Large Scale Earth System Models (ESM) Activity for 2025 Sikumiut Sea Ice School

Alice DuVivier, NSF NCAR (duvivier@ucar.edu)

Background

This activity uses data from the Community Earth System Model (CESM) versions 1 (Hurrell et al. 2013) and 2 (Danabasoglu et al. 2020). The CESM model and its data are freely available, used globally, and developed by a large community of researchers. CESM is a state-of the-art global coupled Earth system model with active atmosphere, ocean, land, and sea ice component models, as well as land and ocean biogeochemistry. Fully coupled global Earth system models provide invaluable information about climate variability and change, including coupled interactions and feedbacks between different parts of the Earth system. Climate feedbacks are natural processes that respond to global warming, either increasing or decreasing the rate of climate change.

PART ONE (20 min): What information does a Large Ensemble provide?   (all groups)

Use: Exercise_1_CESM1-LE.ipynb

PART TWO (15 min): Hypothesis testing and sea ice (each group does one activity)

a) Does changing the dry snow grain radius and melt onset temperature impact sea ice area? *Use: Exercise_2_CESM2_LE_LESSMELT.ipynb*
b) Do mid-latitude fire emissions impact sea ice area? *Use: Exercise_2_CESM2_LE_SMBB.ipynb*
c) Does a smoother surface impact sea ice area? *Use: Exercise_2_CESM2_LE_SMOOTH.ipynb*
d) Does changing the amount of snow on sea ice lead impact sea ice area? *Use: Exercise_2_CESM2_Fsnow.ipynb*

PART THREE (10 min): Group discussion

Discuss as a group other hypotheses you could test using an ESM experiment. How would you set up the experiment to test this hypothesis?

References

Danabasoglu et al. 2020. "The Community Earth System Model Version 2 (CESM2)." https://doi.org/10.1029/2019MS001916

Hurrell et al. 2013. "The Community Earth System Model: A Framework for Collaborative Research." https://doi.org/10.1175/BAMS-D-12-00121.1