DEPARTMENT OF GEOGRAPHICAL SCIENCES

A Multi-State Evaluation of the Climate Change Preparedness of Terrestrial Protected Regions

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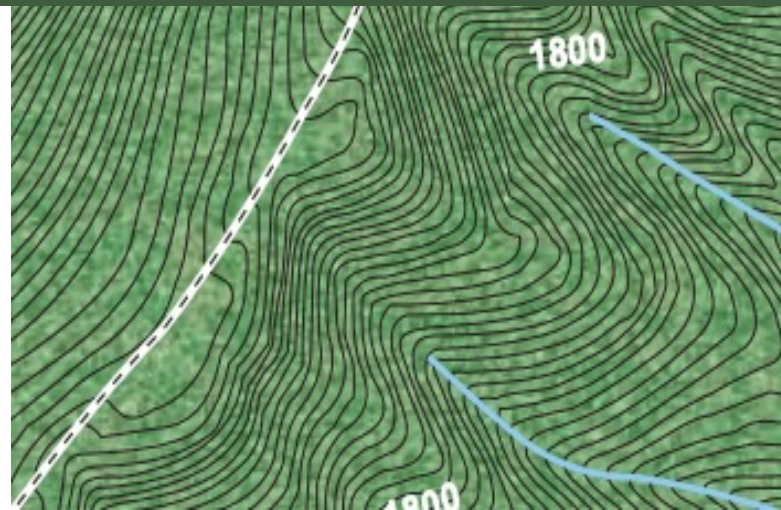
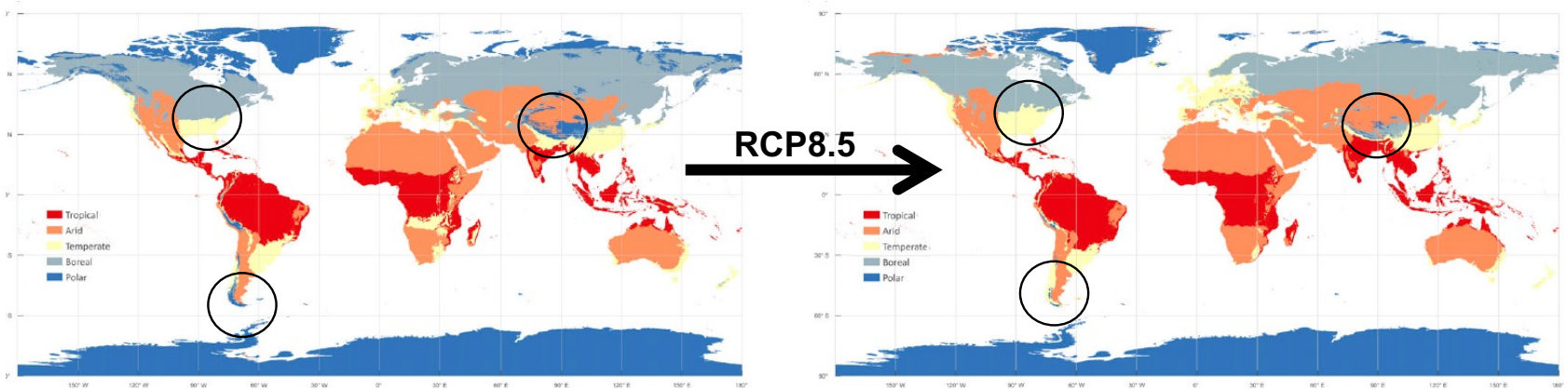


Climate change (CC) will cause a **redistribution of climate zones** across the landscape[1]



1980-2016 2070-2100 Beck et al., 2018

The **climate velocity** (km/yr) measures the speed and direction at which the climate changes over time[1,3]

Protected areas (PAs) are the best tool for preserving ecosystems[2]

- Current PA management design is **outdated** in climate change **mitigation** and **adaptation**[4]
- Evaluating the climate change vulnerability of PAs is valuable for **species conservation**, **resource management**, and **climate action planning**

NAIC Cooperation for Wilderness and Protected Area Conservation (2012)

IUCN World Parks Congress (2014)

(1) Chen et al., 2011; Loarie et al., 2009; Cui et al., 2021 (2) Brito-Morales et al., 2018; Ackerly et al., 2010 (3) Carroll et al., 2017 (4) Araújo et al., 2004

Are terrestrial protected areas adequately prepared for incoming climate changes?

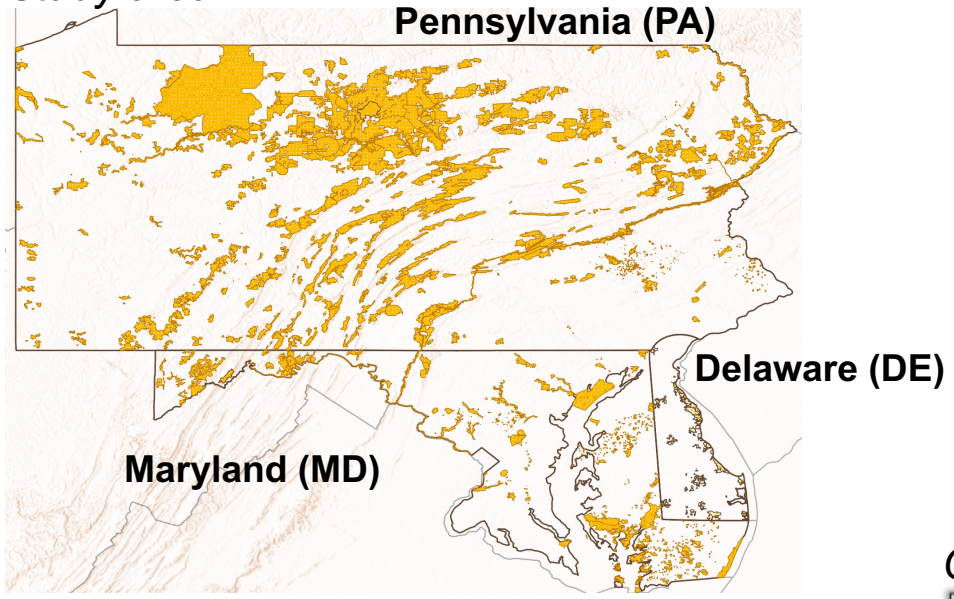
Estimate the magnitude
of threat by calculating
climate velocity of PAs

Assess their adaptive capacity
to deal with incoming changes
by scoring associated plans for
CC preparedness

Policy relevant research

Climate Change Risk Framework

Study area



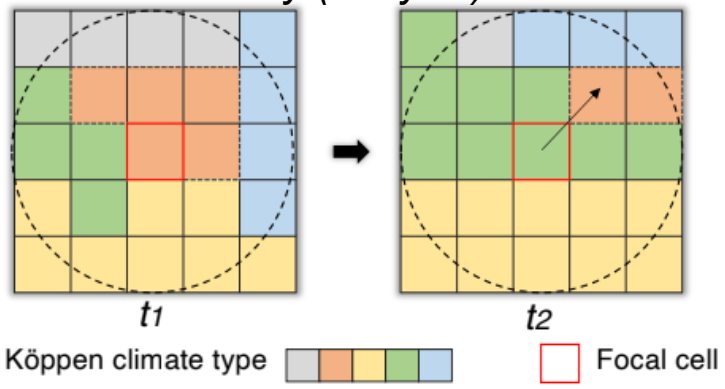
Data sources

- US Census Bureau + State agency's vector boundaries
- Koppen Climate Classifications (Cui et al., 2021)
- Climate zone velocity grids (Cui et al., 2022 in prep)
- World Database on Protected Areas (WDPA) - federal
- USGS-Protected Area Database (PAD) - local

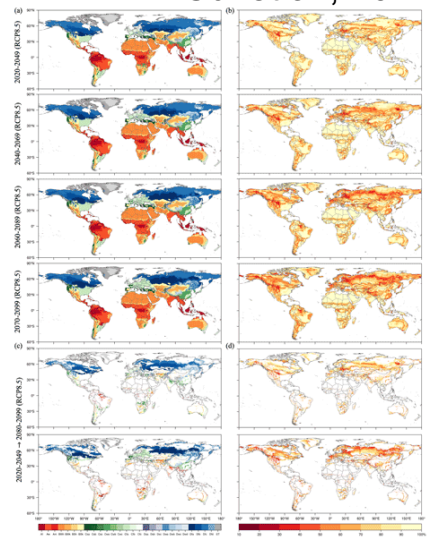
Methods

- Köppen-Geiger Classification Maps
  - Future (2020-2099)
- Climate zone velocity calculation
  - Bioclimatic variables
  - Various time stamps
  - Topography

Climate velocity (km yr $^{-1}$)

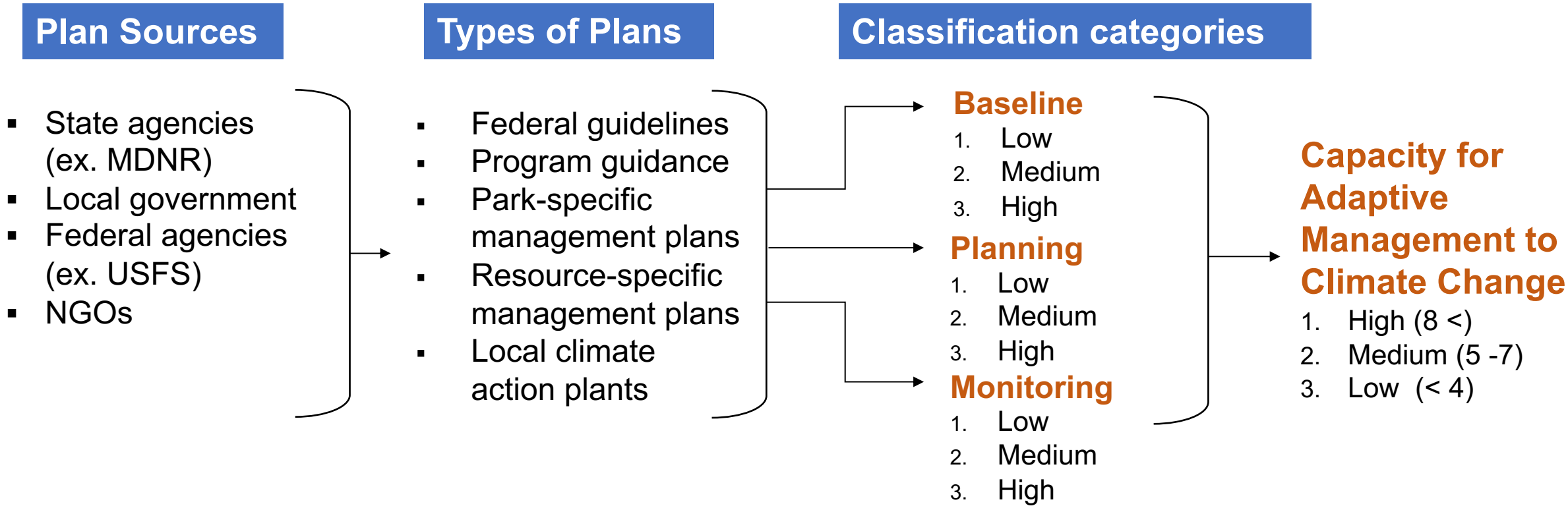


Cui et al., 2021



B22D-1473 - Potential shifts of climate zones in global terrestrial protected areas and implications for biodiversity conservation
Tues, Dec 13 9:00am-12:30pm| Poster Hall, Hall A (South, Level 3)

Climate Change Preparedness Framework



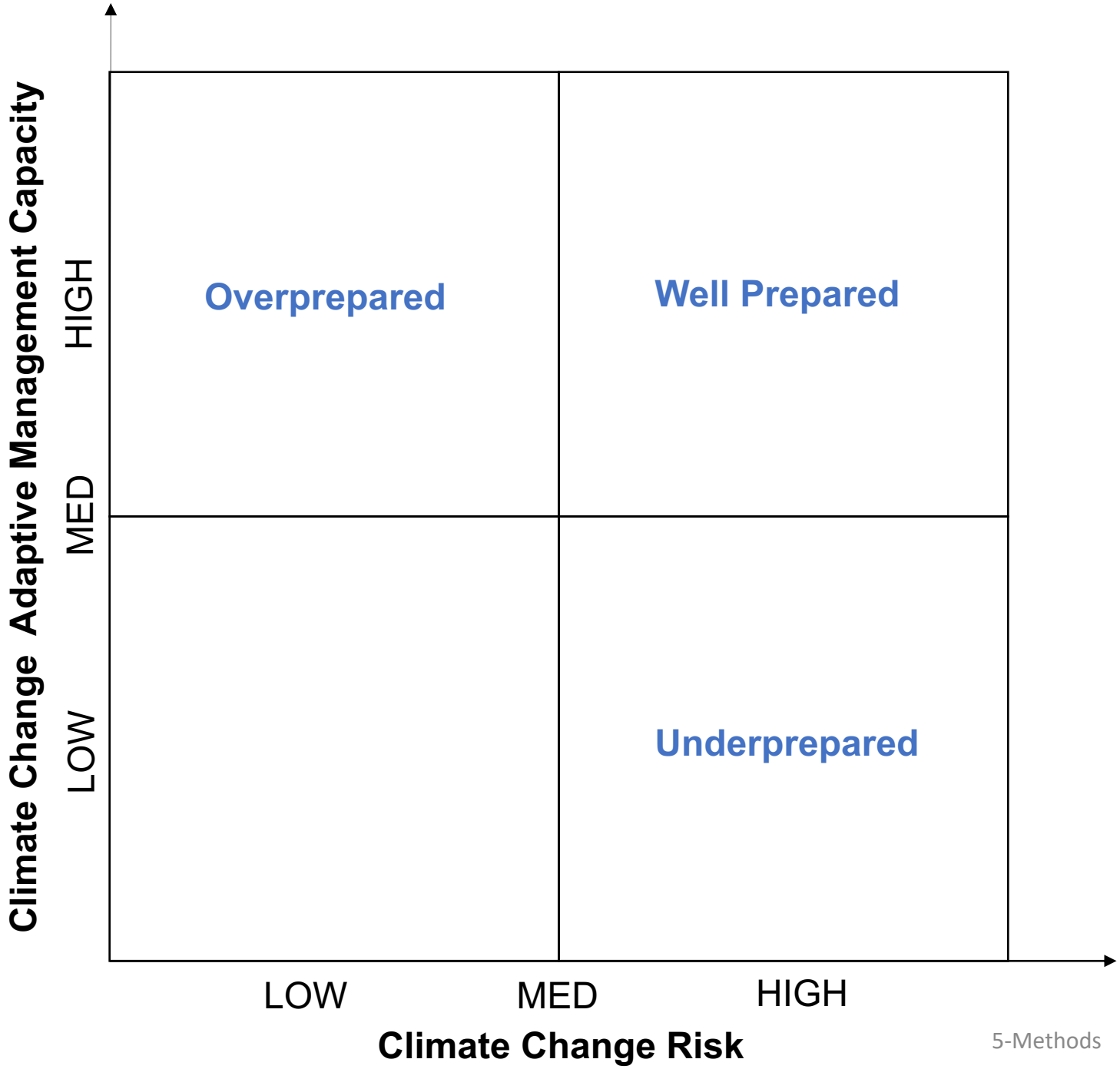
Baseline: Awareness of CC impacts to managed resources
Planning: Level of planned management response to known risk
Monitoring: Planned monitoring and assessment for ongoing planning

Climate Change Preparedness Matrix

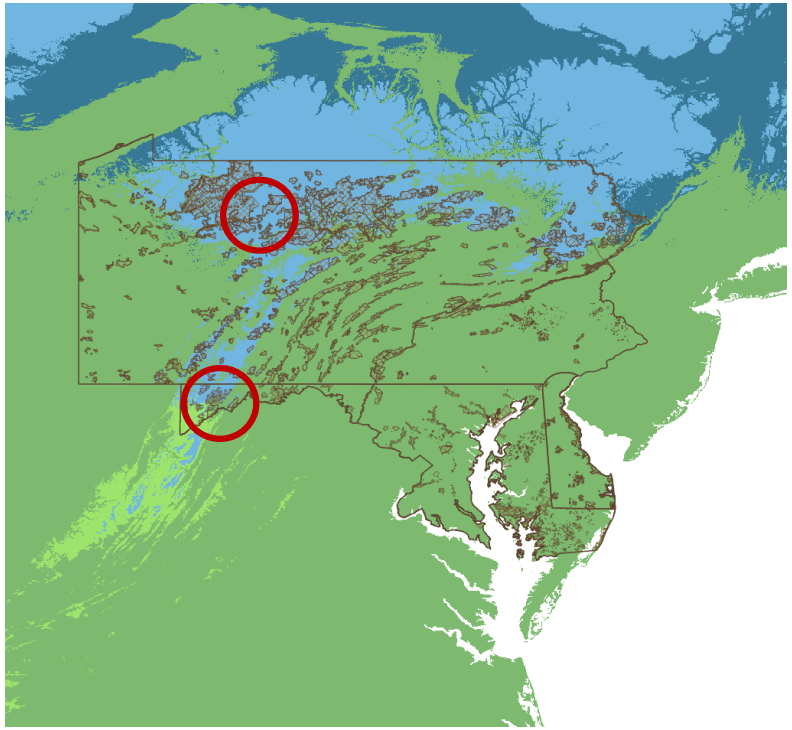
Protected areas and its associated management plans scored for **climate change preparedness** based on:

1. Climate change risk

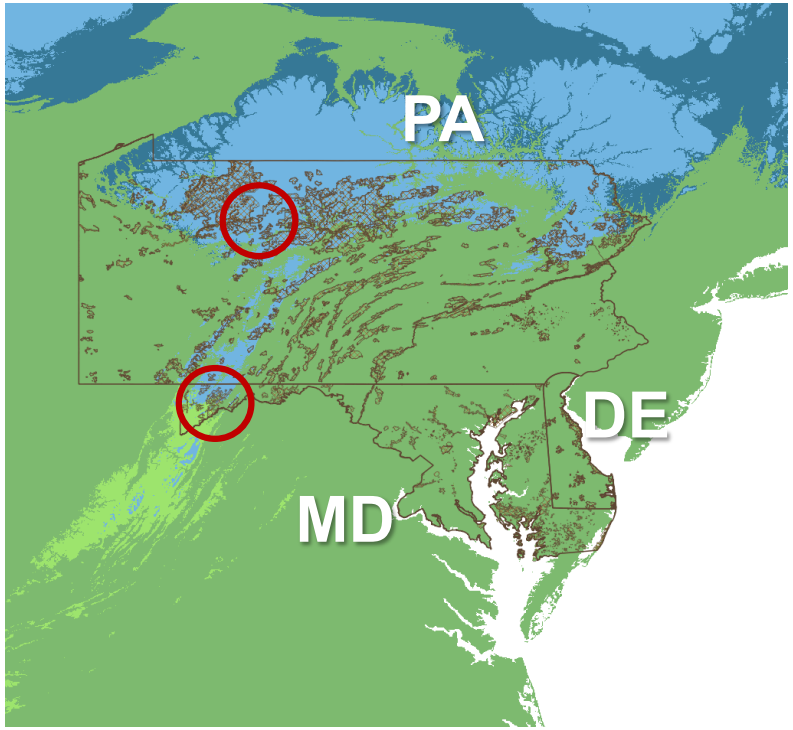
2. Climate change adaptative management capacity



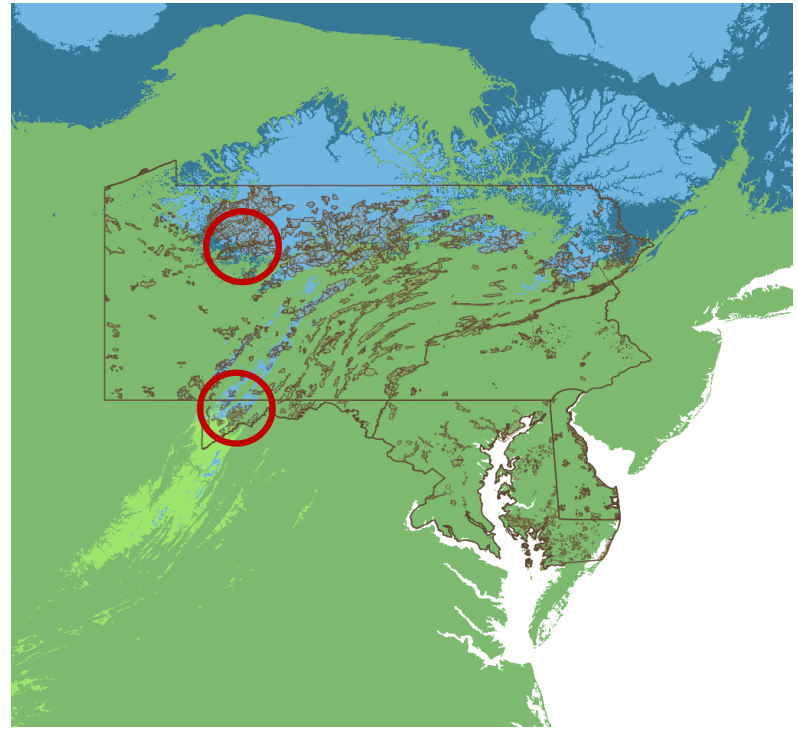
Shifts in Climate Zones 2020-2099



RCP2.6



RCP4.5



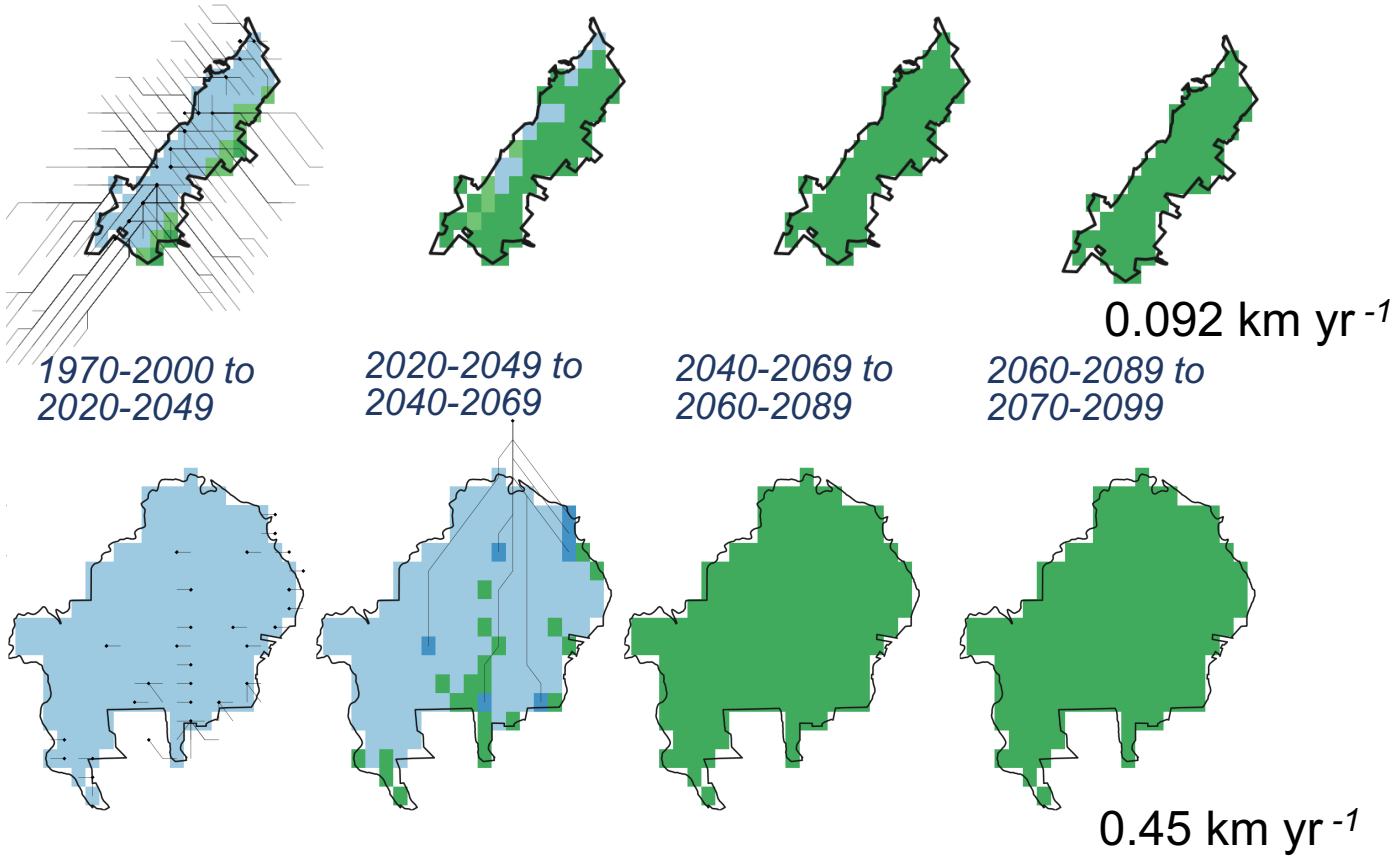
RCP8.5

- **cfa** - Temperate, without dry season, hot summer
- **cfb** - Temperate, without dry season, warm summer
- **dfa** - Boreal, without dry season, hot summer
- **dfb** - Boreal, without dry season, warm summer

- Projected shifts **poleward** and **upward**
- Some PAs undergo up to **3 climate zone changes**

Preliminary Results: MD vs PA Case Study

Dans Mountain Wildlife Management Area (WMA), MD, USA



Susquehannock State Forest, Hammersley Wild Area, PA, USA

Climate Cfa Dfa Dfb Cfb

RCP8.5

WMA 15-Year Vision Plan, 2016

- IUCN V – Protected Landscape
- Capacity for Adaptive Mgmt: **Medium**
  - **Baseline** - 0
  - **Planning** - 2
  - **Monitoring** – 4
- Preparedness Rank: **Moderately Underprepared**

Resource Management Plan, 2016 + Management Activity Plan, 2022

- IUCN VI – PA with sustainable use of natural resources
- Capacity for Adaptive Mgmt: **Low**
  - **Baseline** - 1
  - **Planning** - 0
  - **Monitoring** – 1
- Preparedness Rank: **Highly Underprepared**

Conclusions

- In **~50 years**, most PAs will have **new climates**
- **Minimal adaptive capacity** and overall **little preparation** for CC related impacts

Scale this approach to other states (ex. DE) and quantify impacts towards biodiversity

Recommendations

- Incorporate **updated climate science** and **data** into planning
- **Interagency** and **multilateral** coordination
- **Collaborative** and **adaptive** scales of management

Thank you!
Any questions?

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Learn more about calculating climate velocity in PAs

Diyang Cui - Tuesday, Dec 13 9:00-12:30
Poster Hall, Hall A (South, Level 3)
B22D-1473 - Potential shifts of climate zones in global terrestrial protected areas and implications for biodiversity conservation

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