Novel ecosystems?

Hobbs et al (2006): ecosystems with new species assemblages

Wikipedia: no natural analog, hallmark of Anthropocene

Brave New World of Ecology

Wetland function & composition in novel environments

USGS science for a changing world

Dr. Beth Middleton

USGS science for a changing world

USGS National Wetlands Research Center, Lafayette, LA

surveyor's marker 1800s

CO_2

Then:278 Now:378 Future:756 ppm

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environmental constraints → novel ecosystem

-changes in temp extremes, CO_2, water

-migration

-local genetic flexibility (seed bank)

-competition

-land use change

-interactions of environments

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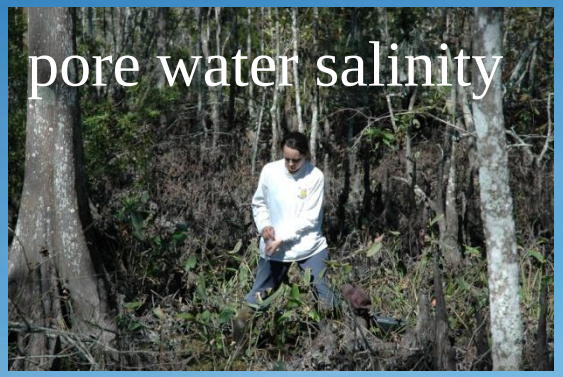
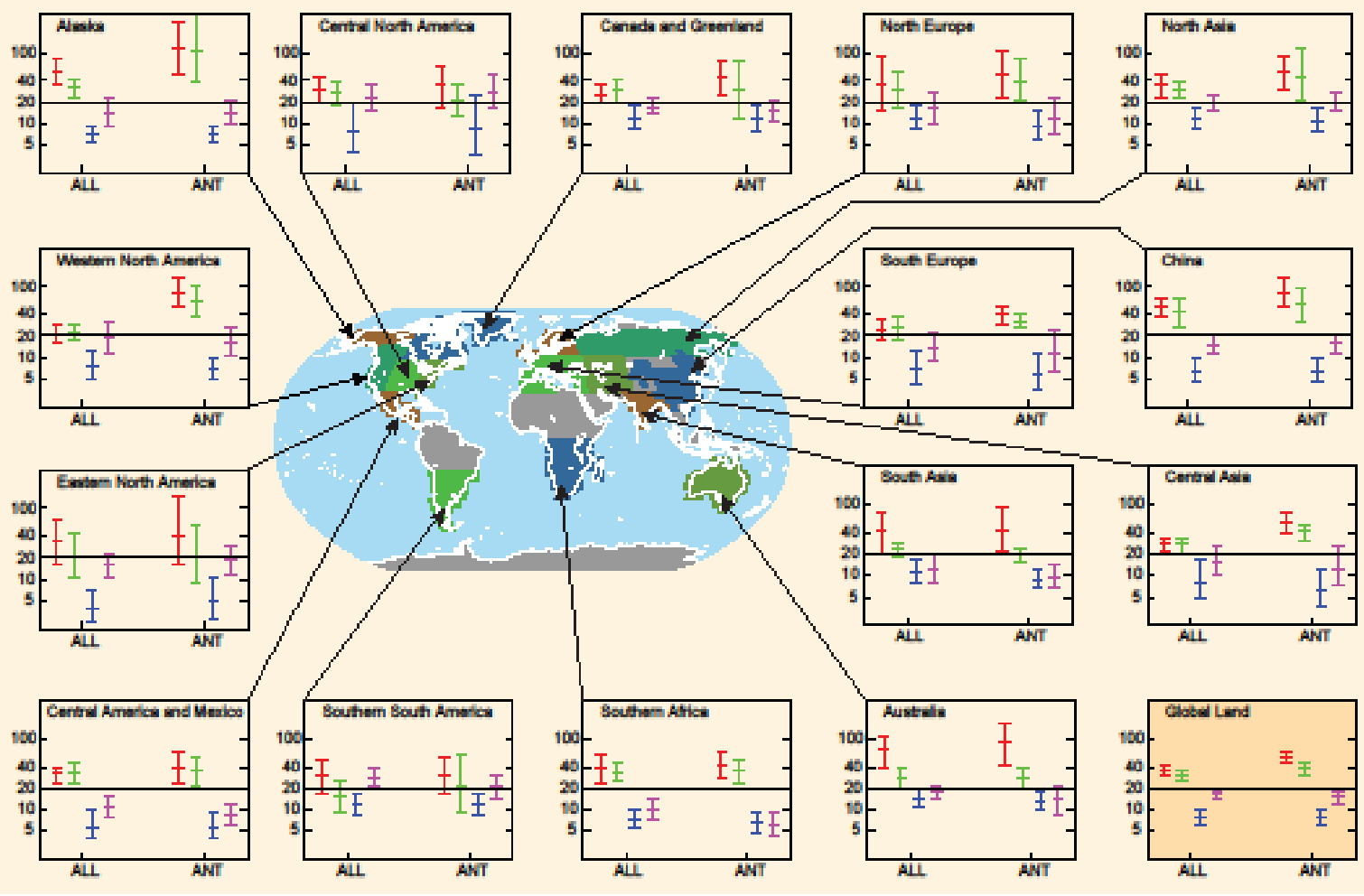


sea level rise – salinity & water level: very likely

IPCC 2012

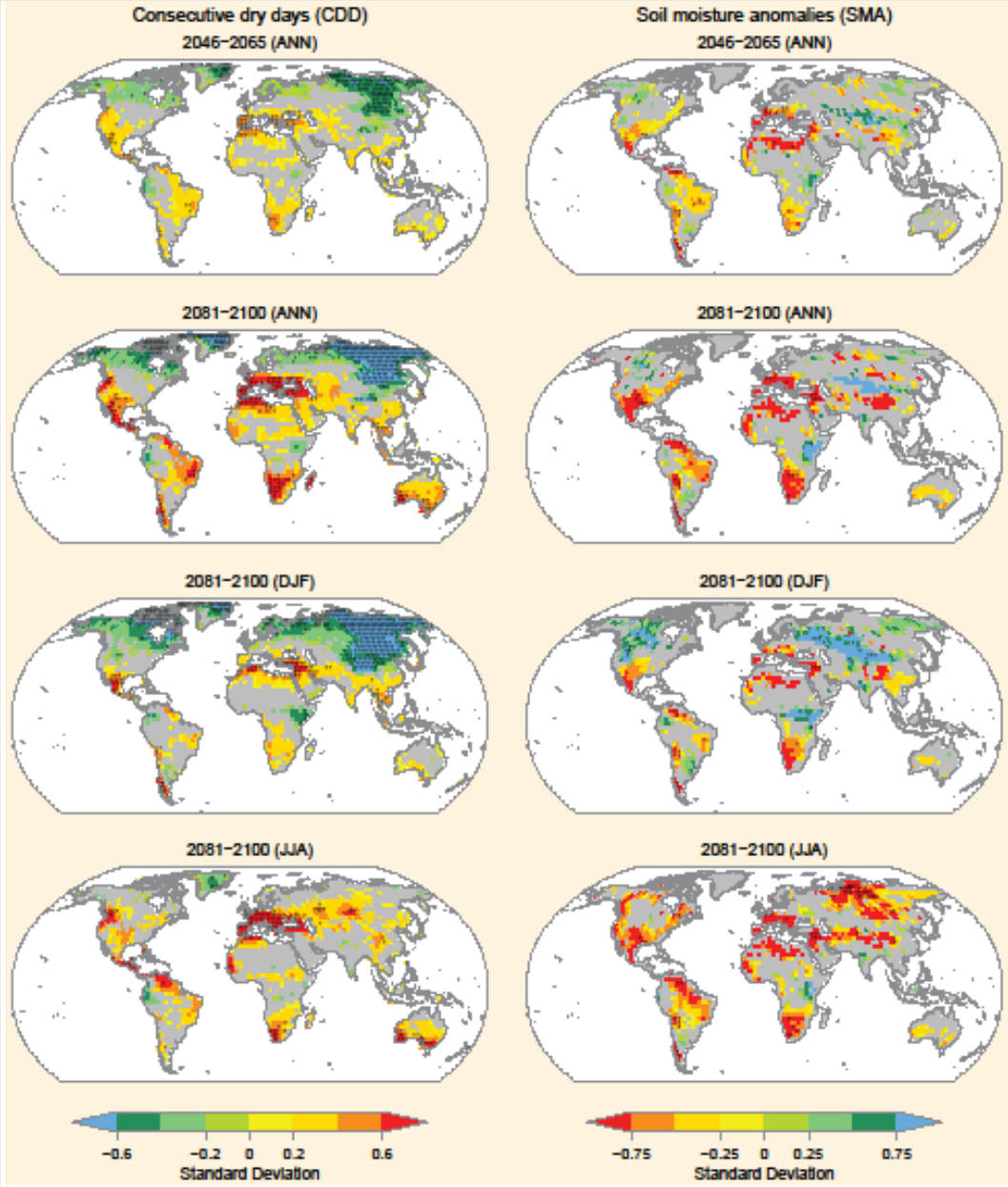


Climate warming to 2100 (virtually certain)

-increase in extreme warm days/night

-decrease in cold days/nights

IPCC 2012



Extreme flood
= likely > precip
= very likely spring

Extreme drought
= medium confidence
c North America, s Africa
s&c Europe, c America,
Mediterranean,

-major wetland impact

IPCC 2012

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Extreme drought/flooding
-novel ecosystem
production & regeneration

canopy damage images

extreme storm/hurricane
-low confidence
-little model agreement

*regeneration & composition

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Much hand waving

-info needed: species responses to climate change

-individualistic tolerance for novel environments

-Gleasonian perspectives!

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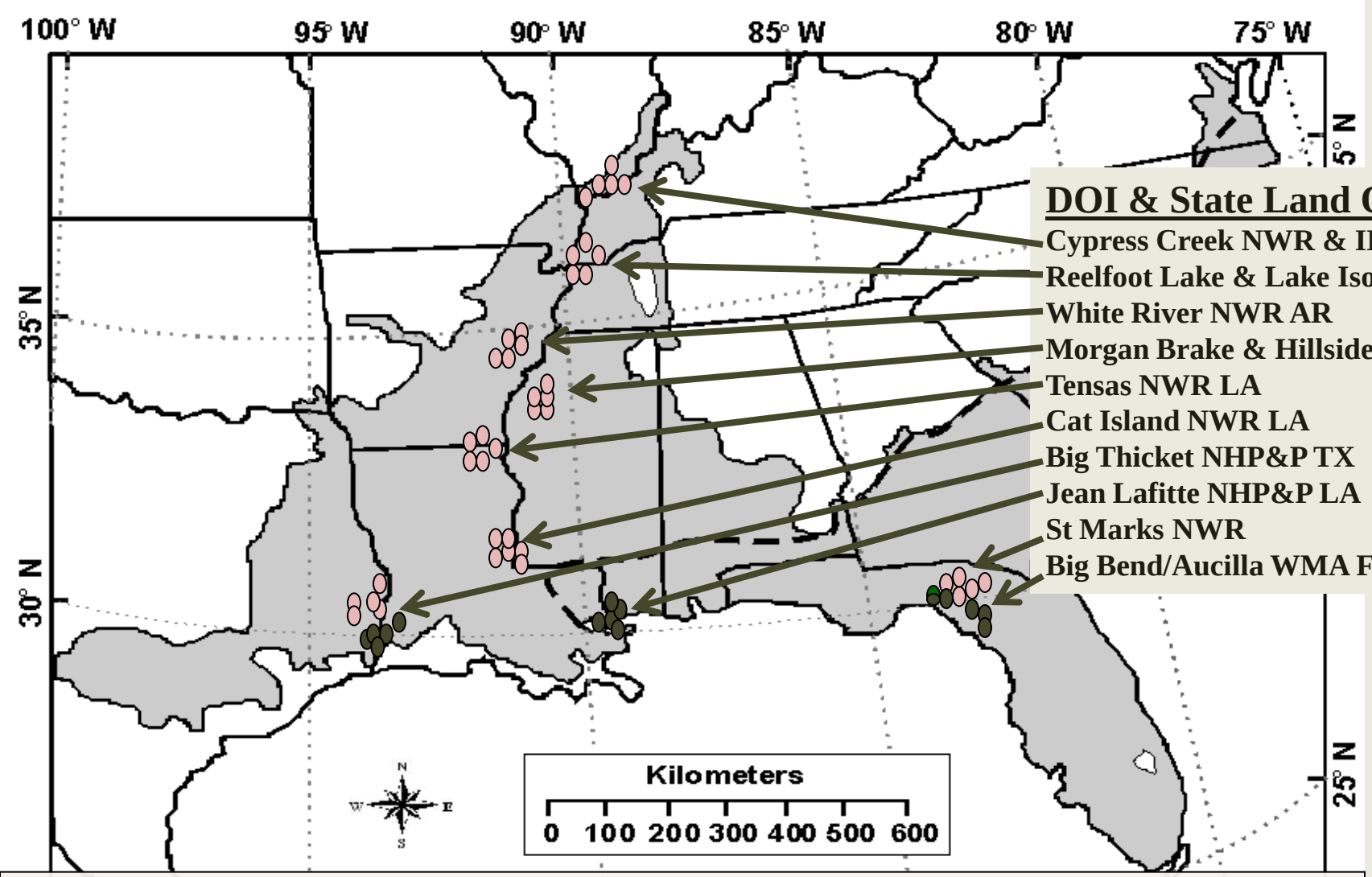

North American Baldcypress Swamp Network

NABSCN: ecosystem response environment gradient

Production across NABSCN latitude gradients

Tree & knee growth

Root production

Leaf litter

Cone production

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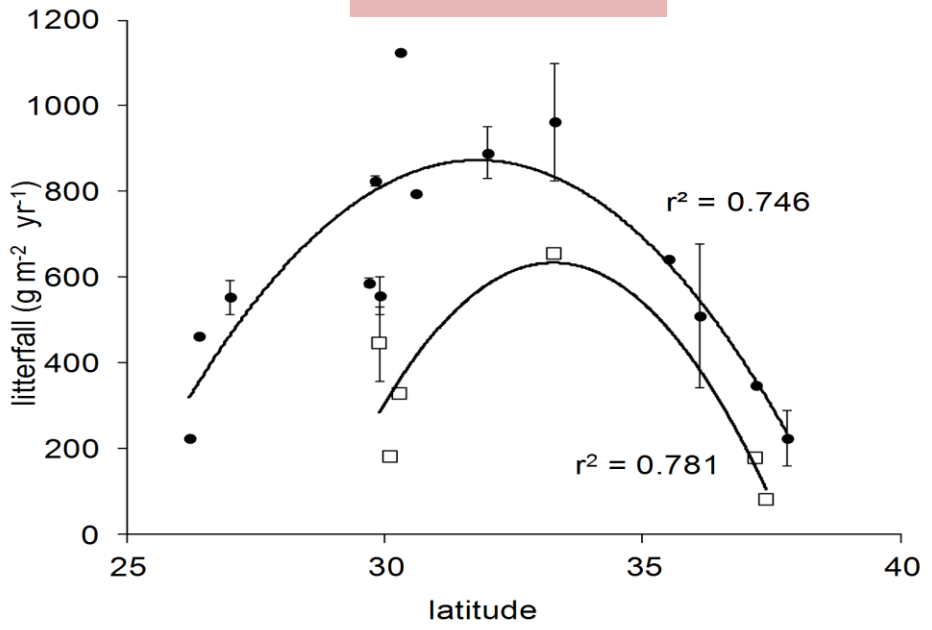
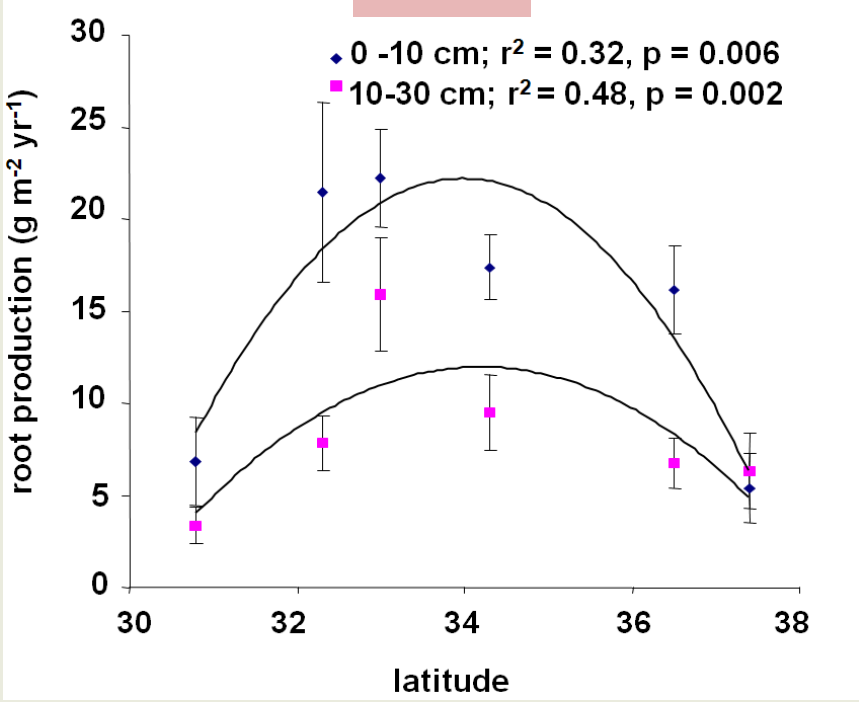
Current Day: production highest in center of range

litterfall



root



Future novel environments?

-peak production farther north than Arkansas

-constricted southern distribution

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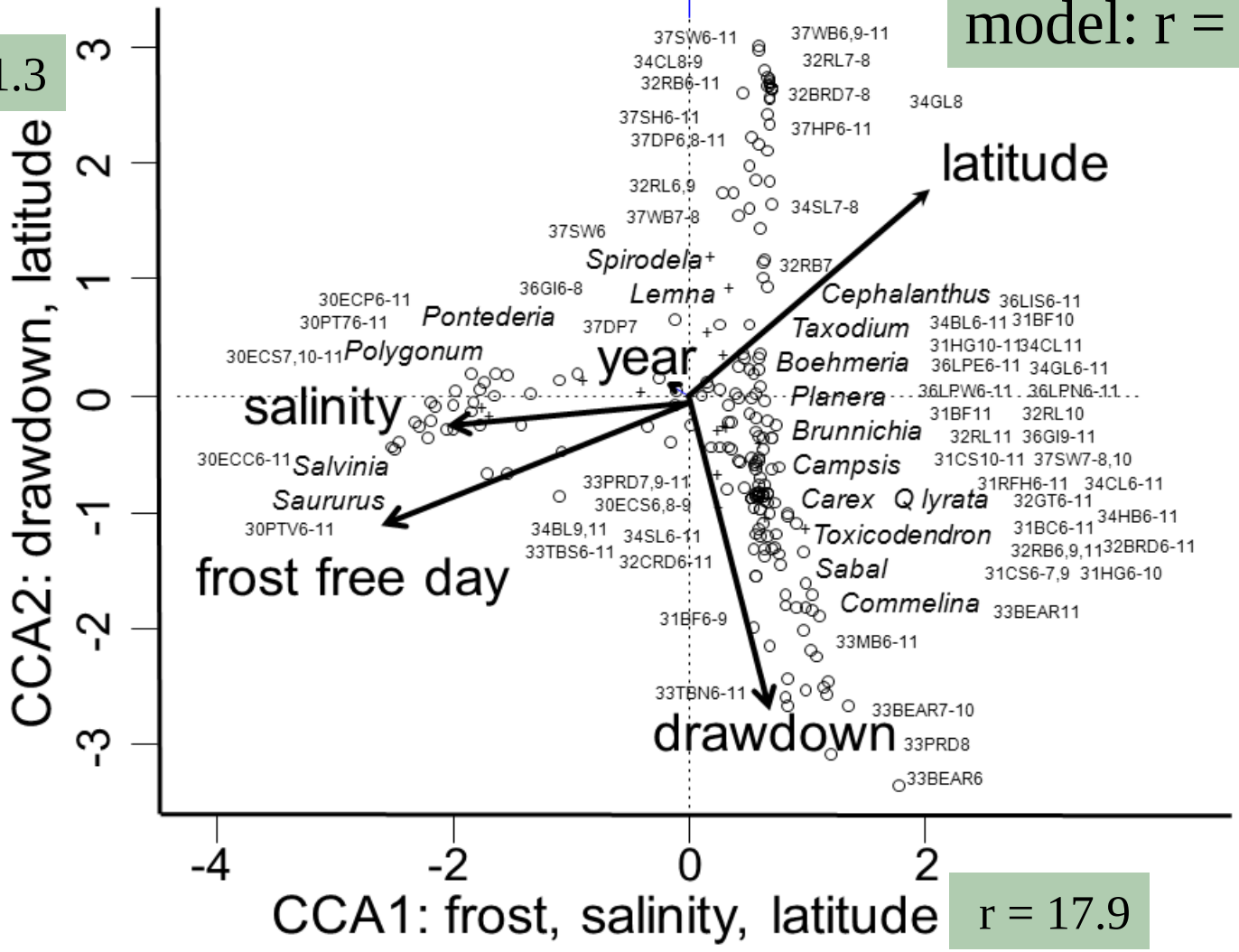
Ground cover & environment:

r = 11.3

model: r = 41.7



r = 17.9

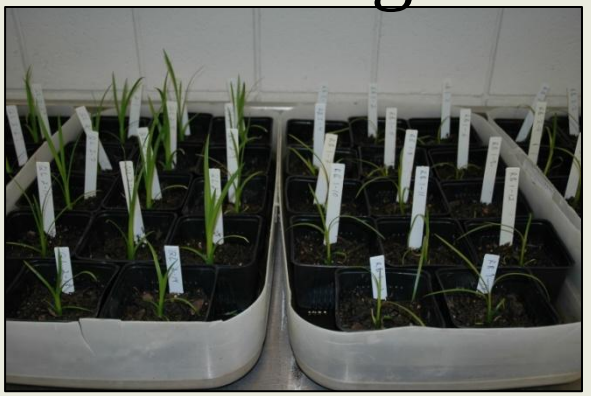
future swamps: frost, salinity, latitude (temp), drawdown

Climate change environments….

CO_2, temperature, water regime, salinity

seed banks

seedlings



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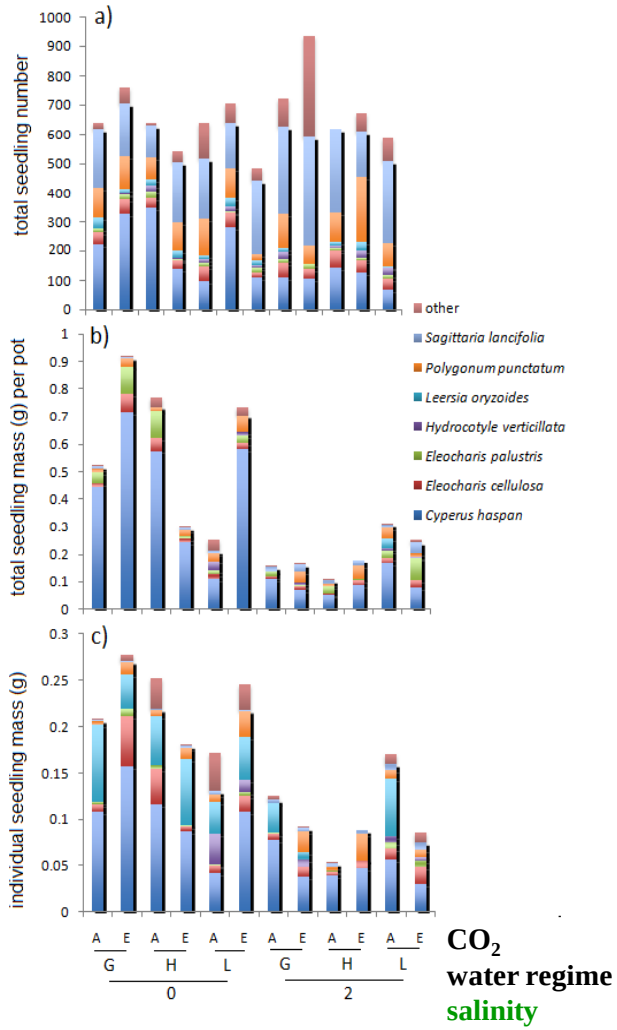
Future marsh & swamp: few species respond to CO_2



freshwater marsh: *Cyperus haspan*
*responds to CO_2 if not stressed

swamp: 4 of 92 species responded to CO_2
Gratiola neglecta, *Gamochaeta*, *Saururus*, *Typha*

water regime * latitude interaction important!

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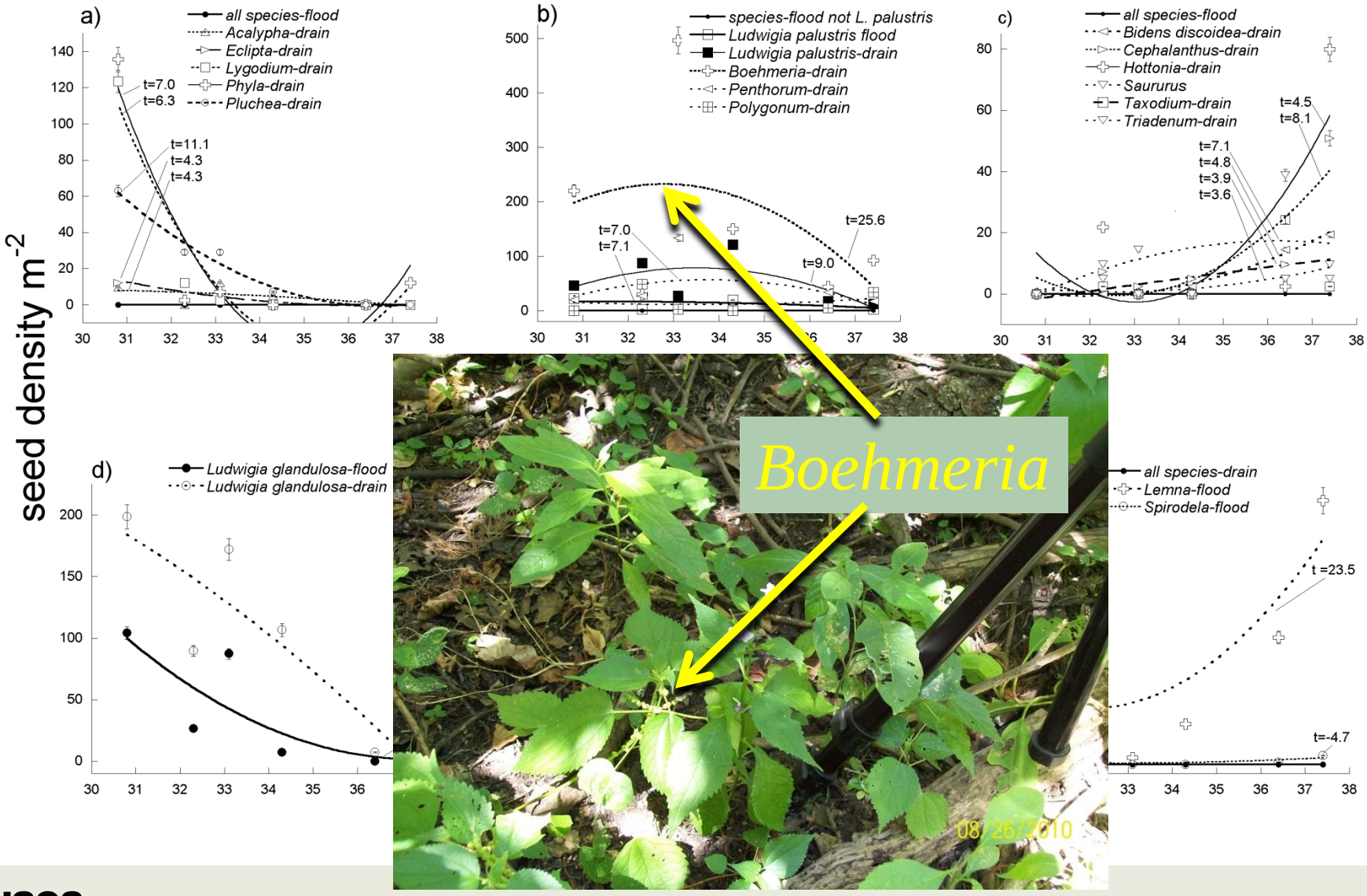
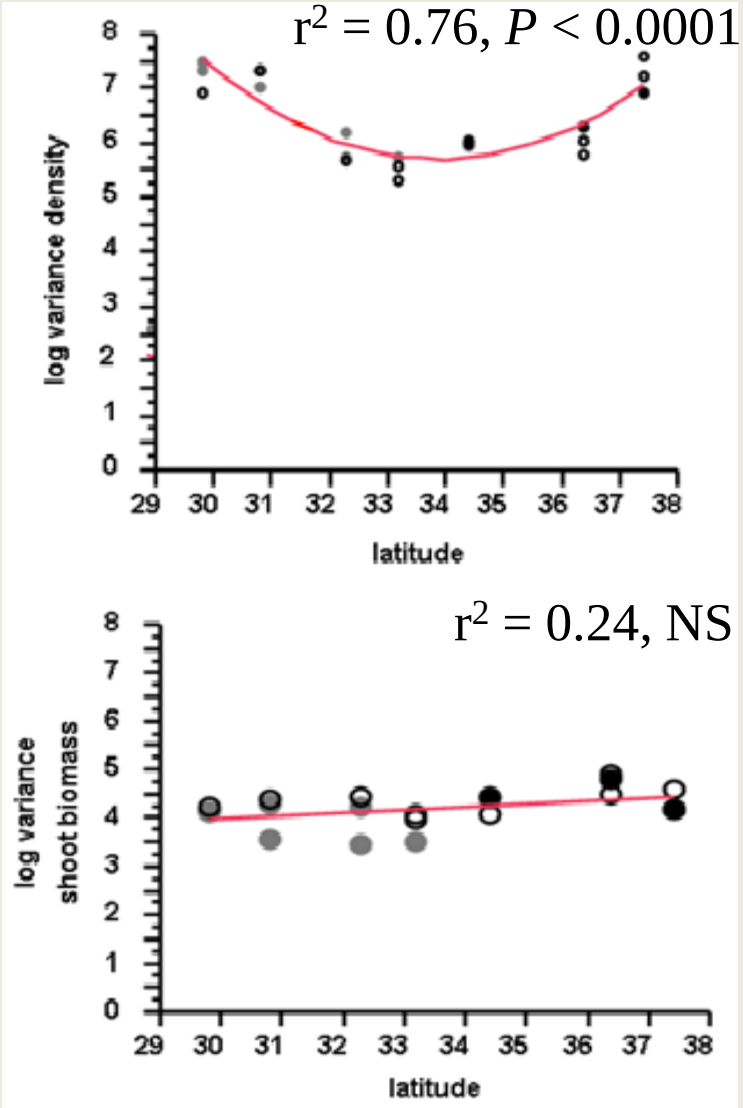
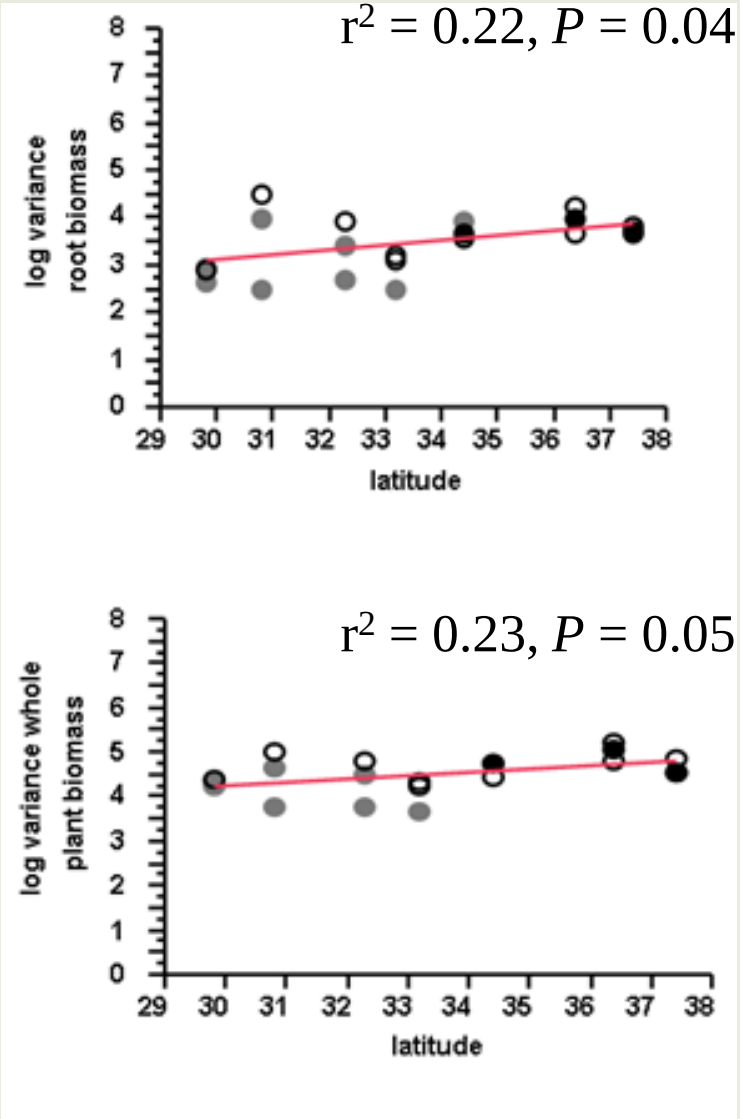
Middleton & McKee 2012

water regime x latitude interactions



Swamp: Seed/seedlings more variable northward if experiment temperature warmer than spring normal.





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Middleton & McKee 2012

Distribution range shifts in novel environments

southern

– higher production northward

northern

– lower production southward

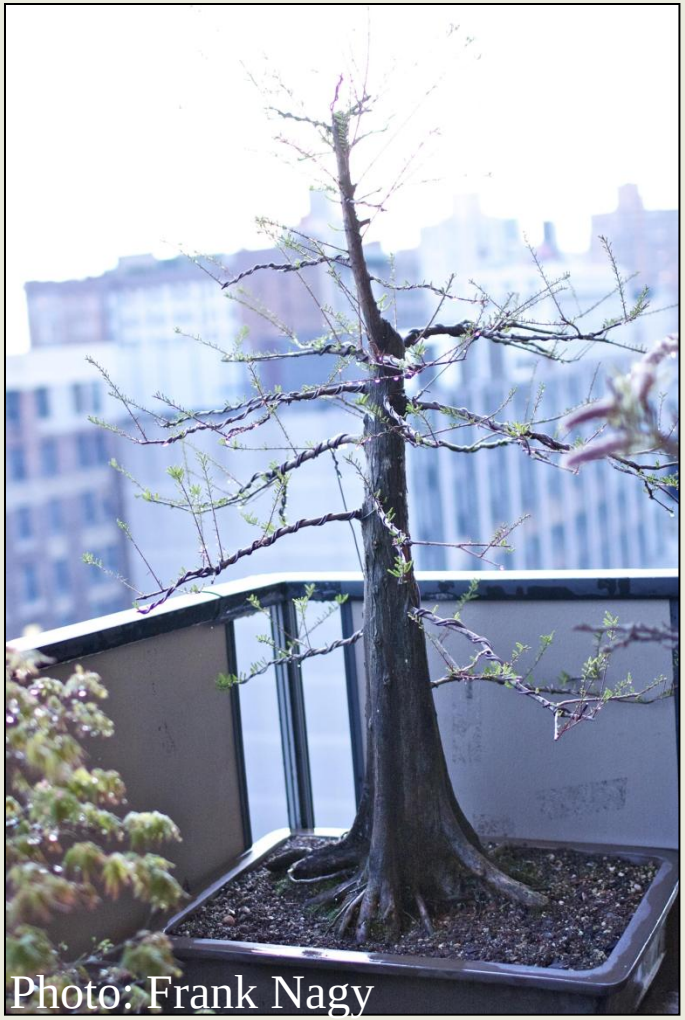
Invasive Species?

We know that novel environments will be…..

-extreme

-higher in temp, flood/drought, CO_2, salinity

Environments will interact!



Novel ecosystems: Gleasonian species

Thanks: USGS, National Science Foundation DEB1049838 RAPID, ESA Seeds, Japanese/Korean/Turkish/Czech/Chinese Academies of Science

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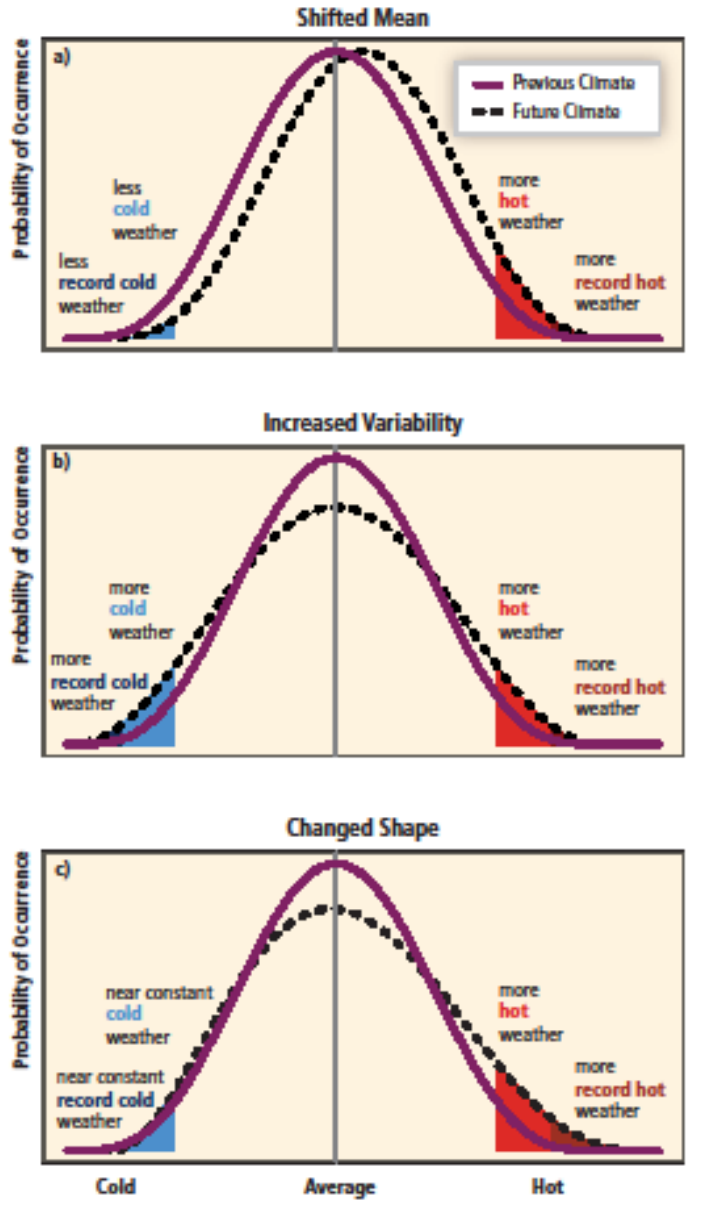
Mean vs. Extremes



hot/cold extremes; > mean

more variable; <mean

asymmetry

from IPCC 2012

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