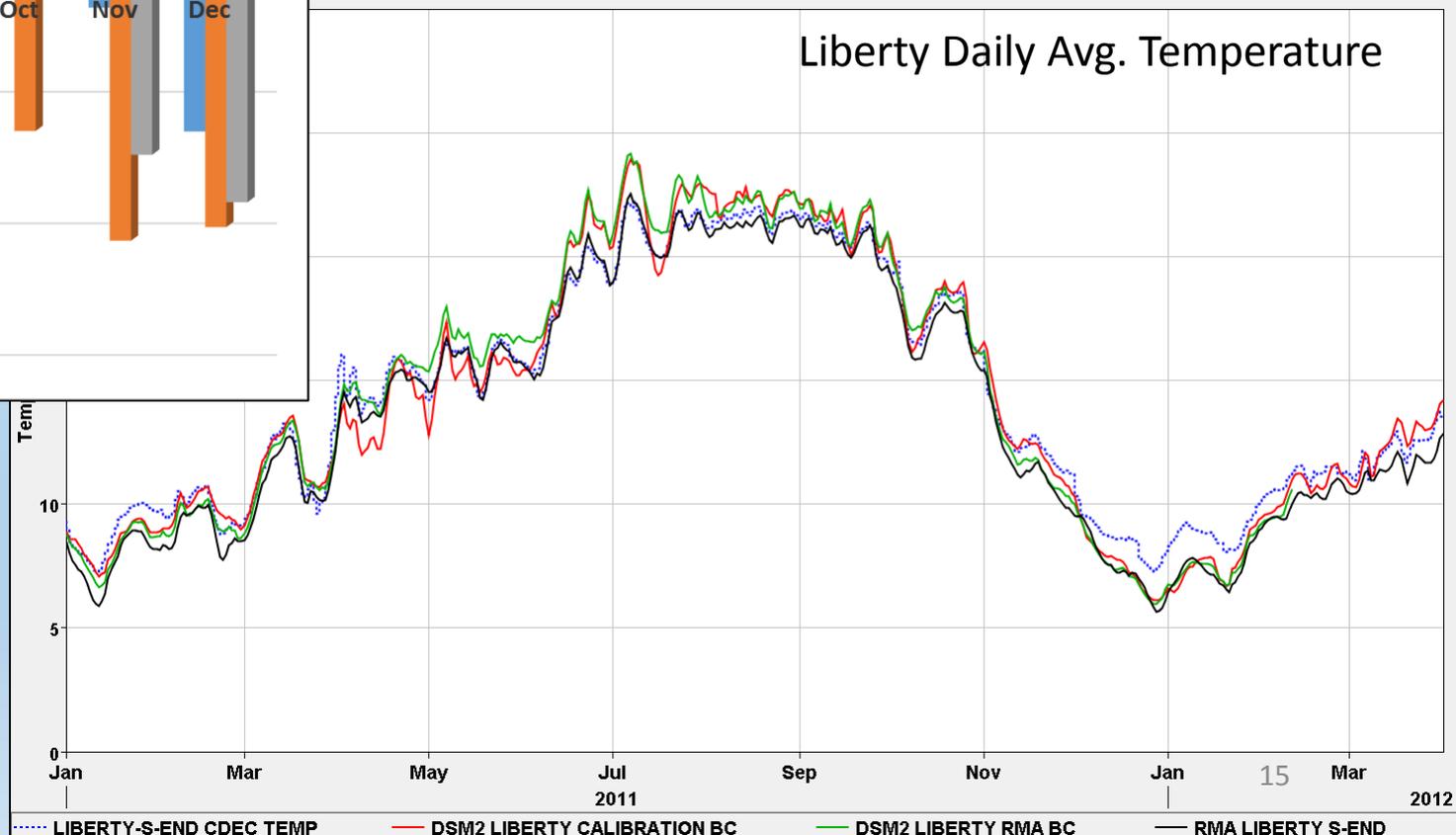


Note –

DSM2 Liberty is the average temperature in the water body
 RMA Liberty temperature is in the correct location, S. end

DSM2 model w/RMA BCs for flow, water temperature, and meteorology, but wind increased by a factor of 1.25

Liberty Daily Avg. Temperature

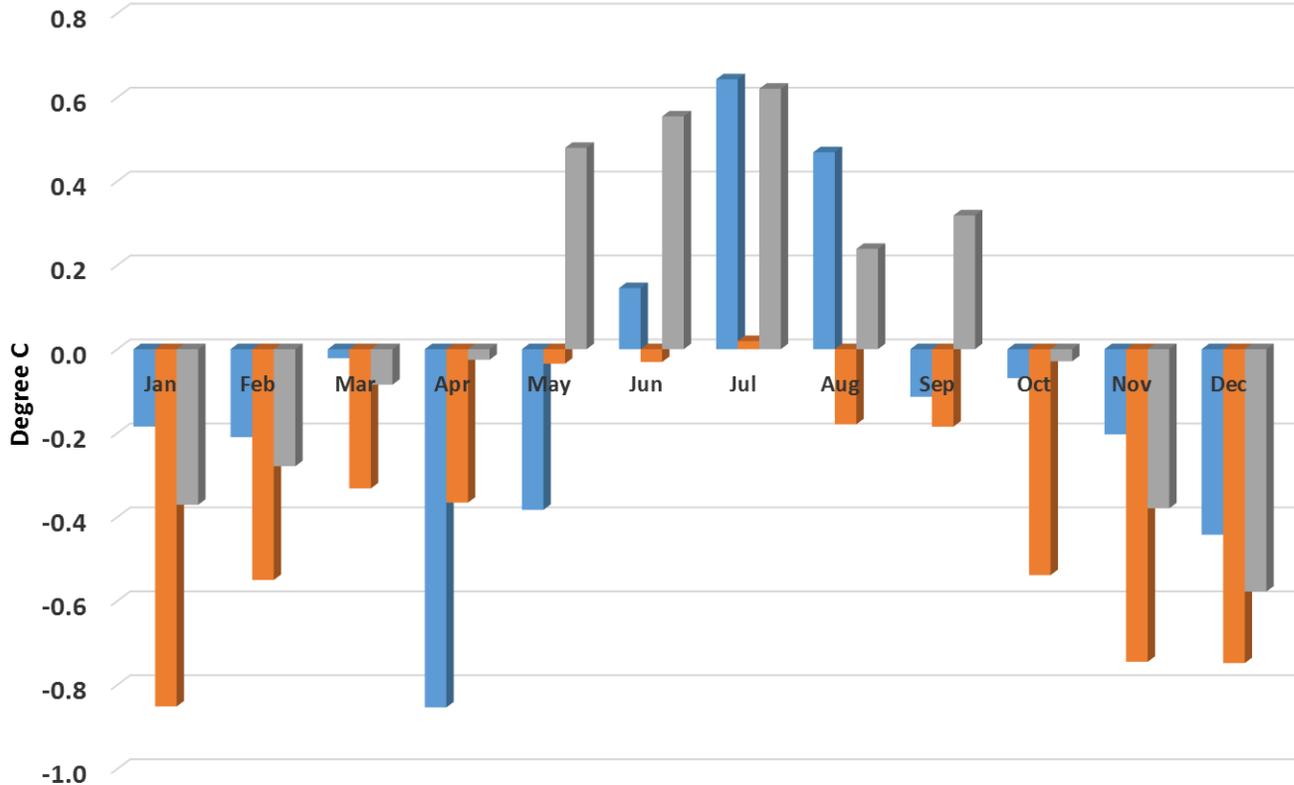


LIBERTY-S-END CDEC TEMP DSM2 LIBERTY CALIBRATION BC DSM2 LIBERTY RMA BC RMA LIBERTY S-END

Average Daily Temperature Difference Cache Sl. at Ryer Jan. 2010 - Dec. 2011:

Model - Data

■ DSM2 ■ RMA ■ DSM2 w/RMA Met



Note –

DSM2 model w/RMA BCs for flow, water temperature, and meteorology, but wind increased by a factor of 1.25

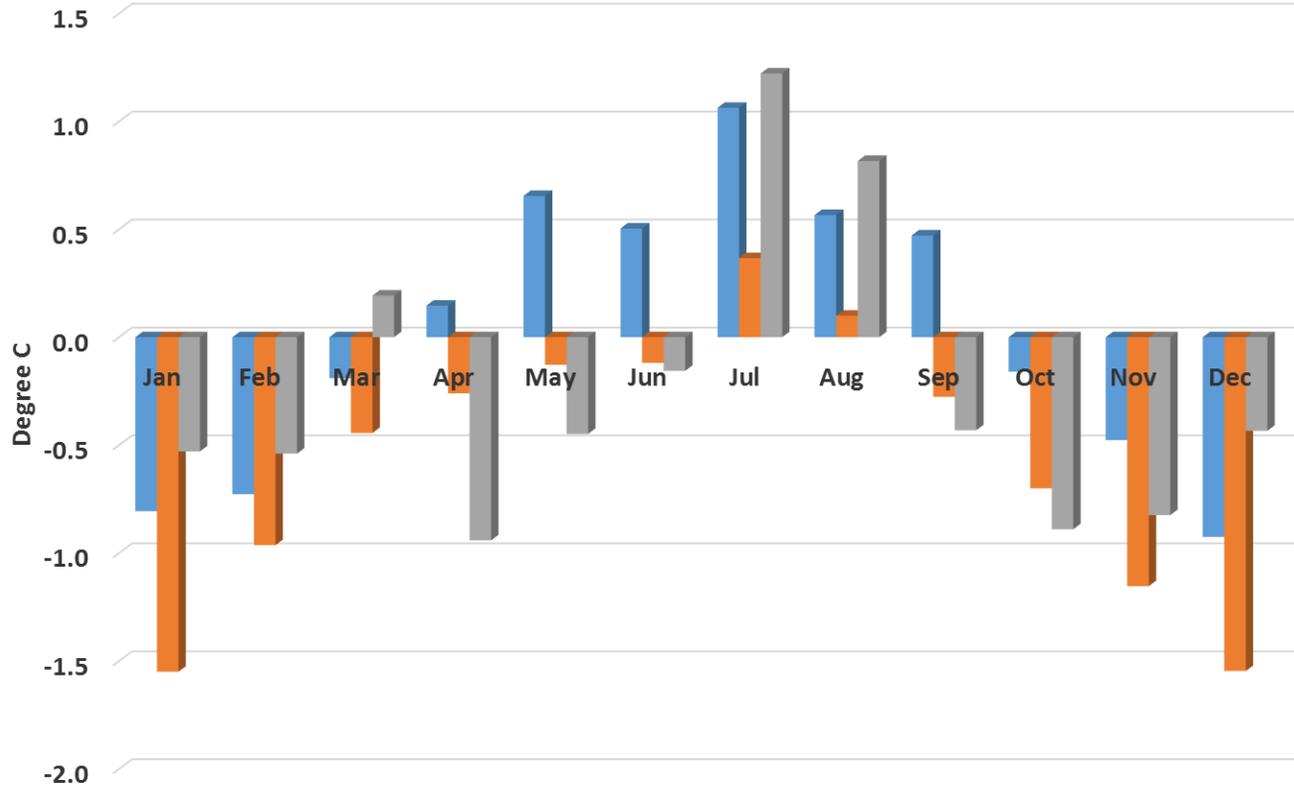


--- CACHE-RYER CDEC TEMP — DSM2 RYI CALIBRATION BC — DSM2 RYI RMA BC — RMA RYI

Average Daily Temperature Difference Lindsey Sl. Jan. 2009 - Dec. 2011:

Model - Data

■ DSM2 ■ RMA ■ DSM2 w/RMA Met



Note –

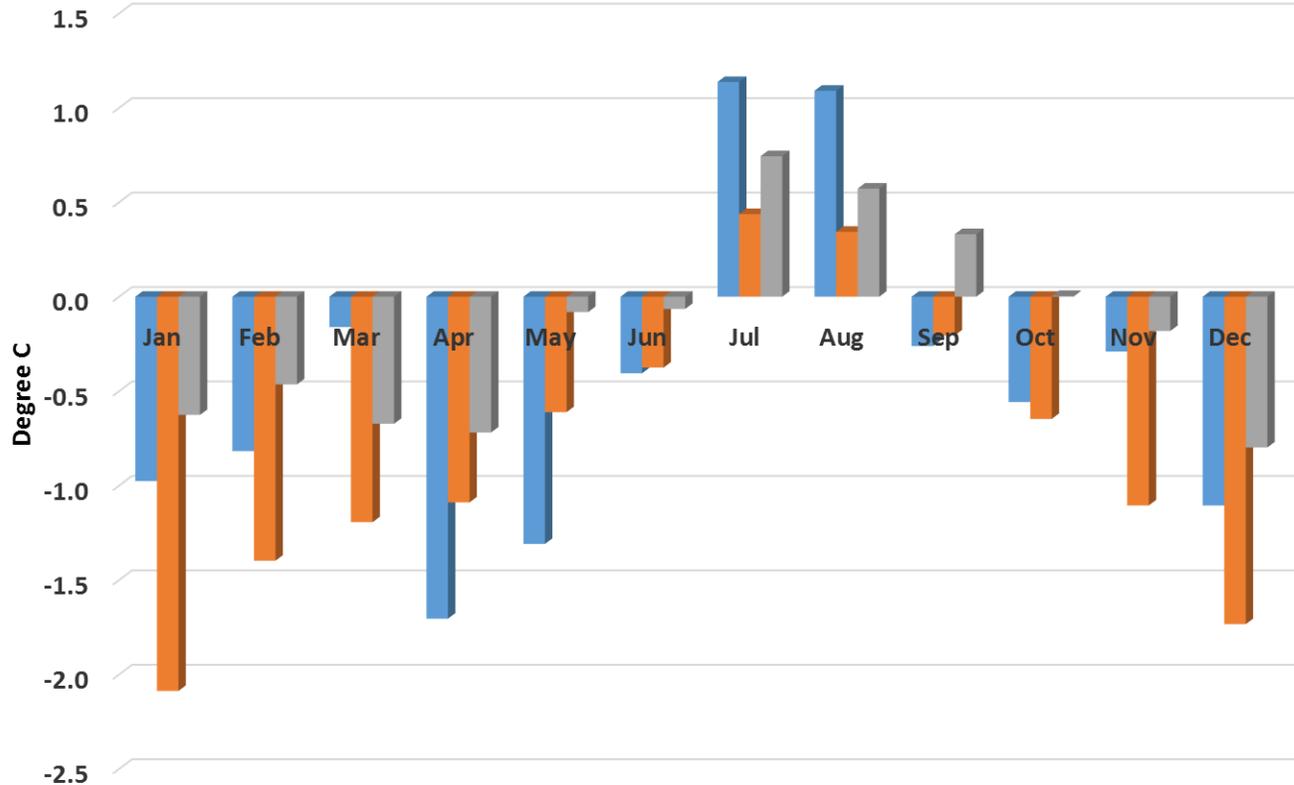
DSM2 model w/RMA BCs for flow, water temperature, and meteorology, but wind increased by a factor of 1.25



Average Daily Temperature Difference Cache Sl. Jan. 2009 - Dec. 2011:

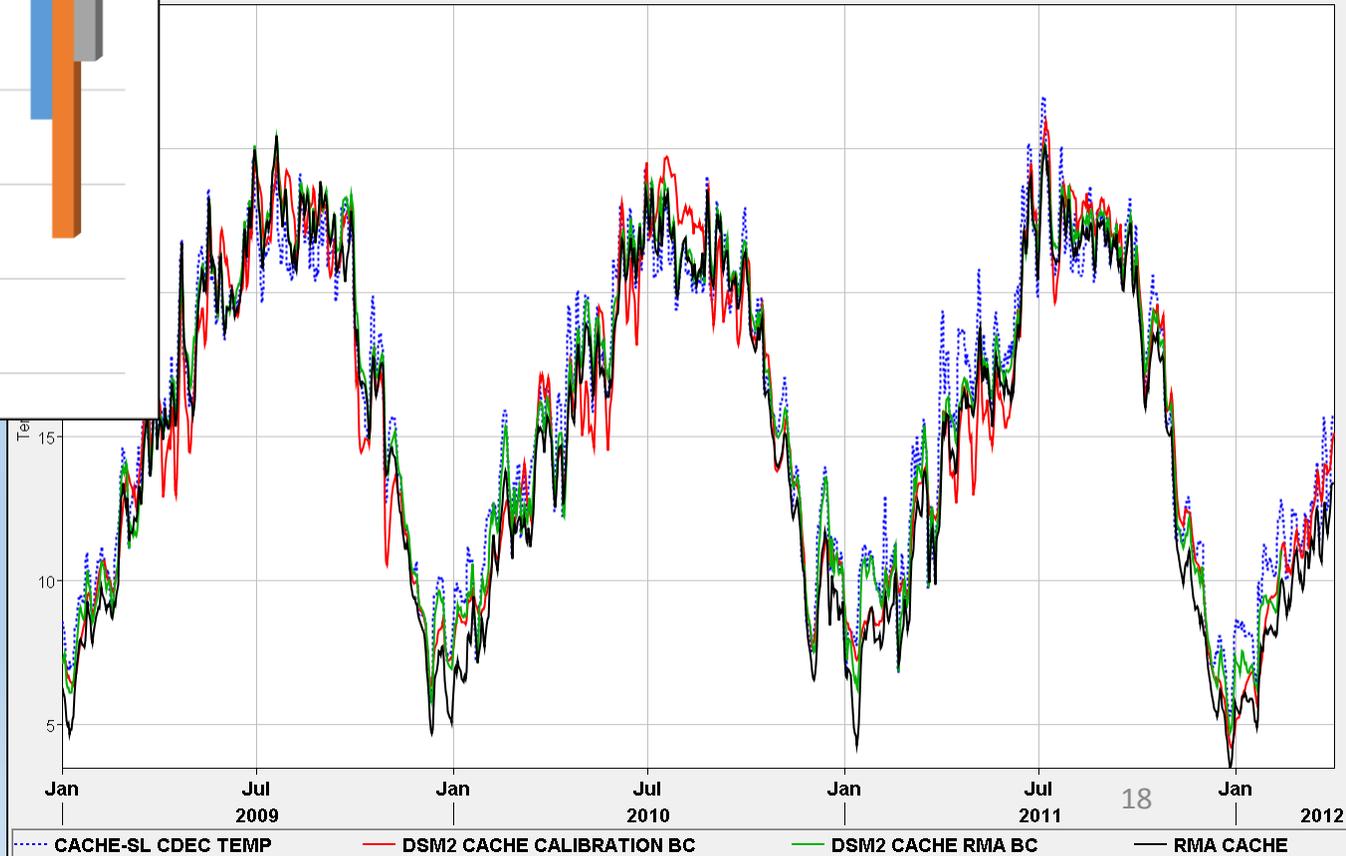
Model - Data

■ DSM2 ■ RMA ■ DSM2 w/RMA Met



Note –

DSM2 model w/RMA BCs for flow, water temperature, and meteorology, but wind increased by a factor of 1.25

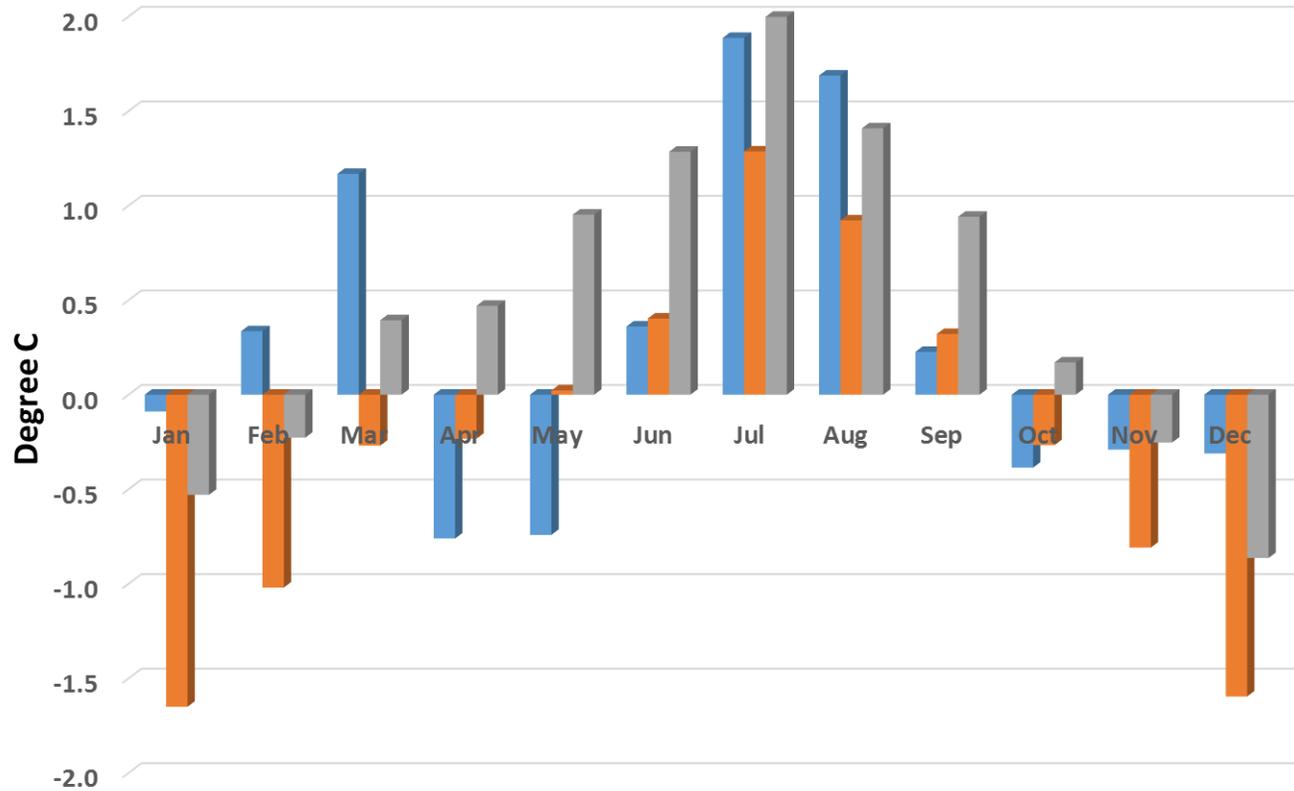


--- CACHE-SL CDEC TEMP — DSM2 CACHE CALIBRATION BC — DSM2 CACHE RMA BC — RMA CACHE

Average Daily Temperature Difference Barker Slough Jan. 2009 - Feb. 2011:

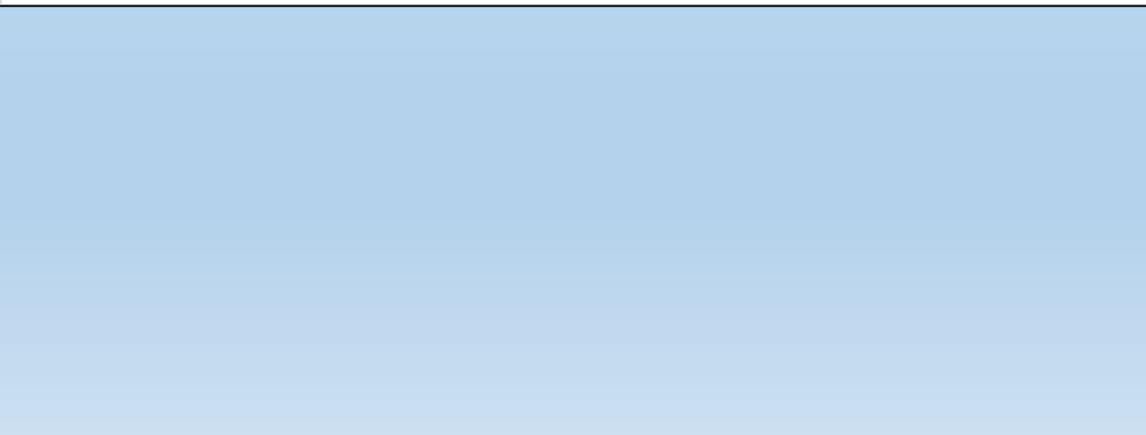
Model - Data

■ DSM2 ■ RMA ■ DSM2 w/RMA Met



Note –

DSM2 model w/RMA BCs for flow, water temperature, and meteorology, but wind increased by a factor of 1.25



Findings

- Monthly Averages:
 - RMA daily average model results in the Cache-Liberty region were generally accurate within +/- 1°C April – October
 - DSM2 daily average model results were generally too warm June – August, the accuracy varied by location
 - Both models were generally too cold otherwise (always in the winter months)
- Liberty Island –
 - Accuracy of RMA temperature results for Liberty Island was very good during calibration/verification periods
 - DSM2 results for average Liberty Island temperature were within 3°C of rough RMA volume-average calculation

To Do List:

- Investigate better DSM2 conceptualization of :
 - High inflow location node for Yolo, low inflow location node for Lisbon
 - Inflow-outflow locations for Liberty on east side
- Recalibrate DSM2 water temperature for the entire Delta, without a focus on Sacramento River (PEST project!)
- Recalibrate DSM2 with a focus on the Cache-Liberty region using Hastings Tract CIMIS meteorology
- Investigate the bias to cold modeled water temperatures in winter months

Thank-you for your attention!