May 6 2019—ASWM-NRCES Webinar #9

Wetlands in an era of rapid environmental change

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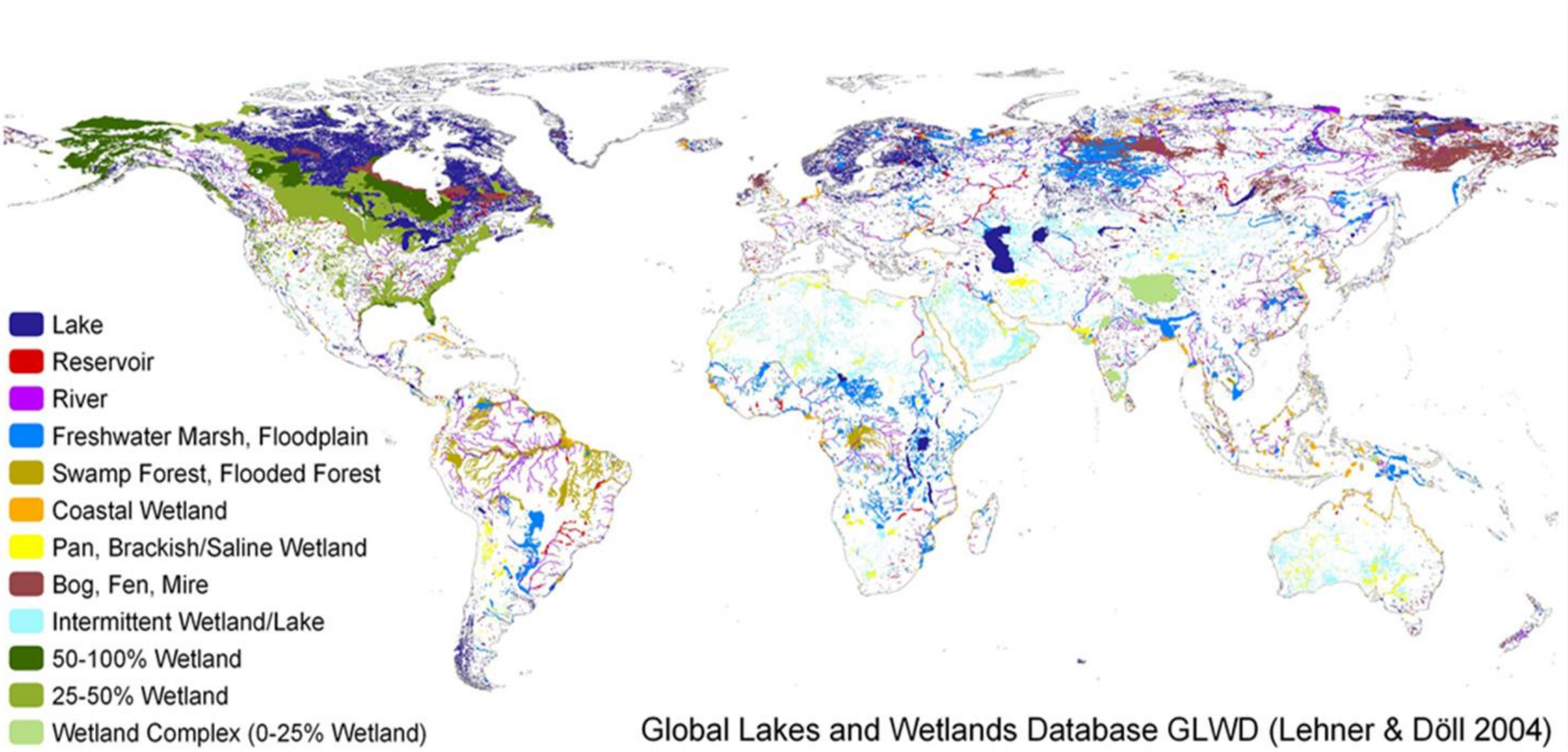
Fisheries, Wildlife, & Conservation Biology

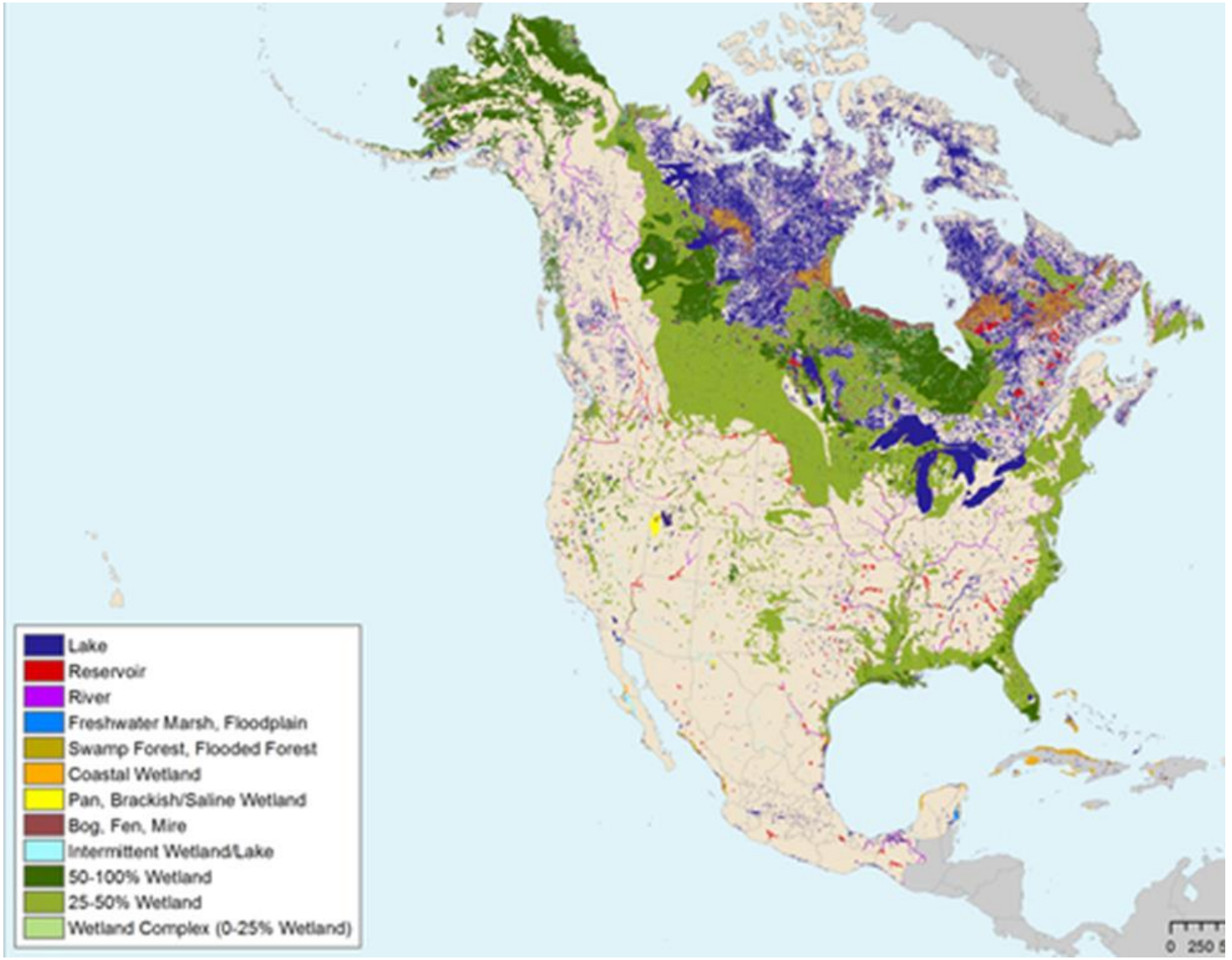
Wetlands are a global resource



Global Lakes and Wetlands Database GLWD (Lehner & Döll 2004)

Wetlands of North America

240 Mha
Current Extent



Wetland Ecosystem Services

Ecosystem Services (ES) related to Wetlands

Provisioning	Regulating	Cultural	Supporting
▪ Floodplain recession agriculture ▪ Fresh water supply ▪ Food source (fishery, birds, wildlife) ▪ Grazing area for cattle	▪ Flood attenuation and protection ▪ River flow regulation ▪ Improvement of water quality ▪ Nutrient cycling and sediment retention	▪ Ecotourism ▪ Services meeting aesthetic, emotional, ethnic or spiritual needs	▪ Biodiversity ▪ Carbon sequestration and storage ▪ Groundwater recharge




….aka Wetland Functions and Values

Wetlands are diverse

This diversity reflects the wide array of environments wetlands occupy

Environments

↓

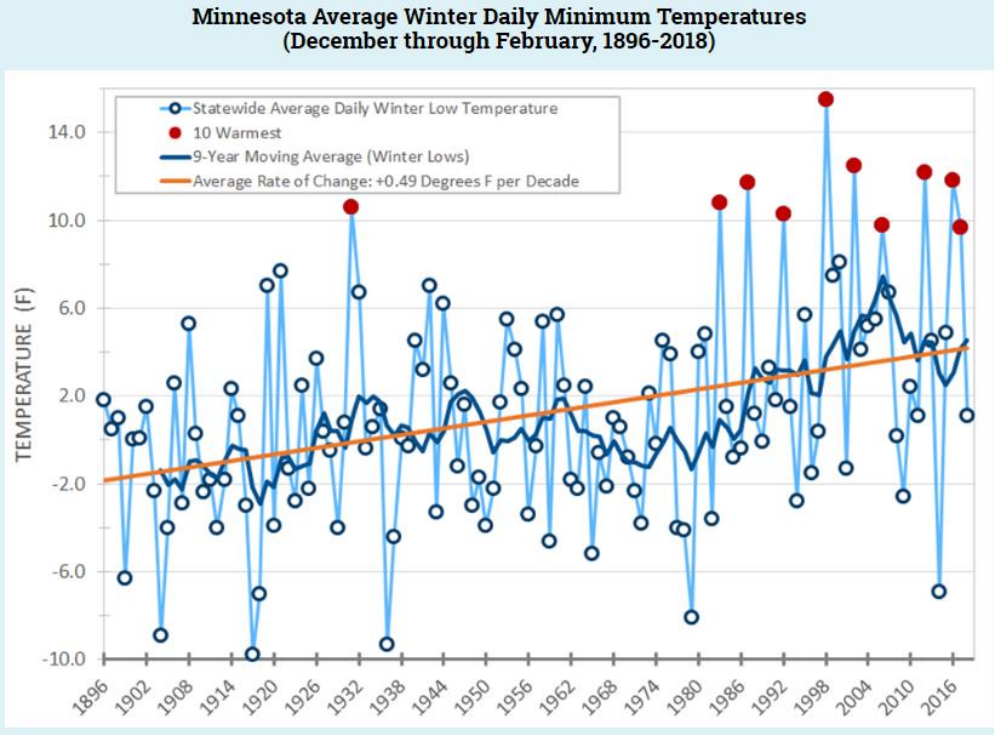
Climates + Landforms

Climate governs key wetland attributes

Changes in atmospheric conditions

precipitation
temperature

Climate vs weather?

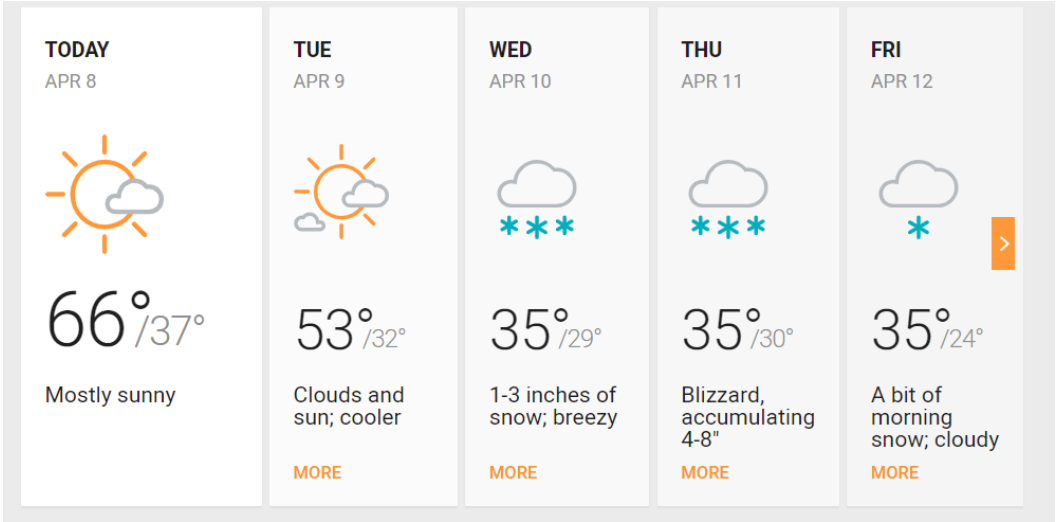


Climate change:

Trends over a few decades

Weather Change:

Shifts in conditions over minutes to weeks



Climate affects all facets of a wetland's water budget—either directly or indirectly

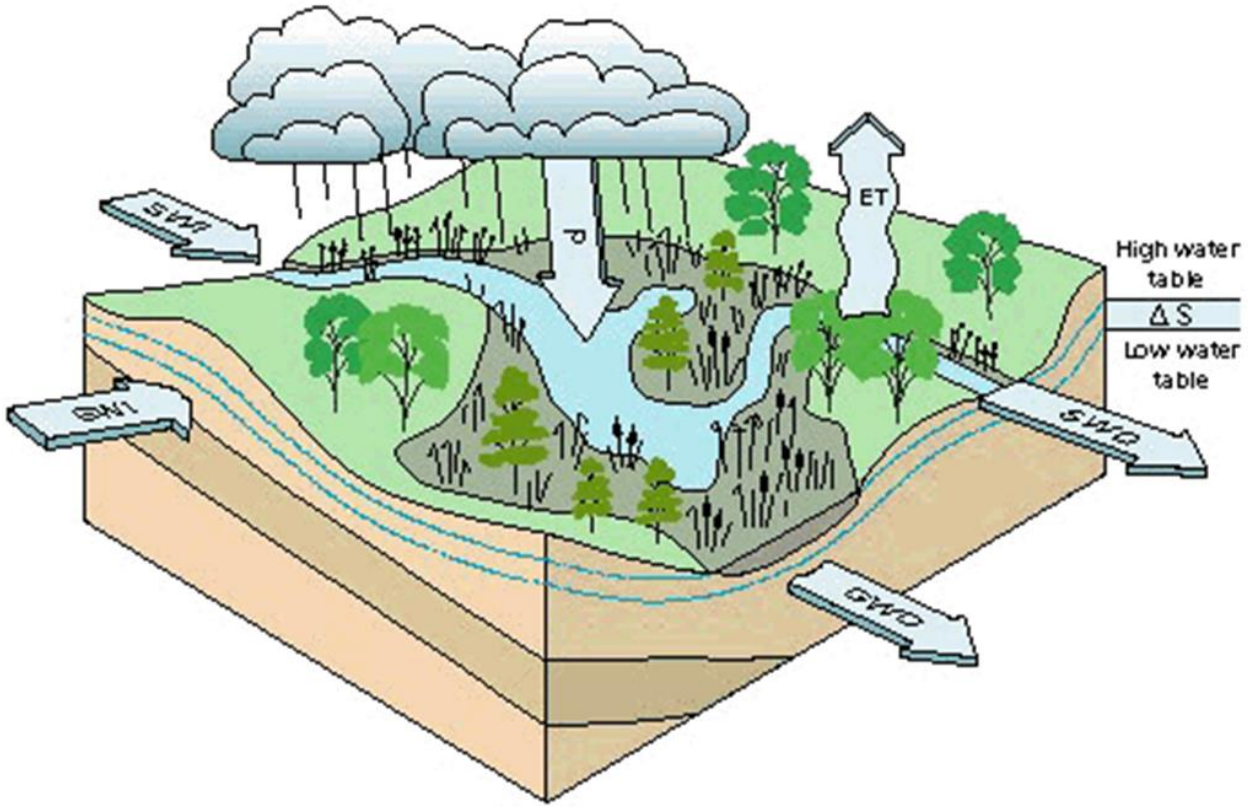


Figure 18. Components of the wetland water budget. (P + SWI + GWI = ET + SWO + GWO + ΔS, where P is precipitation, SWI is surface-water inflow, SWO is surface-water outflow, GWI is ground-water inflow, GWO is ground-water outflow, ET is evapotranspiration, and ΔS is change in storage.)

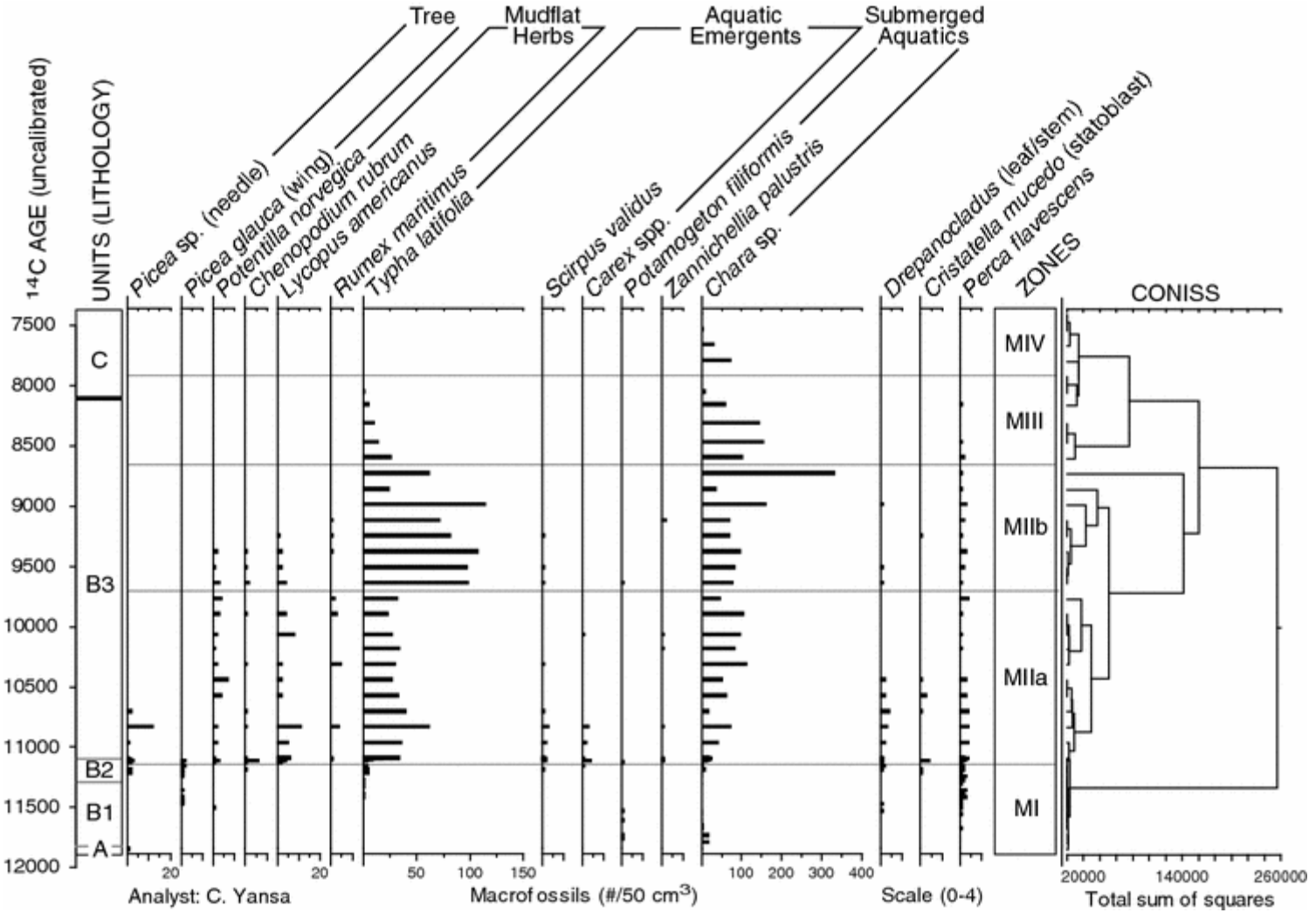
Climate & wetland biota

Direct Effects:
Seasonality of wet & dry phases, Rates of biological reactions, Organismal stress

Indirect Effects:
Water & soil chemistry, Organismal stress

Wetland changes linked to climate change

Natural causes



Wetland change in a North Dakota ephemeral wetland (Yansa et al 2007)

Climate change – Primary human trigger:

↑ CO_2 temp ↑

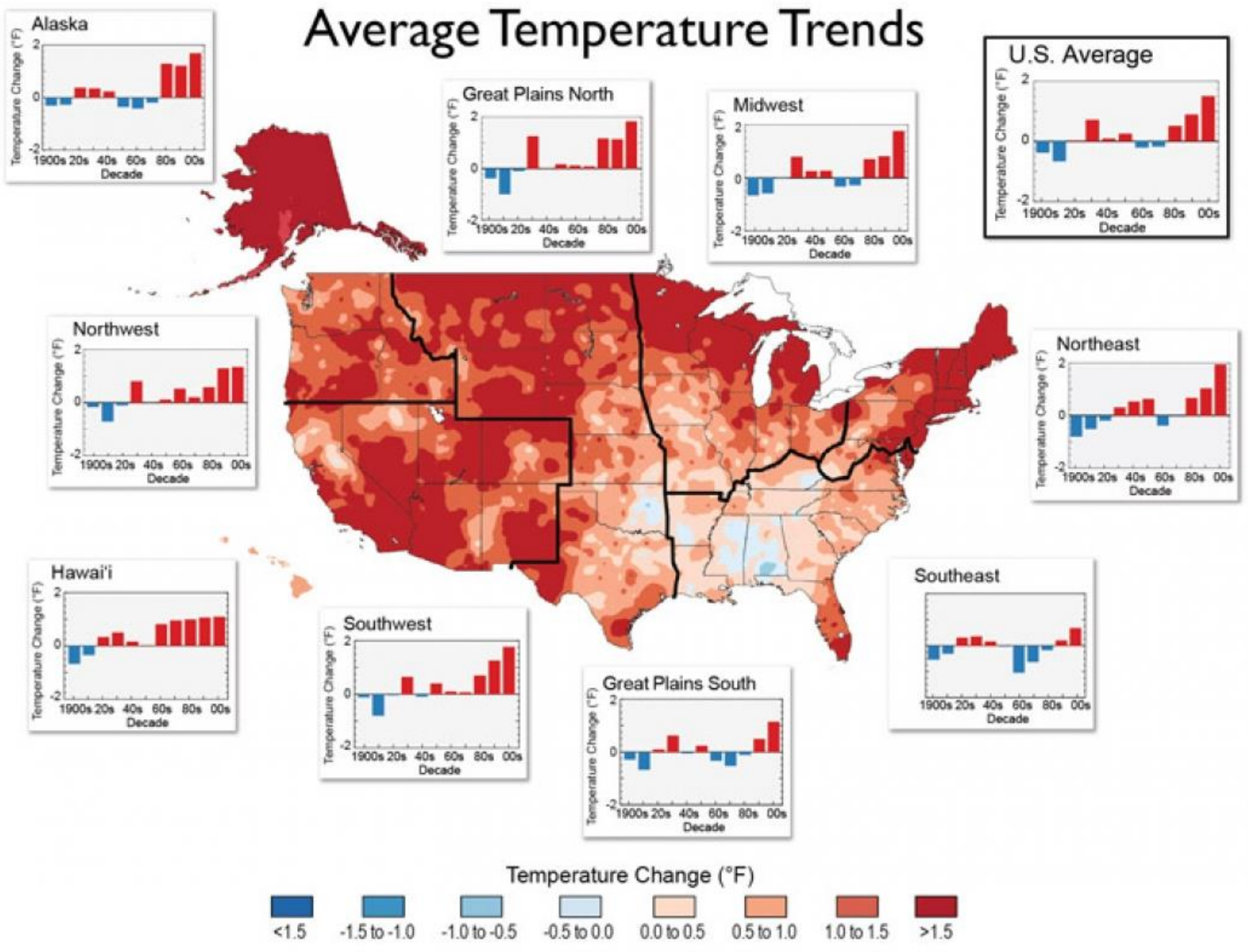
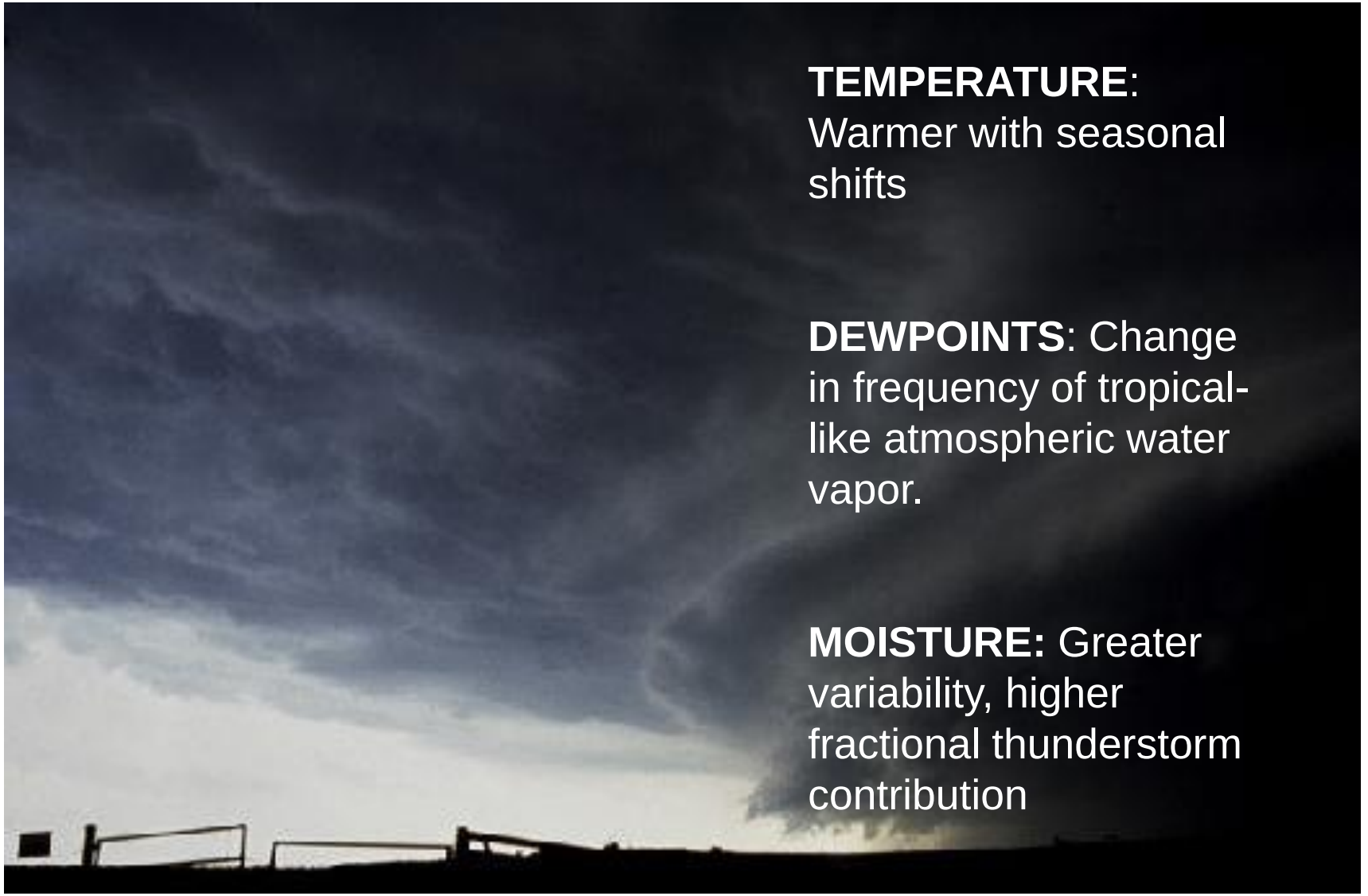


Image source: Climate Central

Recent Significant Climatic Trends in the Eastern Great Plains

Seeley- 2013



TEMPERATURE: Warmer with seasonal shifts

DEWPOINTS: Change in frequency of tropical-like atmospheric water vapor.

MOISTURE: Greater variability, higher fractional thunderstorm contribution

How warmer global & regional temperatures affect wetland water sources

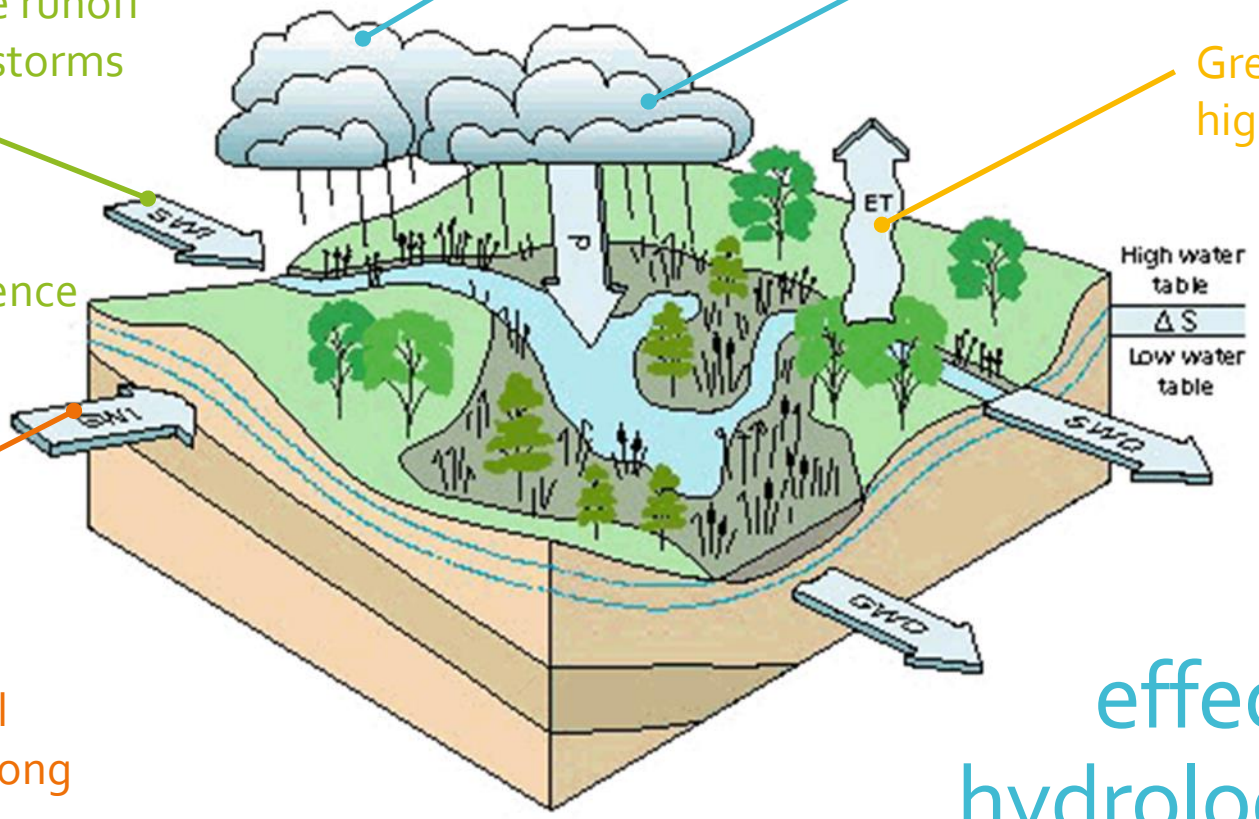
Changes in distribution of ppt—more deluges & drought

Seasonal changes to ppt patterns

High volume runoff assoc. with storms

Greater water loss due to higher ET

Land use changes-strong influence



Land use changes-strong influence

Changes to regional water balances –strong influence

What are the effects to wetland hydrology & ecology?

Example:

Predicted ecological changes to Minnesota wetlands

Galatowitsch et al. 2008

Reduced extent of shallow wetlands
Shorter duration of flooding in wetlands
Lower water table in peatlands, increased fires
Influx of new exotic species in lakes

Photo source: BBC

Projected effects on breeding waterfowl

Johnson et al. 2005

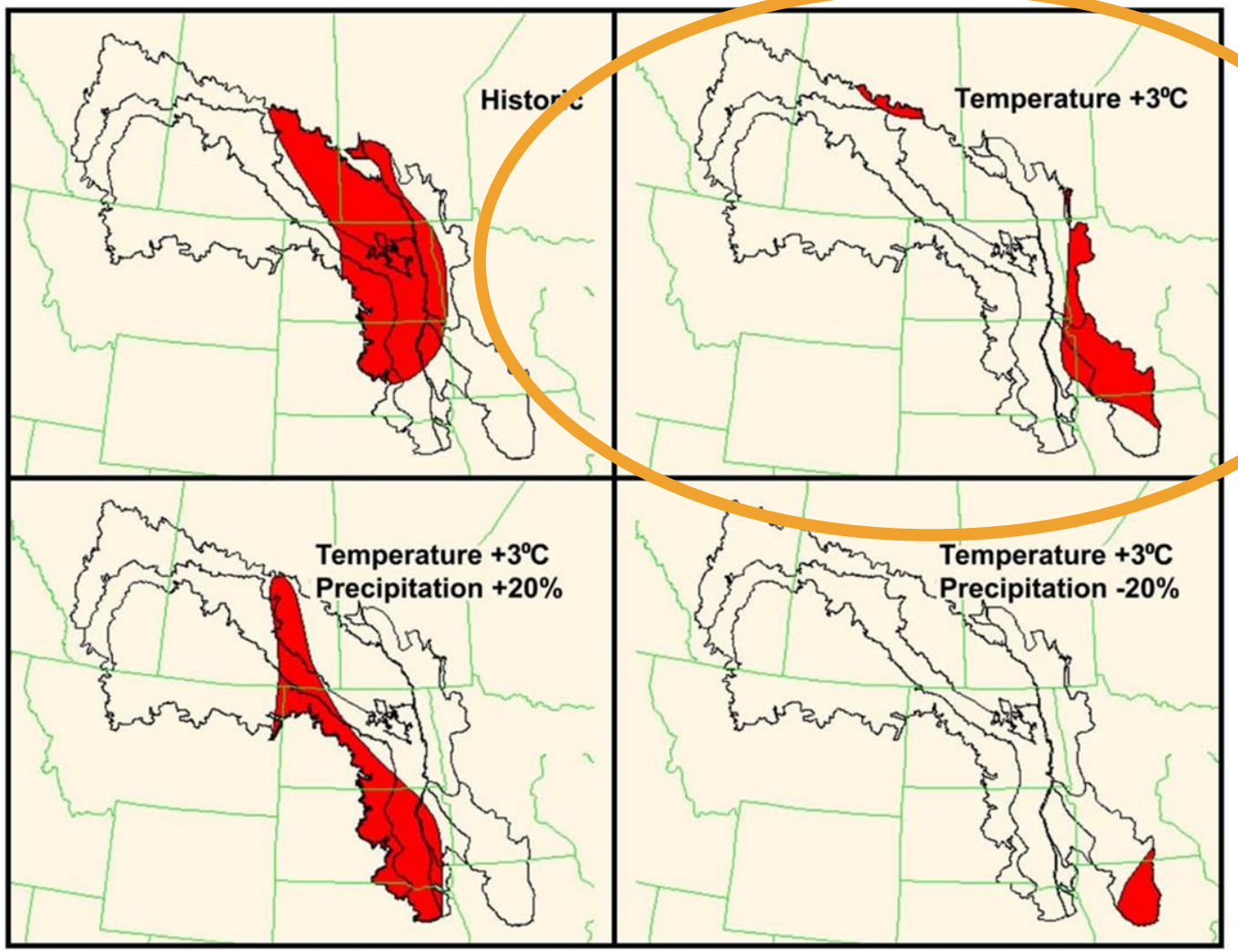
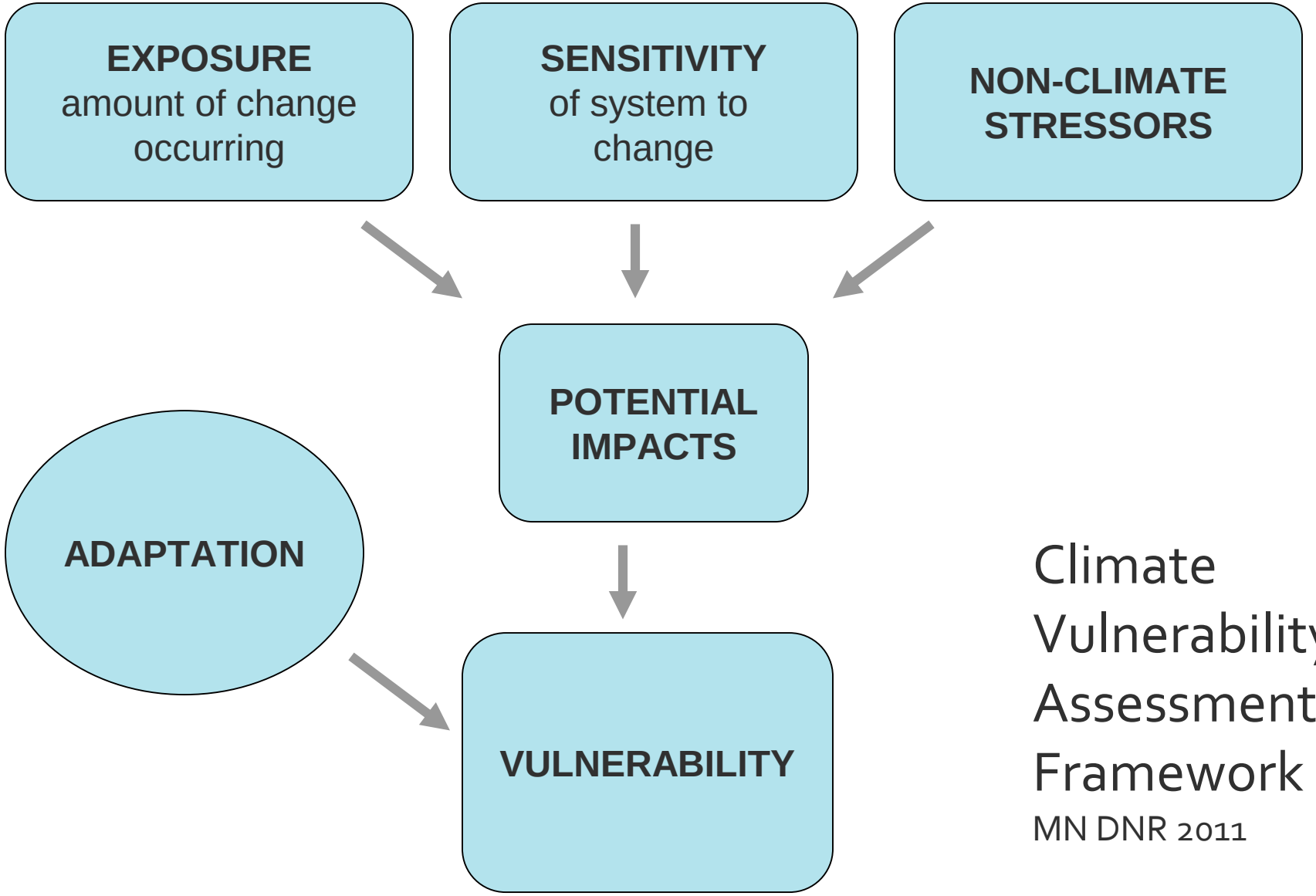


Figure 2. Model simulations that locate the most favorable wetland conditions for breeding waterfowl under historic and alternative future climates (Johnson et al. 2005).

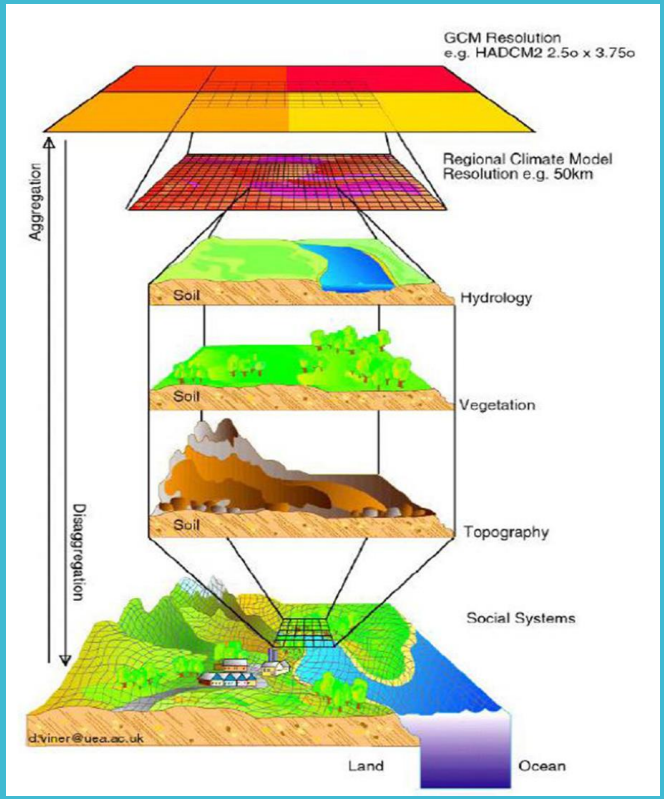
"No regrets" decisions during a time of high climate uncertainty



Climate Vulnerability Assessment Framework

MN DNR 2011

Amount of change: down-scaled projections



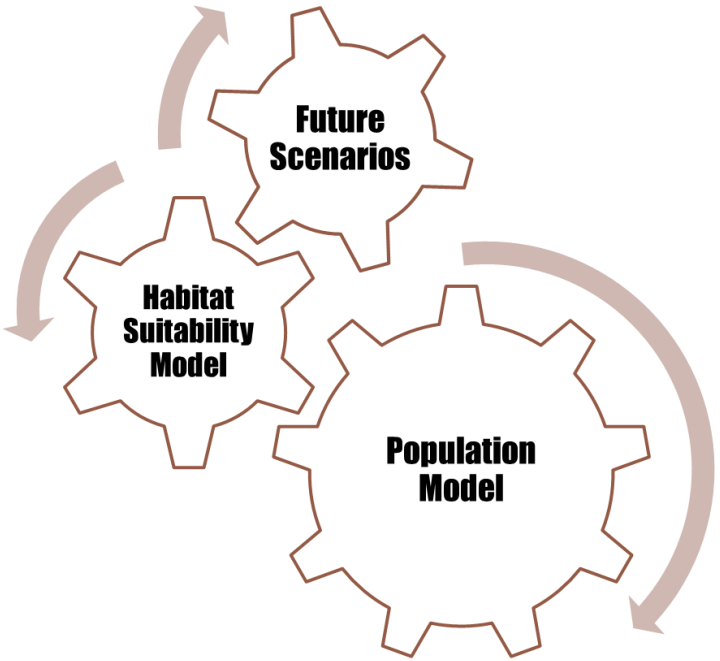
Viner 2012

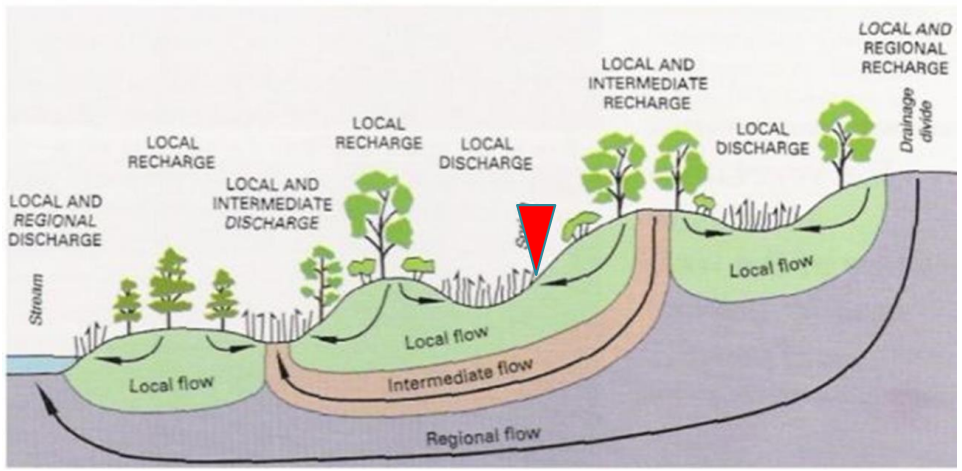
What does this mean to management decisions on specific sites?

Aim:
No-regrets management strategies
to reduce climate change risks

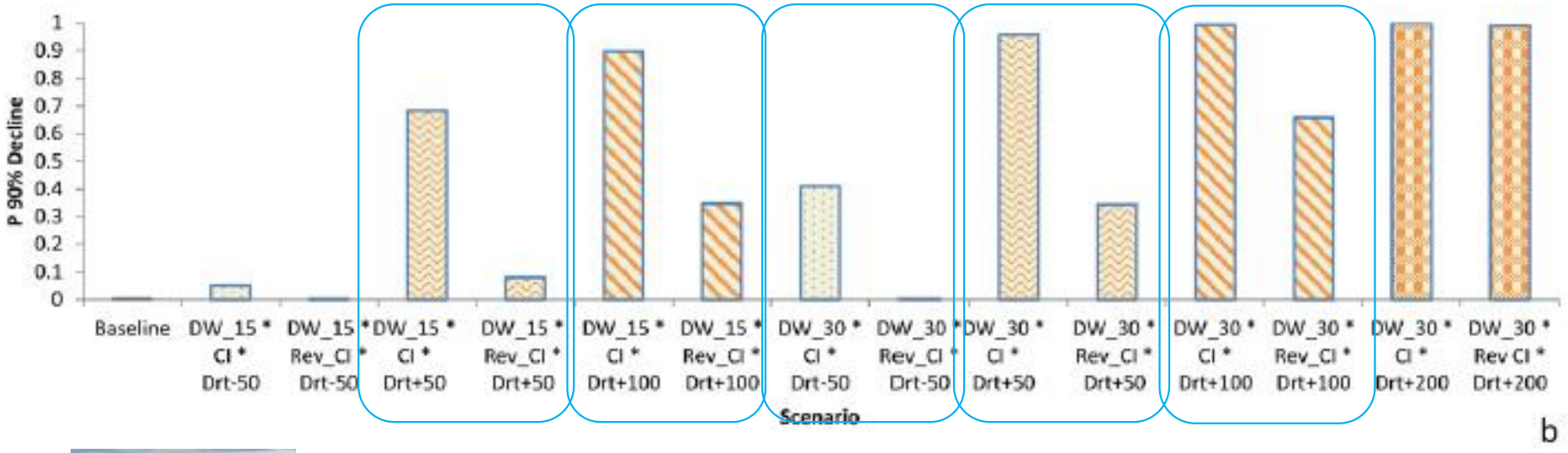
Expandere WMA
363 ha, 14 m relief
Large *Cypripedium* population

Linked habitat suitability & population models
to simulate climate change-management scenarios





How likely is a 90% decline in population?



“No regrets” strategy:

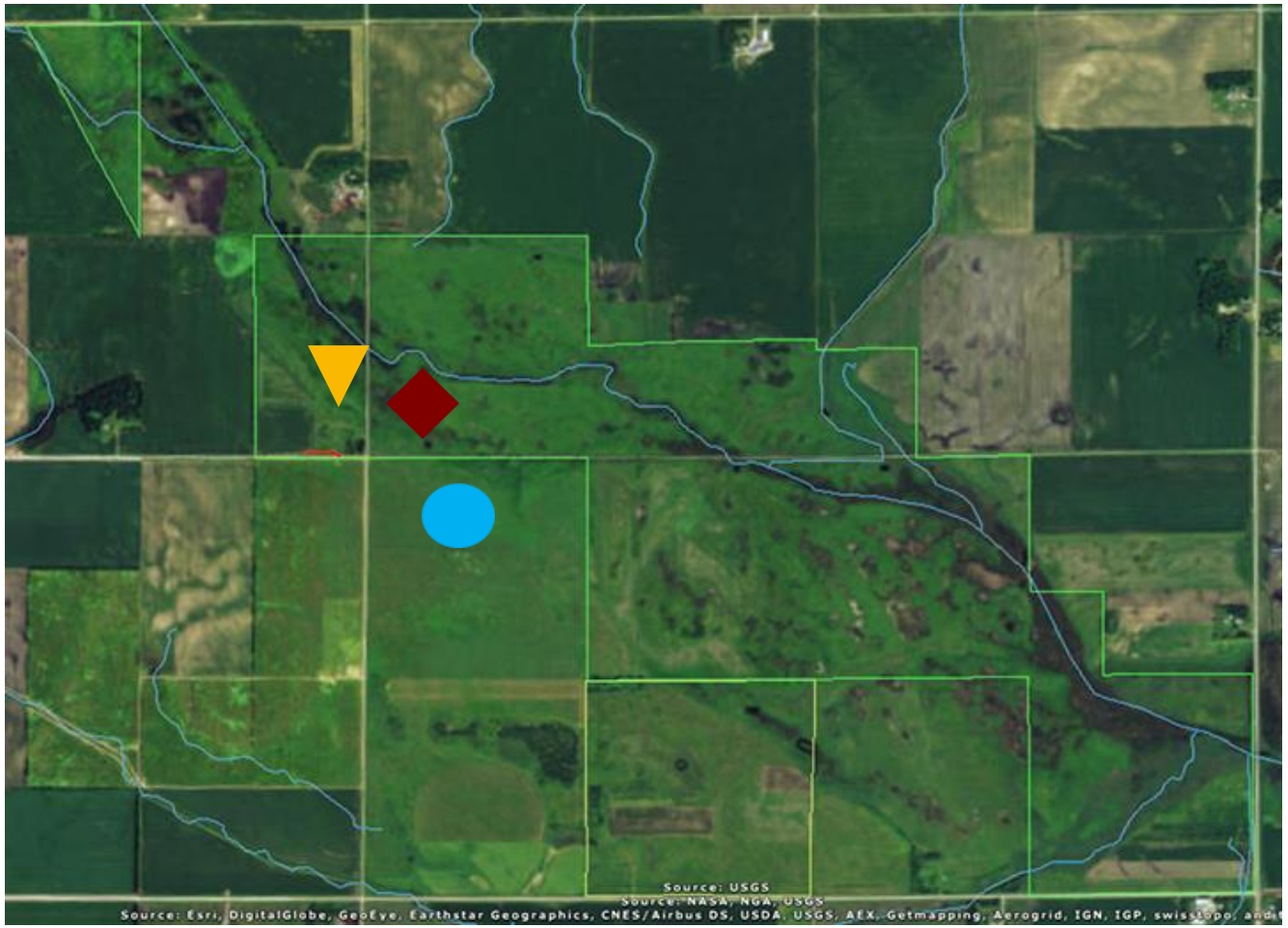
Controlling invasive species in the vicinity of small white lady slipper populations should reduce vulnerability to climate change effects … up to a point!

Manage invasive species, monitor changes to lady slippers

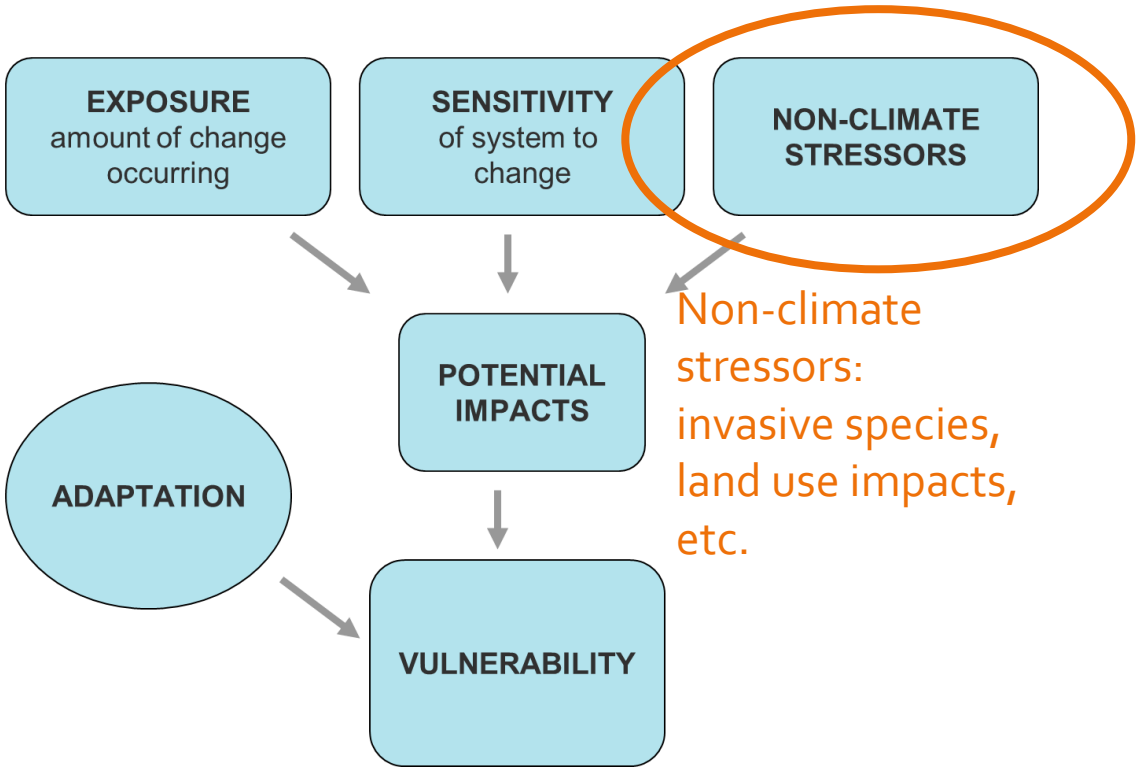
Protect groundwater flow by purchase, restoration

Develop plans to deploy "high risk" actions– irrigation & translocation.

What should happen now?



No regrets" decisions during a time of high climate uncertainty



Non-climate stressors: invasive species, land use impacts, etc.

Central Platte River wetlands –FWS photo

SUMMARY:

Assess potential effects of climate change to all aspects of wetland water budgets;

Look for ways to minimize:

- direct effects (stress from environmental extremes),
- indirect effects (changing water regimes),
- multiple stressors (eg invasive species x climate);

Don't defer: seek "No regrets strategies now!

Wetland decision-making & climate change