Ocean and Atmosphere Impacts on Helheim Glacier Calving

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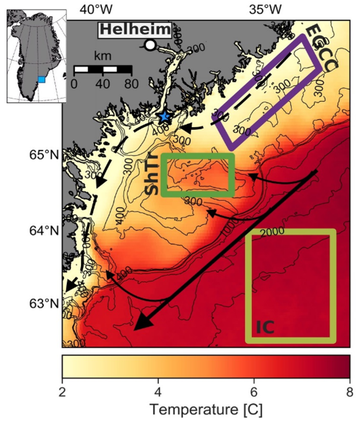
Background

- Greenland ice sheet could contribute 20ft of sea level rise if entirely melted.
- Since 1990 half of Greenland ice loss occurred at glaciers.
- Helheim Glacier is Greenland's fifth largest glacier.
- Helheim experienced major ice loss from 2002-2005 and 2014-present.
- Speed up from 8 km (5.0 mi) per year in 2001 to 11 km (6.8 mi) per year in 2005.
- Calving may be caused by factors such as warmer air and water temperatures, and wind changes in the area.

Data Set

- ECMWF ERA-5: 2-m air temperature and 10-m wind velocities
- MODIS Sea surface temperatures (SST) from Snow et al. (In review)
- Calving from ERCD CCREL Time-lapse Camera.



Winds taken from Shelf Trough (ShTr)

2000-2016 mean nighttime MODIS SST of the Ammassalik region around Sermilik Fjord.

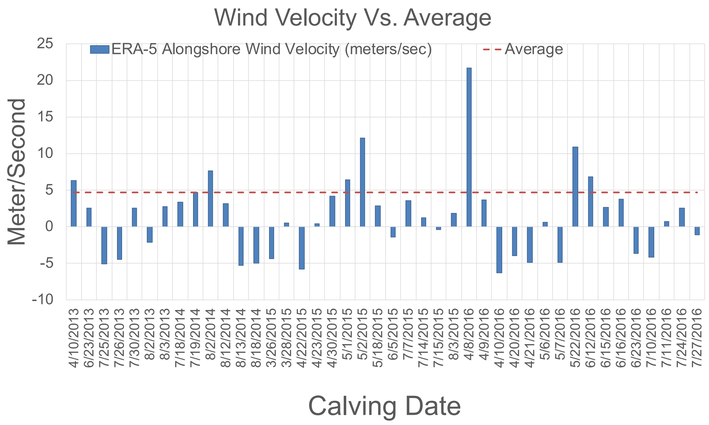
Methods

- Wind velocities have been referenced so that winds in the V direction are oriented similarly to the prevailing wind direction from the northeast (toward 230 degrees)
- For all records, determined the averages for each.
- During the calving events, determined if the atmospheric or ocean variables were above or below average.

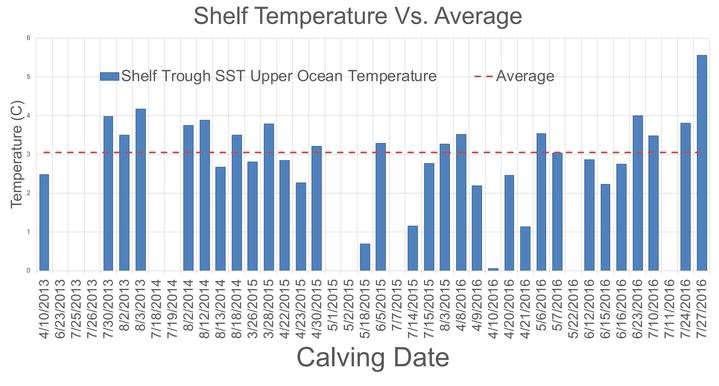
Motivation

Our research is focused on how ocean and atmosphere variability may correlate with calving events at Helheim Glacier over the course of 2009 to 2016

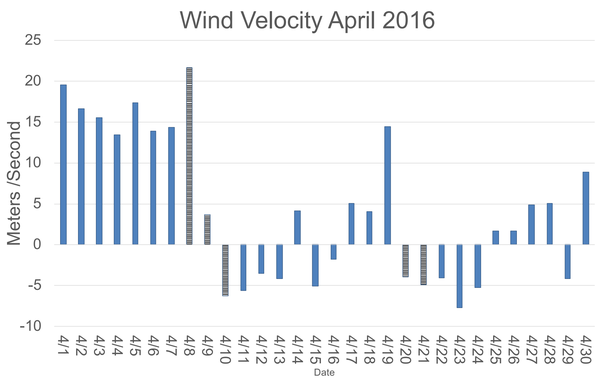
Results



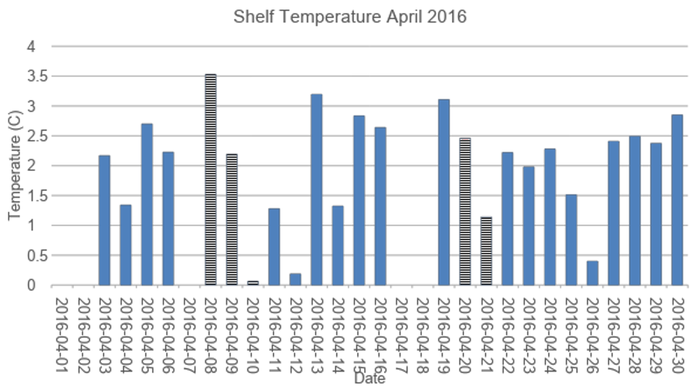
Wind velocity during calving events from 2013 to 2016 in comparison to the average.



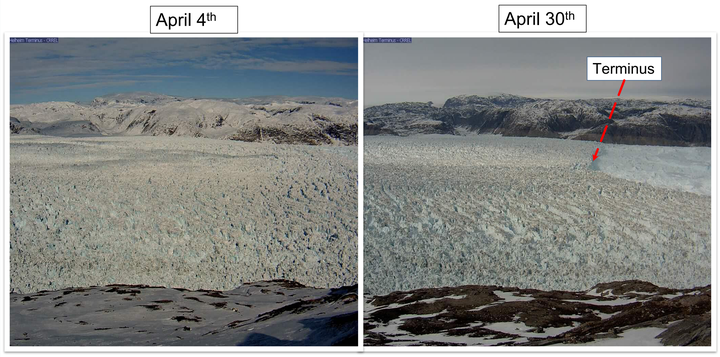
Continental Shelf Trough Temperatures during calving events from 2013 to 2016 in comparison to the average.



Wind velocity in April 2016



Shelf Trough Temperatures in April 2016



Helheim Glacier Terminus in April 4th – 30th 2016

- 19% of calving events occurred when the wind velocity was over the average velocity, and 35% of calving events occurred when wind velocities were negative (winds blowing north from the southwest).
- 38% of calving events had a shelf temperature that was about 0.2℃ to 2.5℃ higher than the average temperature.
- 21% of the calving events occurred when the air temperatures were above 0℃. Compared to the 79% when the air temperature was below 0.
- During the month of April of 2016, winds were exceptionally strong and transitioned to blowing in the opposite direction which we think brings warmer water into the fjord. Continental shelf water temperatures were above average leading into these calving events.

Discussion

- Despite warmer air temperatures occurring during some calving events, more calving events occurred with lower temperatures, showing that other factors other than air temperature are at play during calving events.
- Winds may have caused the calving event on the glacier during April 8th to April 10th of 2016.
- Other factors may be at play, but we do not have measurements for them.

Conclusions

Our results show that air temperature did not effect days with calving as much as days with high positive winds likely did. During April 2016, at least 2 calving events occurred. During these the shelf temperature was warmer than average. The wind velocity was higher than average leading up to the calving events and becoming negative during them. What can be done now is to investigate calving events at other glaciers in Greenland and other areas of the Artic.

References

Snow, T., et al. (in review). *Journal of Geophysical Research: Oceans*.

Straneo, F., et al., (2010). *Nature Geoscience*. Vol. 3, pg. 182-186.

Acknowledgements

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