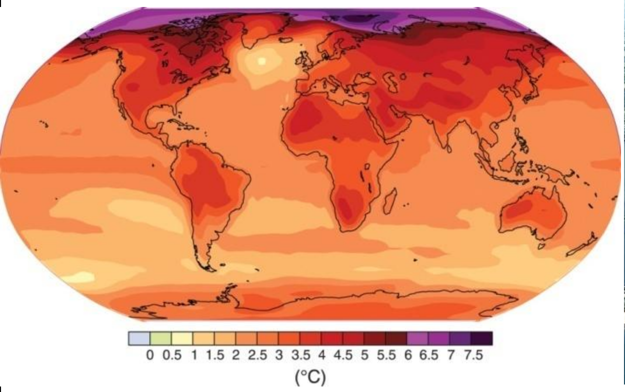

Climate change and Michigan's Wildlife: Updating management and conservation

Kimberly Hall
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Credits: IPCC 2007,
Photos – Photography Plus,
Julie Craves

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Michigan State University -- MCC


Freshwater Mussels
of Michigan

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Where do we start?

- Become climate change pro-active:
  - Link research and management
  - Think and work at several scales
- Assess the vulnerability of species and systems:
  - Link strategies to climate stressors
- Stop waiting, start adapting and learning!
  - Communicate & collaborate
  - Identify a few key decisions/processes to update first
  - Re-examine our targets, goals, and values

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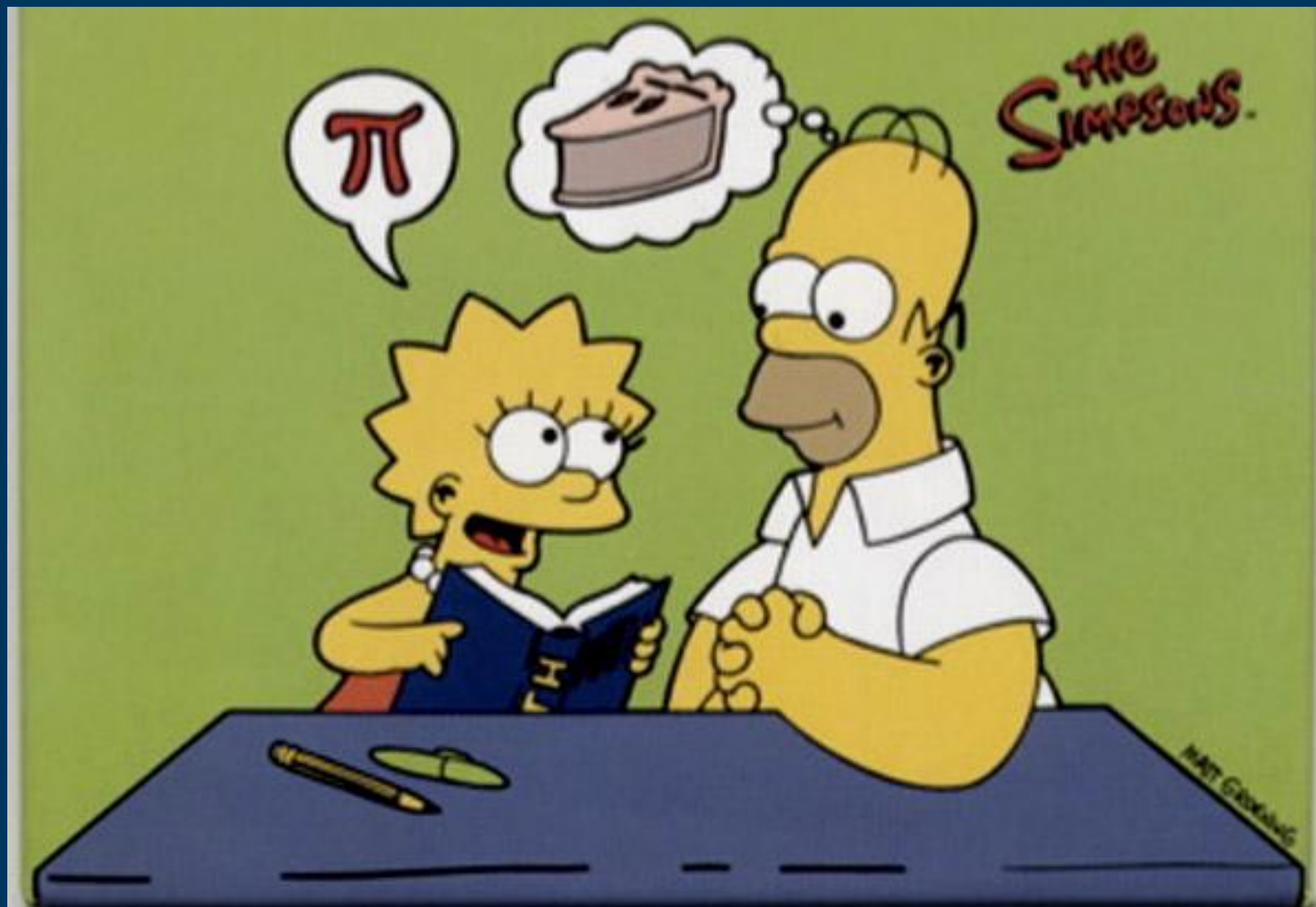
Step 1 – learn the lingo



Mitigation and Adaptation

Mitigation – Reduce the build up of greenhouse gases in the atmosphere and slow the rate of climate change.

Adaptation – Adjustments in human or natural systems that promote persistence/function under changed climatic conditions.

Phenology & phenology mismatches

Changes in timing of seasonal events (e.g., budburst, insect emergence, migration)

Triggers can be linked to climate directly (e.g., temp), indirectly (lake turnover), or partially (day length +++)

Mismatch – interacting species shift at different rates/directions

Predicted change

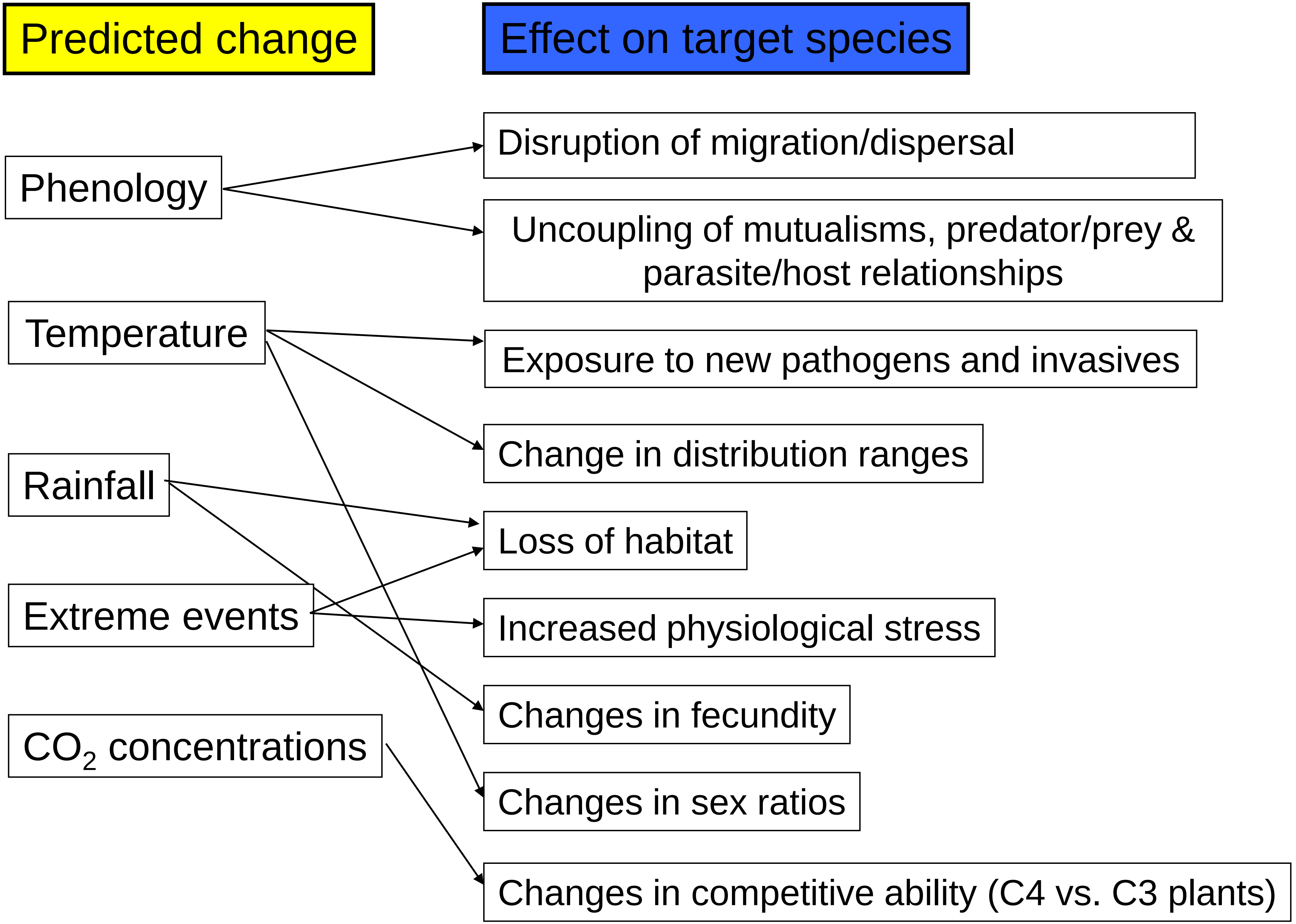
Phenology

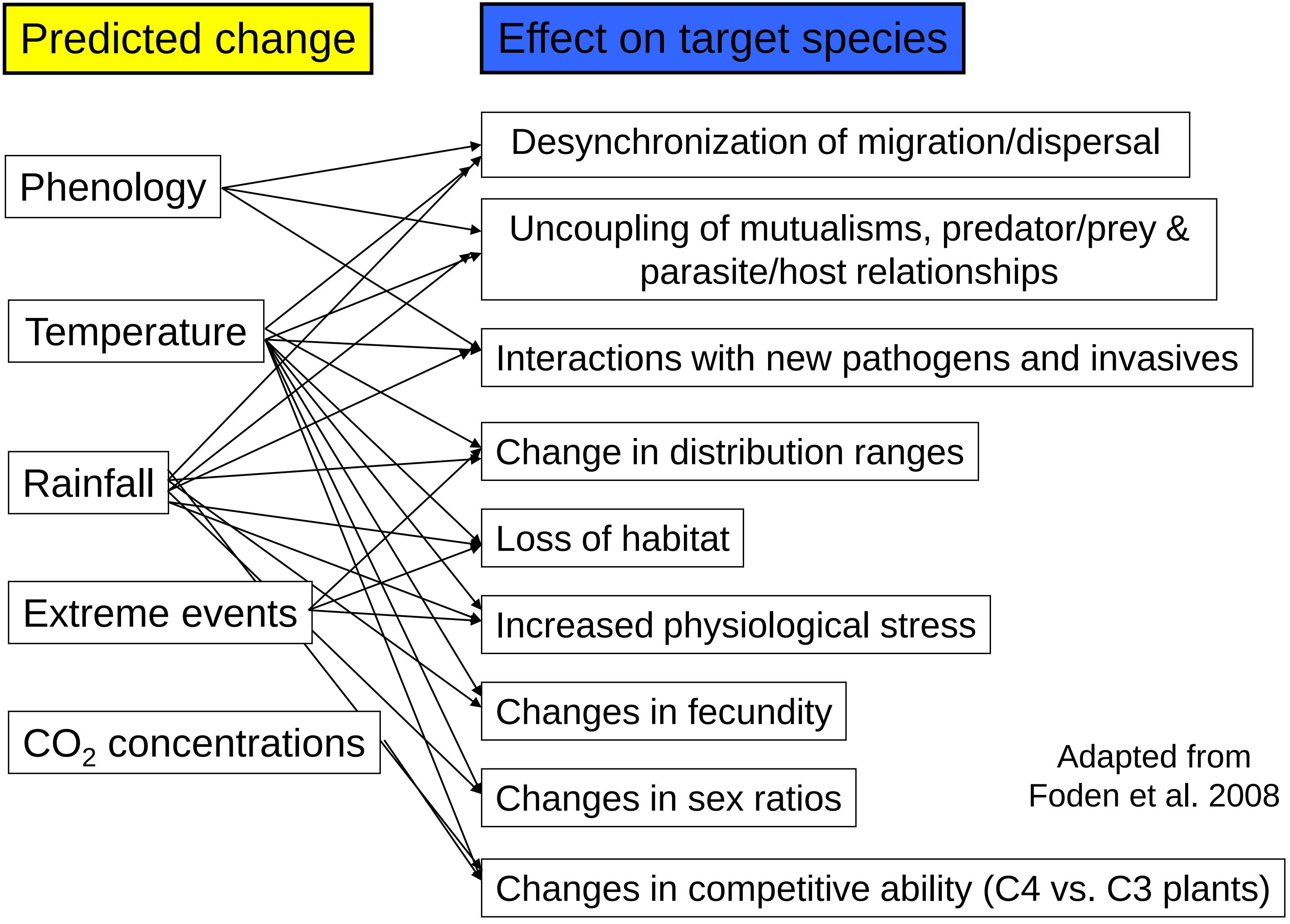
Temperature

Rainfall

Extreme events

CO_2 concentrations


Predicted change
Effect on target species
Phenology
Temperature
Rainfall
Extreme events
CO2 concentrations
Disruption of migration/dispersal
Uncoupling of mutualisms, predator/prey & parasite/host relationships
Exposure to new pathogens and invasives
Change in distribution ranges
Loss of habitat
Increased physiological stress
Changes in fecundity
Changes in sex ratios
Changes in competitive ability (C4 vs. C3 plants)



Predicted change
Effect on target species
Phenology
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Desynchronization of migration/dispersal
Uncoupling of mutualisms, predator/prey & parasite/host relationships
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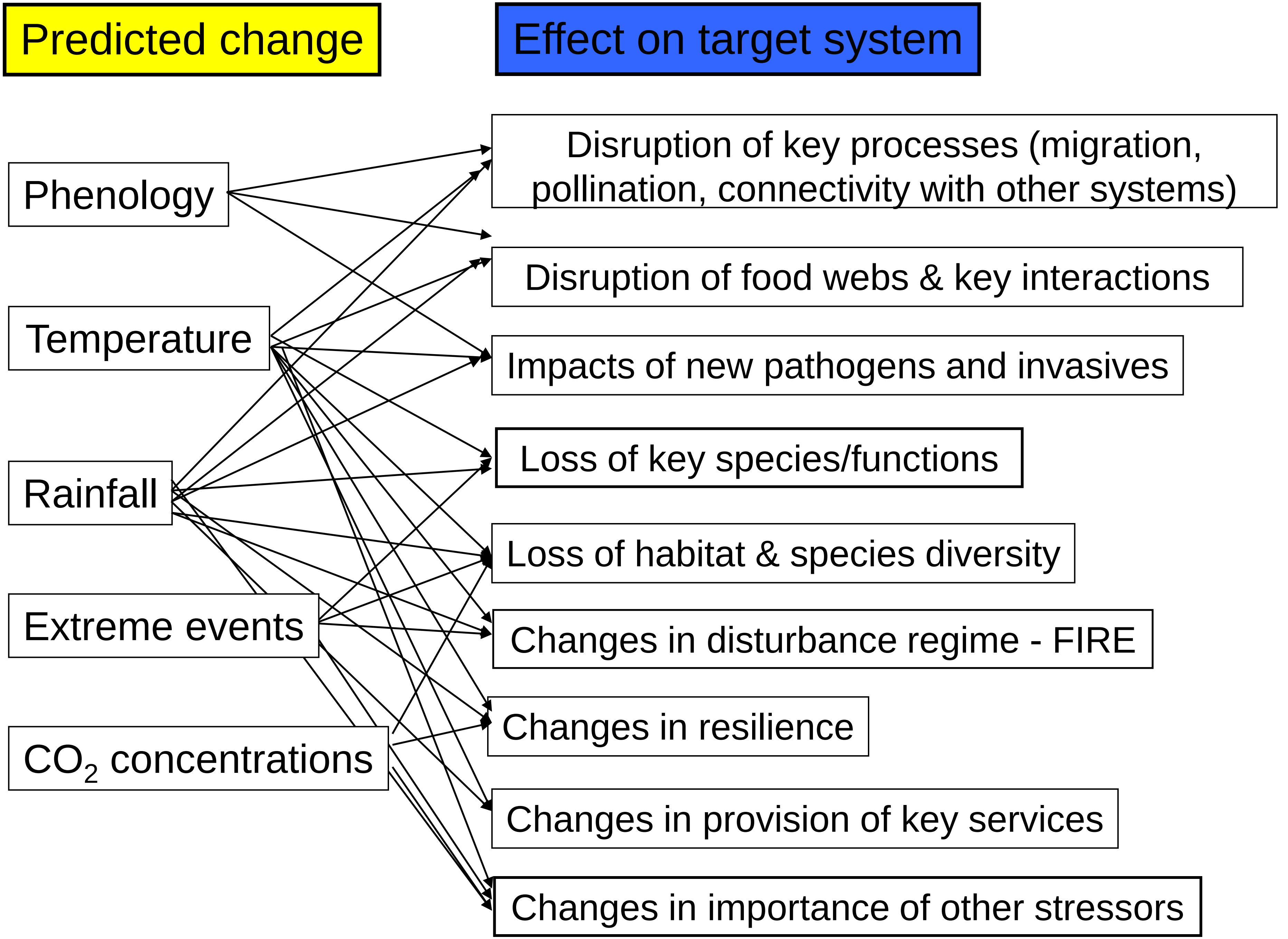
Increased physiological stress
Changes in fecundity
Changes in sex ratios
Changes in competitive ability (C4 vs. C3 plants)
Adapted from Foden et al. 2008


Predicted change
Effect on target system
Phenology
Temperature
Rainfall
Extreme events
CO_2 concentrations
Disruption of key processes (migration, pollination, connectivity with other systems)
Disruption of food webs & key interactions
Impacts of new pathogens and invasives
Loss of key species/functions
Loss of habitat & species diversity
Changes in disturbance regime - FIRE
Changes in resilience
Changes in provision of key services
Changes in importance of other stressors

Expect surprises!

Red-eared sliders in Illinois

- Temp-dependent
  sex determination
  (warmer = more females)

But phenology changed too…

Tucker et al. 2008, Chelonian Conservation and Biology

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We can't expect to find or be experts....

Complexity, uncertainty & scale issues, oh my!

- Responses of climate systems
- Responses of ecological systems
  (focal species and stressors)
- Responses of human systems
  (management, societal adaptation efforts)

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Where do we start?

- Become climate change pro-active:
  Types of impacts, links to scale
- Assess the vulnerability of species and systems:
  What can we influence?
- Stop waiting, start adapting and learning!
  Communicate & collaborate

Components of vulnerability

Vulnerability = Exposure X Sensitivity

- Adaptive capacity

Sensitivity checklist

- Temperature tolerance, ability to move
- Drought tolerance
- Dependence on a particular hydrologic regime
- Dependence on a particular disturbance regime
- Dependence/sensitivity to specific habitats or species interactions

  Is it there? (range changes, mortality)

  Is it there at the right time? (phenology)

Understanding adaptive potential
(Klausmeyer and Shaw 2009)

Intrinsic: Species-specific traits that facilitate an adaptive response (dispersal ability, genetic diversity).

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Management : The ability of a management system to facilitate adaptation, given institutional, regulatory, etc., constraints.

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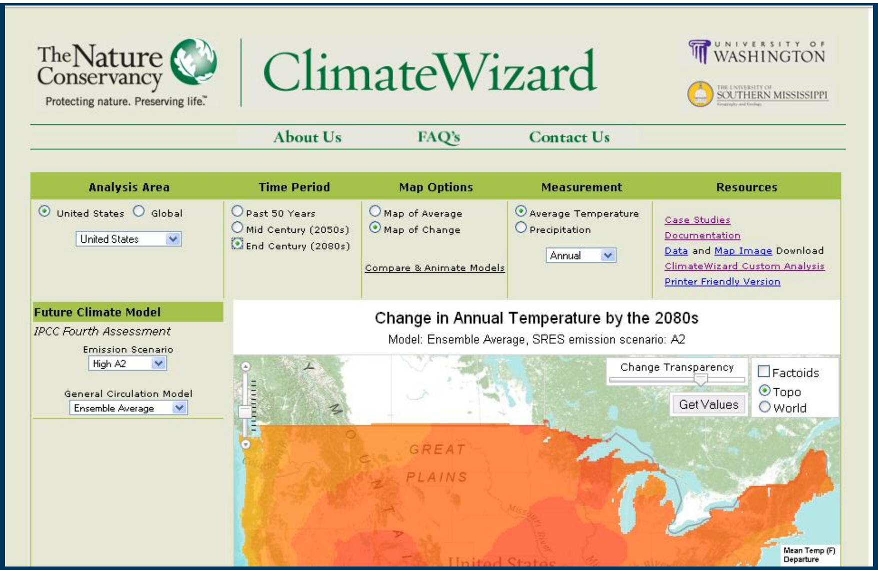
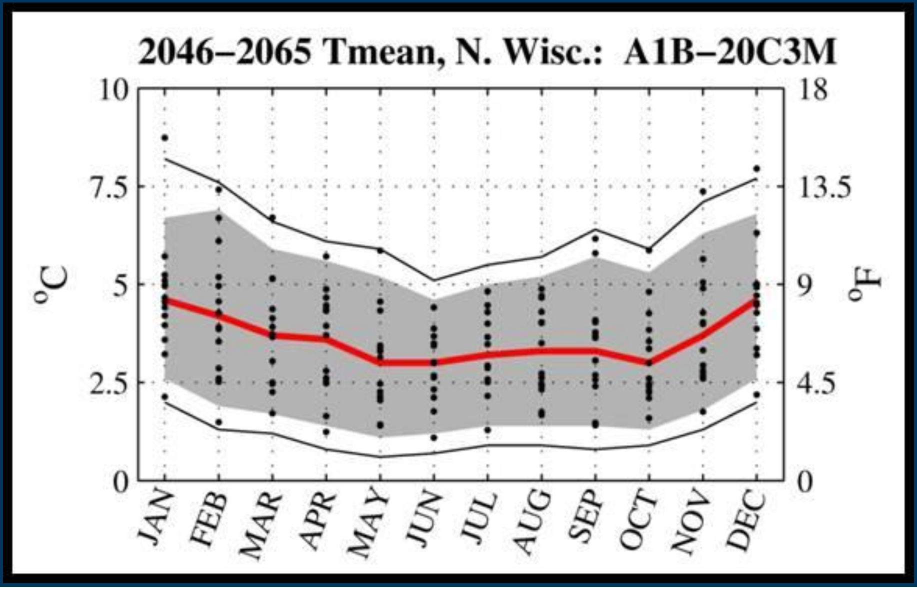
Collaborate with climate scientists…



climatewizard.org



WICCI Climate working group

www.wicci.wisc.edu

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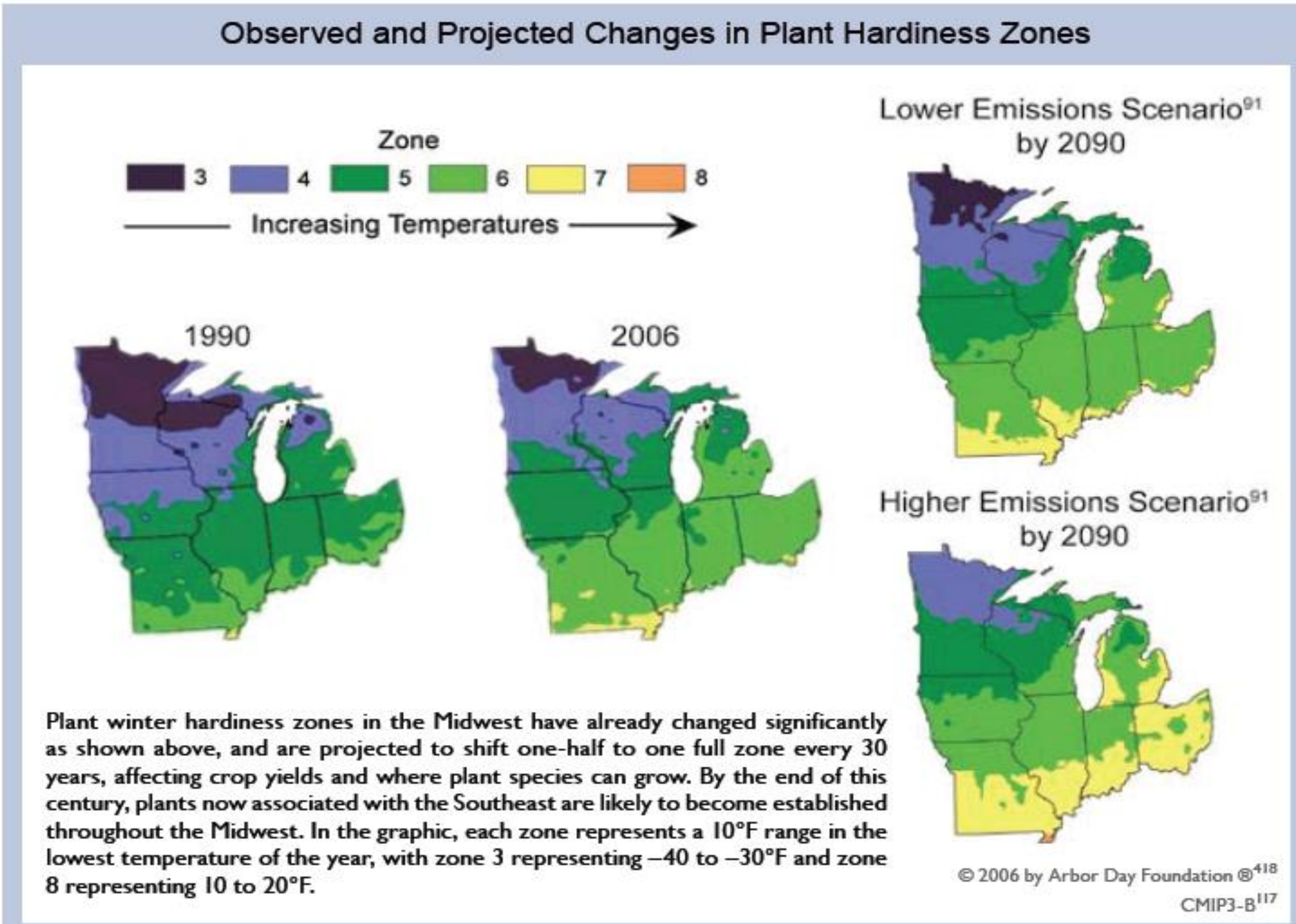
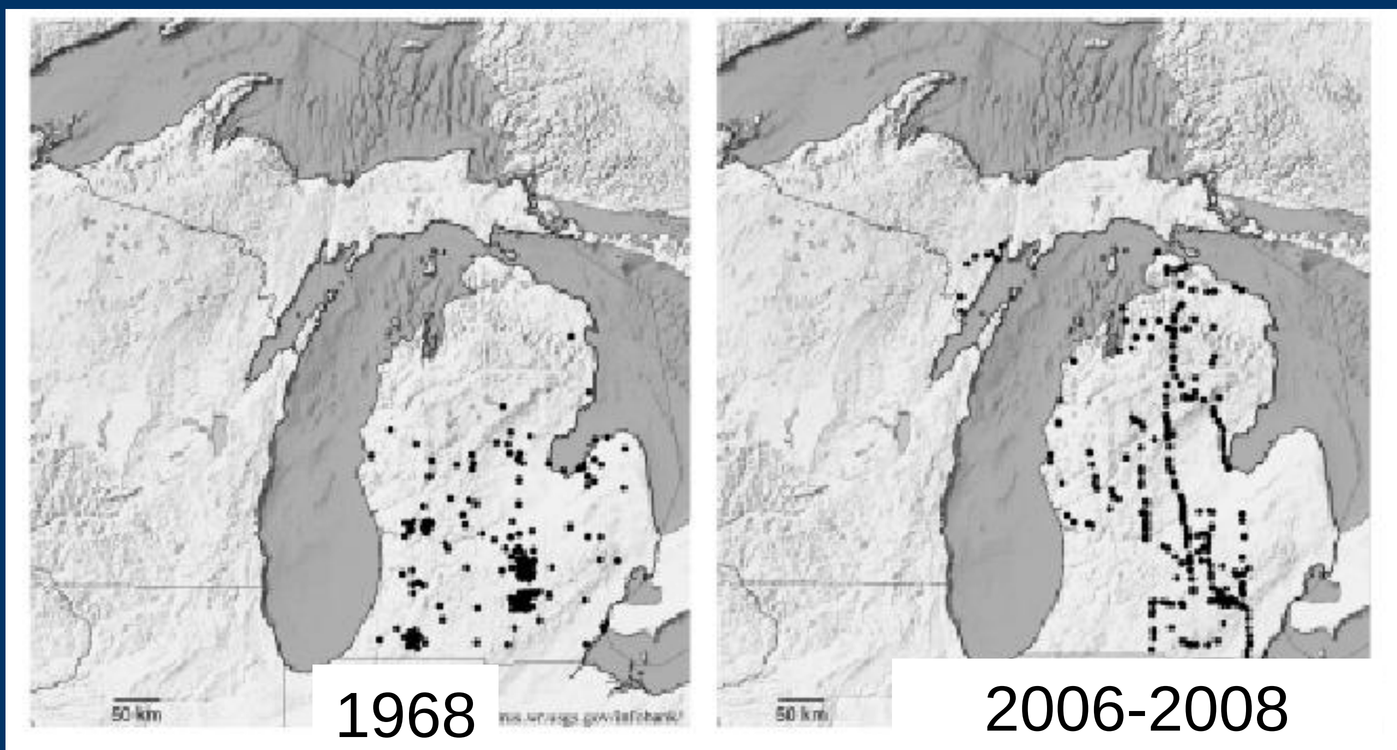
What data provide the best fit?

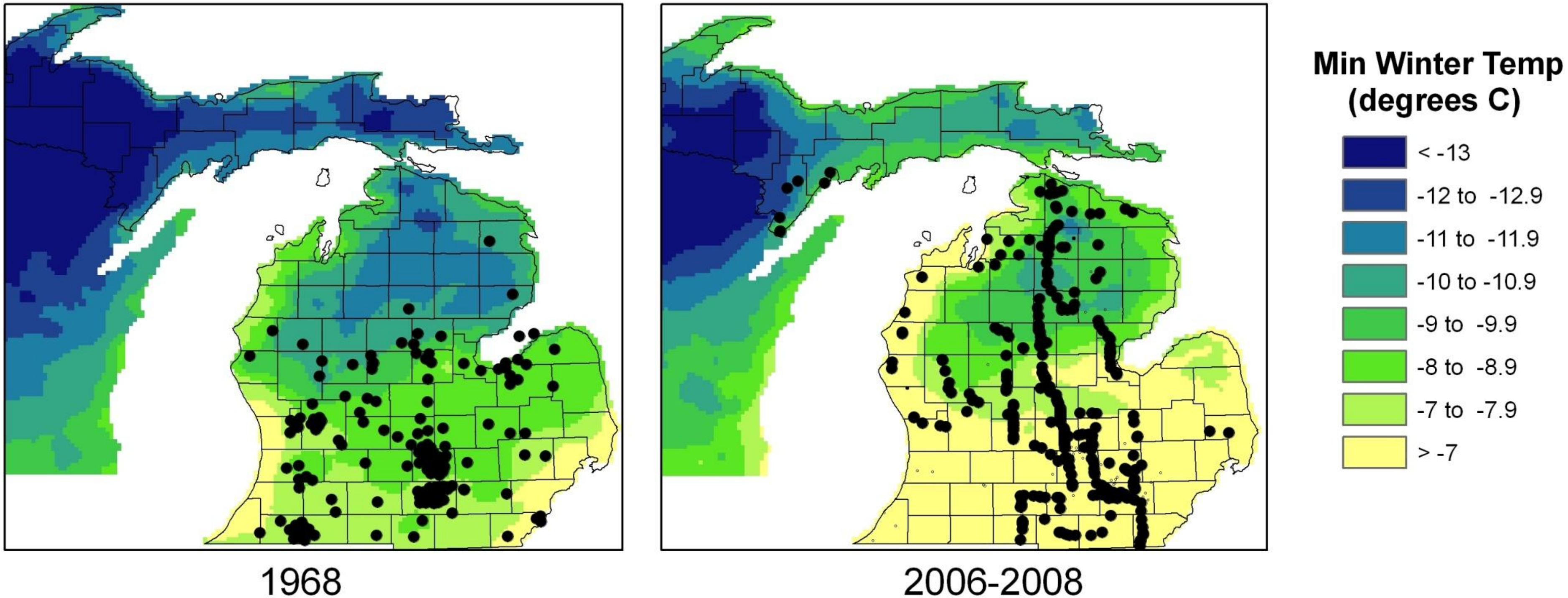


Communicate what we observe



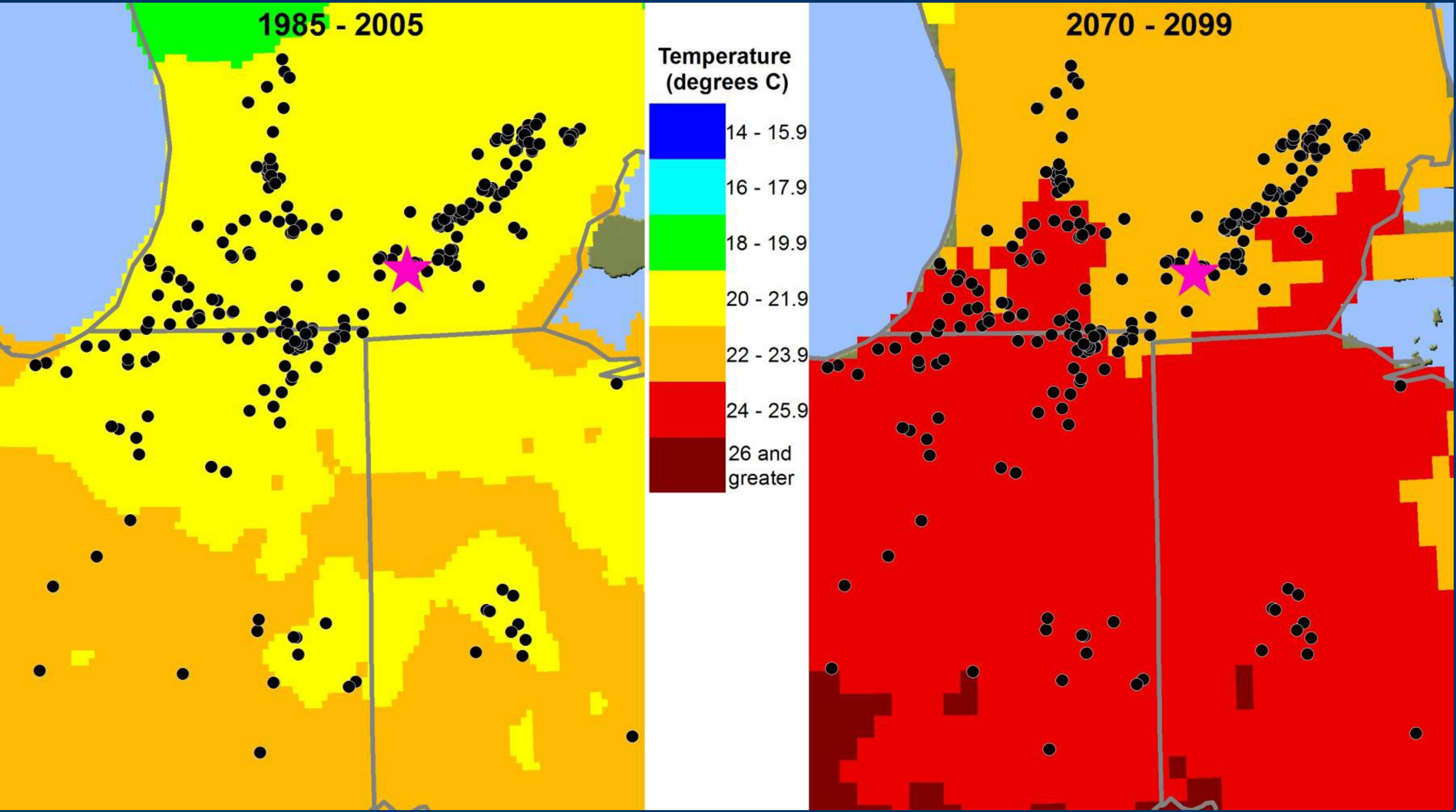
Common opossum distribution (Myers et al. 2009)

Communicate what we observe

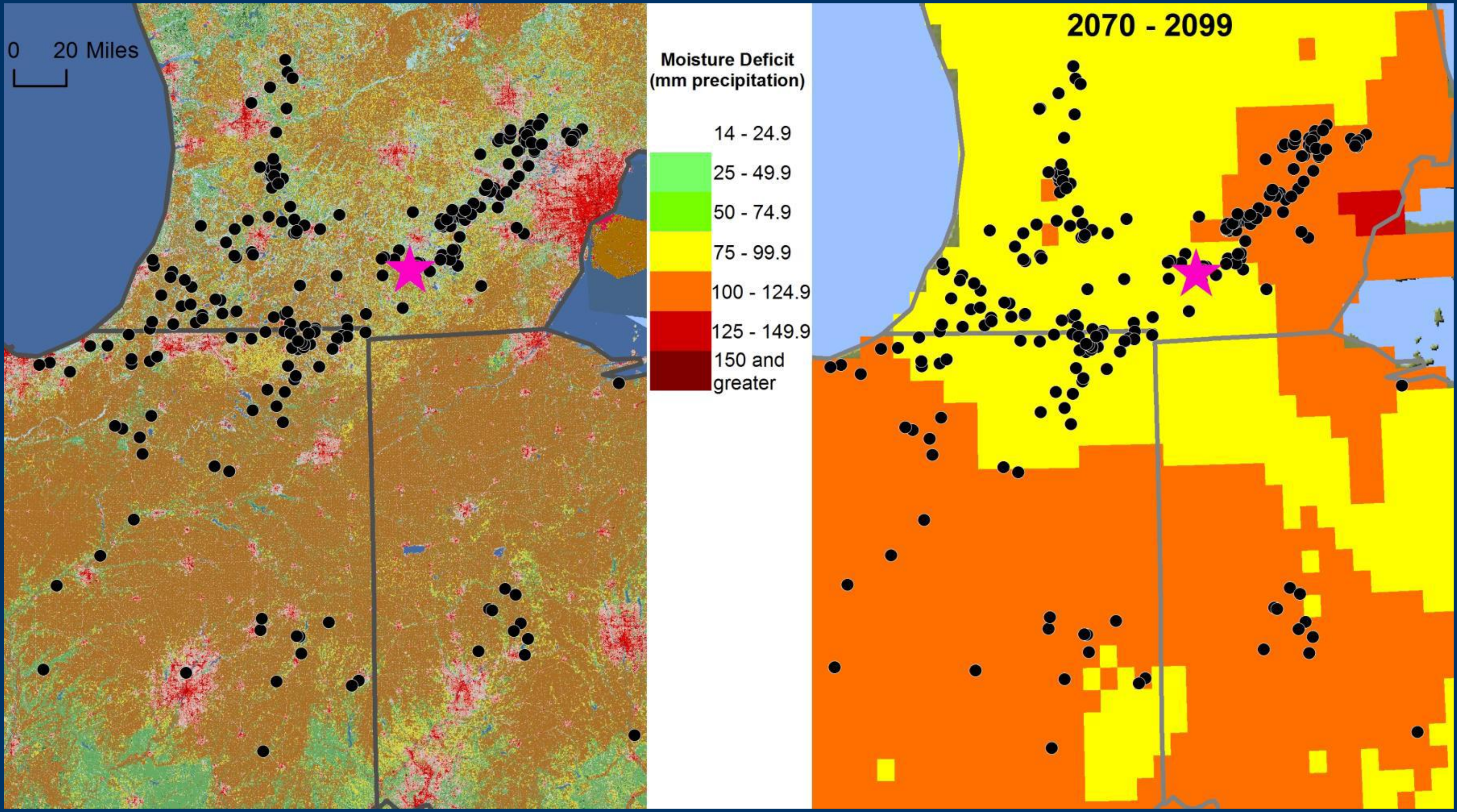


Common opossum distribution (Myers et al. 2009), linked with ClimateWizard temperature data

Connecting climate data to prairie fen conservation: Can we organize learning across gradients?

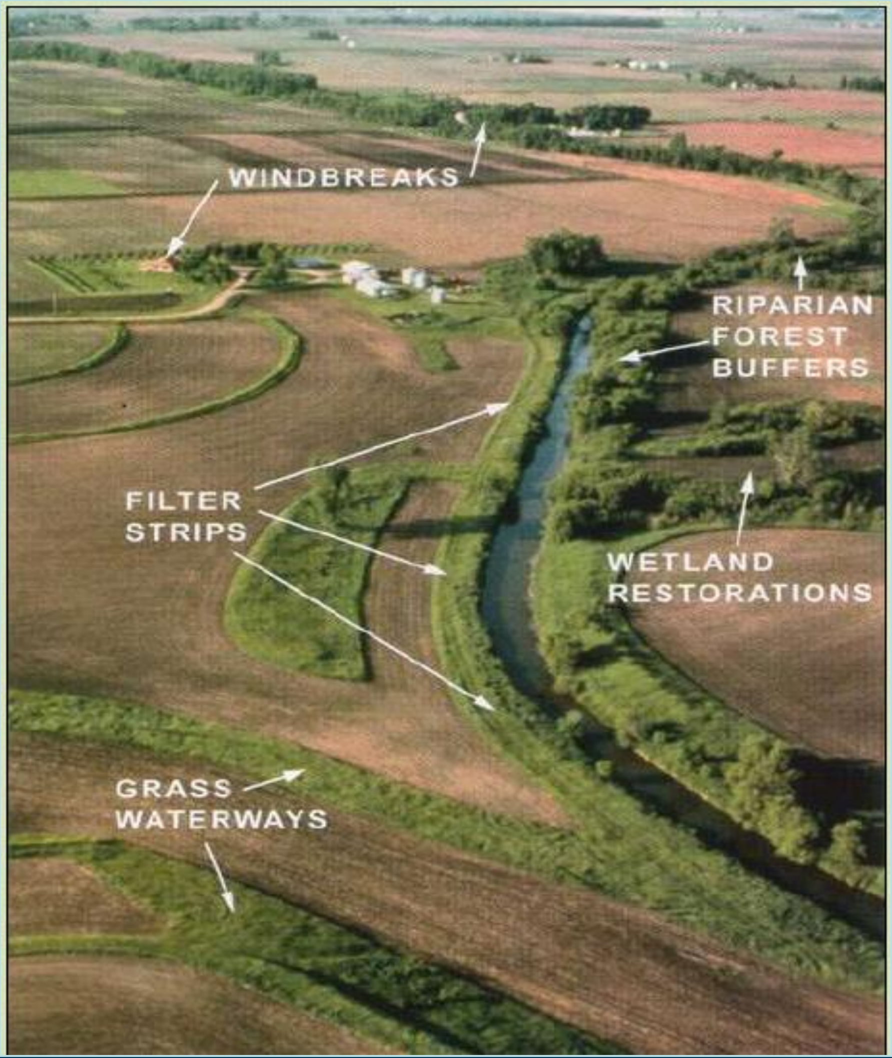


Prairie fen strategies – mapping drought stress (moisture deficit) to help anticipate future threats



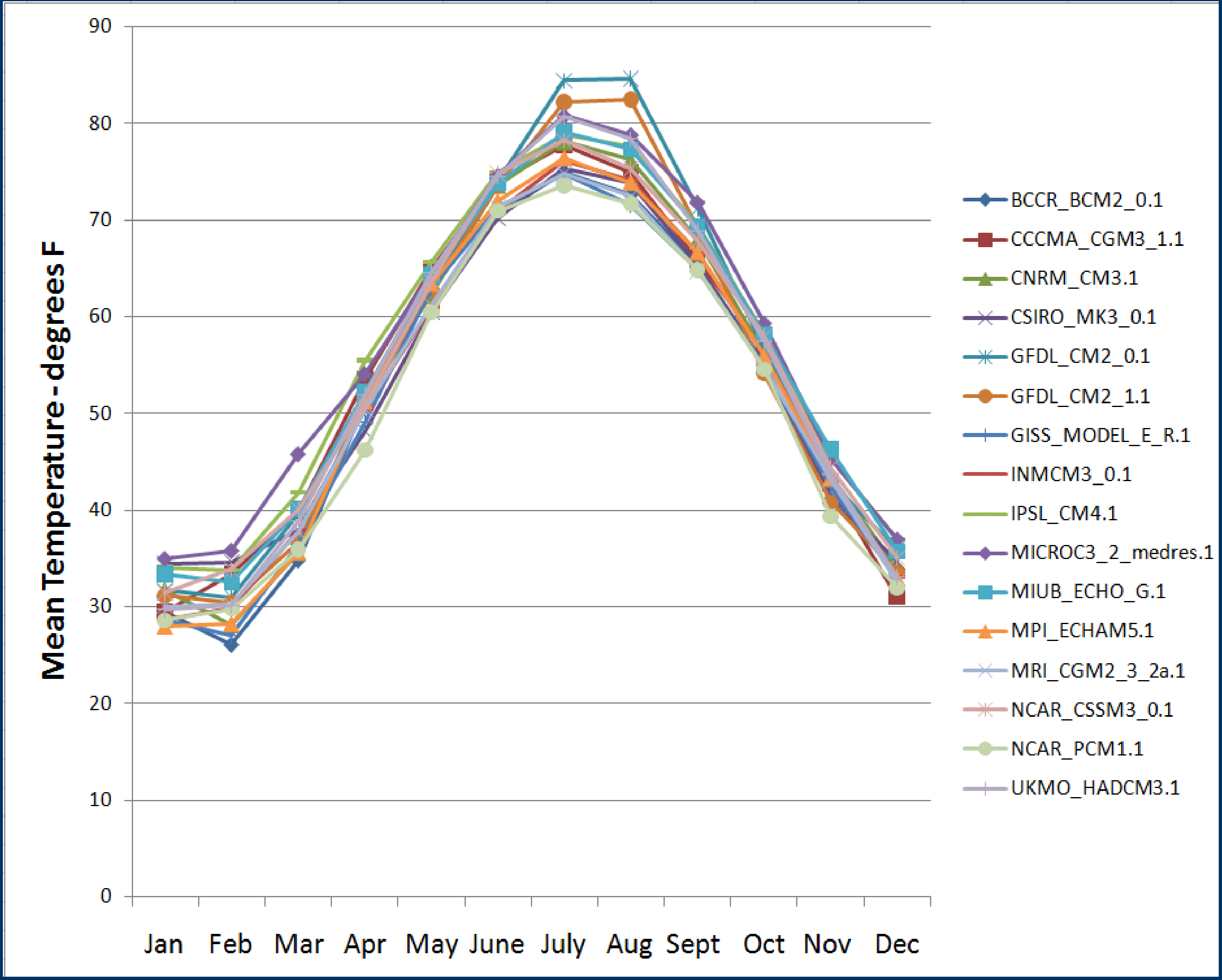
Start with something you know...

Partnership with MSU/Ag Econ to use SWAT modeling to evaluate effectiveness of agricultural best management practices to improve conditions for fish in watersheds of Saginaw Bay

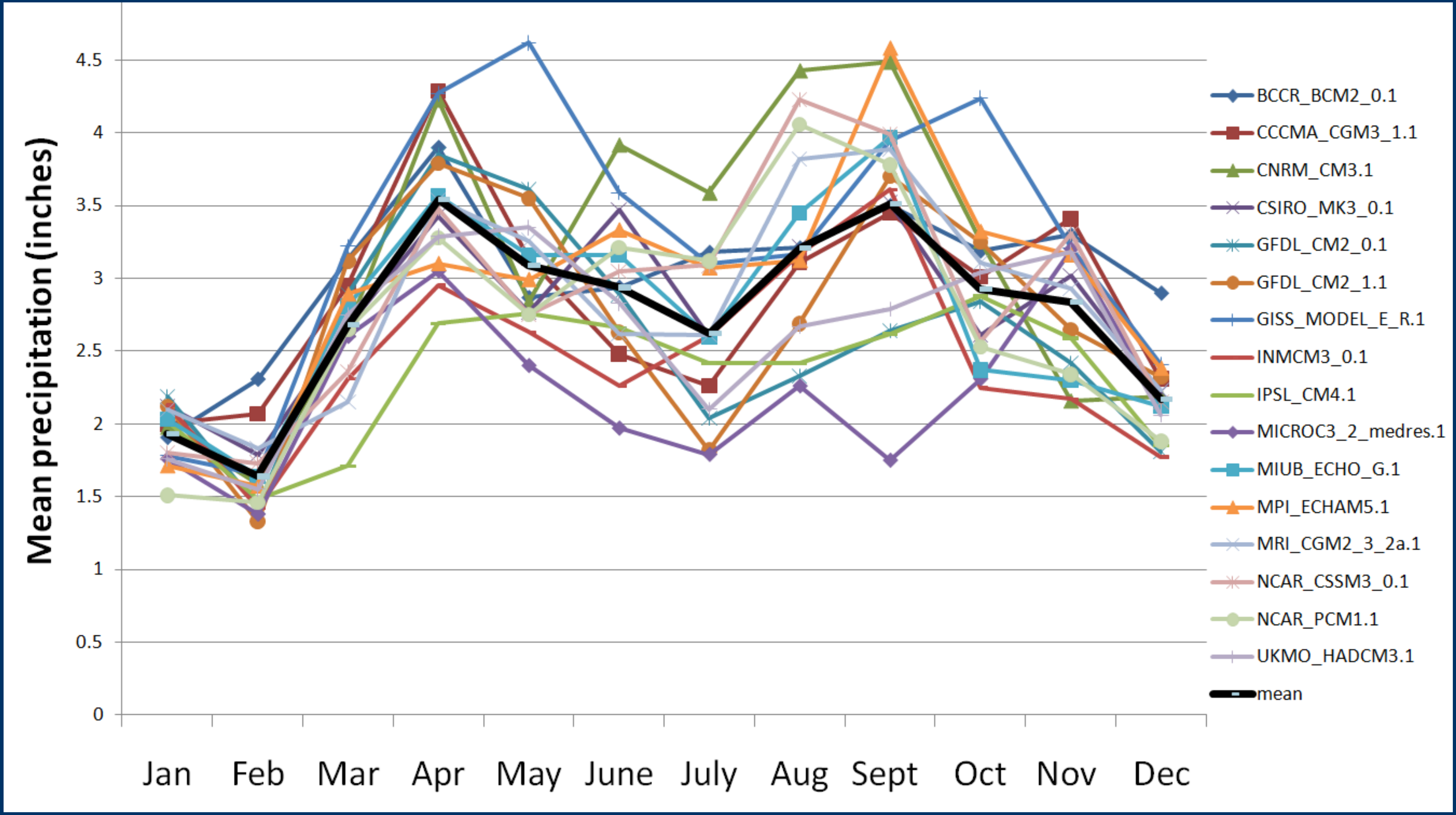


How do answers change under future climates?

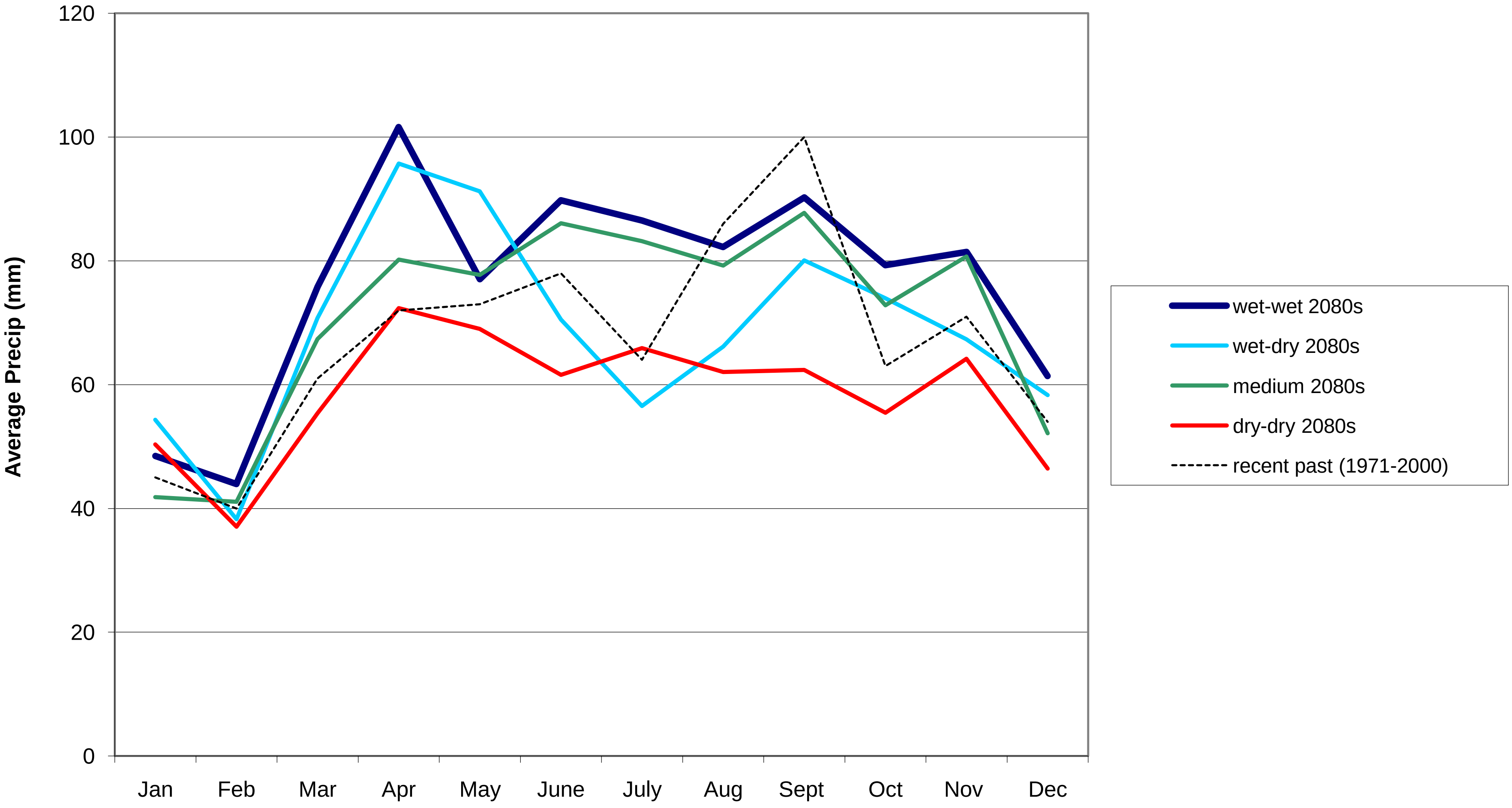
Saginaw Bay project area – model variability for temperature, 2080s



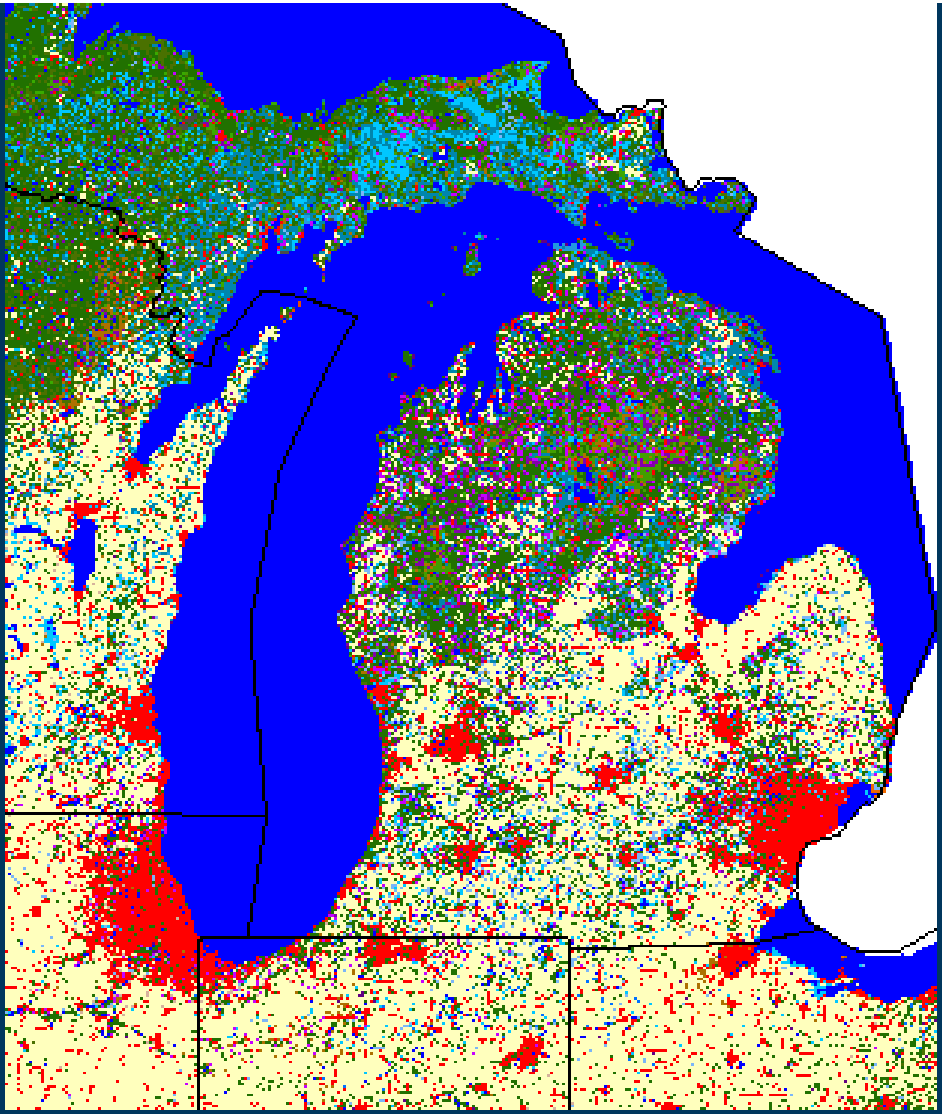
Saginaw Bay project area – model variability for temperature



Saginaw Bay project area – “custom” climate scenarios from subsets of models, informed by knowledge of the threat & fish ecology



Why we need good frameworks...



- Habitat loss & fragmentation
- Invasives
- Pollution
- Altered hydrology
- Altered disturbance regimes
- Resource extraction
- Dams & other barriers
- Disease

Source: USGS Gap/NBII Land Cover Viewer, 2010

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Moving forward: Don’t we know what to do?

1. **Increase connectivity** (design corridors, remove barriers to dispersal, restore habitat)
2. **Integrate climate change into planning** (e.g. reserve selection, pest outbreak & invasive species prediction, incentive programs for agricultural BMPs).
3. **Study species responses to climate** (physiological, behavioral, demographic)

Heller and Zavaleta – 2009 (Biological Conservation 142: 14-32)

Likely response....

How?

Where?

When?

Who?

Do this instead of what?   (who pays for it?)

We need frameworks for answering these questions systematically

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Collaboration is key

What do we want to protect?

What is the overall goal of adaptation planning & strategies?

Who needs to be at the table?

What **decisions** are we trying to inform?

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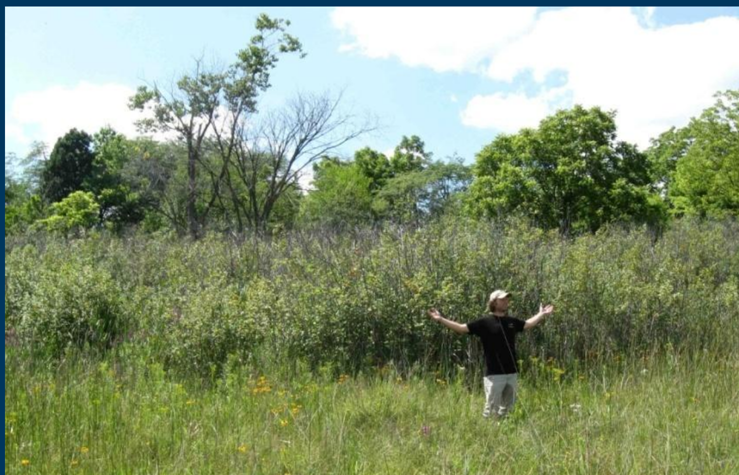
Acknowledgements



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