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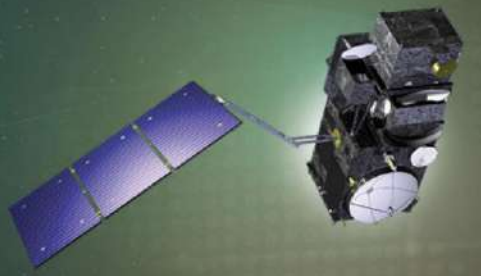


7th Sentinel-3 Validation Team Meeting 2022

18-20 October 2022 | ESA-ESRIN | Frascati (Rm), Italy

Status of Copernicus Sea-ice Surface Temperature Demonstrational Product

Igor Tomazic, Gary Corlett and Anne O'Carroll

EUMETSAT

Acknowledgment

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

DMI
Danish Meteorological Institute

- Steinar Eastwood (MET.NO/MET Norway)

Meteorologisk institutt

- Jean Francois Piollé (Ifremer/France)

RÉPUBLIQUE FRANÇAISE
Liberté
Égalité
Fraternité
Ifremer

+ whole IST prototype project team

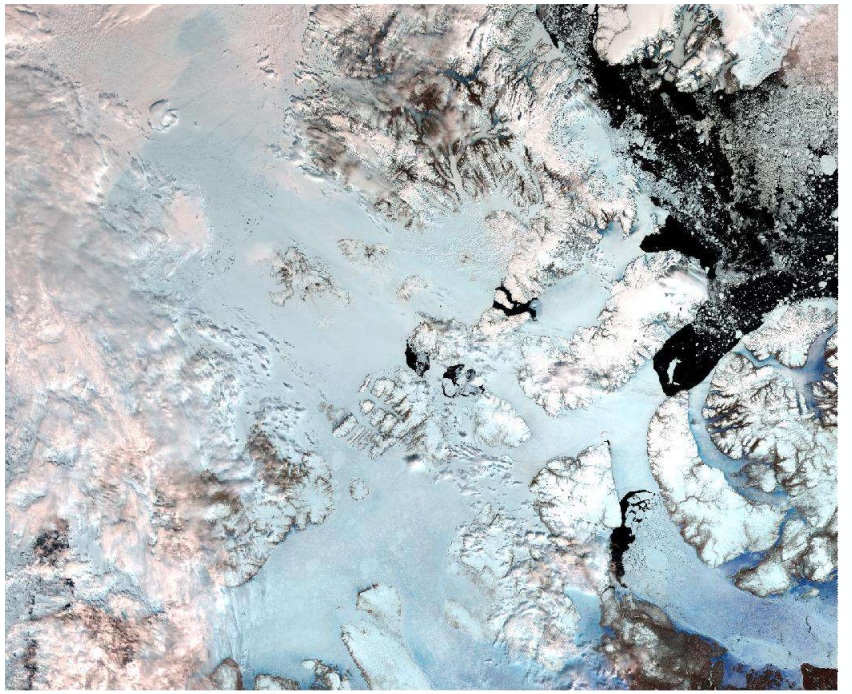
+ Sci4MaST project led by NOVELTIS

NOVELTIS

Content

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

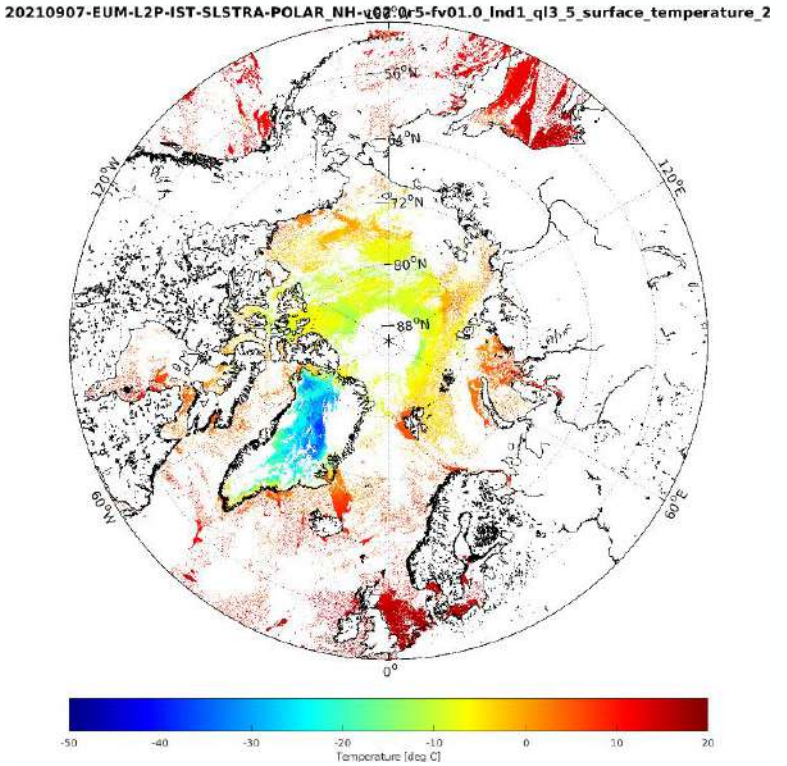
SLSTR IST prototype improvement, monitoring, validation within Sci4MaST project

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

  Further refinements in 2023

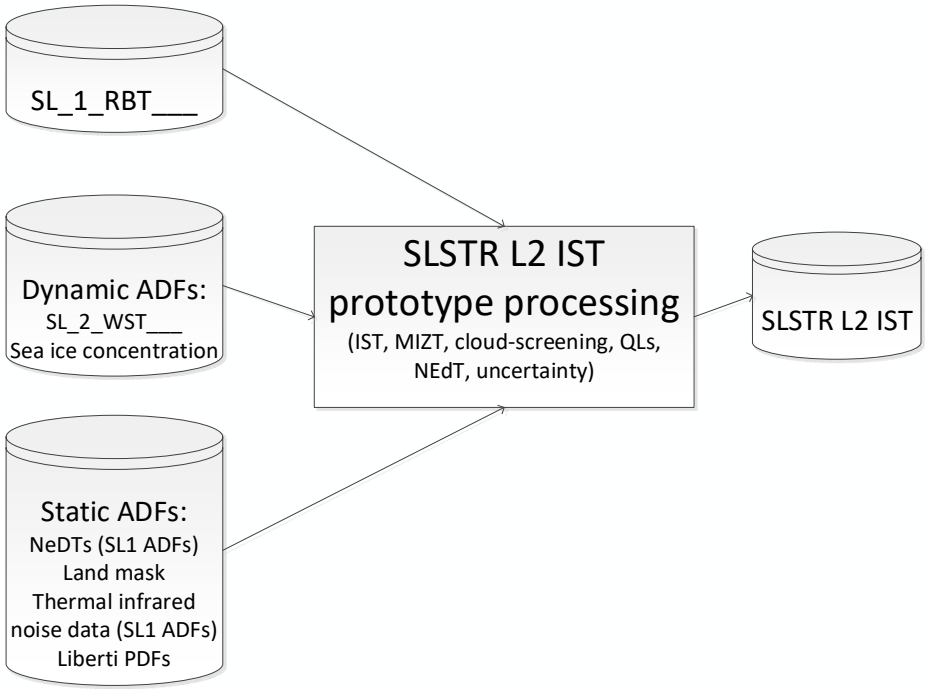


Sea-IST prototype: algorithm & processing

- Sea-IST algorithms $$IST2 = a_0 + a_1 Tb_{11nadir} + a_2 Tb_{12nadir} + a_3 \left((Tb_{11nadir} - Tb_{12nadir}) \left(\frac{1}{\cos\theta} - 1 \right) \right)$$

$$IST12 = a_0 + a_1 Tb_{11nadir} + a_2 Tb_{11oblique}$$

- MIZT algorithm: $$MIZT = 0.5*(Tb_{11nadir} - 268.95)*SST - 0.5*(Tb_{11nadir} - 270.95)*IST$$
- 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 (GHRSST): NH/SH, S3A/S3B



IST prototype information/documentation

SLSTR IST algorithm study

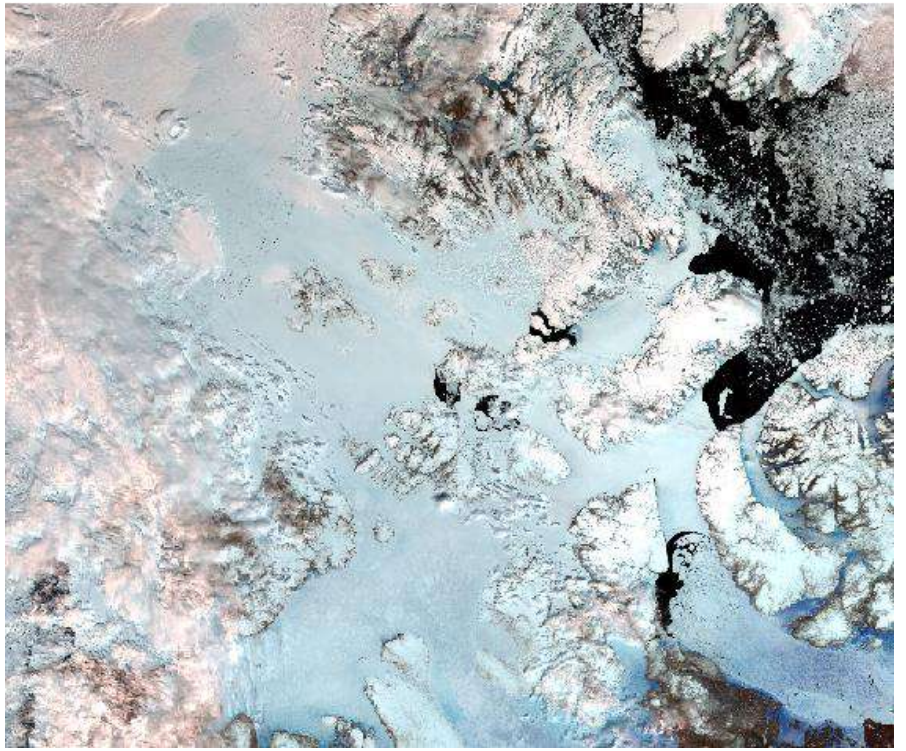
ATBD for SLSTR IST

Product validation plan

IST prototype product specification (PSD)

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

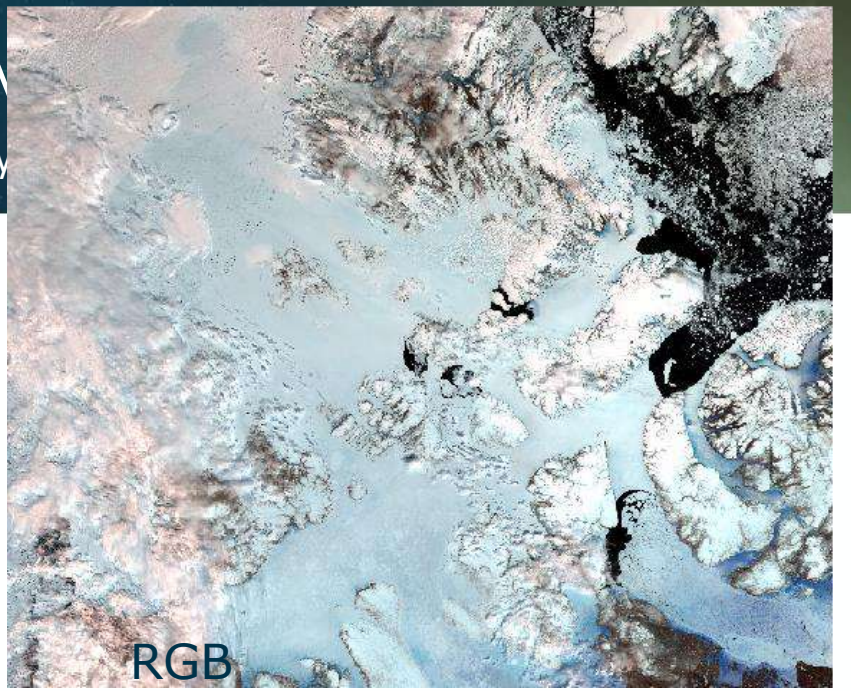


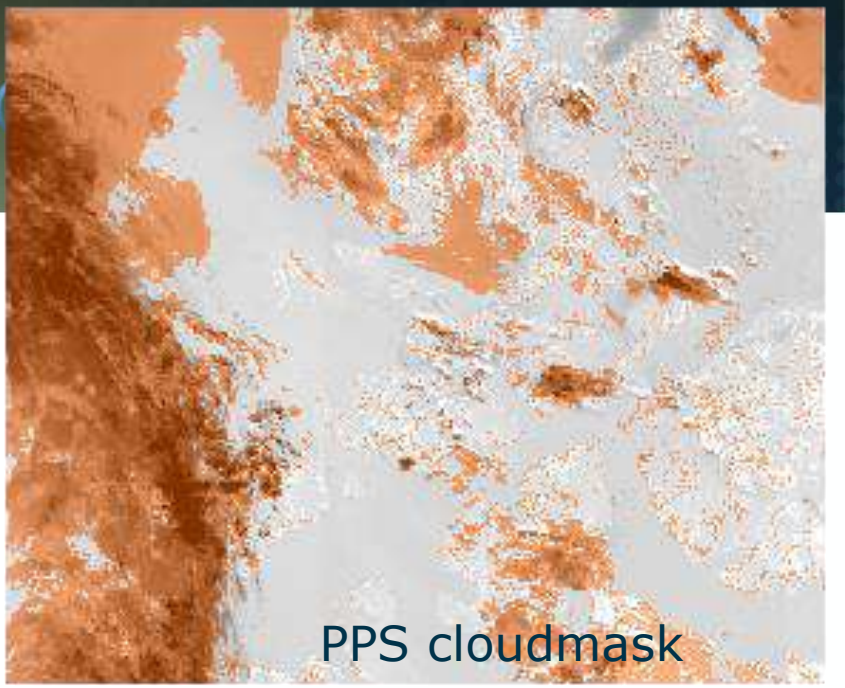
Example scene:

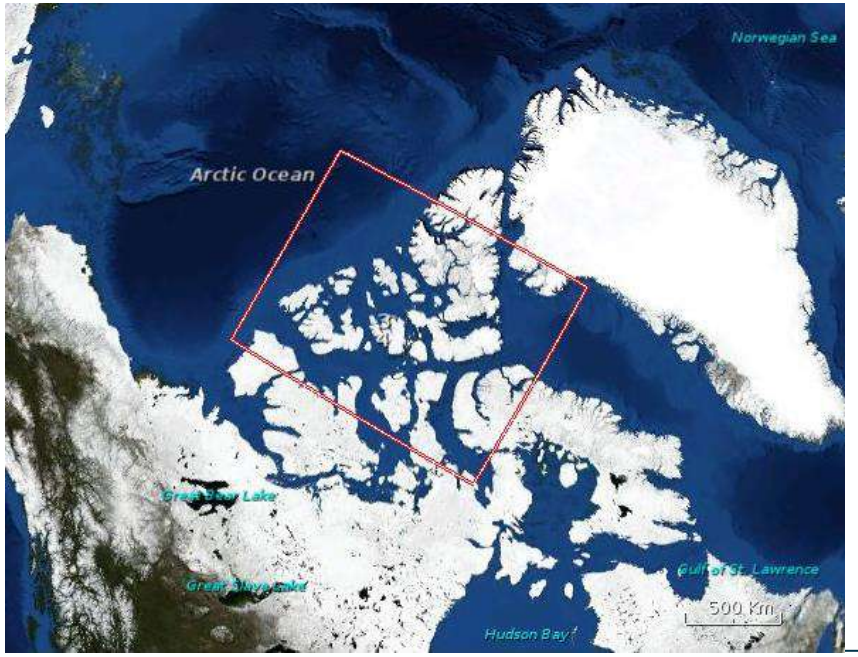
SLSTR-A

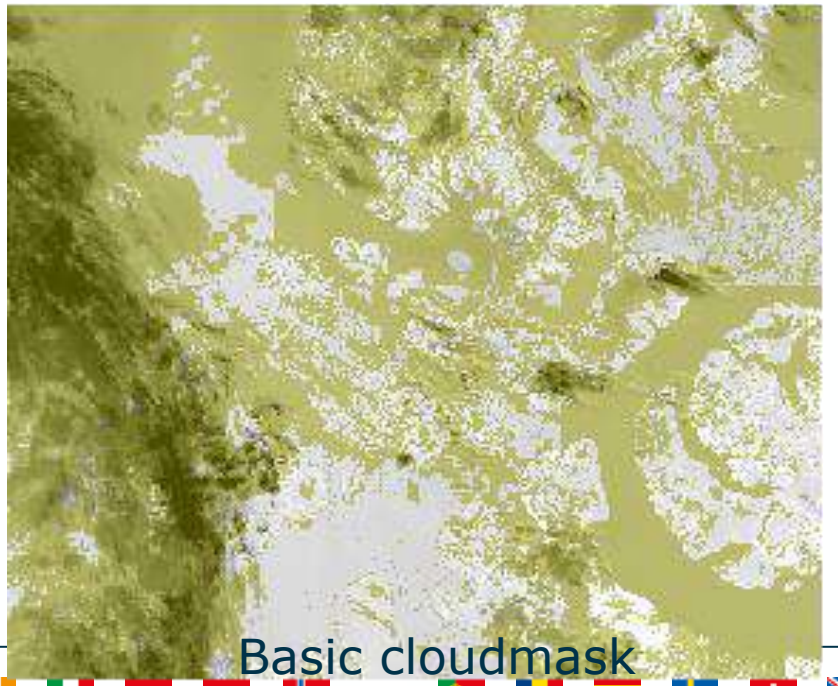
20220618181757

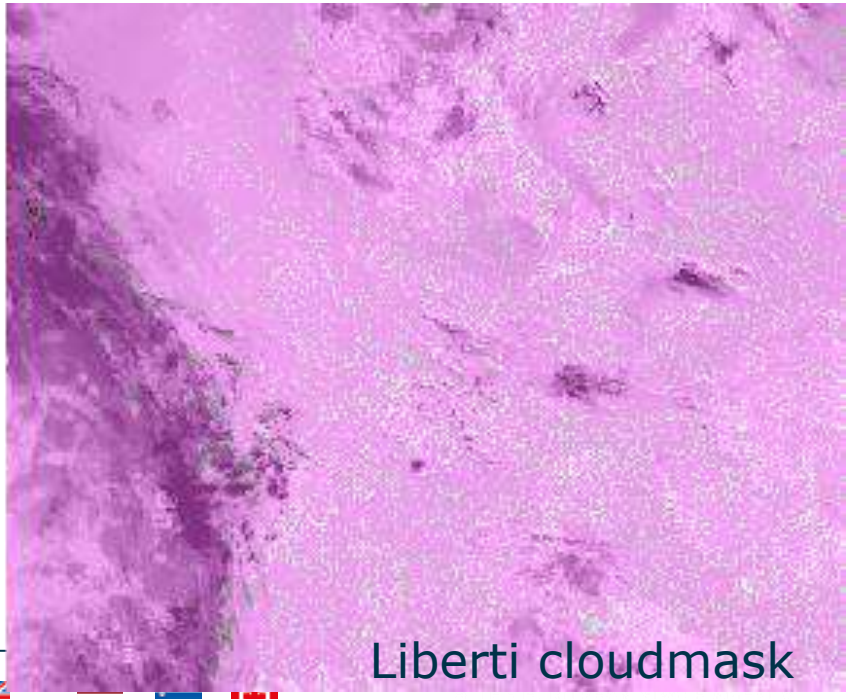
Nadir view









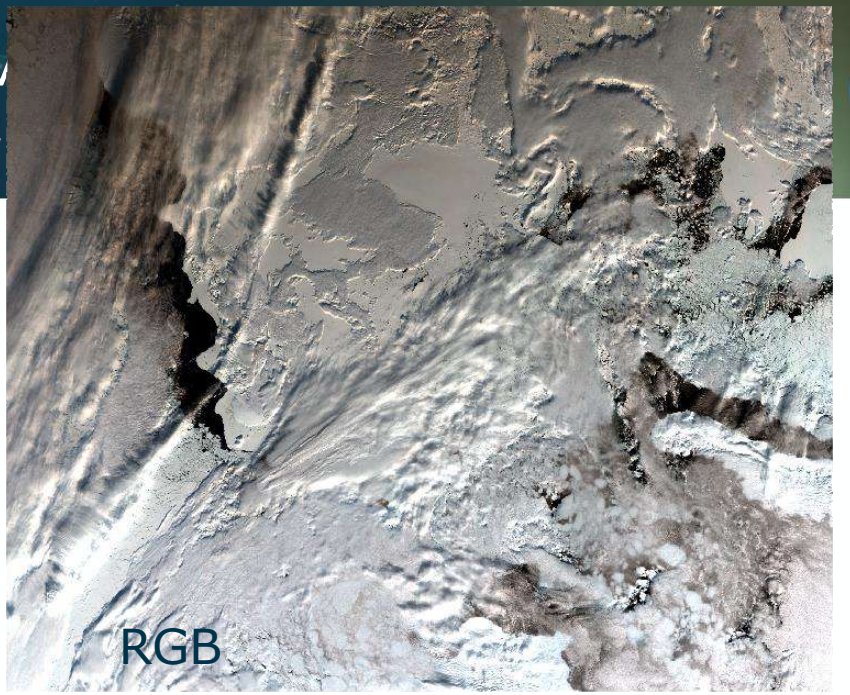


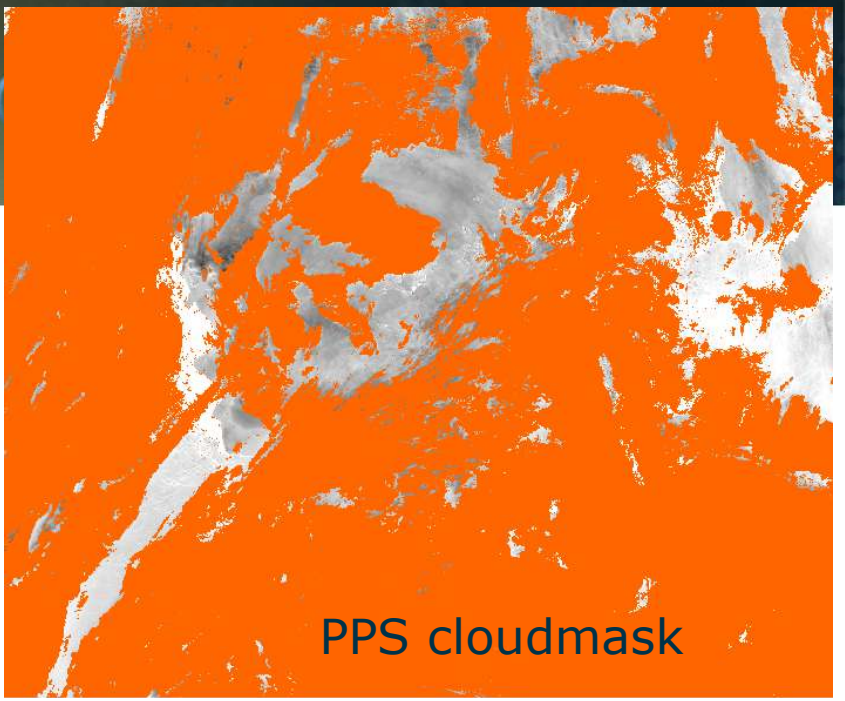
Example scene:

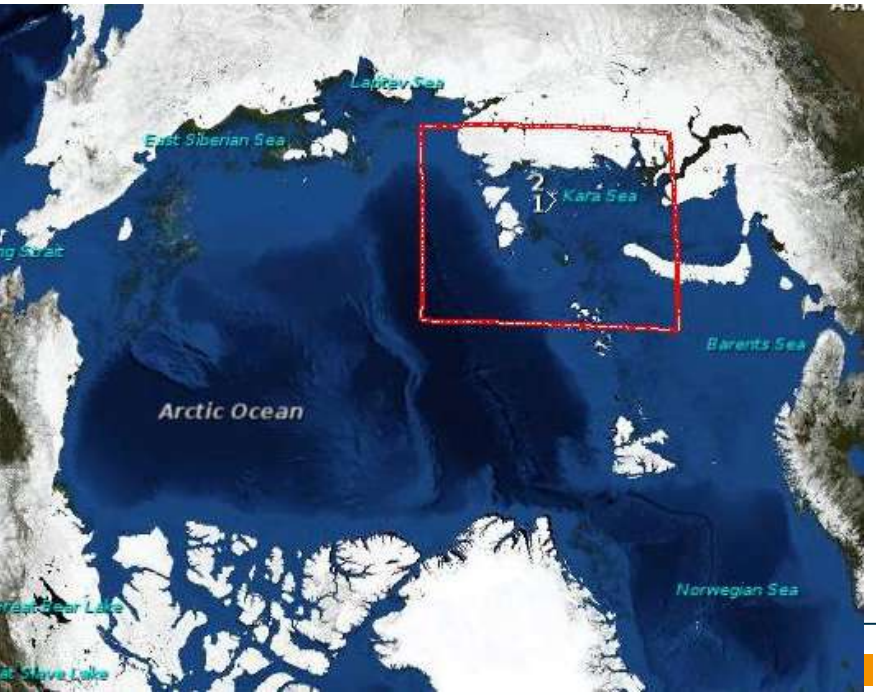
SLSTR-B

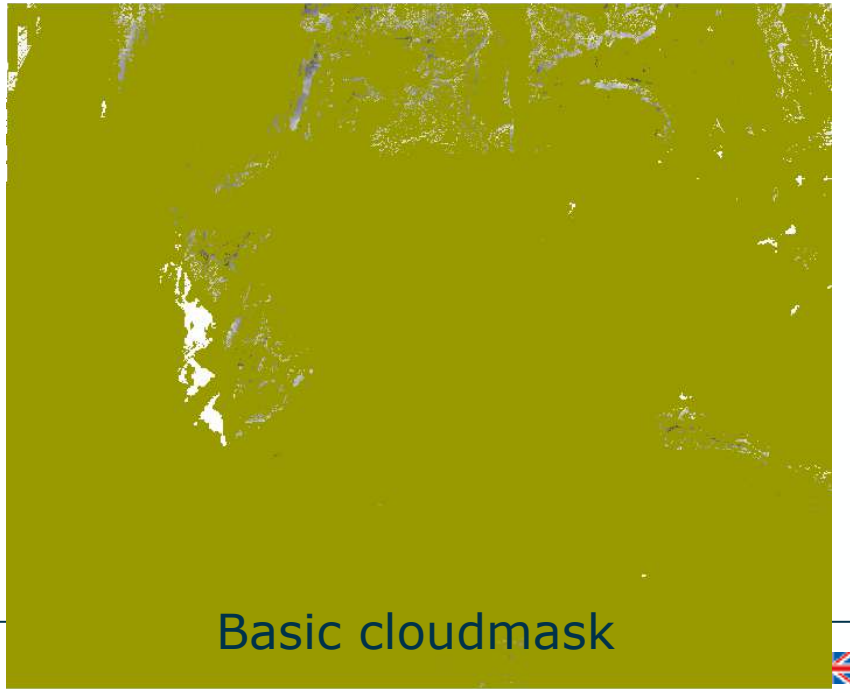
20210517140300

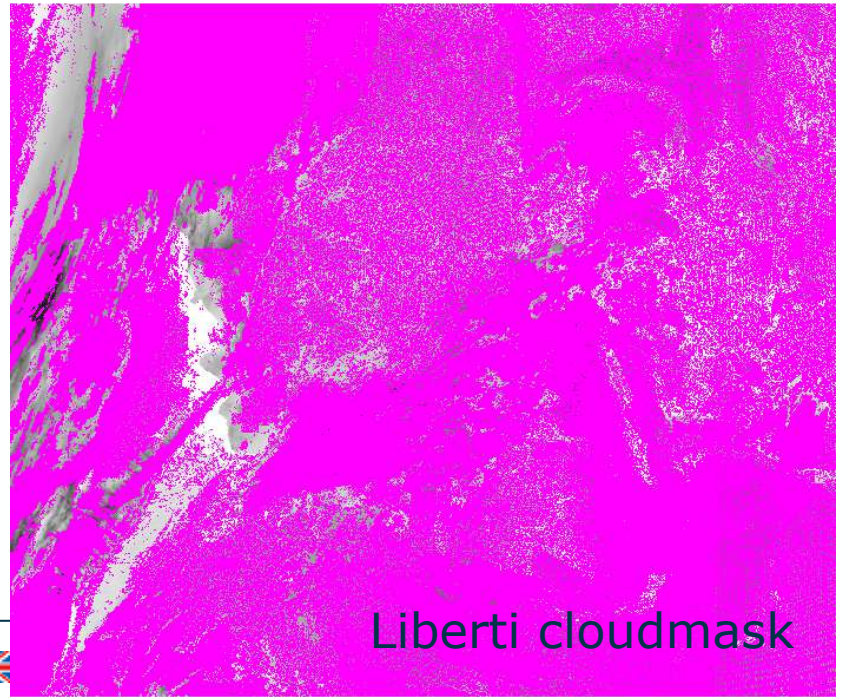
Nadir view







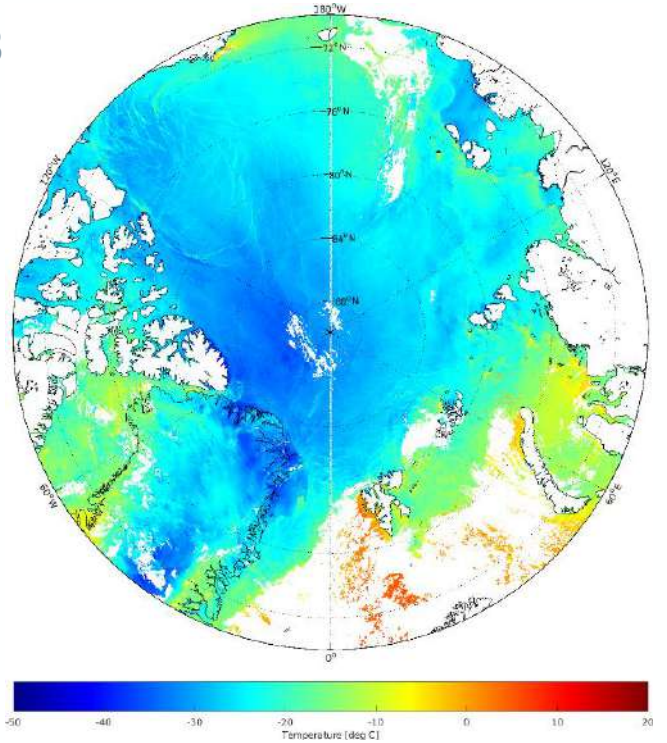




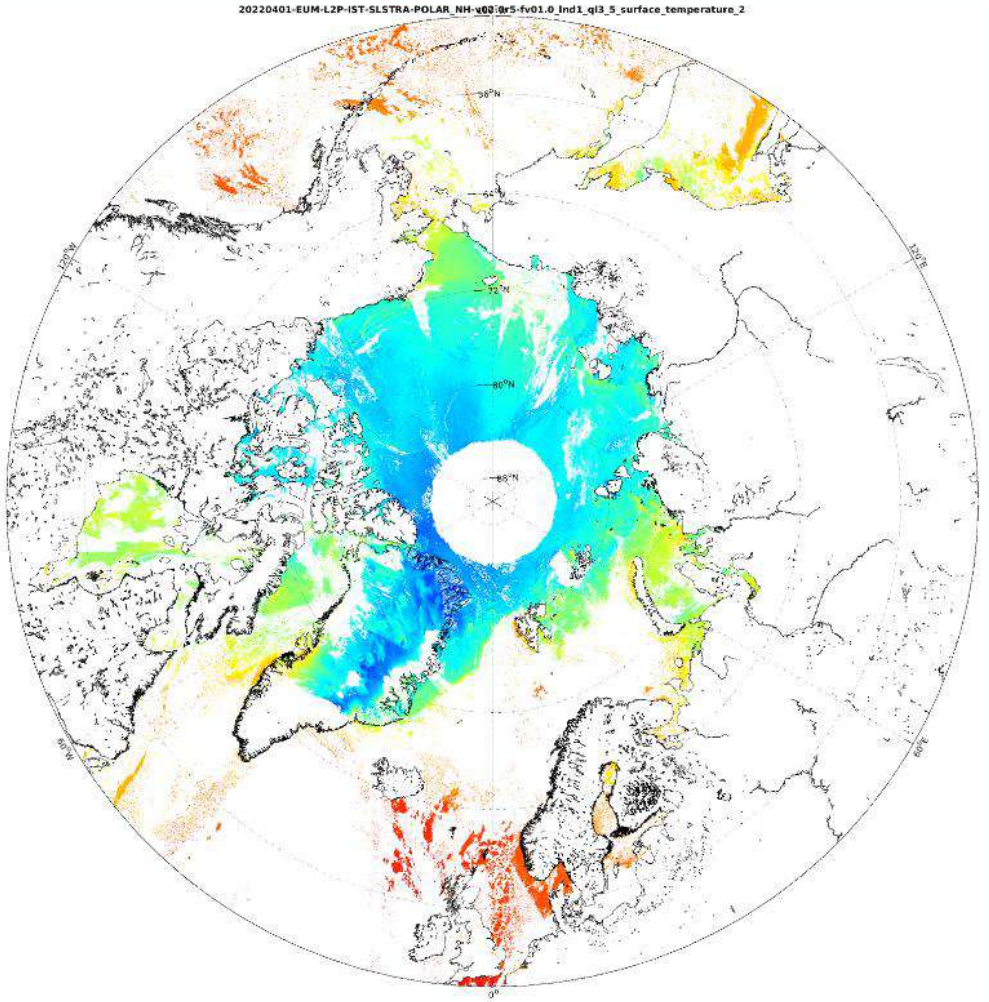
IST Level 3

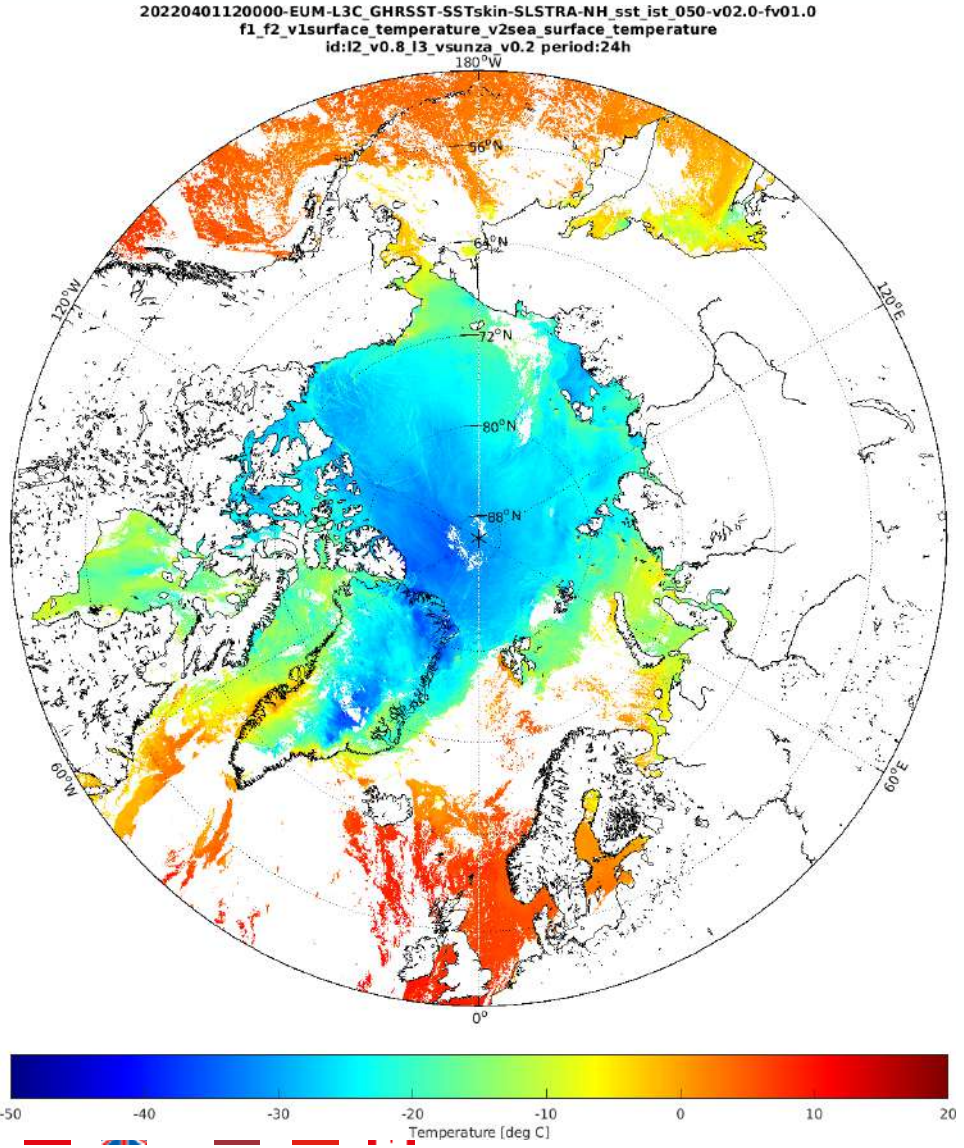
Implemented using OSI-SAF/Met.no L3 processor

- 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

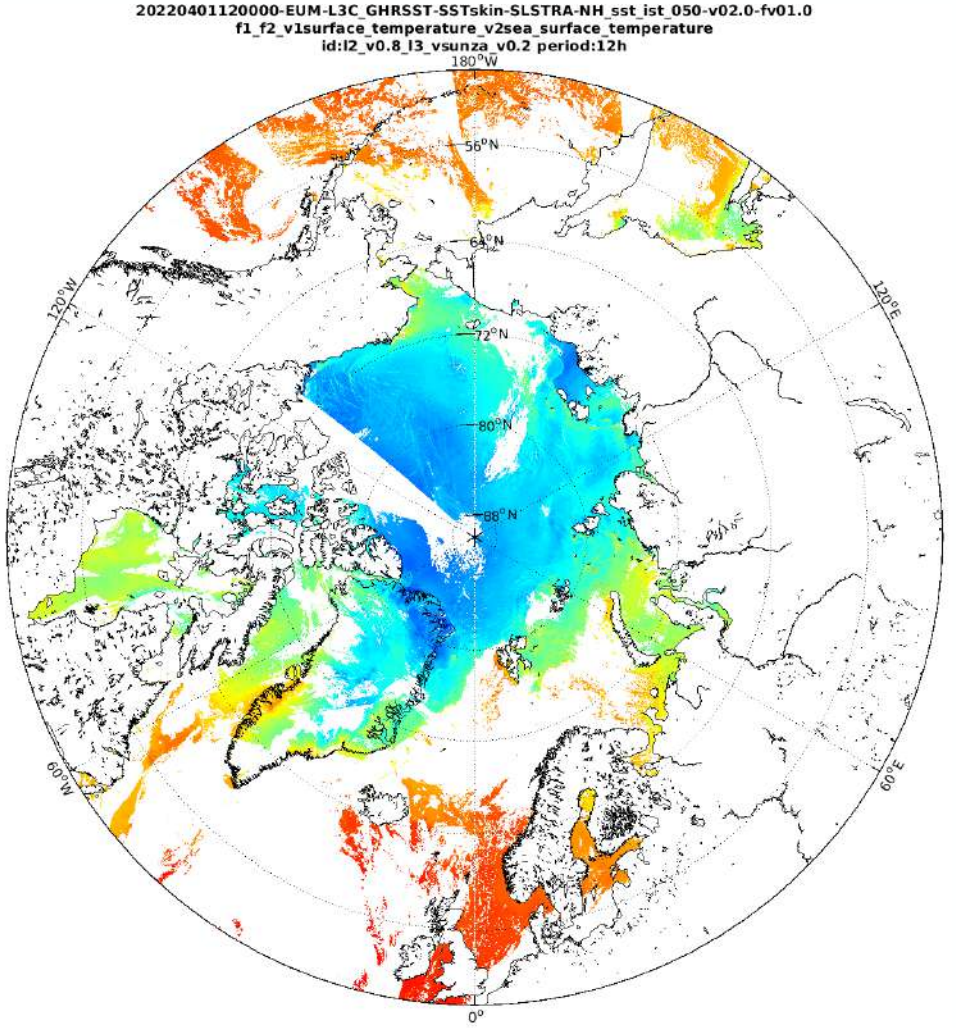


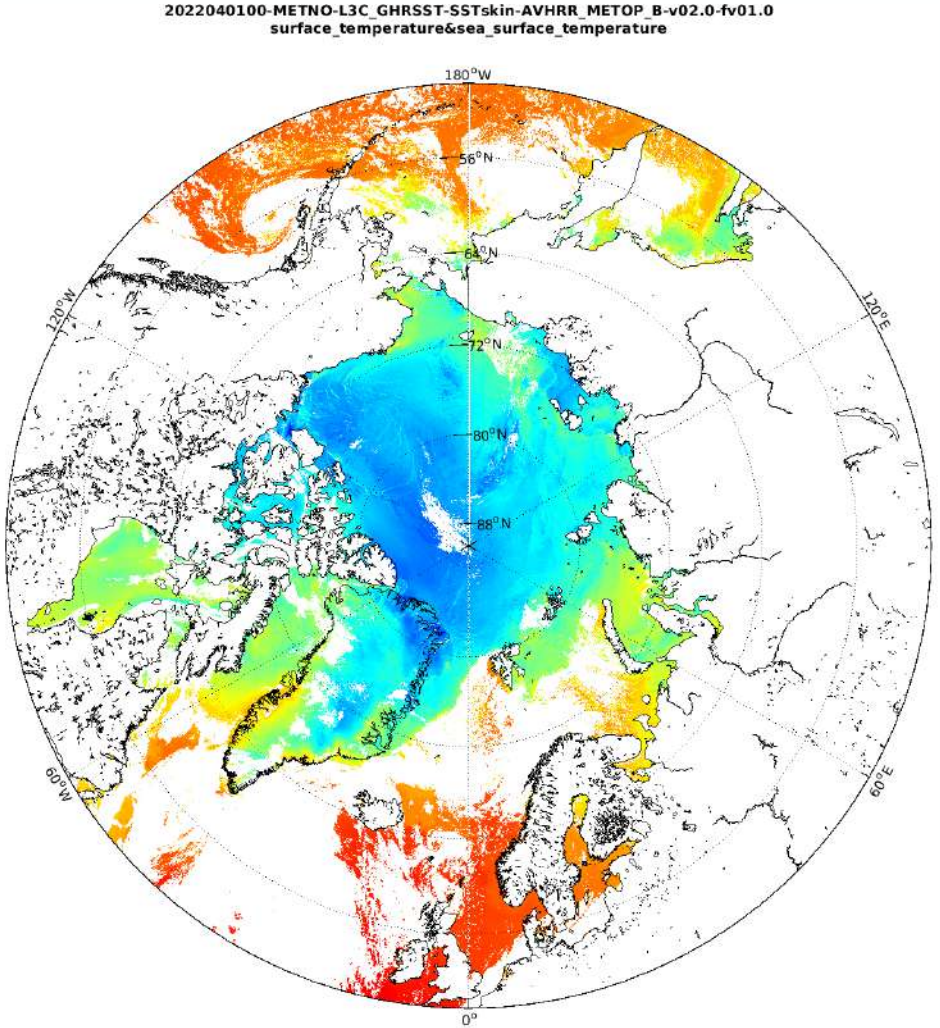
SLSTR-A IST Level 3:
01/04/2022:
left: Liberti/basic cloudmask
right: PPS cloudmask





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



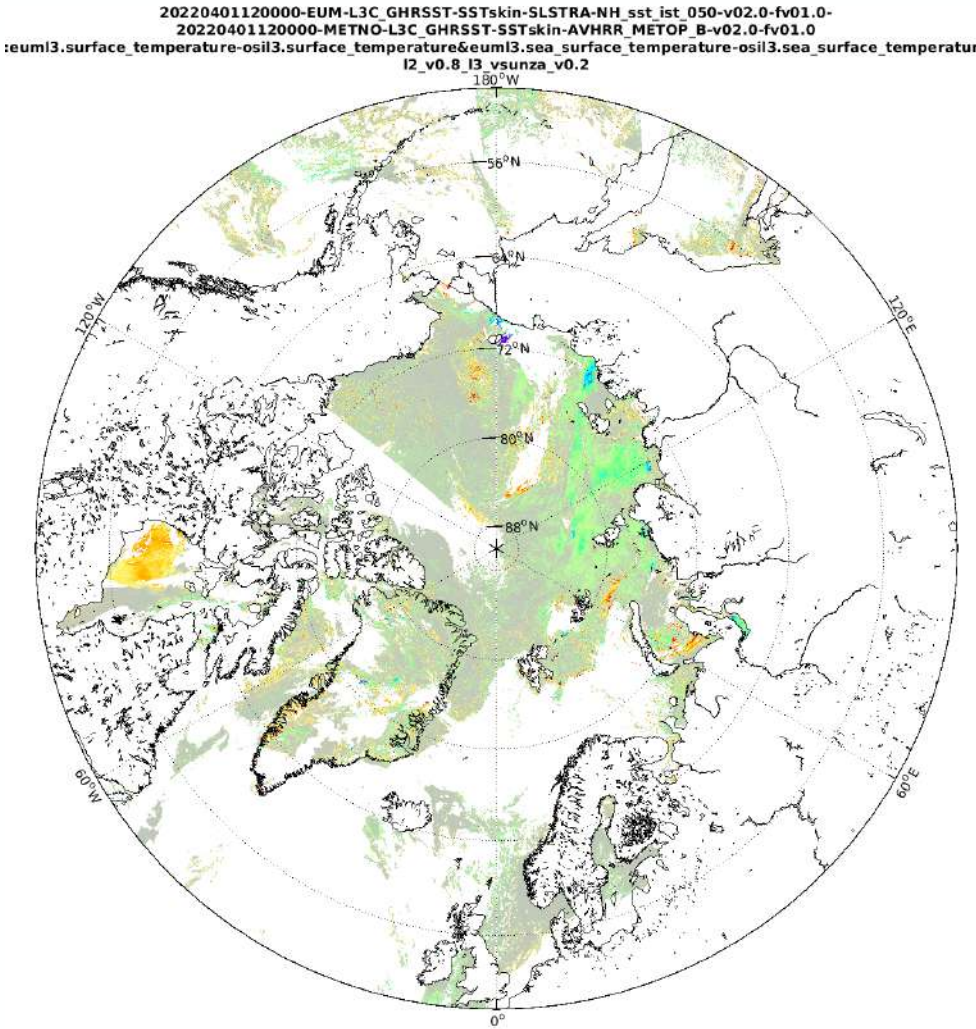


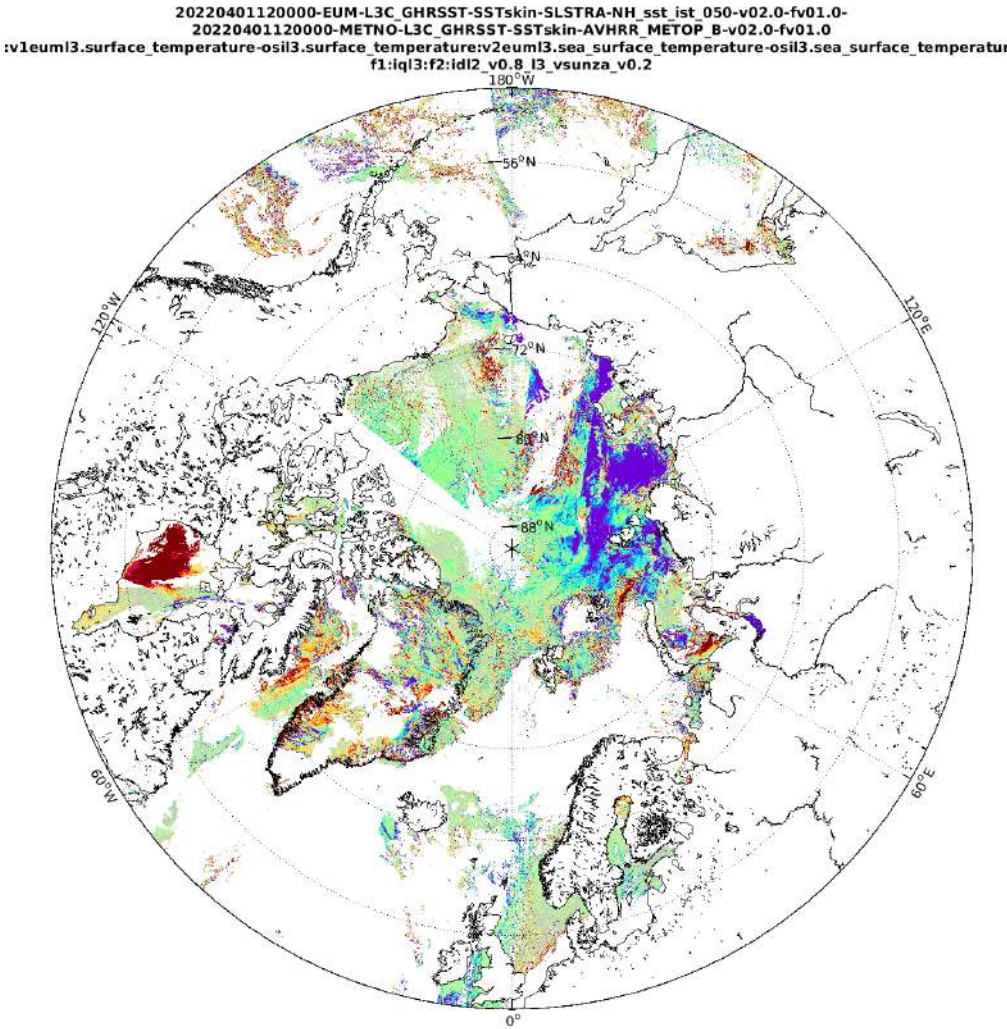
IST Level 3 differences:

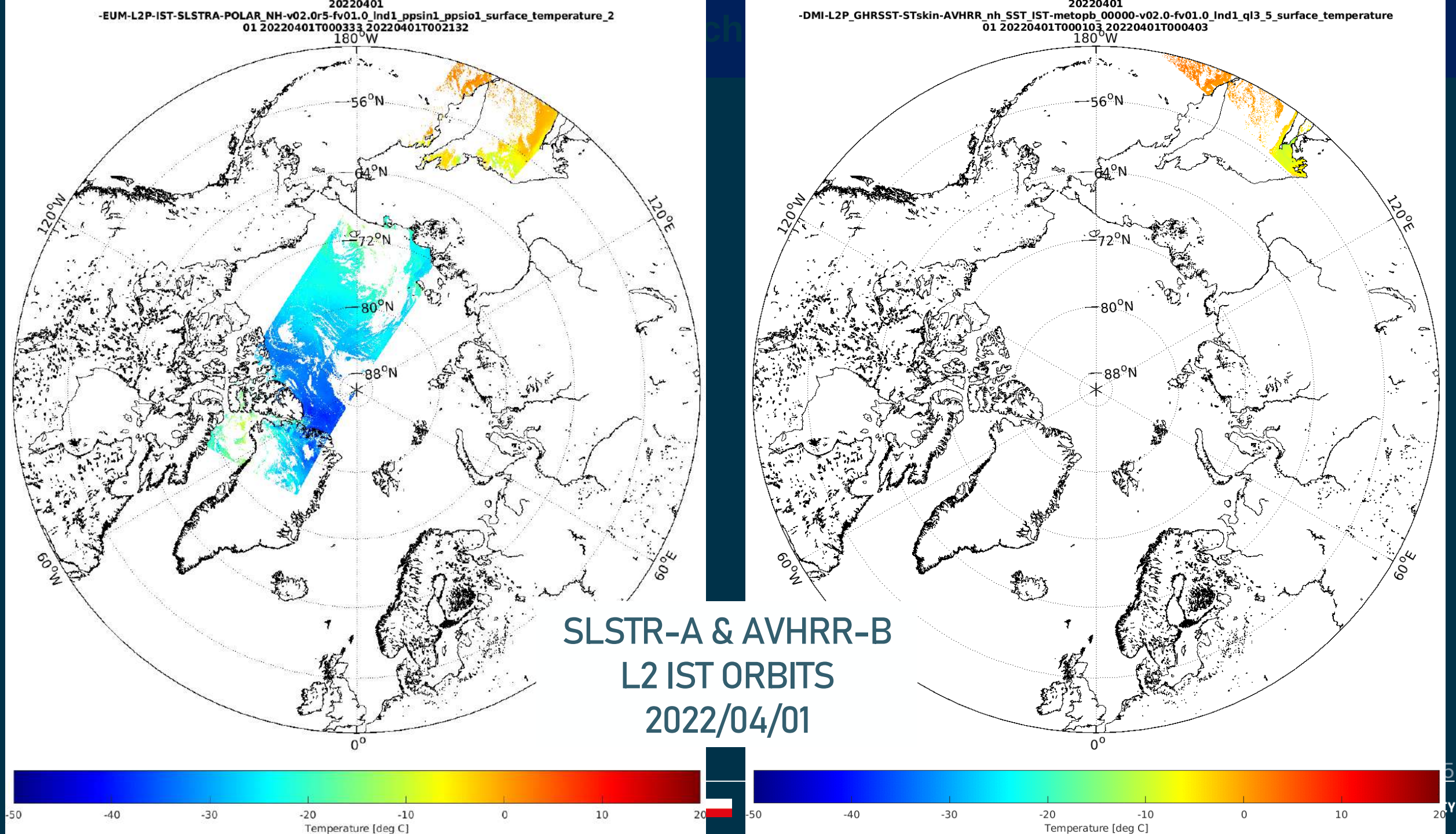
2022/04/01 12h
SLSTR-A IST&SST vs AVHRR-B IST&SST

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



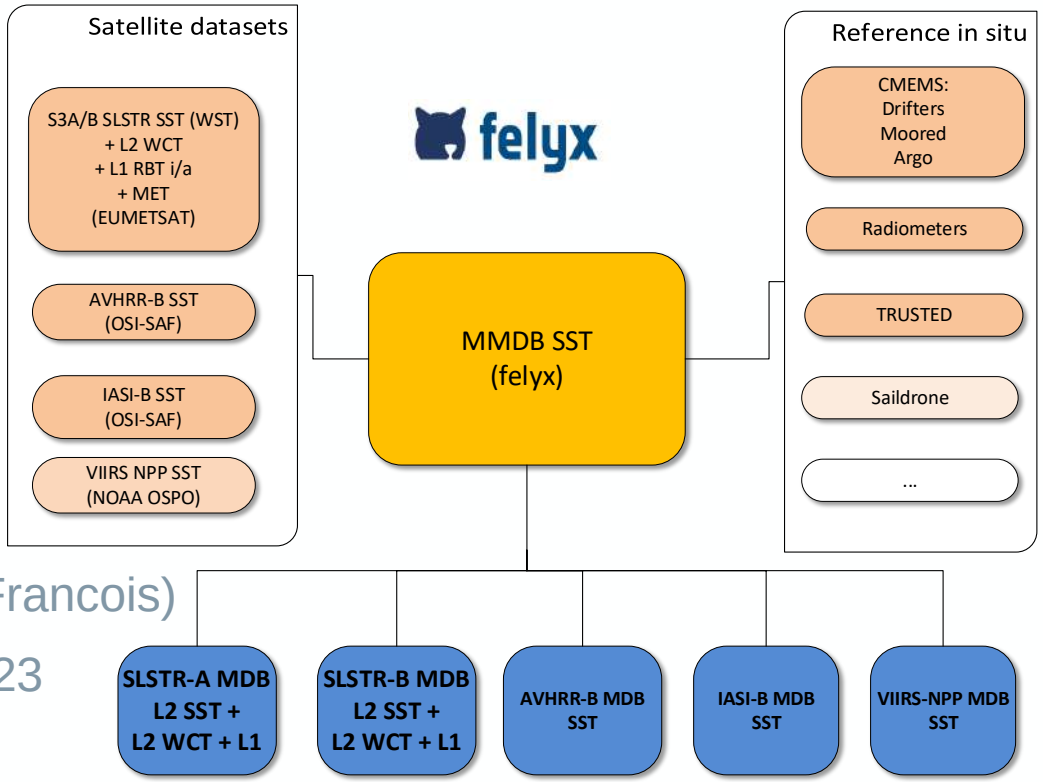




SLSTR-A & AVHRR-B
L2 IST ORBITS
2022/04/01

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

7th Sentinel 3 Validation Team Meeting 2022

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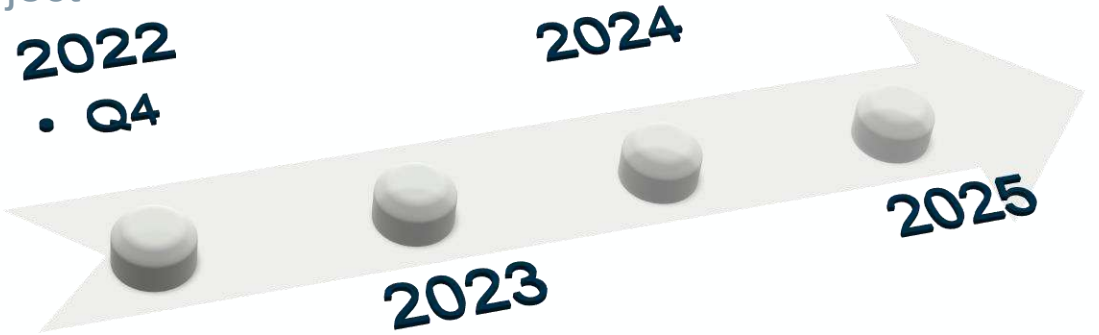
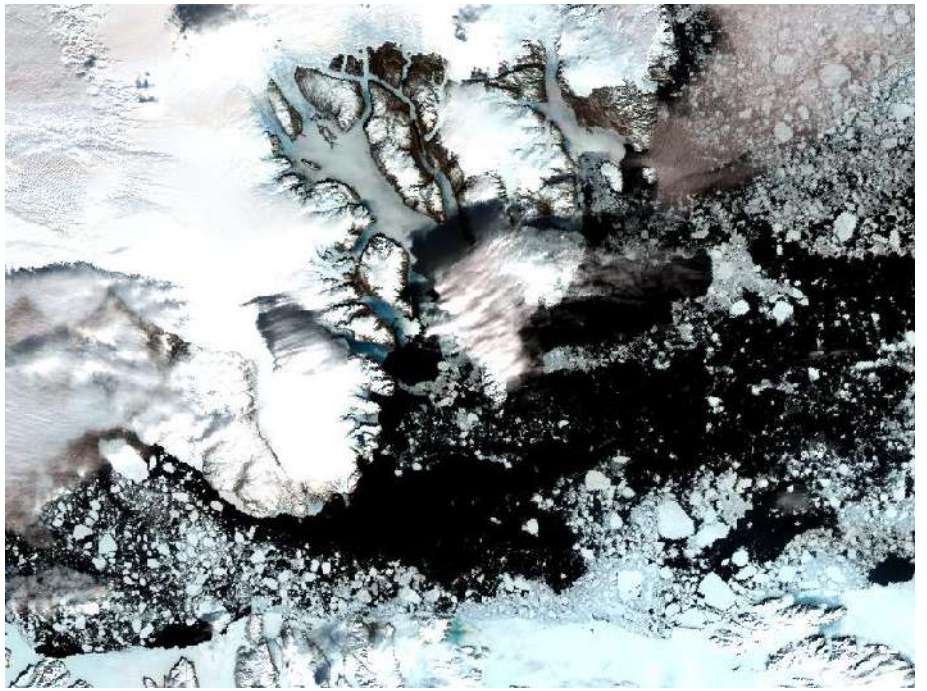
Next planned activities

- ~~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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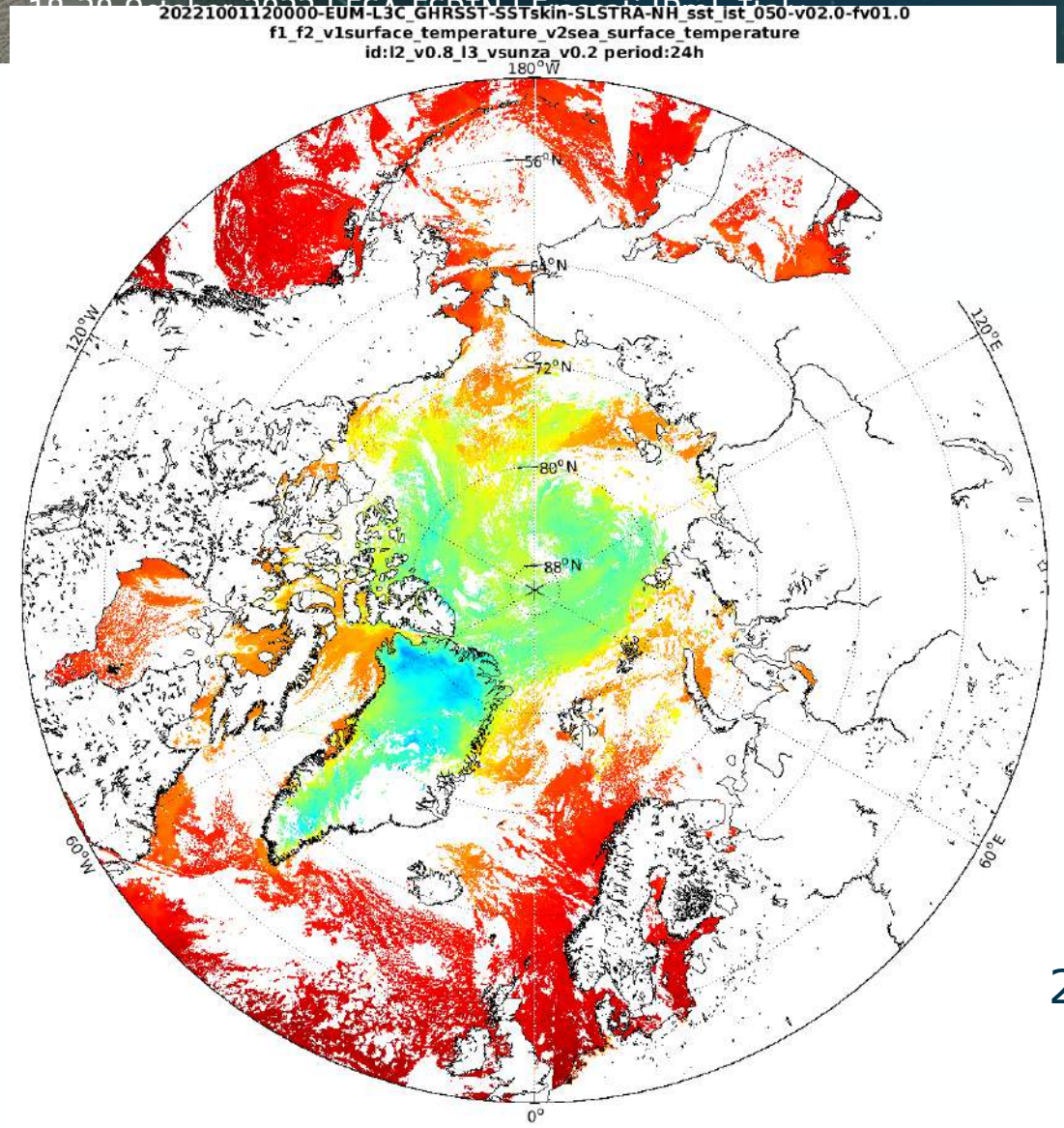

Thank you!
Questions?

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