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Prediction of Ocean State by assimilation of FerryBox temperature and salinity data. A case study for the German Bight

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JONSMOD 2012, BREST, France, 21th – 23th May 2012

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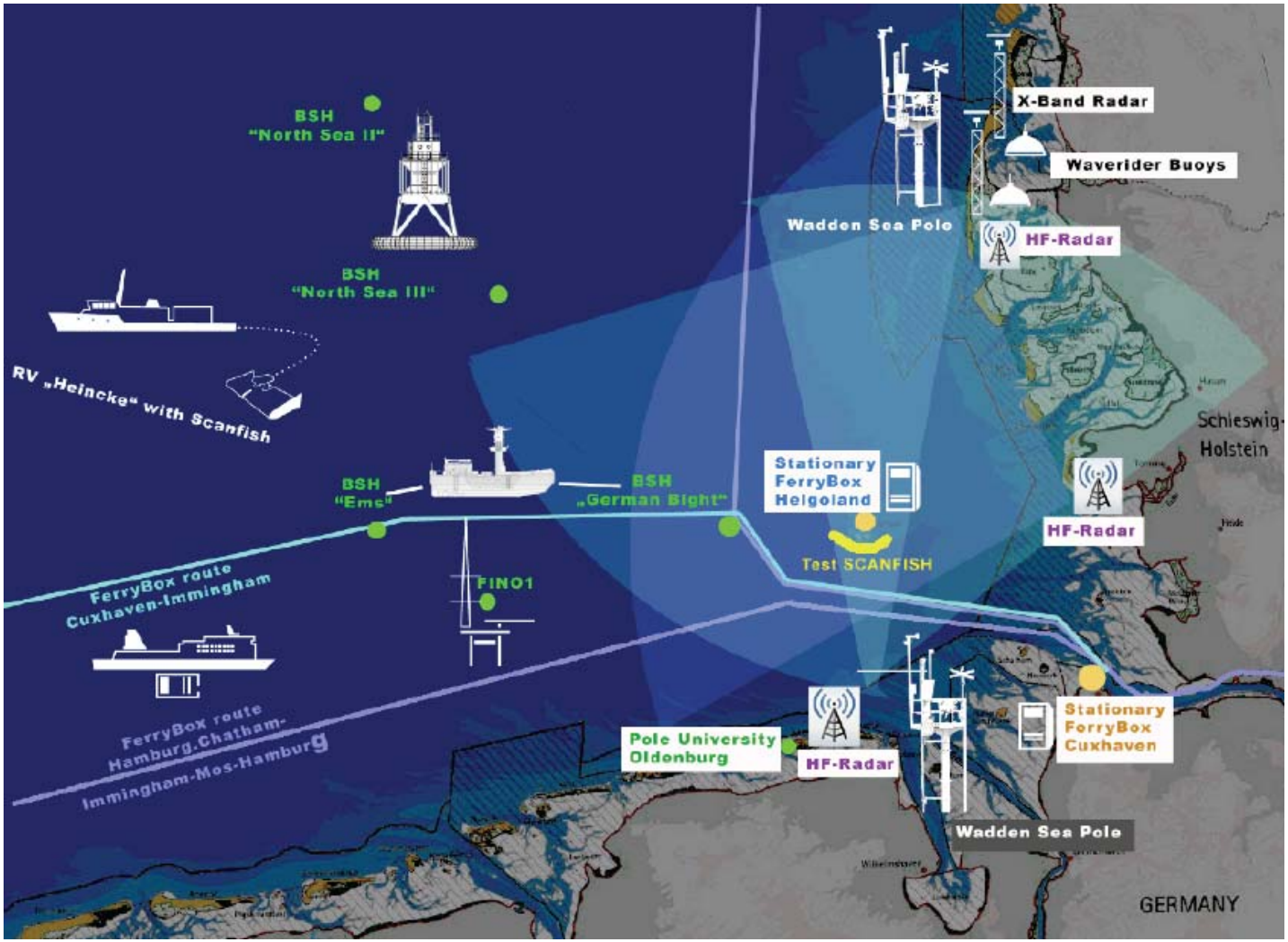
COSYNA



COSYNA

***C**oastal*
***O**bserving*
***SY**stem*
for
***N**orthern*
and
***A**rtic Seas*

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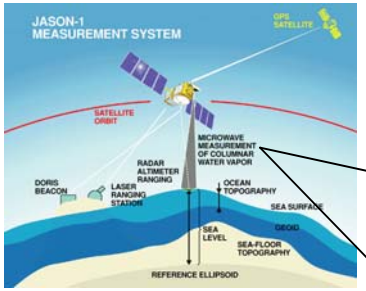
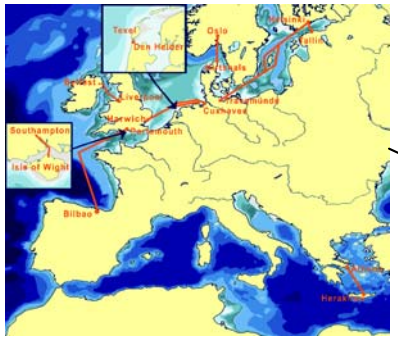
Data Use for ASSIMILATION



OSTIA SST



FerryBox SST/SSS

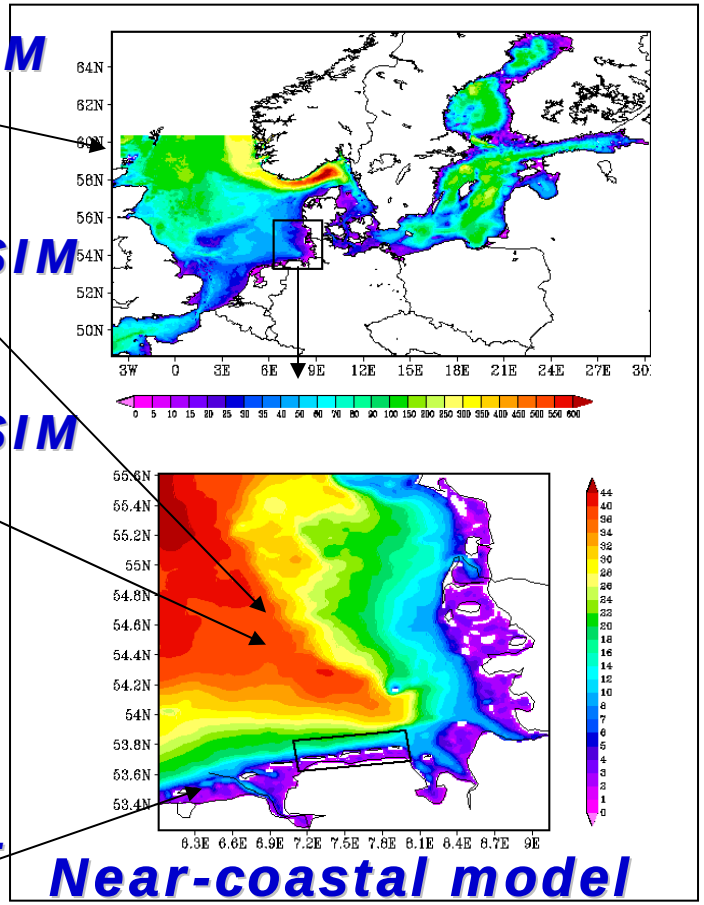
MARNET SST/SSS

ASSIM

ASSIM

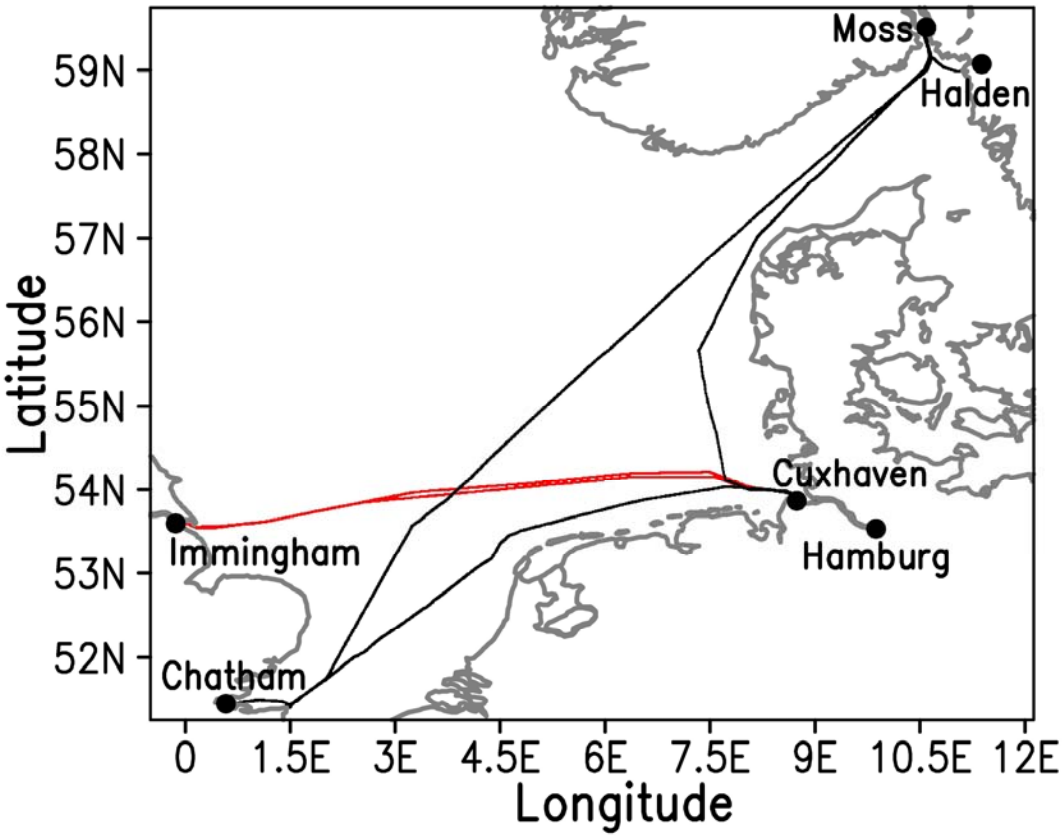
ASSIM

VAL



Near-coastal model

FerryBox Routes



Cuxhaven–Immingham Route:

Cruising Speed:	15 Kn
Sampling Rate:	0.1 Hz
Revisit time:	≈36 hrs
Sampling depth:	4-6 m

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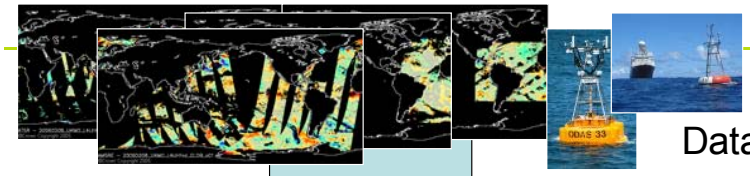
Operational Sea Surface Temperature and Sea Ice Analysis (OSTIA)

Basic Architecture

Met Office



Data Sources

Database

Quality Control
-Background check -Diurnal warming flagging

Anomaly Persistence Forecast
With weak relaxation to climatology

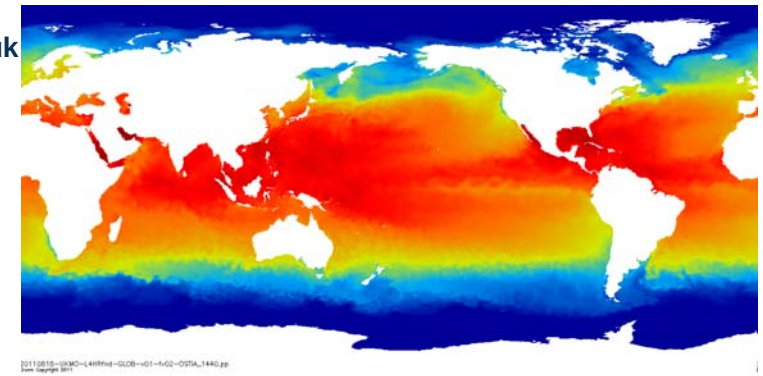
Satellite Bias Estimation
-Find match-ups -O.I. estimate.

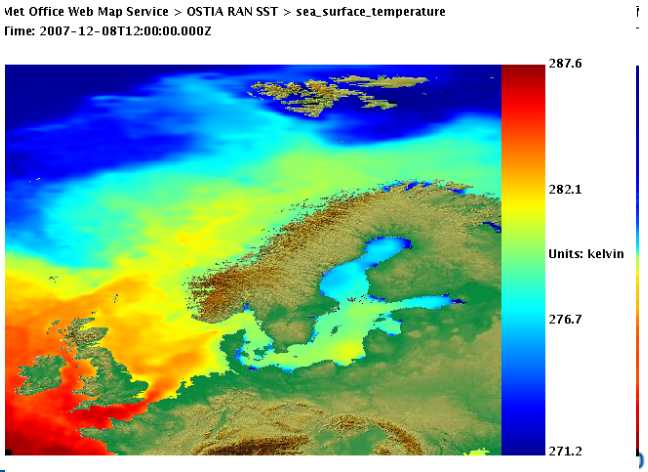
Analysis
-Using 2 background error scales
-Spatially varying backgrd. errors

NCOF

OSTIA uses satellite data provided by the GHRSST project, together with in-situ observations to determine the sea surface temperature. The analysis is performed using a variant of optimal interpolation (OI). The analysis is produced daily at a resolution of 1/20° (approx. 5km). OSTIA data is provided in GHRSST netCDF format every day.

www.ncof.gov.uk





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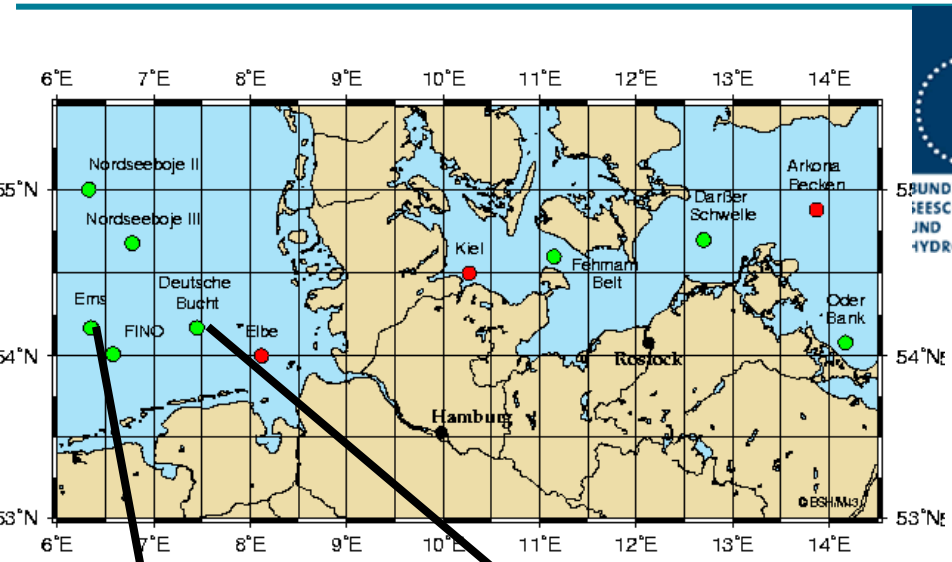
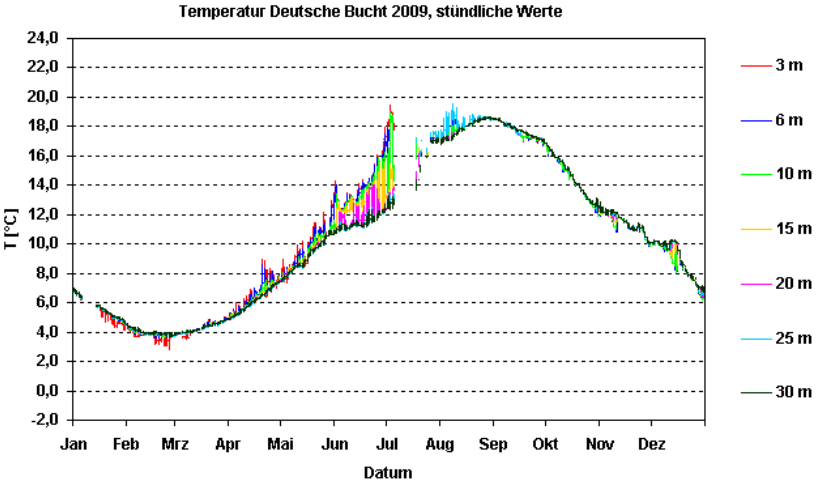
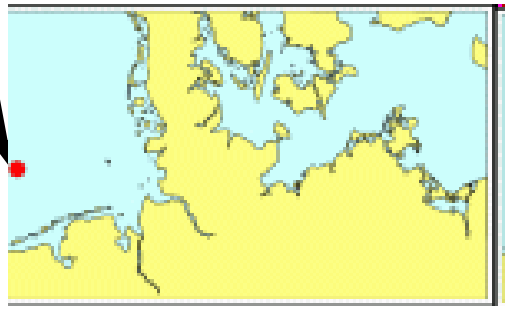
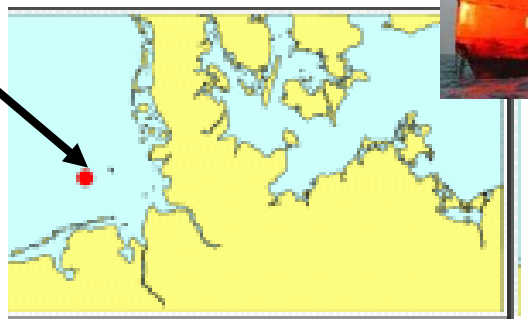
MARNET Stations - BSH









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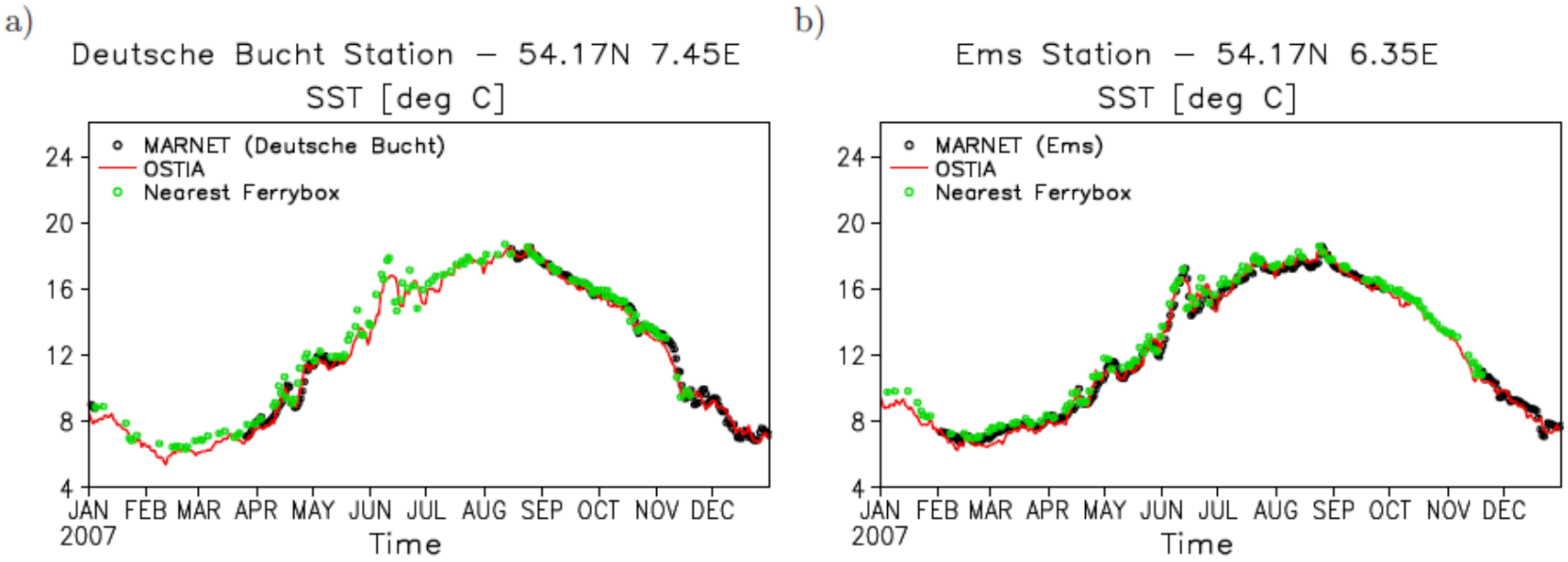
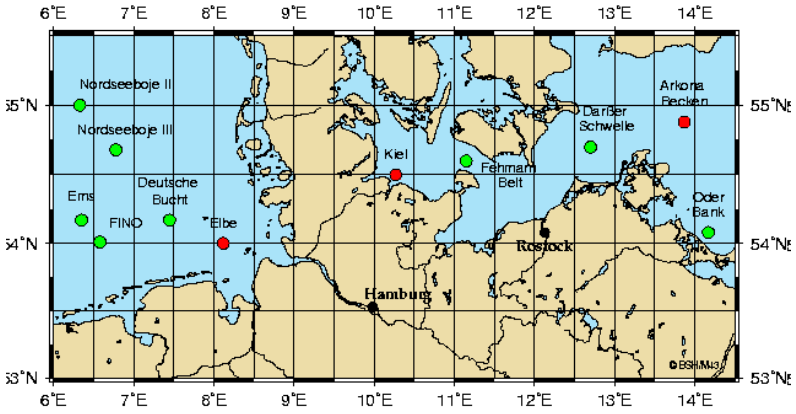
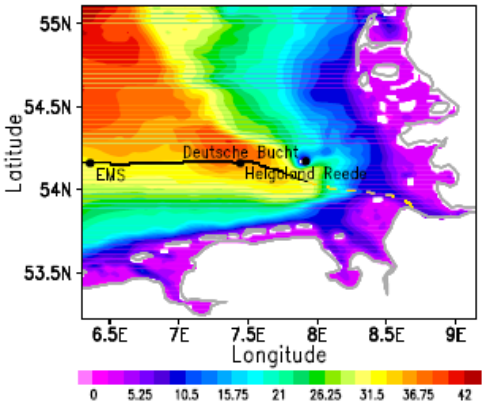
SST (MARNET, OSTIA, Ferrybox)







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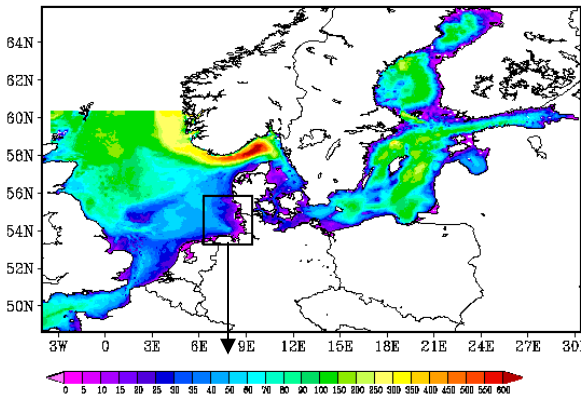
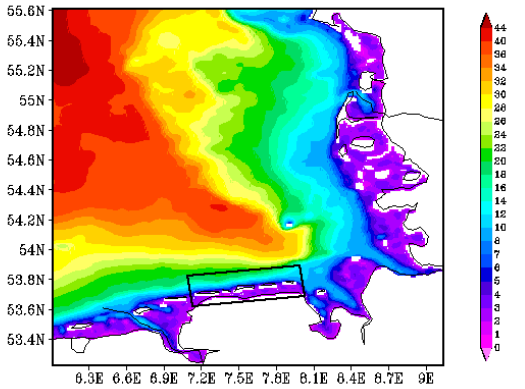
Nested Modelling System

Atmospheric forcing (6–hr ECMWF reanalyses, DWD 1-hr atmospheric forecasts), rivers–1hr
Open BC – tides, T and S



North Sea-Baltic Sea

$\Delta\lambda=\Delta\phi=$ 3 nm, Time step = 30 s
2 open boundaries (S and N)

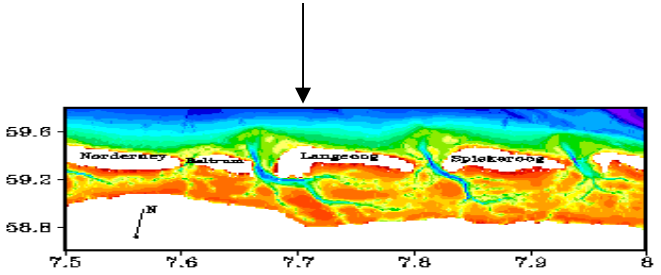


German Bight

$\Delta\lambda=\Delta\phi=$ ~ 1 km, Time step = 10 s
2 open boundaries (W and N)

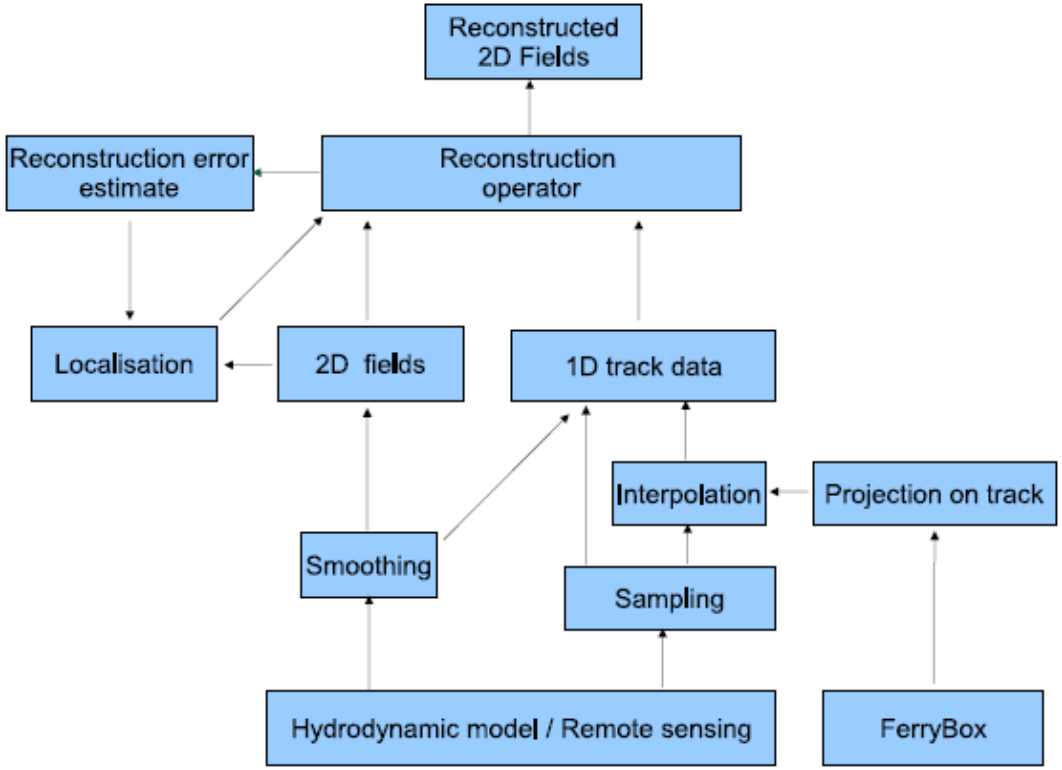
Coastal (Wadden Sea/Elbe, Sylt-Römo)

$\Delta\lambda=\Delta\phi=$ 200 m, Time step = 3 s
3 open boundaries (W, N and E)



Assimilation

- Based on Kalman Analysis equation with localisation
- Assimilation is done every 24 hours at 12 o'clock UTC.



Lit: Grayek et al., J. Mar. Sys., 2011

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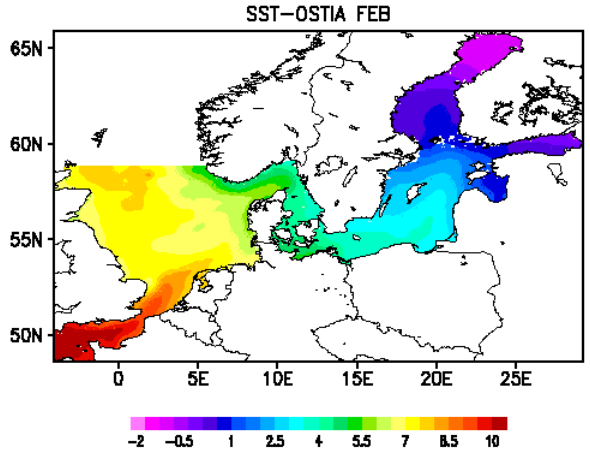
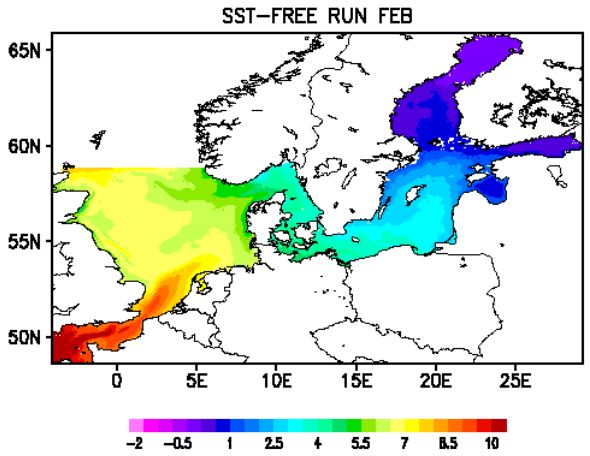
Assimilation of OSTIA SST in NS-BS Model - Monthy Mean SST

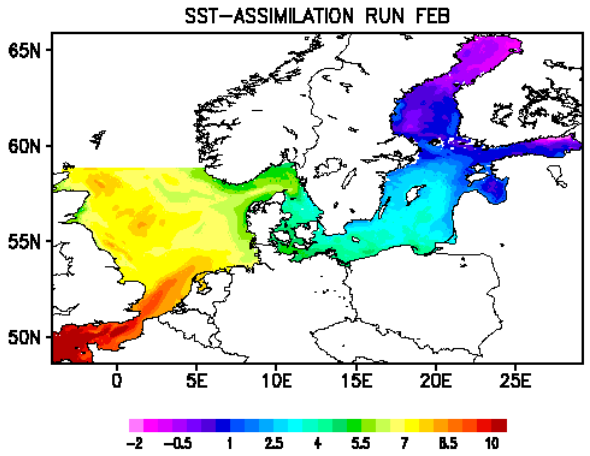
OSTIA

Free RUN

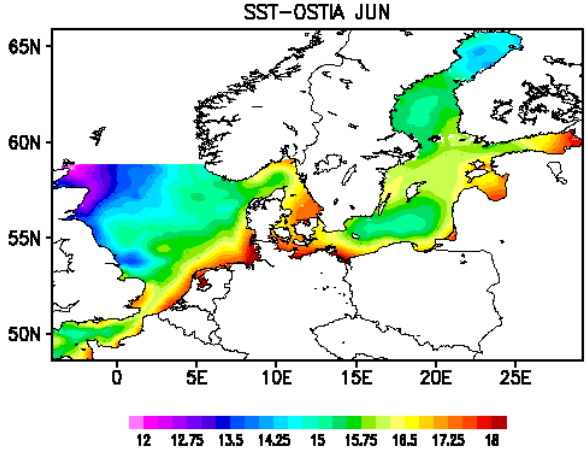
Assimilation

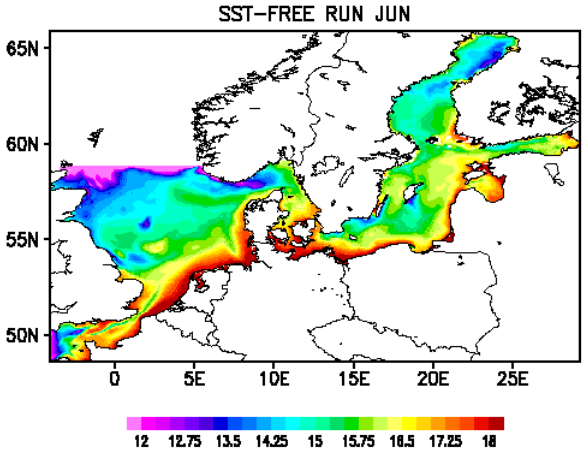


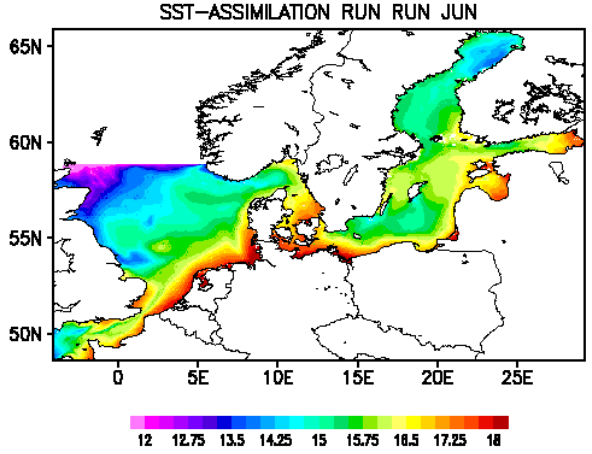




Winter







Summer

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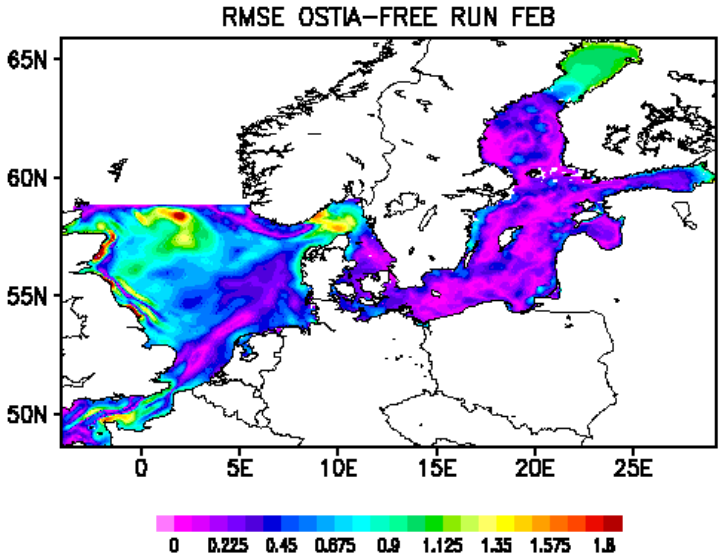
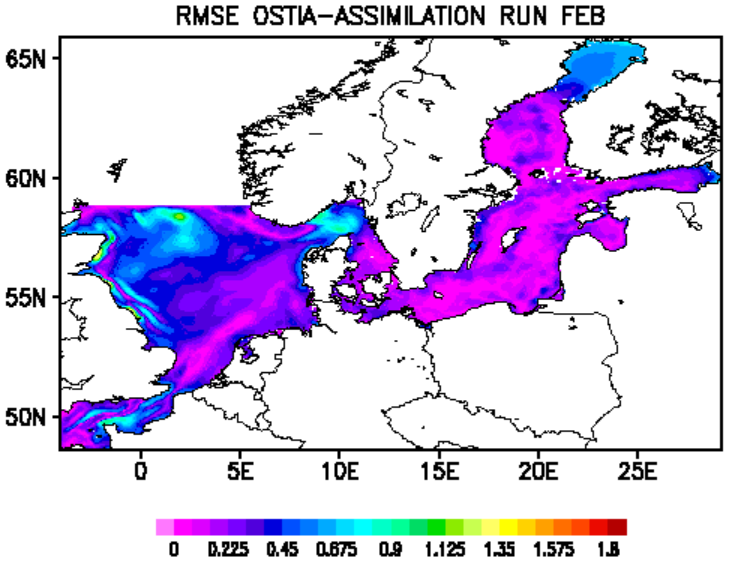
RMSE of SST

RMSE=0.59



RMSE=0.31



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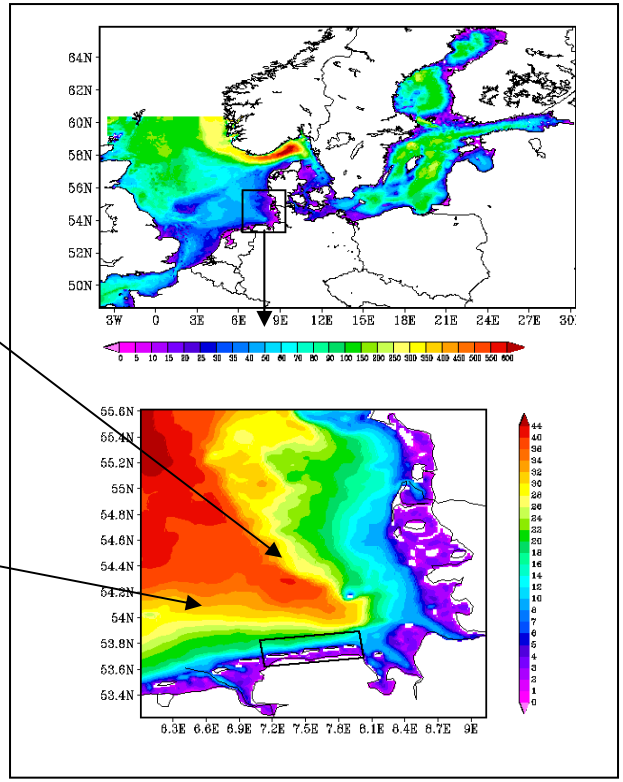
Assimilation experiments for the German Bight

OSTIA SST

ASSIM

FerryBox SST/SSS

ASSIM



DA1 – only OSTIA SST, NO SSS Assimilation – pure OSTIA
DA2 - FB- SST, FB SSS Assimilation – pure FerryBox
DA3 - only OSTIA SST, FB SSS Assimilation
DA4 - OSTIA+FB SST, FB SSS Assimilation

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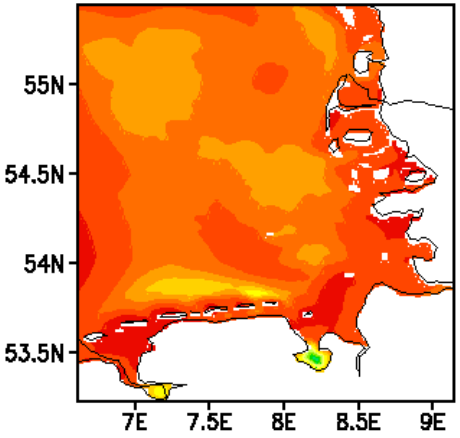
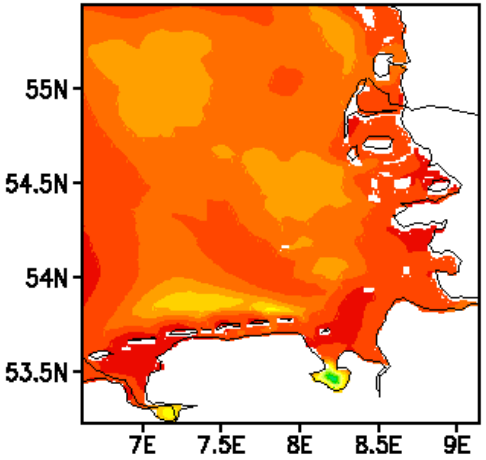
Assimilation Impact - Skill of DA for 2011

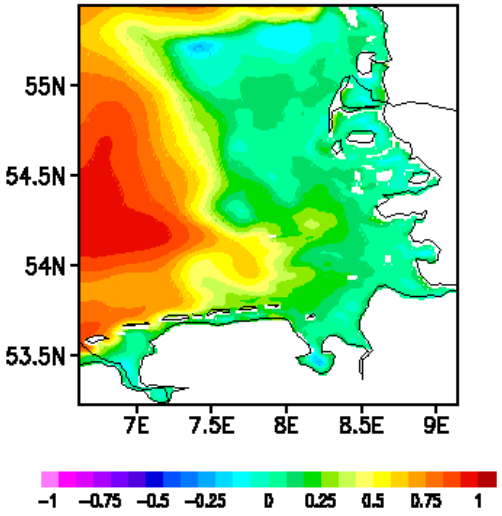
DA1 (only OSTIA SST, no SSS)



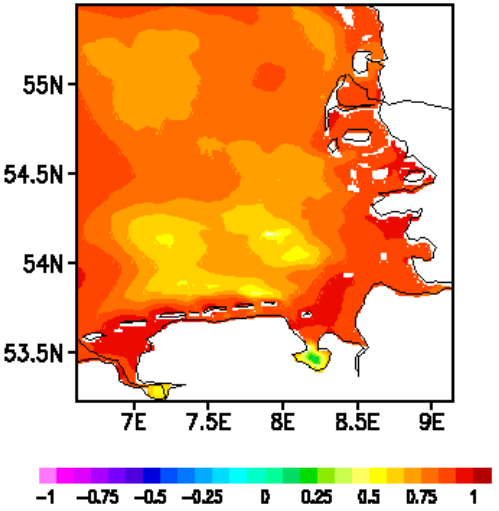
DA3 (OSTIA-SST +FB-SSS)



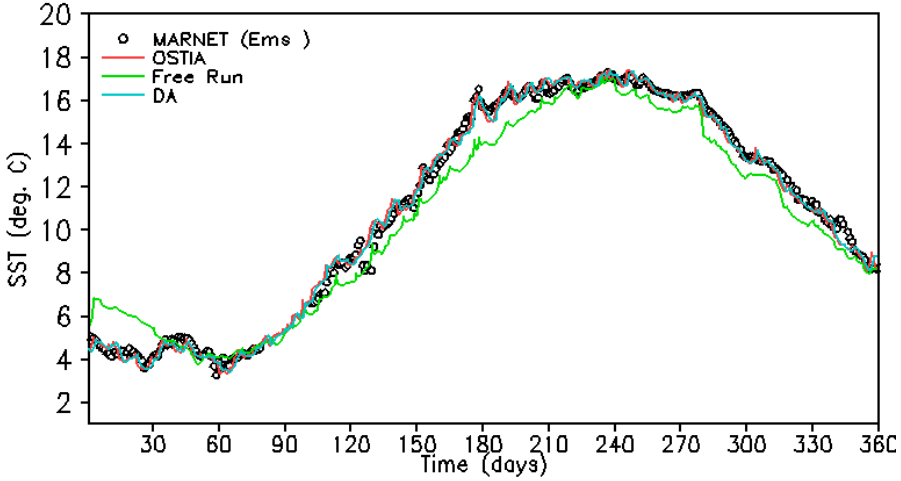
DA2 (only FB-SST FB-SSS)

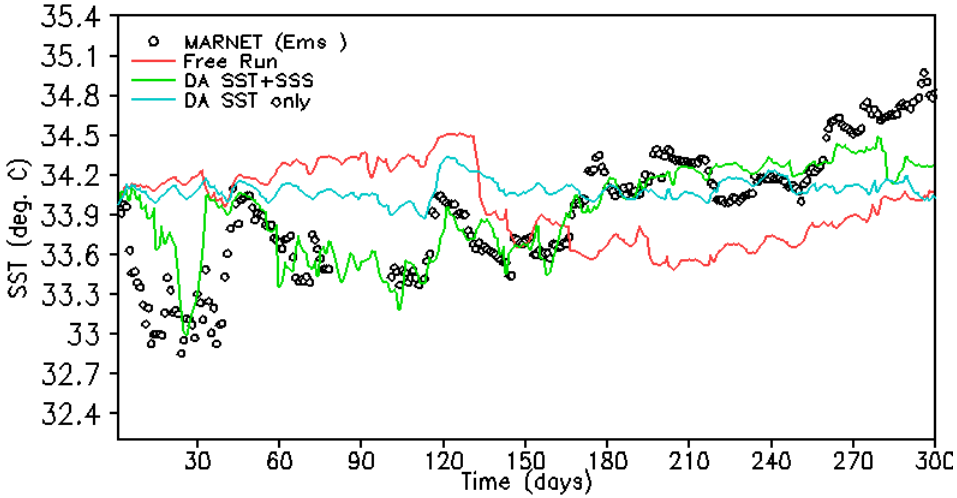


DA4 (OSTIA+FB-SST FB-SSS)

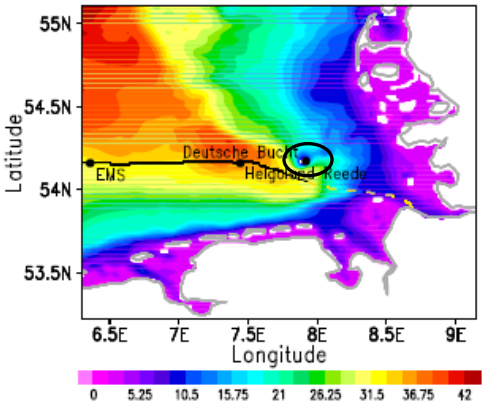


Validation of SST and SSS





Validation of simulated SST and SSS against MARNET observations for 2011 in MARNET-EMS location

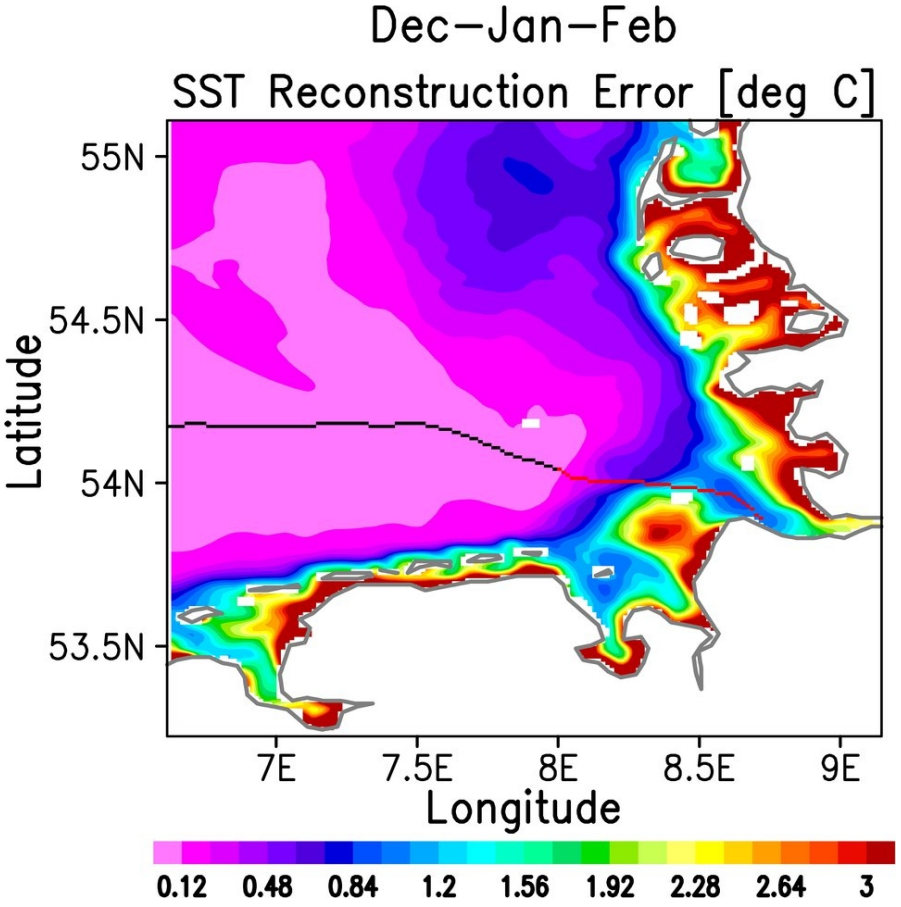


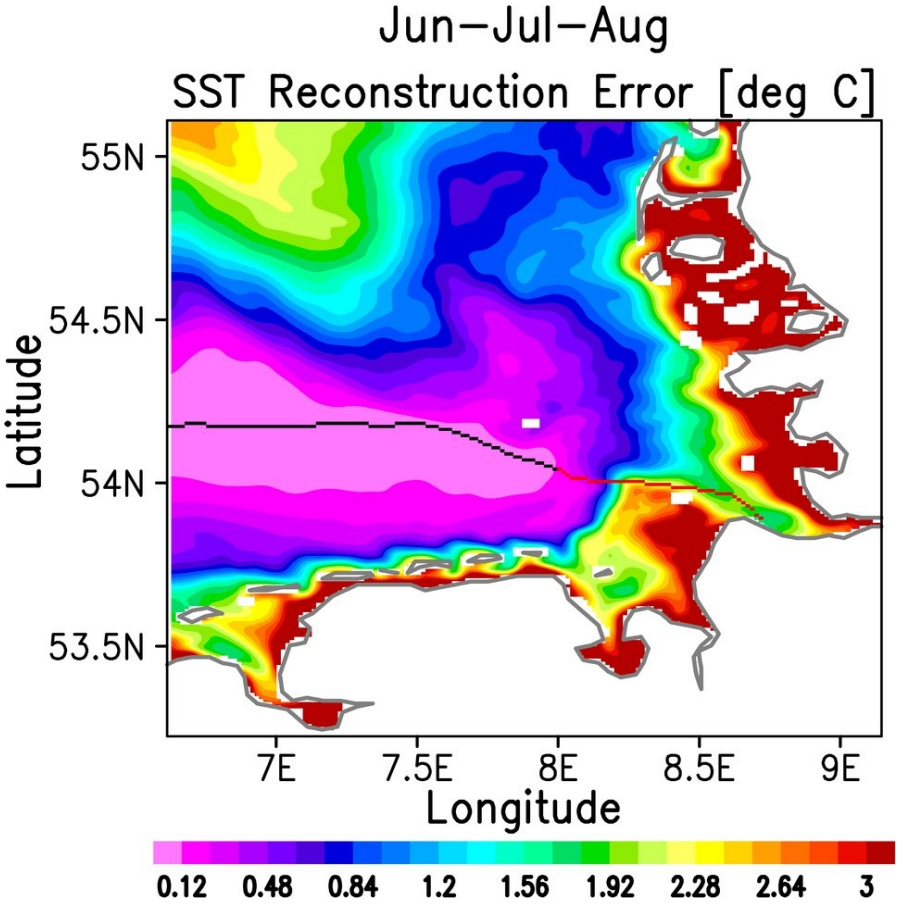
Conclusions

- Nested-grid model is set-up and applied to study the circulation and thermohaline evolution of the German Bight
- Synergy between data and modelling shows promissing results.
- Assimilation of only FerryBox Data improves the state estimate of temperature and salinity, but ONLY locally (ca. 30 km around the track).
- Adding the assimilation of OSTIA SST contributes to improving of the temperature predictions.
- Assimilation of both OSTIA SST data and Ferry Box SSS data improves the ocean state and increases predictabilty

Re-construction errors

Question: How well can we extrapolate the 1D FerryBox information to the 2D domain ?





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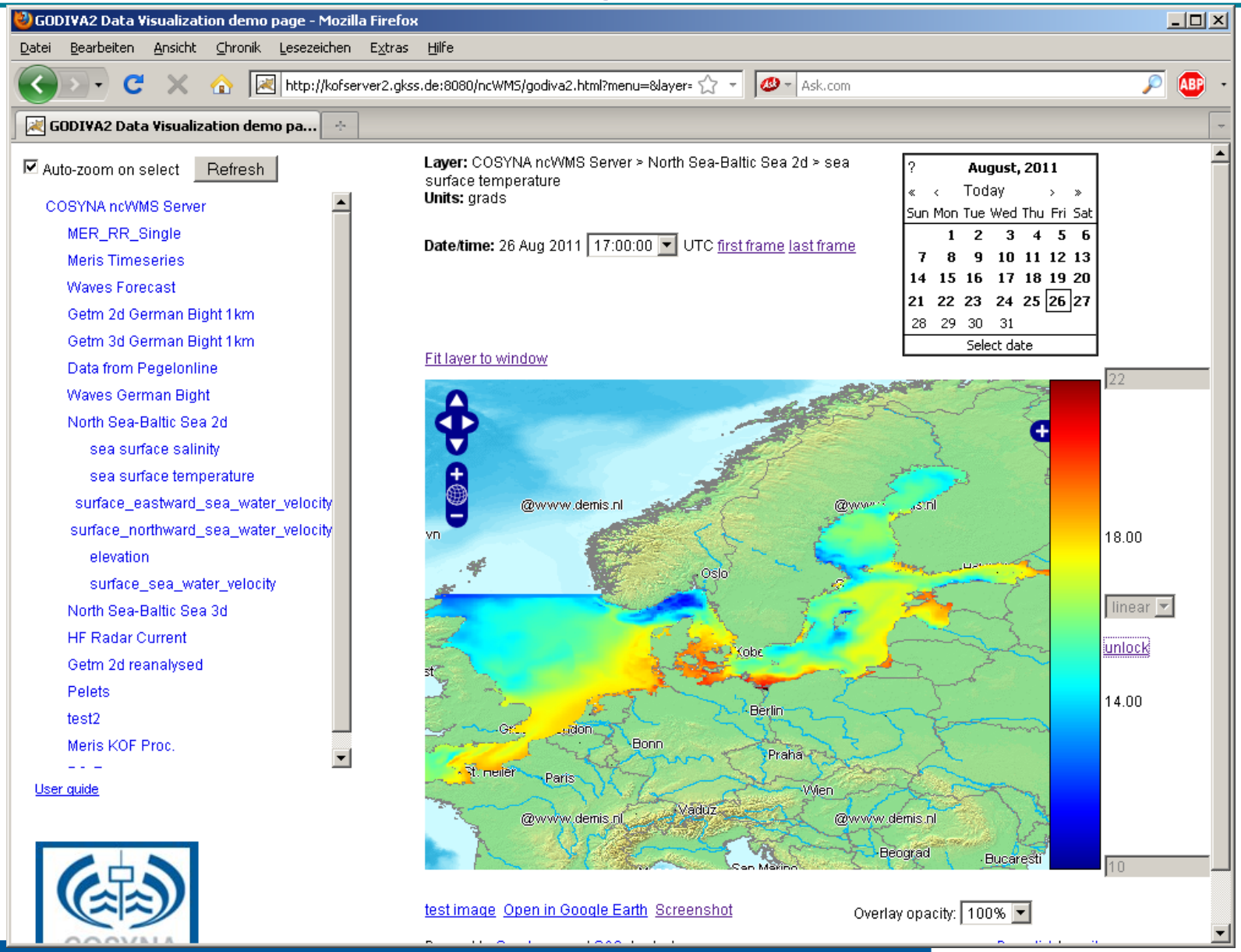
Toward pre-operational oceanography: Real time products www.cosyna.de



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