ENVIRONMENTAL
SCIENCE
DIVISION

AI APPLICATIONS TO CLIMATE SCIENCE

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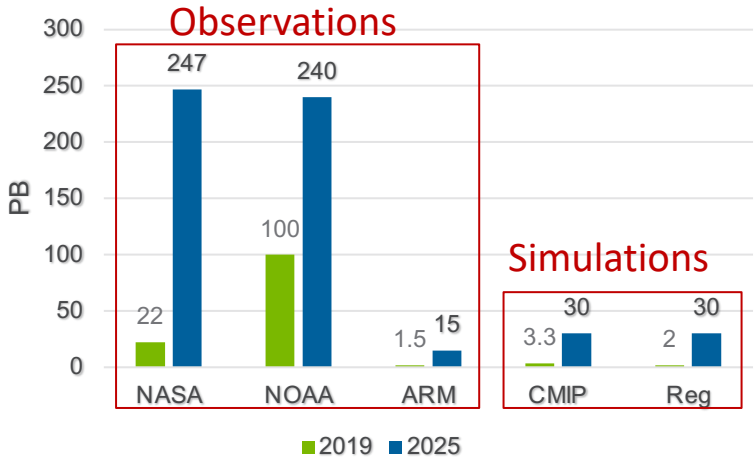
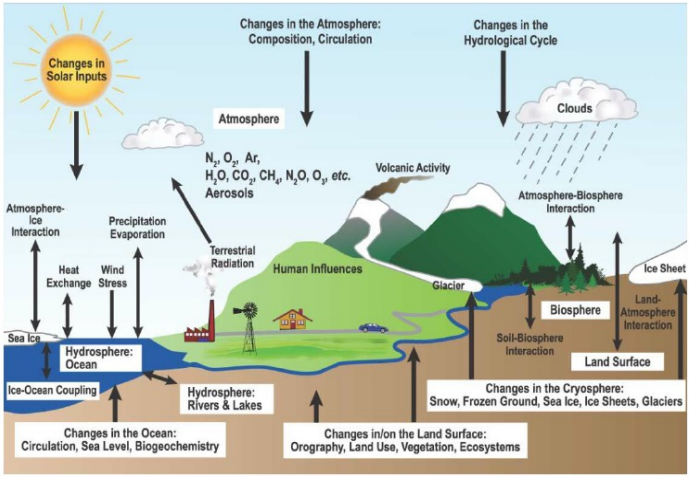
WHY?

- Multiscale datasets in earth sciences are abundant and increasing in volume



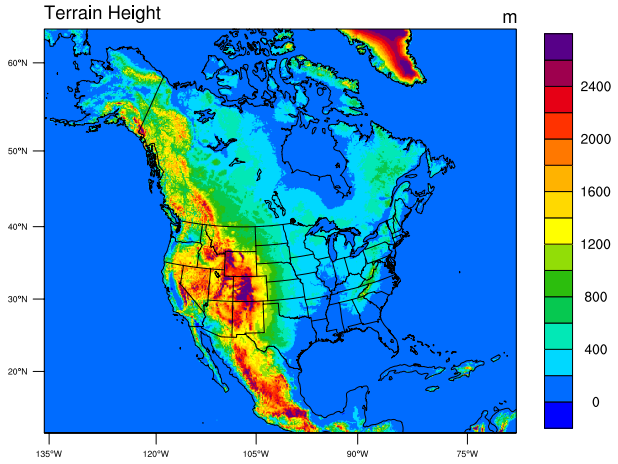
Earth System

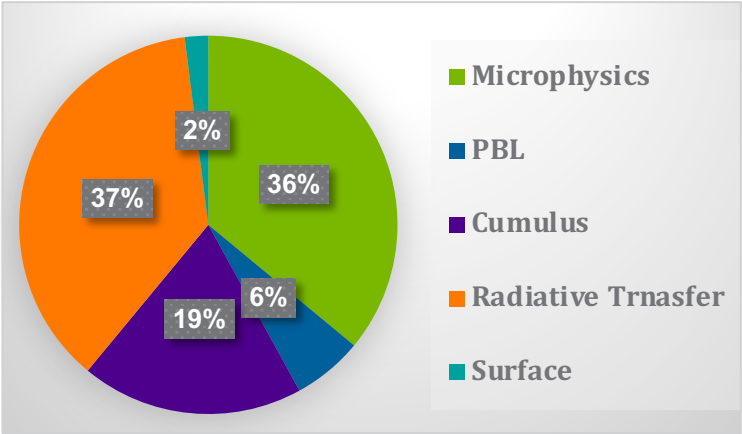


- Development of an accepted process scale model (physics-based) takes several years

STATE-OF-THE-ART CLIMATE MODELS

It takes 2 wks to simulate 1-yr over entire North America at 4km resolution using 300K CPU hours.

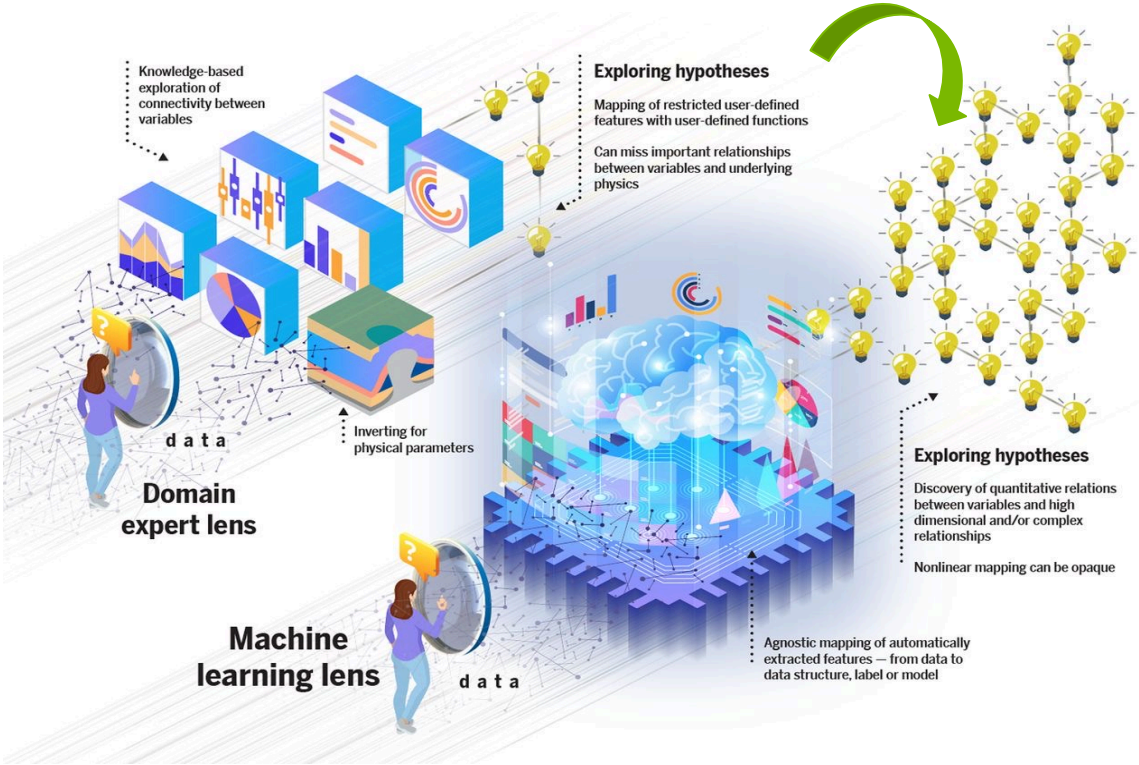




EXAMPLES OF AI APPLICATIONS

- **Develop AI emulators/surrogates for the most expensive physics schemes.**
  - ➢ **A lot of simulations to better quantify uncertainties.**
- **Increase spatial and temporal resolutions to enable climate risk assessment at neighborhood scale.**

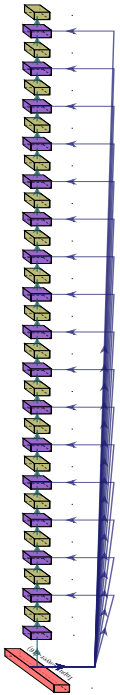
IMPORTANCE OF COLLABORATIONS



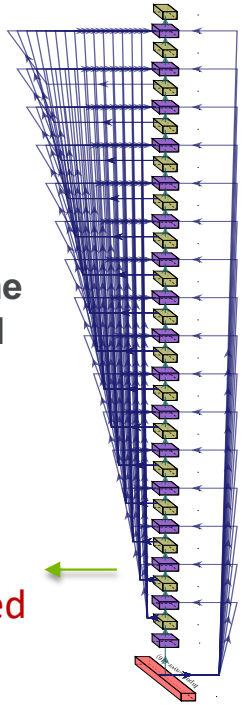
Bergen et al., Science, 2019

BUILDING A BOUNDARY LAYER AI-EMULATOR: TESTING THREE DIFFERENT HYPOTHESIS

Each atmospheric layer is only connected to the layer below (K diffusion)



Each layer is connected to the layer below and the surface (hybrid)



Each layer is connected to all layers below (non-local mixing)

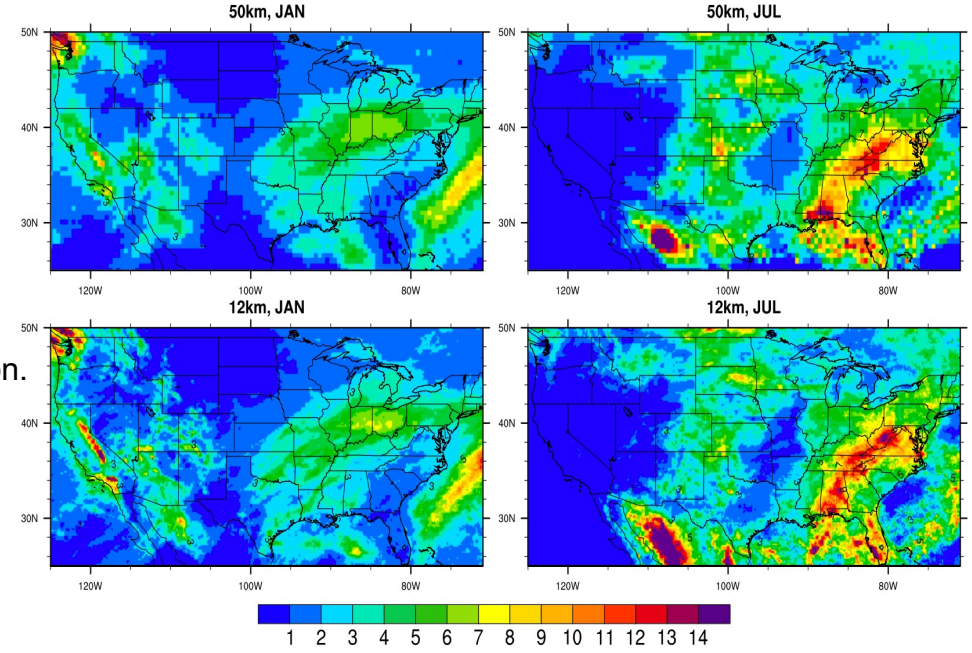
Physics embedded

Wang, Balaprakash and Kotamarthi 2019

FAST AND ACCURATE DOWNSCALING FOR PRECIPITATION

Regional climate model resolution causes image differences not only in resolution but also in geospatial pattern of precipitation. Because:

1. Resolution effect on physics parameterization.
2. Resolution effect on terrain.
3. Computing time steps.
4. Domain coverage.



Wang, Liu, Foster, Kotamarthi et al. 2021

THANK YOU AND QUESTIONS?