How tropical Pacific sea surface cooling enhanced Arctic sea ice melt from 2007 to 2012

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Sea Ice Sensitivity

- Rosenblum & Eisenman (2017)
  - Models too insensitive?

- Change in Arctic sea ice
  - Vs.

- Change in global mean temperature
Sea Ice Trends

Trends anchored in 2007-2012 period
Anticyclonic circulation warms the Arctic via adiabatic processes

Positive JJA geopotential height (m)

JJA Specific Humidity (g/kg)
Linear Trends (79-06)

Anomalies (07-12 minus 79-17)
Cool Pacific-warm Arctic phase.
Enhanced melting.

Anomalies (13-17 minus 79-17)
Warm Pacific with weak Arctic cooling.
Correlation map between detrended JJA SST and September sea ice area

*a Stippling indicates statistical significance at the 95% confidence level*
Fast melting composite CESM1

a) Time series of 6-yr mean September sea ice area

b) Sep sea ice

c) JJA Z200

d) Zonal mean variables
Summertime tropical-Arctic teleconnection in CESM1
6-yr non-overlapping periods (15 lowest periods)

Z200 (shading)
Wave activity flux (vectors)

Precipitation (contour)
SST (shading)
Fast melting composite CESM2

a Time series of 6-yr mean September sea ice area

b Sep sea ice
c JJA Cloud Fraction
d JJA Temp & Height
Summertime tropical-Arctic teleconnection in CESM2

6-yr non-overlapping periods (15 lowest periods)

Z200 (shading)
Wave activity flux (vectors)

Surface Temperature (red/blue)
What happened in 2019?

Domain: 60-90N
Nudging Factor: 0.5

Bottom of nudging: ~800 hPa

Adiabatic descent
radiation
Sea ice
Export

Total Sea Ice Extent (million km²)

Mean Tropospheric Temperature (K, 300-1000 hPa)
Summary

• Sea Ice Sensitivity should take into account connections between the Arctic and the rest of the globe (tropical Pacific)

• Tropically-driven atmospheric teleconnections partially enhanced melting from 2007 to 2012 in combination with anthropogenic forcing.

• A better understanding of this tropical-Arctic teleconnection and its effects is important for the prediction of sea ice loss in global climate model simulations, especially the cloud response.