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METEOROLOGISKA INSTITUTET
FINNISH METEOROLOGICAL INSTITUTE

Finnish Meteorological Institute

WEATHER – SEA – CLIMATE – SPACE

IESWG-5 Workshop
Helsinki, Finland
26-28 Sep 2023

26.9.2023 **Ali Nadir Arslan**

FINNISH METEOROLOGICAL INSTITUTE IS A RESEARCH AND SERVICE AGENCY UNDER THE MINISTRY OF TRANSPORT AND COMMUNICATIONS.

We produce observation and research data on the atmosphere, the near space and the seas, as well as weather, sea, air quality and climate services for the needs of public safety, business life and citizens.

LAW ON FMI 212/2018

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VISION

We are an international pioneer in our field. We provide information for weather and climate ready future so that no one is caught unaware by nature's conditions.

STRATEGIC OBJECTIVES

- International leadership
- Best expertise in the Nordic region
- Anticipating customer and stakeholder needs

CONDITIONS FOR SUCCESS

- Efficient infrastructure and production
- Effective use of research and technology
- Thriving and agile workplace
- Coordinated communication
- Common practices

VALUES

- Collaboration
- Impact
- Pioneering

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International collaboration is the backbone of our operation

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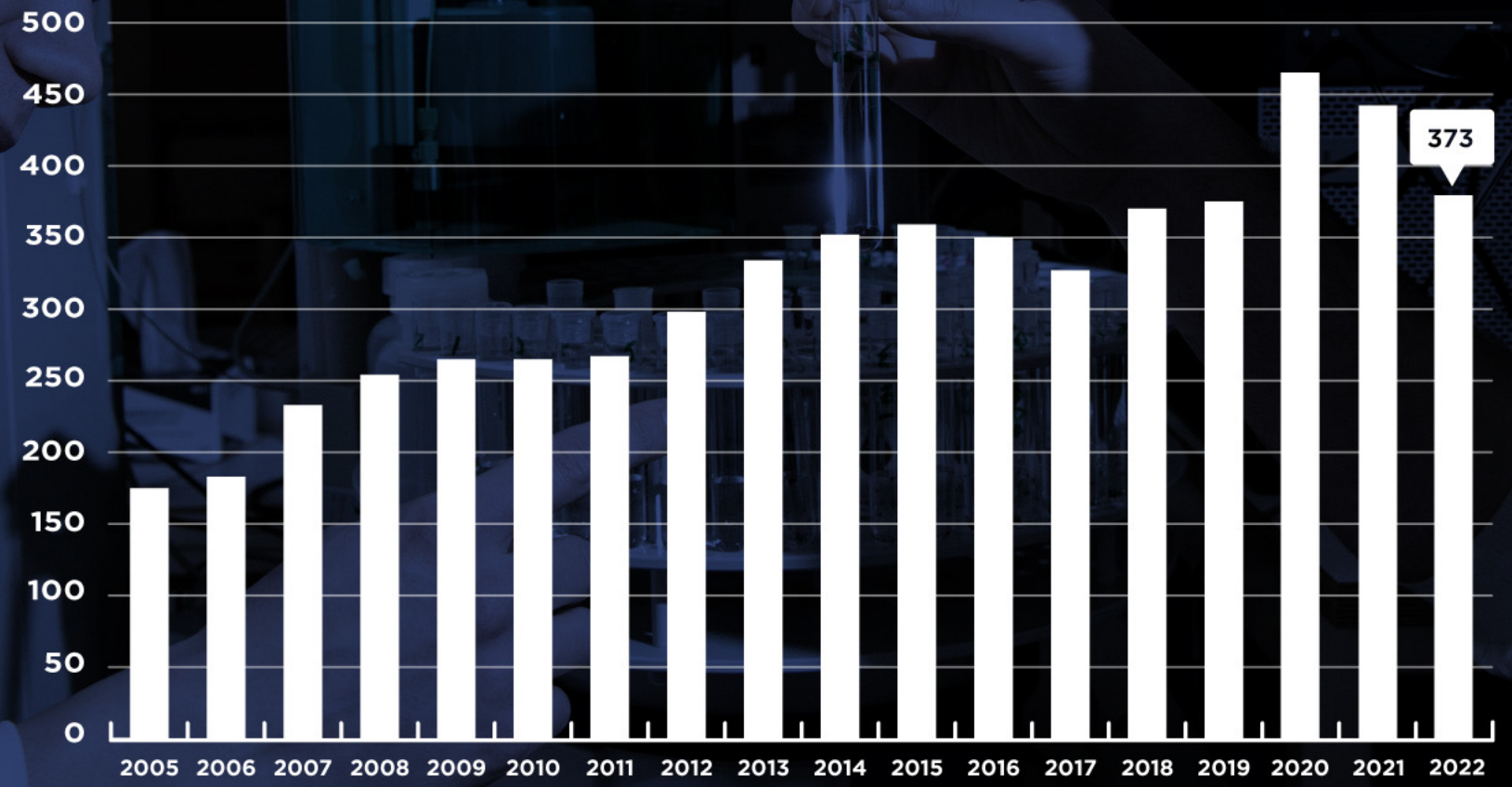
We produce scientific and verified information to support decision making

PEER REVIEWED PUBLICATIONS 2022



Source: Justus publication registry used by FMI

Open science

- FMI strongly promotes open science practices, open publication as well as accessibility of both open data and open source code
- Open science enhances the quality, efficiency and usability of research information
- FMI reached outstanding level in the National Open Science monitoring in 2022
- FMI contributes to the development of international open science practices

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Observations and measurements are the basis of research and service development

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Research infrastructures ACTRIS and ICOS

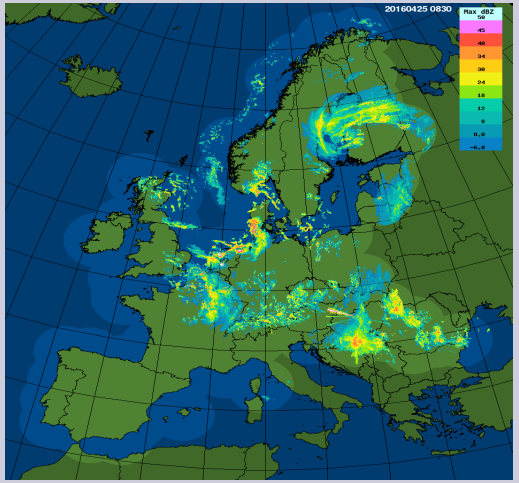
ACTRIS – Aerosol, Clouds and Trace Gases Research Infrastructure

ICOS – Integrated Carbon Observation System infrastructure

ACTRiS

ICOS | INTEGRATED CARBON OBSERVATION SYSTEM

OPERA – European radar programme

150 radars from around Europe	send their measurements	to see rain areas in Europe
		

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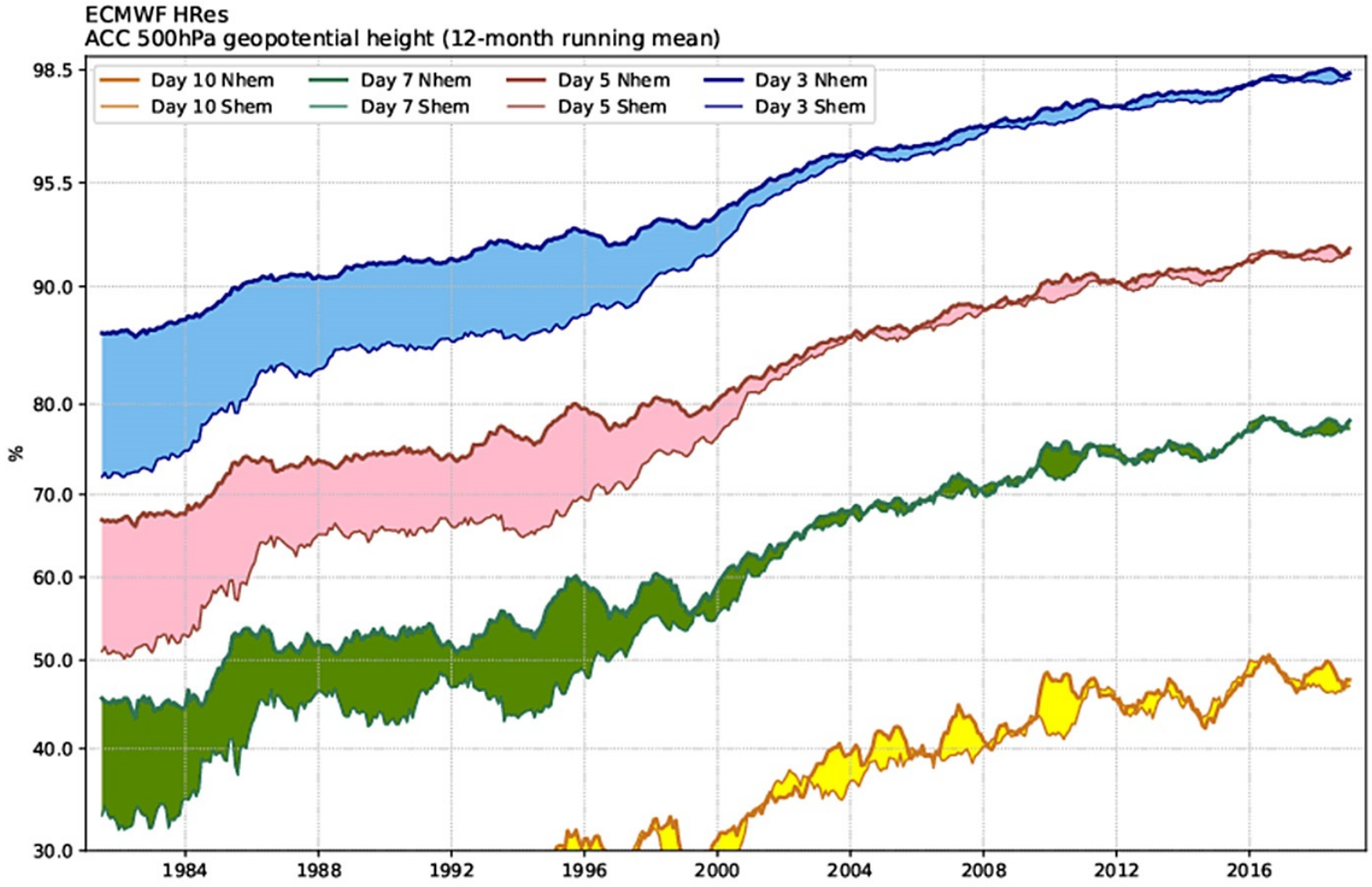
ECMWF – Collaboration to develop weather forecasts



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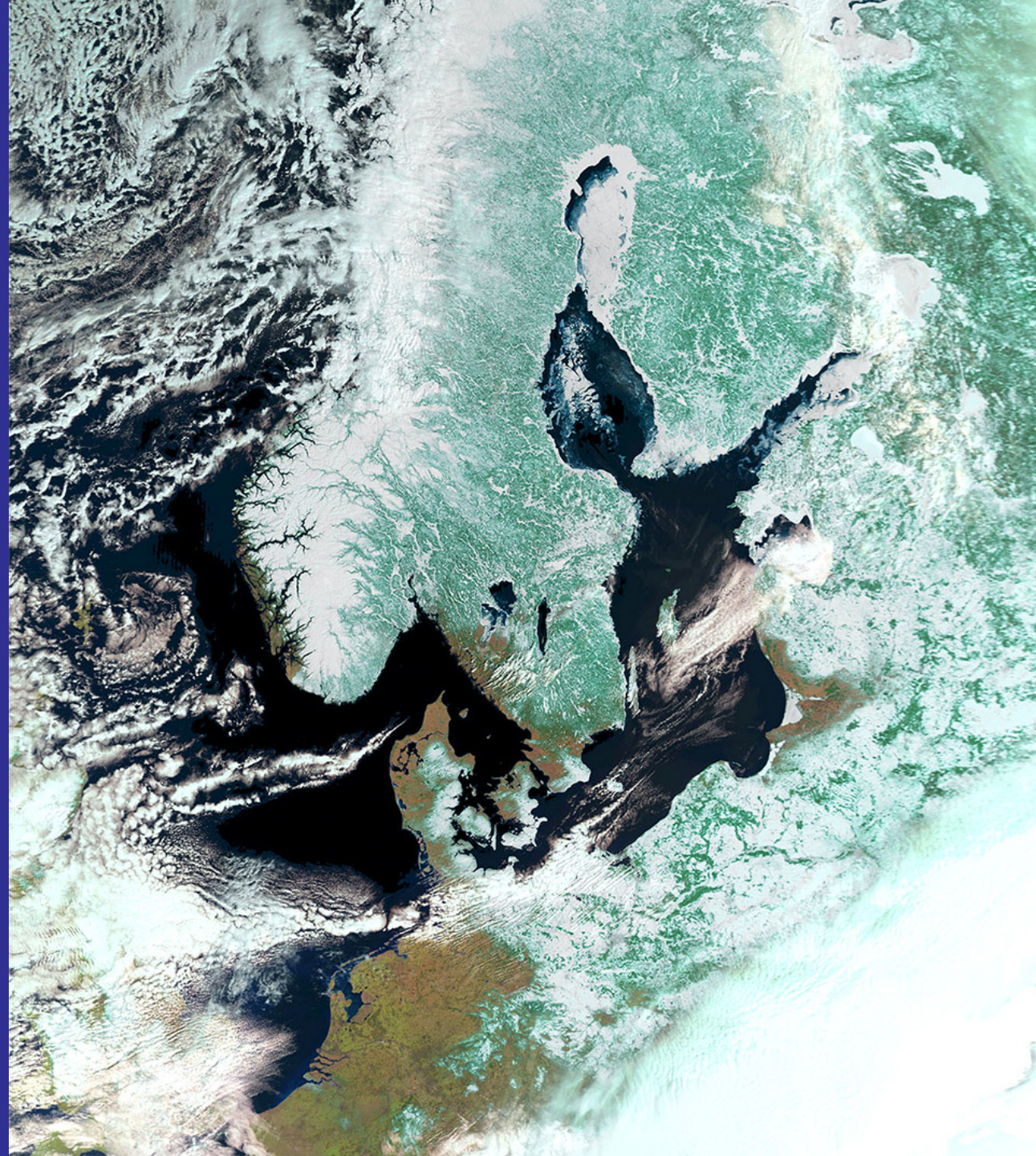
EUMETSAT

European satellite collaboration

Satellites provide information about, e.g.

- Atmopsheric composition
- Ground (ice, snow)
- Sources and sinks of greenhouse gases
- Ground frost



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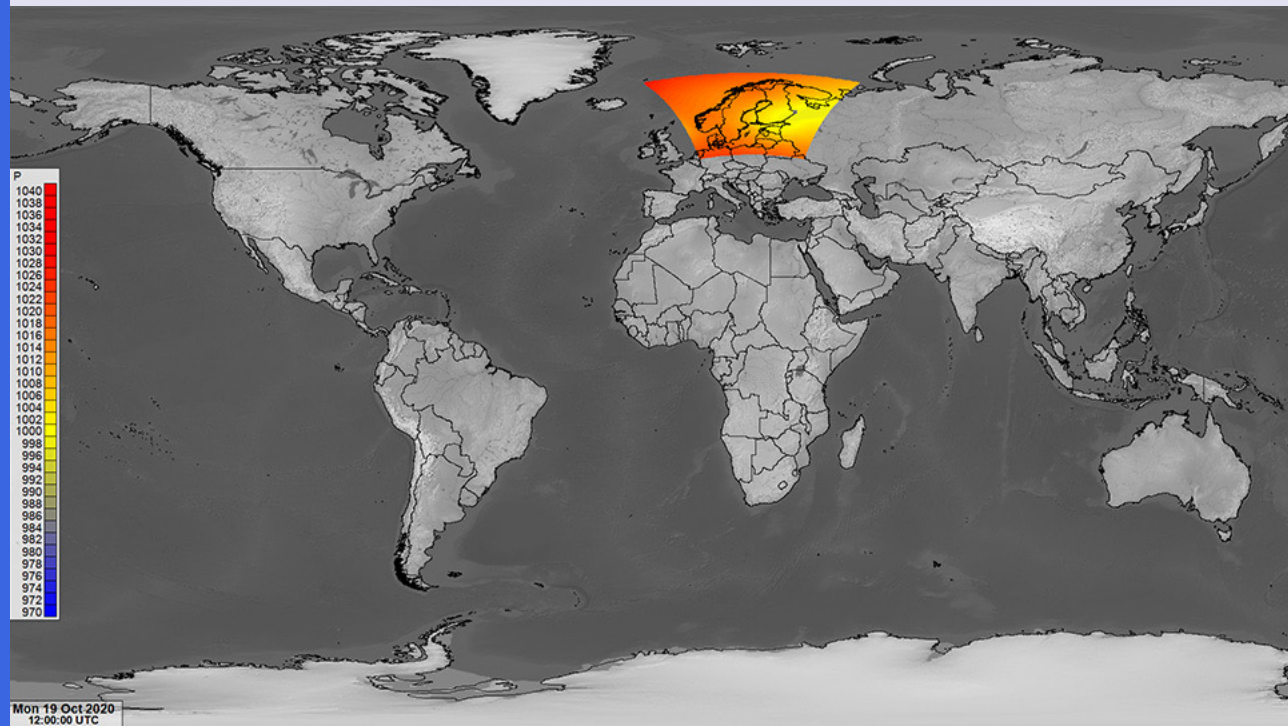
Regional collaboration

MetCoOp



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Nordic collaboration in regional climate modelling

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Services for all traffic sectors

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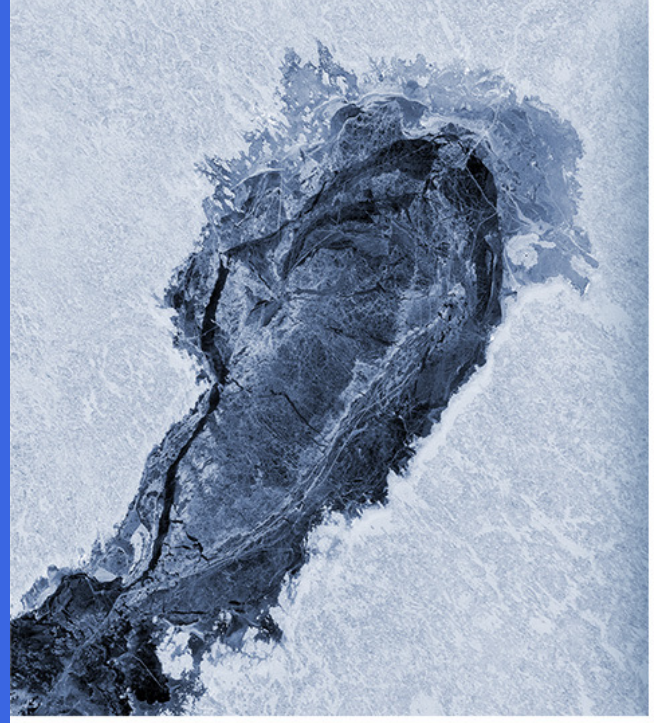
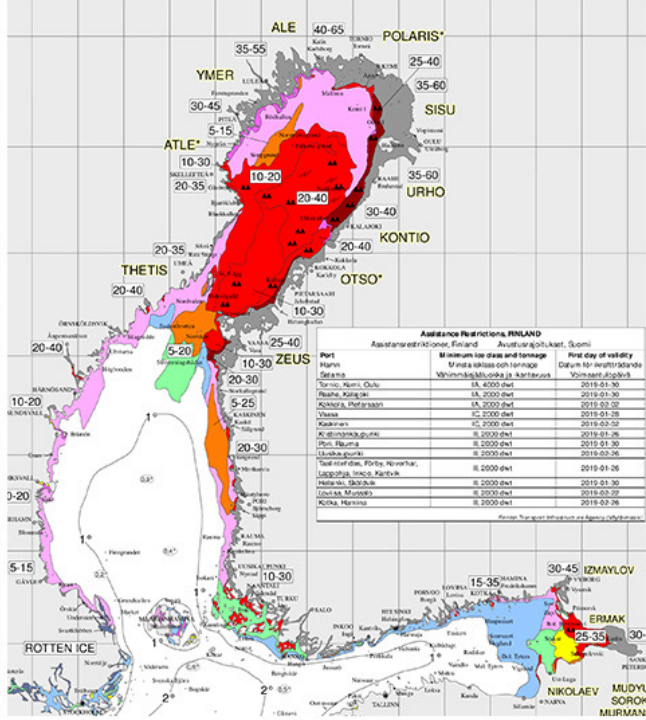
Services to ensure safe sea traffic in all conditions





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Services for the military

KUVAT: Puolustusvoimat

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Service portfolio – from research to mobile applications, from tailored services for authorities to social media

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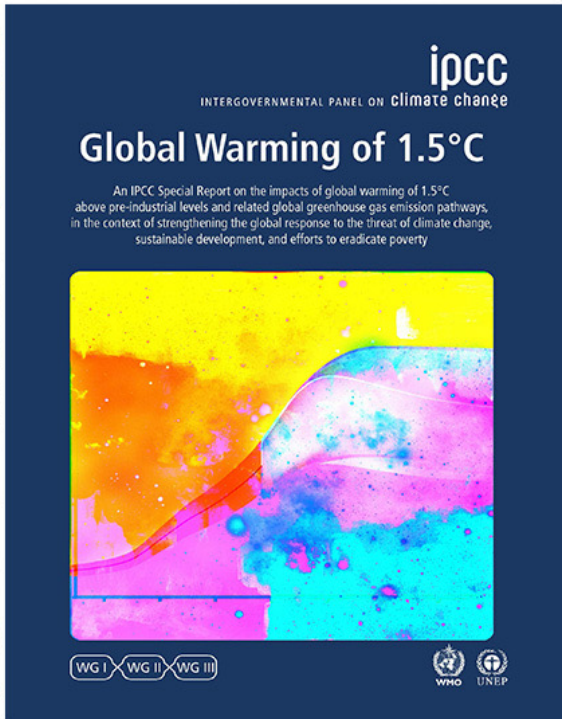
The Finnish Climate Change Panel and the IPCC



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Benefits of regional climate modelling

- Information to support adaptation
- More accurate information on precipitation
- Information about changes in heavy precipitation, floods and draught periods

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Arctic Space Center in Sodankylä

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Ground stations in the Arctic area

Satellite data reception

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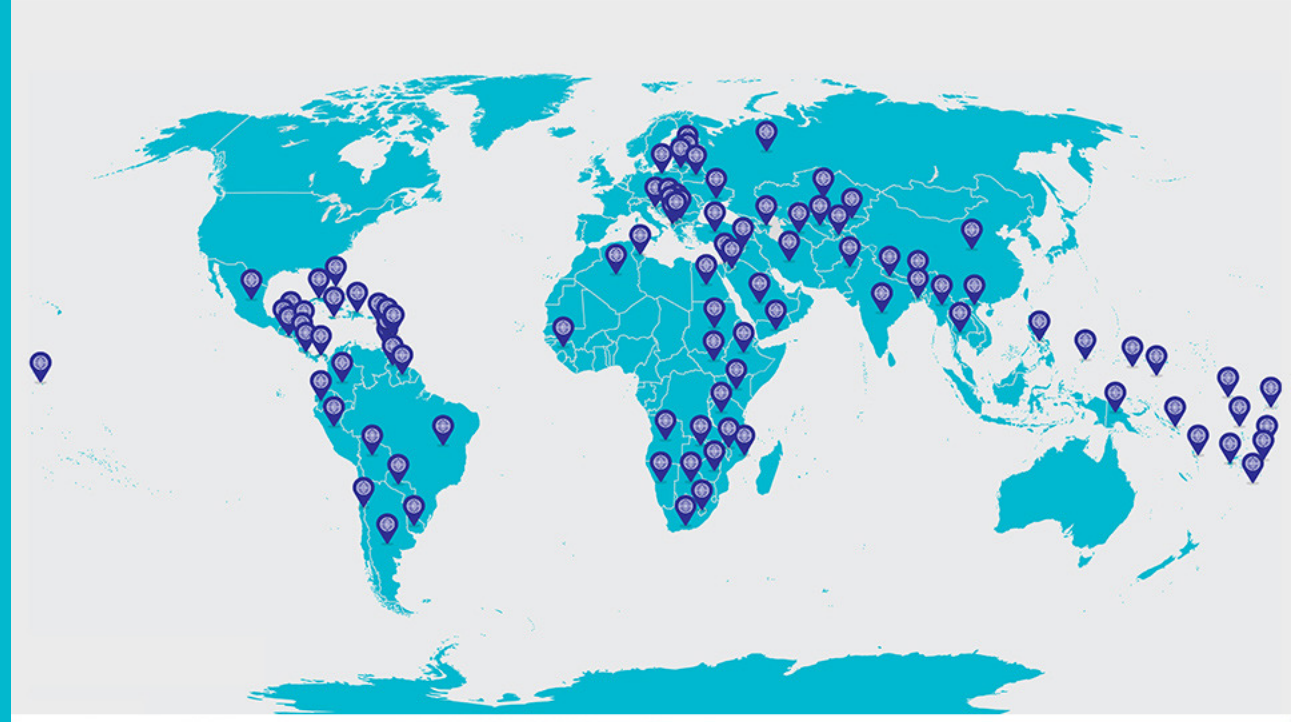
Capacity building in over 100 countries since 1970



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Tulanet – cooperation body of Finnish government research institutes

thl
Työterveys-laitos
MML MAANMITTAUSLAITOS
SYKE
GTK
RUOKAVIRASTO
Livsmedelsverket • Finnish Food Authority
VTT
stuk
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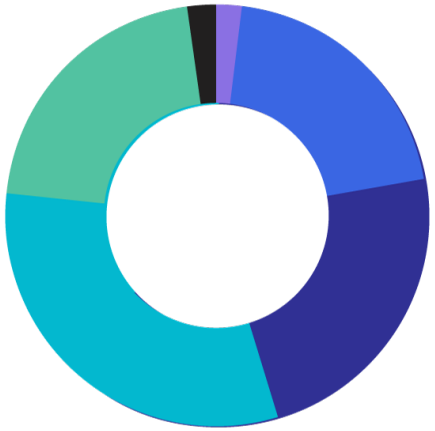
Luke
NATURAL RESOURCES INSTITUTE FINLAND

PERSONEL AGE DISTRIBUTION 2022



Age

2%	65-
29%	35-44
20%	55-64
23%	25-34
24%	45-54
2%	15-24

GENDER BALANCE 2022

39%	Female 296
61%	Male 455

Organization

DIRECTOR GENERAL'S OFFICE
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Communications group
Nina Kukkurainen

Research Coordination group
Jari Liski

METEOROLOGICAL AND MARINE RESEARCH PROGRAMME
SAMI NIEMELÄ

Meteorological Research
Anders Lindfors

Marine Research
Laura Tuomi

Weather and Climate Change Impact Research
Hilppa Gregow

CLIMATE RESEARCH PROGRAMME
HANNELE KORHONEN

Climate System Research
Annalea Lohila

Atmospheric Composition
Antti Hyvärinen

Atmospheric Research Centre of Eastern Finland
Sami Romakkaniemi

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JOUNI PULLIAINEN

Earth Observation Research
Johanna Tamminen

Space Research and Observation Technologies
Ari-Matti Harri

Arctic Space Centre
Jyri Heilimo

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TARJA RIIHISAARI

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Vesa Kurki

ICT and Data Production
Matti Keränen

Service Development
Mikko Visa

WEATHER, SEA AND CLIMATE SERVICE CENTRE
JUHANA HYRKKÄNEN

Weather and Safety Centre
Anssi Vähämäki

Customer Services
Jaakko Nuottokari

Expert Services
Harri Pietarila

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Financial
Janna Karasjärvi

Personnel
Minna Laatikainen

Administrative Services
Jaana Palmunoksa

Quality Manager
Sanna Mäkinen

Risk Management Manager
Sanna Matikainen

Chief Architect
Mikko Rauhala

Production Manager
Anu Petäjä

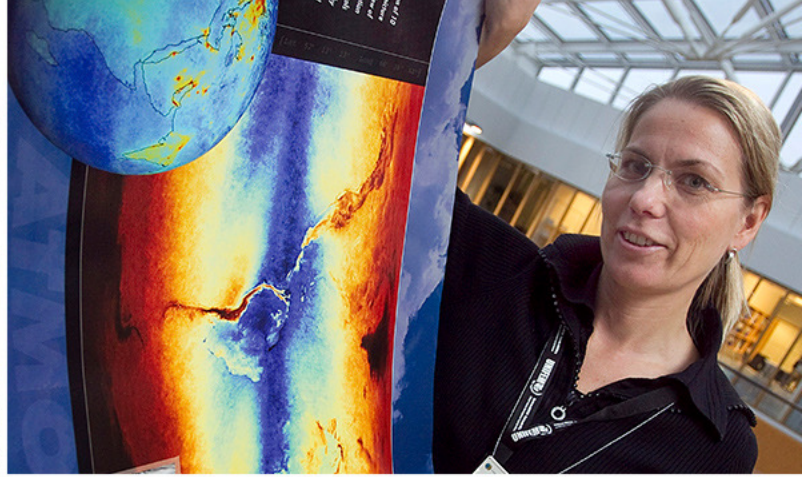
Information Security Manager
Simo Poskiparta

Security Manager
Veli-Pekka Rautava

Preparedness Manager
Ari-Juhani Punkka

PROFESSORS 2022

1	Academy Professor
21	Research Professor
7	Research Professor (tenure track)
5	Professor (joint professorships with universities)



Eumetsat H SAF Snow Products for Supporting Operational Hydrology and Water Management

A.N. Arslan[1], Z. Akyurek[2], M. Takala[1], N. Siljamo[1], Ç. Karaman[2], S. Kuter[3], B. Simsek[1], C.M. Tanış[1], B. Akpinar[2], S. Çil[4]

[1]Finnish Meteorological Institute, Arctic Space Center, Helsinki, Finland.
[2]Middle East Technical University- Turkey, Civil Engineering, Ankara, Turkey.
[3]Çankırı Karatekin University, Forest Engineering, Çankırı, Turkey.
[4]Turkish State Meteorological Service, Remote Sensing Division, Ankara, Turkey.

EUMETSAT is the European operational satellite agency for monitoring weather, climate and the environment from space.

Utilising specialist expertise from the Member States, Satellite Application Facilities (SAFs) are dedicated centres of excellence for processing satellite data. They form an integral part of the distributed EUMETSAT Application Ground Segment.

Meet the SAFs

AC SAF

Atmospheric Composition Monitoring

The AC SAF processes satellite data on ozone, other trace gases, aerosols and ultraviolet data.

Learn more about AC SAF

CM SAF

Climate Monitoring

The CM SAF generates and archives high-quality climate datasets.

Learn more about CM SAF

LSA SAF

Land Surface Analysis

The LSA SAF exploits remotely-sensed data on land, land-atmosphere interactions and biosphere applications.

Learn more about LSA SAF

OSI SAF

Ocean and Sea Ice

The OSI SAF provides comprehensive information on the ocean-atmosphere interface.

Learn more about OSI SAF

NWP SAF

Numerical Weather Prediction

The NWP SAF supports the interface between satellite data and European activities in NWP.

Learn more about NWP SAF

ROM SAF

Radio Occultation Meteorology

The ROM SAF generates and archives high-quality GNSS Radio Occultation (RO) data for NWP.

Learn more about ROM SAF

NWC SAF

Nowcasting and Very Short Range Forecasting

Nowcasting is a weather forecast for the next few hours, based on current information.

H SAF

Operational Hydrology and Water Management

The H SAF generates and archives datasets and products for operational hydrological applications.

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Copernicus services catalogue | C

Home Page - H SAF Official web

https://hsaf.meteoam.it

HOME

EUMETSAT H SAF
SUPPORT TO OPERATIONAL HYDROLOGY AND WATER MANAGEMENT

HOME ABOUT PRODUCTS NEWS & MEDIA SUPPORT

- Precipitation
- Soil Moisture
- Snow
- Quality Assessment
- Hydrological Validation
- Download Products

The main goal of the HSAF project is to provide accurate and timely hydrological parameters estimations to monitor end to forecast the meteorological and hydrological conditions to services, agencies, authorities and other initiatives which need information on water at the ground in order to prevent hazards and natural disasters, as well to improve water management.

Precipitation

Latest news

Tweets from @HydroSAF Follow

H SAF Retweeted

Lothar Sc... @LotharSc... · 17h

When high(er) spatial resolution meets

Latest products

Product : P-IN-SSMIS (H60)

(Precipitation rate at ground by MW cross track scanners)

User notifications

announcement
4/1/2023
A Visiting Scientist Activity at TU Wien, Vienna, Austria is available and funded by H SAF. The activity will focus

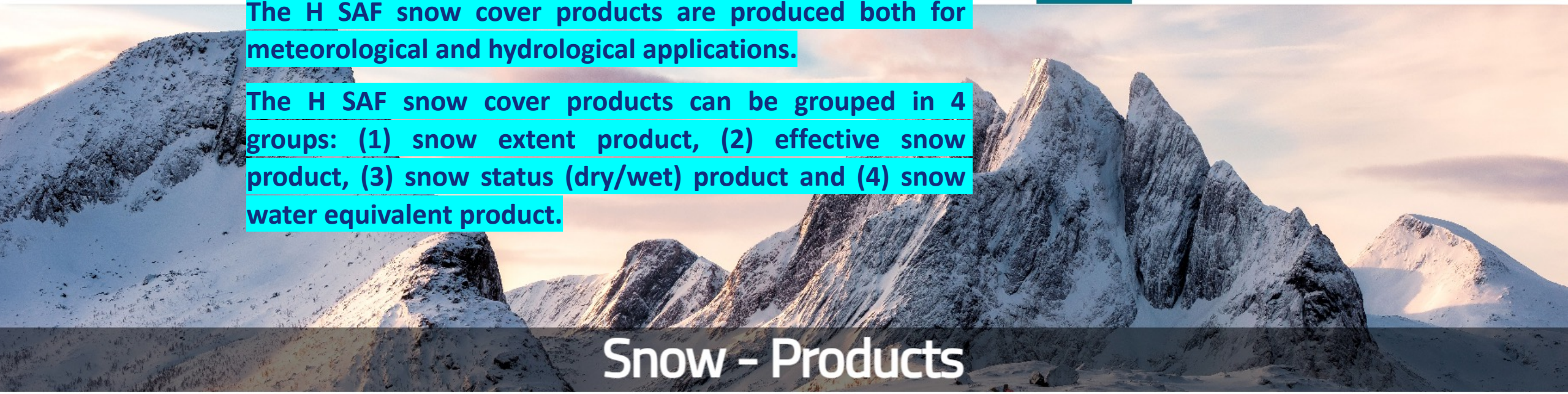
read more...

announcement

Type here to search

5°C Enimm. pilvistä

4.19
11.5.2023



Snow - Products

The H SAF snow cover products are produced both for meteorological and hydrological applications.

The H SAF snow cover products can be grouped in 4 groups: (1) snow extent product, (2) effective snow product, (3) snow status (dry/wet) product and (4) snow water equivalent product.

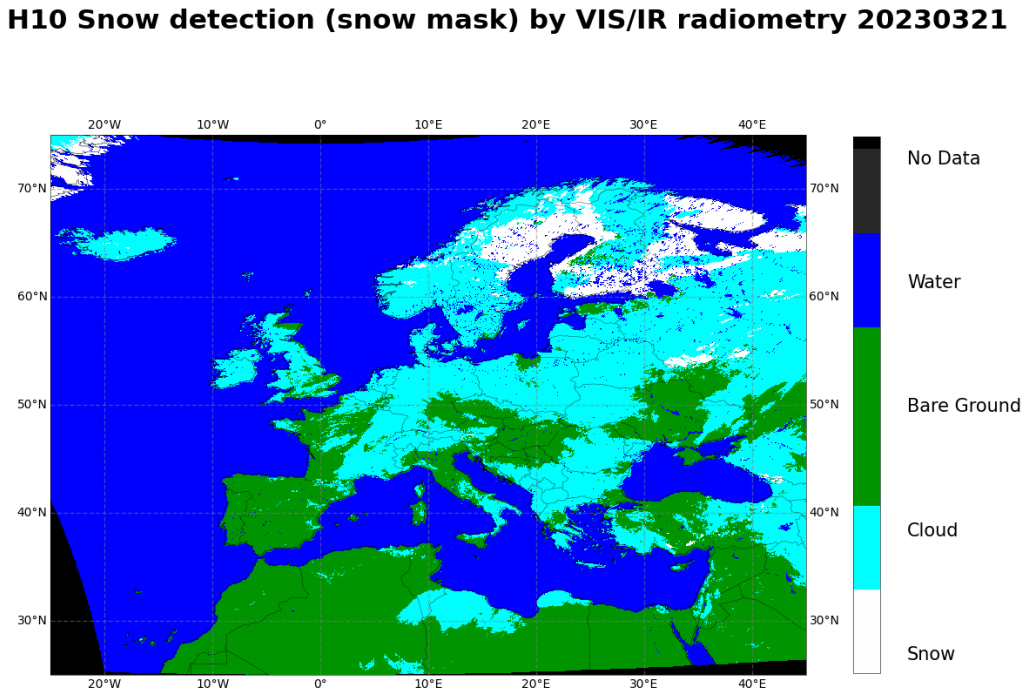
SNOW PRODUCT CODE FORMAT

SN-<type>-<area><input data/resolution><applicability>

<type>	SE = Snow Extent, WE= Wet Snow, ESC= Effective Snow Cover, SWE= Snow Water Equivalent
<area>	E = Europe, H=hemispherical, G= Global, D=SEVIRI disk
<applicability>	F = flat land and forested areas only

H10 MSG/SEVIRI Snow Extent

- Geostationary orbit
- Operational
- Daily Pan-European area product
- Obtained by merging H10 flat (FMI, H31 is the flat part) and H10 mountainous (METU/TSMS) part
- No snow/snow/water/cloud
- 3km x 3km resolution at NADIR, degrading to ~5km over Europe
- Available since late 2011



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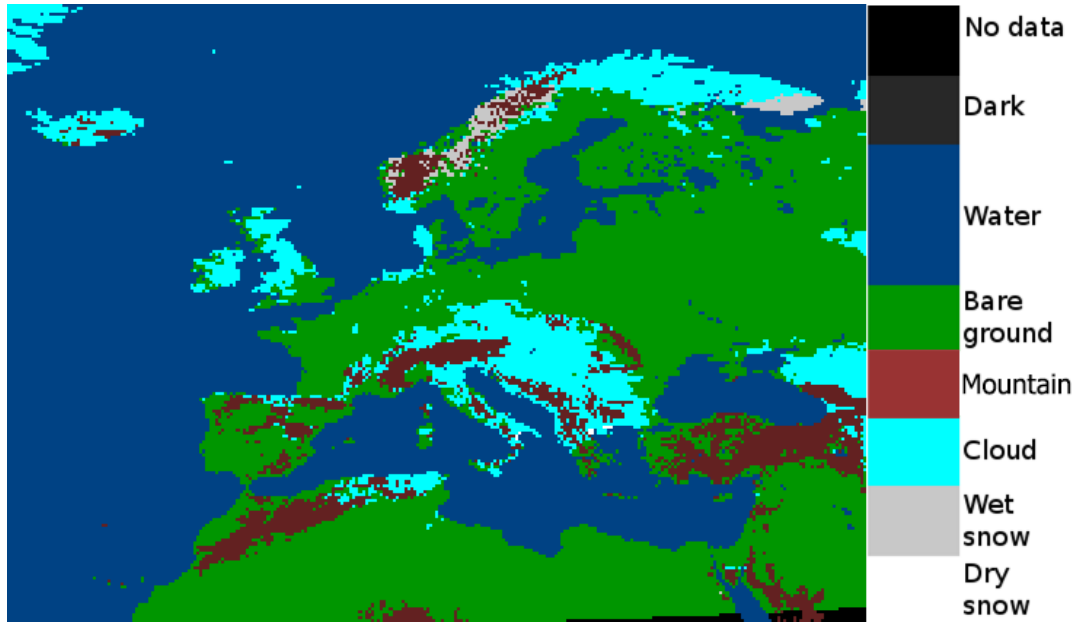
SUPPORT TO OPERATIONAL HYDROLOGY AND WATER MANAGEMENT

H10 merged product, 20230321

H11 SSMIS Snow Status

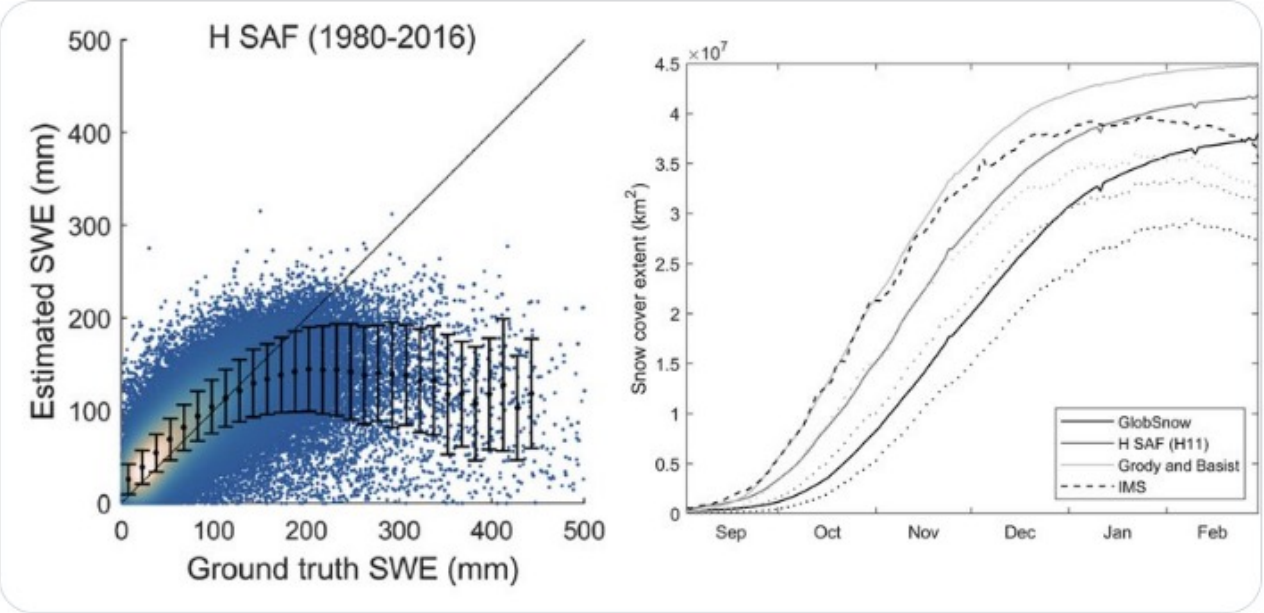
- Polar orbit
- Operational
- Pan-European product (0.25x0.25 degree lat-lon)
- Dry snow / Wet snow / Bare land / Mountain / Water / Dark / No data
- Based on H10 Optical product and SSMIS MW data
  - Detection of dry snow using BT differences and thresholding
- Daily product, available following H10, in the morning



H11 SSMIS Snow Status

H SAF
@HydroSAF

The #HSAF #H11 algorithm excels in dry #snow detection, surpassing other algorithms in accuracy and performance, and improving snow mapping and thus #SWE🇸🇪 retrieval of the #GSv3.0 product on hemispheric scale. A step closer to comprehensive SWE retrieval. 👉 sciencedirect.com/science/articl...



EUMETSAT and 7 others

EUMETSAT H SAF H11 improved SWE estimation in shallow snowpack during autumn.

ELSEVIER

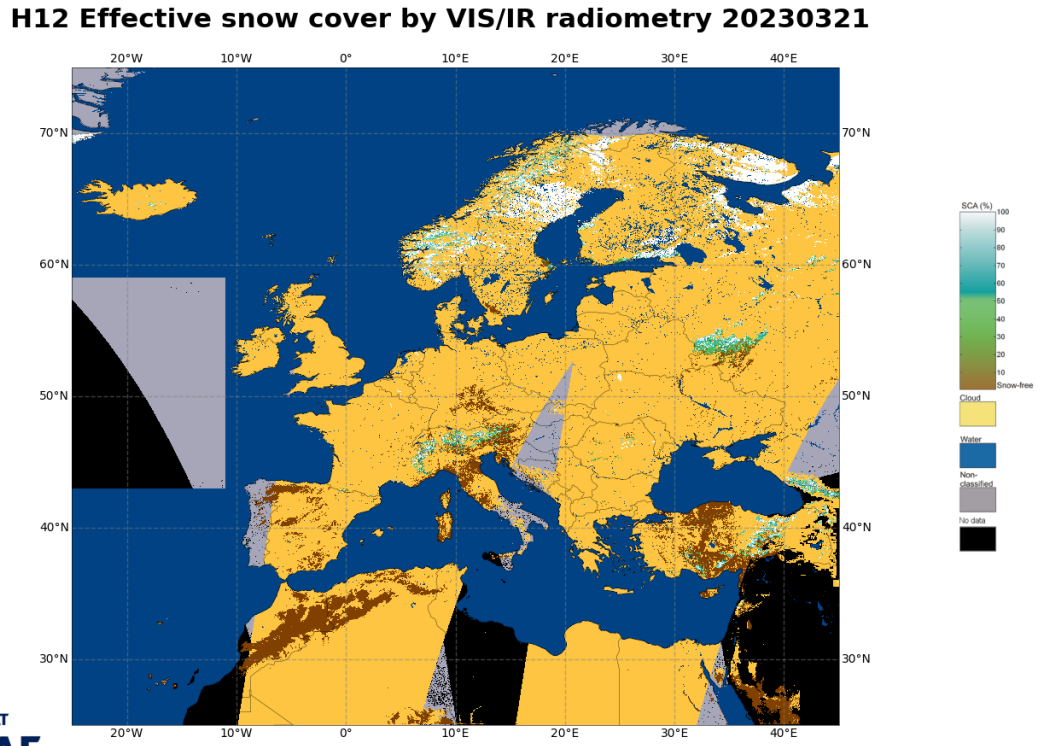
Remote Sensing of Environment
Volume 288, 1 April 2023, 113476

Evaluation of passive microwave dry snow detection algorithms and application to SWE retrieval during seasonal snow accumulation

Lina Zschenderlein, Kari Luojus, Matias Takala, Pinja Venäläinen, Jouni Pulliainen

H12 AVHRR Effective Snow Cover

- LEO
- Operational
- Daily Pan-European area product
- Obtained by merging H12 flat (FMI) and H12 mountainous (METU/TSMS) part
- Fractional Snow Cover (0-100) / Cloud / Unclassified / Nodata
- 0.01 deg x 0.01 deg Lat/Lon grid
- Available since late 2012



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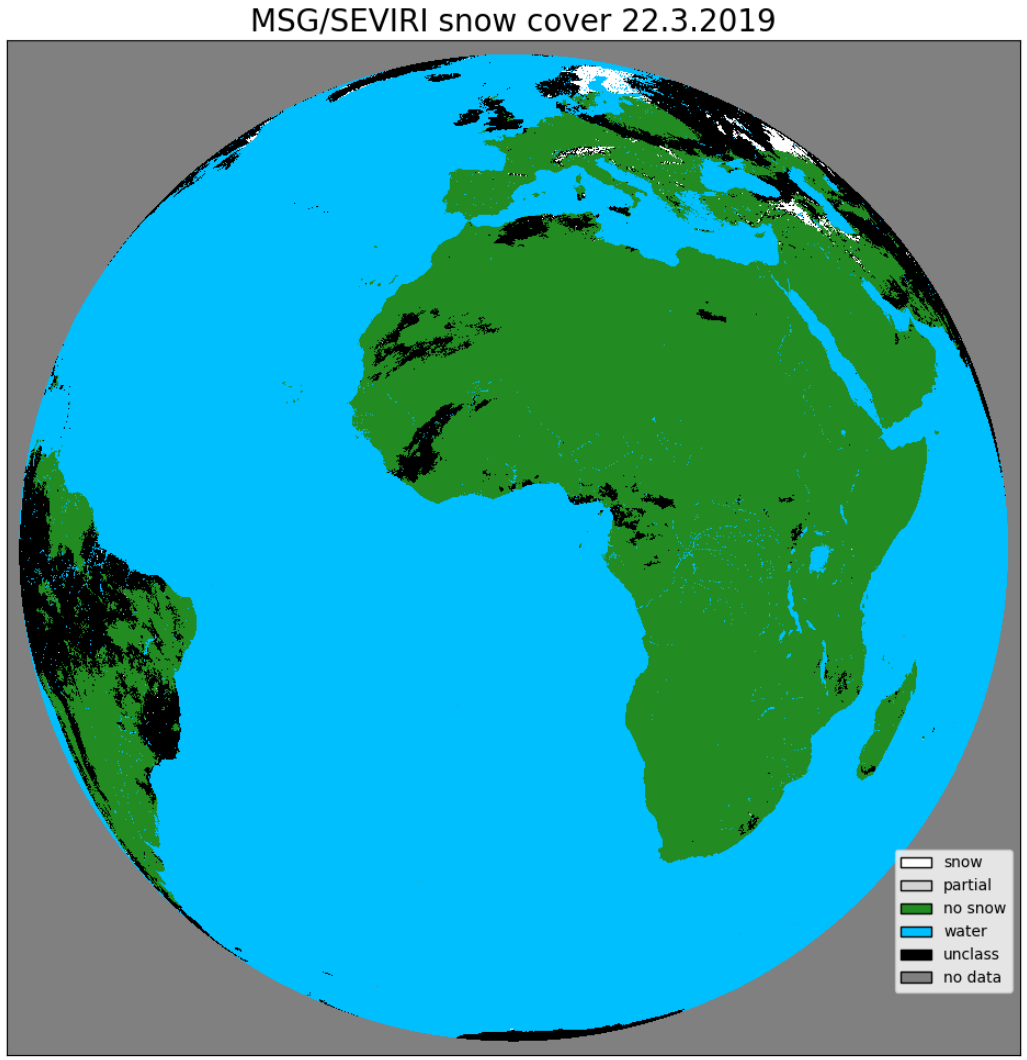
SUPPORT TO OPERATIONAL HYDROLOGY AND WATER MANAGEMENT

H12 merged product, 20230321

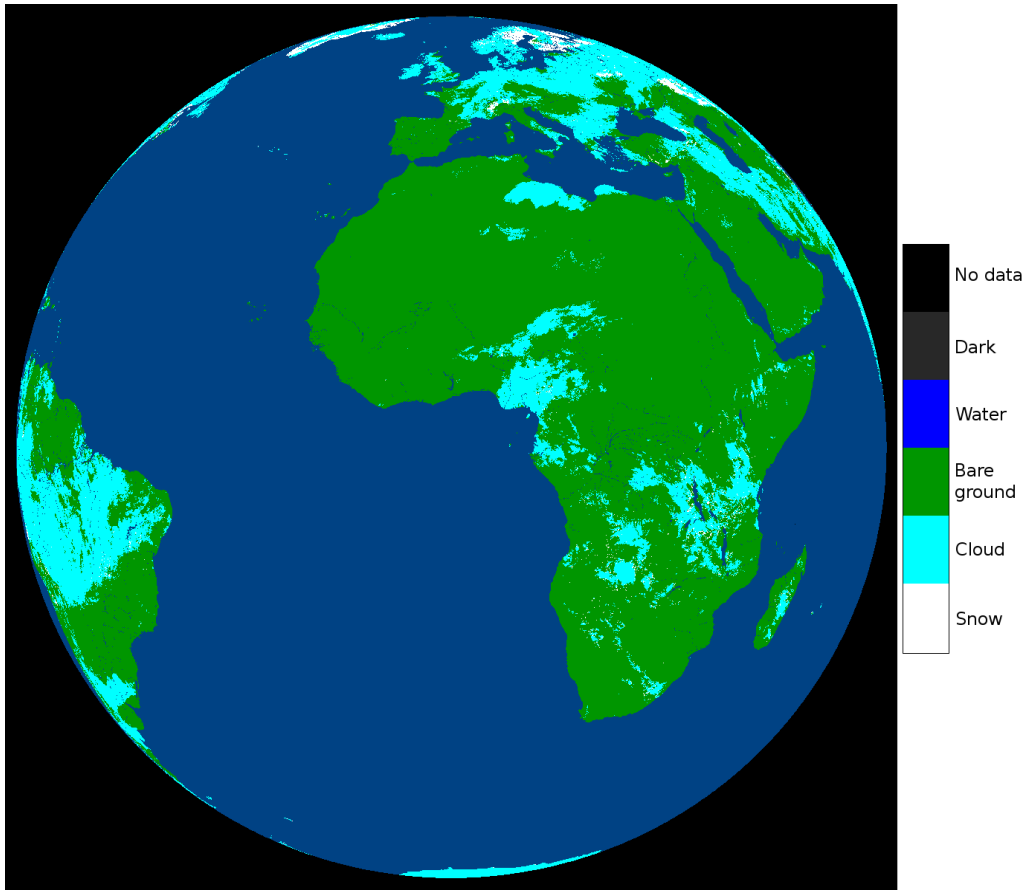
H31 MSG/SEVIRI Snow Extent

- Geostationary orbit
- Operational
- Daily full MSG/SEVIRI disk product
- Especially for flatland areas
- No snow/snow/partial snow/water/unclassified
- available since 2008
- Excellent validation results vs weather station observations
- See: Siljamo, N., & Hyvärinen, O. (2011). New Geostationary Satellite–Based Snow-Cover Algorithm, Journal of Applied Meteorology and Climatology, 50(6), 1275-1290
- Also: Siljamo, N. (2020). Empirical Approach to Satellite Snow Detection. University of Helsinki



H34 MSG/SEVIRI Snow Extent

- Geostationary orbit
- Pre-Operational
- Daily full MSG/SEVIRI disk product
- Obtained by merging H34 flat (FMI, H31 is the flat part) and H34 mountainous (METU/TSMS) part
- No snow/snow/water/cloud
- 3km x 3km resolution at NADIR, degrading to ~5km over Europe
- Available since late April 2019
- Successor of H10

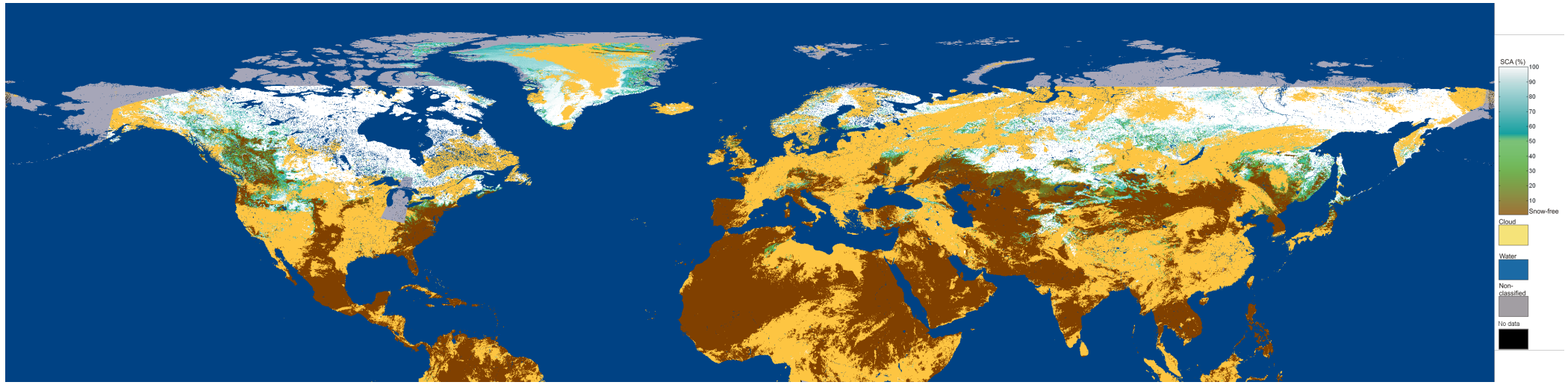


H34 merged product, 20230321

H35 AVHRR Effective Snow Cover

- Low Earth Orbit
- Pre-Operational
- Daily Northern Hemisphere product
- Obtained by merging H35 flat (FMI) and H35 mountainous (METU/TSMS) part

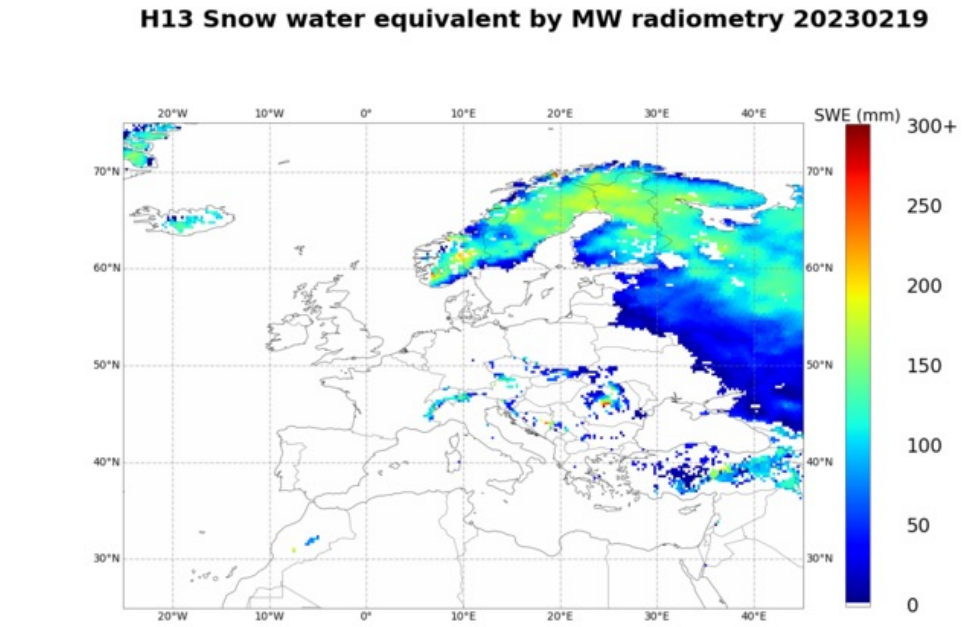
- Fractional Snow Cover (0-100) / Cloud / Unclassified / Nodata
- 0.01 deg x 0.01 deg Lat/Lon grid
- Available since mid-May 2019
- Successor of H12



H35 merged product, 20230321

H13 Snow water equivalent by MW radiometry

- H13 is an operational product
- The EUMETSAT H SAF product H13 provides SWE over the Pan European region (between longitude 25° W–45 ° E and latitude 25 °–75 ° N). The nominal resolution is 0.25° ~ 25 km
- H13 over flat lands is a data fusion of ground based Snow Depth data and spaceborne derivated estimates.
- Over mountains the product is based on spaceborne estimates.
- The product H13 currently is based on SSMI/S instrument brightness temperature data on board DMSP-series satellites.
- The SWE values are validated against independent snow courses yearly.



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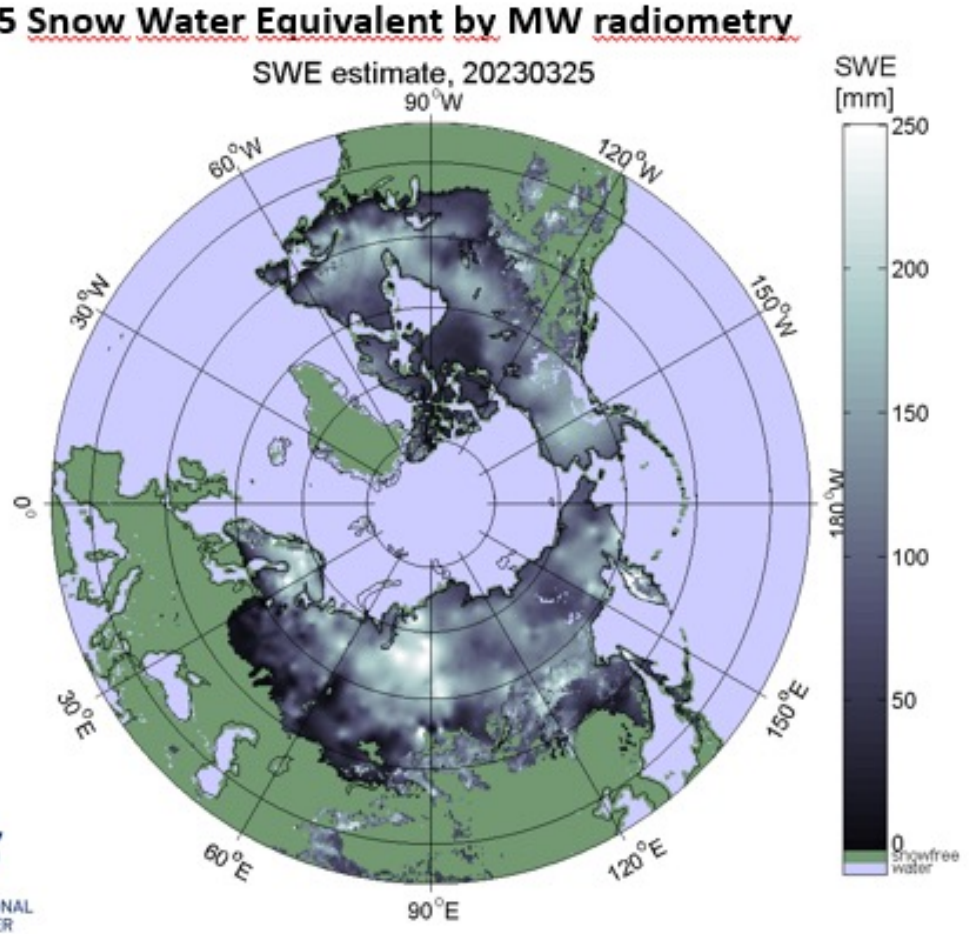
H65 Snow water equivalent by MW radiometry

- The EUMETSAT H SAF product H65 provides SWE over the Northern Hemisphere
- H65 over flat lands is a data fusion of ground based Snow Depth data and spaceborne derivated estimates.
- Over mountains the product is based on spaceborne estimates.
- The product H65 currently is based on SSMI/S instrument brightness temperature data on board DMSP-series satellites.
- Once Metop-B MWI data becomes available, H665 using MWI will supersede H65
- The SWE values are validated against independent snow courses yearly (if available)



EUMETSAT H SAF
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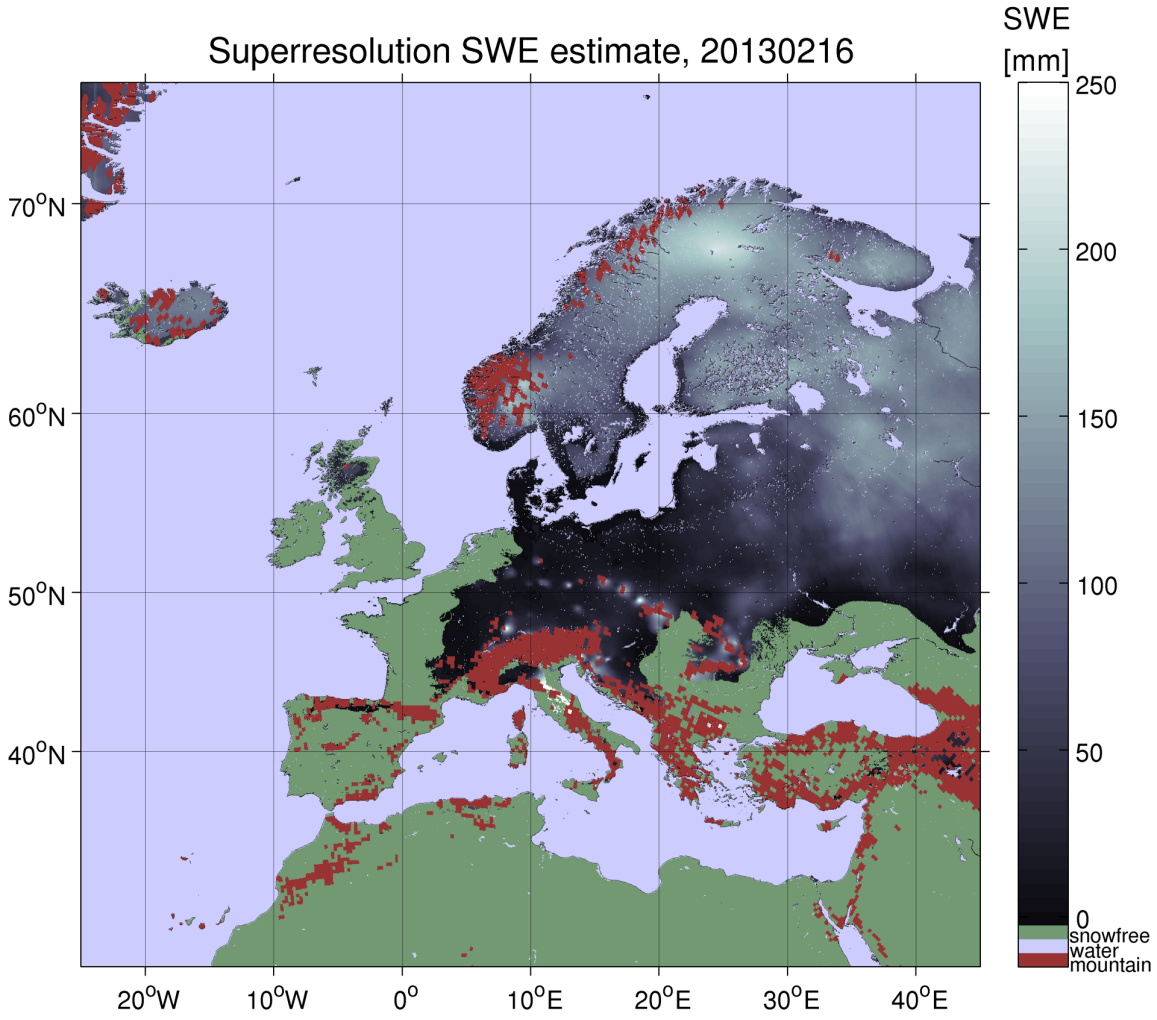
H66 Snow water equivalent by MW radiometry

- H66 is a product in development
- Flat areas are being produced already
- The EUMETSAT H SAF product H66 provides SWE over the Pan European region (between longitude 25° W–45 ° E and latitude 25 °–75 ° N). The nominal resolution is 0.05° ~ 5 km
- H65 over flat lands is a data fusion of ground based Snow Depth data and spaceborne derivated estimates (Takala et al. 2017)
- Over mountains the product is based on spaceborne estimates (METU, TSMS)
- The product H66 currently is based on SSMI/S instrument brightness temperature data on board DMSP-series satellites.
- Once Metop-B MWI data becomes available, H666 using MWI will supersede H66
- The SWE values are validated against independent snow courses yearly (if available)



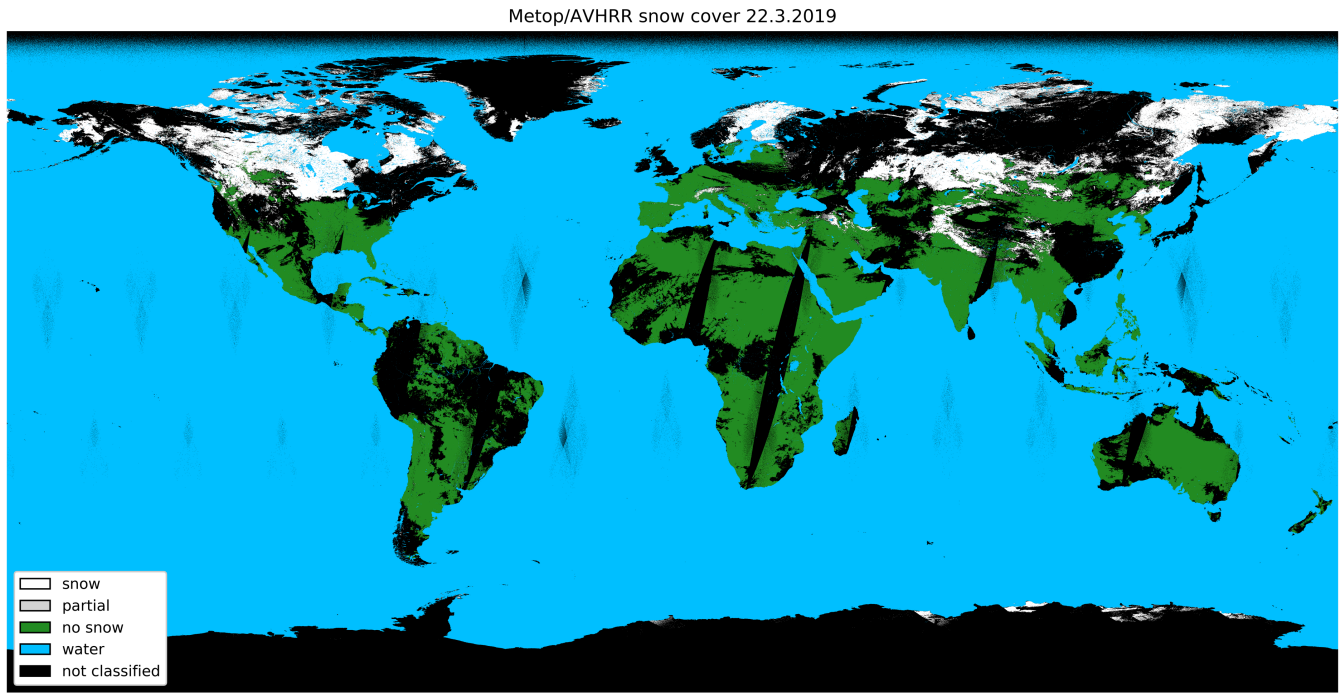
Sample image doesn't contain mountain part!

H43 MTG/FCI Snow Extent

- Geostationary orbit
- Daily full MTG/FCI disk product
- Satellite grid
- Continuation product for H10/H31/H34
- Three variants (flatland/mountain/merged)
- No snow/snow/water/unclassified (clouds, darkness etc)
- Day 1 product, will be available when MTG/FCI operational
- Current status: production system available, waiting FCI data (Earliest September, 2023)

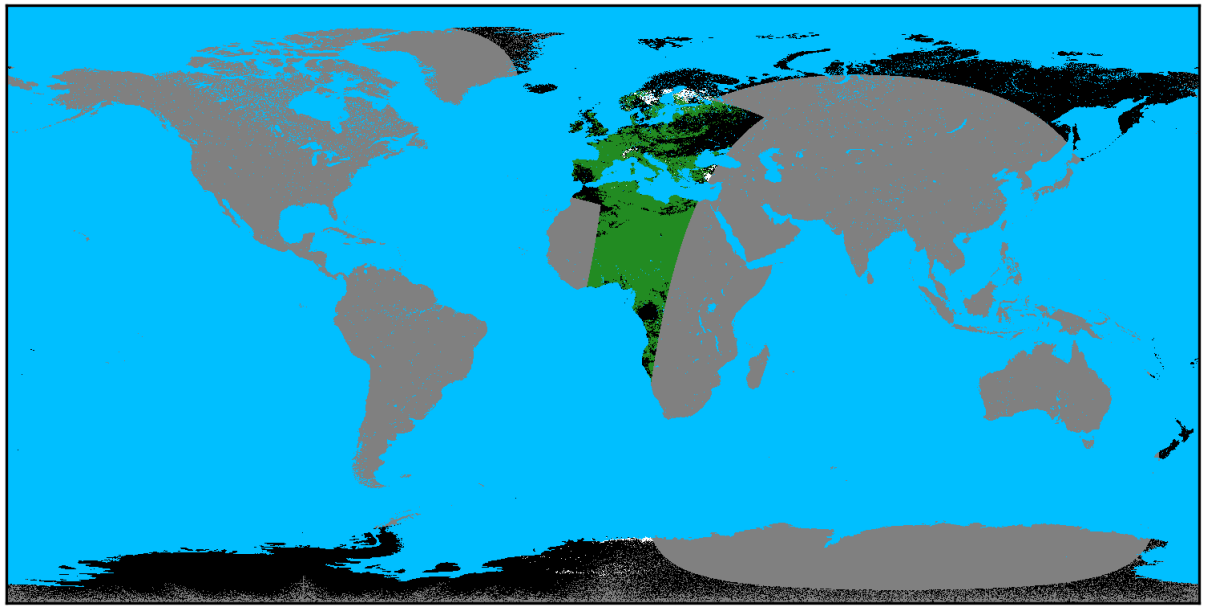
H32 Metop/AVHRR Snow Extent

- Polar orbit
- Operational
- Daily global product (0.01x0.01 degree lat-lon)
- No snow/snow/partial snow/water/unclassified
- available since 2015
- Excellent validation results vs weather station observations
- See: Siljamo, N., Hyvärinen, O., Riihelä, A., & Suomalainen, M. (2020). MetOp/AVHRR Snow Detection Method for Meteorological Application Journal of Applied Meteorology and Climatology, 59(12), 2001-2019
- Also: Siljamo, N. (2020). Empirical Approach to Satellite Snow Detection. University of Helsinki

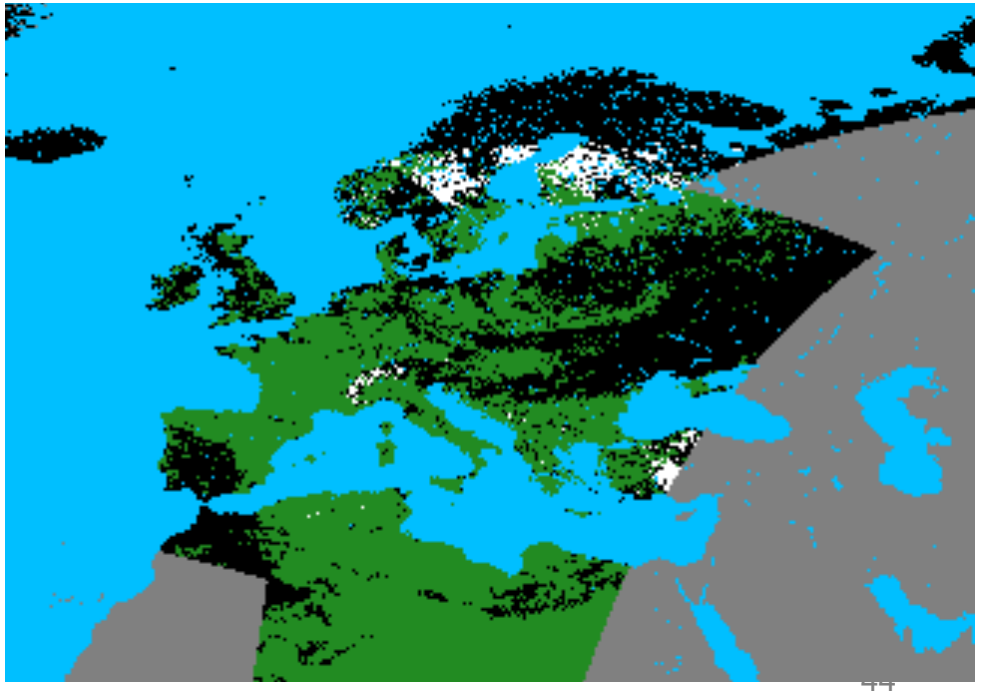


H32 is being tested in MetCoOP Weather Model data assimilation

H85 Metop-SG/METimage Snow Extent (Day 1)



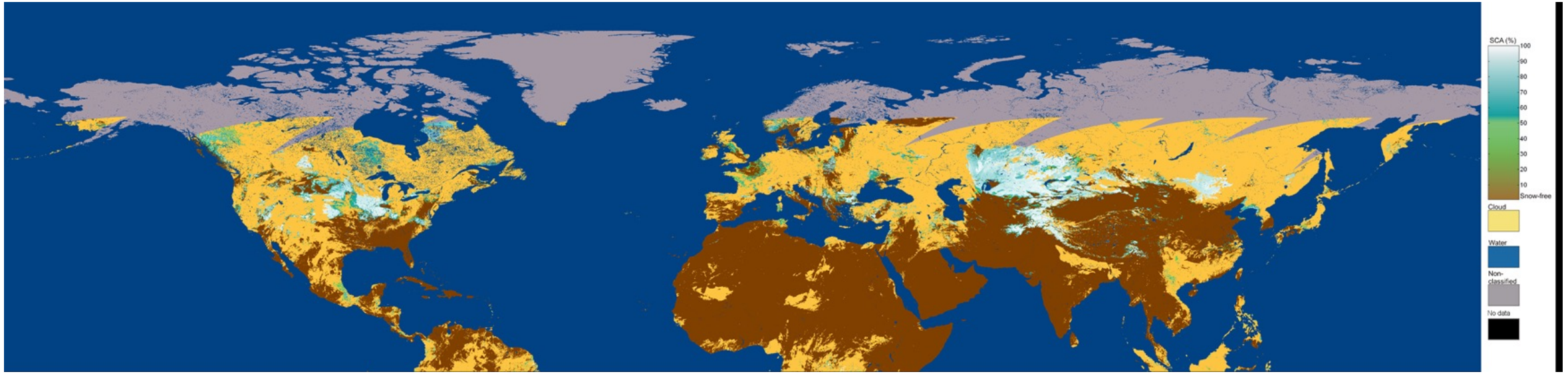
- Polar orbit
- Continuation product for H32
- Daily global product (0.01x0.01 degree lat-lon)
- No snow/snow/water/unclassified/no data
- Production system available, tests with demo data are successful
  - Swaths processed as they arrive, merged at night
- Day 1 product, available when Metop-SG/METimage operational
- Check-point review has been passed and we are waiting more test data (planned launch date Q1/2025)



H86 Effective snow cover

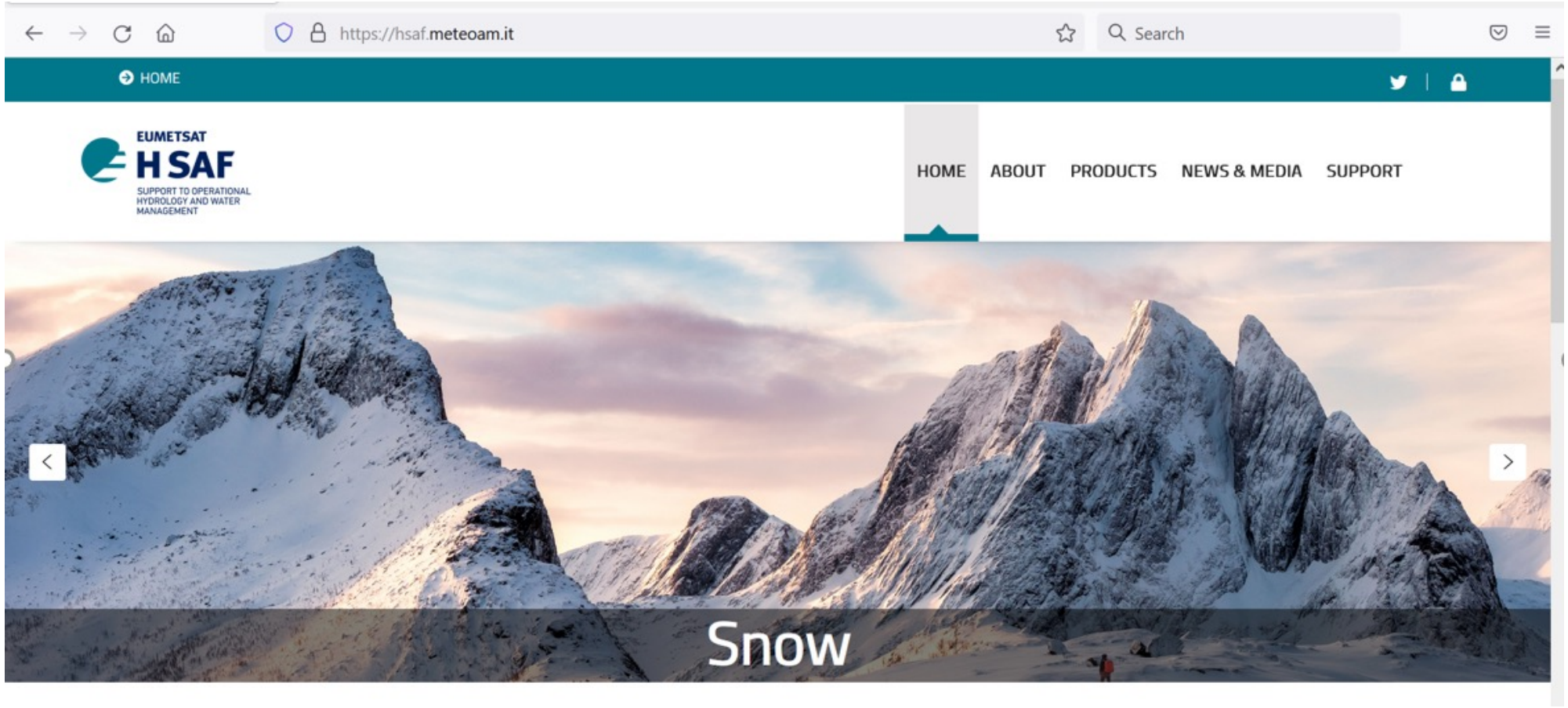
- Polar orbit
- In development
- Daily, Northern Hemisphere (0.01°)
- Day 2 product, algorithm development begins when actual Metop SG/METimage data available
- Algorithm will be based on machine learning algorithms (MARS, Random Forest, Deep learning)
- Product retrieved from METOP data is running offline.

Kuter, S., Bolat, K., & Akyurek, Z., (2022).
A machine learning-based accuracy enhancement on EUMETSAT H-SAF H35 effective snow-covered area product
Remote Sensing of Environment, 272 (2022) 112947



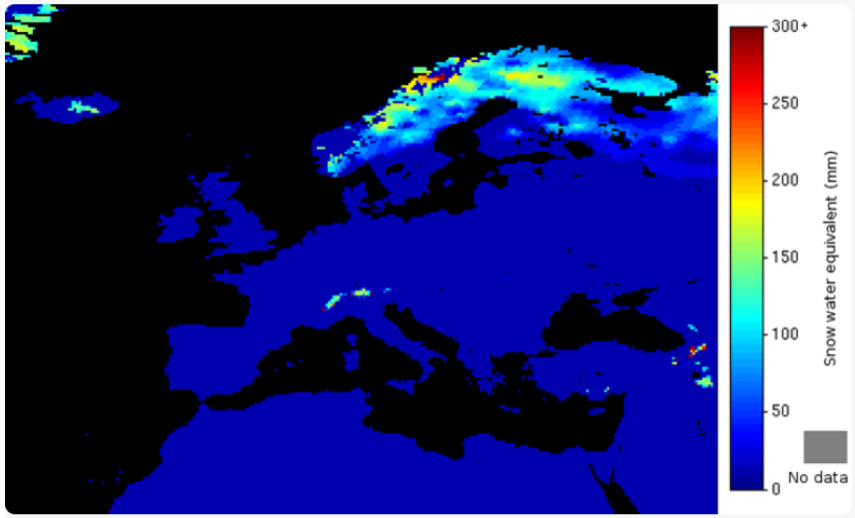
28 January 2021 - MARS

Snow Products –Detailed -Webpage



Snow Products –Detailed -Webpage

HOME / PRODUCTS / SNOW



SWE-E (H13)

Maps of snow water equivalent derived from MW measurements sensitive to snow thickness and density. The algorithm is based on assimilating MW brightness temperatures of several channels at frequencies with different penetration in snow, into a first-guess field built by the (sparse) network of stations measuring snow depth.

ATBD PUM PVR

DETAIL DOWNLOAD

Arctic Space Center
Sodankyla / Finland

Thank You

CONTACT

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