Snow monitoring in a globalized world

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DWD

Introduction

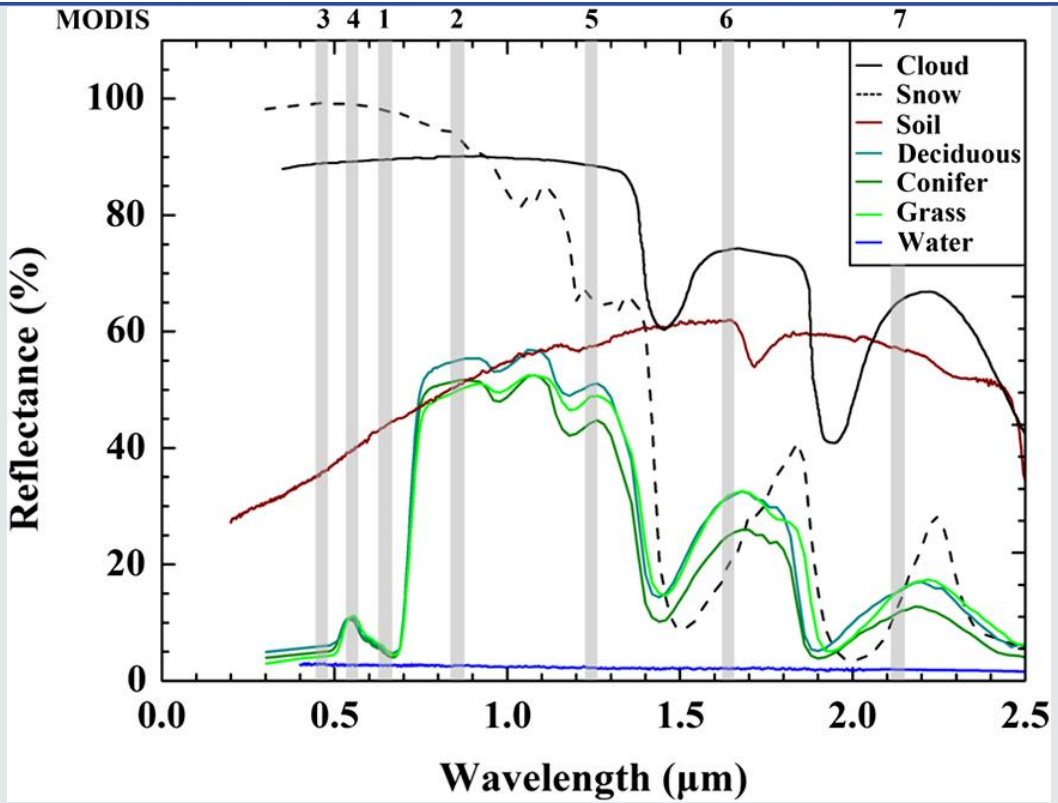
Snow and ice information is needed for many applications, e.g.

Advice and warning of shipping.

Hydrological modelling, regional and global.

Marburg 8.1.2011. Quelle das-marburger.de

Retrieval of Snow



Snow has a different spectral fingerprint. This can be used to retrieve snow with multi-spectral instruments.

Quelle: Pan et al., Snow cover detection based on two-dimensional scatter plots from MODIS imagery data.

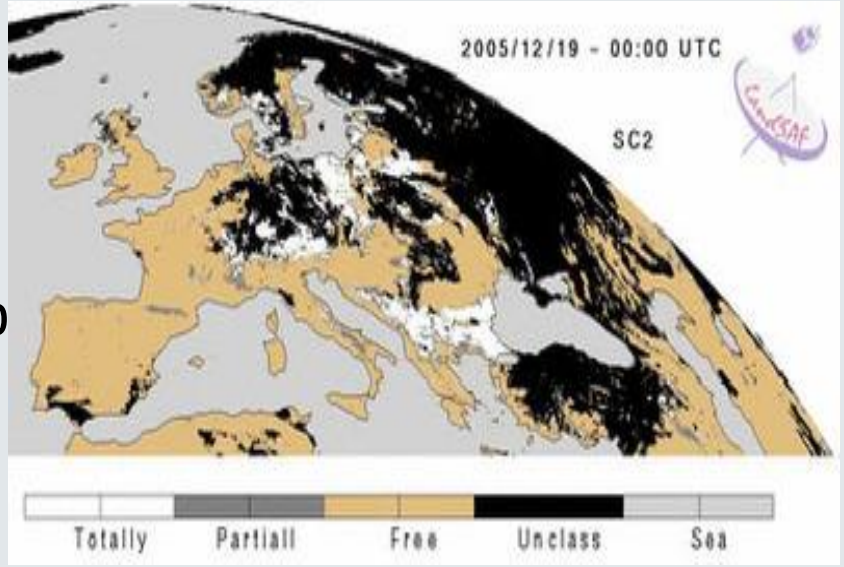
J. Appl. Remote Sens. 9(1), 096083 (Feb 16, 2015). doi:10.1117/1.JRS.9.096083

The daily snow products

Deutscher Wetterdienst
Wetter und Klima aus einer Hand

1 LSA-SAF – Snow cover product.

- Daily product, 3 km resolution:
- Single sensor approach (SEVIRI, GEO).
- Does not cover Arctic region.
- Large regions with unclassified p due to cloudiness.



SNOW products: Core handicaps

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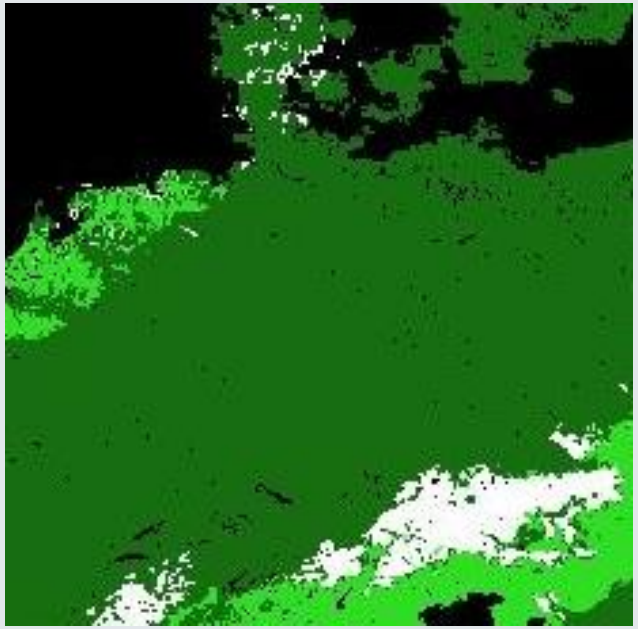
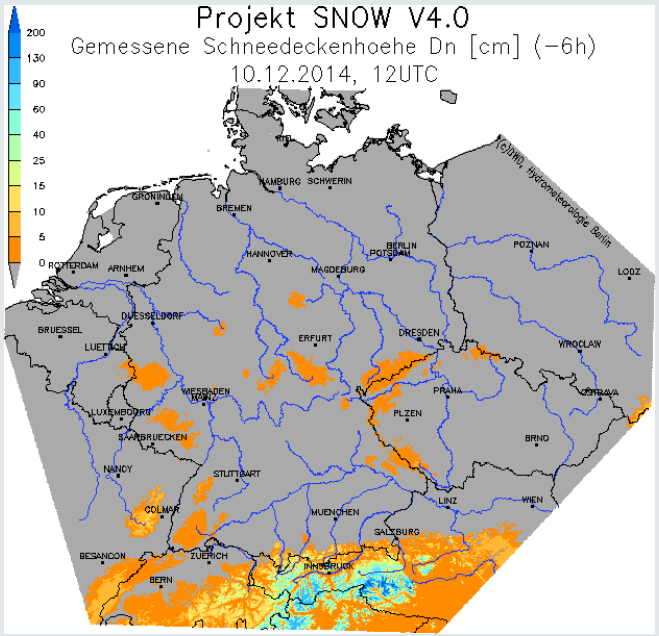
1 LSA-SAF – Snow map



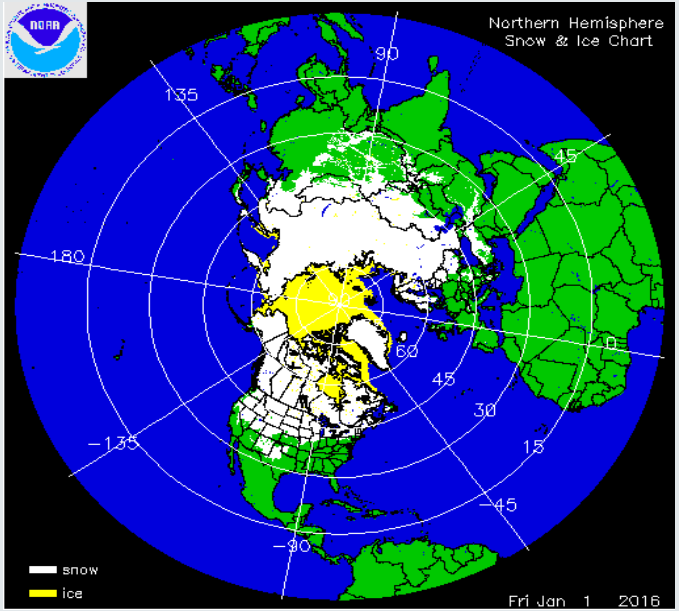


Left hand LSA
Right hand:
„ground measurements“

10.12.2014
The snow in the highlands is not apparent in LSA („cloudy“),
but snow is in Denmark mistakenly.

2 IMS – Interactive Multisensor Snow product

- Daily product, up to 1km resolution:
- Based on geostationary & polar orbiting satellites, including MicroWave (information in cloud situations).
- Covers arctic region.
- Allmost no data gaps.
- Available from 1987 onwards (24 km resolution).



IMS

IMS:
List of
Data
sources

MSG/SEVIRI
MODIS
AVHRR
SSMI
RADAR
Weather Reports

Sensor or Source	Platform or Organization	Version of Data this Applies to (may not apply exclusively to the named version)
ACNFS sea ice area fraction and sea ice thickness	NIC	1.3
AMSR-2	GCOM-W	1.3
AMSU	NOAA POES Satellites (15 - 18), Aqua, EUMETSAT MetOp-A	1.1, 1.2, 1.3
ASCAT	EUMETSAT MetOp-A	1.2, 1.3
ATMS (MIRS based)	S-NPP	1.3
Automated snow detection layers	NESDIS and NCEP	1.1, 1.2, 1.3
AVHRR	NOAA POES Satellites (14 - 19), EUMETSAT MetOp-A	1.1, 1.2, 1.3
Canadian snow analysis	Environment Canada	1.3
GFS daily snow depth	NCEP	1.3
GMS Imager	JMA GMS-5 (Himawari 5)	1.1, 1.2
GOES Imager	NOAA GOES Satellites (9, 10, 11, 13)	1.1, 1.2, 1.3
Hourly surface weather reports	METAR	1.3
MODIS	Aqua and Terra	1.2, 1.3
MTSAT-1R Imager	JMA MTSAT-1R (Himawari 6)	1.2
MTSAT-2 Imager	JMA MTSAT-2 (Himawari 7)	1.3
MVIRI	MFG	1.1, 1.2
Radar	Various radar published from Europe, Japan, China, South Korea, Canada, or U.S.	1.3
SAR	Radarsat-2	1.3
SAR (C-band)	Sentinel-1A	1.3
SEVIRI	MSG	1.3
SNODAS	NOHRSC	1.1, 1.2, 1.3
SSM/I	DMSP Satellites	1.1, 1.2, 1.3
SSMIS	DMSP Satellites	1.2, 1.3

IMS comparison

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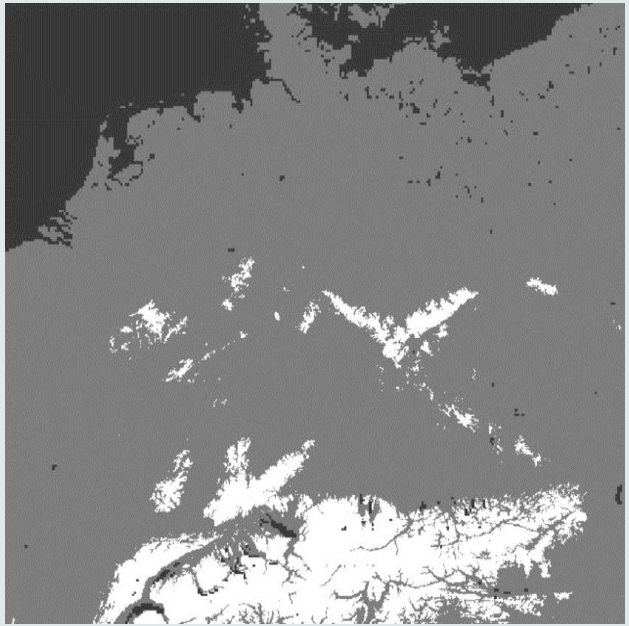
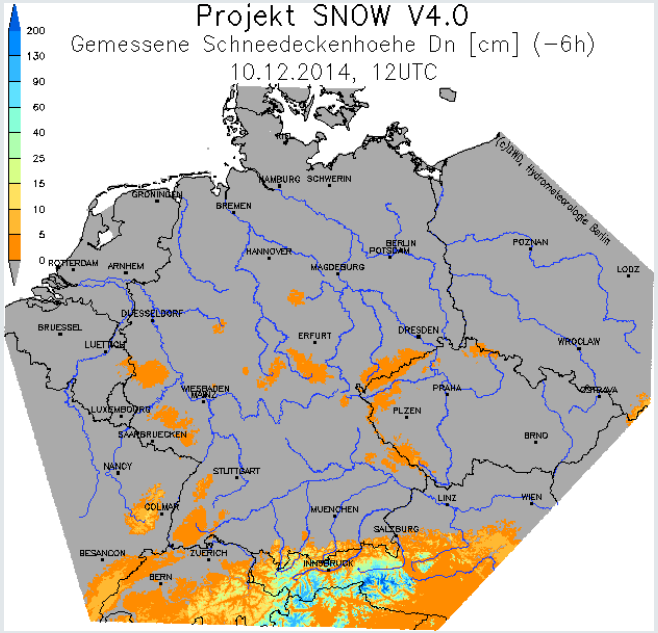
Wetter und Klima aus einer Hand

2 IMS – Interactive Multisensor Snow product

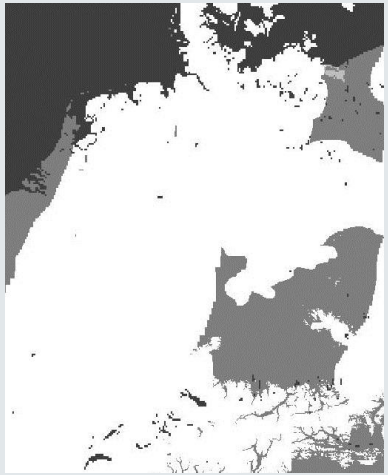


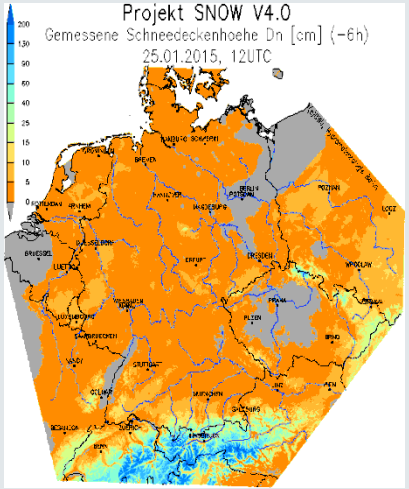


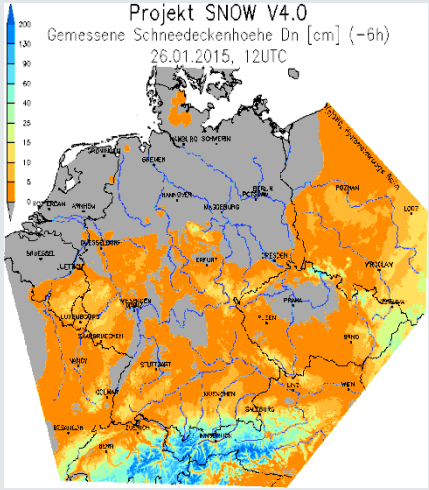
Left hand IMS
Right hand: interpolated ground measurements.

10.12.2014 was quite warm However, snow is apparent in the highlands, well detected by IMS.

2 IMS – Interactive Multisensor Snow product







Left hand IMS 25 and 26 January 2014. Right hand: interpolated ground measurements (dito). No melting in the North and Rhine valley in IMS, but increase in snow cover in the South-East is well reflected. Be careful: IMS 0 UTC, gbm 12UTC, but melting comes 1.5 days later !

SNOW products: Core handicaps

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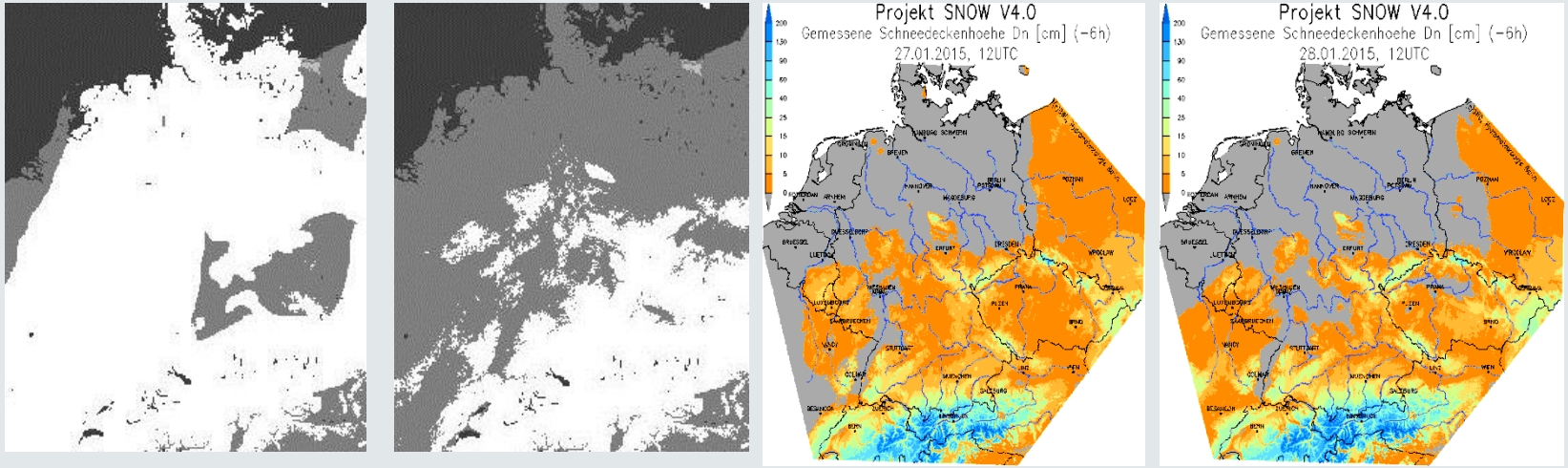
Wetter und Klima aus einer Hand

2 IMS – Interactive Multisensor Snow product



Left hand IMS 27 and 28 January 2014. Right hand: interpolated ground measurements (dito).
The melting in the North and Rhine valley appears with a significant delay on 28 th of January.

Daily SNOW products: Summary

2 IMS – Interactive Multisensor Snow product

Works well, 1st source but it seems that melting is sometimes observed with an delay (due to lingering clouds). Further, the customer needs 12 UTC information. Thus, inter-daily updates desired.

1 LSA-SAF – Snow map

The single-sensor approach together with the algorithm design leads to large data gaps for cloudy weather (not only for cloudy pixel). Thus it is only used as backup.

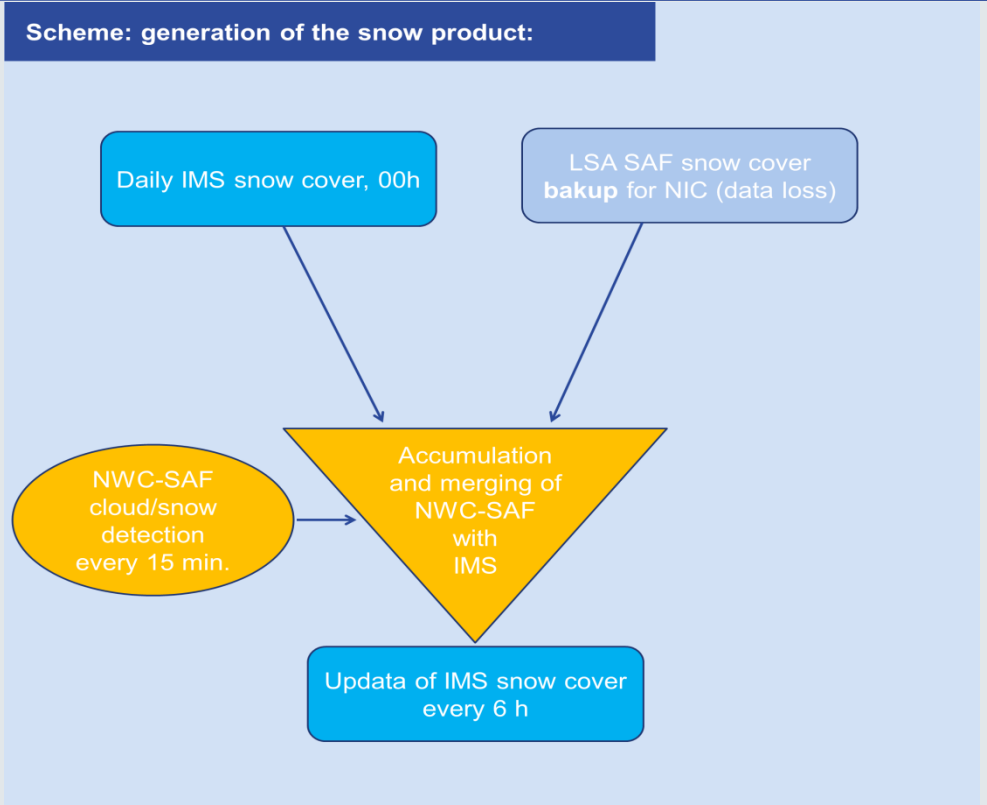
The concept and status

NIC / IMS as daily basis.
LSA-SAF as bakup if data loss of IMS occurs.

Both are ready & regurarly generated by a cronjob.

Inter-daily update is not Implemented so far, but asked for by customers.

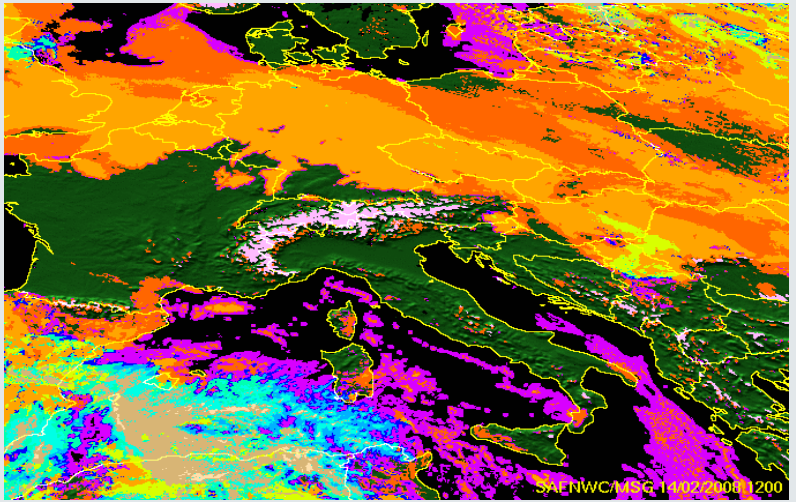
Best Approach ?



Snow cover update options

1u NWC-SAF – Cloud Type.

Every 15 min., up to 3km, based on SEVIRI multi-channel approach (IR,VIS).
Disadvantage linked with an technical overhead
if only snow is needed. Not well validated. If IMS update fails cause of lingering cloudy skies NWC-SAF might fail as well



Snow cover update options

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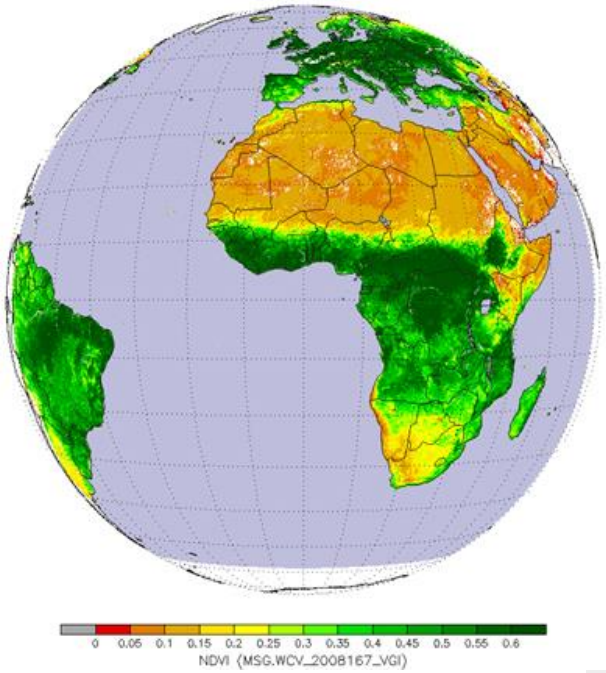
2u PYTROLL NDVI

„Normalized Difference Vegetation Index” (NDVI) can be used to detect melting for cloud free pixels.
Based on VIS006 and VIS008 channel.
NDVI=VIS008-VIS006/(. + .)
NDVIcld=IR106-VIS008/(. + .)



Snow cover update options

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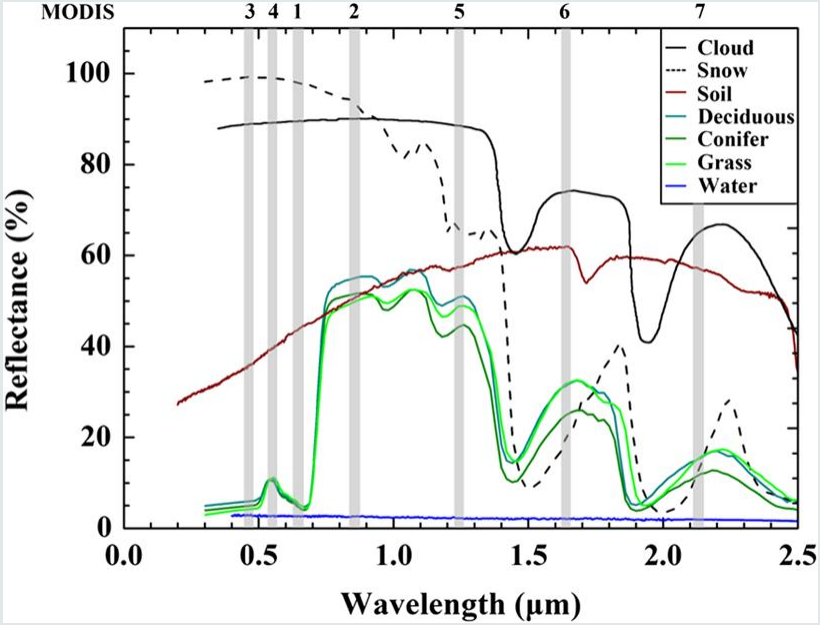
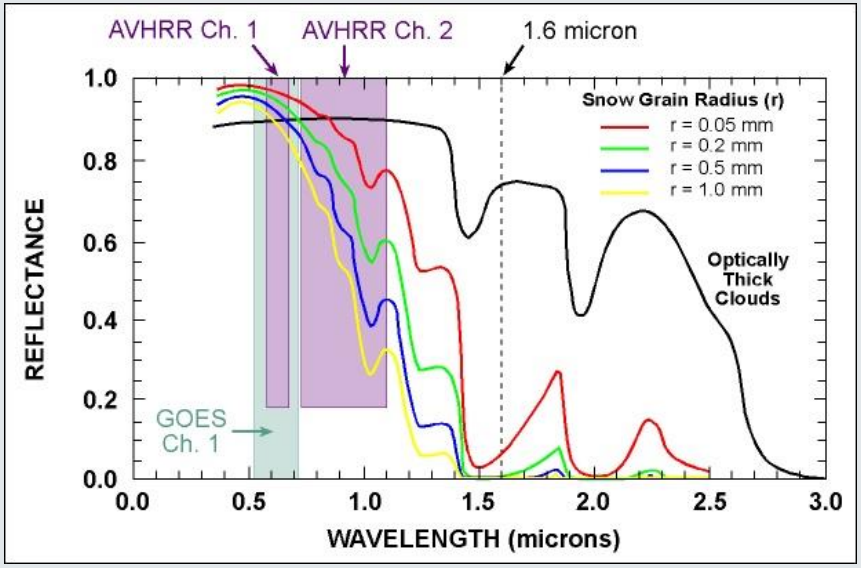
2u PYTROLL NDVI





Source: Source National Sea Ice Data Center

Conclusion

Snow and ice information is based on IMS snow and ice maps. As a result of evaluation results and user requests interdaily updates based NWC-SAF or NDVI should be used. However, long lasting clouds are still a problem than (IMS example)

The updates will override the IMS information.

LSA-SAF as bakup, if IMS is not available.

Acknowledgement

Thanks to NIC for providing the high quality data.
A multi-satellite, multi-sensor approach is a huge Work.

Thanks for LSA-SAF and NWC-SAF for their service dealing with snow.

Thanks to CM-SAF for the validation.

This is the end

Good bye & thanks for your attention

Snow cover update options

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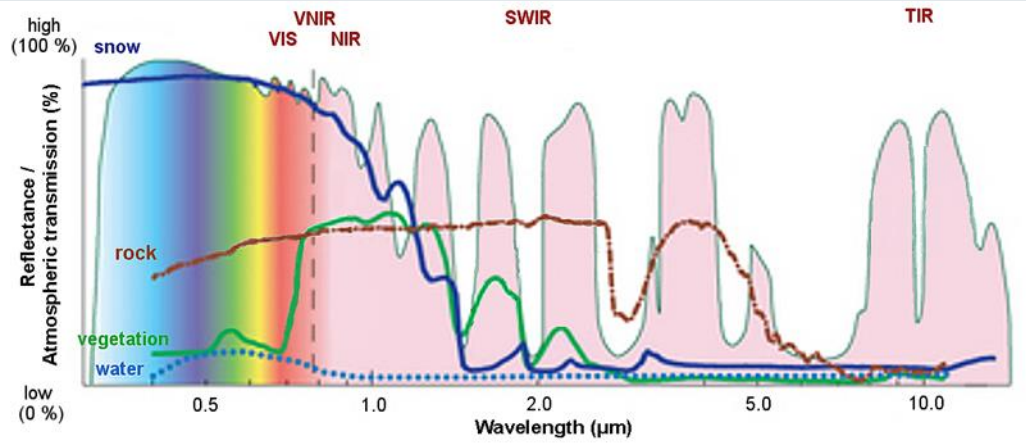
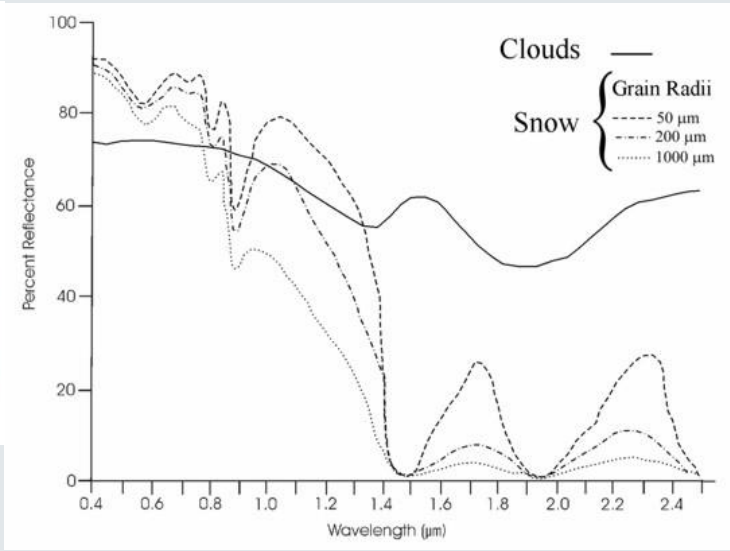
2 PYTROLL NDVI

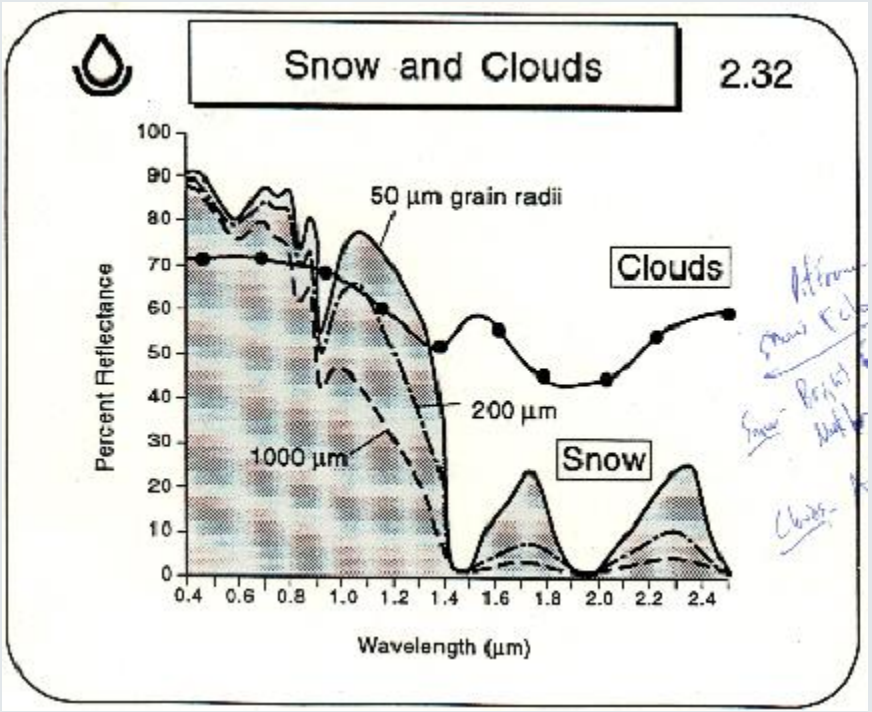
Source Eumetrain: Schnee Eis VIS006>VIS008





Source http://www.geol-amu.org
Aligarh Muslim University

Introduction



Snow reflectance is unique. It is very high in the visible and NIR wavelengths, but plummets to near zero in the water absorption bands, and remains at

Marburg 8.1.2011. Quelle das-marburger.de