

Cloud retrievals over snow and sea-ice

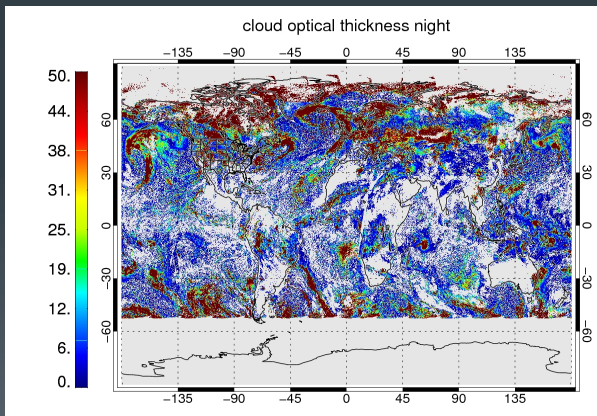
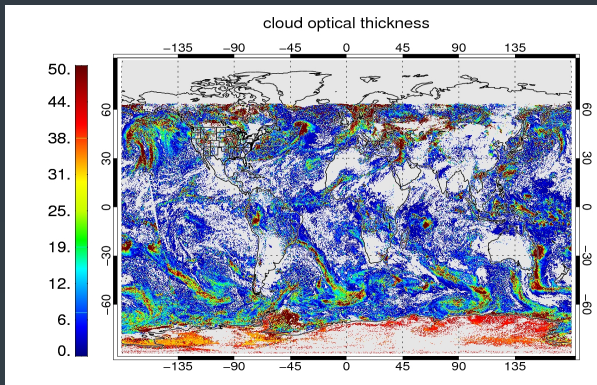
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²NOAA/NESDIS/Center for Satellite Applications and Research

¹University of Wisconsin, CIMSS, Madison Wisconsin

Motivation

NPP-VIIRS/CLAVR-x
COD composite:



GEWEX Assessment Report:

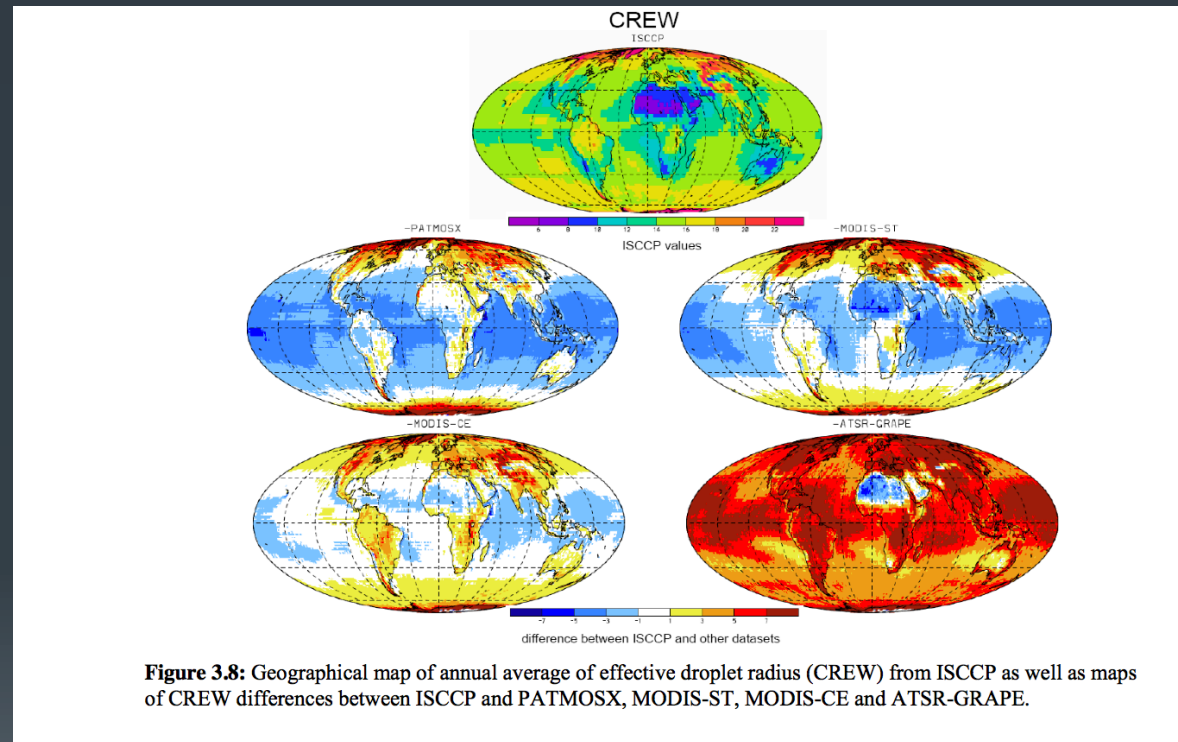


Figure 3.8: Geographical map of annual average of effective droplet radius (CREW) from ISCCP as well as maps of CREW differences between ISCCP and PATMOSX, MODIS-ST, MODIS-CE and ATSR-GRAPE.

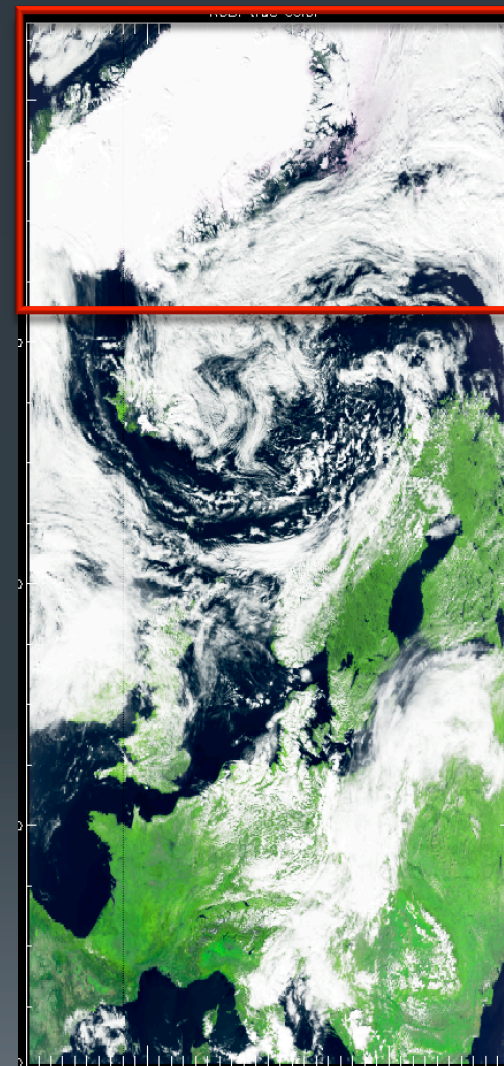
Comparison study

- Cloud detection
- Cloud Optical Thickness
- Effective Radius

NPP/ VIIRS 20 August 2013 12 UTC
orbit

Daytime scene over Greenland

PPS = CM-SAF
LARC = NASA Langley
CHM = NASA Goddard
CLAVER-x = CIMSS Madison



CLAVR-x Cloud detection

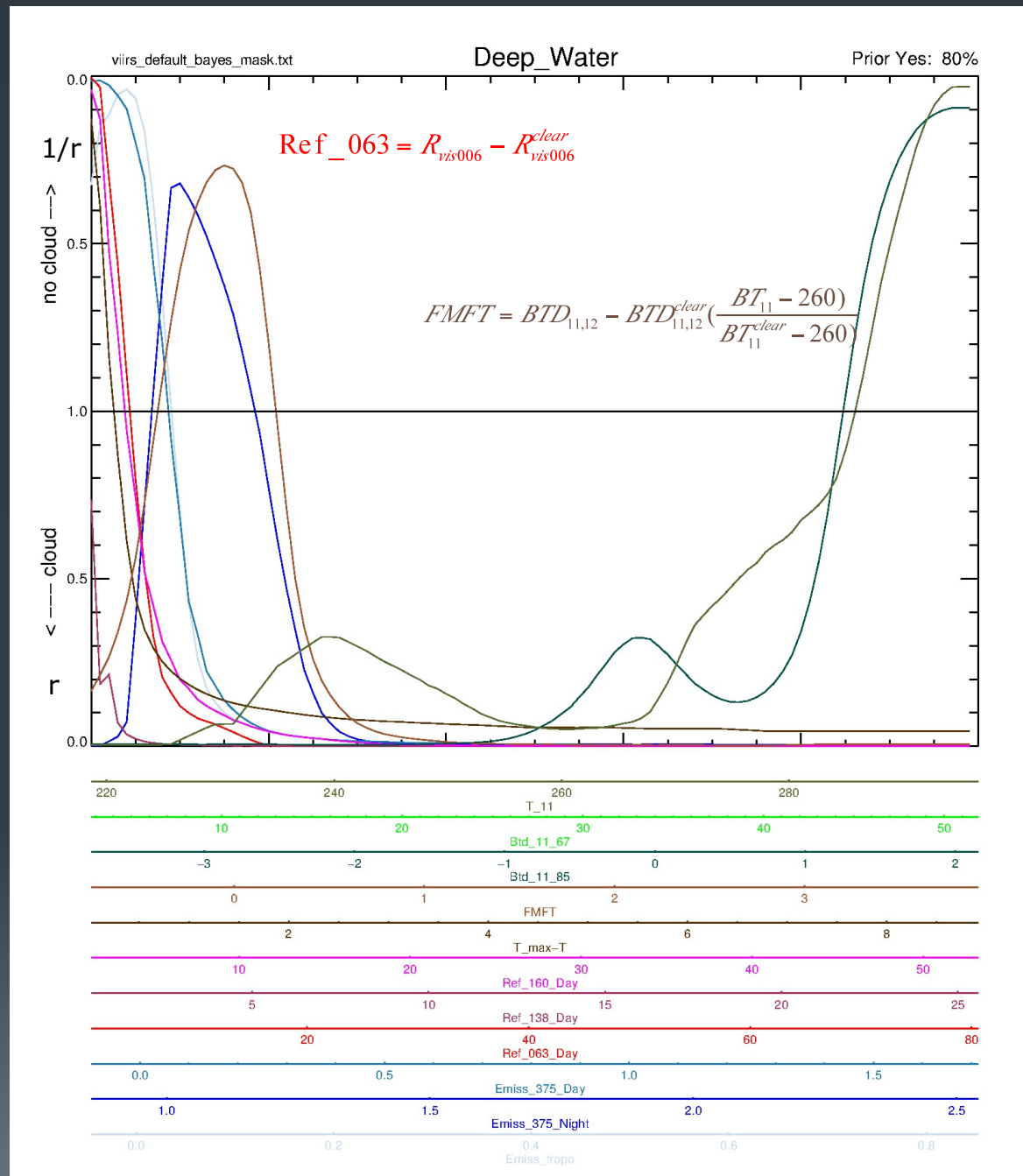
Naïve Bayesian formulation:

$$p_{bl} = \frac{P_Y \prod_i Y}{P_Y \prod_i Y + P_N \prod_i N}$$

$$r = \frac{\prod_i N}{\prod_i Y} \quad P_N = 1 - P_Y$$

$$p_{prior} = \frac{1}{1 + \frac{r}{P_Y}} = \frac{1}{1 + r}$$

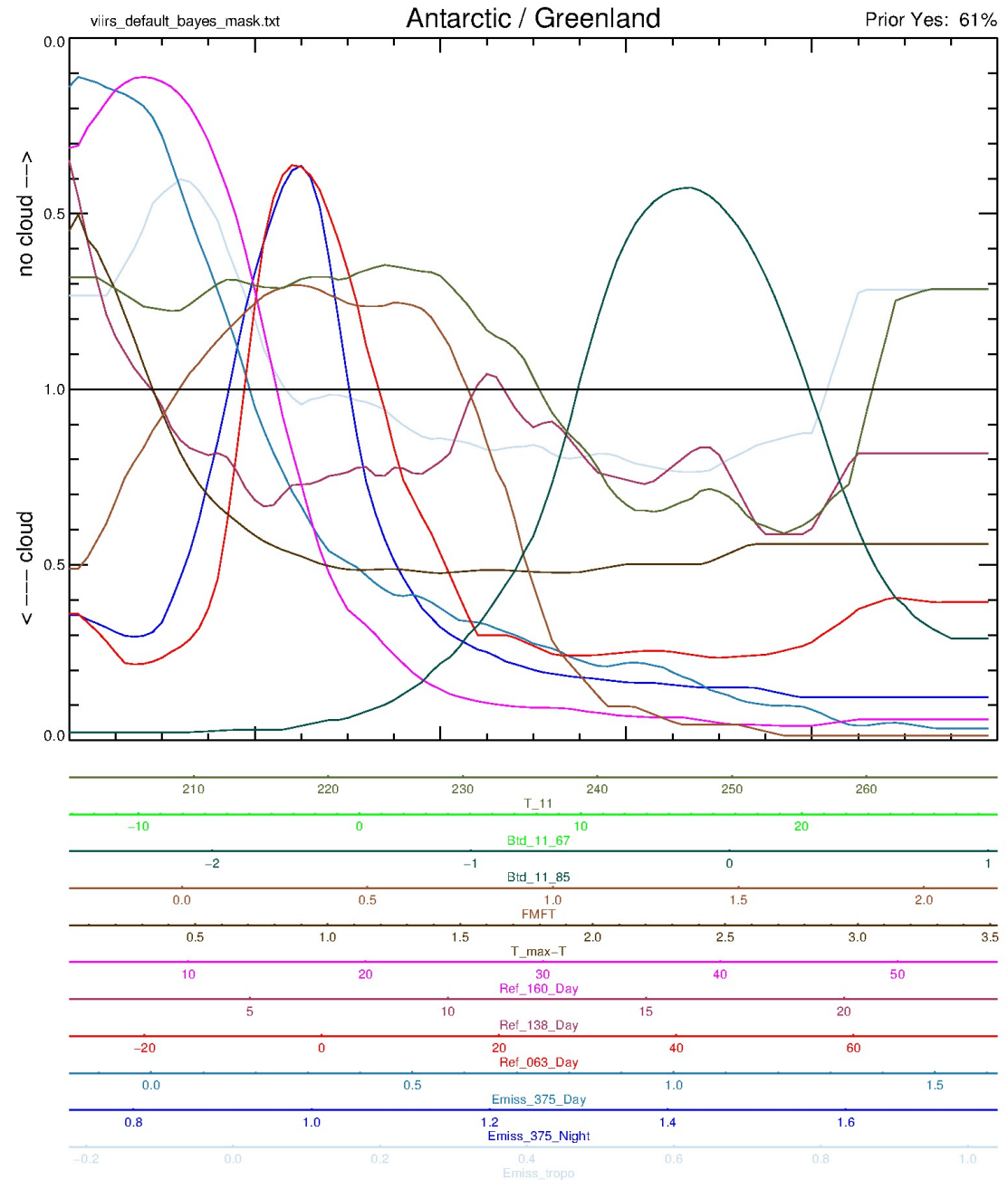
Build from statistics with
 "true" data (CALIPOS
 cloud mask)
 Image shows impact of
 each detection test



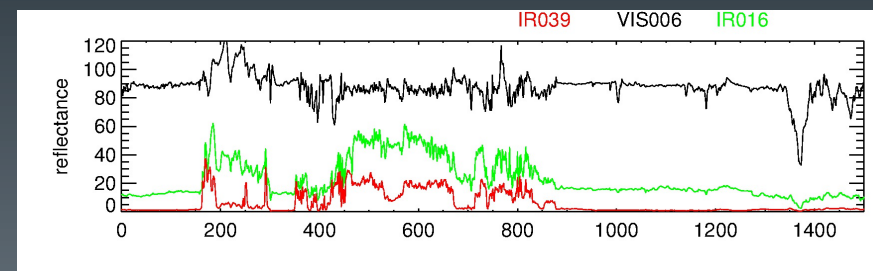
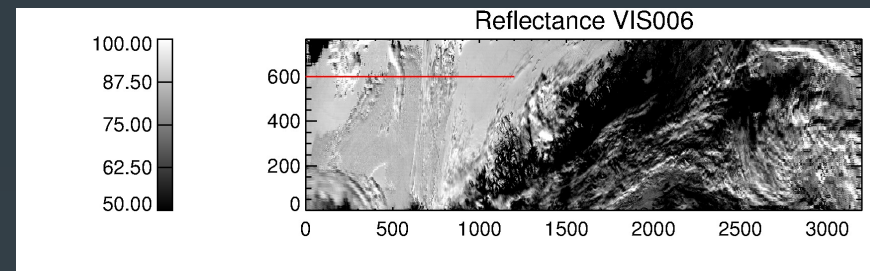
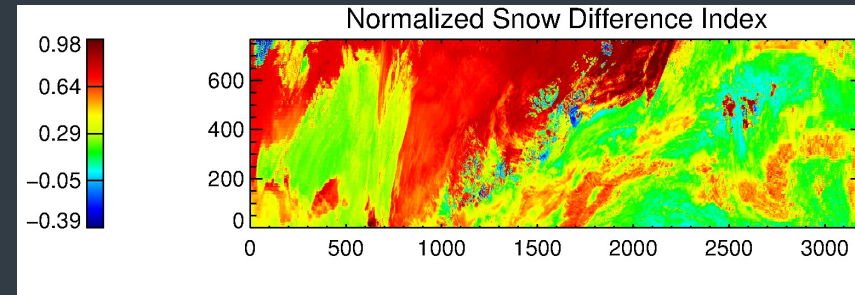
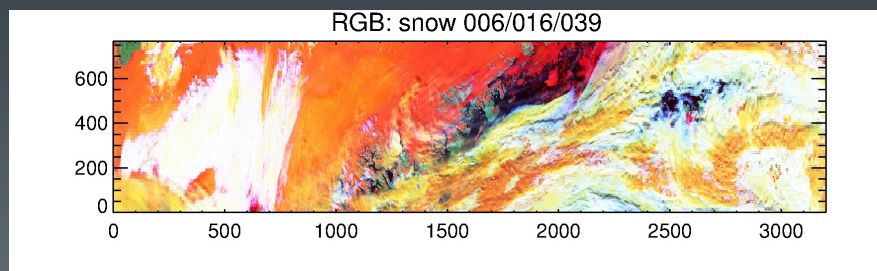
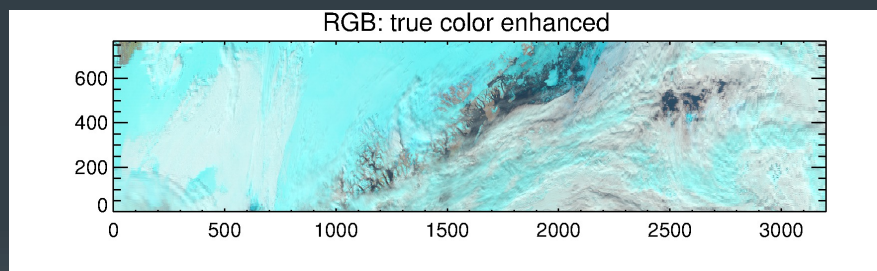
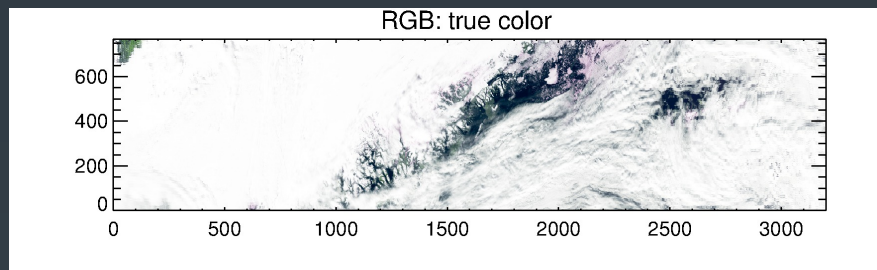
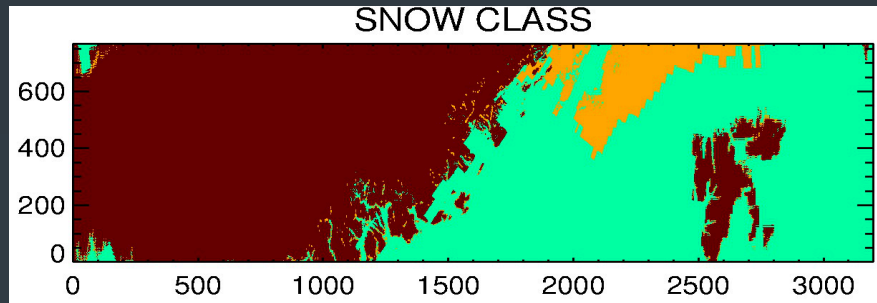
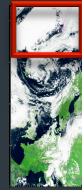
Cloud detection

Image shows weight of each cloud detection test

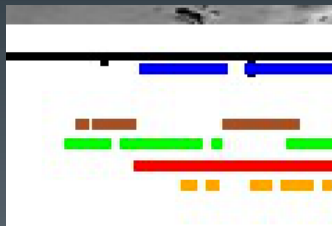
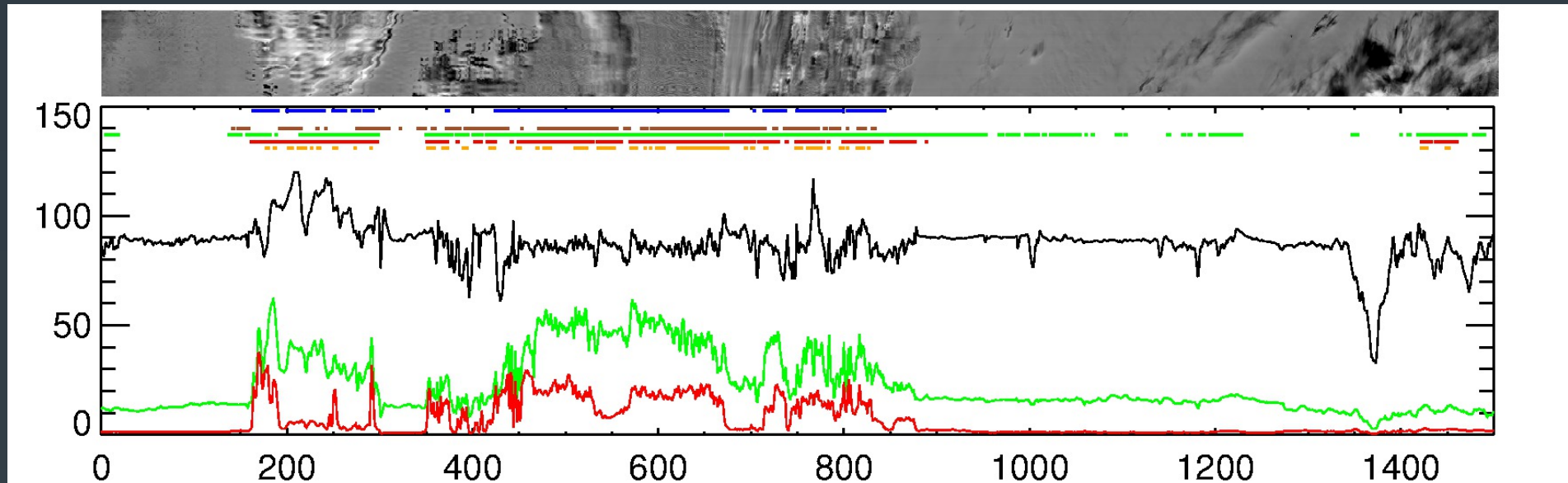
Cloud detection tests over permanent snow surface are less informative than over other surface types



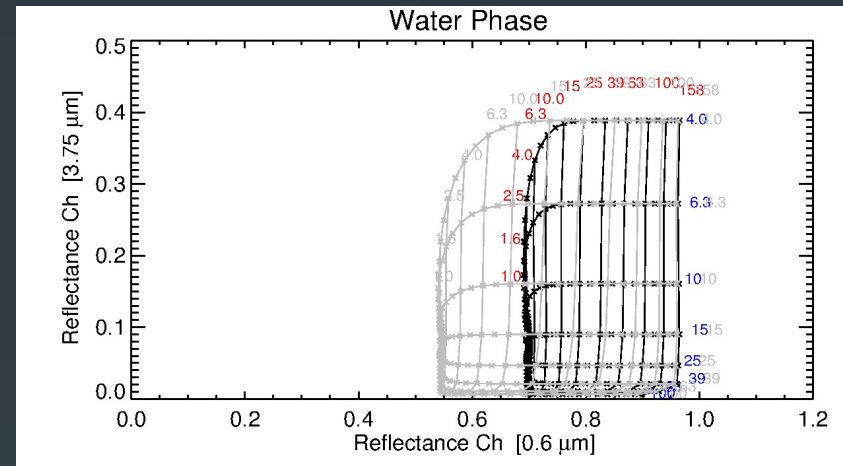
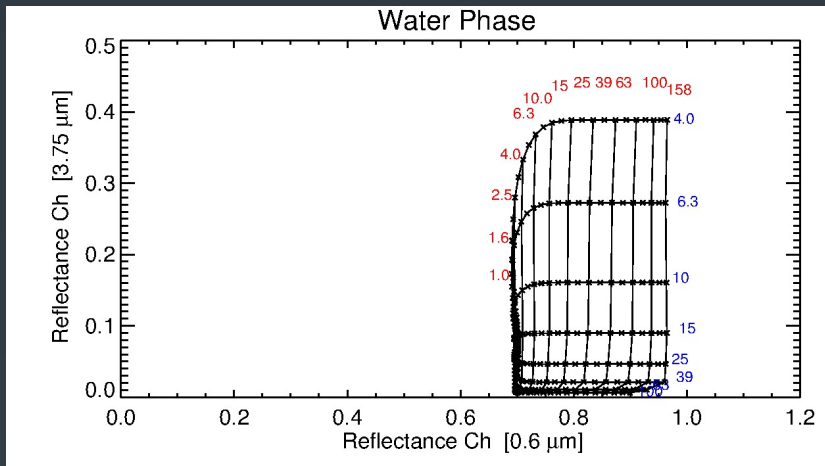
Greenland : cloud masking



Cloud detection



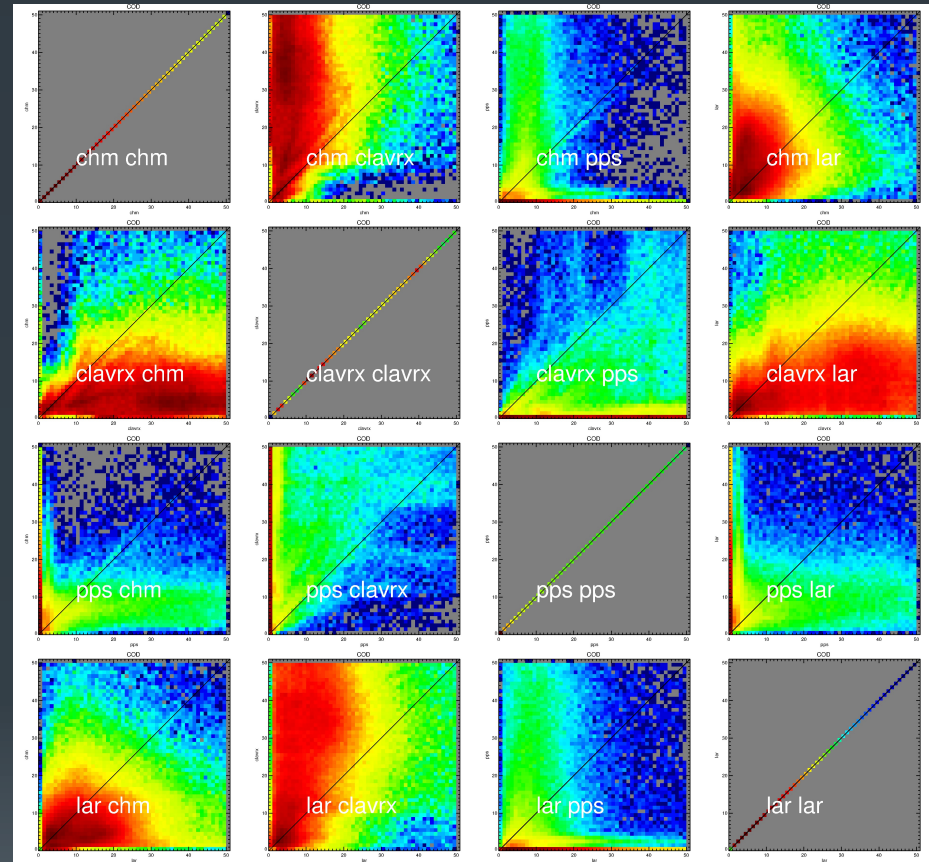
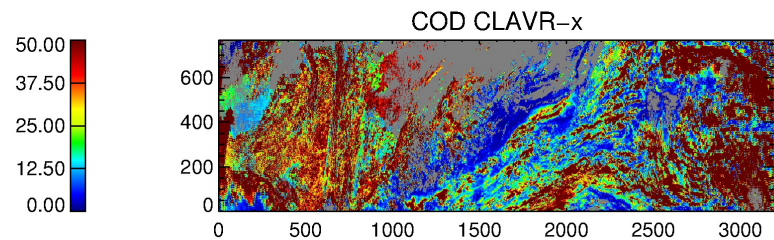
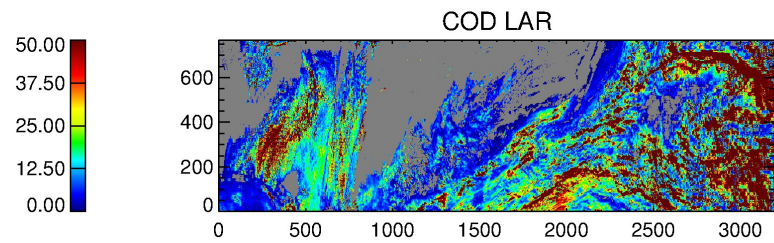
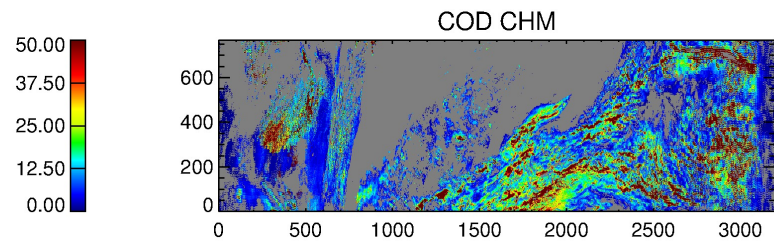
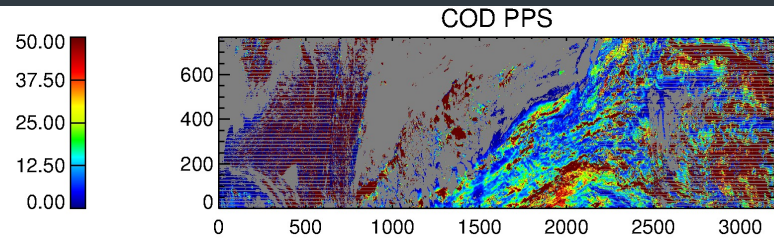
Microphysical retrieval



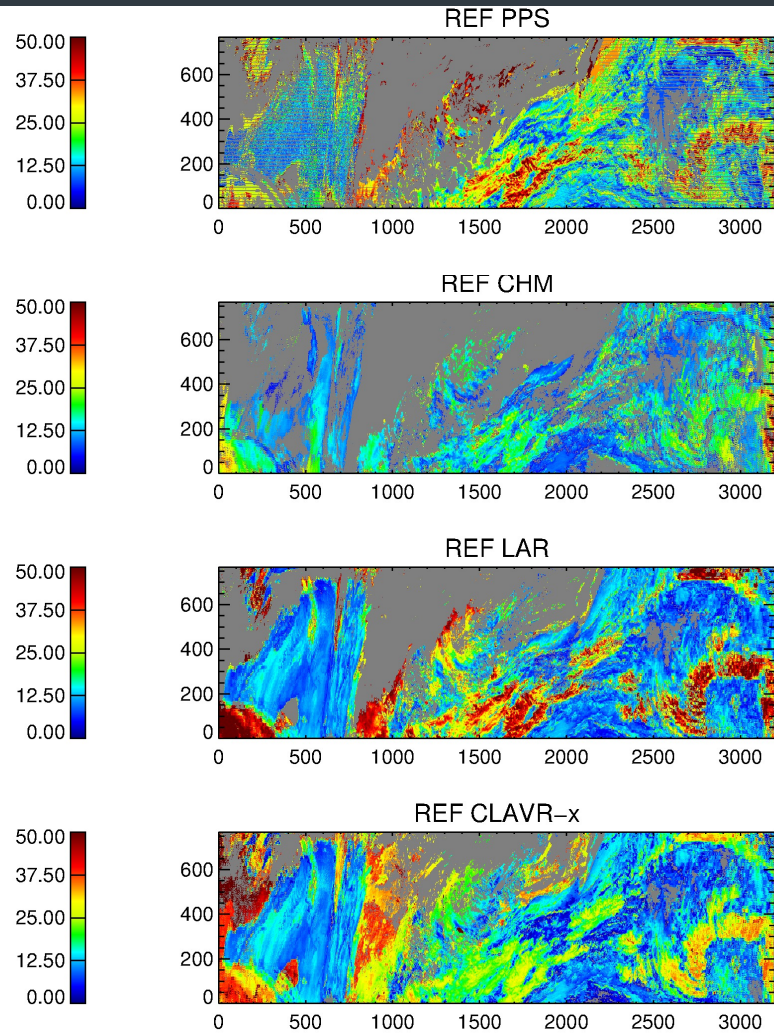
0.6 / 3.75 approach:

- Snow is very bright and has high VIS surface albedo
- Snow albedo is highly variable (uncertain VIS surface albedo)
- → COD is not retrievable
- REF is retrievable with limitations (one-channel approach)

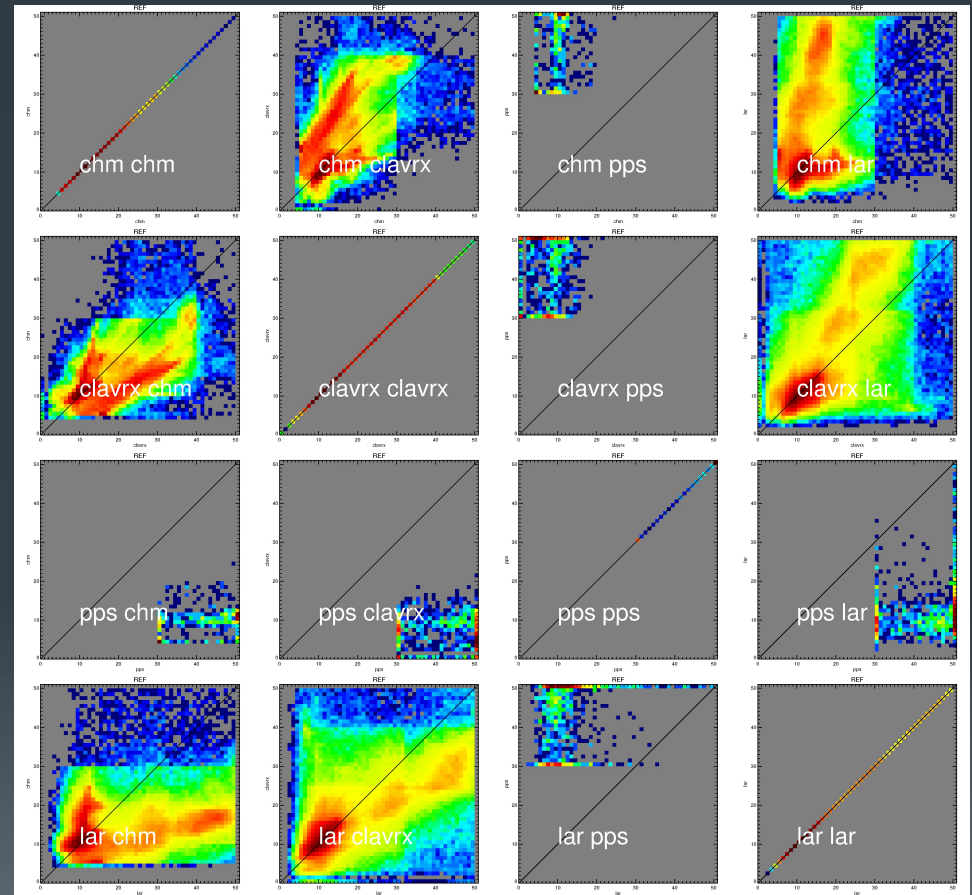
Cloud Optical Thickness



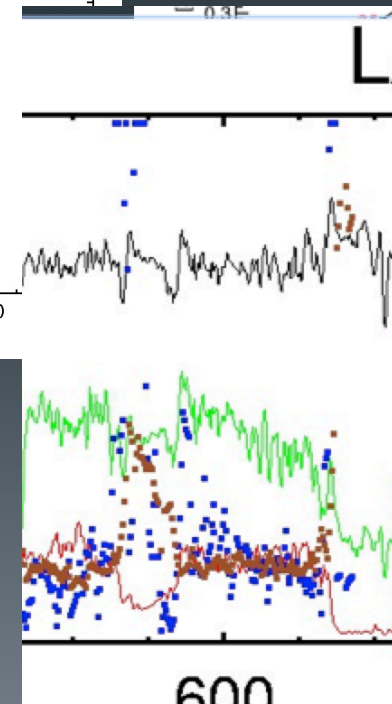
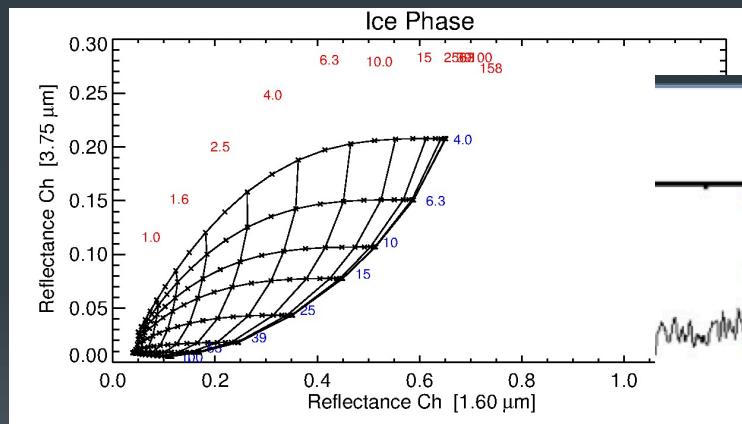
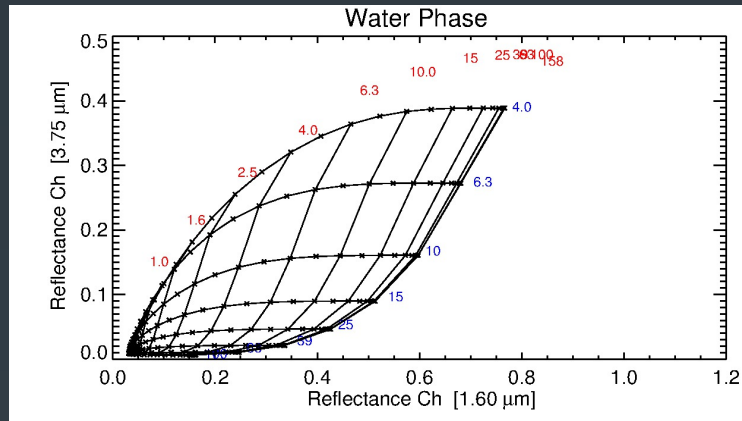
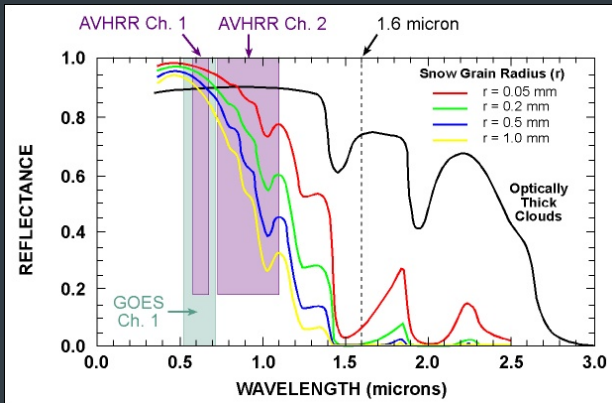
Effective Radius



Snow pixels



Microphysical retrieval



1.6 / 3.75 approach

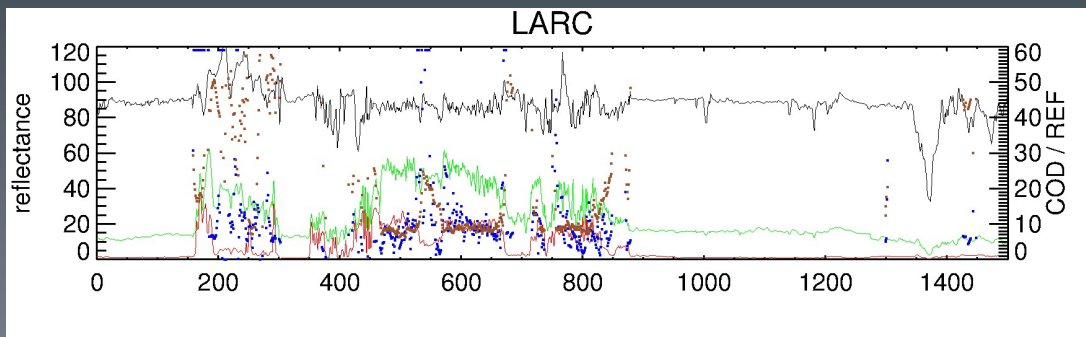
(Steve Platnick et al 2001)

Using two absorption channels:

+ : low snow surface albedo

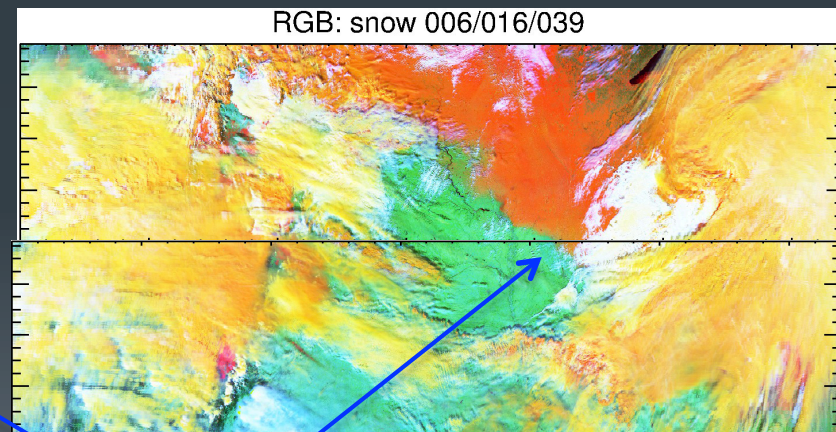
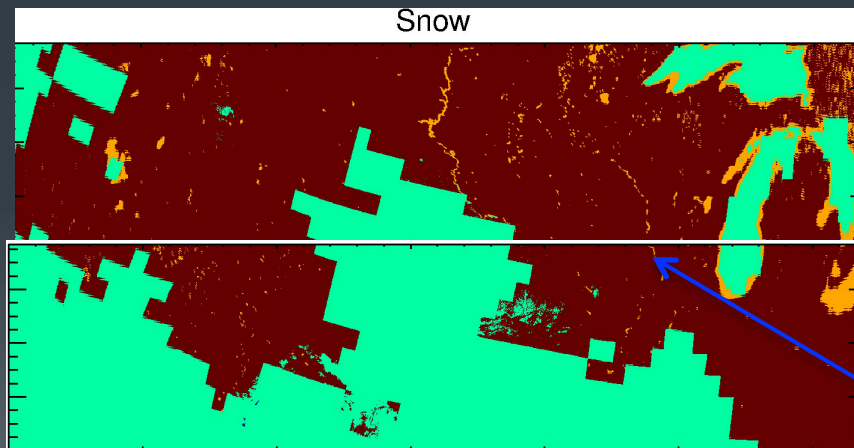
- : low cloud reflectance

less orthogonal forward model



Snow map options

- CFSR NWP snow depth on 0.5 lon / lat grid 6-hourly
- Glob Snow Daily / 25km
- ...
- Combining highly temporally with highly spatially resolved maps
- High uncertainty from false snow/snow-free (and vis-s-vis) assumption.
- Idea: Real-time adjustments from neighbored clear-sky pixel



Map: Snow
Obs: snow-free

Summary



- Evaluation of cloud retrievals over snow shows many difficulties
- Reason is low reflective and thermal contrast to surface conditions and high uncertainty in surface albedo
- But we can do better..

Our first steps:

- Additional cloud mask tests based on NDSI to Bayesian cloud mask.
- CLAVR-x DCOMP will have added 1.6/3.75 channel combination over snow.
- Snow map options have to be evaluated.
- Breakout Session “Retrievals over snow and sea ice” today 1:15pm