Ocean Heat Fluxes And Rapid Sea Ice Decline

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Minimum Sea Ice Extent
CCSM3

Holland et al., 2006
Ocean Heat Transport

Pathways

Rudels et al., 1996, Bourgain et al., 2011
Cold Halocline Layer
Ocean Heat Transport
Simulated - Observed

Bieszczynska-Moller et al., 2011
OHT and Rapid Sea Ice Declines
Area Tendencies
Dynamic and Thermodynamic
Rapid Declines
Correlation over 20-year moving window

<table>
<thead>
<tr>
<th>Rapid declines linked to OHT in...</th>
<th>64/79</th>
</tr>
</thead>
<tbody>
<tr>
<td>... Bering Strait</td>
<td>44 (23)</td>
</tr>
<tr>
<td>... BSO</td>
<td>37 (14)</td>
</tr>
<tr>
<td>... Fram Strait</td>
<td>12 (1)</td>
</tr>
<tr>
<td>... both BSO and Bering Strait</td>
<td>15</td>
</tr>
</tbody>
</table>
OHT and Min SIE
Ensemble Member #10
Bering OHT and Min SIE
Ensemble Member #10
Change in SIC

Earlier Decline

1938-1948
Change in SIC During Rapid Declines
EM-10

1st Rapid Decline

2nd Rapid Decline

79 rapid declines in total over the 40 ensemble members
Mechanisms
Bering Sea Opening
BSO OHT – Ice Conditions
Regression Analysis

March Thick

Sept SIC

1921-1999

2000-2049
BSO OHT

Turbulent Fluxes

OHT - Winter Ice Growth

OHT - Summer melt
Atmosphere Feedback

CCSM3
Bering Strait
Bering Strait OHT – Ice Condition
Regression Analysis

March Thick

Sept SIC

1921-1999
2000-2049
Fram Strait
Fram Strait OHT – Ice Condition
Regression Analysis

March Thick

Sept SIC

1921-1999

2000-2049
Conclusions

- 83% of the rapid declines in CESM-LE are linked to anomalous ocean heat transport through Bering Strait and Barents Sea Opening.
- The sea ice loss is amplified by anomalies in surface heat fluxes.
- OHT entering the Arctic Ocean over shallow shelves have the largest impact on Rapid Sea Ice Declines.
Future Work

• Impacts of melt onset date [Stroeve et al., 2013], spring melt-pond fraction [Schröder et al., 2014] and spring longwave cloud forcing [Gorodetskaya et al., 2008]