Request for
Snow Cover EDR Beta Maturity

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Outline

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- Beta EDR Maturity Definition
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- Snow Cover EDR requirements
- History of Algorithm Changes/Updates
- Beta Maturity Evaluation
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- Conclusions

Snow Cover EDR Product Users

- U.S. Users
  - NOHRSC - National Operational Hydrological Remote Sensing Center
  - NSIDC, National Snow Ice Data Center
  - NIC, National/Naval Ice Center
  - OSPO, Office of Satellite and Product Operations
  - STAR, Center for Satellite Applications and Research
  - GSFC, NASA/Goddard Space Flight Center Hydrological Sciences Branch
  - NWS, National Weather Service, including the Alaska Ice Desk
  - CLASS, Comprehensive Large Array-data Stewardship System

- User Community
  - Transportation
  - Agriculture and Hydrology
  - Emergency Management
  - Operational Weather Prediction
  - Climate Research
  - DOD

Beta EDR Maturity Definition

- Early release product.
- Minimally validated.
- May still contain significant errors.
- Versioning not established until a baseline is determined.
- Available to allow users to gain familiarity with data formats and parameters.
- Product is not appropriate as the basis for quantitative scientific publication studies and applications.

VIIRS Snow Cover EDR

- The VIIRS Snow Cover/Depth Environmental Data Record (EDR) products consist of a snow/no snow binary map and snow fraction in a horizontal cell.
- The objective of the VIIRS retrieval is to achieve the performance specifications designed to meet the requirements stated in the JPSS L1RD Supplement.
- The specifications apply under clear, daytime conditions only. Surface properties cannot be observed through cloud cover by a Visible/Infrared (VIS/IR) sensor.
- The specification for the Snow Cover/Depth EDR places requirements on the VIIRS binary map product and the VIIRS snow fraction product.

Specification of the VIIRS Binary Map

Parameter	Specification Value
a. Binary Horizontal Cell Size,	
1. Clear – daytime (Worst case)	0.8 km
2. Clear – daytime (At nadir)	0.4 km
3. Cloudy and/or nighttime	N/A
b. Horizontal Reporting Interval	Horizontal Cell Size
c. Snow Depth Range	> 0 cm (Any Thickness)
d. Horizontal Coverage	Land
e. Vertical Coverage	> 0 cm
f. Measurement Range	Snow / No snow
g. Probability of Correct Typing	90%
h. Mapping Uncertainty	1.5 km

Specification of the VIIRS Snow Fraction

Parameter	Specification Value
a. Horizontal Cell Size,	
1. Clear – daytime (Worst case)	1.6 km
2. Clear – daytime (At nadir)	0.8 km
3. Cloudy and/or nighttime	N/A
b. Horizontal Reporting Interval	Horizontal Cell Size
c. Snow Depth Ranges	> 0 cm (Any Thickness)
d. Horizontal Coverage	Land
e. Vertical Coverage	> 0 cm
f. Measurement Range	0 – 100% of HCS
g. Measurement Uncertainty	10% of HCS (Snow/No Snow)
h. Mapping Uncertainty	1.5 km

Summary of the Snow Cover EDR Algorithm Inputs

xDRs & IPs

VIIRS 375m SDRs I1, I2, I3, I5
VIIRS 750m SDRs M15, M16
VIIRS 375m TC GEO
VIIRS 750m TC GEO
VIIRS Cloud Mask IP
VIIRS AOT IP
VIIRS COP IP

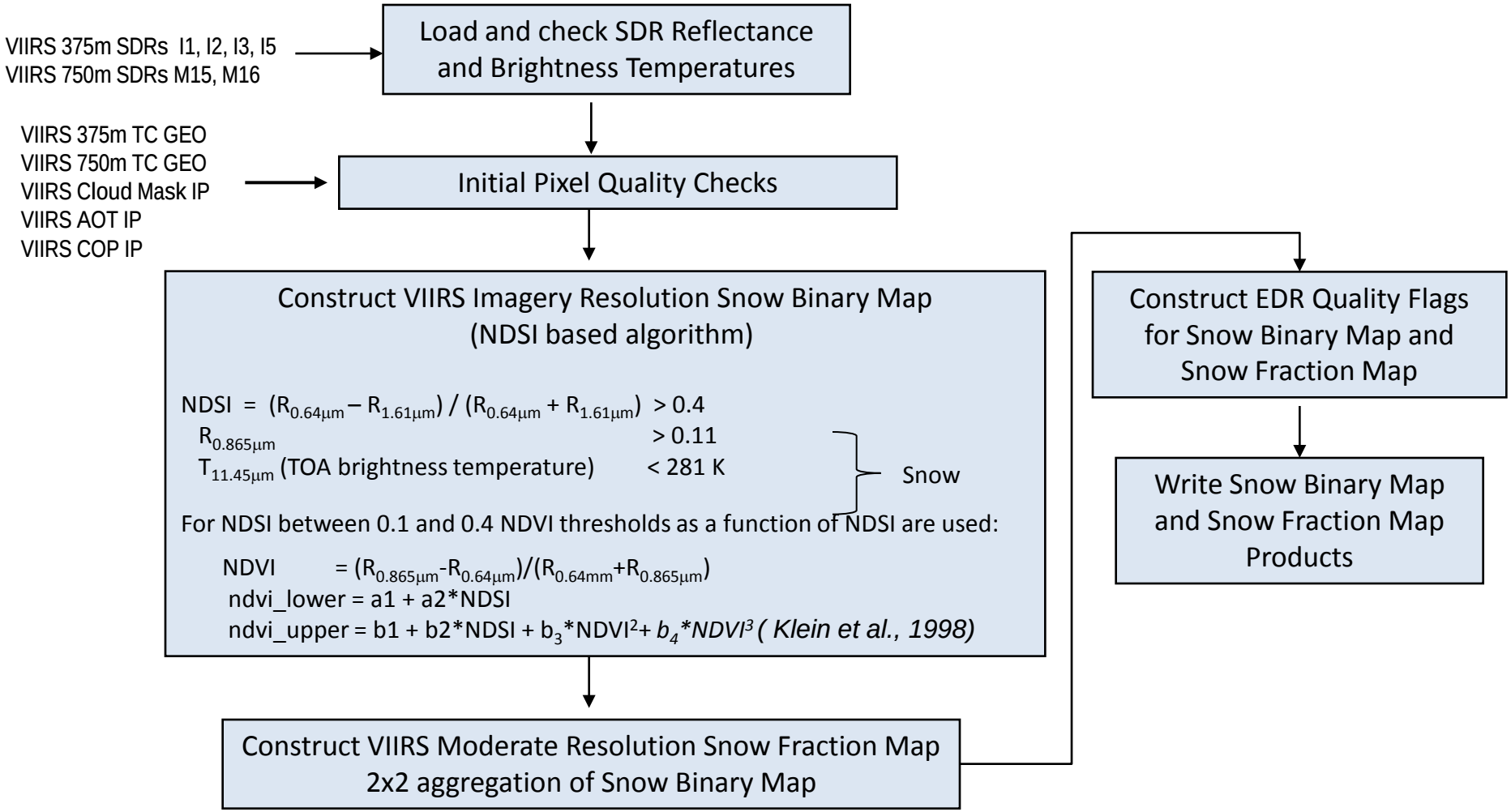
Auxiliary Data

VIIRS Snow Cover Tunable Parameter File
VIIRS Snow Cover Quality Tunable Parameter

Output EDRs & IPs

VIIRS Snow Cover Binary Map EDR
VIIRS Snow Cover Fraction EDR

Snow Cover EDR Processing Flow



Snow Cover EDR Algorithm

- The VIIRS Snow Cover EDR algorithm is an adaptation of the heritage MODIS SnowMap algorithm (Hall et.al 2001) that classifies snow based upon the Normalized Difference Snow Index (NDSI) and additional reflectance, thermal and NDVI thresholds.
- The EDR consists of two products: (1) snow binary map (375 m spatial resolution @nadir) and (2) a snow fraction map (750 m spatial resolution @nadir) that is derived from the binary map as a 2x2 aggregated snow fraction.
- The VIIRS algorithm adaptations from that of the MODIS heritage are: (1) use of a TOA brightness temperature for thermal false snow screening instead of a surface temperature and (2) use of the VIIRS imagery resolution 0.645μm (I1) reflectance in the NDSI instead of the 0.555 μm reflectance used by the MODIS algorithm.

History of Algorithm changes/updates (1/2)

Date	Update/DR#	Reason	Completed
12-20-2010	VIIRS Snow Cover EDR Look-up/DR4138	Updated false snow thermal screening threshold. Previous threshold value was based on MODIS data. New threshold values has been derived from VIIRS F1 test program results	No indication that the work has been completed
03-31-2011	Snow algorithm inconsistent with new requirements/DR 4246	Operational approach for snow fraction retrieval is inadequate	Not Completed
04-10-2013 (last update)	Snow EDR has fixed limit setting on solar zenith angle (SZA)/DR4895	Need to remove the fixed limits on solar zenith angle and make the limits tunable	Not Completed
04-25-2012	Alternative snow/ice grid needed to support algorithms/DR470	Need to modify the Snow/Ice GranToGrid algorithm to make use of the NOAA Global Multisensor Automated Snow/Ice Map	Not Completed

History of Algorithm changes/updates (2/2)

Date	Update/DR#	Reason	Completed
06-18-2012	VIIRS-SNOW-COVER-QUAL LUT SZA Thresholds/DR4787	Updates needed to solar zenith angle thresholds in the VIIRS-SNOW-COVER-QUAL LUT and to the seed data for the GridIP-VIIRS-Snow-Ice-Cover-Rolling-Tile dataset	Completed
04-12-2013	Request for Beta Maturity Status for VIIRS Cryospheres EDRs and Ips/DR7132	Approval requested for the Snow Cover EDR (a snow / no snow binary map product).	Not Completed

Beta Maturity Evaluation of the

Binary Snow Cover Product

Beta Maturity Evaluation Approach, Binary Snow Cover (1/3)

- Maturity evaluation approach:
  - Visual analysis of the product, identification of obvious failures of the algorithm/product including
    - Missed snow in the regions which are known to be always snow covered at the time of the year when observations were made
    - Mapped snow in the regions which are known to be always snow-free at the given time of the year
  - Comparison of VIIRS Snow Cover EDR with independent in situ and remote sensing-based information on the snow cover distribution including
    - In situ snow cover observations
    - IMS interactive snow cover analysis
    - MODIS Terra/Aqua snow cover maps
    - METOP AVHRR snow cover maps

Beta Maturity Evaluation Approach, Binary Snow Cover (2/3)

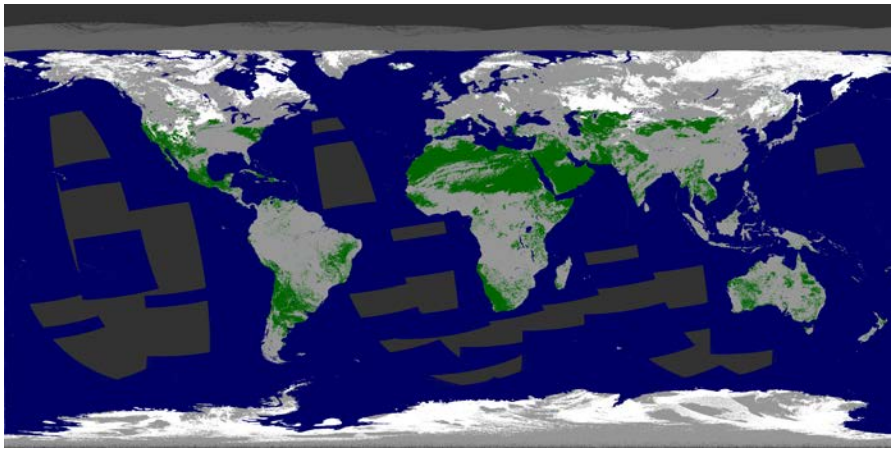
- Details:
  - Evaluation has been performed
    - Globally for the visual analysis and when comparing with MODIS and AVHRR products
    - Over Northern Hemisphere when comparing with IMS
    - Over Continental US (CONUS) when comparing to station data
  - Time period when comparison has been conducted
    - Routine comparison since the beginning of the VIIRS snow product generation
    - Maturity assessment is based on the VIIRS snow maps generated in the last four months period (December 2012-March 2013) when no major changes were introduced to the VIIRS cloud mask (VCM)
    - VIIRS global snow data were acquired and processed on every third day

Beta Maturity Evaluation Approach, Binary Snow Cover (3/3)

- More details:
  - Preprocessing of VIIRS snow retrievals
    - All daily granules have been processed to generate gridded daily global snow cover map
      - 1, 5 km and 10 km grid cells size
    - Two cloud masks were tested, “conservative” and “relaxed”
      - “relaxed” cloud mask included observations identified as “confidently cloudy” and “probably cloudy”
      - “conservative cloud mask included observations identified as “confidently cloudy” , “probably cloudy” and “probably clear”

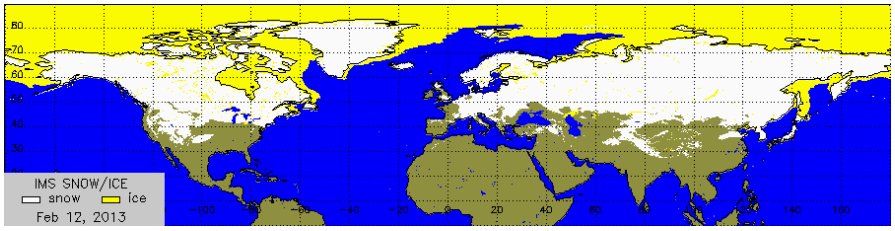
Beta Maturity Evaluation, Qualitative analysis of VIIRS binary snow maps

VIIRS snow map



snow land cloud No data

IMS Snow and Ice Chart



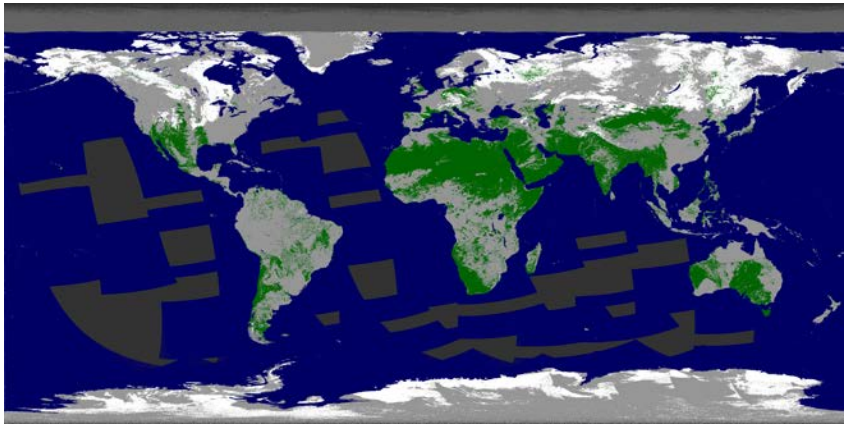
February 12, 2013

Qualitative analysis of the VIIRS Binary Snow maps (which are part of the Snow Cover EDR) has shown that this product provides realistic characterization of the global-scale snow cover distribution.

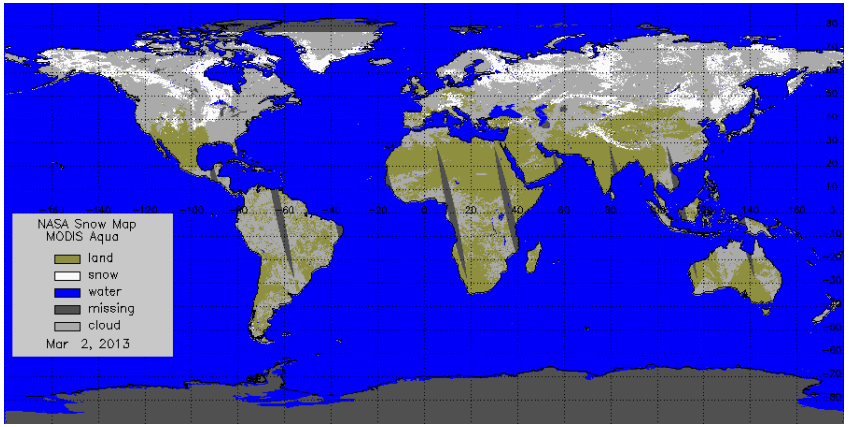
In clear sky portions of the image snow mapped by VIIRS closely corresponds to the snow cover identified interactively by IMS analysts.

Beta Maturity Evaluation – VIIRS vs MODIS Binary Snow Map

NPP-Suomi VIIRS snow cover map



MODIS Aqua snow cover map



March 2, 2013 (day 2013061)

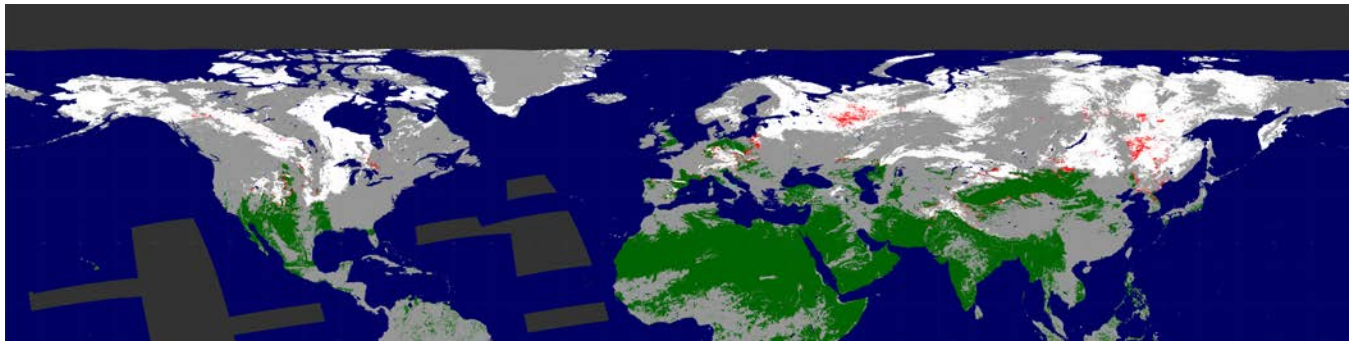
Visual analysis has shown that VIIRS binary snow maps compare well to MODIS Aqua snow maps. There are some differences in the cloud mask applied in the two products.

No severe overestimates or underestimates of the snow cover have been found in the VIIRS snow product.

Beta Maturity Evaluation – VIIRS vs IMS Quantitative Comparison

To facilitate the analysis of the VIIRS binary snow product accuracy we have brought VIIRS and IMS snow maps to the same projection and generated an overlay of the two maps.

VIIRS binary snow cover with IMS overlaid (March 2, 2013)



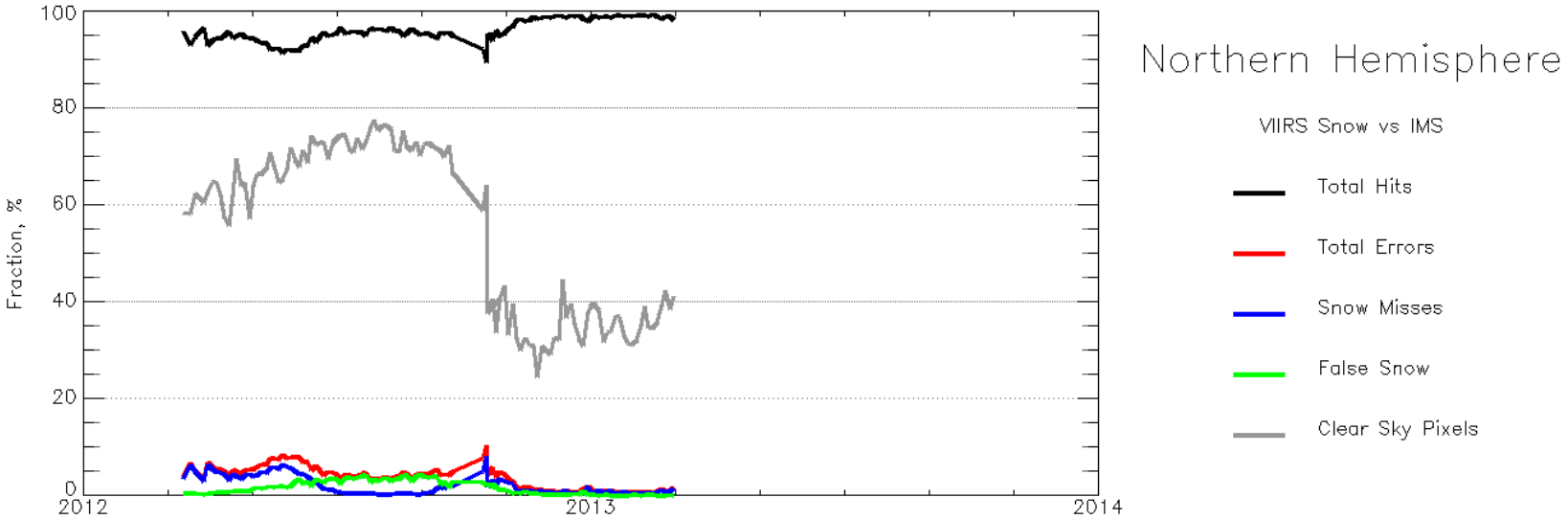
White: VIIRS & IMS snow
Light Gray: VIIRS clouds
Green: VIIRS & IMS snow-free land
Dark gray: not processed, or no data

VIIRS snow map errors: Omission (snow miss) Commission (false snow)

The agreement between the two maps on the snow cover distribution calculated in cloud-clear portions of the VIIRS product over the Northern Hemisphere was 98.3%. Omission and commission errors comprised 1.6 and 0.1% respectively. Snow omissions occur mostly over densely forested areas.

Beta Maturity Evaluation – VIIRS Binary Snow vs IMS Time Series

Time series of estimates of correspondence between the VIIRS binary snow map and the IMS snow product



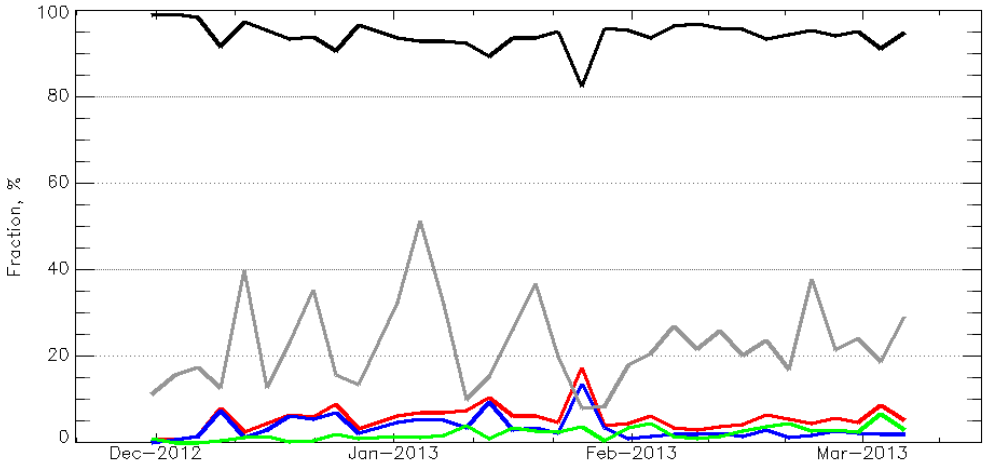
- VIIRS binary snow map data aggregated within 4 km size grid cells
- Each 4 km grid cell was then labeled according to the dominant category of pixels in it
- Comparison was performed by matching the two products grid cell by grid cell

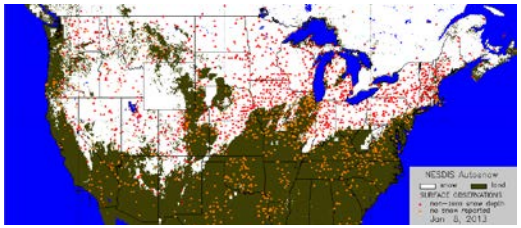
"Total hits" include snow-snow and land-land correct classifications
"Total errors" include VIIRS snow misses and VIIRS false snow identifications
The percent of Clear Sky Pixels in the VIIRS product is given for the 25-60^0 N latitude band

A noticeable drop in the amount of available cloud-clear grid cells in the VIIRS product in October 2012 corresponds to substantial changes the cloud team introduced to the cloud algorithm. Since the end of 2013 the agreement between the two products over Northern Hemisphere remains above 98%.

VIIRS Binary Snow Map vs In Situ Snow Observations

Daily statistics of correspondence between VIIRS snow and in situ data.





North America

Location of US Coop Stations

VIIRS Snow vs Station Data

- Total Hits
- Total Errors
- Snow Misses
- False Snow
- Fraction of Stations Used

"Total hits" include correct snow-snow and land-land classifications
"Total errors" include VIIRS snow misses and VIIRS false snow identifications

Observations from US Cooperative network stations over Continental US have been used. The number of daily VIIRS-in situ match ups ranges from 150 to 1030.

Except of one day disagreement between VIIRS daily snow retrievals and in situ data did not exceed 10%.

VIIRS Binary Snow Cover: Cloud Flag Issue (1/2)

VIIRS snow maps were produced with two cloud masks, "**relaxed**" and "**conservative**". The "relaxed" cloud mask included "confidently cloudy" and "probably cloudy" categories. The "conservative " cloud mask included "confidently cloudy", "probably cloudy" and "probably clear" categories.

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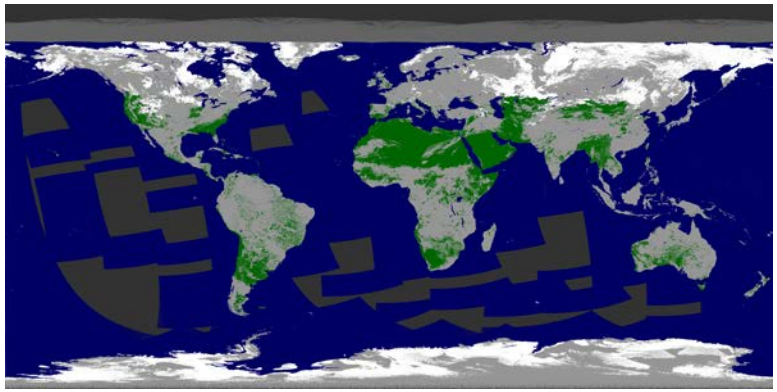
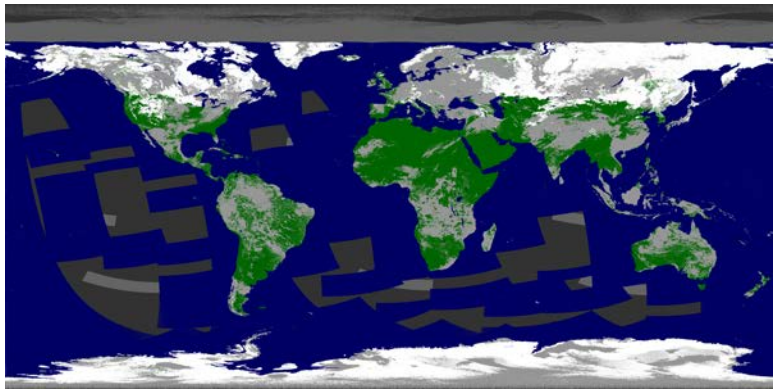
"Conservative" cloud mask used



"Relaxed" cloud mask used



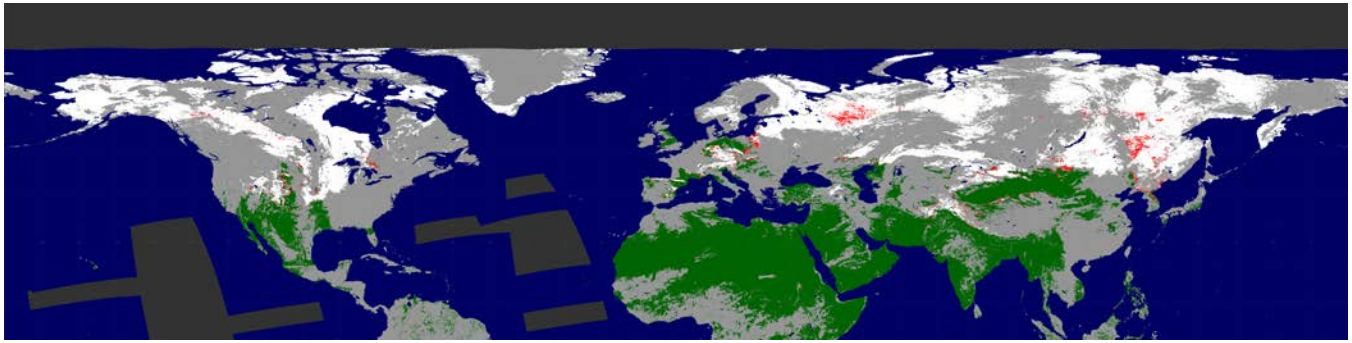
White: snow
Light Gray: clouds
Green: snow-free land
Dark gray: not processed, or no data)

Maps with "conservative" cloud mask have noticeably more clouds than maps with the "relaxed" cloud mask

VIIRS Binary Snow Cover: Cloud Flag Issue (2/2)

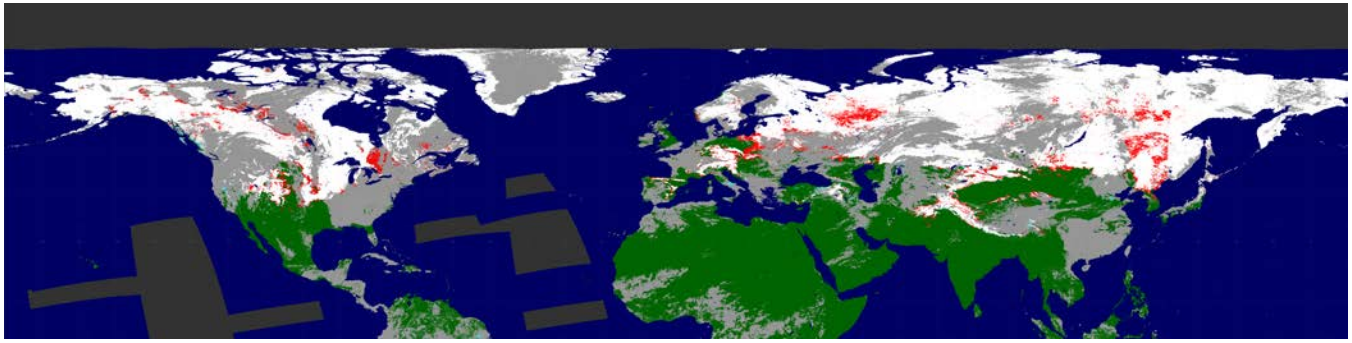
VIIRS maps with different cloud masks were compared with the IMS product.

"Conservative" cloud mask used



White: VIIRS & IMS snow
Light Gray: VIIRS clouds
Green: VIIRS & IMS snow-free land
Dark gray: not processed, or no data

"Relaxed" cloud mask used



VIIRS snow map errors:

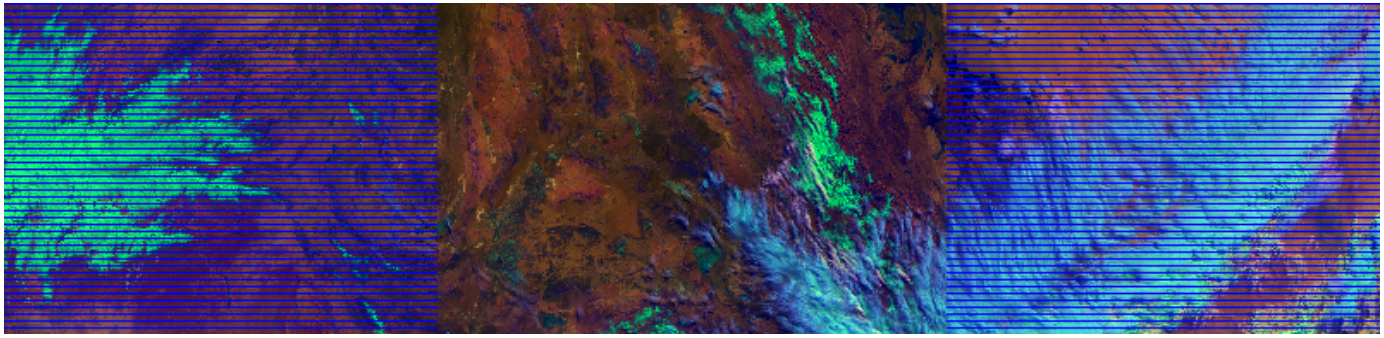
Omission (snow miss)

Commission (false snow)

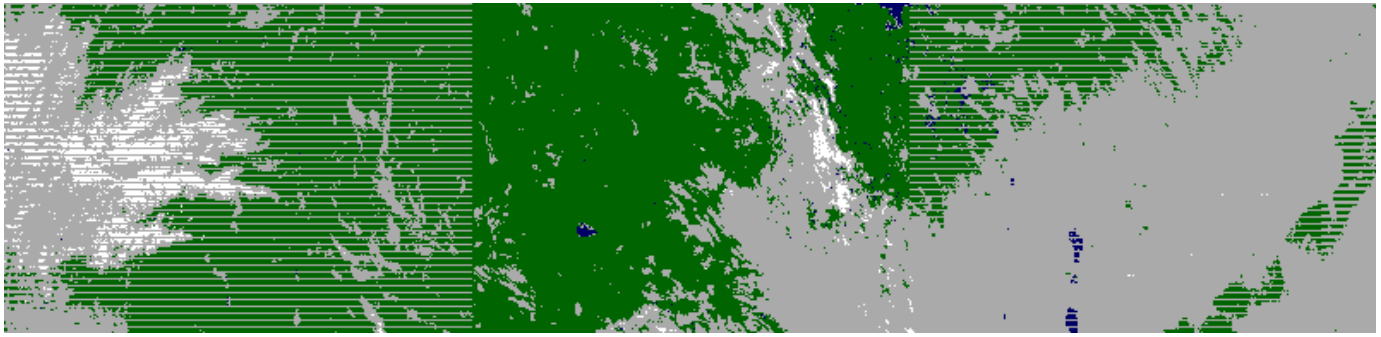
The snow product with a "conservative" cloud mask tends to miss less snow as compared to the snow map with the "relaxed" cloud mask. Therefore at this time it is recommended to us the "conservative" cloud mask.

VIIRS Binary Snow Cover: Other Issues

The use of “conservative” cloud mask results in the cloud clear snow cover scenes frequently labeled as cloudy.



VIIRS RGB granule image



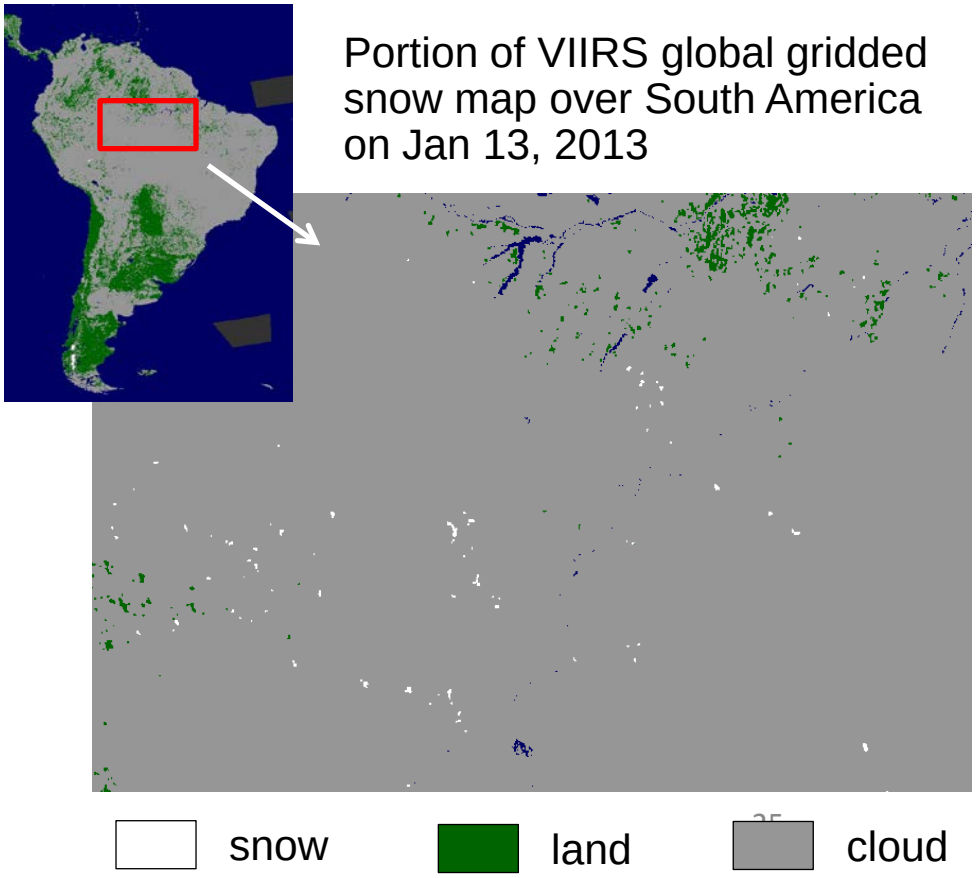
VIIRS granule snow product

snow land cloud No data / not processed

VIIRS Binary Snow Cover: Other Issues

Some clouds are missed by the VIIRS cloud mask (VCM). Missed clouds are most often interpreted as snow and thus may appear in the snow product as spurious snow.

The extent of spurious snow cover is small compared to the true snow. However these errors tend to accumulate in the VIIRS clear sky snow/ice composited images and affect other VIIRS products that rely on them (e.g., LST, NDVI, Albedo, etc)

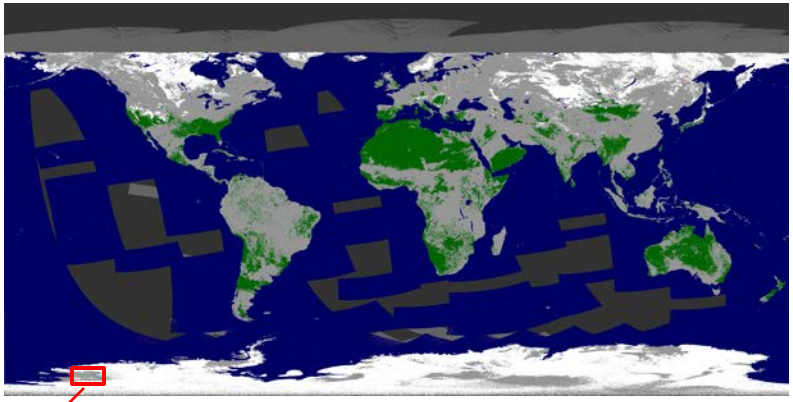


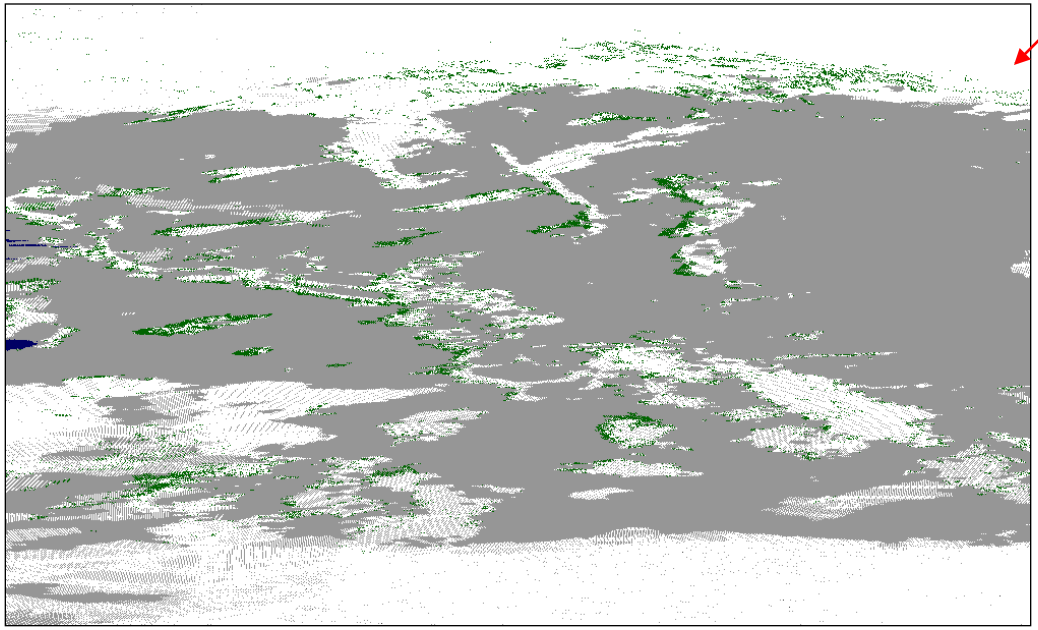
Portion of VIIRS global gridded snow map over South America on Jan 13, 2013

VIIRS Binary Snow Cover: Other Issues

Occasional failures to detect snow shadowed by clouds were noticed in the VIIRS snow product

VIIRS snow cover, January 31, 2013 (day 2013031)



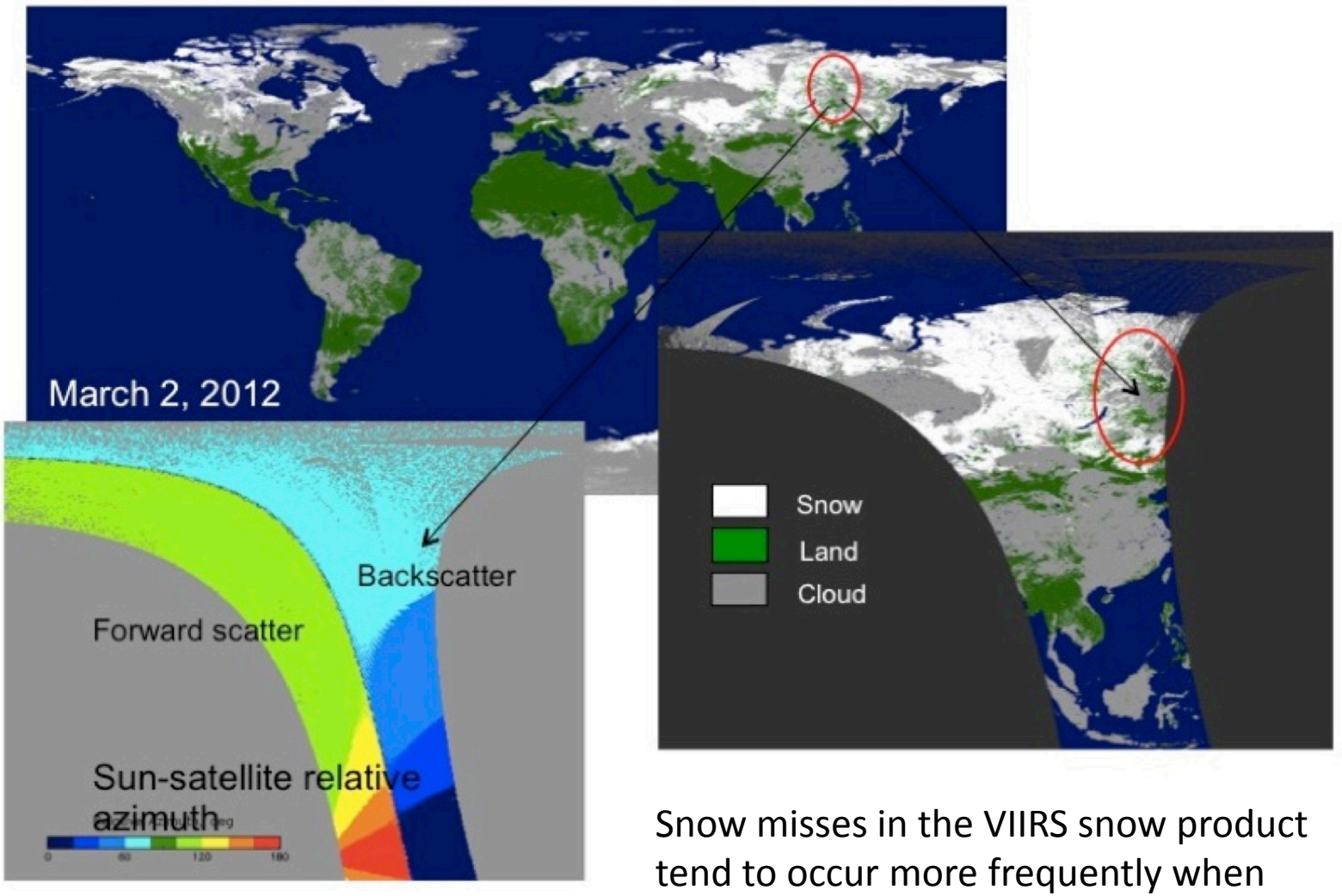


snow

land

cloud

VIIRS Binary Snow Cover: Other Issues



Snow misses in the VIIRS snow product tend to occur more frequently when observations are made in the backscatter

Beta Justification Summary: Binary Snow Cover

- Criteria: Early release product
  - Snow Cover EDR performance is dependent on VIIRS SDR, VIIRS Cloud Mask IP and the Aerosol Optical Thickness IP
    - VIIRS SDR Cal and Geo products reached provisional maturity in March, 2013.
    - VIIRS Cloud Mask IP reached provisional maturity in February, 2013
    - VIIRS Aerosol Optical Thickness reached beta maturity in September 2013
    - VIIRS COP IP has reached beta maturity in March 2013
- Criteria: Minimally validated
  - Evaluation is based on a limited number of focus days (global comparisons for retrieval products)
    - About 40 days during December 2012-March 2013 time period
    - Earlier evaluation results are not valid because of significant modifications introduced to the cloud mask prior to this time period.

Beta Justification Summary: Binary Snow Cover (2/3)

- Criteria: Available to allow users to gain familiarity with data formats and parameters
  - Cryosphere Snow Cover EDR team has evaluated IDPS EDR products available from STAR Central Data Repository (SCDR). Same products are available at NOAA CLASS
    - Users can access and read the products and the product compares reasonably with the heritage satellite snow map products
  - Beta release will allow other users within the community to gain experience with the data formats and parameters.
    - This is important to allow users to complement the validation activity.

Beta Justification Summary: Binary Snow Cover

- Criteria: Product is not appropriate as the basis for quantitative scientific publication studies and applications
  - The product has known flaws but is of sufficient quality to justify use by a broader community.
  - The product may change considerably with the further expected changes to the VIIRS cloud mask.
  - Most of the issues
    - Missing and false snow may be linked to maturing, improving VIIRS Cloud Mask (VCM) and out of date (not daily updated) Grid-VIIRS-Snow-Ice-Cover-Rolling Tiles that affect performance.
  - Comprehensive estimates of the VIIRS snow cover product will become possible once the VIIRS cloud mask algorithm is finalized and allowed to run unchanged for a period of several months. The decision on the provisional status of the product will be made when these estimate are made.

Future Plans and Issues: Binary Snow Cover Product

- Several changes/modifications to the Binary Snow Map algorithm are considered
  - Spatial-based filter to identify potentially spurious snow
  - Climatology-based filter to identify "false snow"
  - Changes to the algorithm threshold values to improve snow detection
    - In the backscatter
    - Over forested areas
- Detailed performance characterization requires:
  - Comprehensive evaluation of the product stratified by the season of the year, climatic/geographic zone and surface cover type
  - A more detailed analysis of the algorithm and product performance at local scales
- Further validation of the VIIRS Binary Snow Map product with the most recent cloud mask is needed before the decision on the provisional maturity of the product can be made

Conclusion: Binary Snow Cover Product

- The **VIIRS Binary Snow Cover Product** (which is part of the VIIRS Snow Cover EDR) has met the beta maturity stage based on the definitions and the evidence shown
  - It exceeds the definition of beta in most cases
  - The product performance is close to meeting requirements at this time.
- Issues have been uncovered during validation of **the VIIRS Binary Snow Cover Product** and solutions are being evaluated.
  - Identified problems are mostly related to failures of the VIIRS cloud mask algorithm and product
  - If the accuracy of the cloud mask does not change as the result of latest improvements, modifications to the VIIRS Binary Snow Map algorithm should be introduced to at least partially compensate for the cloud mask errors

Beta Maturity Evaluation of the

Fractional Snow Cover Product

Binary Snow Product vs Snow Fraction

"Snow cover is the fraction of a given area of the earth's horizontal surface that is masked by snow. In addition, a binary snow/no-snow mask will be produced." JPSS Level 1 Requirements, SUPPLEMENT – Final, Version: 2.3 11/02/2012

- Different requirements
  - Imagery vs moderate resolution
  - Binary classification vs continuous range from 0 to 1
- Different physical meaning and approaches to retrievals
  - Absence / presence vs relative coverage
- Different presentation
  - Thematic maps vs fraction maps
- Different validation
  - Probability of correct classification vs uncertainty

History of Algorithm Evolution

1998-1999 Multiple Endmember Spectral Mixture Analysis (MESMA) developed, implemented, tested and evaluated

2001 Inclusion of BRDF correction factor

2004 Development of modeled Snow Reflectance LUT

2005 Optional processing of snow cover fraction from the binary mask using 2x2 aggregation of the imagery resolution snow binary map incorporated

2007a MESMA "algorithm for computing snow fraction has been developed but is not being implemented operationally "

2007b "2x2 binary map aggregation based snow fraction will be implemented operationally for NPP in place of MESMA"

2010 Sections related to the MESMA snow fraction algorithm eliminated

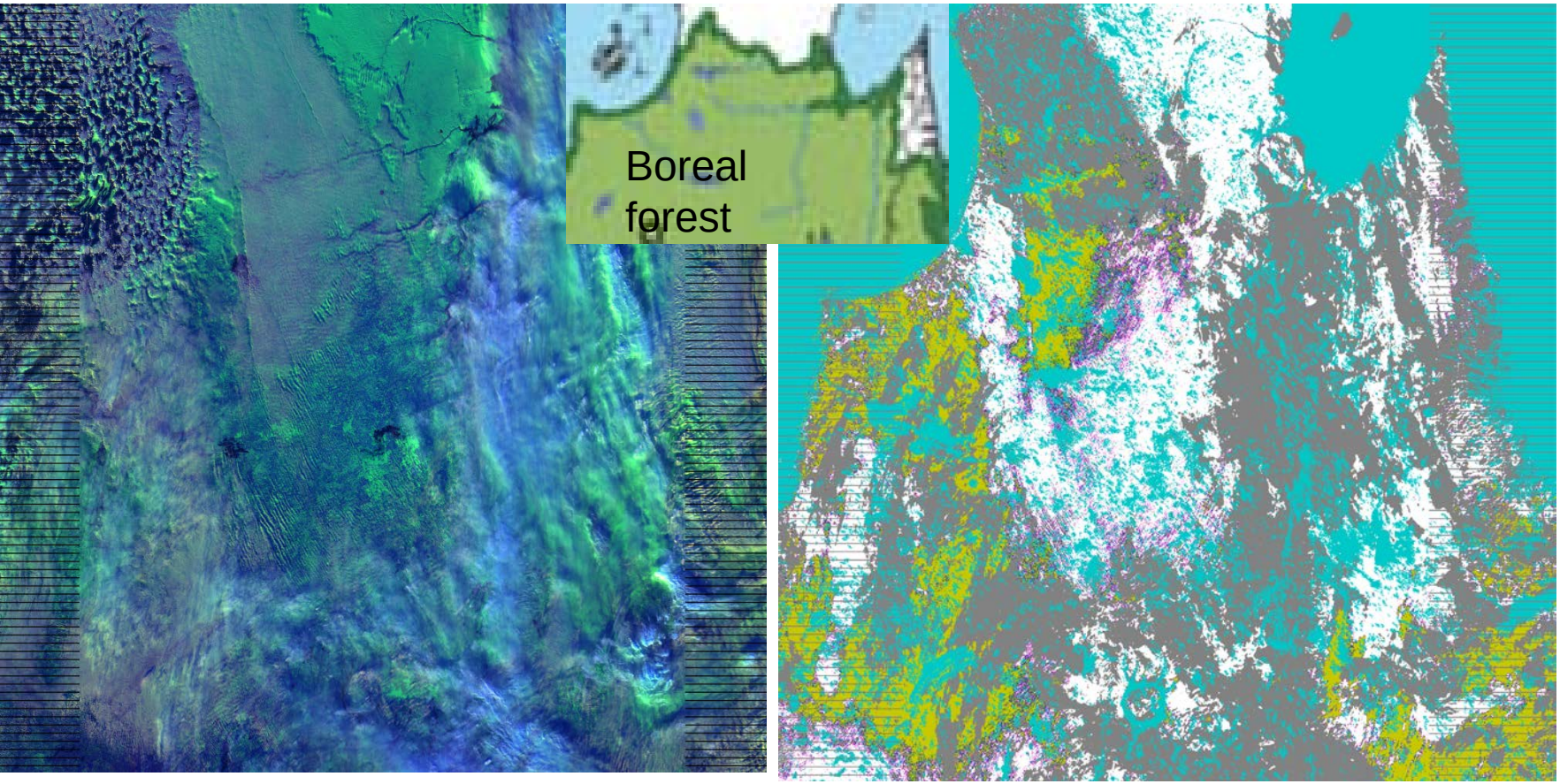
Snow Fraction

- The snow fraction algorithm has undergone significant development since the Critical Design Review (CDR).
- Snow fraction computed using 2x2 aggregation of the binary snow mask, results in reporting of snow fraction in 25% increments.
- The performance of snow fraction is determined by the performance of the snow binary map since the snow fraction is based on a 2x2 aggregation of the snow binary map pixels.
- The snow fraction algorithm will produce an error estimate for each pixel.

Beta Maturity Evaluation Approach

- Daily global calculations of snow fraction aggregated within grid cells of different scales (from 1 km to 0.3°) were used to identify the areas of significant errors.
- Calculated results of fractional snow cover products were compared locally with VIIRS false color imagery presenting ground truth to explore the commission and omission errors in calculations and determine possible reasons of the errors.
- The comparisons of calculations with ground truth were made at the highest possible resolution at pixel scale for 5 min granule in the natural satellite coordinates with X axis corresponding to scan line and Y axis parallel to satellite motion.
- The calculations with modified approach were repeated for individual days to assess the influence of corrections and averaged for a month to consider a systematic picture of changes in the results of calculations

Example of Omission Errors Due to Missing Clouds (yellow zone within white snow cover)



False color image

Snow thematic map

Current Status of Snow Cover Processing

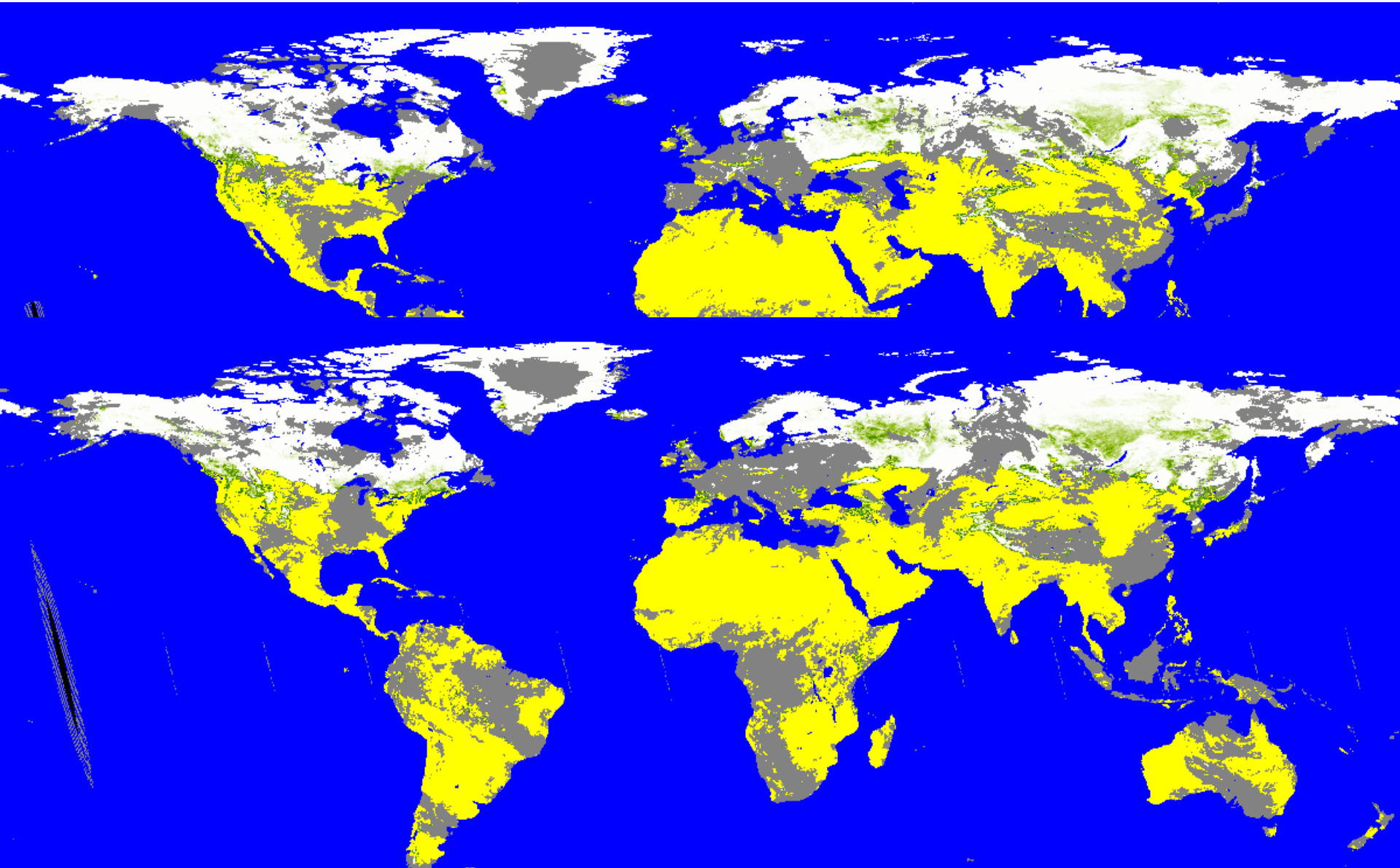
The following improvements have been implemented for calculations:

- New updated cloud mask is used
- Snow retrieved only for “confidently clear” pixels
- Speckle-like false snow in low latitudes is removed by applying double filtering (Minimum number of observations and snow fraction above 0.1)

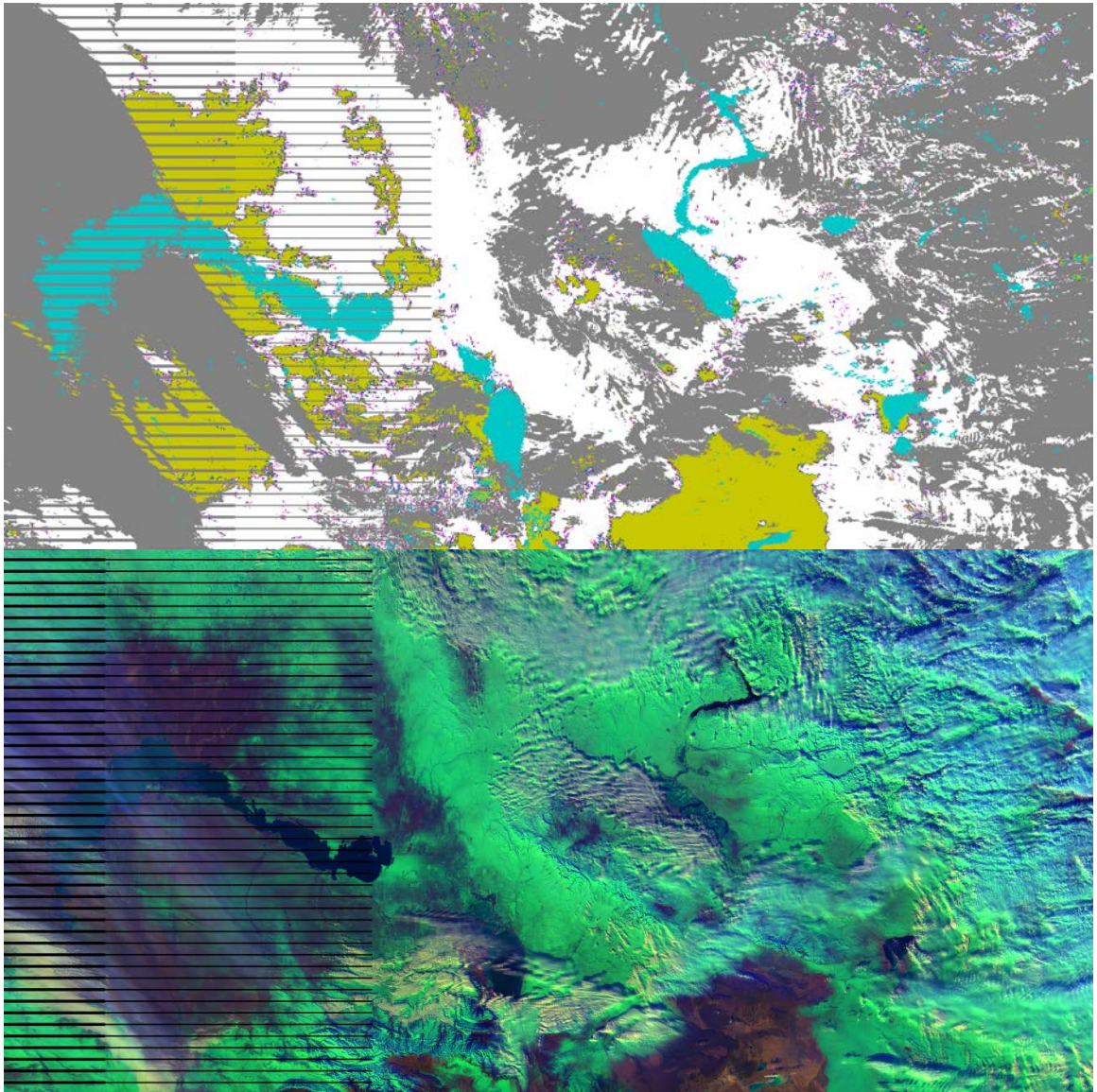
The following results are obtained:

- Daily global calculations provide a systematic picture of Snow Cover distributions without significant commission and omission errors
- The areas of lower snow fraction are associated with the influence of boreal forest mostly in Europe and Asia and to much less degree in Eastern and Western Canada

Snow Cover on March 29 and 30, 2013 (calculations illustrate consistency)



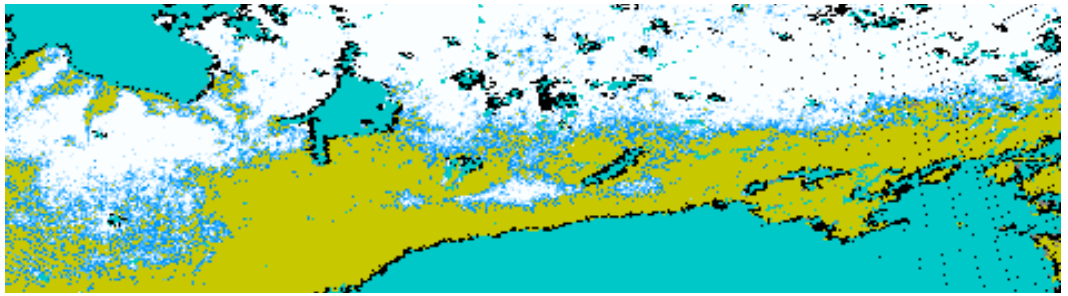
Satisfactory Retrieval of Snow Line (border between snow and non-snow)



The locations of snow free (yellowish) regions in the thematic map (top) closely correspond to the areas without snow easily distinguishable in the false color image (bottom)

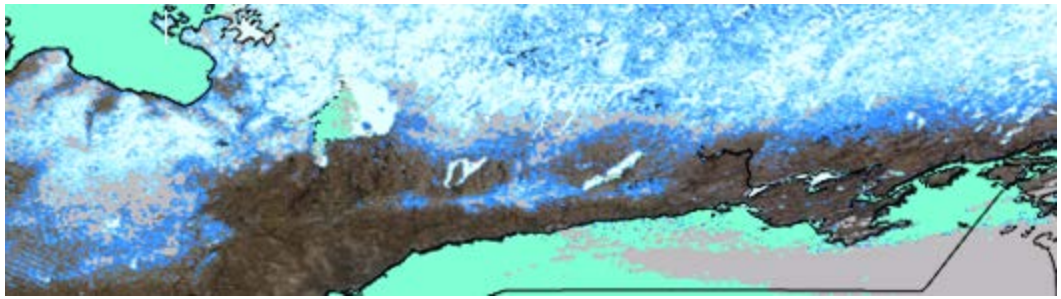
Transition Zones from Snow Covered Regions to Snow Free Areas are Very Narrow

VIIRS fraction



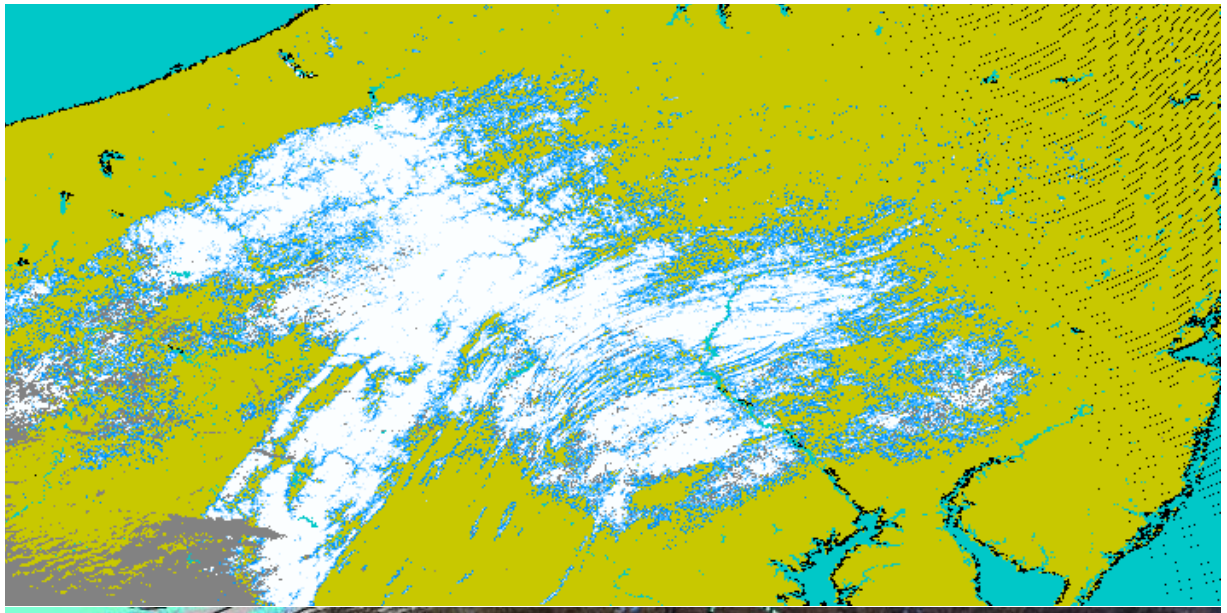
Image

MODIS fraction

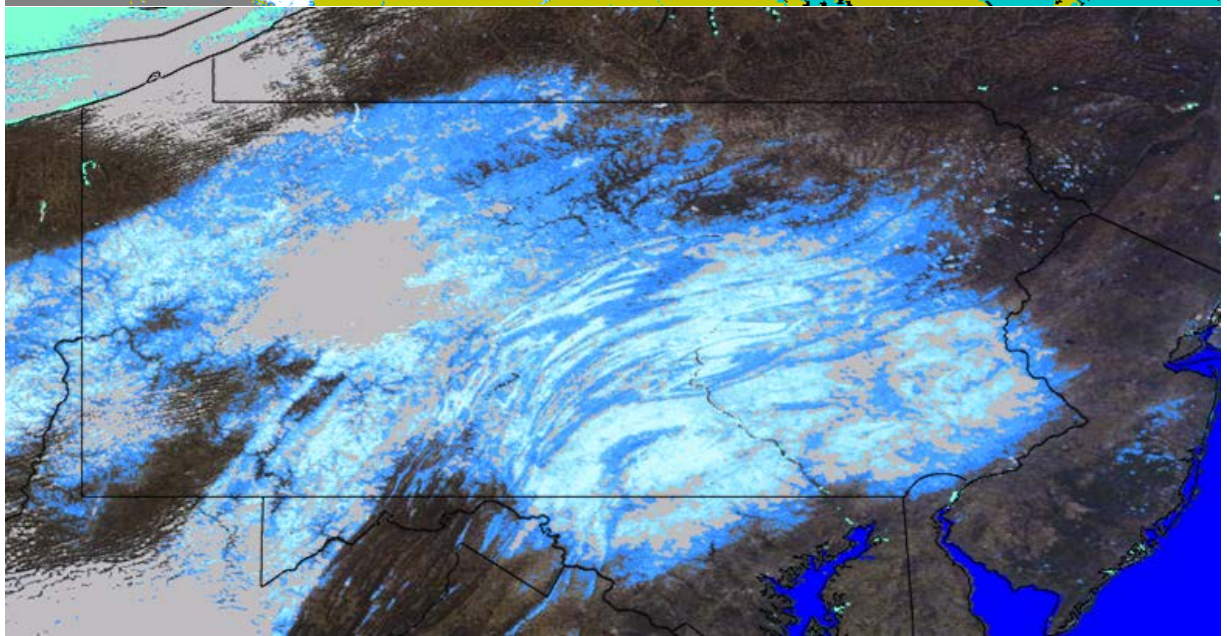


Loosing Details of Fraction Distributions within the Snow Zone

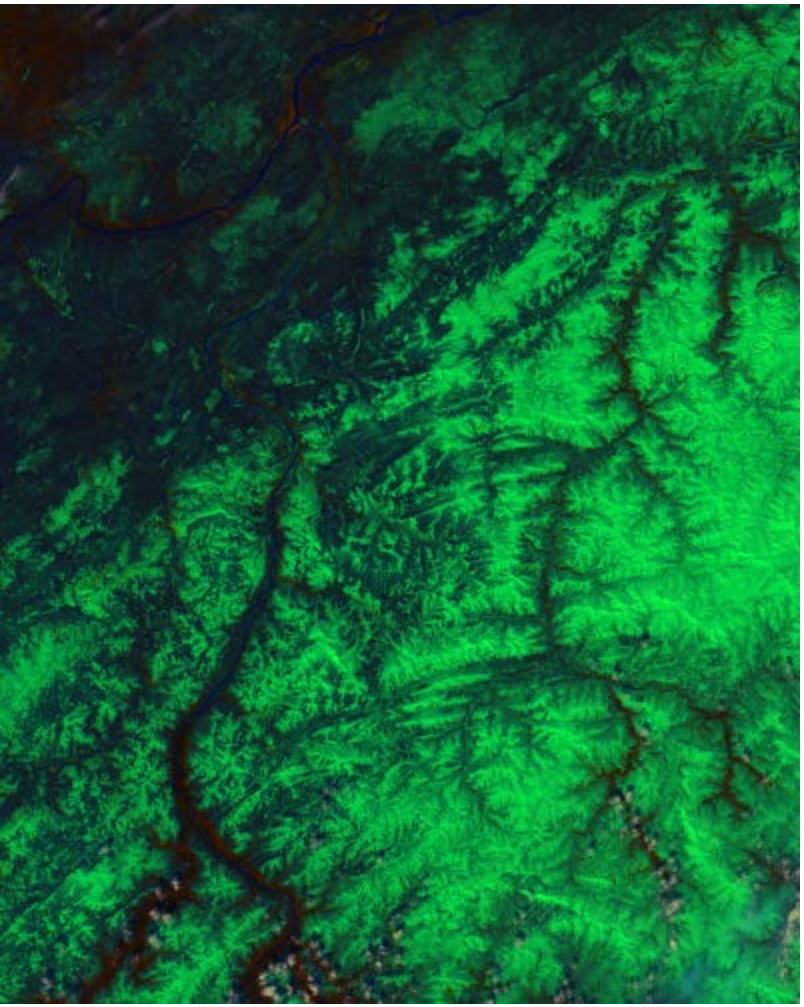
VIIRS fraction

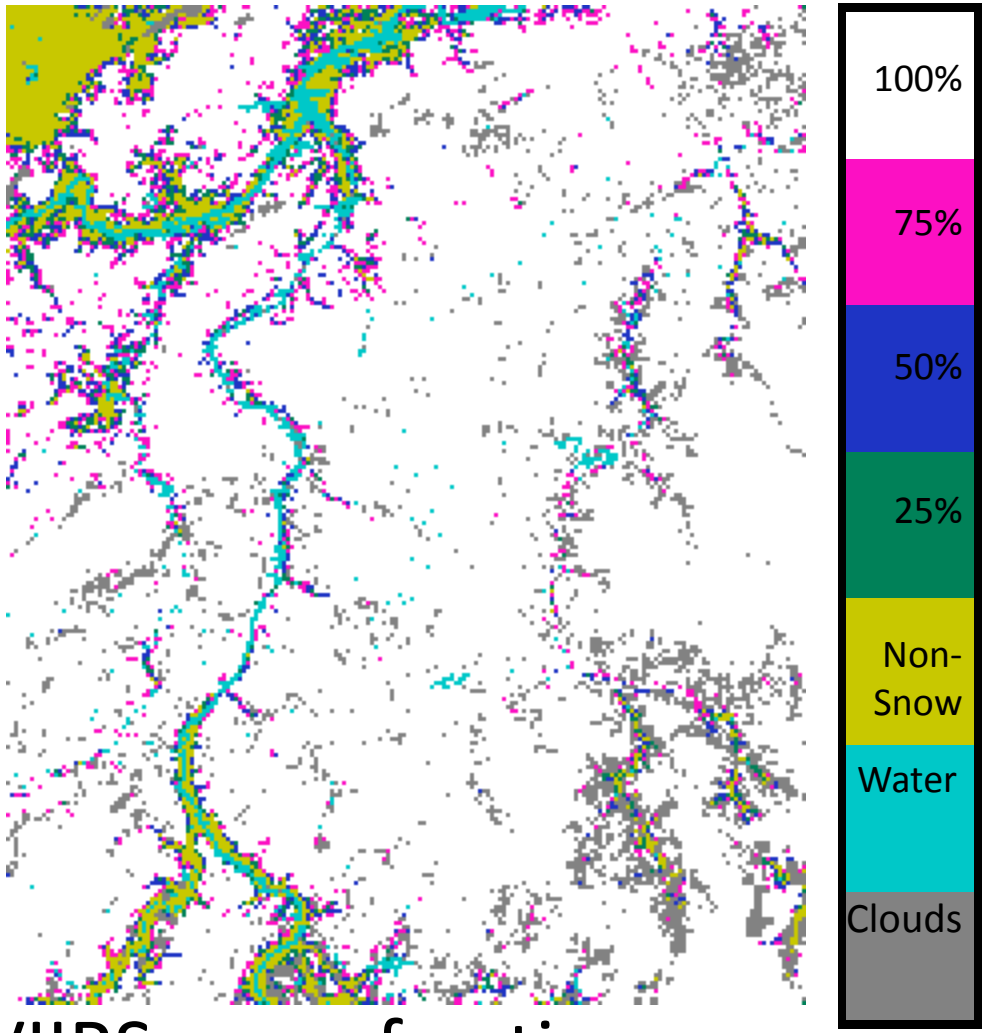


MODIS fraction



Missing Snow Structure in VIIRS Fractional Snow Product

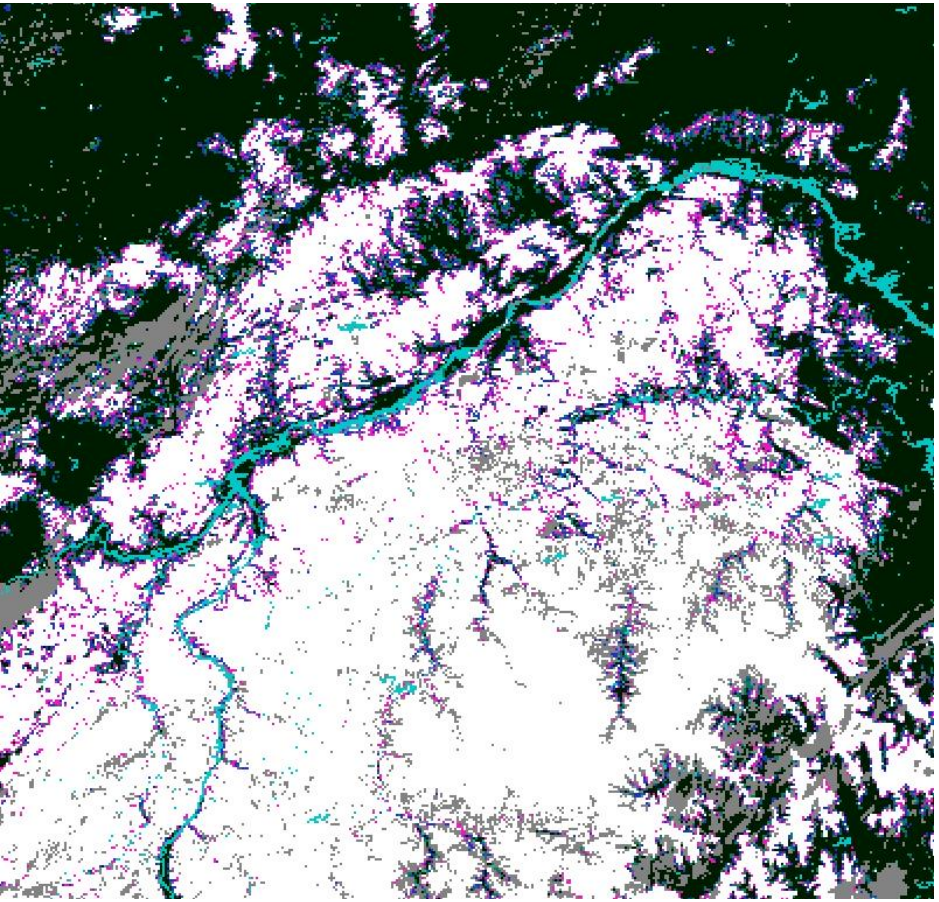




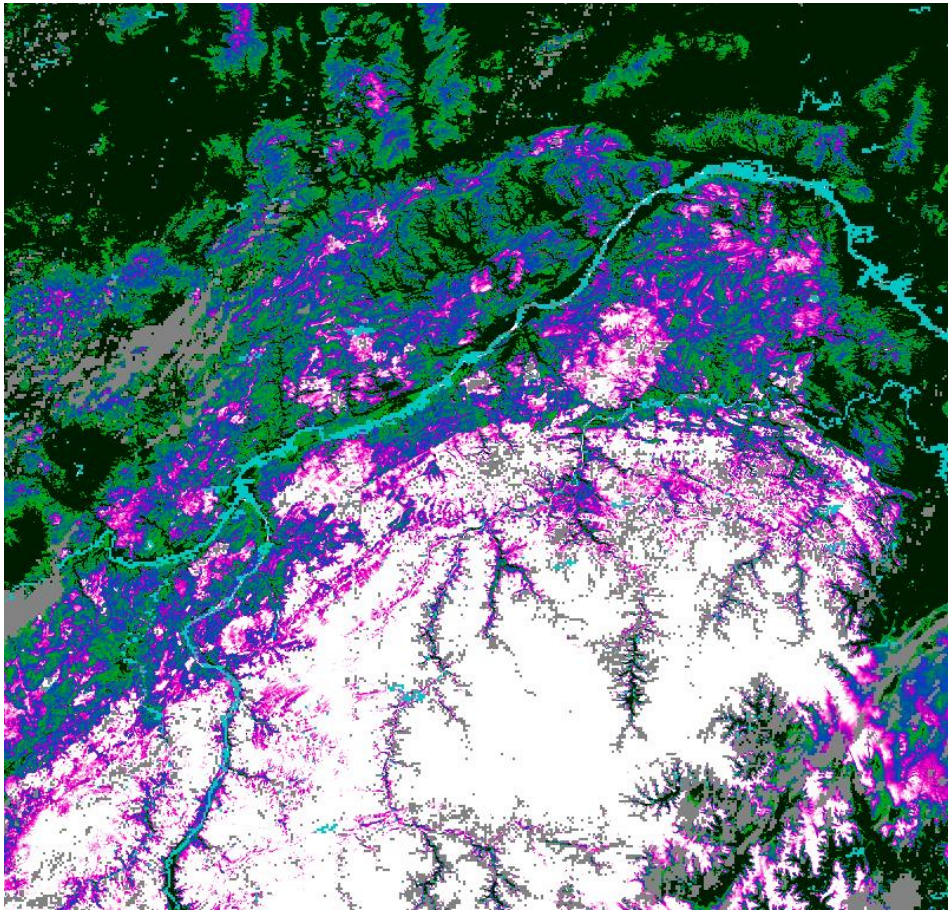
False color image VIIRS snow fraction

Comparison of Snow Fractions

VIIRS Product

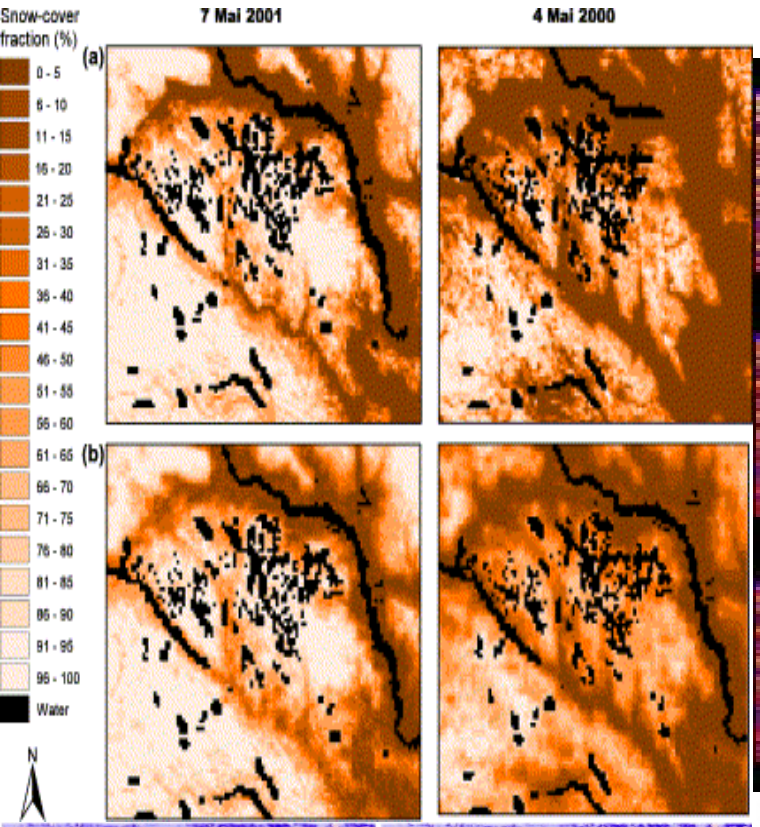


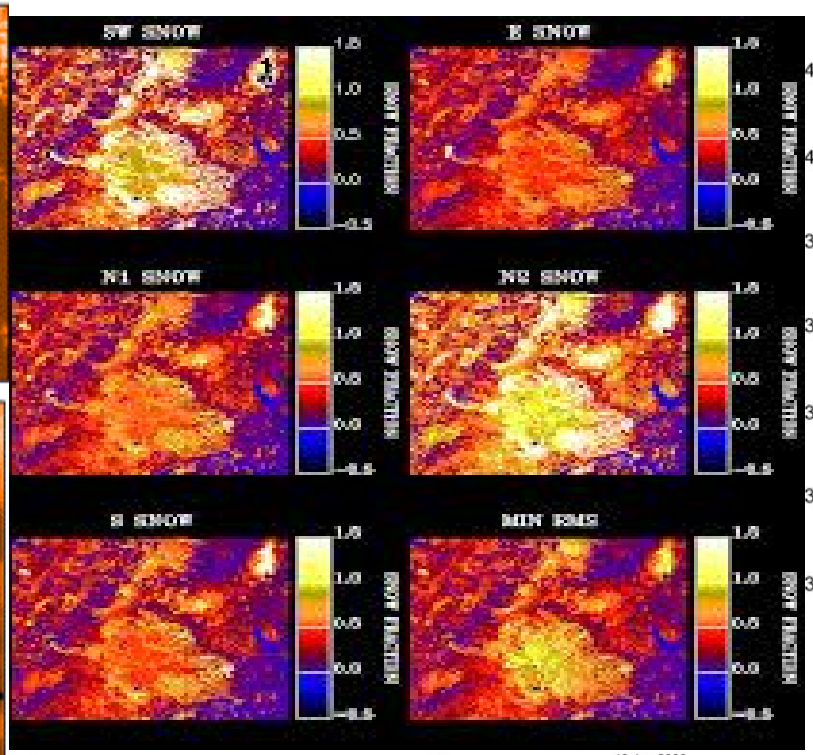
Simple simulation

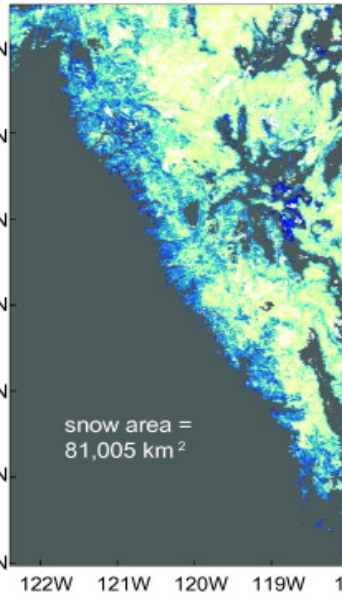


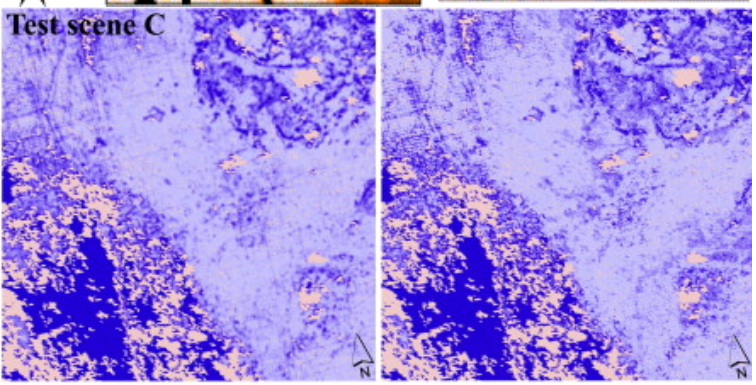
0% 100%

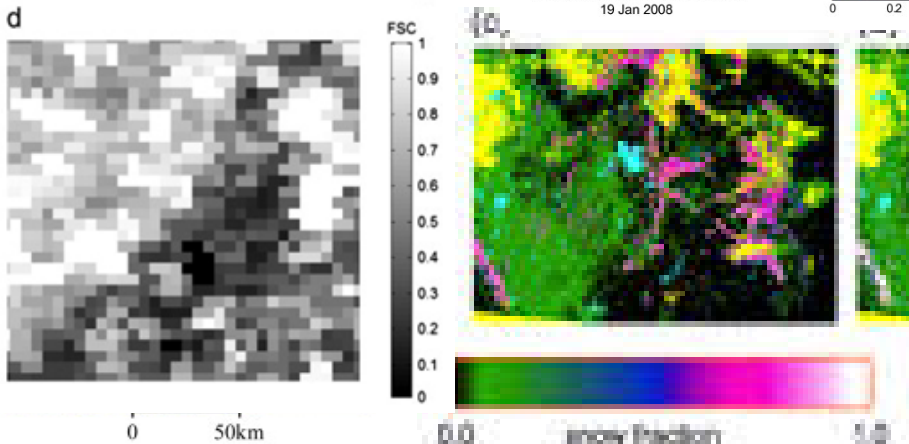
Typical View of Snow Fractions



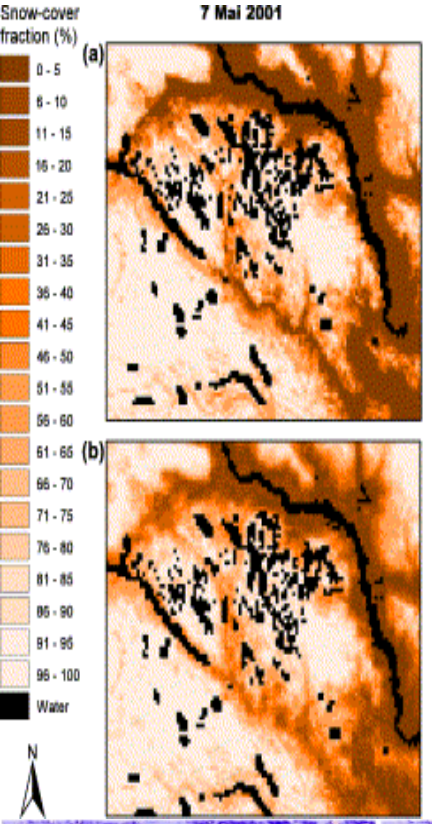


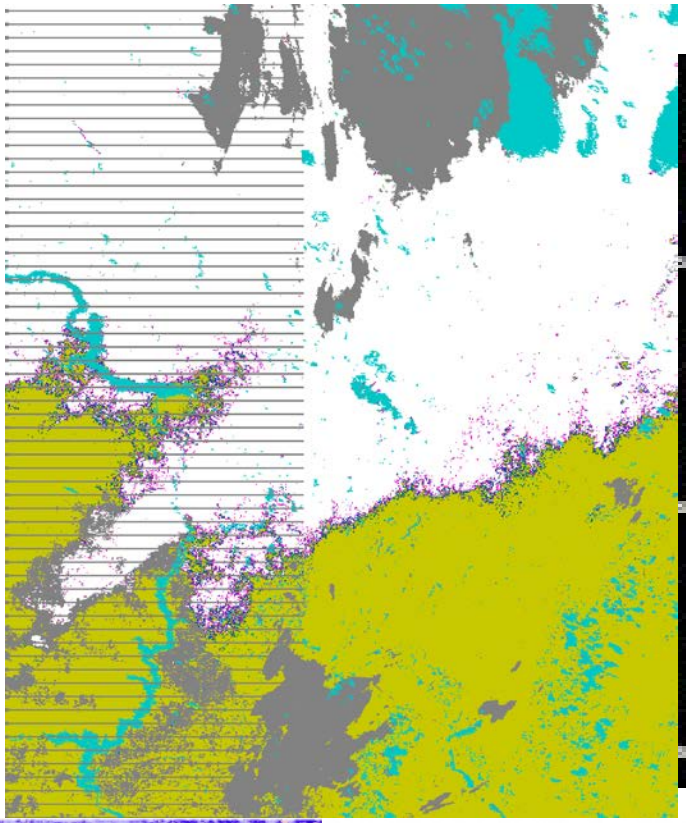


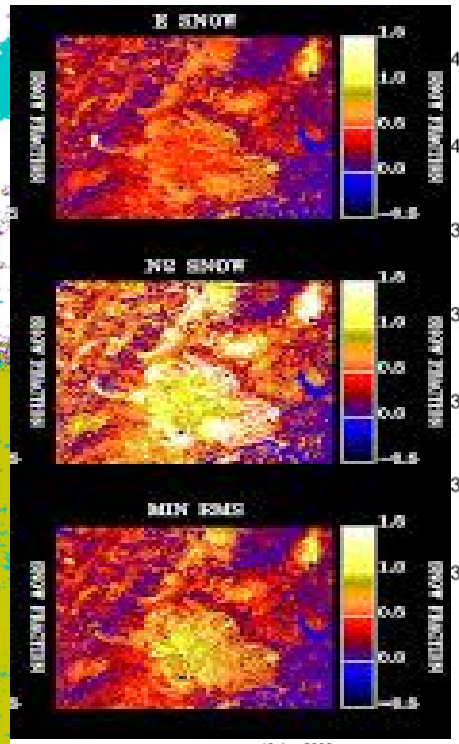


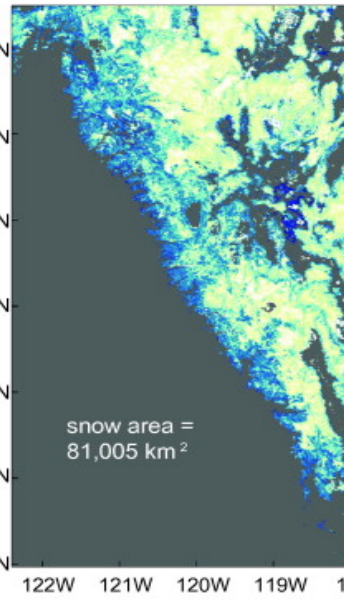


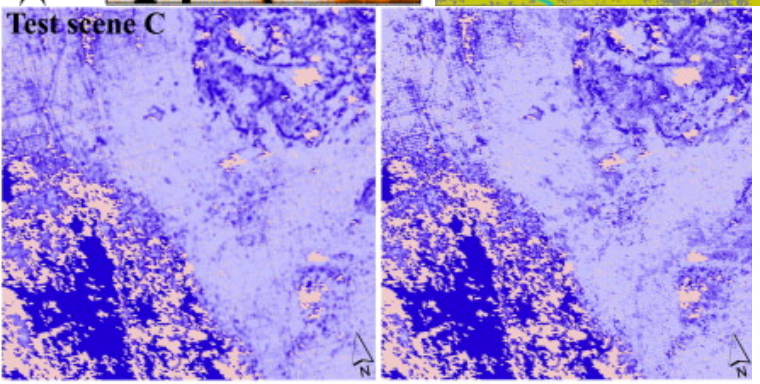
VIIRS Snow Fraction Product (in a center) Differs from Similar Existing Products

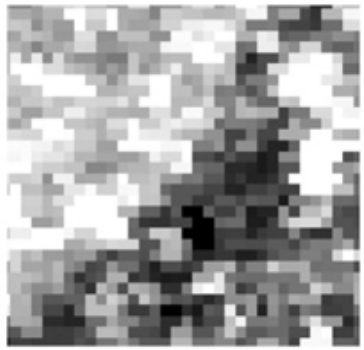


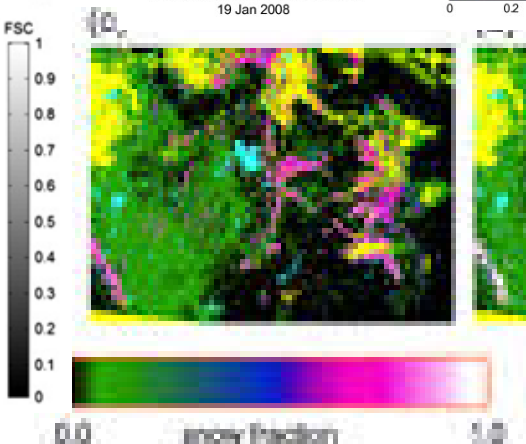












Beta Maturity Justification

Early release product

Snow Cover EDR is dependent on VIIRS SDR, VIIRS Cloud Mask IP, and Geolocation, each meeting maturity requirements

Minimally validated

Fractional snow cover product is validated:

- globally for each day at 5 km grid cells in months representative for four seasons
- globally averaged for months at 5 km grid cells
- locally at pixel resolution for numerous 5 min granules

May still contain significant errors

Fractional Snow Cover product is of questionable utility:

- Does not correspond to existing scientific conception
- Differs significantly from other similar existing products
- Does not correspond to its name & purpose replacing typical smooth changes in snow fraction by sharp jump from 0 to 1
- Does not represent the variability of snow fraction within snow zones
- It is likely that it will not (ever) meet requirements

Beta Maturity Justification (2/3)

<u>Versioning not established until Beta establishes the baseline for this product</u>

It is considered unnecessary to establish the baseline for this product as the product requires changes in approach and realization

<u>Available to allow users to gain familiarity</u>

- Cryosphere team has evaluated IDPS EDR products available from CLASS
  - Users can access and read the products and the product compares reasonably with the heritage satellite snow map products
- Beta release will allow other users within the community to gain experience with the data formats and parameters.
  - This is important to allow users to complement the validation activity.

Beta Maturity Justification (3/3)

Product is not appropriate as the basis for quantitative scientific publications studies and applications

Identified known deficiencies in fractional snow product require corrective actions to implement an alternative approach.

Potential Solution: MESMA

Multiple Endmember Spectral Mixture Analysis (MESMA) uses the reflectances in nine VIIRS moderate resolution reflectance bands to retrieve snow fraction.

An objective of any spectral mixture analysis is the definition of subpixel proportions of spectral endmembers that may be related to mappable surface constituents.

Spectral mixture analysis "unmixes" the mixed pixel, determining the fractions of each spectral endmember that combine to produce the mixed pixel's spectral signature.

The approach is to model the signature from each pixel as a combination of two components: a modeled snow reflectance spectrum and a modeled non-snow reflectance spectrum.

The approach is based on the assumption that the non-snow endmember spectrum for each pixel can be estimated from non-snow surface BRDF that will be obtained from the VIIRS Gridded Surface Albedo IP.

MESMA Performance Analysis (1999)

Snow Fraction Measurement Uncertainty: Stratified Performance for Typical Case

Scan Angle	Snow Fraction (Truth)			
	0.0– 0.25	0.25 – 0.5	0.5 – 0.75	0.75 – 1.0
Nadir	.070	.072	.076	.081
Edge-of-Scan	.077	.079	.089	.102

Benefit and Opportunity to Restore MESMA (exceptional circumstances)

- MESMA was a part of all NPOESS algorithm and code developments for more than 10 years and delivered to IDPS
- The approach was considered, approved, and recommended to retrieve snow fraction at many meetings at all levels
- The code is still a part of a relatively recent version of software
- MESMA is currently a standard approach to such kind of tasks
- Existing experience of applying MESMA to retrieve snow fraction clearly demonstrates the advantages of the approach considered as one of the best for snow remote sensing
- There is no need for a lengthy process of approving a new approach since it has been already approved
- It is possible to start validation of the algorithm immediately

Additional Supporting Documentation

- TIM Meetings and Presentations
  - Relevant TIM presentations:
  - Conference presentations:

Romanov P., Appel I. (2012) Mapping Snow Cover with Suomi NPP VIIRS, EUMETSAT Conference, Gdansk, Poland, September 2012.

Romanov P., Appel I. (2012) Snow cover products from Suomi NPP VIIRS: Current status and potential improvements, IGARSS, Munich, Germany, July 2012.

Romanov P., Appel I. (2012) Mapping Snow Cover with Suomi NPP VIIRS, NOAA 2012 Satellite Science Week. Meeting. Summary Report. April 30 – May 4, 2012. Kansas City, Missouri.

- List reports
  - Weekly, monthly, quarterly Progress Reports are posted at ftp://ftp.star.nesdis.noaa.gov/pub/smcd/emb/promanov/VIIRS_SNOW

Snow Cover Fraction: Conclusions (1/2)

- The **VIIRS Snow Cover Fraction** (which is part of the VIIRS Snow Cover EDR) has met the beta maturity stage based on the beta criteria.
- The current algorithm for estimating Snow Cover Fraction has significant limitations and is of questionable utility. The method does not correspond to other fractional snow cover products and to current scientific conceptions of fractional snow cover.
- The proposed approach cannot be “fixed”; the nature of the product makes it (arguably) not useful.
- The NASA snow team has reached these same conclusion.

Snow Cover Fraction: Conclusions (2/2)

- Acceptable approaches to snow cover retrieval should take the advantage of using available spectral VIIRS information at moderate resolution.
- One of possible options to be considered – MESMA (one of the best for Snow Cover remote sensing) that was a part of all NPOESS algorithm and code developments for more than 10 years and successfully delivered to IDPS.
- While validation and evaluation of this product will continue, it is possible that is will not be recommended for Provisional maturity status.