

# Investigating sea surface temperature retrievals of lakes using geostationary and polar orbiting platforms



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## Introduction

Since the launch and operational takeover of the Geostationary Operational Environmental Satellite (GOES) – 16 (R), the Advanced Baseline Imager (ABI) has provided a geostationary instrument with improved spatial resolution (2-km) to measure sea surface temperatures (SST) of oceans and lakes. This capability was evaluated as a summer internship project for the 45th Weather Squadron (WS) and Kennedy Space Center (KSC) in Cape Canaveral, FL.

Surrounding the KSC are brackish estuaries that function as small lakes known as the Indian River Lagoon (IRL). This body of water generates river breeze fronts and convection similar to sea breeze fronts along the coast and is not accounted for with the current local high-resolution numerical weather prediction (NWP) model.

The intent of this project is to provide a case study comparison of the GOES-16 ABI SST measurements (and others) to in-situ water quality (WQ) station SST measurements of the IRL and Lake Ontario (for a larger lake comparison).

## Background

### Indian River Lagoon

- Mosquito Lagoon, Indian River, & Banana River
- Length: 40 – 195 km, Width: 2 – 6 km, Average Depth: ~1.5 m
- Brackish; mixed through wind air-sea interaction primarily
- **Wet/Warm Season - May – October**
- **Dry/Cool Season – November – April**
- Five IRL Water Quality Sensors and three coast side buoys

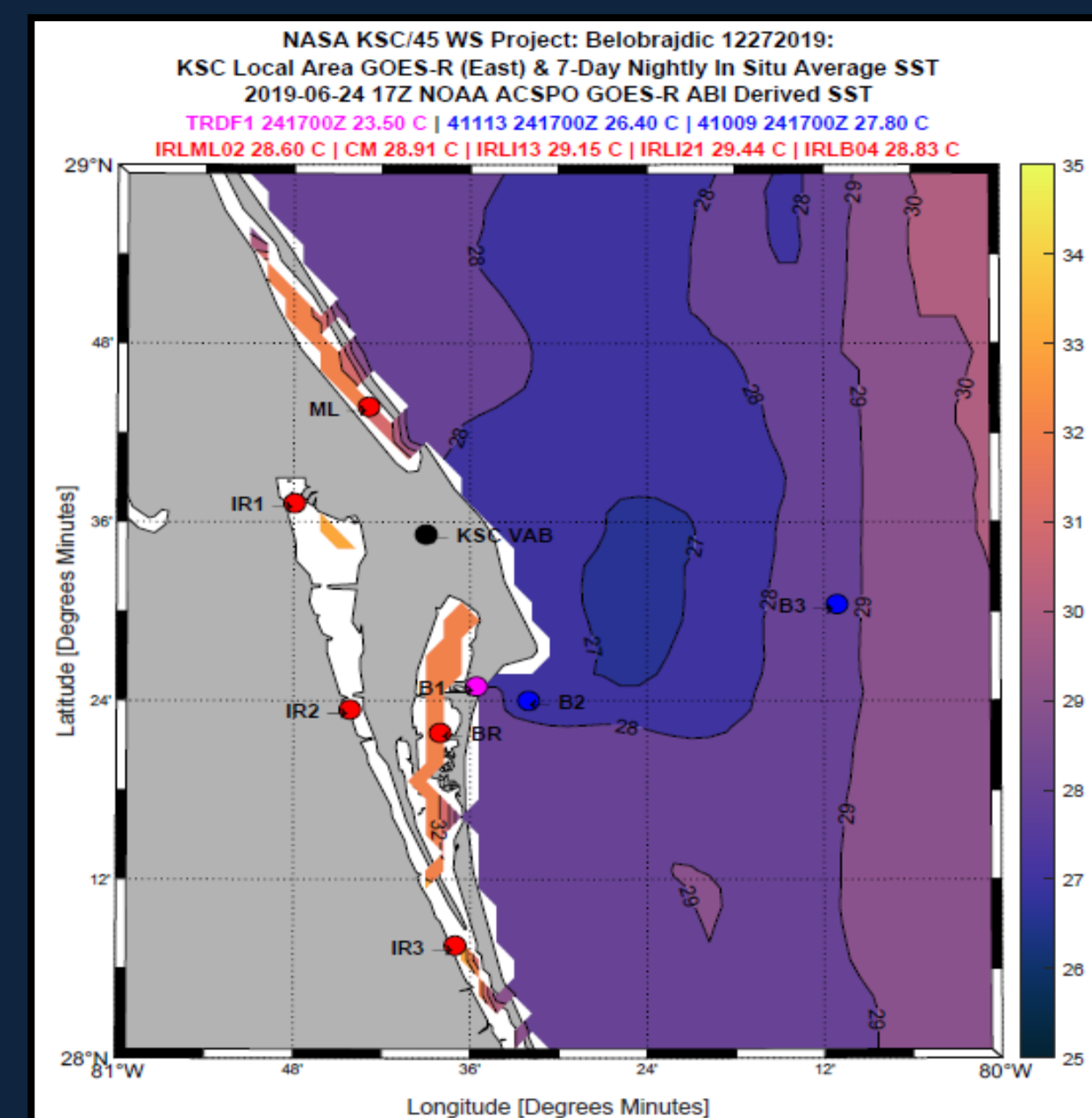
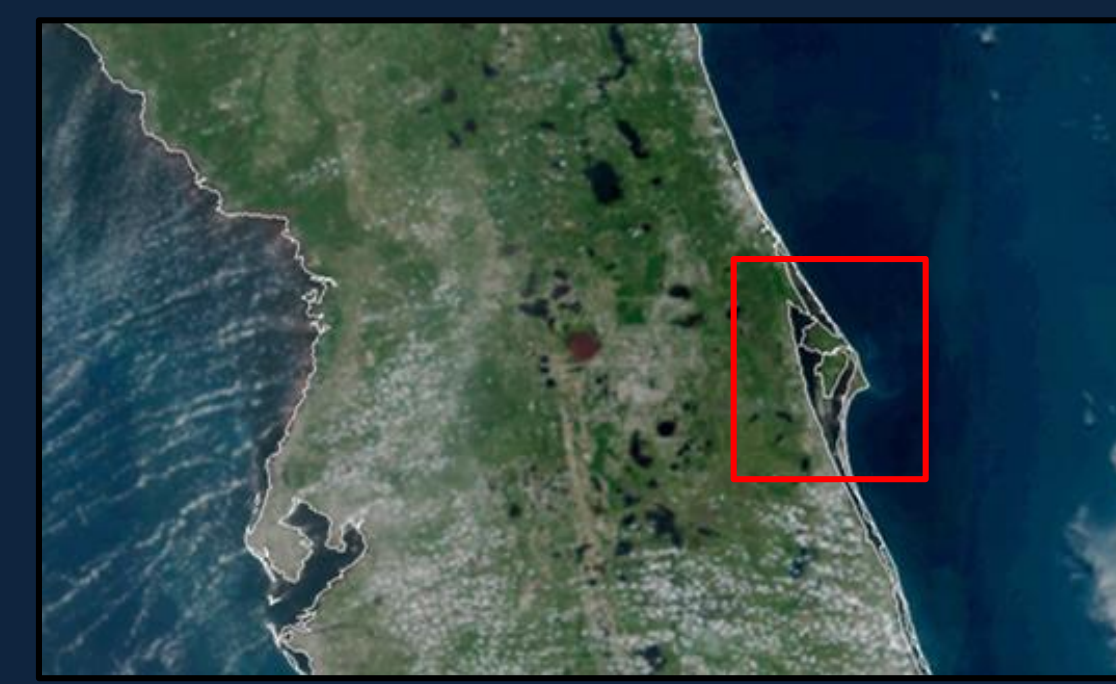
### Products

- NOAA ACSPO GOES-16 ABI
  - GOES-16 ABI Skin-SST Measurements
  - Level 3 - Single sensor collated product
- NASA JPL GHRSSST Global Multiscale Ultra-high Resolution Analysis (MUR)
  - Aqua/Terra MODIS, NOAA-19 AVHRR Skin & Sub-skin SST Measurements
  - Level 4 - Combined interpolated product



## Phase 1

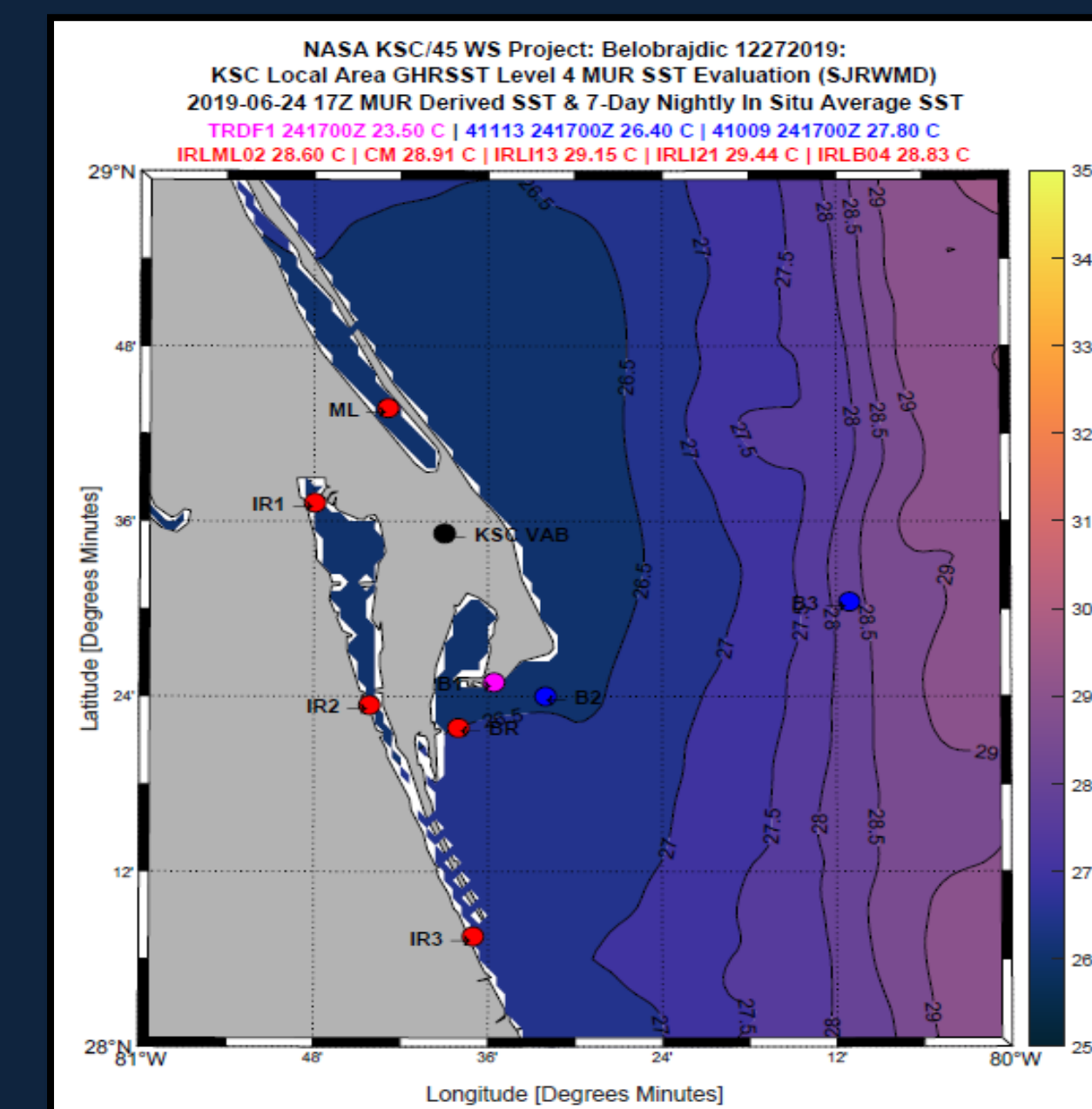
### Case Study : Indian River Lagoon - GOES-16 - Visible – 2019-06-24 - 17Z



#### ACSPO GOES-16 ABI

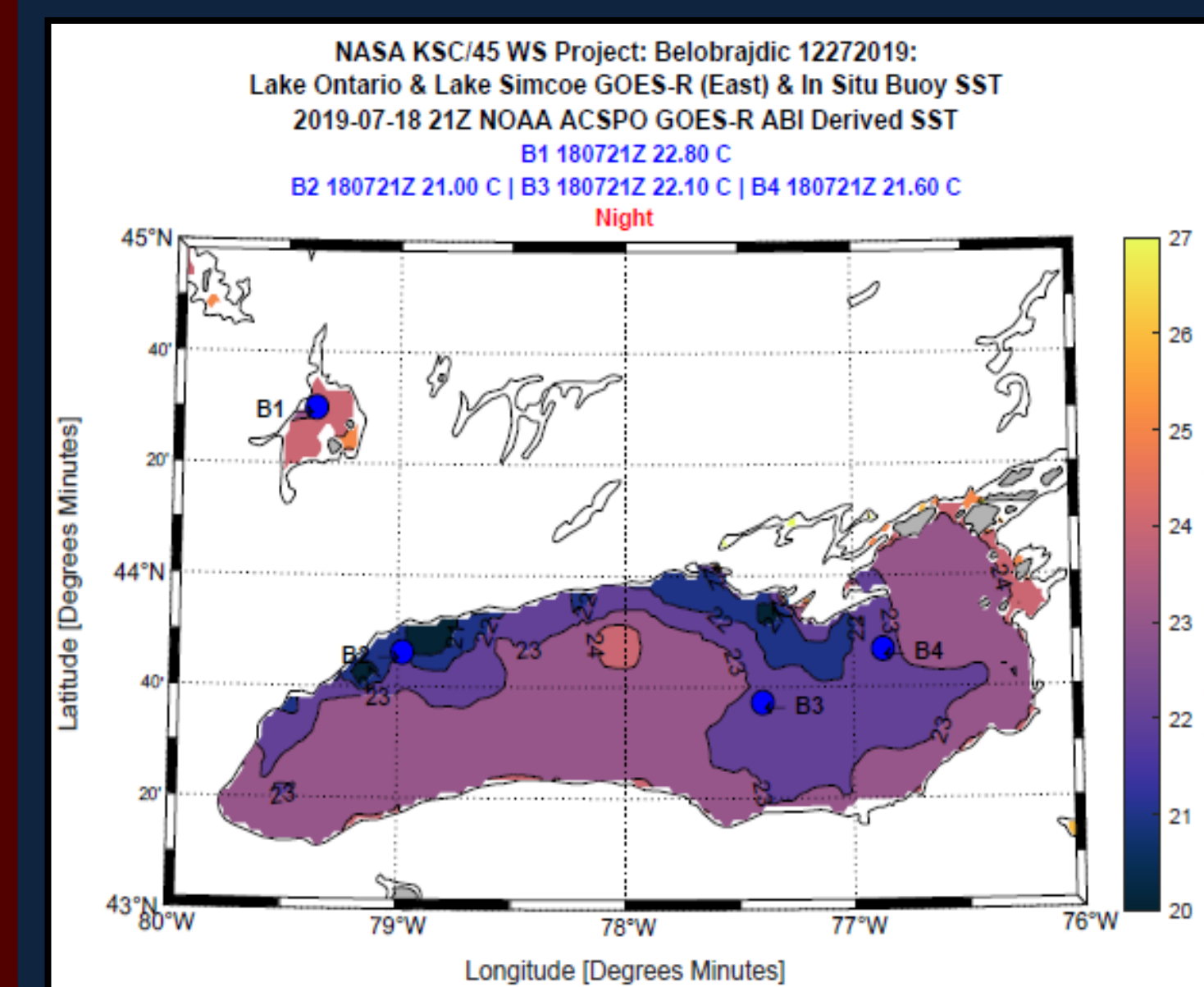
- Coastline/Lagoon partially resolved
  - **GOES ABI indicates ~1-2 C warmer**
- #### GHRSSST Global MUR Product
- Coastline/Lagoon is thoroughly resolved
  - **MUR dataset to the east indicate ~2 C warmer**
  - **MUR dataset to the west indicate ~2 C cooler**

\*Dataset tested in Day/Night Clear, Partly-Cloudy, and Overcast conditions.



- The GOES-16 ABI SST measurements are within 1-2 C of in-situ sensors during the best optically available times for *small lakes*. ( Warming bias ).

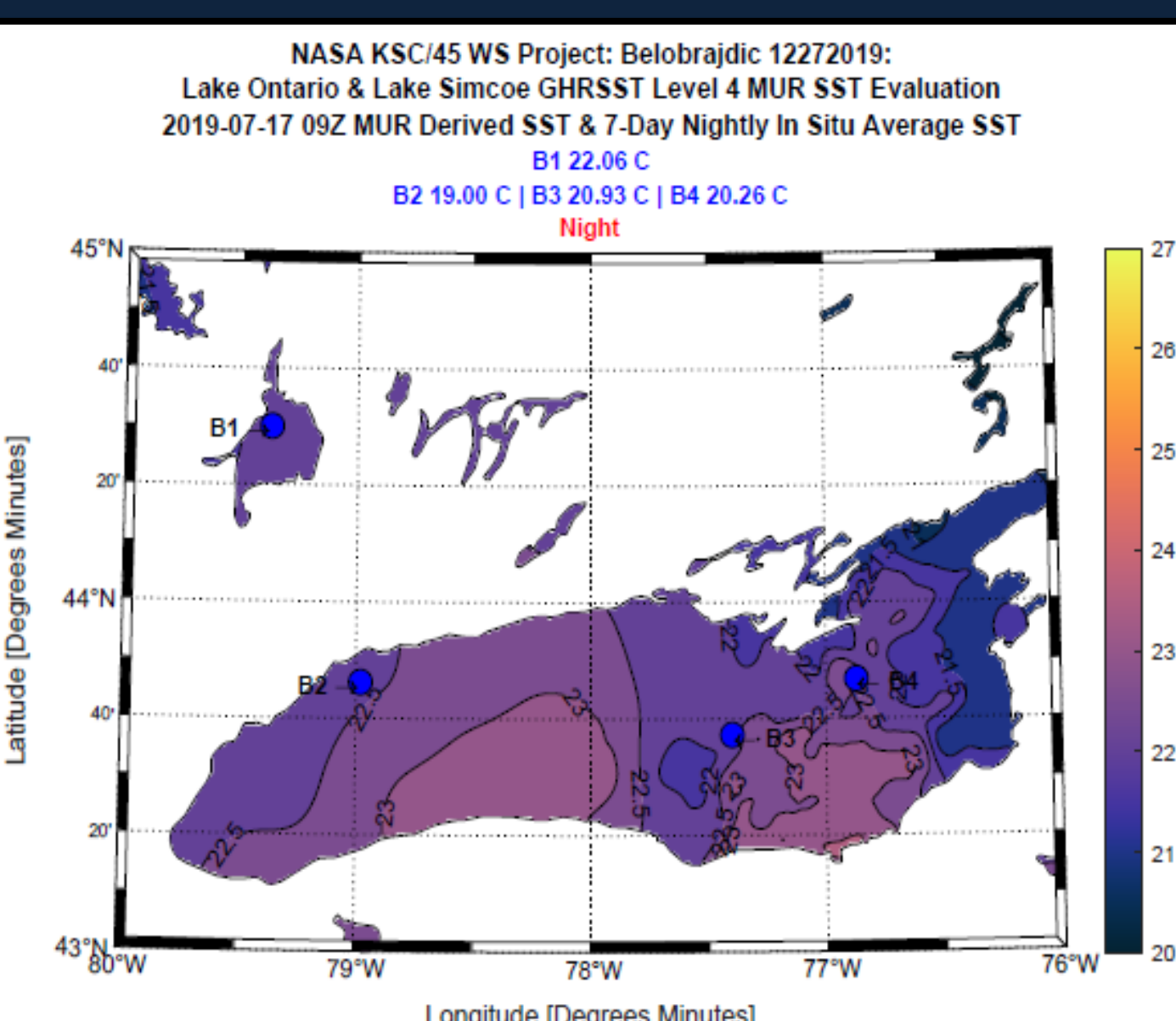
### Case Study : Lake Ontario - GOES-16 - Visible – 2019-07-18 - 21Z



#### Lake Ontario

- L: 311 km x W: 85 km x D: 86 m
- #### ACSPO GOES-16 ABI
- Coastline/Lake is thoroughly resolved
  - **GOES ABI indicate ~0.5 C cooler**
- #### GHRSSST Global MUR
- Coastline/Lake is thoroughly resolved
  - **MUR indicate 1-2 C warmer**

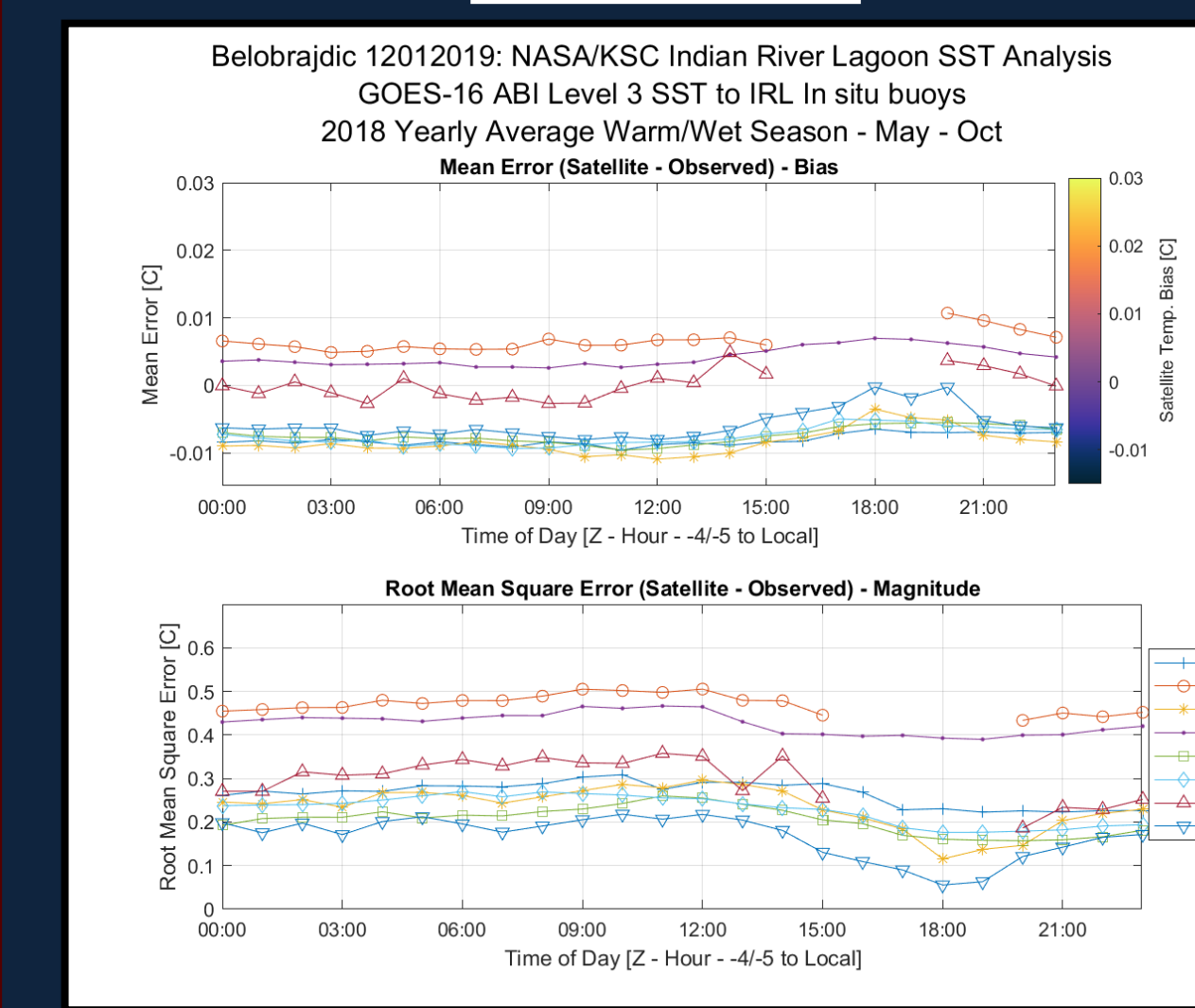
\*Dataset tested in Day/Night Clear, Partly-Cloudy, and Overcast conditions.



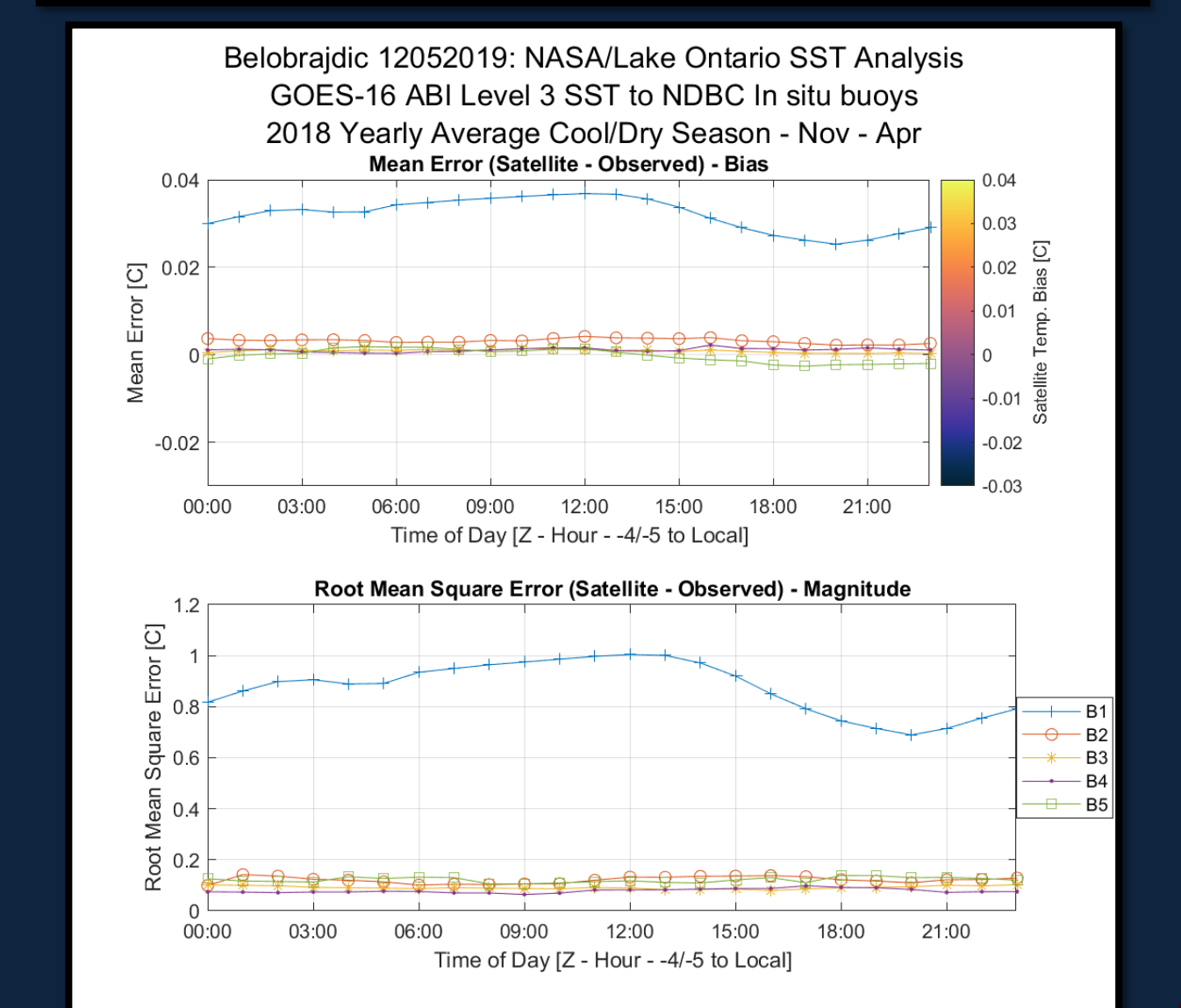
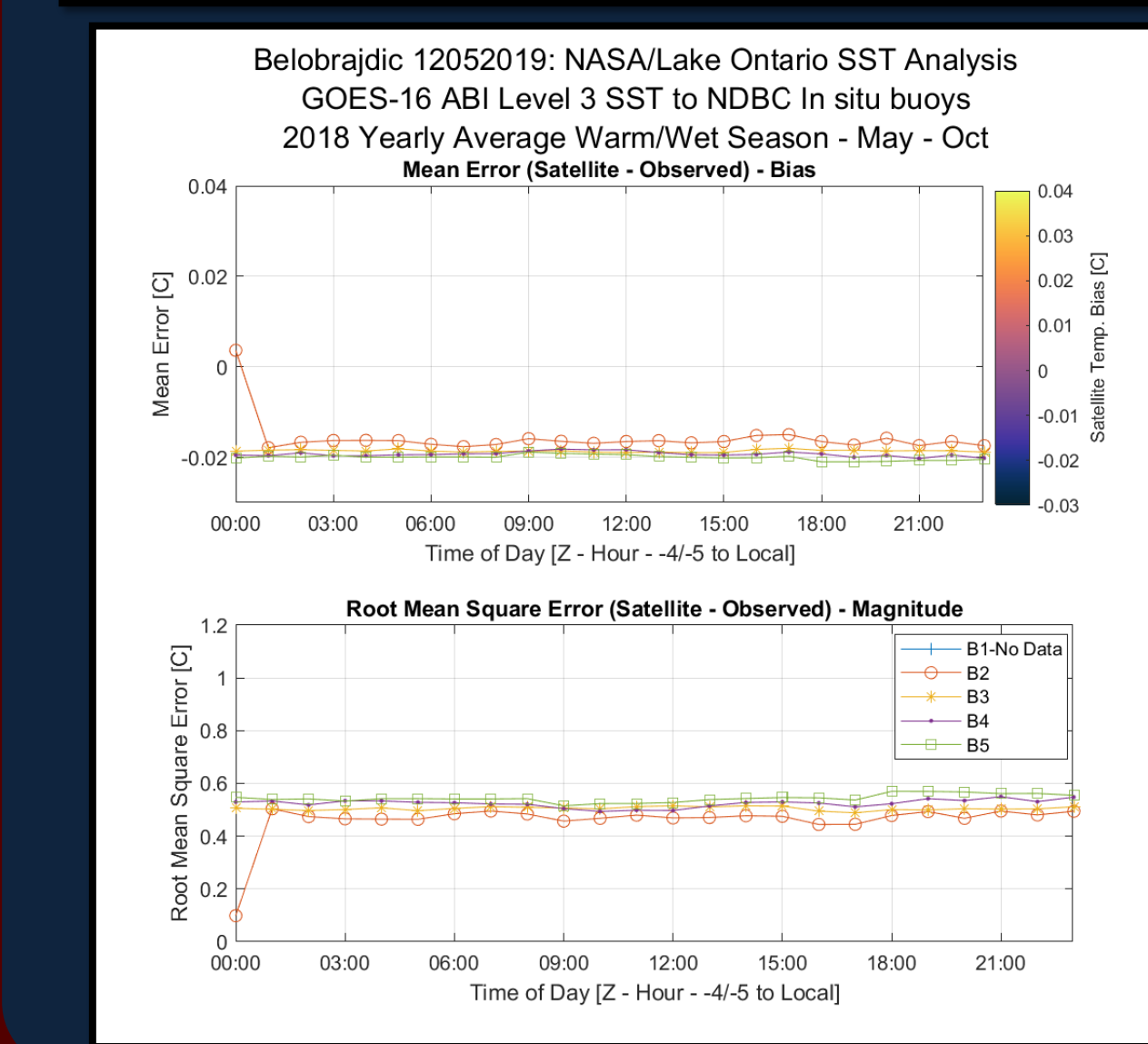
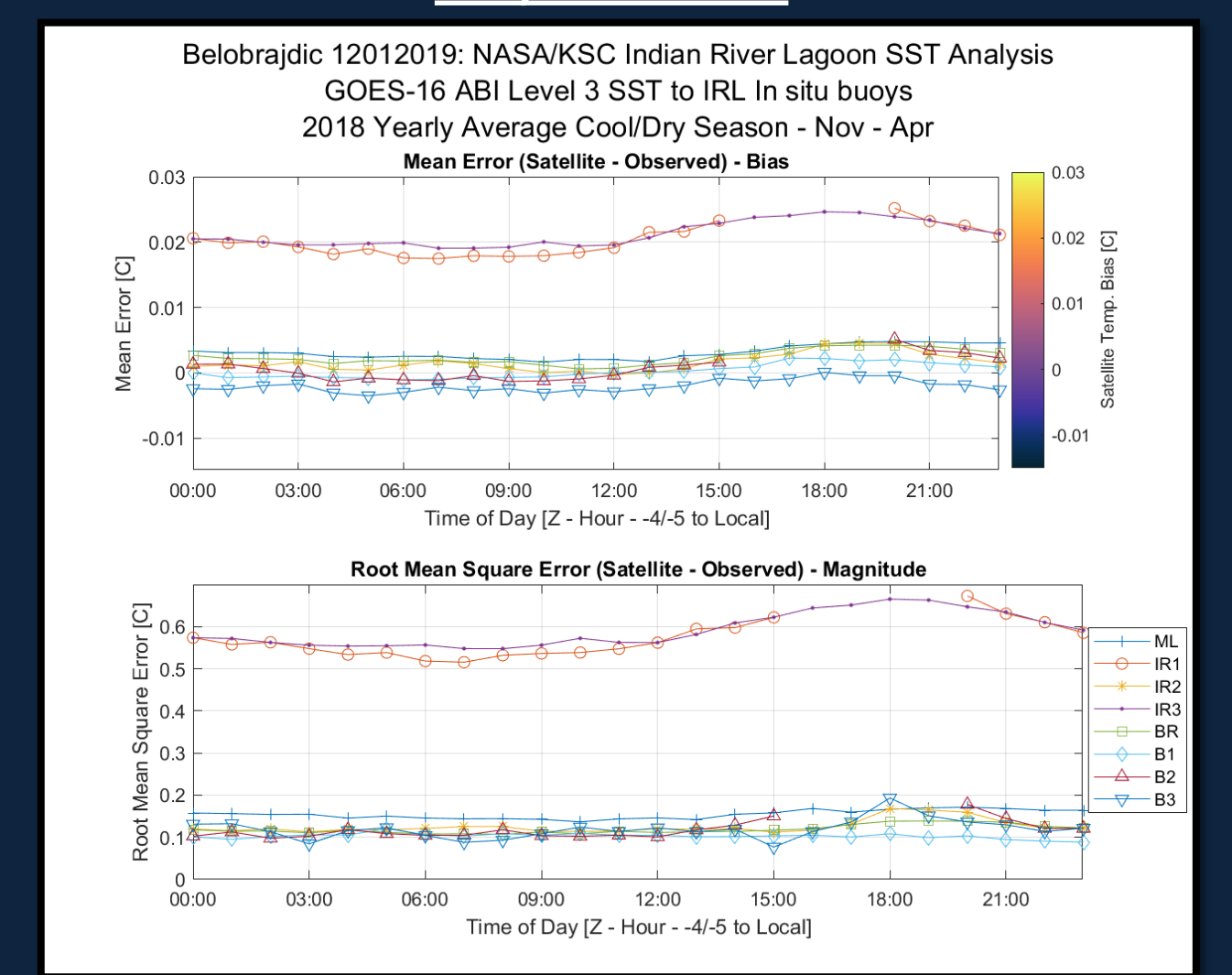
- The GOES-16 ABI resolves *large lakes* with 'gaps' from cloud contamination with +0.5 C accuracy for Lake Ontario from a variety of sky conditions. ( Warming Bias ).
- Next phase will evaluate seasonality and time of day accuracy for large and small lakes.

## Phase 2

### Wet Season



### Dry Season



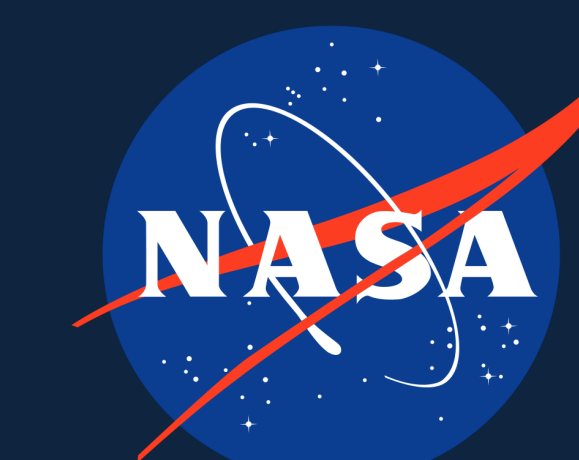
## Conclusions

- For both large and small scale lakes, a cooling bias from the satellite is present during warm/wet season. Limited or no bias during cool/dry season.
- Time of day variability only a factor for small lake with most accuracy during noon – evening in warm/wet season, and most inaccurate during the same time in cool/dry season.
- Next phase will utilize these findings and data to simulate and calibrate 1-D/2-D Sea Surface Temperature model for the Indian River Lagoon using GOTM.

## Acknowledgements

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- Additionally this project was supported by Kennedy Space Center's Meteorologists Dr Kristen A. Smith and Dr Katherine A. Rice.

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