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

spring/early summer
freshets
ice abrasion

summer
base-line flow

late summer/autumn
wave erosion

export of sediments and Organic Matter

OC – to Organic Carbon

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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
Are standard Ocean Colour products usable for Siberian Arctic waters?

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

Chl-a products

example MODIS 2009

Chl-a JUL

Chl-a AUG

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

TRANSDRIFT 2010 a440cDOM [m-1]

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

HZG-AWI
LENA2011 Expedition
Reflectance
SPM
turbidity
Chl-a
PSICAM absorption

MERIS 03-07-2011

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coastcolour

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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)

from 2006 to 2010: 8 to 15 usable (JUL to SEPT) / year
MERIS RR 20110703, Signal Depth z90 max
MERIS RR 20110703,
Total absorption of water constituents at 443 nm
Evaluation using Ground data from Russian-German Expeditions

TRANSIRDRIFT 2010 sampling stations
09-09-2010 to 18-09-2010

storm events between

Z_90max

7th of September
11th of September
20th of September

3rd CC UCM, Lisboa 2011
Evaluation using Ground data from Russian-German Expeditions

TRANSDRIFT2010 acDOM [m-1]

C2R parameters
- a_total
- a_ys

Z_90
- +2,3,4 d
- + 9,10,11 d

K_min

K_d

2010/09/07 2010/09/18 2010/09/20
- +2,3,4 d -9,-8,-7 d -11,10,9 d
- + 9,10,11 d -2,-1,0 d +4,3,2 d

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Evaluation using Ground data from Russian-German Expeditions

\[
\text{acDOM}_{440}(2\,\text{m}) = 7.05 \times \text{C2R } \alpha_{\text{ys}_443} - 0.59
\]

\[
\text{acDOM}_{440} = 2.26 \times \text{C2R } \alpha_{\text{total}_443} - 0.87
\]
Evaluation using Ground data from Russian-German Expeditions

MODIS Aqua Chl-a

07-09-2010

MODIS Chl-a [mg/m-3]

09-09 to 18-09-2010

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3rd CC UCM, Lisboa 2011
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$^3$]
Evaluation using Ground data from Russian-German Expeditions

CC L2W turbidity [FNU]

07-09-2010

CC L2W, FNU

Transdrift 2010 FTU

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coastcolour

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

K_min

K_d

Z_90

C2R parameters

a_total

a_vs

TRANSDRIFT Turbidity (FTU) (2 m)

3rd CC UCM, Lisboa 2011
Ocean Colour shows large-scale hydrodynamics

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

RapidEye
27-08-2010

MERIS C2R attenuation
27-08-2010
Ocean Colour shows large-scale hydrodynamics

no large-scale mixing events

MERIS C2R attenuation
08-08-2010

RapidEye
08-08-2010
Ocean Colour shows large-scale hydrodynamics

**Laptev Sea Index**
- 2008: anti-cyclonic

Freshwater to the outer shelf

Laptev Sea Index
- 2008: anti-cyclonic

Quasi-estuarine circulation & E' Siberian coastal stream

3rd CC UCM, Lisboa 2011
Ocean Colour delivers intra and inter-annual summer hydrodynamics.

Chl-a overestimation due to high organic terrestrial matter.


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