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TOPAZ4b: a new version of the ocean and sea-ice Arctic reanalysis

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Outline

- ❑ TOPAZ4 reanalysis system and its upgradates

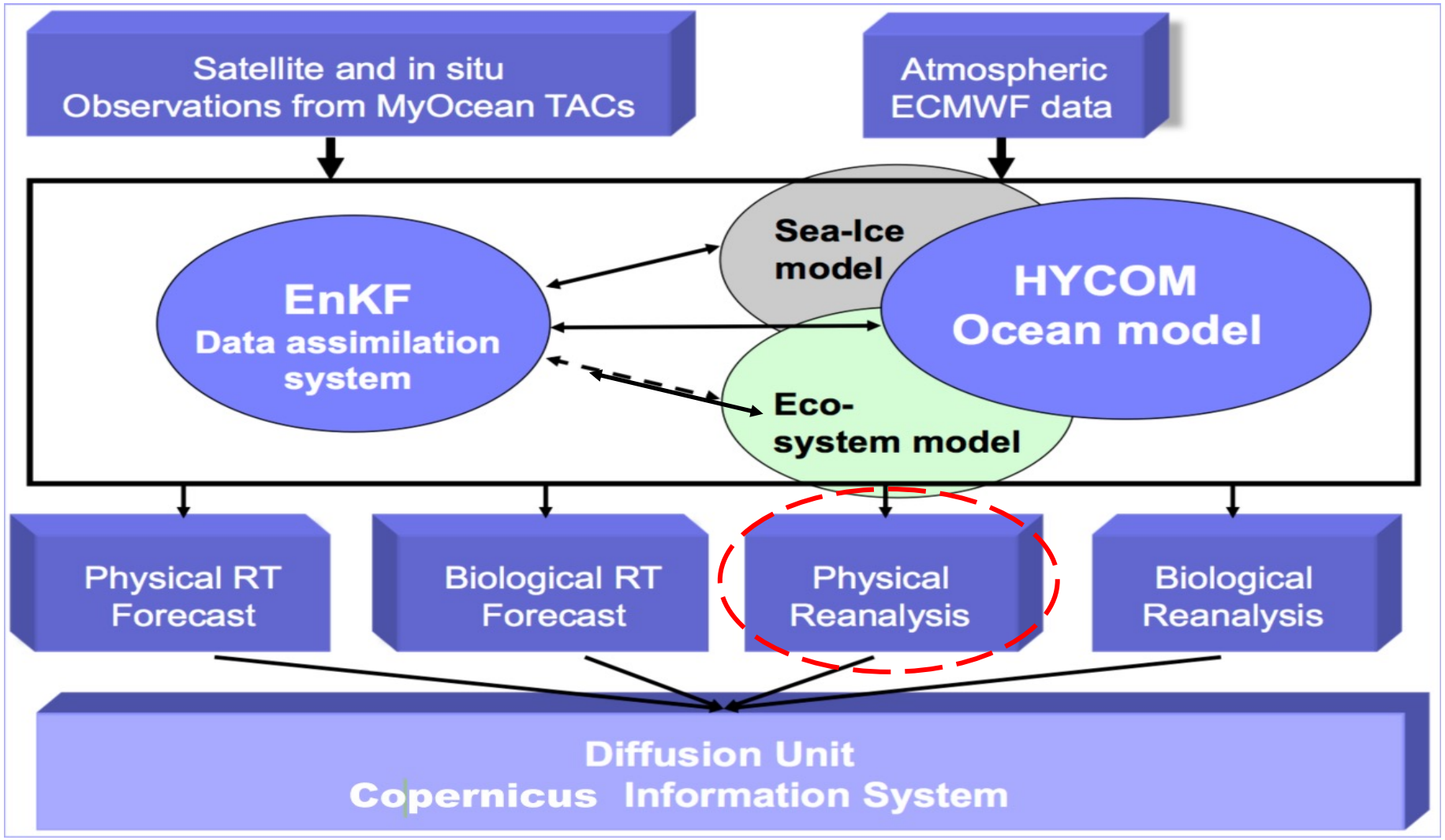
(Model resolution, forcing, DA setting)

- ❑ Evaluation of the new reanalysis

(Temp/salt stratification, volume transports, sea ice features)

- ❑ Summary

❑ TOPAZ4 reanalysis system and its upgradates



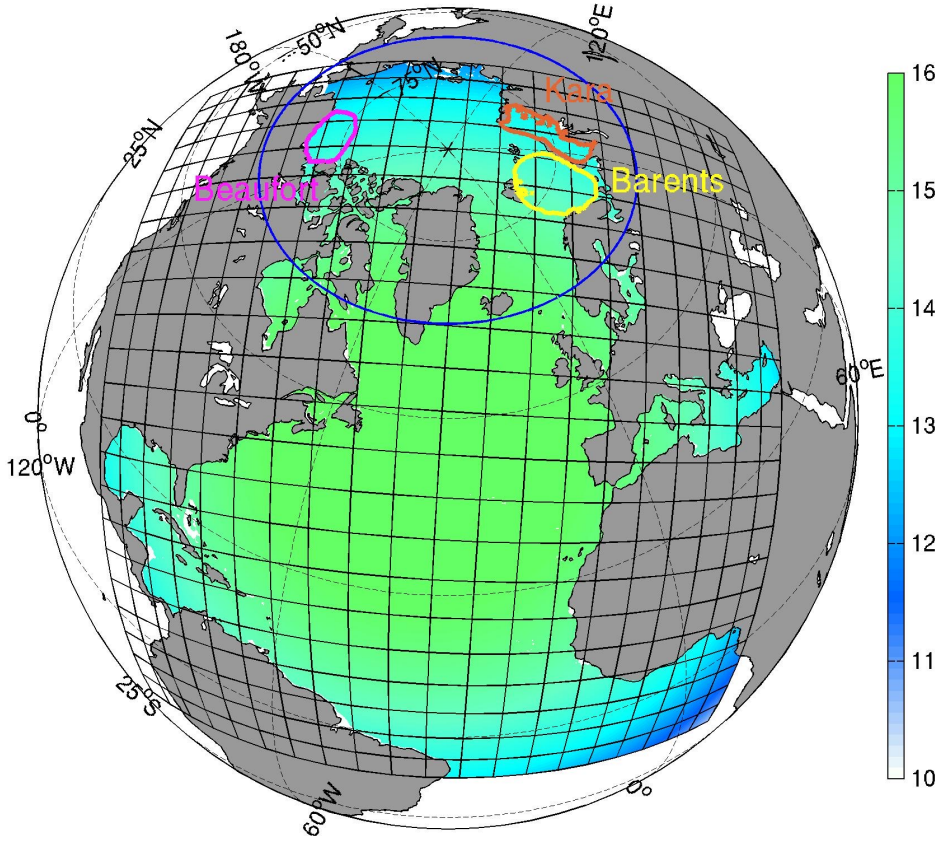
Product ID

Previous:
ARCTIC_REANALYSIS_PHY_002_003

New:
ARCTIC_MULTIYEAR_PHY_002_003

The Arctic component in Copernicus marine service

The HYCOM model in TOPAZ4



- 3D numerical ocean model
  - Hybrid Coordinate Ocean model, HYCOM (U. Miami)
  - Coupled with sea ice model (EVP+ simple thermodynamic model)
- Hybrid vertical coordinate
  - Isopycnal in the interior
  - Z-coordinate near surface
- **New features for improving in TP4b**
  - **Model version 2.2.12 replaced by 2.2.37**
  - **Vertical layers from 28 to 50**
  - **Seasonal river fluxes corrected around Greenland with the glacier melting water**
  - **Relaxation boundary from WOA2018**
  - **6-hourly forcing ERA5 to replace ERA-I**

Observation Network for data assimilation (TP4a)

Table 1. Overview of assimilated observations per cycle, with average numbers for the cycles during which the observations are present.

Type	Number	After SO	Spacing	Resolution	Period	Provider
SLA	9×10^4	5×10^4	Track	7 km	1992–2013	CLS
SST	6×10^3	6×10^3	Gridded	100 km	1990–1998	Reynolds SST from NCDC (http://www.nhc.noaa.gov/aboutsst.shtml)
SST	2×10^6	2.4×10^5	Gridded	5 km	1998–2013	OSTIA from UK Met Office
In situ T/S	3×10^4	5×10^3	Point	–	1990–2013	Ifremer + other
SIC (SSM/I)	9×10^4	5×10^4	Gridded	25 km	1990–2002	OSISAF
SIC (AMSR-E)	1.6×10^5	5×10^4	Gridded	12.5 km*	2002–2013	OSISAF
SIC (AMSR-E)	1.6×10^5	5×10^4	Gridded	12.5 km	2008–2009	AMSR-E (http://nsidc.org/data/amsre/)
Ice drift (CERSAT)	6×10^3	10^3	Gridded	35 km	2002–2010	Ifremer
Ice drift (OSISAF)	4×10^3	10^3	Gridded	62.5 km	2011–2013	OSISAF
Total	2.3×10^6	4×10^5				

from Xie et al.(2017)

* The resolution of ice concentration product increased to 10 km. Unless specified, all observations are from http://marine.copernicus.eu. NCDC is the National Climatic Data Center.

Observation Network for data assimilation (TP4b)

Type	Number	After SO	Spacing	Resolution	Period	Provider
SLA	$9x10^4$	$5.5x10^4$	Track	7 km	1993-2020	CMEMS
SST	$2x10^6$	$2.4x10^5$	Gridded	5 km	1991-2020	CMEMS (CCI SST)
In situ T/S	$2.9x10^4$	$1.6x10^4$	Point	-	1991-2020	CMEMS (CORA V5.2)
SIC	$9x10^4$	$2.0x10^4$	Gridded	25 km	1991-2020	CMEMS
Ice drift	$4x10^3$	$4x10^3$	Gridded	62.5 km	1999-2020	CMEMS (CERSAT)
SIT	*$1.5x10^4$*	*$1.5x10^4$*	*Gridded*	*25 km*	*2011-2020**	*CMEMS (CS2SMOS)*
SSS	*$2x10^4$*	*$2x10^4$*	*Gridded*	*25 km*	*2013-2019*	*BEC (v3.1)*
Total	$2x10^6$	$3.6x10^5$				

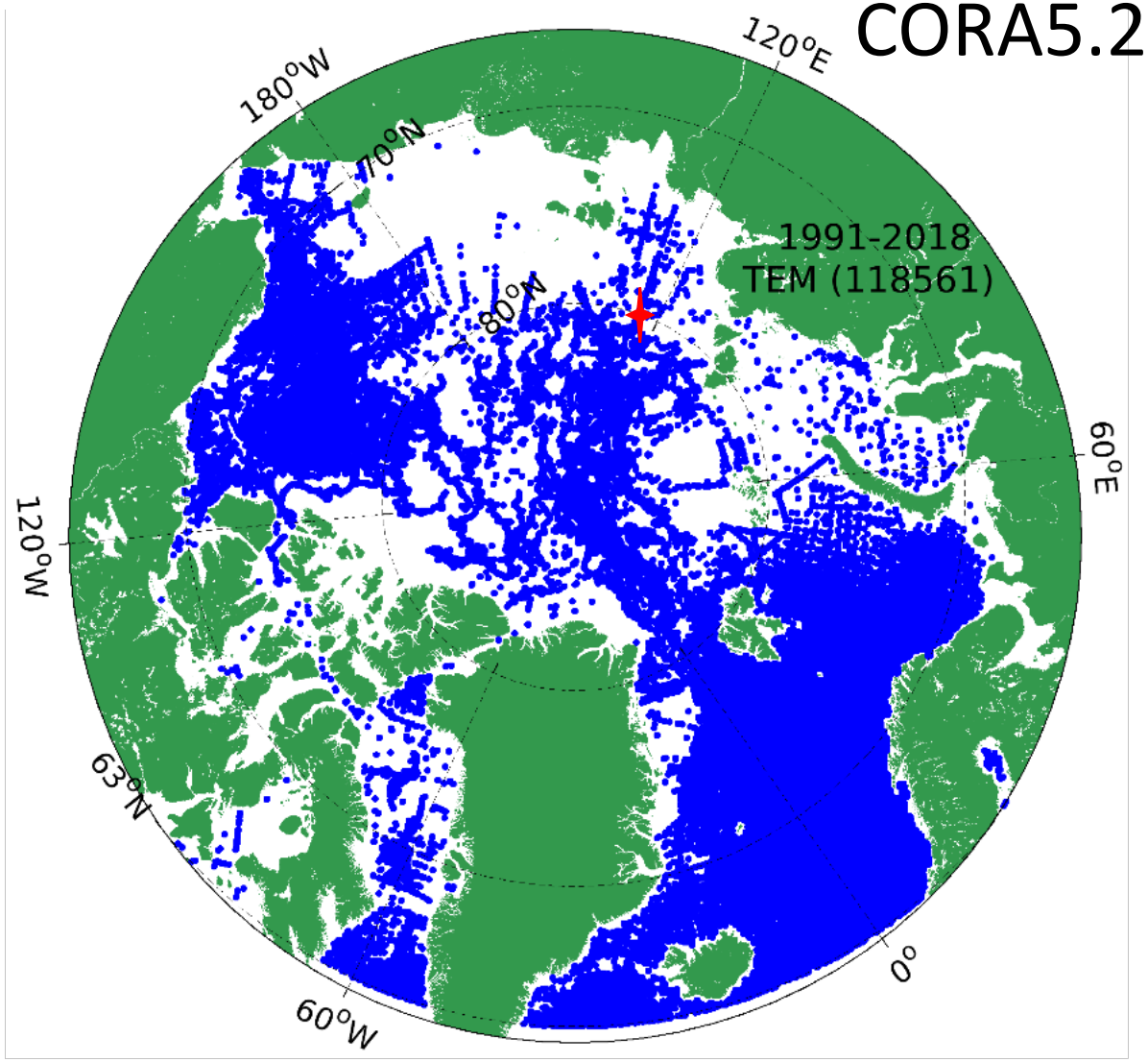
- Main data source from Copernicus Marine Service Information (http://marine.copernicus.eu)
- SSS from BEC (http://bec.icm.csic.es)

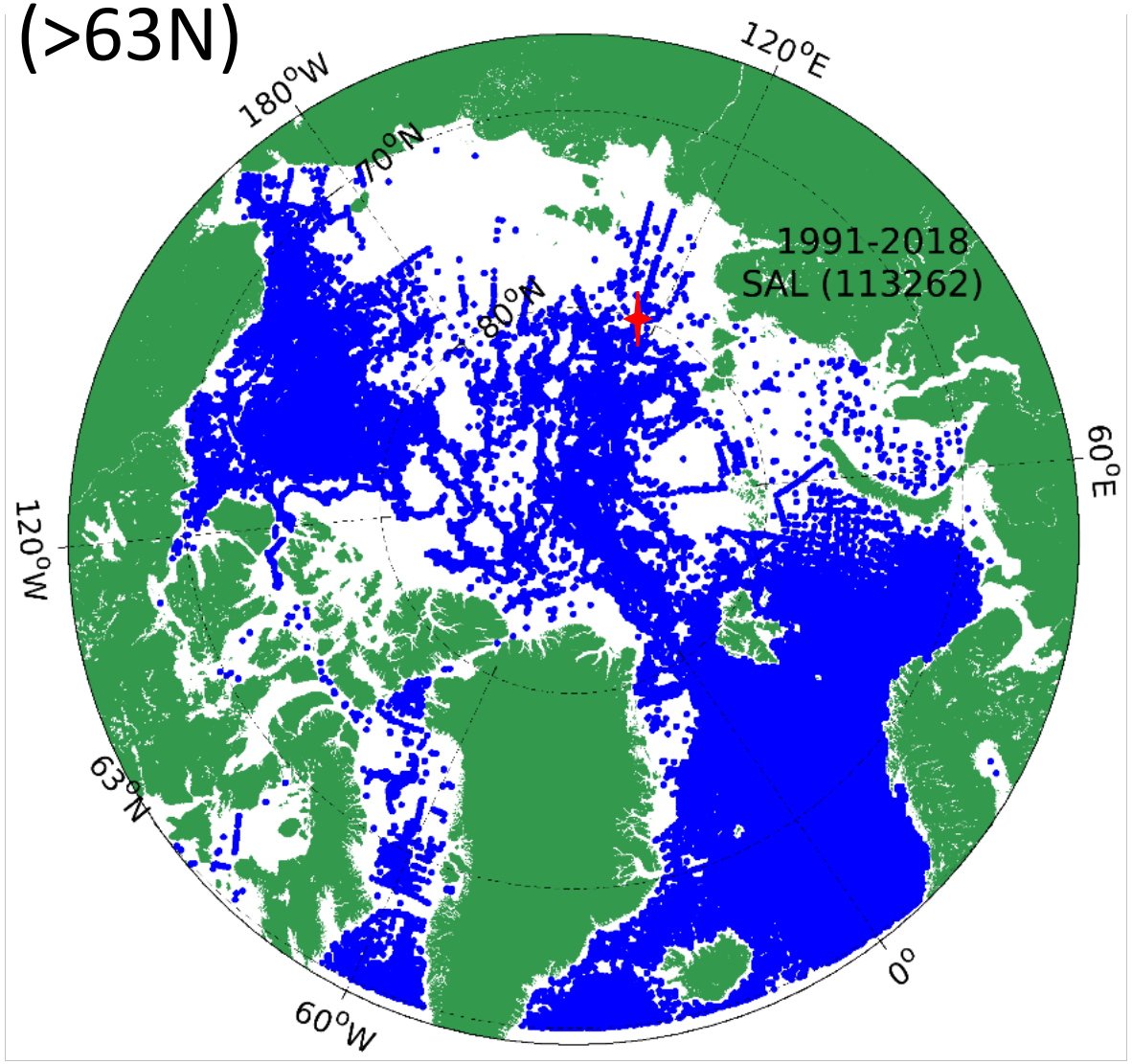
New setting for DA:

- **Different localization scale for T/S profile (600 km vs. the default 300 km)**
- **Mean SSH from Rio2018 to replace that from the model itself**

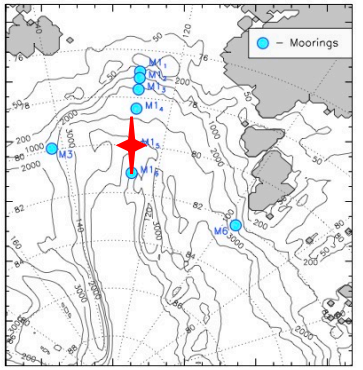
❑ Evaluation of the new reanalysis

Locations of assimilated profiles from CORA5.2 (>63N)

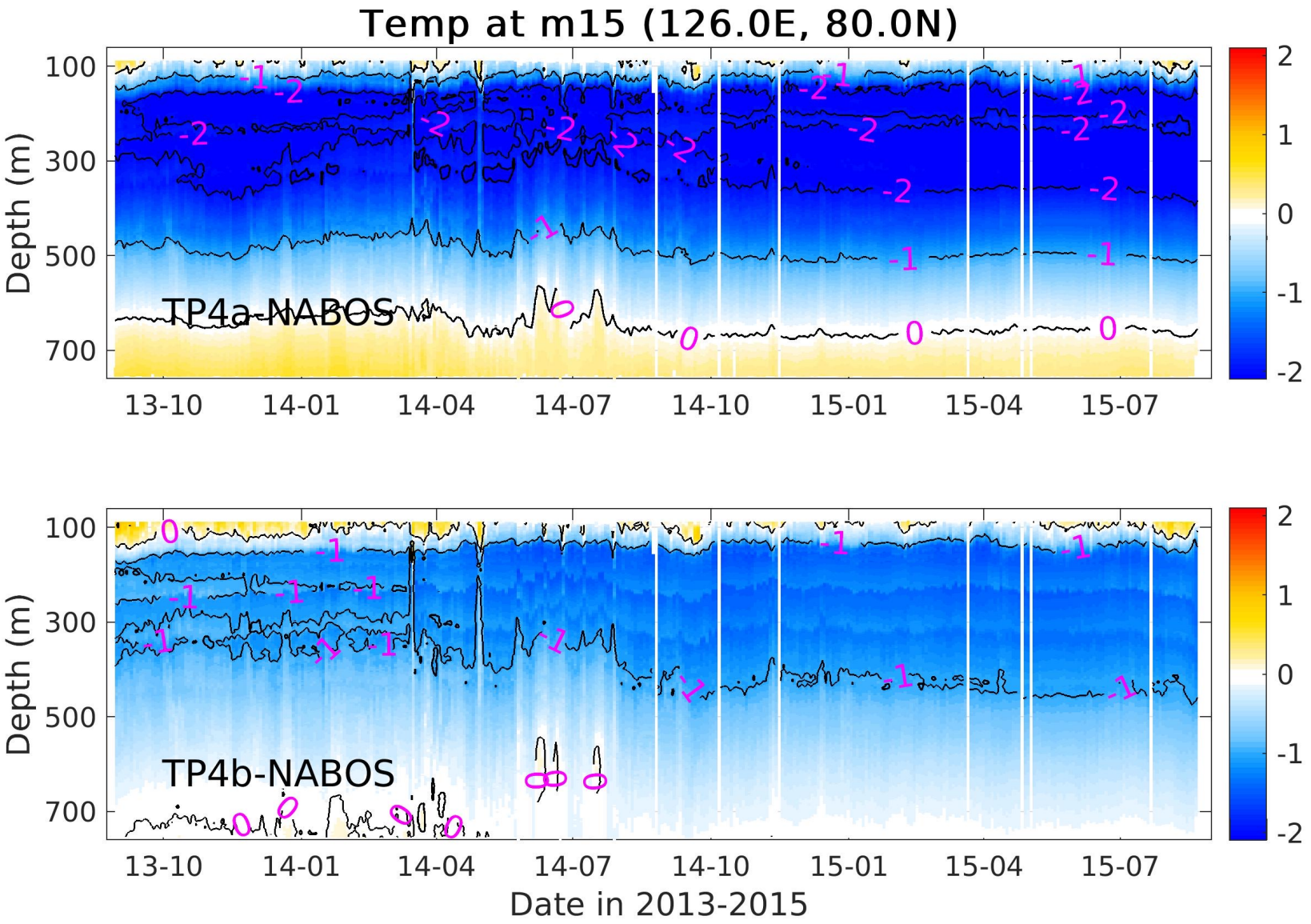


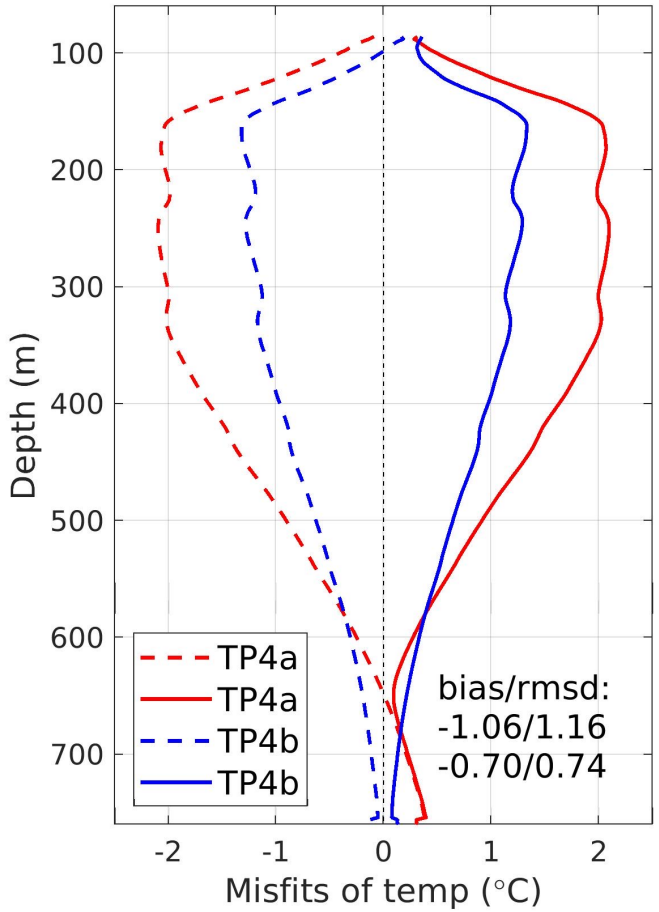


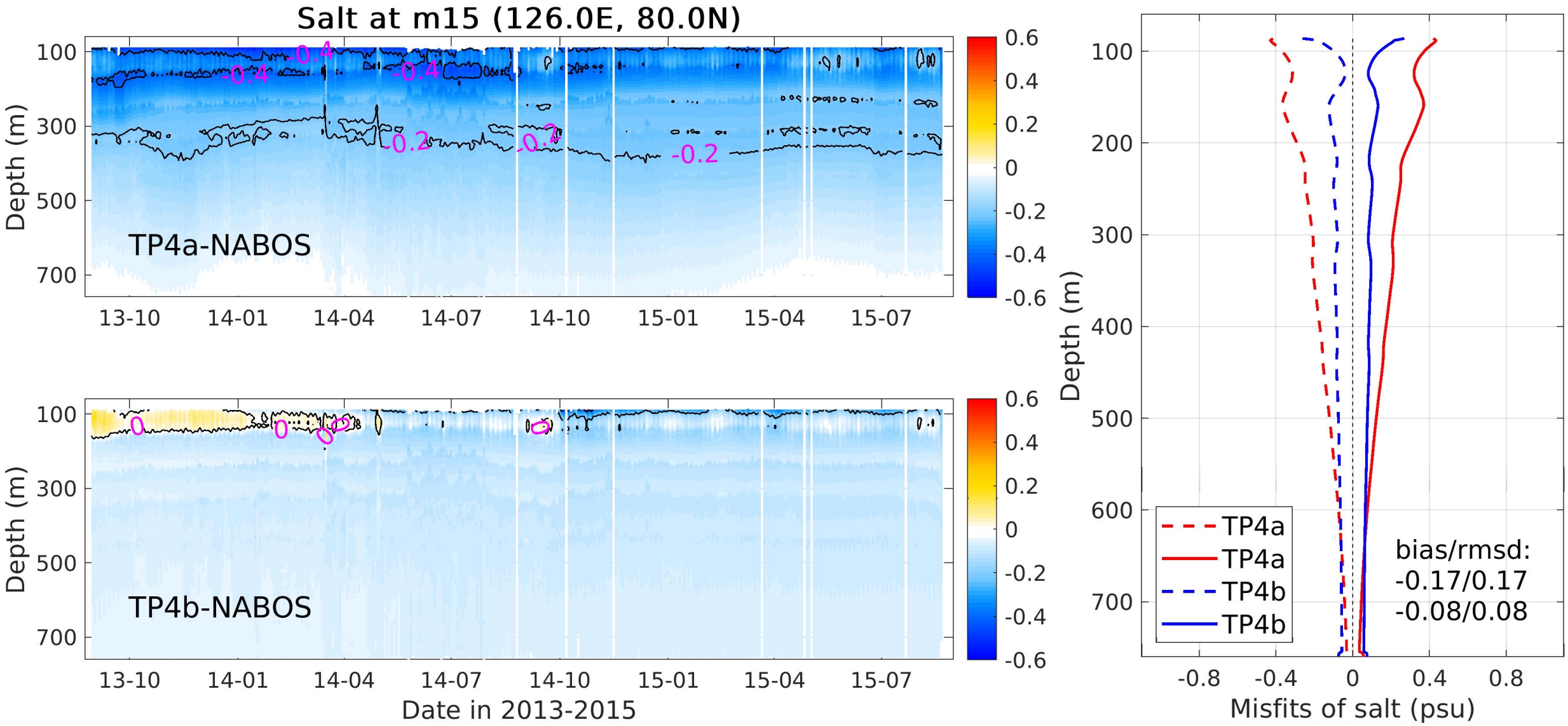
Validation against the NABOS moorings (2013-2015)



https://uaf-iarc.org/nabos/

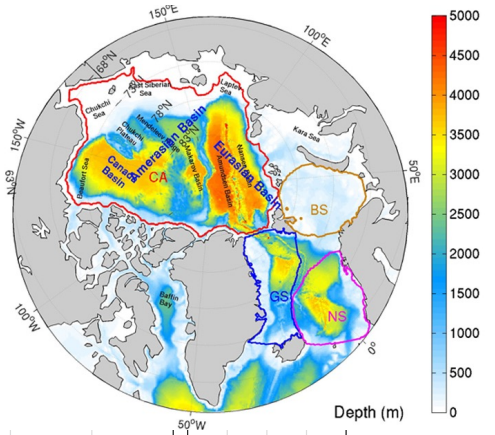


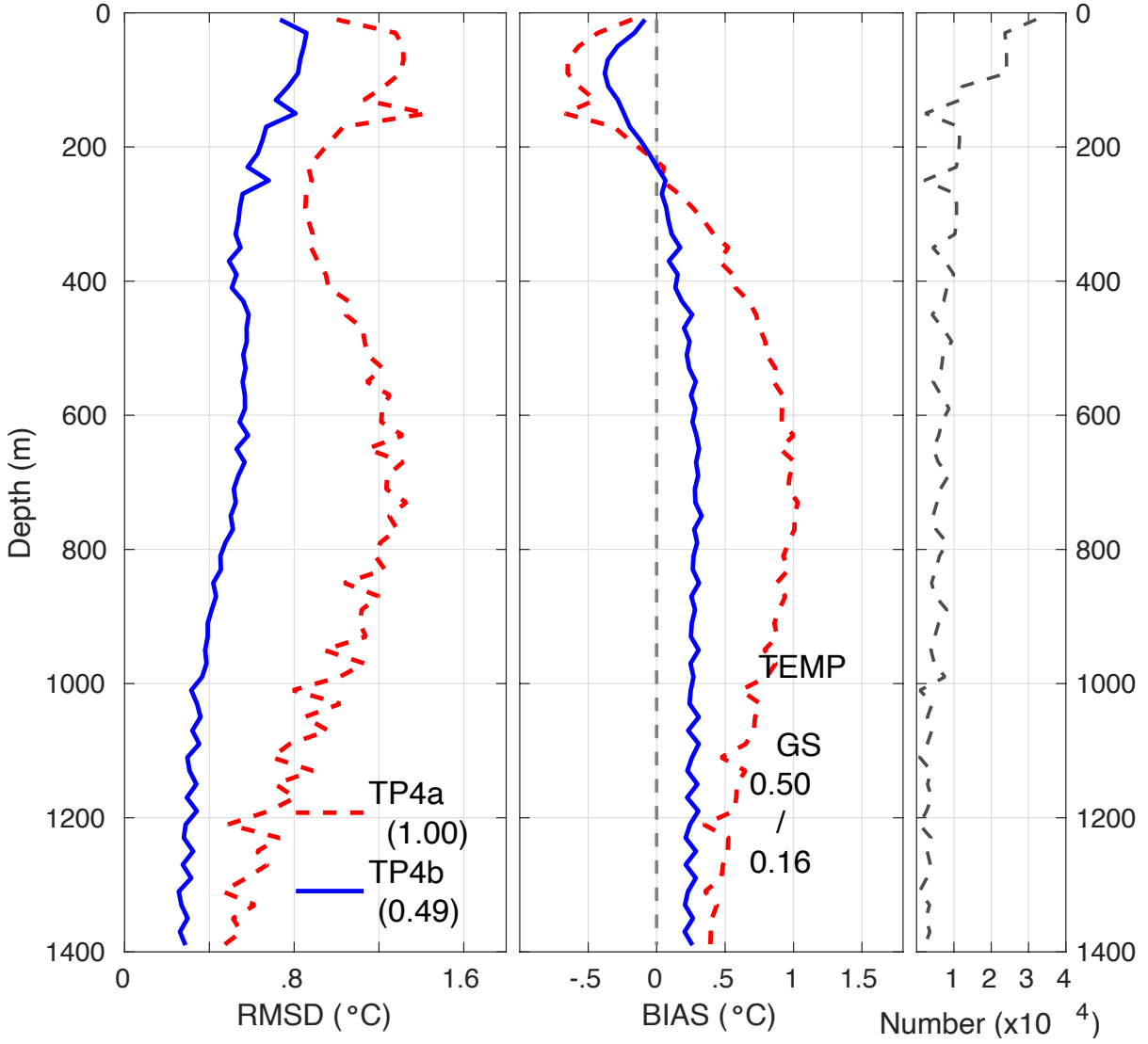


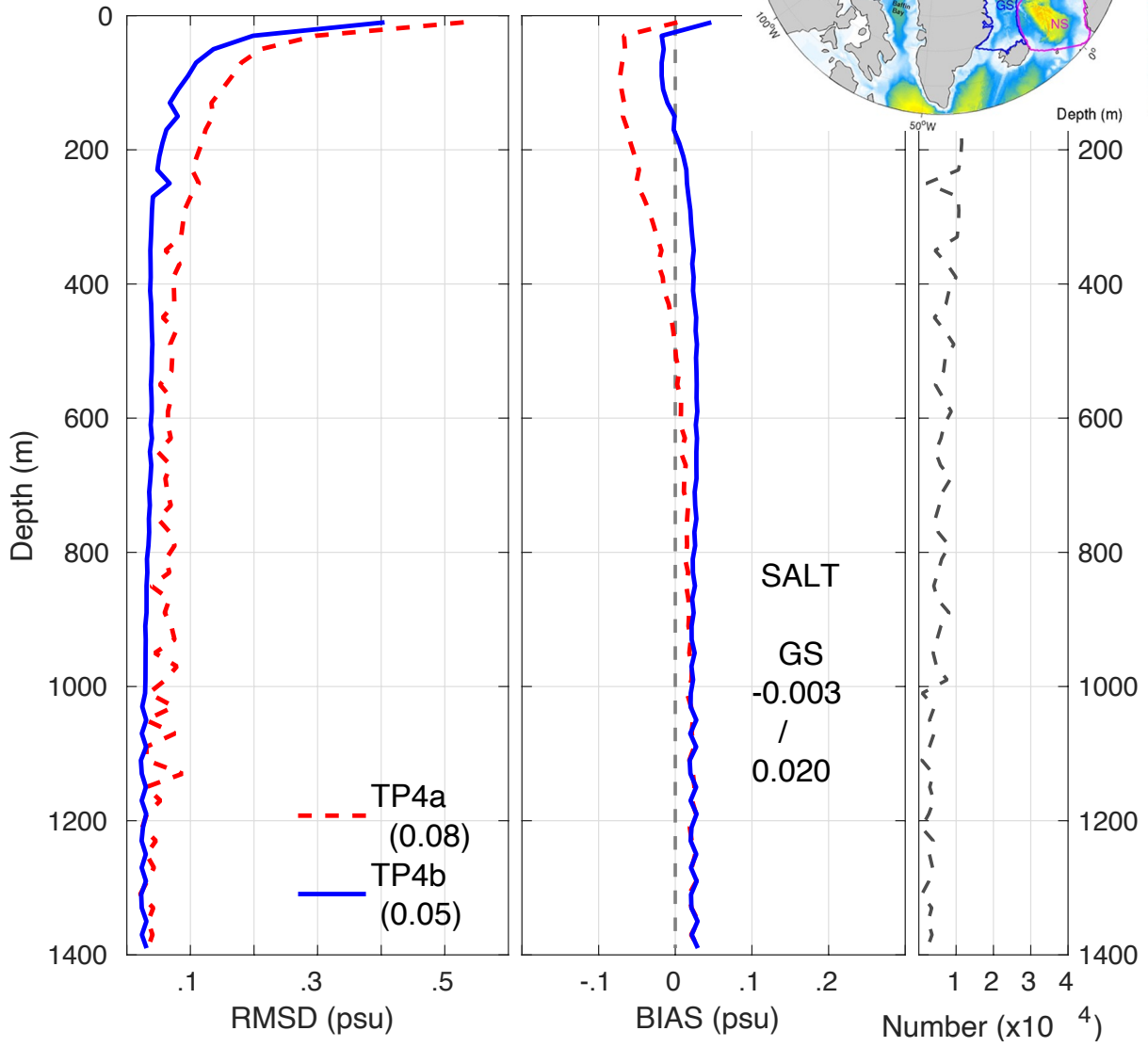

Salt at m15 (126.0E, 80.0N)
Depth (m)
100
300
500
700
-0.4
-0.2
TP4a-NABOS
13-10
14-01
14-04
14-07
14-10
15-01
15-04
15-07
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
0
TP4b-NABOS
Date in 2013-2015
200
400
600
TP4a
TP4a
TP4b
TP4b
bias/rmsd:
-0.17/0.17
-0.08/0.08
-0.8
-0.4
0
0.4
0.8
Misfits of salt (psu)

Validation by CORA5.2

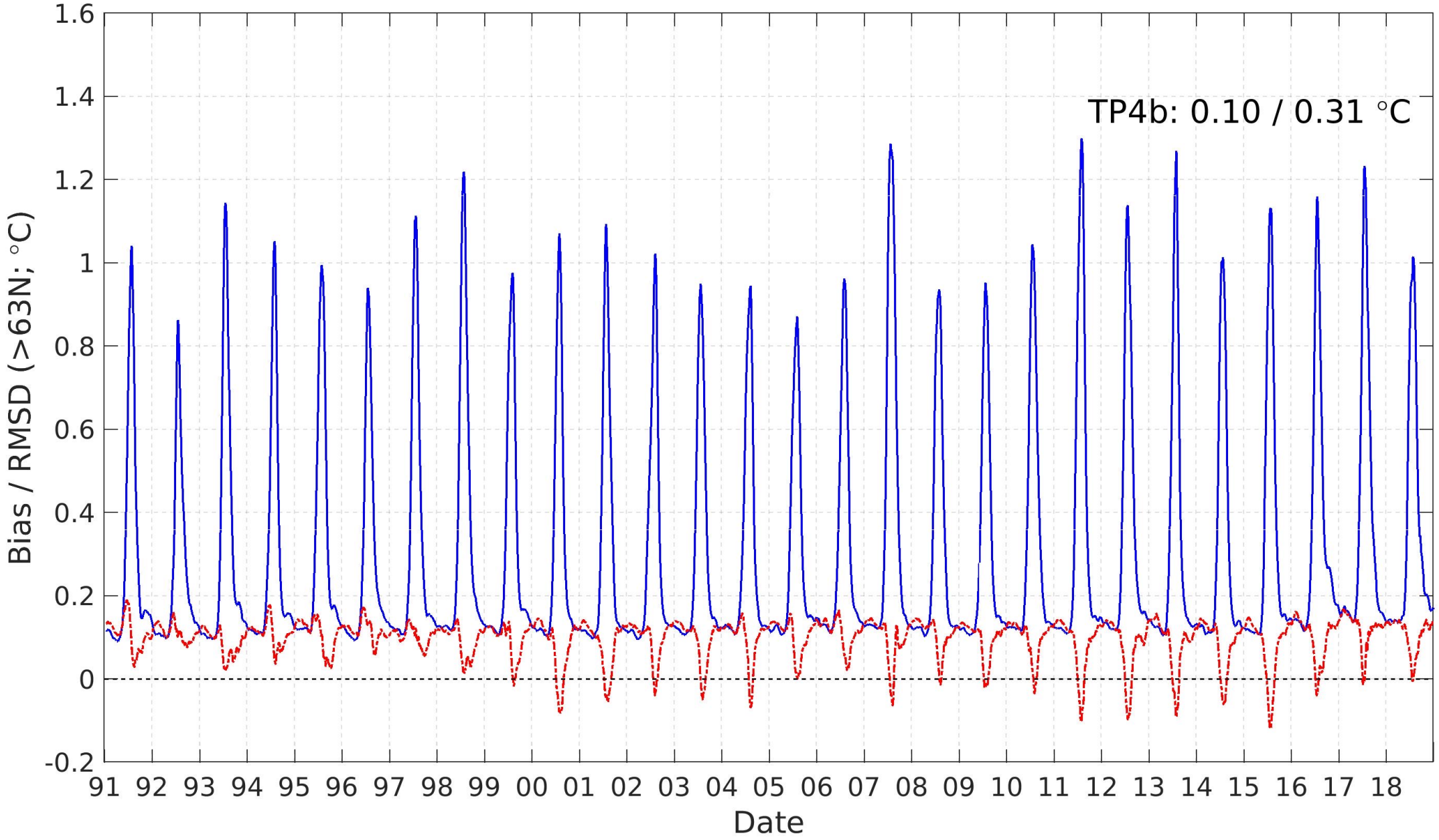
Greenland Sea



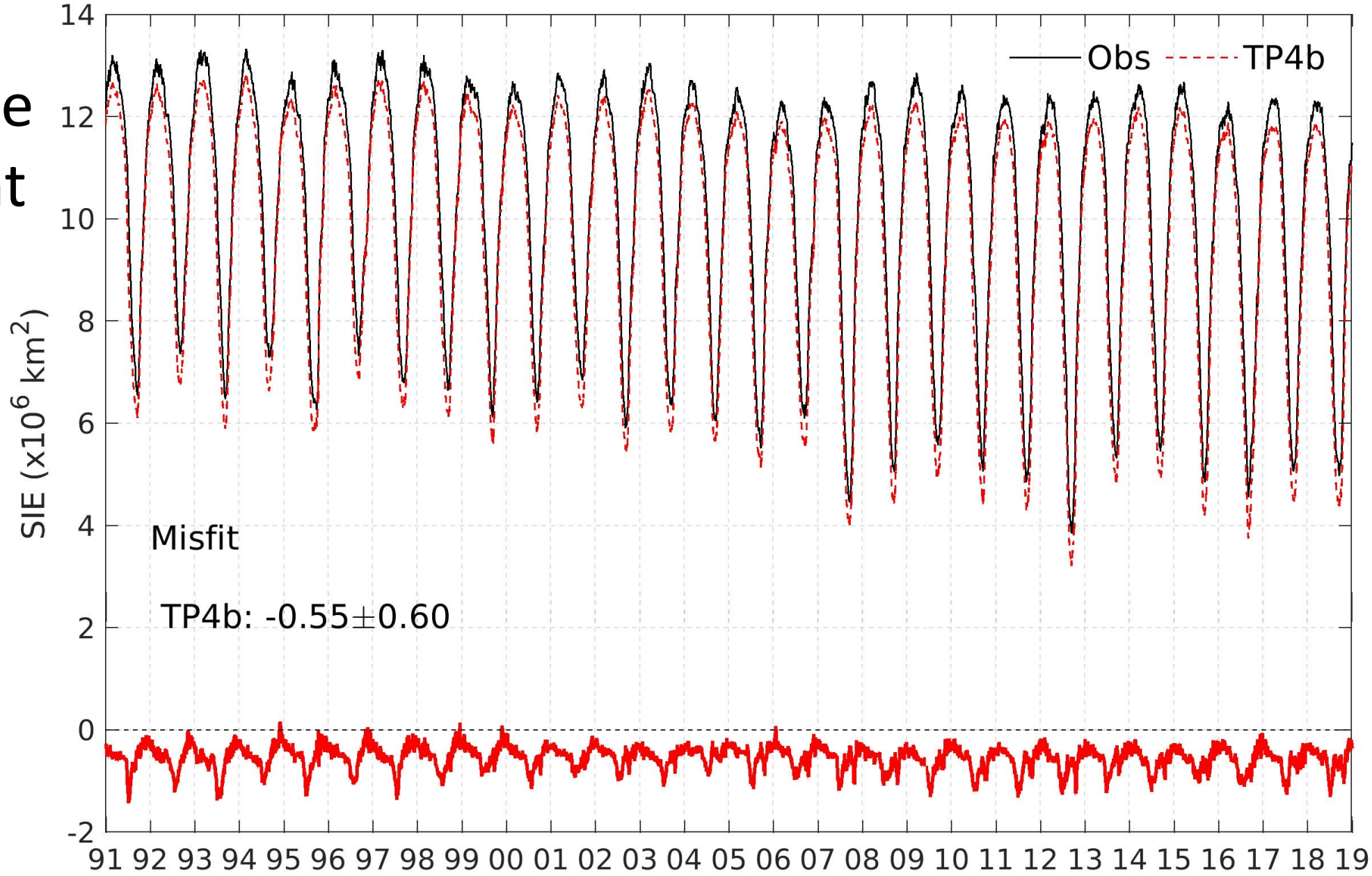




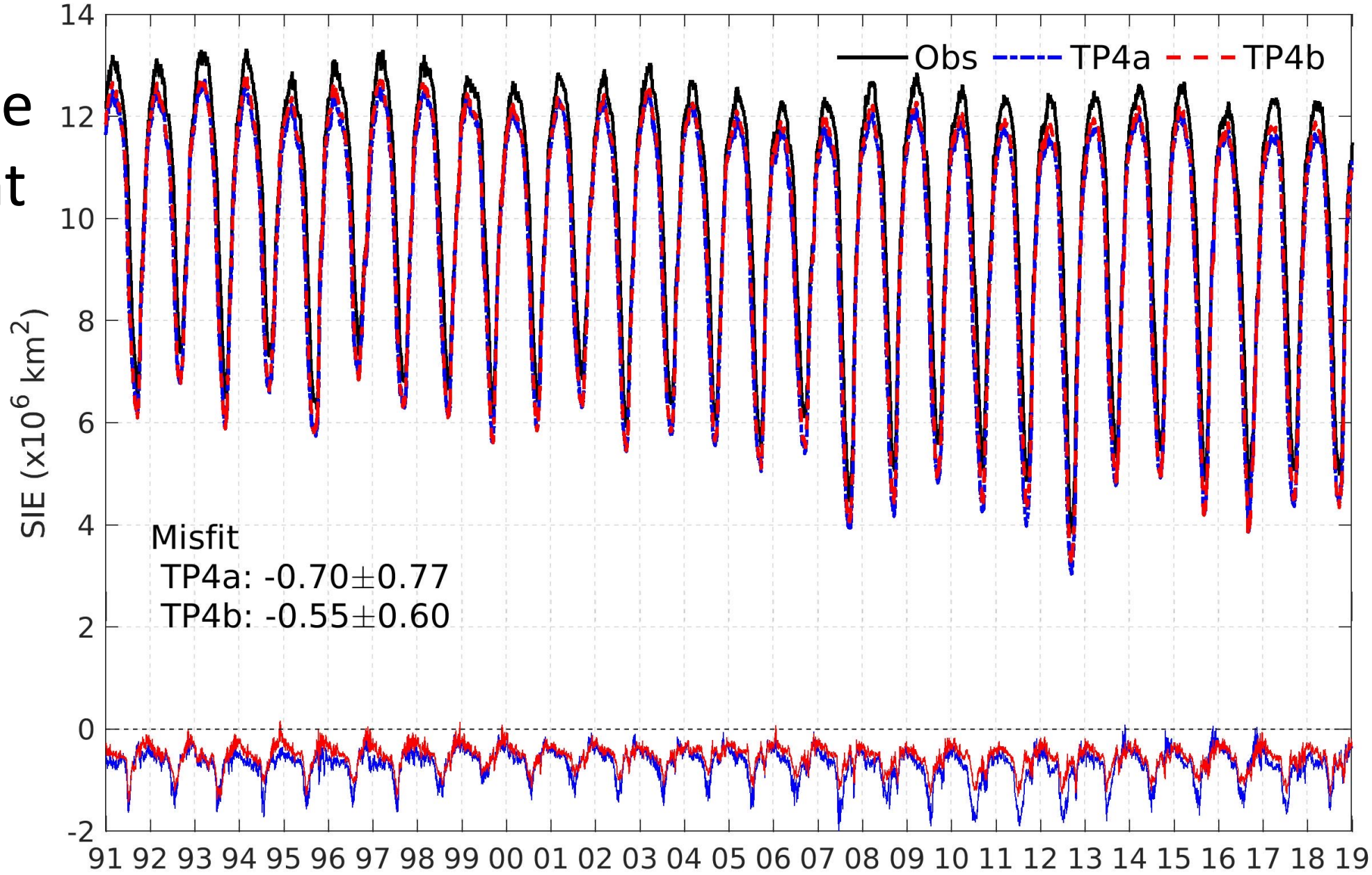
Time seires: SST misfit in the Arctic (>63N; 28 days moving smooth)



Sea ice extent

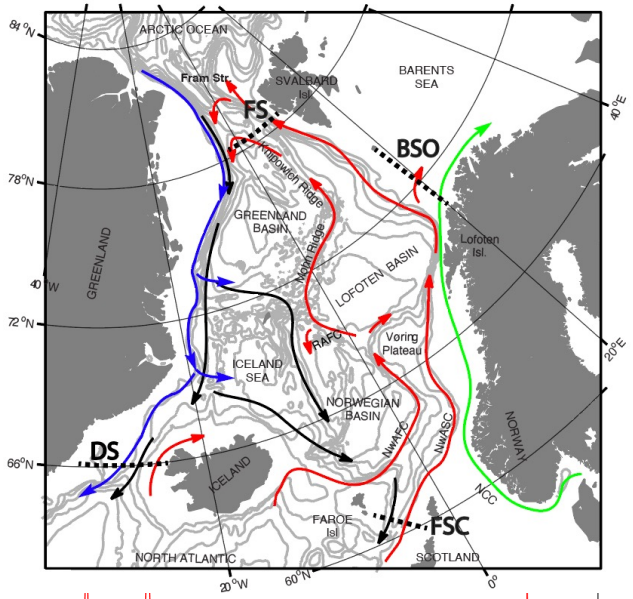


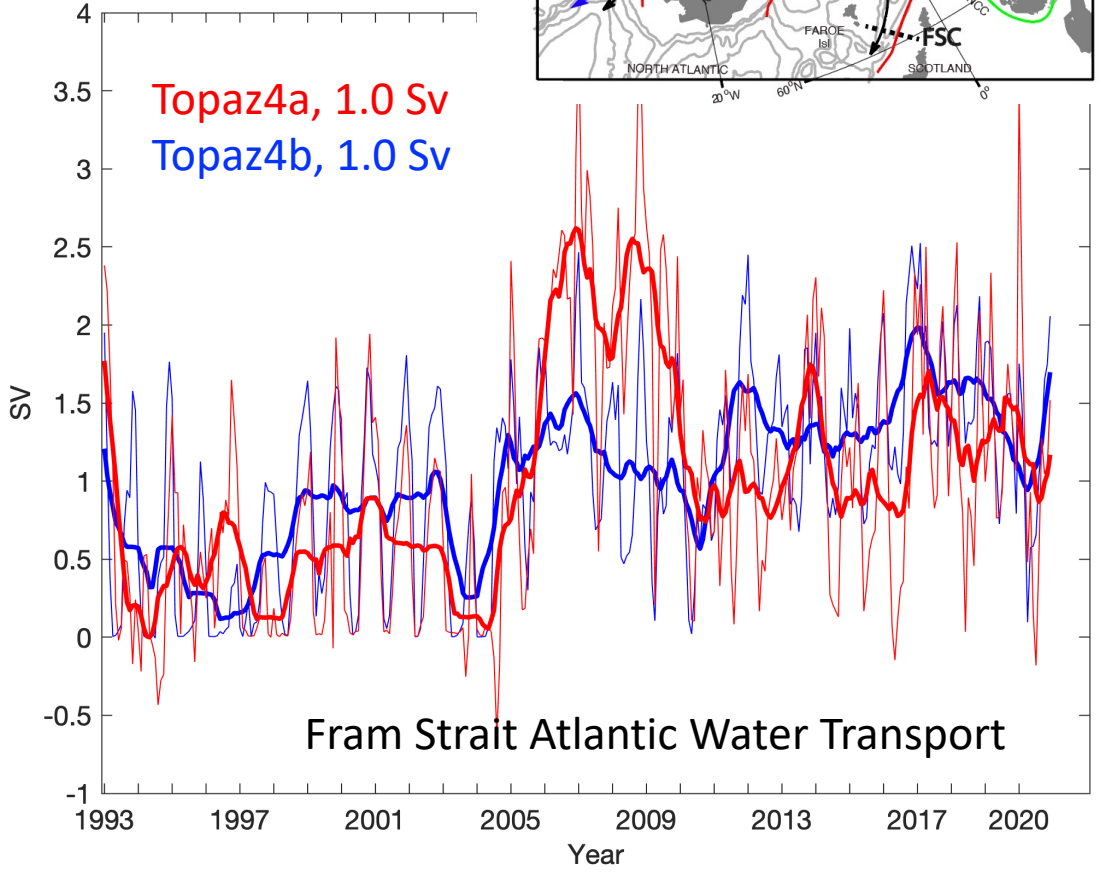
Sea ice extent

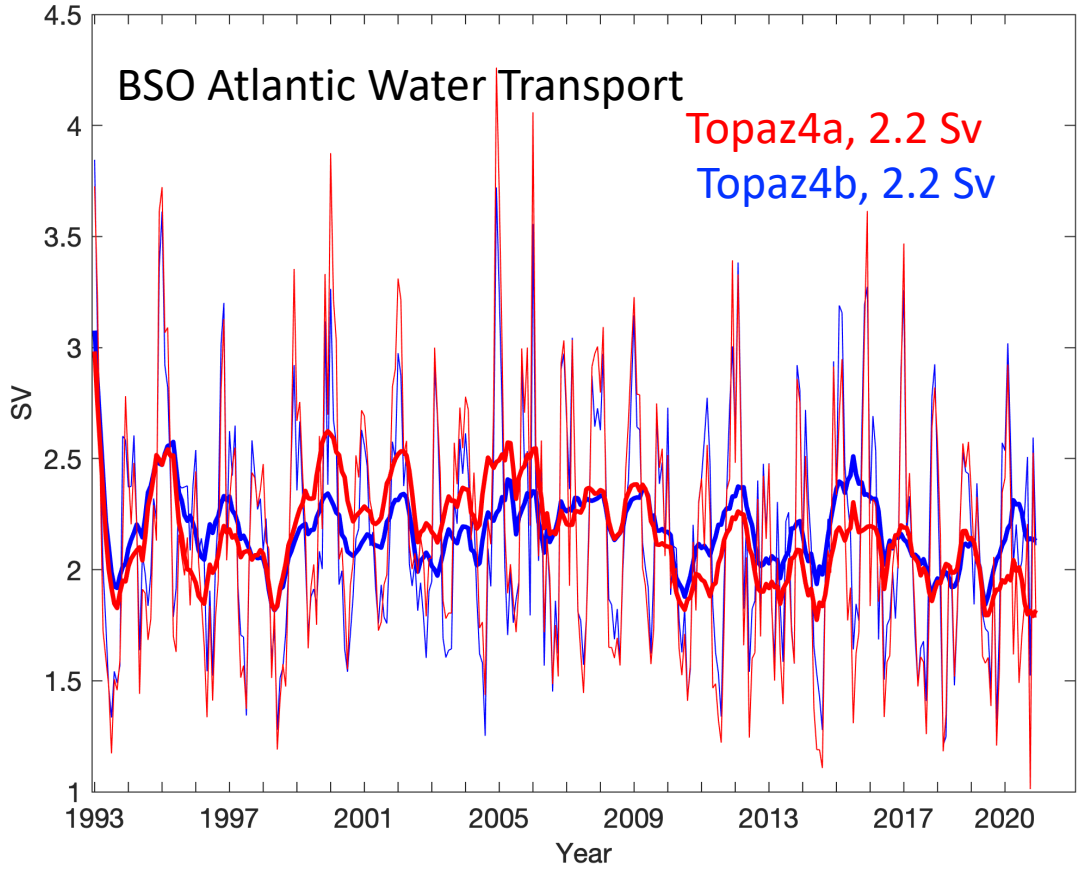


Volume transports of Atlantic Water

--from Roshin P. Raj







❑ Summary

- A 30-years reanalysis of the Arctic ocean and sea ice is available under the Copernicus Marine Environment Monitoring Service.

- The comparison to in situ profiles shows that the temperature and salinity stratification has benefits from the increased vertical resolution (especially for improvements in the Nordic Seas).

- Contrary to the previous Arctic reanalysis, this reanalysis clearly benefits from using consistent ESA CCI data.

- These improvements encourage the use of this Arctic reanalysis for climate studies.

Thank you for your attention !