Ecological enhancements of the Charlotte Harbor spectral optical model for interpretation of inter-annual seagrass performance

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Spectral Optical Model for CHNEP:

Model of Kd, Attenuation Coefficient,
Using WQ parameters of color, chlorophyll and turbidity

Advantages over field-measured Kd

The **distribution** of modeled Kd from 2003-2007,
(when seagrass coverage was acceptable)
used to set water clarity targets

The Scoring Tool compares and rates the distribution of Kd each year by water quality segment

Water Clarity Reporting Tool

Year	Dona and Roberts Bay	Lower Lemon Bay	Tidal Peace River	West Wall	East Wall	Matlacha Pass	Tidal Caloosahatchee	Estero Bay	Upper Lemon Bay	Tidal Myakka River	Bokeelia	Cape Haze	Pine Island Sound	San Carlos Bay
1998									-2					
1999									-2					
2000									-1					
2001		-2	-2	-2	-2				0	-2		-2		
2002		-1	-1	-1	-2		-2		0	0	-2	-2		2
2003	-2	-1	-2	-2	-2		-2		-1	-2	-2	-2		1
2004	0	0	0	0	1	1	0	-1	0	0	0	0	0	2
2005	0	0	-1	-2	-2	-2	-2	0	0	-1	-1	0	-1	-1
2006	0	0	0	0	0	0	2	1	1	1	0	0	-1	-2
2007	2	1	2	2	2	2	2	2	1	2	2	1	2	2
2008	1	-1	0	1	1	0	1	-1	0	0	2	-1	2	0
2009	0	-2	-1	-1	-1	0	0	0	1	0	1	-1	0	-1
2010	-2	-2	0	-1	0	-2	1	-1	-1	0	0	-1	0	-1
2011	-1	-1	0	-1	0	-2	1	-1	-1	-1	1	-2	0	-1
2012	0	-1	0	-2	-2	-2	2	2	-1	-1	-2	-2	2	-2
2013	-1	0	-1	-2	-2	-2	2	2	0	-1	-1	-1	2	-1
2014	0	0	0	-2	-1	1	2	2	1	-2	1	-1	2	1
2015	-2	0	-1	-2	-2	0	2	-1	-2	-2	-1	-1	2	2

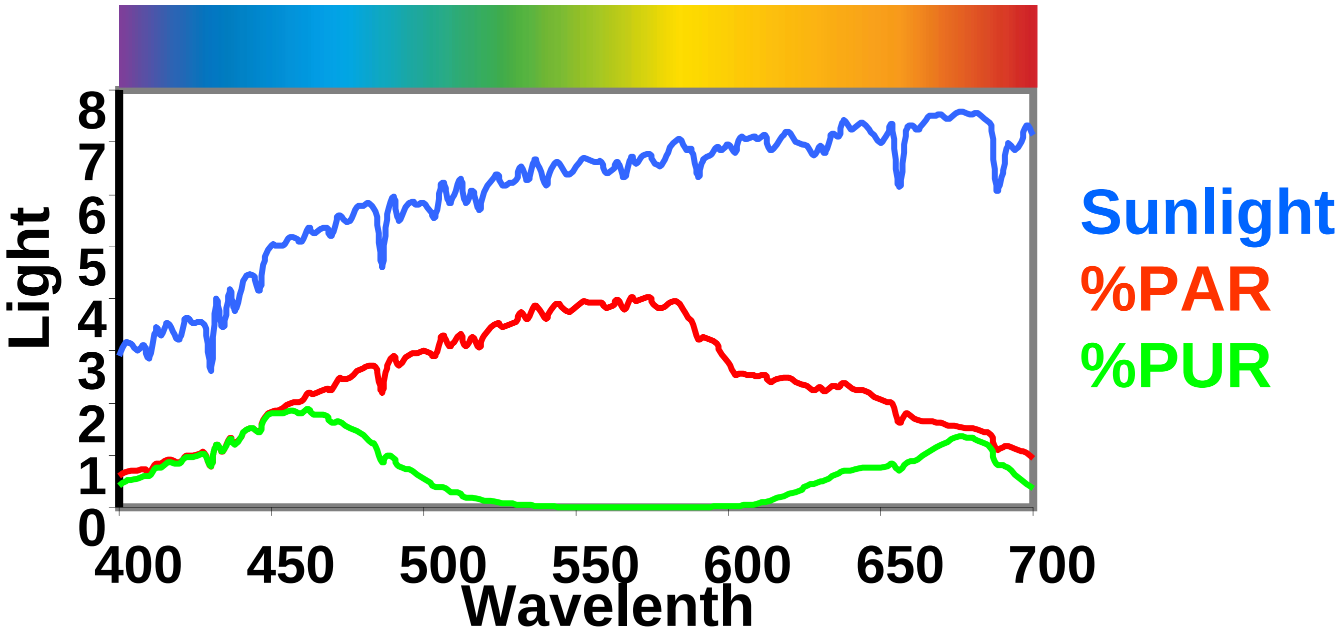
http://www.chnep.wateratlas.usf.edu/water-clarity/

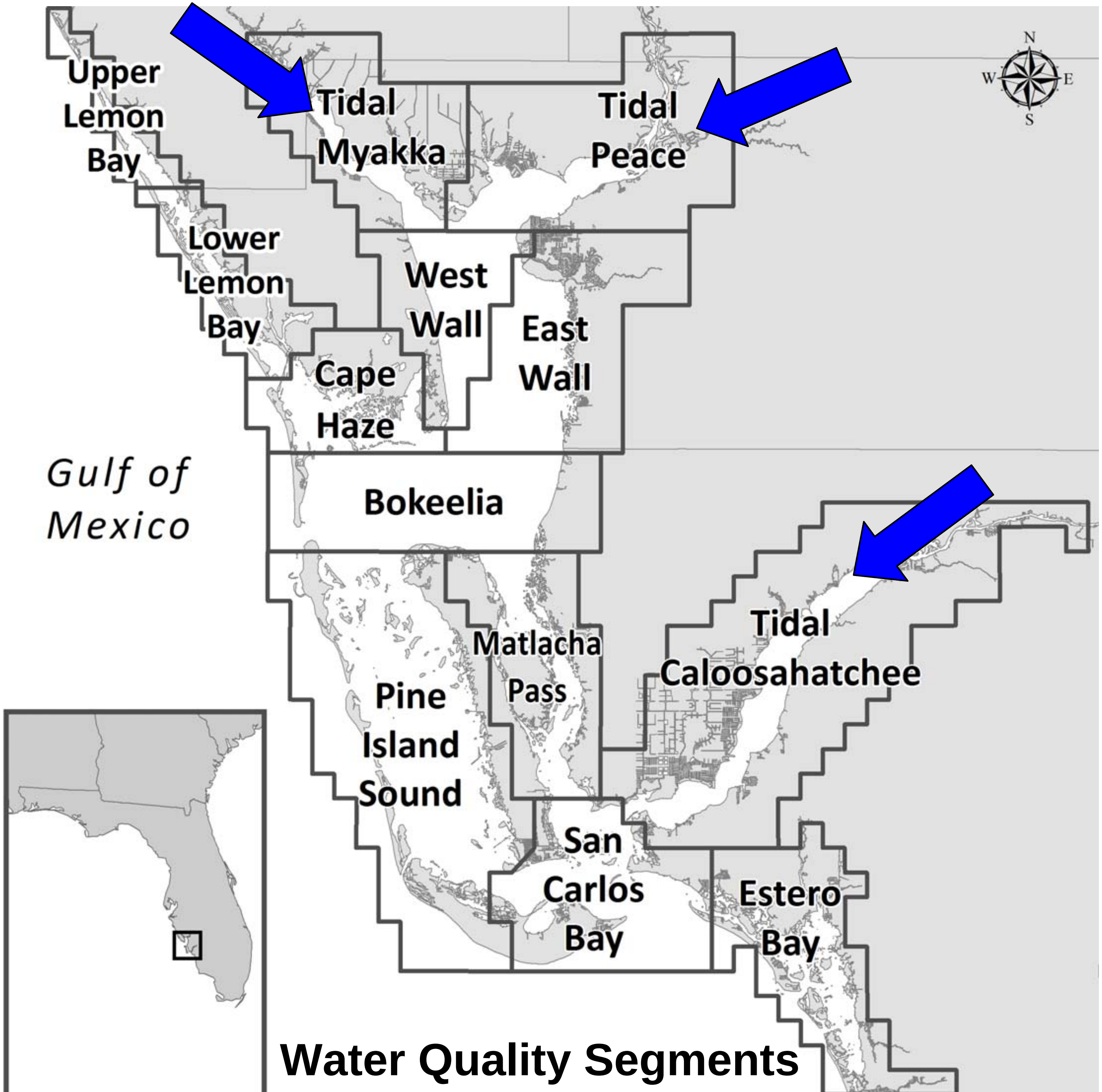
New work using model to examine:

From Kd, compute %PAR at deep edges
(%PAR a function of both Kd AND depth)

Model %PUR – Photosynthetically Useable Radiation

Seagrass response relative to %PAR, %PUR received?





Water Quality Segments

Water Quality Data:

Color, Chlorophyll Turbidity, (Salinity, Temperature)

1998-2017

- ~29,000 Salinity, temperature observations
- ~18,700 modeled Kd, %PAR, %PUR

By segment, year, and month,

- median WQ, and physical
- median light parameters (%PAR, %PUR)
- variety of cumulative light parameters
- growing season (Apr-Nov), spring season (Apr-Jul)
- physical minima, maxima

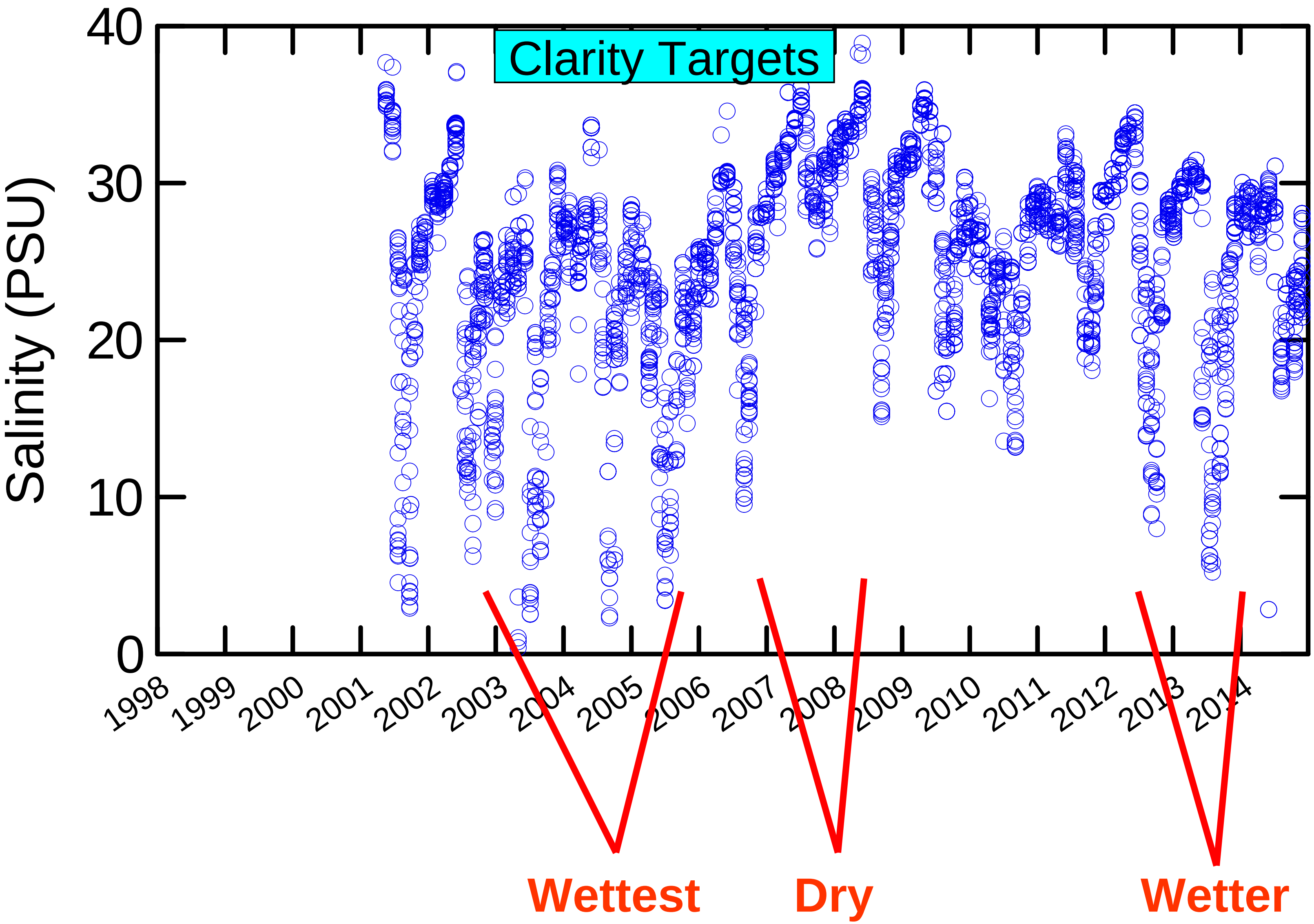
Light is quantified <u>at target depths</u>

Link back to seagrass transect data

Salinity inversely related to color,

Color controls Kd

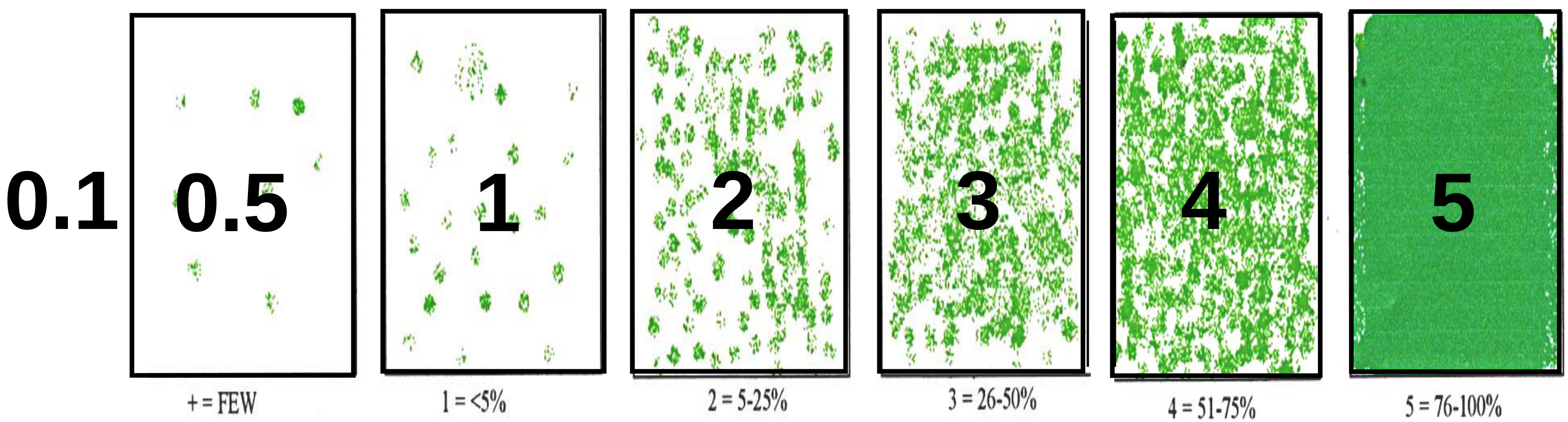
Kd + Depth controls %PAR

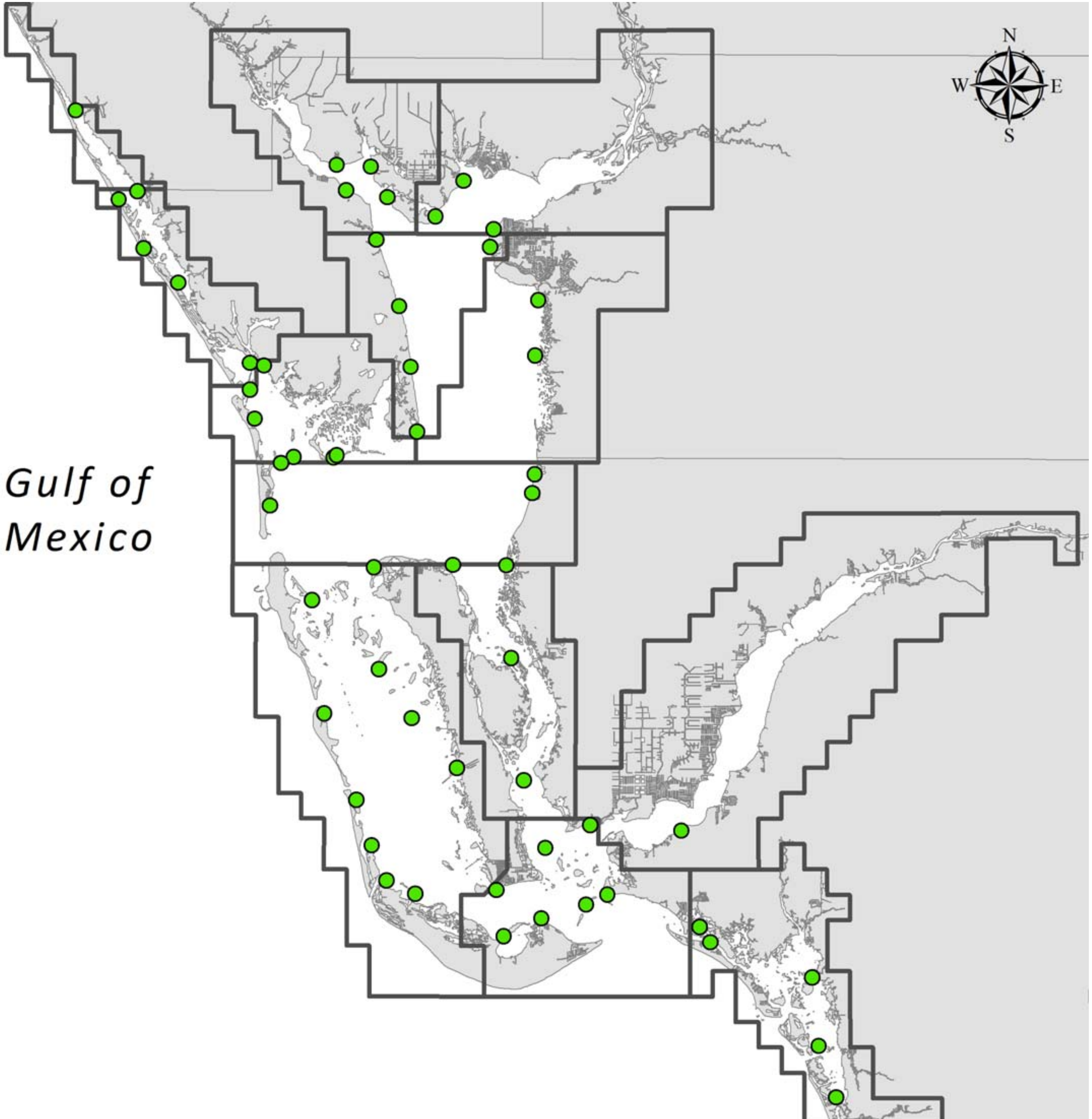


Transect Data – Generally in August - December
Quadrats with water depth, sediment type, species, abundance (Braun-Blanquet), blade lengths, shoot counts, and epiphyte loads

1998-2016
~63 Transects ~12,000 quadrat observations

Used sites with longer records, defined "end" of bed, and not upriver
Selected deepest edge by transect, year, and month

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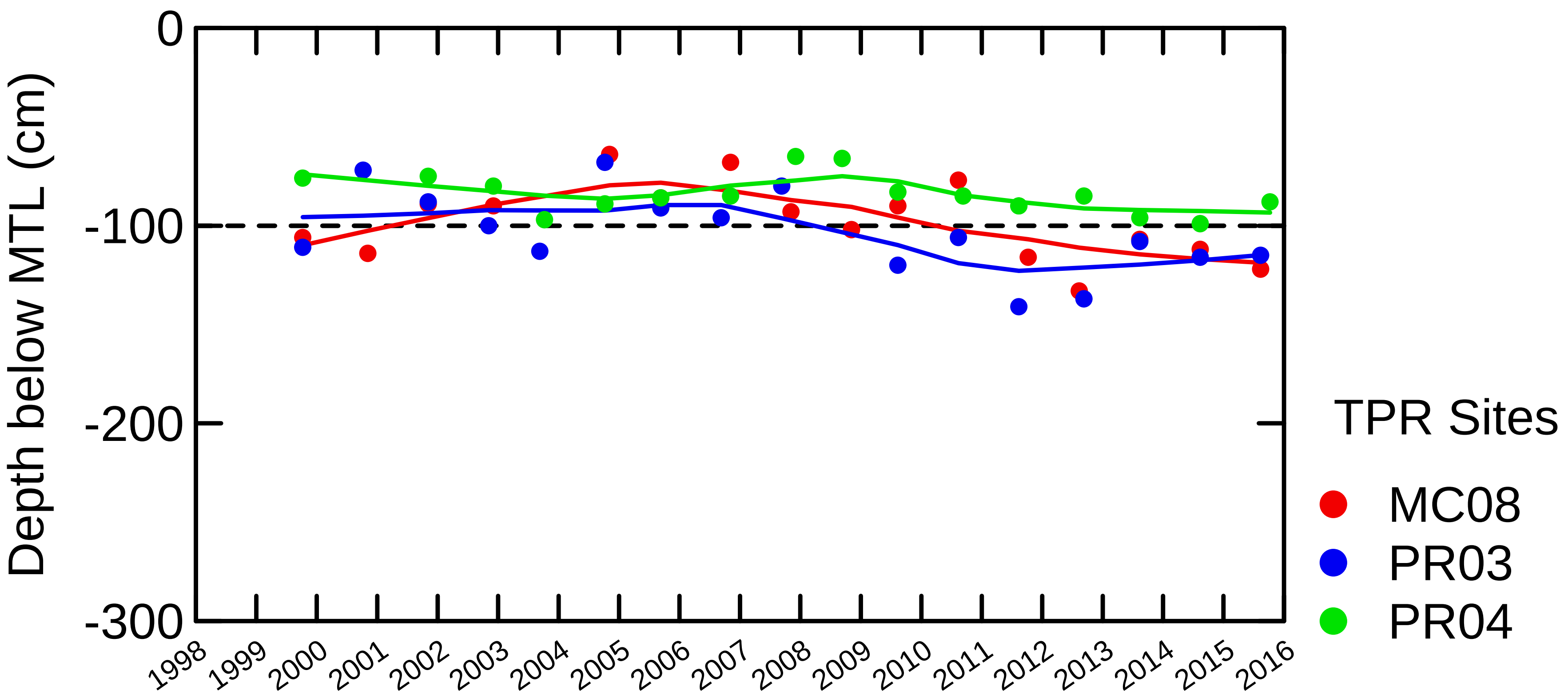
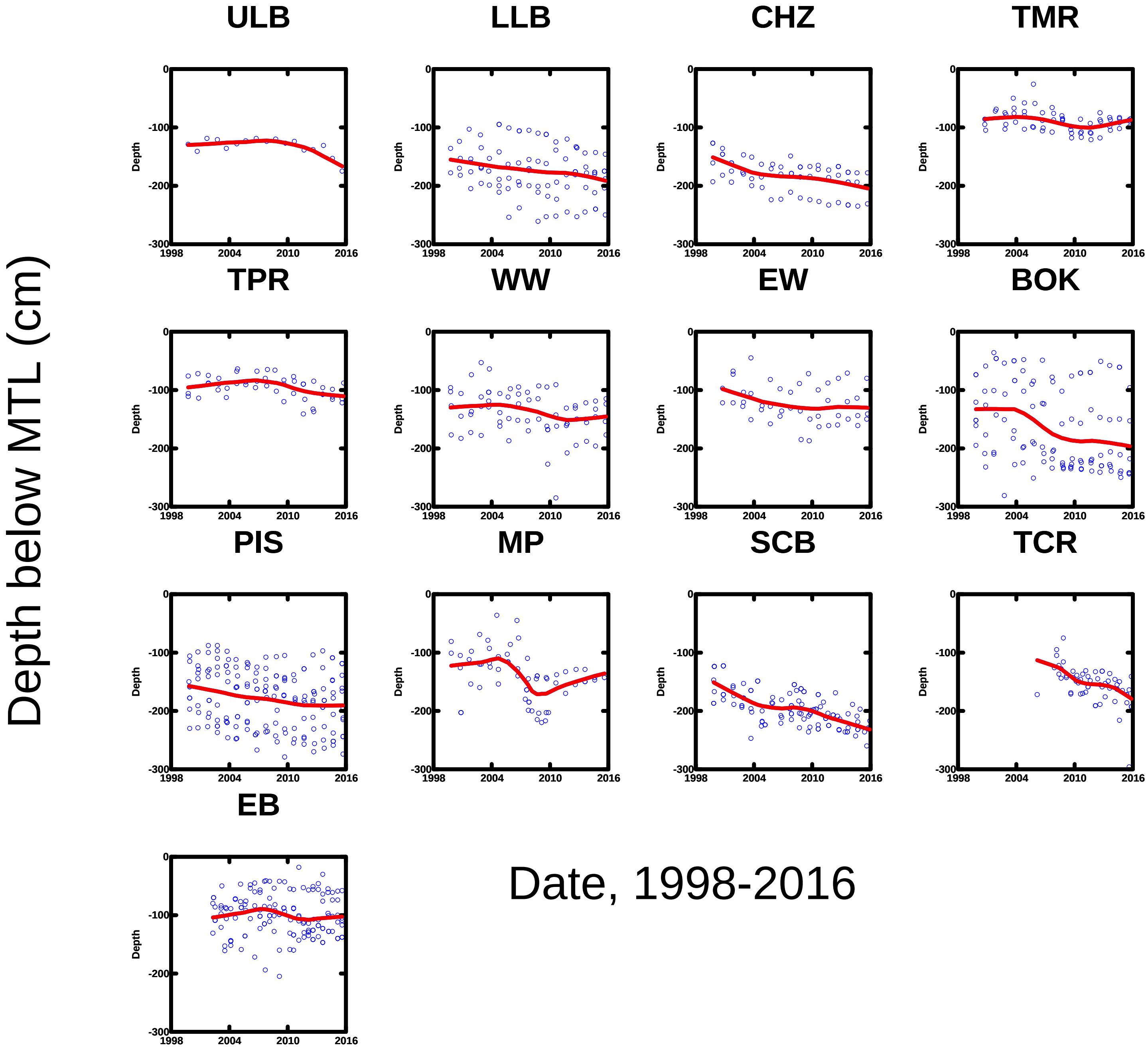
S
E
W
Gulf of
Mexico



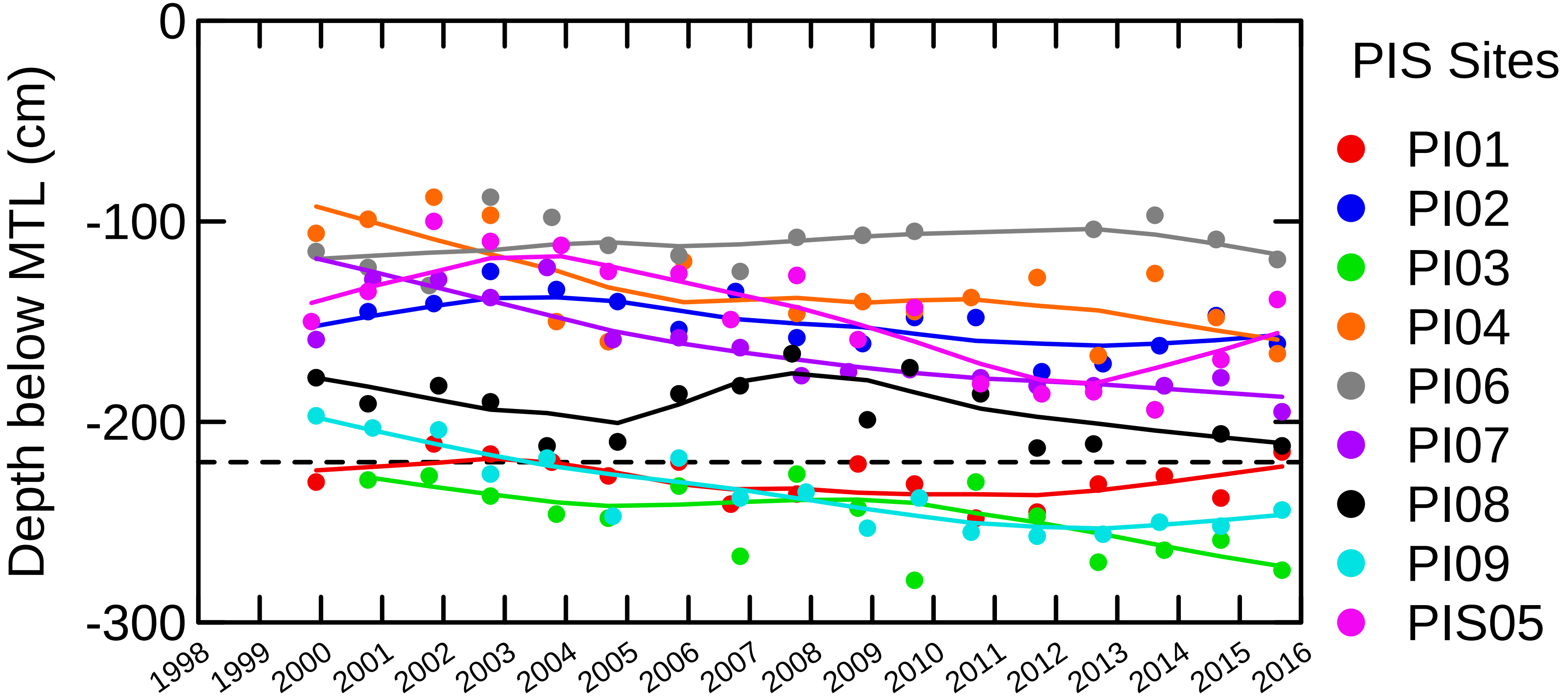
1998-2016

Deep edge regardless of species

Not much response!



Gradually increasing depth of deep edges in most segments



Wide range of depths among individual transects
Subdivide WQ segments

Issues:

To quantitatively examine deep edge response to light, need:

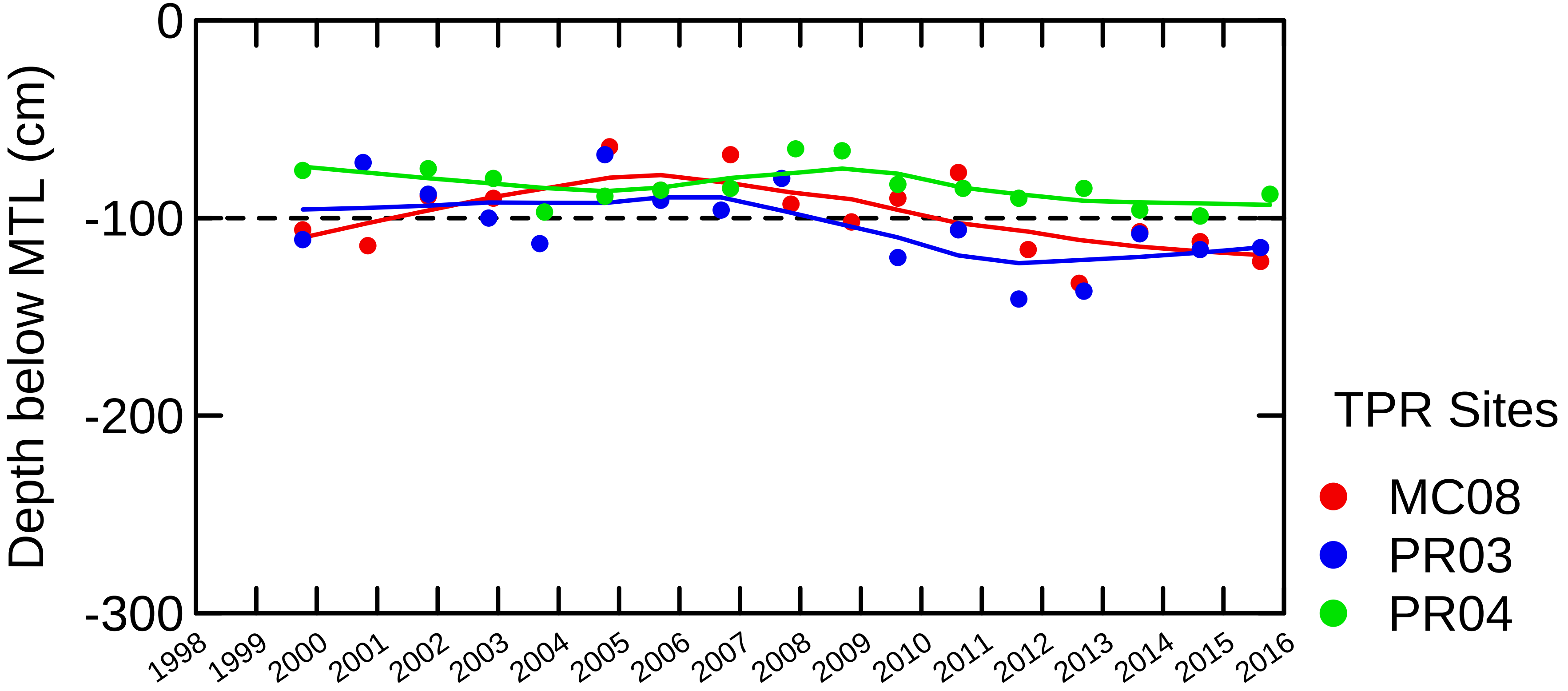
1) changes in depth

2) %PAR at the seagrass depth

Can’t model a single, stable transect

Since light modeled to target depths,
Limit the transects evaluated to those near the target depths

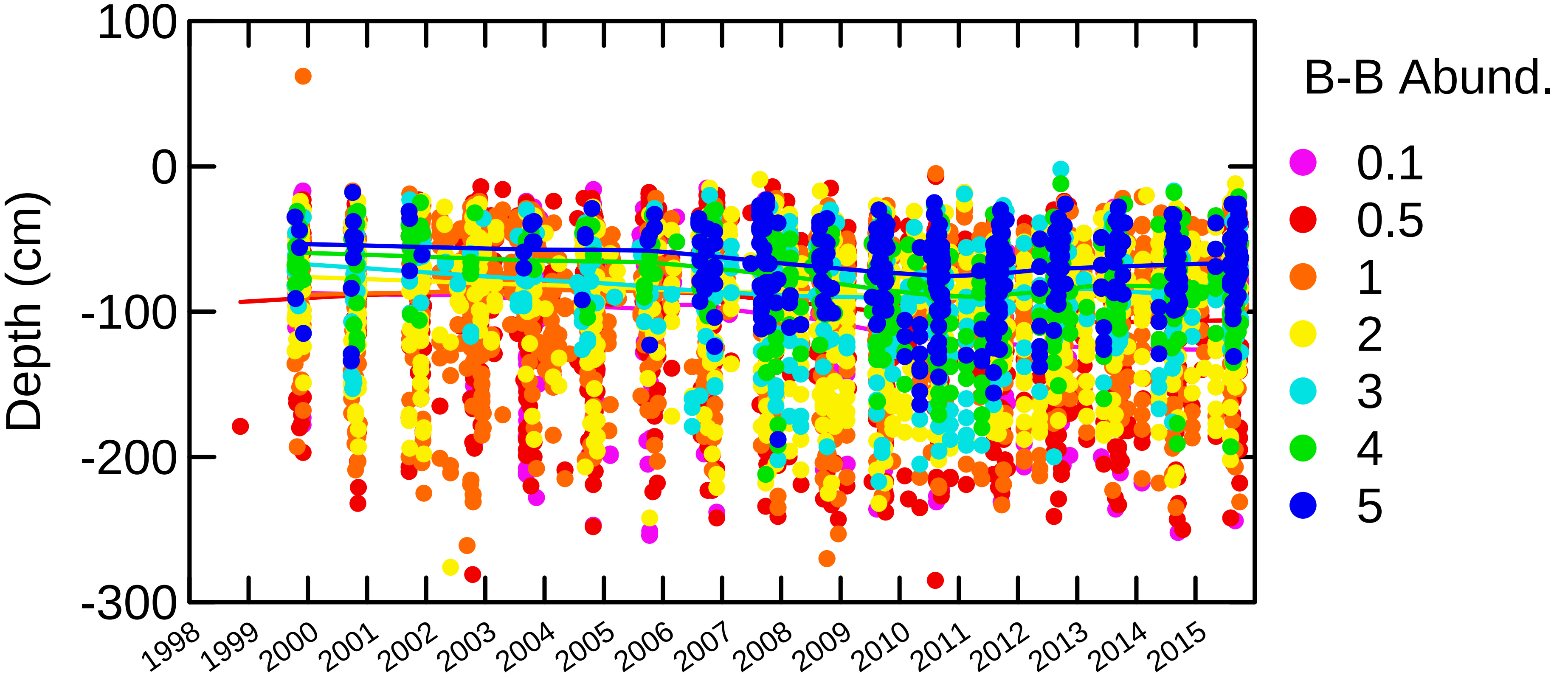
Interim Results!



No significant relationships found for:

- Depth of deep edge as a function of light
- Species-specific deep edges

BUT WAIT!



Halodule, all quads

“Bed Rating’

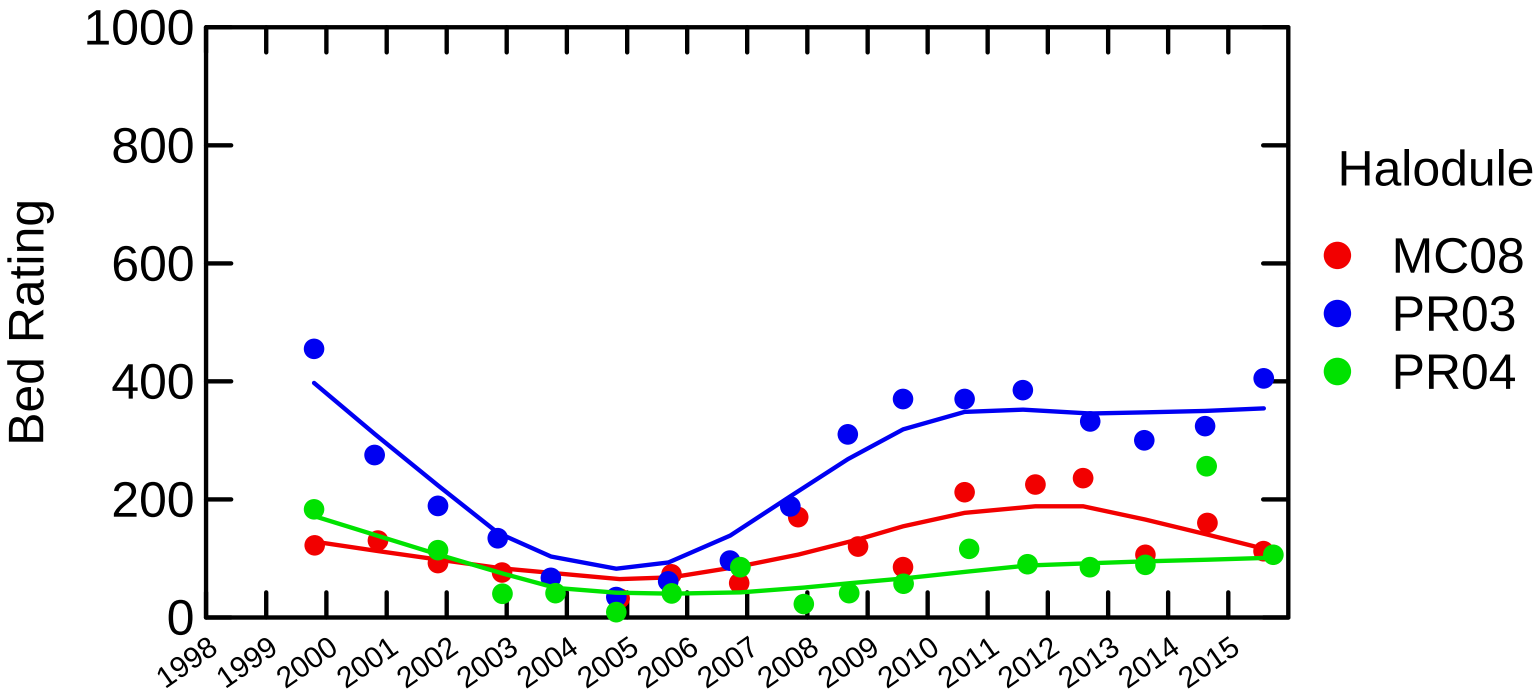
B-B Abundance = 0 to 5
Depth = 0 to -300 cm (normalize to 0-5)

Bed Rating = ABS(Depth) X Abundance
(Similar results if normalized or not)

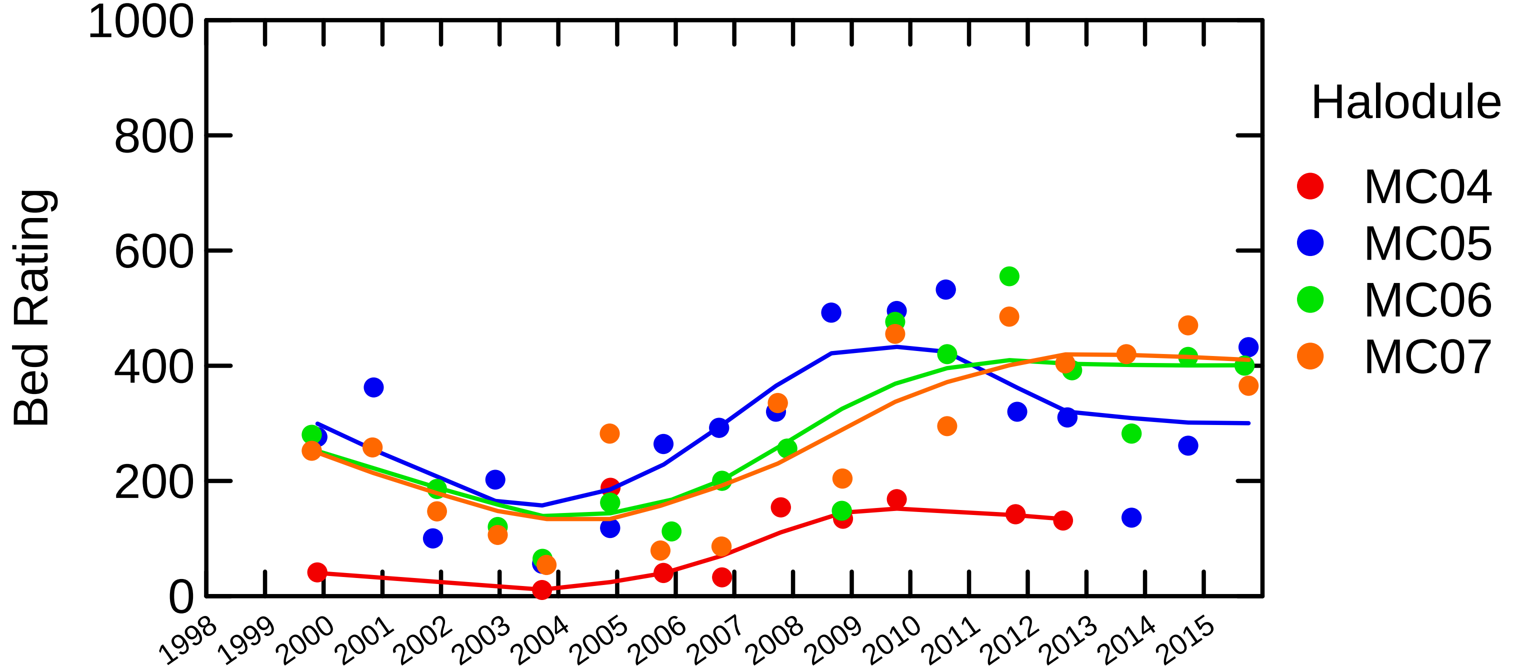
Use maximum Bed Rating for date, transect, species

Inverse from deep edges

Low (negative) depths = “good”
High Bed Rating = “good”



Bed Rating
1000
800
600
400
200
0
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
Halodule
MC08
PR03
PR04



Bed Rating
1000
800
600
400
200
0
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
Halodule
MC04
MC05
MC06
MC07

MLR of *ln*(Bed Rating)

Halodule - n=349, r^2=0.28, p<0.001

- Median annual salinity
- Minimum temperature for the year
- 24 month average %PUR

Thalassia - n=219, r^2=0.15, p<0.001

- 24 month average %PAR
- Minimum salinity for the year

Syringodium - n=149, r^2=0.15, p<0.001

- 24 month average %PAR

Conclusions:

•Kd is the better parameter for evaluating water clarity trends

•Seagrass should respond to %PAR or %PUR less epiphyte reduction

•Need modeled light at the individual transect depths

•Deep edge alone is not a sensitive to %PAR variations

•Abundance responds to light

•Maximum “Bed Rating” responds to changes in light, but with lags

•24 month average %PAR, %PUR may not be long enough

•Changes in Bed Rating may appear as change in aerials

Future Steps:

Explore longer, other light periods

Optimize “Bed Rating”

Influences on abundance at selected depth range

Numerically incorporate epiphytes impact on light

Acknowledgements :

The CCHMN Water Quality partners:

- ~Charlotte County
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- ~City of Cape Coral
- ~FDEP Charlotte Harbor Aquatic Preserves
- ~FDEP South District / Div. of Environmental Assessment & Restoration
- ~FWC Charlotte Harbor Field Lab
- ~Lee County Environmental Lab
- ~Sanibel Captiva Conservation Foundation
- ~Sarasota County
- ~South FL Water Management District
- ~Southwest FL Water Management District

Seagrass Transect Monitoring

- ~Charlotte Harbor Aquatic Preserves Staff
- ~CHNEP Scientist
- ~Citizen scientists and interns
- ~Estero Bay Aquatic Preserve
- ~FDEP South District / Div. of Environmental Assessment and Restoration
- ~South FL Water Management District
- ~Southwest FL Water Management District

Steven West

Thank you!