

Long-term global change projection using MIROC-ESM under KAKUSHIN program

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The KAKUSHIN program (Innovative Program of Climate Change Projection for the 21st Century) is a 5-year research project, which started in FY 2007 and comes to an end this FY, dedicated to global warming projection covering uncertainty estimation and impact assessment. The targets of KAKUSHIN program include near- and long- term projection and extreme events, as in the CMIP5 protocol. In this presentation we focus on the results from the long-term projection component, which have been obtained with MIROC-ESM and MIROC-lite: the former is a GCM-based earth system model and the latter an EMIC. As of April 2011, we have mostly finished the experiment listed in the CMIP5 protocol. Preliminary analyses show some intriguing results that, among others, future land use scenario may have a critical impact on the global carbon cycle, and that CO₂ emission may have to be totally cut around 2040's, if future warming is to be suppressed under 2 deg.C. Model analysis is underway also on aspects other than carbon cycle, and indicates a longer periodicity of Quasi-Biennial Oscillation (QBO) under global warming and a significant impact of sea-ice melting on ocean acidification in the Arctic Sea. Furthermore, uncertainty estimation on the future scenarios is going on with the help of MIROC-lite. Examination on the RCPs revealed that "negative emission (or anthropogenic carbon sink)" may be necessary even for achieving the RCP4.5 concentration, for which the standard emission pathways does not include any negative emission. Also, it turned out that the differences between the RCP standard emission pathways and those obtained our GCM-based ESM (MIROC-ESM) fall within the uncertainty range estimated by MIROC-lite. It is expected that EMICs can be utilized as a powerful tool for uncertainty estimation on results obtained by GCM-based ESMs.