Thermal stress in South Florida estuaries: A multi-sensor assessment

Chuanmin Hu, University of South Florida

huc@usf.edu, https://optics.marine.usf.edu

NASA Award 80NSSC20K0076, ROSES2018 A.7

Co-Principal Investigators:

Brian Barnes, University of South Florida

Zhiqiang Chen, South Florida Water Management District

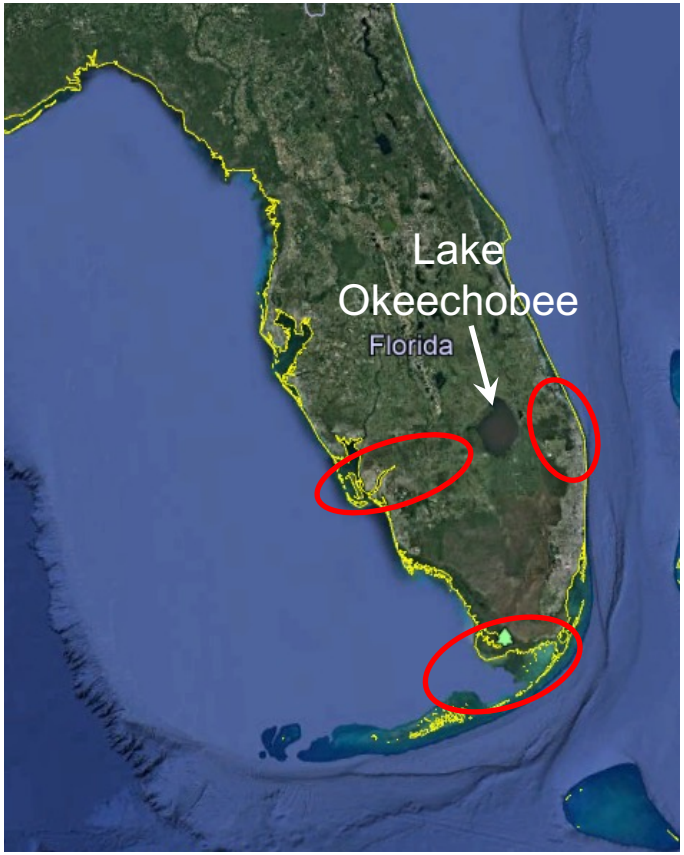
Graduate Student:

Jing Shi, University of South Florida

What's the problem?

SF estuaries faced environmental stress

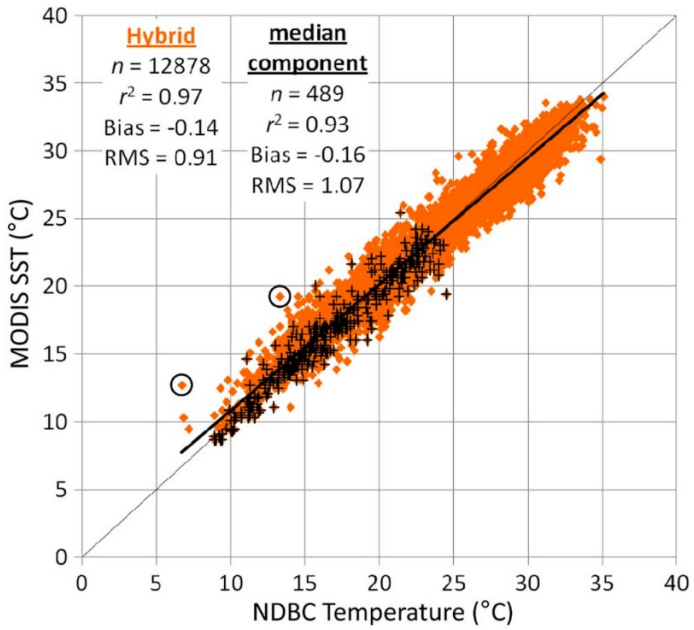
- Harmful algae blooms
- Seagrass dieoffs



Thermal stress – how?

Some previous works - cloudmasking and validation

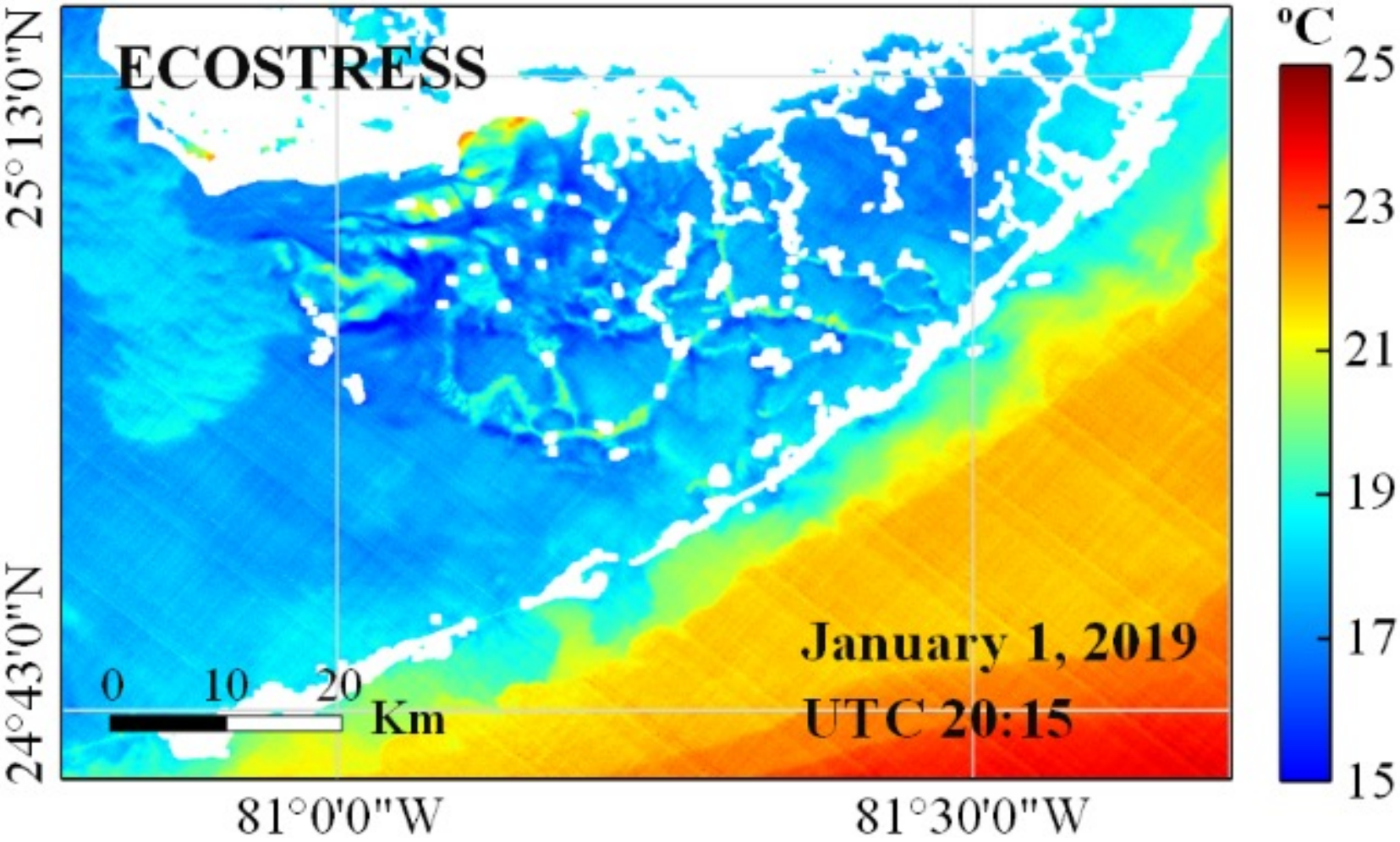
Cloudmask Algorithm	Matching Pairs	Images	Matchups per Image	r^2	Linear Regression		Bias (°C)	RMS (°C)	Min (°C)	Max (°C)
					Slope	Intercept				
Median (Hu)	13877	2125	6.53	0.96	0.93	1.52	-0.28	0.97	8.9	35
L2 Flags	5413	1074	5.04	0.96	0.92	1.93	0.07	1.04	6.7	35
MOD35	11996	2125	5.65	0.95	0.94	1.43	-0.16	1.07	6.7	35.1
Quality SST	10477	2125	4.93	0.97	0.94	1.45	-0.14	0.86	11.1	35.1
Hybrid	12878	2125	6.06	0.97	0.94	1.45	-0.14	0.91	6.7	35.1



Hu et al. (2009, TGRS)
Barnes et al. (2011, GRSL)
Barnes and Hu (2013, TGRS)

ECOSTRESS data over water

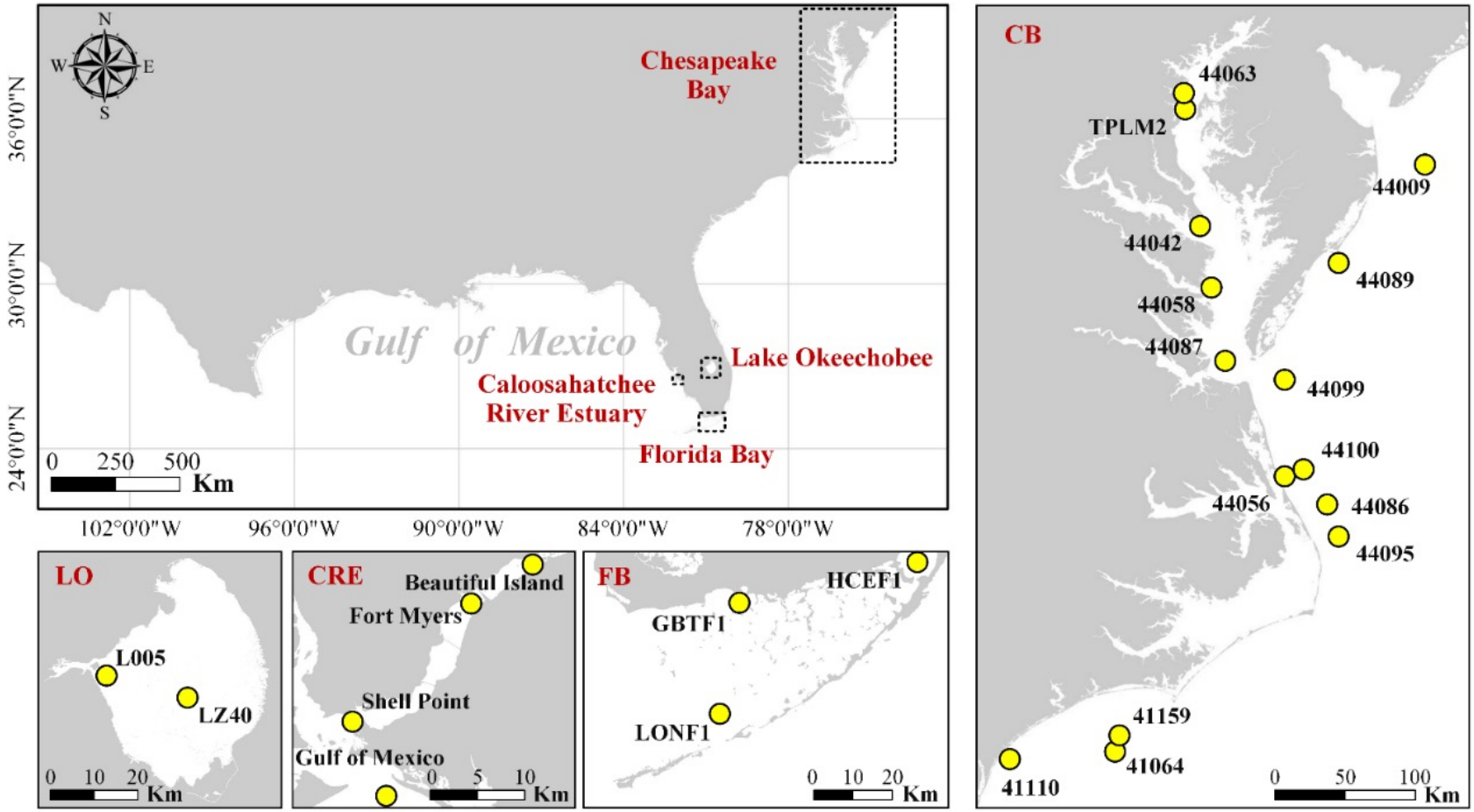
High-res thermal images



ECOSTRESS data over water

Evaluations

Evaluation using *in situ* data collected from NDBC buoys



+- 3 hour, 3x3 homogeneity test, customized ECOSTRESS cloud mask, after geocorrection

ECOSTRESS data over water

Evaluations

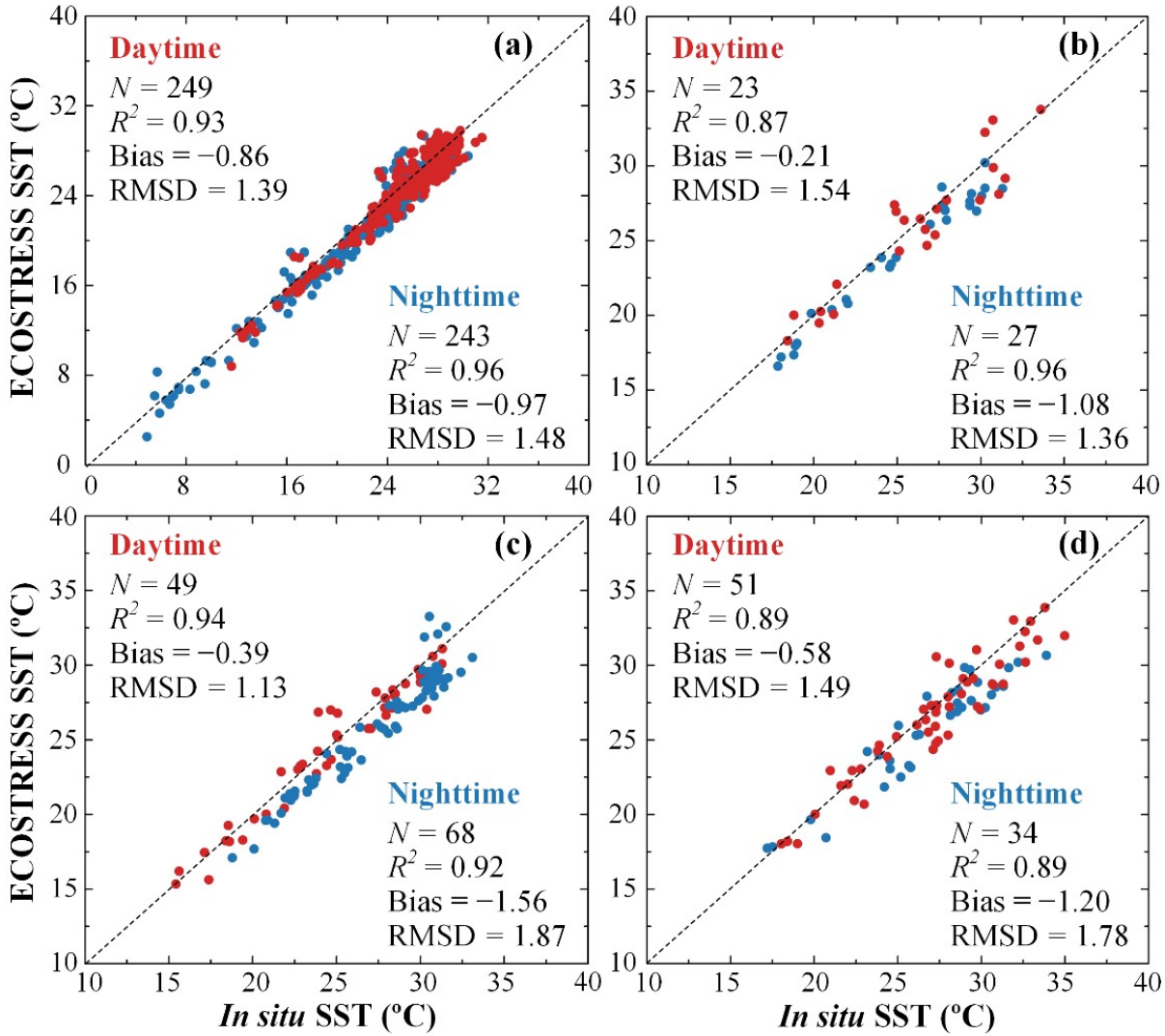
Statistics of ECOSTRESS-NDBC comparisons

Chesapeake Bay

Lake Okeechobee

Caloosahatchee River estuary

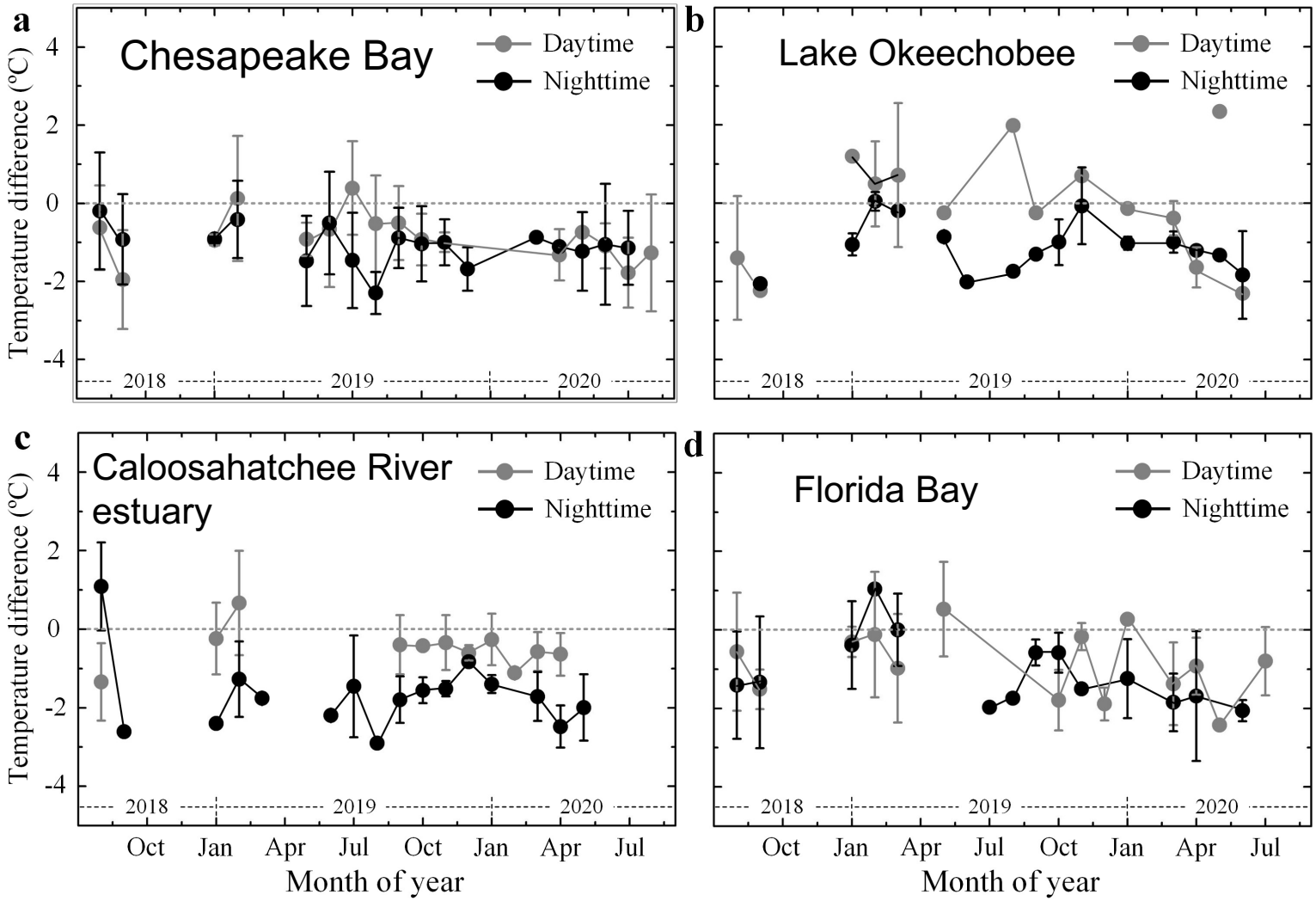
Florida Bay



ECOSTRESS data over water

Evaluations

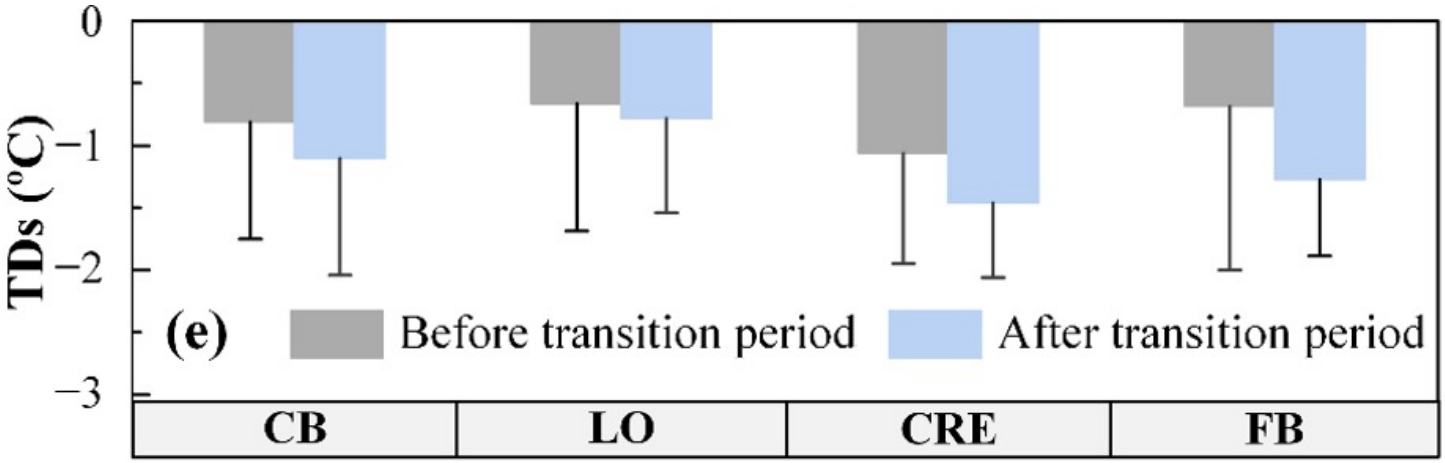
Average monthly differences (ECOSTRESS minus *in situ*)



ECOSTRESS data over water

Evaluations

Average monthly differences (ECOSTRESS minus *in situ*)

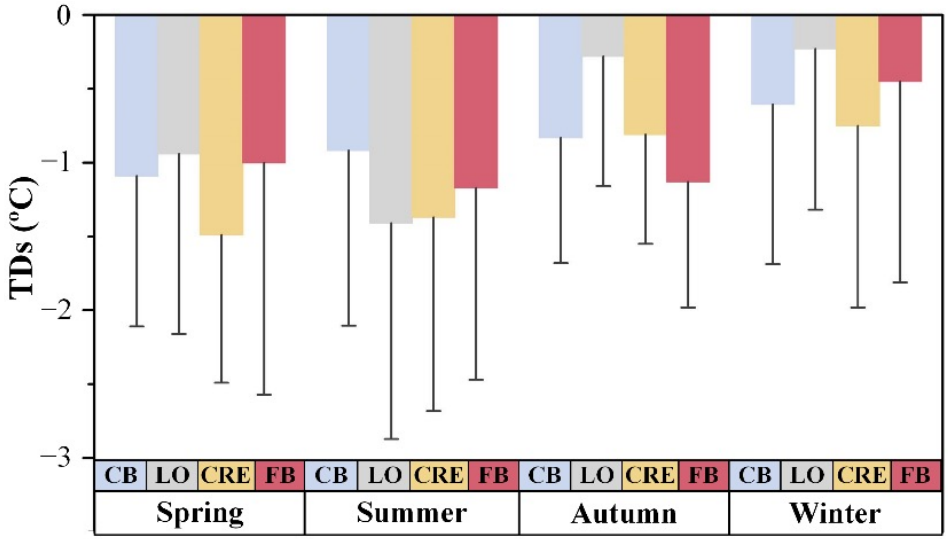


Before transition:

5 bands used to estimate SST

After transition:

3 bands used to estimate SST

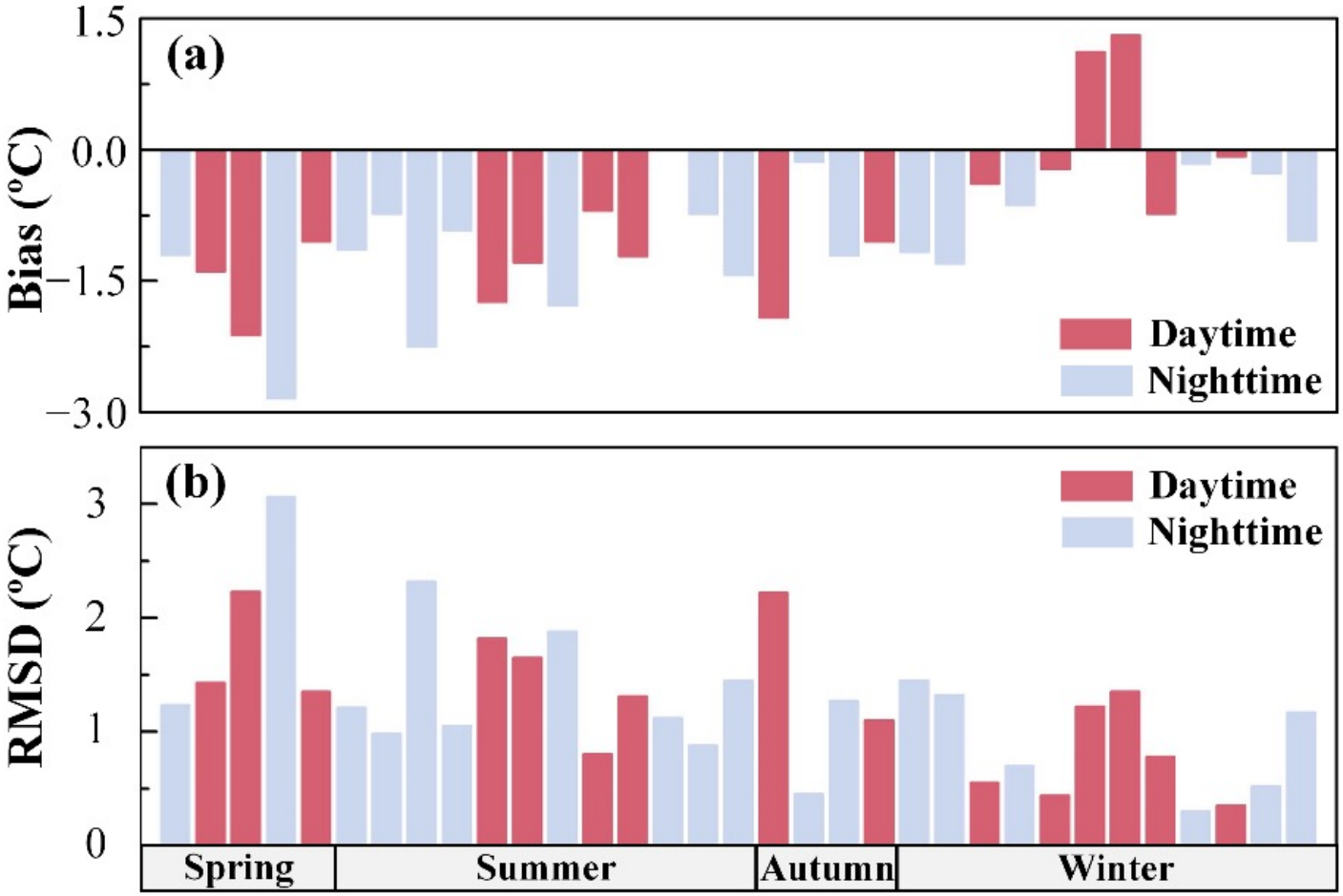


ECOSTRESS data over water

Evaluations

Comparison between ECOSTRESS and MODIS SST

Florida Bay, August 2018 – August 2020



ECOSTRESS data over water

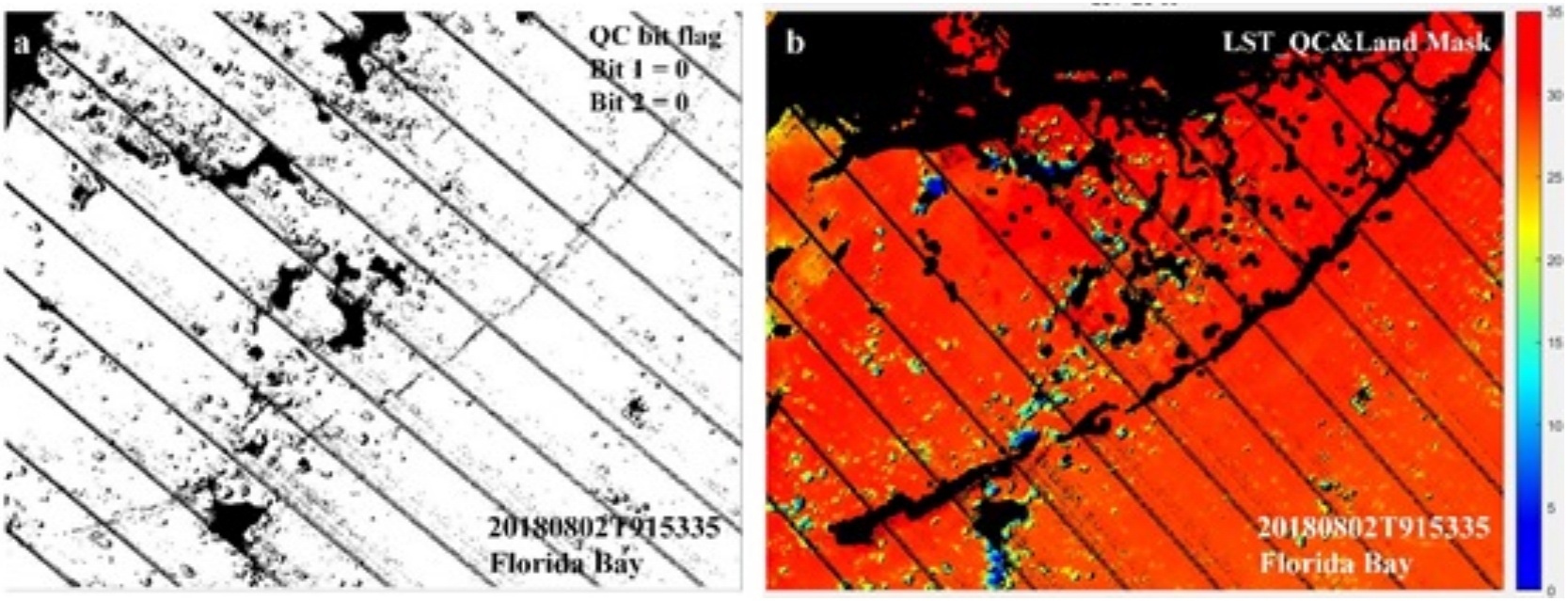
Evaluations

Residual errors:

(a) Occasional geolocation errors (up to a few pixels) – require manual fix

(b) Cloudmasking errors (small clouds and cloud edges) – require post processing

The example below shows cloudmasking using Bit 1=0 & Bit 2=0 from the QC file. White indicates “best quality”;



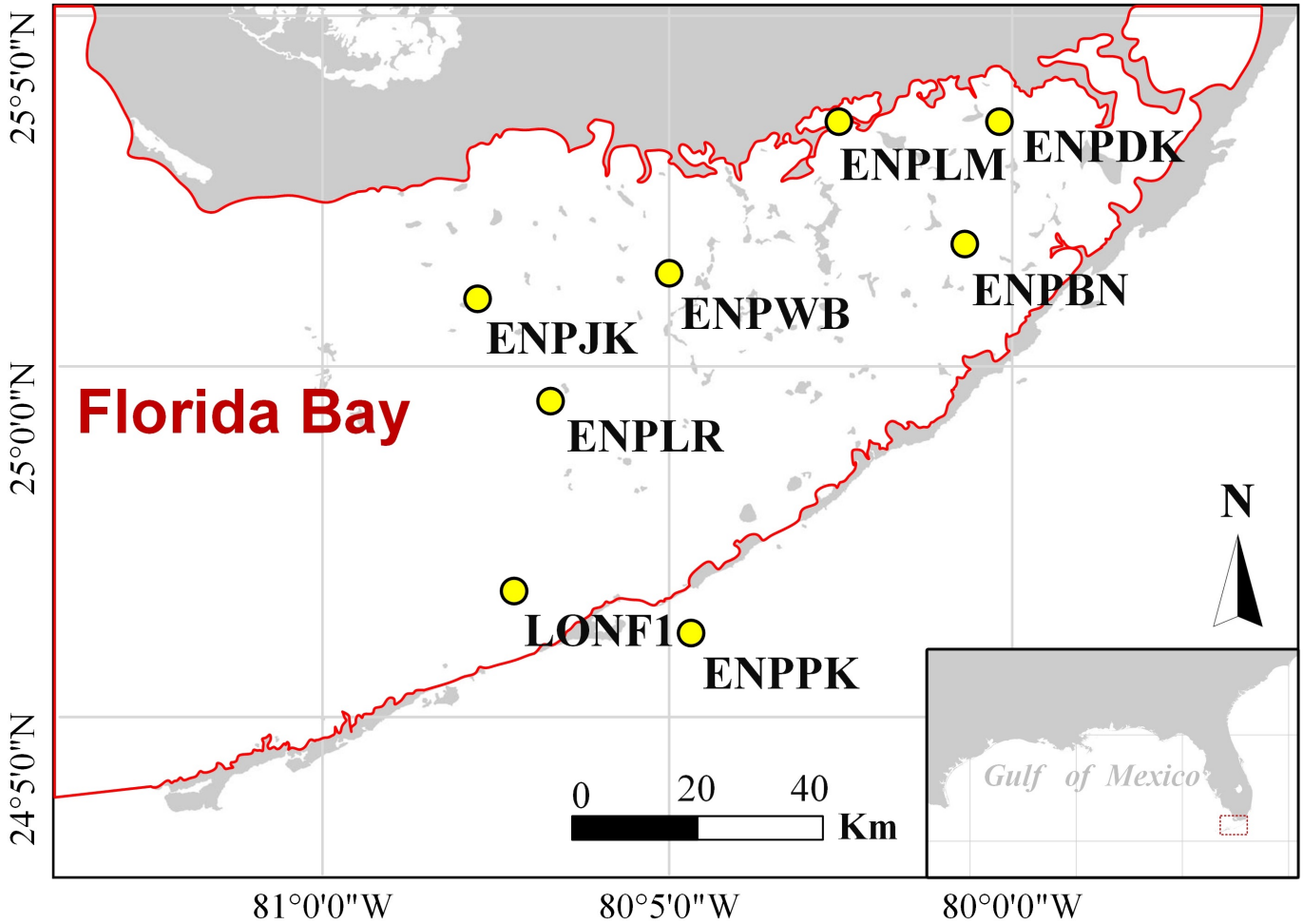
All evaluation results published in:

Shi, J., and C. Hu (2021). Evaluation of ECOSTRESS Thermal Data over South Florida Estuaries. Sensors, 21,4341. https://doi.org/10.1016/j.rse.2018.02.003

Time series analysis

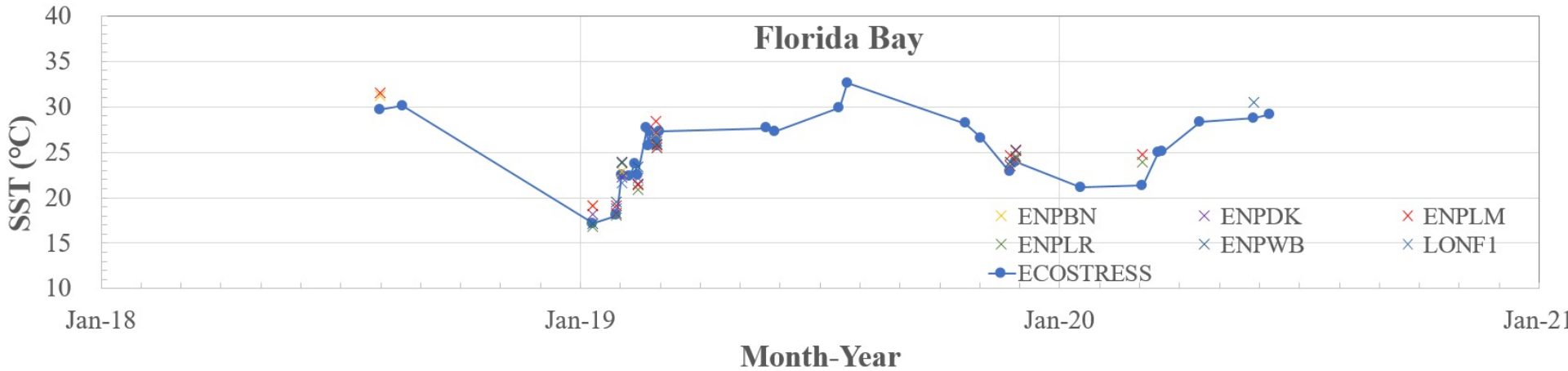
Multi-year SST patterns in Florida Bay

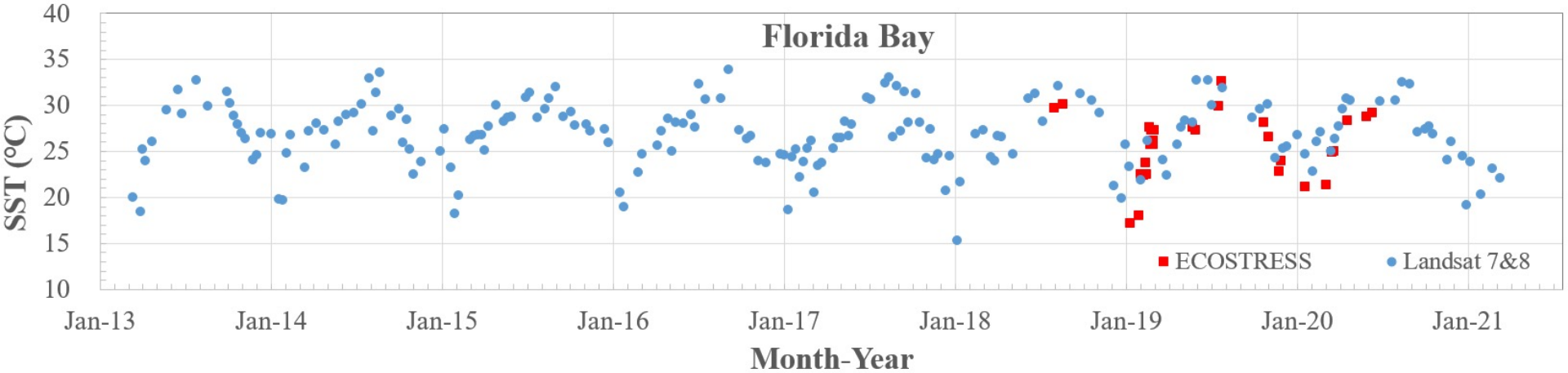
Locations of field stations



Time series analysis

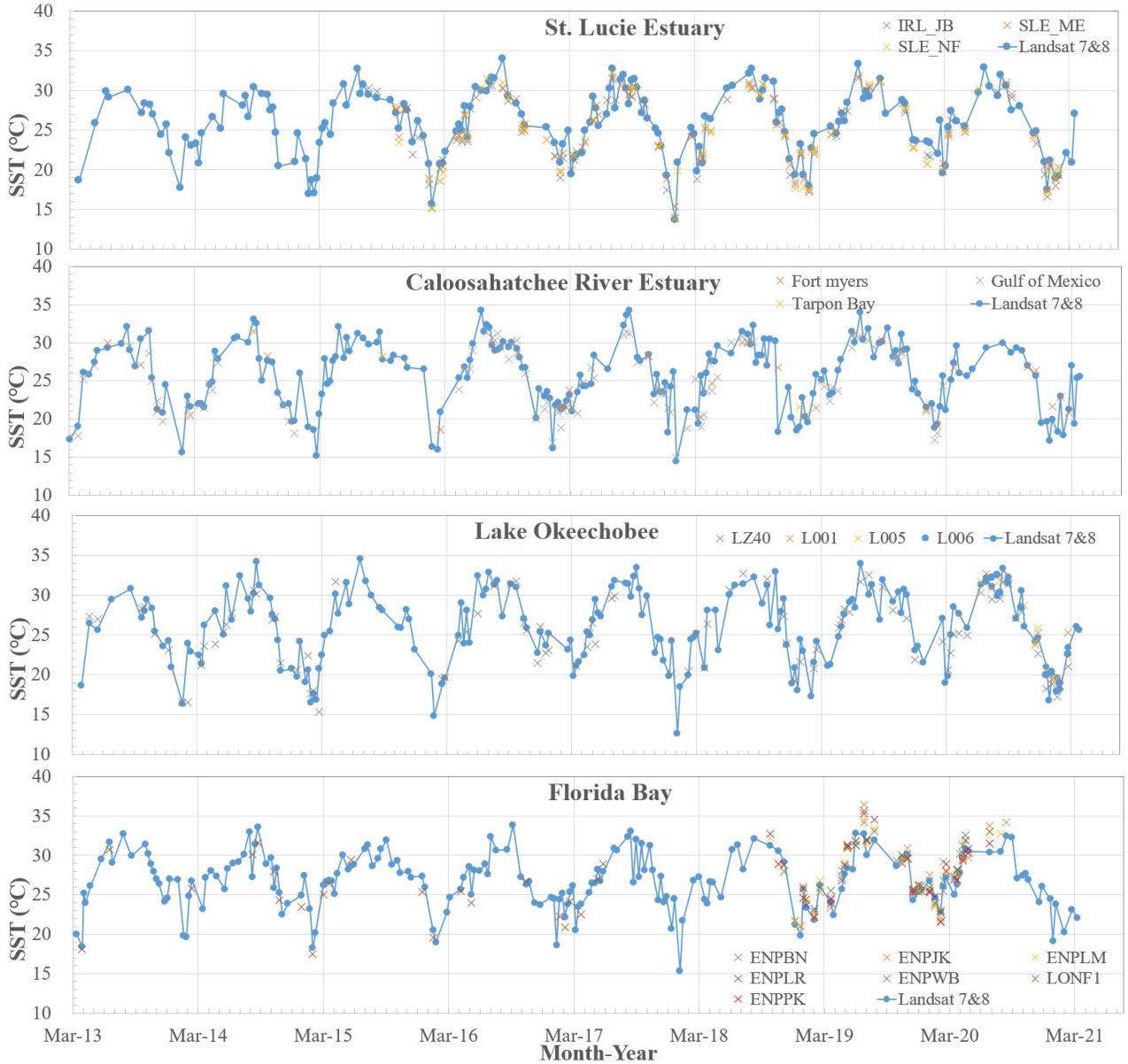
Multi-year SST patterns in Florida Bay





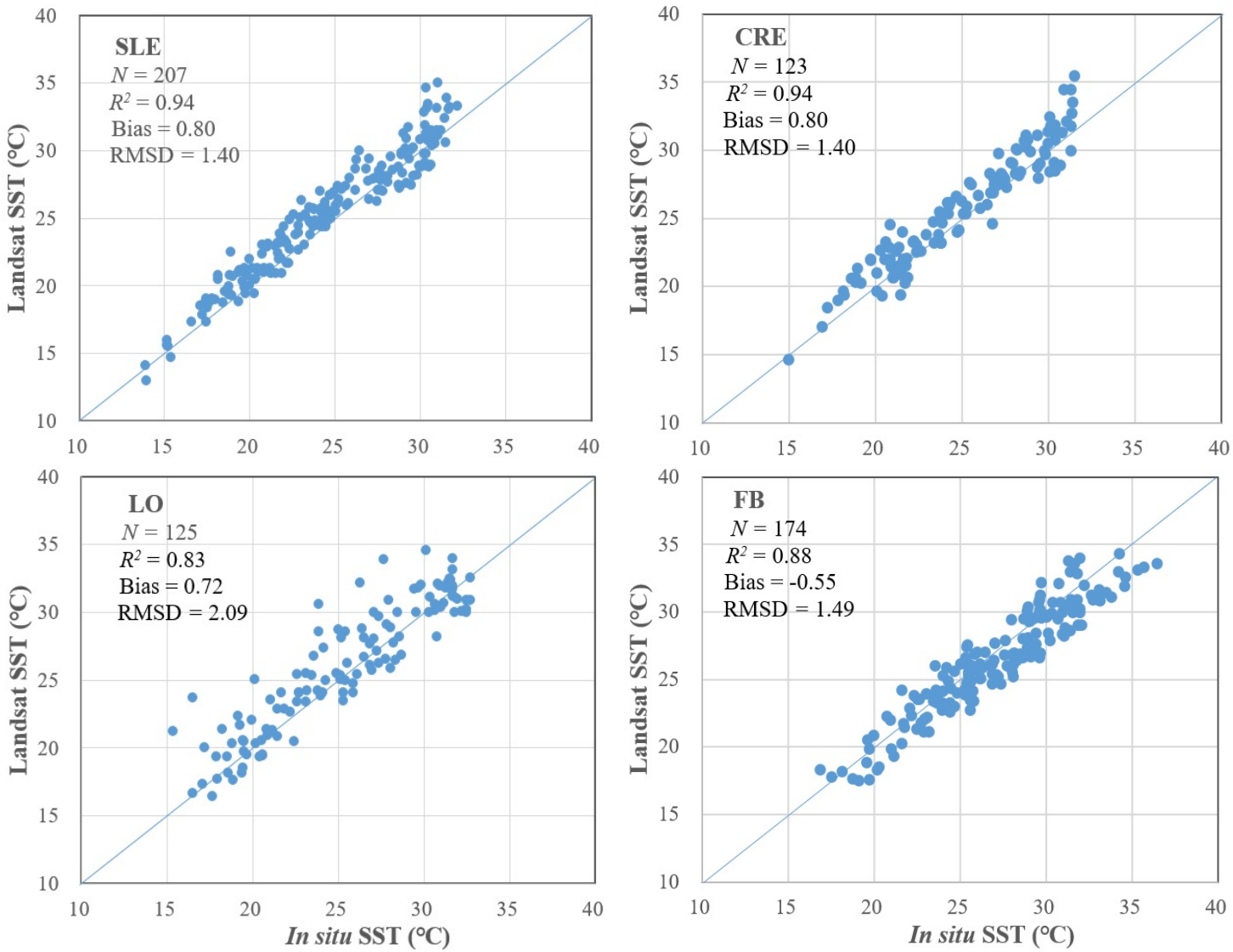
Time series analysis

Multi-year SST patterns in SW estuaries



Summary

- ECOSTRESS LST accuracy over estuaries slightly worse than MODIS SST over open waters, but still acceptable
- Slight negative bias found in ECOSTRESS LST data, as gauged by both *in situ* and MODIS SST. Bias correctable through regressions
- Most challenge in automation due to occasional geo-location errors and cloudmasking errors
- Targeted long-term temperature assessment possible by combining ECOSTRESS and Landsat – preliminary results from S Florida estuaries

Landsat long-time series water temperature

Statistics of Landsat-NDBC comparisons