# *Development of a Water Clarity Index for the Southeastern US as a climate indicator*

**RESEARCH TEAM**

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**WORKING HYPOTHESES**

- Episodic and seasonal weather events are mechanistically linked to changes in southeast coastal water clarity, and
- Changes in the frequency and intensity of these events yield responses in water clarity levels on multiple timescales

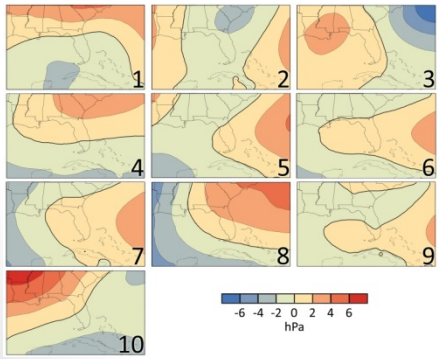
**OBJECTIVES**

- Develop a multi-decadal water clarity indicator ($K_d$ index) for coastal waters of the southeastern United States
- Assess how high frequency perturbations and long-term changes in atmospheric conditions (circulation patterns, weather types, and precipitation events) are associated with variability in the $K_d$ index
- Develop an empirical-based moving estimate of water clarity and light- stressed conditions for purposes of tracking and monitoring critical changes in coastal regions and assessing impacts on light-sensitive species (corals, seagrass).

# *Water Clarity Index*
# Theoretical framework and data

## CLIMATOLOGICAL DATA

- NNR reanalysis data 1948-present
- Synoptic climatology
  - Circulation patterns across the southeastern US at the regional and possibly mesoscale levels
  - Spatial synoptic classification weather-type classifications for individual stations in the study region
- Other variables
  - Precipitation events; river discharge(?)




Anomalous SLP patterns across the SE

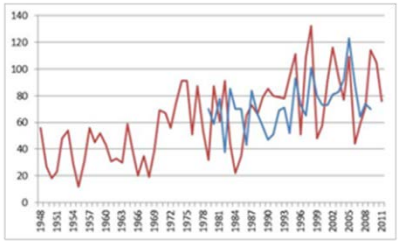


Fig. 4. Trends in the annual total of Moist Tropical Plus (MT+) days in Miami by year, using the Spatial Synoptic Classification (red); and cyclonic circulation days across the region (Sheridan et al. 2013, blue).

## Kd INDEX

- Satellite data from several sensors:
  - CZCS 1978-1986
  - SeaWifs 1997-2010
  - MODIS 2002-present
- Algorithms needed to derive diffuse attenuation coefficient (Kd)
  - Complicated by study region being in coastal waters
- Temporal and spatial filtering to derive time series that addresses gaps in coverage

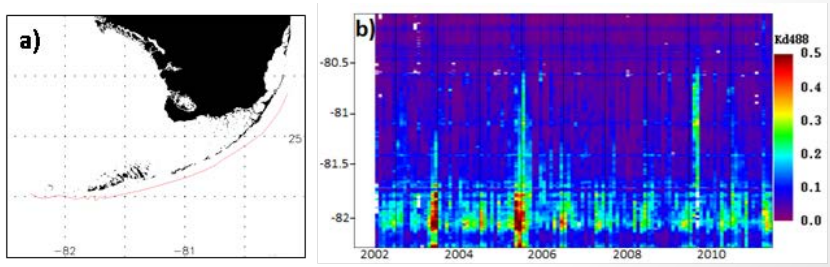
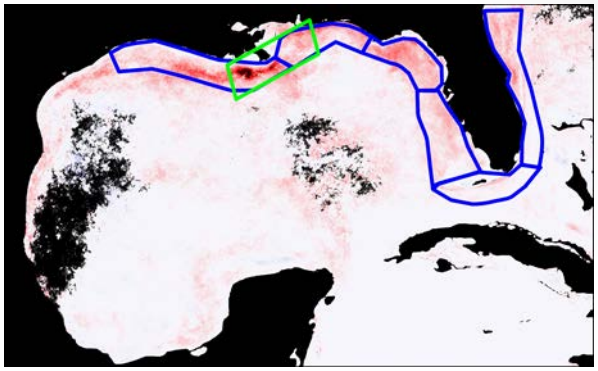



Fig. 2. (a) Artificial transect line along the Florida Key's Reef Tract; (b) MODISA $K_d488$ ($m^{-1}$) along this transect line derived from the Lee et al. (2005) algorithm after some local tuning.

# *Water Clarity Index*
# Methods

- THE Kd INDEX – CLIMATE RELATIONSHIP
  - Climate: Event frequencies and event frequency anomalies
    - Circulation pattern, synoptic typing, precipitation
    - Aggregates over weekly to monthly periods
    - Lagged analysis of up to 1 month
  - Kd Index
    - Transects along with regional means
    - Threshold exceedance
  - Modeling the Kd – climate relationship
    - Multivariate linear mixed model, distributed lags
    - Binary logistic regression model, distributed lags
  - Development and validation
    - Tested on 1997-present
    - Cross-validated and validated against earlier data
    - Development of historical Kd index values based on developed relationships



Seven preliminary study regions

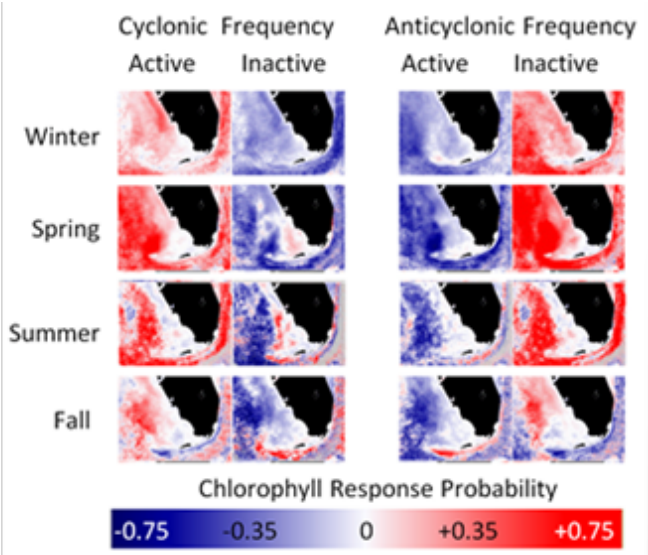



Fig. 3. Chlorophyll response characteristics based on frequency levels (active/inactive) of cydonic and anticydonic circulation patterns. The figure enables visualization of positive (red) and negative (blue) chlorophyll response as a probability to regional forcing. Adapted from Sheridan et al. (2013).