

## S12

# The Arctic Ocean and Nordic Seas: Supplementary Materials

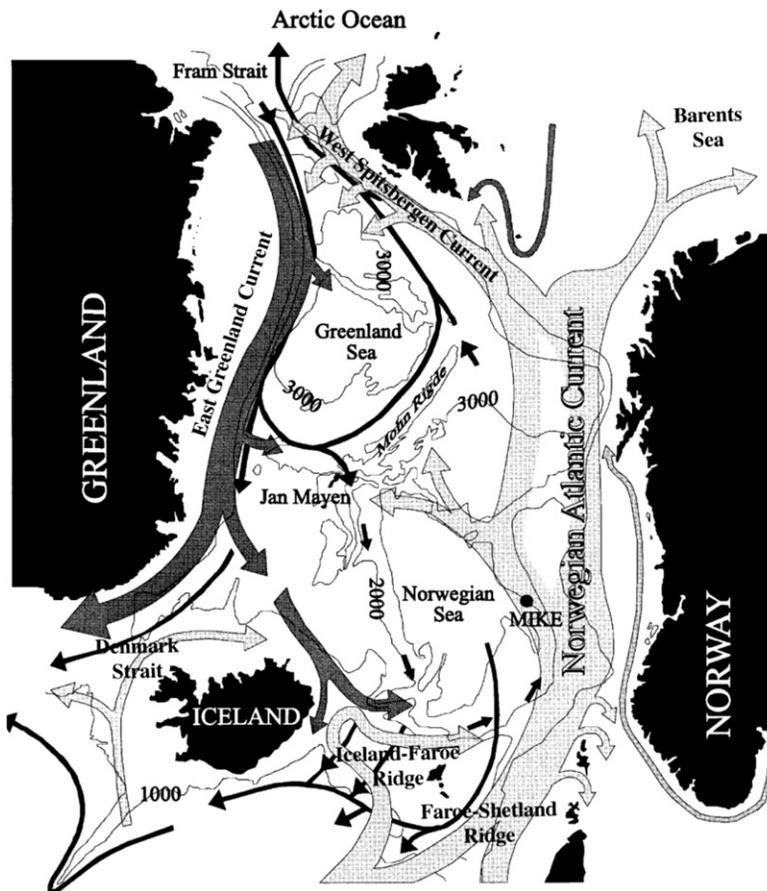
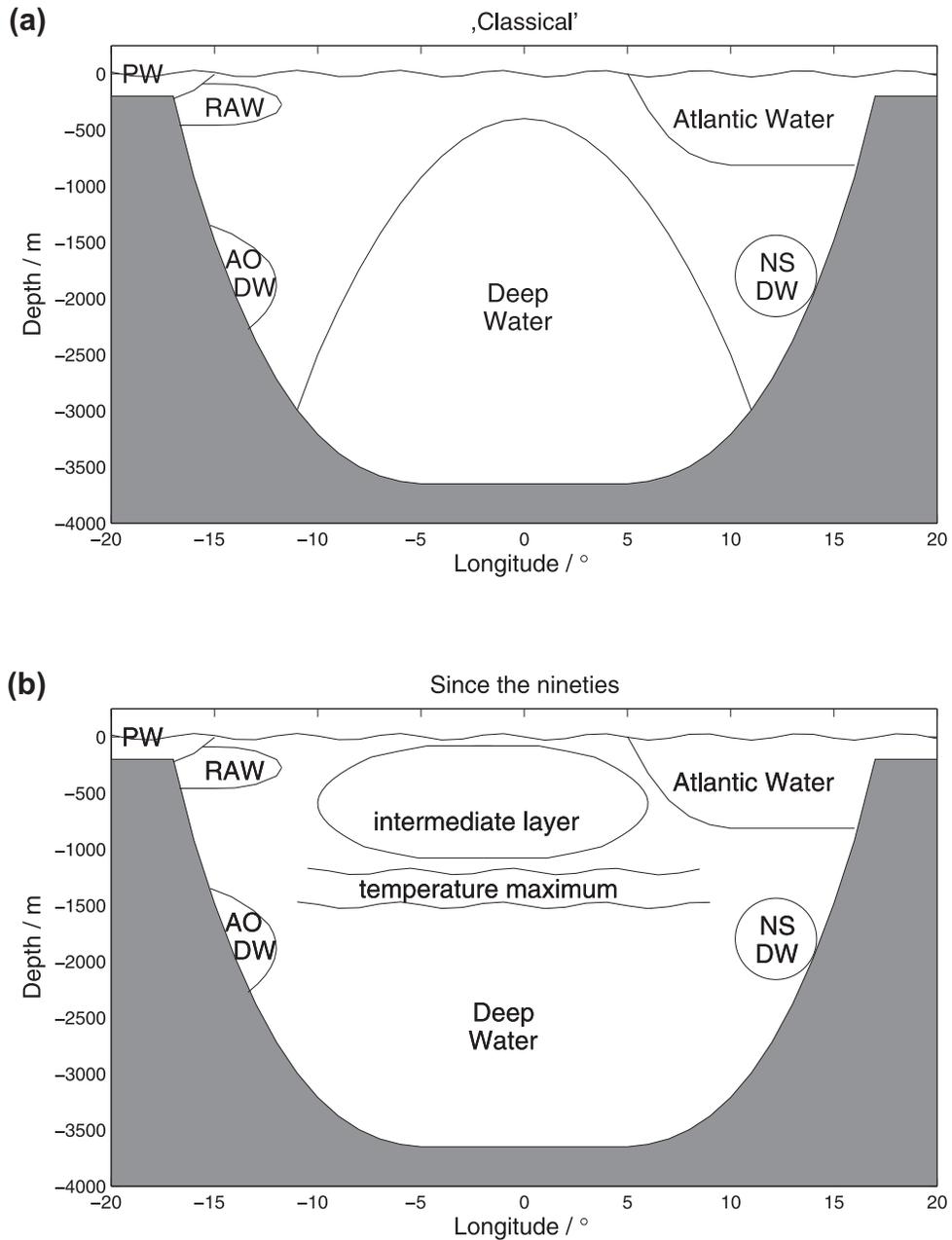


FIGURE S12.1 Principal currents of the Nordic Seas. Shaded currents show upper ocean circulation; thin black arrows show deep circulation. ©American Meteorological Society. Reprinted with permission. Source: From Østerhus and Gammelsrød (1999).



**FIGURE S12.2** Classical and recent structure of the Nordic Seas water column: (a) with deep convection and (b) with intermediate depth convection. PW, Polar Water; RAW, Return Atlantic Water; AODW, Arctic Ocean Deep Water; and NSDW, Norwegian Sea Deep Water. *Source: From Ronski and Budéus (2005b).*

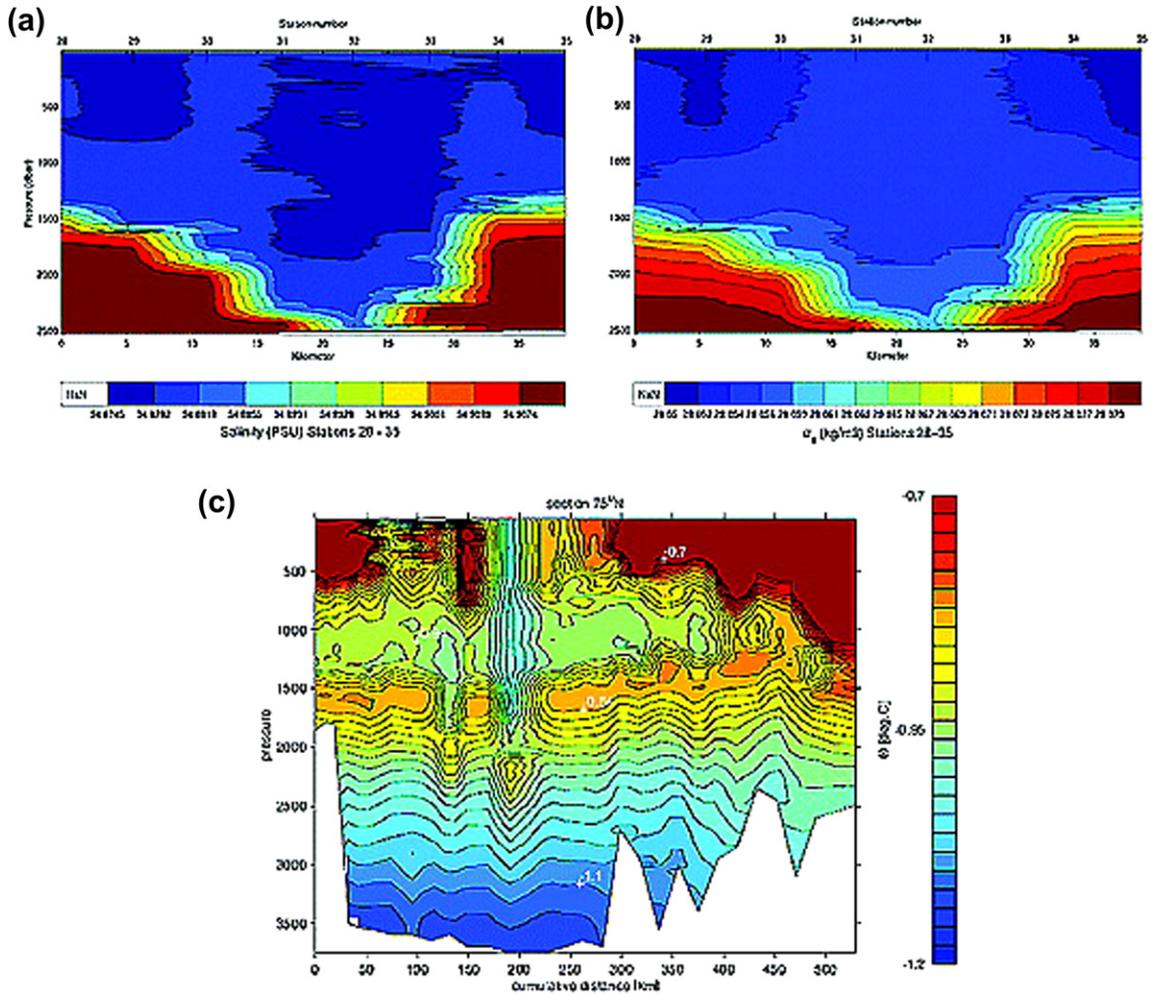


FIGURE S12.3 (a) Salinity, (b) potential density ( $\text{kg/m}^3$ ), and (c) potential temperature ( $^{\circ}\text{C}$ ) sections at 75°N across the Greenland Sea “chimney.” The last shows the whole section, while the first two are expanded views of the chimney itself. Source: From Wadhams, Holfort, Hansen, and Wilkinson (2002).

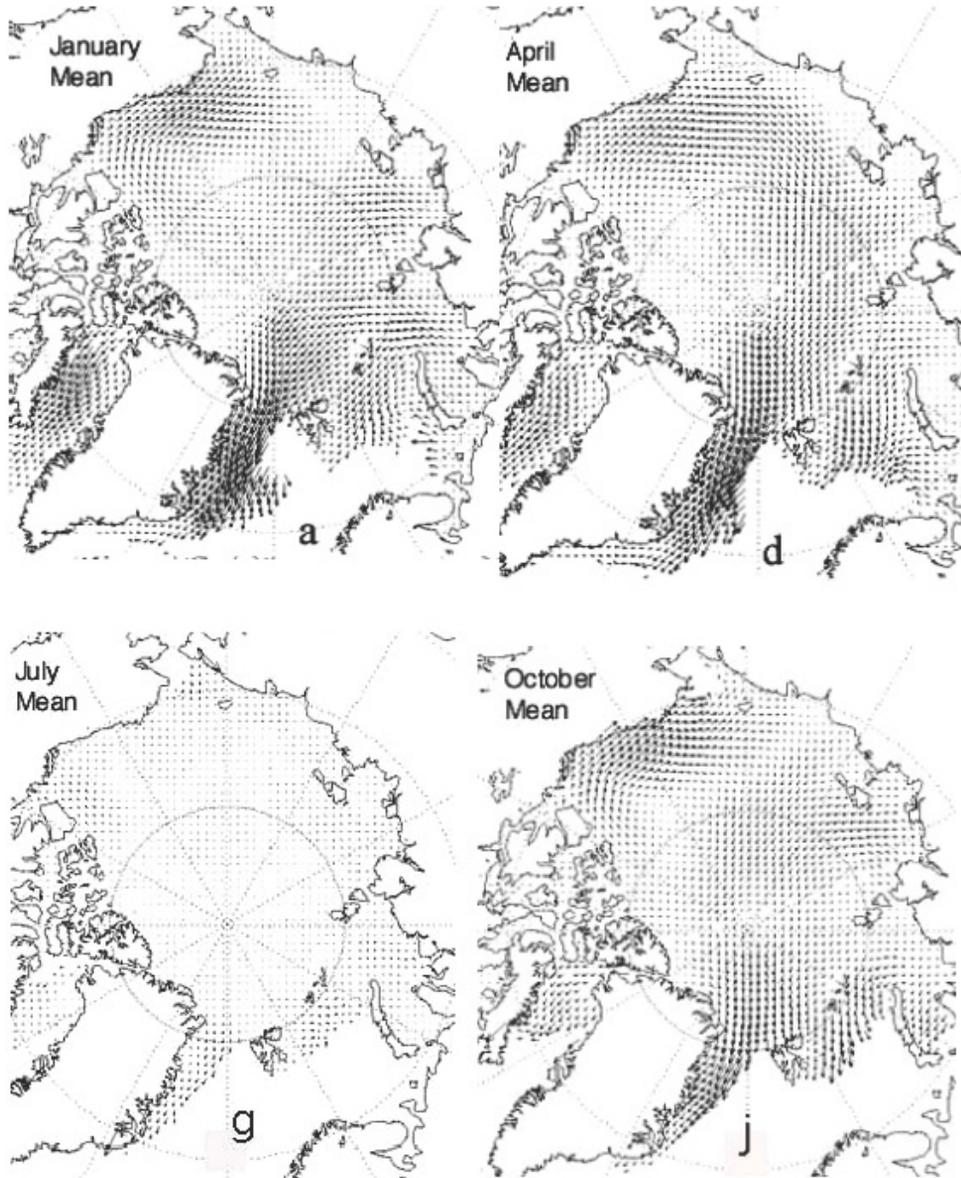
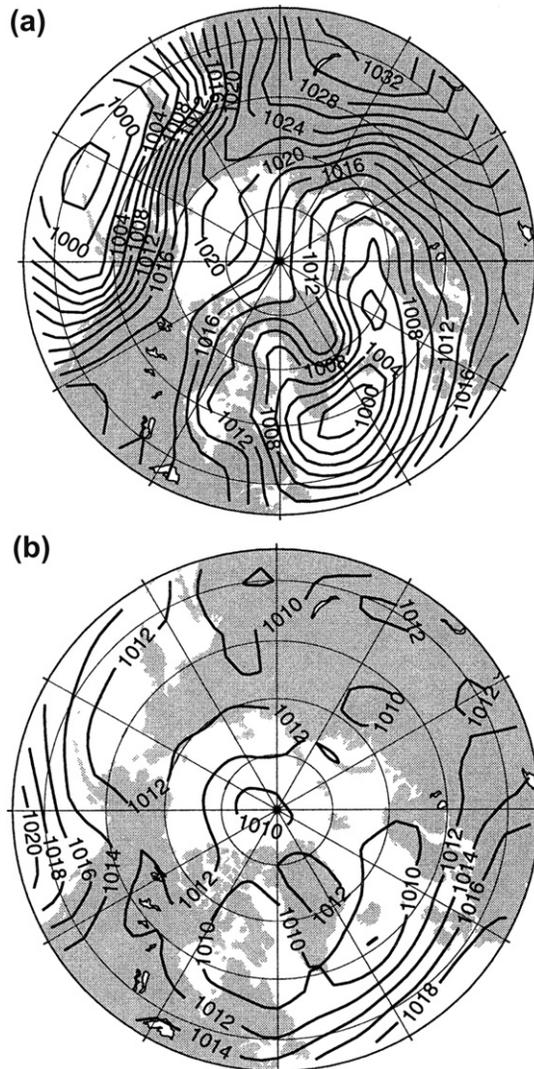


FIGURE S12.4 Monthly mean Arctic sea ice motion from 1979–2003 from Special Sensor Microwave Imager (SSM/I) passive microwave satellite data. Extended from Emery, Fowler, and Maslanik (1997); data from NSIDC (2008a).



**FIGURE S12.5** Mean sea level pressure from ERA-15 and NCEP-NCAR reanalyses for (a) winter (December–February) and (b) summer (July–September) ©American Meteorological Society. Reprinted with permission. *Source: From Bitz, Fyfe, and Flato (2002).*

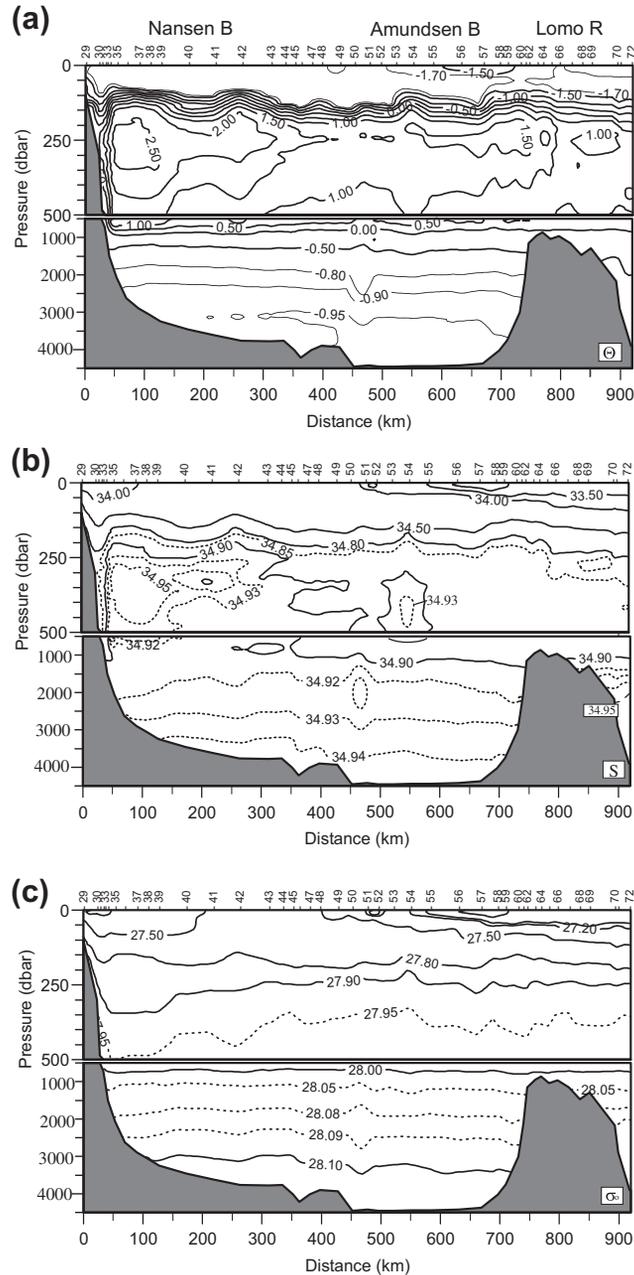


FIGURE S12.6 (a) Potential temperature ( $^{\circ}\text{C}$ ), (b) salinity, and (c) potential density  $\sigma_0$  in the Eurasian Basin, with the Russian coast on the left and Lomonosov Ridge at the right. Source: From Schauer et al. (2002).

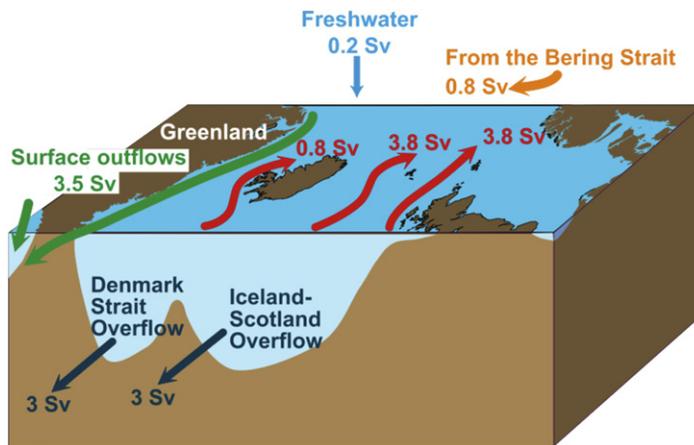
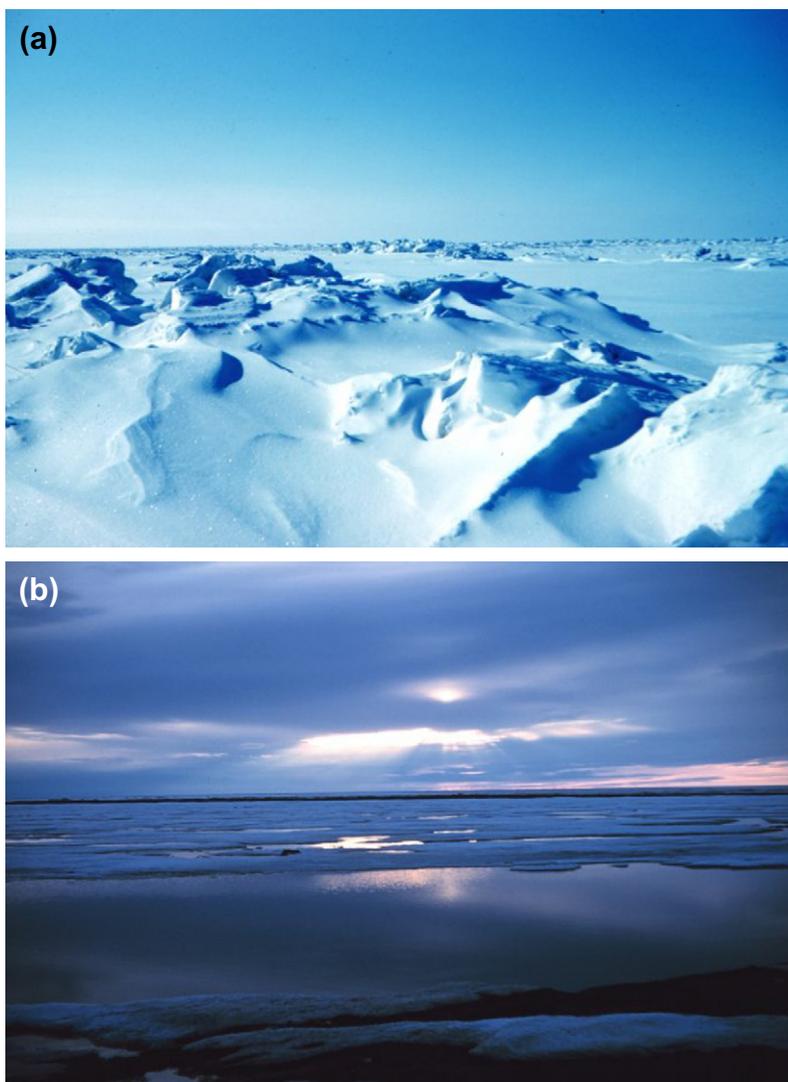
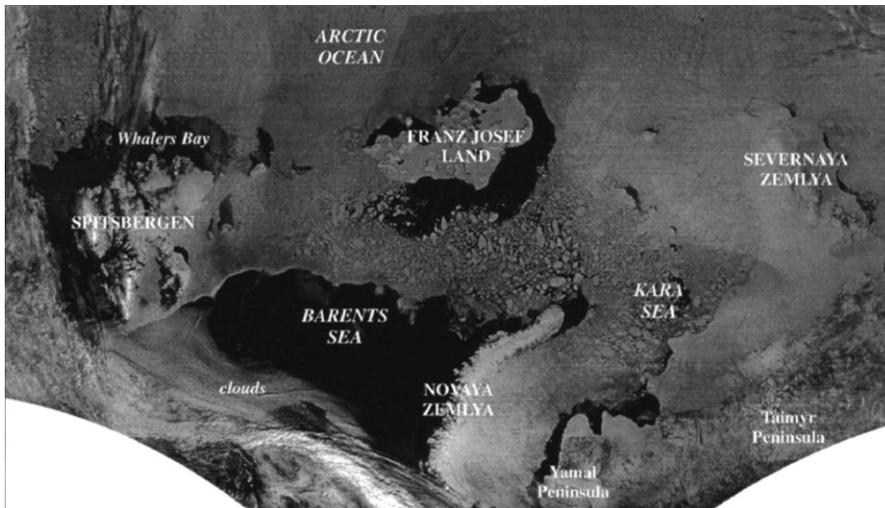


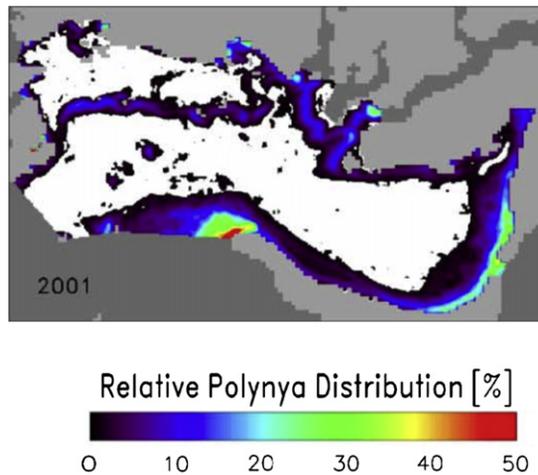
FIGURE S12.7 Volume transport budget for the Nordic Seas. Source: From Hansen et al. (2008).



**FIGURE S12.8** (a) Winter (spring 1949) and (b) melting (spring 1950) sea ice in the Beaufort Sea. <http://www.photolib.noaa.gov/htmls/corp1014.htm> and <http://www.photolib.noaa.gov/htmls/corp1104.htm> (NOAA Photo Library, accessed 2009.) (Photographer: Harley D. Nygren.)



**FIGURE S12.9** Ice cover in the Barents Sea in early June 1994, using NASA AVHRR near-infrared imaging. Black indicates lack of ice (open water and polynyas). *Source: From Anselme (1998).*



**FIGURE S12.10** Kara Sea polynya distribution for January–April 2001. Light gray indicates land: Novaya Zemlya is at the bottom of the image. Dark gray is masked regions. *Source: From Kern (2008).*

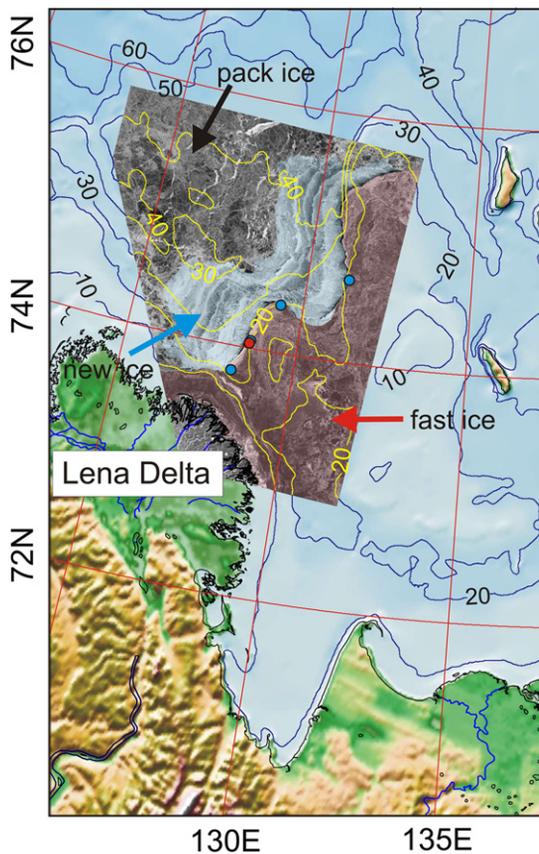


FIGURE S12.11 The Laptev Sea flaw polynya, imaged using Envisat advanced synthetic aperture radar, 1 May 2008. The polynya region is labeled as “new ice.” Source: From Dmitrenko *et al.* (2010).

TABLE S12.1 Major Nordic Seas Water Masses

Water Mass	Acronym	Depth	Characteristic Properties	Source
Polar (Arctic) Surface Water	PSW (ASW)	Surface to 25–50 m	–1.5 to –1.9 °C 28 to 33.5 psu (polar mixed layer and halocline) S: 28 to 33.5	Local (associated with sea ice) and inflow from Arctic
Atlantic Water	AW	200–900 m	>3 °C >34.9 psu ( $\theta$ and salinity maximum)	Norwegian Atlantic Current flow
Arctic Intermediate Water	AIW	Upper ocean to 1200 m	–1.2 °C, 34.88 psu (salinity minimum at ~800 m)	Intermediate depth convection in the Greenland and Iceland Seas
Upper Polar Deep Water	uPDW	800–1500 m (Nordic Seas)	–0.5–0 °C 34.85 to 34.9 psu (salinity minimum)	Upper Polar Deep Water from the Arctic Ocean
Arctic Ocean Deep Water	AODW	2000 m to bottom	–0.53 °C, >34.95 psu –0.4 to –0.2 °C	Canadian and Eurasian Basin Deep Waters from the Arctic Ocean
Greenland Sea Deep Water	GSDW	2000 m to bottom	<–1.2 °C 34.88–34.90 psu	Greenland Sea deep convection
Norwegian Sea Deep Water	NSDW	2000 m to bottom	–1.055 °C, 34.91 psu	GSDW and mixing

Source: After Aagaard, Swift, and Carmack, 1985 and Rudels et al., 2005.

**TABLE S12.2** Arctic Ocean and Nordic Seas Surface Circulation Elements (Partial List)

<b>Name</b>	<b>Description</b>
Transpolar Drift (TPD)	Broad drift across Arctic from Siberian region to Greenland
Beaufort Gyre	Anticyclonic gyre in the Canadian Basin
“Rim” current	Cyclonic coastal flow around the Arctic
Siberian Coastal Current	Portion of rim current along the Siberian coast
Alaskan Coastal Current	Portion of rim current along the Alaskan coast
Bering Strait inflow	Inflow to the Arctic from the Bering Sea
West Spitsbergen Current (WSC)	Northward flow through Fram Strait
Norwegian Atlantic Current (NAC)	Northward eastern boundary flow in the Nordic Seas
Norwegian Coastal Current (NCC)	Northward coastal current along Norway in the Nordic Seas (rim current along Norwegian coast)
East Greenland Current (EGC)	Southward western boundary current along Greenland coast
Jan Mayen Current (JMC)	Eastward flow branching from the EGC into the Greenland Sea toward Jan Mayen
East Iceland Current (EIC)	Southeastward flow branching from the EGC in the Iceland Basin
Iceland-Faroe Front (IFF)	Eastward flow along the Iceland-Faroe Ridge
Irminger Current (IC) and North Irminger Current (NIC)	Northward flow in the North Atlantic along the western flank of the Reykjanes Ridge, and its northeastward branch around Iceland
West Greenland Current	Northward eastern boundary flow along Greenland in the Labrador Sea and Baffin Bay
Baffin Current	Southward western boundary flow in Baffin Bay
Labrador Current	Southward western boundary flow in the Labrador Sea
Canadian Archipelago flows	Outflow from Arctic to Baffin and Hudson Bays through the many island passages, including Lancaster Sound, Jones Sound, and Nares Strait

TABLE S12.3 Major Arctic Ocean Water Masses<sup>a</sup>

Water Mass	Acronym	Depth	Characteristic Properties	Source
Polar Surface Water	PSW	Surface to 25–50 m	–1.5 to –1.9 °C 31–34 psu S: 28 to 33.5	Local, associated with sea ice, river runoff; includes Polar Mixed Layer and halocline
Alaskan Coastal Water	ACW		–1.1 to –1.2 °C 31–32 psu (temperature maximum)	Surface water with river runoff
summer Bering Strait Water (Pacific Summer Water)	sBSW	70–130 m	–1.3 °C 32–33 psu (temperature maximum)	Bering Strait summer flow
winter Bering Strait Water (Pacific Winter Water)	wBSW		33.1 psu	Bering Strait winter flow
Atlantic Water (Atlantic Layer)	AW	200–1000 m	0– 3 °C >34.9 psu ( $\theta$ maximum)	Norwegian Atlantic Current inflow, modified within the Arctic
upper Polar Deep Water	uPDW	1000–1700 m	–0.5– 0 °C 34.85–34.9 psu	
Canadian Basin Deep Water; bottom water	CBDW	1700 m to bottom	–0.53 °C ~34.95 psu –0.4 to –0.2 °C	Eurasian Basin; bottom water isolated
Eurasian Basin Deep Water; bottom water	EBDW	1700 m to bottom	–0.95 °C ~34.94 psu	Brine-rejected shelf waters and Greenland Sea Deep Water

Source: From Jones, 2001 and Steele et al., 2004.

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