Progress of MIROC-ES2 simulations in CMIP6 and the analysis of the biogeochemical feedbacks

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In order to reveal how climate-biogeochemical system responds to anthropogenic forcing, a new Earth system model “MIROC-ES2L” has been developed for CMIP6. The physical core of the model is “MIROC5.2”, and the biogeochemical component are updated from that used for CMIP5: the new model has explicit CN interaction in land ecosystem, and ocean component has been improved to include P, Fe, and O in addition to C and N cycles that were already incorporated into that of CMIP5 ver. In the new model, ocean N cycle is opened to other subsystems: N input via biological fixation, deposition and riverine transport are considered, and denitrification process controls N loss from the ocean. This model is used for CMIP6 runs, by participating in endorsed MIPs such as C4MIP, PMIP, OMIP, LUMIP, CDRMIP, ScenarioMIP, VolMIP, etc.
A provisional historical simulation by MIROC-ES2L with CMIP6 official forcing (v6.2.1) clearly showed a global warming trend from 1970’s, which is consistent with observation (HadCRU4). Carbon stored in land ecosystem decreased by responding to the land-use change forcing, and started to increase around 1960 by responding to CO2 increase and increased N input into land (N deposition and fertilizer), in addition to the response to LUC. Ocean continuously store the anthropogenic CO2: the increase during 1850-2005 is about 150PgC, which is almost similar level to the number reported in Global Carbon Budget 2017. In addition to C cycle, the historical simulation showed drastic changes in global N budget, by directly responding to the anthropogenic forcing (LUC and agriculture), and indirectly affected by climate–carbon cycle change. Agriculture increased both land N2O emission (diagnosed) and N leaching, the latter of which impacted on ocean biogeochemistry near river mouths.

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