IHESD

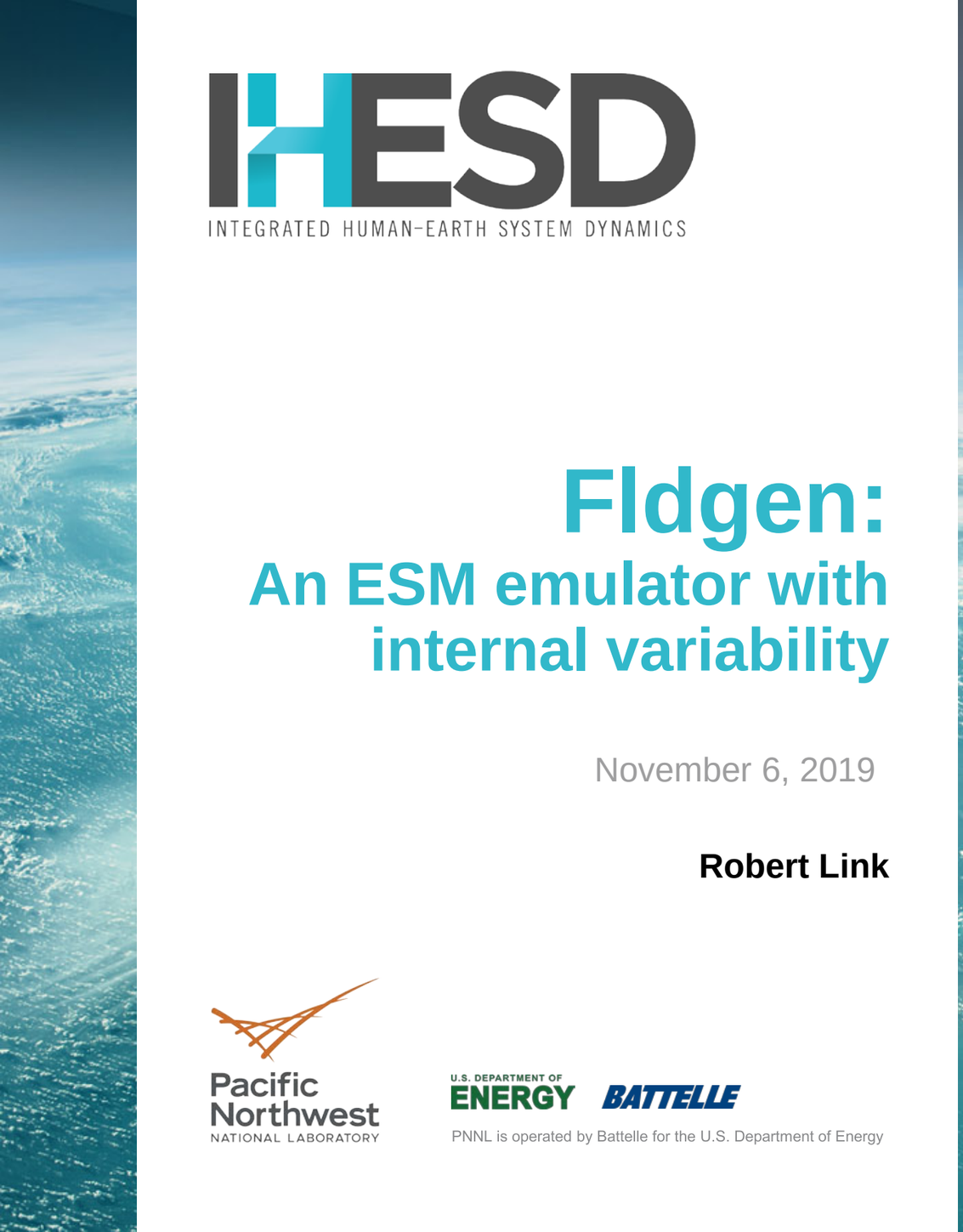
INTEGRATED HUMAN-EARTH SYSTEM DYNAMICS

Fldgen:

An ESM emulator with internal variability

November 6, 2019

Robert Link



Pacific Northwest NATIONAL LABORATORY

U.S. DEPARTMENT OF ENERGY BATTELLE

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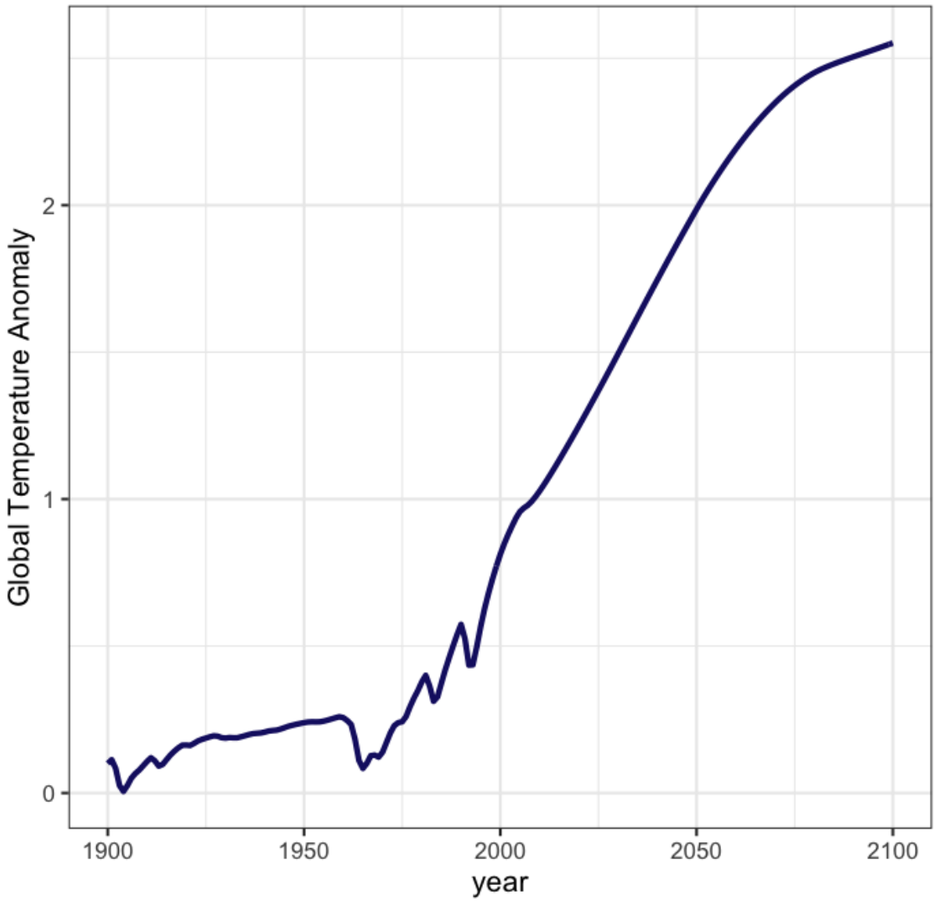
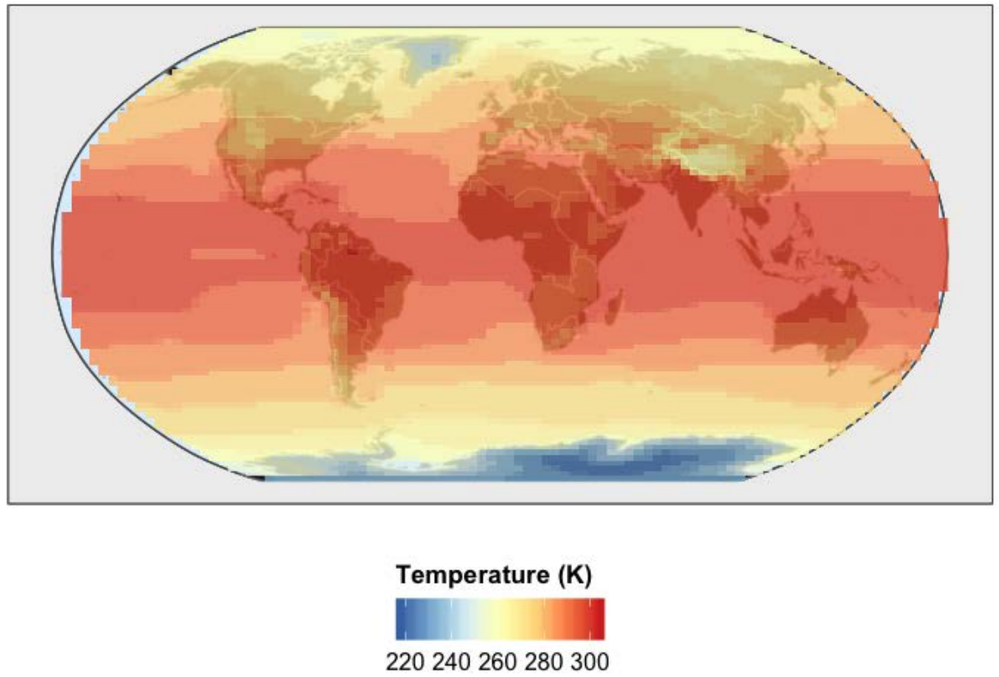
Emulators: what are they good for?





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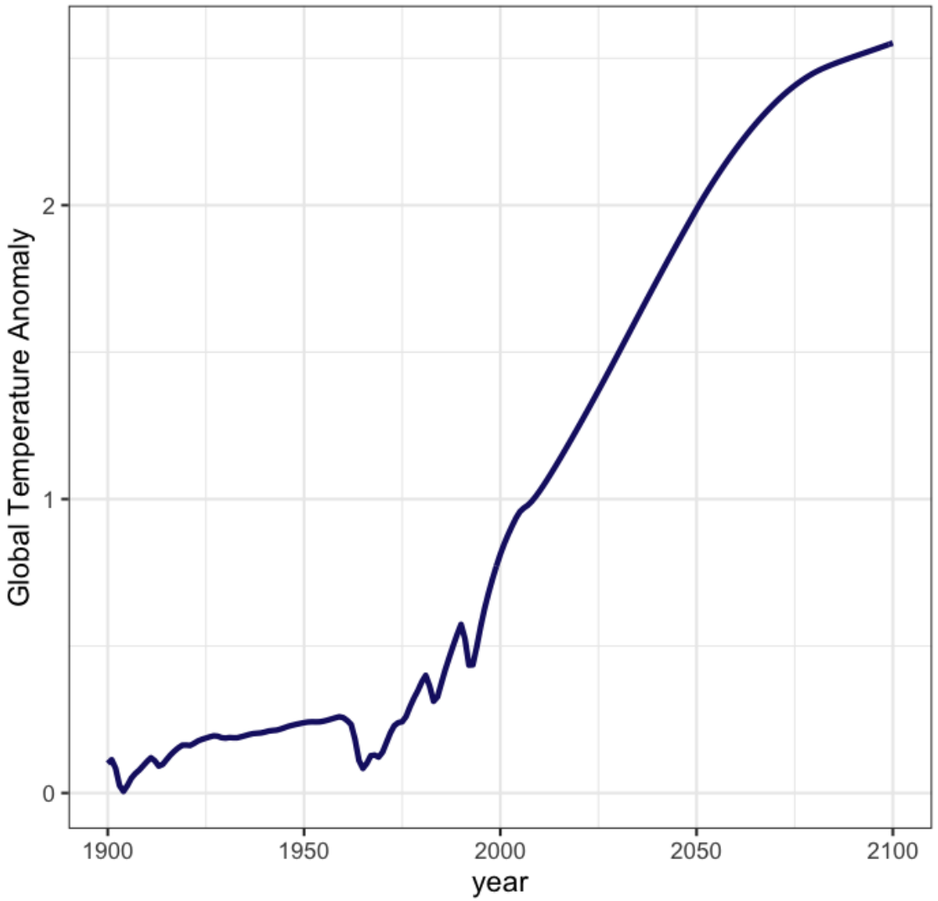

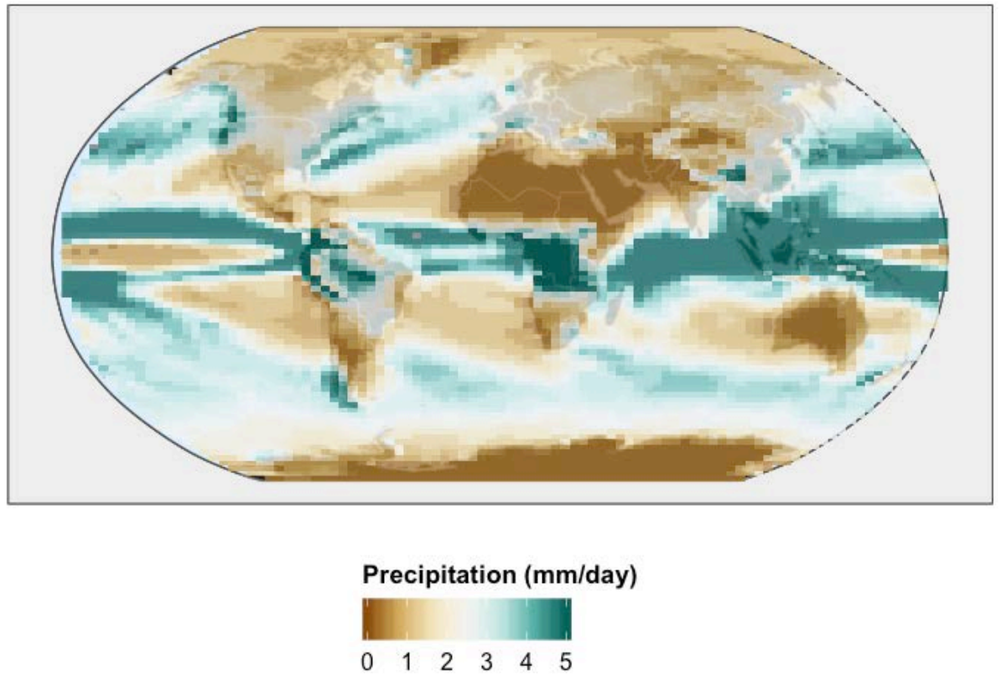

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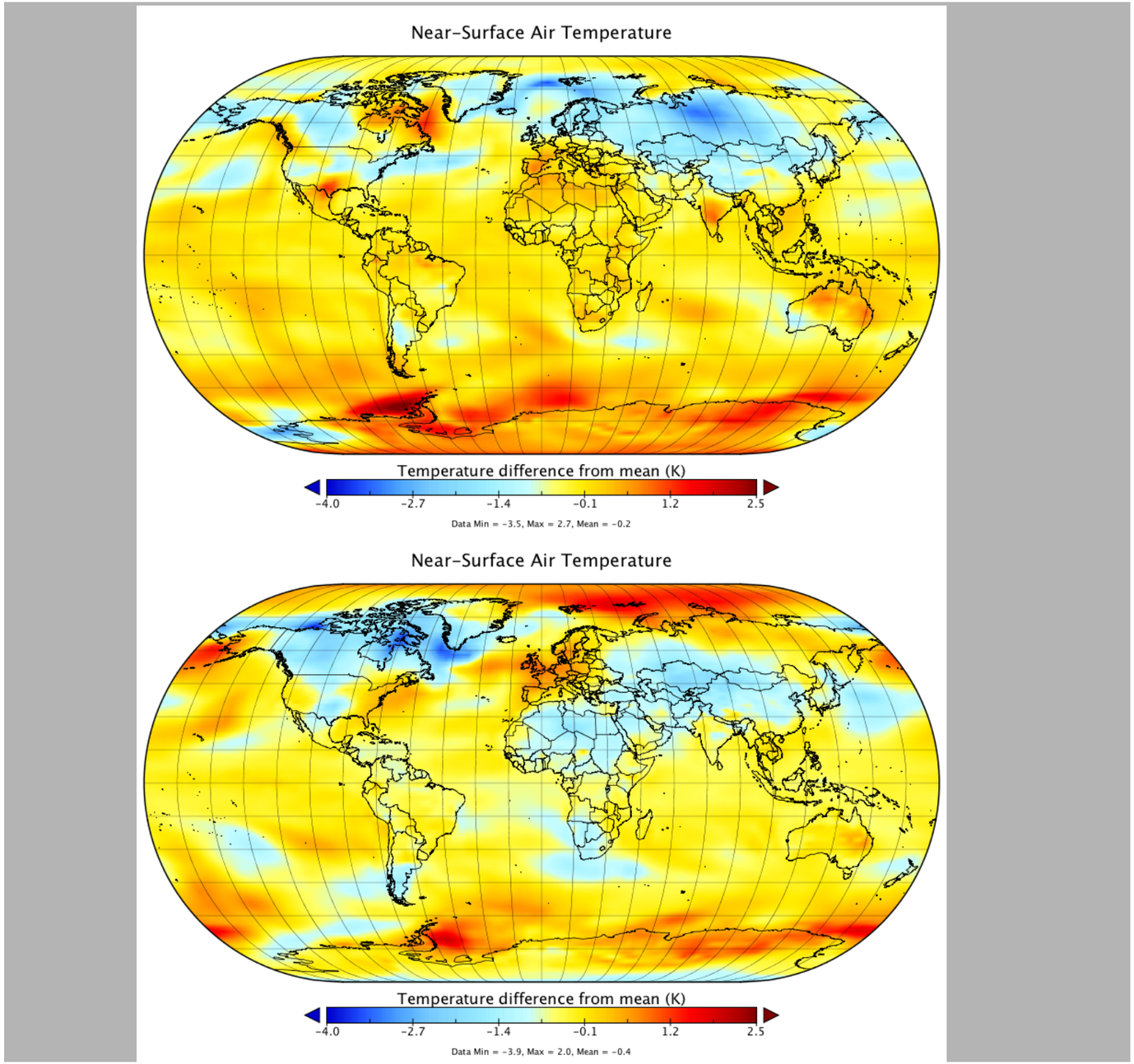
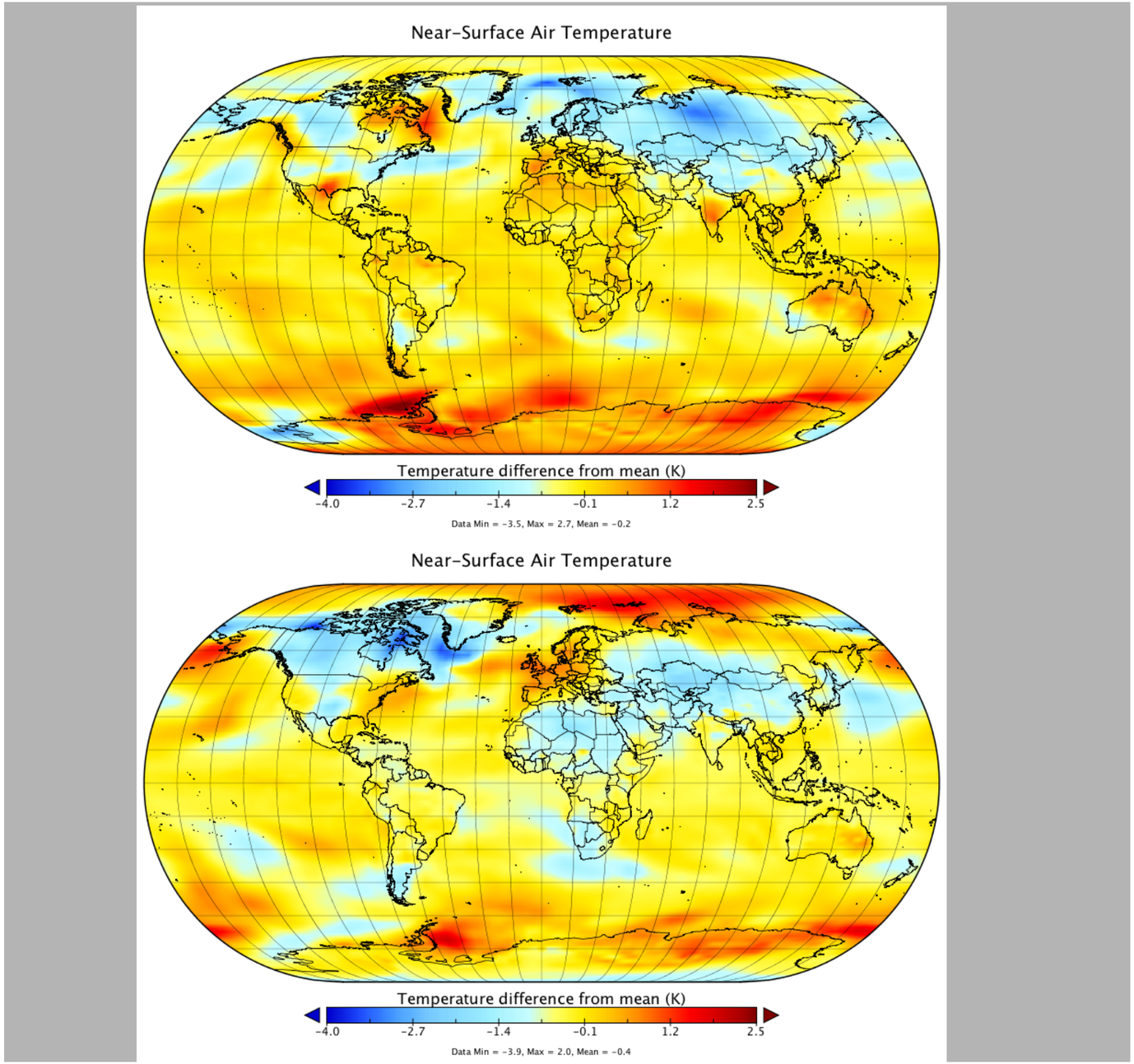
Two runs from a single ESM

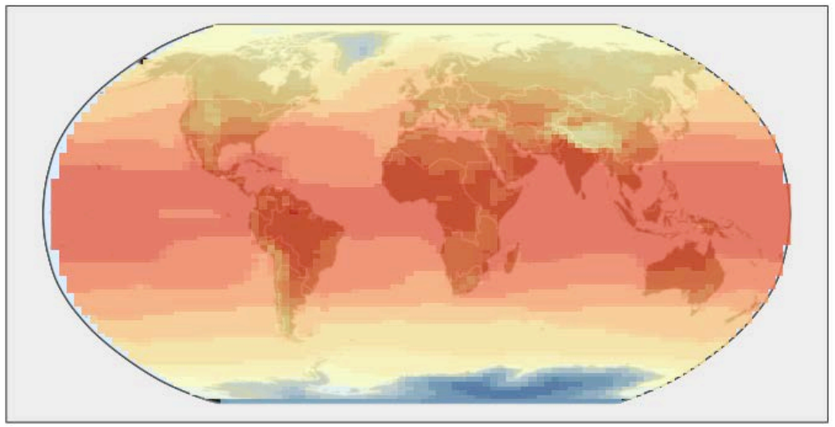


An ESM is a fancy-pants random number generator

- No, really.
- Sampling from the RNG distribution is as good as running the model.
- Training an emulator = characterizing the joint distribution
- Distribution is not so easy to learn.
- Have to make some assumptions.

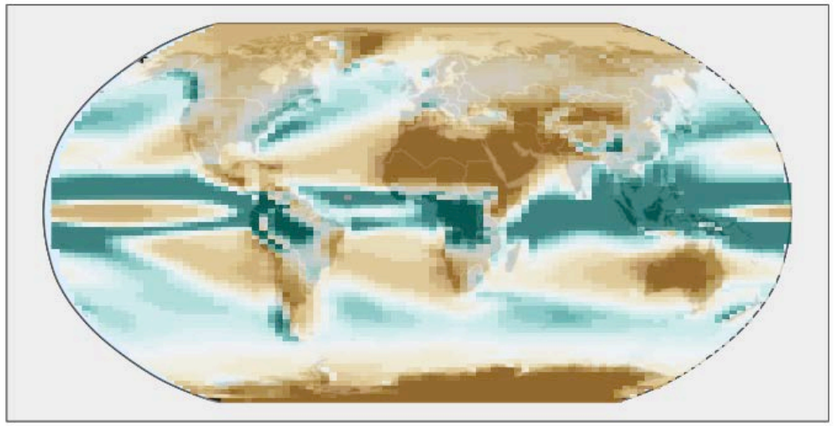


Fldgen Assumption 1
Forced and variable components are separable



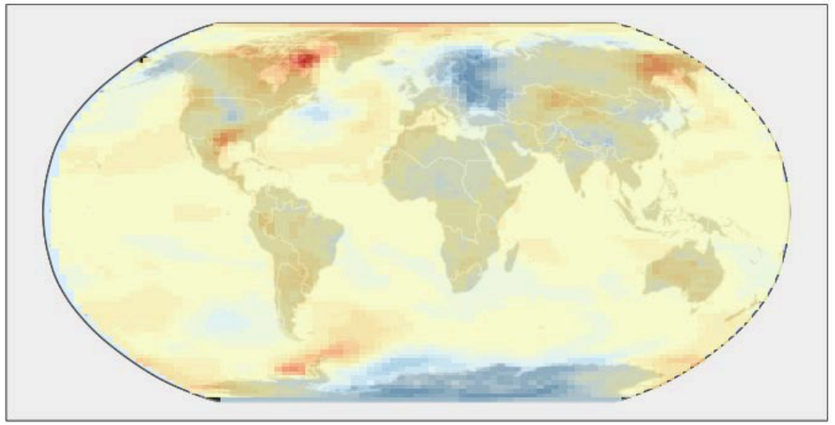
Temperature (K)

220 240 260 280 300



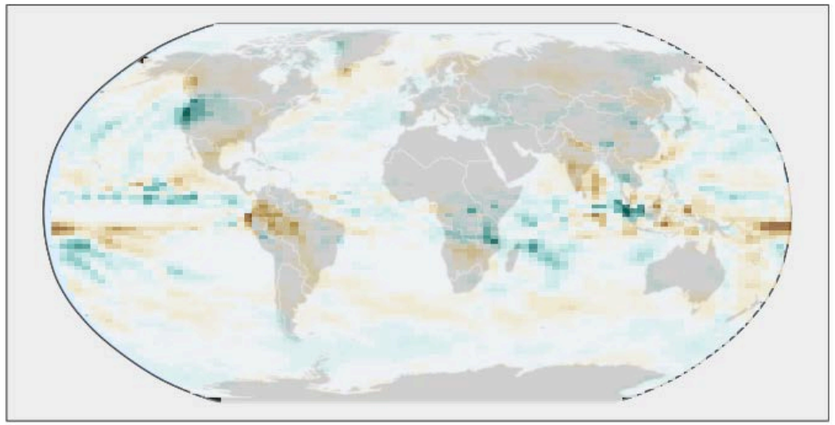
Precipitation (mm/day)

0 1 2 3 4 5



Temperature Resid. (K)

-3 -2 -1 0 1 2 3

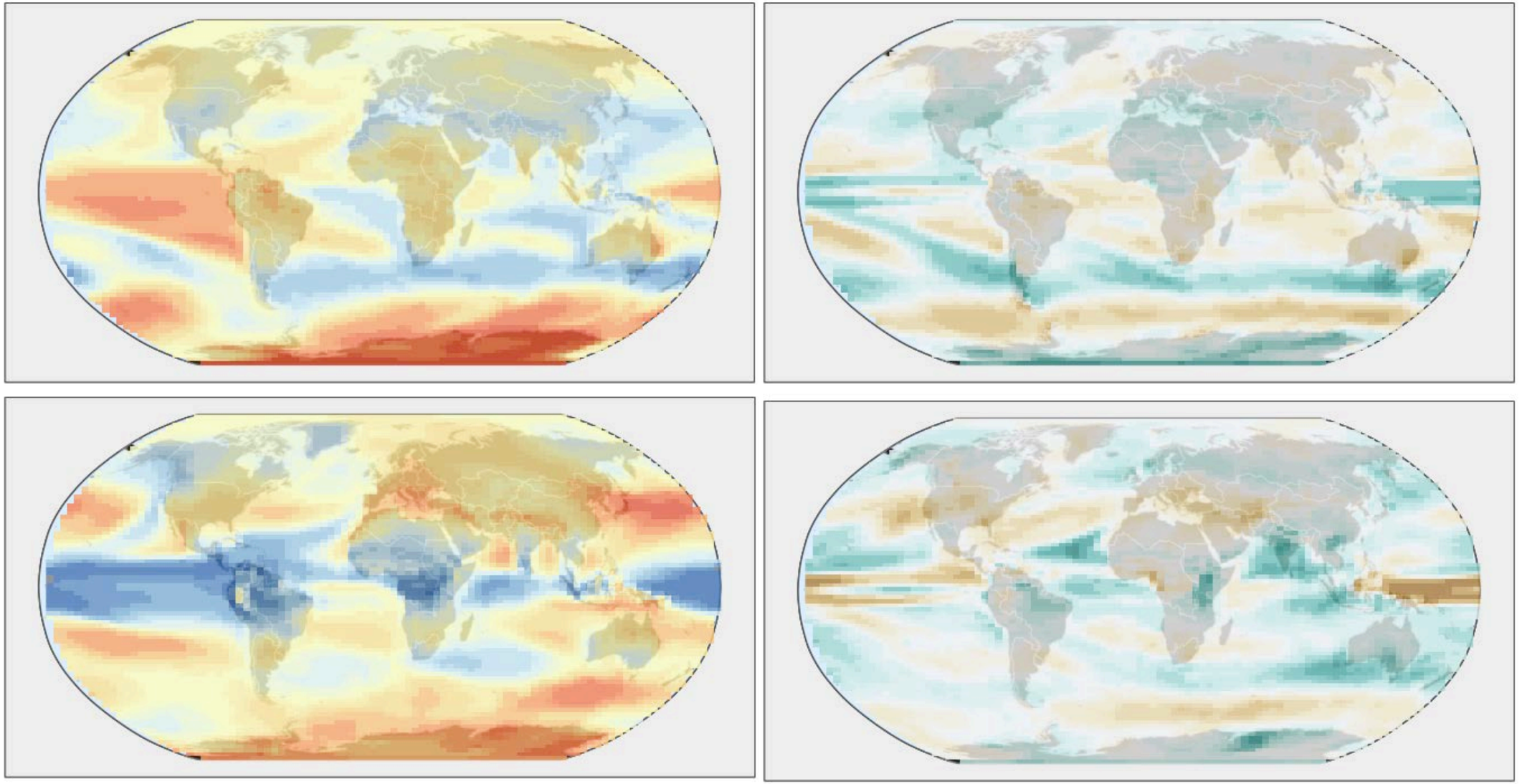


Precipitation resid. (mm/day)

-2 -1 0 1 2

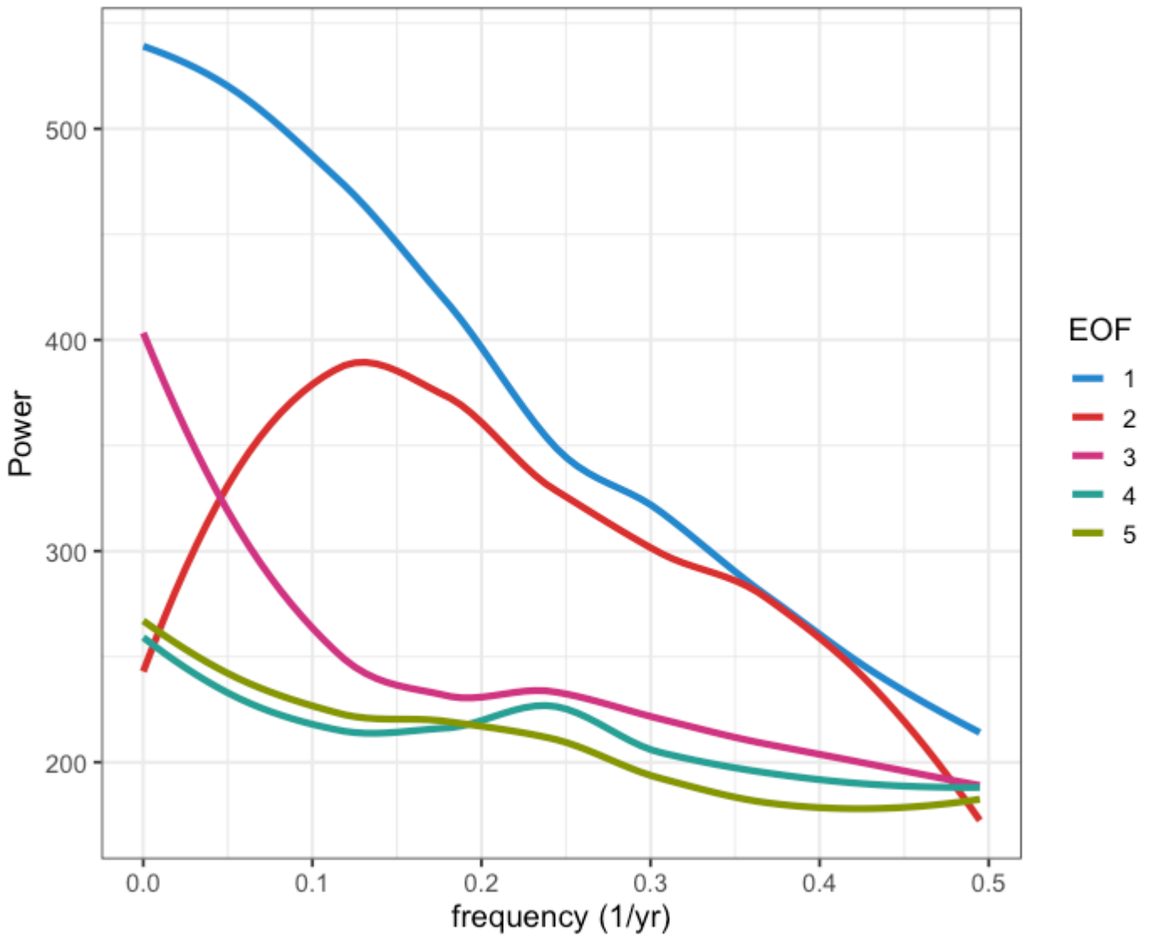
Fldgen Assumption 2

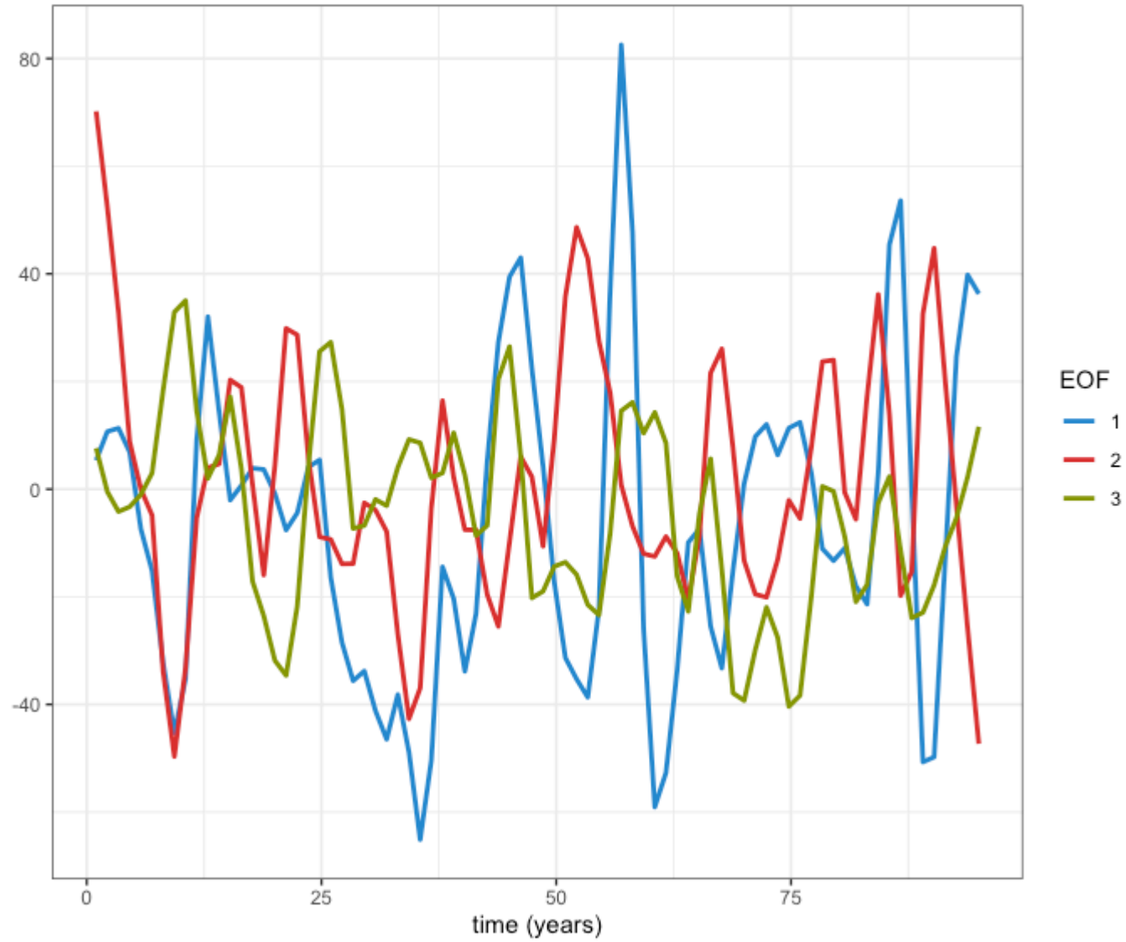
Spatial variability can be broken down into independent, additive modes.



Fldgen Assumption 3

Time variability is fully described by its power spectrum and may display quasiperiodic behavior in some modes.





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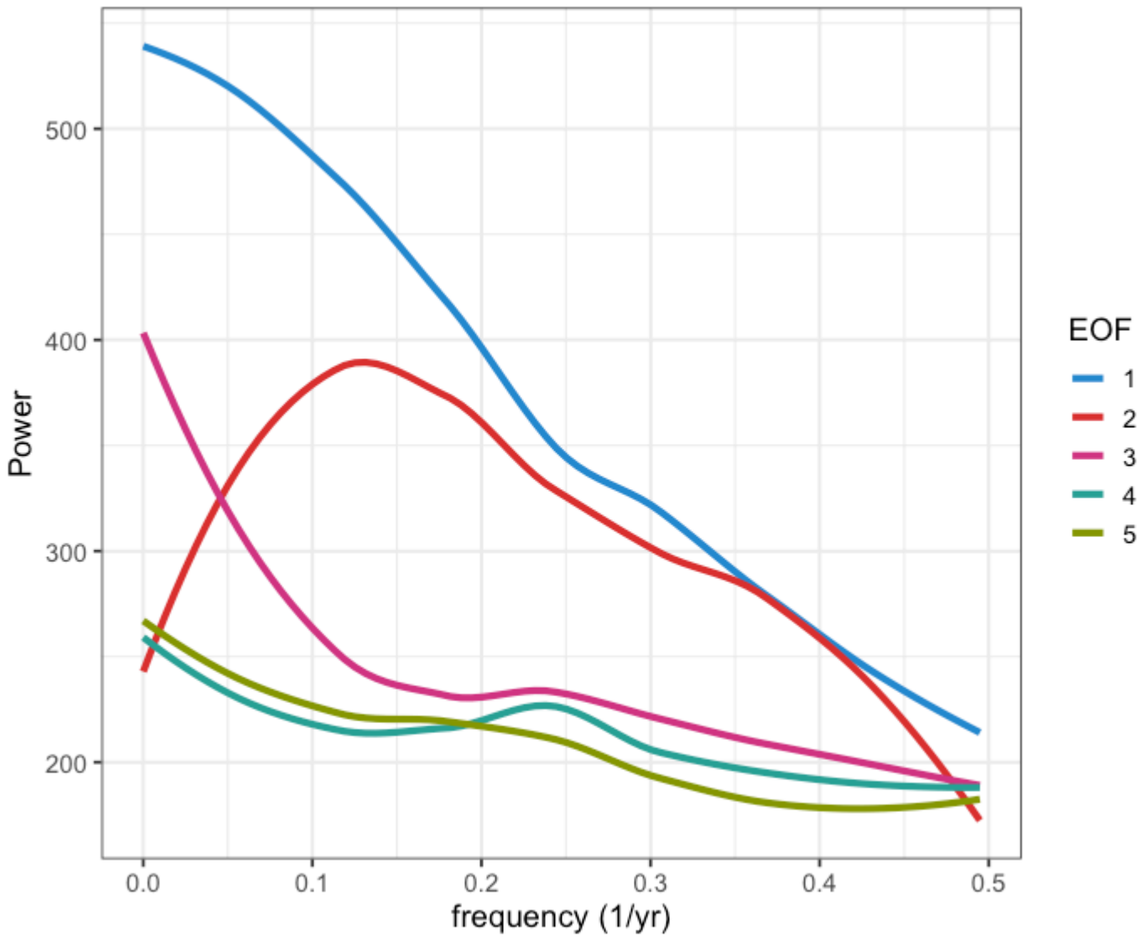
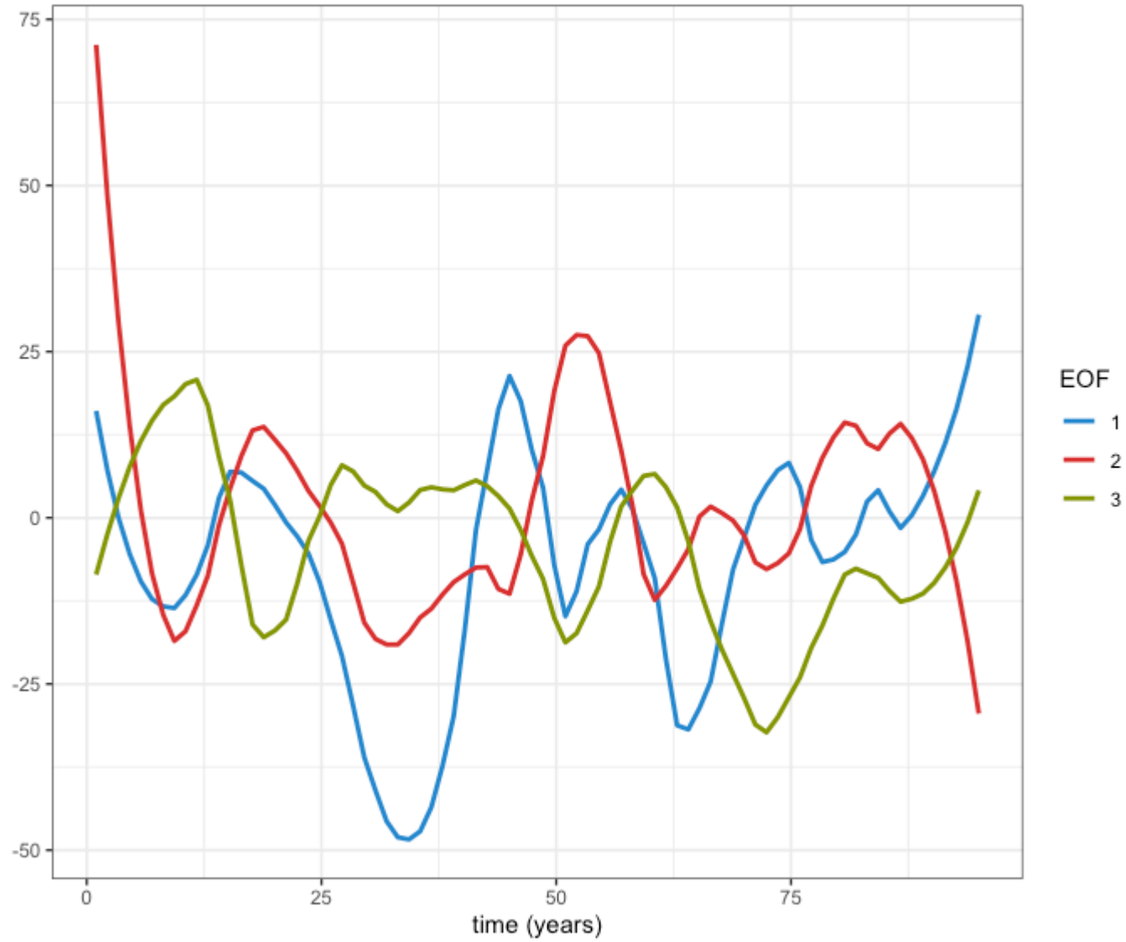
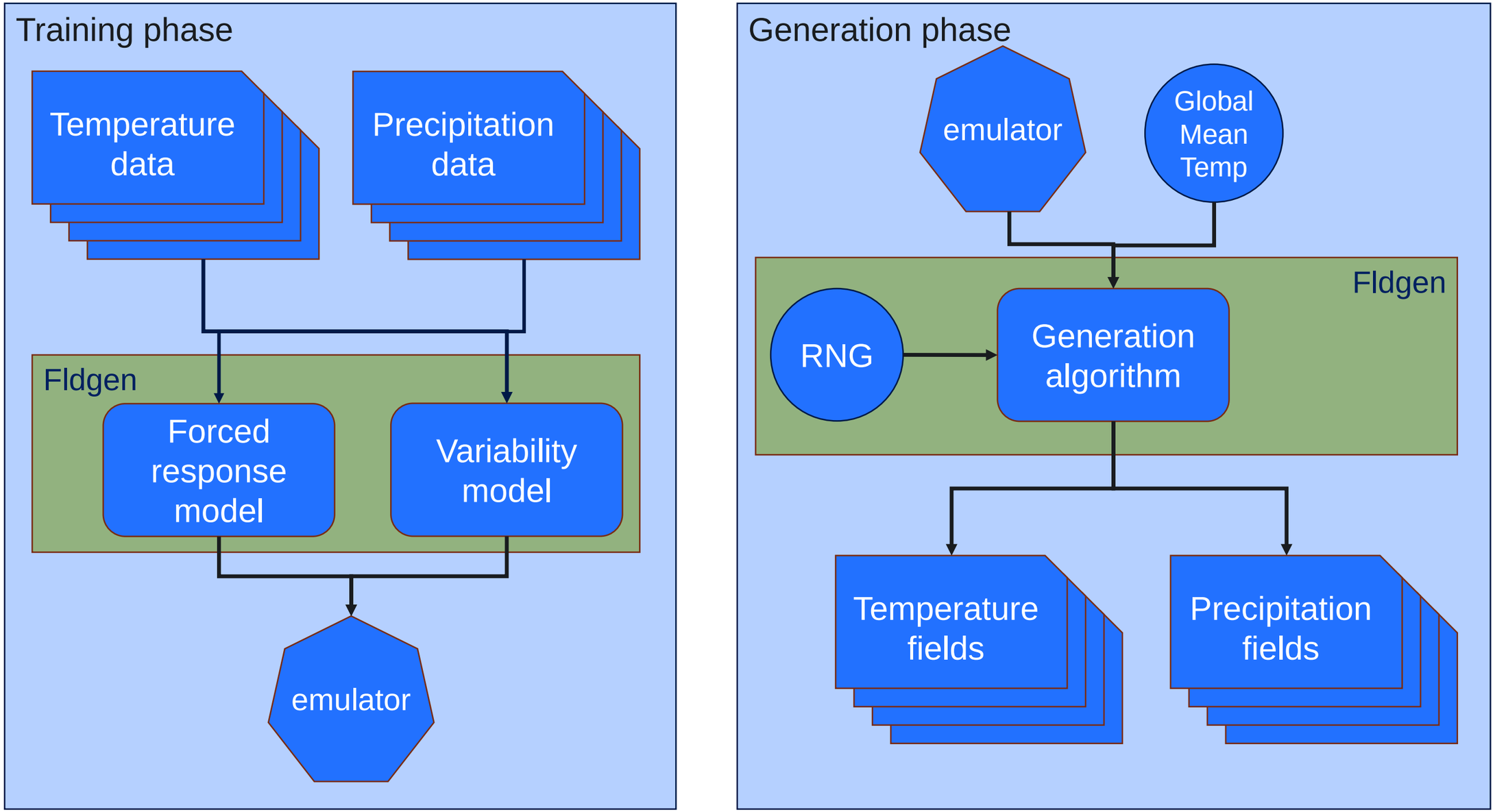
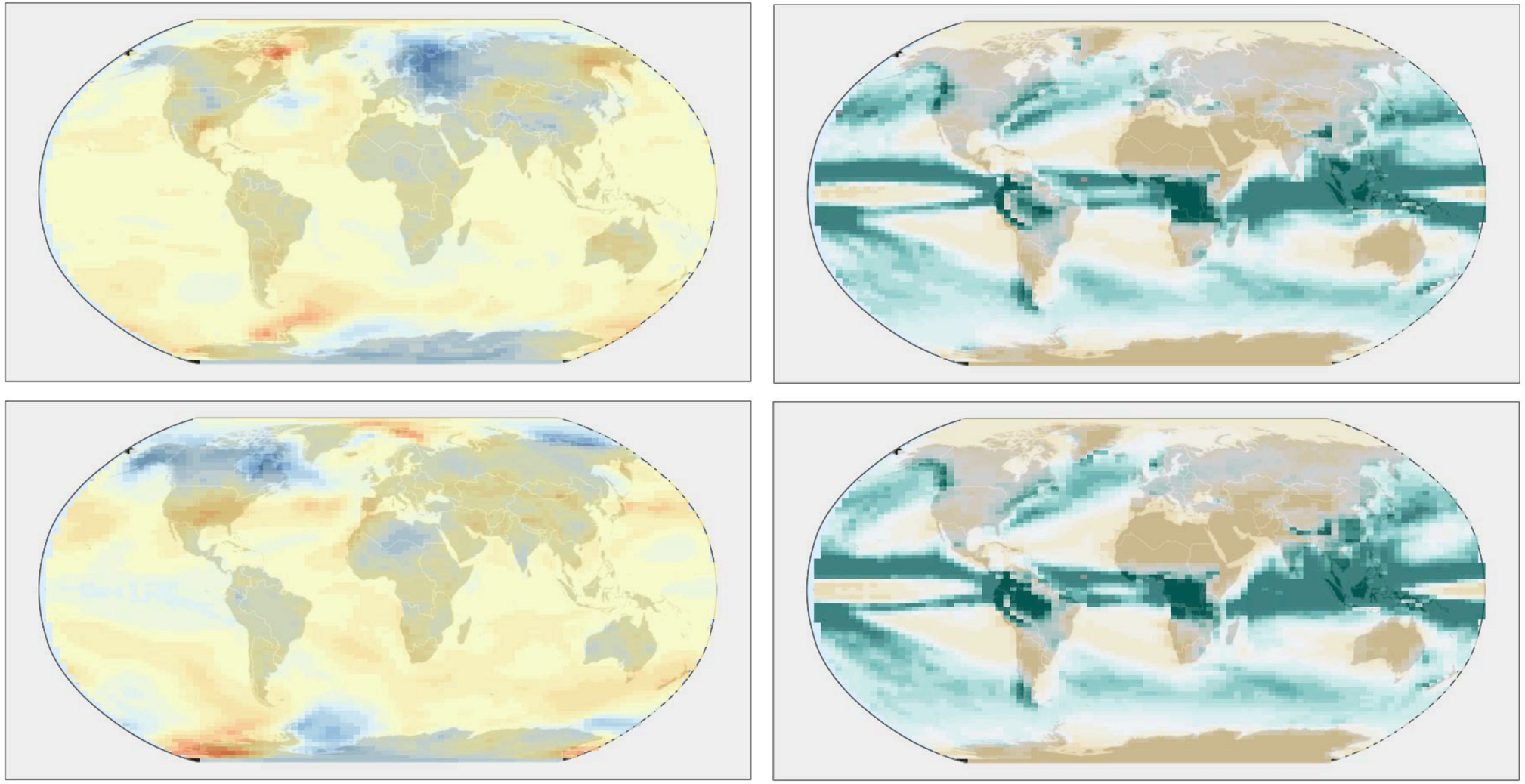




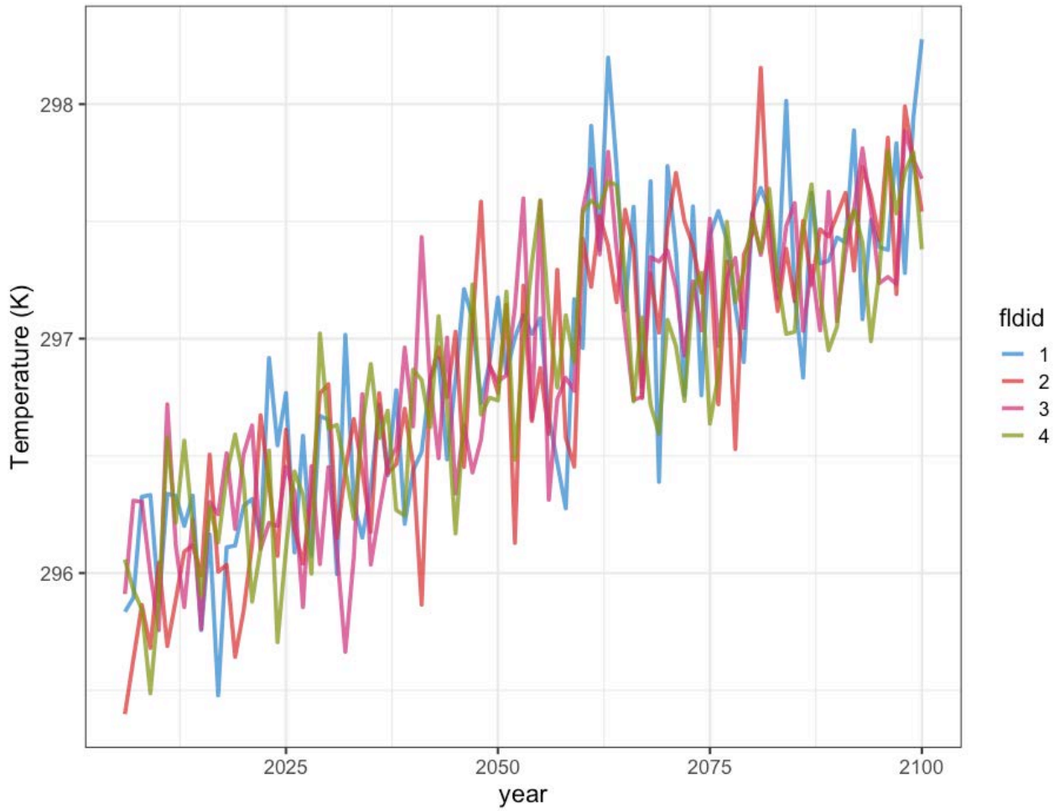
Fldgen workflow

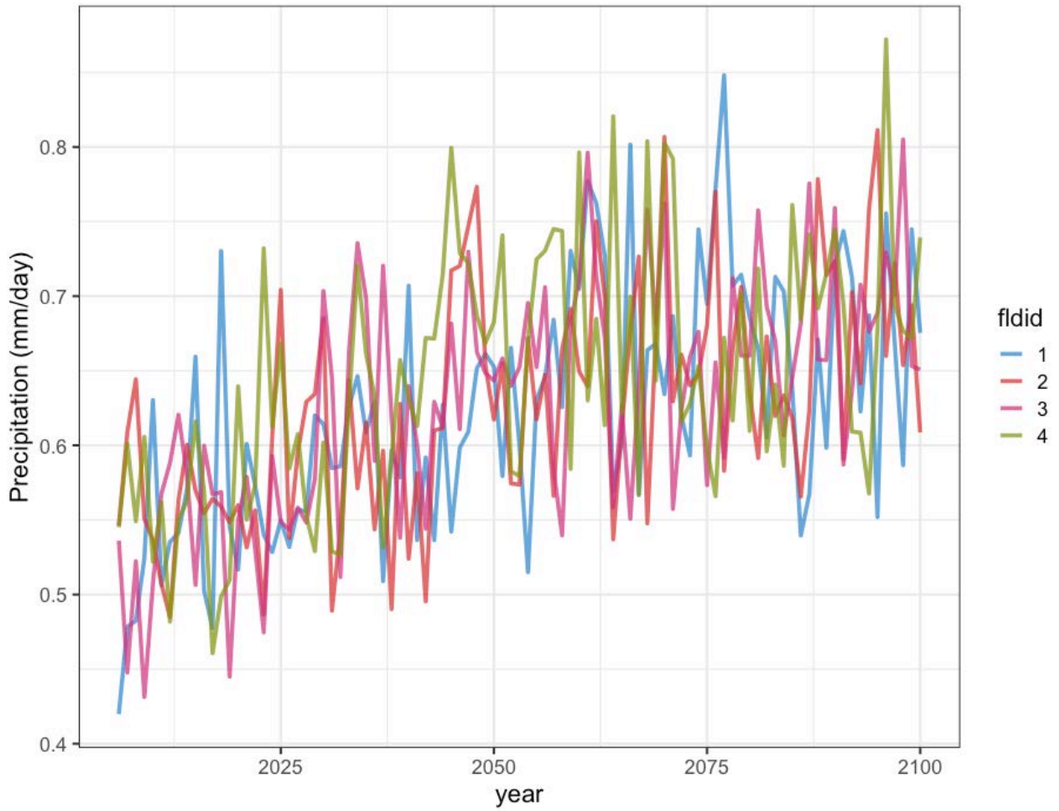


Fldgen results: global



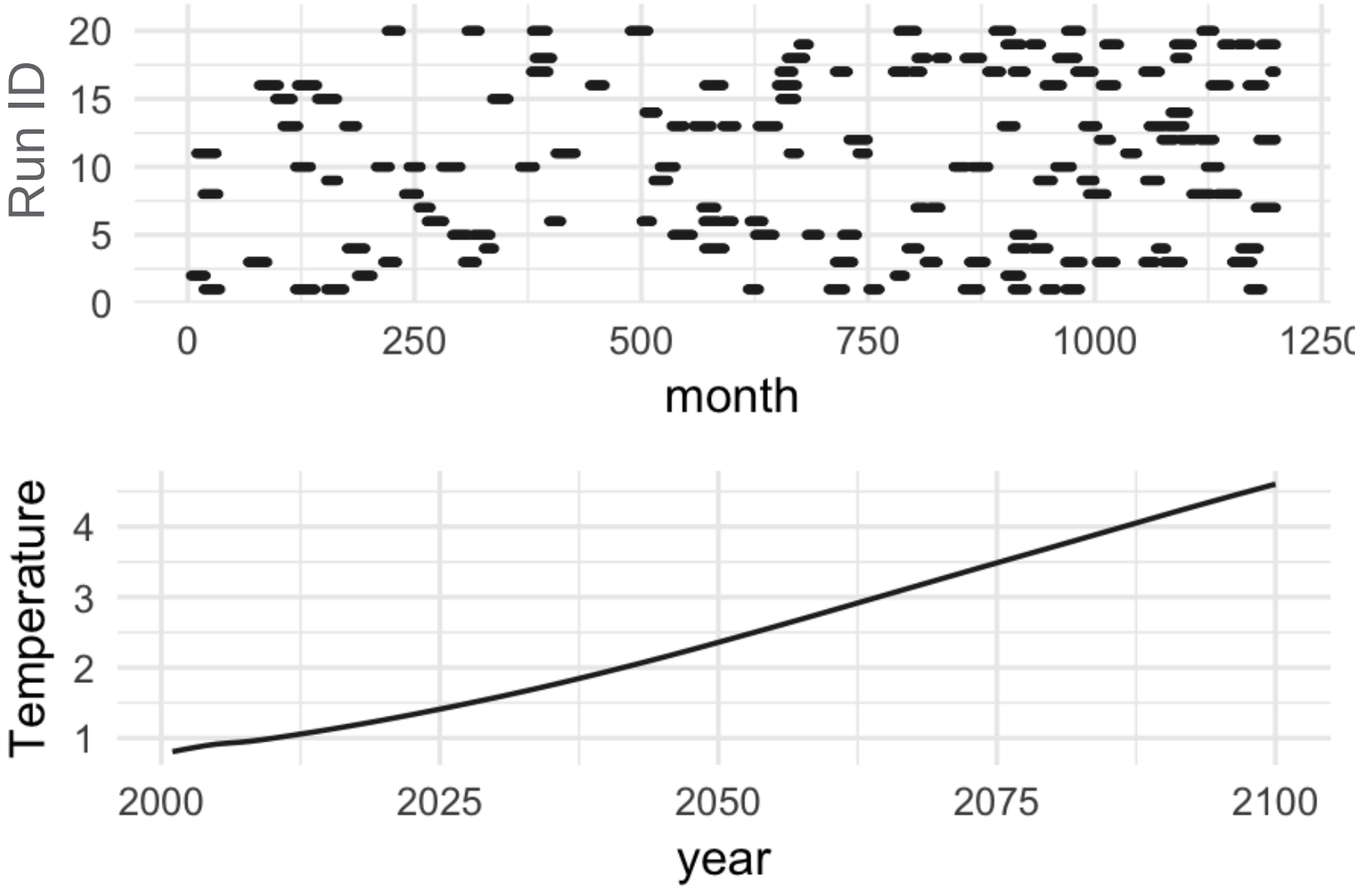
Fldgen results: local





Applications of fldgen

Analyze change in drought hazard as global temperature changes



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Where can I get fldgen!?

- https://github.com/JGCRI/fldgen
  - Code
  - Documentation
  - Issue tracker
- Requires R v.3.3 or later
- Version 2.0.0 is current