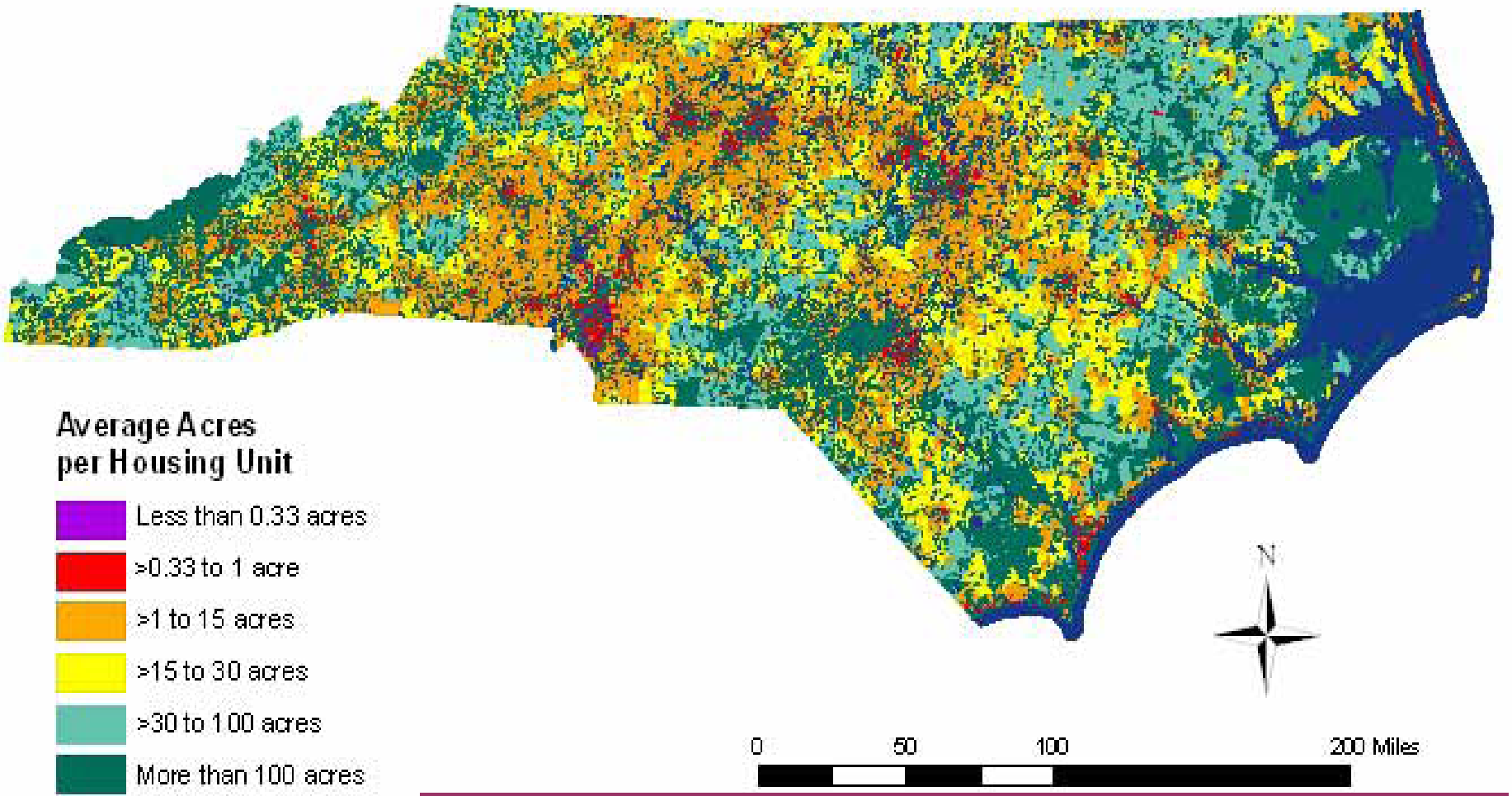
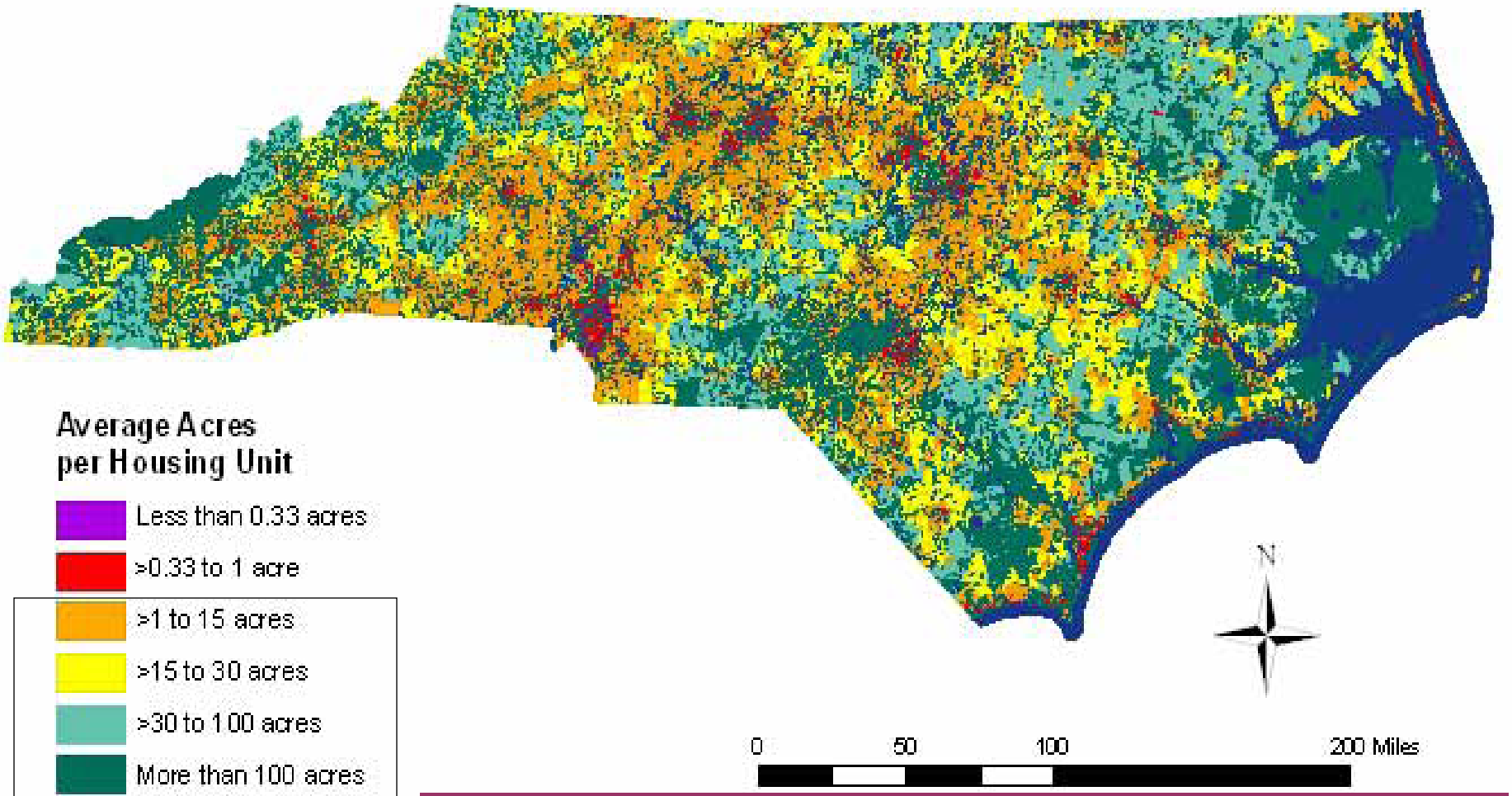
ENVIRONMENTAL DEFENSE FUND



Adaptation Strategies for Rural and Conservation Lands and Waters

Sam Pearsall, EDF

ENVIRONMENTAL DEFENSE FUND



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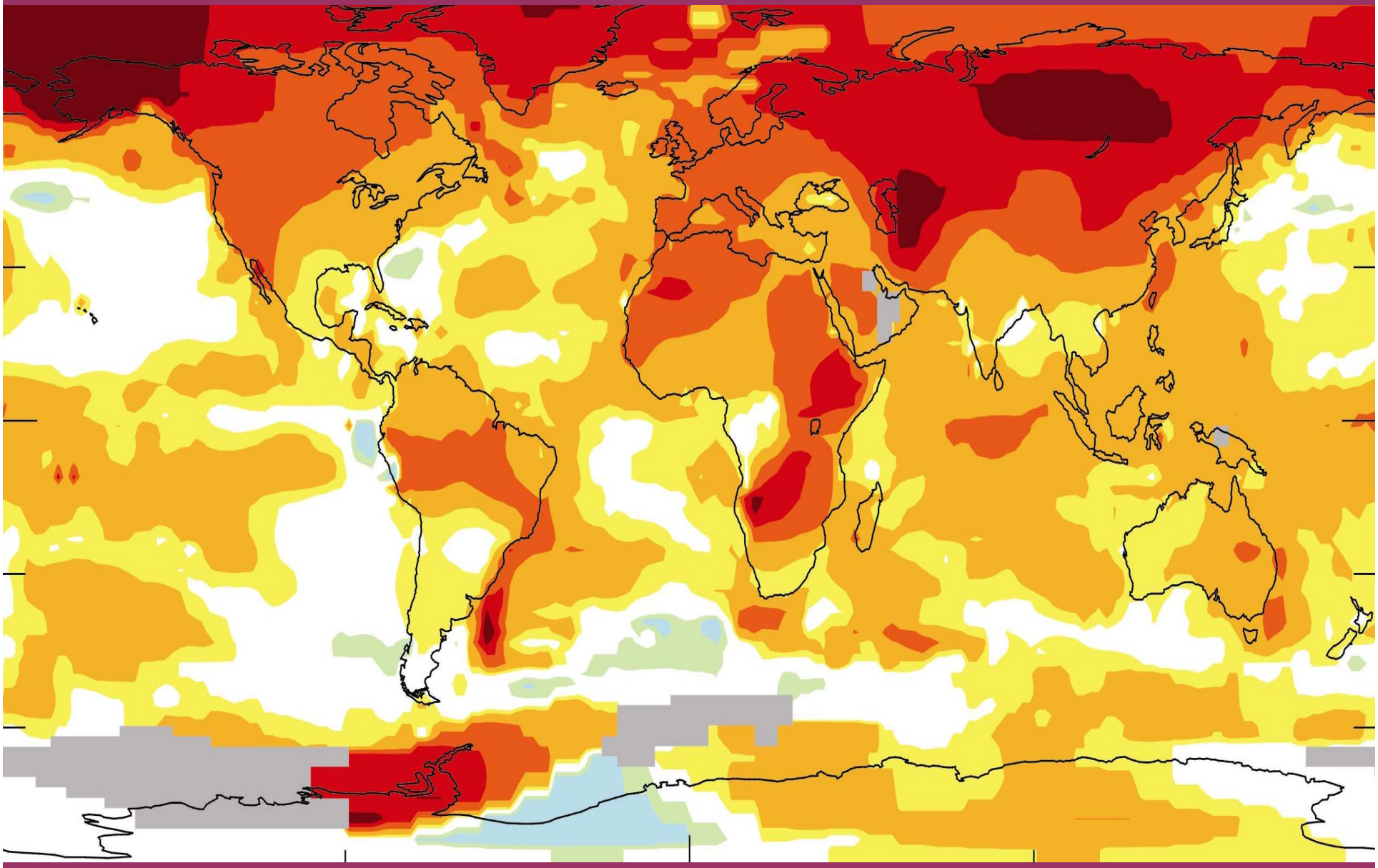
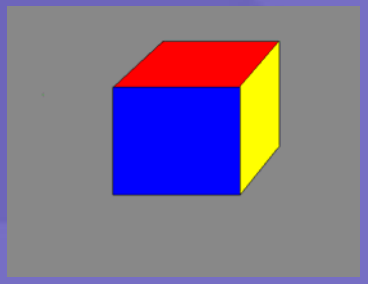
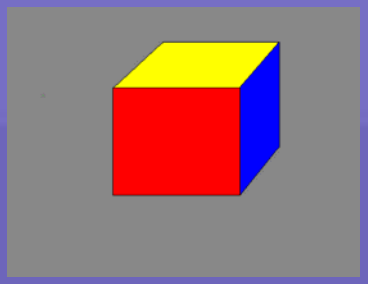


CLIMATE DISRUPTION

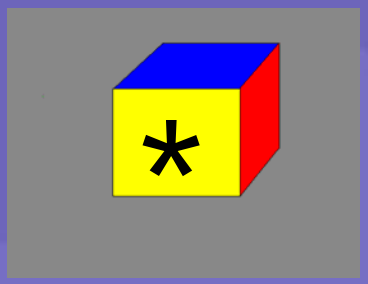
THREE CATEGORIES OF RESPONSE



REGULATIONS, LEGISLATION, NEGOTIATIONS TO REDUCE EMISSIONS



CARBON CREDITS TO PAY FOR CONSERVATION & OFFSET POLLUTION



DEVELOPMENT OF ADAPTATION STRATEGIES

- The need for adaptation
- Principles for adaptation strategy development (Terrestrial examples – Piedmont, Mountains, Coastal Uplands)
- Albemarle-Pamlico Case Study for Sea-level Rise


CLIMATE DISRUPTION
ALMOST CERTAINLY
REPRESENTS THE MOST
SEVERE THREAT TO
PLANETARY
BIODIVERSITY!

I have two reasons for believing this:

1. The magnitude of the expected changes.

Within 100 years, 86% of unique climate-soil-topo combinations disappear from North America in the BAU scenario.

If we drastically dial back emissions, we can significantly reduce, but not eliminate this change.

Each unique ecosystem that disappears will be replaced by another ecosystem. Some or most of these will be NEW ecosystems.

I have two reasons for believing this:

1. The magnitude of the expected changes.

Within 100 years, 86% of unique climate-soil-topo combinations disappear from North America in the BAU scenario.

NEW ECOSYSTEMS ARE PART (MAYBE MOST) OF OUR FUTURE.

“NON-ANALOGUE ECOSYSTEMS”

I have two reasons for believing this:

1. The magnitude of the expected changes.

Within 100 years, 86% of unique climate-soil-topo combinations disappear from North America in the BAU scenario.

2. The speed of the expected changes.

In the past, during comparable rates of temperature change, accompanied by the emergence of non-analogue ecosystems, many species did not survive the abrupt habitat changes.

- Preindustrial CO_2 in the atmosphere was 280 PPM
- Current atmospheric CO_2 is 380 PPM
- The “2x scenario” is 560 PPM. Probable best case.
- Scientists think natural systems will no longer be able to adapt without our help at around 450-550 PPM

Conclusion:

For NC's natural systems to adapt to (survive) climate disruption, people are going to have to help.

- The need for adaptation
- Principles (Rules of Thumb) for adaptation strategy development (Terrestrial examples)

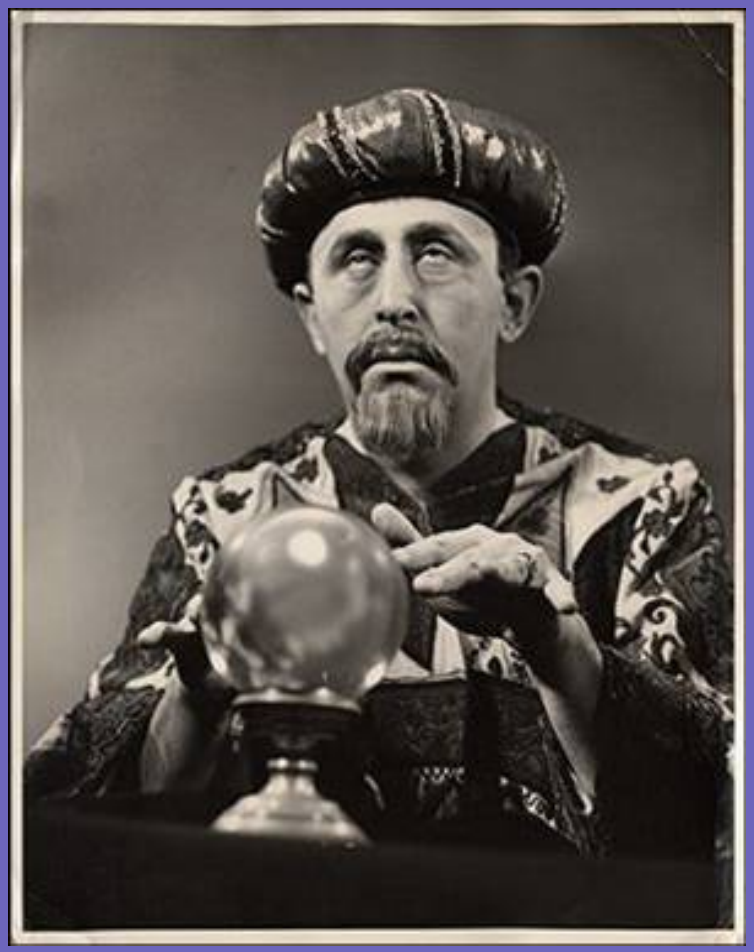
RULE OF THUMB:

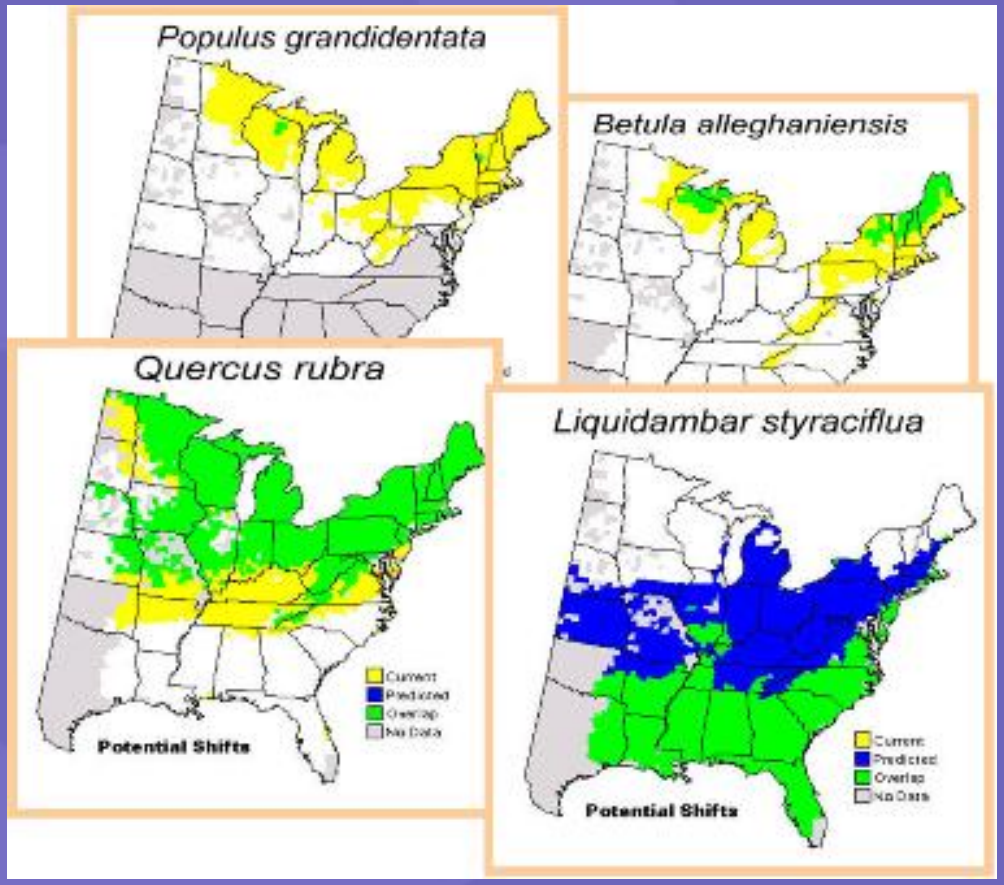
Mitigate against FUTURE stress.

- **Develop theoretical future baselines**
- **Adapt disturbance regimes to future conditions**
- **Develop pragmatic responses to invasion**

ATTEMPT TO MANAGE ECOSYSTEMS TO ACCOMMODATE EXPECTED FUTURE CONDITIONS RATHER THAN HYPOTHETICAL PRE-EUROPEAN CONDITIONS.

IT SHOULD NO LONGER BE ABOUT WHAT WE THINK WE USED TO HAVE BUT ABOUT WHAT WE THINK WE WILL OR OUGHT TO HAVE!





TREAT FUTURE RANGE MAPS WITH EXTREME CAUTION!


BROOKINS
WELL, DUH-H-H!...
CLIMATE SHIFTS BUT SOILS AND TOPO STAY PUT!

TIMING PROBLEMS

EVENTS THAT ARE DRIVEN MAINLY BY LENGTH OF THE DAY (e.g., FLOWERING)) WILL BE INCREASINGLY OUT OF SYNCH WITH EVENTS THAT ARE DRIVEN MAINLY BY TEMPERATURE (e.g., MIGRATION).

ENVIRONMENTAL DEFENSE FUND

SNOW GEESE & SEDGES

ENVIRONMENTAL DEFENSE FUND

RULE OF THUMB:

Mitigate against FUTURE stress.

- **Develop theoretical future baselines**
- **Adapt natural disturbance regimes to future conditions**
- **Develop pragmatic responses to invasion**

EVEN THOUGH SOIL IGNITION WAS ONCE A NATURAL PART OF THE STABILITY DOMAIN FOR COASTAL POCOSINS, NOW, IN THE PRESENCE OF CLIMATE DISRUPTION AND SEA LEVEL RISE, IT SHOULD NOT BE.

Evans Road Fire
Pocosin Lakes NWR
2008

5 Million Tons of CO_2 is equivalent to the carbon content of a coal train from Raleigh, NC to Wright, WY

RULE OF THUMB:

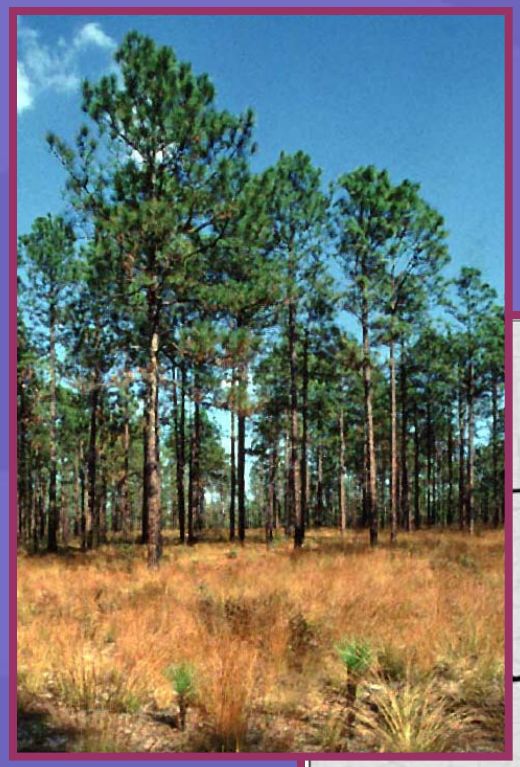
Mitigate against FUTURE stress.

- **Develop theoretical future baselines**
- **Adapt disturbance regimes to future conditions**
- **Develop pragmatic responses to invasion**

DEFINITION:

AN INVASIVE SPECIES (INVADER) IS ONE THAT CAUSES THE ECOSYSTEM TO SIMPLIFY RAPIDLY.

INVASIVE SPECIES MAY BE THE BIGGEST THREAT UNDER MODERATE CLIMATE DISRUPTION SCENARIOS

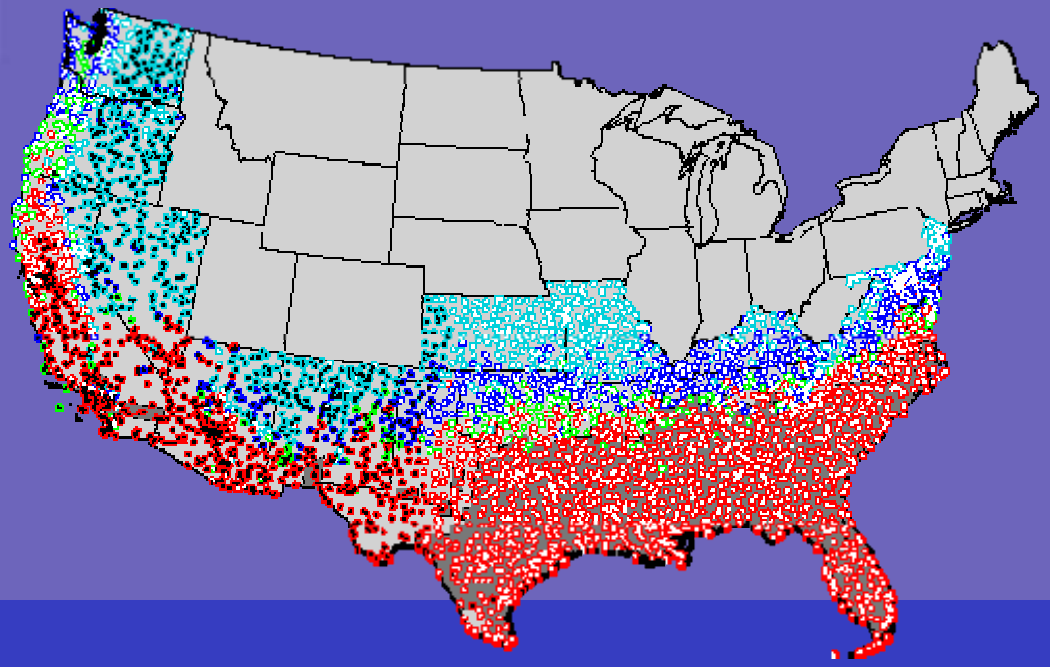


LONG LEAF PINE IS ONE OF THE MOST INVASION-RESISTANT SUITE OF ECOSYSTEMS

S. AMERICAN FIRE ANTS

Single Queen versus Multi-Queen Colonies

7 versus 40 million / acre



COGON GRASS
JAPANESE BLOOD GRASS

CLIMBING FERN

BUT NEW SPECIES ARE NOT NECESSARILY INVASIVE (SIMPLIFYING)

AND NATIVE SPECIES MAY BECOME INVASIVE

WE NEED PREDICTIVE MODELS!

RULE OF THUMB:

Look for simple, obvious strategies.

- **We probably have enough tools in our toolboxes to make very significant differences <u>now</u> in anticipation of climate disruption; and**

- **While we do need new tools very badly, we don't have time to wait for them.**

THE ESSENTIAL IDEAS:

USE TOOLS WE ALREADY HAVE AND ALREADY KNOW HOW TO USE,

USE THEM IN NEW AND INNOVATIVE WAYS IN THE CONTEXT OF A DISRUPTED CLIMATE AND A FOCUS ON FUTURE CONDITIONS.

BE FLEXIBLE!

TOOLS FOR FORESTERS

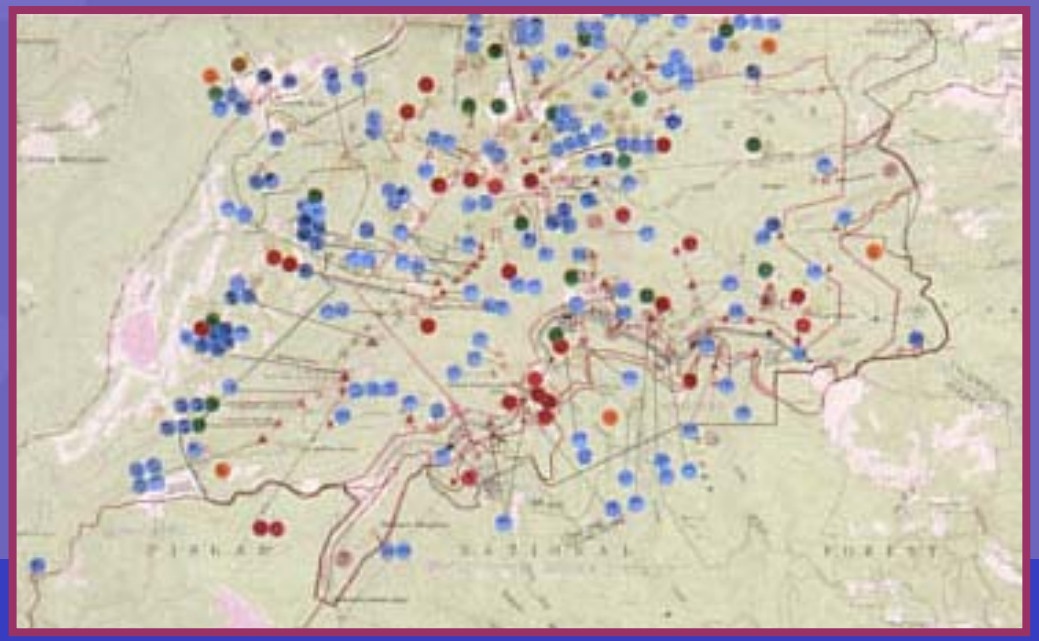
- PRESCRIBED FIRE
- HYDROLOGICAL MANAGEMENT & RESTORATION
- AGE CLASS MANAGEMENT AND OTHER STAND MANAGEMENT TECHNIQUES
- SOIL AMENDMENT
- HARVEST STRATEGIES

FOREST FIRES SEEM LIKELY TO BE MORE SEVERE IN HOTTER, DRIER SPRINGS AND SUMMERS,

SO THE FREQUENCY FOR PRESCRIBED FIRE MAY NEED TO BE SHORTER TO PREVENT FUEL ACCUMULATION AND EXCESSIVELY HOT FIRES.

RULE OF THUMB:

Don’t bet on corridors and refugia. 80,000 years to get in and 8,000 years to get out weren’t long enough for some species last time around.

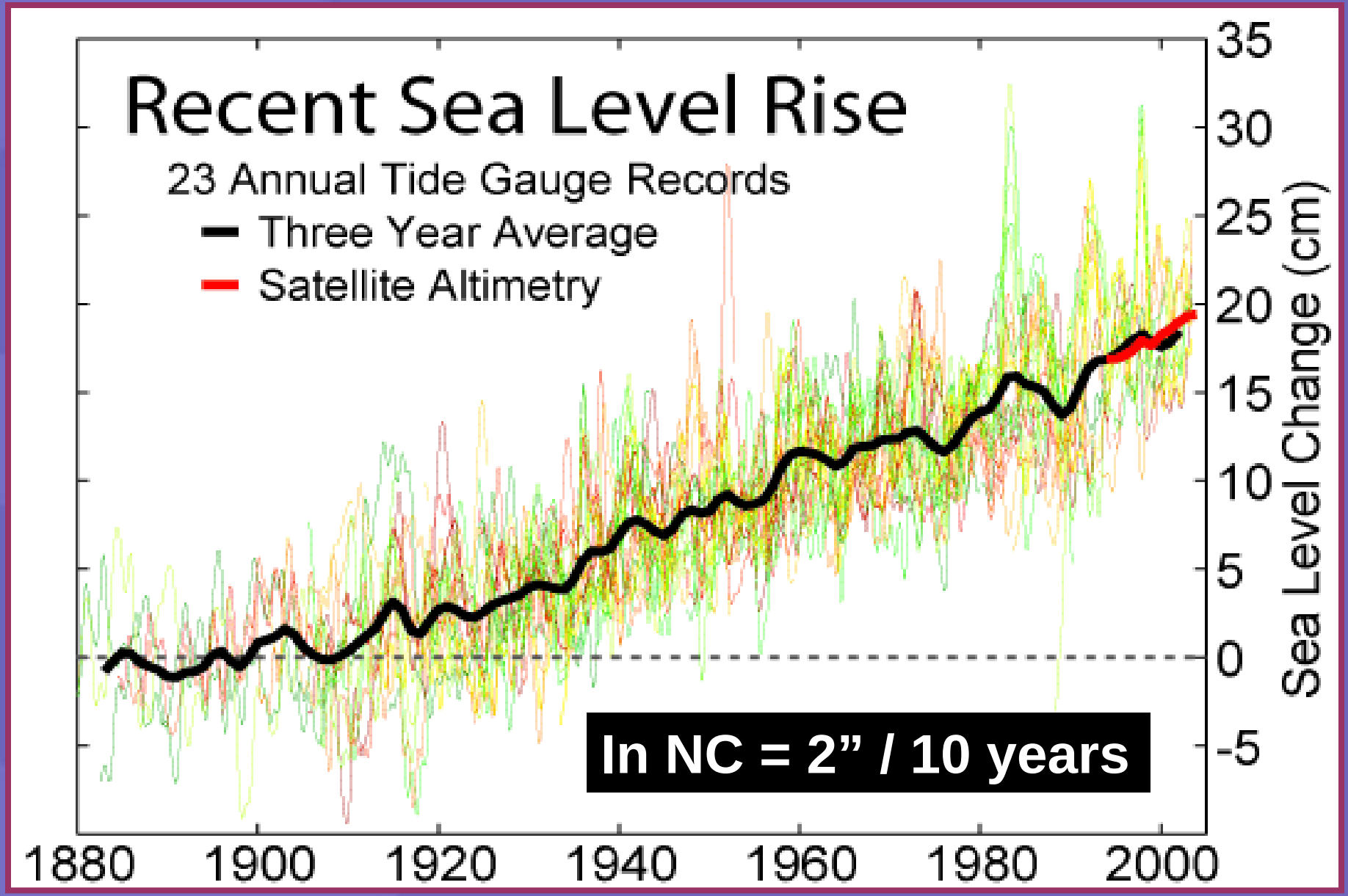


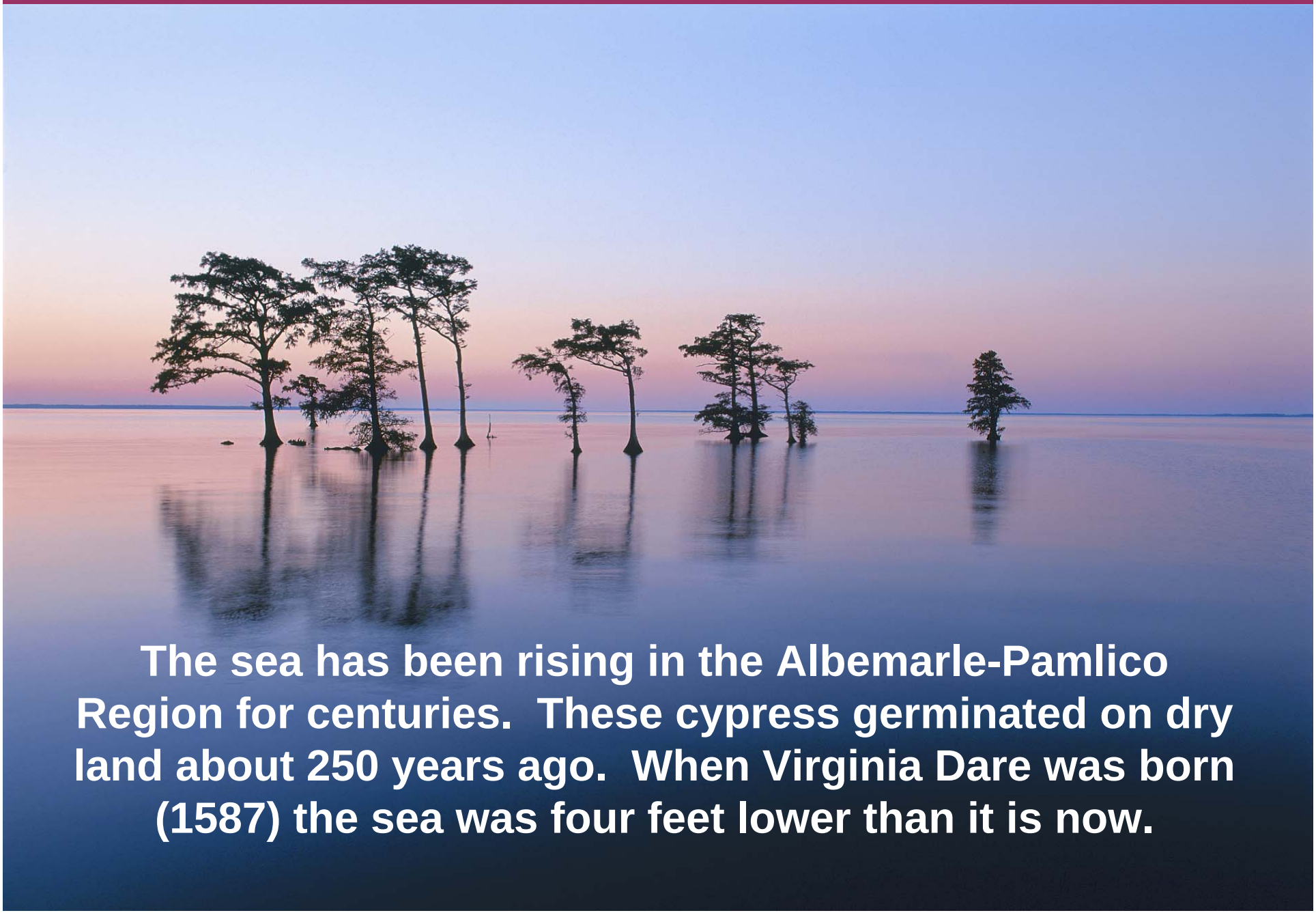
SUMMARY RULES OF THUMB:

- **Mitigate against future stress.**
  - **Develop theoretical future baselines.**
  - **Adapt disturbance regimes to future conditions.**
  - **Develop pragmatic responses to invasions.**
- **Look for simple, obvious strategies, relying at least for now on tools we already have.**
- **Don’t bet on corridors and refugia.**

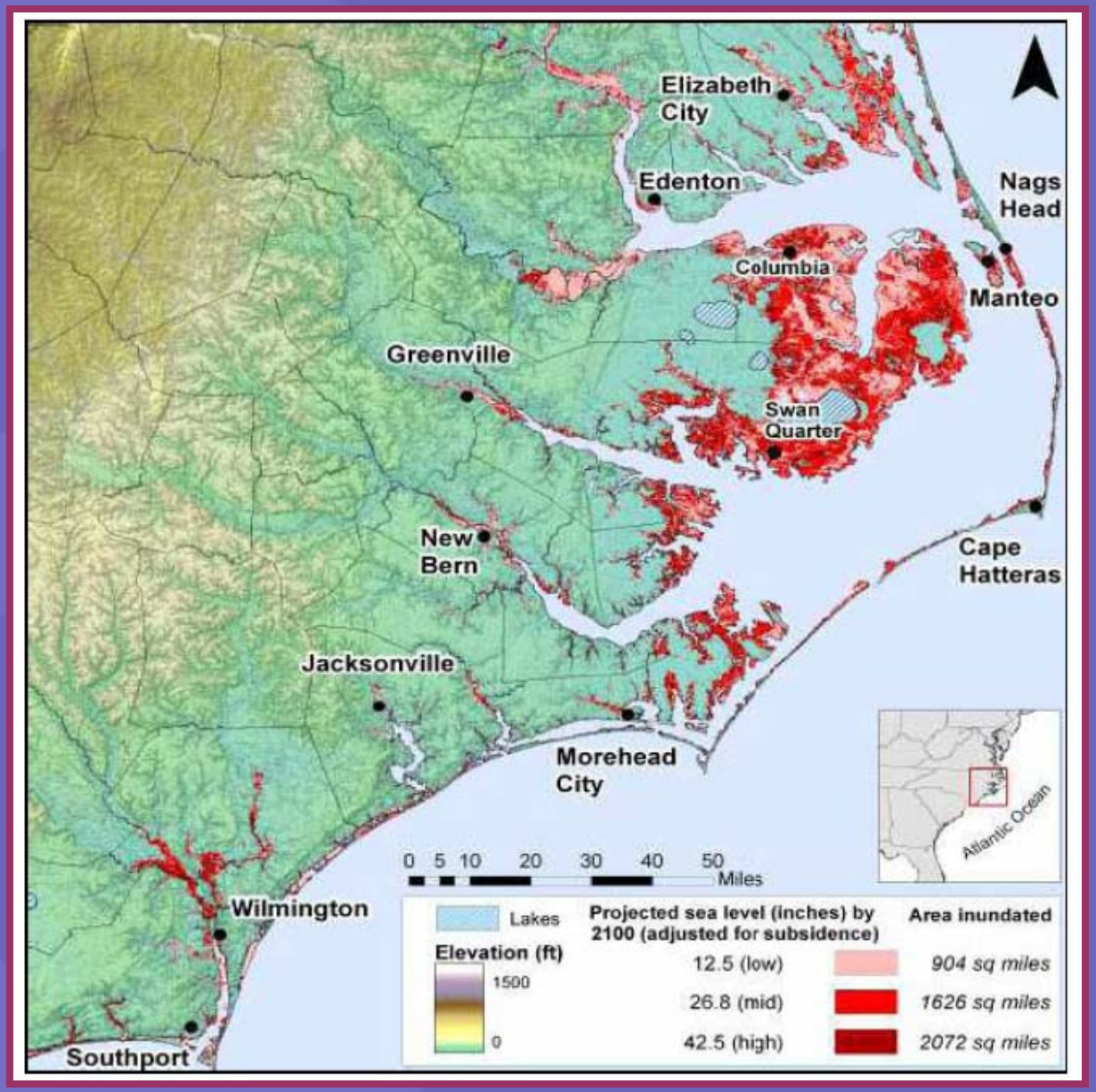
- The need for adaptation
- Principles for adaptation strategy development (Terrestrial examples)
- Albemarle-Pamlico Case Study for Sea-level Rise
  - Using tools we already have, in new and innovative ways, to manage for future ecosystems on NC's coast.


Albemarle-Pamlico


Recent Sea Level Rise
23 Annual Tide Gauge Records
Three Year Average
Satellite Altimetry
In NC = 2” / 10 years
Sea Level Change (cm)
35
30
25
20
15
10
5
0
-5
1880
1900
1920
1940
1960
1980
2000



The sea has been rising in the Albemarle-Pamlico Region for centuries. These cypress germinated on dry land about 250 years ago. When Virginia Dare was born (1587) the sea was four feet lower than it is now.

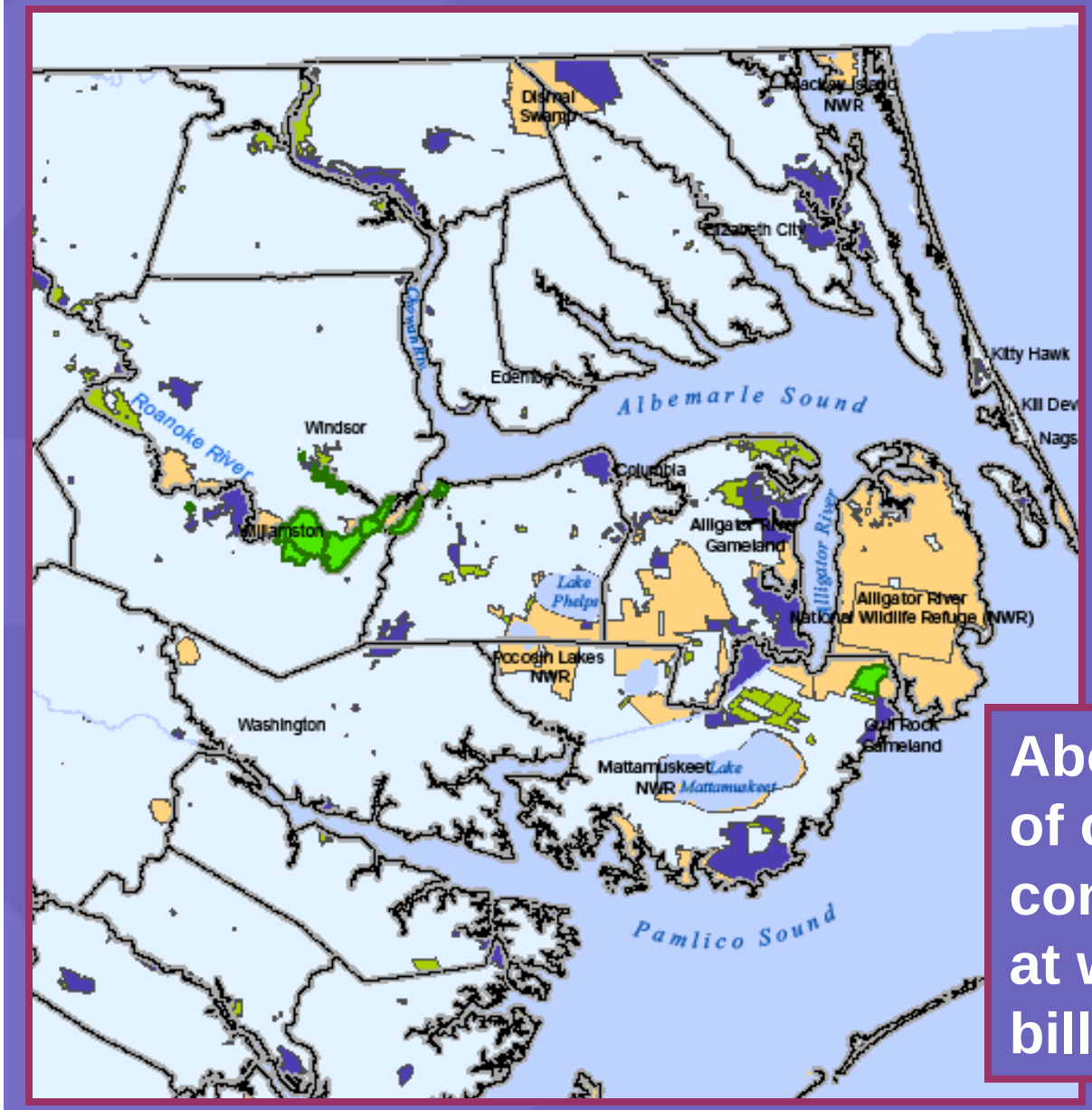


The Albemarle-Pamlico Region is the portion of NC's coast most vulnerable to sea level rise.

The Albemarle-Pamlico Region is one of the continental areas most severely threatened by rising seas (top 3 in continental US).

In the Albemarle-Pamlico Region, we have a landscape that is defined by the many interactions of land and water. One of the world's healthiest estuaries, and the world's largest lagoon.

ENVIRONMENTAL DEFENSE FUND



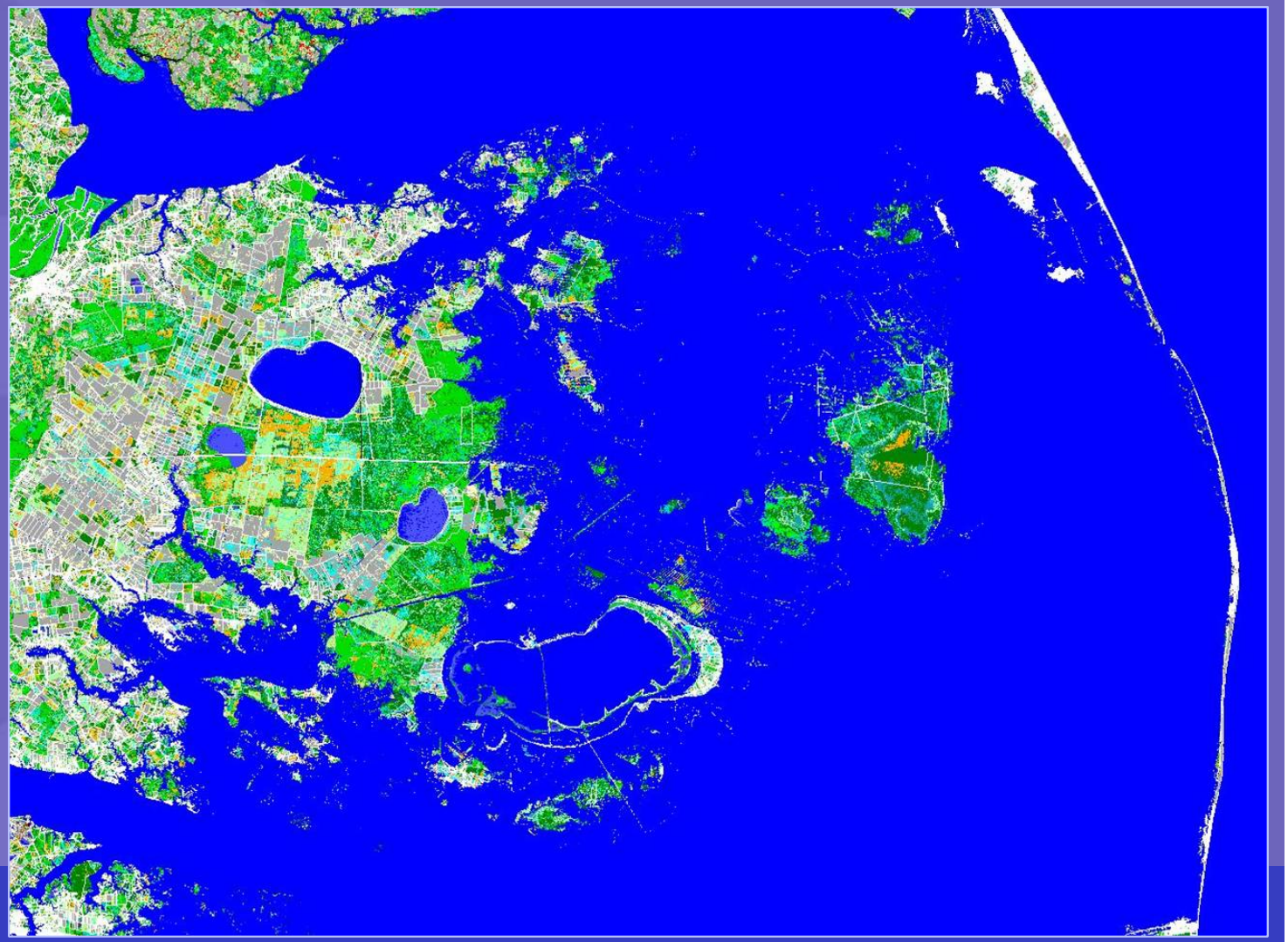
About 540,000 acres of conservation land, conservatively valued at well over half a billion dollars.

More than a million acres disappear under 32 inches of water.

Current rate (2”/10 Years) = 160 years

2x case = 120 years

Business as usual = 40-60 years

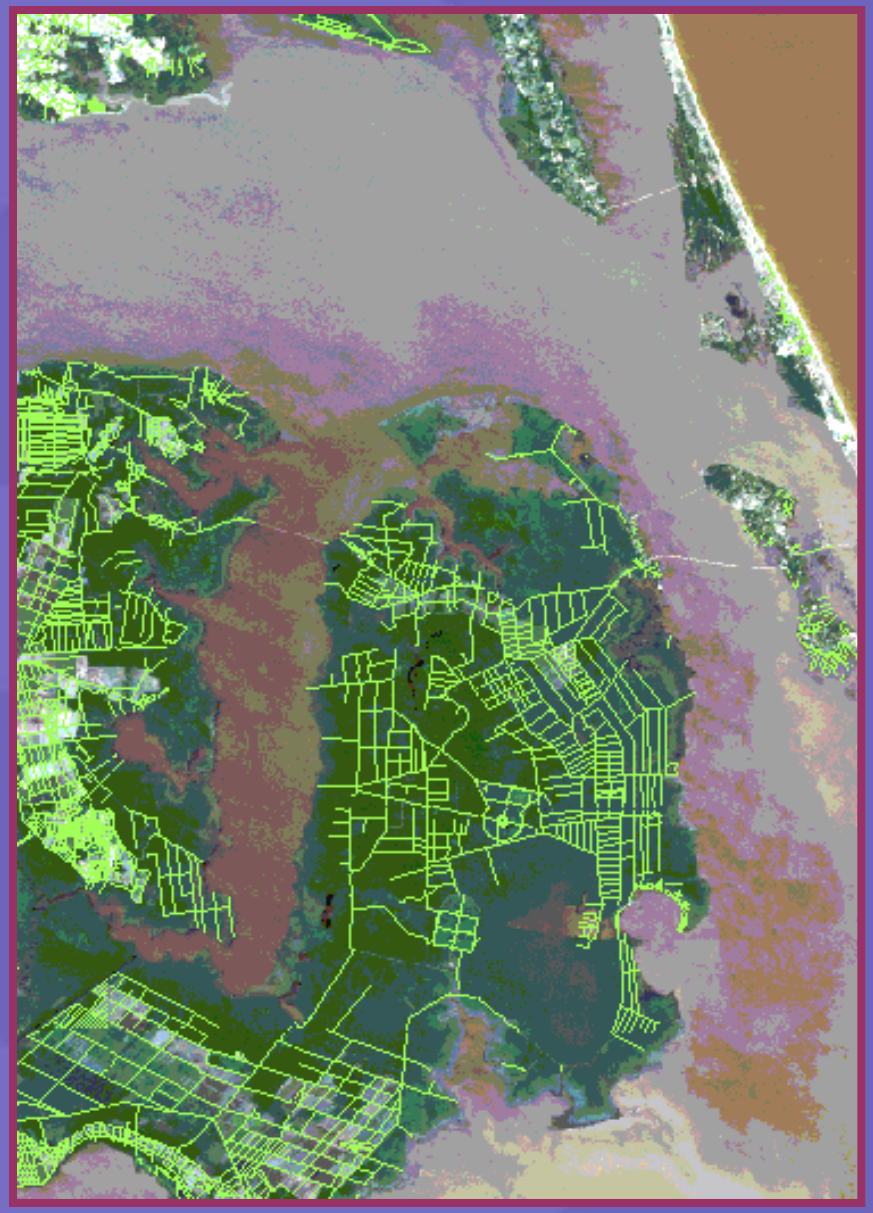


The first foot:

At the present rate (2”/10 years, this will take 60 years.

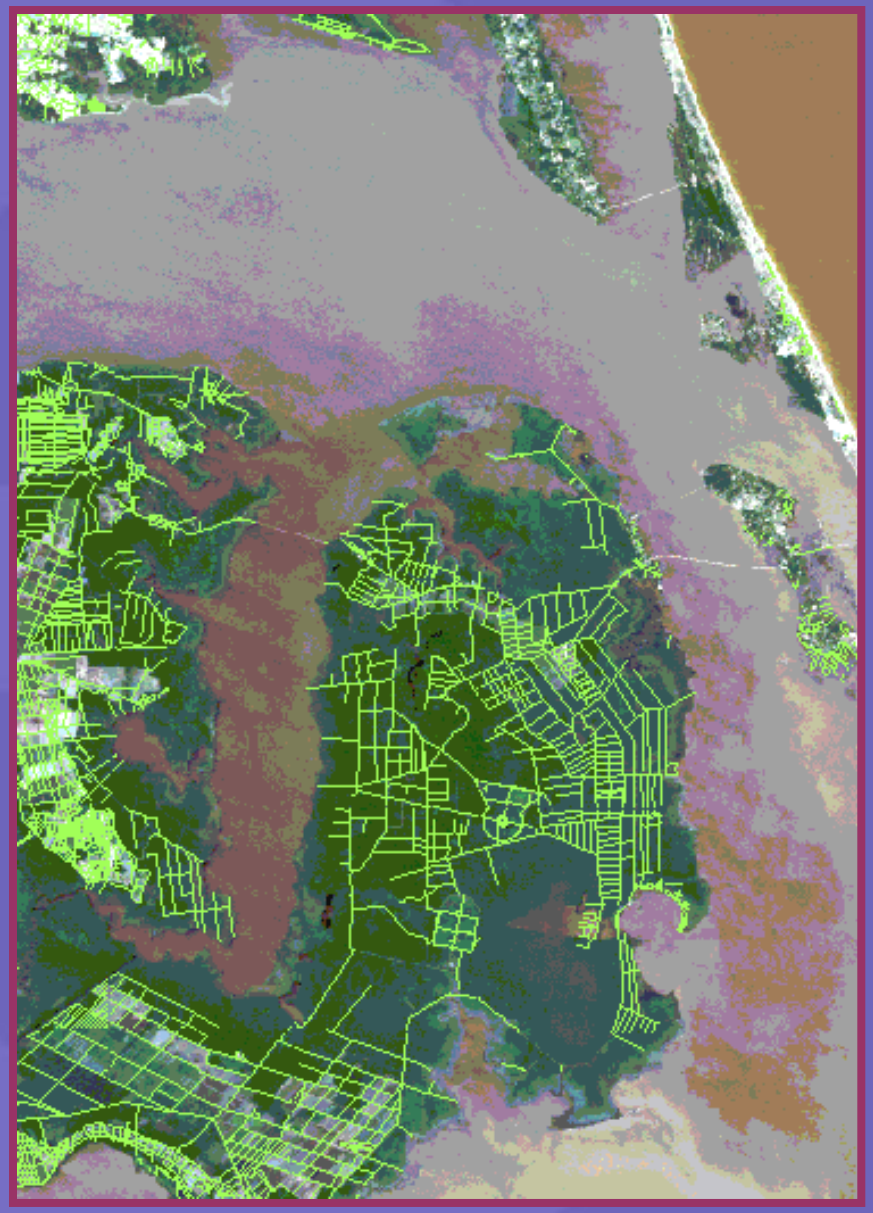
THE MAIN THREATS WE WILL ENCOUNTER FROM SEA LEVEL RISE:

- Ditches that severely alter local hydrology
- Higher energy currents, waves, and storms
- Fast rising water outrunning slow moving species
- Irrational human responses

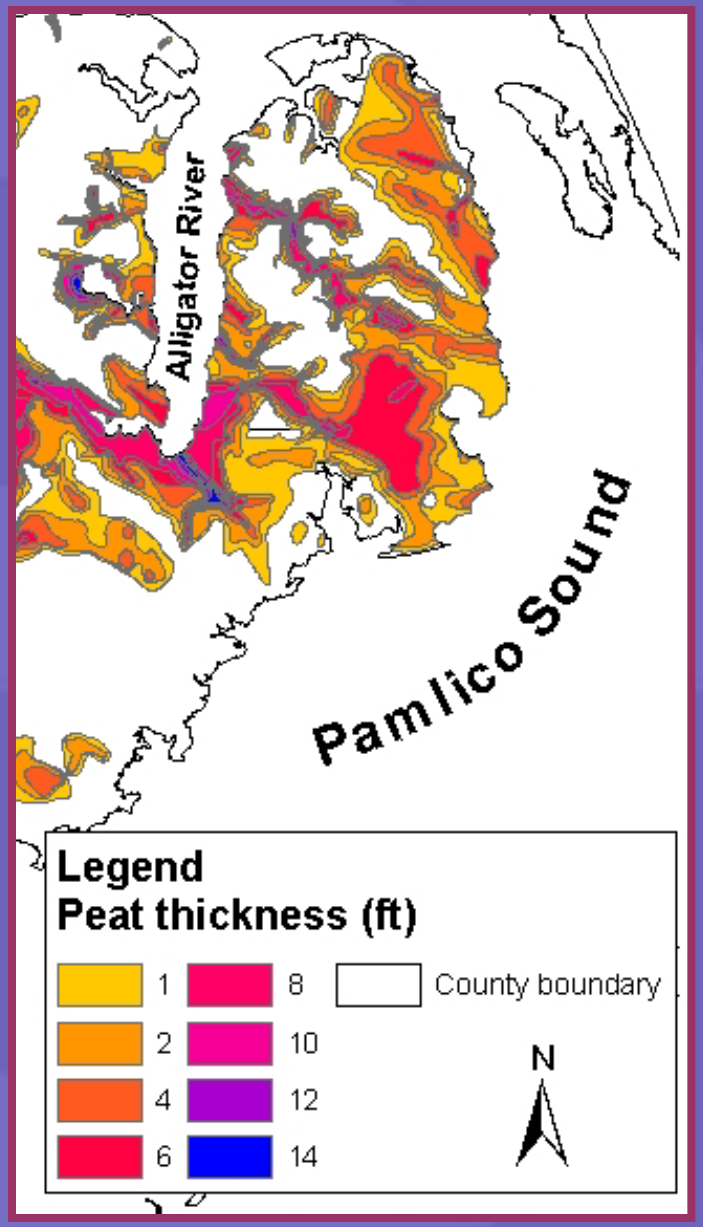


For over two hundred years, people have been digging ditches in the NC Coastal Plain.

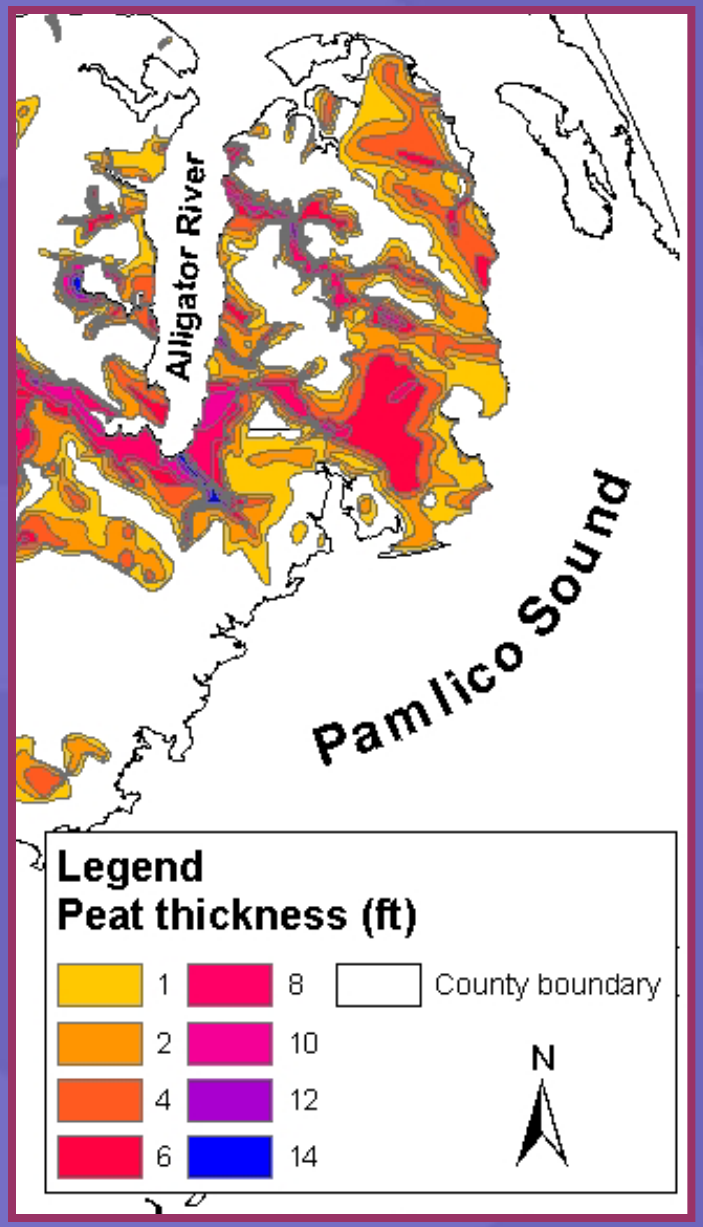
DITCHES



With rising seas, the ditches provide conduits for salt water to reach the interior.



When salt water comes in contact with peat soils, it causes them to rot very rapidly. This results in both local and global problems:

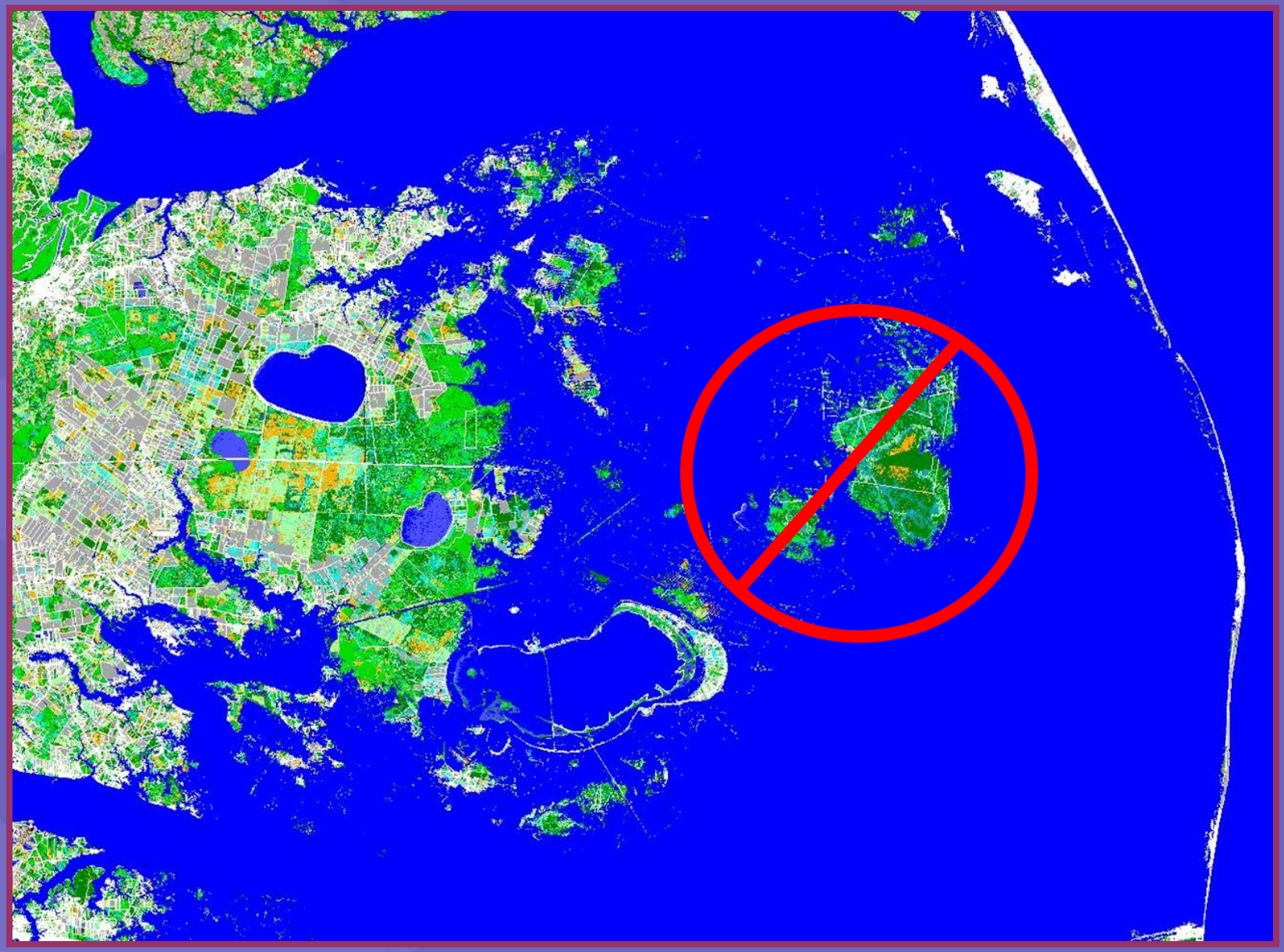


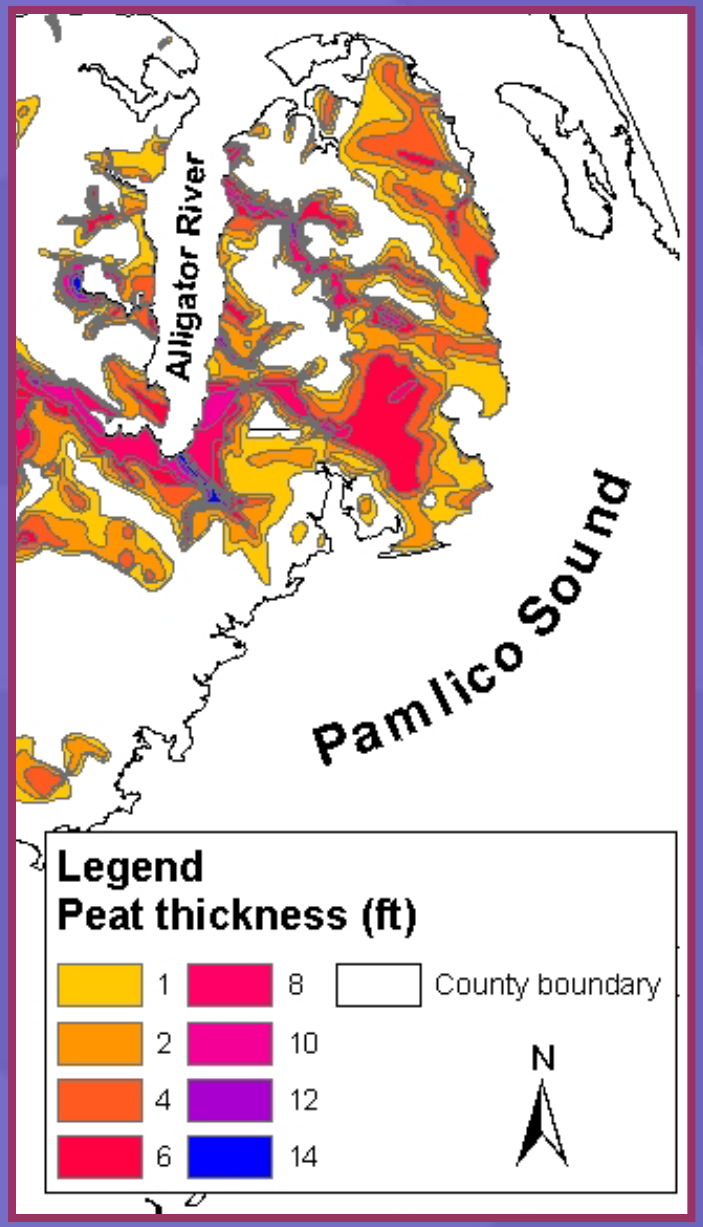
When salt water comes in contact with peat soils, it causes them to rot very rapidly. This results in both local and global problems:

Locally, as the peat soils rot, the land subsides, and the rate of inundation increases.

ENVIRONMENTAL DEFENSE FUND

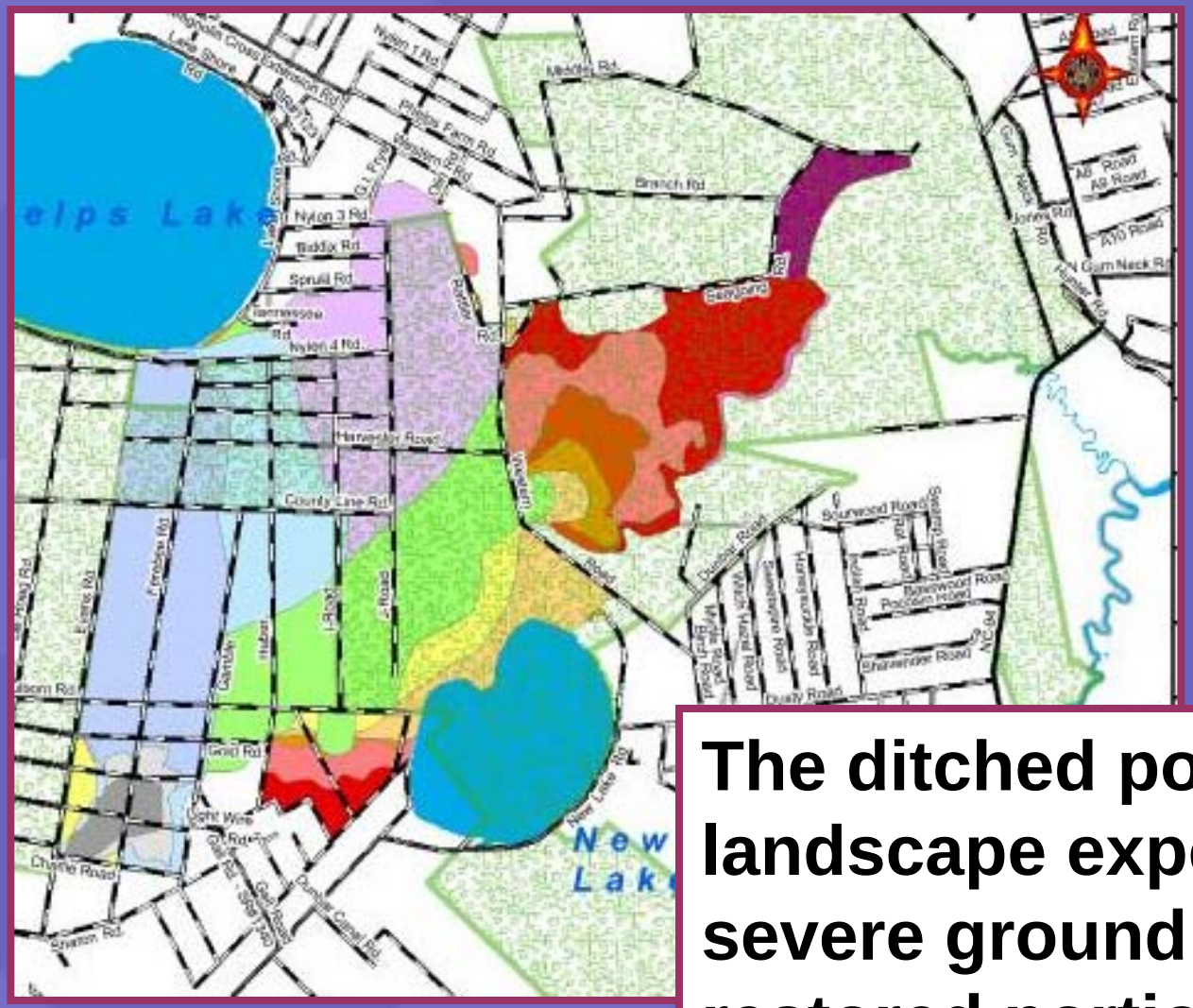
ENVIRONMENTAL DEFENSE FUND





Globally, the loss of these peat soils results in vast amounts of previously sequestered carbon being released into the atmosphere as carbon dioxide and methane.

Conservation land owners should manage ditches to prevent salt intrusion all the time and to prevent drainage of peat lands in dry weather. Management strategies range from flash boards and risers, to tide gates, to soil plugs, to complete hydrological restoration.



The ditched portions of this landscape experienced severe ground fire, while the restored portions did not!

ENVIRONMENTAL DEFENSE FUND

HIGHER ENERGY CURRENTS, WAVES, AND STORMS

The best strategy for reducing coastal energy is to build elevated oyster reefs to buffer wave action and to slow currents.

Oyster reefs will also sequester new carbon, help to ensure clean water, and provide habitat for many species in addition to oysters.

ENVIRONMENTAL DEFENSE FUND

RISING WATER AND MOVING HABITATS

Pre-historically, estuarine communities were usually able to keep up with rising seas. That's how they arrived at where they are now.

...but now, we need to help: we need to give them TIME to adapt.

As the sea rises, we need to plant salt marsh species ahead of the moving front and sea grass beds on newly submerged lands.

OR

We need to explore strategies for preventing the hard armoring of the shore, on the sounds as well as along the ocean front.

Local exceptions threaten ecosystem-wide solutions.

We need to plant cypress in the interior, at least 30 years ahead of the rising sea.

“PRESTORATION”

We think that these steps (and others like them) will provide a slow transition from one kind of ecosystem to another,

and then another, and another …

Sustaining the likelihood that these ecosystems, in their new form and position, can continue to:

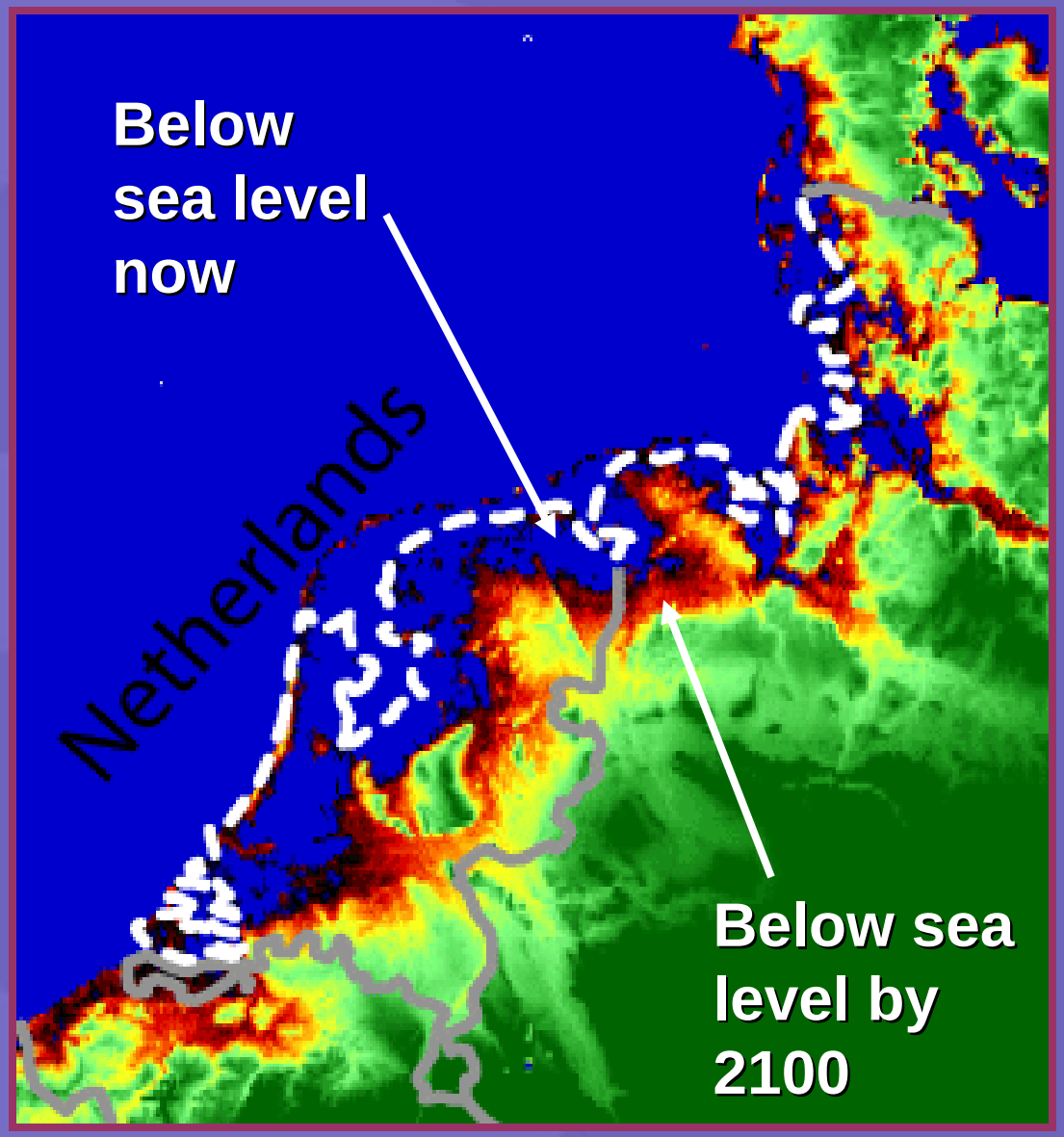
- **Provide sanctuary for biological diversity**
- **Produce clean water**
- **Sequester old and new carbon (e.g., in salt marsh peat and cypress wood)**
- **Provide seafood, recreation, and other human benefits**

IRRATIONAL HUMAN RESPONSES

- **Some people don't believe the sea is rising. Coastal "erosion events" are not recognized as evidence of SLR.**
- **Existing infrastructure (e.g., roads, landfills) and pollutants may be abandoned in the coastal zone.**
- **We may hope to "polder" (dike and pump) the coast and thereby protect it from sea level rise.**

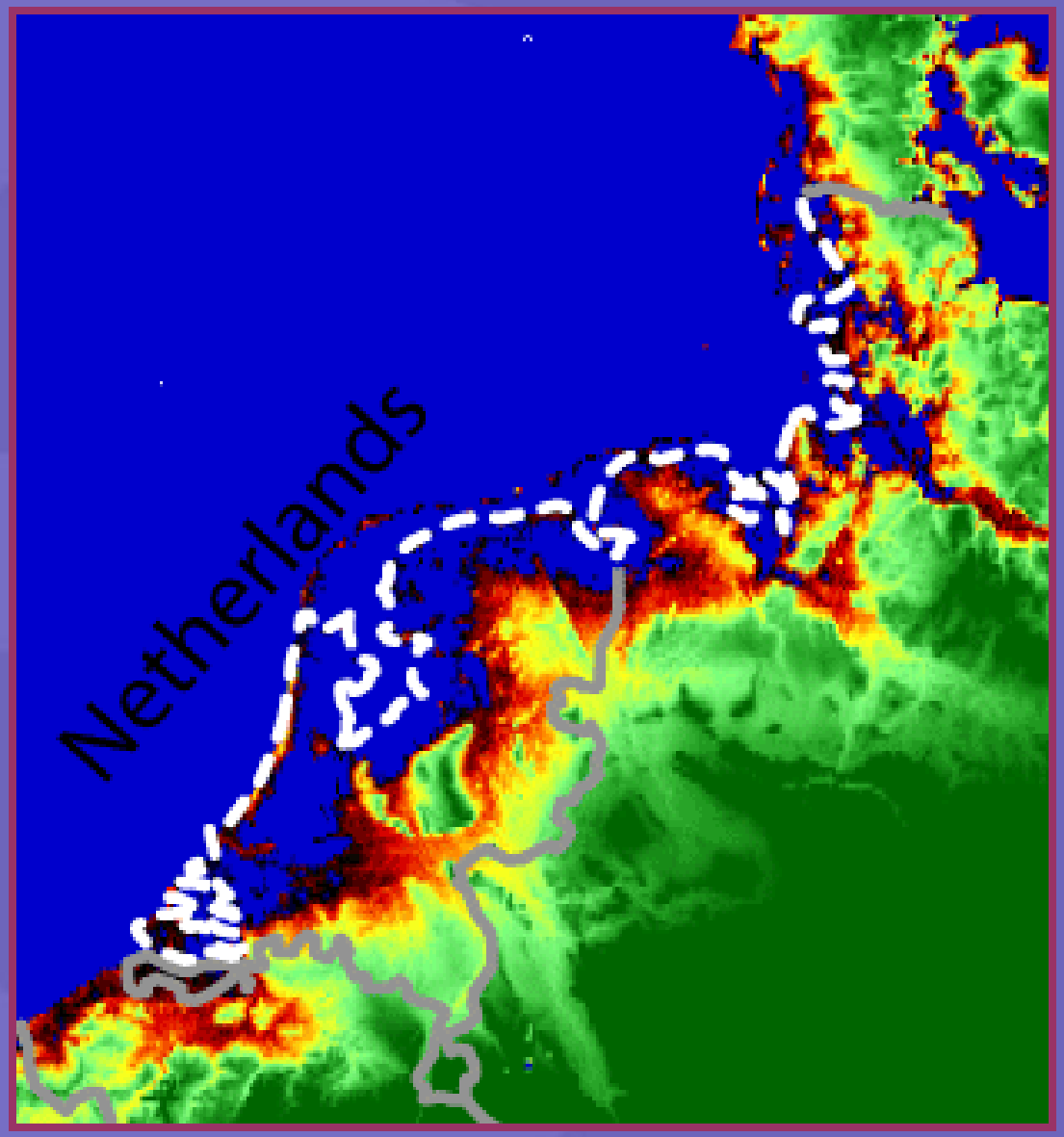
Traditional dike and pumps

Modern dike & pumps



The Netherlands has about 13,000 square miles, 27% of which is below sea level now.

Roughly that much more is expected to be below sea level by 2100.

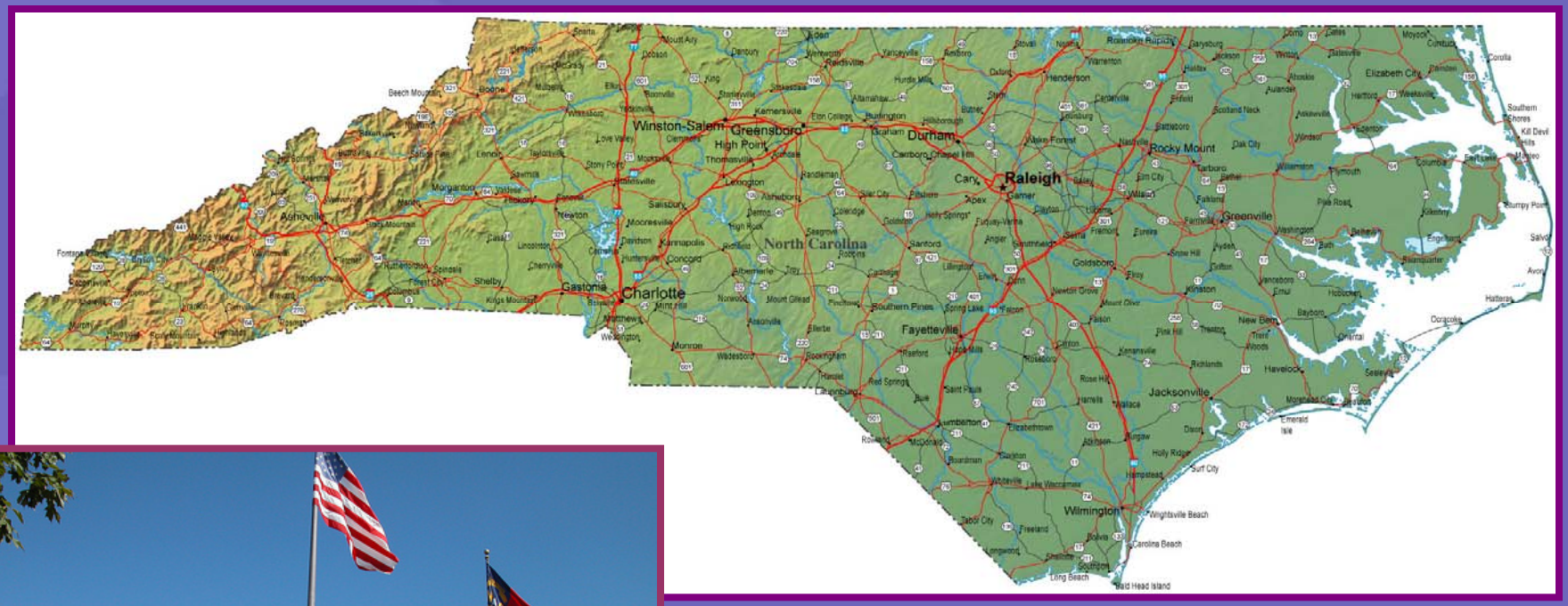


$100 Billion project launched to address sea level rise.

Building on existing base of dikes and pumps.

Probably won't work.

ENVIRONMENTAL DEFENSE FUND



Bringing it home…

What can the state do?

- **Public education: The climate is clearly changing.**
- **Keep climate change adaptation on your agenda! While working on emissions and carbon offsets, don’t overlook our certain and unavoidable need for adaptation strategies.**

What can the state do?

- **Every state agency that manages land or advises land managers should develop strategies for applying its tools to the challenges of adaptation.**
- **The state should capitalize on the potential for creating new “green” jobs supporting climate change adaptation.**

What can the state do?

- **The state university system should dedicate significant resources to exploring and developing new land and water management strategies for climate change adaptation. New tools are needed for every kind of land, every kind of land-use, and all the waters of NC.**

What can the state do about sea level rise?

- **Public education: The sea is clearly rising, and the rate is certain to increase.**
- **Develop strategies for mitigating “road dams” and ditches.**
- **Develop strategies to remove hazardous materials and infrastructure before they are inundated.**

What can the state do about sea level rise?

- **Invest in elevated oyster reefs, soft-armoring, "prestoration," and other appropriate measures.**
- **Comprehensively map areas likely to be inundated in a BAU scenario.**
- **Develop strategies to avoid new development in areas likely to be inundated in a BAU scenario.**

What can the state do about sea level rise?

- **Develop a strategy for the orderly retreat from appropriate areas, rather than letting the process be driven by “disasters.”**
- **Develop incentives for landowners and communities to participate in such a strategy.**

QUESTIONS?

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