



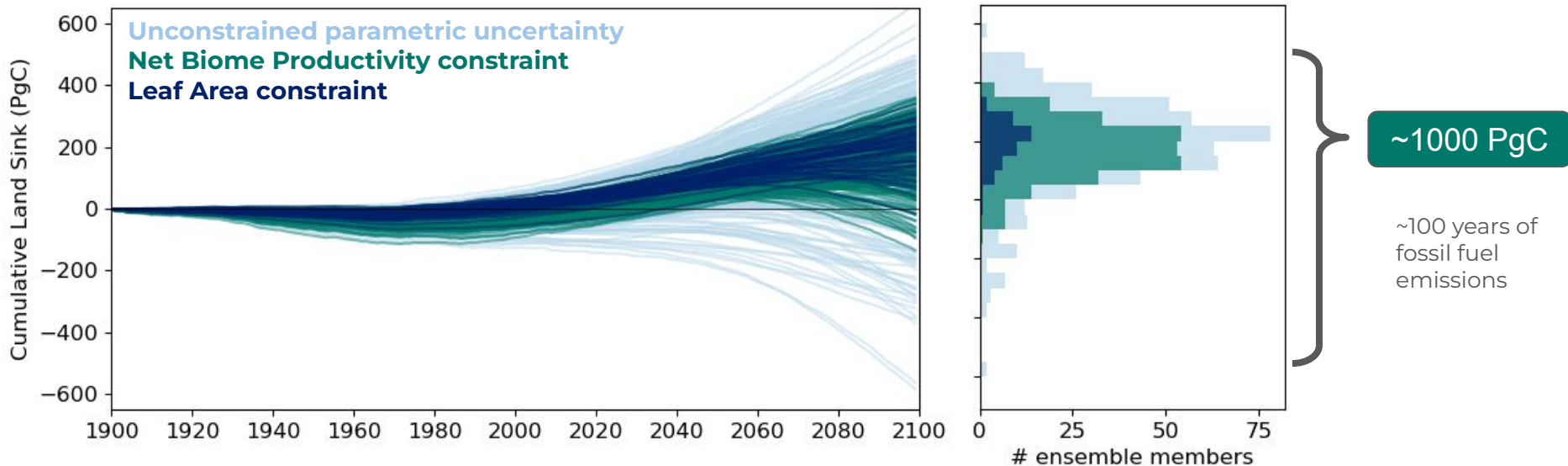
Tuning Leaf Area in CLM: Insights and Challenges

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Parameter Estimation Interest Group
& CLM-PPE community

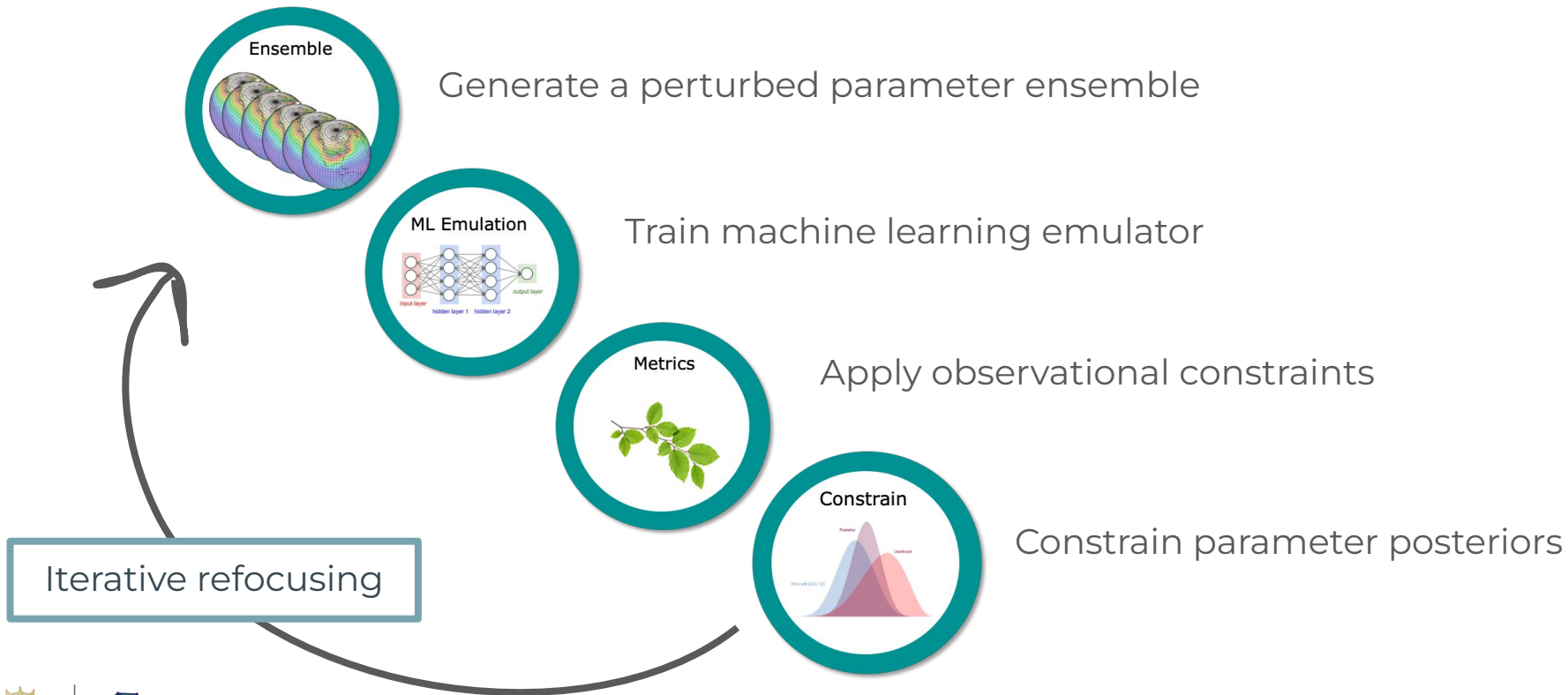
Constraining parametric uncertainty

32 parameters in the Community Land Model
500 member perturbed parameter ensemble



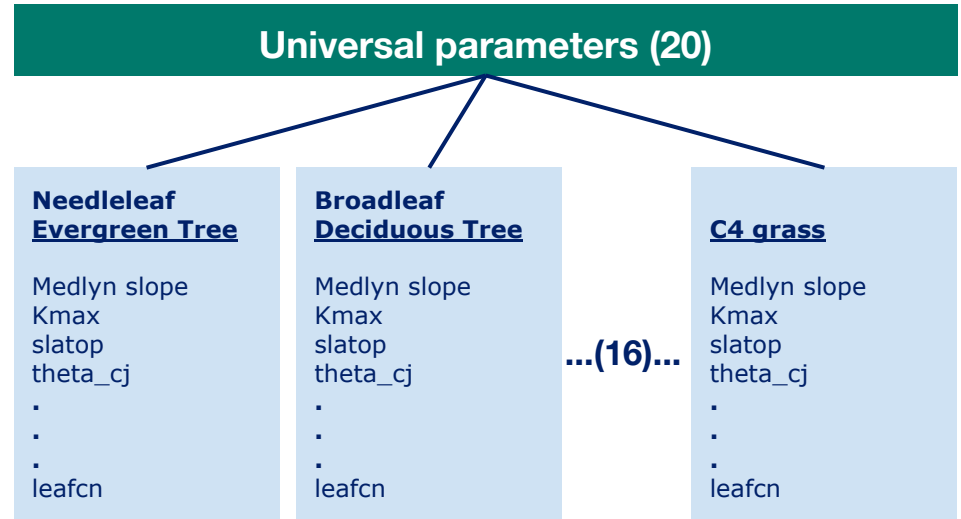
LEAP

History matching methodology



Tuning PFT parameters independently

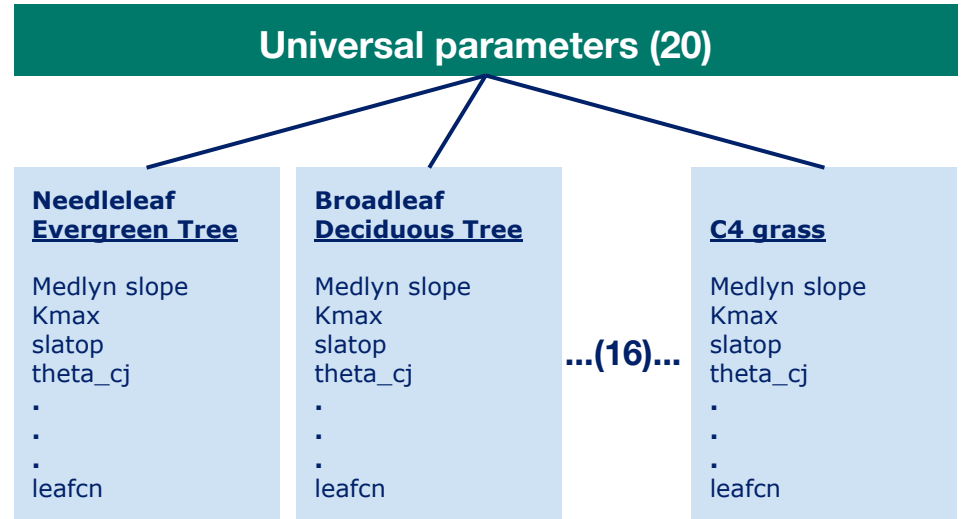
- Necessary to tune spatially
- Treating PFT specific parameters independently is computationally infeasible
 - 212 parameters
- Retain interactions with universal parameters



Tuning PFT parameters independently

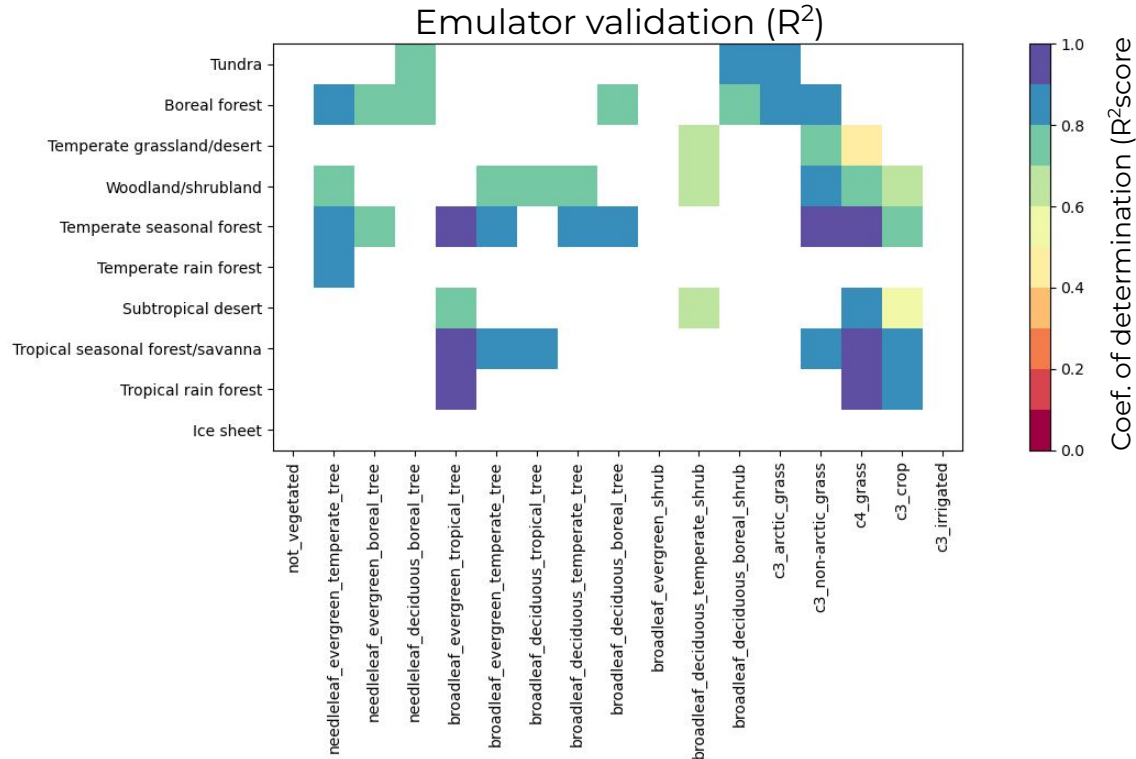
- Necessary to tune spatially
- Treating PFT specific parameters independently is computationally infeasible
 - 212 parameters
- Retain interactions with universal parameters

Objective: Tune PFT parameters independently & retain interactions



Ensemble of emulators

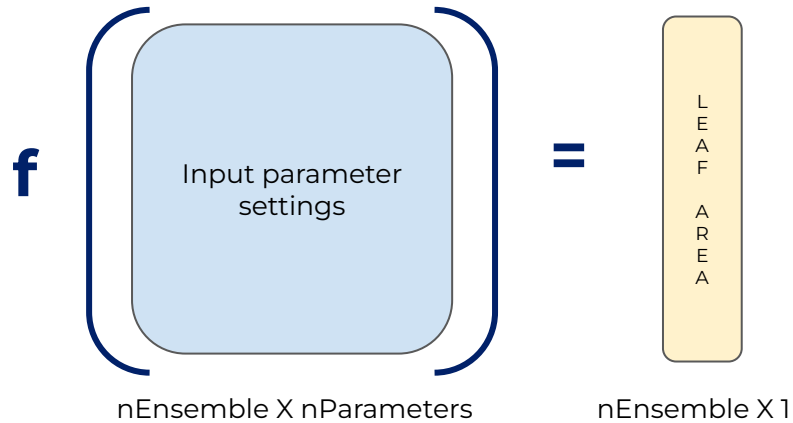
- Separate emulator for each PFT in each biome



(side bar)

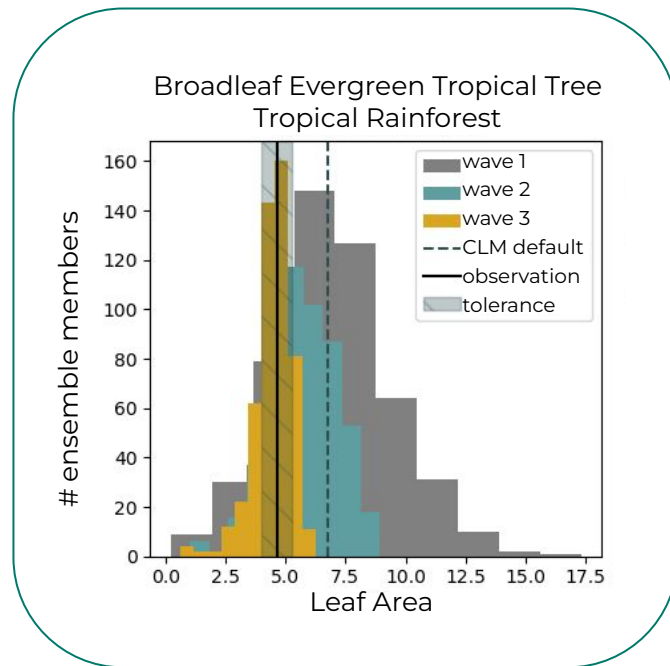
Emulator:

Gaussian process model that relates CLM parameter settings to CLM output variables



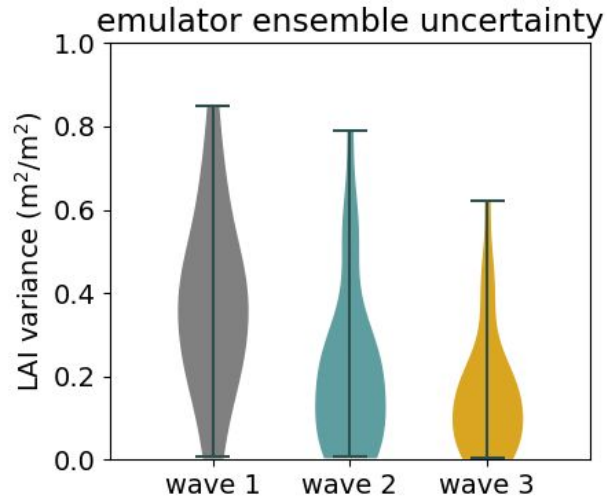
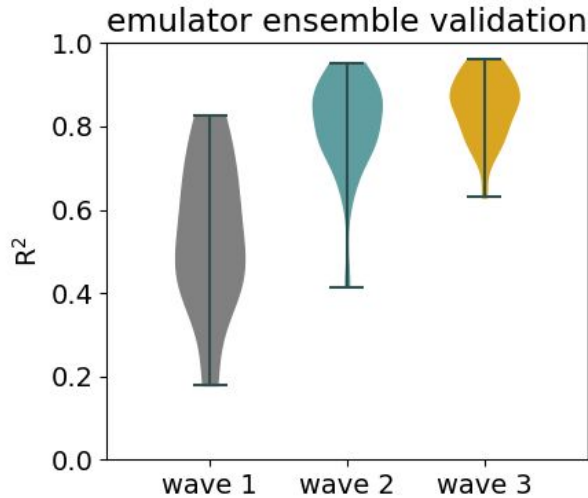
History matching

- Wave 1: 500 ensemble members
(1850-2014)
GSWP3 forcing
Latin Hypercube Sampling
PFT parameters scaled uniformly
- Wave 2: 500 ensemble members
PFT parameters vary independently
Sampled to reduce emulator uncertainty
- Wave 3: 500 ensemble members
PFT parameters vary independently
Sampled with higher PFT:universal parameters



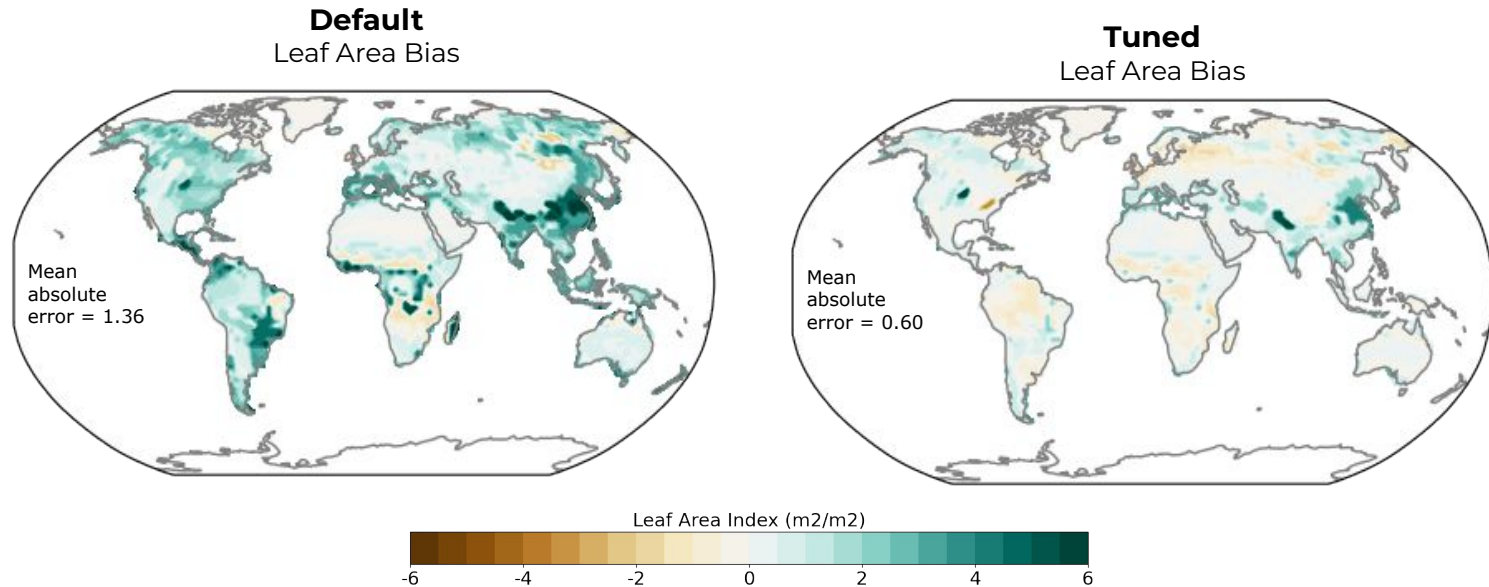
Build a robust ensemble of emulators

- Improvement of emulator predictive skill with each wave
- Reduction in emulator of uncertainty

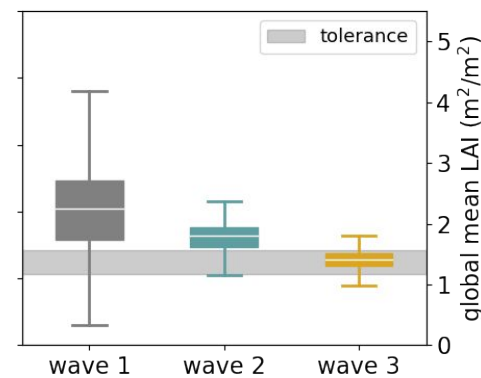
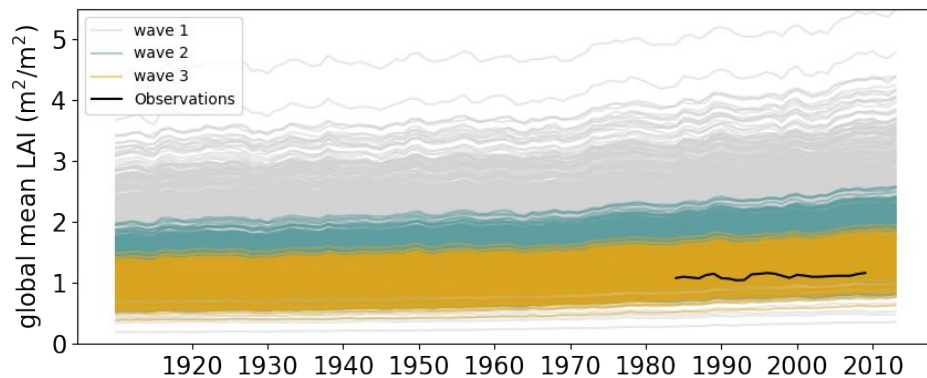


Calibration

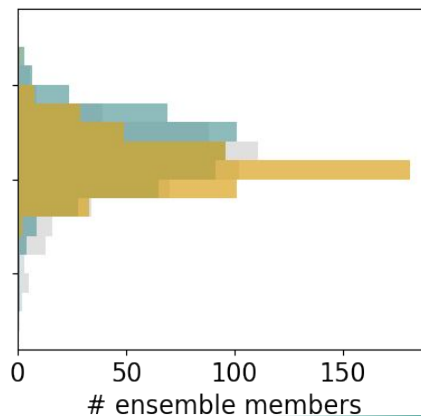
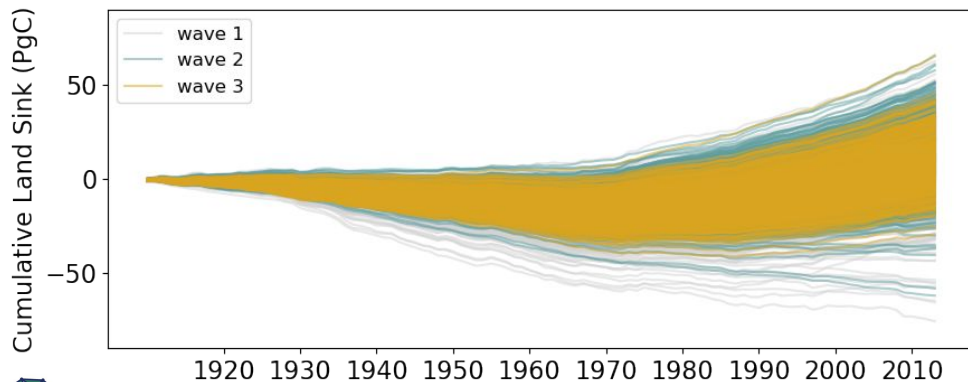
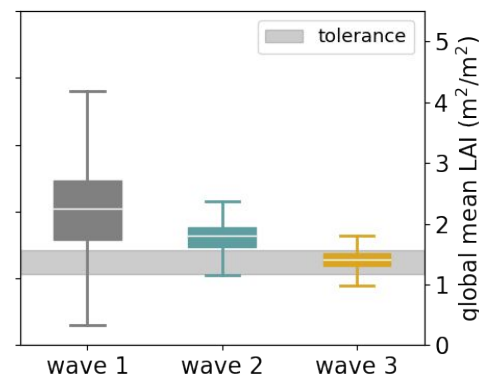
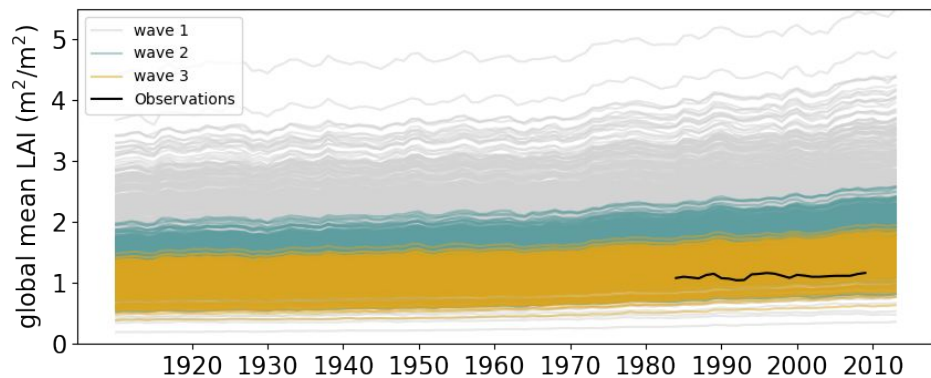
- Robust ensemble of emulators can be used for calibration.



Constraining parametric uncertainty



Constraining parametric uncertainty



LEAP

Take away

- Insights
 - An ensemble of emulators and strategic sampling enables PFT specific tuning
 - Competition among PFTs can be influential in resource limited regions
- Challenges
 - Emulating higher order metrics (seasonality, trend)
 - Resampling method for each wave of history matching
- Next steps
 - Tuning CLM6
 - Incorporate additional observational constraints
 - Create tools for CLM development

