Norwegian Meteorological Institute

Ice and Cloud masking at High Latitudes

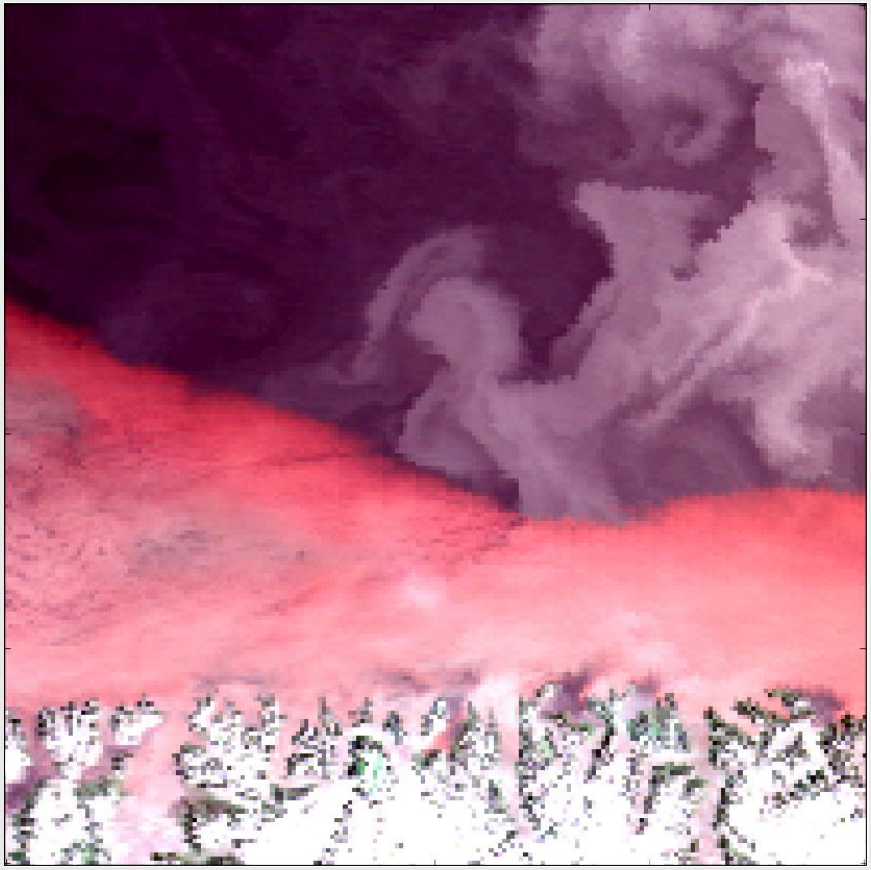
Steinar Eastwood, Norwegian Meteorological Institute (MET)

Claire Bulgin (UoE), Sonia Pere and Pierre LeBorgne (M-F), Adam Dybbroe (SMHI)

GHRSST XIV, Woods Hole, 17-21. June 2013

Outline

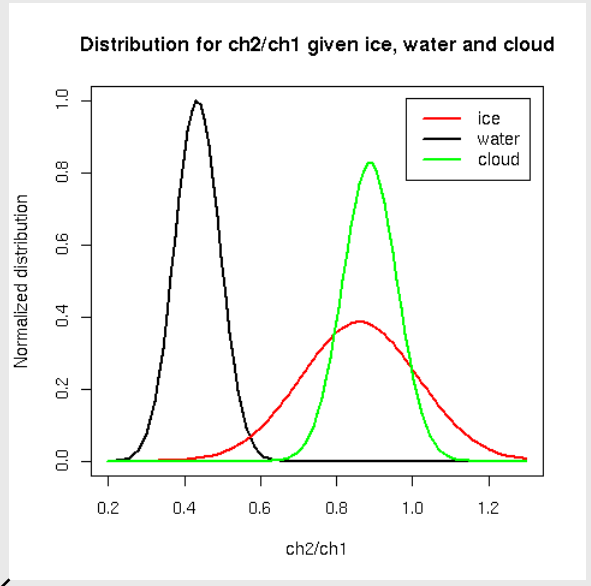
- Current OSI SAF masking method
- Updating method for NPP VIIRS
- Updating method during ESA CCI on SST
- Automatic collection of training data with Calipso

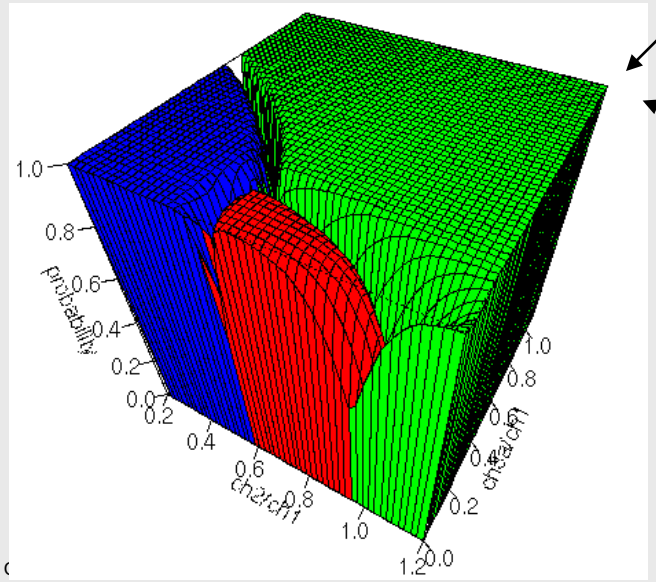


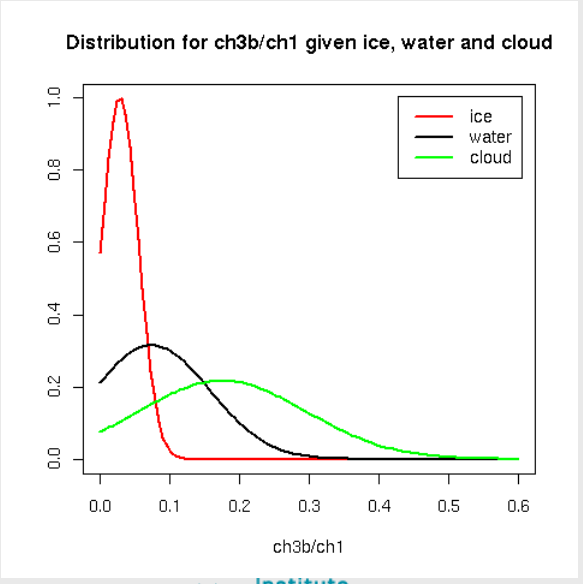
AATSR, South-east coast of Greenland

Current OSI SAF method

- Need additional cloud and ice masking step after applying conventional cloud mask
- Method is based on probability density functions (PDF)
- We approximate PDFs with Gaussian distrib
- Provides the probability of the satellite data being cloudy, water or ice given the observed data





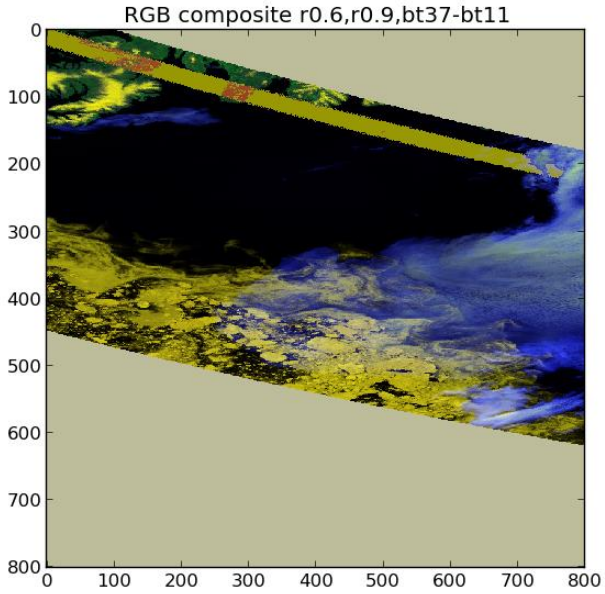


OSI SAF

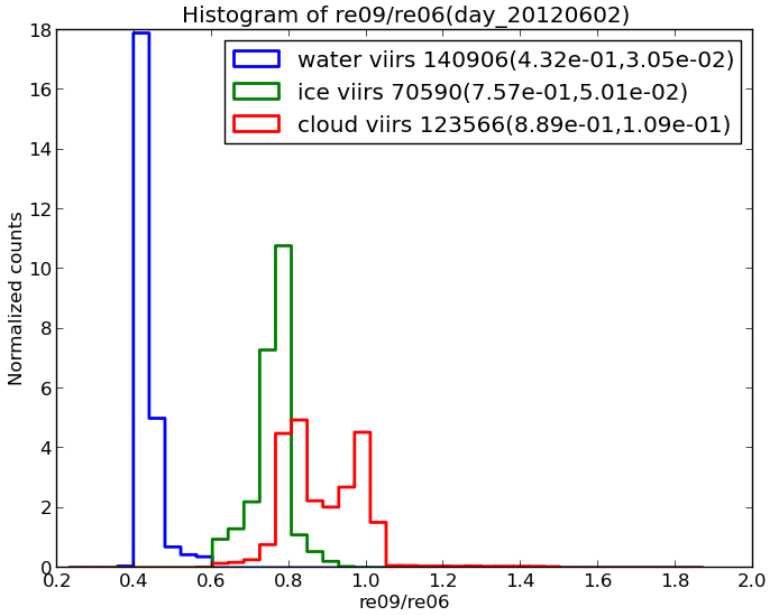
Institute

Updating for NPP VIIRS

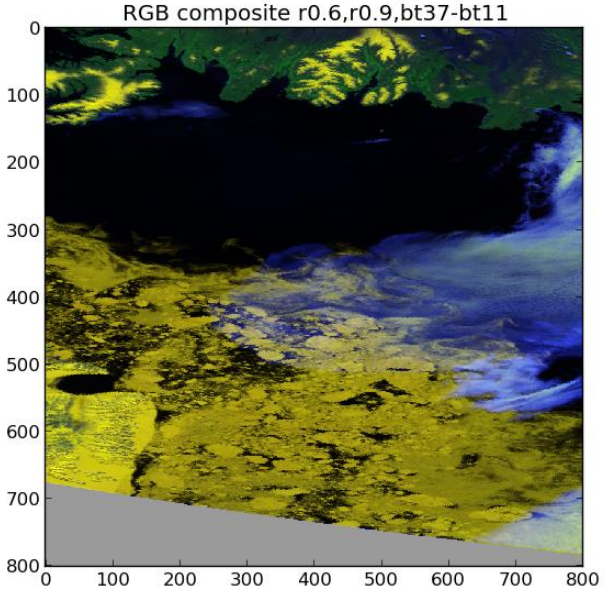
- The current OSI SAF method has coefficients for AVHRRs on NOAA17,18,19 and METOP-A
- We have updated the current OSI SAF method to work on VIIRS data (during day)
- Had no time to do an extended training of method by manual classification
- Wanted to adjust the existing N19 AVHRR coefficients to VIIRS
- Comparing N19 and NPP orbits close in time (+/- 0.5 hour)



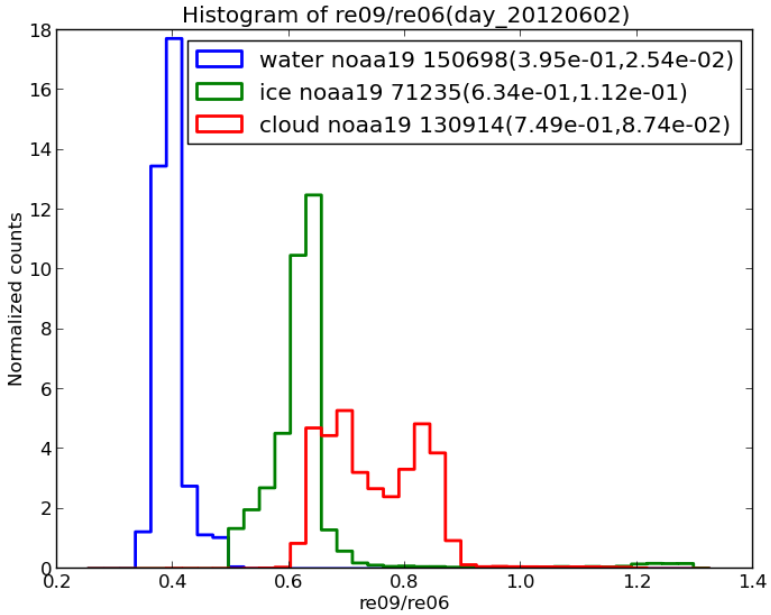
NPP VIIRS



r0.9um/r0.6um



N19 AVHRR



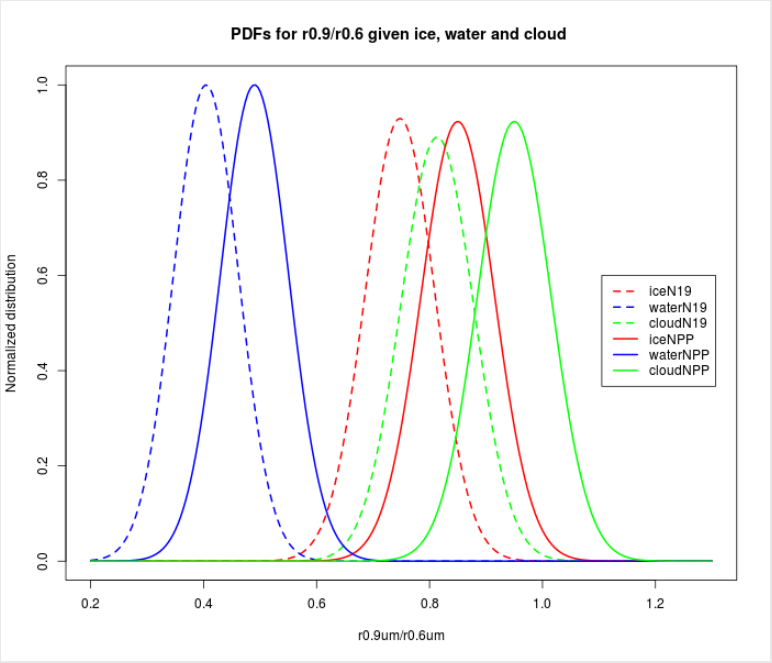
02.06.2012

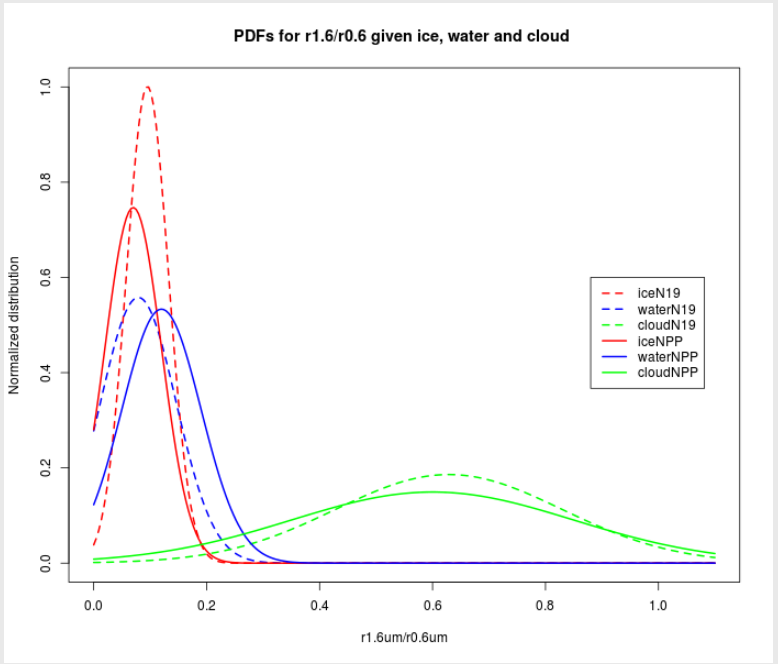
NPP VIIRS PDFs

- Use the limited set of collocated VIIRS + AVHRR data to find average shift between PDFs for this limited set
- Apply this average shift to define overall VIIRS PDFs:

$PDF_{VIIRS} = PDF_{AVHRR}$ - shift(AVHRR-VIIRS)

- VIIRS chain at CMS/MF run with these new coefficients and work fine
- Nighttime: will have a look at improved capabilities with 8.7um





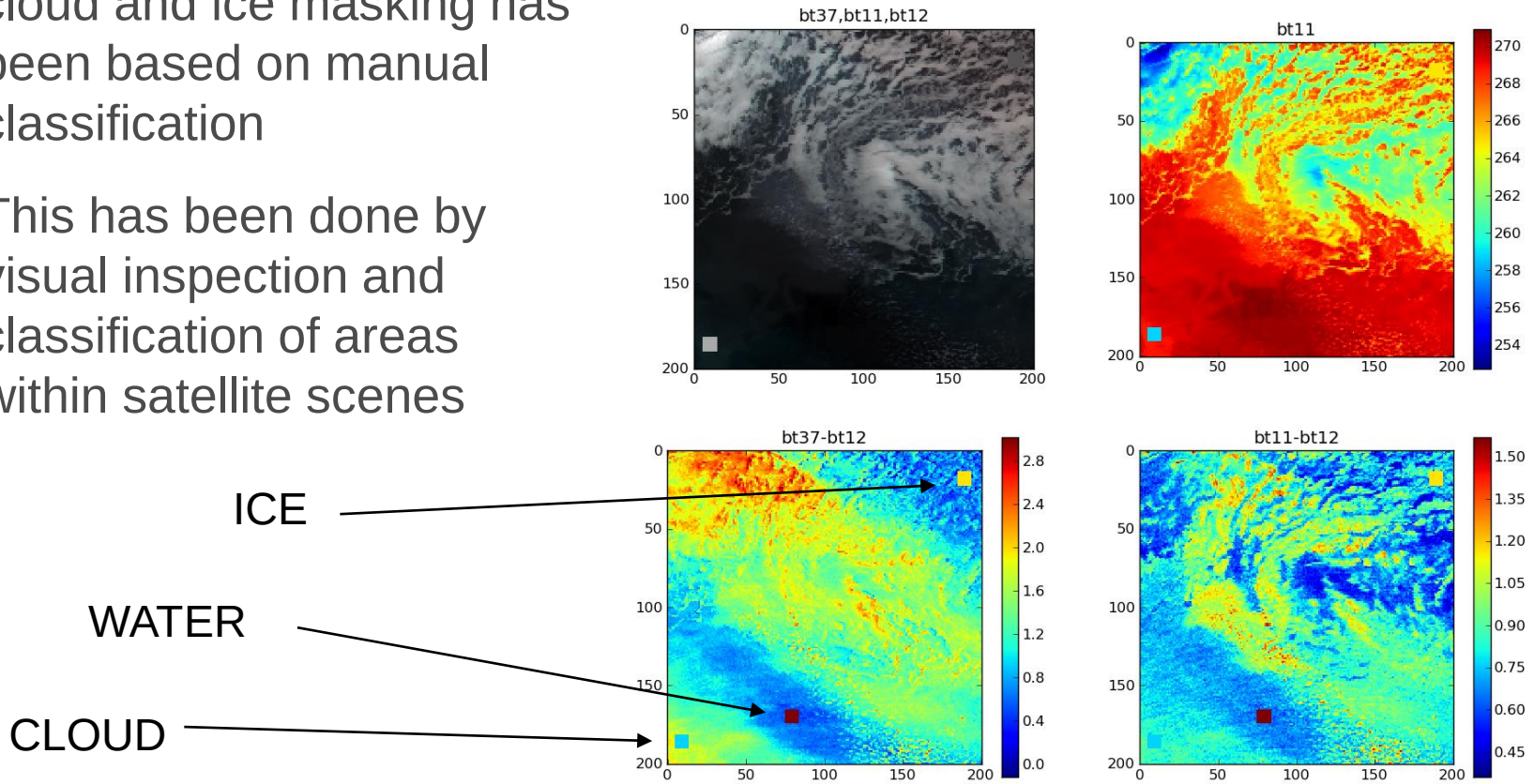
ESA Climate Change Initiative Phase 1

Sea Surface Temperature (SST)

Improving cloud and ice masking algorithm at high latitudes during ESA CCI on SST

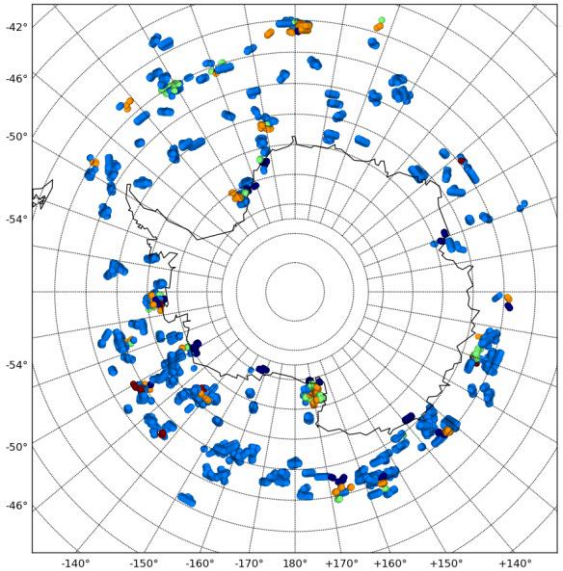
Cloud and ice masking in ESA CCI SST

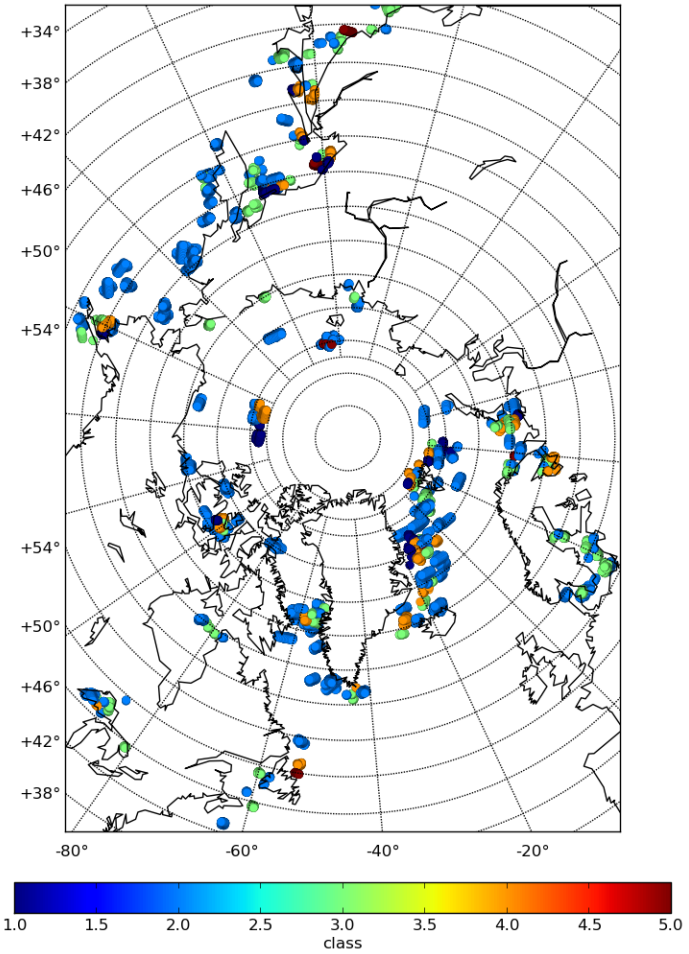
- Training of method for cloud and ice masking has been based on manual classification
- This has been done by visual inspection and classification of areas within satellite scenes



Cloud and ice masking in ESA CCI SST

- Have collected scenes close to sea ice border from different satellites, months, day/night/twilight
- Also use this data set for validation
- This data set will be published for all interested to access



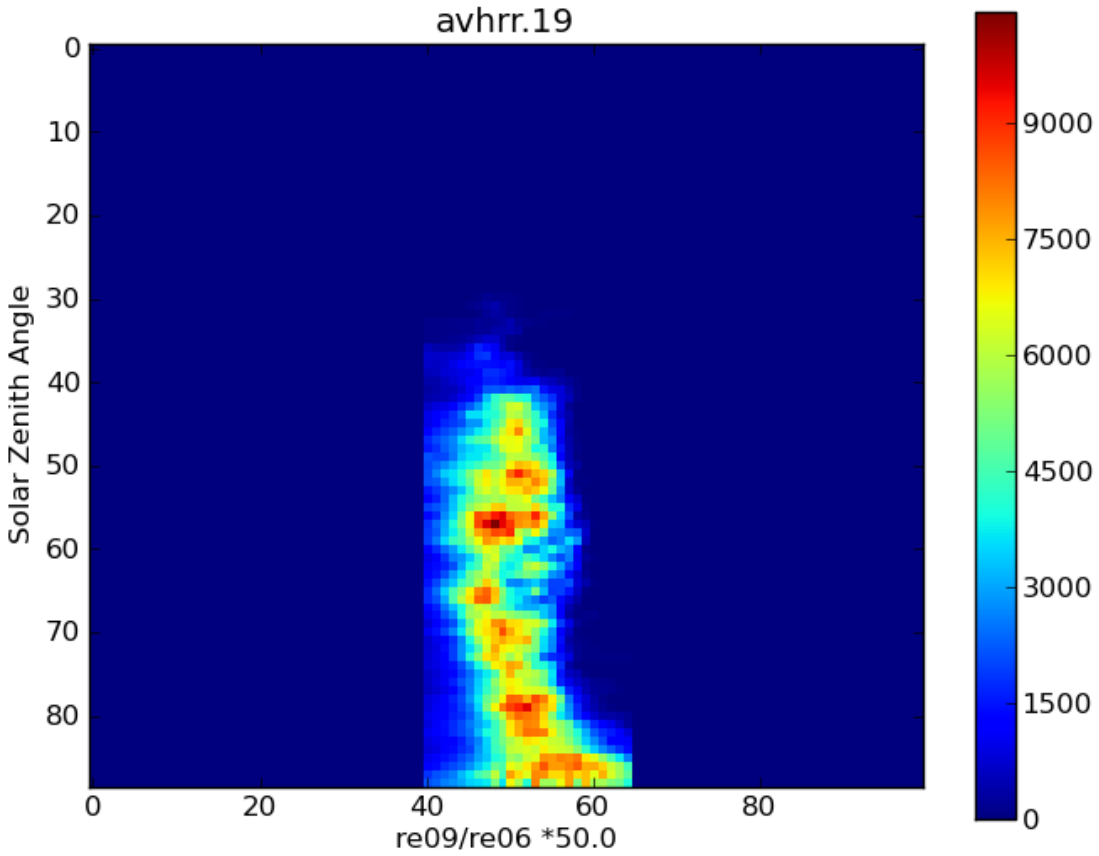


1/4: ice, 2: clouds, 3: water

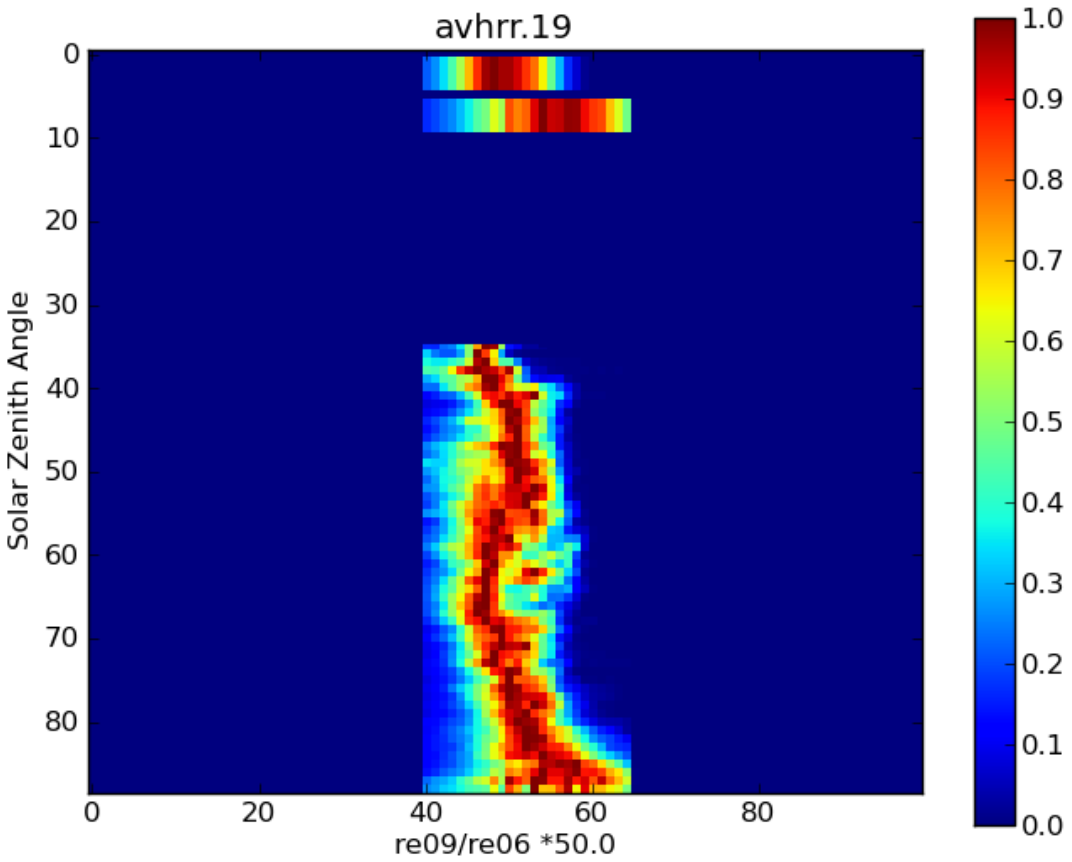
Update of algorithm

- Want to improve masking during twilight and night
- Have looked at dependency on sun zenith angle for the PDFs
- Using existing cloud mask (CLAV-X) from the HL MMD to study cloud signatures for all seasons, in areas close to the ice edge

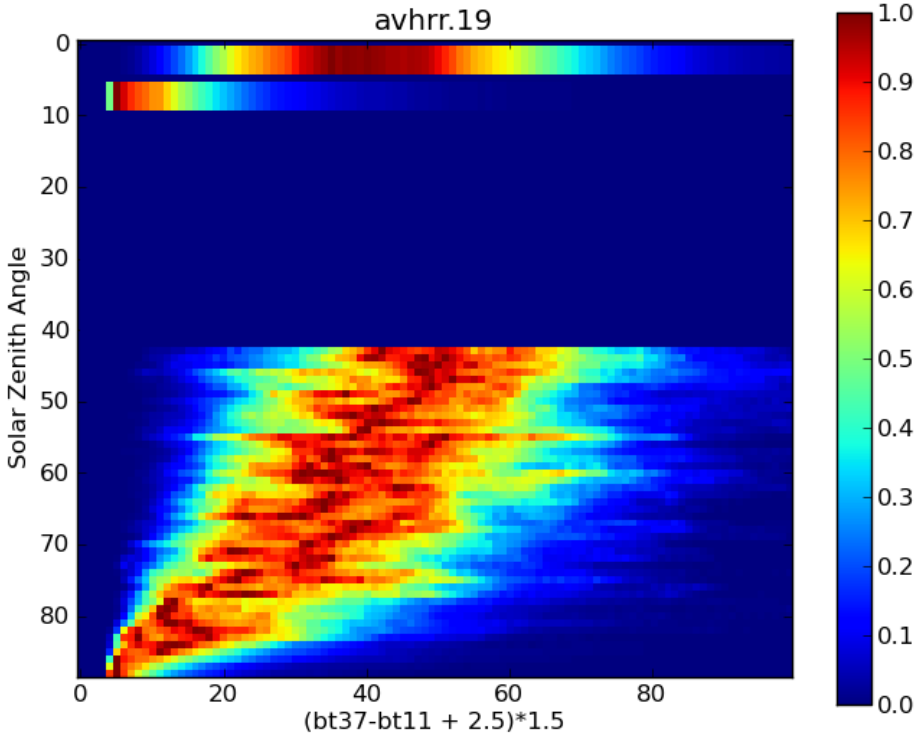
Daytime r0.9/r0.6, cloud

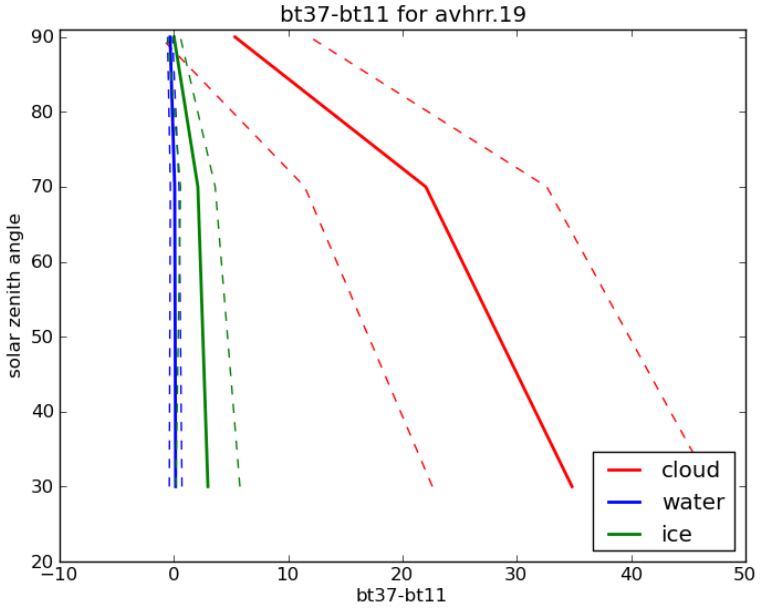


Daytime r0.9/r0.6, cloud



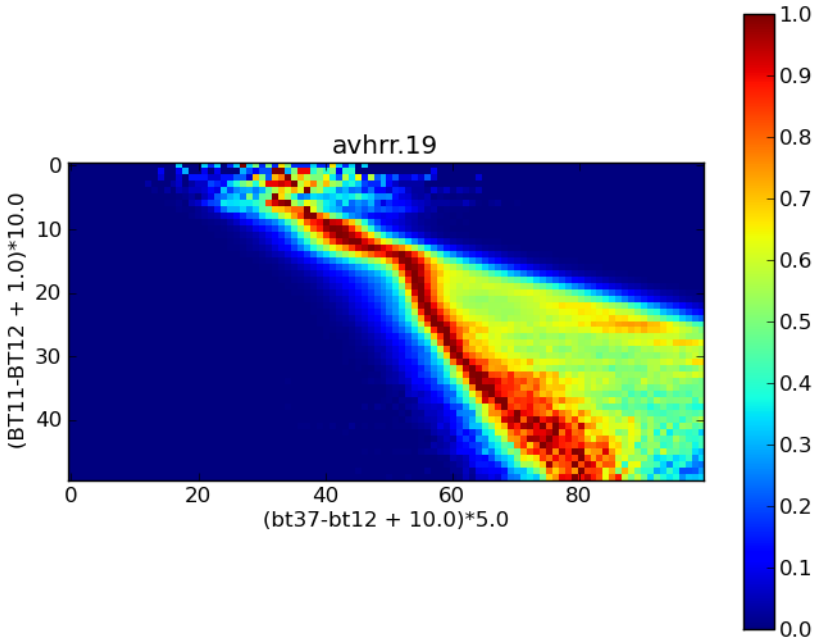
Daytime bt3.7-bt11





PDFmean = MA*SOZ + MB
PDFstd = SA*SOZ + SB

Night time bt3.7-bt12, cloud



Validation night time

Satellite	Class	probWa01	probWa05	probWa09	probIc01	probIc05	probIc09	probCl01	probCl05	probCl09	NumObs
atsr.3	water	0.031	0.354	0.615	0.626	0.357	0.017	0.994	0.006	0.000	7507
atsr.3	ice	0.972	0.028	0.000	0.181	0.695	0.124	0.168	0.651	0.181	10498
atsr.3	cloud	0.983	0.015	0.002	0.837	0.140	0.023	0.044	0.120	0.835	47250
avhrr.12	water	0.040	0.140	0.820	0.900	0.100	0.000	0.867	0.133	0.000	150
avhrr.12	ice	0.675	0.104	0.221	0.312	0.597	0.091	0.325	0.610	0.065	77
avhrr.12	cloud	0.975	0.025	0.000	0.488	0.512	0.000	0.230	0.469	0.300	5498
avhrr.14	water	0.051	0.148	0.801	0.913	0.083	0.004	0.894	0.062	0.044	528
avhrr.14	ice	0.553	0.395	0.053	0.171	0.829	0.000	0.118	0.803	0.079	152
avhrr.14	cloud	0.947	0.053	0.000	0.561	0.439	0.000	0.000	0.518	0.482	4588
avhrr.15	water	0.040	0.030	0.931	0.941	0.038	0.021	0.978	0.021	0.001	677
avhrr.15	ice	0.488	0.340	0.172	0.195	0.805	0.000	0.295	0.705	0.000	1334
avhrr.15	cloud	0.989	0.008	0.003	0.789	0.207	0.004	0.009	0.203	0.788	13542
avhrr.16	water	0.000	0.005	0.995	0.995	0.005	0.000	1.000	0.000	0.000	379
avhrr.16	ice	0.388	0.429	0.183	0.199	0.801	0.000	0.360	0.640	0.000	891
avhrr.16	cloud	0.985	0.014	0.001	0.690	0.303	0.008	0.015	0.296	0.688	12775
avhrr.17	water	0.000	0.034	0.966	0.969	0.031	0.000	1.000	0.000	0.000	638
avhrr.17	ice	0.632	0.304	0.063	0.098	0.898	0.004	0.251	0.738	0.011	1009
avhrr.17	cloud	0.959	0.035	0.006	0.715	0.279	0.006	0.029	0.263	0.708	9869
avhrr.18	water	0.000	0.083	0.917	0.917	0.083	0.000	0.958	0.042	0.000	48
avhrr.18	ice	0.518	0.311	0.171	0.179	0.817	0.004	0.363	0.629	0.008	502
avhrr.18	cloud	0.960	0.031	0.009	0.727	0.256	0.018	0.053	0.230	0.717	8130

Validation night time

Satellite	Class	probWa01	probWa05	probWa09	probIc01	probIc05	probIc09	probCl01	probCl05	probCl09	NumObs
atsr.3	water	0.031	0.354	0.615	0.626	0.357	0.017	0.994	0.006	0.000	7507
atsr.3	ice	0.972	0.028	0.000	0.181	0.695	0.124	0.168	0.651	0.181	10498
atsr.3	cloud	0.983	0.015	0.002	0.837	0.140	0.023	0.044	0.120	0.835	47250
avhrr.12	water	0.040	0.140	0.820	0.900	0.100	0.000	0.867	0.133	0.000	150
avhrr.12	ice	0.675	0.104	0.221	0.312	0.597	0.091	0.325	0.610	0.065	77
avhrr.12	cloud	0.975	0.025	0.000	0.488	0.512	0.000	0.230	0.469	0.300	5498
avhrr.14	water	0.051	0.148	0.801	0.913	0.083	0.004	0.894	0.062	0.044	528
avhrr.14	ice	0.553	0.395	0.053	0.171	0.829	0.000	0.118	0.803	0.079	152
avhrr.14	cloud	0.947	0.053	0.000	0.561	0.439	0.000	0.000	0.518	0.482	4588
avhrr.15	water	0.040	0.030	0.931	0.941	0.038	0.021	0.978	0.021	0.001	677
avhrr.15	ice	0.488	0.340	0.172	0.195	0.805	0.000	0.295	0.705	0.000	1334
avhrr.15	cloud	0.989	0.008	0.003	0.789	0.207	0.004	0.009	0.203	0.788	13542
avhrr.16	water	0.000	0.005	0.995	0.995	0.005	0.000	1.000	0.000	0.000	379
avhrr.16	ice	0.388	0.429	0.183	0.199	0.801	0.000	0.360	0.640	0.000	891
avhrr.16	cloud	0.985	0.014	0.001	0.690	0.303	0.008	0.015	0.296	0.688	12775
avhrr.17	water	0.000	0.034	0.966	0.969	0.031	0.000	1.000	0.000	0.000	638
avhrr.17	ice	0.632	0.304	0.063	0.098	0.898	0.004	0.251	0.738	0.011	1009
avhrr.17	cloud	0.959	0.035	0.006	0.715	0.279	0.006	0.029	0.263	0.708	9869
avhrr.18	water	0.000	0.083	0.917	0.917	0.083	0.000	0.958	0.042	0.000	48
avhrr.18	ice	0.518	0.311	0.171	0.179	0.817	0.004	0.363	0.629	0.008	502
avhrr.18	cloud	0.960	0.031	0.009	0.727	0.256	0.018	0.053	0.230	0.717	8130

Day time algorithms uses:

- r0.9/r0.6 and
- r1.6/r0.6

or

- r0.9/r0.6 and
- bt3.7-bt11

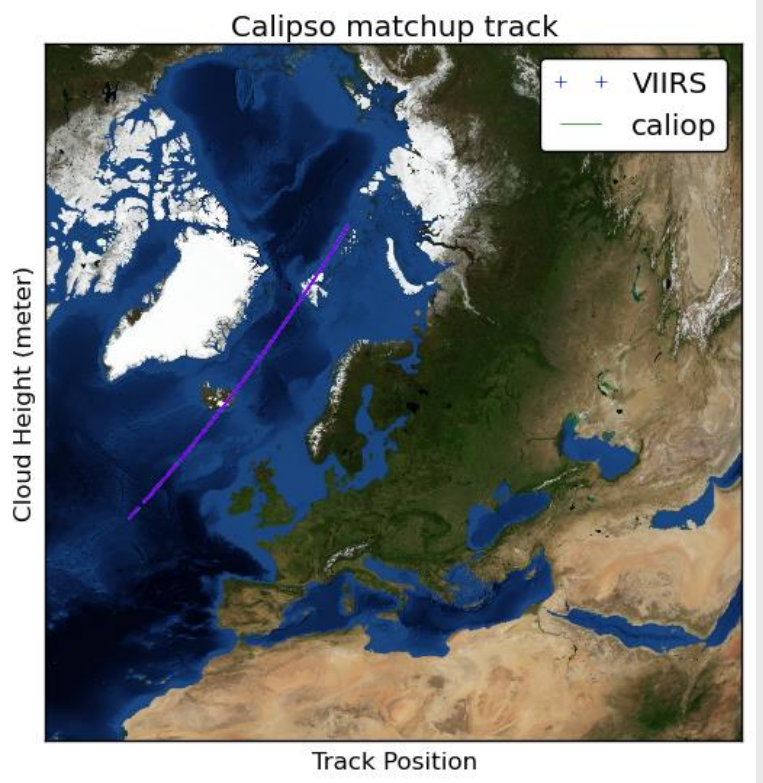
Night time algorithm uses:

bt3.7-bt11 (bt11-bt12)

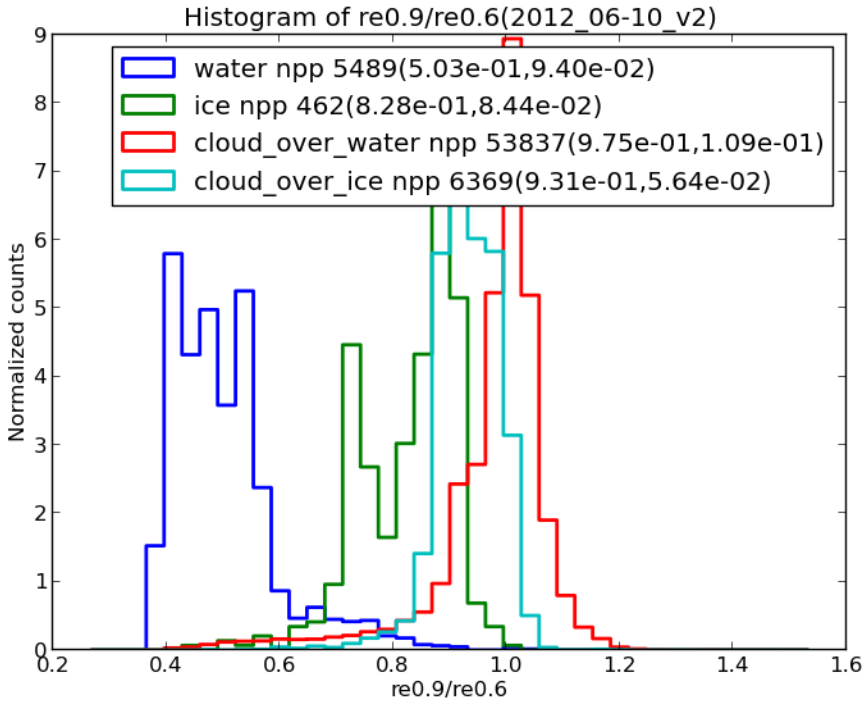
LSD(bt3.7-bt11) , log-normal distribution

Automatic collection of training data with Calipso cloud lidar

- Project with SMHI/NWC SAF
- Have just started to look at Calipso cloud lidar data collocated with VIIRS data and ice concentration for collection of training data
- Use Calipso to define/classify cloudy and cloud free areas, even over ice
- Can then define the PDFs for cloud, ice and water



PDFs defined from Calipso traning



r0.9um/ r0.6um	PDF mean	PDF mean
	Manual	Calipso
Water	0.49	0.50
Ice	0.85	0.83
Cloud	0.96	0.95

Norwegian Meteorological Institute

Questions?