CLIMATE2030: A Japanese Project for Decadal Climate Prediction

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Active discussions are under way in the international climate science community on the design of the next coordinated experiment for climate projection, CMIP5, to contribute to the fifth assessment report of IPCC envisioned to be published in 2013. One of the highlights of CMIP5 is a new category of experiments aimed at near-term prediction up to 2030. In order to make political decisions against climate change over the coming decades, we need to take into account the large-scale climate changes associated with internal variability in the climate system in addition to global warming. While global climate change is the main subject in centennial-scale warming studies, a globally averaged surface air temperature (SAT) forecast up to 2030 depends little on socioeconomic scenarios or models used in centennial climate projection experiments. On decadal timescales, SAT changes due to internal climate variability are comparable to those associated with global warming in magnitude and major uncertainties are closely related to the predictability of internal climate variations rather than global warming. Therefore, in addition to natural and anthropogenic climate forcings, near-term climate prediction models are initialized, like in daily weather forecasting, by observational data of recent decades to incorporate actual evolution of natural modes of climate variability. In other words, the climate projection experiment for the first time becomes a mixed boundary-initial value problem. Whether such an attempt is successful or not is not known and poses a significant scientific challenge.

In parallel to international discussion, Japanese community has been discussing the possibility of near-term high-resolution experiments and the CLIMATE2030 project has been started since April 2007 under so-called KAKUSHIN Program (the Innovative Program of Climate Change Projection for the 21st Century) supported by the Ministry of Education, Culture, Sports, Science and Technology (MEXT). In the CLIMATE2030 project, we update the coupled ocean-atmosphere climate model, MIROC, and develop an initialization scheme for decadal predictions by using historical subsurface ocean data. In addition to limited number of high-resolution (60 km atmosphere + 20x30 km ocean) ensemble predictions, a comprehensive suite of hindcast and forecast experiments are conducted by using a medium resolution (280 km atmos. + 140 km ocean) version of MIROC in order to explore impact of initialization and to assess predictability of natural climate variations. The system for assimilation and prediction by MIROC is called SPAM and is being tested not only for decadal prediction but also for seasonal to interannual predictions.

An initial result of SPAM on decadal prediction is reported. It is found in the hindcast experiments that there is useful decadal predictability in one of the well-known natural decadal modes, called the Pacific Decadal Oscillation (PDO), which is known to affect the pan-Pacific climate and ecosystems. In a prediction experiment started in year 2005, the PDO signal is expected to suppress the present global warming trend in the coming decade albeit with enhancement in some regions including the East Asia. The initial tendency of PDO polarity change has been successfully verified by observations.