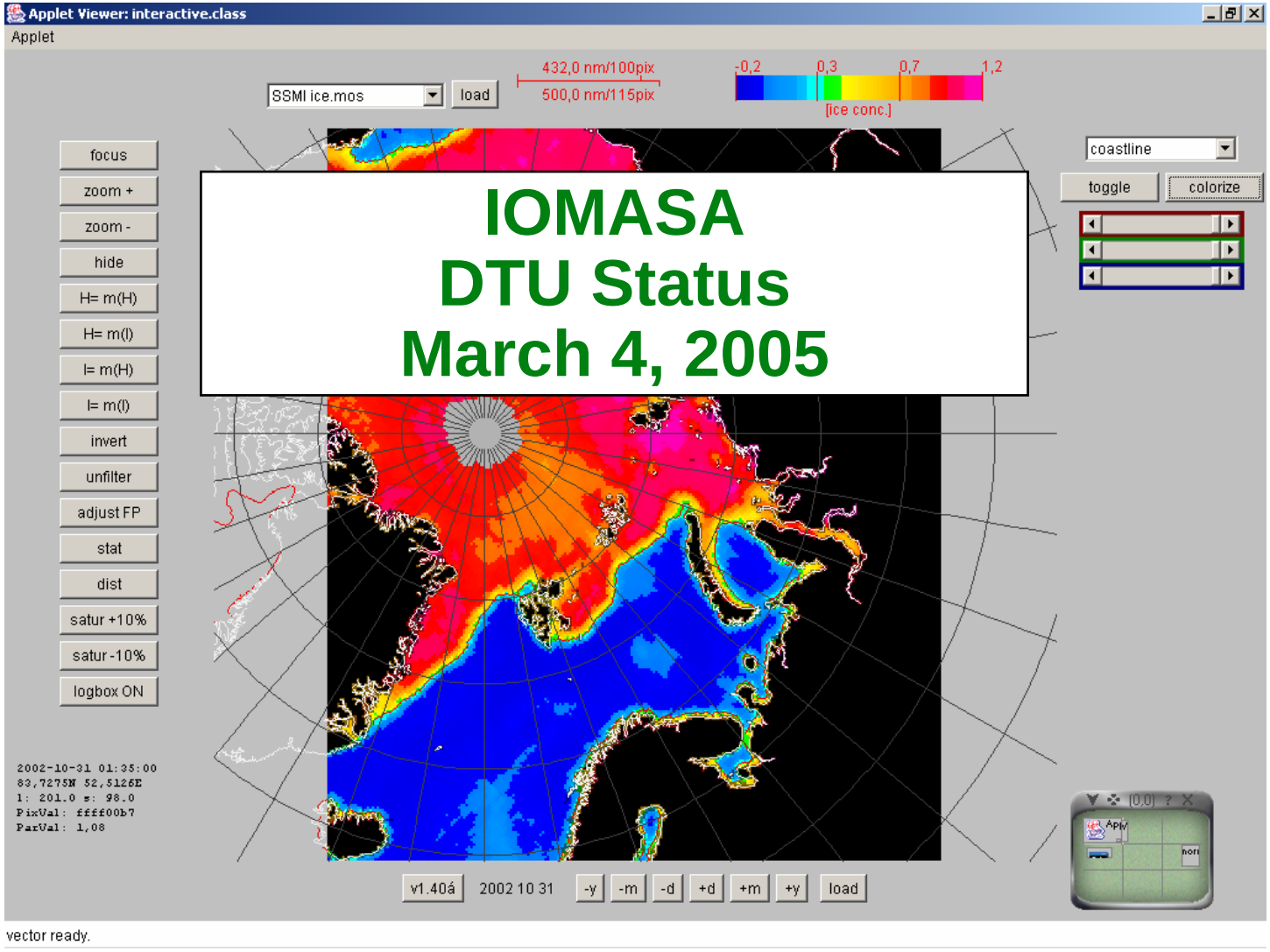
Applet Viewer: interactive.class
Applet
SSMI ice.mos
load
432,0 nm/100pix
500,0 nm/115pix
-0,2
0,3
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[ice conc.]
focus
zoom +
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hide
H= m(H)
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I= m(H)
I= m(I)
invert
unfilter
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stat
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satur +10%
satur -10%
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toggle
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IOMASA
DTU Status
March 4, 2005
2002-10-31 01:35:00
83,7275N 52,5126E
1: 201.0 s: 98.0
PixVal: ffff00b7
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-y
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+m
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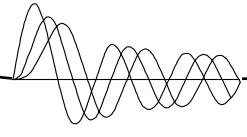
load
vector ready.

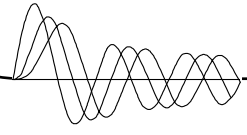
IOMASA data processing at DTU

- **Emissivities at AMSU-A&B frequencies**
- **Advanced statistical retrieval**
  - SST, WS, WV, CLW, C, F,T_{ice}
  - Near real time processing
- **Web-site for distribution**



EMISSIVITIES

- Emissivities at AMSU-A and AMSU-B frequencies



AMSU emissivities - Theory

The radiative transfer equation for the total microwave radiation received at satellite altitude can be simplified to:

$$T_b = \varepsilon T_s (1-\alpha) + \alpha T_a + \alpha T_a (1-\alpha)(1-\varepsilon) + T_{sp}(1-\alpha^2)(1-\varepsilon)$$

where:
T_b is the microwave brightness temperature
T_s is the temperature of the surface (the emissive layer)
α is the absorption coefficient for the atmosphere
T_{sp} is the brightness temperature of space (2.7 K)
ε is the emissivity of the surface (the one we want to find from Tb measurements)
T_a is the temperature of the atmosphere

AMSU emissivities - Theory

The basic idea is that the down welling atmospheric brightness temperature (T_{dn}) can be estimated/modeled using an atmospheric radiative transfer model (MWMOD). This allows us to calculate the total atmospheric absorption coefficient α at each of the AMSU frequencies.

$$T_{dn} = T_{sp}(1-\alpha) + \alpha T_a$$

solving for α yields

$$\alpha = \frac{T_{dn} - T_{sp}}{T_a - T_{sp}}$$

Frequency(GHz)	Tdn (K)
23.8	8.2
31.4	10.4
50.3	76.4
89.0	14.8
150.0	15.0
176.3	43.0

AMSU emissivities - Theory

Inserting this in the basic radiative transfer equation

$$T_b = \varepsilon T_s (1-\alpha) + \alpha T_a + \alpha T_a (1-\alpha)(1-\varepsilon) + T_{sp}(1-\alpha^2)(1-\varepsilon)$$

we can now solve for ε:

$$\varepsilon = \frac{T_b - \alpha T_a - (1-\alpha)\alpha T_a - T_{sp}(1-\alpha^2)}{T_s(1-\alpha) - \alpha T_a(1-\alpha) - T_{sp}(1-\alpha^2)}$$

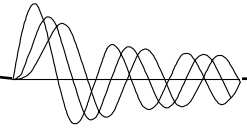
which allows us to estimate ε from measurements of T_b.

AMSU emissivities - Theory

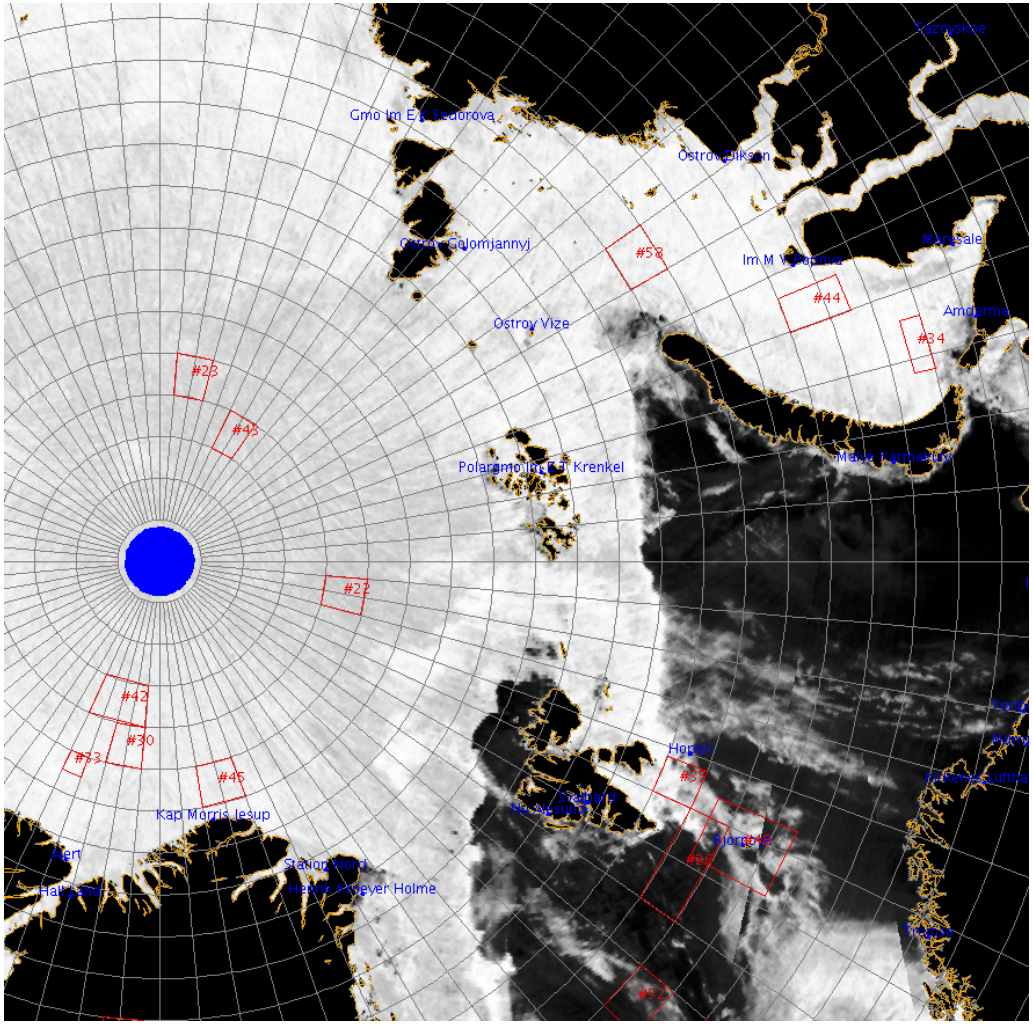
The assumptions are that:

the atmospheric attenuation can be reasonably approximated by absorption coefficient and reference temperature, and

in the following application we will assume a minimal water vapor load so the main contribution to the absorption is from oxygen.

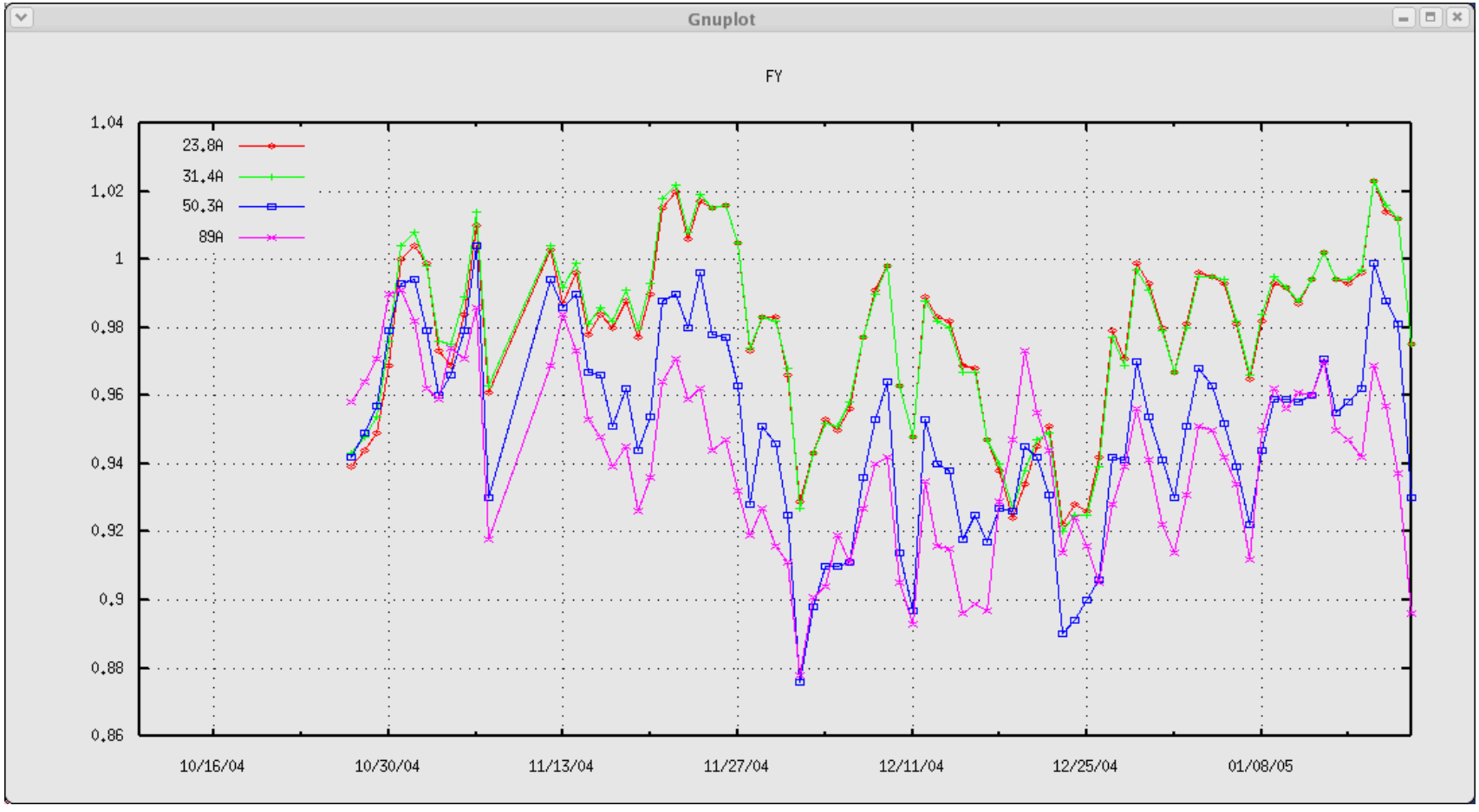


Emissivity – AMSU



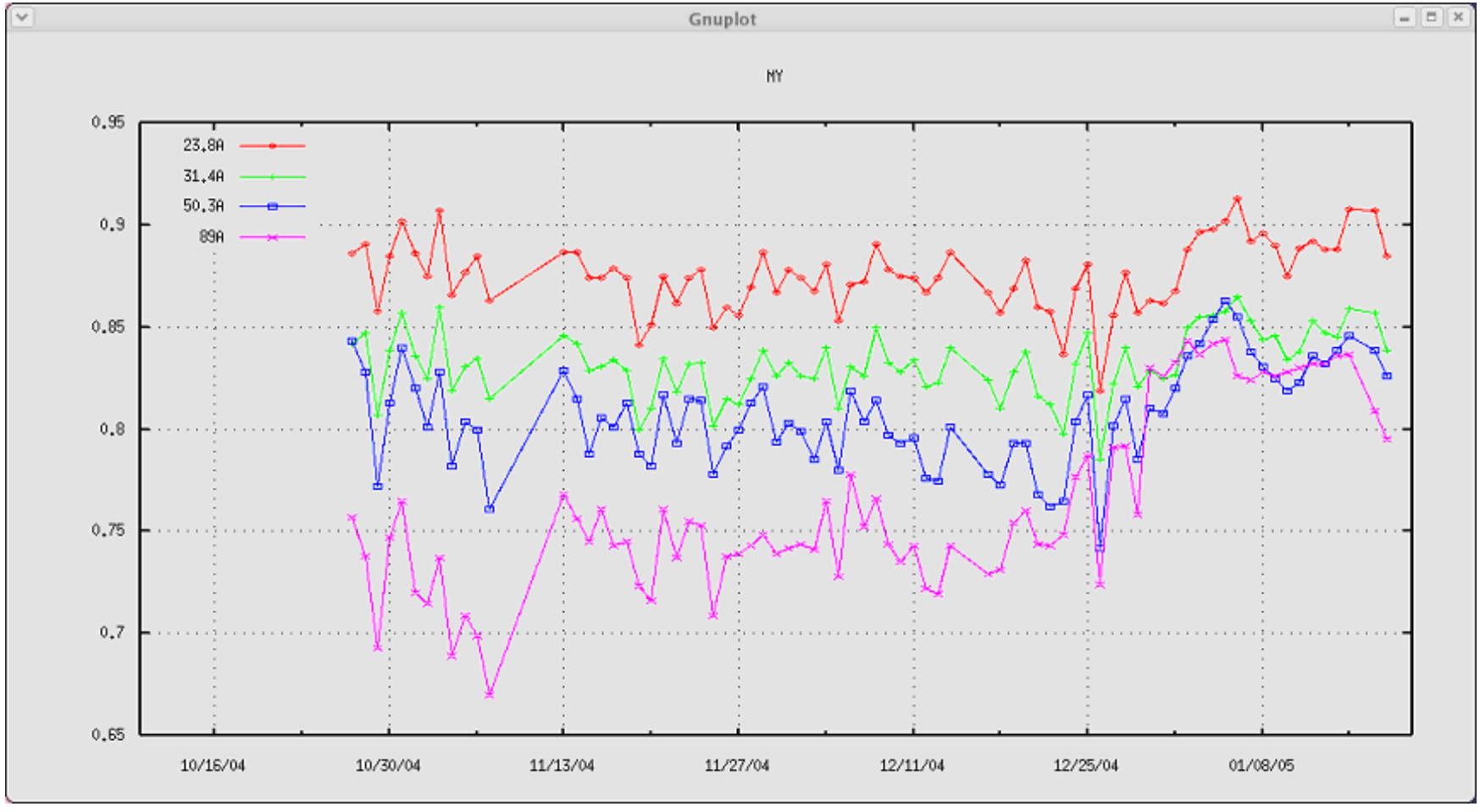
Specification of areas
Kara Sea (FY)
(76.5 – 77N, 77-79E)
N. Greenland (MY)
(84-84.6N, 32-35W)

Emissivities – AMSU-A - FY

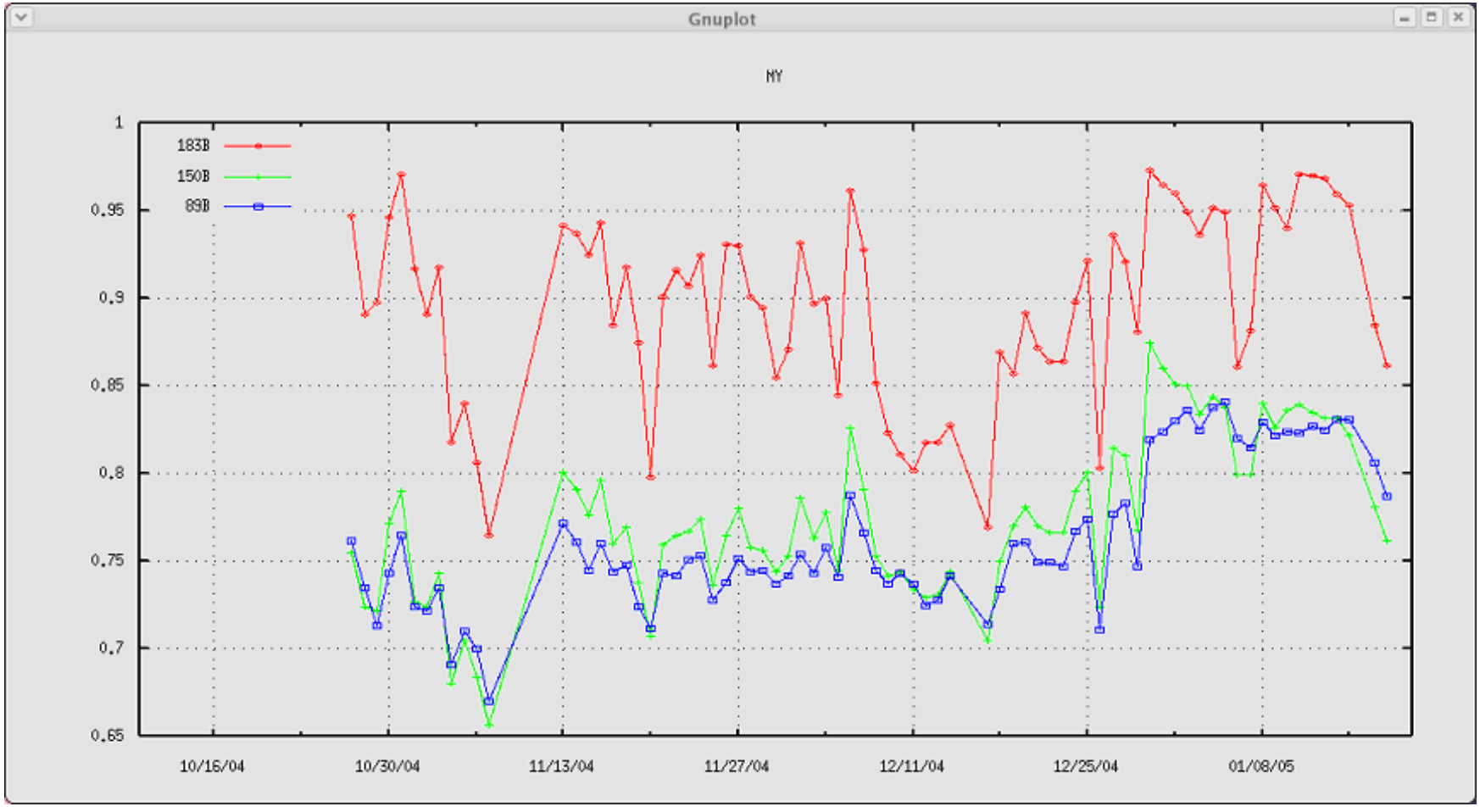


Emissivities – AMSU-B - FY

Emissivities – AMSU-A - MY



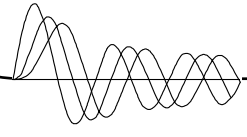
Emissivities – AMSU-B - MY



Emissivities – AMSU – MY Covariances

Correlation Matrix 2004 11 28 2004 12 10

	23A	31A	50A	89A	89B	150B	180B	mean	min	max	stdv
23A	1.000	0.958	0.671	0.514	0.010	-0.006	-0.020	0.874	0.853	0.891	0.009
31A	0.958	1.000	0.668	0.658	0.087	0.053	0.000	0.830	0.810	0.850	0.009
50A	0.671	0.668	1.000	0.713	0.468	0.433	0.469	0.802	0.780	0.821	0.012
89A	0.514	0.658	0.713	1.000	0.757	0.715	0.560	0.748	0.728	0.778	0.013
89B	0.010	0.087	0.468	0.757	1.000	0.969	0.791	0.749	0.737	0.788	0.014
150B	-0.006	0.053	0.433	0.715	0.969	1.000	0.895	0.765	0.742	0.826	0.024
180B	-0.020	0.000	0.469	0.560	0.791	0.895	1.000	0.882	0.811	0.962	0.043



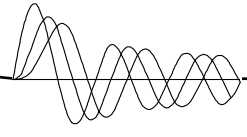
Emissivity at AMSU-A and AMSU-B frequencies

Status

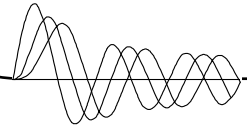
- Program code delivered to met.no

To do

- Seasonal variability
  - Improved water vapour correction (HIRLAM)
  - Improved Ta (HIRLAM)
  - Incidence angle dependence (from U-Bremen)



Least squares optimal estimation from AMSR-E data



Estimation theory - 1

$$T_A(f, \theta, p) = F\,(SST, WS, WV\,(z), CLW(z), T_{air}(z), T_{ice}, C, e_t(f)\ldots) \qquad \textbf{(7.1)}$$

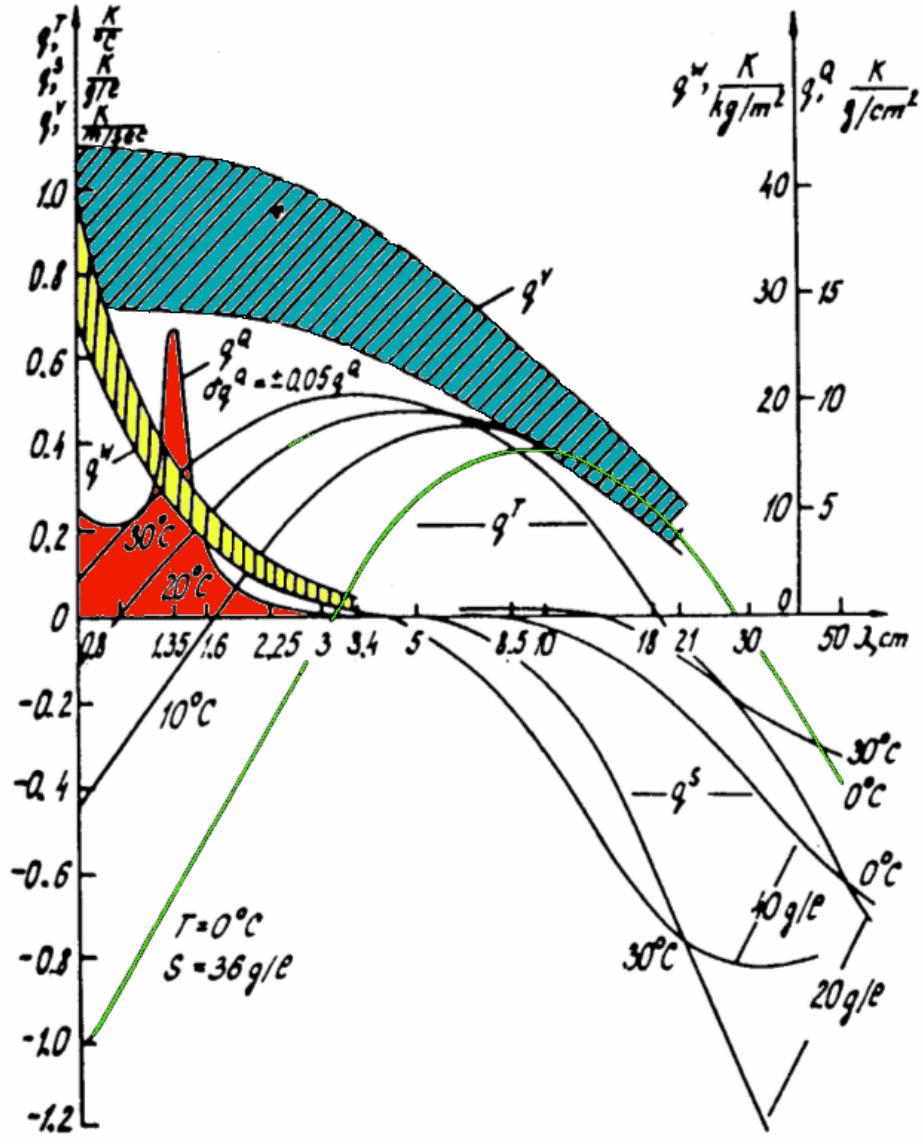
$$\mathbf{T_A = F(p)} \qquad \textbf{(7.2)}$$

$$\mathbf{p} = (SST, WS, WV, CLW, T, C, F) \qquad \textbf{(7.3)}$$

$$\mathbf{T_A = Mp} \qquad \textbf{(7.4)}$$

$$M_{ij} = \frac{\delta T_{ap_i}}{\delta p_j} \qquad \textbf{(7.5)}$$

Partial derivatives
Atmosphere
Ocean surface



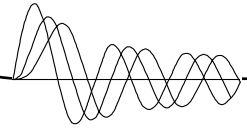
Estimation theory - 2

$$\hat{\mathbf{p}} = (\mathbf{M}^t\mathbf{M})^{-1}\,\mathbf{M}^t\,\mathbf{T}_{ap} \qquad (7.6)$$

$$\mathbf{T}_A = \mathbf{M}\mathbf{p} + \mathbf{e} \qquad (7.7)$$

$$\hat{\mathbf{p}} = (\mathbf{M}^t\,\mathbf{S}_e^{-1}\,\mathbf{M})^{-1}\,\mathbf{M}^t\,\mathbf{S}_e^{-1}\,\mathbf{T}_A \qquad (7.8)$$

$$\hat{\mathbf{S}} = (\mathbf{M}^t\,\mathbf{S}_e^{-1}\,\mathbf{M})^{-1} \qquad (7.9)$$



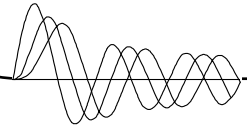
Estimation theory - 3

$$\hat{S} = (S_p^{-1} + S_D^{-1})^{-1} \qquad (7.10)$$

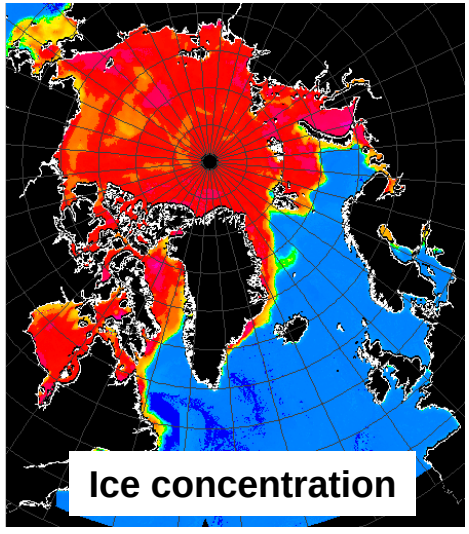
$$\hat{S} = (S_p^{-1} + M^t S_e^{-1} M)^{-1} \qquad (7.11)$$

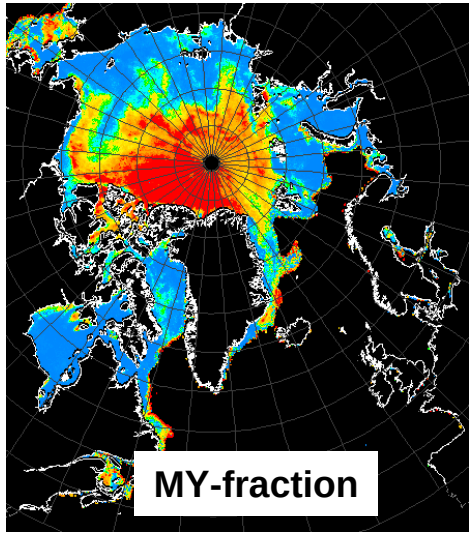
$$\hat{p} = (S_p^{-1} + S_D^{-1})^{-1} (S_p^{-1} p_0 + S_D^{-1} p_1) \qquad (7.12)$$

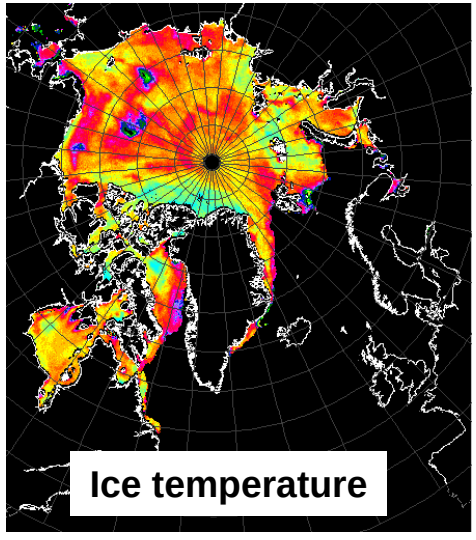
$$\hat{p} = \hat{S} (S_p^{-1} p_0 + M^t S_e^{-1} T_A) \qquad (7.13)$$

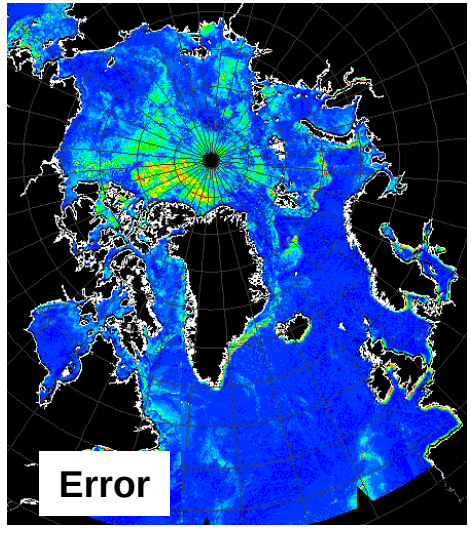


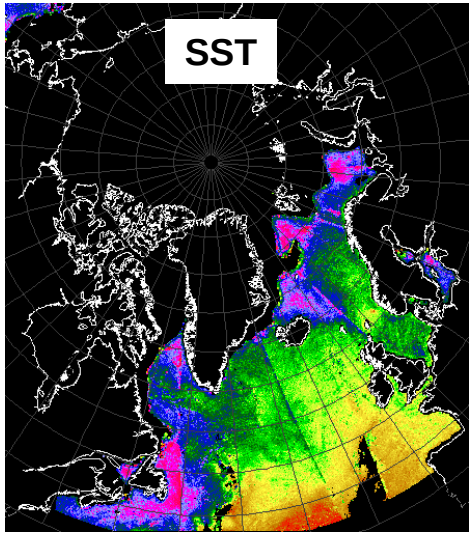
AMSR-E parameter retrieval February 15, 2004

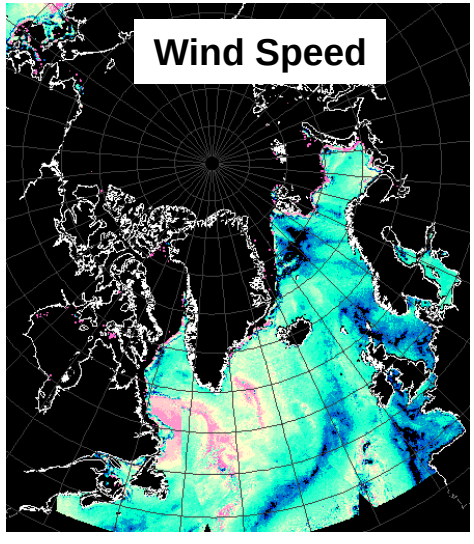


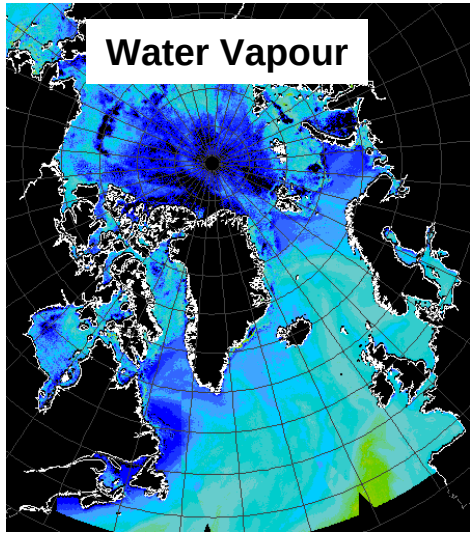


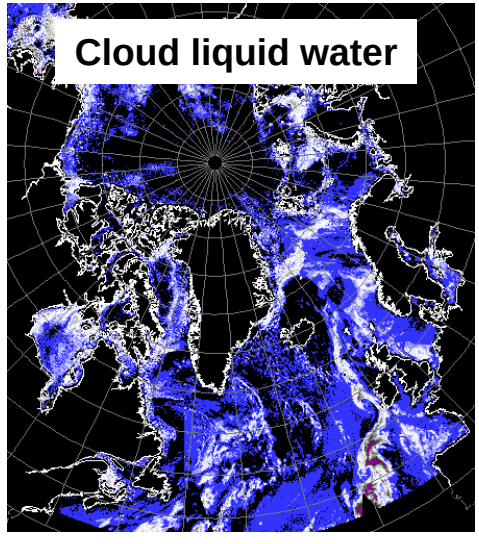


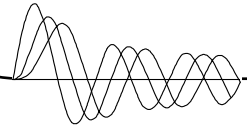




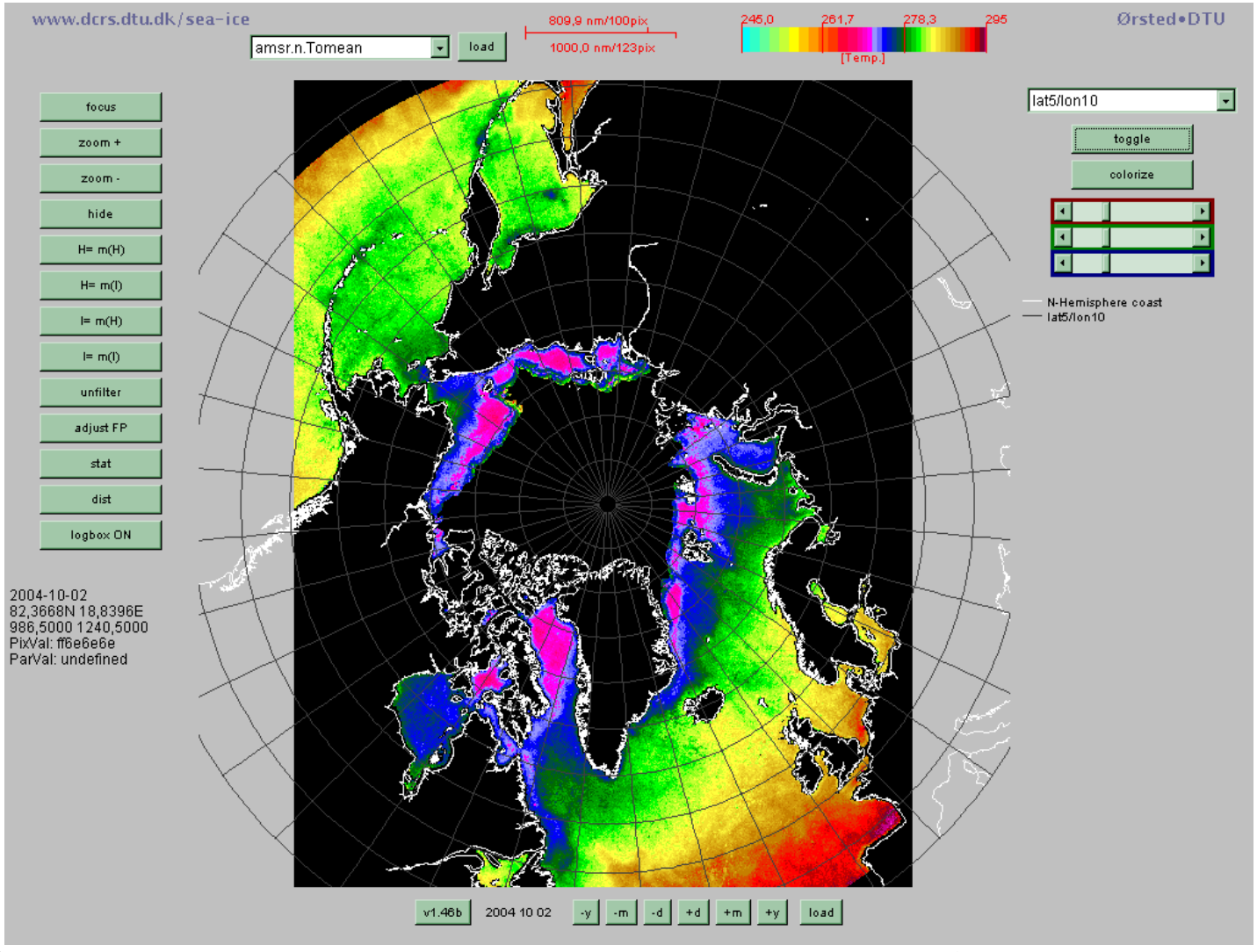




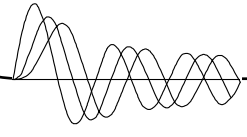




AMSR-E Sea surface temperature

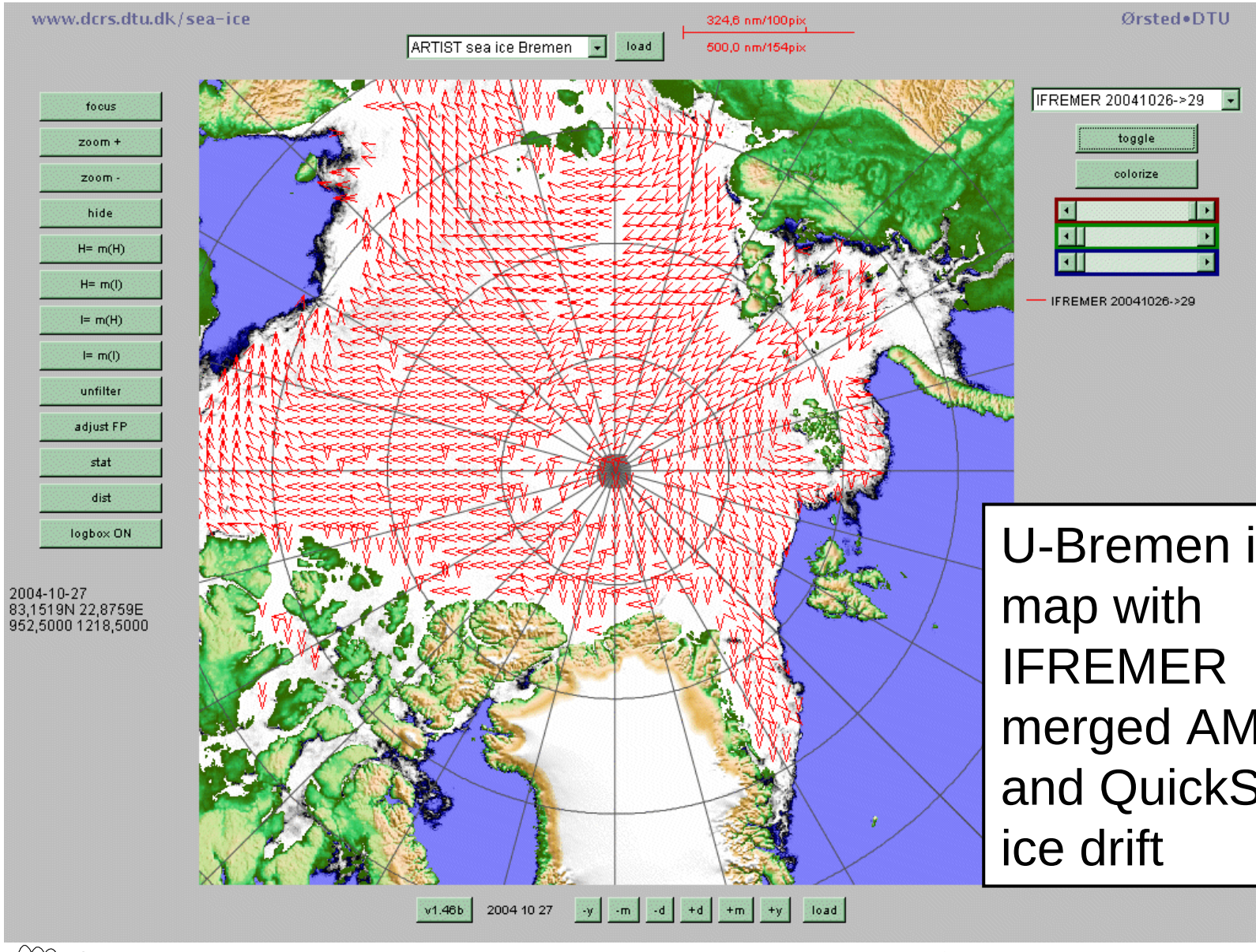


Web data distribution
of selected satellite retrievals



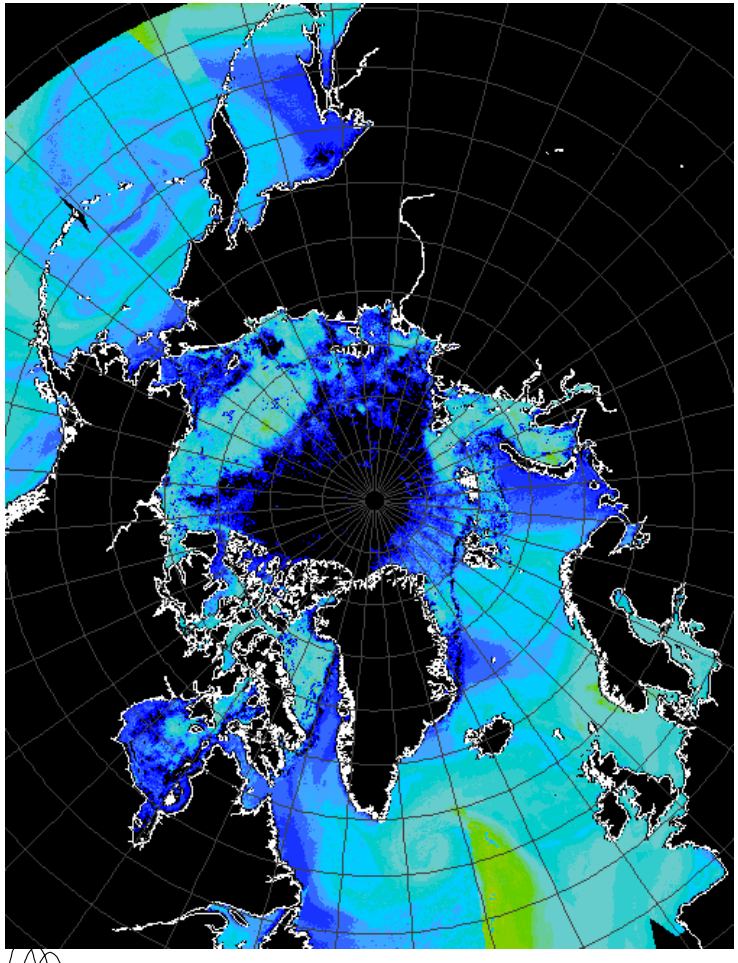
DTU IOMASA Web site

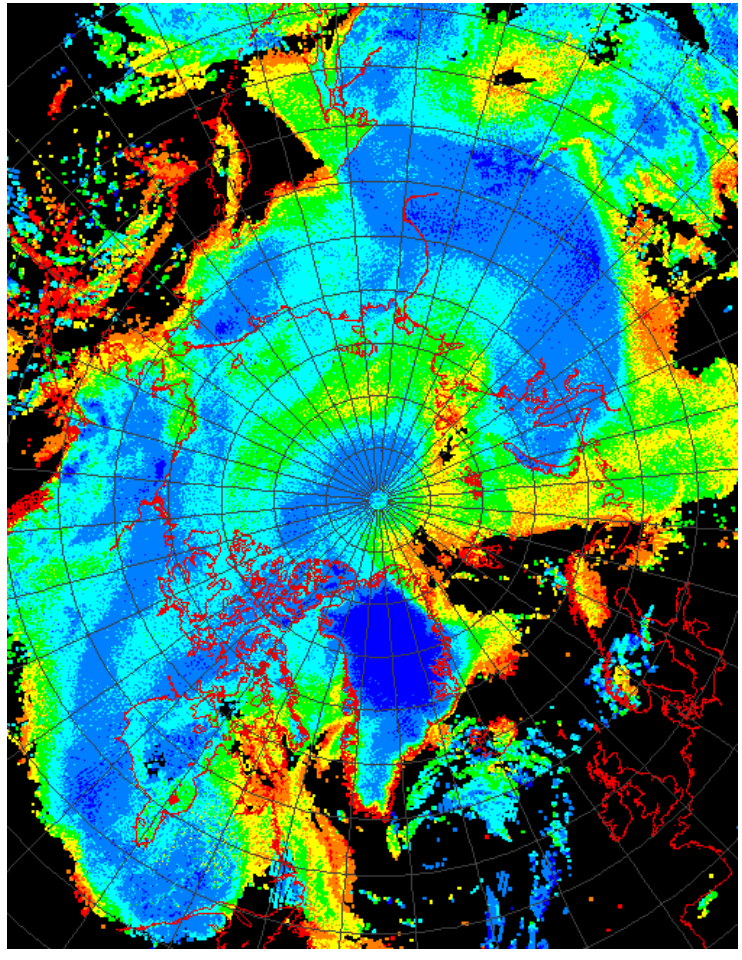
http://www.seaice.dk/iomasa



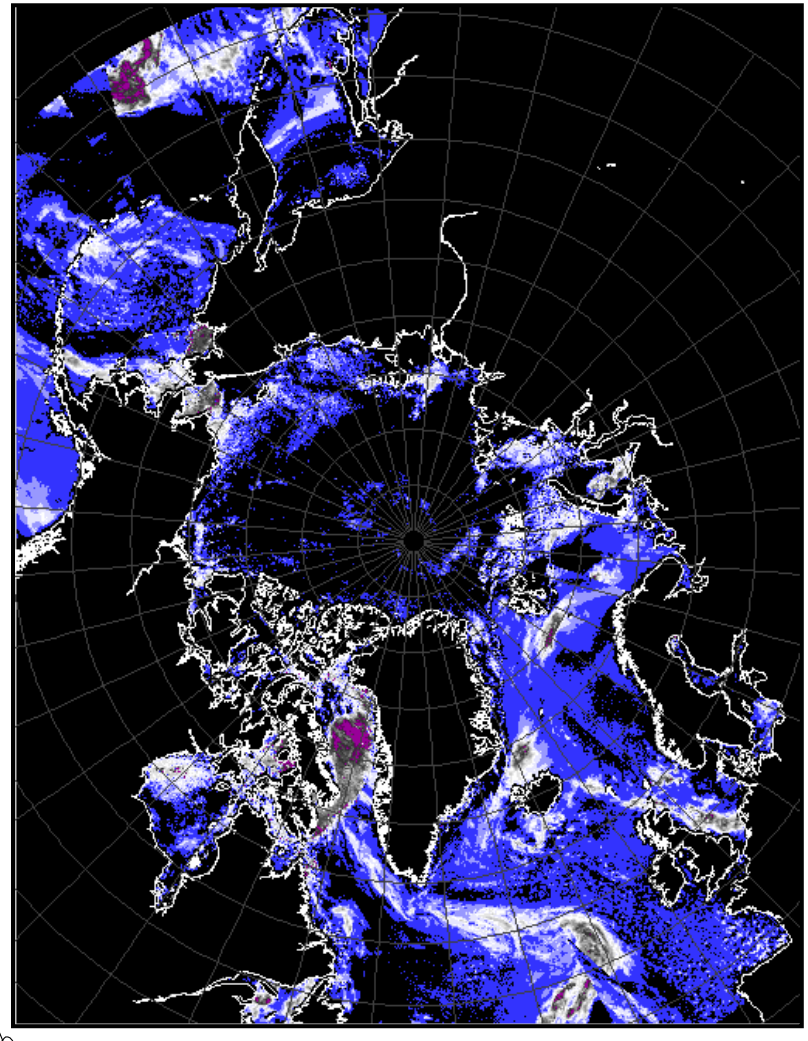
U-Bremen ice map with IFREMER merged AMSR and QuickSCAT ice drift

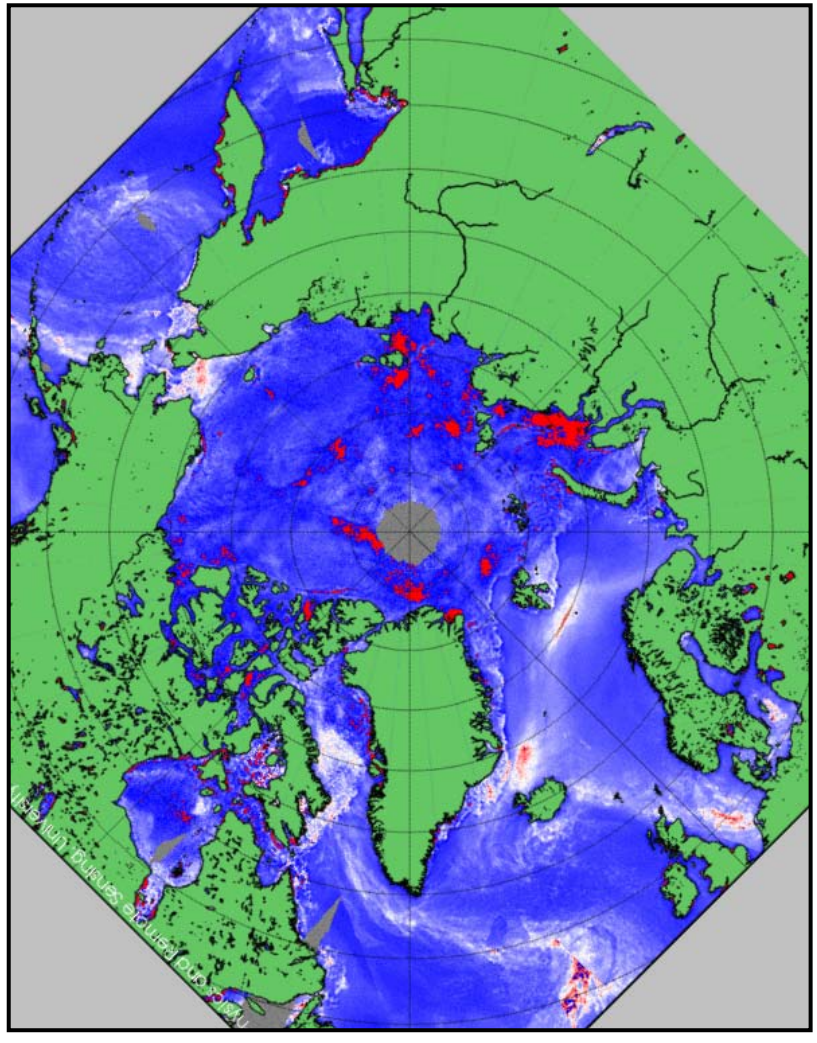
AMSR-E and AMSU total water vapour
December 5, 2004 (run since 12/7 2004)



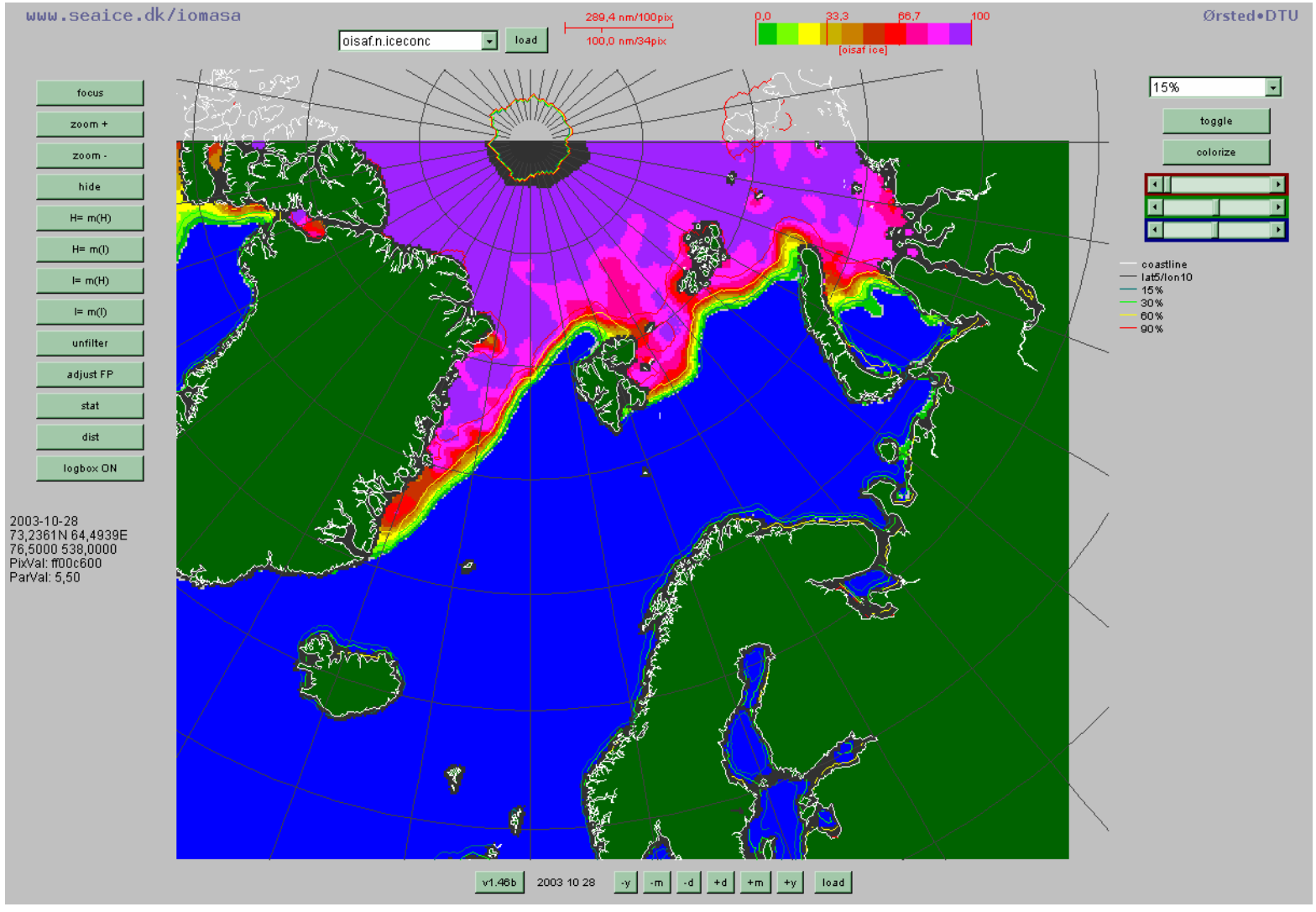


CLW and R-factor 2004 05 07

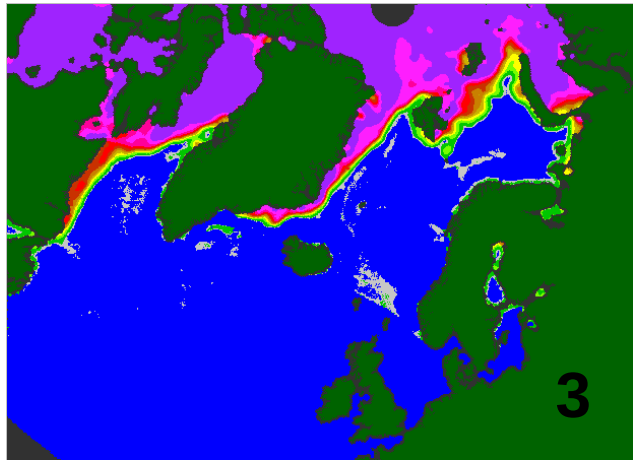


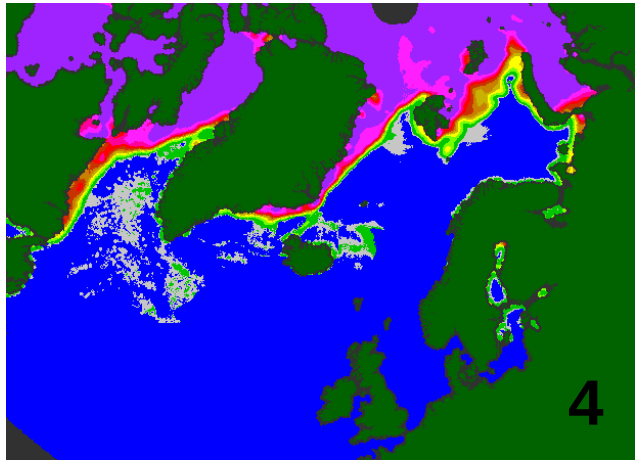


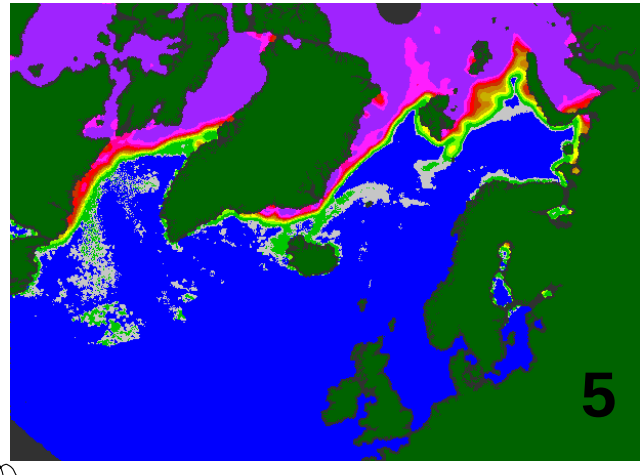
OI-SAF products in browser

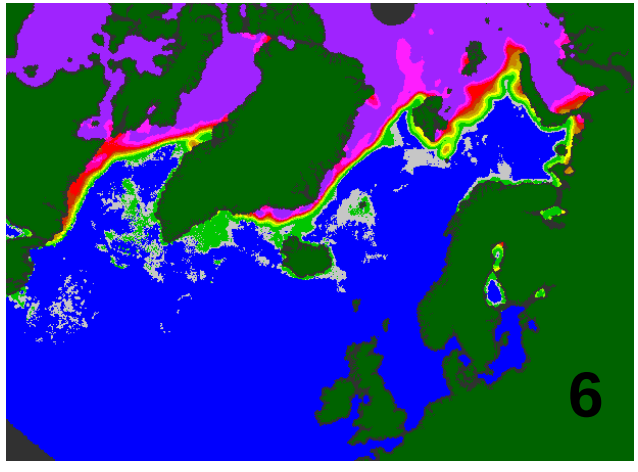


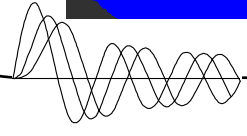
OI-SAF ICE January 3-5 2005





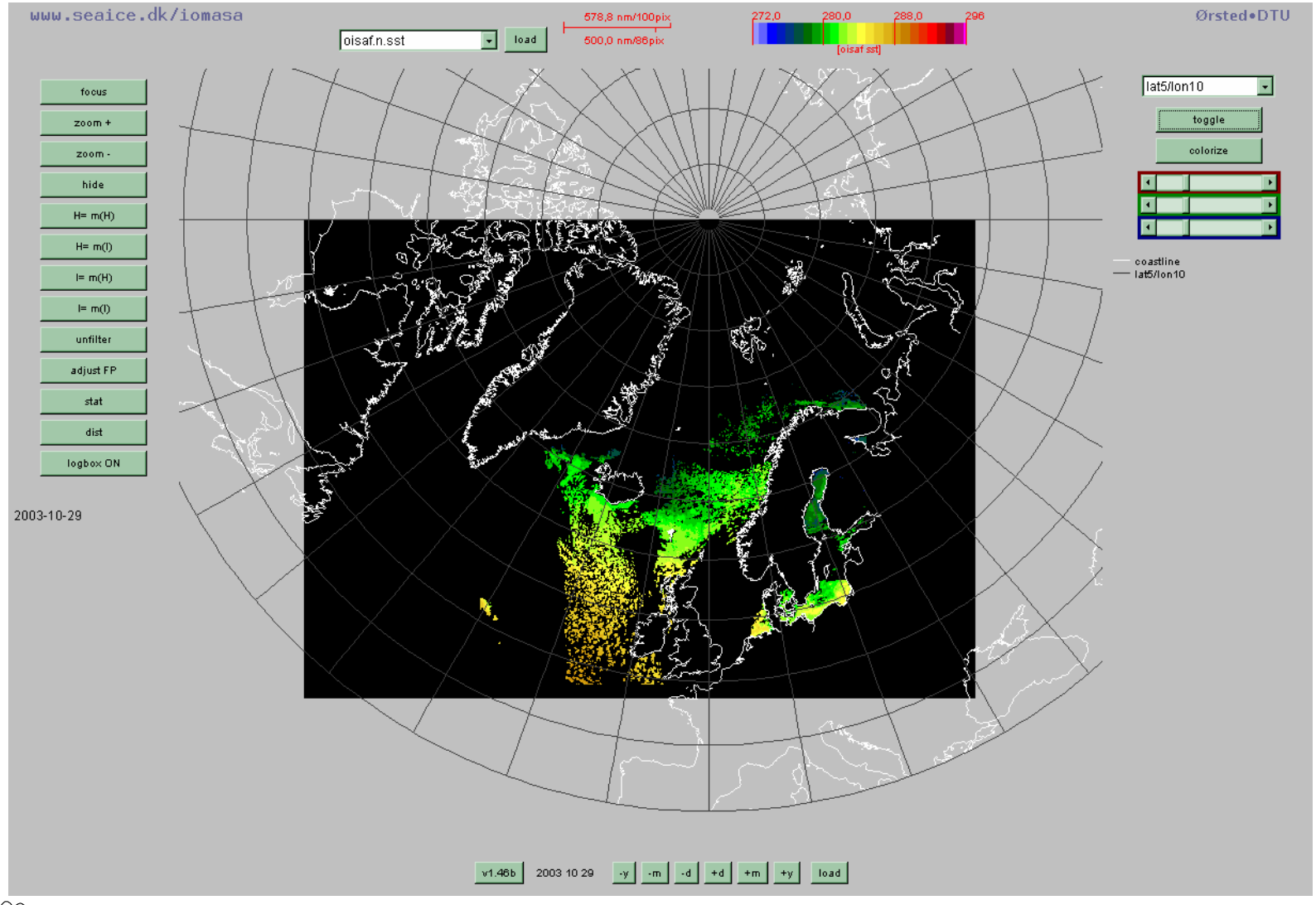




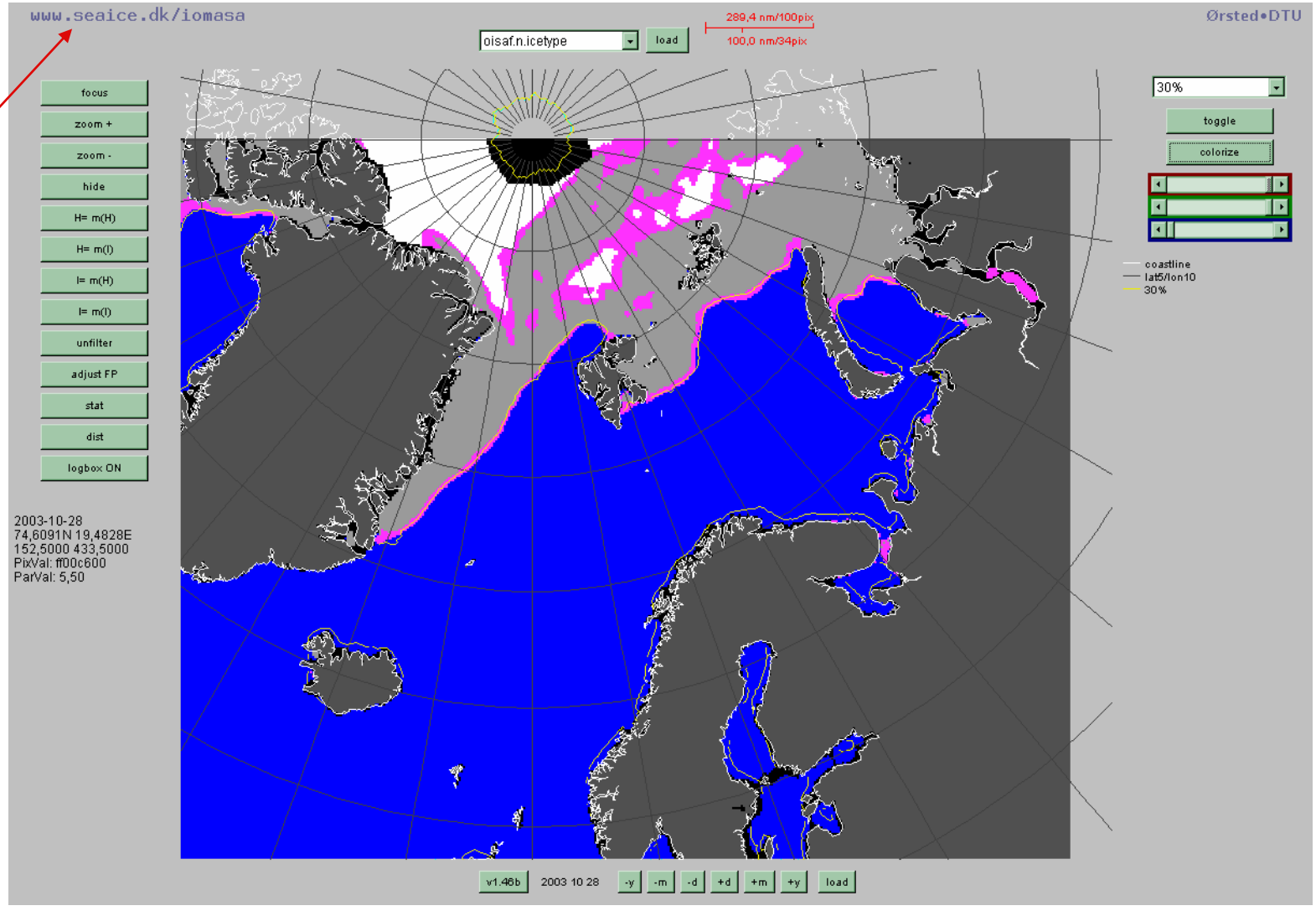


Danish Center for Remote Sensing
Ørsted•DTU

OI-SAF products in browser



OI-SAF products in browser



www.seaice.dk - web server log