EGU2020-5264
https://doi.org/10.5194/egusphere-egu2020-5264
EGU General Assembly 2020

Arctic Sea Ice: Observations and Global Climate Modelling

Juilin Li[1], Mark Richardson[2], Wei-Liang Lee[3], Jonathan Jiang[4], Kuan-Man Xu[5], Yi-Hui Wang[6], Eric Fetzer[7], Yinghui Liu[8], Jia-Yuh Yu[9], and Graeme Stephens[10]

[1]JPL/NASA at CalTech, United States of America (jli@jpl.nasa.gov)
[2]JPL/NASA at CalTech, United States of America (kuan-man.xu@nasa.gov)
[3]RCEC, Academia Sinica, Taiwan (leelupin@gate.sinica.edu.tw)
[4]JPL/NASA at CalTech, United States of America (Jonathan.H.Jiang@jpl.nasa.gov)
[5]Science Directorate, NASA Langley Research Center, Hampton, USA (kuan-man.xu@nasa.gov)
[6]California Polytechnic State University, San Luis Obispo, California, USA (concertowang@gmail.com)
[7]JPL/NASA at CalTech, United States of America (Eric.J.Fetzer@jpl.nasa.gov)
[8]SSEC, University of Wisconsin at Madison, USA (yinghuil@ssec.wisc.edu)
[9]Department of Atmospheric Sciences, National Central University, Taoyuan City, Taiwan (jiayuh@atm.ncu.edu.tw)
[10]JPL/NASA at CalTech, United States of America (Graeme.Stephens@jpl.nasa.gov)

Recent Arctic sea ice retreat has been quicker than the projection in most general circulation model (GCM) simulations. Natural factors may have amplified this, but reliable attribution and projection requires accurate representation of relevant physical processes. In the meeting, we will present results indicating robust links between CloudSat-CALIPSO falling ice and Arctic sea ice melting from observations and global climate modelings. Most current GCMs don't fully represent falling ice radiative effects (FIREs). We find that a small set of Coupled Model Intercomparison Project, phase 5 (CMIP5) models that include FIREs tend to show a faster Arctic sea ice retreat. We investigate this using controlled simulation with the CESM1-CAM5 model both in present-day and 1%CO2 scenarios. With FIREs, CESM1-CAM5 simulates more realistic present-day annual and seasonal variations of radiation and skin temperatures and Arctic sea ice coverage and thickness. Over 60—90 °N oceans, simulated radiative flux trends are similar but the current-day state differs substantially due to FIREs. Falling ice reduces downward shortwave and increase downward longwave, resulting in an improved agreement with the satellite-based CERES-EBAF surface dataset. Under 1pctCO2 simulations, including FIREs results in the first occurrence of an "ice free" Arctic (extent $< 1\times10^{6}$ km^{2}) in year 64, compared with year 91 otherwise. We propose that the equivalent greenhouse effects from falling ice results in fewer safe spaces in which sea ice can thicken during winter, resulting in a thinner pack whose retreat is more easily triggered by global warming. However, this explanation does not apply across the CMIP5 ensemble members. Our results therefore only apply to one model but we have shown that this can have substantial implications for Arctic sea ice projection. Given that falling ice interaction with radiation in reality, we propose that including FIREs in models is a high priority.