

Outlook for flights

ACT - America
25 June, 2019

Southern region science objectives (objective numbers with flights on the scenarios table)

1. Gather data that will constrain CH₄ emissions from coastal / regional wetlands. Onshore flow pattern.
2. Gather data that will constrain Gulf ecosystem CO₂ fluxes earlier in the summer than our first summer campaign, and in flooded conditions. Onshore flow pattern.
3. Keep an eye out for OCO₂/TROPOMI under-flight opportunities, especially those that might have an XCO₂ spatial gradient.
4. Gather 1-2 additional frontal crossing flights, sampling weather systems typical of the region. Hypothesis is that the CO₂ frontal gradients will be suppressed compared to our first campaign, as Gulf ecosystem net photosynthesis will be large compared to the MidWest, and this will counter the larger-scale continental boundary conditions (what is their sign / magnitude now?).
5. Watch for any warm conveyor belt situations (not likely in the south).
6. Gather data that can constrain N₂O sources.
7. Address puzzling ethane from the Gulf (Houston?).
8. Capture data from the Permian basin?

Blue if we've acquired some data for this.

Discussion

Science / weather:

W-Th - fair weather, 1 or 2 days? W-Th has almost no wind over Mississippi and Alabama. This would be good for a 24-hour flux integral. Maybe one aircraft on each day. Relatively short flight pattern, but centered on stagnant air and biological fluxes over the region. Where do these winds drift over this time?

Draft plan - B200 on Wednesday. Joint flight on Thursday, or just the C130. Tower assets: Grenada tower. 33.75N, 89.85W; Panama City tower. 30.20N, 85.83W.

TROPOMI track is close on Th. Clouds? Worthwhile? Western gradient? See discussion on the next slide.

W/Th challenge - avoid convective storms as much as possible, roughly follow the air flow from day 1 to day 2, try to compass a full day of air modification (early day 1, later day 2?) Is a broader swath worthwhile? What are broader region back trajectories for Th?

F-Sa-Su. No signature of frontal activities till Sunday over South-GoM region. Any reason to wait for fair weather flights until later in the week? (F/Sa/Su). W-Th look very good in the current forecast. Looks like more convective precip later in the week.

If we don't get another frontal crossing this week, we should be able to get the midwest / Gulf contrast when flying from Lincoln.

Instrument / aircraft / logistics issues:

Any?

Planning:

TROPOMI tracks available. See flight plans folder. OCO2 comes back online (if all goes well) on 1 July.

See updated greenness info and flooding info. Upper Midwest is brown. Whole Mississippi River valley is flooded.

Summary

Wed: Good day for a flight for day 1, fair. Wing-to-wing?

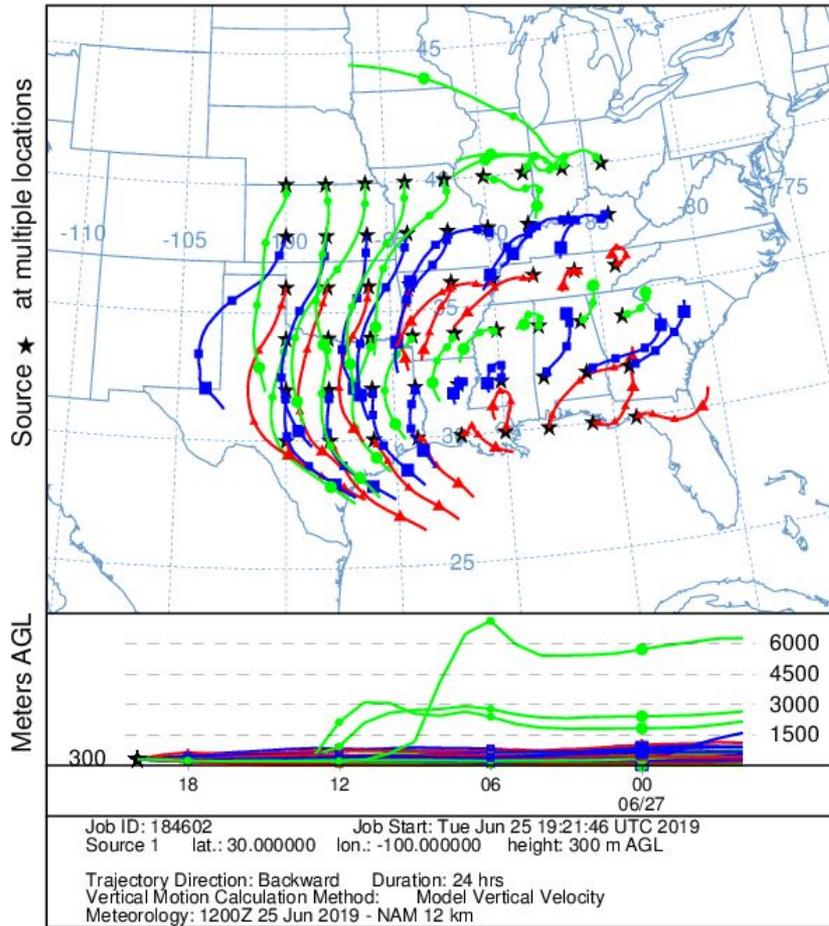
Thu: Also, very stagnant conditions with calm weather over Gulf States. From Wed-Thu, a big blob/CO₂ band oriented NW-SE through central OK and eastern TX is predicted to be evolving is-evolving which sounds interesting to capture (see slide 121 for Thu). So, we discussed that Wed B200 flight over Gulf States with stagnant air condition and Thu transacting through that plume with C130 long flight in the BL with some flight hours with B200 in the east (part of the 2-day air movement)

Ken. I'm looking at the Tropomi track on that day. I think we could have a good underflight merged with "day 2" of the Gulf. I am hesitant to drive flight patterns solely on the basis of the Goddard model forecast to chase gradients. We should be acquiring plenty of data to test the models. That western high CO₂ may be forecast gradients in ecosystem fluxes. We haven't been focused on west Texas/Oklahoma to date. We did just get Gulf inflow over east Texas.

What is the air mass history over TX and OK? What are the back trajectories? Would we gain quantitative information about ecosystem fluxes by flying west? (What about north, where the Goddard system expects to find very low CO₂?) If flying across a spatial difference, in addition to monitoring the draw-down in the Gulf, advantageous to just documenting the drawdown in the Gulf?

TROPOMI track for Th looks partly cloudy. Maybe not worthwhile. Opinions?

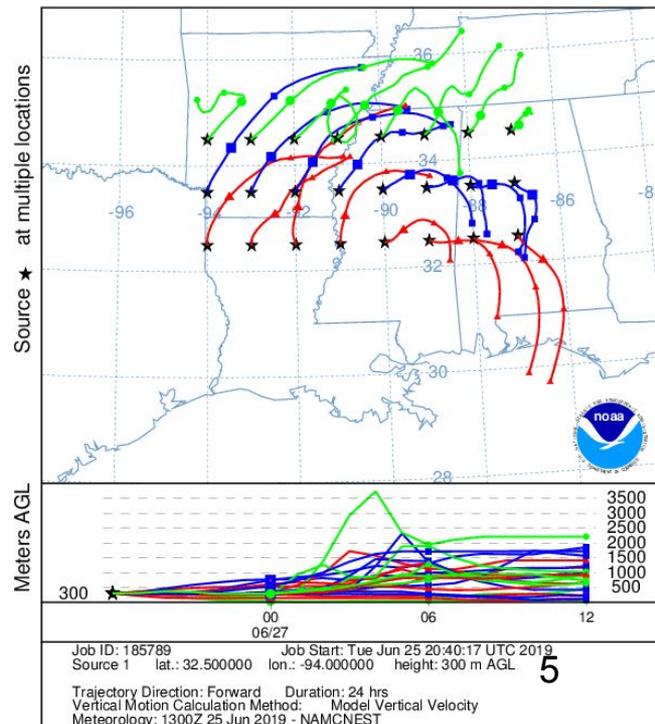
NOAA HYSPLIT MODEL
 Backward trajectories ending at 2000 UTC 27 Jun 19
 12 UTC 25 Jun NAM Forecast Initialization



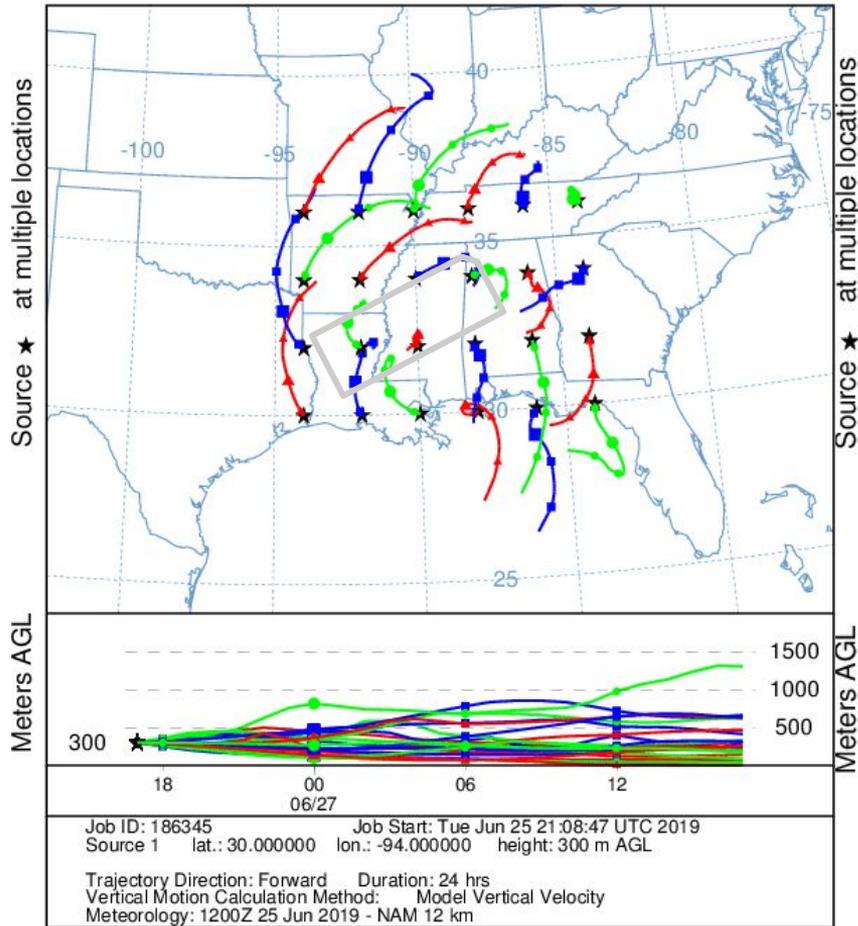
Thursday, 15 CDT 24 hour ABL back-trajectories

18 hours
 forward from
 flight plan
 tomorrow

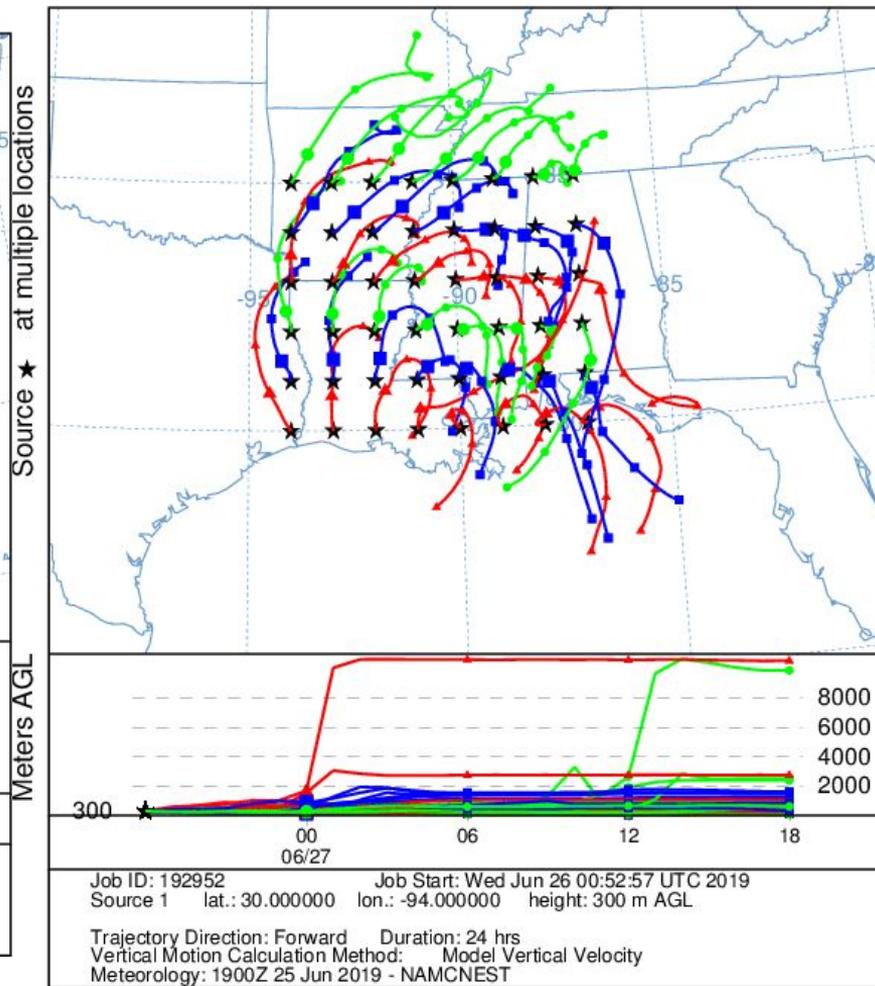
NOAA HYSPLIT MODEL
 Forward trajectories starting at 1800 UTC 26 Jun 19
 12 UTC 25 Jun NAMS Forecast Initialization



NOAA HYSPLIT MODEL
 Forward trajectories starting at 1700 UTC 26 Jun 19
 12 UTC 25 Jun NAM Forecast Initialization

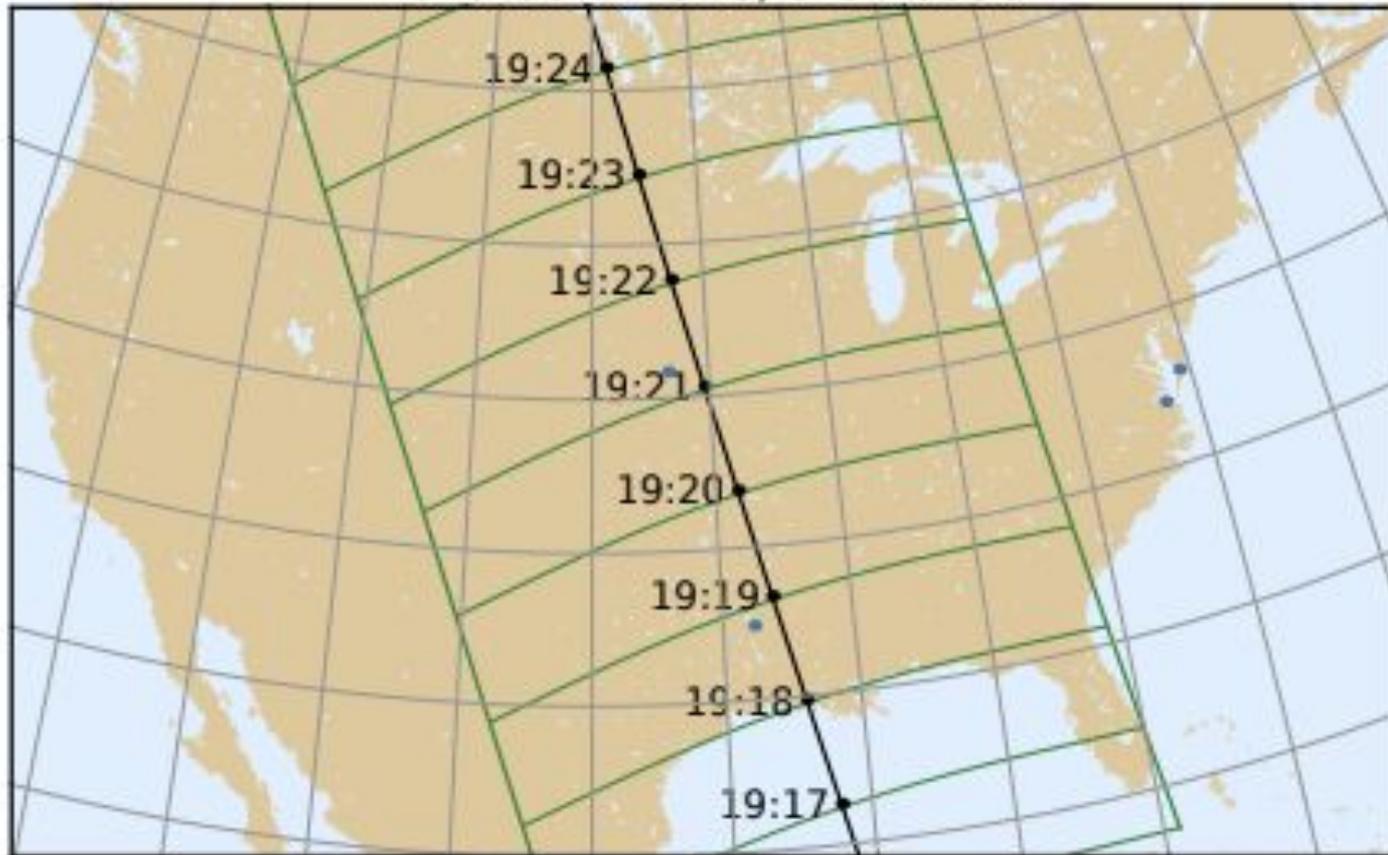


NOAA HYSPLIT MODEL
 Forward trajectories starting at 1800 UTC 26 Jun 19
 18 UTC 25 Jun NAMS Forecast Initialization



27 June TROPOMI track.

2019-06-27 UTC, orbit 8830



G=glint, N=nadir

Scenarios - South

OCO2	offline	offline	offline	offline	offline	offline
Date	Tu, 25 June	W, 26 June	Th, 27 June	F, 28 June	Sa, 29 June	Su, 30 June
Scenario 1	down	Gulf forest fair weather - 2, 4?	Gulf forest fair weather - 2, 4?	down	down	down
Scenario 2		TROPOMI?	TROPOMI?			
Scenario 3		down	down			

Next hard down day required by Monday, 1 July. So really, required by Sunday, 30 June since Monday is transit day and can't be a hard down day.

Overall flight hours: C130: 26.1. B200: About 23 thus far?

South: C130. 5.2 transit, 14.6 south science. B200. 6 transit? 11 south science?

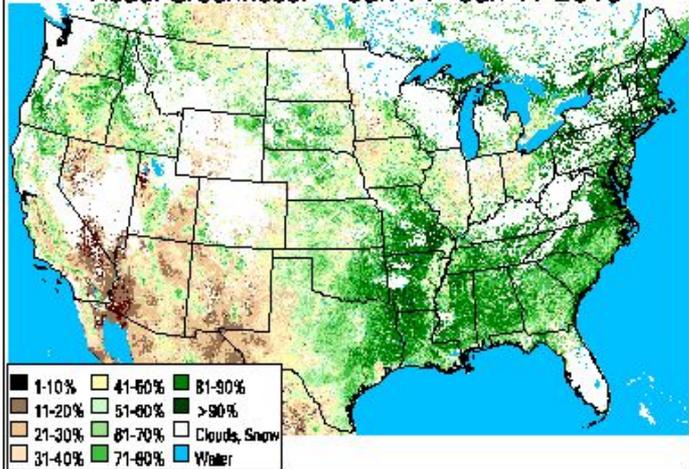
Ken's regional target: About 5 research flights. 5x5-6 hours/flight = 25-30 hours, C130; 5x4 hours/flight = 20 hours, B200. OCO2 flights (target of 2-3 total / campaign) adds. WCB flights will probably be longer. Aiming for 2-3 of those.

Date	Weather	Flight	Comments/ Science Objectives
<i>M 17 June</i>	<i>Onshore flow continues across the entire Gulf region. Strong N-S line of convective storms interrupted the flight lines in Mississippi. Storms are likely to break up the simple onshore ABL flow in those storms and (in the ABL to their west?).</i>	<i>Transit from coastal Virginia to Shreveport, Louisiana</i>	<i>ABL and lower free trop / lidar legs downwind of coast - quantify coastal CH4 emissions, and nighttime CO2 fluxes (12 hour advection time). Soundings from east to west across the Gulf region. Mass balance for CH4 east of the storms might work well. Contrast in the atmosphere east and west of the convective storm line might be interesting. No front, just organized convection mid-track.</i>
<i>Tu 18 June</i>	<i>Two fronts to the north, but more southerly front dissipates.</i>	<i>No flight.</i>	<i>Weak / ambiguous front.</i>
<i>W 19 June</i>	<i>Front to the NW (more northerly front from Tu).</i>	<i>No flight.</i>	<i>Frontal crossing would have primarily western surface influence.</i>
<i>Th 20 June</i>	<i>L moves east, front recedes to N</i>	<i>Frontal Crossing / onshore flow.</i>	<i>Contrast CO2, CH4 and N2O across the front, comparing upwind fluxes in the Gulf and Midwest regions. Quantify Gulf emissions of all gases with onshore flow data. These data should limit N2O emissions from the Mississippi River Valley, and the low B200 line may also address Houston ethane emissions.</i>

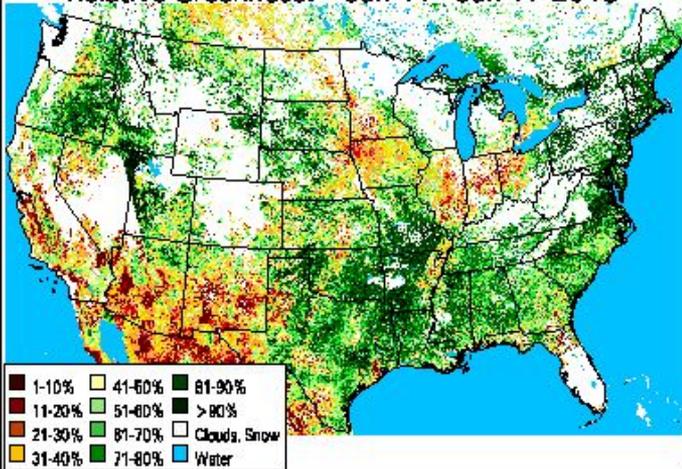
Date	Weather	Flight	Comments/ Science Objectives
<i>F 21 June</i>	<i>On shore flow, less convection. L forms near Lincoln, NE. Warm conveyor belt flight possible.</i>	<i>down</i>	<i>Not a strong WCB, and a little far away. Hope for similar conditions with a stronger low when we're in Lincoln.</i>
<i>Sa 22 June</i>	<i>Strong regional Gulf inflow - deep inflow. Southern end of the warm conveyor belt. Warm front moves to the northeast. Regions of storms kick up inland within the Gulf Inflow.</i>	<i>Gulf Inflow / southern end of the Warm Conveyor Belt flight.</i>	<i>Constrain regional CO2 (bio) and coastal / riverine CH4 emissions. Characterize the WCB at its southern end. Upwind (Gulf) data from the B200. See notes</i>
<i>Su 23 June</i>	<i>Gulf inflow continues, front forming to the NW. Severe storms pass through Shreveport, moving in from the northwest.</i>	<i>down</i>	<i>Small tornado(?) passes by the Residence Inn, Shreveport.</i>
<i>M 24 June</i>	<i>Frontal boundary in the region, but diffuse. Low pressure center moves far to the northeast.</i>	<i>down</i>	<i>Not a distinct boundary, perhaps due to extensive convection, L pressure moving away, and regional high pressure beginning to build. Not a good/clear frontal case.</i>

Date	Weather	Flight	Comments/ Science Objectives
Tu 25 June	Low moves east - front dissipates. High pressure builds in the Gulf states. Transitional.		
W 26 June	High pressure moves in over Gulf. Stagnant air.	Fair, day 1	Constrain regional biological CO2 fluxes, maybe CH4. Short flight pattern with one aircraft, more north? Get initial conditions.
Th 27 June	High pressure remains. Stagnant air.	Fair, day 2	Constrain regional biological CO2 fluxes, maybe CH4. Short flight pattern with one aircraft, more south? Get final state a day later.
F 28 June	High pressure remains. Stagnant air.		
Sa 29 June	High pressure remains. Stagnant air.		
Su 30 June	High pressure remains. Stagnant air.		

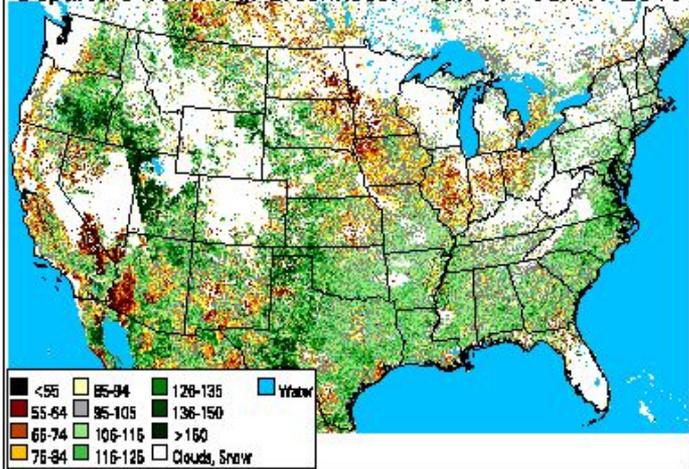
Visual Greenness: Jun 11 - Jun 17 2019



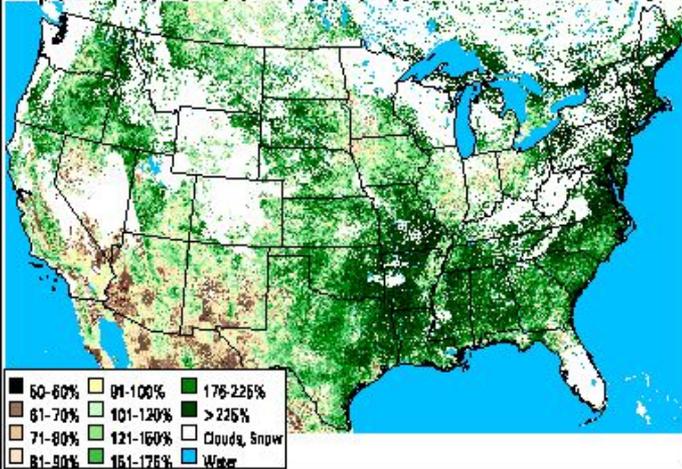
Relative Greenness: Jun 11 - Jun 17 2019

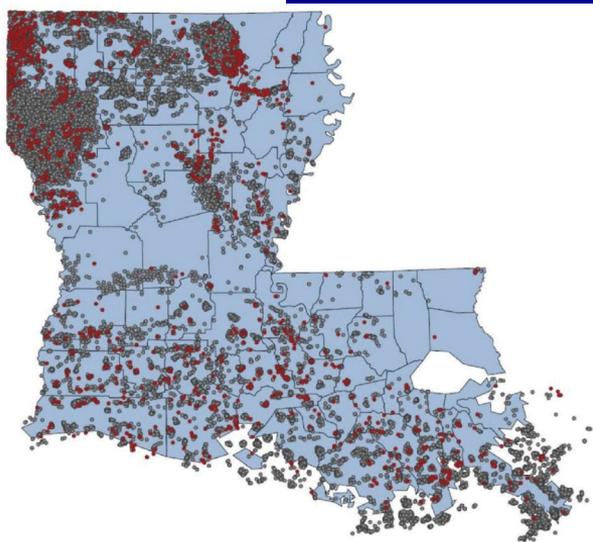


Departure from Avg. Greenness: Jun 11 - Jun 17 2019

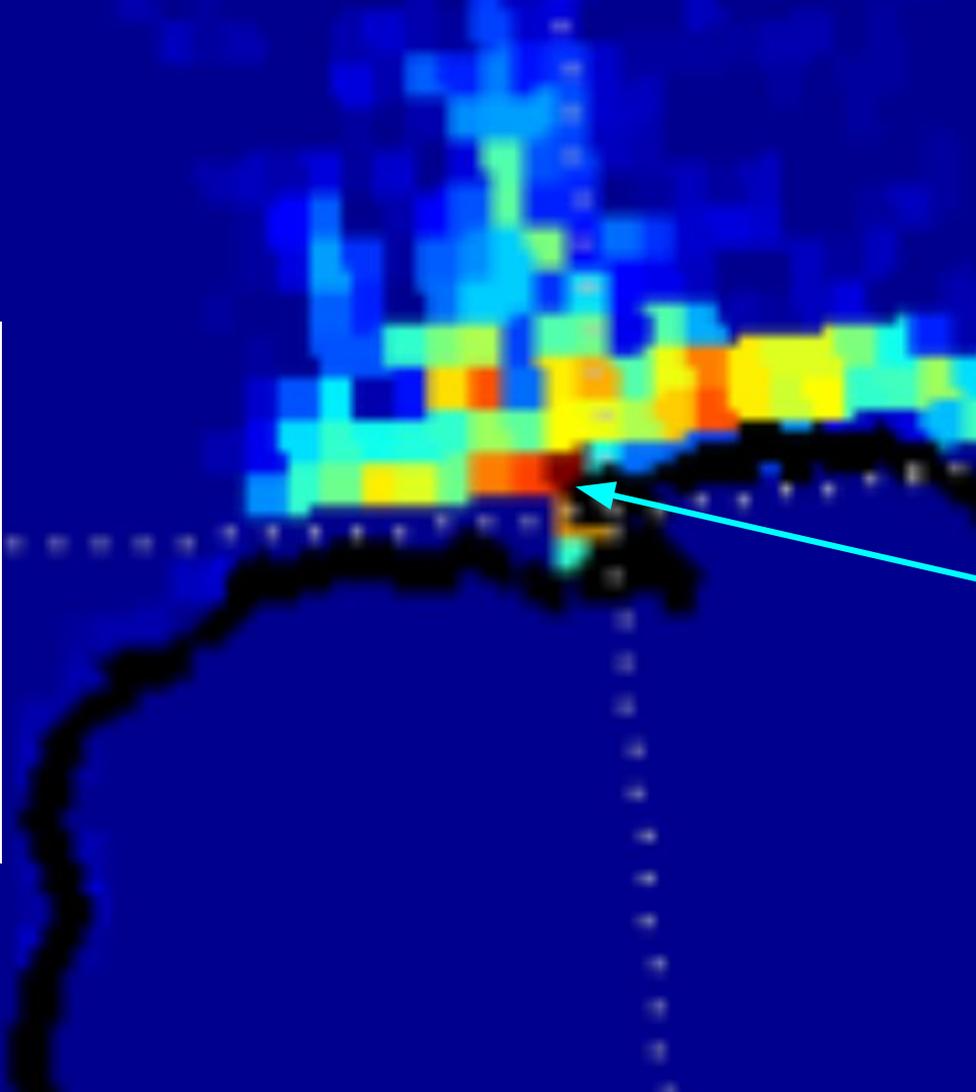


Experimental Shrub Moisture: Jun 11 - Jun 17 2019



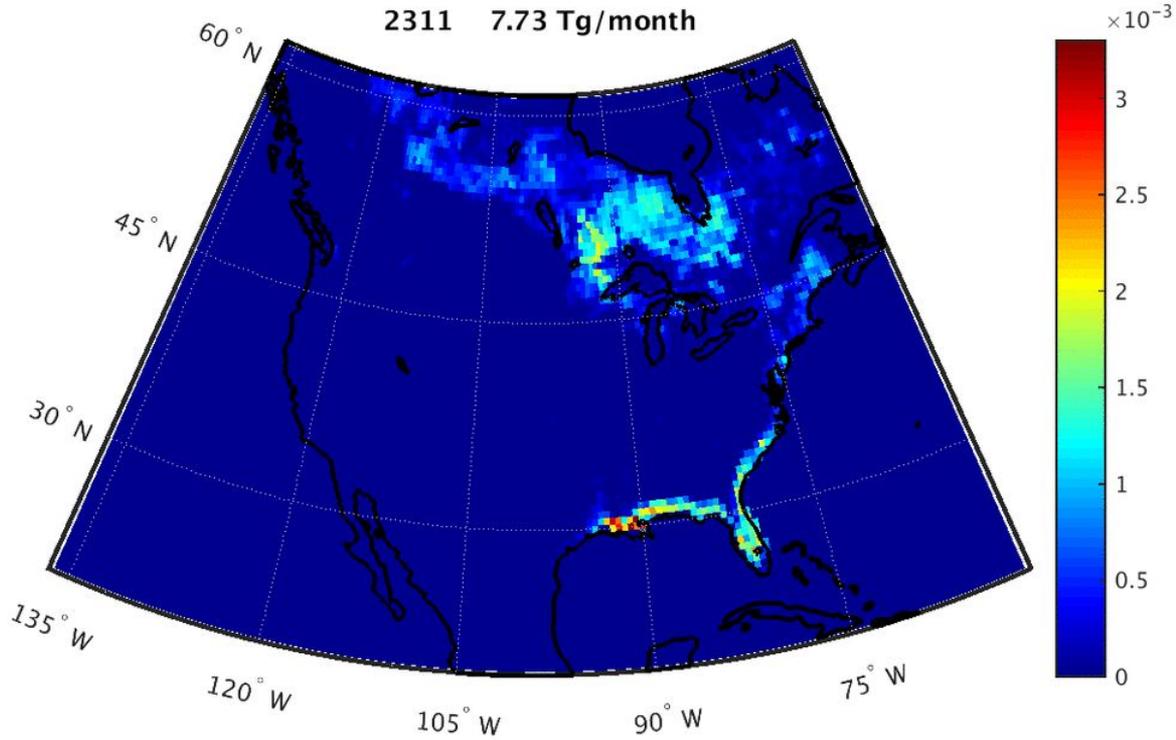


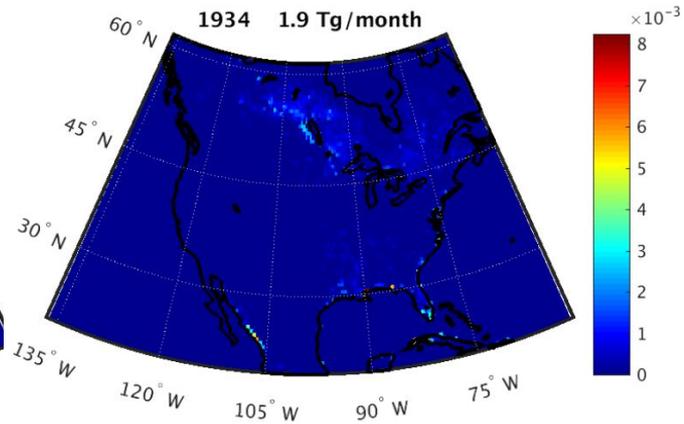
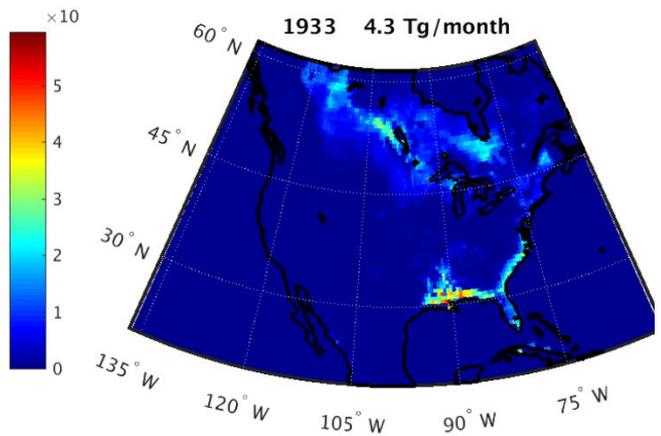
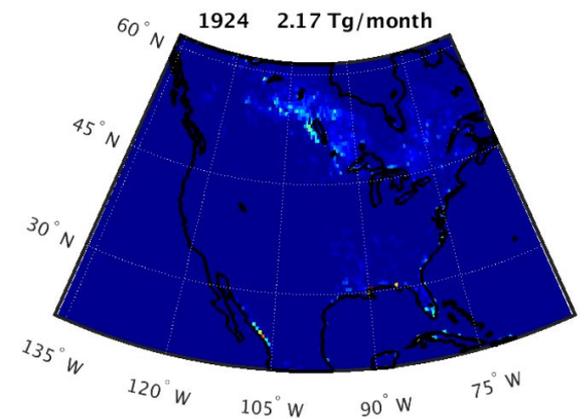
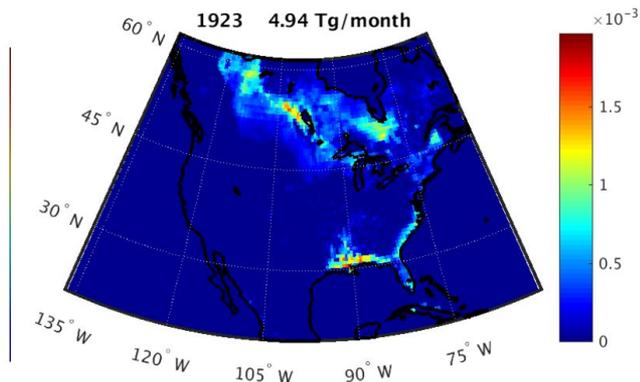
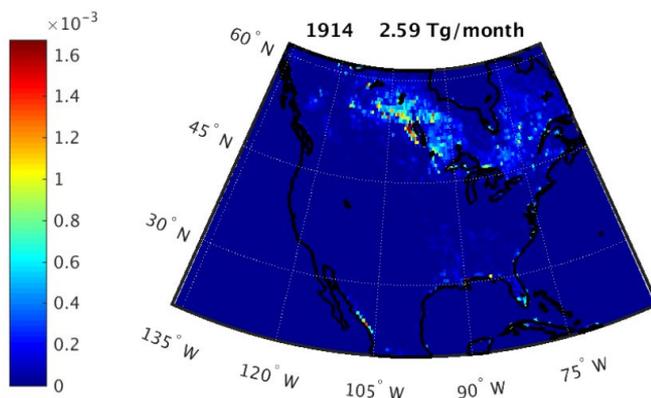
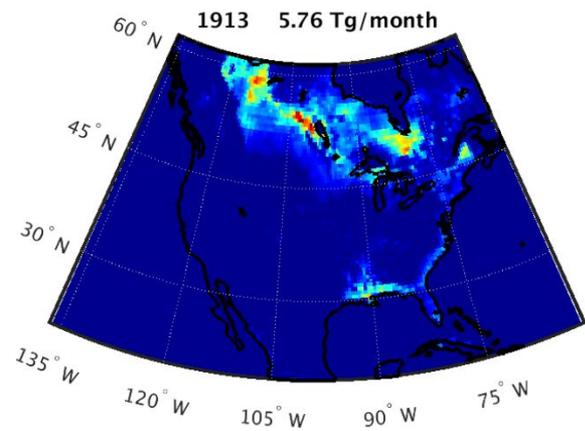
wells



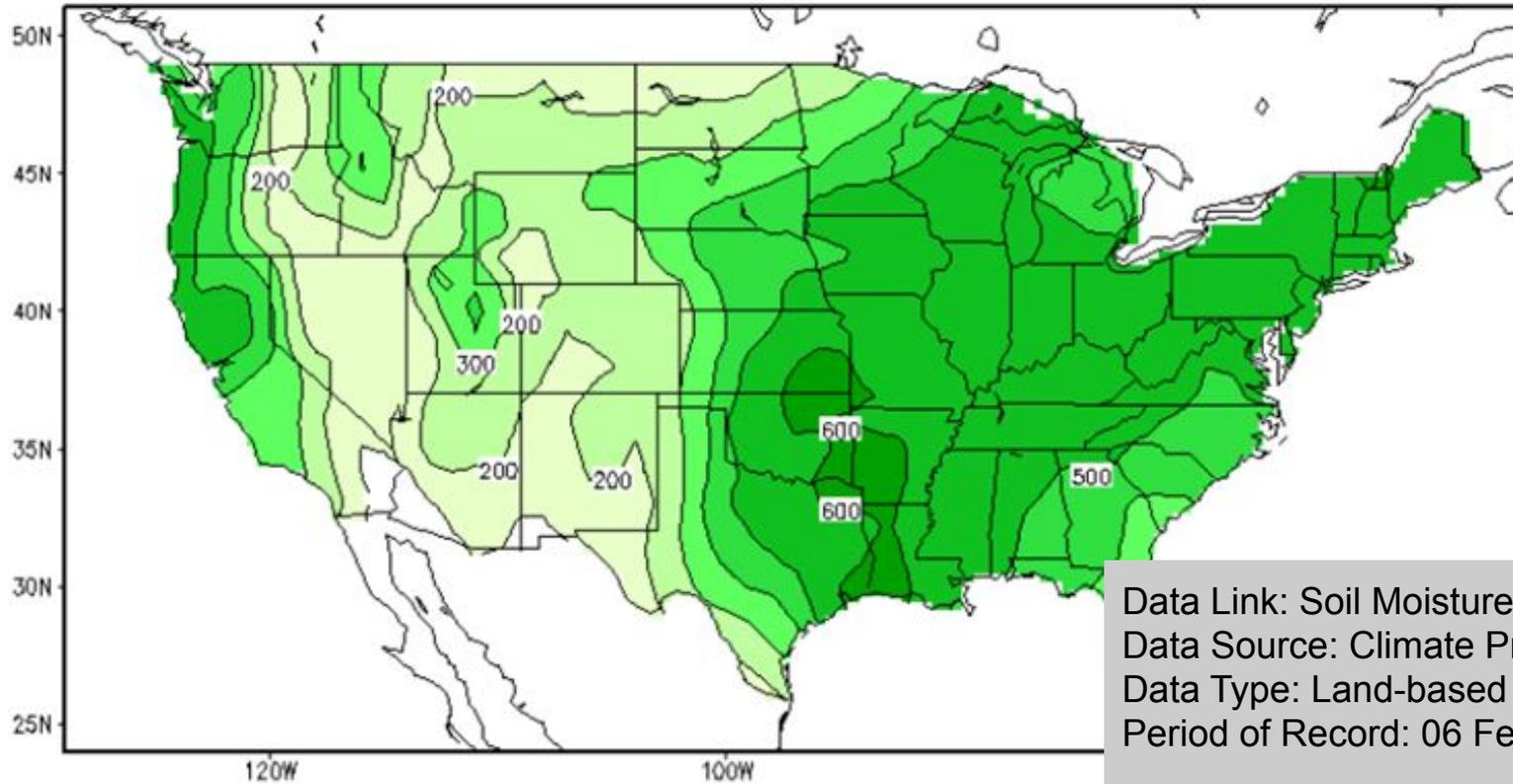
That spot is a high point in multiple ensembles. I would be sure to try and get that.

Here, have a wetlands map





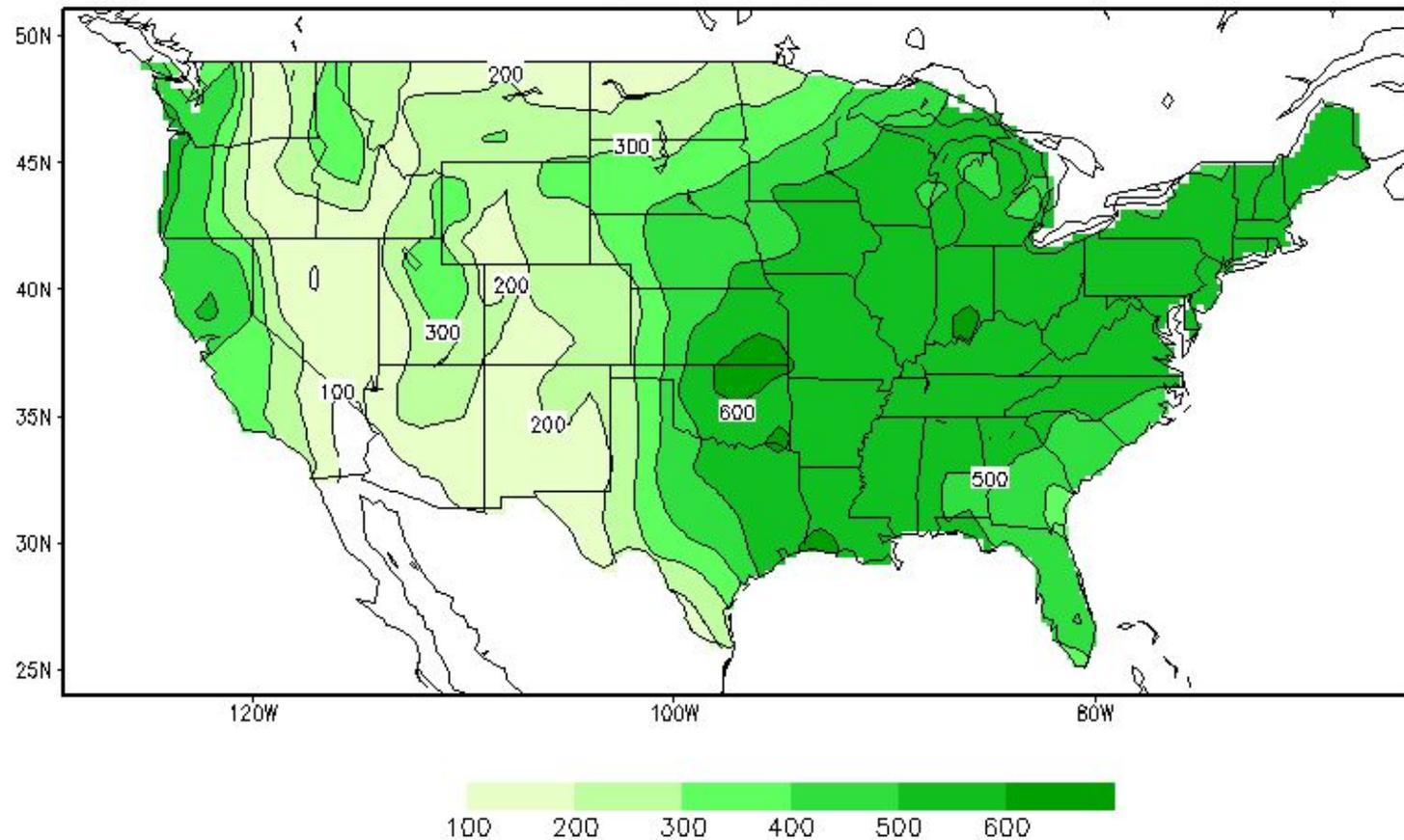
Calculated Soil Moisture (mm) JUN 07, 2019



Data Link: Soil Moisture
Data Source: Climate Prediction Center
Data Type: Land-based Station
Period of Record: 06 Feb 2008 - Present

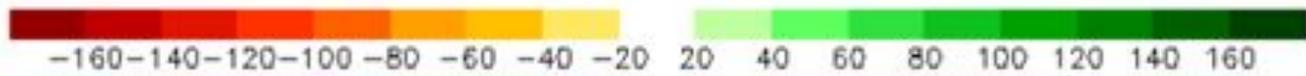
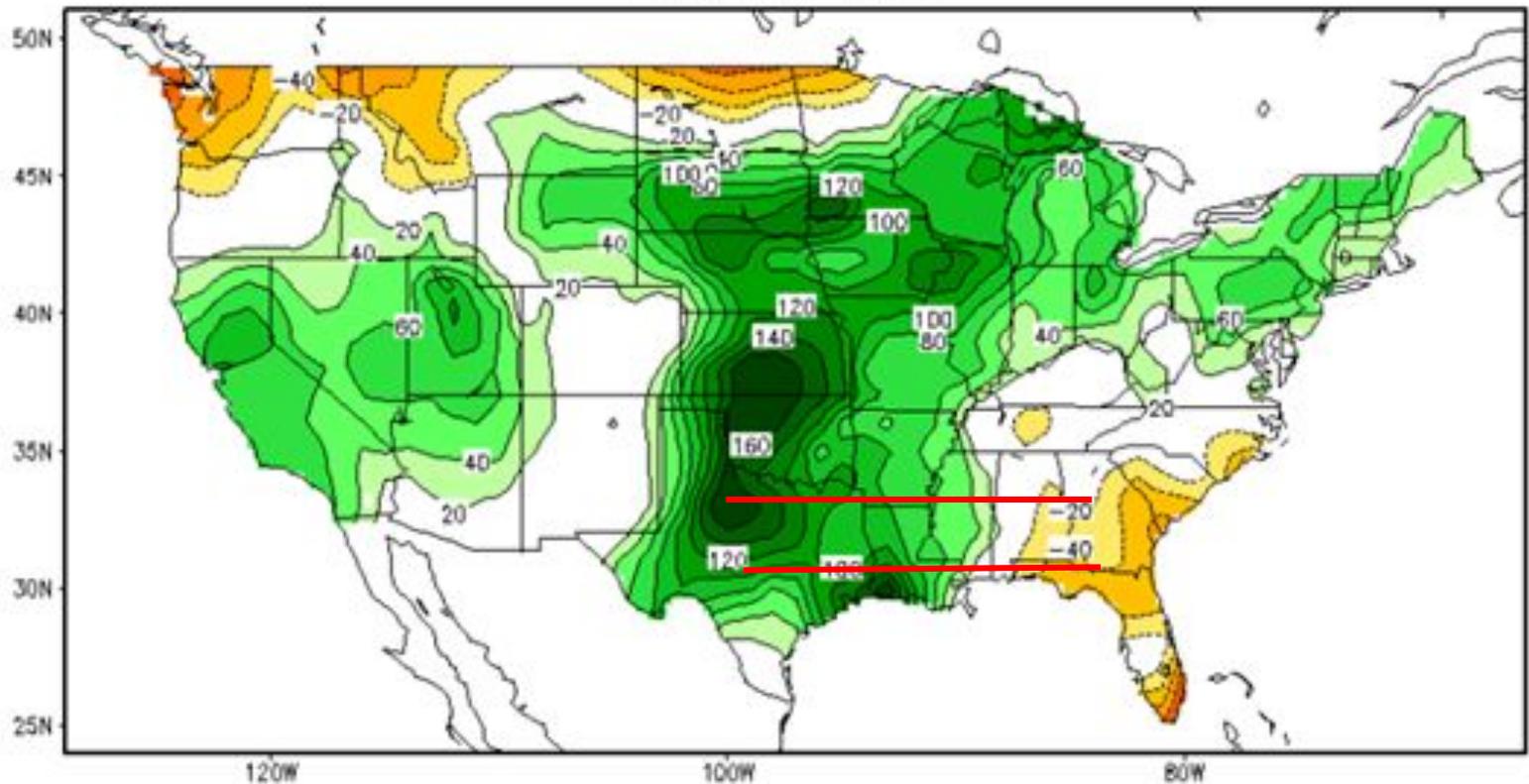


Calculated Soil Moisture (mm) JUN 19, 2019

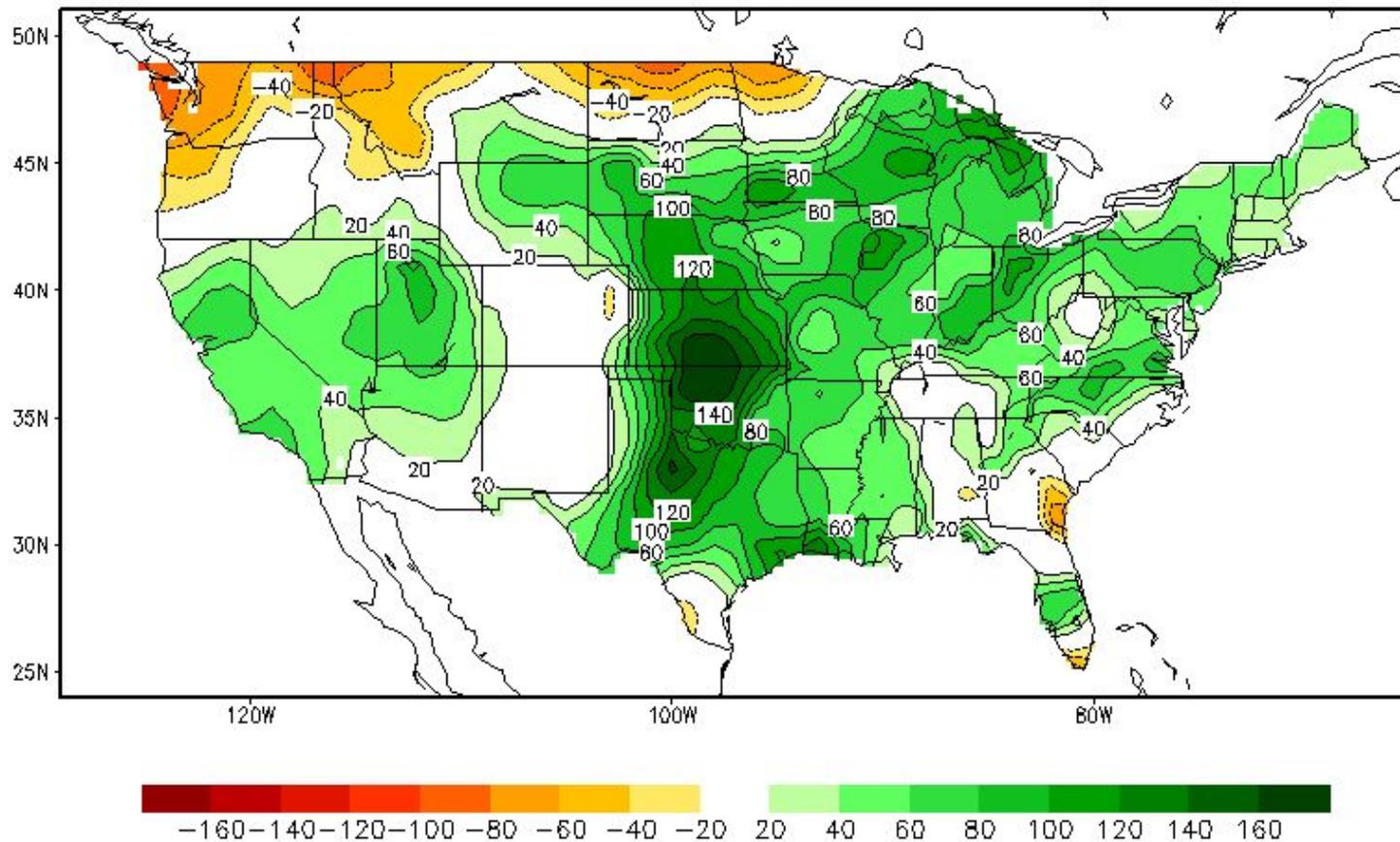


Calculated Soil Moisture Anomaly (mm)

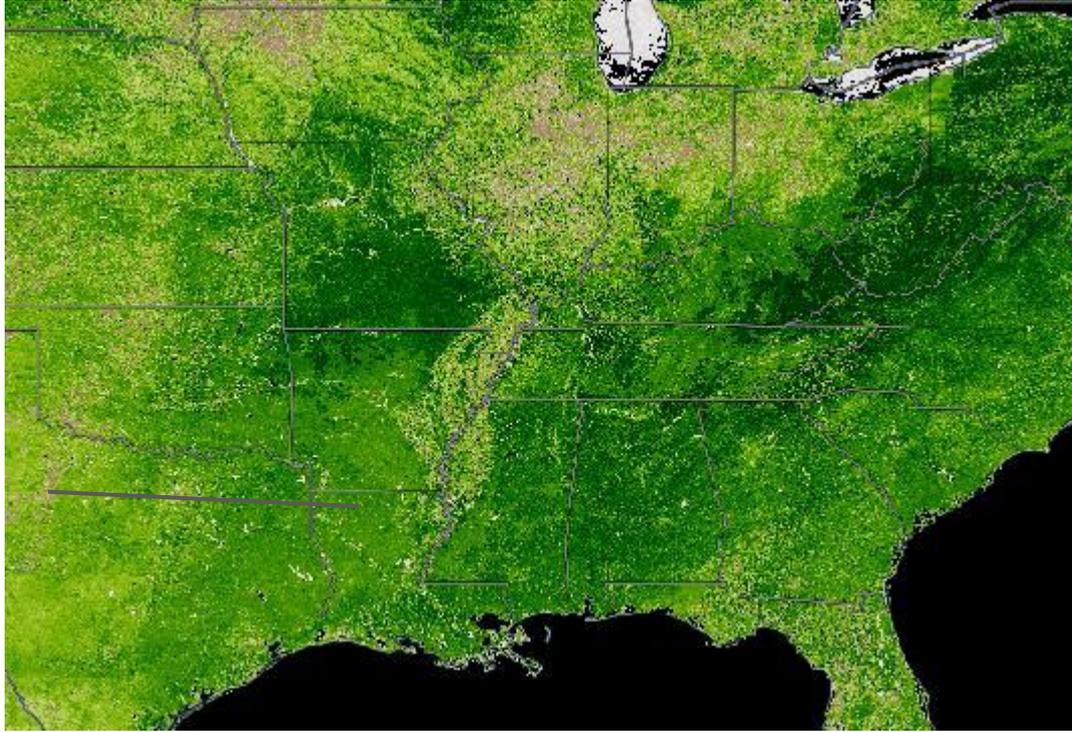
JUN 07, 2019



Calculated Soil Moisture Anomaly (mm) JUN 19, 2019



8-day rolling MODIS-Terra EVI for 19 June 2019

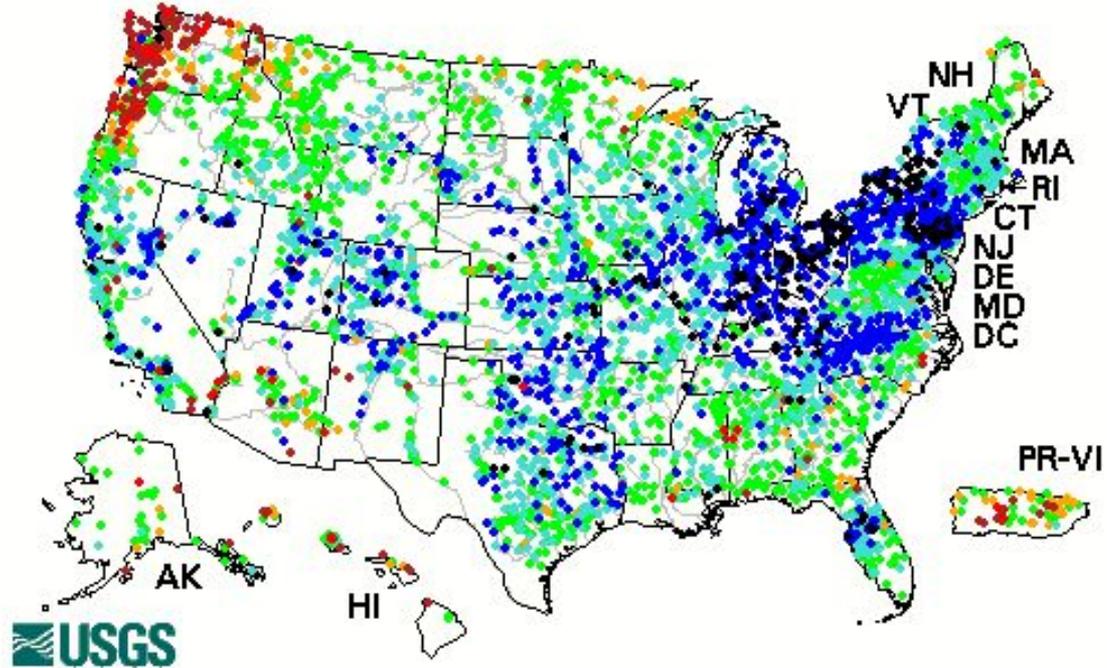


8-day rolling MODIS-Terra EVI for 23 June 2019



USGS Current streamflow for 2019/06/20

Thursday, June 20, 2019 16:30ET



USGS Current Flooding (black) and 95+ percentile readings

