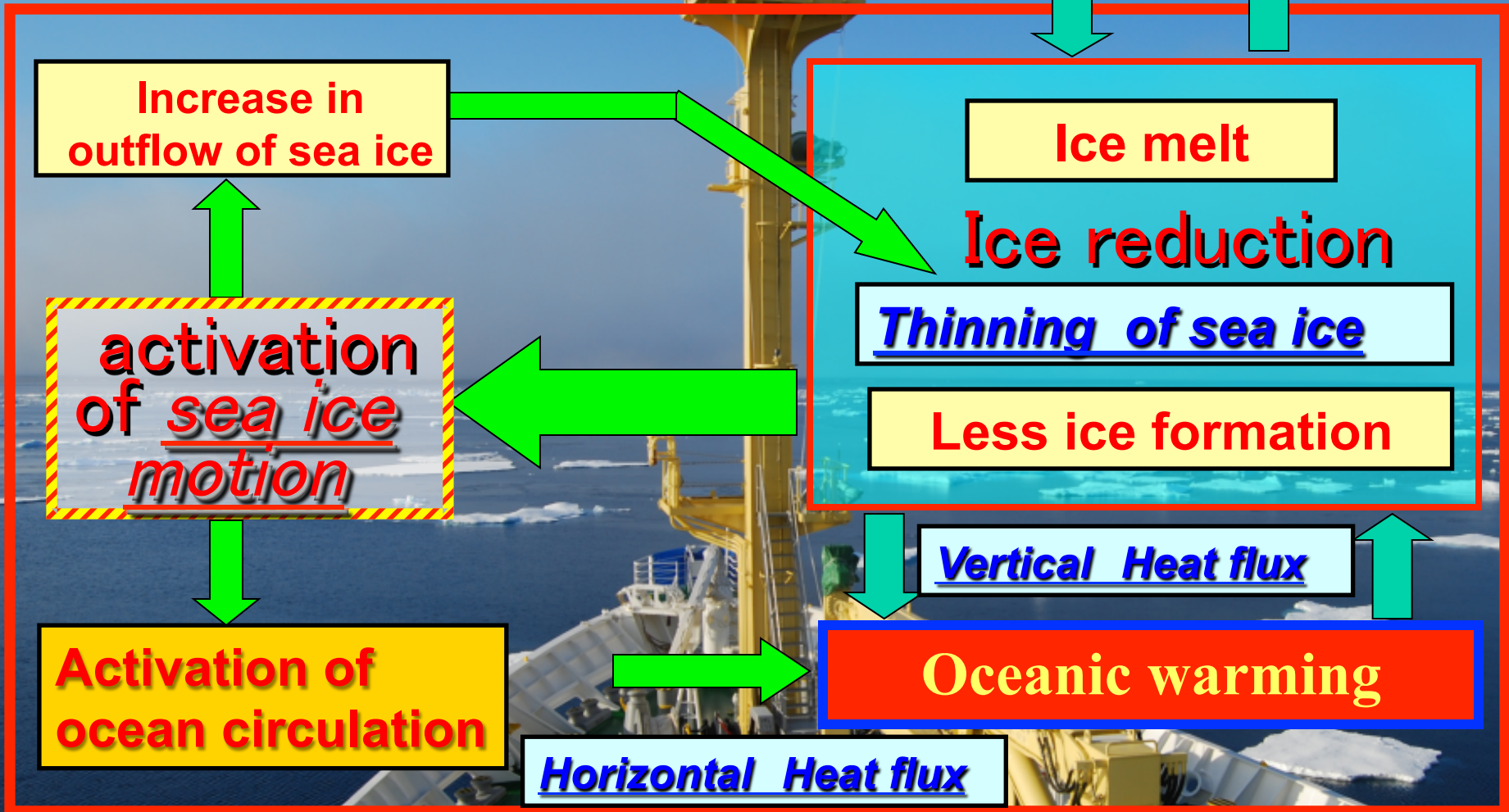


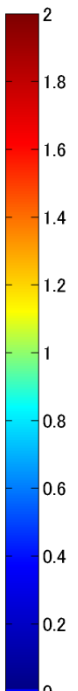
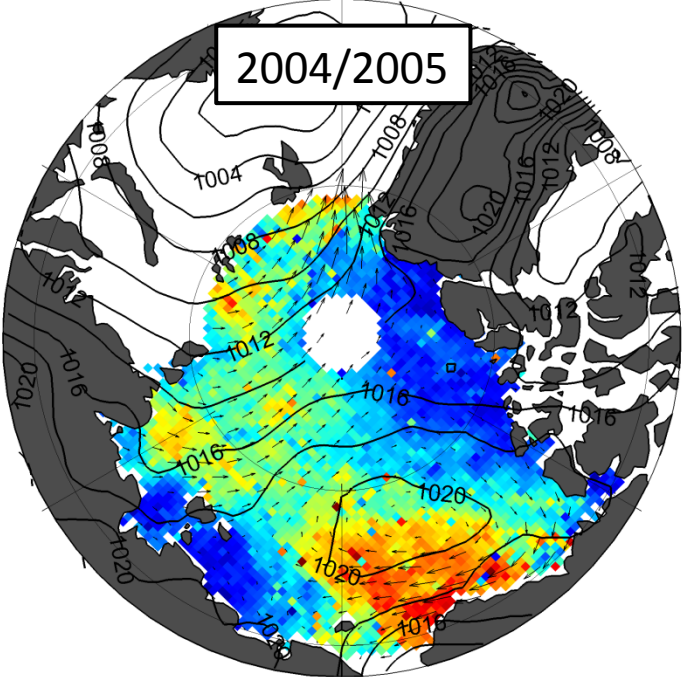
Changes in Atmospheric circulation



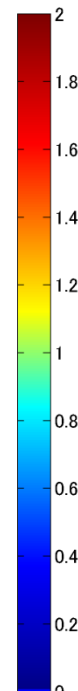
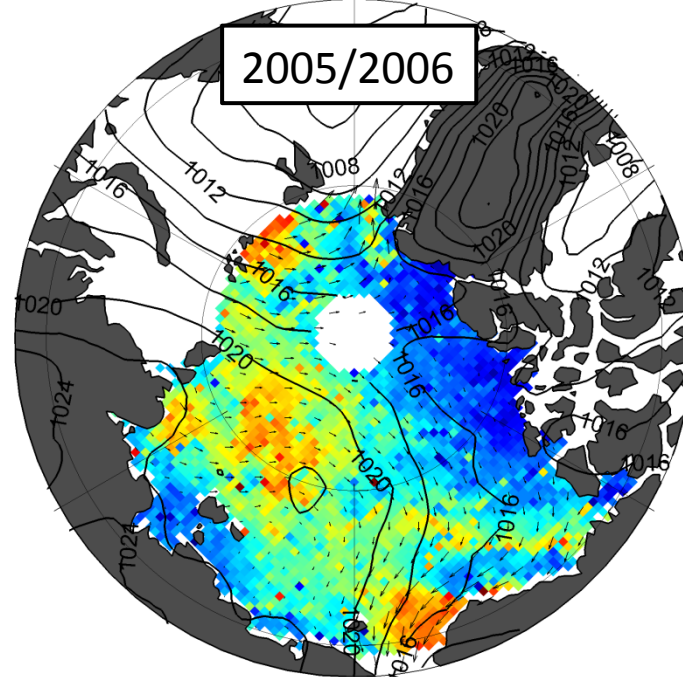
Positive feedback to drive catastrophic changes of the Arctic climate system

Activation of sea ice motion
associated with increase in wind factor
(sea ice speed/wind speed)

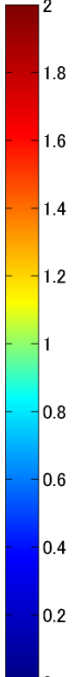
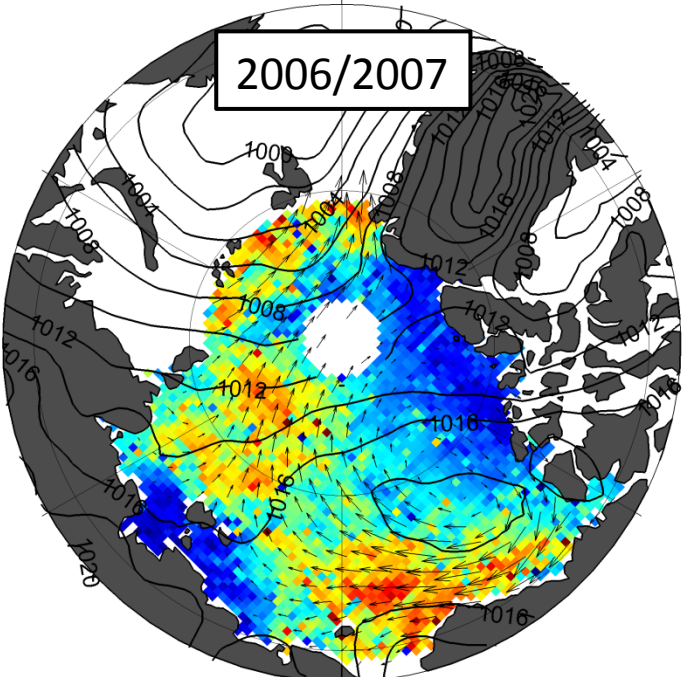
2004/2005



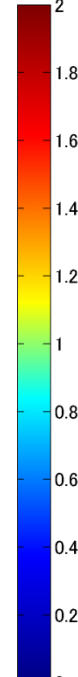
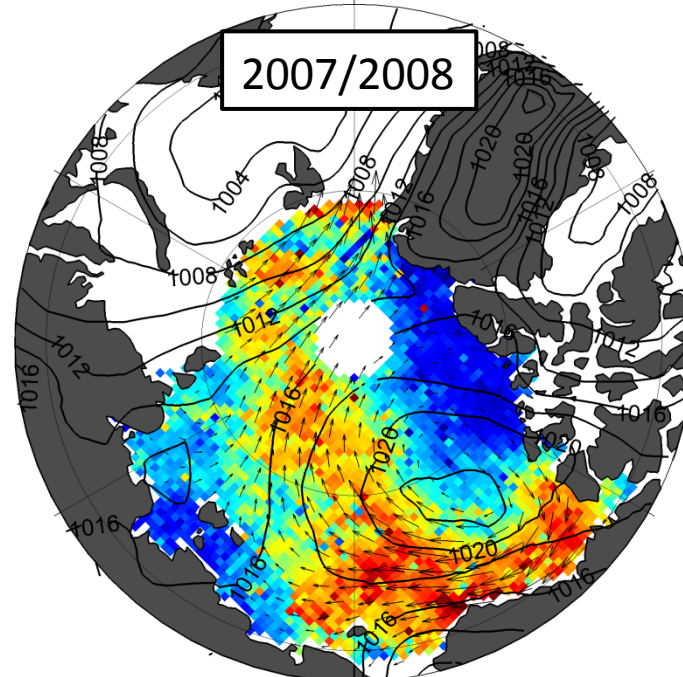
2005/2006



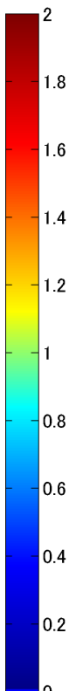
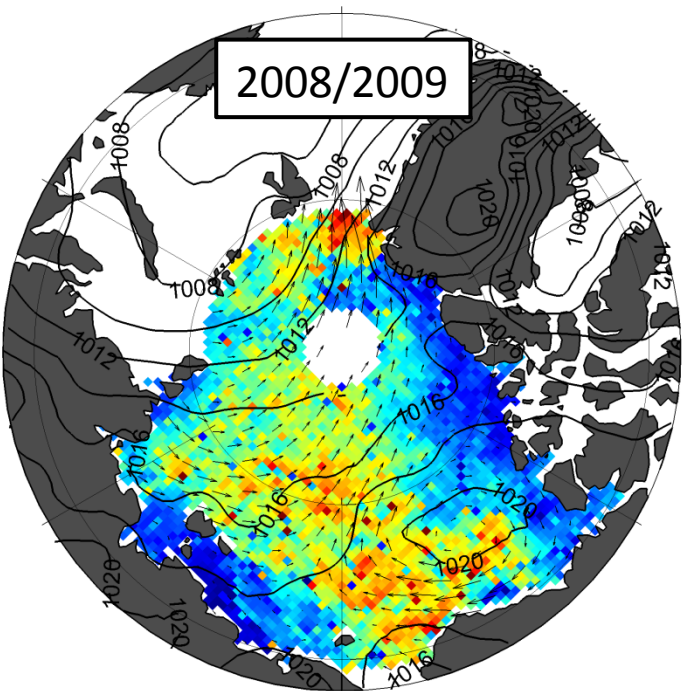
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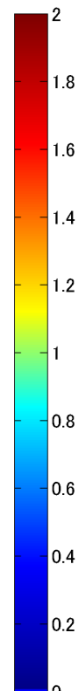
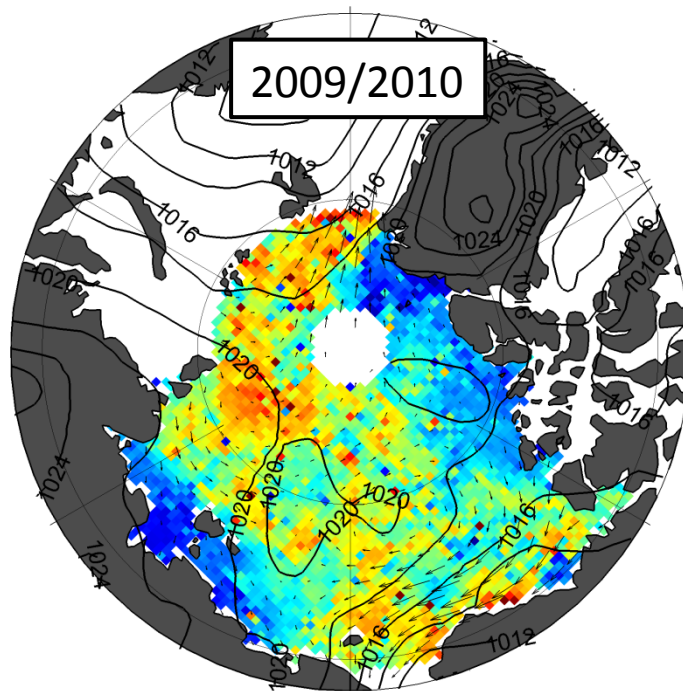
2007/2008



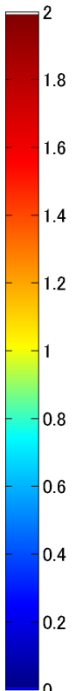
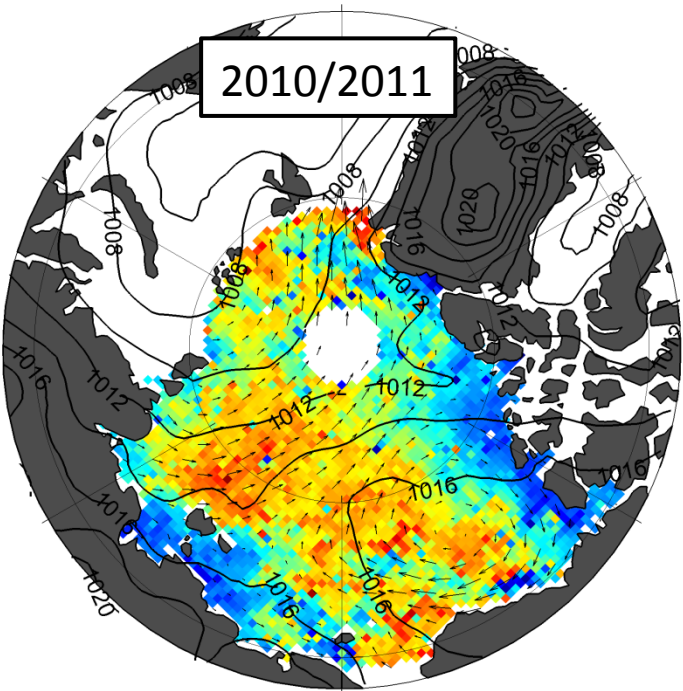
2008/2009



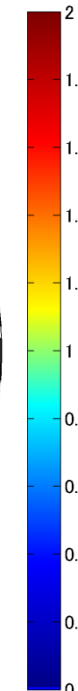
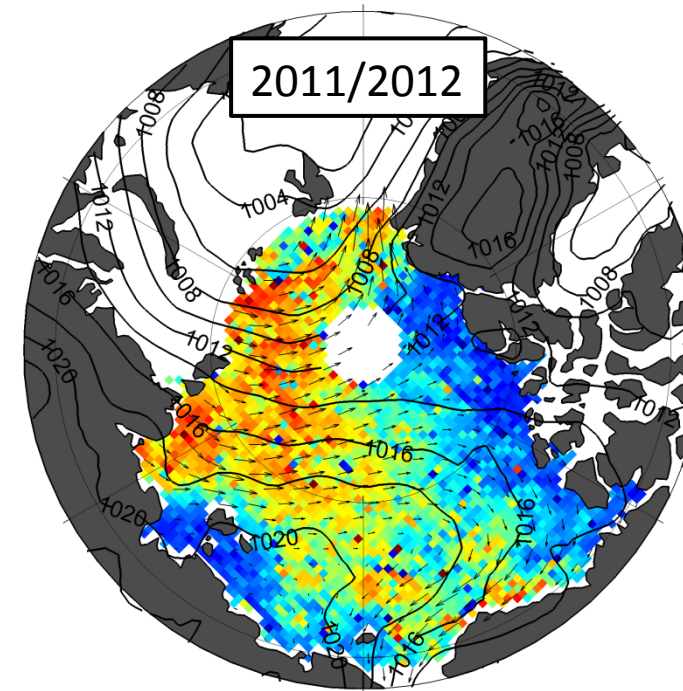
2009/2010



2010/2011

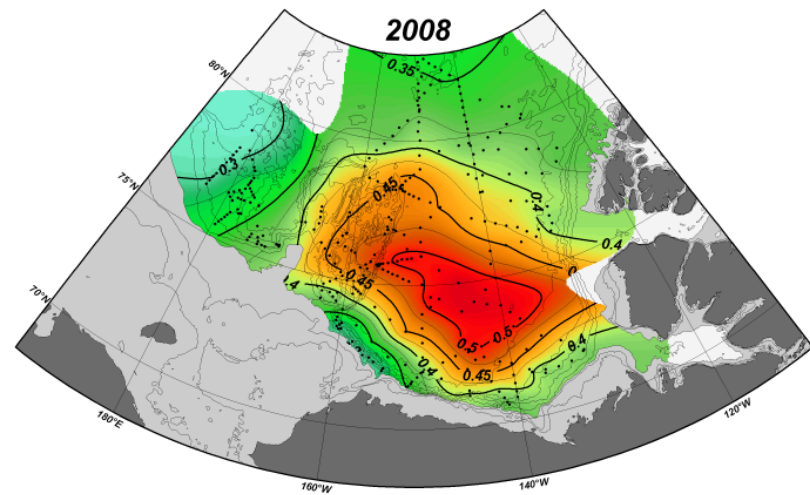
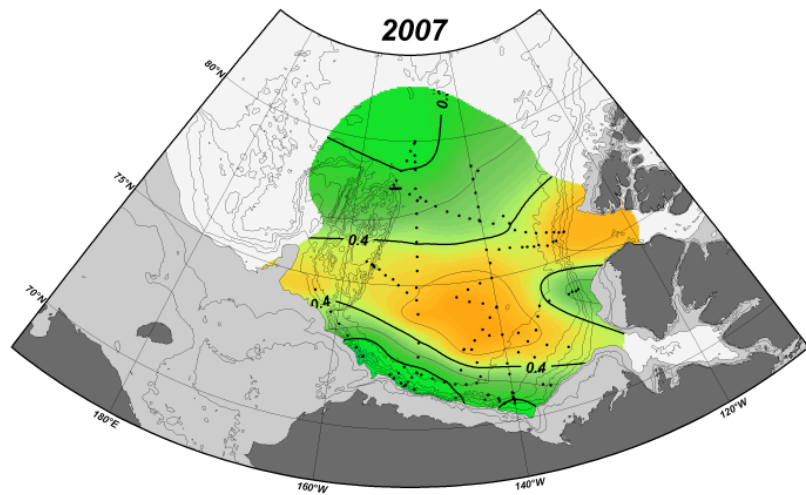
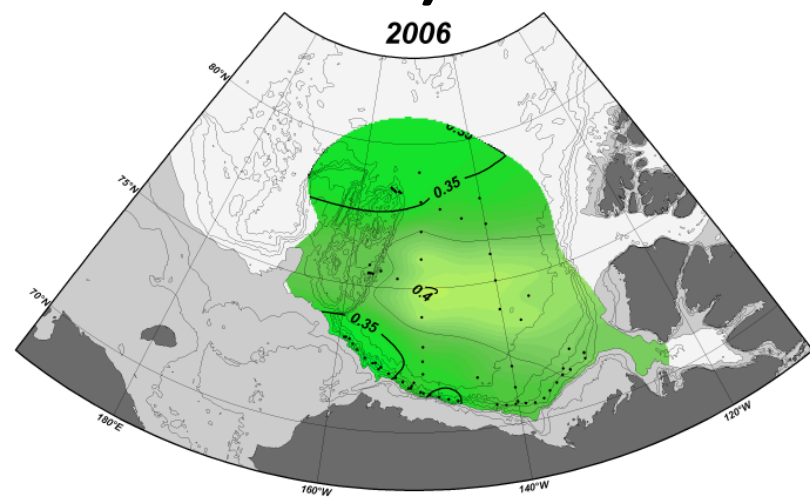
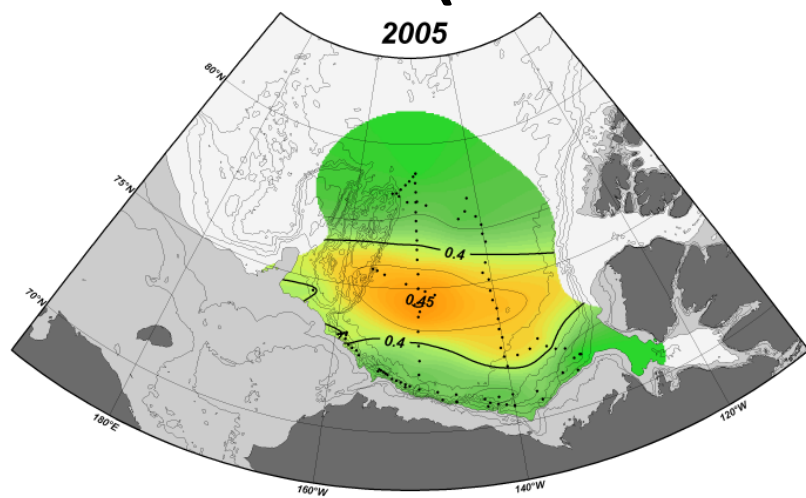


2011/2012

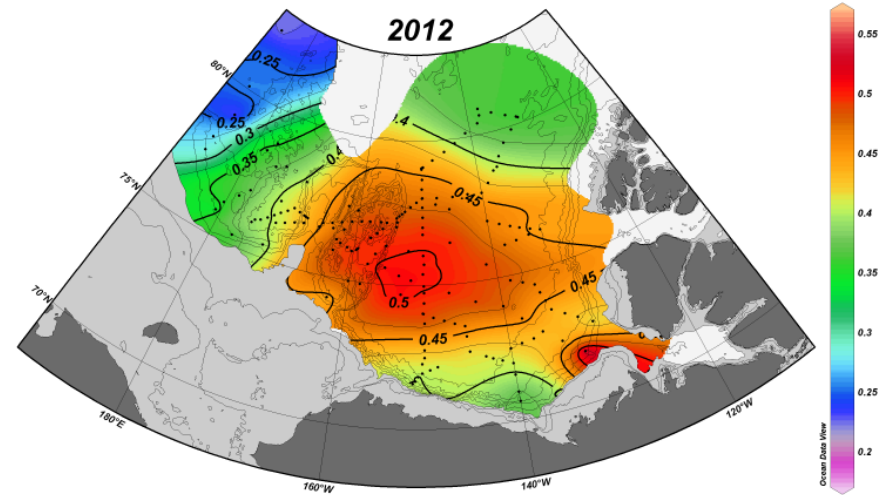
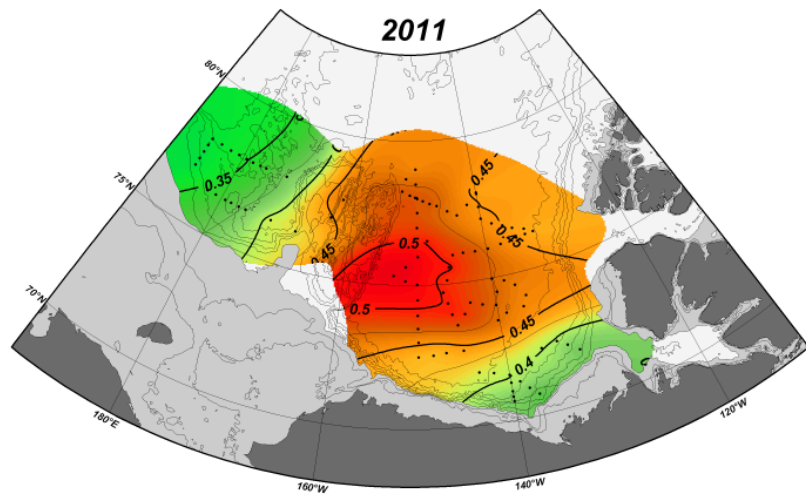
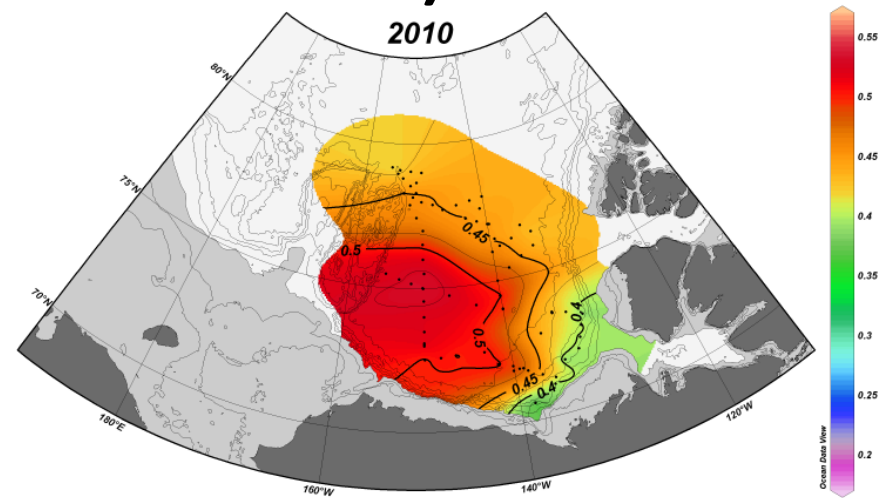
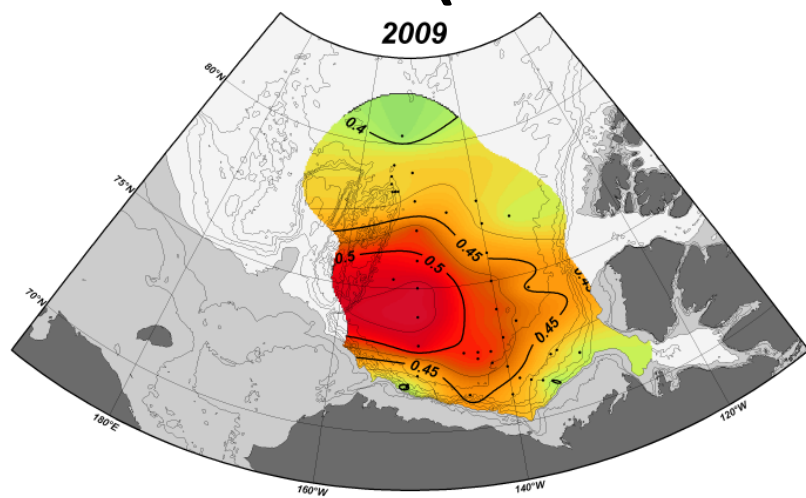


Activation of upper ocean circulation

Dynamic Height at 50dbar (reference 800dbar)

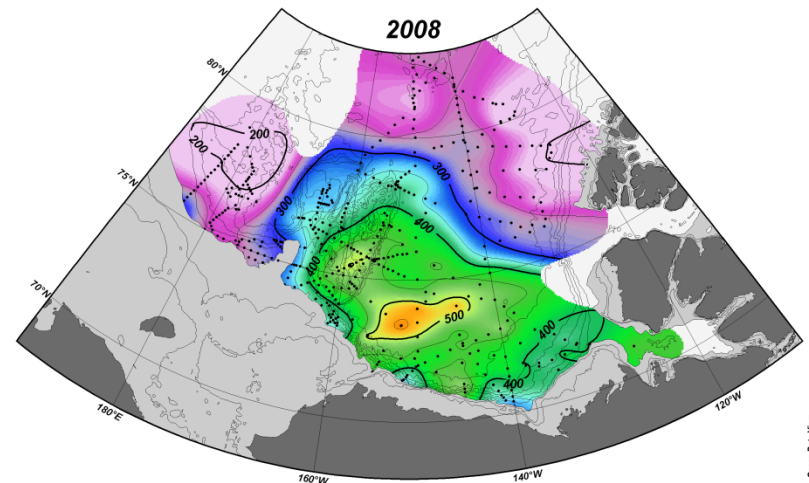
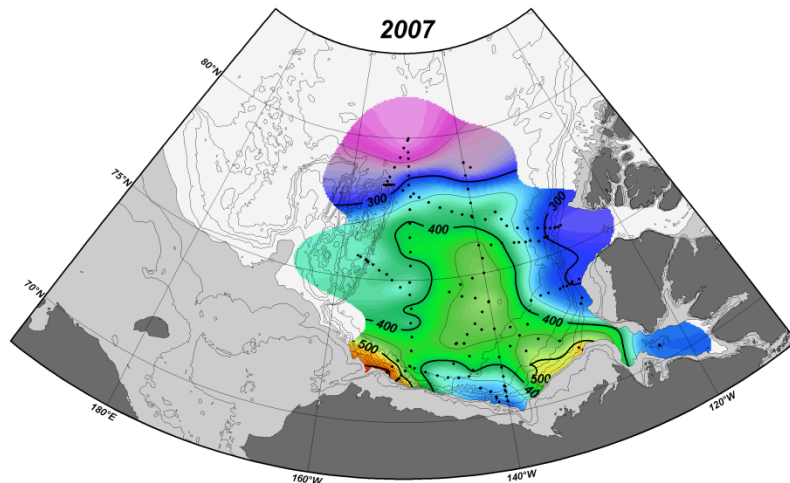
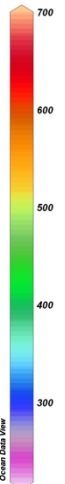
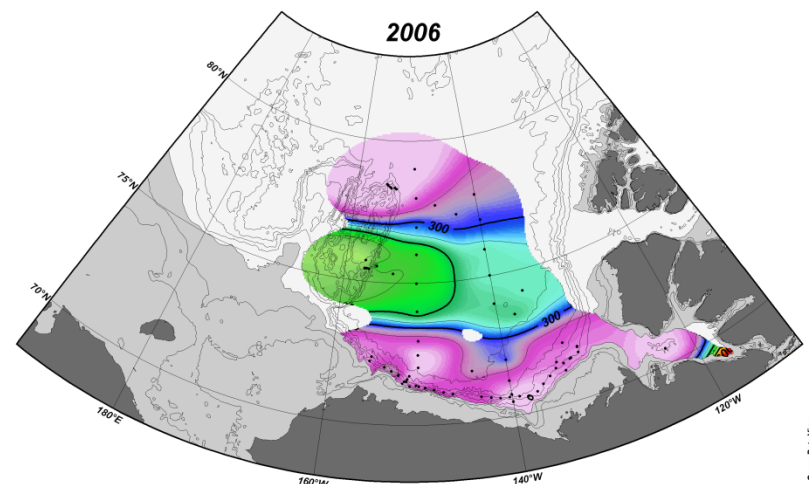
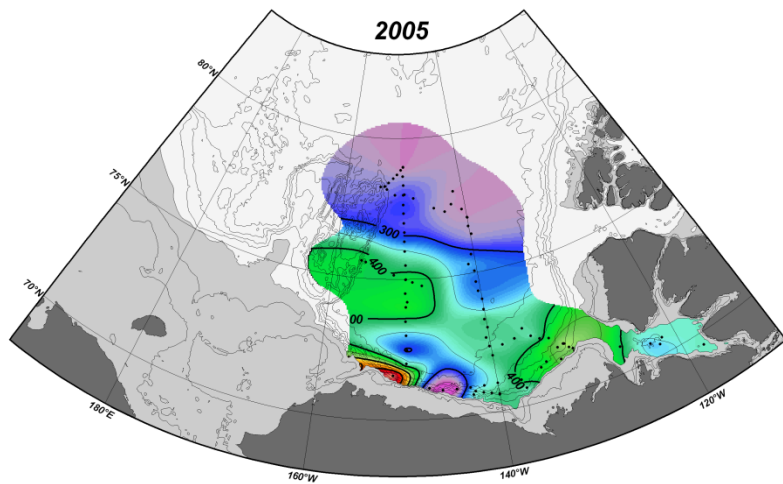


Dynamic Height at 50dbar (reference 800dbar)

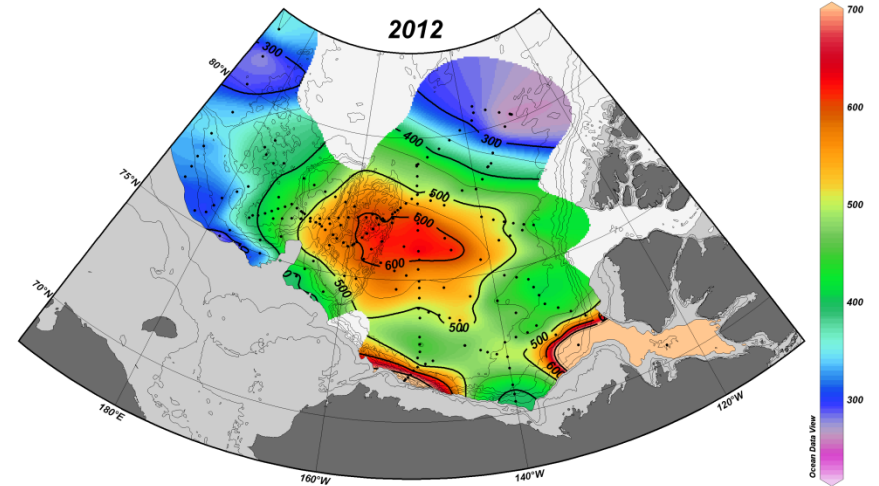
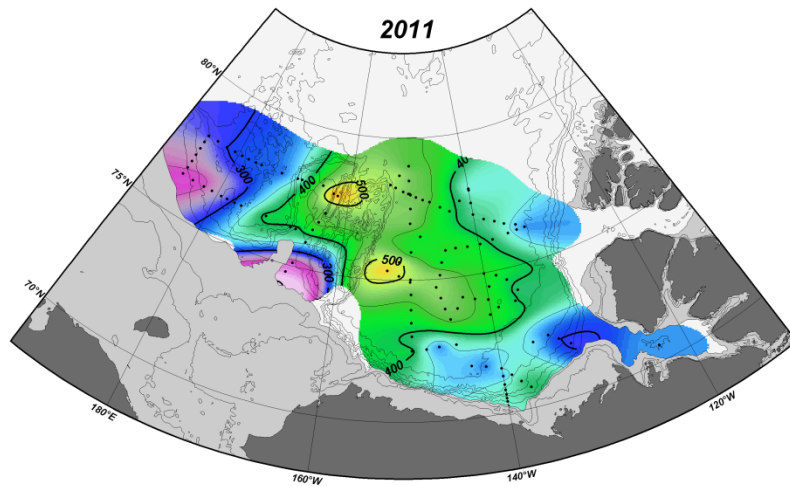
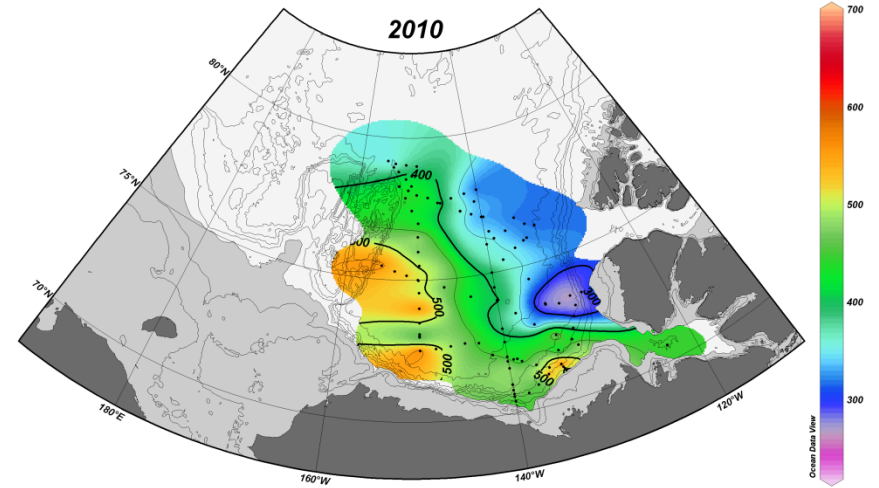
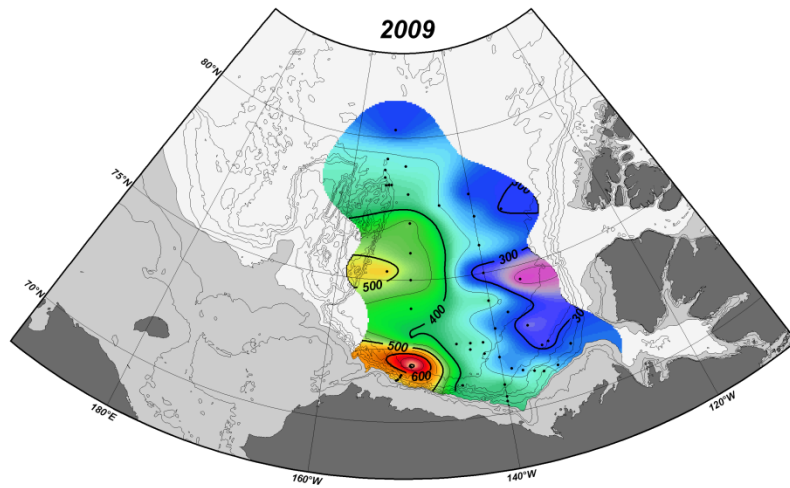


Upper ocean warming

Heat content (20-150m)



Heat content (20-150m)

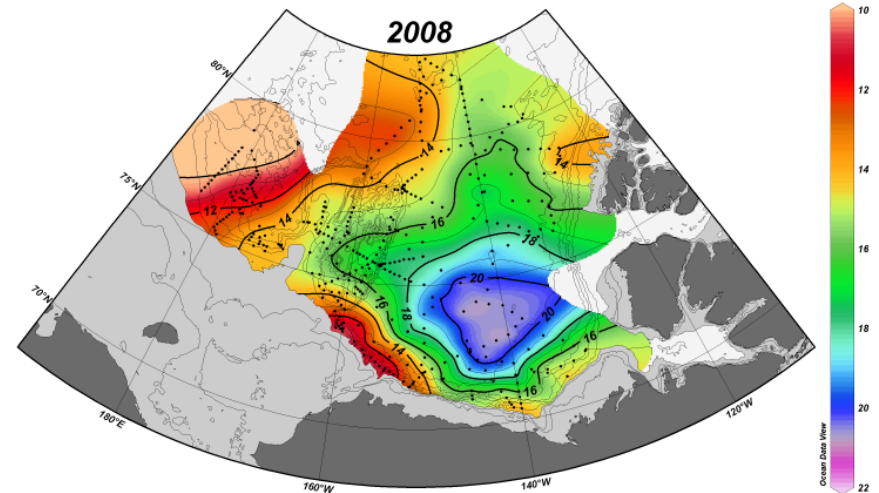
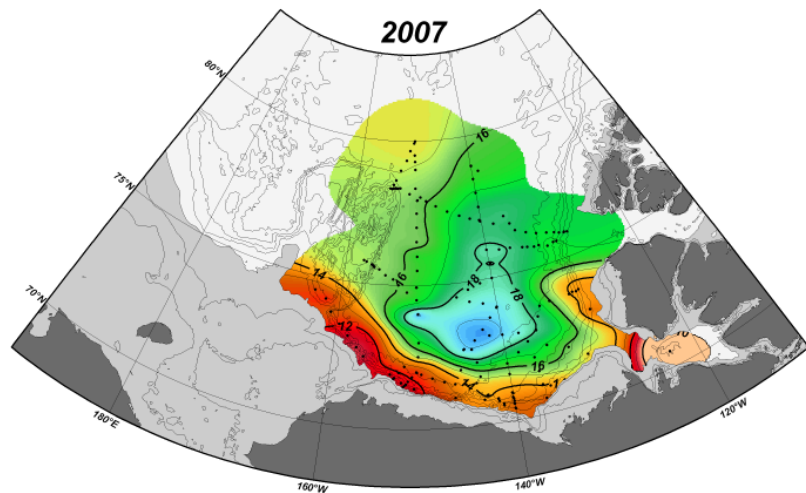
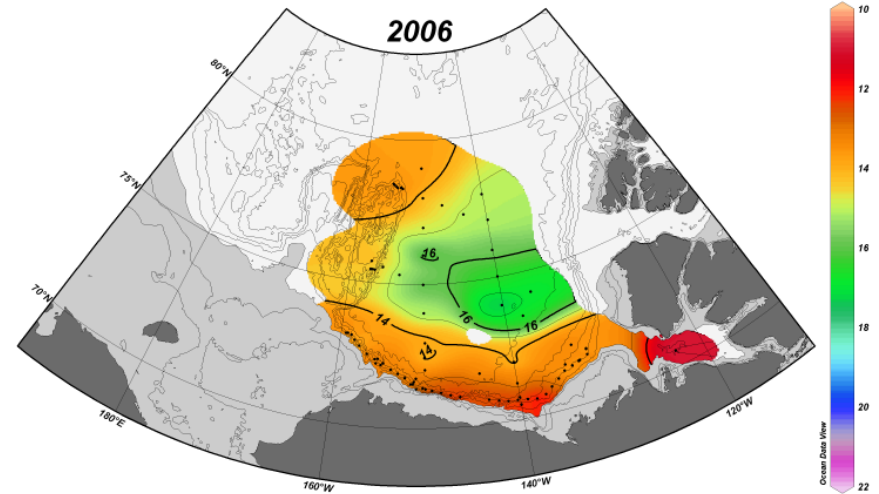
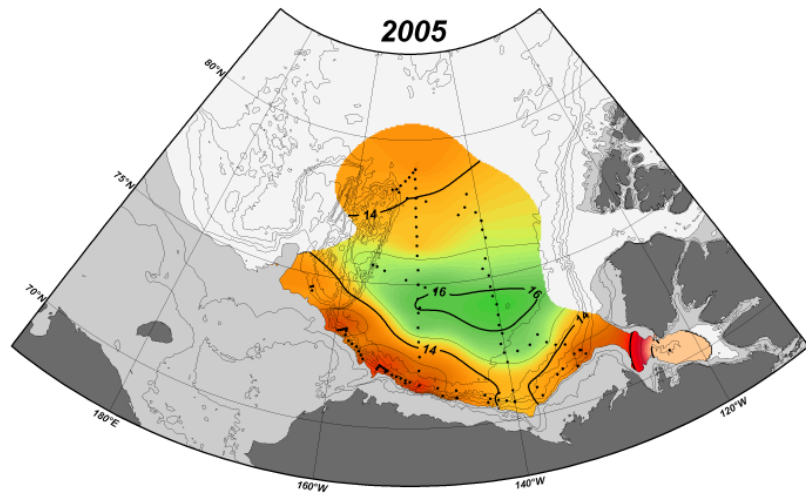


Freshwater content

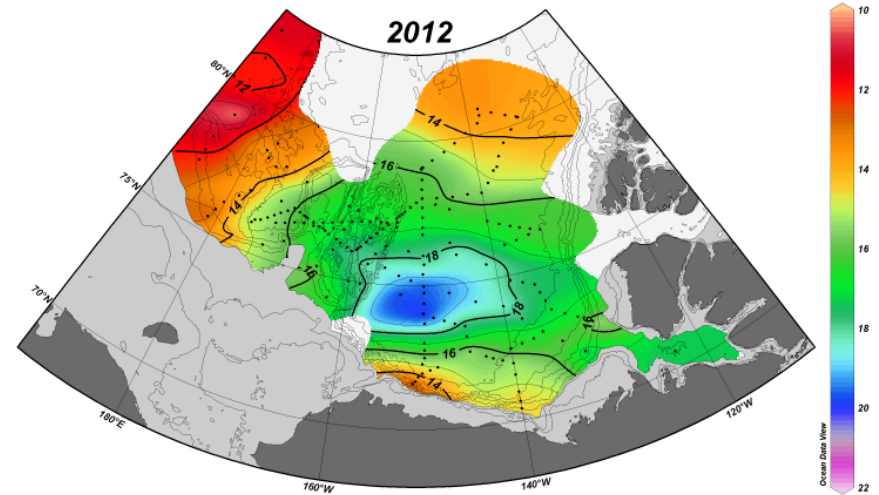
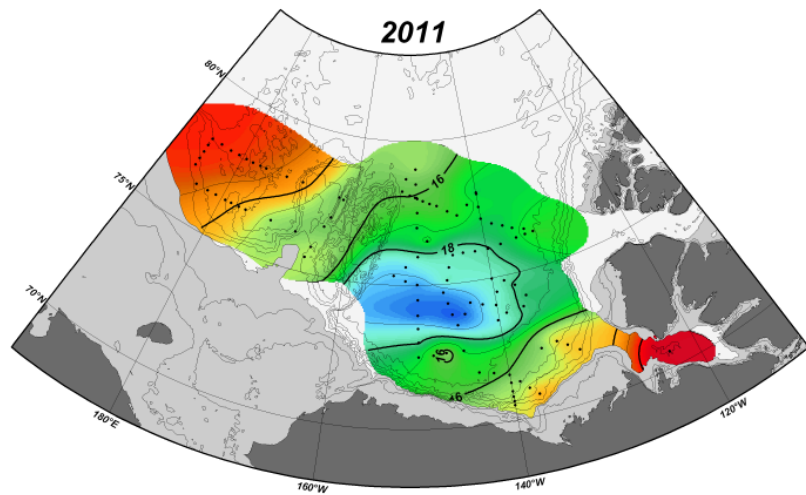
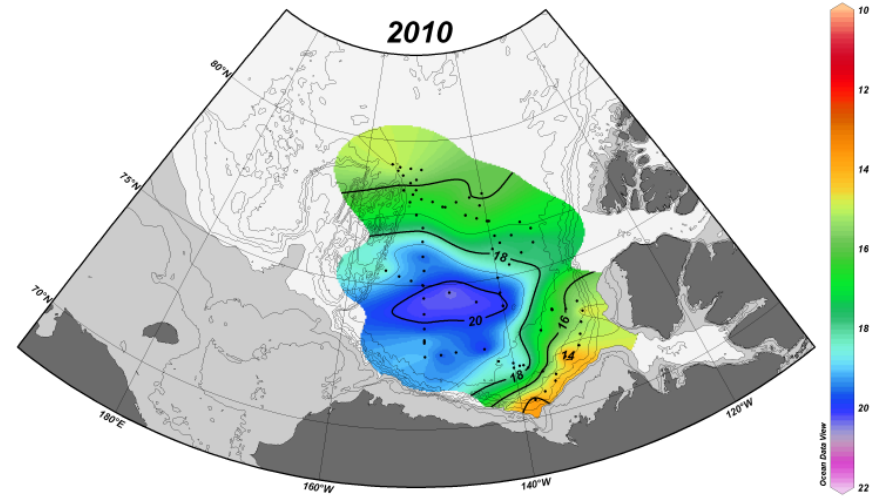
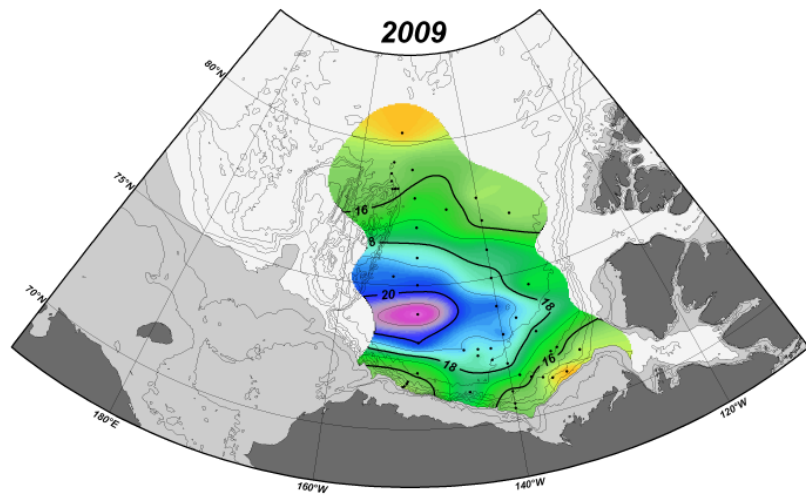
increase : <2008

decrease : >2009

Freshwater content (5-150m) reference salinity 34.8



Freshwater content (5-150m) reference salinity 34.8

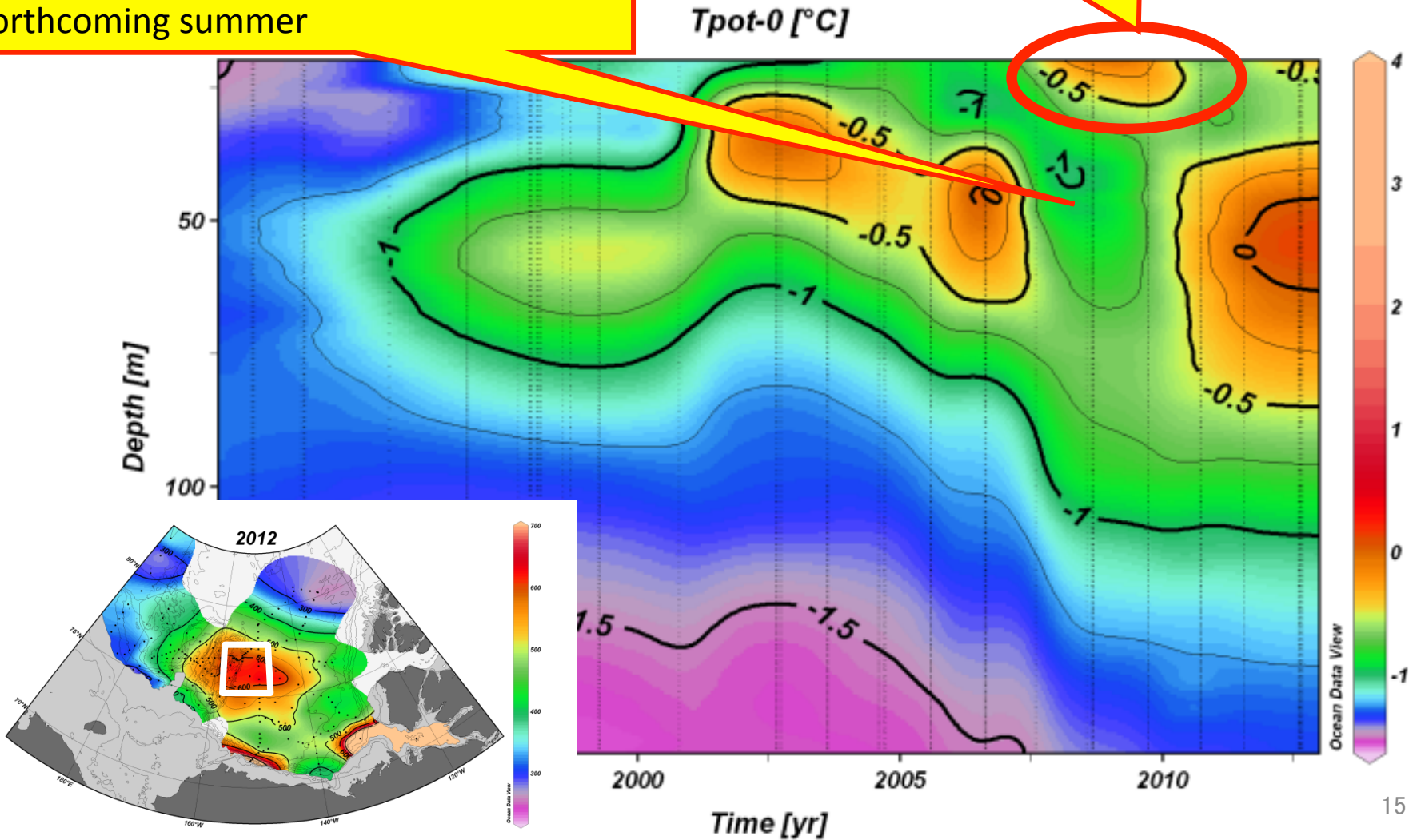


Heat release from upper ocean 2007 and 2008 sea ice reduction caused by heat release event

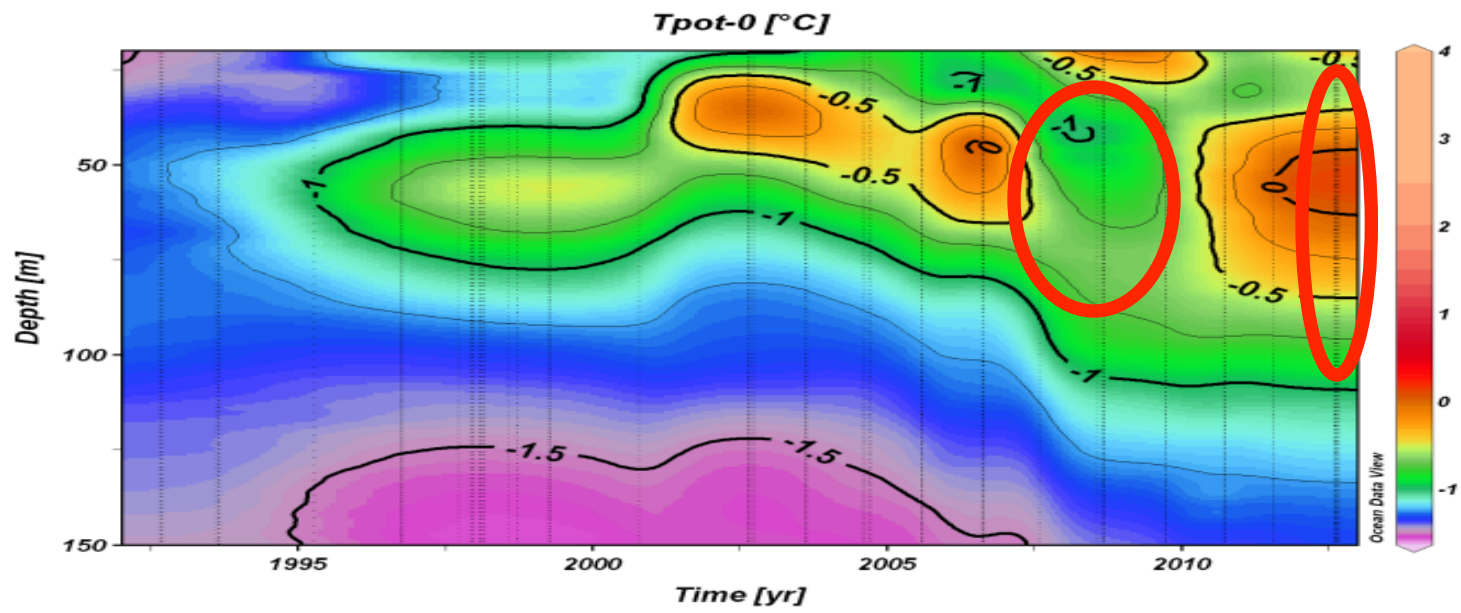
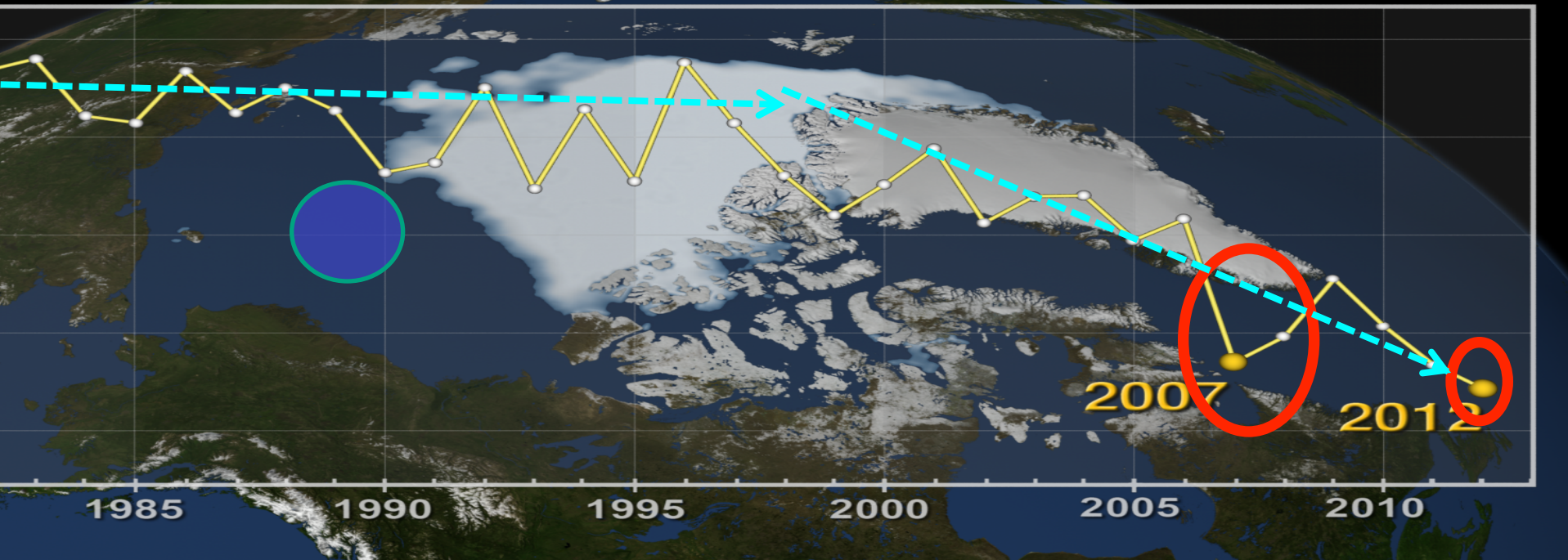
If the accumulated heat in the current state is released,
anomalous reduction of sea ice will occur.

Surface warming (NSTM) is a kind of resultant feature after heat release from PSW.

Heat release from PSW during is crucially important for sea ice reduction in forthcoming summer



Arctic Sea Ice Area



Key issues

1. Momentum transfer from atmosphere into the ocean via sea ice

Atmospheric circulation
Wind factor associated with sea ice properties

2. Upper ocean circulation and horizontal heat transportation

Vorticity input by wind and sea ice motion
Location of freshwater pool (Low PV water)
Lateral volumetric input of Pacific Water (Low PV water)

3. Vertical heat flux associated turbulent mixing

Activation of sea ice motion in both large scale (basin scale sea ice motion) and small scale
(inertial Oscillation)

Direct input of momentum by synoptic disturbance of atmosphere
Less damping of tidal current associated with less ice cover



***Understanding of “Feedback system”
consisting of key processes in the Arctic Ocean***