

Global Distribution of Projected Sea Level Changes Using Multiple Climate Models and Economic Assessment of Sea Level Rise

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In recent years, many climate models have been developed and they have provided reliable parameters related to future climate changes, most of which have been adopted in the United Nation's Intergovernmental Panel on Climate Change assessment reports. However, relevant outputs for sea level changes from those models do not exactly coincide with each other. This might create an obstacle to practical studies on impacts of and adaptations to climate change. The objective of this study was to investigate not only the uncertainties but also the certainties of future sea level rise projections by comparing the projected global distributions of sea level changes using multiple climate models, to assess potential areas of future inundation using the outputs of climate models, and to assess populations affected and economic damages in coastal zones around the world.

Of the various climate model outputs relevant to sea level changes provided for CMIP5, we selected outputs of four models (CanESM2, MIROC-ESM, MPI-ESM-MR, and NorESM1-M) to compare projected sea level changes. Using the outputs of these four climate models, we investigated the variances in global mean sea level changes and the differences in distribution patterns of sea level changes based on the same RCP scenarios (RCP2.6, RCP4.5, and RCP8.5). Temporal changes in sea level were also investigated for each of the RCP scenarios.

Inundation damage in costal zones was considered a significant impact due to sea level rise. Potentially inundated areas and the temporal change of inundation were estimated using topographic data (ETOPO1) and sea surface height data (MIROC-ESM), which were adjusted vertically at the geoid. Astronomical high tide was included in the calculations, but storm surges were not. Global areas of inundation as well as inundated areas in major countries were estimated. Combining the results of inundated areas with SSP scenarios, the populations affected and the economic damages caused by inundation due to future climate change were also estimated.

Consequently, the global distributions of projected inundation impacts induced by sea level rise as well as temporal change of inundation were shown through this study. This qualitative and quantitative information is expected to be valuable in implementing measures to adapt to climate change in the future.

Keywords: Sea-level rise, climate model, inundation damage, RCP, SSP