Changing Arctic Ocean

Photo by Jen Freer

Implications for marine biology and biogeochemistry

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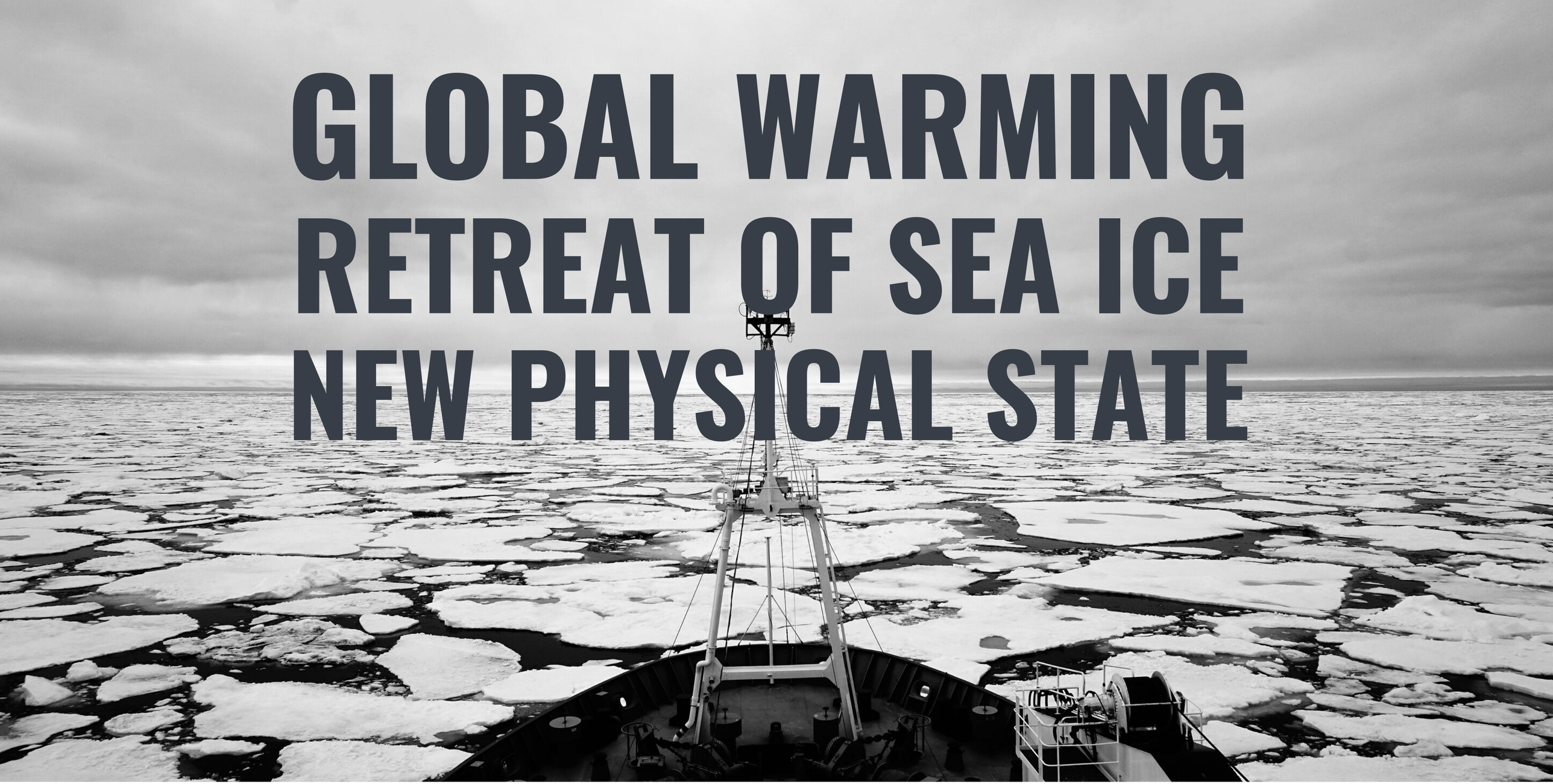
Federal Ministry of Education and Research

UKRI Natural Environment Research Council

Changing Arctic Ocean NERC

THE UNIVERSITY of EDINBURGH

Dr Kirsty Crocket
Science Coordinator
k.crocket@ed.ac.uk



GLOBAL WARMING
RETREAT OF SEA ICE
NEW PHYSICAL STATE

Changing Arctic Ocean: Implications for marine biology and biogeochemistry

Photo by Jen Freer

Average air temperature anomaly in Oct 2019

relative to 1951-1980 baseline

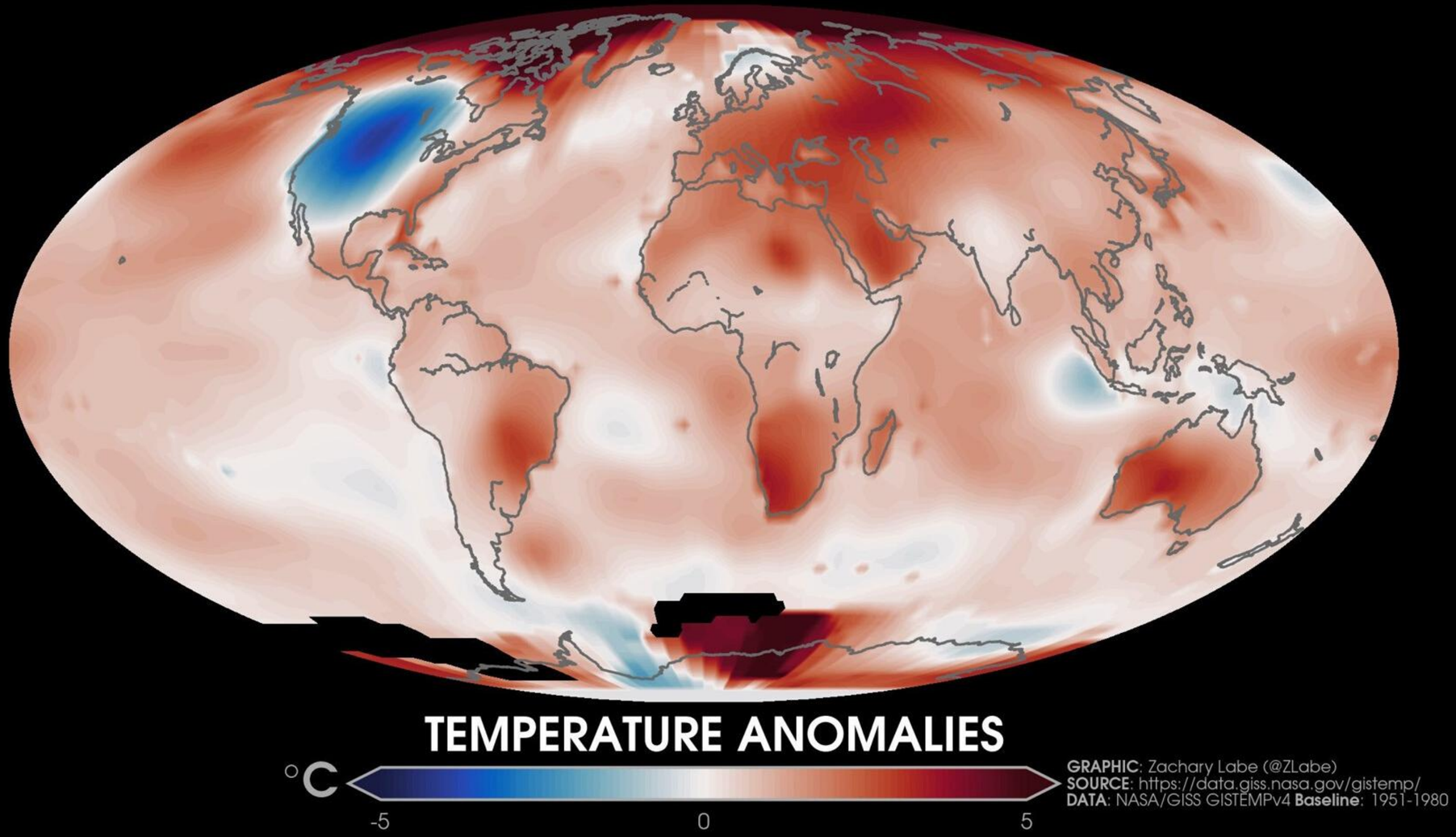


Figure from Zack Labe ~ @ZLabe ~ https://sites.uci.edu/zlabe/

Data: NASA/GISS GISTEMPv4

Average air temperature anomaly from Oct 2017 to Sep 2018

relative to 1981-2010 baseline

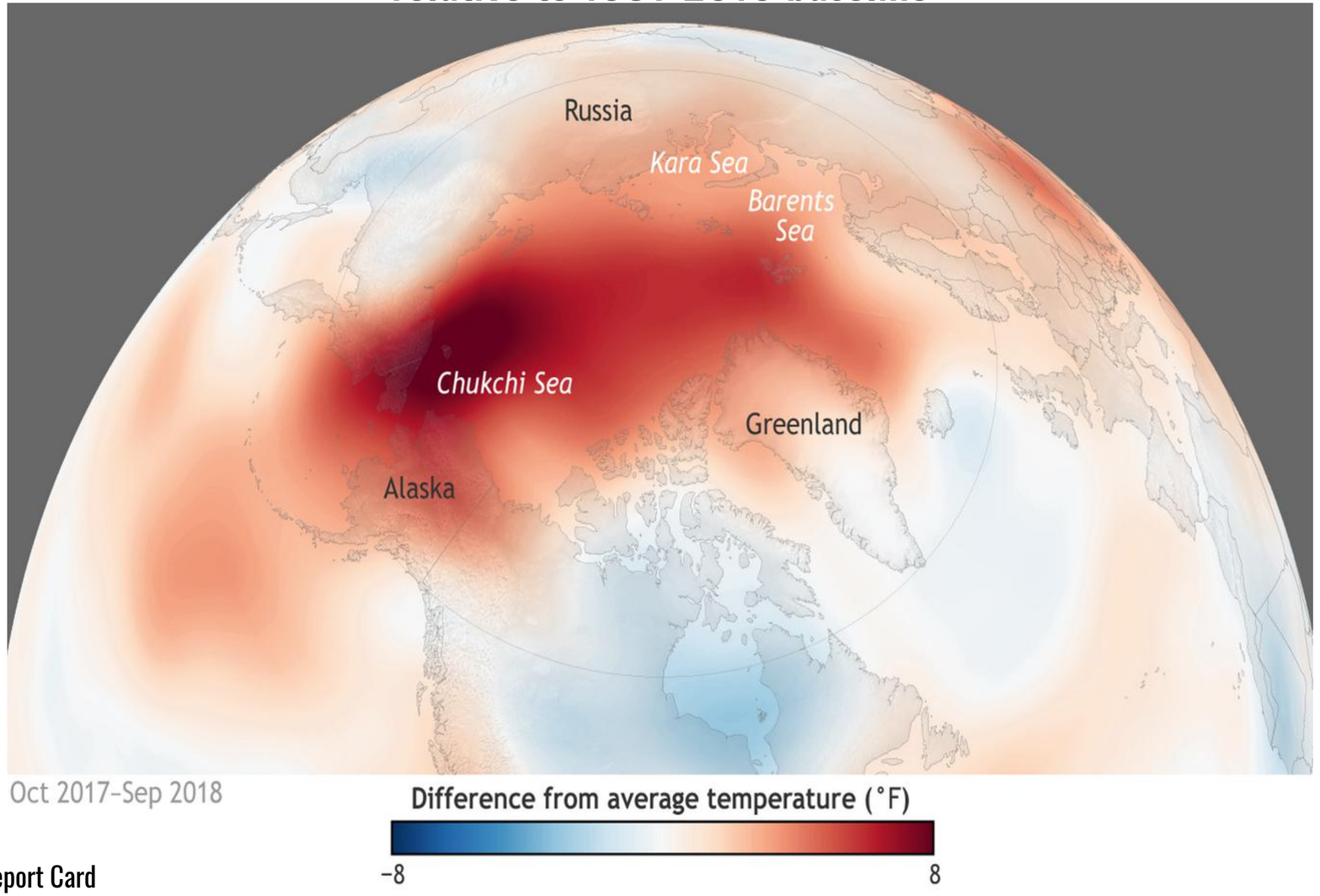
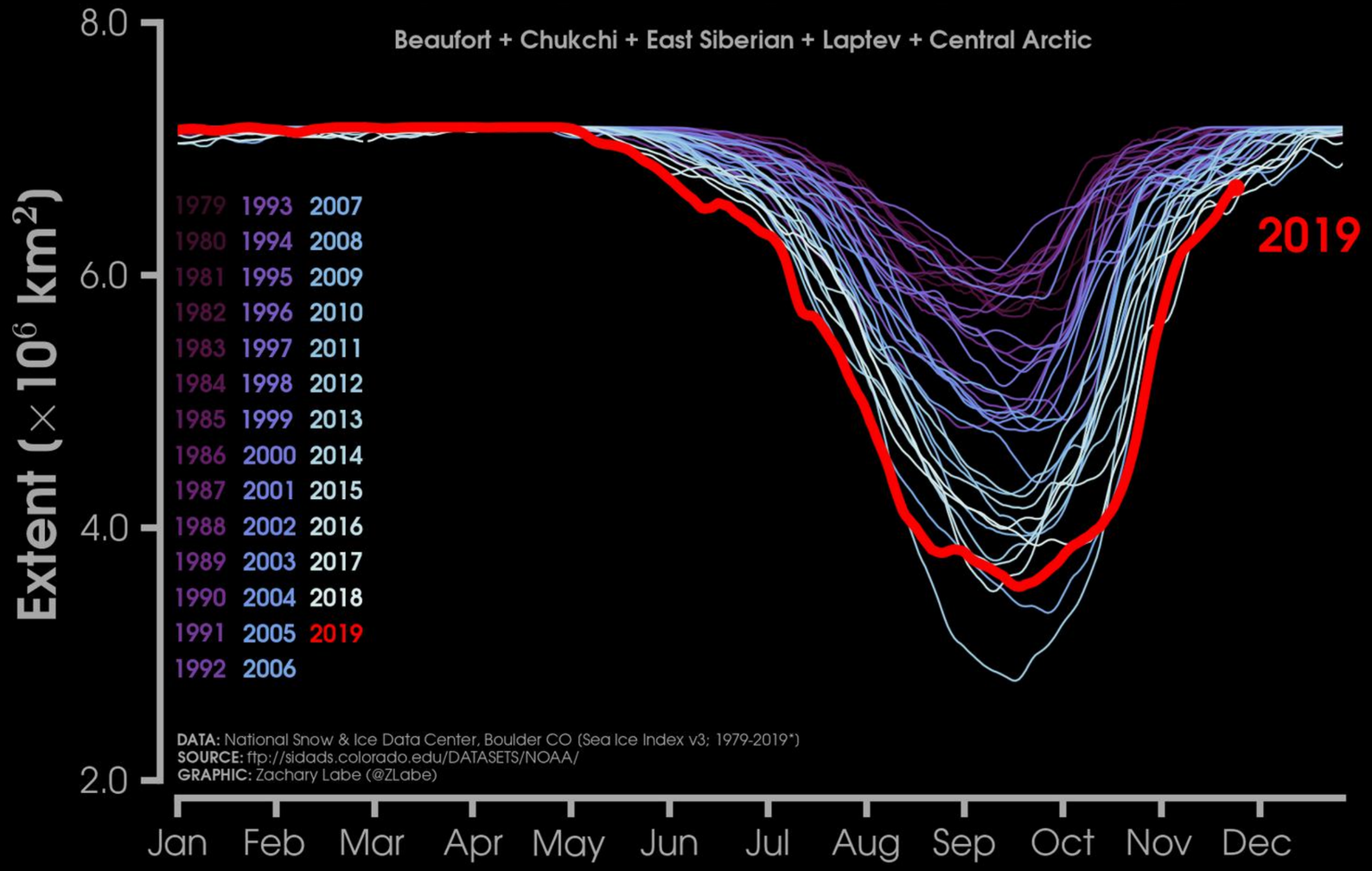


Figure from the 2018 Arctic Report Card

Sea ice extent in the Arctic Ocean



Updated 25 Nov 2019

Figure from Zack Labe ~ @ZLabe ~ https://sites.uci.edu/zlabe/

Data: National Snow & Ice Data Center, USA (Sea Ice Index v3)

Loss of sea ice older than 4 years

comparison March 1985 to March 2018

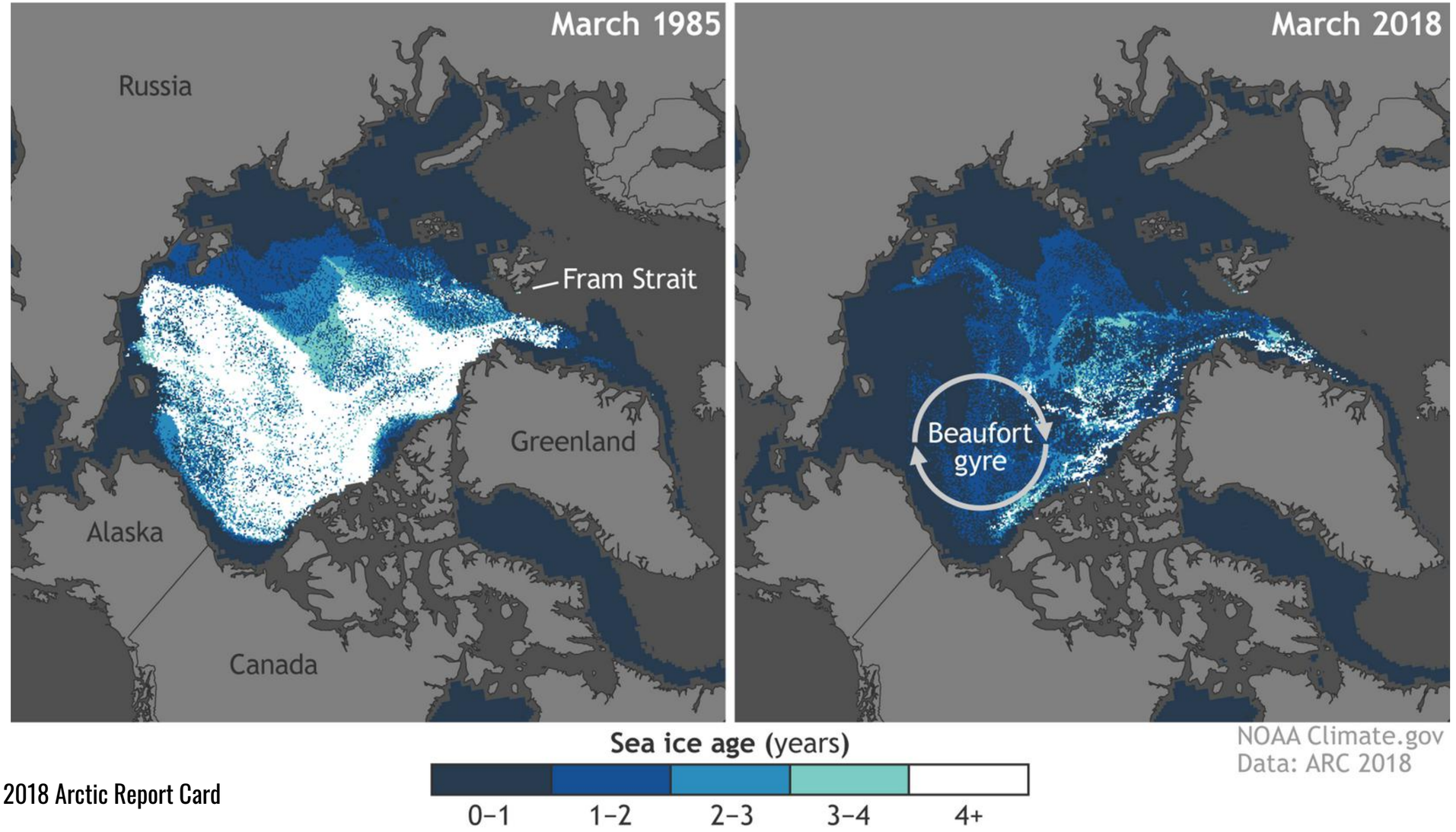
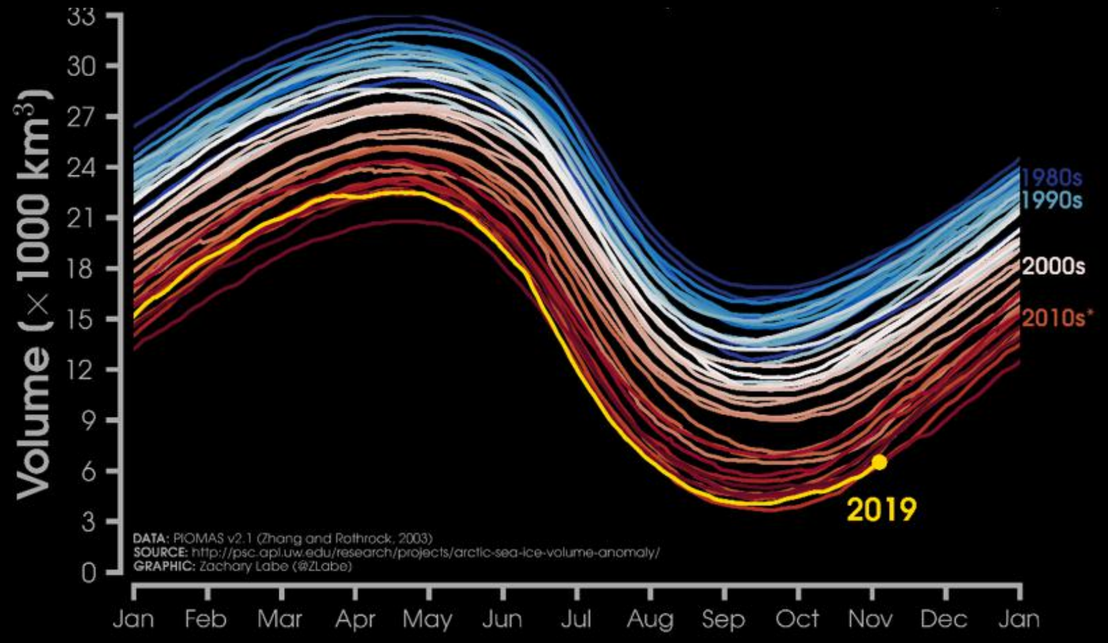


Figure from the 2018 Arctic Report Card

Arctic Sea Ice 1979-2019

Volume



Thickness

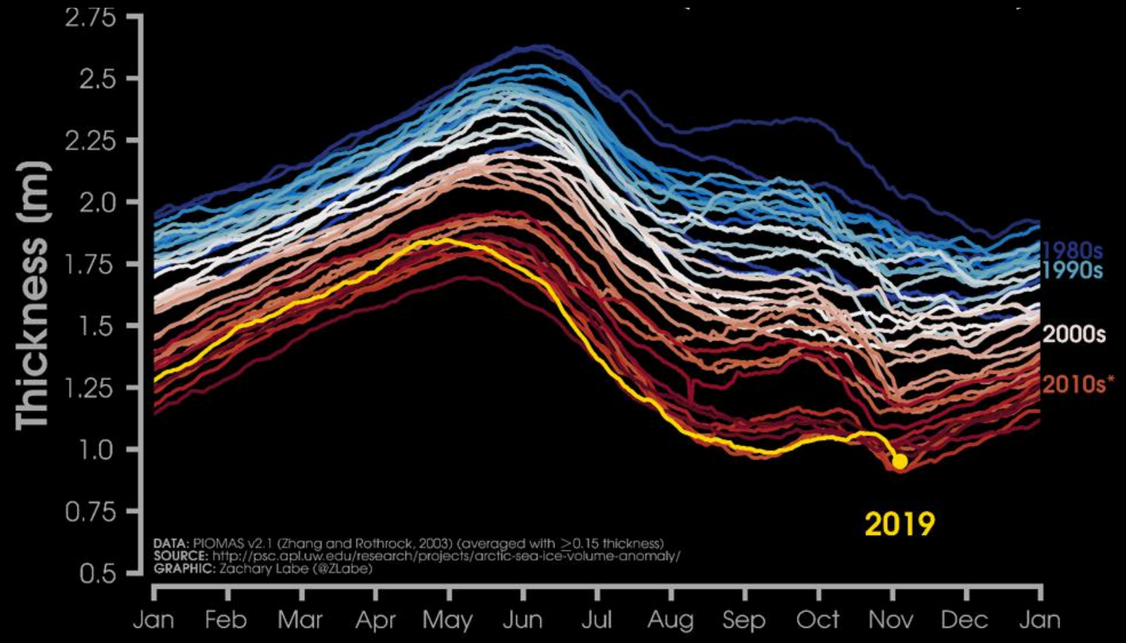
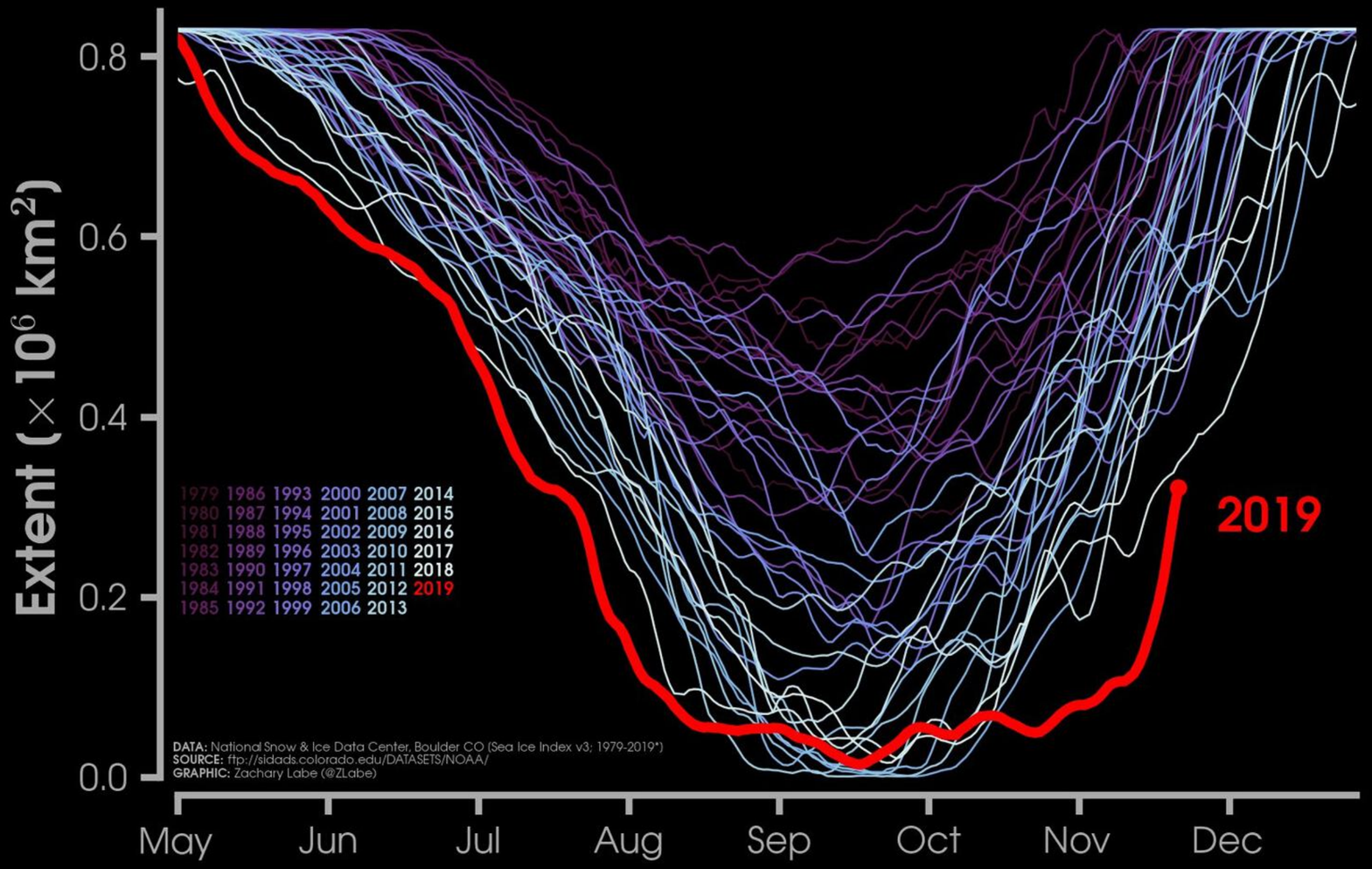


Figure from Zack Labe ~ @ZLabe ~ https://sites.uci.edu/zlabe/

Data: PIOMAS v2.1 (Zhang and Rothrock, 2003)

Chukchi Sea Ice - abnormal behaviour in 2019



Updated 22 Nov 2019

Figure from Zack Labe ~ @ZLabe ~ https://sites.uci.edu/zlabe/

Data: National Snow & Ice Data Center, USA (Sea Ice Index v3)

Reconstruction of Arctic sea ice extent

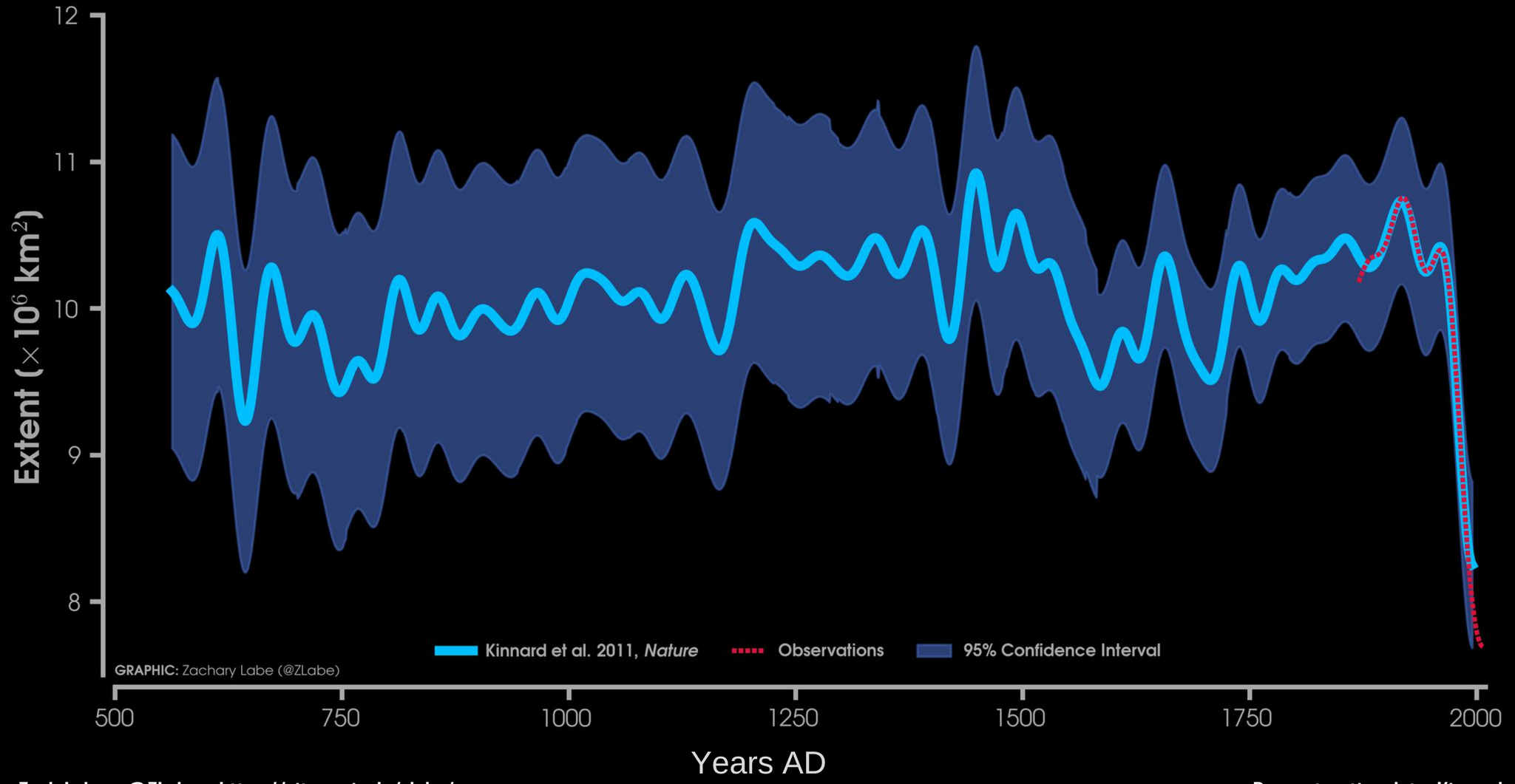
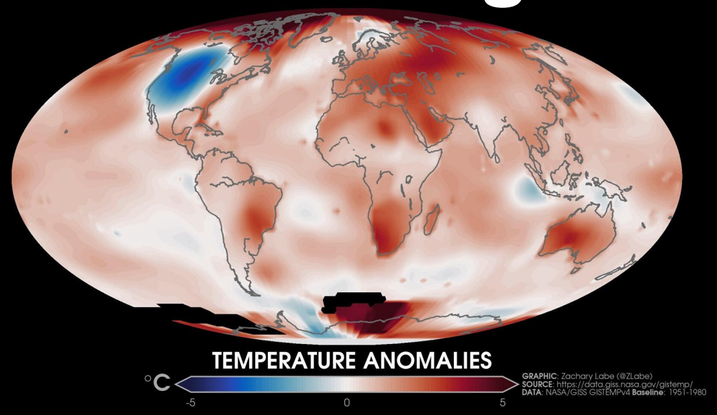


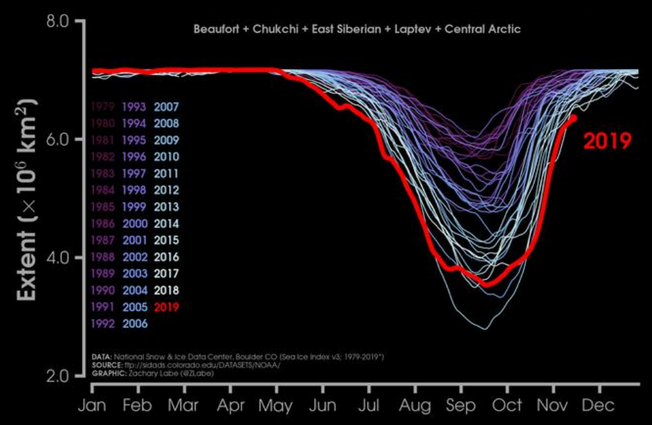
Figure from Zack Labe ~ @ZLabe ~ https://sites.uci.edu/zlabe/

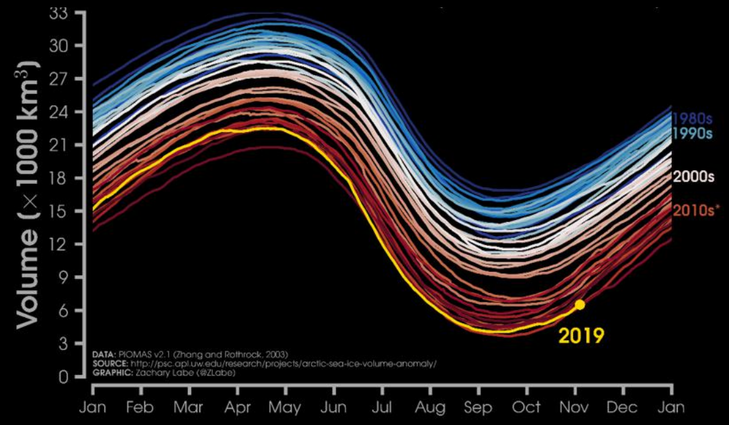
Reconstruction data: Kinnard et al., 2011

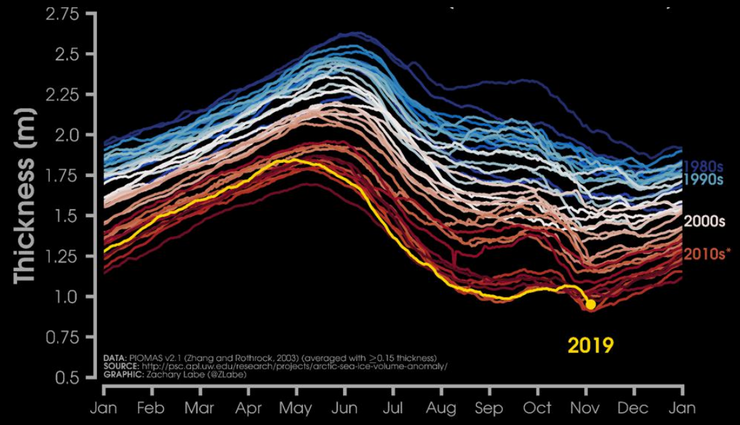
Warming



Reduction in sea ice extent, volume and thickness

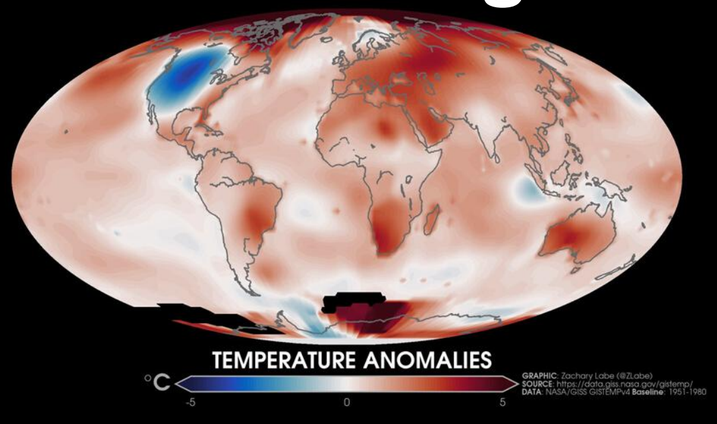




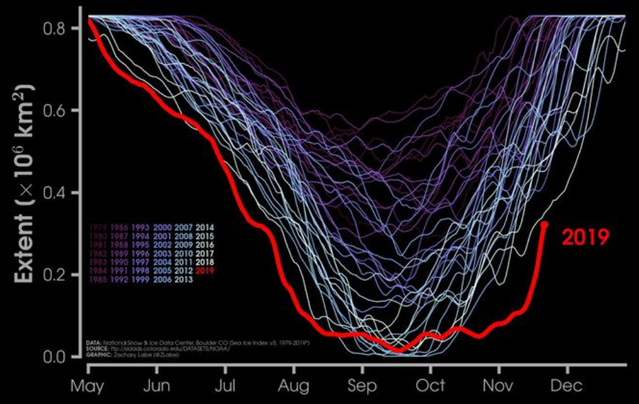


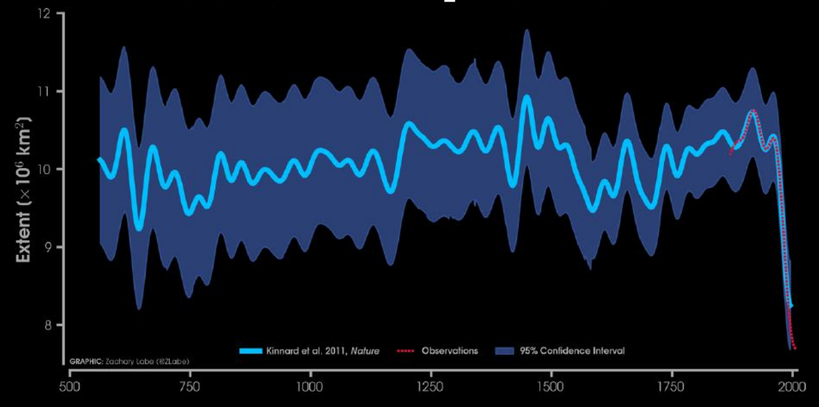
Figures from Zack Labe ~ @ZLabe ~ https://sites.uci.edu/zlabe/

Warming



Record anomalies No recent precedent





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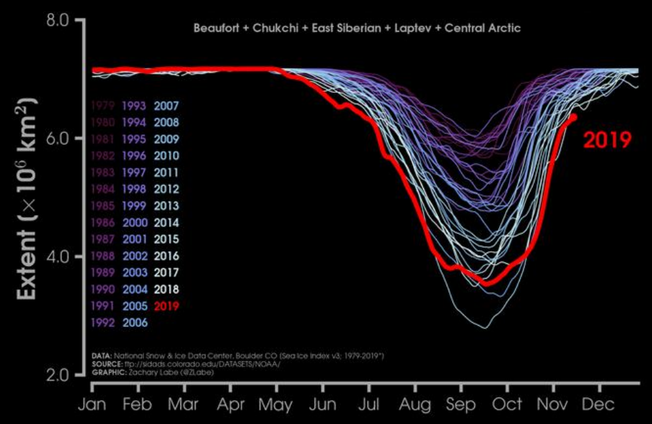
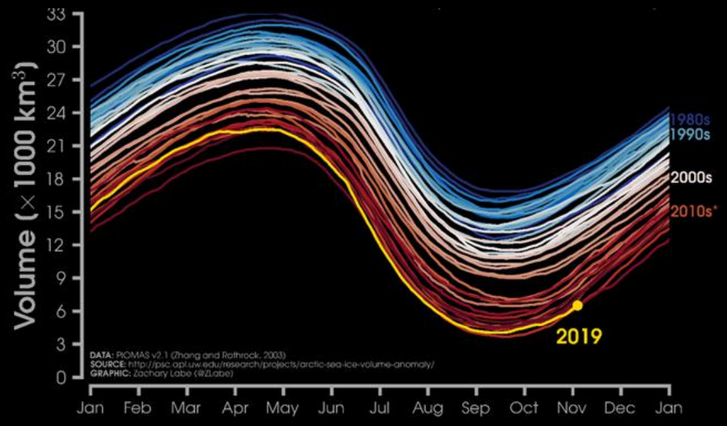
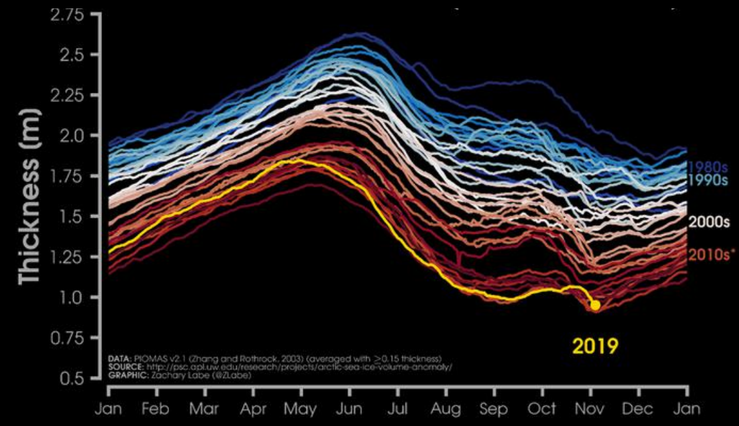
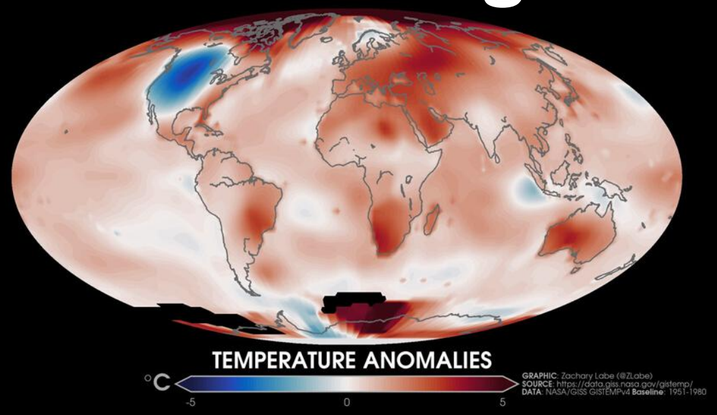




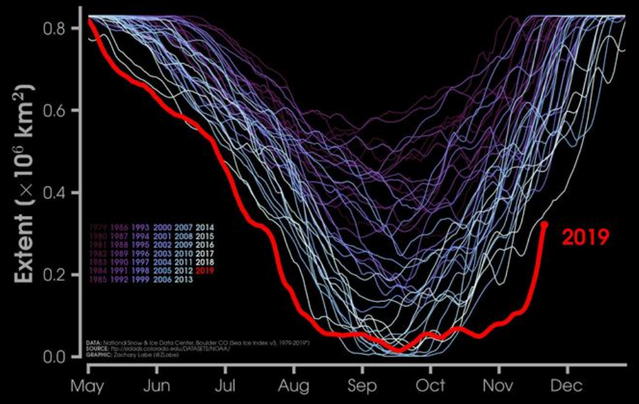


Figures from Zack Labe ~ @ZLabe ~ https://sites.uci.edu/zlabe/

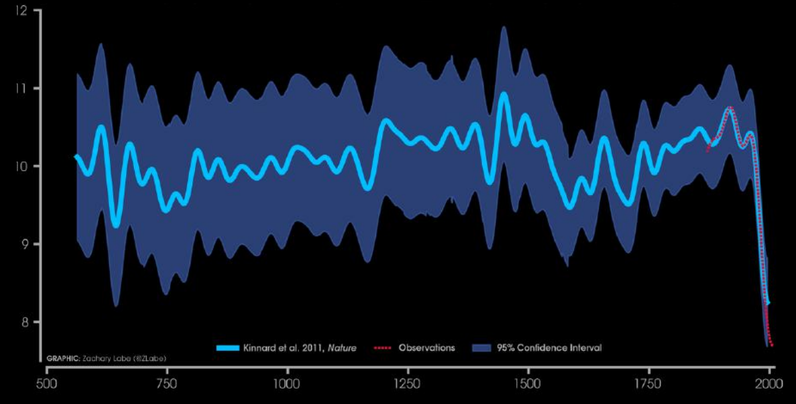
Warming



Record anomalies

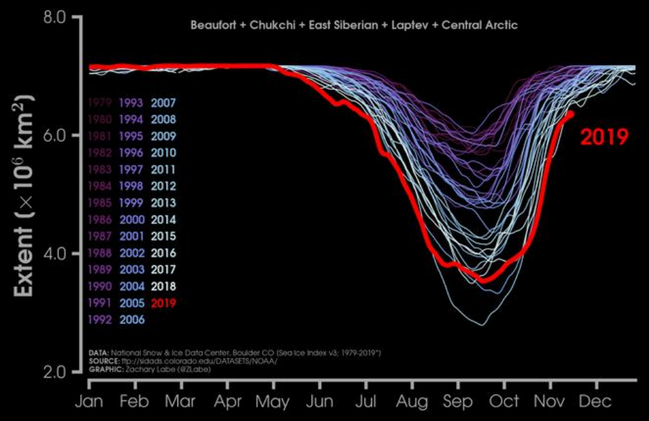


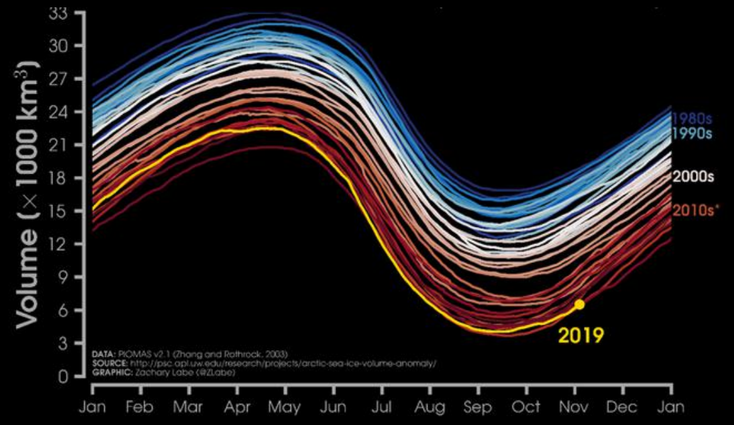
No recent precedent

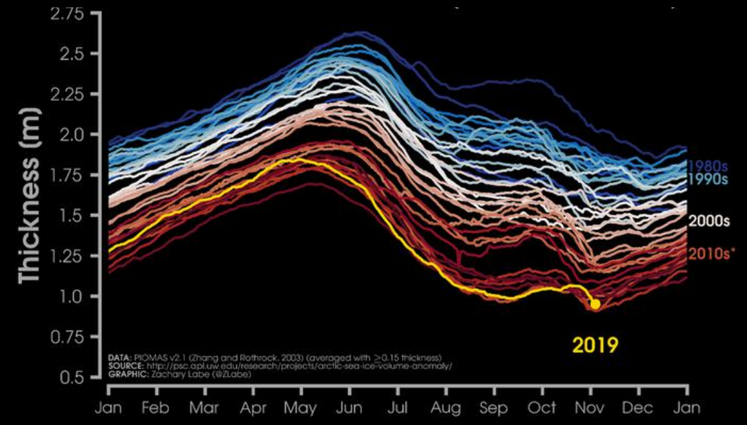


Extreme, unprecedented, rapid change

Reduction in sea ice extent, volume and thickness







Figures from Zack Labe ~ @ZLabe ~ https://sites.uci.edu/zlabe/

Why is it important to know about change in the Arctic Ocean?

Photo by Callum Whyte

Why is it important to know about change in the Arctic Ocean?

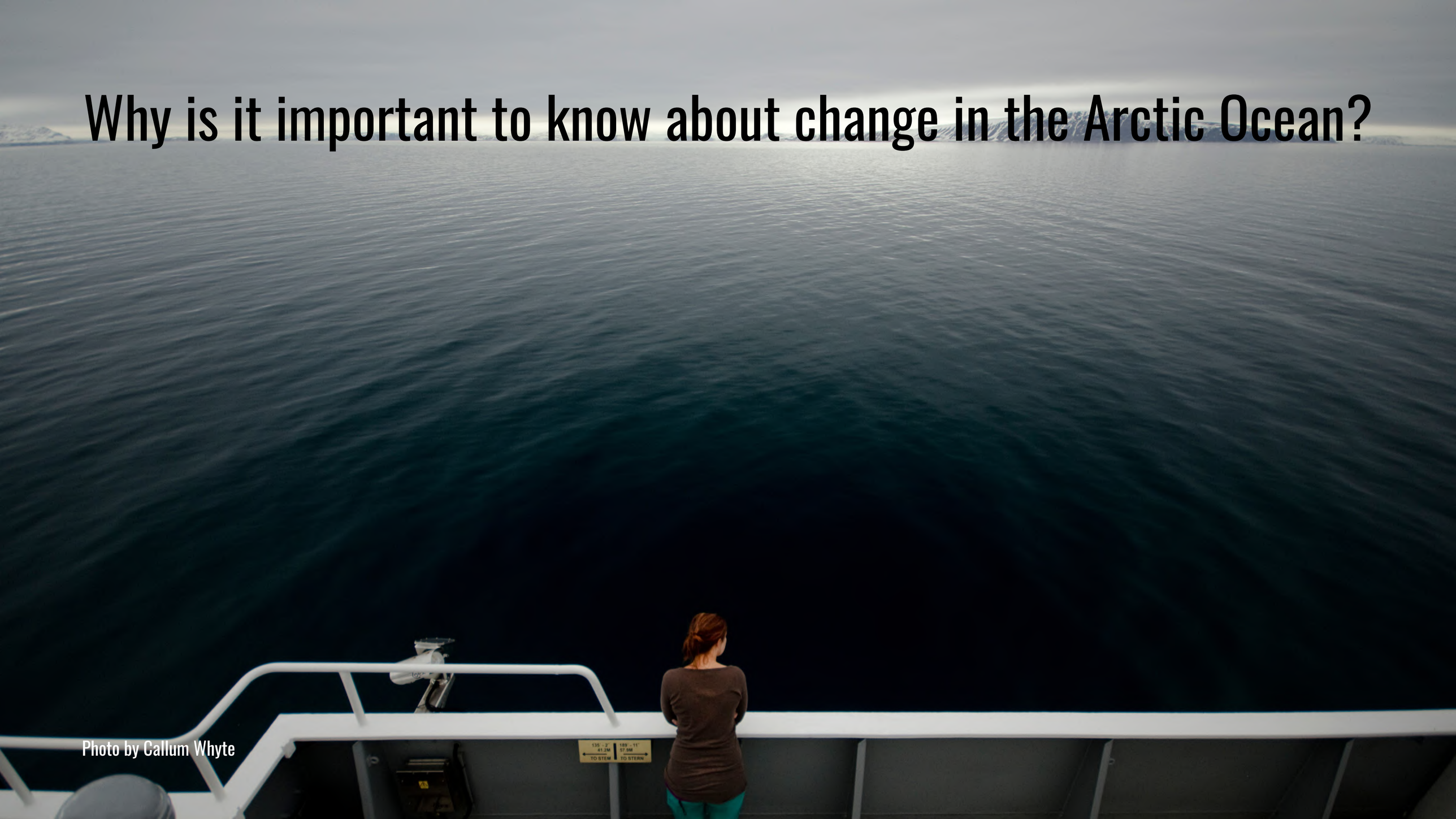
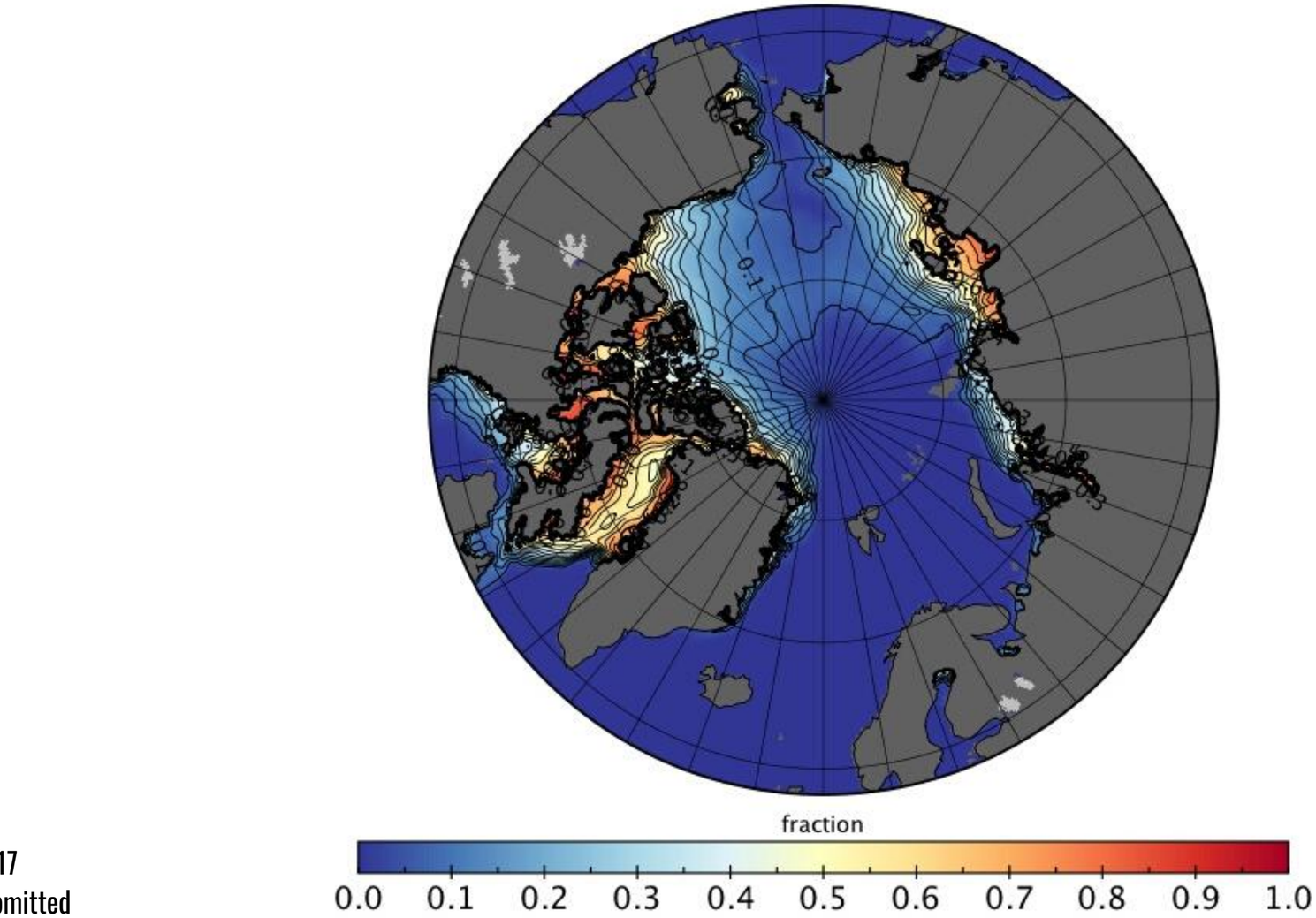


Photo by Callum Whyte

Mean winter (DJF) 2090-2099 sea ice fraction ~ RCP8.5 scenario



Representative Concentration Pathway 8.5:

- 8.5 Wm2 in 2100
- 1370 ppm CO2 equivalent
- 4.9 °C temperature anomaly

Aksenov et al., 2017
Aksenov et al., submitted

Changing Arctic Ocean

Photo by Jen Freer

Implications for marine biology and biogeochemistry

Understanding and quantifying the impacts of climate change on Arctic ecosystems and their global consequences

Changing Arctic Ocean NERC

£20 million research

5-year programme
2017-2022

SPONSORED BY THE

Federal Ministry of Education and Research

UKRI Natural Environment Research Council

Dual national funding
UK and Germany

16 projects
32 research institutions

2 KEY RESEARCH CHALLENGES

1. A quantified understanding

To develop a quantified understanding of the structure and functioning of Arctic ecosystems

2. Sensitivity to change and future projections

To understand the sensitivity of Arctic ecosystem structure, functioning and services to multiple stressors, and the development of projections of the impacts of change

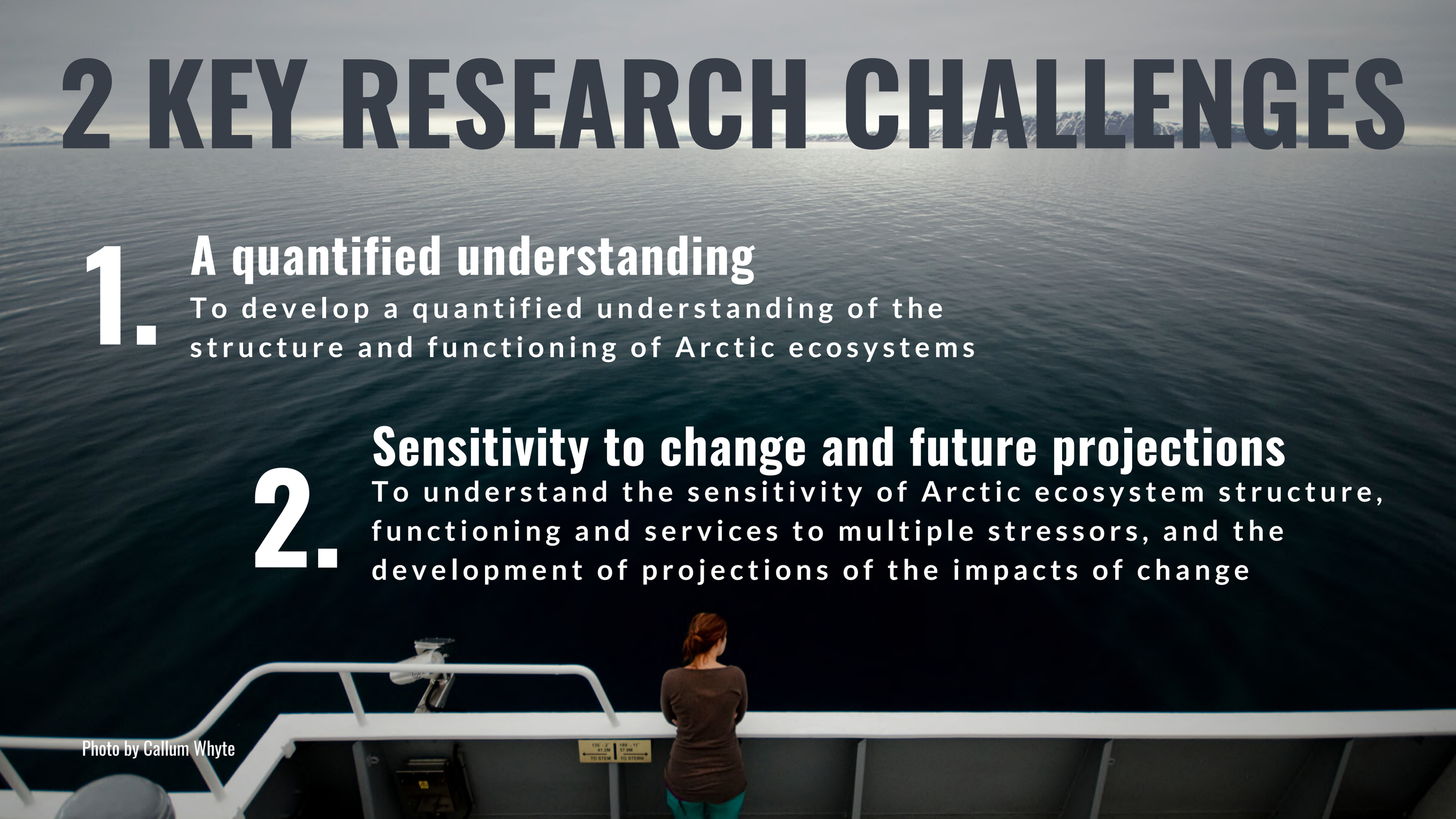


Photo by Callum Whyte

Changing Arctic Ocean NERC

4 LARGE PROJECTS

2017 - 2021

Arctic PRIZE

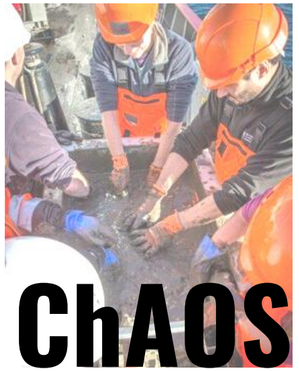
How does seasonal sea ice control Arctic productivity?

Prof Finlo Cottier

ARISE

Can we detect changes in Arctic ecosystems?

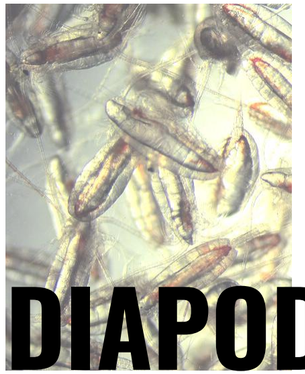
Prof Claire Mahaffey



ChAOS

How do changes in the surface ocean affect seafloor processes?

Dr Christian Maerz



DIAPOD

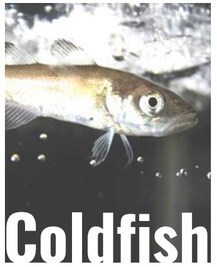
How does Arctic change affect Calanus, a key Arctic species?

Prof David Pond

Changing Arctic Ocean NERC

12 NEW PROJECTS

2018-2021

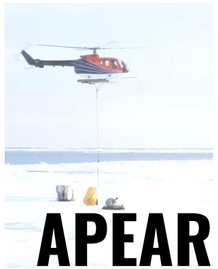


Coldfish

Key Arctic fish response

MiMeMo

Fishery yields

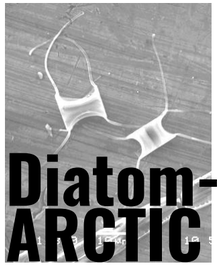


APEAR

Influx of Atlantic and Pacific waters

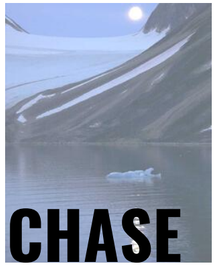
Eco-Light

Under-ice light field



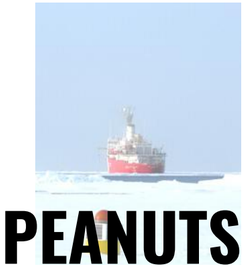
Diatom-ARCTIC

Sea-ice algae



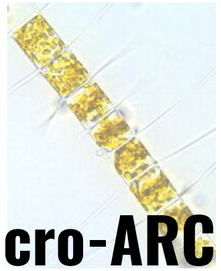
CHASE

Biological clock



PEANUTS

Ocean circulation and nutrients

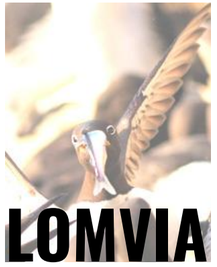


Micro-ARC

Pelagic microbial ecosystem

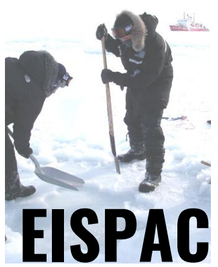
CACOON

Permafrost thaw



LOMVIA

Ecosystem competition



EISPAC

Contaminant cycling

PETRA

Climate-active gases

INTERNATIONAL COLLABORATION

SPONSORED BY THE

Federal Ministry of Education and Research

UKRI Natural Environment Research Council

>200 investigators at 32 research organisations

Collaboration with scientists in 15 other countries

Collaboration with policy makers

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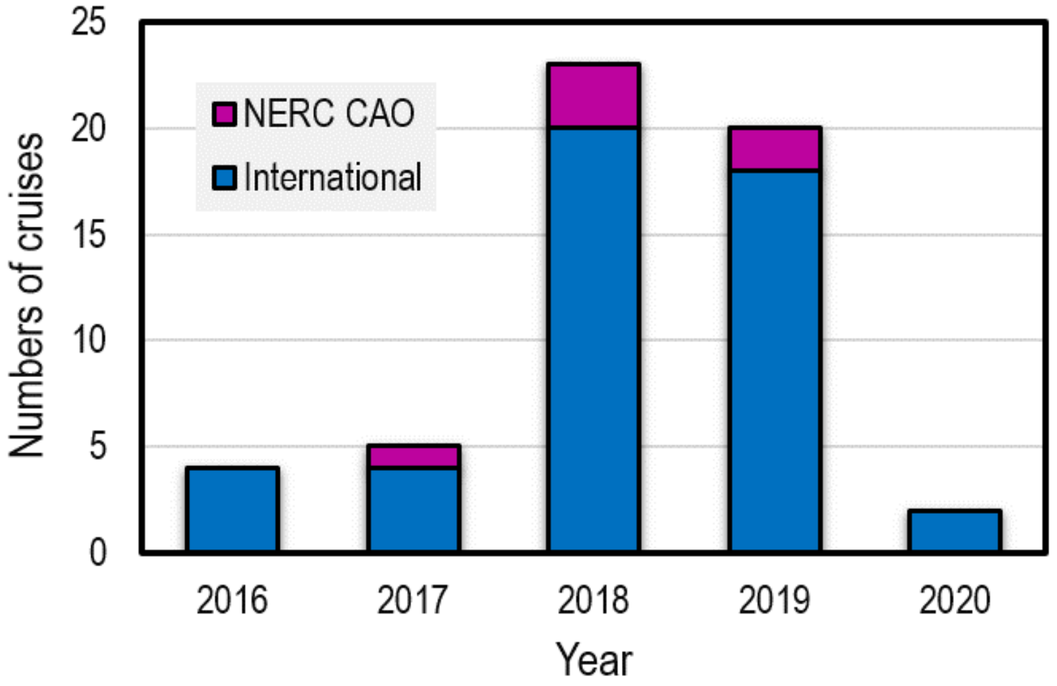

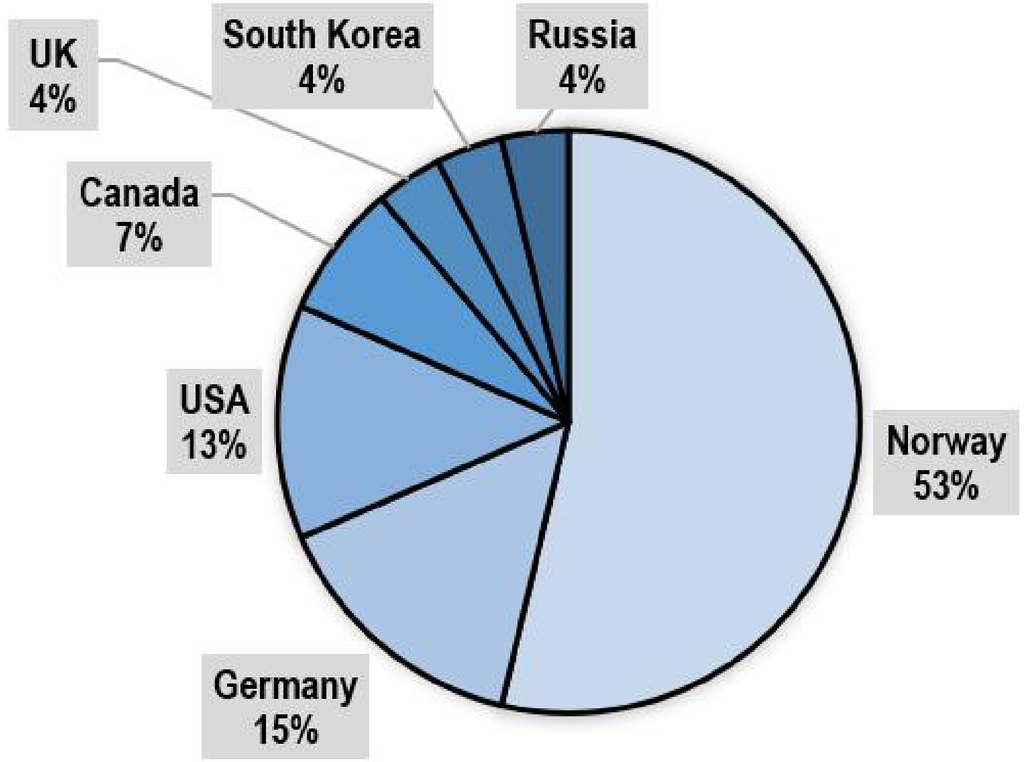

Climate change impacts on the Arctic Ocean

Environmental, Economic, Societal

Primary and secondary productivity
Ecosystem response to warming
Impact on fishery yields
Effects of species competition
Large-scale changes in ocean circulation
Sequestration of carbon
Cycling of contaminants

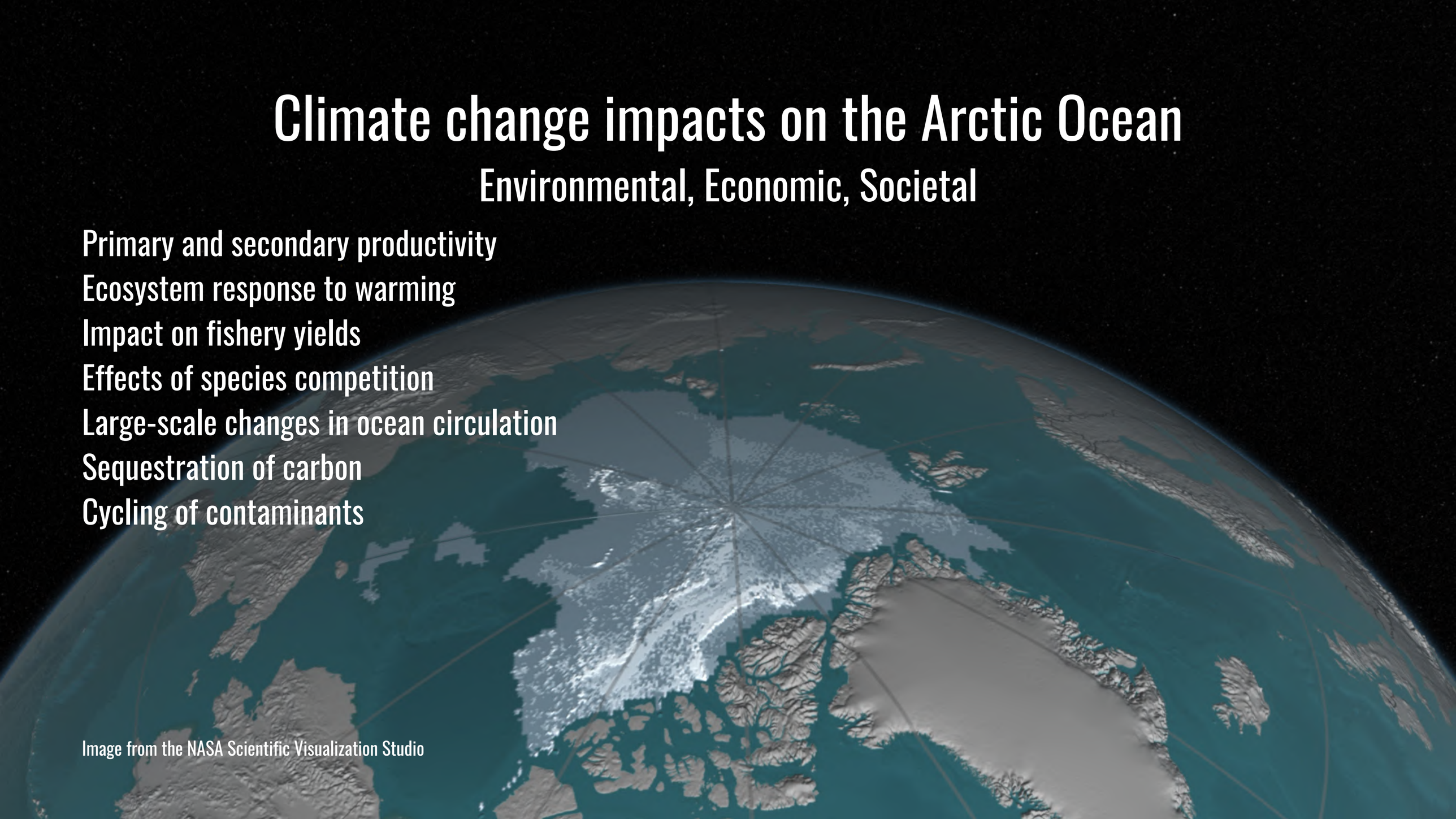

Image from the NASA Scientific Visualization Studio

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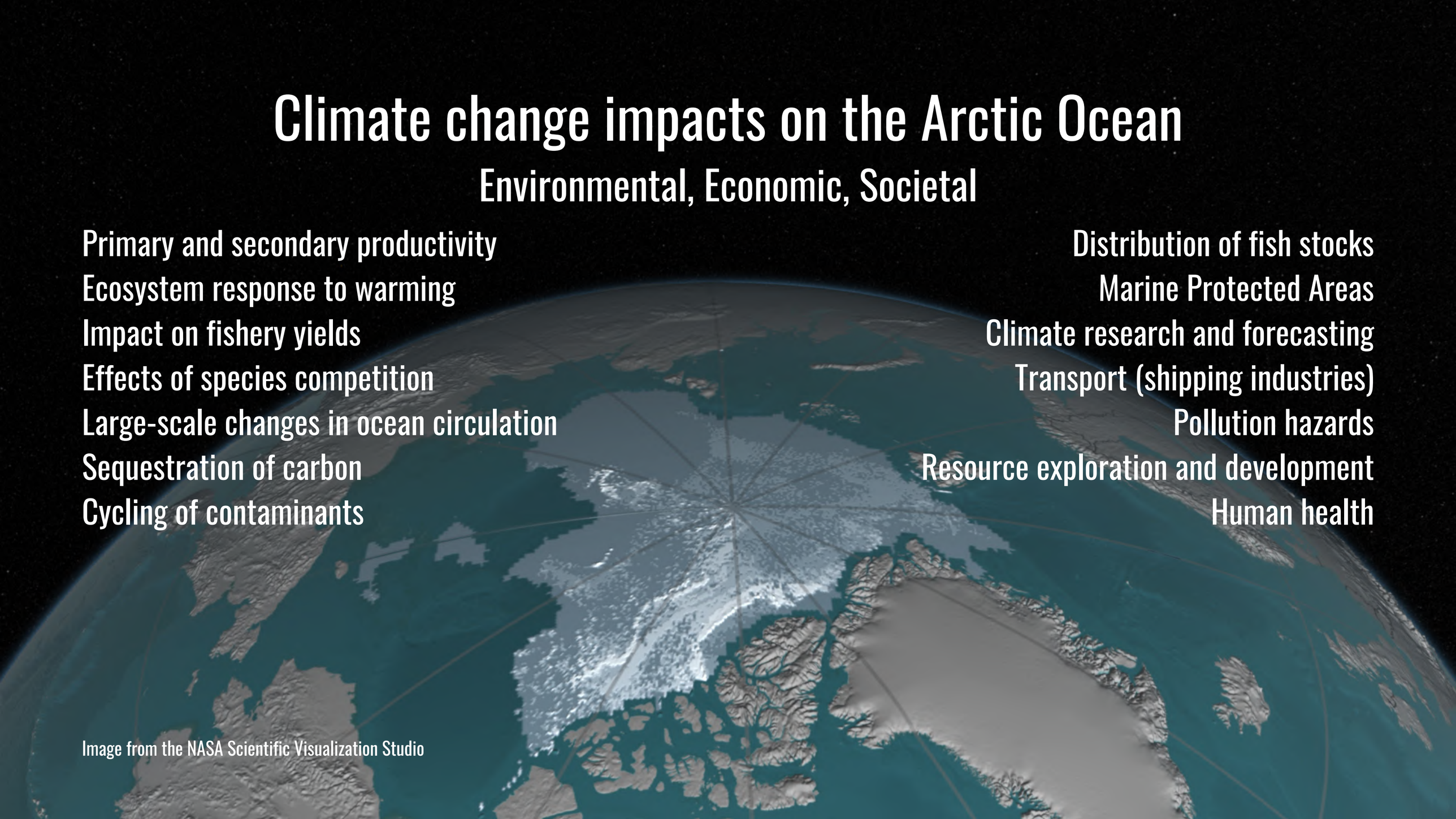
Distribution of fish stocks
Marine Protected Areas
Climate research and forecasting
Transport (shipping industries)
Pollution hazards
Resource exploration and development
Human health



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Existing and new connections to the international Arctic community

Membership of international expert groups

Direct information exchange with policy stakeholders

Distribution of fish stocks
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Human health

- **Programme-level policy orientation briefing session in late 2020**

Image from the NASA Scientific Visualization Studio

TIME FOR ACTION

COP25
CHILE
MADRID 2019
UN CLIMATE CHANGE CONFERENCE

SIDE EVENT

FRIDAY 6 DECEMBER 2019, 10:00-11:30

CRYOSPHERE PAVILION, BLUE ZONE (HALL 8 ~ LEVEL 0)

ARKTIS IM WANDEL

Changing Arctic Ocean

Evidence of Change, Global Implications, Policy Response

Welcome by Dr Kirsty Crocket, University of Edinburgh, UK

Tim Eder, Federal Ministry of Education and Research, Germany

Mr Bo Storrank, Senior Specialist, Nordic Working Group for Climate and Air, Ministry of the Environment, Finland

Dr Martin Sommerkorn, Coordinating Lead Author of Chapter 3 SROCC, IPCC, and Head of Conservation, WWF Arctic Programme

Dr Carol Turley OBE, Plymouth Marine Laboratory, UK

Dr Yevgeny Aksenov, National Oceanography Centre, UK

Dr Jack Landy, University of Bristol, UK

Dr Geoffrey Abbott, Newcastle University, UK

Q&A/Panel Discussion

Changing Arctic Ocean NERC

Dr Kirsty Crocket
Science Coordinator
University of Edinburgh

k.crocket@ed.ac.uk

www.changing-arctic-ocean.ac.uk

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@nerc_cao

Photo by Johan Faust

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