Less Climatic Resilience in the Arctic, More Rare Events

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UNUSUAL OR UNEXPECTED ARCTIC EVENTS (2017–2022)

- Extreme Temperatures: 212
- Sea Ice: 190
- Seasonal Timing: 185
- Snow: 165
- Unusual Species Range: 134
- Permafrost: 111
- Species Declines: 106
- Wildfires: 65

Data: from Local Environmental Observer (LEO) Network; based on knowledge and observations of the individual
Sea Ice Volume Loss: 70%
More responsive to Storms; Non-Linear

R. Kwok
Conceptual Model of causal network for new ecosystem impacts from extremes

- Natural Variability
- Storms
- Climate Change
- Arctic Amplification
- New Extremes
- Ecosystem Impact
- Life Histories

Overland 2021
Climatic Change
THREE TAKE-AWAYS

• Multiple extreme events in the Arctic at or beyond previous records, often record-shattering

• Radical uncertainty concerns events whose determinants are insufficiently understood for forecasting *(hint: Use Scenarios)*

• Normal range of weather combines with Arctic Amplification *(Temperatures, Sea ice and Permafrost thaw)* to cause extremes
The 2020 Siberian heat wave
January-June

Wildfire
Permafrost thaw
Delayed sea ice freeze-up
Jet stream Polar vortex anomaly
Jan-April 2020
Barents Sea Atlantification

25 Feb 2018

Lind et al 2018
Greenland: Weather Causal Connection

Runoff = a * GPH + b

- a = 0.77554
- b = 5420.2
- R = 0.85

2019

Tedesco and Fettweis 2020
Bering Sea  Winter 2018 & 2019

Fig. 4. 700 mb geopotential height for February–March 2019 showing a wavy jet stream (purple/blue) that supported southerly winds and no sea ice growth.
Weak Arctic Front Continuing
Pollock, Cod move to North Bering in 2018 & 2019
Lack of food in South (Euphausids), Ice seal Mortality

Adult Cod and Pollock are top down Predators
Eleven major community impacts through 2021

Eisner et al. 2020
Arctic change is faster than models; Less resistance to change; The Arctic is in a period of Radical Uncertainty

Events well beyond previous records

Extremes tied to weather events

*Greenland ice mass loss;
*Sea ice is thin and more mobile;
*Permafrost thaw; *wildfires;

Fractal?
*

Ecosystem reorganization;

*Asian cold events

Events vary by type, timing and location:

Extremes tied to weather events

Non-linear

Extreme Impacts = Π

Cascade

Cumulative Changes are

Fractal?
Factor Analysis of Arctic Amplification
AO not selected

<table>
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<th>Factor 1</th>
<th>T2m_DJF</th>
<th>Permafrost</th>
<th>Tundra_NDVI</th>
<th>SIE_March</th>
<th>SIE_Sept</th>
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Overland and Wang, ERL, 2019