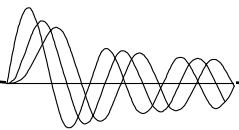
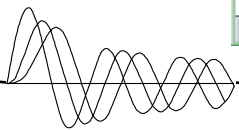
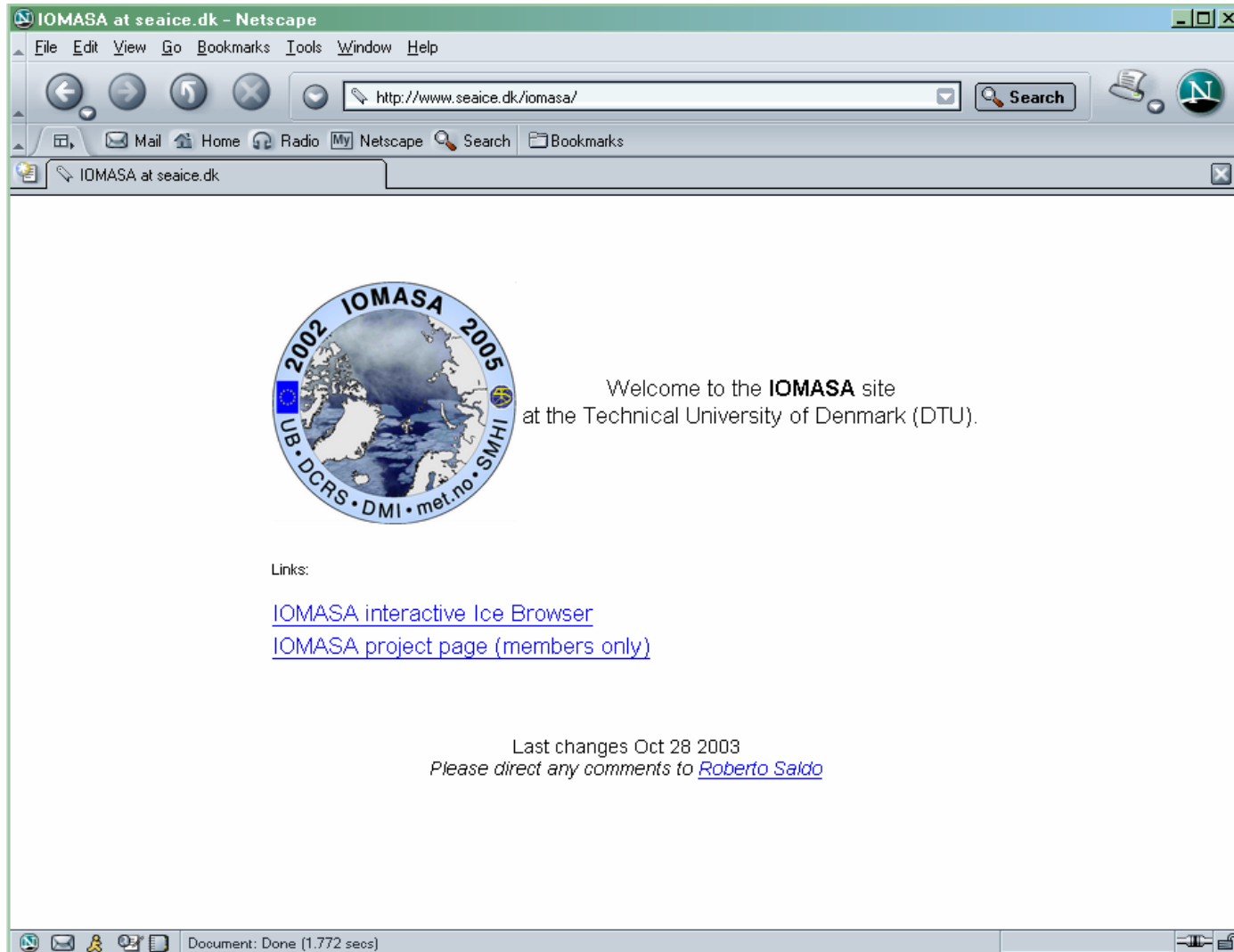


vector ready.



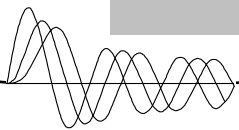
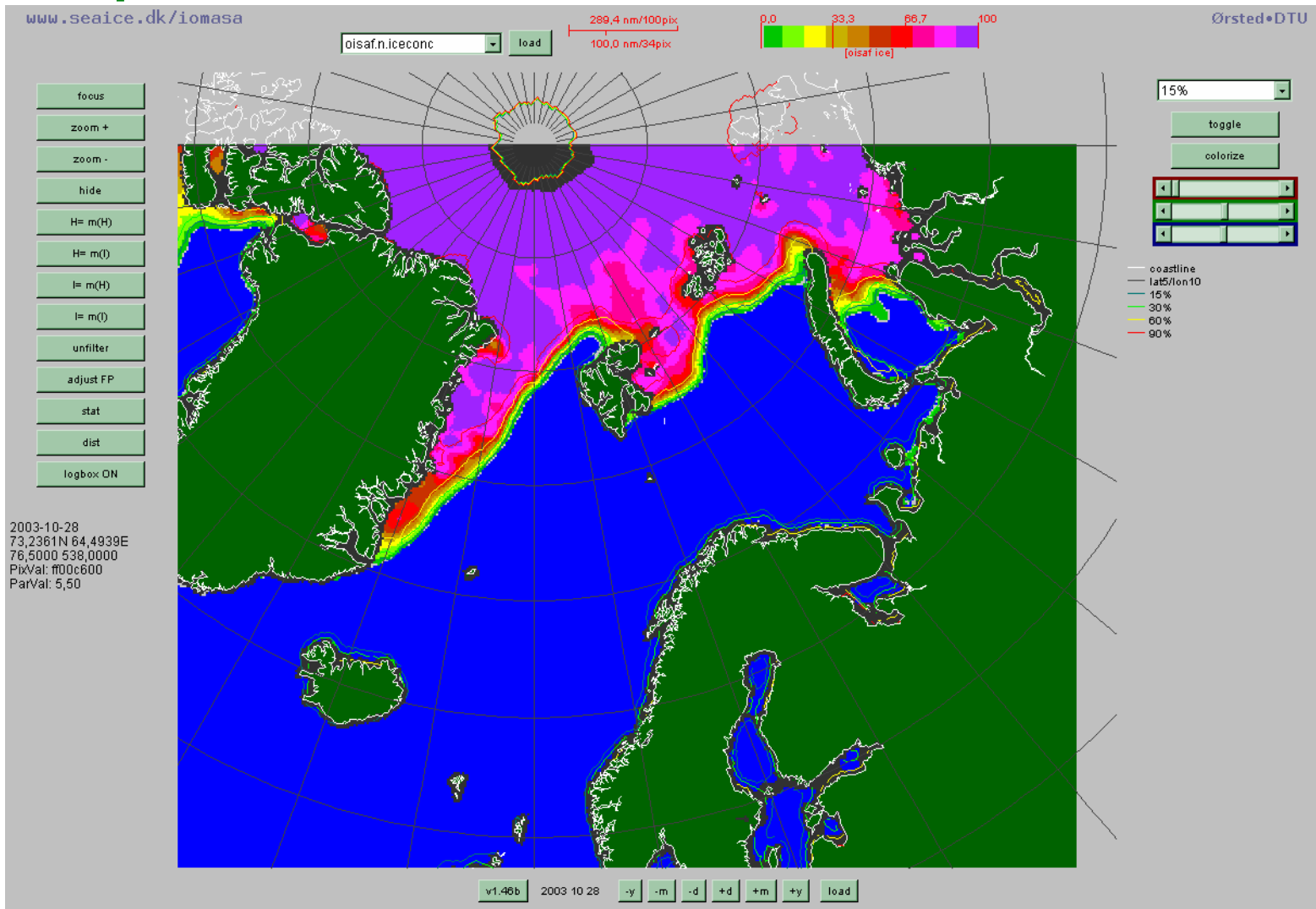
DTU IOMASA Web site

<http://www.seaice.dk/iomasa>

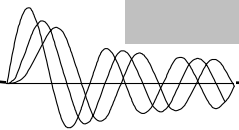
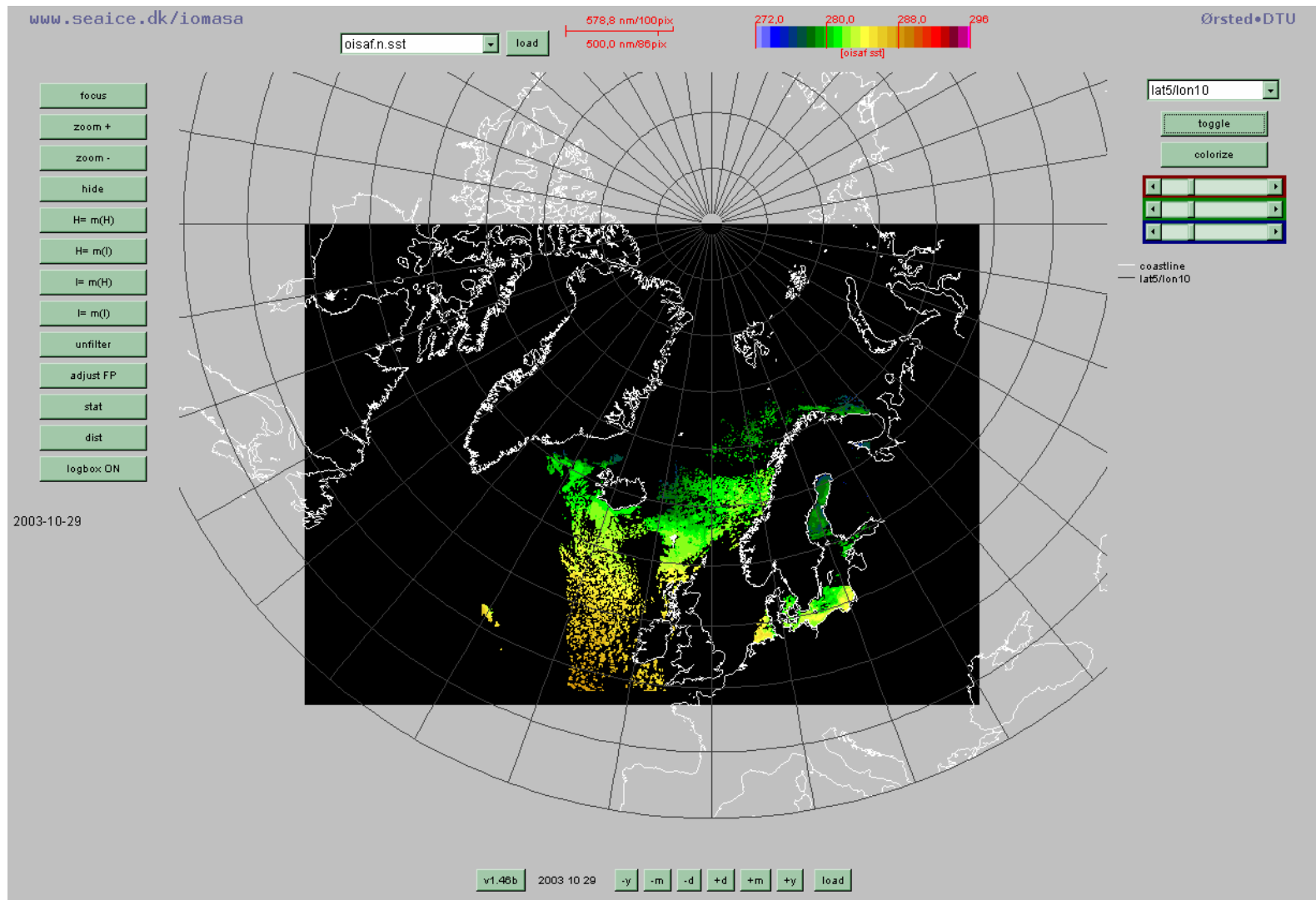


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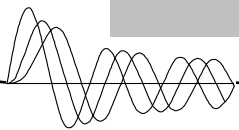
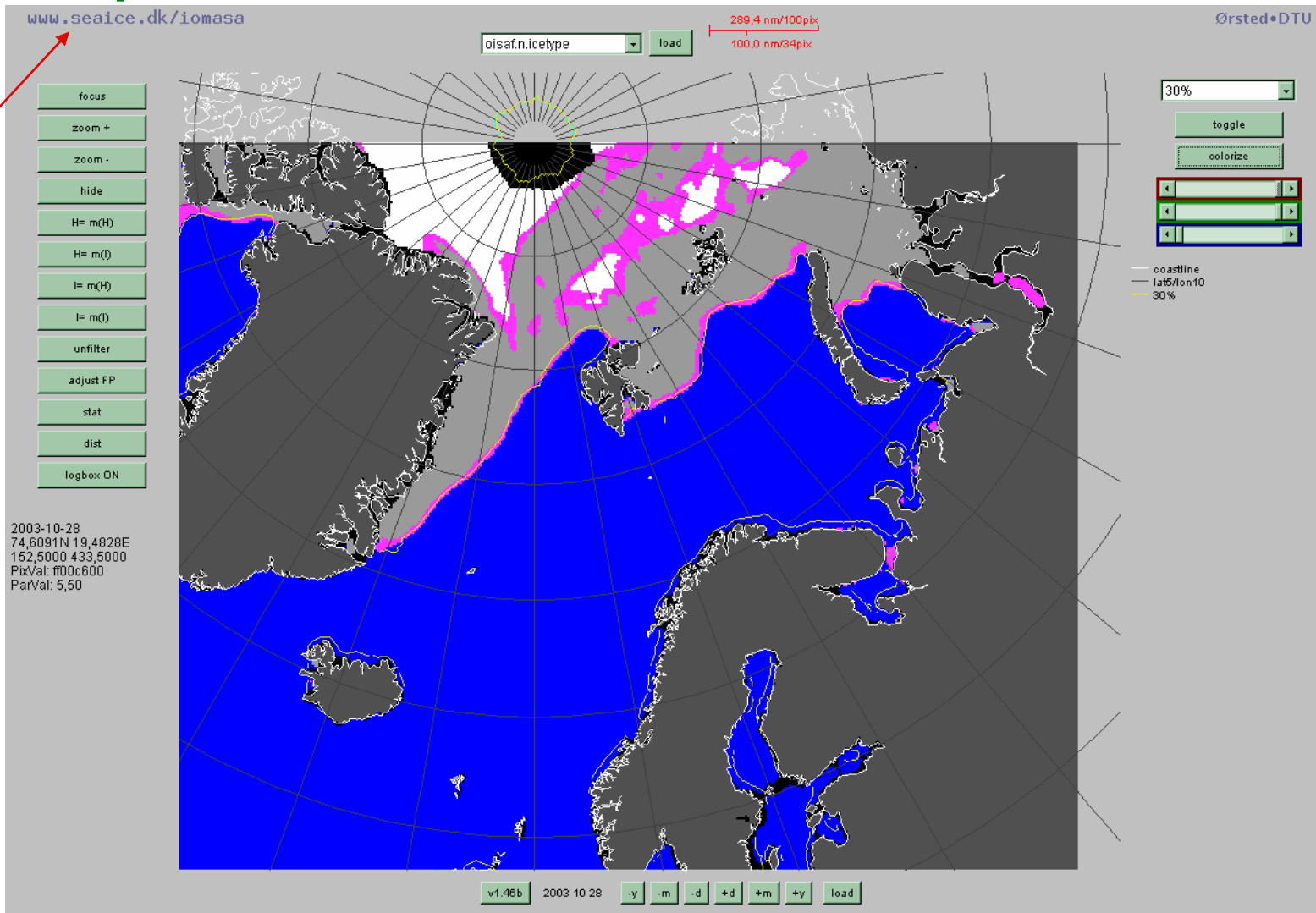
OI-SAF products in browser



OI-SAF products in browser

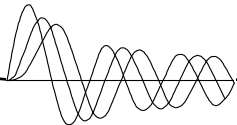


OI-SAF products in browser



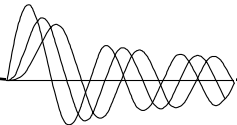
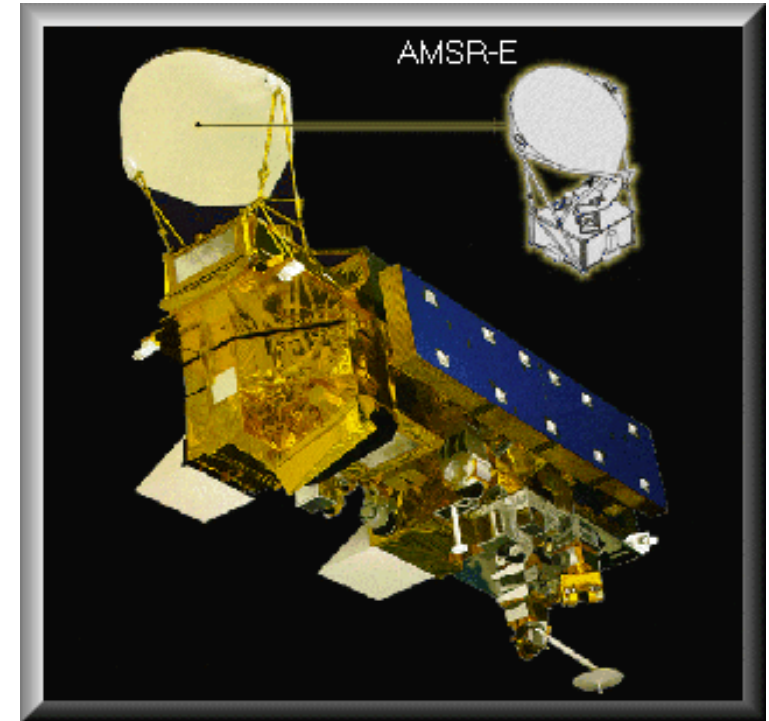
AMSR-E data processing at DTU

- **Ice products**
 - 89 GHz polarization difference
 - Bootstrap algorithm ice conc.
 - Combined alg. ~5 Km resolution.
- **Advanced statistical retrieval**
 - SST, WS, WV, CLW, C, F, T_{ice}



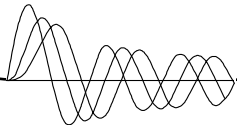
NASAs AMSR-E on AQUA

Precision	1K					
Quantifying Bit Number	12-bit	10-bit				
Center Frequency (GHz)	6.925	10.65	18.7	23.8	36.5	89.0
Bandwidth (MHz)	350	100	200	400	1000	3000
Sensitivity (K)	0.3	0.6				1.1
Mean Spatial Resolution (km)	56	38	21	24	12	5.4
IFOV (km)	74 x 43	51 x 30	27 x 16	31 x 18	14 x 8	6 x 4
Sampling Interval (km)	10 x 10					5 x 5
Integration Time (msec)	2.6					1.3
Main Beam Efficiency (%)	95.3	95.0	96.3	96.4	95.3	96.0
Beamwidth (degrees)	2.2	1.4	0.8	0.9	0.4	0.18

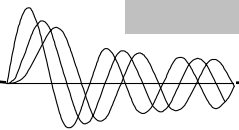
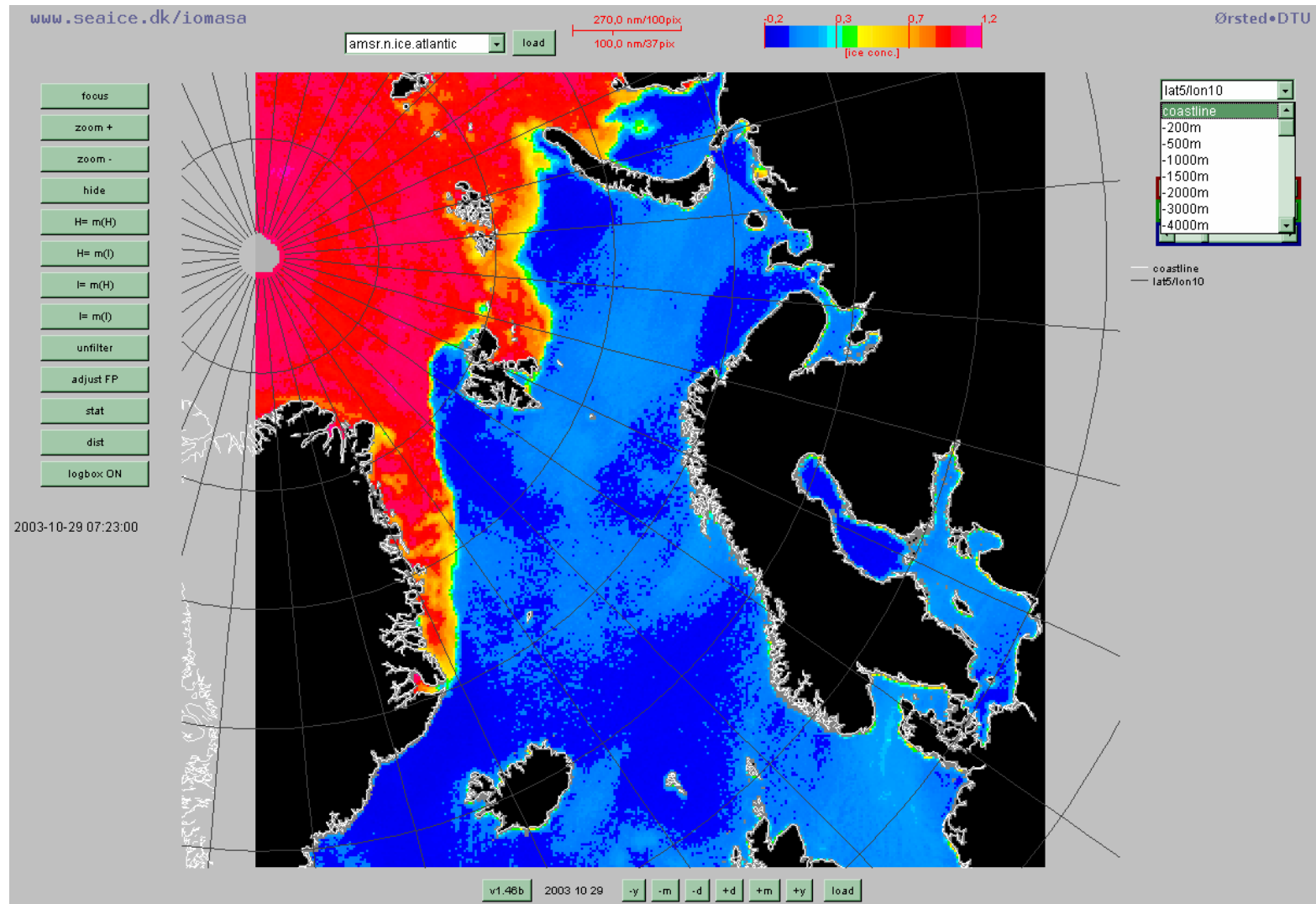


Operational microwave radiometer systems 1978-200x

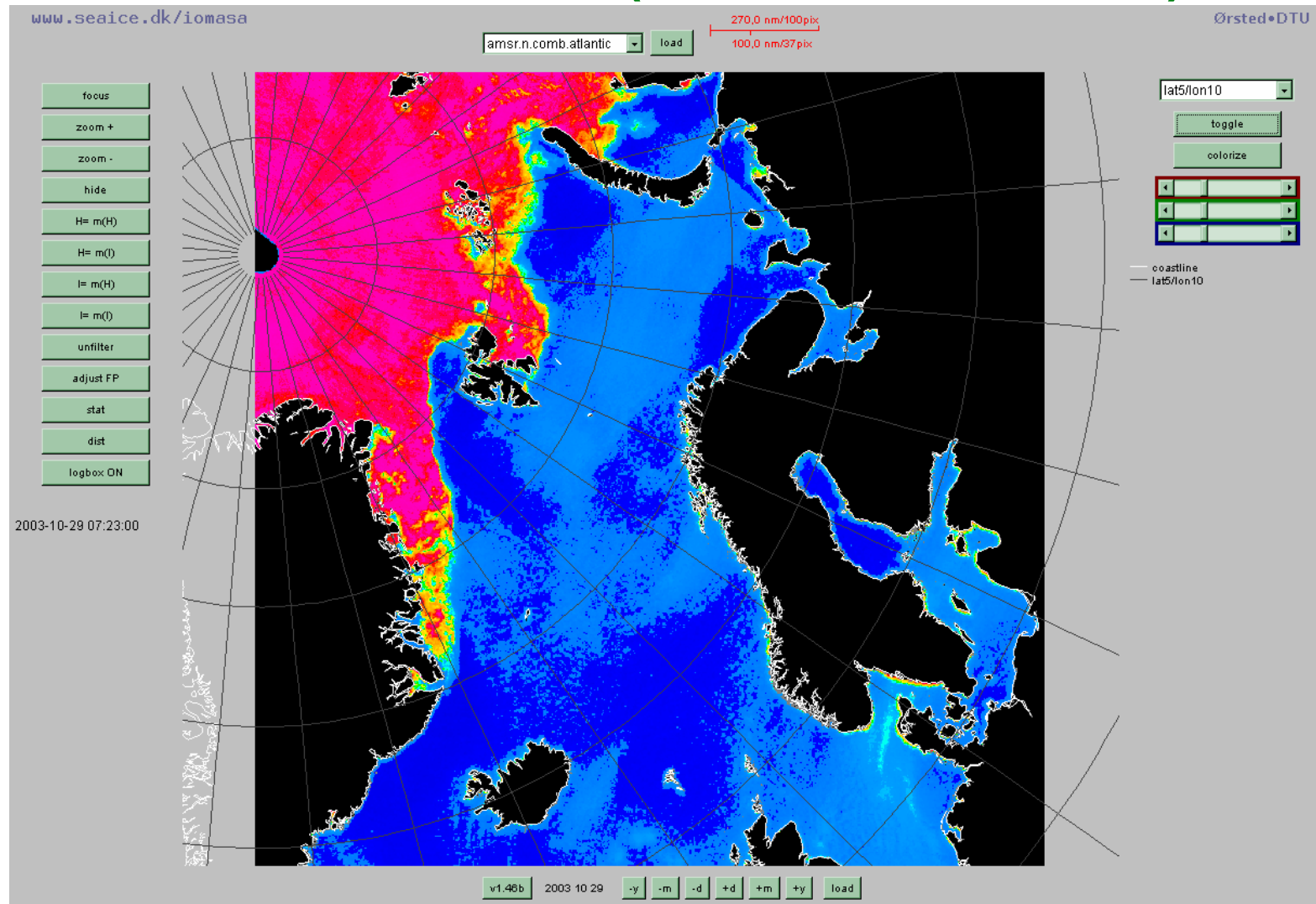
Comparative Operating Characteristics of SMMR, SSM/I, and AMSR-E			
Parameter	SMMR (Nimbus-7)	SSM/I (DMSP- F08,F10,F11,F13)	AMSR (Aqua, ADEOS-II)
Time Period	1978 to 1987	1987 to Present	Beginning 2001
Frequencies (GHz)	6.6, 10.7, 18, 21, 37	19.3, 22.3, 36.5, 85.5	6.9, 10.7, 18.7, 23.8, 36.5, 89.0
Sample Footprint Sizes (km):	148 x 95 (6.6 GHz) 27 x 18 (37 GHz)	37 x 28 (37 GHz) 15 x 13 (85.5 GHz)	74 x 43 (6.9 GHz) 14 x 8 (36.5 GHz) 6 x 4 (89.0 GHz)



AMSR-E ice concentrations

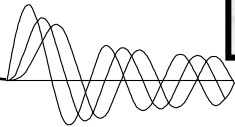
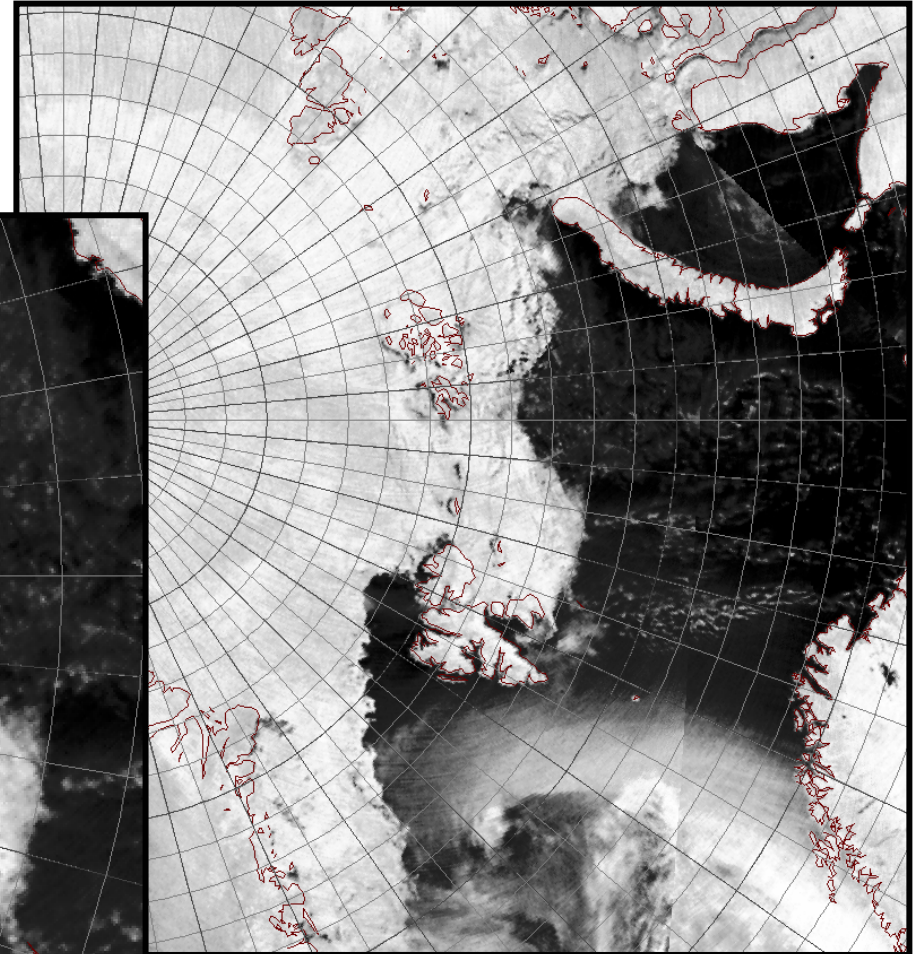
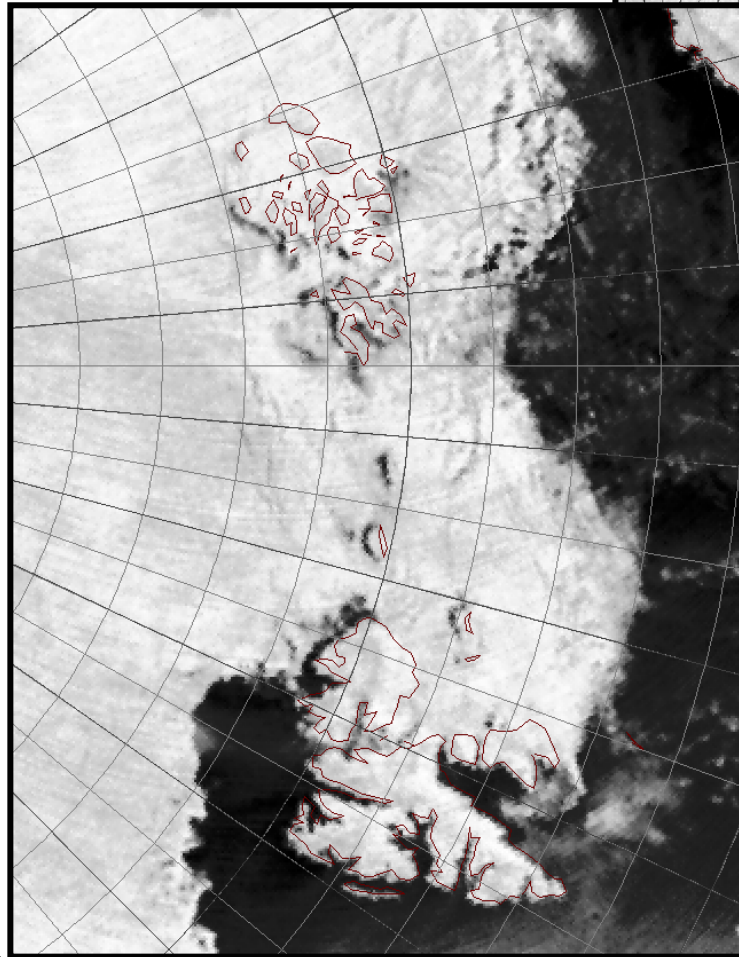


AMSR-E ice concentrations (resolution enhanced)



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**AMSR 89 GHz
3 Km
Polarization Difference**



**Ørsted* DTU
Danish Center for Remote Sensing**

Estimation theory - 1

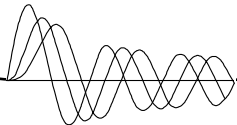
$$T_A(f, \theta, p) = F(\text{SST}, \text{WS}, \text{WV}(z), \text{CLW}(z), T_{\text{air}}(z), T_{\text{ice}}, C, e_t(f) \dots) \quad (7.1)$$

$$\mathbf{T}_A = \mathbf{F}(\mathbf{p}) \quad (7.2)$$

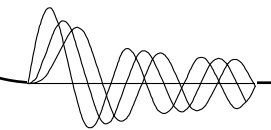
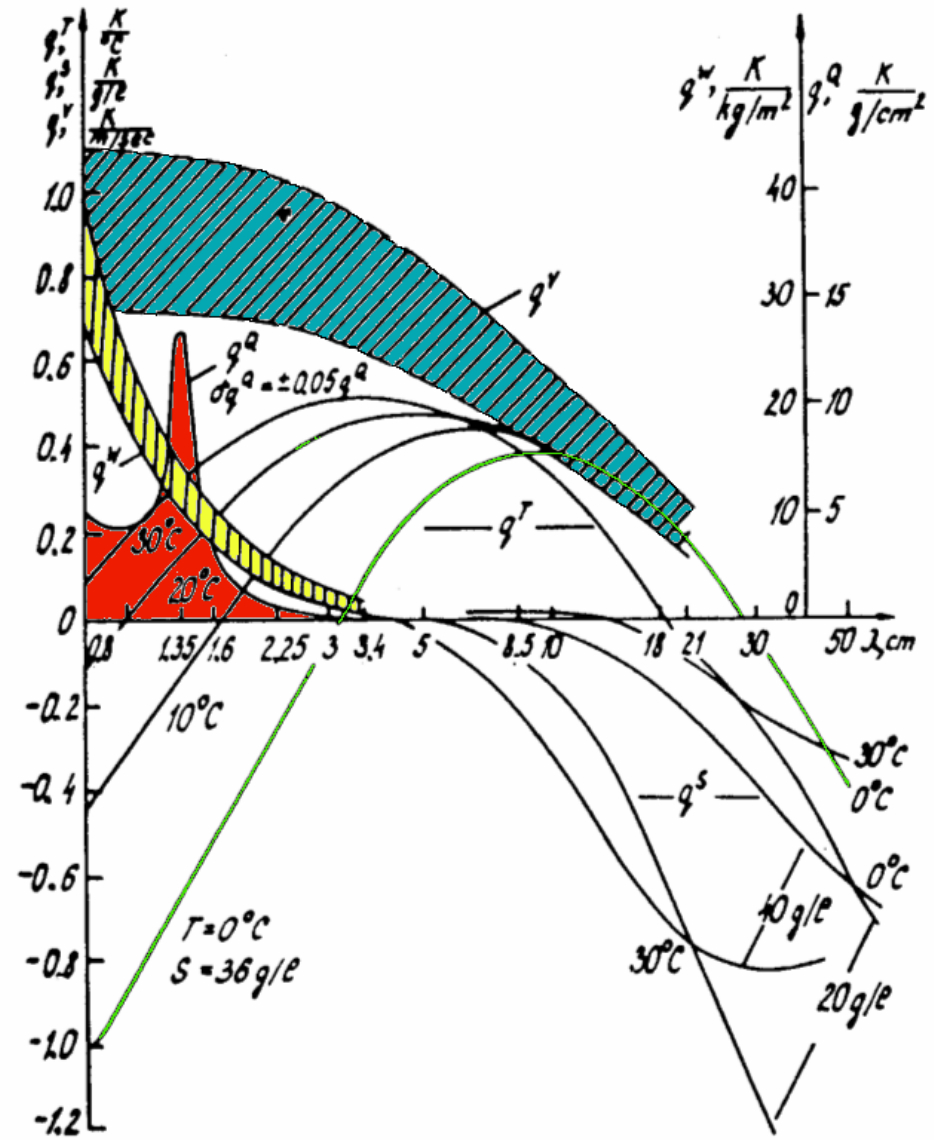
$$\mathbf{p} = (\text{SST}, \text{WS}, \text{WV}, \text{CLW}, T, C, F) \quad (7.3)$$

$$\mathbf{T}_A = \mathbf{M}\mathbf{p} \quad (7.4)$$

$$M_{ij} = \frac{\delta T_{\text{api}}}{\delta p_j} \quad (7.5)$$



Partial derivatives Atmosphere Ocean surface



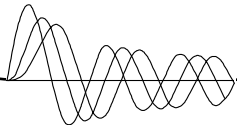
Estimation theory - 2

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

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

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

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



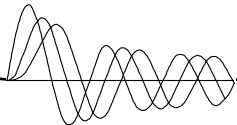
Estimation theory - 3

$$\hat{\mathbf{S}} = (\mathbf{S}_p^{-1} + \mathbf{S}_D^{-1})^{-1} \quad (7.10)$$

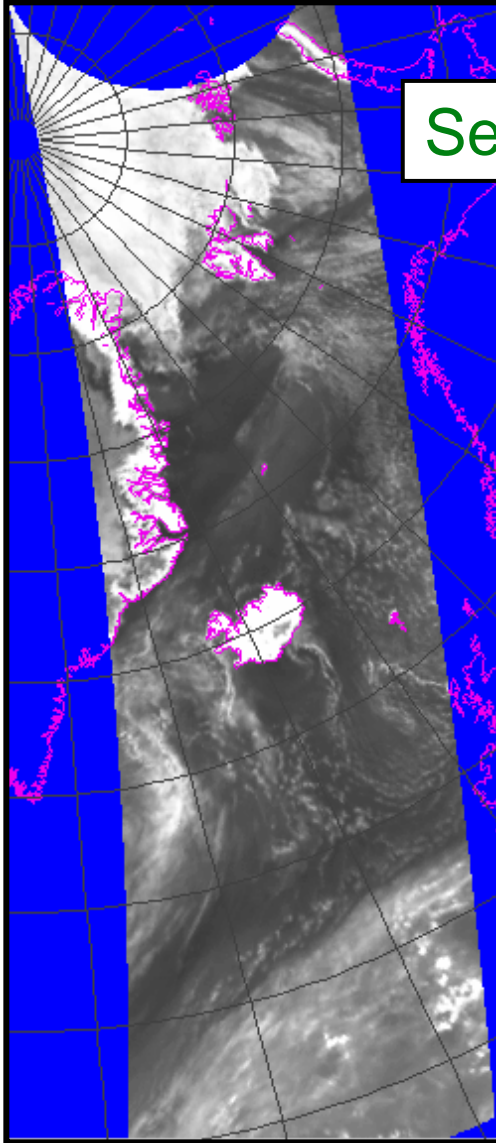
$$\hat{\mathbf{S}} = (\mathbf{S}_p^{-1} + \mathbf{M}^t \mathbf{S}_e^{-1} \mathbf{M})^{-1} \quad (7.11)$$

$$\hat{\mathbf{p}} = (\mathbf{S}_p^{-1} + \mathbf{S}_D^{-1})^{-1} (\mathbf{S}_p^{-1} \mathbf{p}_0 + \mathbf{S}_D^{-1} \mathbf{p}_1) \quad (7.12)$$

$$\hat{\mathbf{p}} = \hat{\mathbf{S}} (\mathbf{S}_p^{-1} \mathbf{p}_0 + \mathbf{M}^t \mathbf{S}_e^{-1} \mathbf{T}_A) \quad (7.13)$$



September 26, 2003, ~04:30 UTC

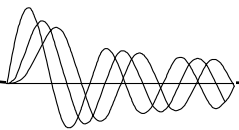
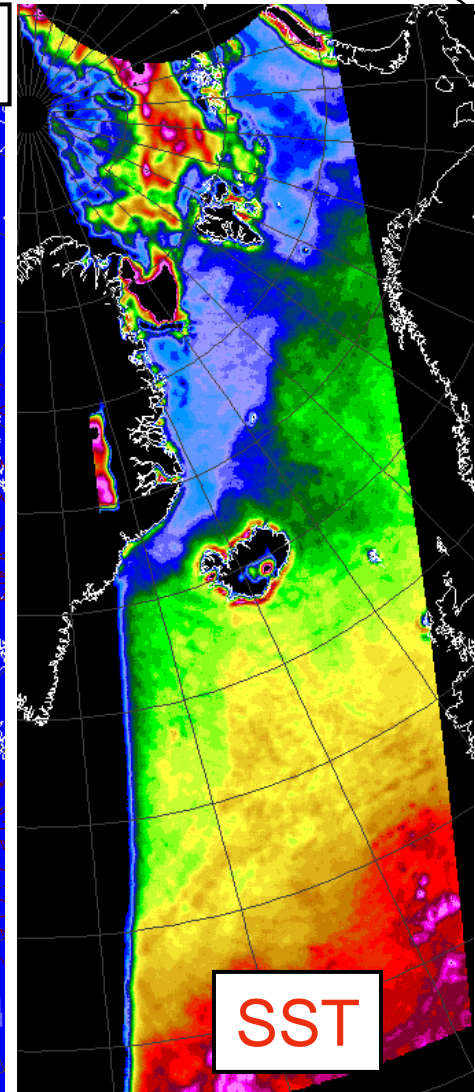
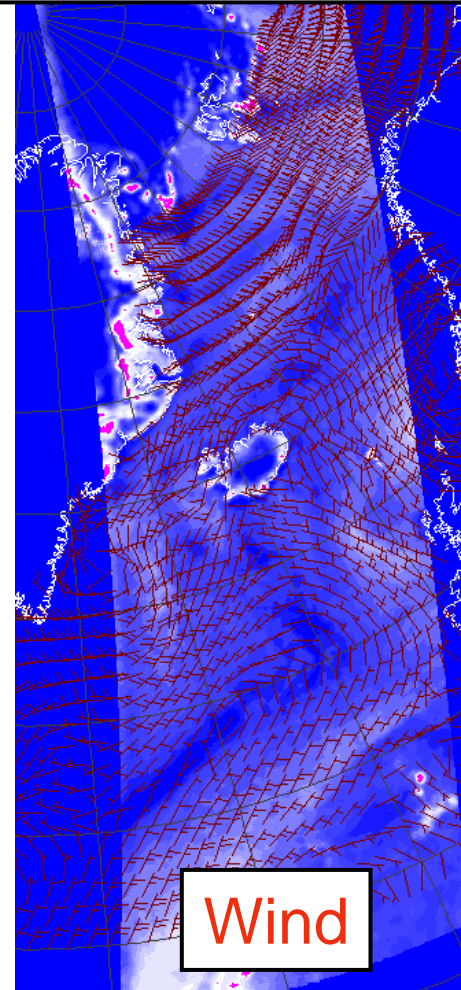
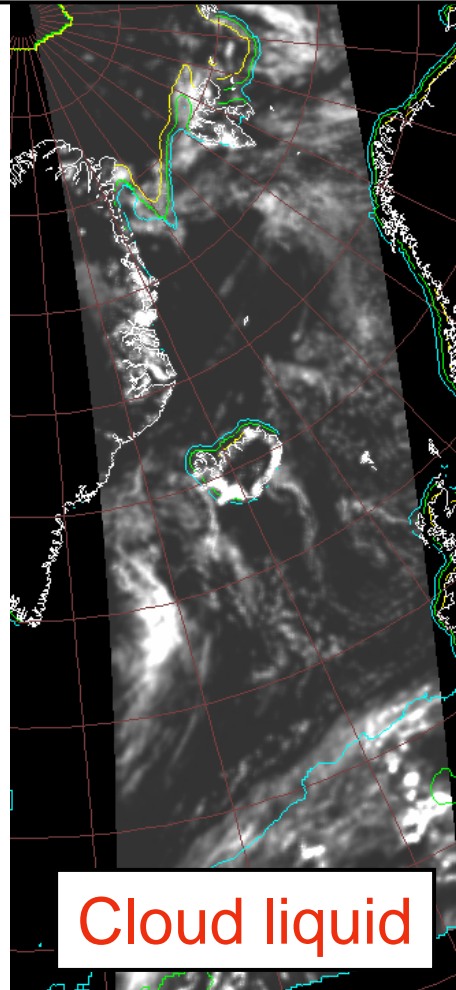
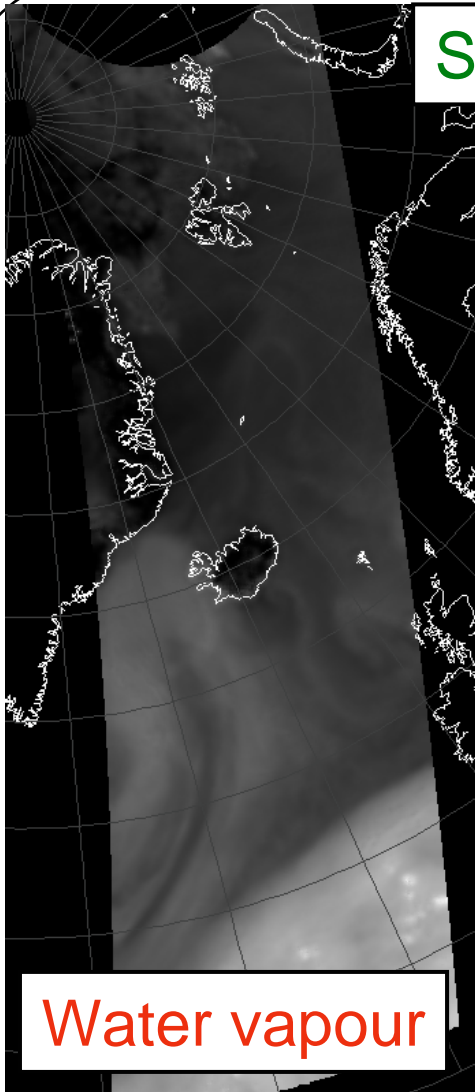


Water vapour
Clouds (CLW)
Wind
Sea surface temperature

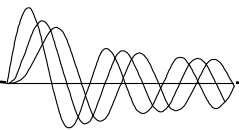
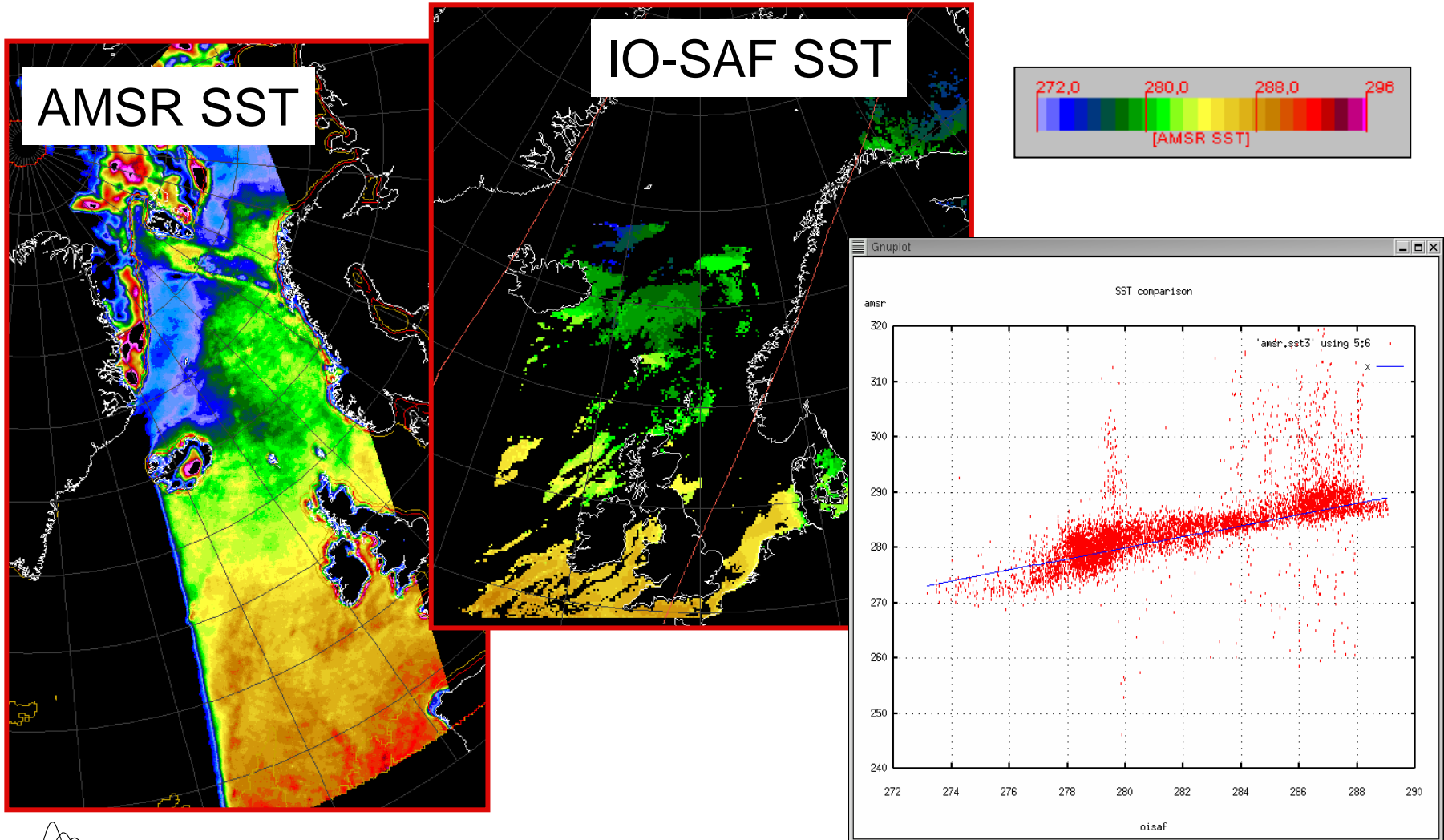
(Ice surface temperature)
(Ice (C,F))



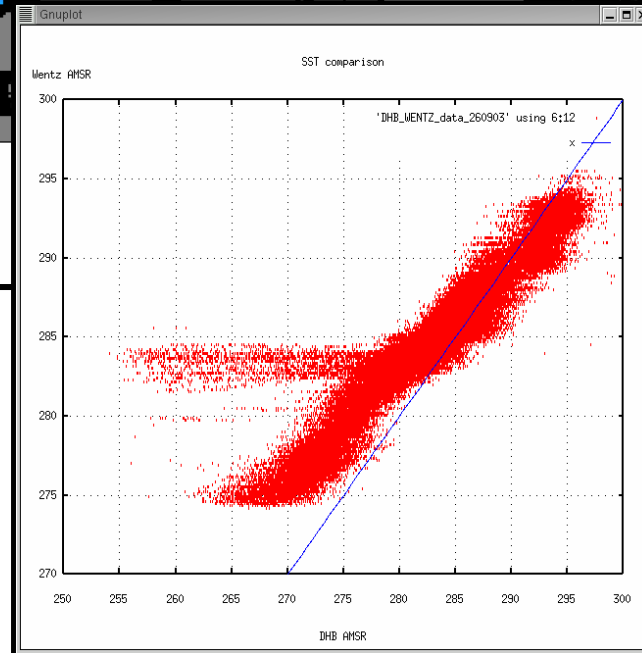
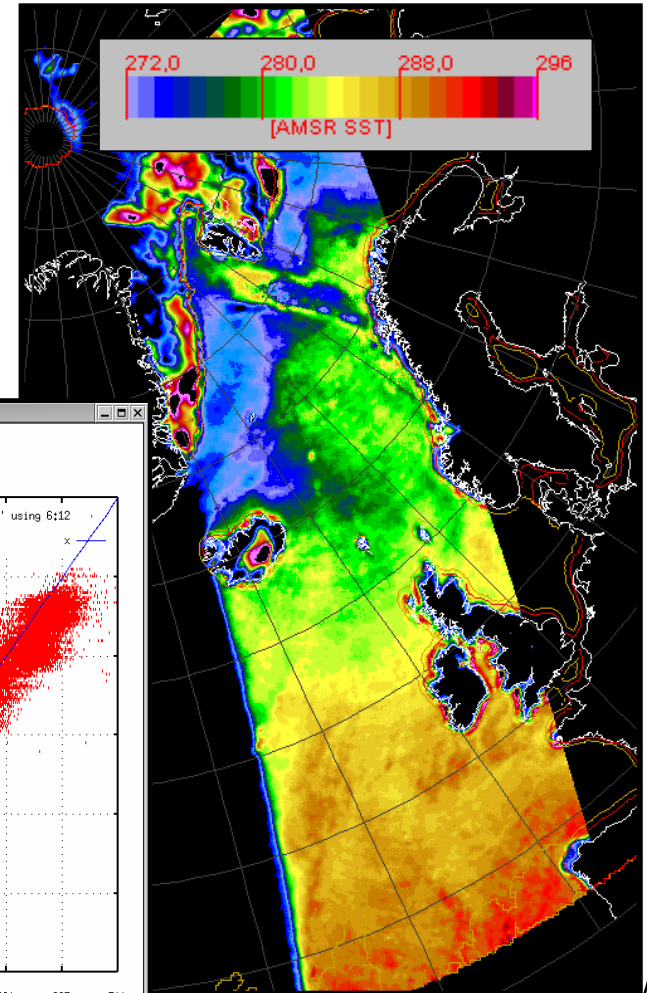
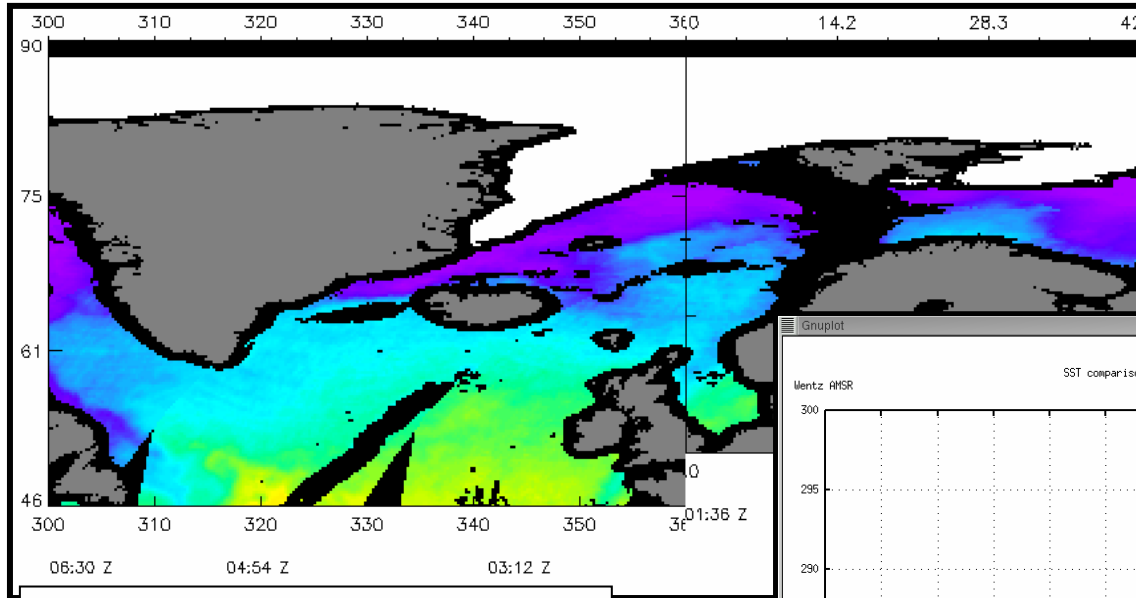
September 26, 2003, ~04:30 UTC



Comparison of AMSR and IOSAF SST 2003-10-27

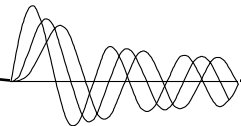


SST comparison DTU vs. Wentz 2003-10-27 03:28



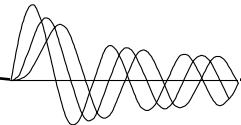
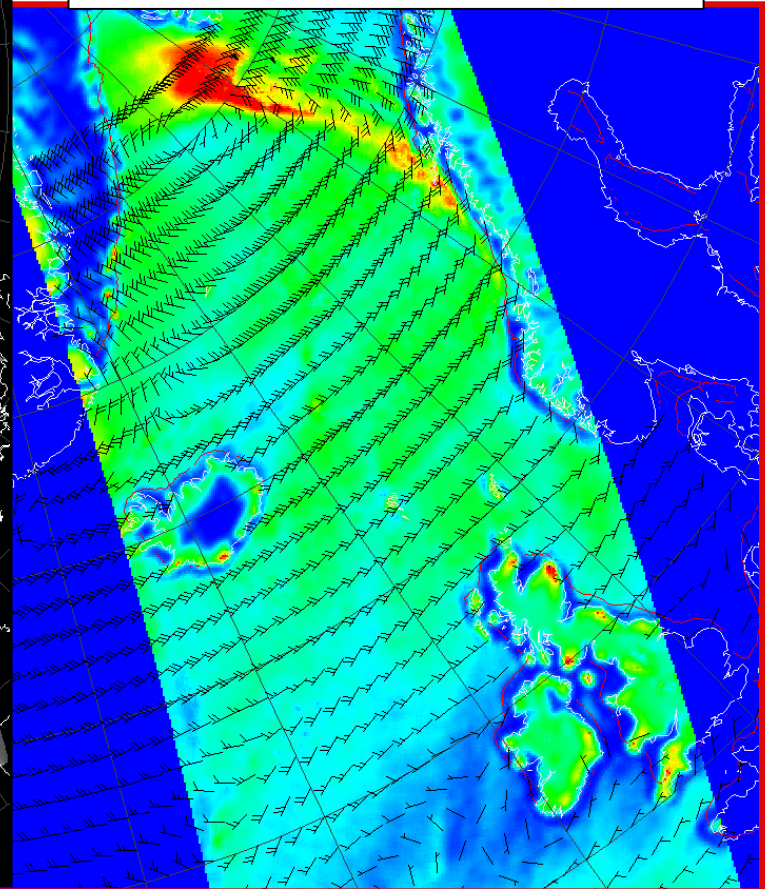
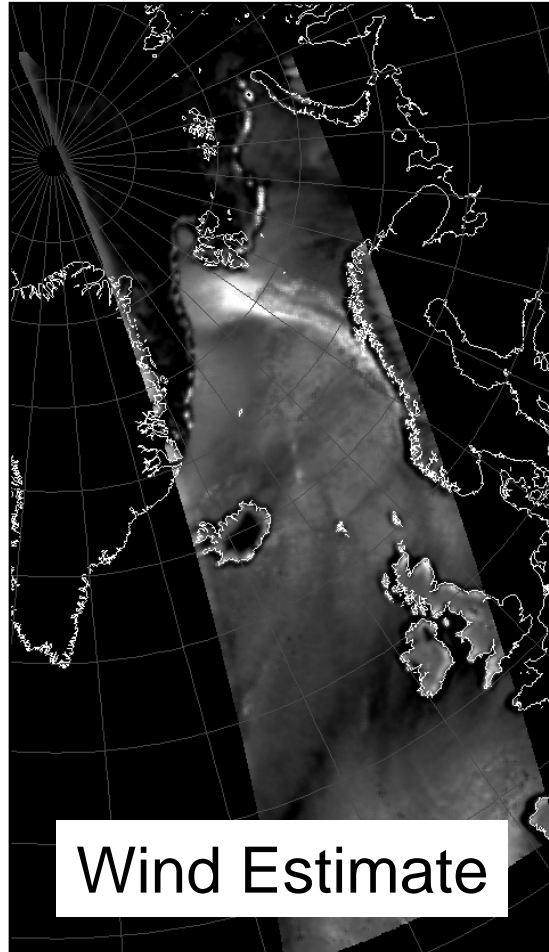
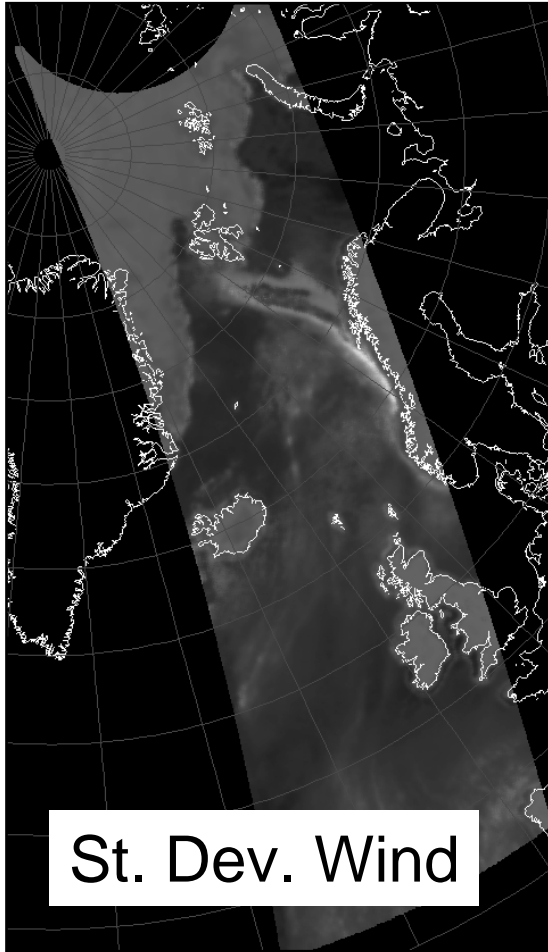
Ørsted* DTU

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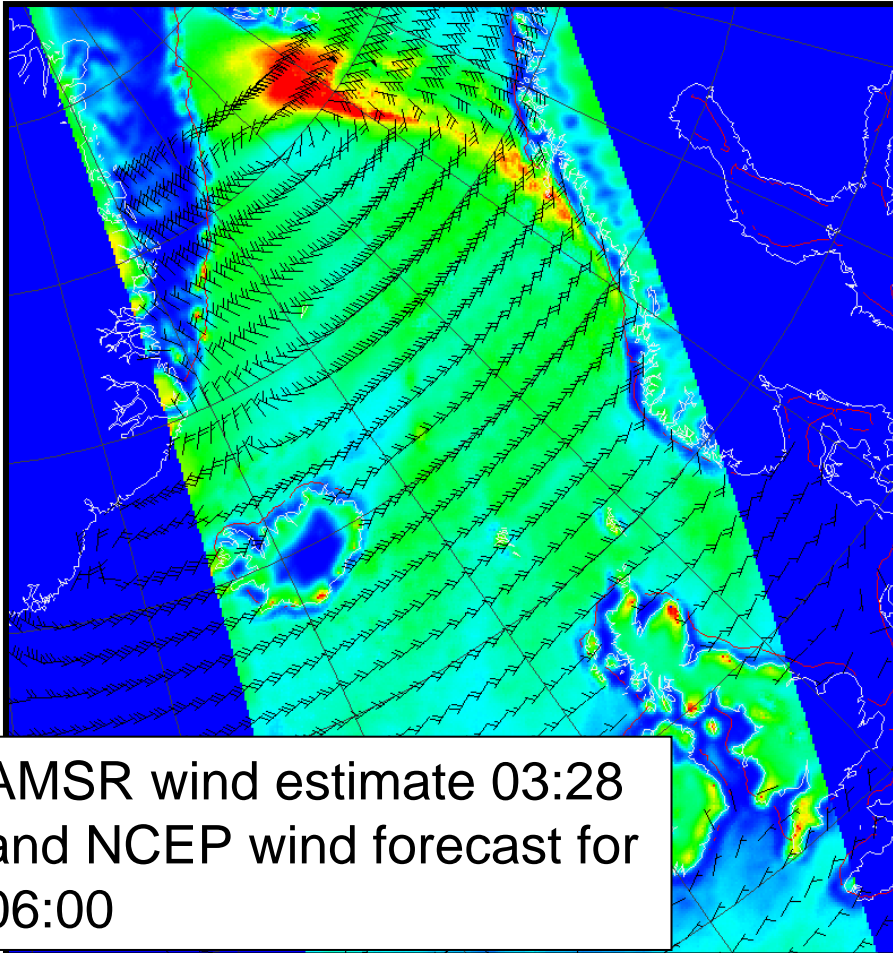


Wind estimate 03:28, 2003-10-27

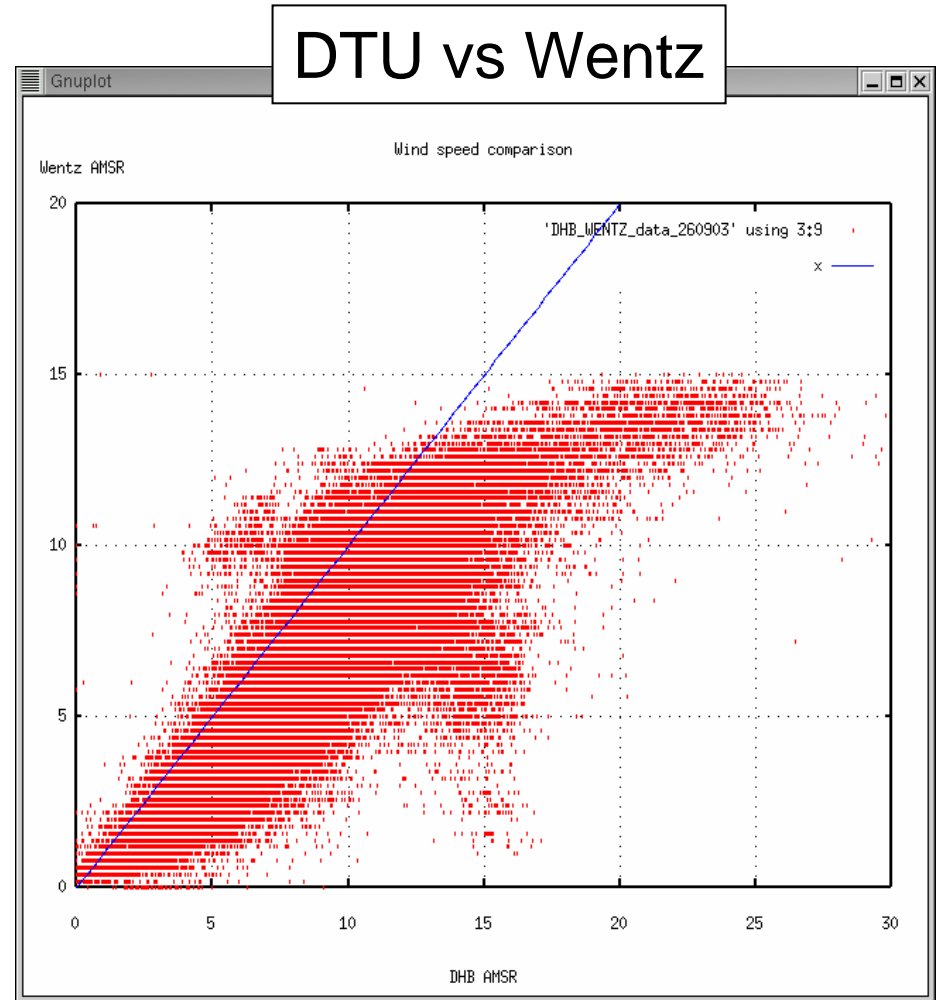
AMSR wind estimate
and NCEP wind forecast
06:00



AMSR-E wind retrieval DTU vs F. Wentz



AMSR wind estimate 03:28
and NCEP wind forecast for
06:00



DTU vs Wentz

Wentz AMSR

Wind speed comparison

'DHB_WENTZ_data_260903' using 3:9

x

20

15

10

5

0

0

5

10

15

20

25

30

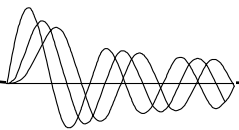
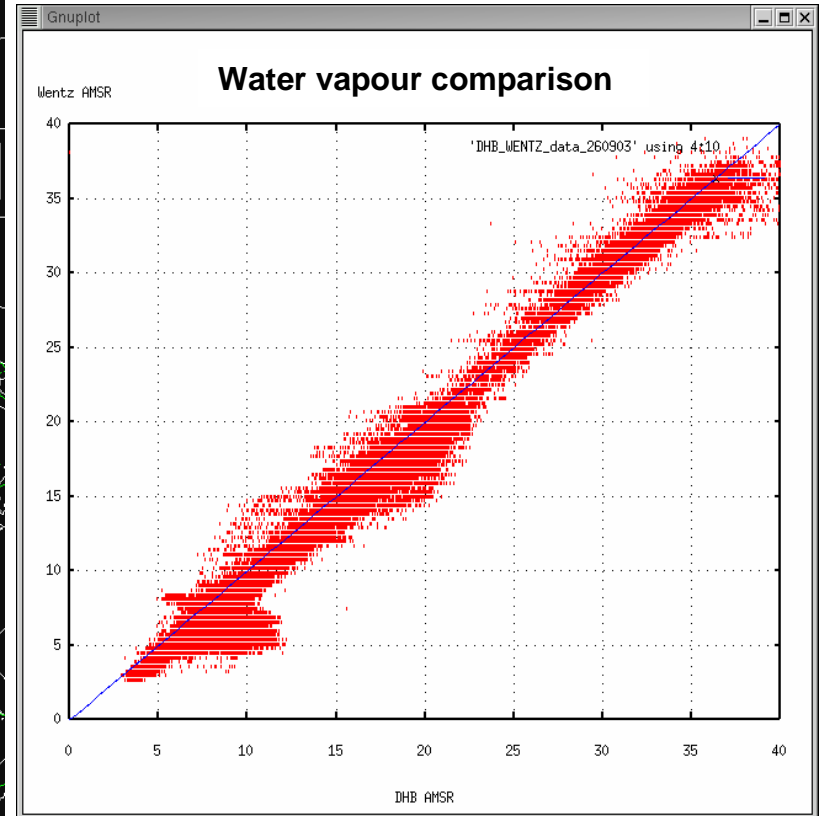
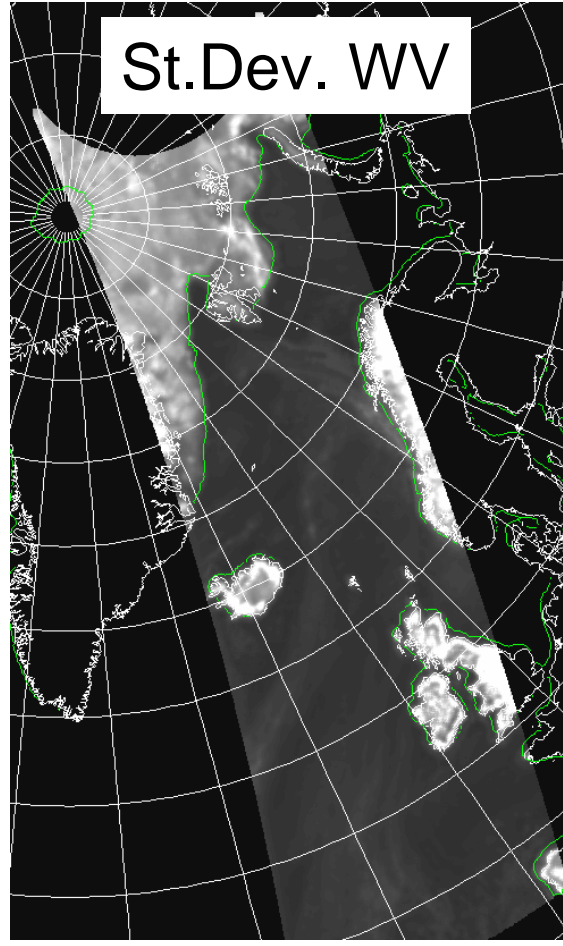
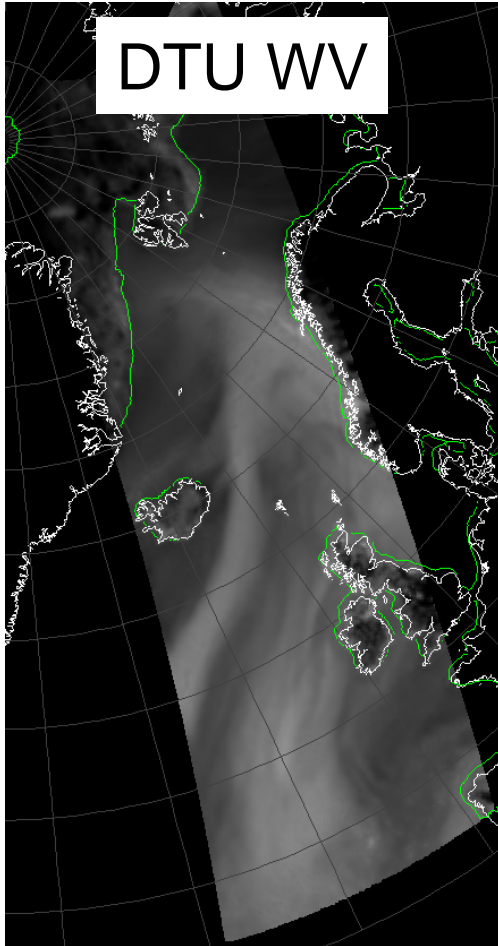
DHB AMSR

Ørsted* DTU

Danish Center for Remote Sensing

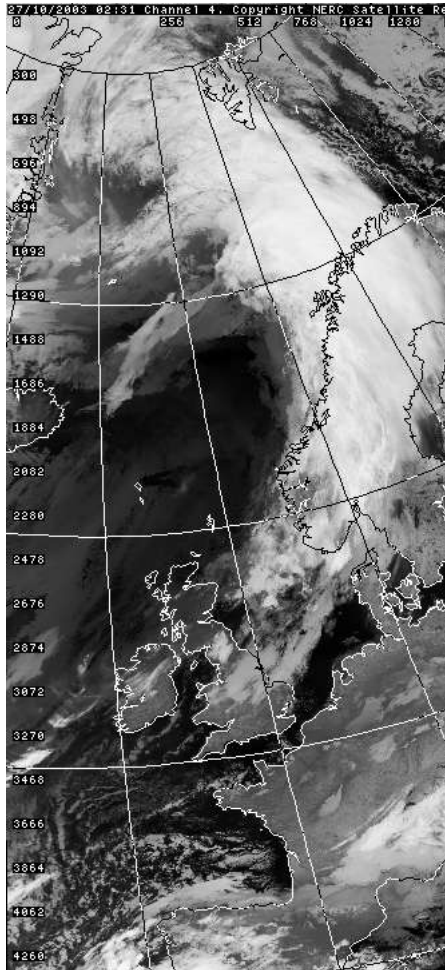
AMSR Water Vapour retrieval

DTU vs Wentz

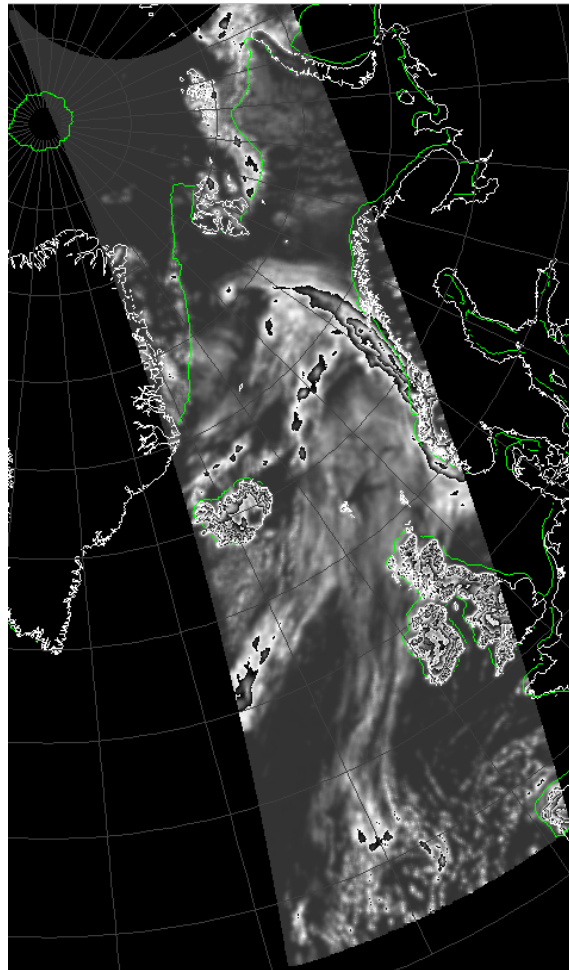


Cloud Liquid Water retrieval

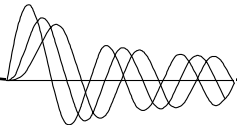
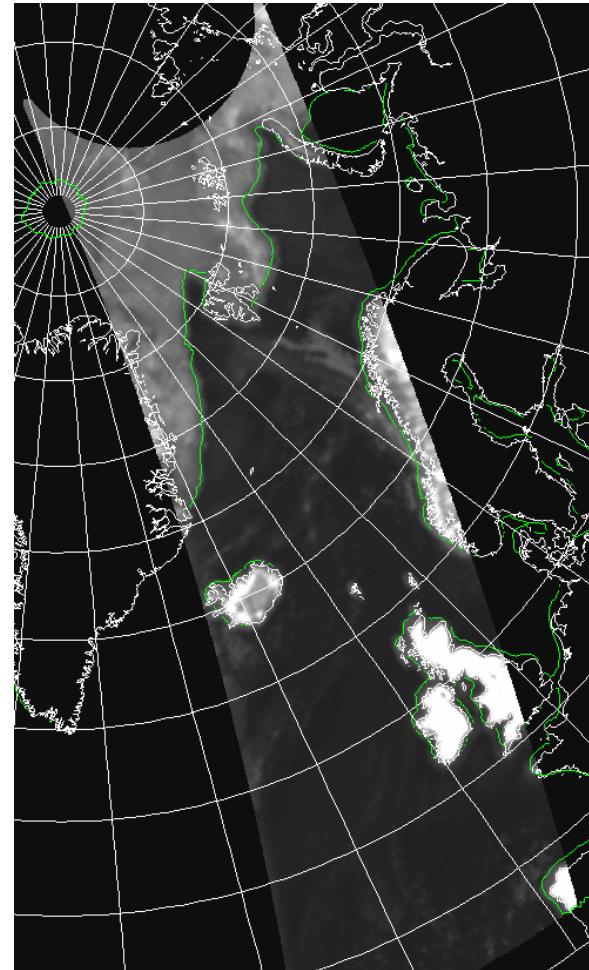
Avhrr ch4 02:12



Amsr clw 03:28

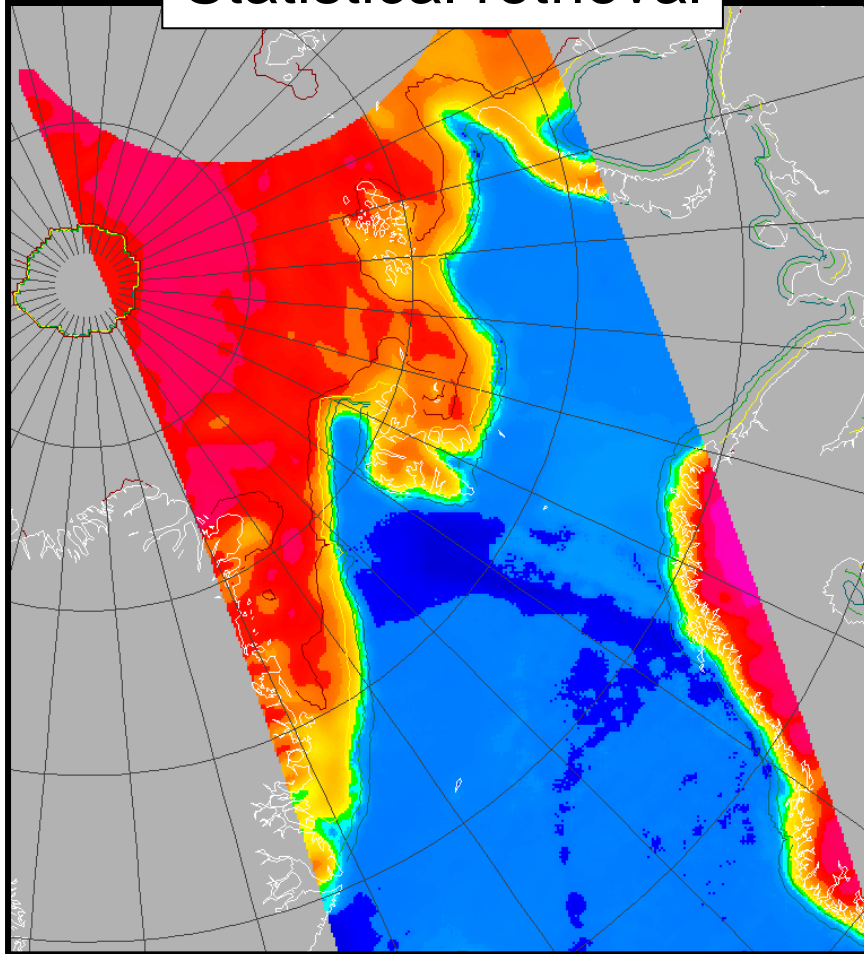


Amsr Std clw 03:28

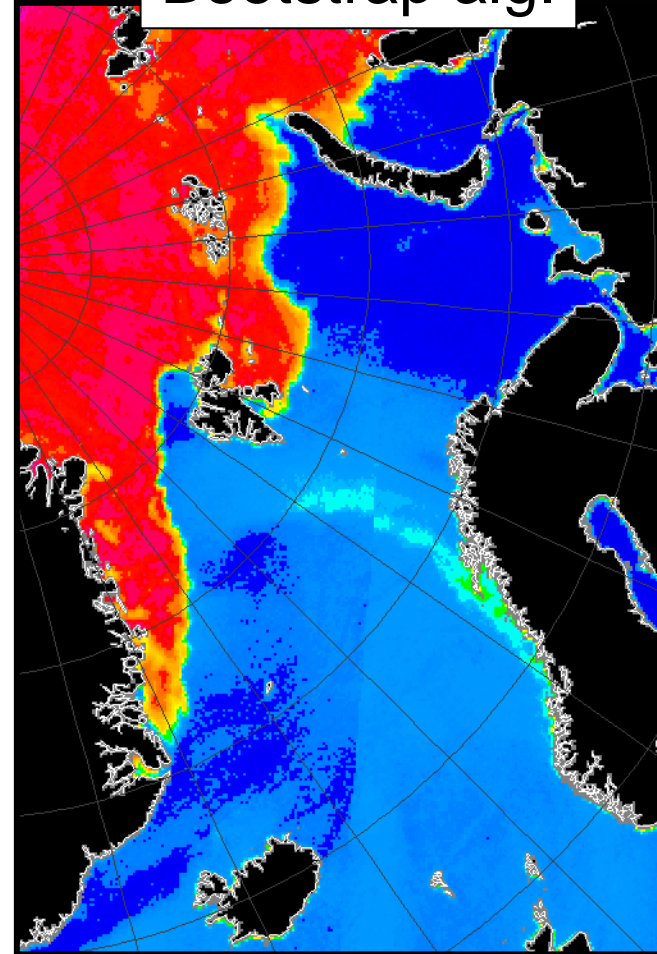


Ice concentration retrieval

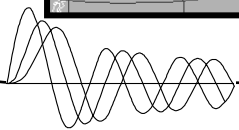
Statistical retrieval



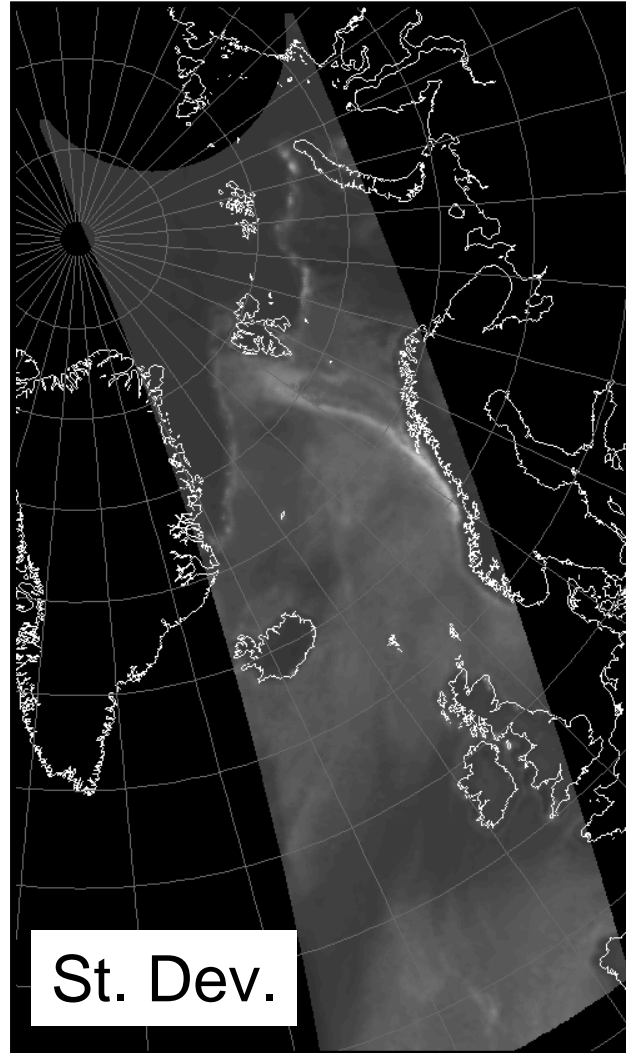
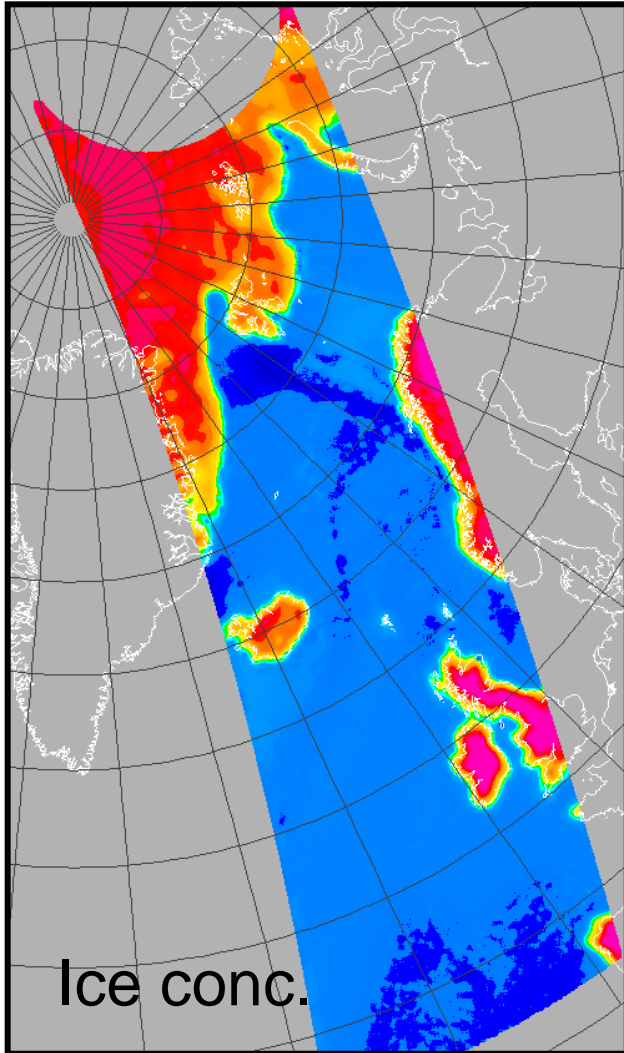
Bootstrap alg.



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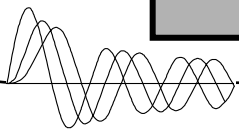


Ice concentration retrieval

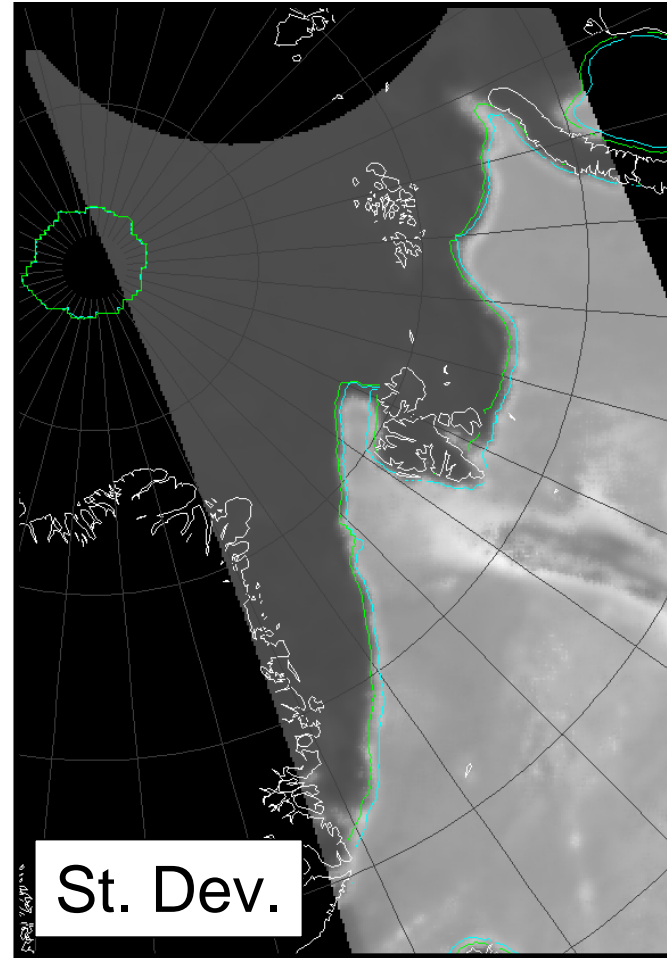
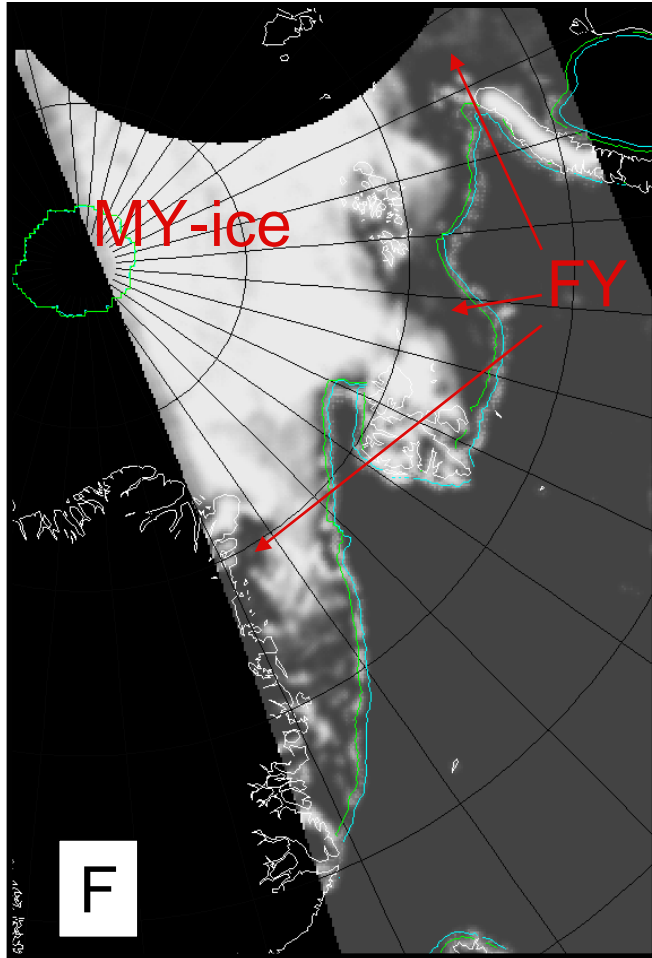


Ørsted* DTU

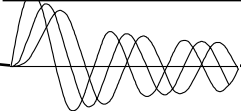
Danish Center for Remote Sensing



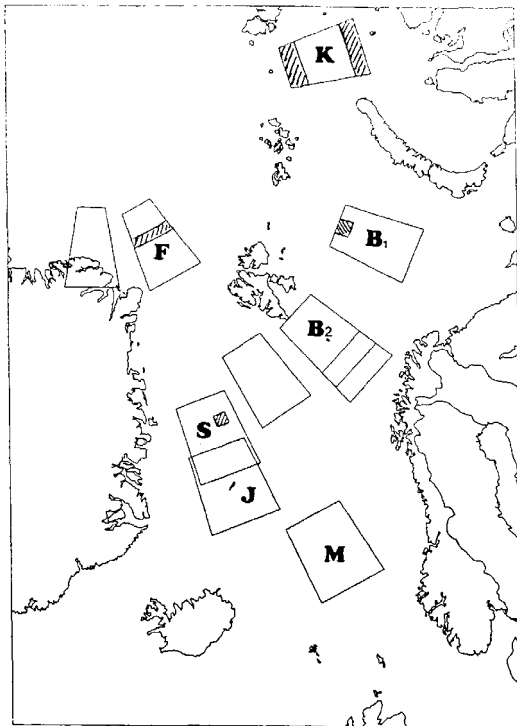
Multi-year ice fraction



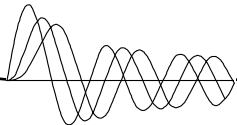
Ørsted* DTU
Danish Center for Remote Sensing



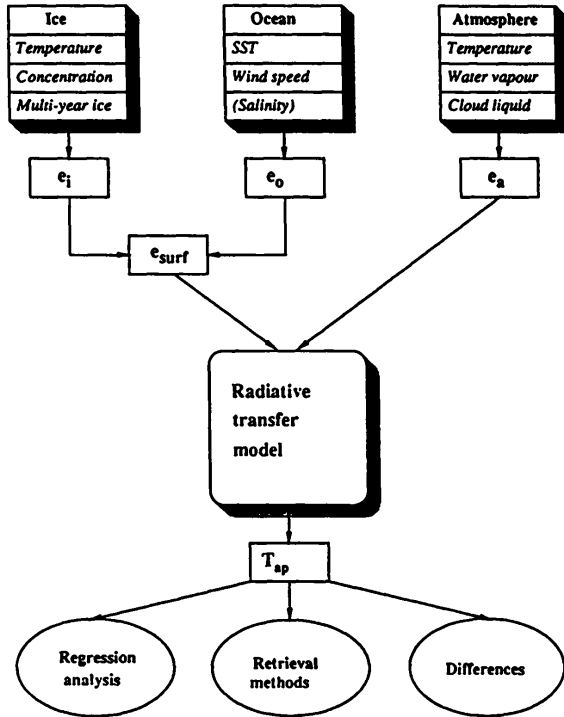
Algorithm performance



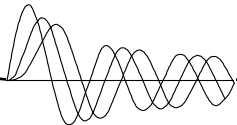
N	Algorithm	MIKE	MIKE	Baren	GS	Kara-	Kara-	Fram	Fram	Fram	Fram
		JAN	JUL	t	JAN	S	N	FEB	APR	AUG	OCT
1	Simple 6.6 GHz	1.0	-1.2	95.4	81.0	84.0	86.6	84.5	89.7	71.1	83.3
3	Simple 18 H+V	-2.1	-1.9	91.5	74.7	99.9	104.3	105.9	103.2	63.5	51.2
4	Simple 21 H+V	-8.1	18.8	93.5	70.5	91.4	93.6	100.0	103.1	83.1	80.6
5	Simple 37 H+V	-3.4	5.1	95.4	84.1	101.3	102.1	102.3	102.2	70.6	79.3
7	Cavalieri et al.	2.8	3.3	102.3	81.3	98.9	102.2	119.6	121.7	77.6	89.4
12	Comiso-Polarizati	-1.8	6.6	95.5	84.4	101.3	102.1	102.2	102.2	71.1	79.7
13	Comiso-Frequency	0.2	-1.3	96.1	80.9	86.7	87.7	96.0	101.3	79.4	96.4
1	Simple 6.6 GHz	2.2	1.2	2.3	4.5	1.5	1.0	1.1	0.9	9.9	2.8
3	Simple 18 H+V	7.2	7.6	3.6	11.3	3.4	4.2	2.7	4.2	9.8	13.4
4	Simple 21 H+V	15.5	14.6	7.0	11.2	6.3	6.3	2.9	3.8	7.5	6.0
5	Simple 37 H+V	10.4	11.7	3.6	6.7	3.0	3.6	1.9	3.2	10.2	6.5
7	Cavalieri et al.	2.8	1.8	3.5	6.3	1.6	2.6	1.8	4.2	18.7	8.9
12	Comiso-Polarizati	10.3	11.6	3.5	6.6	2.9	3.5	1.9	3.2	10.1	6.4
13	Comiso-Frequency	3.2	2.6	2.6	4.0	0.9	1.0	1.1	2.2	15.8	2.9
N		117	118	27	21	83	82	32	30	20	17



Sensitivity analysis

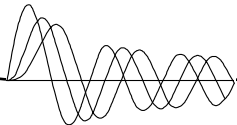


Parameter	default	min	max	σ
SST ($^{\circ}\text{C}$)	-1.75	-1.75	2.25	2.6
WS (m/s)	8	5	15	5.0
Integrated water vapour (cm)	0.4	0.2	1.0	0.55
Surface air temperature ($^{\circ}\text{C}$)	-5	-35	-5	8
Integrated liquid water (cm)	0.005	0	0.01	0.007
Rain/snow mm/hr	0	0	0	
Ice temperature ($^{\circ}\text{C}$)	-2	-14	-2	
Ice concentration	0 to 1			
MY ice fraction	0 to 1			



Sensitivity analysis – water case

No	Algorithm	SST	WS	WV	T	CLW	Total
1	Simple 6.6 GHz H	0.2	1.2	0.2	0.2	0.3	1.3
3	Simple 18 H+V	1.3	6.4	4.6	-1.7	2.1	8.4
4	Simple 21 H+V	0.6	5.1	14.7	-1.1	3.1	15.9
5	Simple 37 H+V	0.4	8.5	7.2	-3.7	9.6	15.1
7	Cavalieri et al.	0.1	1.6	2.7	-0.2	-0.3	3.2
12	Comiso Polarization	0.4	8.1	6.8	-3.5	9.1	14.4
13	Comiso Frequency	0.1	0.7	2.7	0.1	-2.6	3.8



Sensitivity analysis – FY case

No	Algorithm	SST	WS	WV	T	CLW	Total
1	Simple 6.6 GHz H	0.0	0.1	0.1	1.7	0.1	1.7
3	Simple 18 H+V	0.1	0.7	1.6	-5.1	0.7	5.4
4	Simple 21 H+V	0.1	0.6	3.5	-1.8	0.7	4.0
5	Simple 37 H+V	0.0	0.9	2.6	-3.3	3.4	5.5
7	Cavalieri et al.	0.1	0.4	0.7	-1.2	-1.4	2.0
12	Comiso Polarization	0.0	0.9	2.5	-3.2	3.2	5.3
13	Comiso Frequency	0.0	0.1	0.2	1.7	-1.5	2.3

