

REMOTE SENSING + ECOLOGICAL EXPERIMENTATION TO DETECT & EXPLAIN MANGROVE RANGE EXPANSION

John Parker



Smithsonian Environmental
Research Center



Mangrove wetlands

~75% of the world's tropical coastlines
\$1.6 trillion/year in ecosystem services









(another shameless picture of charismatic megafauna)

'Mangrove' is a saltwater lifestyle, not a (plant) family

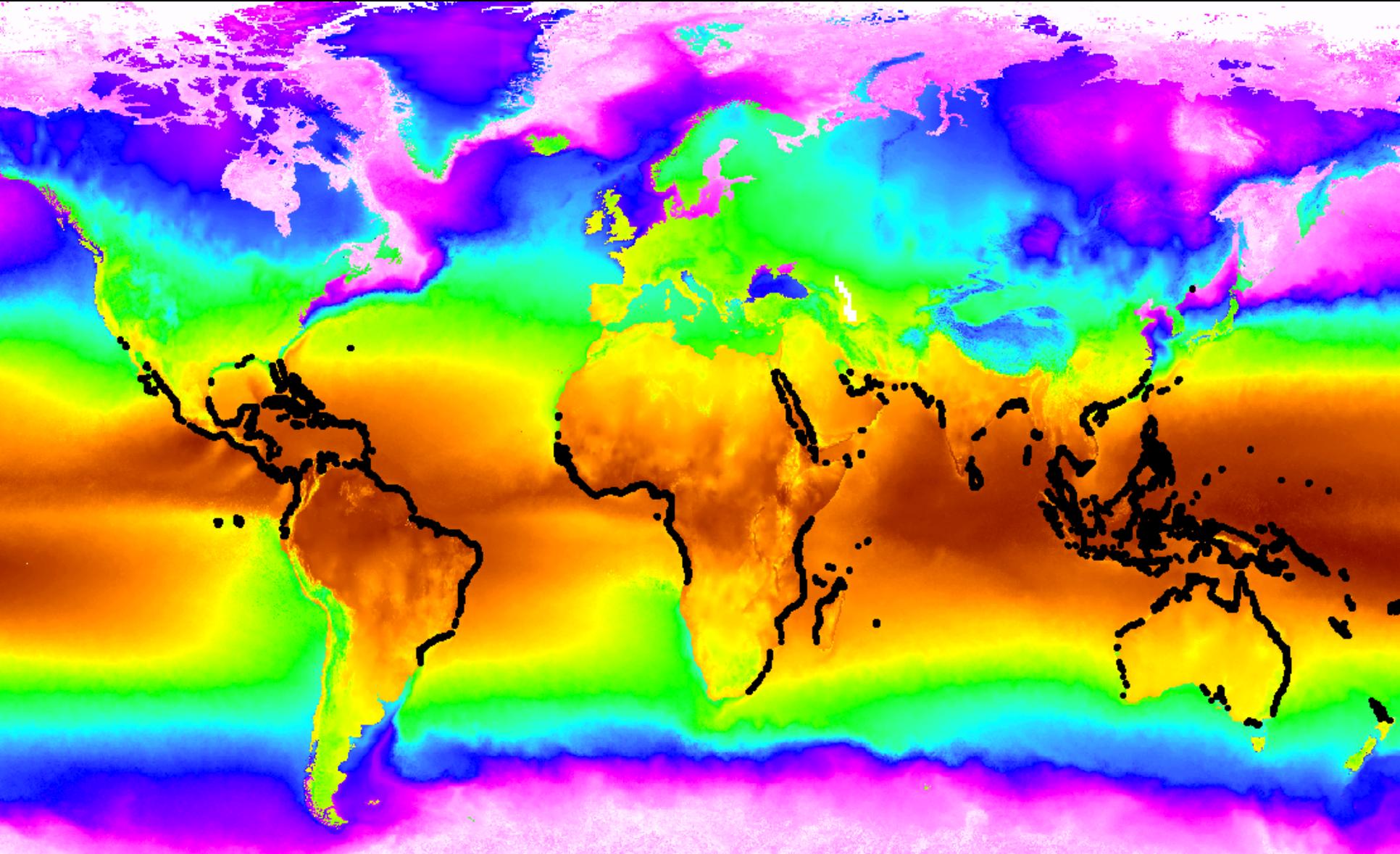
~60,000 tree species

~70 mangrove species

~0.1% of trees are mangroves



NO COLD MANGROVES



**AT/SST: Mean Monthly Winter
Minimums (BIOCLIM/MODIS)**

2010 cold snap in Florida





1980s sign, Merritt Island National Wildlife Refuge

2016



Spared Winter Freeze, Florida's Mangroves Are Marching North

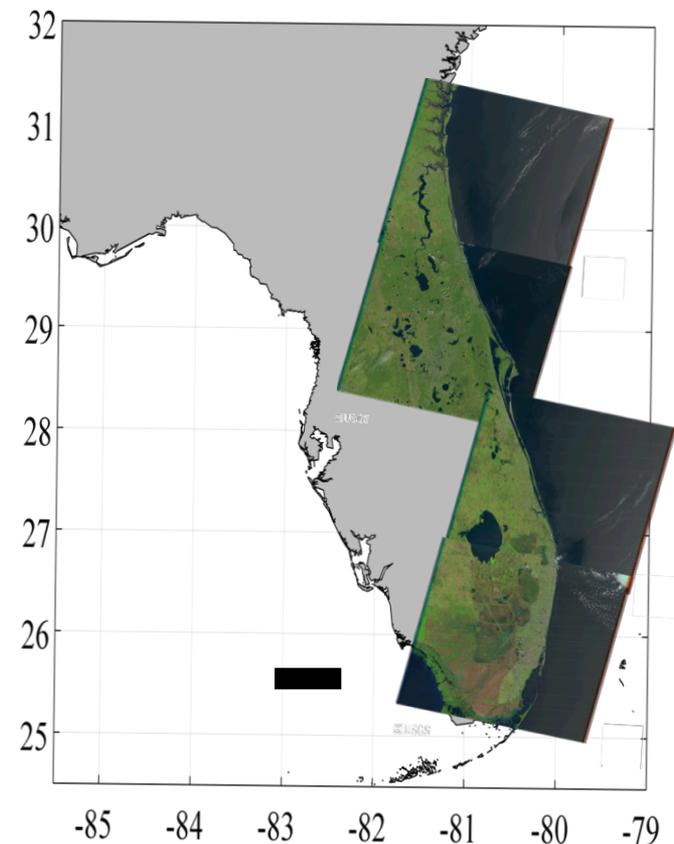


Barbara P. Fernandez for The New York Times

Mangrove forests, like in the Everglades, serve as spawning grounds and nurseries for fish and as habitat for a wide array of organisms. But salt marshes are also ecologically valuable.

By JUSTIN GILLIS

Published: December 30, 2013 | 173 Comments



Poleward expansion of mangroves is a threshold response to decreased frequency of extreme cold events

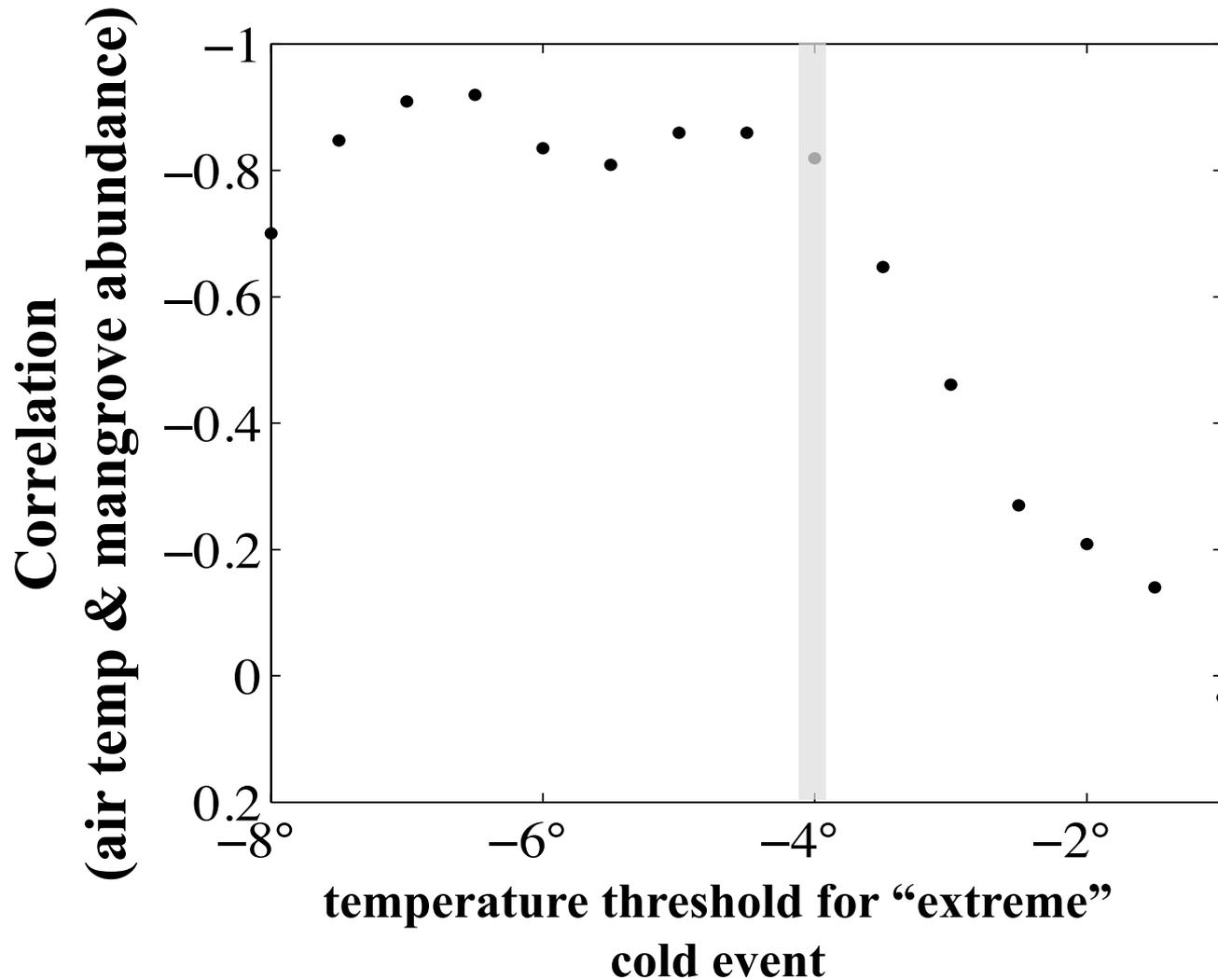
Kyle C. Cavanaugh^{a,b,1}, James R. Kellner^b, Alexander J. Forde^c, Daniel S. Gruner^d, John D. Parker^a, Wilfrid Rodriguez^a, and Ilka C. Feller^a

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Edited by George M. Woodwell, Woods Hole, MA, and approved November 22, 2013 (received for review August 20, 2013)

Temperature threshold

$< -4^{\circ}\text{C}$ in winter = reduced mangrove cover in summer

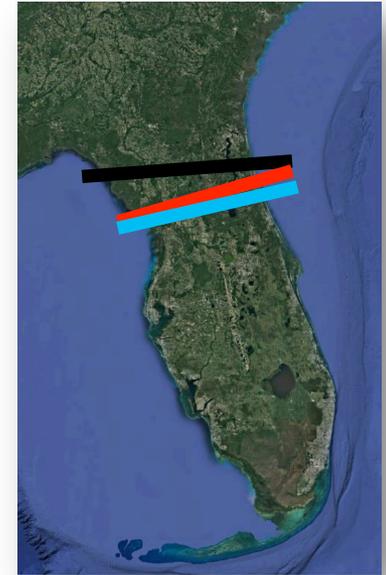
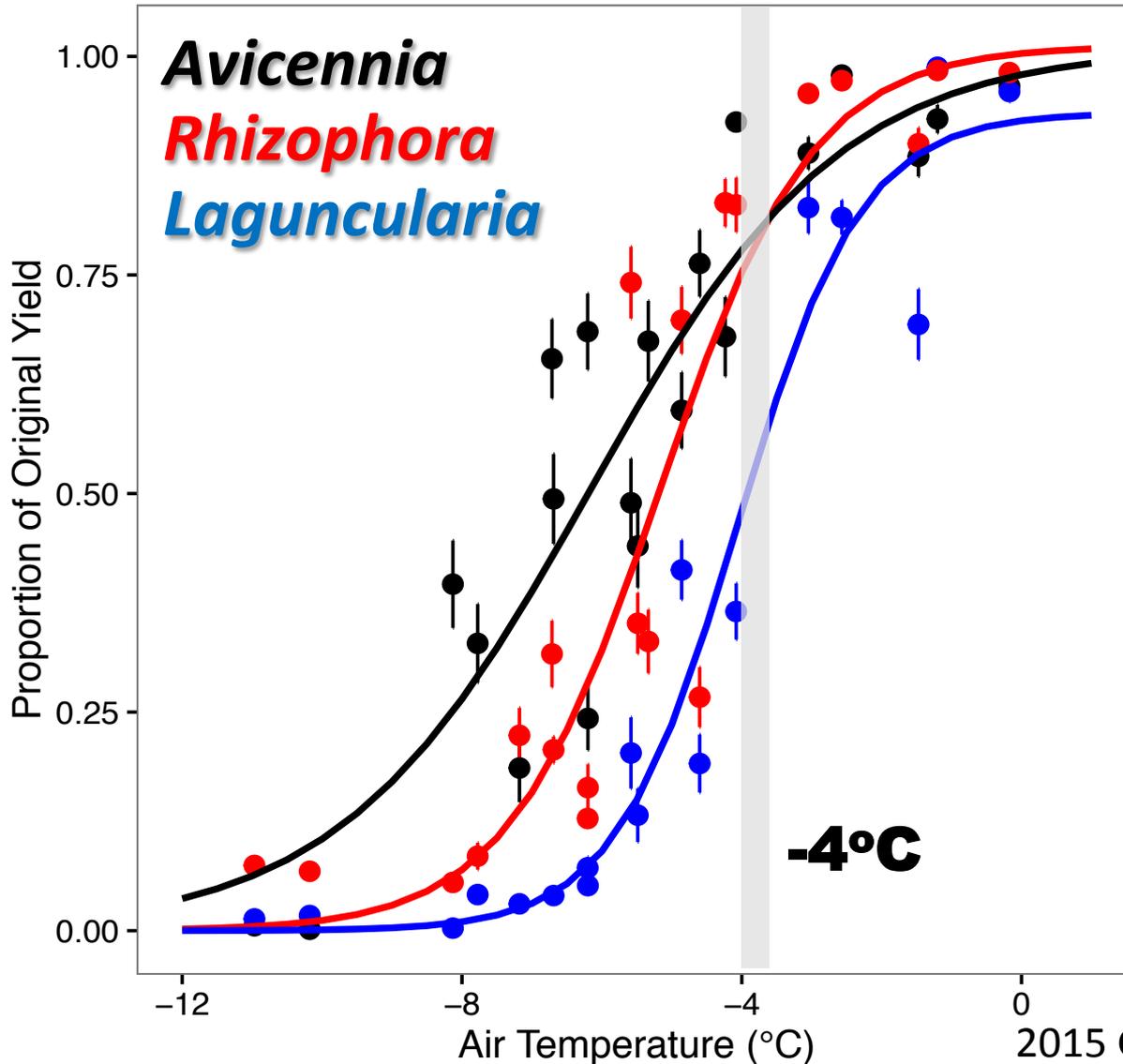


Simulated 'freeze' events

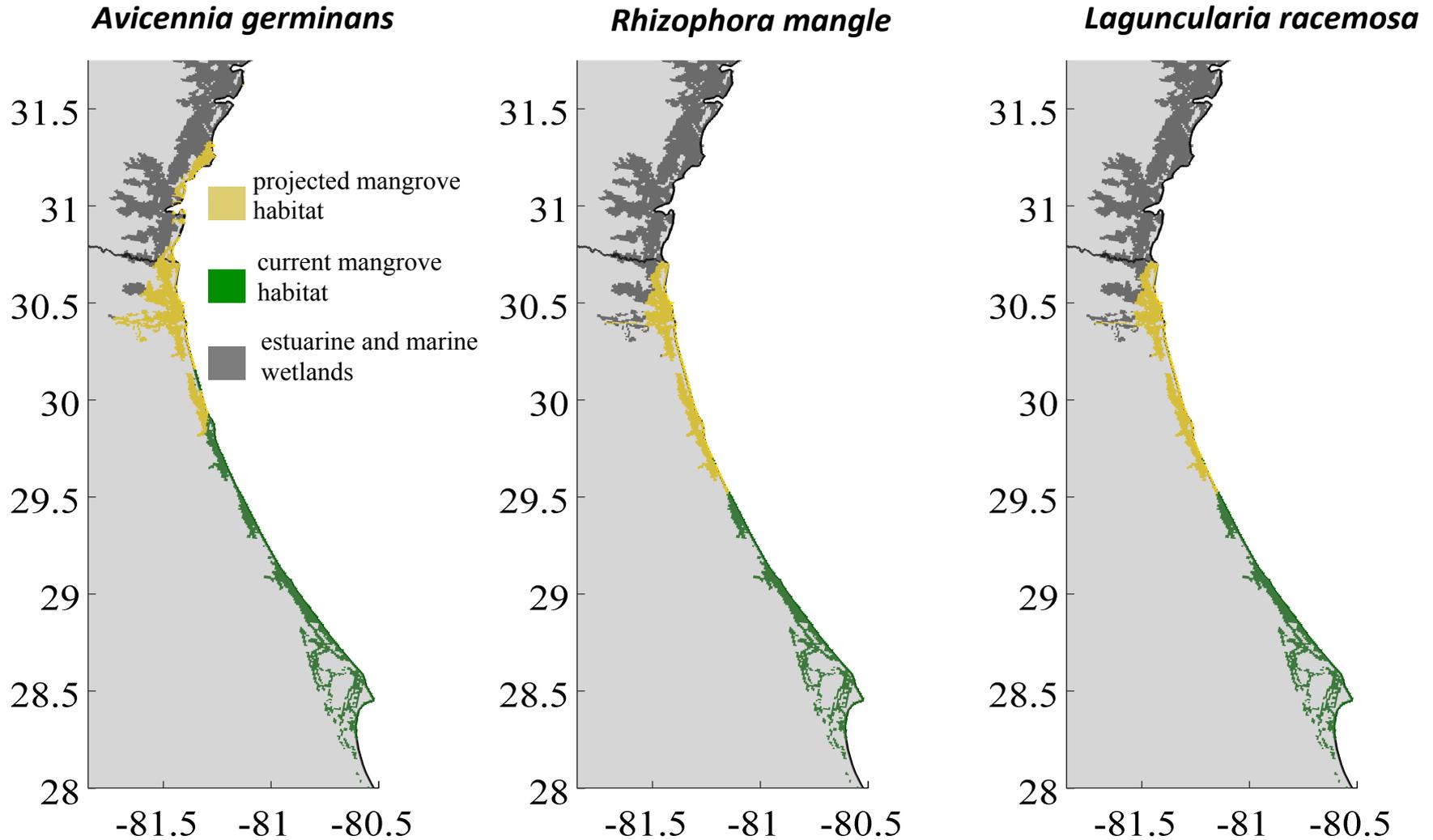
-11°C, -10, -8, -6, -4 -2, 0



SPECIES-SPECIFIC RESISTANCE TO FREEZING AIR = RANGE-LIMITS



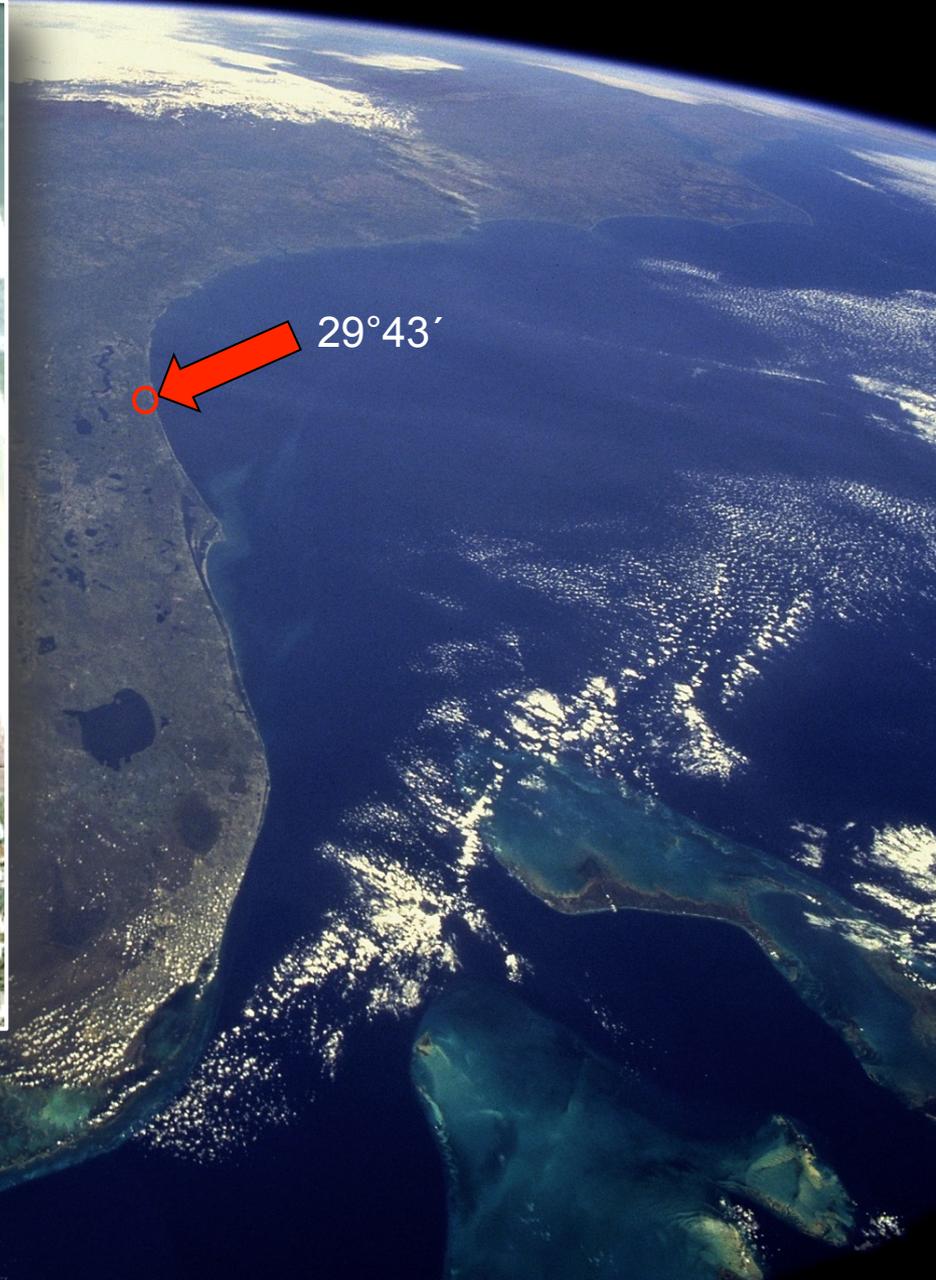
Projected mangrove distributions in 2060

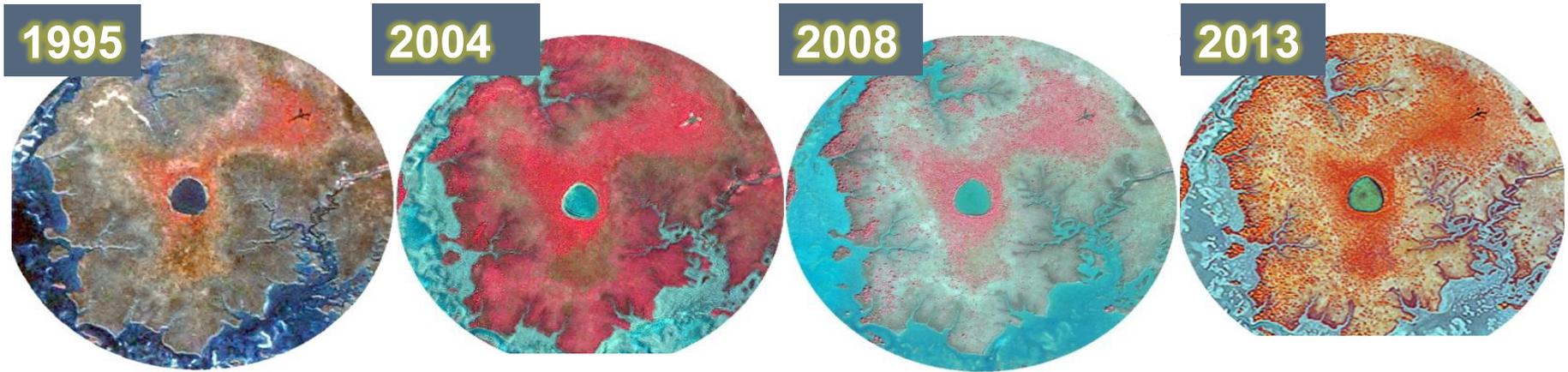
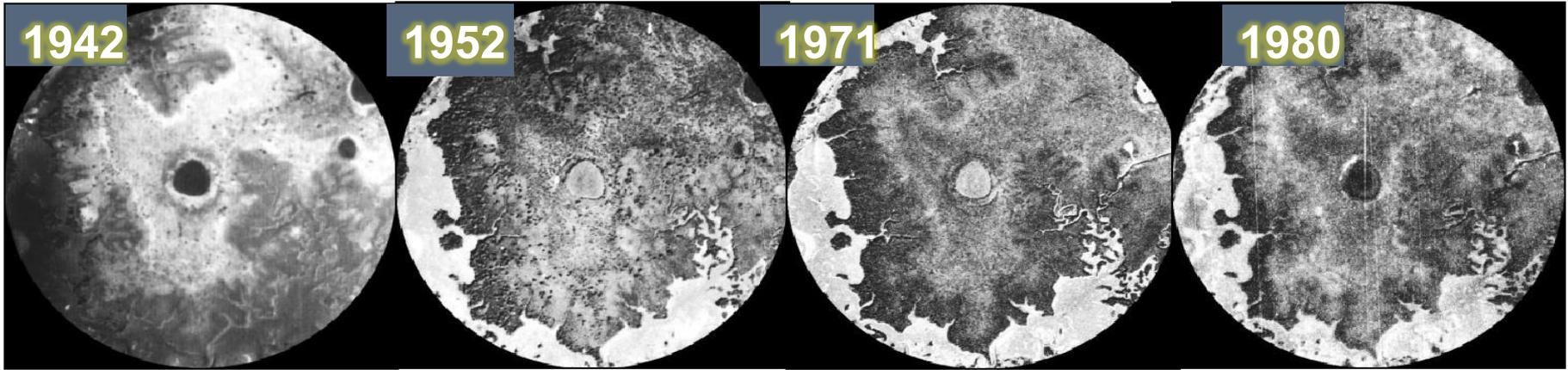


Georgia: 1/3 of all eastern US saltmarsh

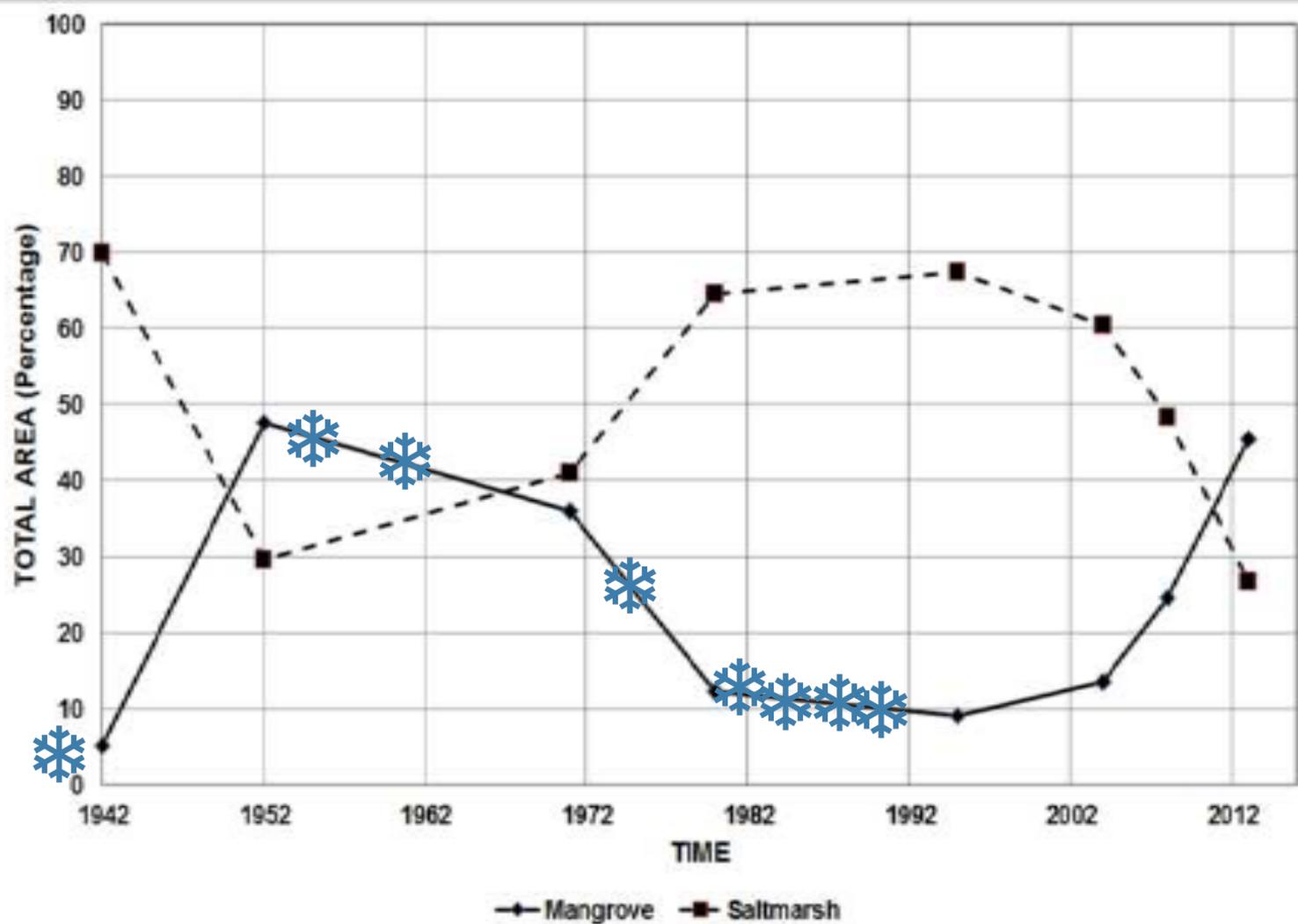


Expansion/contraction of mangroves and saltmarsh habitats





Mangrove/marsh oscillation at the edge





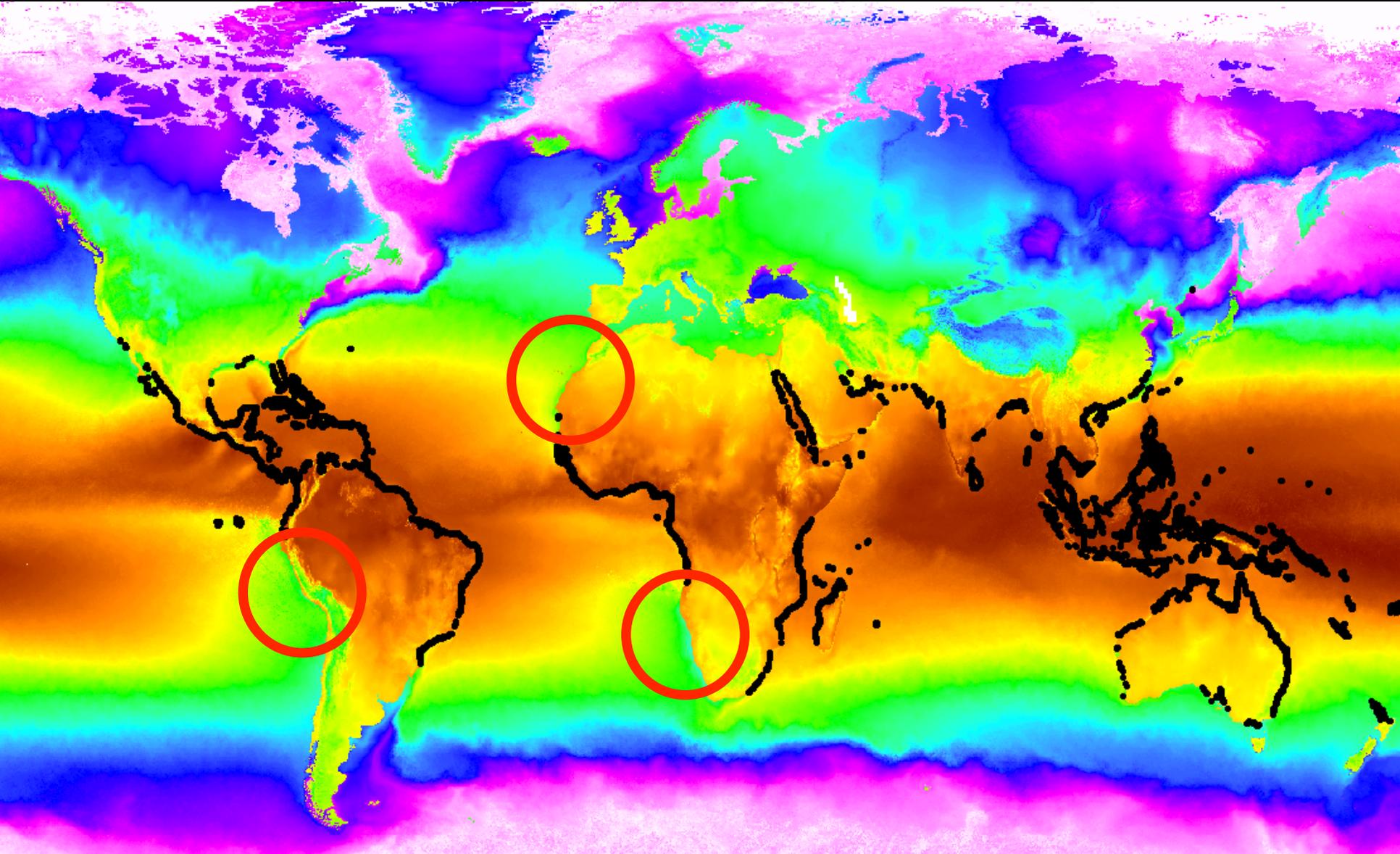
1, 2 *Bruguiera* 3 *Kandelia* 4-6 *Rhizophora apiculata* 7, 8 *Rhizophora* sp1 (cf. *stylosa*)
 9 *Rhizophora* sp2 (cf. *mucronata*) 10 *Ceriops* 11 *Aegiceras corniculatum* 12 *Avicennia*
 13 *Xylocarpus* 14 *Excoecaria agallocha* 15 *Sonneratia* sp1 (unidentified) 16-18 *Sonneratia caseolaris*
 19 *Sonneratia* cf. *ovata* 20, 21 *Sonneratia* cf. *alba* 22 *Barringtonia* 23 *Nypa fruticans*

MANGROVE RANGE LIMITS ~

COLD AIR

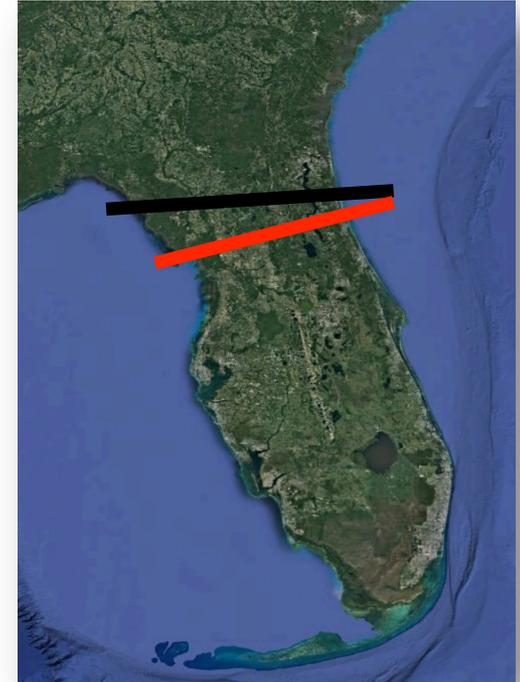
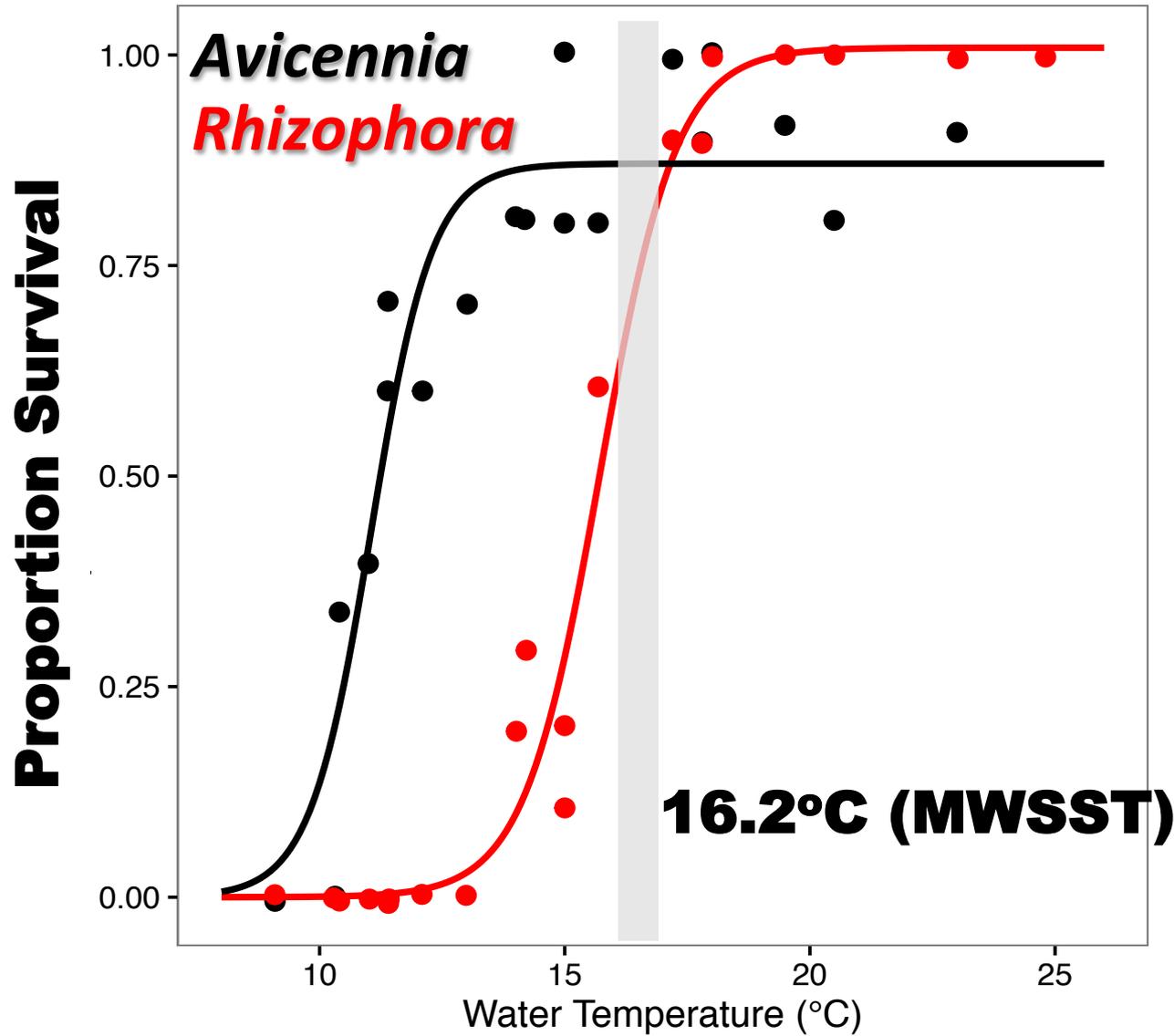


RANGE LIMITS ~ COLD WATER?



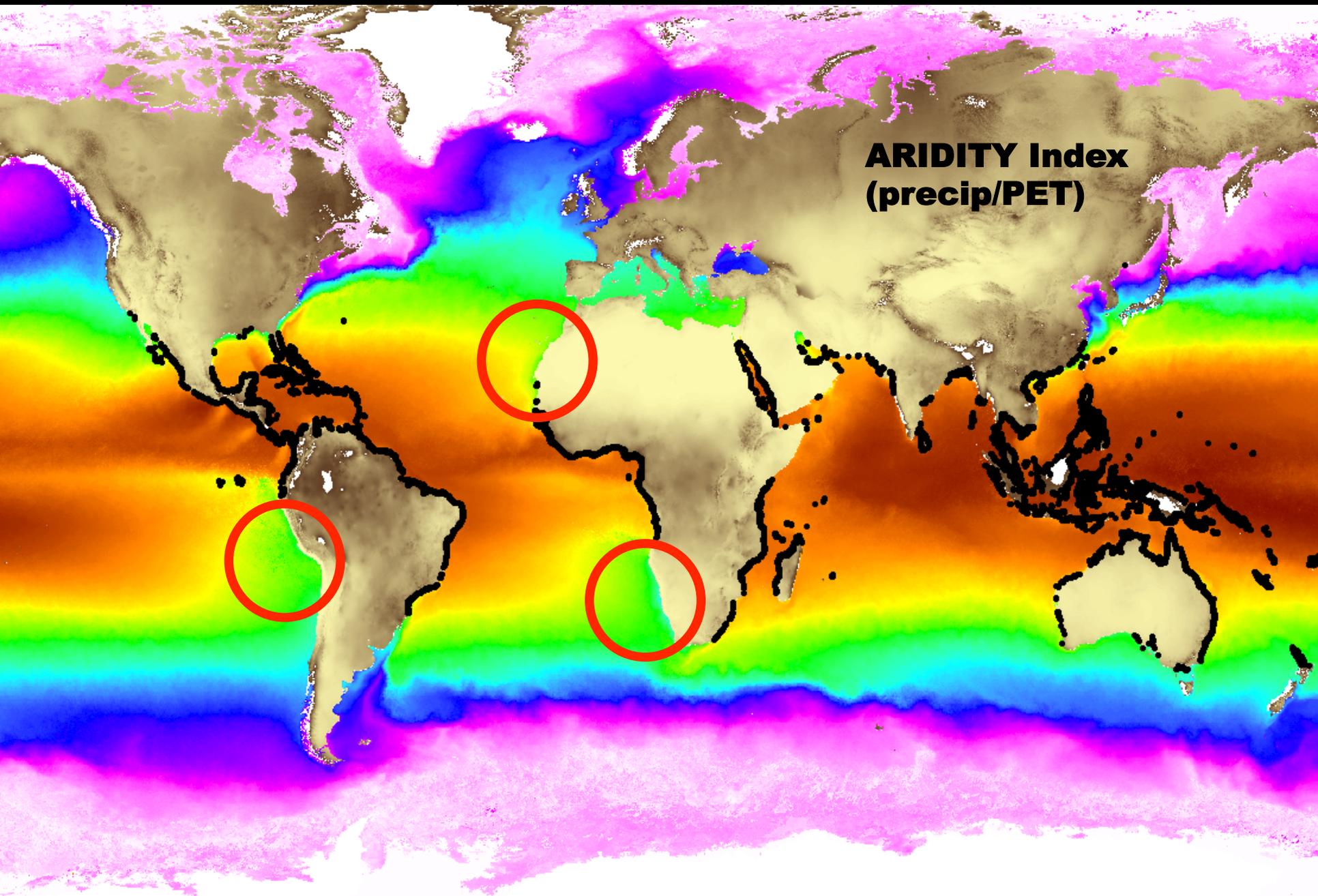
**SST: Avg Winter
Minimums (MODIS)**

RANGE-LIMITS ~ COLD WATER





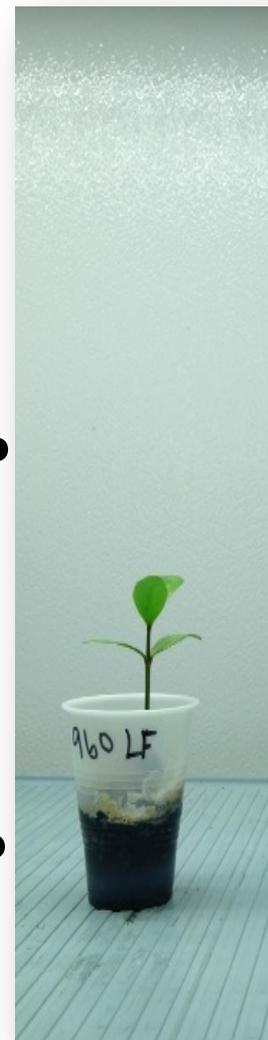
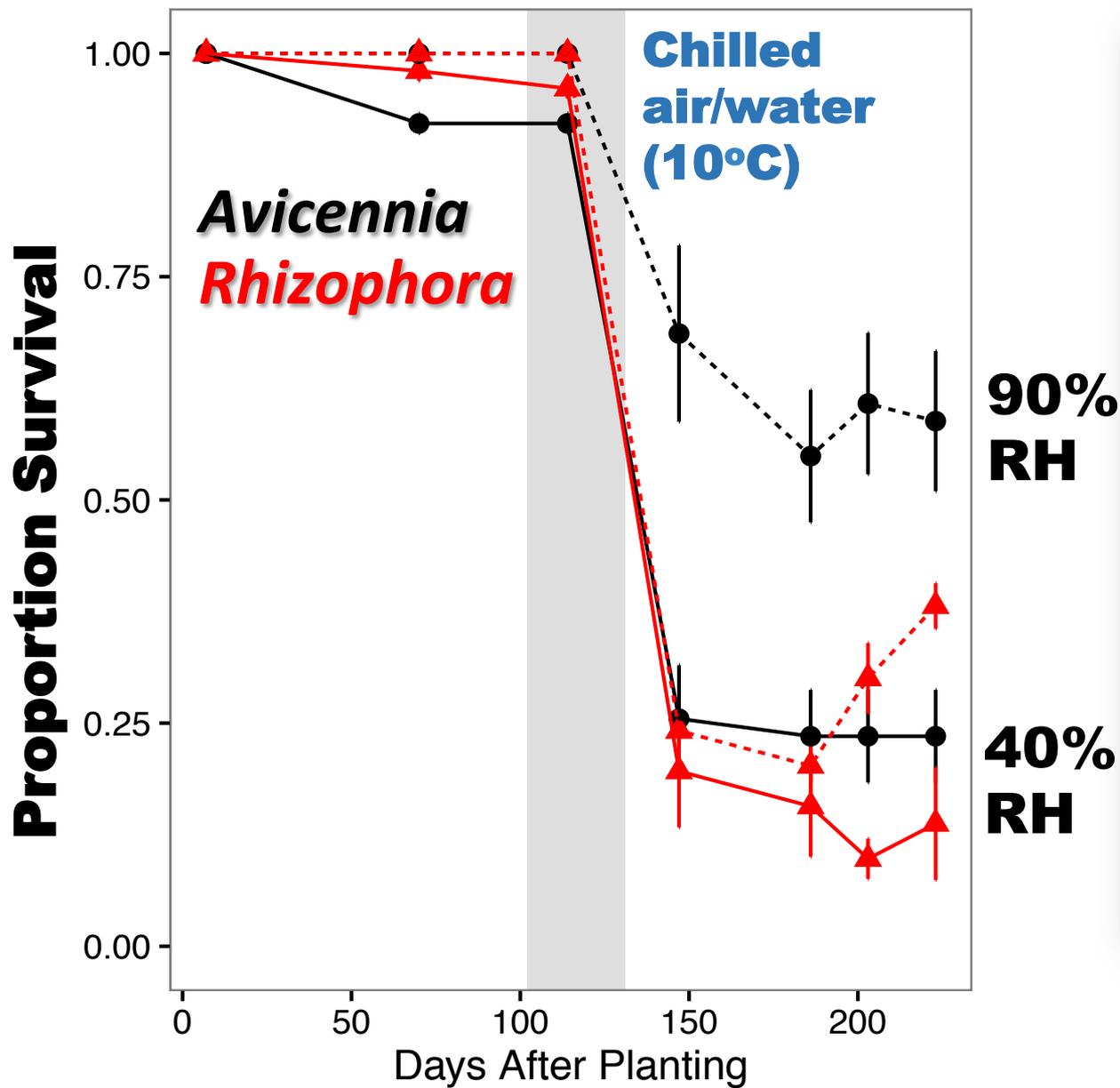
RANGE-LIMITS ~ ARIDITY * COLD WATER?



GROWTH-CHAMBER EXPERIMENTS: HUMIDITY*CHILLING



Survival ~ Aridity*Chilling*Species

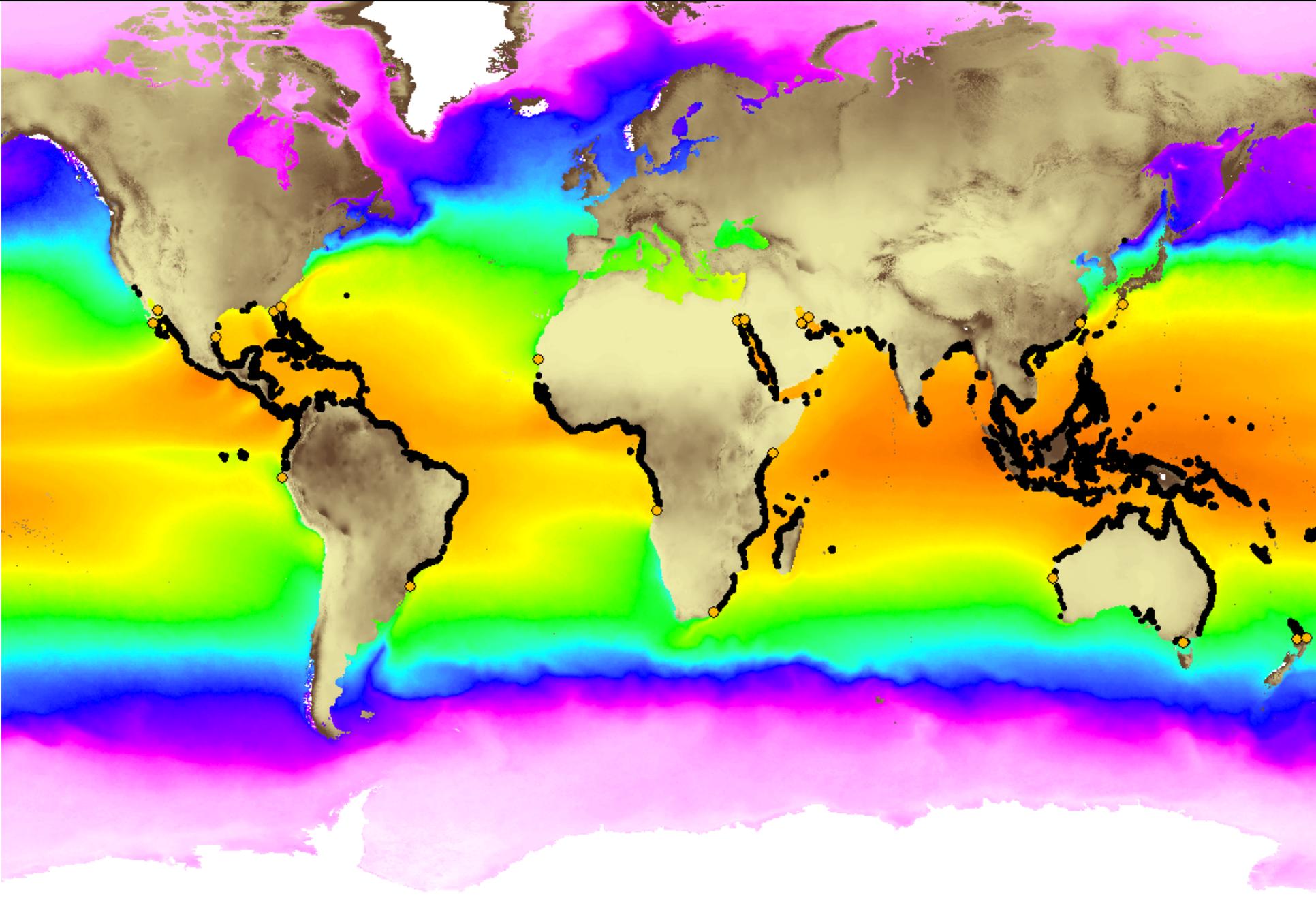


**40%
RH**

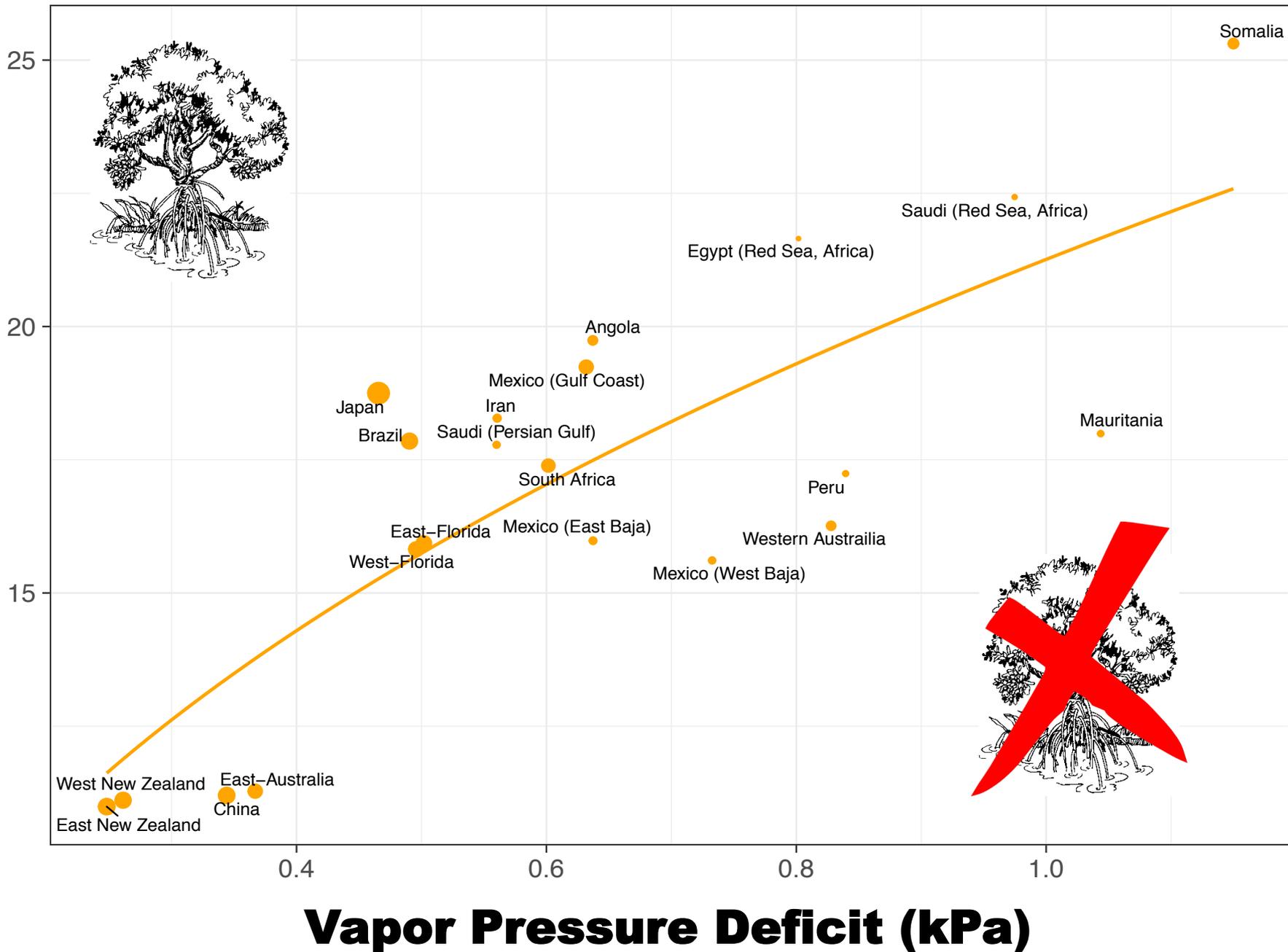


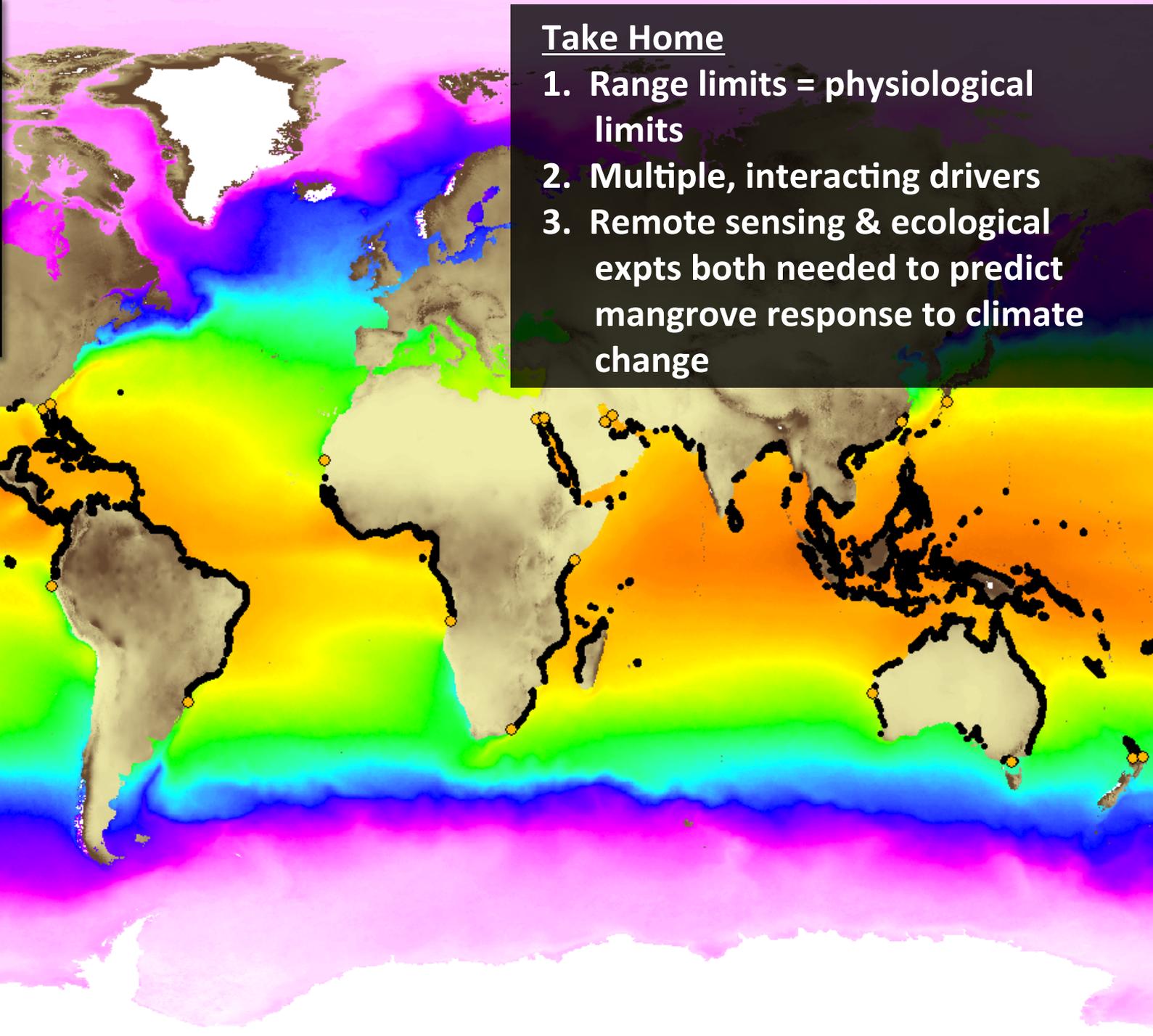
**90%
RH**

What envt factors define mangrove ranges?



Mean Winter Sea Surface Temp C





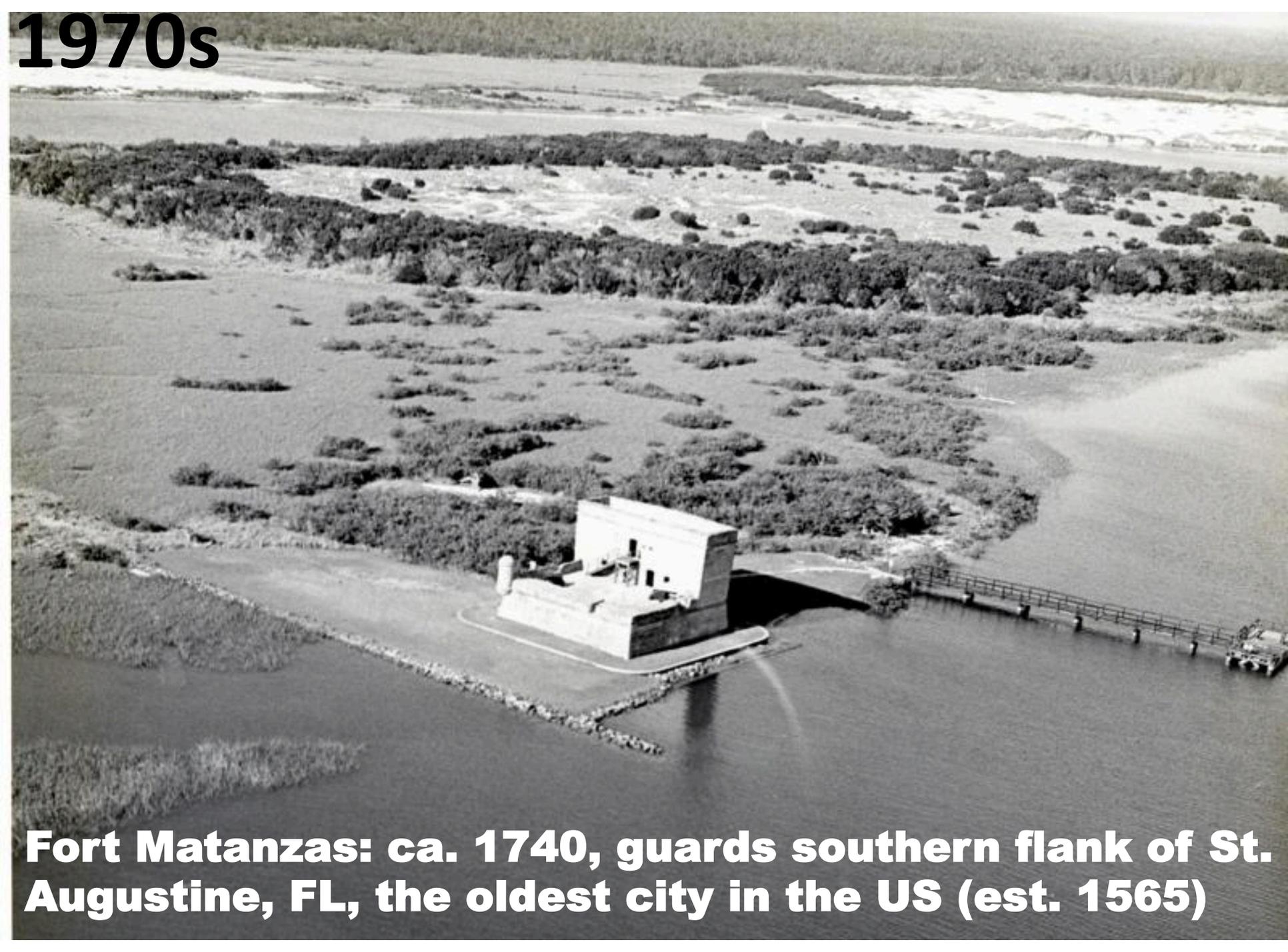
Take Home

1. Range limits = physiological limits
2. Multiple, interacting drivers
3. Remote sensing & ecological expts both needed to predict mangrove response to climate change

1947



1970s

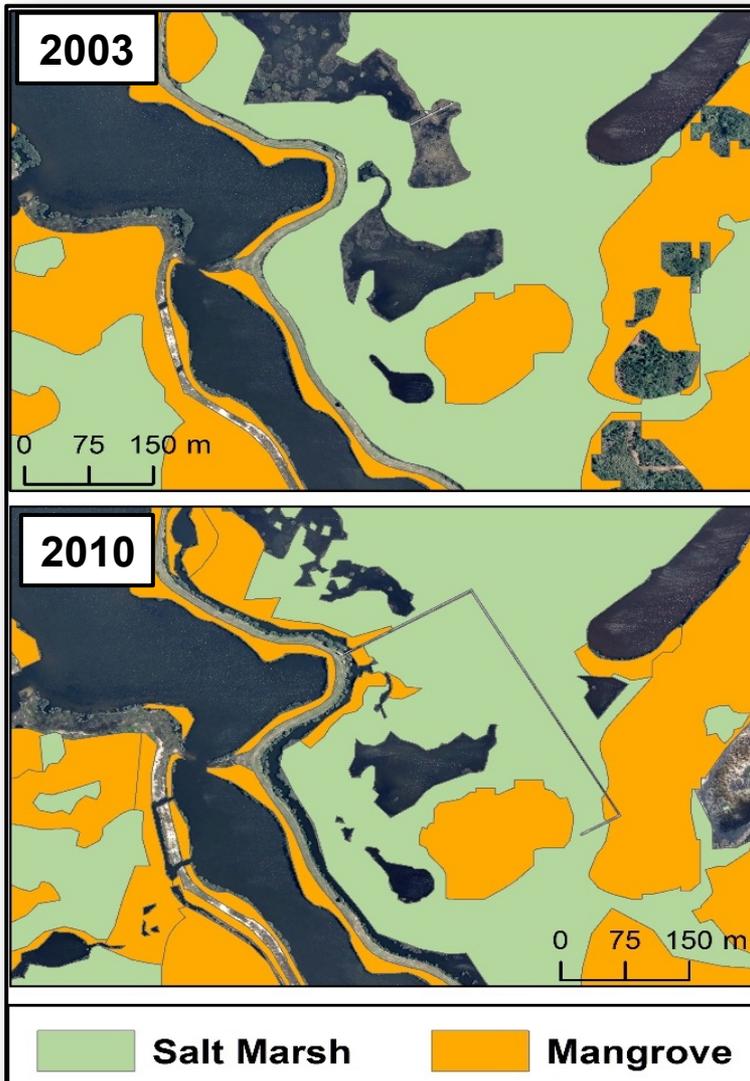


Fort Matanzas: ca. 1740, guards southern flank of St. Augustine, FL, the oldest city in the US (est. 1565)

2012



Carbon sequestration



Land cover change analysis
2003 vs. 2010:

Kennedy Space Center

	2003	2010
VEGETATION CLASS	Area (ha)	Area (ha)
Mangrove	1,516	2,555
Salt Marsh	5,182	4,531
TOTAL	6,698	7,086

- 70% increase in mangrove area
- 12% decrease in salt marsh area
- 6% increase in wetland area

GREEN

The Northern Australian Die-Off That's Going To Bite Us Where It Hurts

If you love barramundi, you have to love mangroves.

14/03/2017 2:45 PM AEDT | Updated 14/03/2017 5:32 PM AEDT



 **Anthony Sharwood**
Sports And Environment Editor,
HuffPost Australia



Nobody loves mangroves. They're stinky, they're muddy, they're not particularly nice to look at and really, if a few thousand hectares of mangroves died on a remote part of the NT coastline, why should we care?

TRENDING

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“Nobody loves mangroves.
They’re stinky, they’re muddy,
they’re not particularly nice to look at
and really, if a few thousand hectares of mangroves died
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