Drastic Intensification of the Super Arctic Summer Storm during 5-10 August 2012

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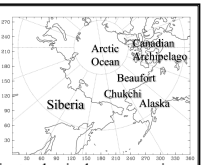
Introduction

- Along with dramatic changes in the Arctic, it has been noted that extreme weather events have occurred with increasing frequency over the Chukchi and Beaufort Seas.



- In this study, we investigate physical processes in the development of August 2012 super storm and its impacts on the surface wind.
- The Weather Research & Forecasting Model (WRF) is used to model the storm with initial & boundary conditions from ERA-Interim reanalysis. Resolution: 20 km ;Vertical levels: 49 layers Simulation period: Aug. 2-14, 2012.

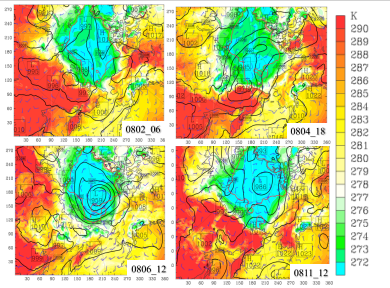
Life Cycle of the Super Strom in August 2012

Aug. 2: The storm generated over the East Siberian Sea coastal area.

Aug. 4: The storm developed and extended to the central Arctic Ocean.

Aug. 6: The storm reached its mature phase with sea level pressure of 959 hPa over the Arctic Ocean.

Aug. 6-14: The storm decayed and moved towards the Canadian Archipelago.



The WRF model simulated 2-m temperature (shaded), sea level pressure (black contours),10-m wind field (Barb: full barb:5 m/s)

Intensification of the Storm

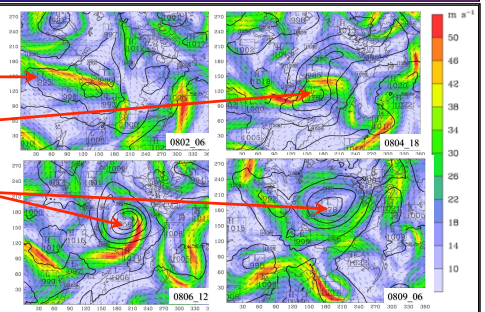
Coupling of Upper Jet Streaks & Surface Low

Aug. 2: The surface low was located at right entrance of jet streak, favoring the surface storm to develop

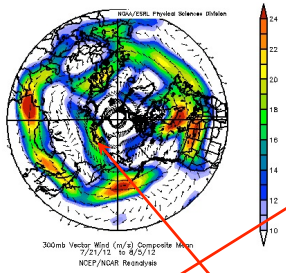
Aug. 4: The double jet streaks occurred above the surface low, intensifying the surface storm.

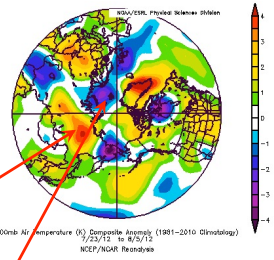
Aug. 6: The jet streak cyclonically swirled with the storm.

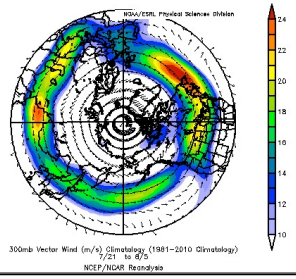
Aug. 9: The jet streak cut off from the storm.



WRF simulated 300hPa wind speed (shaded), sea level pressure (black contours), and 10-m wind field (Barb: full barb in 5 m/s);





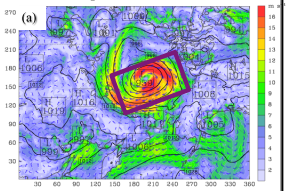


Upper Level Jet

- Climatologically, the polar jet stream is located around 50 – 60 N (right)
- A warmer temperature anomaly and a colder anomaly occurred from 850 hPa to 400 hPa over Eastern Siberia and the Arctic Ocean about 10 days before the storm genesis, resulting in greater temperature gradient along the East Siberia sea coast
- A branch of the jet streak was generated along the coast

Impacts of the Storm on Surface Winds

- The storm induced high winds occurred over the Chukchi/Beaufort Seas (Purple box in Fig (a))
- Strong winds (12-14 m/s) mainly happened during Aug 5-9 when the storm was at mature stage (Fig (b)). Before and after that, most wind are 4~6 m/s.
- Chance of wind speeds between 4-10 m/s m dominates the area during the entire storm period by ~60%, while during the mature stage of the storm, the chance of wind speeds between 6-12 m/s dominate the area by ~60% (Fig (c))
- Climatologically, northeast winds dominate the Chukchi/Beaufort sea, however the storm brought more southwest and northwest winds to the area (Fig (d)).
- Frequency of southwest winds increased when the storm lingered over the area.



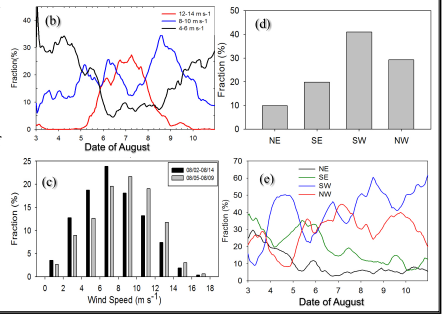
(a)WRF simulated surface wind speed (shaded) at 12 UTC Aug 6. Results shown in Fig.(b)~(e) are based on the data inside the purple rectangle

(b) Frequency evolution of different wind speed intervals during entire storm period

(c) Probability distribution function of wind speeds during entire storm period (black bars) and mature storm period (grey bars)

(d) Frequency of wind directions in each quadrant of NE, SE, SW, and NW for entire storm period

(e) Frequency evolution of four quadrant wind directions during entire storm period



CONCLUSIONS

- The upper level jet stream plays a critical role in the storm intensification.
- The warm anomaly over East Siberia and cold anomaly over the Arctic ocean generated a branch of upper jet streaks along the East Siberian Sea coast.
- The storm brought strong wind anomalies to the area, which mainly occurred during the mature stage of the storm.
- The storm weakened prevailing northeast winds over the Chukchi and Beaufort seas. Instead, southwest winds became dominant over the area.

Acknowledgements

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