




University of Colorado **Boulder**

 nicola.maher@colorado.edu

 <https://nicolamaher.weebly.com/>

 @Nicola_Maher

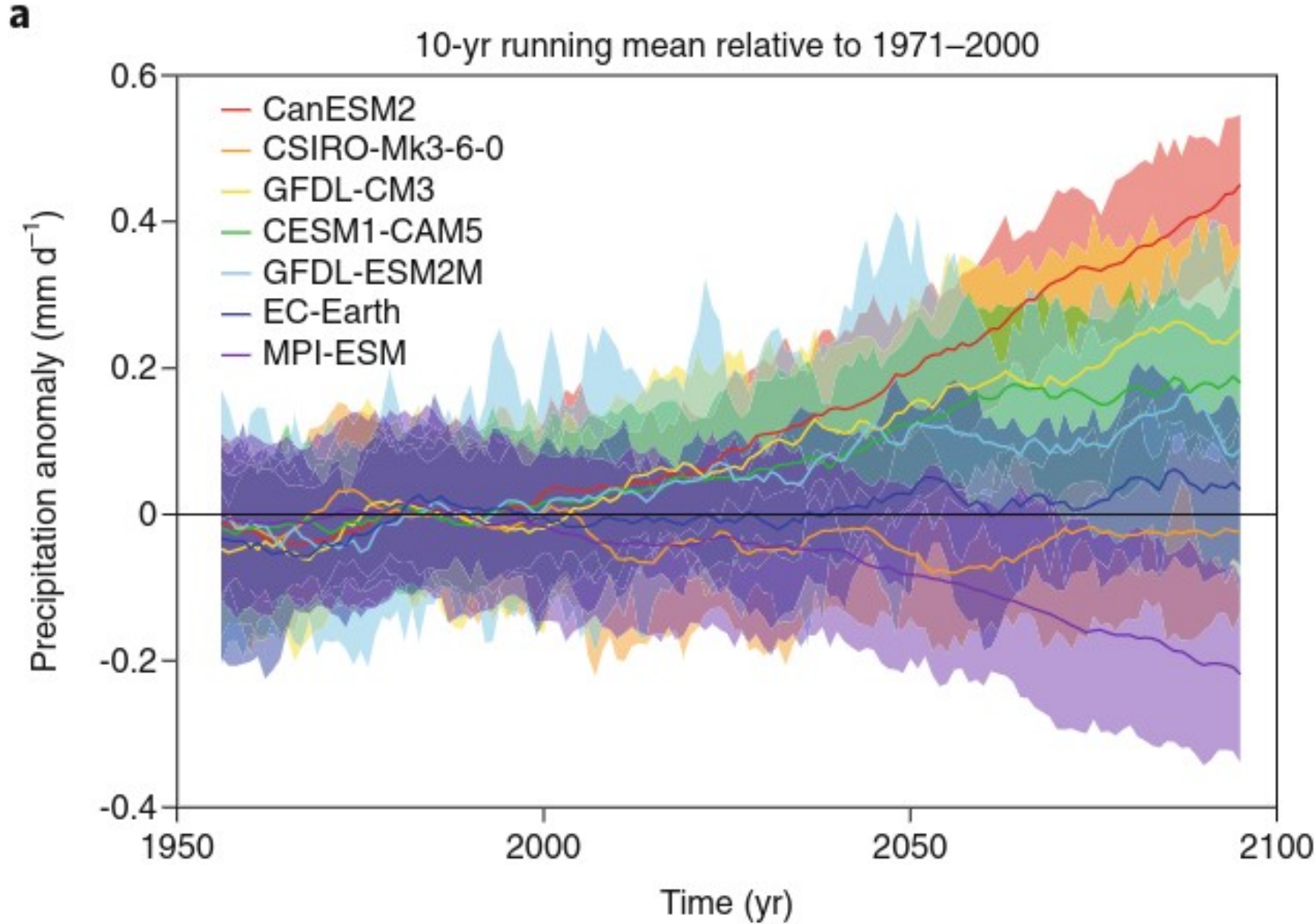
Large Ensembles

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

Nicola Maher



What are large ensembles?



Deser et al, 2020 *Nature Climate Change*



Examples of things we can do with large ensembles



Three examples:

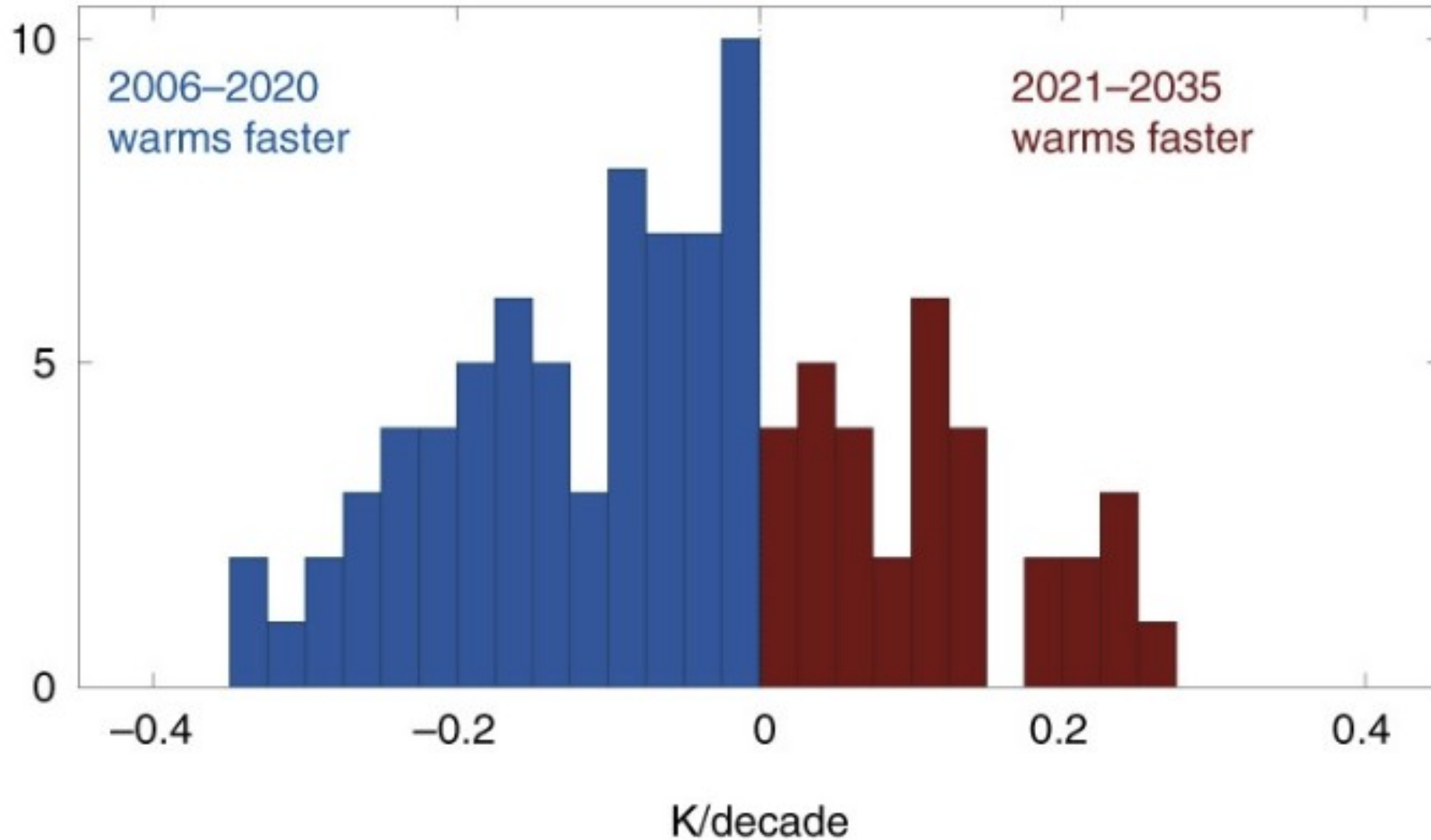
- 1 Understanding internal variability →
better communicate with general public
- 2 Partitioning uncertainty →
to better decide where to invest resources
- 3 Temporal statistics →
use different methods, answer different questions than
traditional multi-model ensembles



1. Understanding internal variability

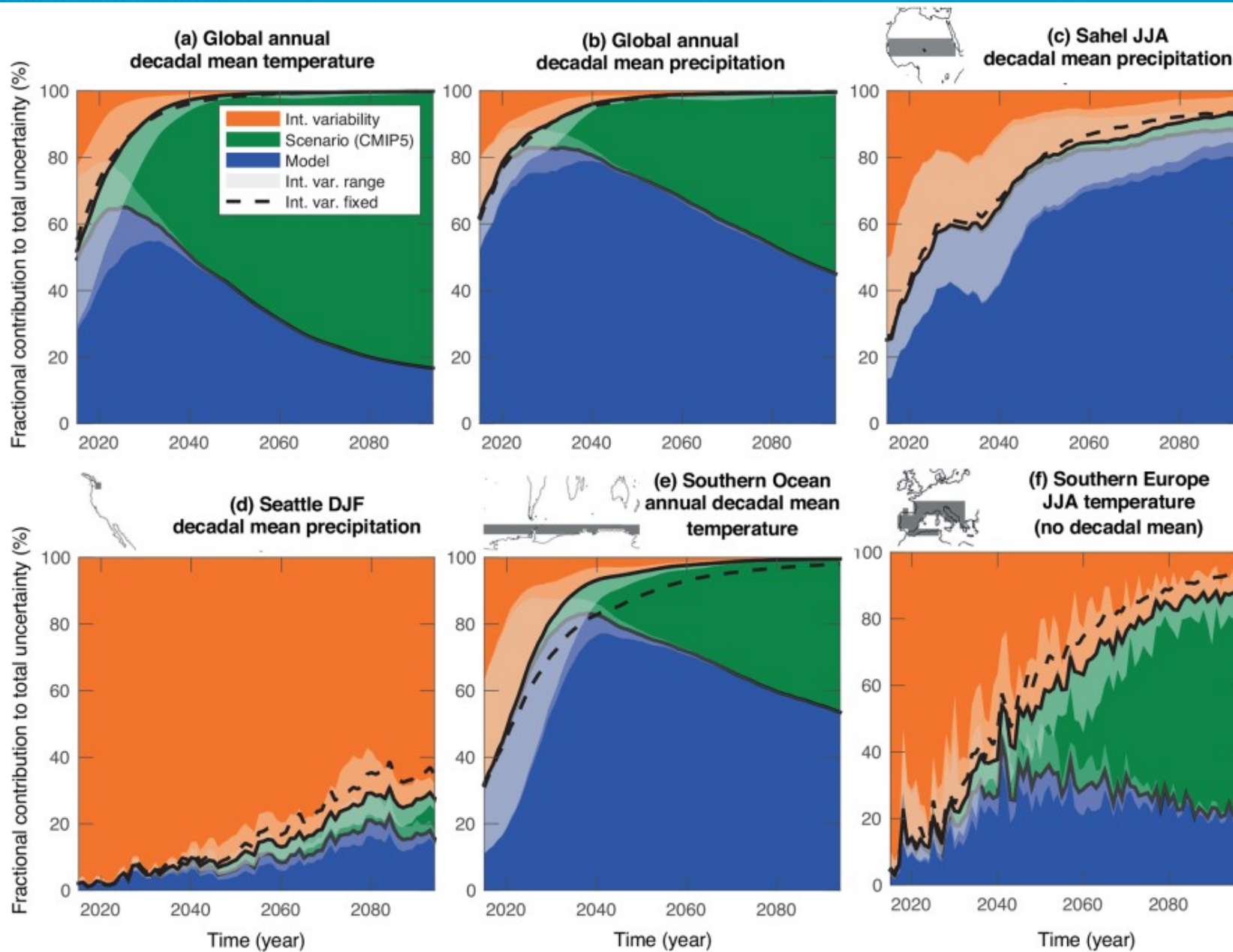


Change in GMST trend, 2035 vs. 2020, RCP2.6



Marotzke.
2018 *WIRES*

2. Partitioning uncertainty



Lehner et al, 2020
Earth System Dynamics



3. Temporal statistics

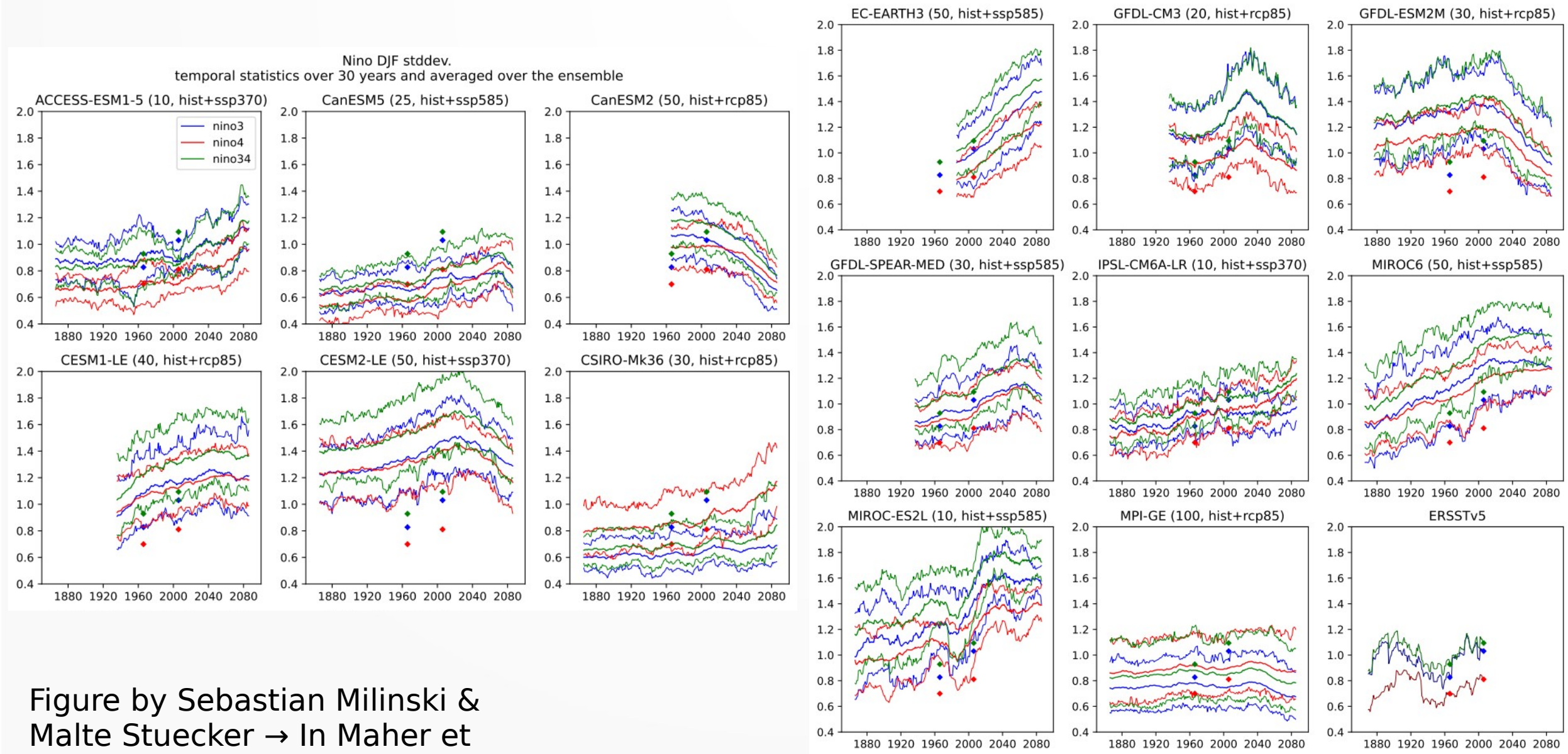


Figure by Sebastian Milinski & Malte Stuecker → In Maher et al, in prep



Exciting prospects of large ensembles



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