Large Ensembles

Exciting and relevant science that can be done using Earth System Models

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What are large ensembles?

Deser et al, 2020 Nature Climate Change
Examples of things we can do with large ensembles

Three examples:

1. Understanding internal variability →
   better communicate with general public
2. Partitioning uncertainty →
   to better decide where to invest resources
3. Temporal statistics →
   use different methods, answer different questions than
traditional multi-model ensembles
1. Understanding internal variability

Change in GMST trend, 2035 vs. 2020, RCP2.6

2006–2020 warms faster

2021–2035 warms faster

Marotzke. 2018 WIRES
2. Partitioning uncertainty

Lehner et al, 2020
Earth System Dynamics
3. Temporal statistics

Figure by Sebastian Milinski & Malte Stuecker → In Maher et al, in prep
**Key point:** Don’t have to do things the way we did before

**Future modeling prospects:**
- Before running an ensemble: *think about problem and how large your ensemble needs to be*
- *Use current ensembles to understand where internal variability dominates → run ensembles there*
  - And where model differences dominate improve models

**Exciting scientific prospects**
- Signal to noise problems
- Understanding communicating internal variability decision making
- Fully sampling extreme distributions
- Investigating poorly sampled things (e.g. decadal variability)
- Putting observations in the context of models
- Better evaluating climate models
- Test bed for methods
- Suite of data for AI/Machine learning
- Inform observing systems