



Sea ice from OSI SAF

EUMETTrain Snow Event Week, 10-02-2021
Steinar Eastwood, OSI SAF/MET Norway

Who am I

- Steinar Eastwood
- Senior Scientist in remote sensing at Norwegian Meteorological Institute
- Project leader for sea ice in EUMETSAT OSI SAF
- I am fortunate to live in a country with snow and ice since I love both :-)



Outline

- What is EUMETSAT OSI SAF
- Description of OSI SAF sea ice products
- Other relevant sea ice products
- Examples of use of OSI SAF sea ice products

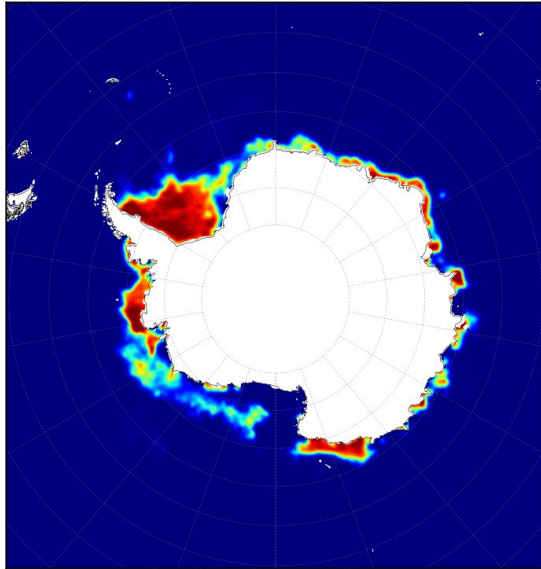
What is EUMETSAT OSI SAF

- OSI SAF = Ocean and Sea Ice Satellite Application Facility
- Part of EUMETSAT distributed ground segment for processing of satellite data
- 8 SAFs in total for different application areas, delivering products and software
- OSI SAF is a consortium of 5 partners, led by Meteo-France
- OSI SAF have delivered operational and climate products for sea ice, sea surface temperature, sea surface radiative fluxes and surface wind since 2002

Sea Ice Concentration

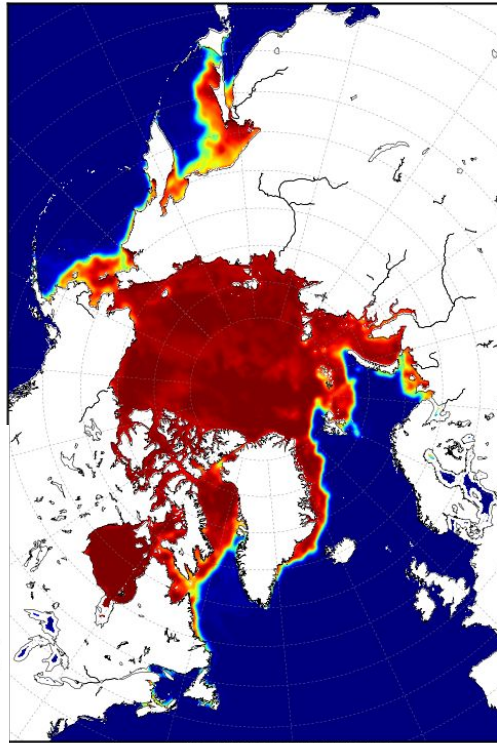
Sea Ice Concentration

Ice Concentration SH / 2021-02-01 12:00:00



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Ice Concentration NH / 2021-02-01 12:00:00

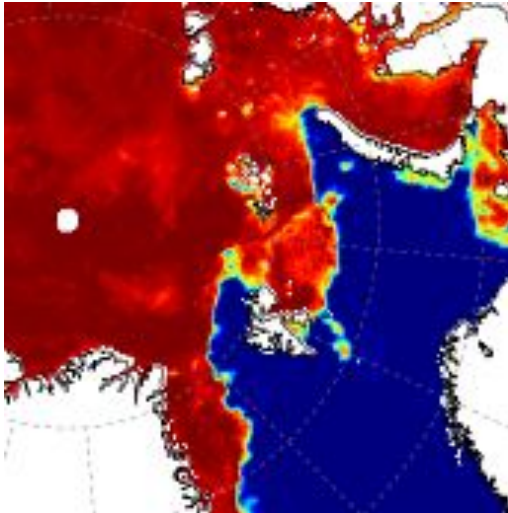


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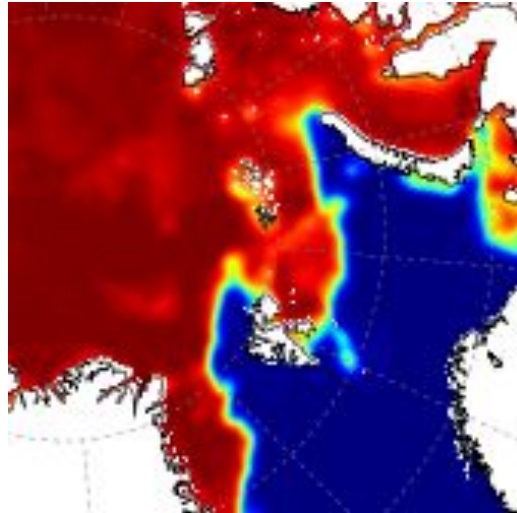
- Gives the fraction of sea covered by ice in percentage
- Uses passive microwave instruments from SSMIS and AMSR2 (19,37,85GHz, V+H polarization)
- PMW instruments are great in polar conditions as they see through clouds and do not depend on sunlight
- Both winter and summer, but less accurate during summer due to meltponds

Sea Ice Concentration

AMSR2



SSMIS



- Gives the fraction of sea ice covered by ice in percentage
- Uses passive microwave instruments from SSMIS and AMSR2
- AMSR2 gives more details than SSMIS due to smaller footprint (5-25km vs 13-50km)
- => Two products

Sea Ice Type and Edge

Sea Ice Type - How we define it

Differentiates between classes of different ice:

- **Multiyear ice [MYI]**
Ice that has survived *at least* one summer melting
 - older, less saline, more air pockets, stiffer
 - thicker, often more rough surface
- **First-year ice [FYI]**
Ice that has formed since last summer melting, also called “seasonal ice”
 - younger, more saline, more breakable/drift
 - generally thinner and more flat surface, but also contains ridges



MYI

Image courtesy www.nsidc.org

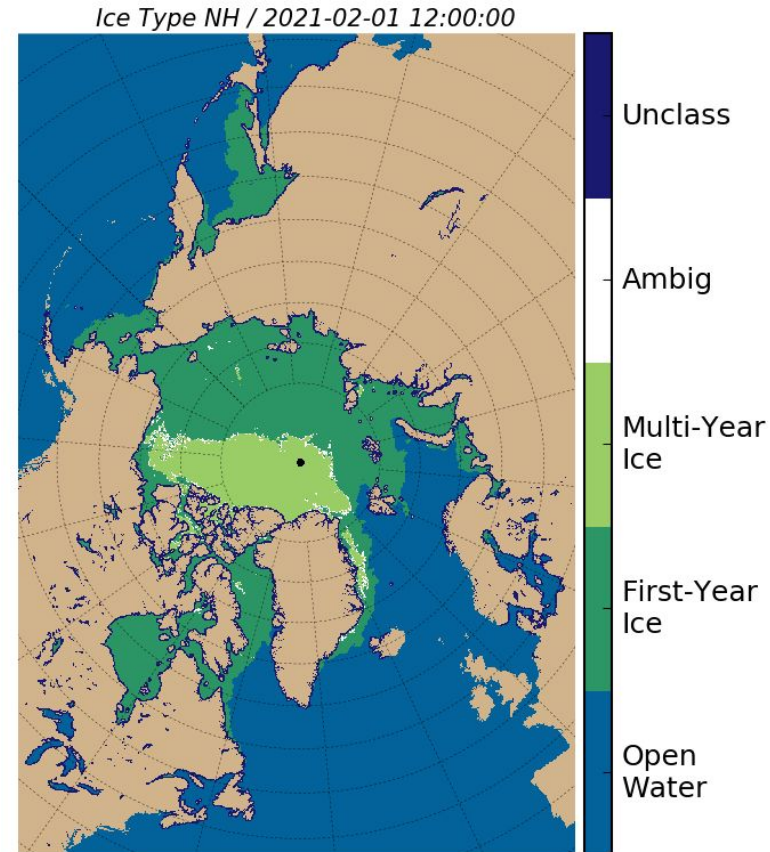


FYI

Sea Ice Type and Edge

Sea Ice Type and Edge are multi-sensor products:

- Combine different instruments to take advantage of the different sea ice characteristics these instruments observe
- We use AMSR2/SSMIS (=passive microwave) and ASCAT (=active microwave) instruments
- Differences:
 - emissivities
 - polarizations
 - sensitivity to air and salt water pockets in the ice etc

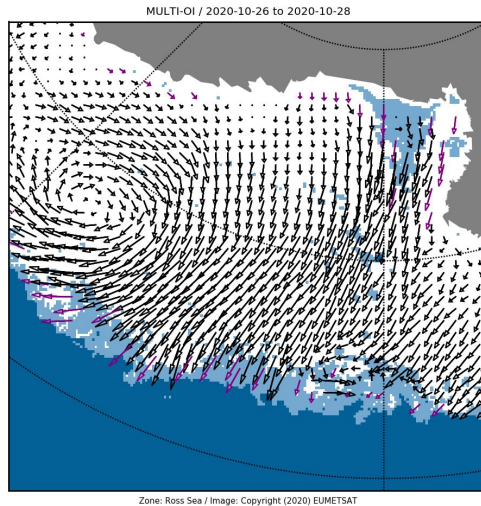
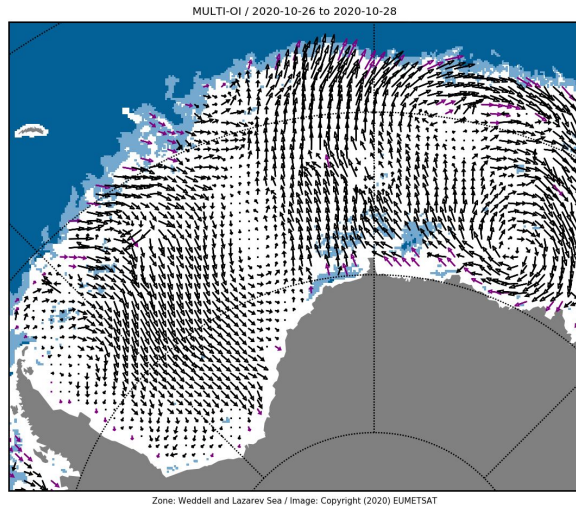
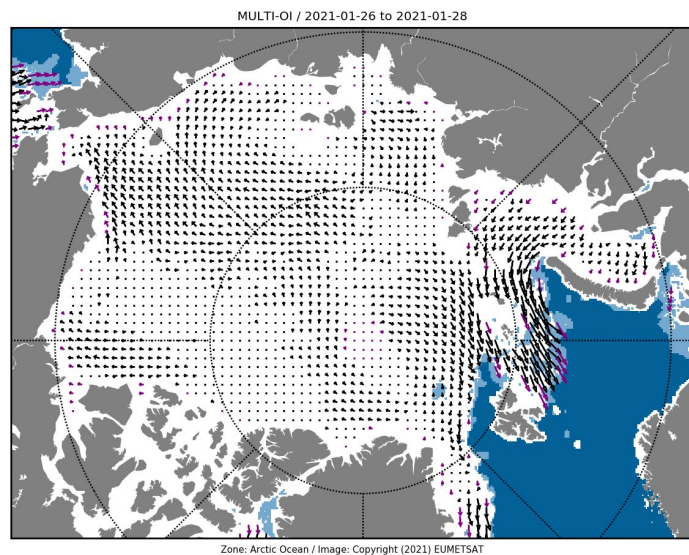


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Sea Ice Drift

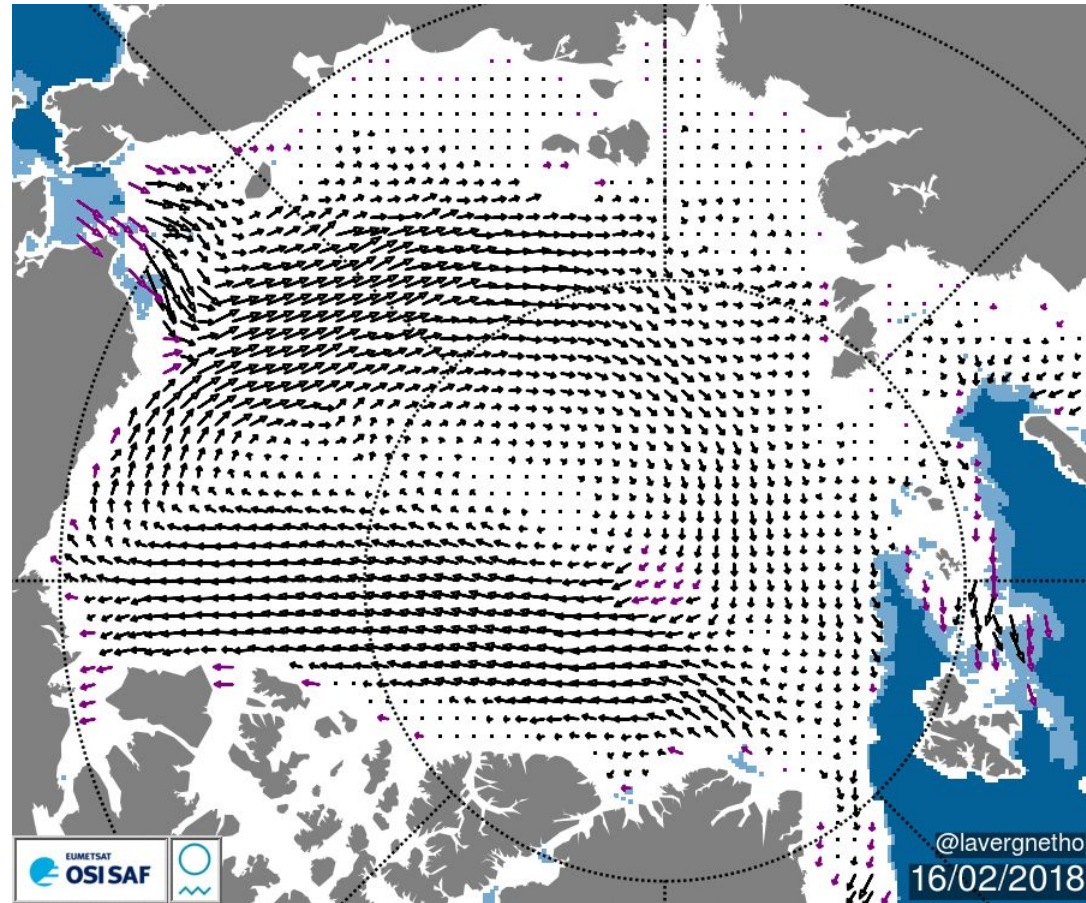
Sea Ice Drift

- Gives the sea ice displacement using cross-correlation between satellite data with 48 hour separation
- Ice drift caused by currents and weather patterns
- Combines several sensors: AMSR2, SSMIS, ASCAT
- Both winter and summer (less accurate during summer), with 62.5km grid
- Similar product also from optical data (AVHRR) with 25km grid, but limited by clouds



Sea Ice Drift

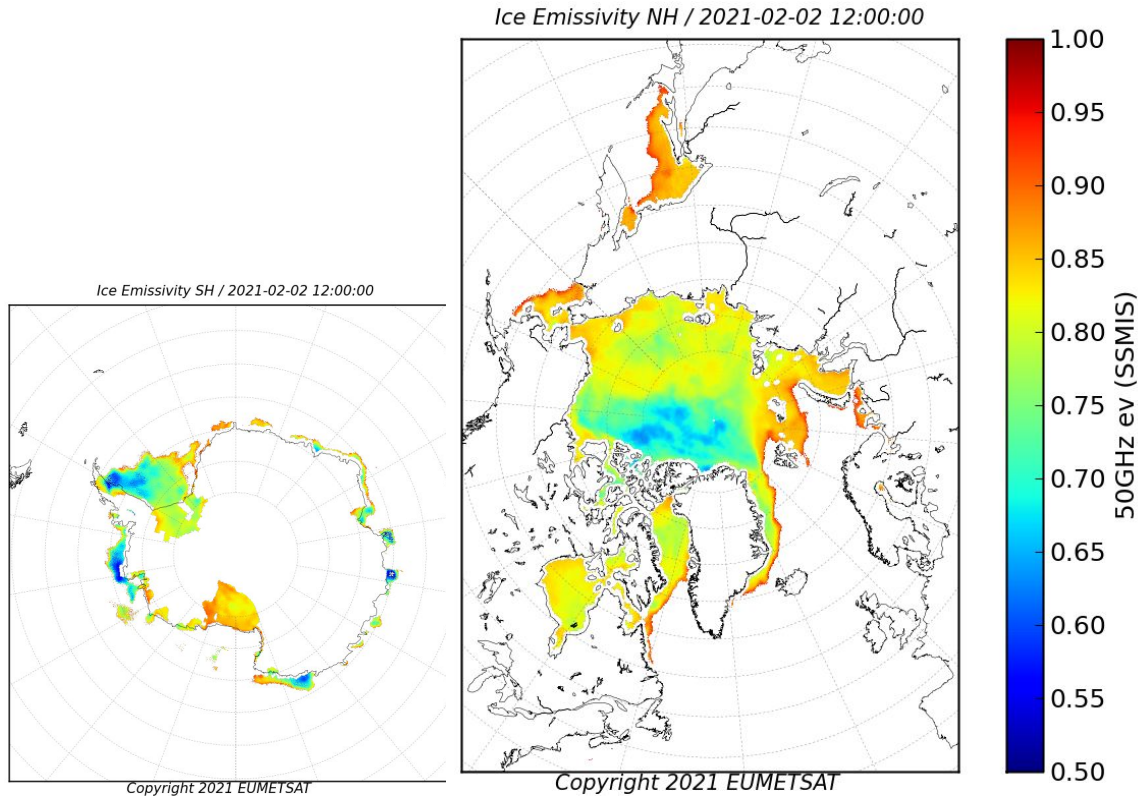
Opening of ice north of
Greenland in February 2018



Sea Ice Emissivity

Sea Ice Emissivity

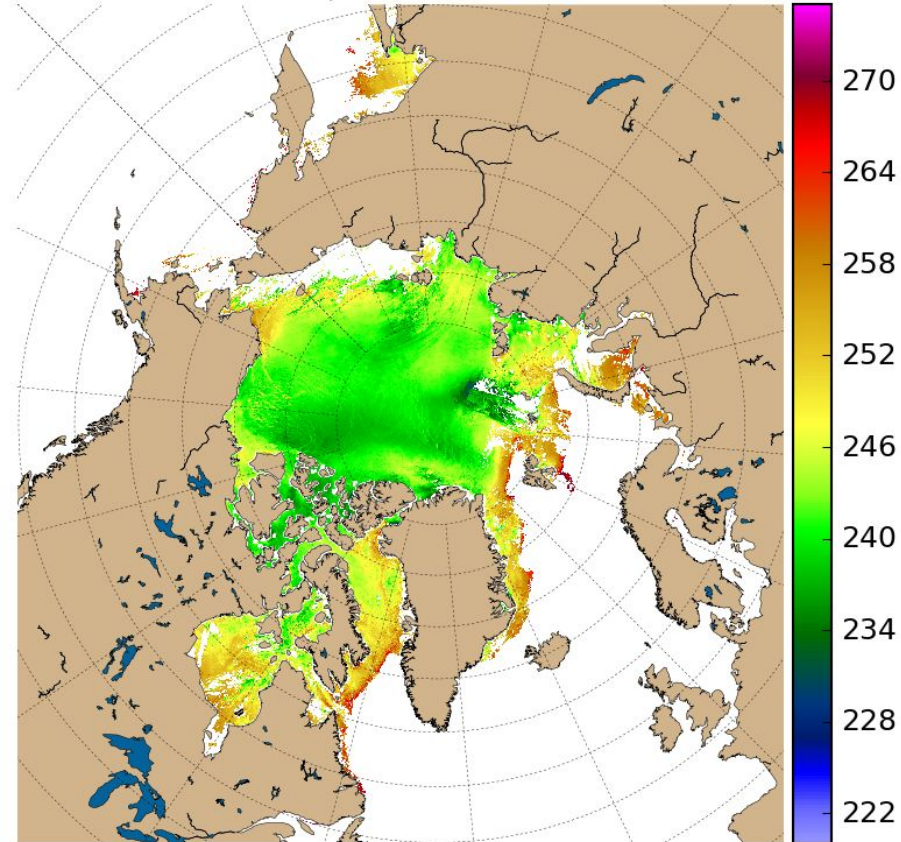
- Estimate of sea ice emissivity at 50GHz
- Main purpose is to use in data assimilation of PMW sounding instruments in NWP



Sea Ice Temperature

Sea Ice Temperature

IST HL / 2021-02-02 00:00:00



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- Use IR instruments (AVHRR and VIIRS) to estimate the temperature of the ice surface
- Only in cloud free conditions, as IR is absorbed by clouds
- So cloud masking is important for this product, and this can be a challenge during polar winter conditions
- Ice surface temperature changes faster than ice conc/type/drift, so we have products both for each satellite orbit and 12h averages

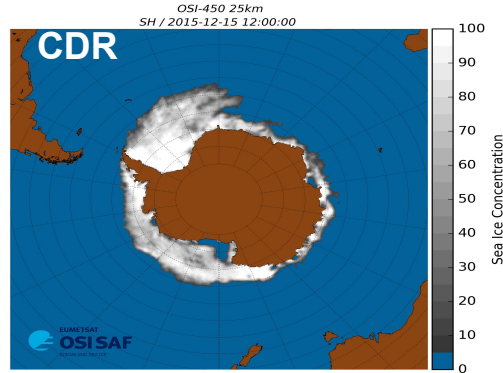
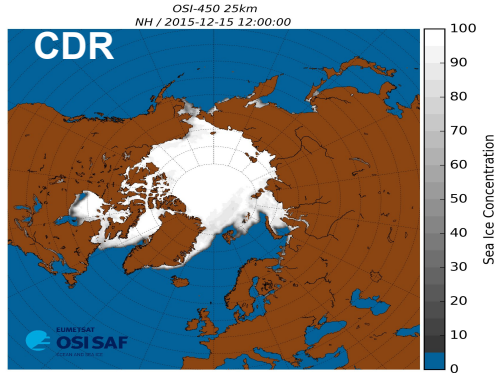
OSI SAF Sea Ice NRT products

- Delivered daily (at least) on polar stereographic grid and per swath
 - Ice Conc, Type, Edge, Emissivity: 10km grid size, centred on 12 UTC
 - Ice Drift: 62.5km
 - Ice Temperature: L3=5km, L2=0.75 and 1.1km
- Global coverage = NH + SH
- Delivered on NetCDF format
- Each product also comes with uncertainty estimates
- Timeliness: 2-5 hours
- Available through
 - FTP, <ftp://osisaf.met.no> and Thredds <https://thredds.met.no/thredds/osisaf/osisaf.html>
 - EUMETCast and EUMETSAT Data Center, <https://www.eumetsat.int>
- More information on <https://osi-saf.eumetsat.int>

Sea Ice Concentration Climate Data Records

Sea Ice Concentration - Seamless Climate Monitoring

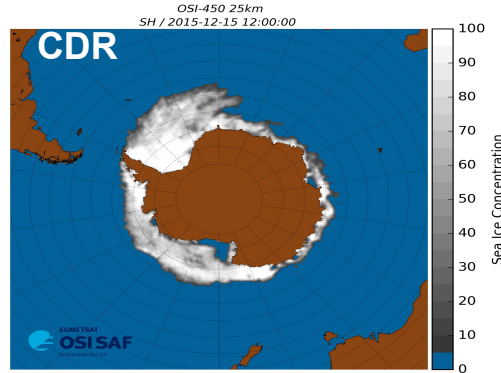
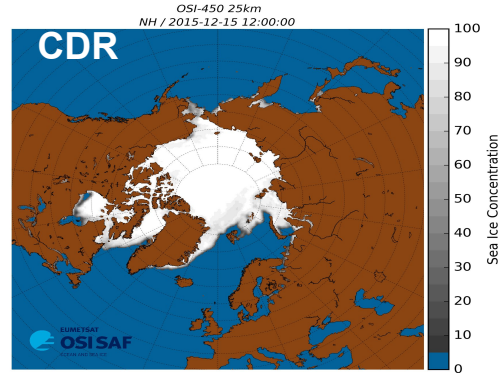
Climate Data Record,
1979 - 2015



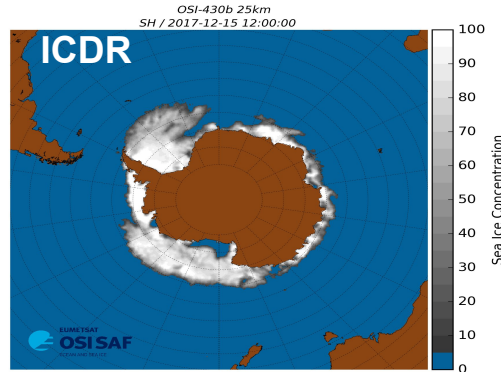
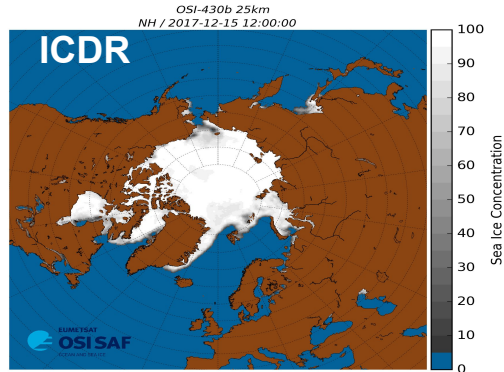
A *Climate Data Record* (CDR) is built from quality-checked and re-calibrated Fundamental CDR (FCDR) satellite data - and uses consistent algorithm.

Sea Ice Concentration - Seamless Climate Monitoring

Climate Data Record,
1979 - 2015



Interim CDR,
starts jan 2016

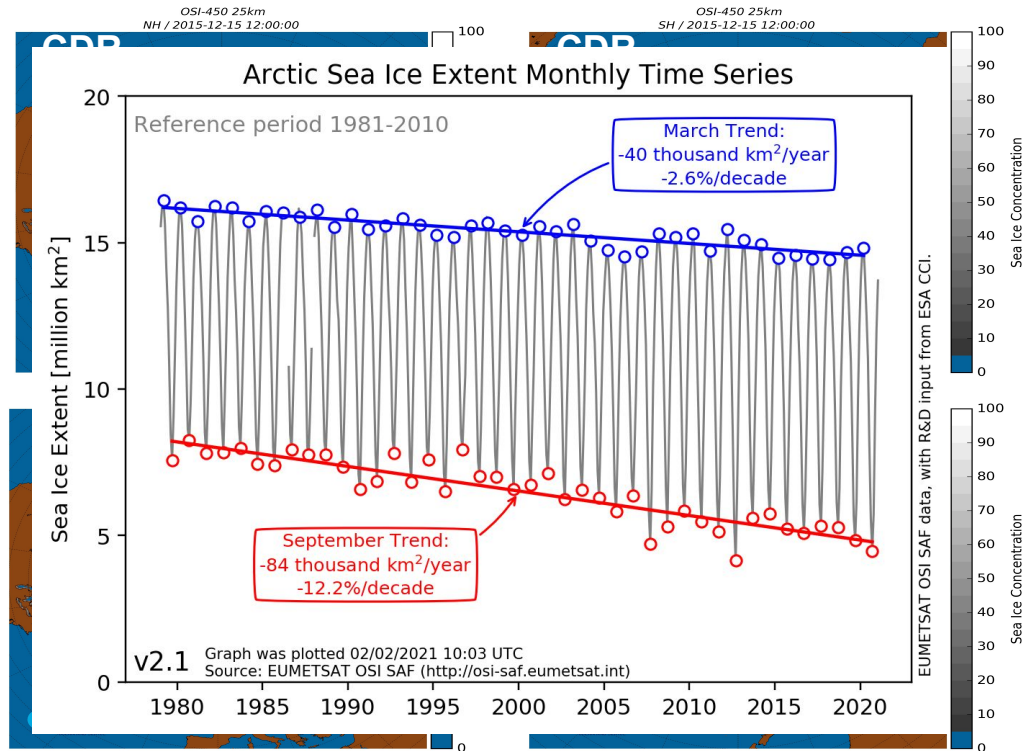


A *Climate Data Record* (CDR) is built from quality-checked and re-calibrated Fundamental CDR (FCDR) satellite data - and uses consistent algorithm

This CDR is complemented by an *Interim CDR* (ICDR)

The ICDR applies the same algorithms as CDR, but processes NRT satellite data (until FCDR data gets available)

Sea Ice Concentration - Seamless Climate Monitoring



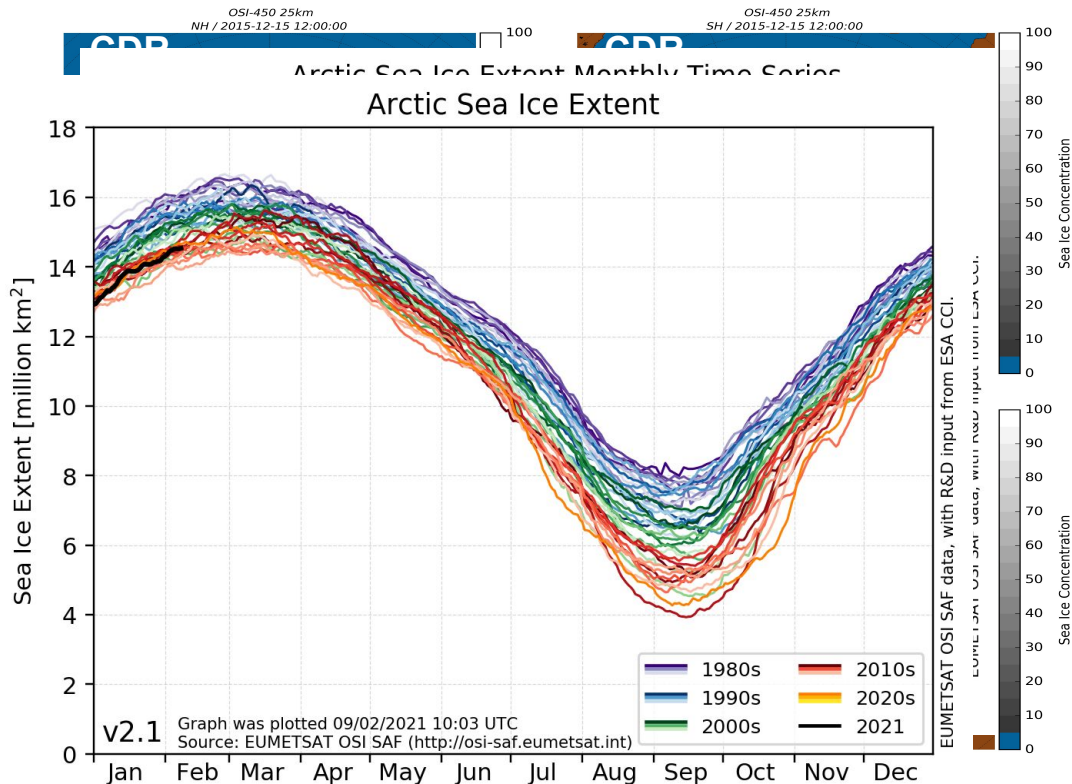
A *Climate Data Record* (CDR) is built from quality-checked and re-calibrated Fundamental CDR (FCDR) satellite data - and uses consistent algorithm

This CDR is complemented by an *Interim CDR* (ICDR)

The ICDR applies the same algorithms as CDR, but processes NRT satellite data (until FCDR data gets available)

CDR+ICDR enables seamless Climate Monitoring in form of time-consistent and traceable Climate Information Records

Sea Ice Concentration - Seamless Climate Monitoring



A *Climate Data Record* (CDR) is built from quality-checked and re-calibrated Fundamental CDR (FCDR) satellite data - and uses consistent algorithm

This CDR is complemented by an *Interim CDR* (ICDR)

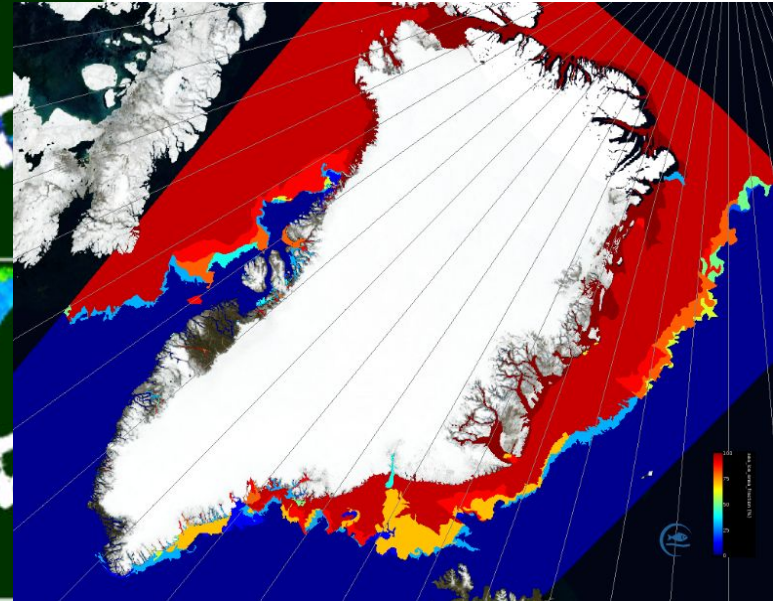
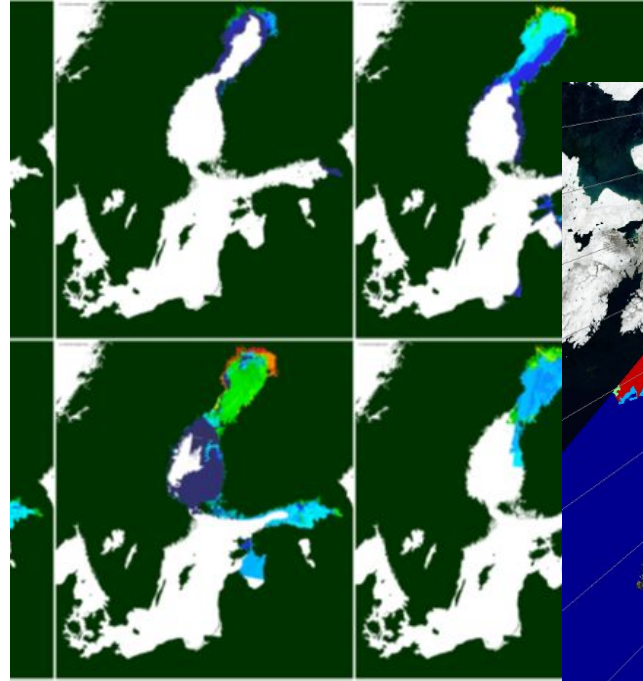
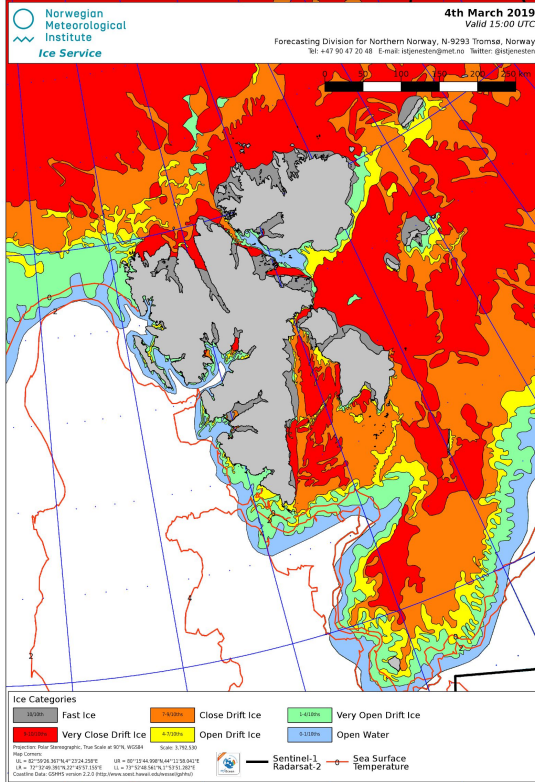
The ICDR applies the same algorithms as CDR, but processes “live” satellite data (until FCDR data gets available)

CDR+ICDR enables seamless Climate Monitoring in form of time-consistent and traceable Climate Information Records

Other sources of sea ice data

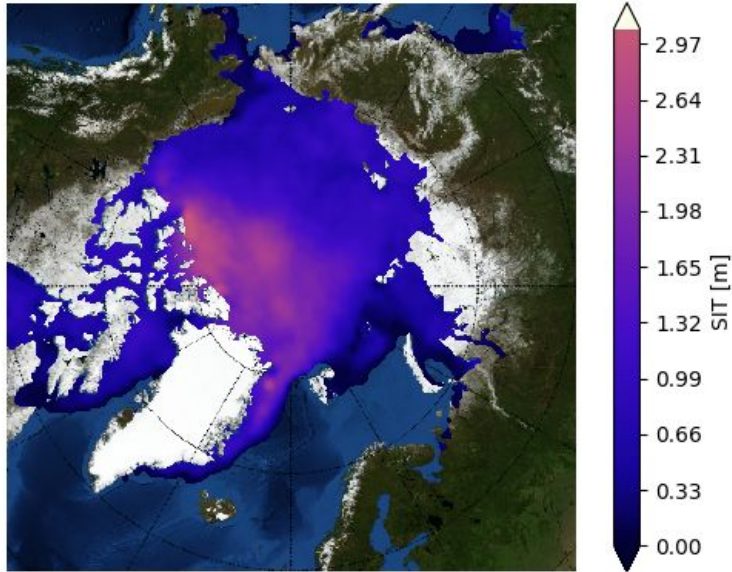
CMEMS - Copernicus Marine Service

- OSI SAF covers a lot, but not all
- Additional from CMEMS:
- Detailed ice charts



CMEMS - Copernicus Marine Service

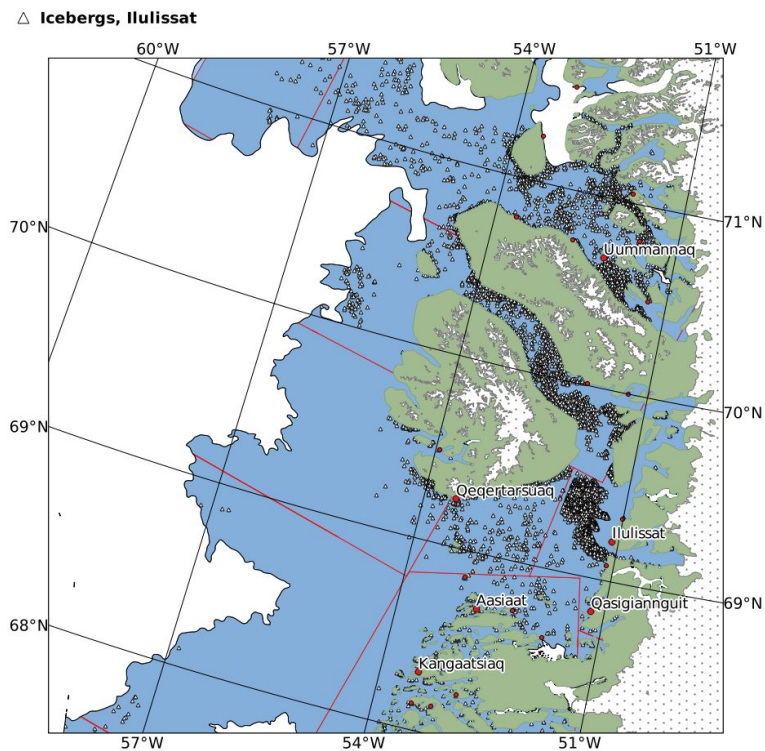
CS2/SMOS SIT 21.12.-27.12.2020



- OSI SAF covers a lot, but not all
- Additional from CMEMS:
- Detailed ice charts
- Sea ice thickness

CMEMS - Copernicus Marine Service

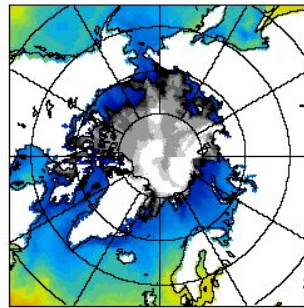
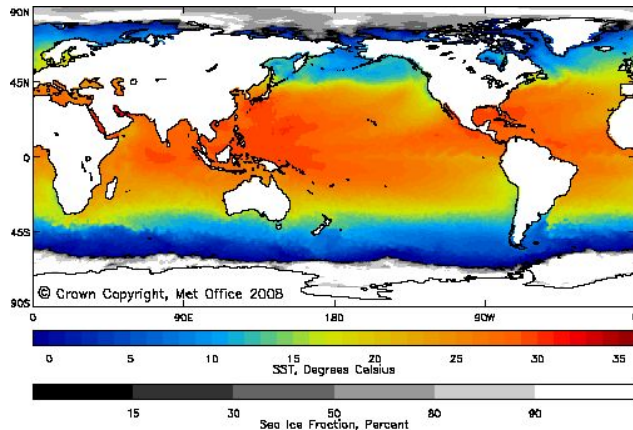
- OSI SAF covers a lot, but not all
- Additional from CMEMS:
- Detailed ice charts
- Sea ice thickness
- Iceberg density
- ++
- <https://marine.copernicus.eu/>



Users and use of data

Main user categories

- Monitoring of sea ice, operationally and from a climate perspective
- Operational numerical modelling, weather and ocean (ECMWF, NMS ++)
- Environmental monitoring (polar institutes, environmental agencies ++)
- Climate modelling

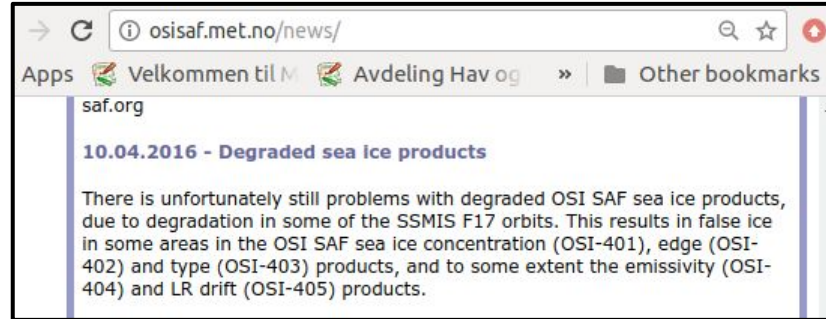
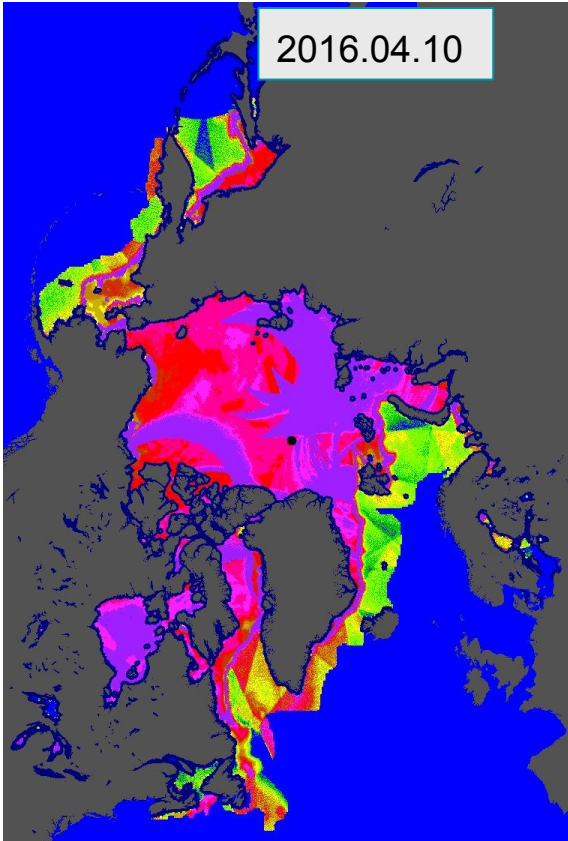


OSTIA MetOffice



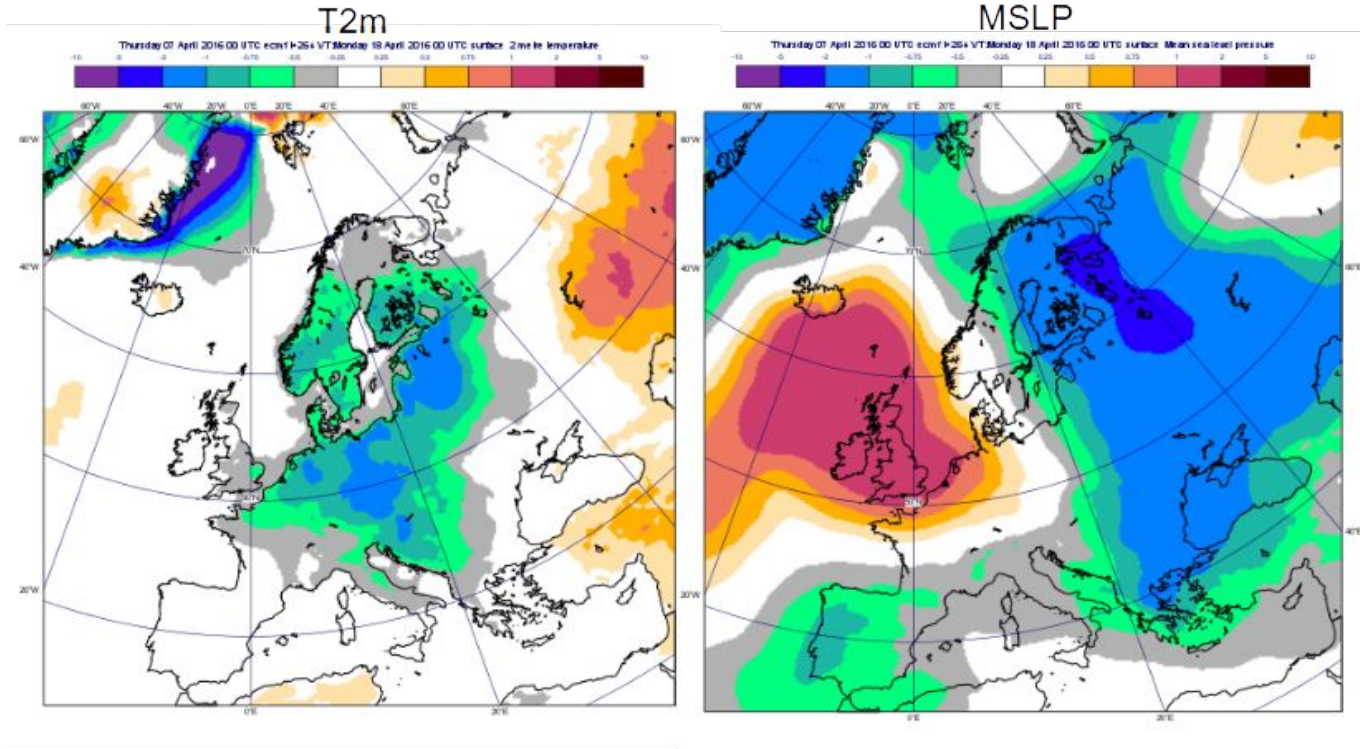
Carla Freitas et al., NPI

Example of data use in ECMWF NWP

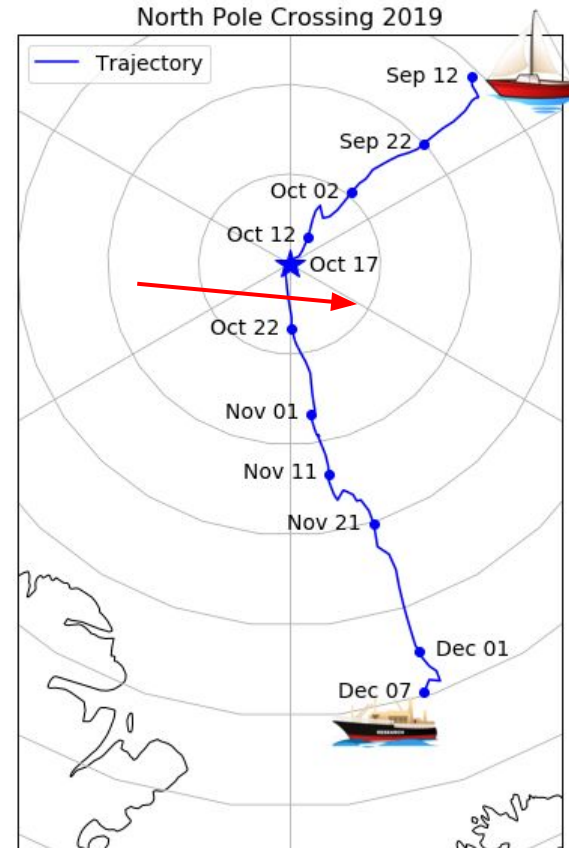
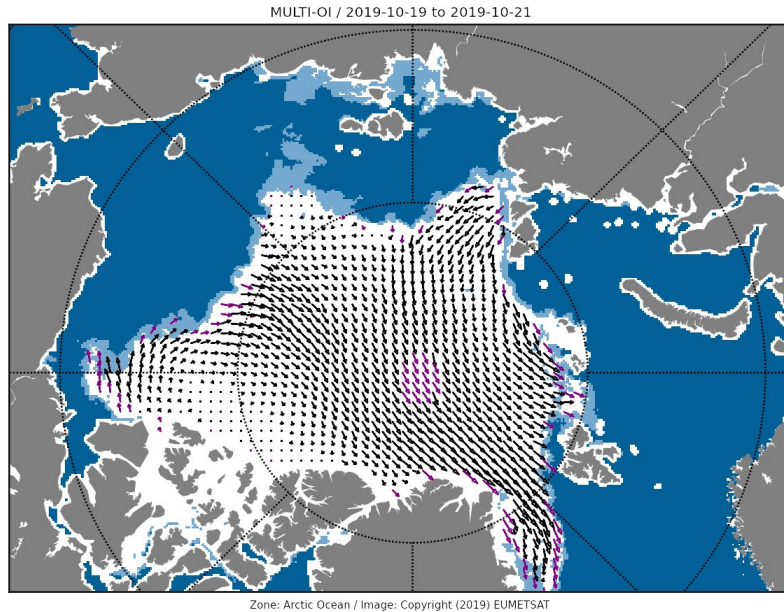


Impact of (persisted) erroneous ice. Ensemble mean difference – week 2

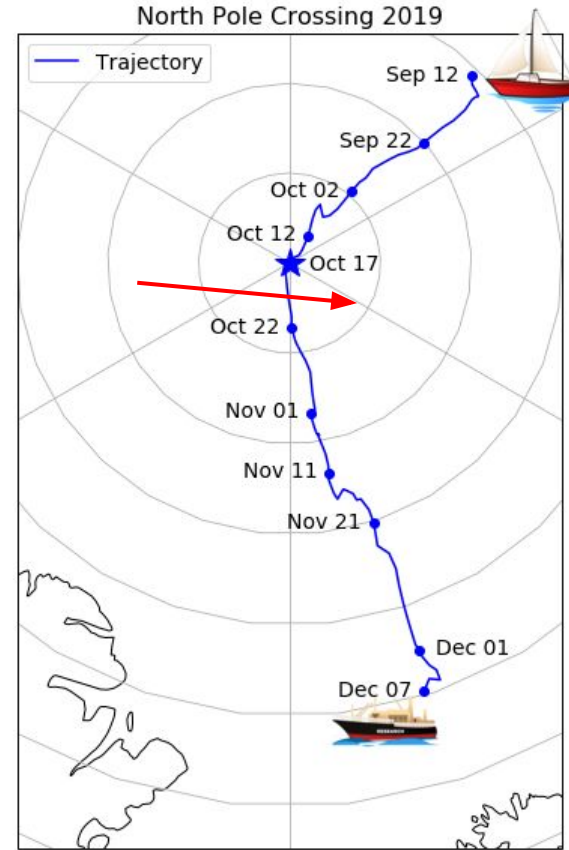
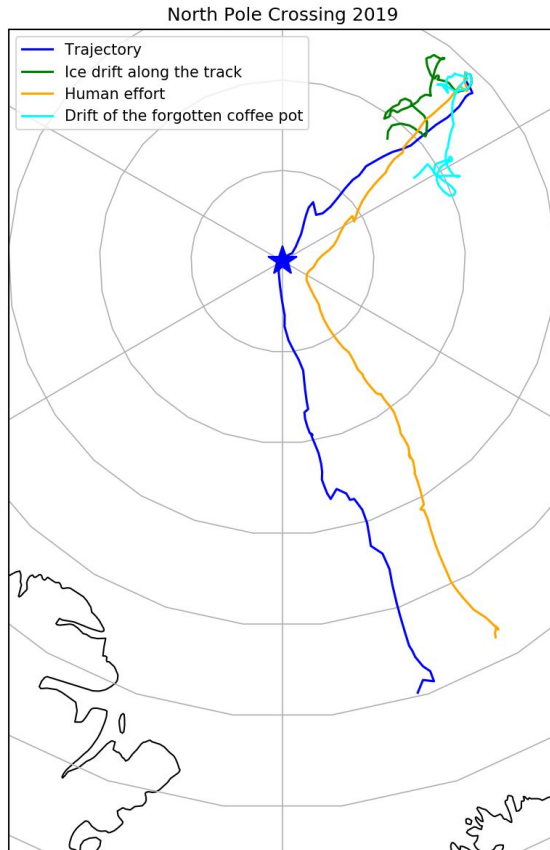
Ensemble with persisted ice field - Ensemble with missing swath.
51 ensemble members –operational resolution



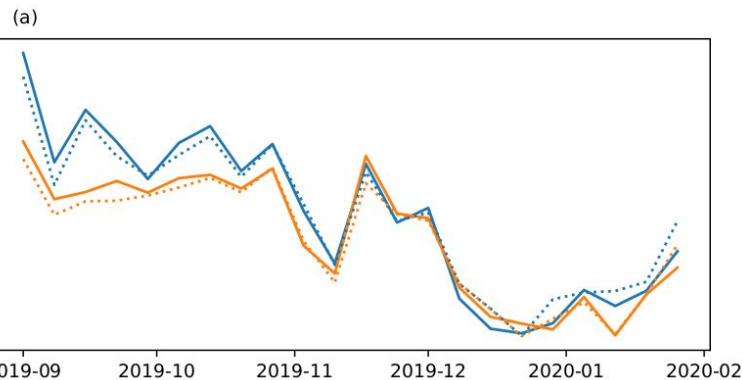
User case Ice-Drift : Down-drift or Up-drift ?



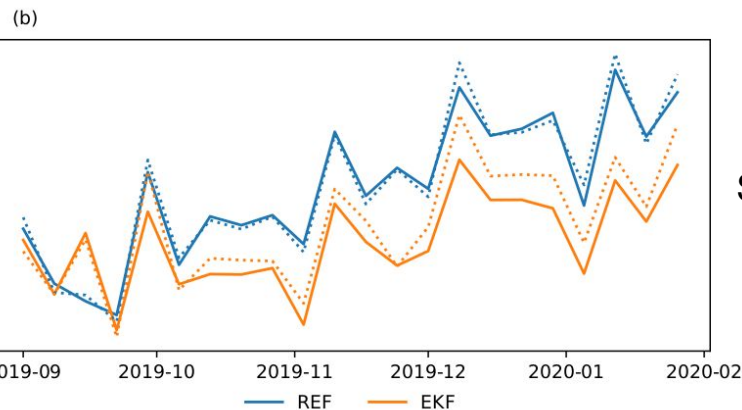
User case Ice-Drift : Down-drift or Up-drift ?



Assimilation of ice surface temperature



Bias



Std

- IST is not always well captured by NWP models
- Can be improved by assimilation of IST from satellite
- An example here shows impact of assimilating VIIRS IST from OSI SAF in Harmonie-Arome model using EKF
- Overall improvement with assimilation in yellow
- Largest bias in autumn when ice freezes and snow on top of ice is not correct in the model

From Yurii Batrak, MET Norway

Thank you for your attention

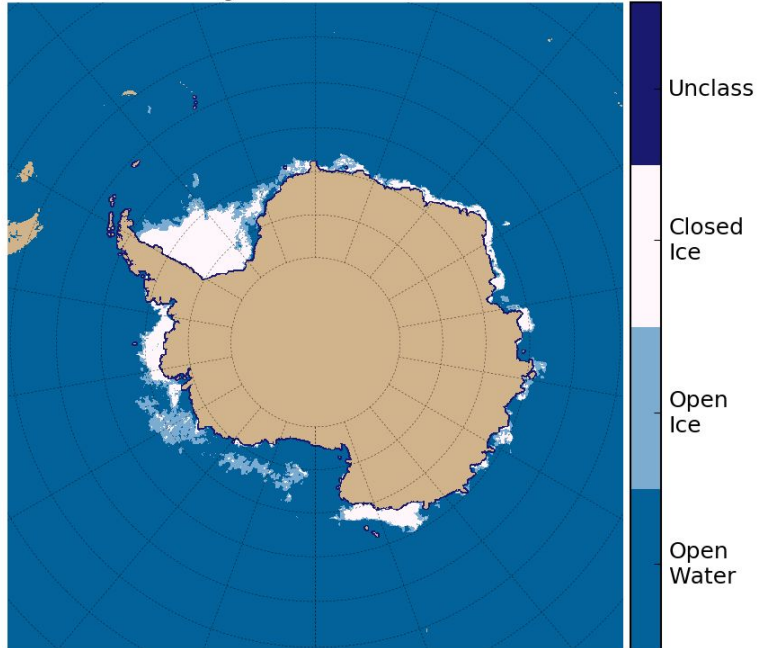
Any questions?

More information on <https://osi-saf.eumetsat.int>

Extra slides

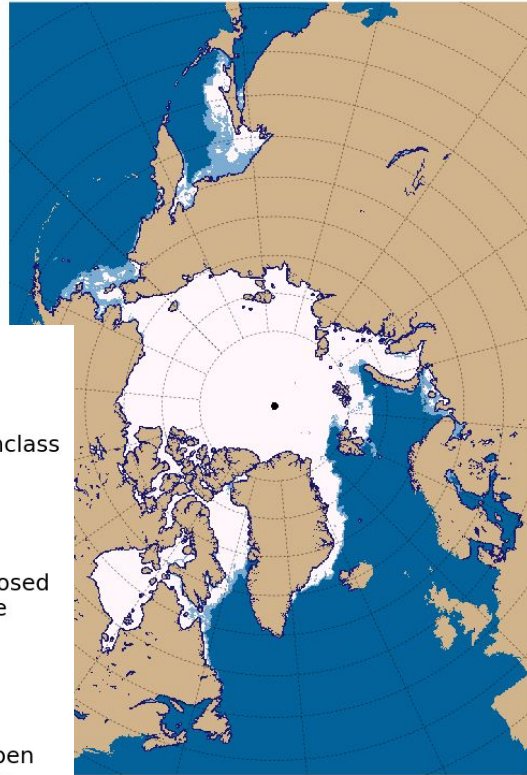
Sea Ice Edge

Ice Edge SH / 2021-02-01 12:00:00



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Ice Edge NH / 2021-02-01 12:00:00



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Sea ice from satellite images

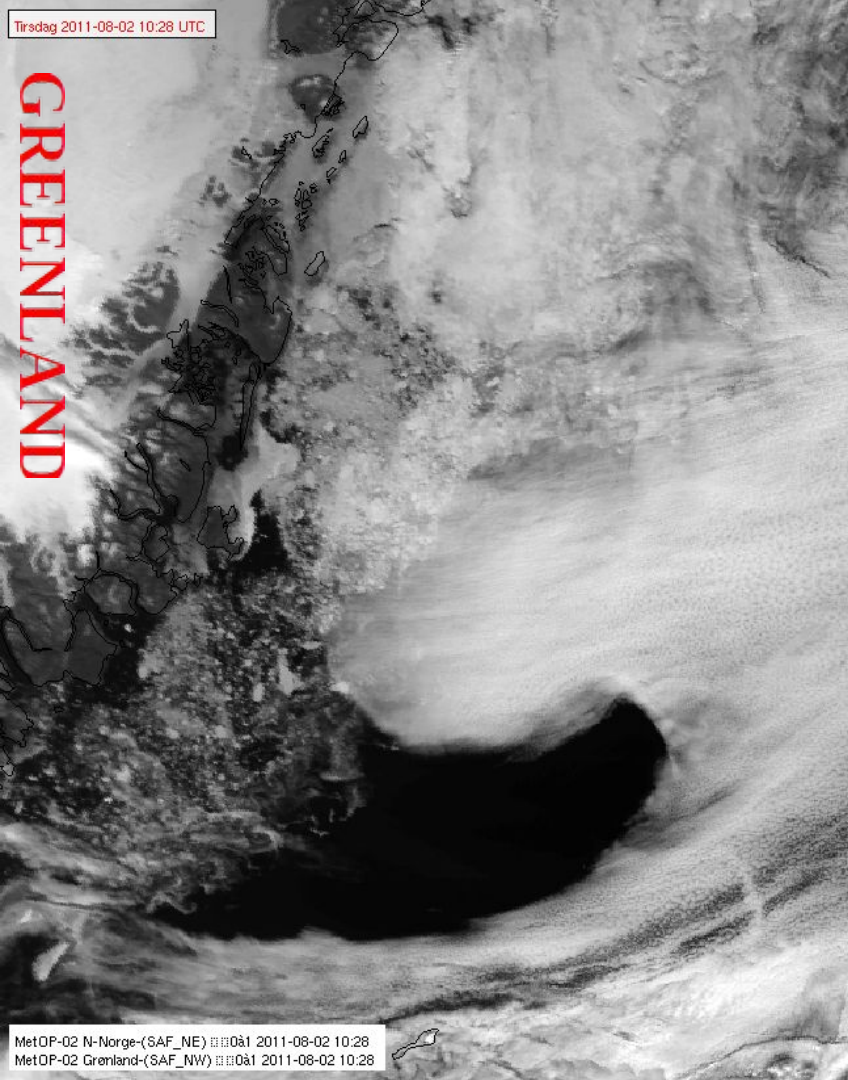
Single visible channel

Easy to see the clear
water

But what is ice and what
is cloud?

Ice has the same
reflectance as clouds in
the visible channel

0.6 μ m from AVHRR



Sea ice from satellite images

Single visible channel

Easy to see the clear water

But what is ice and what is
cloud?

Ice has the same
reflectance as clouds in the
visible channel

Combining more channels,
including near infrared,
gives us a change to also
separate ice from clouds

0.6um+1.6um+11um
from AVHRR

