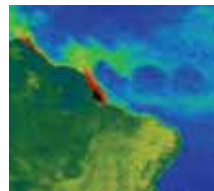
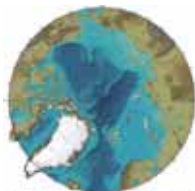
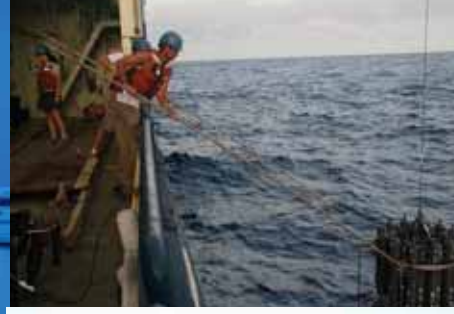


CLIMATE CONNECTIONS TO MARINE ECOSYSTEMS - FROM THE AMAZON TO THE POLES

Dr. Patricia Yager
UGA Marine Sciences



GORDON AND BETTY
MOORE
FOUNDATION



Climate and the marine biosphere

- Temperature
- Light availability
- Nutrients
- pH

Climate change forcing



Climate and the marine biosphere

- Temperature
- Light availability
- Nutrients
- pH

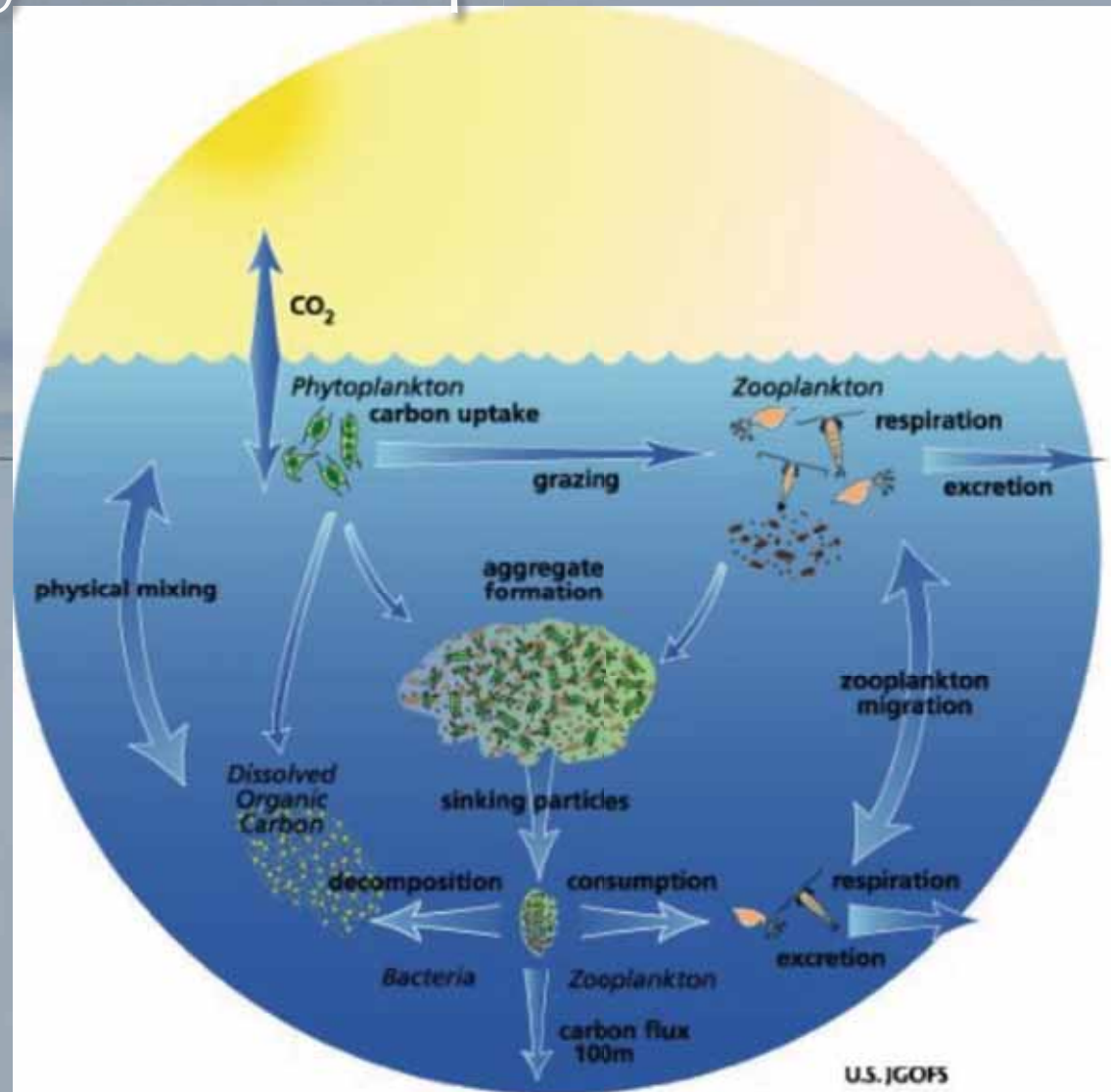
Climate change forcing

Biosphere feedback

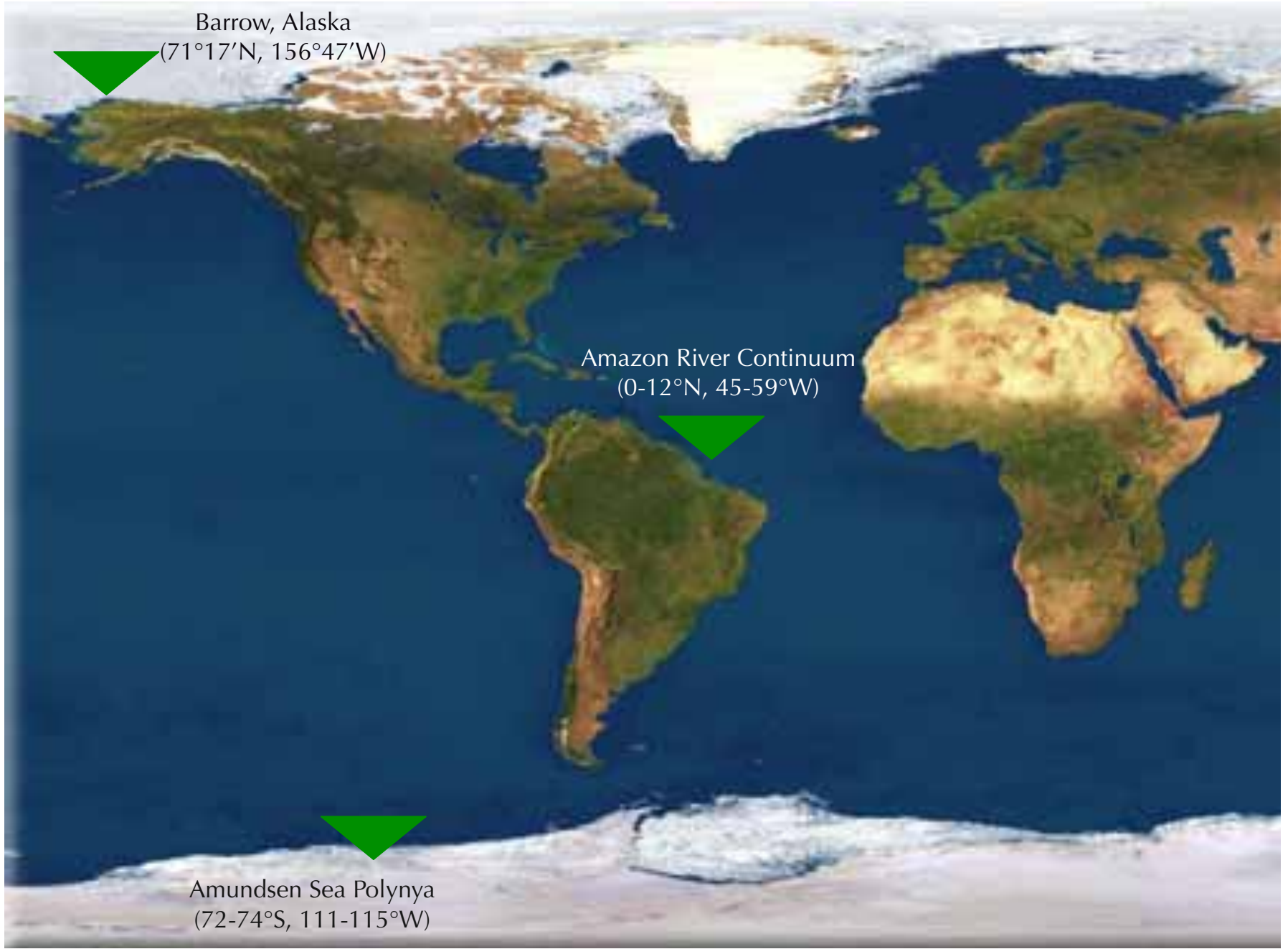
Ecosystem changes

Climate-active gases
(CH_4 , N_2O , DMS, CO_2)
Ocean color effects on albedo

The Biological Pump



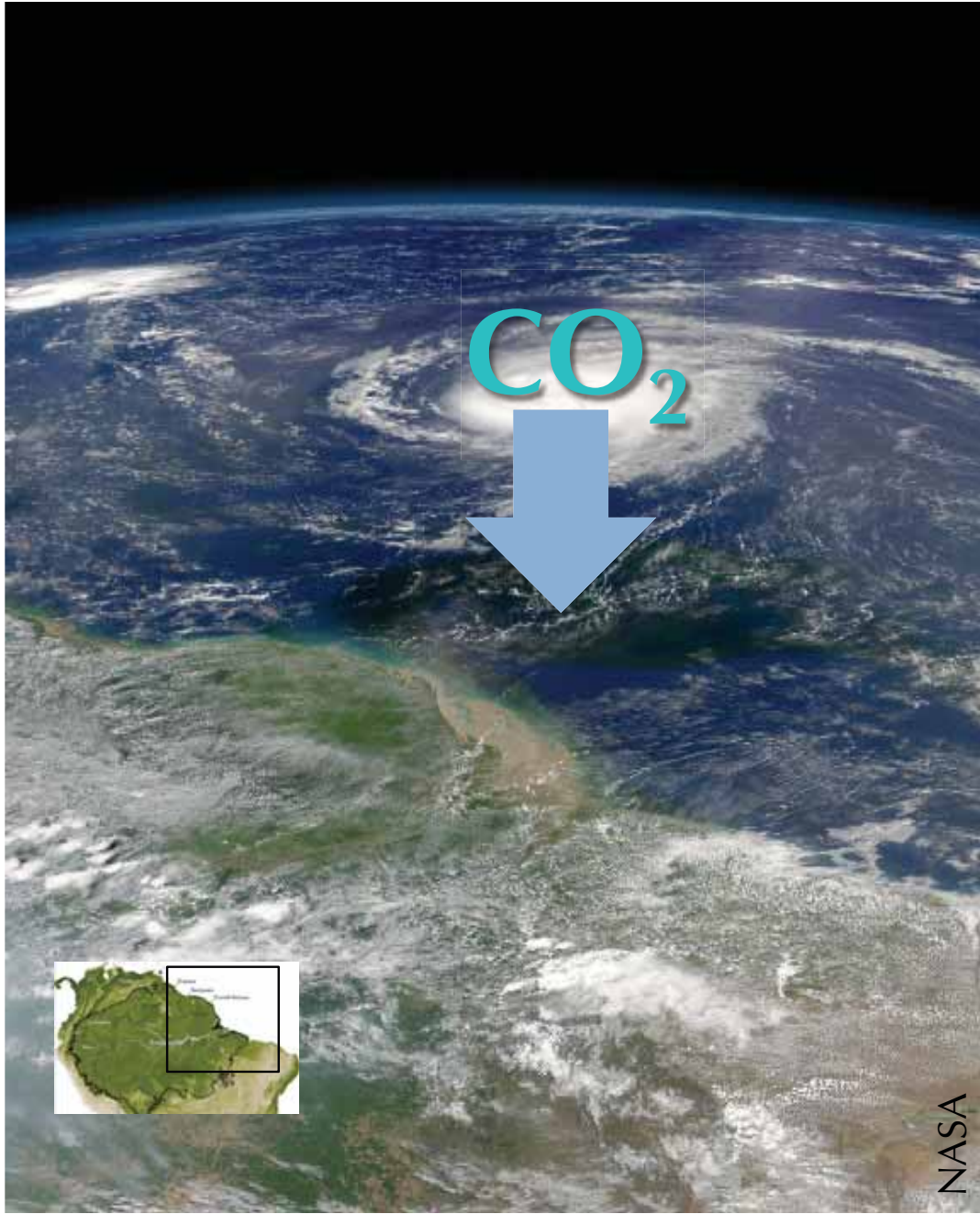
See: Garay&Yager
Pumping Carbon activity
<http://www.polartrec.com/resources/activity/pumping-carbon>



Barrow, Alaska
(71°17'N, 156°47'W)

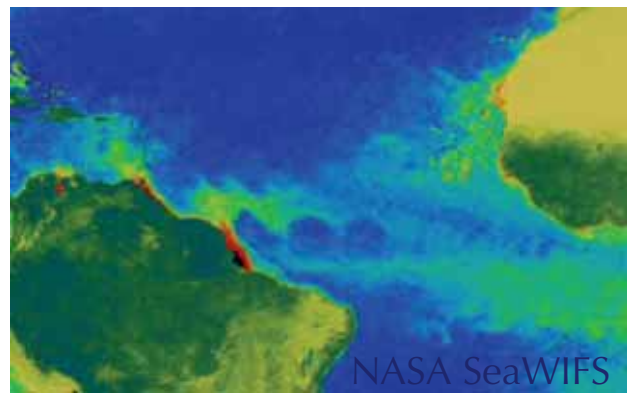
Amazon River Continuum
(0-12°N, 45-59°W)

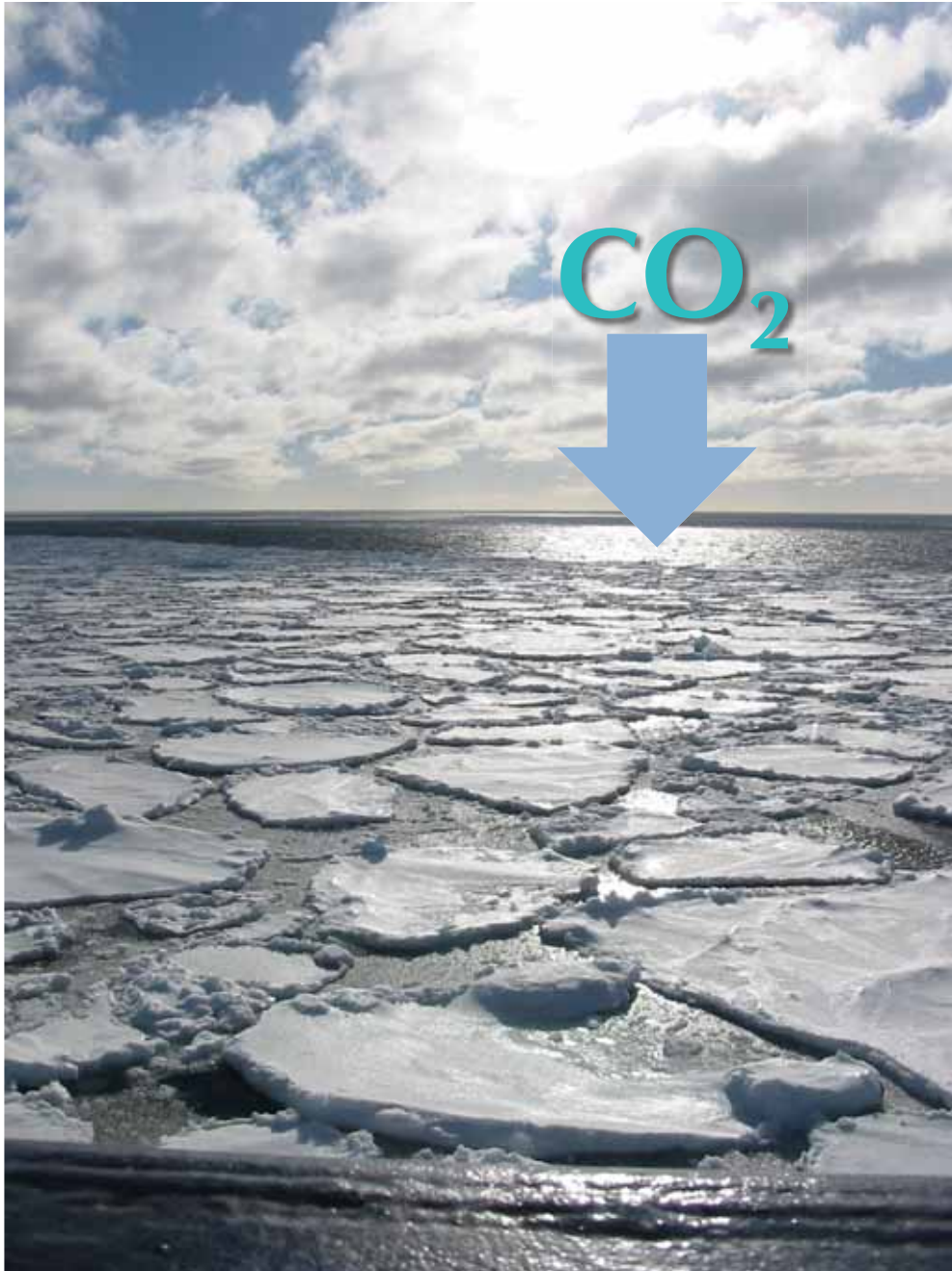
Amundsen Sea Polynya
(72-74°S, 111-115°W)



Why is the Amazon plume taking up so much CO₂ from the atmosphere?

Is this sink climate sensitive?

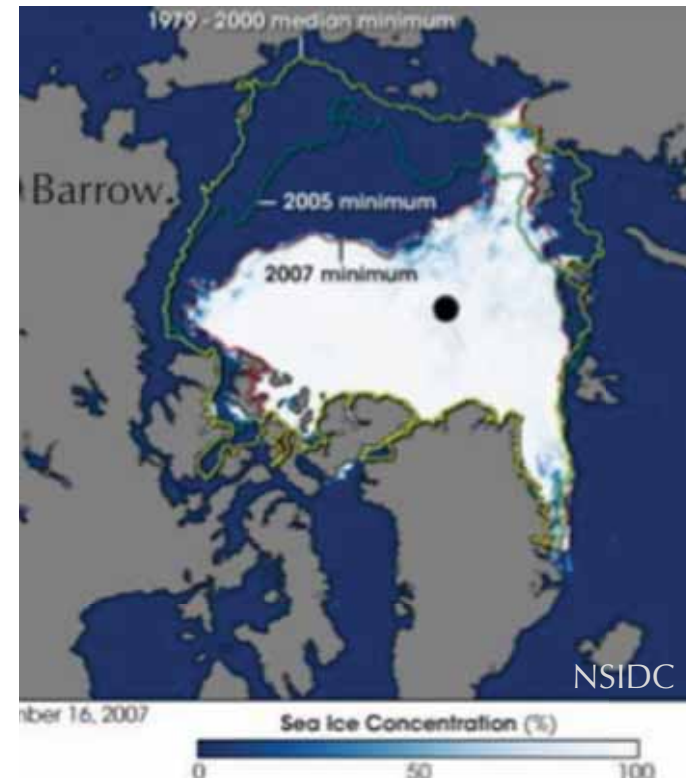
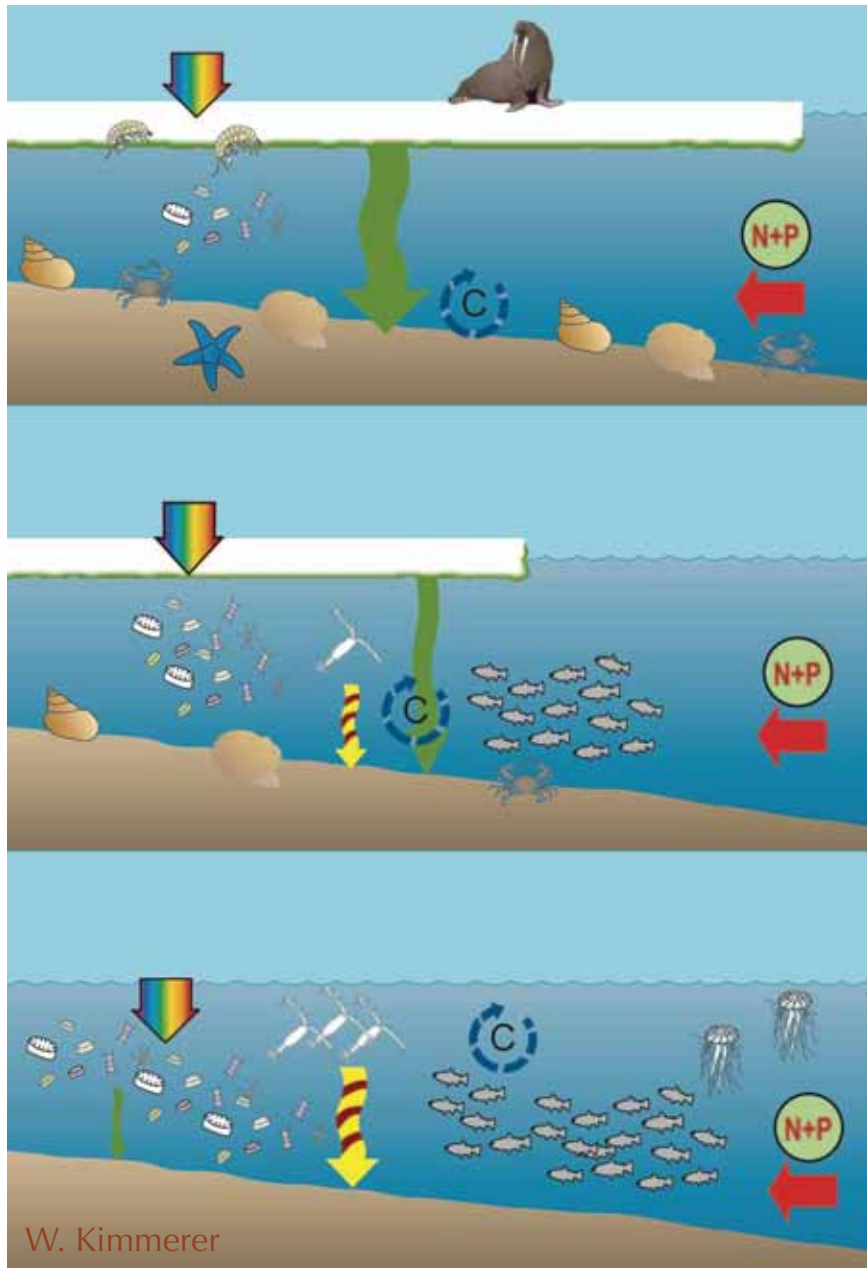




Why is the Amundsen Sea polynya taking up so much CO₂ from the atmosphere?

Is this sink climate sensitive?





How will the loss of sea ice and other climate changes affect the coastal Arctic carbon cycle and food web?



Microbial control on the productivity of Barrow's coastal waters - Will the battle for nitrogen intensify under climate change?



Patricia Yager
University of Georgia

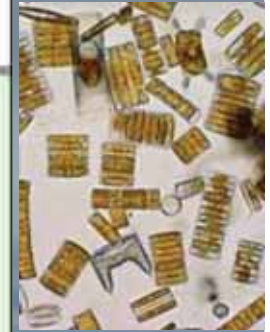
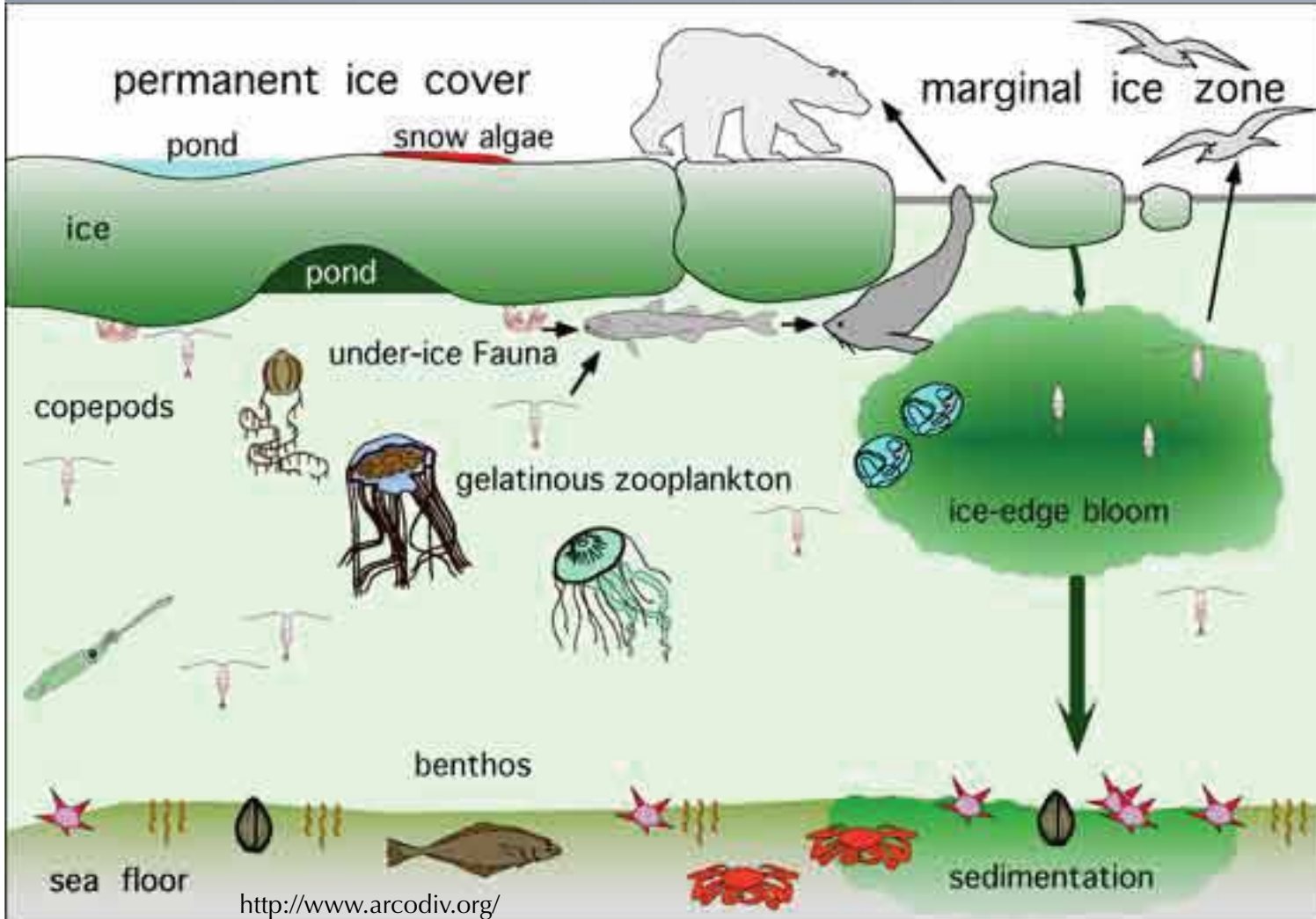


Debbie Bronk
Virginia Inst. Mar Sci



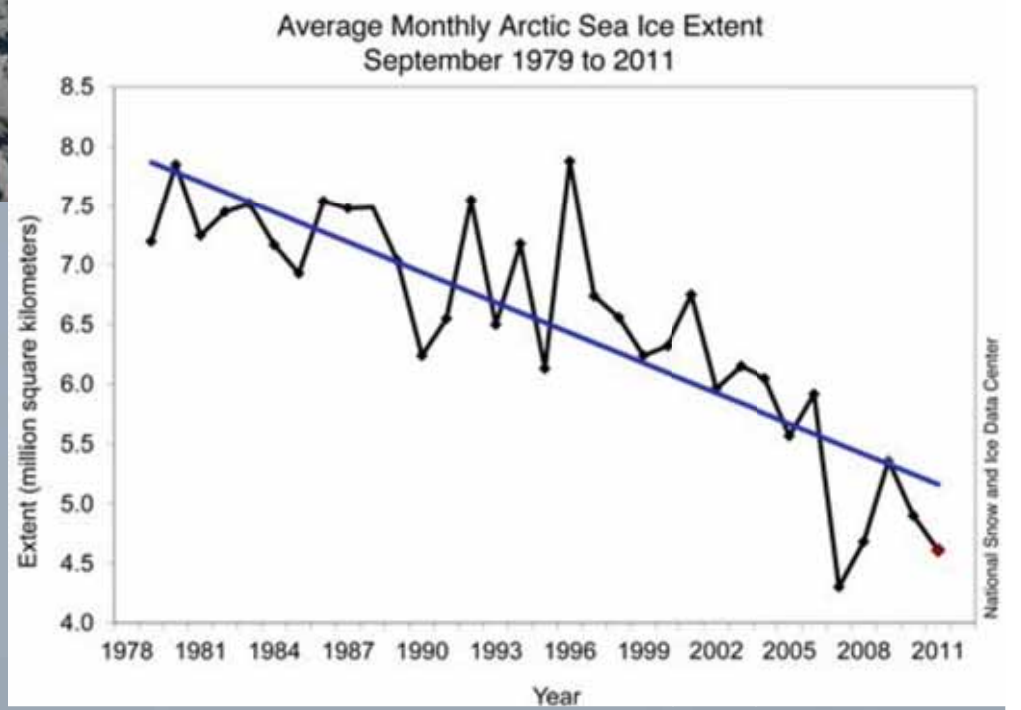
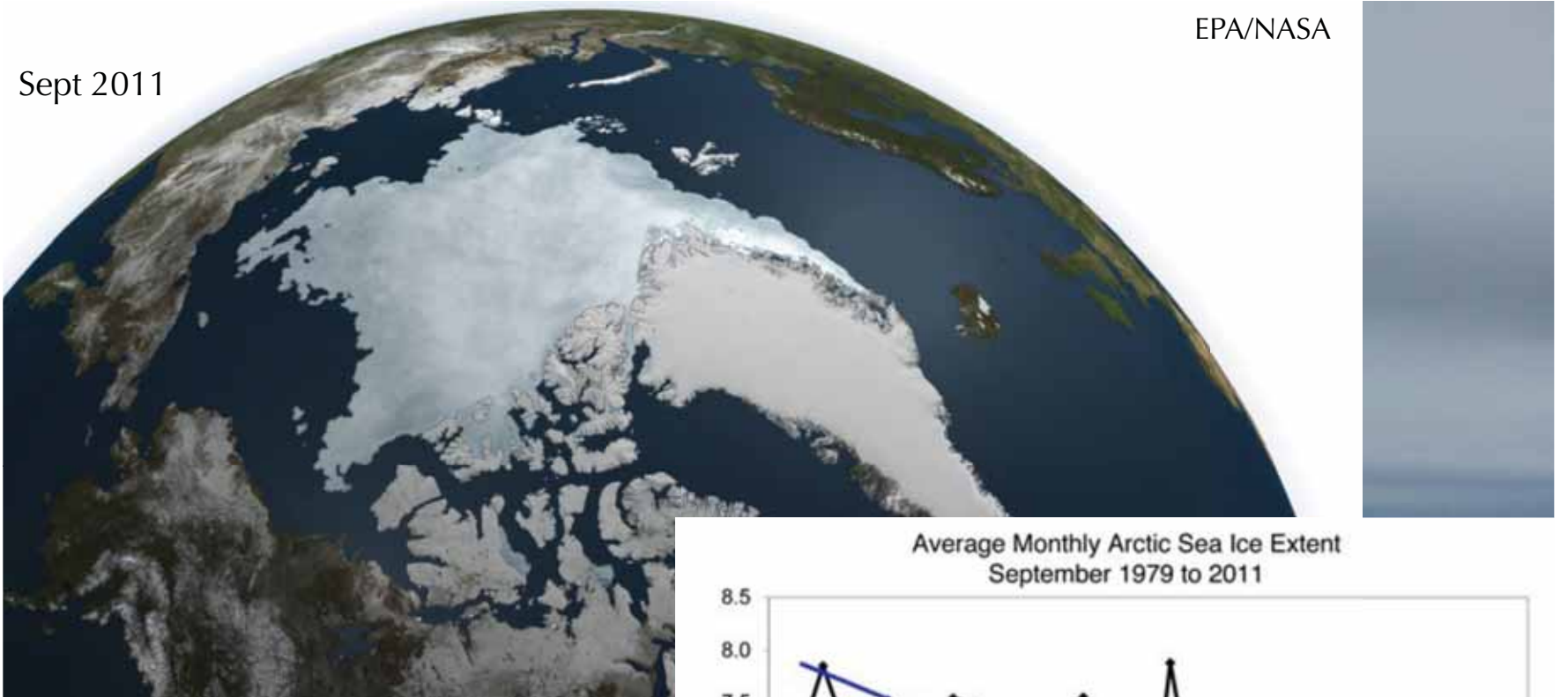
Marc Frischer
Skidaway Inst. Oceanogr.

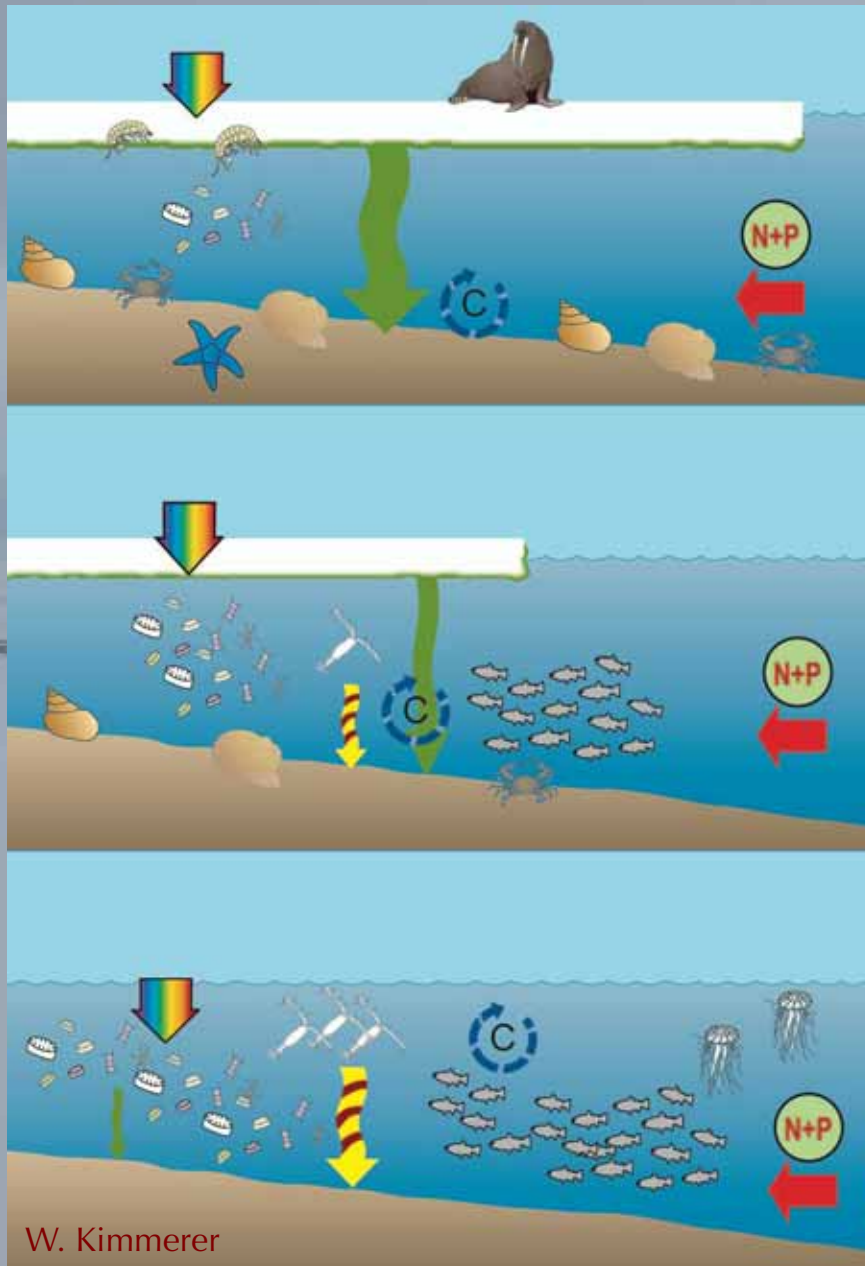
Arctic Marine Food Web



Sept 2011

EPA/NASA





W. Kimmerer

How will the loss of sea ice affect the food web?

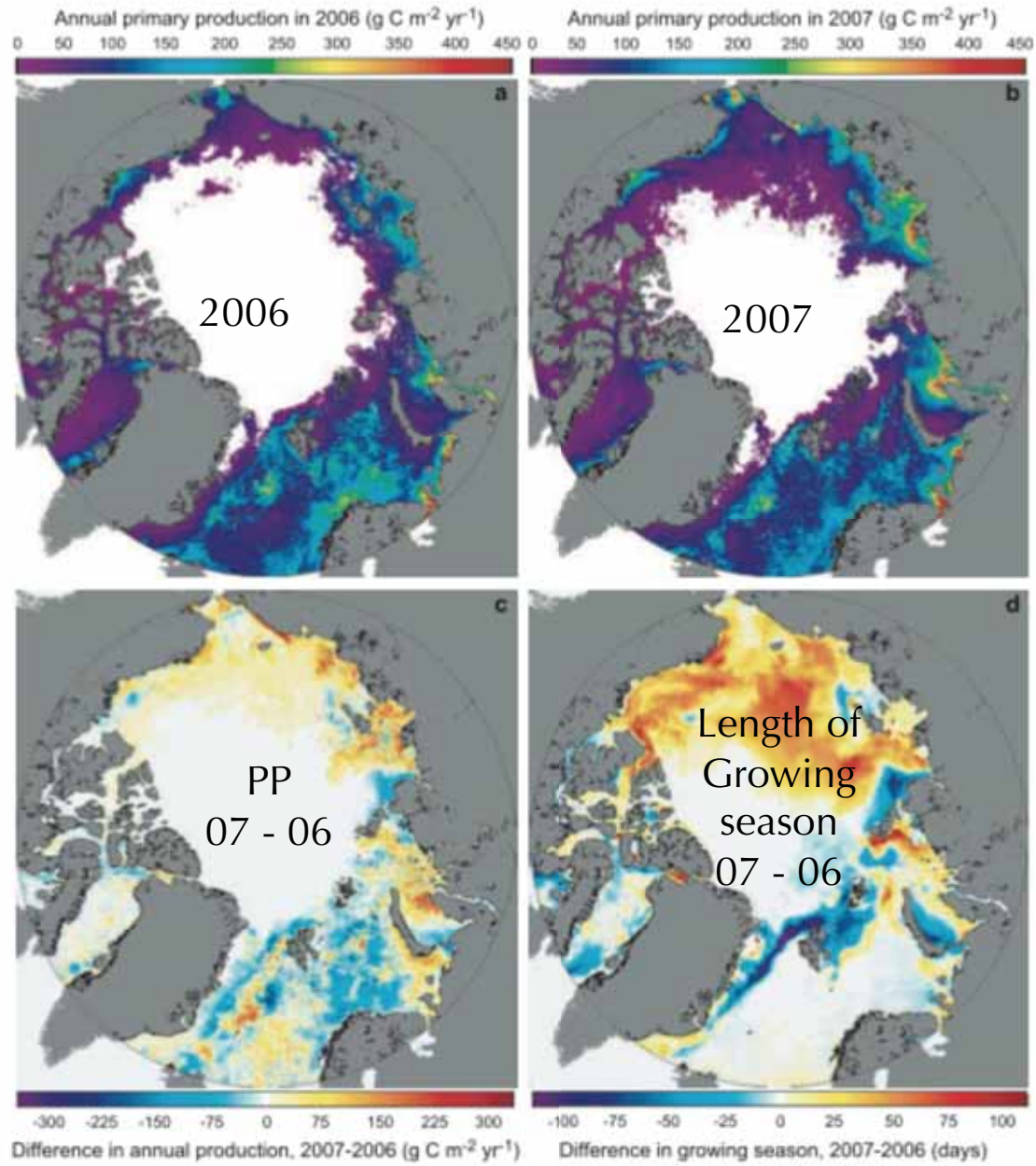
Hypothesis:

Reduced benthic?

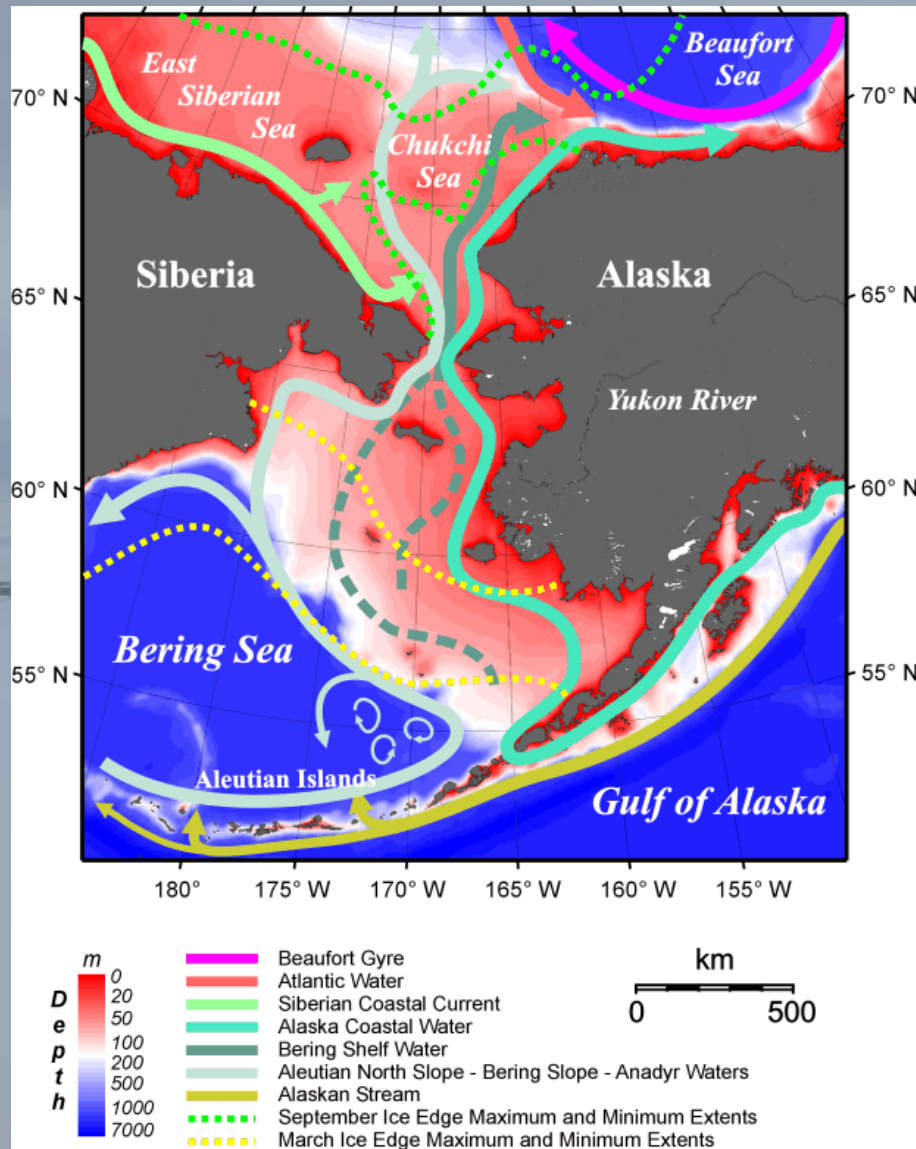
Increased pelagic?

Nutrients required!

ARRIGO ET AL.: ARCTIC ICE AND MARINE PRIMARY PRODUCTION



Arrigo et al. 2008

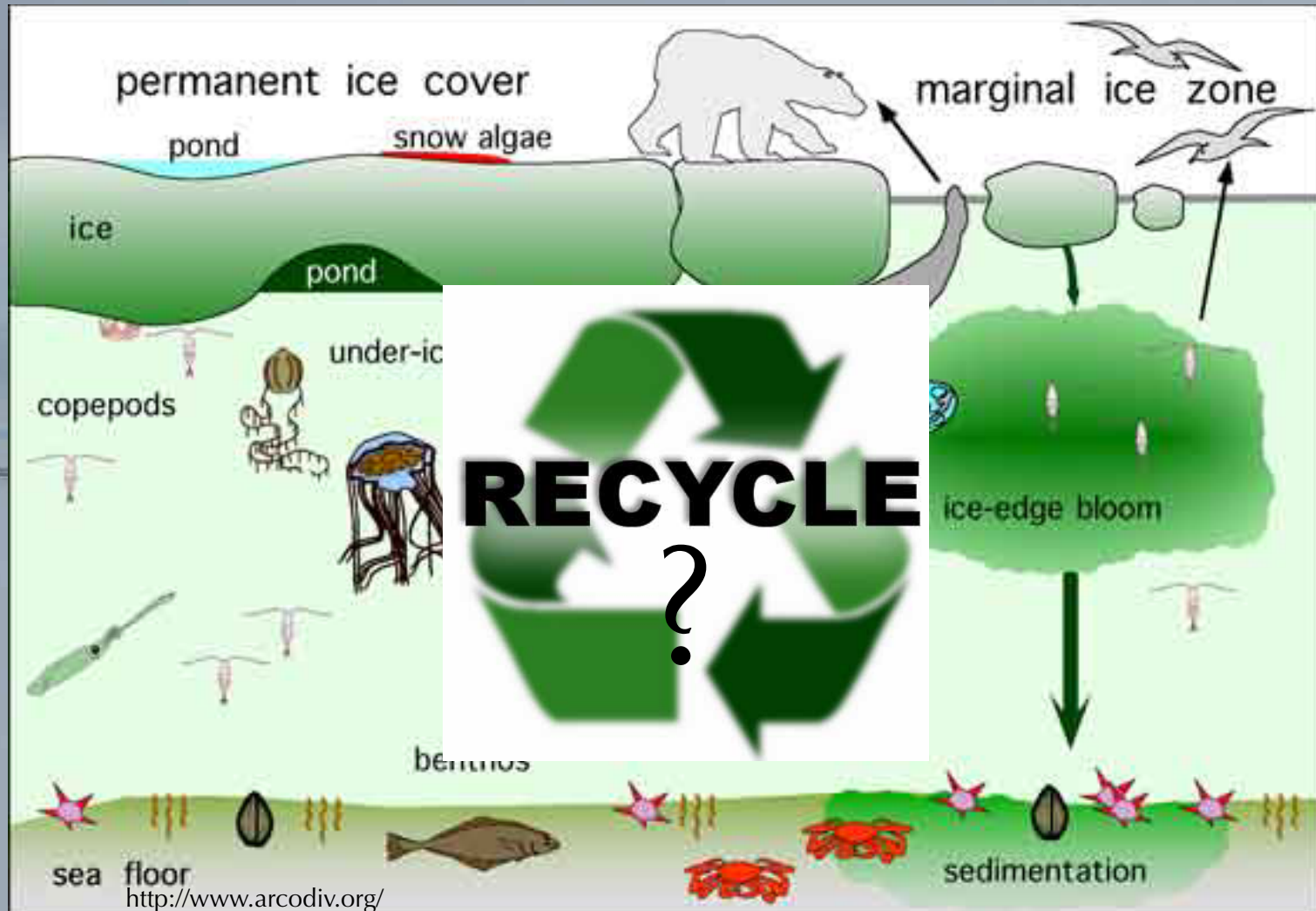


[Courtesy Tom Weingartner]

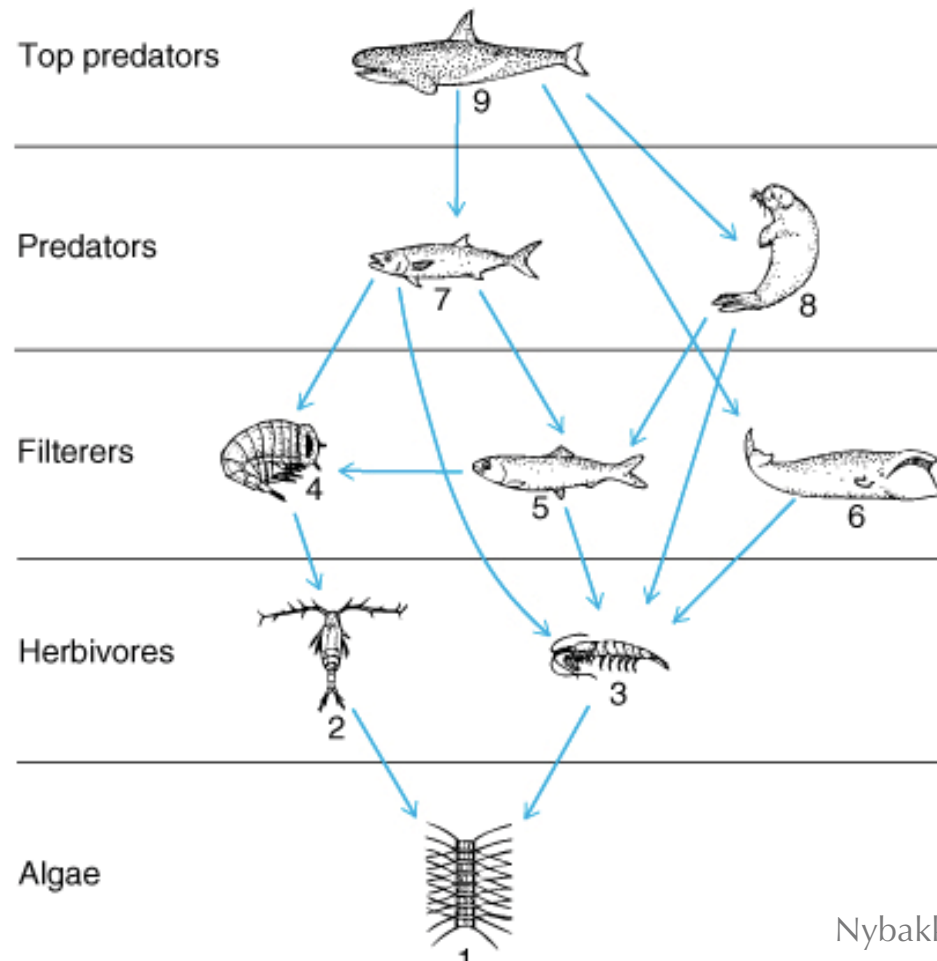
Nutrients come from the Bering Sea

or from upwelling near the shelf break

Arctic Marine Food Web



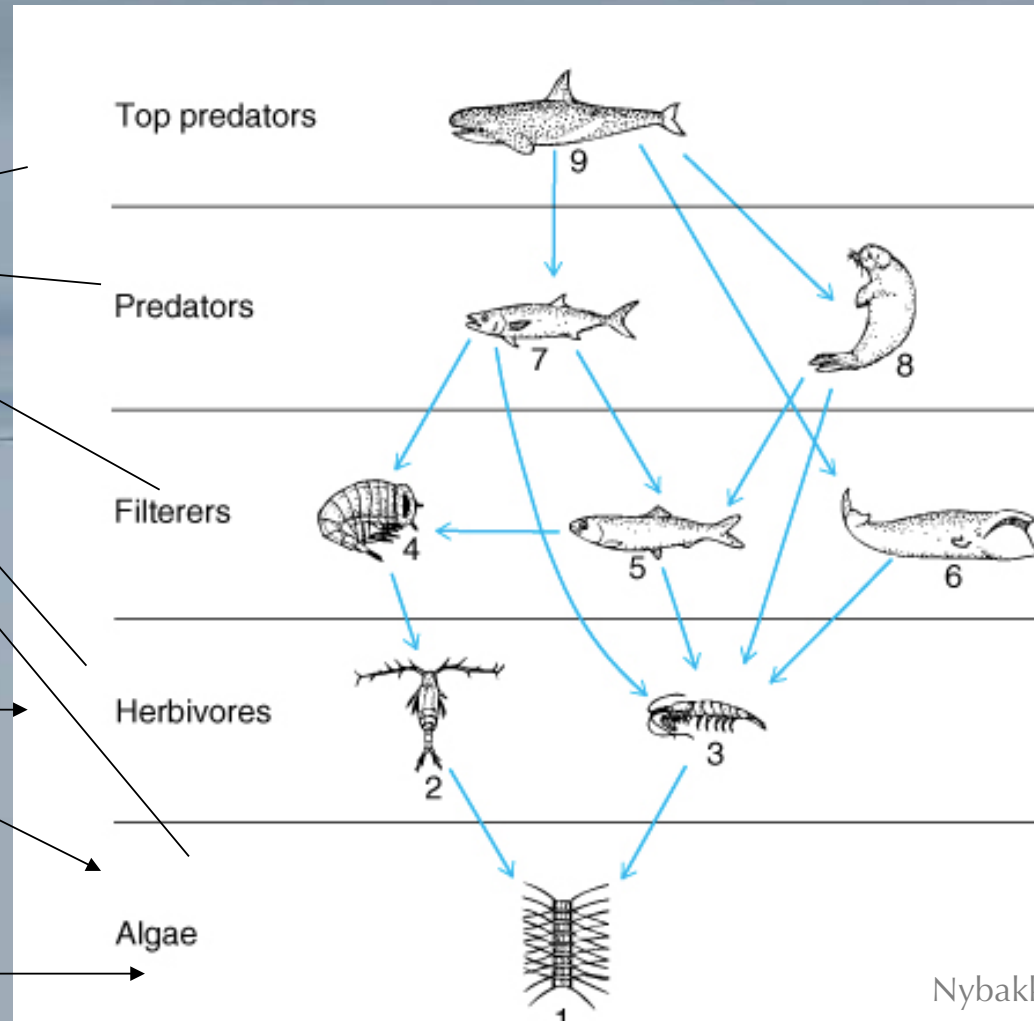
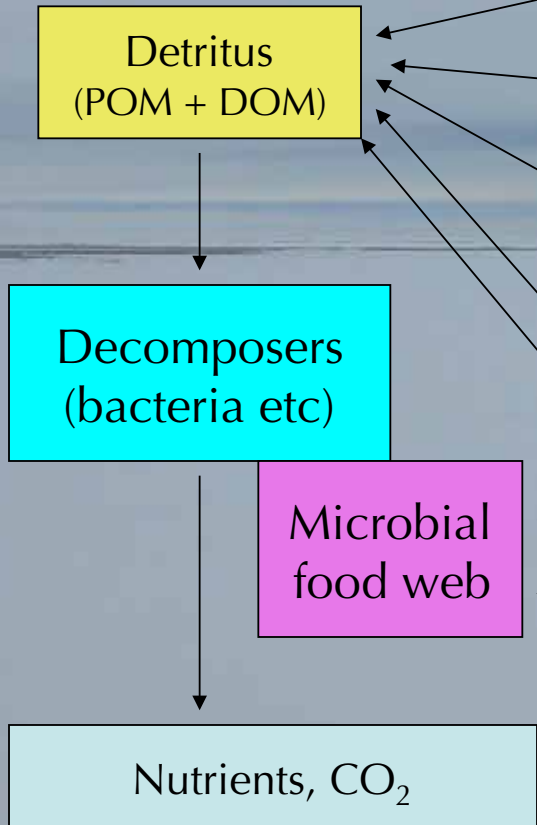
Herbivorous Food Web



Nybakken

Food Web

Don't forget to recycle!



Nybakken

Microbial Food Web

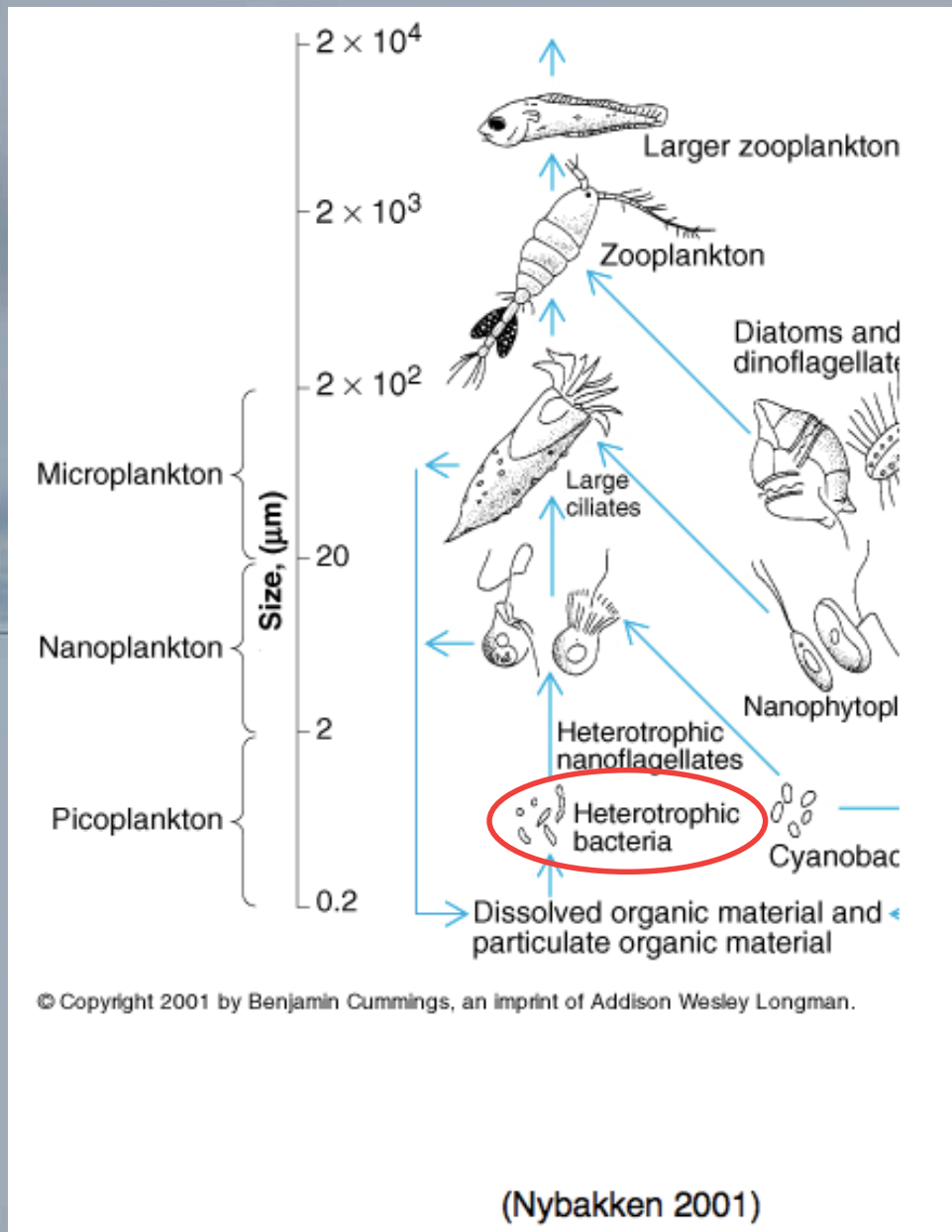
Adds to the classical herbivorous food web

Bacteria in food webs

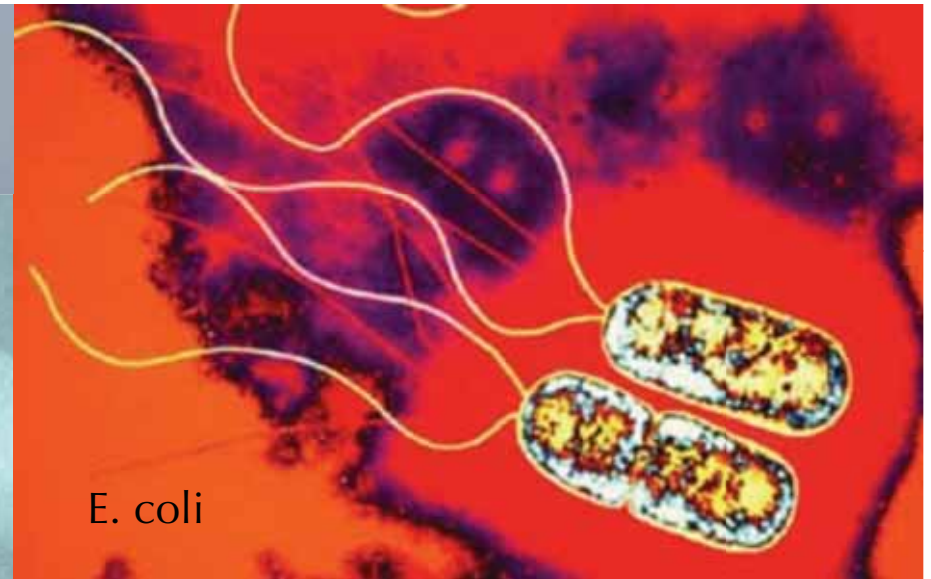
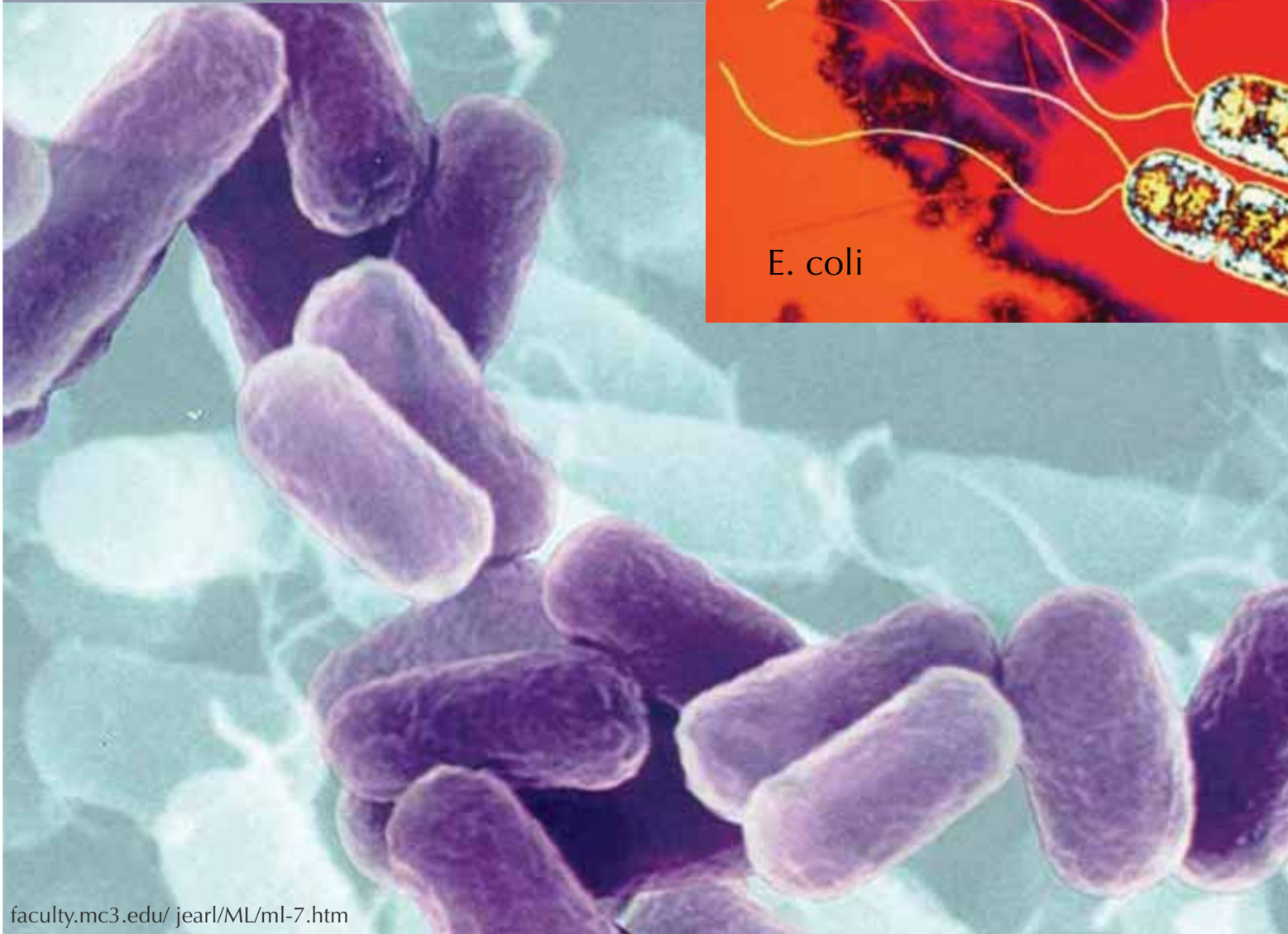
Decomposers

Prey for protozoans

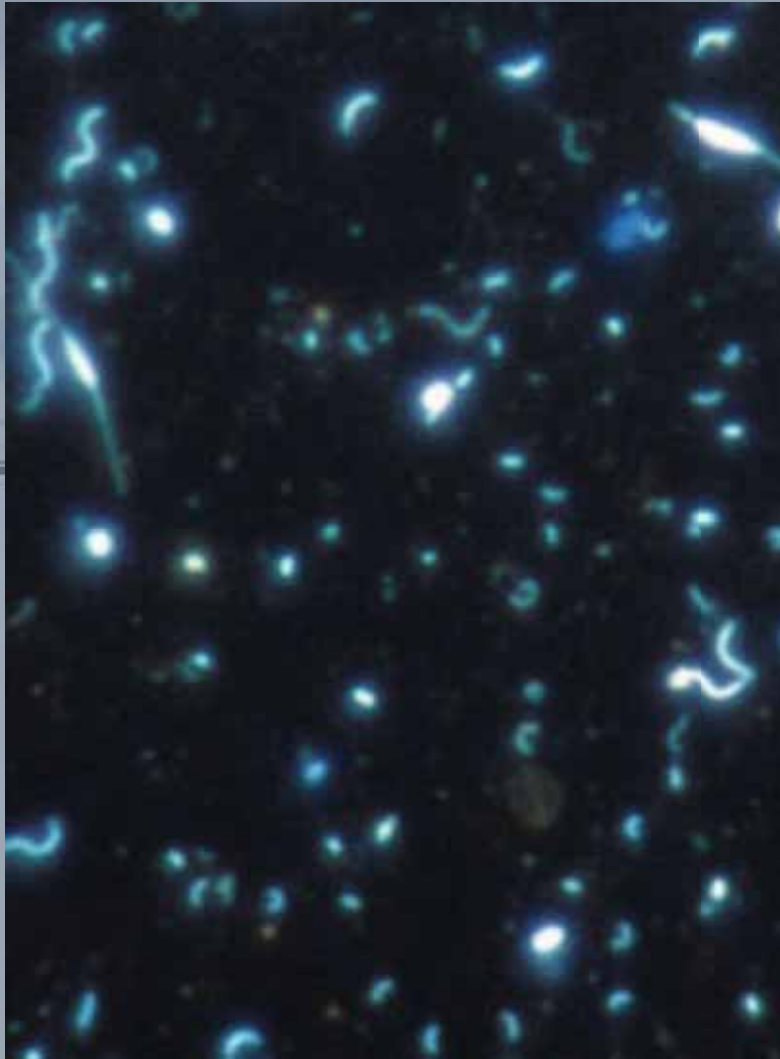
Infected by viruses



Aren't bacteria bad?



No – most are needed for healthy ecosystems...



Marine Bacteria

Smallest marine organisms: 0.5 μm in diameter (although largest marine bacterium is 750 μm)

Three lifestyles: planktonic, attached, symbiotic

2 million per drop (milliliter) of coastal seawater

Decomposers

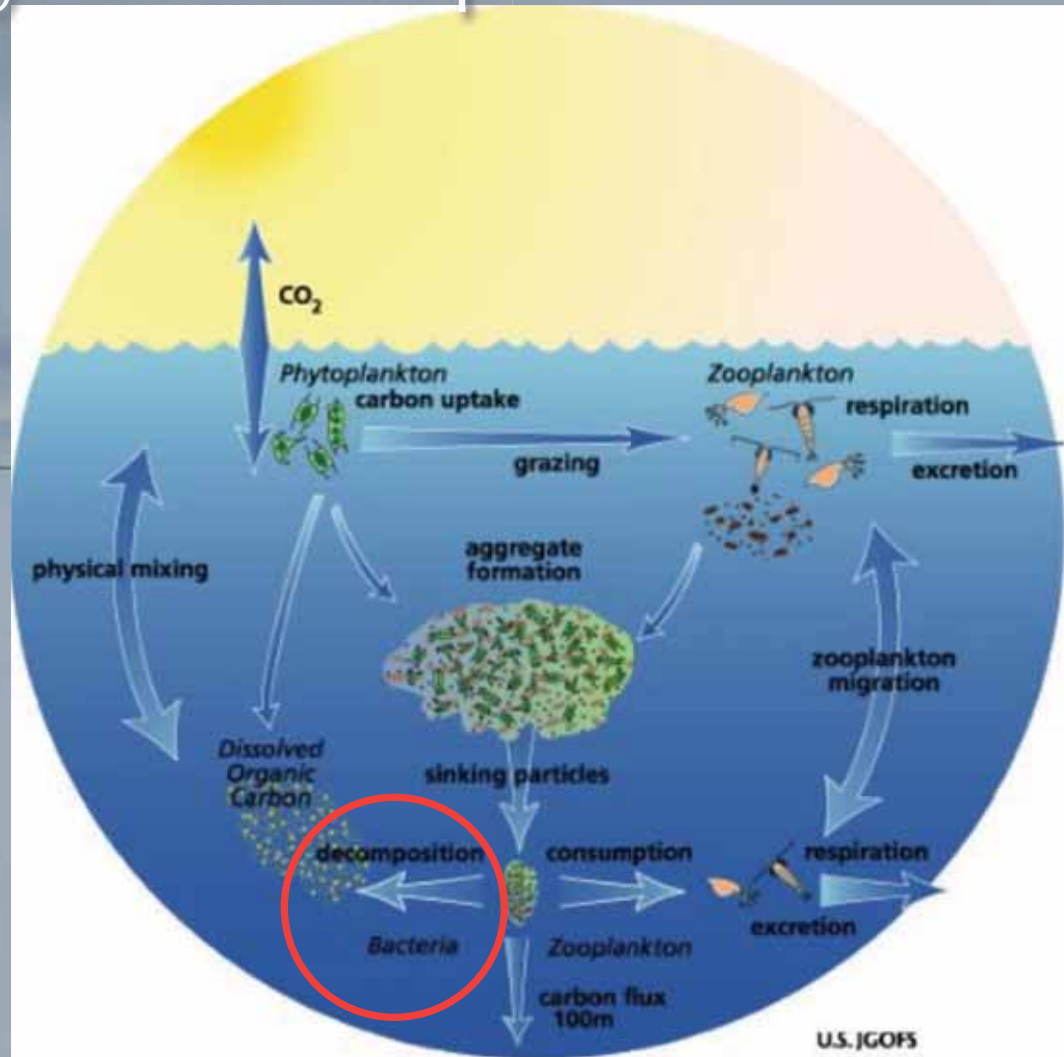
Significant metabolic diversity

Low morphological diversity

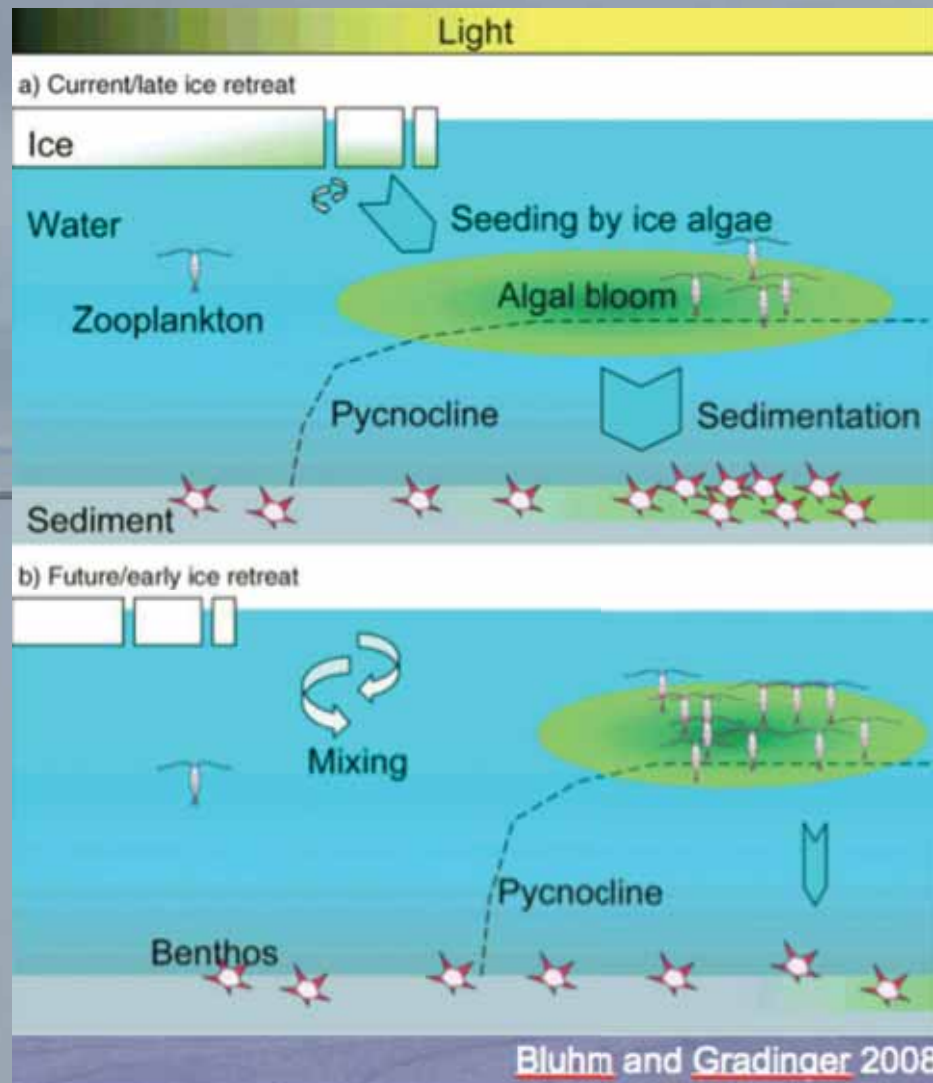
The Biological Pump

Focus on
bacteria as
heterotrophs or
“decomposers”

But also perhaps
nutrient
consumers????

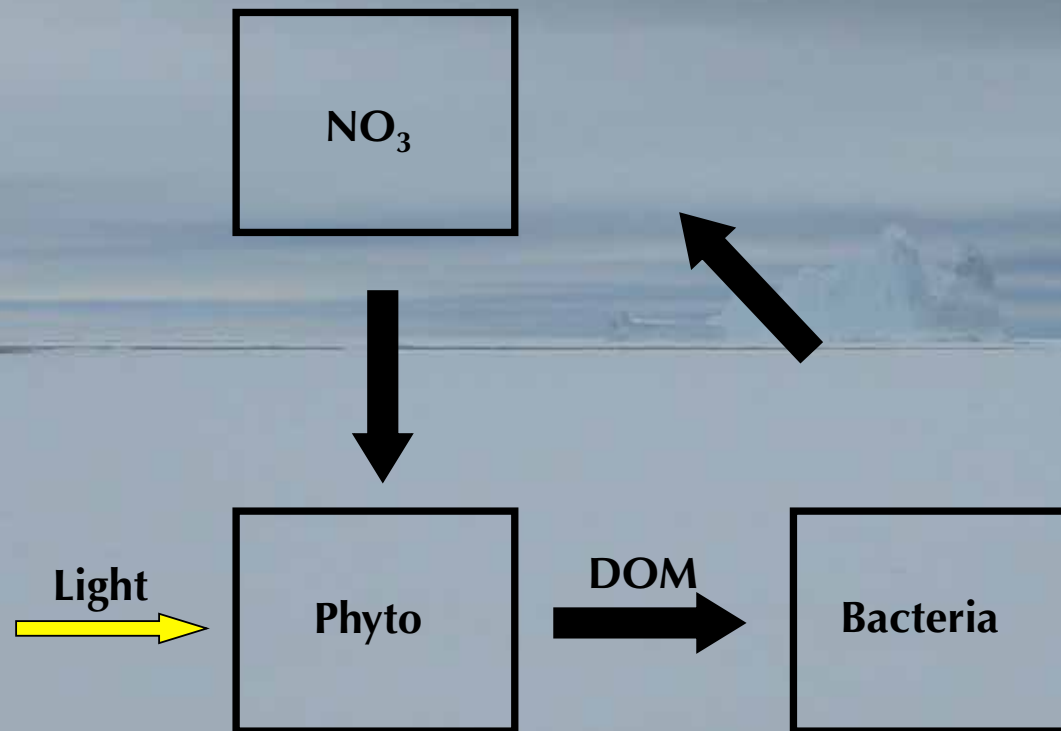


Marine life responds to physical change

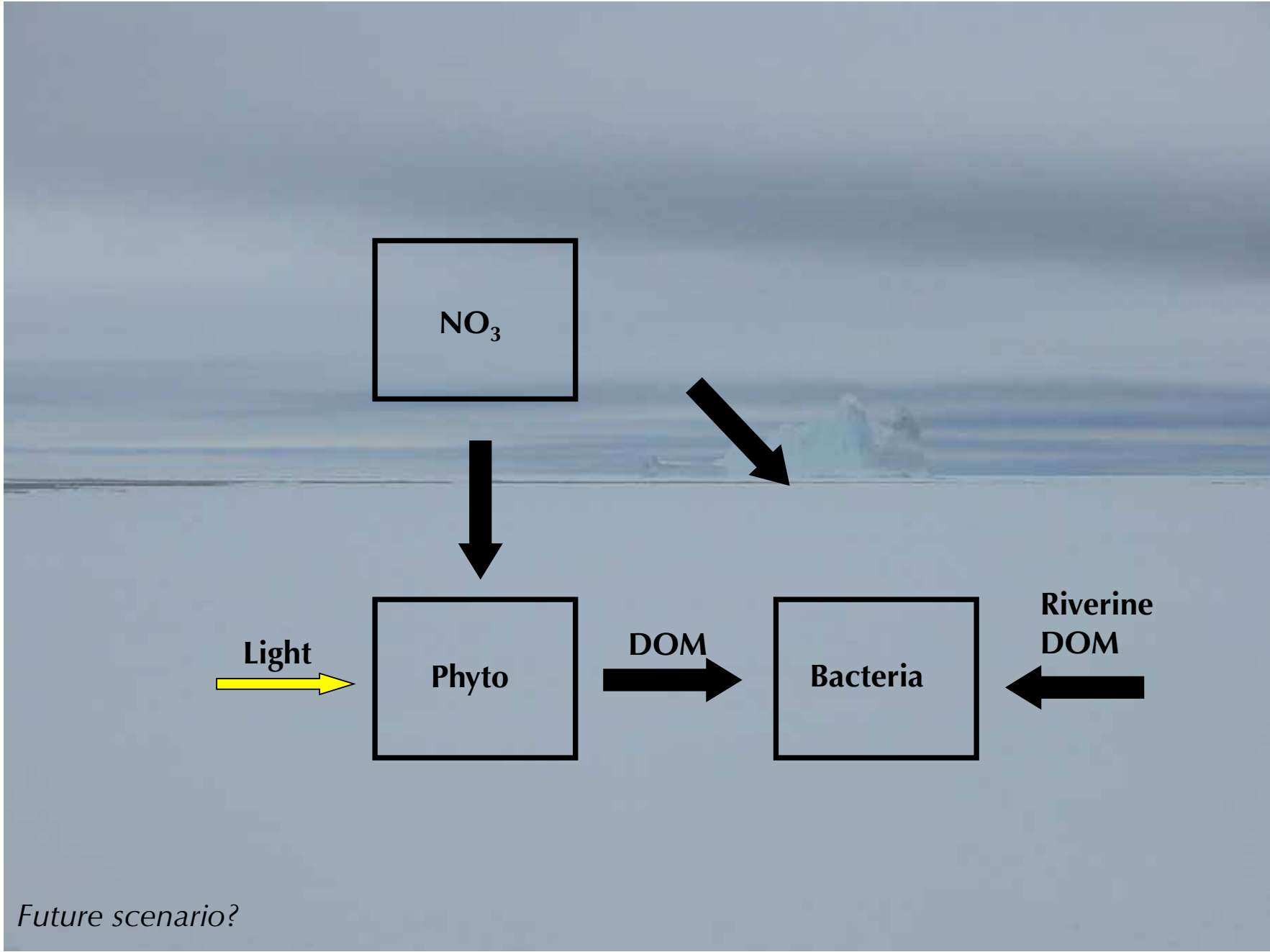


Late ice retreat
Early bloom
Benthic production

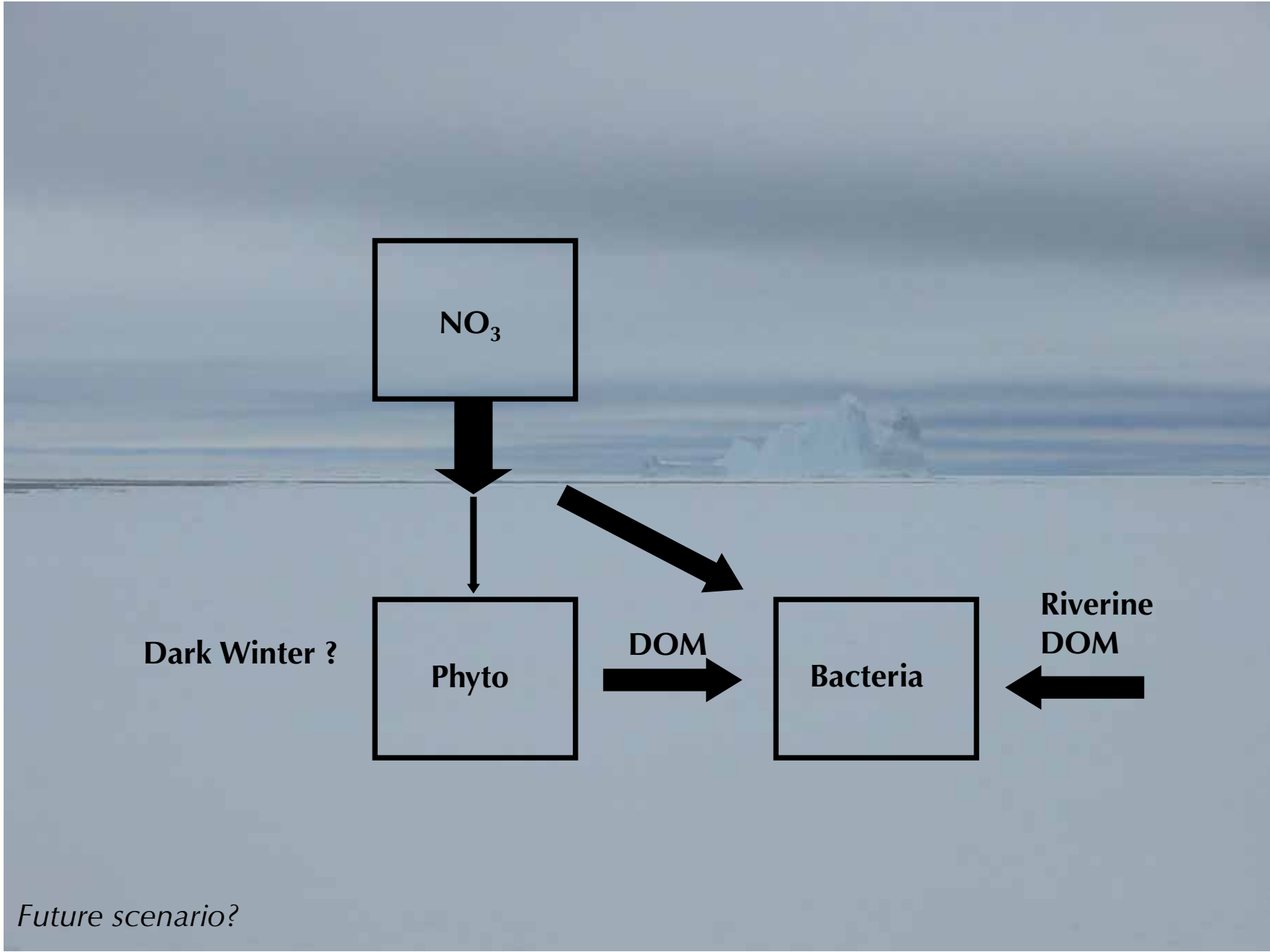
Early ice retreat
Late bloom
Pelagic production



Standard "model"



Future scenario?



Dark Winter ?

NO_3

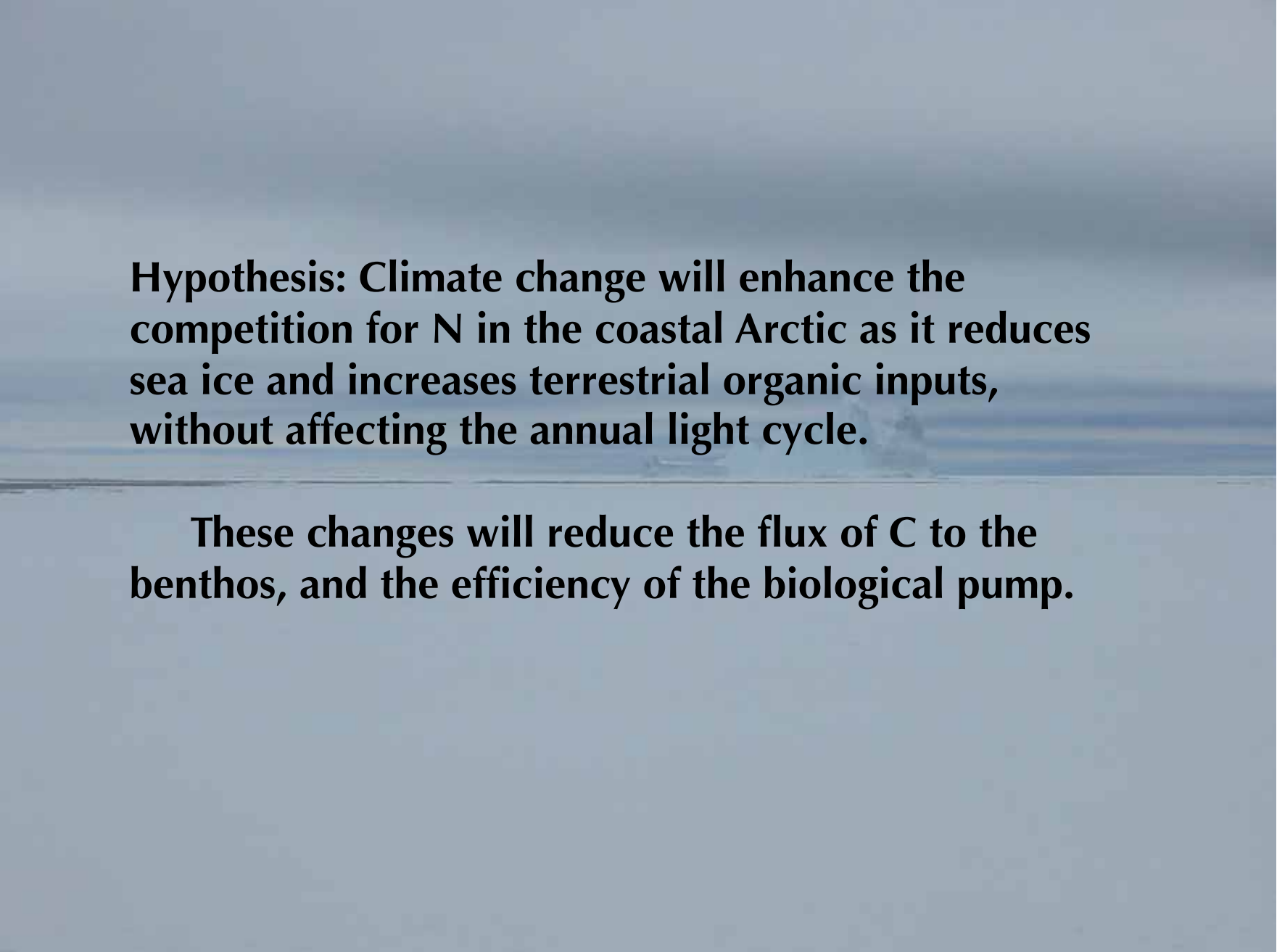
Phyto

DOM

Bacteria

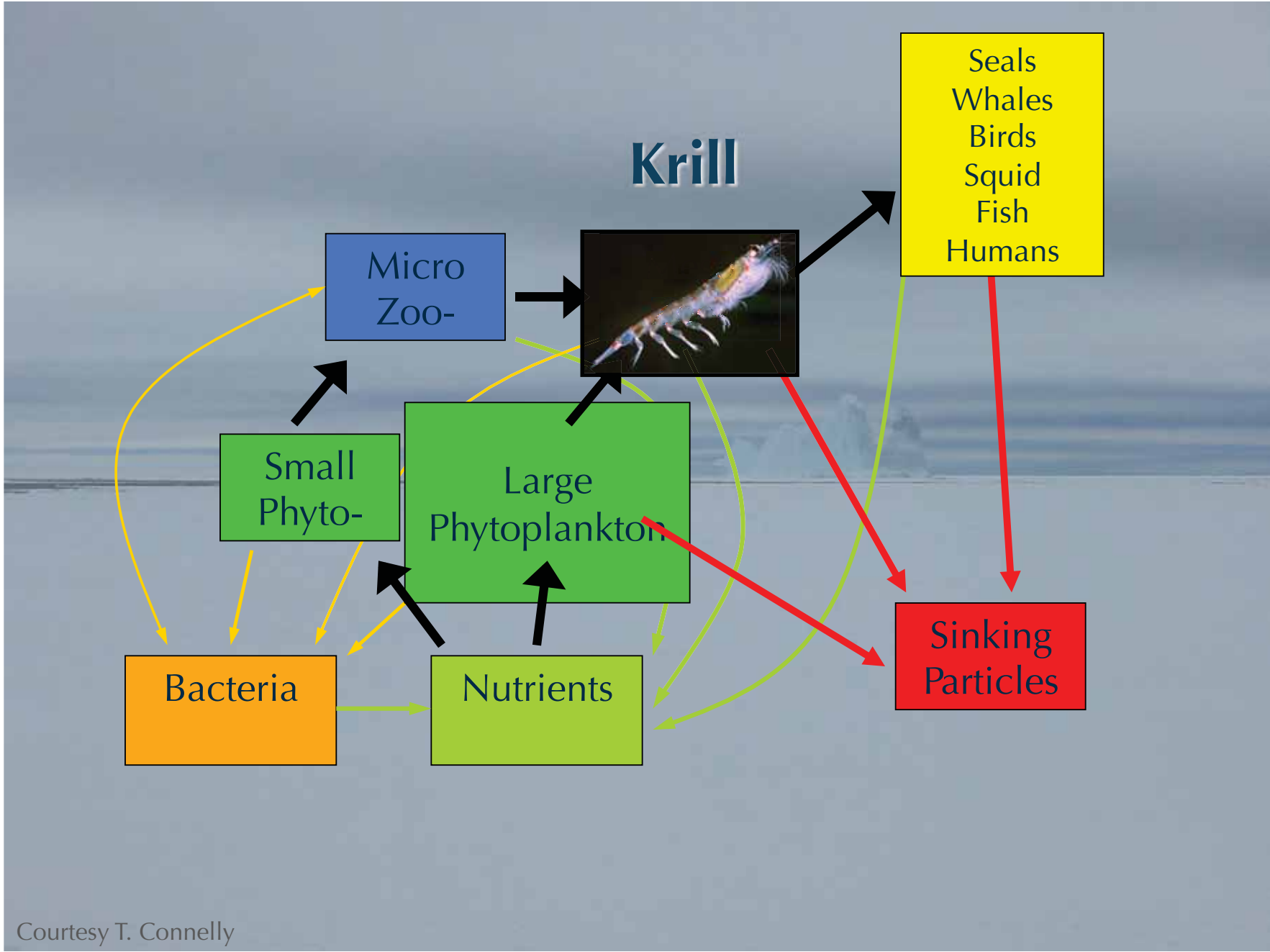
Riverine
DOM

Future scenario?



Hypothesis: Climate change will enhance the competition for N in the coastal Arctic as it reduces sea ice and increases terrestrial organic inputs, without affecting the annual light cycle.

These changes will reduce the flux of C to the benthos, and the efficiency of the biological pump.



Courtesy T. Connelly

