Shifting Ground:
Landscape-Scale Modeling Of Soil Biogeochemistry under Climate Change in the Florida Everglades

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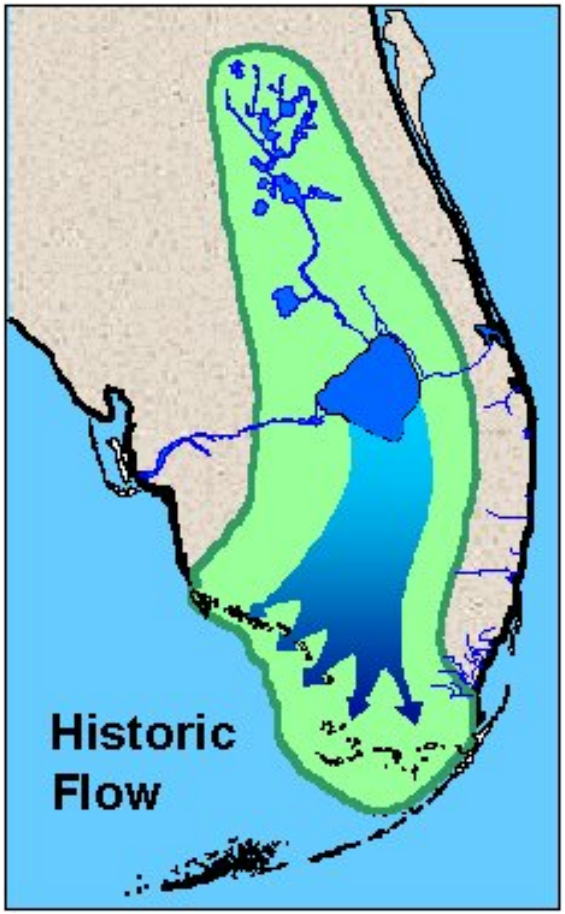
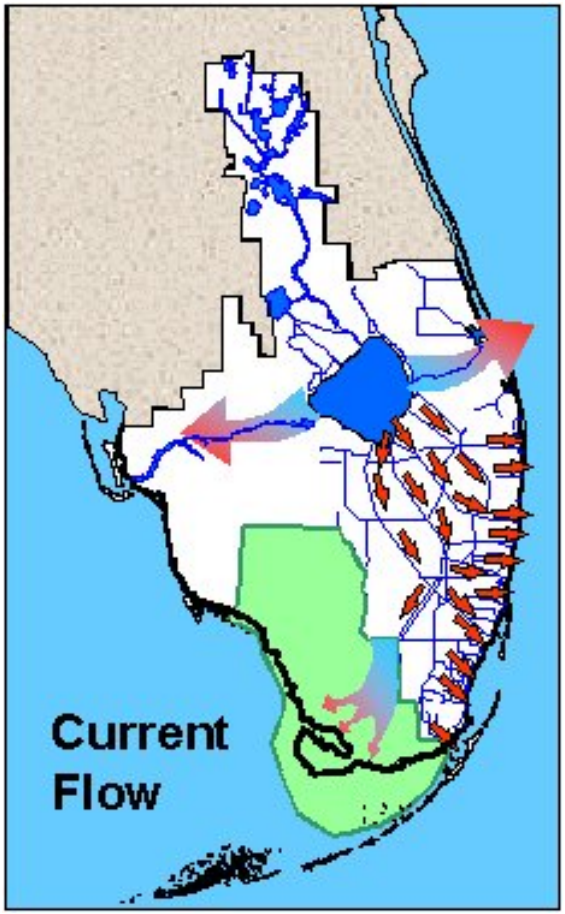
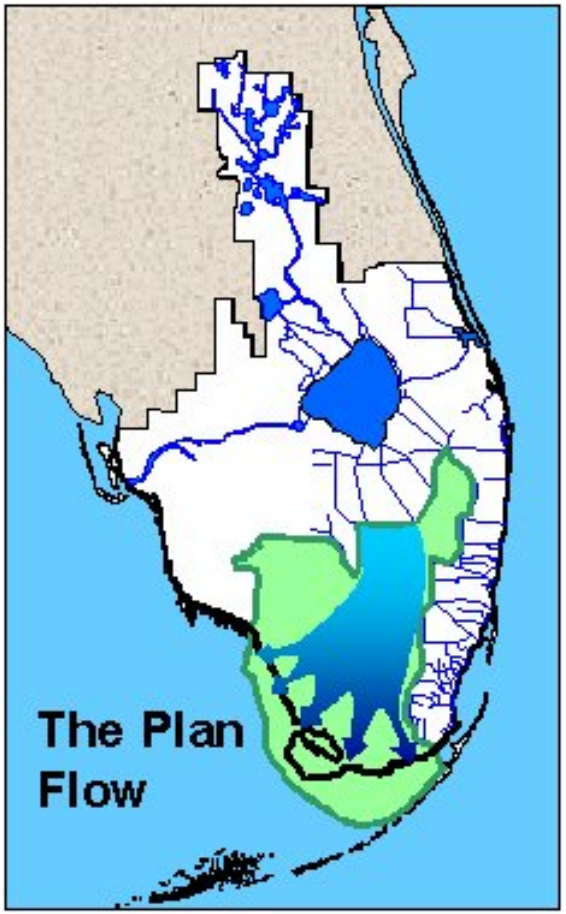
12th International Symposium on Biogeochemistry of Wetlands

April 23-26, 2018
Coral Springs, Florida, USA

We need to assess:
Ecosystem Vulnerability & Resilience to Climate Change





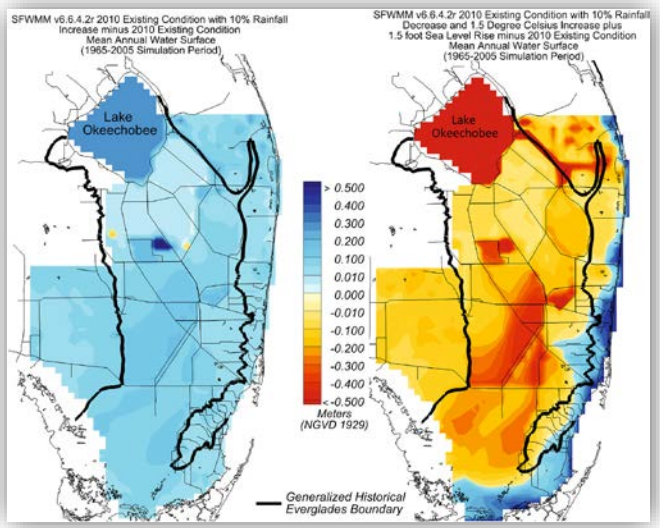


Scenarios Modeling:

"What if?"

Climate-Scenarios Workshop led by FAU and USGS South Florida Water Management Model (SFWMM)

Obeysekera, Barnes, and Nungesser 2015



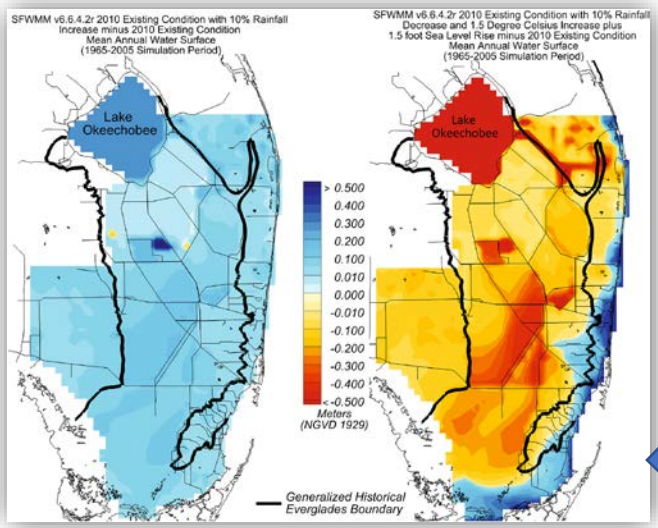
Plausible Hydrologic Outcomes for Climate Scenarios 2060

- Water level distributions
- Water flows through control structures

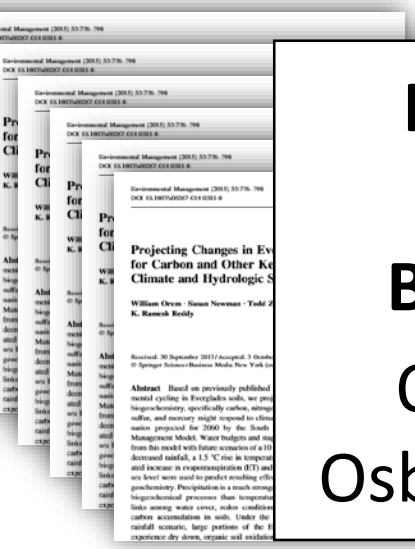
Climate-Scenarios Workshop led by FAU and USGS South Florida Water Management Model (SFWMM)

Obeysekera, Barnes, and Nungesser 2015

Expertise on a variety of topics

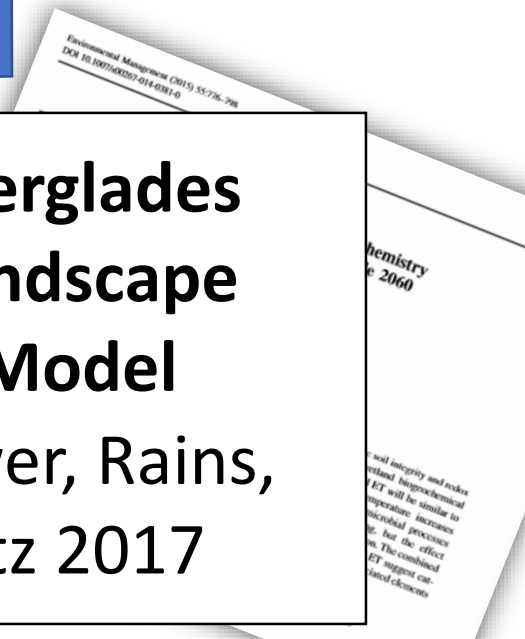


Boundary Conditions



Implications for Soil Biogeochemistry

Orem, Newman, Osborne, Reddy 2015



Everglades Landscape Model

Flower, Rains, Fitz 2017

Three Future Climate Scenarios
Everglades Landscape Model

<u>Soil Biogeochemistry</u>

Time Series of Muck fire risk

Map of Soil Phosphorus

Implications for Restoration

Three climate scenarios for 2060

	Temp	ET	Rain	Sea Level Rise
Baseline	2010	2010	2010	none
Decreased Rainfall	+1.5°C	+7%	-10%	0.5 m
Increased Rainfall	+1.5°C	+7%	+10%	0.5 m

Variability "borrowed" from 1965-2000

Using current water management rules

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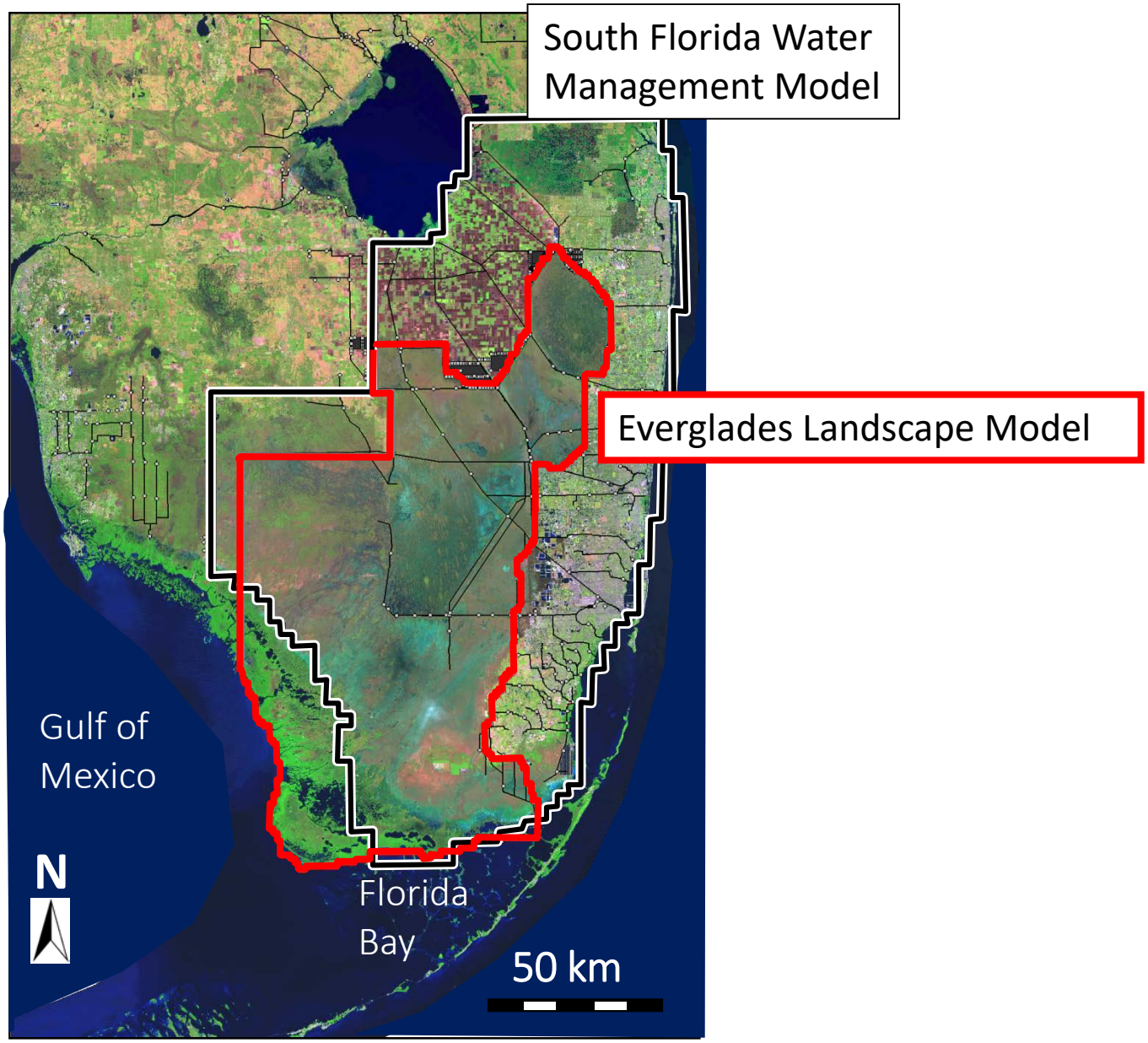
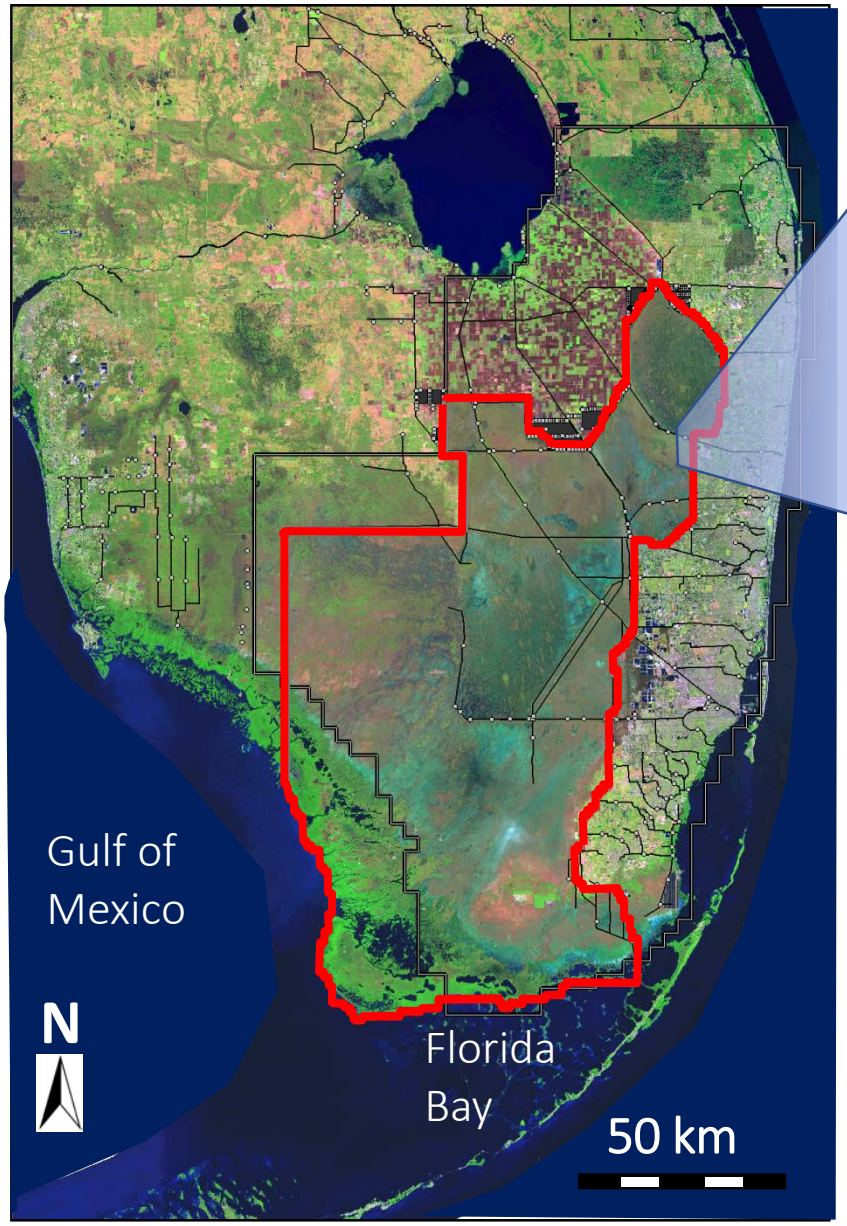
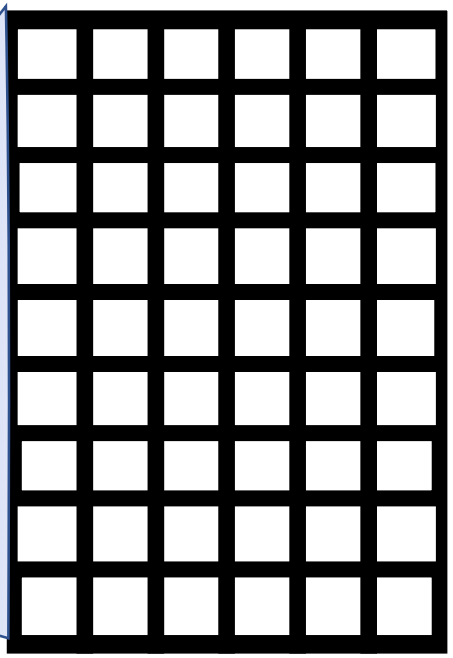
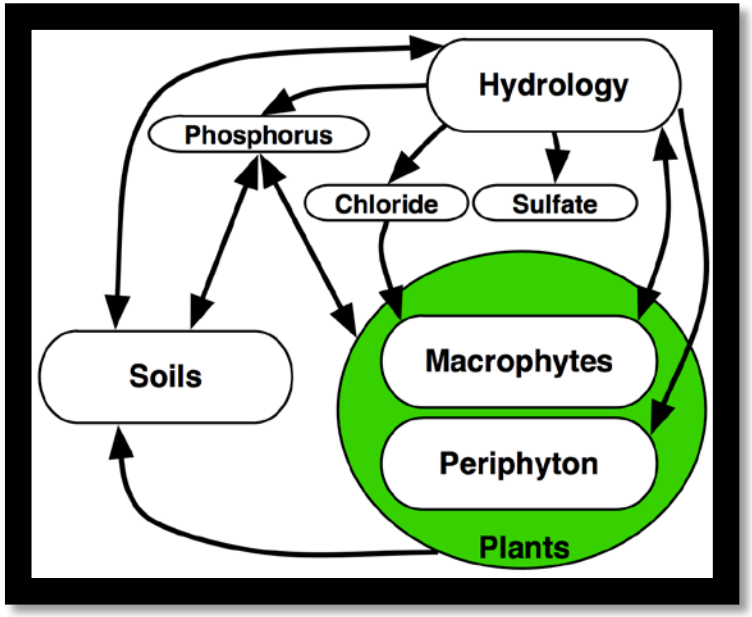

South Florida Water Management Model
Everglades Landscape Model
Gulf of Mexico
Florida Bay
N
50 km

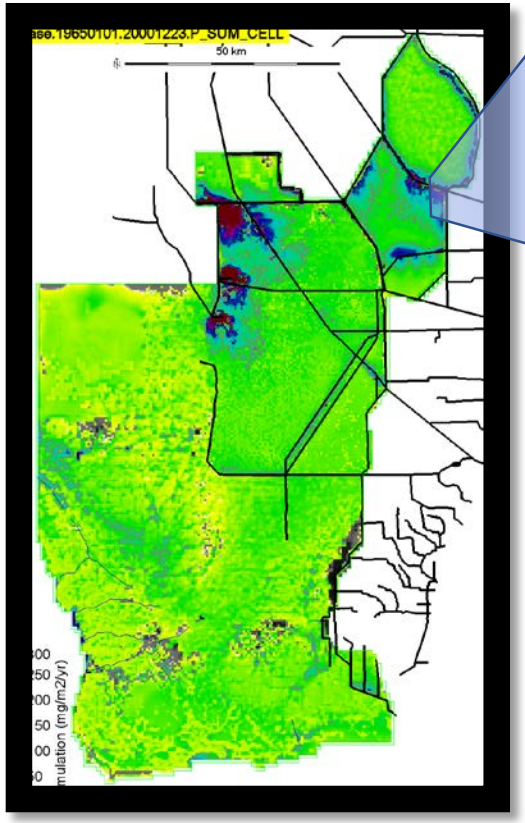
Everglades Landscape Model

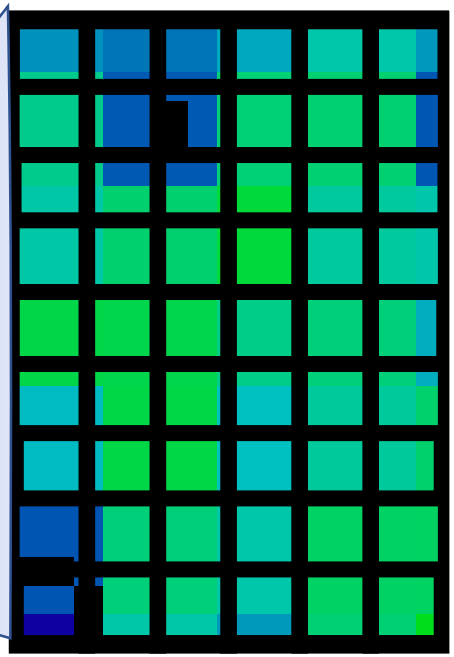






Everglades Landscape Model





Phosphorus Accumulation Rate mg/m²/yr

300
200
100
0
-50
Null

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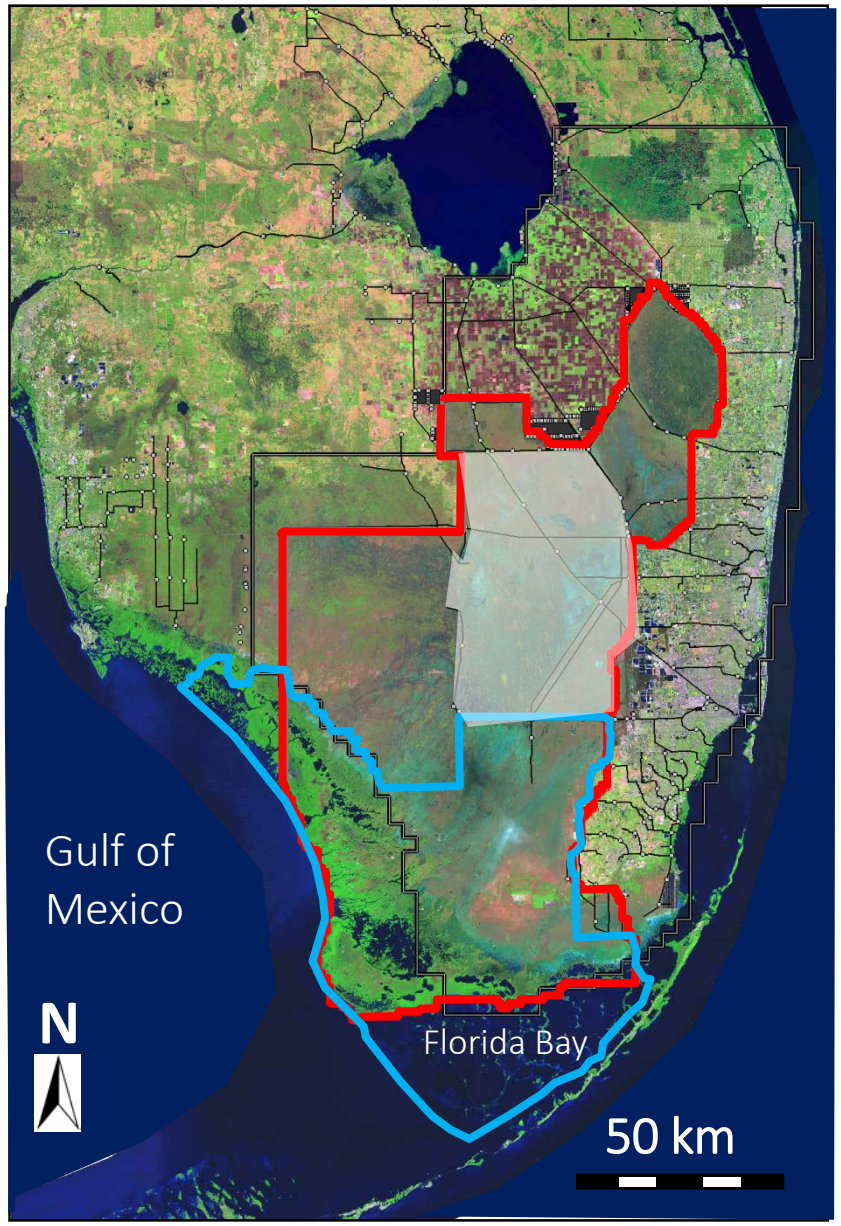
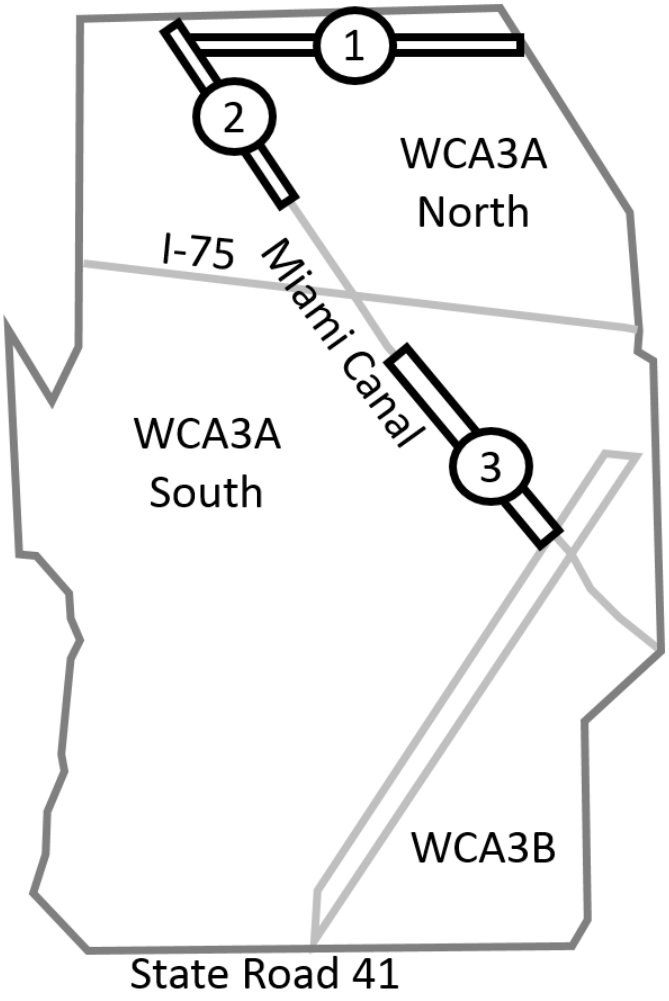
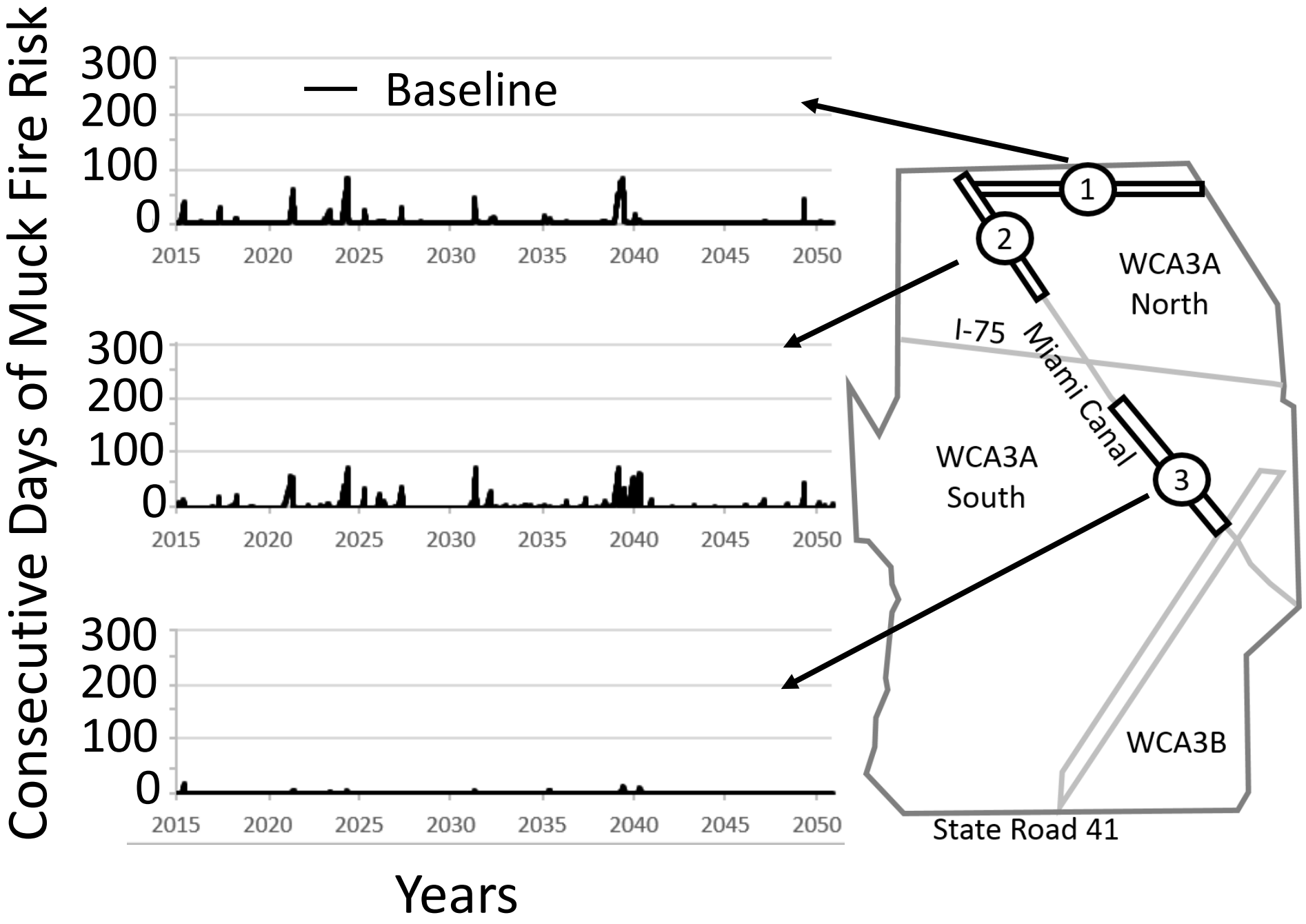
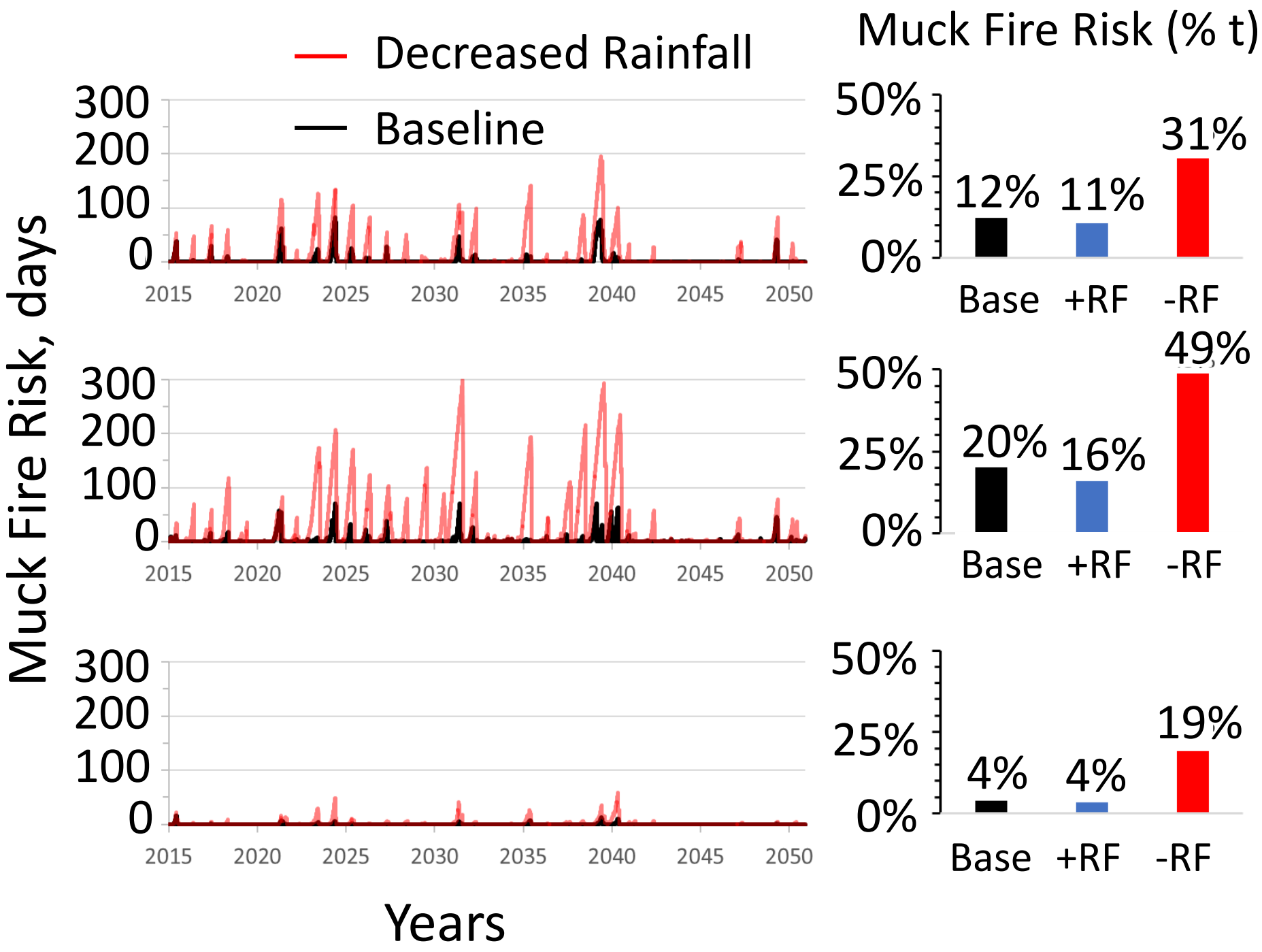
Time series of muck fire risk






Consecutive Days of Muck Fire Risk
Baseline
300
200
100
0
2015
2020
2025
2030
2035
2040
2045
2050
Years
1
2
3
WCA3A
North
I-75
Miami Canal
WCA3A
South
WCA3B
State Road 41


Decreased Rainfall
Baseline
Muck Fire Risk, days
300
200
100
0
2015
2020
2025
2030
2035
2040
2045
2050
Years
Muck Fire Risk (% t)
50%
25%
0%
12%
11%
31%
Base
+RF
-RF
20%
16%
49%
4%
4%
19%

In a warming world, in the absence of restoration:

Increased rainfall

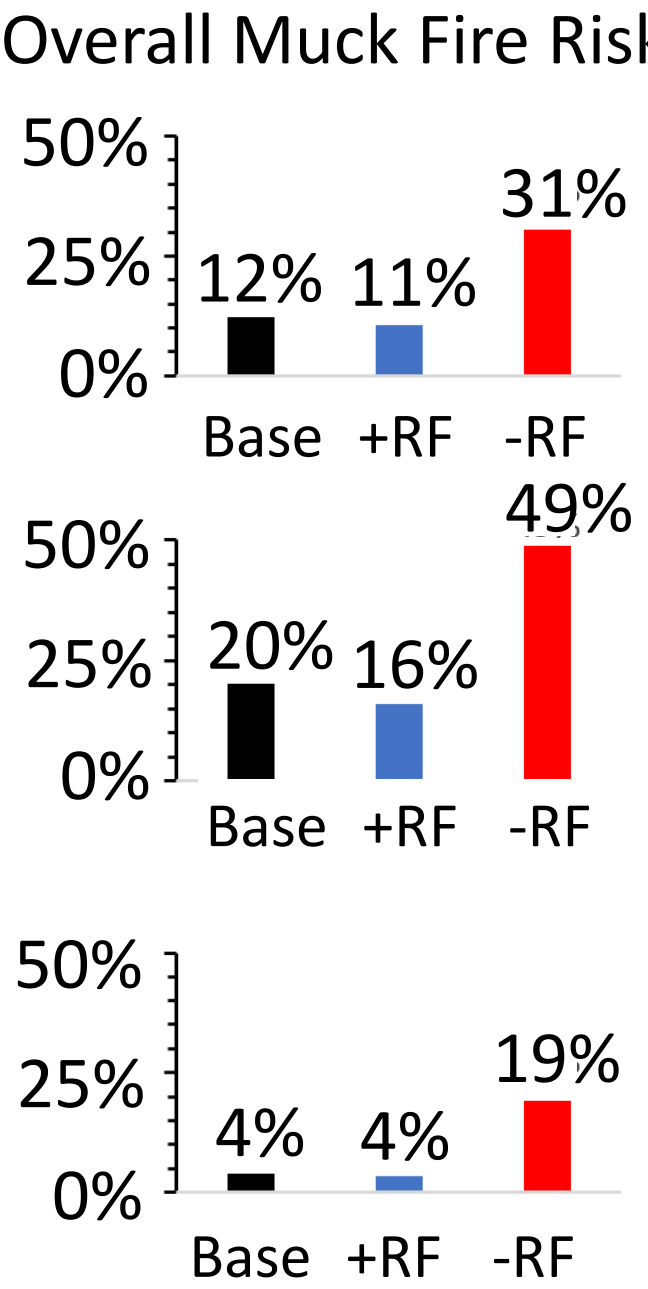
Slightly lower muck fire risk

More protection is needed

Decreased rainfall

Soaring muck fire risk

Catastrophic soil loss



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Map of Soil Phosphorus

Implications for Restoration

Eutrophication: Phosphorus limited ecosystem

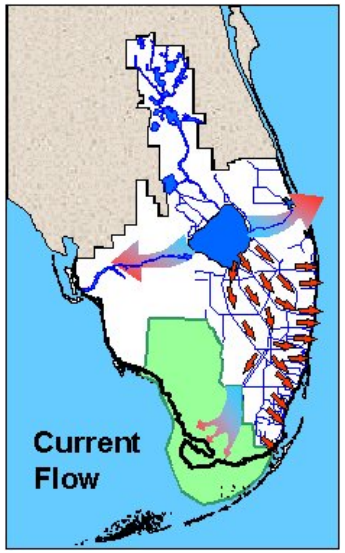
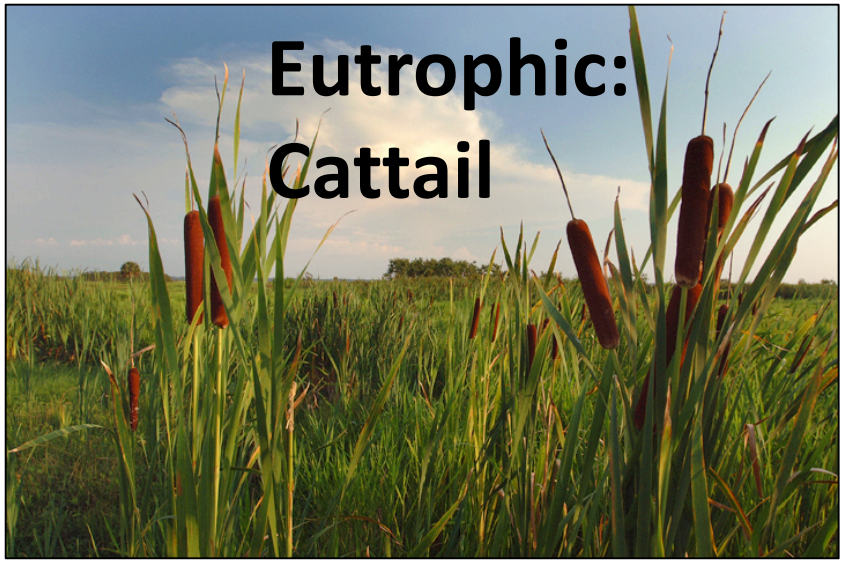
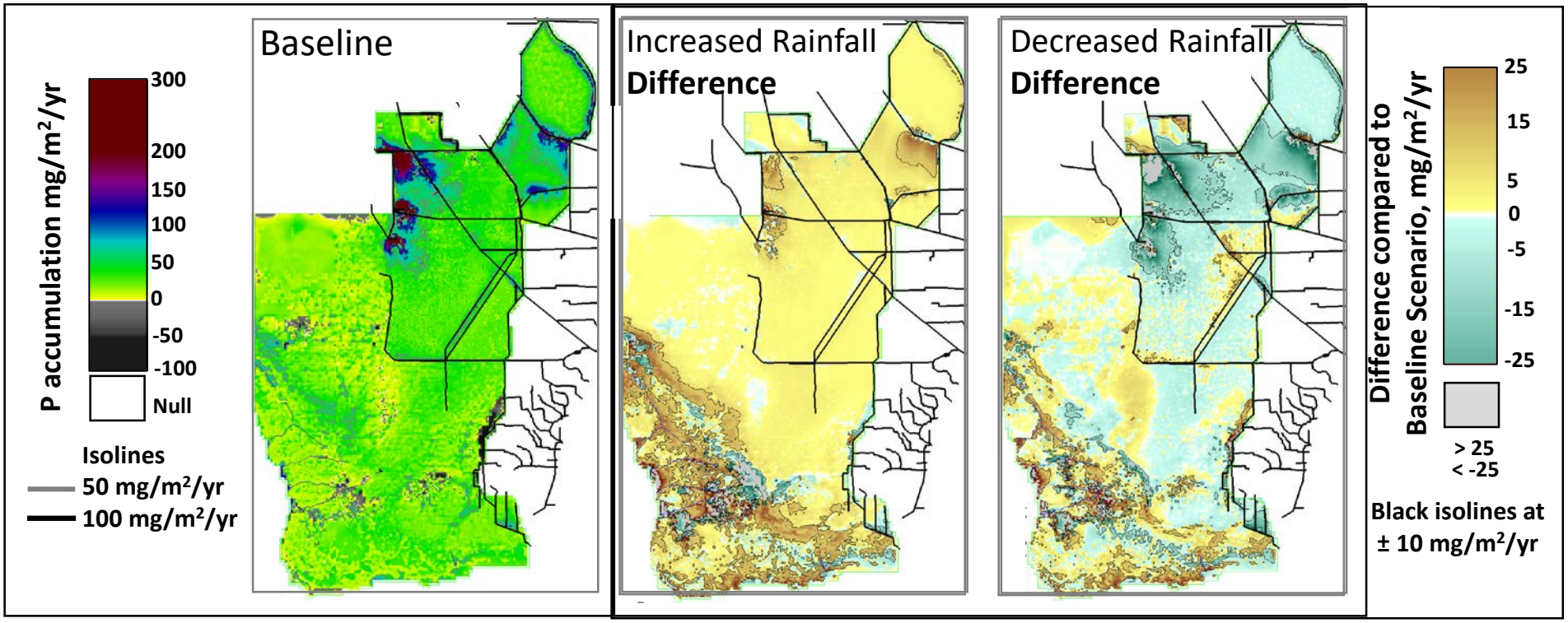


Photo credit: South Florida Water Management District



Phosphorus accumulation rate in soil



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Implications for Restoration

In a warming world-
in the absence of restoration-

what different trajectories of ecological response are likely

depending on whether rainfall increases or decreases?

Ecosystem Vulnerability & Resilience to Climate Change

Increased Rainfall:

- **Protects peat** (but not enough)
- **Exacerbates** Eutrophication & Methylmercury

Decreased Rainfall:

- **Destroys peat** - catastrophic muck fires

Restoration:

- **More water**
- **Cleaner water**

Restoration is more urgent with climate change.

Based on a 2018 Paper in Prep:
Hilary Flower, Mark Rains, Carl Fitz, William Orem, Susan Newman, Todd Osborne, Ramesh Reddy, and Jayantha Obeysekera

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Based on:
Flower H, Rains M, Fitz HC, (2018 in prep) Shifting Ground: Landscape-Scale Modeling of Soil Biogeochemistry under Climate Change in the Florida Everglades

Related work:
Flower H, Rains M, Fitz HC (2017) Visioning the Future: Scenarios Modeling of the Florida Coastal Everglades Environmental Management 60:989–1009

Obeysekera J, Barnes J, Nungesser M. Climate sensitivity runs and regional hydrologic modeling for predicting the response of the greater Florida Everglades ecosystem to climate change. Environmental management. 2015 Apr 1;55(4):749-62.

Orem W, Newman S, Osborne TZ, Reddy KR. Projecting changes in Everglades soil biogeochemistry for carbon and other key elements, to possible 2060 climate and hydrologic scenarios. Environmental management. 2015 Apr 1;55(4):776-98.

We gratefully acknowledge funding for this project form: NSF as part of the Florida Coastal Everglades Long Term Ecological Research Project, and the USGS Greater Everglades Priority Ecosystems Studies Program (Nick Aumen Program Manager).