Overview of near surface winds near the Labrador Sea

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+ many others
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Greenland coast vicinity experiences the most frequent high winds in the world oceans.

QuikSCAT satellite Observed Frequency (%) of winds ≥ 20 m/s

Sampe and Xie (2007)
Two main flavors of wintertime jets, but both impact the Labrador Sea.

- Max wind speeds 30-50 m/s, 50-200km in size, 1-2 days long.
Strong winds drive large waves \(\rightarrow\) few boat or aircraft observations.

Figure from: WHOI
<http://www.whoi.edu/oceanus/viewArticle.do?id=66549>
Strong topographic winds impact ocean mixing in 1D idealized models.
Greenland and surrounding topography distort atmospheric flow causing strong jets.

Note: The vertical and horizontal dimensions are not equal scales

Figure from: Doyle and Shapiro (1999)
High resolution (vertical and horizontal) models needed to resolve wind events.

DuVivier and Cassano 2013; DuVivier et al. 2017
There are other small scale jets in this region that could be important

Hughes and Cassano 2015
Self Organizing Map groups weather “types”.

- Algorithm sorts data based on similarity.
  - Neural Network algorithm
  - Identifies user-specified number of patterns within a data set.
  - Assigns each input data vector to a particular node based on pattern similarity (RMSD).
  - 1990-2010 RASM daily winter (NDJFM) wind vectors used to train SOM.
SOM identifies range in types of wind patterns around Greenland

DuVivier, A.K. et al. (2016)
SOM identifies range in types of wind patterns around Greenland

- Easterly tip jets
- Westerly tip jets

DuVivier, A.K. et al. (2016)
Composites of conditions during wind events indicate strong connection between Lab Sea region and jet.


Vage et al. 2009
Heat flux maximum better correlated with wind than sea ice edge → topographic wind impact.

Moore et al. 2014

Wind speed (colors)

Air-sea temperature gradient

Surface heat flux

NARR reanalysis (32km)
Observations, reanalyses, regional high res all show increase in wind speed over the Labrador Sea.

* Wind max from katabatic and topographic effects
Mean Labrador Sea lowest U winter (JFM) winds in CESM2.0

- Speeds are too low
- No maximum in winds over the Labrador Sea
  - Katabatics stop at coast
  - No Baffin Island topographic effect
- Topography very smooth
Thank You
Discussion Time!
Midlatitude jet is right over Lab Sea. So increase this stress, get increased mixing and ocean upwelling. Thought that enhancing stress over Lab Sea would be helpful. Lots of attempts
- Mahrt and Sun, etc.
- Wanted enhanced turbulent stresses and surface fluxes to mess with boundary layer over lab sea. But these didn’t work. Maybe seemed to work but others would freeze. We couldn’t even show that these impacted the system in any consistent way.

At what stage can you intervene and flip the system?

Maybe related to CLUBB? CLUBB momentum stress wrong in high wind situations.

Land surface seems secondary. We tried re-directing runoff out of this region, still froze over.

Spin up phenomena. There seems to be a stable state with this gone, but we don’t accept this as realistic.

Did not try increasing speeds of winds around Greenland and Baffin Island. But this could be important. Smoothed topography in ASD.

Justin – EBM added?
Upwelling along ice edge

Seasonal NDJFM change in mixed layer for 20 winter seasons (+ = deepening)

Bathymetry
Fig. 8. Near-coast dropsonde, lidar, and WRF (a), (d) wind speed (m s$^{-1}$); (b), (e) wind direction ($^\circ$); and (c), (f) temperature ($^\circ$C) in the lowest 1500 m. Profiles at location D3 (2030 UTC) are shown in (a)-(c) while profiles at location D5 (2059 UTC) are shown in (d)-(f). WRF profiles are a weighted average of the nearest four surrounding points.