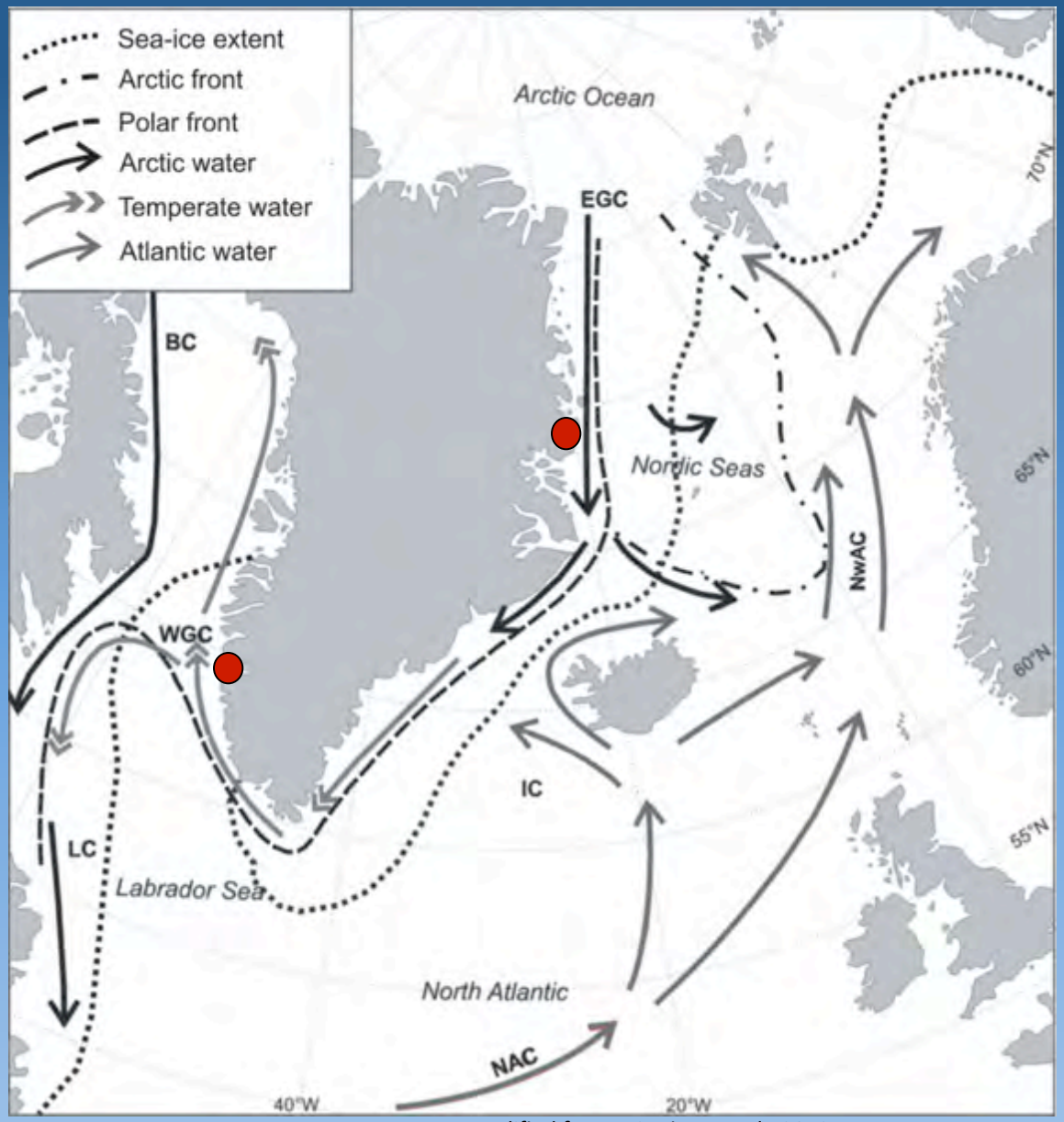
Linking ocean-fjord-glacier interactions with pelagic biodiversity around Greenland

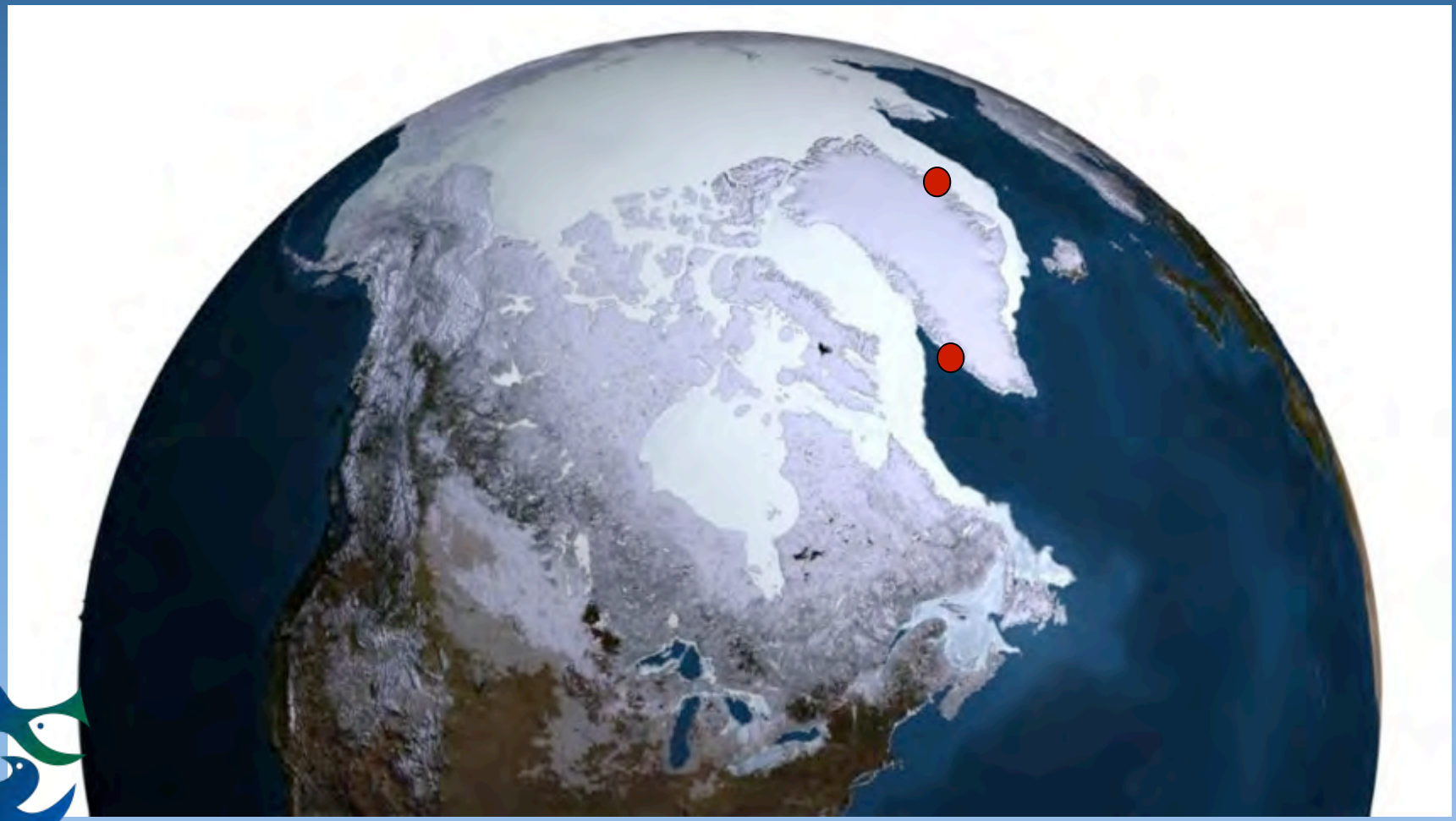
Kristine Arendt, Thomas Juul-Pedersen and Mikael Sejr
Greenland Ecosystem Monitoring

Monitoring stations in relation to North Atlantic Current System



Modified from Miettinen et al., 2012

Monitoring stations in relation to winter Sea Ice extent



NASA/GSFC

Greenland Ecosystem Monitoring GEM

Zackenberg
Terrestrial - 1996
Marine – 2002

Nuuk
Terrestrial - 2007
Marine - 2005

Greenland Ecosystem Monitoring GEM

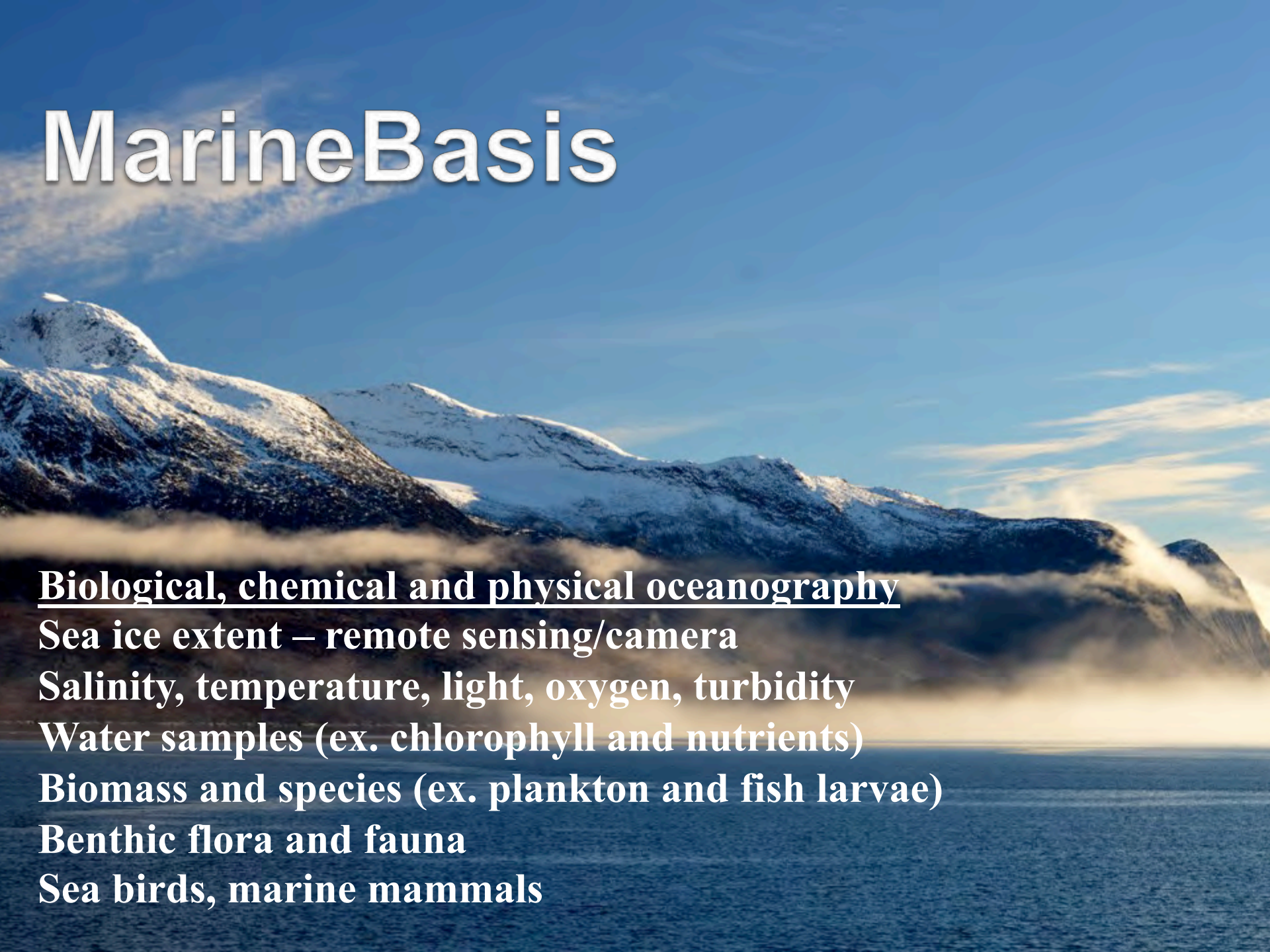
Stn. North upcoming

Zackenberg
Terrestrial - 1996
Marine – 2002

Disko Bay upcoming

Nuuk
Terrestrial - 2007
Marine - 2005

Sermilik upcoming

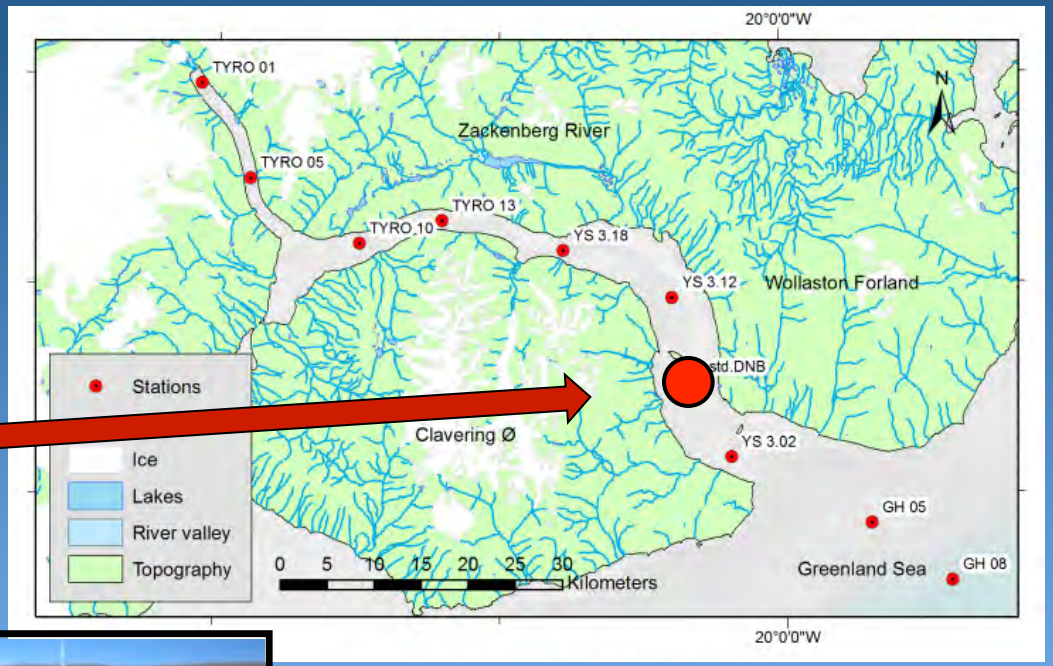

MarineBasis
Biological, chemical and physical oceanography
Sea ice extent – remote sensing/camera
Salinity, temperature, light, oxygen, turbidity
Water samples (ex. chlorophyll and nutrients)
Biomass and species (ex. plankton and fish larvae)
Benthic flora and fauna
Sea birds, marine mammals

High-Arctic monitoring area (74˚N)

Zackenberg

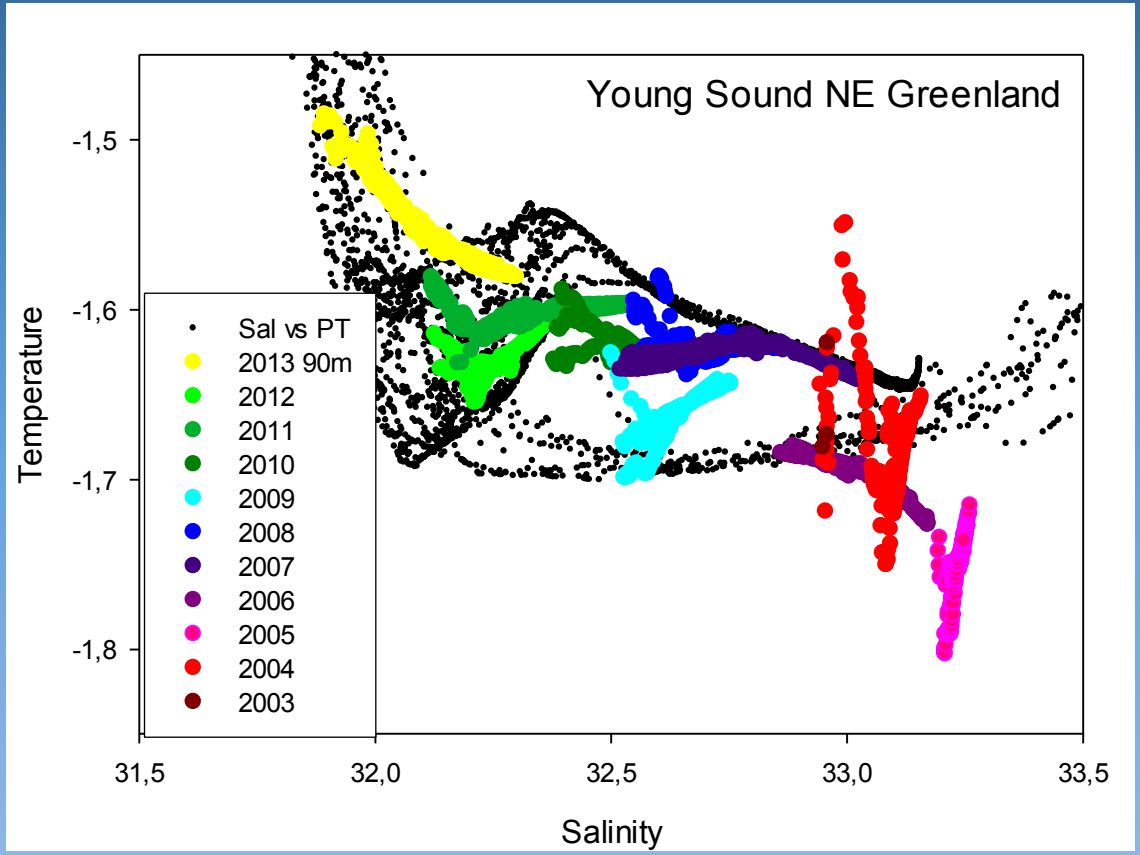
High-Arctic monitoring area (74˚N)

Zackenberg



Changes in salinity and temperature in a 10 year time series

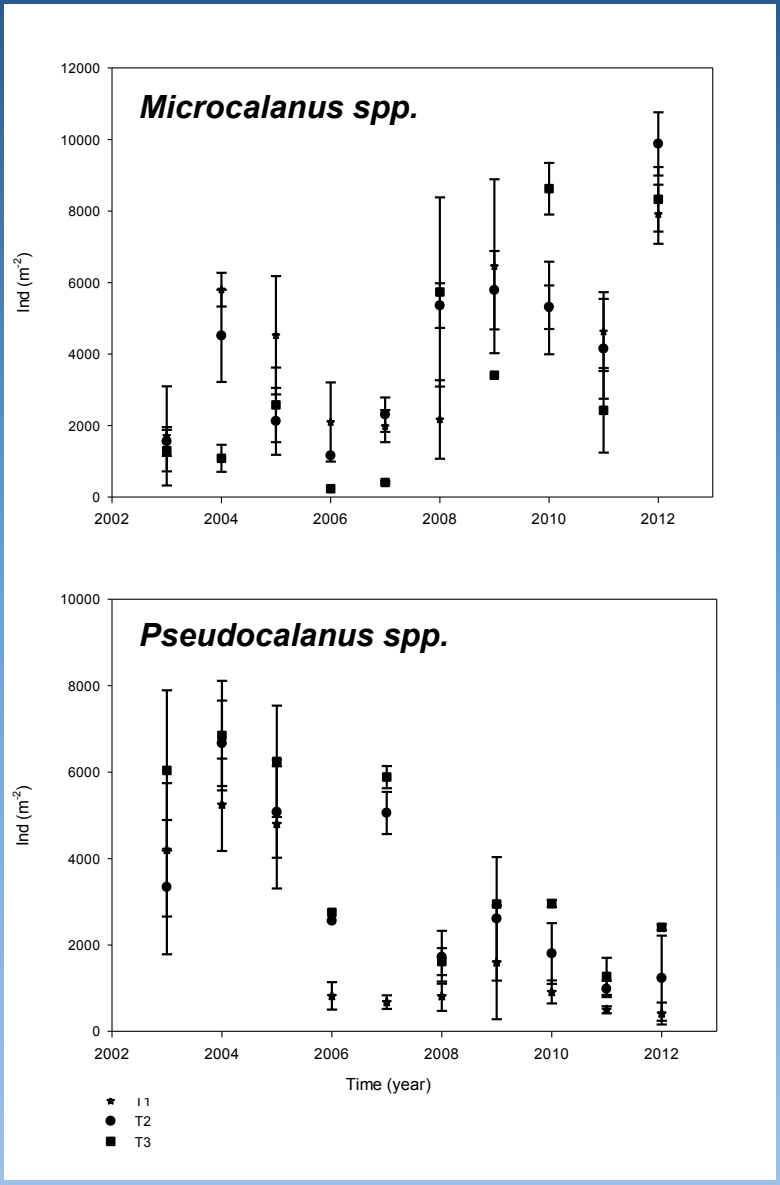
Zackenberg



Marine Basic Zackenberg
Greenland Ecosystem Monitoring

Changes in copepod species composition

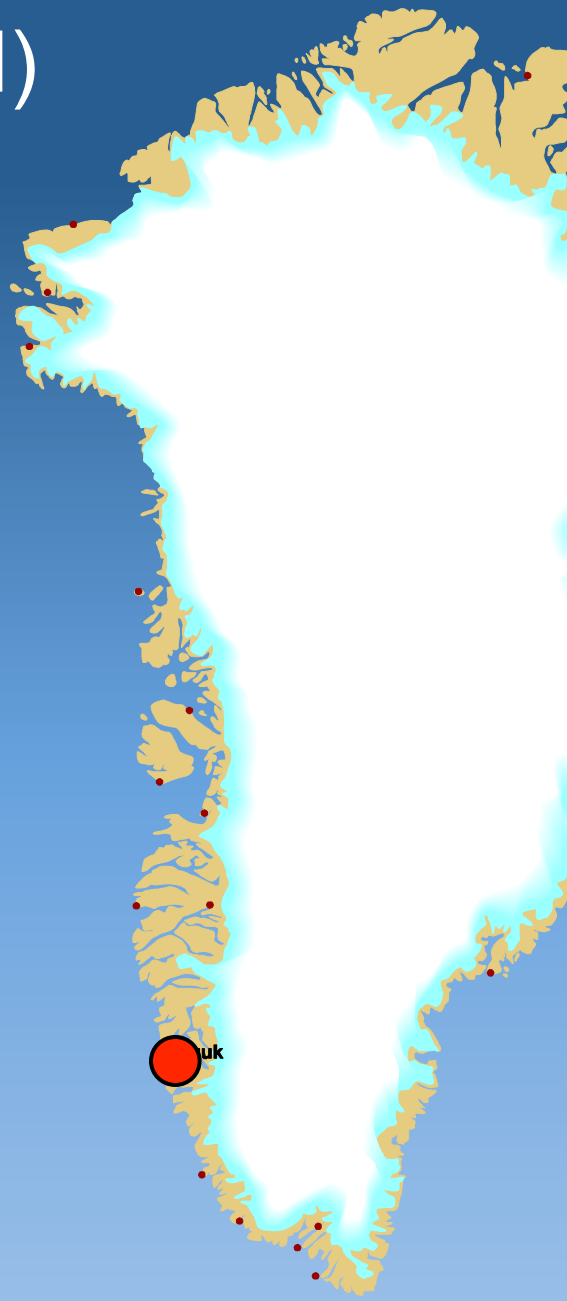
Zackenberg



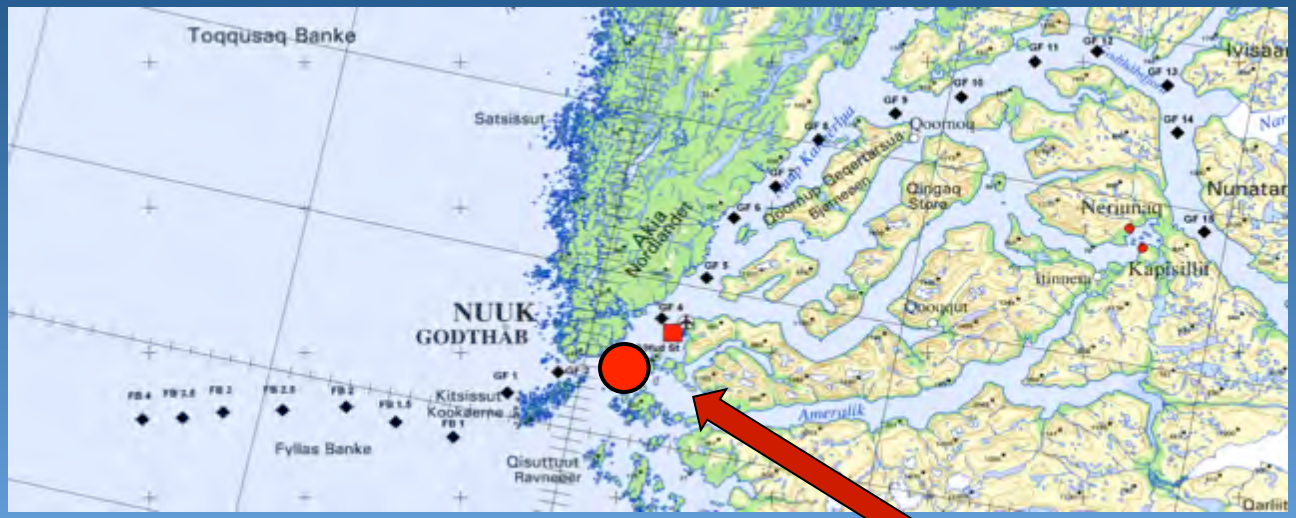
Marine Basic Zackenberg
Greenland Ecosystem Monitoring

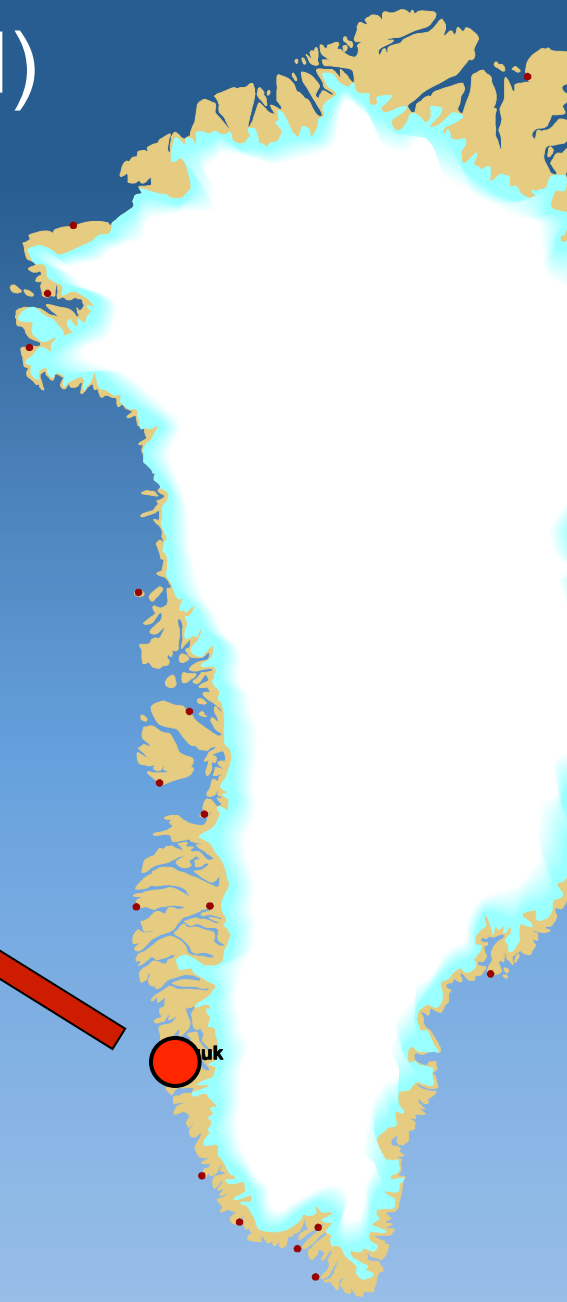
Sub-Arctic monitoring area (64˚N)

Nuuk

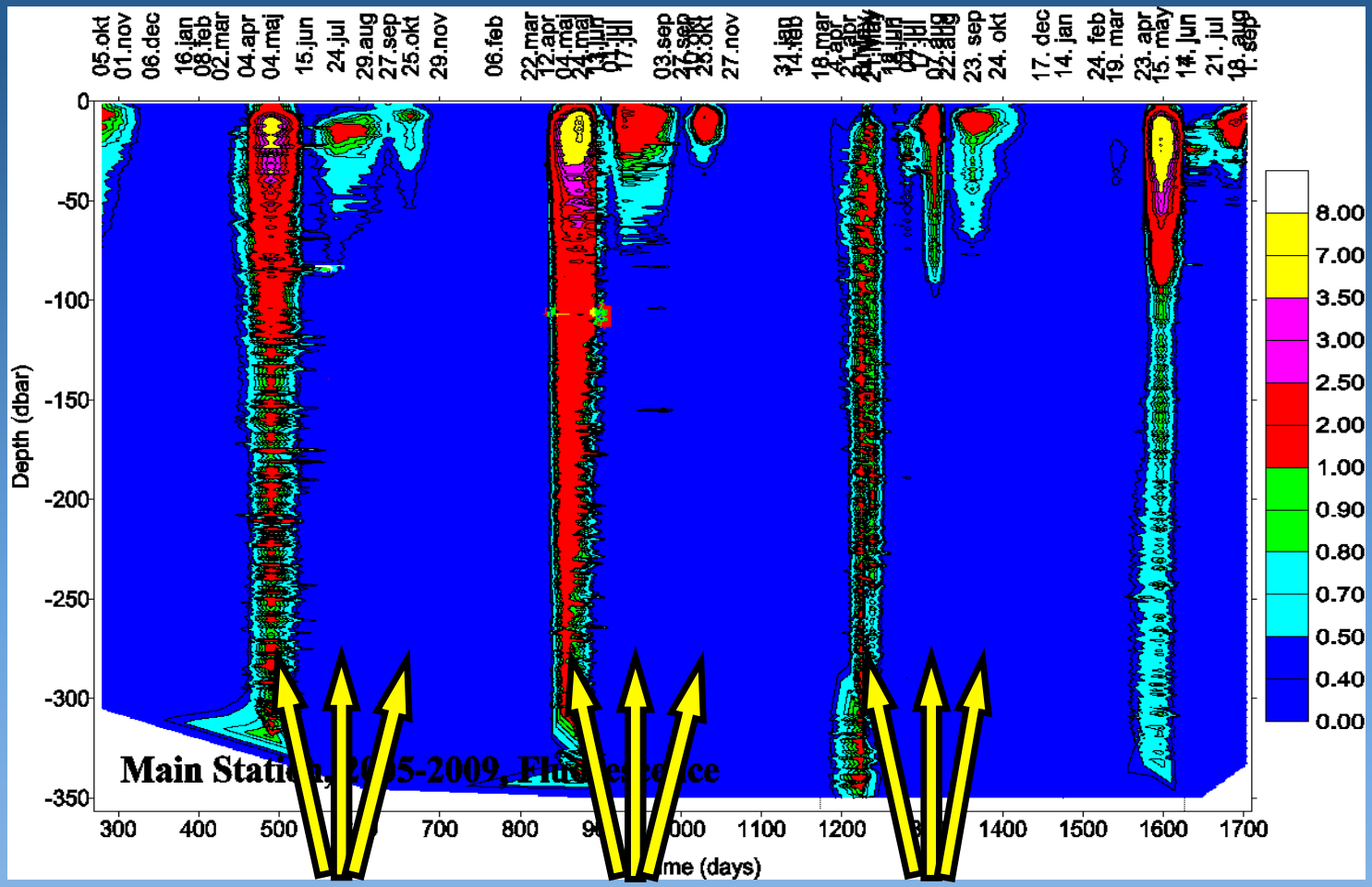


Sub-Arctic monitoring area (64˚N)





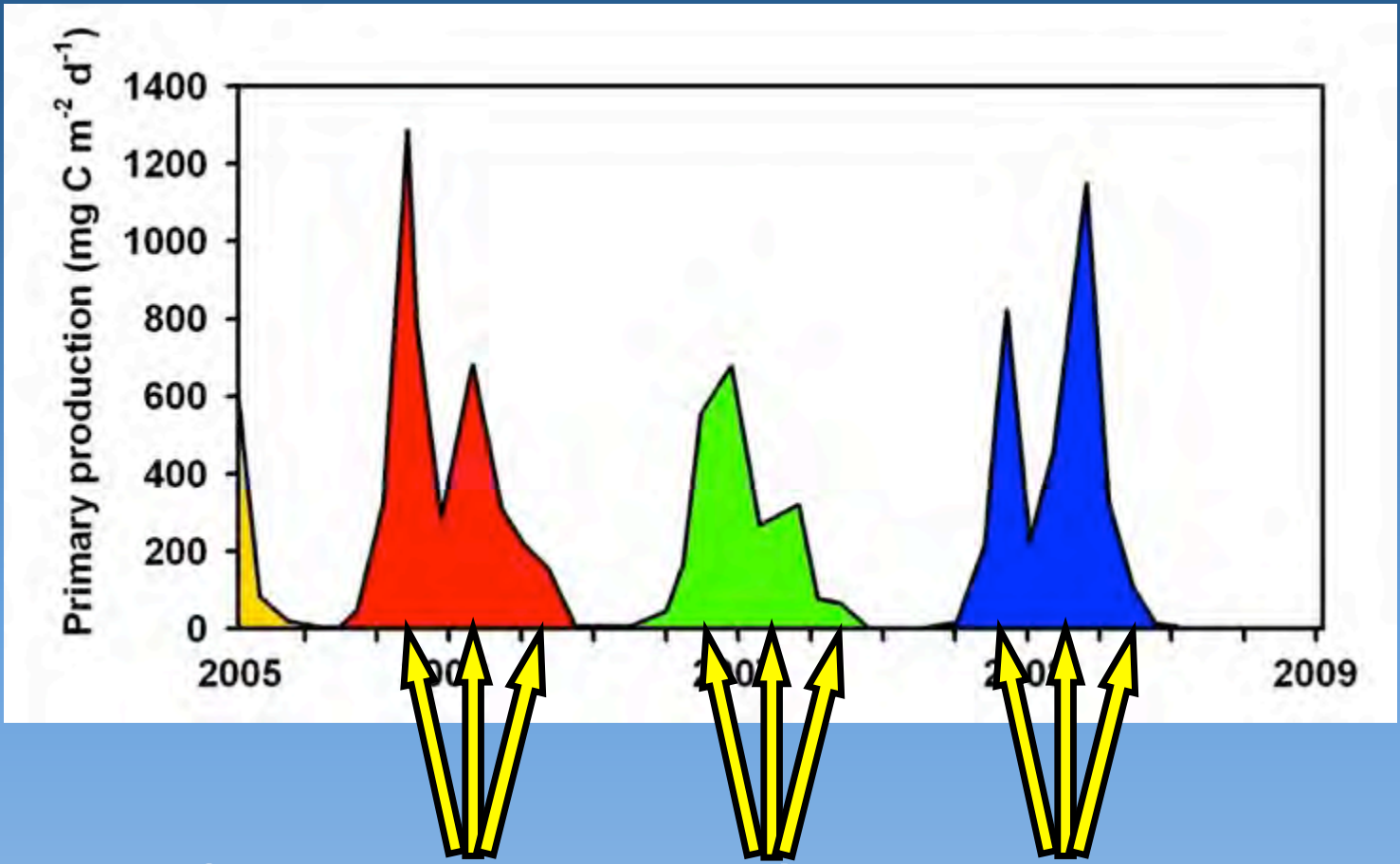
Phytoplankton biomass



3 separate annual bloom events

Marine Basic Nuuk
Greenland Ecosystem Monitoring

Primary production

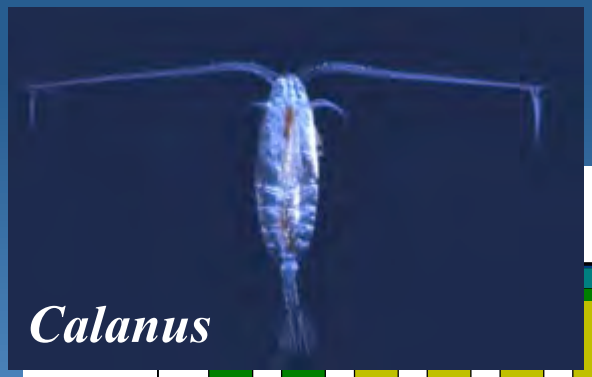


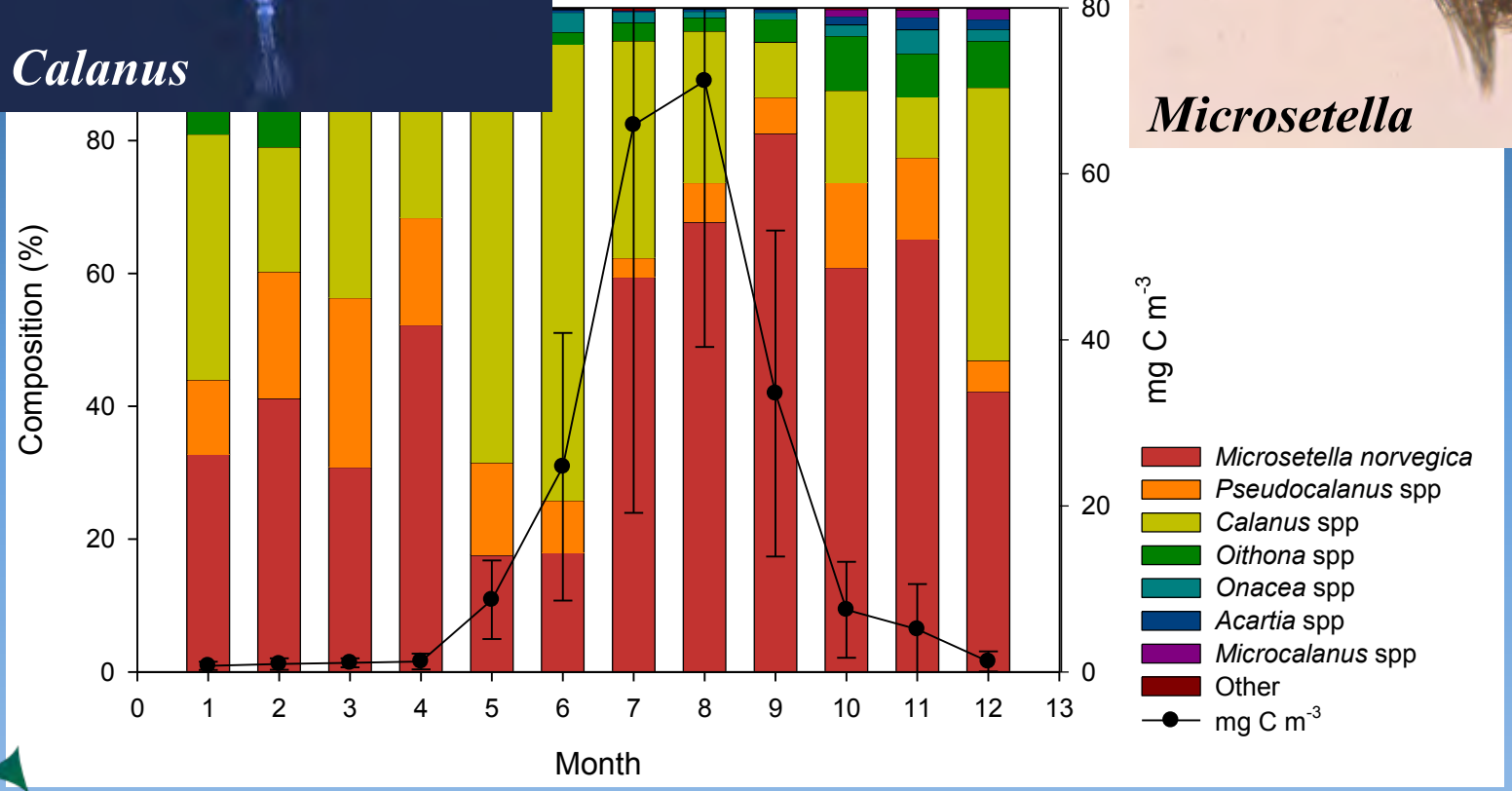
3 separate annual bloom events

Annual primary production ~94 g C m^{-2} yr^{-1}

Marine Basic Nuuk
Greenland Ecosystem Monitoring

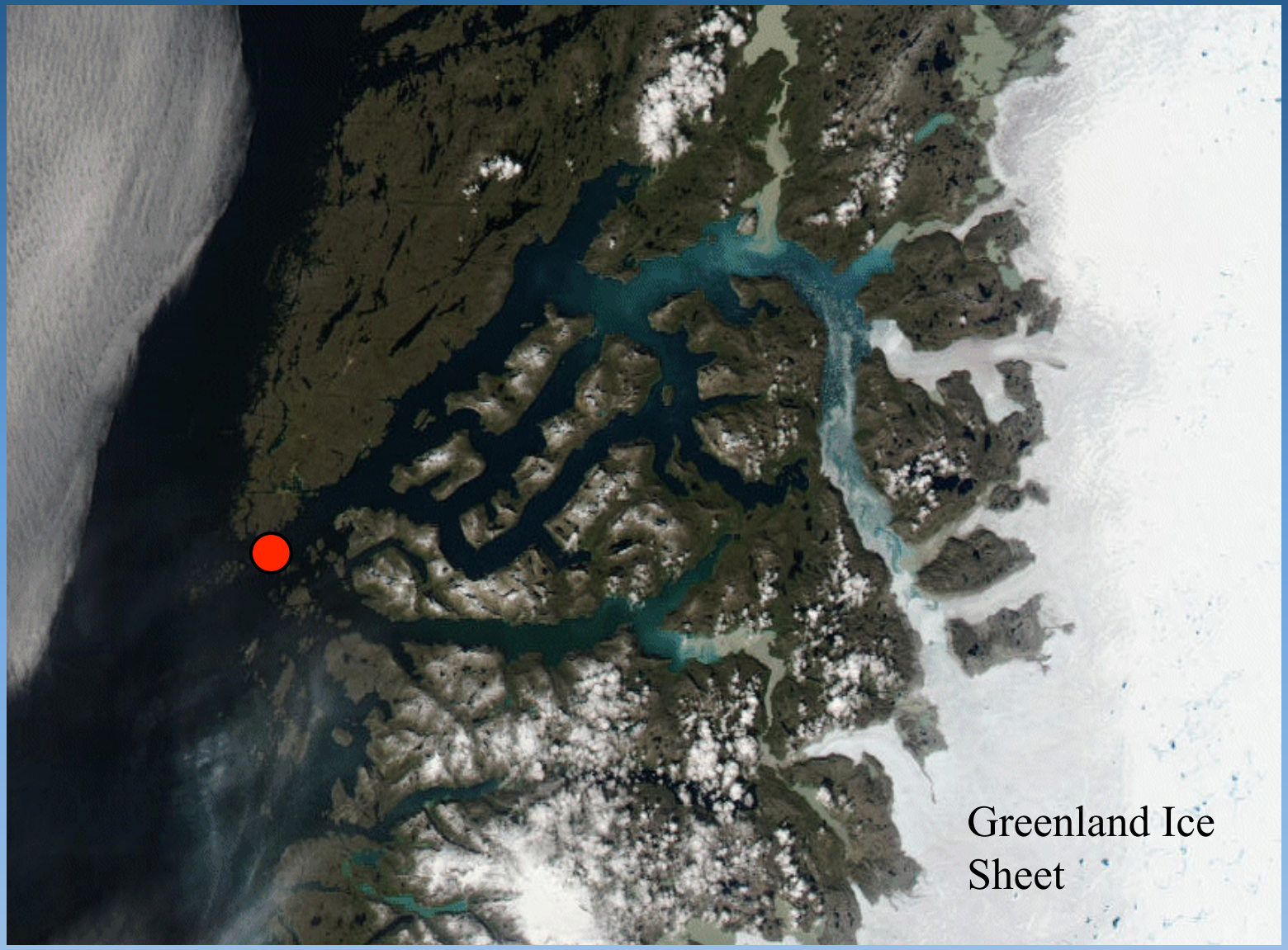
Copepod biomass peaks in August





Arendt et al. 2013

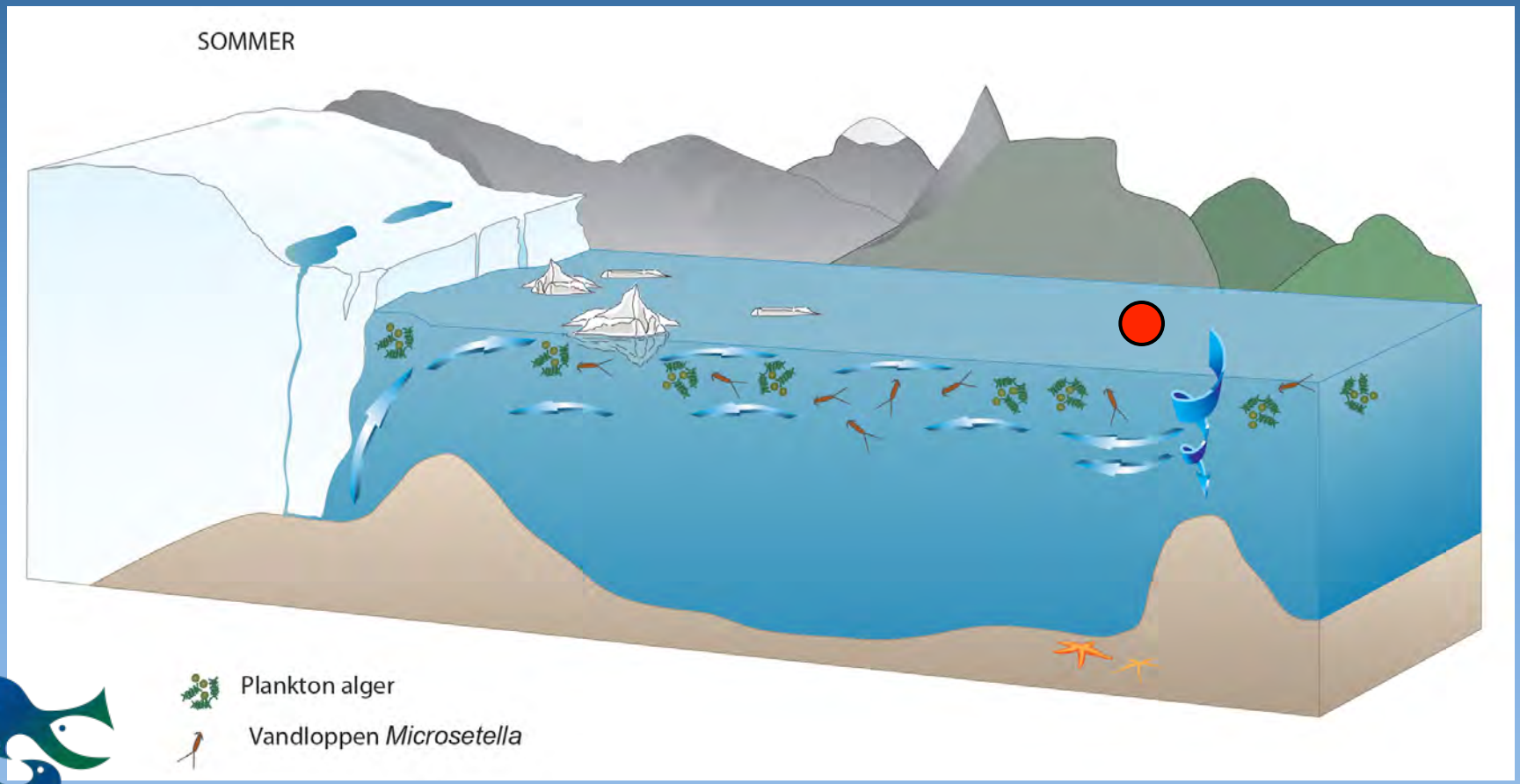
Ocean – Fjord - Glacier



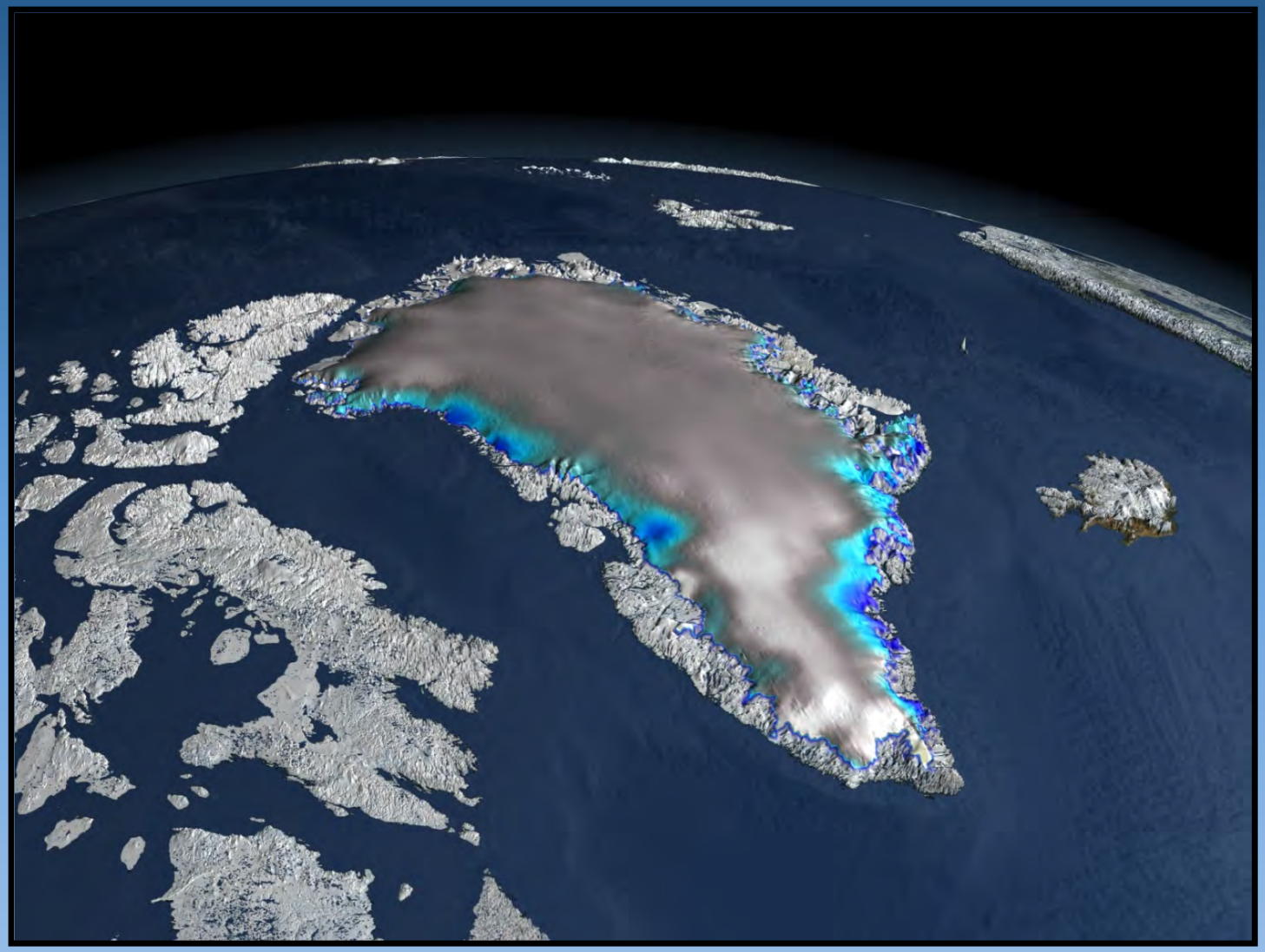
Glacier → sub-glacial runoff

Kjeldsen et al. 2014

Pelagic biodiversity influenced by runoff from the Greenland Ice Sheet



Observed ablating of the Greenland Ice Sheet



NASA/Goddard Space Flight Center Scientific Visualization Studio

Ocean-fjord-glacier interactions

Greenland Ice Sheet

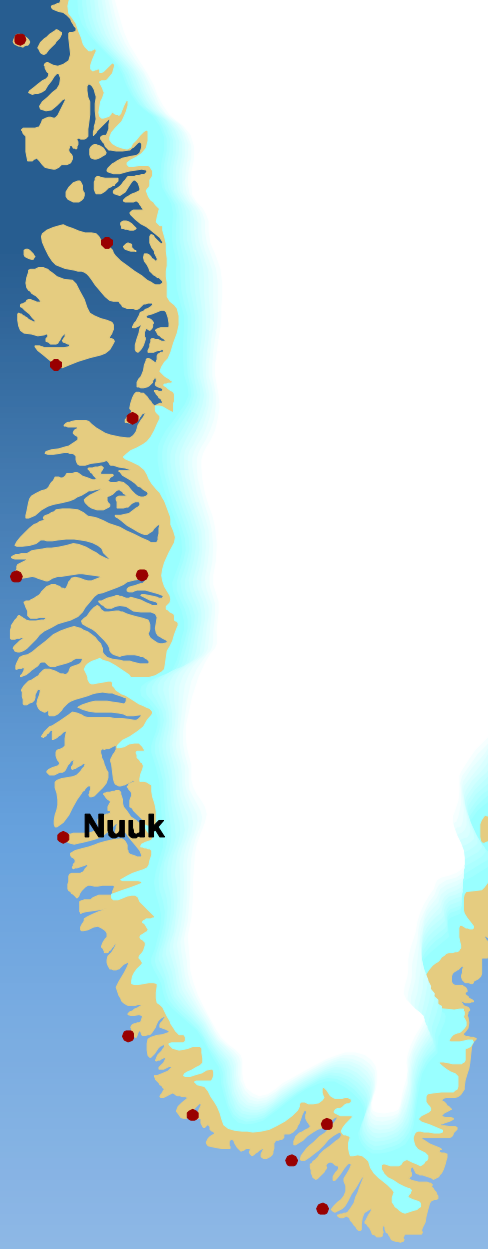
Second largest ice body in the world

Covering 1,710,000 km^2
80% of the surface of Greenland

Runoff > 1000 km^3 $year^{-1}$

If all the ice in Greenland melted,
the sea level would rise by 6.4 meters globally

Climate Changes stressors

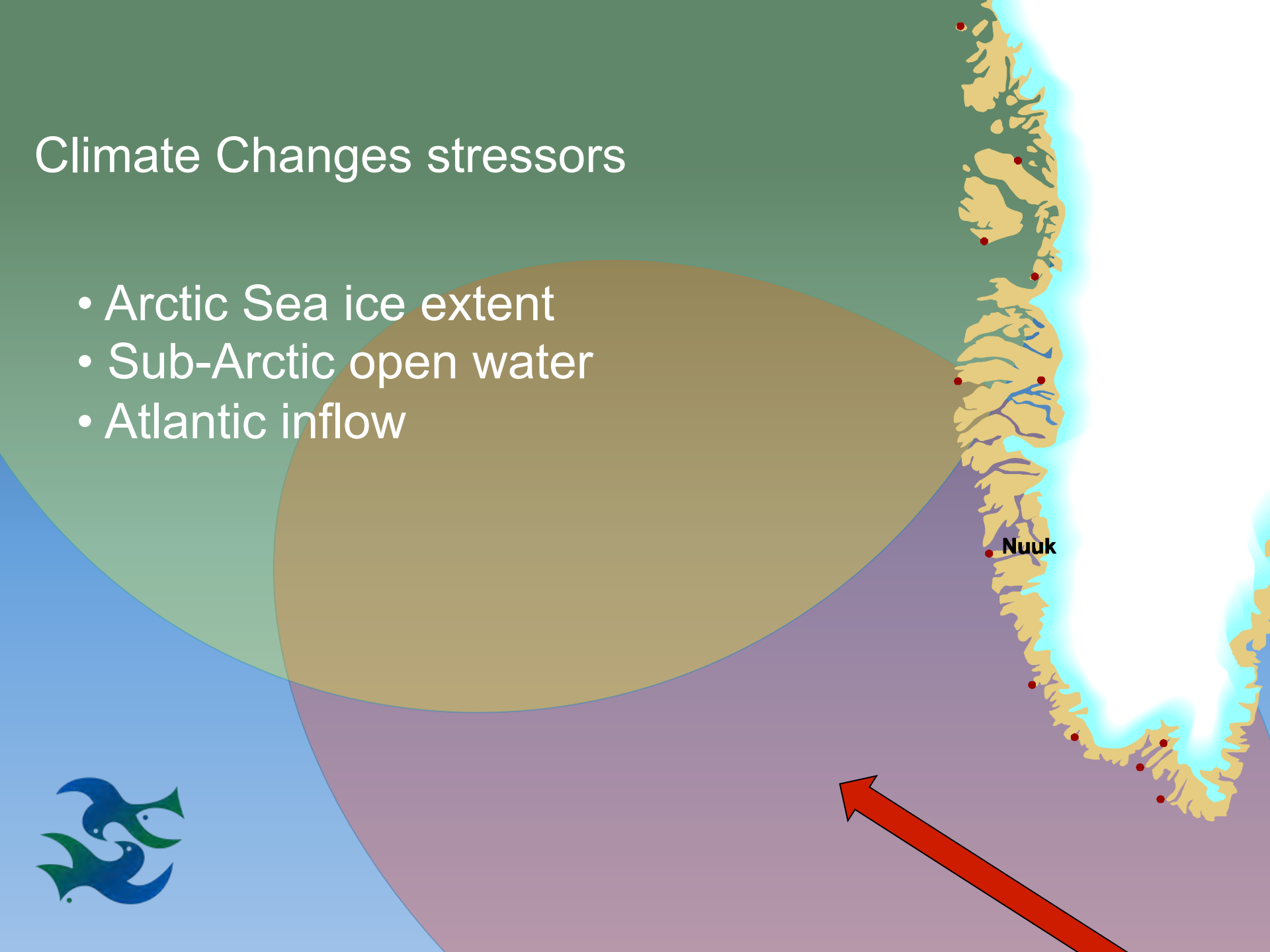


Climate Changes stressors

- Arctic Sea ice extent

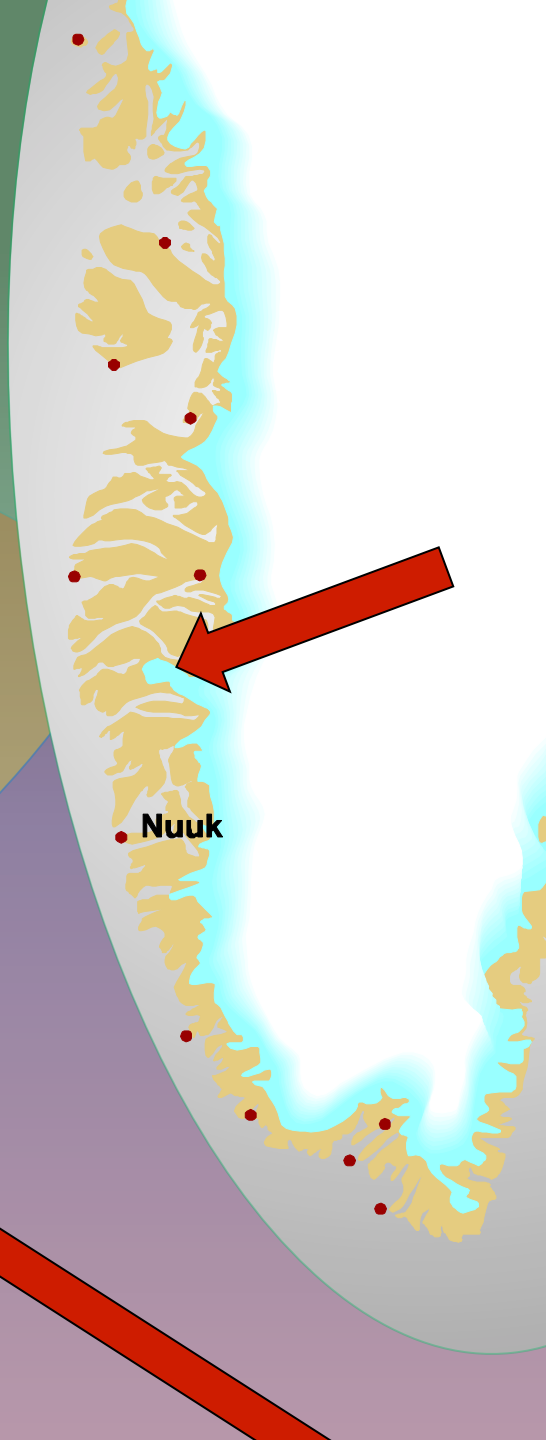
Climate Changes stressors

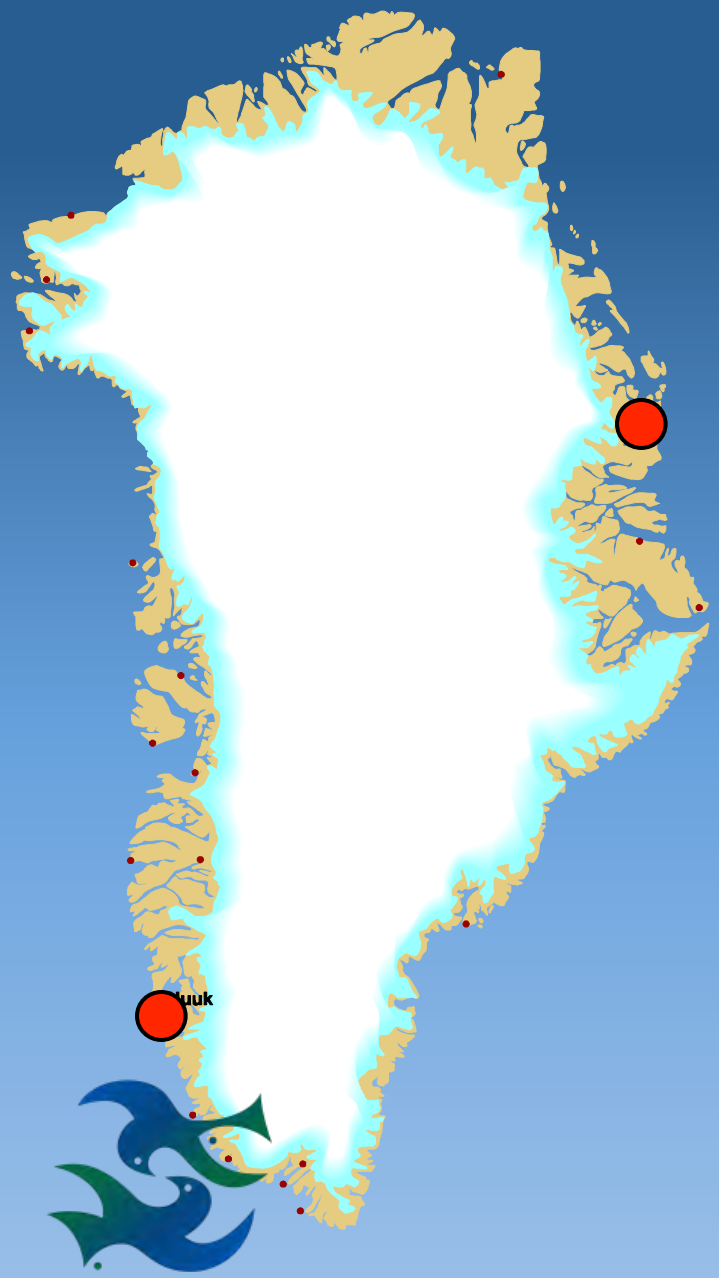
- Arctic Sea ice extent
- Sub-Arctic open water
- Atlantic inflow



Climate Changes stressors

- Arctic Sea ice extent
- Sub-Arctic open water
- Atlantic inflow
- Runoff from the Greenland Ice Sheet





Greenland Ecosystem Monitoring Programme

God indication for ecosystem changes in two fjords

Research projects in the next 200+ fjords

Next step - ecosystem monitoring offshore systems

Recommendation # 16 of the Arctic Biodiversity Assessment

Climate Changes stressors → ablating of the Greenland Ice Sheet

- Biological Oceanography
- Year-around monitoring station in offshore area
- Studies on interactions to higher trophic levels

Funding:
Greenland Ecosystem Monitoring Programme (GEM)
Danish Ministry of the Environment (DANCEA)
Greenland Institute of Natural Resources (GINR)