

# **Coral Heat Stress User SST Requirements (CORAL)**

**Chair: William Skirving**

**Co-chair: Jonathan Mittaz**

**Presenter: William Skirving**

# Current Members

## Co-Chairs:

William Skirving                      University of Reading

Jonathan Mittaz                      University of Reading

## Task Team Members:

Christopher Merchant              University of Reading

Owen Embury                      University of Reading

Andrew Norrie                      ReefSense

Prasanjit Dash                      NOAA

Liam Lachs                      Newcastle University

Miguel Meis                      University of Sao Paulo

# Purpose and Main Objective of the TT

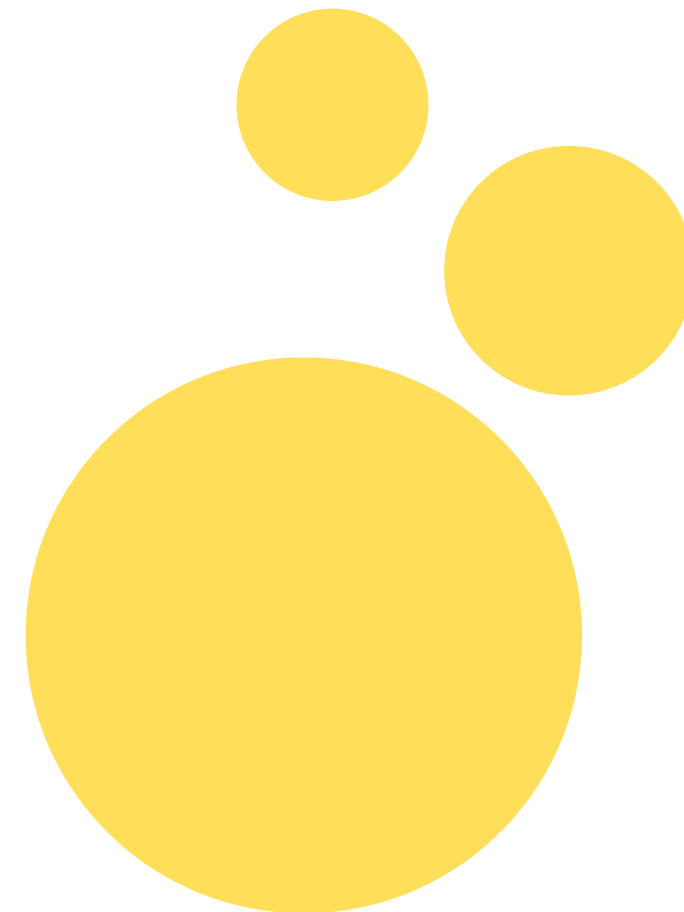
The purpose of this task team is to help the GHRSSST community to understand:

- How users in the biological world use SST
- Their needs in terms of what they desire and what they actually need
- Weaknesses in current SST products for use in coastal and shallow water
  - Suggestions on how to overcome these weaknesses
  - Testing various SST datasets against physiological responses to heat stress



# Expected Closure of TT

- There is no planned closure date for this TT
- Each task will have a logical completion based on achieving its goal:
  - Publication of a paper
  - Generation of a document
  - Presentation of outcomes to GHRST community and/or international conference



# Task Team Activities

Three official tasks and one new task

# Task 1: Update the Coral Heat Stress User Requirements Document

- Task Lead/Contact Point:
  - William Skirving
- Involved TT members:
  - All members
- Status/Expected completion:
  - Each version of this document is complete in its own right, the next version of the User Requirements Document will be available June 2026.
- Task Description: Description of SST requirements for marine biology use, including scientific and managerial use.

# Task 1: Update the Coral Heat Stress User Requirements Document

- Update current user requirements and add sea ice section
- The new version of the User Requirements document will be available by June next year via the GHRSSST web site.

## **Task 2:** Investigate the strengths and weaknesses of physical retrieval vs regression-based SST retrieval over coral reefs

- Task Lead/Contact Point:

- William Skirving

- Involved TT members:

Christopher Merchant, Andrew Norrie, Owen Embury, Prasanjit Dash

- Status/Expected completion:

- No expected completion date, it will be completed once a paper has been written and published

- Task Description:

- Comparison of performance of physical retrieval and regression-based algorithms for retrieval of SST over coral reefs



## Task 2: Investigate the strengths and weaknesses of physical retrieval vs regression-based SST retrieval over coral reefs

- Used ACSPO to represent regression-based algorithms
- Used CCI to represent physical retrieval algorithms

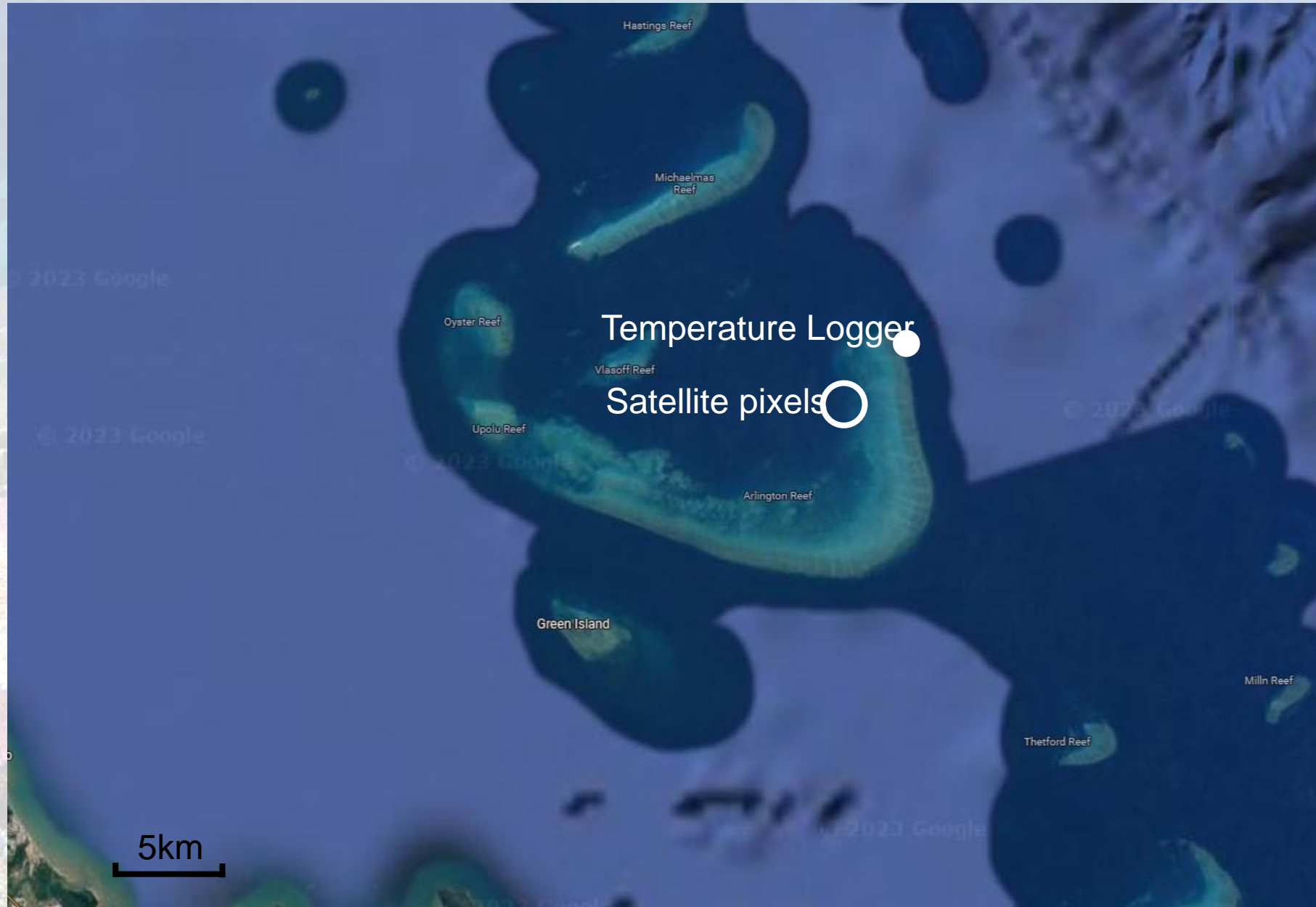
2024-2025

# Dry Tortugas, Florida Keys



2024-2025

# Arlington Reef (Great Barrier Reef)

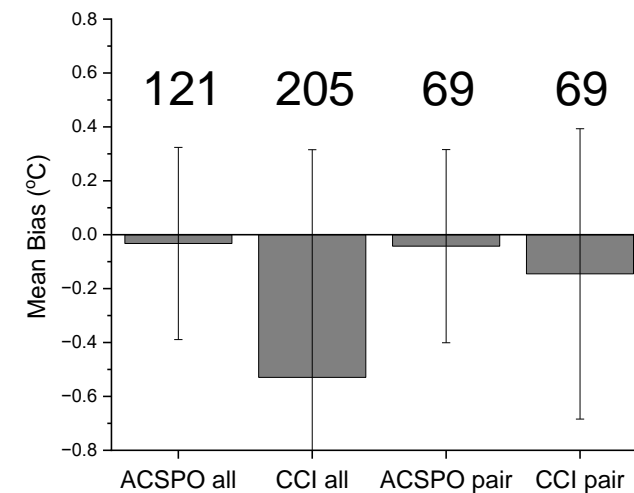
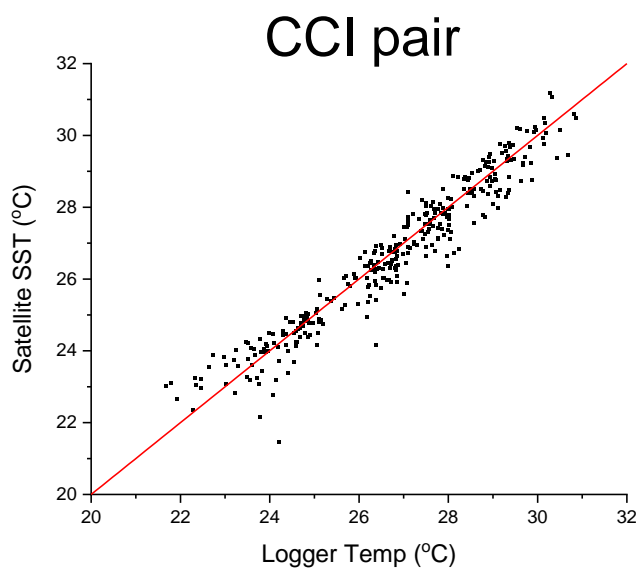
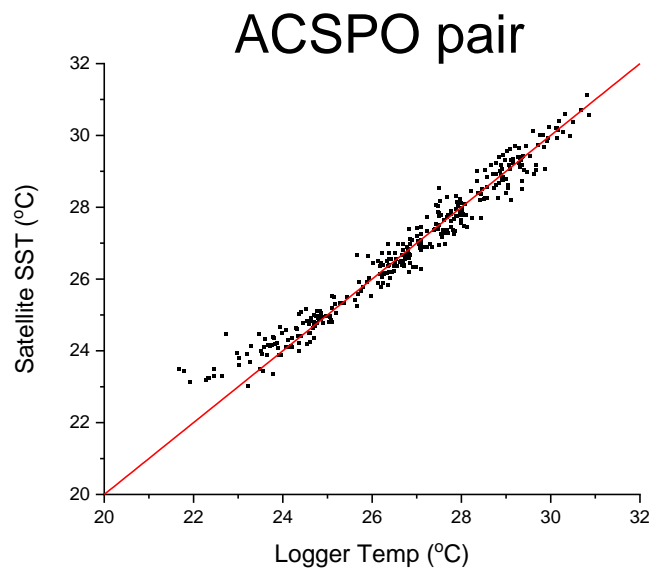
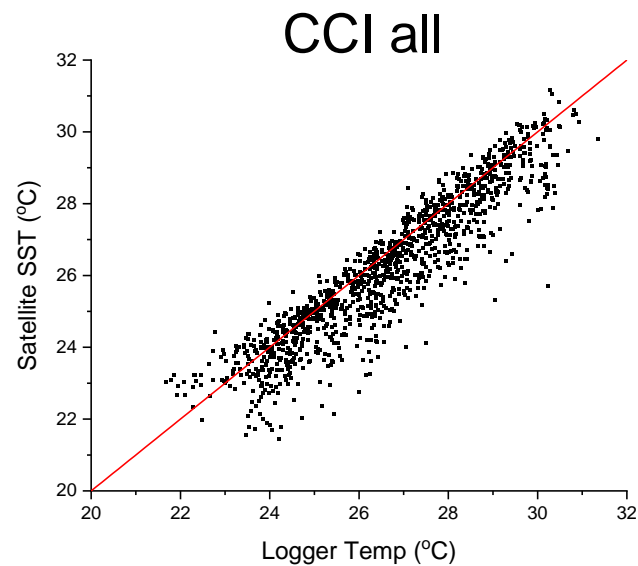
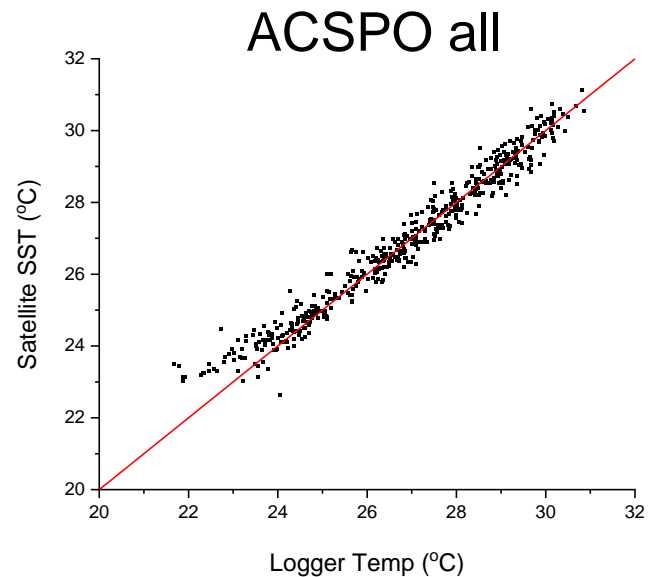


2024-2025

# Arlington Reef, Night, Metop A

GHR SST26

INTERNATIONAL SST USERS'  
SYMPOSIUM AND GHR SST  
SCIENCE TEAM MEETING

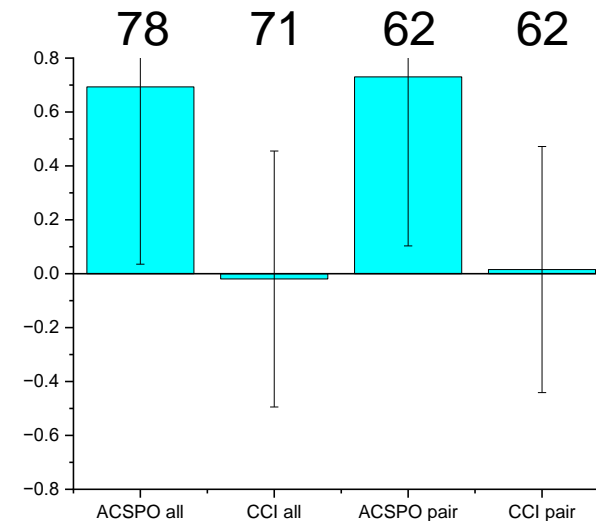
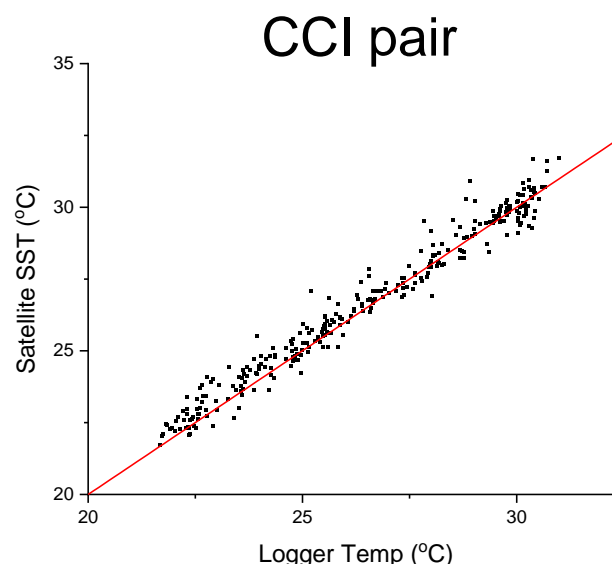
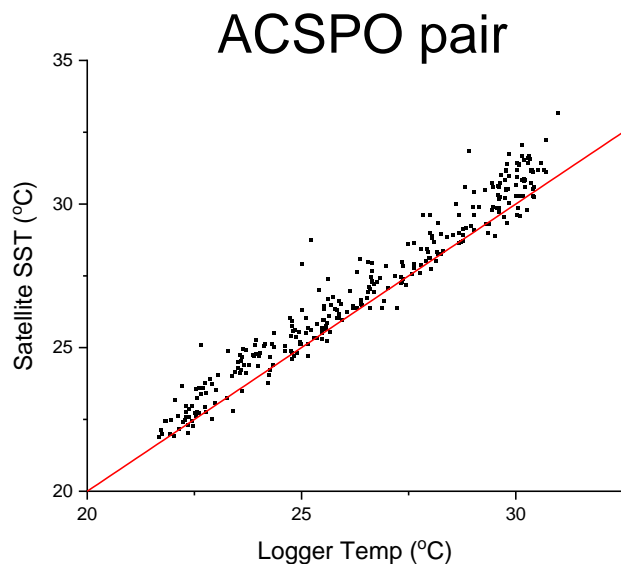
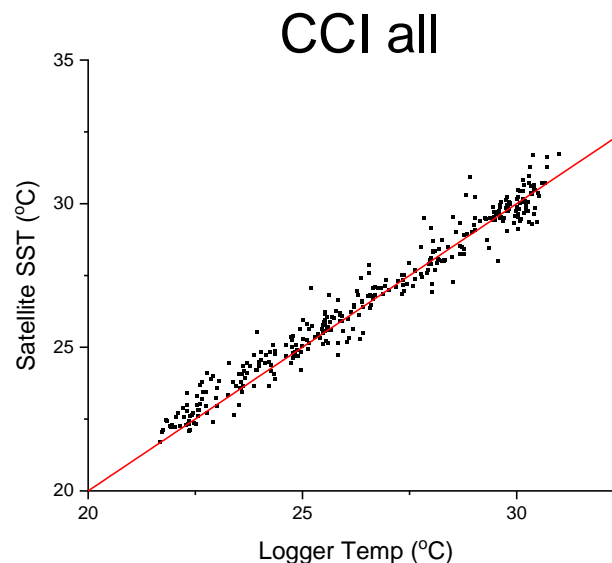
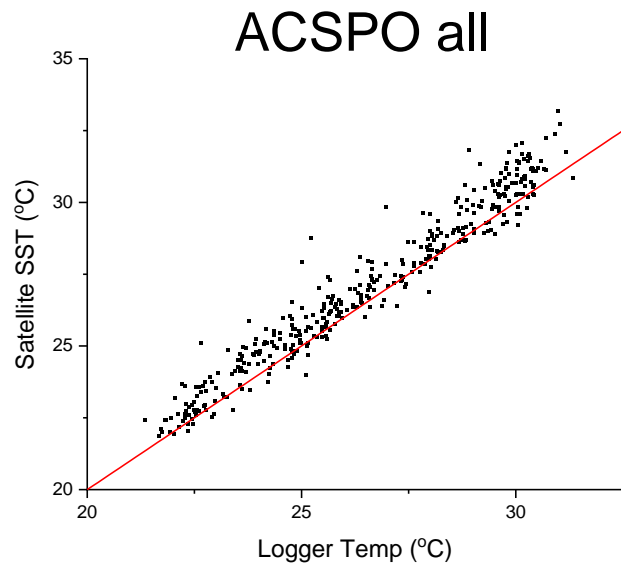


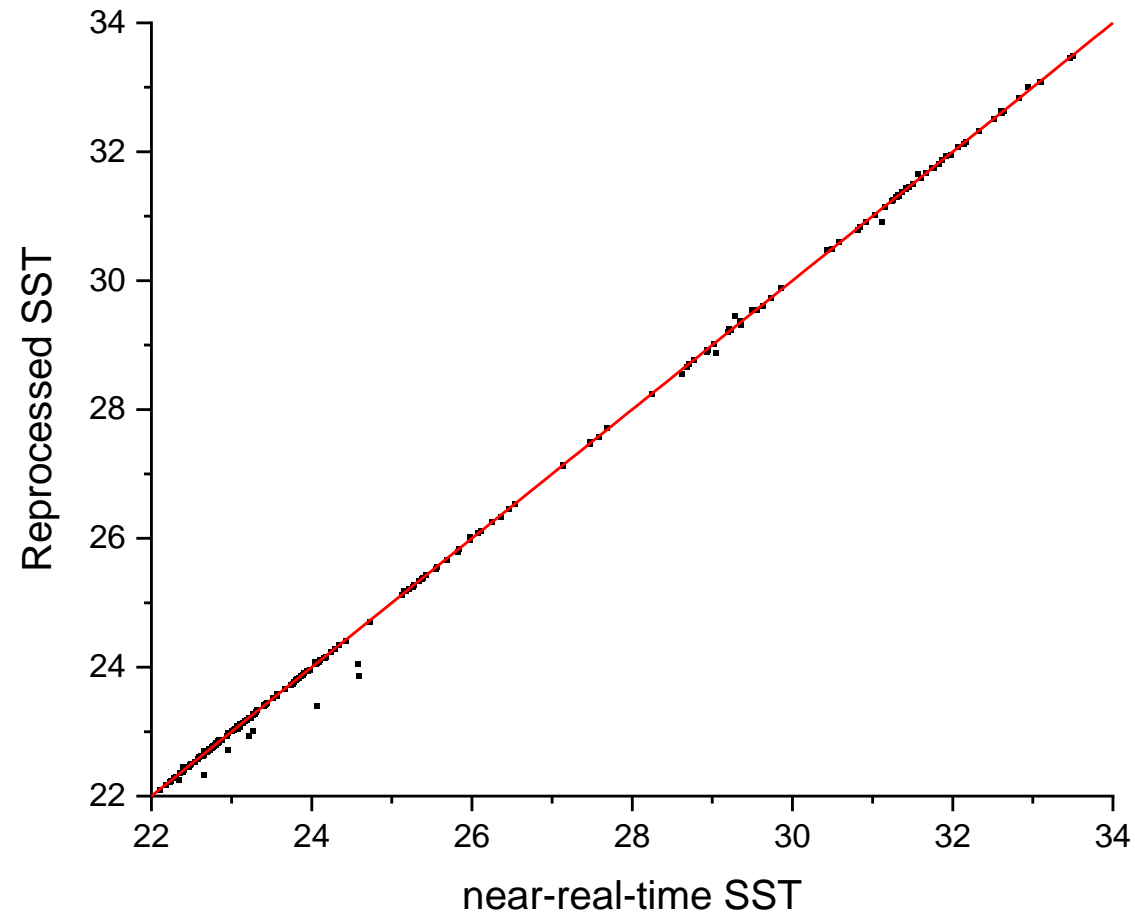
2024-2025

# Dry Tortugas, Day, NOAA 19

GHR SST26

INTERNATIONAL SST USERS'  
SYMPOSIUM AND GHR SST  
SCIENCE TEAM MEETING



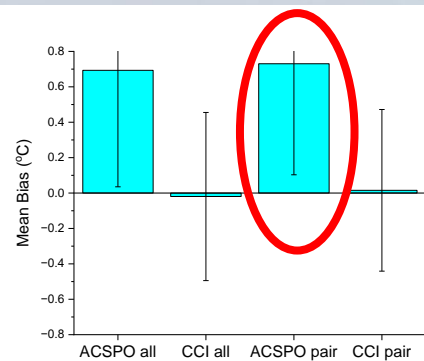




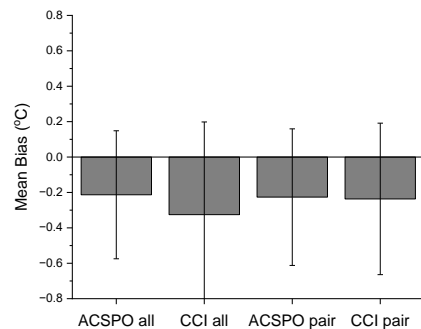
2024-2025

# All bias plots

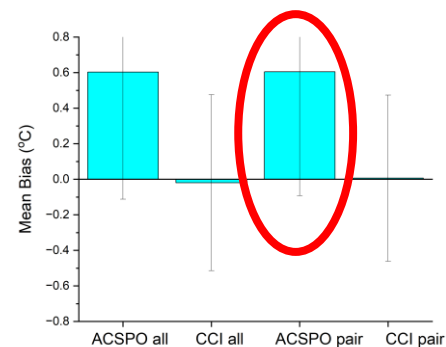
Dry Tortugas Day



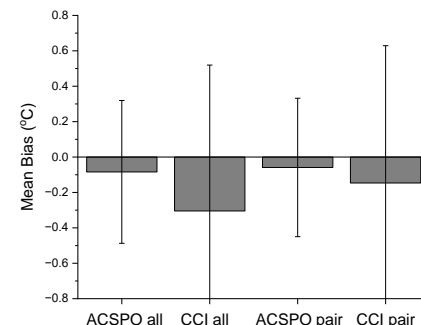
Dry Tortugas Night



Arlington Day



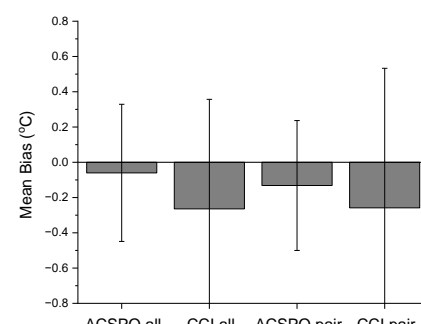
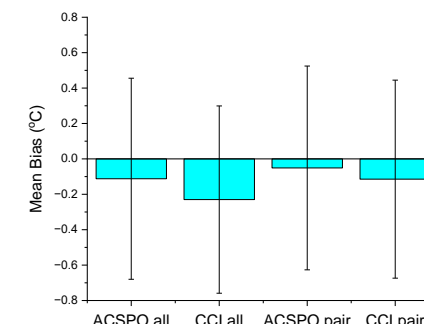
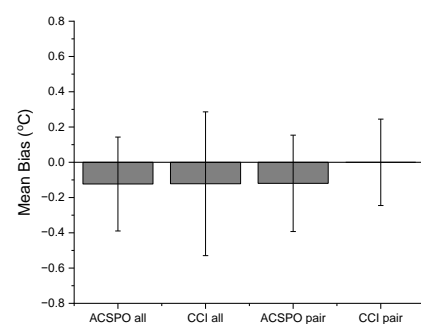
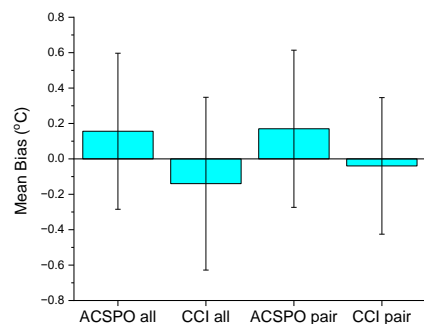
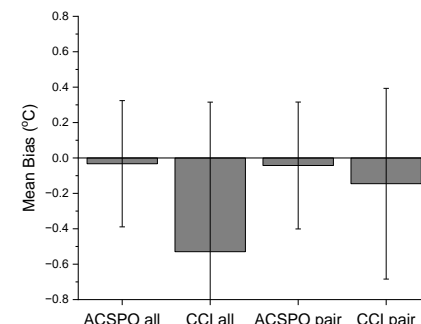
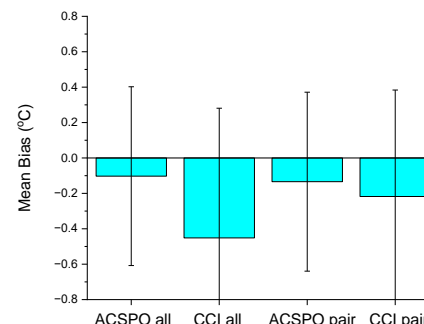
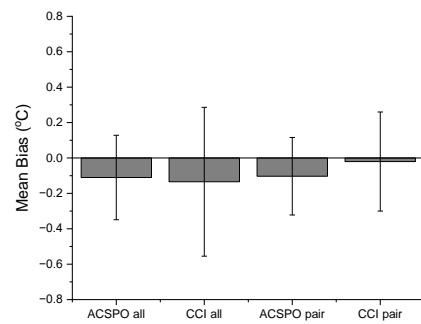
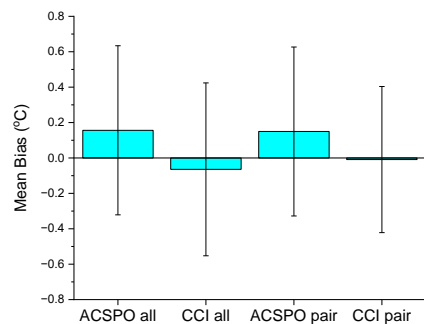
Arlington Night

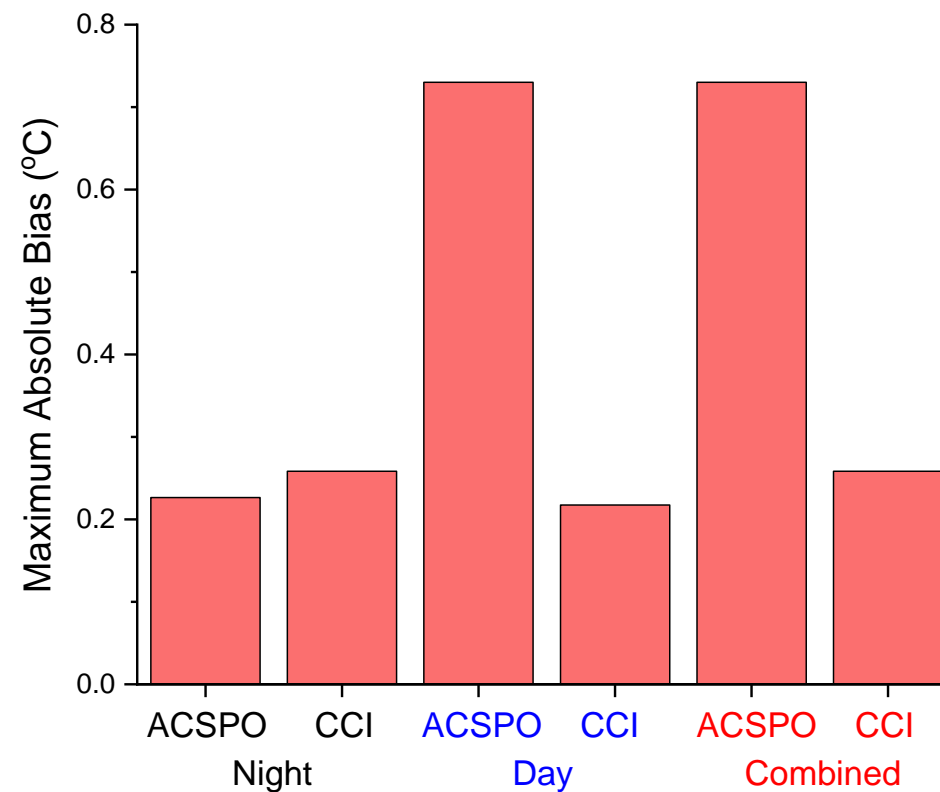
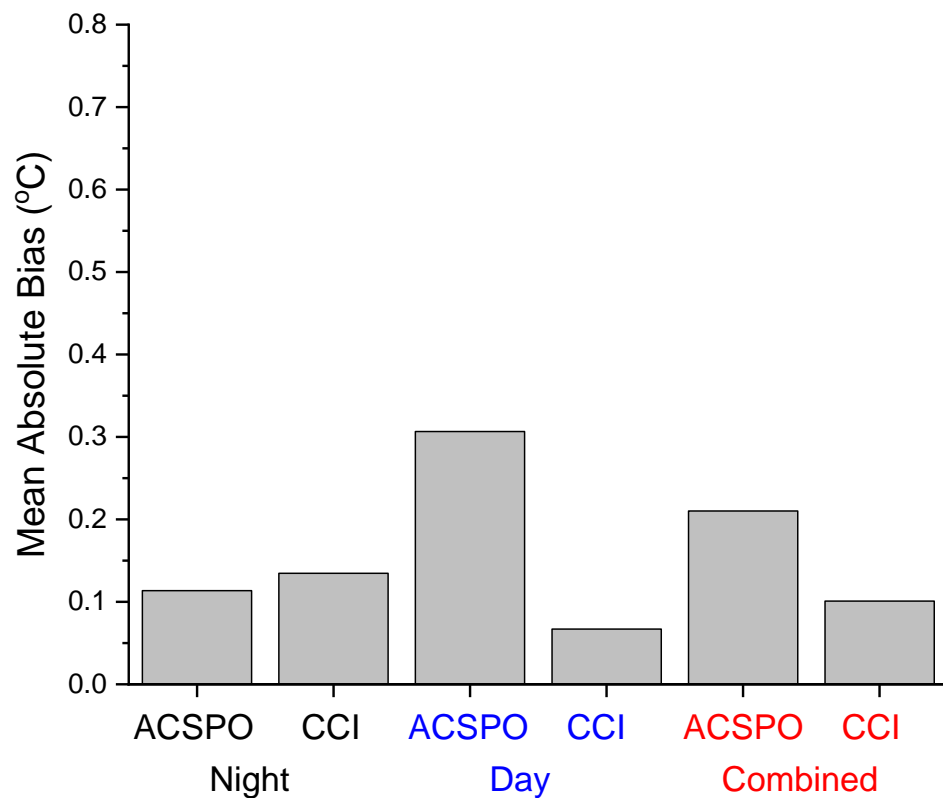


NOAA 19

Metop A

Metop B







## Task 2: Investigate the strengths and weaknesses of physical retrieval vs regression-based SST retrieval over coral reefs

### Summary of findings so far:

- Used ACSPO as being representative of Regression-based SST retrieval algorithms
- Used CCI as being representative of Physical Retrieval algorithms
- Results so far:
  - During the night both algorithms perform well
  - During the day ACSPO had real problems with NOAA 19 in both locations

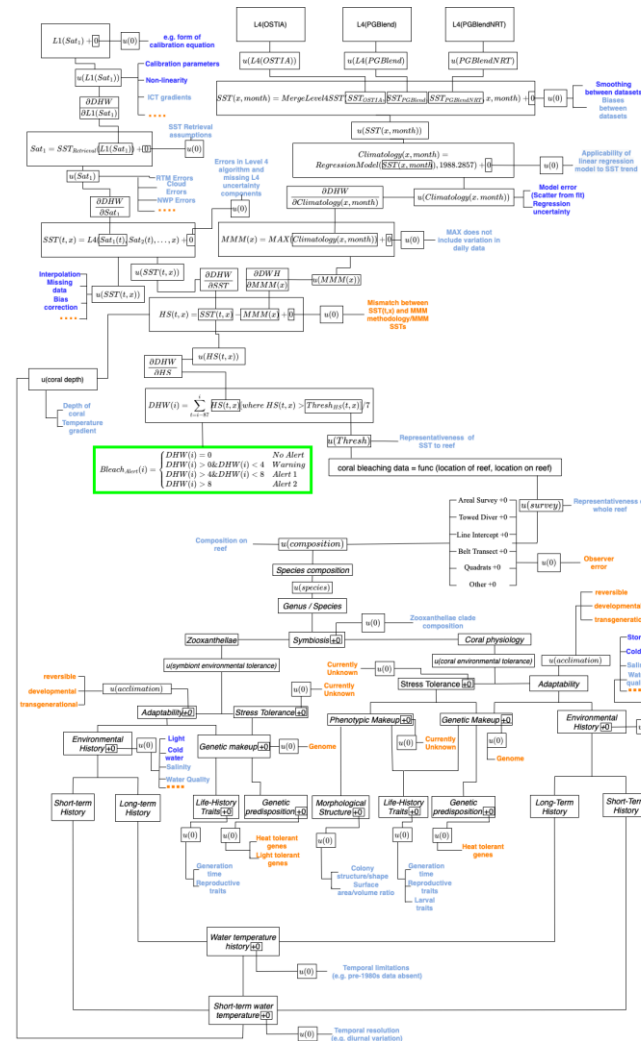
## Task 2: Investigate the strengths and weaknesses of physical retrieval vs regression-based SST retrieval over coral reefs

- During the next 12 months we aim to progress this analysis:
  - Given what we have learned so far, decide on an analysis methodology
  - Expand the analysis to many more reefs
- Expected Outputs and Results:
  - Published paper

### Task 3: Apply meteorology to satellite-based coral heat stress monitoring tools

- Task Lead/Contact Point:
  - Jonathan Mittaz
- Involved TT members:
  - Jonathan Mittaz, Miguel Meis, William Skirving
- Status/Expected completion:
  - Sometime within the next 2 to 3 years we aim to publish a paper
- Task Description:
  - Developed an uncertainty tree for the NOAA Coral Reef Watch satellite-based Degree Heating Week (DHW) product.

# Task 3: Apply meteorology to satellite-based coral heat stress monitoring tools



PHYSICAL

BIOLOGICAL

## **Task 3:** Apply meteorology to satellite-based coral heat stress monitoring tools

- Activities planned for the next 12 months:
  - Improve uncertainty tree
- Expected Outputs and Results:
  - Published paper

### **Task 4 (new task):** Use of Improved SST datasets for Heat Stress Product Production

- Task Lead/Contact Point:
  - William Skirving
- Involved TT members:
  - William Skirving, Andrew Norrie
- Status/Expected completion:
  - Completed
- Task Description:
  - Using CCI as an example of an improved SST dataset, apply the Degree Heating Week (DHW) algorithm and compare outputs with DHW to demonstrate that recreating DHW is not a trivial task.

## Task 4 (new task): Use of Improved SST datasets for Heat Stress Product Production

The most successful product for detecting coral bleaching

Degree Heating Week (DHW) product  
Developed and served by NOAA Coral Reef Watch

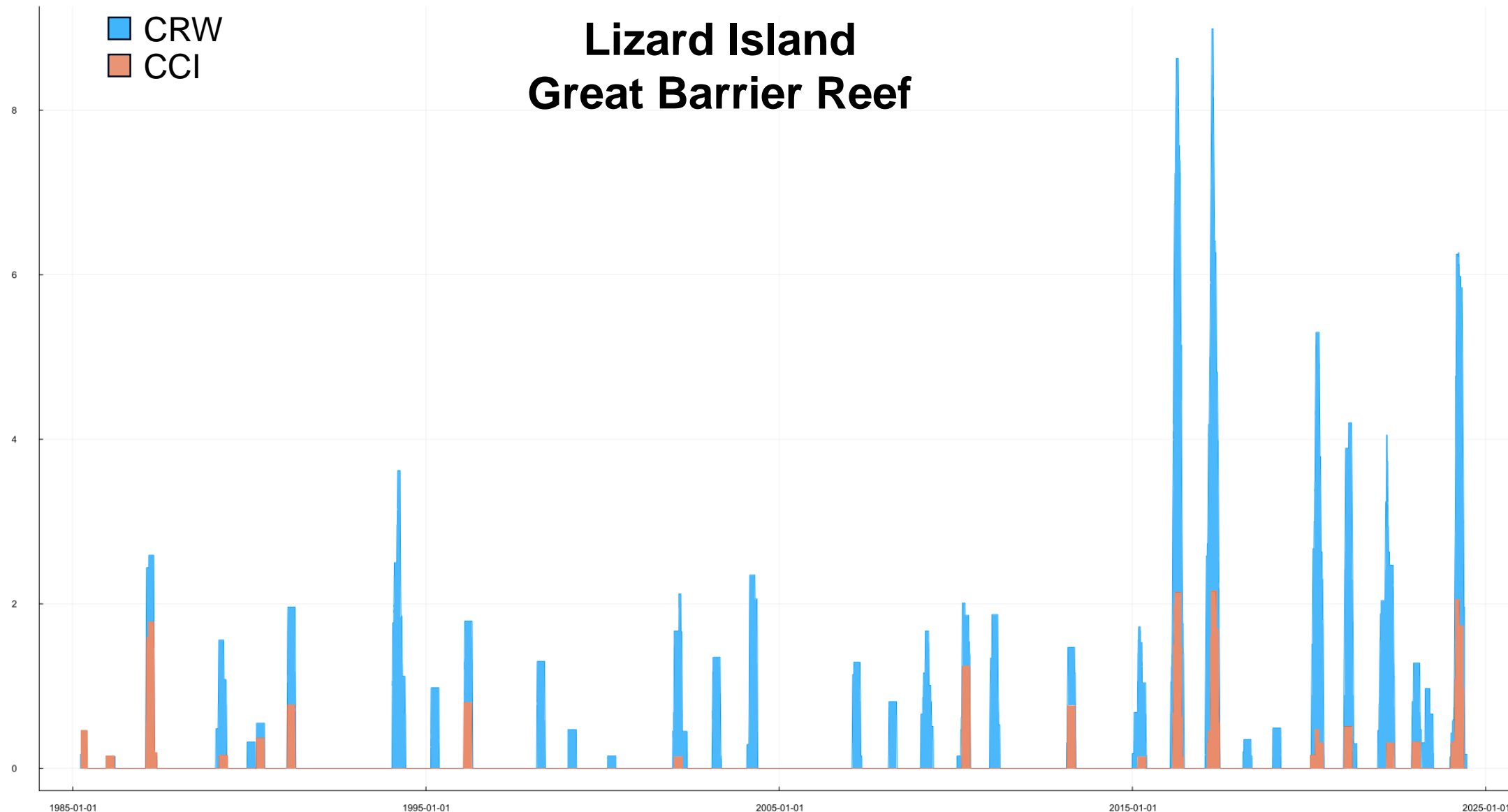
$$DHW_i = \sum_{n=i-83}^i \left( \frac{HS_n}{7} \right), \quad \text{where } HS_n \geq 1$$

$$HS_i = SST_i - MMM, \quad HS_i \geq 0$$

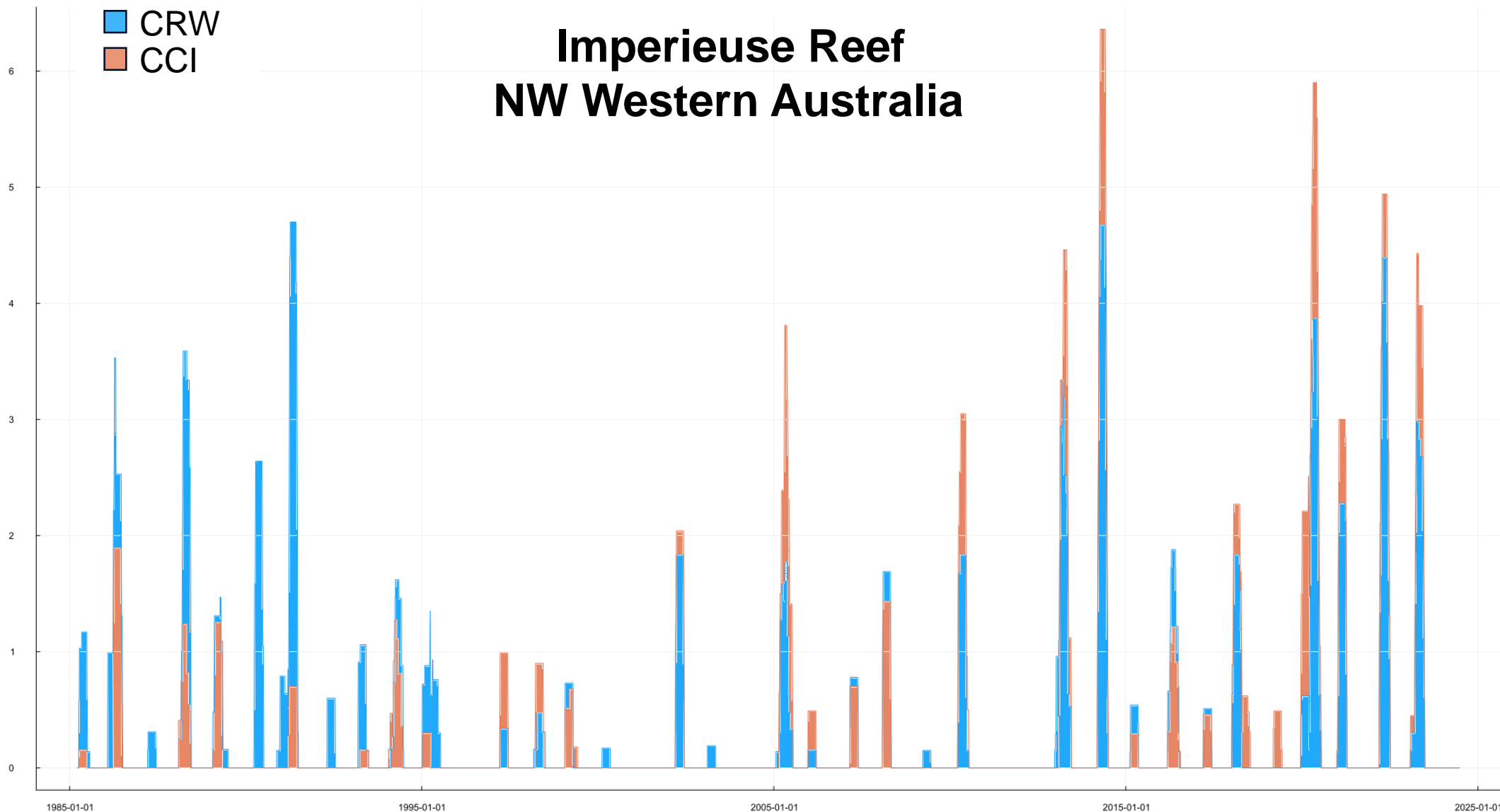
MMM = maximum monthly mean SST  
HS = HotSpot (daily SST anomaly wrt MMM)

Skirving, W., et al. (2020) CoralTemp and the Coral Reef Watch Coral Bleaching Heat Stress Product Suite Version 3.1. *Remote Sensing* **12**, 3856.

# Lizard Island Great Barrier Reef







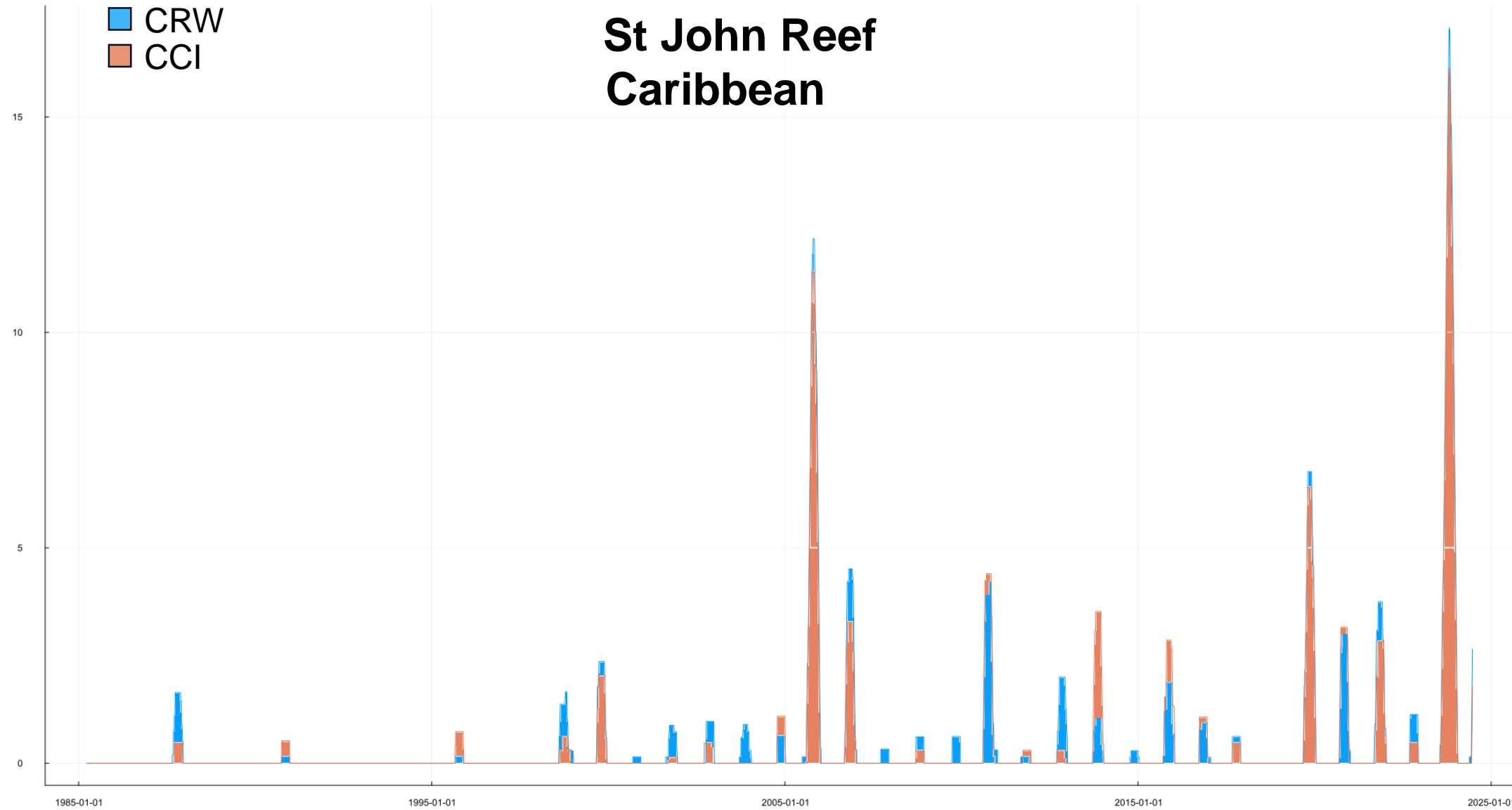
2024-2025

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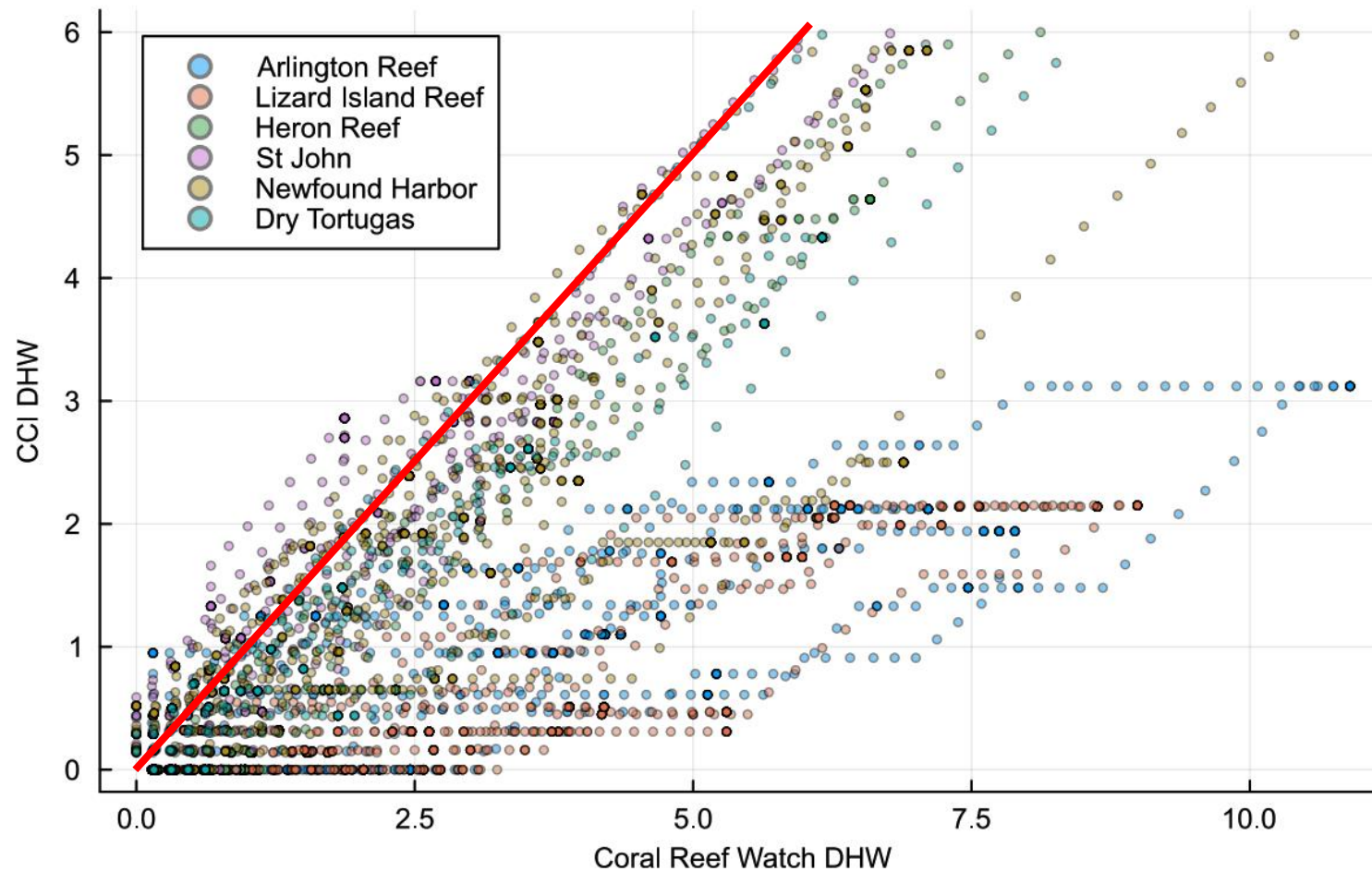
# St John Reef Caribbean

CRW  
CCI



# Task 4 (new task): Use of Improved SST datasets for Heat Stress Product Production

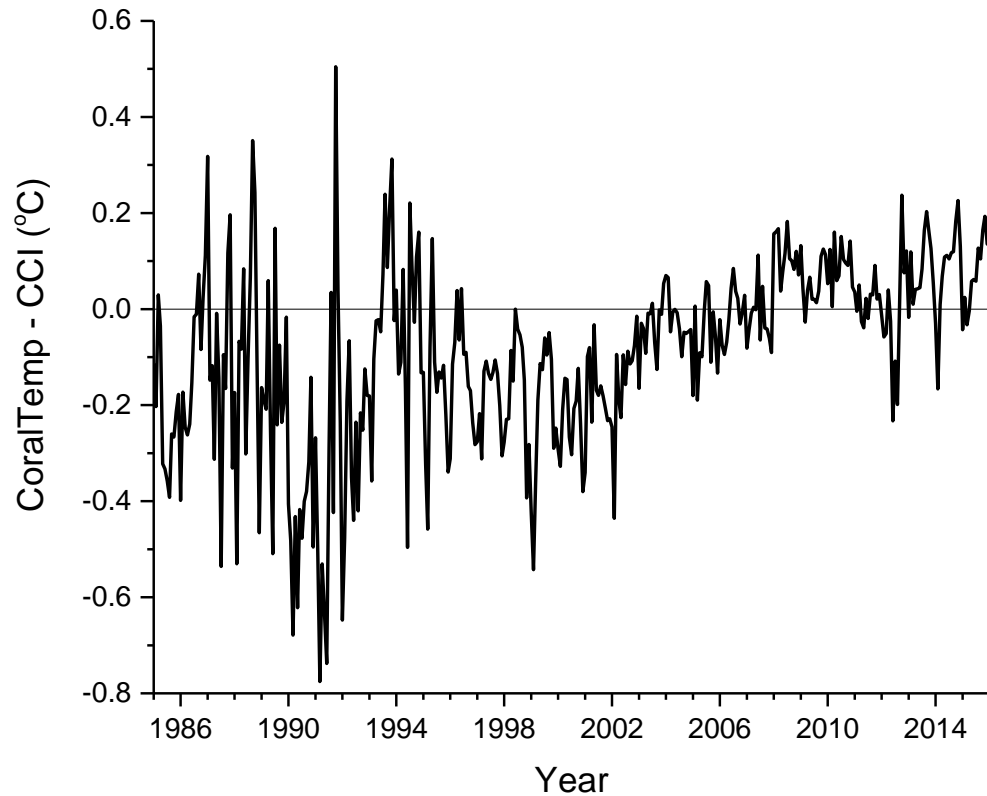
CRW < 6 DHW or CCI < 6 DHW from 1 Jan 2015 to 22 June 2024



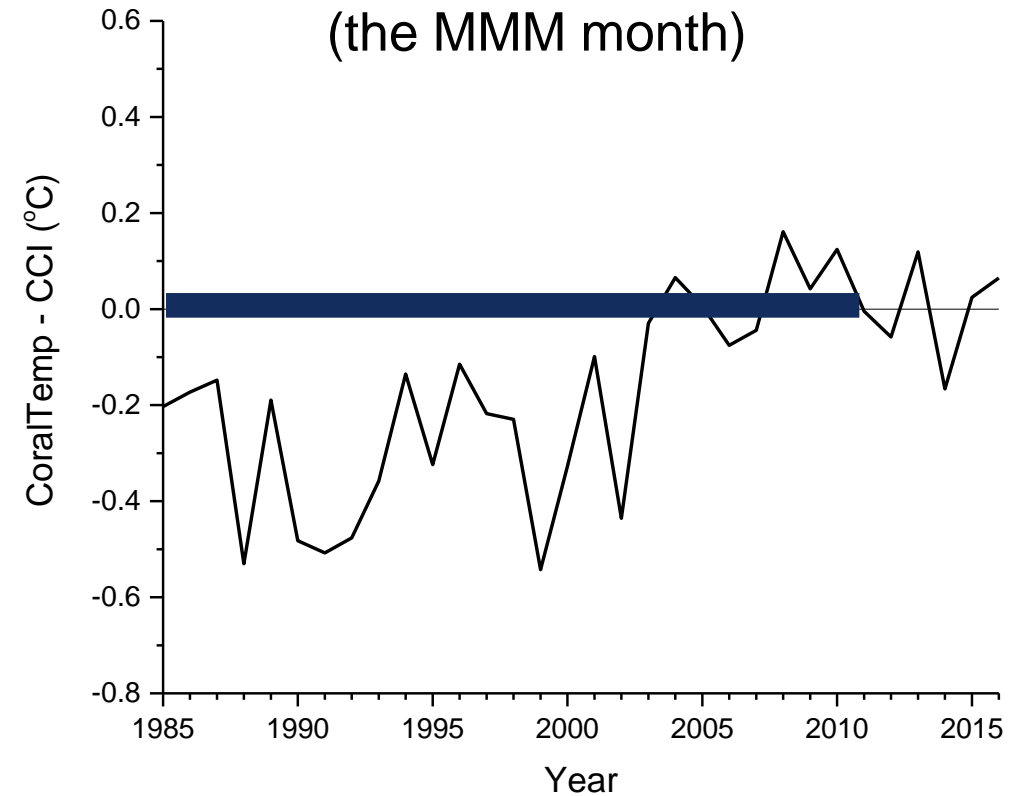
# CoralTemp vs CCI

## 1985-2016 (Great Barrier Reef)

All Months



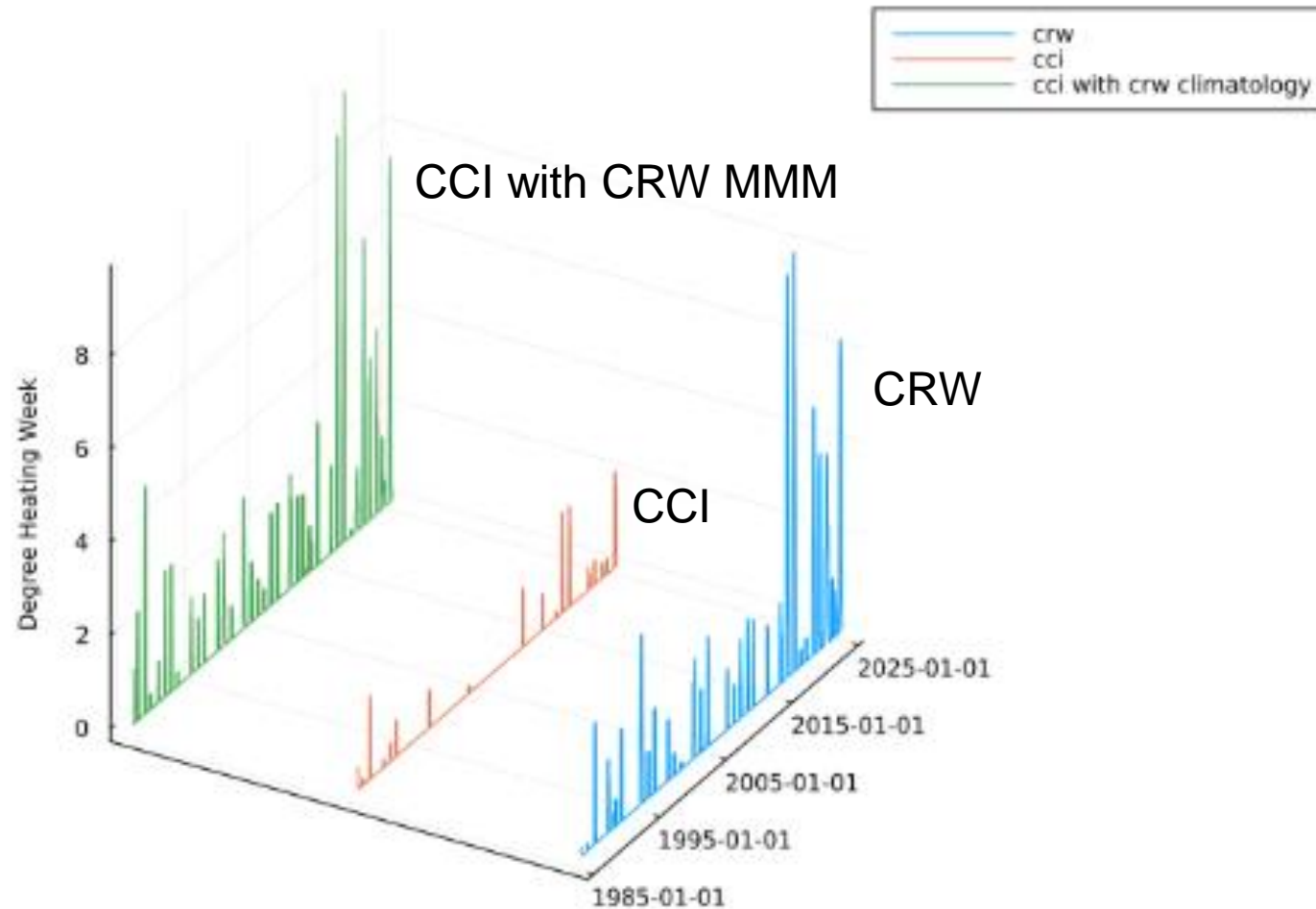
1985 to 2012 average diff =  $-0.11^{\circ}\text{C}$

February-only  
(the MMM month)

1985 to 2012 average diff =  $-0.19^{\circ}\text{C}$

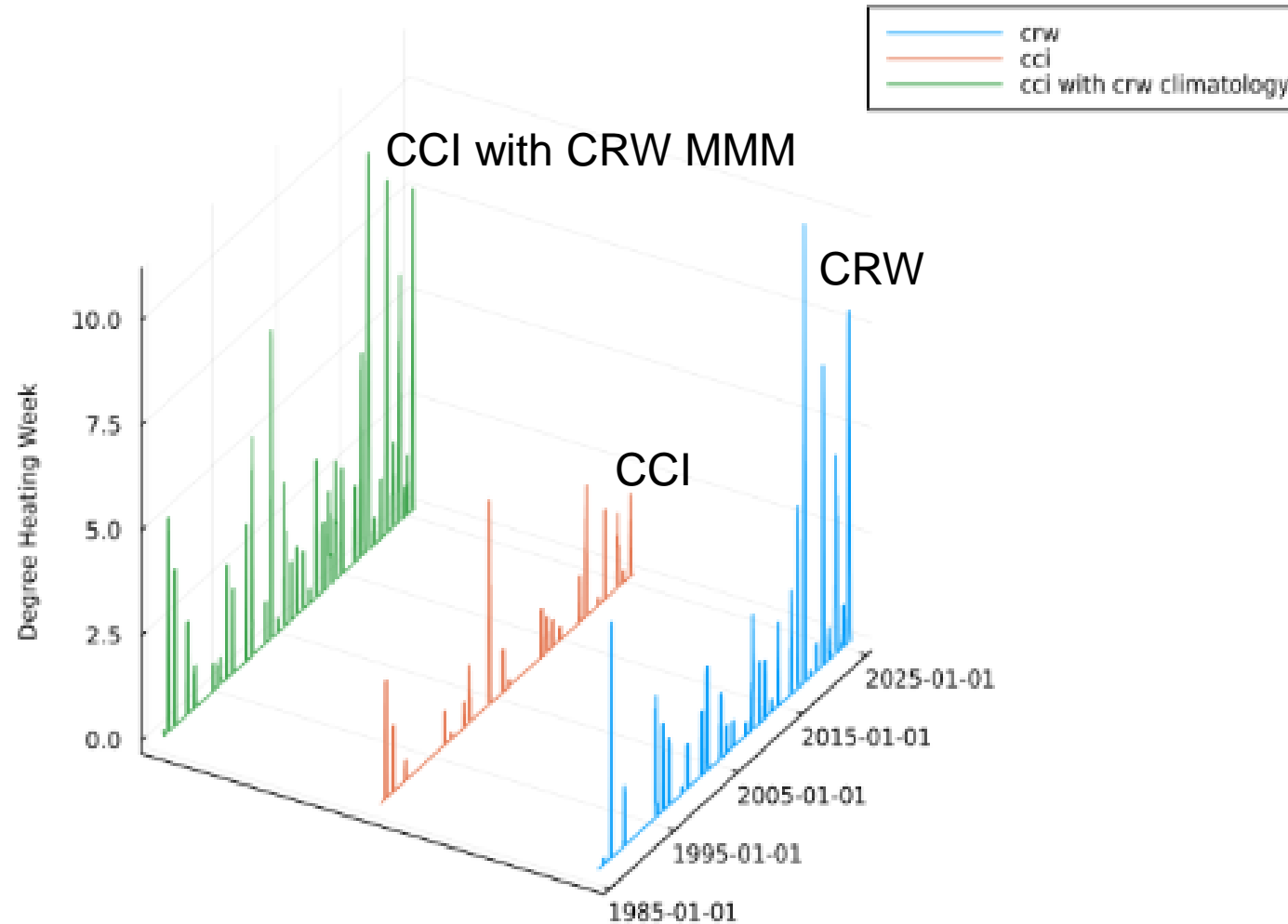
# Use of CoralTemp MMM with CCI

CRW and CCI DHW at Lizard Island Reef from 1985-03-25 to 2024-06-22



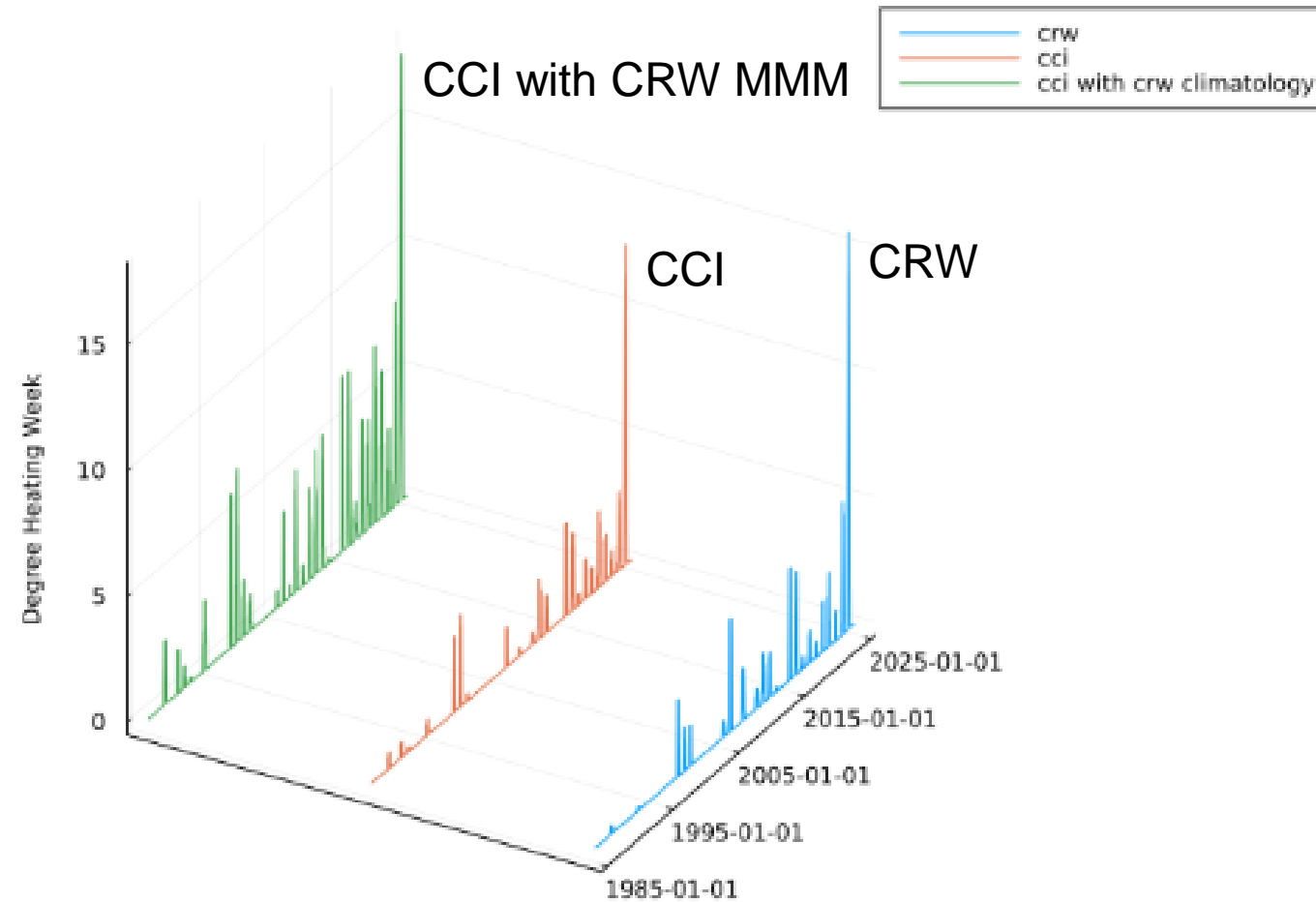
# Use of CoralTemp MMM with CCI

CRW and CCI DHW at Arlington Reef from 1985-03-25 to 2024-06-22



# Use of CoralTemp MMM with CCI

CRW and CCI DHW at Molasses Reef from 1985-03-25 to 2024-06-22



## Task 4 (new task): Use of Improved SST datasets for Heat Stress Product Production

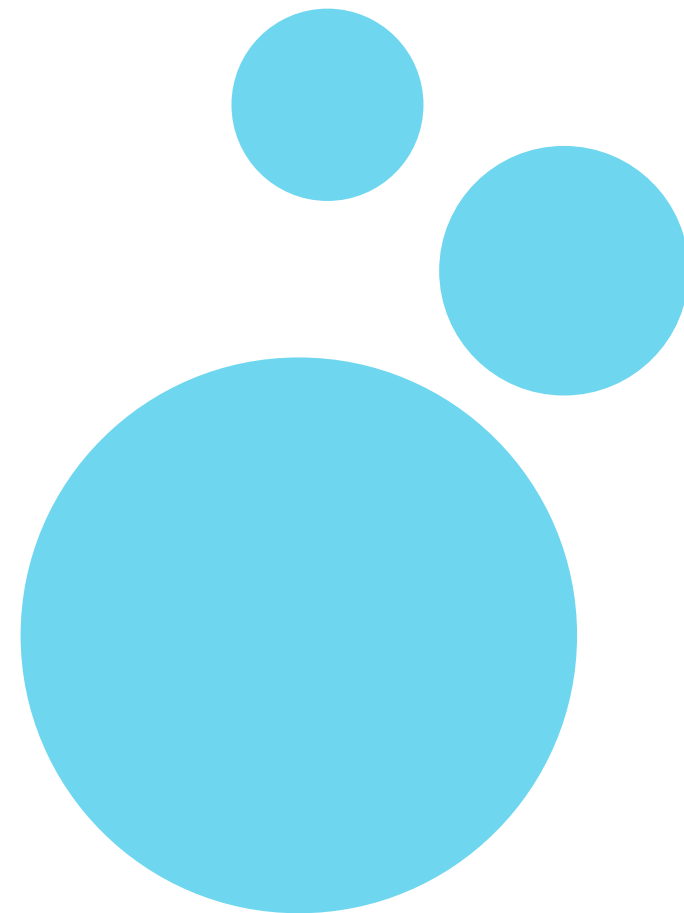
### Take Home Message:

- The DHW algorithm is simple
- Applying it to a dataset other than CoralTemp 3.1 is very difficult



# Challenges and Needs

- Challenges for this work mostly revolve around funding and time.
  - Todate, all work has been performed with no funding
  - We have been actively looking for funding, however we are yet to be successful.
  - So, while this work remains unfunded, the main constraint is the available time for participants to spend on this work. There is much desire, but precious little time.



# Additional points?

- We would like to expand the scope of the Task Team to include non-coral applications and regions
- This may open up new funding opportunities
- Therefore we propose to change the Task Team's name to:

## Marine Heat Stress Task Team