Institute of Monitoring of Climatic and Ecological Systems SB RAS
Laboratory of Geosphere-Biosphere Interactions

The influence of Arctic sea ice loss on winter cooling in Northern Eurasia

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Tomsk, 2020

Arctic sea ice loss and cold winter extremes in northern continents

Papers:

- Overland J.E. et al. Warm Arctic – cold continents: climate impacts of the newly open Arctic Sea // Polar Res. 2011. V. 30. P. 15787.
- Tang Q. et al. Cold winter extremes in northern continents linked to Arctic sea ice loss // Environ. Res. Lett. 2013. V. 8, N 1. P. 14036.
- Sun L. et al. Mechanisms of stratospheric and tropospheric circulation response to projected Arctic sea ice loss // J. Climate. 2015. V. 28, N 19. P. 7824-7845.
- Sun L. et al. What caused the recent "Warm Arctic, Cold Continents" trend pattern in winter temperatures? // Geophys. Res. Lett. 2016. V. 43, N 10. P. 5345-5352.
- Zhang P. et al. A stratospheric pathway linking a colder Siberia to Barents-Kara Sea sea ice loss // Sci. Adv. 2018. V. 4, N 7. P. 6025.
- Nakamura T. et al. The stratospheric pathway for Arctic impacts on midlatitude climate // Geophys. Res. Lett. 2016. V. 43. P. 3494-3501.

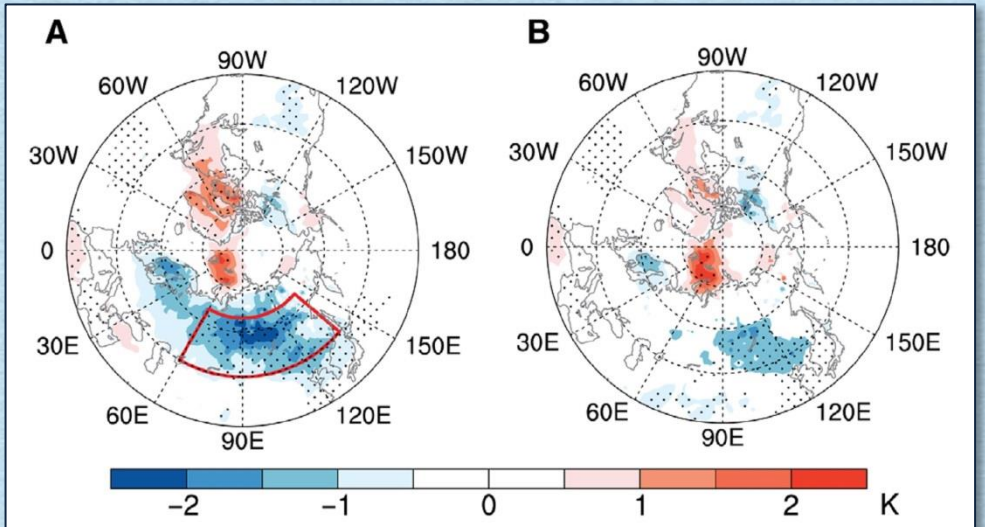


Fig. 1. Observed linkage between cold Siberia and BKS sea ice loss with and without the stratospheric circulation activity. (**A**) Regression of SAT (in Kelvin) in December-January-February (DJF) on the normalized early winter [November-December (ND)] BKS sea ice concentration (SIC). (**B**) Same as (A) after first regressing out the component of SAT variability related to DJF stratospheric vortex anomalies.

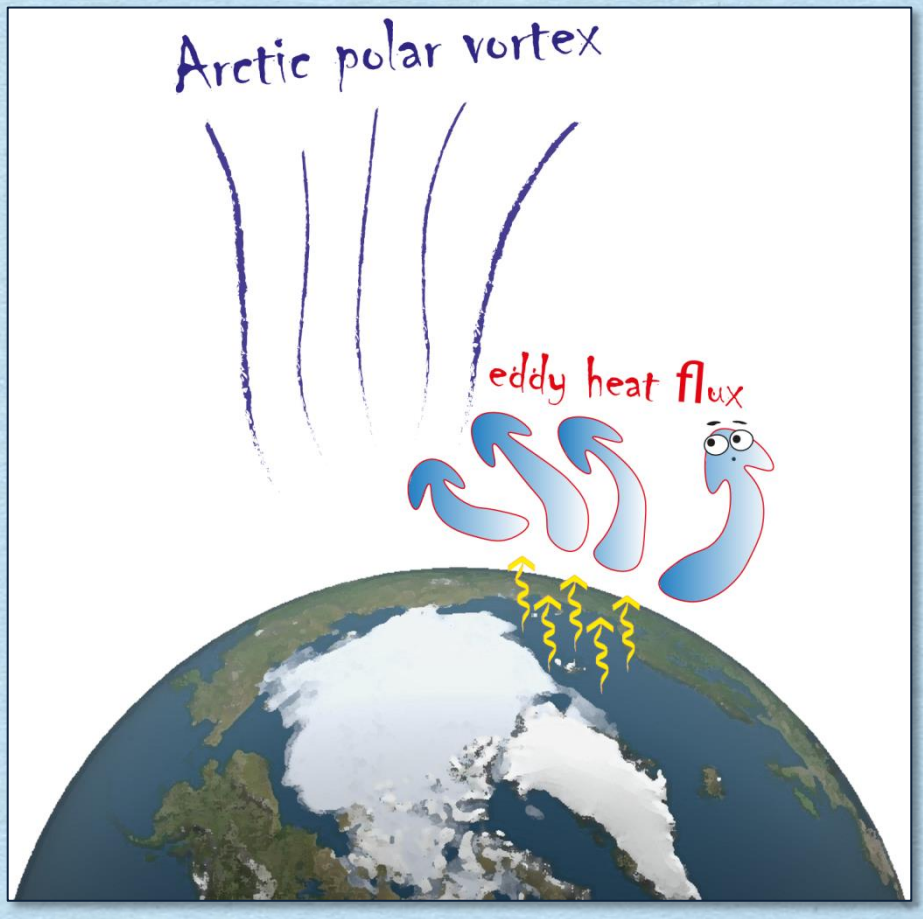
Authors write about a stratospheric pathway...

Arctic polar vortex involved?

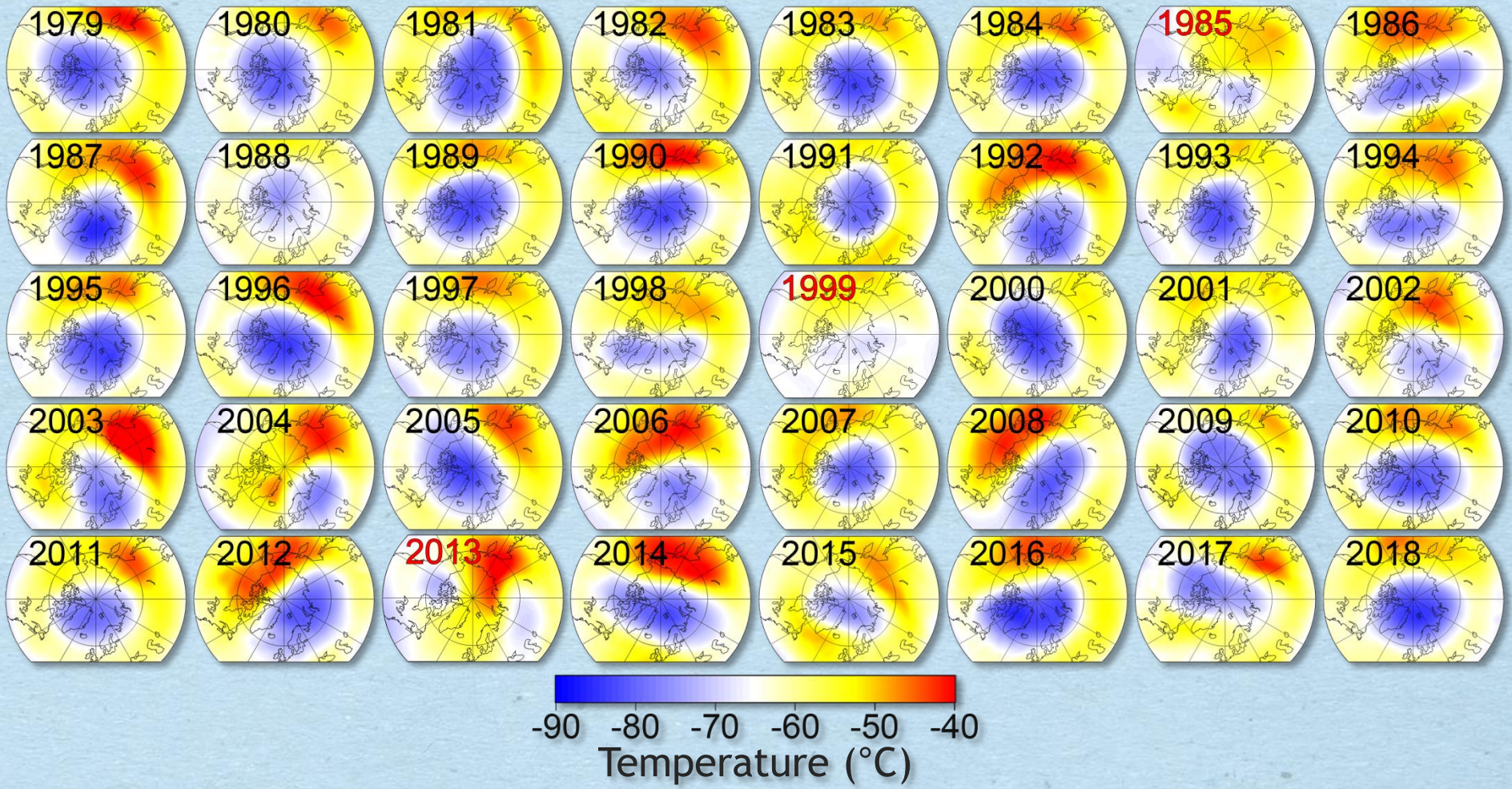
Weakening of the polar vortex by Arctic sea ice loss

Papers:

- Jaiser R. et al. Stratospheric response to Arctic sea ice retreat and associated planetary wave propagation changes // Tellus A. 2013. V. 65, N 1. P. 19375.
- Kim B.-M. et al. Weakening of the stratospheric polar vortex by Arctic sea-ice loss // Nature Commun. 2014. V. 5. P. 4646.
- Pedersen R.A. et al. The impact of regional Arctic sea ice loss on atmospheric circulation and the NAO // J. Climate. 2016. V. 29, N 2. P. 889-902.
- Hoshi K. et al. Poleward eddy heat flux anomalies associated with recent Arctic sea ice loss // Geophys. Res. Lett. 2017. V. 44. P. 446–454.
- Ando Y. et al. Detection of a climatological short break in the polar night jet in early winter and its relation to cooling over Siberia // Atmos. Chem. Phys. 2018. V. 18. P. 12639–12661.

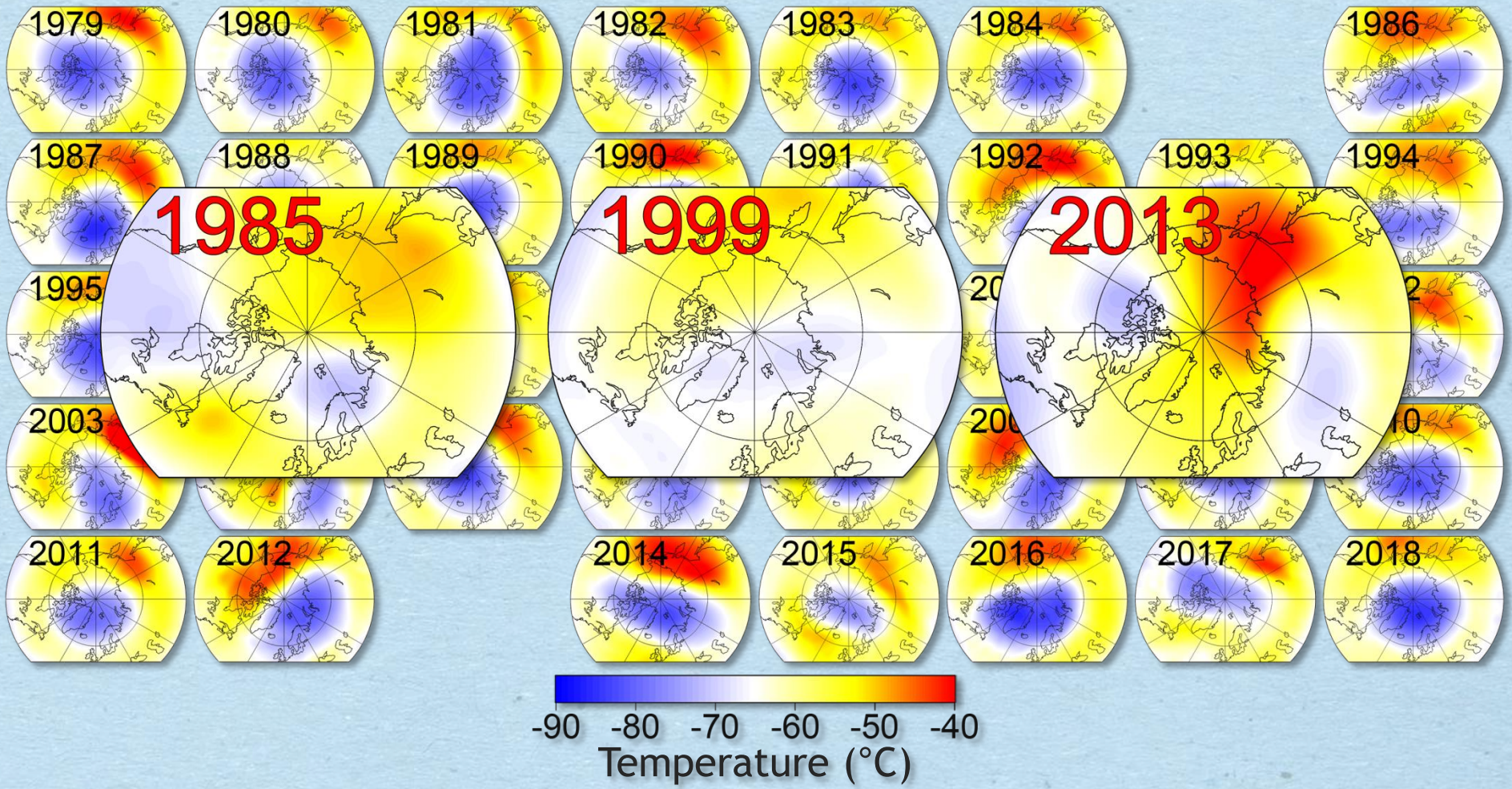


Events of the polar vortex breakdown in mid-winter



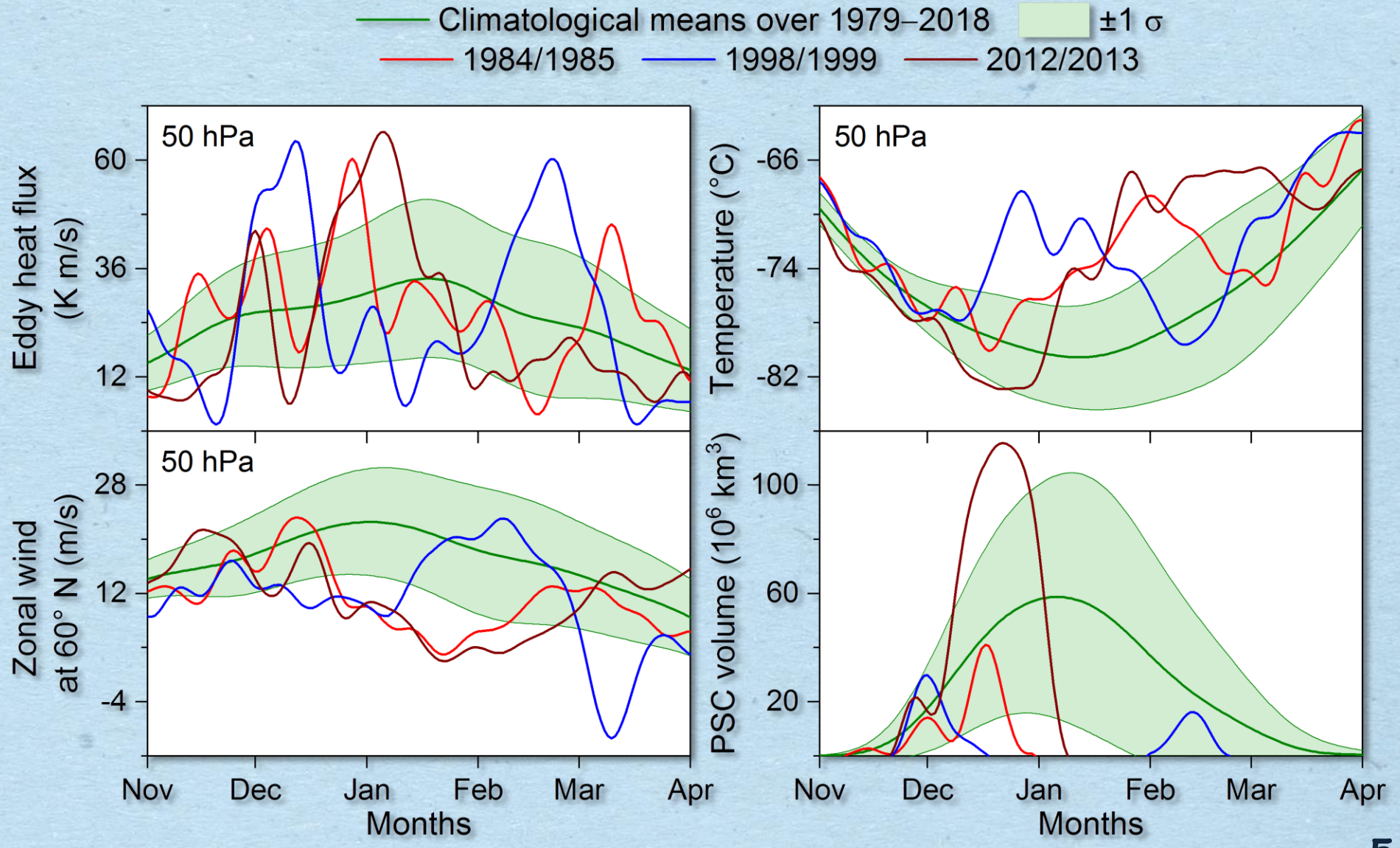
Temperature distributions at the 50 hPa pressure level over the Arctic on average over 10–15 January from 1979 to 2018.

Events of the polar vortex breakdown in mid-winter

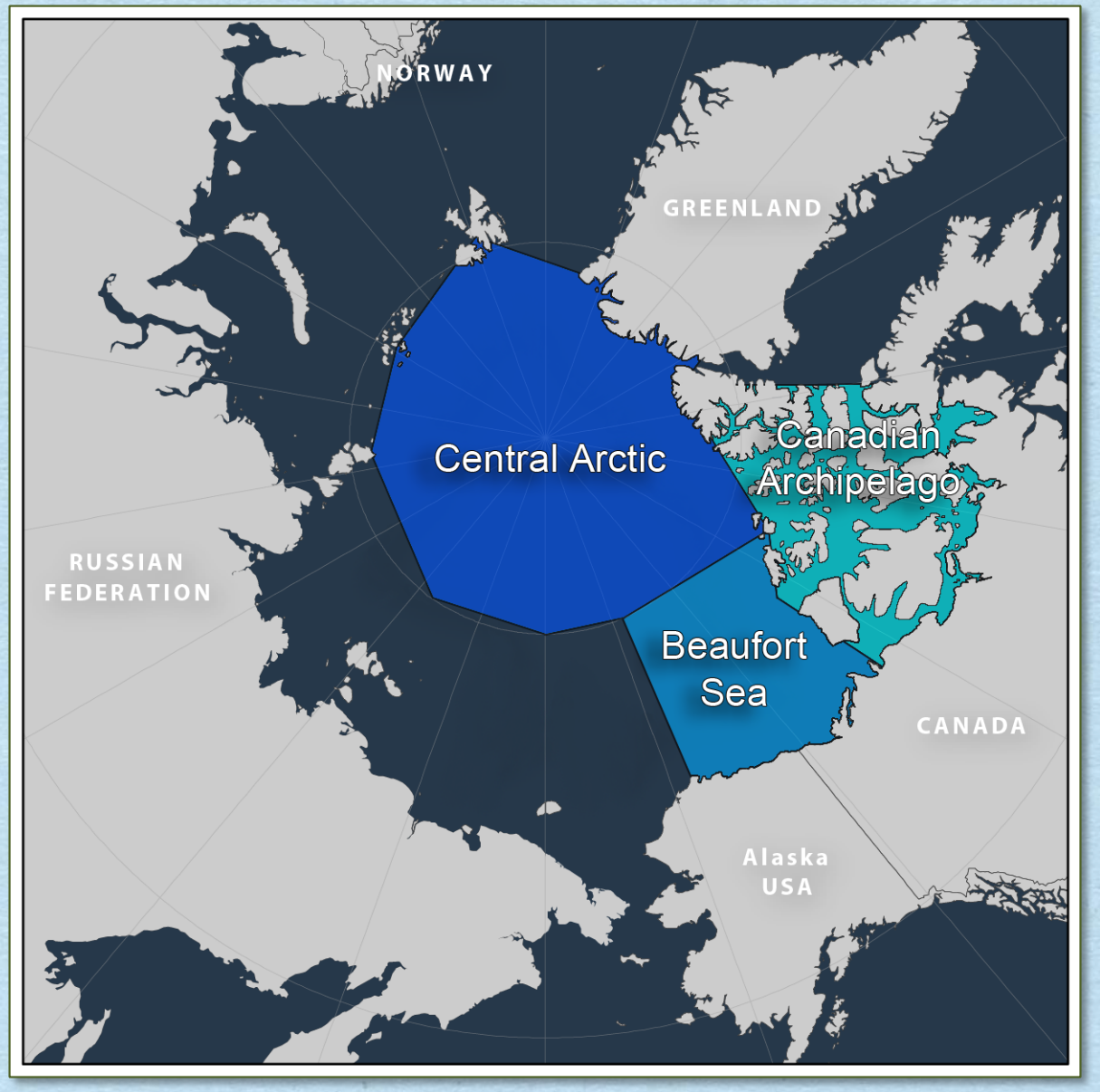


Temperature distributions at the 50 hPa pressure level over the Arctic on average over 10–15 January from 1979 to 2018.

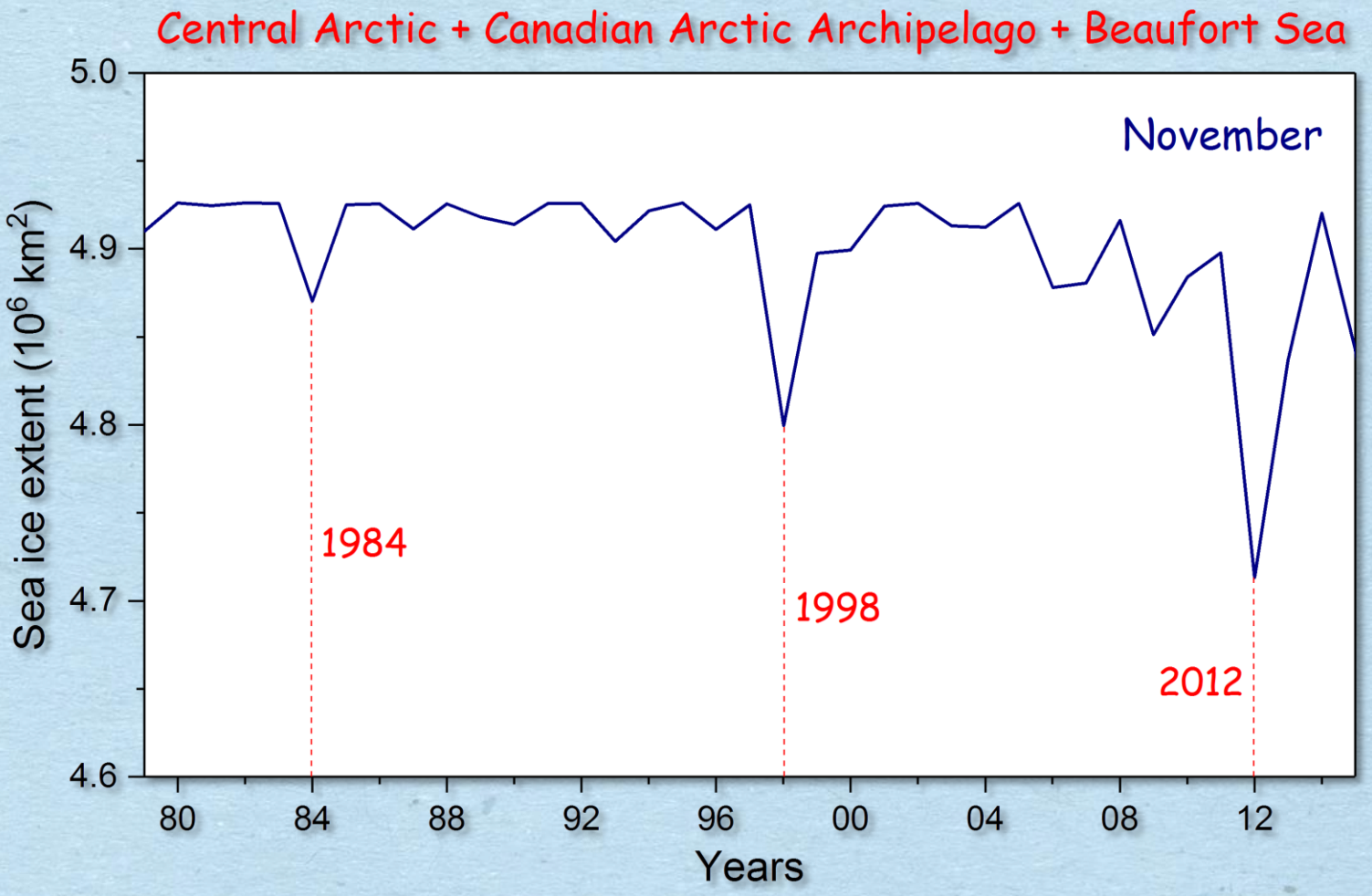
Increased activity of planetary waves and Arctic polar vortex dynamics in 1984/85, 1998/99 and 2012/13



Arctic sea ice loss in the Central Arctic, Beaufort sea, Canadian Archipelago in 1984, 1998 and 2012

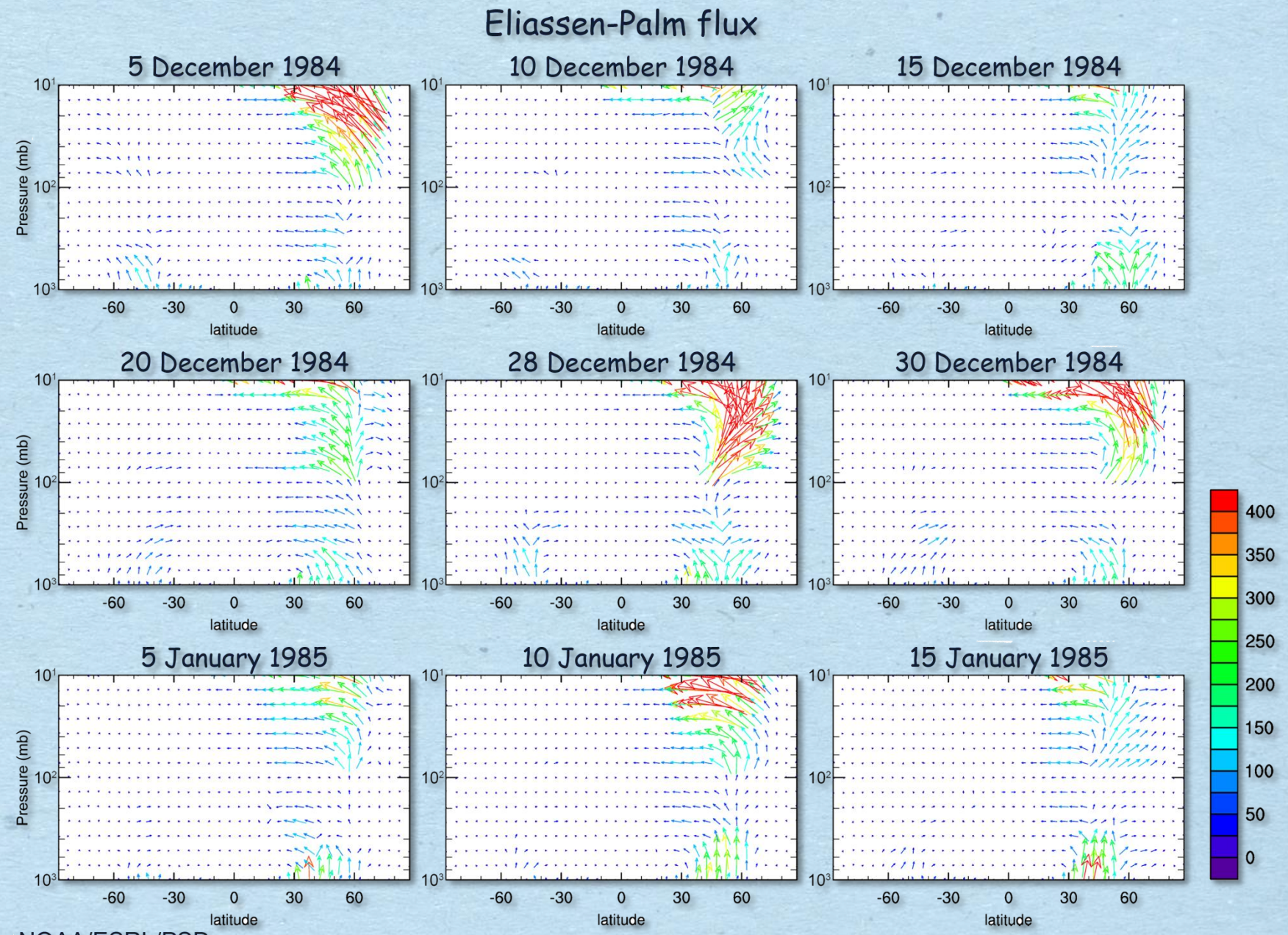


Arctic sea ice loss in the Central Arctic, Beaufort sea, Canadian Archipelago in 1984, 1998 and 2012



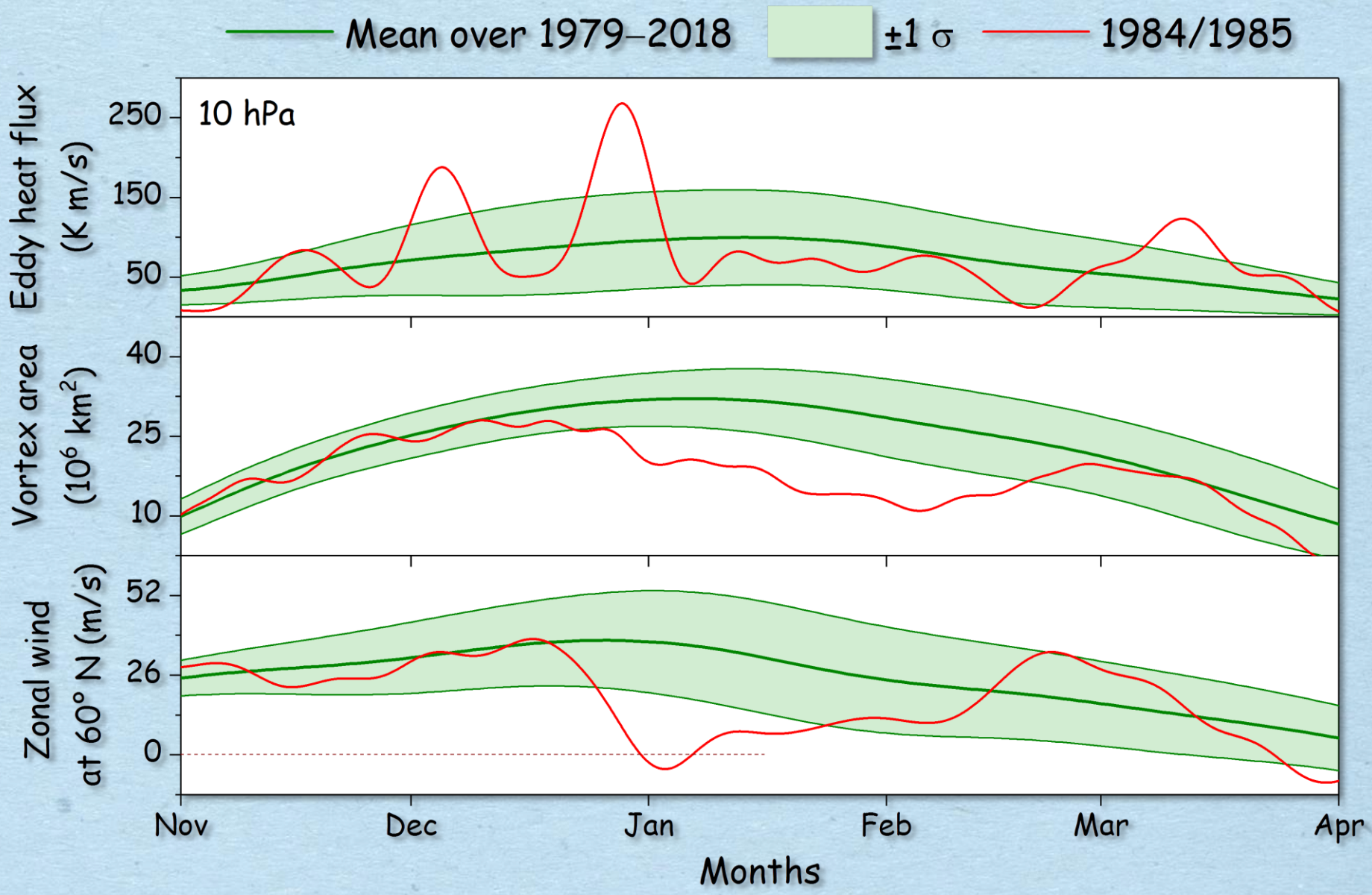
The unusually early breakdown of the polar vortex in mid-winter 1984/1985, 1998/1999, and 2012/2013 occurred when the decrease in sea ice extent in the investigated regions in November exceeded the previous record by at least 1, 7 times.

Upward wave activity flux in the winter 1984/1985

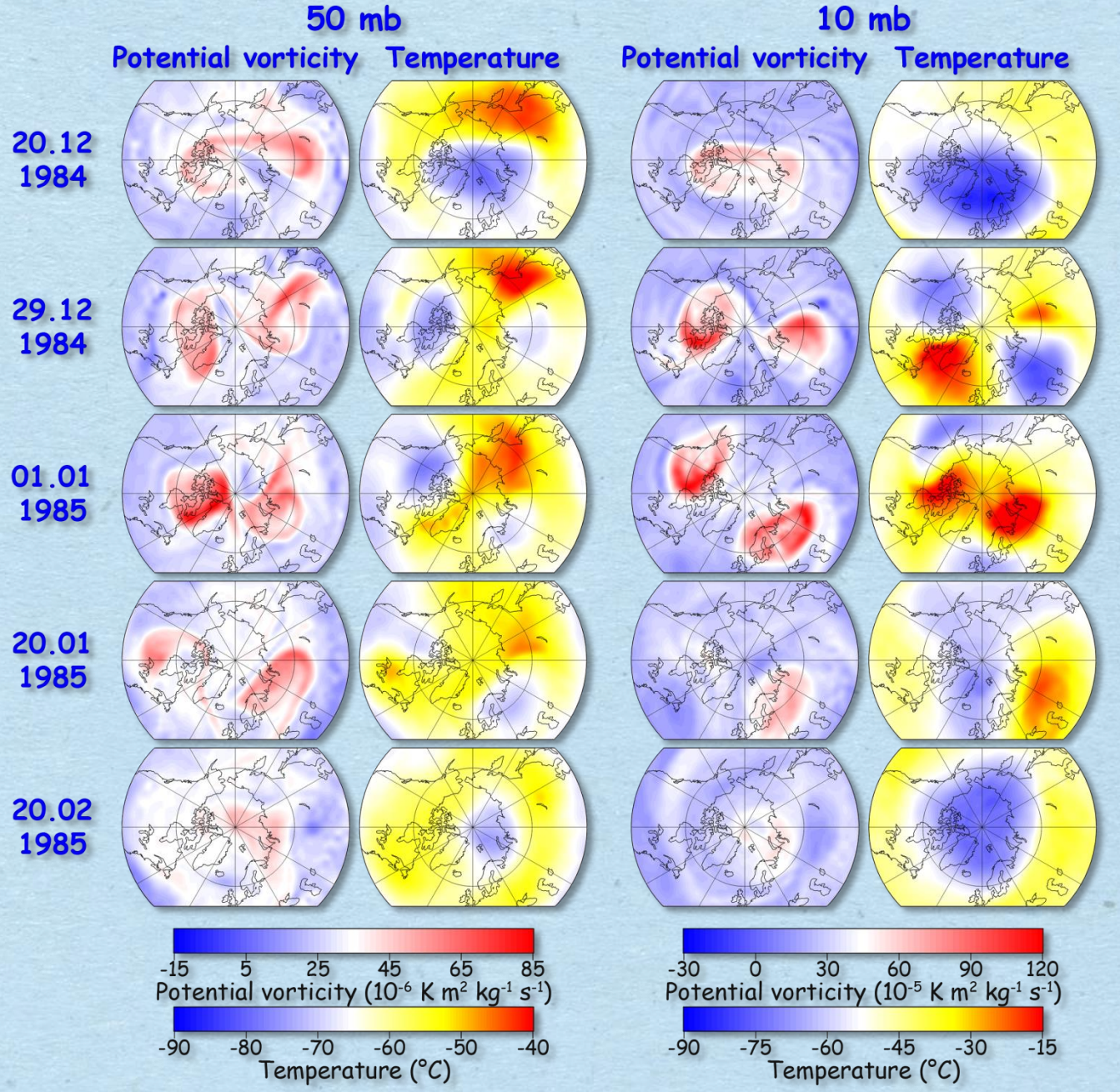


NOAA/ESRL/PSD

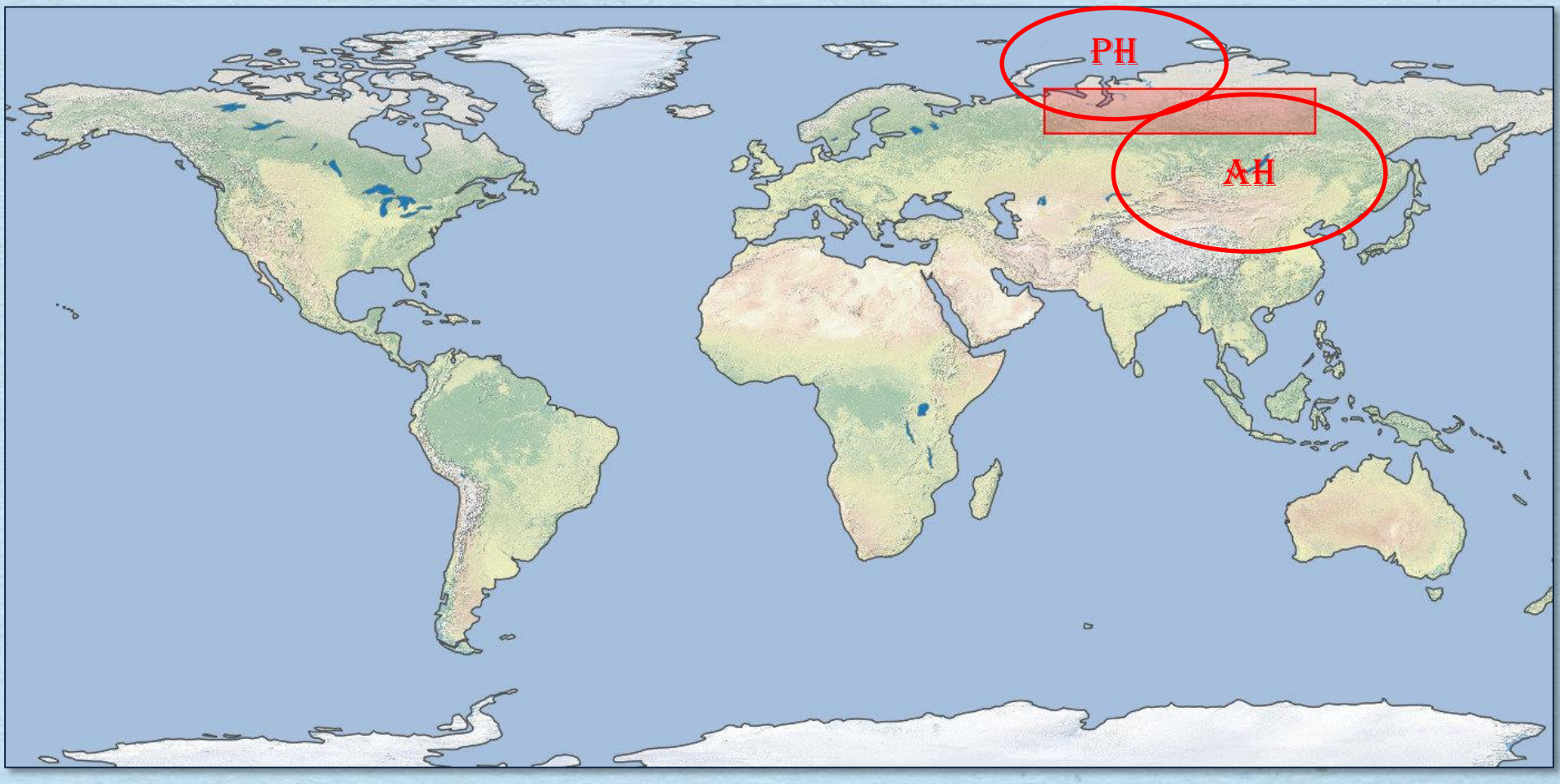
The polar vortex dynamics during the winter 1984/1985



The 1984/1985 sudden stratospheric warming

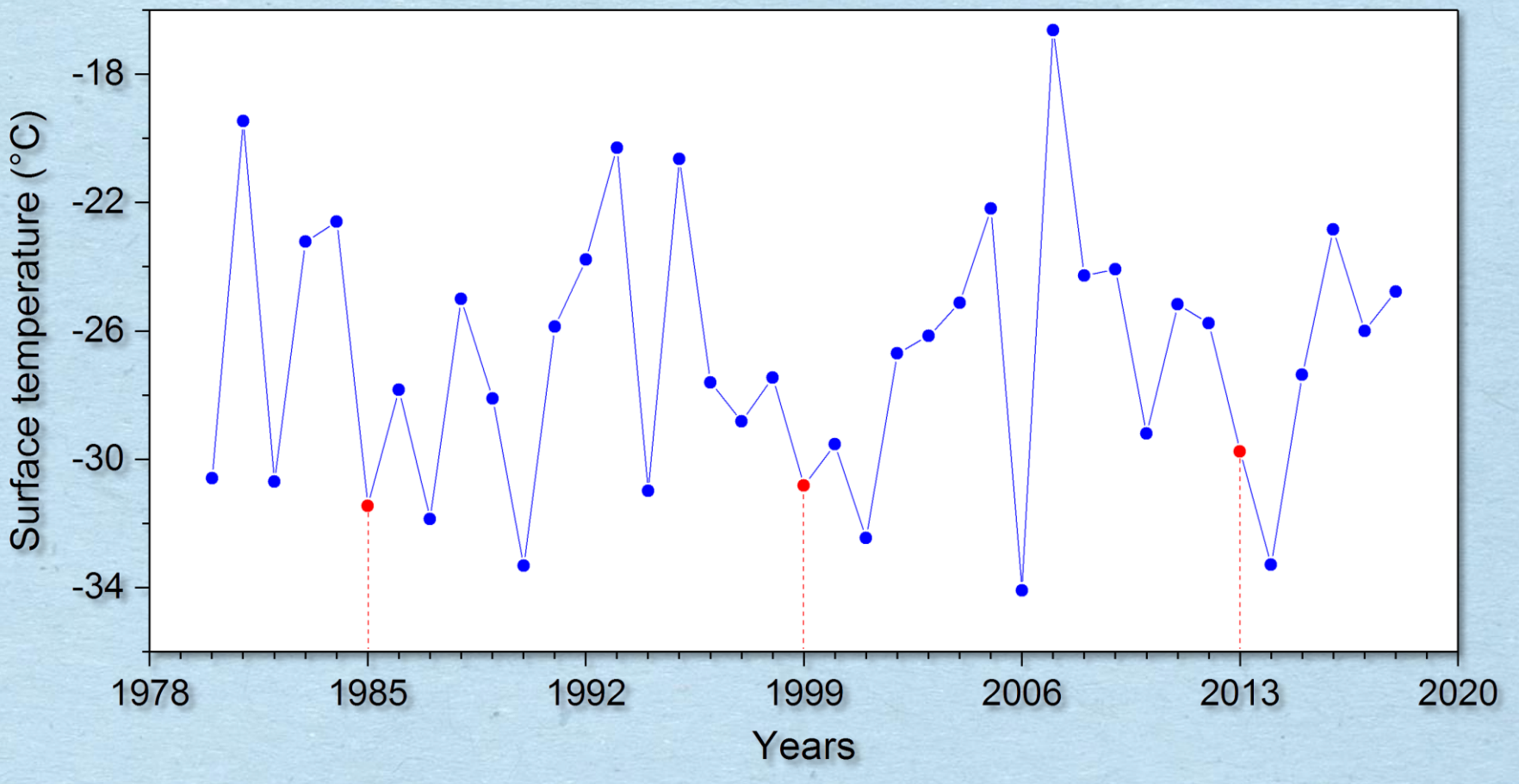


The influence of Arctic sea ice loss on winter cooling in Northern Eurasia



Central part of Northern Eurasia:
60–120° E, 60–70° N

The influence of Arctic sea ice loss on winter cooling in Northern Eurasia



60–120° E, 60–70° N
(monthly means for January)


Thank you for
attention!