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The Novaya Zemlya Bora and its Impact on Barents Sea Dense Water Formation

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Novaya Zemlya is a large and mountainous island in the Eastern Arctic that separates the Barents and Kara Seas. Weather station data indicates that surface wind speeds in excess of 15m/s occur approximately 50% of the time during the winter months. The air-sea interaction that occurs within a polynya that forms along the eastern shore of the island is thought to play an important role in Arctic thermohaline circulation and the water mass transformation of the incoming Atlantic water that passes by the island enroute to the central Arctic Ocean.
Although it has been proposed that a bora is responsible for these high winds, there have been no quantitative analysis of these winds and their impact on the environment.
Here we use the recently completed Arctic System Reanalysis (ASR) with its 30km spatial resolution to provide the first detailed high-resolution climatology of the surface wind field in the Novaya Zemlya region. The highest surface wind speeds are found on the western side of the island during easterly flow that is associated with a low-pressure system centered over the western Barents Sea. The high wind events are associated with a reversal in the zonal wind direction with height.
We show that the vertical structure of these high wind events shares many characteristics with idealized models of downslope windstorms associated with environmental critical layers as well as observations of the Yugoslavian Bora. In this regard, the high static stability of the upwind flow over the ice covered Kara Sea acts to increase the effective height of the topographic barrier thereby contributing to the acceleration of the flow that on the lee side of the island.
The highest wind speeds are most commonly found in the region where dense water is observed to form and we show that during high wind events, there is an approximate doubling, as compared to winter mean values, in the magnitude of the turbulent heat transfer from the ocean to the atmosphere. It is therefore proposed that the winds associated with this bora and the concomitant intense air-sea interaction contributes to the dense water formation in the Barents Sea.