

HSAF SNOW COVER PRODUCTS:

From Developing to Operation Stage

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***names are given in alphabetic order




The **objective** of the snow cluster is to **provide** satellite-derived **snow products** from existing and future satellites to support overall objective of the H-SAF project.

The partners of snow cluster are from both Finland and Turkey:

- Finnish Meteorological Institute (**FMI**) (Snow Cluster Leader)-**FI**
- Turkish State Meteorological Service (**TSMS**)-**TR**
- Middle East Technical University (**METU**)-**TR**

Snow Cluster Product Summary

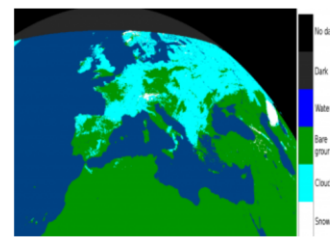
- **H10:** Snow detection (snow mask) by VIS/IR radiometry
- **H11:** Snow status (dry/wet) by MW radiometry
- **H12:** Effective snow cover by VIS/IR radiometry
- **H13:** Snow Water Equivalent
- **H31:** MSG/SEVIRI snow extent
- **H32:** Metop/AVHRR snow extent
- **H34:** Snow detection (snow mask) by VIS/IR radiometry of SEVIRI
 - successor of H10
- **H35:** Snow detection (snow mask) and effective snow cover by VIS/IR radiometry of AVHRR
 - successor product of H12
- **H43:** MTG/FCI snow extent
- **H65:** Snow Water Equivalent
 - successor of H13
- **H85:** Metop-SG/METimage snow extent



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Images

Descriptions

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User Documents

Visiting Scientist

References

SN OBS 1 - H10

SN OBS 2 - H11

SN OBS 3 - H12

Snow detection (snow mask) by VIS/IR radiometry

Snow status (dry/wet) by MW radiometry

Effective snow cover by VIS/IR radiometry

Snow

operational

operational

operational

DESCRIPTION: SN-OBS-1

Snow detection (snow mask) by VIS/IR radiometry

Contours of snow-covered areas, presented as mask-like maps (binary image). VIS/IR images from both LEO and GEO are used. The product may be processed in different ways and have different quality depending on the surface being flat, forested or mountainous.

- Coverage:** The H-SAF area [25-75°N lat, 25°W-45°E long]
- Cycle:** Daily
- Resolution:** 1 to 5 km, depending on the instrument providing the retained pixel (best for MODIS, worst for SEVIRI)
- Accuracy:** POD 95 %, FAR 10 % - Depending on geographical situation (flat/forested areas, mountainous regions)
- Timeliness:** Fixed time of the day, product updated to account for data available until 1 h before delivery
- Dissemination:** By dedicated lines to centres connected by GTS - By EUMETCast to most other users, especially scientific
- Formats:** Values in fixed grid points of the Meteosat projection (GEO satellites) or fixed latitude-longitude grid (WGS 84) representing the resolution of the used satellite (polar orbiting satellites). Also JPEG or similar for quick-look.

Short description of the basic principles for product generation

The product is an output of image classification processing. The snow signature is recognised as differential brightness in more short-wave channels, intended to discriminate snow from no-snowed land and snow from clouds. Both radiometric signatures are used (specifically, the 1.6 micron channel as compared with others), and time-persistence (for cloud filtering by the "minimum brightness" technique applied over a sequence of images). The Meteosat/SEVIRI contribution is mostly for southern Europe (including mountainous regions) and minimum brightness technique application. For mountainous regions multispectral threshold technique implemented on VIS and IR satellite reflectance values is used in order to get maximum daily snow coverages.

SN-OBS-1

SN-OBS-2

SN-OBS-3

SN-OBS-4

H31

H32

SN OBS 1 - H10

description

19-11-2019

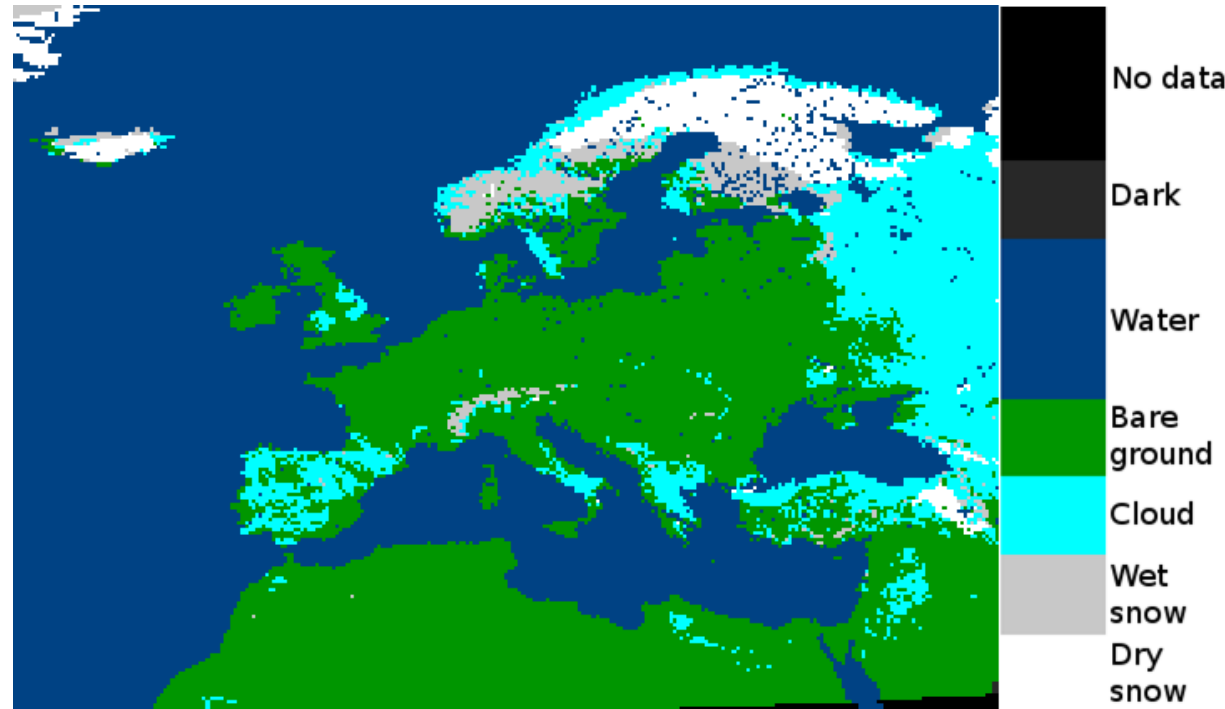
18-11-2019

17-11-2019








16-11-2019

15-11-2019

H11 Snow status (dry/wet) by MW radiometry










This product indicates the status of the snow mantle, whether it is wet or dry and, in time series, thawing or freezing, by multi-channel MW observation (middle frequencies).

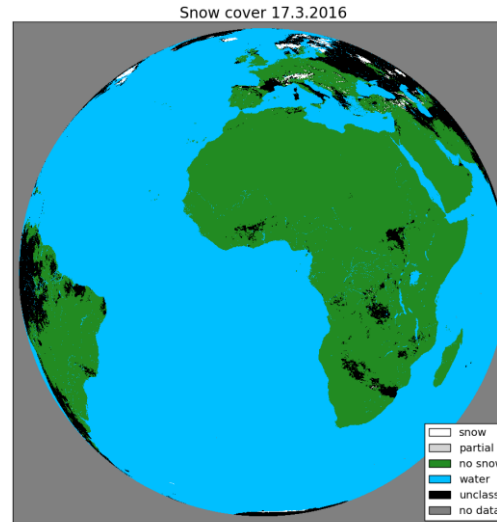
-  **Coverage:** The H-SAF area [25-75°N lat, 25°W-45°E long]
-  **Cycle:** Daily
-  **Resolution:** 10-30 km (0.25 deg grid), depending on the location (best for northern parts, worst for southern parts of the H-SAF area)
-  **Accuracy:** HR 80 %, FAR 10 % - Depending on snow thickness (it must not be too shallow)
-  **Timeliness:** Fixed time of the day, product updated to account for data available until 1 h before delivery
-  **Dissemination:** By dedicated lines to centres connected by GTS - By EUMETCast to most other users, especially scientific
-  **Formats:** Values in fixed grid points in latitude/longitude grid - Also JPEG or similar for quick-look.

H12 Effective snow cover by VIS/IR radiometry

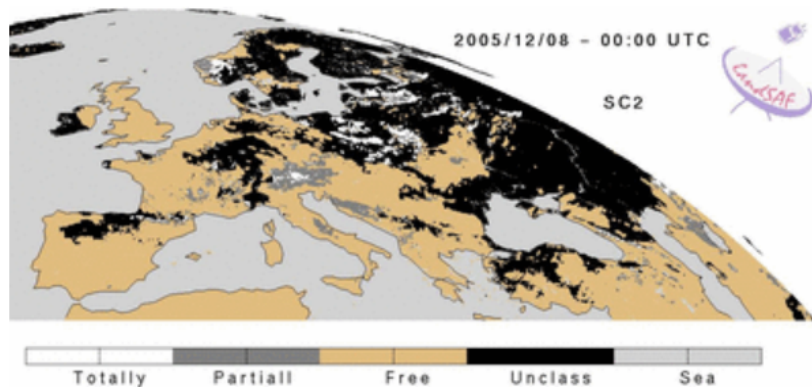








Combined effect, within a product resolution element, of fractional snow cover and other reflective contributors is used to estimate the fractional cover at resolution element level. The product may be processed in different ways and have different quality depending on the surface being flat, forested or mountainous.

-  **Coverage:** The H-SAF area [25-75°N lat, 25°W-45°E long]
-  **Cycle:** Daily
-  **Resolution:** 5 to 10 km (0.05 degrees), depending on the location (best for northern parts, worst for southern parts of the H-SAF area)
-  **Accuracy:** Around 20 % - Depending on geographical location (flat/forested areas, mountainous regions)
-  **Timeliness:** Fixed time of the day, product updated to account for data available until 1 h before delivery
-  **Dissemination:** By dedicated lines to centres connected by GTS - By EUMETCast to most other users, especially scientific
-  **Formats:** Values in fixed latitude-longitude grid representing a resolution element of the used instrument. Also JPEG or similar for quick-look.



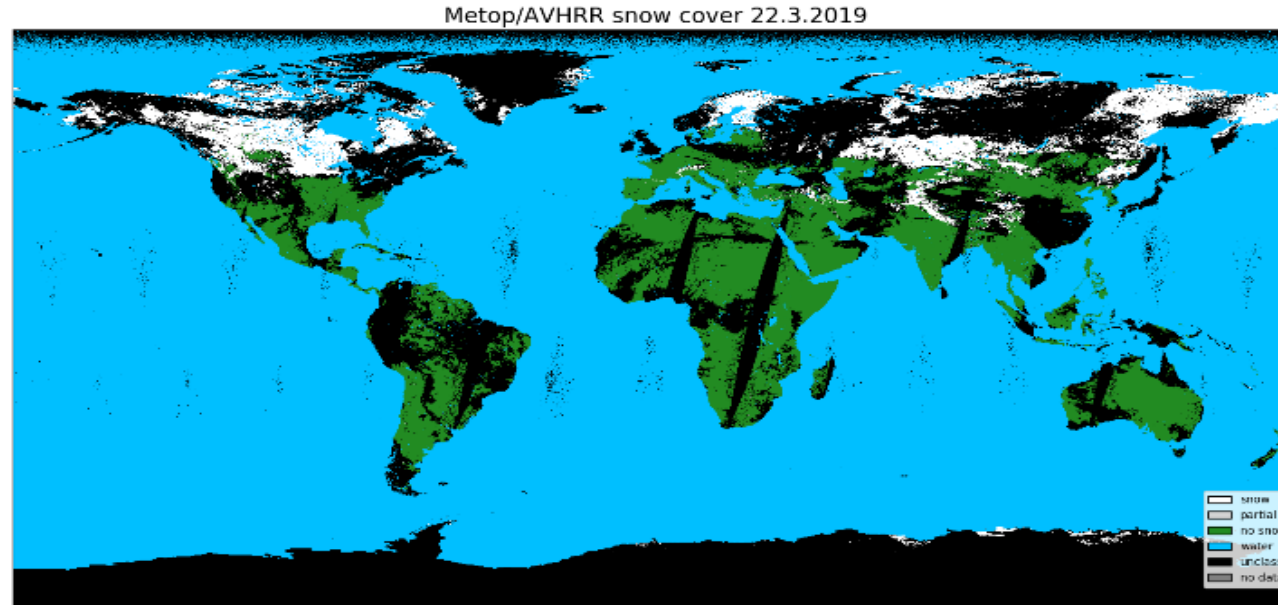
Snow Cover (SC) is the presence of snow over land. SC plays an important role in the physics of land surface as it is involved in the processes of energy and water exchange with the atmosphere. SC is useful for the scientific community, namely for those dealing with meteorological and climate models. Accurate detection of snow in a pixel is also important for a wide range of areas related to land surface processes, including meteorology, hydrology, climatology and environmental studies.



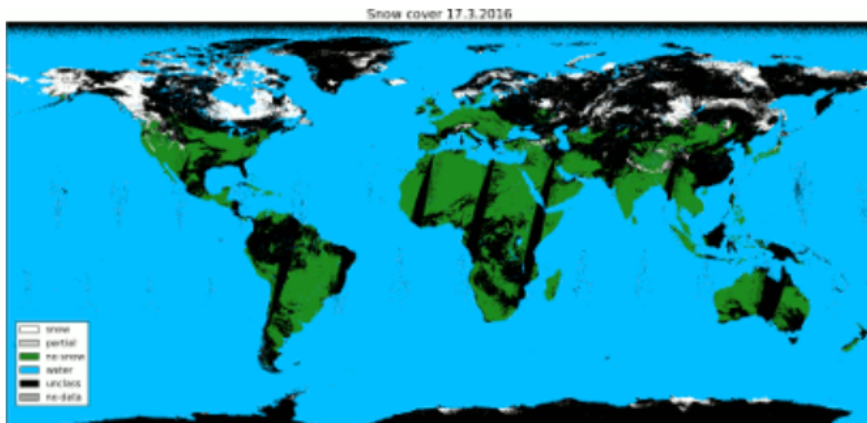
-  **Coverage:** The SC product is computed within the area covered by the MSG disk, over 4 specific geographical regions (Europe, Africa - N_Africa and S_Africa- and South America),
-  **Cycle:** 15 min
-  **Resolution:** SEVIRI pixel resolution and grid
-  **Timeliness:** 3 hours
-  **Dissemination:** FTP - EUMETCast
-  **Formats:** P HDF5, NetCDF

UPDATES: NO NetCDF, Full-disk

H32 Snow detection for flat land (snow mask) by VIS/NIR of Metop/AVHRR



Snow Cover (SC) is the presence of snow over land. SC plays an important role in the physics of land surface as it is involved in the processes of energy and water exchange with the atmosphere. SC is useful for the scientific community, namely for those dealing with meteorological and climate models. Accurate detection of snow in a pixel is also important for a wide range of areas related to land surface processes, including meteorology, hydrology, climatology and environmental studies



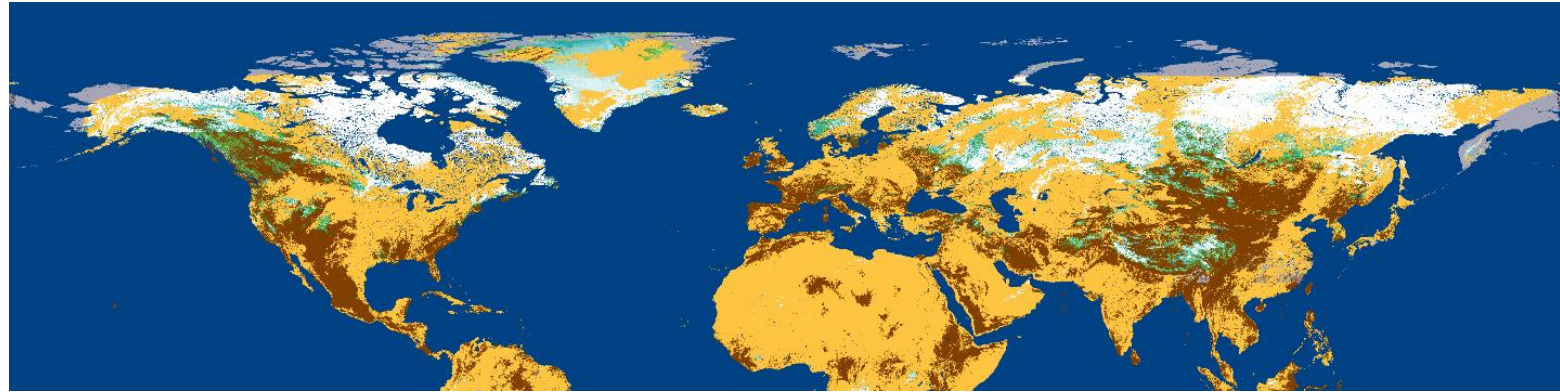
- Coverage:** Global
- Cycle:** Four products (integrals over 3, 6, 12 and 24 h) every three hours (rolling)
- Resolution:** $0.01^\circ \times 0.01^\circ$
- Timeliness:** 3 hours
- Dissemination:** FTP - EUMETCast
- Formats:** HDF5

UPDATES: Daily product

H35 Effective snow cover by VIS/IR AVHRR radiometry

March 28, 2019

H35 will be the successor product of H12. In particular, H35 will extend H12 to Northern Hemisphere



H85 (Metop-SG/METimage snow extent)

- Metop-SG continuation product for H32
- Daily
- Global
- Grid/projection: TBD
- Resolution: about 1 km
- The development principles and methods are expected to be similar we used in the development of the successful products H31 and H32.
- The product will be semi-empirical which means that actual satellite data is necessary for the final development of the product.
- **In development**

H43 (MTG/FCI snow extent)

- MTG continuation product for H31 and H34
- Daily
- Full Disk
- Grid/projection: TBD
- Resolution: about 1 km
- Contains flat land snow, mountain snow and merged snow
- The development principles and methods are expected to be similar we used in earlier products.
- Actual satellite data is necessary for the final development of the product.
- **In development**

Operational Snow Cover Products

Table 1. Summary of some existing operational satellite snow cover products.

Snow cover product	Sensor	Available since	Spatial resolution	Temporal resolution	Mapping accuracy
NOHRSC/ +GOES	NOAA/AVHRR	1986	1 km	Daily	76 % (Klein and Barnett, 2003)
NOAA/NESDIS (IMS)	GOES+SSM/I	1998	4 km	Daily, weekly	85 % (Romanov et al., 2000); < 20 % (October), ~ 60 % (November), ~ 95 % (December), ~ 70 % (March) (Brubaker et al., 2005)
MOD10A1, MYD10A1, MOD10A2, MYD10A2, MOD10C1, MYD10C1, MOD10CM, MYD10CM	MODIS- Terra/Aqua	2000/2002	500 m –0.05°	Daily, 8-day, monthly	~ 94 % summary in Parajka and Riggs, 2007 or (see e.g., Hall and Blöschl, 2012)
HSAF (EUMETSAT)	MSG-SEVIRI	2008	5 km	Daily	80 % compared to IMS (Siljamo and Hyvärinen, 2011); 69–81 % in winter months (Surer and Akyurek, 2012)

H10 Snow detection (snow mask) by VIS/IR radiometry

Cycle: Daily

Coverage: Europe, Northern Africa, Middle East

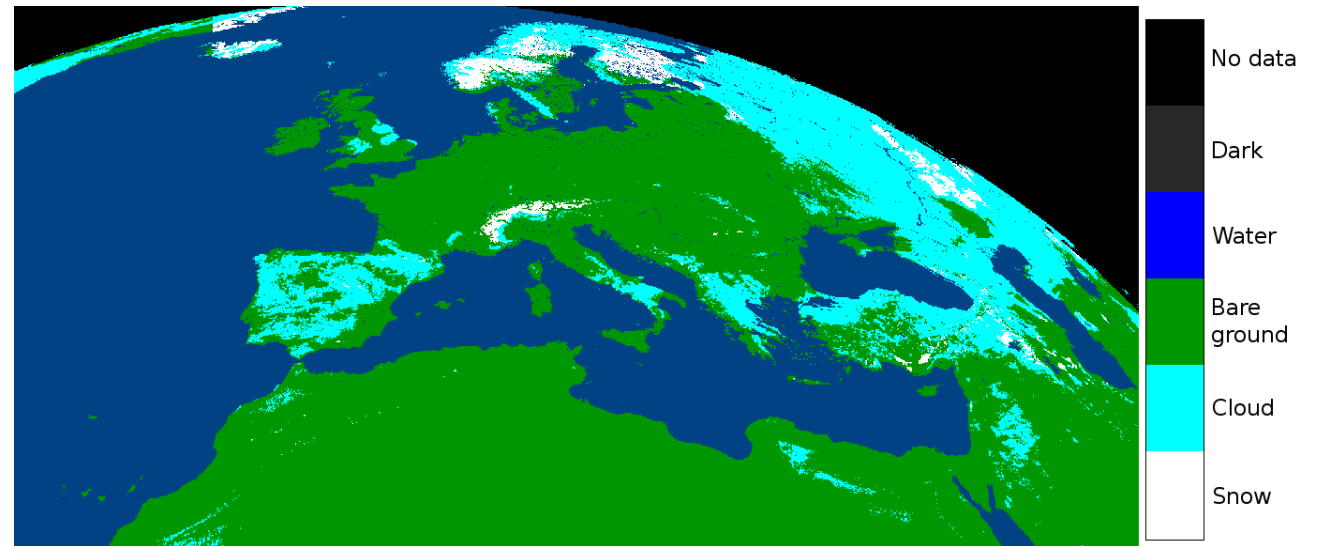
Grid/Projection: Part of Meteosat/SEVIRI 0°
fulldisk, GEOS projection

Resolution: Variable from 3 km to 10 km,
depending on distance from sub-satellite
point

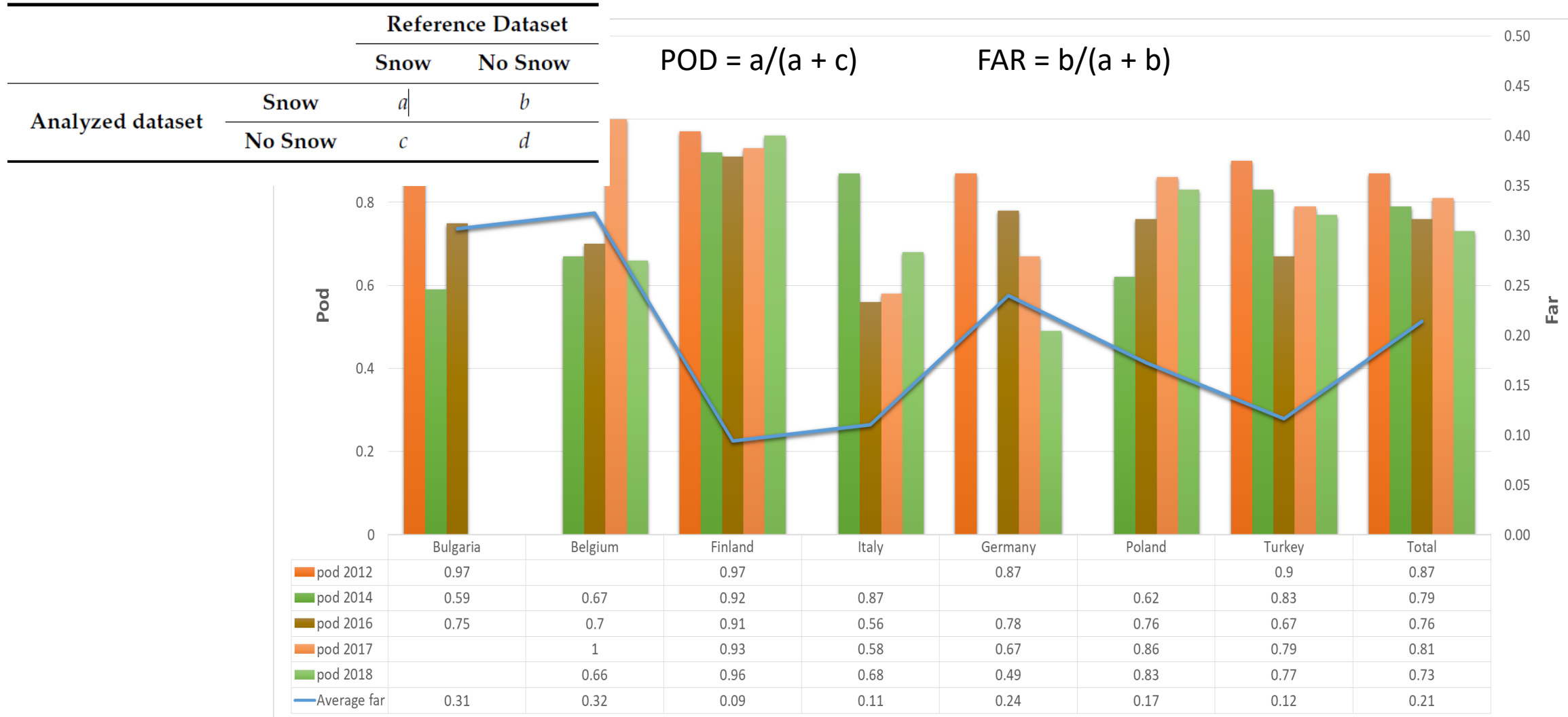
Formats: HDF5, PNG quicklook

Operational status: **Operational**

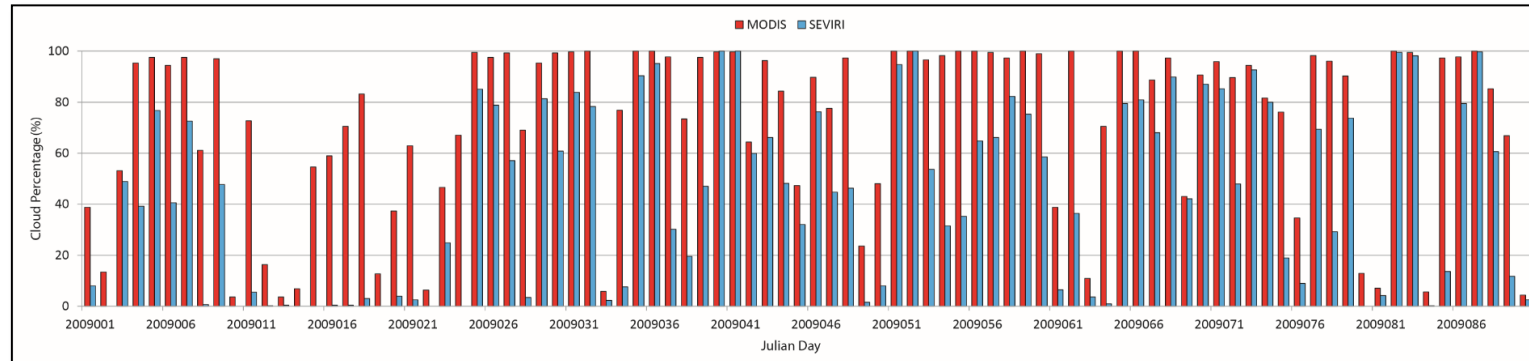
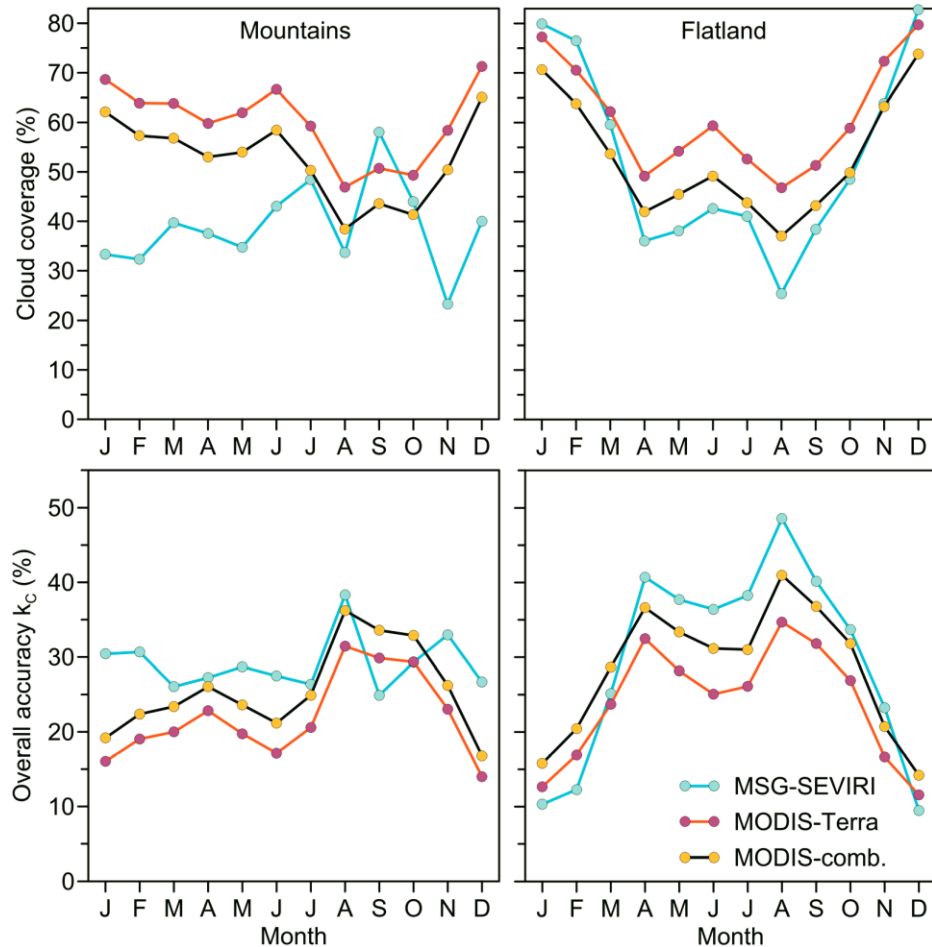
January 19, 2019



H10 Snow detection (snow mask) by VIS/IR radiometry



H10 Snow detection (snow mask) by VIS/IR radiometry



Surer and Akyurek, 2012

Evaluating the utility of the EUMETSAT HSAF snow recognition product over mountainous areas of eastern Turkey Hydrological Science Journal, 57 (8), 1-11, 2012.

The possibility of 37% cloud cover reduction from MSG-SEVIRI compared to using only one daily observation from MODIS

Sürer, S., J. Parajka, and Z. Akyurek, "Validation of the operational MSG-SEVIRI snow cover product over Austria", Hydrol. Earth Syst. Sci. 18, 763–774, 2014

H34 Snow detection (snow mask) by VIS/IR SEVIRI radiometry

October 27, 2017

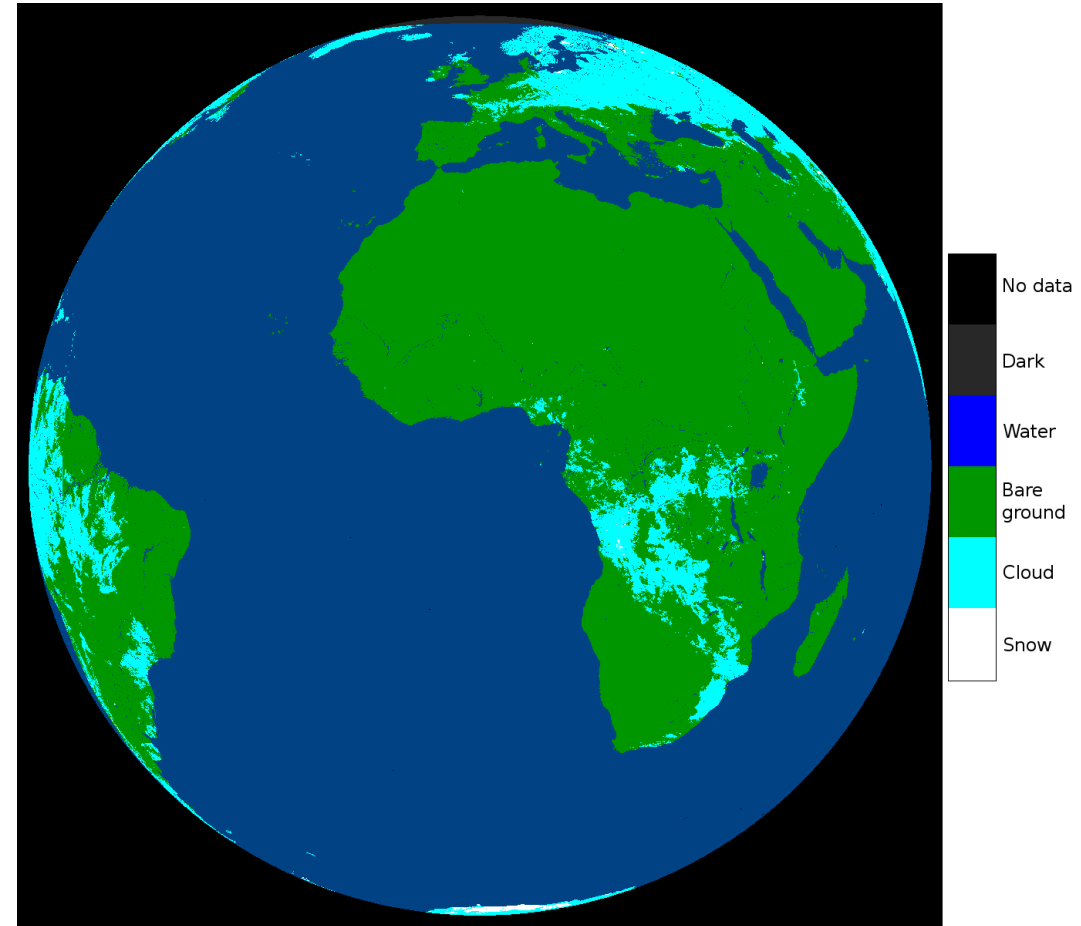
Cycle: Daily

Coverage: Full disk

Grid/Projection: Part of Meteosat/SEVIRI 0° fulldisk,
GEOS projection

Resolution: Variable from 3 km to 10 km, depending
on distance from sub-satellite point

Formats: HDF5, PNG quicklook



H13 Snow Water Equivalent by MW radiometry

March 26, 2019

Cycle: Daily

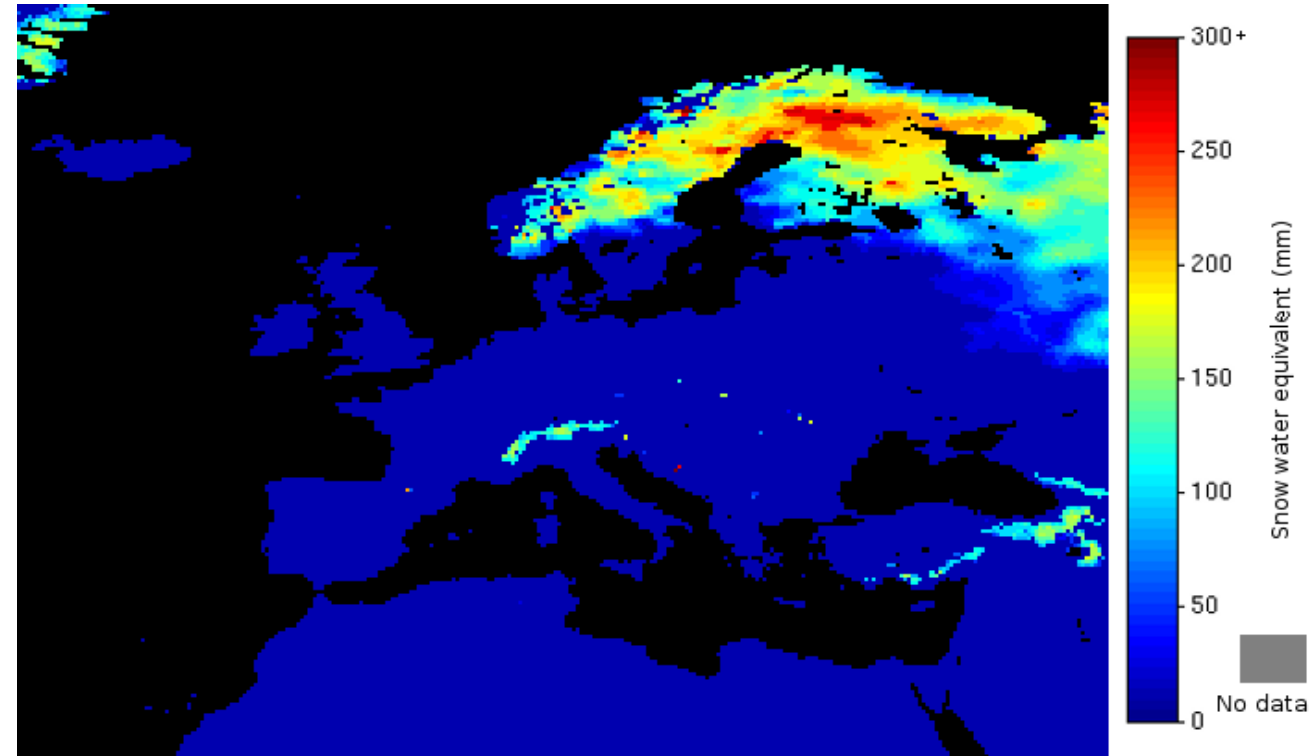
Coverage: 25 ° W – 45 ° E, 25 ° N – 75 ° N

Grid/Projection: Equidistant cylindrical

Resolution: 0.25 ° x 0.25 °

Formats: gzip compressed GRIB2, PNG quicklook image

Operational status: **Operational**



SWE estimate, 2017/01/01

90°W

60°W

30°W

0°

30°E

60°E

120°E

150°E

180°E

150°W

120°W

90°W

60°N

50°N

40°N

30°N

20°N

10°N

0°

SWE [mm]

250

200

150

100

50

0

snowfree

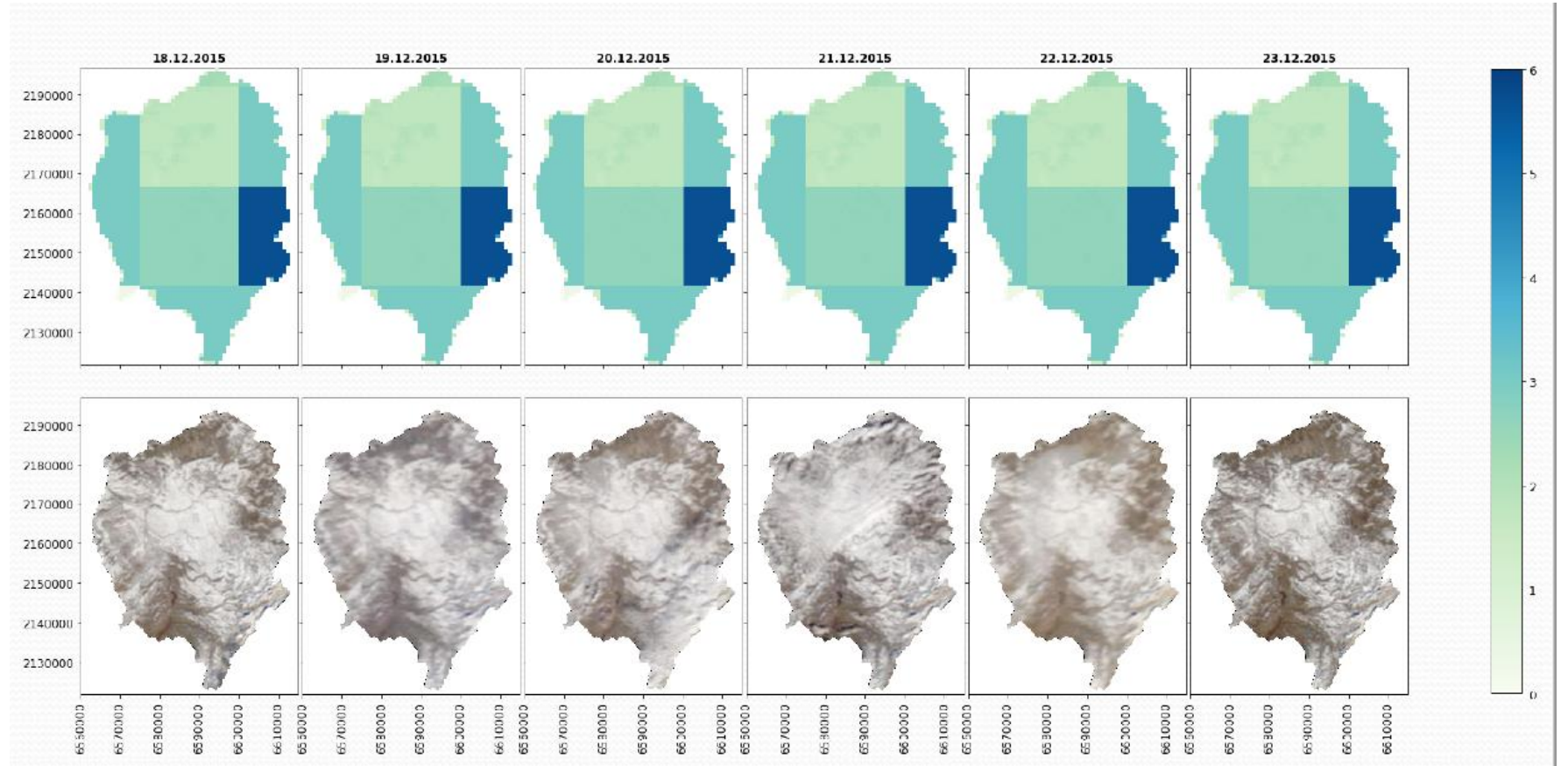
water

mountain

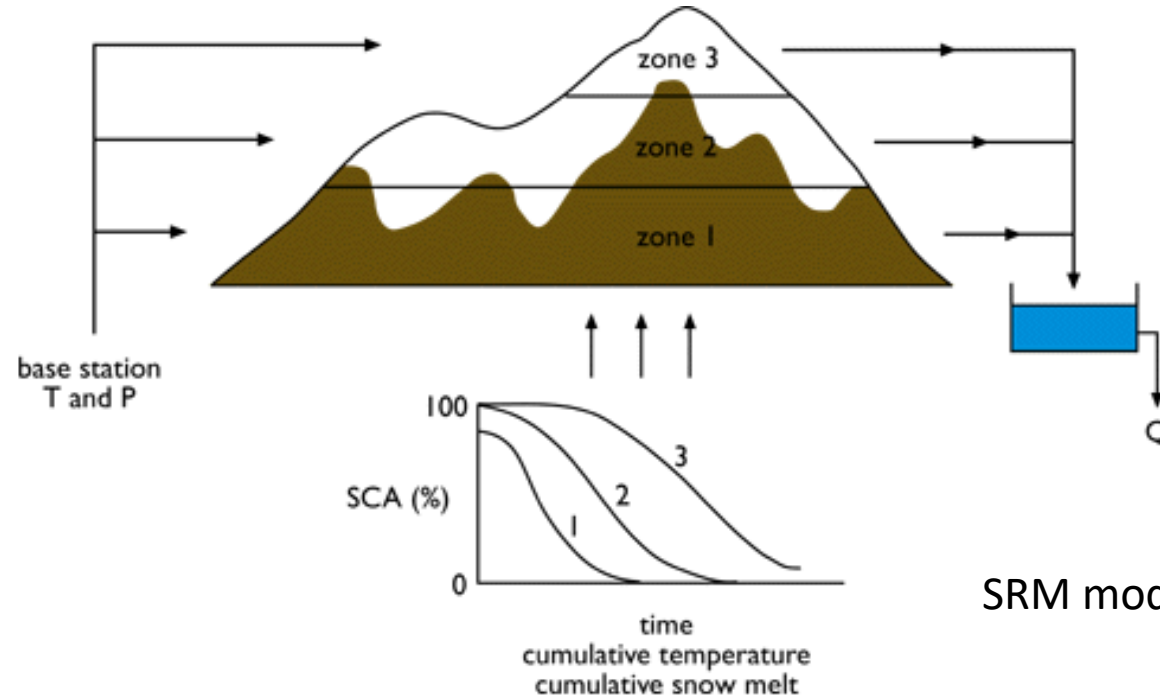
The use of Snow Products: Time Series Analyses

Mesoscale Hydrologic Model
(mHM)
Simulated SWE

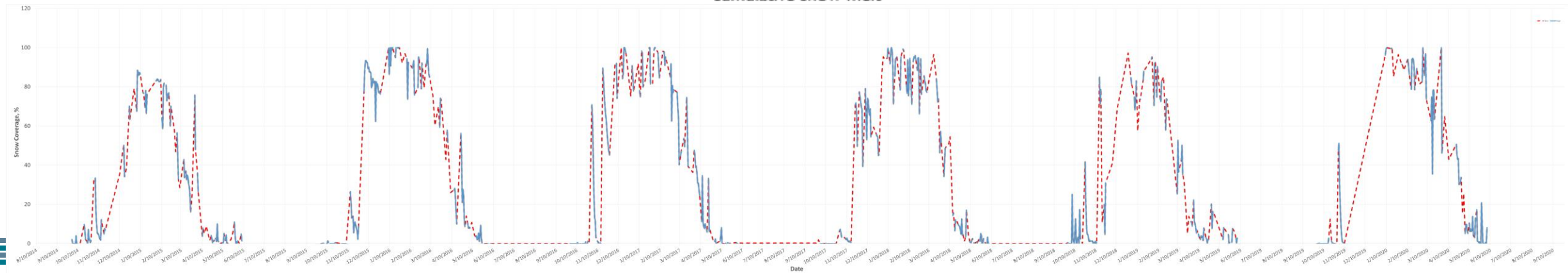
MOD10A1 snow products



The use of Snow Products: Snow Cover Area



SRM model (Martinec, 1975)



THANK YOU !!!