The U.S. CLIVAR CPT Program
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Numerical models have become essential tools in the study and prediction of natural climate variability and anthropogenic climate change. However the skill of such models in simulating the observed climate variability is still severely limited by (1) numerical approximations in the discretization of the hydrodynamical equations and (2) imperfect parameterizations of the myriad of atmospheric and oceanic processes that happen at scales too small to be explicitly resolved by the model. In the 1960s, at the dawning of the age of numerical modeling, the accuracy of the numerical schemes was the real bottleneck. For example, early models of the ocean generated excessive mixing across density surfaces due to poor numerical discretization. Great strides have been made over the past four decades in overcoming these technical difficulties both through improvement of the numerical codes and through increase in computational power. Currently the major source of model error has become the imperfect or missing parameterization of unresolved processes.

In the U.S., a large fraction of the development and maintenance of IPCC-class models is carried by scientists working at specialized modeling centers. These centers have been successful in improving the numerical kernel of climate models. However the development of effective parameterizations is intellectually more challenging and cannot devolved to a few centers. It demands physical understanding of how the relevant process relate to the overall ocean and atmosphere dynamics, and a careful consideration of issues related to model resolution and numerical formulation. While the modeling centers have the expertise to deal with the latter, progress in basic understanding is typically the result of observations, theory, and idealized studies which involve the whole scientific community. Currently there is little coordination between research at the modeling centers and elsewhere. As a result, parameterizations in atmospheric and oceanic general circulation models do not reflect recent advances in our understanding of the corresponding processes. This is arguably the biggest bottleneck in improving high-end climate models.

Climate Process and Modeling Teams (CPTs) were created in 2003 by the U.S. Climate Variability and Predictability (CLIVAR) program to provide a thorough and efficient forum for improving model parameterizations. The idea of a CPT is to fund a small group of observationalists, theoreticians, small-scale modelers, and scientists at the modeling centers to work closely together to improve parameterizations of a particular process in one or more climate models. After a call for proposals, three pilot CPTs have been funded for a three year period: one CPT examining cloud-feedbacks in the atmosphere, and two smaller CPTs focused on ocean dynamics, one on eddy variability in the upper ocean and the other on gravity currents. The three pilot CPTs are currently being reviewed by the National Science Foundation to evaluate the effectiveness of the new framework. The goal of the following brief papers is to summarize key results obtained by the CPTs so far and to provide a basis for discussion of the CPT approach within the scientific community.