Future scenario assessment by an integrated land surface model: MIROC-INTEG-LAND

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Future socio-economic and climate changes can have a great impact on water resources, food, bioenergy, land use, leading to various societal problems. In this study, we performed future projections by using a land integrated model, MIROC-INTEG-LAND, that considers land surface physics, ecosystems, water management, crop growth, and land use, under various socio-economic scenarios (Shared Socio-economic Pathways, SSP). Under the sustainability scenario (SSP1), demands for food and bioenergy are basically kept low, so that the increase in cropland areas for food and bioenergy are suppressed. On the other hand, in the middle of the road and regional rivalry scenarios (SSP2 and SSP3), these cropland areas are projected to increase due to high demand for food and bioenergy. The expansion of cropland areas is projected to increase the water demand for irrigation and CO2 emissions due to land use change. MIROC-INTEG-LAND simulations indicate that the impacts of the CO2 fertilization effect and climate change on crop yields are comparable, with the latter being greater than the former under climate scenarios with high greenhouse gas concentrations. We also show that the CO2 fertilization effects and climate change play important roles in changes in food cropland area, water demand for irrigation, and CO2 emissions due to land use change. Our results underscore the importance of considering Earth-human system interactions when developing future socio-economic scenarios and studying climate change impacts. In the presentation, we also show the results of the integrated Earth system model, MIROC-INTEG-ES.

Keywords: climate change, earth system model, future projection

