The Role of Intense Cyclones for Precipitation, Sea Ice and Snow Cover Distribution in the Nordic Seas

E.M. Knudsen[1] *, K.I. Hodges[2], A. Rinke[3] and S. Crewell[1]

[1] Institute of Geophysics and Meteorology, Univ. of Cologne (Germany), [2] Institute for Department of Meteorology, Univ. of Reading (UK) , [3] Climate Sciences, Alfred Wegener Institute (Germa

Research Questions

Main:

- What role do cyclones play in the rapidly changing Nordic Seas with regards to precipitation, sea ice and snow cover?

Secondary:

- Is there a significant trend in cyclone-associated precipitation?
- Which cyclones contribute the most to overall precipitation, and why?
- How is sea ice loss linked to intense cyclones?

Motivation

- Arctic warming at twice the rate of global average (Arctic amplification)[i].
- Barents Sea sea ice trend anomalous for Arctic average, with significant retreat also in winter (Fig. 1)[ii].
- Marked positive trend in wintertime atmospheric moisture over Ny-Ålesund[iii].
- Even so relatively little focus on late fall/early winter compared to summer[iv,v,vi].

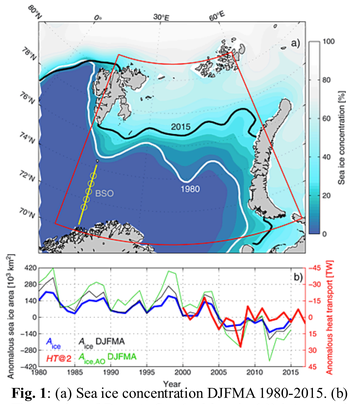

Fig. 1: (a) Sea ice concentration DJFMA 1980-2015. (b) Time series of Barents Sea (red box in (a)) interannual sea ice area (SIA) July-June [blue] and DJFMA [black], Arctic Ocean interannual SIA DJFMA [green] 1980-2015, and Barents Sea Opening (BSO; yellow line in (a)) heat transport (2 year lag relative to SIA) July-June 1997-2015 [red]. From Onarheim et al. (2015)[ii].

Preliminary Results

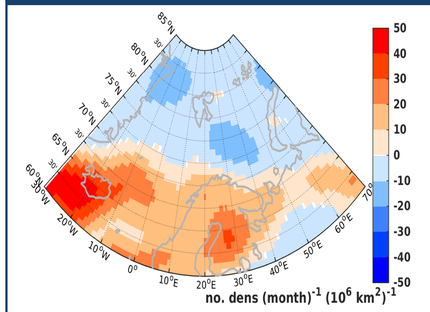

Fig. 2: Cyclone frequency (track density) in wet-dry seasons OND 1979-2014.

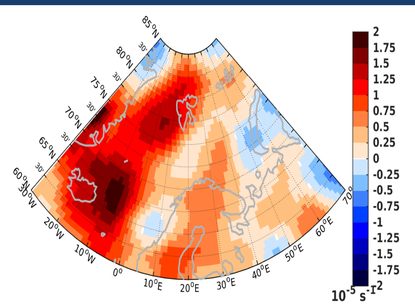

Fig. 3: Cyclone intensity (mean intensity) in wet-dry seasons OND 1979-2014.

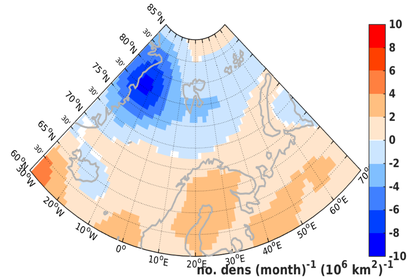

Fig. 4: Cyclone formation (genesis density) in wet-dry seasons OND 1979-2014.

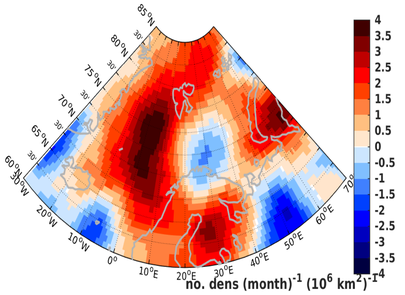

Fig. 5: Cyclone dissipation (lysis density) in wet-dry seasons OND 1979-2014.

Cyclone frequency (Fig. 2):

- Precipitation mainly from cyclones in the North Atlantic Ocean, Norwegian and Baltic seas.

Cyclone intensity (Fig. 3):

- The more intense cyclone, the more precipitation.
- Fewer, but more intense, cyclones in the Greenland and Barents seas in wet seasons.

Cyclone formation (Fig. 4):

- Similar features as cyclone frequency (Fig. 2).
- More cyclones forming in the Greenland Sea in dry seasons, more in the Irminger Sea in wet seasons.

Cyclone dissipation (Fig. 5):

- Similar features as cyclone intensity (Fig. 3).
- Heavy precipitation as cyclones die out.

Data Set and Methods

Data set:

- ERA-Interim reanalysis OND 1979-2014.

Method:

- 6-hourly cyclone tracking and statistics (TRACK)[vii].
- Total precipitation (*Ptot*) standardization to isolate wet (≥ 1 STD) and dry (≤-1 STD) seasons (6 each).
- $Wet\text{-}dry = Ptot_{[1983,1986,2006,2007,2011,2013]} - Ptot_{[1987,1989,1997,2000,2002,2010]}$

Next Steps

1. Composite analysis of wet-dry seasons for cyclone-associated precipitation amount and phase, sea ice and snow cover.
2. Comparison to HIRHAM5 regional climate model.
3. Case study on an extreme case also including Ny-Ålesund weather station and radiosondes and CloudSat satellite data.

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* Correspondence to: eknudsen@uni-koeln.de