An Arctic Summer Intense Storm and its Role in Accelerating Sea Ice Decrease

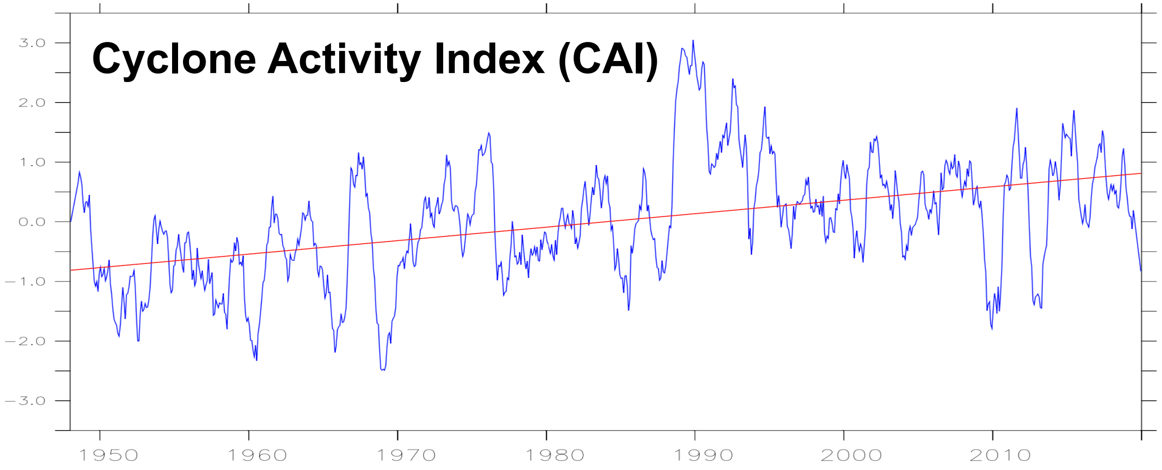
Xiangdong Zhang

International Arctic Research Center and Department of Atmospheric Sciences
University of Alaska Fairbanks
Email: xzhang9@alaska.edu

In collaboration with numerous colleagues

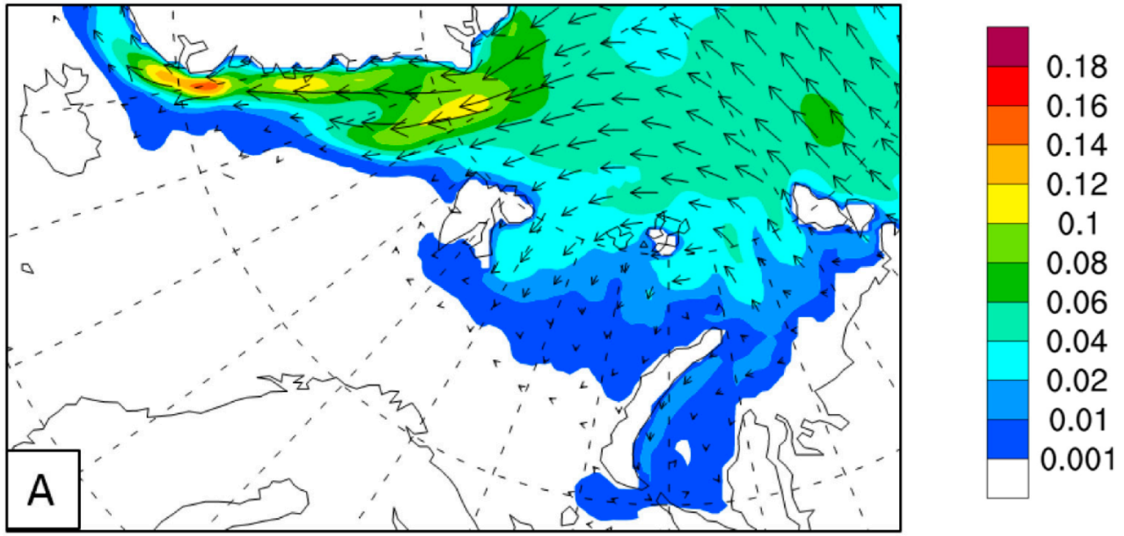
DOE Project Meeting, October 13-16, 2020

A long-term trend of intensifying Arctic storm activities



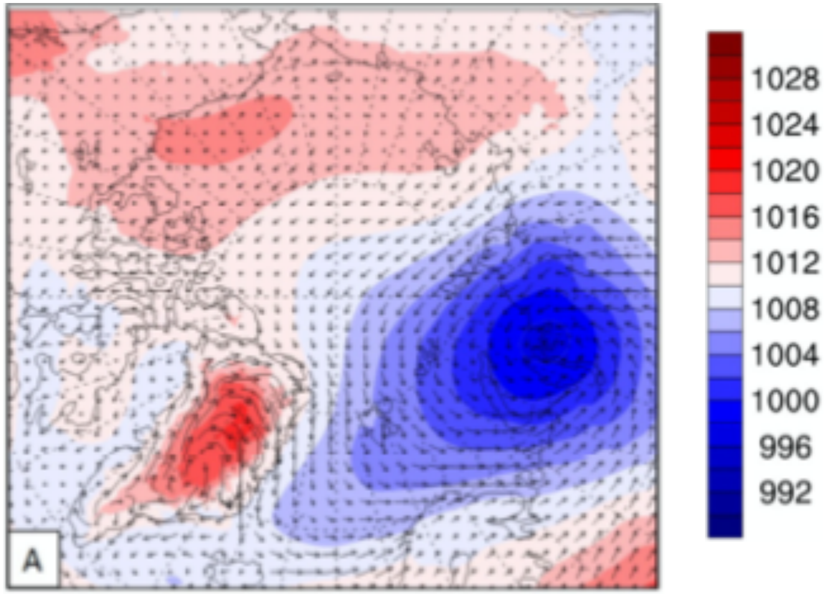
Updated from X. Zhang, J. Walsh, J. Zhang, et al. 2004

An increase in sea ice outflow when the high number of intense storms occurs

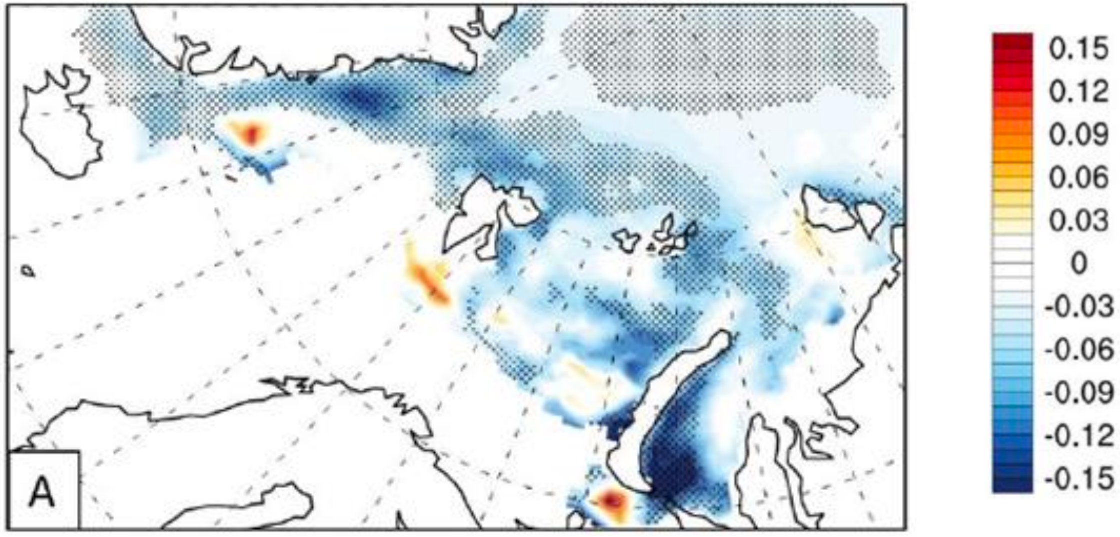


Impacts of intense storms on summer sea ice simulated by the Arctic regional fully coupled model, HIRHAM-NAOSIM (Semenov, Zhang, Rinke, Dorn, Dethloff, 2019)

A low pressure centered in the Barents-Kara seas corresponding to the higher number of intense storms

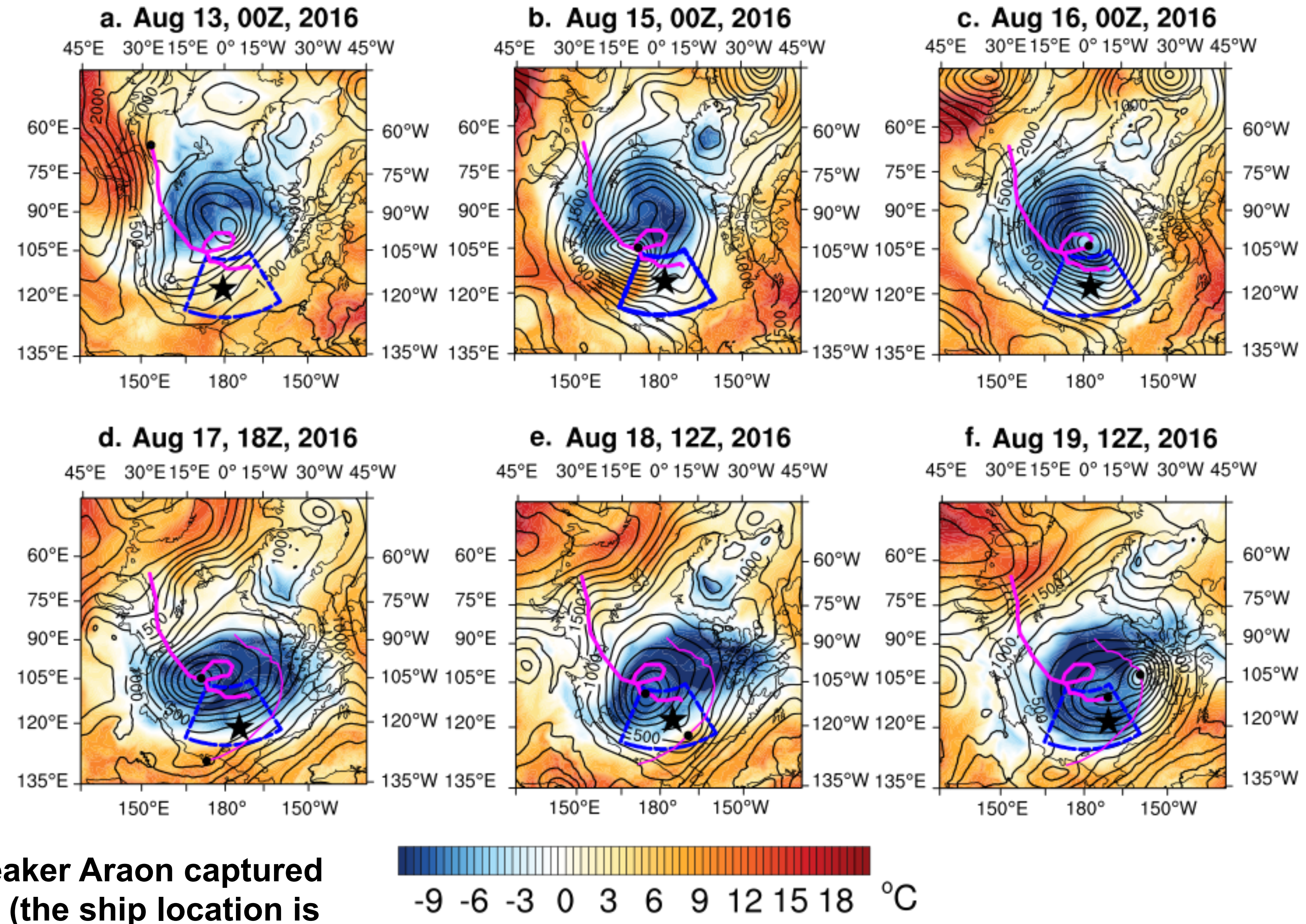


A decrease in sea ice concentration and thickness when the high number of intense storms occurs



An intense storm occurred in August 2016, followed by a second record minimum of sea ice extent

ERA5: geopotential height and temperature at 850 hPa

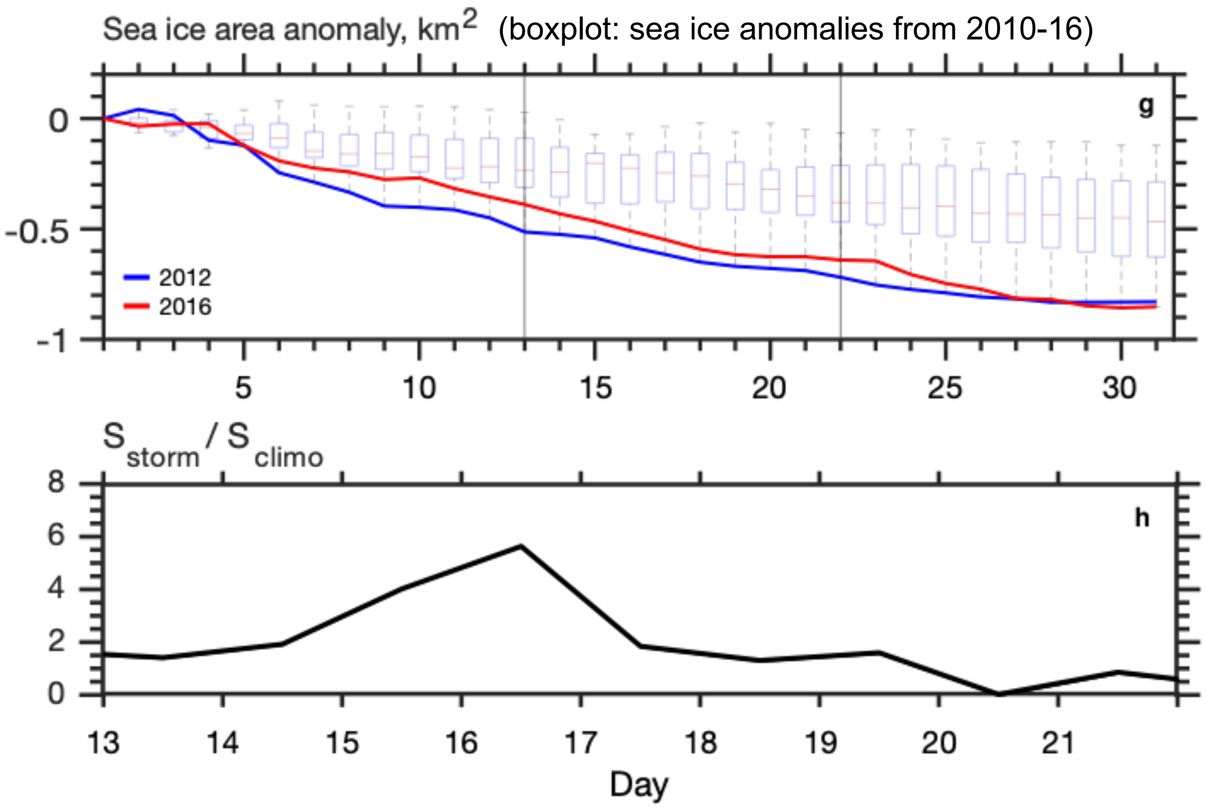


The Korean icebreaker Araon captured this intense storm (the ship location is marked by star).

Peng, Kim, Zhang, et al. 2020

1. The sea ice area reached its lowest value when an intense storm occurred in the Augusts of 2012 and 2016;

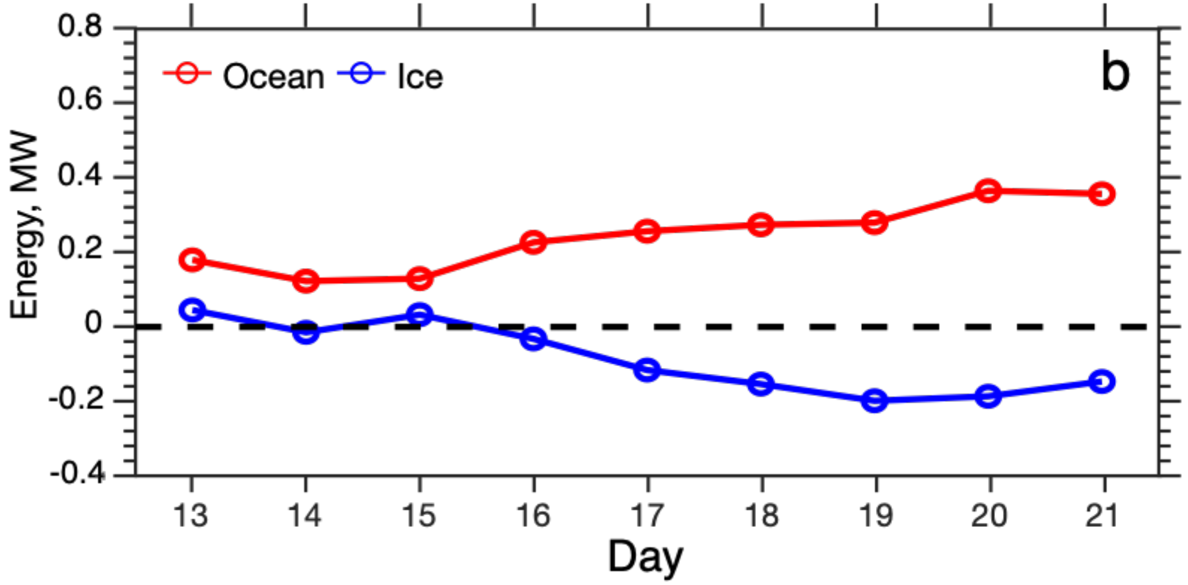
2. The storm in August 2016 accelerated the sea ice area decrease.



S: day-to-day sea ice area change

1. The sea ice surface lost a net heat energy, while the open water surface gained a net heat energy.

2. The net heat energy gained from the open water surface was not sufficient to increase ocean mixed layer temperature to the observed one by CTD.



Peng, Kim, Zhang, et al. 2020

1. The storm-driven Ekman pumping transported heat upward to the mixed-layer from the Pacific-origin warm water layer;

2. The storm enhanced mixing in the upper mixed-layer, as indicated by deepening of Ekman layer depth;

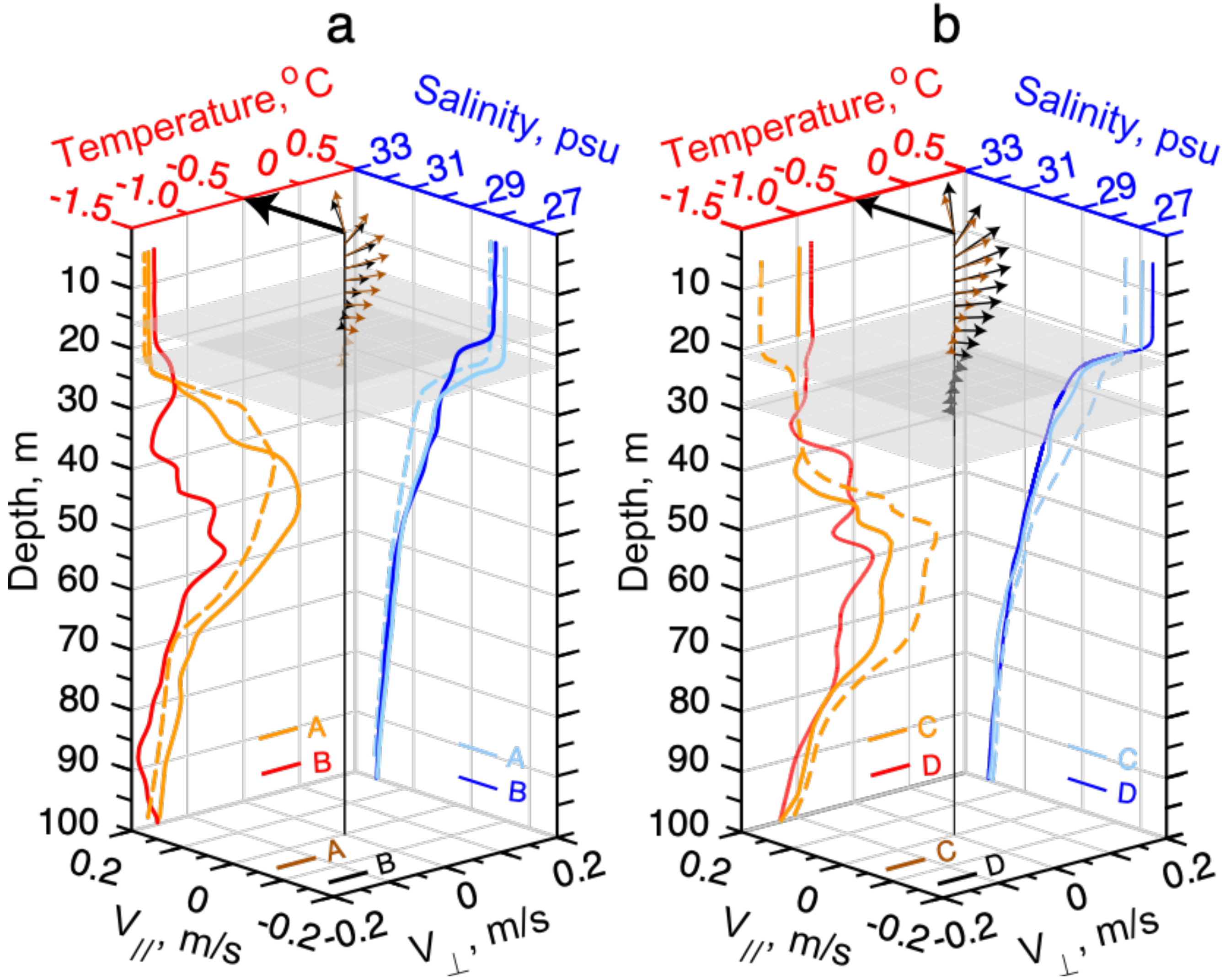
3. The mixed layer temperature increased with intensified storm and associated increase in wind speed.

4. The oceanic heat flux (turbulent heat flux from ocean to the bottom of sea ice) increased;

5. The sea ice bottom melt increased, resulting in the acceleration of sea ice decrease.

This study provides an observational basis for validating and improving model simulations of storm-sea ice-ocean interactions.

CTD Observations of Temperature and Salinity Profiles and Diagnosed Ekman Transports on 16 and 19 August 2016



Peng, Kim, Zhang, et al. 2020