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Identifying Structures and Impacts of Uncertainty on Climate Change Detection Results

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Abstract: The proposed work in the original grant addresses the question of how to incorporate the uncertainty in observational errors, mainly from potential systematic biases, into the climate change detection statistical algorithms. The potential biases are mainly an issue with sea surface temperatures where a fraction of the original data have unknown sources. The bias corrections for these data must be inferred from the data for which it is known how the original temperatures were measured. Typically, the relative fractions of each measurement type from the known data sources are then applied to the data for the unknown measurement types. This has a potential bias that will be explored here and formalized in the statistical detection algorithms.
In the original proposal, the major questions to be addressed were: To what extent can we:1. estimate further the biases and structures of observational uncertainty?2. clearly identify robust patterns of variability from climate model results?3. estimate the impact of these biases and uncertainty on CCD results?4. distinguish between bias structures and variability structures?
At this time, in work with Bruno Sansó, we have developed the statistical tools to discuss item 2, and in the continuation of this grant, we will proceed with incorporating the bias and uncertainty components from the observational data to advance items 3 and 4.
The proposed work will proceed by exploring the error structures in the observational data sets (e.g., GHCN-ERSST, HadCRUT3, and HadAT2). The effort will continue to make use of the archive of atmosphere-ocean general circulation model (AOGCM) simulations available at the PCMDI IPCC Data Portal for work on the IPCC Fourth Assessment Report. These AOGCM data for the 20th century and pre-industrial control simulations will be used directly in the optimal detection algorithm. The majority of the effort will be to quantify the errors and, where possible, spatio-temporal structures. These multiple sources of estimated errors will be incorporated into the climate change detection algorithm. The current method is a hierarchical Bayesian framework for estimating the detection statistics that incorporates the identified error sources.