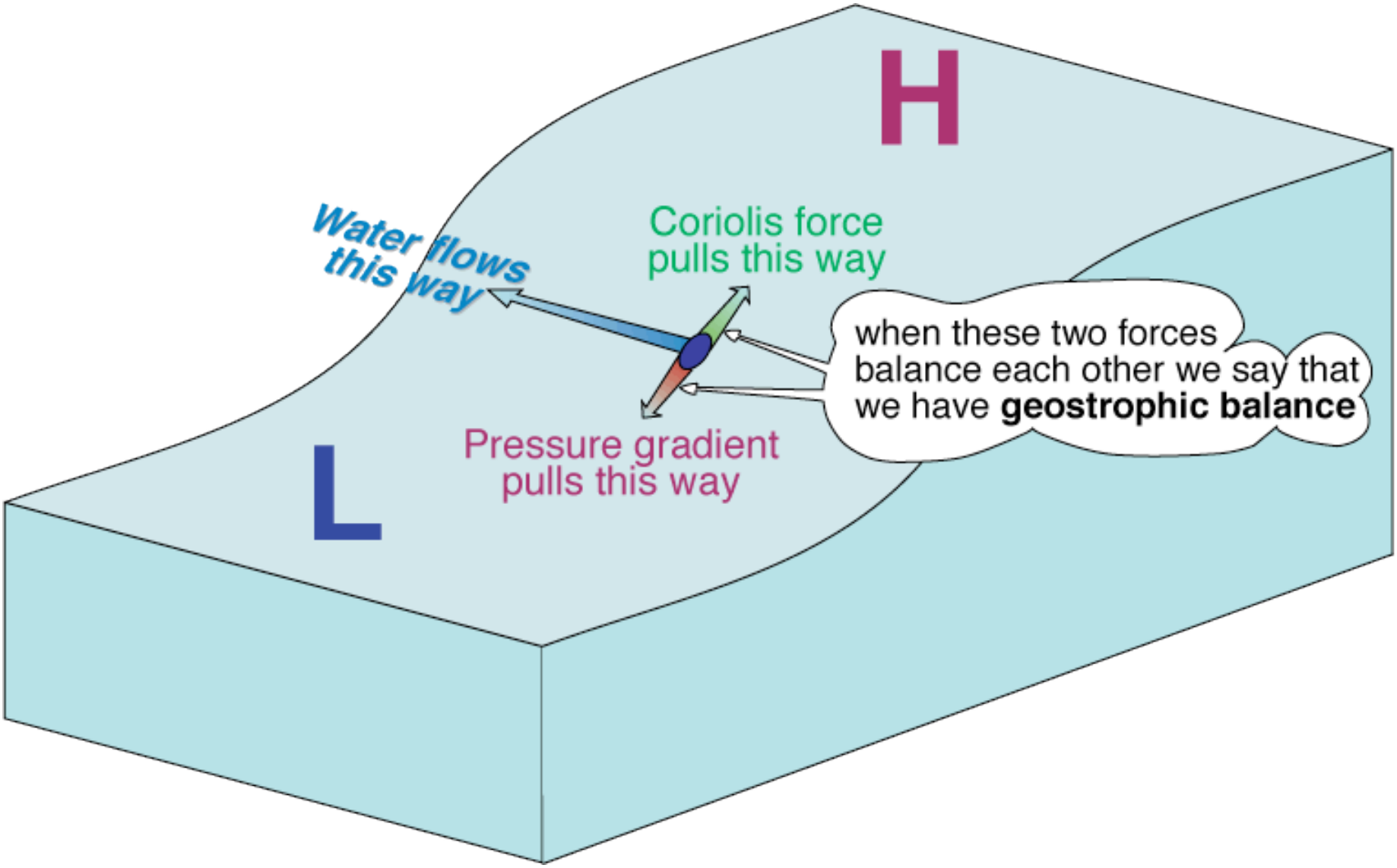
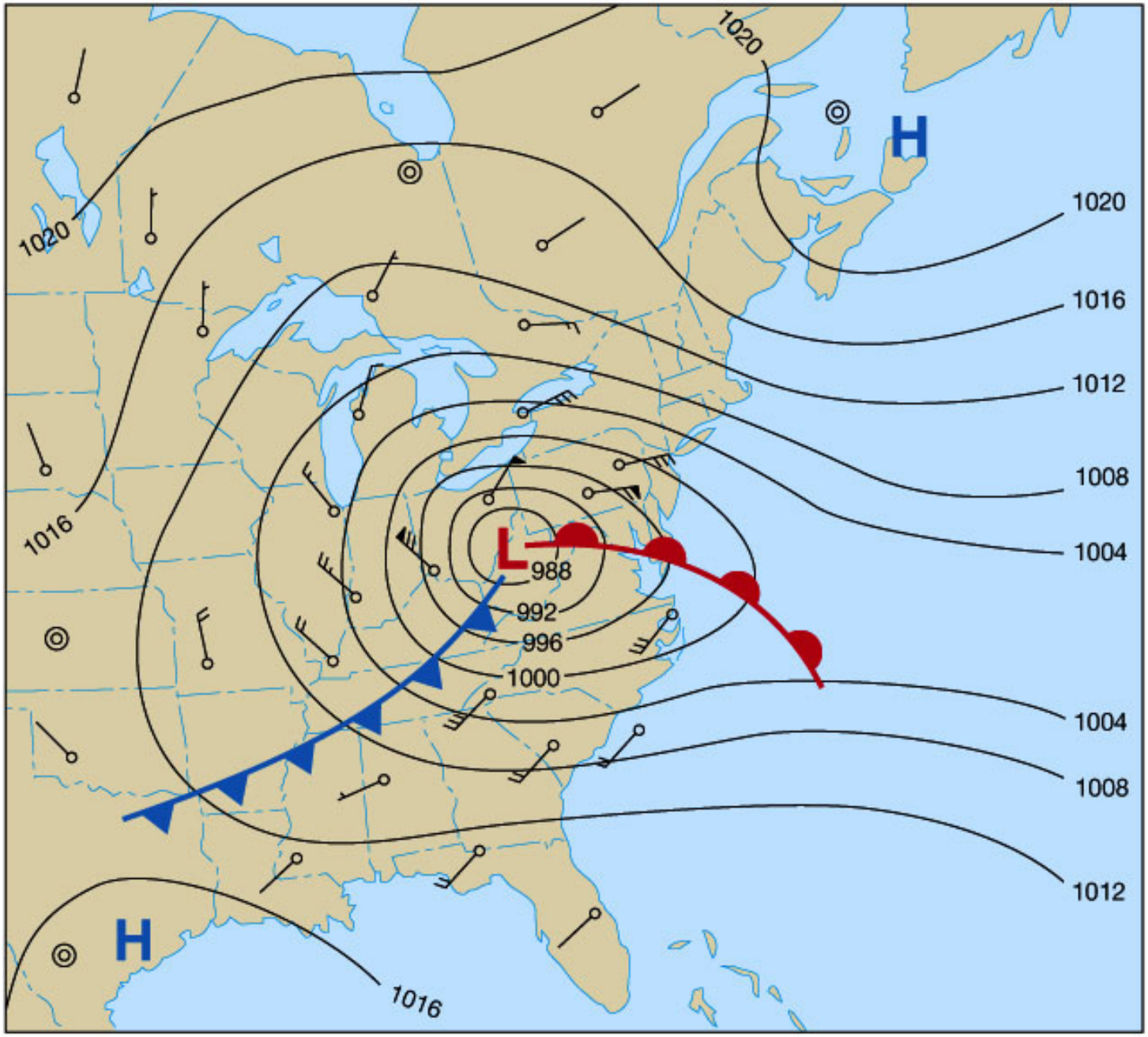
Mixing & Rotation Movies

http://paoc.mit.edu/labweb/lab1/gfd_1.htm

Geostrophic Balance – Without Freshwater



http://www.seos-project.eu/modules/oceancurrents



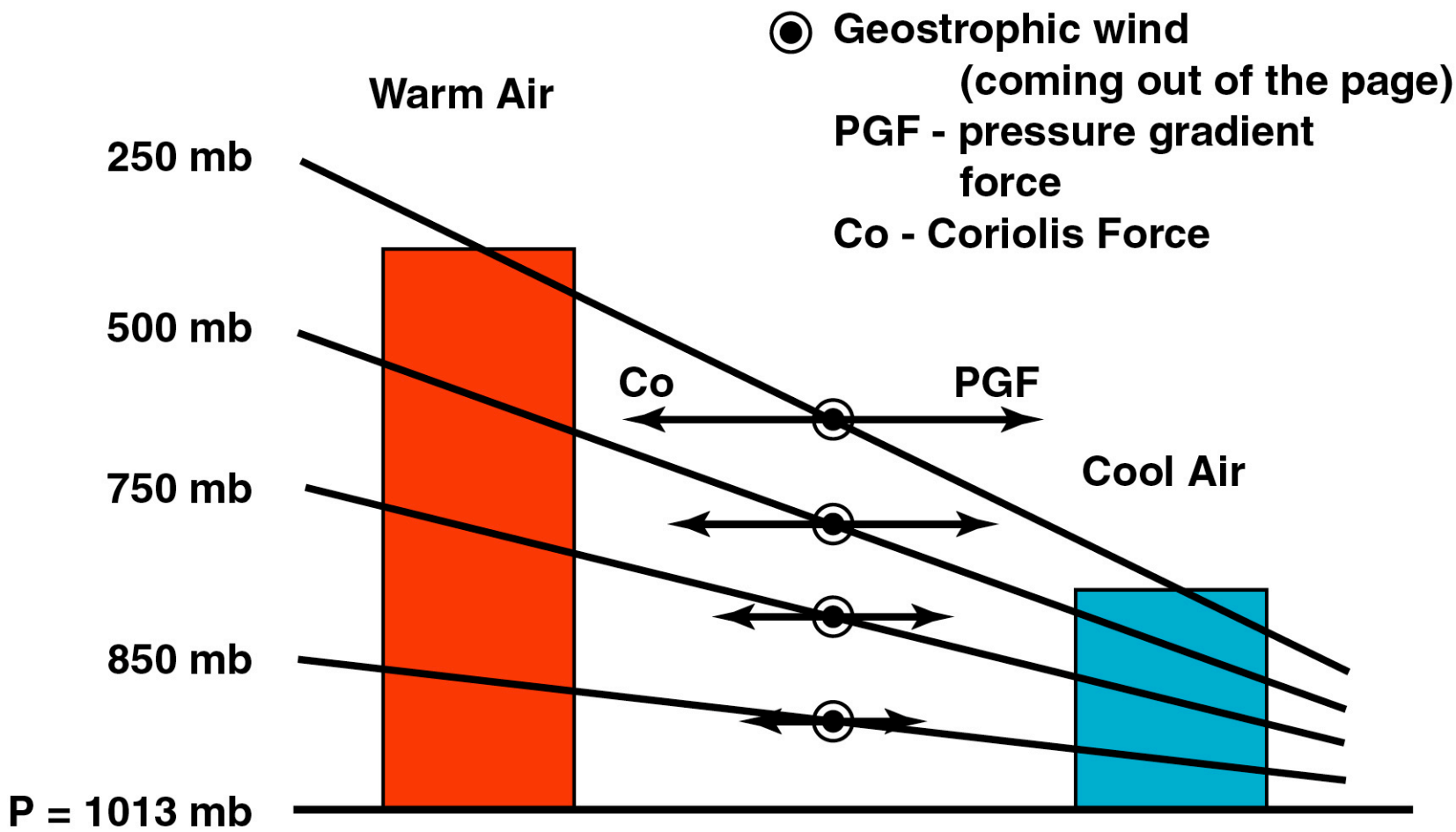
ff	Miles per hour
◎	Calm
	1–2
	3–8
	9–14
	15–20
	21–25
	26–31
	32–37
	38–43
	44–49
	50–54
	55–60
	61–66
	67–71
	72–77
	78–83
	84–89
	119–123

http://www.ux1.eiu.edu/~cfjps/1400/pressure_wind.html

Ekman Pumping Movies

http://paoc.mit.edu/labweb/lab9/gfd_9.htm

Geostrophic Balance – With Freshwater
(Thermal Wind Balance, Baroclinic Shear)



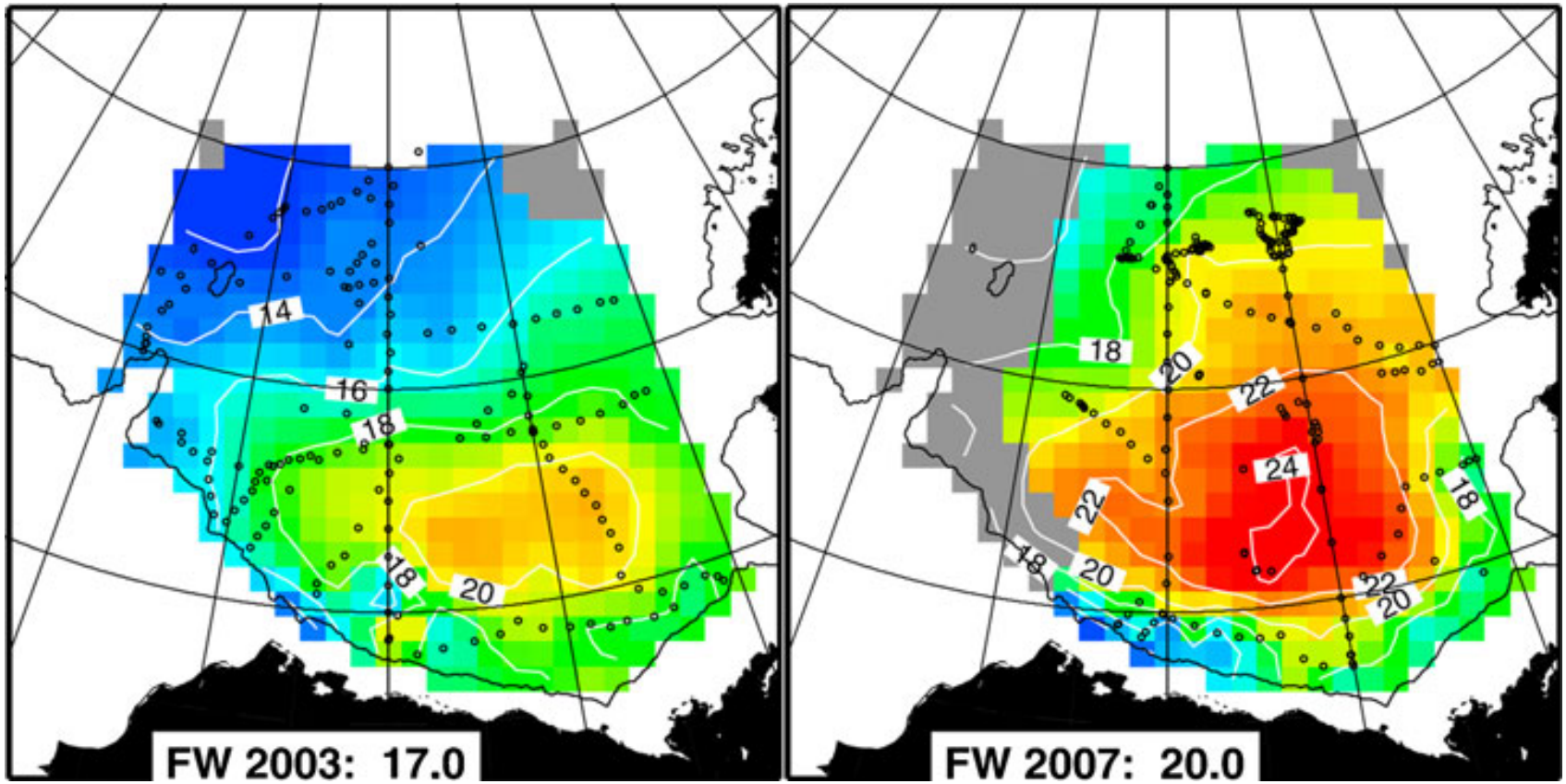
http://www.ux1.eiu.edu/~cfjps/1400/pressure_wind.html

Derive Thermal Wind

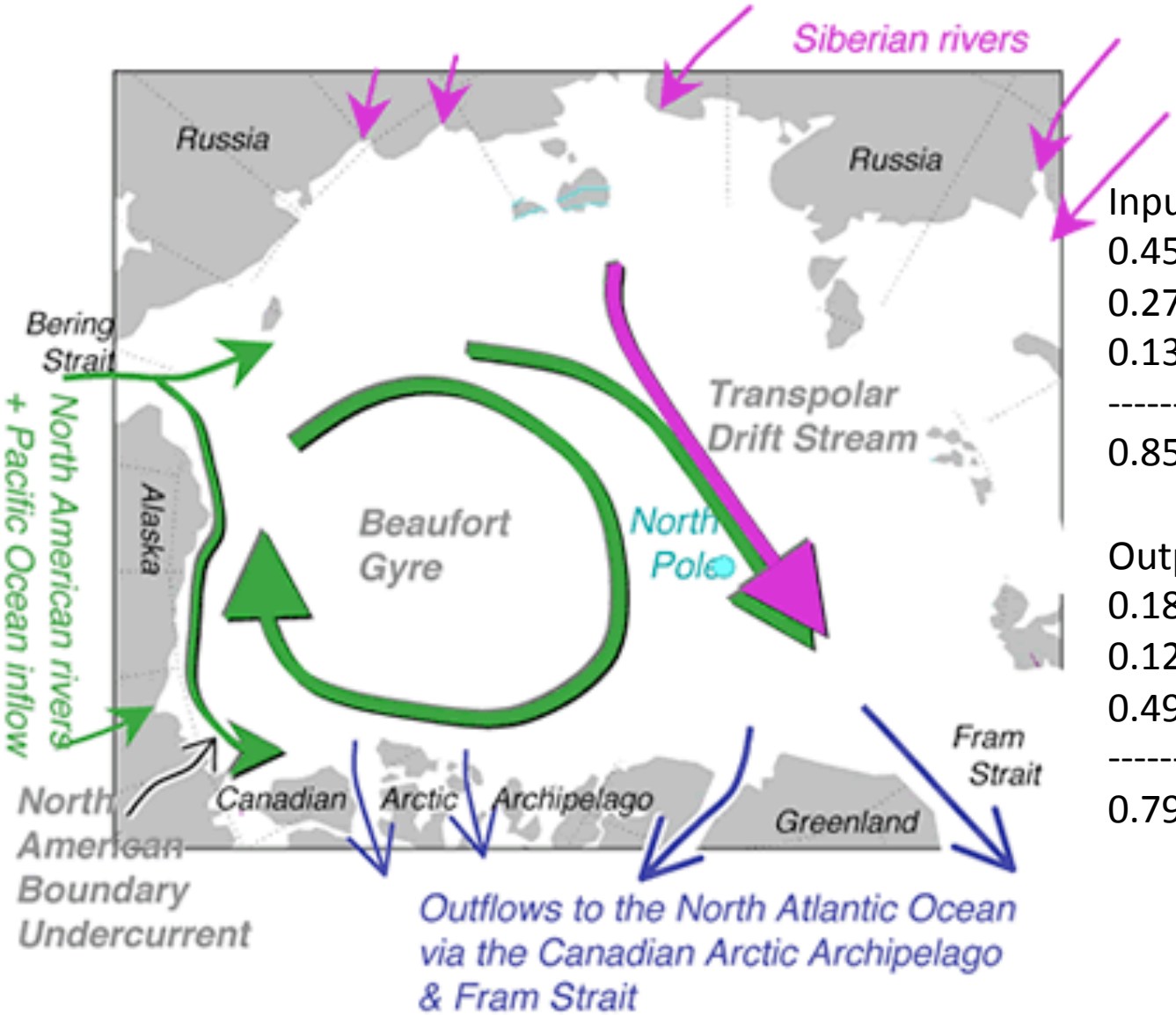
and

Rossby Radius of Deformation

Freshwater Content in Canada Basin (m)



Proshutinsky et al. (2009)



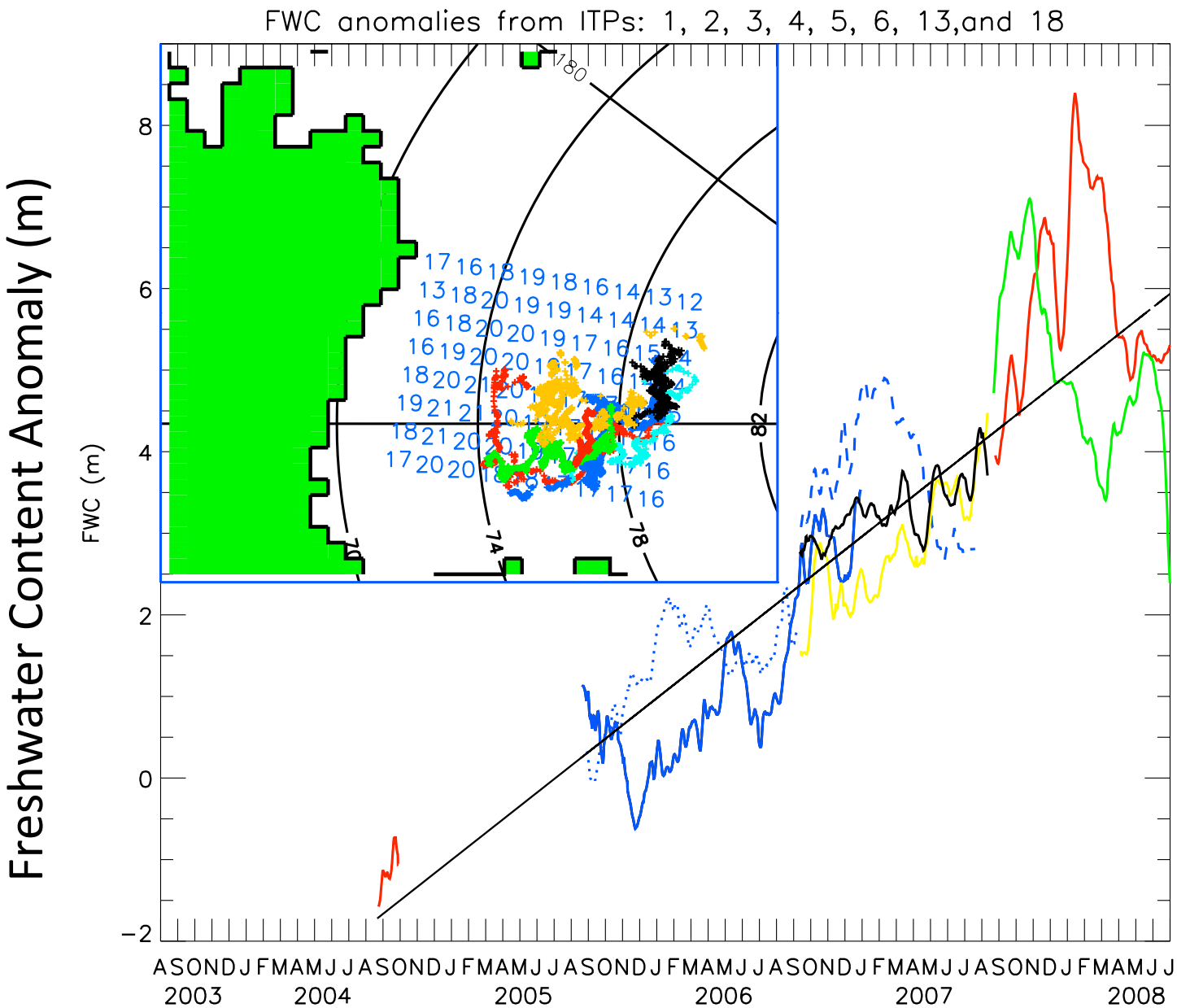
Input:
0.45 m Rivers
0.27 m Bering Strait
0.13 m P-E

0.85 m

Output:
0.18 m Canadian Archipelago
0.12 m Fram Strait Water
0.49 m Fram Strait Ice

0.79 m

http://psc.apl.washington.edu/switchyard/overview_pages/circulation.html

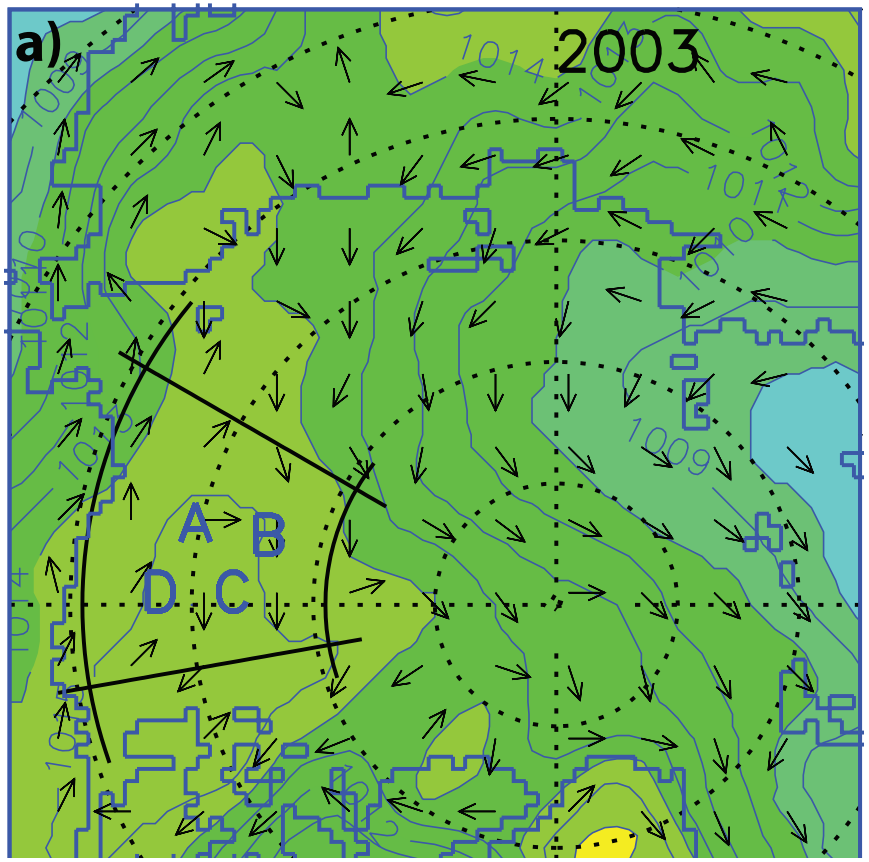


Proshutinsky et al. (2009)

Atmospheric Pressure at Sea Level (hPa)

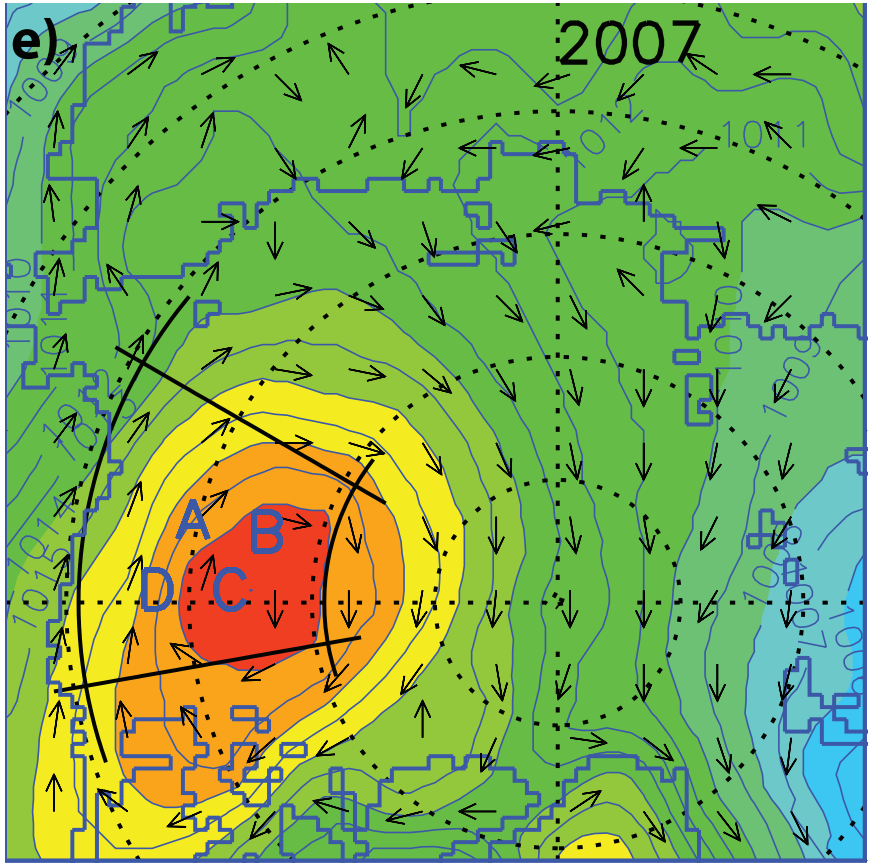
2003: Less Freshwater Storage

Small Wind Stress Curl



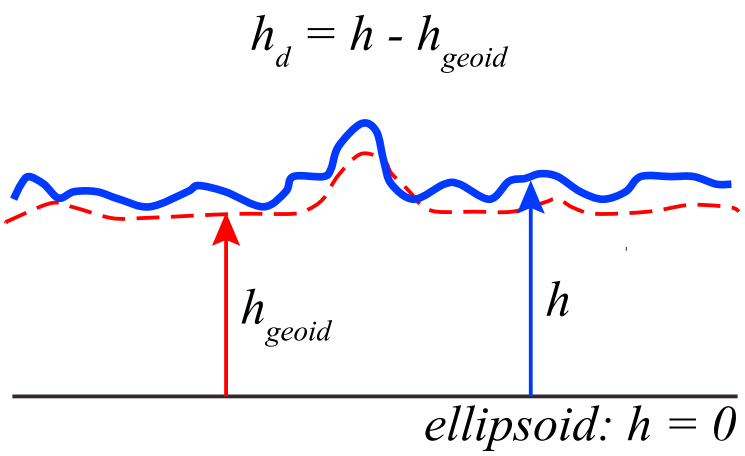
2007: More Freshwater Storage

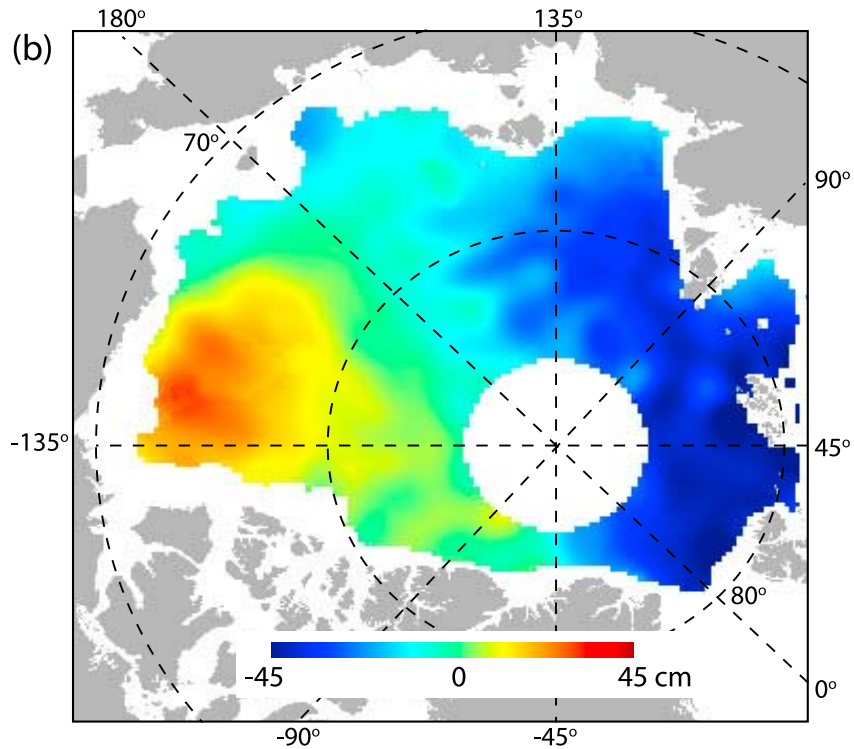
Large Wind Stress Curl



Proshutinsky et al. (2009)

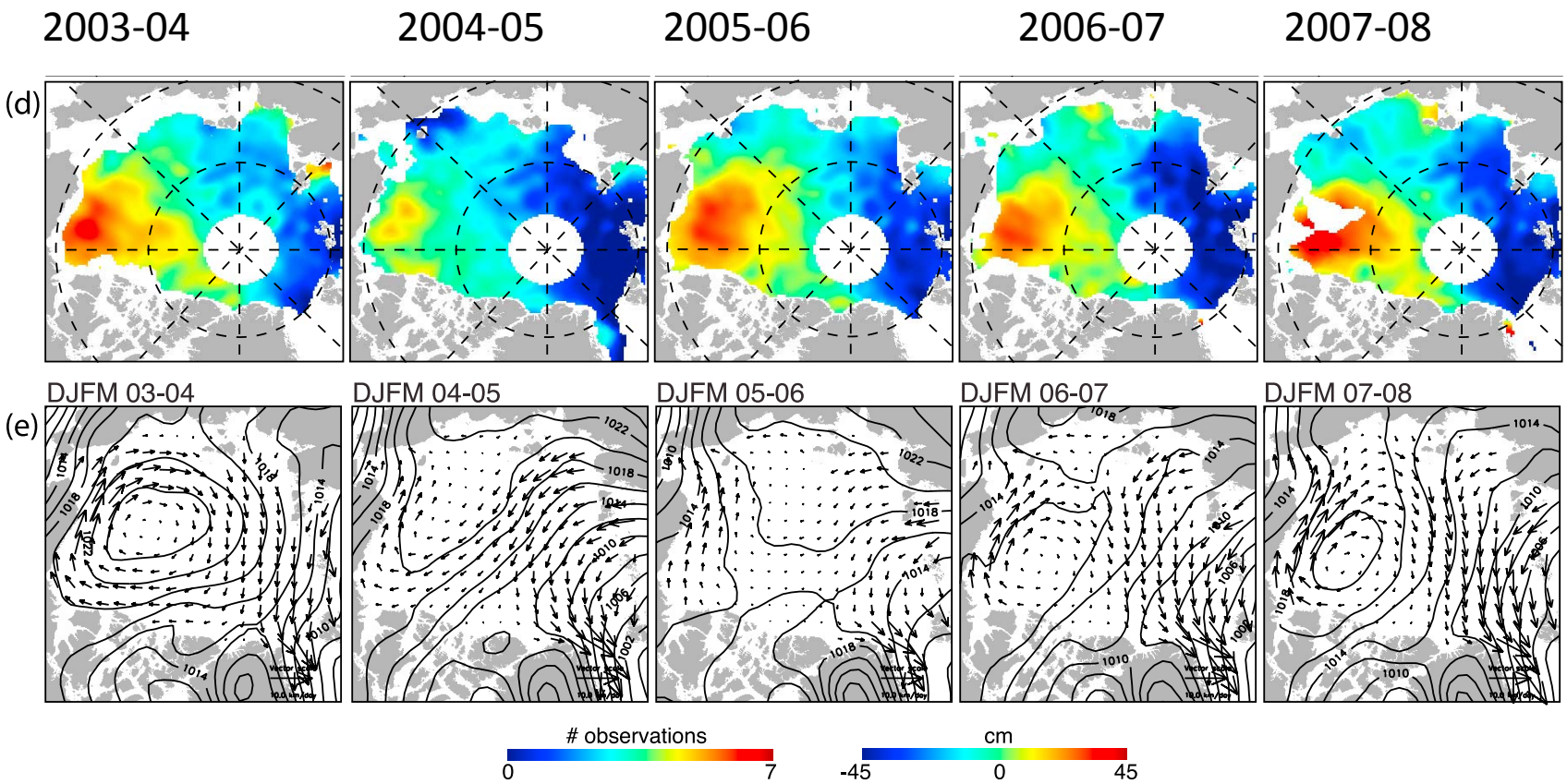
Arctic Sea Surface (geostrophic or dynamic) Height from Altimeter (winters 2004-2006)





Kwok and Morison (2011)

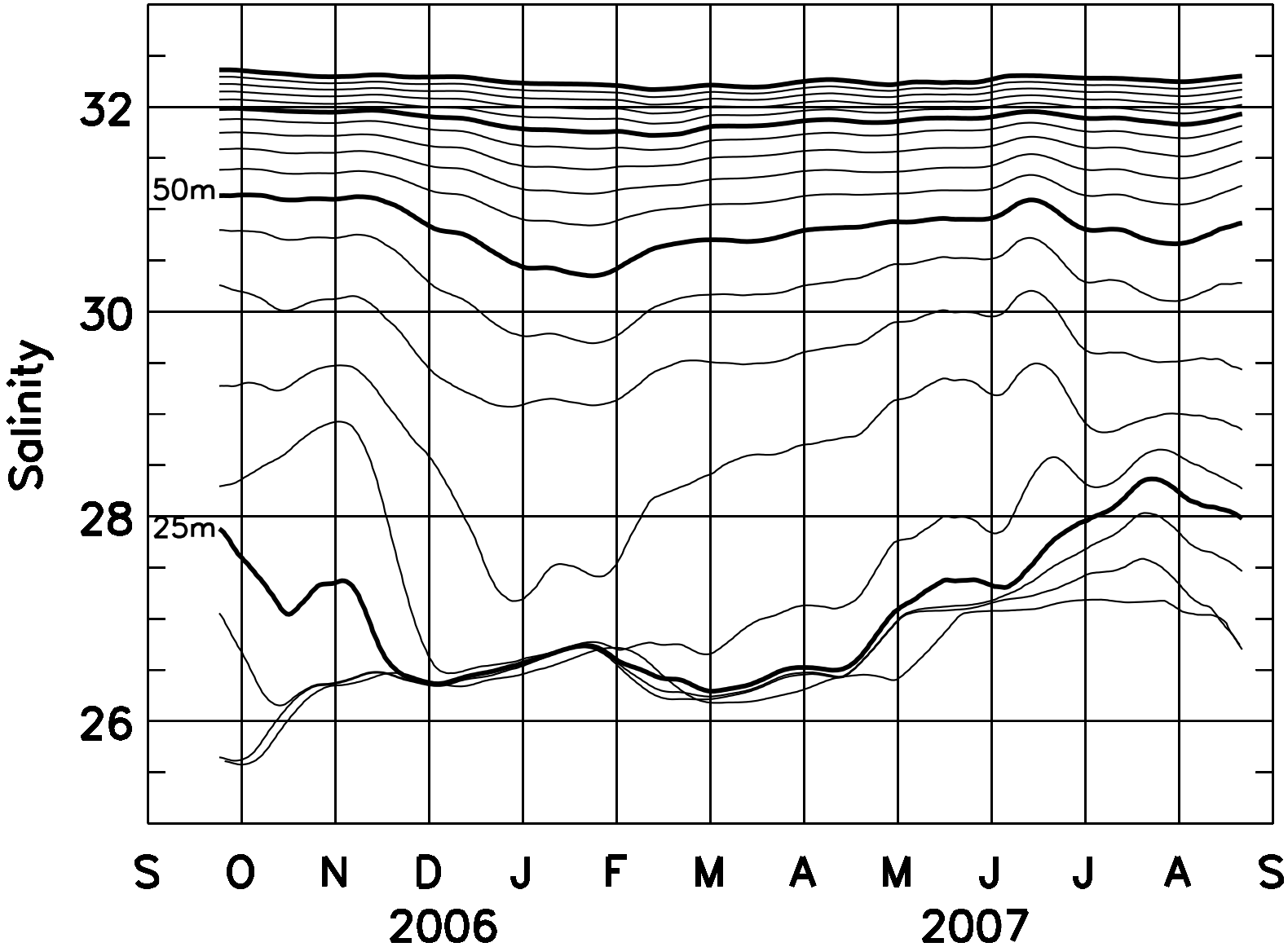
Winter Sea Surface Height (geostrophic or dynamic)



Winter Atmospheric Pressure and Ice Motions

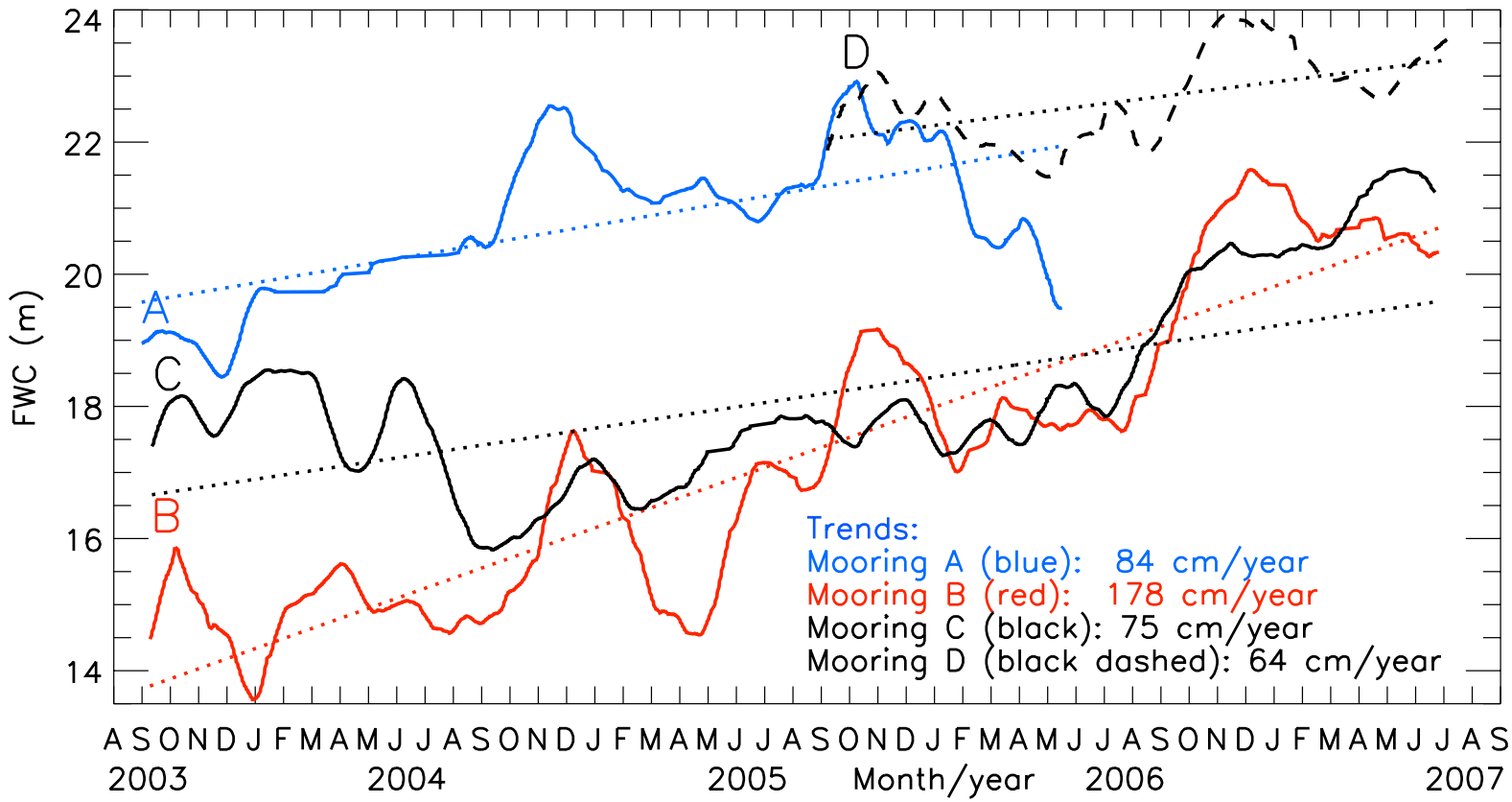
Kwok and Morison (2011)

ITP Buoy indicates fresher surface waters in Winter 2007



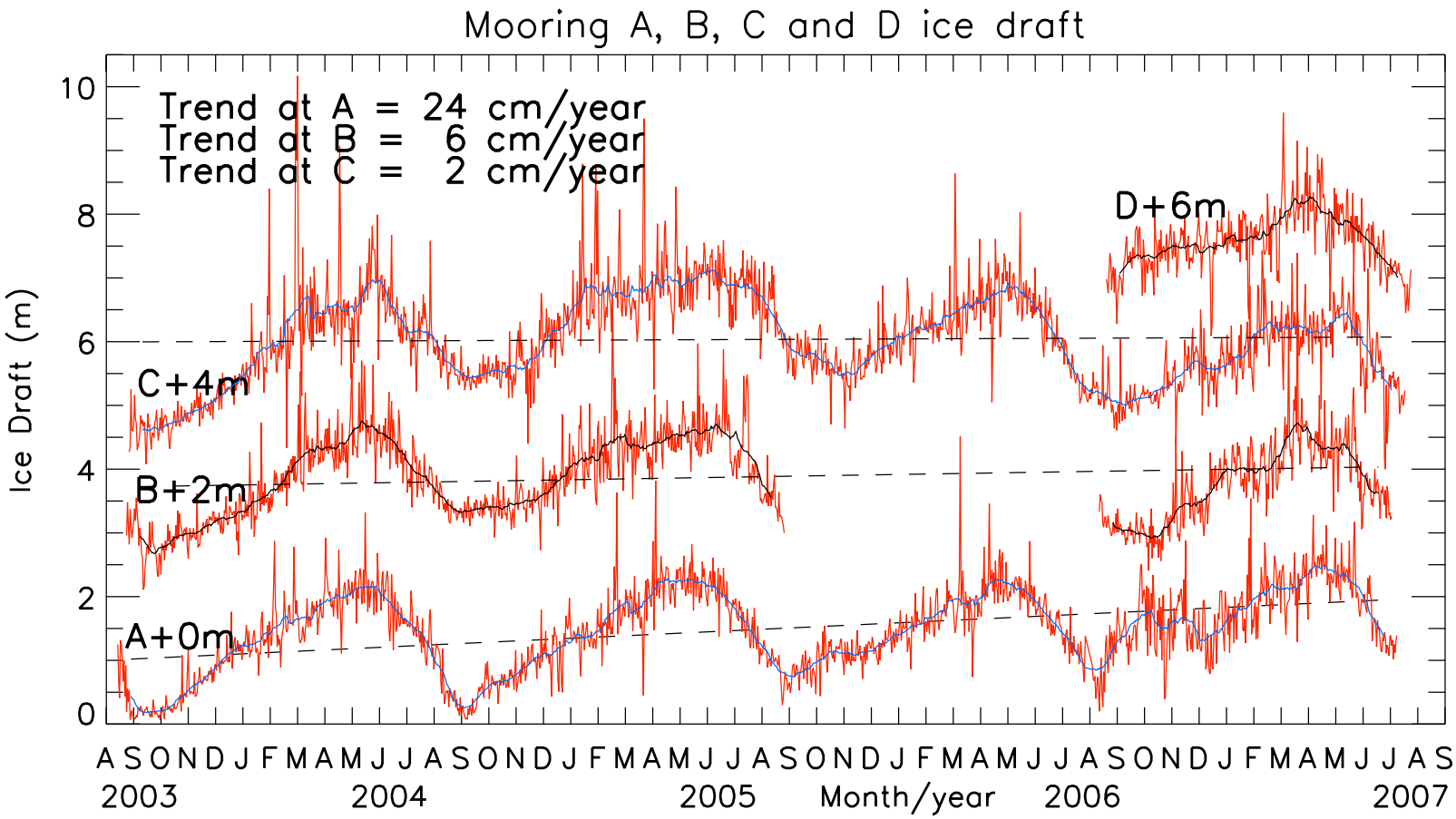
Proshutinsky et al. (2009)

Freshwater Content Increases 2003 through 2007 ...



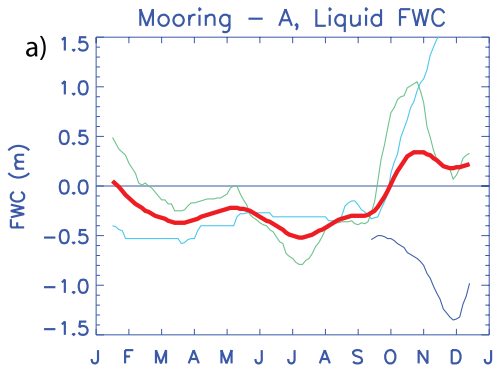
Proshutinsky et al. (2009)

… and ice thickness Increases 2003 through 2007

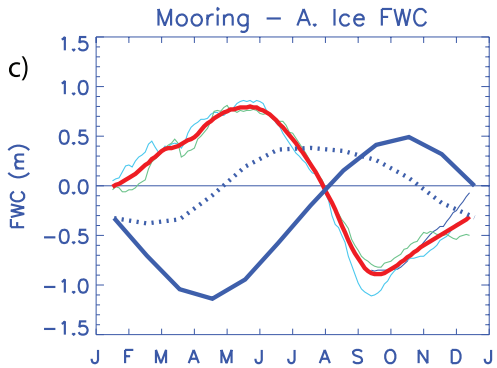


Proshutinsky et al. (2009)

Seasonal Cycle of Freshwater Content
(from 3-year records)



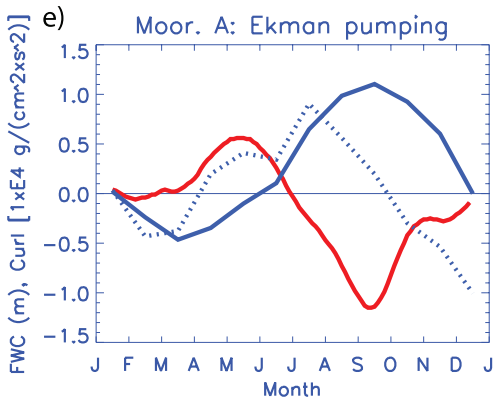
Water



Air Temperature

Degree days

Ice

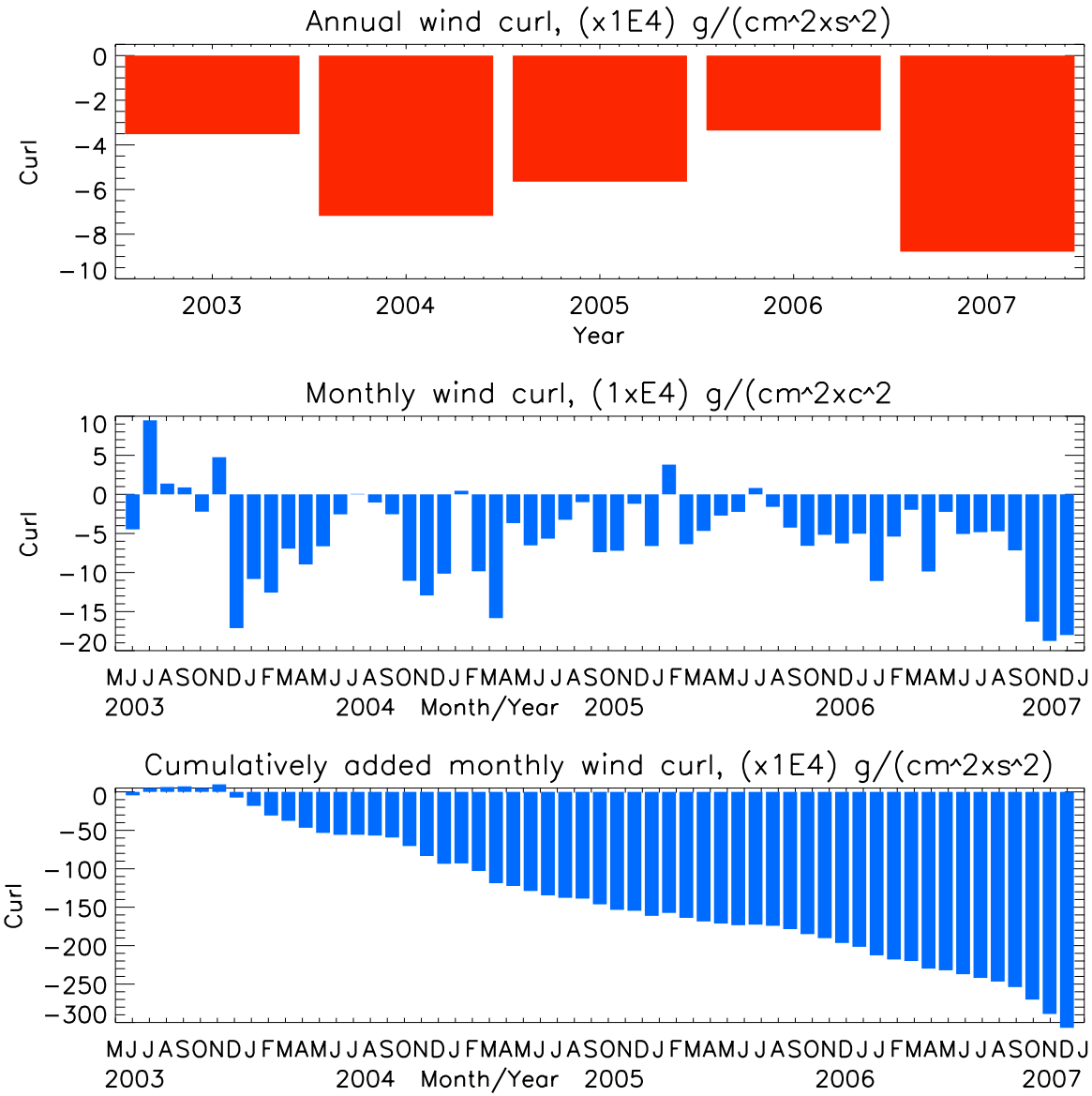


Wind-Stress Curl

Wind-Stress Curl Sum

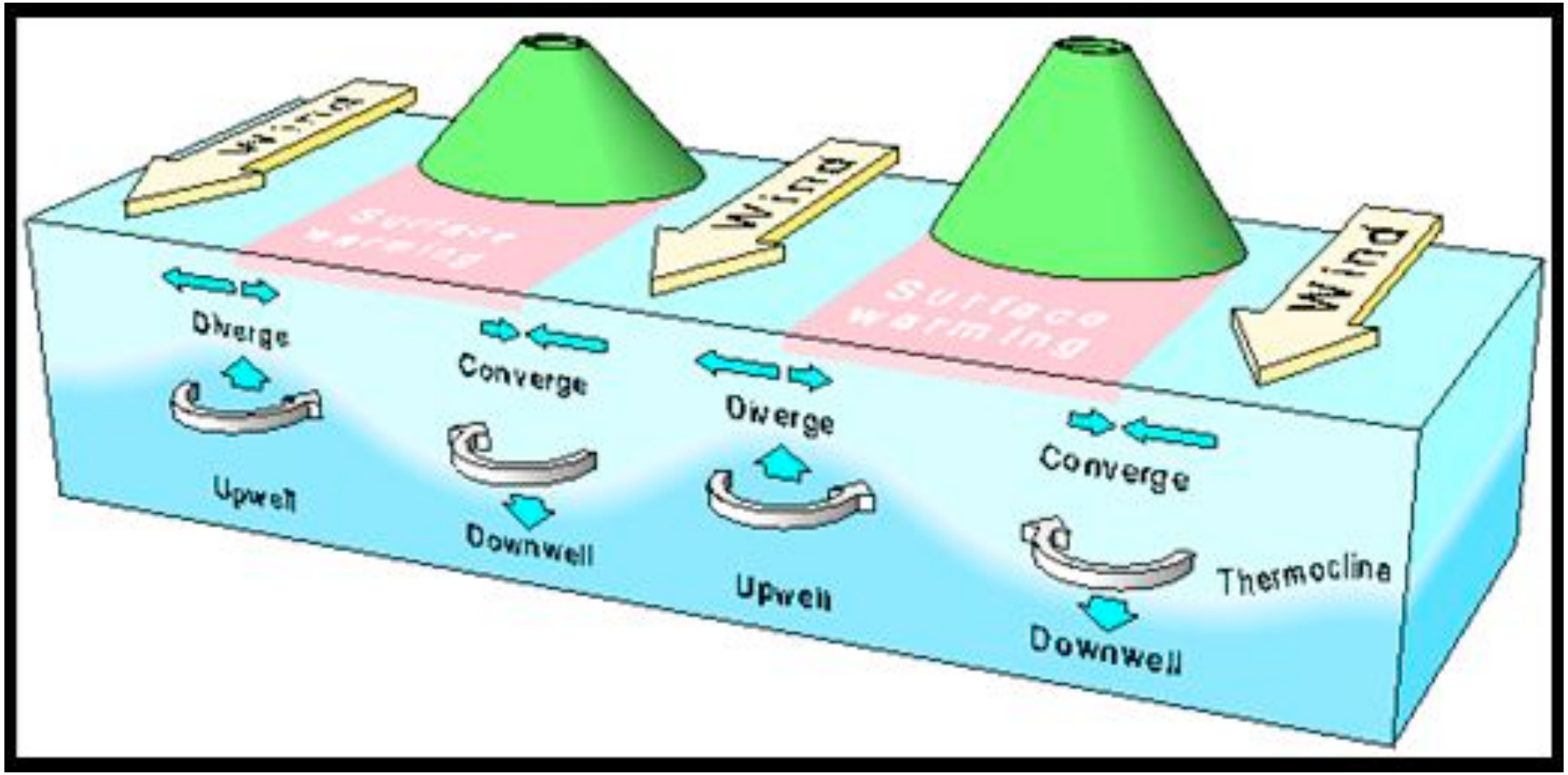
Ekman Pumping

Driving the Beaufort Gyre:
Wind-Stress Curl (Convergent Ekman Flux)



Wind-Stress Curl
Ekman Flux Divergenc/Convergence

Ex.: Hawaiian Islands



Chavanne, C., P. Flament, R. Lumpkin, B. Dousset, and A. Bentamy (2002): Scatterometer observations of wind variations induced by oceanic islands: Implications for wind-driven ocean circulation. Can. J. Remote Sensing, 28(3), pp.466-474.