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Emerging signals at various spatial scales

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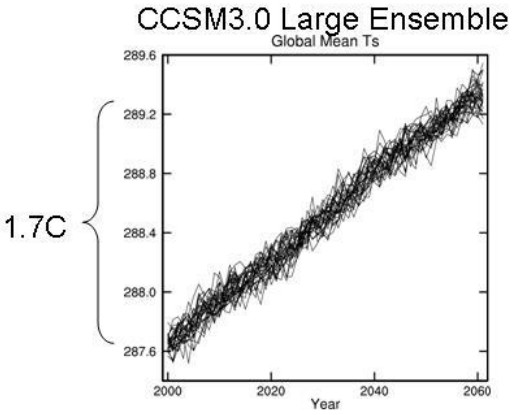
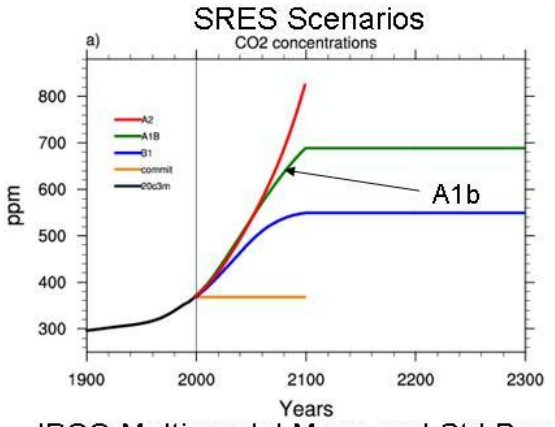
CCSM3 Large Ensemble Experiment

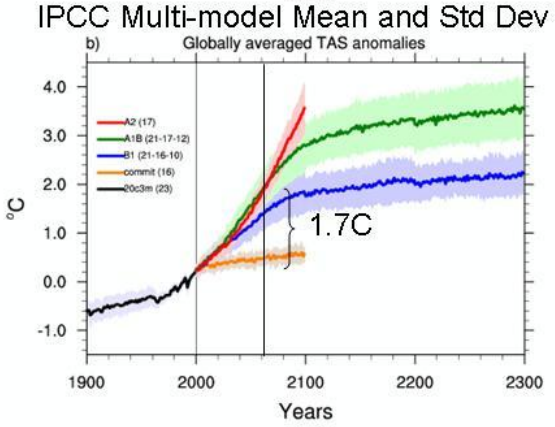
- the 30-member ensemble allows a thorough statistical analysis of emerging signals ie. the point at which the forced signal exceeds the noise

CVWG/CCWG Large Ensemble Experiment

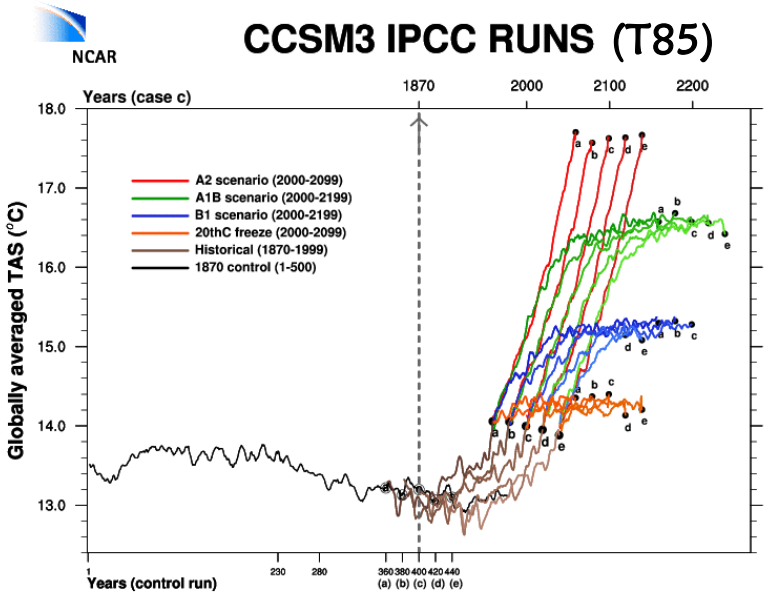
- SRES A1b
- CCSM3.0 T42 1x
- 30 members
- 2000-2061
- Only vary initial atmospheric state

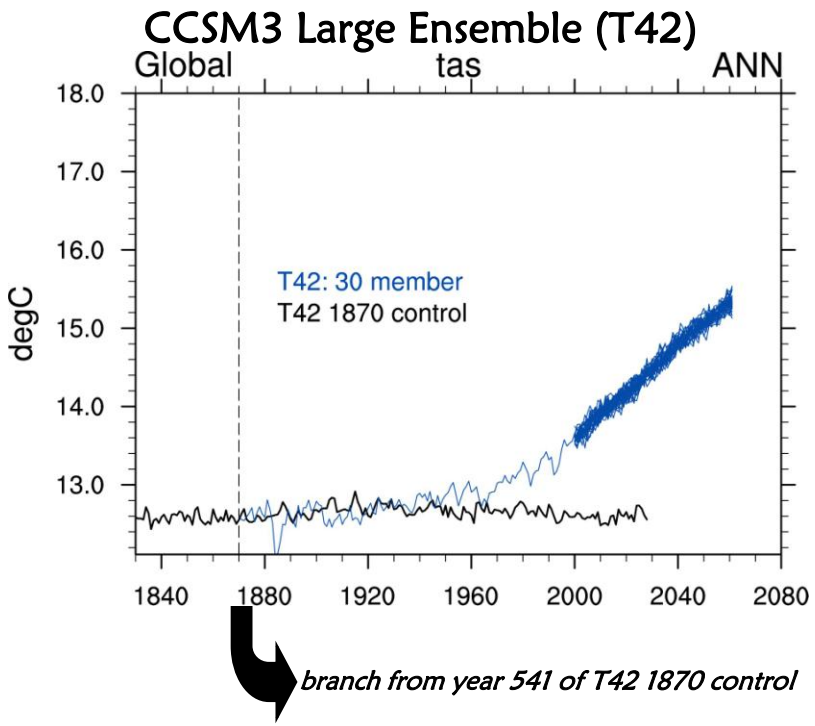






Experimental design: compared to IPCC runs





- In the Large Ensemble the initial state is identical except for atmosphere which varies from December 1, 1999 to January 15, 2000 from the 20th Century experiment

Estimates of internal variability: temperature

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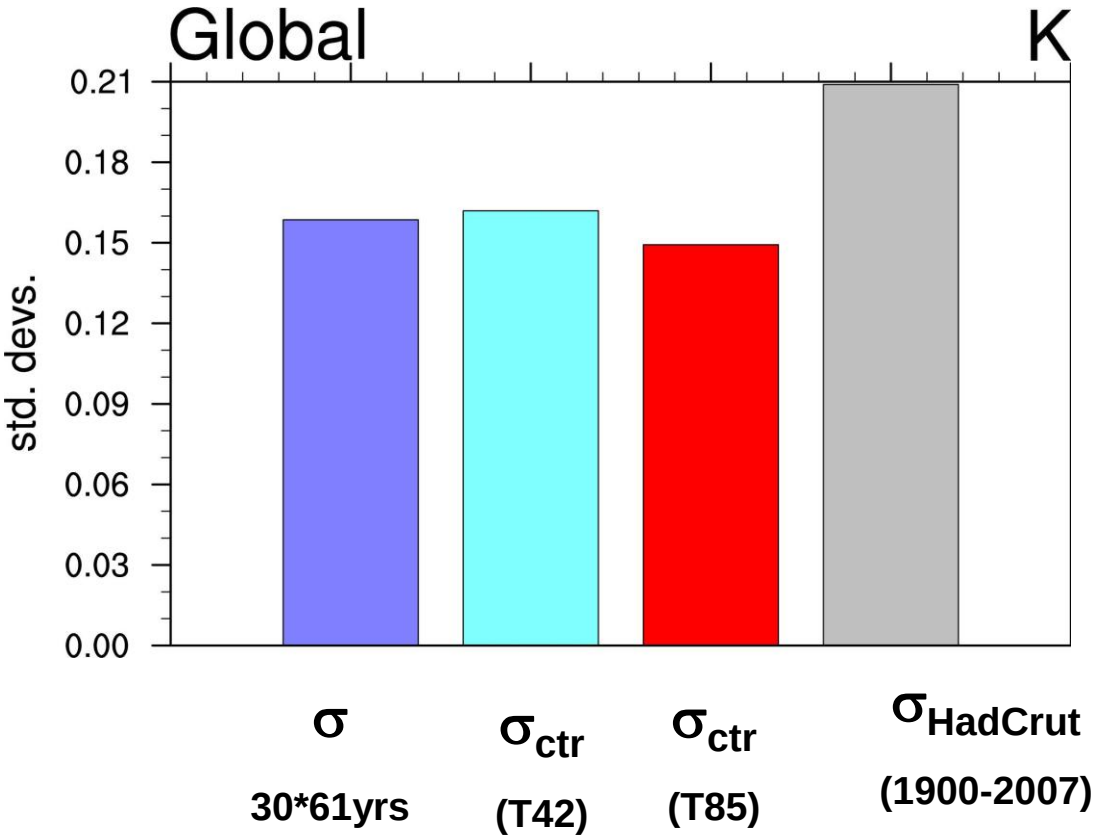
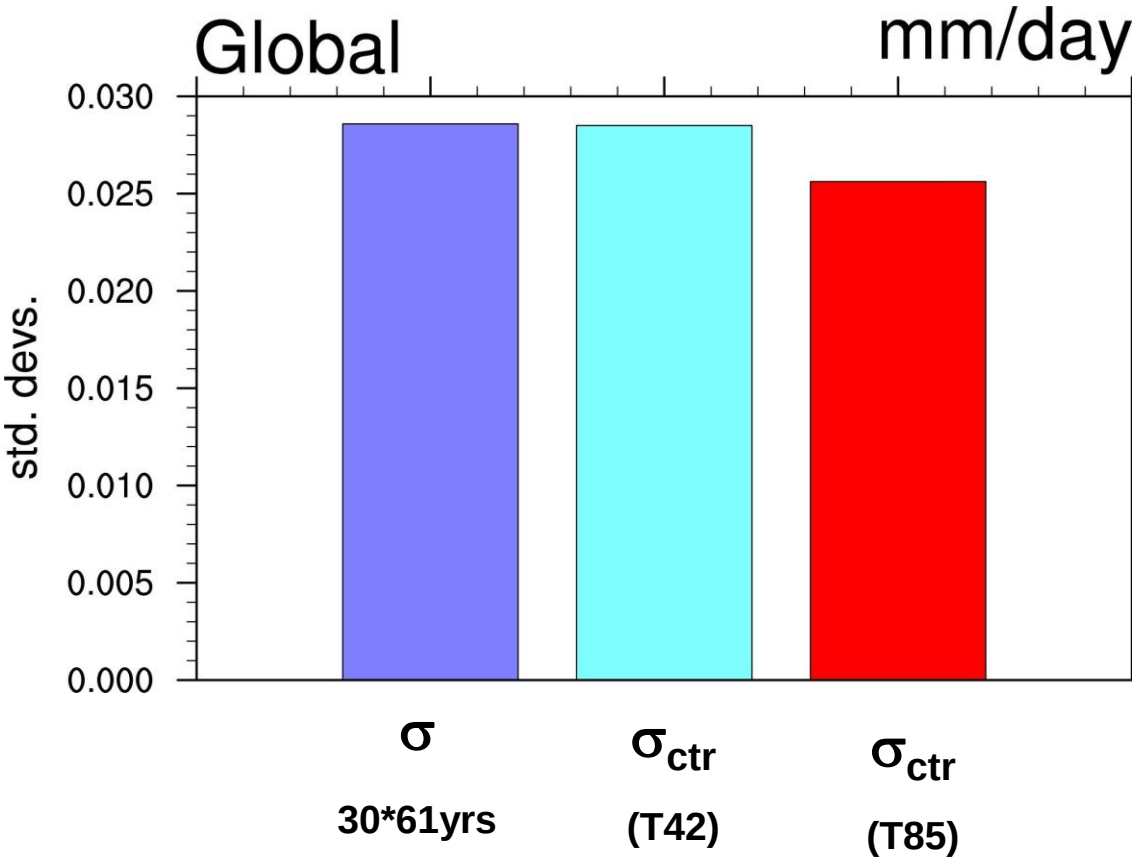
Standard deviations of global surface air temperature indicate that the internal variability can be mostly represented by the ensemble spread



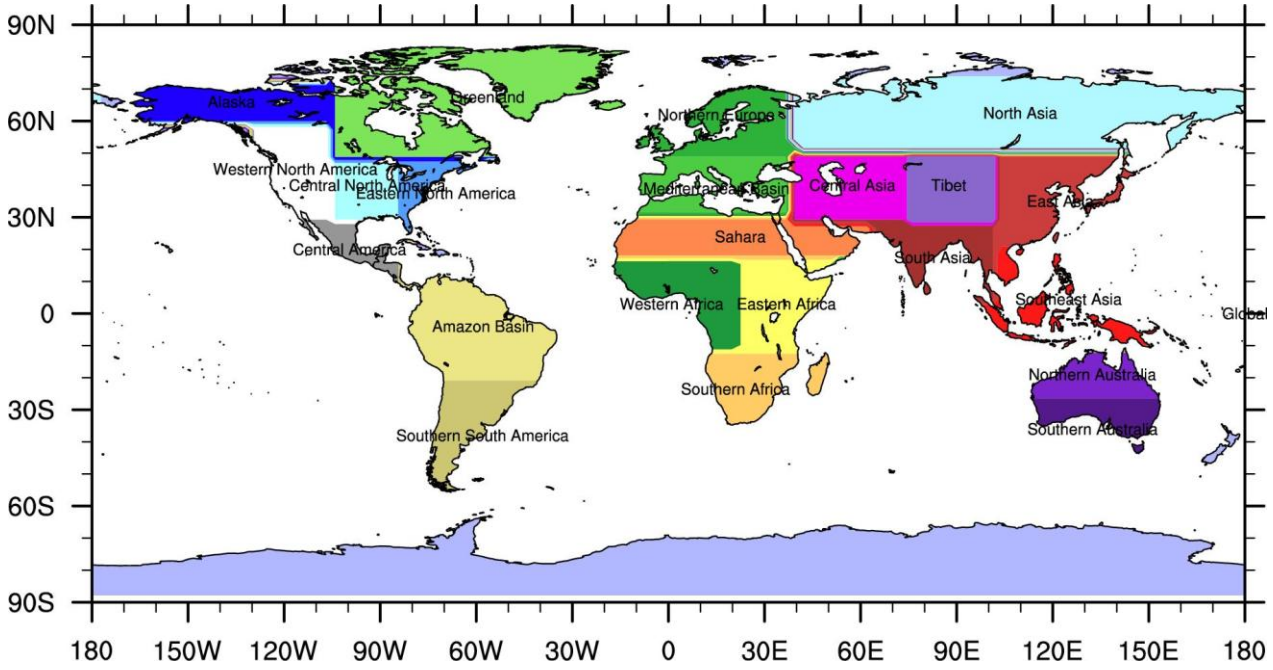
Estimates of internal variability: precipitation

Standard deviations of global precipitation also indicate that the internal variability can be mostly represented by the ensemble spread



Estimates of internal variability

- Land points split into 22 regions, based on Giorgi and Francisco, Climate Dynamics, 2000



Estimates of internal variability: regional temperature

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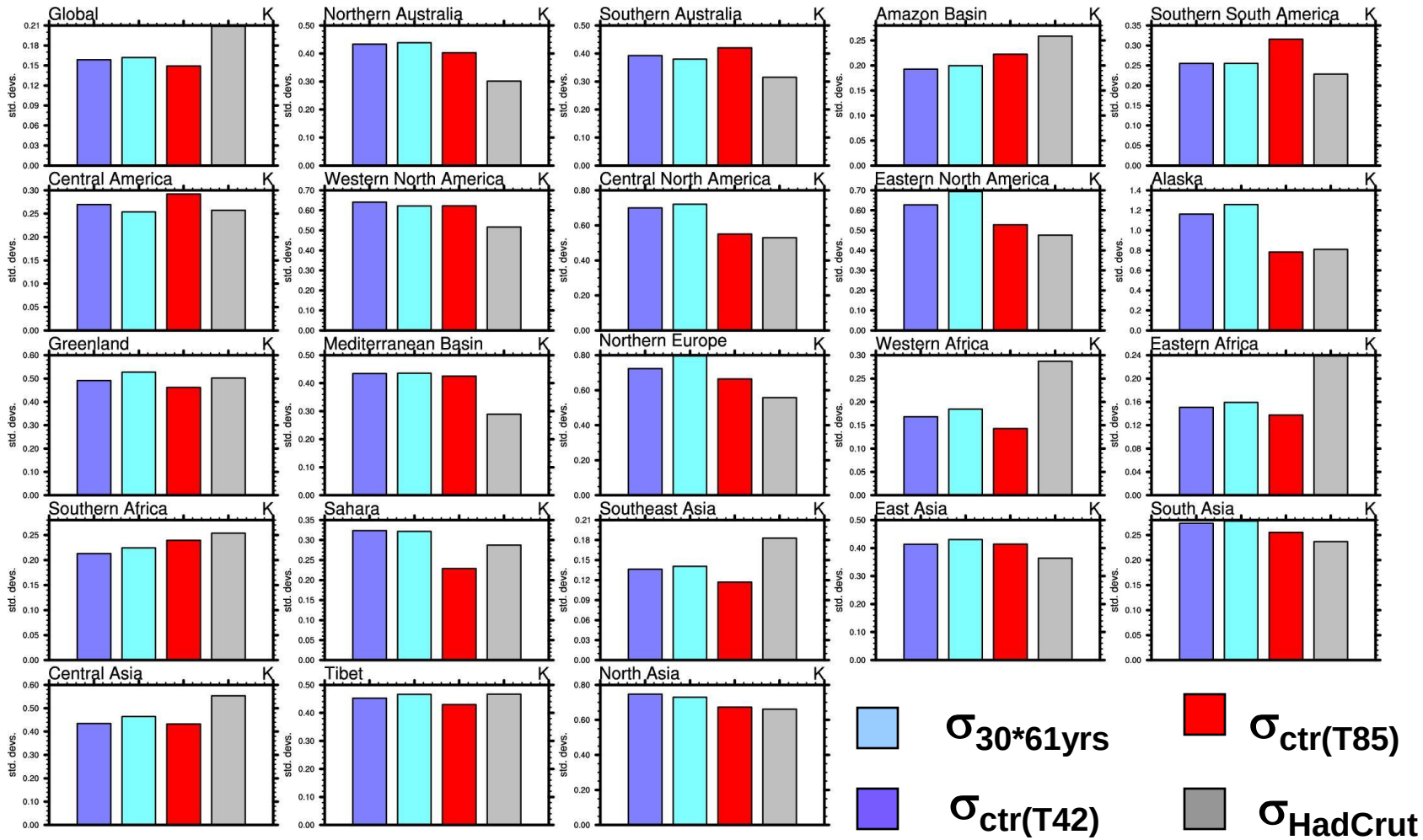

Estimates of internal variability: regional precipitation

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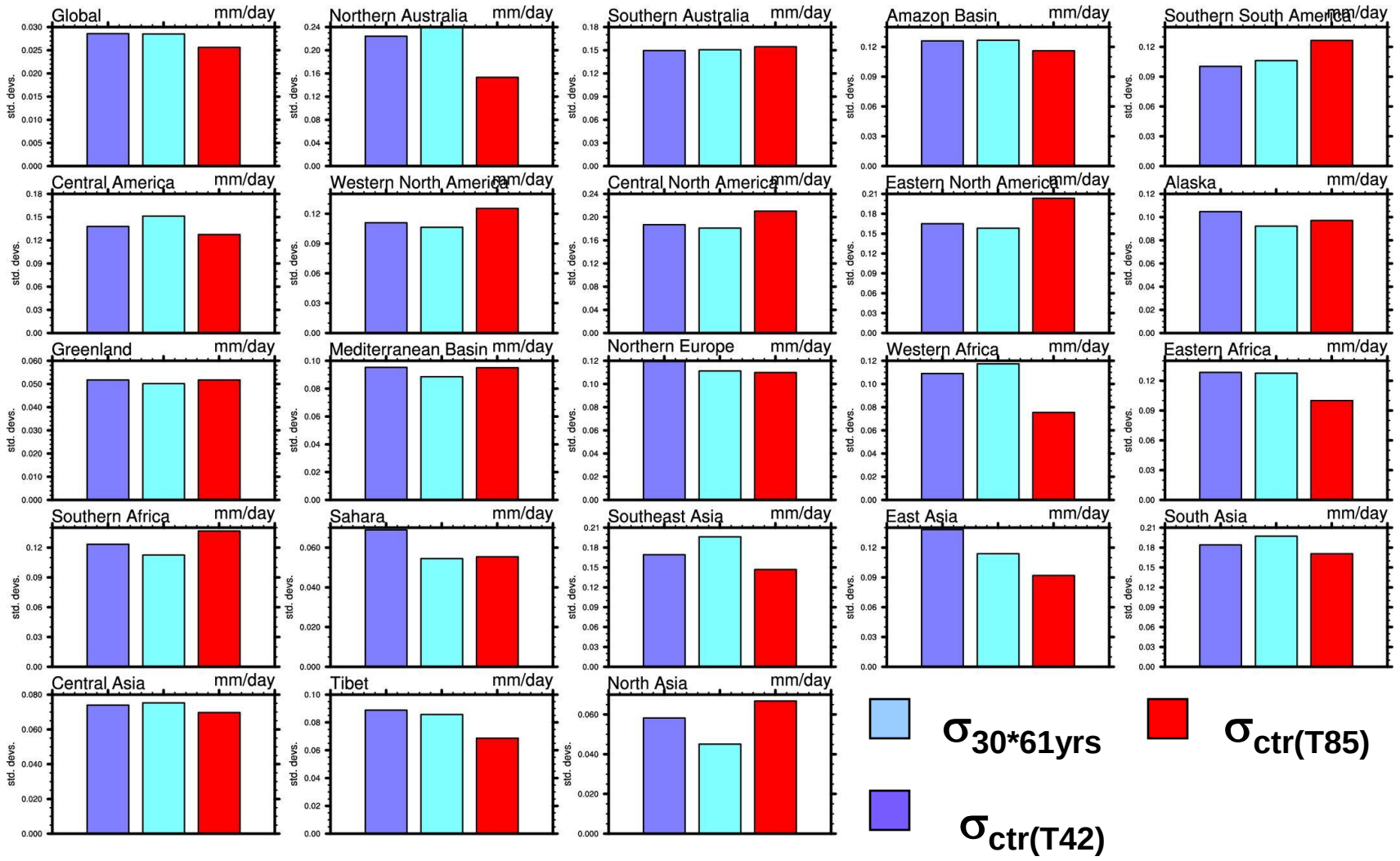
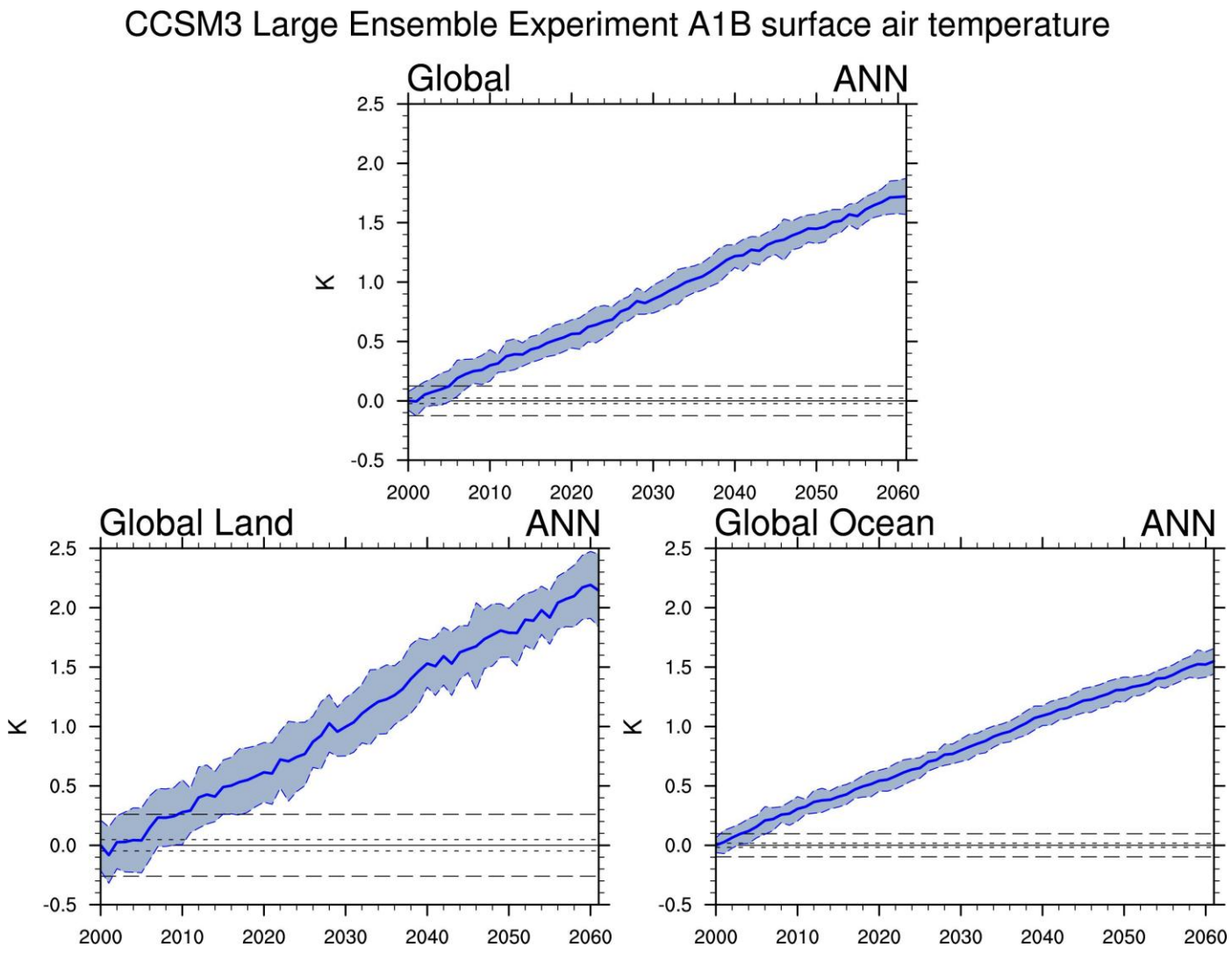
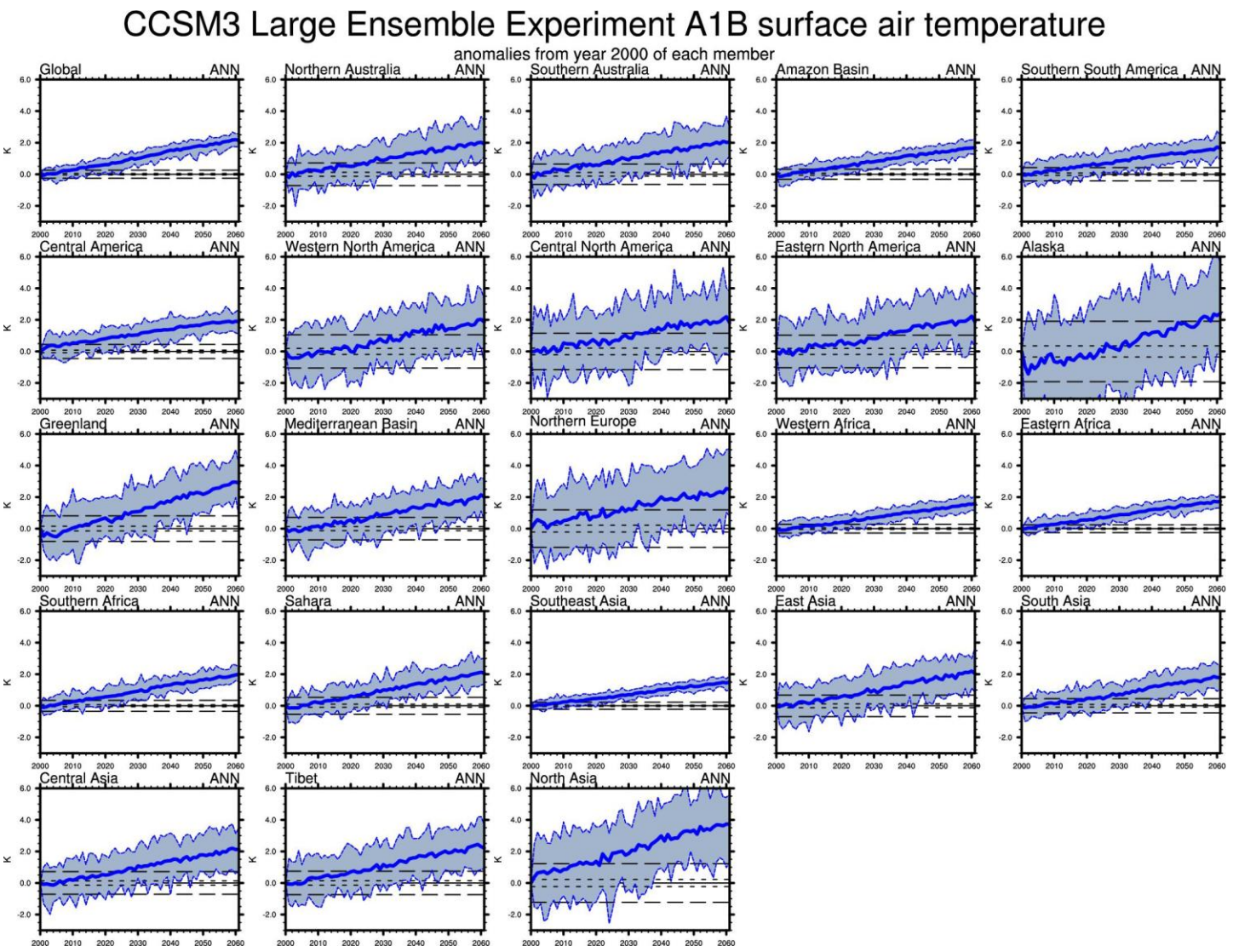


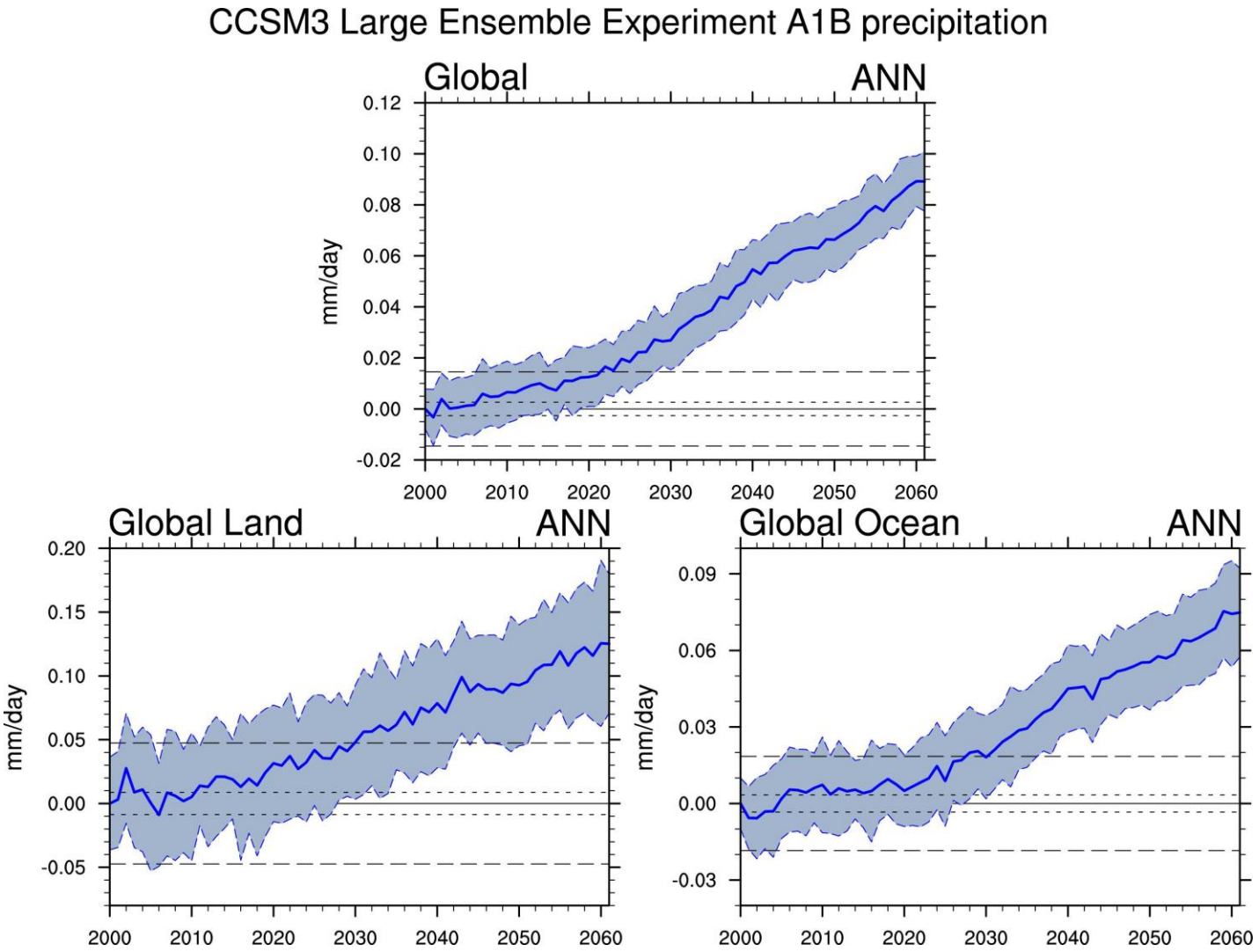
Emerging signal: temperature



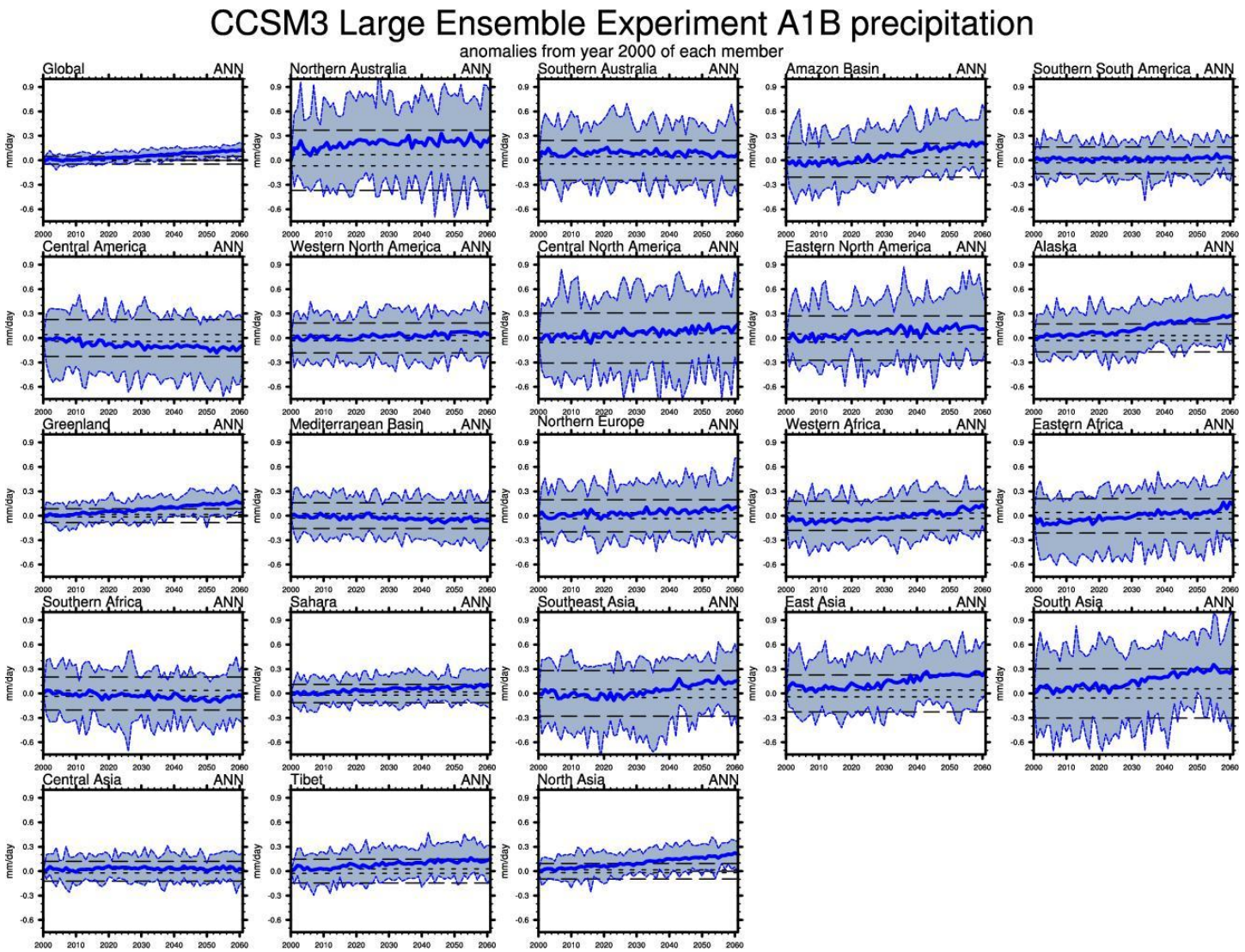
Emerging signals: regional averages



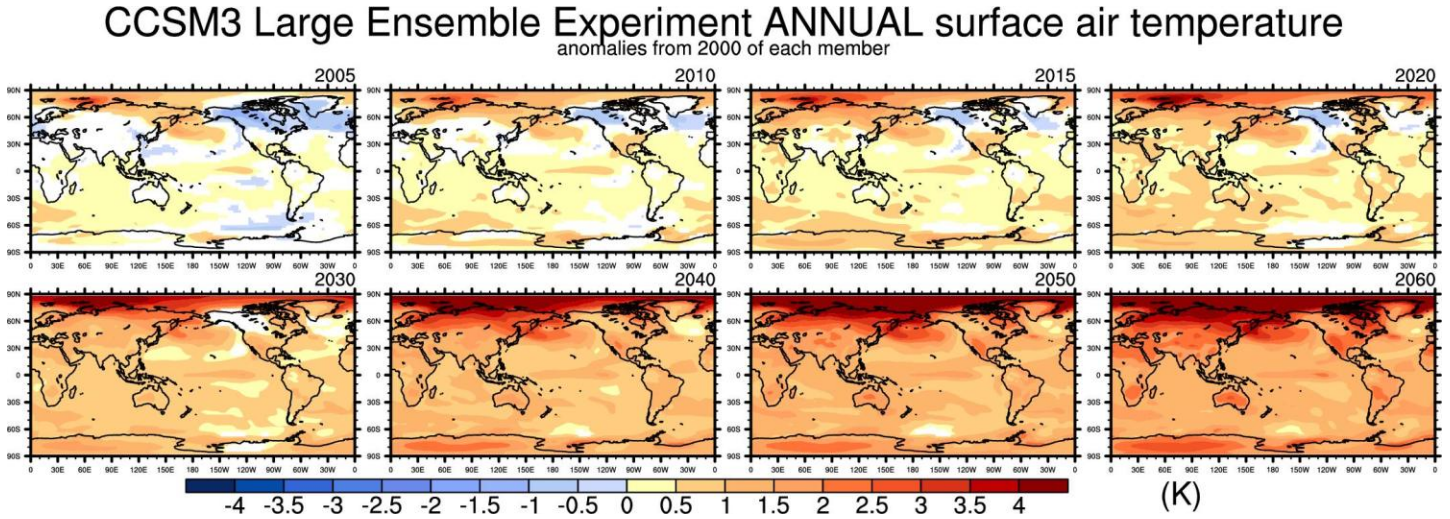
Emerging signal: precipitation



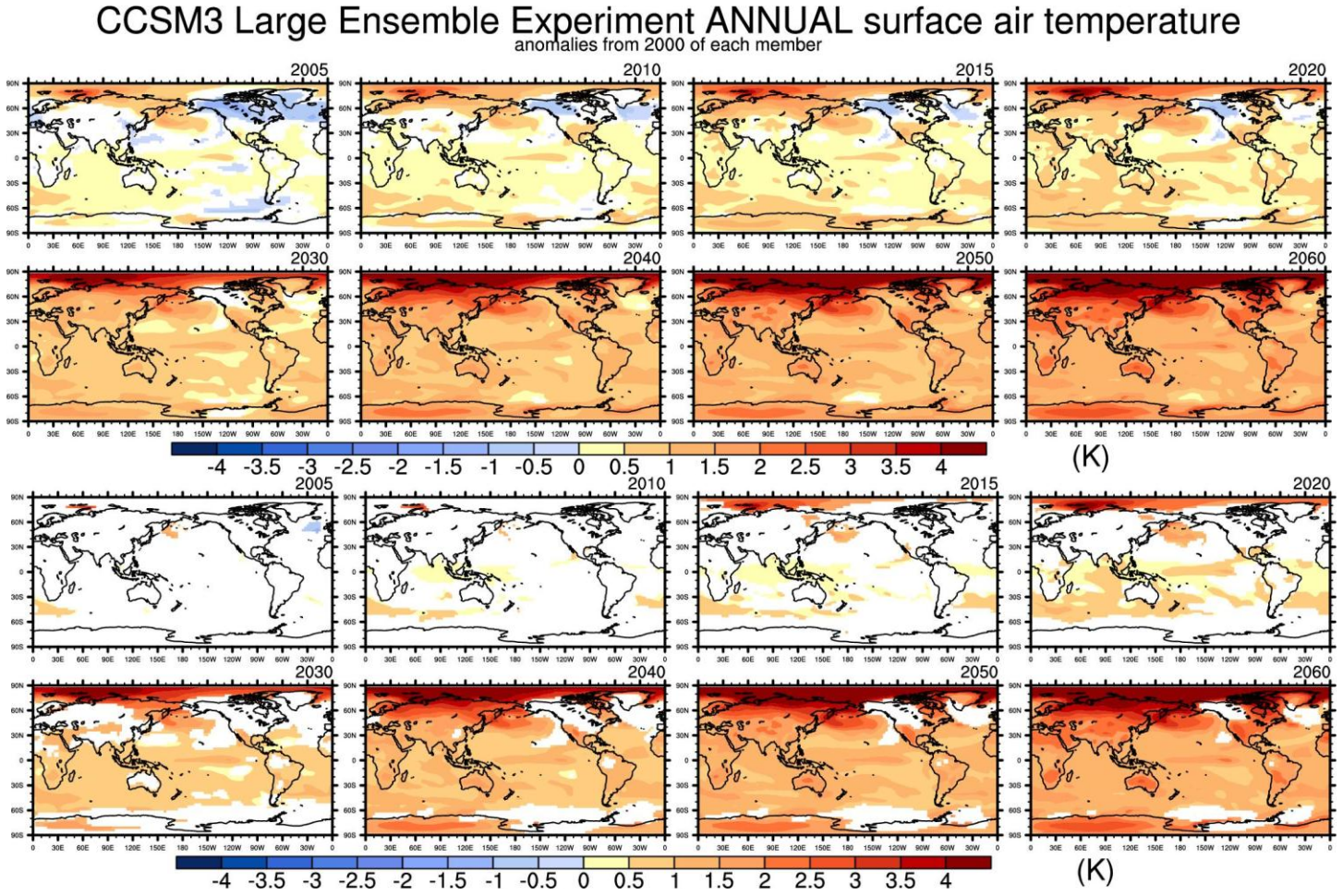
Emerging signals: regional averages



Emerging signals: at gridpoint scale



Emerging signals: at gridpoint scale



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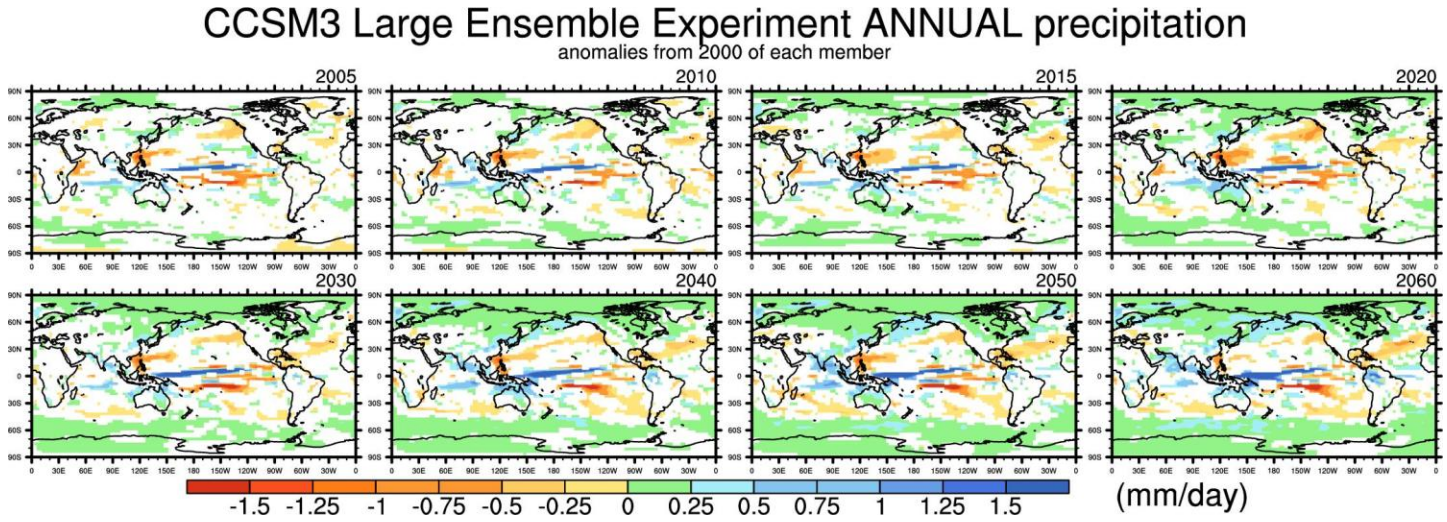
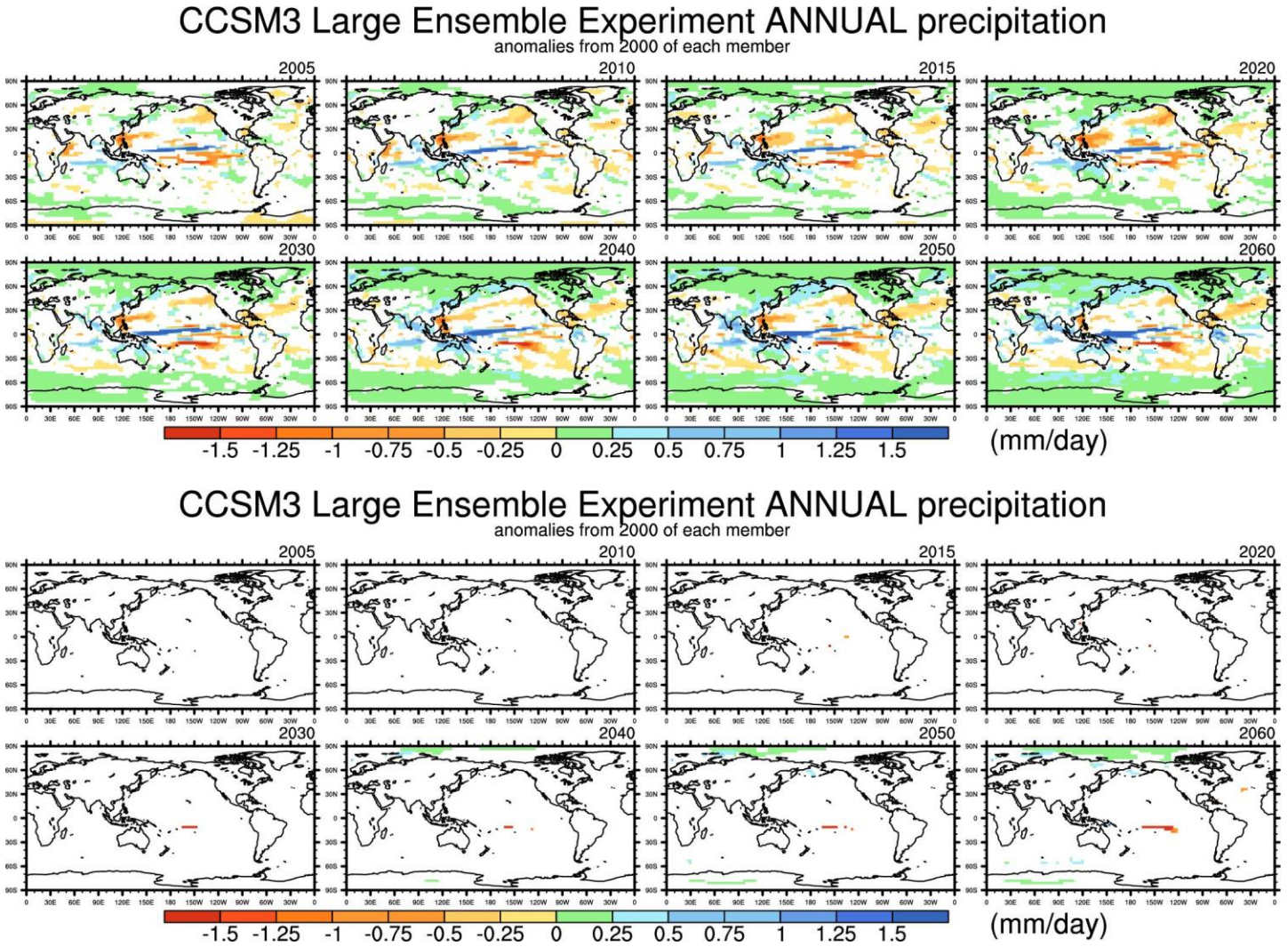
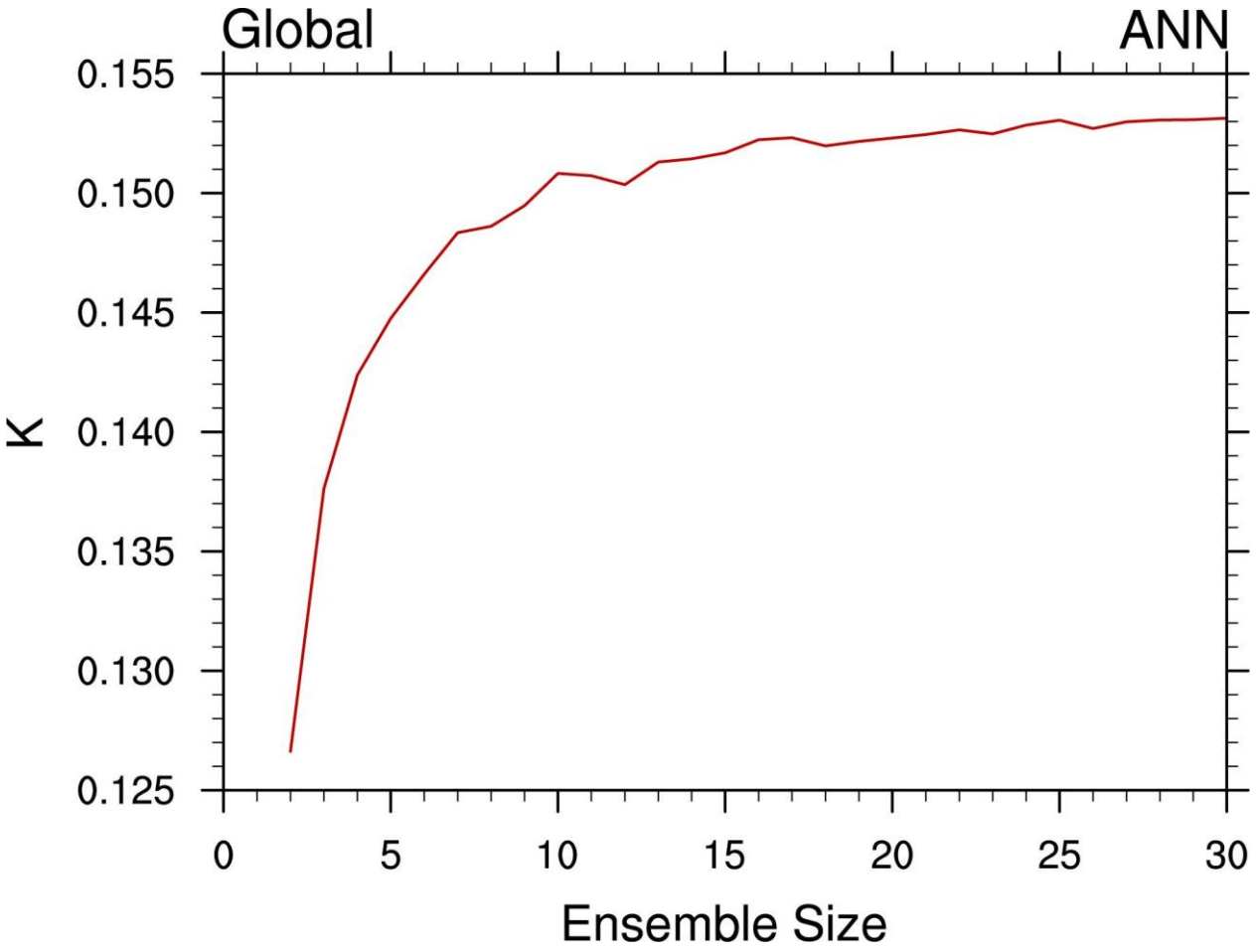


Emerging signals: at gridpoint scale



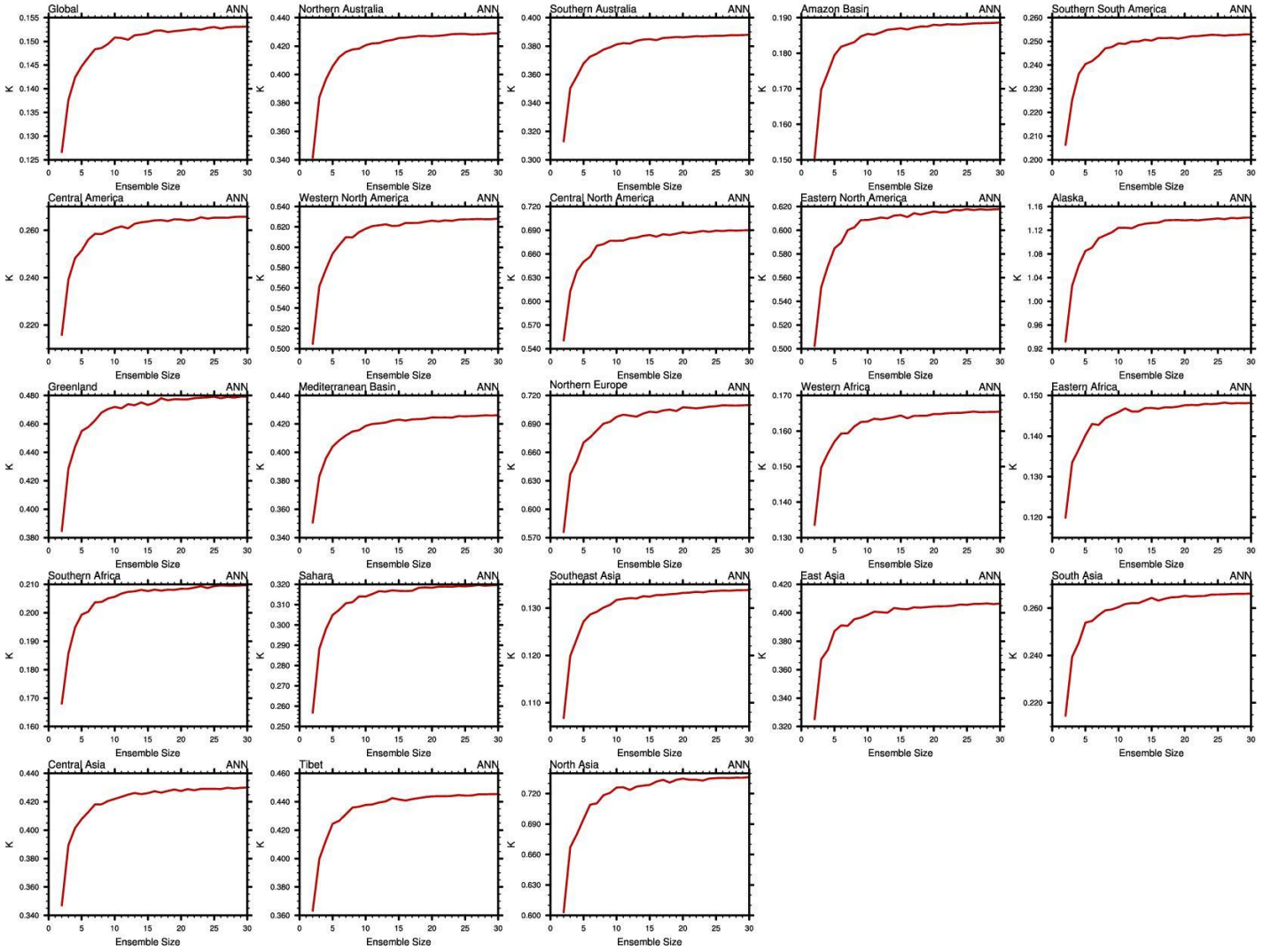
Ensemble size dependence of noise

Standard deviations of global surface air temperature across ***N*** randomly sampled members of the large ensemble



Ensemble size dependence of noise

CCSM3 Large Ensemble Experiment A1B surface air temperature



Summary and future work

Estimates of noise due to interannual variability

- ensemble spread is a good estimate of unforced interannual variability for global and regionally averaged *tas* and *pr*, except for some NH high latitude regions

Emerging signal

- forced signal (from 2000) emerges from the ensemble mean noise for most regions by 2020, spread by ~2050
- cooling is possible for first decade

Ensemble size and uncertainty in forced change

- preliminary results suggest spread saturates with ~10 members, for global values

Summary and future work

Extremes

- eg. precipitation signal does not exceed the noise, but precipitation extremes are expected to respond more strongly to anthropogenic forcing

T85 (initial states varying) vs T42 Large Ensemble

- impacts of initial state on internal variability on interannual and decadal timescales