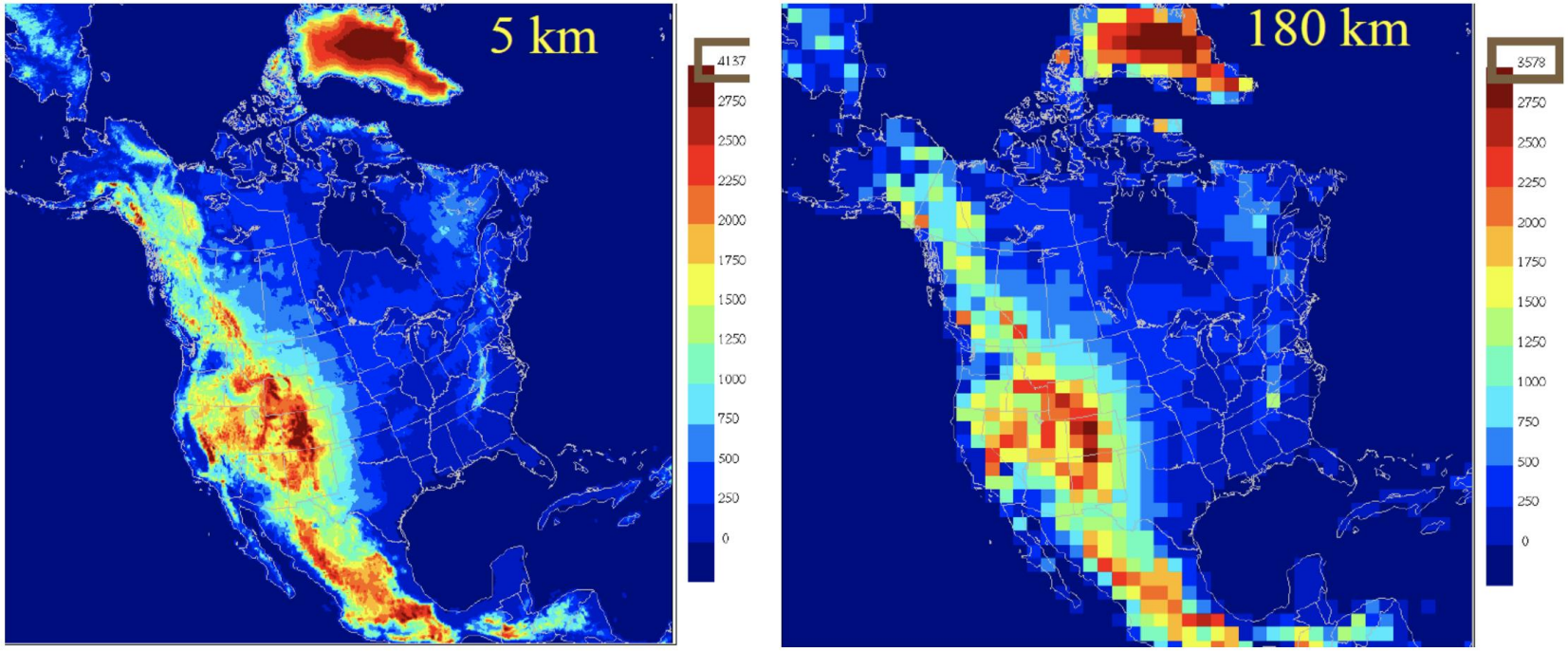
Downscaling Techniques



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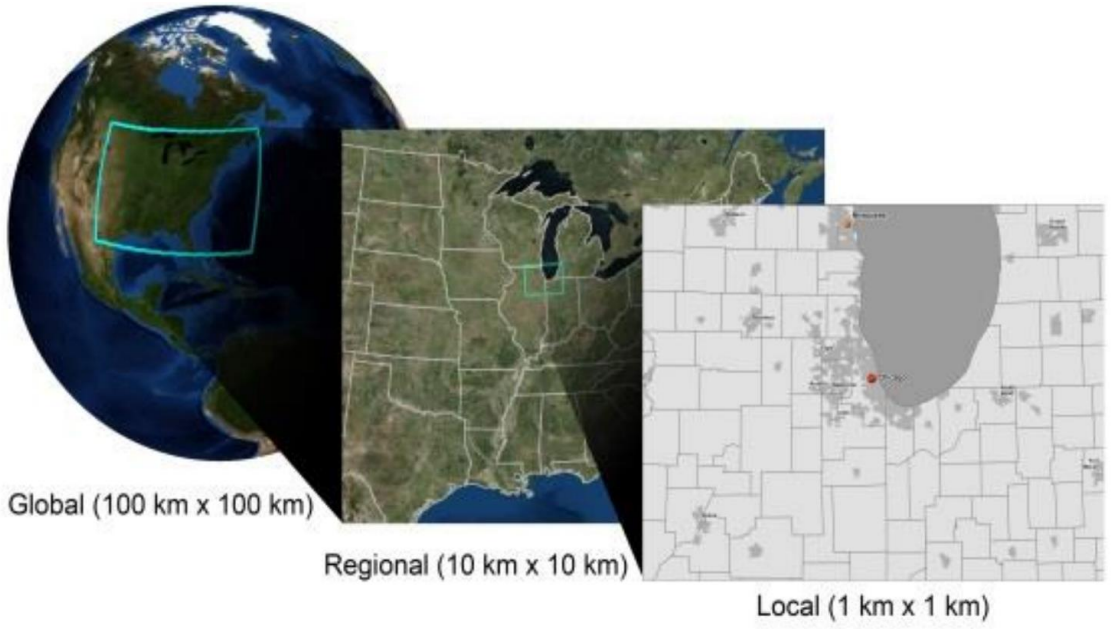
Downscaling Techniques

- Simple & Complex Statistical
  - delta method
  - bias-adjustment + spatial disaggregation
  - weather typing
  - weather generators
  - neural networks*
- Hybrid/Quasi-Dynamical
  - statistical emulators (using a limited set of dynamical simulations)
  - intermediate complexity models*
- Dynamical
  - regional (earth system) models*
  - variable resolution AGCMs*



*Emerging Innovations

Pros (+) and Cons (-)

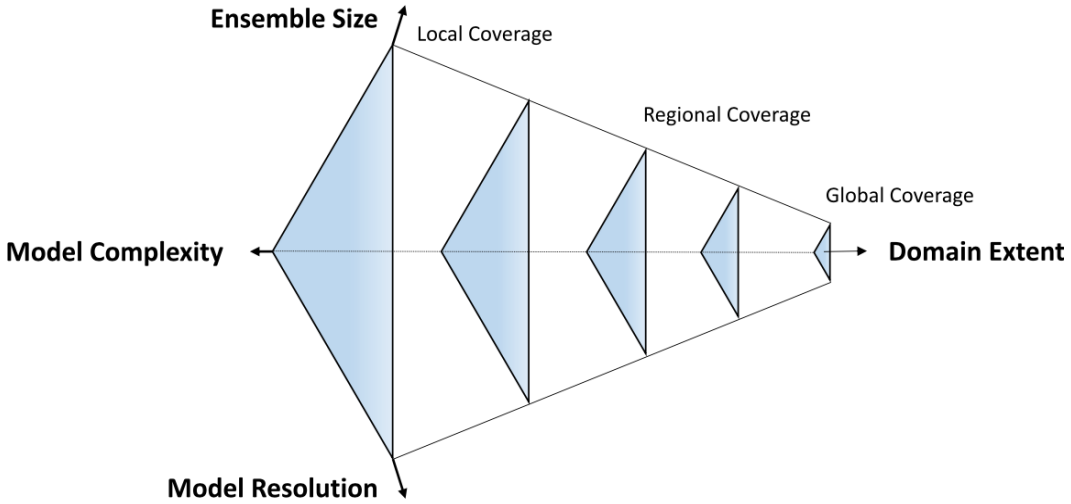


Fig. 3. A depiction of the allowed state space for modeling experiments given a prescribed limit on computational resources. Reducing the domain extent allows for more options for model resolution, ensemble size, and model complexity.
Gutowski et al. 2020, BAMS

<u>Dynamical</u>

+ represents physical processes
+ no stationarity assumption
+ physical consistency between variables
- resource intensive/computationally expensive
- smaller ensembles
- data availability limited

<u>Simple and Statistical</u>

+ computationally inexpensive
+ larger ensembles
+ many available datasets
+ consistent with observations (bias-adjusted)
- stationarity assumed
- may not represent climate change signal correctly, no local-scale projection feedbacks
- fewer variables

Grand Challenges

- Data quantity and usefulness.
- Does the method produce credible future projections?
  - Historical accuracy?
  - Physically consistent and plausible projections?
- Is this method fit for purpose?
  - Which method should be used?
  - Was this designed with your application in mind?

A few resources:

- https://na-cordex.org/guidance-data-use.html
  - SERDP Report: Use of Climate Information for Decision-Making and Impacts Research (Kotamarthi et al. 2016)
  - EURO-CORDEX Guidance for Data Use
  - Which model should I use?
- Book: Downscaling Techniques for High-Resolution Climate Projections From Global Change to Local Impacts, 2021 (grew from the above report)
- Book: Downscaling of Climate Information. In: Climate Modelling, Philosophical and Conceptual Issues, 2018 (free download through some institutions)