Arctic MFC
marine.copernicus.eu

Copernicus Marine Services
The Arctic Marine Forecasting Center

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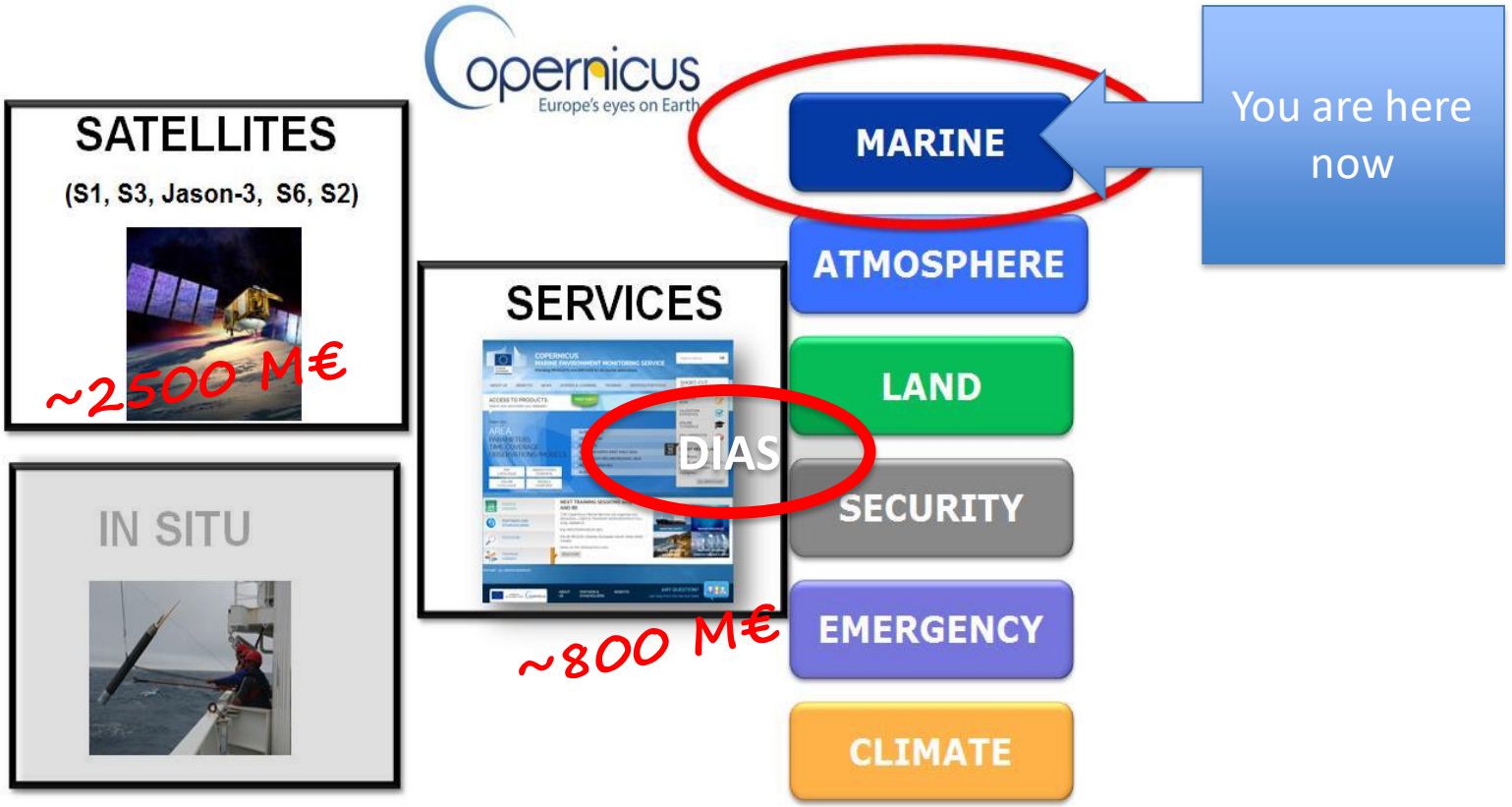
The EU Copernicus Programme



2014 2015 2016 2017 2018 2019 2020 2021 2022 2023 2024

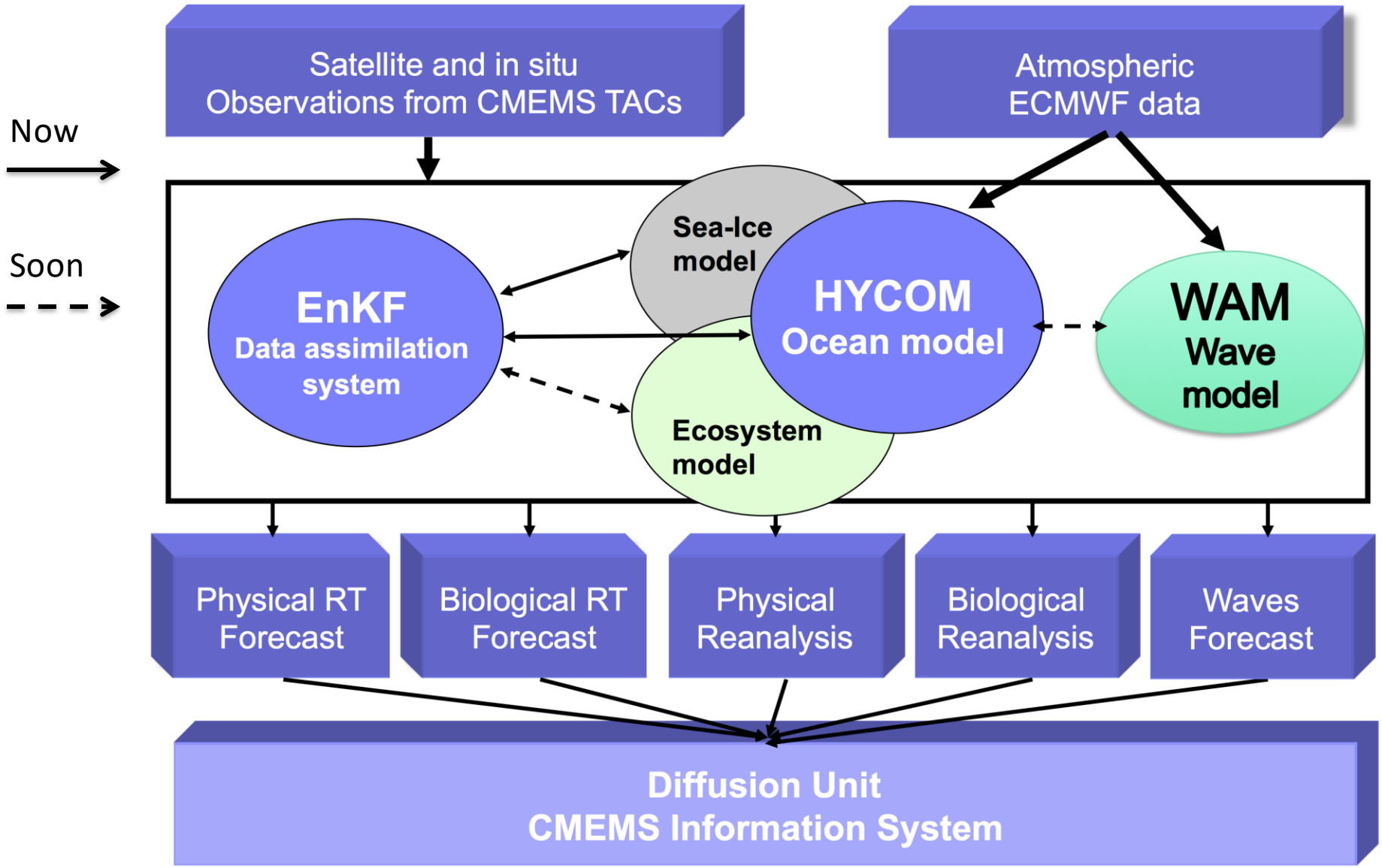
EU framework: 2014-2020
Copernicus 1
Operational

EU framework: 2021-2027
Copernicus 2
Ongoing discussion

The Copernicus Marine Environment Monitoring Services (CMEMS)

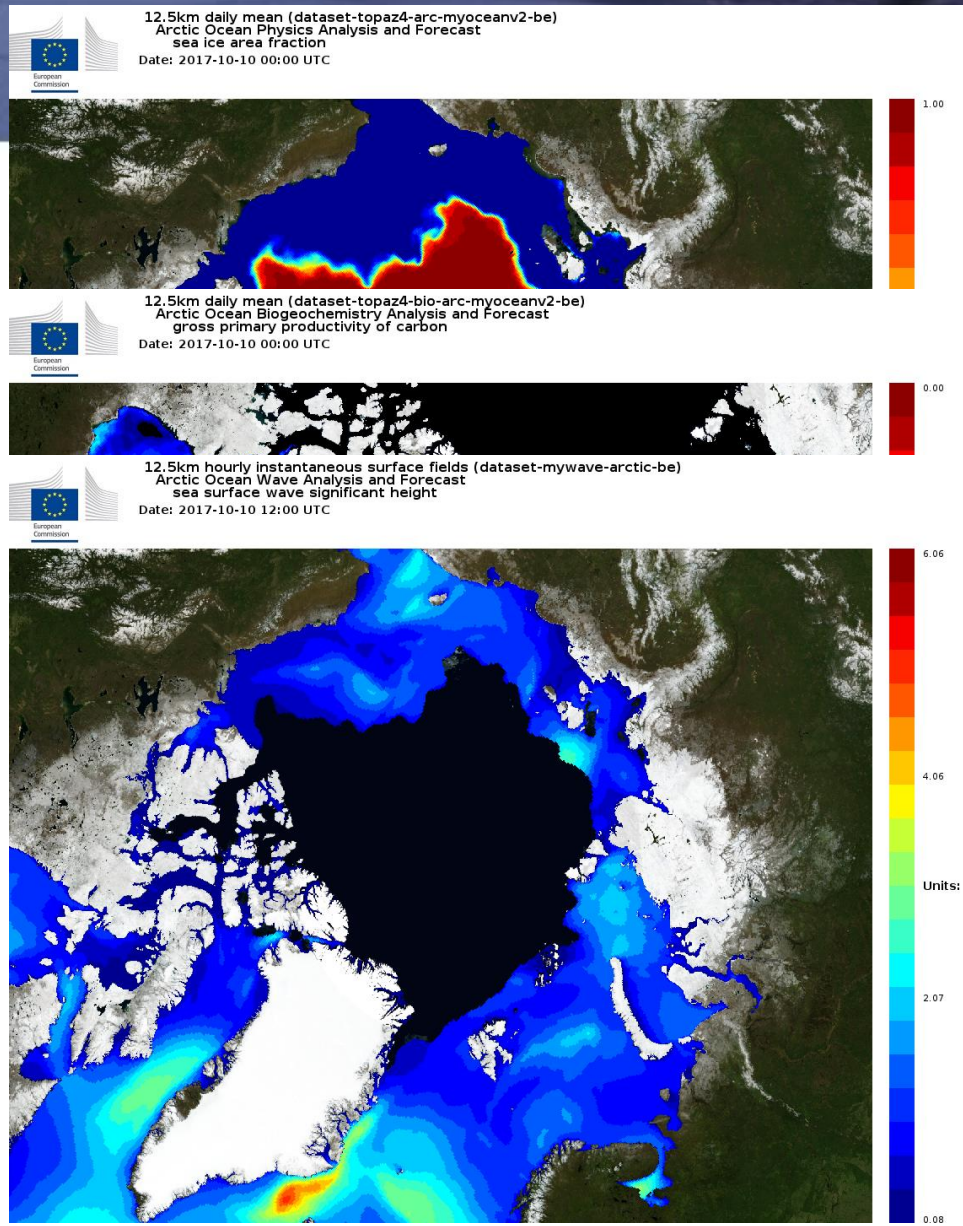
- **CMEMS uniqueness:**
  - Strong focus on internal consistency
  - Open & Free data distribution
  - Added value to Copernicus satellites (data assimilation)
  - Distributed European Service
  - Cloud data with a single data portal
  - Delegated to Mercator Ocean Intl.
    - 5 new international partners
- **CMEMS Opportunity**
  - A major initiative supporting ambitious modeling systems development and validation
  - Intended for sustainable operations by the EU
  - NERSC, MET, IMR and NPI have joined to participate in Mercator Ocean Intl.

The ARC MFC (TOPAZ system + WAM)



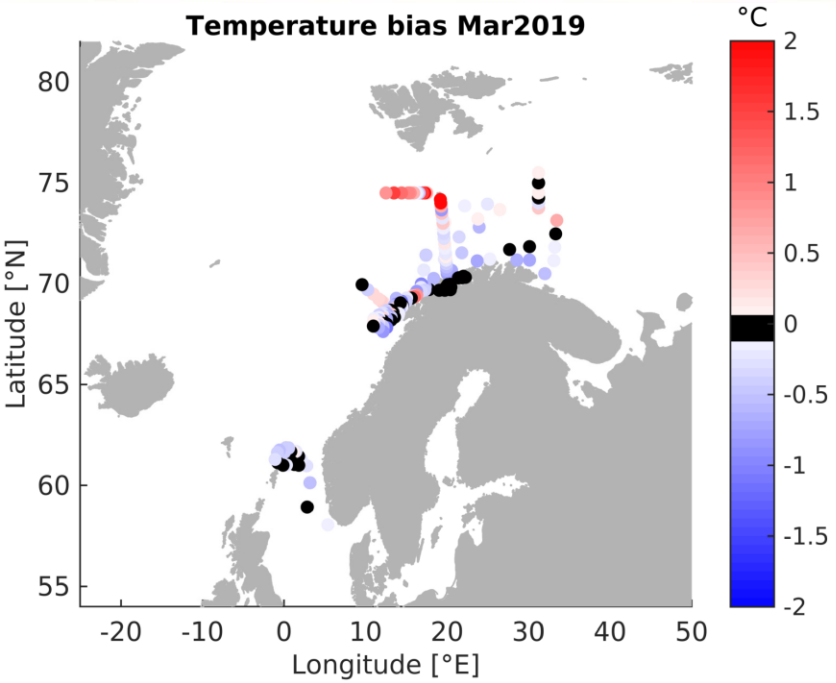
The TOPAZ system

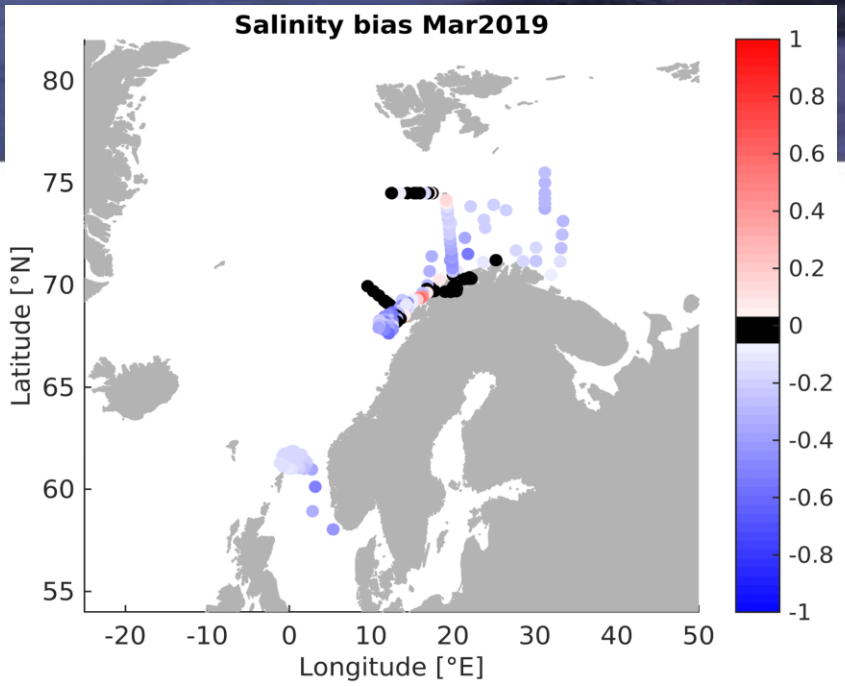
- Exploited operationally at MET Norway (Since 2008)
  - Daily updated 10-days forecast
  - Ecosystem coupled online in Jan. 2012
  - Monitored 24/7
- Waves forecast (since 2017)
  - From MET Norway's WAM model
- 26 years reanalysis at NERSC
  - Same system as operations
  - Updated twice a year until Y-1
- 3-years ecosystem reanalysis
  - Assimilation of ocean colour data and in situ profiles
  - Update ongoing 2005-2015
- Copernicus marine service
  - Availability > 93%
  - Service desk

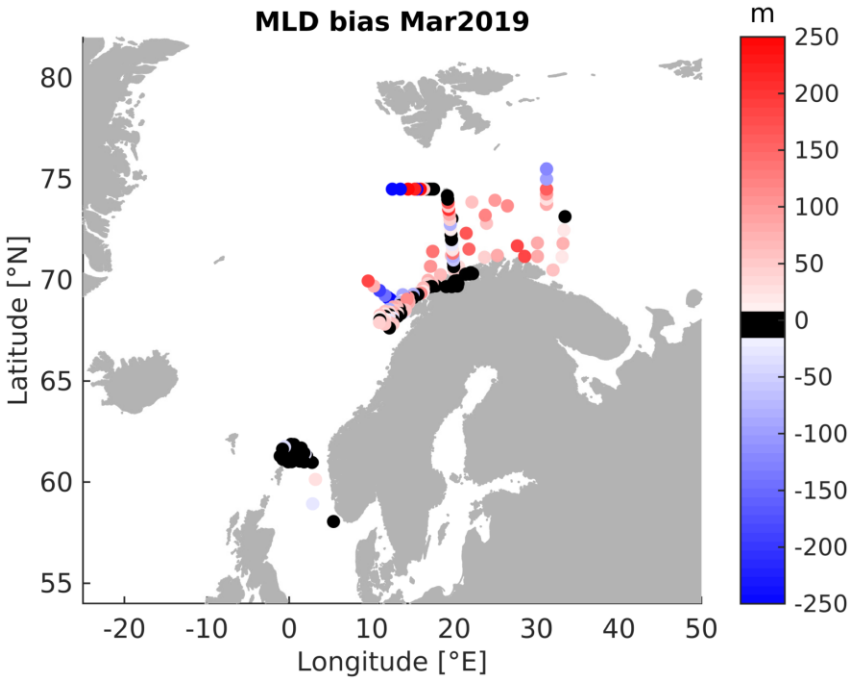


Ice fraction forecast for 10th Oct 2017
And associated primary production
And significant wave heights

Validation: IMR cruises





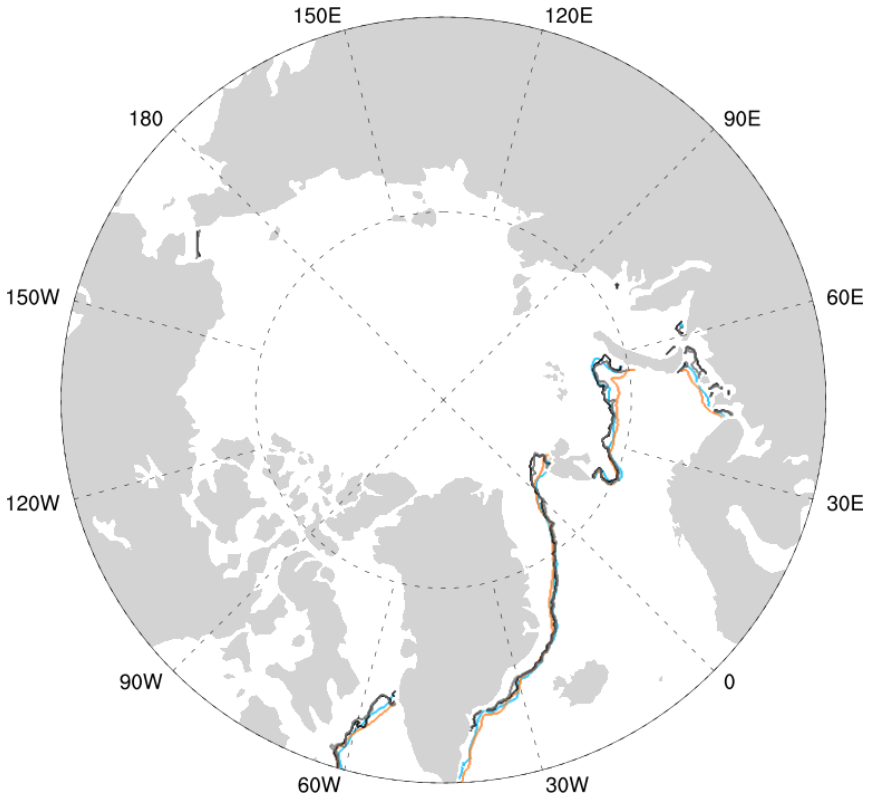


Temperature (vertically averaged) OK but too cold to the South

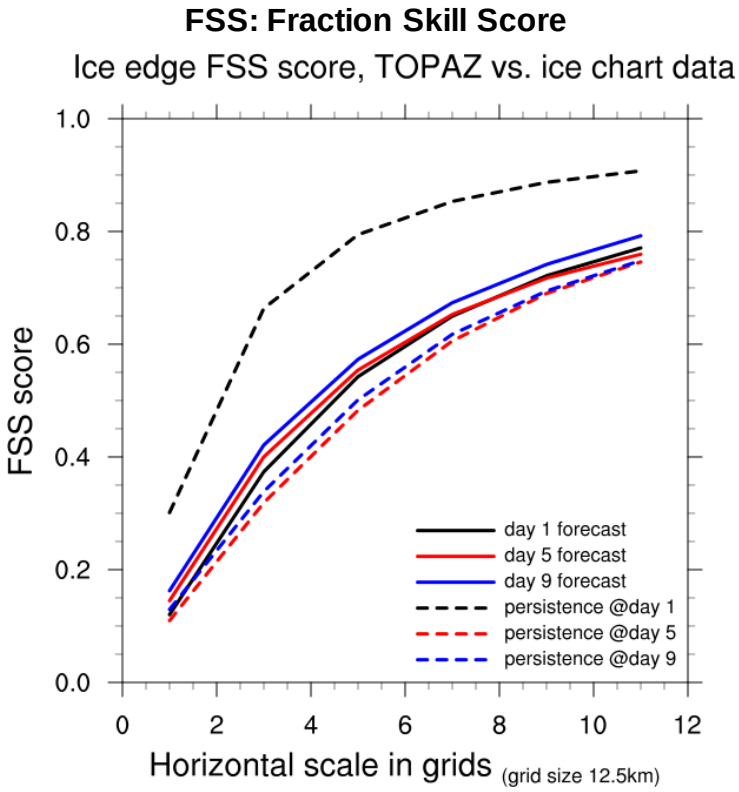
Salinity generally too fresh

Mixed Layer Depth OK In Norwegian Sea but shoals too early in Barents Sea

Ice edge forecast on 21st Mar. 2019

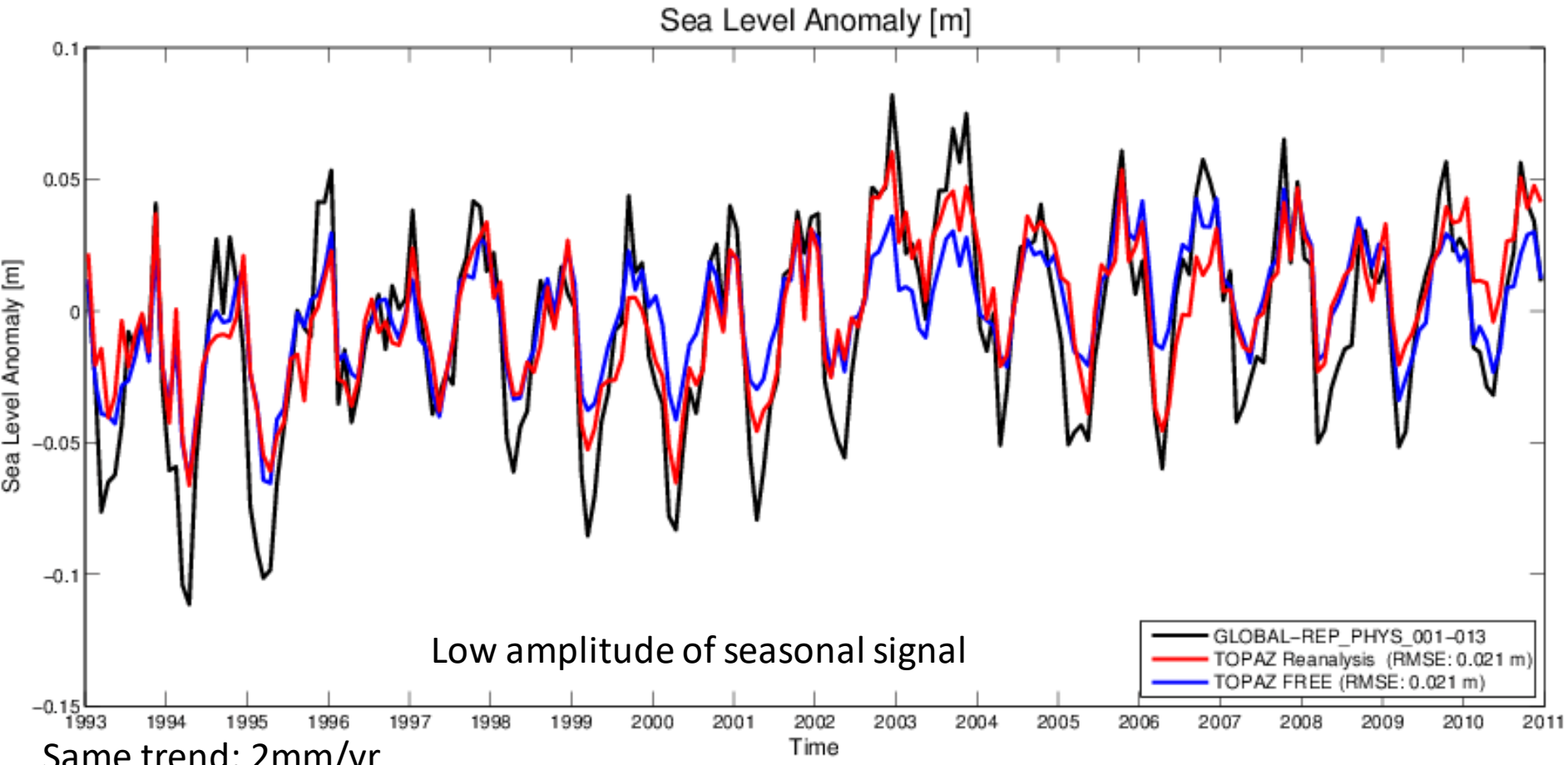


Persistence Obs Best estimate Forecast



Performance depends on times and locations
Model useful wrt to persistence of ice charts after 5 days forecast and at all scales.
See Melsom et al. OSD (2019)

Arctic-wide sea level change



Low amplitude of seasonal signal

Same trend: 2mm/yr

Same performance wrt tide gauges

No improvements, no degradation

Main upcoming updates: pan-Arctic systems

December release

- **Wave forecast: WAM 3km**

February ‘20 release

- **New sea ice rheology: neXtSIM ~7km mesh**
- **TOPAZ6-tides: HYCOM at 3 km (but no DA)**

July ‘20 release

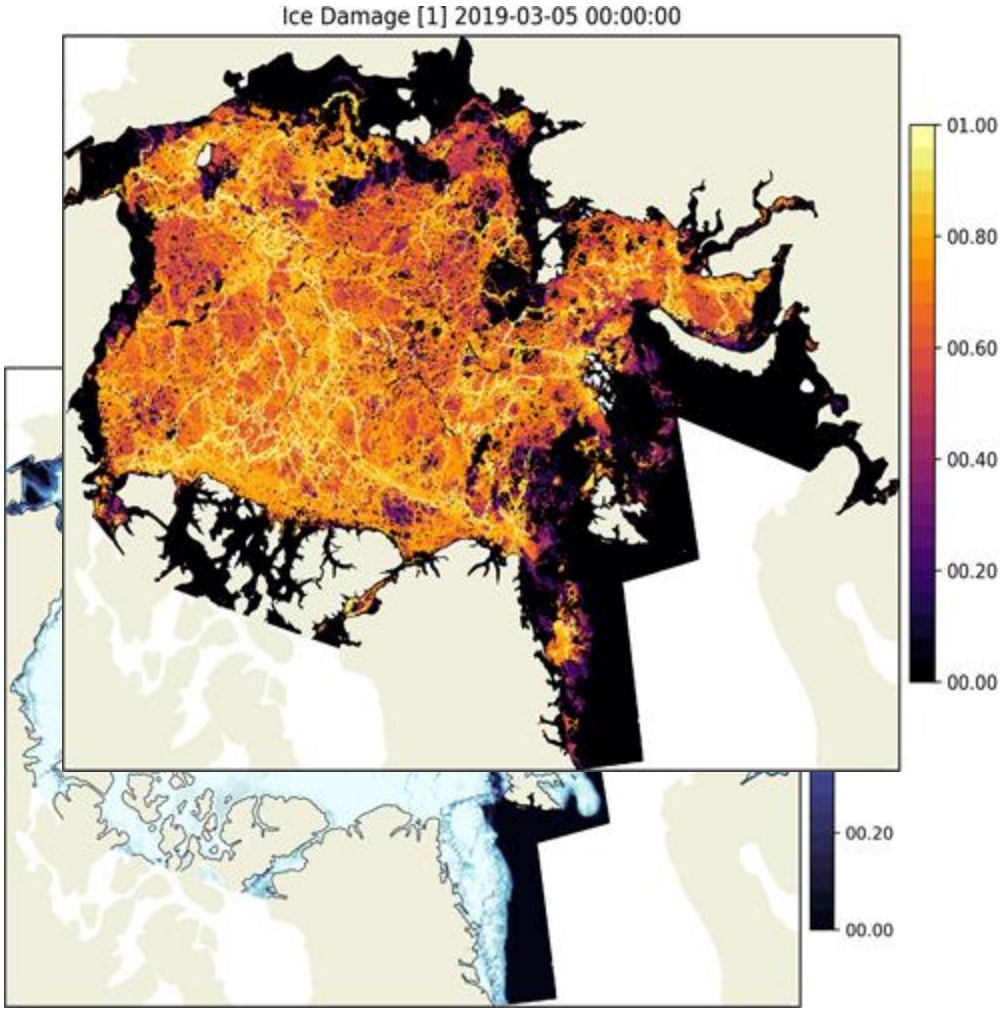
- **TOPAZ5: HYCOM-CICE at 6 km (with data assimilation)**
- **ECOSMO: with the Carbon cycle**

December ‘20 release:

- **WAM 3km hindcast …**

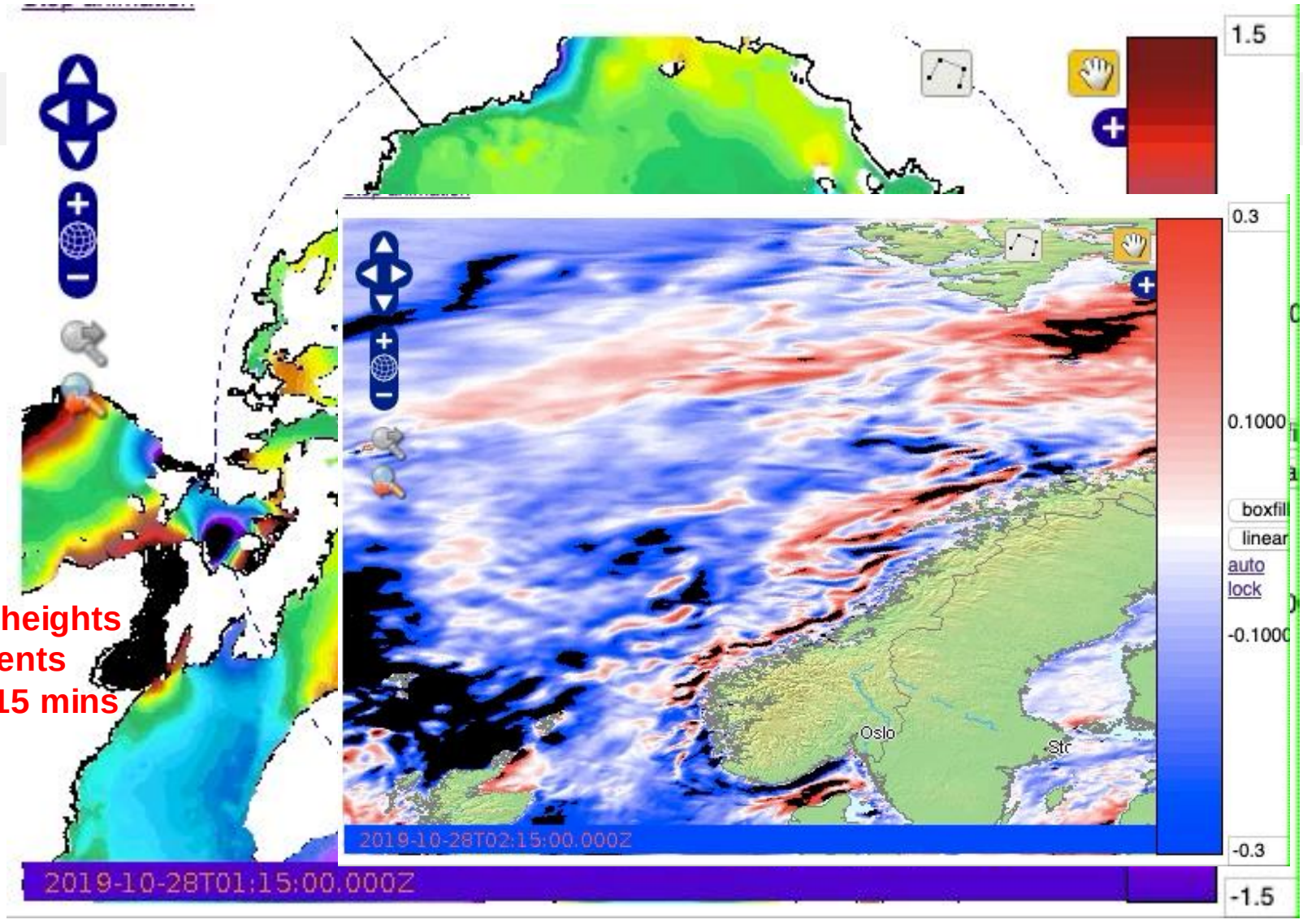
Forecasts from neXtSIM

- neXtSIM stand-alone at ~7km mesh size
  - Maxwell-EB rheology (Dansereau et al. 2016)
  - Lagrangian triangular mesh
- ECMWF (winds) and TOPAZ forcing (ocean)
- Daily assimilation of
  - OSI-SAF concentrations
  - SMOS ice thickness
  - Nudging: Implementation of EnKF made tricky by remeshing …
- Scheduled for Feb 2020
  - Larger Arctic domain
  - Hourly frequency



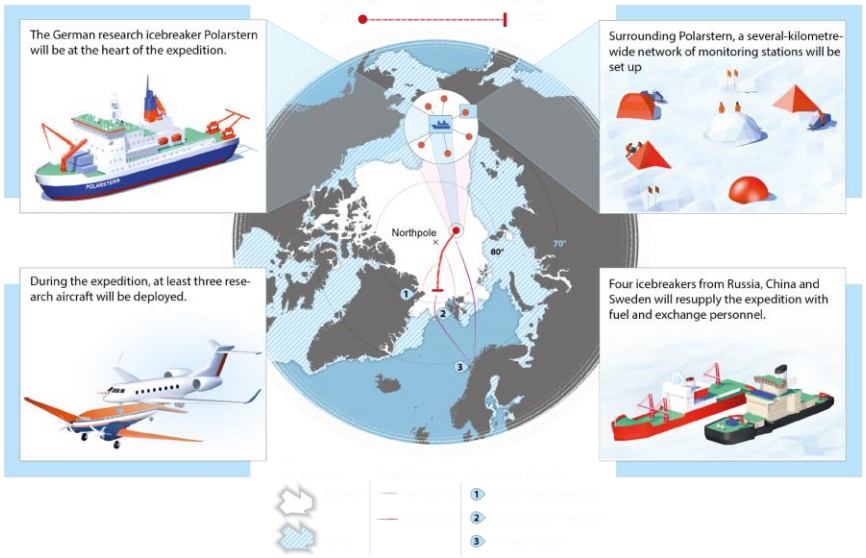
HYCOM @ 3 km with tides

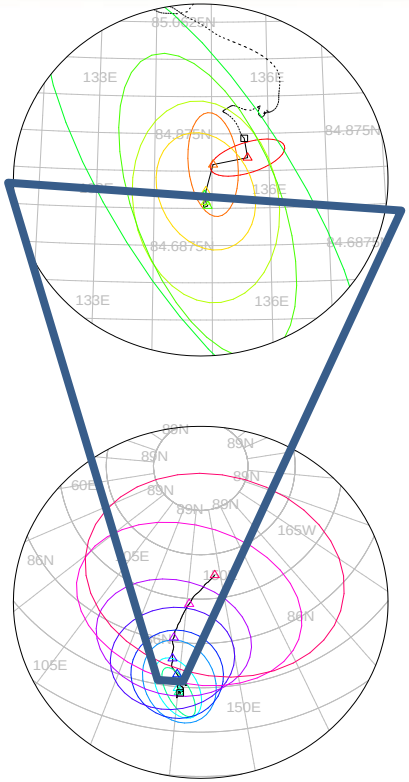
http://thredds.met.no/thredds/godiva2/godiva2.html?server=http://thredds.met.no/thredds/wms/cmems/topaz6/dataset-topaz6-arc-15min-3km-be.ncml#

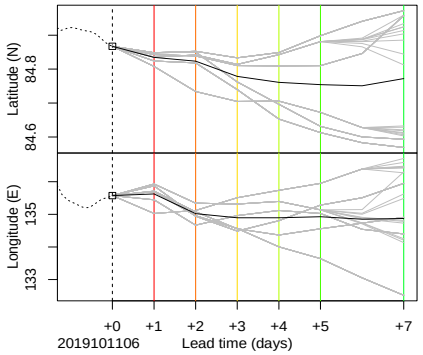


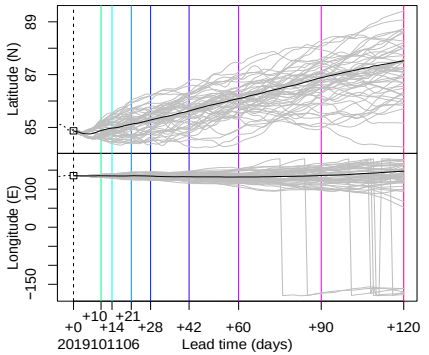
Sea Surface heights
Surface currents
Output freq 15 mins

International coordination: YOPP/MOSAiC









SIDFEx

- ~11 international sea ice forecast models contribute

Short-term forecasts

- Order SAR images from DLR for day-to-day operations

Seasonal forecasts

Consensus ensemble forecast

SIDFEx consensus forecast for the MOSAiC drift

Initial time (YYYYMMDDHH): 2019101106

Consensus forecast version: 20191009v0
Generated at: 2019−284.294
Forecasts included:
ukmo001v1_cplNWPv1 ukmo001v1_FOAMv1 ukmo001v1_cplNWP−HRv1 eccc001_giops esrl001_SeaIceVelocity metno001_RK2 ecmwf001_SEAS5
Age of forecasts included (relative to initial time):
1.25 1.25 2.25 1.25 1.25 2.25 10.25
Remaining lead time range of forecasts included:
8.75 5.75 7.75 8.75 8.75 6.75 113.75

WARNING: This is an experimental forecast product with no warranty

More information: https://sidfex.polarprediction.net
Contact: helge.goessling@awi.de

Outlook

- 2018-2021 coming to an end
- Preparations for Copernicus2 (2021-2027)
- Good time to suggest new information, products upgrades
- New inputs:
  - New initiatives on in situ observations
  - New initiatives on river discharge
  - New Sentinel-6
- Inclusion of Copernicus high-priority polar mission
  - (CIMR / CRISTAL?)
- Inclusion of ESA Earth Explorer missions

Thank you!