Geophysical Research Abstracts
Vol. 19, EGU2017-13380, 2017
EGU General Assembly 2017

Extreme cyclone events in the Arctic during wintertime: Variability and Trends

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Extreme cyclone events are of significant interest as they can transport much heat, moisture, and momentum poleward. Associated impacts are warming and sea-ice breakup. Recently, several examples of such extreme weather events occurred in winter (e.g. during the N-ICE2015 campaign north of Svalbard and the Frank North Atlantic storm during the end of December 2015). With Arctic amplification and associated reduced sea-ice cover and warmer sea surface temperatures, the occurrence of extreme cyclones events could be a plausible scenario. We calculate the spatial patterns, and changes and trends of the number of extreme cyclone events in the Arctic based on ERA-Interim six-hourly sea level pressure (SLP) data for winter (November-February) 1979-2015. Further, we analyze the SLP data from the Ny Alesund station for the same 37 year period. We define an extreme cyclone event by a extreme low central pressure (SLP below 985 hPa, which is the 5th percentile of the Ny Alesund/N-ICE2015 SLP data) and a deepening of at least 6 hPa/6 hours. Areas of highest frequency of occurrence of extreme cyclones are south/southeast of Greenland (corresponding to the Islandic low), between Norway and Svalbard and in the Barents/Kara Seas. The time series of the number of occurrence of extreme cyclone events for Ny Alesund/N-ICE show considerable interannual variability. The trend is not consistent through the winter, but we detect an increase in early winter and a slight decrease in late winter. The former is due to the increased occurrence of longer events at the expense of short events. Furthermore, the difference patterns of the frequency of events for months following the September with high and low Arctic sea-ice extent ("Low minus high sea ice") conforms with the change patterns of extreme cyclones numbers (frequency of events "2000-2015 minus 1979-1994") and with the trend patterns. This indicates that the changes in extreme cyclone occurrence in early winter are associated with sea-ice changes (regional feedback). In contrast, different mechanisms via large-scale circulation changes/teleconnections seem to play a role in late winter.