What Happens in Florida Bay Does Not Stay in Florida Bay: Seagrass Die-off Under Climate-Change

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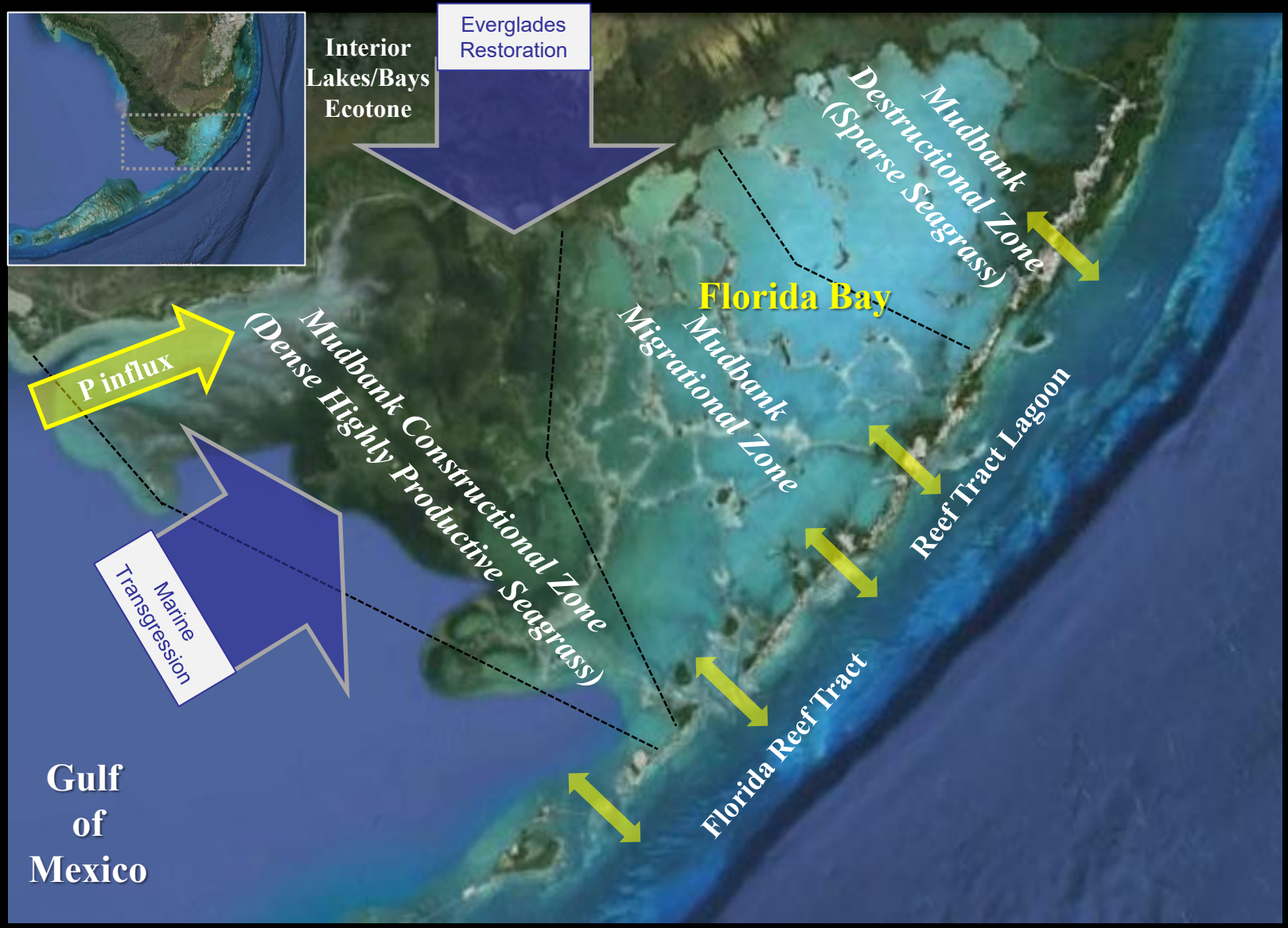
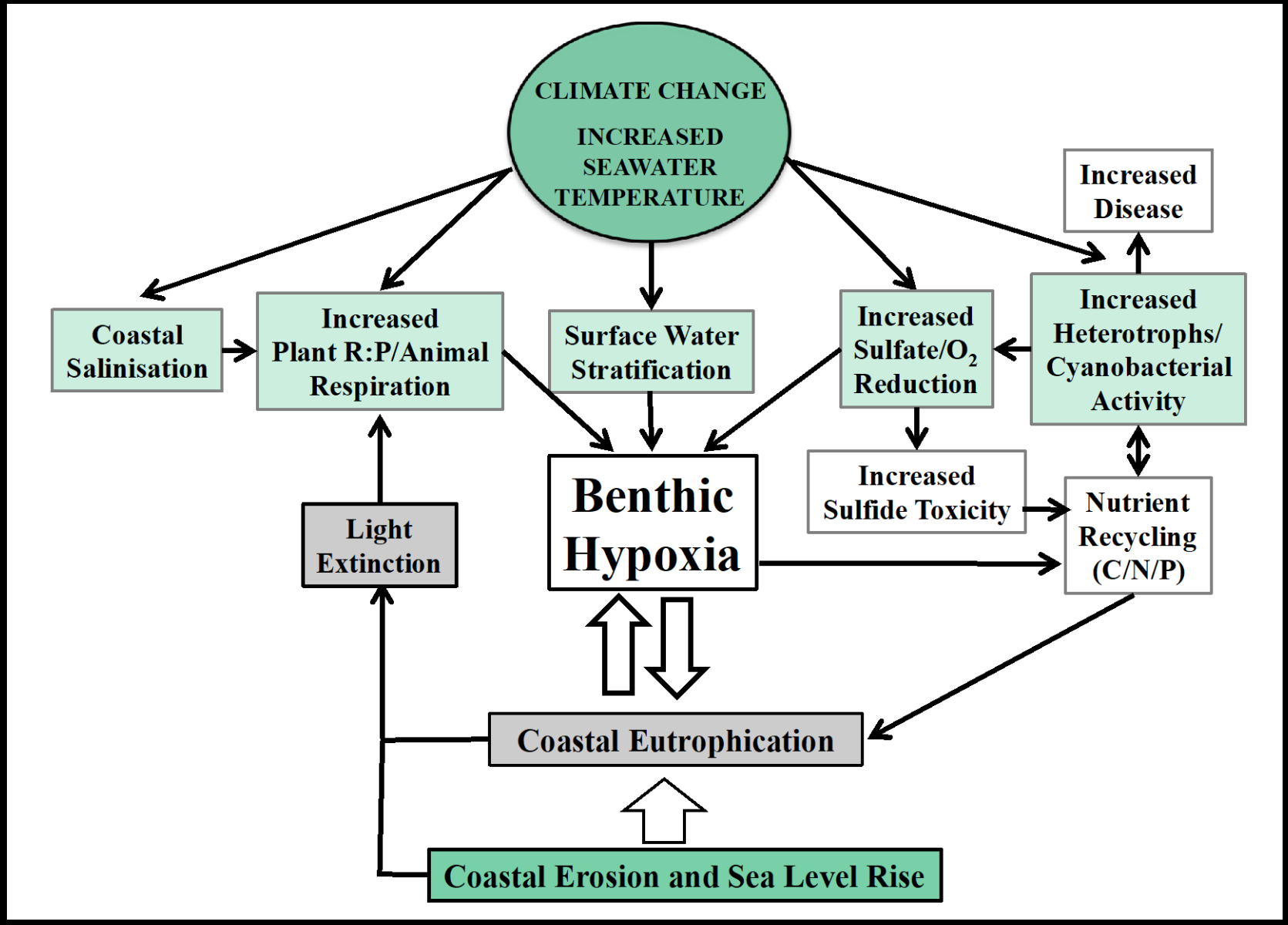
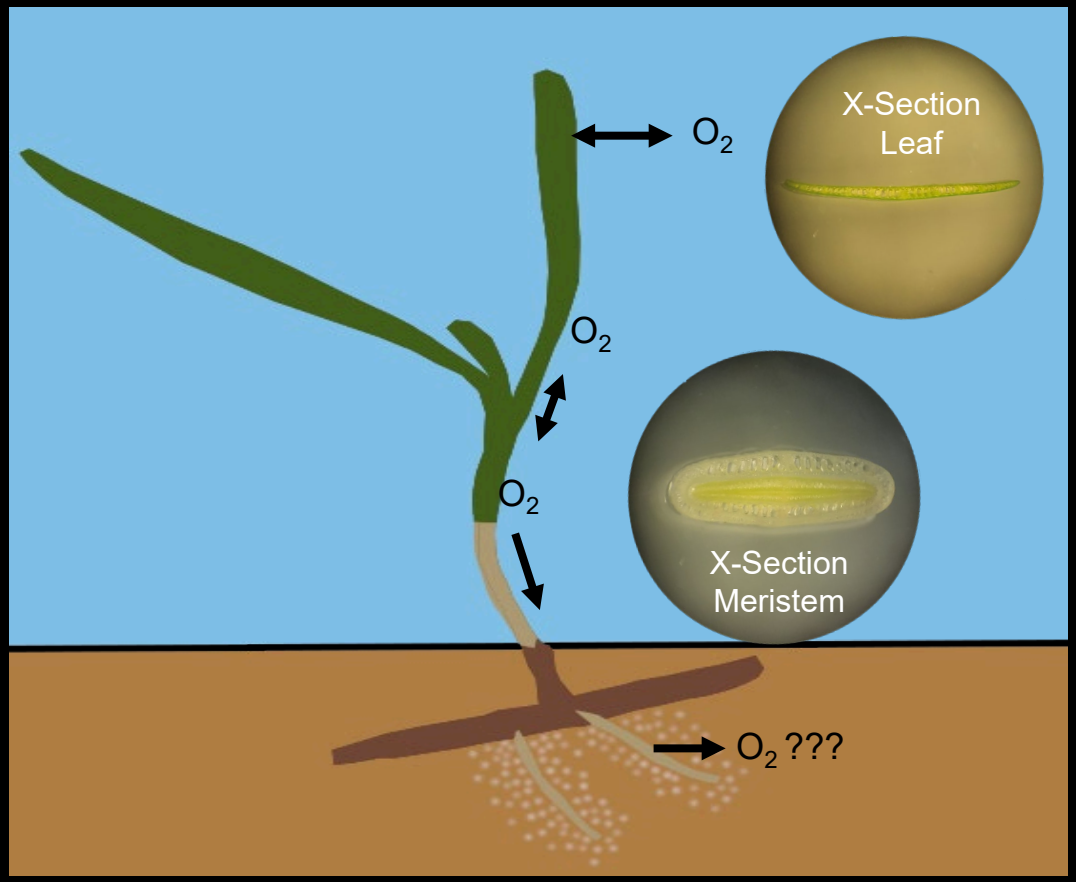
SEAGRASS ECOSYSTEM: FLORIDA BAY

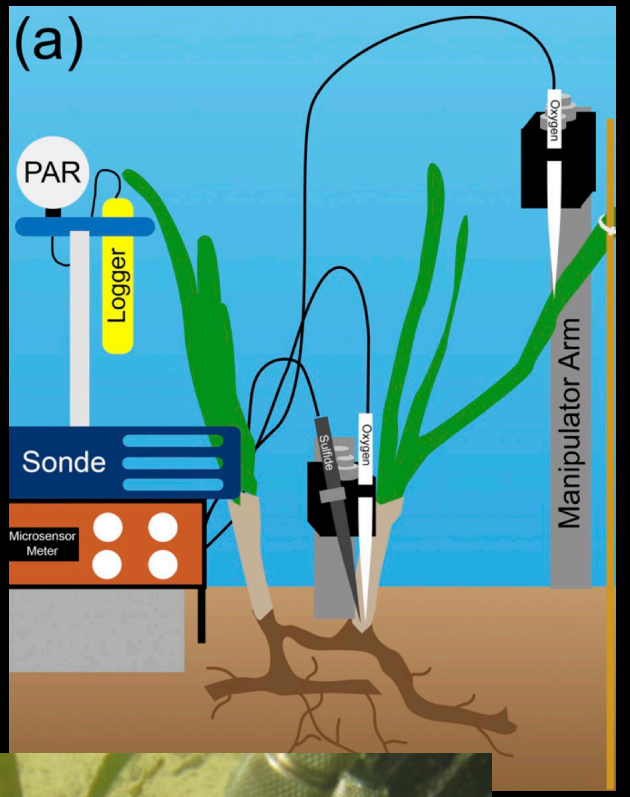


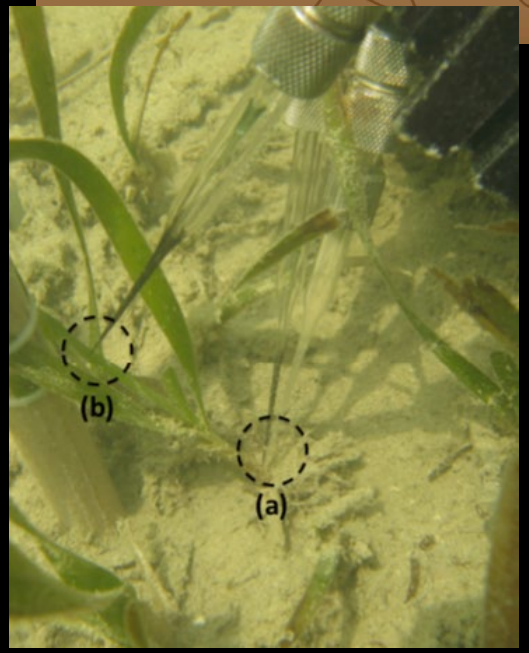
Multiple Climate Driven Coastal Stressors



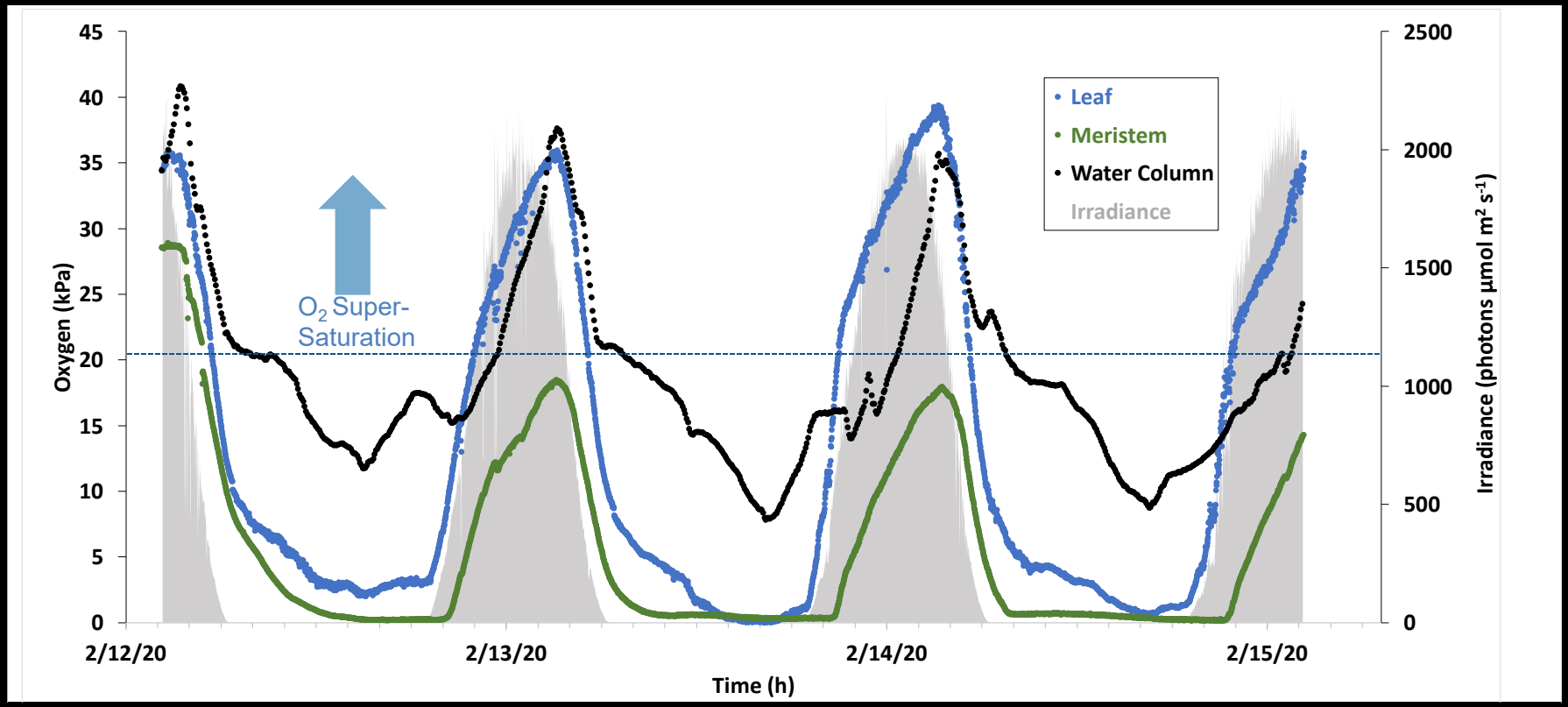
Oxygen Dynamics





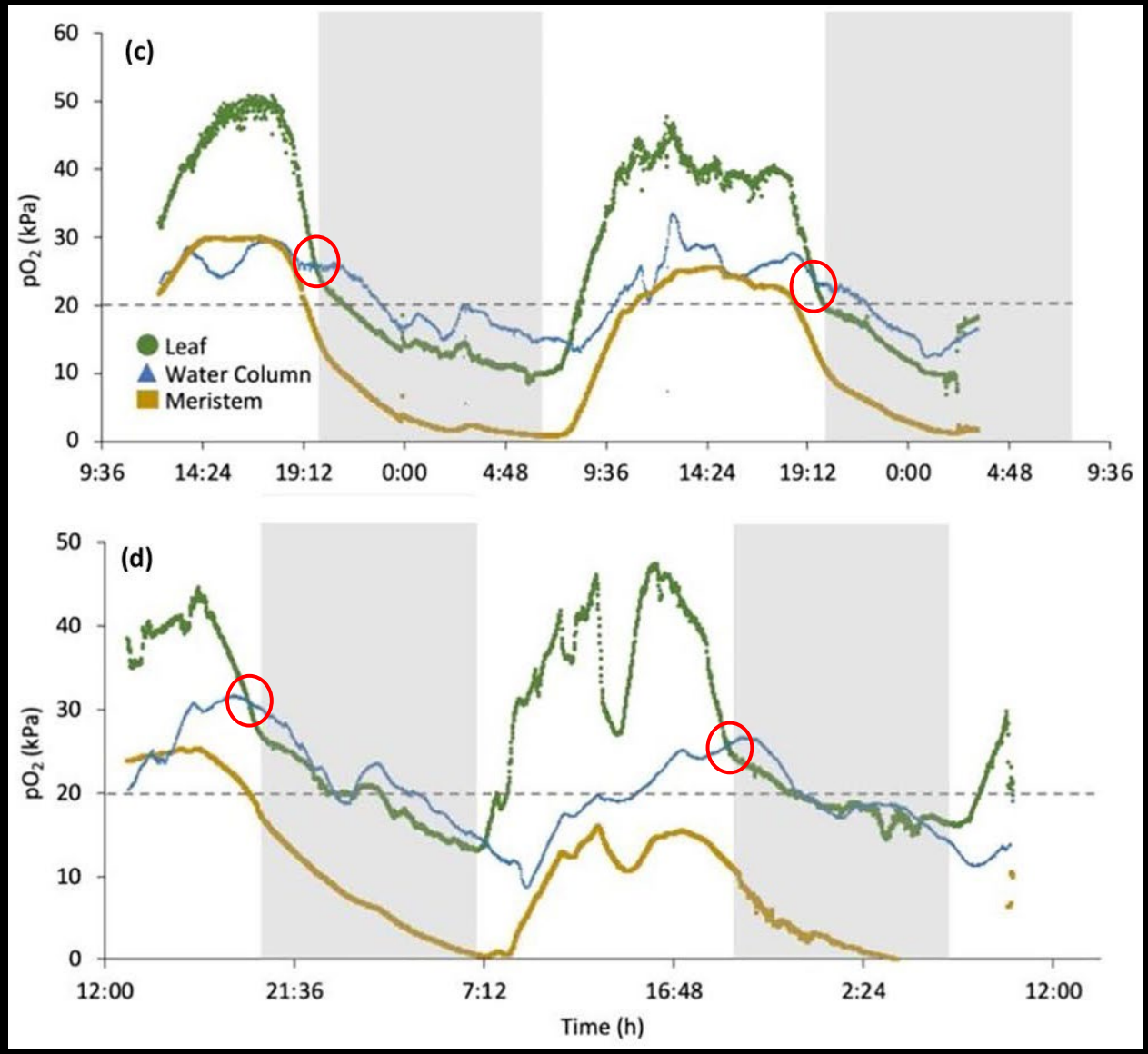


Daytime - Supersaturated O_2 in Leaf and Water Column



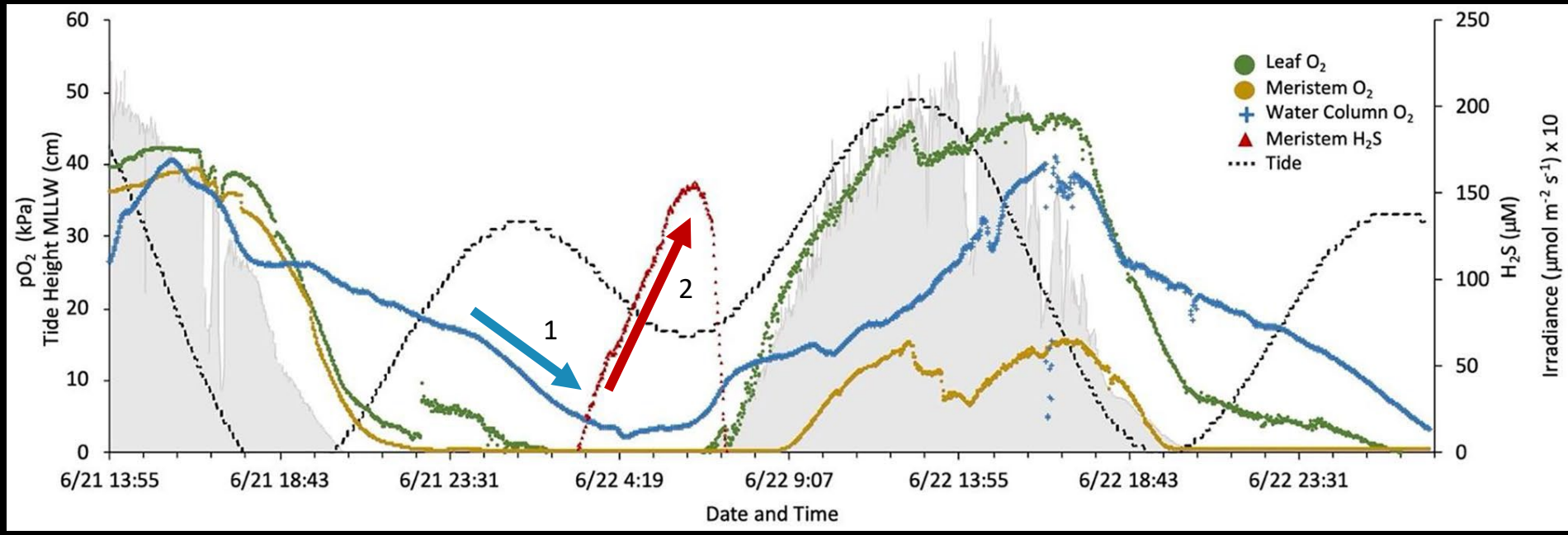
Koch et al. 2022a

Nighttime - Water Column Buffering Leaf Hypoxia



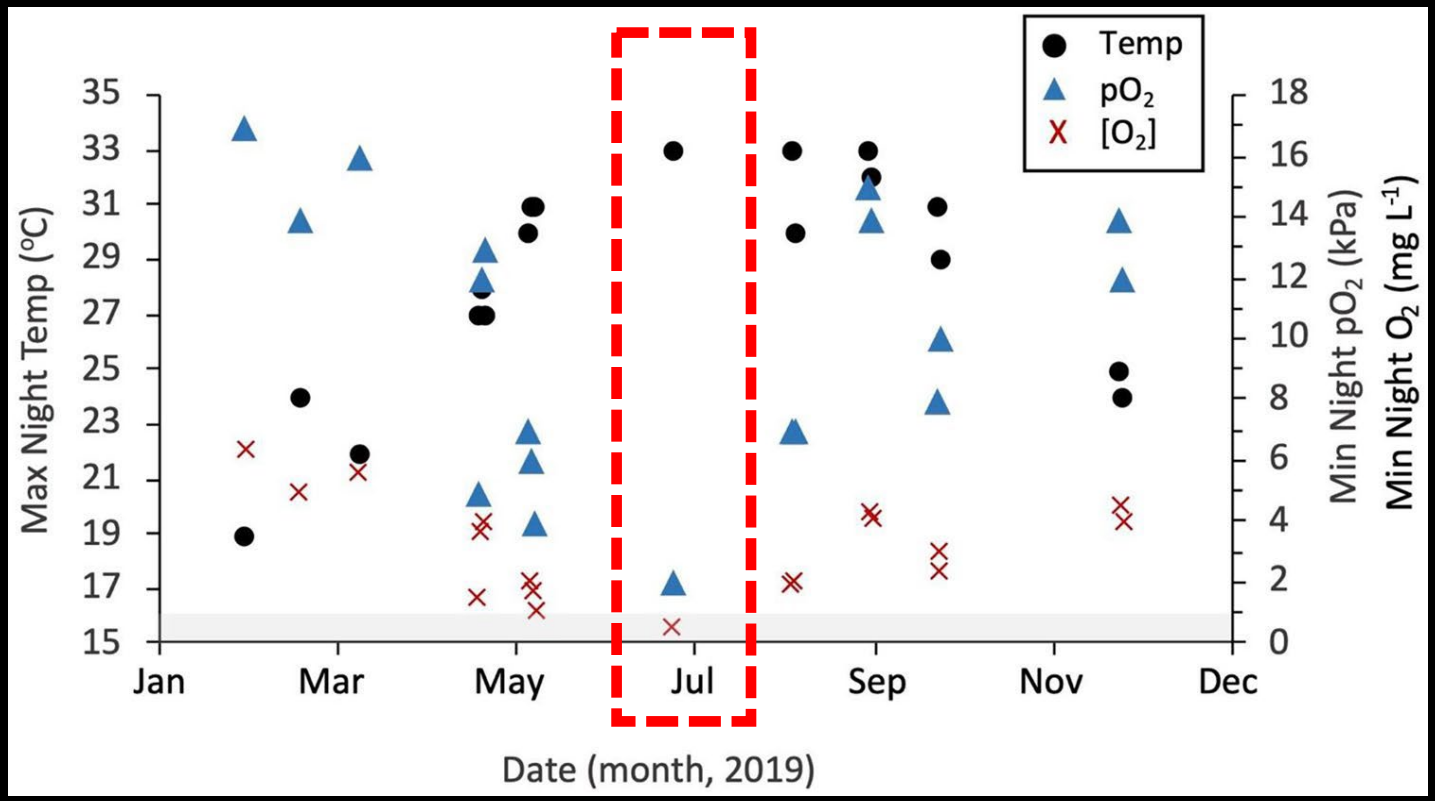
Koch et al. 2022

Water Column Hypoxia Corresponded to Meristem H_2S Intrusion



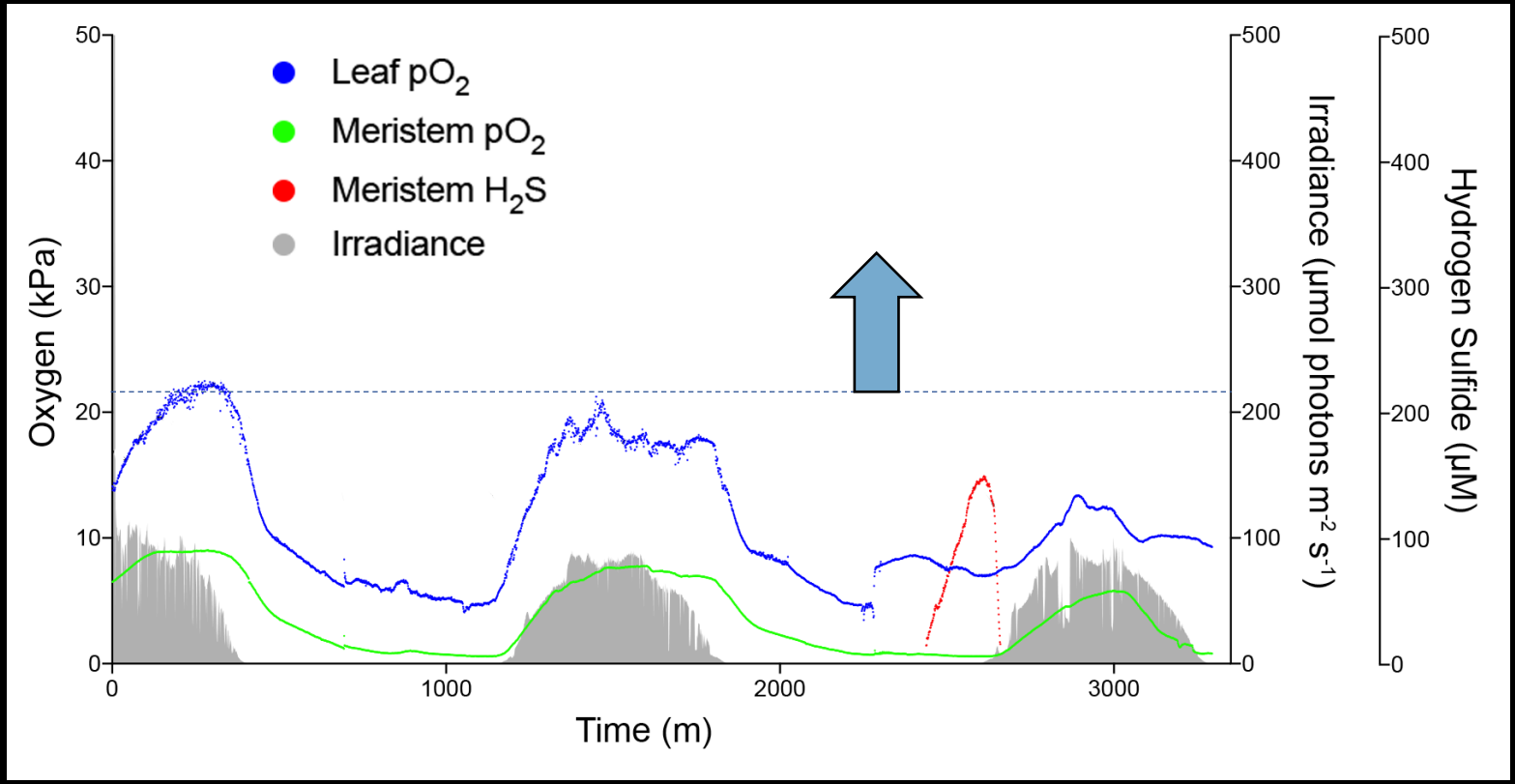
Koch et al. 2022

Meristem H_2S Intrusion During Highest Temperature and Lowest Water Column O_2



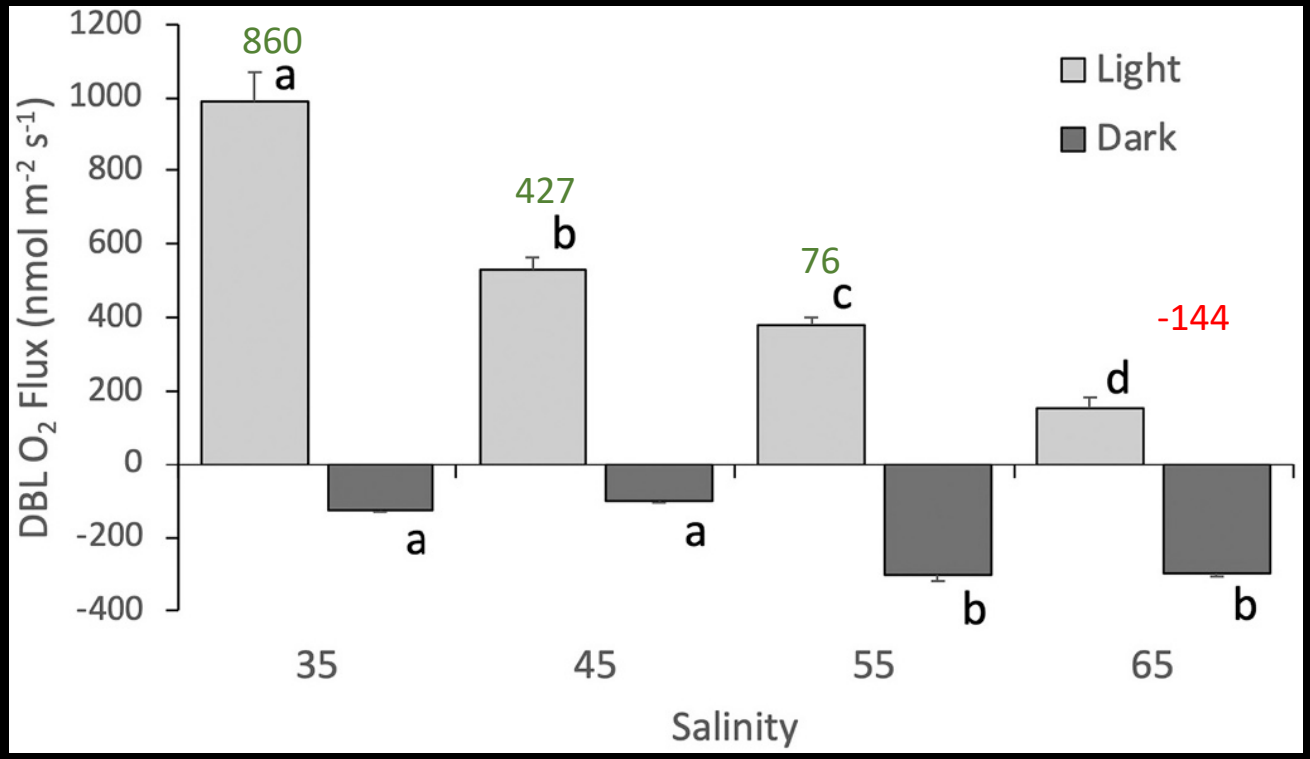
Koch et al. 2022

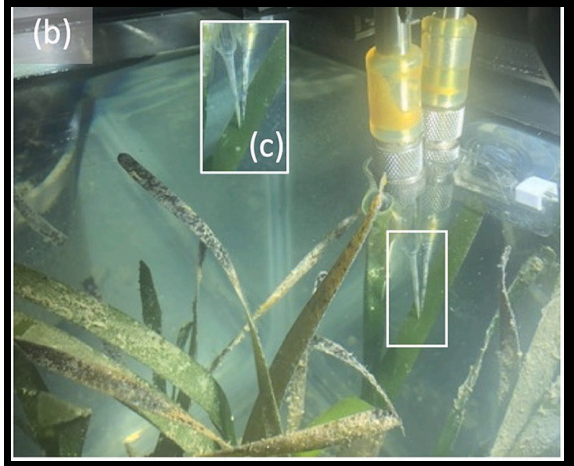
Low Light Experiments High Frequency of H_2S in Meristems



Koch et al. 2022b

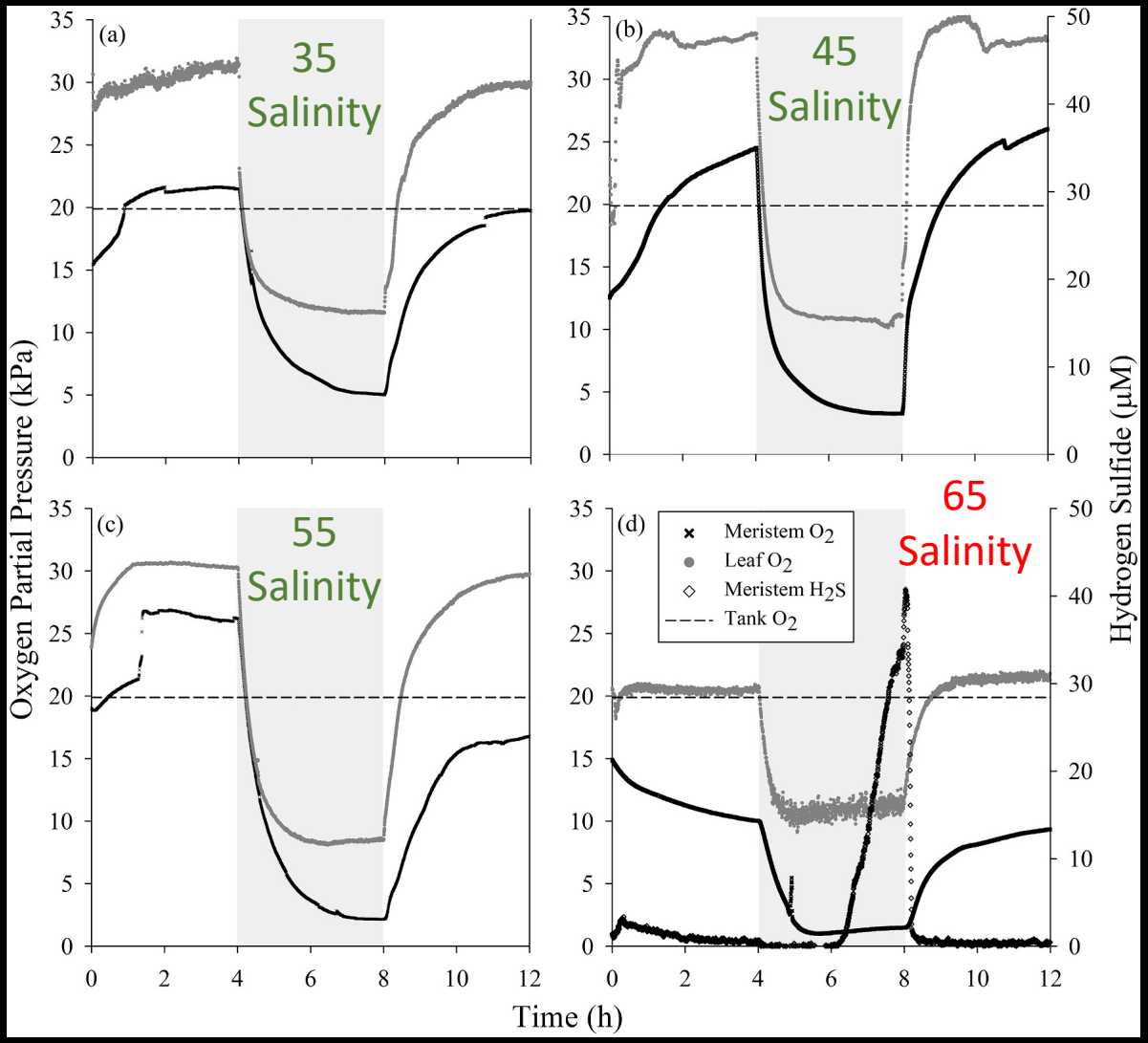
Salinity Limits Leaf O_2 Flux in Light-Enhances Consumption in Dark





Koch et al. 2022c

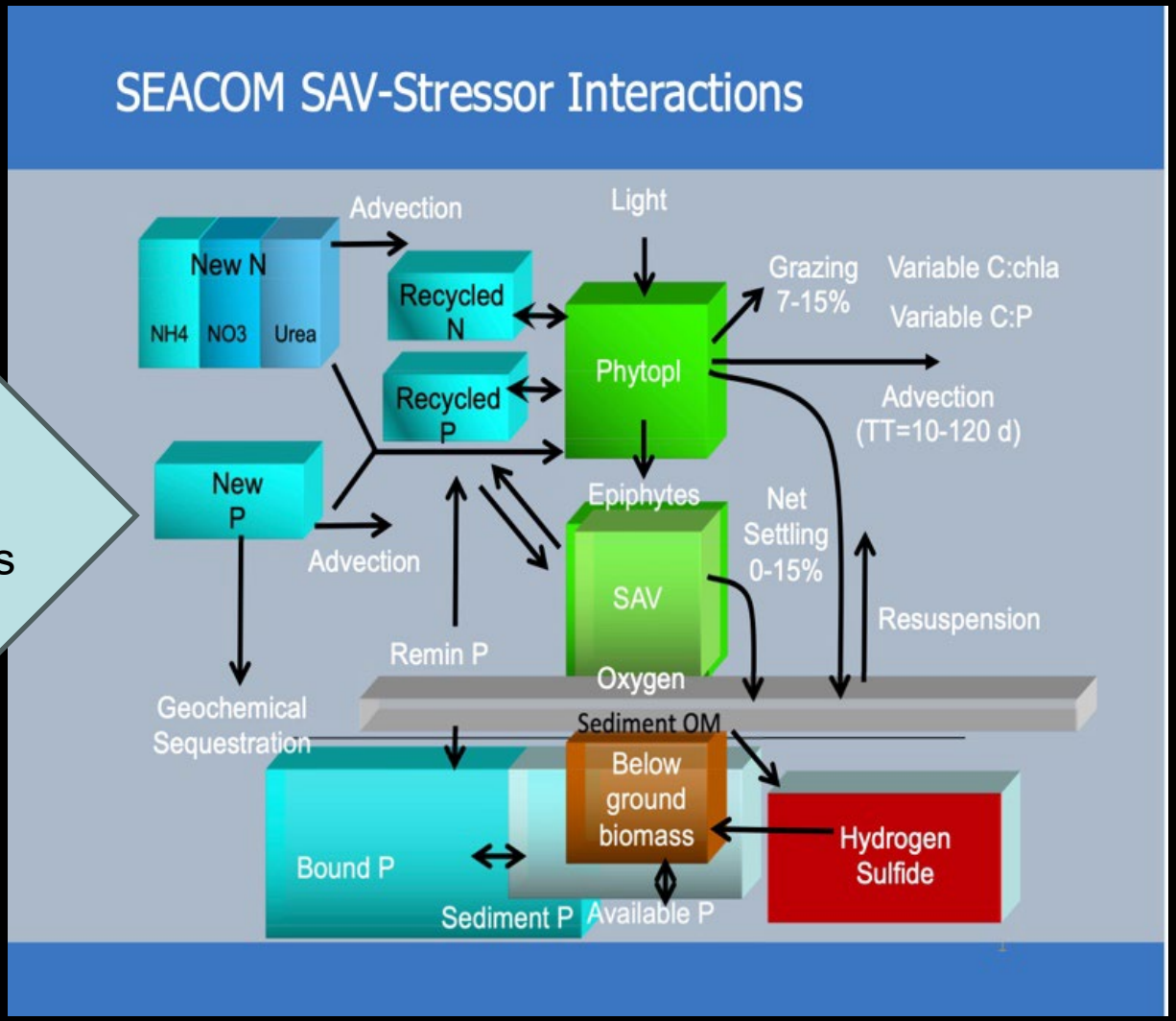
Salinity Limits Oxidation
H_2S Intrusion Dark



Johnson et al. 2020

INTEGRATE MECHANISTIC UNDERSTANDING INTO ECOSYSTEM MODEL

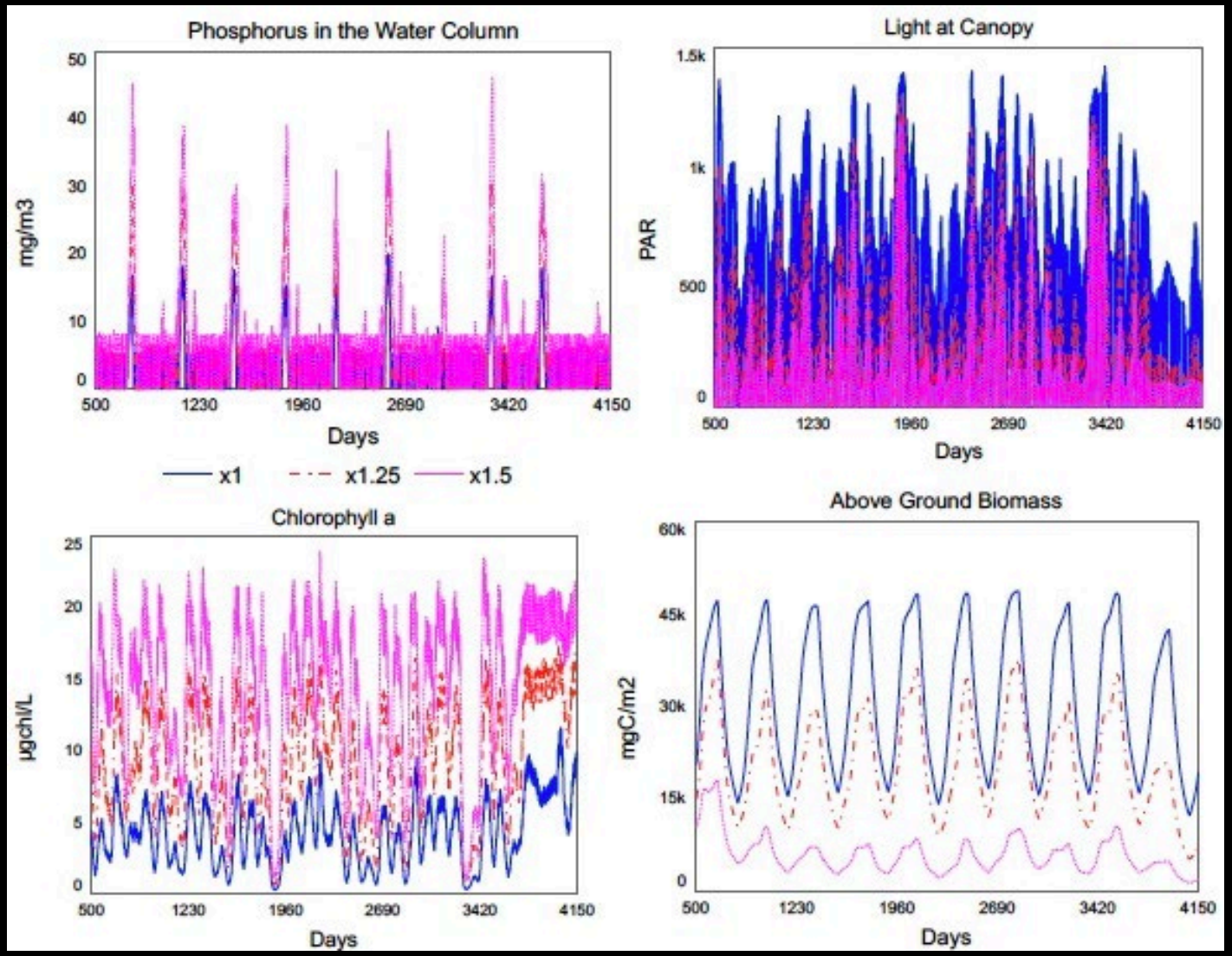
Parameterize
Seagrass Model
Focus on Multiple Stressors



Madden et al. 2016

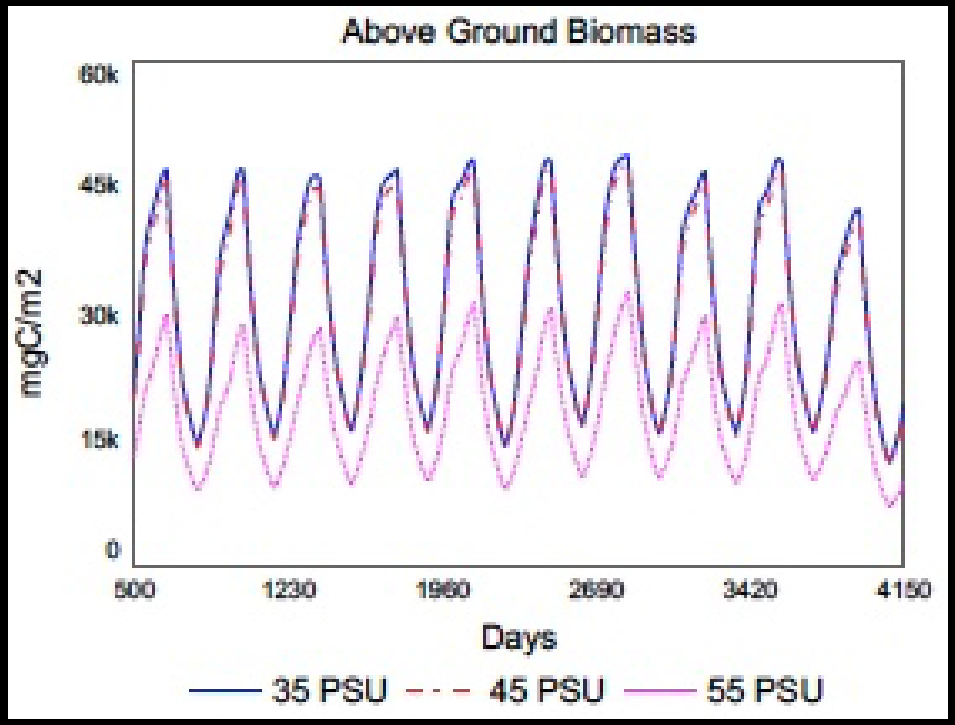
Climate Change Seagrass Scenarios

1. Increased Nutrient Pulses (x1.25, 1.5), Stimulate Phytoplankton Blooms, Lowers Light at Canopy, and Drives Down Seagrass Biomass

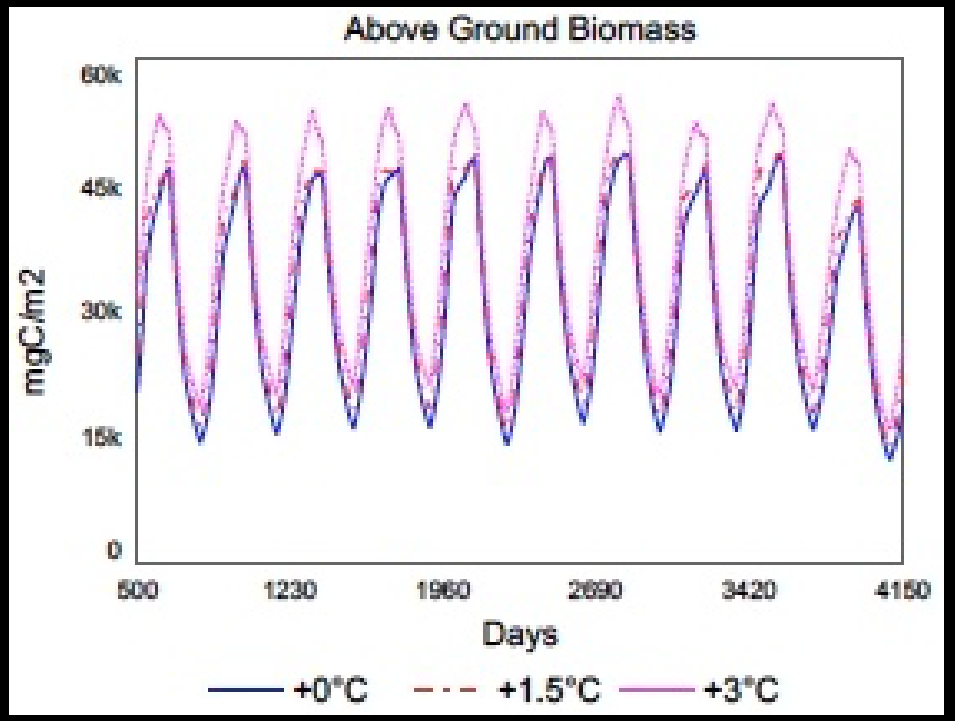


Climate Change Seagrass Scenarios

2. Hypersalinity (55 psu) Directly Lowers Photosynthesis and Biomass

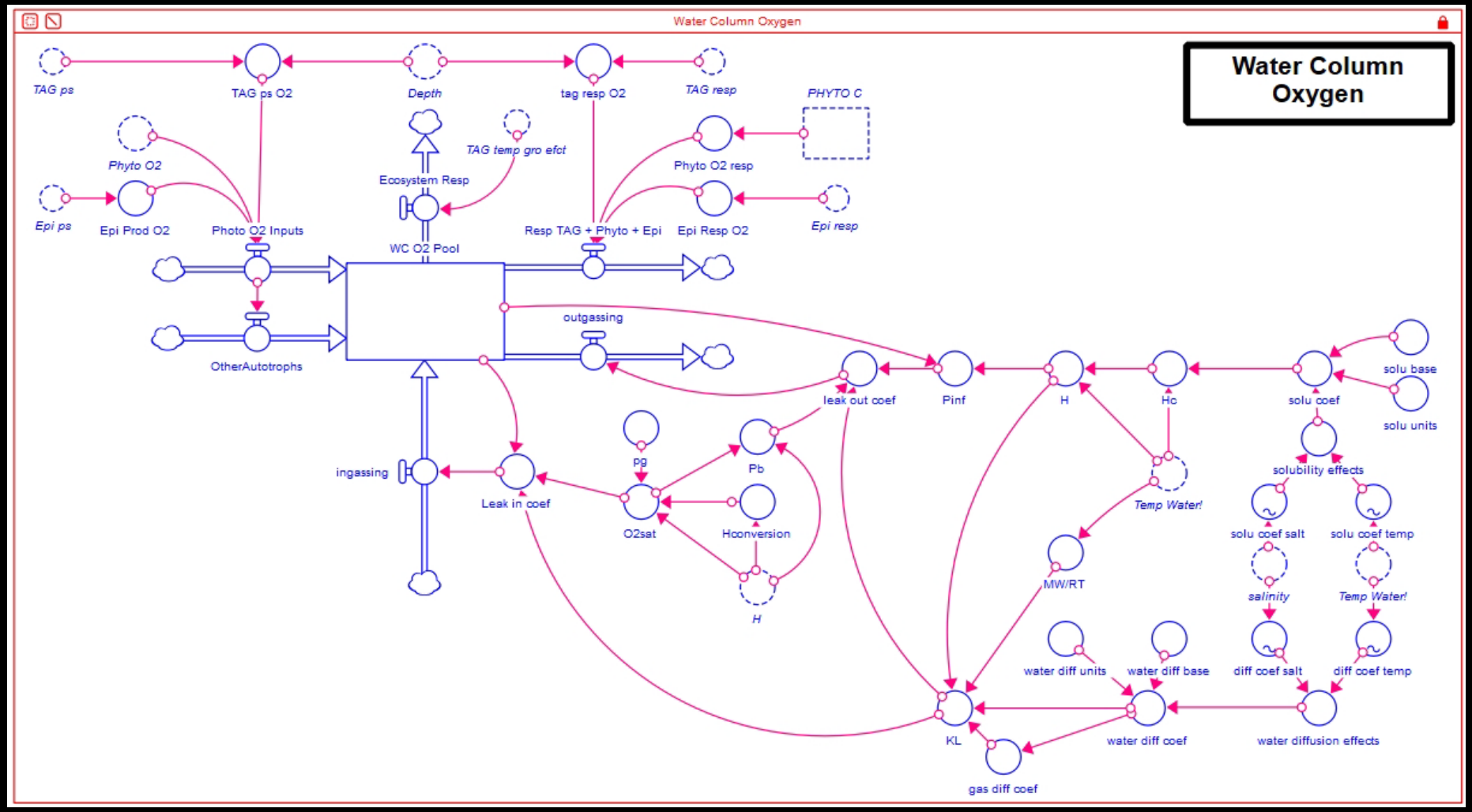


3. Increase in Temperature (+3oC) Increases Photosynthesis and Biomass



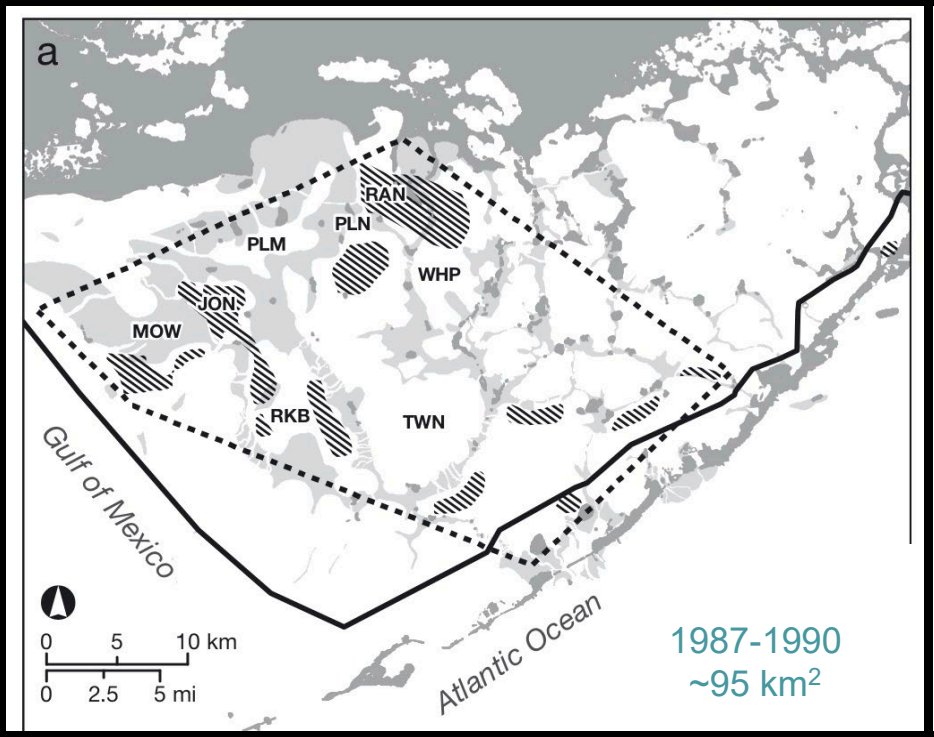
Missing from the Current Seagrass Model: Hypersalinity/Temperature Effects on Oxygen in the Water Column!

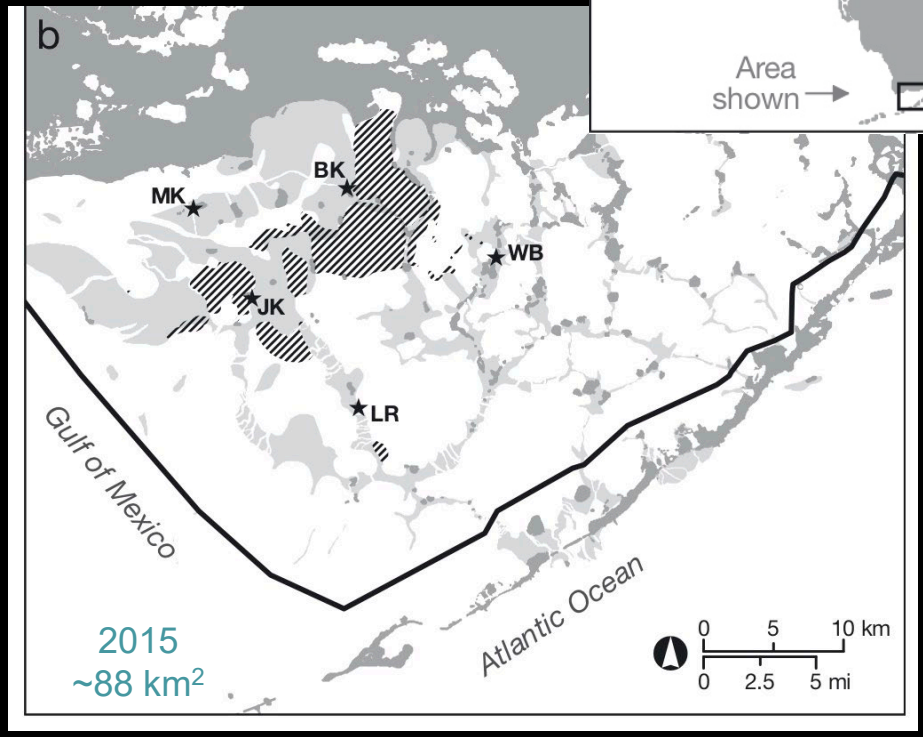
Water Column Oxygen Dynamics Module Florida Bay



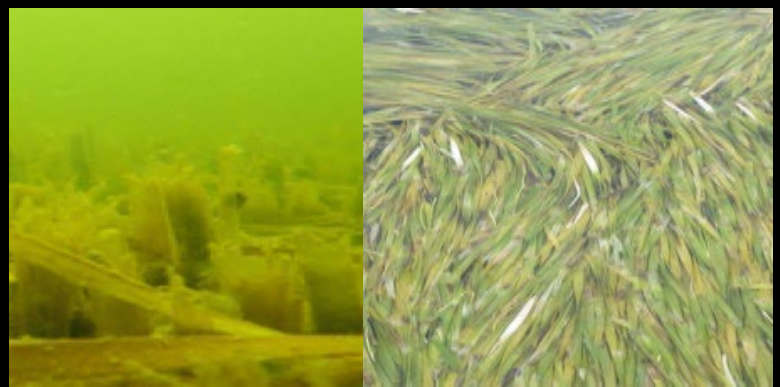
Quezada, Koch, Talley, Madden
(2025-2027 in development)

South Florida and Globally Large-Scale Seagrass Mortality “Die-Off” E Attributed to Hypoxia- multiple drivers





After: Robblee et al. 1991

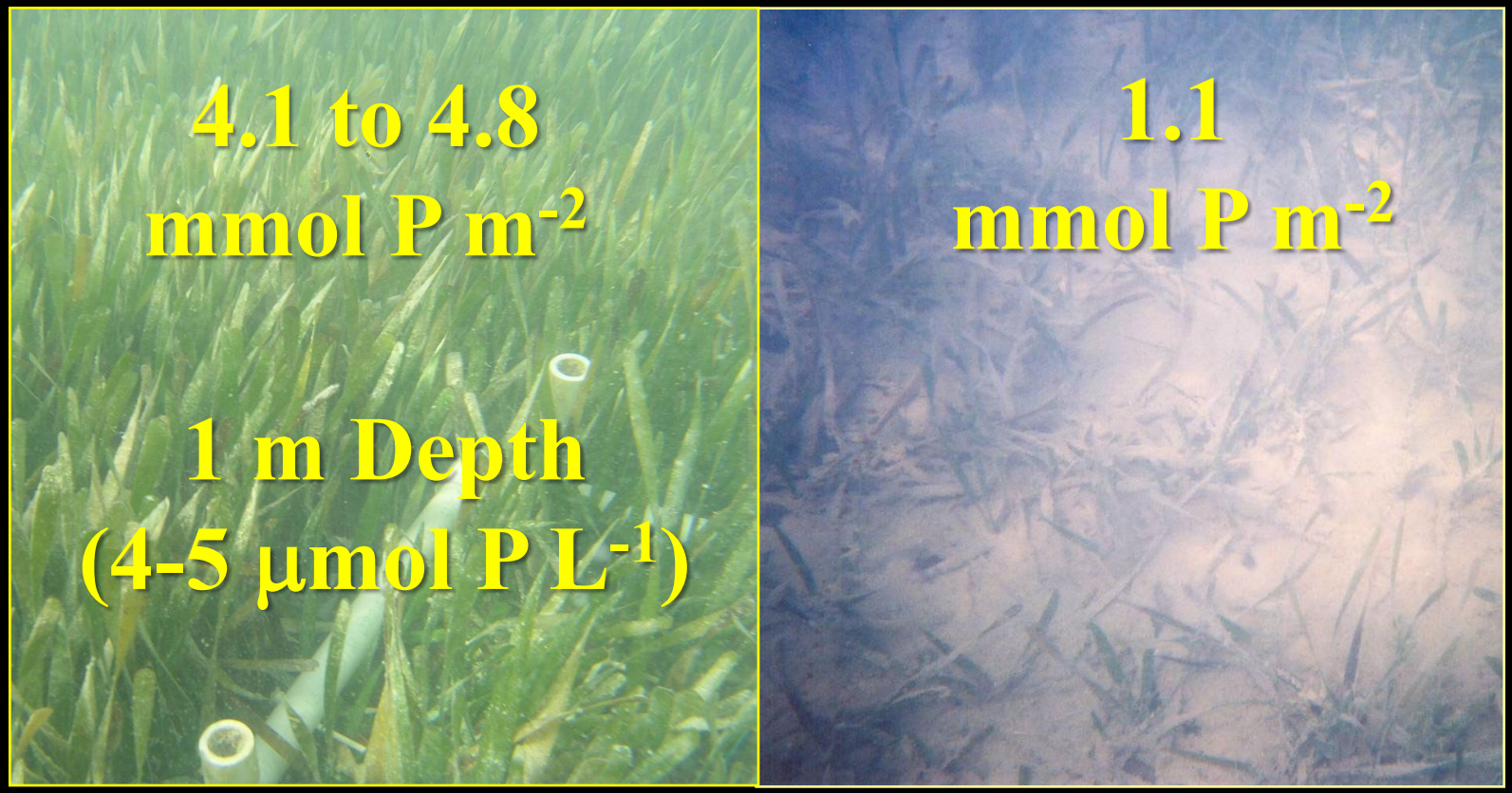


Hall et al. 2016

Large Scale Seagrass Mortality Events
Nutrient Pulses to Water Column Florida Bay

Western/Central Bay

Eastern Bay



- **Pulsed Event (4,000 ha major die-off ~6,000 kg P)**

40 km^2

October 22, 2025 (Tin Can Channel)

Take Home Message

Questions?


VENTURER
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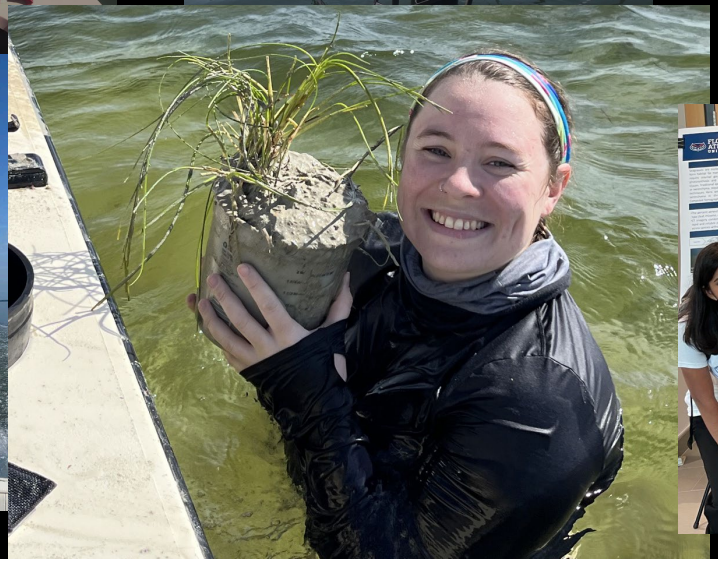


Application of Computed Tomography (CT) imaging in tropical seagrasses:
Quantifying aerenchyma tissue (critical for gas exchange
Minimal Radial Oxygen Loss from Tropical Seagrasses:
A Counter Paradigm

Specific Future Climate Scenarios (2060)

I. 1.5 Foot SLR Increase (9.5 mm y^{-1})
II. +1.5 ^{o}C Temperature Increase
III. 490 ppm CO_2
IV. +/- 10% Change in Precipitation

Environmental Management
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Climate Change Projected Effects on Coastal Foundation Communities of the Greater Everglades Using a 2060 Scenario: Need for a New Management Paradigm

M. S. Koch · C. Coronado · M. W. Miller · D. T. Rudnick · E. Stabenau · R. B. Halley · F. H. Sklar

Received: 14 October 2013 / Accepted: 12 September 2014

Abstract Rising sea levels and temperature will be dominant drivers of coastal Everglades' foundation communities (i.e., mangrove forests, seagrass/macroalgae, and coral reefs) by 2060 based on a climate change scenario of +1.5 °C temperature, +1.5 foot (46 cm) in sea level, ±10 % in precipitation and 490 ppm CO_2. Current mangrove forest soil elevation change in South Florida ranges from 0.9 to 2.5 mm $year^{-1}$ and would have to increase Florida. Uncertainties in regional geomorphology and coastal current changes under higher sea levels make this prediction tentative without further research. The 2060 higher temperature scenario would compromise Florida's coral reefs that are already degraded. We suggest that a new paradigm is needed for resource management under climate change that manages coastlines for resilience to marine transgression and promotes active ecosystem

Climate Effects on Seagrass Ecosystems

Foundation Community	Effect	Strength	Direct	Summary/Comments	Confidence (L,M,H)
Sea Level Rise (46 cm)					
Seagrass/	(-)	2-3	I	• Wetland and mudbank erosion/nutrient flux leads to low light • Shift seagrass to phytoplankton system under low light conditions	• L • L
Temperature Rise (+1.5°C)					
Seagrass/	(-)	1-2	D-I	• Long water residence time FL Bay - ↑ temperatures (36-40°C) at thermal limits • Hypersalinity (60-70 psu) with ↑ temp • Greater exchange with sea level rise may ameliorate this temperature/salinity stress • Hypoxia & toxic sulfides sediments ↑ with ↑ temp	• H • H • L • H
Lower Precipitation (10%)					
Seagrass/	(-)	2-3	D/I	• Increased hypersalinity events FL Bay • Increased hypoxia • Less seagrass biodiversity at ecotone • Percent increase in precipitation cause impacts	• MH • M • MH • L