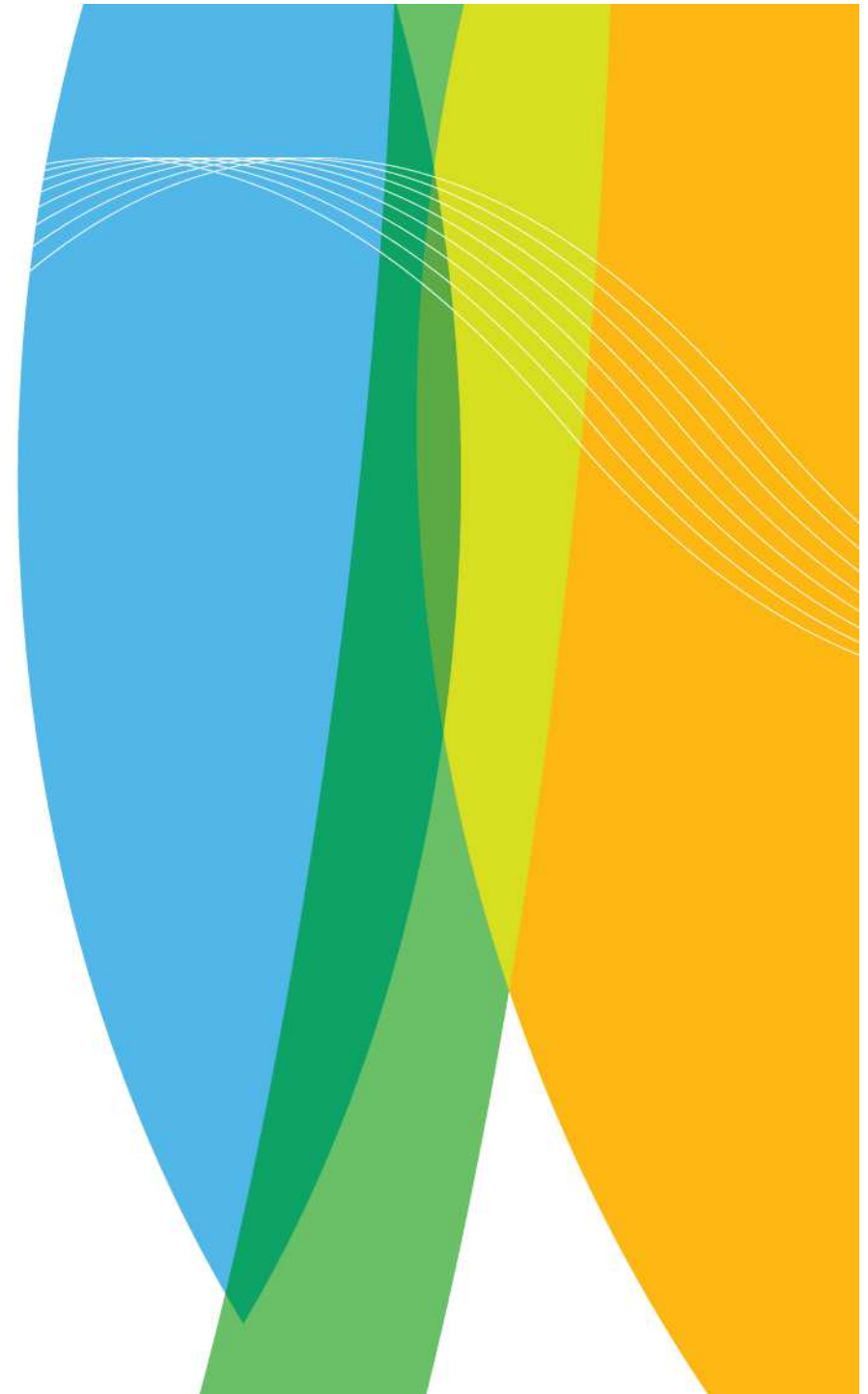




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Snow cover mapping using METOP/AVHRR data

Niilo Siljamo, Markku
Suomalainen, Otto Hyvärinen
Finnish Meteorological Institute





Contents

- LandSAF snow cover products
 - MSG/SEVIRI (operational)
 - METOP/AVHRR (under development)
- Snow (photos)
- METOP/AVHRR snow cover product
- Validation



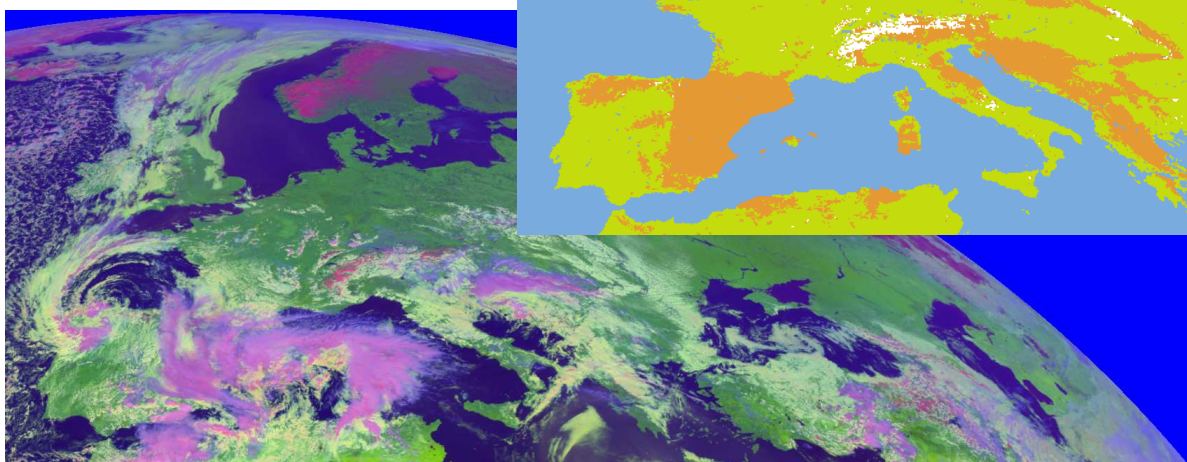
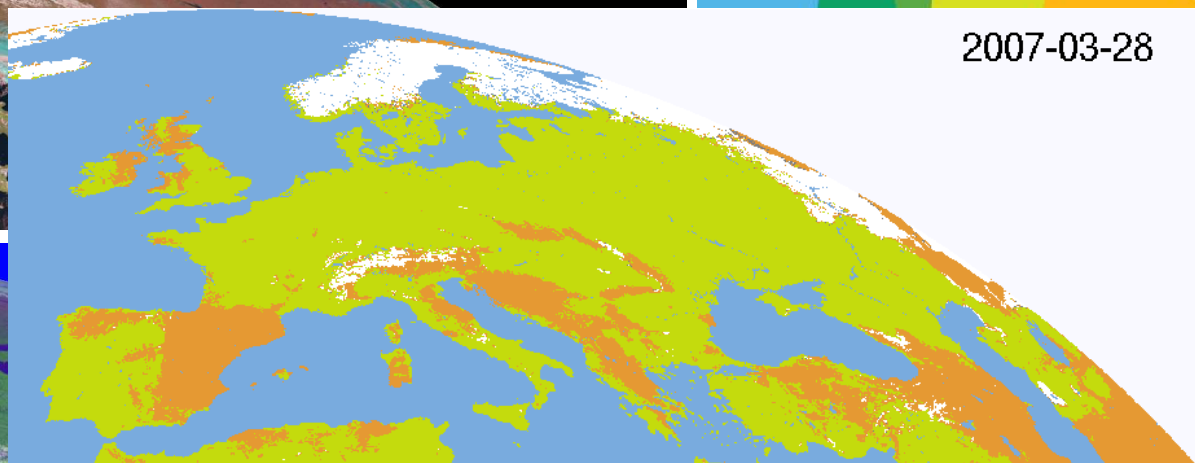
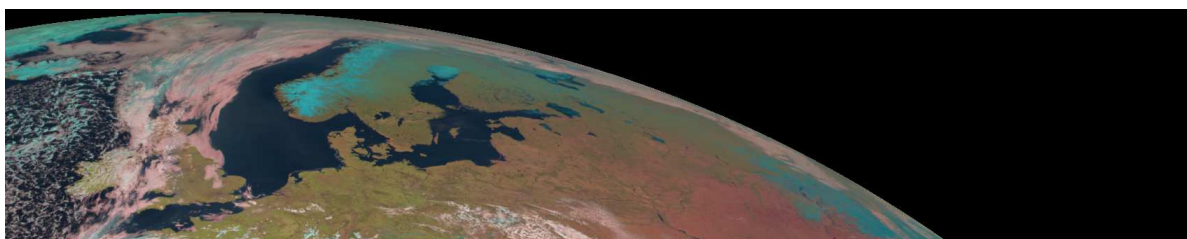
MSG/SEVIRI snow product

- Operational
- Daily
- Classification of pixels as (if possible):
 - Snow free
 - Partially snow covered
 - Snow covered
- HDF5 format



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Example, March 28th, 2007





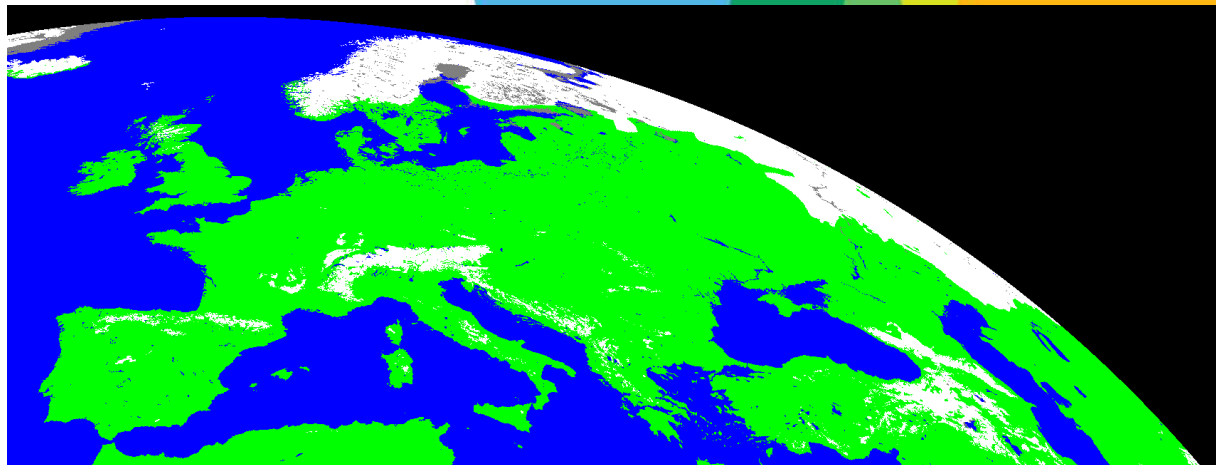
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LSA SAF SC vs. IMS snow cover maps

LSASAF SC

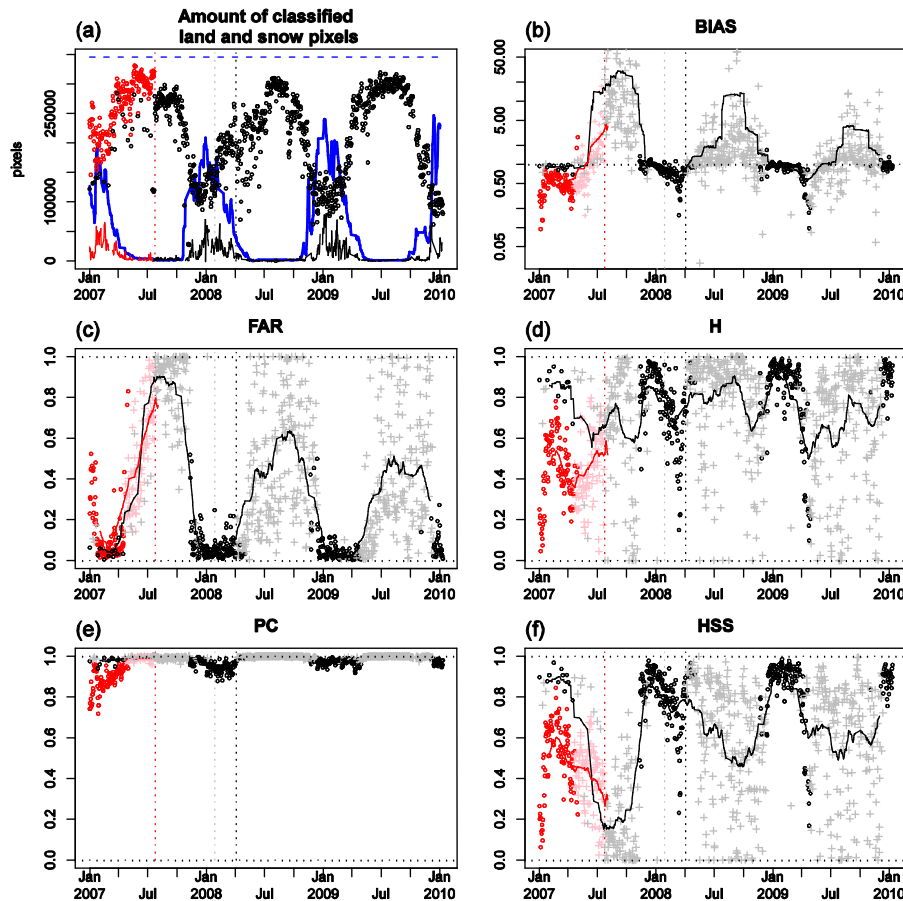


NOAA/NESDIS IMS





Comparison of LandSAF SC with NOAA/NESDIS IMS



- IMS is well-known global product = good for comparison
- LandSAF MSG/SEVIRI snow cover product quality seems to be similar
- There are misclassifications in both, but in different conditions
- LandSAF SC is fully automatic
- Figure from: Siljamo & Hyvärinen, New geostationary satellite-based snow cover algorithm, Journal of Applied Meteorology and Climatology (submitted)



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What is snow? Why it is difficult to see from space?



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Little bit of everything





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How about this?





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Topography





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Snow on a fjell





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Mountains





Best possible target: no trees, no clouds





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It is cloudy when it is snowing





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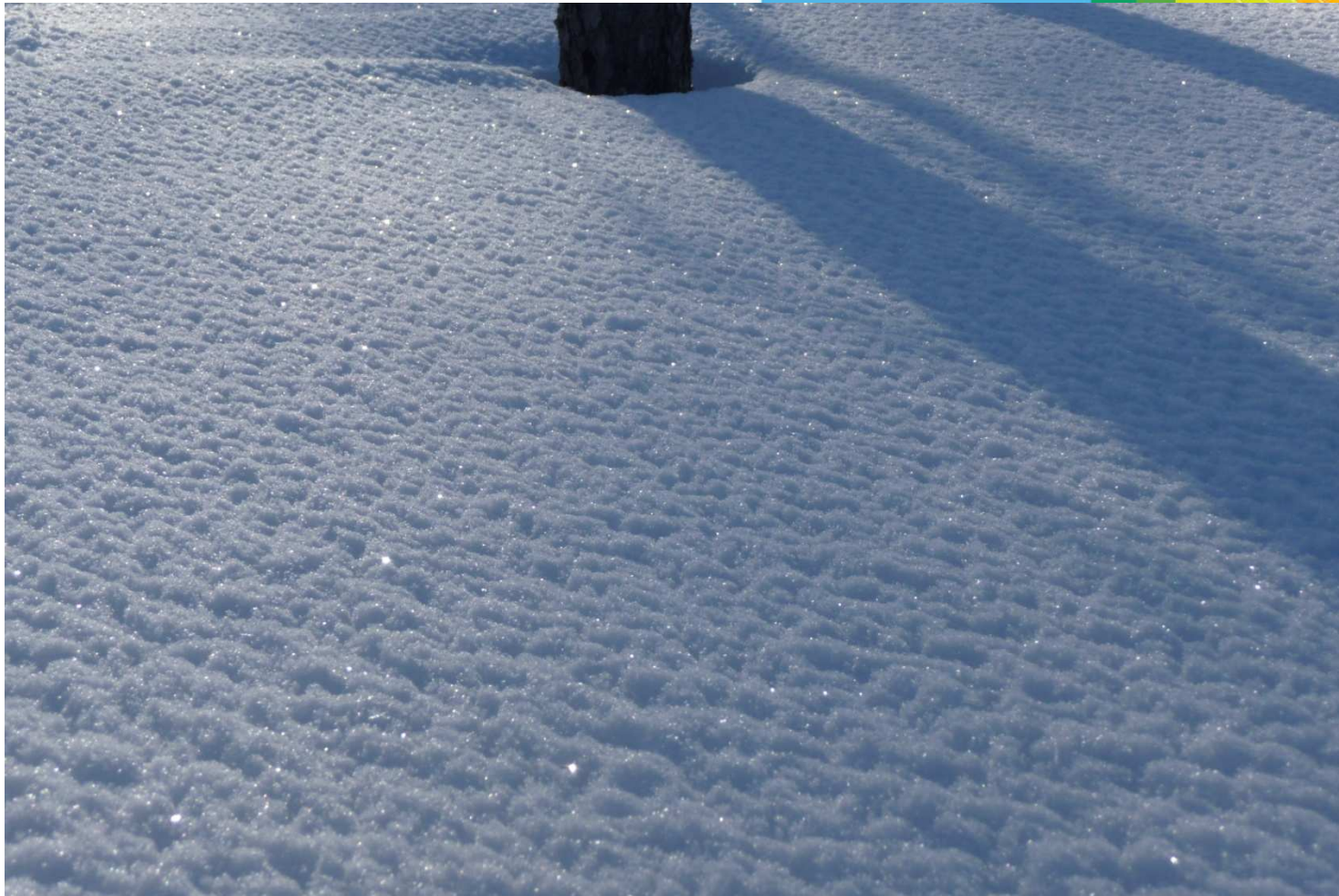
Wind





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New snow on top of old snow





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Snow on ice





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Forests





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Melting snow in forest





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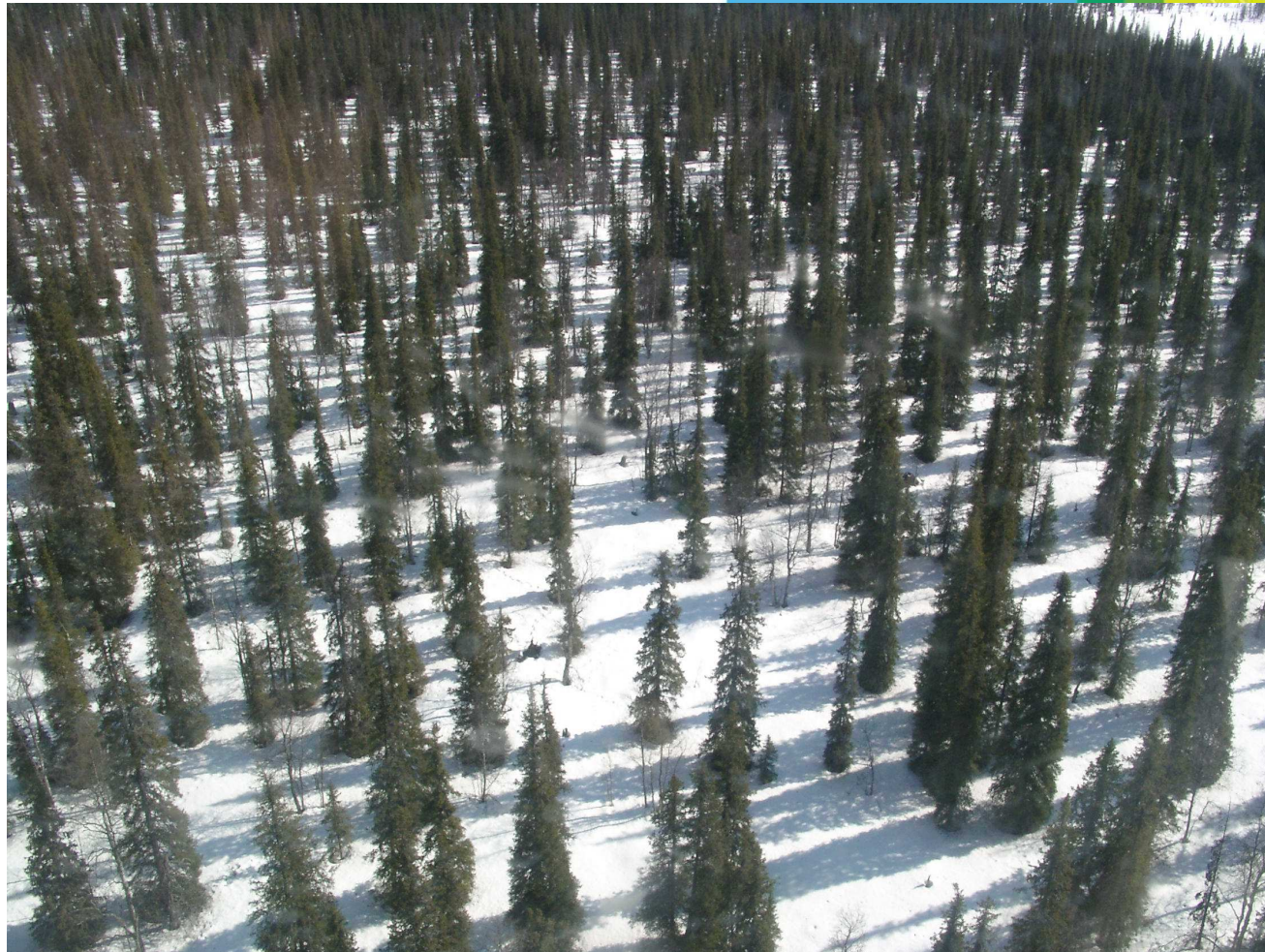
Forest





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Shadows of trees





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Snow on trees

Early winter 2005
Helsinki, Finland

Niilo Siljamo



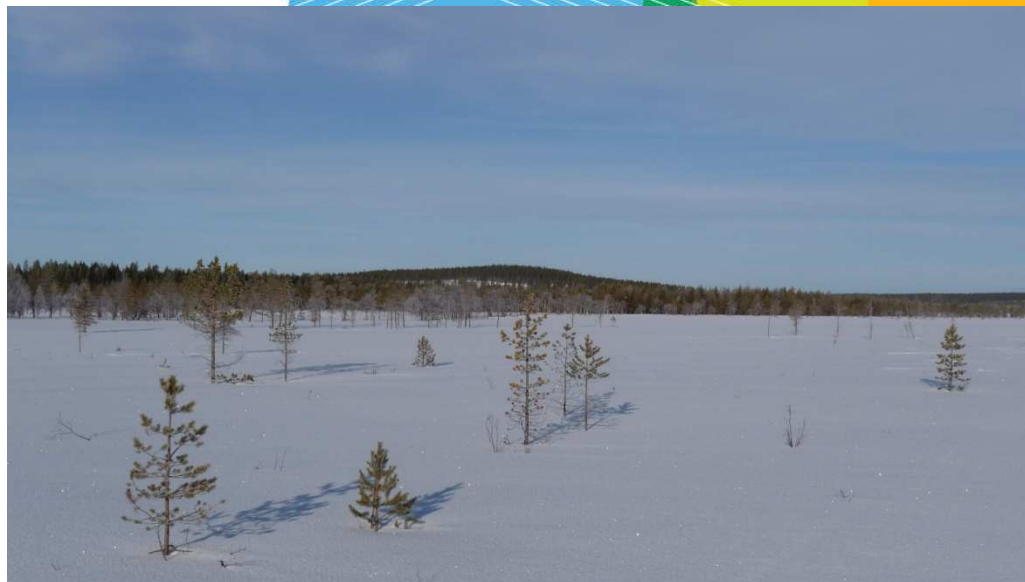
11/30/2010

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Frost on trees: morning and afternoon





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Winter in forest





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Too much snow?





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Snow in the forest, melting season





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Melting snow and water in forest





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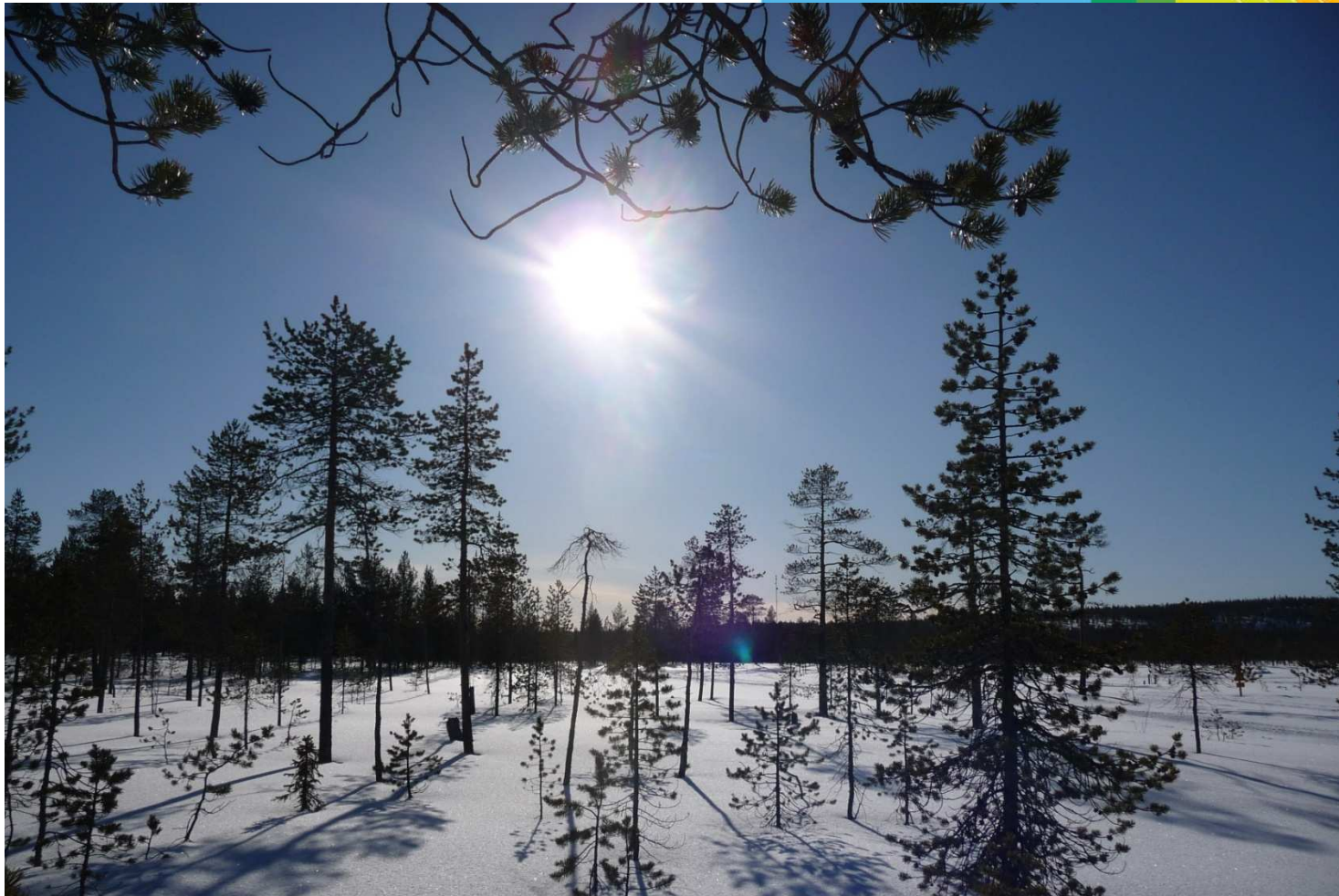
Melting snow in forest





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Just a pretty picture





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Melting season





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Snow free aapa and snow in the forest





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Melting snow





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Still some snow in the forest



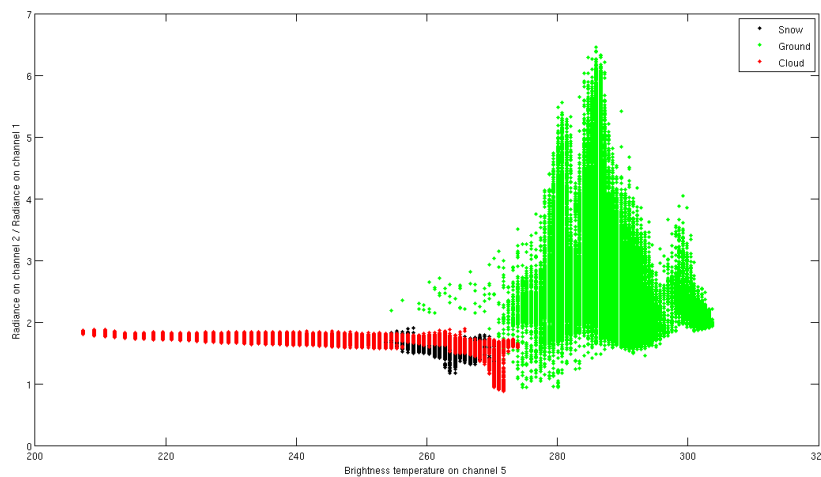
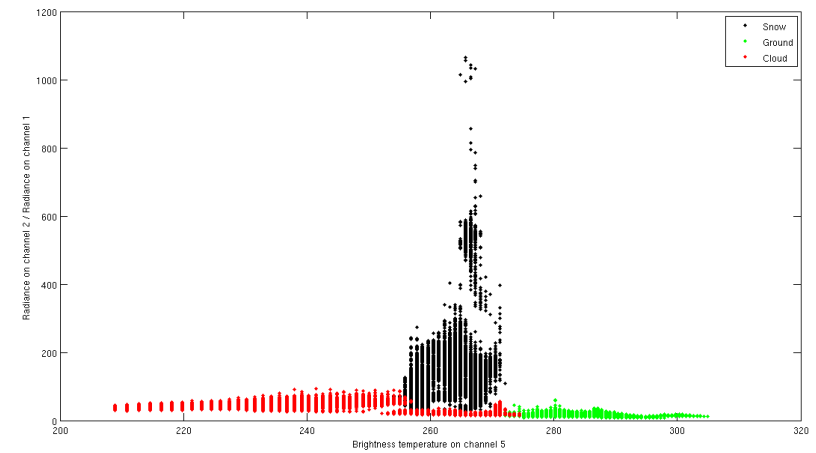
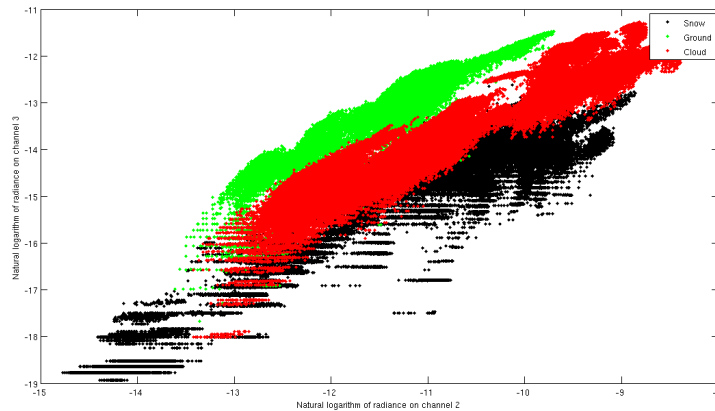


LandSAF METOP/AVHRR snow product

- AVHRR rather limited instrument
 - Some useful channels missing
 - Good resolution
 - Covers the polar regions
- Snow cover map of every image, no daily product
- Development version running in the LandSAF system
- But not yet available for public
- Classification as snow covered or snow free, and later also partially snow covered



Scatterplots of the AVHRR data

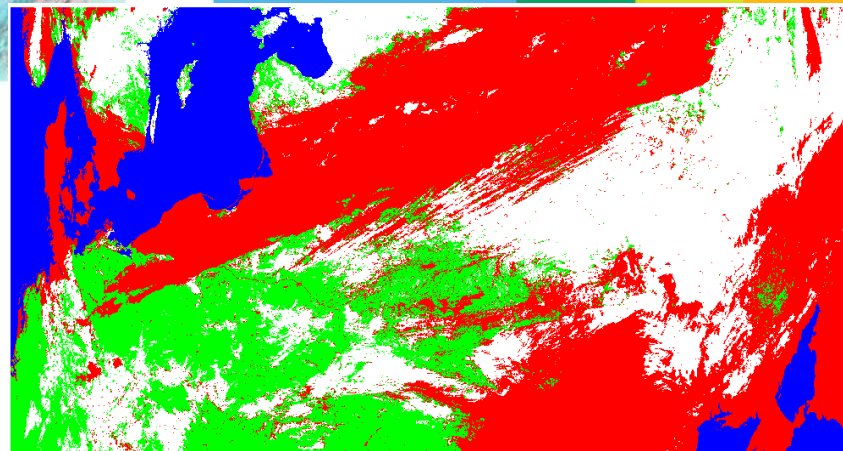
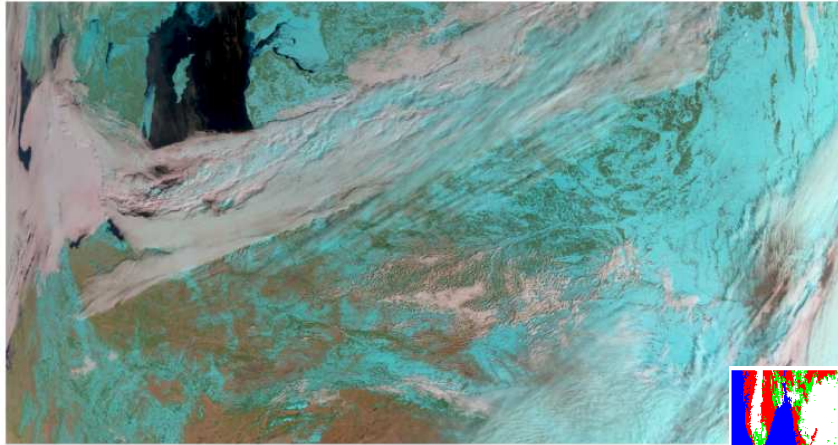


- Green = snow free
- Black = snow
- Red = clouds



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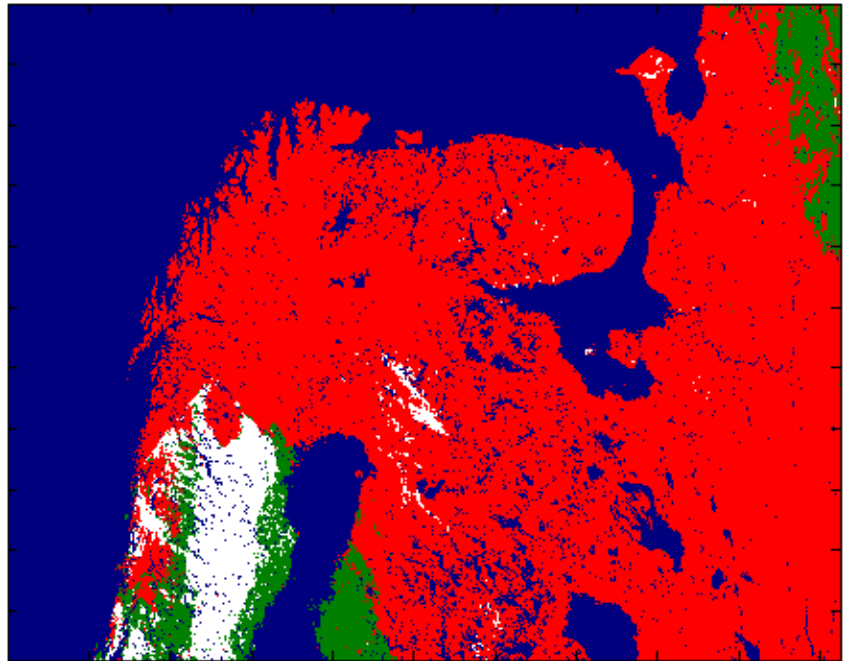
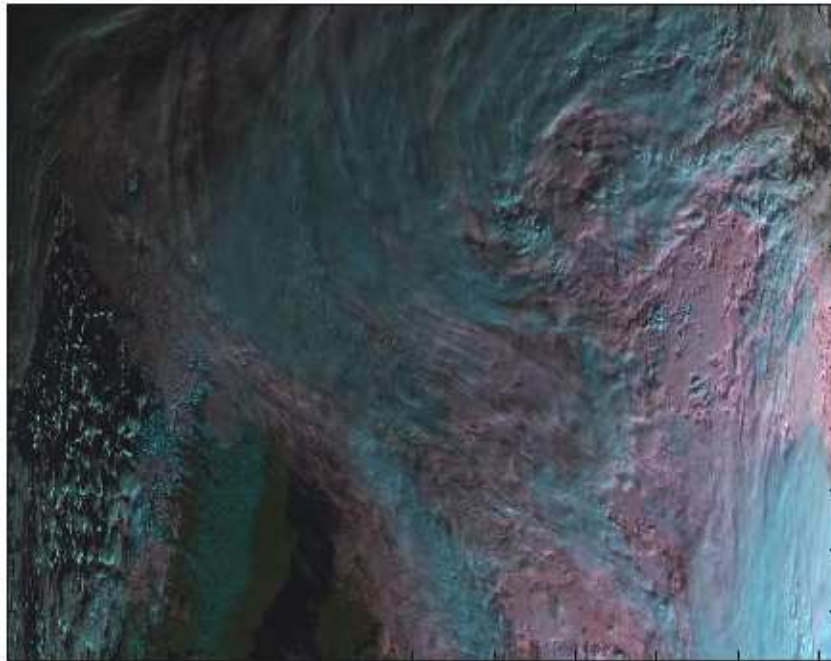
Test version in MATLAB





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First test run of the version 0.90 at FMI RGB vs. METOP/AVHRR SC October 21, 2010 0852UTC





LandSAF METOP/AVHRR SC summary

- Algorithm should be running at IM soon
- First results are promising, but not yet perfect
- Needs testing and validation
- Data in HDF5 format



Validation

- Weather stations do not report "no snow" = we do not know when there is no snow
- If there is snow the station may report it, but not always
- At least one common automatic snow depth sensor needs 2.5 cm of snow before it can see it.
- Difficult to get observations which cover large areas
- We need measuring campaigns, such as SNORTEX
- We need observations of partial snow cover and edge of snow
- International co-operation



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Snow measurements during SNORTEX





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Measuring snow during SNORTEX





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International co-operation





Conclusions

- LSA SAF MSG/SEVIRI snow product
 - Quality comparable to IMS in cloud free areas
 - Available from: **landsaf.meteo.pt**
 - Development continues
- LSA SAF METOP/AVHRR snow product
 - First version almost finished, but
 - Not yet publicly available
- These snow products will be part of the H-SAF in the future (CDOP2). The processing stays in the LandSAF.



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