

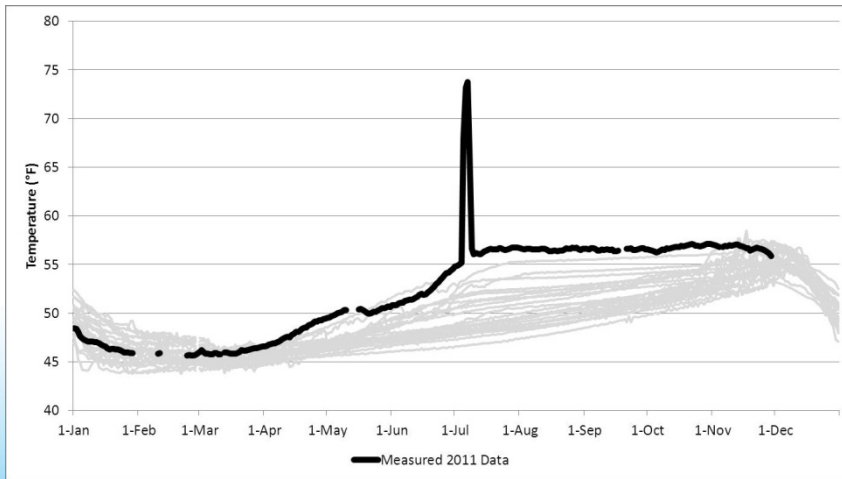
# Water Management Millerton Lake Temperature Model Verification



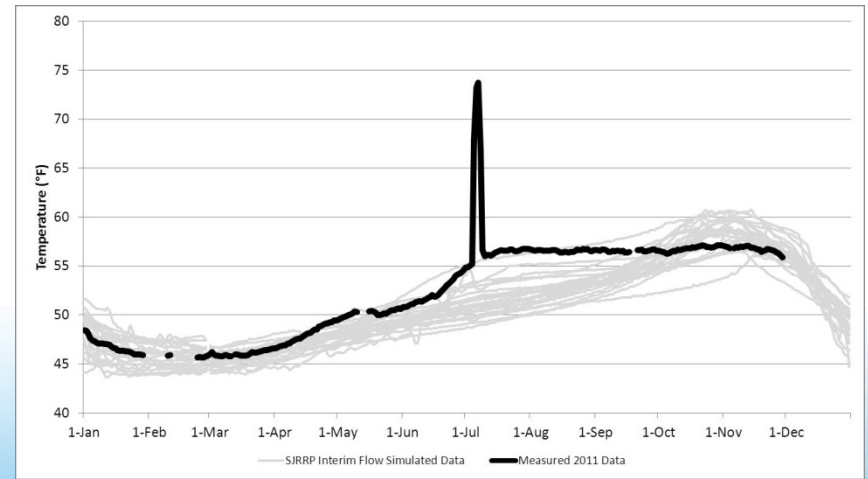
## Restoration Goals Technical Feedback Group Meeting

# 2011 Measured Temperatures

## SJRRP Full Restoration Flows



## SJRRP Interim Flows



# Model Description

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- CE-QUAL-W2 based 2-D reservoir model of Millerton Lake
- Outputs hourly temperatures
- Initial development by Reclamation, Upper San Joaquin River Basin Storage Investigation project team developed model to current status. (Upper San Joaquin River Basin Storage Investigation, Administrative Draft, Plan Formulation Report Technical Appendices, October 2006)

# Methodology

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- Selected period 10/1/2010 through 11/30/2011
- Gather and verify metrological data with SJRRP modeling input data
- Gather water operations flow and temperature data
- Compare simulated temperature outputs with measured temperatures



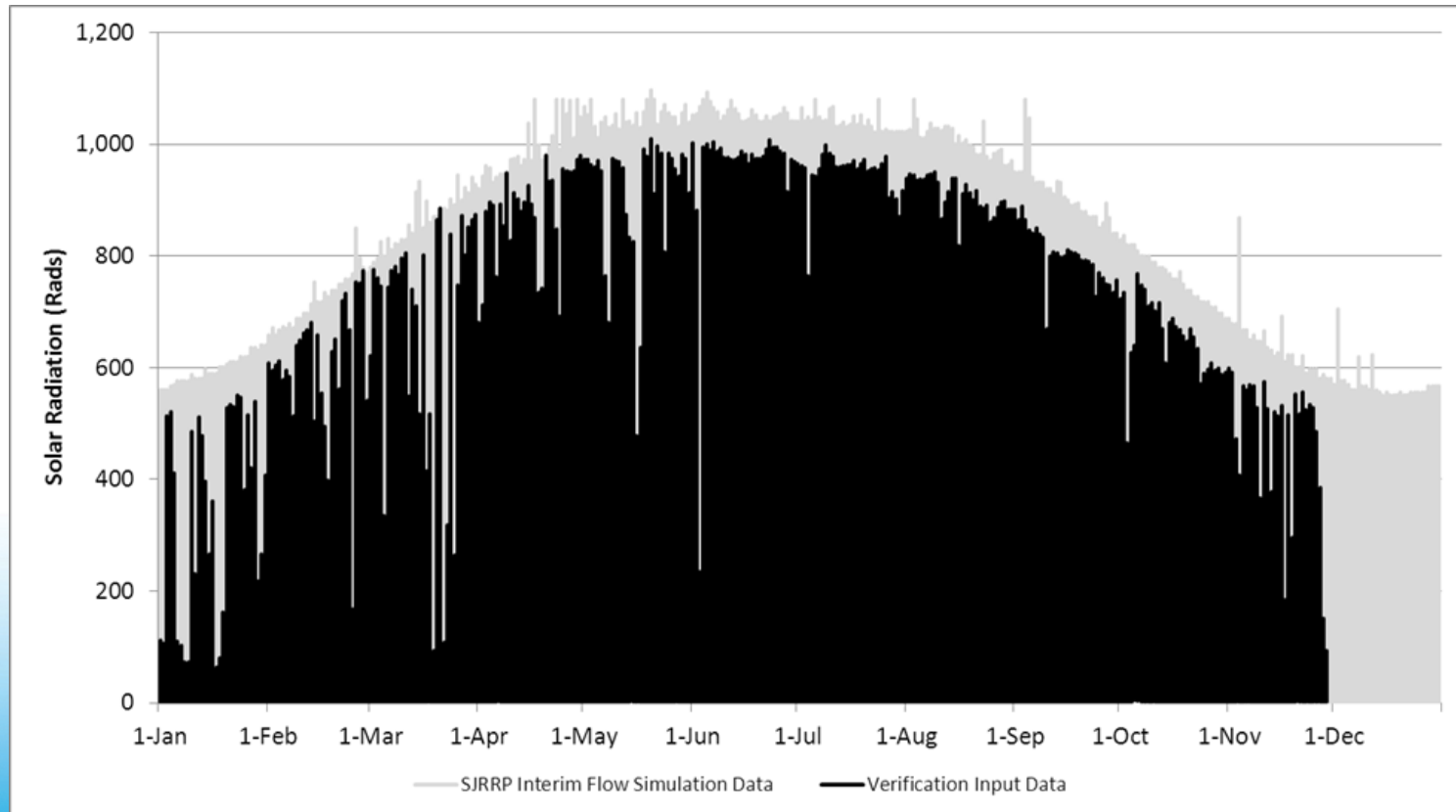
# Metrological Data

## California Data Exchange Center (CDEC) Friant Dam station

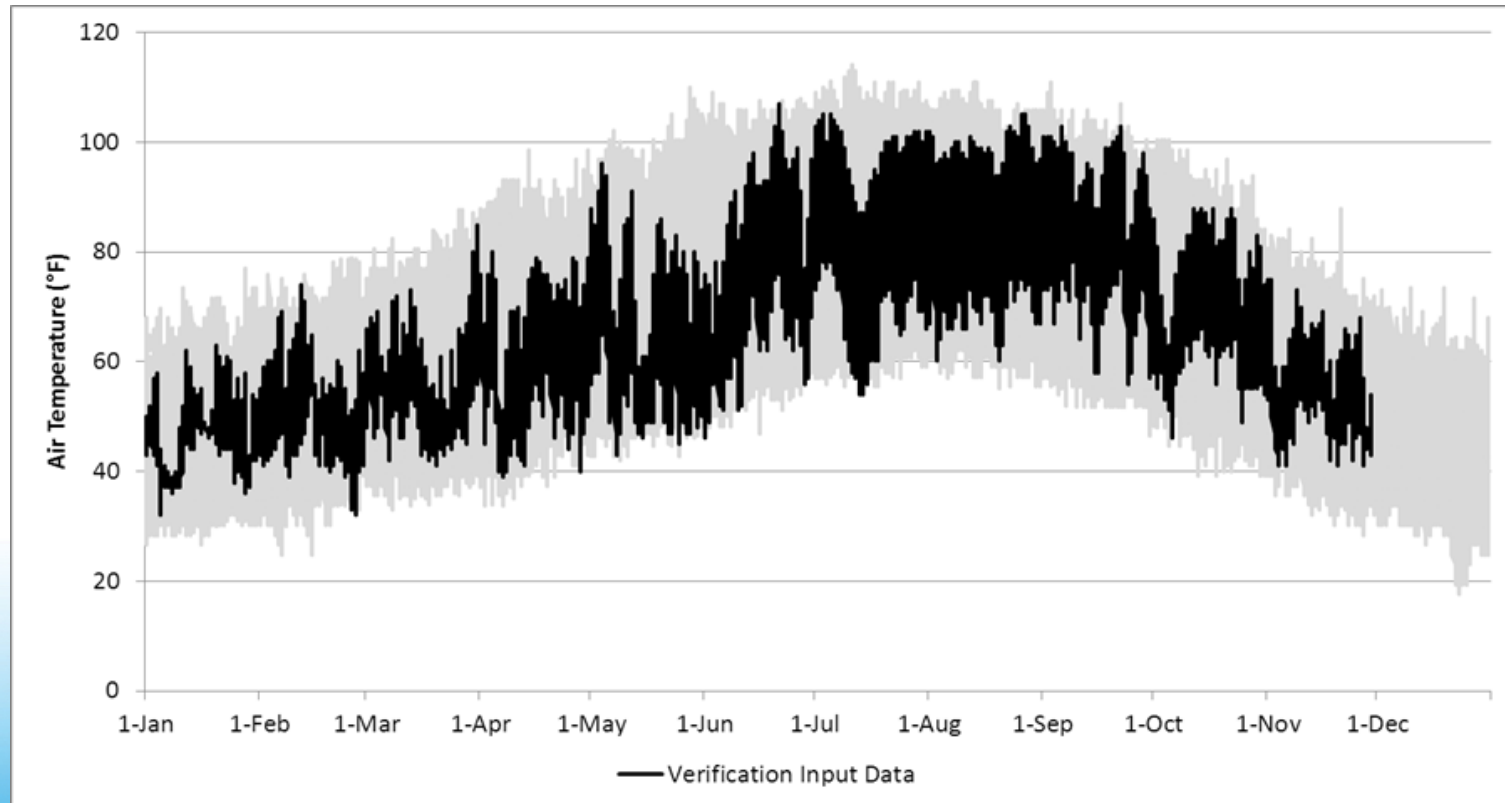
<b>Station ID</b>	FRT	<b>Elevation</b>	578' feet
<b>River Basin</b>	San Joaquin River	<b>County</b>	Fresno
<b>Hydrologic Area</b>	San Joaquin River	<b>Nearby City</b>	Friant
<b>Latitude</b>	36.995000°N	<b>Longitude</b>	119.692000°W
<b>Operator</b>	Reclamation	<b>Data Collection</b>	

<b>Metrological Data</b>	<b>Sensor Number</b>
Solar Radiation	15706
Air Average Temperature	15720
Wind Speed	15702
Wind Direction	15700
Relative Humidity	15704

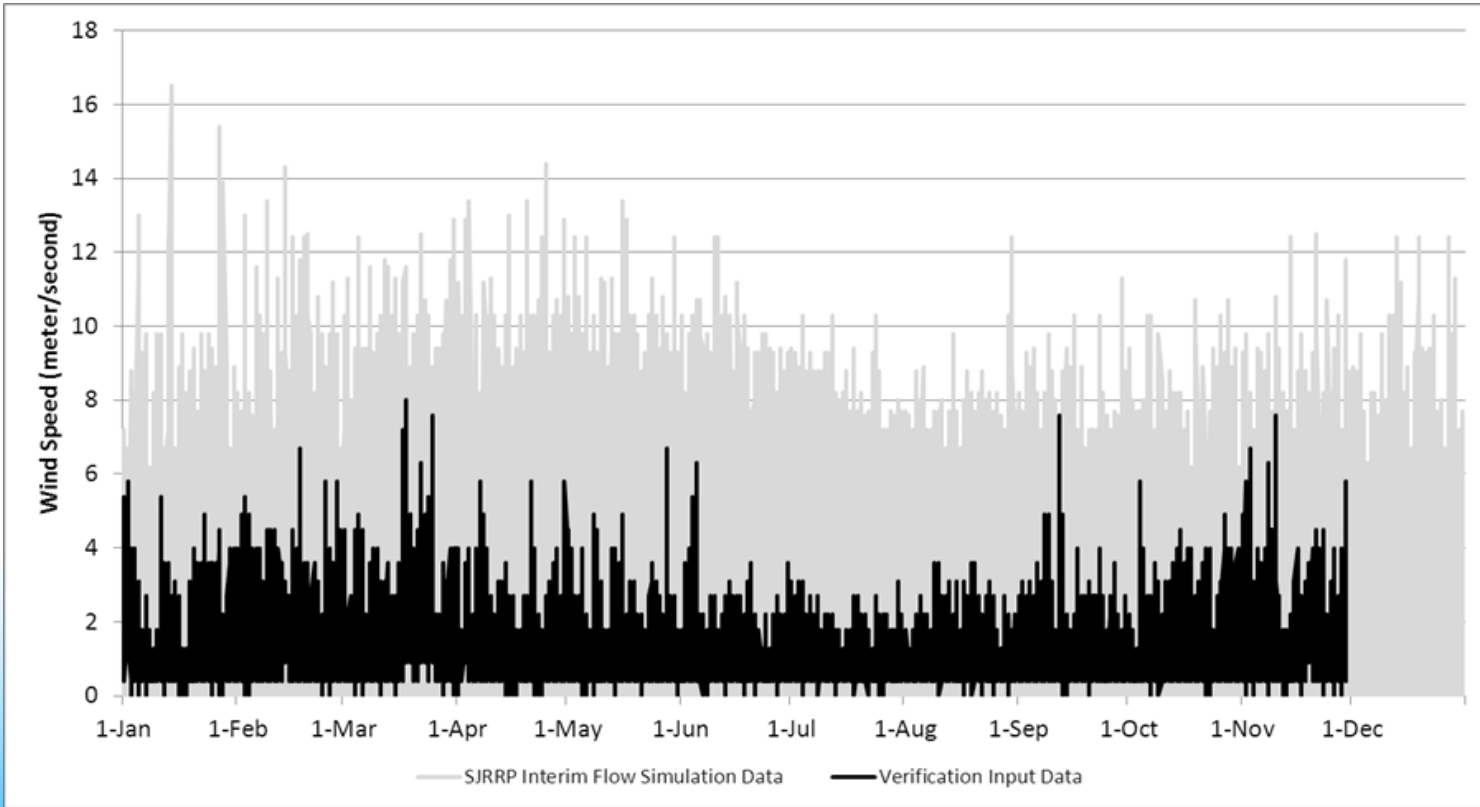
# Solar Radiation



# Air Temperature

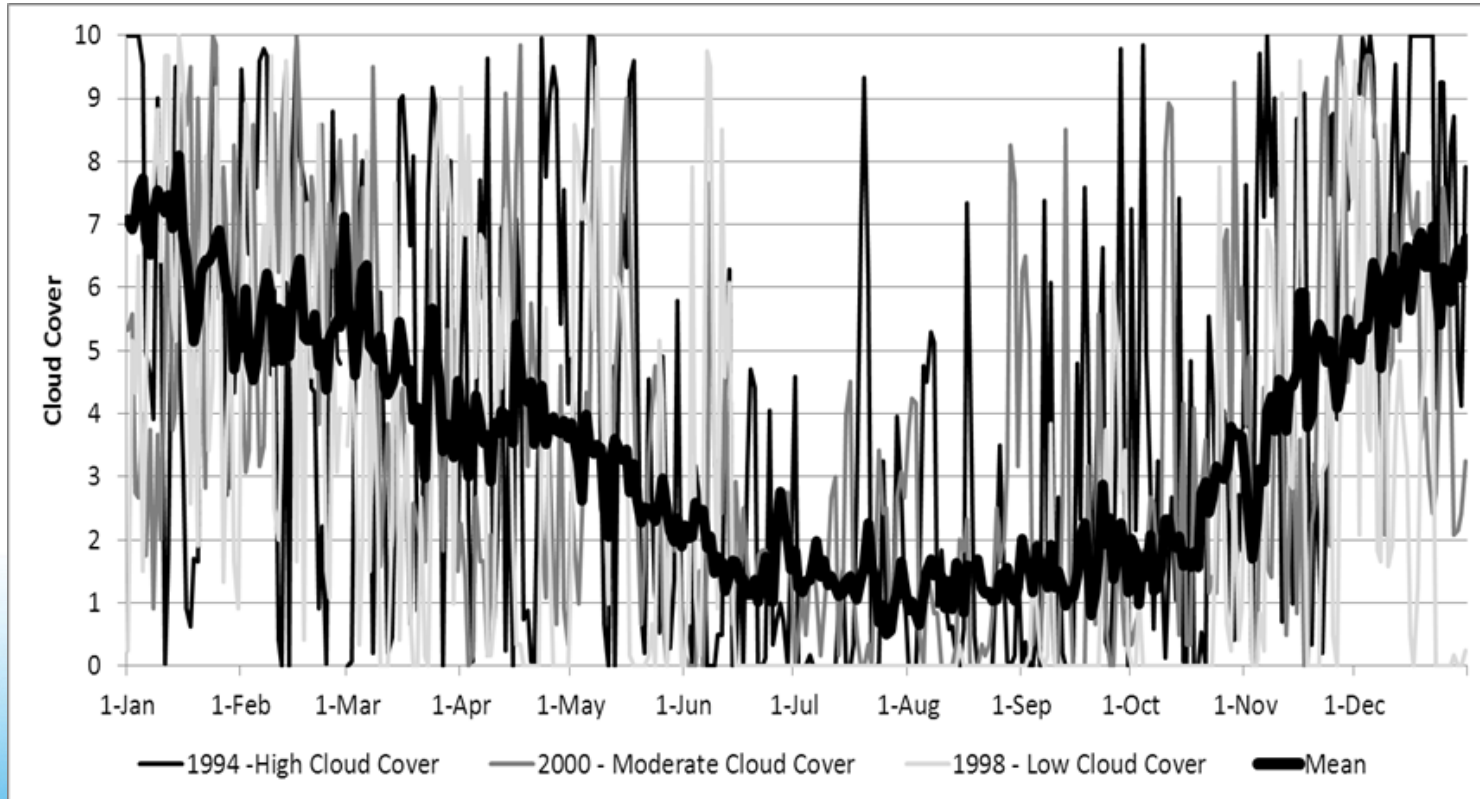


# Wind Speed





# Cloud Cover



# Water Operations Data

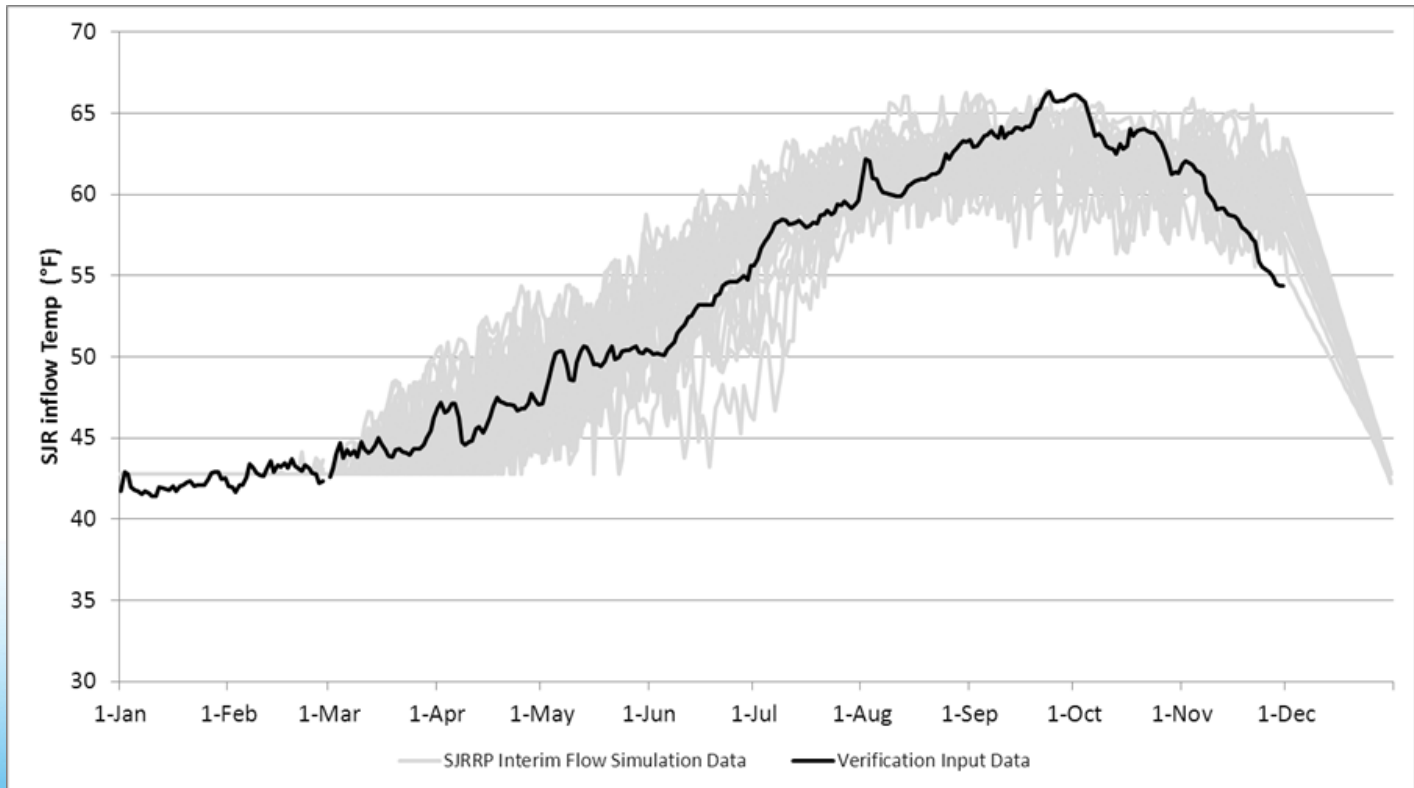
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## Water Operations Data

- Inflow (San Joaquin River + Kerkhoff Power Tunnel Inflow)
- Madera Canal diversion
- Friant-Kern Canal diversion
- San Joaquin River release
- San Joaquin River spill

From the Reclamation website, 2010 and 2011 Reservoir Operations Reports, Millerton Lake (<http://www.usbr.gov/mp/cvo/reports.html>)

# Inflow Temperature





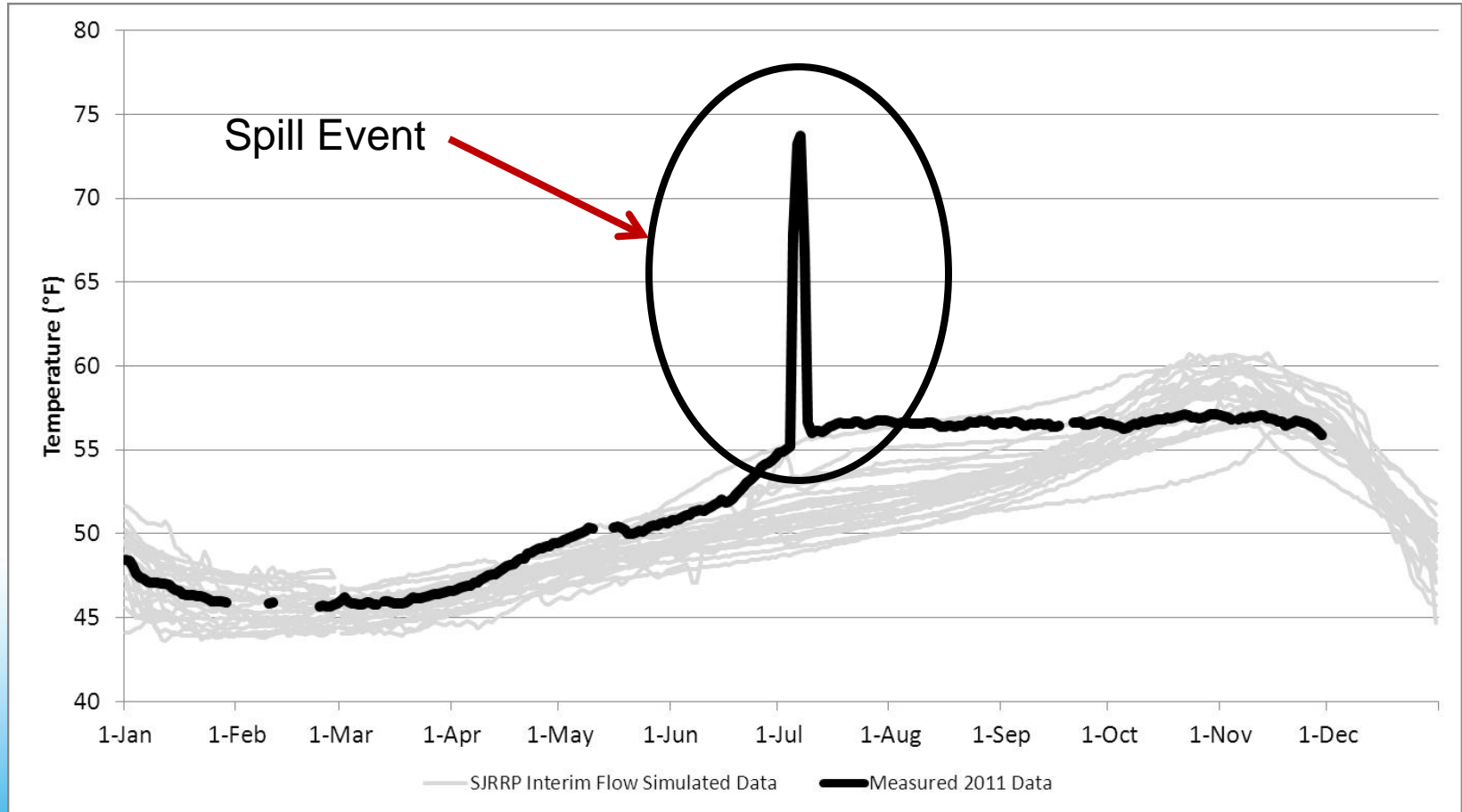
# San Joaquin River Temperature

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## California Data Exchange Center (CDEC) San Joaquin River Below Friant Station

<b>Station ID</b>	SJF	<b>Elevation</b>	294' ft
<b>River Basin</b>	San Joaquin River	<b>County</b>	Fresno
<b>Hydrologic Area</b>	San Joaquin River	<b>Nearby City</b>	Friant
<b>Latitude</b>	36.984394°N	<b>Longitude</b>	119.724312°W
<b>Operator</b>	US Geological Survey	<b>Data Collection</b>	

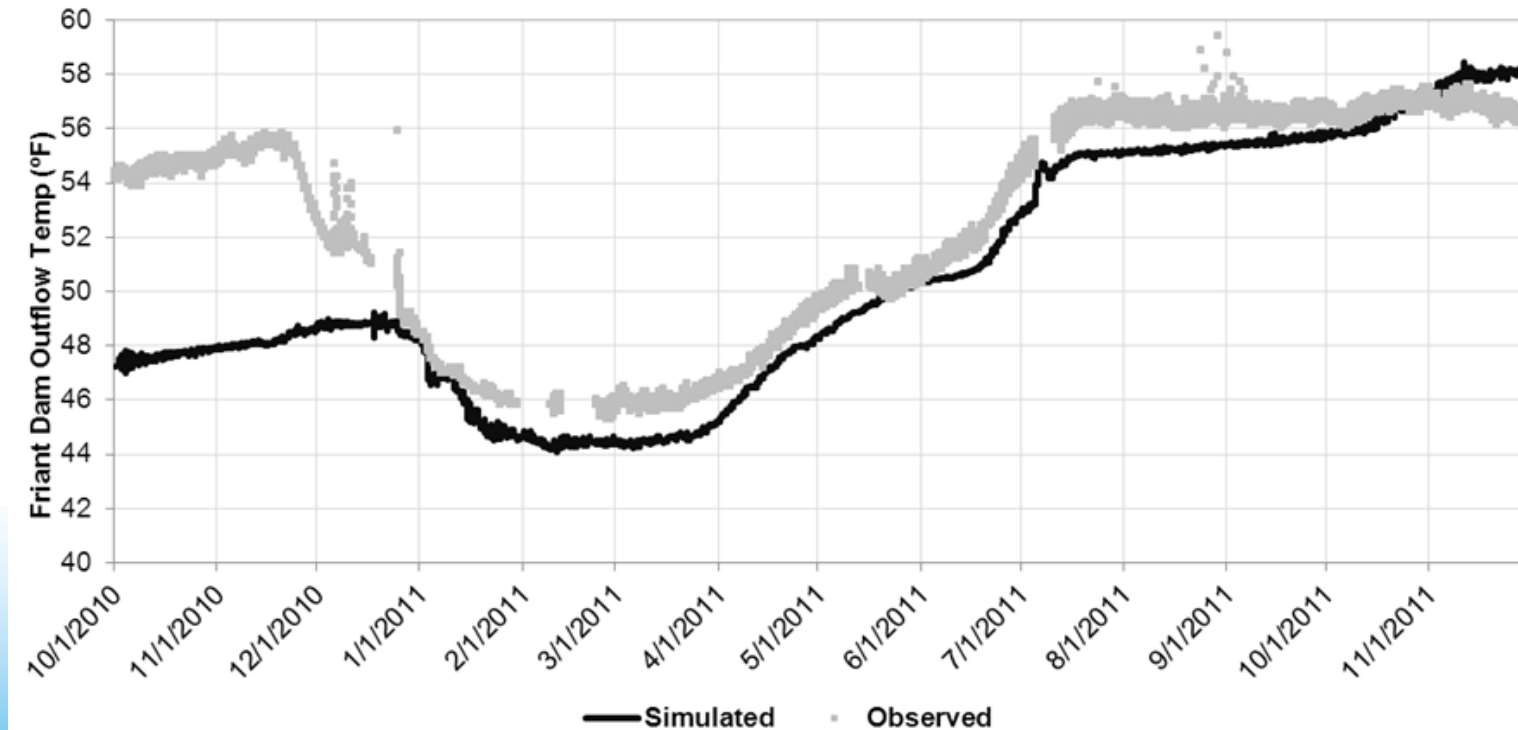
# Temperature Spike





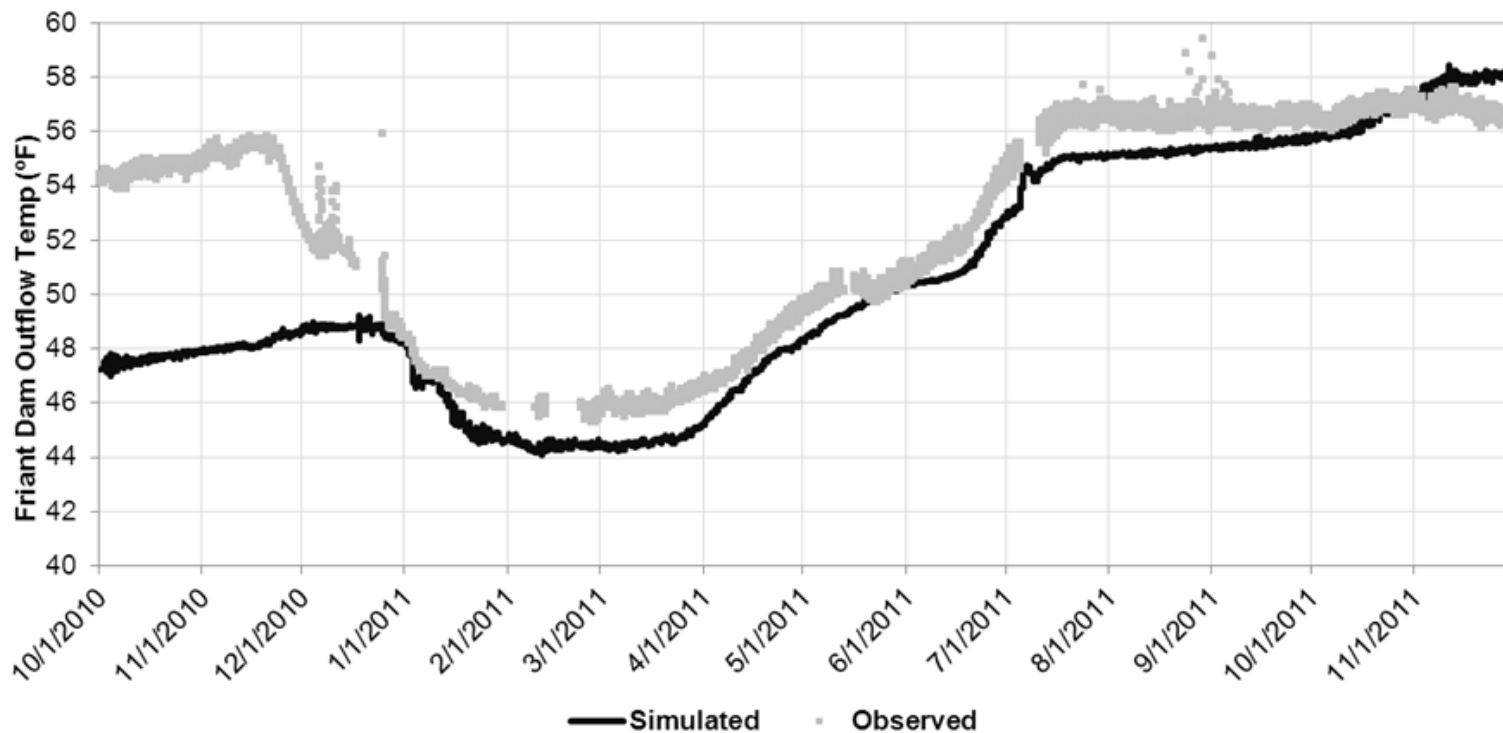
# Simulation Results

Simulated Millerton Release and Measured San Joaquin River Below Friant Station

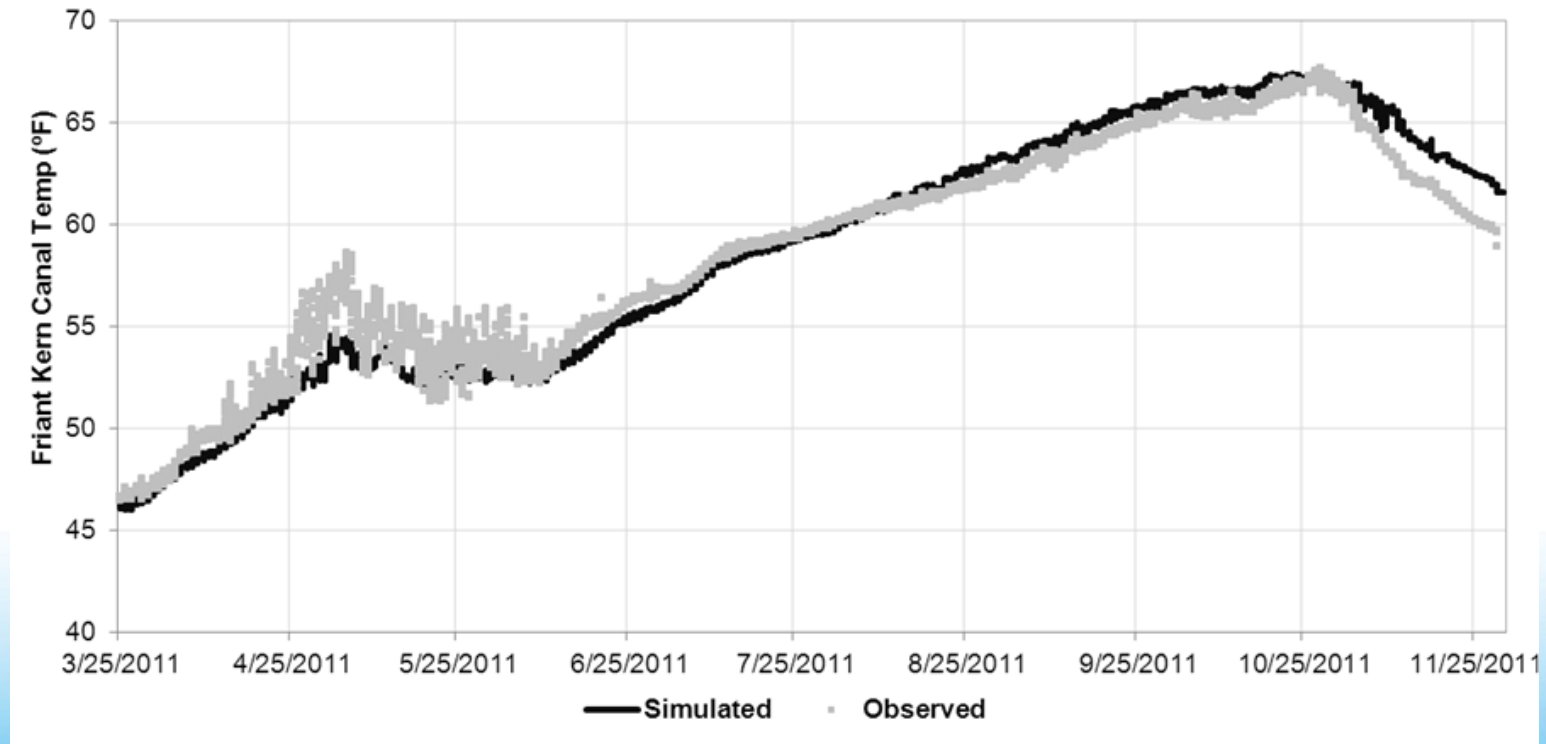


# Simulation Results

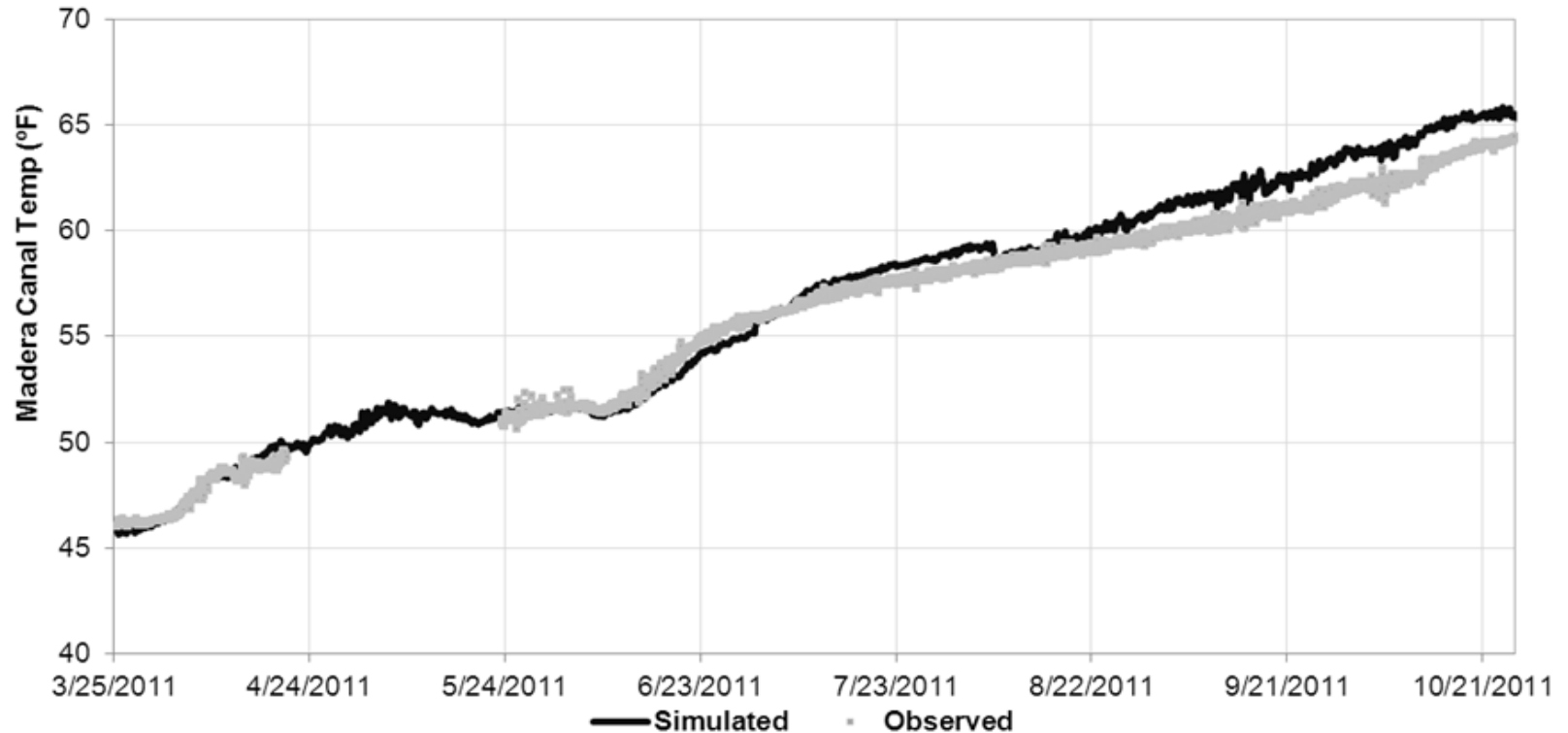
Simulated Millerton Release and Measured San Joaquin River Below Friant Station



# Simulated Vs. Measured FKC Temperature



# Simulated Vs. Measured Madera Canal Temperature







# Error Statistics

## Simulated Millerton Release Temperature Vs. Measured SJR Temperature

Month	Low Cloud Cover			Moderate Cloud Cover			High Cloud Cover		
	BIAS	MAE	RMSE	BIAS	MAE	RMSE	BIAS	MAE	RMSE
Jan	-1.05	1.05	1.27	-0.86	0.86	0.94	-0.66	0.67	0.58
Feb	-1.44	1.44	2.15	-1.37	1.37	1.97	-1.14	1.14	1.39
Mar	-1.49	1.49	2.26	-1.42	1.42	2.06	-1.28	1.28	1.69
Apr	-1.02	1.02	1.08	-0.93	0.93	0.91	-0.76	0.76	0.62
May	-0.75	0.75	0.78	-0.71	0.72	0.72	-0.61	0.62	0.53
Jun	-1.02	1.02	1.21	-1.03	1.03	1.26	-1.05	1.05	1.29
Jul	-1.50	1.50	2.33	-1.55	1.55	2.48	-1.56	1.56	2.50
Aug	-1.25	1.25	1.68	-1.32	1.32	1.85	-1.33	1.33	1.87
Sep	-0.94	0.94	0.97	-1.00	1.00	1.09	-1.01	1.01	1.10
Oct	-0.32	0.41	0.23	-0.37	0.44	0.27	-0.36	0.44	0.27
Nov	1.08	1.08	1.40	1.07	1.08	1.39	1.09	1.09	1.41
Dec	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
<b>Overall</b>	<b>-0.84</b>	<b>1.06</b>	<b>1.34</b>	<b>-0.82</b>	<b>1.04</b>	<b>1.31</b>	<b>-0.76</b>	<b>0.98</b>	<b>1.18</b>

Key:

BIAS = (observed- simulated) in degrees Fahrenheit

MAE= mean absolute error

N/A = Not available

RMSE= root mean squared error



# Summary of Results

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- RMSE of 1.31 °F is good. (Below 1°C, Cole and Wells, 2006)
- Bias of -0.8°F indicates slight under prediction.
  - Simulated temp is at the outlet
  - Measured temperature is downstream, may have mixed with warmer water.

# Friant Dam



March 21, 2013

Preliminary draft; subject to revision

# Friant Dam

## •Questions?

