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Managing Water in the West

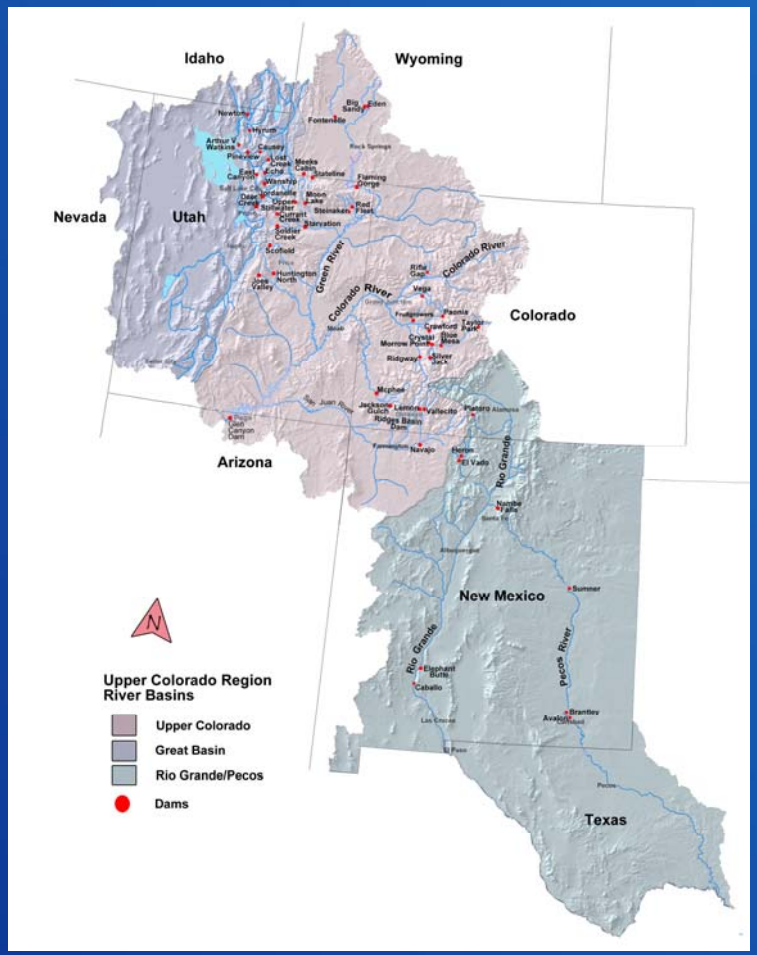
Risk and Uncertainty
Upper Colorado Region
Mid-term Operations and Planning

Risk and Uncertainty Workshop
June 16, 2009

U.S. Department of the Interior
Bureau of Reclamation

Katrina Grantz, PhD
Upper Colorado Region
Hydraulic Engineer

Upper Colorado Region



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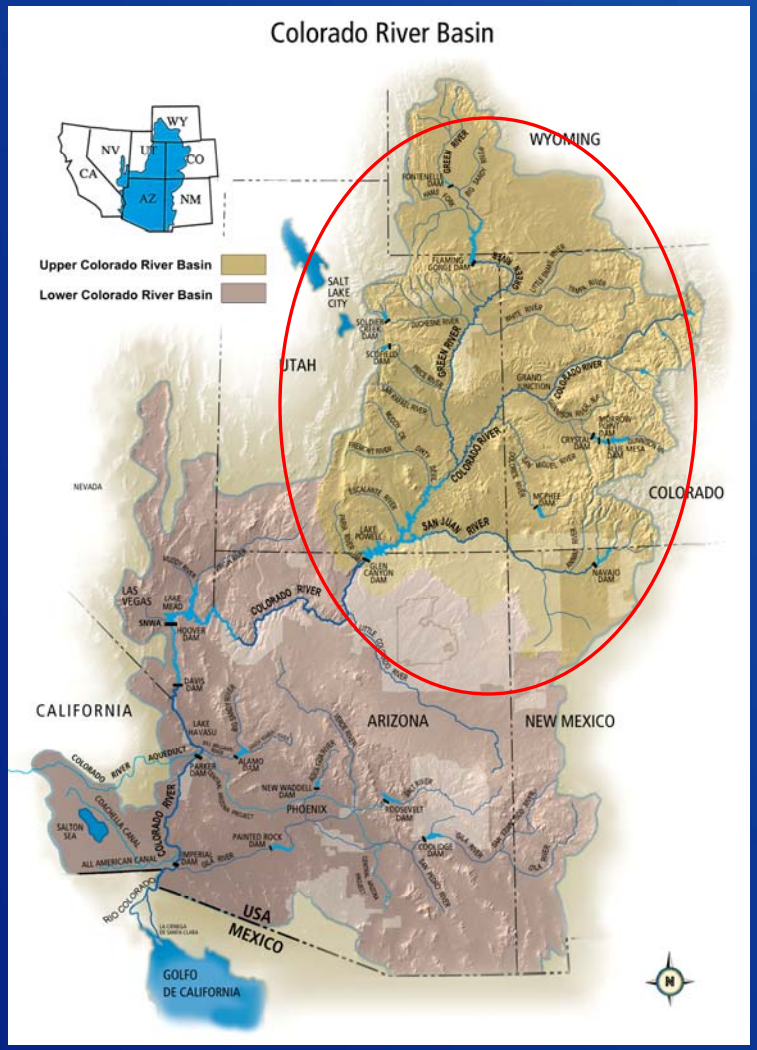
Colorado River Basin



- Flaming Gorge and Fontenelle
  - Green River
- Aspinall Unit
  - Gunnison River
- Navajo and Vallecito
  - San Juan River
- Lake Powell
  - Colorado River Mainstem

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Operations and Planning

- Use operations models
  - Daily and Monthly timestep
- Annual Operating Plan
  - August and then updated each month in 24-Month Study
- Largest source of uncertainty is inflow forecasts
- Consider min, most, and max probable inflow forecasts, though not in every month

24-Month Study

- Monthly timestep model
  - Projects reservoir elevations, releases 24 – 27 months into the future throughout basin
- Deterministic model
- Coordination between Upper Colorado and Lower Colorado regions
- Run once a month

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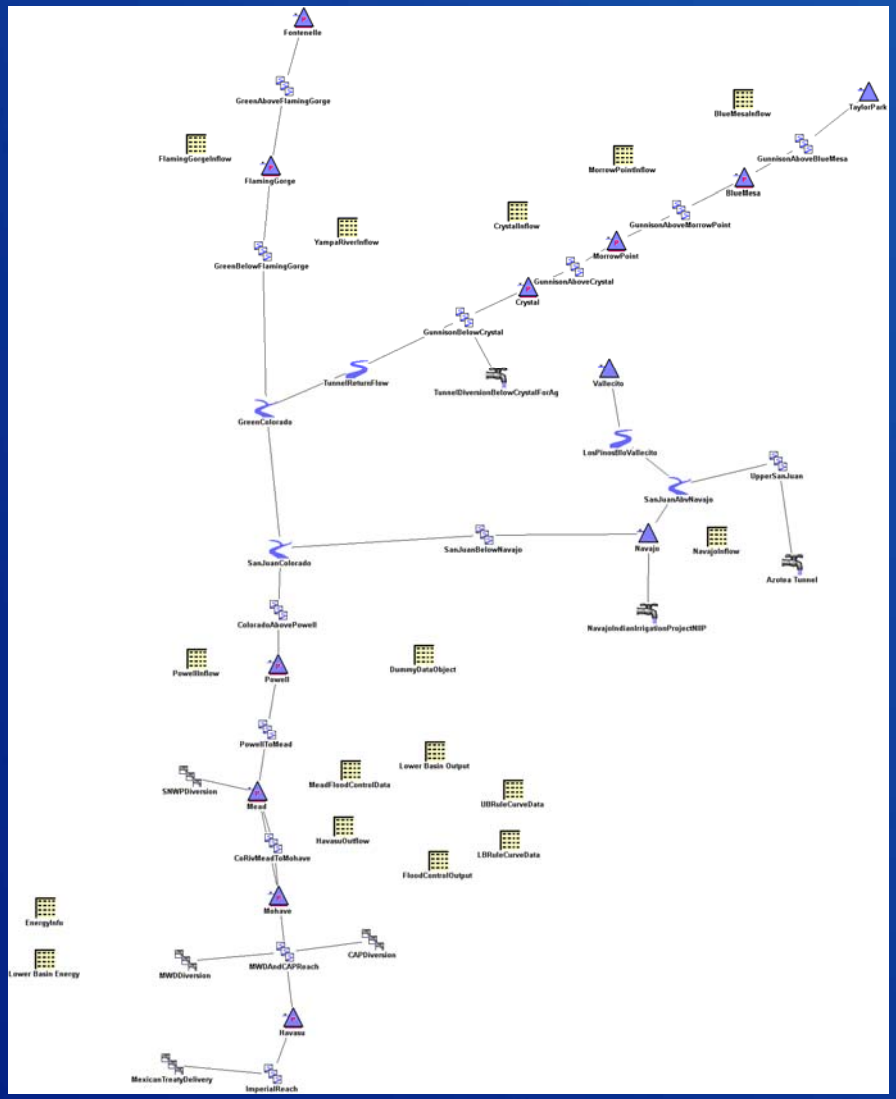
24 Month Study Model (UC)



- Inflow forecast from RFC and NRCS
- UC operators input projected reservoir releases, diversions
- Model simulates flows, reservoir elevations, etc.

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24 Month Study Report

O P E R A T I O N P L A N F O R C O L O R A D O R I V E R S Y S T E M R E S E R V O I R S

Bureau of Reclamation - CRFS 6/2009 Most Prob Water Supply 09-jun-2009 15:35:33
Lake Powell

		Unreg Inflow 1000 Ac-Ft	Regulated Inflow 1000 Ac-Ft	Evap Losses 1000 Ac-Ft	PowerPlant Release 1000 Ac-Ft	Bypass Release 1000 Ac-Ft	Total Release 1000 Ac-Ft	Reservoir Elevation EOM Feet	Bank Storage 1000 Ac-Ft	EOM Storage 1000 Ac-Ft	Lees Ferry 1000 Ac-Ft
*	Jun 2008	3566	3330	49	791	0	791	3631.05	17042	14971	810
H	Jul 2008	1709	1430	63	865	0	865	3633.00	17320	15192	887
I	Aug 2008	489	596	62	890	0	890	3629.55	17353	14803	914
S	Sep 2008	390	555	56	723	0	723	3626.90	17423	14509	738
	WY 2008	12344	12417	396	8885	93	8978				9164
T	Oct 2008	382	498	38	749	0	749	3623.82	17470	14172	762
O	Nov 2008	419	455	36	603	0	603	3621.90	17493	13966	612
R	Dec 2008	312	386	28	801	0	801	3617.89	17478	13541	818
I	Jan 2009	329	394	9	802	0	802	3614.17	17444	13155	822
C	Feb 2009	323	377	9	602	0	602	3612.05	17426	12938	612
A	Mar 2009	470	445	16	626	0	626	3610.43	17393	12774	632
L	Apr 2009	788	669	25	604	0	604	3611.26	17350	12858	611
*	May 2009	2923	2448	31	582	0	582	3629.09	17291	14751	586
	Jun 2009	2300	2015	47	625	0	625	3639.93	17391	15994	625
	Jul 2009	1080	1072	55	830	0	830	3641.39	17404	16168	830
	Aug 2009	500	642	57	812	0	812	3639.62	17388	15958	812
	Sep 2009	424	576	49	595	0	595	3639.09	17383	15896	595
	WY 2009	10249	9977	400	8230	0	8230				8317
	Oct 2009	487	553	44	615	0	615	3638.26	17375	15798	615
	Nov 2009	523	566	36	600	0	600	3637.70	17370	15733	600
	Dec 2009	418	510	30	800	0	800	3635.14	17346	15436	800
	Jan 2010	384	486	23	900	0	900	3631.59	17314	15032	900
	Feb 2010	395	464	21	800	0	800	3628.64	17287	14701	800
	Mar 2010	628	588	26	900	0	900	3625.81	17262	14389	900
	Apr 2010	952	768	29	900	0	900	3624.44	17250	14240	900
	May 2010	2161	1838	40	997	0	997	3631.14	17310	14981	997
	Jun 2010	2808	2441	48	1078	0	1078	3641.65	17407	16199	1078
	Jul 2010	1345	1233	56	1180	0	1180	3641.63	17407	16197	1180
	Aug 2010	566	671	56	1125	0	1125	3637.63	17369	15724	1125
	Sep 2010	459	597	48	595	0	595	3637.25	17366	15681	595
	WY 2010	11127	10714	456	10490	0	10490				10490
	Oct 2010	506	602	44	615	0	615	3636.81	17361	15629	615
	Nov 2010	523	596	36	600	0	600	3636.49	17358	15592	600
	Dec 2010	418	548	30	800	0	800	3634.22	17338	15331	800
	Jan 2011	384	514	23	850	0	850	3631.29	17311	14998	850
	Feb 2011	395	489	21	675	0	675	3629.59	17296	14807	675
	Mar 2011	628	614	26	750	0	750	3628.24	17284	14657	750
	Apr 2011	952	802	29	800	0	800	3628.01	17282	14631	800
	May 2011	2161	1872	41	850	0	850	3636.03	17354	15539	850

- Distributed monthly

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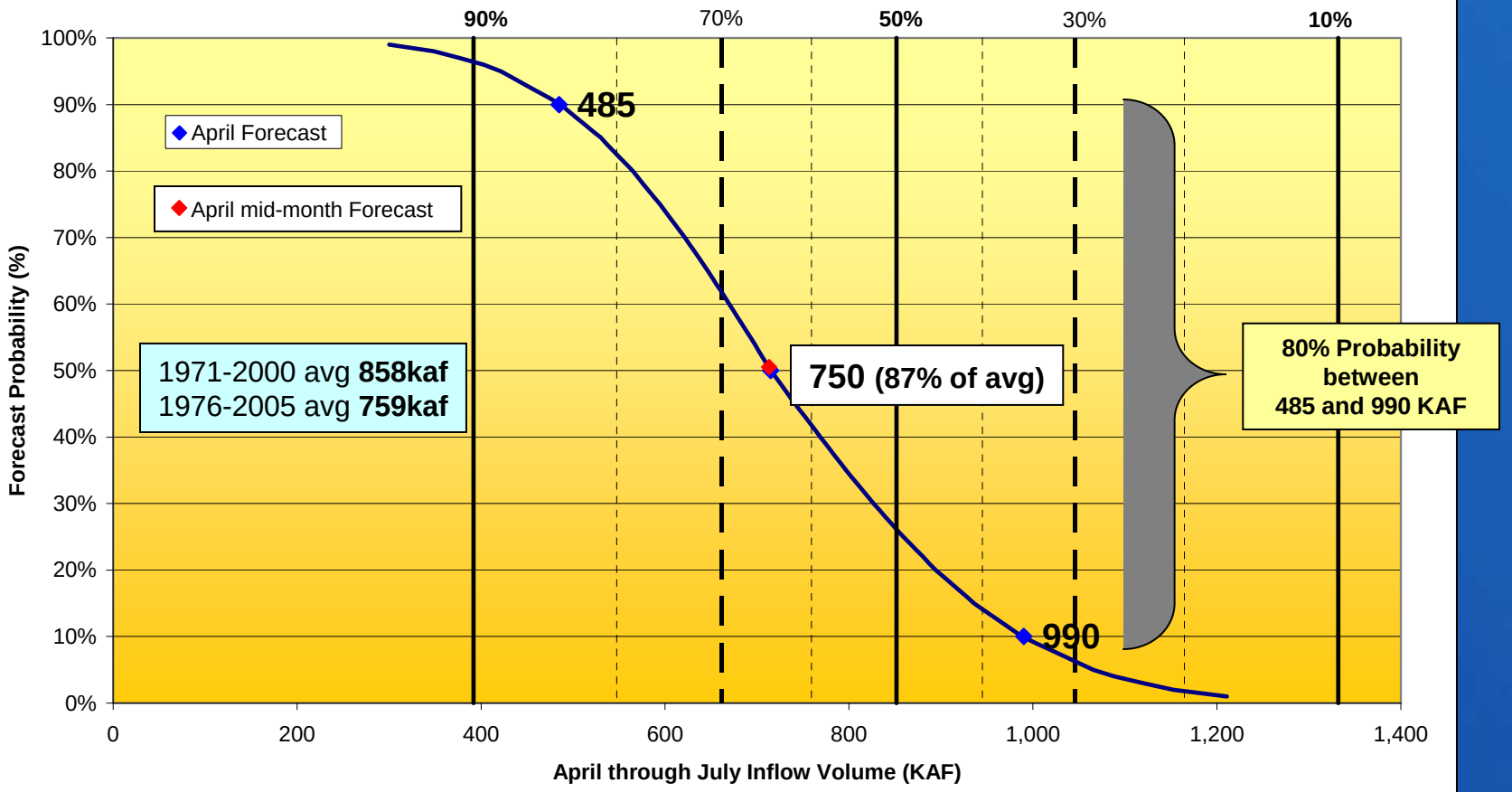
Uncertainty in the 24-Month Study

- Largest source of uncertainty is forecasted inflows
  - Also model uncertainty, data, projected operations, projected diversions, policy, etc.
- Only explicitly address uncertainty in August, January and April
  - Run model with min, most, and max probable inflow forecasts
  - Provides range of possible operations
  - Use results to inform stakholders and assess risk

Working Group Meetings

- Forum for information exchange between Reclamation and stakeholders
- Typically held in January, April and August
- Meet with stakeholders
- Discuss projected operations and basin conditions
- Forum for discussion, flow requests, reviewing past opertions, etc.

Forecast Uncertainty



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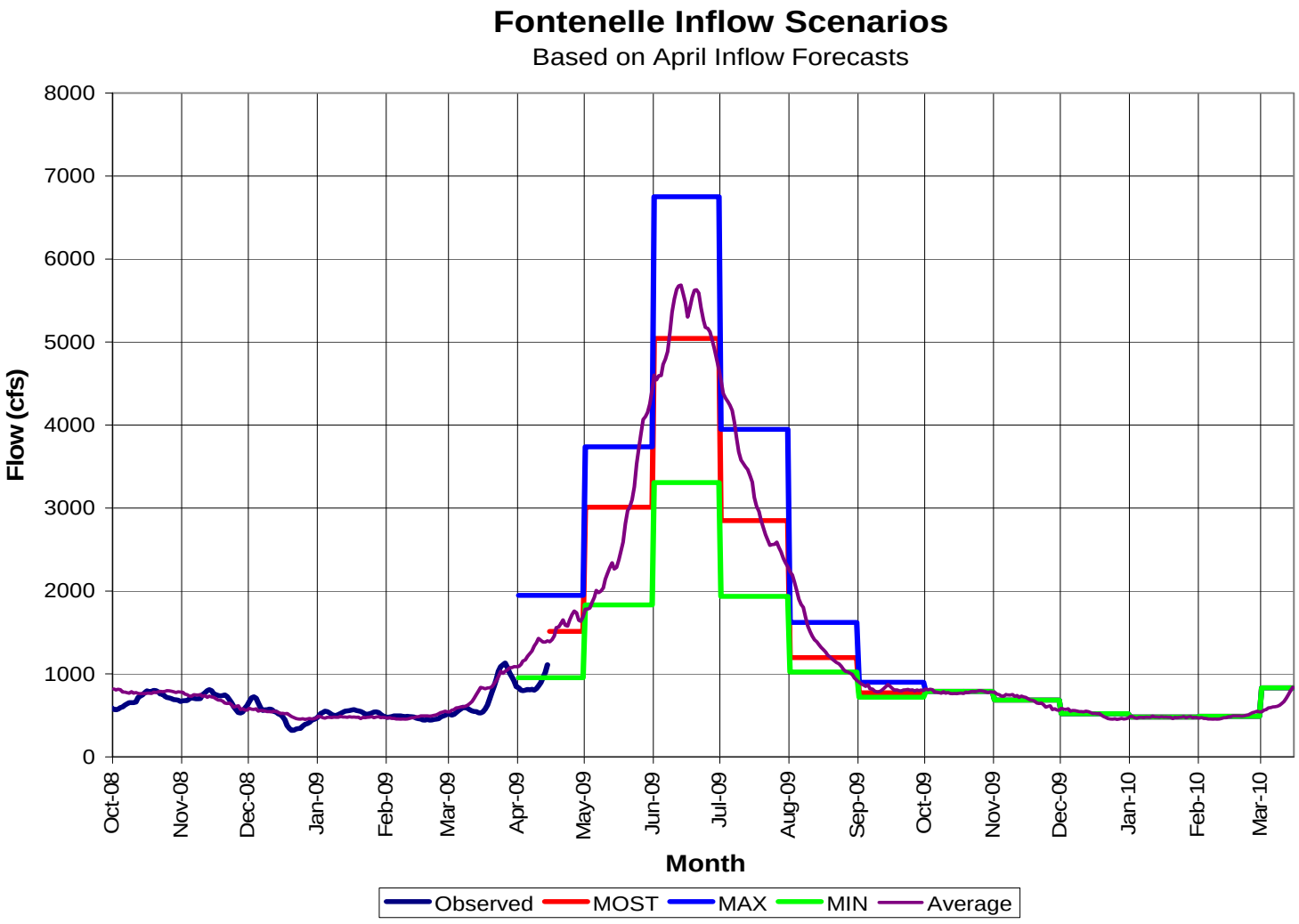
Inflow Scenarios



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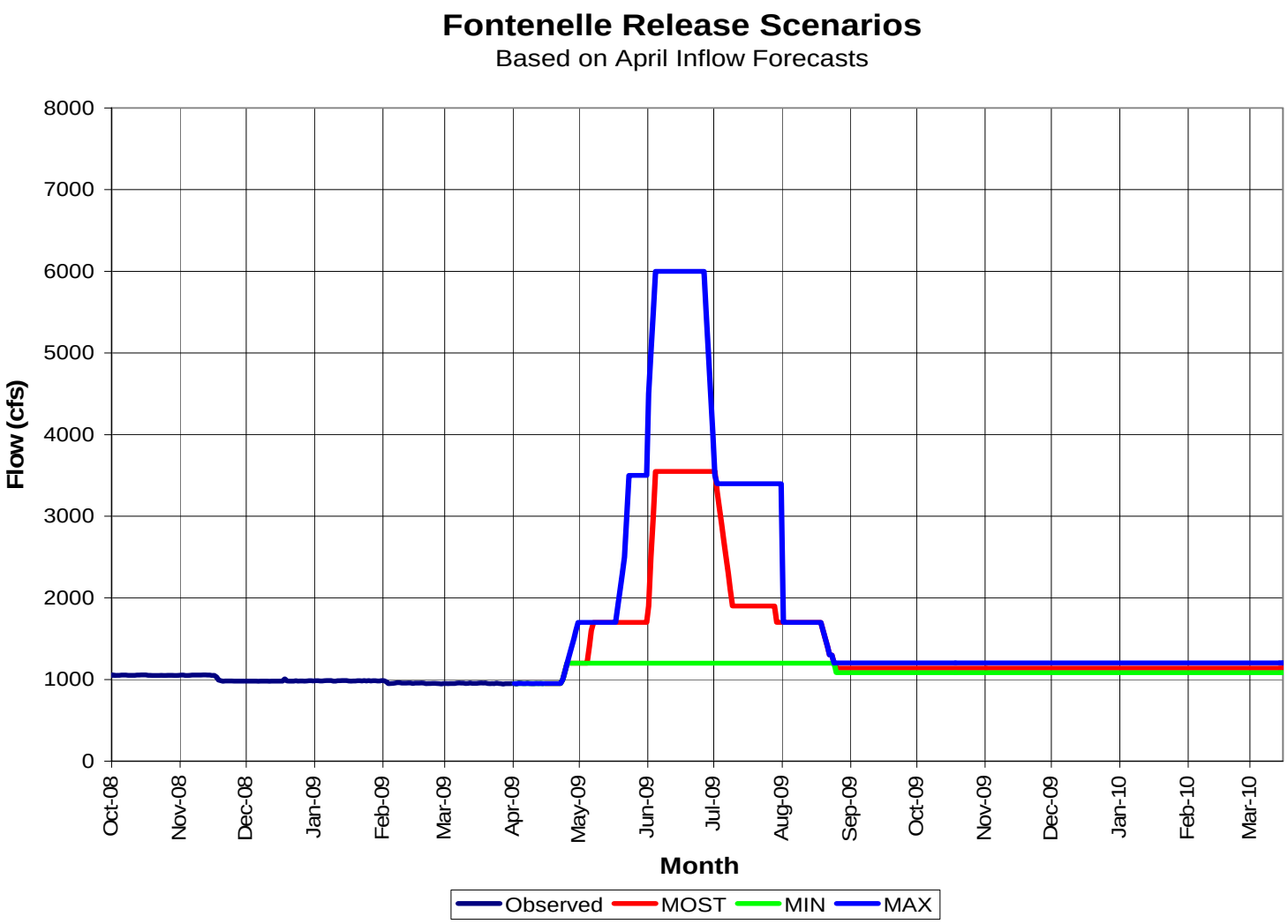
Release Scenarios



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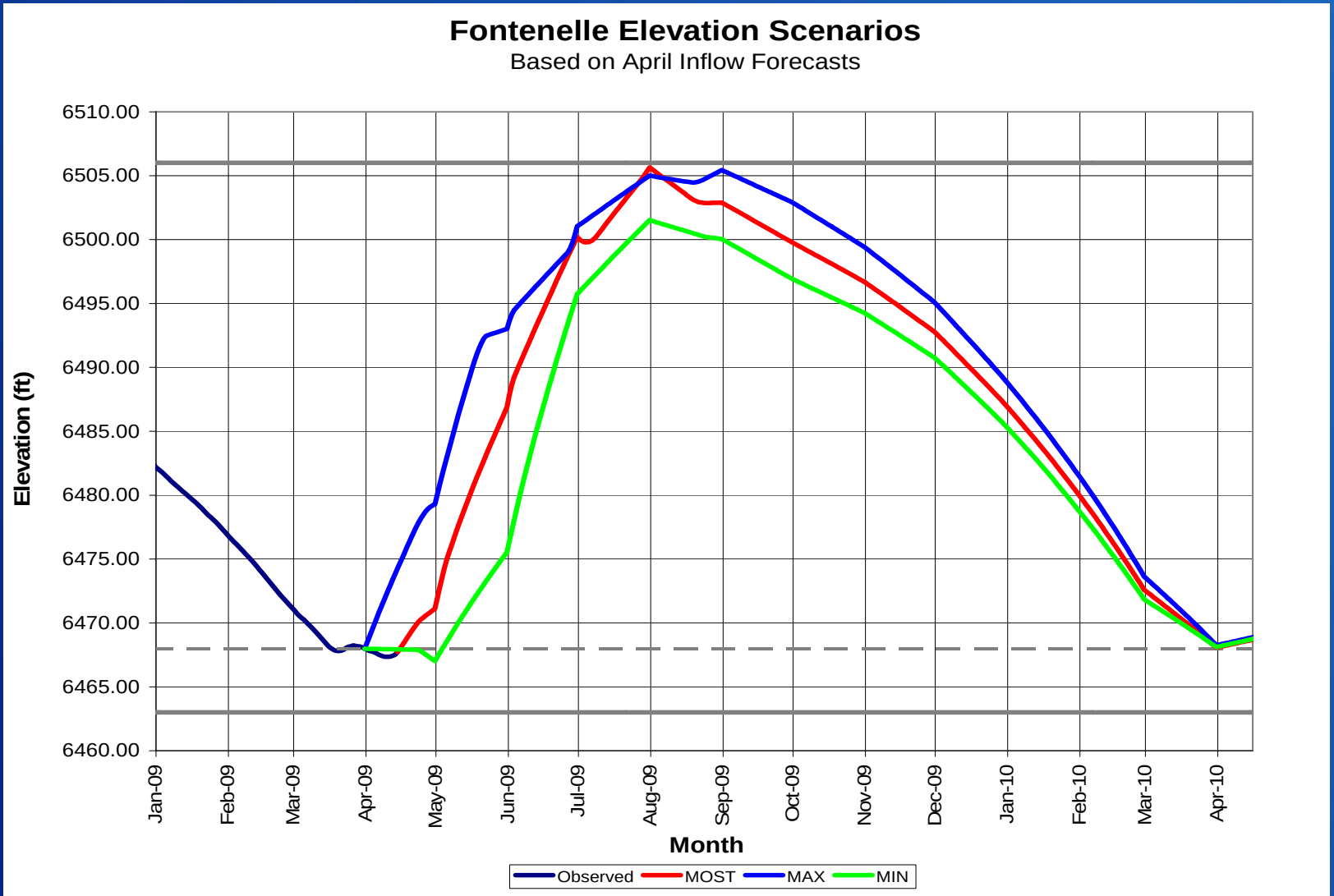
Elevation Scenarios



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Summary

- 24 Month study provides good view of **most probable** monthly operations throughout the basin
  - Water supply, power, streamflows (somewhat)
- Min, most and Max probable runs provide range of potential operations
- Would be nice to assess probability of a certain event (e.g., reservoir above certain trigger elevation)

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Current Efforts

- Continued communication with stakeholders and public
- Working toward utilizing written logic to set initial reservoir releases in model
- Working toward a probabalistic 24-Month Study model that uses Enesemble Streamflow Prediction product of the RFC

Questions?

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