DTU

DTU

Ioanna Karagali, Jun She, Jens Murawski, Jacob Høyer

DIVOST-COM

Improved Diurnal Variability ”Forecast” Of Ocean Surface Temperature through Community Model development

DIVOST-COM

- **Rationale**
  - ”Develop and integrate a diurnal variability model with the **Baltic MFC** 3-D physical-biological model and the **SST TAC** level 4 analysis thus improving the CMEMS modelling and satellite products for the Baltic Sea.”

- **DMI’s approach**
  - BAL MFC models (HBM/NEMO): good quality of SST_{bulk} (no data assimilation).
  - Do not resolve vertical variability of temperature in the upper few meters.
  - Goal: generate GOTM operational water temperature forecast (upper few meters).
  - Quality requirement: GOTM bulk SST should have similar quality as HBM or NEMO.

- **Potential Impact**
  - MFC PHY-BIO forecasting system (improved upper ocean temperature representation → detection of algal blooms, improvement on heat and gas exchange with atmosphere
  - SST TAC (diurnal SST field to complement L4 product)

GOTM

- TKE K_ε turbulence scheme
- 2-band vs 9-band light absorption scheme
- Timestep 60 seconds, Hourly output
- Meteo forcing (HIRLAM)
  - x, y wind components
  - Air pressure
  - Dry air temperature
  - Relative humidity
  - Cloud cover
  - Short wave radiation
- Ocean forcing (HBM)
  - Temperature profiles
  - Salinity profiles

Table 1. Options for the Different GOTM Parameters

Category	Option	
I. Surface fluxes		
	1	Prescribed (usually from NWP outputs)
	2	Calculated using meteorological inputs
II. Short-wave radiation		
	1	Prescribed (usually from NWP outputs)
	2	Calculated (using meteorological inputs)
III. Long-wave radiation (BRM)		
	1	*Clark et al.* [1974]
	2	*Hastenrath and Lamb* [1978]
	3	*Bignami et al.* [1995]
	4	*Berliand and Berliand* [1952]
	5	Brunt formula, coefficients *Grant and Hignett* [1998]
IV. Length scale method		
	1	Dynamic dissipation
	2	Mellor-Yamada q^2l
	3	Generic Length Scale
V. Stability method		
	1	Mellor-Yamada
	2	*Burchard and Baumert* [1995], full version
	3	*Kantha and Clayson* [1994], quasiequilibrium
VI. Light extinction		
2 bands	1	Jerlov-I [*Jerlov*, 1968]
	2	Jerlov-I (for upper 50 m)
	3	Jerlov-IA
	4	Jerlov-IB
	5	Jerlov-II
9 bands	6	*Paulson and Simpson* [1981]
	7	*Paulson and Simpson* [1981], COART
	8	*Paulson and Simpson* [1981], MODTRAN

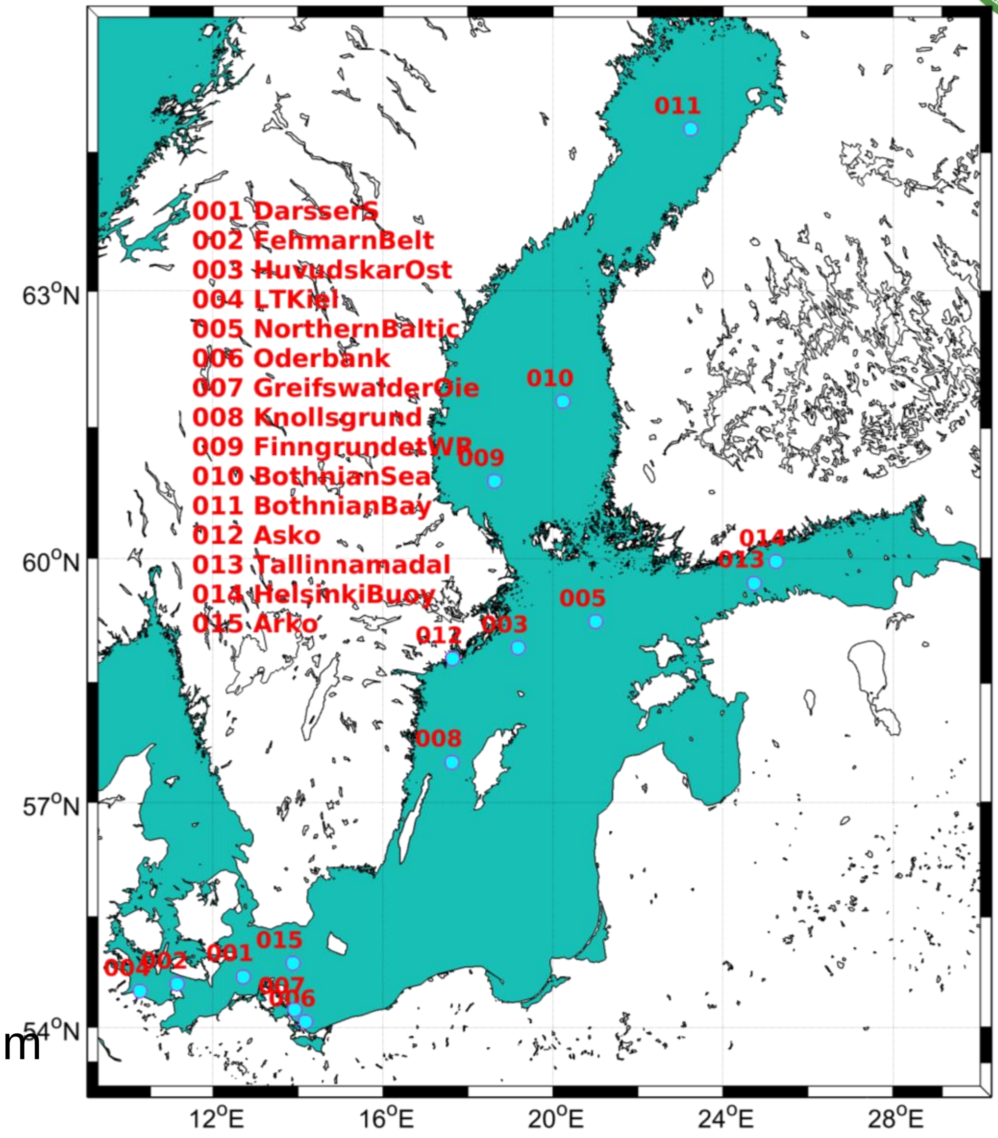
Karagali, I., Høyer, J. L., & Donlon, C. J. (2017). Using a 1-D model to reproduce the diurnal variability of SST. Journal of Geophysical Research: Oceans, 122(4), 2945–2959.

Data & Methods

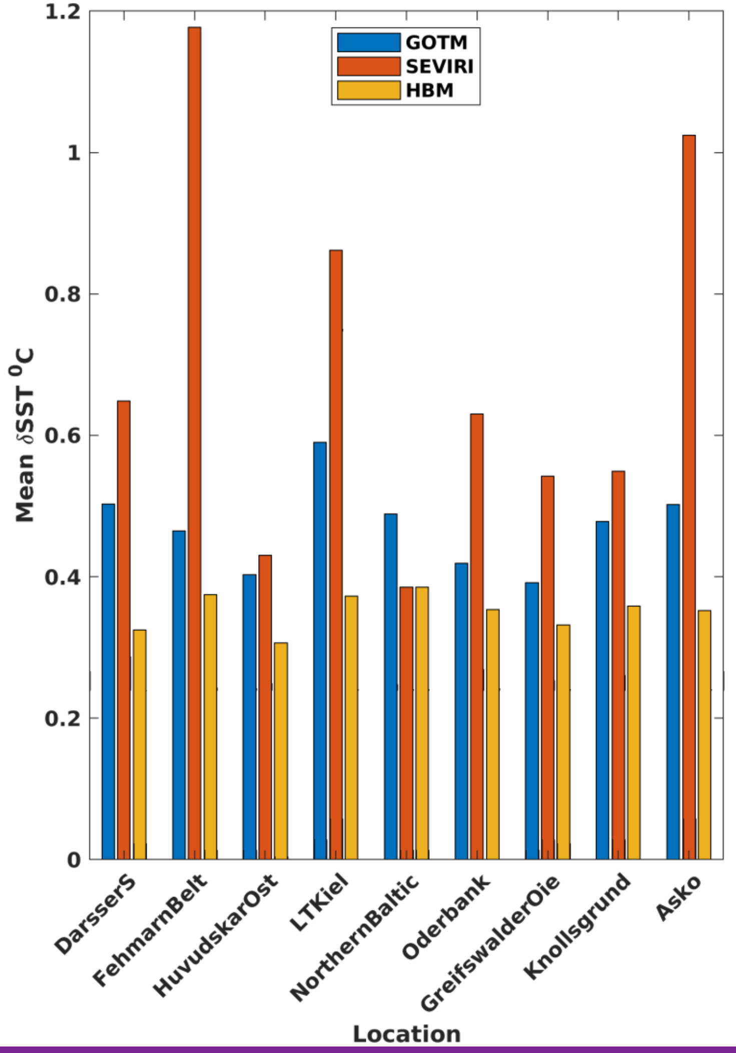
- Test sites
  - 6 profiling stations
  - 9 surface stations
  - Depths: 8-110 m

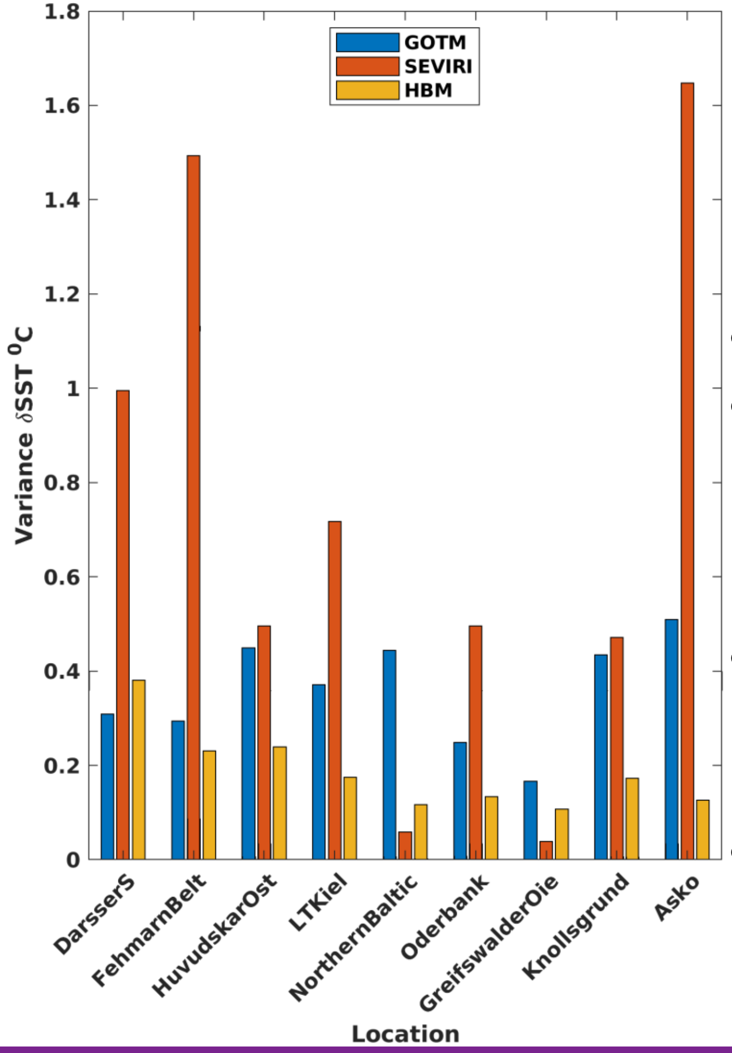
- SEVIRI
  - O&SI SAF L3C
  - Hourly
  - 0.05º regular grid
  - DOI 10.15770/EUM_SAF_OSI_0004

- DV analysis
  - 4 dates in 2018 identified
  - GOTM daily simulations: surface to 25 m depth

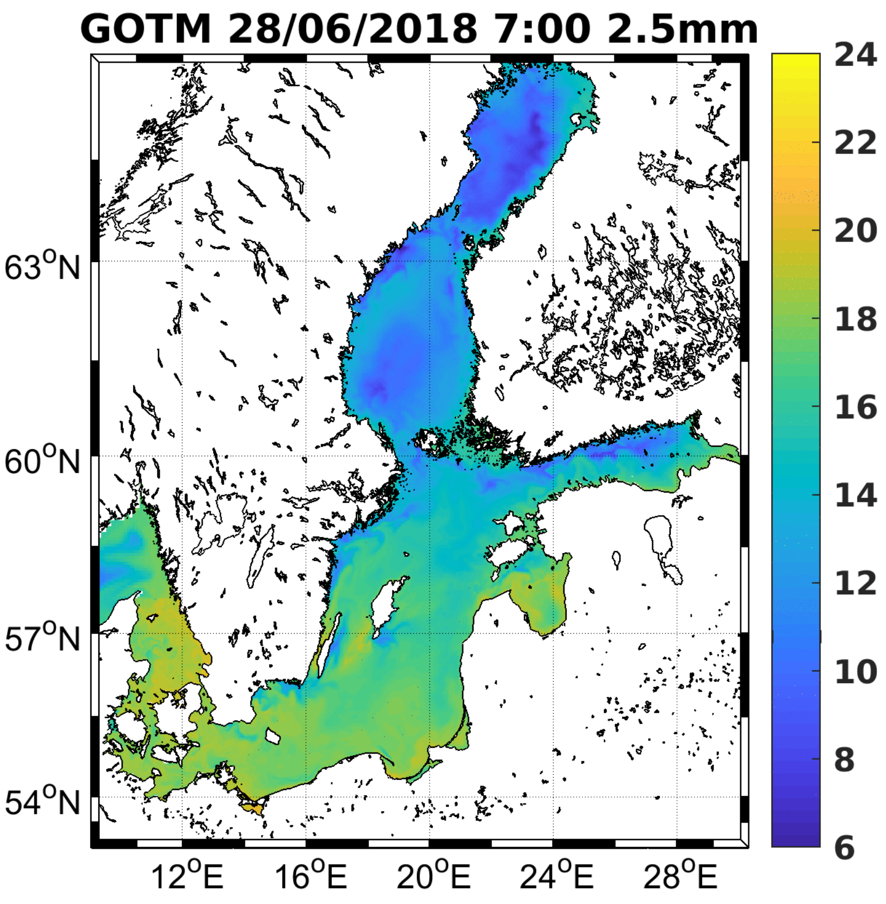


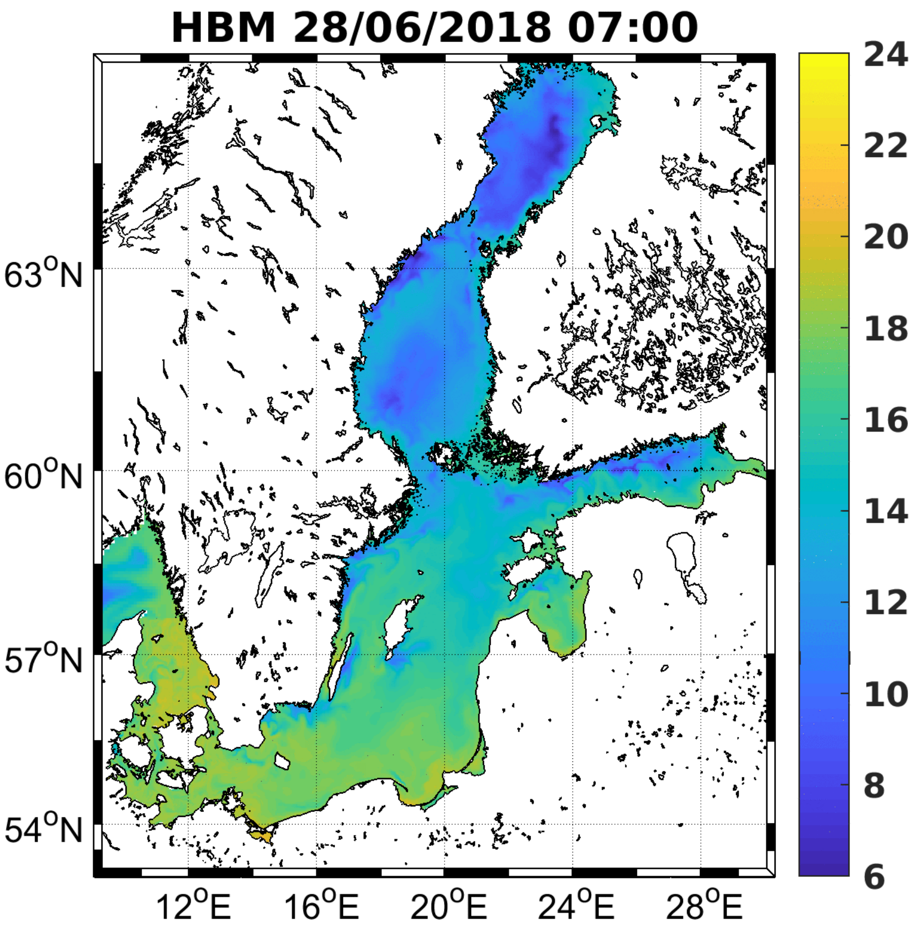
SEVIRI – GOTM – HBM





- April to August 2018
- Mean diurnal variability at test sites higher than 0.5 ^{o}C and up to 1.2 ^{o}C (SEVIRI)
- GOTM mean DV values closer to SEVIRI, compared to HBM
- GOTM 4-month simulation without daily initialization → improvement with daily re-starts


GOTM 28/06/2018 7:00 2.5mm
63°N
60°N
57°N
54°N
12°E
16°E
20°E
24°E
28°E
24
22
20
18
16
14
12
10
8
6


HBM 28/06/2018 07:00
63°N
60°N
57°N
54°N
12°E
16°E
20°E
24°E
28°E
24
22
20
18
16
14
12
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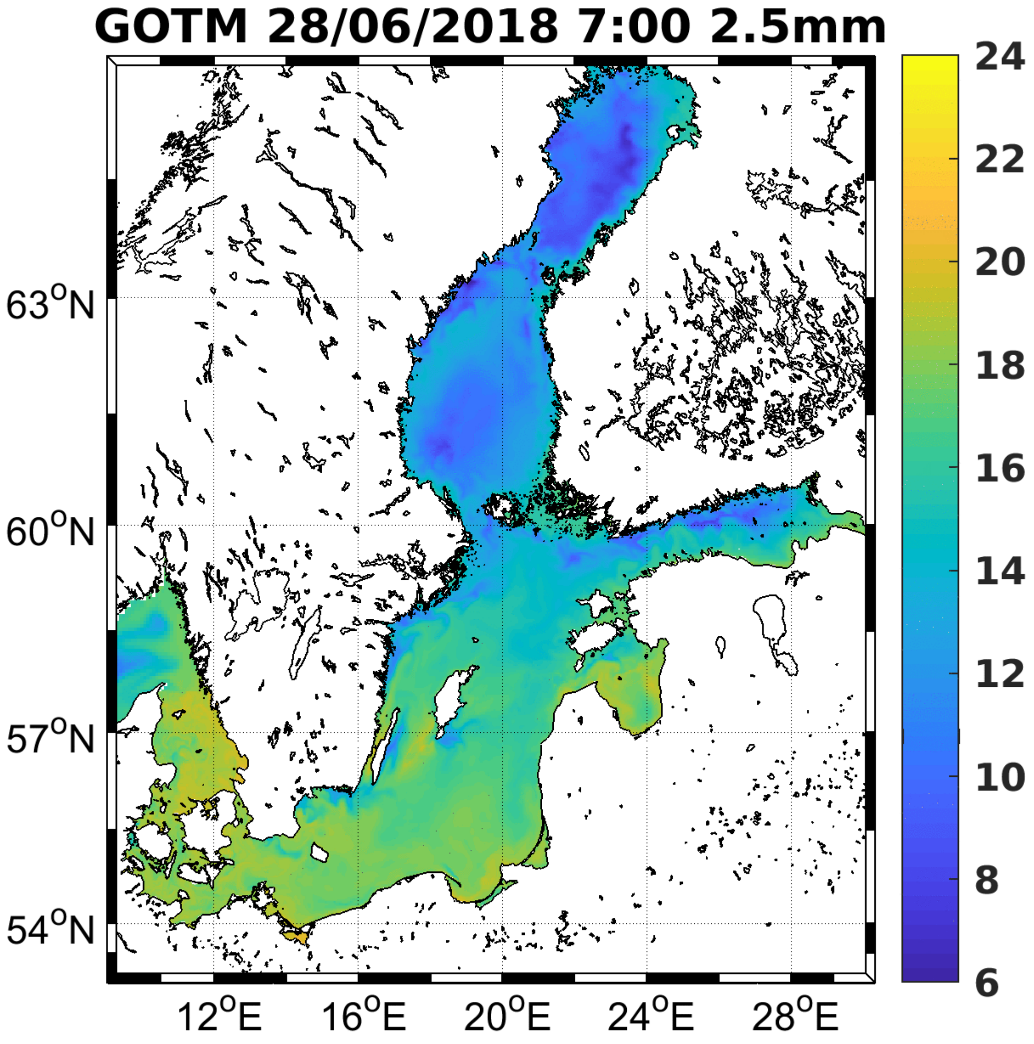
GOTM 28/06/2018 7:00 2.5mm
63°N
60°N
57°N
54°N
12°E
16°E
20°E
24°E
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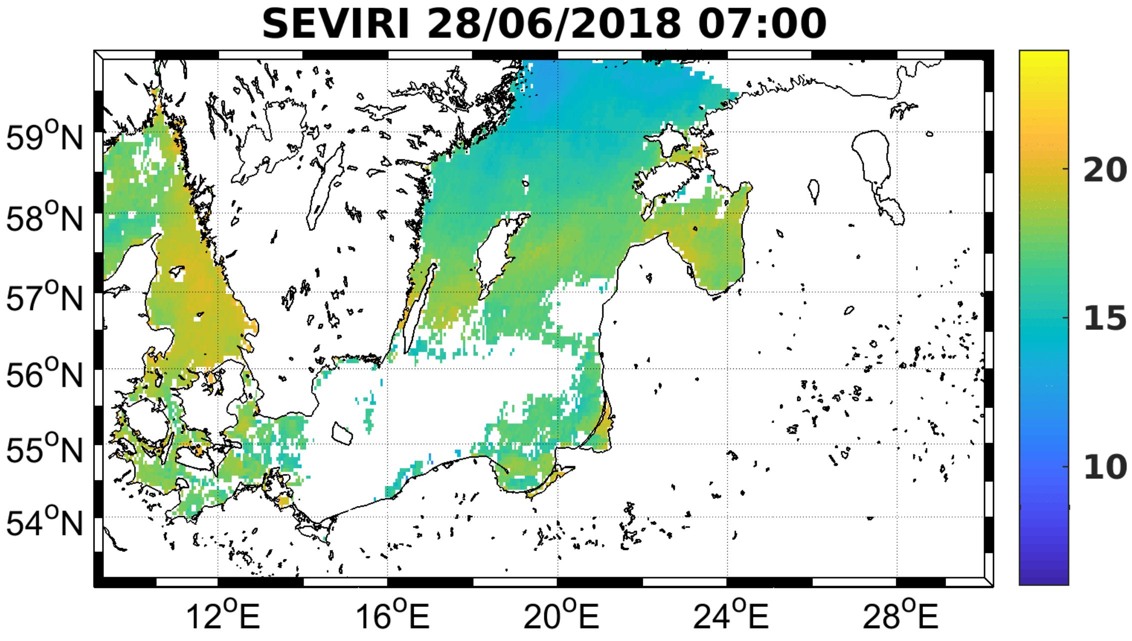
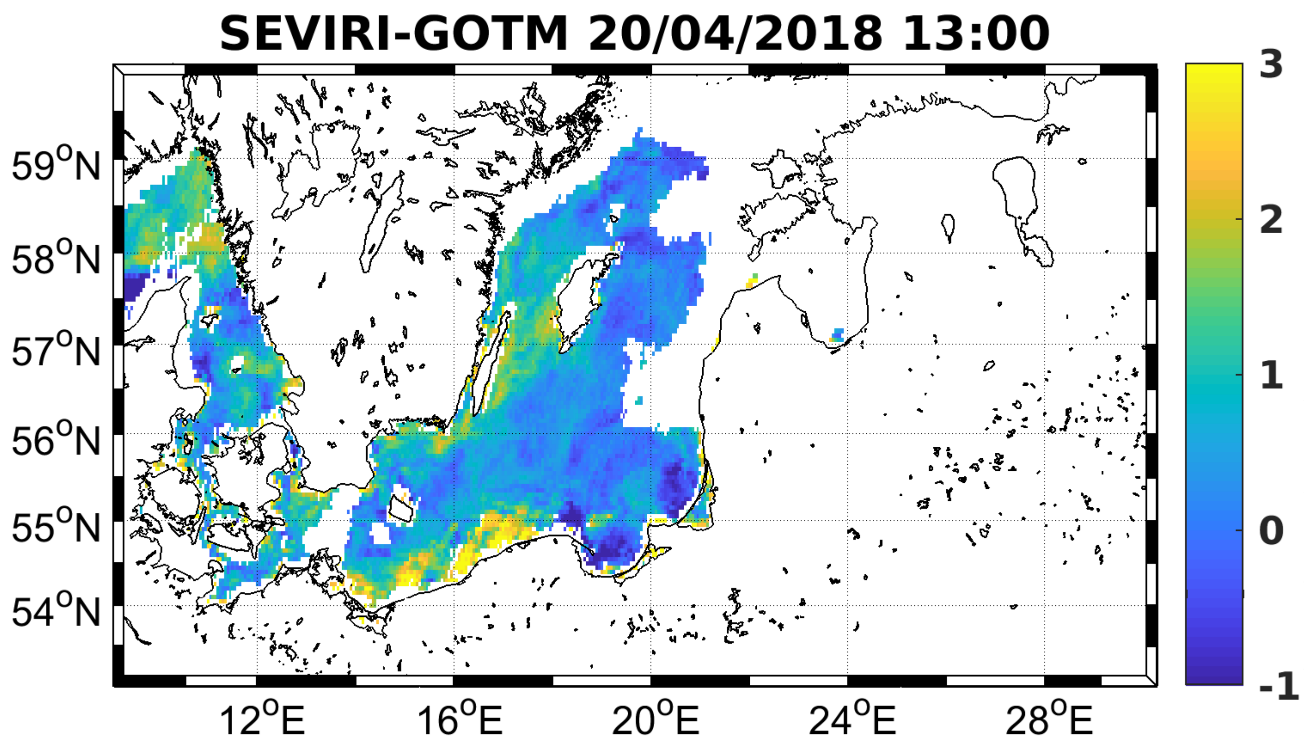
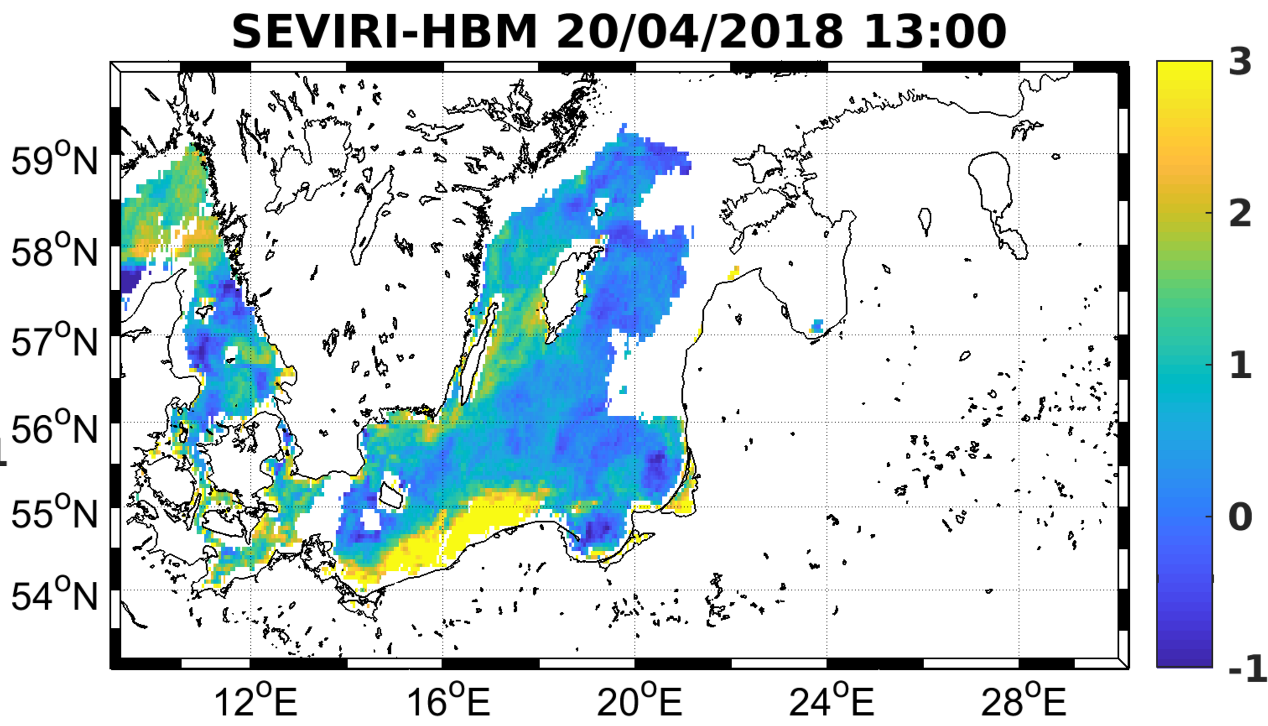

SEVIRI 28/06/2018 07:00
59°N
58°N
57°N
56°N
55°N
54°N
12°E
16°E
20°E
24°E
28°E
20
15
10

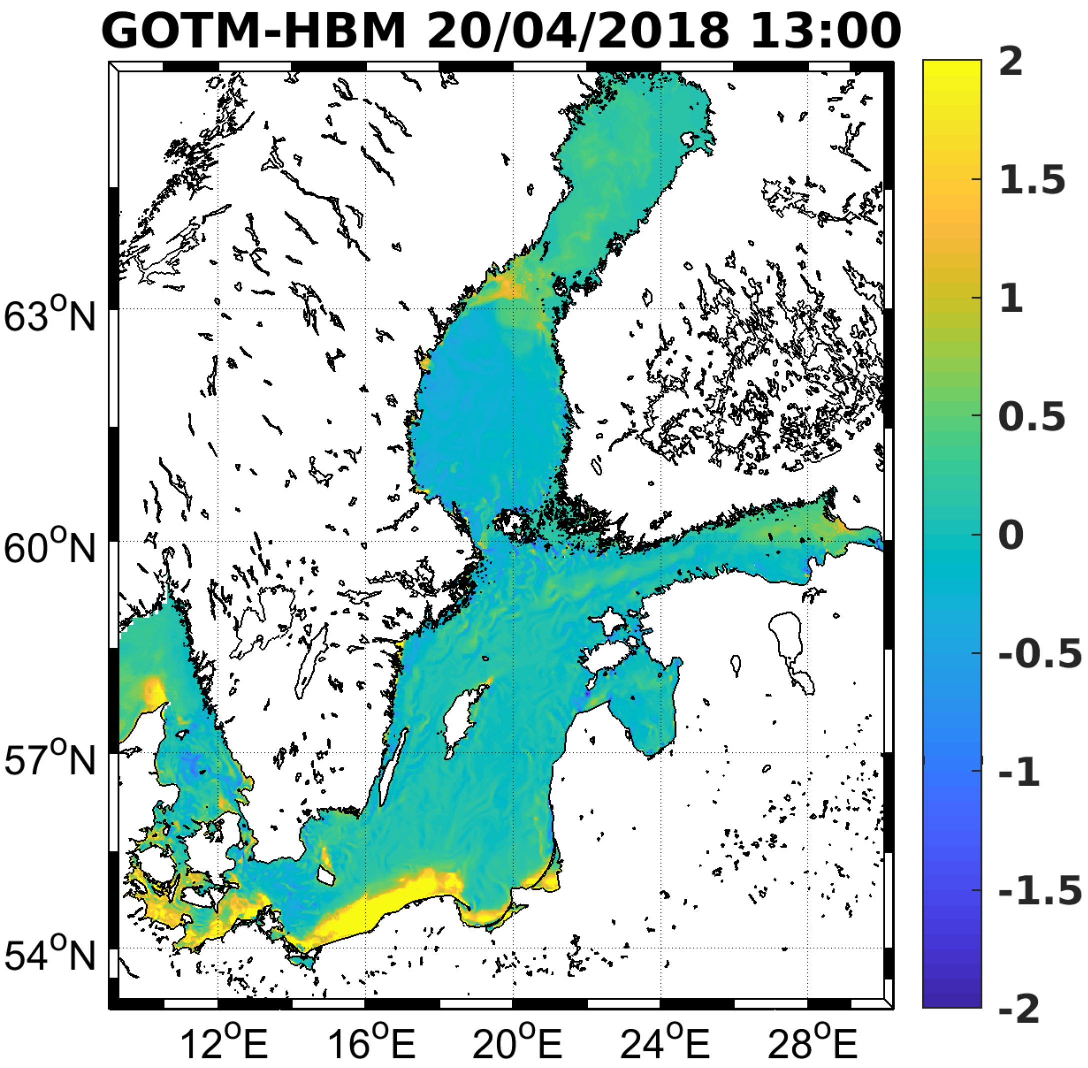
GOTM 2D – HBM – SEVIRI April 20 2018





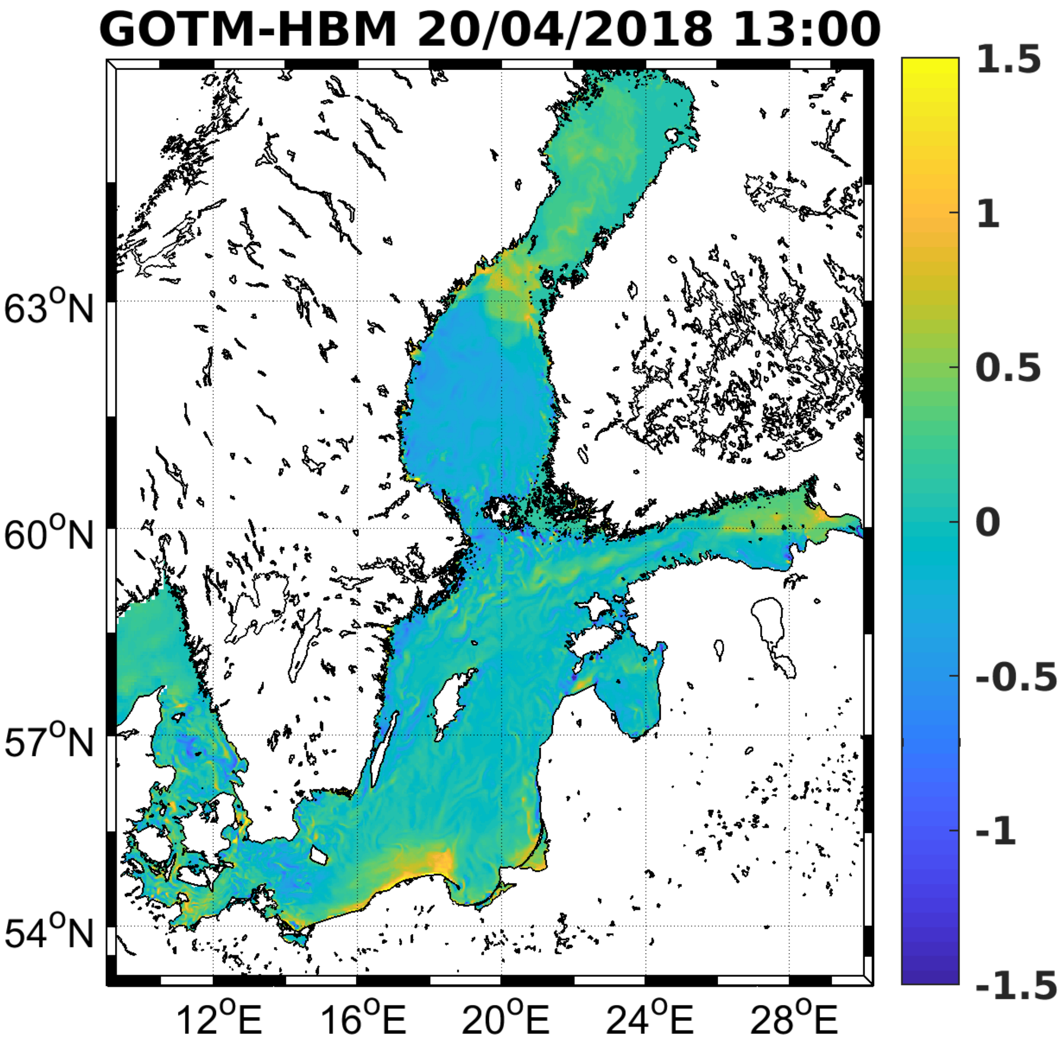
SEVIRI-GOTM mean bias: 0.64, RMSE: 1.1
HBM-GOTM mean bias: 0.93, RMSE: 1.44

GOTM 2D – HBM April 20 2018

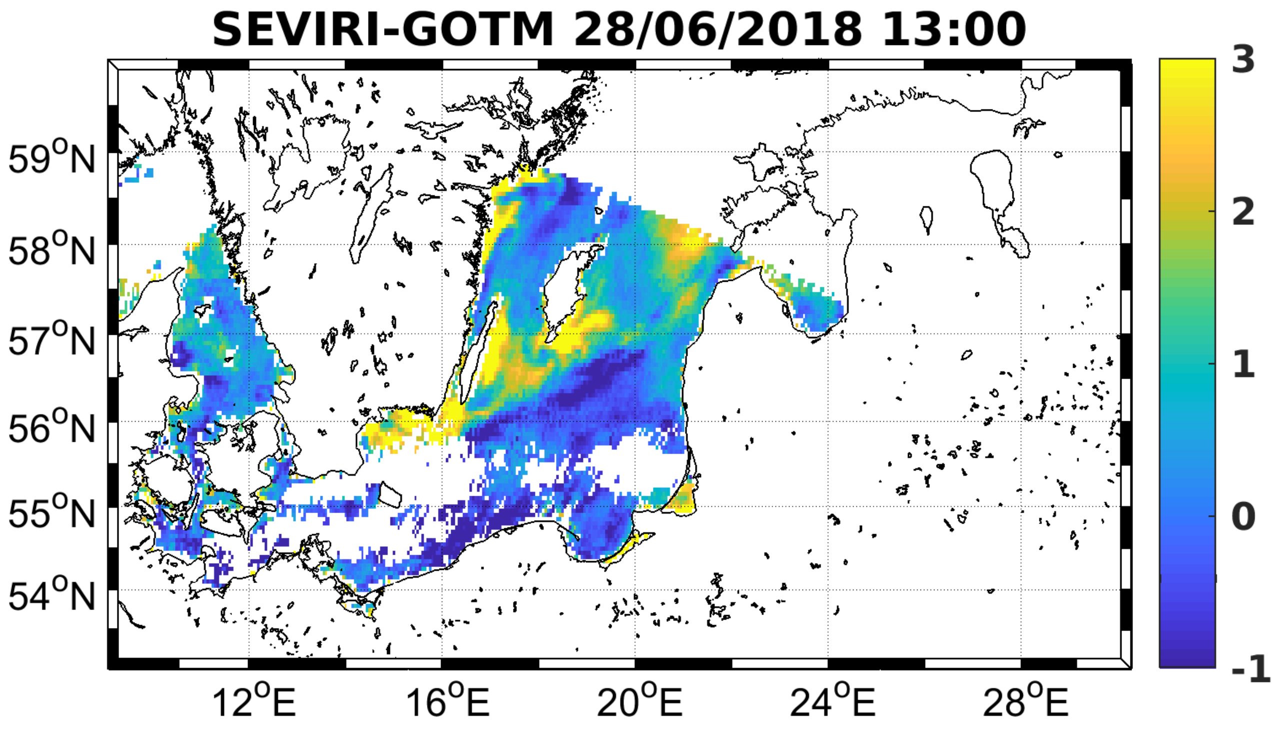


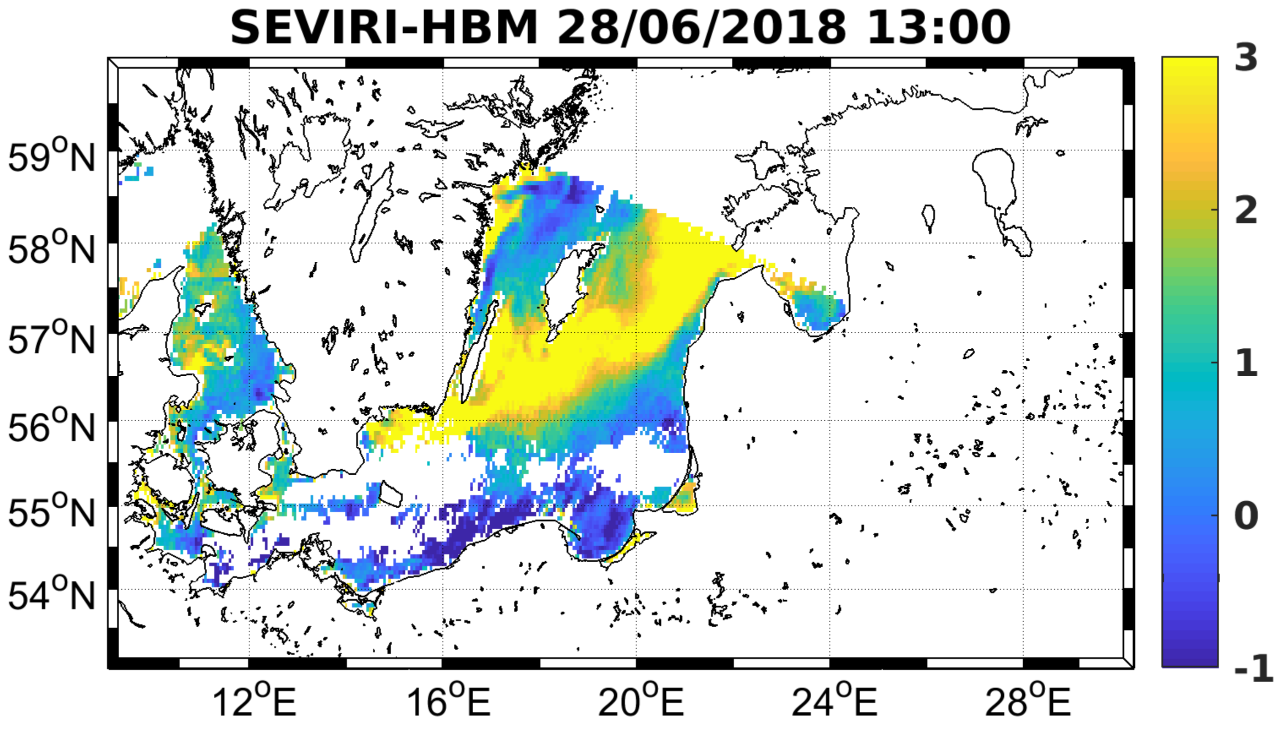
← GOTM at 2 mm minus HBM top layer (1.5 m)

→ GOTM at 1.5 m minus HBM top (1.5 m)



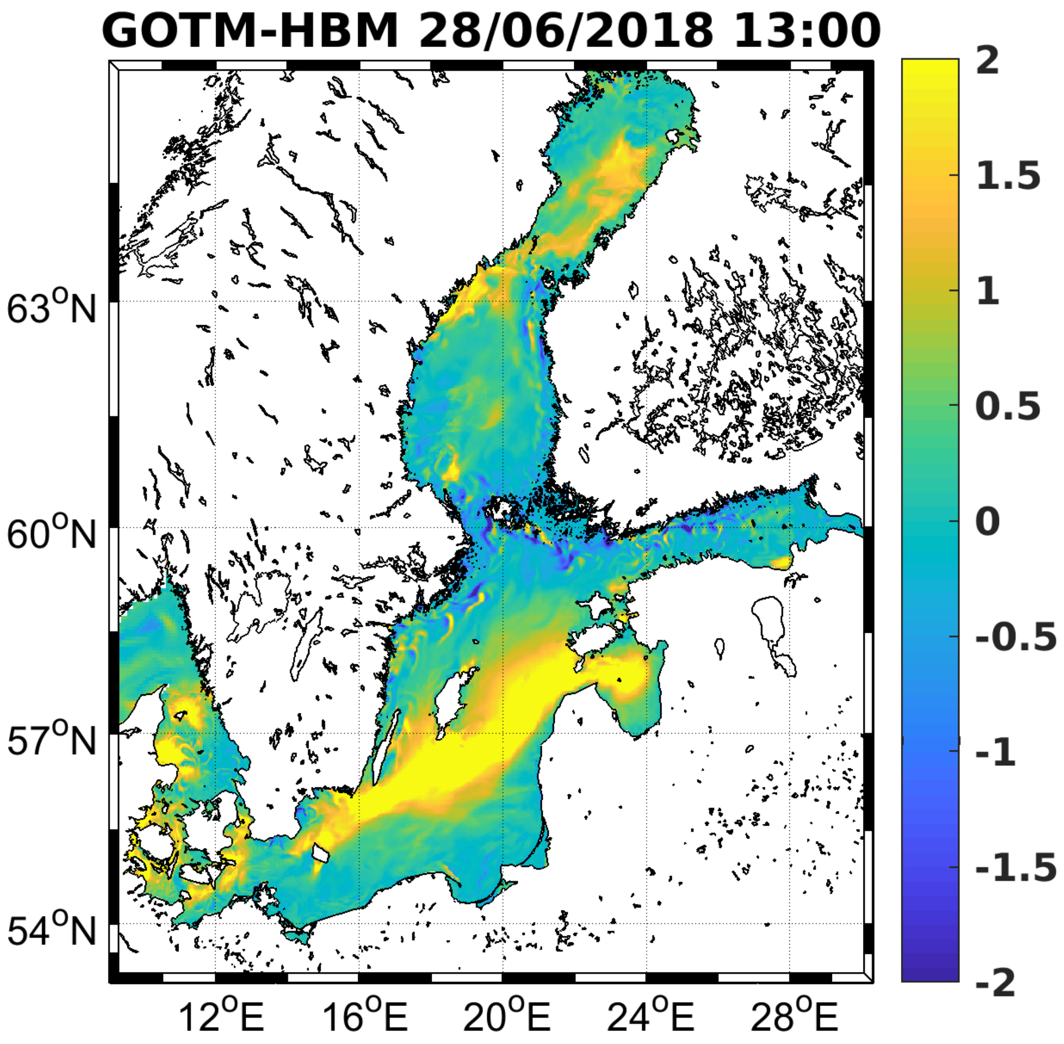
GOTM 2D – HBM – SEVIRI June 28 2018





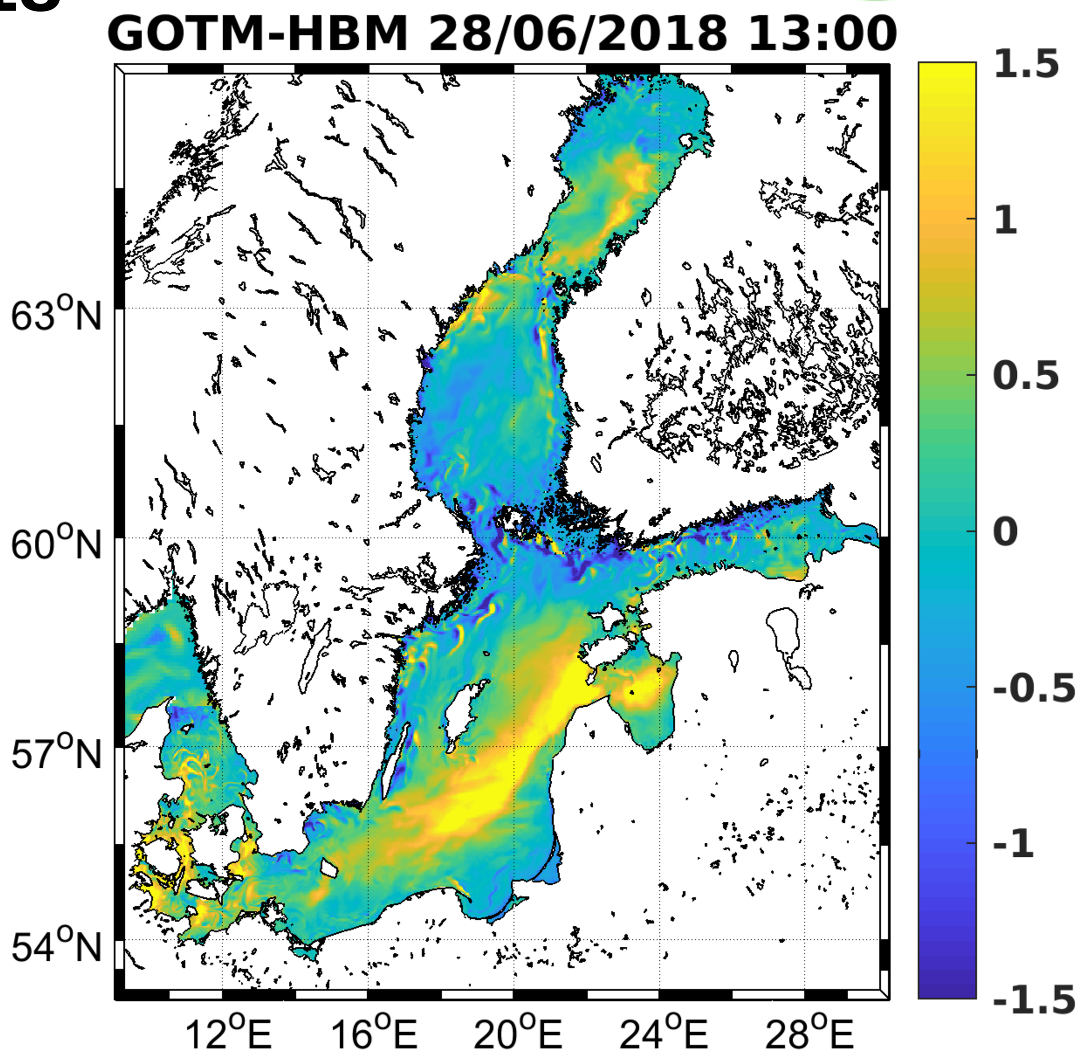
SEVIRI-GOTM mean bias: 0.6, RMSE: 1.4
SEVIRI-HBM mean bias: 1.6, RMSE: 2.3

GOTM 2D – HBM June 28 2018

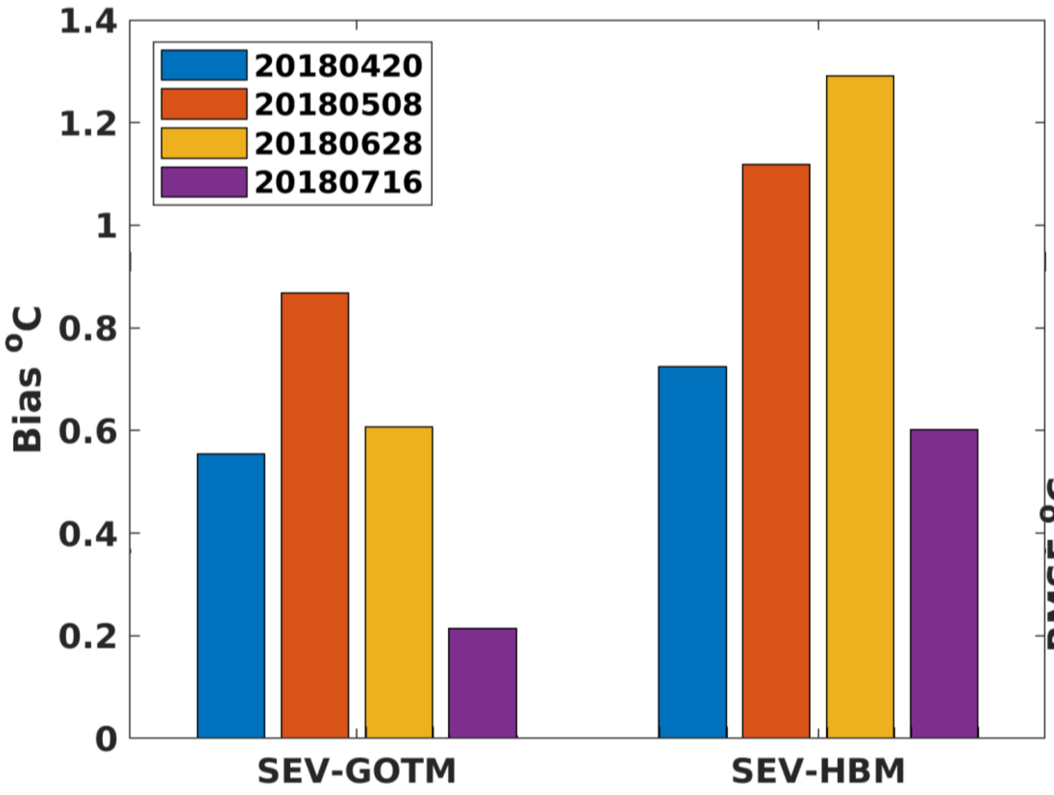


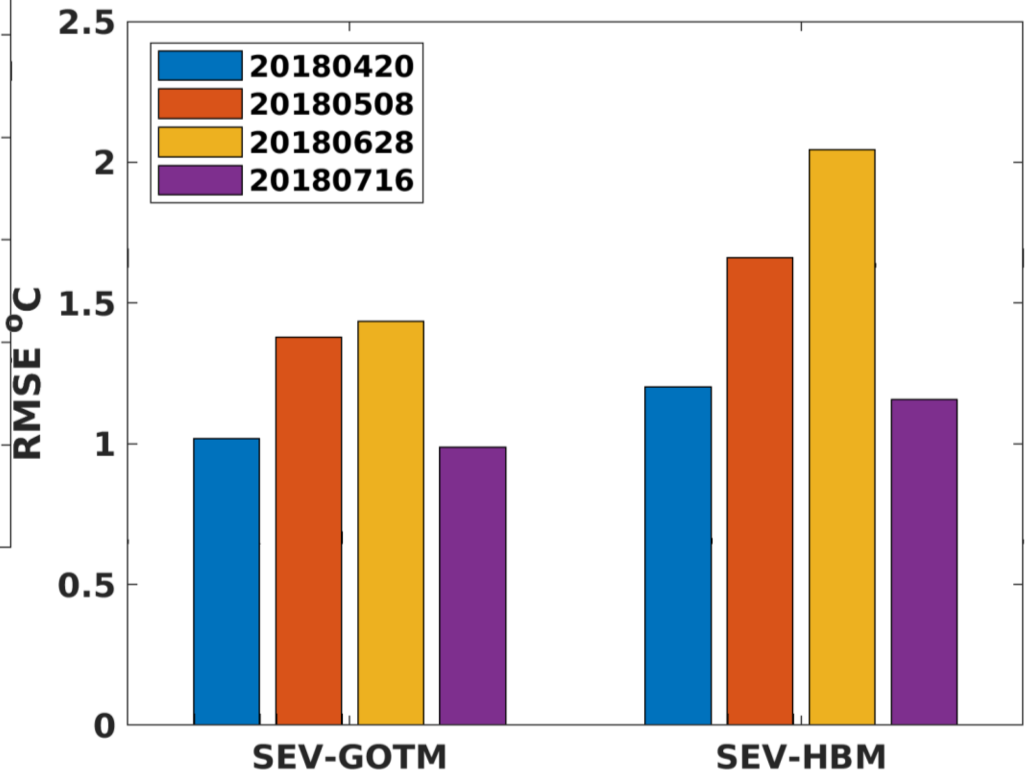
← GOTM at 2 mm minus HBM top layer (1.5 m)

→ GOTM at 1.5 m minus HBM top (1.5 m)



SEVIRI – GOTM – HBM





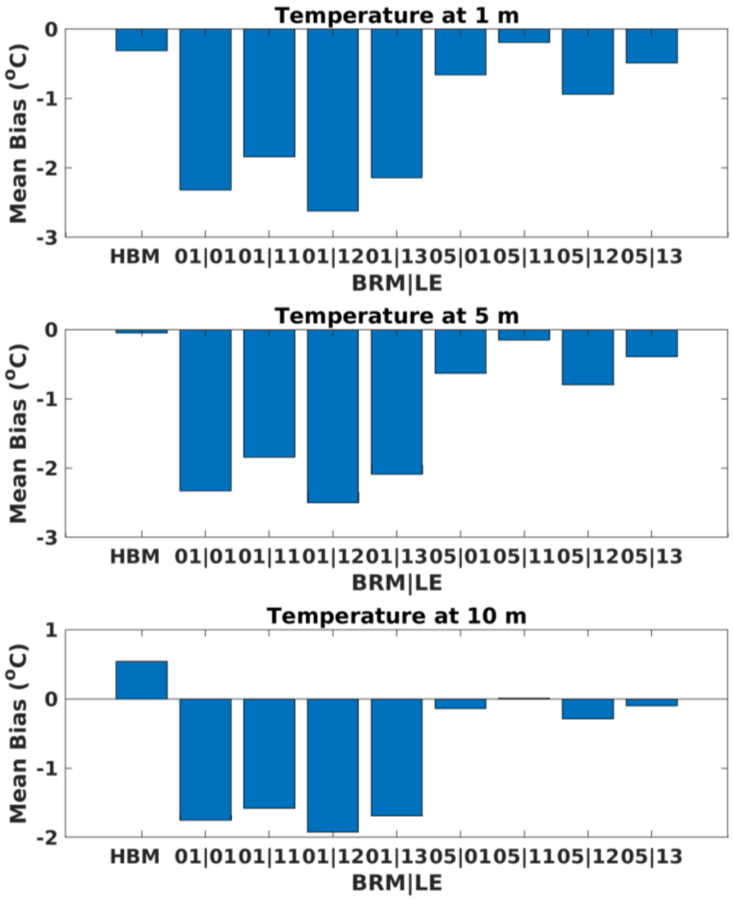
- 4 dates with DV
- Temperature fields 07:00-19:00

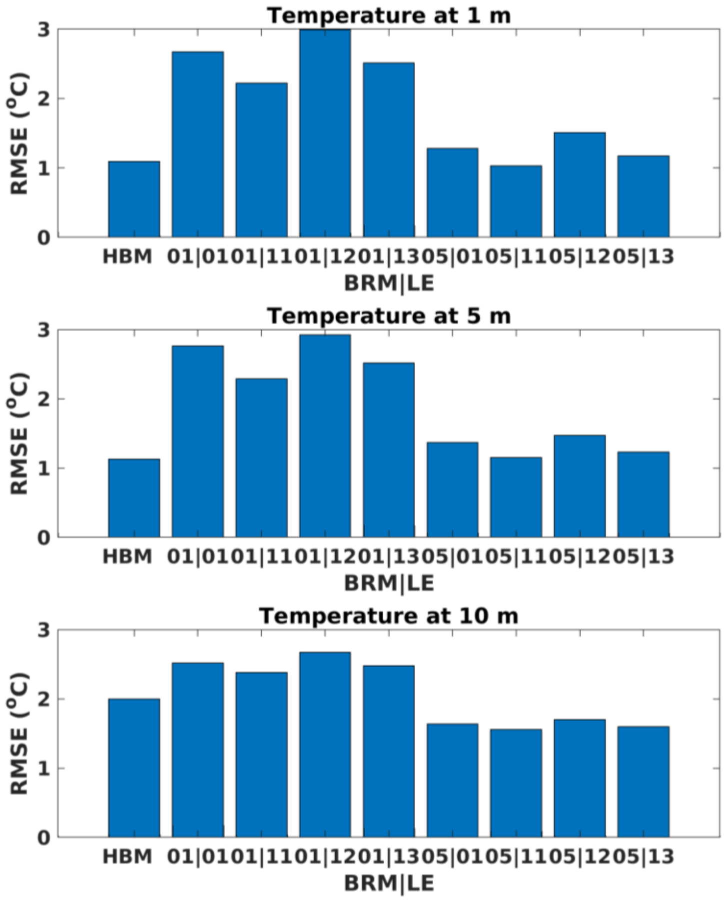
Summary

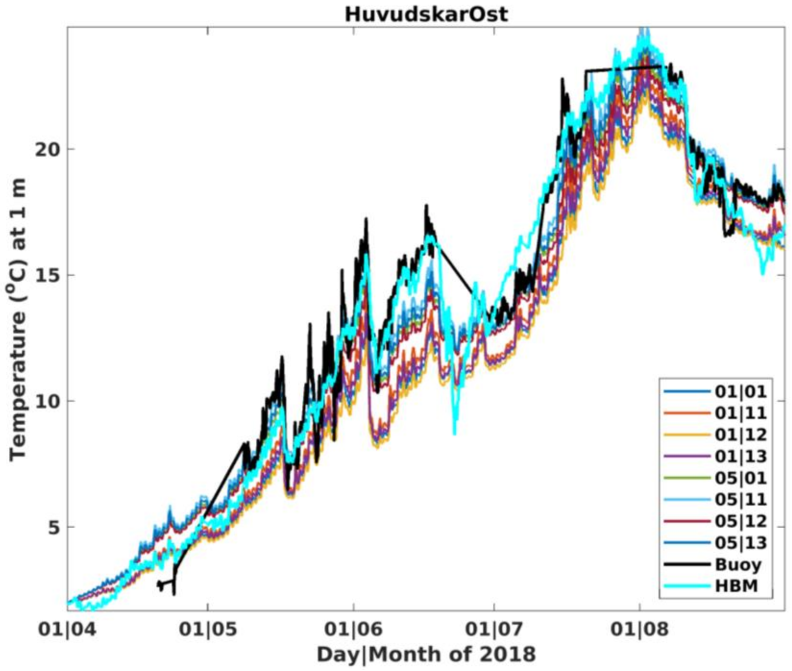
- Mean dSST from SEVIRI exceeding 1 degree at test locations in the Baltic
- Mean DV amplitude from GOTM closer to SEVIRI compared to HBM, at test locations
- Individual diurnal warming cases simulated over the entire domain
- Mean biases SEV-GOTM lower by 0.5 ^{o}C compared to SEV-HBM
- For extended diurnal warming cases, GOTM reduces biases with SEVIRI by 1 degree or more compared to HBM
- Next steps:
  - Conclude on GOTM set-up
  - Include new modifications to the latest stable GOTM release
  - Extend the 2D simulations to the entire period April-August 2018

Thank you for your attention

GOTM – Buoy: Huvudskar Ost







GOTM – SEVIRI: Huvudskar Ost