

Ocean Acidification Impacts on Sea Surface Biology, Biogeochemistry and Climate Consortium

Arctic Cruise – Summer 2012



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Arctic Cruise Objectives

- Dedicated cruise to Atlantic sector of Arctic during period of year with enhanced productivity and minimum sea-ice cover.
- To cover the ice edge region where strong changes in carbonate system occur due to winter respiration with prevention of water column CO₂ degassing resulting in a reduced pH.
- Post-melt enhanced primary production in meltwater-induced low salinity surface waters resulting in enhanced pH.
- Annually occurring coccolithophore blooms in the Barents Sea
- Saturation state (Ω_{CaCO_3}) gradients along N-S and E-W gradients (lower in Arctic sourced waters near Greenland).
- In situ physical, chemical and biological observations
- On-deck bioassay experiments examining response of in situ community to elevated CO₂.

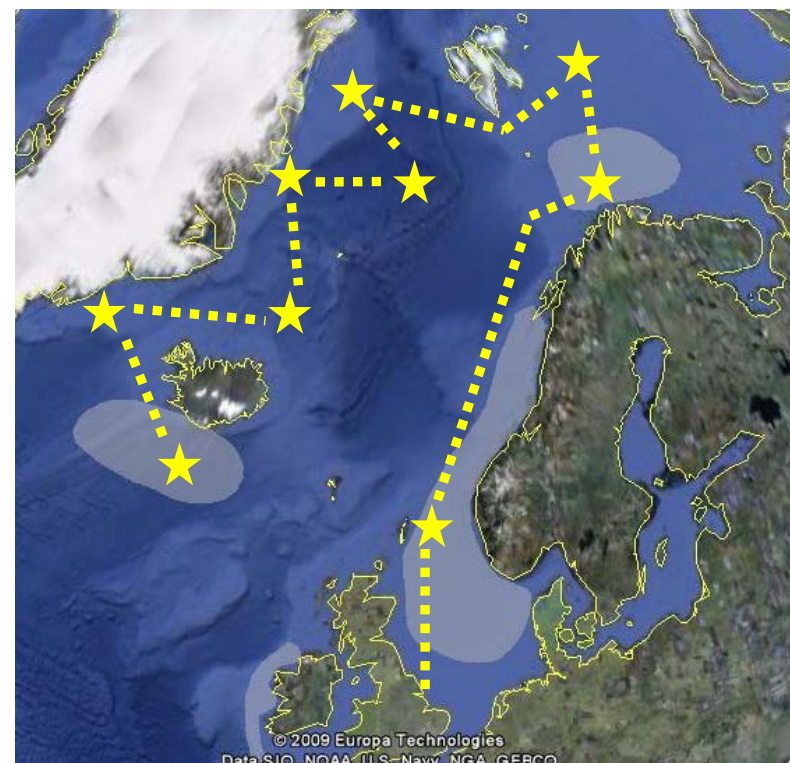


Arctic Cruise Itinerary

North, Norwegian, Greenland and Icelandic Seas

RS *James Clark Ross* Cruise JR271

2 June to 5 July 2012 (33 Science Days)



Science Plan and Study Sites

Priority stations are:

- Greenland Shelf to access true cold Arctic outflow water (ice-covered & MIZ)
- Barents Sea to access cold water coccolithophore bloom and E-W gradient
- North Sea station re-visit to give “shakedown” station and N-S gradient
- Iceland Basin to give low Fe waters

Limited in north by ice cover

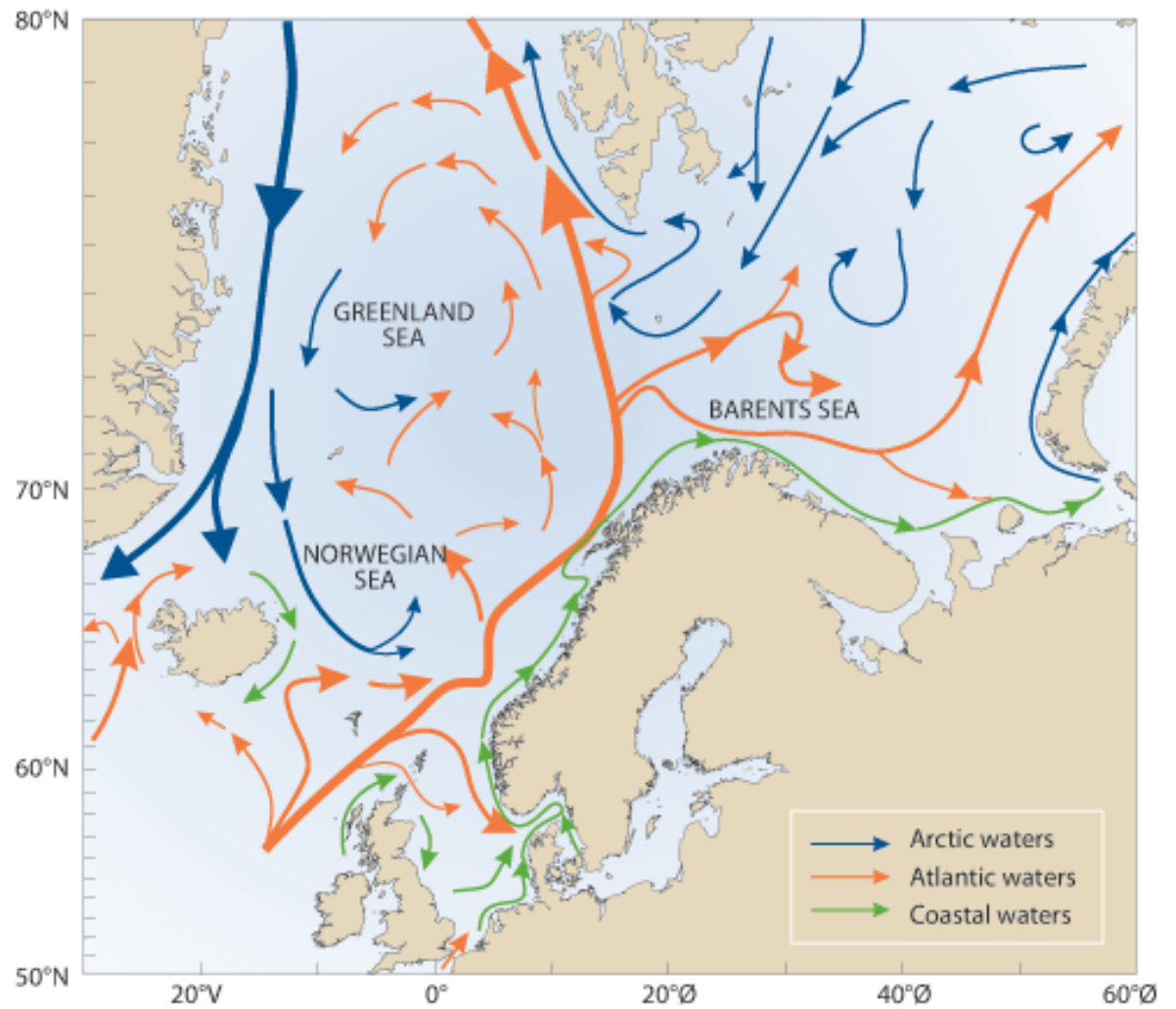
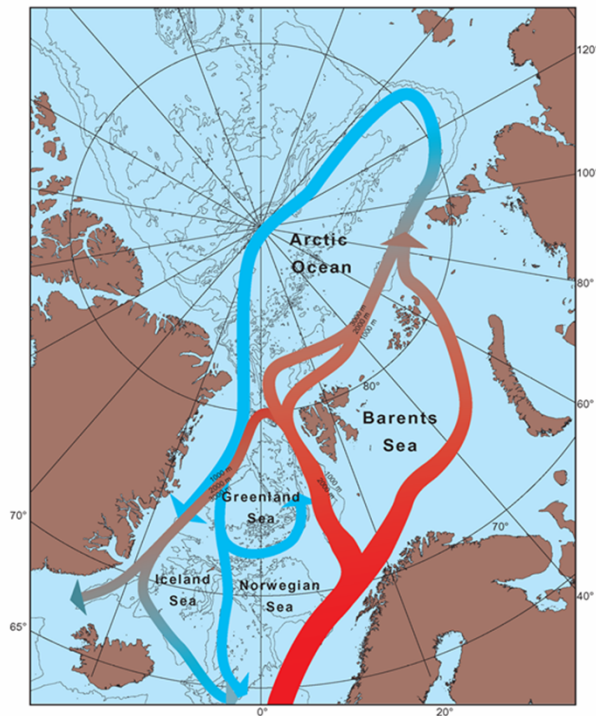
Limited in the Barents Sea by Russian waters at 38°E

Bioassays require 5 day cycle (4 days incubation + 1 day turnaround) so maximum of 6 main bioassay stations in 33 days

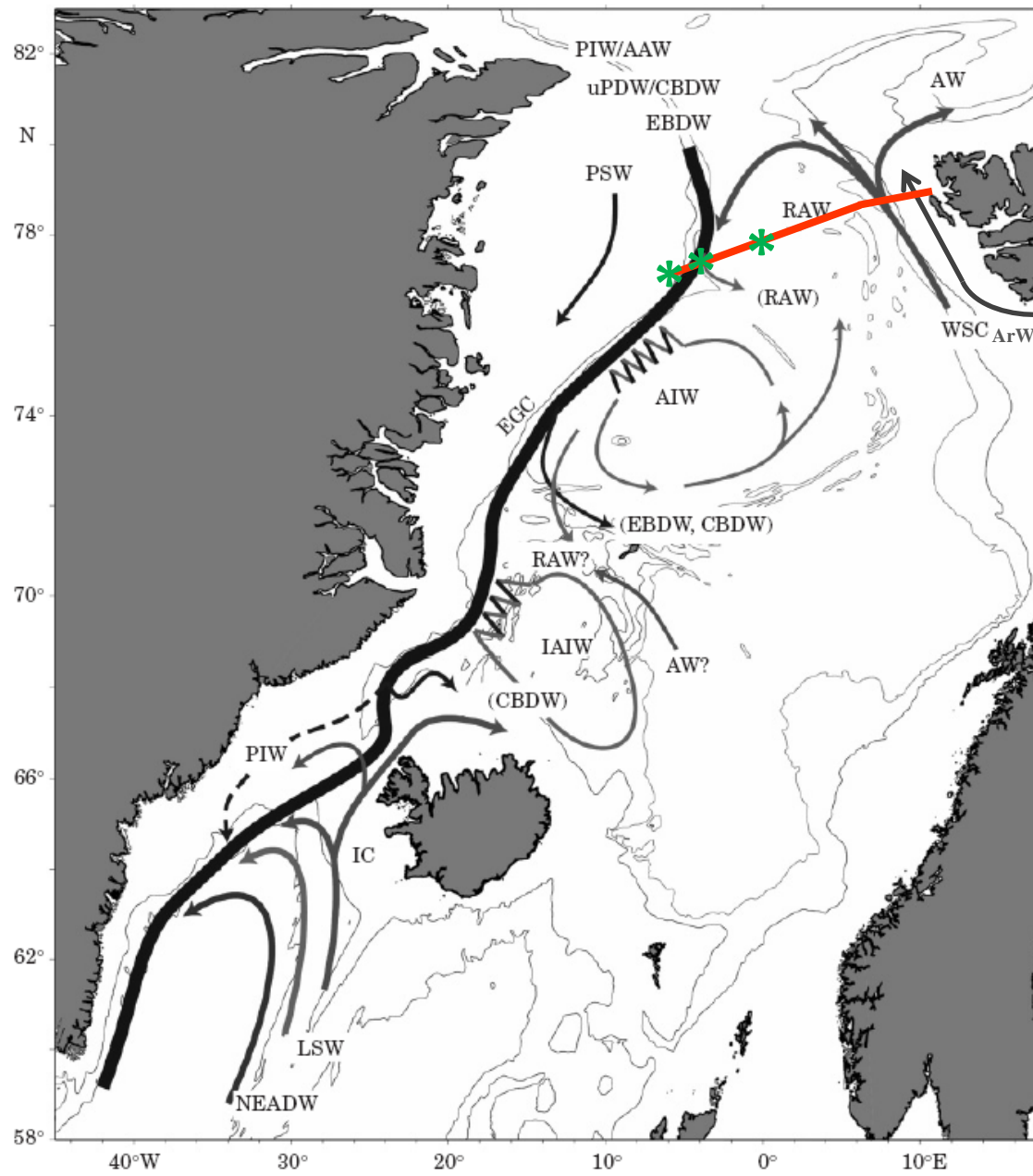
Distances between stations is short (e.g. 3 days from Barents Sea to Greenland Shelf) so ship will have spare time on and between stations.

Ice-cover will slow progress to access the Greenland Shelf or possible North Barents Sea station.



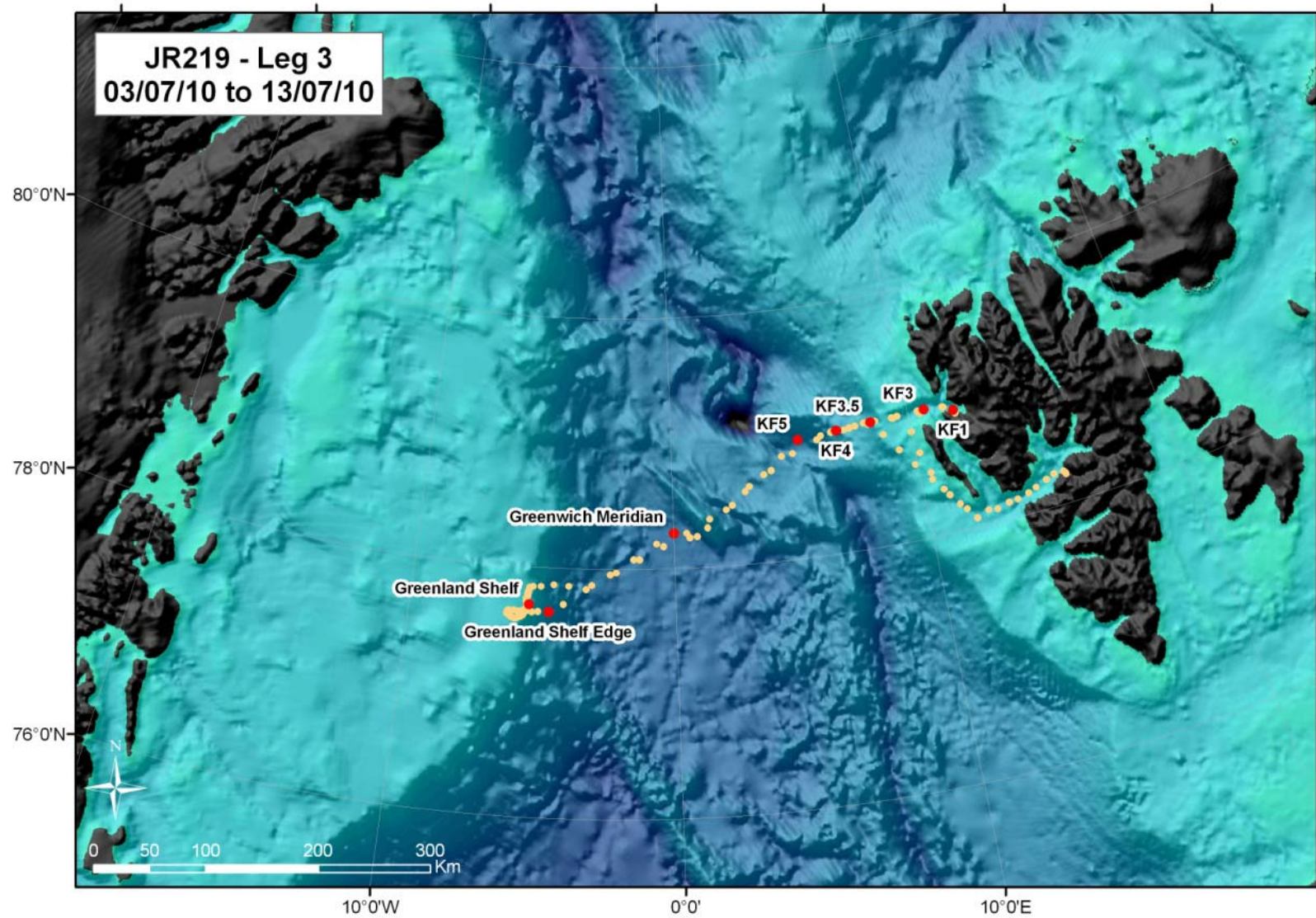


Source: North Sea Task Force, 1993. *North Sea Quality Status Report 1993*, Oslo and Paris Commissions, London, Olsen & Olsen, 132+vi pp.



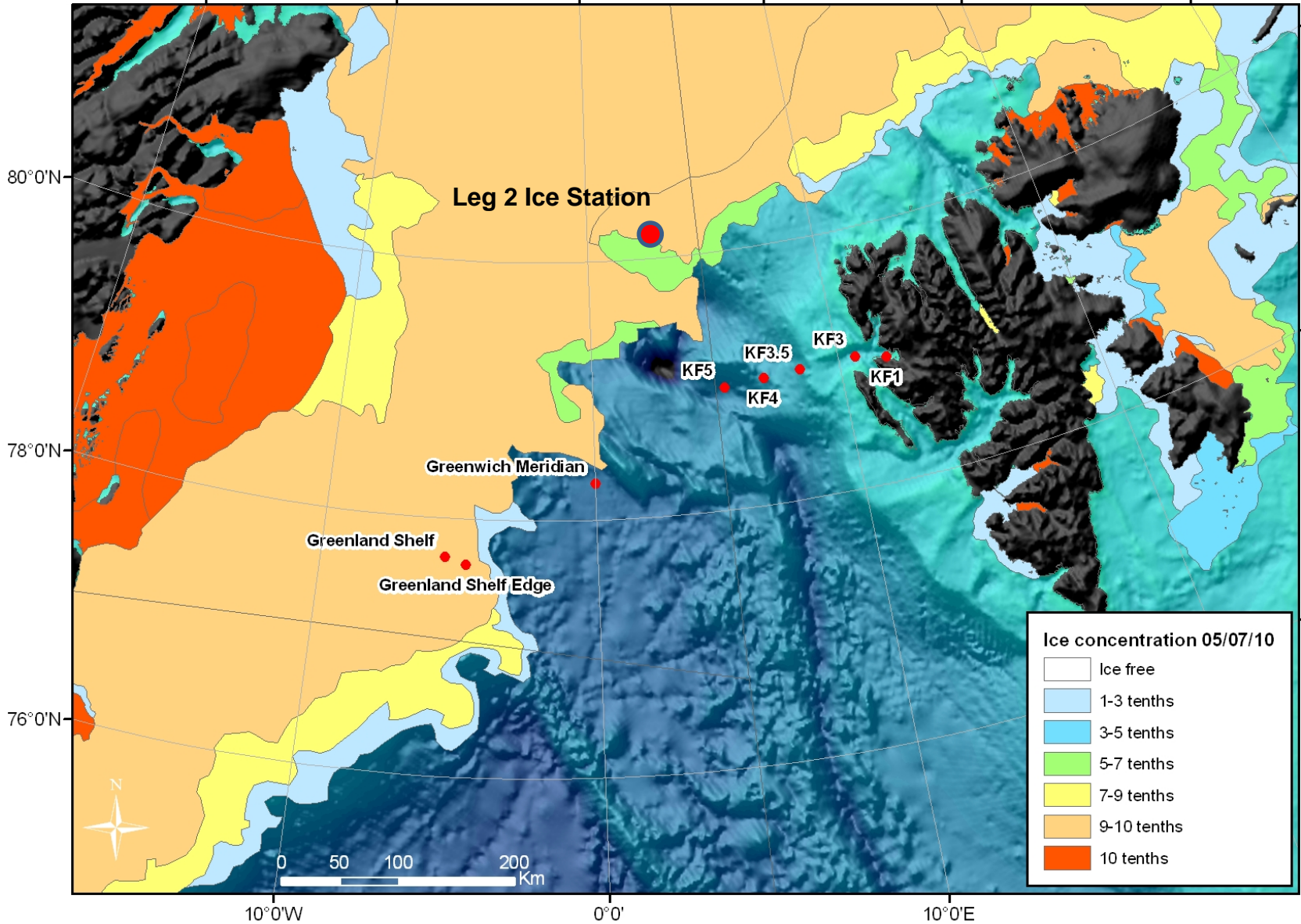
From: B. Rudels, et al., 2002. ICES Journal of Marine Science, 59: 1133–1154

Greenland Shelf Access on Oceans2025 Arctic Cruise



Map c/o E DuMont (SAMS)

Sea Ice Concentration During Oceans2025 Arctic Cruise



Map c/o E DuMont (SAMS)

Barents Sea Oceanography

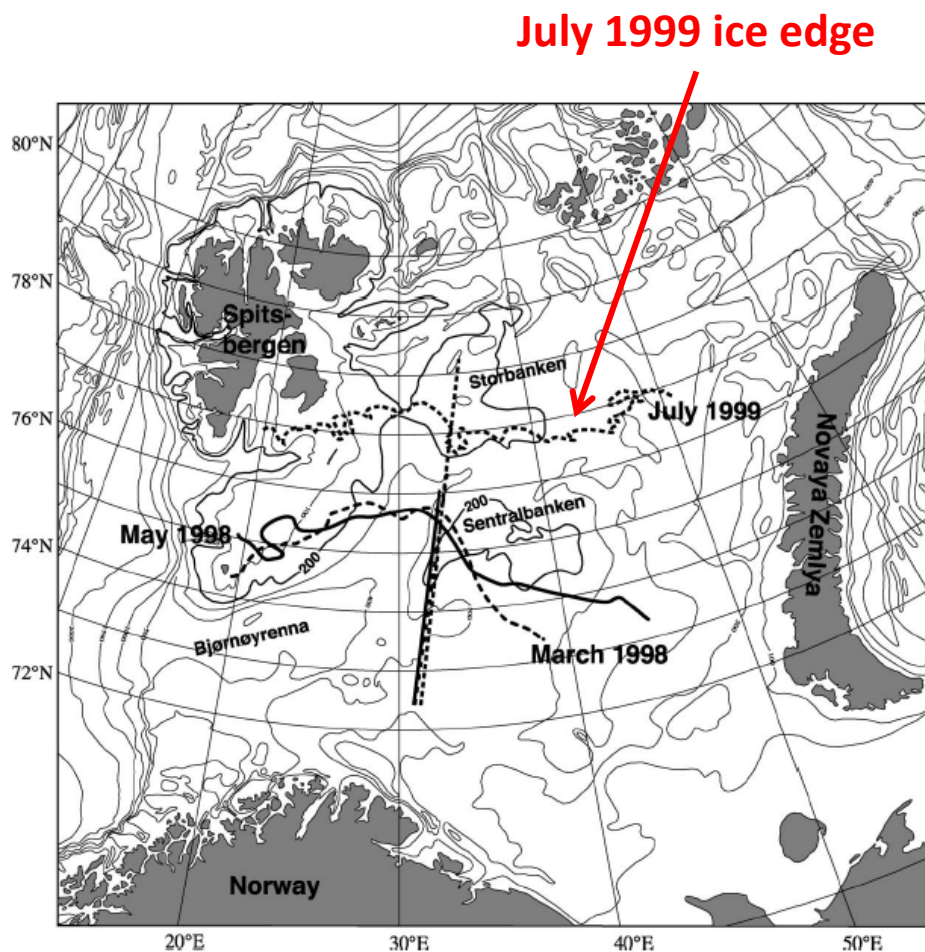


Fig. 1. The investigation area in the central Barents Sea and the investigated transects and ice edge locations during three cruises in March 1998, May 1998, and July 1999. Sentralbanken and Storbanken are indicated by the bold 200 m isobath.

M. Reigstad et al. / Journal of Marine Systems 38 (2002) 9–29

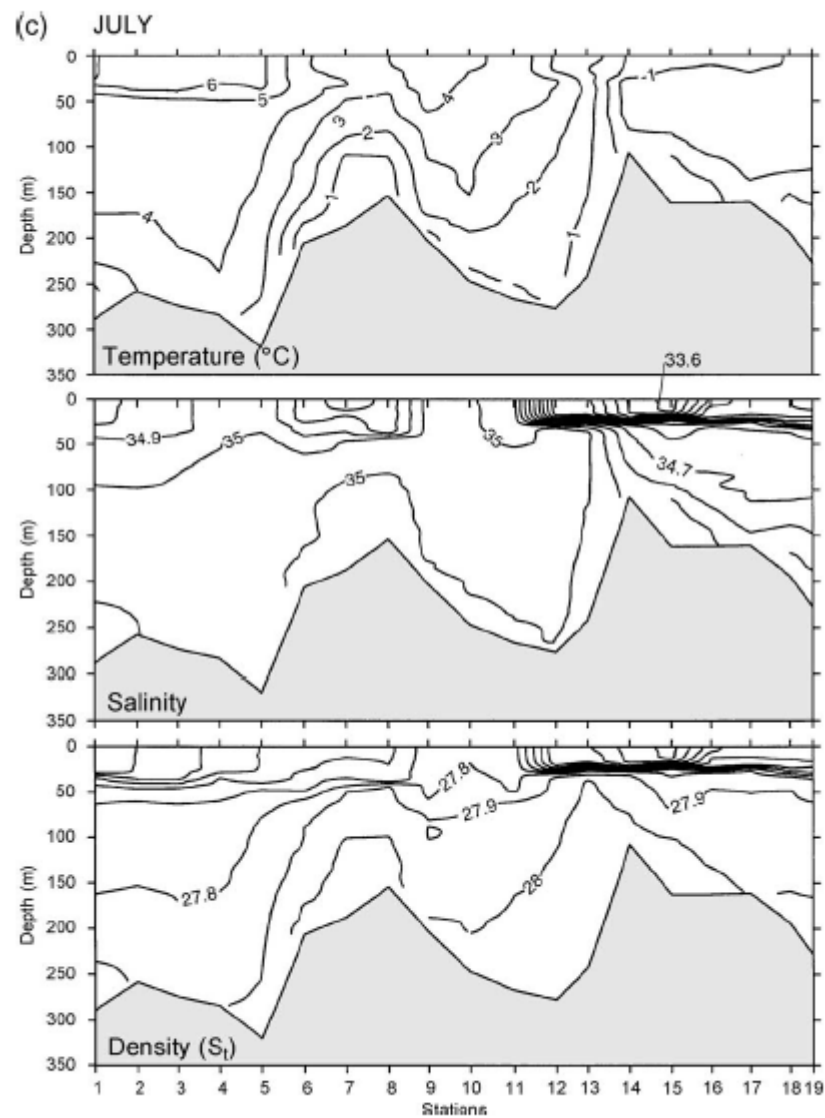


Fig. 3 (continued).

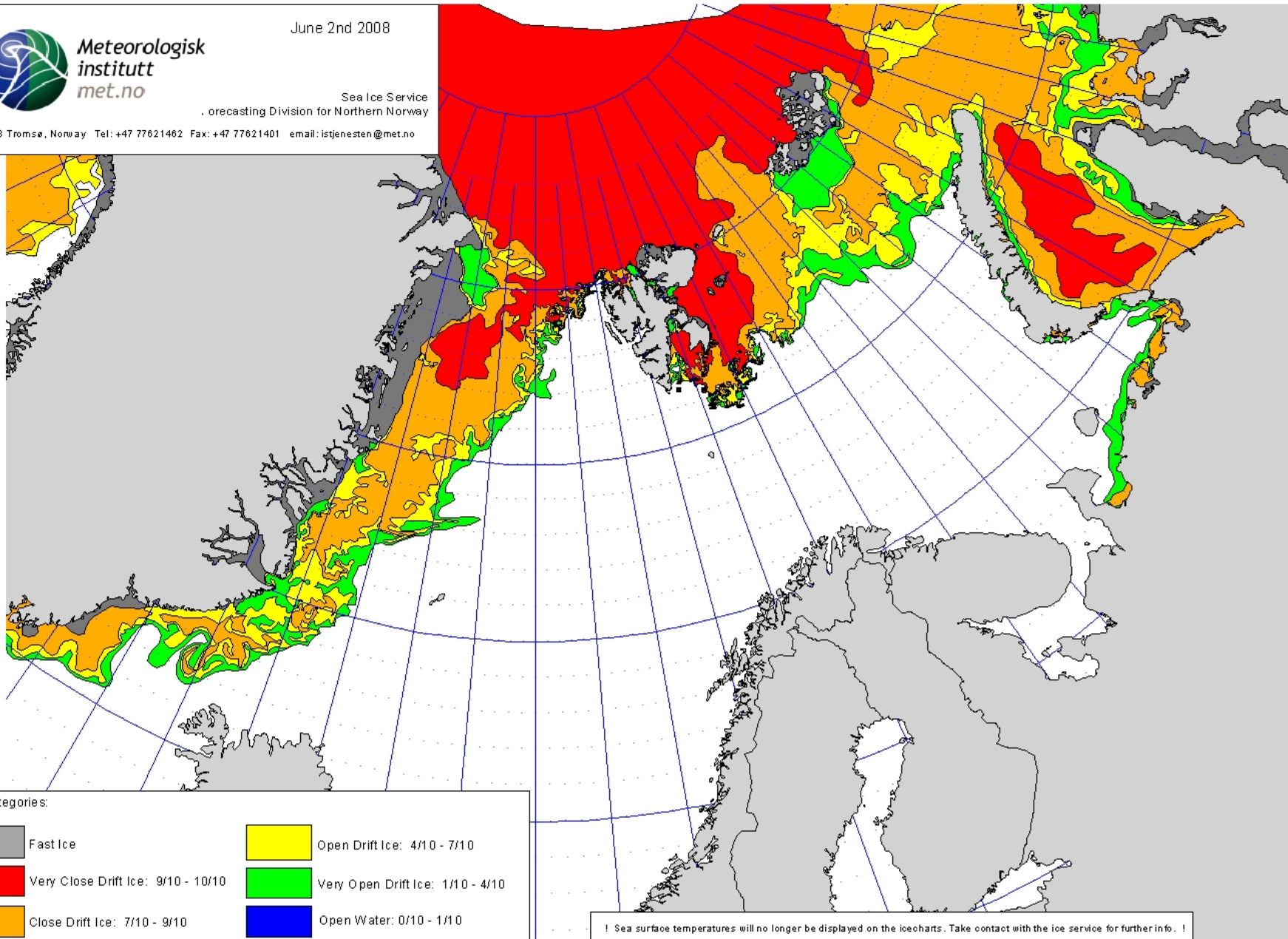


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June 2nd 2008

Sea Ice Service
Forecasting Division for Northern Norway

N-9293 Tromsø, Norway Tel: +47 77621462 Fax: +47 77621401 email: istjenesten@met.no



Ice Categories:

 Fast Ice	 Open Drift Ice: 4/10 - 7/10
 Very Close Drift Ice: 9/10 - 10/10	 Very Open Drift Ice: 1/10 - 4/10
 Close Drift Ice: 7/10 - 9/10	 Open Water: 0/10 - 1/10

! Sea surface temperatures will no longer be displayed on the icecharts. Take contact with the ice service for further info. !

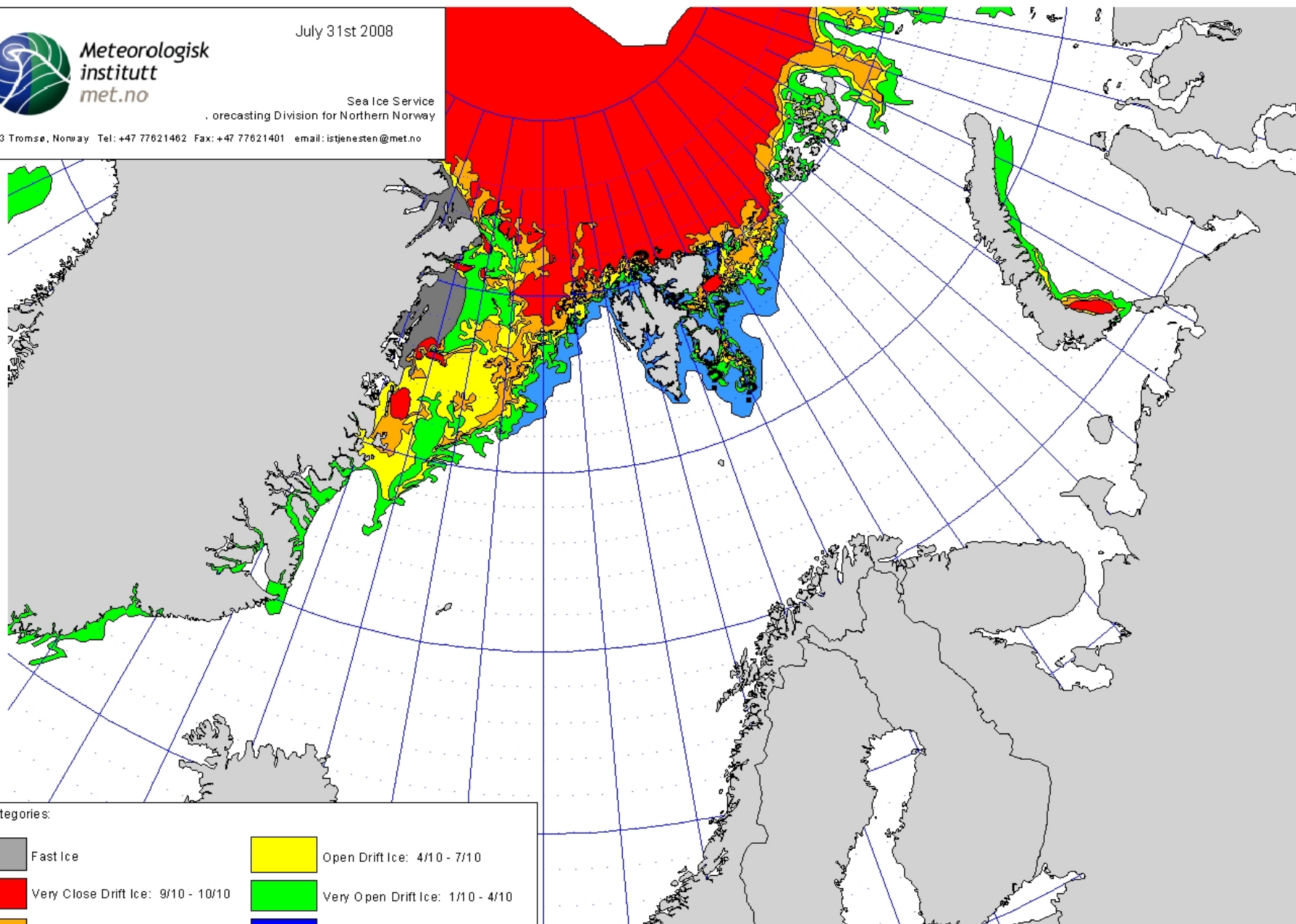


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July 31st 2008

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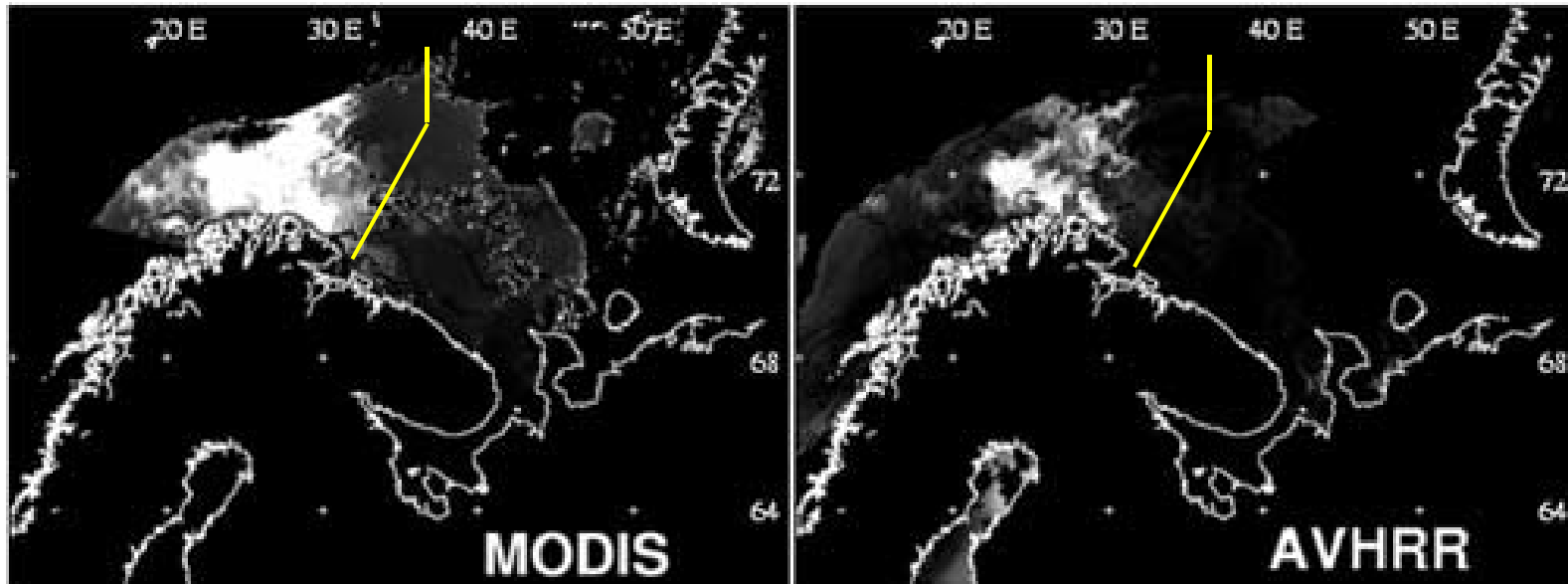


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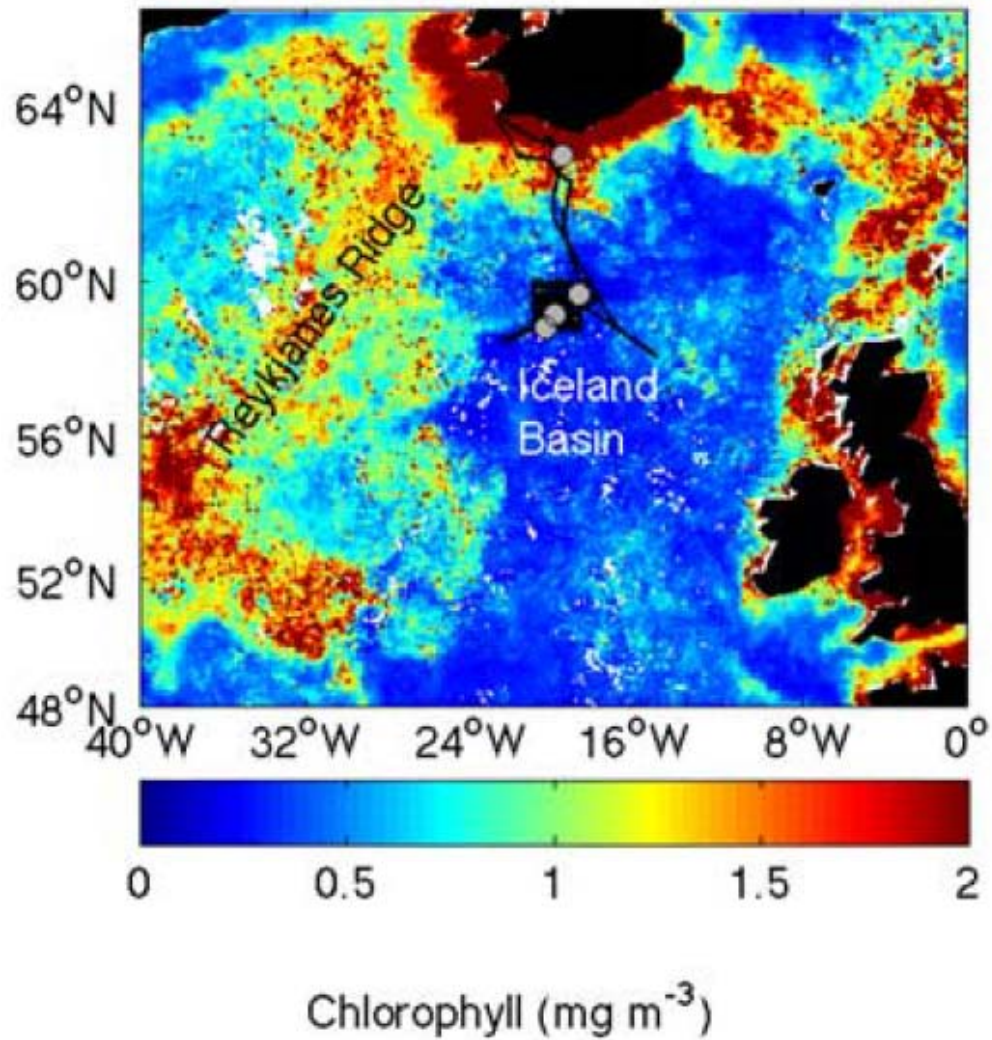
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Location of Coccolithophore Blooms in Barents Sea ?

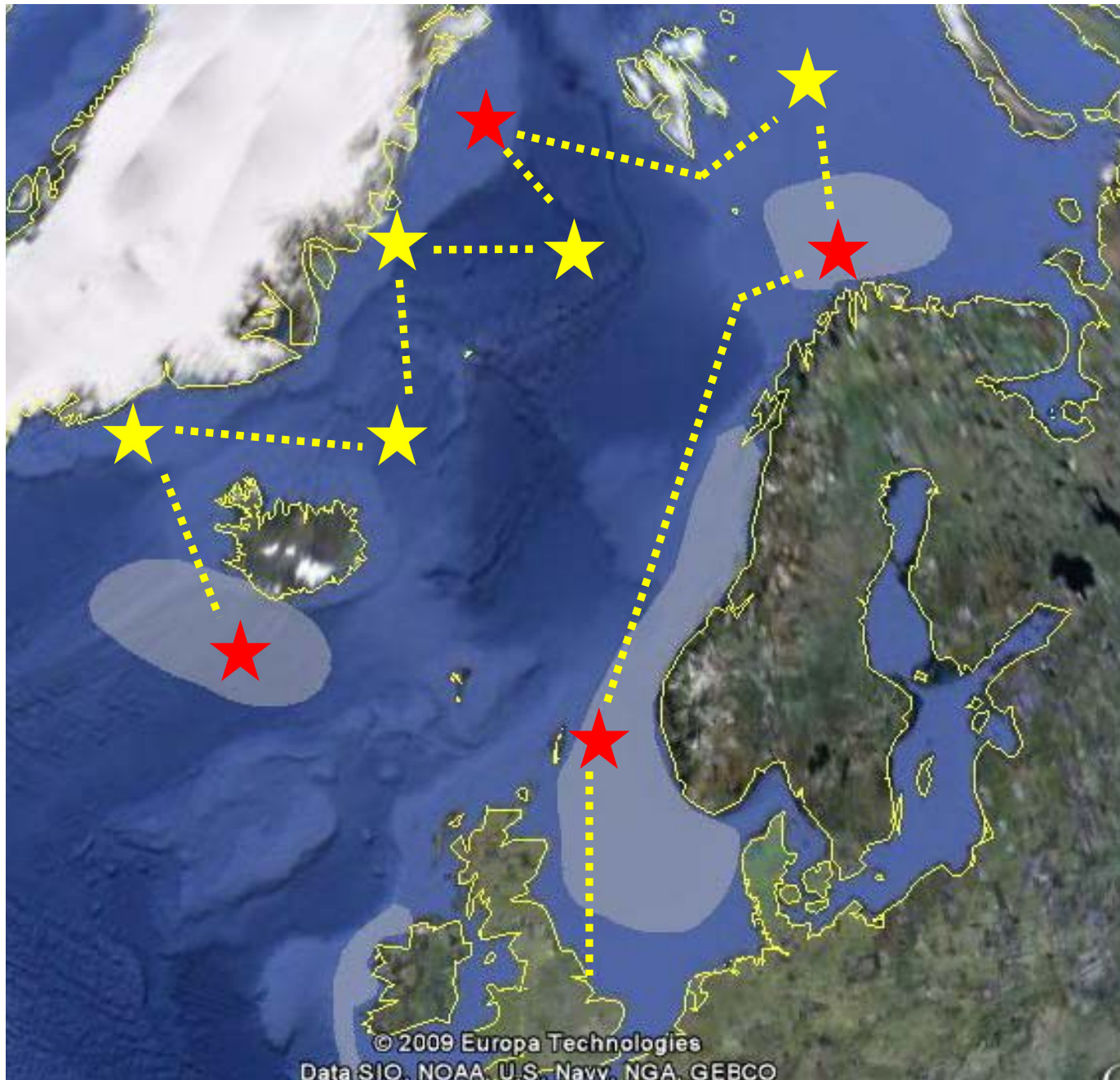


MODIS true colour composite at 16:10 UTC together with the AVHRR reflectance product for 09:23 UTC on 19 July 2003. (From Smyth et al. 2004 *GRL* 31 L11302)

Low Fe waters in Iceland Basin



From: Nielsdóttir, M.C et al. (2009) Iron limitation of the postbloom phytoplankton communities in the Iceland Basin. *Global Biogeochemical Cycles*, 23, GB3001.



Arctic Cruise Sampling and Bioassay Design

In situ observations/measurements:

- As for UKOA cruise but including microbial and zooplankton parameters

On-deck bioassay experiments:

- Up to 6 assays each with 4 CO₂ treatments x 3 times x 3 replicates
- Analysis as for UKOA but including microbial and zooplankton parameters
- Trace metal clean

Additional activities:

- Continuous plankton recorder tows
- Snowcatcher & thorium-234 work (investigation of OA impact on export fluxes)
- Deployment of Argo floats



UKOA Arctic Cruise Participants

Name	Affiliation	Task
Mark Moore	NOCS	Bioassays
Sophie Richier	NOCS	Bioassays
Laura Bretherton	Essex	Phytoplankton and FRRF
Tiera-Brandy Robinson	NOCS	Phytoplankton and FRRF
Alex Poulton	NOCS	Primary Production, Calcification
Fred Le Moigne	NOCS	Export (Thorium/SAPS)
Sinhue Torres-Valdez	NOCS	Nutrients
Chris Daniels	NOCS	Primary Production, Calcification
Helen Smith	NOCS	Export (Snow Catcher)
Eric Achterberg	NOCS	CO2
Eithne Tynan	NOCS	CO2
Gianna Battaglia	NOCS	Trace Metals
Sara Fowell	NOCS	Trace Metals
Maria Ribas Riba	NOCS	CO2
Matthew Humphreys	NOCS	CO2
Victoire Rerrole	NOCS	PH & DIC & TA
Tingting Shi	NOCS	DOC

Name	Affiliation	Task
Jeremy Young	NHM	Calcifiers (morphology)
Cecilia Balistreri	MBA	Calcifiers (genetics)
Geraint Tarling	BAS	Zooplankton
Vicki Peck	BAS	Zooplankton
Mike Zubkov	NOCS	Bacteria & Protists
Polly Hill	NOCS	Bacteria & Protists
Ben Russell	NOCS	Bacteria & Protists
Ray Leakey	SAMS	Bacteria & Protists + PSO
Elaine Mitchell	SAMS	Bacteria & Protists
Darren Clark	PML	N2O
Ian Brown	PML	N2O
John Stephens	PML	DMS
Frances Hopkins	PML	DMS
Jeff Benson	NMF	Ships support (CTD)
Mark Preston	BAS	Ships support (engineering)
Luke Collings	BAS	Ships support (IT)



Arctic Cruise Deliverables

Date	Del no.	Deliverable name	Nature
Feb 2013	D8	Observational data [‡] on all potential response variables, cruise 2	Preliminary dataset
Feb 2013	D9	All data from bioassays, cruise 2	Preliminary dataset
Mar 2013	D10	Cruise report, cruise 2 (Ray Leakey)	Report
Aug 2014	D28	Observational data [‡] on all potential response variables, cruise 2	Quality-controlled final dataset
Aug 2014	D29	All data from bioassays, cruise 2	Quality-controlled final dataset