Upper Rio Grande Water Operations Model (URGWOM)

Brief History, 2010 AOP Model Results

October 14, 2010

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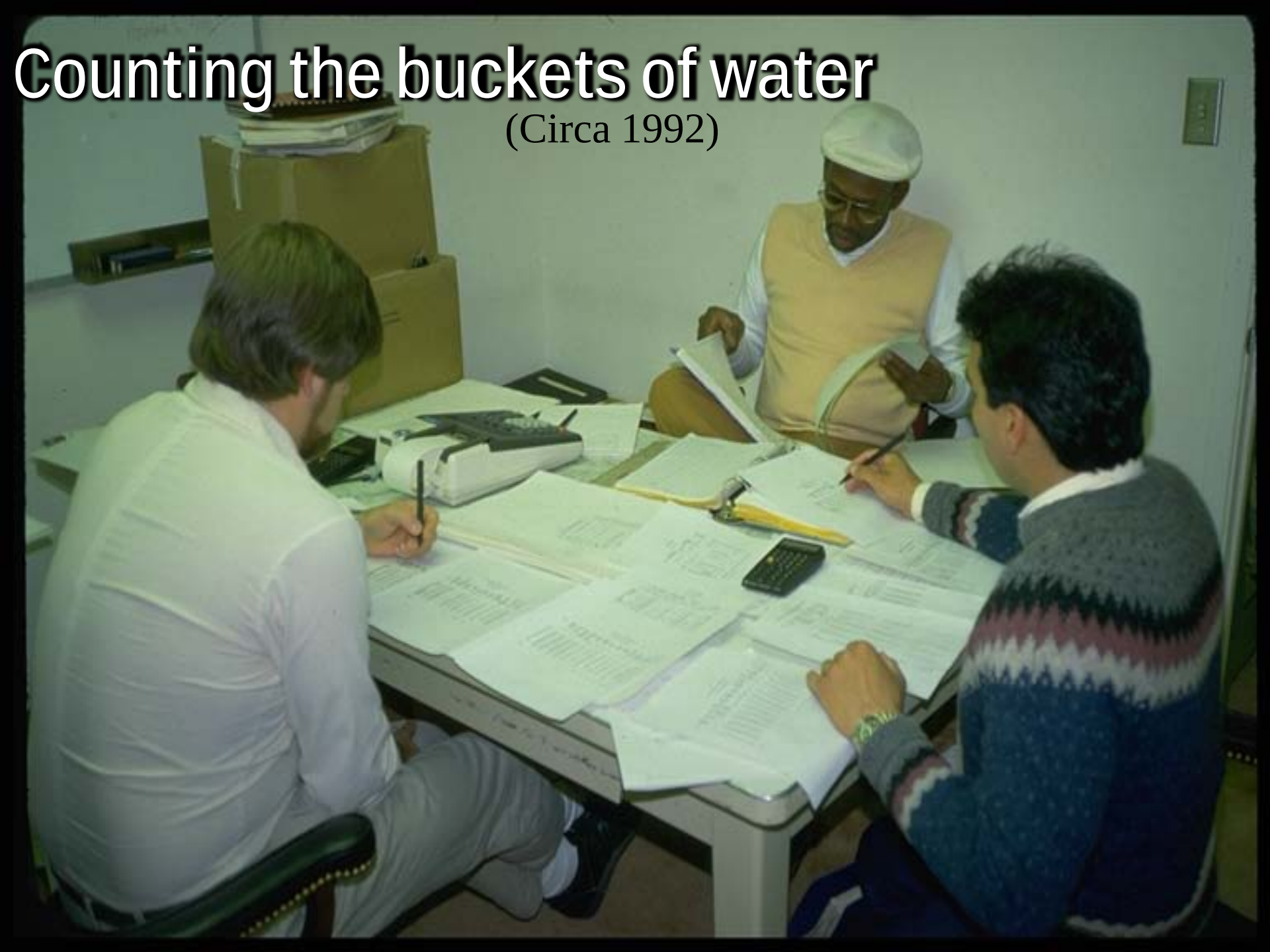
USACE

History of URGWOM:

- Pre 1996
  - No comprehensive reservoir and river model of entire basin
  - Multitude of independent cumbersome programs, spreadsheets, and paper records used in water operations, forecasting, and planning

Counting the buckets of water

(Circa 1992)



History of URGWOM:

- A need for several interdependent water management organizations and other related entities to collaborate better
- Need to compute and disseminate flows and storages better and faster
- Memorandum Of Understanding (MOU) signed in 1996 (updated in 2008)

History of URGWOM: Partnership Goals

- Long-Term Multiple Stakeholder Partnership;
- Goal: Develop Unified Water Operations Model for the Upper Rio Grande Basin
  - Common water operations tool within the Rio Grande Basin to coordinate diverse entities / interests
  - Decision-Making tool to Address Contemporary Water Management Needs
  - Capable of representing the physical, accounting, and operational complexities of the Rio Grande basin

History of URGWOM:

- Accomplishments:
  - 1996-1997 Model screening and evaluation
  - 1998 Test Case on Rio Chama/RiverWare chosen for model development
  - 1999 Accounting Model Developed / Documentation available on COE website; periodic revisions
  - 2000 Forecast/WaterOps Models Developed / Used for AOP
  - 2001 Accounting Model Approved / Used for EDWA
  - 2002 Models updated to include separate Rio Grande Accounts (EDWA and Prior and Paramount Storage)
  - 2003-2004 Planning Model Developed / Used for EIS
  - 2005 Stakeholder testing; Model publicized with updated documentation
  - 2006 GW/SW approach researched, Draft Rules Documentation
  - 2007 GW/SW approach finalized, 5-Year Plan Draft

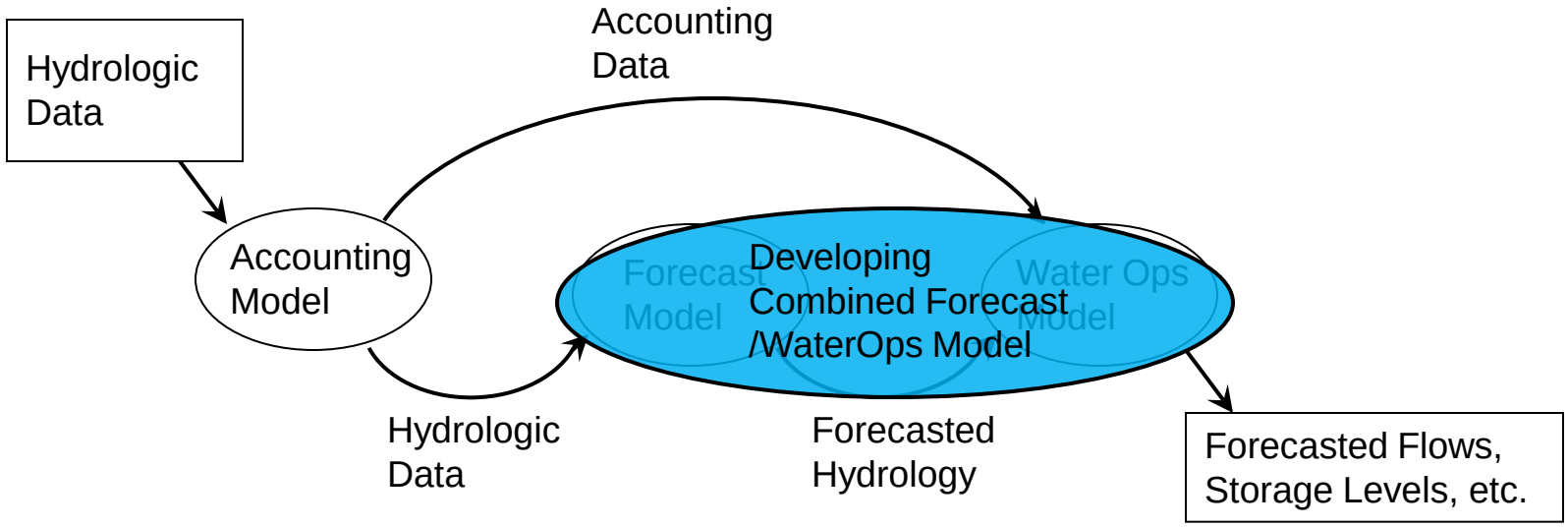
URGWOM Software & Use

- Daily time-step model: RiverWare;
- RiverWare, developed by CADSWES, selected as software of choice following extensive review of eleven reservoir and river simulations models
- URGWOM Use:
  - After the fact – Accounting Model;
  - Forecasting:
    - Water Operations, Forecast Models (Annual Operating Plans (AOP))
    - Planning Model(Long-Term (10-50 years), EIS, BA Alternative Analyses)
      - Monthly time-step model: Powersim;
        - Monthly model used to define scenarios to run with the daily model

System of Models

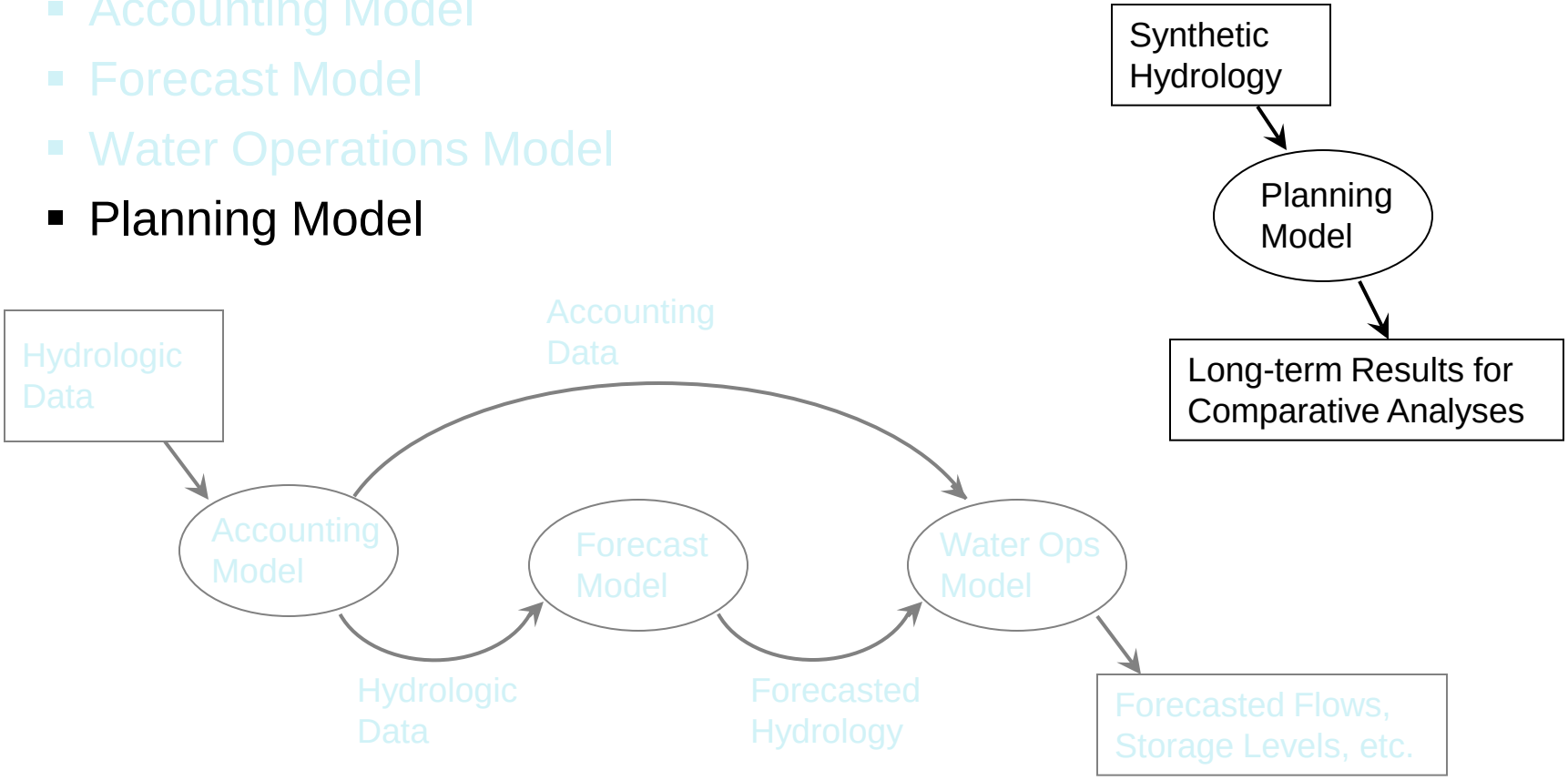
- Four separate daily timestep modules of URGWOM
  - Accounting Model
  - Forecast Model
  - Water Operations Model

Arrows represent data transfers from HEC-DSS datafiles via DMI's



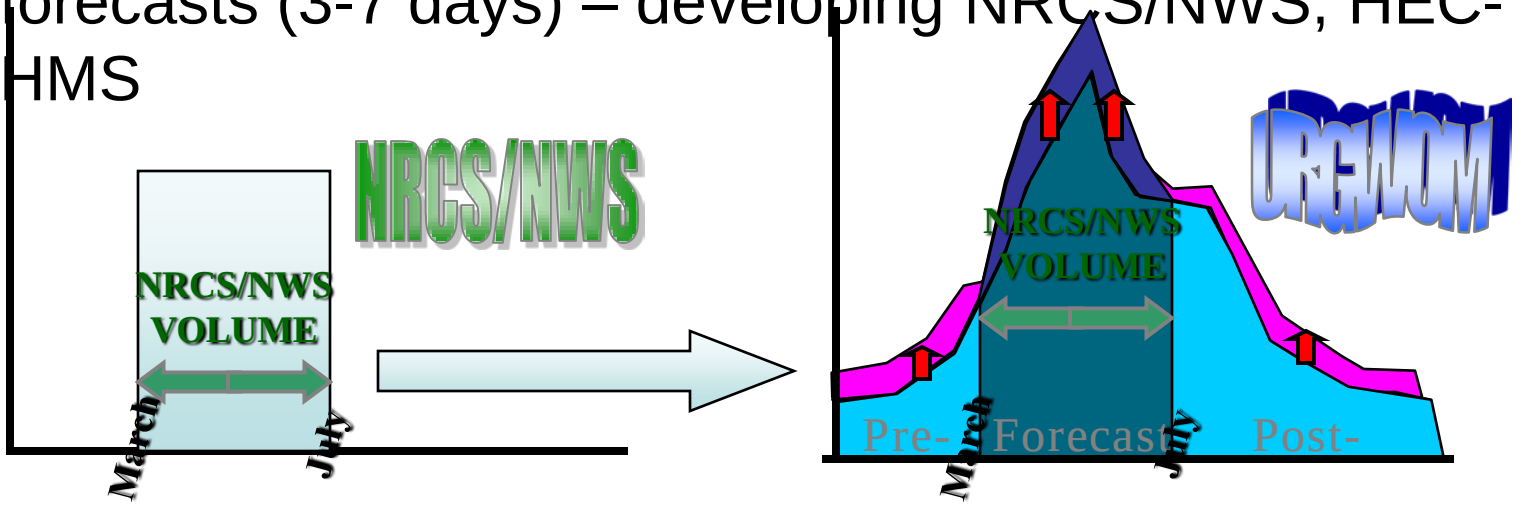
System of Models

- Four separate daily timestep modules of URGWOM
  - Accounting Model
  - Forecast Model
  - Water Operations Model
  - Planning Model



Forecasting

- Used with NRCS/NWS forecasts to convert forecast volume into daily hydrograph(s)
- User can also match volume to specific historic year for more insight into the shape, ascending and descending limbs
- Output hydrographs and other data used in WaterOps model (e.g., Annual Operating Plans (AOP) runs)
- Need for rainfall and snowmelt runoff data for short-term forecasts (3-7 days) – developing NRCS/NWS, HEC-HMS

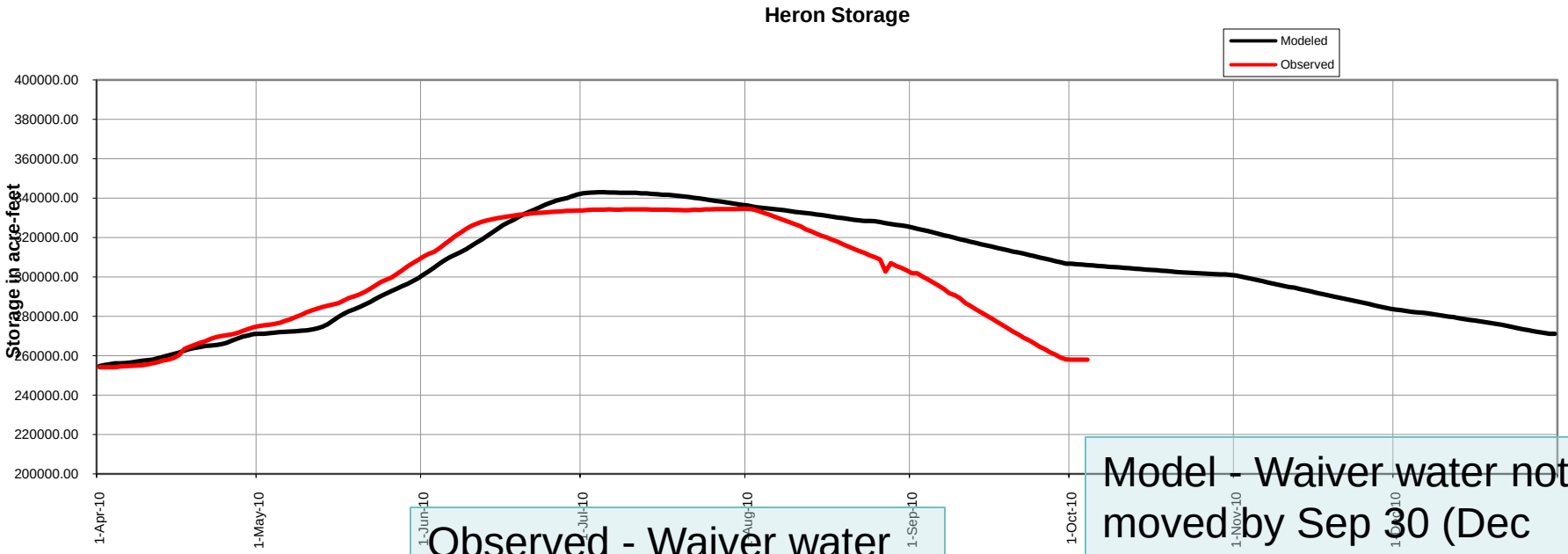


Water Operations

- Up to 1 year runs
- Used together with forecasting model to develop AOPs
- Used to manage target flows for Biological Opinion compliance
- Improvements in middle valley characterization
  - Surface water/groundwater (GW/SW) interactions
  - ET toolbox
  - Drain return flow contributions
- Real-Time Model needed for short-term forecasts (3-7 days)
  - Capture rainfall-runoff events to conserve water when possible
  - Better predict shape of hydrograph and timing of peak flows during snowmelt-runoff

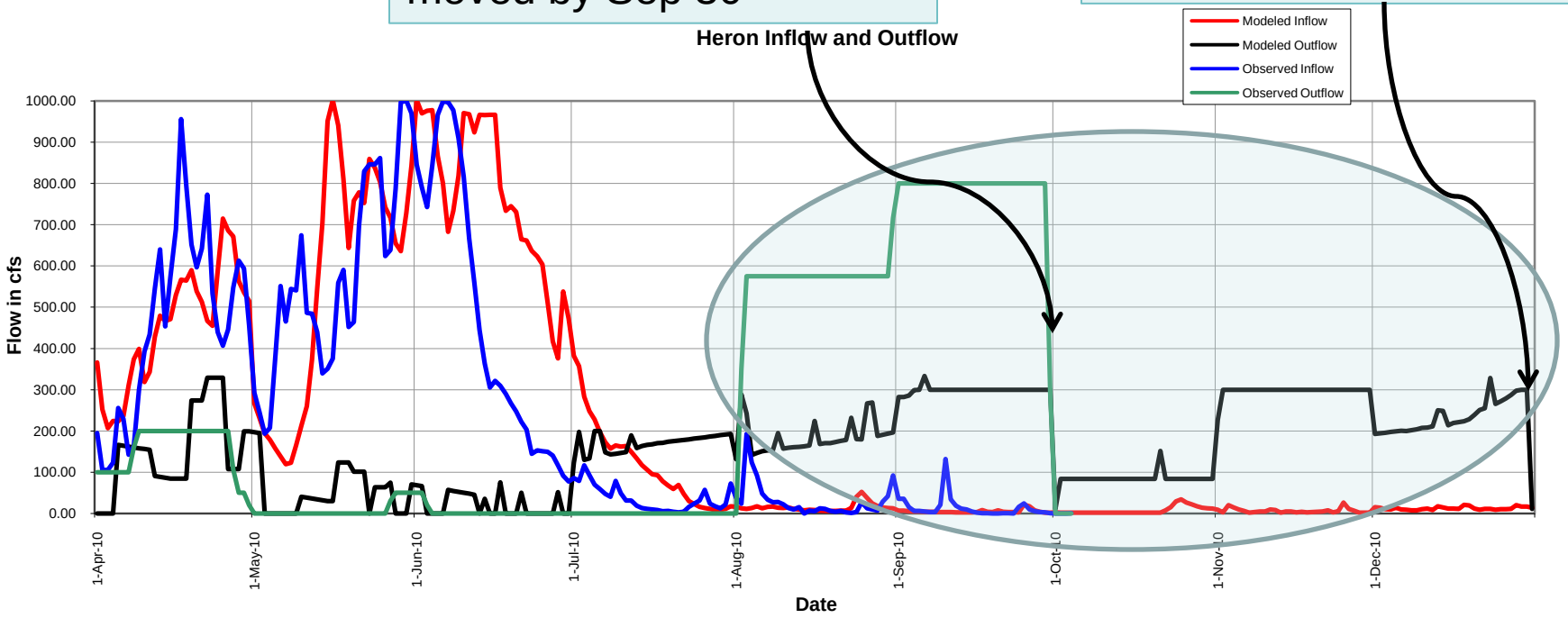
Comparison of 2010 AOP Model Results vs. Observed Values

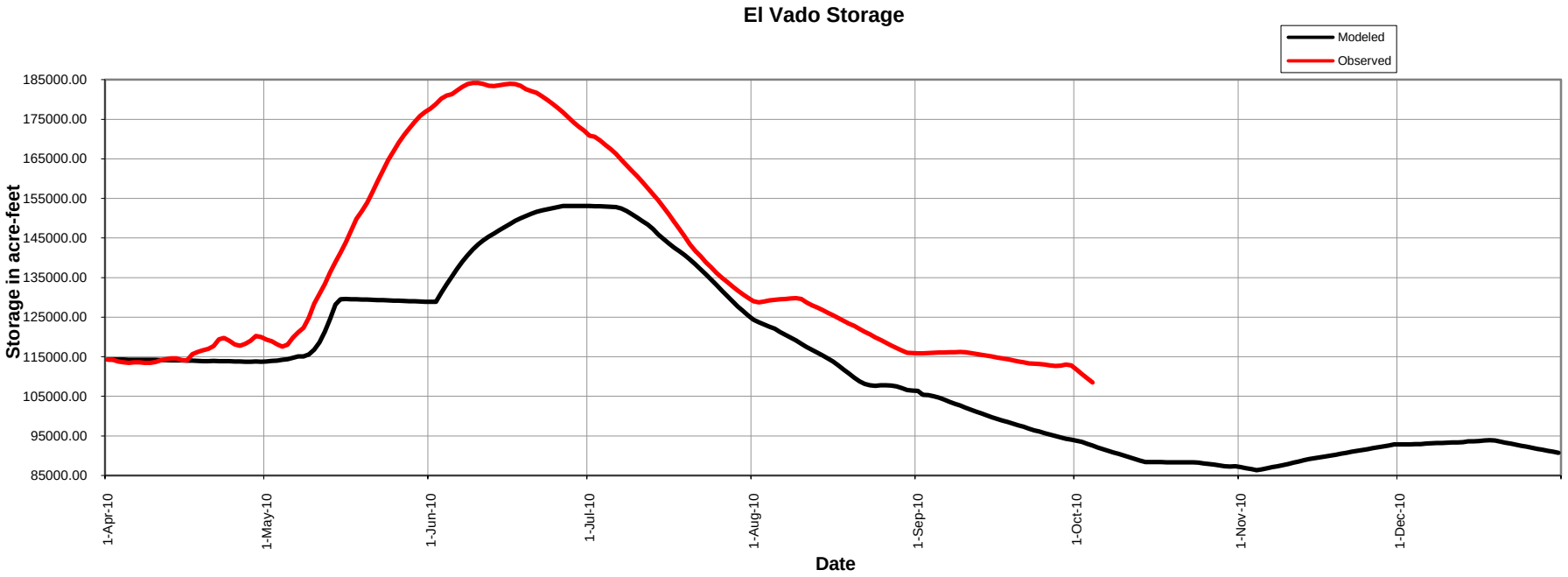
- April Forecast
- New Middle Valley update version of model

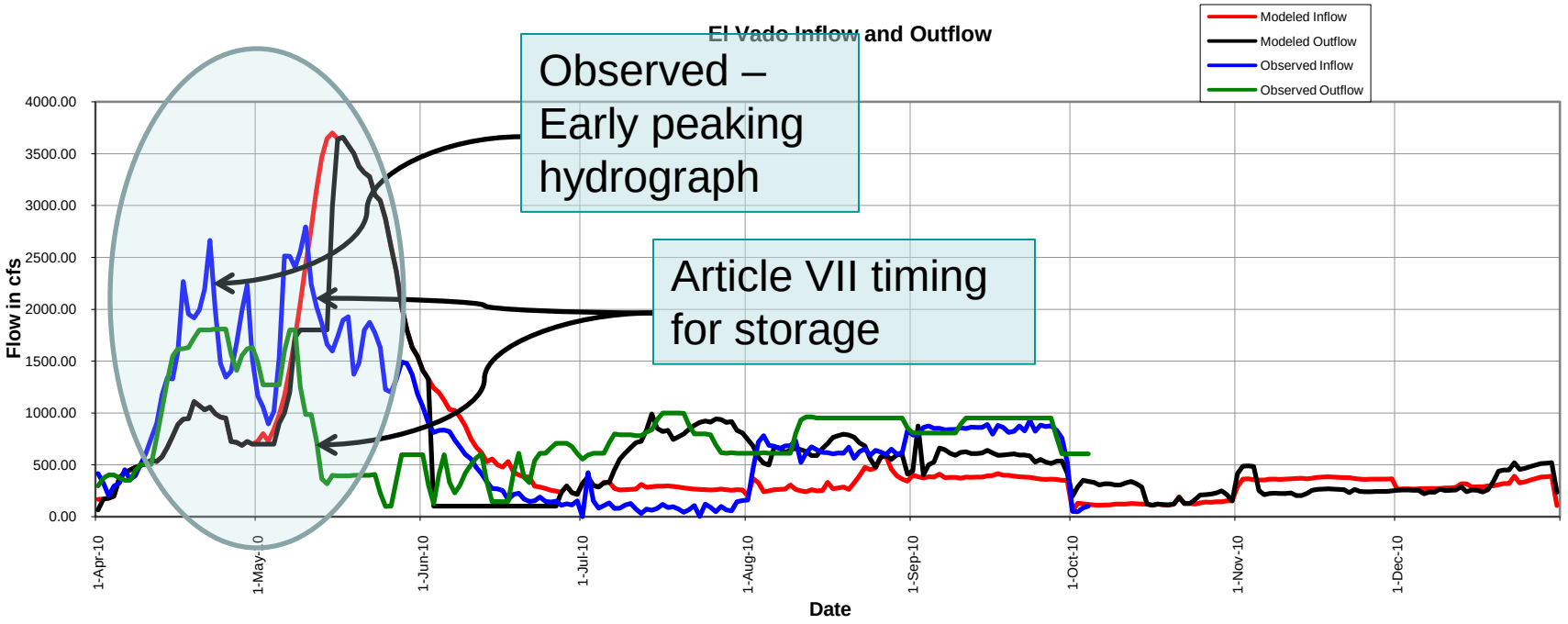


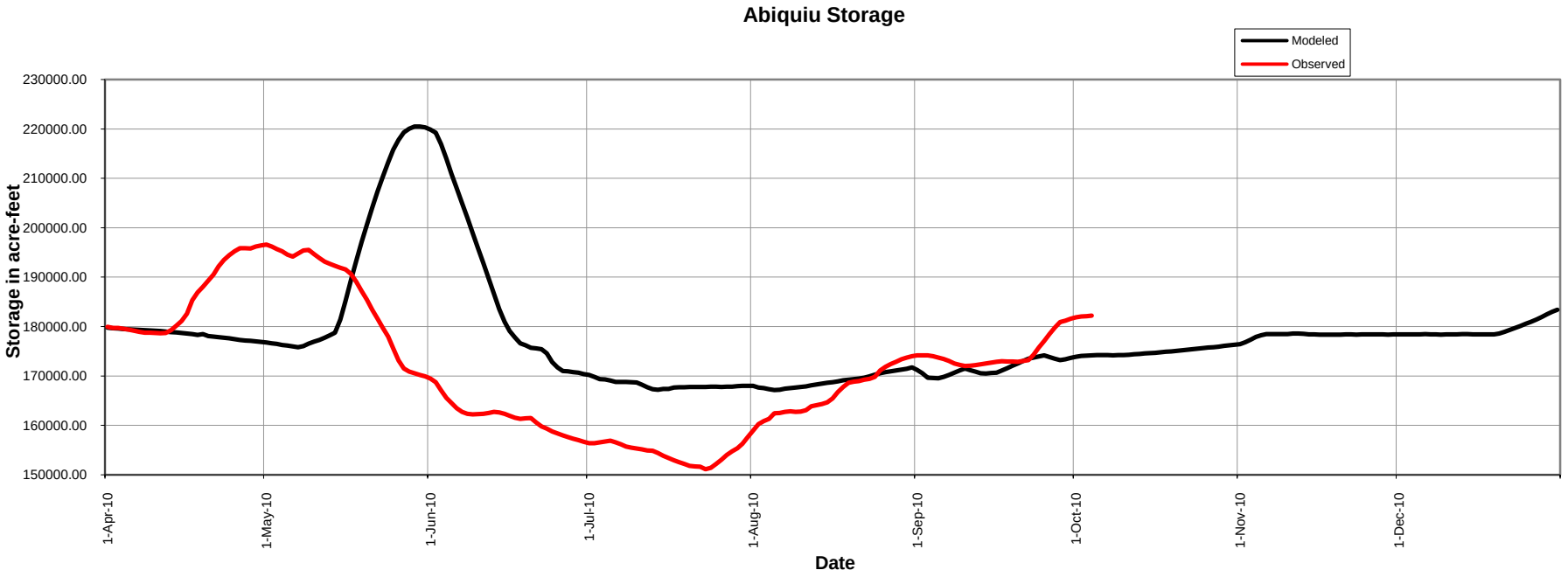
Observed - Waiver water moved by Sep 30

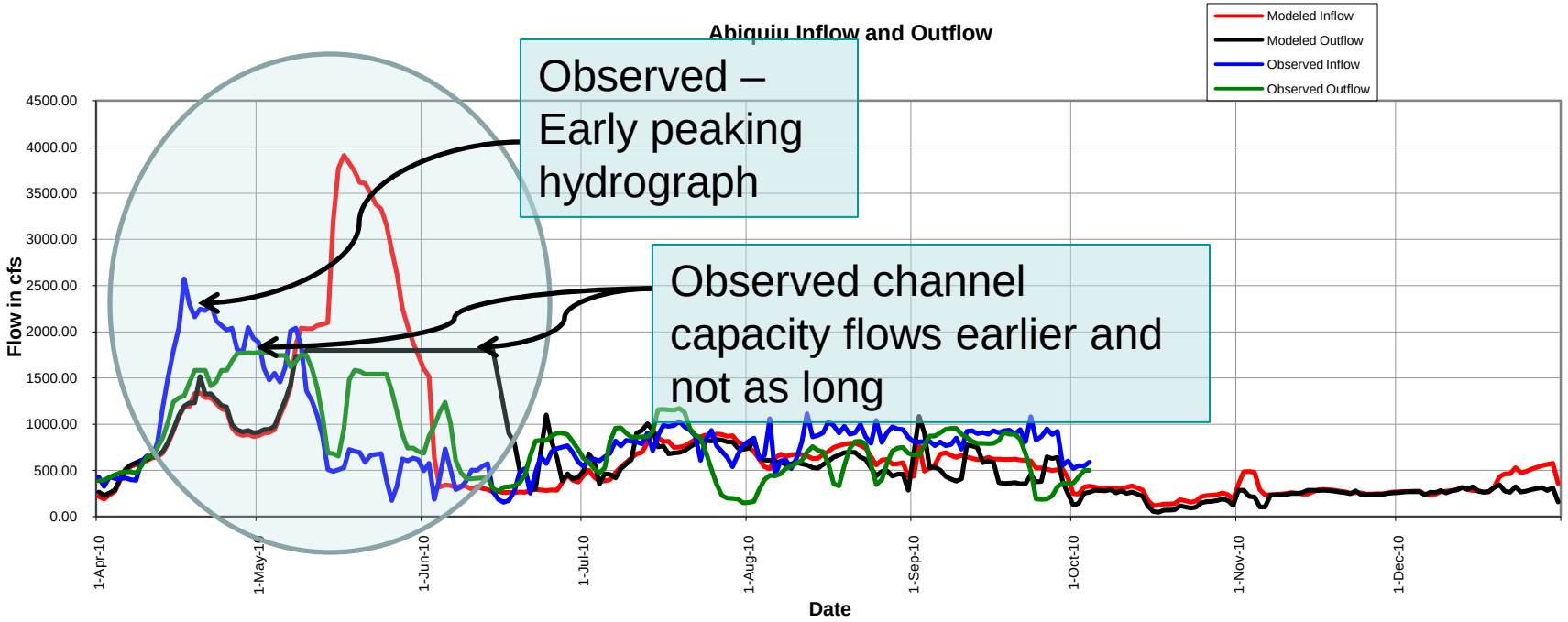
Model - Waiver water not moved by Sep 30 (Dec 31- setup)

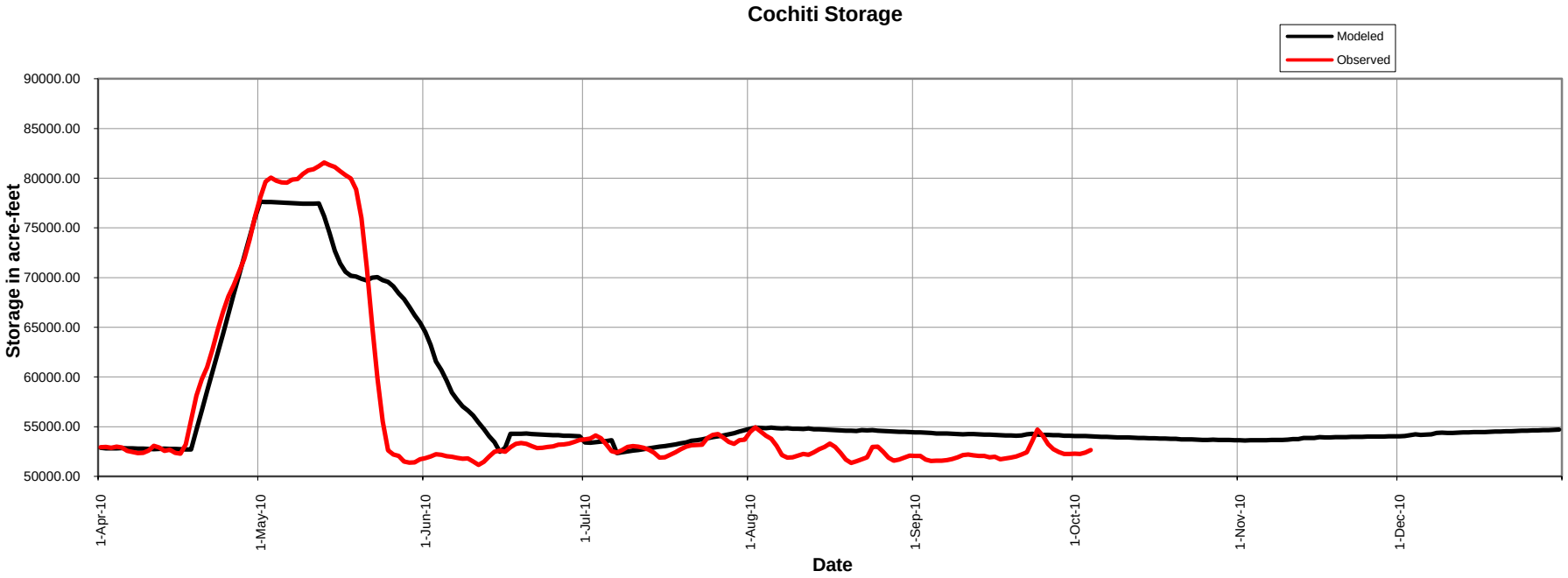


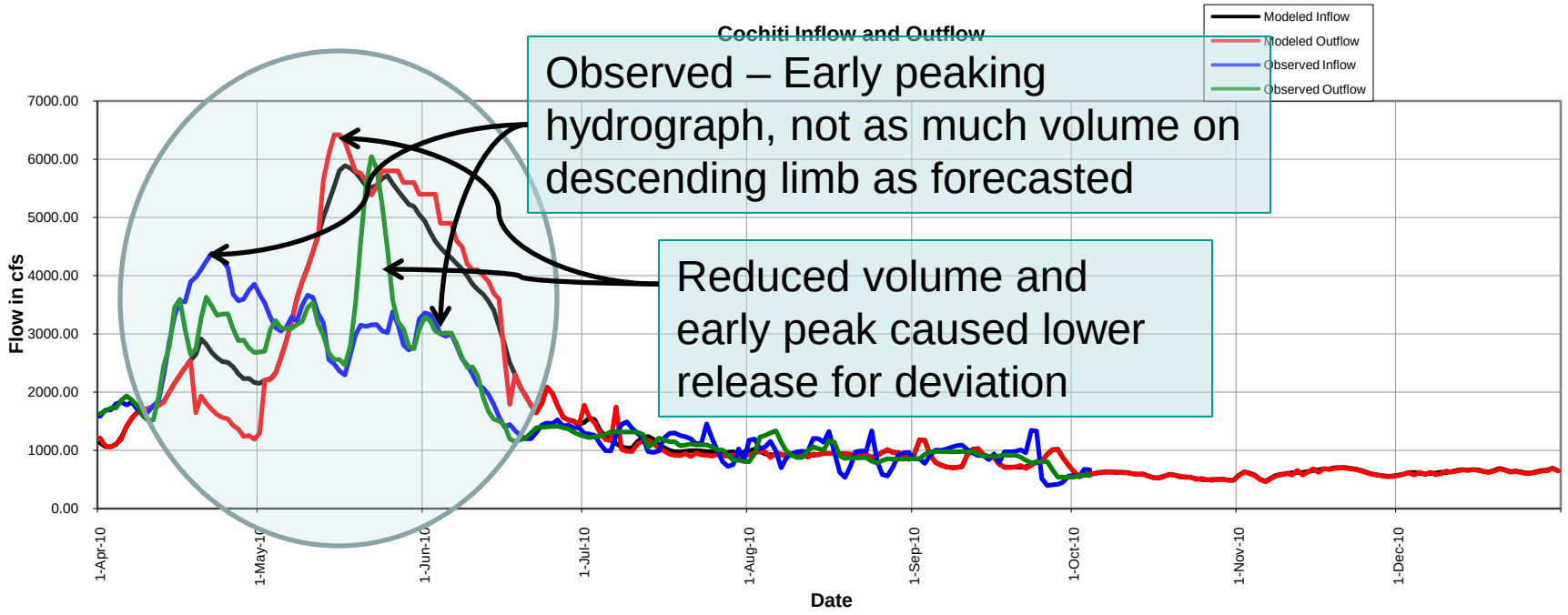

El Vado Storage
Modeled
Observed
185000.00
175000.00
165000.00
155000.00
145000.00
135000.00
125000.00
115000.00
105000.00
95000.00
85000.00
Storage in acre-feet
1-Apr-10
1-May-10
1-Jun-10
1-Jul-10
1-Aug-10
1-Sep-10
1-Oct-10
1-Nov-10
1-Dec-10
Date


El Vado Inflow and Outflow
Modeled Inflow
Modeled Outflow
Observed Inflow
Observed Outflow
Observed – Early peaking hydrograph
Article VII timing for storage
4000.00
3500.00
3000.00
2500.00
2000.00
1500.00
1000.00
500.00
0.00
Flow in cfs
1-Apr-10
1-May-10
1-Jun-10
1-Jul-10
1-Aug-10
1-Sep-10
1-Oct-10
1-Nov-10
1-Dec-10
Date

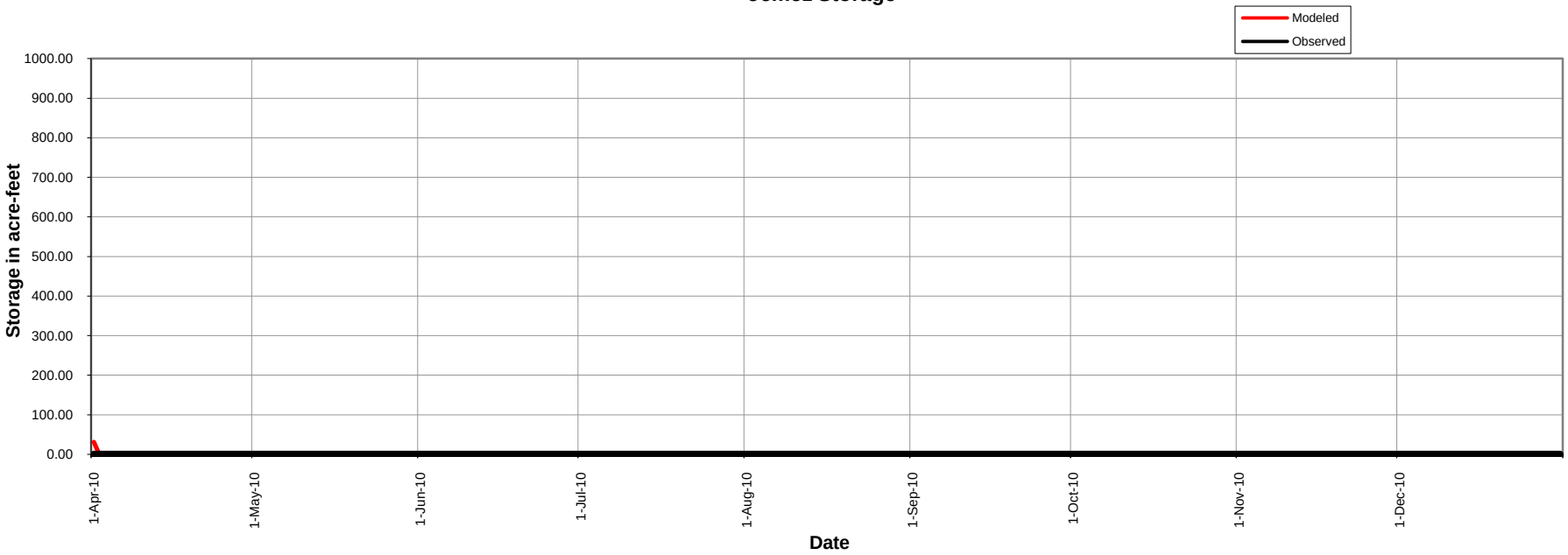

Abiquiu Storage
Modeled
Observed
Storage in acre-feet
230000.00
220000.00
210000.00
200000.00
190000.00
180000.00
170000.00
160000.00
150000.00
1-Apr-10
1-May-10
1-Jun-10
1-Jul-10
1-Aug-10
1-Sep-10
1-Oct-10
1-Nov-10
1-Dec-10
Date


Abiquiu Inflow and Outflow
Modeled Inflow
Modeled Outflow
Observed Inflow
Observed Outflow
Observed – Early peaking hydrograph
Observed channel capacity flows earlier and not as long
Flow in cfs
4500.00
4000.00
3500.00
3000.00
2500.00
2000.00
1500.00
1000.00
500.00
0.00
1-Apr-10
1-May-10
1-Jun-10
1-Jul-10
1-Aug-10
1-Sep-10
1-Oct-10
1-Nov-10
1-Dec-10
Date

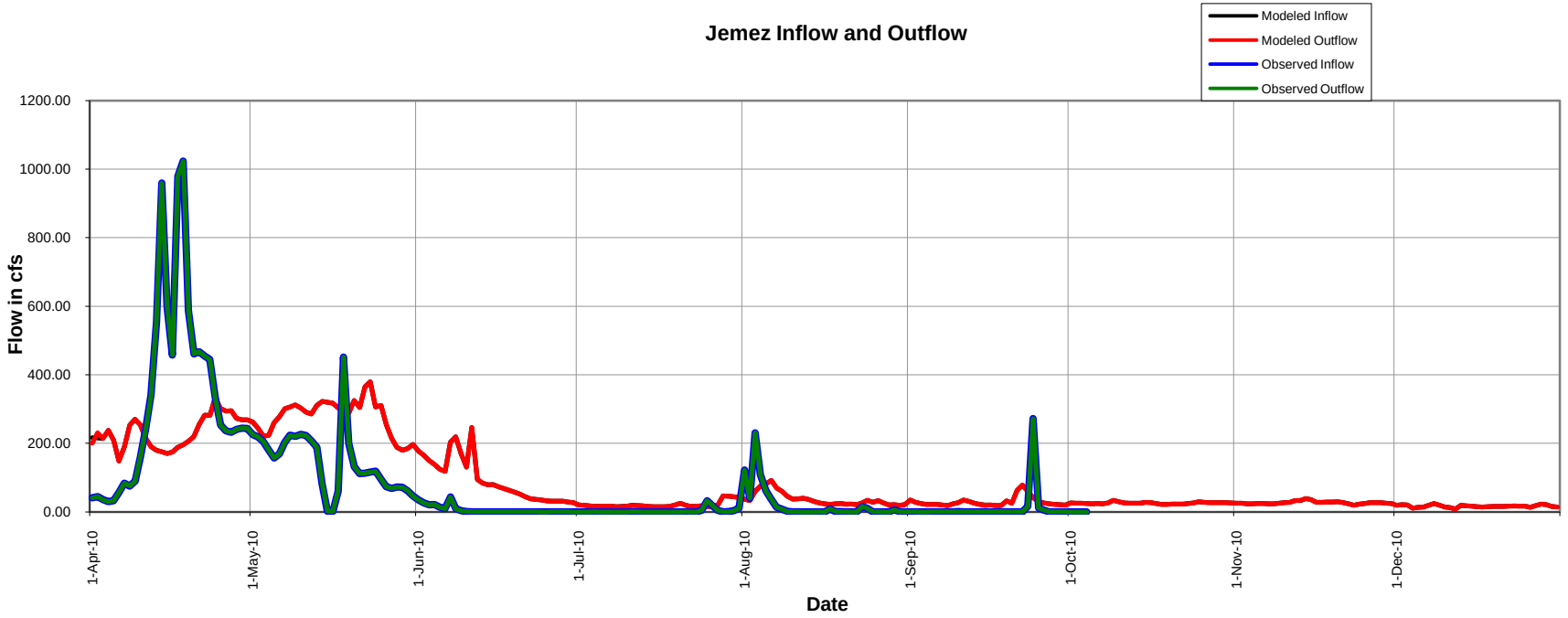

Cochiti Storage
Modeled
Observed
Storage in acre-feet
90000.00
85000.00
80000.00
75000.00
70000.00
65000.00
60000.00
55000.00
50000.00
1-Apr-10
1-May-10
1-Jun-10
1-Jul-10
1-Aug-10
1-Sep-10
1-Oct-10
1-Nov-10
1-Dec-10
Date

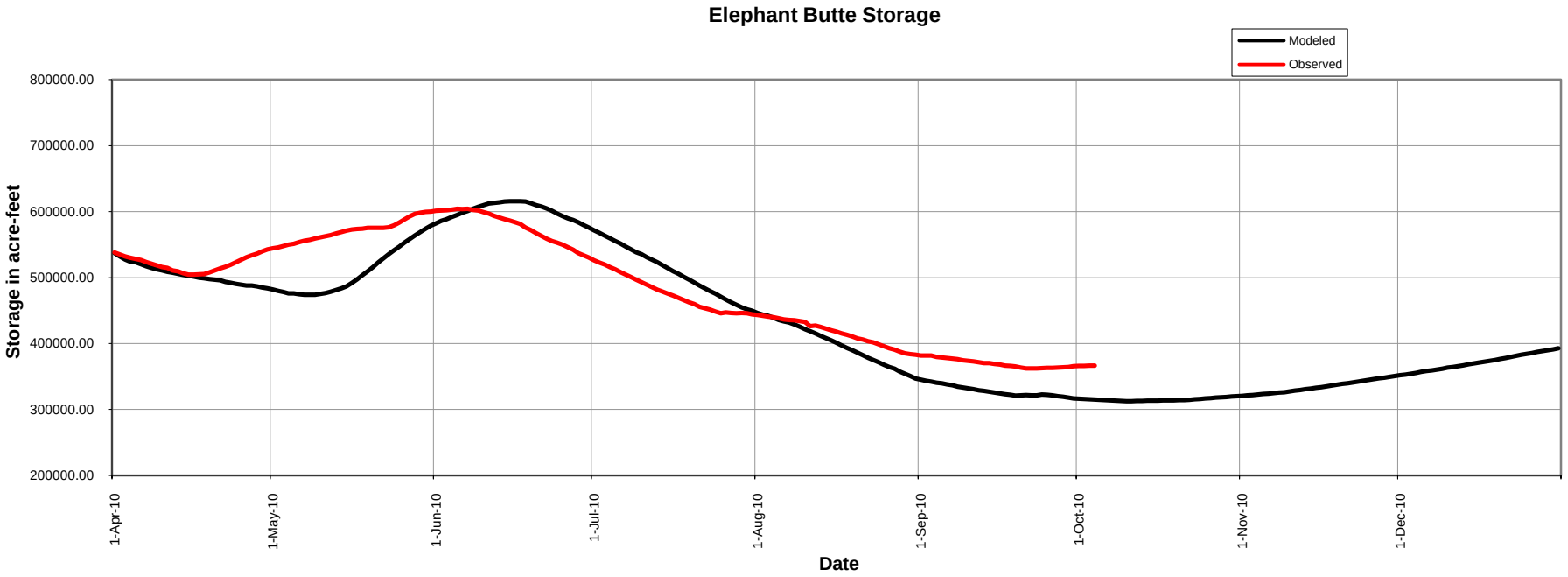

Cochiti Inflow and Outflow
Modeled Inflow
Modeled Outflow
Observed Inflow
Observed Outflow
Flow in cfs
7000.00
6000.00
5000.00
4000.00
3000.00
2000.00
1000.00
0.00
1-Apr-10
1-May-10
1-Jun-10
1-Jul-10
1-Aug-10
1-Sep-10
1-Oct-10
1-Nov-10
1-Dec-10
Date
Observed – Early peaking hydrograph, not as much volume on descending limb as forecasted
Reduced volume and early peak caused lower release for deviation

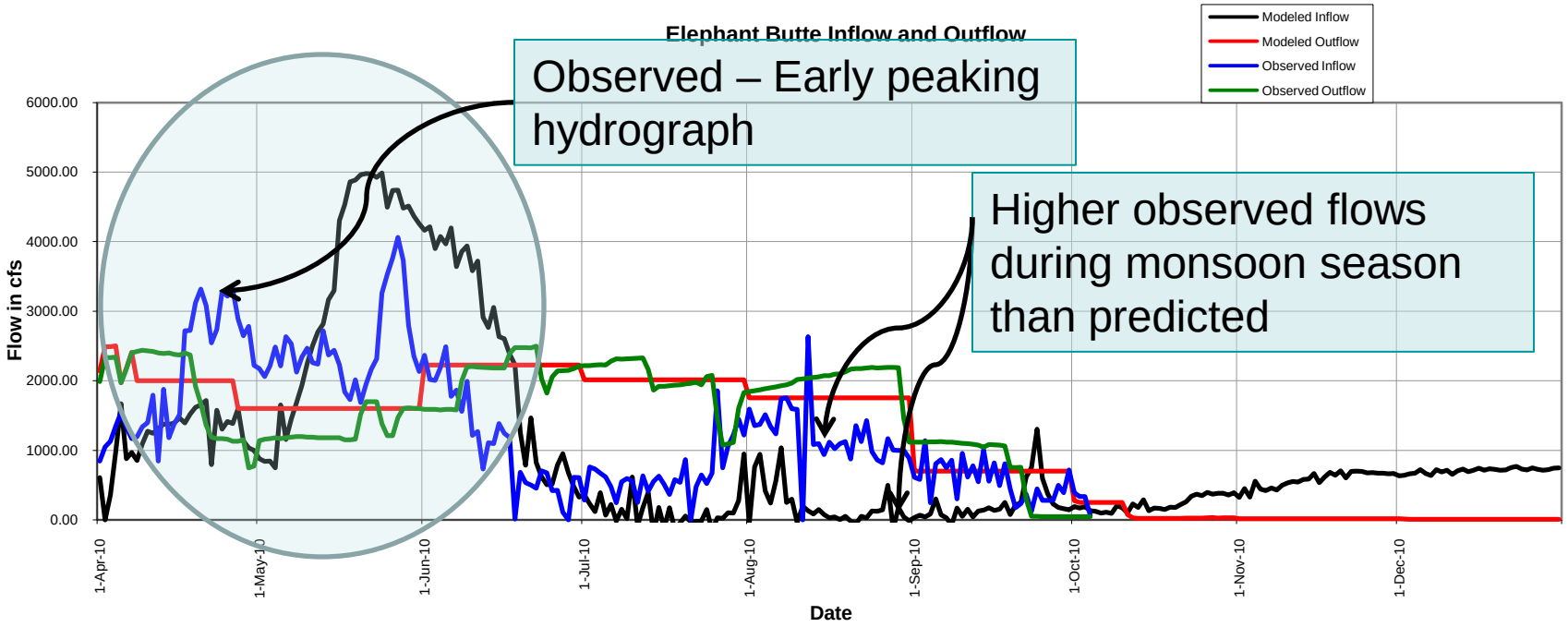
Jemez Storage

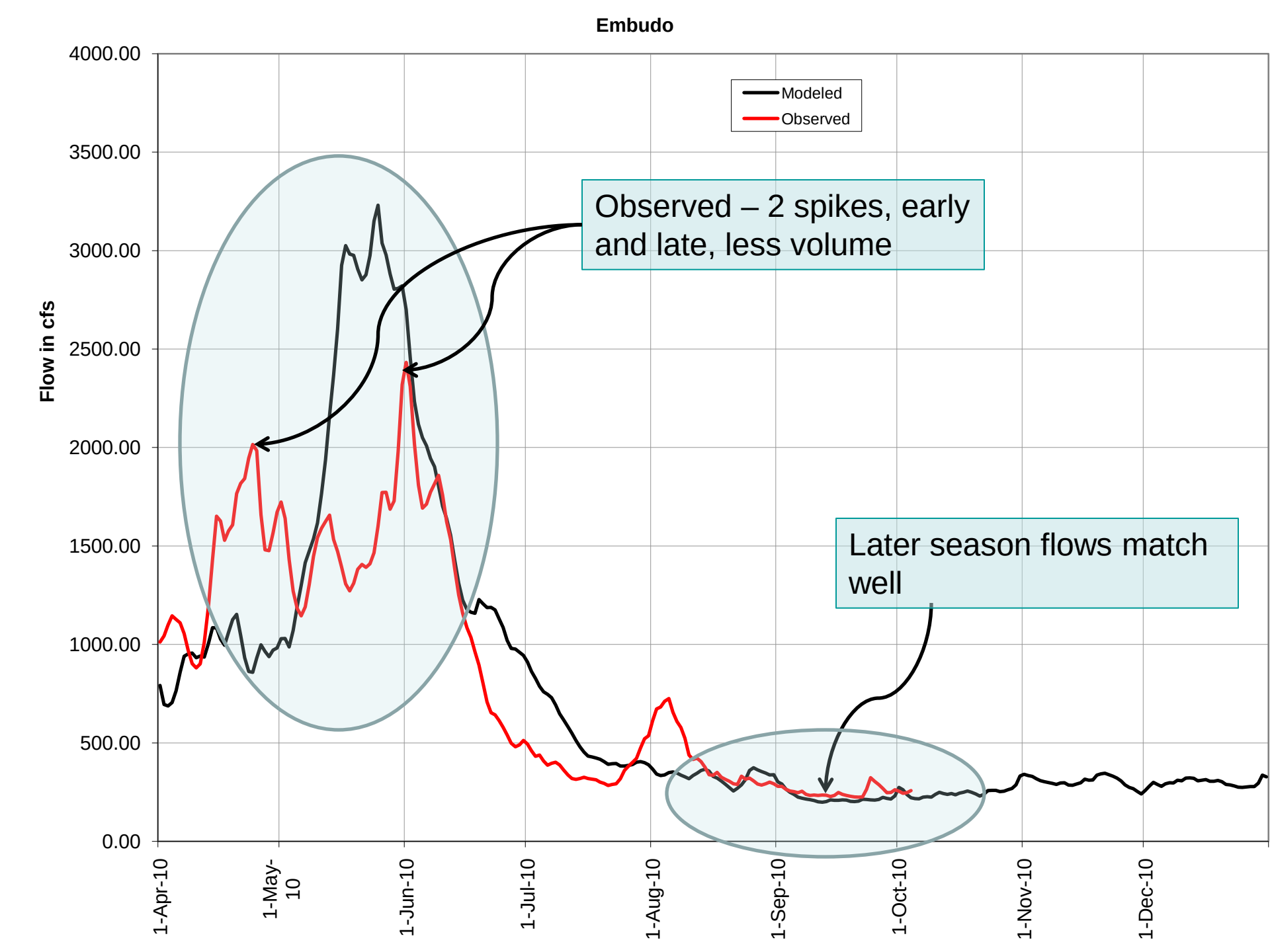


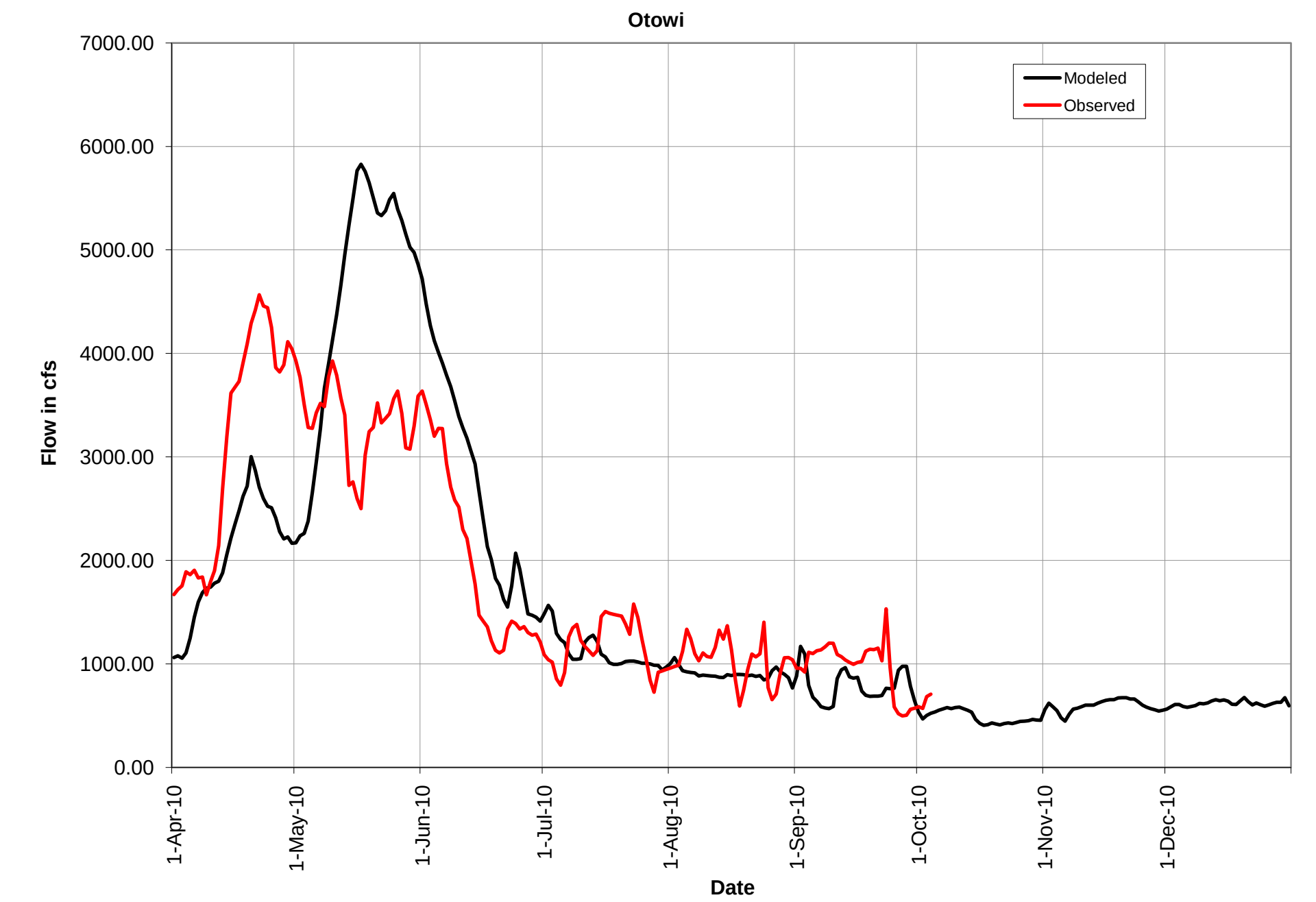
Jemez Inflow and Outflow

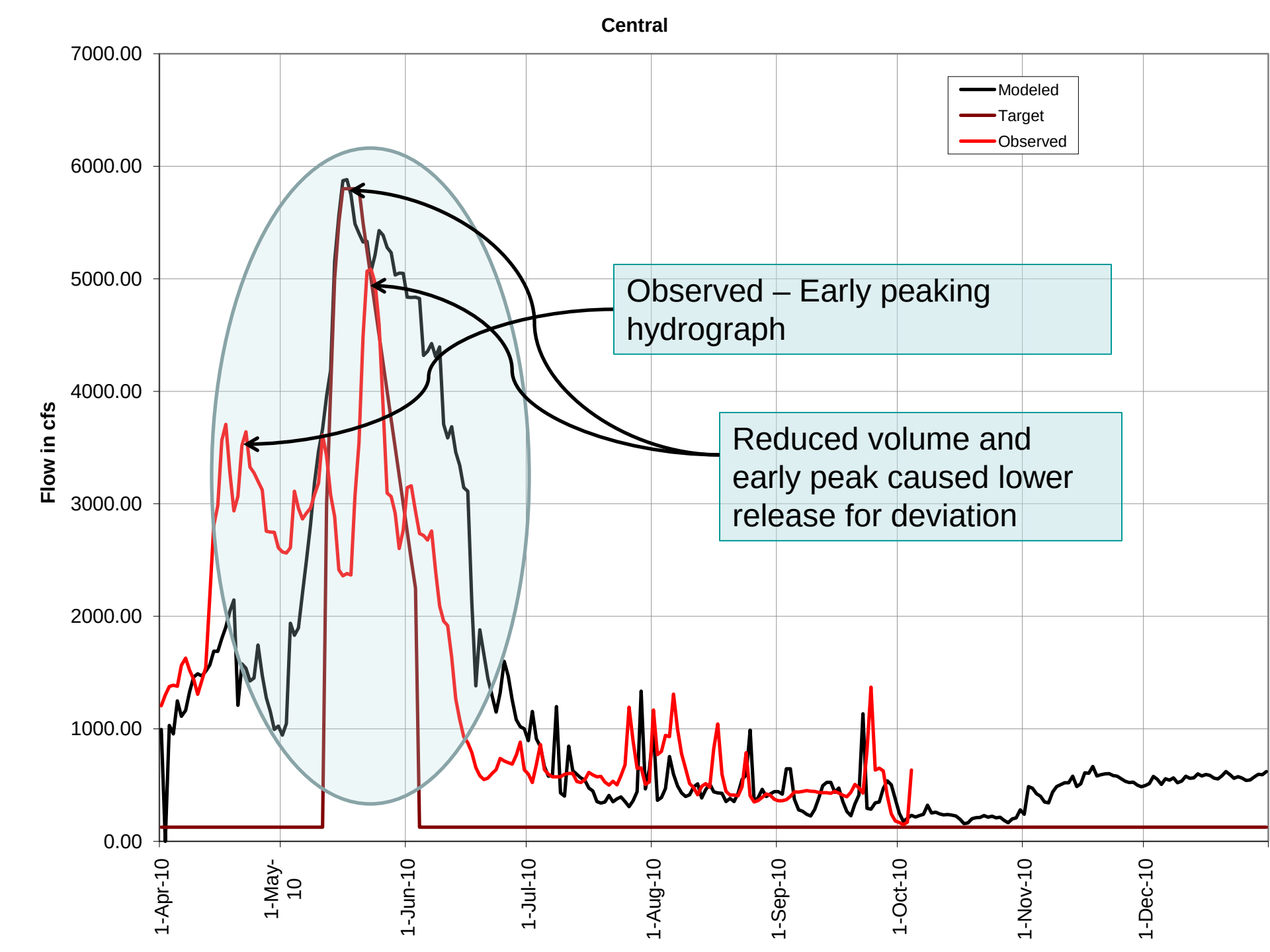


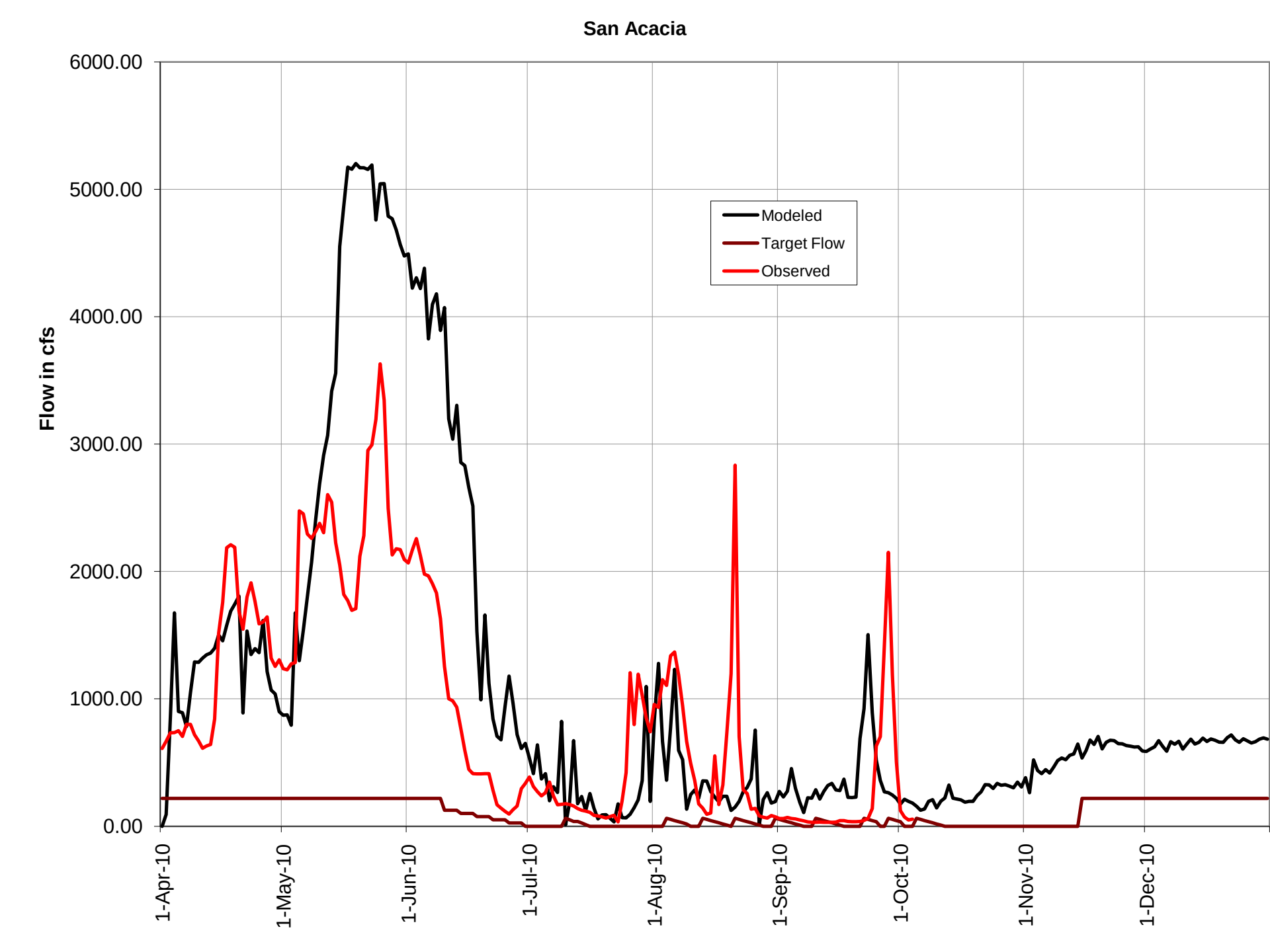

Elephant Butte Storage
Modeled
Observed
800000.00
700000.00
600000.00
500000.00
400000.00
300000.00
200000.00
Storage in acre-feet
1-Apr-10
1-May-10
1-Jun-10
1-Jul-10
1-Aug-10
1-Sep-10
1-Oct-10
1-Nov-10
1-Dec-10
Date

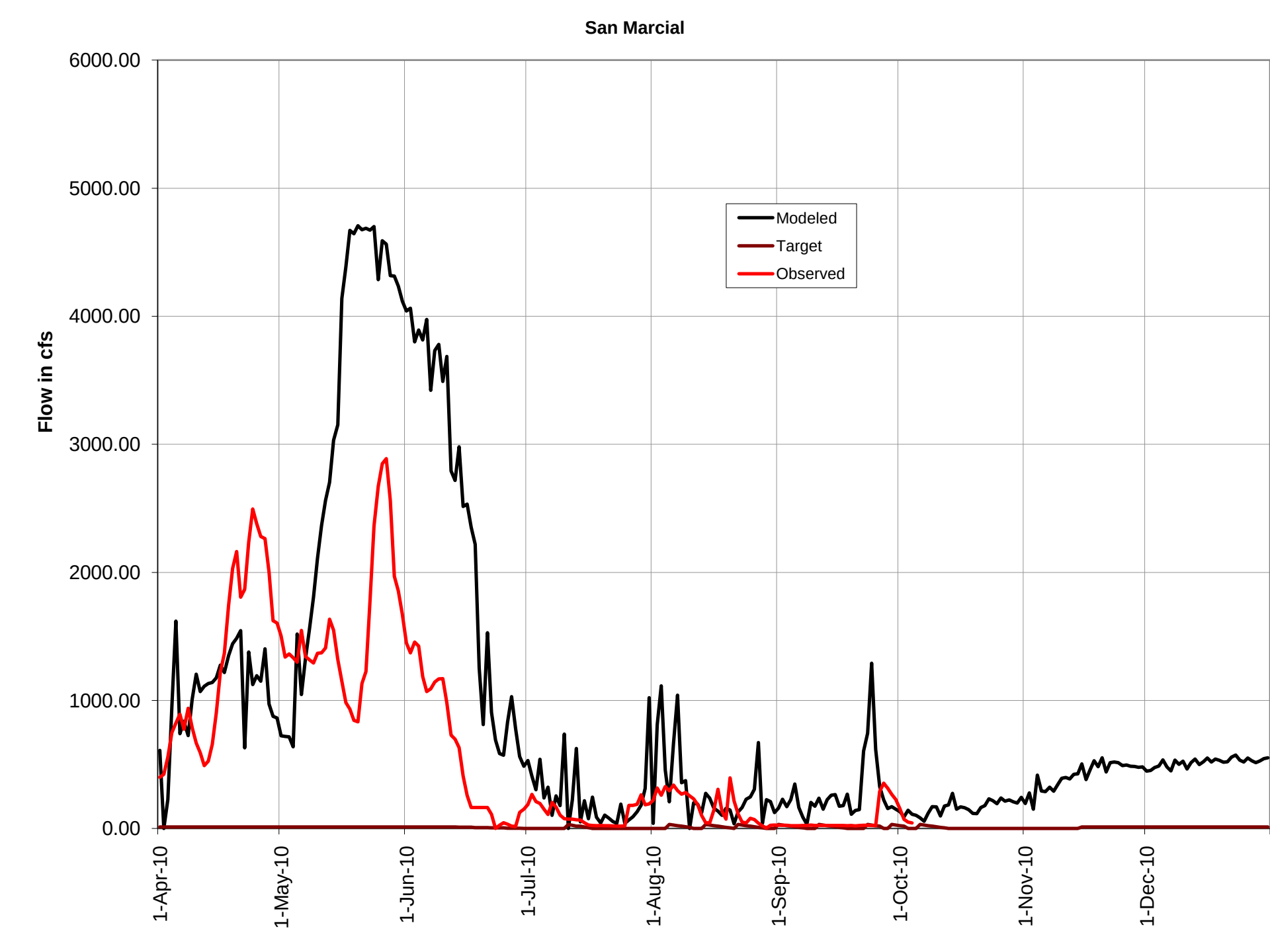

Elephant Butte Inflow and Outflow
Modeled Inflow
Modeled Outflow
Observed Inflow
Observed Outflow
Observed – Early peaking hydrograph
Higher observed flows during monsoon season than predicted
6000.00
5000.00
4000.00
3000.00
2000.00
1000.00
0.00
Flow in cfs
1-Apr-10
1-May-10
1-Jun-10
1-Jul-10
1-Aug-10
1-Sep-10
1-Oct-10
1-Nov-10
1-Dec-10
Date

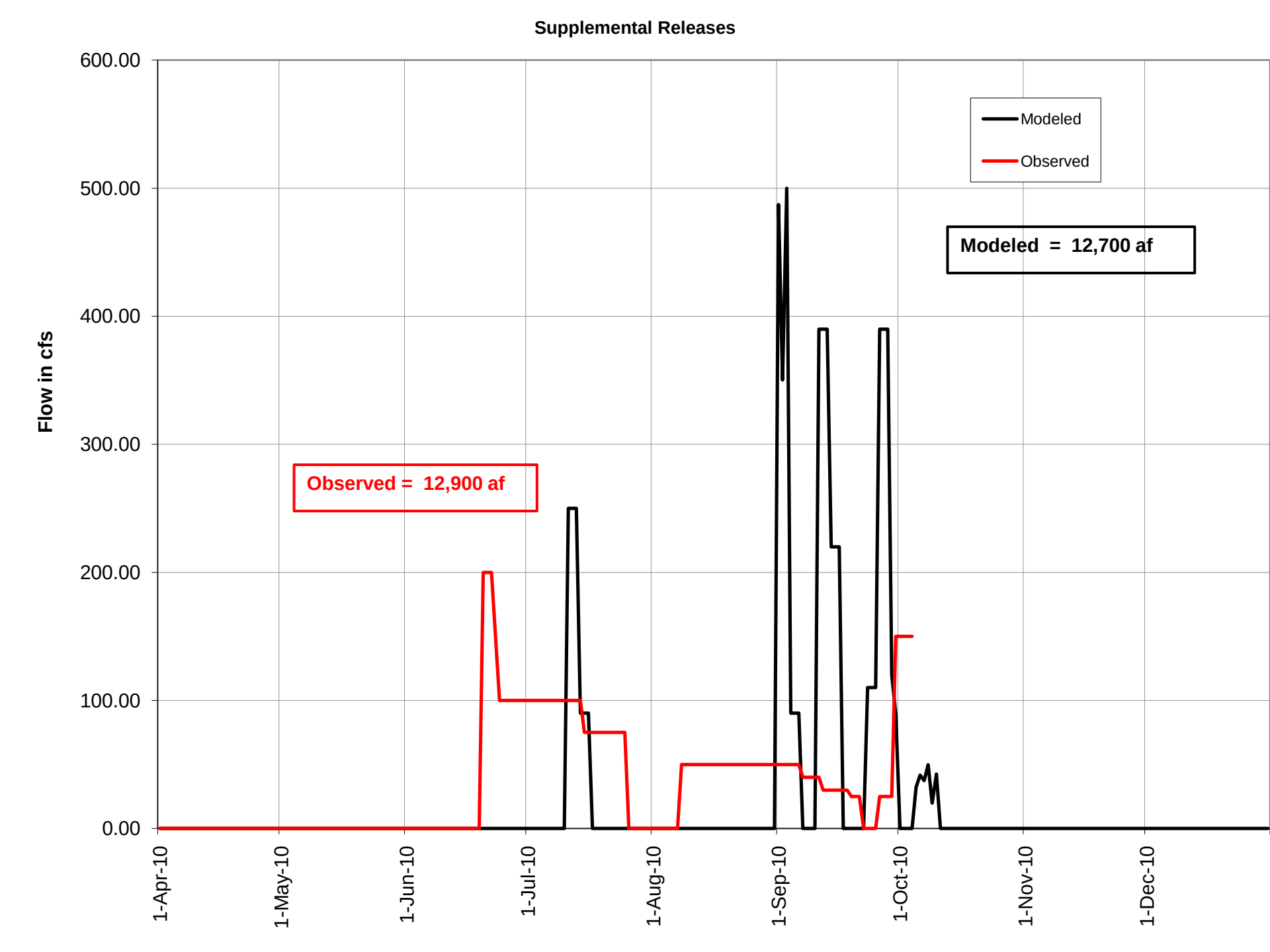

Embudo
Modeled
Observed
Flow in cfs
4000.00
3500.00
3000.00
2500.00
2000.00
1500.00
1000.00
500.00
0.00
1-Apr-10
1-May-10
1-Jun-10
1-Jul-10
1-Aug-10
1-Sep-10
1-Oct-10
1-Nov-10
1-Dec-10
Observed – 2 spikes, early and late, less volume
Later season flows match well


Otowi
Modeled
Observed
Flow in cfs
7000.00
6000.00
5000.00
4000.00
3000.00
2000.00
1000.00
0.00
1-Apr-10
1-May-10
1-Jun-10
1-Jul-10
1-Aug-10
1-Sep-10
1-Oct-10
1-Nov-10
1-Dec-10
Date


Central
Modeled
Target
Observed
Flow in cfs
7000.00
6000.00
5000.00
4000.00
3000.00
2000.00
1000.00
0.00
1-Apr-10
1-May-10
1-Jun-10
1-Jul-10
1-Aug-10
1-Sep-10
1-Oct-10
1-Nov-10
1-Dec-10
Observed – Early peaking hydrograph
Reduced volume and early peak caused lower release for deviation


San Acacia
Flow in cfs
6000.00
5000.00
4000.00
3000.00
2000.00
1000.00
0.00
Modeled
Target Flow
Observed
1-Apr-10
1-May-10
1-Jun-10
1-Jul-10
1-Aug-10
1-Sep-10
1-Oct-10
1-Nov-10
1-Dec-10


San Marcial
Flow in cfs
6000.00
5000.00
4000.00
3000.00
2000.00
1000.00
0.00
Modeled
Target
Observed
1-Apr-10
1-May-10
1-Jun-10
1-Jul-10
1-Aug-10
1-Sep-10
1-Oct-10
1-Nov-10
1-Dec-10


Supplemental Releases
600.00
500.00
400.00
300.00
200.00
100.00
0.00
Flow in cfs
Modeled
Observed
Modeled = 12,700 af
Observed = 12,900 af
1-Apr-10
1-May-10
1-Jun-10
1-Jul-10
1-Aug-10
1-Sep-10
1-Oct-10
1-Nov-10
1-Dec-10

2010 Spring Runoff Comparison

	Rio Grande nr Lobatos	Red River blw Fish Hatchery	Rio Pueblo De Taos at Los Cordovas	Embudo Creek at Dixon	El Vado Inflow	Rio Grande at Otowi	Jemez River nr Jemez	Rio Grande at San Marcial
Observed Mar-Jul Volume in ac-ft	157903	37769	35485	31576	213086	561200	48384	331500
April Forecast Mar-Jul Volume in ac-ft	144000	50000	45000	55000	230000	695000	51000	465000
% Difference (Observed vs Forecasted)	9	-32	-27	-74	-8	-24	-5	-40
Average Mar-Jul Volume in ac-ft	230000	35000	40000	51000	237000	757000	47000	573000
% Difference (Observed vs Average)	-46	7	-13	-62	-11	-35	3	-73