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## Developing probability distributions for climate feedbacks using models' output

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Uncertainty about biases common across models and about unknown and unmodeled feedbacks is important for the tails of temperature change distributions and thus for climate risk assessments. This paper develops a hierarchical Bayes framework that explicitly represents these and other sources of uncertainty. It then uses models' estimates of albedo, carbon cycle, cloud, and water vapor-lapse rate feedbacks to generate posterior probability distributions for feedback strength and equilibrium temperature change. The posterior distributions are especially sensitive to prior beliefs about models' shared structural biases: nonzero probability of shared bias moves some probability mass towards lower values for climate sensitivity even as it thickens the distribution's positive tail. Obtaining additional models of these feedbacks would not constrain the posterior distributions as much as would narrowing prior beliefs about shared biases or, potentially, obtaining feedback estimates having biases uncorrelated with those impacting climate models. Carbon dioxide concentrations may need to fall below current levels in order to maintain only a 10% chance of exceeding official 2 degrees Celsius limits on global average surface temperature change.