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Bayesian climate change detection using multi-AOGCM ensembles

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We apply a Bayesian approach to the observd global temperature changes using multi-model ensembles (MMEs) of the IPCC 20C3M simulations. The Bayesian decision method by Min et al. (2004, 2005) is used as a tool for classifying observations into scenarios (or hypotheses) concerned, including consideration of uncertainties of and subjective beliefs in the scenarios. The Bayes factor (or likelihood ratio) provides an observational evidence for the each scenario against a reference scenario defined. In this study, four scenarios are considered to explain observed climate changes: Cntrl (control or no change), Natural (natural forcing induced climate change), GHG (greenhouse-gas induced climate change), and All (natural plus anthropogenic forcing induced climate change). Parameters needed to define the four scenarios are estimated from single- or multi-AOGCM ensemble simulations. Application results for global mean 2m temperature changes for the whole 20th century (1900-1999) show 'decisive' evidences (Logarithm of Bayes factor > 5) for the 'All' scenario and 'strong' evidences (Log of Bayes factor > 2.5) for the 'GHG' scenario. While 'strong' evidences are found for both 'Natural' and 'All' scenarios in temperature changes for the first half of the 20th century (1900-1949), there are 'decisive' evidences for the 'All' scenario only in temperature changes for 1950-1999. According to the comparison of results from MMEs with single model ensembles, our Bayesian detection for global mean temperatures is largely insensitive to inter-model uncertainties. Extensive analyses using regional temperatures and/or other possible variables will be done for future works.