ocOC –
from Ocean Colour to Organic Carbon

IPY EoI #1176; DFG 4575

Birgit Heim[1], Alexandra Loginova[4], Roland Doerffer[2], Paul Overduin[1], Hugues Lantuit[1], Jens Hoelemann[1,6], Fedor Martynov[4,6], Ekaterina Abramova[5,6], Frank Guenther[1], Carolyn Wegner[3], Heidi Kassens[3,6]

[1] *Alfred Wegener Institute for Polar and Marine Research AWI (DE)*
[2] *Helmholtz Centre Geesthacht HZG (DE)*
[3] *IFM-GEOMAR (DE)*
[4] *St. Petersburg State University (RU)*
[5] *Lena-Delta Nature Reserve, Tiksi (RU)*
[6] *Otto-Schmidt-Laboratory*, St. Petersburg (*RU*)

❑ ***Ocean Colour*** applications for Siberian Arctic waters?

❑ **Ocean Colour** data (NASA, ESA):
freely available, daily acquisition, super-spectral optical information, *attenuation, SPM, Chl-a, transparency,....* ready-to-use products?

❑ NEED OF GROUND TRUTH? NEED OF REGIONAL OC PRODUCTS?

The eroding coast

ACD Circumarctic Arctic Coastal Dynamics Project

IPY ACCONET

AWI – HZG Arctic Coast Research Program

Helmholtz German-Russian Kara Sea and Laptev Sea Program

OC – to Organic Carbon

spring/ early summer

freshets

ice abrasion

summer

base-line flow

late summer /autumn

wave erosion

export of sediments and Organic Matter

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3rd CC UCM, Lisboa 2011

Are standard Ocean Colour products usable for Siberian Arctic waters?

shallow Siberian Shelf

submarine permafrost

organic-rich bottom sediments

coastal cliffs with ice-rich, organic rich sediments

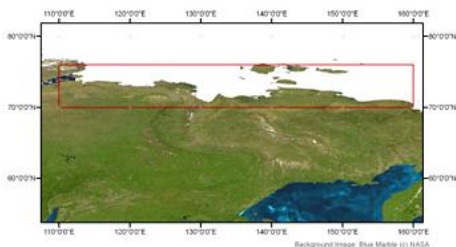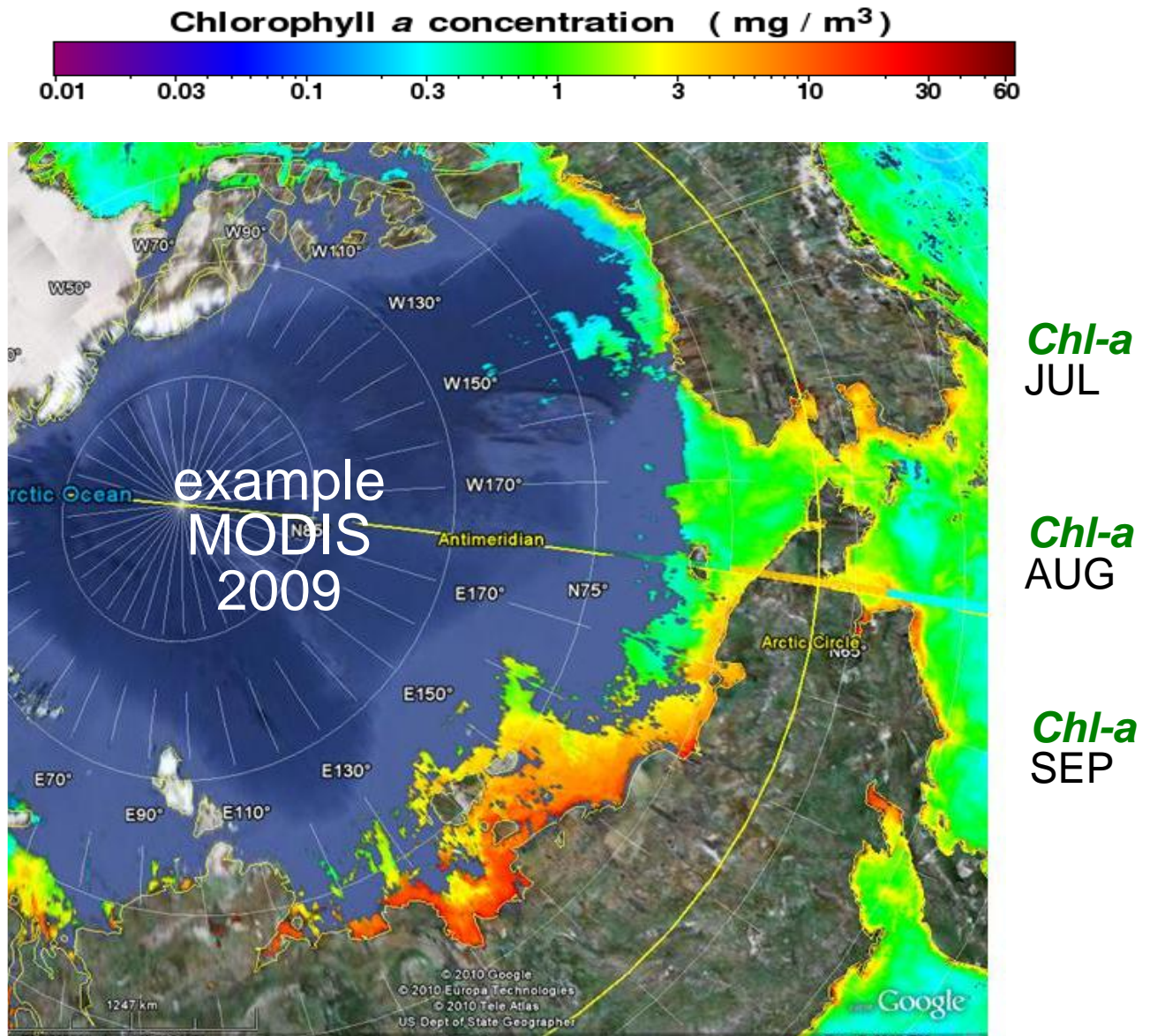*organic-rich permafrost catchments*

Ice-free season
July to September

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Siberian Arctic coastal waters:
-> failure of all standard
Ocean Colour
(SeaWiFS, MODIS, MERIS...)
Chl-a
products

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Chlorophyll *a* concentration (mg / m³)

0.01 0.03 0.1 0.3 1 3 10 30 60

example
MODIS
2009

Chl-a
JUL

Chl-a
AUG

Chl-a
SEP

Ground data from Russian-German Expeditions in the Laptev Sea Region

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TRANSDRIFT 2010 a440cDOM [m-1]

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MERIS 03-07-2011
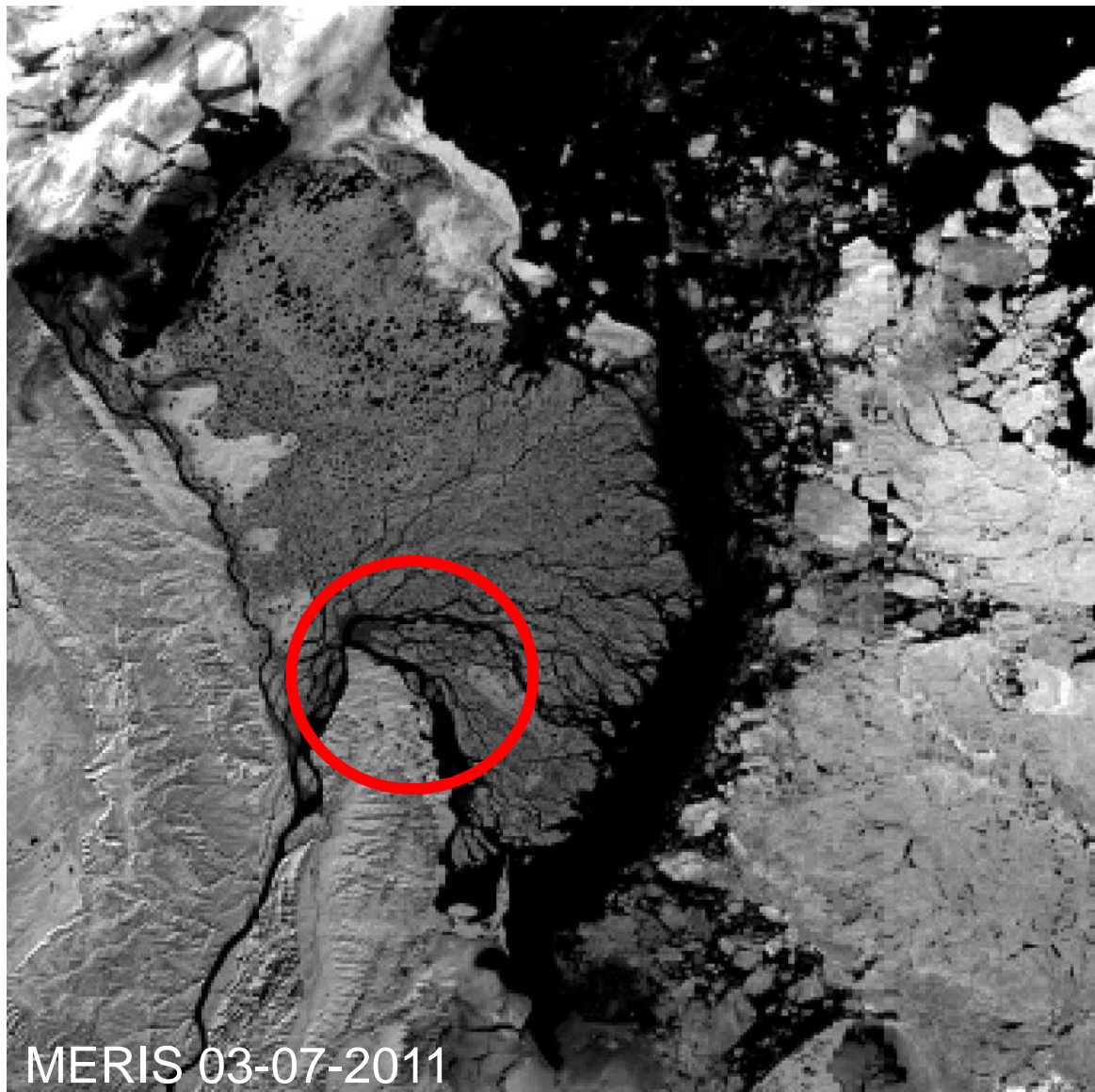
HZG-AWI

LENA2011 Expedition

Reflectance

SPM

turbidity

Chl-a

PSICAM absorption

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MERIS L1B processed with: BEAM-VISAT 4.9© *(ESA/ Brockmann Consult)*
& HZG-MERIS Case2Regional Processor for coastal water application (C2R)

atmospheric correction: HZG Neural Networks
(Doerffer & Schiller 2008)

HZG-MERIS C2R
(Doerffer & Schiller 2008)
- derives aquatic IOPs (backscattering, absorption)
aquatic AOPs (water leaving reflectance, k)
and derived products (Z90, absorption cDOM,
absorption phytoplankton, Chl-a, SPM)

C2R
total
absorption
[m^{-1}]

3
2.5
2
1.8

1

0.5

from 2006 to 2010: 8 to 15 **usable** (JUL to SEPT)/ year

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MERIS RR 20110703, Signal Depth z90 max

Z90_max [m]

-2.92 -2.67 -2.42 -2.16 -1.91 -1.65 -1.4 -1.15 -0.89 -0.64 -0.38
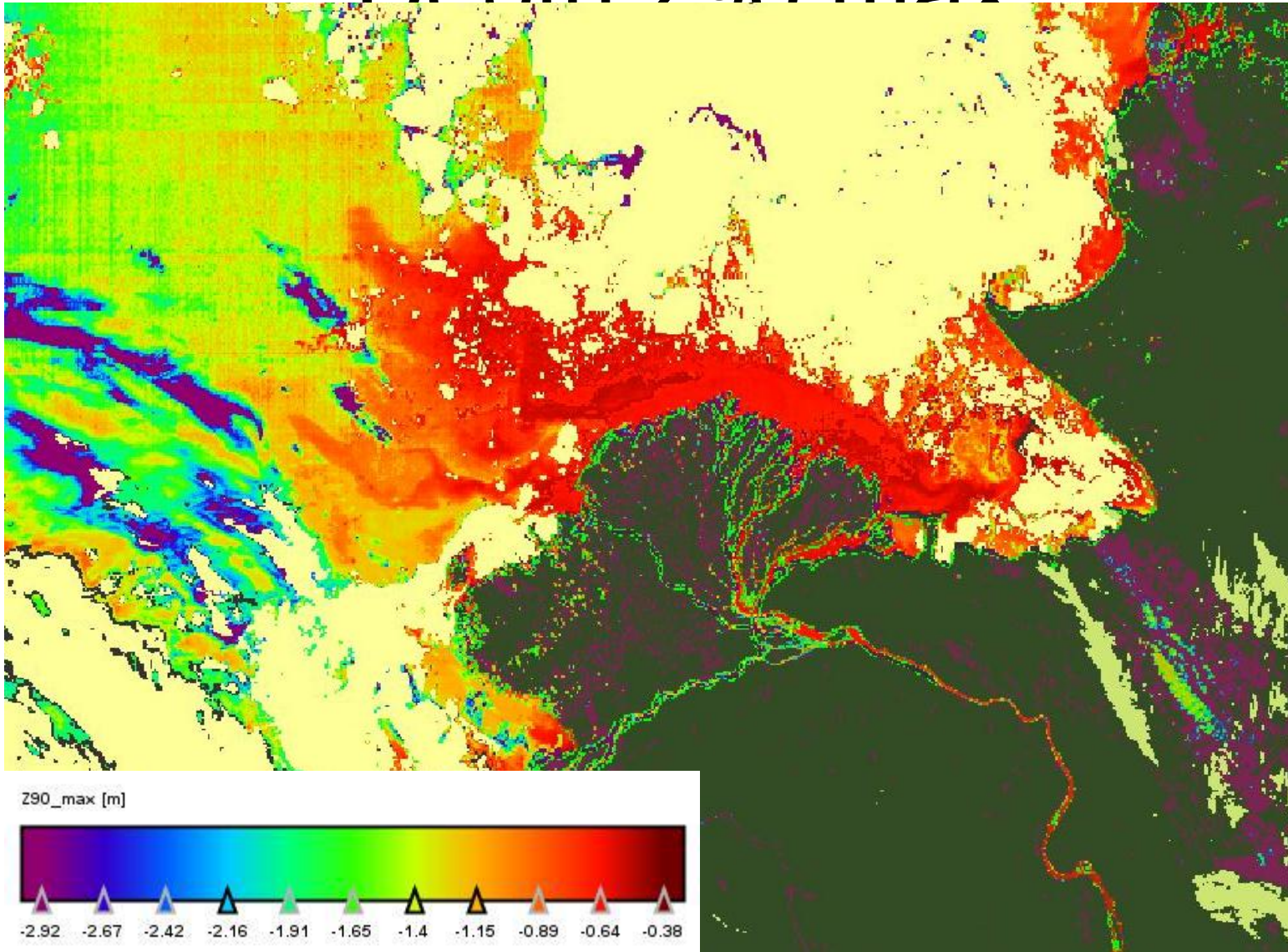
MERIS RR 20110703, Total absorption of water constituents at 443 nm

a_total_443 [m^-1]

0.01 0.69 1.37 2.05 2.73 3.41 4.09 4.77 5.45 6.13 6.81
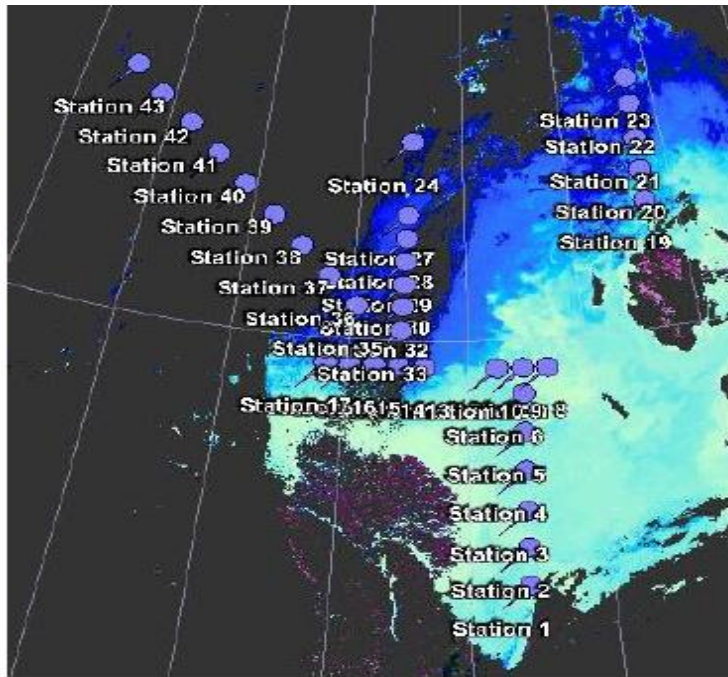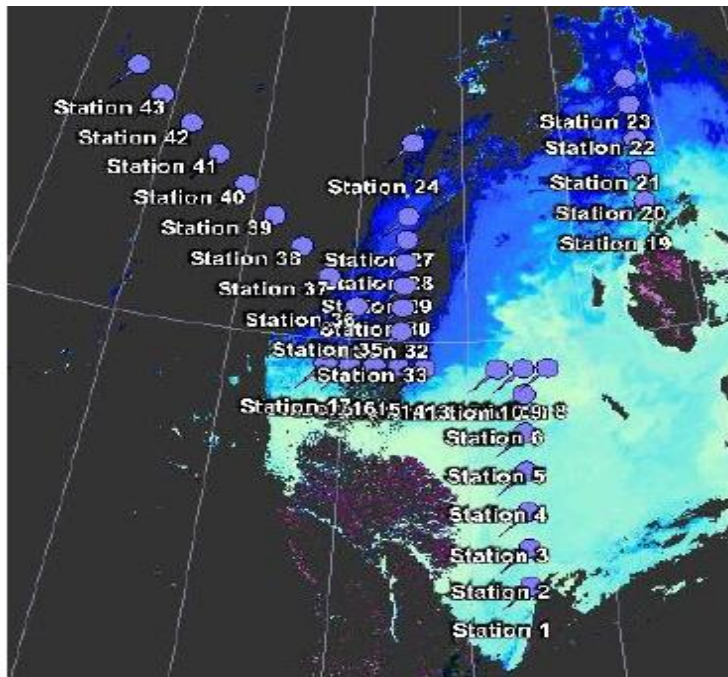
TRANSDRIFT 2010 sampling stations
09-09-2010 to 18-09-2010

storm events between
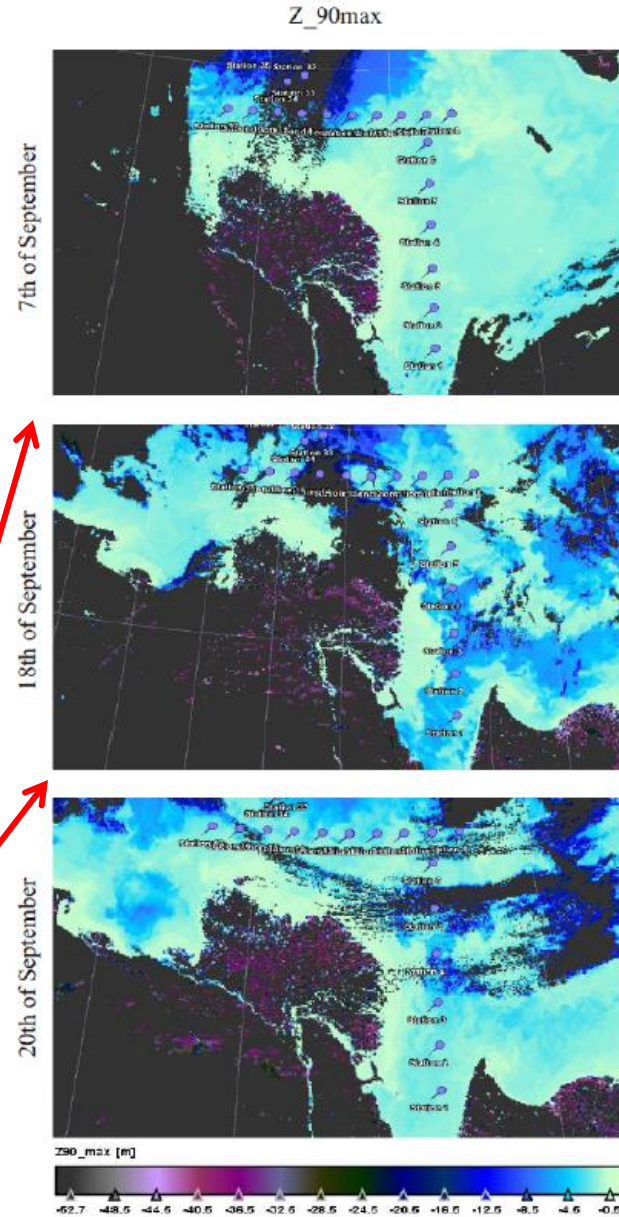
Evaluation using Ground data from Russian-German Expeditions

TRANSDRIFT2010 acDOM [m-1]

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3rd CC UCM, Lisboa 2011

a_total = 0,4416* a_440 + 0,3847
R^2 = 0,7536

a_ys = 0,1419* a_440 + 0,0844
R^2 = 0,7182
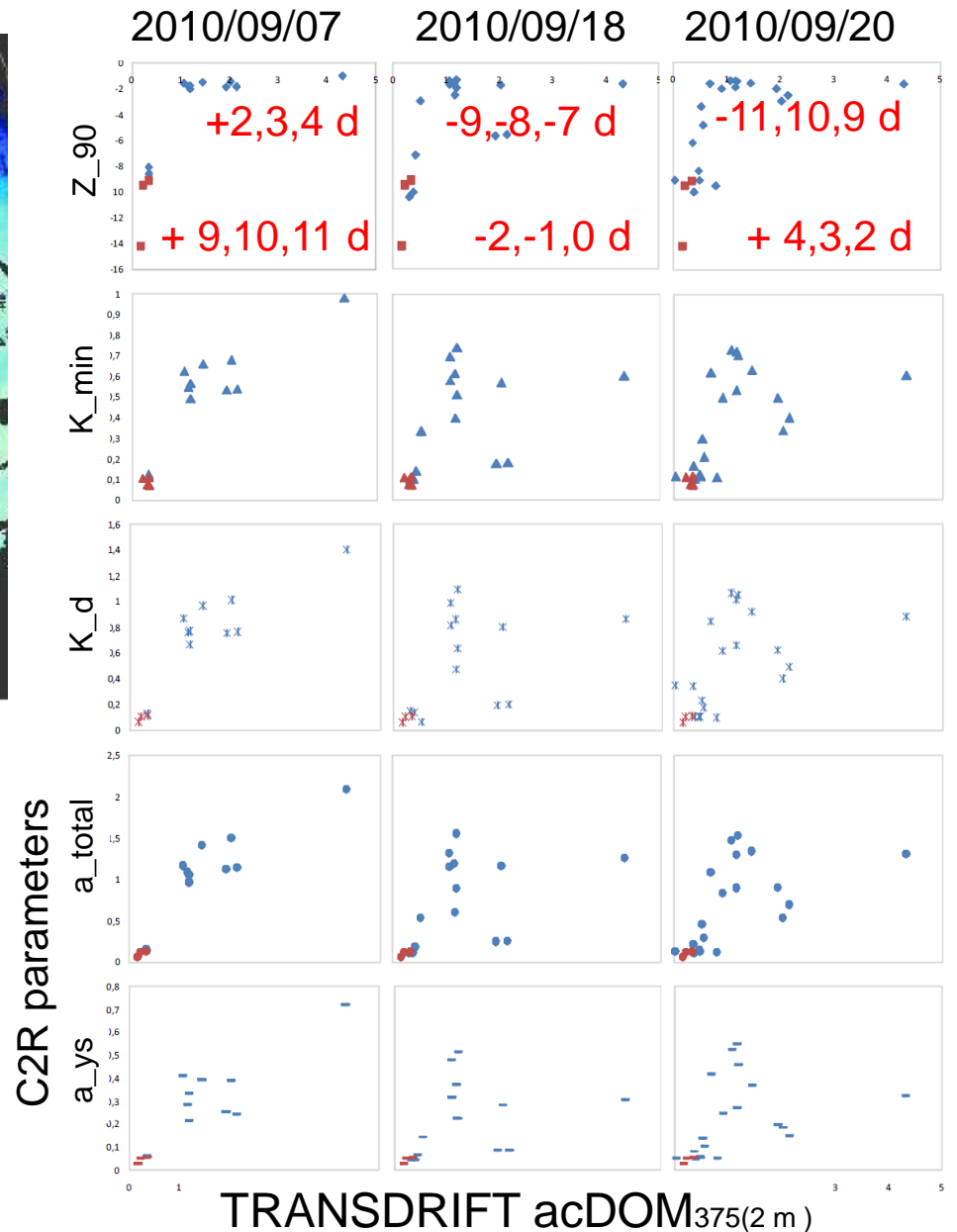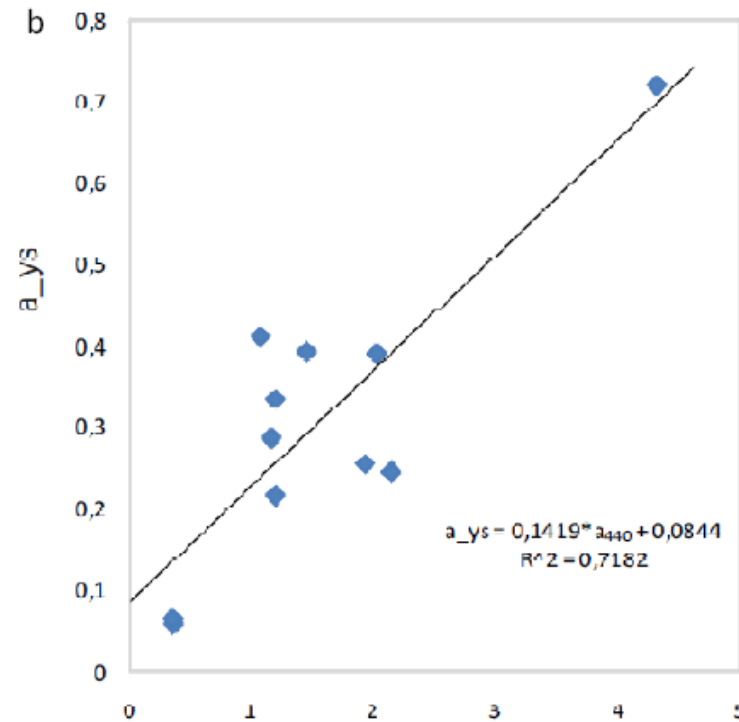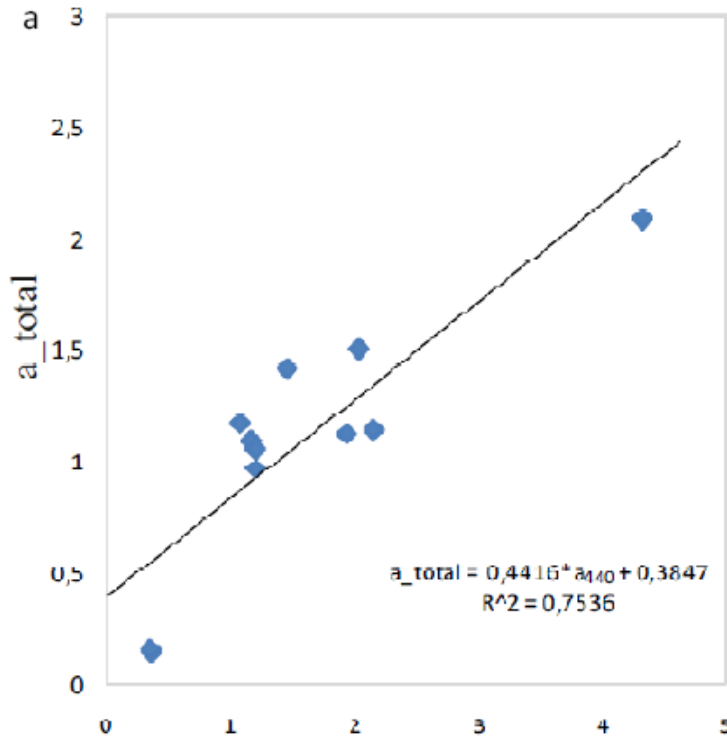
acDOM$_{440(2m)}$

acDOM$_{440}$ = 7,05 * C2R α_ys_443 − 0,59

acDOM$_{440}$ = 2,26* C2R α_total_443 − 0,87

TRANSDRIFT 2010 Chl-a (2 m)

MODIS Aqua Chl-a

07-09-2010

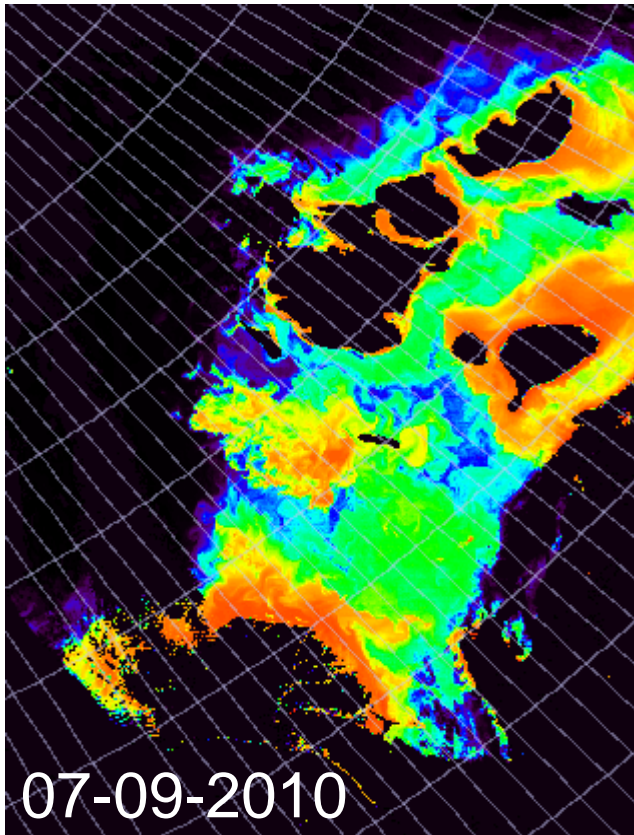09-09 to 18-09-2010

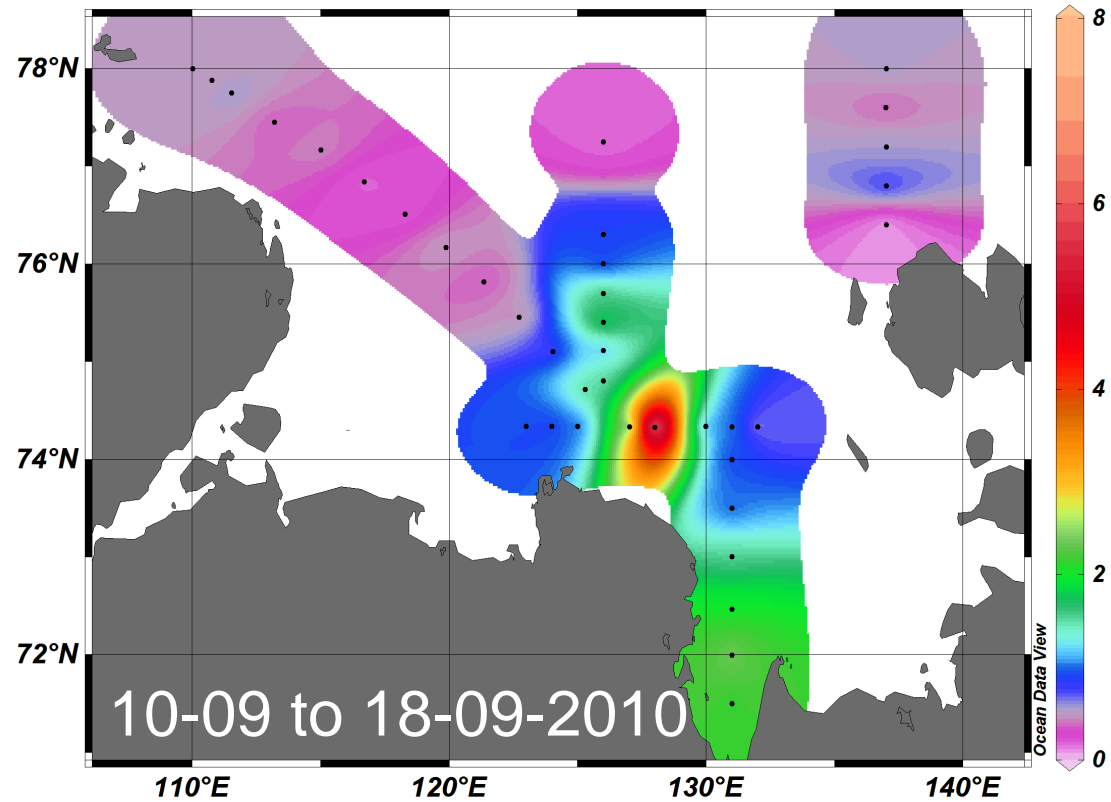MODIS Chl-a [mg/m-3]

4   5   7   10   20
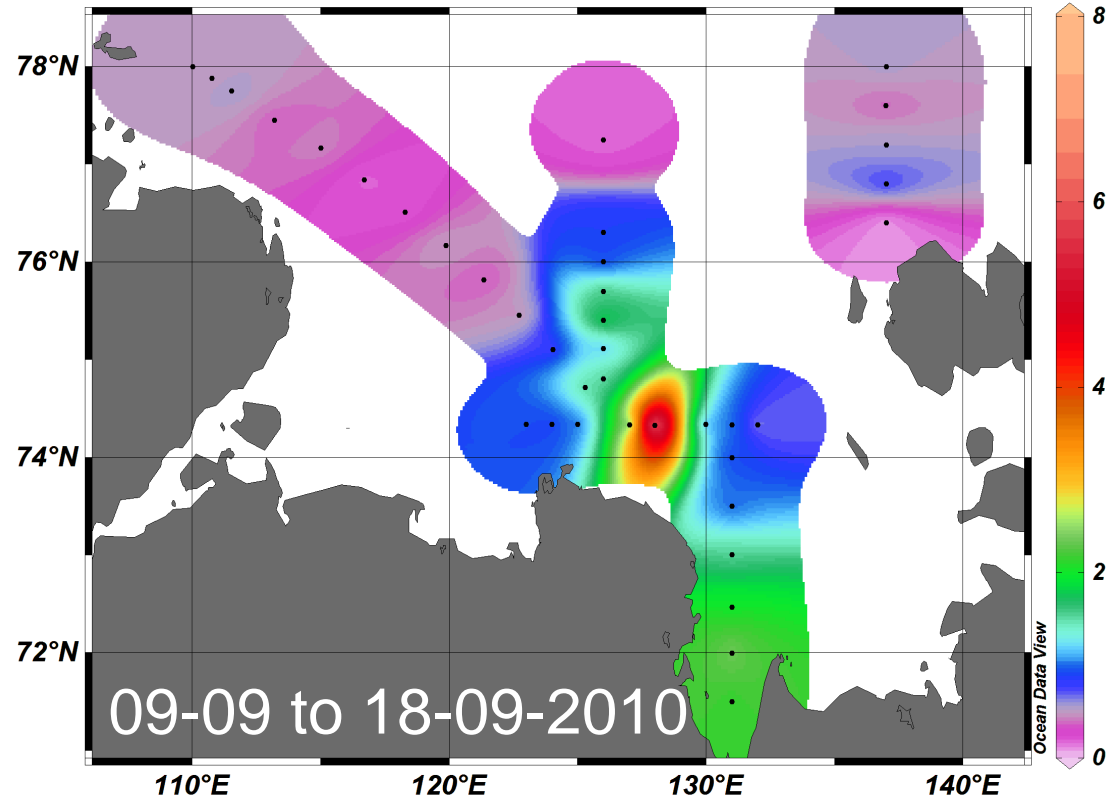
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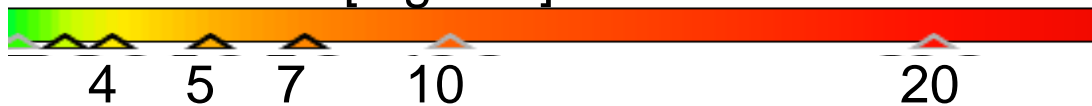
Evaluation using Ground data from Russian-German Expeditions
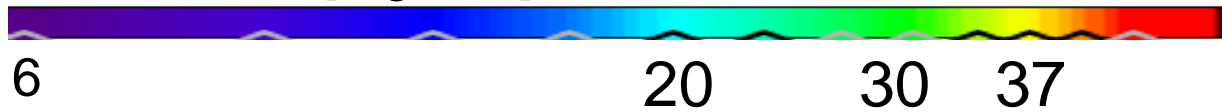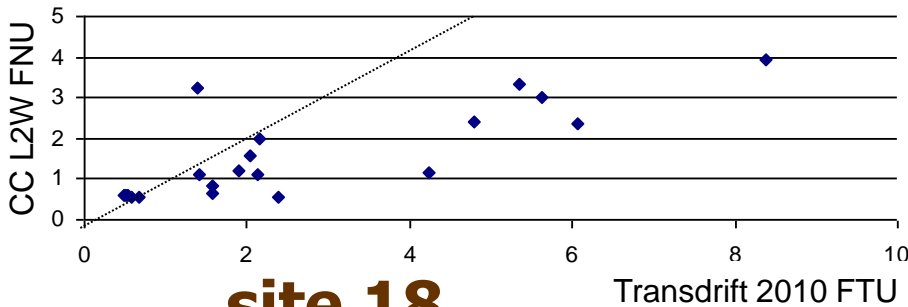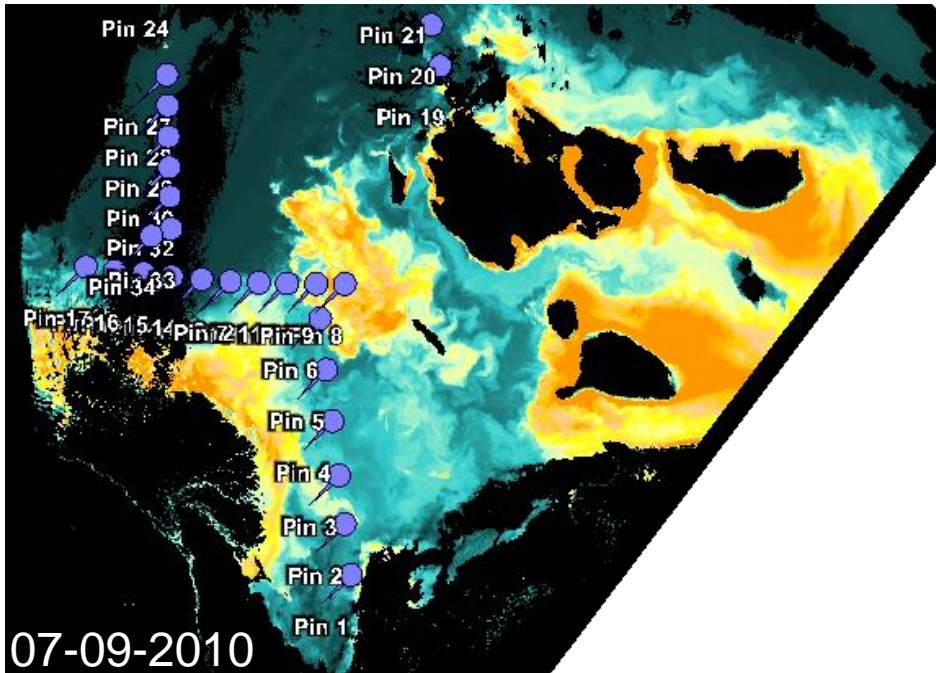
COAST COLOUR L2W Chl

TRANSDRIFT 2010 Chl-a (2 m)

07-09-2010

10-09 to 18-09-2010

CC L2W Chl [mg/m-3]

6   20   30   37

CC L2W turbidity [FNU]

07-09-2010

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2011/09/07   2011/09/18   2011/09/20

+2,3,4 d   -9,-8,-7 d   -11,10,9 d

+ 9,10,11 d   -2,-1,0 d   + 4,3,2 d

Z_{90}

K_{min}

$K_{d,i}$

C2R parameters a_total

C2R parameters a_ys

CC L2W FNU

Transdrift 2010 FTU
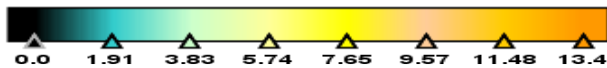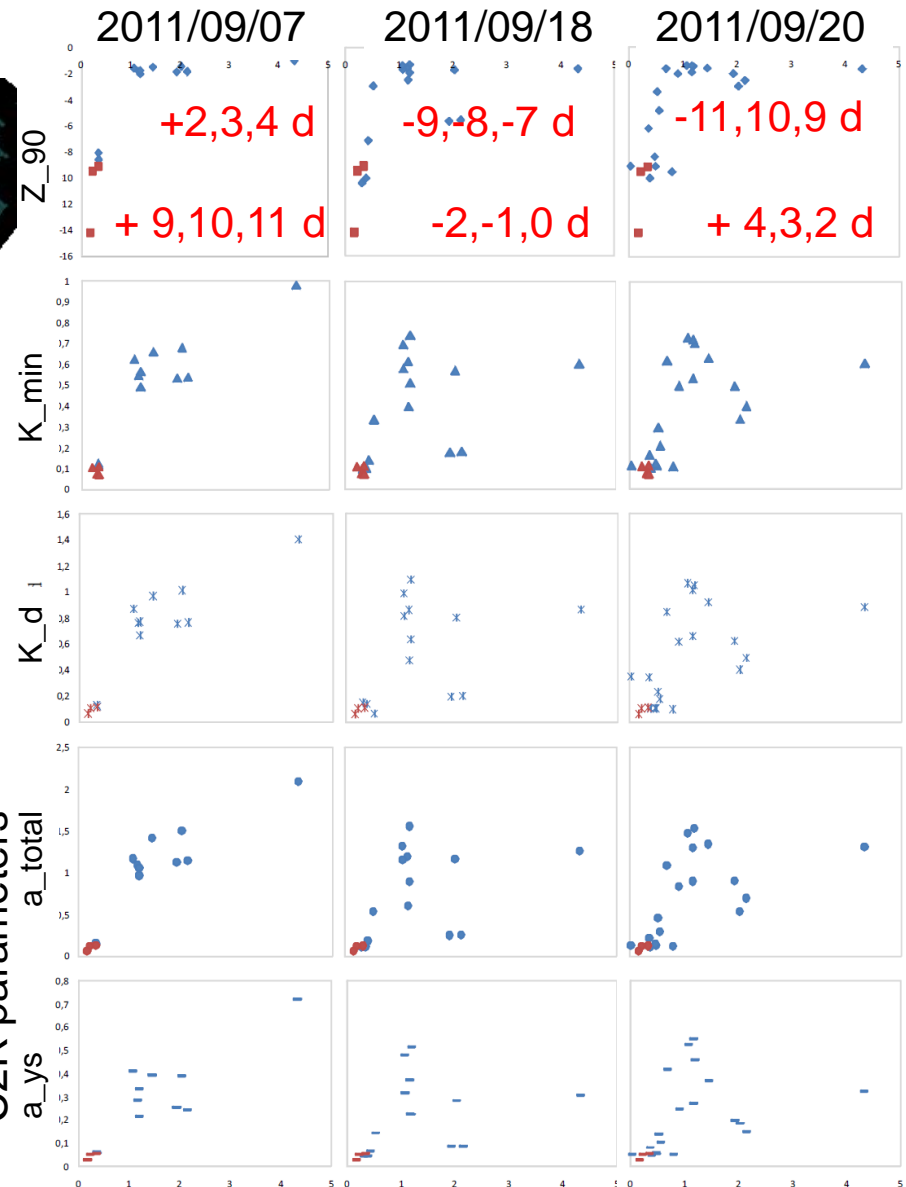
TRANSDRIFT Turbidity (FTU) (2 m)

3rd CC UCM, Lisboa 2011

high winds: large-scale mixing events down to 10 m

RapidEye
27-08-2010
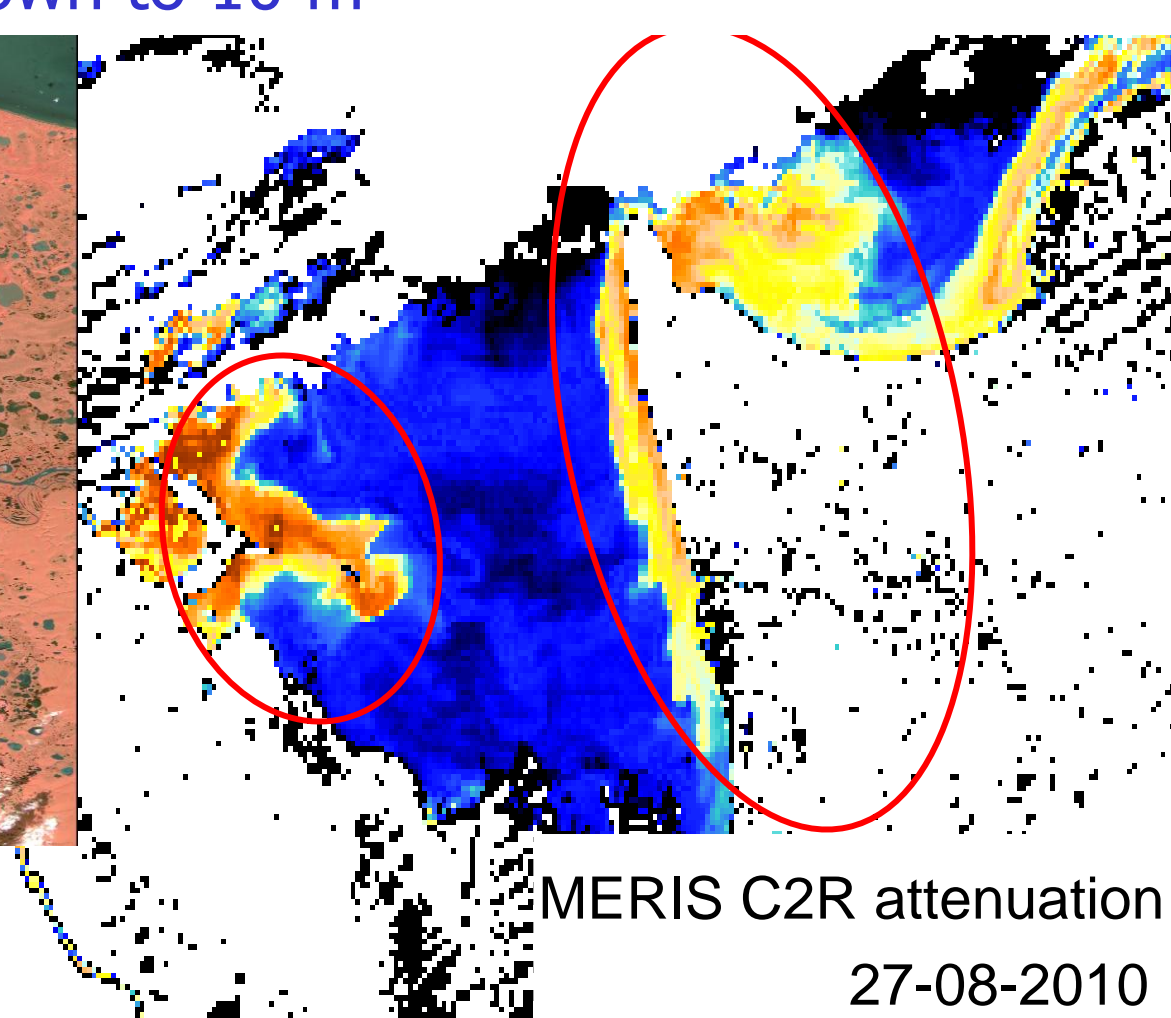
MERIS C2R attenuation
27-08-2010

no large-scale mixing events

MERIS C2R
attenuation

08-08-2010

K_min [m^-1]

-0.01 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0 1.1 1.2 1.3 1.4 1.5
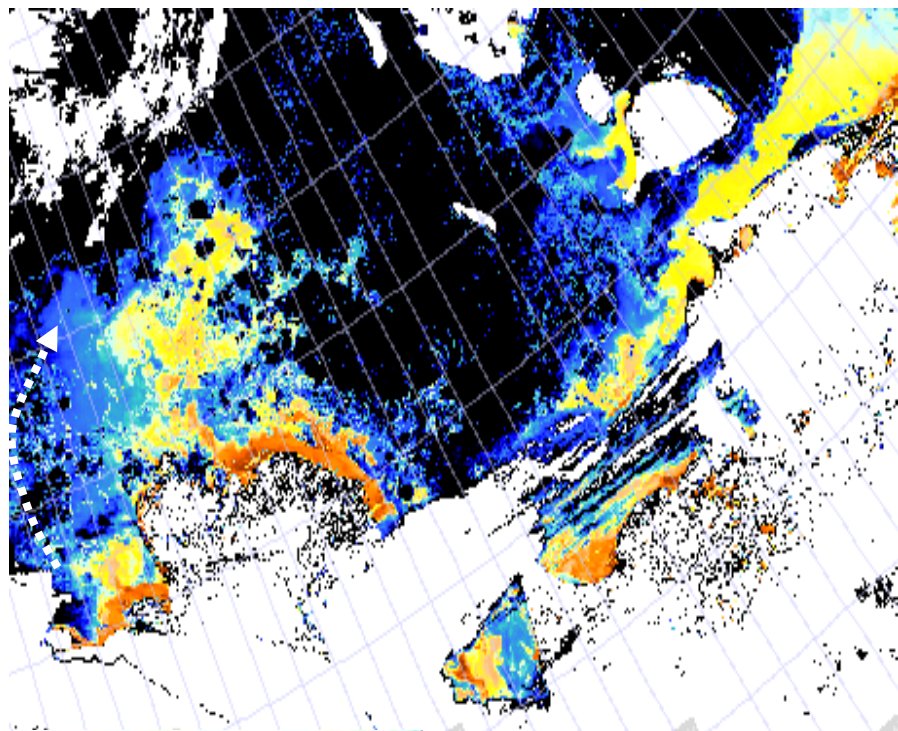
RapidEye
08-08-2010

Ocean Colour shows large-scale hydrodynamics

Laptev Sea Index
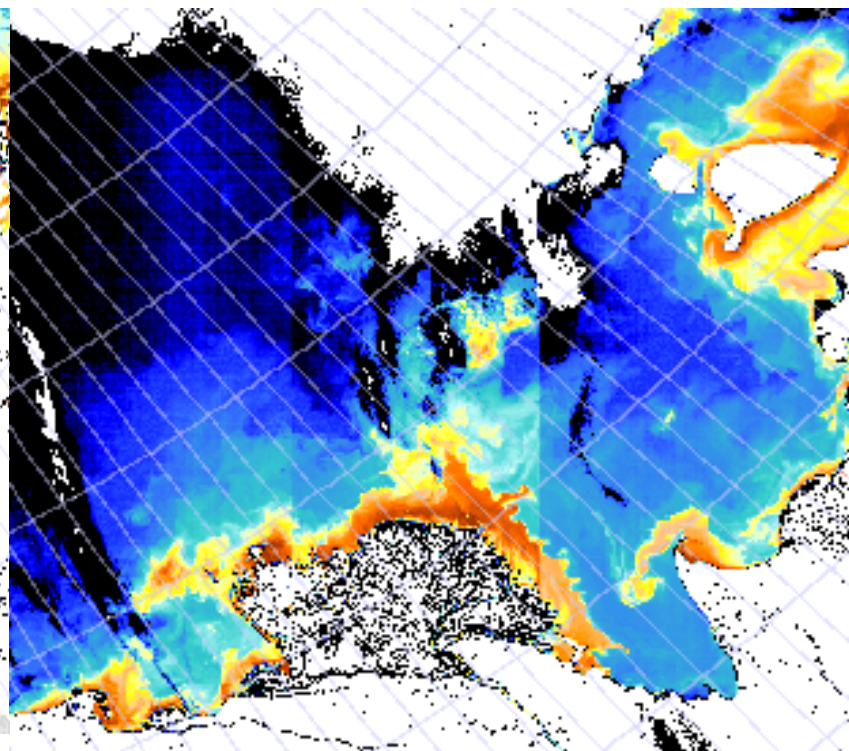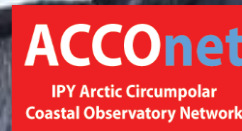2008
anti-cyclonic

freshwater to the outer shelf

Laptev Sea Index
2007, 2009, 2010
cyclonic

quasi-estuarine circulation
& E' Siberian coastal stream

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Thank You

Ocean Colour delivers intra and inter-annual summer hydrodynamics.

Chl-a overestimation due to **high organic terrestrial matter.**

TRANSDRIFT 2007, 2008, 2009, 2010, 2011; Lena2008, Lena2010, Lena2011; Chl-a$_{filter}$, Chl-a$_{fluores}$, Turbidity, SPM$_{filter}$, cDOM

Future Laptev Sea programms: **Adaption of OC products for modelling** (ecological, hydrodynamics, submarine permafrost)

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