Climate Models and Ecosystems on the Move

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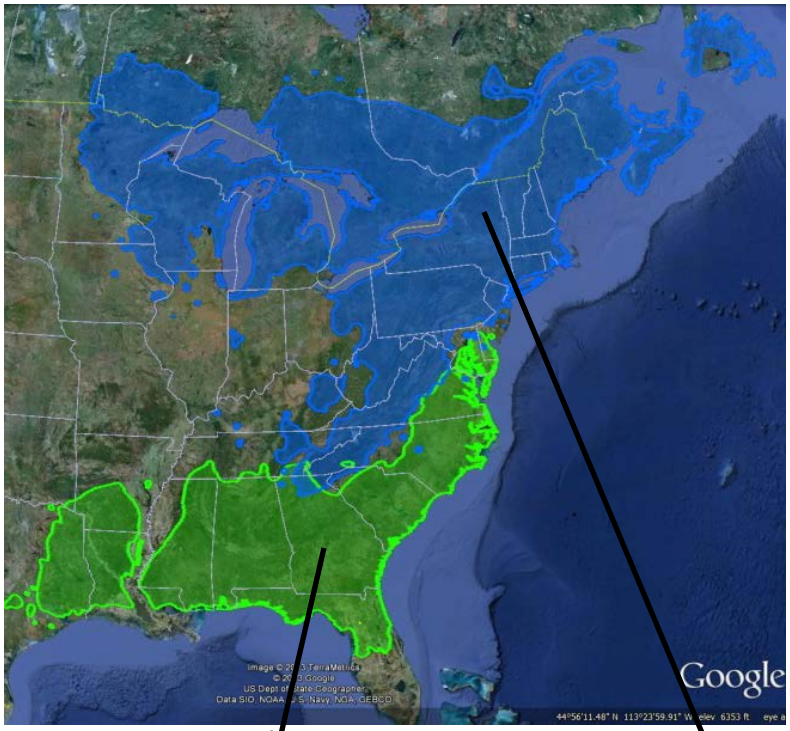
Atlas of Change exercise

- Students will use two online resources, the Climate Change Tree and Bird Atlases from the United States Forest Service, to explore the effects of climate change on the future distributions of suitable habitats for forest types, tree species, and bird species in southeastern United States.

Atlas of Change exercise

- Students will explain how modeling is used to project potential climate change.
- Students will describe the effects of climate change on forest ecosystems and bird populations.
- Students will apply importance values of forest health to climate change data.
- Students will communicate to others the potential future distributions of forest types, tree species, and bird species.

Important Concepts – Range Maps

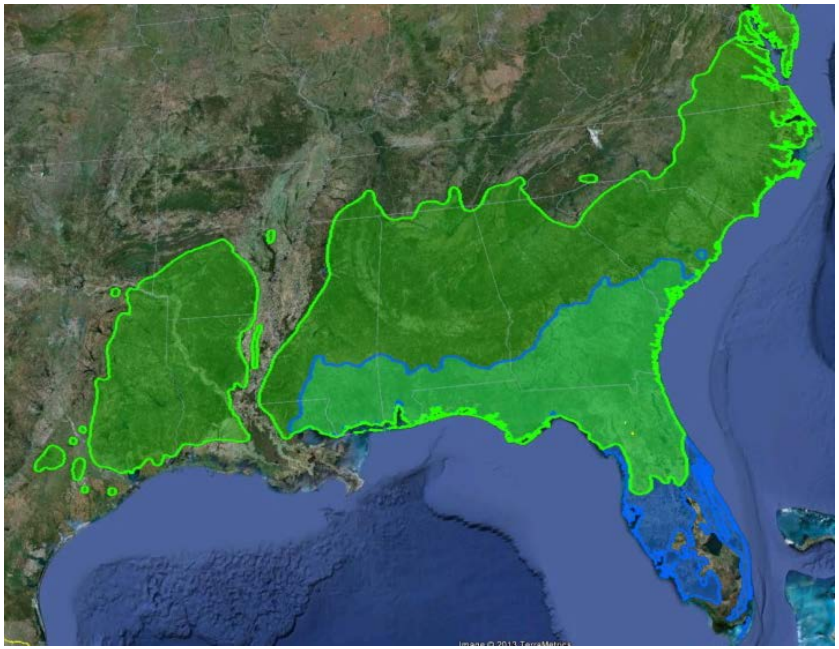


loblolly pine range

eastern white pine range

- Shows where species **may** currently be found
- Main determinants for plants
  - Climate
  - Soils

Important Concepts – Natural Ranges



loblolly pine range in green
slash pine range in blue

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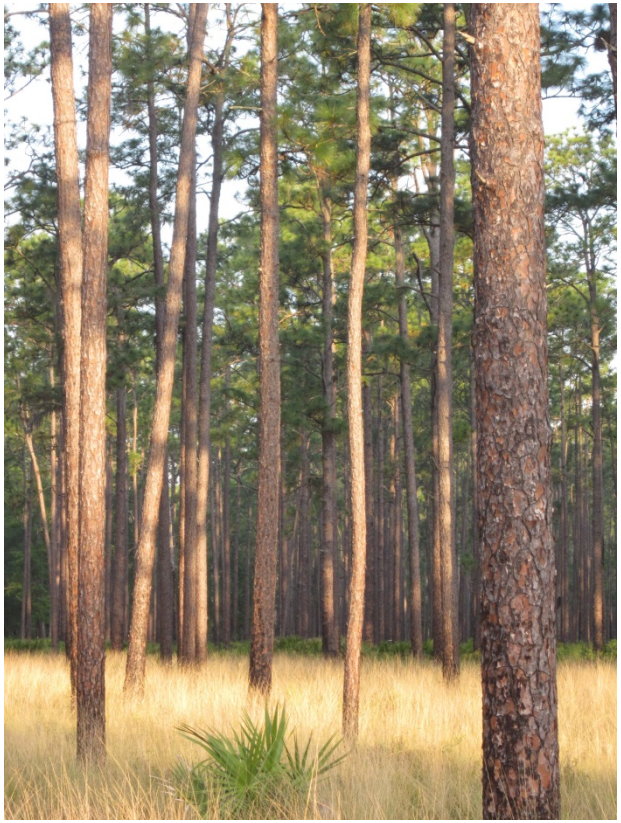
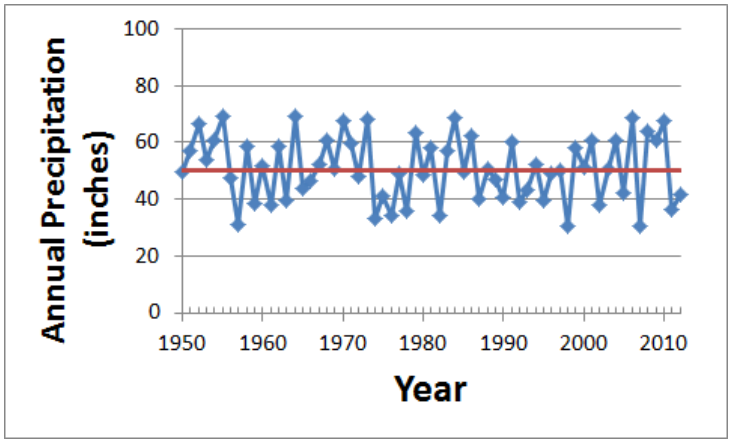
Important Concepts – Natural Ranges



This stand is in the middle of slash pine range but has only longleaf pine in it; frequent prescribed fire prevents establishment of slash pine and other tree species

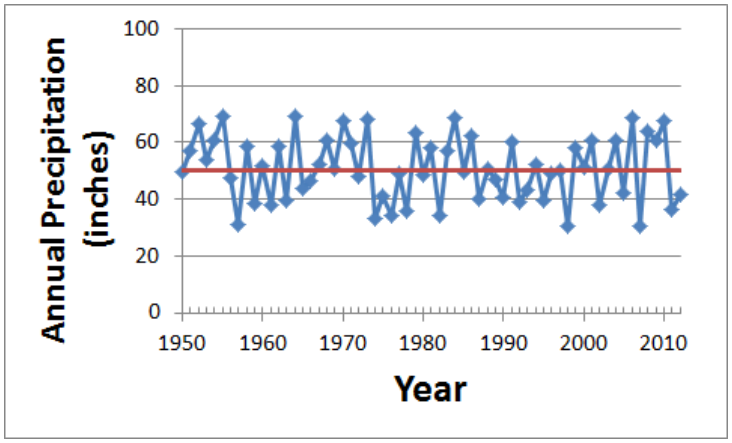
- Additional factors determine **actual** presence of a species in a particular place
  - Availability of seed
  - Places for seeds to germinate (parking lot vs. bare soil vs. shady forest understory)
  - Competition from other trees or plants
  - Presence or absence of disturbance factors like disease or fire

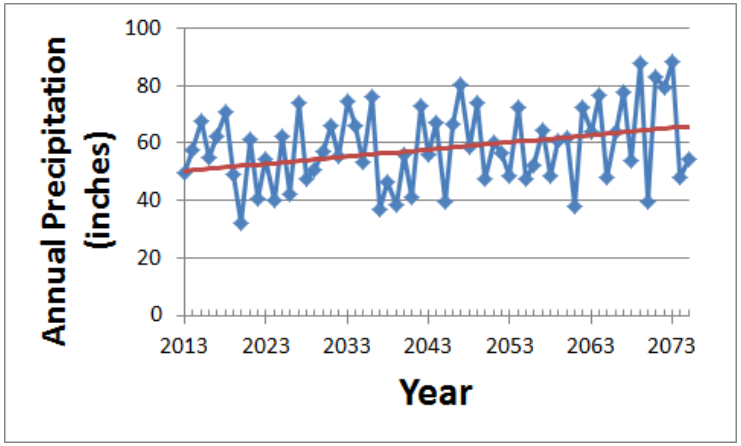
Important Concepts – Climate vs. Weather



- Time is main factor
  - Weather = short term
  - Climate = long term
    - Averages
    - Variability (max, min)
    - Frequency of extreme events

Important Concepts – Climate vs. Weather





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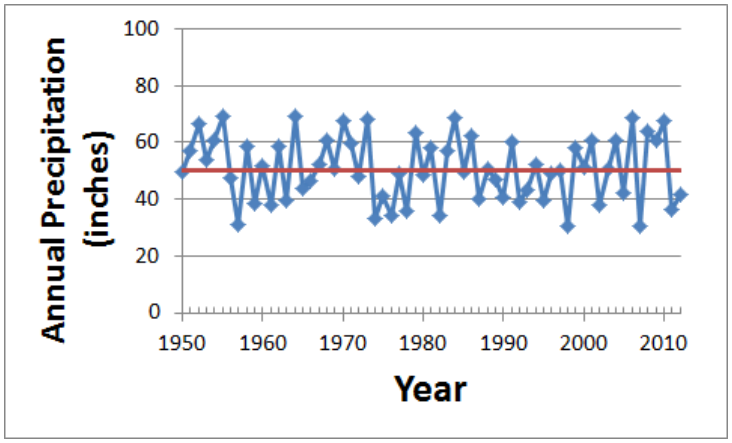

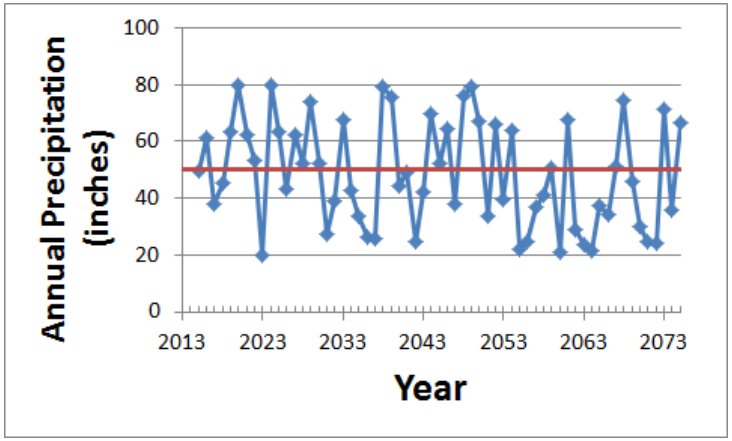

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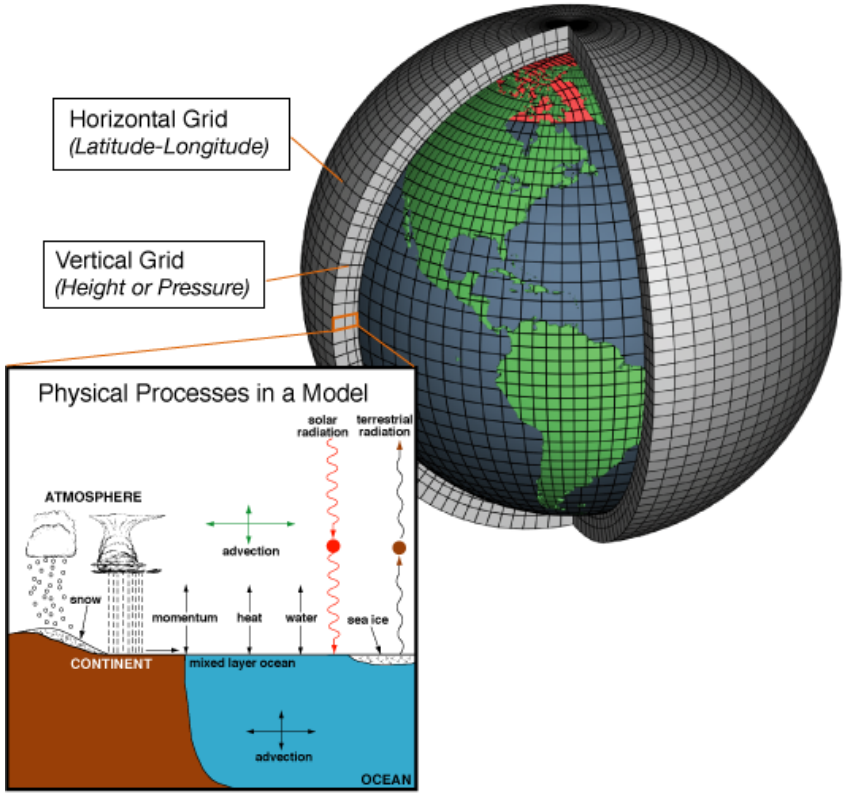
Important Concepts – Climate Models



- GCMs = Global Circulation Models or Global Climate Models
- Among the most complex models in existence
- Can be tested by using them to "predict" climate conditions in the past
  - Most do a very good job with temperature
  - Greater uncertainty associated with precipitation
  - Most produce predictions at very large spatial scales, which means confidence in future climate at specific locations is not great

Important Concepts - Uncertainty

- For most non-scientists, uncertainty = not knowing
- For scientists, uncertainty = degree of certainty or confidence
  - Often expressed as the probability or chance of a particular fact being true or an outcome occurring

http://www.ucsusa.org/global_warming/science_and_impacts/science/certainty-vs-uncertainty.html

Important Concepts - Uncertainty

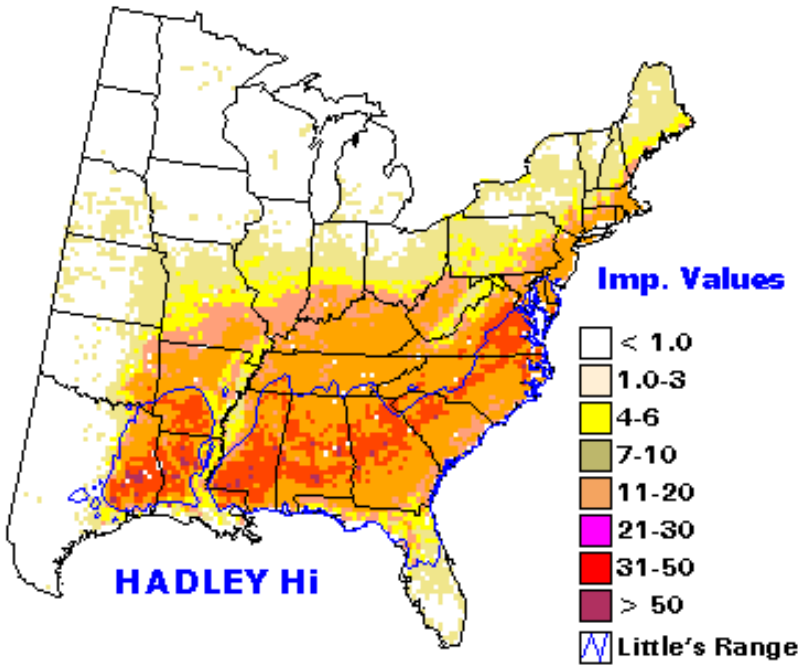
TABLE D.1 Language Adopted by the IPCC to Describe Confidence About Facts or the Likelihood of an Outcome

Terminology for Describing Confidence About Facts	
Very high confidence	At least 9 out of 10 chance of being correct
High confidence	About 8 out of 10 chance
Medium confidence	About 5 out of 10 chance
Low confidence	About 2 out of 10 chance
Very low confidence	Less than 1 out of 10 chance
Terminology for Describing Likelihood of an Outcome	
Virtually certain	More than 99 chances out of 100
Extremely likely	More than 95 chances out of 100
Very likely	More than 90 chances out of 100
Likely	More than 65 chances out of 100
More likely than not	More than 50 chances out of 100
About as likely as not	Between 33 and 66 chances out of 100
Unlikely	Less than 33 chances out of 100
Very unlikely	Less than 10 chances out of 100
Extremely unlikely	Less than 5 chances out of 100
Exceptionally unlikely	Less than 1 chance out of 100

SOURCE: IPCC (2007a).

Intergovernmental Panel on Climate Change (IPCC)

US Forest Service Climate Change Atlas



- Given predicted future climate conditions, what areas might have suitable climate and soils for particular species?
- Focused on climate, soils
- No consideration of seed availability or movement rates
- Considerable **uncertainty** about downscaled climate predictions

Climate Model Options

Global Climate Models

1. Parallel Climate Model (PCM)
2. Geophysical Fluid Dynamics Laboratory (GFDL) model
3. Hadley CM3 model (Hadley)

Emission Scenarios

1. High emission scenario (where little conservation efforts are taken to reduce atmospheric CO_2)
2. Low emission scenario (where significant efforts are taken to reduce atmospheric CO_2)

In total, you can view projected changes in eight combinations of models and scenarios:

1. Hadley-High
2. Hadley-Low
3. PCM-High
4. PCM-Low
5. GFDL-High
6. GFDL-Low
7. Avg. of 3-High
8. Avg. of 3-Low

Overview Video and Orientation

http://www.nrs.fs.fed.us/atlas