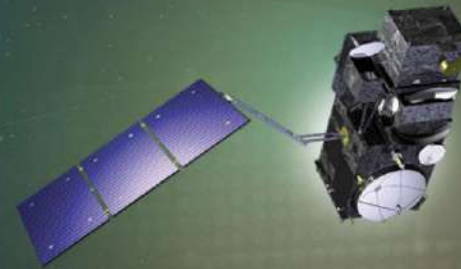




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Status of Copernicus Sea-ice Surface Temperature Demonstrational Product

Igor Tomazic, Gary Corlett and Anne O'Carroll

EUMETSAT

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Acknowledgment

- Gorm Dybkjær (DMI/MET Denmark)
- Jacob L. Høyer (DMI/MET Denmark)



- Steinar Eastwood (MET.NO/MET Norway)



- Jean Francois Piollé (Ifremer/France)



+ whole IST prototype project team

+ Sci4MaST project led by NOVELTIS



Content

Objective

IST Prototype

Cloudmask

IST Level 3

IST matchup in situ datasets

WEkEO processing and dissemination

Next activities

Summary



Objective

Satellite sea-IST: clear sky observation of the skin temperature at the surface of the snow and ice

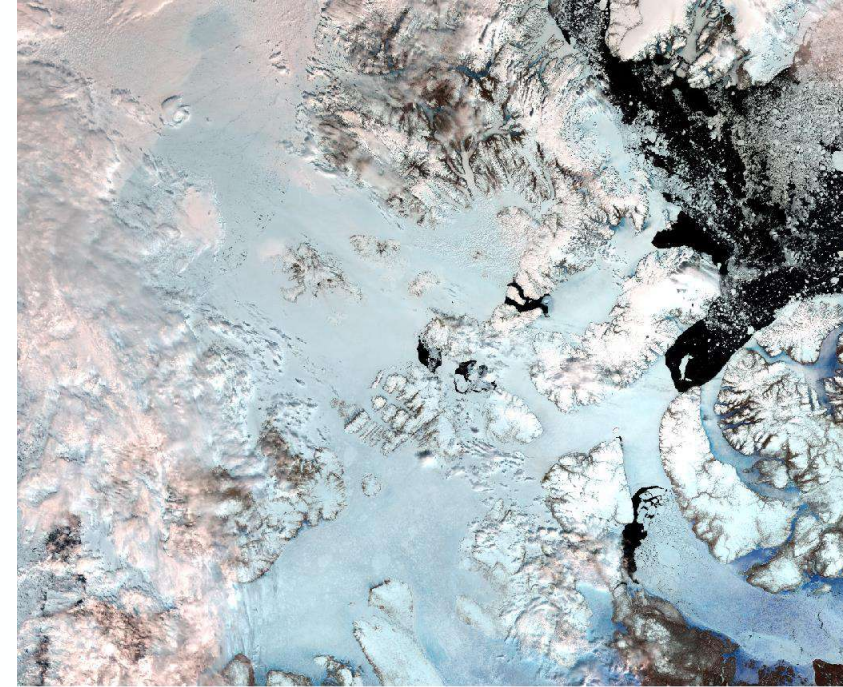
One of the key parameters that determines the state of the polar regions
→ requires high/climate quality long term measurements → [SLSTR](#)

Requested by EC to provide high quality IST measurements from S3/SLSTR

Implemented SLSTR A/B sea-IST (L2) prototype processor based on the [project](#) with DMI/Met.no

SLSTR IST prototype improvement, monitoring, validation within [Sci4MaST project](#)

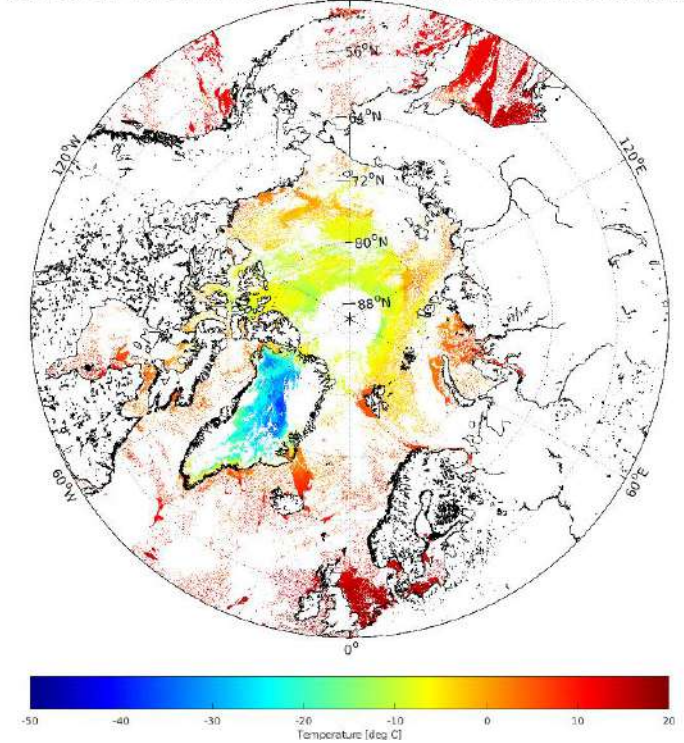
Usage of [WEkEO](#) platform to perform SLSTR IST L2 processing and data dissemination



Sea IST prototype – Demonstrational SLSTR sea-ice surface temperature (sea-IST)

- Based on DMI/Met.no prototype: <https://www.eumetsat.int/S3-SLSTR-SIST>
- SLSTR-A/B
- high latitudes (>50 N/S) (currently focused on Arctic)
- Spatial resolution: 1 km
- Timeliness: NRT 15 minutes processing time + time for level 1 availability at production centre.
- Sea ice temperature (IST), marginal ice zone temperature (MIZT) and SST (from SLSTR/WST)
- IST requirement is 1.0/1.3/2.0 K for 100/200/500 km grid for Goal/Breakthrough/Threshold, respectively
- SLSTR IST must have an accuracy (STD of differences) of 1 K at resolution of < 5 km (Goal 1 km)
- Critical issue: cloud screening - just implemented PPS cloud-screening

20210907-EUM-L2P-IST-SLSTR-POLAR-NH-v02.0r5-fv01.0_Ind1_q13_5_surface_temperature_2



Further refinements in 2023

Sea-IST prototype: algorithm & processing

- Sea-IST algorithms

$$IST2 = a_0 + a_1 T_{b_{11nadir}} + a_2 T_{b_{12nadir}} + a_3 \left((T_{b_{11nadir}} - T_{b_{12nadir}}) \left(\frac{1}{\cos \theta} - 1 \right) \right)$$

$$IST12 = a_0 + a_1 T_{b_{11nadir}} + a_2 T_{b_{11oblique}}$$
- MIZT algorithm:

$$MIZT = 0.5 * (T_{b_{11nadir}} - 268.95) * SST - 0.5 * (T_{b_{11nadir}} - 270.95) * IST$$
- S3A&S3B IST processing:

Inputs: S3A/S3B SLSTR L1

Dynamic ADFs

SST (SL_2_WST), Sea ice concentration (OSI401)

Static ADFs:

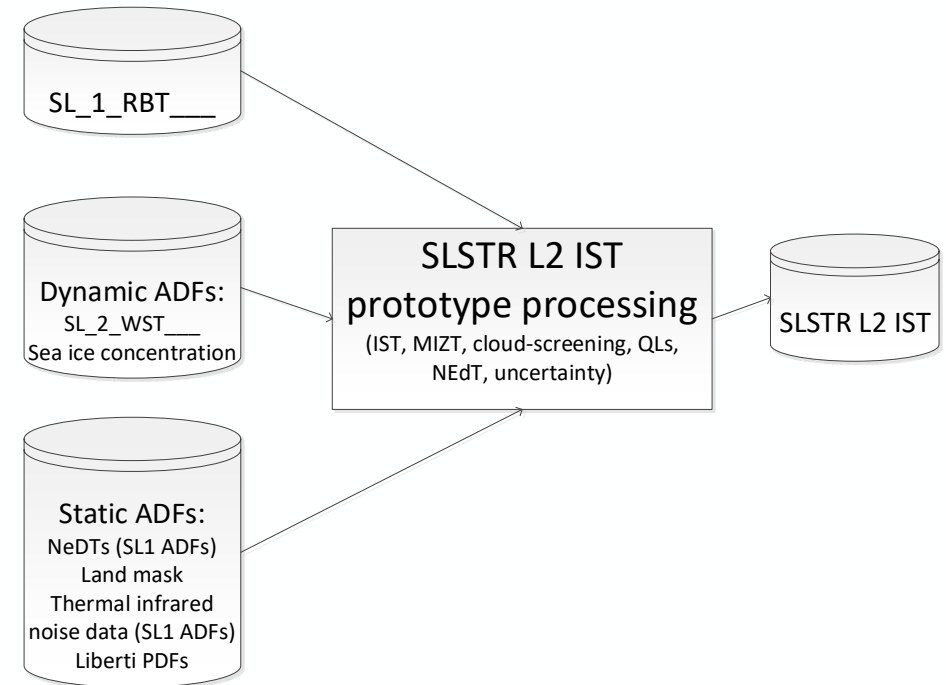
NeDTs (SL1), Land mask, TIR noise, Liberti PDFs, PPS

Processing:

IST2, IST12, MIZT, cloud-screening, QLs, NEdT, unc

Outputs:

IST L2P (GHRSSST): NH/SH, S3A/S3B



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IST prototype information/documentation

[SLSTR IST algorithm study](#)

[ATBD for SLSTR IST](#)

[Product validation plan](#)

IST prototype product specification (PSD)



Sea-ice Surface Temperature Retrieval and Validation for Copernicus Sentinel-3 Sea and Land Surface Temperature Radiometer
ITT No. 215580

Product Validation Plan - 1
cloud mask performance and
IST data.

Document reference number

Authors:
Jacob L. Høyer, Gorm Dybbjerg
Version 2.3

Product Validation Plan
Deliverable 5 (D5)
Deliverable 5 (D5)

19-12-2019

Funded by the European Union



Sea-ice Surface Temperature Retrieval and Validation for Copernicus Sentinel-3 Sea and Land Surface Temperature Radiometer

Product Specification Document (PSD)

Document Reference Number: EUM/OPS-COPEX/21/1214578

Author: Luis Flores Vargas and Gorm Dybbjerg
Version 1.2

PSD
Deliverable 8 (D8)

EUMETSAT ITT No. 215580; Contract No. EUM/CO/18/400902L



Funded by the European Union

Sea-ice Surface Temperature Retrieval and Validation for Copernicus Sentinel-3 Sea and Land Surface Temperature Radiometer

Algorithm Theoretical Baseline Document for SLSTR IST algorithms

Document Reference Number: EUM/OPS-COPEX/20/1205462

Authors: Gorm Dybbjerg and Steinar Eastwood (MET Norway)
Version 1.2

ATBD
Deliverable 7.2 (ATBD v2, D11)
EUMETSAT ITT No. 215580; Contract No. EUM/CO/18/400902L/AOC

29-01-2021

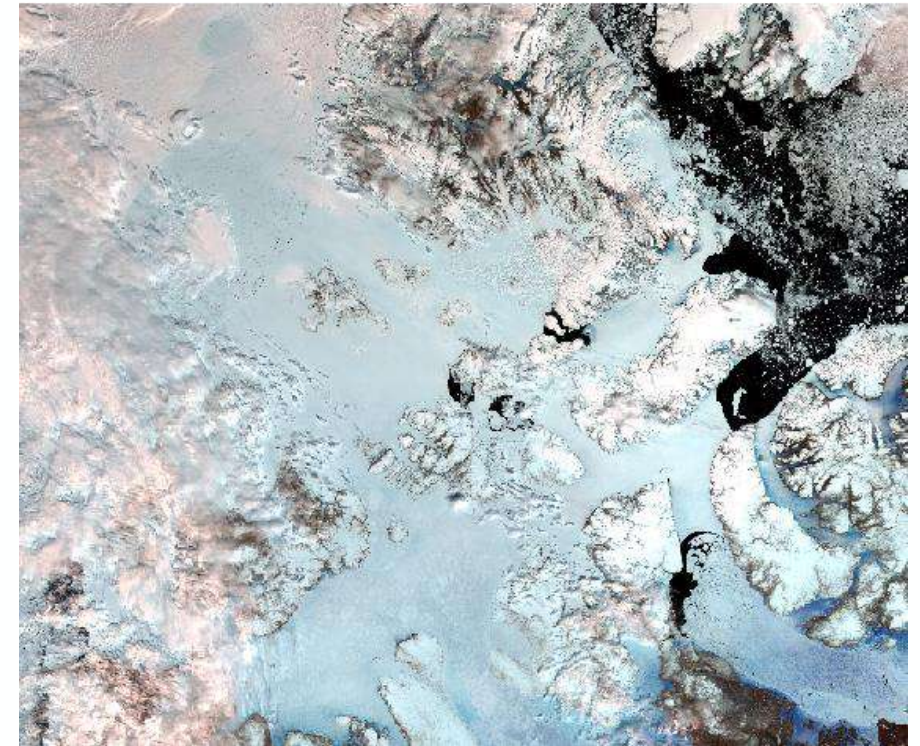


29-01-2021



IST Cloudmask implementations

- Initial IST cloudmask
 - Liberti cloudmask
 - From previous [study](#)
 - Bayesian sea ice-cloud classification
 - MODIS used as proxy for SLSTR
 - Used for daytime
 - Basic cloudmask
 - From SLSTR L1 – features with fixed thresholds
 - Used for night time
- PPS cloud mask (from Oct/2022)
 - From PPS v2021: SMHI NWCSAF (<http://nwcsaf.smhi.se>)
 - Features with dynamic thresholds
 - Further refinements and post-processing within [Sci4MaST project](#)



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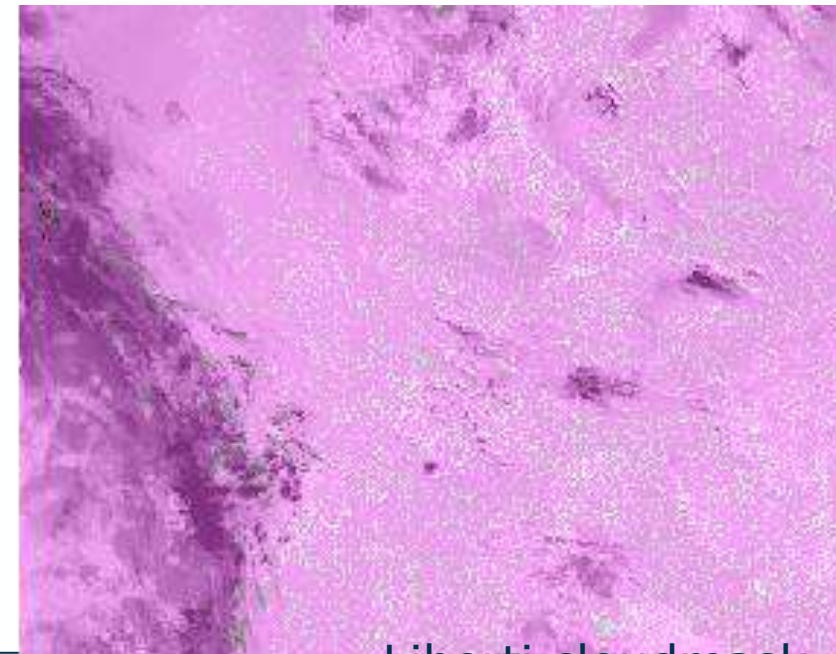
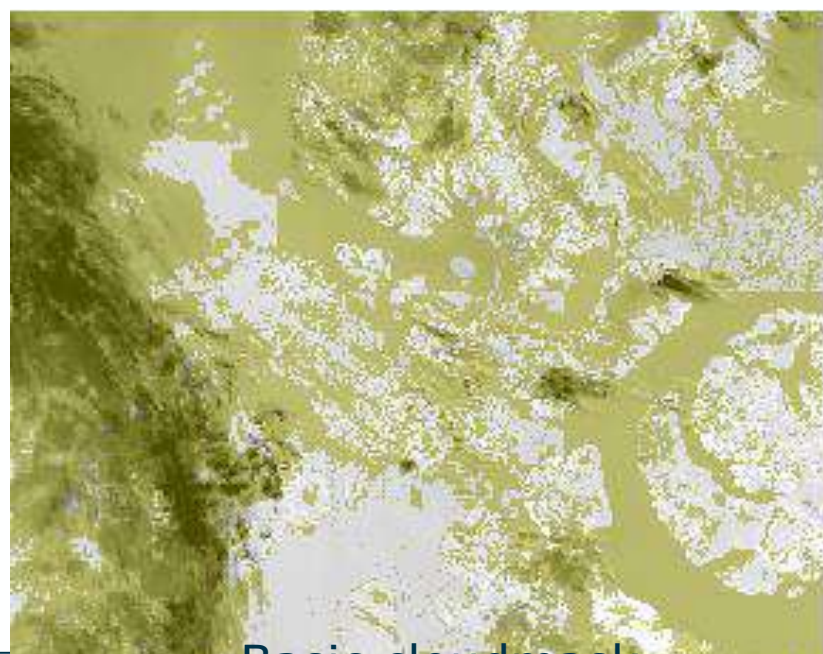
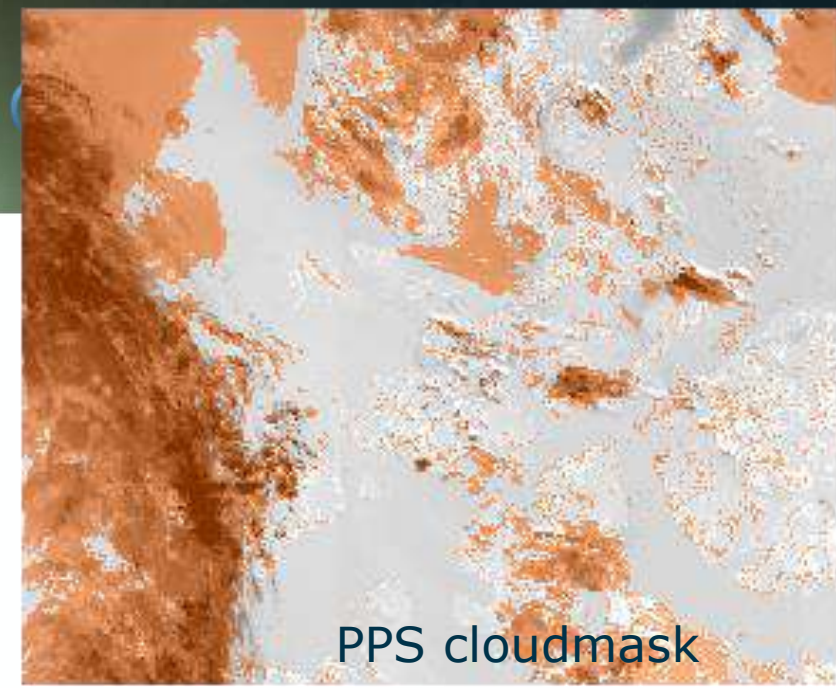
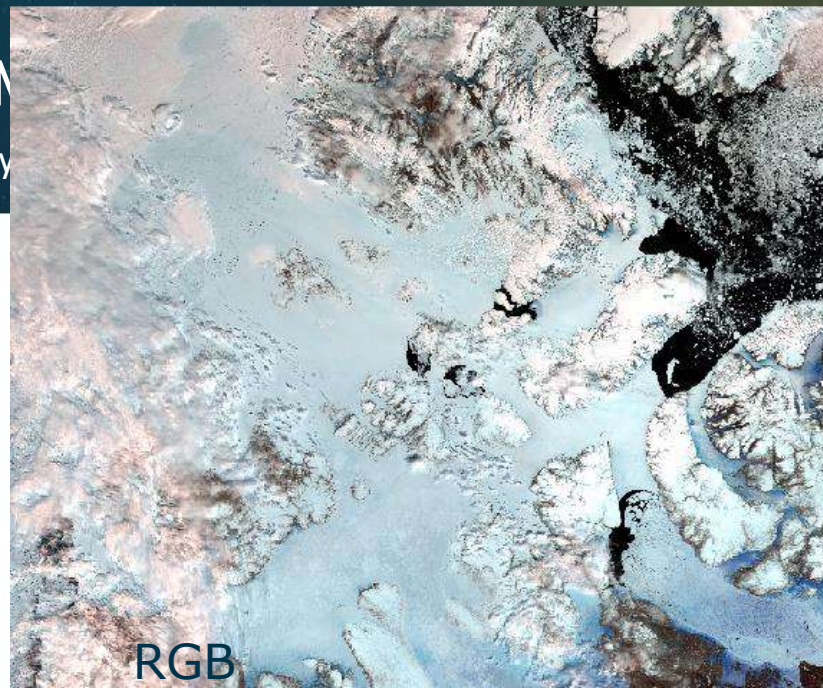
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Example scene:

SLSTR-A

20220618181757

Nadir view



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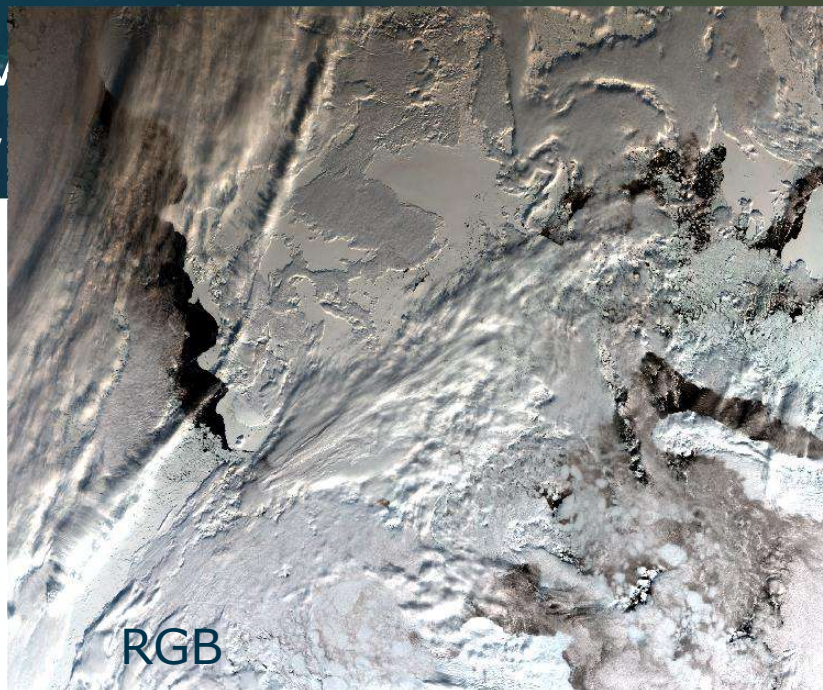
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Example scene:

SLSTR-B

20210517140300

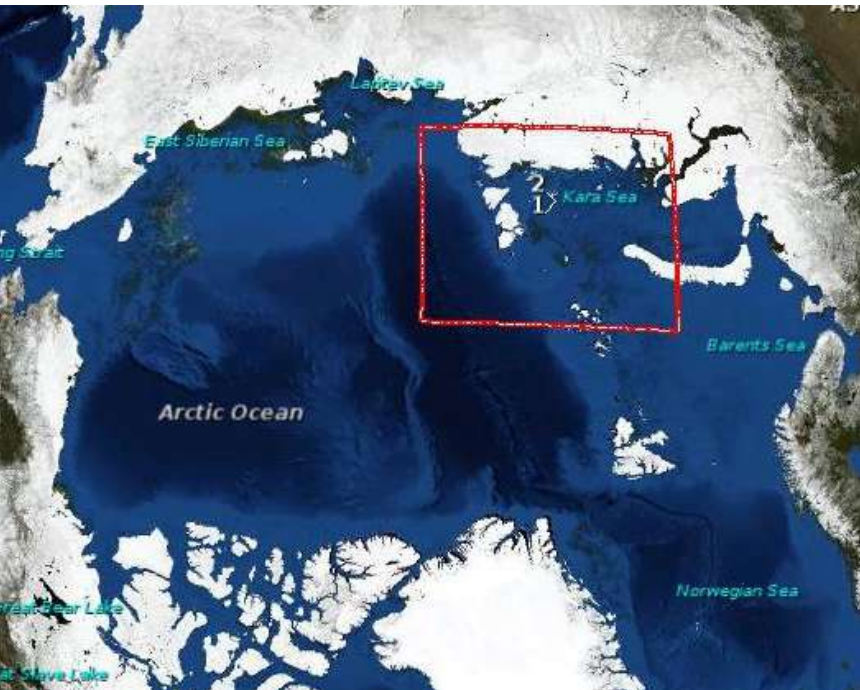
Nadir view



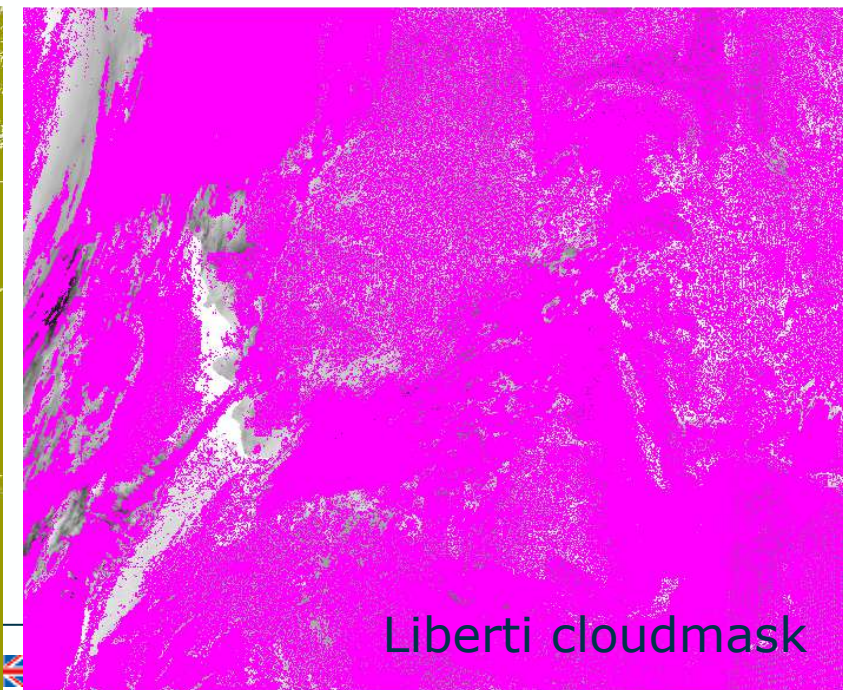
RGB



PPS cloudmask



Basic cloudmask

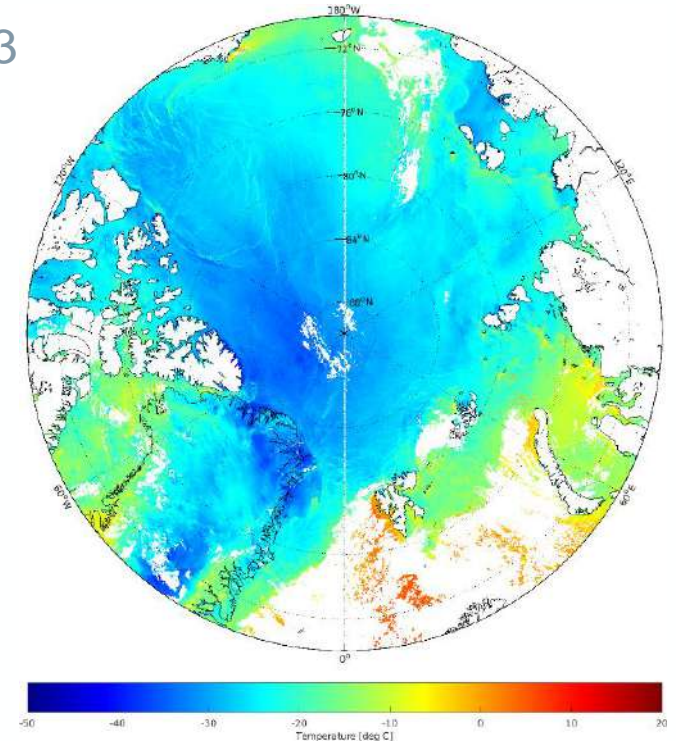


Liberti cloudmask

IST Level 3

Implemented using OSI-SAF/Met.no L3 processor

- Removed all QL checks (on tcwv, solza, ...) → kept only PPS output (for now)
- Currently missing probability of water/ice information in SLSTR IST L2 (only pcloud from PPS)
- For testing and inter-comparison aligned with OSI-SAF Metop-A/AVHRR IST L3
 - 12h window around 00 and 12h
 - 5 km grid
- Otherwise produced also 24h L3
- Test day: 01/04/2022
- Test results:
 - IST L3 with initial and PPS cloud mask
 - IST L3 with PPS and OSI SAF L3
 - IST L3 differences: 12h SLSTR IST&SST vs 12h OSI SAF IST&SST



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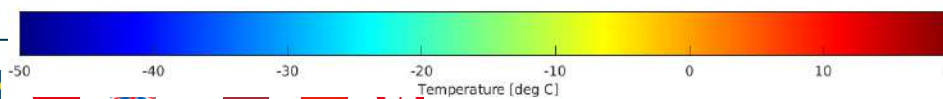
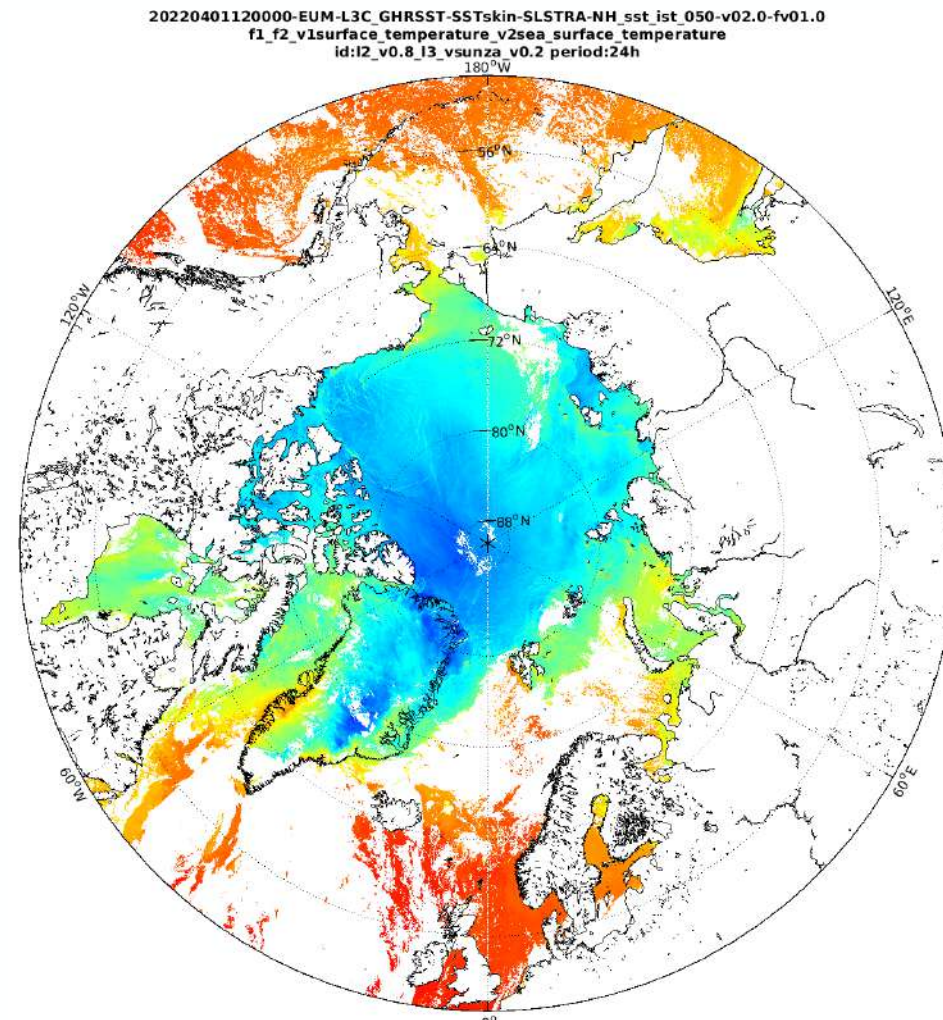
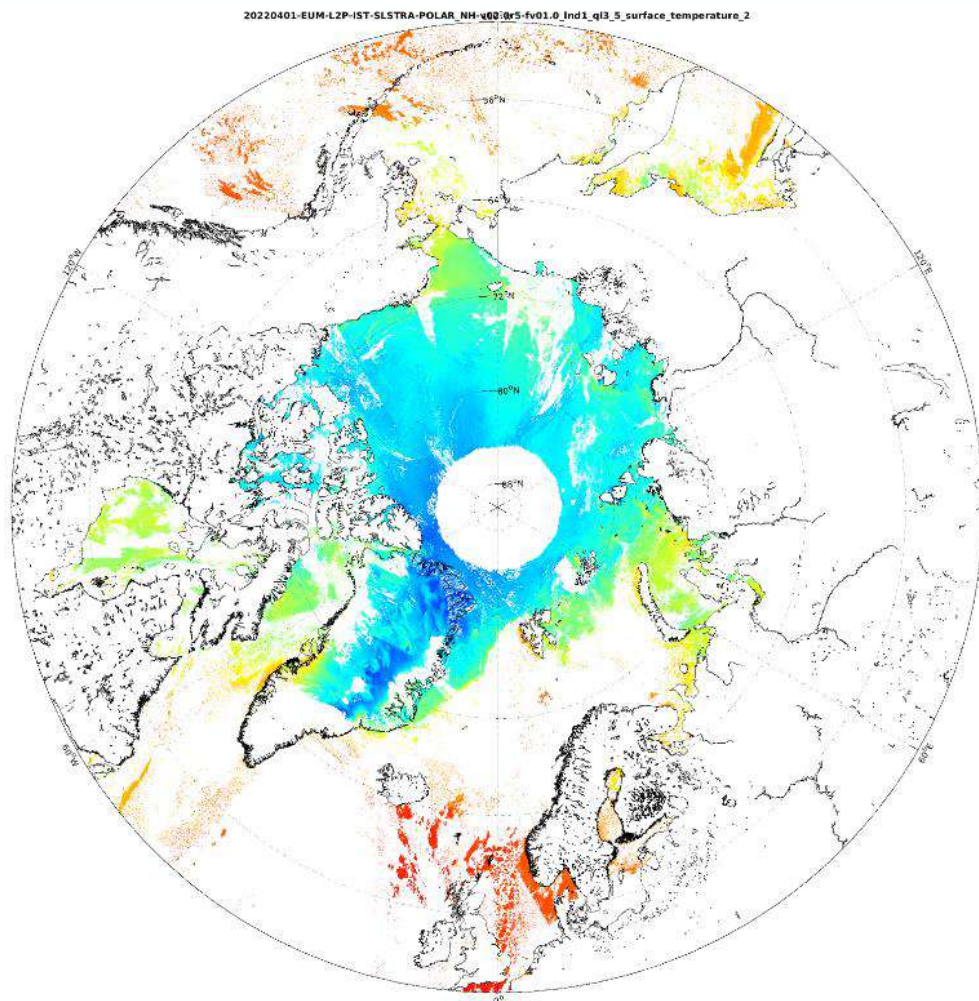


SLSTR-A IST Level 3:

01/04/2022:

left: Liberti/basic cloudmask

right: PPS cloudmask



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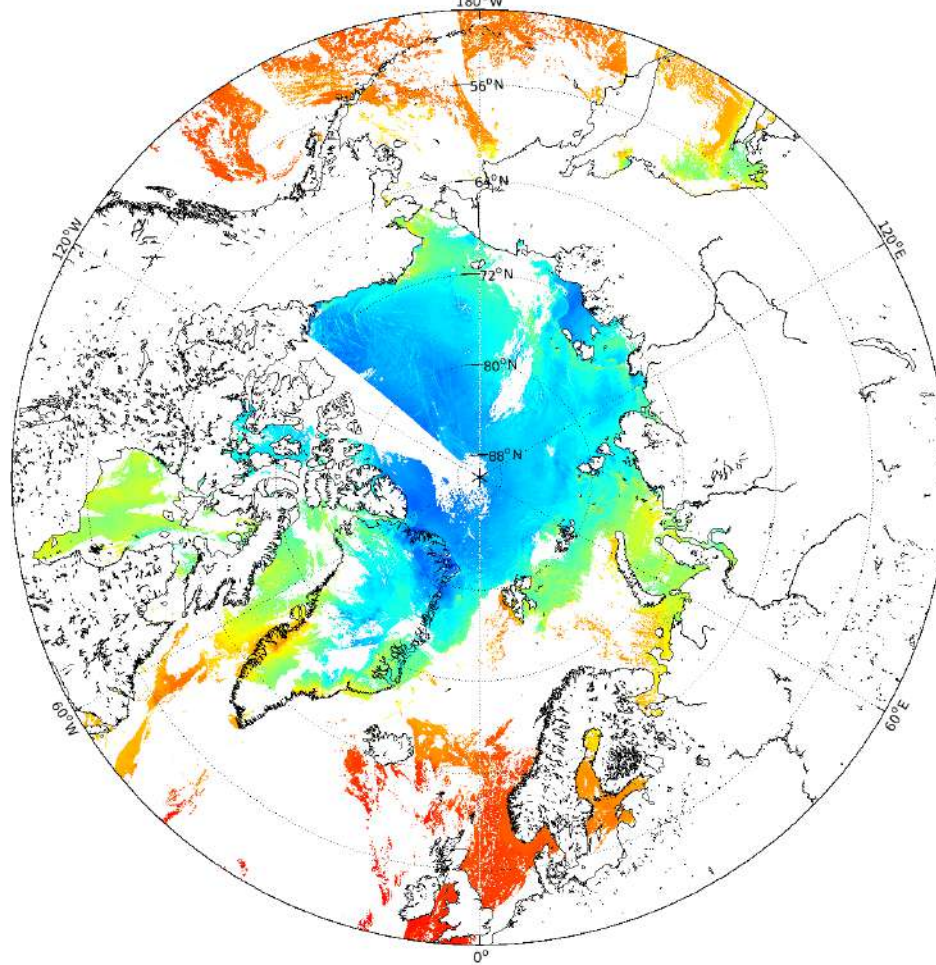


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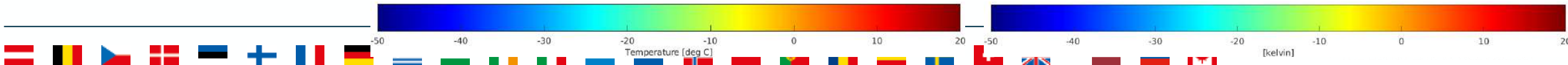
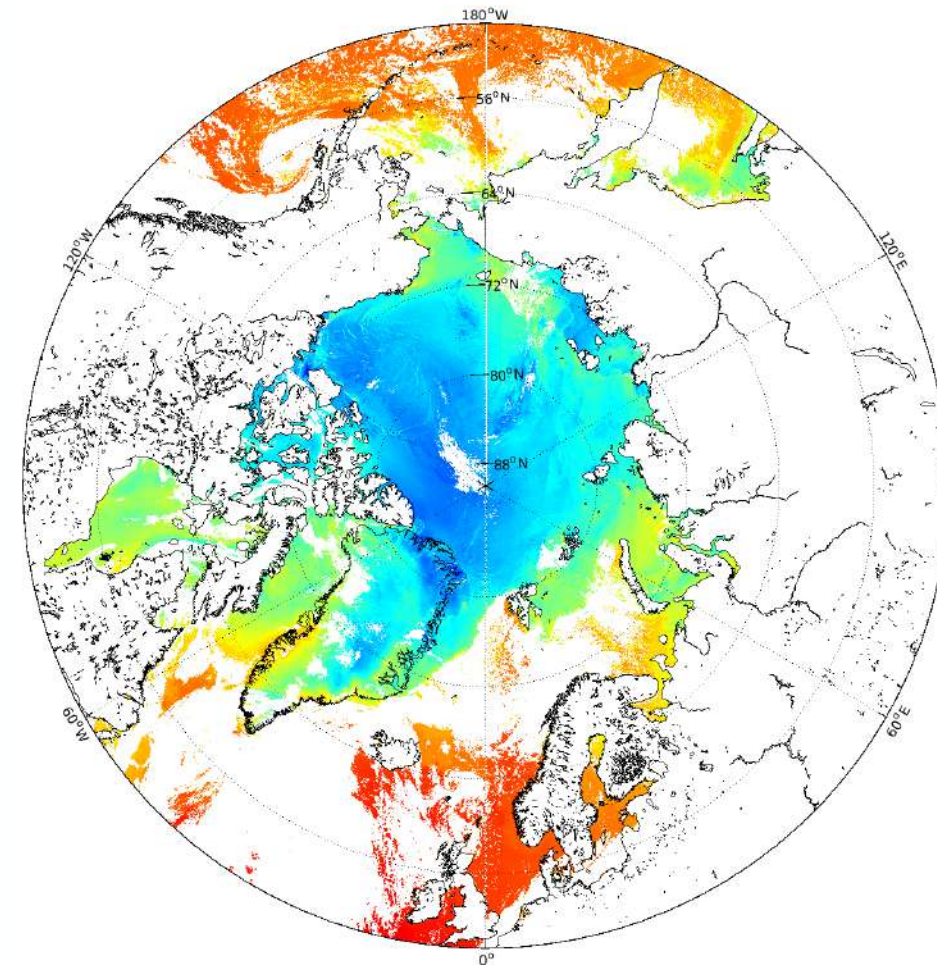


**IST Level 3: 12h window:
2022/04/01 12h
left: SLSTR-A IST&SST L3
right: AVHRR-B IST&SST L3**

20220401120000-EUM-L3C_GHRSSST-SSTskin-SLSTR-A-NH_sst_ist_050-v02.0-fv01.0
f1_f2_v1surface_temperature_v2sea_surface_temperature
id:i2_v0.8_i3_vsunza_v0.2 period:12h



2022040100-METNO-L3C_GHRSSST-SSTskin-AVHRR-METOP_B-v02.0-fv01.0
surface_temperature&sea_surface_temperature



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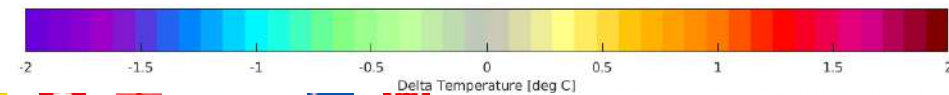
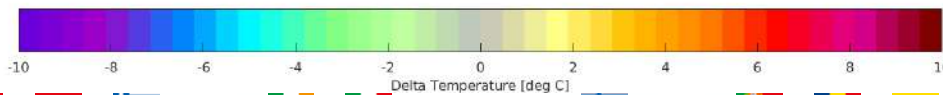
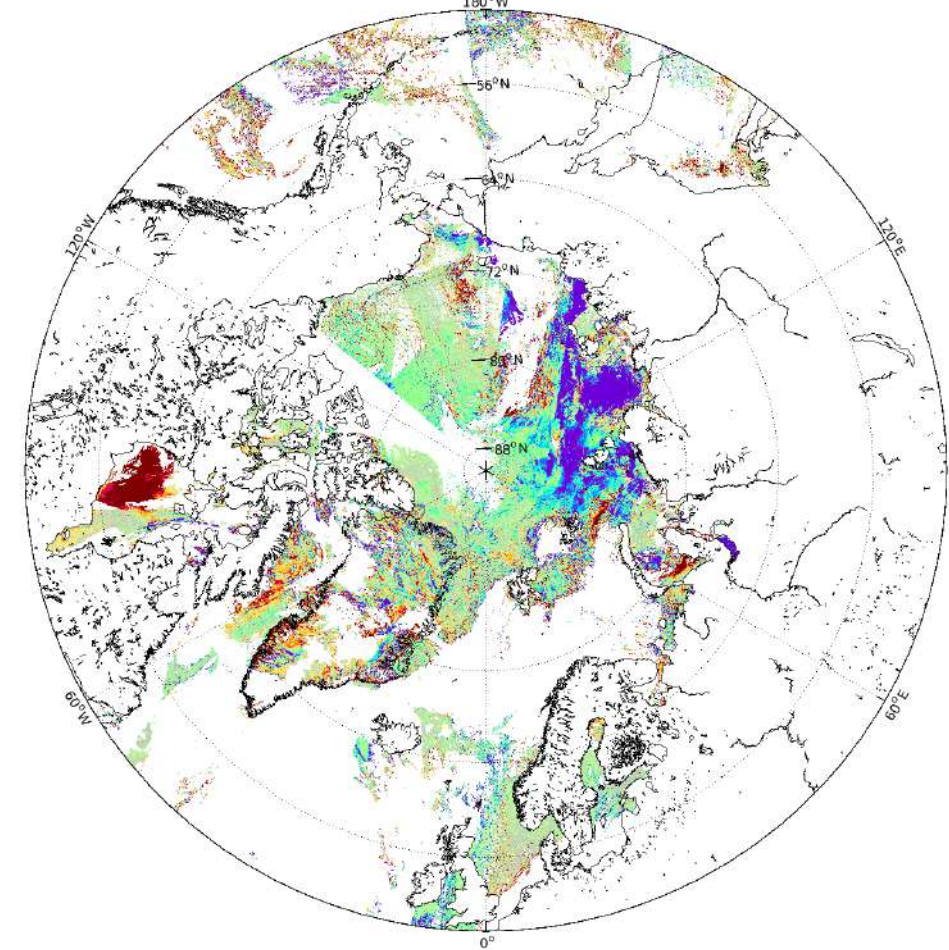
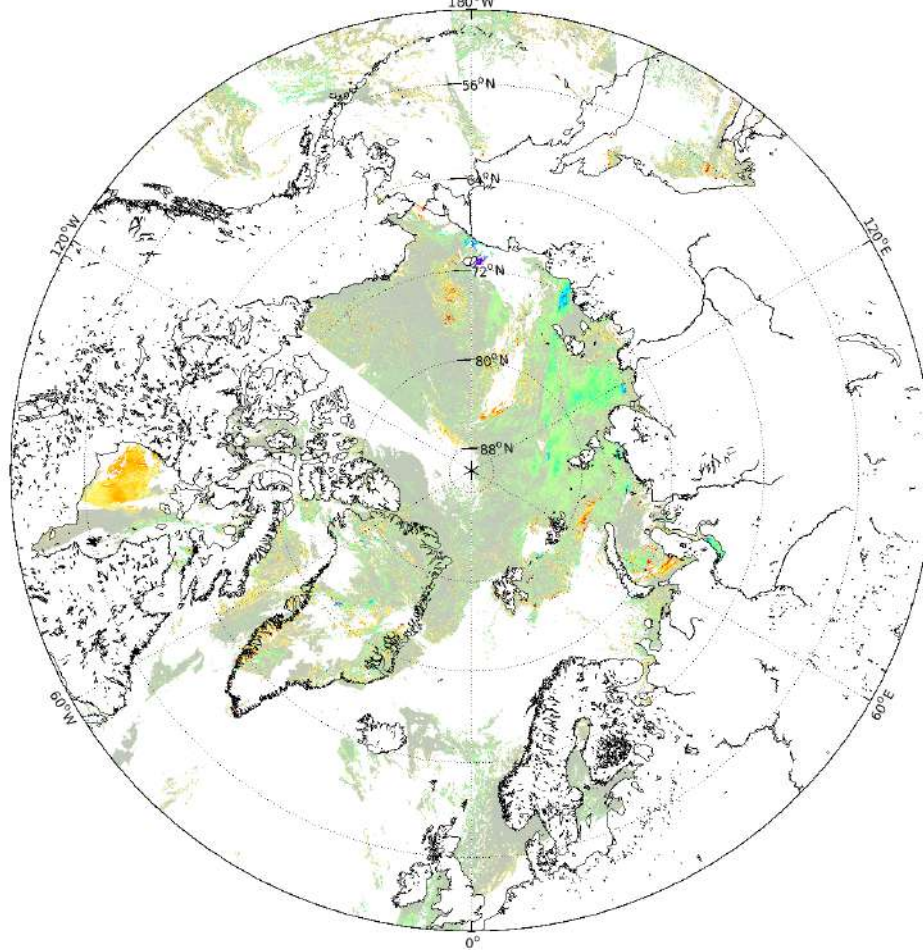
IST Level 3 differences:

2022/04/01 12h
SLSTR-A IST&SST vs
AVHRR-B IST&SST

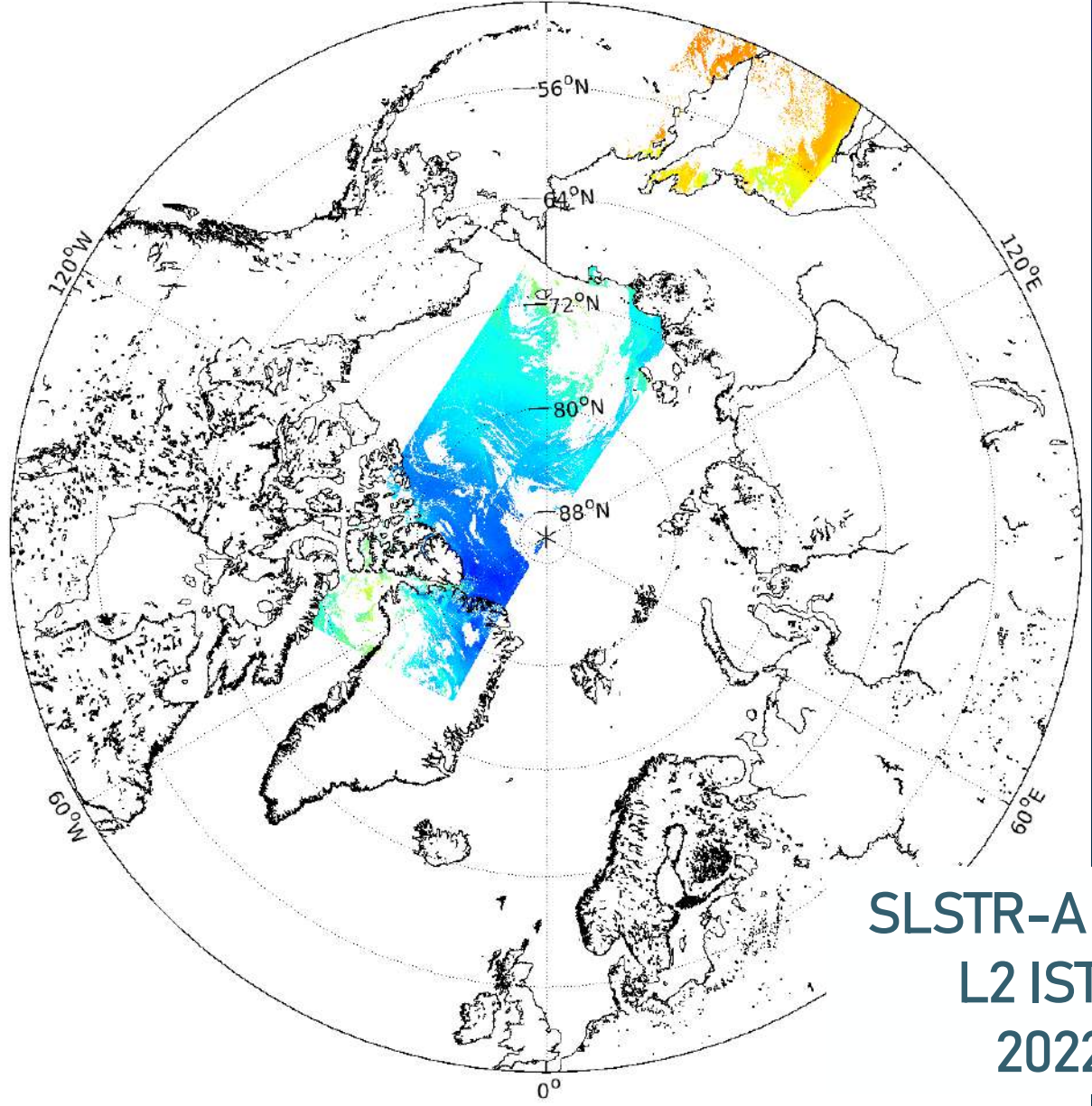
left: [-10 10] degC
right: [-2 2] degC
SLSTR: no QL filtering
AVHRR: ist QL 4&5

→ Promising results
using PPS even
without fine tuning
→ still work to do to
improve cloudmasking

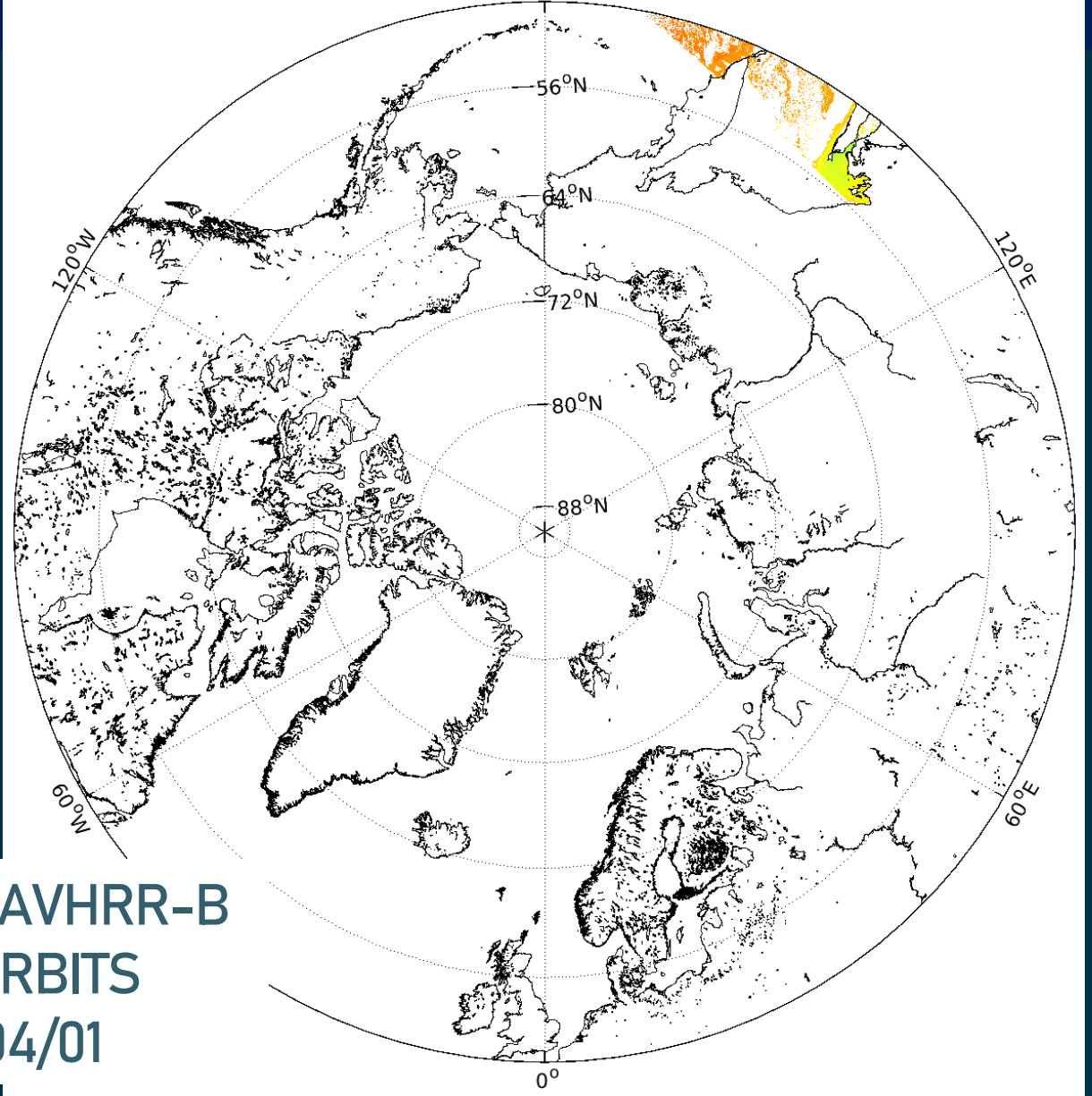
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:euml3.surface_temperature-osil3.surface_temperatureë3.sea_surface_temperature-osil3.sea_surface_temperature :v1euml3.surface_temperature-osil3.surface_temperature:v2euml3.sea_surface_temperature-osil3.sea_surface_temperature
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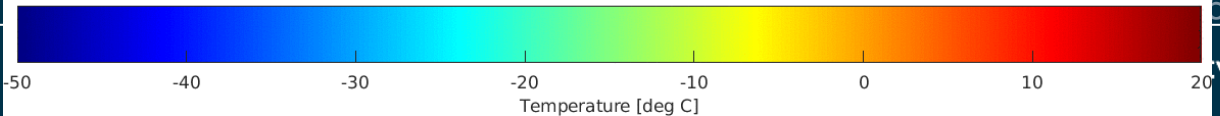
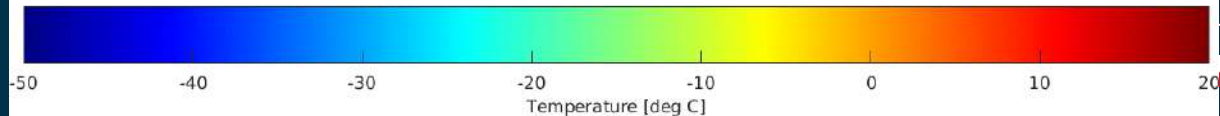
20220401
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180°W



20220401
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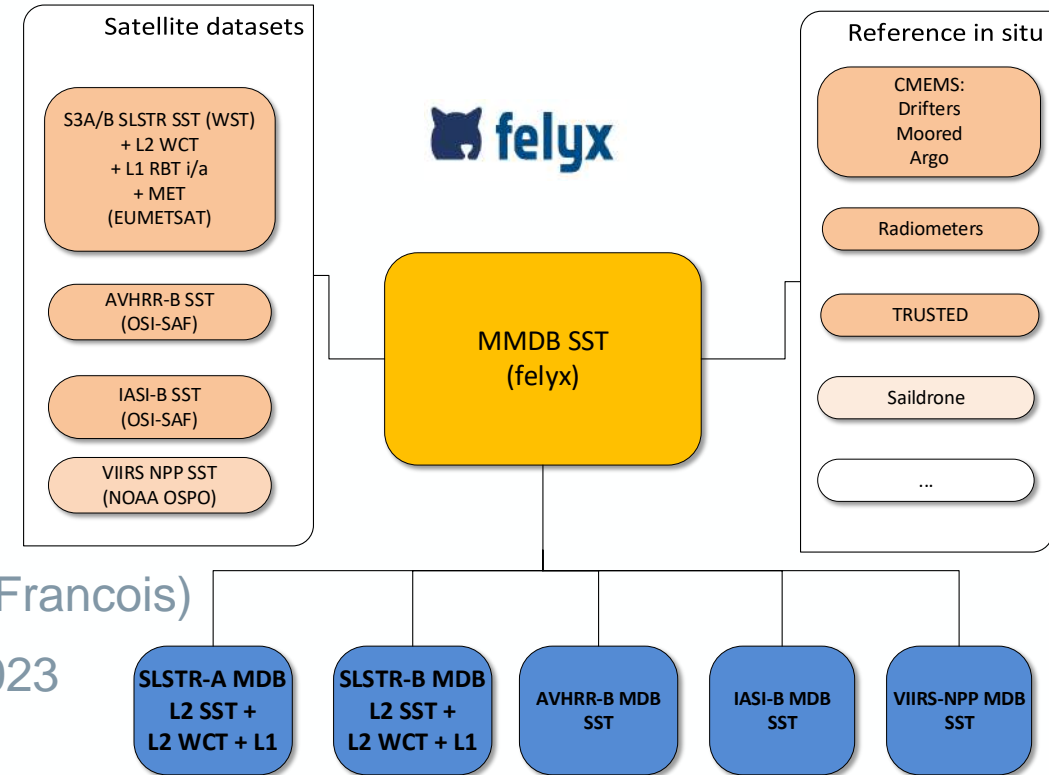


SLSTR-A & AVHRR-B
L2 IST ORBITS
2022/04/01



IST matchup dataset (MDB)

- SLSTR IST vs in situ IST & Cloudmask
 - VIIRS/AVHRR IST for inter-comparison (side activity)
- Cloud mask reference data: CALIPSO/CALIOP, Synoptic
- In situ IST reference data:
 - PROMICE AWS (Greenland)
 - International Arctic Buoy Programme (IABP)
- MDB: to be implemented with new version of MMDB tool (felyx) developed within Sci4MaST project (see presentation from Jean-Francois)
- MMDB IST prep activity started and planned to be ready in Q1/2023
- FRM sea-IST in situ:
 - Extension to TRUSTED project (<https://www.eumetsat.int/TRUSTED>) for design, prototype and implementation of sea-ice buoys (2022-2024)
 - See next talks from Gorm and Marc



WEkEO processing and dissemination

- WEkEO (wekeo.eu): EC Data and Information Access Services (DIAS): EUMETSAT, ECMWF, Mercator Ocean Int., EEA
 - provides single points of access to all Copernicus data and information, along with cloud-based processing resources
- Configured/installed
 - VMs (Morpheus), external data access (sftp), downloads, processing and monitoring (ES/grafana), ...
- S3A/S3B NRT SL2 IST availability
 - <12h from sensing time (could be further improved)
- Dissemination: available through sftp
<sftp://slstr-seaicetemp-demo.wekeo.eumetsat.int>
(new accounts available on demand: s3.ist@eumetsat.int)
- Initial IST implementation in WEkEO: from Oct 2021



New IST version (v0.8) with PPS available from 18/10/2022

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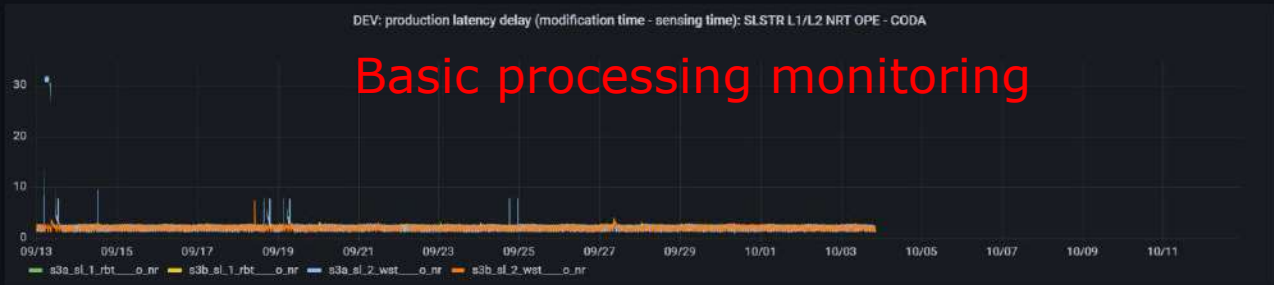
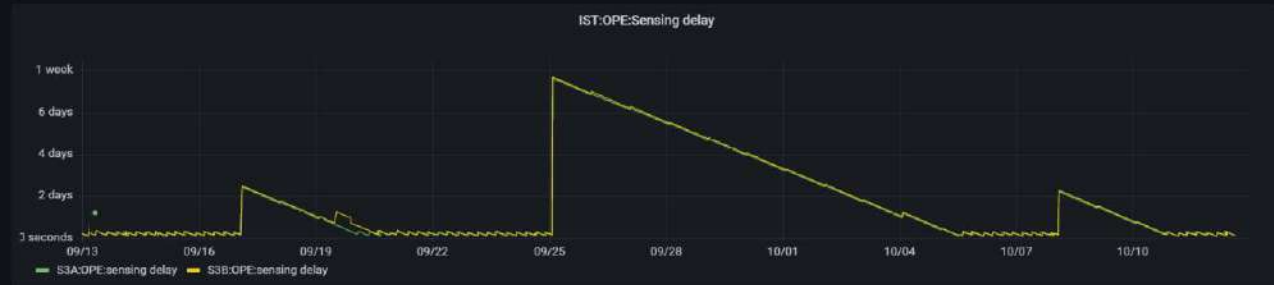
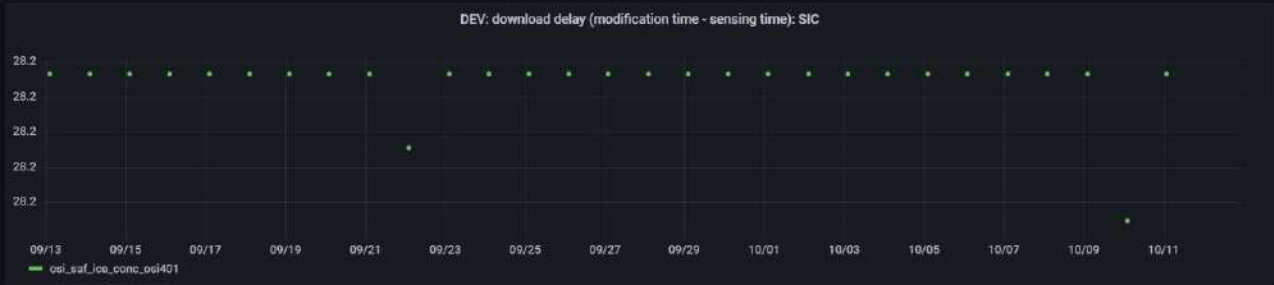
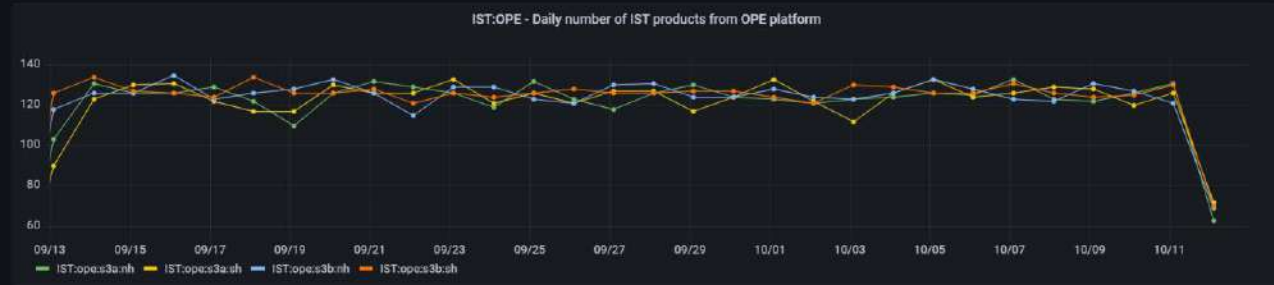
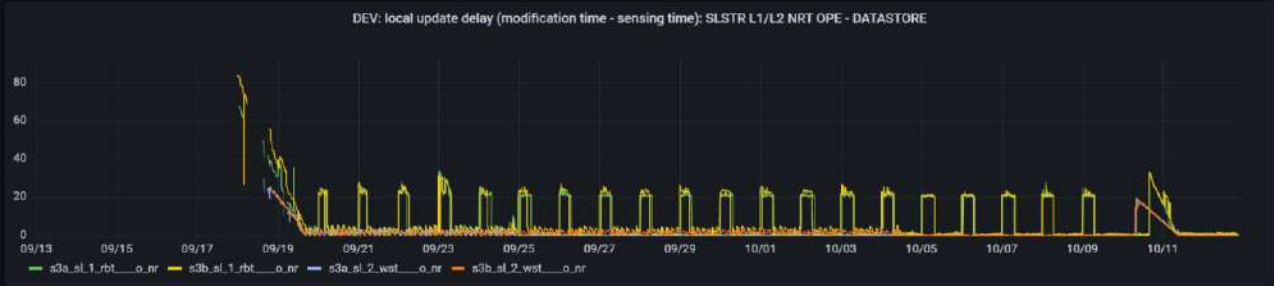
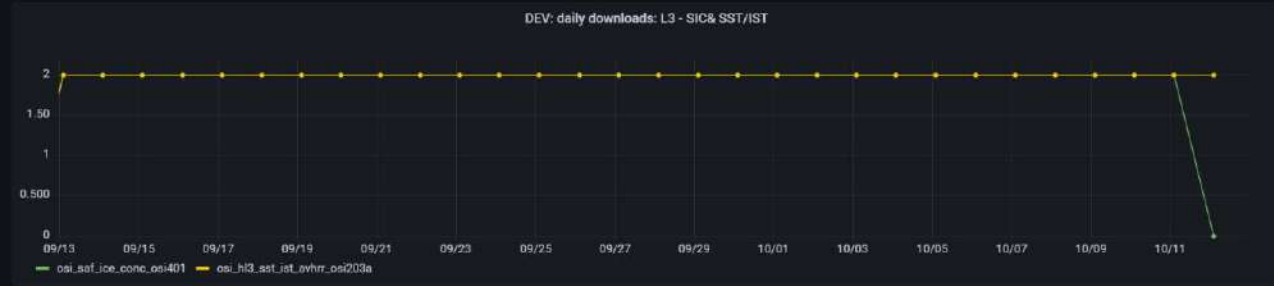
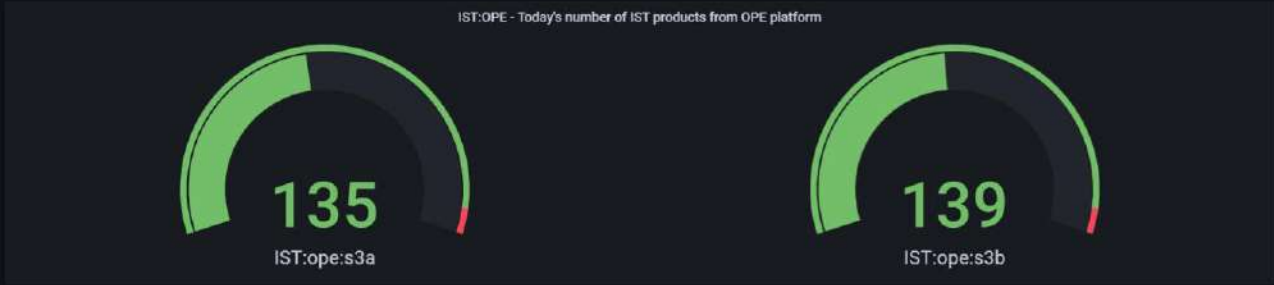
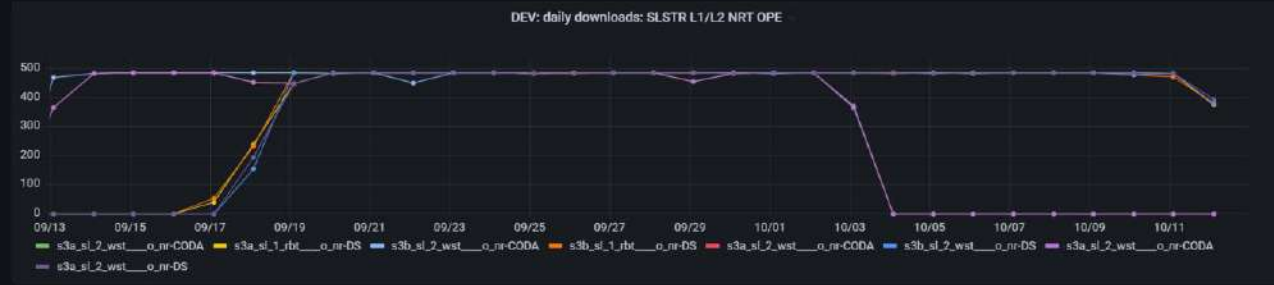


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General / IST

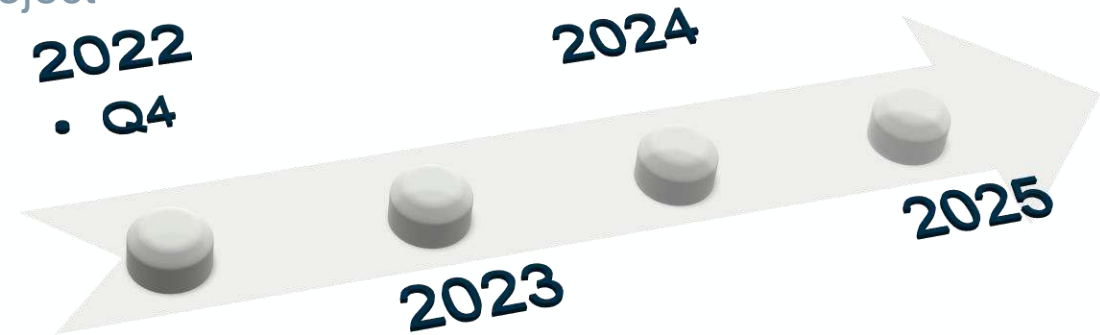
Last 30 days



Basic processing monitoring

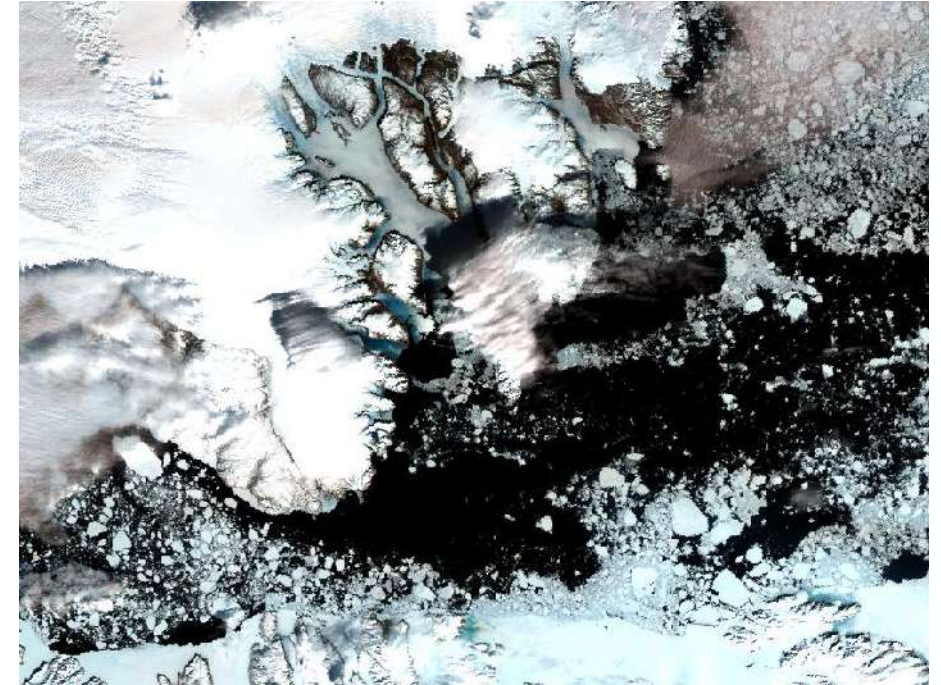
Next planned activities

- ~~IST with PPS available on WEkEO: Q4/2022~~
- L3 IST on WEkEO: Q4/2022
- IST prototyping activities: 2023
 - PPS cloud masking refinements: within Sci4MaST project
 - Quality level refinements
 - Uncertainty
- L3U IST (per orbit): 2023
- Monitoring (METIS like): 2023
- Extensive S3A/S3B IST validation (L2 IST/in situ matchups + L3): 2023/2024
- IST integration with Day2 SST: 2024
- TRUSTED IST FRM in situ buoy: 2024/2025
- Operational implementation (Day1 IST&Day2 SST): 2024/2025
- Full reprocessing: 2025 (tbc)



Summary

- Significant improvement in cloud masking (PPS)
 - Refinements still expected in 2023
- IST demonstrational product with improved cloud masking (NWCSAF/PPS) available now on WEkEO!
 - <sftp://slstr-seaicetemp-demo.wekeo.eumetsat.int>
 - ask for account: s3.ist@eumetsat.int
(s3.sst@eumetsat.int)
 - Feedback is welcomed
- L3 IST implemented:
 - To be provided (through WEkEO): Q4/2022
- Next
 - Product validation (IST/Cloudmask MDB + L3), prototype improvement, monitoring (Q4 2022/2023)
 - Operational implementation and reprocessing (Q4 2024/2025)



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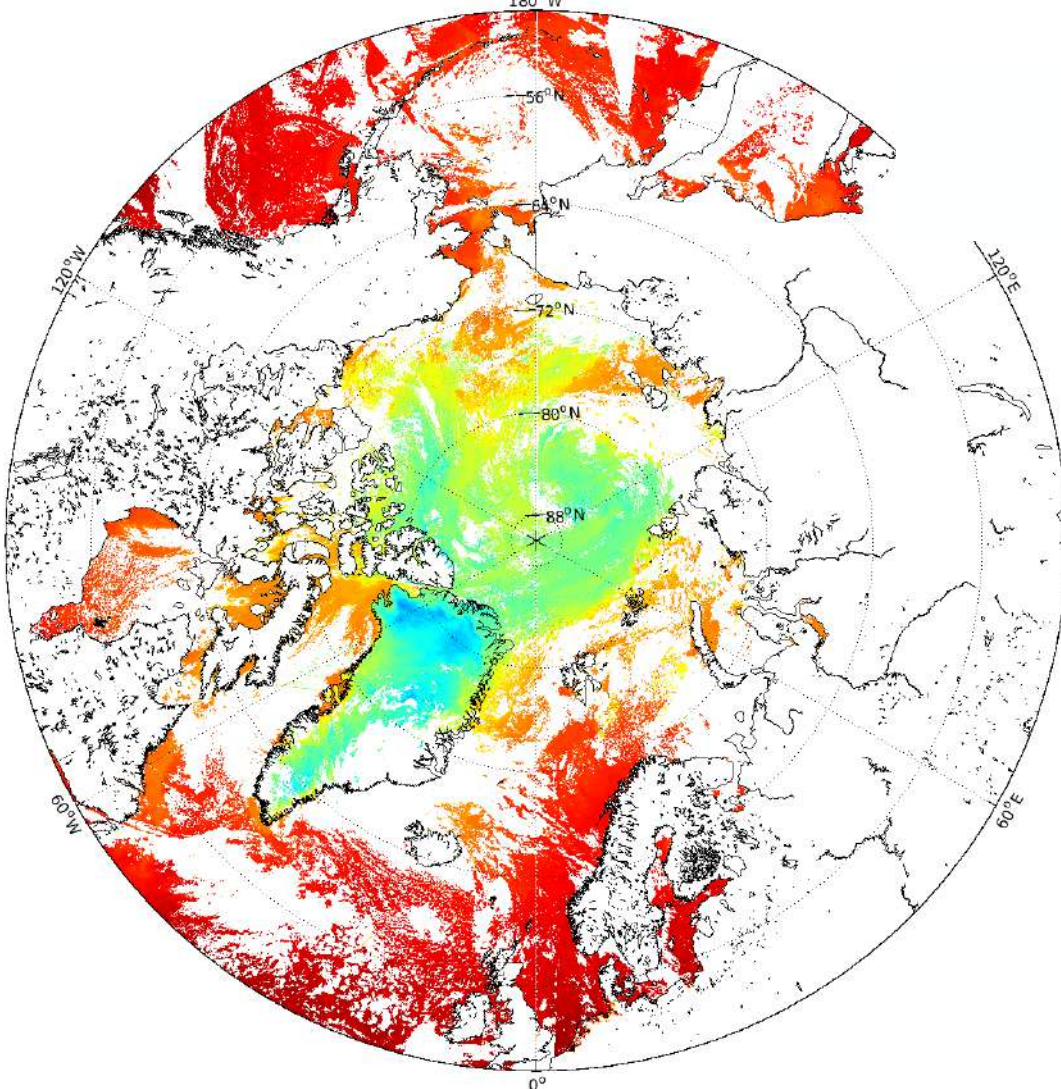
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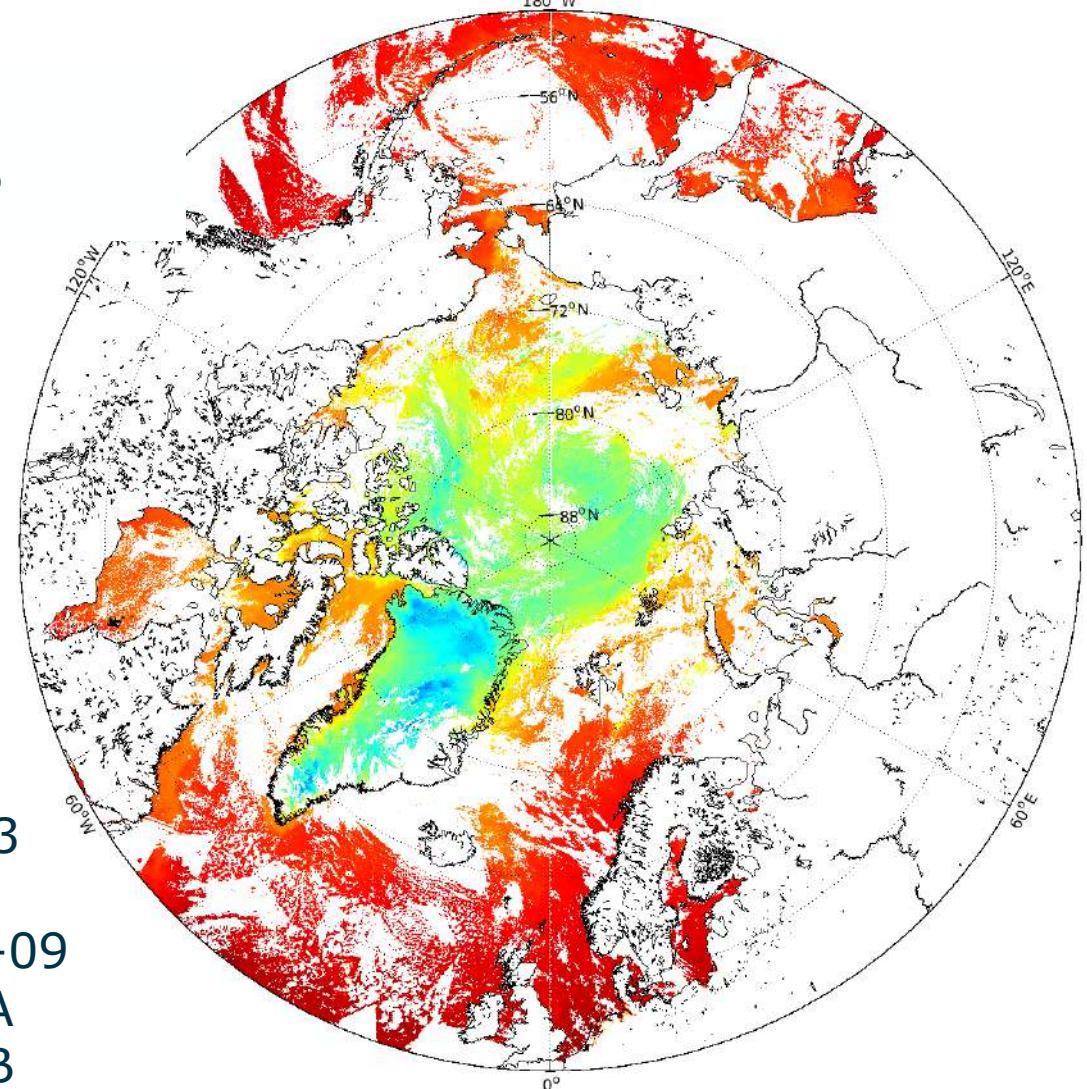
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20221001120000-EUM-L3C_GHRSSST-SSTskin-SLSTRA-NH_sst_ist_050-v02.0-fv01.0
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20221001120000-EUM-L3C_GHRSSST-SSTskin-SLSTRB-NH_sst_ist_050-v02.0-fv01.0
f1_f2_v1surface_temperature_v2sea_surface_temperature
id:l2_v0.8_l3_vsunza_v0.2 period:24h



Thank you!
Questions?

IST Level 3
24h
2022/10/01-09
Left: S3A
Right: S3B

