



TEXAS Geosciences

The University of Texas at Austin
Jackson School of Geosciences
Bureau of Economic Geology

TxSON: the Texas Soil Observation Network

SMAP Cal/Val Workshop #6, 1-3 September 2015

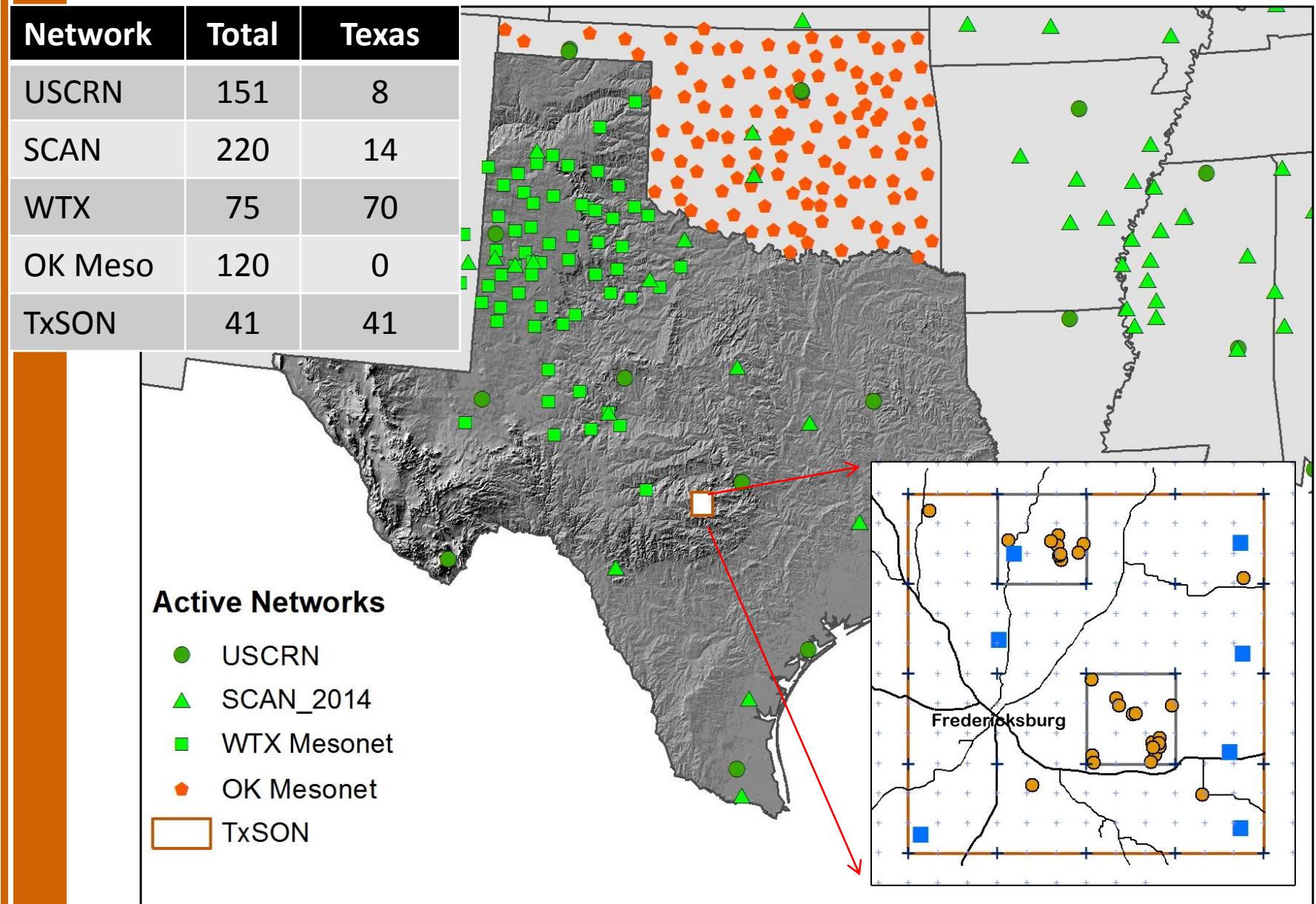
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Texas Soil Observation Network (TxSON)

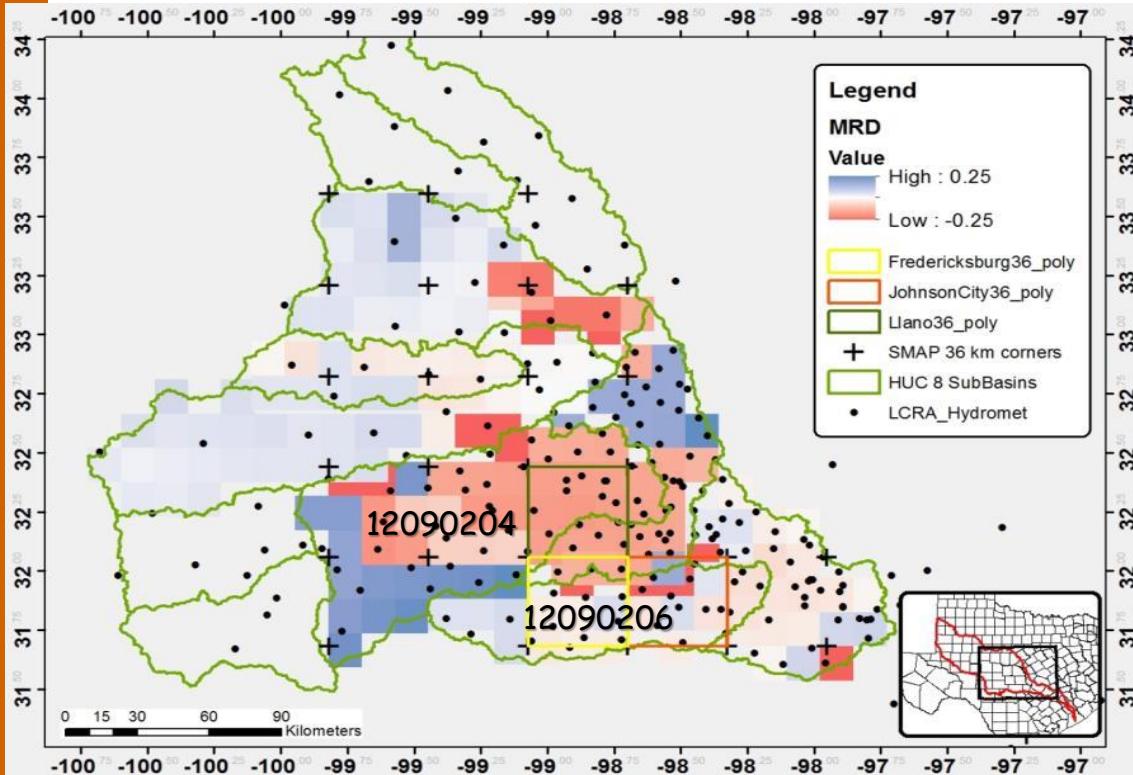
- Began August 2014
- Operational December 2014
- 41 stations, 20 land owners
- 36km footprint (1)
- 9 km cells (2)
- 3 km cells (3)
- Calibration – field and lab
- NASA Airborne campaigns: PALScan (4 flights) and SLAPex15 (perhaps this fall)
- UT-LiDAR for both 9 km cells
- Focal point of hydrologic research
- Expansion throughout TX



Motivation: Networks in Texas (i.e. lack of data)

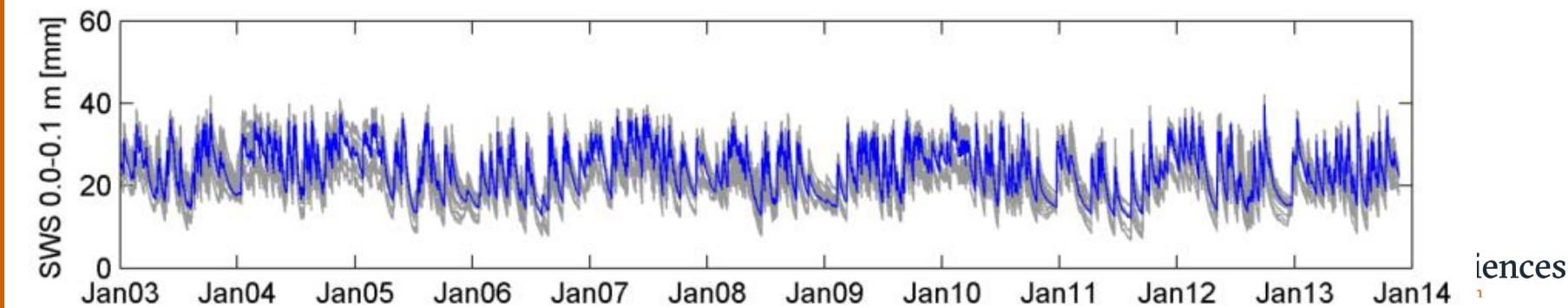


Core Cal/Val EASE-2 Cell Selection

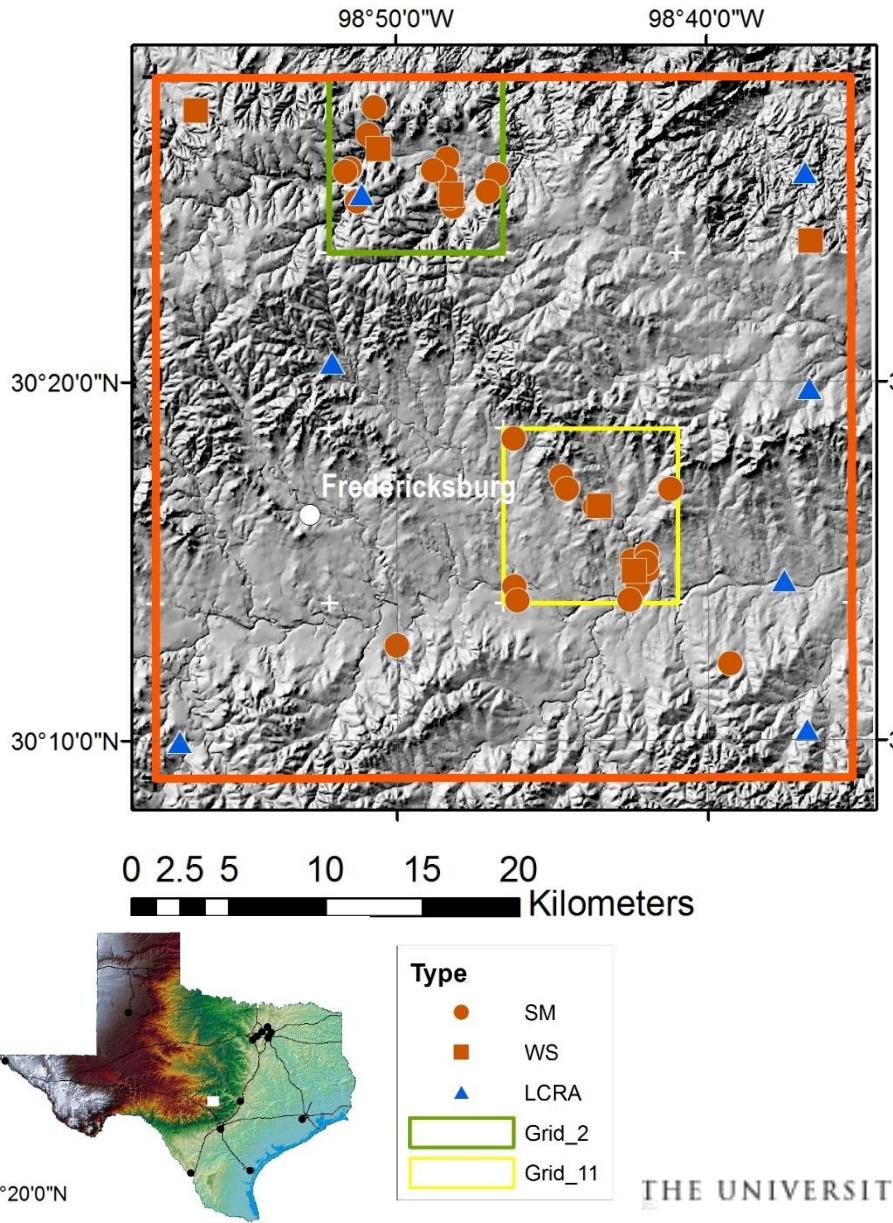


**MRD using NLDAS-2
within each HUC 8**

- Cool = wet (+ 25%)
- Hot = drier (- 25%)
- **12090206** most stable
within Highland Lakes
bounds



SMAP CORE Cal/Val site – Fredericksburg, TX



TxSON:

- 41 soil moisture stations (expanding throughout Texas)
- 6 meteorological stations
- 7 Participating LCRA stations
- 36 km footprint, n = 1
- 9 km footprint, n = 2
- 3 km footprint, n = 3

Soil moisture at 5, 10, 20, and 50 cm

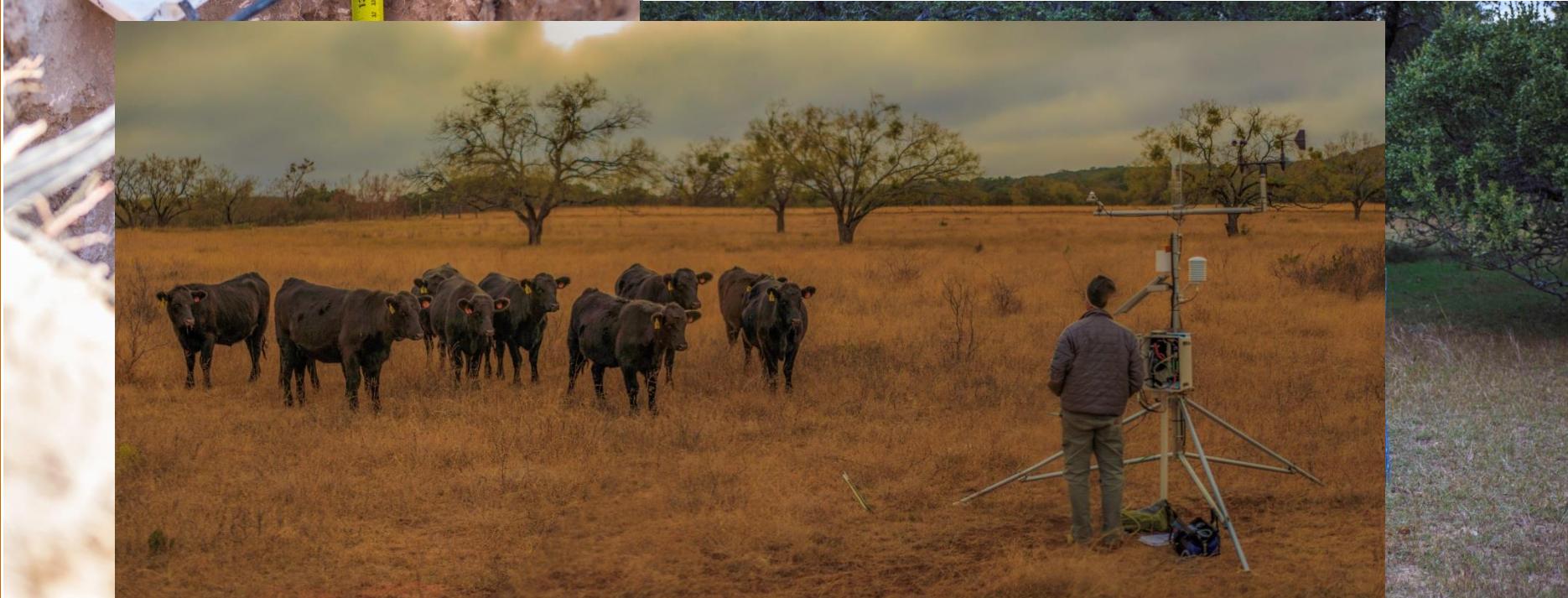
<http://www.beg.utexas.edu/txson/>



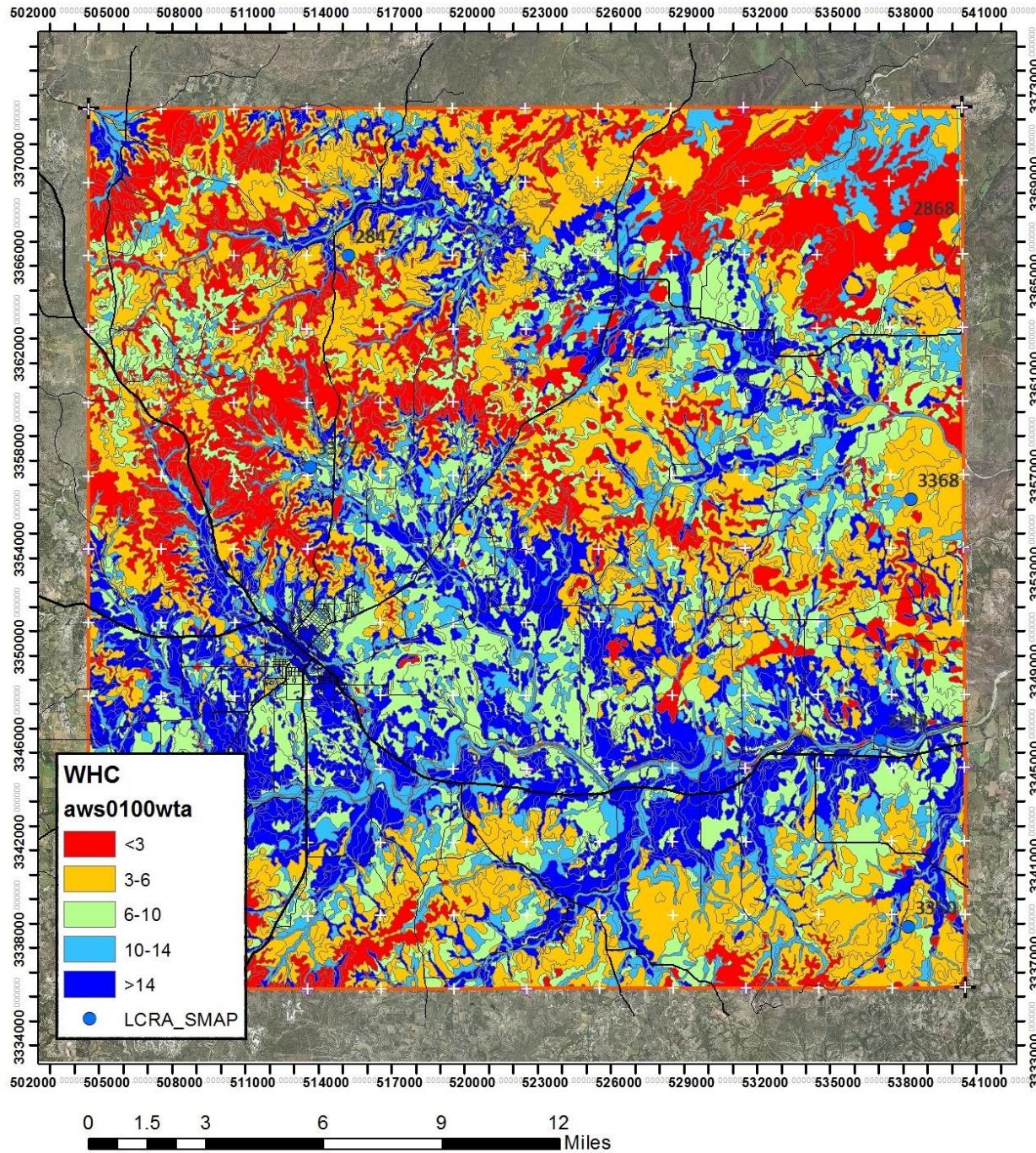
TxSON in action: micro-station



- Insert CS-655 sensors at
 - 5, 10, 20, and 50 cm
- Add precip gage, cell modem
- Fence quickly!



GRID 36



36 km Footprint

Where to put our stations?

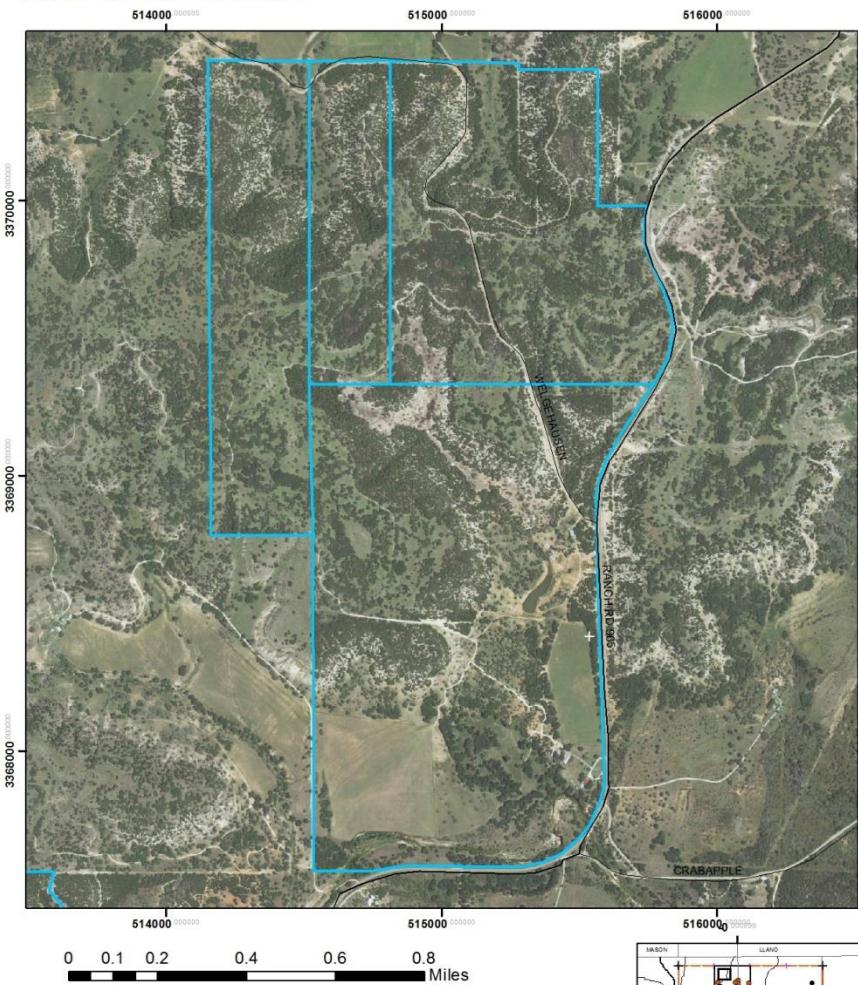
- LSM to determine inherent variability(?)
- Land Accessibility
 - Too limited to spatially distribute stations
 - Variability in landuse and climate
- SSURGO
 - Shallow soils in to north
 - Deep soils along Pedernales (south)

Site selection based on map unit %coverages

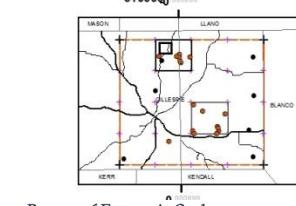
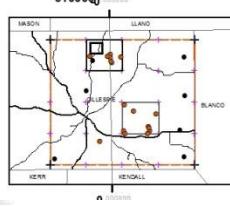
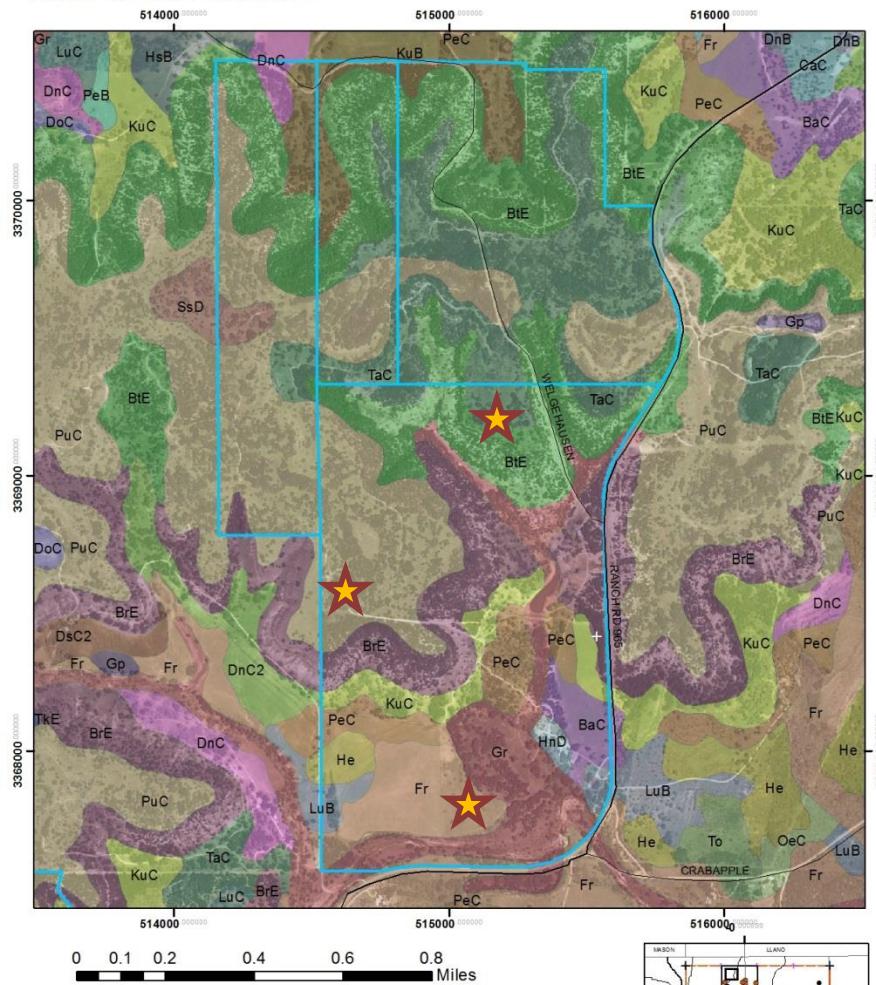
MUSYM	MUKEY	SAND	SILT	CLAY	Dep2Res	%Area	%Grid11	%Grid2	SITES
TaC	Tarrant soils	22.1	27.9	50.0	30	9.1	1.9	6.3	LONG 2 more
PuC	Purves soils	28.7	29.4	41.9	36	8.2	8.5	18.0	2847, 3368, RODE 1 more
PeB/PeC	Pedernales fine sandy loam	55.7	12.5	31.8		7.2	15.4	5.1	WATK, WILD_1, WAHR_4
BrC/BrE	Brackett soils	38.8	36.7	24.5	36	6.8	10.0	7.4	SLAU, 3350, 3285, OTTM_1, RABK, ECKE_3, ALTH
LuB/LuC	Luckenbach clay loam	33.8	32.8	33.4		5.8	8.2	5.0	BEHR, RABK, OWEN
He	Heaton loamy fine sand	85.9	6.6	7.5		5.7	13.3	3.1	TEAG_2, ECKE_2 1 more
DoC/DsC2	Doss silty clay	7.4	48.6	44.0	48	6.8	5.4	1.4	PWC 2 more
DnB/DnC	Denton silty clay	5.8	48.3	45.9	97	4.9	3.7	3.5	1 more
SpC/SsD	Tarpley clay	18.5	24.9	56.6	36	4.7	0.3	4.7	
KrD	Keese-Rock outcrop complex	67.9	19.6	12.5	48	3.8	0.0	6.5	2868
Fr	Oakalla silty clay loam	18.1	47.9	34.0		3.6	5.1	5.0	CoF, RODE_2
Gr	Boerne and Oakalla soils	43.0	39.5	17.5		3.5	3.3	4.1	
BtE	Brackett-Tarrant association	38.8	36.7	24.5	36	3.0	0.0	7.6	
HnD	Hensley loam	29.1	30.8	40.1	46	2.9	7.5	0.3	WILD_2, WAHR_3, 3317, OTTM_3
TkE	Tarrant Rock outcrop	22.1	27.9	50.0	28	2.9	0.0	4.4	
KuB/KuC	Krum silty clay	7.0	47.5	45.6		2.7	4.4	6.8	ECKE_1, RODE_2
BfB/BaC	Bastrop loamy fine sand	83.4	7.5	9.1		2.2	3.1	1.2	TEAG_1, WAHR_2, OTTM_2
TpB	Topia clay	18.5	25.8	55.7	81	1.8	0.6	1.4	
DeC	Loneoak fine sand	89.3	6.9	3.8	142	1.2	0.2	1.1	TEAG_3
LIC	Ligon soils	30.6	33.0	36.4	46	1.2	0.0	3.1	
NrD	Nebgen Rock outcrop	66.9	20.1	13.0	23	1.2	1.6	0.0	
HsB	Hensley soils	29.1	30.8	40.1	46	1.1	0.1	0.2	
LnD	Lindy cobbley clay loam	26.0	31.0	43.0	66	1.0	0.0	0.7	
ObB/OeC	Oben fine sandy loam	63.9	19.0	17.1	48	1.0	0.0	0.0	
To	Tobosa clay	22.1	27.9	50.0		1.0	0.5	0.4	WAHR_1
Gp	Boerne loam	43.0	39.5	17.5		0.9	1.7	0.2	3343
LeA/LeB/Le	Lewisville clay loam	25.8	36.7	37.5		0.7	0.4	0.2	

3 stations: targeting Tarrant (TaC), Oakalla (Fr), and Purves (PuC)

TOMFORDE RANCH

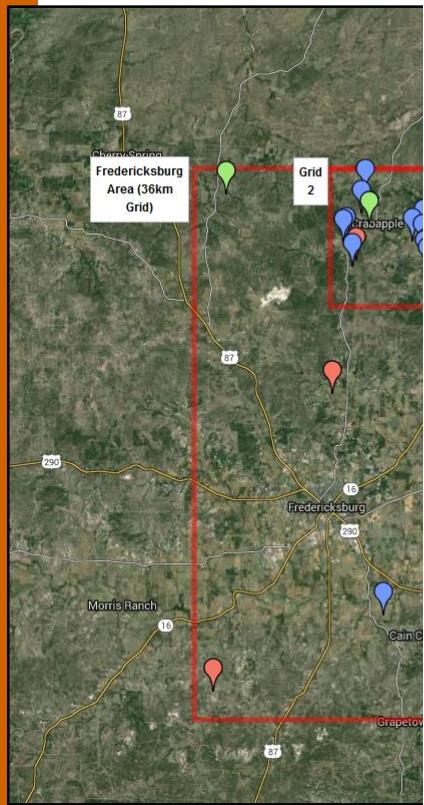


TOMFORDE RANCH

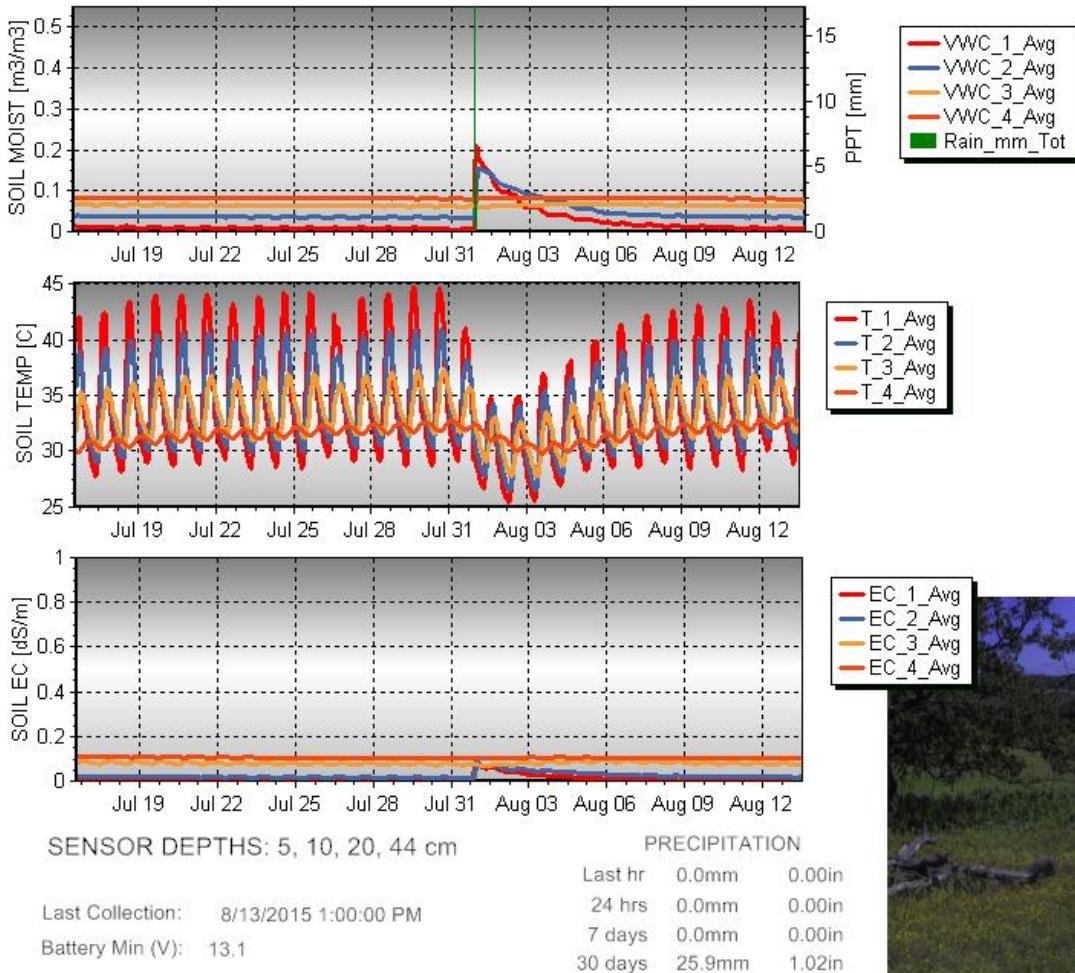


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Real-time web interface

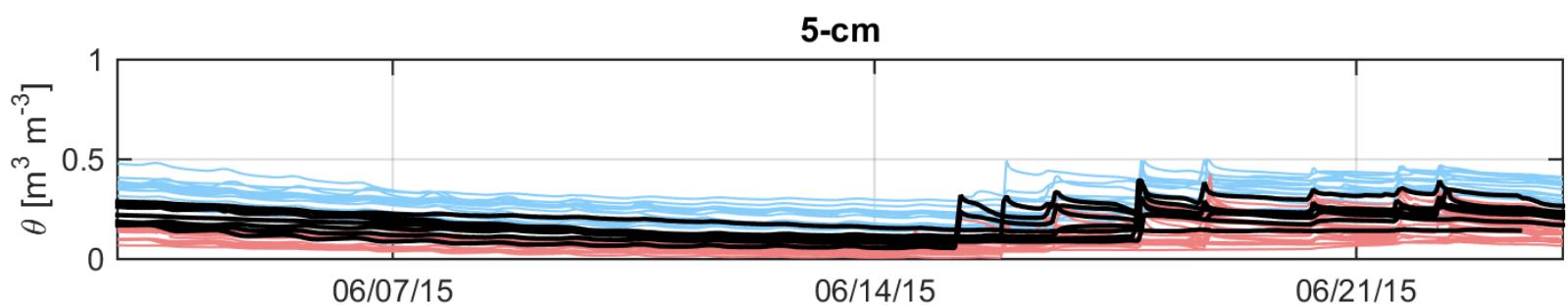
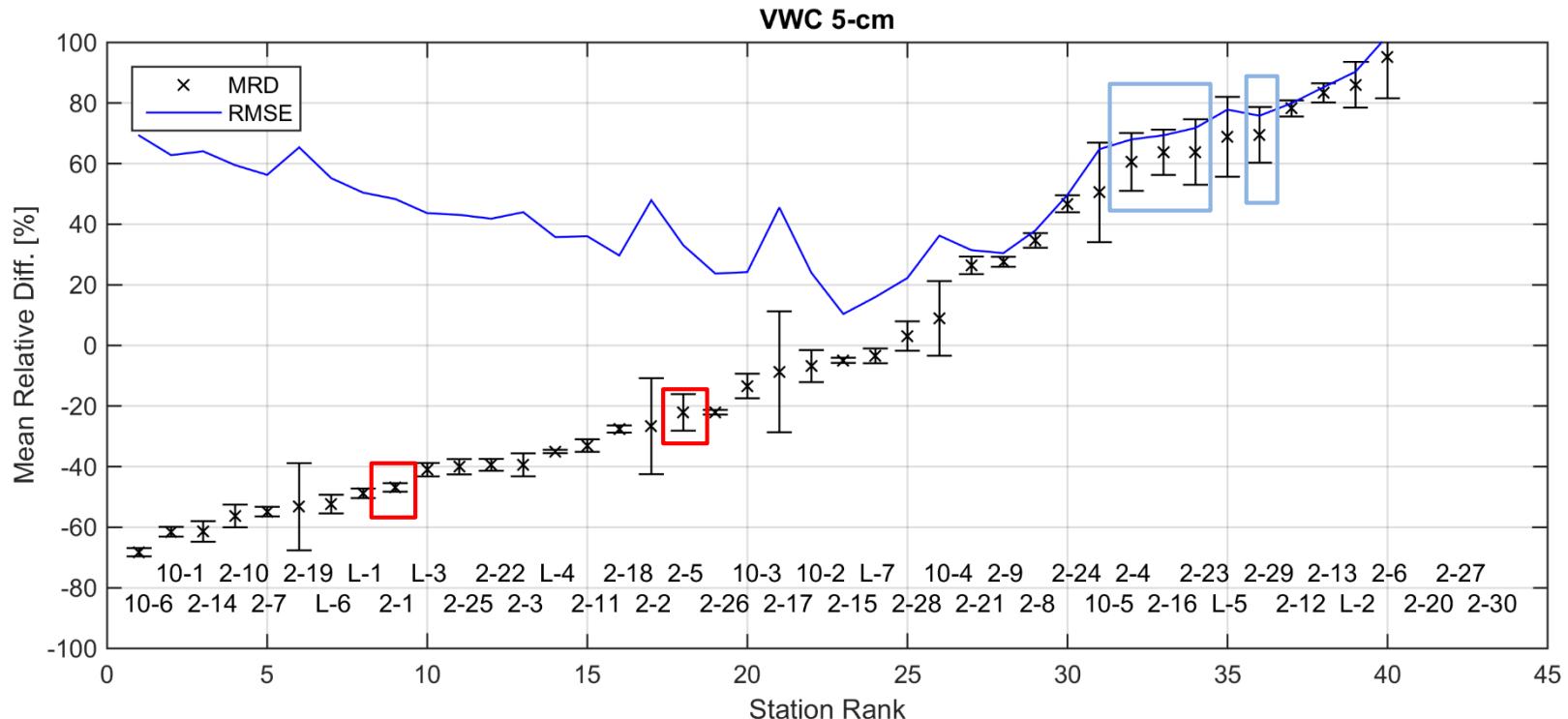


CR200_14 (ECKE_1): Heaton fine loamy sand



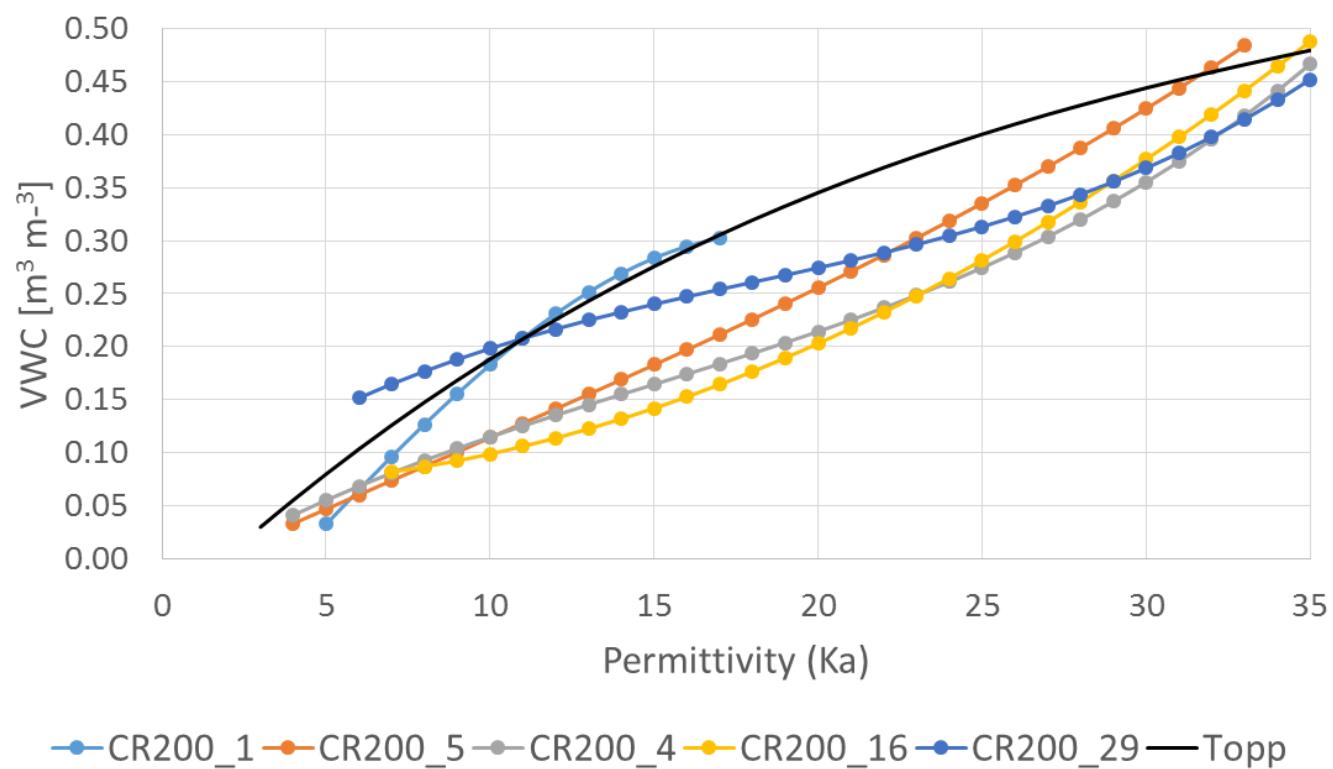
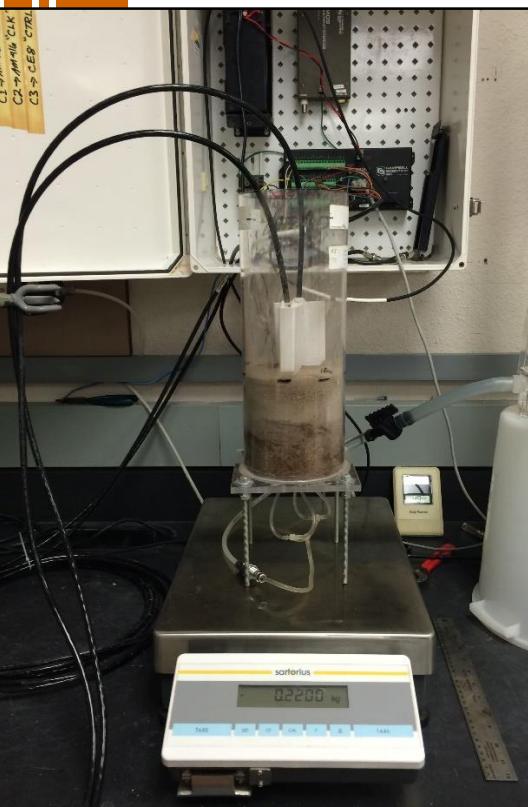
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TxSON Calibration: Mean relative difference

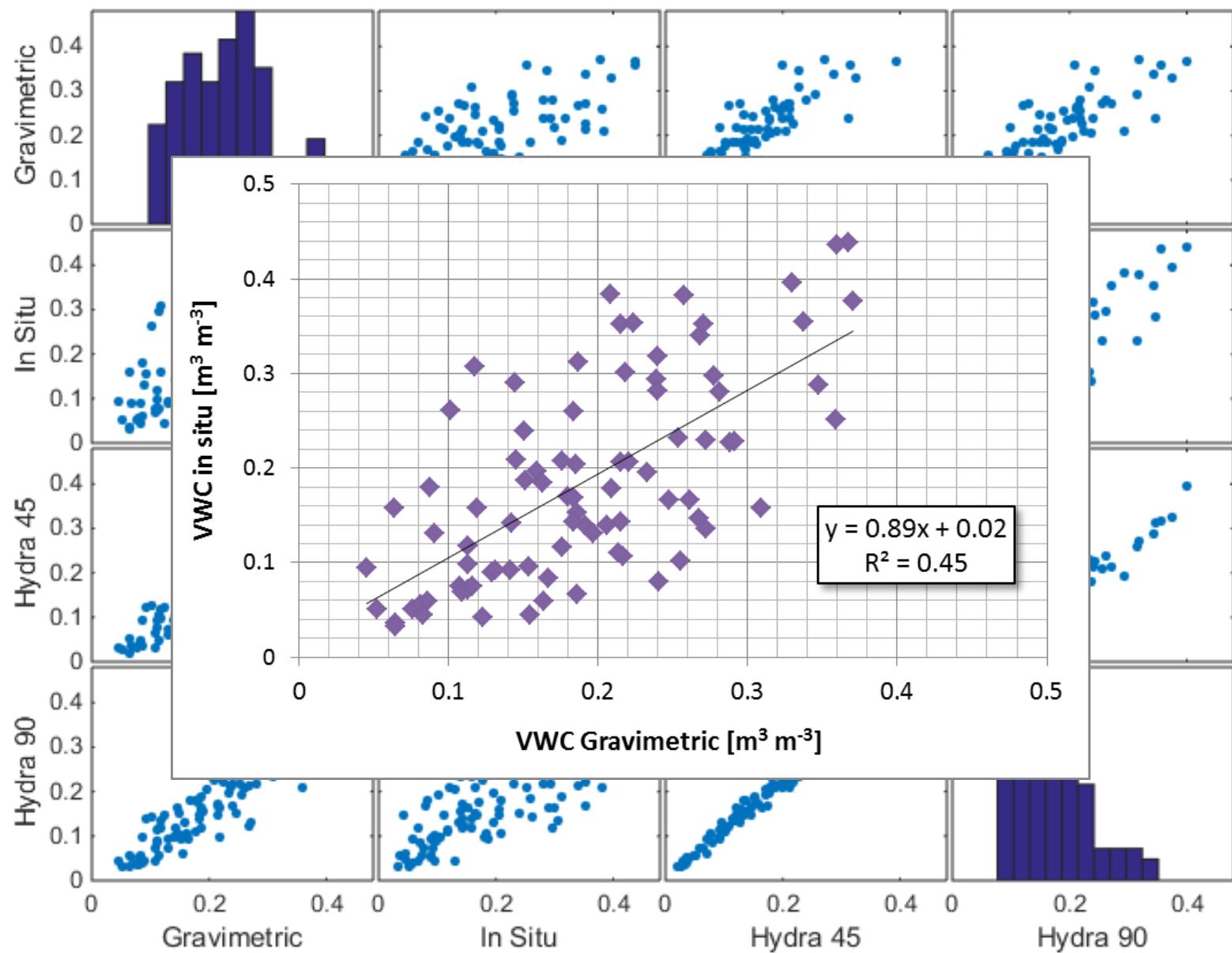


CS-655 Lab calibrations – upward infiltration

- Five soils: ranked low (CR200_1, fine sand) to high (CR200_29, high EC clay); CR200_5 ~ mean
- Low permittivity (<10) variance will likely be reduced
 - Sands will go down when dry; clays will go down everywhere
 - Linear 2-point, site specific calibration my be sufficient



Field calibration – very preliminary



SMAP Soil Moisture (5cm) over TxSON, 36 km



Climate class: Temperate (Cfa)

Landcover: Grasslands

Soil texture:

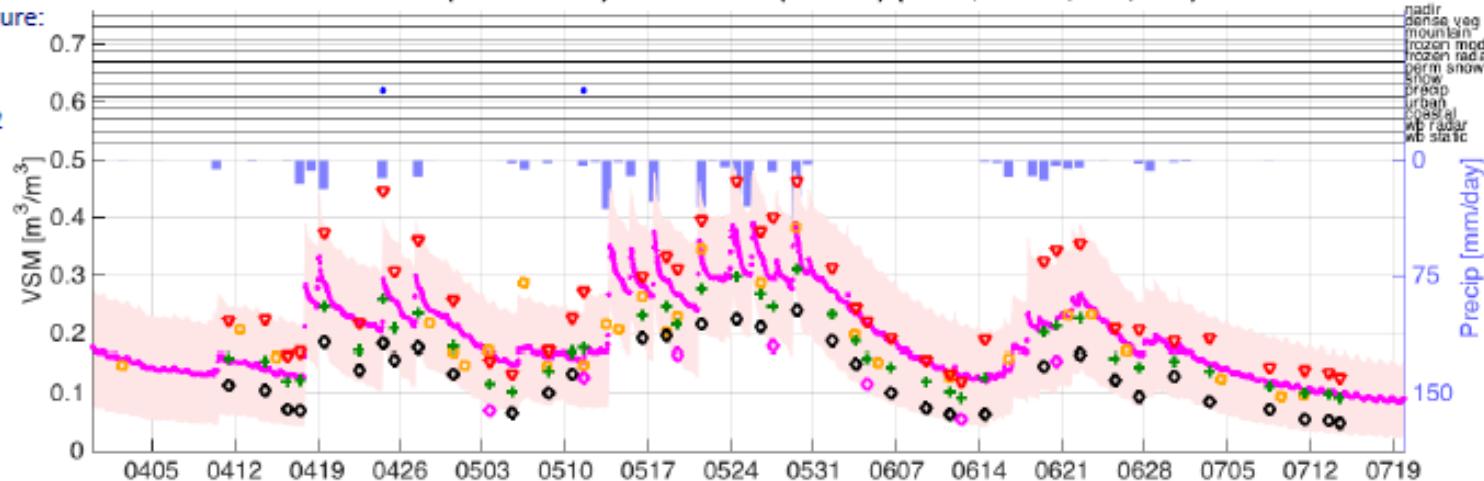
S-%: 33

C-%: 33

BD: 1.42

TxSON (Candidate Pixel)

L2_SM_P-BL (T11757-999): 4801-36-01 (TxSON) (30.31, -98.78; 218, 101)

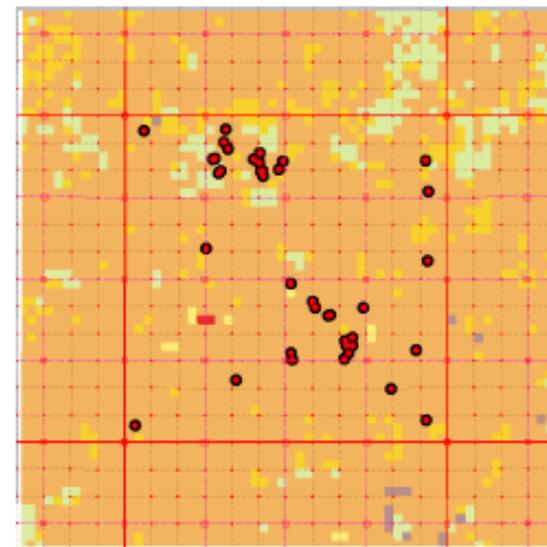
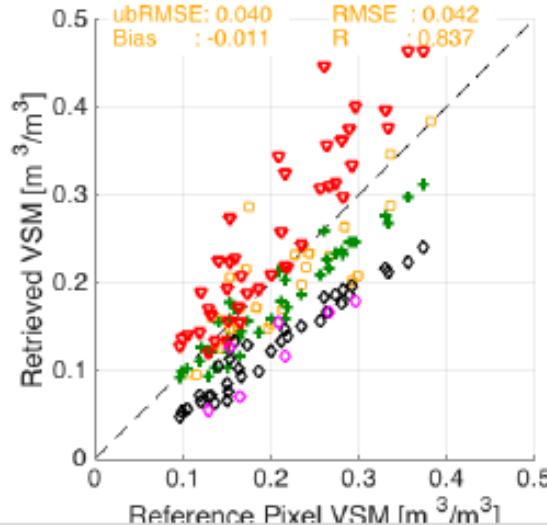


- In Situ
- L2SMP
- SMOS SM
- + SCA-V
- ▽ DCA

Alg	ubRMSE	Bias	RMSE	R
SCA-H	0.026	-0.076	0.081	0.976
SCA-V	0.022	-0.028	0.035	0.974
DCA	0.039	0.044	0.059	0.909

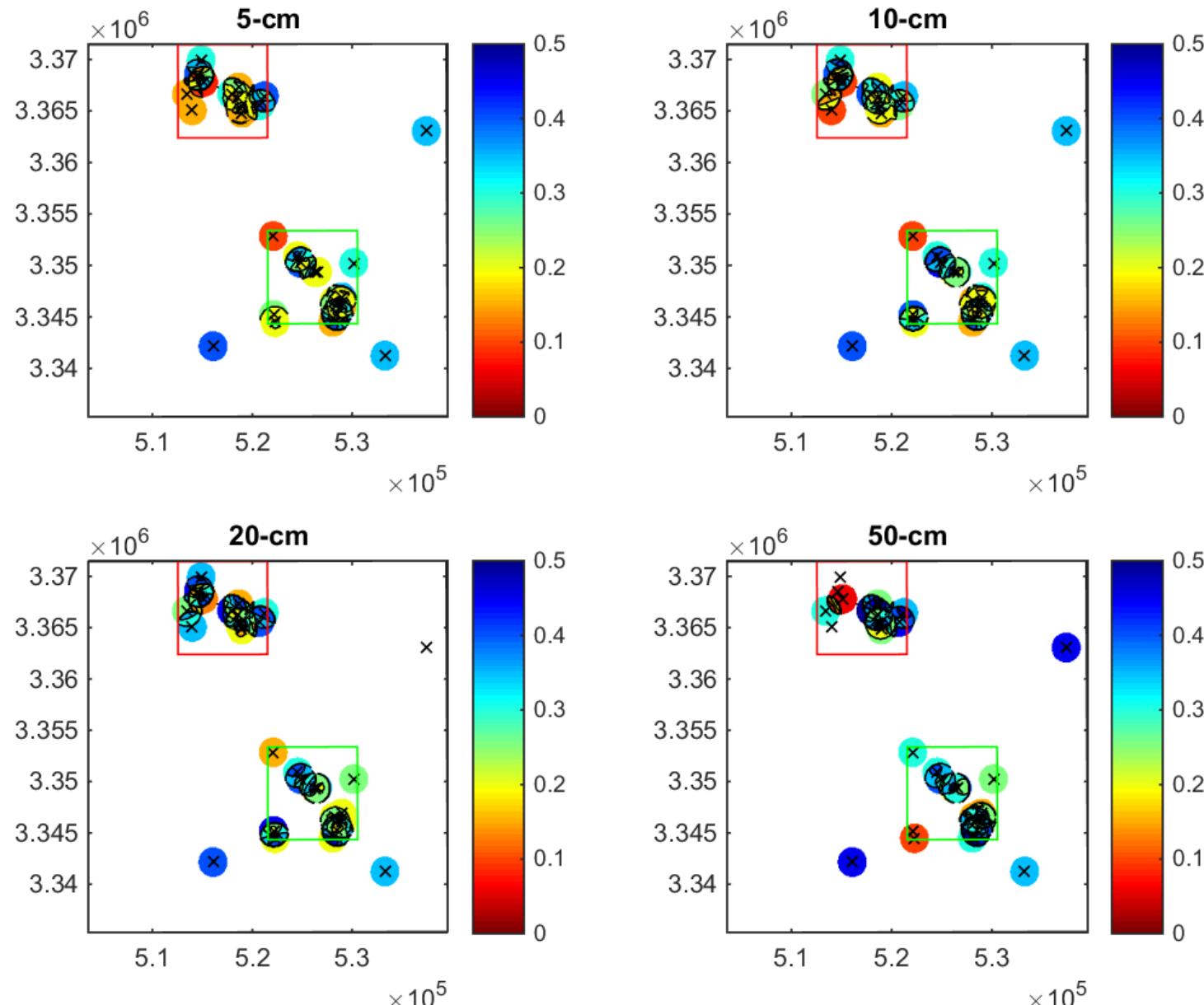
ubRMSE: 0.026 RMSE : 0.081
Bias : -0.076 R : 0.976

ubRMSE: 0.040 RMSE : 0.042
Bias : -0.011 R : 0.837

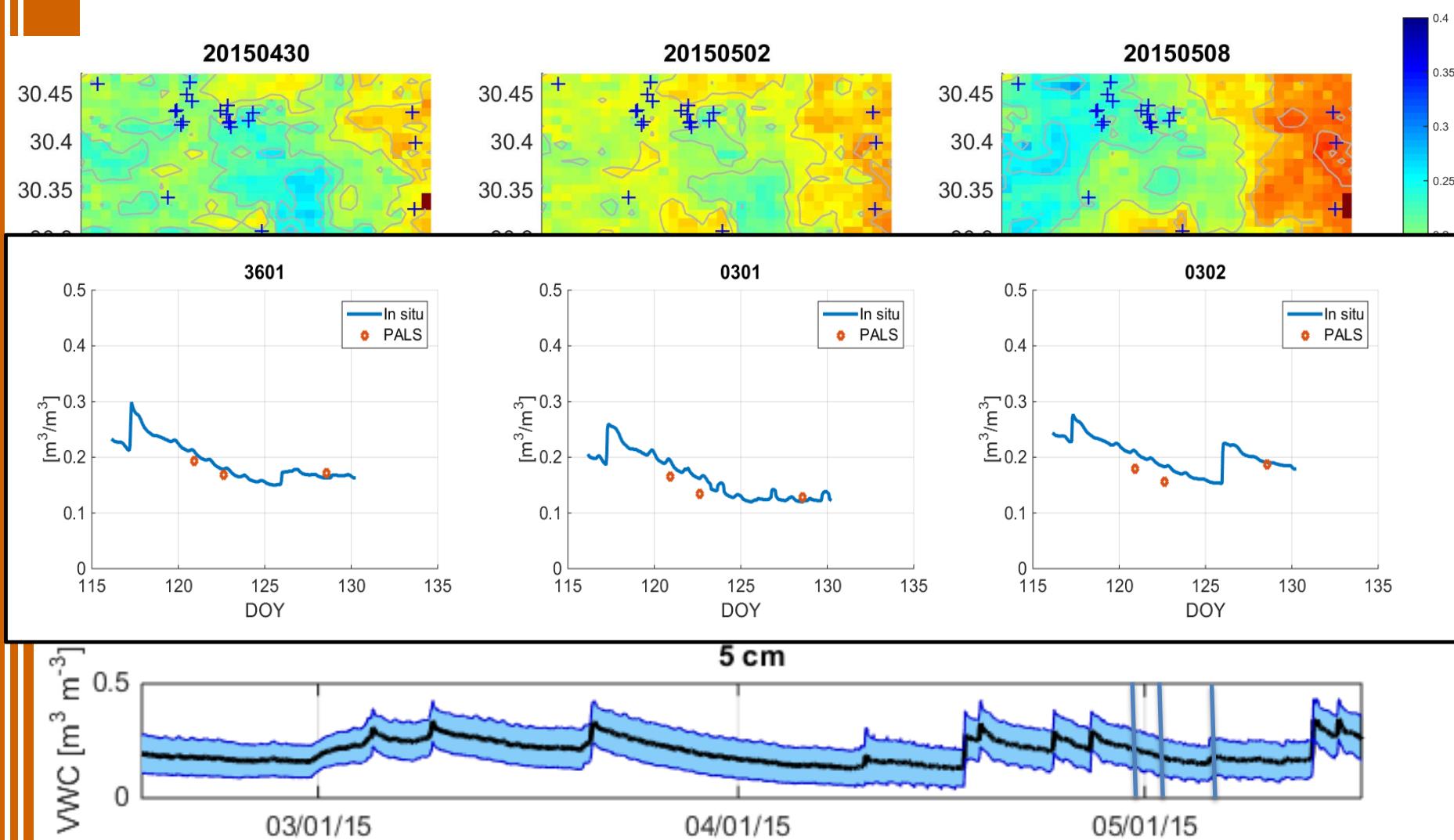


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TxSON Scaling: Inverse distance weighing, 1km radius



TxSON Scaling: PALScan Airborne Microwave Surveys

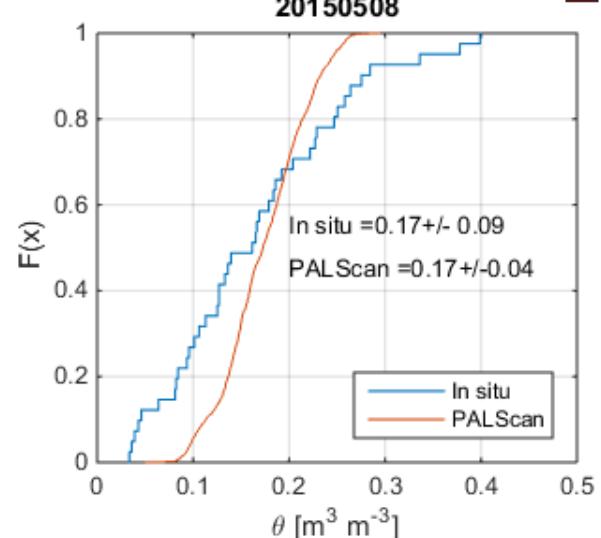
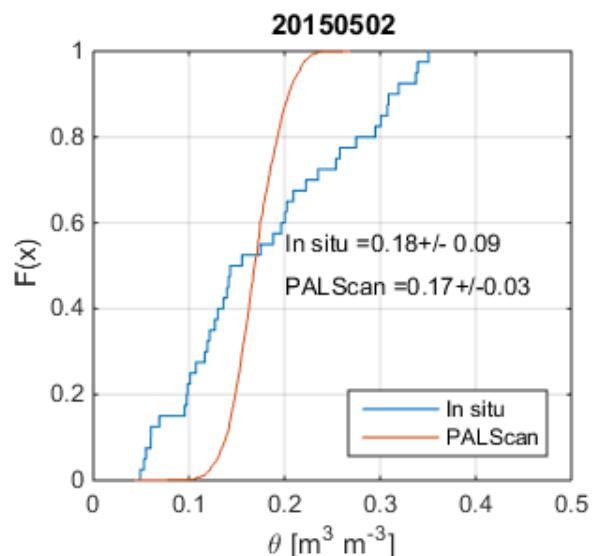
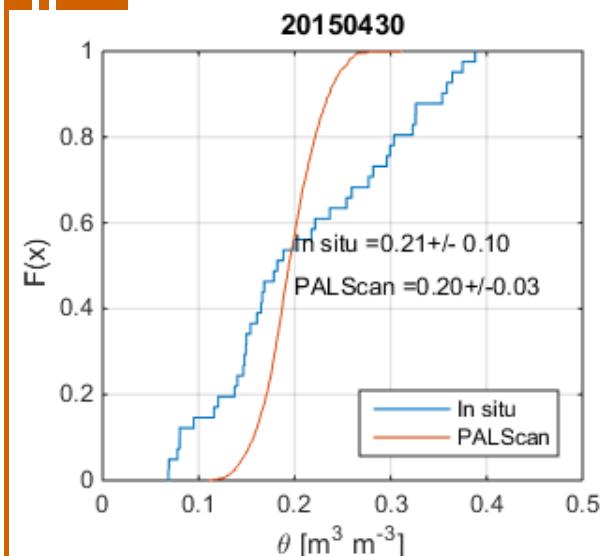
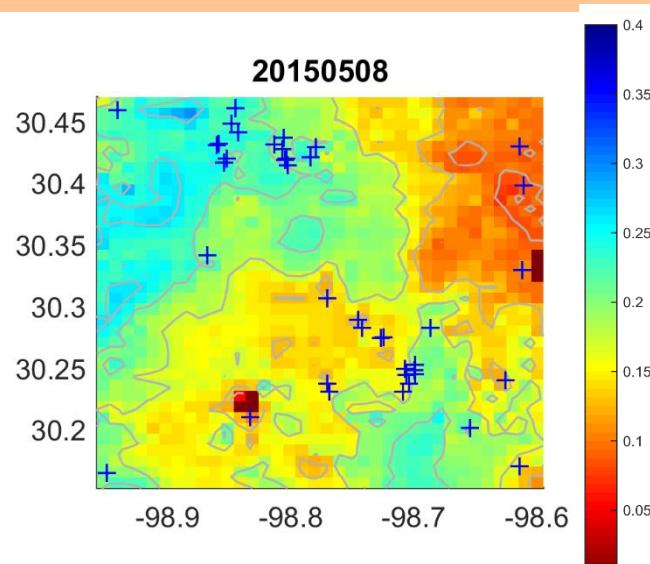
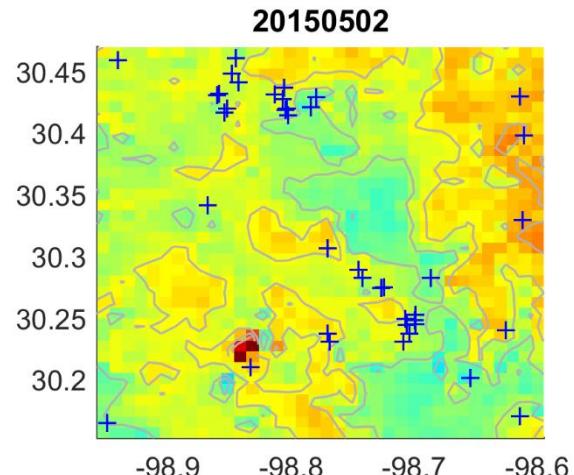
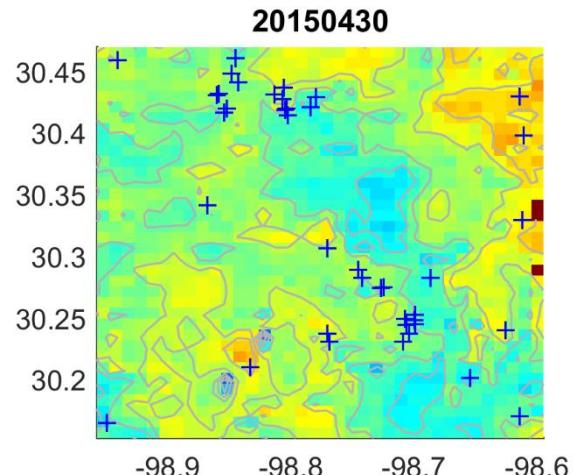


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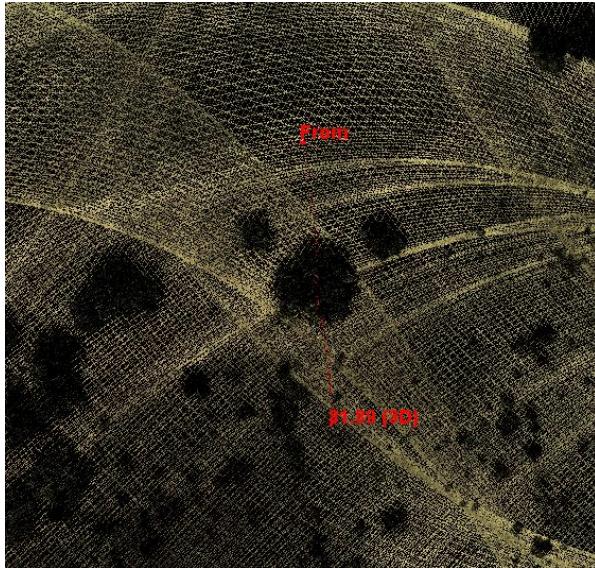
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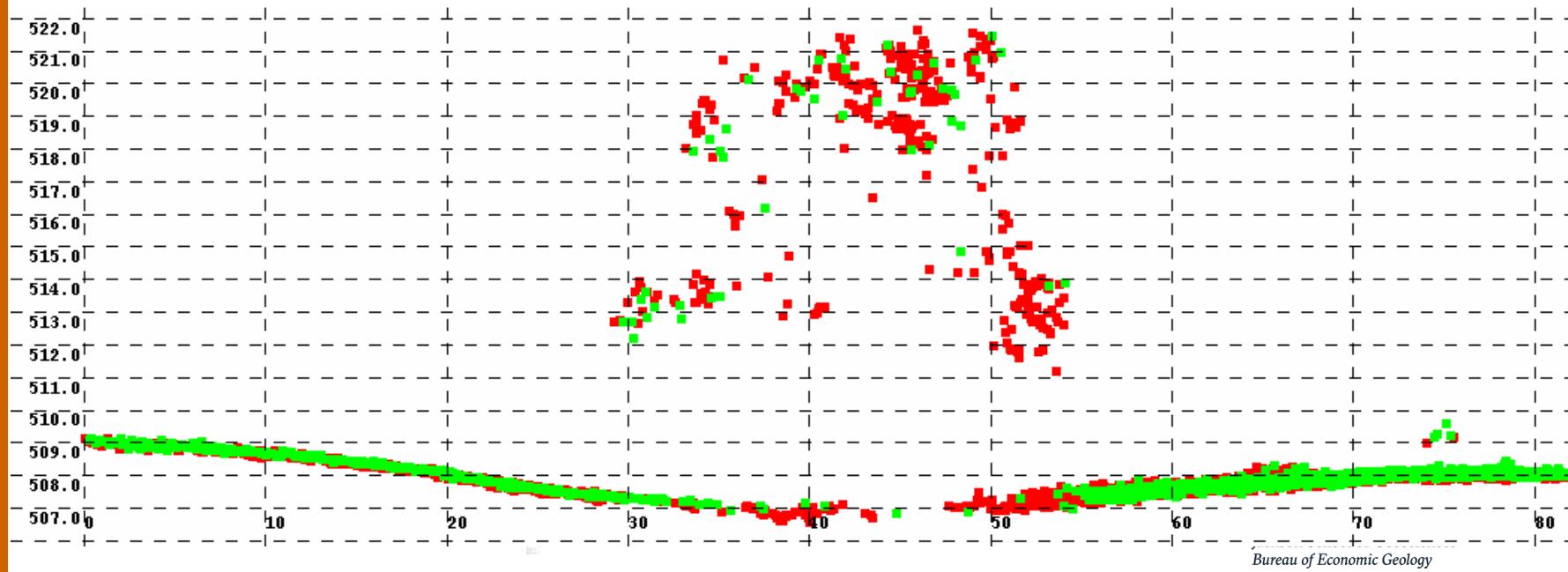
TxSON Scaling: PALScan Airborne Microwave Surveys



Airborne lidar – August 24 & 28, 2015



- Both 9km cells are complete
- 10 lines at 1200 msl, full wave-form
- Chiroptera Topo/Bathy Imagining System
- Hyperspectral system (TBD)
 - VNIR (0.4-1 um)
 - SWIR (1-2.5 um)
 - NWIR (2.5-5 um)
 - LWIR (5-14 um)



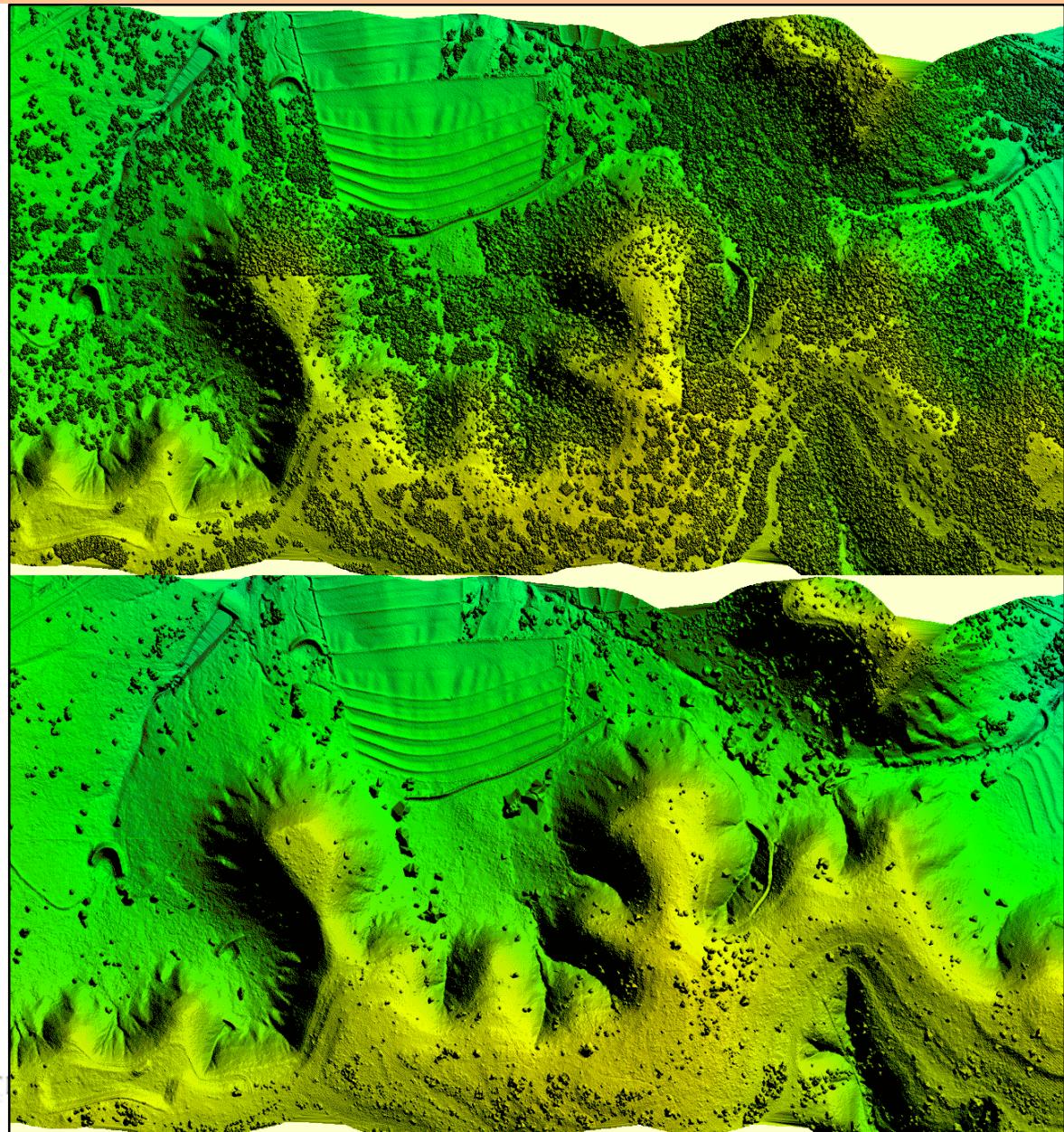
Airborne lidar – vegetation removal

6 million total points
per line (~ 2 pts/m 2)

4.6 million- bare
earth

1.4 million – other

- Working to improve

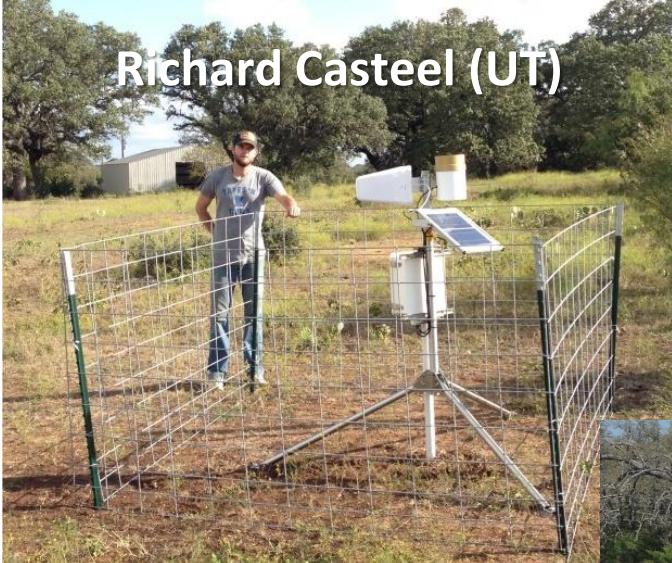


Texas Soil Observation Network (TxSON)

- Continued field sampling and maintenance
- Scaling via a land surface model (Noah-MP and Hydrus)
- Airborne Hyperspectral – soil mapping and scaling
- Network Expansion:
 - EAA: 20 weather stations with EC5 sensors, sparse
 - DOD Camp Bullis: 18 station with EC5, dense, eddy covariance
 - McCulloch County: migrate ~8 stations; they'll match, dense



<http://www.beg.utexas.edu/soilmoisture/>



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