ECOSTRESS Surface Temperature Applications in the San Francisco Estuary

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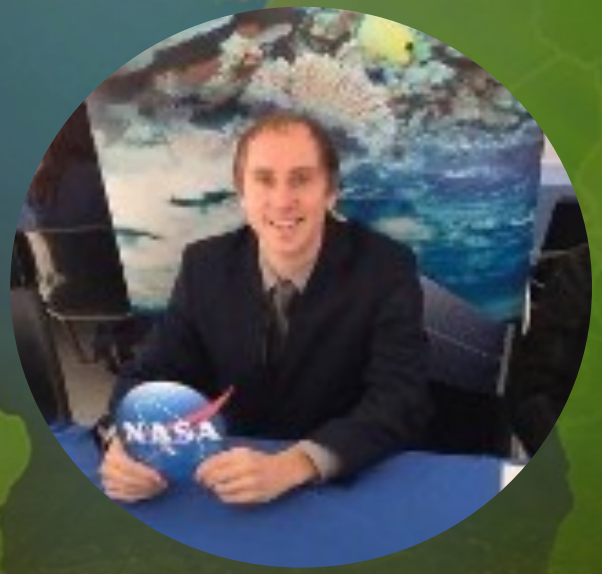
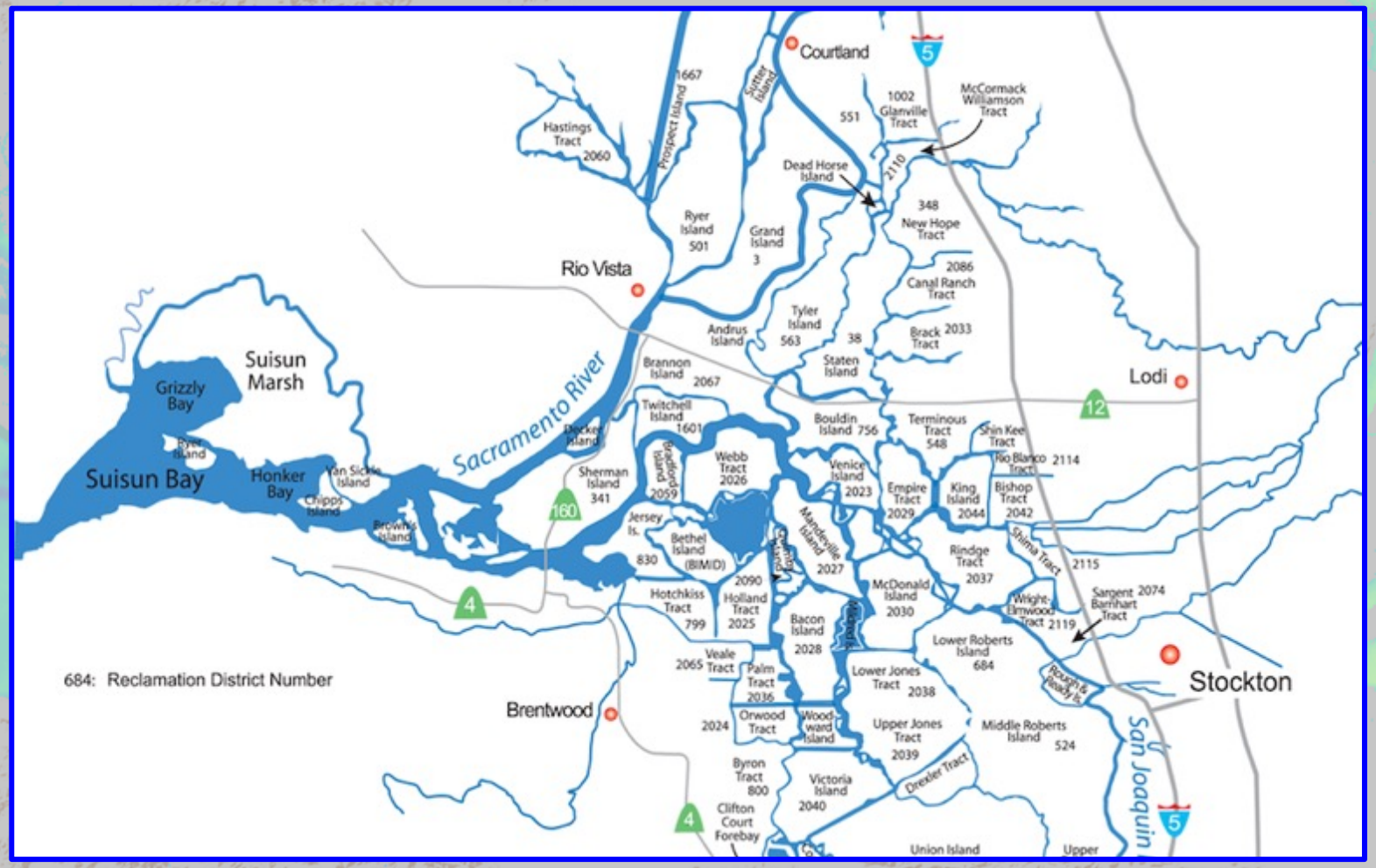
ECOSTRESS

Special thanks



Gregory Halverson, JPL

Rebecca Gustine, WSU



CA Department of Water Resources

- Highly altered system, 1100 miles of levees
- Hub of California's water supply
- Largest Pacific side estuary, and part of a world biodiversity hotspot
- Receives 40-50% of streamflow generated by Sierra Nevada

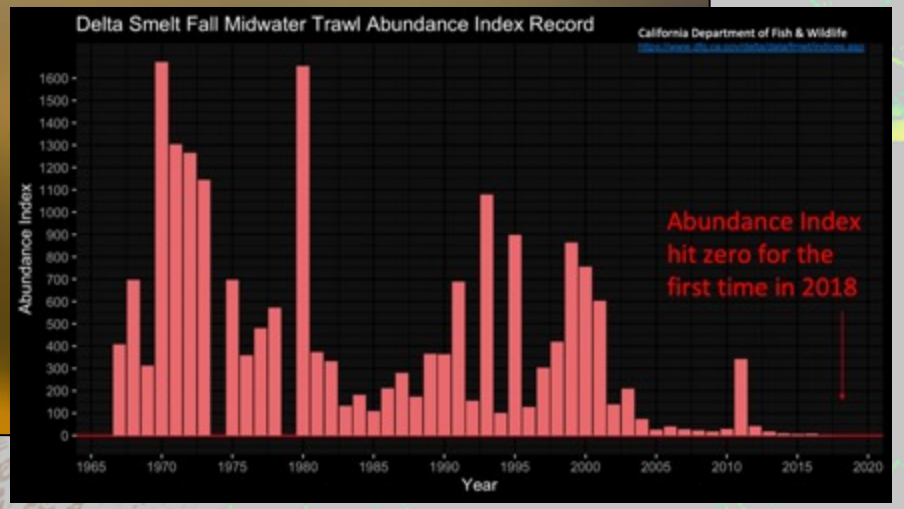
Reduction in freshwater outflows

Entrainment losses to water diversion

Changes in food organisms

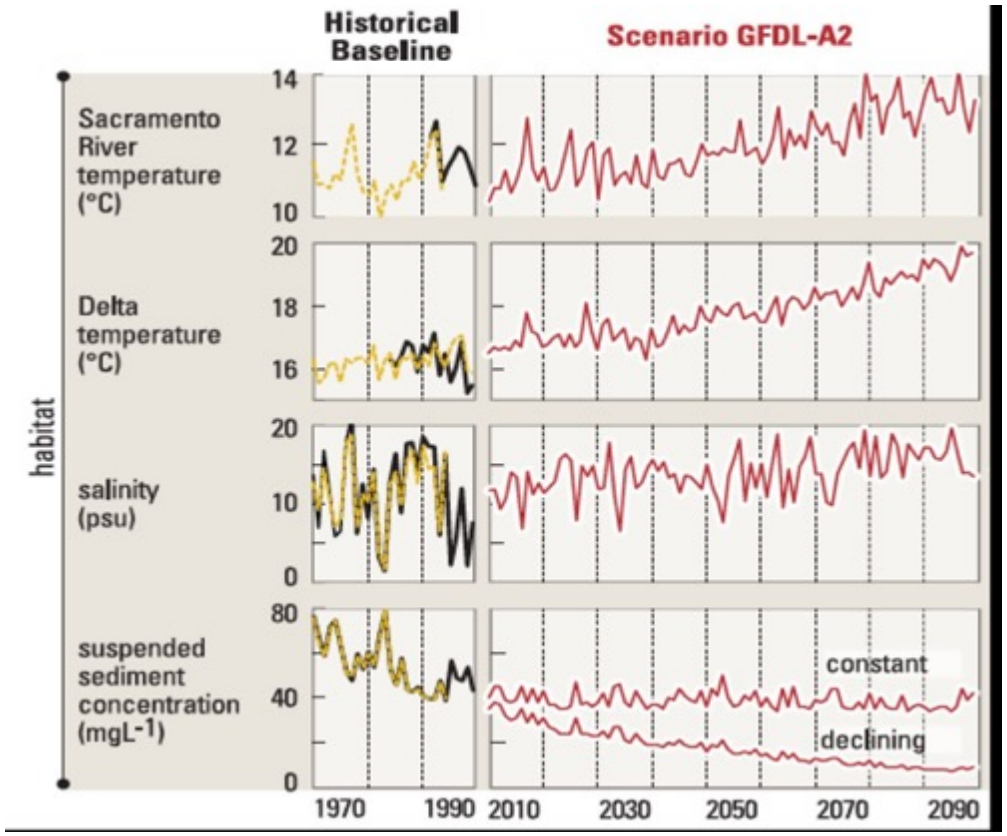
Toxic substances

Disease, predation, invasive species

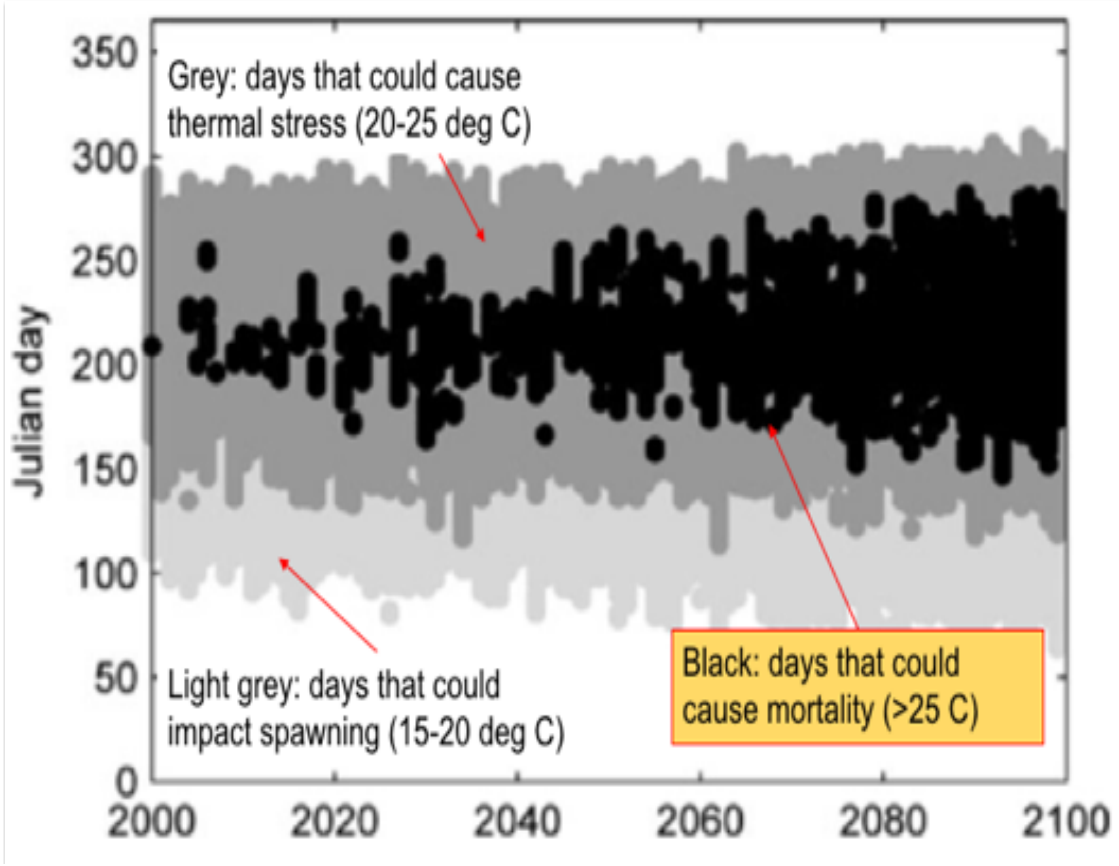


Water temperature is a critical factor governing habitat suitability in aquatic and estuarine systems

Cloern et al 2011



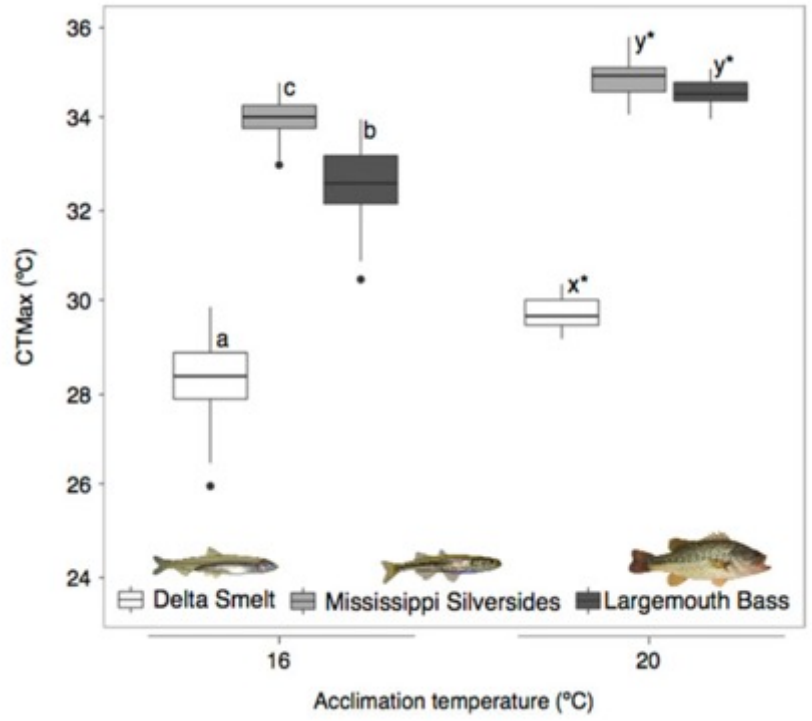
Wagner et al 2011

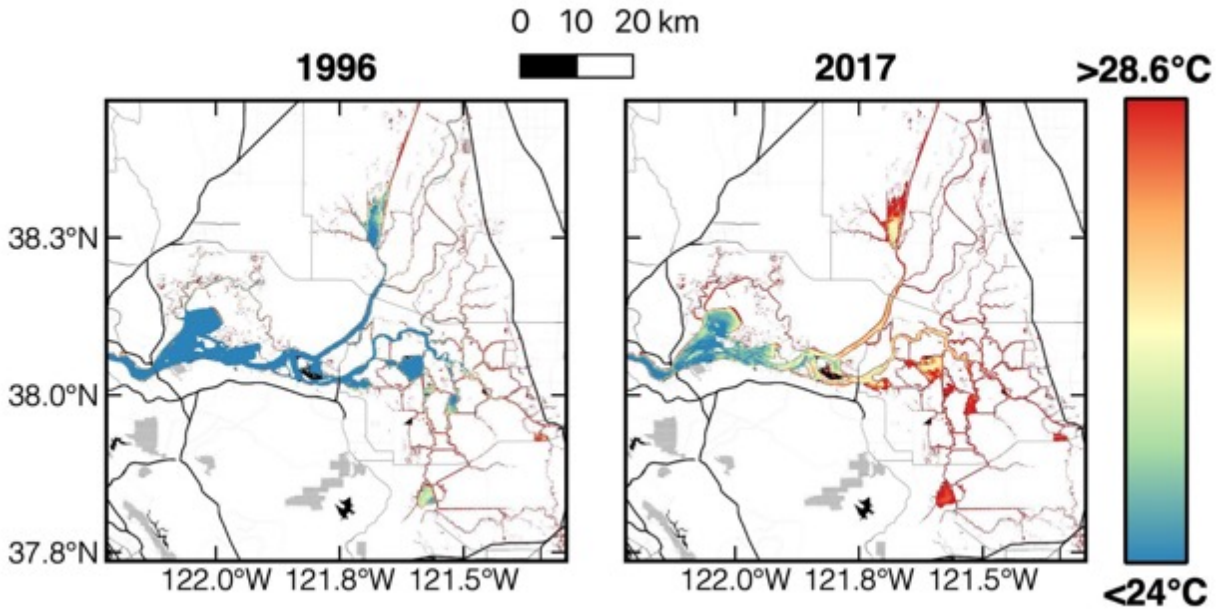


Temperatures in Delta habitat projected to increase

Along with increases in conditions that are considered lethal to the Delta Smelt

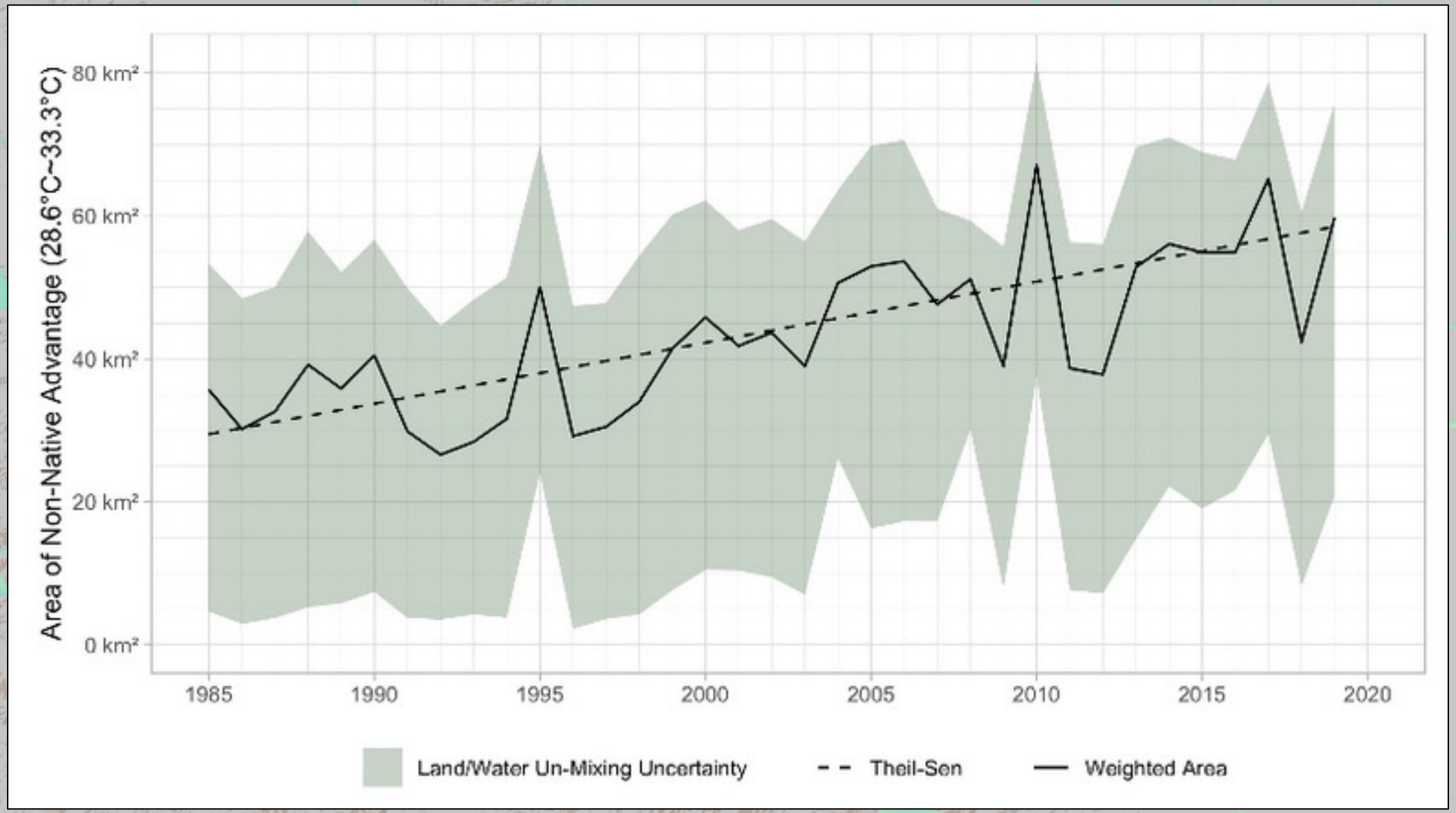
Linking remotely sensed temperature to thermal tolerances of invasive fish species and the Delta smelt.



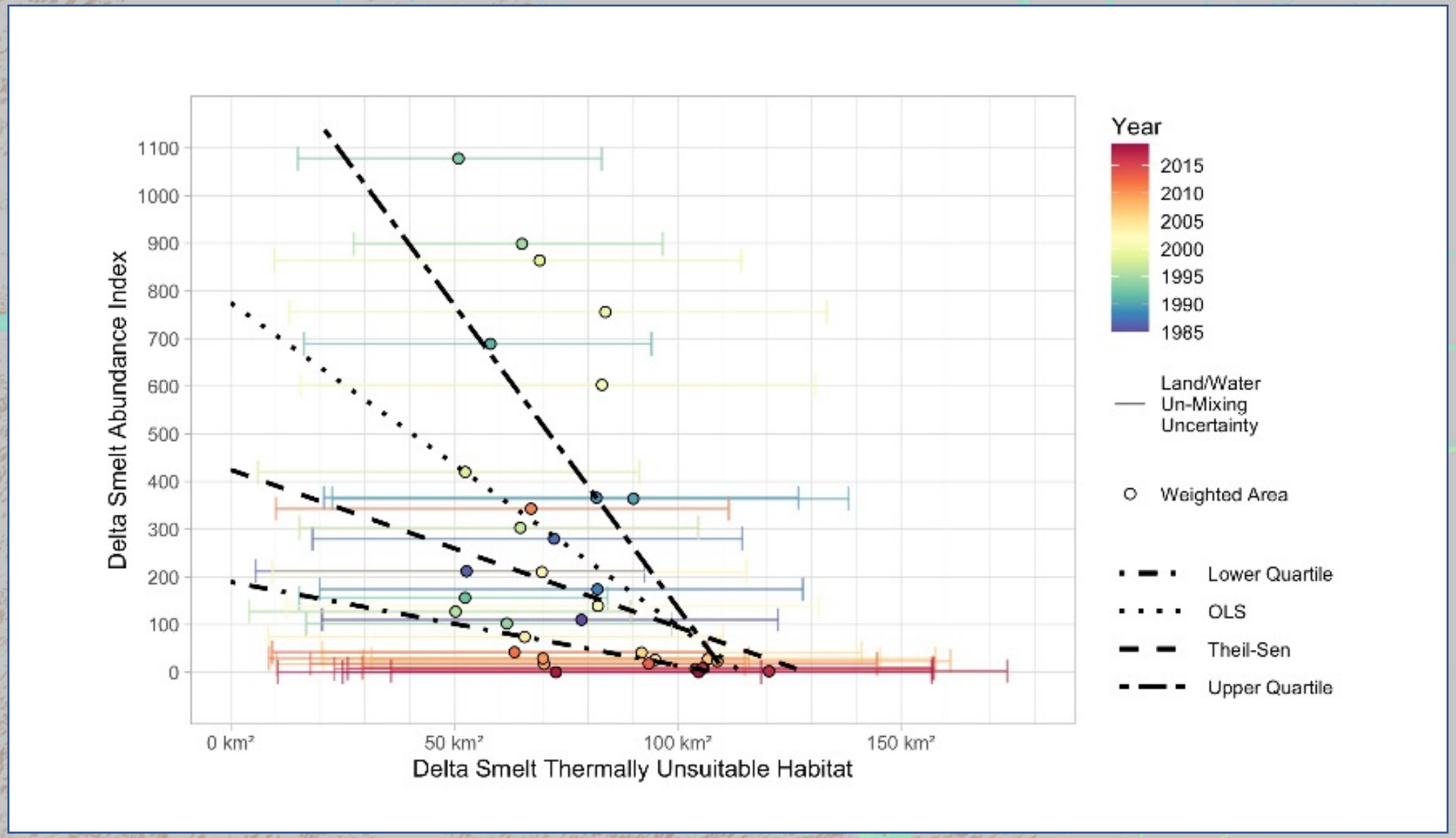


Davis et al. 2019

Thermal habitat for Delta smelt is degrading faster than it is for non-native species (Halverson et al, in revision)



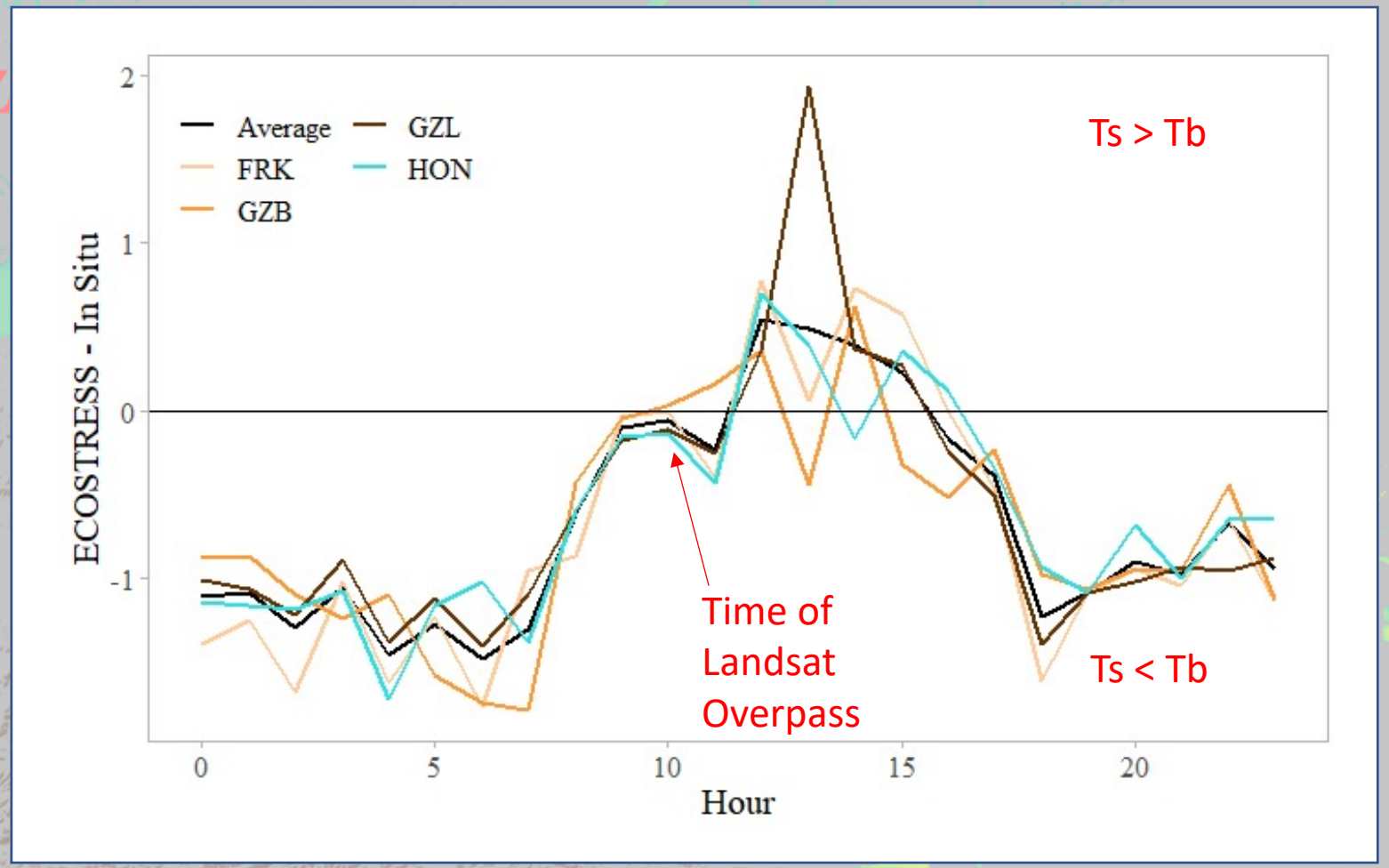
When thermally unsuitable habitat exceeds 109 km2 in a given year, the smelt abundance index is likely to be very low



ECOSTRESS for ecosystem management applications (Gustine et al, in revision)

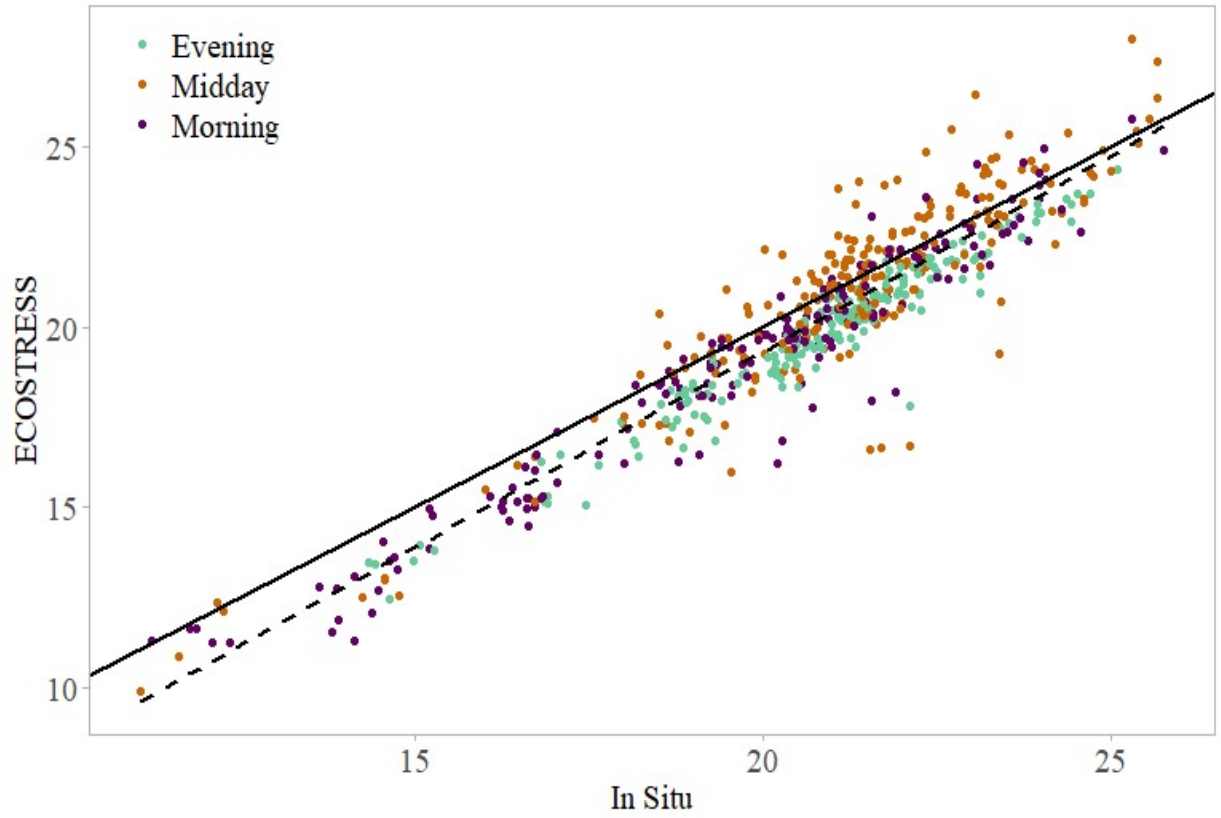
Differences in skin and bulk temperature varies throughout the day

- Landsat overpass time happens to line up at a point during the day when DT is minimal
- Ts > Tb midday
- Ts < Tb morning and evening
- Ts = Tb around 10 or 11 am and 4 pm
- Greatest difference between Ts and Tb around 2 pm and 6 PST



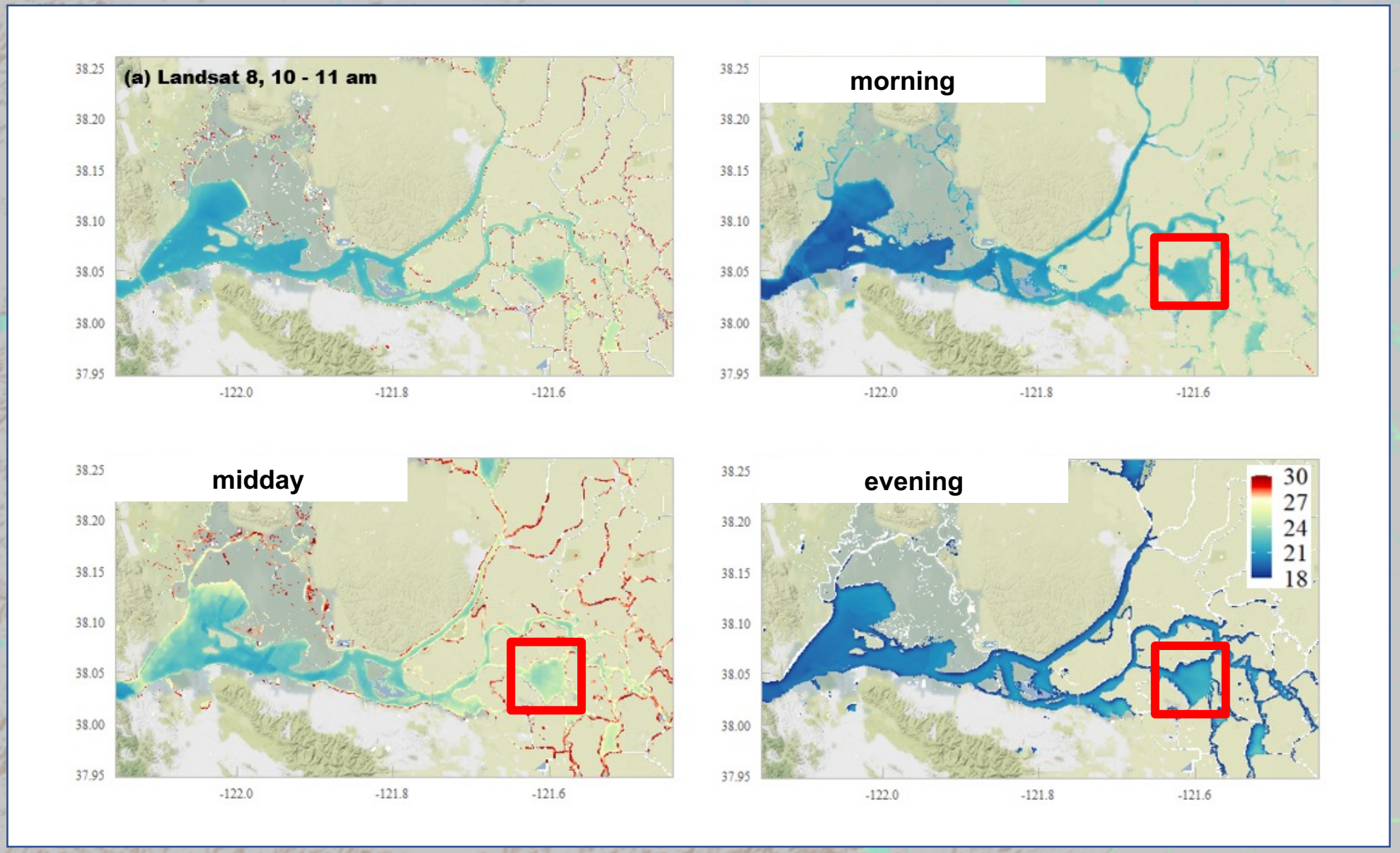
Credit: R. Gustine

ECOSTRESS surface temperature compared with bulk temperature measurements



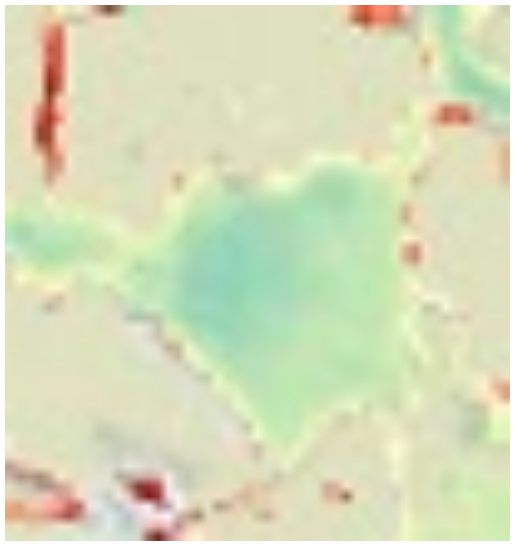
	Period of Data	n	r				RMSD				R^2			
			Overall	Morning	Midday	Evening	Overall	Morning	Midday	Evening	Overall	Morning	Midday	Evening
ECOSTRESS (1): All Data	2018-07-15 - 2021-01-14	555	0.940	0.966	0.903	0.971	2.079	2.029	2.158	2.023	0.884	0.933	0.815	0.943
ECOSTRESS (2): 10-11 AM only	2018-07-15 - 2021-01-14	53	0.989	NA	NA	NA	0.934	NA	NA	NA	0.978	NA	NA	NA
Landsat: 10-11 AM	2015-06-01 - 2021-01-08	226	0.976	NA	NA	NA	1.808	NA	NA	NA	0.953	NA	NA	NA

Average surface water temperature conditions at different times of day
12-7PM exhibit hotter water temperature conditions than morning and evening



Open waters show substantial diurnal variability in surface temperatures, where sensitive species are more likely to seek refuge

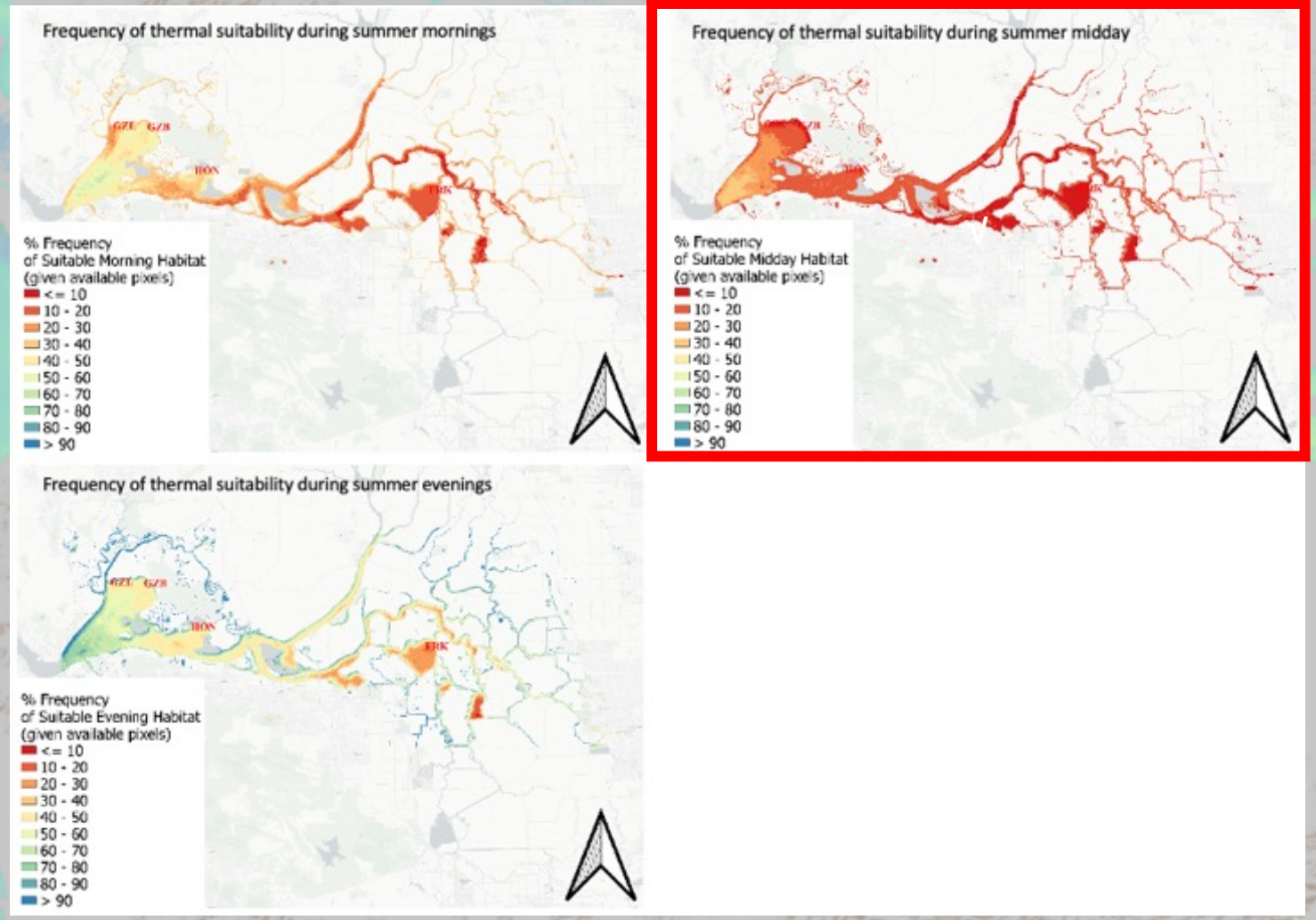
morning



midday

evening

Preliminary assessment of thermal habitat suitability by time of day using stress threshold

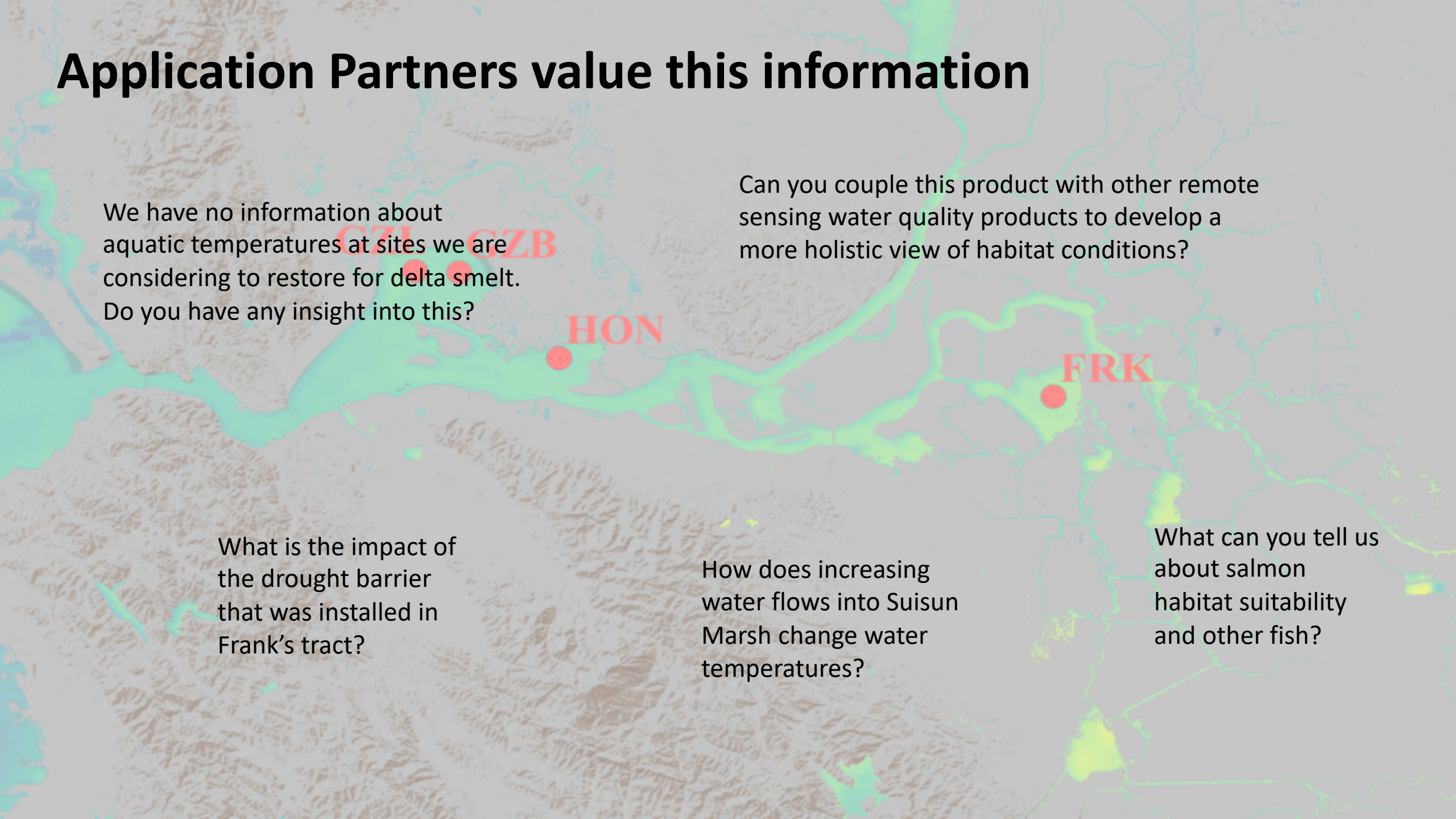


- ~90% of the Delta smelt habitat appears thermally unsuitable during summer afternoons (2018-2020)
- Next steps will include an adjustment that accounts for skin effect and constructing suitability plots for invasive fish with higher thermal tolerance

Application Partners value this information

We have no information about aquatic temperatures at sites we are considering to restore for delta smelt. Do you have any insight into this?

Can you couple this product with other remote sensing water quality products to develop a more holistic view of habitat conditions?

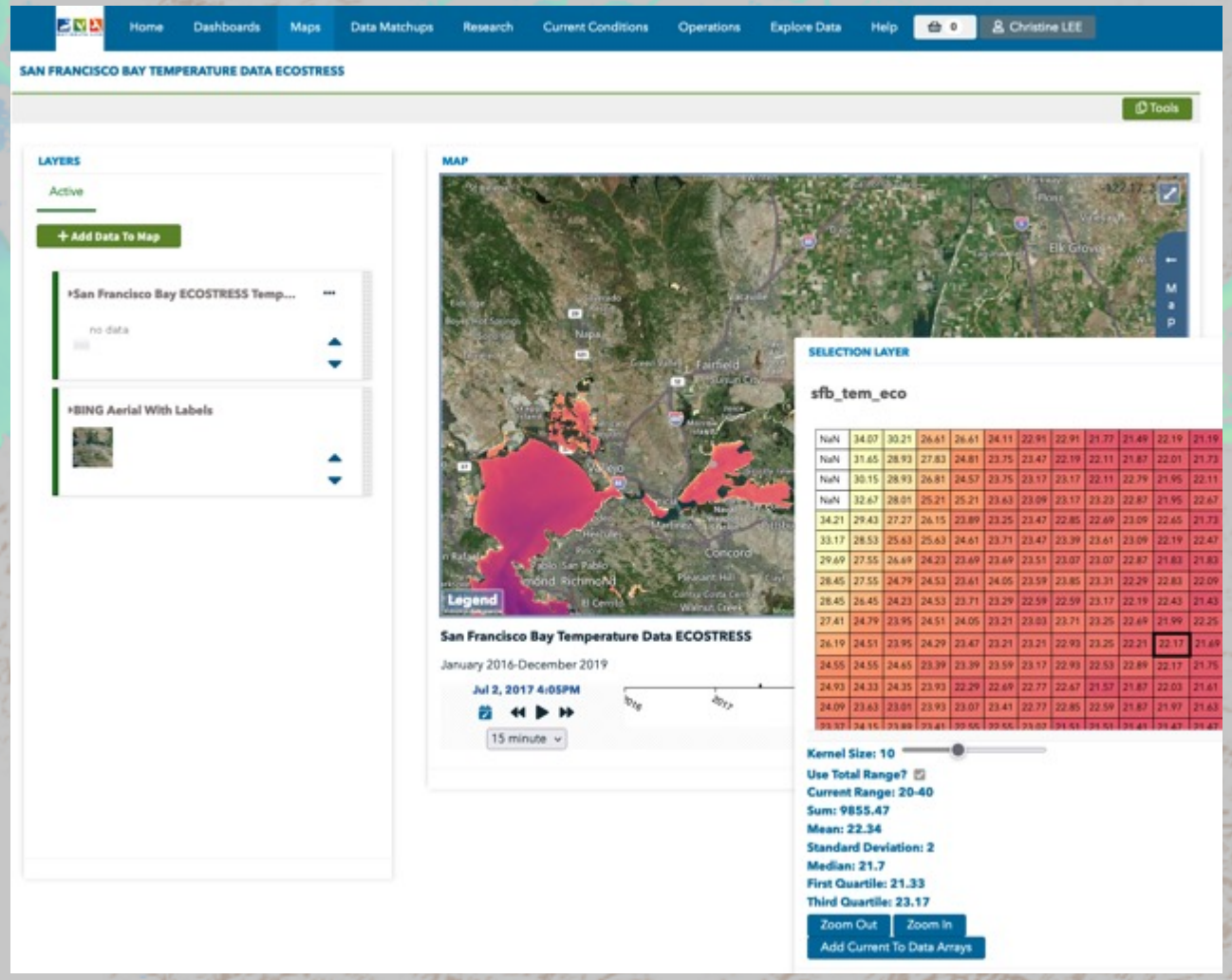


What is the impact of the drought barrier that was installed in Frank's tract?

How does increasing water flows into Suisun Marsh change water temperatures?

What can you tell us about salmon habitat suitability and other fish?

Landsat 35 year+ record now operationally accessible at Bay Delta Live
ECOSTRESS data to be incorporated after Collection 2 release



- Landsat record is now operationally accessible on Bay Delta Live (yay) for our stakeholders to access
- ECOSTRESS test data are now available too, but operational pipeline will be implemented after collection 2 is released
- Bay Delta Live is sustained by external stakeholders
- Our studies, and anything requested by stakeholders, become data dashboards
- https://nasa.baydeltalive.com