STATE OF THE ARCTIC

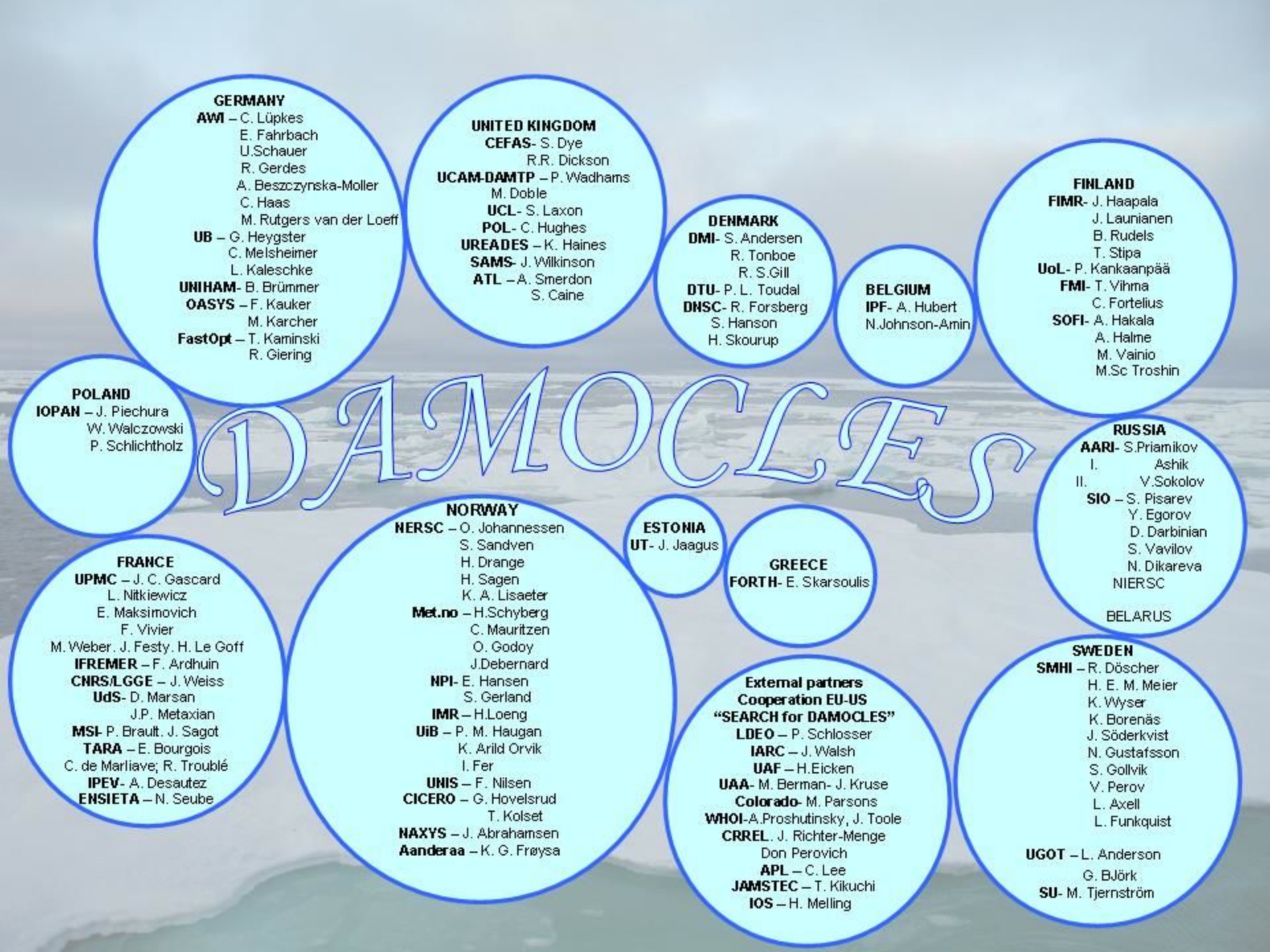
16 - 19 March 2010 • Hyatt Regency Miami

JEAN-CLAUDE GASCARD

DAMOCLES

Climate Change, the Arctic Ocean and the European Community contribution during the 4th IPY

by Jean-Claude Gascard
Damocles coordinator
University Pierre & Marie Curie, Paris, France


DAMOCLES
GERMANY
AWI – C. Lüpkes
E. Fahrbach
U.Schauer
R. Gerdes
A. Beszczynska-Moller
C. Haas
M. Rutgers van der Loeff
UB – G. Heygster
C. Melsheimer
L. Kaleschke
UNIHAM- B. Brümmer
OASYS – F. Kauker
M. Karcher
FastOpt – T. Kaminski
R. Giering
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CEFAS- S. Dye
R.R. Dickson
UCAM-DAMTP – P. Wadhams
M. Doble
UCL- S. Laxon
POL- C. Hughes
UREADES – K. Haines
SAMS- J. Wilkinson
ATL – A. Smerdon
S. Caine
DENMARK
DMI- S. Andersen
R. Tonboe
R. S.Gill
DTU- P. L. Toudal
DNSC- R. Forsberg
S. Hanson
H. Skourup
BELGIUM
IPF- A. Hubert
N.Johnson-Amin
FINLAND
FIMR- J. Haapala
J. Launianen
B. Rudels
T. Stipa
UoL- P. Kankaanpää
FMI- T. Vihma
C. Fortelius
SOFI- A. Hakala
A. Halme
M. Vainio
M.Sc Troshin
POLAND
IOPAN – J. Piechura
W. Walczowski
P. Schlichtholz
RUSSIA
AARI- S.Priamikov
I. Ashik
II. V.Sokolov
SIO – S. Pisarev
Y. Egorov
D. Darbinian
S. Vavilov
N. Dikareva
NIERSC
BELARUS
FRANCE
UPMC – J. C. Gascard
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F. Vivier
M. Weber. J. Festy. H. Le Goff
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J.P. Metaxian
MSI- P. Brault. J. Sagot
TARA – E. Bourgois
C. de Marliave; R. Troublé
IPEV- A. Desautez
ENSIETA – N. Seube
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NERSC – O. Johannessen
S. Sandven
H. Drange
H. Sagen
K. A. Lisaeter
Met.no – H.Schyberg
C. Mauritzen
O. Godoy
J.Debernard
NPI- E. Hansen
S. Gerland
IMR – H.Loeng
UiB – P. M. Haugan
K. Arild Orvik
I. Fer
UNIS – F. Nilsen
CICERO – G. Hovelsrud
T. Kolset
NAXYS – J. Abrahamsen
Aanderaa – K. G. Frøysa
ESTONIA
UT- J. Jaagus
GREECE
FORTH- E. Skarsoulis
External partners
Cooperation EU-US
"SEARCH for DAMOCLES"
LDEO – P. Schlosser
IARC – J. Walsh
UAF – H.Eicken
UAA- M. Berman- J. Kruse
Colorado- M. Parsons
WHOI-A.Proshutinsky, J. Toole
CRREL. J. Richter-Menge
Don Perovich
APL – C. Lee
JAMSTEC – T. Kikuchi
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SWEDEN
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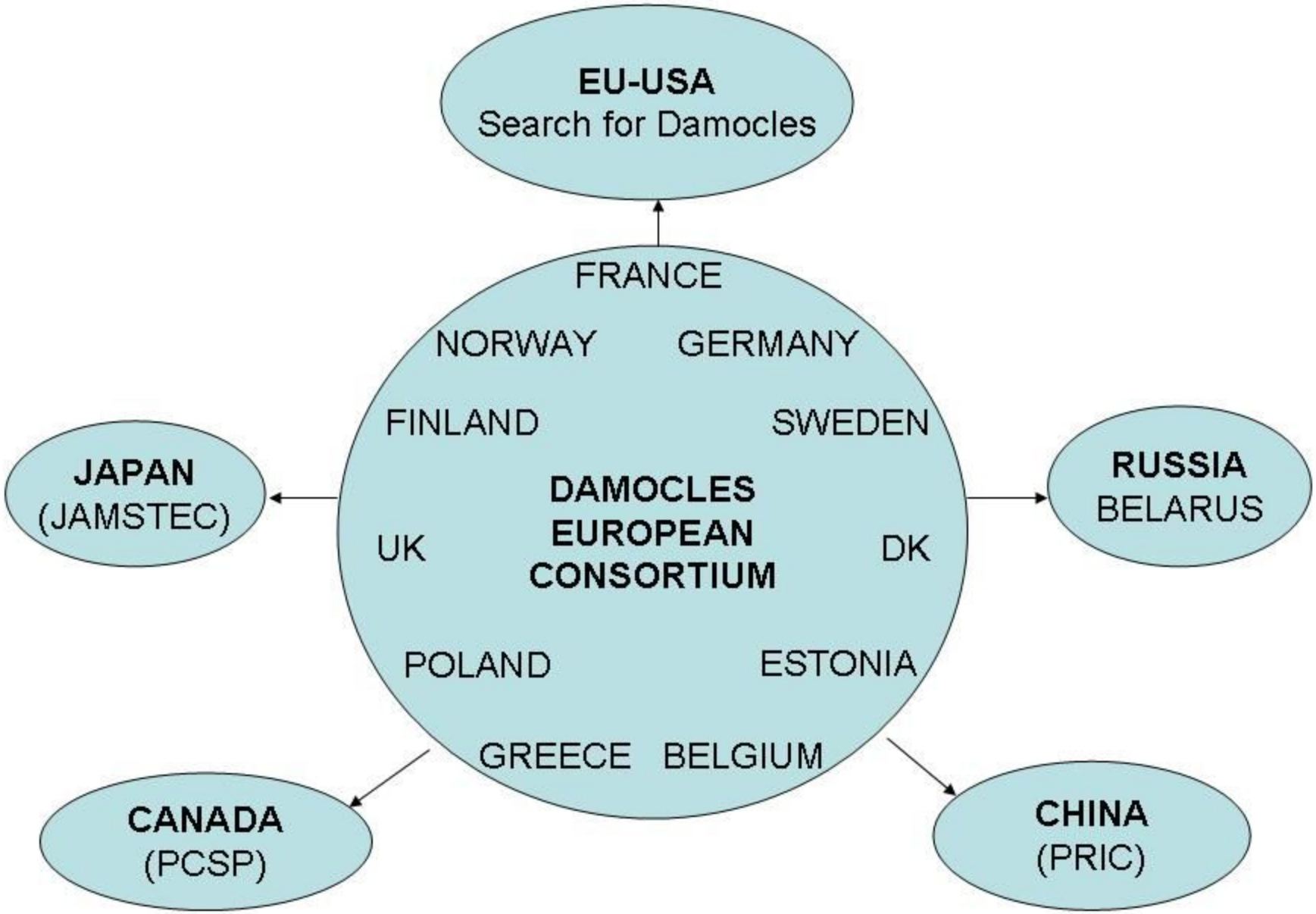
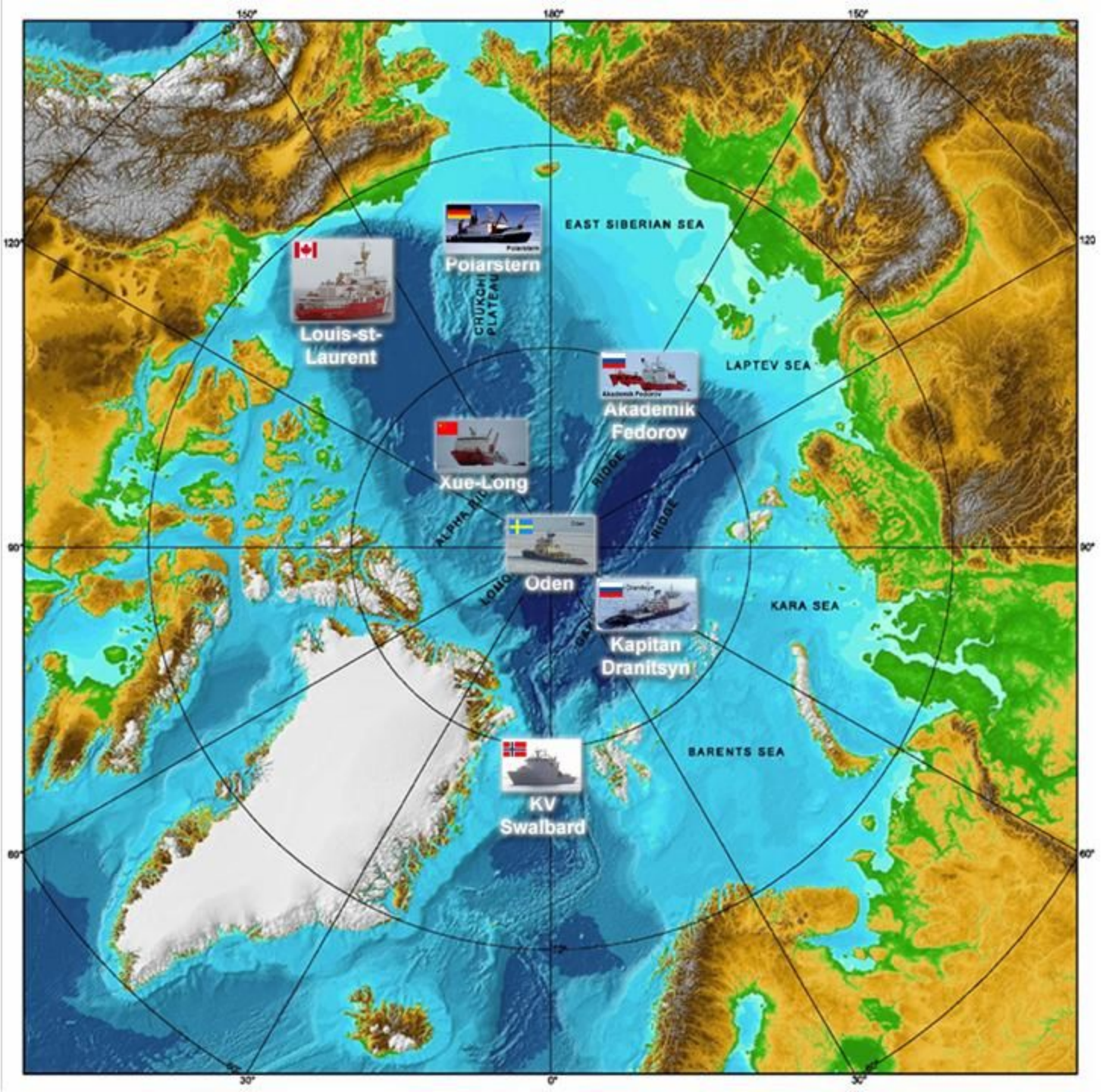
L. Funkquist
UGOT – L. Anderson
G. BJörk
SU- M. Tjernström



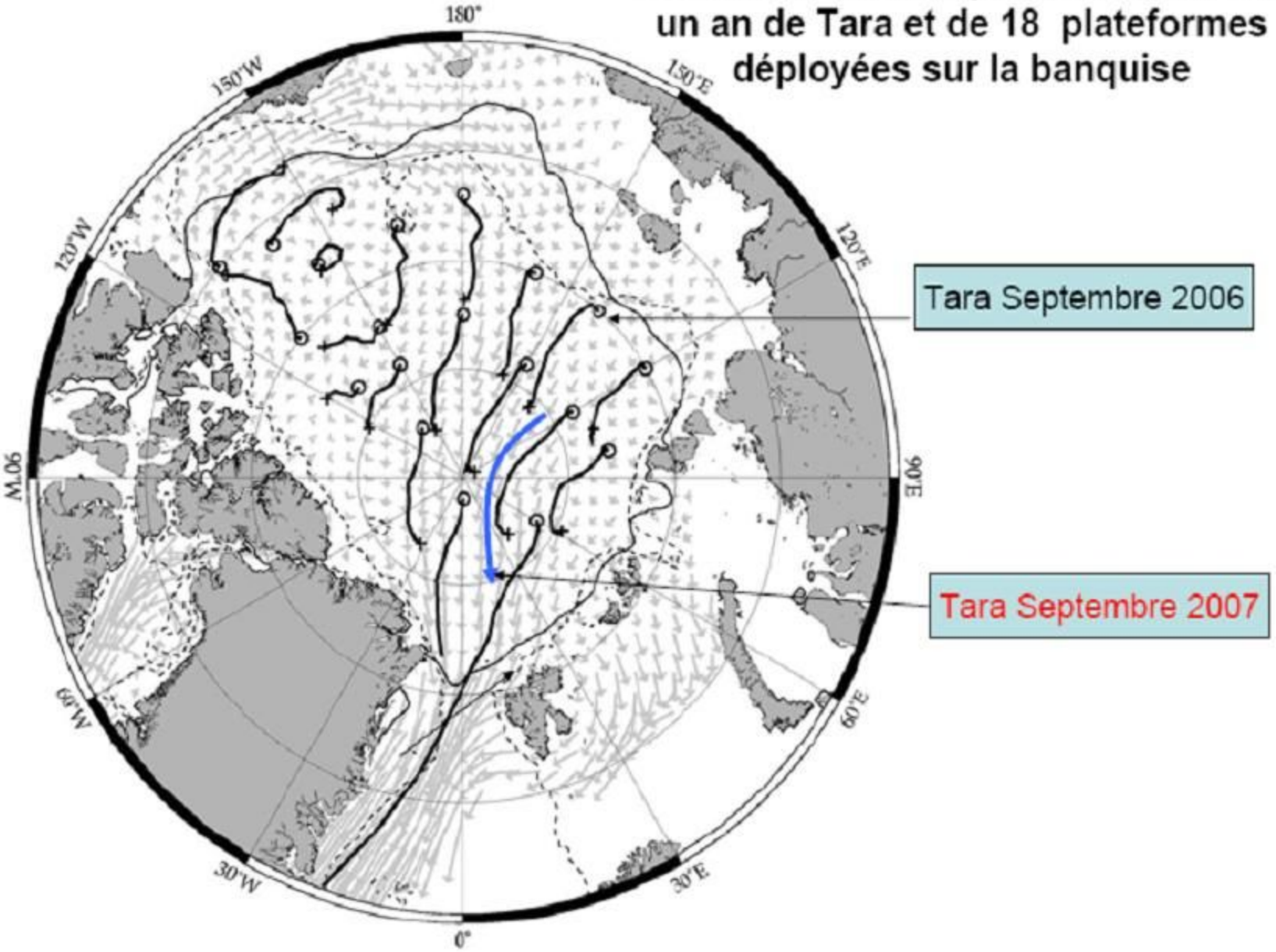
iAOOS & IPY and the International cooperation

IPY

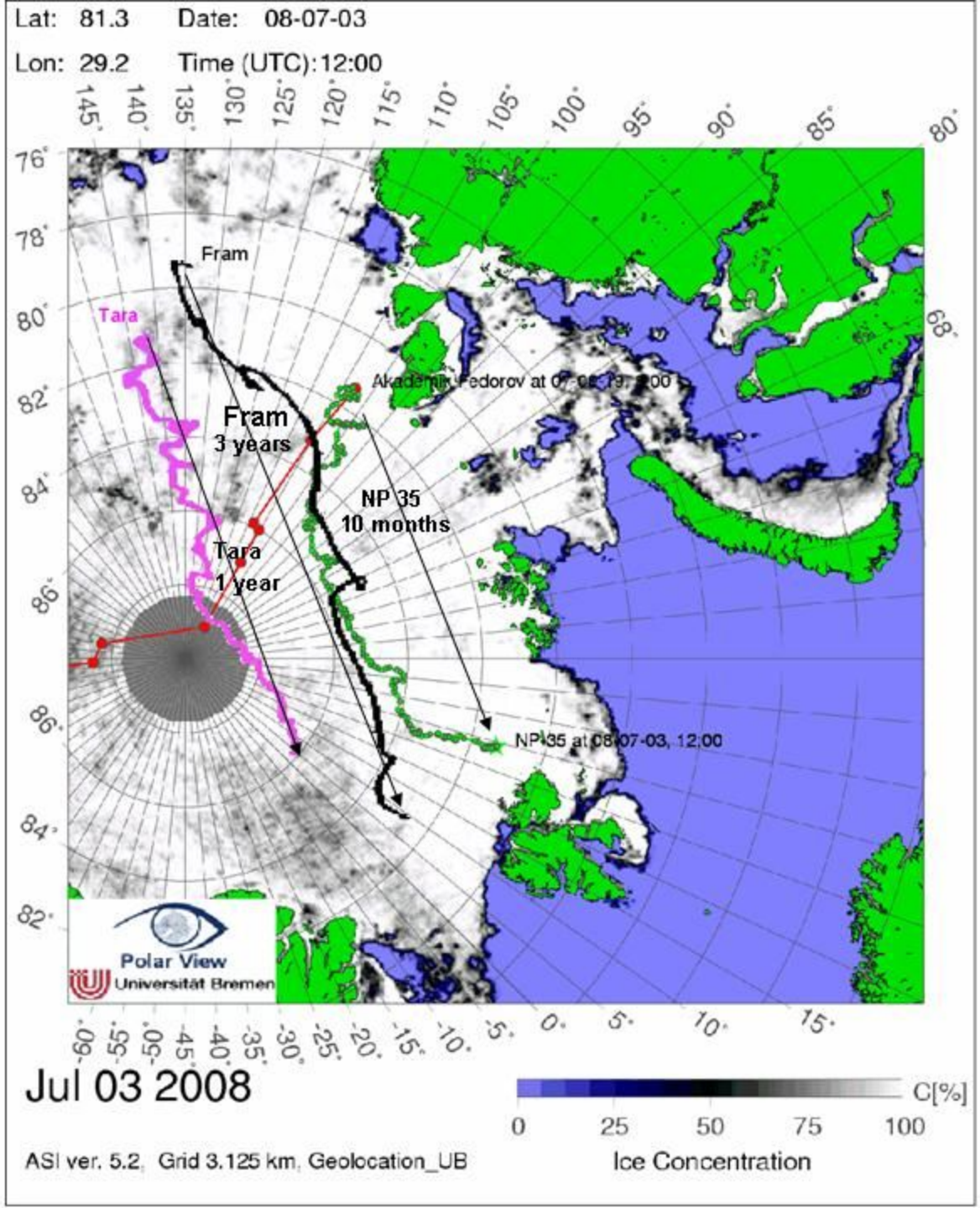
Summer 2008

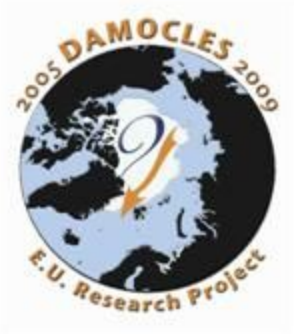


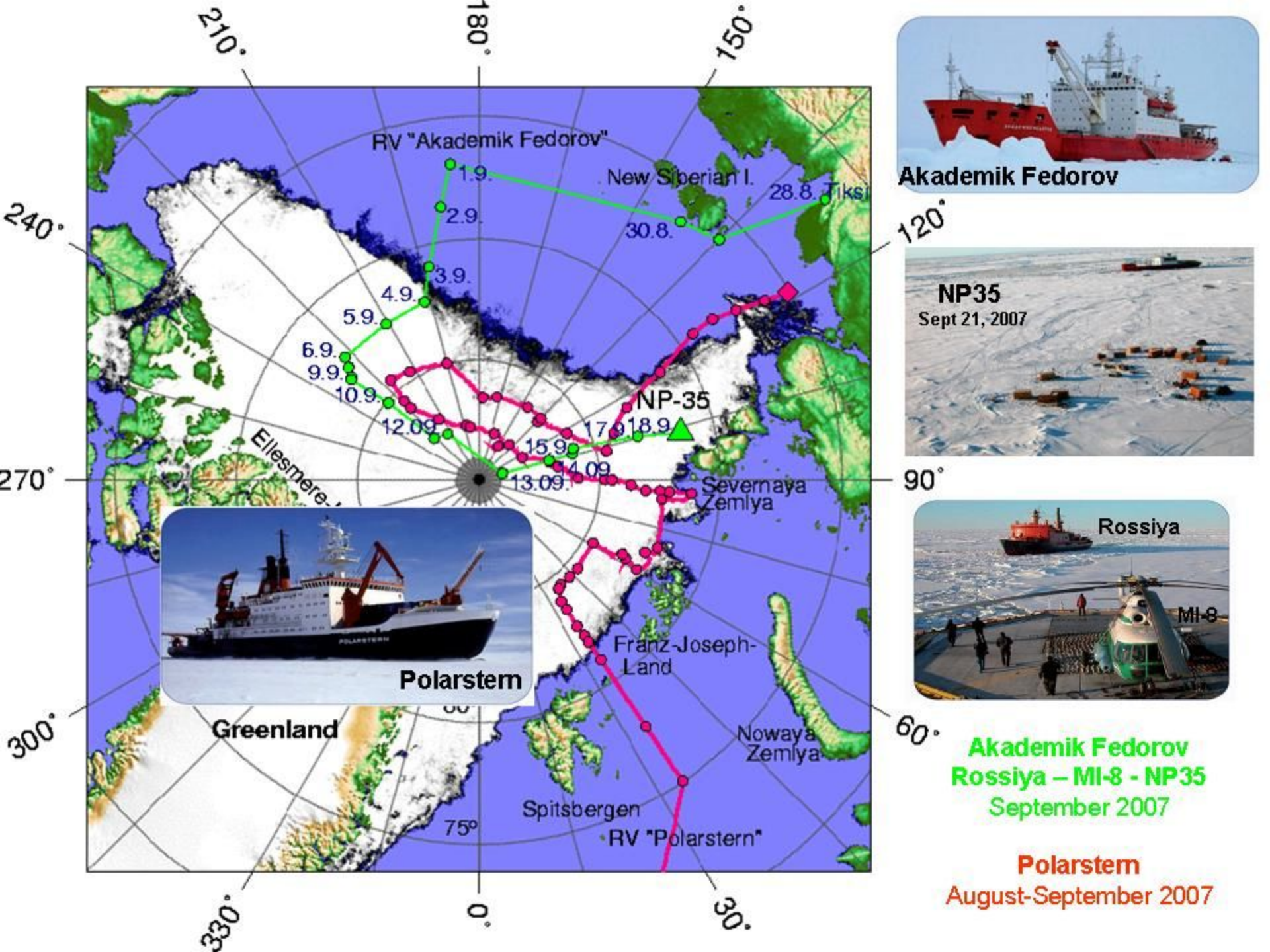
Simulation numérique de la dérive en un an de Tara et de 18 plateformes déployées sur la banquise



Damocles Experimental design (2005)


Lat: 81.3 Date: 08-07-03
Lon: 29.2 Time (UTC):12:00
Fram
Tara
Fram
3 years
Tara
1 year
NP 35
10 months
NP35 at 08-07-03, 12:00
Polar View
Universität Bremen
Jul 03 2008
C[%]
0 25 50 75 100
Ice Concentration
ASI ver. 5.2, Grid 3.125 km, Geolocation_UB

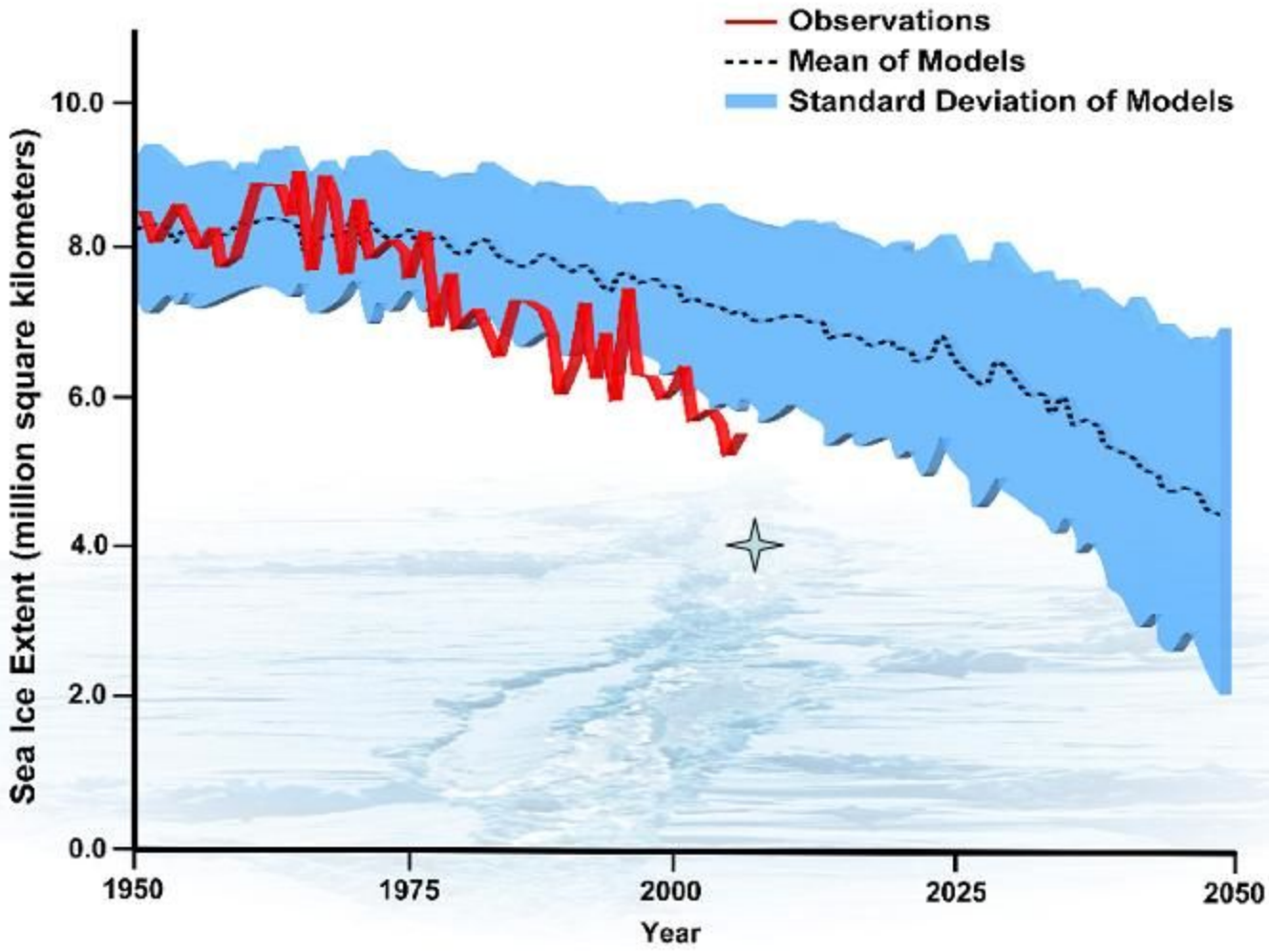

2005 DAMOCLES 2009
E.U. Research Project



Akademik Fedorov
Rossiya – MI-8 - NP35
September 2007

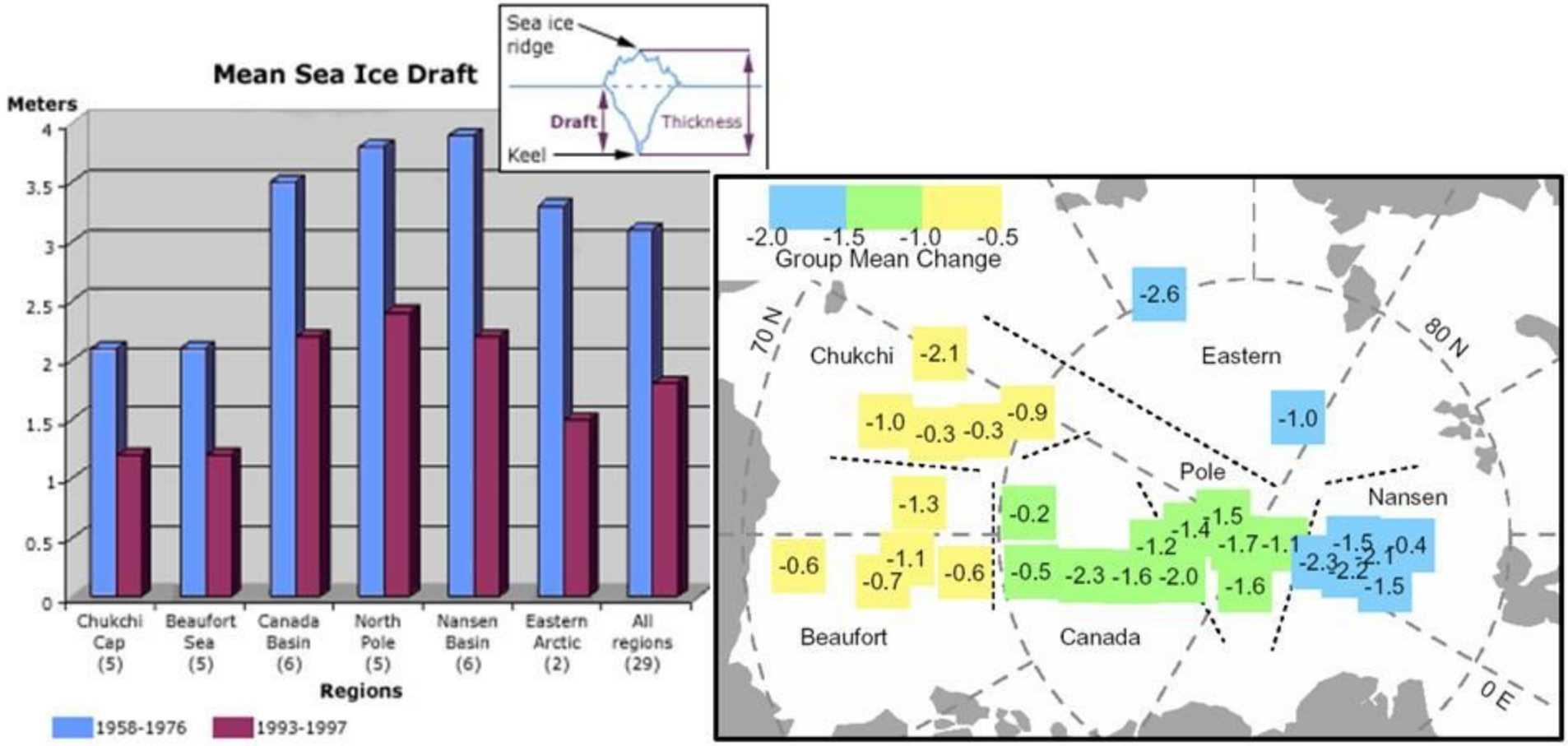
Polarstern
August-September 2007

Arctic September Sea Ice Extent: Observations and Model Runs



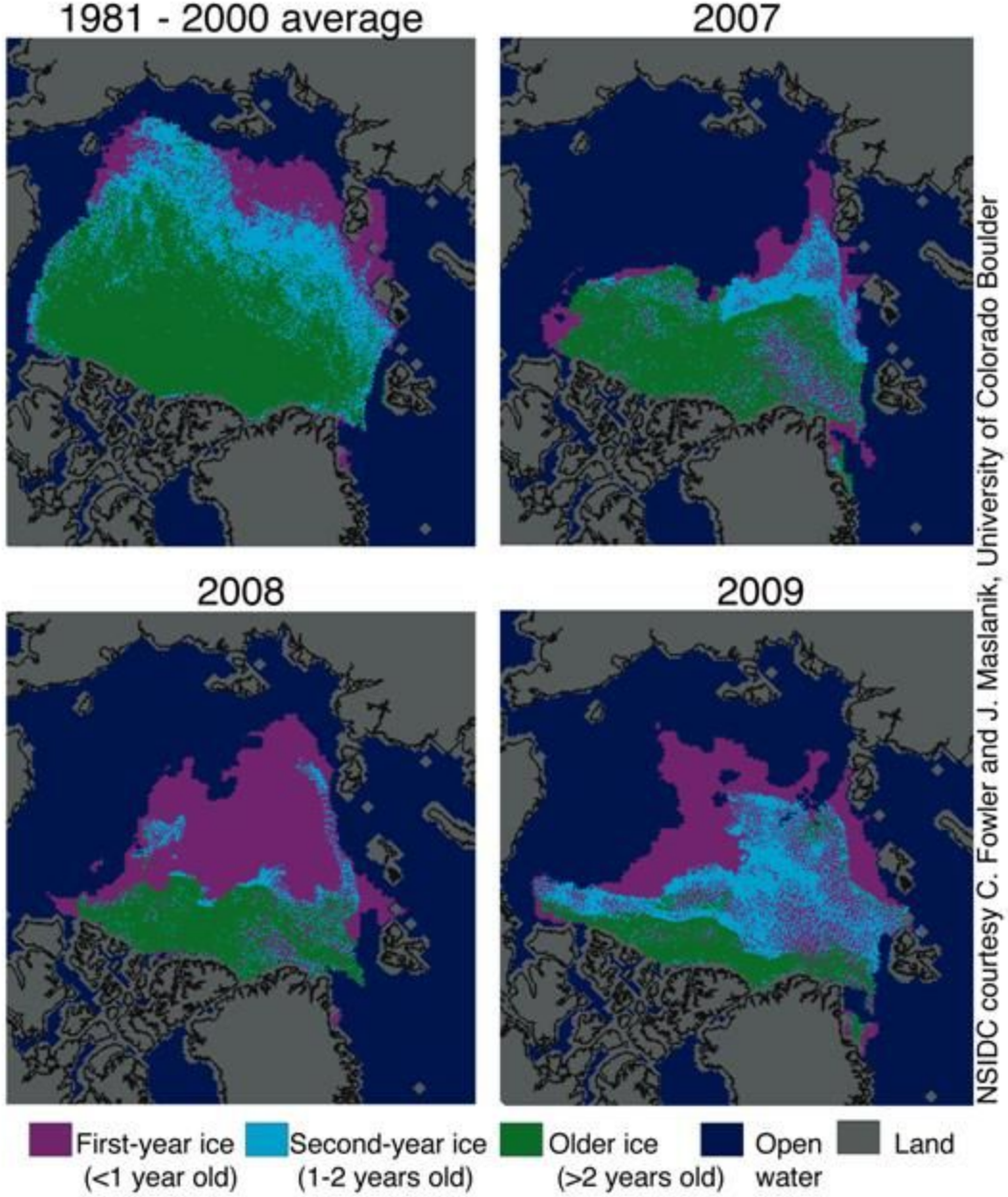
UCAR 2007, Steve Deyo

Ice thickness changes

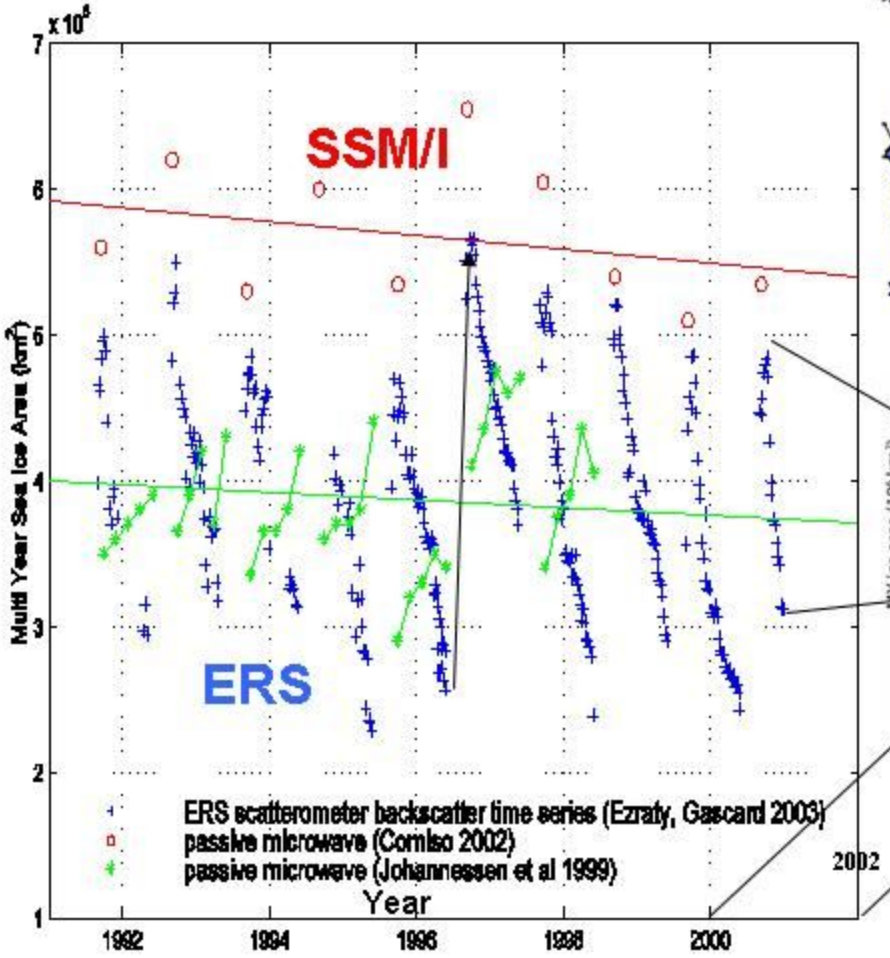


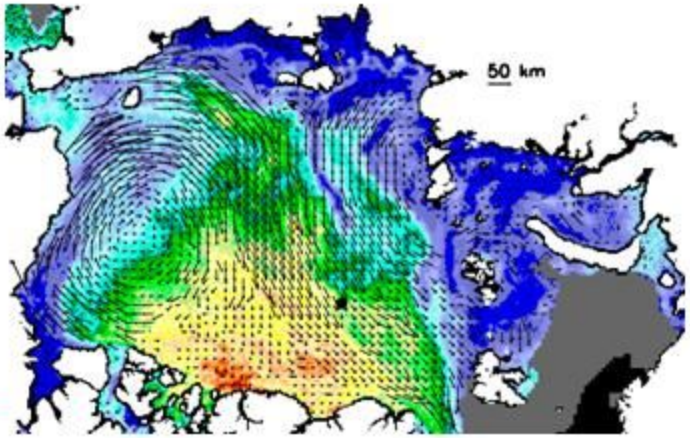
(Rothrock et al. ,1999)

Arctic sea ice age at the end of the melt season

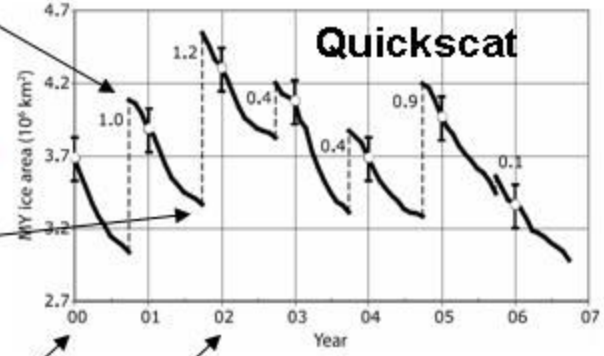


Multi Year Ice





Four days Sea-ice drift (April 30-May 3, 2002)



Time series of arctic MYI from ERS (R.Ezraty and J-C.Gascard 2003) and Quickscat scatterometers (R.Kwok 2007).
Backscatter maps and intercomparison with passive microwave data (J.Comiso 2002, O. Johannessen et al 1999)

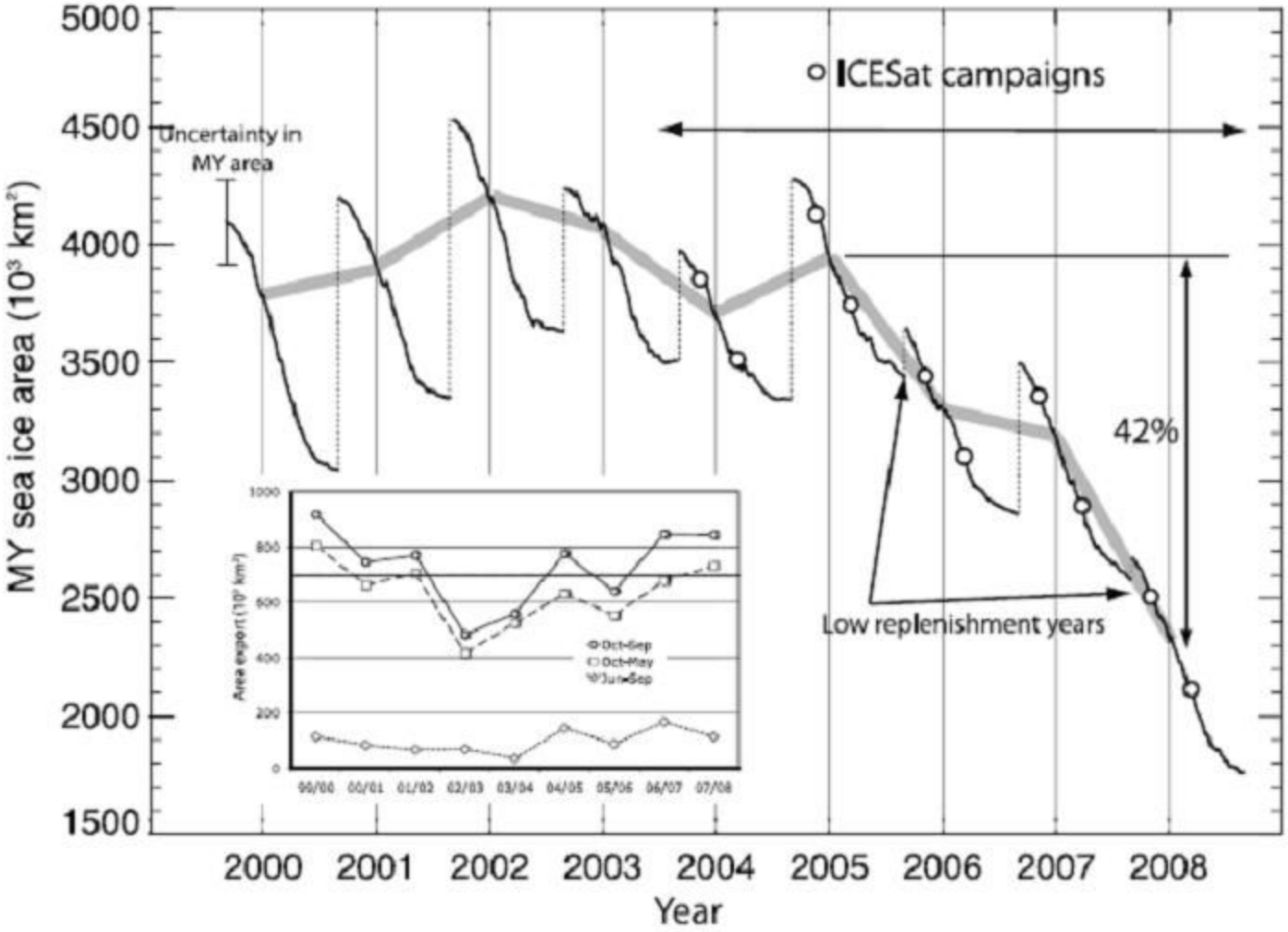
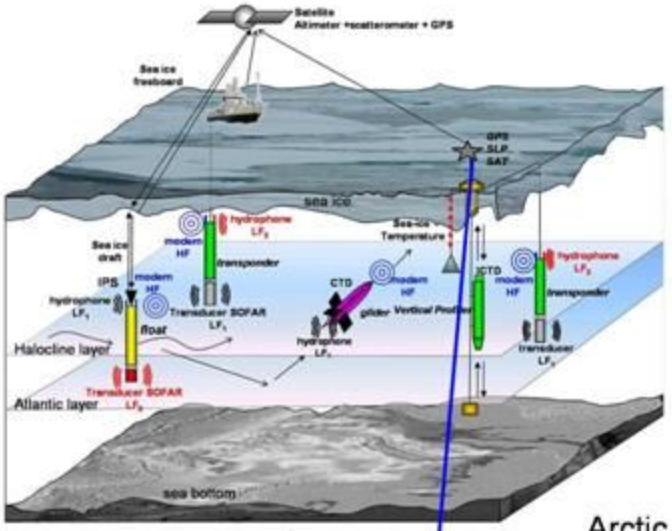
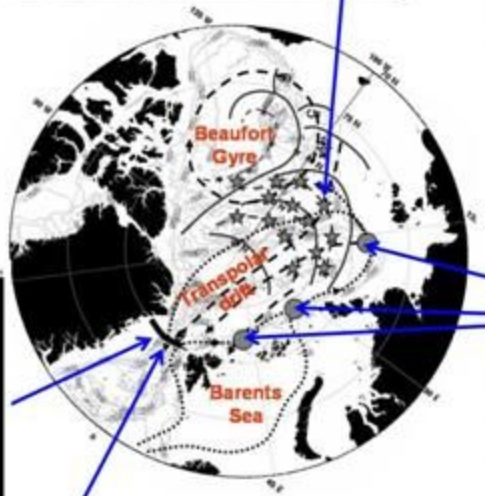


Figure 9. Nine annual cycles of replenishment/export of Arctic Ocean multiyear ice area constructed using QuikSCAT data and Fram Strait ice export. Open circles show the approximate times of the 10 ICESat campaigns used here. The dashed vertical lines show the replenishment of the MY ice reservoir by first-year ice at the end of each summer. The two near-zero replenishment years of 2005 and 2007 are indicated. Inset shows the annual and seasonal Fram Strait ice export over the same period.

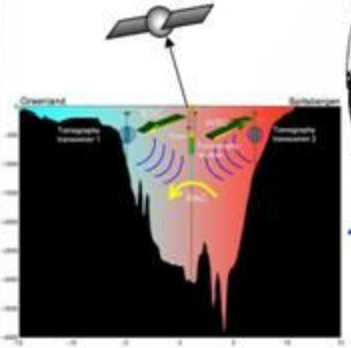
Kwok, R., Cunningham, G.F., Wensnahan, M., Rigor, I., Zwally, H.J., Yi, D. 2009. Thinning and volume loss of the Arctic Ocean sea-ice cover: 2003-2008. JGR.

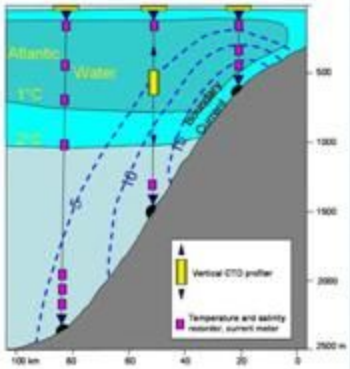


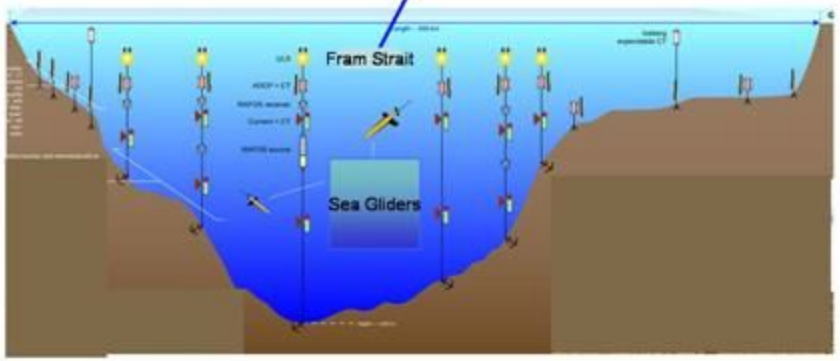
Arctic Ocean
Central Basin

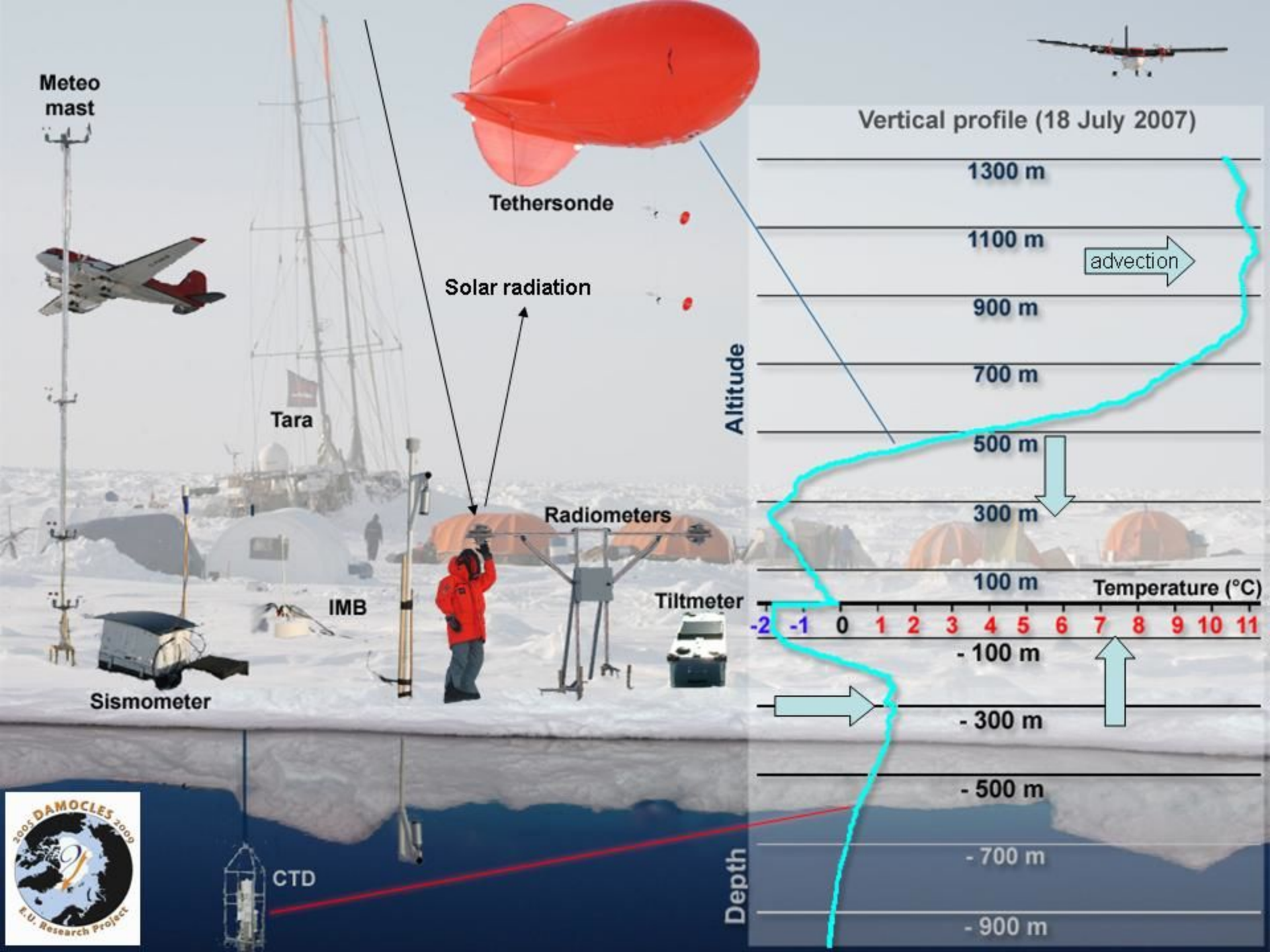


Eurasian
Continental Slope

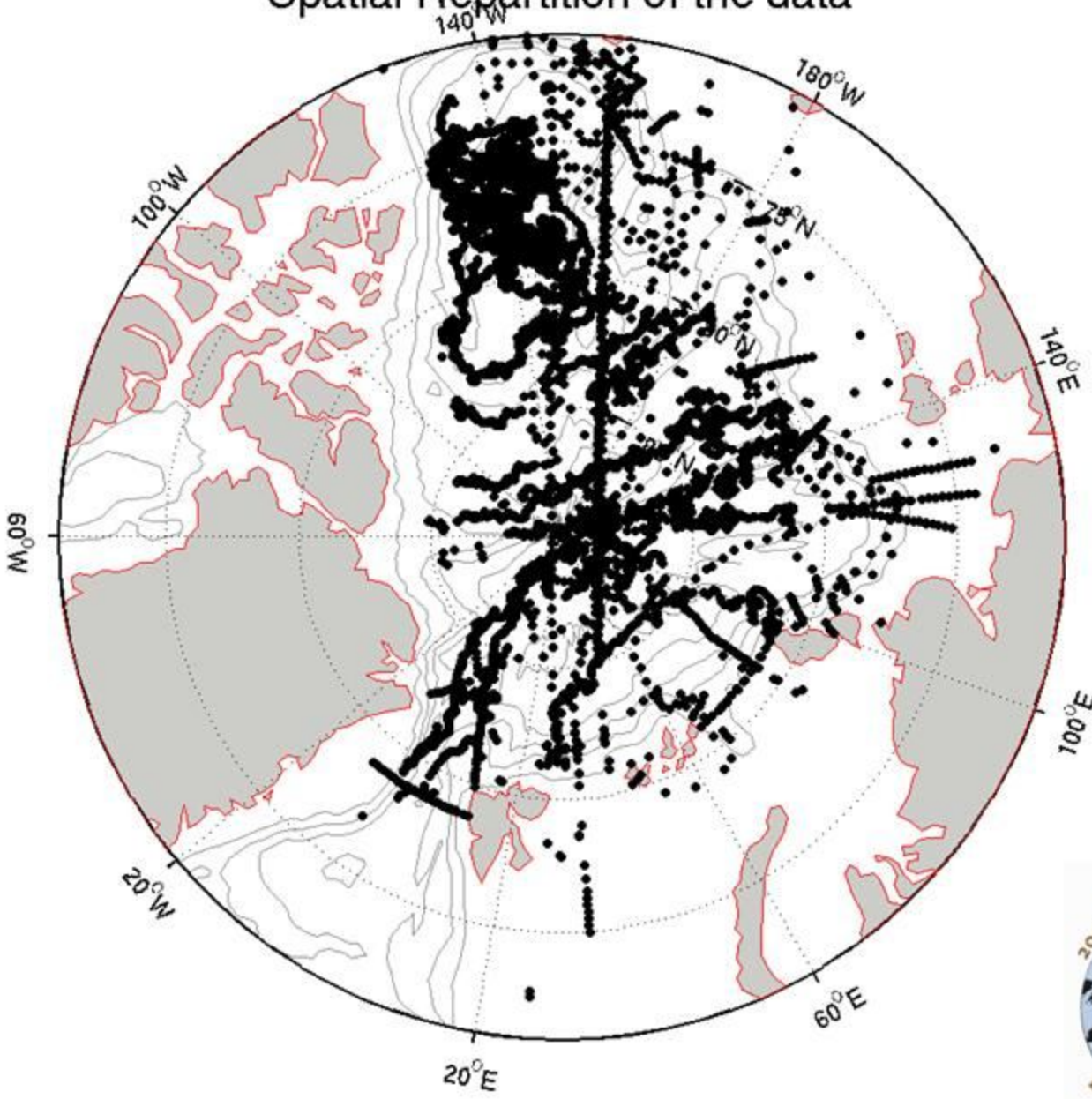




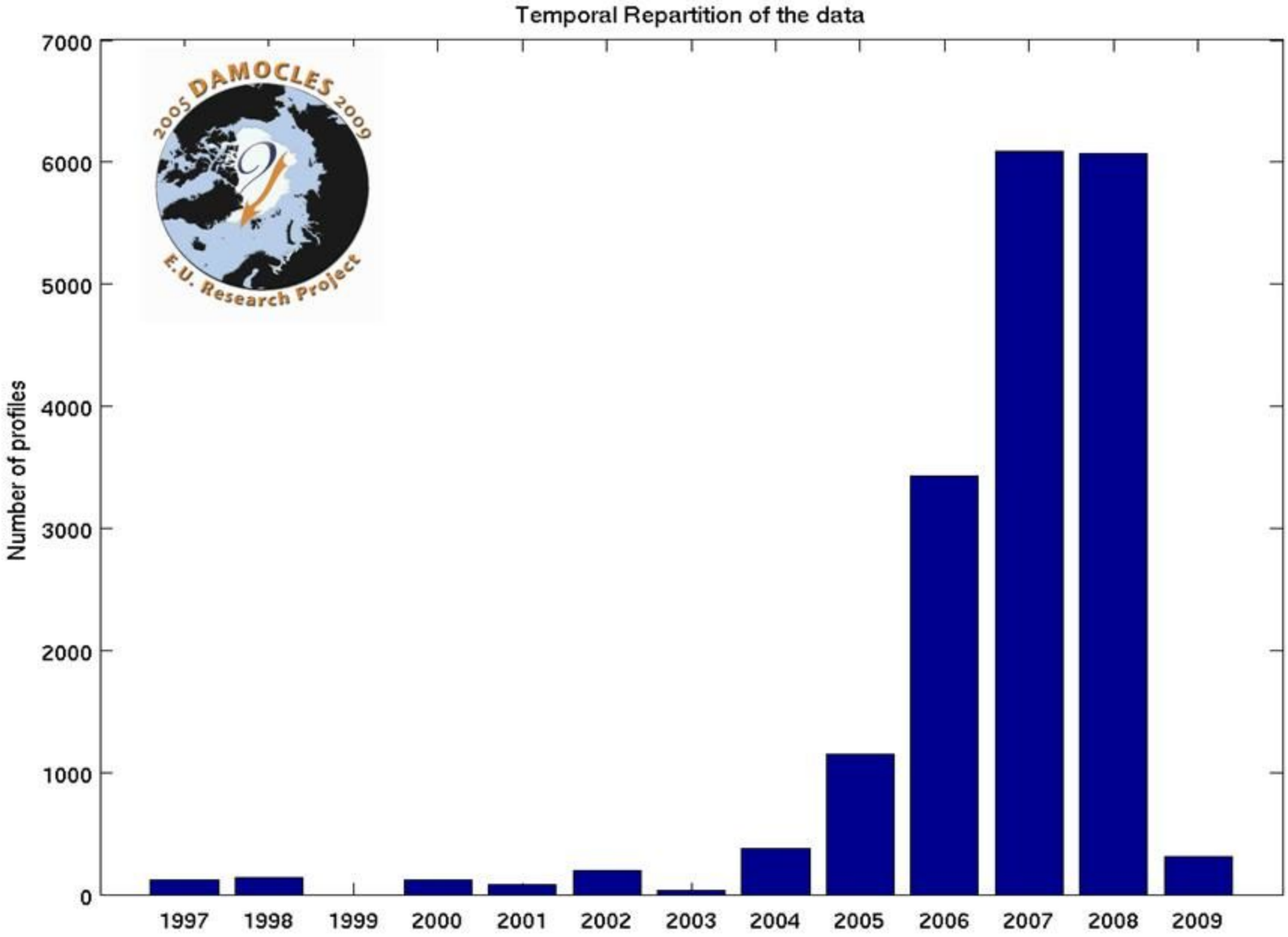


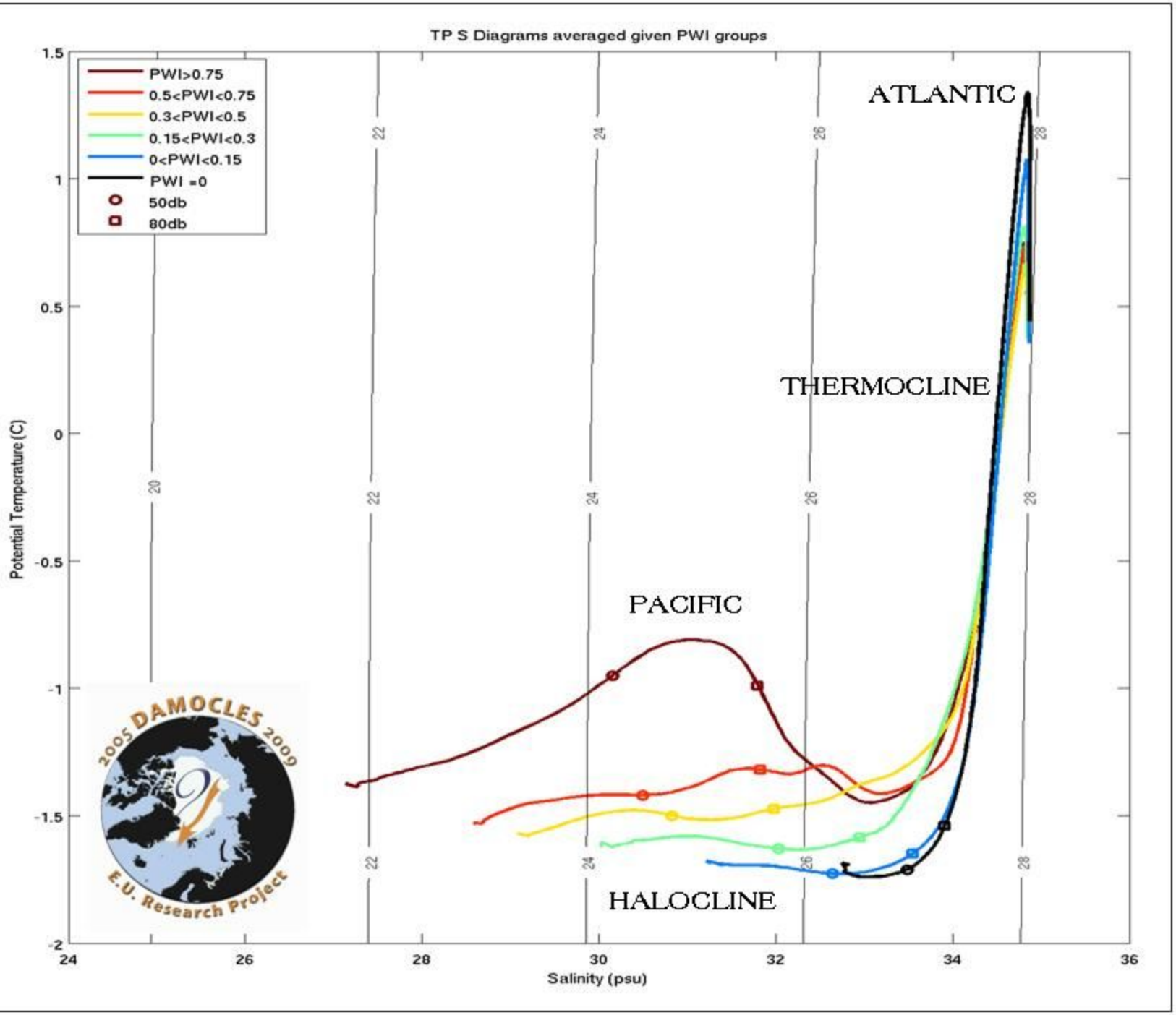

Meteo mast
Tethersonde
Solar radiation
Tara
Radiometers
IMB
Tiltmeter
Sismometer
CTD
Vertical profile (18 July 2007)
1300 m
1100 m
advection
900 m
700 m
500 m
300 m
100 m
Altitude
Temperature (°C)
-2 -1 0 1 2 3 4 5 6 7 8 9 10 11
- 100 m
- 300 m
- 500 m
- 700 m
- 900 m
Depth
2005 DAMOCLES 2009
E.U. Research Project

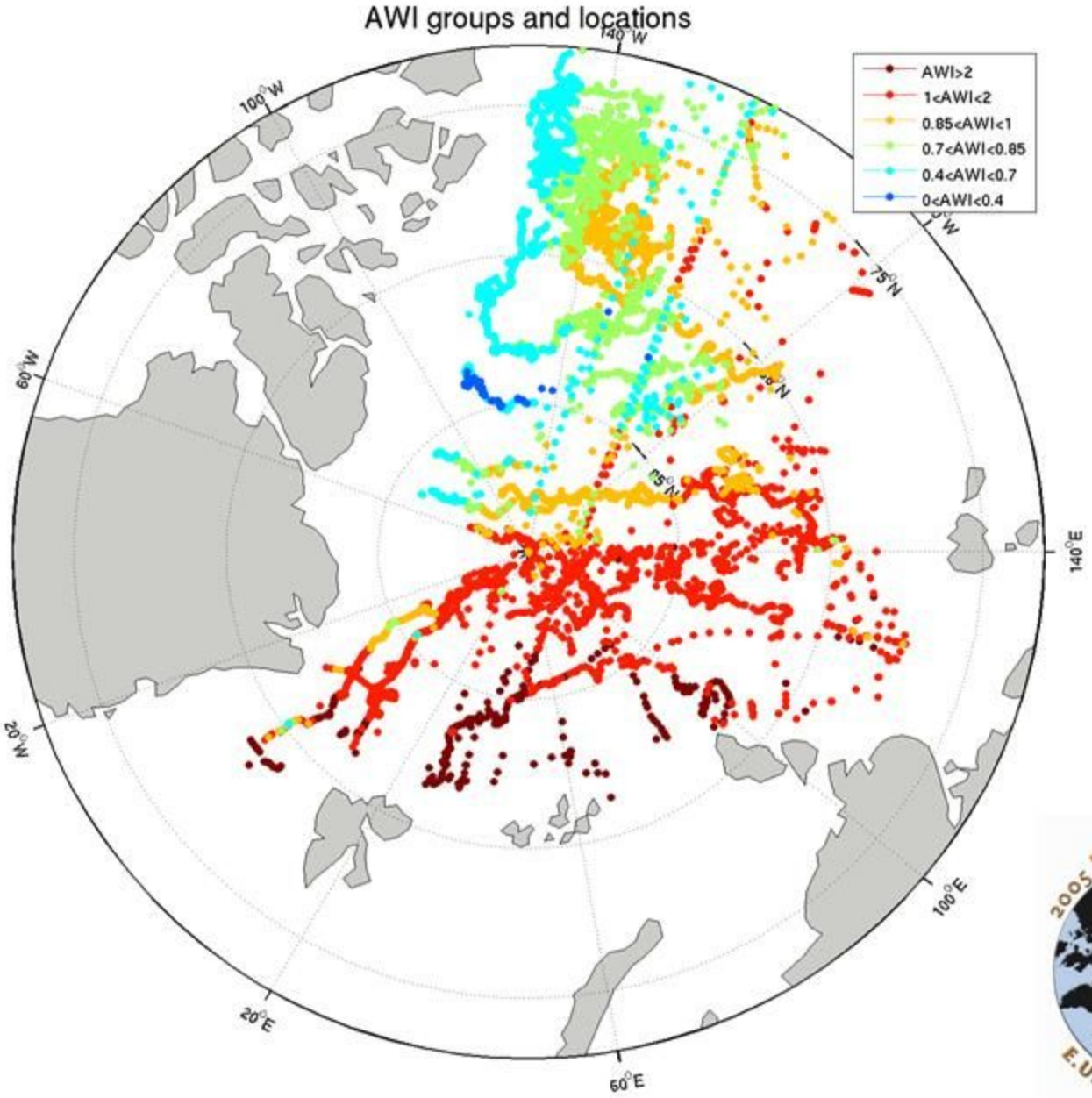
Spatial Repartition of the data



2005 DAMOCLES 2009
E.U. Research Project

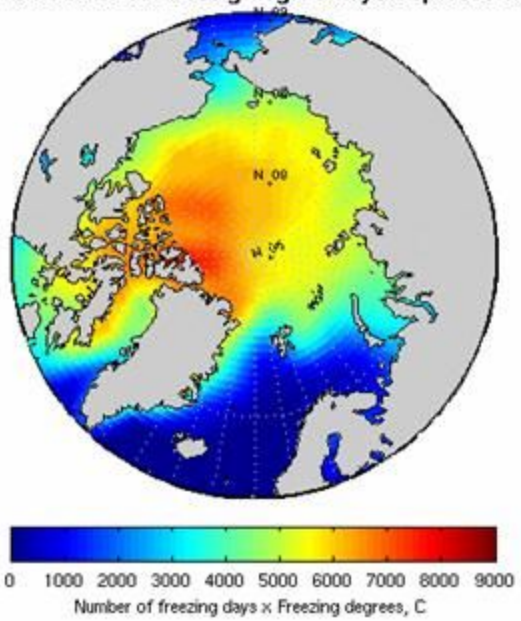

Temporal Repartition of the data
Number of profiles
7000
6000
5000
4000
3000
2000
1000
0
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2005 DAMOCLES 2009
E.U. Research Project


TP S Diagrams averaged given PWI groups
PWI>0.75
0.5<PWI<0.75
0.3<PWI<0.5
0.15<PWI<0.3
0<PWI<0.15
PWI =0
50db
80db
ATLANTIC
THERMOCLINE
PACIFIC
HALOCLINE
Potential Temperature (C)
Salinity (psu)
2005 DAMOCLES 2009
E.U. Research Project

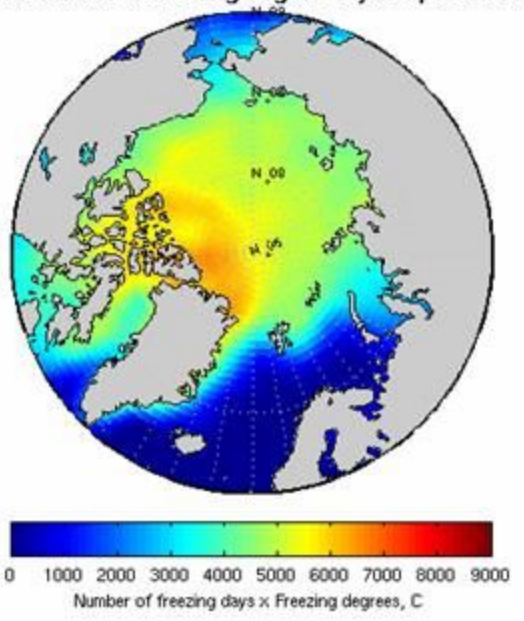


Pascaline Bourgain & J-C. Gascard (Poster)

Cumulative number of freezing degree days Sept1986-May1987

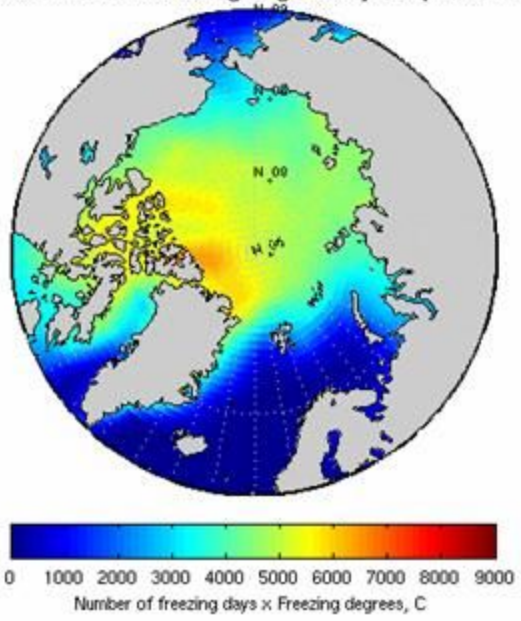


Cumulative number of freezing degree days Sept1994-May1995



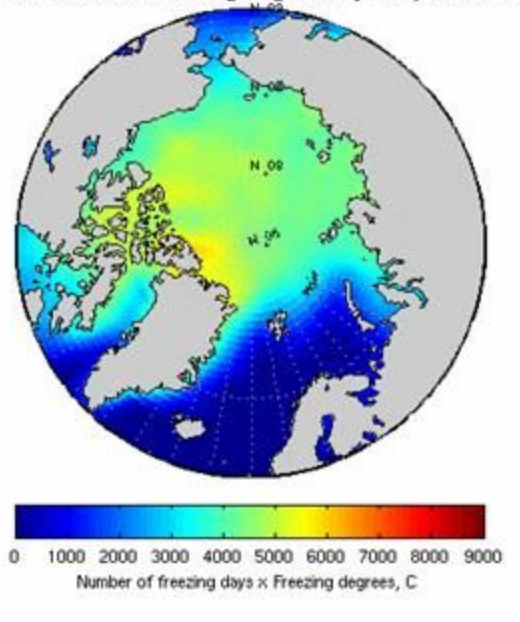
Tfreez - 1.7C

Cumulative number of freezing degree days Sept2004-May2005

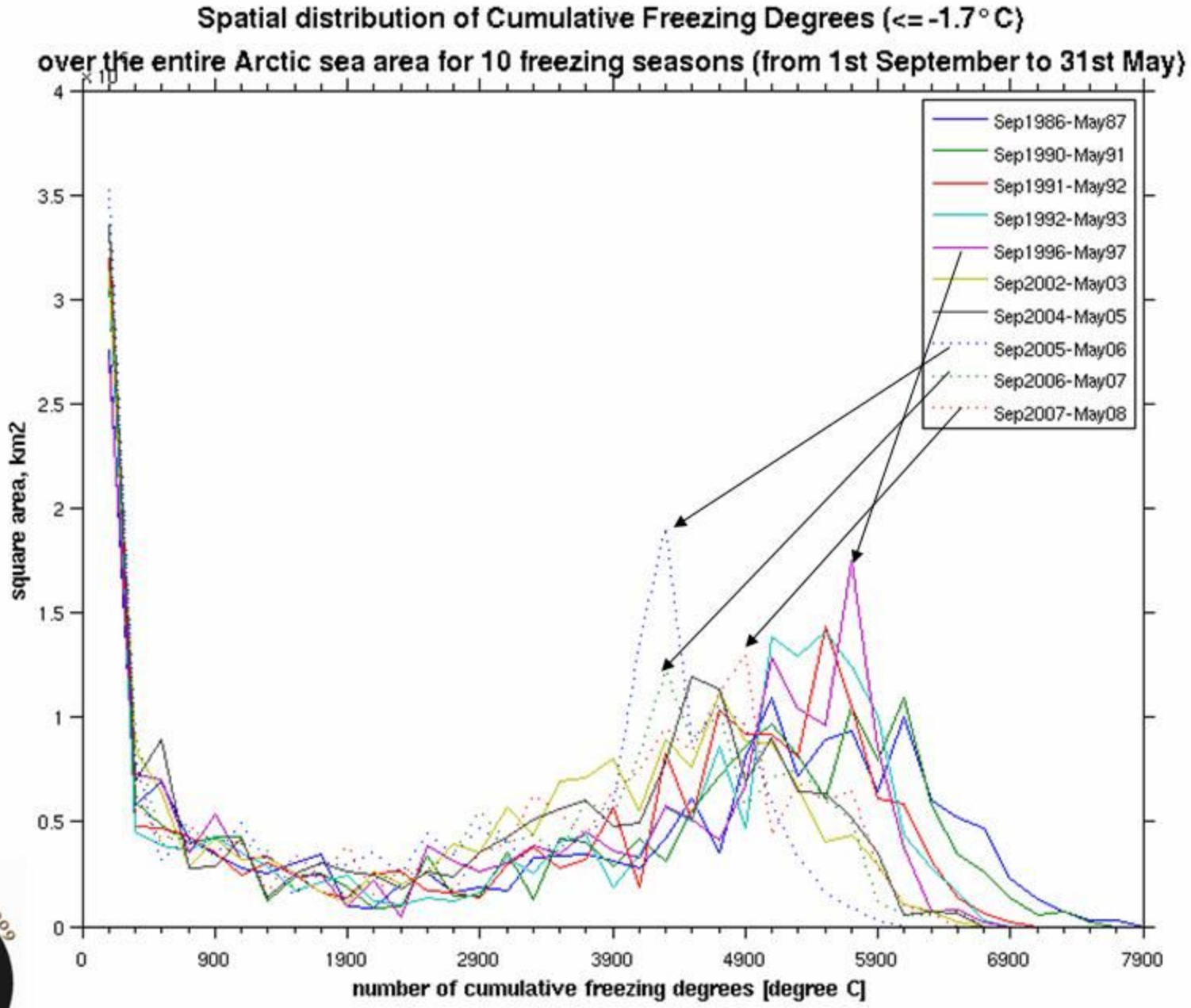


2005 DAMOCLES 2009
E.U. Research Project

Cumulative number of freezing degree days Sept2005-May2006



Elena Maksimovich & J-C Gascard (poster)



Winter index I = $\int x\, f(x)$ units : C.km2 (Sea Ice Outlook)

Summary

The main parameters characterizing Arctic Sea-Ice changed drastically during the past 30 years: **extent decreased, thickness decreased, drift speed increased, age decreased**.

The extreme sea-ice summer minimum extent in 2005 and 2007, were characterized by a **quasi disappearance of FYI and SYI** resulting in no replenishment of MYI.

In 2008 & 2009, FYI & SYI spread widely at the expense of **MYI that reduced drastically**.

Thinning of sea-ice started 30 years ago well before any other arctic sea-ice main characteristics were reported to change.

Long term global atmospheric warming related to GHG effect, seems to be the triggering process for sea ice thinning while the albedo is the polar amplifying feedback process. Less thick ice would be formed during milder winters. More sea-ice would melt during longer summers affecting sea-ice extent.

There is a strong need for dedicating lot of attention to the evolution of the **Arctic sea-ice thickness distribution** which is a sensitive element of the Arctic climate system. We are looking forward to Cryosat 2 in addition to new in situ observations, on-going space obs and advanced numerical modelling.