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Data assimilation system for the operational and reanalysis products in the Baltic Sea area

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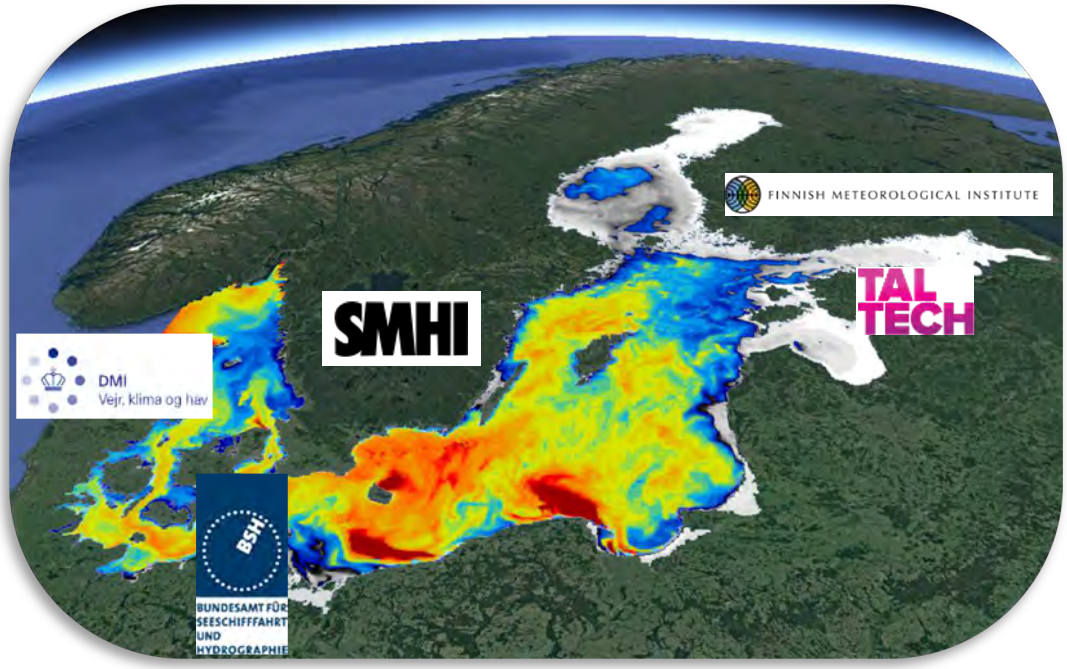
BAL MFC

Consortium of five Baltic Sea Institutes:

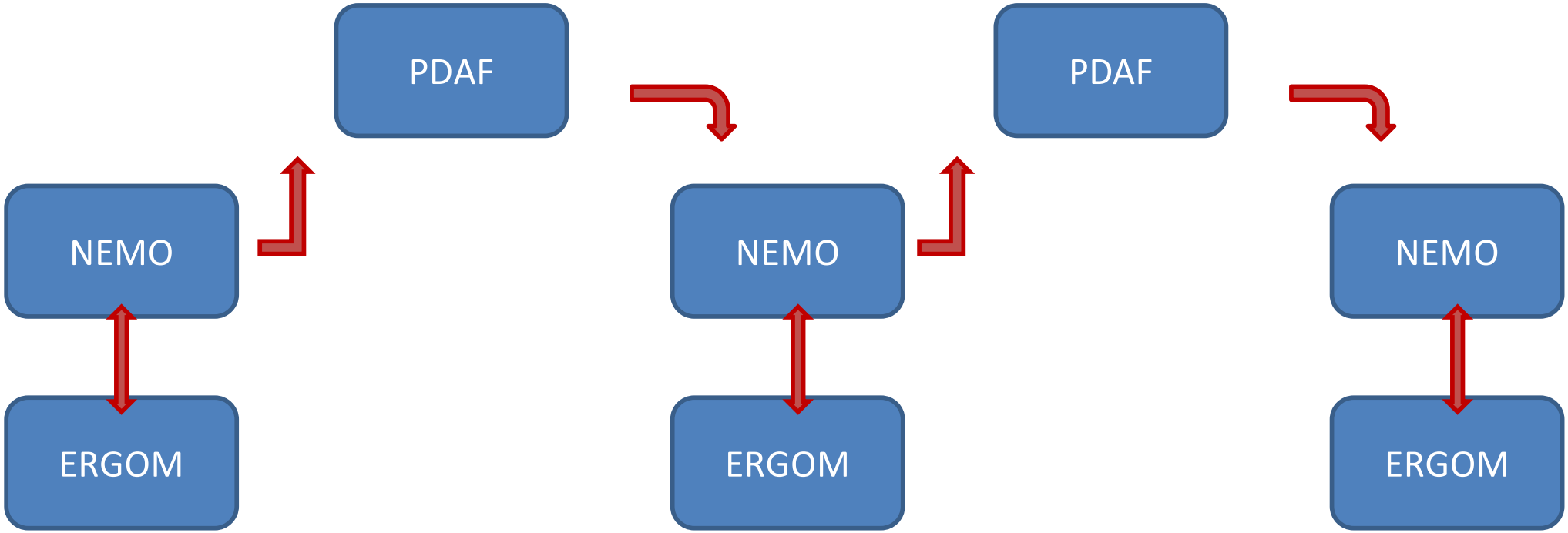
Danish Meteorological Institute (DMI)
Swedish Meteorological and Hydrological Institute (SMHI)
Finnish Meteorological Institute (FMI)
Federal Maritime and Hydrographic Agency (BSH), Germany
Marine System Institute (MSI), TalTech, Estonia



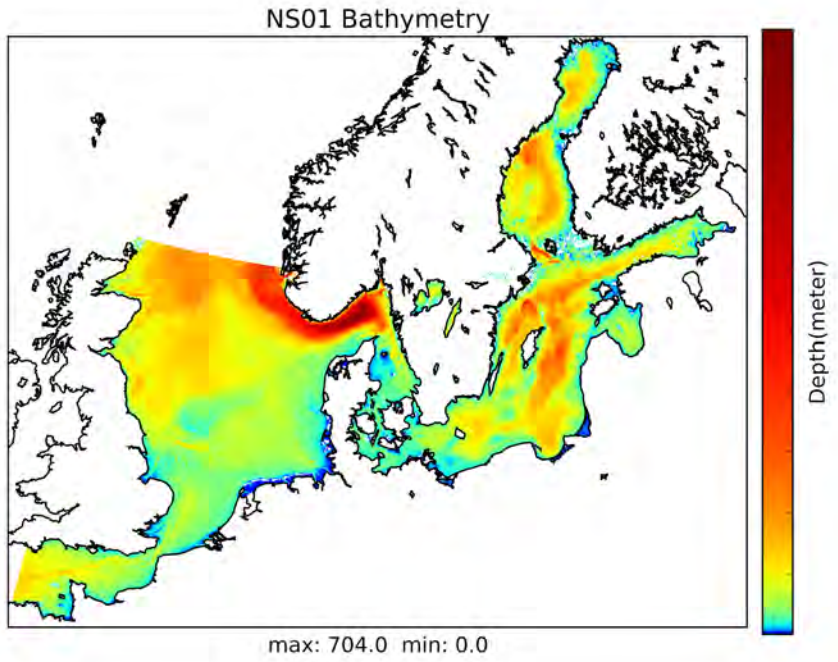
BAL MFC Nemo-Ergom-PDAF system

Baltic Sea Model System consists of four parts:

- **NEMO + SI3 model:** ***sea level, sea current, temperature, salinity, sea ice***
- **WAM :** ***wave height, wave period, wave direction***
- **ERGOM:** ***dissolved oxygen, nutrients, chl-a, carbon cycle***
- **PDAF Data assimilation system:** ***increments for T, S***



Model setup



- Grid size: 1046 x 1238 x 56
- Horizontal resolution of 1 nm
- 56 z* vertical layers
- GLS turbulence scheme
- OBCs from NWS system (T,S,U,V,SSH including tides)
- ATM forcing: ERA5
- EHYPE hydrology

DA scheme: PDAF LESTKF

- DA scheme: LESTKF (Local Ensemble Square-root Transform Kalman Filter)
- Error covariances: anomalies sampled from 5-year long historical run without DA
- Ensemble size = 70 members
- Constant influence radius for both SST and T/S profiles
- Gaspari-Corn localization with exponential support and radius R = 50 km

  for SST and 25 km for T/S profiles

- Nemo model runs on 15 nodes, PDAF runs on 4 nodes

	SST	T/S
DA exp1	daily	---
DA exp2	72 hours	72 hours

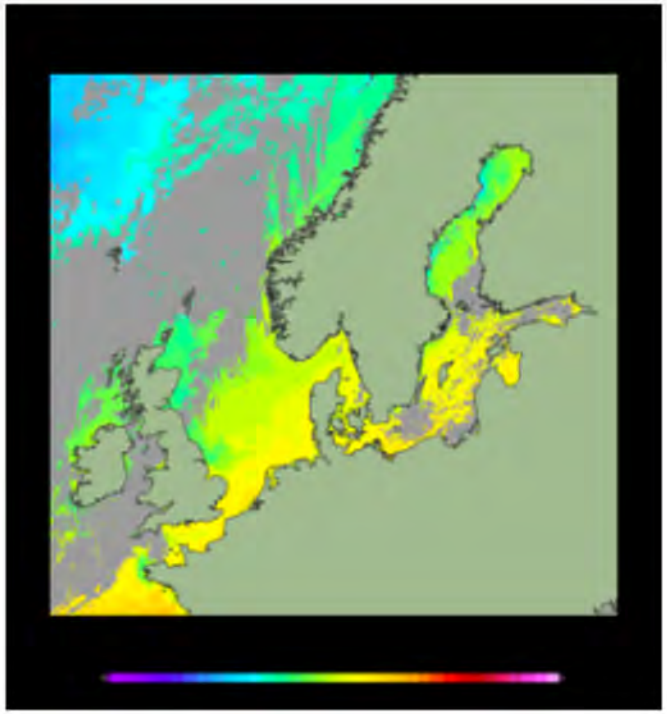
DA exp1: assimilation of SST

Assimilated data set: SST_BAL_SST_L3S_NRT_OBSERVATIONS_010_032 from CMEMS

NORTH SEA/BALTIC SEA - SEA SURFACE TEMPERATURE ANALYSIS L3S

Metadata provided by CMEMS

Credits: E.U. Copernicus Marine Service Information



OVERVIEW

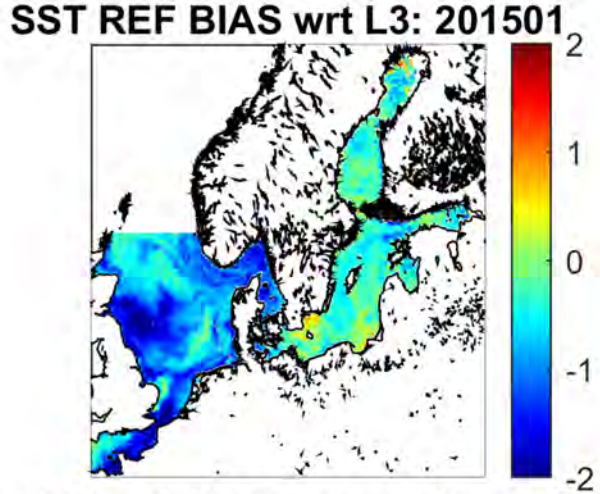
Short description:
For the Baltic Sea- The DMI Sea Surface Temperature L3S aims at providing daily multi-sensor supercollated data at 0.03deg. x 0.03deg. horizontal resolution, using satellite data from infra-red radiometers. Uses SST satellite products from these sensors: NOAA AVHRRs 7, 9, 11, 14, 16, 17, 18 , Envisat ATSR1, ATSR2 and AATSR.

REFERENCES

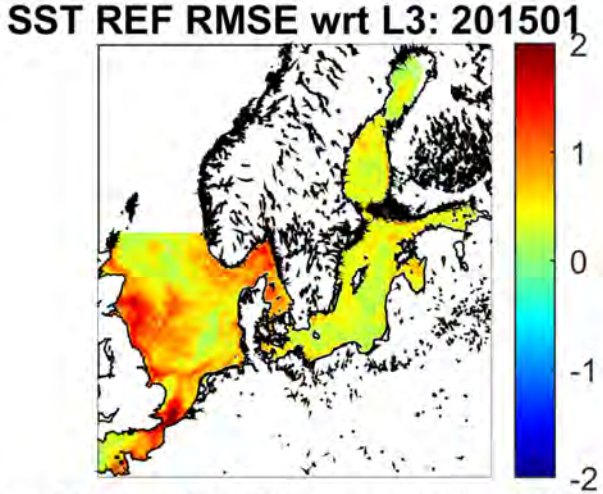
Høyer, J. L., Le Borgne, P. and Eastwood, S. 2014. A bias correction method for Arctic satellite sea surface temperature observations. Remote Sensing of Environment. https://doi.org/10.1016/j.rse.2013.04.020.

Høyer, J. L. and She, J., Optimal interpolation of sea surface temperature for the North Sea and Baltic Sea, J. Mar. Sys., Vol 65, 1-4, pp., 2007.Høyer, J. L. and She, J., Optimal interpolation of sea surface temperature for the North Sea and Baltic Sea, J. Mar. Sys., Vol 65, 1-4, pp., 2007.

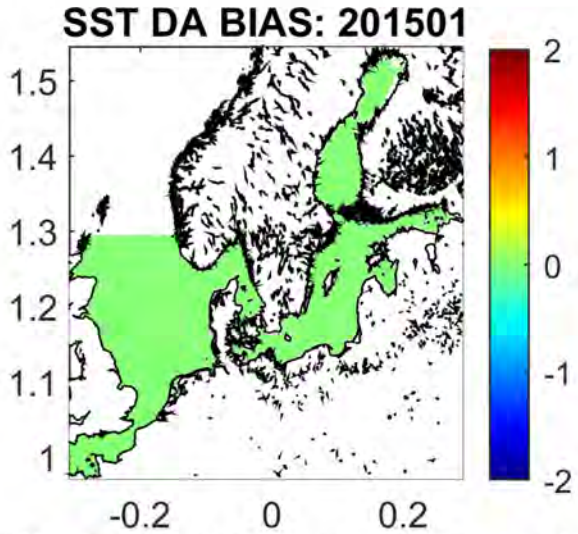
Results DA exp1: monthly mean SST errors for January 2015



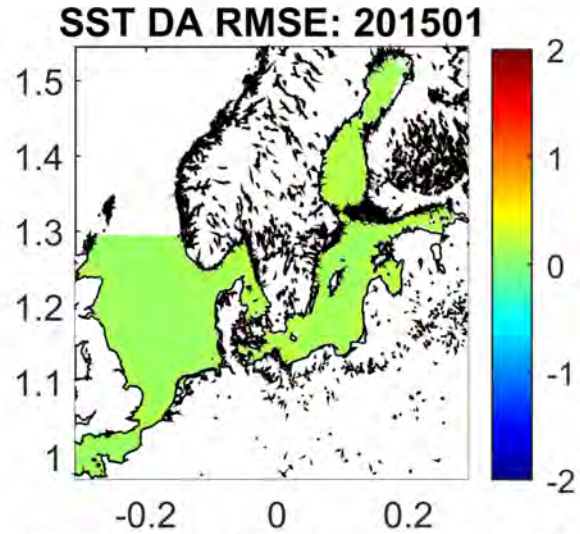
mean NS =-1.0085, mean BS =-0.28074



mean NS =0.68744, mean BS =0.38007

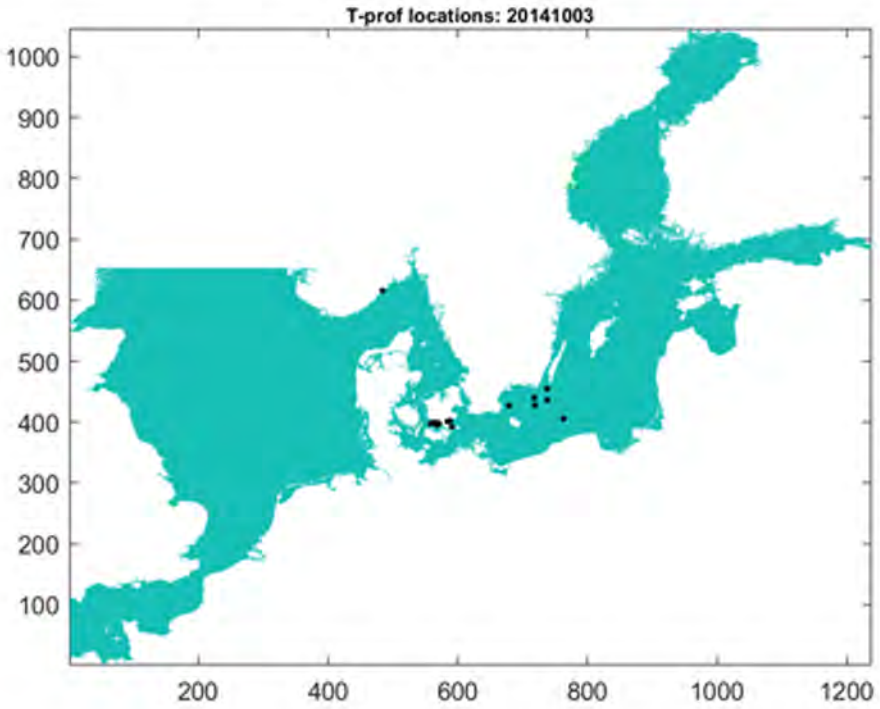


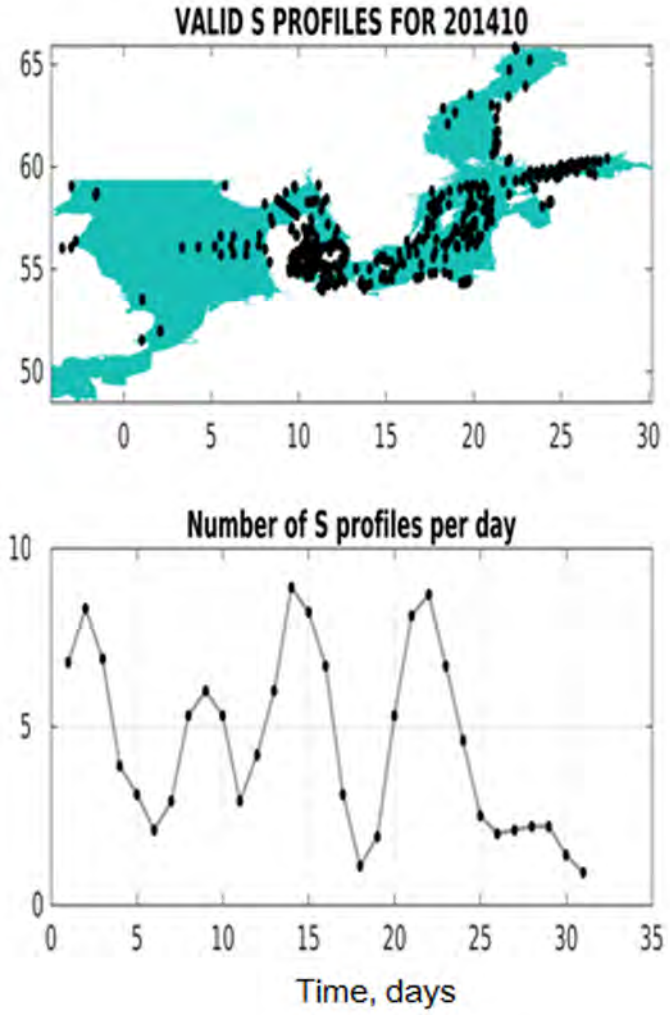
mean NS =0.0032764, mean BS =0.01062



mean NS =0.10377, mean BS =0.15293

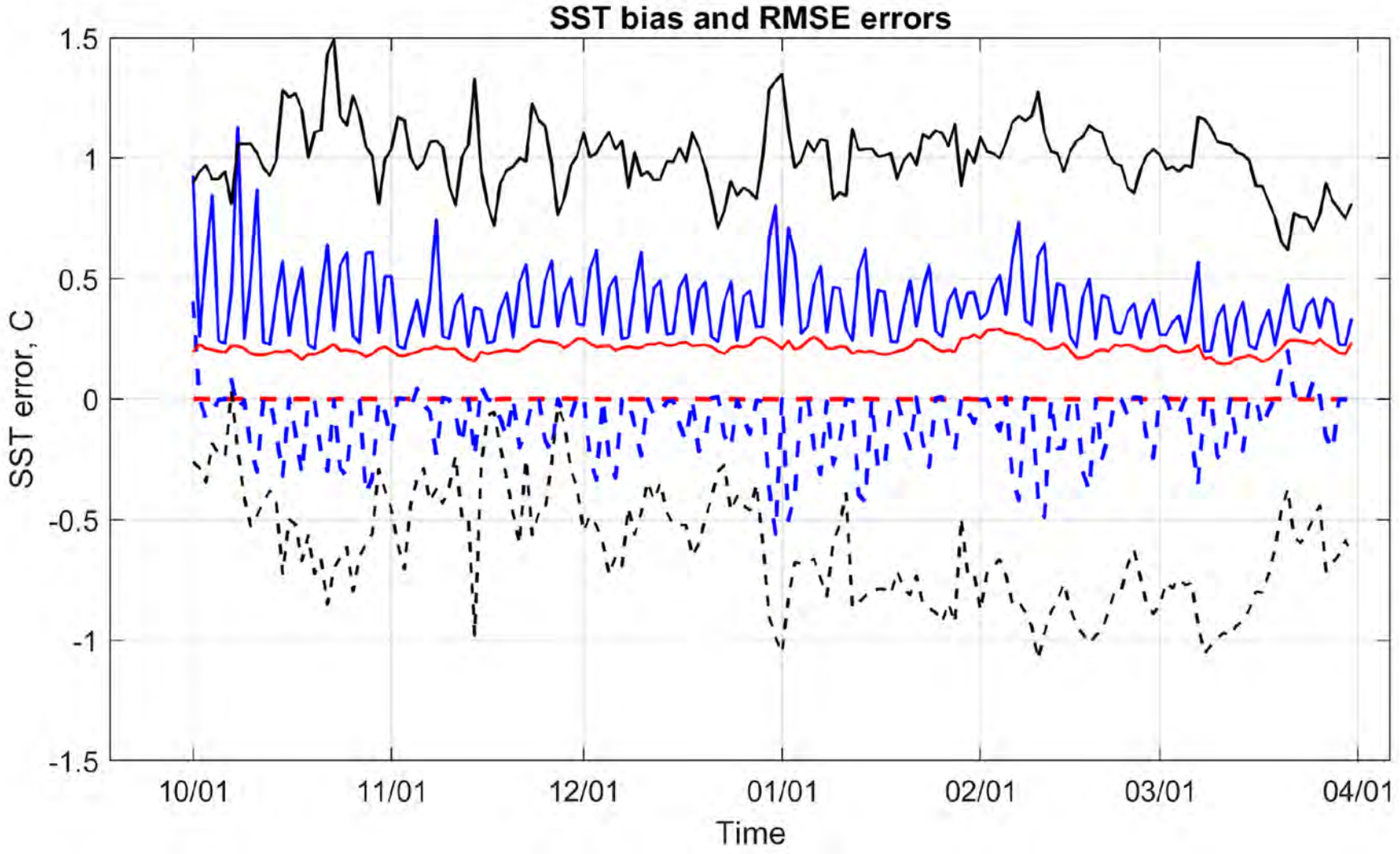
DA exp2: assimilate SST + T/S profiles





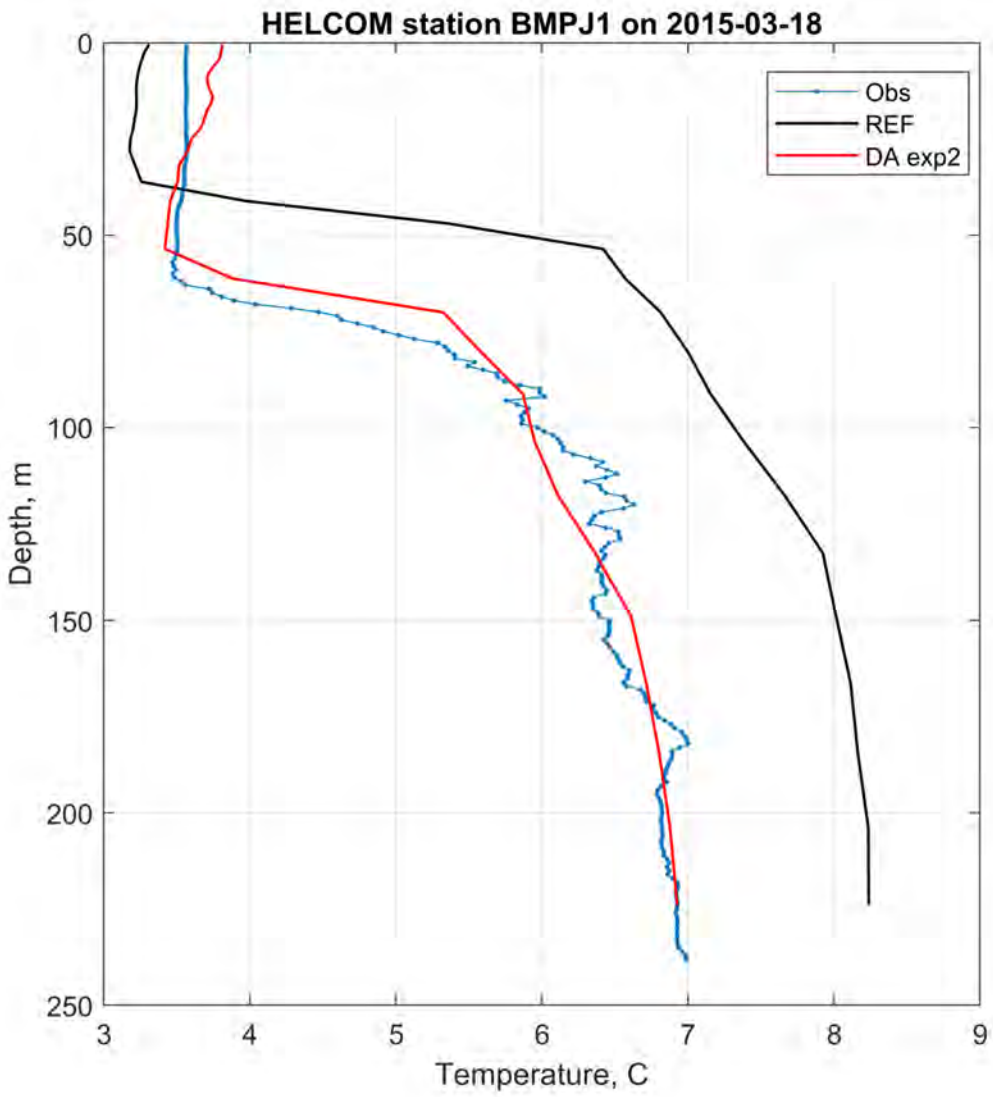
- SST data set: same as in DA exp1
- Daily T/S profiles from ICES

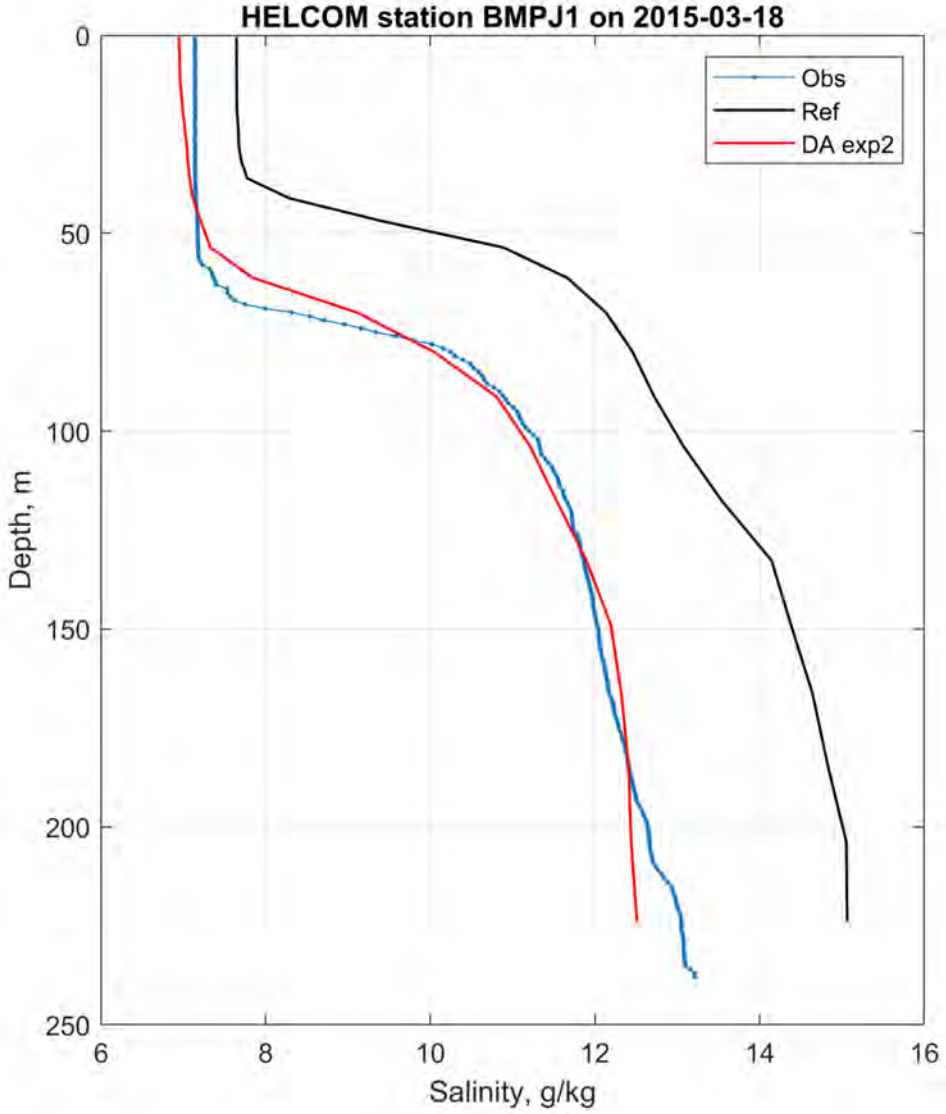
Results DA exp2



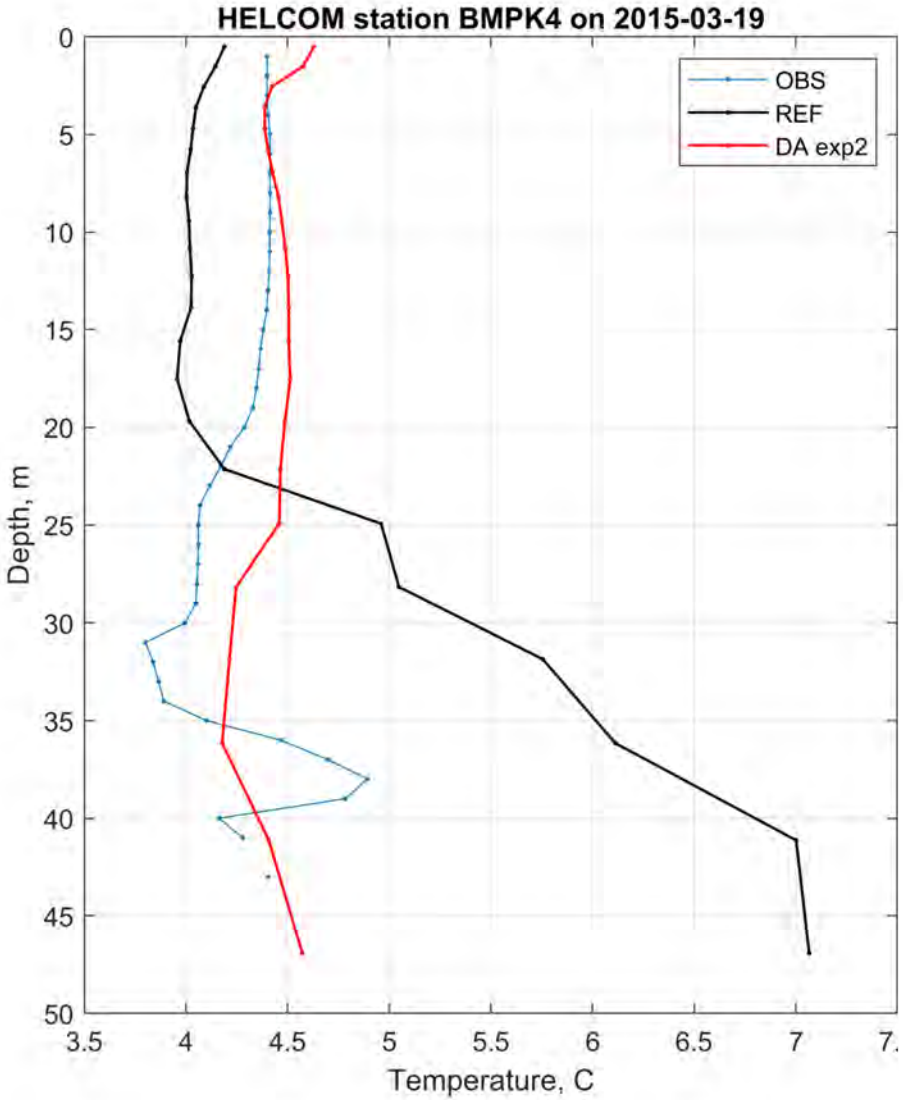
REF DA exp1 DA exp2

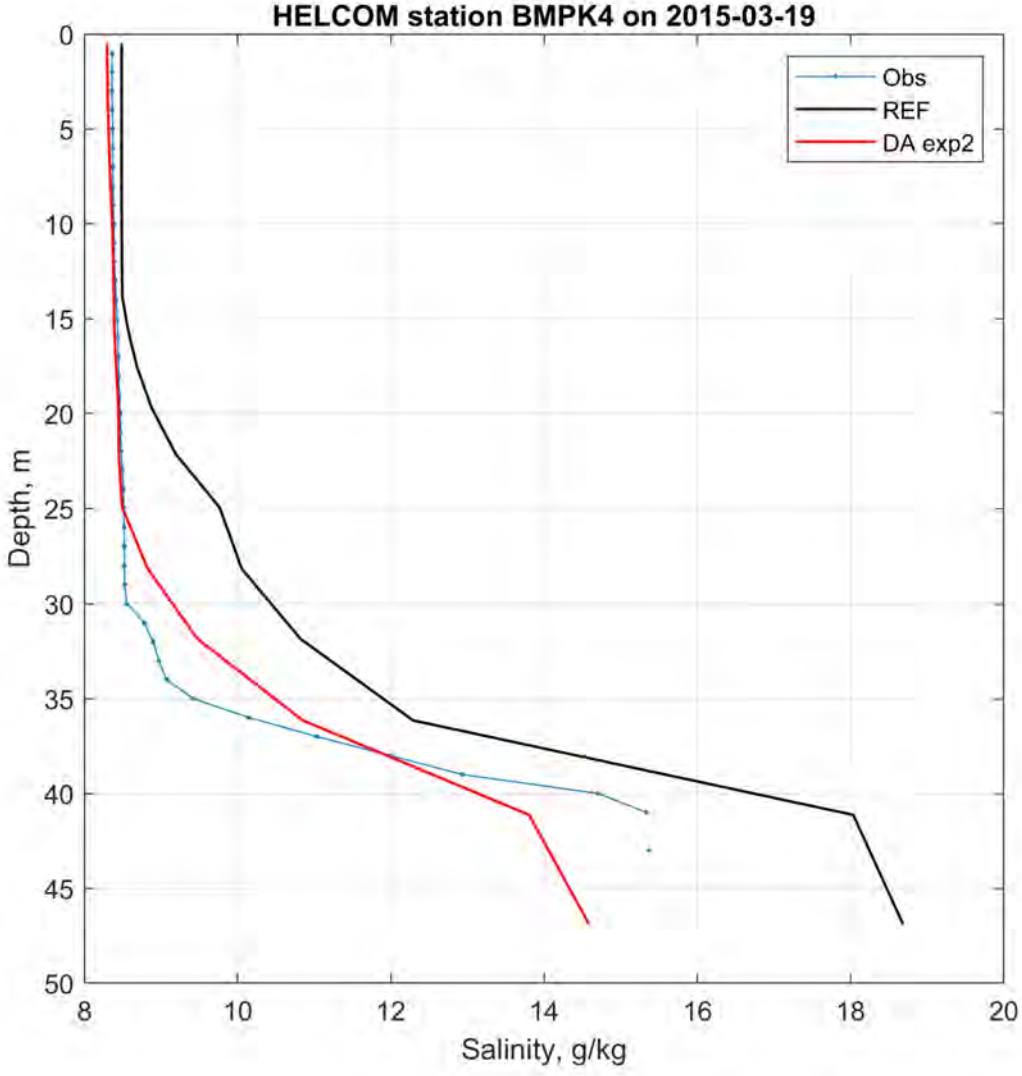
Results DA exp2: verification against HELCOMt observations



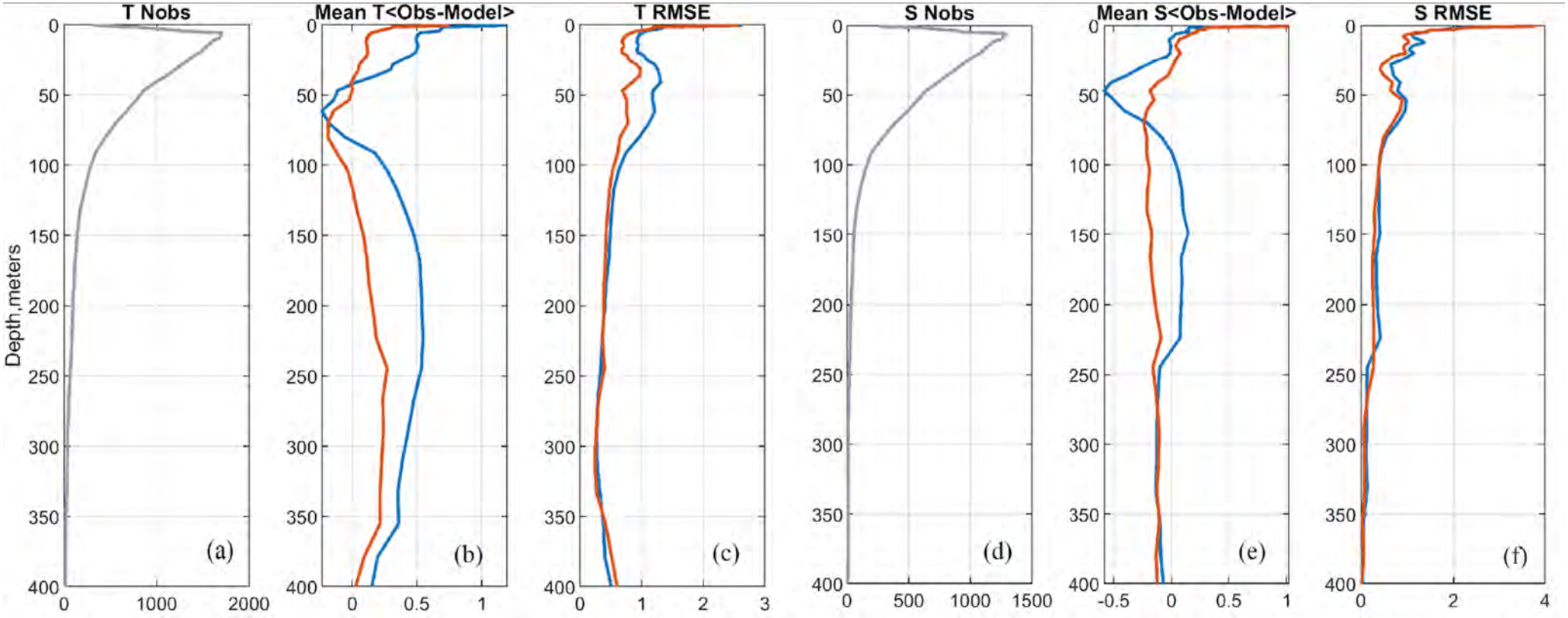


Results DA exp2: verification against HELCOM observations

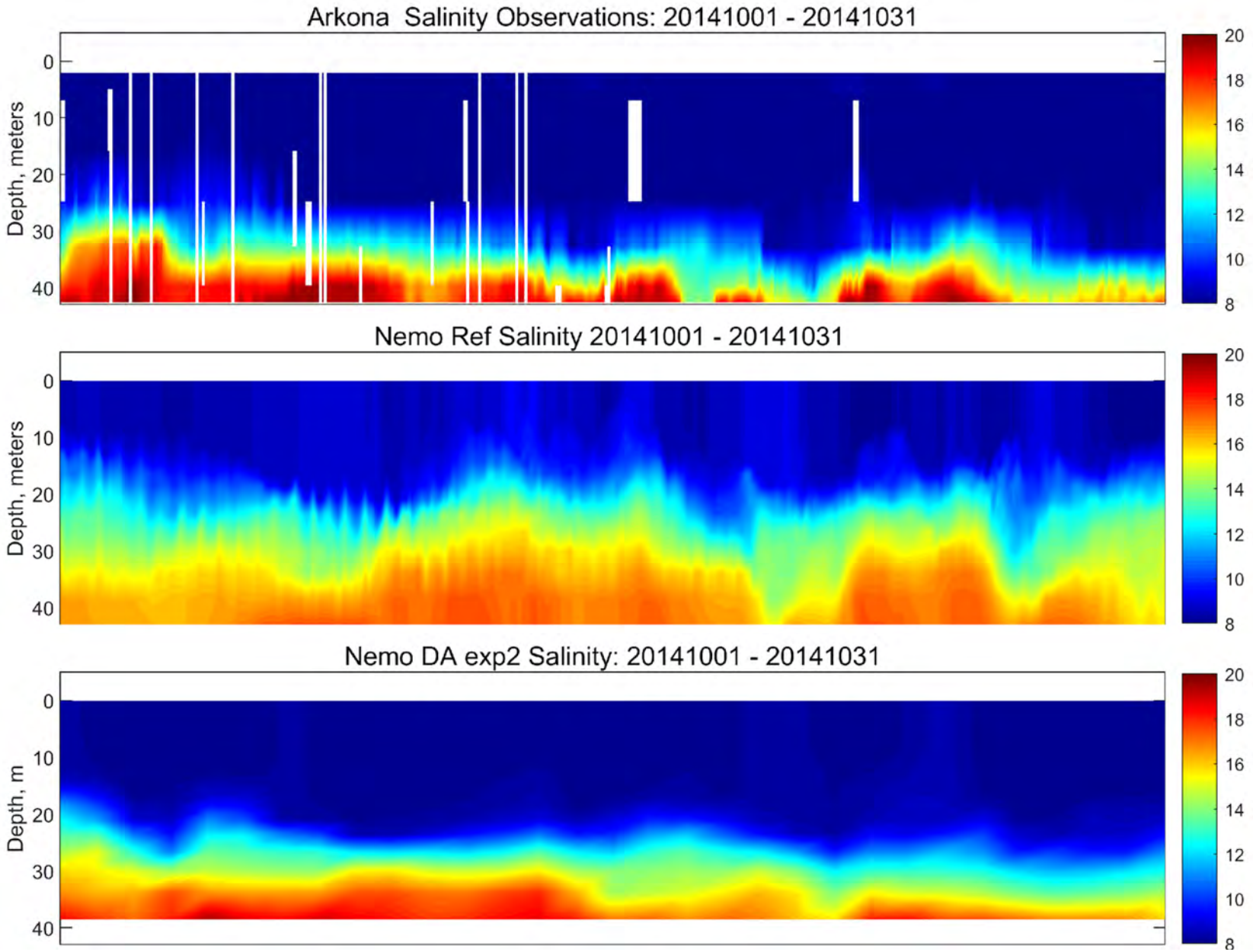




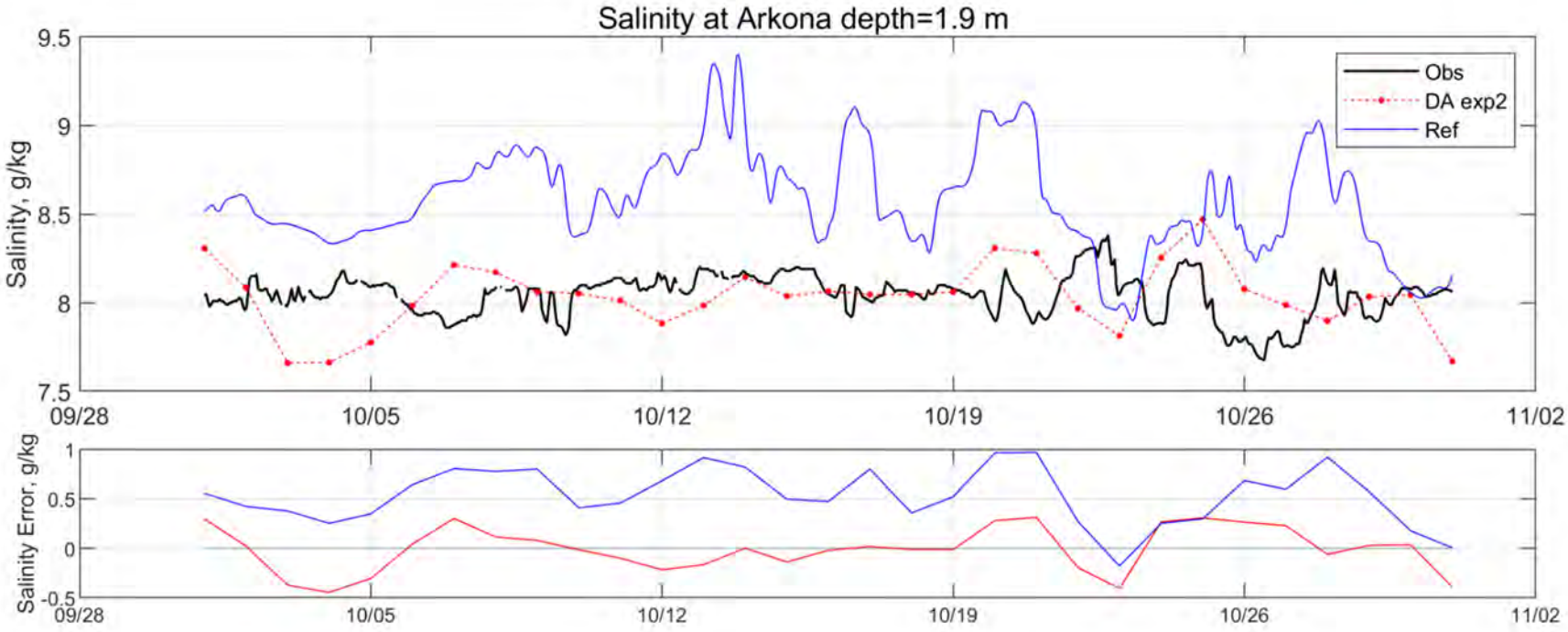
Results DA exp2: averaged error statistics over October 2014 – April 2015



Results DA exp2: verification against independent MARNET stations

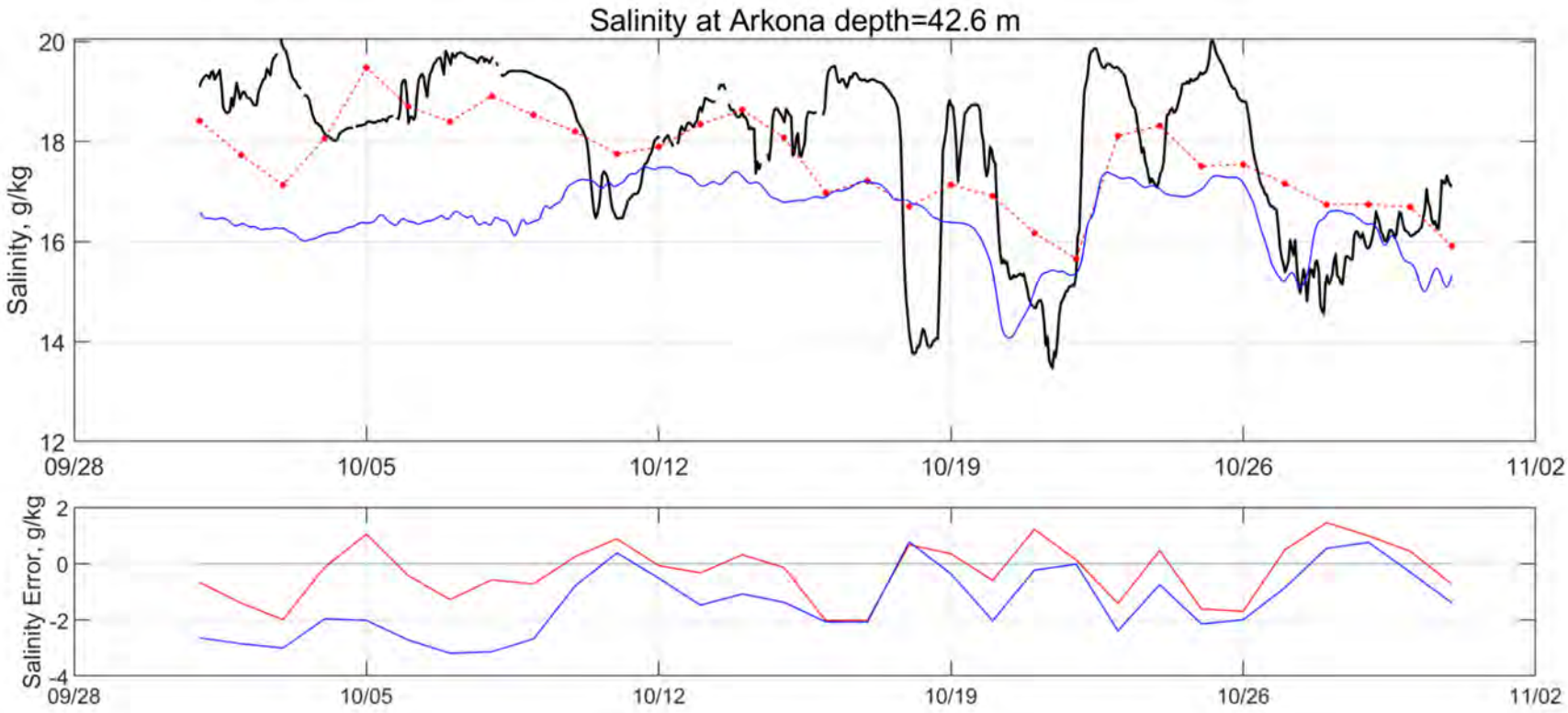


Results DA exp2: verification against independent MARNET stations



Salinity, g/kg	Ref run	DA exp2
Mean bias	0.53	-0.01
RMSE	0.60	0.22
CRMSE	0.27	0.22

Results DA exp2: verification against independent MARNET stations



Salinity, g/kg	Ref run	DA exp2
Mean bias	-1.40	-0.29
RMSE	1.83	1.04
CRMSE	1.18	0.99

Conclusions and future work

Conclusions:

- The DA system works well for both SST and T/S
- Good improvements for SST and T/S
- The system is ready for the reanalysis

Future work:

- spatially variable localization (SVL)
- Error subspace reduction (EOFs)
- Reduce memory and cpu requirements
- Assimilate more observation types (sea ice charts)