

KEYSMAP (Florida Keys Marine Adaptation Planning)

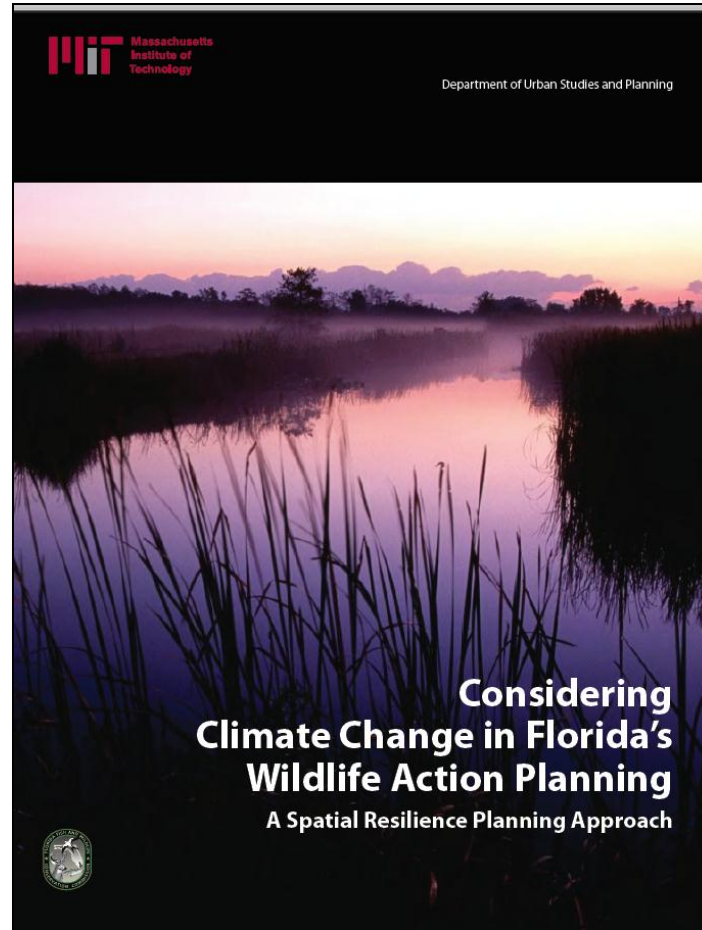


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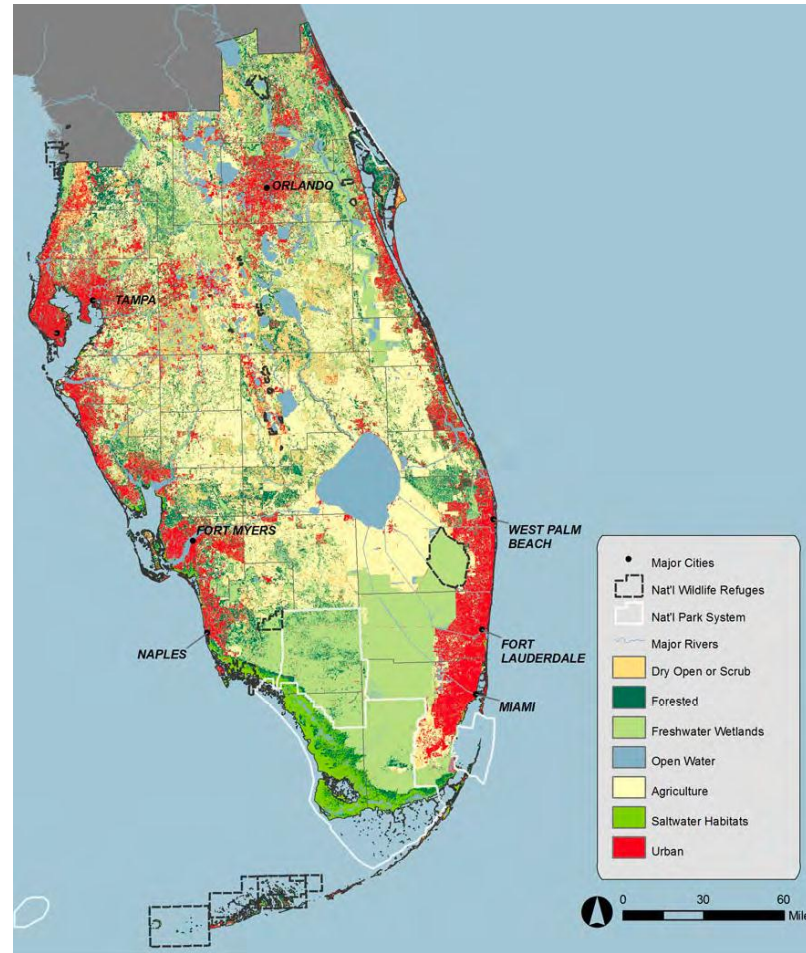
Partners and PIs



How Alternative Future Scenarios are Used in the Terrestrial Climate Change Adaptation Planning

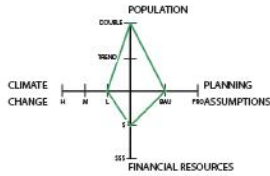


Peninsular Florida Current Land Use



Scenarios

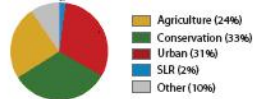
SUMMARY



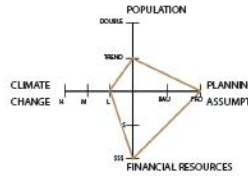
Scenario A Land Cover 2060



Land Use Composition 2060



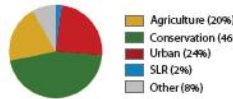
Total Land Use Area (in millions of acres)	2020	2040	2060
Agriculture	6.19	5.52	4.69
Conservation	6.00	6.16	6.32
Urban	4.51	5.20	5.98
Sea Level Rise	0.33	0.38	0.44
Other	2.26	2.03	1.86



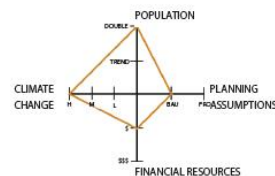
Scenario B Land Cover 2060



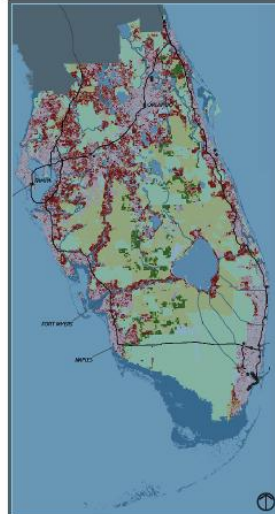
Land Use Composition 2060



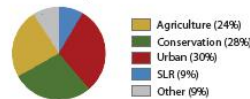
Total Land Use Area (in millions of acres)	2020	2040	2060
Agriculture	6.00	4.96	3.1
Conservation	6.50	7.65	8.1
Urban	4.29	4.47	4.1
Sea Level Rise	0.33	0.38	0.44
Other	2.18	1.83	1.5



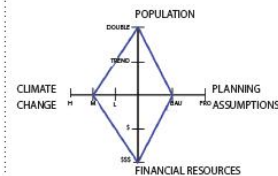
Scenario C Land Cover 2060



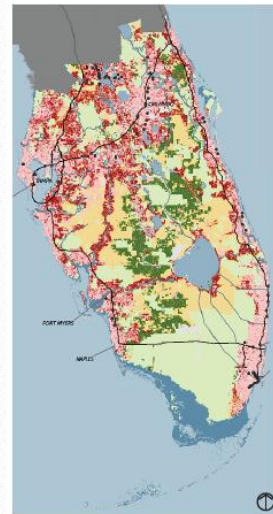
Land Use Composition 2060



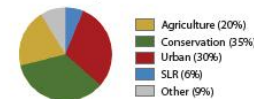
Total Land Use Area (in millions of acres)	2020	2040	2060
Agriculture	6.19	5.51	4.66
Conservation	5.77	5.40	5.40
Urban	4.48	5.09	5.81
Sea Level Rise	0.63	1.34	1.64
Other	2.22	1.95	1.77



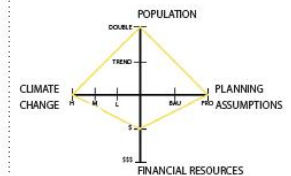
Scenario E Land Cover 2060



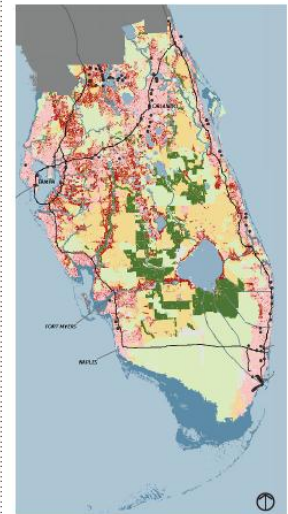
Land Use Composition 2060



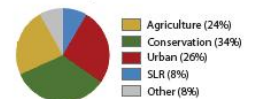
Total Land Use Area (in millions of acres)	2020	2040	2060
Agriculture	6.05	5.04	3.87
Conservation	6.12	6.40	6.69
Urban	4.47	5.10	5.83
Sea Level Rise	0.44	0.82	1.20
Other	2.21	1.92	1.70



Scenario I Land Cover 2060



Land Use Composition 2060



Total Land Use Area (in millions of acres)	2020	2040	2060
Agriculture	6.12	5.38	4.54
Conservation	5.97	5.99	6.39
Urban	4.37	4.70	5.05
Sea Level Rise	0.63	1.34	1.64
Other	2.21	1.87	1.67

Map Legend

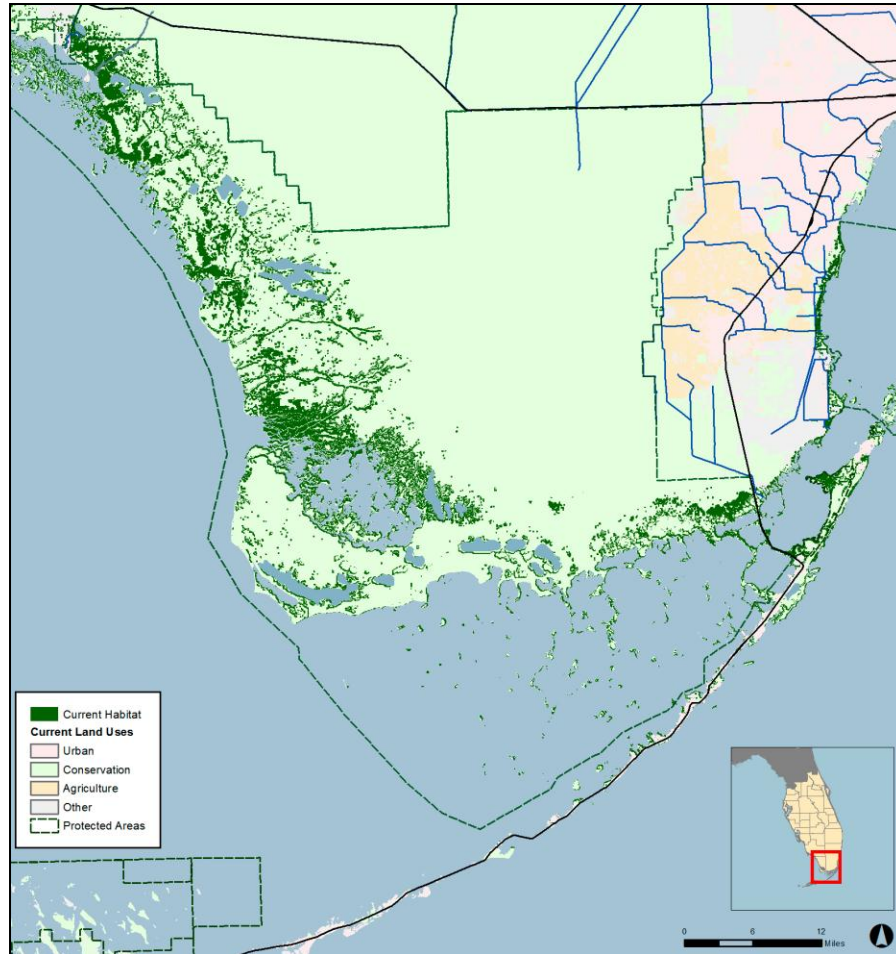
Current Land Use	Projected Land Use
Agriculture	Agriculture
Conservation	Conservation
Urban	Urban

Figure 10: MIT Scenario Summary

A Case Study - The American Crocodile



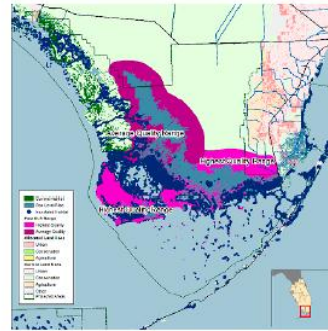
Current Habitat/Range



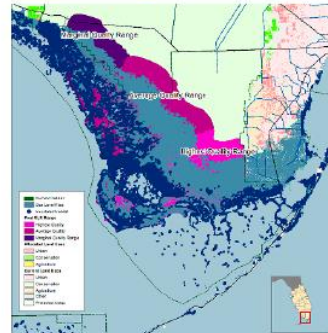
Crocodile Distribution – 2060

Potential Habitat 2060

Potential Habitat Under Low Sea-level Rise



Potential Habitat Under Medium Sea-level Rise

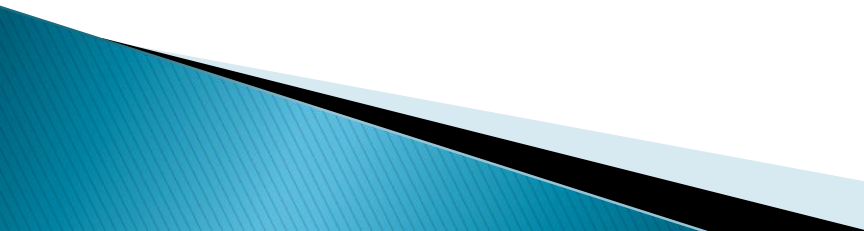


Potential Habitat Under High Sea-level Rise



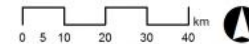
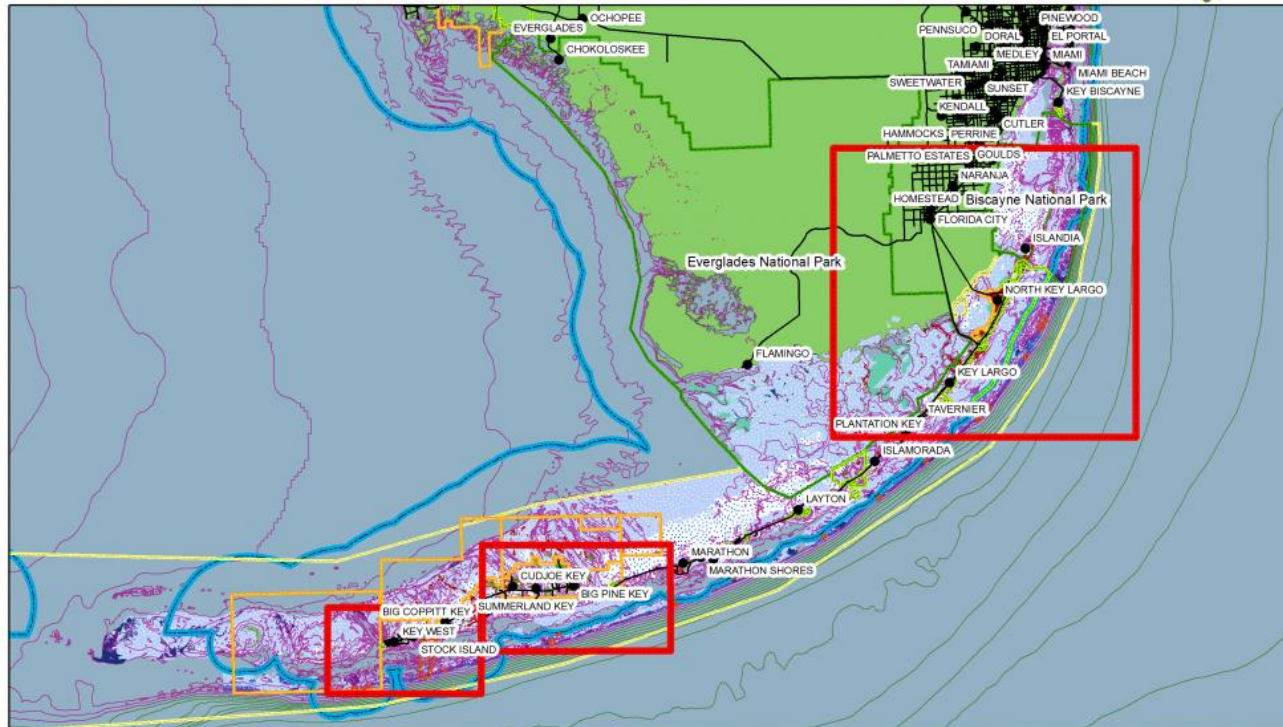
Figure 18: American Crocodile: Potential Habitat 2060

Applying the Concept to the Marine Environment – KEYSMAP

- ▶ Under different IPCC scenarios, what will be the effect on *acidification*, sea level rise, water temperature?
 - ▶ How will those anticipated impacts affect critical habitats?
 - ▶ How will the changes to the habitats impact sentinel species?
 - ▶ Couple these to social scenarios, what will be the effect on human population distribution, and resource use?
 - ▶ What adaptation approaches may be suitable under the different scenarios?
- 

The Study Area

2012 Florida Keys Study Region: Projected SLR 2060



Sources: FWC/FWRI, NOAA

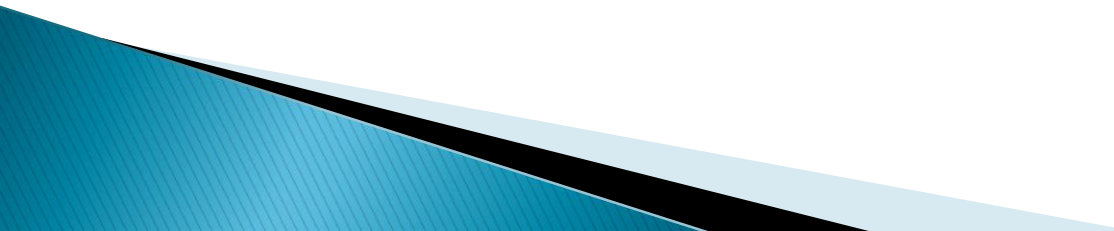
Habitats Under Consideration



Species Under Examination



Workshop Driven

- ▶ Pre-Workshops – SLAMM and habitat vetting with local habitat experts and SLAMM modelers
 - ▶ Workshop 1 – Managers and Habitat Specialists
 - ▶ Workshop 2 – Species Experts and Habitat Specialists
 - ▶ Workshop 3 – Managers
- 

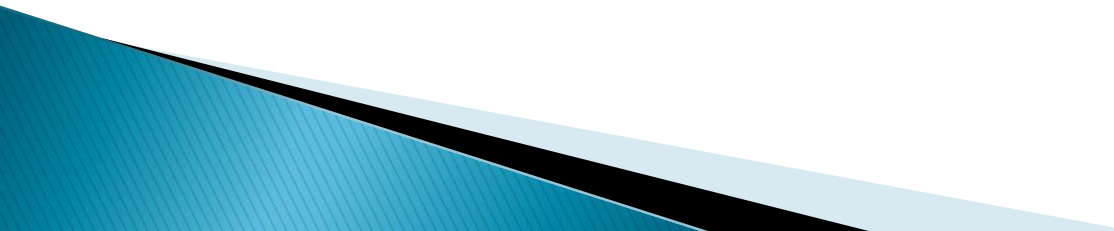
Workshop 1 – Developing Scenarios

Summer 2012

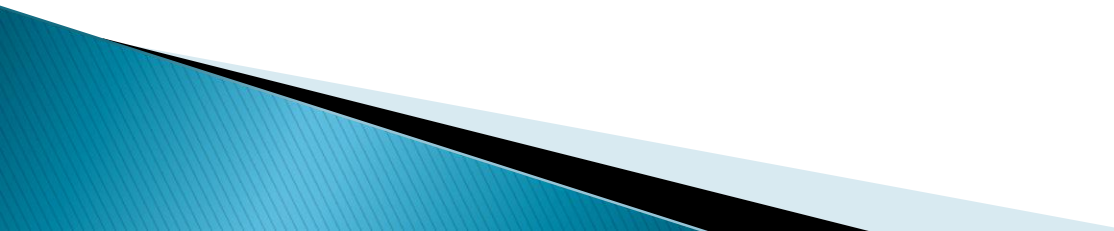


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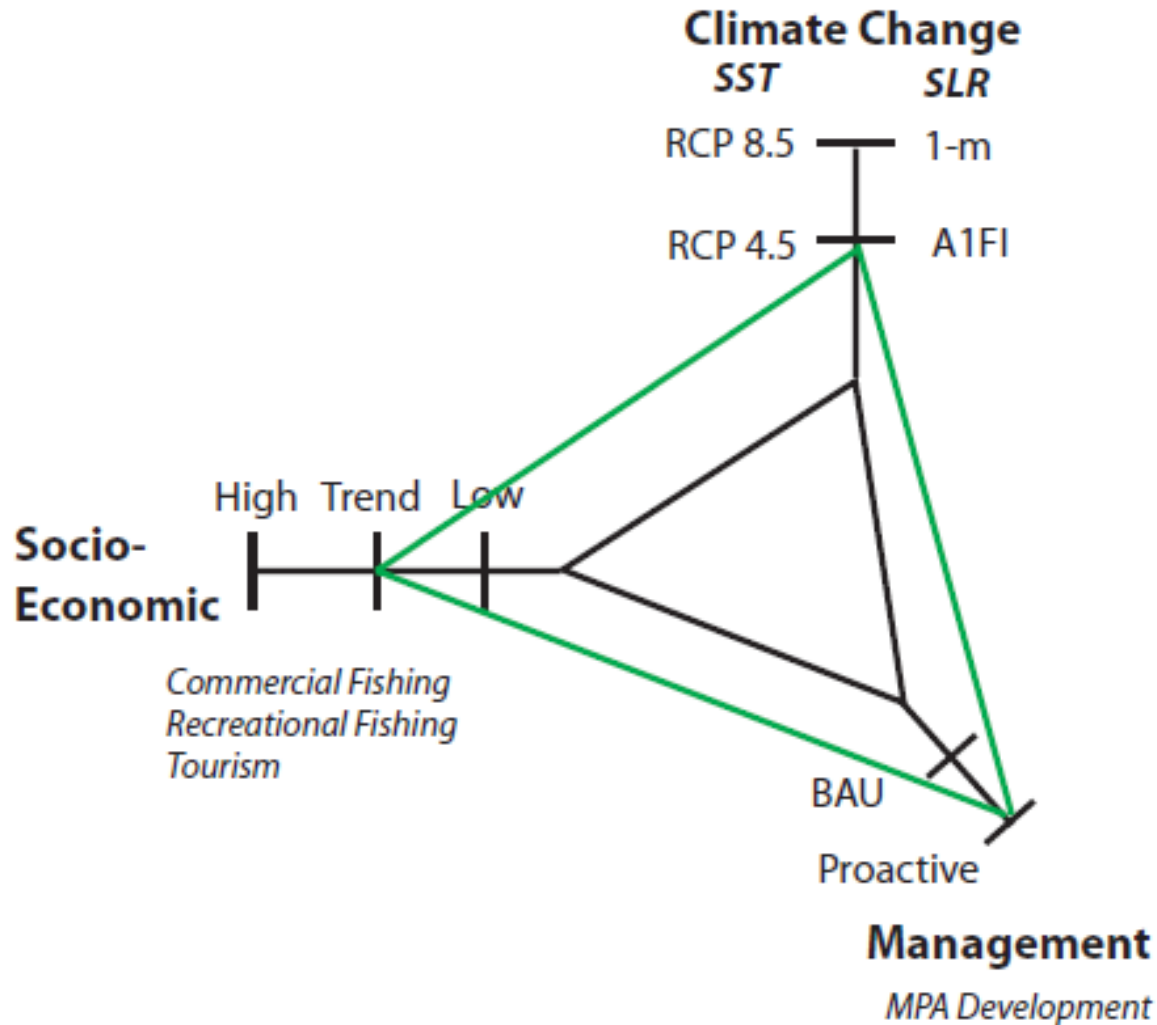
Attended by Managers from

- ▶ FI FWC
 - ▶ NPS
 - ▶ USFWS (e.g., Refuges, LCCs)
 - ▶ USGS (including the SE Climate Science Center)
 - ▶ NOAA FKNMS, NMFS climate, AOML
 - ▶ DEP State Parks
 - ▶ US Navy
 - ▶ TNC
 - ▶ Audubon
- 

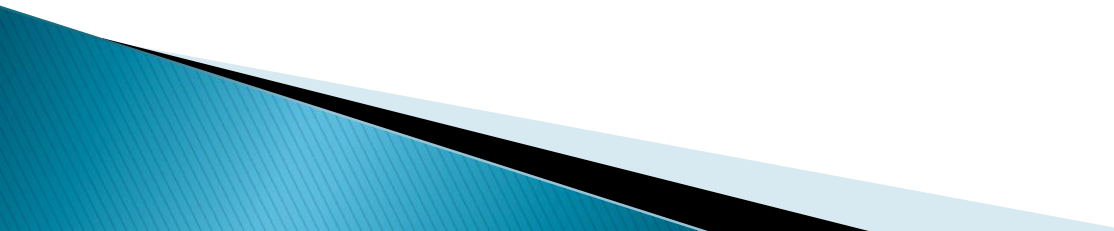
Data Sources Integrated into KEYSMAP

- ▶ SST models from AOML
 - ▶ SLAMM modeling for SLR
 - ▶ Cooperative Land Cover Maps for Terrestrial
 - ▶ FWRI Habitat Maps for Coral
 - ▶ TNC Bleaching GIS
 - ▶ FWC Boater Use GIS (1992 and 2012)
 - ▶ Expert Opinion on Habitat Usage
 - ▶ Zoning
- 

Scenario Development

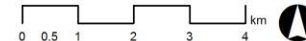
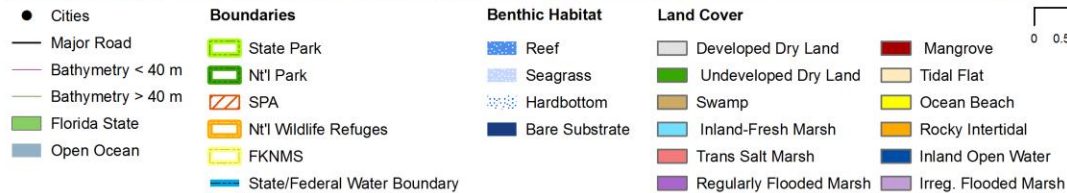
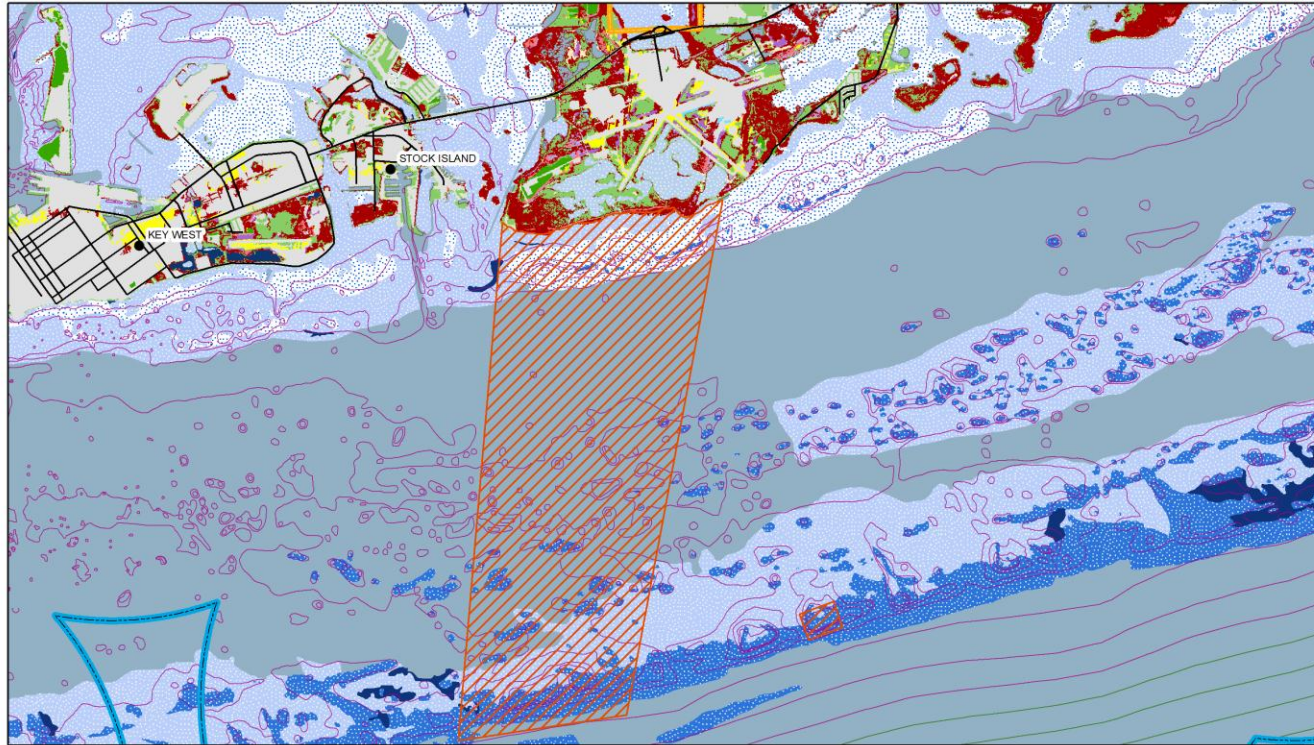


Workshop 2 – March 2013

- ▶ Species Experts
 - ▶ Integrates SLAMM, SST, species distributions, human activities (commercial fishing, recreational fishing, tourism), zoning
 - ▶ TNC reef condition and bleaching GIS
- 

Step 1 – Sea Level Rise Modeling (SLAMM)

2012 Florida Keys Focal Zone Three: Projected SLR 2060

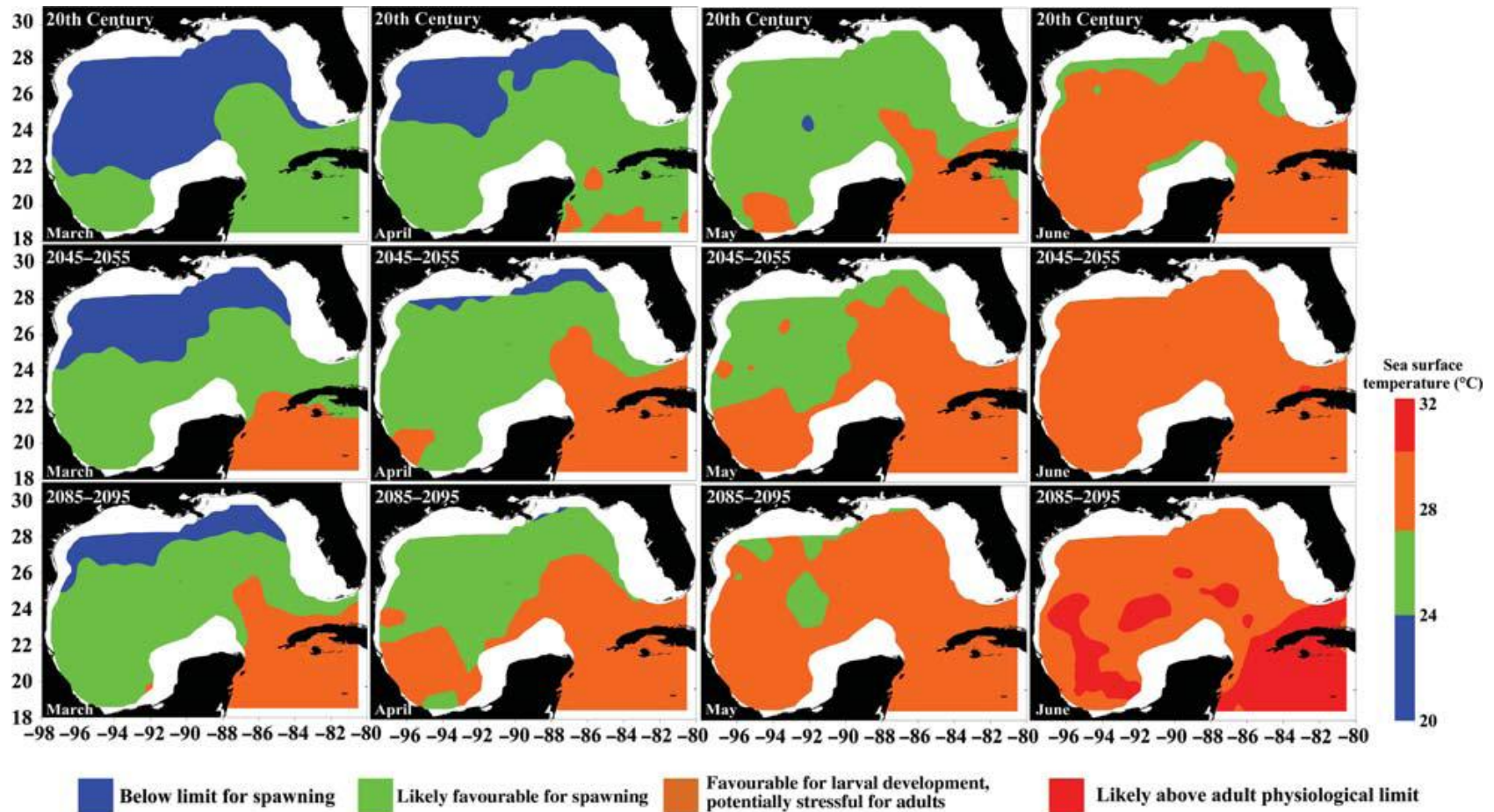


Sources: FWC/FWRI, NOAA

SLAMM Parameters

Description	Lower Keys - Gulf side	Lower Keys - Ocean Side	Middle Keys - Gulf Side	Middle Keys - Ocean Side	Upper Keys - Bayside	Upper Keys - Ocean Side
NWI Photo Date						
DEM Date						
Direction Offshore	N	S	N	S	N	S
Historic Trend (mm/yr)	2.27	2.27	2.94	2.94	2.39	2.39
MTL-NAVD88 (m)	-0.223	-0.247	-0.261	-0.289	-0.232	-0.265
GT Great Diurnal Tide Range (m)	0.563	0.432	0.358	0.542	0.329	0.705
Salt Elev. (m above MTL)	0.431	0.259	0.291	0.227	0.31	0.31
Marsh Erosion (horiz. m/yr)	1.8	1.8	1.8	1.8	1.8	1.8
Swamp Erosion (horiz. m/yr)	1	1	1	1	1	1
T. Flat Erosion (horiz. m/yr)	0.1	0.1	2	2	0.5	2
Reg. Flood Marsh Accr. (mm/yr)	3.9	3.9	3.9	3.9	3.9	3.9
Irreg. Flood Marsh Accr (mm/yr)	4.7	4.7	4.7	4.7	4.7	4.7
Tidal Fresh Marsh Accr (mm/yr)	5.9	5.9	5.9	5.9	5.9	5.9
Inland Fresh Marsh Accr (mm/yr)						
Mangrove Accr (mm/yr)	3.3	3.3	3.3	3.3	3.3	3.3
Tidal Swamp Accr (mm/yr)						
Swamp Accr (mm/yr)						
Beach Sed. Rate (mm/yr)	1	1	0.5	0.5	0.5	0.5
Freq. Overwash (years)	25	25	25	25	25	25

Predicting changes in Sea Surface Temperature

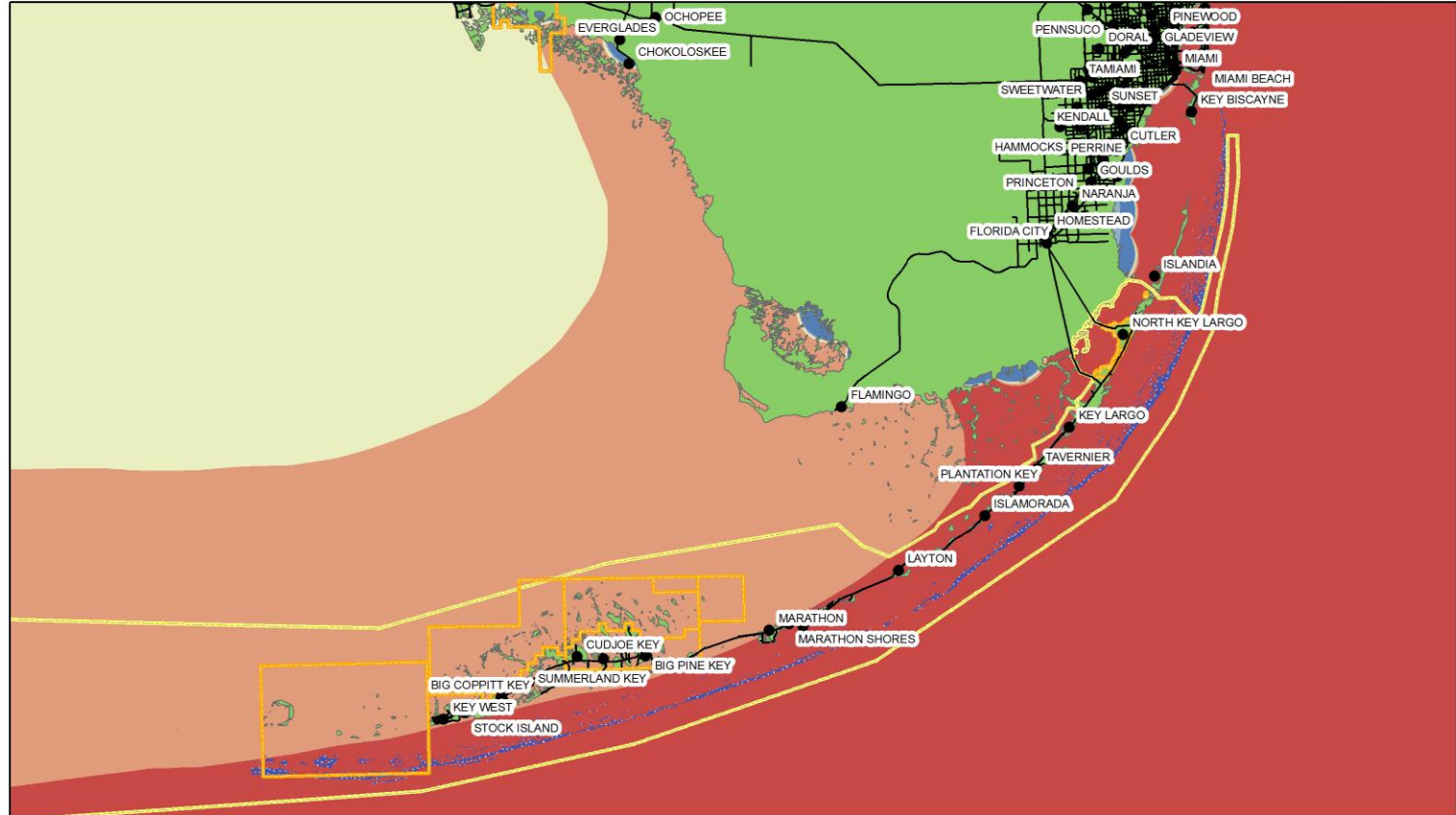


Liu, Lee, Muhling, Lamkin, Enfield. 2012. Significant reduction of the Loop Current in the 21st century and its impact on the Gulf of Mexico. *J Geophysical Res*

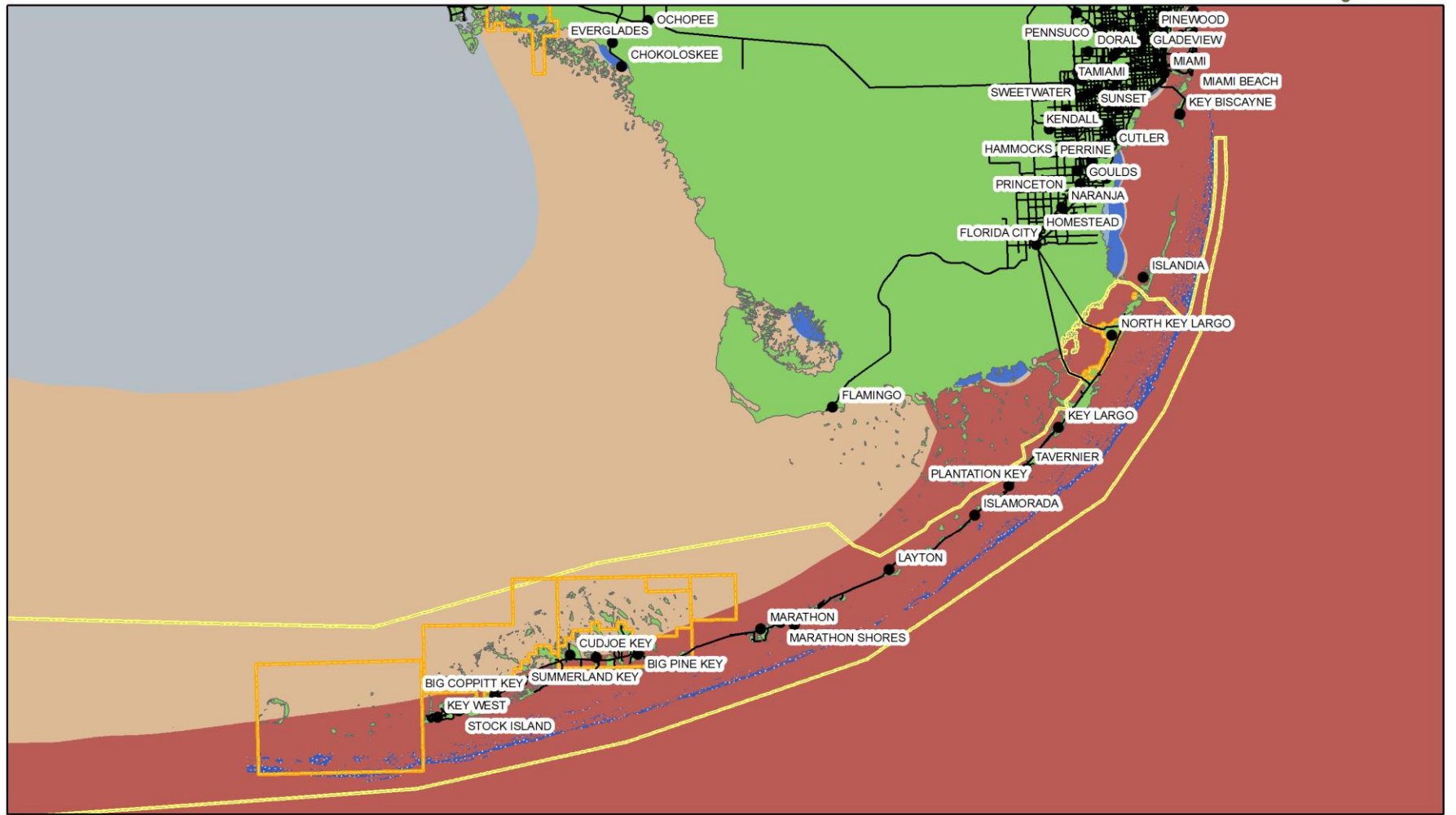
Predicting changes in Sea Surface Temperature

NOAA-AOML

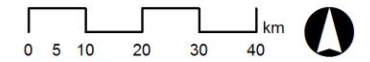
2012 Florida Keys | Sea Surface Temperatures | RCP 4.5 | April



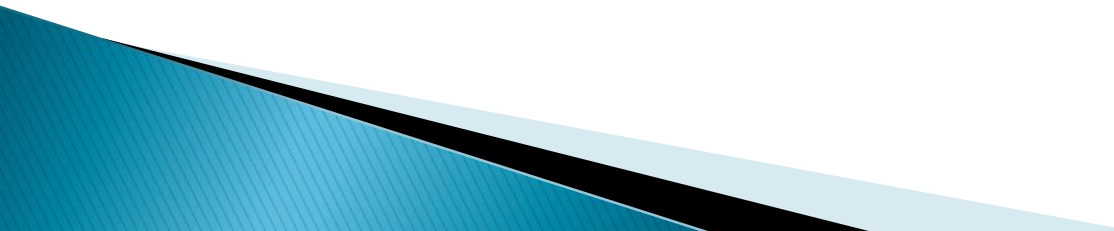
2012 Florida Keys | Sea Surface Temperatures | RCP 8.5 | April



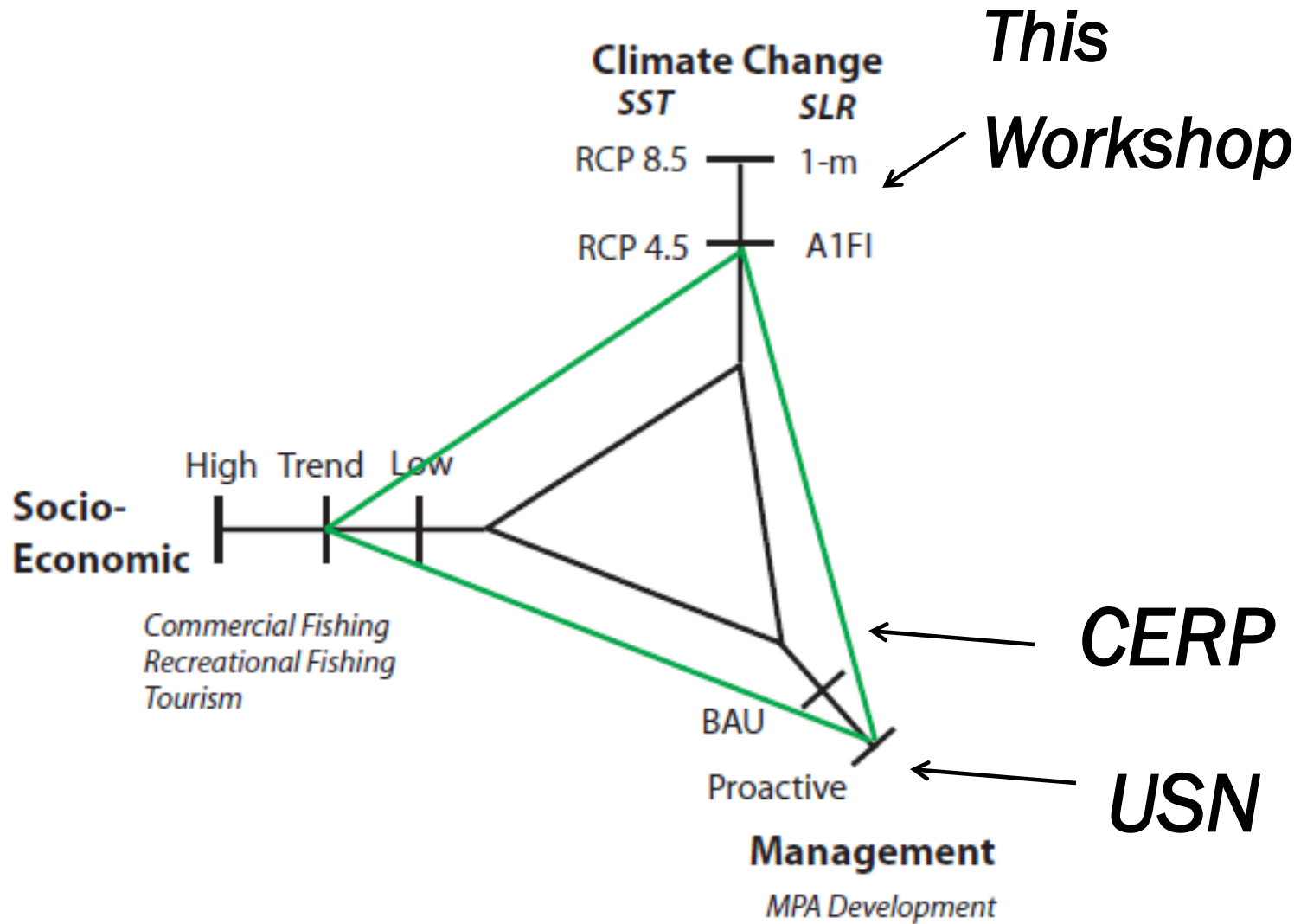
● Cities	Boundaries	Temperature (C)
— Major Road	▭ Nt'l Wildlife Refuges	■ 0.26 - 26.33
■ Florida State	▭ FKNMS	■ 26.34 - 26.83
	Benthic Habitat	■ 26.84 - 27.33
	■ Reef	■ 27.34 - 27.83



Upcoming activities

- ▶ March – 2nd workshop on species
 - ▶ April – 3rd workshop brings back managers for adaptation planning
- 

What's Next



**All Models are Wrong
Some Are Useful**

