LST & ET Mapping and Validating over Yuma, Arizona

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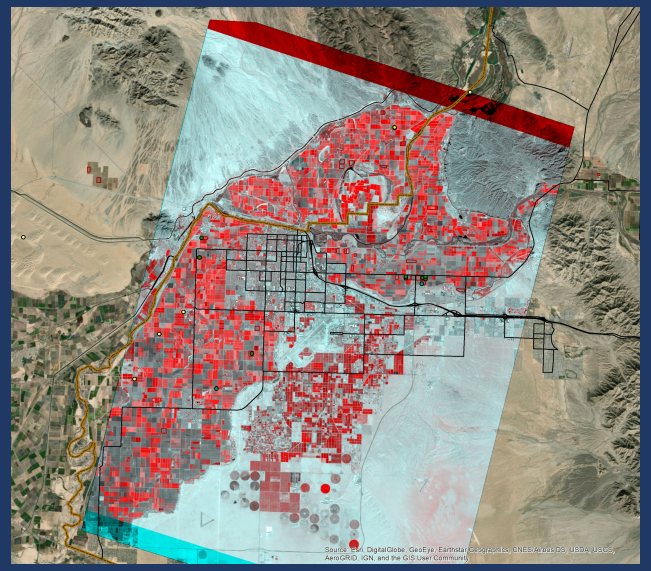
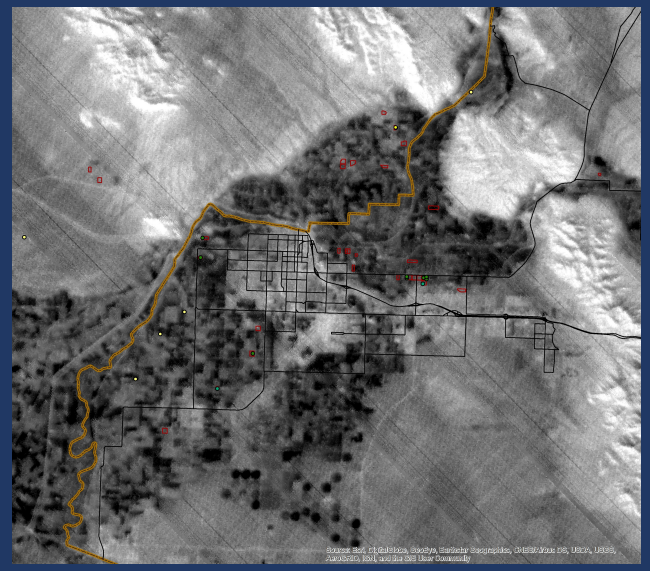


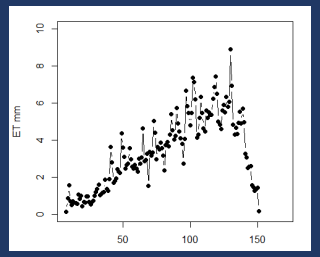
VENUS 2-day repeat



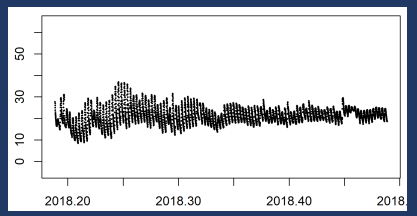
ECOSTRESS ~4 day repeat

Eddy Covariance

ET

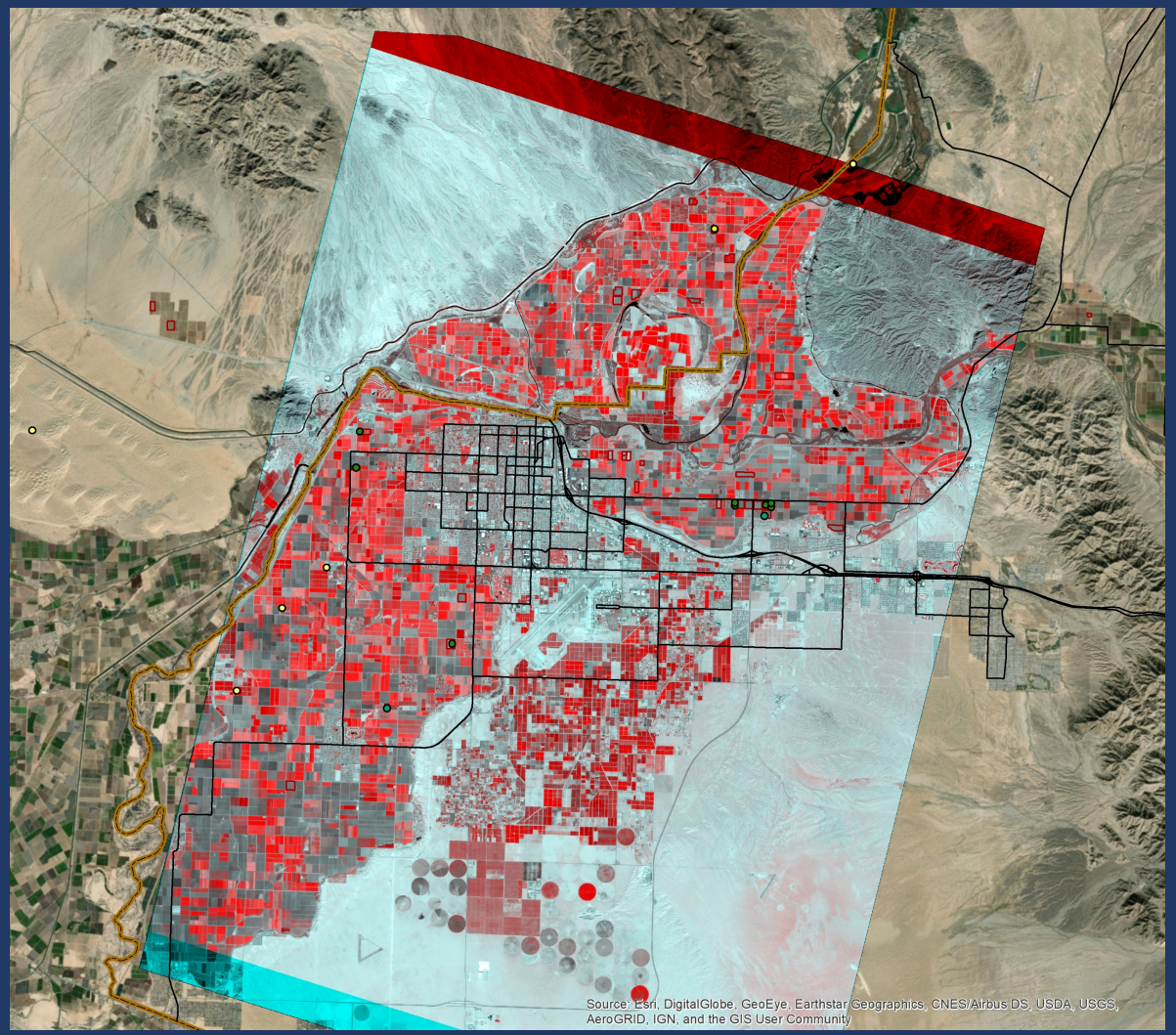


LST

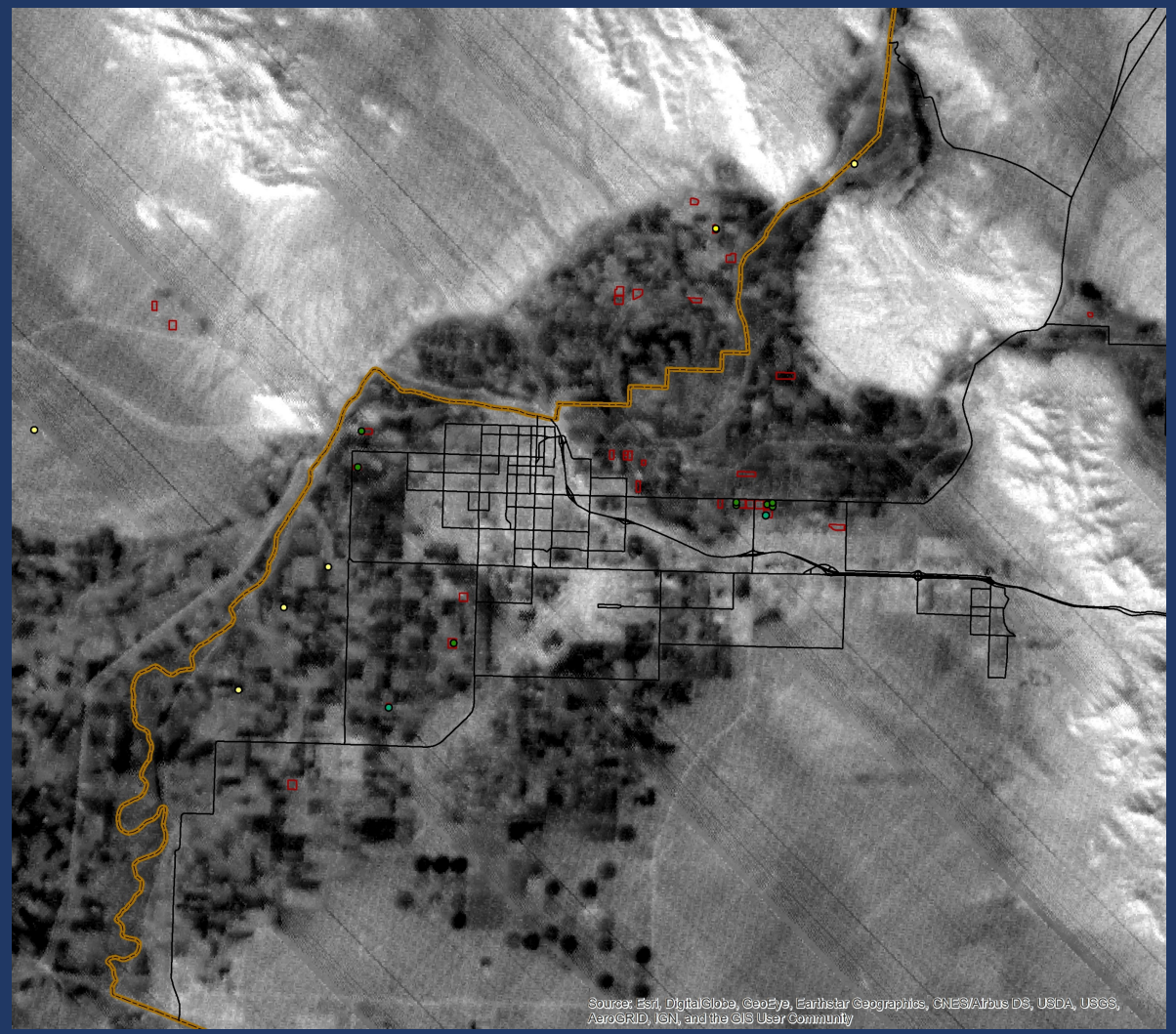


The Water & Salt Study Sites: Yuma, Arizona

Observations sites indicated by red polygons



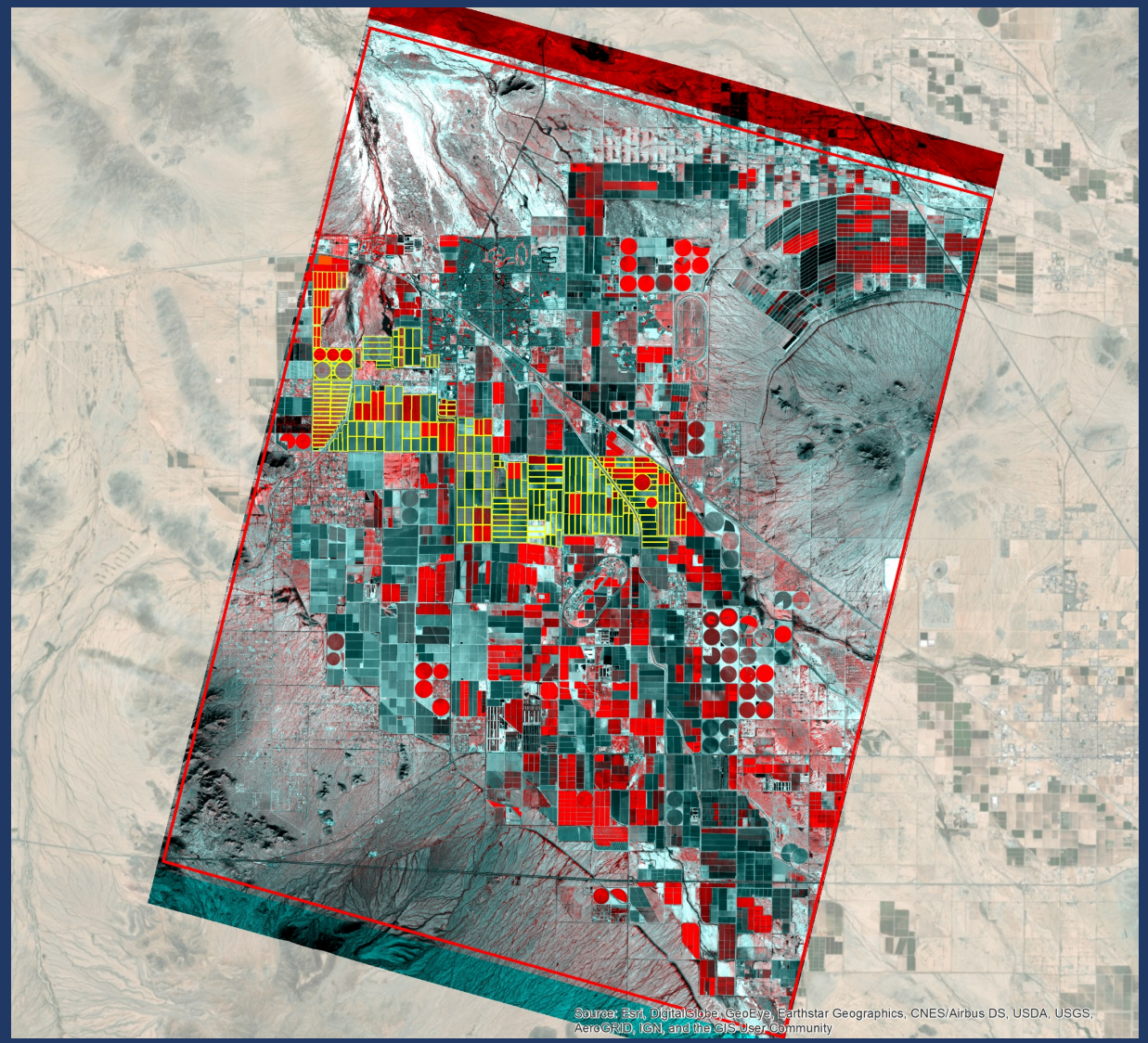
VENUS 23 Jan 2019, L1C 5 m



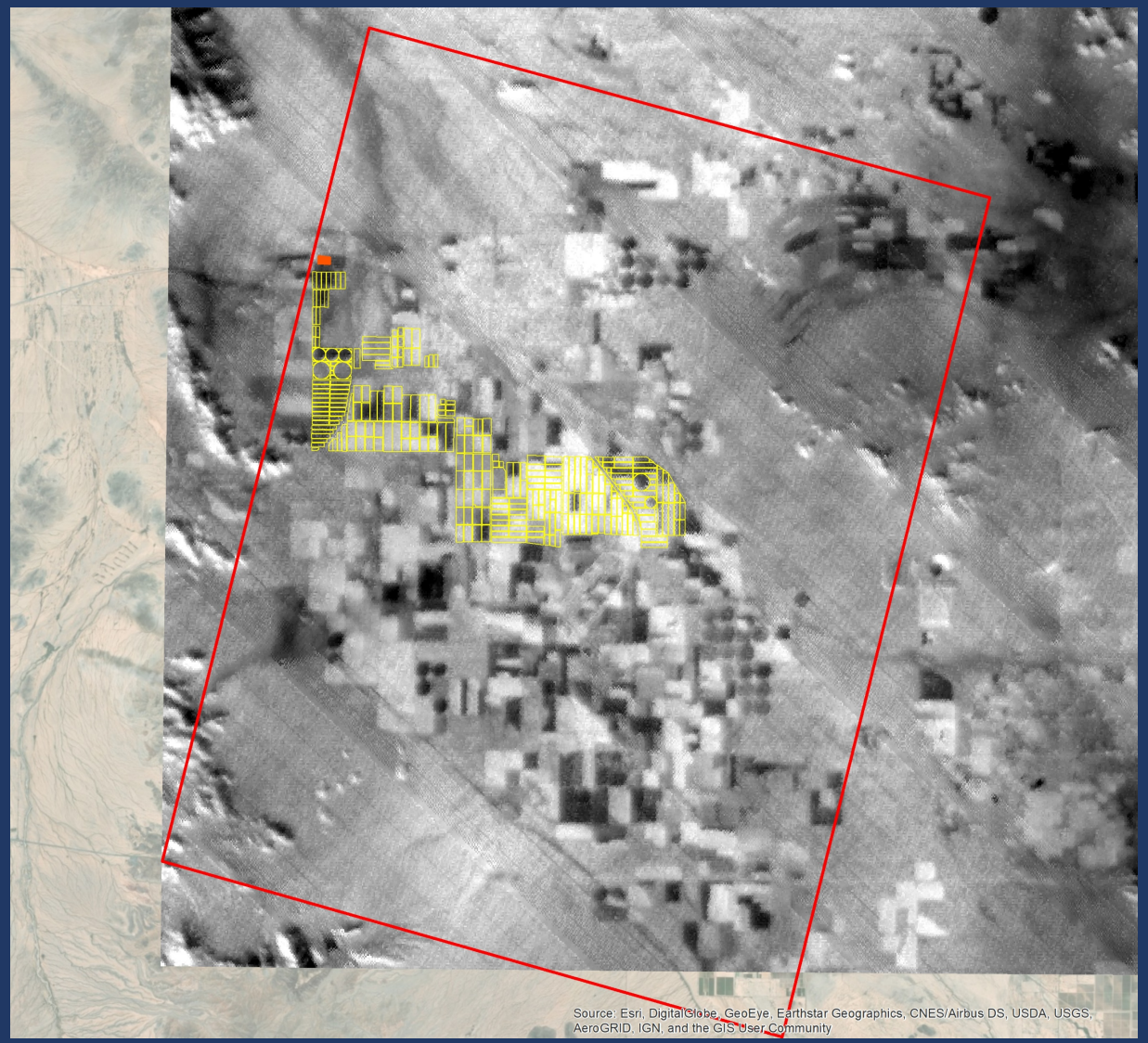
ECOSTRESS 19:40 MST, 24 Jan 2019, L2 LST

The Water & Salt Study Sites: Maricopa and Ak-Chin, Arizona

3 Sites in Central Arizona: Hart Wheat and Barley at NW, Cotton at center



VENUS 27 Jan 2019, L1C 5 m



ECOSTRESS 18:31 MST, 27 Jan 2019, L2 LST

Eddy Covariance Deployments (1/2)

Count	Station	Field	Crop	Deploy	Remove	Lat/Long
1	UA1	KN18	Cauliflower	7 Sep 2018	29 Nov 2018	32 46’ 34.4415” -114 35 19.6712”
2	UA3	KN15	Broccoli	7 Sep 2018	14 Nov 2018	32 46’ 48.6592” -114 35’ 17.7491”
3	ALARC1	Smith8	Cauliflower	18 Sep 2018	12 Dec 2018	32 41’ 36.7695” -114 30’ 51.4291”
4	JPL1	JV114	Iceberg	21 Sep 2018	10 Dec 2018	32 39’ 22.6696” -114 39’ 23.2953”
5	JPL2	Ott807	Iceberg	8 Oct 2018	4 Jan 2019	32 41’ 48.3054” -114 32’ 15.2721”
6	ALARC2	JV521	Broccoli	27 Nov 2018	28 Mar 2019	32 44’ 32.7948” -113 53’ 42.2648”
7	UA2	JV330	Spring Mix	29 Nov 2018	29 Jan 2019	32 42’ 44.0376 -114 34’ 27.0752”
8	UA1	Hart	Wheat	18 Dec 2018	24 May 2019	33 04’ 38.7302” -112 06’ 43.4345”
9	UA3	AkChin15AW	Barley	14 Jan 2019	29 May 2019	33 01’ 41.2536” -112 06’ 47.0808”
10	UA2	KN20	Baby Leaf	7 Feb 2019	28 Mar 2019	32 46’ 46.1115 -114 34’ 51.9133”
11	ALARC1	Sidewinder18	Cantaloupe	15 Feb 2019	16 May 2019	32 45’ 35.4283” -114 47’ 49.1810”
12	JPL2	JV114	Cantaloupe	6 Mar 2019	5 Jun 2019	32 39’ 22.6712” -114 39’ 17.3955”

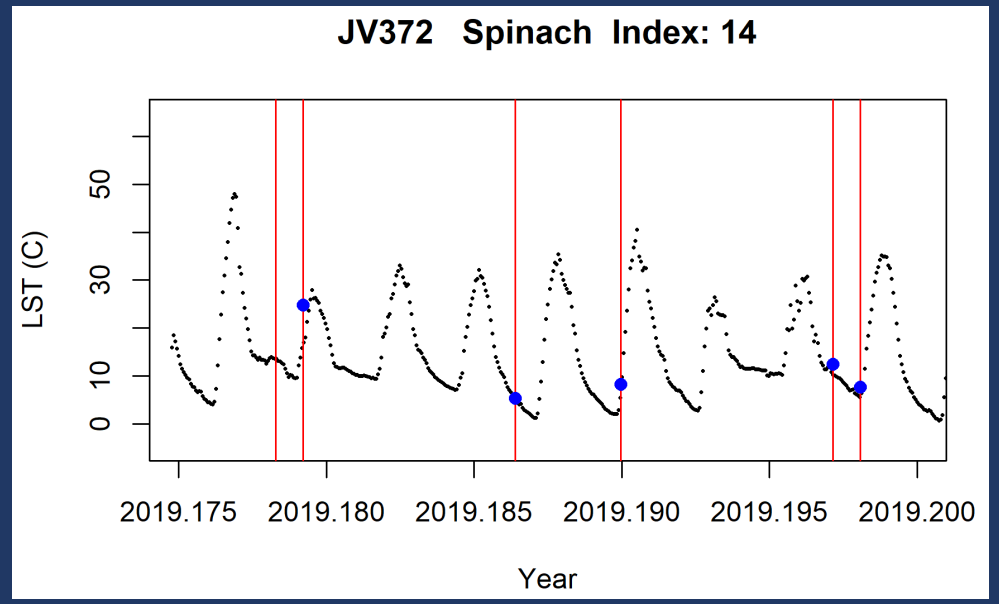
Eddy Covariance Deployments (2/2)

Count	Station	Field	Crop	Deploy	Remove	Lat/Long
13	ALARC 2	OTT 807	Watermelon	10 Apr 2019	19 Jun 2019	32 41’ 48.3054” -114 32’ 15.2721”
14	JPL 1	KN 18	Cotton	25 Feb 2019	3 Sep 2019	32 46’ 33.8181” -114 35’ 17.7886”
15	TULLER	JV 372	Spinach	4 Mar 2019	9 Apr 2019	32 41’ 21.8405” -114 28’ 53.6855”
16	TULLER	AK-Chin 20 E	Cotton	3 May 2019	4 Oct 2019	32 59’ 22.992” -111 59’ 58.945”
17	UA 1	Sidewinder 5	Cantaloupe	29 Aug 2019	18 Nov 2019	32 46’ 03.316” -114 48’ 20.256”
18	UA 2	EB14N	Broccoli	3 Sep 2019	25 Nov 2019	32 46’ 38.425” -114 33’ 03.195”
19	UA 3	Hill 02	Cauliflower	10 Sep 2019	6 Sep 2019	32 47’ 39.256” -114 32’ 15.488”
20	ALARC 1	OTT 530	Lettuce	14 Oct 2019	TBD	32 44’ 55.081” -114 30’ 25.842”
21	ALARC 2	JV 134	Lettuce	23 Se 2019	10 Dec 2019	32 34’ 48.599” -114 43’ 59.863”

Land Surface Temperature Data

- 8 EC stations with 8 Apogee infrared thermometer (IRR-PN, SI-121)
- For 2018-2019 study: 11 infrared thermometer (IRT) sites over 8 crop types
- IRT data block –averaged to 30-min time steps, interpolated to overpass times
- IRT mounted at ~2m, pointing north with ~45°
- Field of view 36°, ~ 4.7 m^2 footprint
- IRT data reported as-is, no emissivity correction (ε >= 0.97?), no land cover partitioning

IRT installation



LST time trace with ECOSTRESS observations (blue)

Eddy Covariance Data

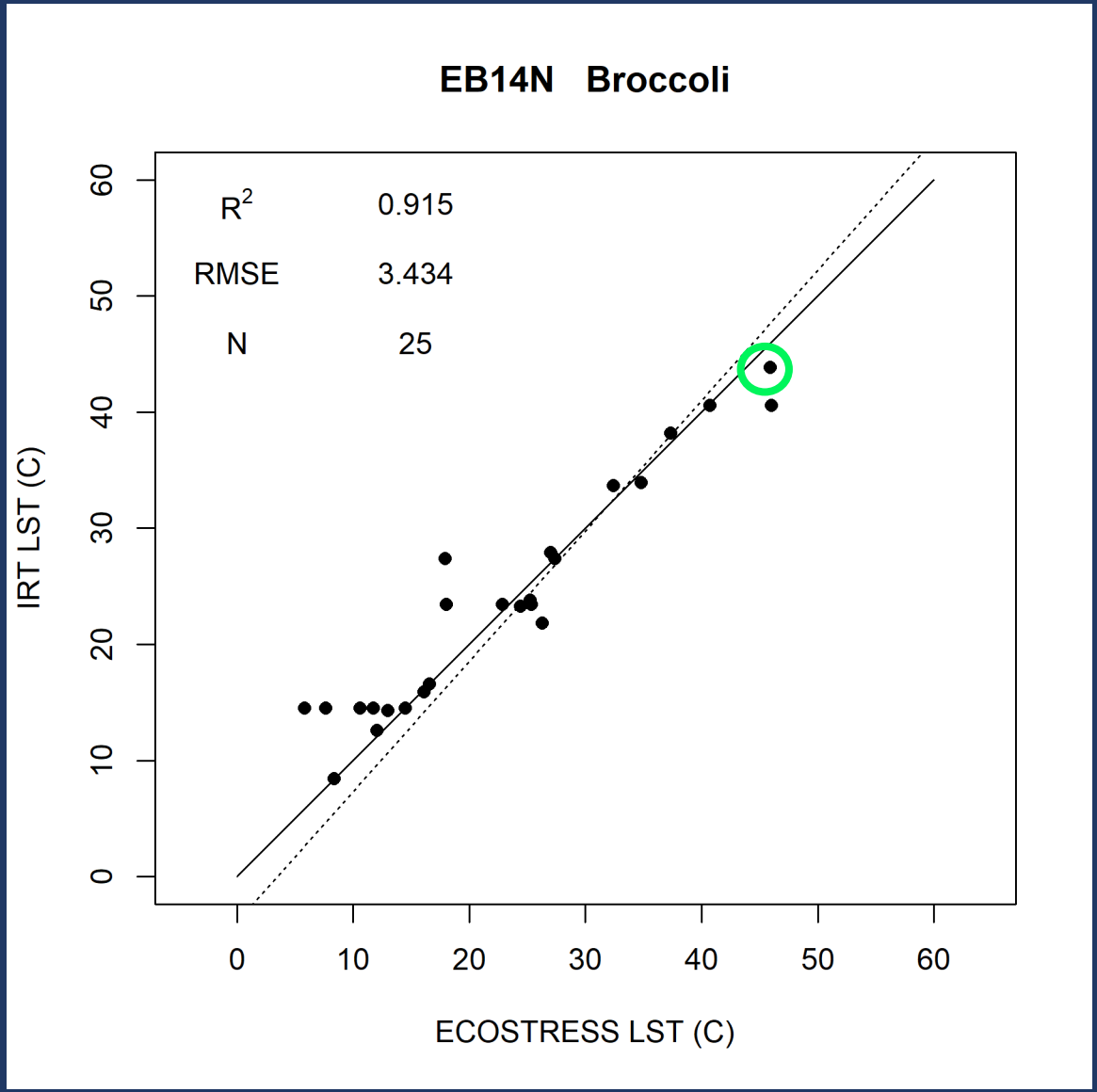
- 8 eddy covariance stations
- Campbell systems
- Campbell, Licor, Kipp & Zonen, Hukseflux sensors
- Data logged at 20 Hz, block-averaged to 30 minutes
- 30-minute data WPL corrected, gap-filled using PM, energy balance closure enforced with Bowen ratio
- Full corrections will consider soil heat storage, gap filling, use source time series
- Irrigation data being used to close the water budget

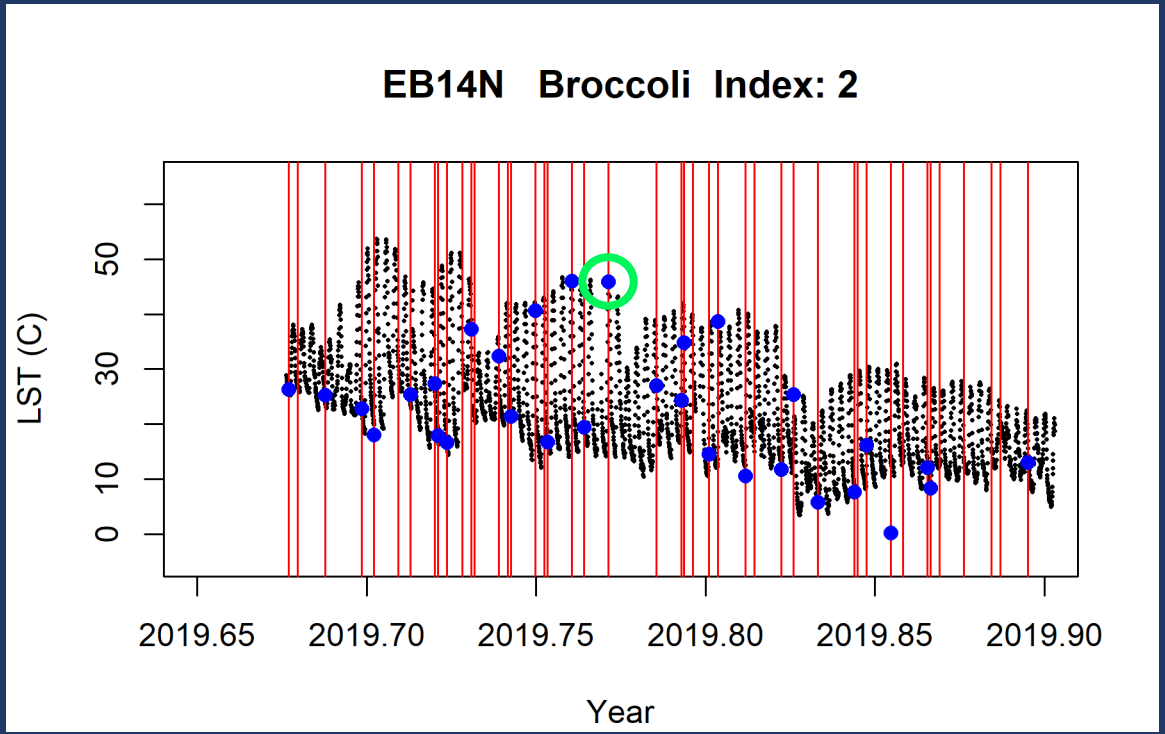
Results: Land Surface Temperatures 2018-2019

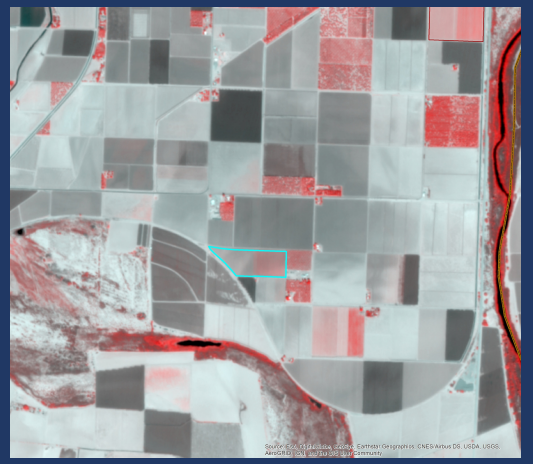
- 8 Yuma sites with statistics + 2 small sample sites
- 2 Maricopa / Ak-Chin sites with statistics
- Outliers: >10 C deviation removed
- R2 values mostly 0.8-0.9; RMSE 2- 3.5 C

Count	Crop	Site	R2	RMSE	N
1	Broccoli	EB14N	0.915	3.4	25
2	Broccoli	JV521	0.878	2.8	17
3	Cantaloupe	JV114	0.824	2.7	8
4	Cantaloupe	Sidewinder5	0.929	3.6	20
5	Cantaloupe	Sidewinder18	0.861	2.2	9
6	Cauliflower	Hill02	0.591	4.6	23
7	Cotton	KN18	0.884	3.6	33
8	Lettuce	JV134	0.907	3.2	23
9	Barley	AkChin15AW	0.977	1.6	13
10	Wheat	Hart8	0.968	1.5	10

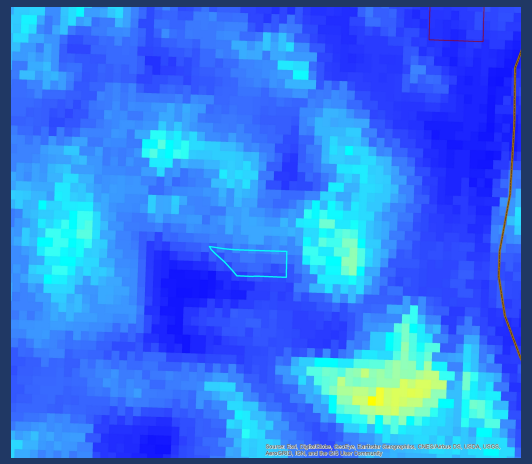
Yuma: Broccoli Water and Nitrogen Study: 3 Sep – 25 Nov 2019
32° 46’ 38.425” N, 114° 33’ 03.195” W







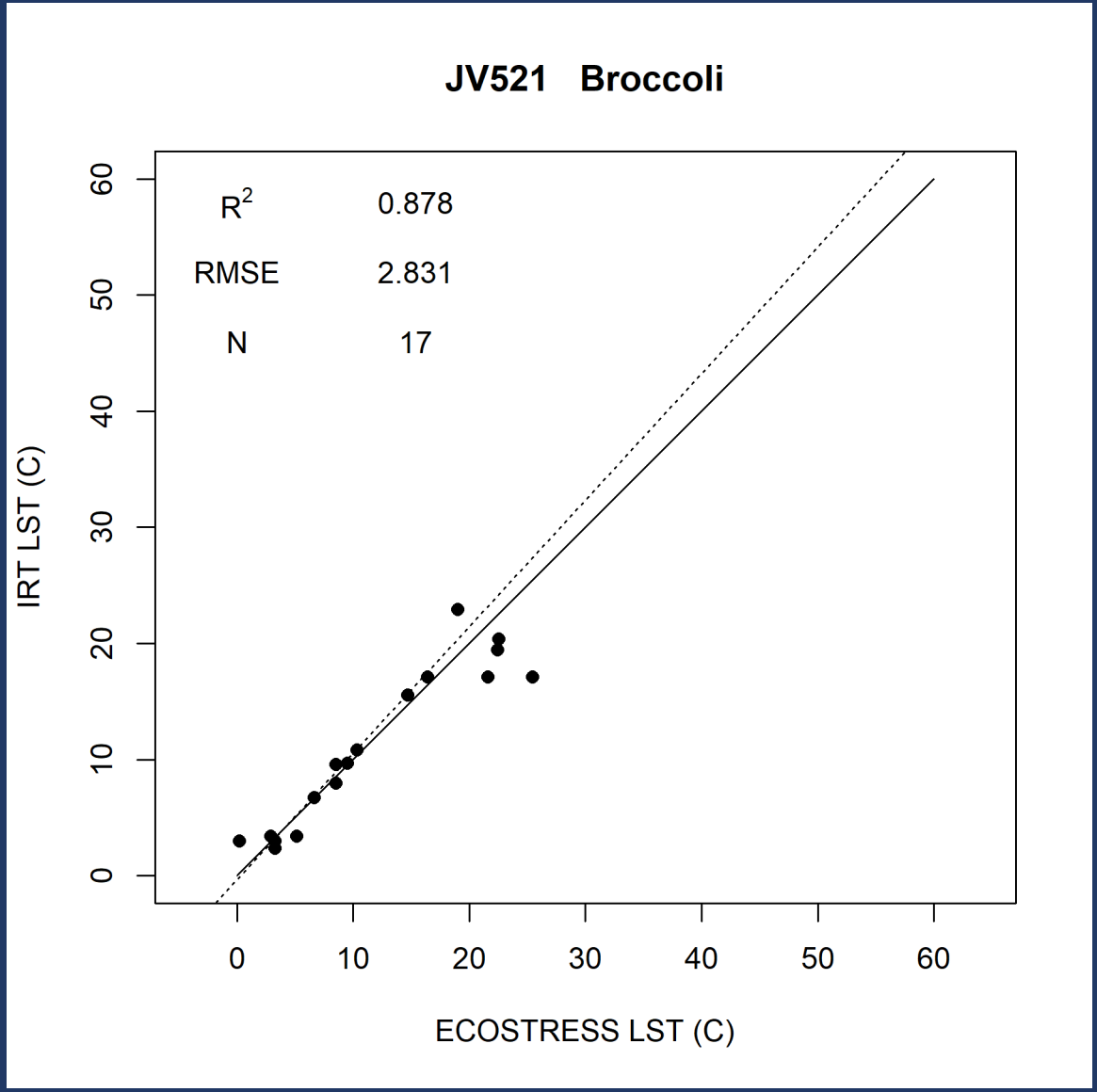
VENUS 6 Oct 2019

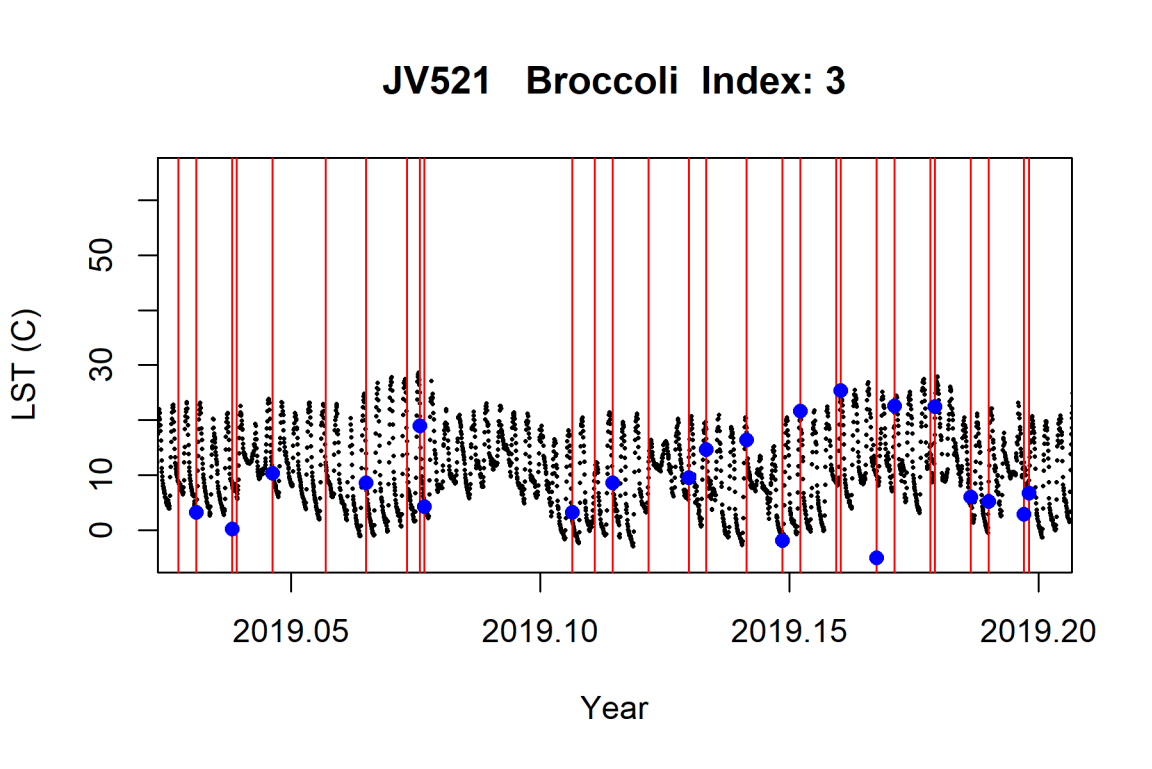


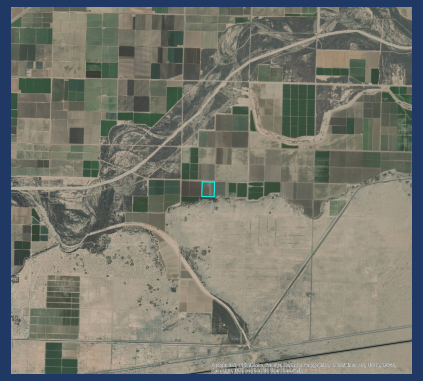
ECOSTRESS 4 Oct 2019, 13:39 MST

Blue dots: ECOSTRESS observation
Red Lines: ECOSTRESS overpass

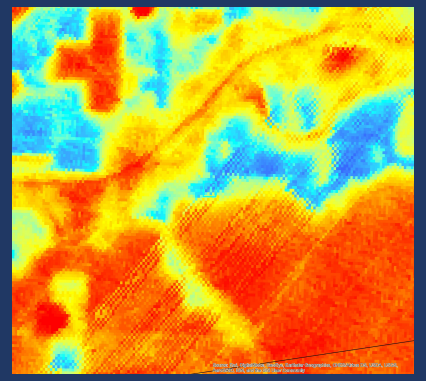
Yuma Broccoli: 27 Nov 2018 – 28 Mar 2019
32° 44’ 32.7948” N, 113° 53’ 42.2648” W





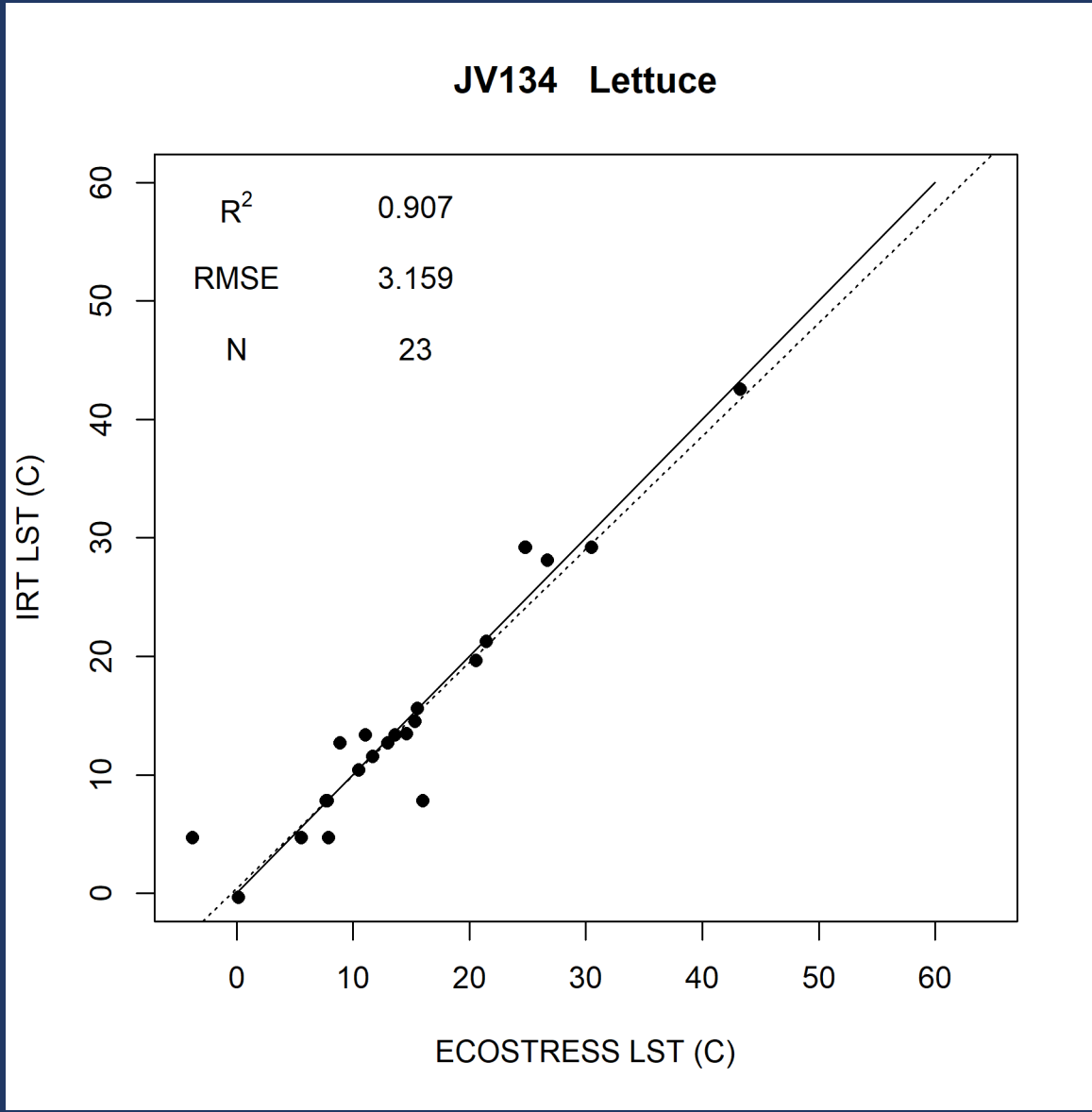


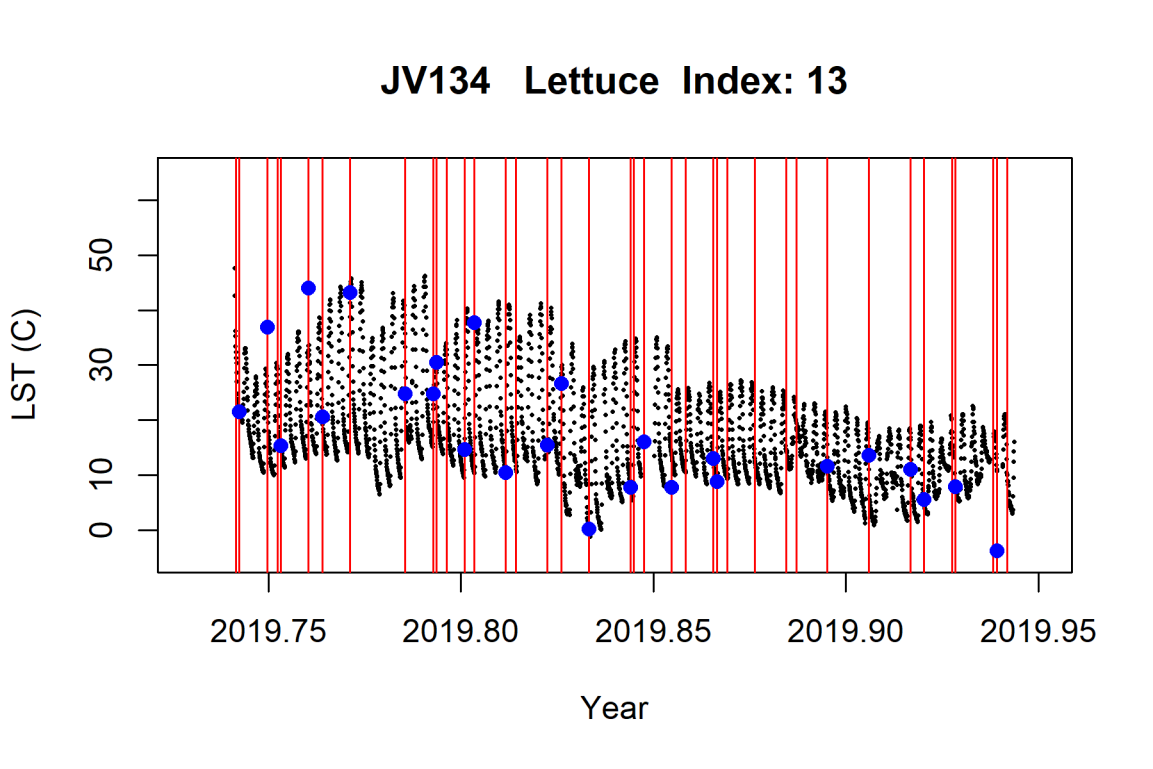
GoogleEarth

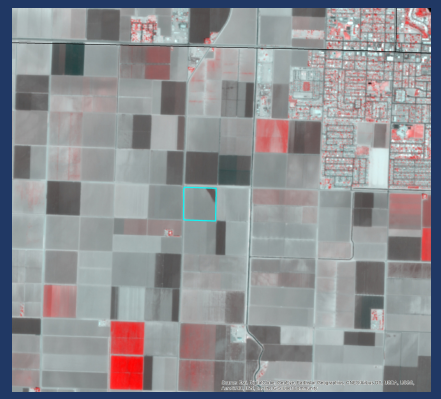


ECOSTRESS 6 Mar 2019, 9:51 MST

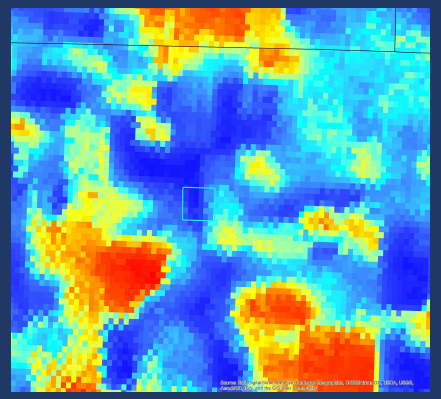
Yuma Lettuce: 23 Sep 2019 – 10 Dec 2019
32° 34’ 48.599” N, 114° 43’ 59.863” W





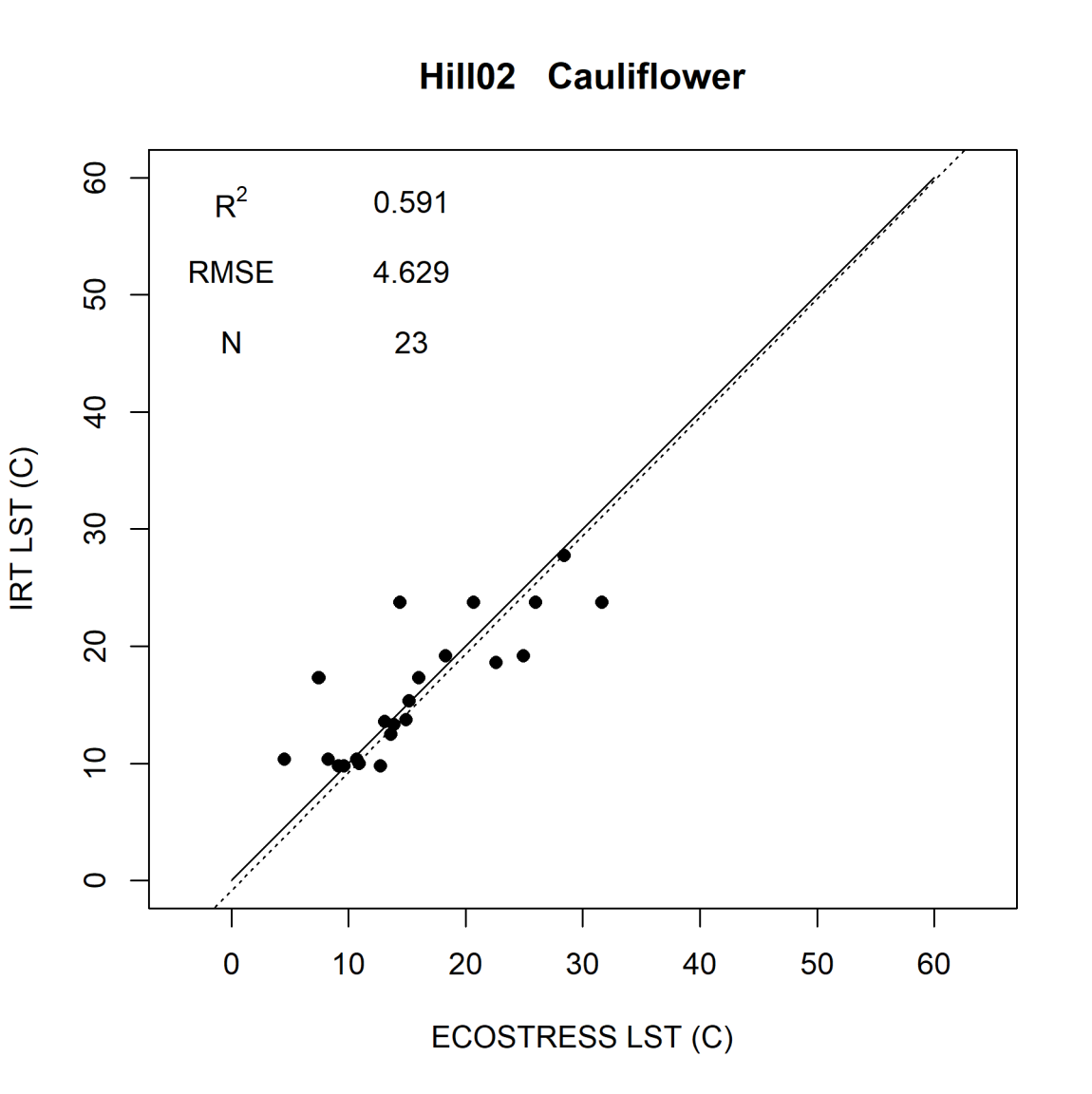


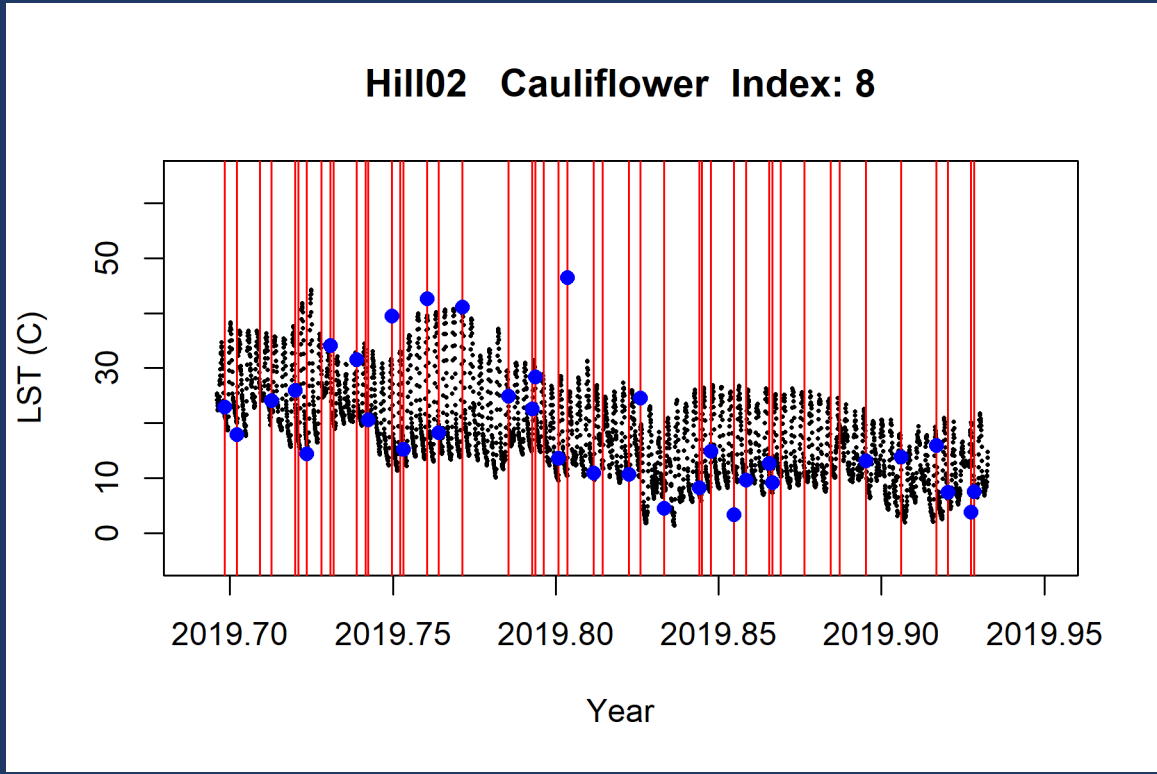
VENUS 8 Oct 2019



ECOSTRESS 4 Oct 2019, 13:39 MST

Yuma Cauliflower: 10 Sep 2019 – 6 Dec 2019
32° 47’ 39.256” N, 114° 32’ 15.488” W





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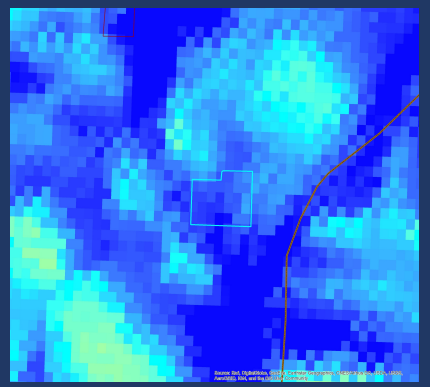
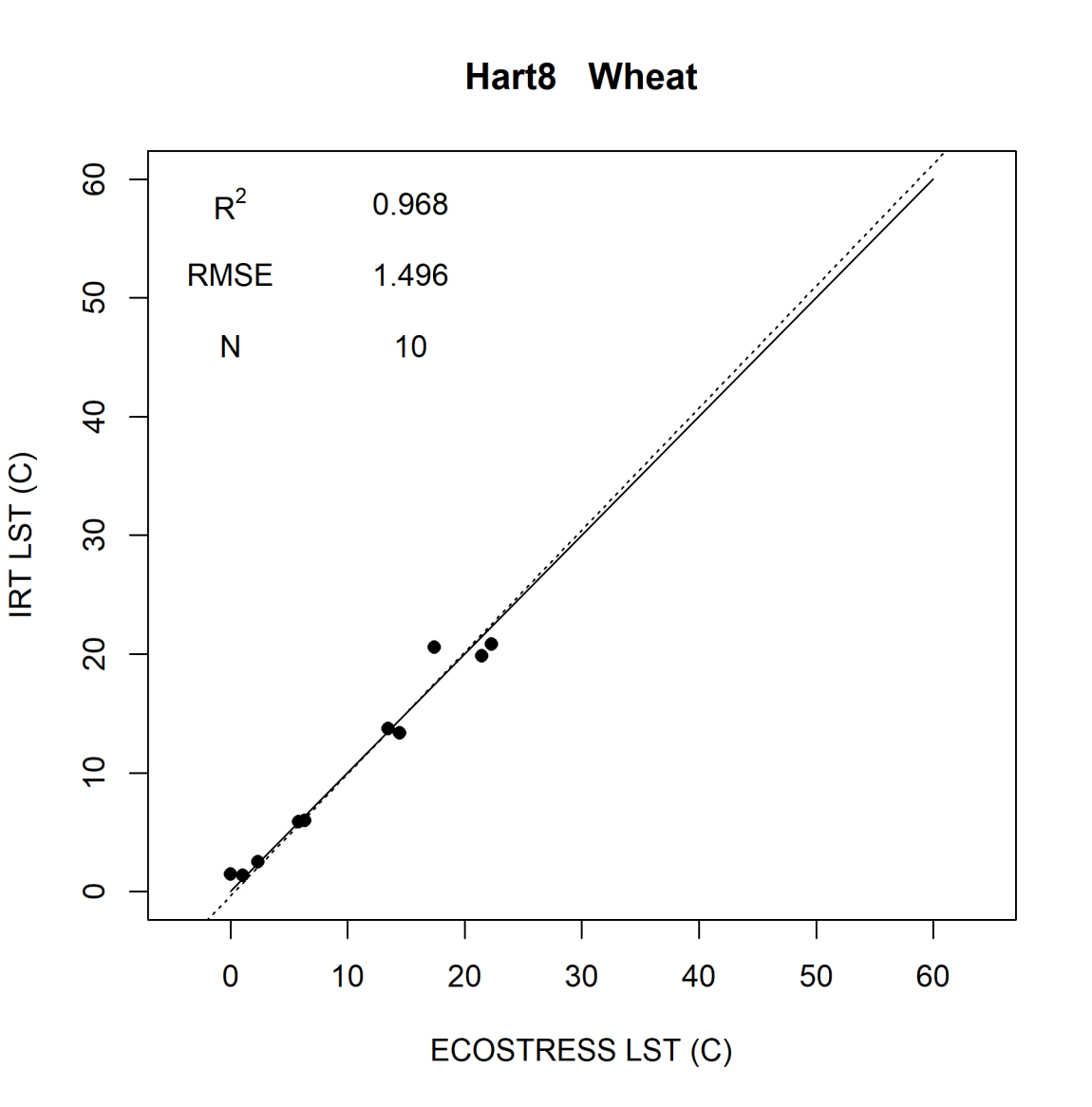
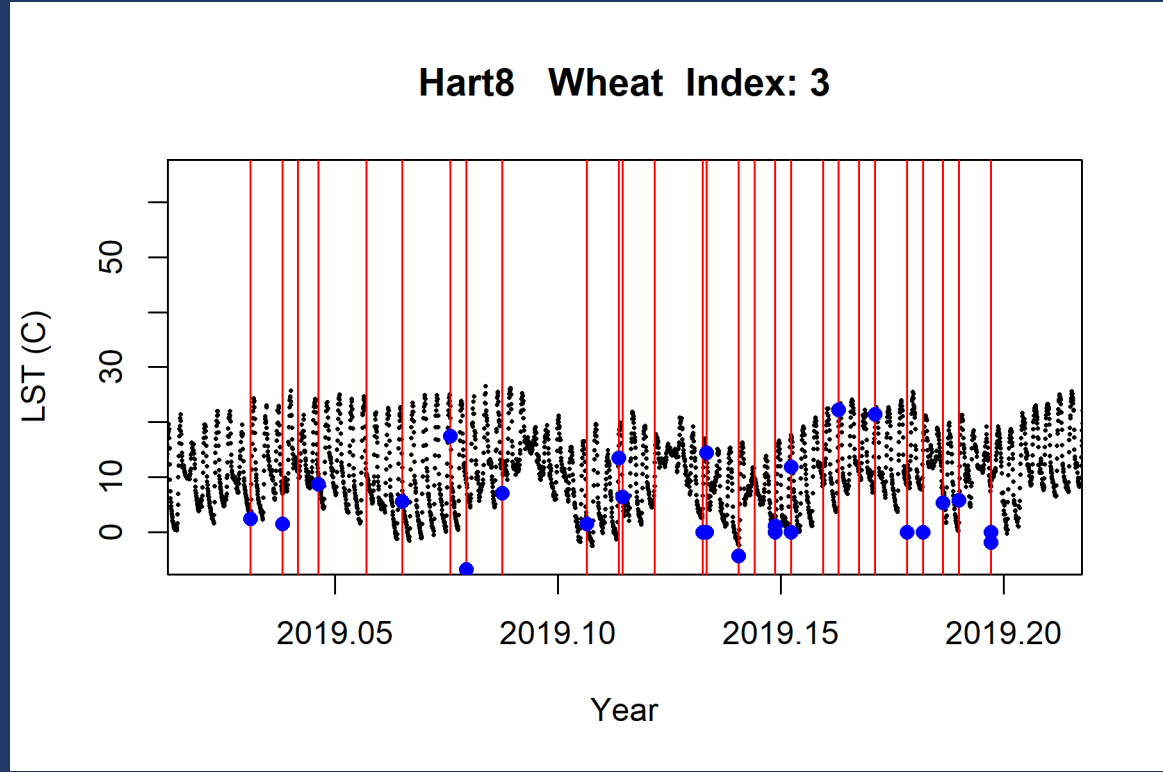
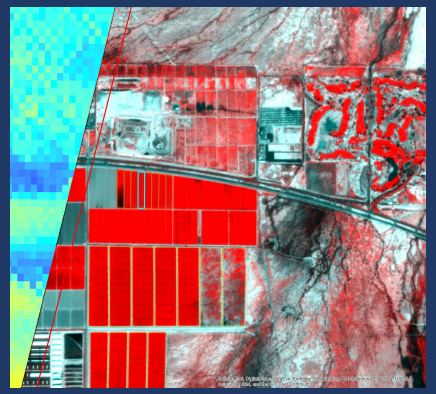


ECOSTRESS 4 Oct 2019, 13:39 MST

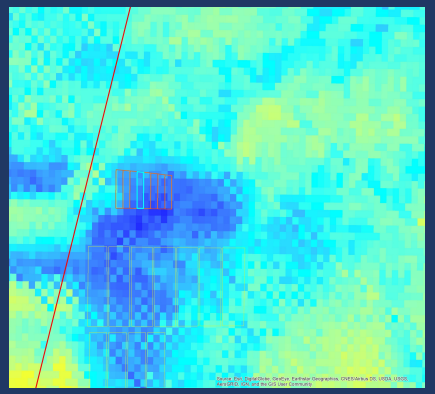
Maricopa Wheat: 18 Dec 2018 – 24 May 2019
33° 04’ 38.7302” N 112° 06’ 43.4345” W







VENUS 10 Feb 2019

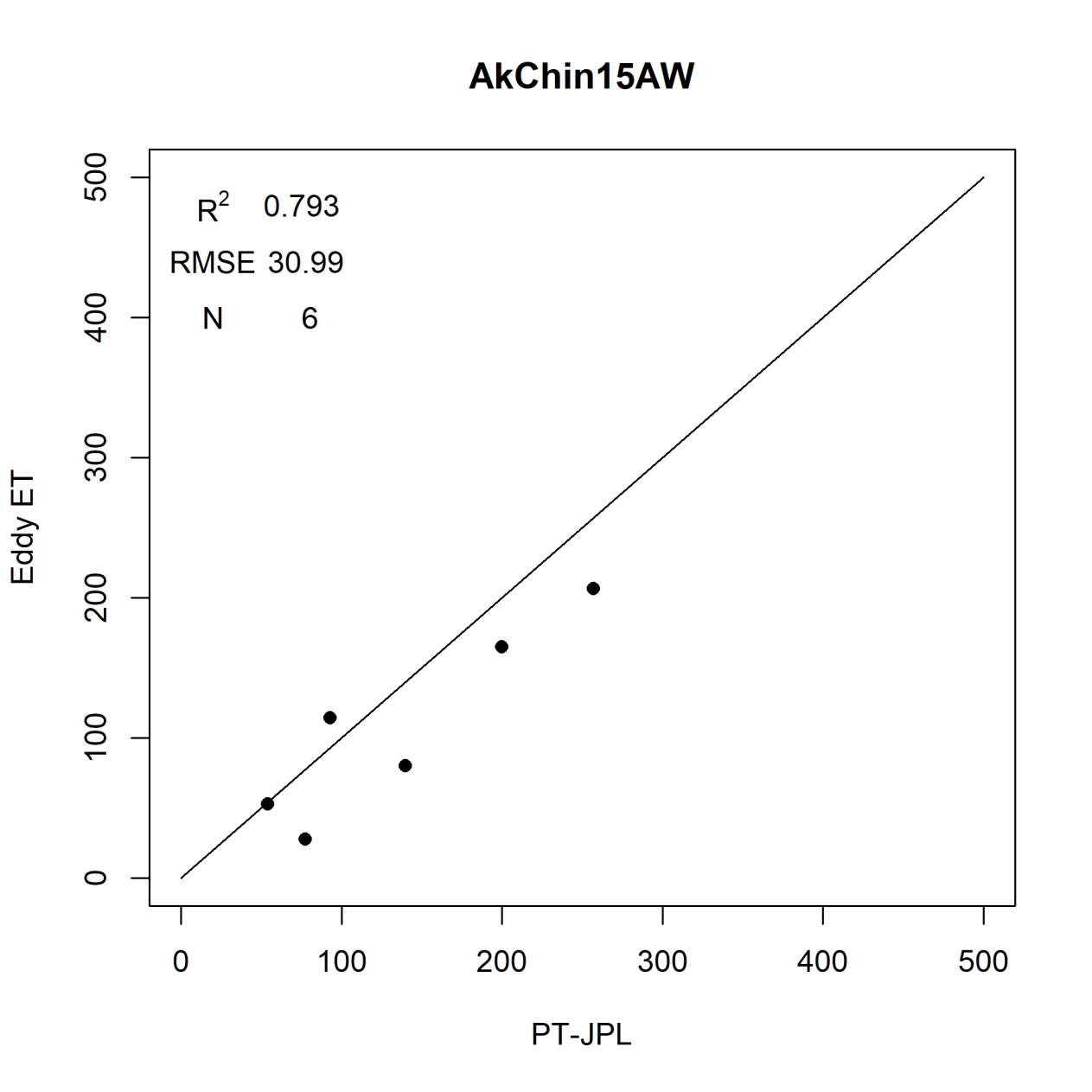


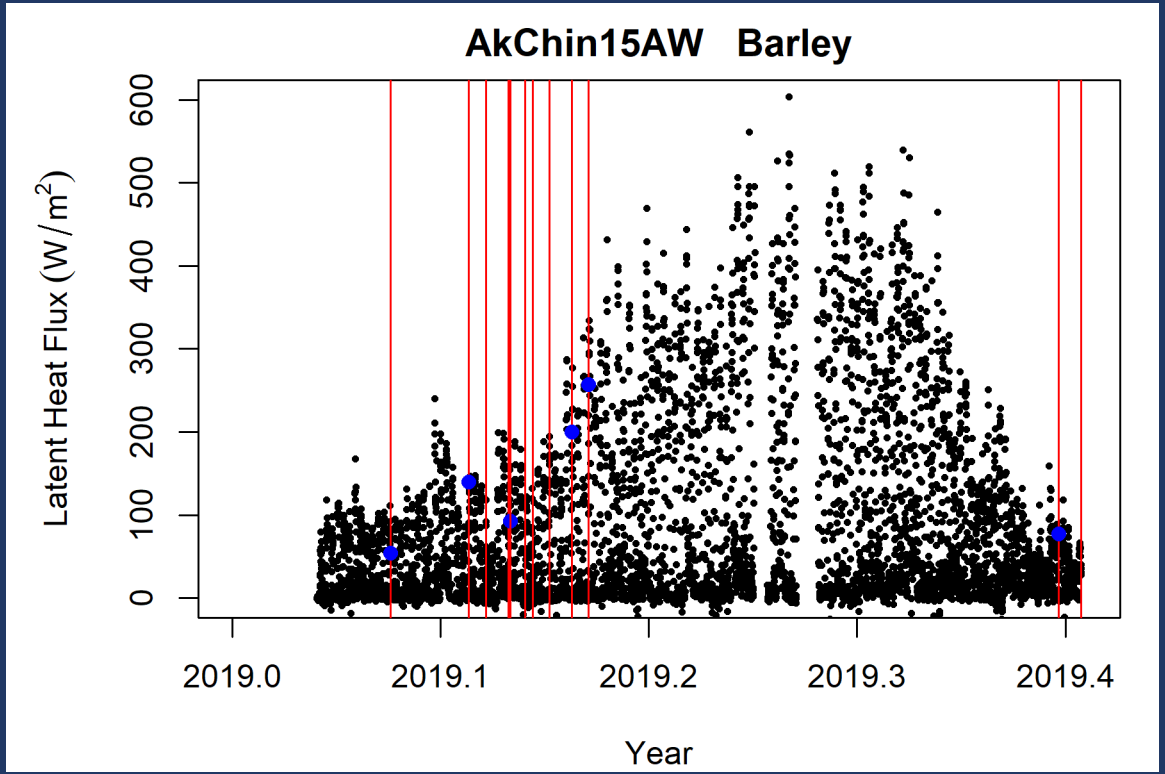
ECOSTRESS 10 Feb 2019, 10:57 MST

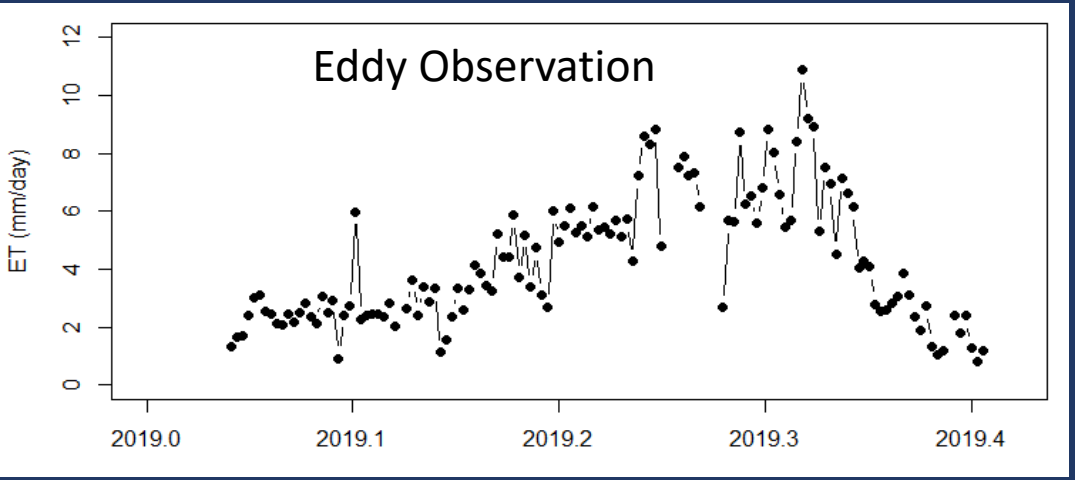
Results: Instantaneous Evapotranspiration

- Quantitative analysis underway
- Qualitative analysis shows good-fair agreement between EC and ET-PTJPL for 10 sites
- Two selected sites (Barley & Spring Mix) shows RMSE 30-50 Wm^{-2}
- Preliminary results from other sites have a lot of scatter
  - Possible resolution limitation
  - Possible time-registration error: LE highly dynamic
  - Integration to weekly/monthly/seasonal should improve correlations

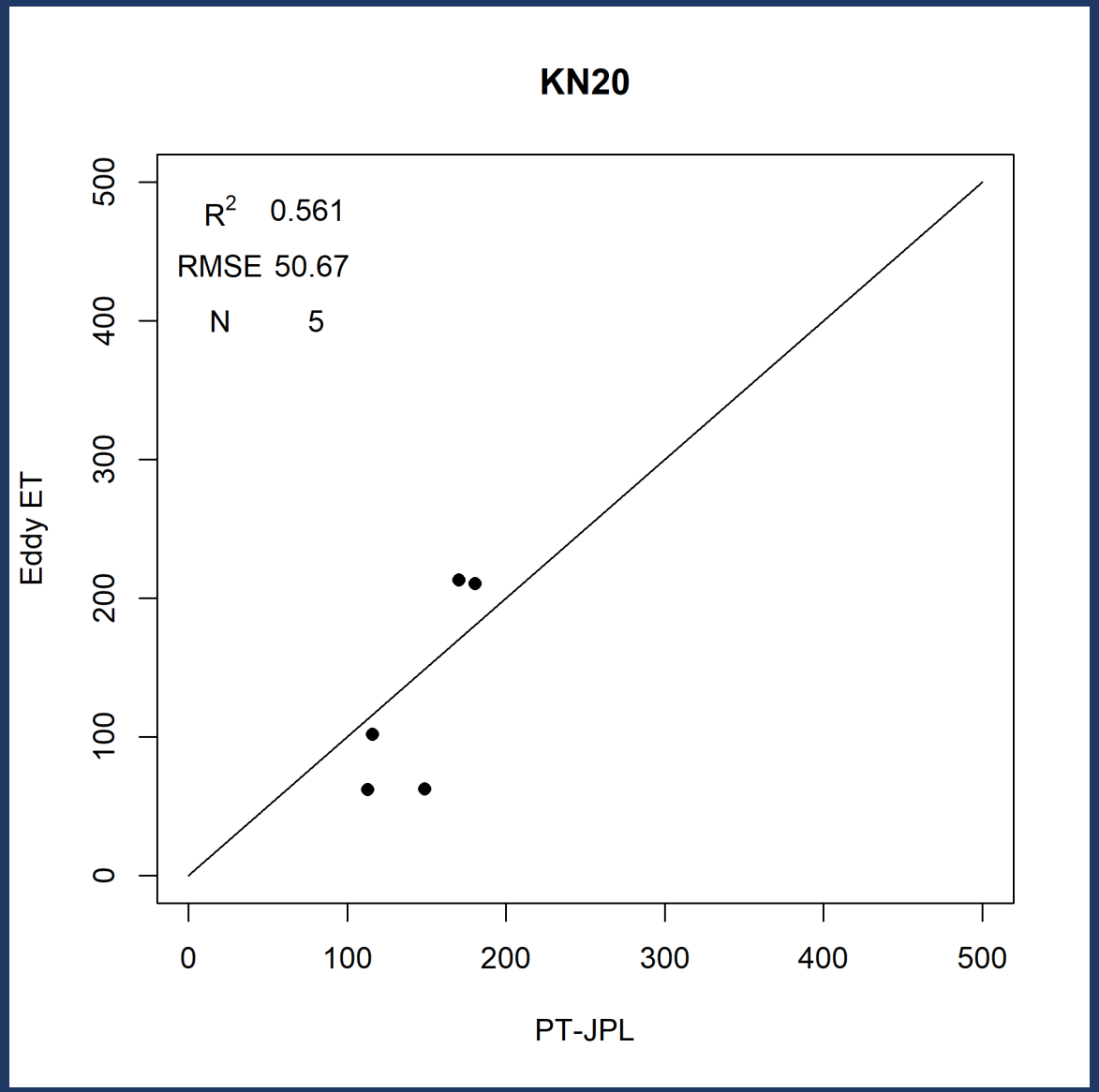
Instantaneous ET: Eddy Covariance & ET-PT-JPL

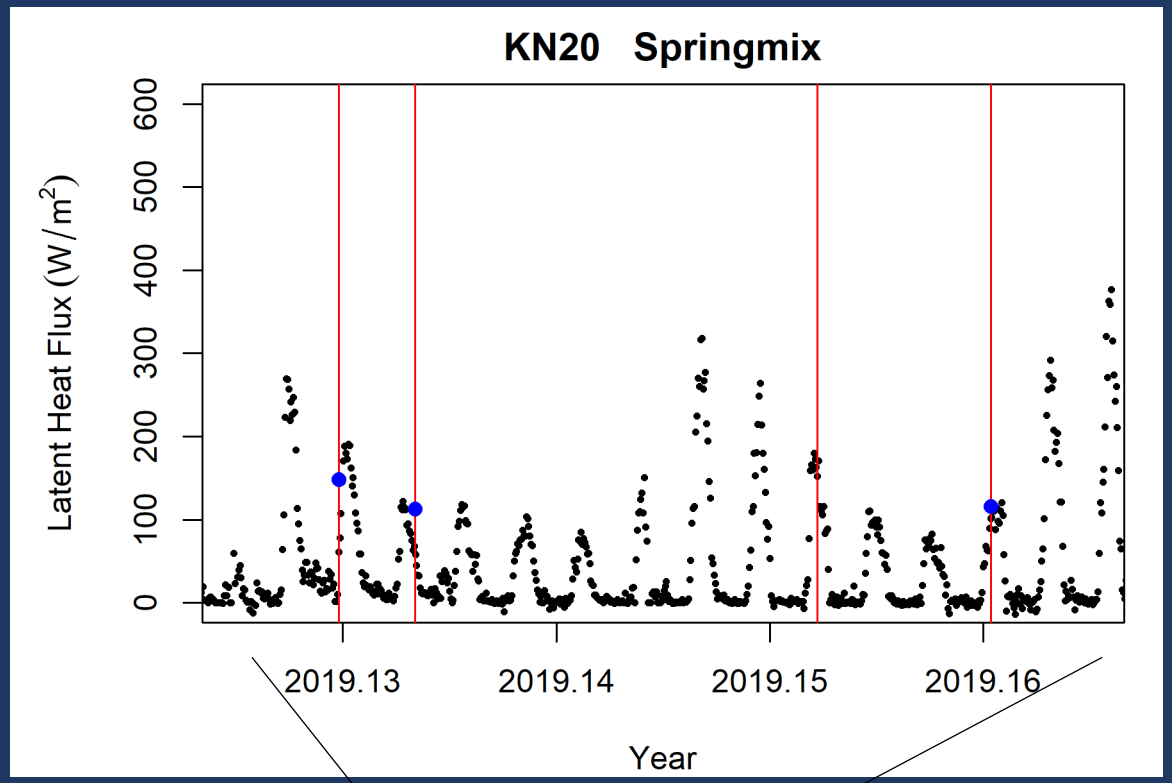


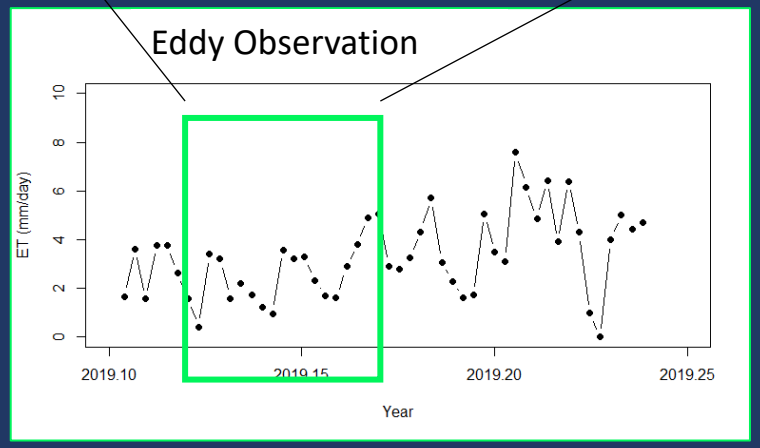




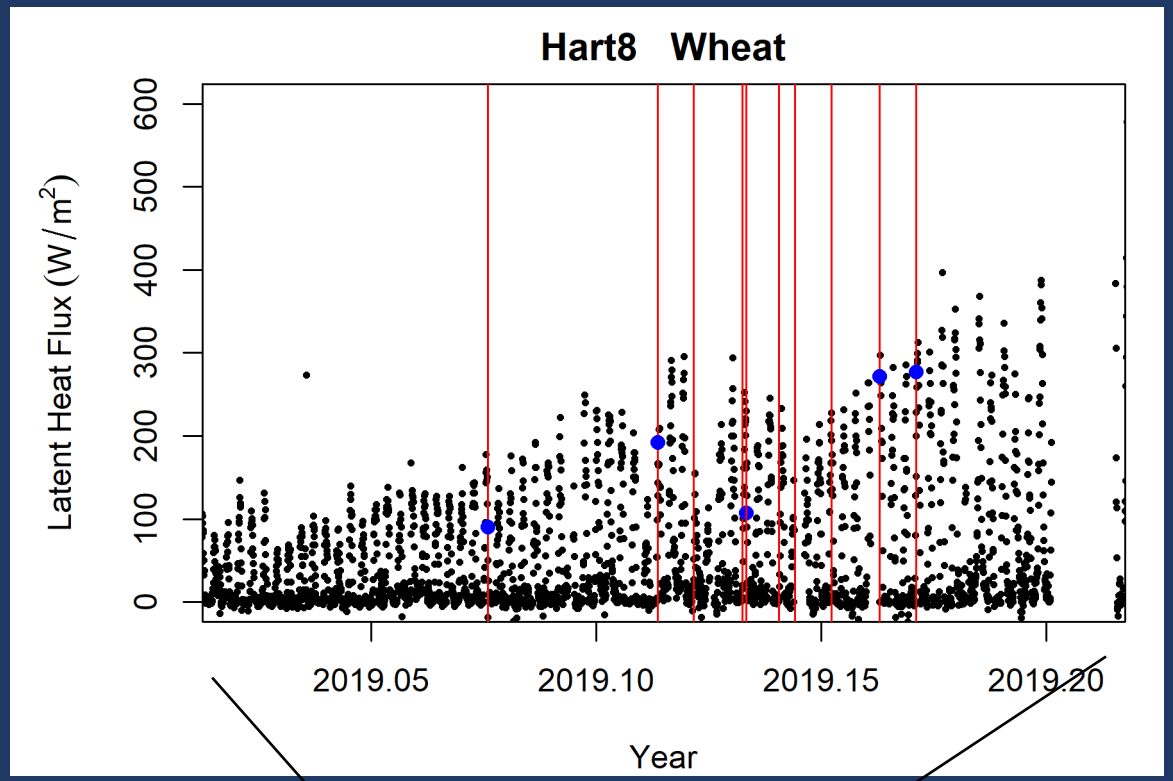
Instantaneous ET: Eddy Covariance & ET-PT-JPL

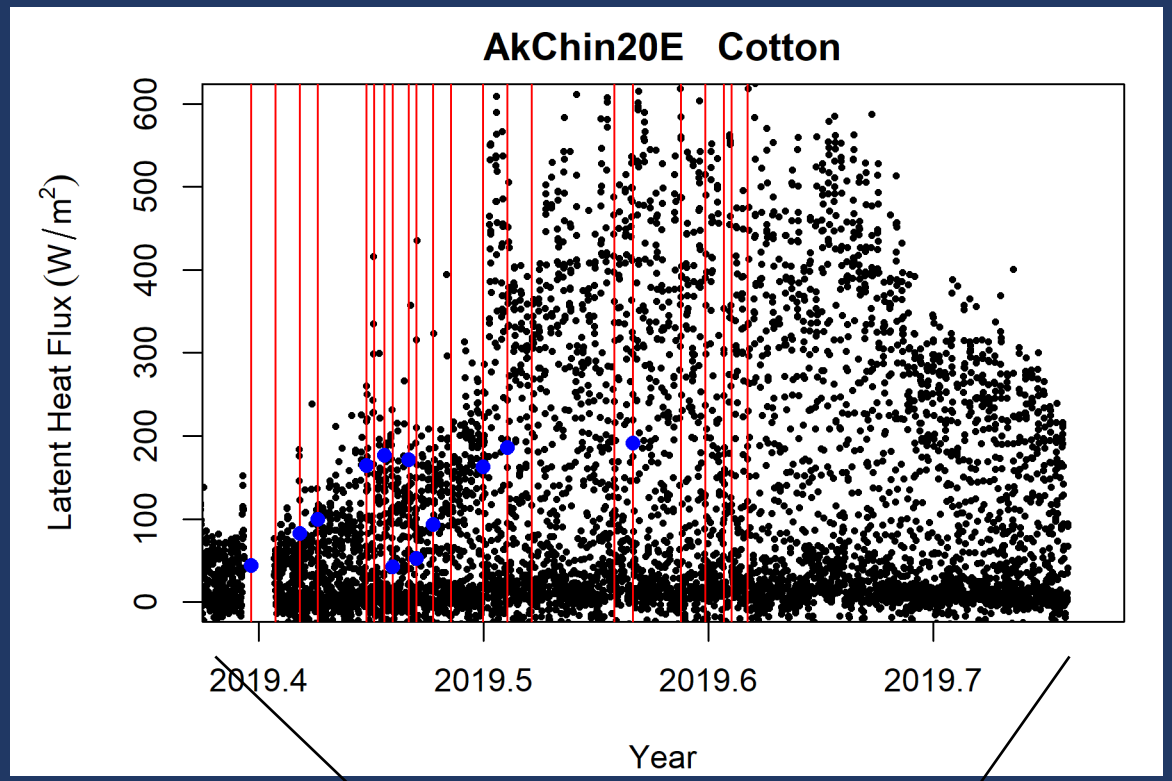


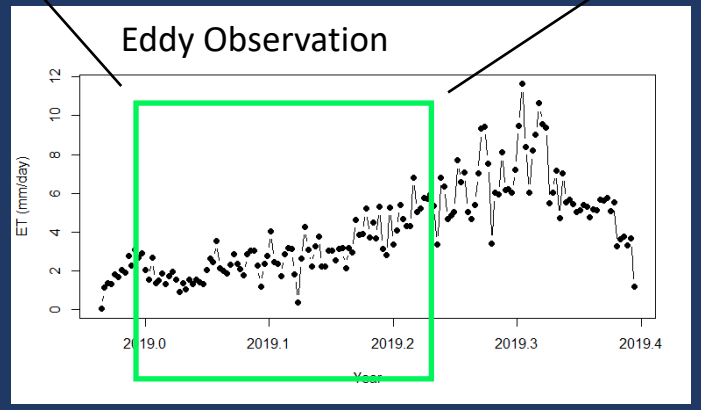


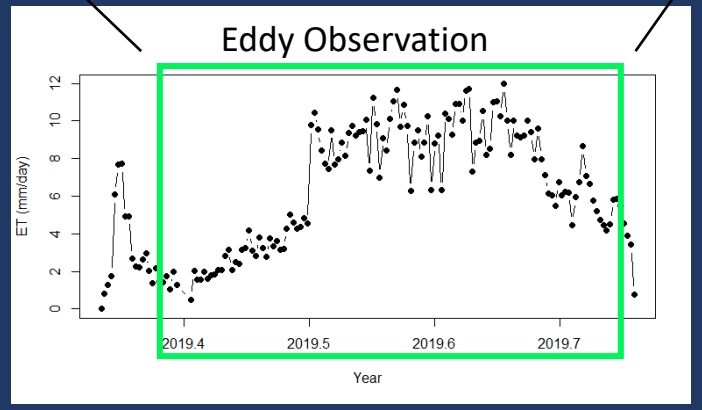


Instantaneous ET: Eddy Covariance & ET-PT-JPL

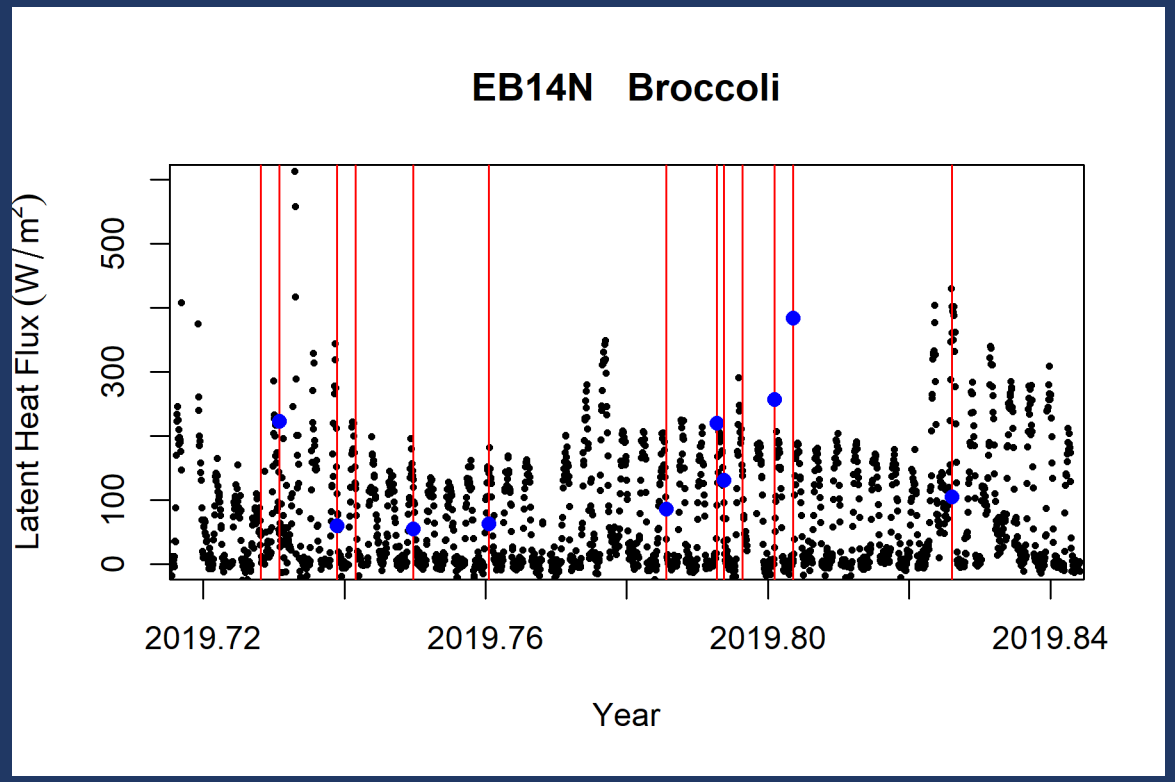


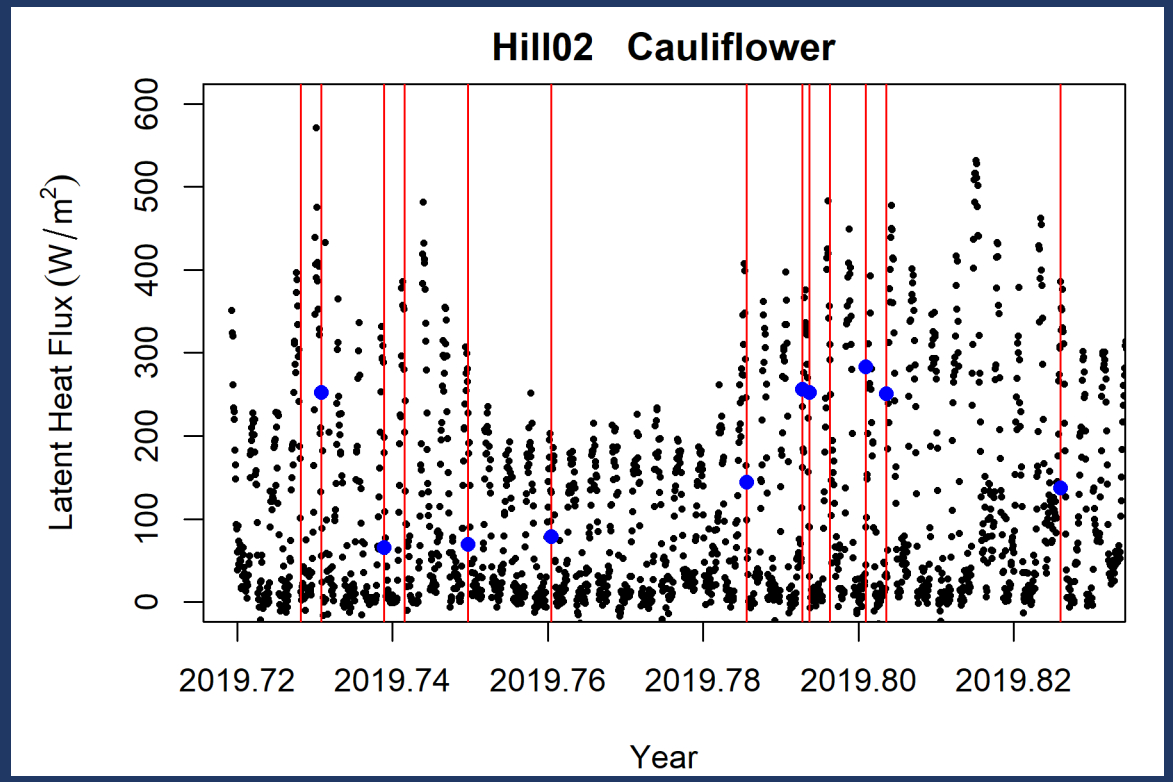


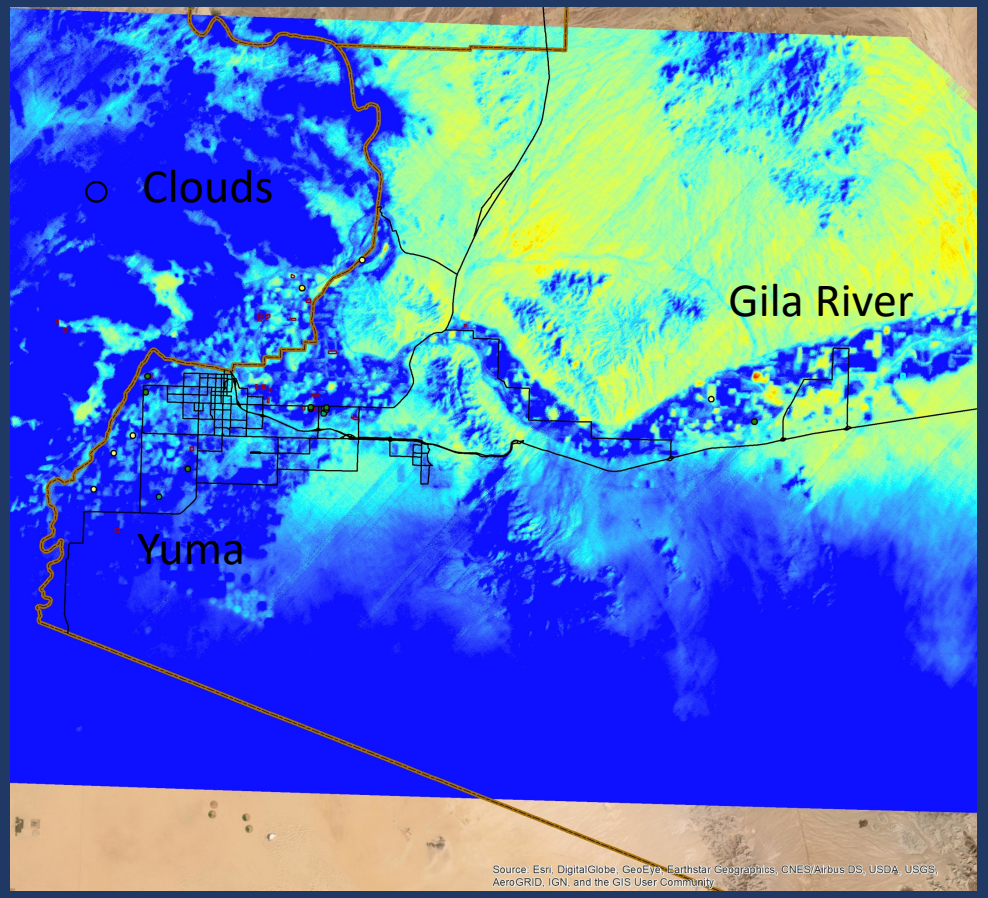




Instantaneous ET: Eddy Covariance & ET-PT-JPL







LST 6 March 2019, 9:51:09 MST

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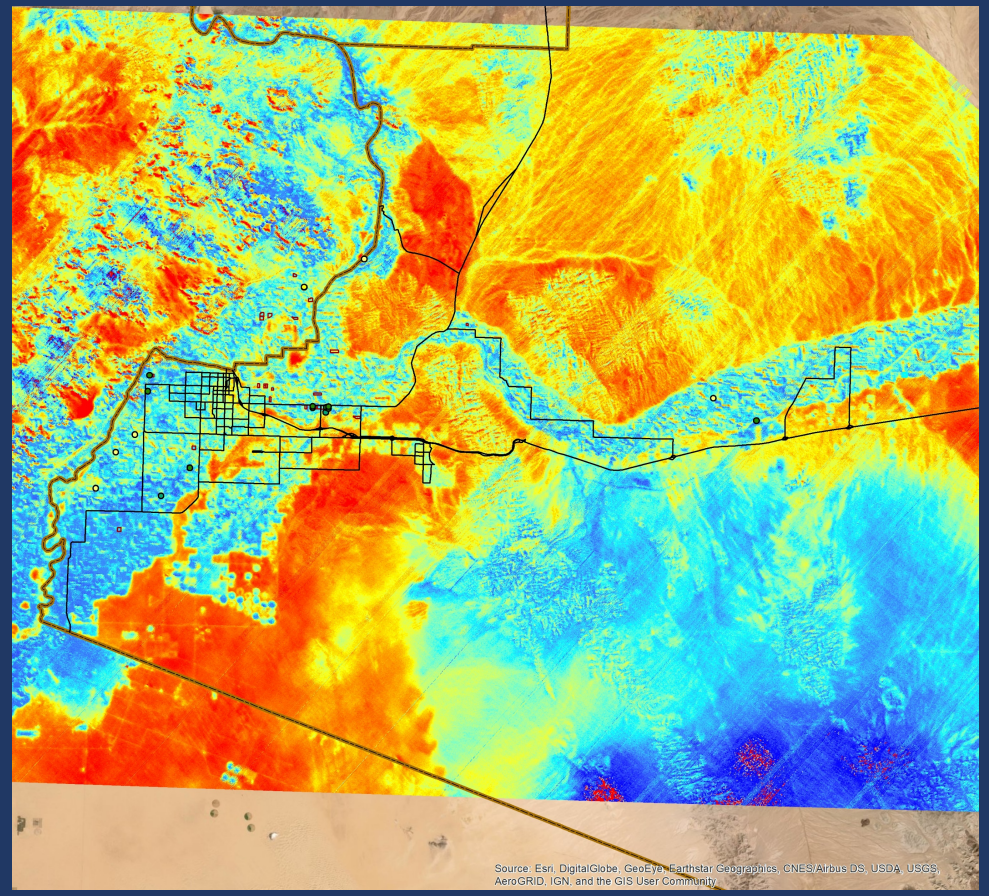
Emissivity Band 2