

## The inapplicability of traditional statistical methods in climate ensembles

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### Abstract

There is growing demand for predictions of future climate to support planning efforts to adapt to 21st century climate change. At the same time there has been growing effort expended in the quantification of uncertainty in model based climate predictions at all scales. This has led to a number of large ensembles of complex climate models; ensembles exploring emissions uncertainty, initial condition uncertainty and model uncertainty. These ensembles do not, of course, explore any of these sources of uncertainty comprehensively. There is a continuing challenge to expand these ensembles and to better design them for a variety of different purposes. However, perhaps the greatest challenges at present relate to their interpretation. Given the lack of any clear definition of “model space” and given the ad hoc nature of the shape of model parameter space the sampling of model uncertainty can not be treated as IID (Independent and Identically Distributed). This lack of independence between ensemble members critically undermines the application of many common statistical methodologies. The challenges here will be discussed and illustrated using a 40,000 member GCM ensemble from climateprediction.net. Differences in the treatment of initial condition uncertainty and model uncertainty will be highlighted along with some discussion of how they may be combined.