Effect on the earth system of realizing 1.5 degree climate target by overshooting after reaching 2 degree level

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By using an Earth system model (ESM) with emissions and land use scenarios consistent with socio-economic projections from an integrated assessment model, the effect of overshooting to 1.5 degree target (in Celsius from pre-industrial periods) after reaching 2 degree level is investigated in selected indicators of the global environment. Unlike the internationally coordinated model intercomparison project, the scenario is developed for a specific climatic model. The ESM output results in delayed achievements for both of 1.5 and 2 degree targets in terms of global surface mean air temperature, but achieved before or around 2100 as expected when we use global mean surface temperature (for which sea surface temperature and surface air temperature are used for ocean and land, respectively) masked with observation areas. In the overshooting scenario more heat is absorbed by the ocean compared to a case without overshooting, but still we found significant difference between the two scenarios in Arctic sea ice, while in both scenarios corals seem difficult to survive the 21st century (when no thermal adaptation is assumed) . The difference in steric sea level rise between the scenarios is only below 2 cm in 2100. In addition, vegetation productivity in broad regions shows slight (~5%) increase. Emission pathways in the scenarios rely on a large amount of carbon sequestration. In the 2 degree scenario CO2 emissions in 2100 are slightly below zero, while for 1.5 degree scenario they are below -20 GtCO2.. When the Earth system has high climate sensitivity and TCRE, to reach the 1.5 degree target we need to take an overshooting temperature pathway, but in case the overshooting is large, difference in some indicators between 1.5 degree and 2 degree scenarios can be non-significant, which is an important indication in implementing adaptive mitigation in the coming decades.

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