Atmospheric Research and Modeling Studies at UAF/IARC

- Atmosphere **provides a fundamental driving force for shaping ocean and sea ice states**
- There is a need to develop a new, high-resolution data to provide the best estimate of the atmospheric forcing
- Synoptic storms become an emerging, key forcing element for ocean and sea ice changes

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PAG meeting, Qingdao, Oct 27-28, 2016

CBHAR – Chukchi-Beaufort Seas High Resolution Atmospheric Reanalysis

Xiangdong Zhang, IARC/UAF, xzhang9@alaska.edu

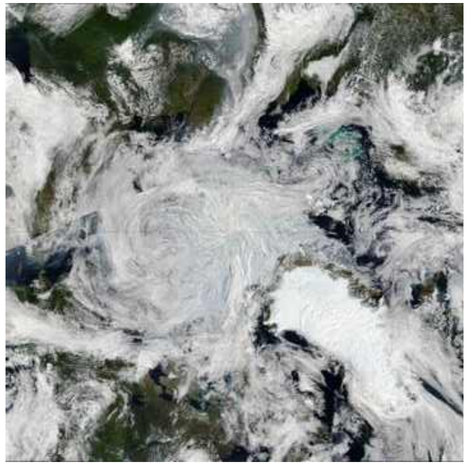
Team Members: Jing Zhang (NCAT), Martha Shulski (UNL), Jeremy Krieger (UAF), Fuhong Liu, Wei Tao, and Steve Stagall (NCAT); + a number of other collaborators

Table 1. List of atmospheric reanalyses. Grid spacing is based on the longitudinal spacing at 70°N. See appendix 1 for descriptions of the associated acronyms.

	Period	Type	Grid Spacing	Reference
NCEP/NCAR	1948-ongoing	Global	213 km, L28	Kalnay et al. (1996)
ERA-15	1979-1993	Global	125 km, L31	Gibson et al. (1997)
NCEP DOE II	1979-2015	Global	213 km, L28	Kanamitsu et al. (2002)
ERA-40	1957-2002	Global	125 km, L60	Uppala et al. (2005)
JRA-25	1979-2004	Global	125 km, L40	Onogi et al. (2007)
NCAR CFDDA	1985-2005	Global	44 km, L28	Rife et al. (2010)
NCEP CFSR	1979-2011	Global	35 km, L64	Saha et al. (2010)
CFSv2	2011-ongoing	Global	23 km, L64	
ERA-Interim	1979-ongoing	Global	52 km, L60	Dee et al. (2011)
MERRA	1979-2015	Global	56 km, L72	Rienecker et al. (2011)
JRA-55	1958-2012	Global	63 km, L60	Kobayashi et al. (2015)
MERRA-2	1980-ongoing	Global	56 km, L72	Bosilovich et al. (2016)
NOAA NARR	1979-2014	Regional	32 km, L45	Mesinger et al. (2006)
CBHAR	1979-2009	Regional	10 km, L49	Zhang et al. (2016)
ASR	2000-2012	Regional	30 km, L71	Bromwich et al. (2016)
v.2			15 km, L71	
HIRLAM EURO4M	1989-2010	Regional	22 km, L60	Dahlgren et al. (2016)
NOAA-CIRES 20CR	1908-1958	Sfc pres.	213 km, L28	Compo et al. (2011)
v.2c	1851-2011			
ERA-20C	1900-2010	Sfc pres.	125 km, L91	Poli et al. (2016)

Systematic Improvements of Reanalyses in the Arctic (SIRTA)

A White Paper



Great Arctic Cyclone of 2012, Imaged by Aqua MODIS, August 7, 2012.

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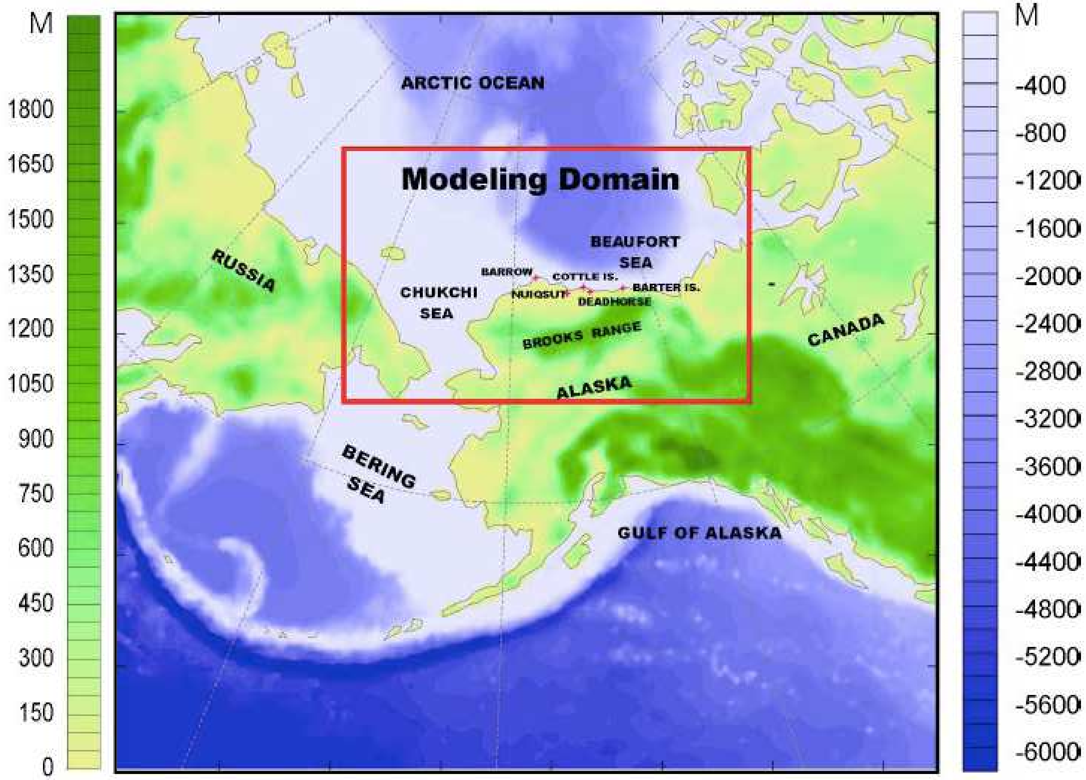
CBHAR – Chukchi-Beaufort Seas High Resolution Atmospheric Reanalysis

Model Domain and Configuration



Model: WRF-ARW

Assimilation: 3D Var

Resolution of the data product:

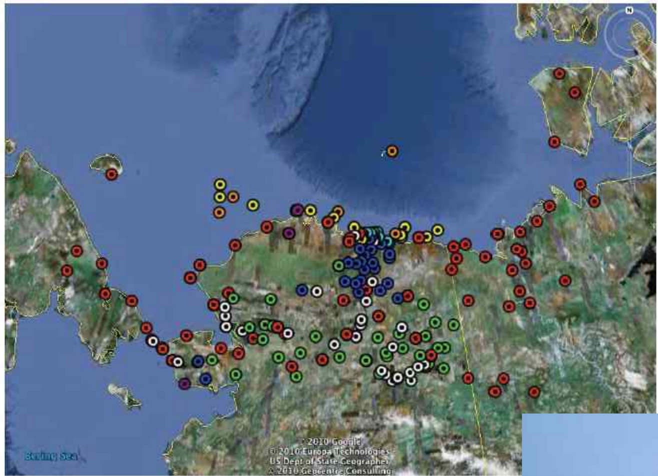
Spatial resolution: 10 km

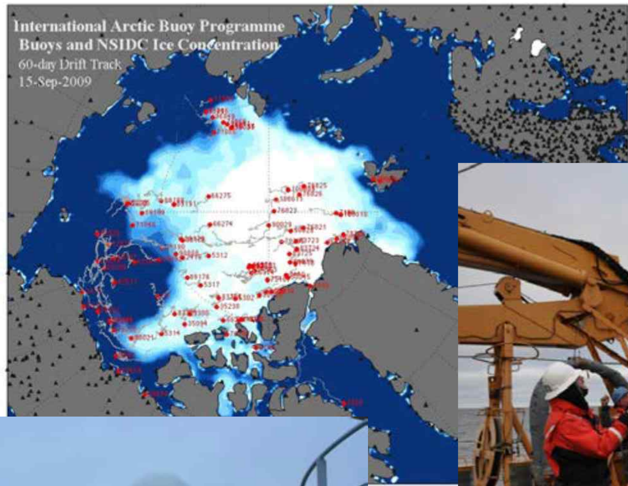
Temporal resolution: 1 hour

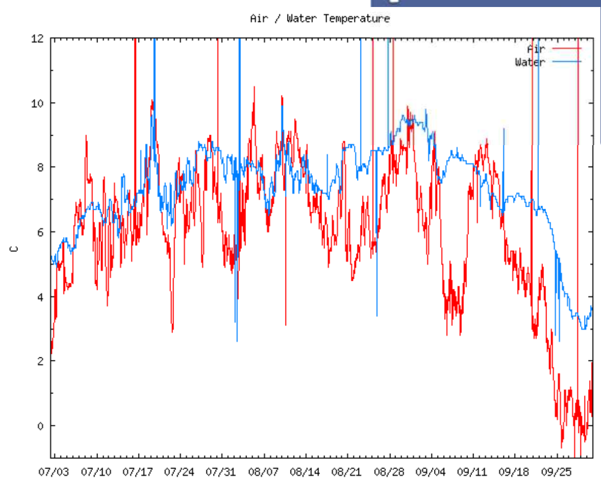
Time period of the data product:

01/01/1979 – 12/31/2009

Observational Data Used For CBHAR: Ground, Satellite, Cruise

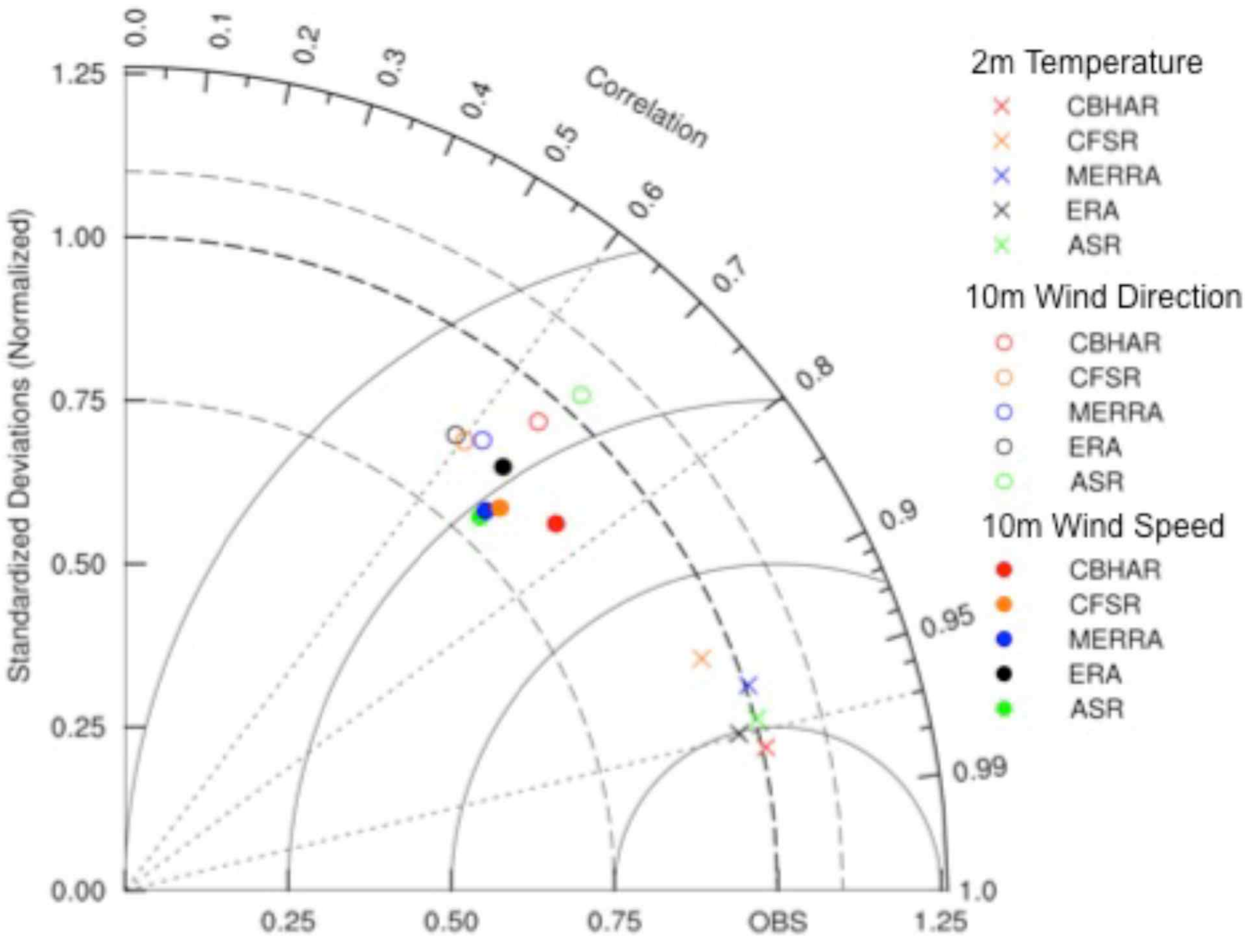






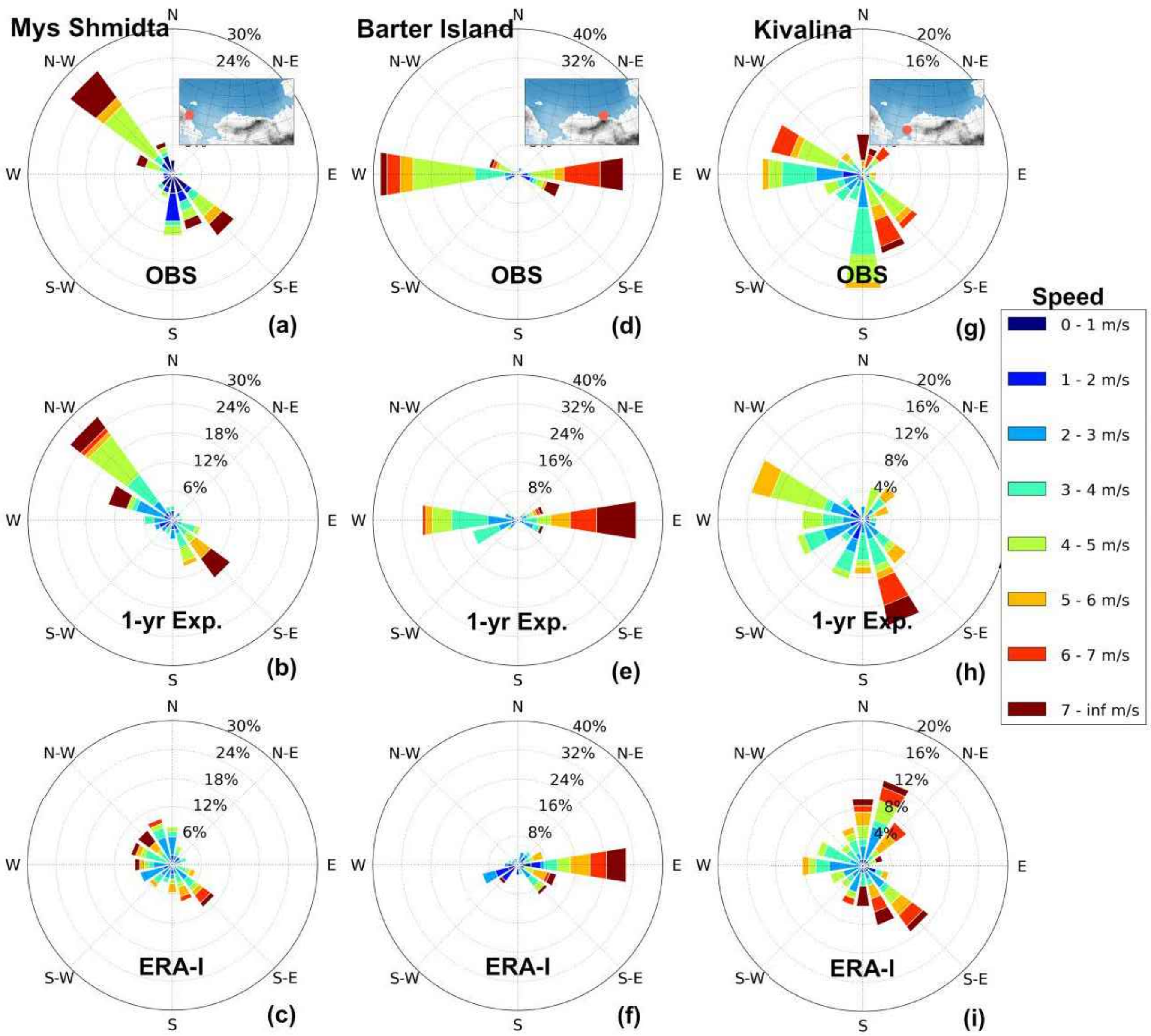
Taylor Diagram: An Overall Evaluation of CBHAR and Four Other Global and Regional Reanalysis Against Observations

CBHAR shows an improved representation of surface wind and 2 m air temperature in the reanalysis domain.

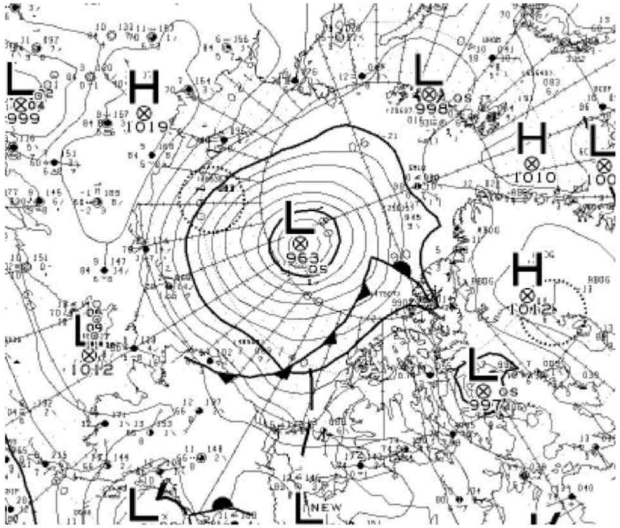


Zhang et al., 2016

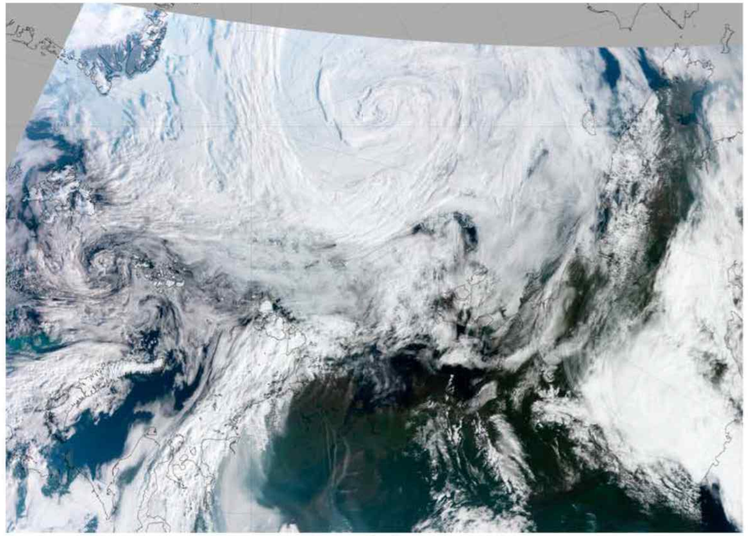
Comparison of CBHAR with Particular Observations: Statistics



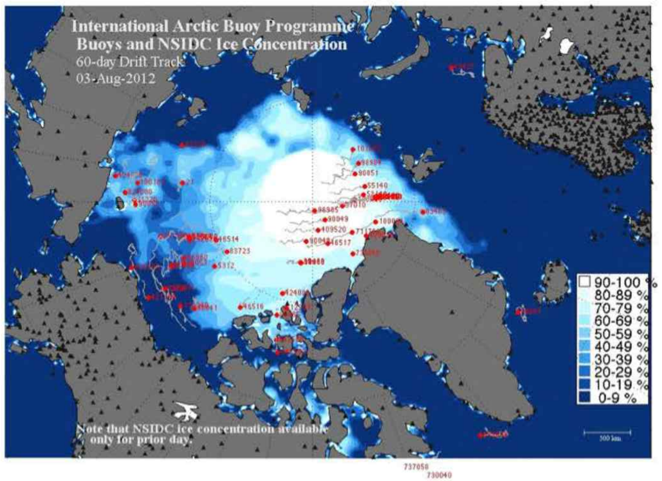
A Super Storm in Early August 2012: Contributed to a Record Low of Sea Ice Cover



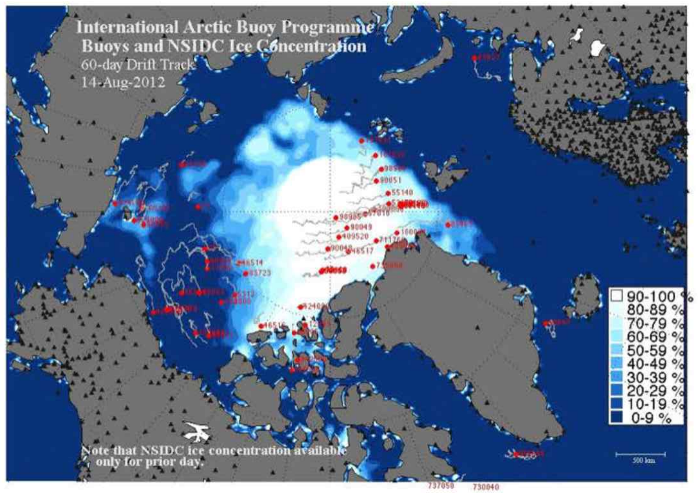
(a)



(b)



(c)



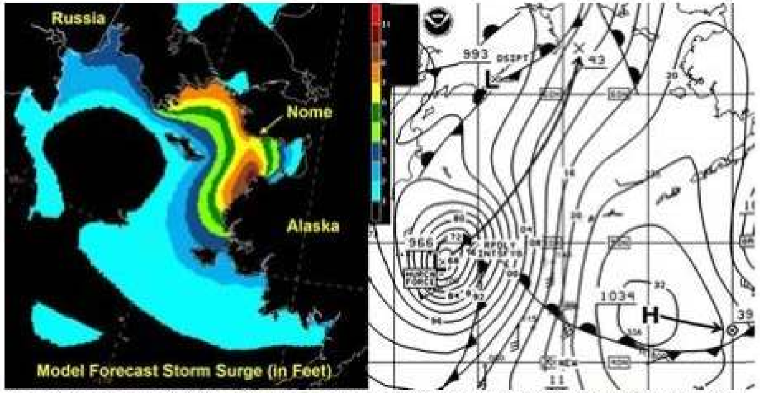
(d)

The Washington Post Make us your start page
POSTLOCAL

Posted at 11:00 AM ET, 11/08/2011

Alaska storm to produce "historic" hurricane-like conditions

By Jason Samenow



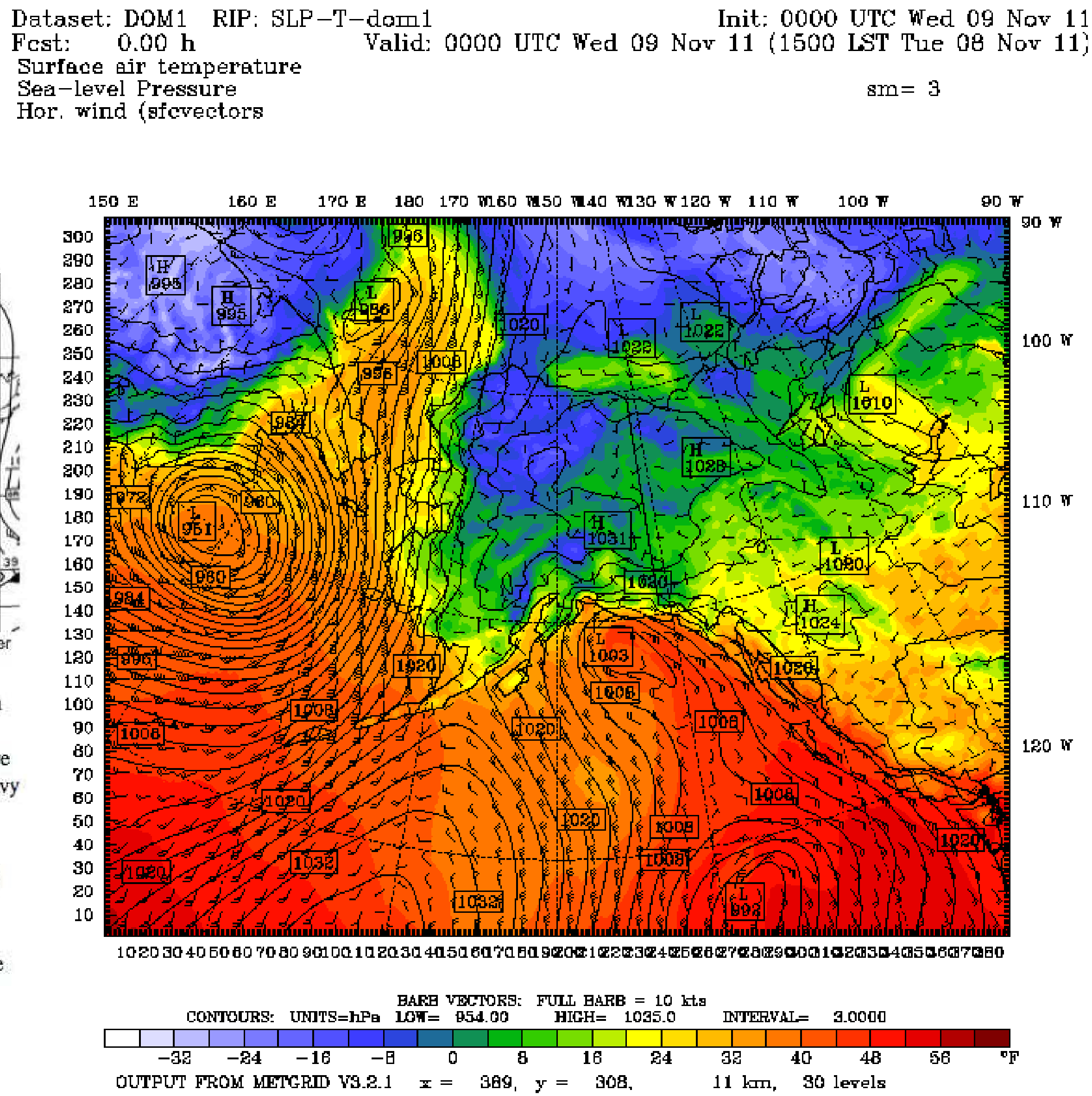
Storm surge forecast (left), surface map showing intensifying storm (right) (National Weather Service)

A ferocious, dangerous storm in the north Pacific is on a collision course with the west coast of Alaska. Referred to as the "Bering Sea Superstorm" by the National Weather Service Office in Fairbanks (NWS), damaging winds, severe beach erosion and major coastal flooding are expected. In some locations, heavy snow and blizzard conditions are also forecast.

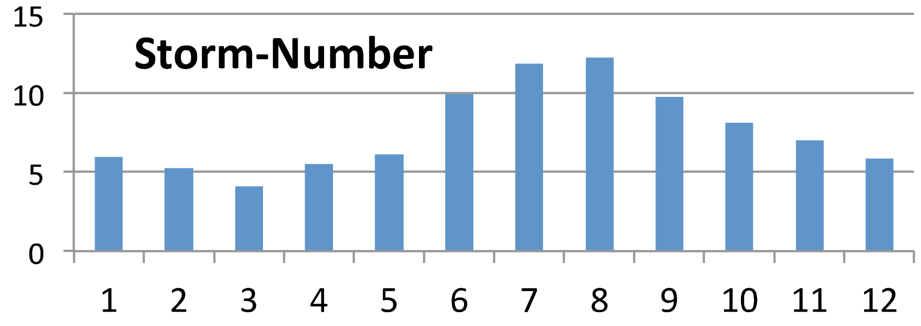
"This will be one of the most severe Bering Sea storms on record," the NWS wrote today.

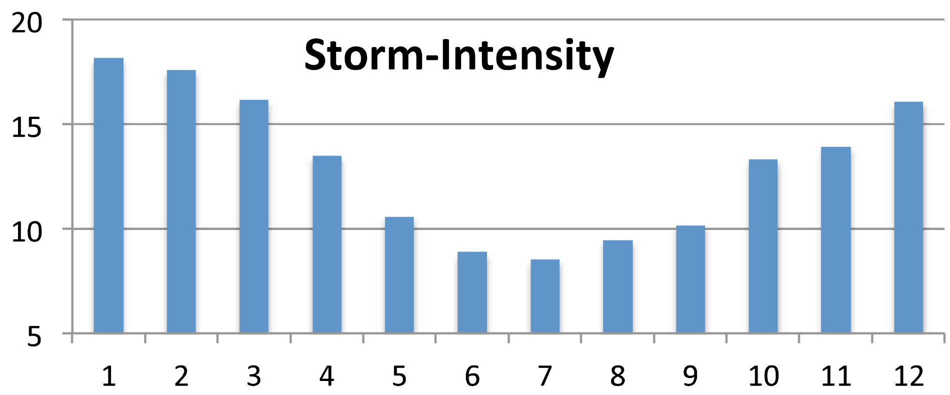
The storm is predicted to deepen at an incredible rate, with its central pressure crashing from 973 mb this morning to 945-950 mb tonight.

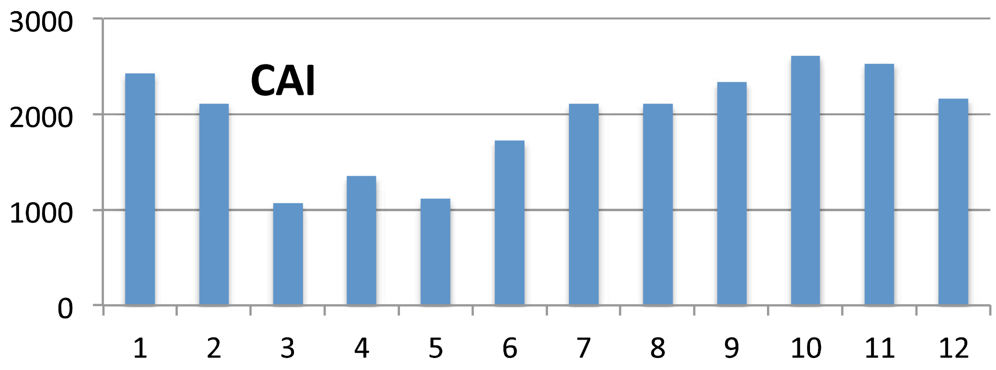
"This storm has the potential to produce widespread damage," the NWS in Fairbanks said.



Storm Climatology (1979-2009) in CBHAR



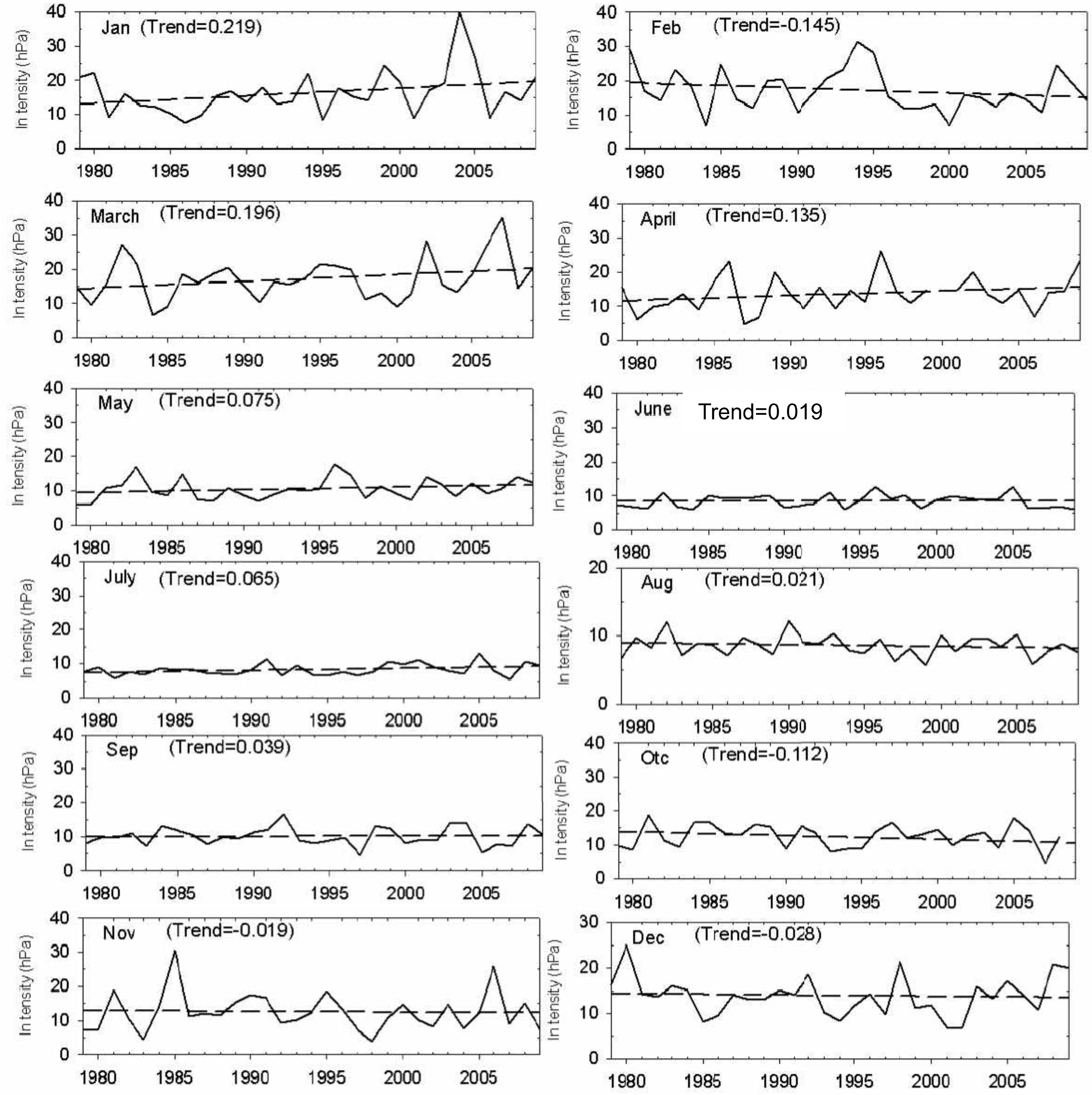




- ➢ More numerous storms in summer season, while a minimum count of storms in March.
- ➢ Stronger storms in winter and weaker storms in summer
- ➢ Weaker CAI in March & May

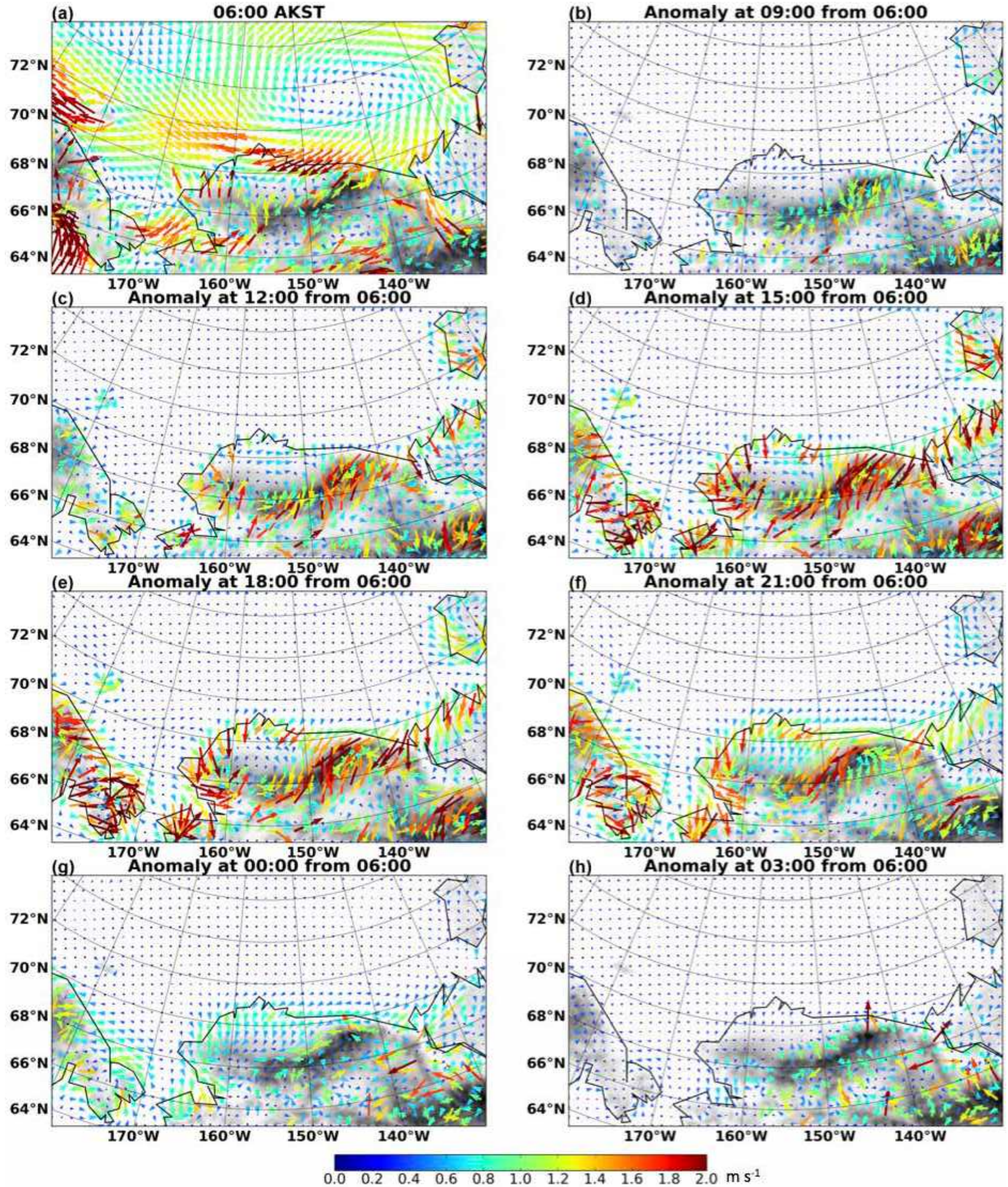
Tao et al., 2016

Variability and changes in storm intensity (1979-2009)



Tao et al., 2016

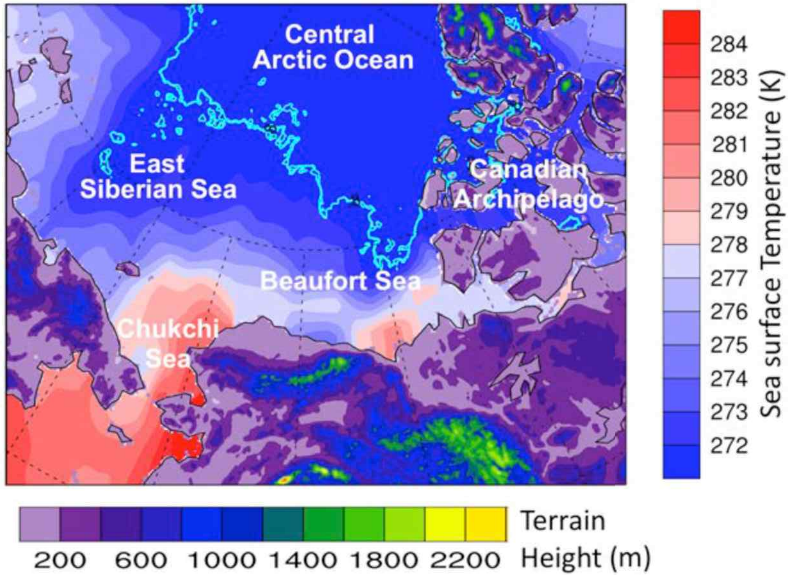
Climatology of high frequency mesoscale winds (1979-2009)

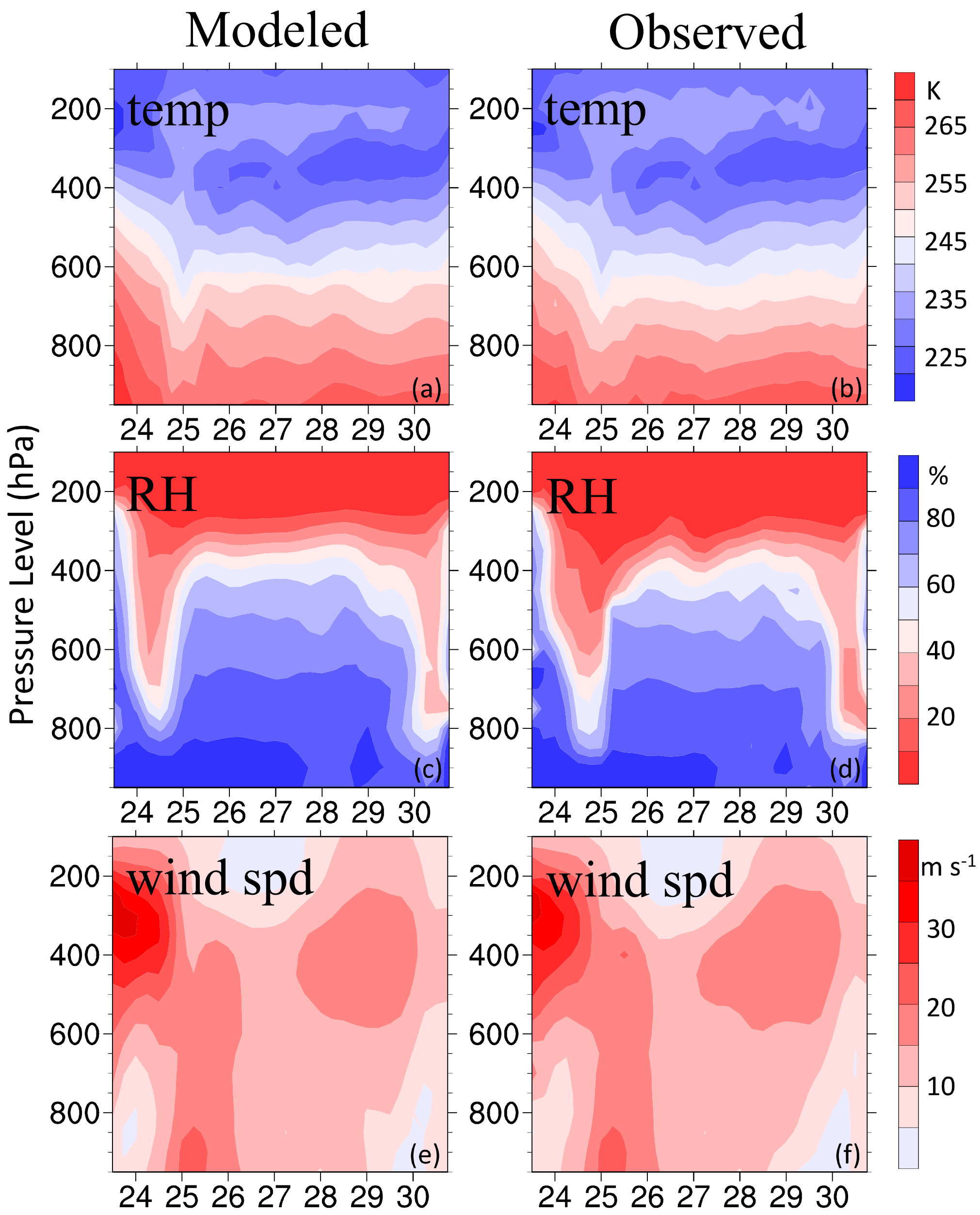


Zhang et al., 2016

Modeling Study on a Long-lasting Arctic Storm, Sept 23-30, 2010

Model Domain





The model realistically captures the spatial and temporal structures by the radiosonde observation onboard R/V Mirai

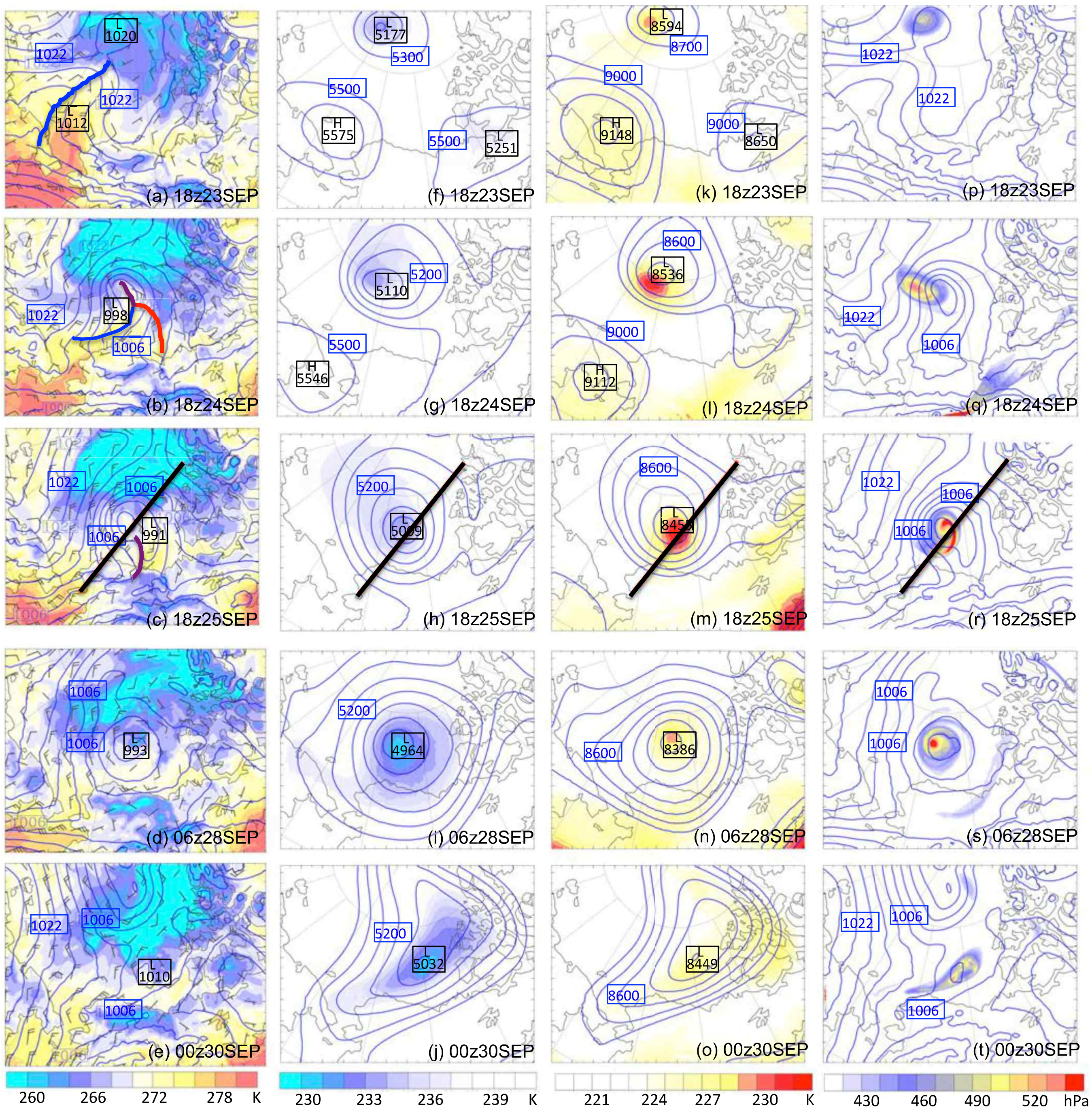
Tao, Zhang, and Zhang, 2016

Modeling Study on a Long-lasting Arctic Storm, Sept 23-30, 2010

Distinct Feature from Regular, baroclinically driven Storms:

Barotropical Structure dominates throughout the lifetime

Tao, Zhang, and Zhang, 2016



Climatological impacts of intense storms on sea ice and ocean

Composite analysis:

Intense storms cause a decrease in sea ice concentration and thickness, and an increase in SST

Results from ensemble simulations by using a fully coupled Arctic ocean-sea ice simulation (in collaboration with AWI; Semenov et al., 2016)