

Is the PMIP ensemble large enough?

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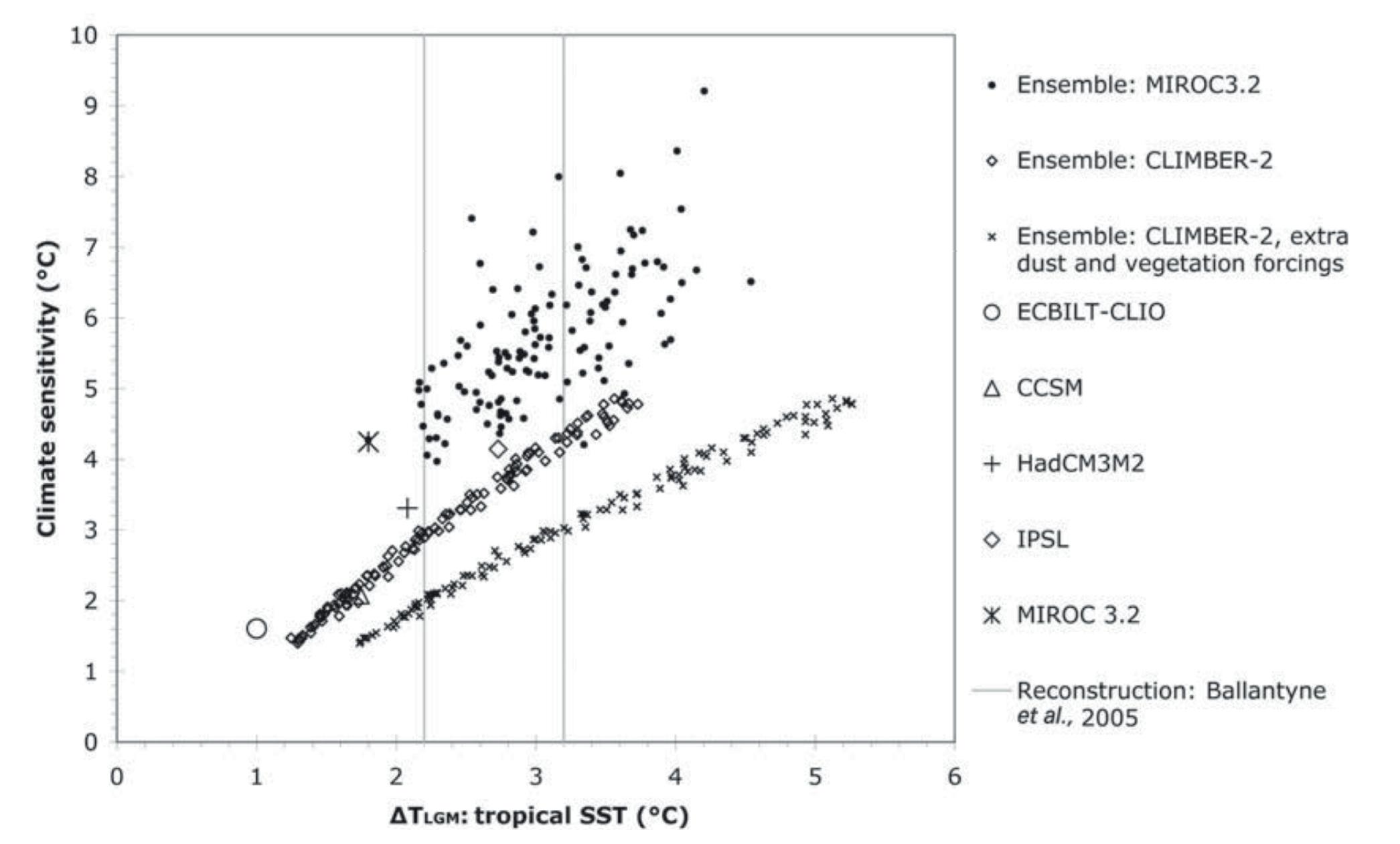
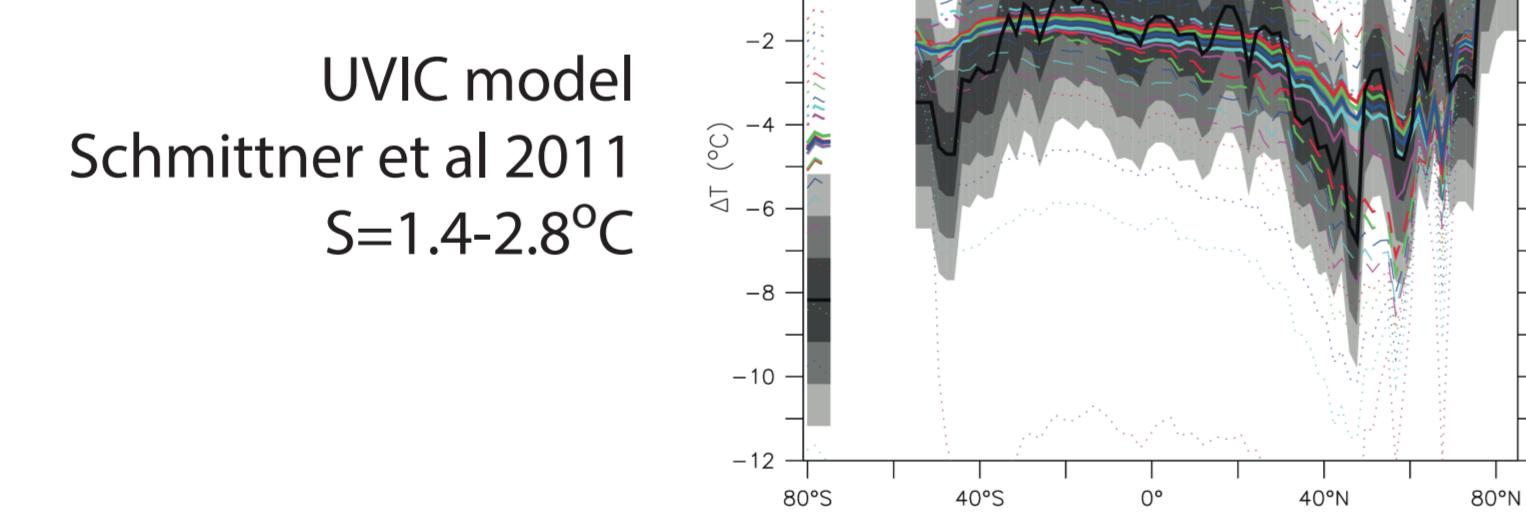
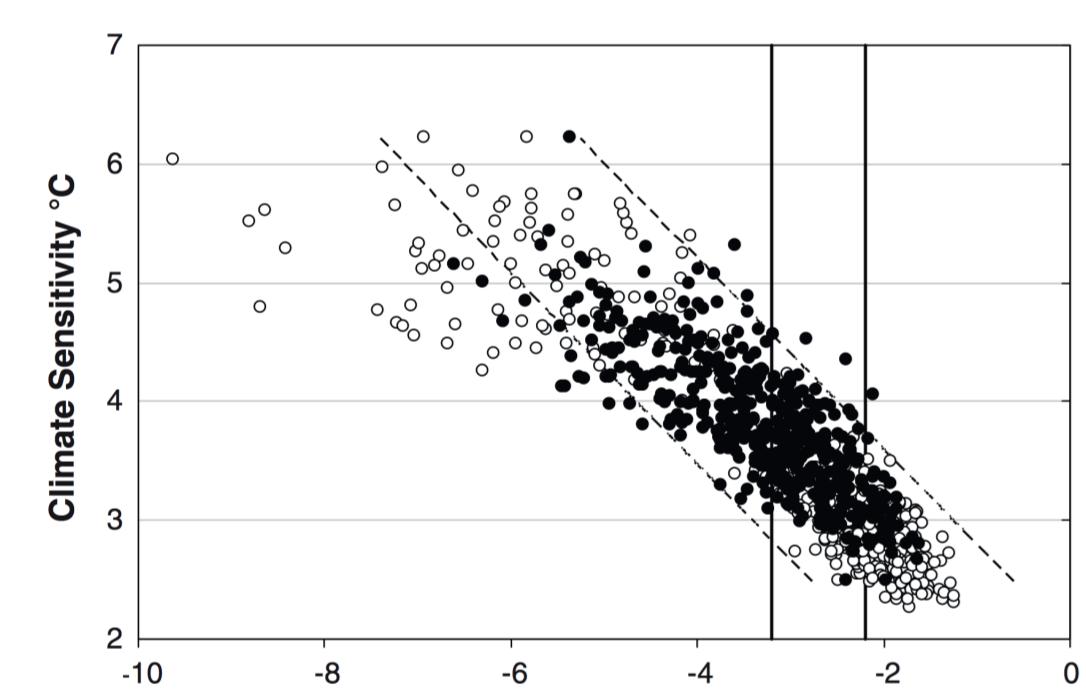
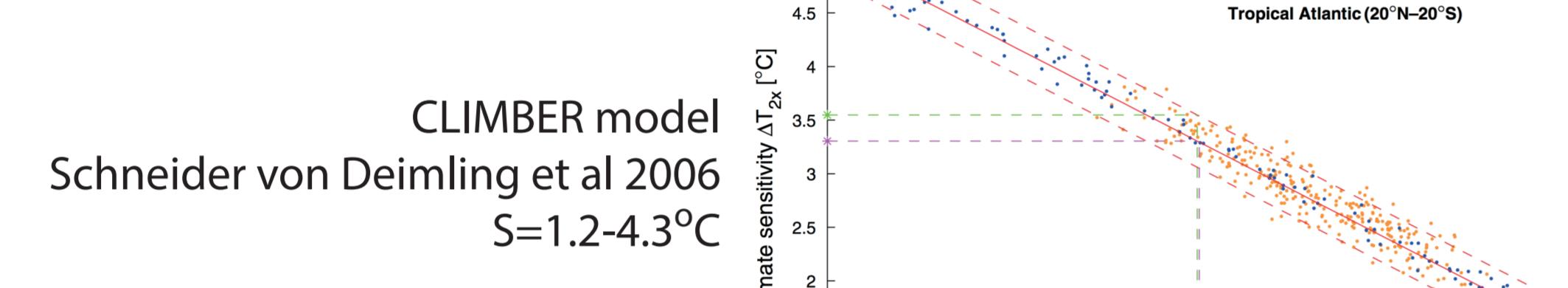
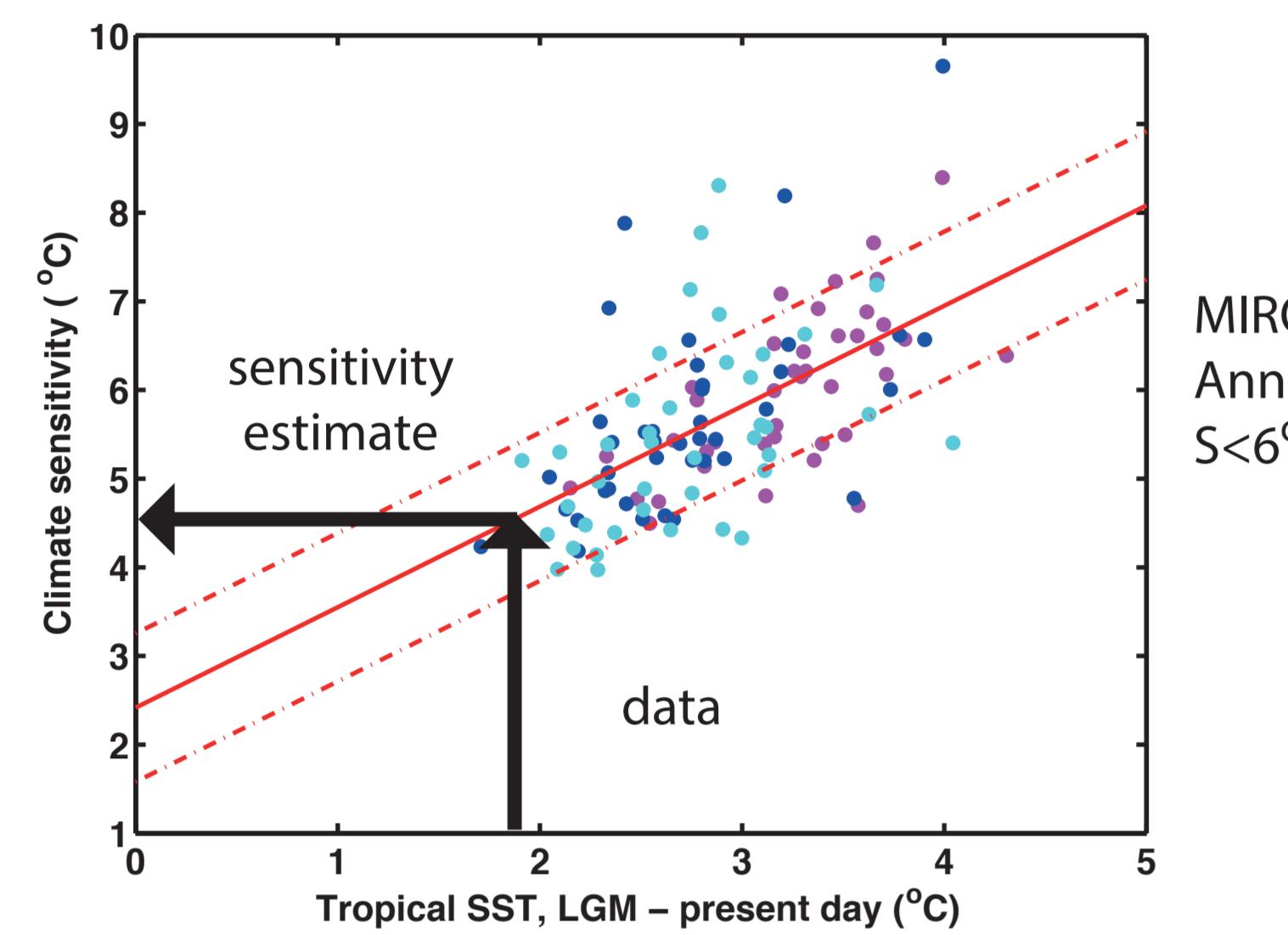
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The context: Estimating climate sensitivity (S) using climate model ensembles and observations of the Last Glacial Maximum (LGM) ...



Using single model ensembles (SME)

Vary the parameters thought to affect sensitivity. Are LGM temperatures correlated with climate sensitivity? Use observations from the LGM to assess/constrain the ensemble spread.



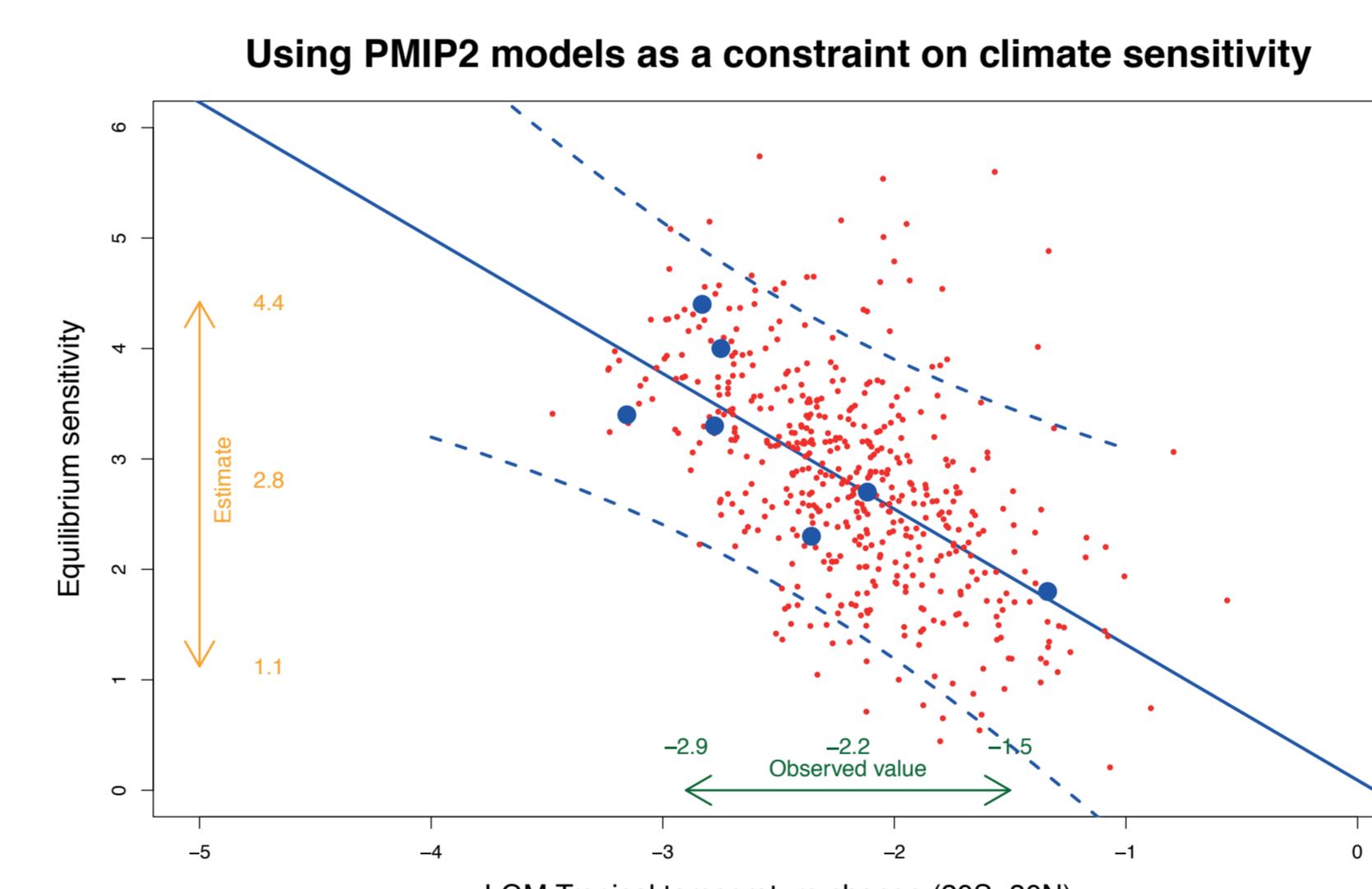
Using multi-model ensembles (MME)

Download the CMIP/PMIP data from the databases. Are LGM temperature anomalies correlated with climate sensitivity? Use observations from the LGM to assess/constrain the ensemble spread.

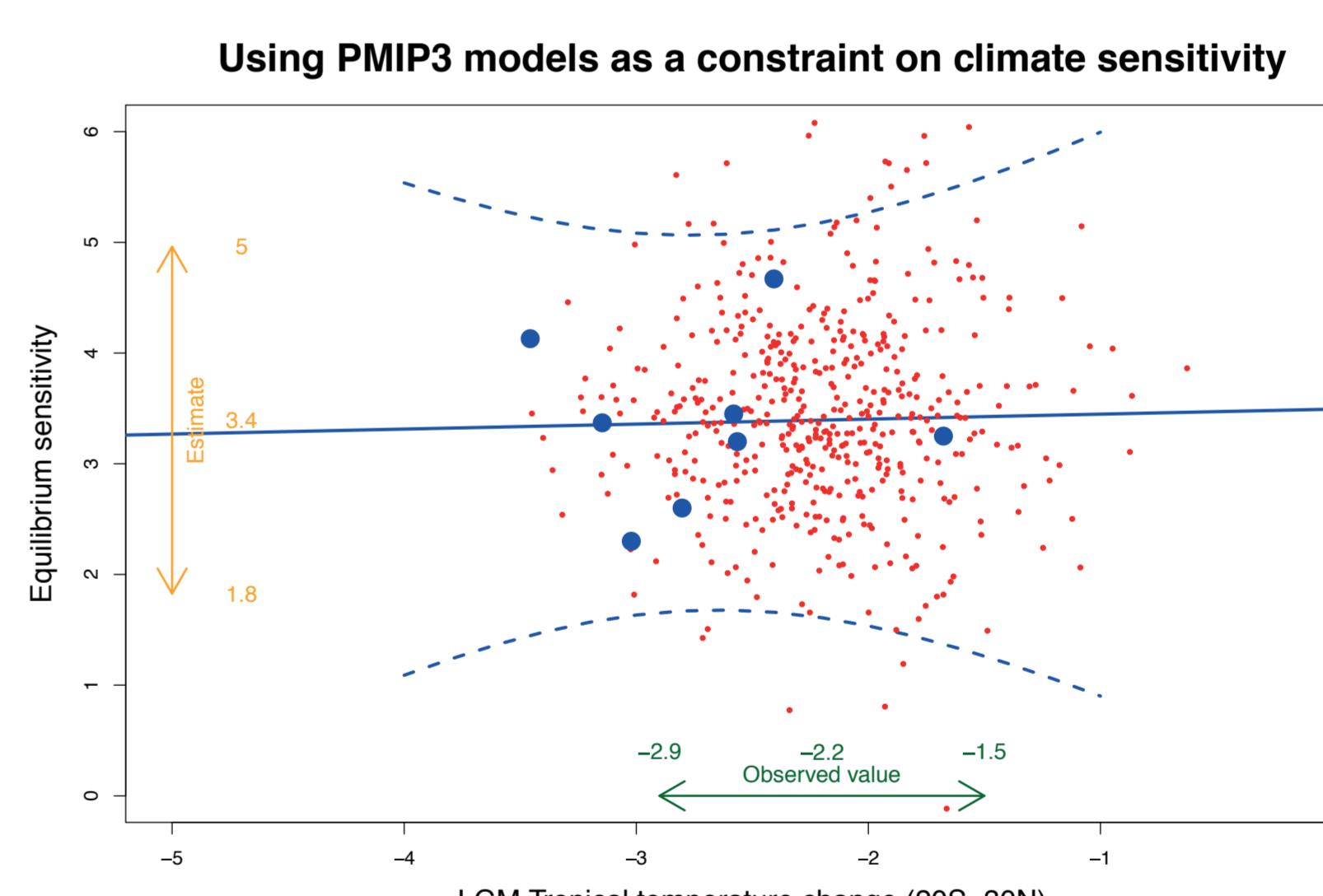
MME vs SME:

Much greater scatter in the multi-model ensemble. Is the correlation strong enough to estimate climate sensitivity??

Yes! PMIP2 $S = 1.1-4.0^\circ\text{C}$
Hargreaves et al 2013



No! PMIP3, S is not constrained by the LGM (Harrison et al 2015)



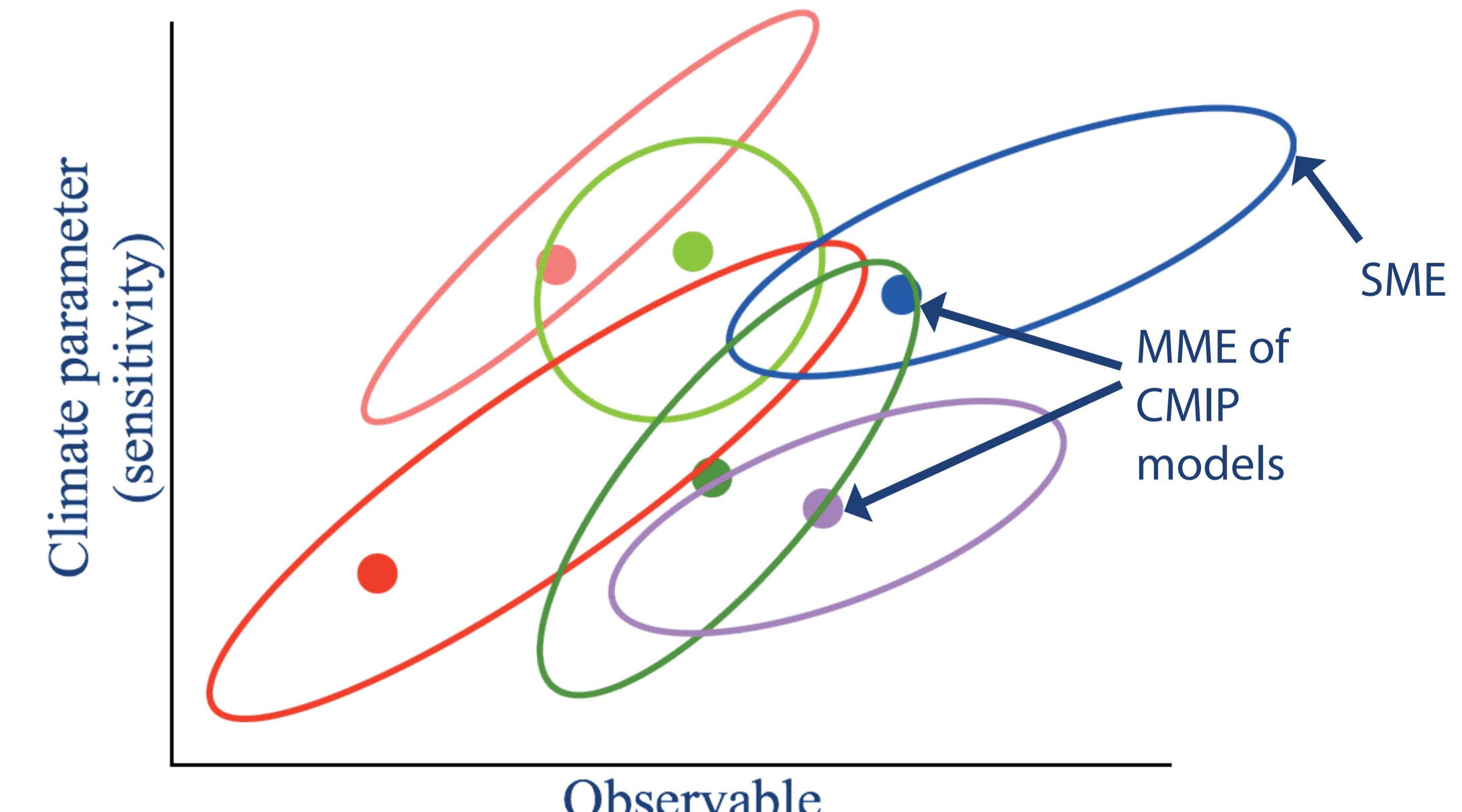
Conclusions

MMEs have been shown to span a much wider range of uncertainty than SMEs (eg. Yokohata et al 2010, 2011, 2013).

Further constraining the ensemble range of sensitivity with LGM data seemed possible in PMIP2, but PMIP3 results disagree. Is this a statistical accident? If PMIP2 correlation was generalisable to new models, then it is very unlikely ($P < 5\%$) that a new 8-member sample would have reverse/zero correlation as found in PMIP3. So, is it caused by greater uncertainty from new processes included in the new model versions?

If the conceptual picture is valid, then a signal might become apparent if the PMIP3 ensemble were much larger, or the range of sensitivity in the ensemble was much greater.

Conceptual picture of MME/SME constraints



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