Geophysical Research Abstracts
Vol. 15, EGU2013-5502, 2013
EGU General Assembly 2013

Arctic sea ice evolution in CMIP5 extended RCP scenarios

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The global climate models that particiapated in the Coupled Model Intercomparison Project 5 (CMIP5) show strong declines in sea ice extent and volume under the some of the Radiative Concentration Pathway (RCP) scenarios through the year 2100, including the transformation from perennial to seasonal ice cover in multiple models in RCP4.5 and RCP8.5. These simulations were extended through the year 2300 by a subset of the CMIP5 modeling groups for the three scenarios RCP2.6, RCP4.5, and RCP8.5. The radiative forcing trajectories are decreasing, constant, and increasing respectively through 2300. Here, we examine the time evolution of Arctic sea ice in these extended RCP scenarios to gauge the response to these forcing pathways. In the RCP2.6 scenario, the summer Arctic sea ice extent begins to slowly recover almost immediately following the peak radiative forcing in 2044 in 6 of the 9 models that ran the extended RCP2.6 simulations. The extended RCP4.5 scenario maintains constant radiative forcing at 4.5 W m^{-2} through 2300 and demonstrates continued summer sea ice decline due to continued warming on longer time scales. The different sea ice respsonse in these two scenarios implies that sea ice extent could recover if and when radiative forcing from greenhouse gases were to decrease. In the RCP8.5 scenario, we show that the winter sea ice extent disappears in 7 of 9 models between 2135 and 2274, at a radiative forcing between 10 and 12 W m^{-2}. We discuss the reasons that cause the lack of ice formation in the models during the winter under this particular scenario.