

# **Linking Antarctic sea ice expansion to high-latitude Southern Ocean surface cooling**

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**Prof. Wei Liu**  
**University of California Riverside**

Observations evince significant trends in Antarctic sea ice expansion and Southern Ocean surface cooling from 1979 to 2014, whereas climate models mostly simulate the opposite. I leverage historical ensemble simulations with multiple climate models to show that sea-ice natural variability enables the models to reproduce the Antarctic sea ice expansion during this period under anthropogenic forcings. Along with sea-ice expansion, sea surface temperature (SST) south of 50°S exhibits a significant cooling trend, consistent with observations. Neither the Southern Annular Mode nor the Interdecadal Pacific Oscillation can fully explain the simulated Antarctic sea ice expansion over 1979–2014, whereas the sea-ice expansion is closely tied to surface meridional winds associated with a zonal wave 3 pattern. My further sea-ice perturbation experiment not only demonstrates this ice-SST linkage but also reveals the relation between Antarctic sea ice expansion and high-latitude Southern Ocean surface salinification.

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**Contacts**

Joonsuk Kang ([jk5081@columbia.edu](mailto:jk5081@columbia.edu))

Lantao Sun([lantao.sun@colostate.edu](mailto:lantao.sun@colostate.edu))

Yu-Chiao Liang ([yuchiaoliang@ntu.edu.tw](mailto:yuchiaoliang@ntu.edu.tw))



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