Geophysical Research Abstracts
Vol. 16, EGU2014-15912-1, 2014
EGU General Assembly 2014

Sea ice radiative forcing, sea ice area, and climate sensitivity

Ken Caldeira and Ivana Cvijanovic
Carnegie Institution for Science, Dept. of Global Ecology, Stanford, CA, United States (kcaldeira@carnegiescience.edu)

Changes in sea ice cover affect climate sensitivity by modifying albedo and surface heat flux exchange, which in turn affect the absorbed solar radiation at the surface as well as cloud cover, atmospheric water content and poleward atmospheric heat transport.

Here, we use a configuration of the Community Earth System Model 1.0.4 with a slab ocean model and a thermodynamic-dynamic sea ice model to investigate the overall net effect of feedbacks associated with the sea ice loss. We analyze the strength of the overall sea ice feedback in terms of two factors: the sensitivity of sea ice area to changes in temperature, and the sensitivity of sea ice radiative forcing to changes in sea ice area.

In this model configuration, sea ice area decreases by $\sim 3 \times 10^{12}$ m^2 per K of global warming, while the effective global radiative forcing per square meter of sea ice loss is $\sim 0.1 \times 10^{-12}$ W m^{-2}. The product of these two terms ($\sim$0.3 W m^{-2} K^{-1}) approximately equals the difference in climate feedback parameter found in simulations with sea ice response (1.05 W m^{-2} K^{-1}) and simulations without sea ice response (1.31 W m^{-2} K^{-1} or 1.35 W m^{-2} K^{-1}, depending on the method used to disable changes in sea ice cover). Thus, we find that in our model simulations, sea ice response accounts for about 20% to 22% of the climate sensitivity to an imposed change in radiative forcing. In our model, the additional radiative forcing resulting from a loss of all sea ice in the "pre-industrial" state is comparable to but somewhat less than the radiative forcing from a doubling of atmospheric CO_2 content.