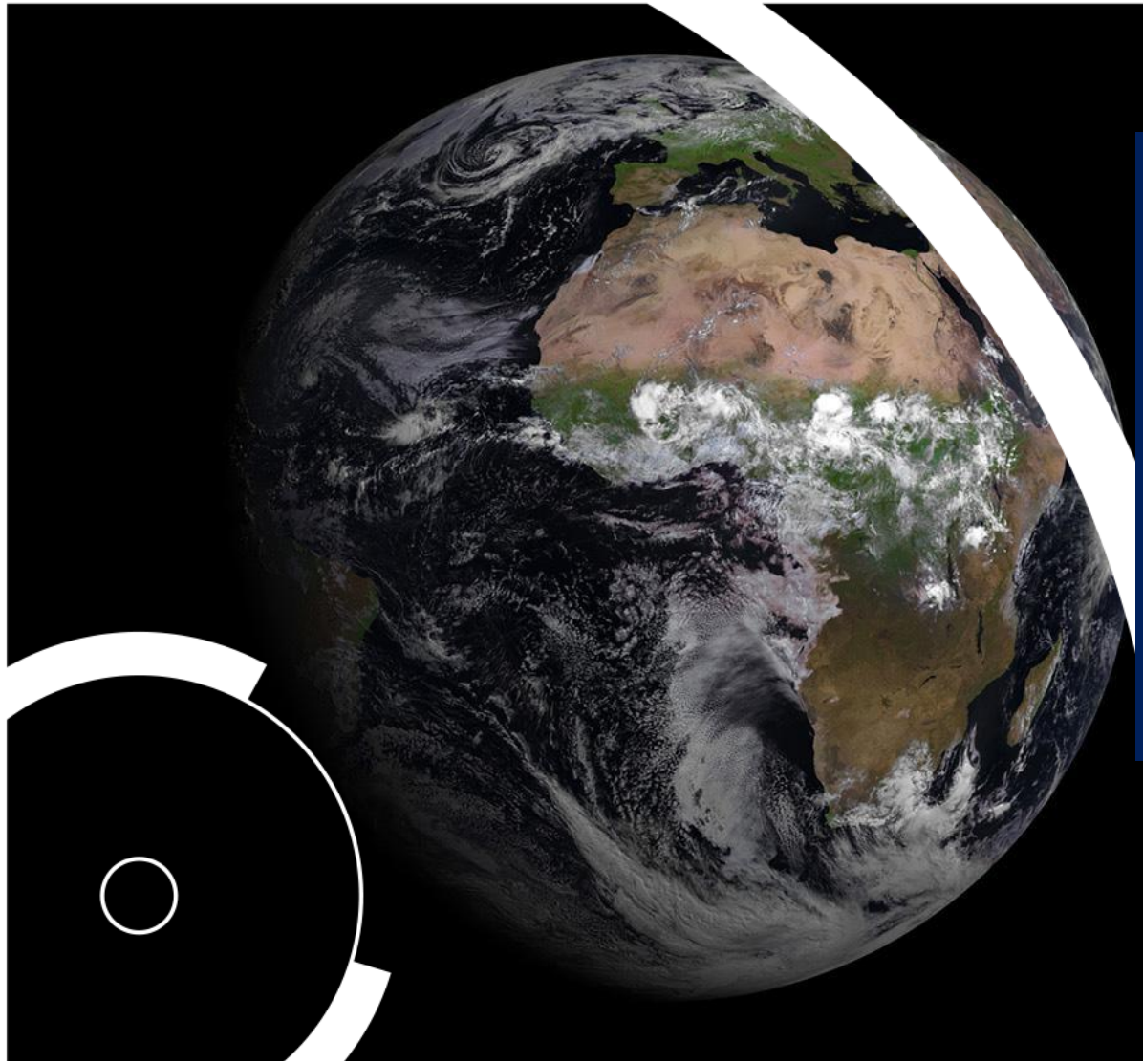
EUMETSAT



# Benefits of VIIRS data for EUMETSAT user community

**Sreerekha Thonipparambil**
*EPS-SG User Support and Applications Expert, EUMETSAT*

*VIIRS User Meeting - Celebrating 10 years of SNPP, 29-30 June 2022*

# Overview



- Introduction
- EUMETSAT dissemination of VIIRS
- How VIIRS benefits EUMETSAT users
- Use cases on Nowcasting, fires, ice charting, preparing for next-gen EUMETSAT satellites
- Conclusion

# An intergovernmental organisation with 30 Member States



AUSTRIA
BELGIUM
BULGARIA
CROATIA
CZECHIA
DENMARK
ESTONIA
FINLAND
FRANCE
GERMANY
GREECE
HUNGARY
ICELAND
IRELAND
ITALY
LATVIA
LITHUANIA
LUXEMBOURG
THE NETHERLANDS
NORWAY
POLAND
PORTUGAL
ROMANIA
SLOVAK REPUBLIC
SLOVENIA
SPAIN
SWEDEN
SWITZERLAND
TURKEY
UNITED KINGDOM

# EUMETSAT mission and vision



## EUMETSAT mission

### Primary objective:

Establish, maintain and exploit European systems of meteorological satellites.

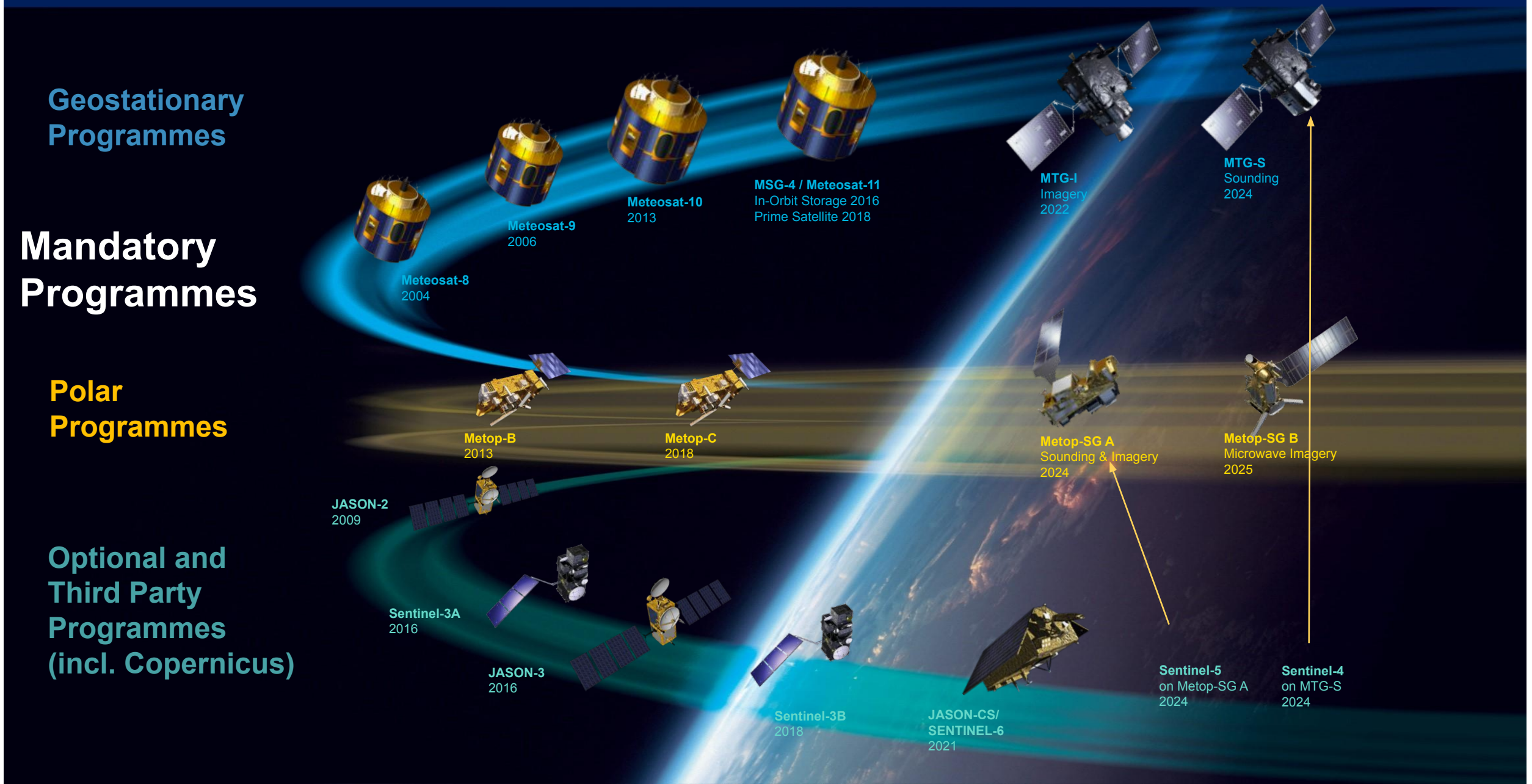
### Further objective:

Contribute to the operational monitoring of the climate and the detection of global climatic changes.

## EUMETSAT vision

To be the leading user-driven operational agency in Europe and a trusted global partner for weather and Earth system monitoring from space.

# EUMETSAT Missions – *current and future*



# EUMETSAT and NOAA collaboration and data exchange



- Over the past 40 years, EUMETSAT has established a strong cooperation with NOAA, particularly with its National Environmental Satellite, Data and Information Service (NESDIS).
    - NOAA and EUMETSAT coordinate their polar-orbiting satellite systems and their respective ground segments with the aim to improve operational meteorological and environmental forecasting and global climate monitoring services worldwide.
    - The cooperation began with the signature of the Initial Joint Polar System (IJPS) Agreement in 1998. This was followed by the signature of a long-term cooperation agreement in 2013, the signature of the Joint Polar System (JPS) Agreement in 2015, and then a Scientific Cooperation Agreement followed in 2019.
    - EUMETSAT and NOAA are also key partners of the Jason-3 and follow-on programmes, which deliver detailed oceanographic data vital to understanding weather forecasting and climate change monitoring. This cooperation will continue with the Copernicus Sentinel-6 ”Michael Freilich” mission, developed in support of the Copernicus programme and also involving the European Commission (EC) and the European Space Agency (ESA).
- EUMETSAT is the European partner for the redistribution of NOAA data to European users through our EUMETCast data access system.

EUMETSAT

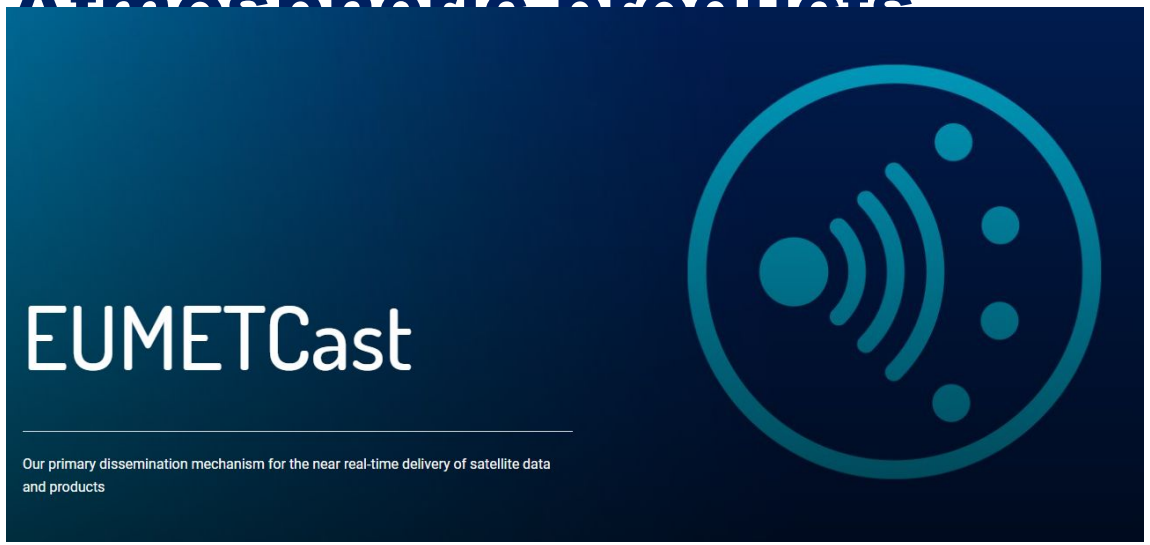
NOAA

# EUMETSAT dissemination of VIIRS

# Global dissemination of VIIRS data by EUMETSAT

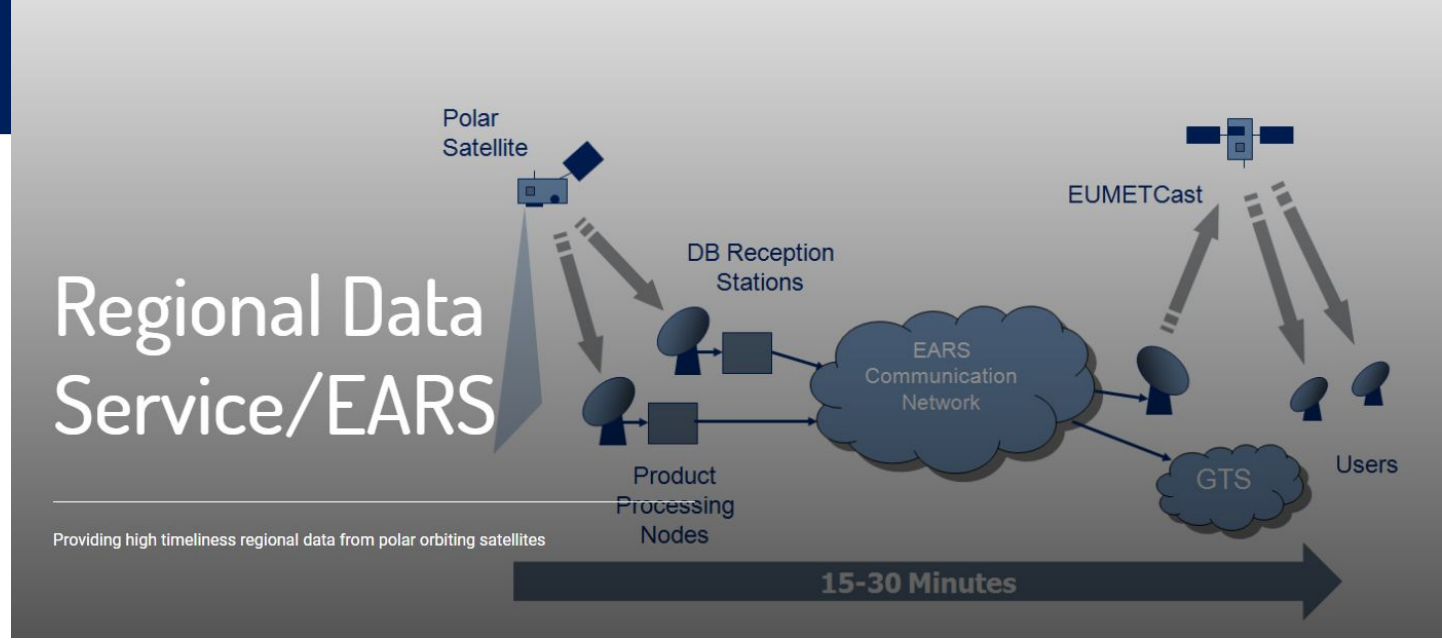


- **VIIRS Environmental Data Records disseminated on EUMETCast**
  - Atmospheric Motion Vectors
  - VIIRS Active Fire
- **Support to Copernicus: VIIRS Marine products**
  - Sea Surface Temperature and Ocean color
- **Support to Copernicus: VIIRS Atmospheric products**
  - VIIRS Aerosol Optical Depth



# Regional dissemination

## EUMETSAT Advanced Retransmission Service (EARS) – VIIRS service




- network of direct broadcast stations receiving and processing data and redistribution of products to users in near-real time.
- provide regional data with high timeliness from polar orbiting meteorological satellites (15-30 mins)
- EARS-VIIRS support Nowcasting applications
  - via EUMETCAST
    - 16 VIIRS M-band channels
    - Day night bands covering dusk, dawn and night time scenes, but excluding day time scenes.
  - Format: Compact VIIRS SDR HDF-5 – calibrated radiances and geolocation information on tie points

# Registered VIIRS users



| Global VIIRS: AMVs | Global VIIRS: Active Fire | Global VIIRS: Marine products | Global VIIRS: Atmospheric products | Regional EARS |
|---|---|---|---|---|
| 597 | 427 | 474 | 466 | 537 |

(note that these are not unique users)

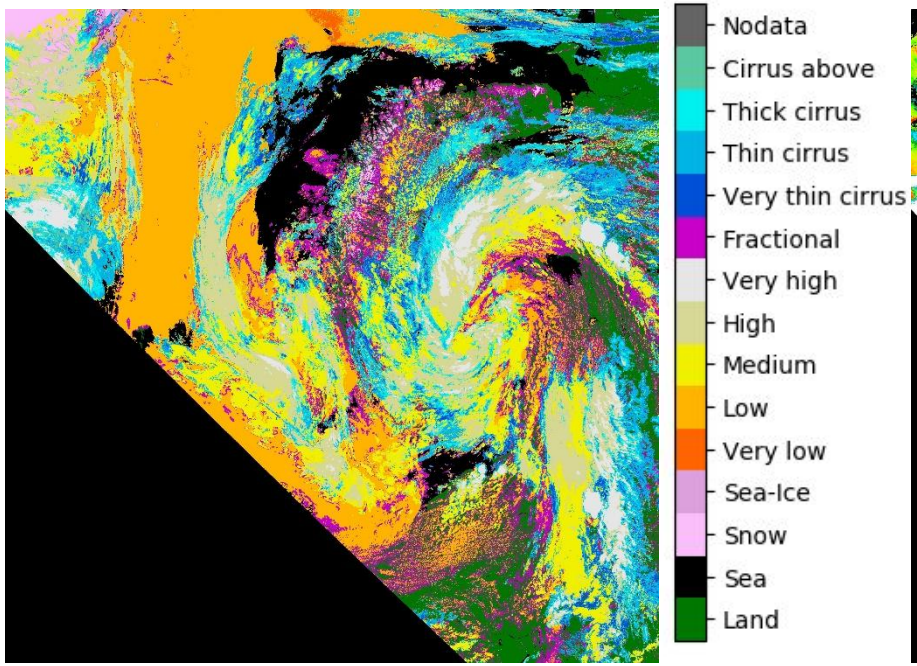
# Use Cases: Benefits of VIIRS

# NWCSAF/PPS products on VIIRS data

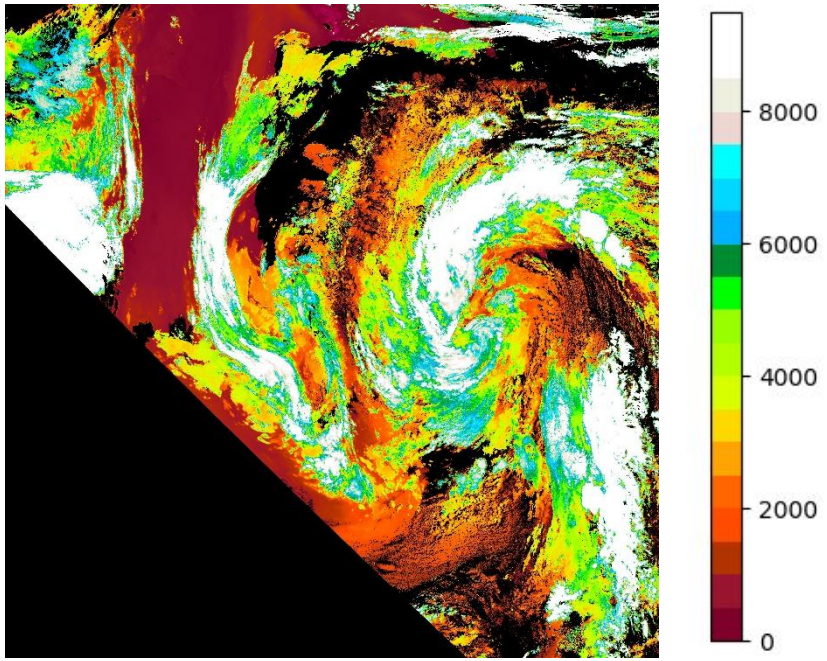


- Support to Nowcasting and Very Short Range Forecasting SAF (NWC SAF) - Polar Platform System

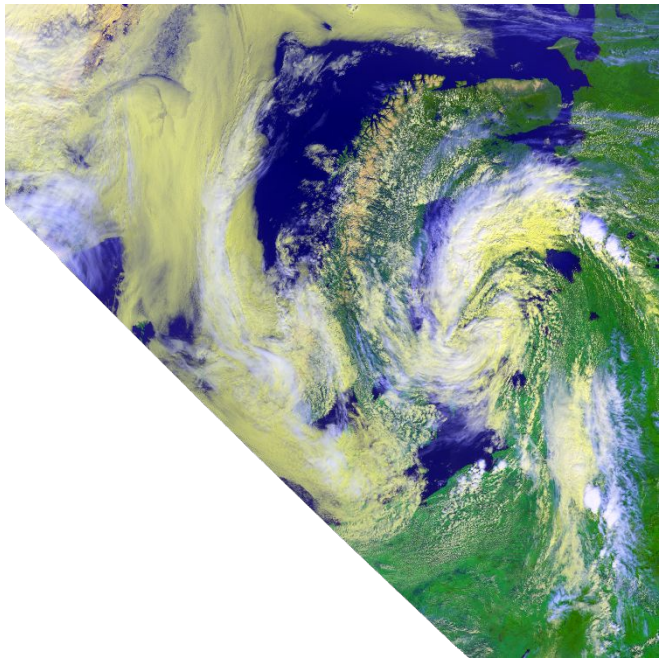
**Cloud type**




**Cloud top height**




**RGB Overview**



- Five different cloud products
- Good coverage in northern areas
- Running operationally in e.g. Sweden, Norway, Finland
- Input to high resolution mesoscale analysis model
- Software available at nwc-saf.eumetsat.int

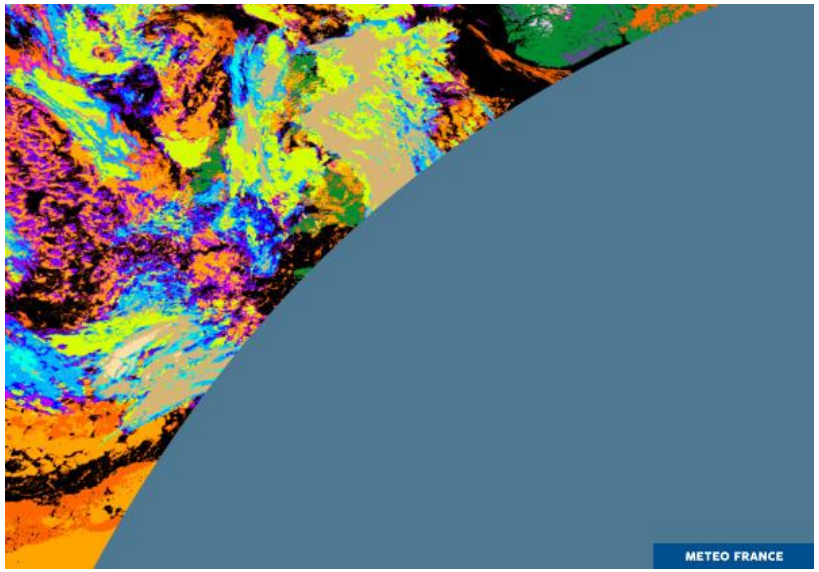
Courtesy:

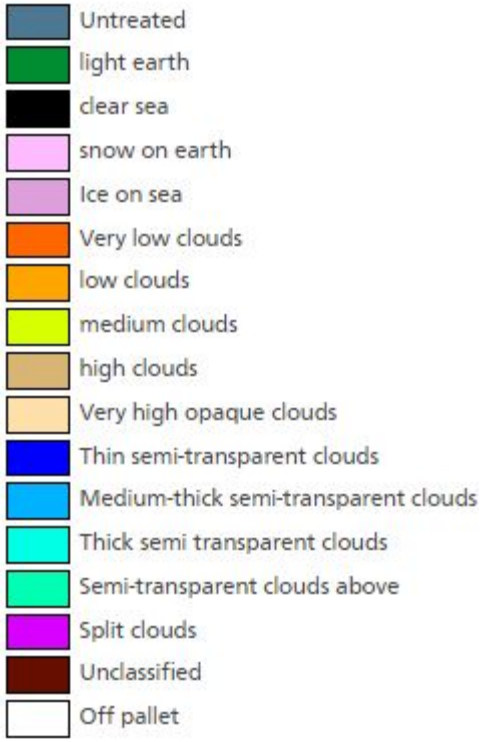
EUMETSAT NWC SAF SUPPORT TO NOWCASTING AND VERY SHORT RANGE FORECASTING

# NWPSAF support to VIIRS



- Fast Radiative transfer model RTTOV and the Radiance Simulator (RadSim) support VIIRS
- AAPP (ATOVS and AVHRR Pre-processing Package):
  - MAIA: Cloud detection and characterization for VIIRS and AVHRR (cloud mask, cloud type) at pixel resolution
  - VIIRS-CRiS Mapping

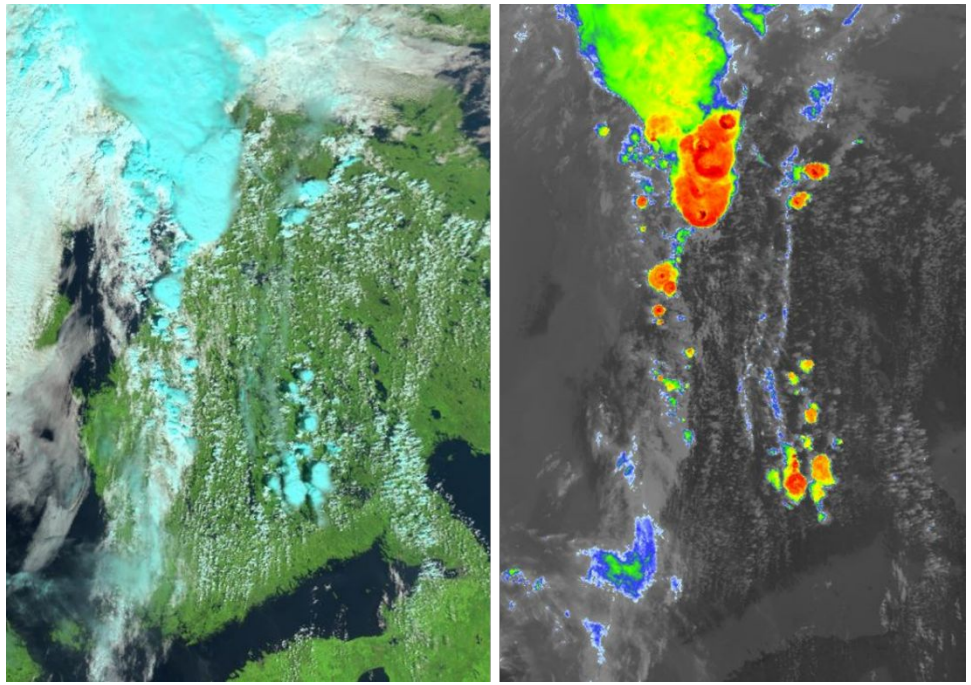



EUMETSAT NWP SAF NUMERICAL WEATHER PREDICTION

# High latitudes: Thunderstorm Ahti over Finland

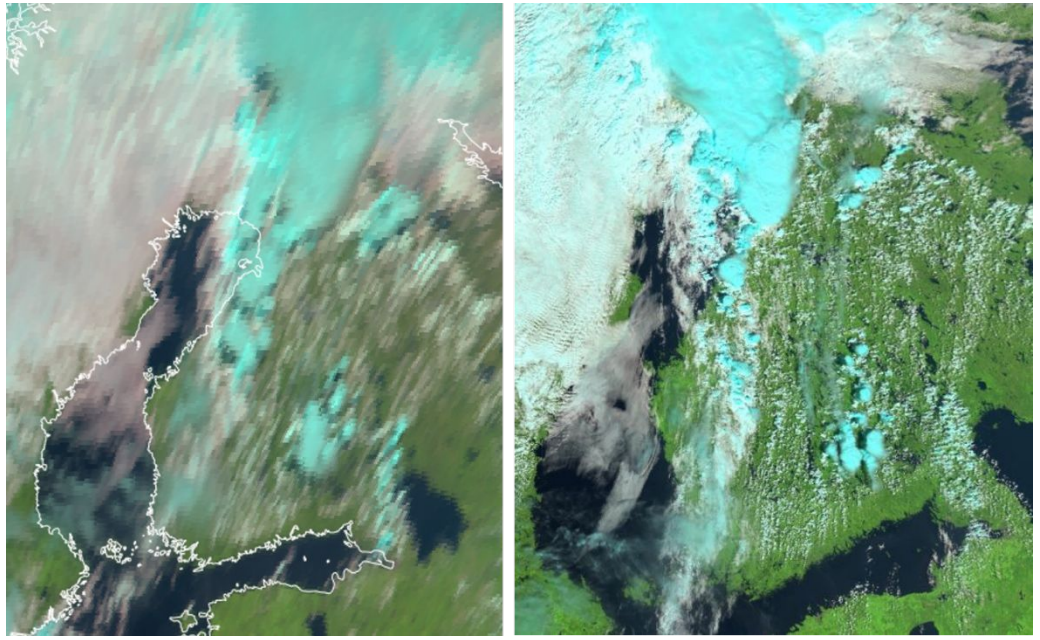




*NOAA-20 VIIRS, 21 June, 12:38 UTC.*
*Natural Colour RGB (left) and colour enhanced IR 10.7µm channel image (right).*

- 21 June 2021
- Maximum gust of 112 km/hr at Oulu Vihreäsaari harbour
- 30-35 mm hailstones were reported
- 65.1mm of precipitation was measured within 24 hours.
- MCS, Overshooting tops, 17000 lightning strikes

- Advantage of VIIRS over current Meteosat at high latitudes

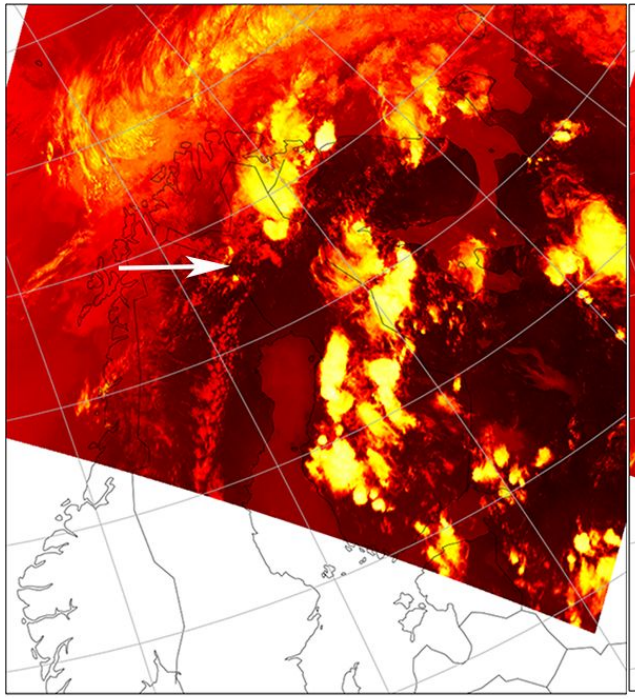


*Meteosat-11 SEVIRI (left) and NOAA-20 VIIRS (right)*
*Natural Colour RGB, 21 June, 12:30 and 12:38 UTC respectively.*

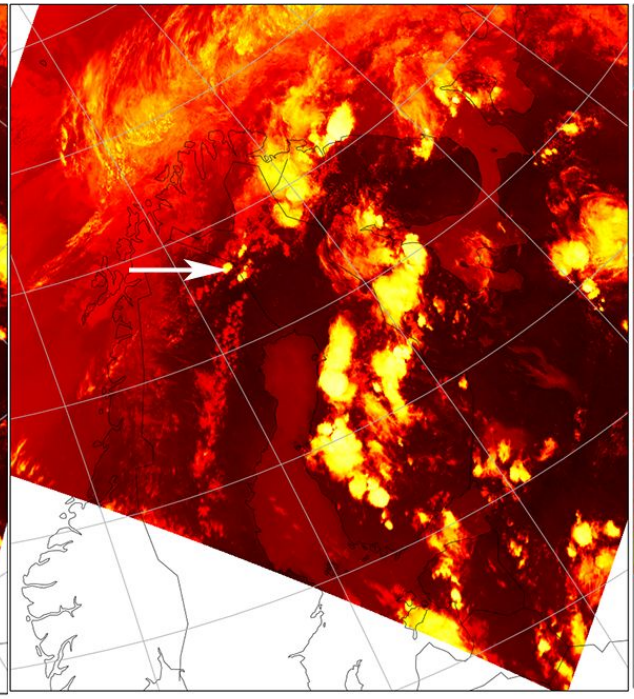
**Further reference: Storm Ahti**

# Nowcasting at high latitudes: more polar overpasses

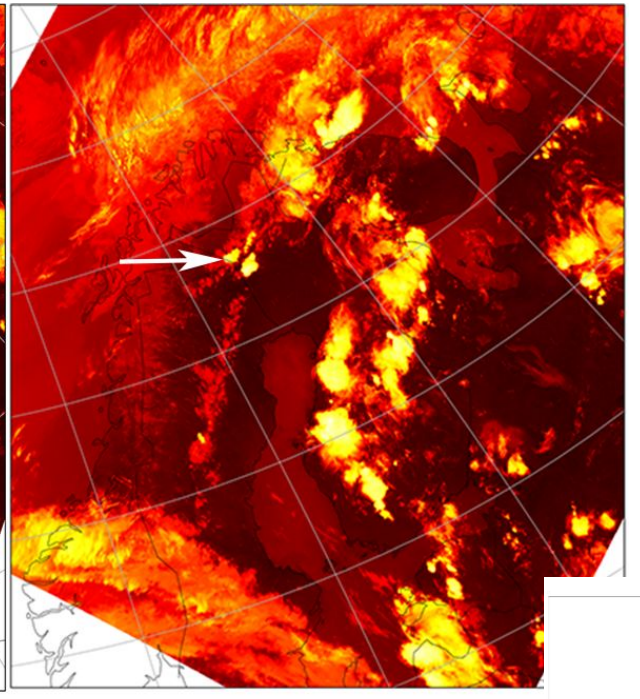
Thunderstorms 8 June 2021 over Finland




Metop-A: 16:35 UTC



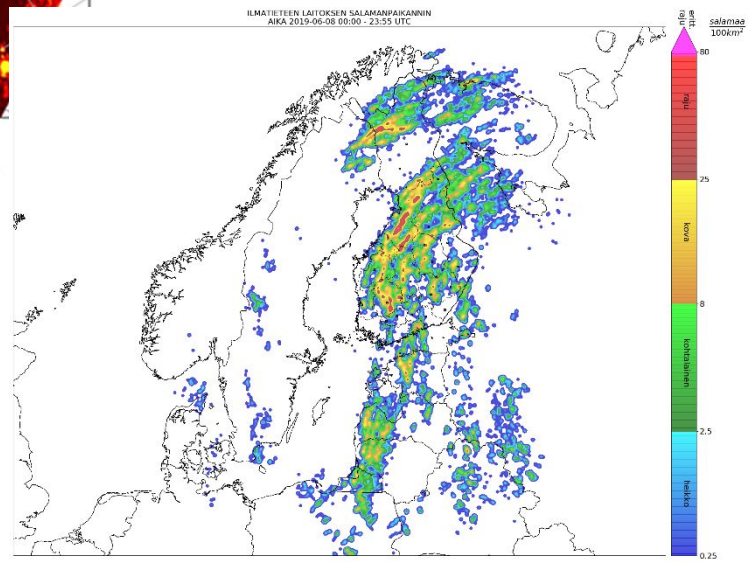

Metop-C: 17:16 UTC




Metop-B: 17:49 UTC

Evolving thunderstorm cells as revealed in consecutive AVHRR images

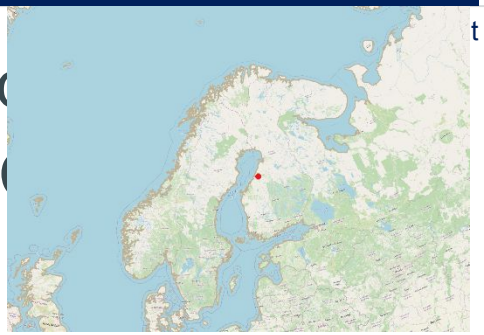
- Note: This thunderstorm could also be seen on the Metosat-11 SEVIRI infrared images, but there is a mismatch on the exact location due to parallax shift




Lightning Map

# VIIRS fire detection capability for Nordic areas

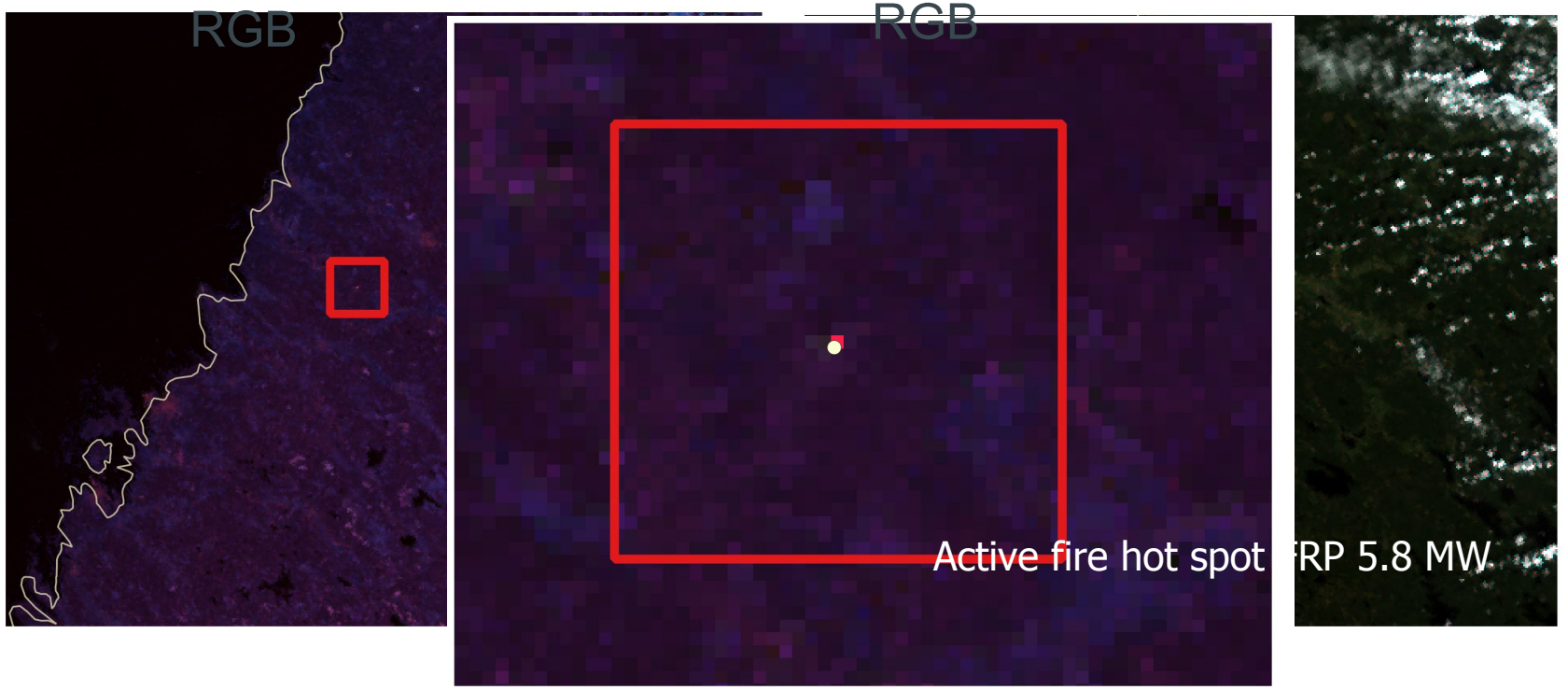
- Kalajoki, Finland, end of July 2021, “worst fires in Finland for deca
- On 26 July, fire started at approximately 10.30 UTC, and at 12.15 UT
  fire was confirmed to be 200 m wide.
- First overpass at 10.49 UTC – NOAA-20 VIIRS



Fire Temperature RGB

True Color RGB

Day Land Cloud Fire RGB




**VIIRS correctly detected fire at that**



Courtesy:

# VIIRS fire detection capability for Nordic areas

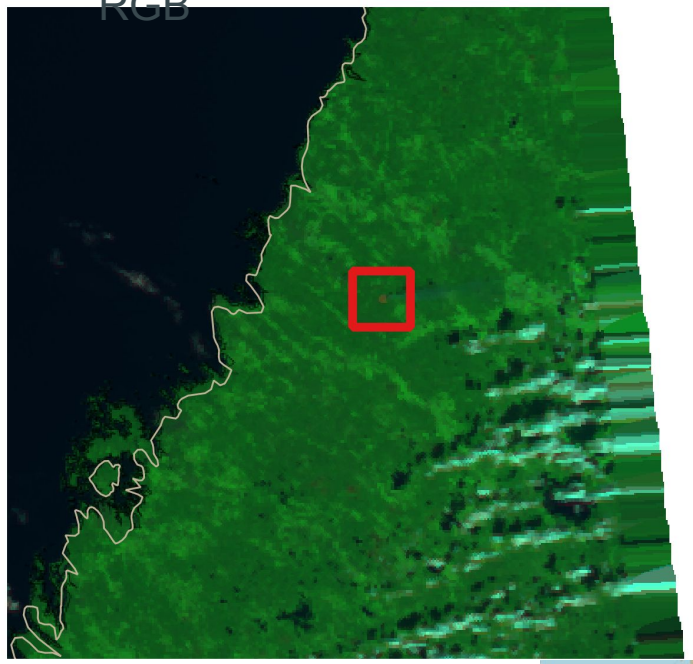


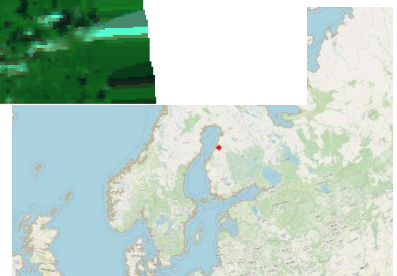
- Kalajoki, Finland, end of July 2021, “worst fires in Finland for decades”
- On 26 July, fire started at approximately 10.30 UTC, and at 12.15 UTC the fire was confirmed to be 200 m wide.
- Second overpass at 11.39 UTC :Fire Temperature RGB detects larger fire with four Active Fire Hot Spots between FRP 23.4 MW and 33.6 MW while True Color RGB and Day Land Cloud Fire RGB showed no signal of fire

Fire Temperature RGB

True Color RGB

Day Land Cloud Fire RGB





**FRP 27.3 MW – 40.2 MW !**

Courtesy: FMI

# VIIRS Active Fires detection and warning system for Sweden

- Swedish fire season: ~February to ~October
- Overlap of grassfire and forest fire seasons
- A very intensive fire season 2018:
  - **~200% increase in fires: 8081 fires**
  - **800% increase in burned area: 24310 ha**


## VIIRS

- Coverage every 50 minutes over northern Scandinavia from local midnight till around 14:00
  - Southern Sweden: ~01:00 - 04:00 & ~11:00 - 14:00
- Direct Broadcast: Low latency ~15 min
- High geo-location accuracy (<50m) of VIIRS
  - Fire detection location error < ~250 meter, except at the very ends of swath



Courtesy:

# VIIRS Active Fires detection and warning system for Sweden



- Local implementation of CSPP VIIRS-AF algorithm
  - NOAA JPSS Active Fires Team
  - Detection using I-bands
  - FRP derived using M13 (~4µm)
  - Implemented in the Community Satellite Processing Package (CSPP) for Direct Readout applications
  - Locally received VIIRS data in Norrköping
  - Detection ~15 minutes after observation
- 2018: 99 collocated detections, 15 early detections, 4 possibly mistaken by another fire
- 2020:
  - 110 unique evaluated detections;
  - 39 evaluated by rescue services


VIIRS Active Fire data are of high quality
Accurate, Sensitive and low False Alarm Rate

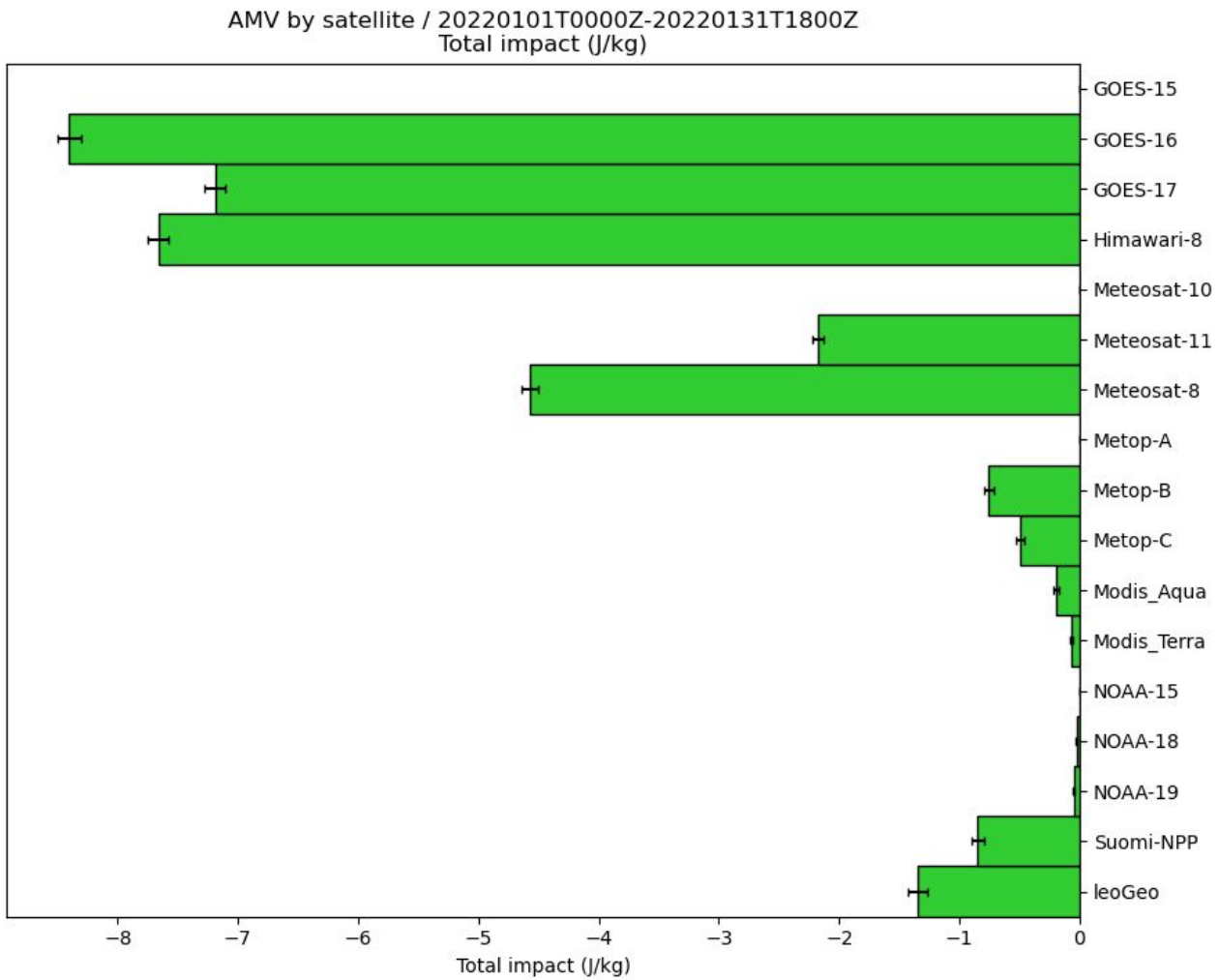
Growing Incentive to use satellite data for early fire warning in Sweden

Courtesy:

# Impact of VIIRS AMVs at the Met Office



work by Francis Warrick and James Cotton, UK Met Office

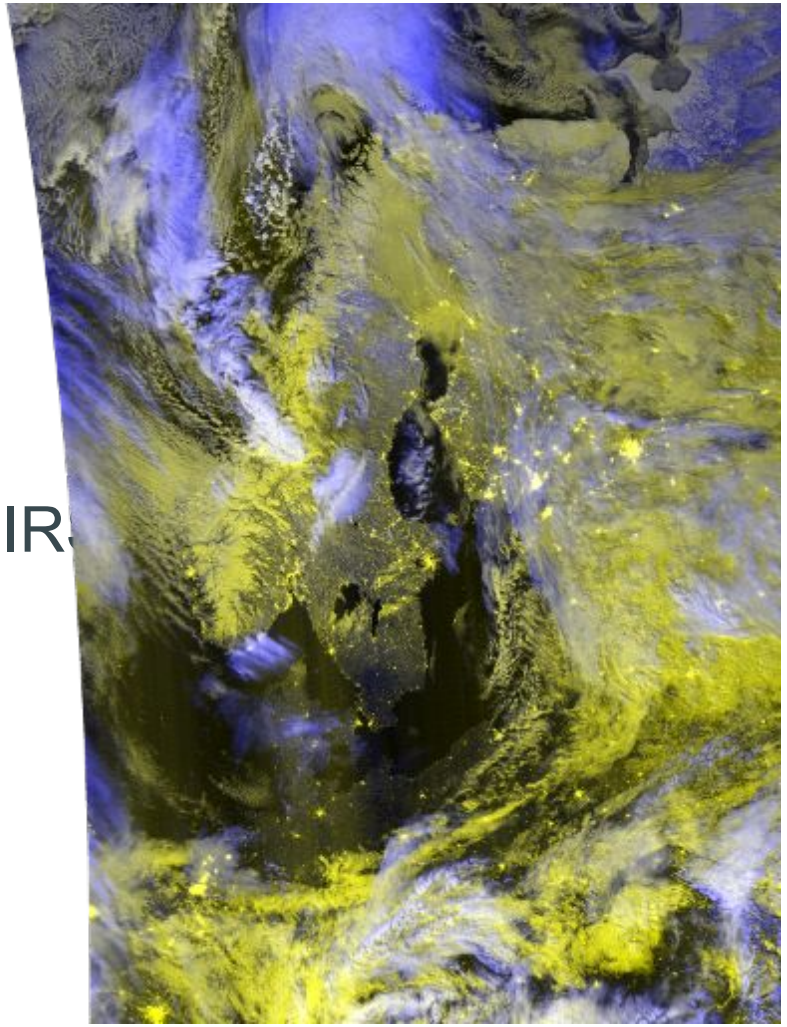



- Atmospheric Motion Vectors are operationally assimilated at the Met Office from:
  - Suomi-NPP – Nov 2016
  - NOAA-20 – May 2022
- Positive impact seen in assimilation trials.
- FSOI shows overall impact from Suomi-NPP AMVs is slightly greater than for AMVs from other polar instruments.

# VIIRS Day Night band for Forecasting of ice sheets



- Forecasting of ice formation and drift: Swedish Meteorological and Hydrological Institute serving the following user communities
  - Swedish Maritime Administration
  - Swedish Navy
  - Shipping companies
- Remote Sensing data used
  - Radarsat-2 SAR, ...when available
  - Under clear or nearly clear skies: AVHRR, MODIS, VIIR
    - Daylight: VIS and NIR bands
    - Night: IR bands and VIIRS DNB



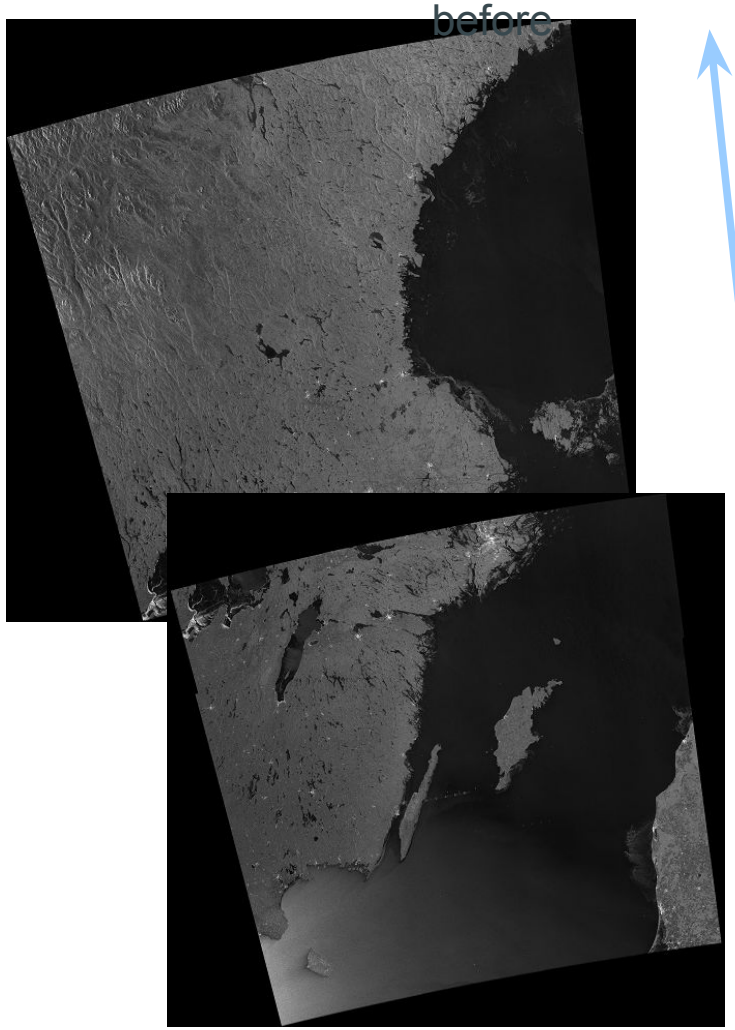
Courtesy:

# VIIRS Day Night band for Forecasting of ice sheets

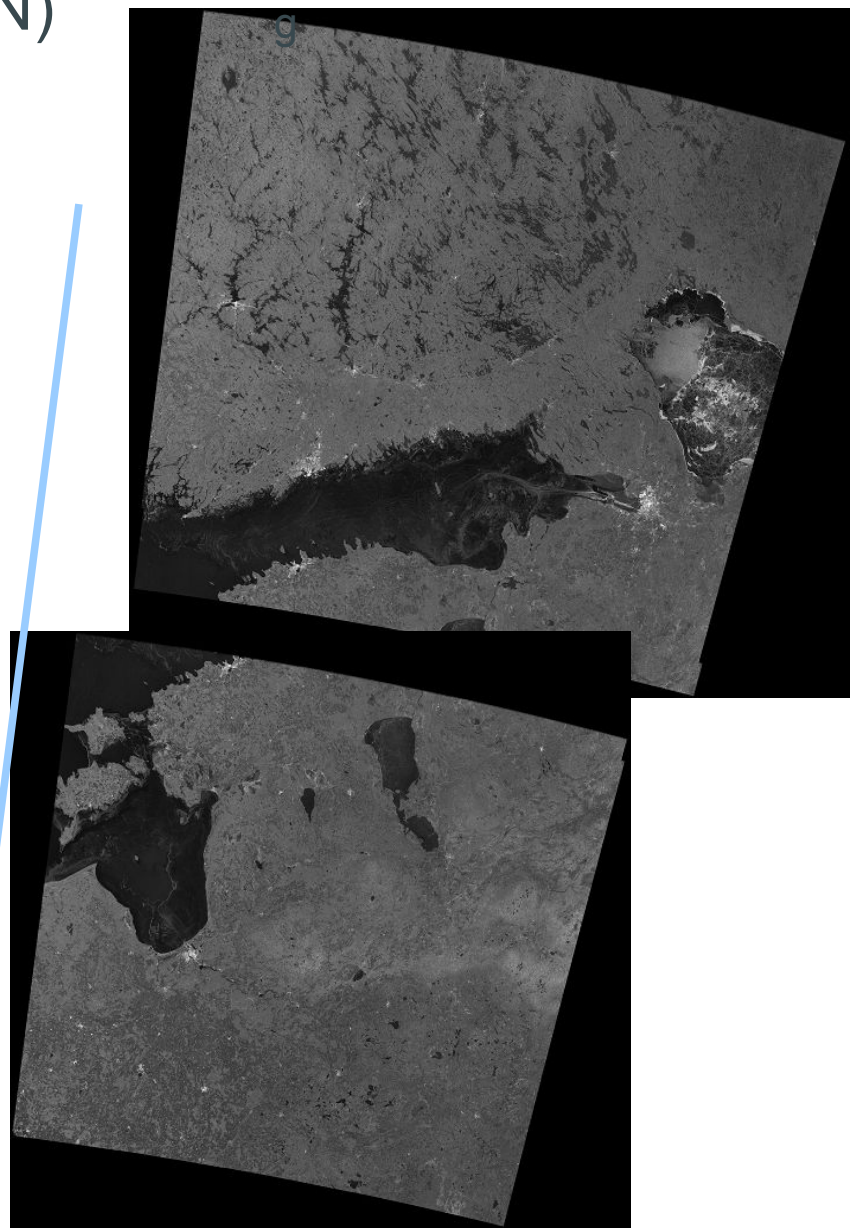


- January 24th, 2013 in Bay of Bothnia (65 N)
  - Ice growth and fast drift

Afternoon Day before



Mornin g



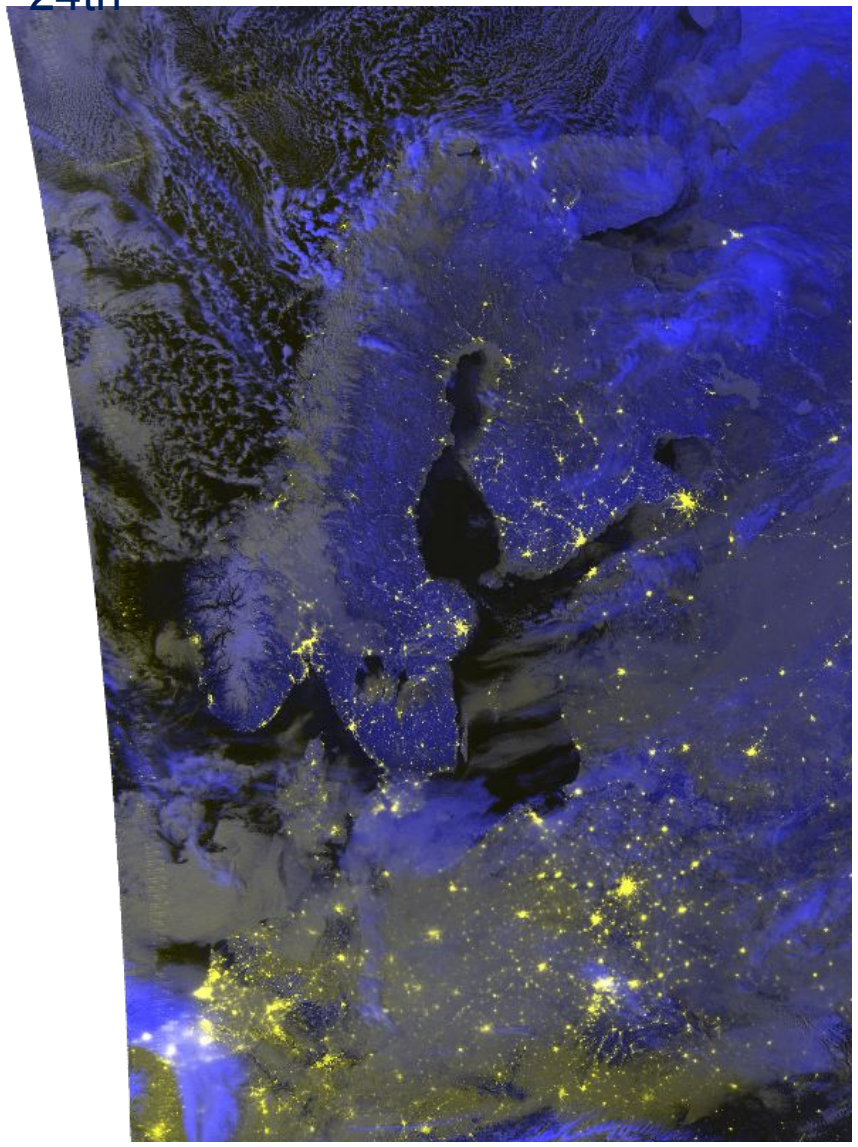


Courtesy:

# Excellent VIIRS DNB coverage in favorable moon conditions



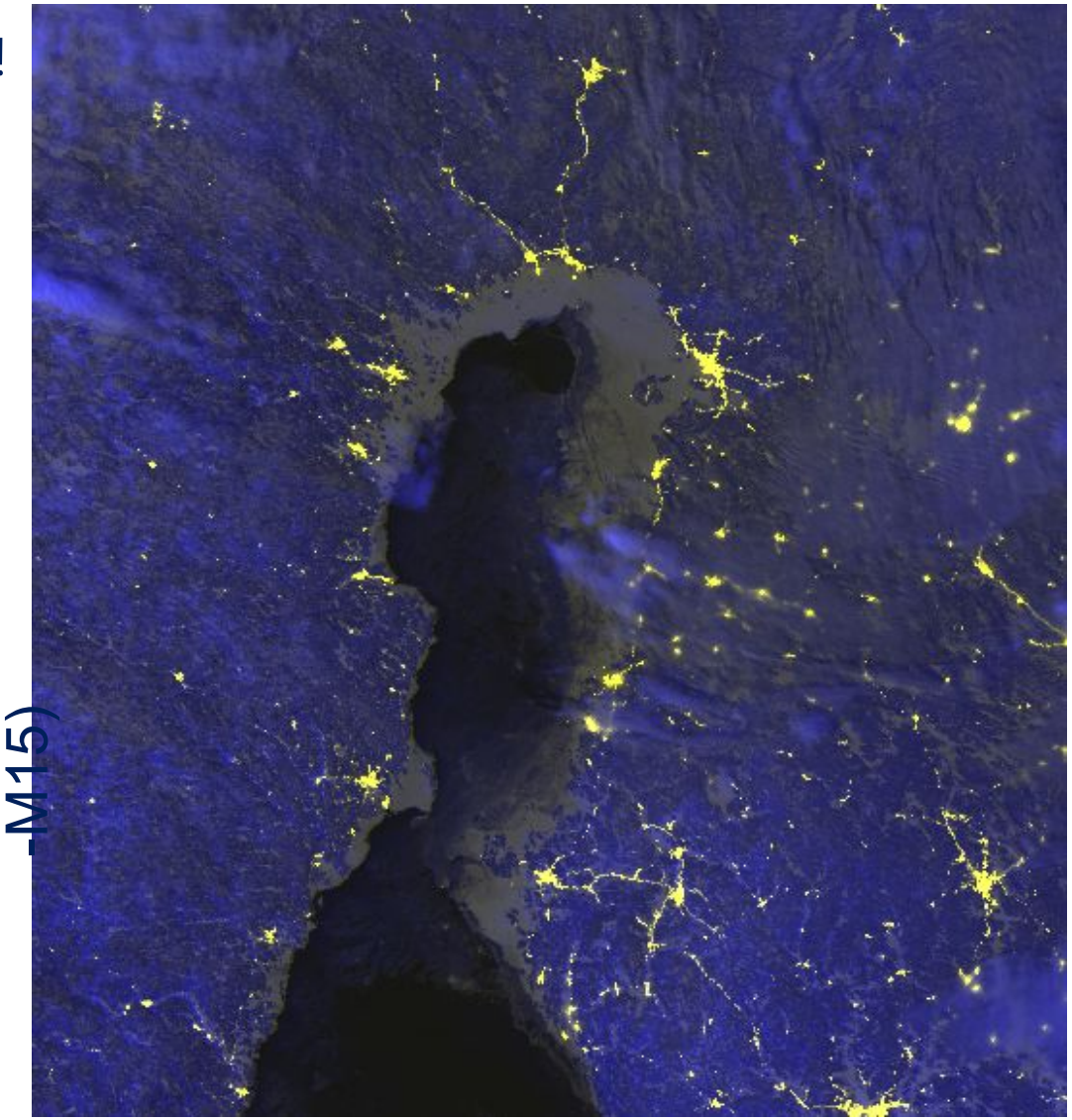
Coverage: S-NPP VIIRS at 00:22 UTC Jan 24th



Lack of SAR data!

Ice conditions in the Bay of Bothnia as seen from the VIIRS Day Night Band RGB

RGB: (DNB, DNB, M15)



Courtesy:

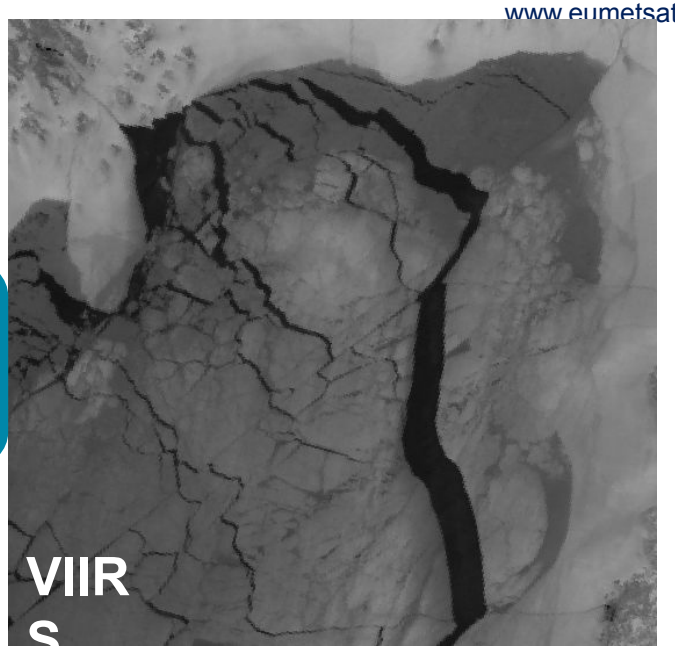
# VIIRS: Forecasting of ice sheets

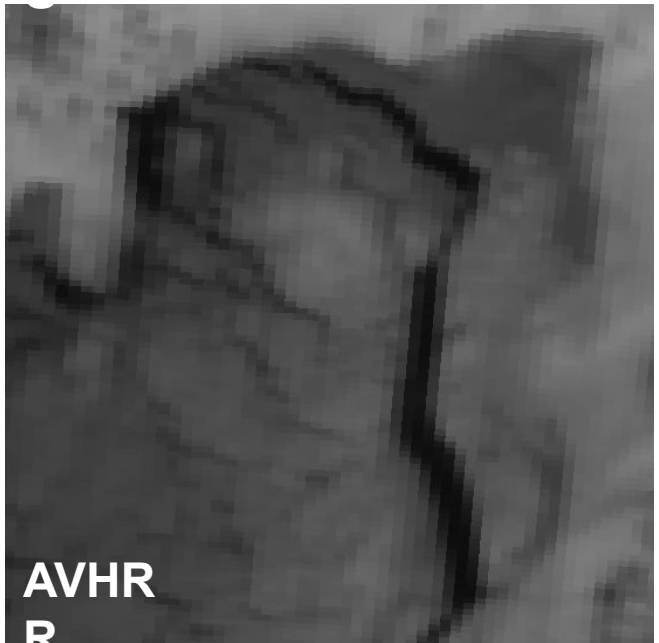


- High resolution daytime imagery using I-bands
- High resolution nighttime imagery using I-band at 10.8 µm

**When SAR data are unavailable VIIRS becomes indispensable!**

- During the ice charting season of 2012-2013
  - In total 16 days with parts of the area analyzed on VIIRS imagery exclusively
  - The charting season lasted for 179 days




Courtesy:

# VIIRS supporting EUMETSAT next generation programmes



- Science support and training for the application areas for MTG-FCI (Flexible Combined Imager) and EPS-SG METImage
- Validation of FCI and METImage products
- VIIRS is used as proxy for developing training materials for MTG-FCI and EPS-SG METImage
  - ESSL Severe storms and Aviation Testbeds
  - Case studies illustrating the use of FCI and METImage
- Development of new RGBs
- Development of Visualisation tools

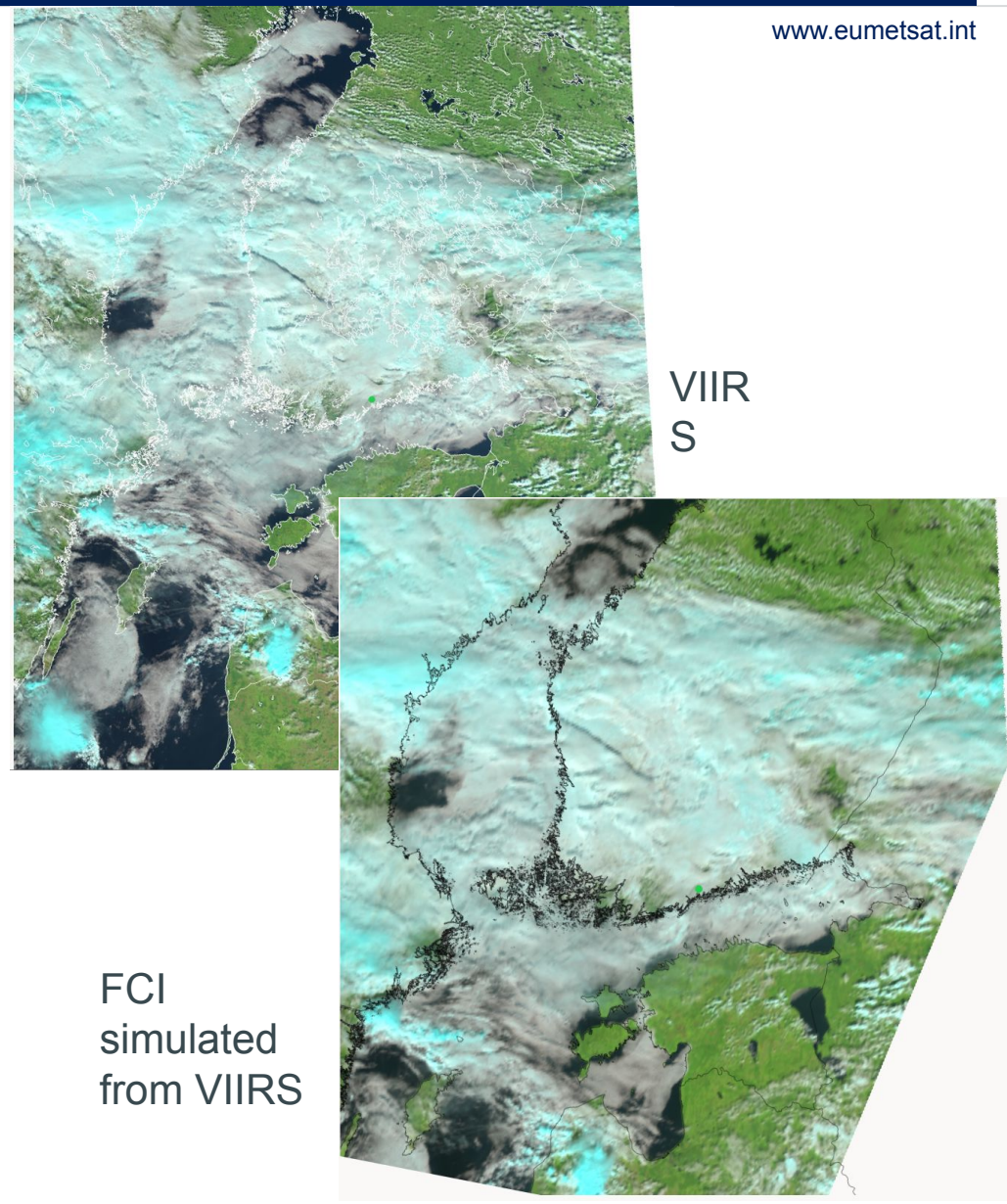



Figure courtesy: FMI, Finland

# Looking forward to EPS-SG METImage

METimage on board EPS-SG will:

- provide enhanced continuity to the AVHRR (Advanced Very High Resolution Radiometer) series on board the EPS/NOAA satellites, and continuity to the VIIRS on board NOAA satellites.
- expected to offer comparable performance with respect to VIIRS
  - Similar channels to VIIRS with the addition of the oxygen-A band channels (752 and 763 nm)
  - the water vapour imagery channels (0.9, 6 and 7 μm) and cloud top height (13 μm).
  - No day night band and fewer atmospheric clearing channels/ocean colour.
- enable additional observation slots in the constellation with other polar orbiters carrying instruments with the same or similar channels and performance – particularly important for high-latitude regions

| *METimage channel* | λ (μm) | VIIRS channels | λ (μm) |
|---|---|---|---|
| | | M1 | 0.412 |
| VII-443 | 0.443 | M2 | 0.445 |
| | | M3 | 0.488 |
| VII-555 | 0.555 | M4 | 0.555 |
| | | I1 | 0.640 |
| VII-668 | 0.668 | M5 | 0.672 |
| | | M6 | 0.746 |
| VII-752 | 0.752 | | |
| VII-763 | 0.763 | | |
| | | DNB | 0.7 |
| VII-865 | 0.865 | I2/M7 | 0.865 |
| VII-914 | 0.914 | | |
| VII-1240 | 1.24 | M8 | 1.24 |
| VII-1375 | 1.375 | M9 | 1.38 |
| | | I3/M10 | 1.61 |
| VII-2250 | 2.25 | M11 | 2.25 |
| | | M12 | 3.70 |
| VII-3740 | 3.74 | I4 | 3.74 |
| VII-3959 | 3.959 | | |
| VII-4050 | 4.05 | M13 | 4.05 |
| VII-6725 | 6.725 | | |
| VII-7325 | 7.325 | | |
| VII-8540 | 8.54 | M14 | 8.55 |
| VII-10690 | 10.69 | M15 | 10.76 |
| | | I5 | 11.45 |
| VII-12020 | 12.02 | M16 | 12.01 |
| VII-13345 | 13.345 | | |

# Thank you!

Questions are welcome.