Wilkes Climate Summit: Polar Climate ad Ecosystems Panel

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Wilkes Center for Climate Science and Policy

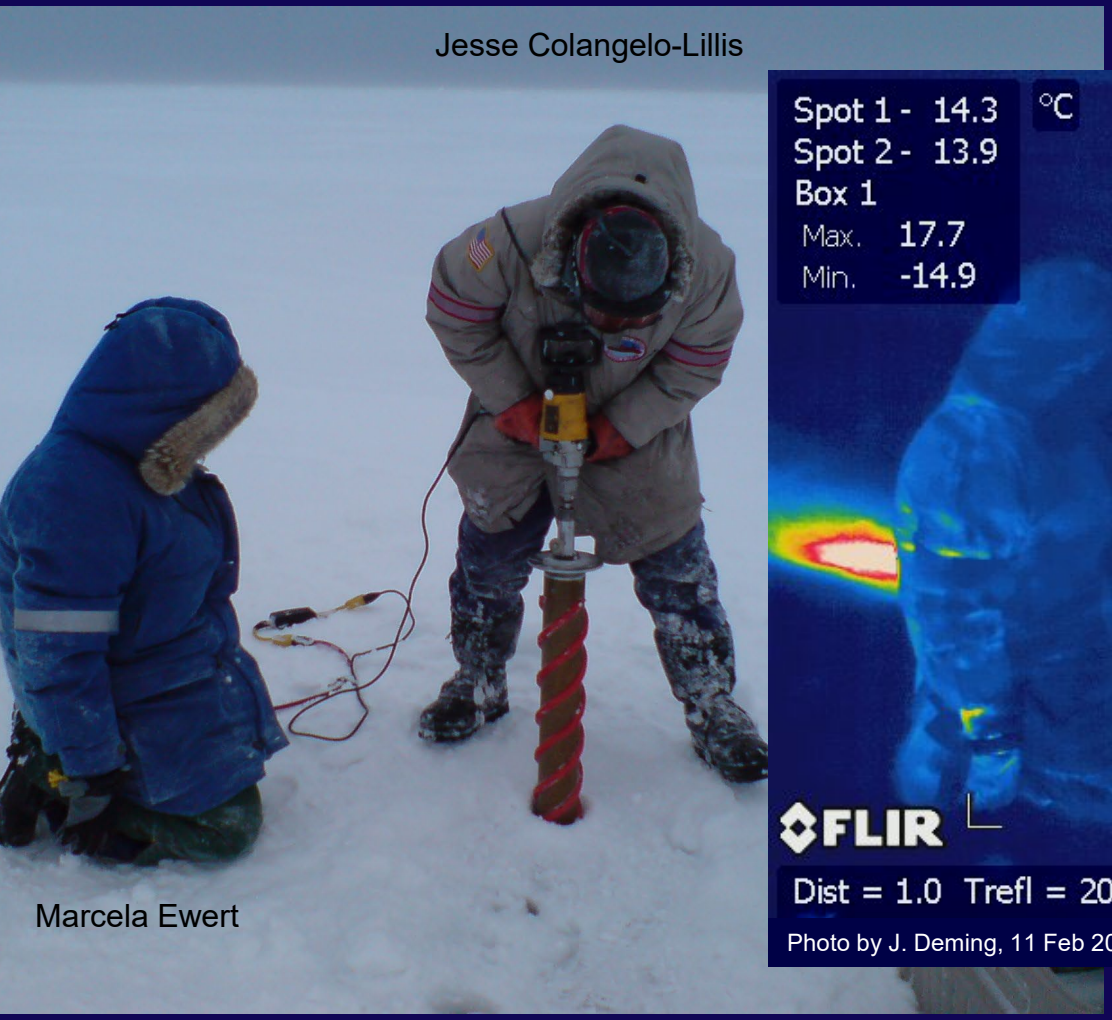
University of Utah, Salt Lake City, UT

Opening comments

Golden et al., 2020

- Microscale habitats within sea ice
- Gas exchange between sea ice and atmosphere
- Mass production of ice-algal biomass in support of the larger ecosystem
- Ecosystem implications of climate-driven thinner ice and snow cover, delayed ice formation, and earlier melting

Coring winter sea ice off Utqiagvik, AK (Feb 2010)



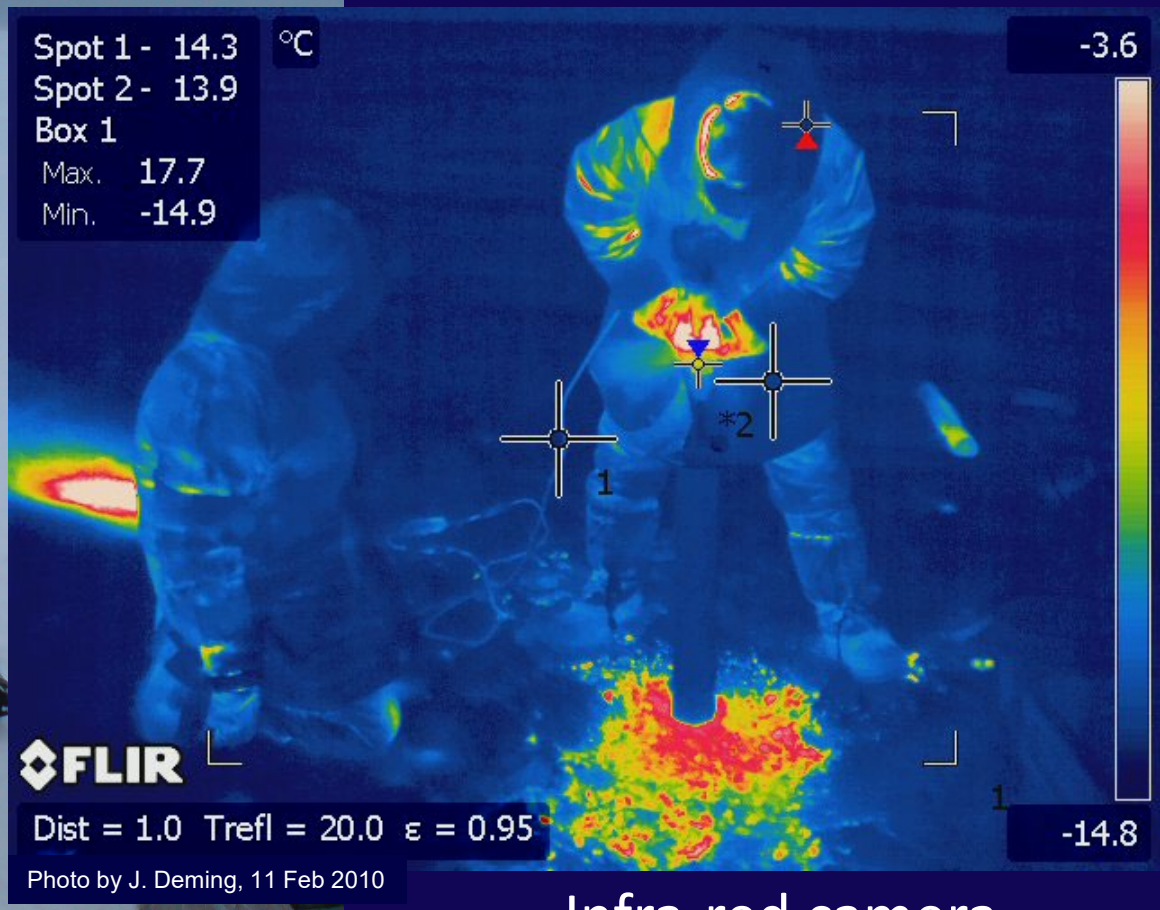
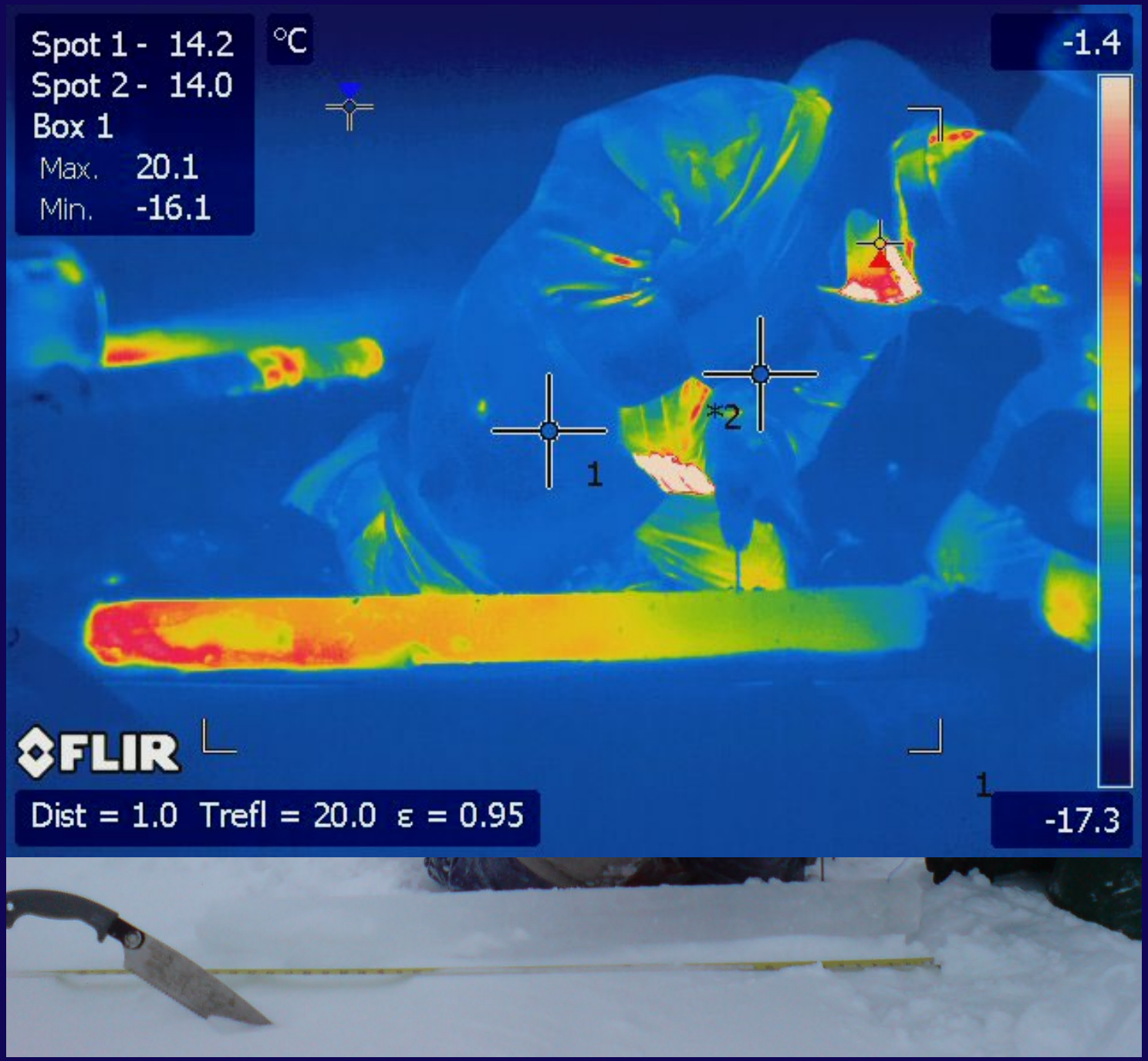
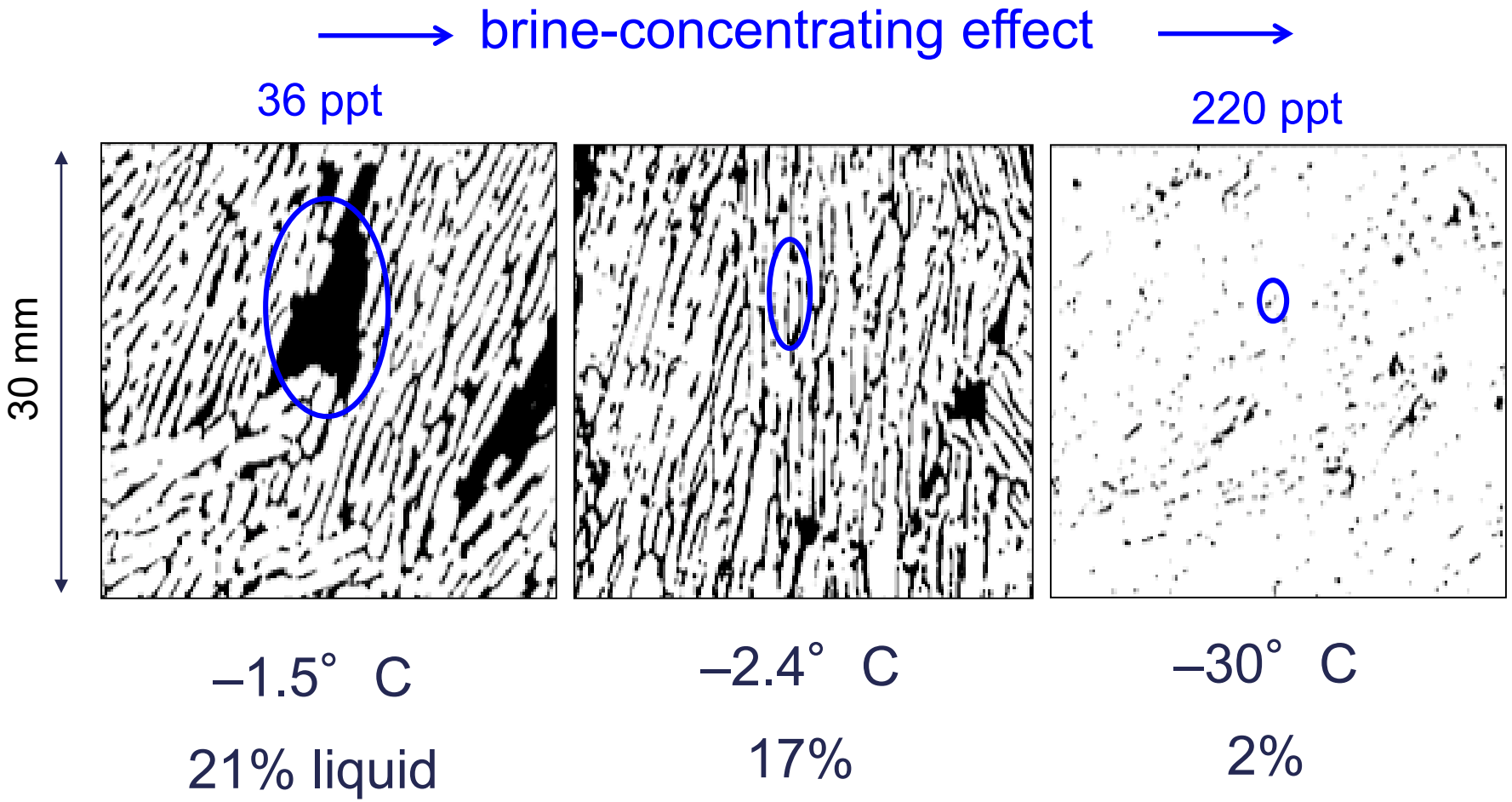


Photo by J. Deming, 11 Feb 2010

Infra-red camera


Spot 1 - 14.2
Spot 2 - 14.0
Box 1
Max. 20.1
Min. -16.1
°C
-1.4
*2
1
FLIR
Dist = 1.0 Trefl = 20.0 ε = 0.95
1
-17.3

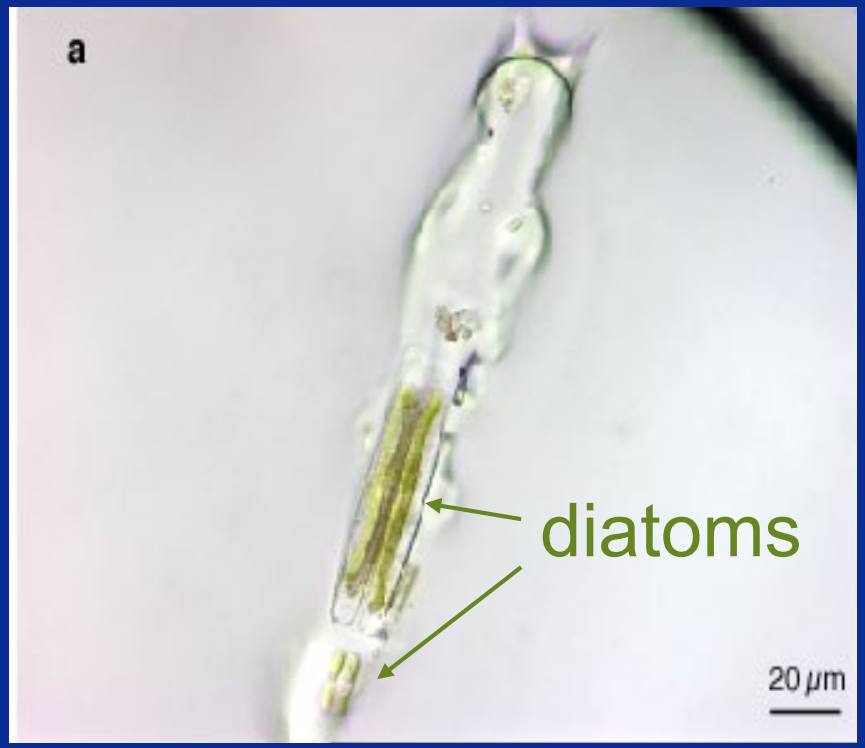
On the small scale: temperature determines sea ice microstructure



Adapted from Eicken et al., 1999

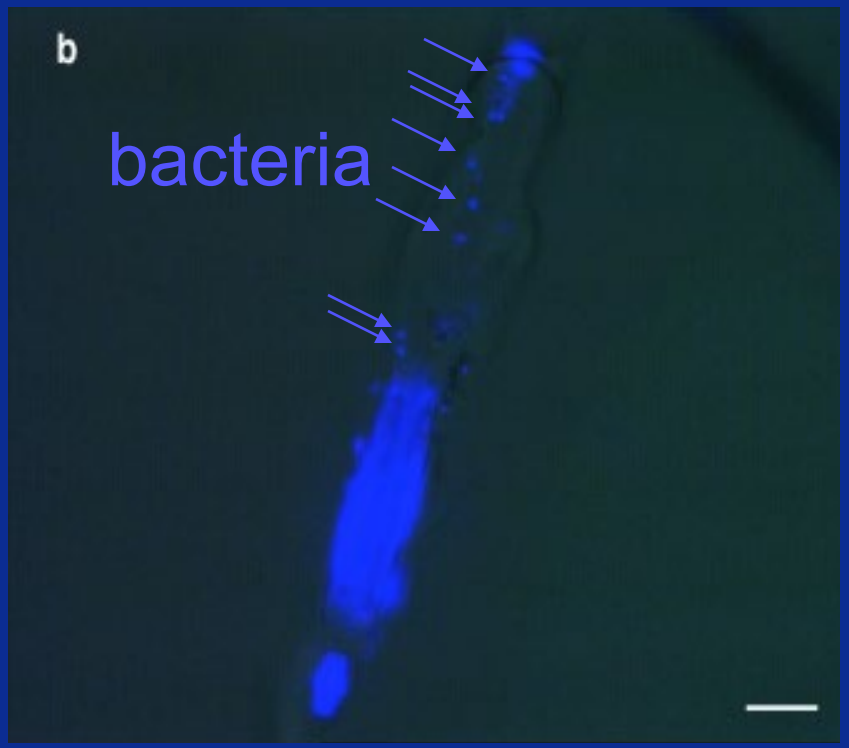
Transmitted light

No stain



Epifluorescent light

Stained for DNA

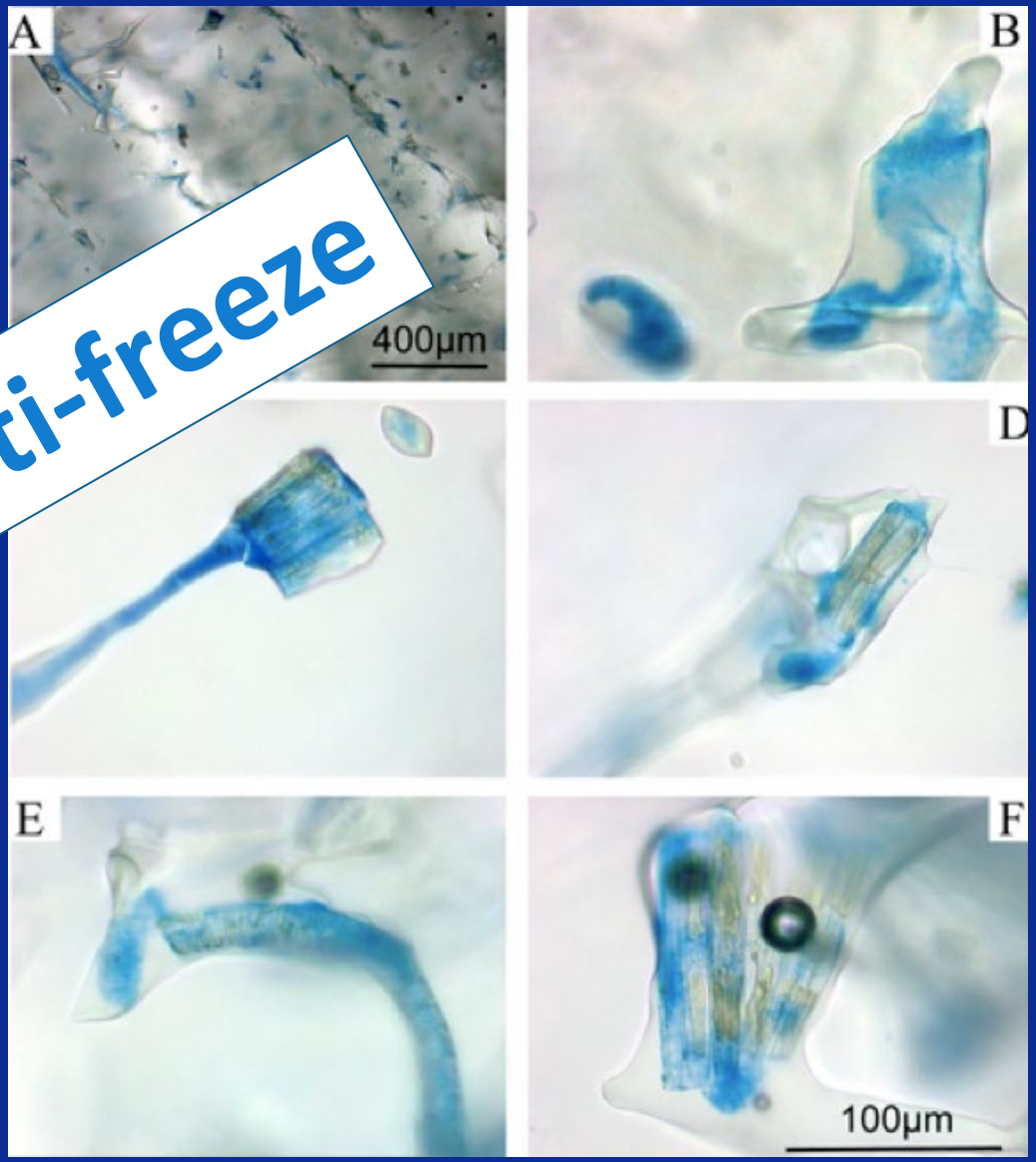


–15°C

Junge et al., 2001 Annals Glaciol

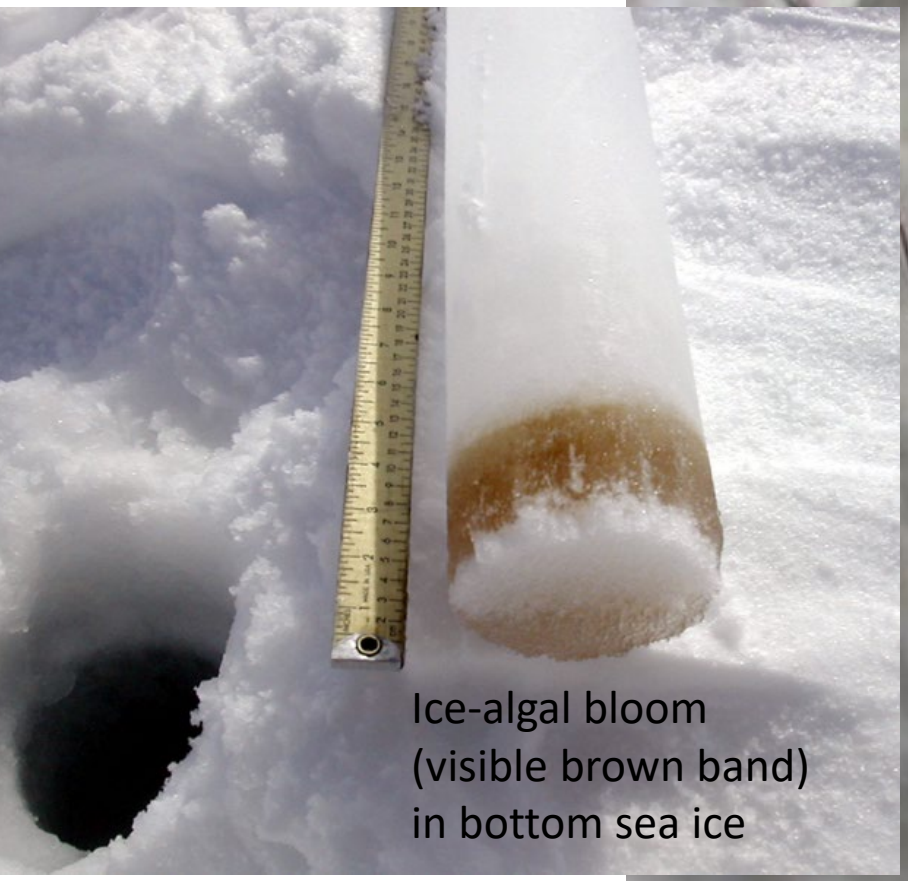
No stain

Stained for Exopolymers



anti-freeze

Krembs et al., 2011 PNAS



Ice-algal bloom
(visible brown band)
in bottom sea ice

Pennate diatoms ~100 µm
long in a brine pocket
in sea ice

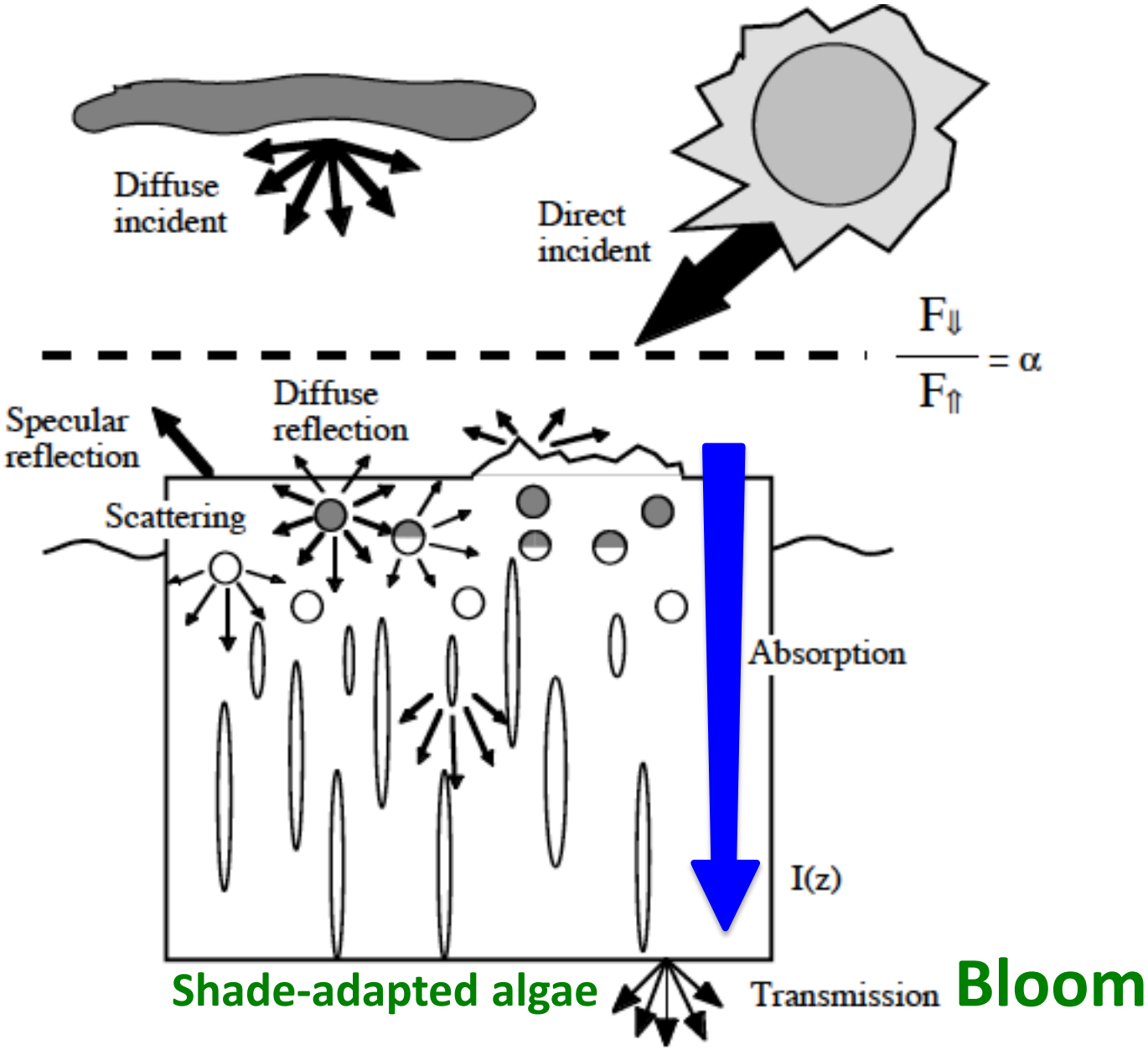


Fig. 2.19: Schematic depiction of sea-ice radiative transfer processes (modified from Perovich [1998]).

(Photo from B. Light, APL)

On the meter–kilometer scale: massive production

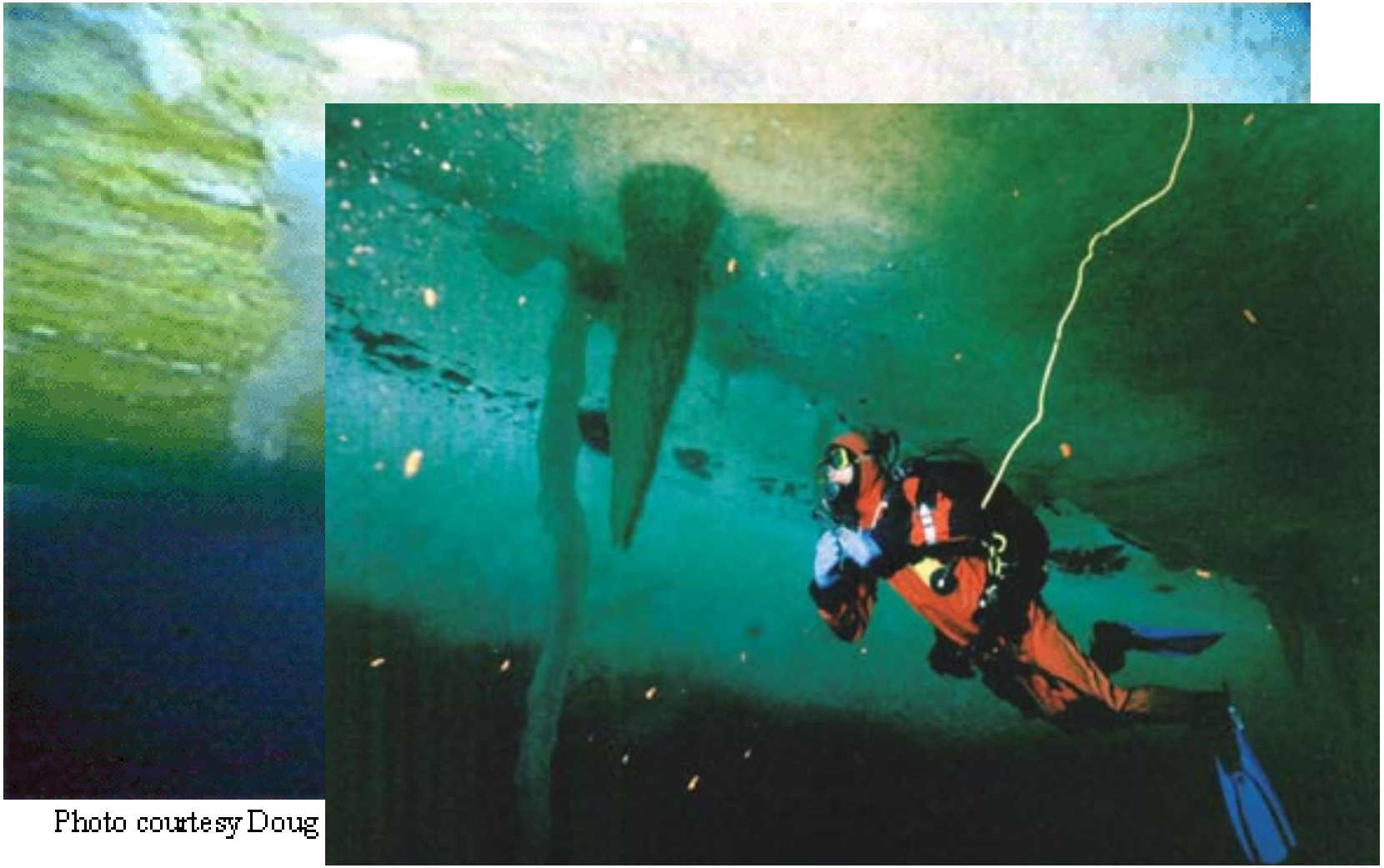
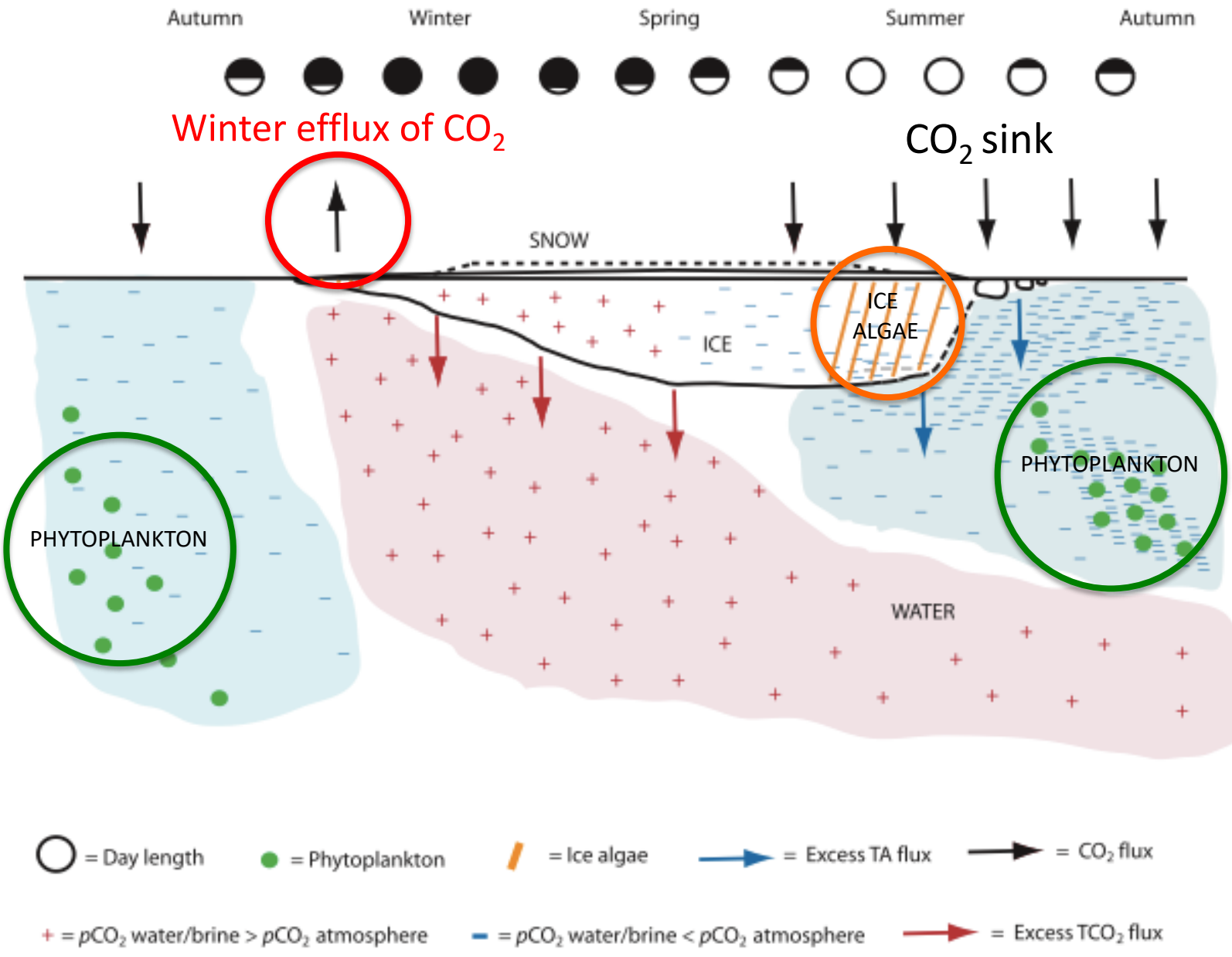


Photo courtesy Doug

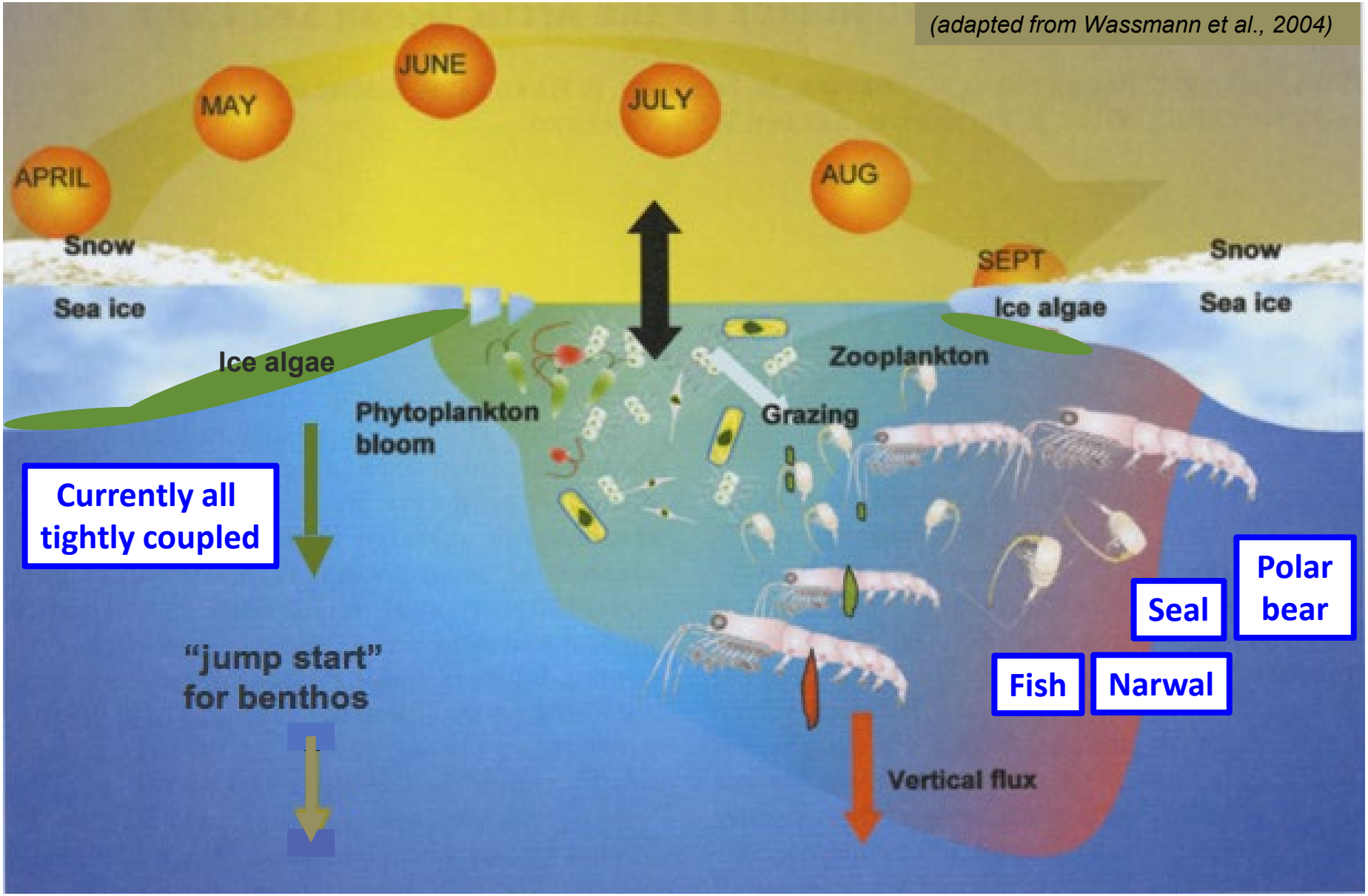


Rysgaard et al., 2011

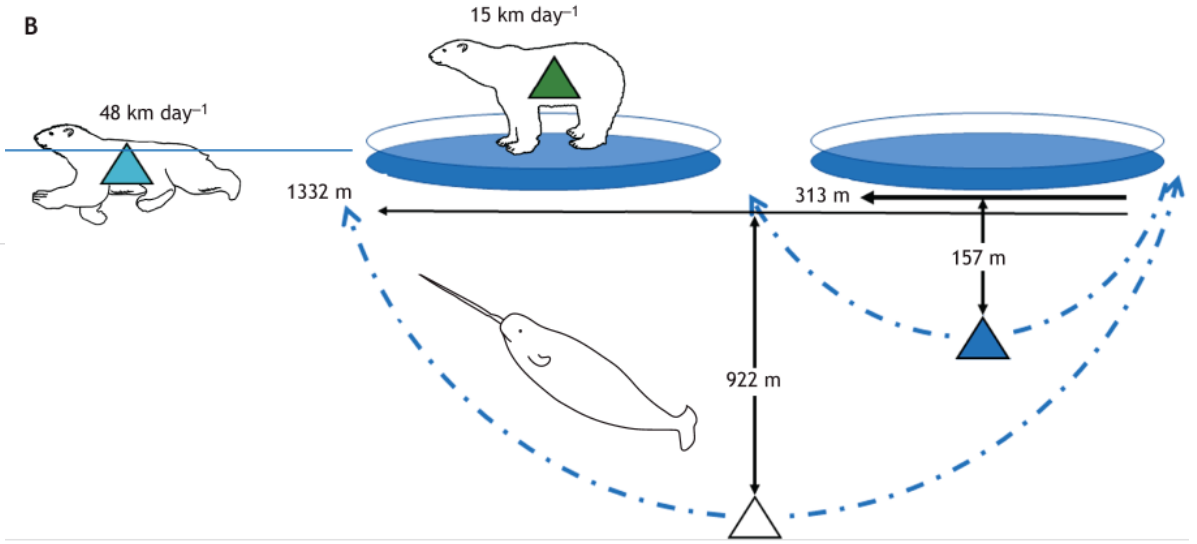

Algal food for under-ice fauna

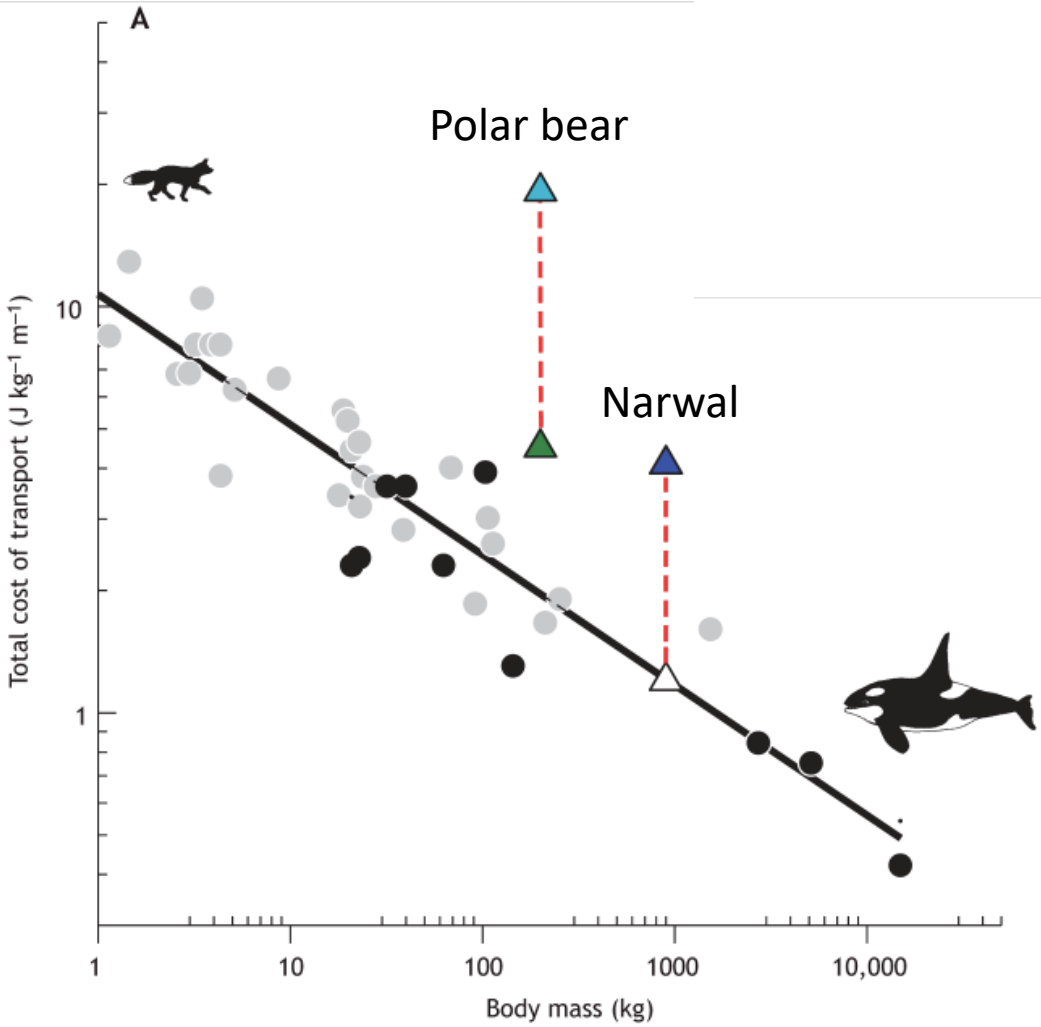

Refuge from predators
Gradinger&Bluhm UAF/NOAA/CoML

Early season support for a whole ecosystem



The energetic costs of sea ice loss

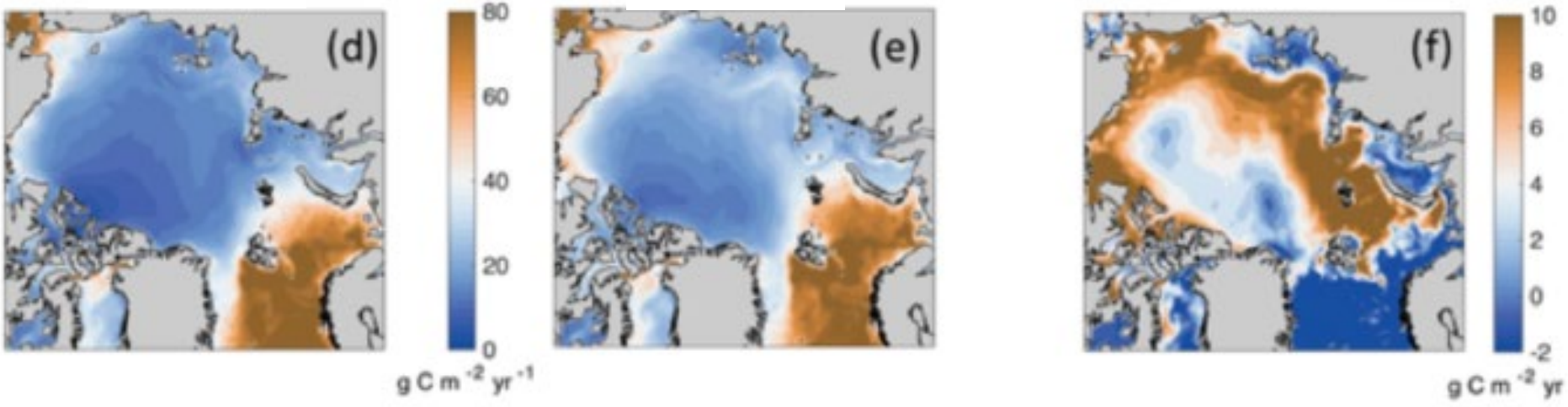




Pagano and Williams, 2021 Exp Biol

On the ocean scale, primary production is increasing as thinner ice with less snow forms later and melts earlier

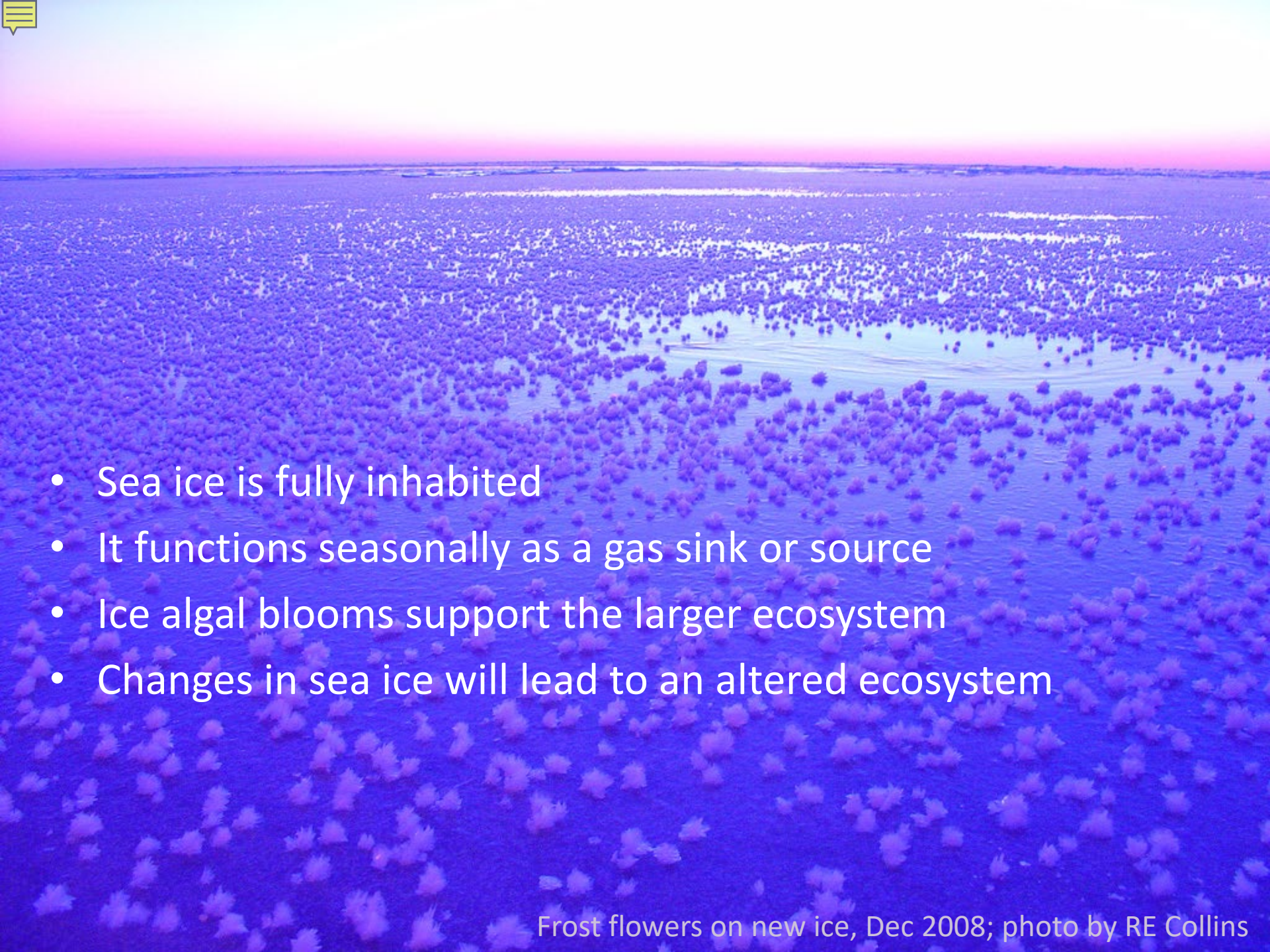
1981–1995 | 2006–2017 | Difference



Not only due to warming and increased light transmission

Available nutrients are essential

Polyakov et al., 2020 Frontiers



- Sea ice is fully inhabited
- It functions seasonally as a gas sink or source
- Ice algal blooms support the larger ecosystem
- Changes in sea ice will lead to an altered ecosystem

Frost flowers on new ice, Dec 2008; photo by RE Collins