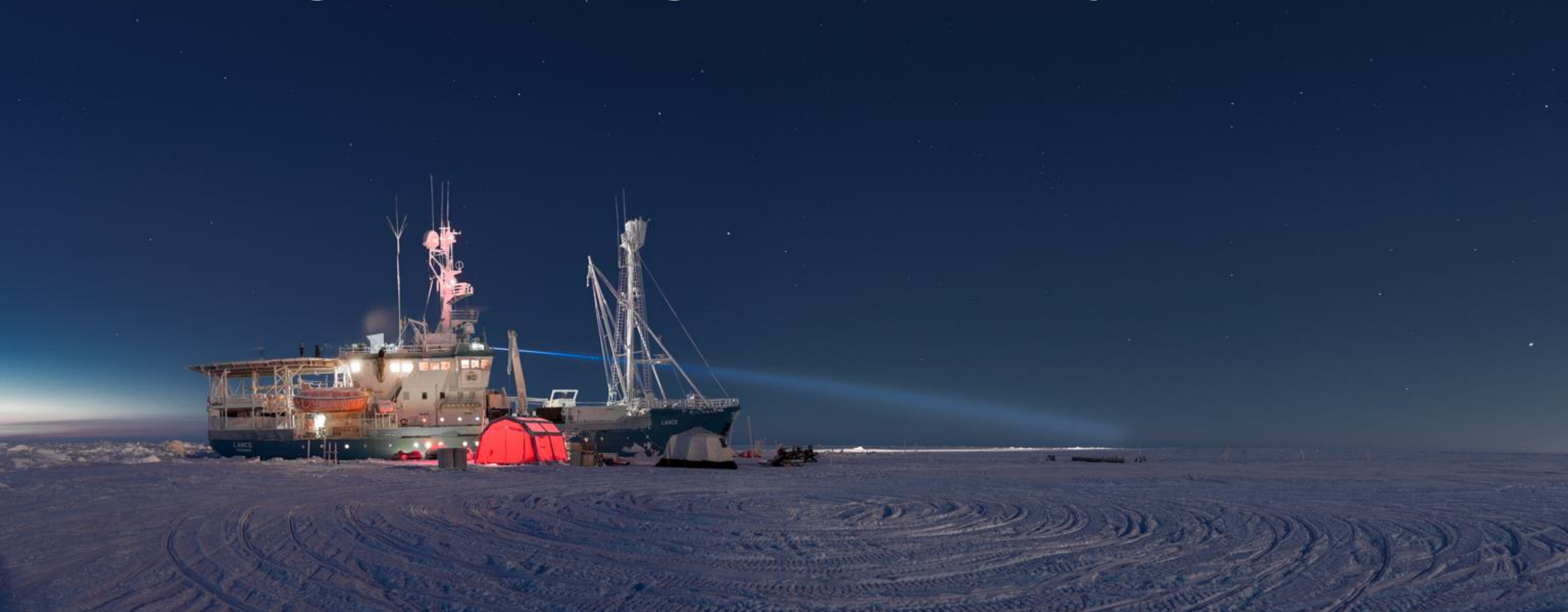
NORWEGIAN YOUNG SEA ICE CRUISE

N-ICE2015

[Photo: Paul Dodd, N-ICE2015]

Changing Arctic sea-ice regime: regional and global consequences



Nalan Koc

Research Director, Norwegian Polar Institute

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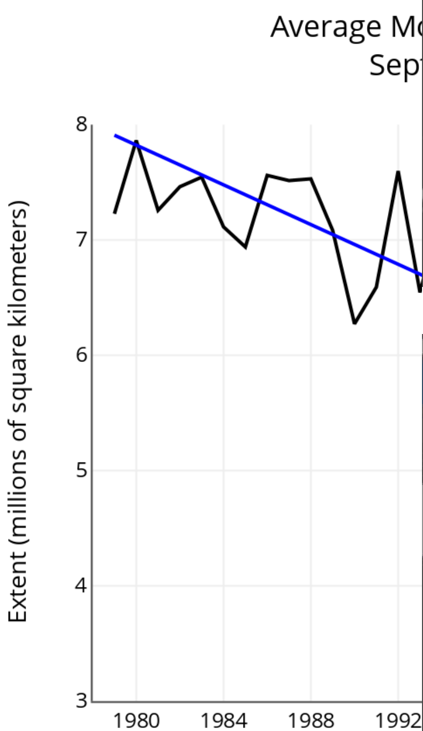
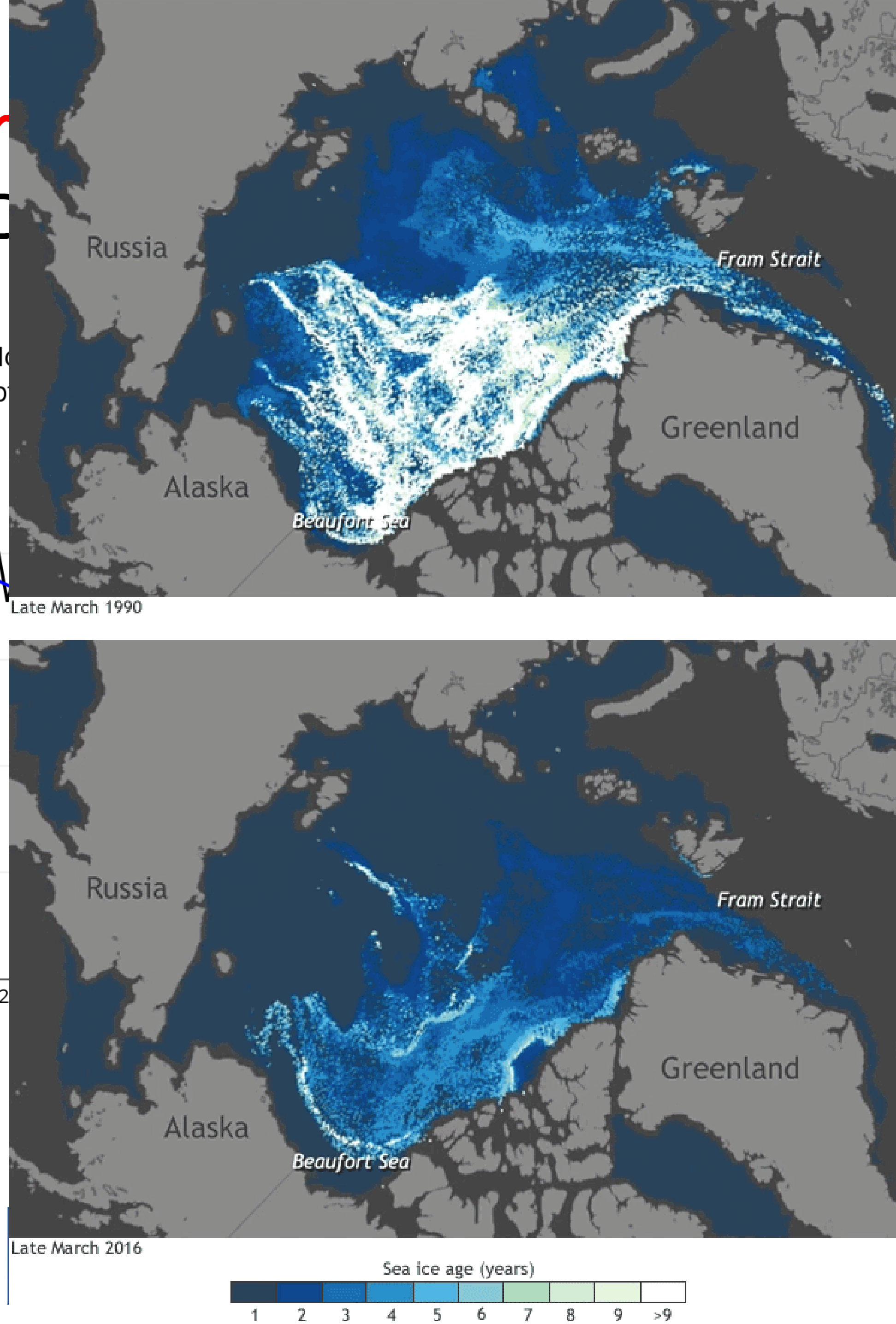
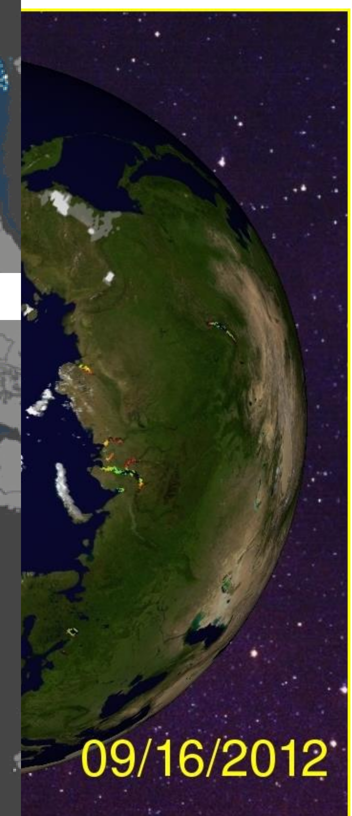


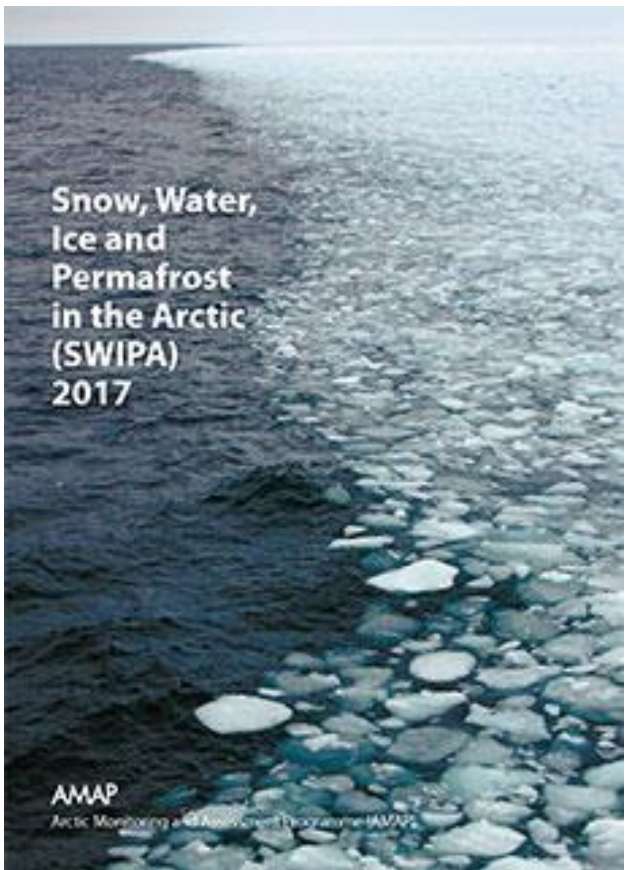


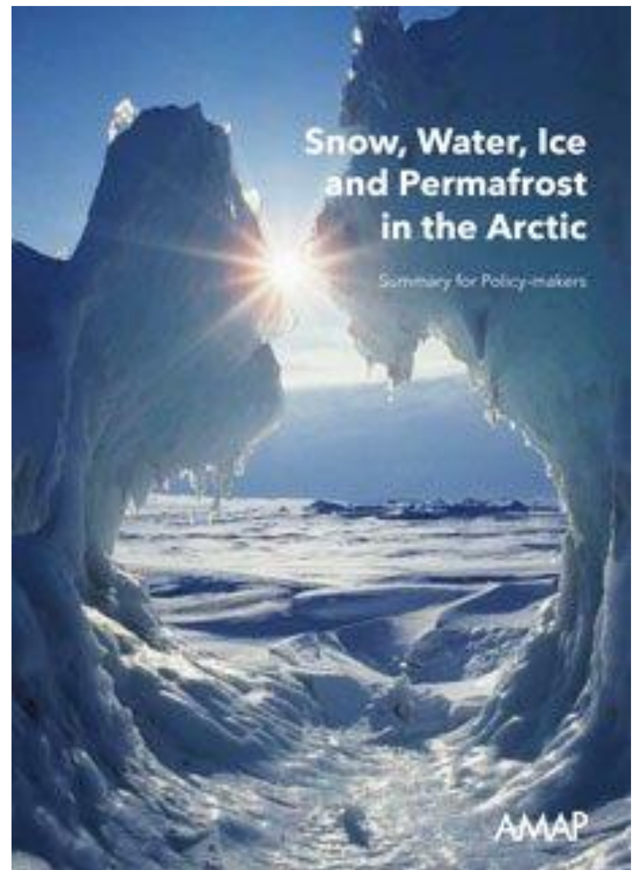


CENTRE FOR ICE, CLIMATE AND ECOSYSTEMS

Snow, Water, Ice and Permafrost in the Arctic (SWIPA)

assessment coordinated by AMAP and produced in collaboration with IASC, WMO/Clic and IASSA





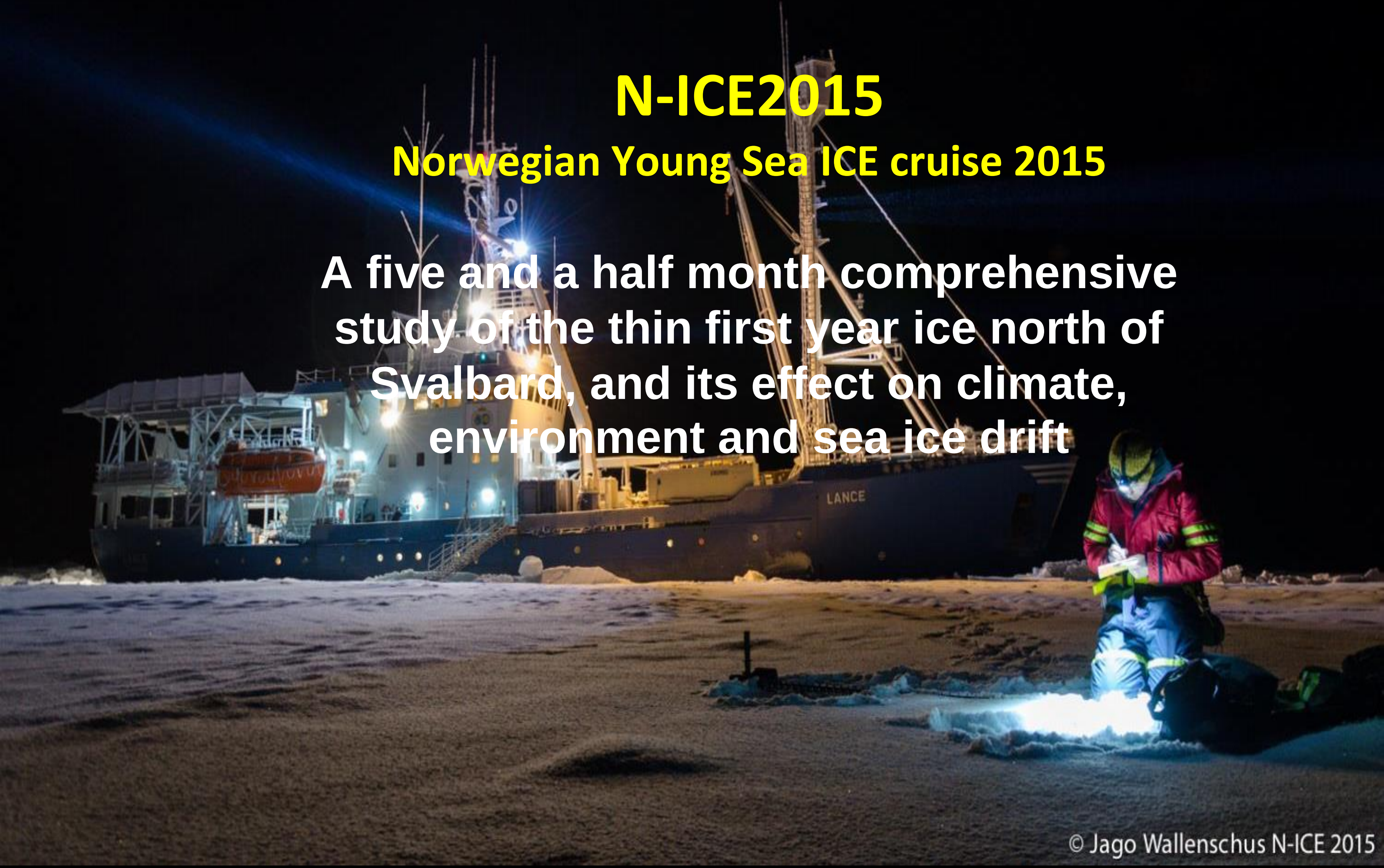
Questions

- What melts the ice? Warm Atlantic water or solar heat?
- How does the thinner ice respond to atmospheric forcing, such as storms?
- How does thinner ice affect ice dynamics, and how can we improve ice drift models?
- What are the effects of the changed sea ice system on the ice-associated ecosystem?
- What are the effects on local and global weather systems?
- Contribute to improved computer models to predict future conditions more accurately.

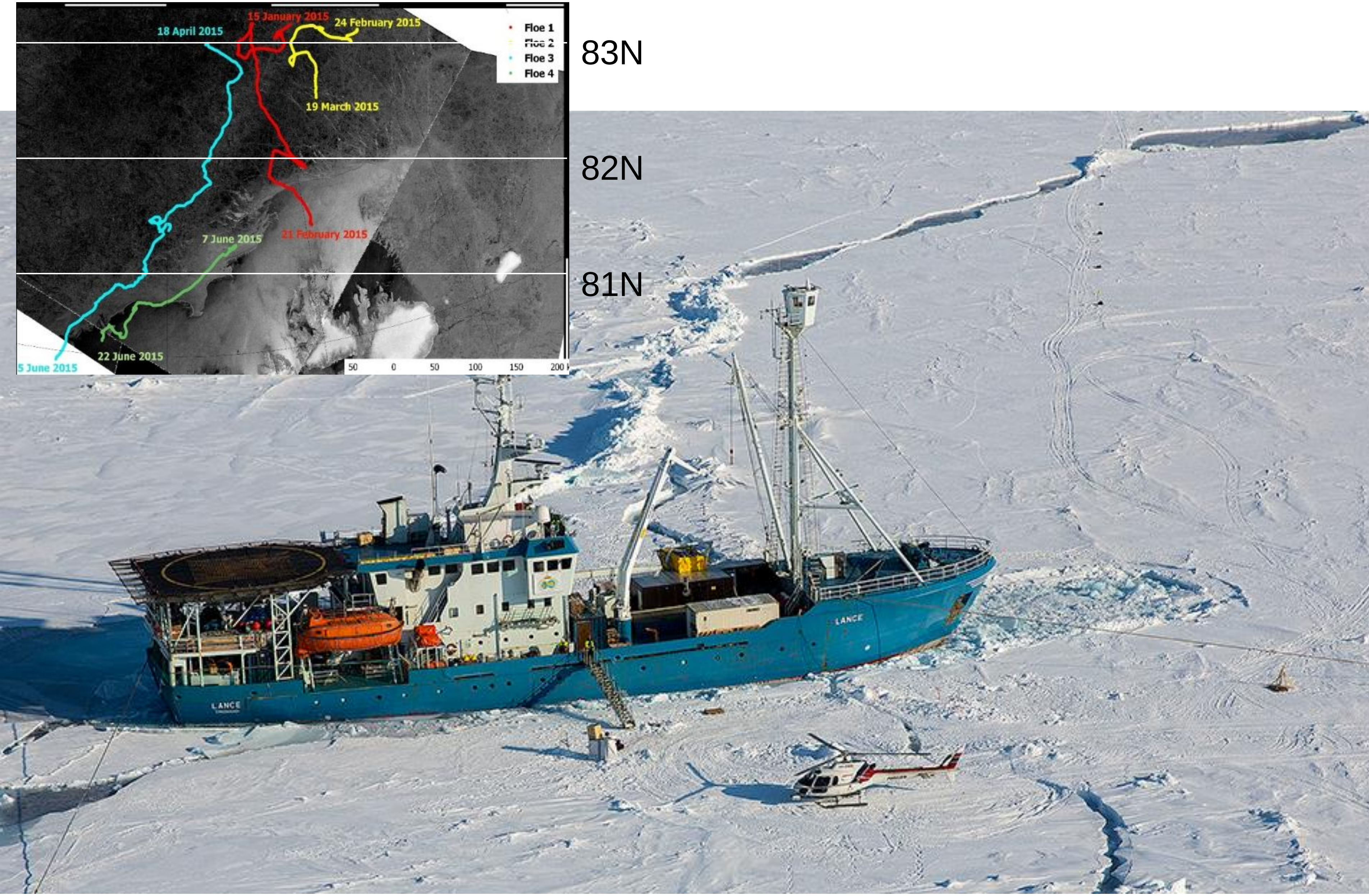
N-ICE2015

Norwegian Young Sea ICE cruise 2015

A five and a half month comprehensive study of the thin first year ice north of Svalbard, and its effect on climate, environment and sea ice drift



Arctic atmosphere-ocean-ice-eco-system interactions in the new thinner ice era: the N-ICE2015 drift ice expedition



CENTRE FOR ICE, CLIMATE AND ECOSYSTEMS

N-ICE 2015
NORWEGIAN YOUNG SEA ICE CRUISE

Participants


03.26.15

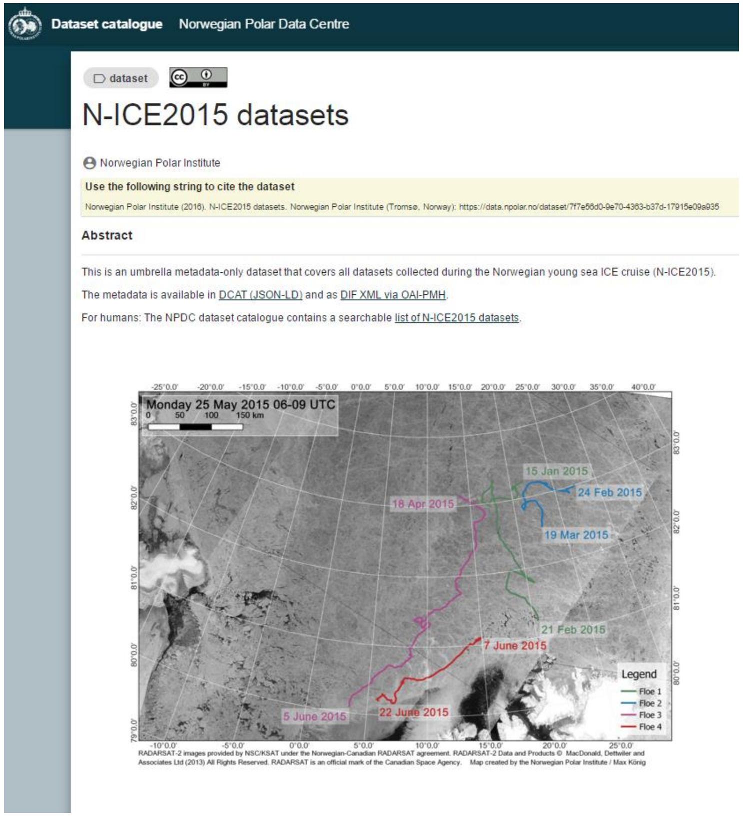
IceBridge Overflies Norwegian Camp On Drifting Sea Ice

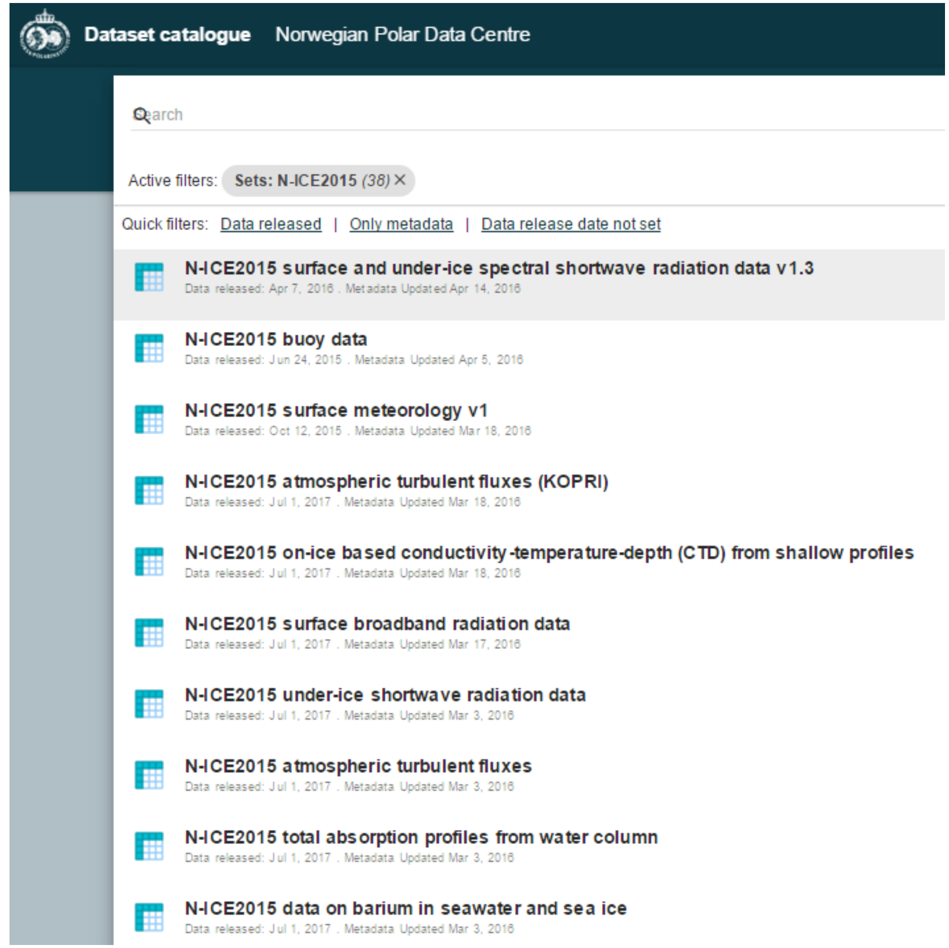
Studying sea ice in the Fram Strait, a passage between Greenland and Svalbard that is the main gateway for Arctic sea ice into the open ocean, is not easy. In this area, not only does ice flow southward quickly – at the same time, warmer ocean waters melt and thin it from below, making it easier for waves to break the ice into smaller floes. This dynamic, unstable environment makes it hard for scientists to set camps on the

The Norwegian research vessel R/V Lance as captured by the Digital Mapping System during an Operation IceBridge flight on March 19, 2015. IceBridge flew

UIT	SFI - Centre for Integrated Remote Sensing and Forecasting for Arctic Operations (CIRFA) and CAGE-Centre for Arctic Gas Hydrate, Environment and Climate
UIB	GFI (internal waves, post doc. and equipment),
NTNU	AMOS, SamCOT ice ridges
MET.NO	Ice dynamics
iAOOS	2 autonomous buoys , CTD, ice parameters and LIDAR
AWI	Radiosondes and receiving eq., PhD student
KOPRI	Radiosondes, EC system
ICE-ARC BAS/EU	10 IMB / GPS buoys, 1 week Dash 7
BAS	Atmospheric chemistry
FMI	Digitizing radar to measure with high resolution ice movement and deformations– ice stress buoy, 2 IMB buoys
FEI	Macro molecules deposited in bacteria
AARI	UAV upper atmosphere measurements and high resolution images of sea ice.
CIRA (ColoState)	Snow modeling
NORUT	CICCI3 (UAV campaign)
Hokkaido Univ	CO2 in flux in sea ice
Washington State univ	Cloud-radiation interactions (lidar)
U. of Manitoba	ROV, radiation-biology interaction
DMI / MET.NO	Ice and snow surface teperature
	Sysselmannen on Svalbard, Lufttransport, Longyearbyen red cross

The legacy:
Articles and datasets





Data sets

https://data.npolar.no/dataset/?filter-sets=N-ICE2015

Main findings

Unexpected thick snow cover

The thick snow cover slowed sea ice growth.

New and growing ice formed in the leads with little snow

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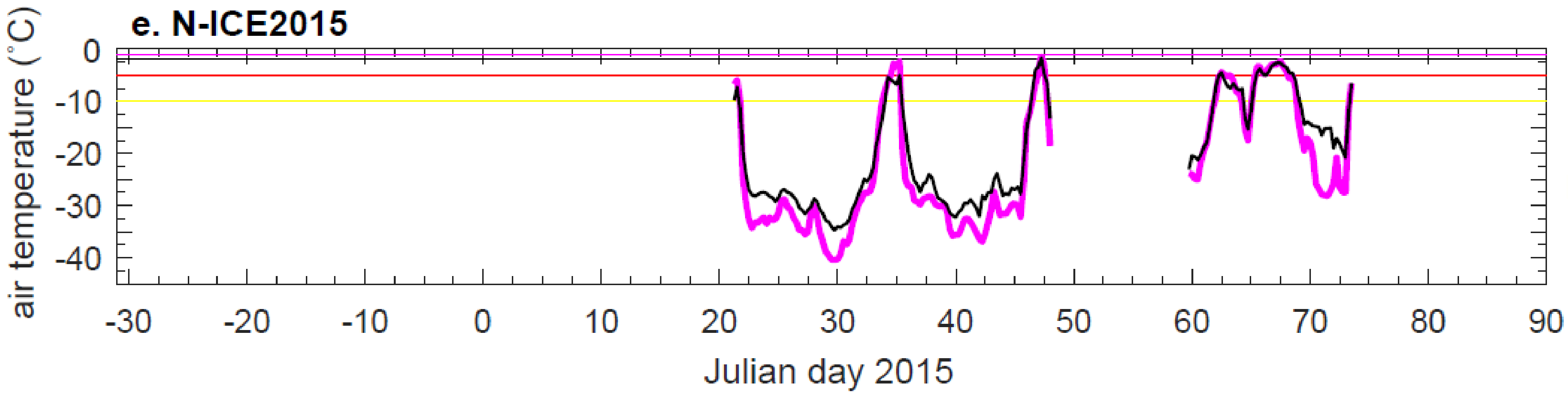
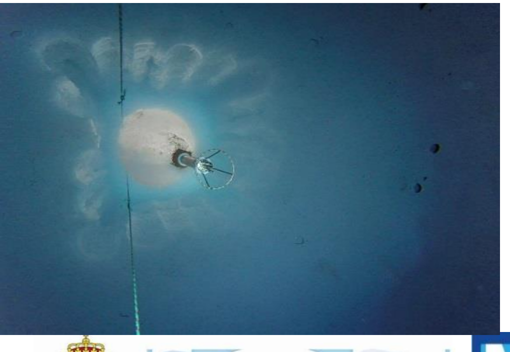
Storms observed during N-ICE2015



Many storms took place, especially in winter. These brought with them warm and moist air, even in the middle of the polar night, also slowing ice growth.

Ocean heat flux increased twofold during storms

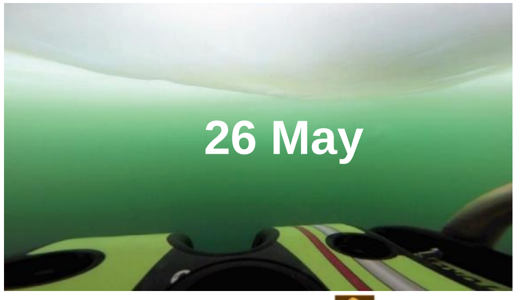
- Wind forcing increases turbulent dissipation seven times in the upper 50 m, and doubles heat fluxes at the ice-ocean interface.
- Presence of warm Atlantic Water close to the surface increases the temperature gradient in the water column, leading to enhanced heat flux rates within the pycnocline.
- Steep topography consistently enhances dissipation rates by a factor of four and episodically increases heat flux at depth.
- It is, however, the combination of storms and shallow Atlantic Water that leads to the highest heat flux rates observed: Ice-ocean interface heat fluxes average 100Wm−2 during peak events and are associated with rapid basal sea ice melt, reaching 25 cm, day−1.



(Meyer et al, 2017)

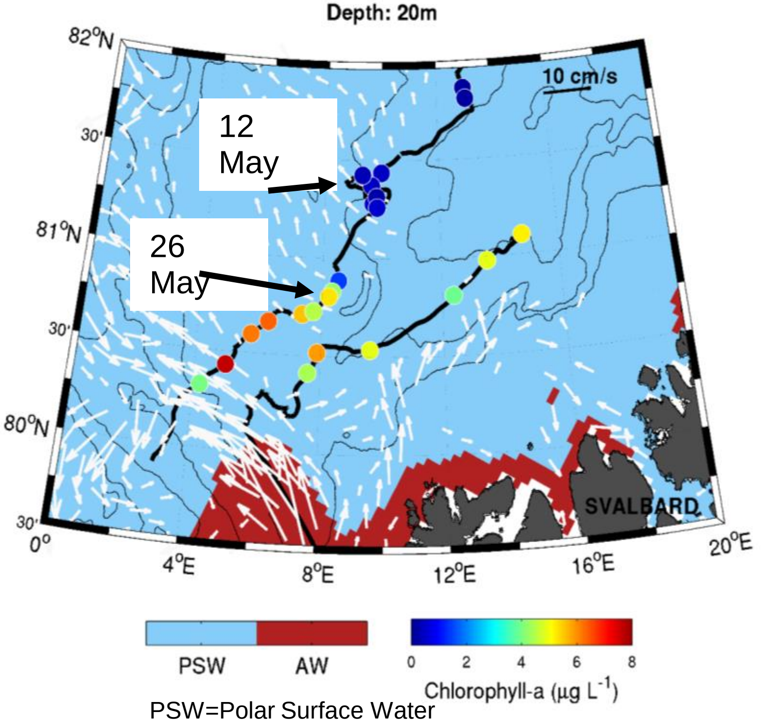
The thinner sea ice was more easily broken up and we saw more ridging and lead formation than previously

Leads in Arctic pack ice enable early phytoplankton blooms below snow-covered sea ice



CJ Mundy

University of Manitoba



PSW=Polar Surface Water
AW=Atlantic Water

Light transmission through leads enabled the under-ice bloom development despite the thick snow cover

Assmy et al. 2017, *Scientific Reports*

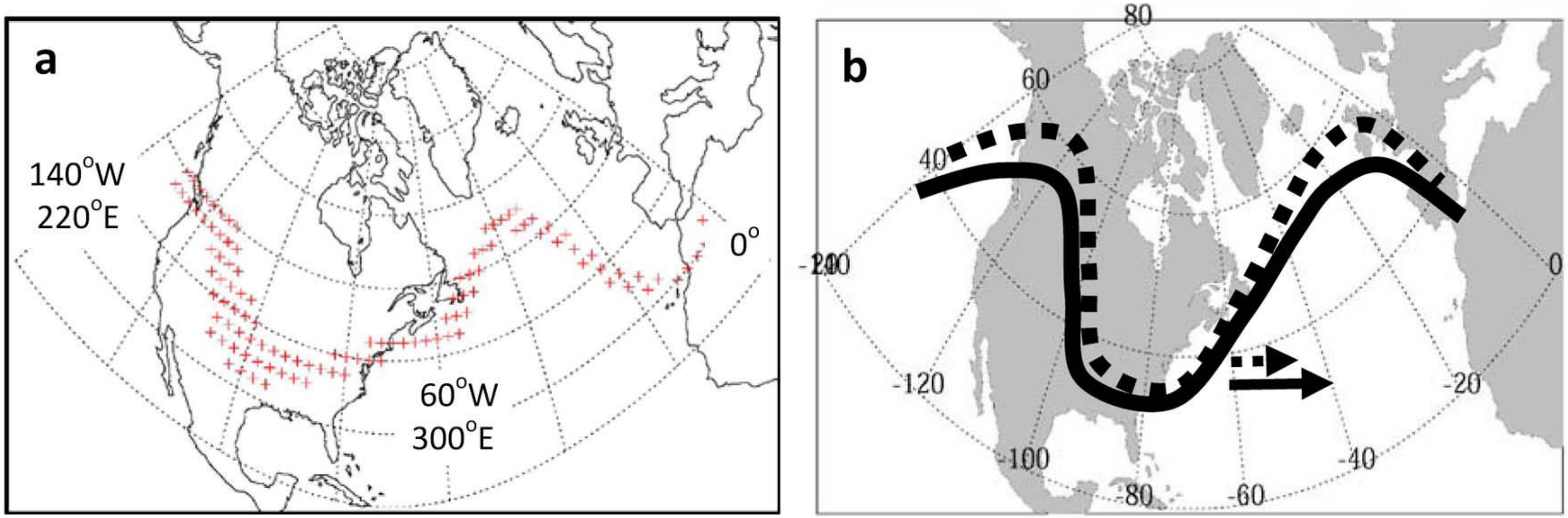
Main findings

- Unexpected thick snow cover
- The thick snow cover slowed sea ice growth. New and growing ice formed in the leads with littles snow.
- We observed an increased amount of stoms bringing warm moist air into the Arctic
- The storms caused vertical doubling in heat flux and CO_2 were mixed throughout the upper water column.
- The thinner sea ice was more easily broken up.
- Leads caused by storms allowed enough light to reach the water, sufficient to initiate and maintain an algae bloom under thick snow-covered ice.
- The heavy snow load resulted in seawater infiltration at the snow–ice interface. This provided a habitat that supported ample algae growth, resembling conditions in the Antarctic sea ice zone.

Photo A Rösel

Warmer Arctic is changing N-hem weather patterns

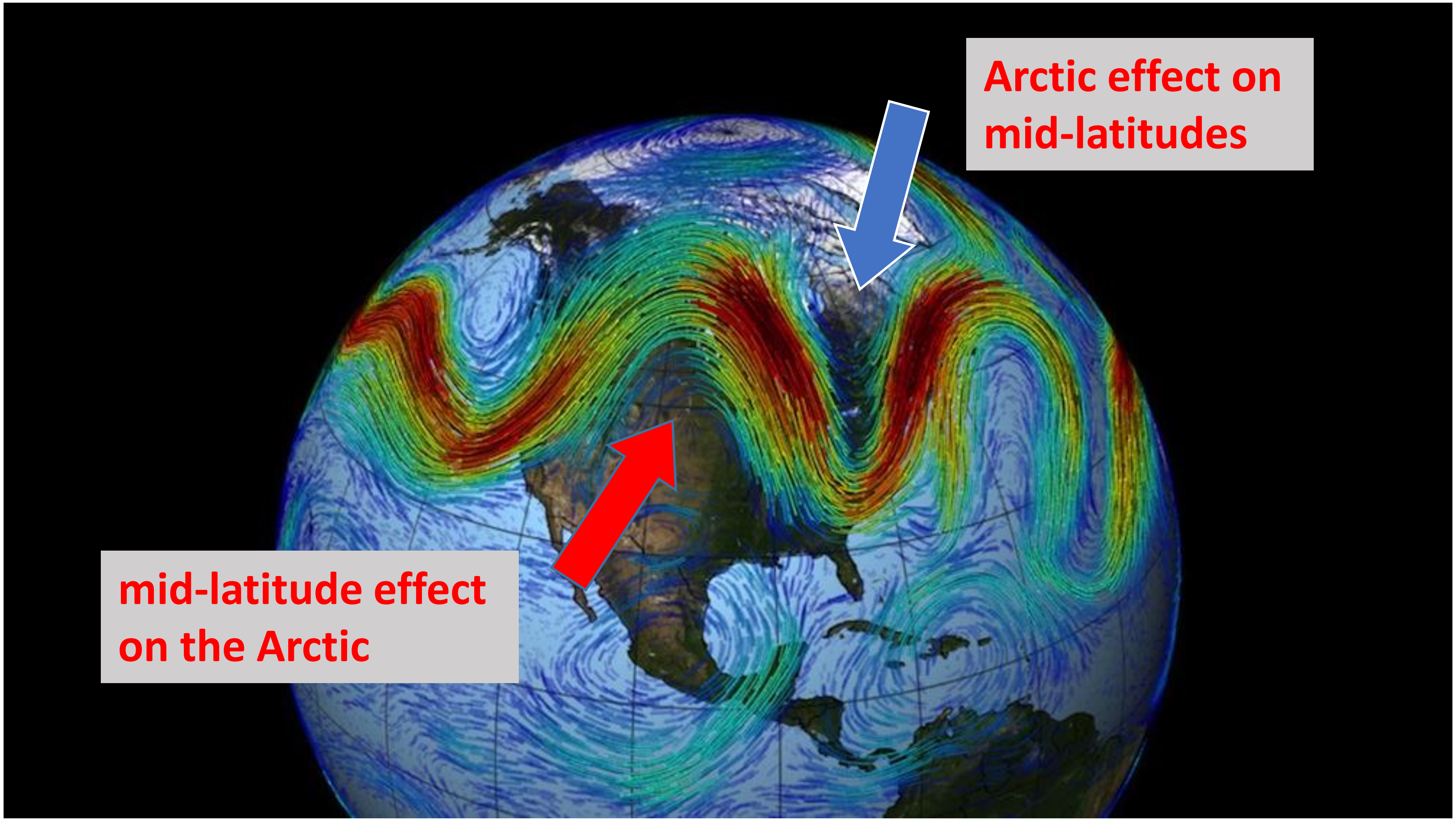
Temp.gradient between mid.latitudes and the Arctic weakens



- Influences the route and speed of the jet stream (”waivier”)
  - Causes slower flow of weather systems which increase the probability for long-lasting extreme events
  - Changes distribution of temp. and precipitation patterns

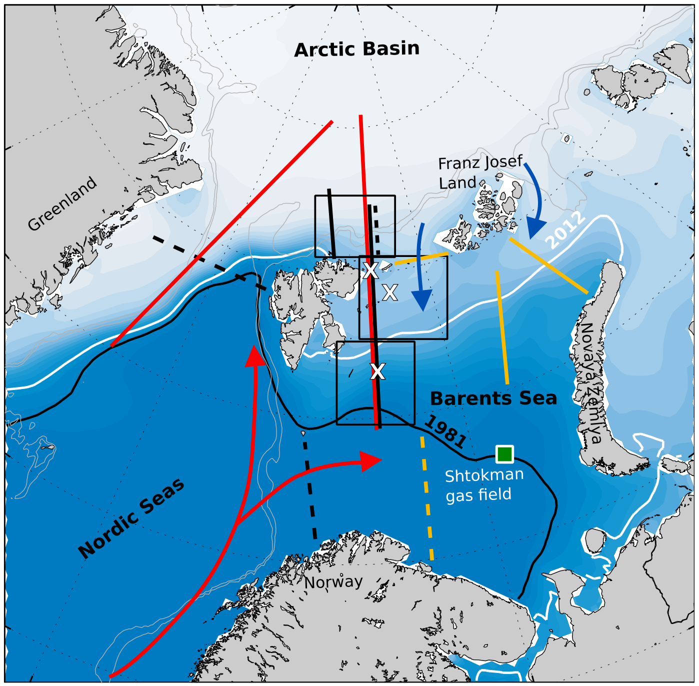
(Francis & Vavrus, 2012)

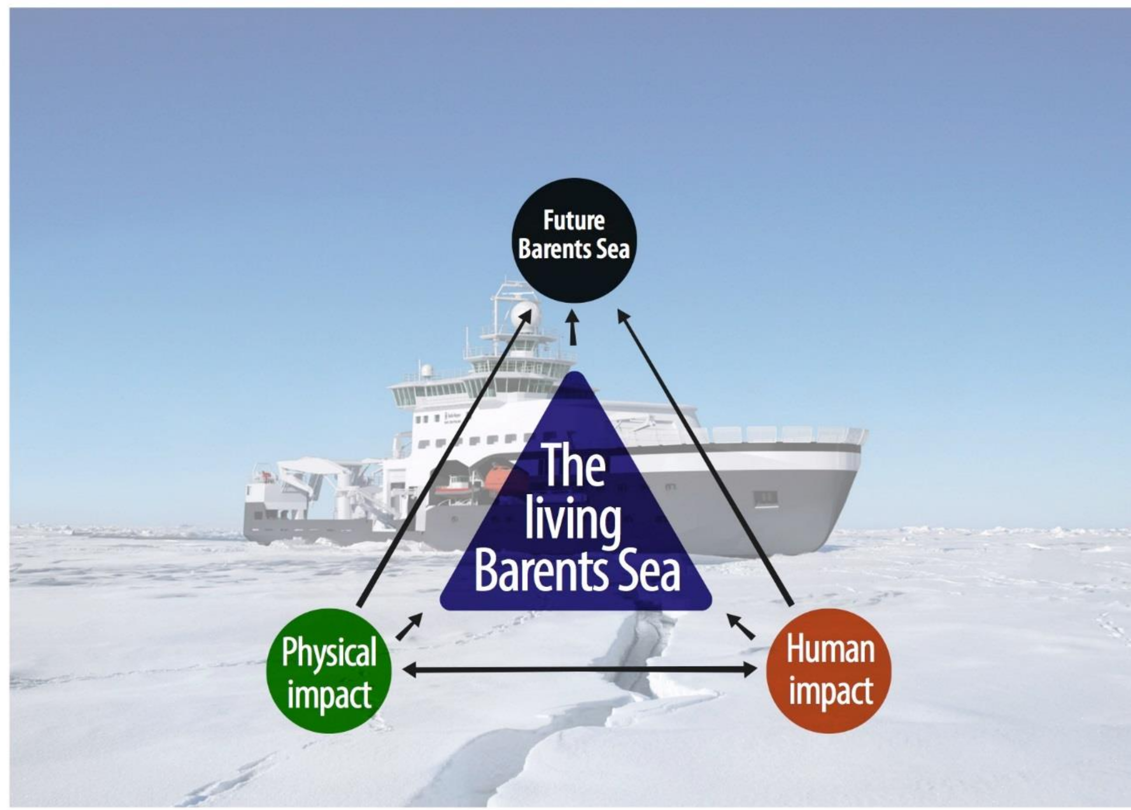
Warmer Arctic is changing N-hem weather patterns



Kronprins Haakon

the Nansen LEGACY






Thank you