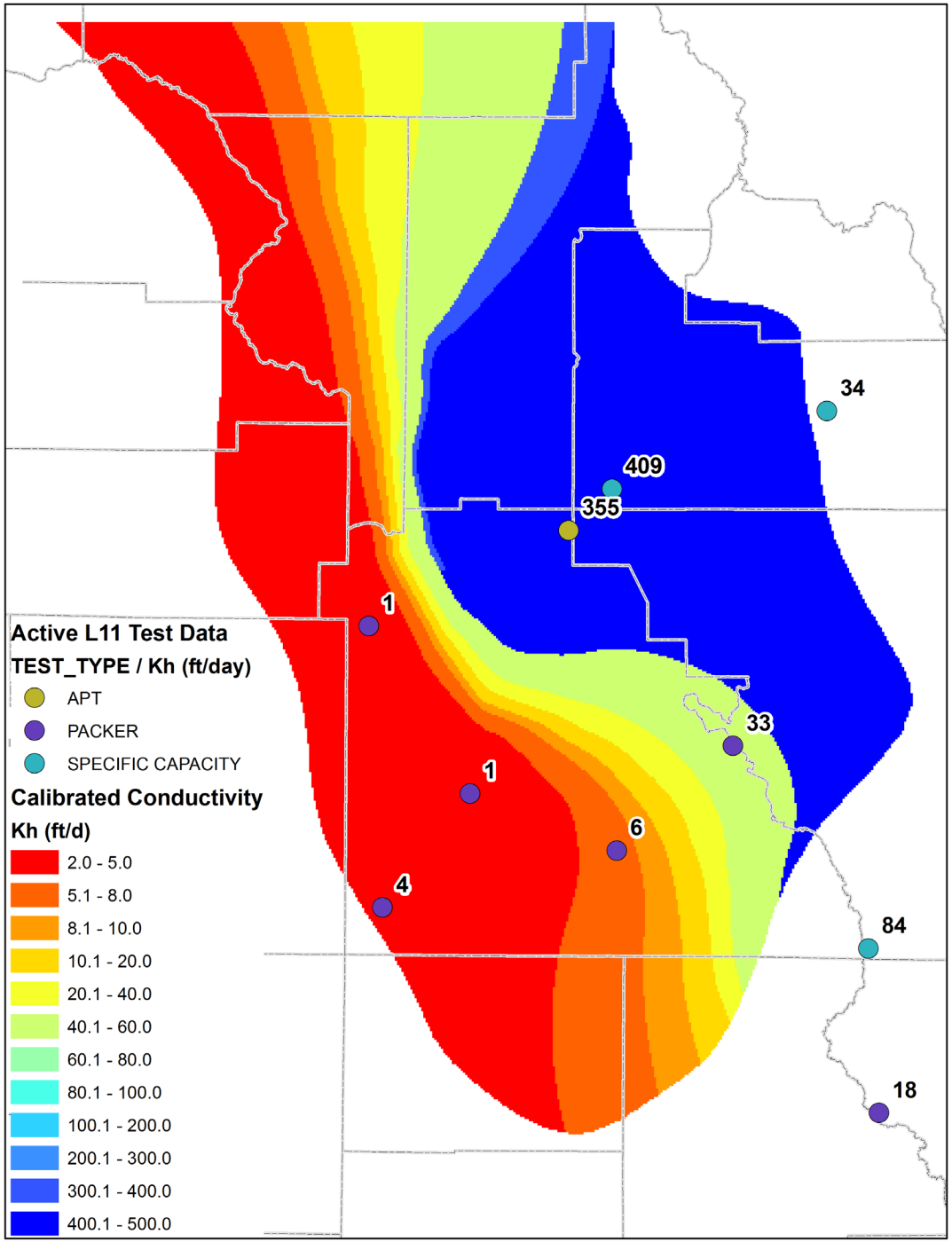
ECFTX TRANSIENT MODEL INTERIM PROGRESS MEETING

Thursday, October 4, 2018 2-4 PM

PEER REVIEW PANEL TELECONFERENCE

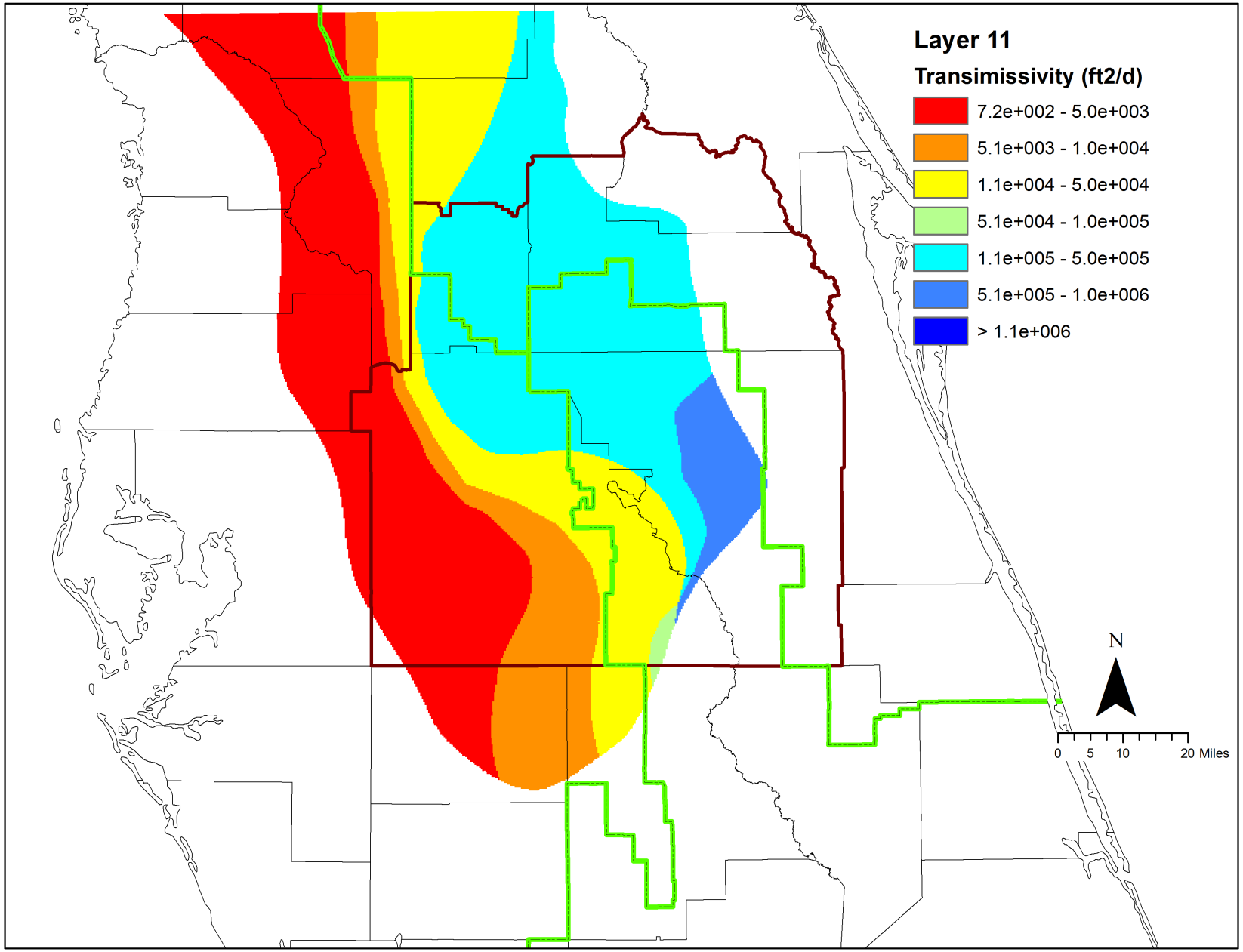
Agenda

1. Introduction
2. Summary of work performed since last meeting
3. Transient Model Calibration summary
4. Calibration metrics/criteria
5. Panel Discussion
6. Schedule
7. Public Comment

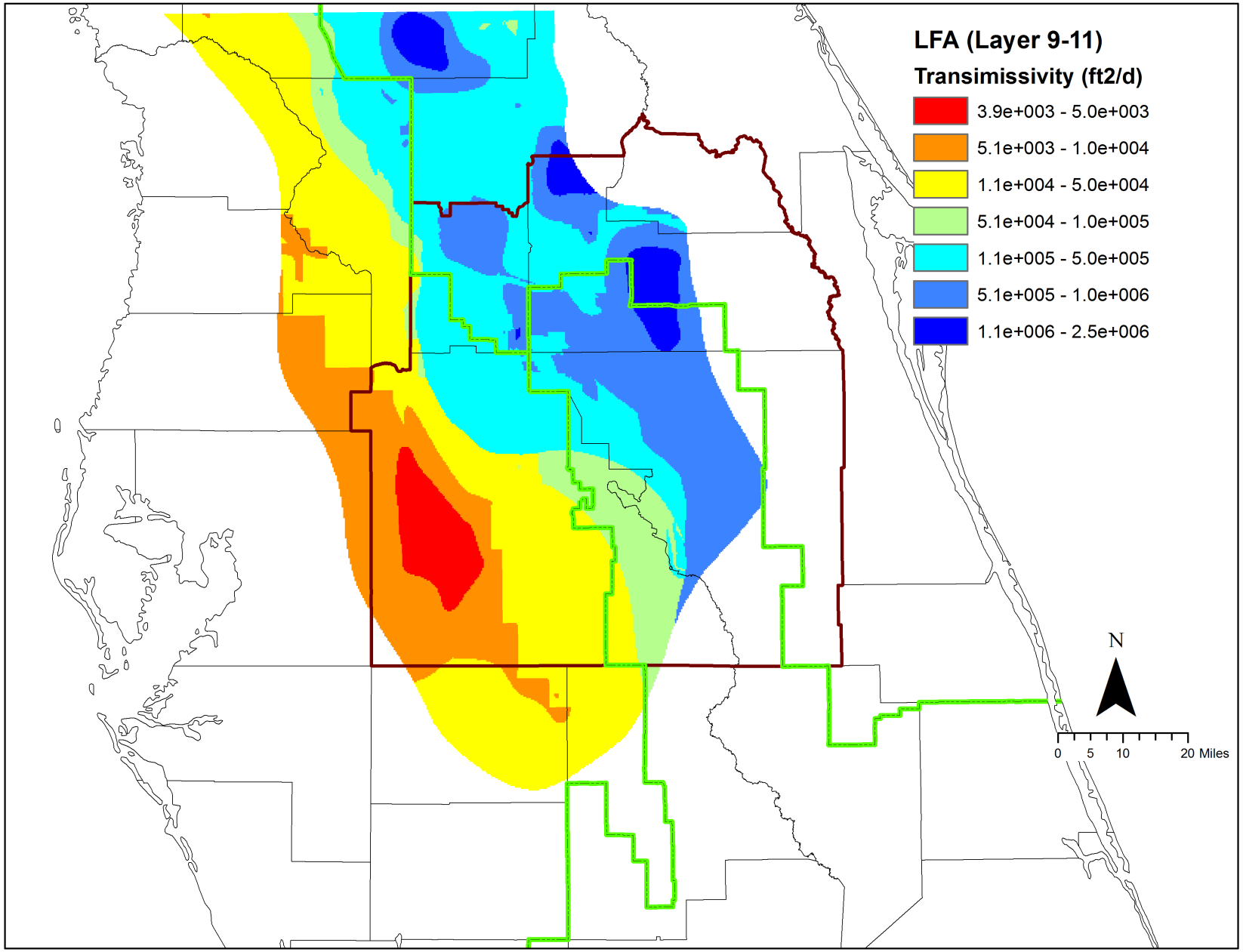


Calibrated layer 11 conductivity (June 26, 2018)

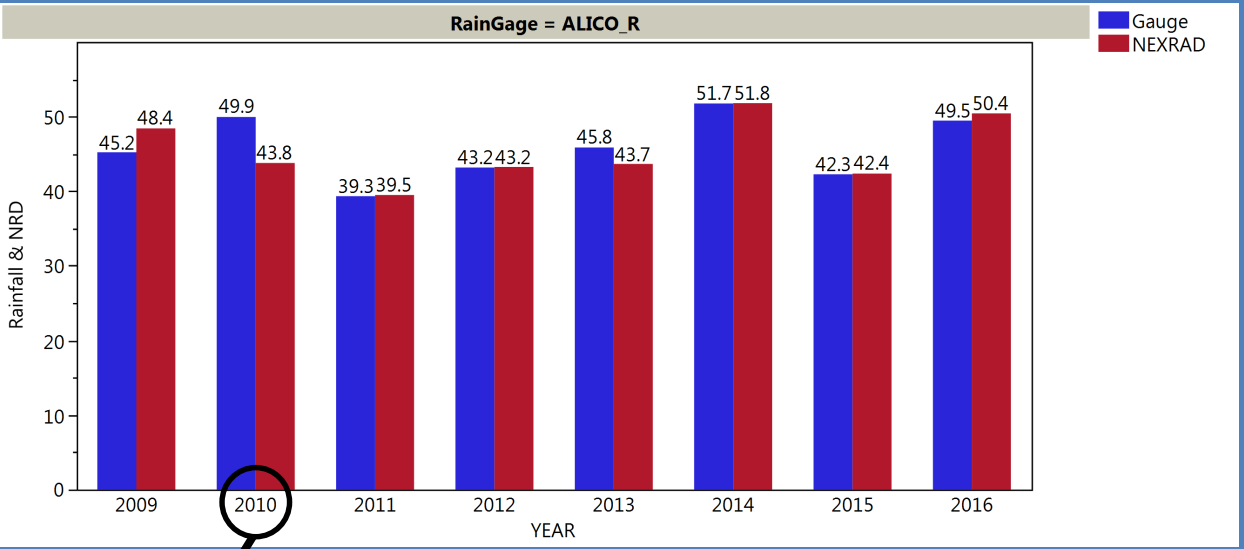
Calibrated layer 11 transmissivity

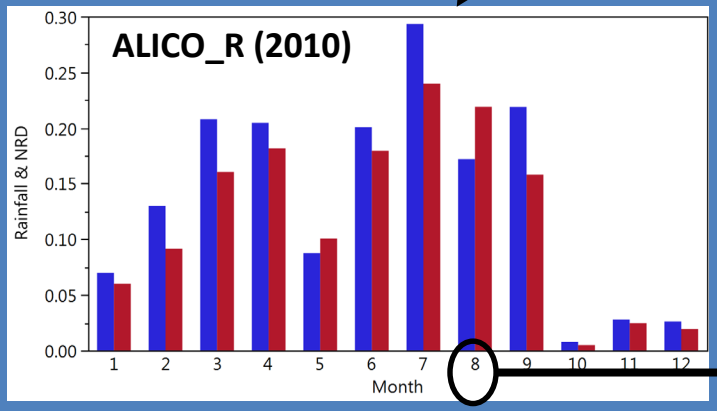


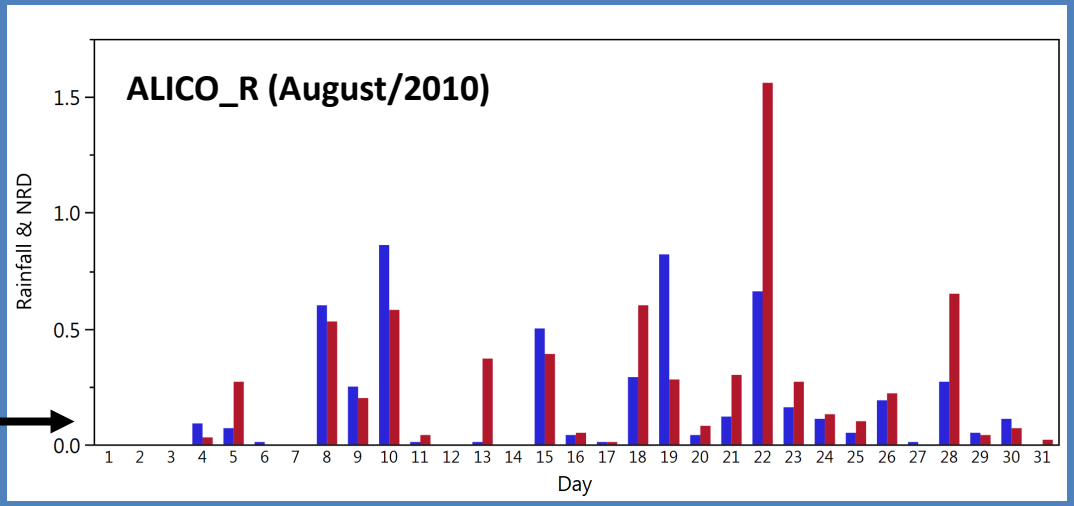
Calibrated layer 9-11 transmissivity



Comparison of NEXRAD pixel vs Rain Gauge







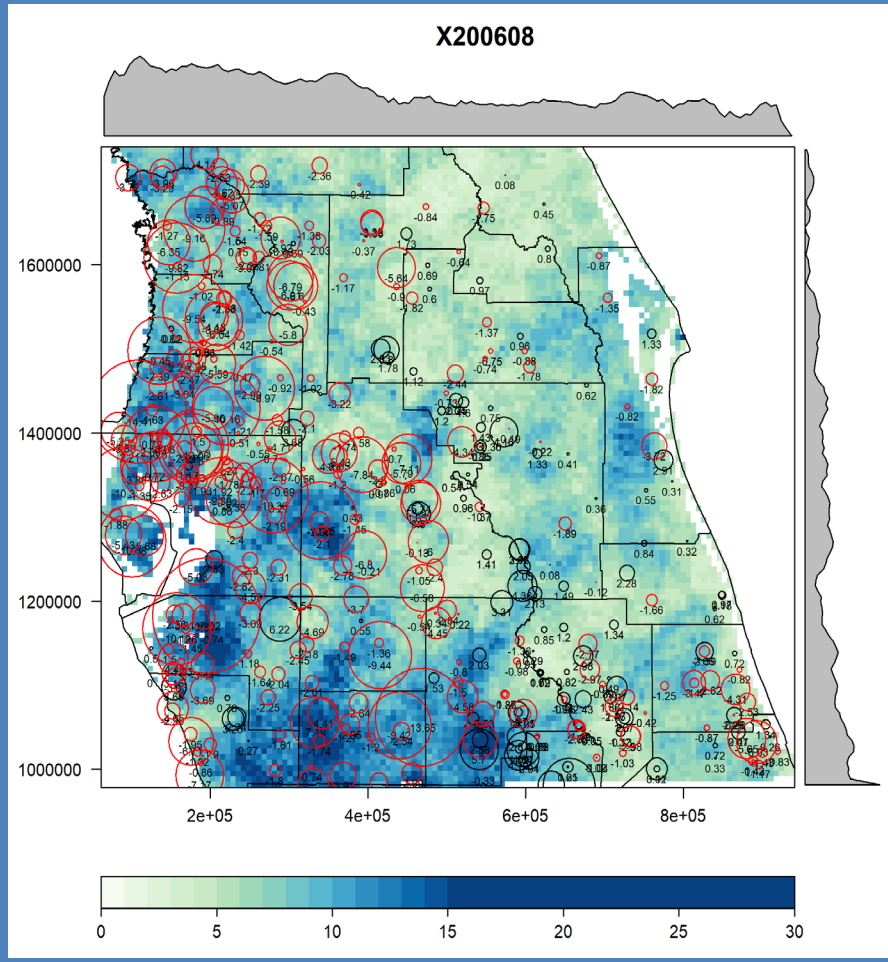
Data and Process

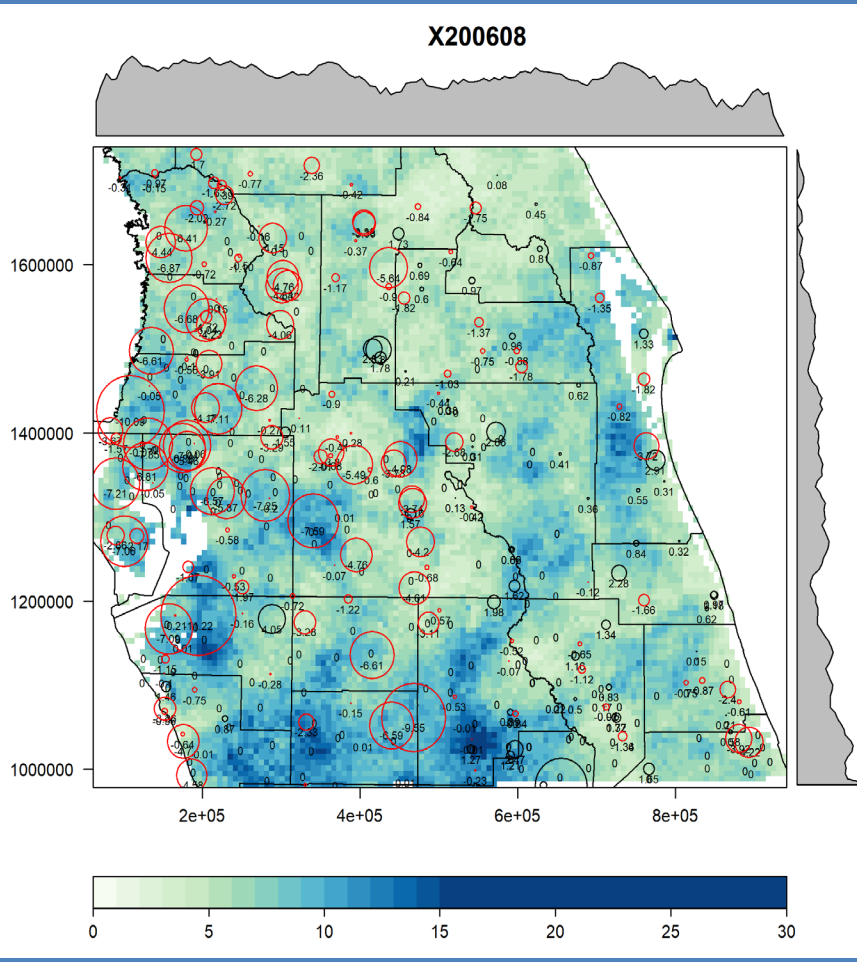
1. NEXRAD daily data provided by WMDs:12,725 pixels
2. Rain gauge daily data from WMDs:370 Rain gage stations
3. Calculated monthly bias multipliers from Rain Gage vs NEXRAD Pixels.
4. Bias factors at rain gauges are interpolated using Ordinary Kriging producing a monthly 'bias' raster.
5. Daily NEXRAD Pixels are rasterized and multiplied by the 'bias' raster to produce 'bias adjusted' Daily NEXRAD rasters.
6. Daily adjusted NEXRAD rasters converted back to pixels by extracting raster values.
7. Adjustments were applied only to SWFWMD and SFWMD

Bias Corrected-Aug 2006

Before Adjustment

After Adjustment



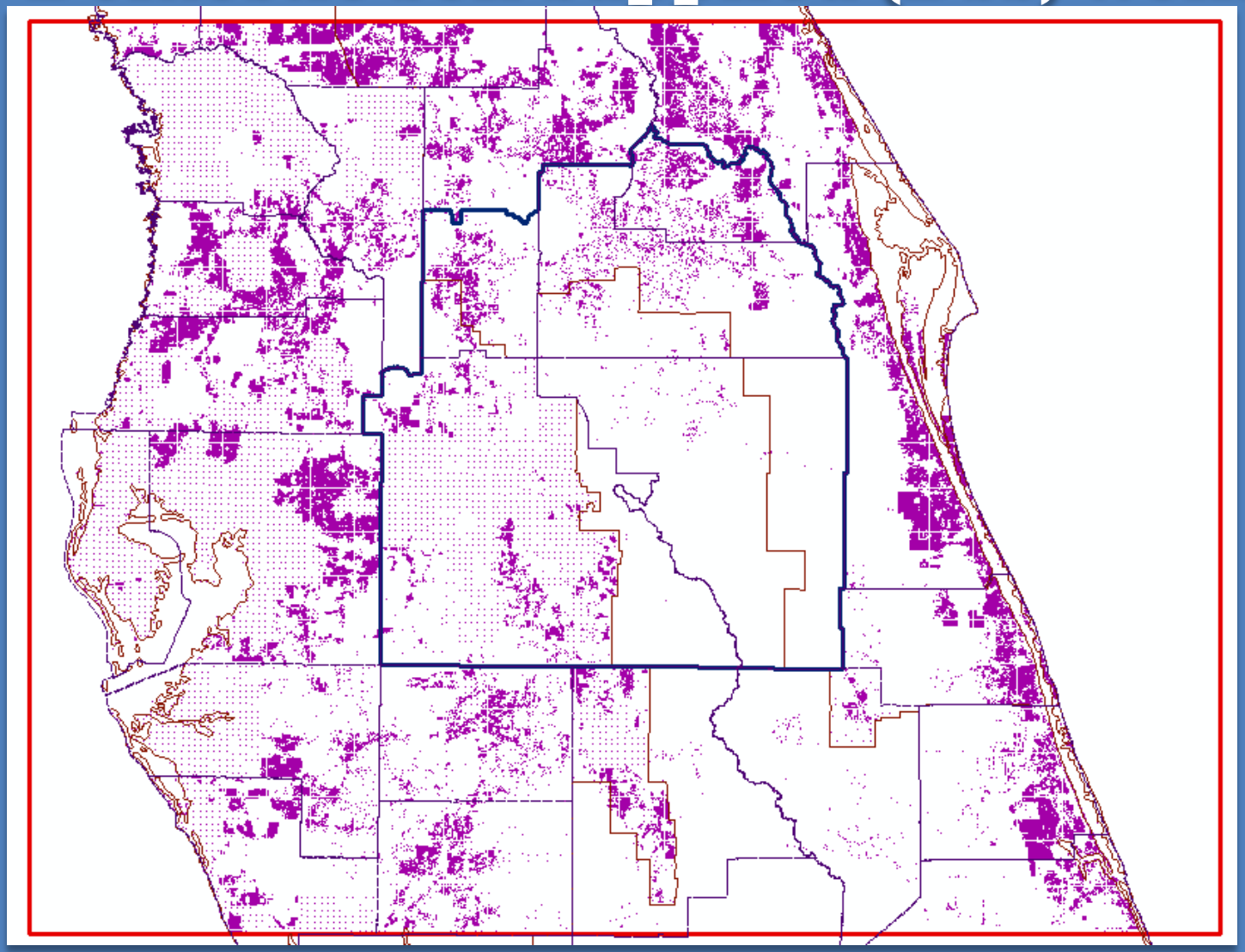


- Improved runoff and ground water level calibrations

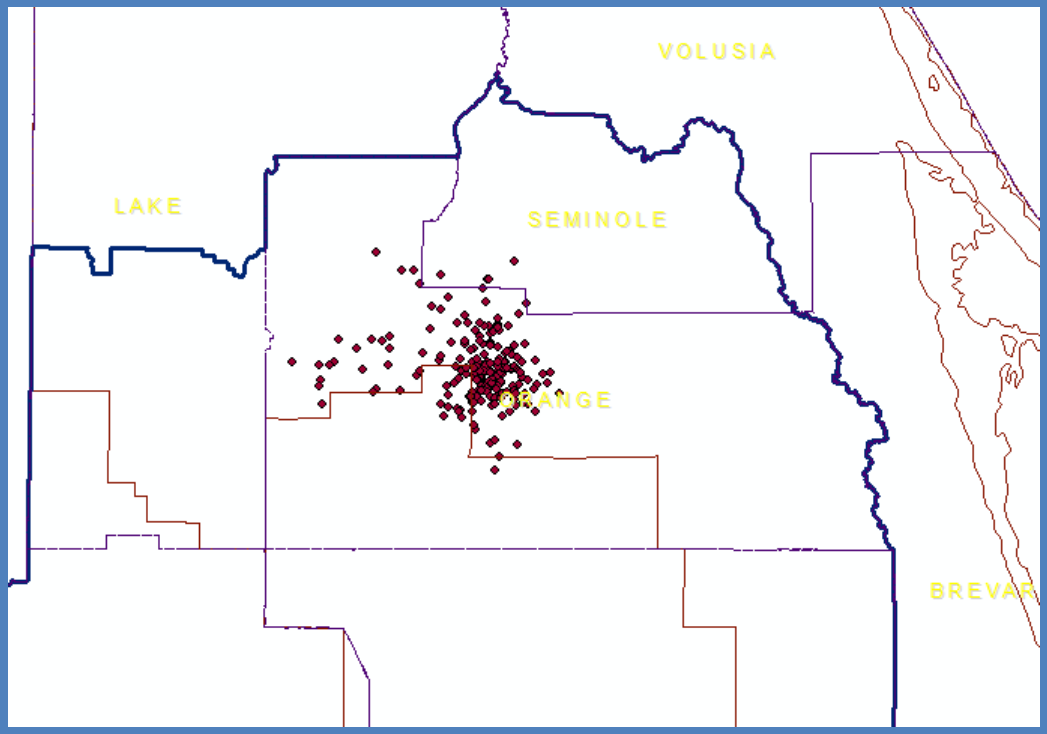
ET-RCH-Runoff Changes

- QA/QC potable and reclaimed water landscape irrigation (LSI)
- DSS well return flows incorporated
  - DSS wells used for LSI → added to rainfall array
  - DSS wells indoor use: septic tank returns → added to recharge package
- Drainage Wells updated
  - Drainage wells were previously simulated using WELL package
  - Currently simulated through DRT and RCH packages
    - Tributary area runoff from each drainage well is routed to a group of cells, which function as drainage well lakes
    - Runoff values from tributary area are directly added to RCH package at the drainage well lake locations
    - Drainage well lake cells are represented using DRT cells, which route the drain flow to layer 3
- Adjustment for higher rainfall conditions

Locations of Return Flows for Domestic Self Supplied (DSS) Wells



Drainage Well Locations



Adjustment for Extreme Rainfall condition

- Some higher peaks associated with extreme rainfall events in simulated groundwater levels
- Underestimated runoff in extreme rainfall events, causes overestimation of recharge
- Forced CN to maximum (100) in extreme rainfall conditions allowing maximum runoff
  - If daily rainfall is greater than 4 inches--> CN=100
- Increased simulated runoff peaks and reduced recharge peaks

TRANSIENT DATA SET/PROCESSING

RUN	DESCRIPTION	MODFLOW PACKAGE ADDED/TESTED	# TIME STEPS	DATE COMPLETE	RUN DURATION (HRS)
TR1	Utilized 2003 SS Model, No Package Revisions		1	7/7	3.8
TR2	Built on TR1	WEL	1	7/9	16.3
TR3	Built on TR2	DRN	1	7/9	19.4
TR4	Built on TR3	RIV	1	7/10	28.4
TR5	Built on TR4	ET	1	7/10	20.7
TR6	Built on TR5	RCH	1	7/11	23.7
TR7	Built on TR6	UPW	1	7/12	12.6
			5	7/14	45.1
TR8	Built on TR7	GHB	1	7/25	0.4
			5	7/26	25.2
			10	7/27	39.8
TR9	Built on TR8	Updates to: GHB, L2 K, HOBS, ETRCH 0830 (TR9b)	6	8/28	31.4
TR10	Built on TR9	Updates to: ETRCH (0914), WEL, DRT, DRN, HOBS, Ss and Sy	6	9/16	31.9
TR11	Baseline Calibration	NA	6	TBD	TBD

Quality Assurance Updates

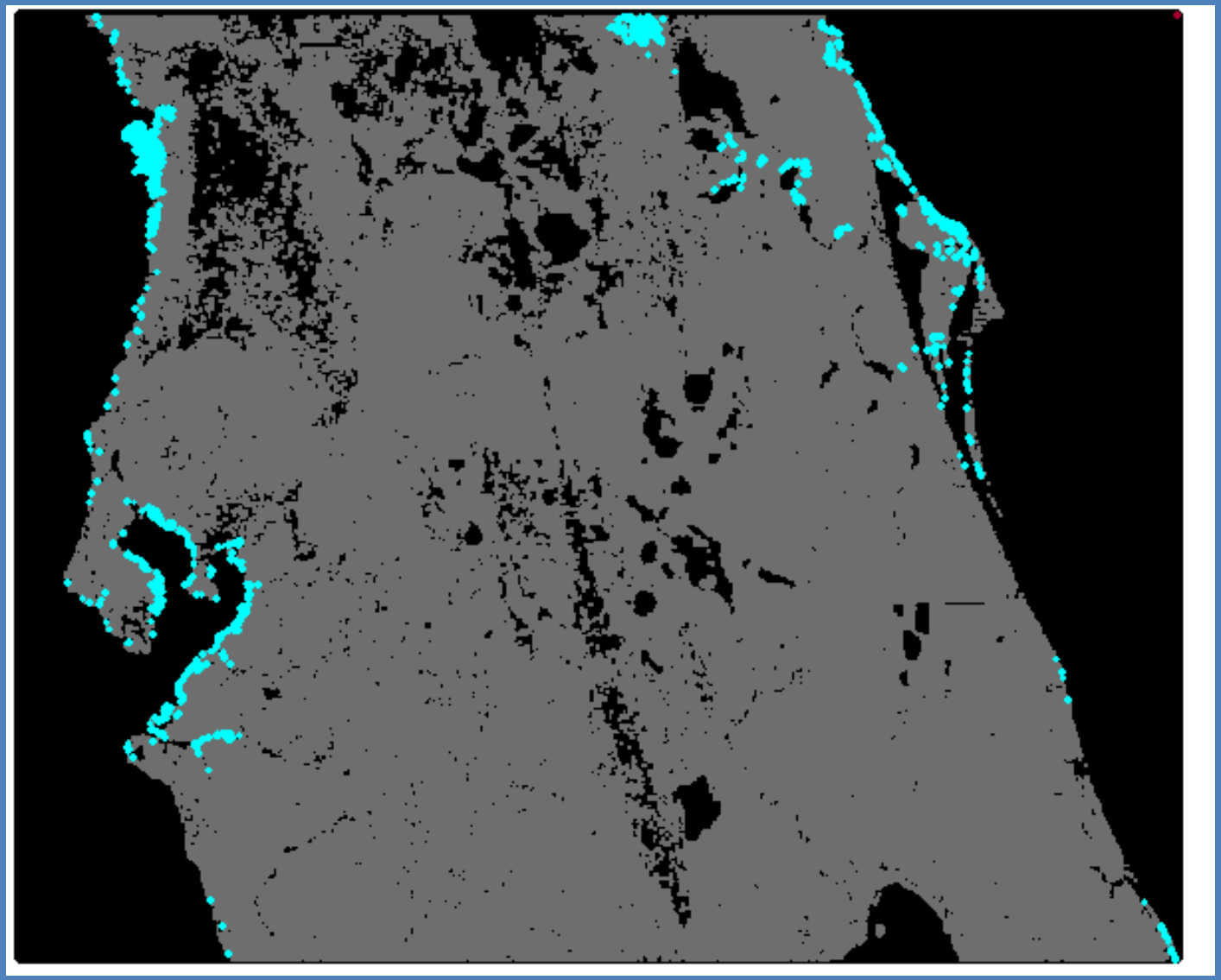
- Pre-TR8
  - Created script to identify the cells having the most trouble converging and isolation of cells where WEL flow was reduced to prevent drying out of a cell. → identified WEL layer assignment issues
  - Created script to compare HDS using different number of timesteps for the transient stress periods. → identified a compromise between simulation speed and accuracy, n of time steps = 6, for purposes of calibration.
  - Created figures depicting the open interval of all monitoring wells within each ROWCOL relative to the model layering, along with hydrograph showing available data. → used to streamline the identification of duplicative observations and layer assignment issues.
- TR9
  - Created script to identify the cell that changed the most compared to the previous stress period. → identified an error in the RIB data
  - Updated input echo scripts → creates a GIS layer to streamline ongoing QC efforts and comparisons (WEL, DIS, BAS, UPW, ETRCH)
- TR10
  - Finalize input echo scripts to include DRN, DRT, RIV, and GHB inputs. (work in progress)

Post-TR8 Quality Control Summary

- TR9
  - GHB – tested/corrected issues with 'flooded' or 'dry' GHBs in layer 1.
  - HOBS – Thorough check of head observation data resulted in discovery that that some data was in the incorrect vertical datum and some of the wells were assigned to the wrong layer, leading to an error in the EFH adjustment. This issue was corrected and EFH calculations redone.

- TR10
  - WEL package – revisited layer assignments (LFA withdrawals, DSS layer assignments) and several isolated updates to the withdrawal rates.
  - DRT – Enforced a minimum DRN elevation ('basement') = mean sea level
  - DRN (springs) – Revised representation of Wekiva Falls flowing well to time-varying based on site history.
  - HOB – incorporated revised SFWMD dataset; SWF and SJR refinement

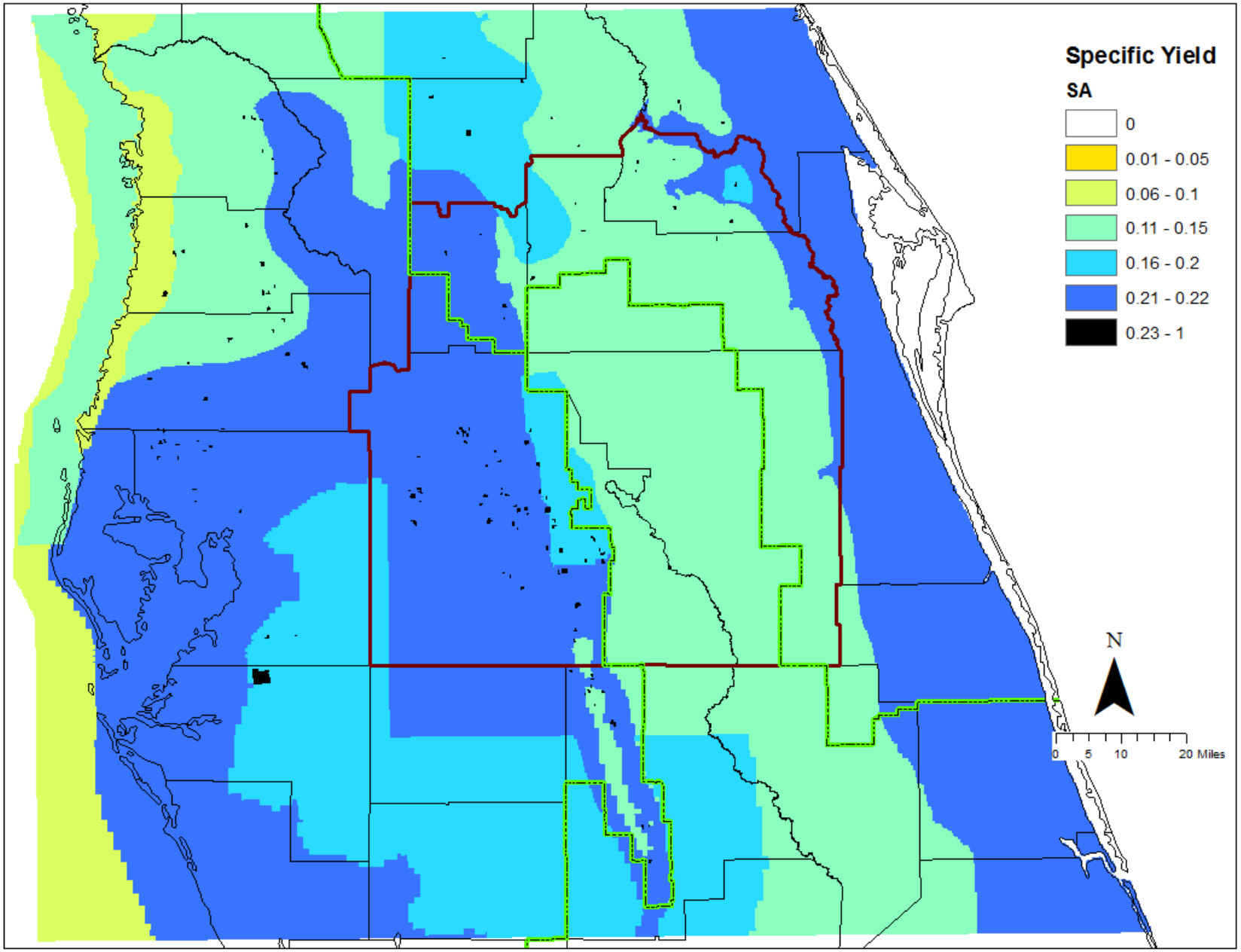
Drain Cells that had elevations set below sea level



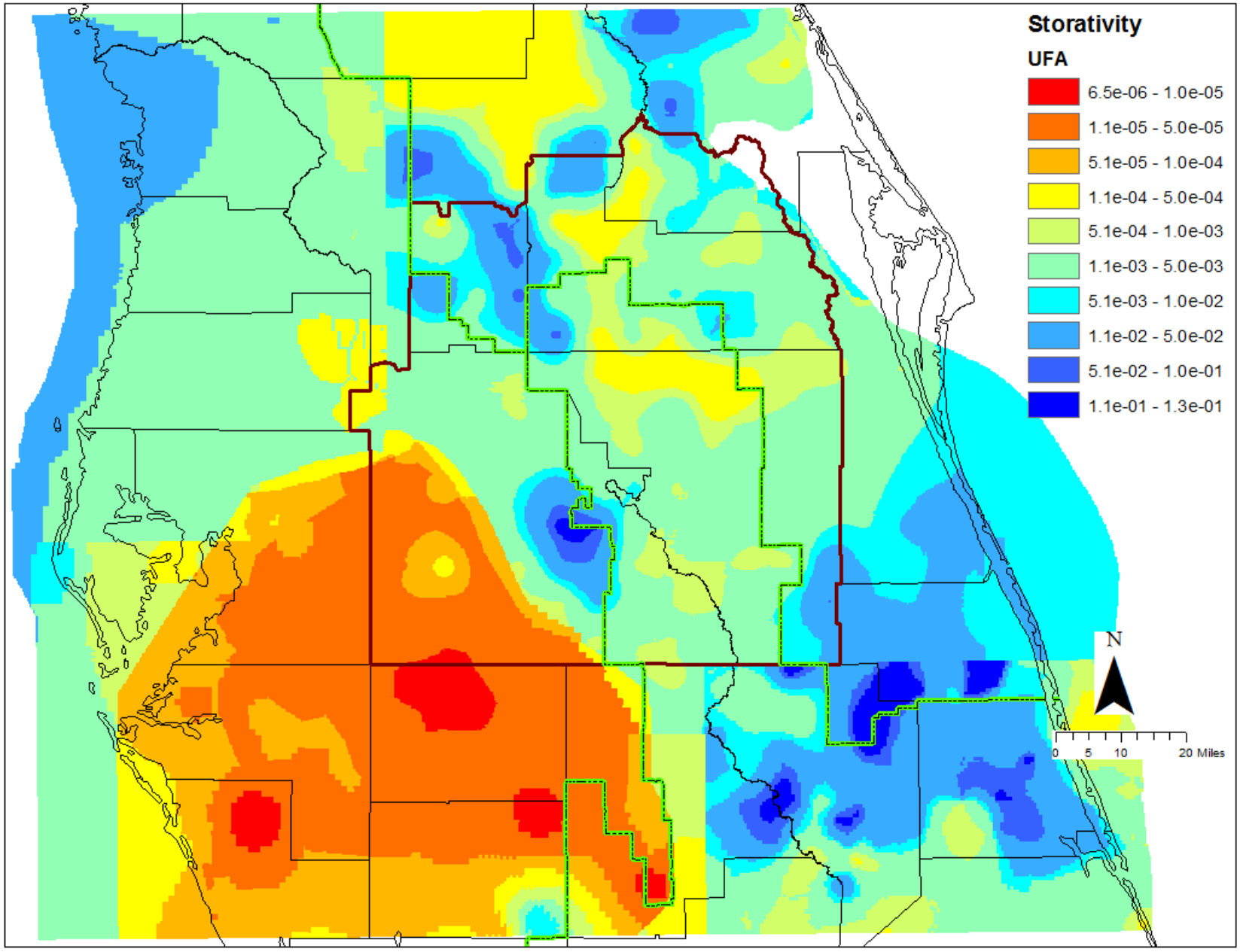
Calibration Criteria

- Structure Flow Criteria:
  - Deviation of Volume (DV) < 15%
  - Nash-Sutcliffe Efficiency (NS) > 0.5
  - Coefficient of Determination (R^2) > 0.5
- Springflow Criteria:
  - ME within +/- 10% for Mag 1 and Mag 2 springs with continuous measurements
  - ME of within +/- 10% for total springflow
- Baseflow Criteria:
  - ME within an order of magnitude for the sum of all simulated baseflow
- Water Level Criteria:
  - Within CFWI, by Aquifer (SAS, UFA, and LFA):
    - 50% of the wells with MAE < 2.5 ft and 80% of the wells with MAE < 5 f
  - Model Wide, by Aquifer (SAS, UFA, and LFA):
    - Average RMSE < 5 ft
    - Average Overall ME < 1 ft
    - Average MAE < 5% of the range of all observed heads within that aquifer

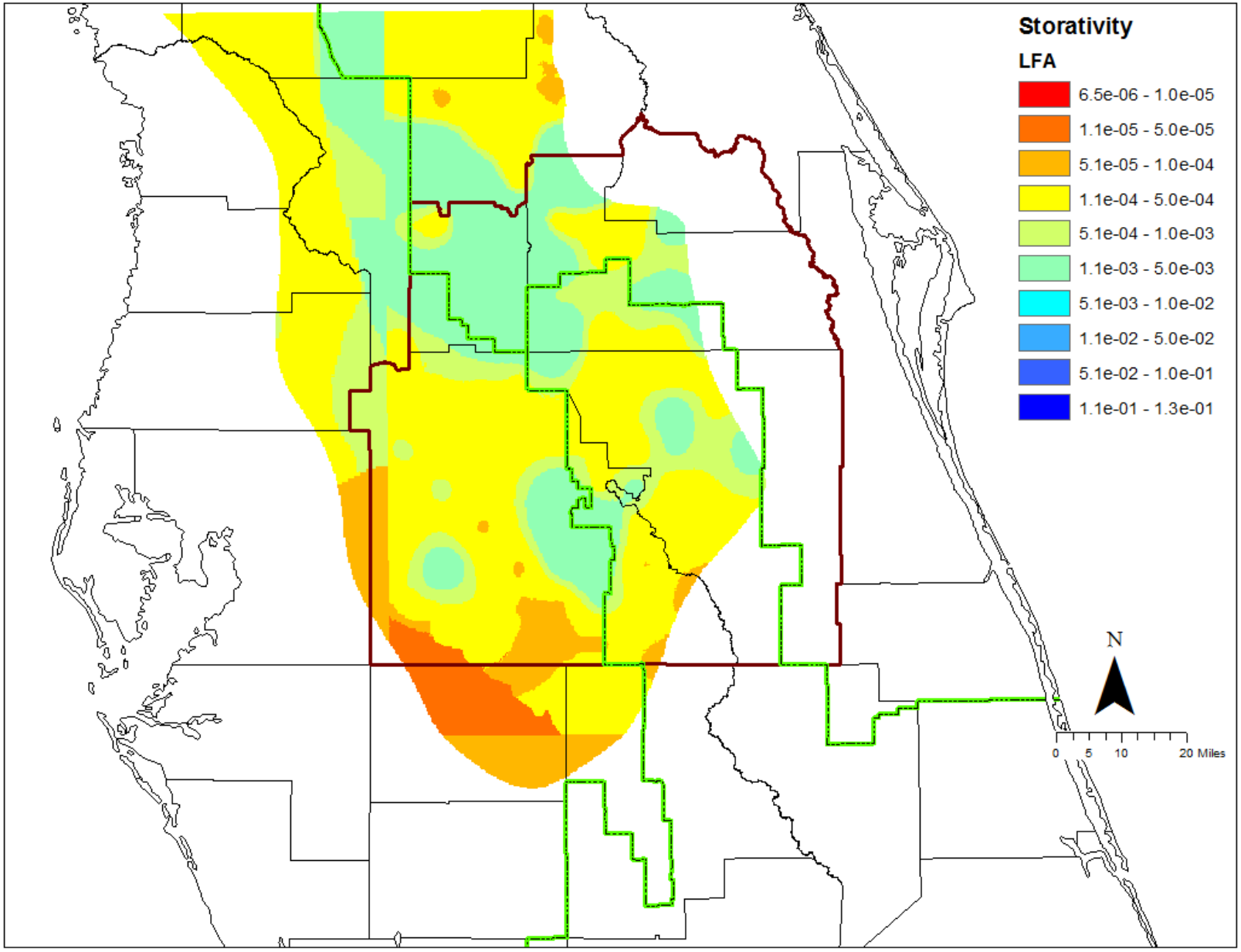
TR 10 Transient model – Specific Yield Layer 1



TR 10 Transient model – Storage Coefficient UFA



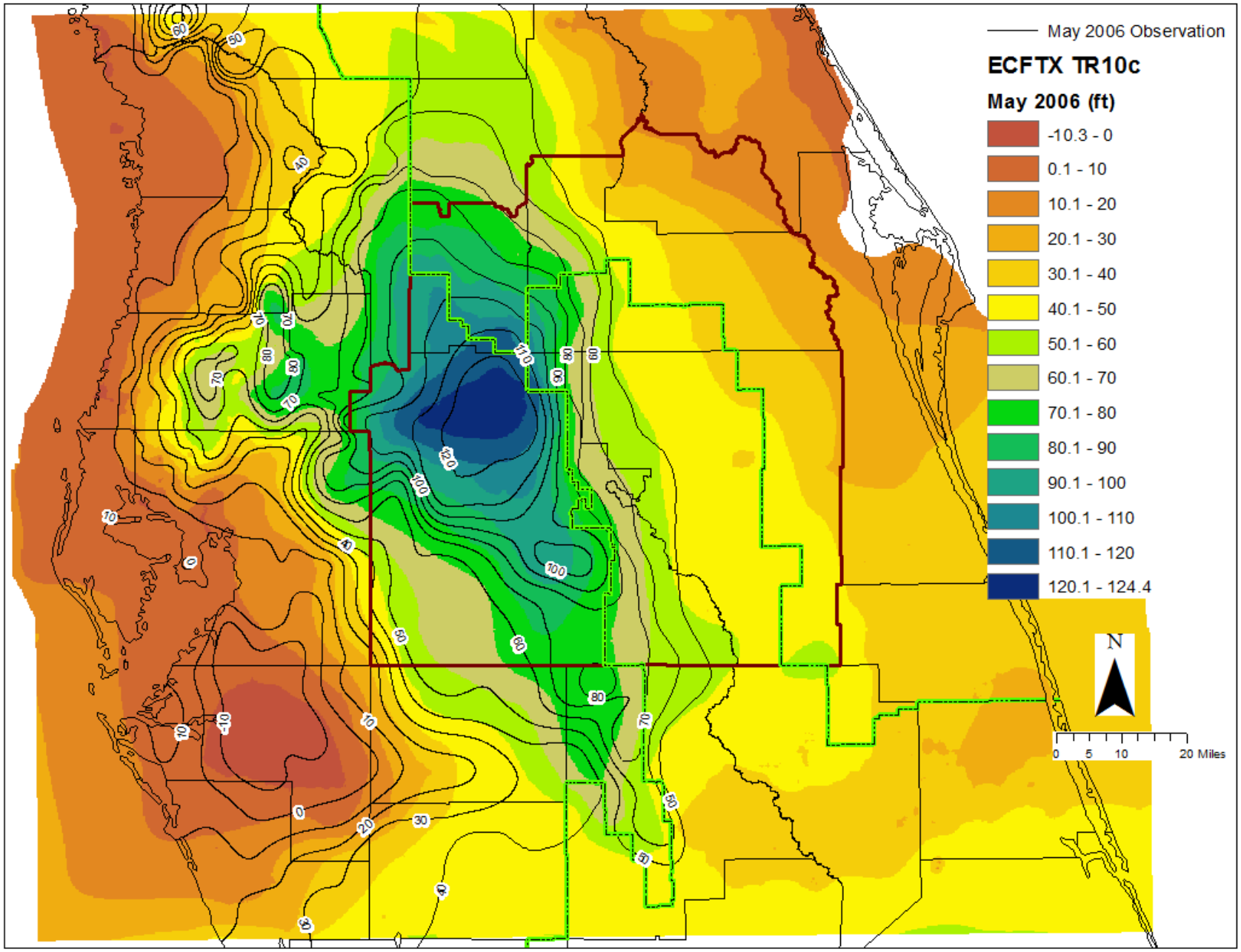
TR 10 Transient model – Storage Coefficient LFA



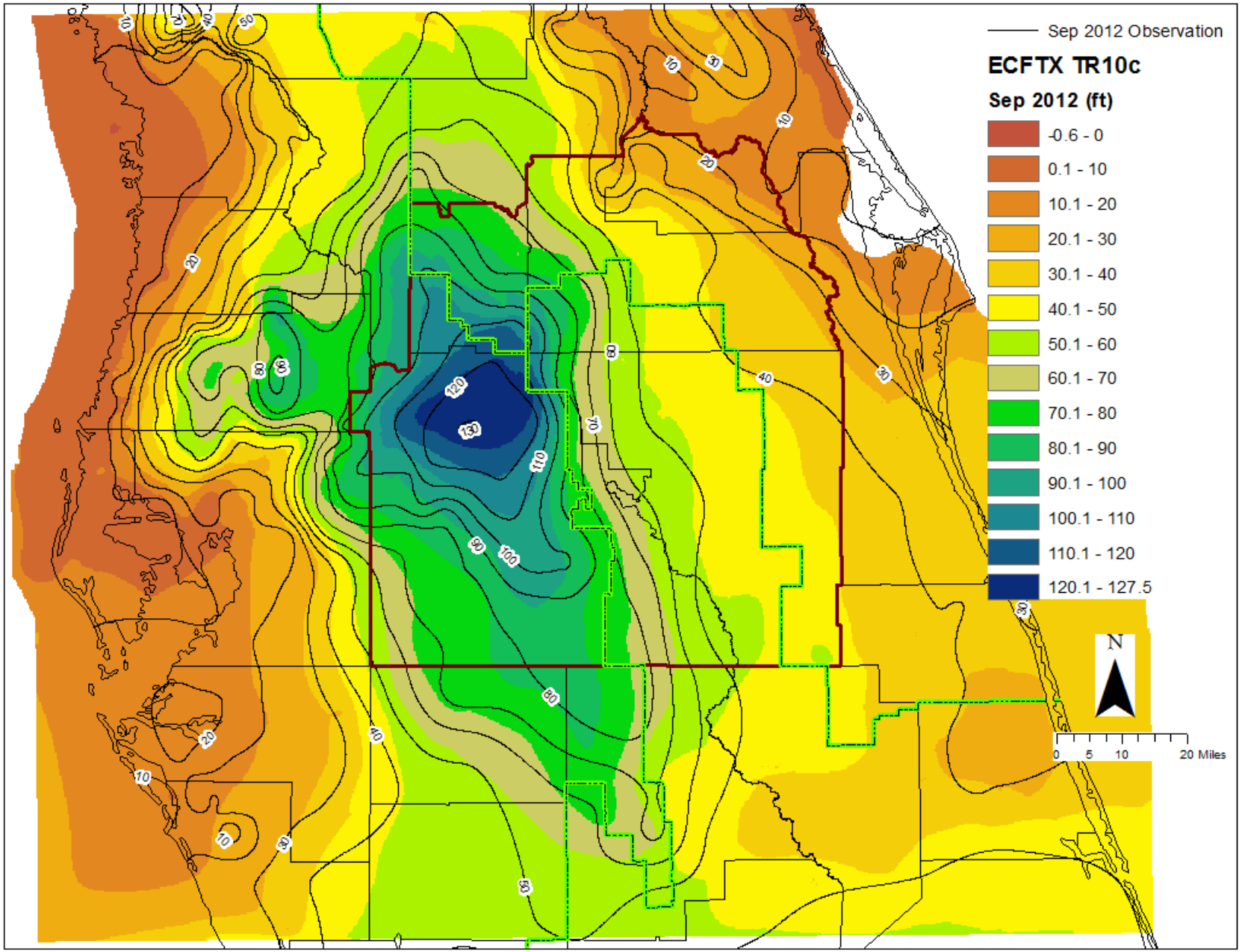
TR 10 Transient Calibration Statistics

	ECFTX				CFWI		
	SA	UFA	LFA		SA	UFA	LFA
Residual Mean	-0.99	0.07	-0.85	Residual Mean	-1.30	-0.17	-0.16
Error Standard Dev	4.83	5.81	9.22	Error Standard Dev	4.63	4.86	9.79
Absolute Residual Mean	3.24	4.55	6.23	Absolute Residual Mean	3.20	3.77	6.48
Error Sum of Squares	24888	31661	3432	Error Sum of Squares	6761	4682	3165
RMS Error	4.93	5.81	9.15	RMS Error	4.8	4.85	9.65
Minimum Residual	-32.59	-28.88	-38.78	Minimum Residual	-19.08	-16.28	-38.78
Maximum Residual	24.75	19.11	17.7	Maximum Residual	24.75	14.73	17.7
Number of Observations	1026	939	41	Number of Observations	293	199	34
Percentage with MAE < 2.5 ft	60%	38%	34%	Percentage with MAE < 2.5 ft	63%	47%	35%
Percentage with MAE < 5.0 ft	83%	64%	54%	Percentage with MAE < 5.0 ft	82%	74%	53%
Percentage with R2 > 0.6	51%	77%	93%	Percentage with R2 > 0.6	56%	85%	94%
Percentage with R2 > 0.4	81%	91%	98%	Percentage with R2 > 0.4	84%	96%	97%

May 2006 UFA Potentiometric Surface - Simulated vs Observed



Sept 2012 UFA Potentiometric Surface - Simulated vs Observed



Surface Water Calibration

SJRWMD

SJRWMD BasinID	Basin	Runoff-12yrAvg		Baseflow-12yrAvg		Total Flow-12yrAvg		Statistics		
		Estimated	Simulated	Estimated	Simulated	Observed	Simulated	%DV	NS	Rsq.
3	Triplet Lake	13.6	13.7	2.1	4.3	15.7	18.0	-18.6	0.65	0.72
7	Wekiva River	81.4	72.2	184.0	34.0	265.4	106.3	-2.3	0.51	0.59
9	North Branch of Crab Grass Creek	24.1	24.3	0.0	2.9	24.1	27.1	-10.8	0.51	0.55
10	Wolf Creek	29.1	23.8	0.8	7.0	29.8	30.8	-5.1	0.44	0.46
11	Bird Lake+Halfway Lake etc. SJRiver	121.1	157.4	86.9	-0.6	208.0	156.7	15.9	0.22	0.23
12	South Fork of Taylor Creek+Taylor Creek-SJRiver	43.2	45.0	1.2	1.0	44.4	46.1	-7.2	0.58	0.60
20	Sixmile Creek	16.2	14.2	0.6	2.0	16.8	16.2	4.0	0.37	0.41
21	Econ River	385.3	450.3	179.0	66.0	564.4	516.3	3.4	0.67	0.67
24	Lake Dorr+Lake Norris	38.2	30.9	15.2	18.2	53.3	49.1	12.7	0.52	0.53
25	Soldier Creek	10.5	13.0	1.7	8.3	12.2	21.3	-75.2	0.32	0.72
27	Bear Gully Lake+Howell Creek	47.4	38.3	16.5	16.6	63.9	55.0	13.7	0.73	0.76

Note: All values cfs

SWFWMD

BasinID	Basin	Runoff-12yrAvg		Baseflow-12yrAvg		Total Flow-12yrAvg		Statistics		
		Estimated	Simulated	Estimated	Simulated	Observed	Simulated	%DV	NS	Rsq.
14	Lake Ariana+Lake Hancock+Lake Parker	43.9	106.1	1.0	-47.6	44.9	58.5	-34.7	0.48	0.55
16	Bear Branch+Thompson Branch etc-Peac River	136.9	170.4	42.0	55.7	178.9	226.1	-28.2	0.50	0.56
17	Payne Creek	91.4	85.3	17.0	14.5	108.4	99.9	8.1	0.62	0.65
33	Lake Arbuckle	181.7	194.0	72.6	1.0	254.4	195.0	18.0	0.64	0.69
34	Hawthorn Creek+Lower Joshua Creek etc	103.6	95.8	13.8	11.9	117.4	107.7	9.8	0.62	0.69
35	Maple Creek+Owen Creek+Wingate Creek+Oglegy Creek	119.4	119.4	7.4	8.3	126.8	127.8	-2.8	0.62	0.65
36	Alderman Creek	24.2	24.9	2.1	2.2	26.3	27.1	-0.3	0.56	0.56
38	Horse Creek	139.3	147.5	9.9	20.3	149.2	167.8	-12.7	0.56	0.63
40	BlackwaterCreek-BranchBoroughChannel-HillsboroughRiverDrain	111.7	181.3	66.5	6.1	178.3	187.4	-29.3	0.56	0.61
41	Carlton Branch-Dug Creek-South Fork of the Little Manatee River etc	91.0	95.4	21.4	16.1	112.5	111.5	0.2	0.66	0.66
43	Cypress Creek	65.6	68.7	4.6	-3.0	70.2	65.7	-2.4	0.46	0.46
46	Brooker Creek	21.5	22.7	0.3	-0.7	21.8	22.1	-6.0	0.65	0.66
47	Sweetwater Creek	19.5	23.0	1.9	-8.6	21.4	14.4	31.9	0.61	0.69
49	Charlie Creek	208.2	224.3	13.0	43.5	221.2	267.8	-27.6	0.58	0.65
67	TurkeyCreek+LittleFishawkCreek etc	26.1	52.9	30.2	9.7	56.2	62.6	-15.6	0.49	0.61
71	03100205+Cypress Creek	41.3	25.7	3.9	6.2	45.2	31.9	26.8	0.55	0.66
75	3100206-Brooker sub watershed	14.7	8.5	-0.1	0.3	14.7	8.8	40.6	0.38	0.49

Note: All values cfs

SFWMD

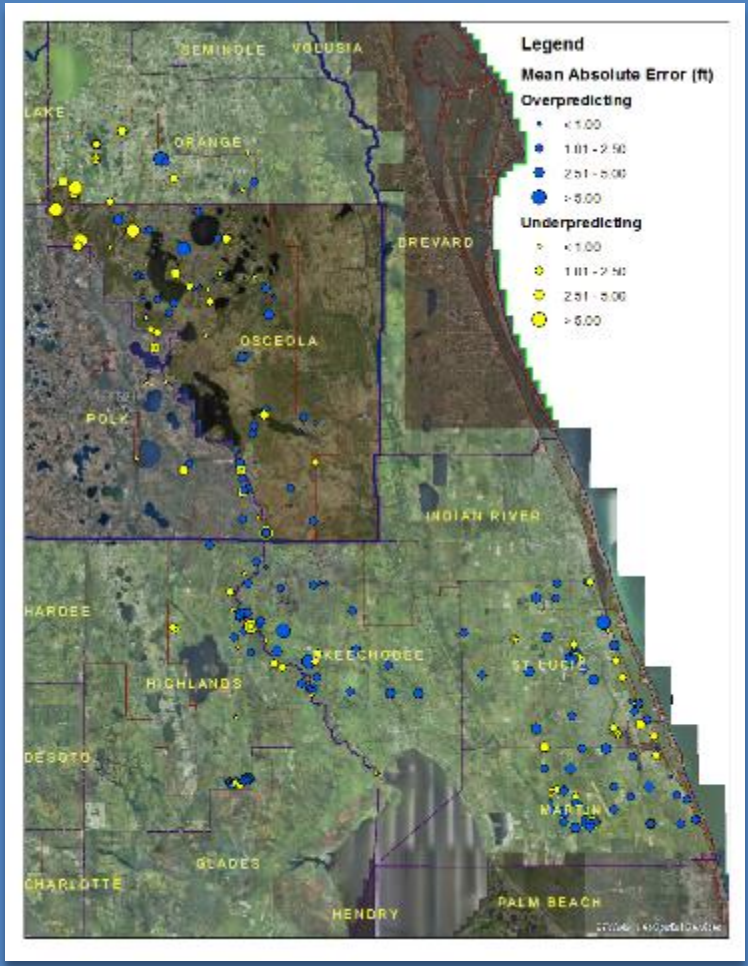
SFWMD		Runoff-12yrAvg		Baseflow-12yrAvg		Total Flow-12yrAvg		Statistics		
BasinID	Basin	Estimated	Simulated	Estimated	Simulated	Observed	Simulated	%DV	NS	Rsq.
5	Reedy Creek	46.5	99.8	5.2	-31.2	51.7	68.6	-10.6	0.47	0.56
28	Shingle Creek	158.5	99.5	52.6	4.8	211.1	104.3	51.0	0.23	0.60
29	Lake Toho	198.3	147.5	-52.6	-79.5	145.7	68.0	57.3	0.16	0.25
31	Alligator Lake-Lake Gentry-Lonesome Camp Swamp	102.7	118.1	11.1	-28.5	113.8	89.6	21.3	0.58	0.60
50	Lower Canal C-41A	40.8	33.6	0.0	10.4	40.8	44.0	-6.7	0.51	0.68
55	Cypress Creek	143.8	164.4	14.5	3.9	158.3	168.3	-9.8	0.61	0.63
62	Boggy Creek	73.6	77.0	11.6	0.5	85.2	77.6	8.9	0.67	0.68

Note: All values cfs

Transient Model Calibration Approach

- Using spatial distribution to focus calibration efforts (each District)
- Calibration Parameters:
  - River conductance
  - Drain control elevations and conductance
  - Recharge
  - Vertical and horizontal hydraulic conductivity
  - Storage coefficients

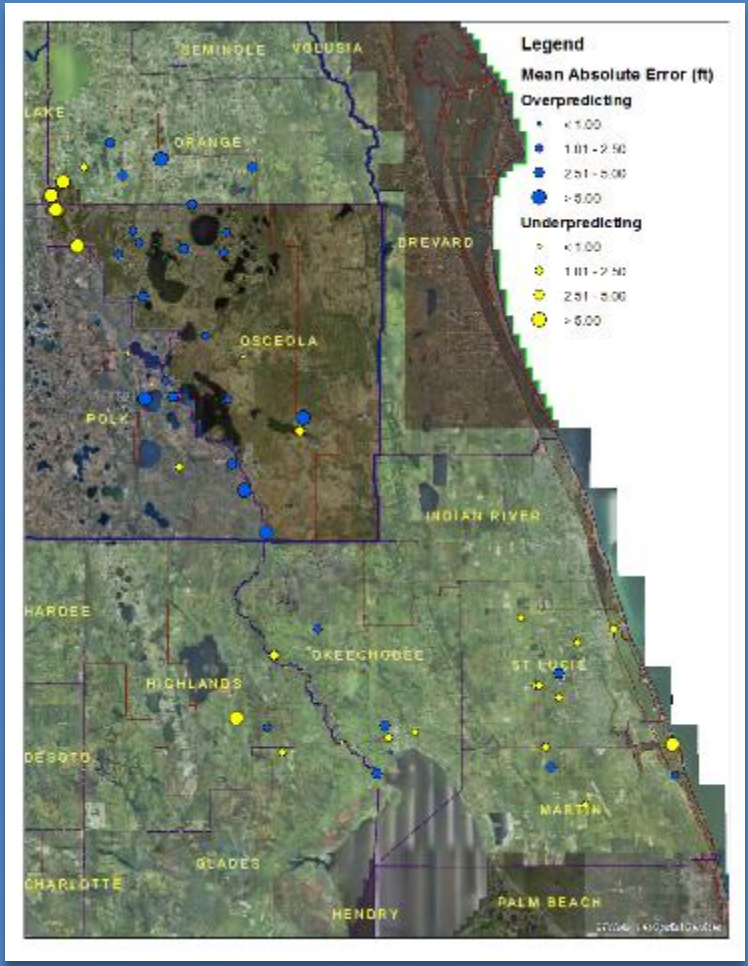
Calibration Status of SAS wells in SFWMD



Statistic	Criteria	TR-10	Current
ME	+/- 1 foot	-0.3 ft	0.2 ft
MAE	> 50% with MAE < 2.5 ft	70 %	81%
MAE	> 80% with MAE < 5 ft	91%	96%
MAE	< 5% Range (11.5 ft)	2.5 ft	1.91 ft
RMSE	< 5 ft	2.7 ft	2.1 ft

Total wells = 328

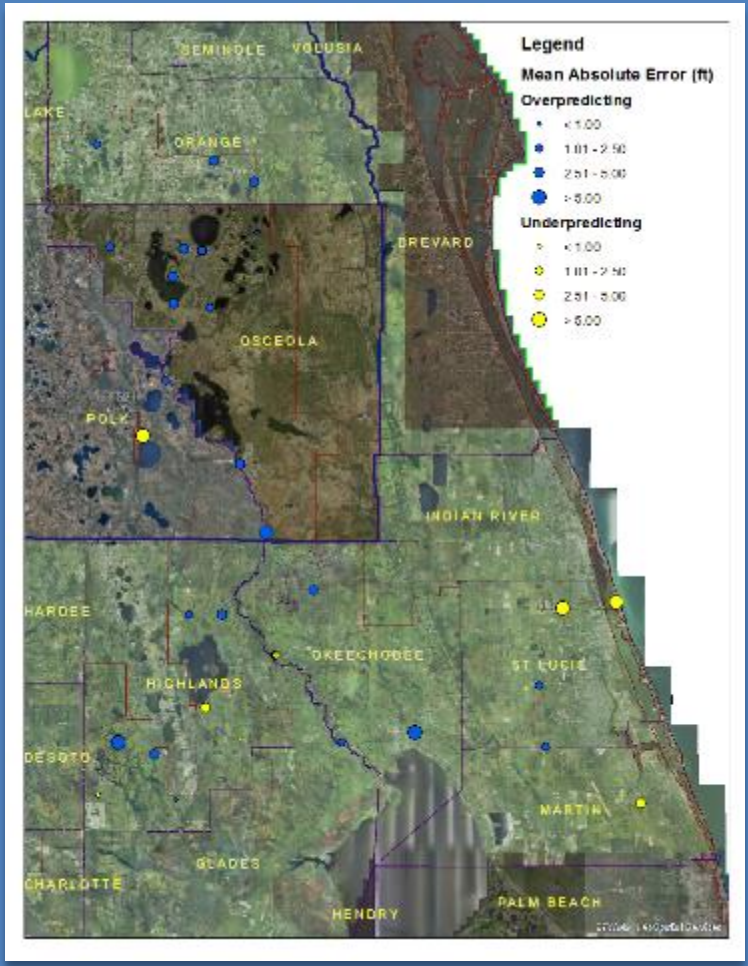
Calibration Status of UFA wells in SFWMD



Statistic	Criteria	TR-10	Current
ME	+/- 1 foot	-2.1 ft	-0.3 ft
MAE	> 50% with MAE < 2.5 ft	39%	56%
MAE	> 80% with MAE < 5 ft	61%	80%
MAE	< 5% Range (7.6 ft)	4.34 ft	3.45 ft
RMSE	< 5 ft	4.5 ft	3.7 ft

Total wells = 59

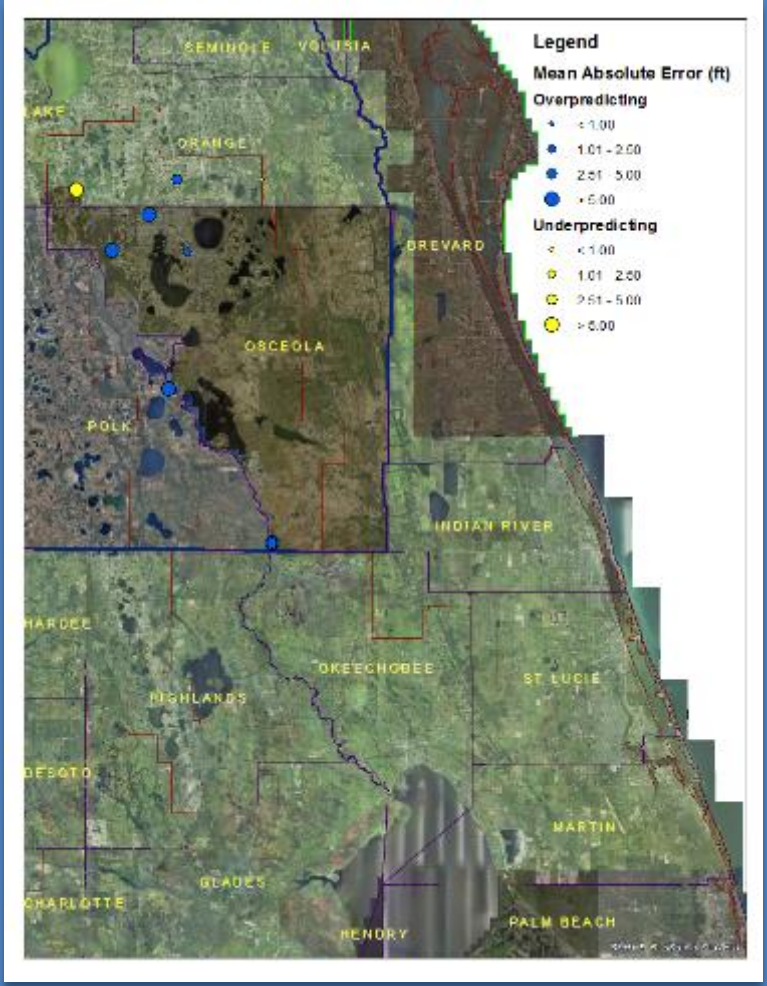
Calibration Status of APPZ wells in SFWMD



Statistic	Criteria	TR-10	Current
ME	+/- 1 foot	-2.0 ft	0.6 ft
MAE	> 50% with MAE < 2.5 ft	33%	44%
MAE	> 80% with MAE < 5 ft	67%	81%
MAE	< 5% Range (7.6 ft)	5.02 ft	3.6 ft
RMSE	< 5 ft	5.2 ft	3.8 ft

Total wells = 36

Calibration Status of LFA wells in SFWMD



Statistic	Criteria	TR-10	Current
ME	+/- 1 foot	3.8 ft	7.9 ft
MAE	> 50% with MAE < 2.5 ft	38%	15%
MAE	> 80% with MAE < 5 ft	54%	31%
MAE	< 5% Range (4.5 ft)	3.77 ft	7.9 ft
RMSE	< 5 ft	5.2 ft	8.7 ft

Total wells = 13

SJR Calibration Summary (TR10)

Head Targets

Criteria 1: More than 50 pct of wells with a residual less than or equal to 2.5 feet in absolute value

Target Group	ct	SJRWMD
SAS	1044	**62.8%**
UFA	949	**48.1%**
LFA	38	**61.1%**

Criteria 2: More than 80 pct of wells with a residual less than or equal to 5.0 feet in absolute value

Target Group	target ct	SJRWMD
SAS	1044	**81.8%**
UFA	949	**72.5%**
LFA	38	**88.9%**

Criteria 3: Root-mean-square-residual of less than 5 feet for each of the simulated years

Target Group	target ct	SJRWMD
SAS	1044	**5.68**
UFA	949	**4.86**
LFA	38	**3.27**

Criteria 4: Maximum overall mean residual l of less than 1 foot in absolute value for each of the simulated years

Target Group	target ct	SJRWMD
SAS	1044	**-1.07**
UFA	949	**0.00**
LFA	38	**-0.70**

SJR & SWF Calibration Summary (TR10)

Sp

ECFTX Transient Springflow Calibration Summary, 2004-2014

Spring Name	2004-2014 (SP2-SP133) OBS_CT	OBS_AVE (cfs)	SIM_AVE (cfs)	RES_AVE (cfs)	RES_AVE_PCT (cfs)
Magnitude 1 (Q>100 cfs)					
WEEKI WACHEE SPRING	132	160	162	2	1%
VOLUSIA BLUE SPRING	132	143	161	17	12%
ALEXANDER SPRING	99	100	105	5	5%
Magnitude 2 (Q>10 cfs)					
HOMOSASSA SPRING #1	132	83	80	-3	-4%
CHASSAHOWITZKA SPRING MAIN	105	60	44	-17	-29%
GUM SPRING MAIN	132	64	37	-27	-42%
WEKIWA SPRING (ORANGE)	132	61	63	2	4%
ROCK SPRINGS (ORANGE)	132	55	57	2	3%
RAINBOW SPRING #1	132	72	45	-27	-38%
CRYSTAL MAIN SPRING (PASCO)	59	45	42	-4	-9%
SULPHUR SPRING (HILLSBOROUGH)	69	35	34	-1	-2%
LITHIA SPRING MAJOR	69	35	34	-2	-5%
APOPKA SPRING	132	25	26	1	5%
SANLANDO SPRINGS	132	19	17	-2	-10%
WEKIVA FALLS RESORT	132	8	9	1	13%
STARBUCK SPRING	131	12	13	1	7%
BUGG SPRING (LAKE)	132	11	8	-2	-22%
BUCKHORN MAIN SPRING	132	12	13	1	6%

*Note: Showing only springs with more than 12 observations/estimates within the calibration period

file: TR10_springflow_analysis_v3.xlsm

SWFWMD Shiny App results

Agenda

1. Introduction
2. Summary of work performed since last meeting
3. Transient Model Calibration summary
4. Calibration metrics/criteria
5. Panel Discussion
6. Schedule
7. Public Comment