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METEOROLOGISKA INSTITUTET  
FINNISH METEOROLOGICAL INSTITUTE

# ARCTIC SPACE CENTRE

Jyri Heilimo  
Head of Unit

21.2.2019 Jyri Heilimo



# ARCTIC SPACE CENTRE ACTIVITIES

- Studies of atmospheric phenomena and their interaction with biosphere and cryosphere in high latitudes
  - Hydrology, snow cover, frozen ground and permafrost
  - High atmosphere processes
  - Ionosphere and stratosphere, aurora borealis, stratospheric ozone
- Development of Earth Observation methods
- Development of new operational EO services
- National Satellite Data Centre providing satellite ground segment and data processing services
- ESA Sentinel Collaborative Ground Station
- Maintenance and development of Sodankylä research infrastructure and in-situ measurement network
- Satellite instrument and product CAL/VAL activities
- Hosting of satellite reference instruments



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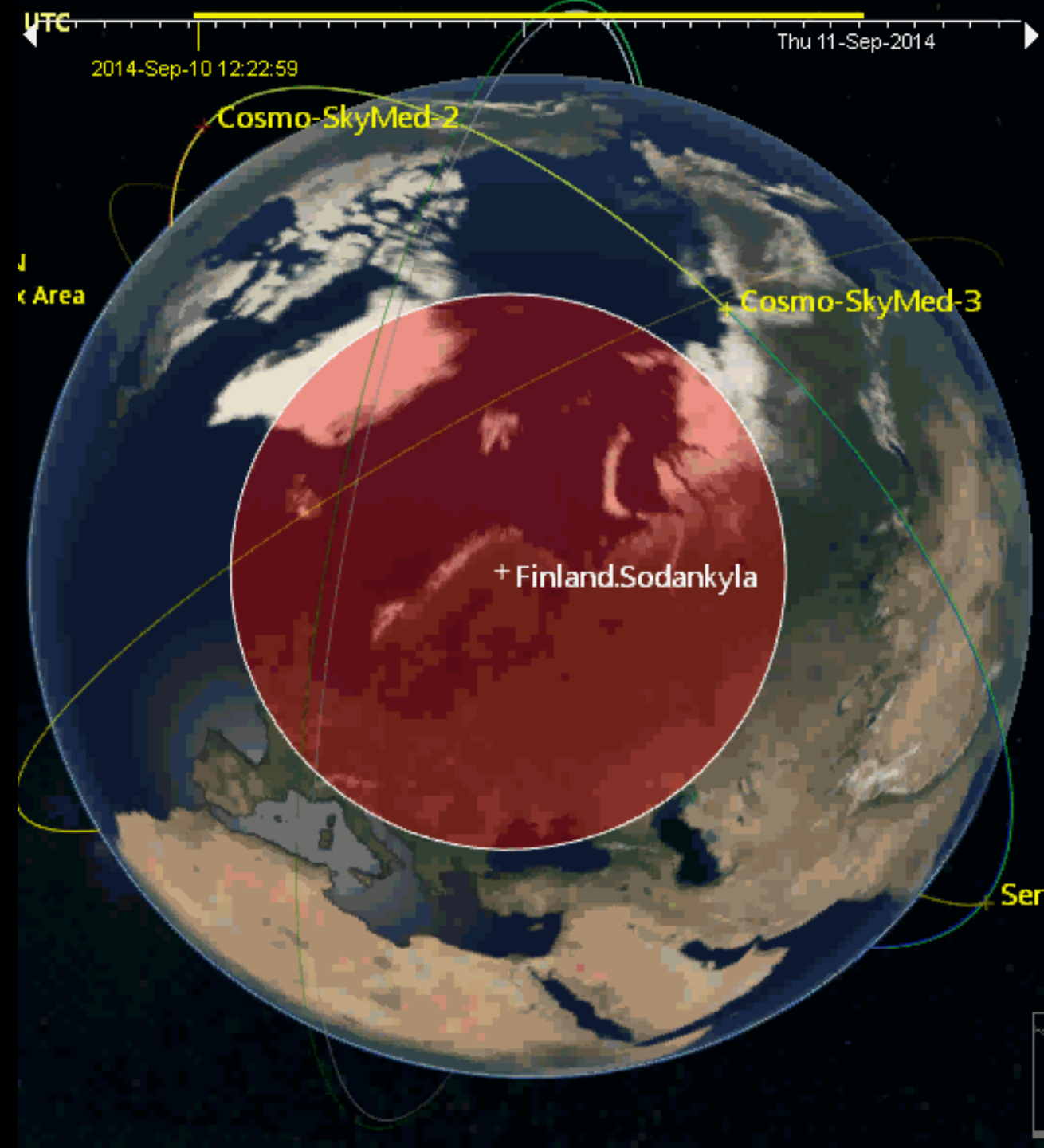


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# GROUND STATION SERVICES

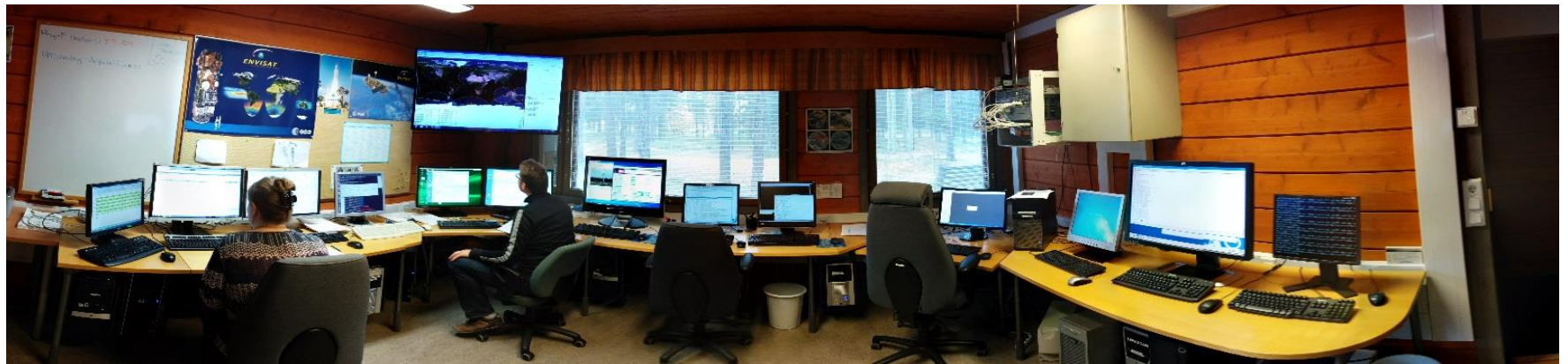
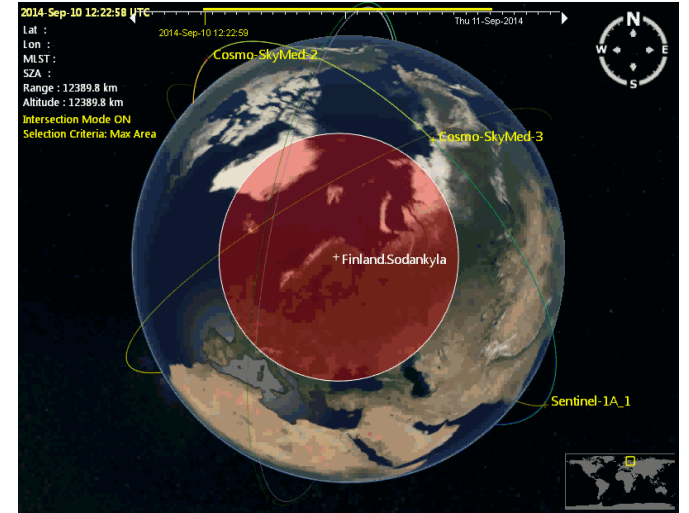
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# National Satellite Data Center



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# FMI-ARC SATELLITE ANTENNAS

ITEM	SOD 01	SOD 02	SOD 03
Reflector	2.4 m X-band Cassegrain	7.3 m X-band Cassegrain	7.3 m X-band Cassegrain
Coverage	Hemispherical No keyholes	Hemispherical No keyholes	Hemispherical No keyholes
X-band downlink <ul style="list-style-type: none"> <li>Frequency</li> <li>G/T</li> </ul>	7.7 – 8.5 GHz 22.8 dB/K	7.7 – 8.4 GHz ≥31.2 dB/K	7.7 – 8.4 GHz ≥31.2 dB/K
S-band <ul style="list-style-type: none"> <li>Downlink</li> <li>Uplink</li> </ul>	N/A	N/A	2200 – 2300 MHz 2025 – 2120 MHz
Polarizations <ul style="list-style-type: none"> <li>Data</li> <li>Tracking</li> </ul>	RHCP/LHCP	RHCP+LHCP RHCP/LHCP	RHCP+LHCP RHCP/LHCP
Accuracy <ul style="list-style-type: none"> <li>Pointing</li> <li>Tracking</li> </ul>	0.1° 0.03°	0.06° 0.04°	0.10° 0.05°
Tracking	Auto and Program Track	Auto and Program Track	Auto and Program Track
De-/anti-icing	Radome	Electrical heating	Electrical heating
Satellite support	NASA EOS and S-NPP	LEO > 250 km, MEO, GEO	LEO > 250 km, MEO, GEO
Data channels	1	2	2
Data rate	0.665 to 20.8 Mbps	2 to 320 Mbps (expandable)	2 to 1600 Mbps
Station control	Fully automated	Fully automated	Fully automated
Operational	2003	2011	2017
Data distribution using 10 Gbps data link			





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# OPERATIONAL EO SERVICES

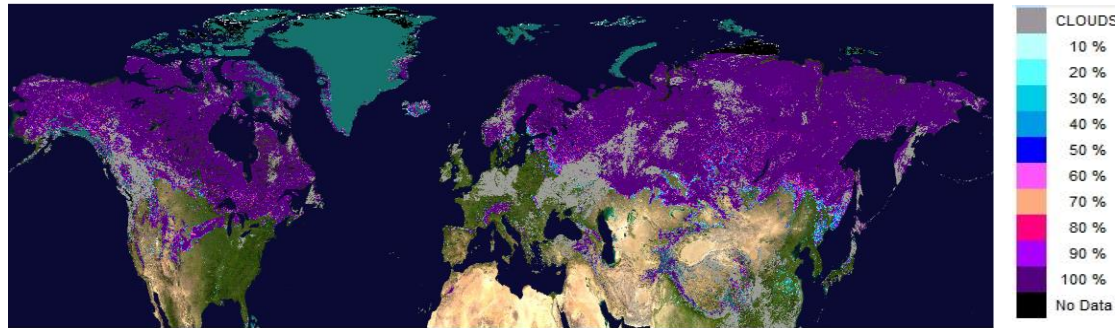
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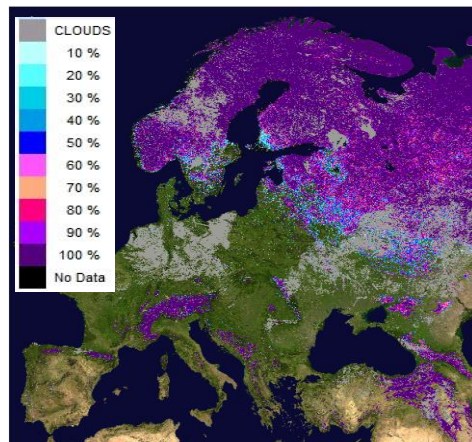


# Copernicus Global Land Service Cryosphere products

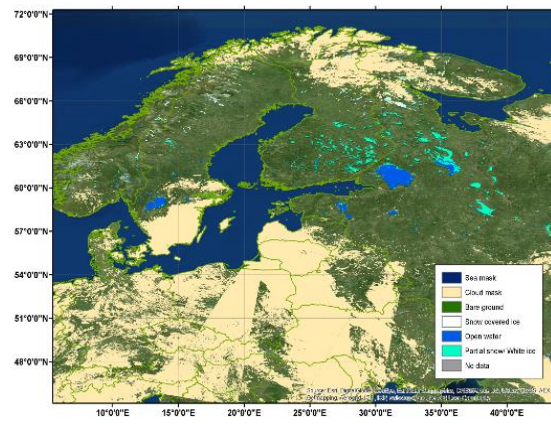
## Snow Extent, Snow Water Equivalent, Lake Ice Extent (by FMI, ENVEO, SYKE)



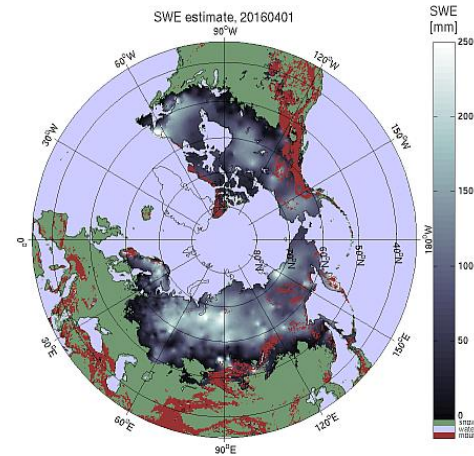
Northern-Hemisphere Snow Extent (SE)



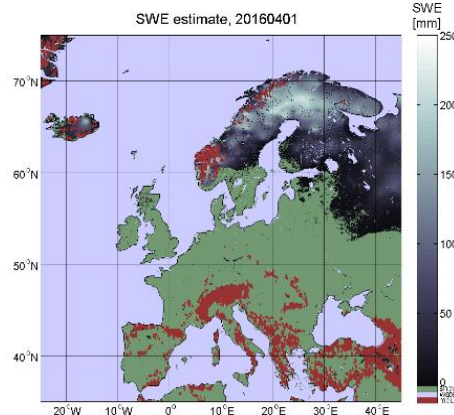
Pan-European Snow Extent (SE)



Lake Ice Extent (LIE) for Baltic Sea area



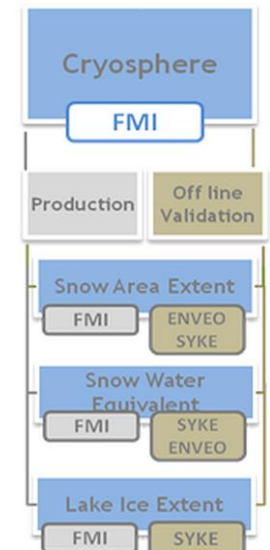
Northern Hemisphere SWE



Pan-European SWE

Finnish Meteorological Institute (FMI), ENVEO and Finnish Environment Institute (SYKE) are producing daily near-real time products on snow cover and lake ice for Pan-European domain and Northern Hemisphere. The products have a long-standing legacy from ESA GlobSnow and EC Cryoland projects.

The cryosphere products have been developed in close collaboration between FMI, ENVEO and SYKE and will be produced jointly at the FMI production centre.



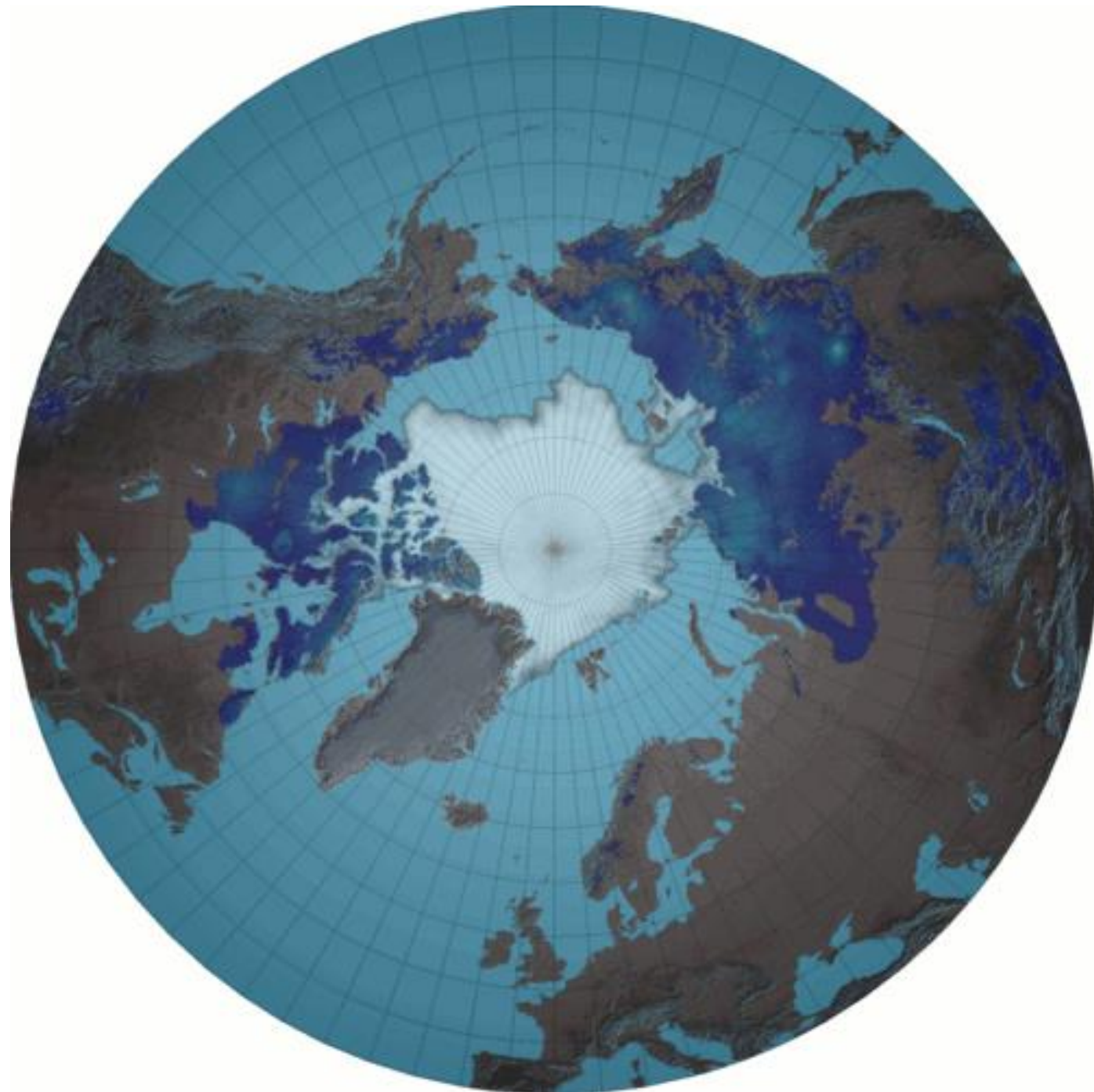
# SNOW AND ICE IN THE ARCTIC

Space-borne data-derived information  
for climate research and Near real time  
applications

- Atmospheric phenomena and their interaction with biosphere and cryosphere
- Snow covered area
- Snow water equivalent
- Seasonal frost / thaw
- Permafrost
- Sea ice cover
- Hydrology



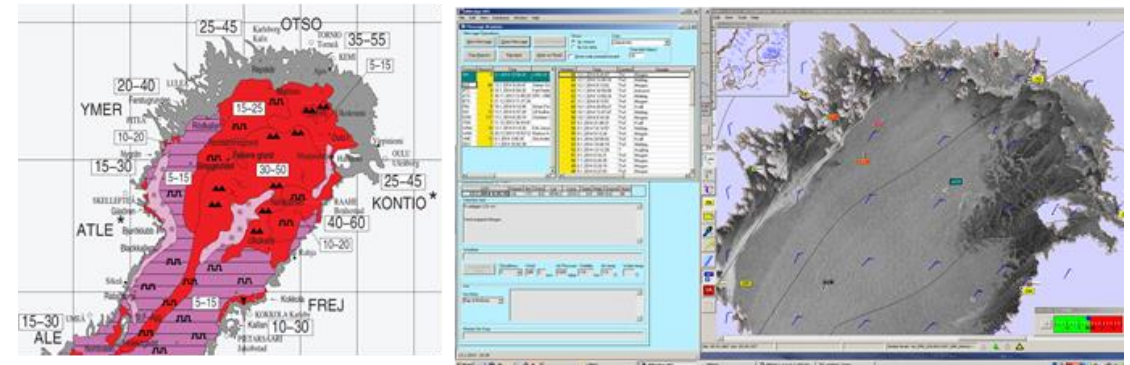
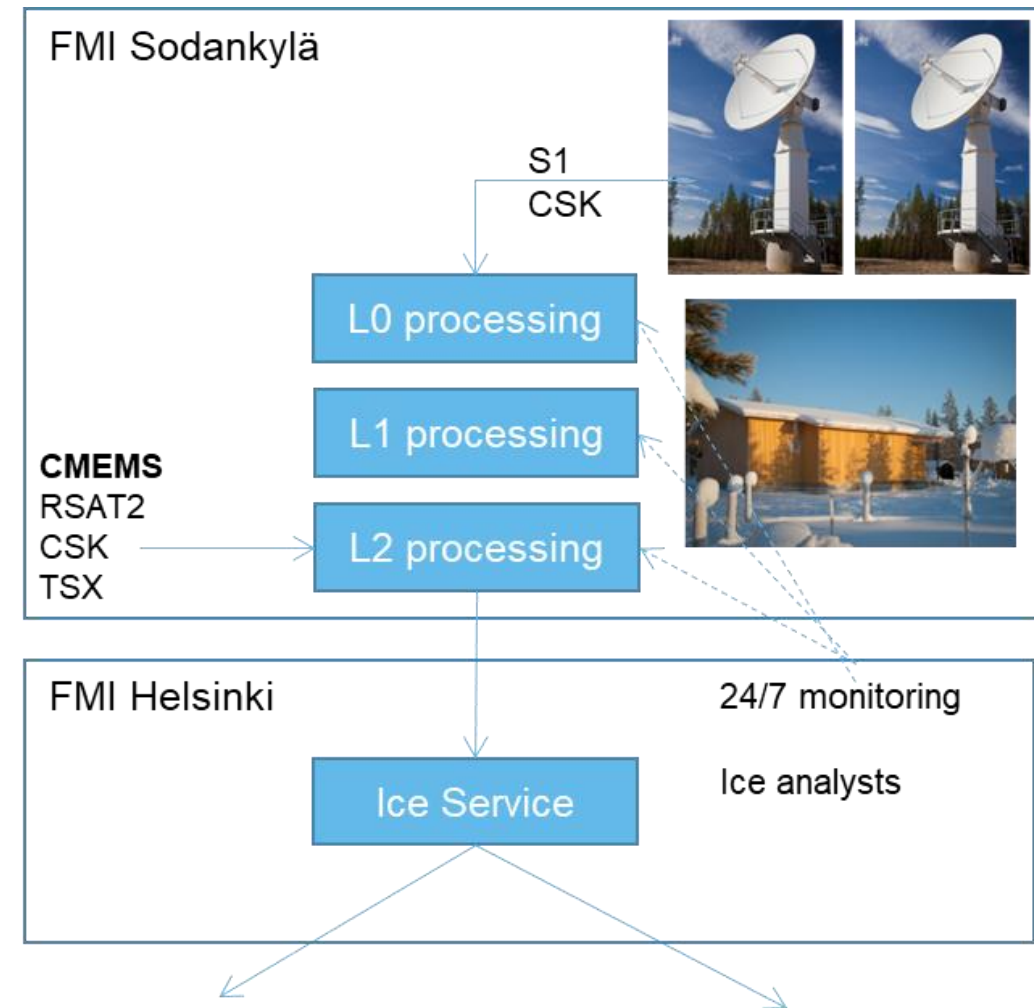
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# BALTIC SEA ICE MONITORING

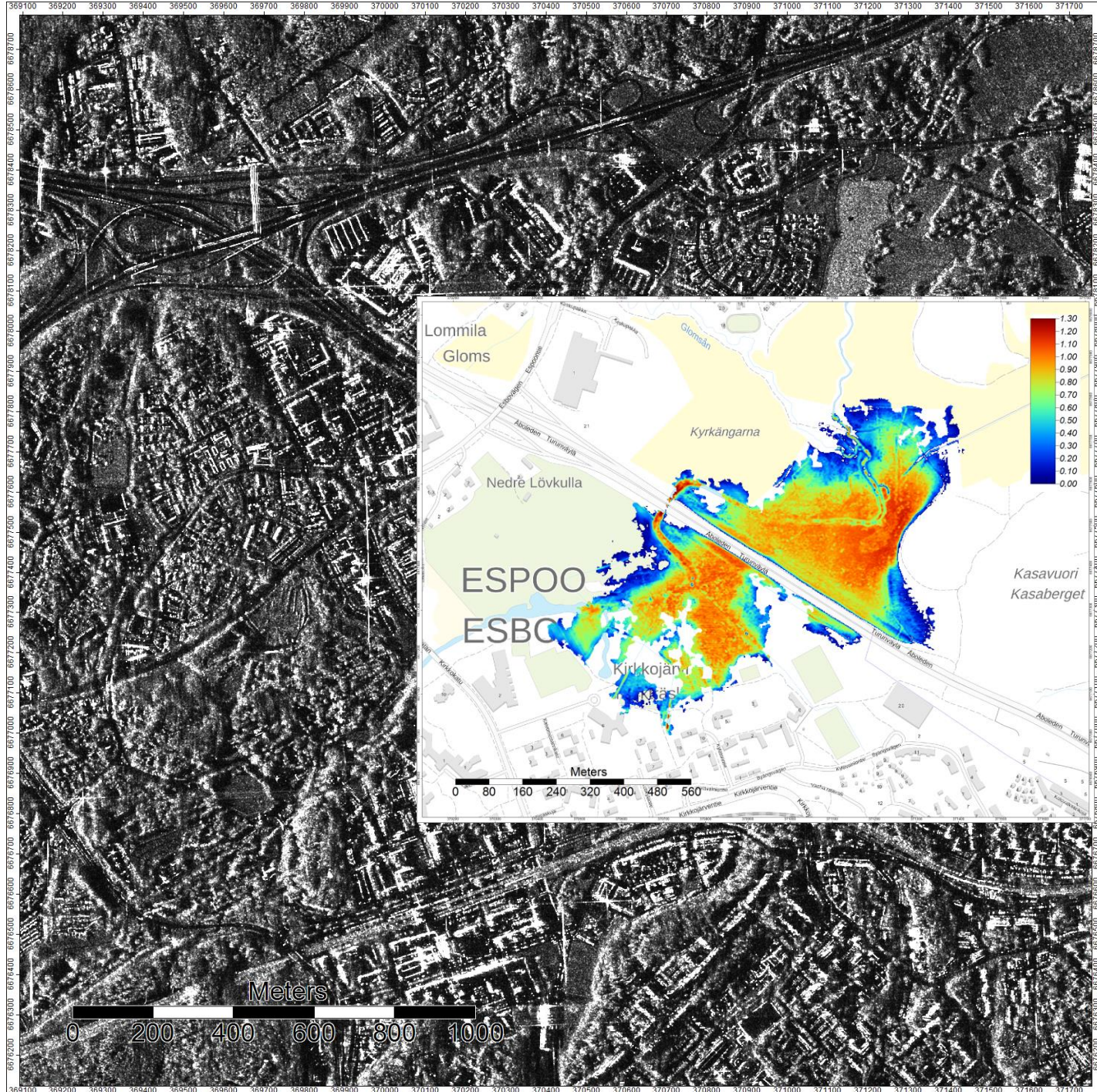
- Commercial and environmental needs
  - Finland is essentially an island
  - ~90% of Finland's import and export via sea routes
  - Gulf of Finland is one of the most busiest marine routes for oil transport
  - Annual economic impact €24m and €116m (EARSC2015)
- Operative Service
  - Availability target 99.9%
  - Quasi-real-time / NRT needs
  - Daily products
- Customer:
  - Finnish Transport Agency
  - Finnish, Swedish, Estonian Ice breakers
- Operations:
  - Fully automated processing lines at Sodankylä
  - Operators and ice analysts in 2 shift
  - 24/7 monitoring of the processing lines





# FLOOD MONITORING

- Annual flooding of rivers in Bothnia
  - Spring floods due snow melt
  - Autumn floods due heavy rain
- Use of Synthetic Aperture Radar (SAR) provides weather independent observation
- Detection of Flooded areas both in open areas and forested regions
- Operational service for regional authorities in collaboration with SYKE
  - Flood covered area, Flood depth
  - Forest floods







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# SODANKYLÄ SATELLITE DATA CENTRE

Available services

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# NATIONAL SATELLITE DATA CENTRE

## ESA Sentinel Collaborative Ground Station

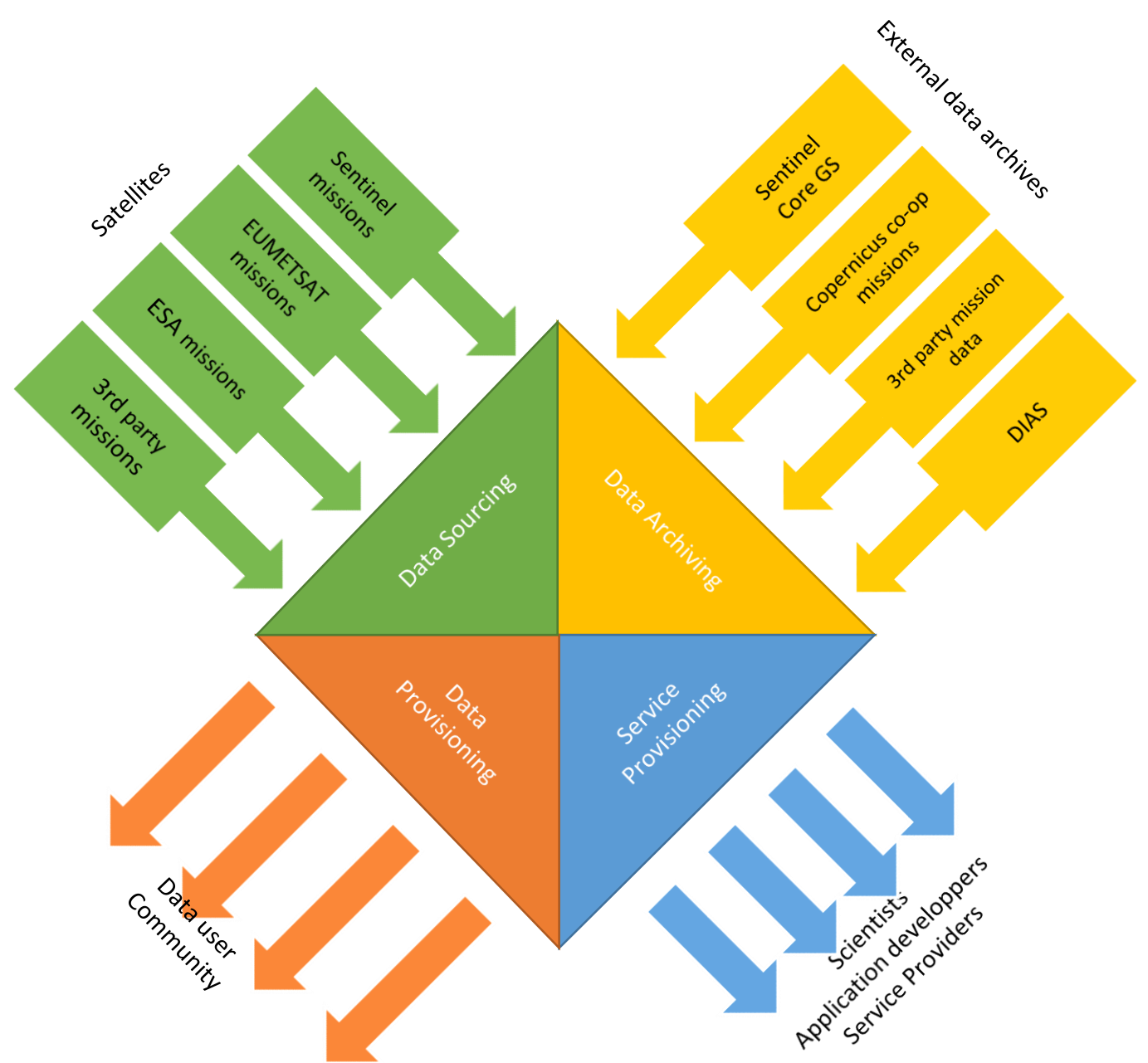
- Local reception of Sentinel-1 Direct Broadcast
- Focus on NRT and Quasi-Real-Time products

## Sentinels' data local mirror site

- Safe long-term archive of scientific data
- Long-term data archive
- Automated data processing lines for specific products
- Bulk processing
- Sentinels data dissemination:  
<https://finhub.nsdci.fmi.fi>

## Data processing services

- Virtualization environment for operational product processing
- Hosted processing (IaaS, PaaS)
- Calvalus – Processing Cluster for efficient Remote sensing data storage and processing





# SATELLITE DATA AVAILABILITY

## Current operational (free access)

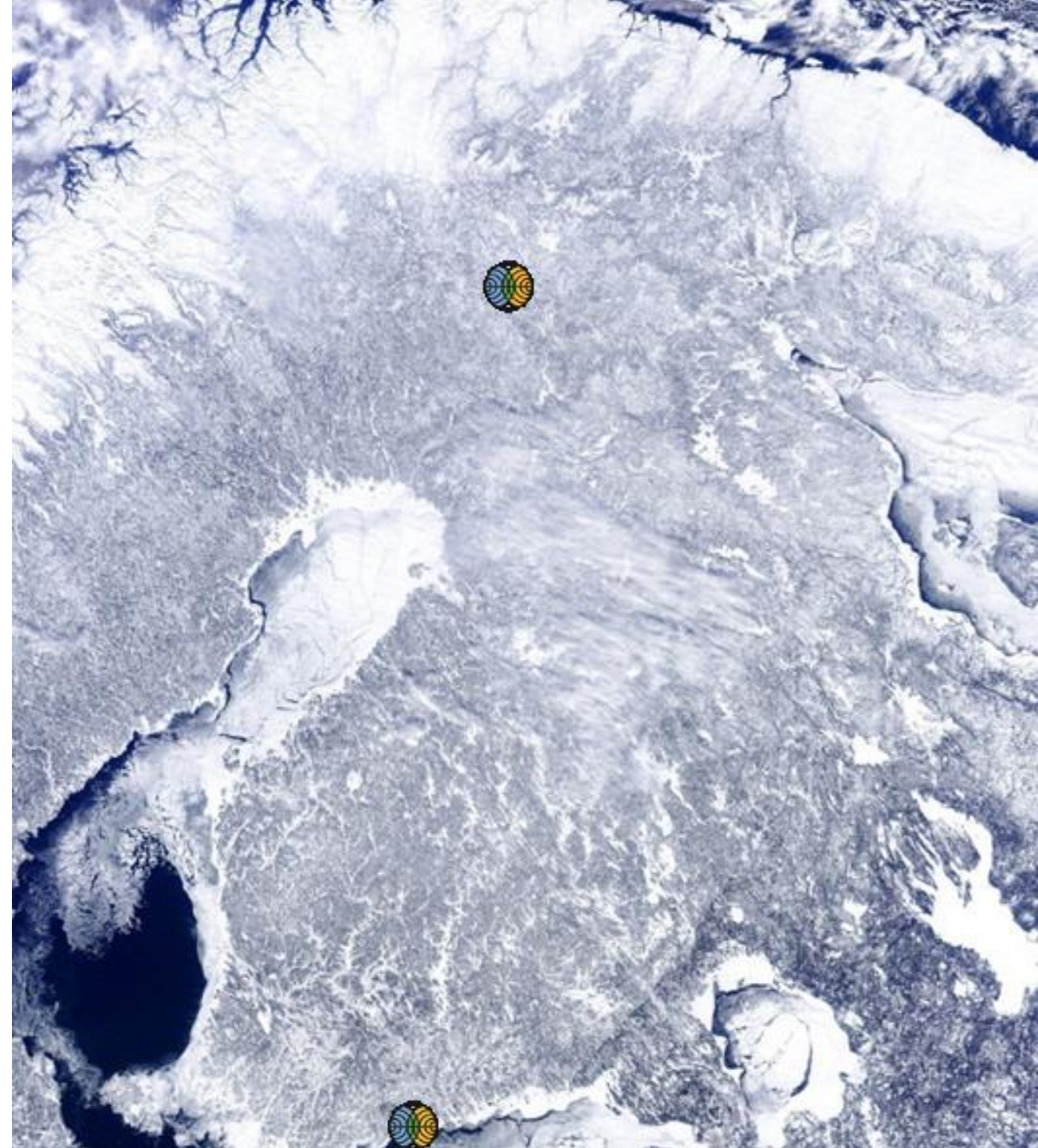
- EOS-Terra/MODIS
- EOS-Aura/ OMI
- Suomi-NPP/VIIRS & OMPS
- NOAA-20
- Sentinel 1A & 1B
- Sentinel 2A & 2B
- Sentinel 3A

## Current operational (commercial)

- COSMO-SkyMed (SAR)

## Test/Pre-operational/planned

- FY-3D
- HY-2A/B
- EPS-SG







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Services for New Space industry

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# SUPPORT FOR NEW SPACE?

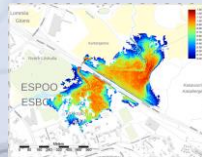


Joint  
development

X-band  
Downlink

Cloud processing  
Cloud storage

S-Band  
Up/downlink



Data distribution



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