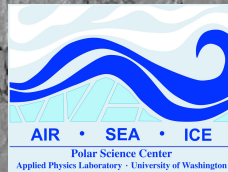


Recent changes in Arctic sea ice and ocean circulation

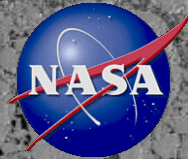
Ron Kwok¹ and Jamie Morison²

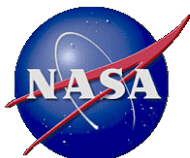
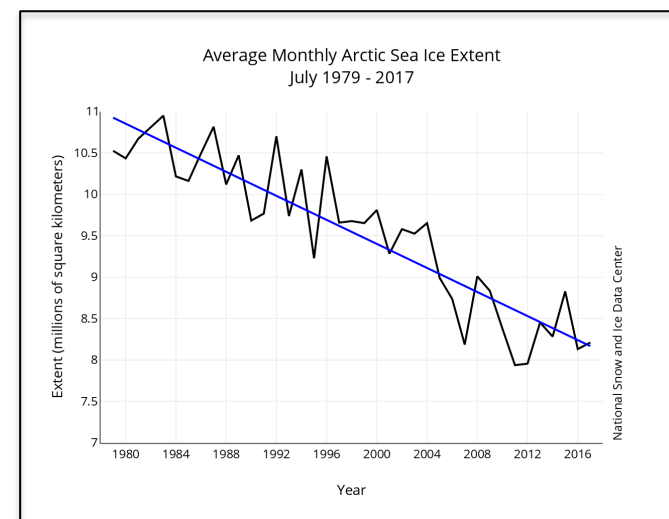
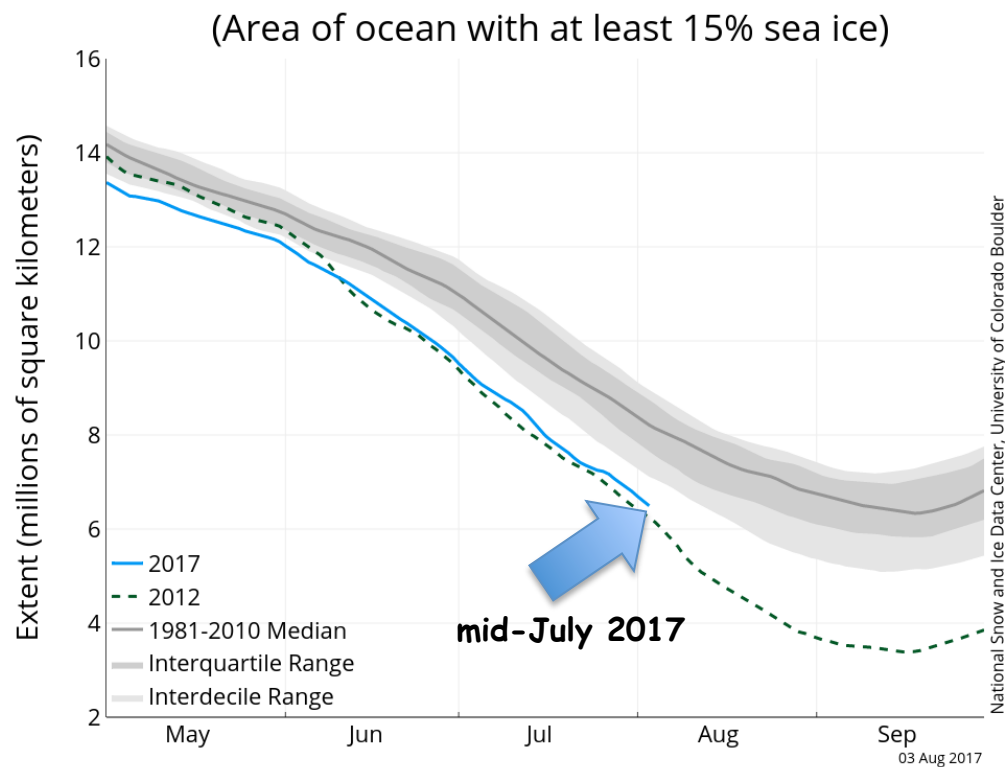
Jet Propulsion Laboratory
California Institute of Technology

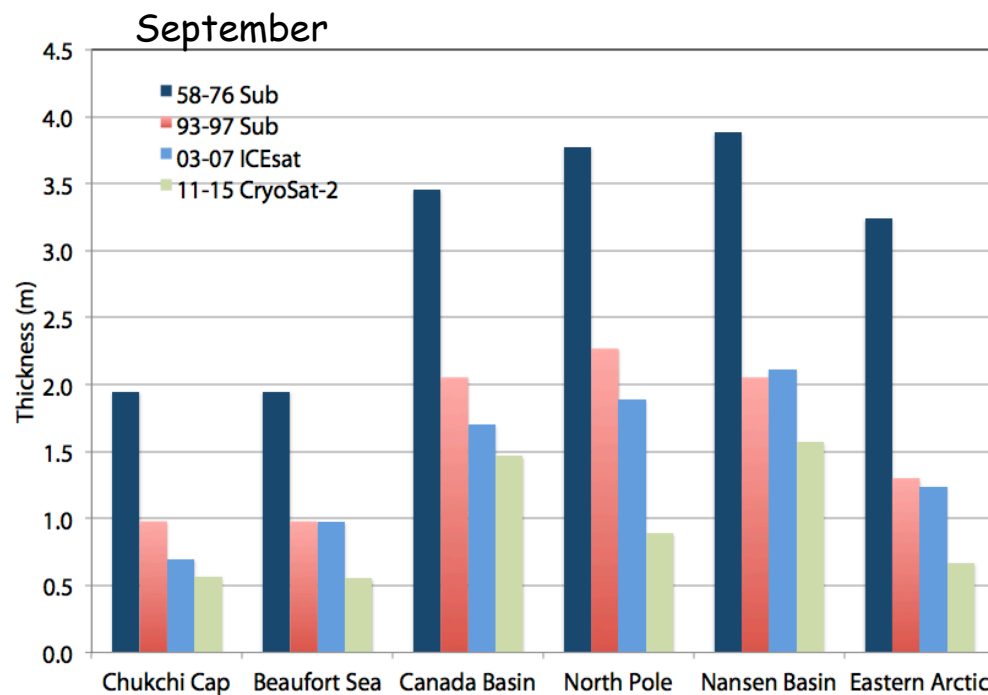
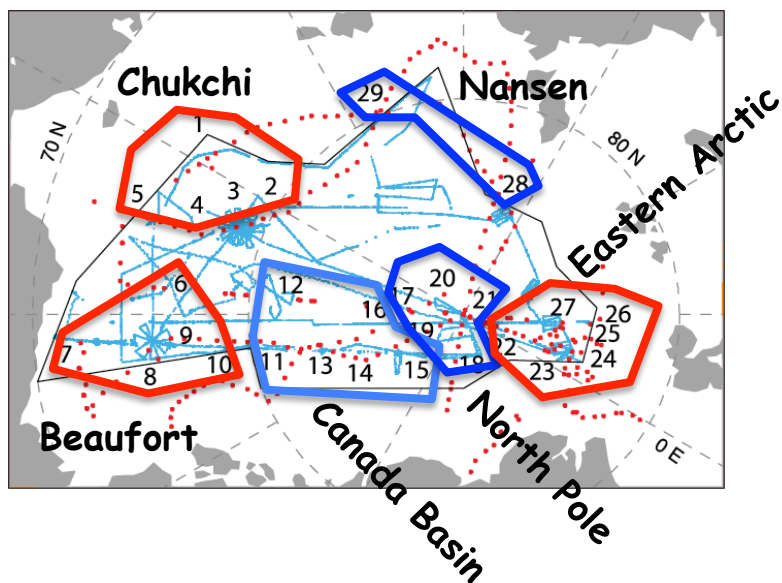
Polar Science Center
University of Washington

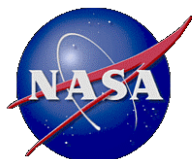
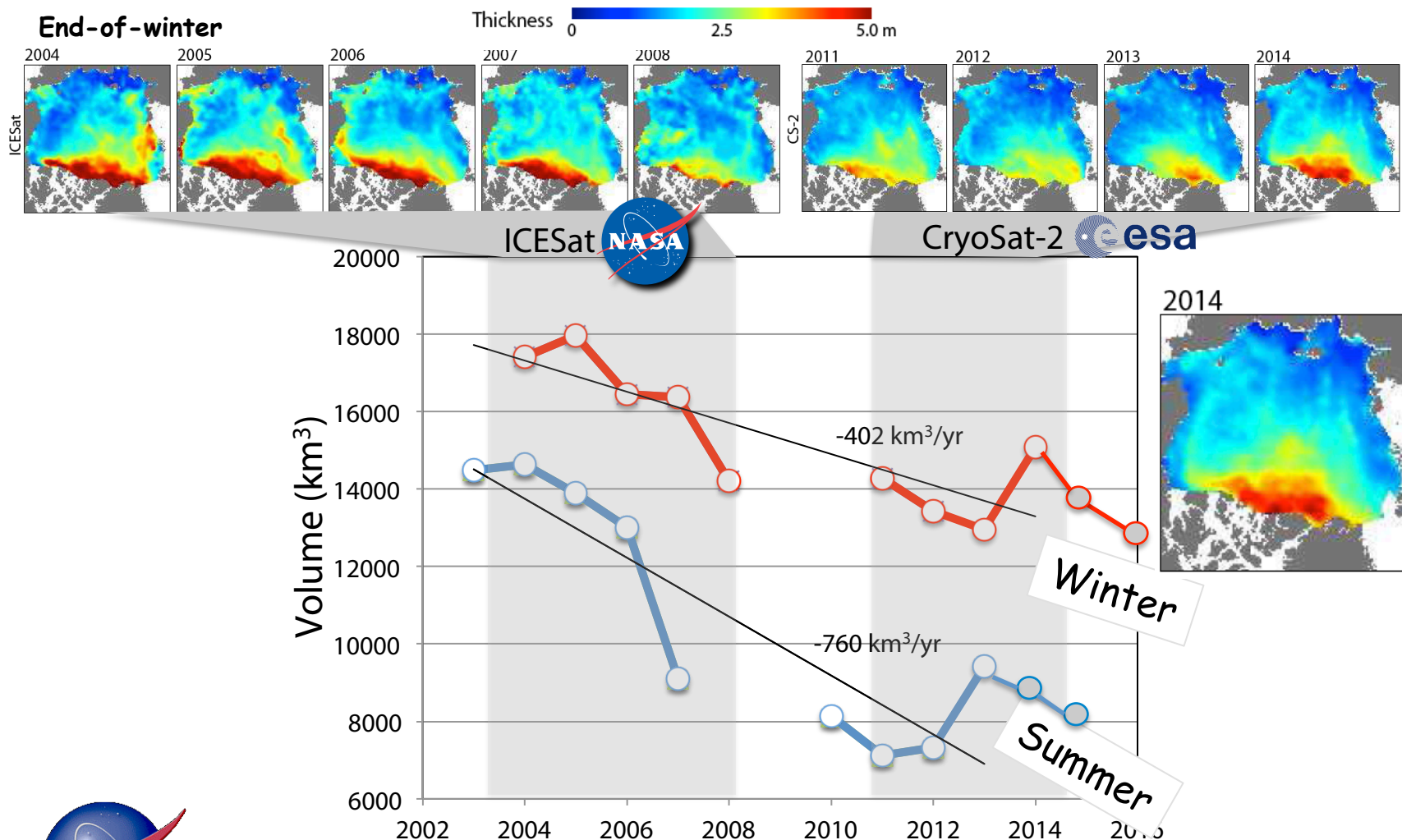


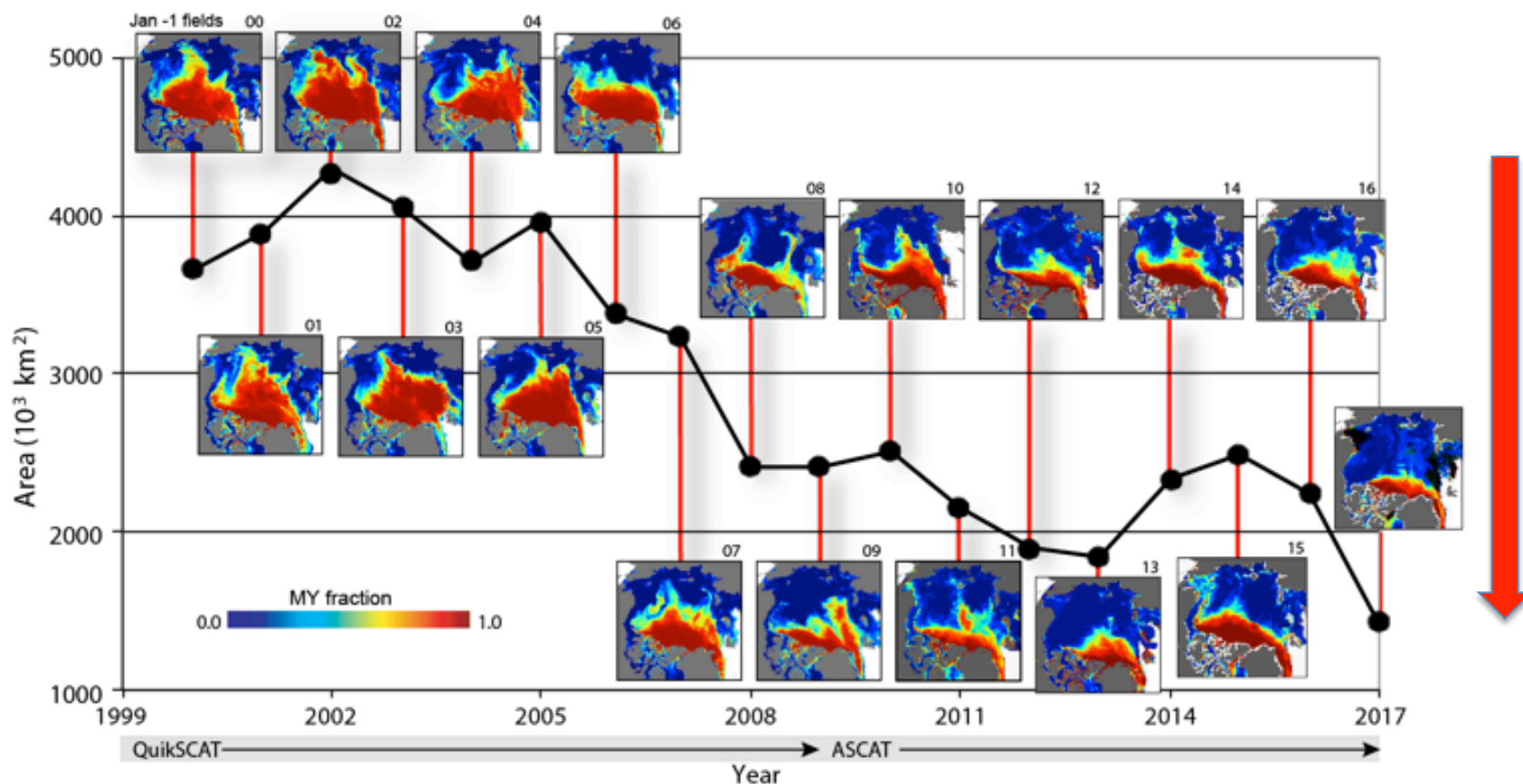
US CLIVAR Summit
August 8-10, 2017
Baltimore, MD





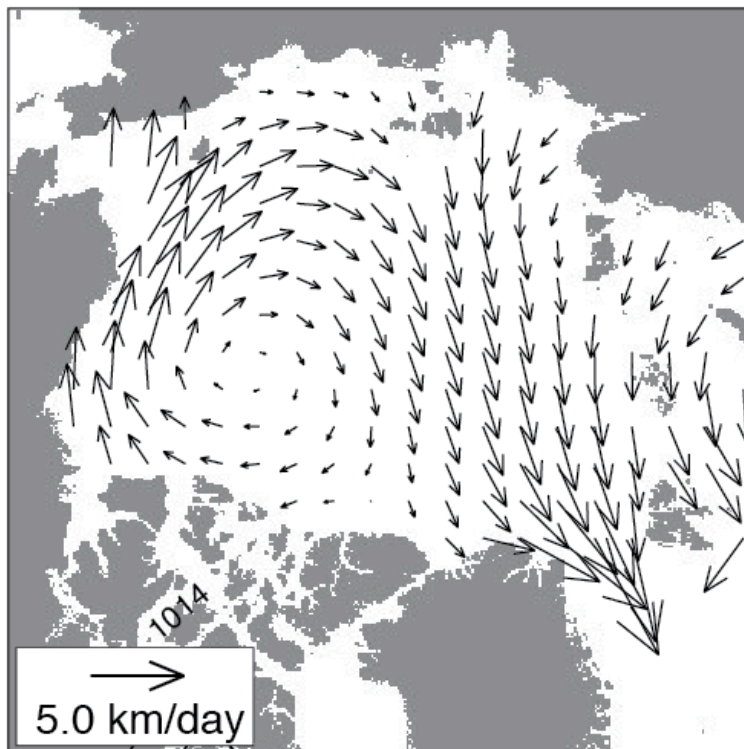






Arctic ice drift (forced by wind and ocean)

Mean ice drift (1992-2013)



Changes in Mean Circulation affect

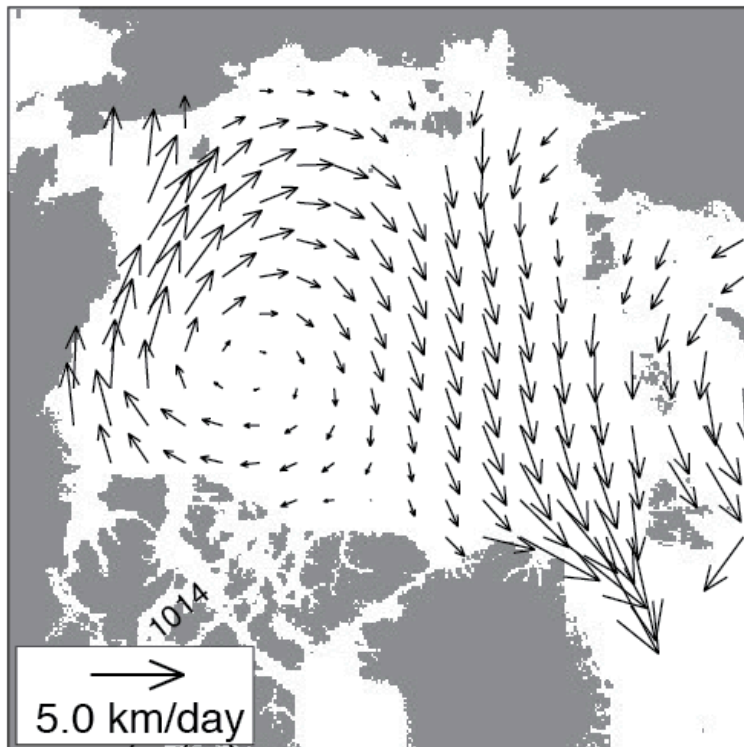
- export and regional redistribution of sea ice
- Redistribution and export of freshwater

Variability of short time scale ice motion affects (ice concentration)

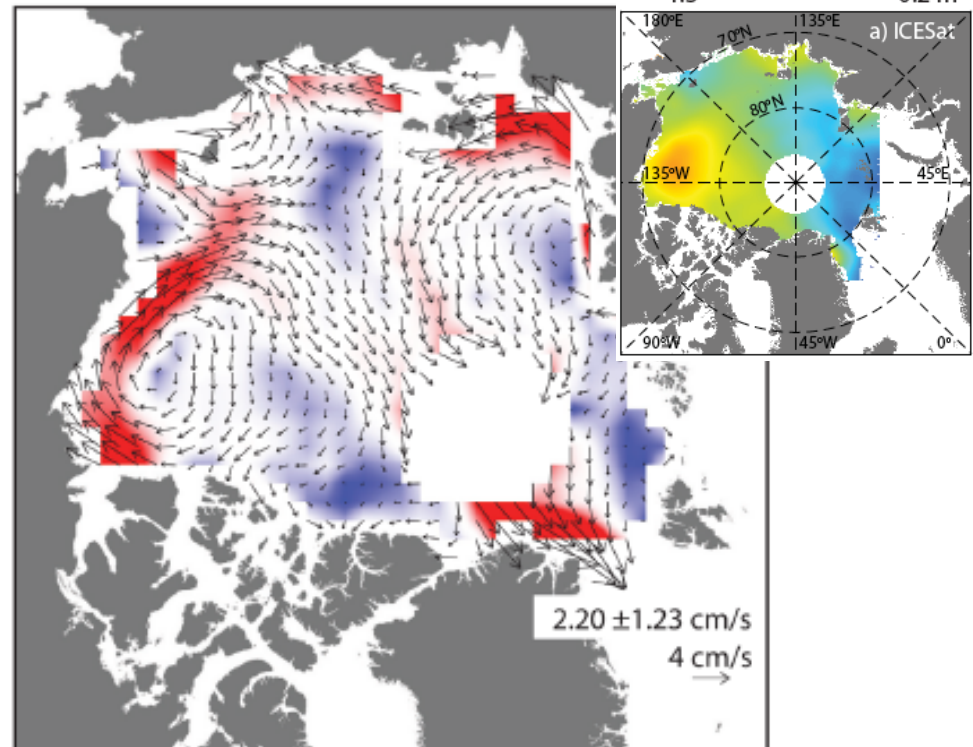
- abundance of open water
- ice deformation: redistribution of ice thickness

Over longer time scales (controlled by ocean)

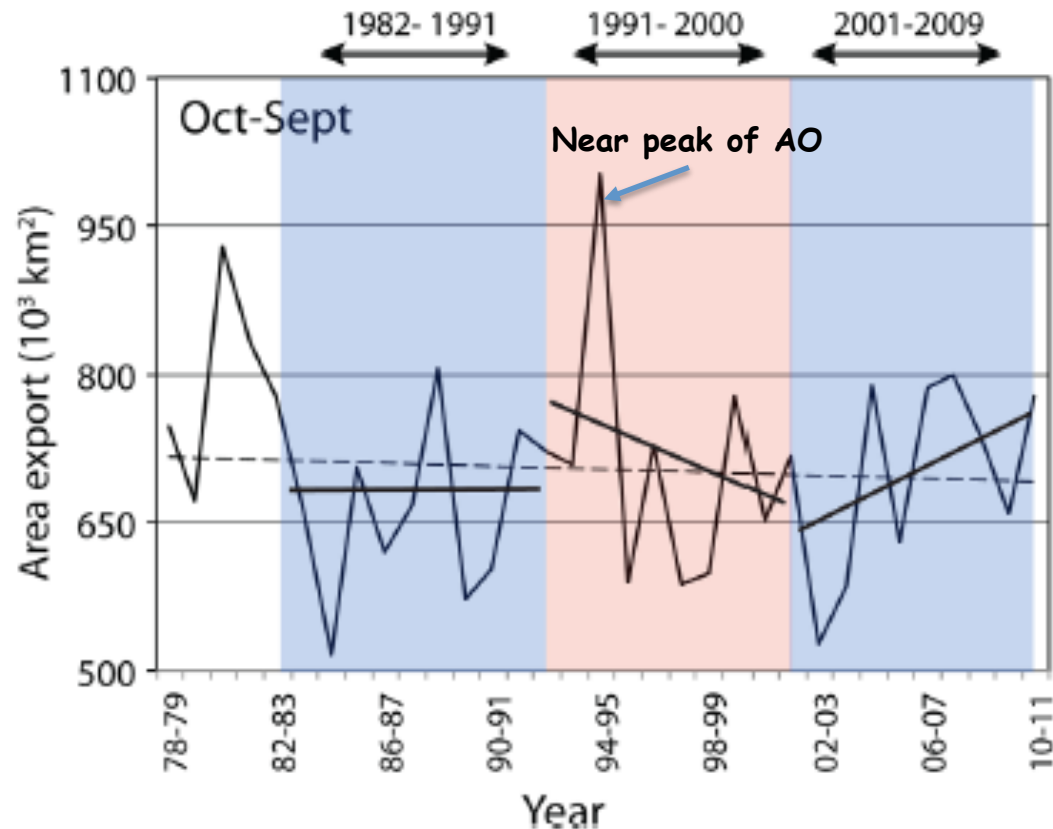
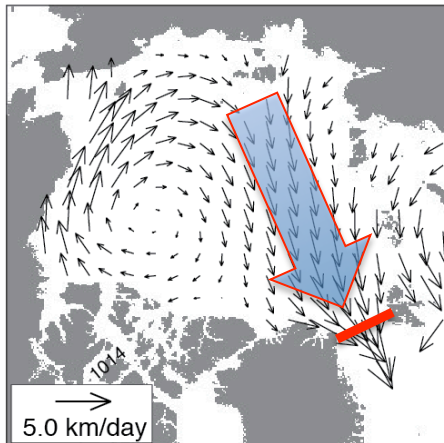
Mean ice drift (1992-2013)



**Mean ocean current from
Satellite dynamic ocean topography
(2003-2008)**

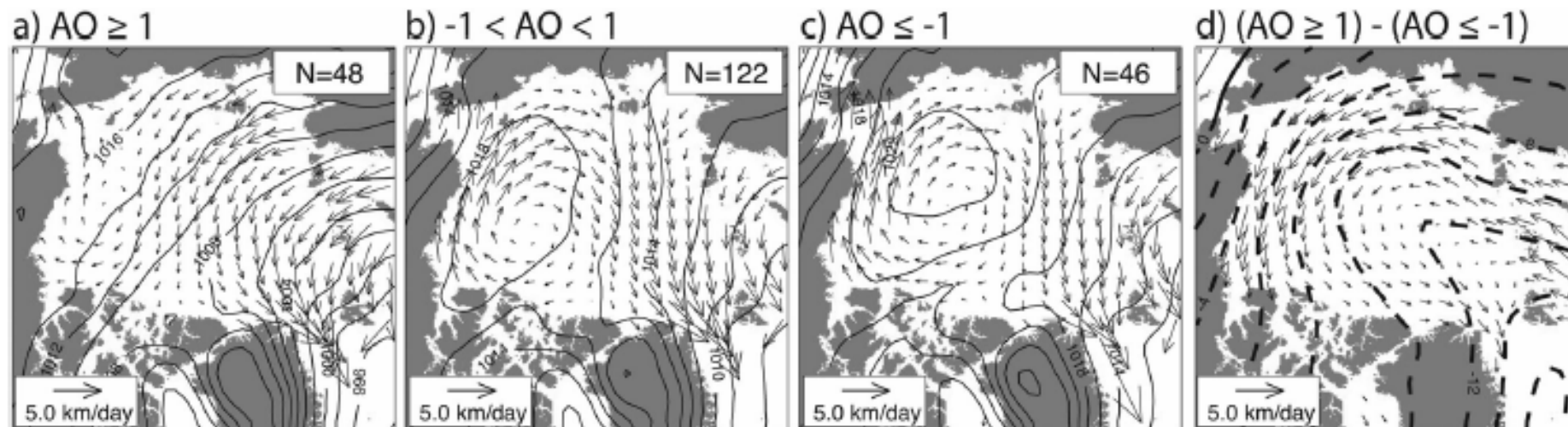


Sea ice outflows at the Fram Strait

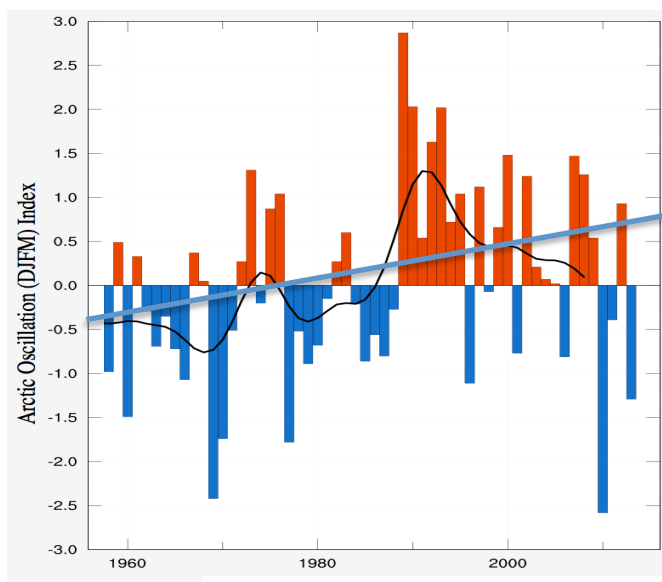


**10% of the Arctic sea ice area
Peak $\sim 3000 \text{ km}^3$ in 1994-1995**

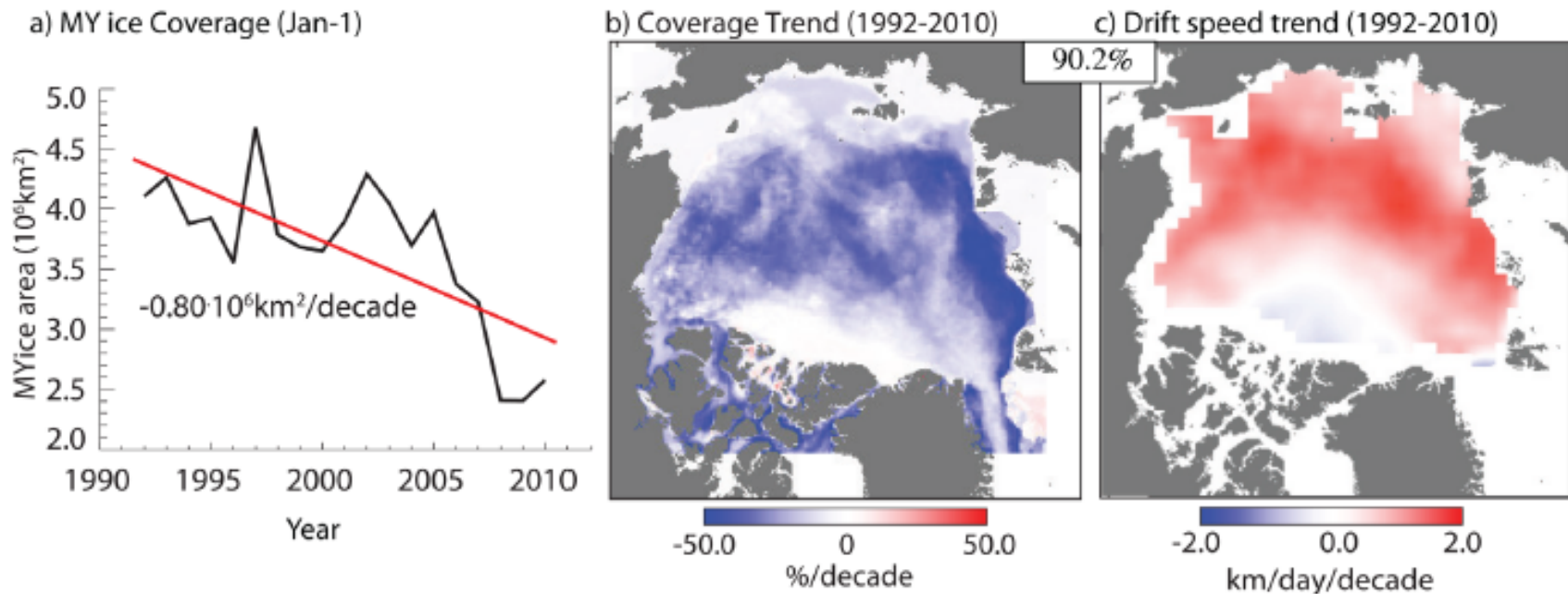
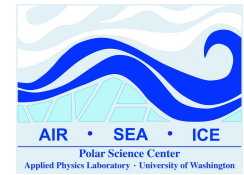
Circulation patterns associated with phases of the Arctic Oscillation



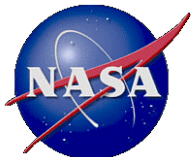
Kwok et al., 2013



JPL Increased mobility of the ice cover

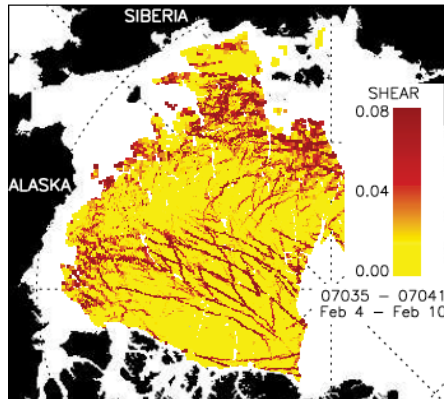
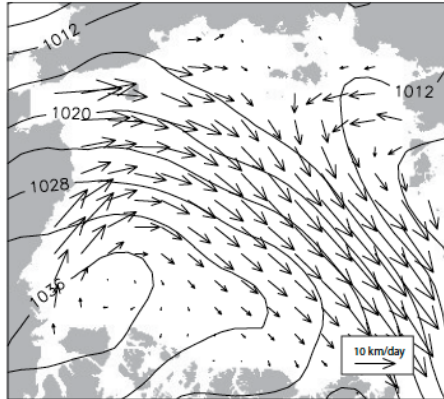


Kwok et al., 2013



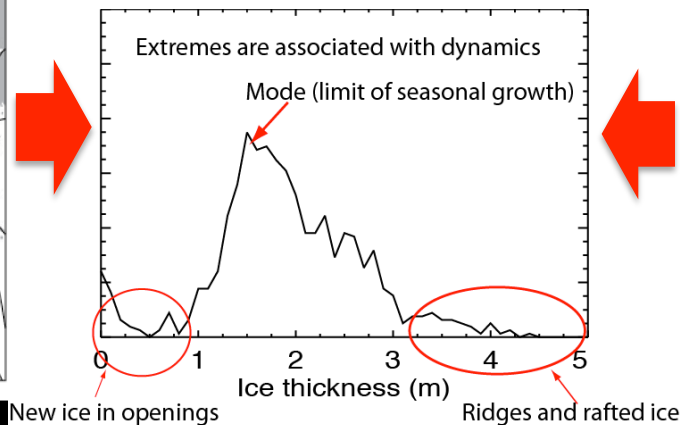
Sea Ice Motion and Deformation

$\sim 10^2$ km

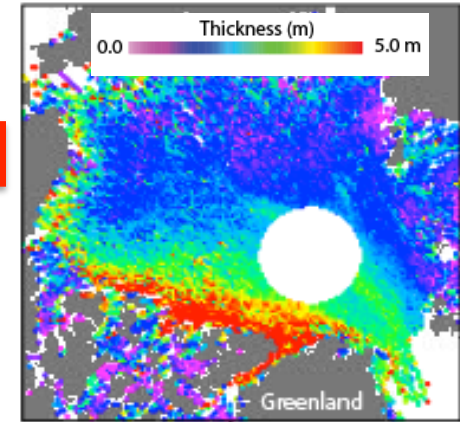


$\sim 10^2$ m

Ice Thickness distribution

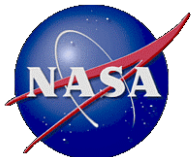


Sea Ice Thickness



- Small-scale motion for quantifying deformation-relation thickness changes
- Volume storage due to ridging

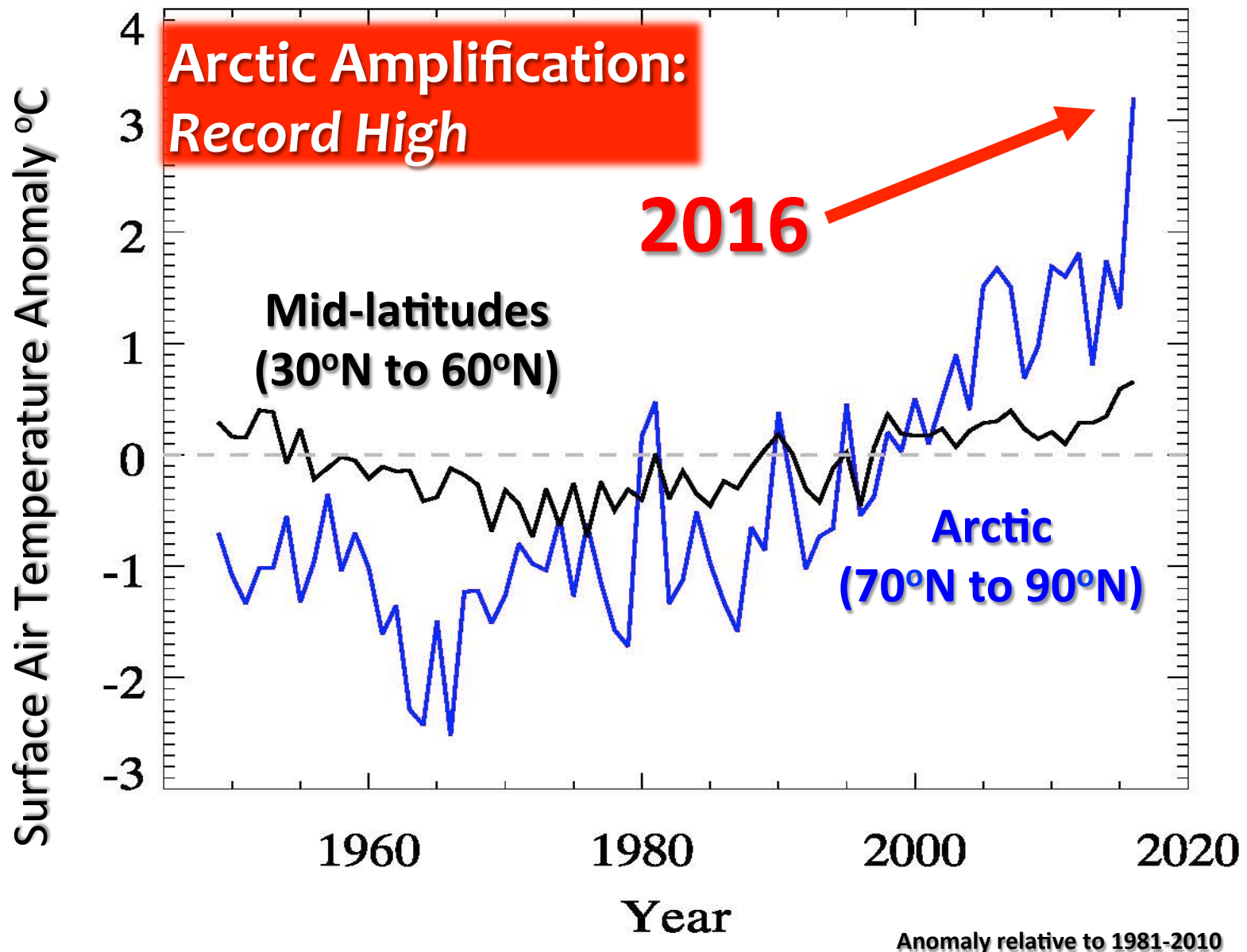
- Three important parameters that describe the recent changes of the Arctic ice cover: ice thickness, ice drift, and ocean circulation
- There is broad interest in improved forecasts and projection of sea ice stat
- Presently, gaps in our understanding/observation of sea-ice/ocean/atmosphere interactions represent a significant challenge in attempting to assign specific causes for ice loss and to project/forecast ice behavior



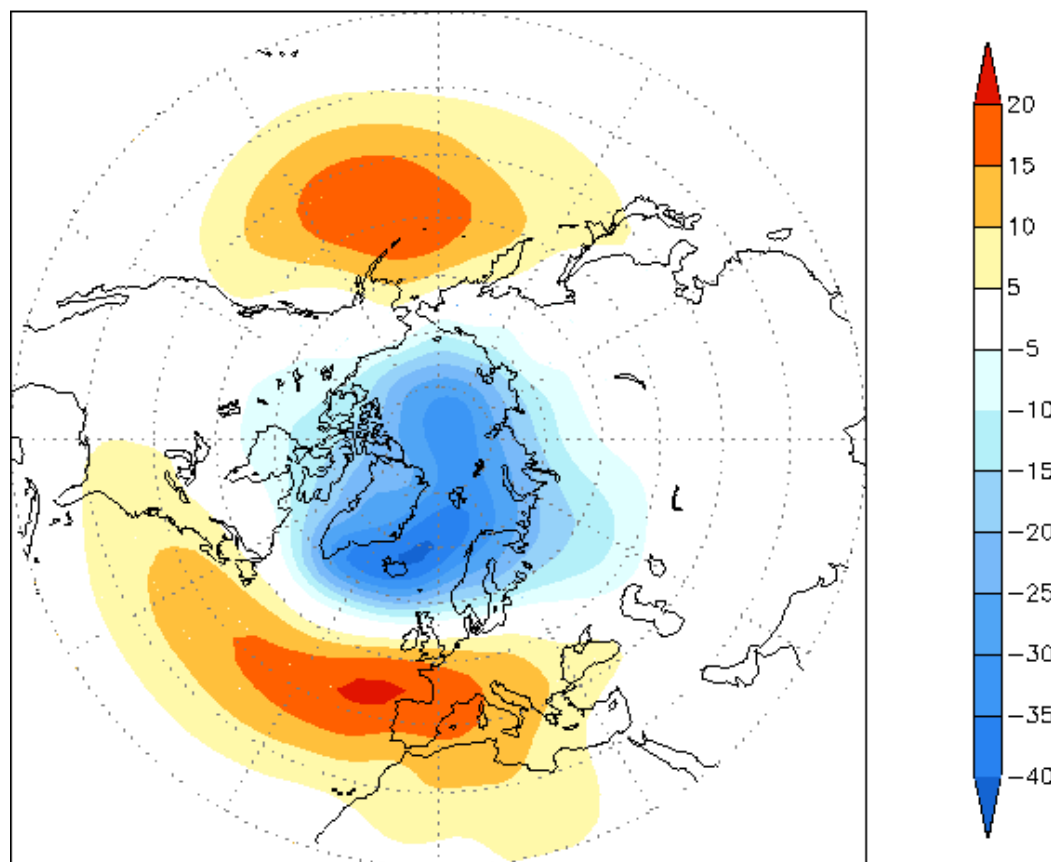
**Thank you
for your attention**



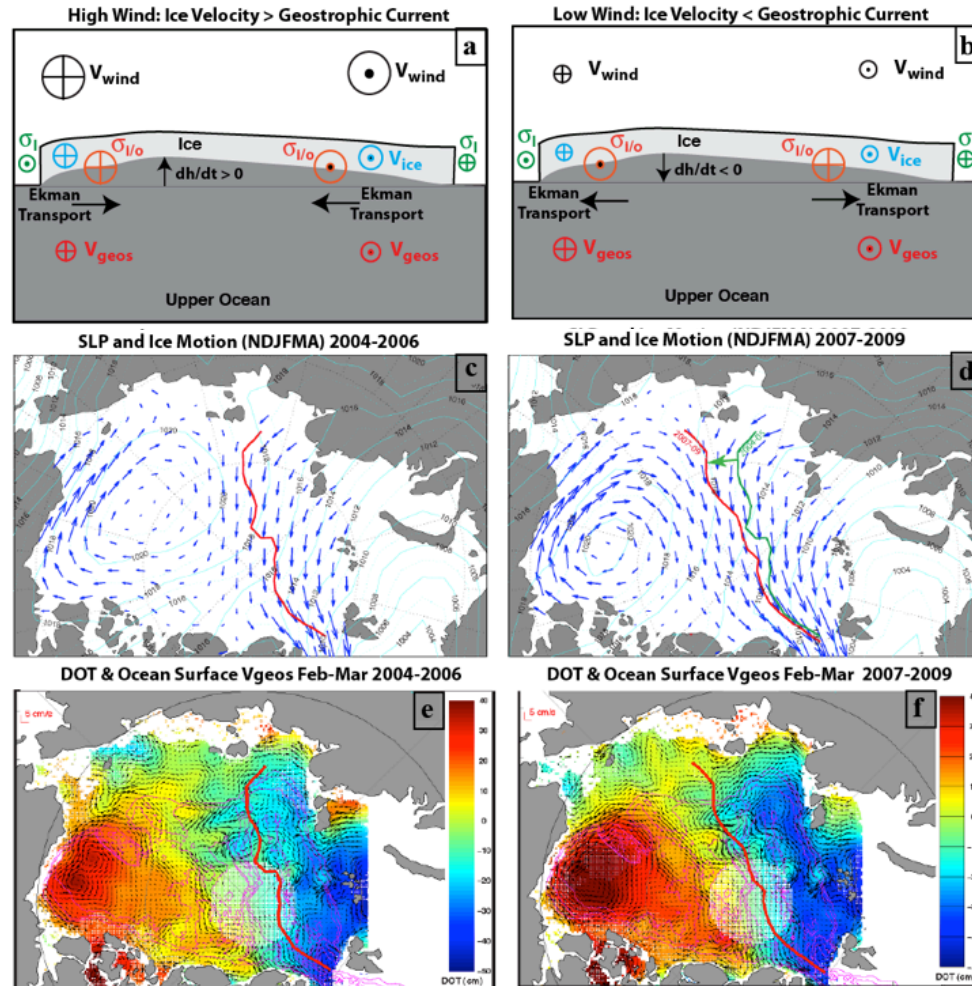
Jan. – Oct. Air Temperature Anomalies



Leading EOF (19%) shown as
regression map of 1000mb height (m)



Correlation between longer time-scale ice drift and geostrophic currents



Mean sea ice drift

Dynamic Ocean Topography and currents from ICESat