The Laptev Sea polynya project - multi-disciplinary studies of hydrography, sea ice and sea-ice/ocean/atmosphere interactions

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Russian-German Cooperation Project ‘System Laptev Sea‘

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Laptev-Sea System

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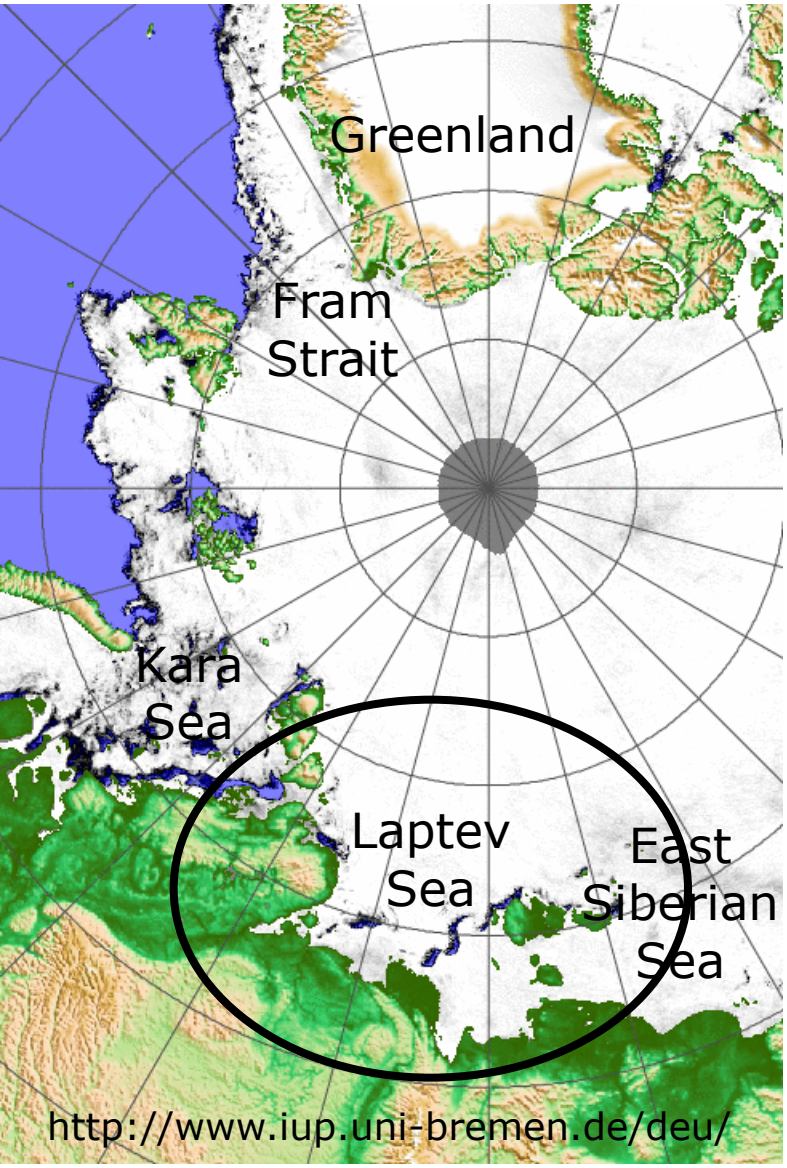
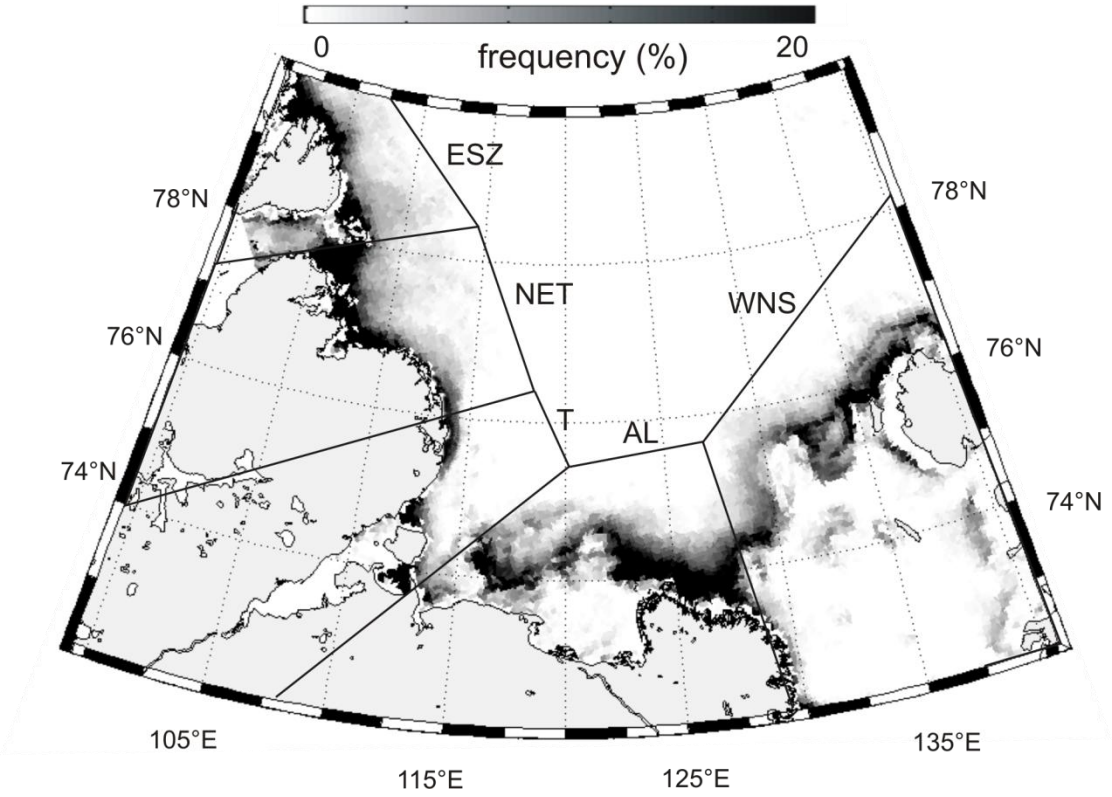
Region of interest



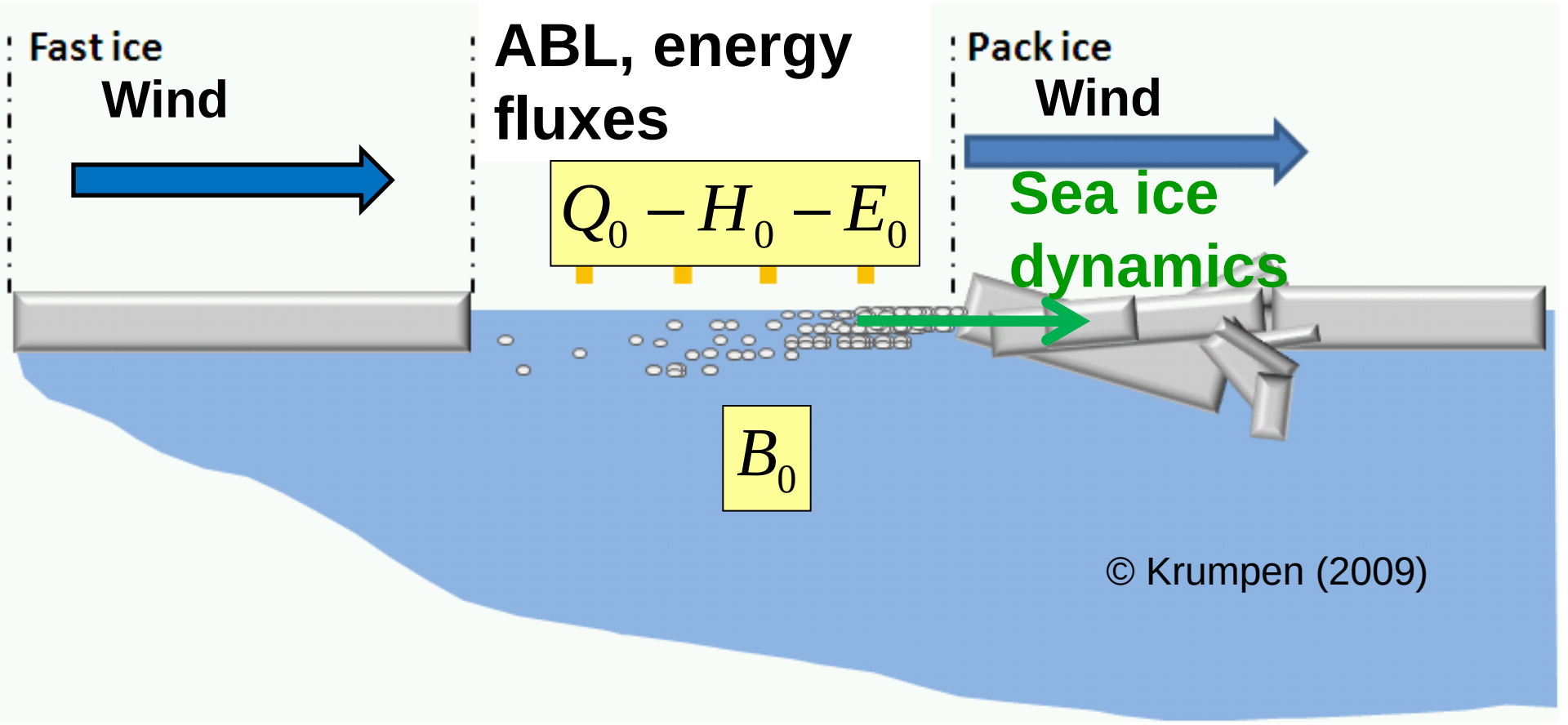
Polynya frequency



PSSM (AMSR-E) Nov-Apr 2002-2008

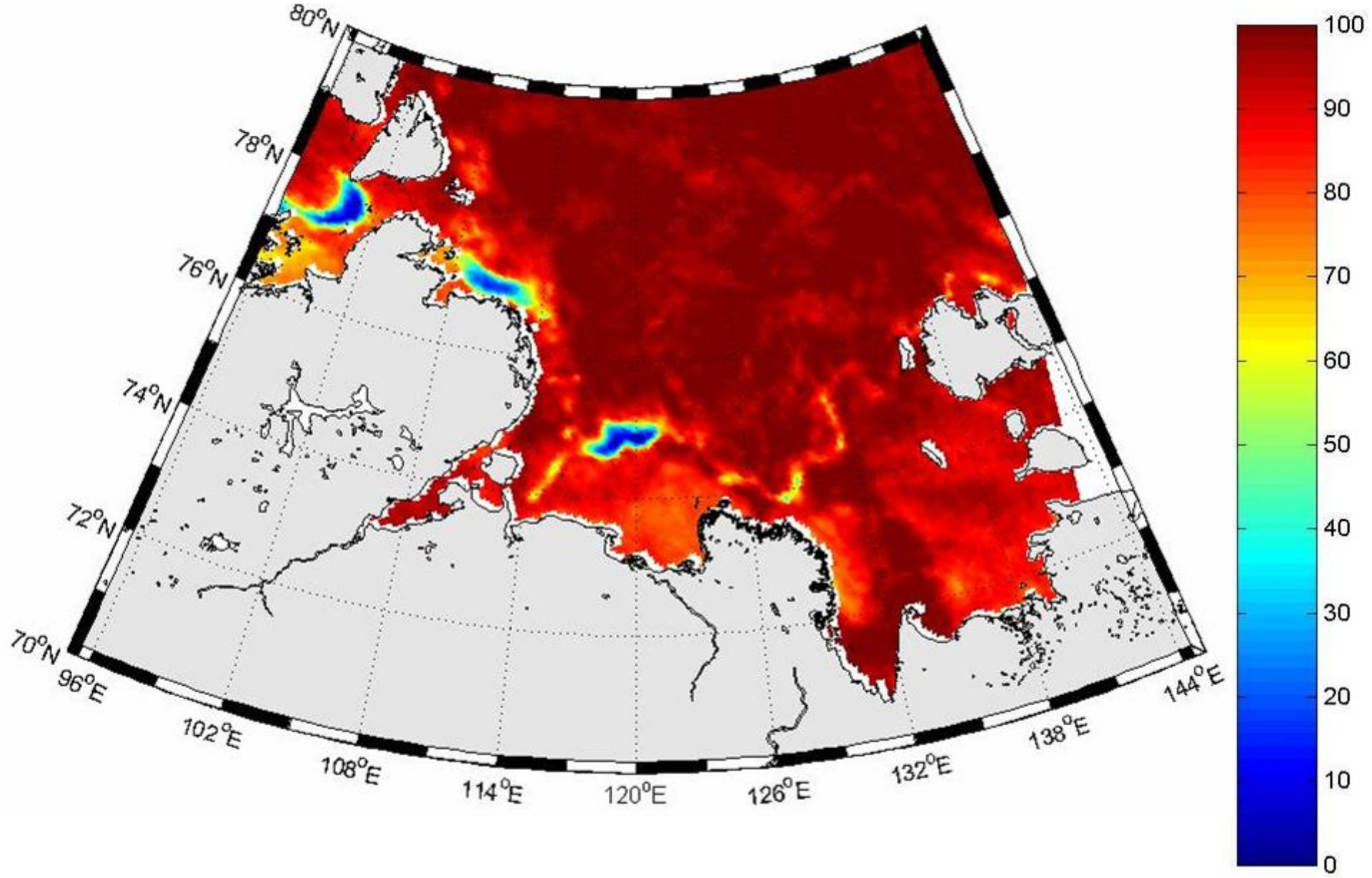
Willmes et al. (2010)

Polynya processes

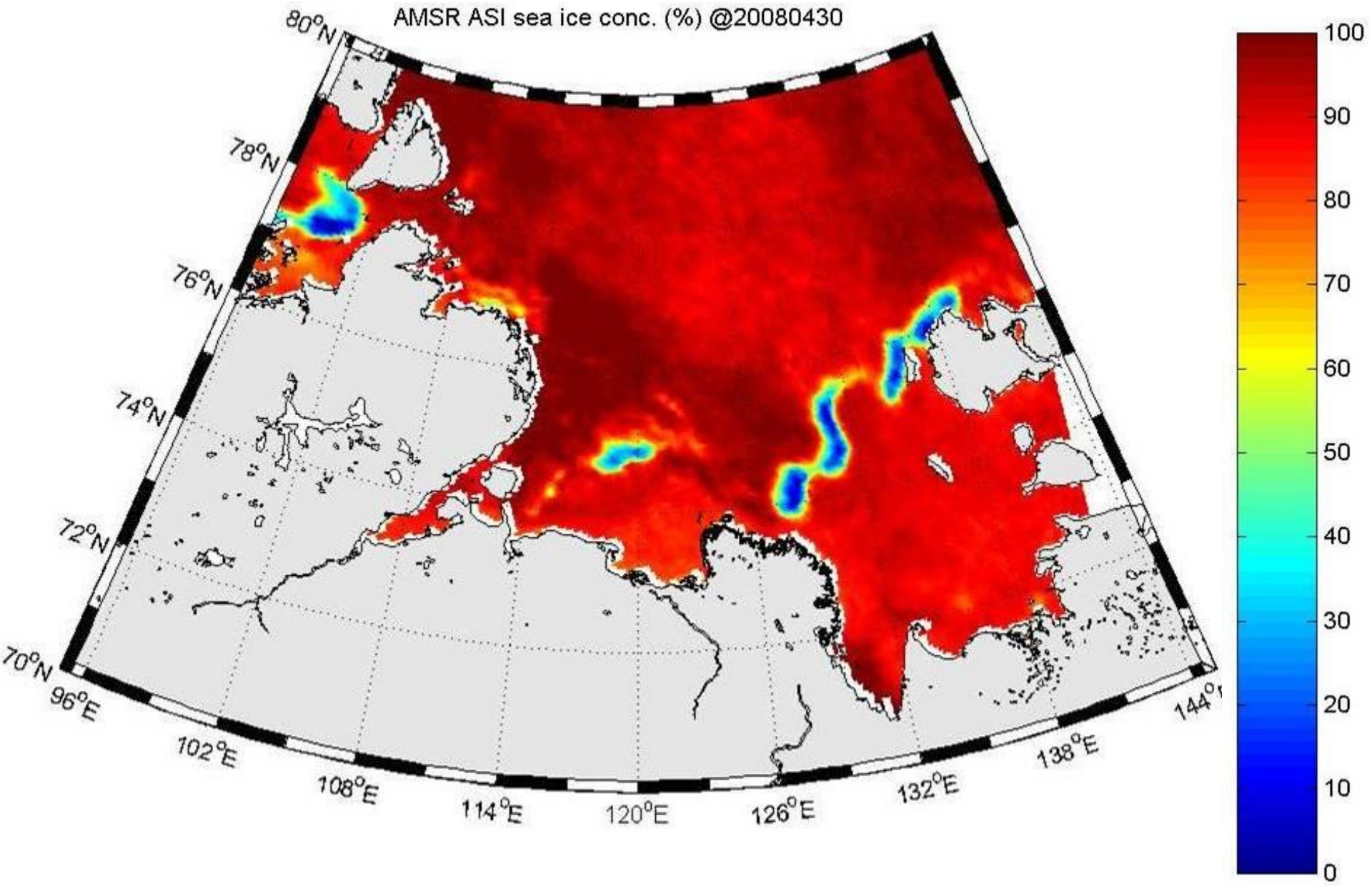


Q_0: net radiation
H_0: sensible heat flux
E_0: latent heat flux
B_0: soil heat flux (ice production)

Sea ice coverage 28 April 2008

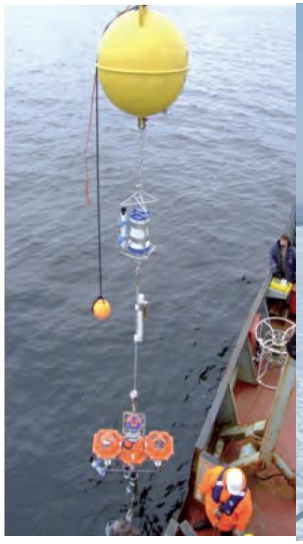


Sea ice coverage 30 April 2008



MODIS VIS 0340 UTC, 31 March 2012 (day91)

Field studies



Three winter expeditions (2008, 2009 and 2012)

- in-situ measurements of oceanic and atmospheric quantities at the polynya edge

- remote sensing measurements of ice properties across the polynya

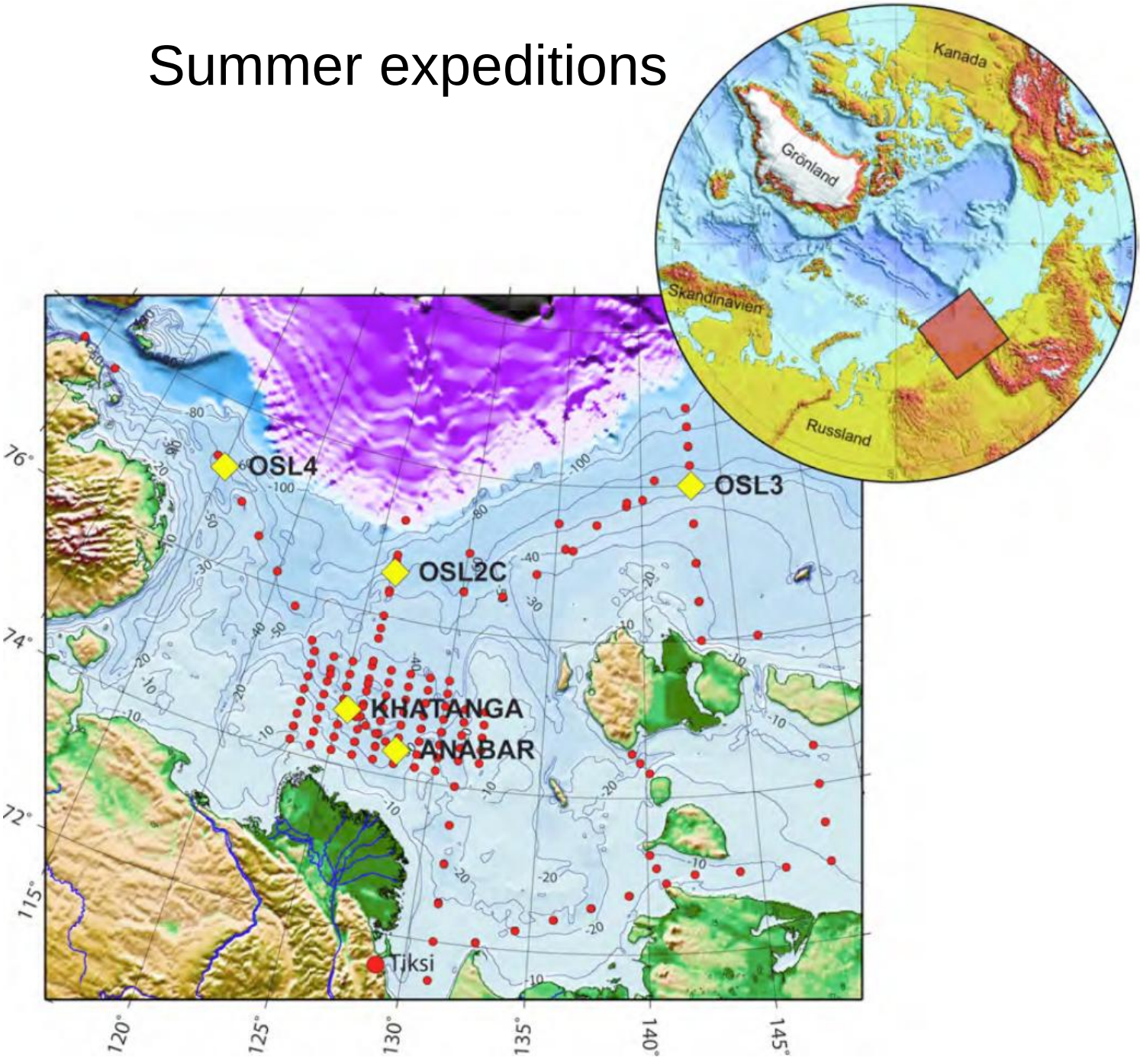
Five summer expeditions (2007, 2008, 2009, 2010, 2011)

- hydrographical and biogeo-chemical measurements in ice free parts of the Laptev Sea

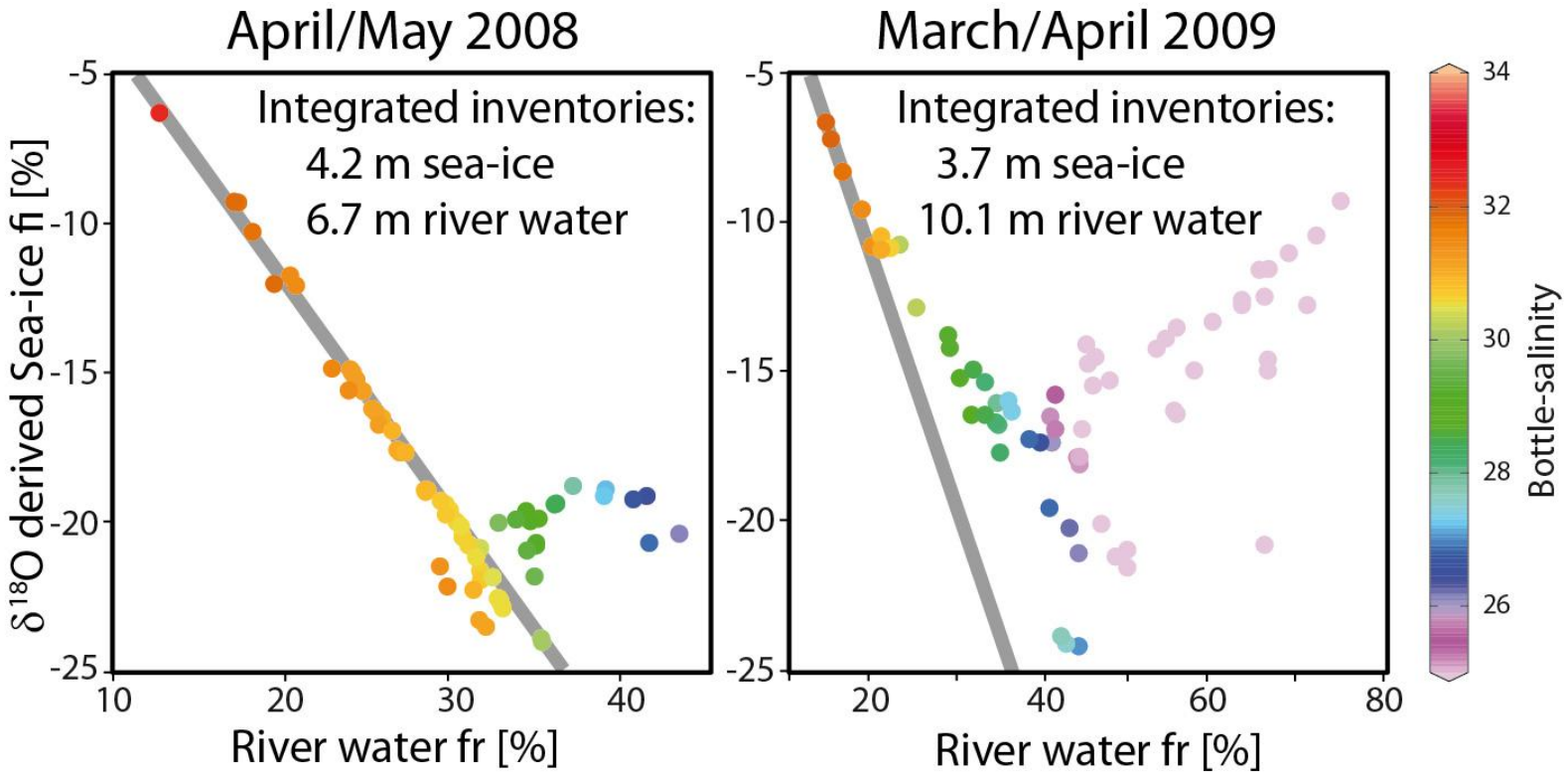
Two permanent buoy moorings

Summer expeditions

stations (red dots)
and moorings
(yellow sqares)



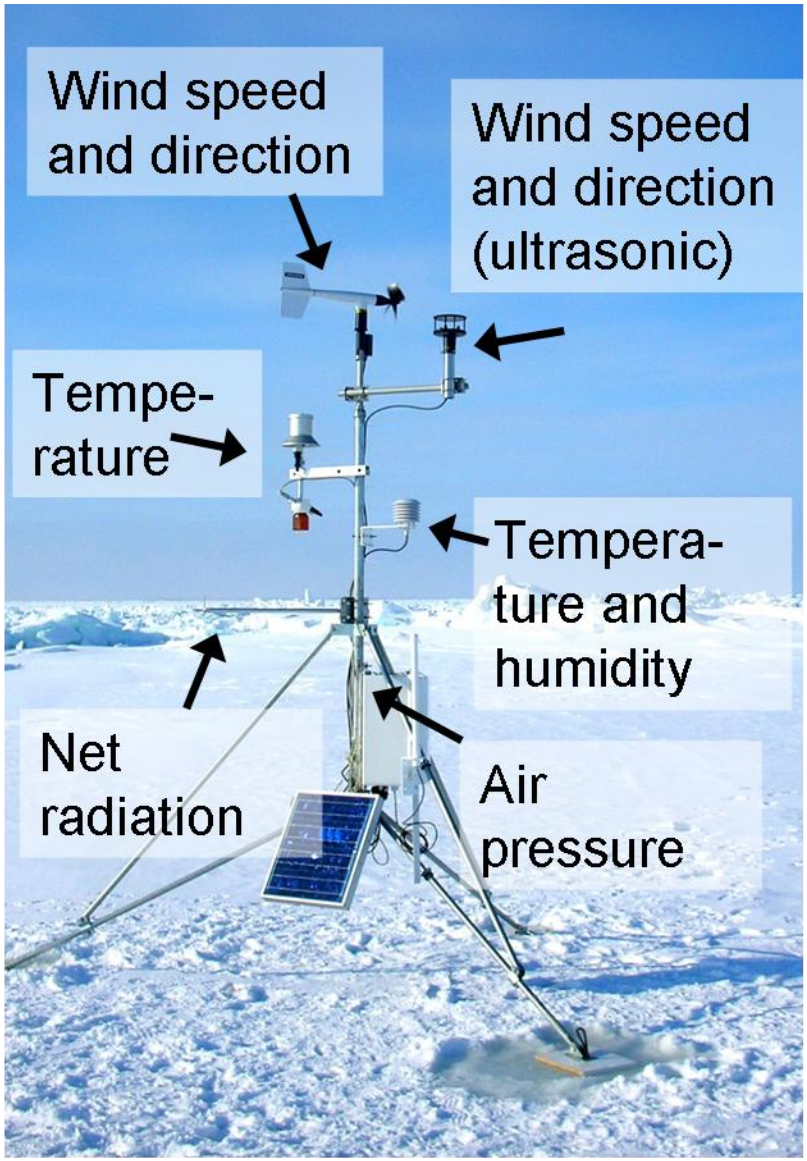
Stable oxygen isotope ($\delta^{18}O$) studies



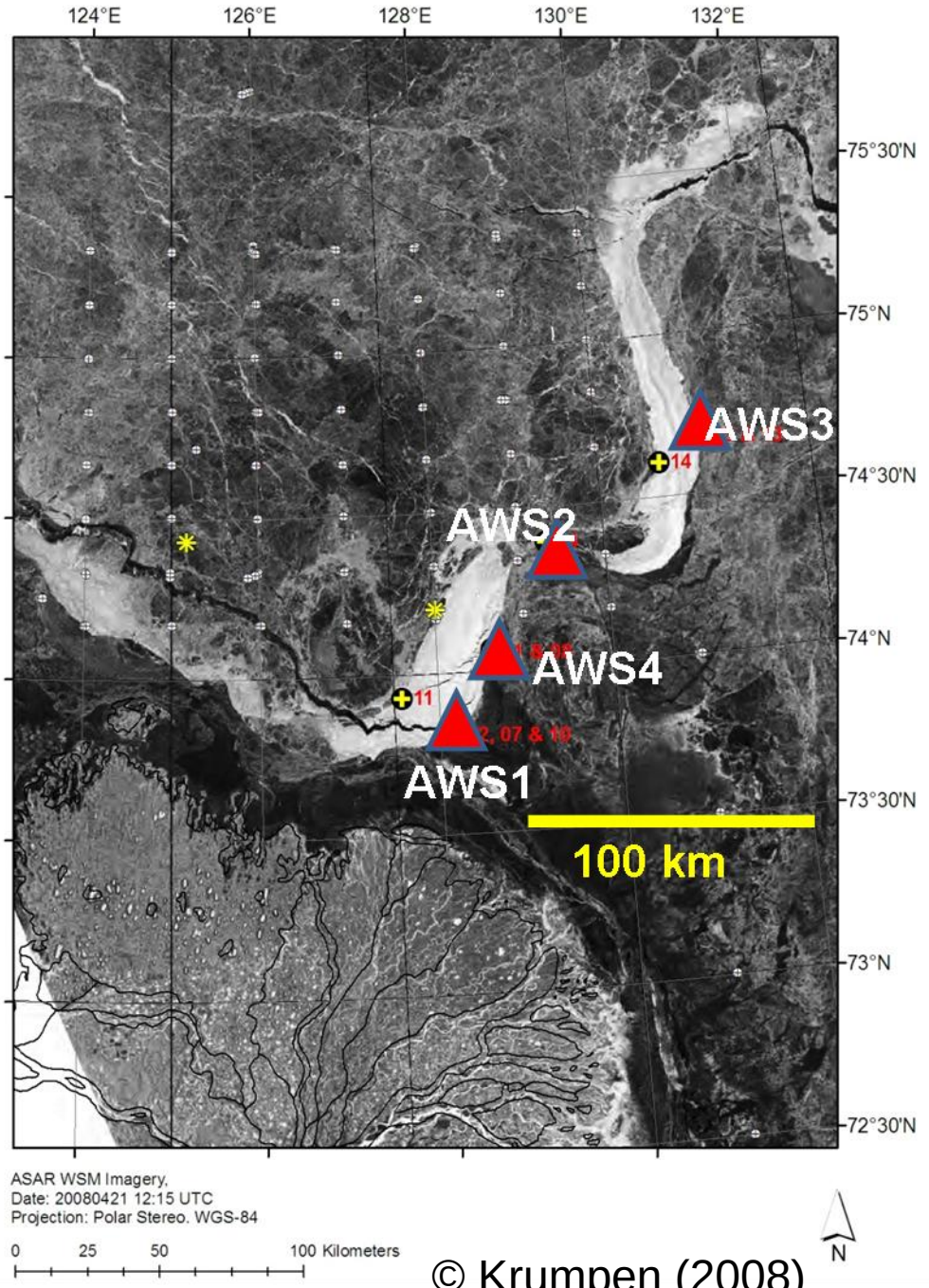
Contributions of $\delta^{18}O$-derived sea-ice (fi) versus river water (fr) fractions within the water column during late winters. Bauch et al. (2012).

AWS measurements

March/April 2008, 2009, 2012



© Helbig (2008)



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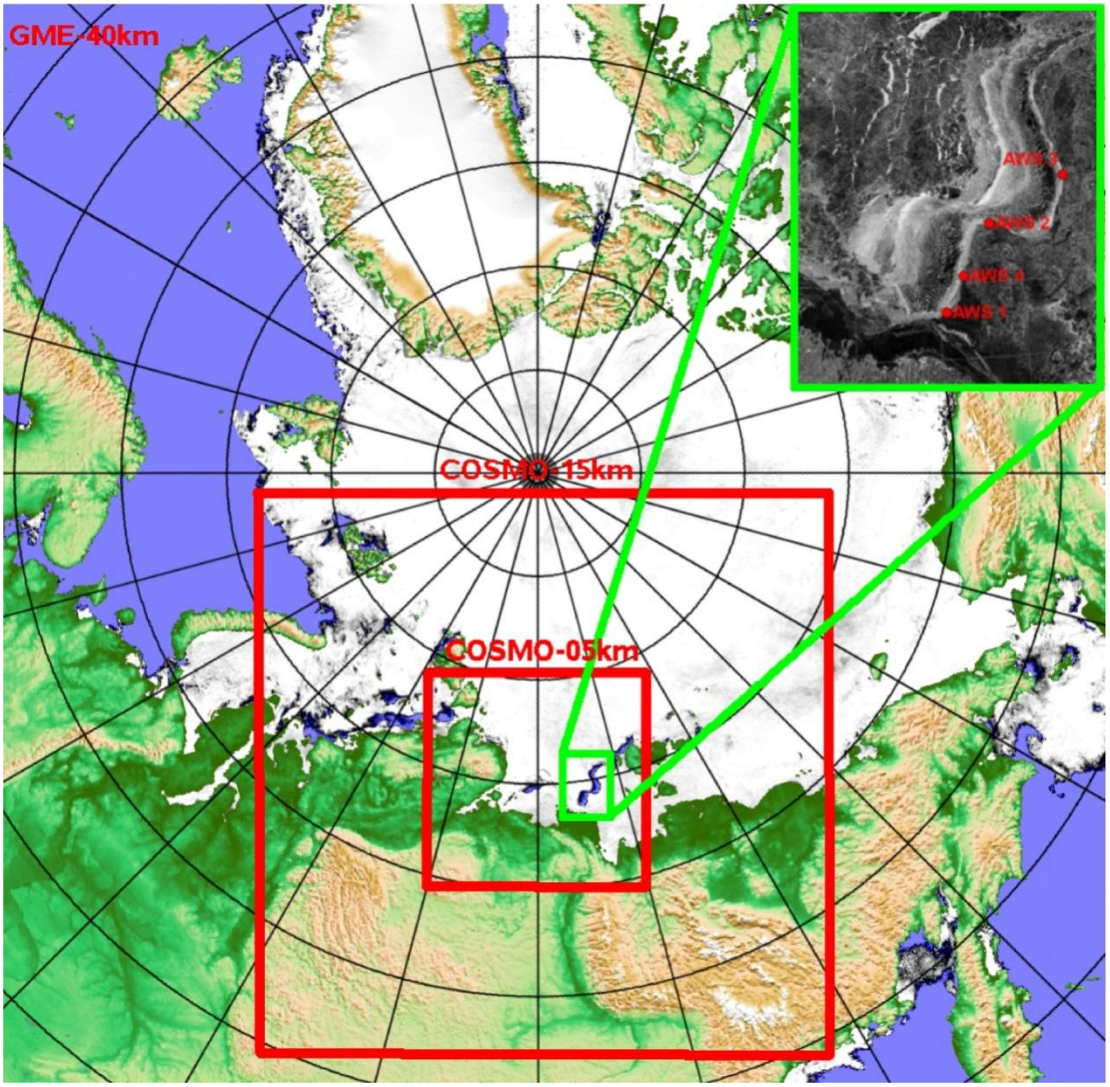
Atmospheric modelling: COSMO



Model domains
COSMO-15km: 3000km
COSMO-5km: 1000km

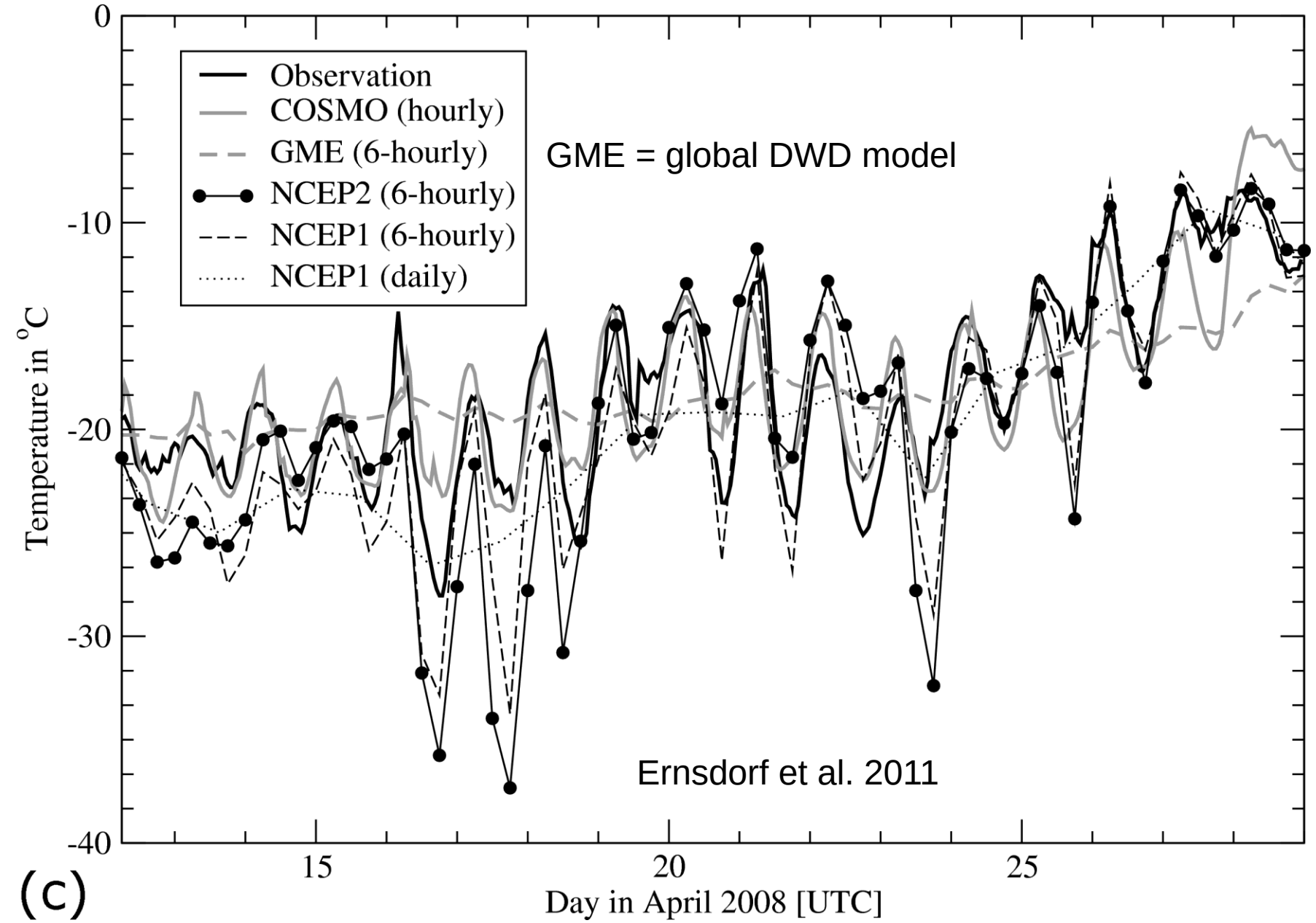
Forcing
GME (global DWD model)
ERA-Interim

Forecast mode
+30h, 6h spin-up

Schröder et al. (2011)

→ thermodynamic two-layer sea-ice model
→ dynamic-thermodynamic sea-ice-ocean model FESOM (AWI)

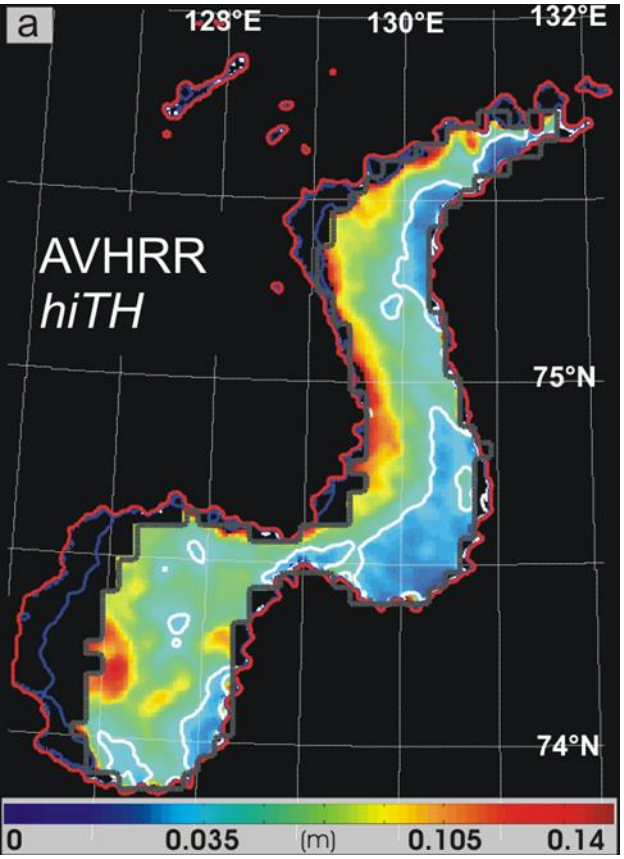
Verification using AWS: temperature



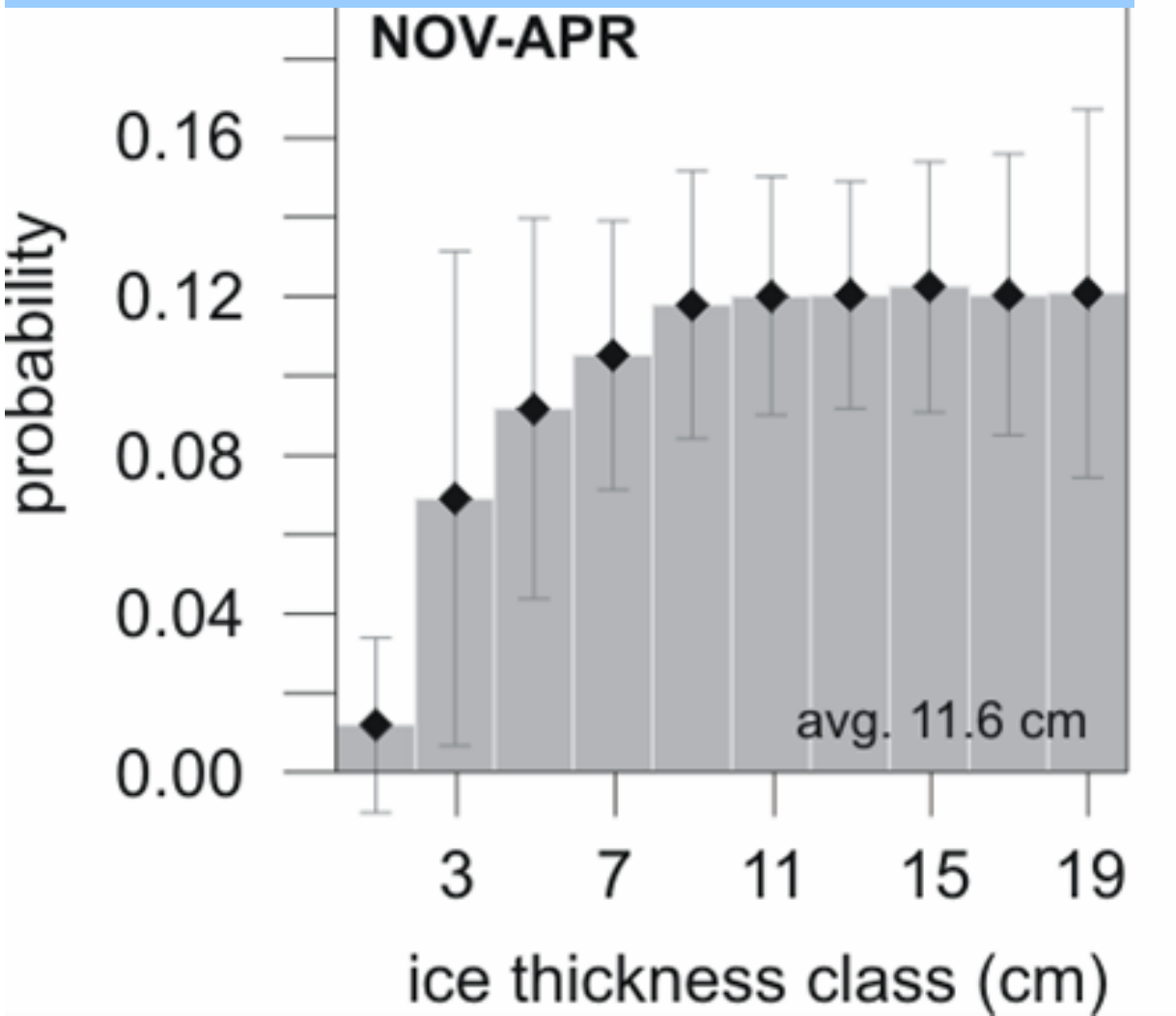
Remote sensing: sea ice

Thin ice statistics: MODIS, 59 Laptev polynya cases

thin-ice thickness
AVHRR (hiTH)



hiTH contour lines 0.05m (white), 0.2m (blue), 0.5m (red)

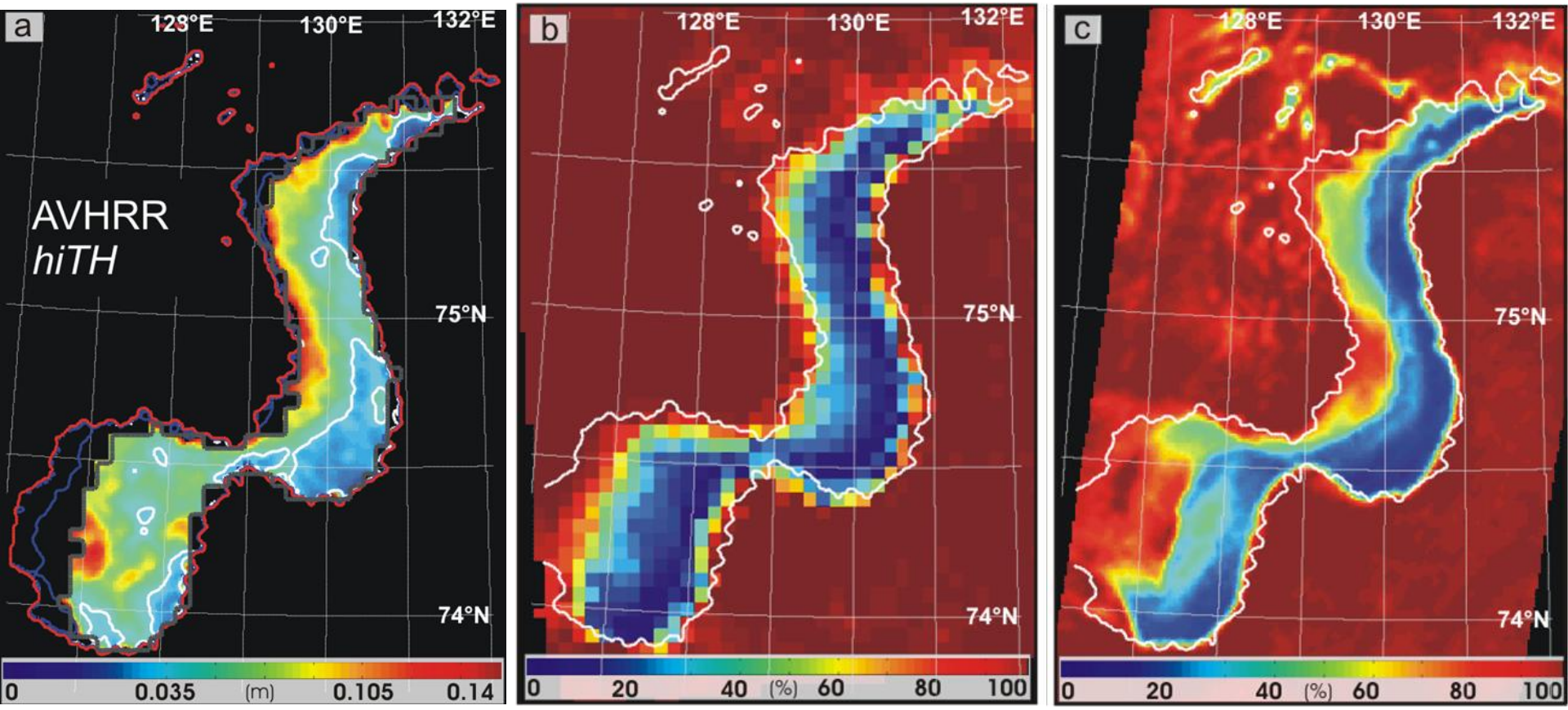


Remote sensing: sea ice

thin-ice thickness AVHRR (hiTH)

sea-ice concentration AMSR-E

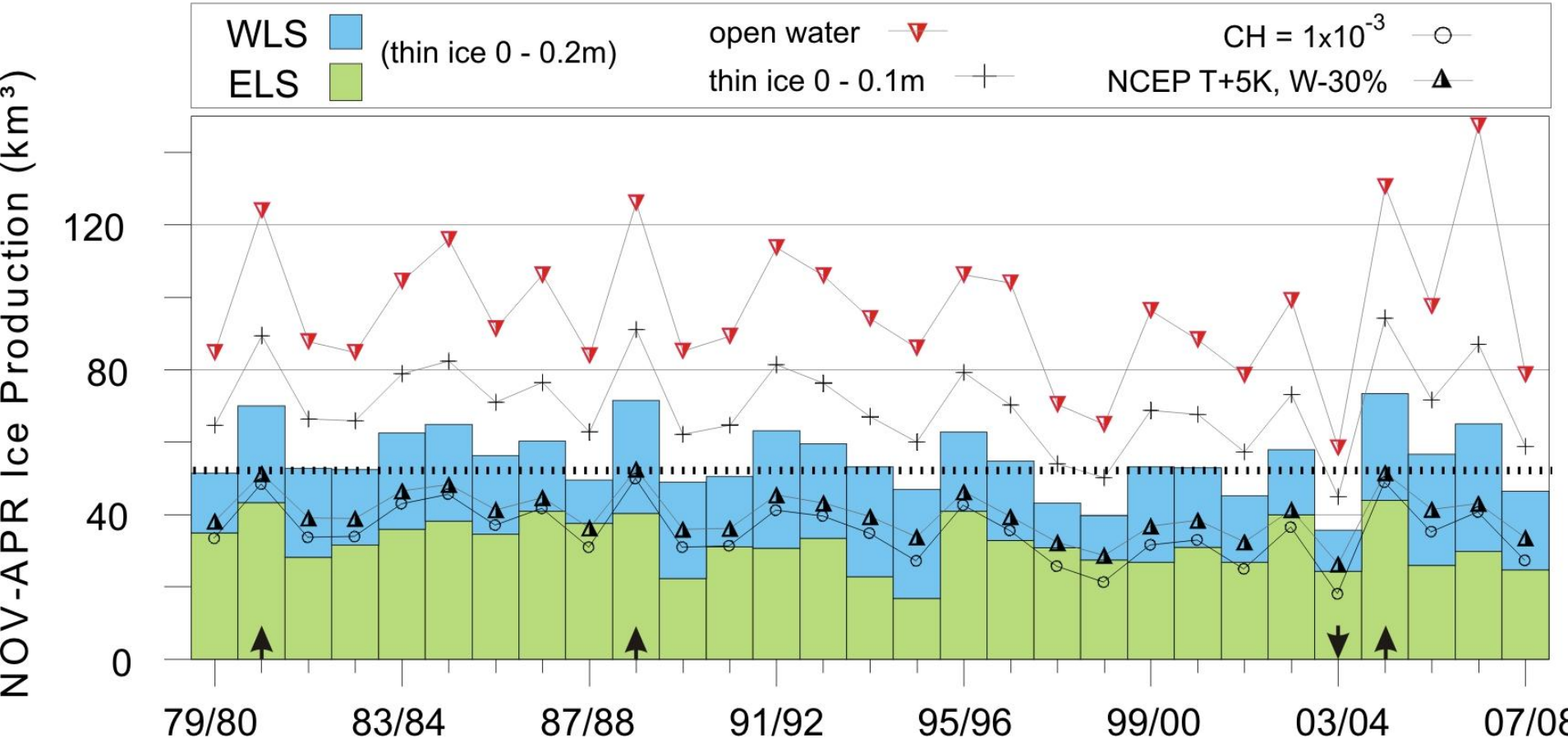
POTOWA sea-ice concentration from AVHRR (Heinemann and Drüe, 2005)



hiTH contour lines 0.05m (white), 0.2m (blue), 0.5m (red)

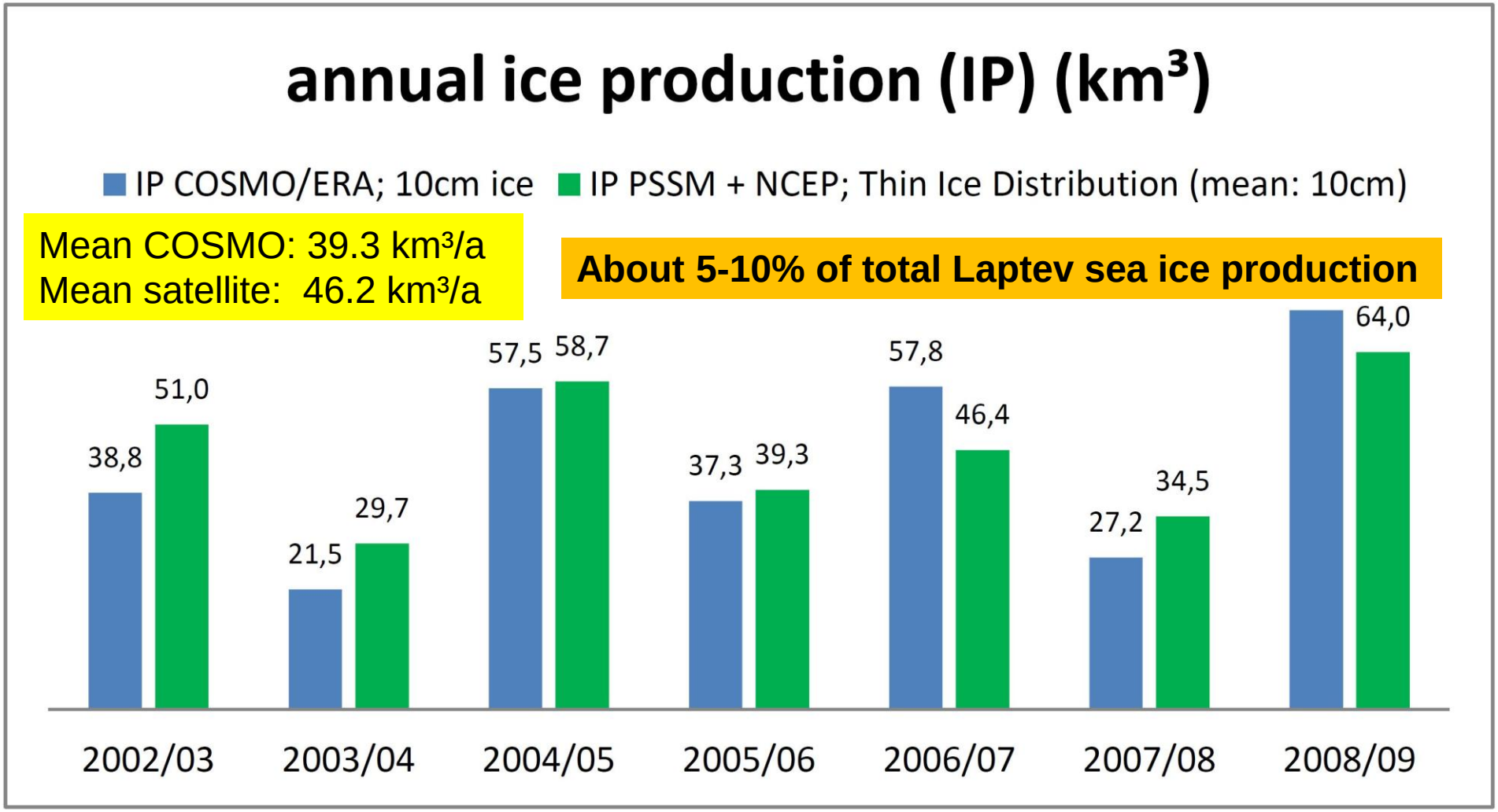
hiTH contour lines 0.5m (white)

Willmes et al. (2010)



Willmes et al. (2011)

Ice production in Laptev polynyas



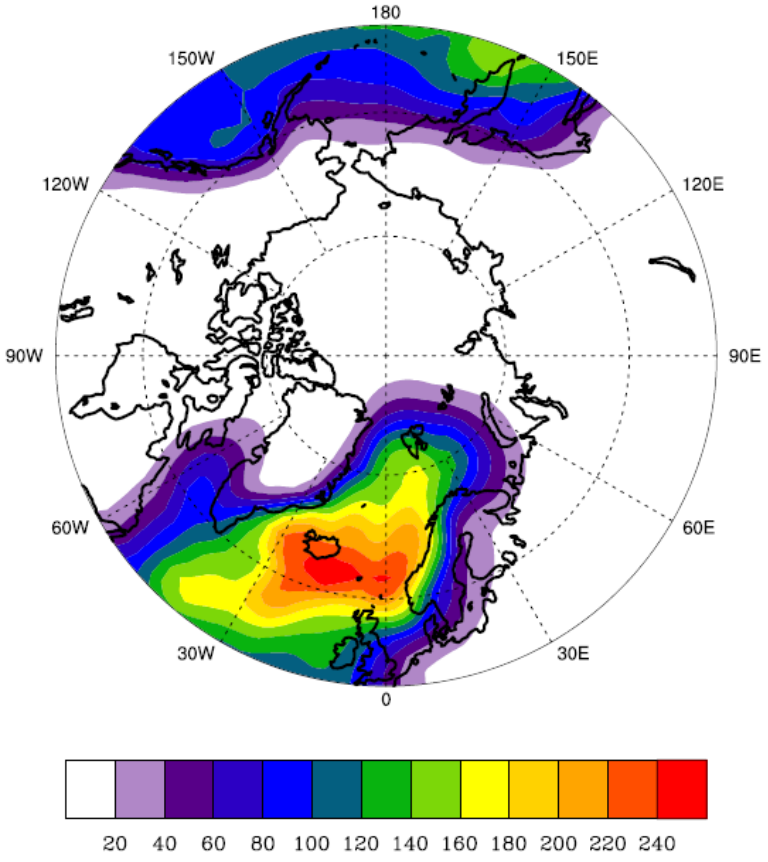
blue: COSMO nested in ERA-Interim, green: satellite-based estimate after Willmes et al. (2011). Bauer et al. (2012, in review)

MC/cyclone tracking

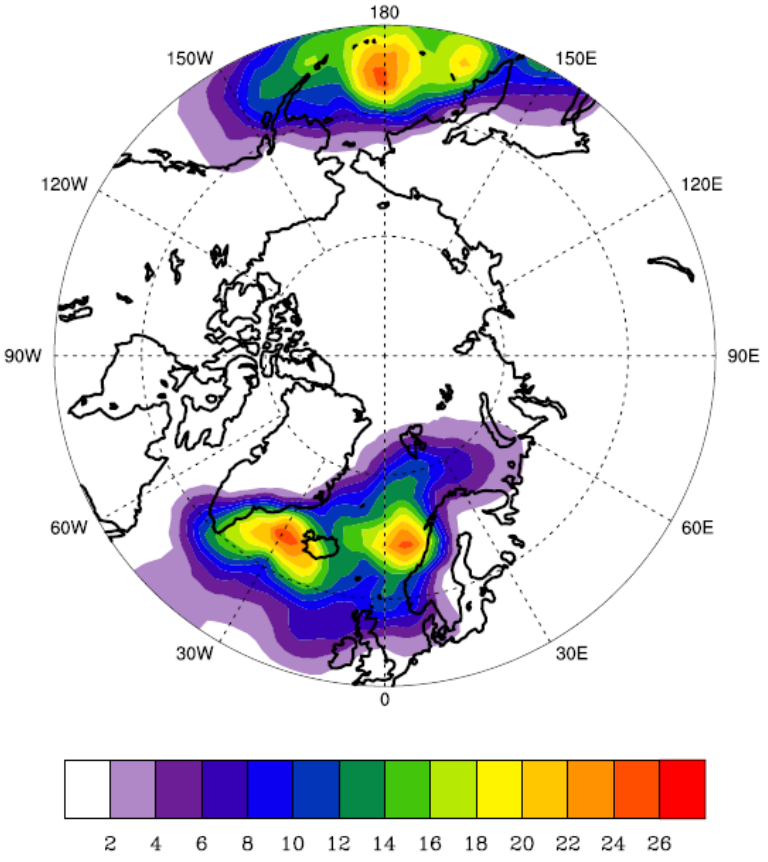
MC tracking Norwegian Sea, April 2007 to December 2008
Wind > 13.9 m/s, T(surface)-T(500hPa) >43°C

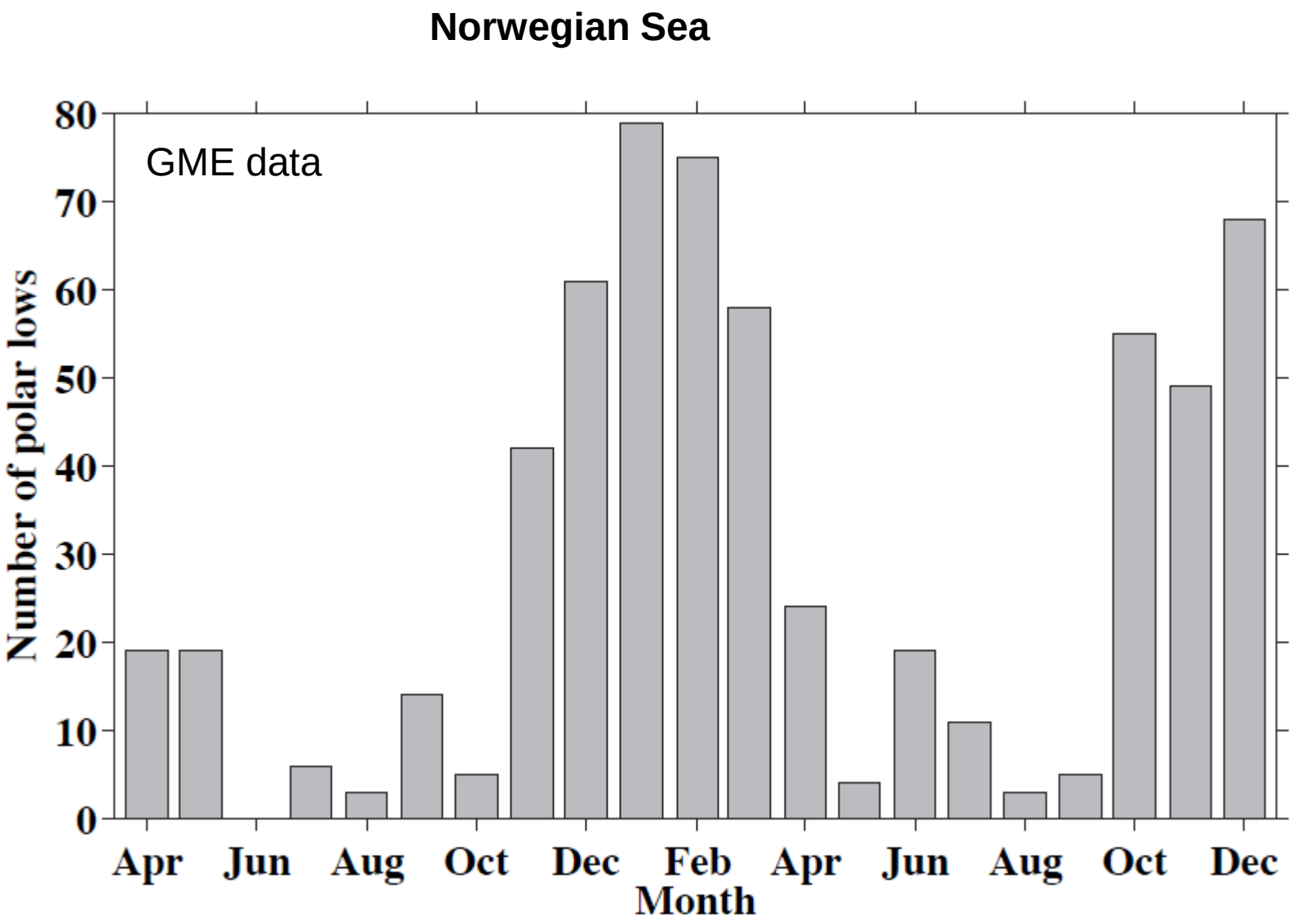
number densities per year and per $10^6 km^2$

GME data



ERA-Interim data




Norwegian Sea
GME data
Number of polar lows
0
10
20
30
40
50
60
70
80
Apr
Jun
Aug
Oct
Dec
Feb
Apr
Jun
Aug
Oct
Dec
Month

MCs Laptev Sea