

EU Coastal Use Cases Workshop

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Estonian Coastal Monitoring and Forecast Service

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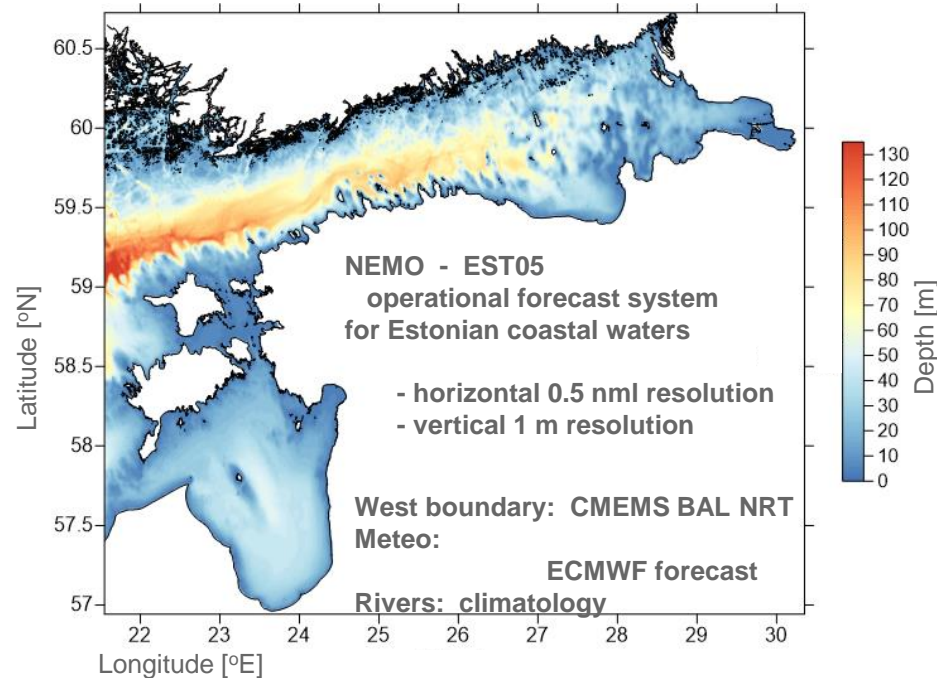
Upgrade the present Coastal Monitoring and Forecast Service, relying on the products from the Copernicus Marine Service, to the level compatible with Copernicus Marine Service

- update of coastal ocean model;
- operational automated validation;
- digital data service;
- demonstration of use cases for emerging coastal problem;
- outreach and dissemination.

Benefits:

Upgraded model is main source of Estonian State marine forecasts provided by Estonian Environment Agency

Marine forecast engine NEMO regional configuration

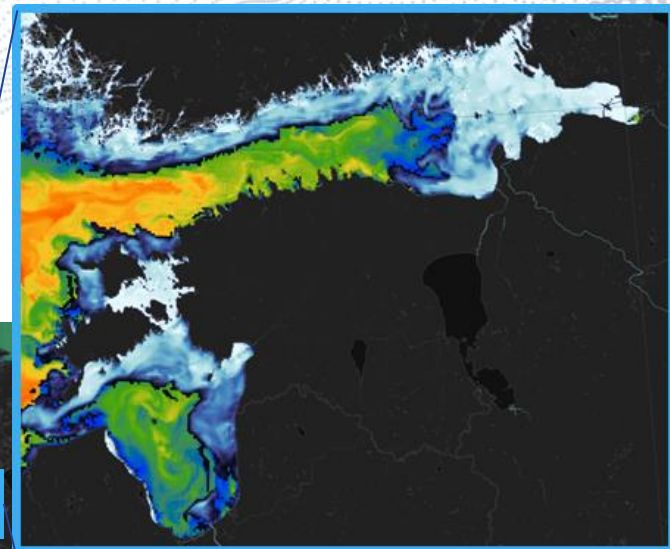
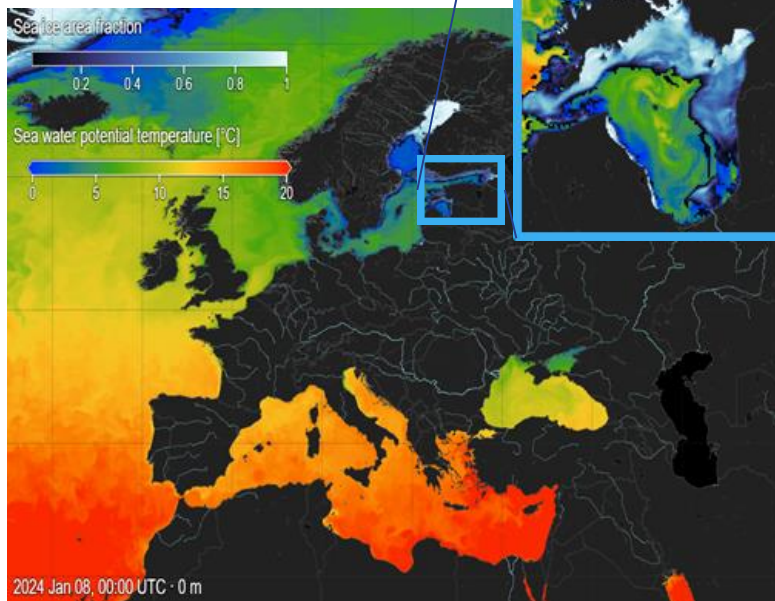


- Tallinn University of Technology (TalTech) is leading University in Estonia focused on connecting science and technology innovations
- Founded in 1918, TalTech is a research-based university offering Bachelor's, Master's and Doctorate degrees in engineering, natural sciences, IT, business and maritime studies. TalTech is also the most international university in Estonia.
- The task of the Department of Marine Systems (MSI) is basic and applied research in learning about and modeling the physical and biogeochemical processes of the Baltic Sea based on the effects of the atmosphere, land and human activities.
- The Department of Marine Systems has over 30-years experience in marine science and applications
- MSI is the leading developer of ocean models in Estonia
- All the team members are involved (or have been involved) in BAL MFC of Copernicus Marine Service



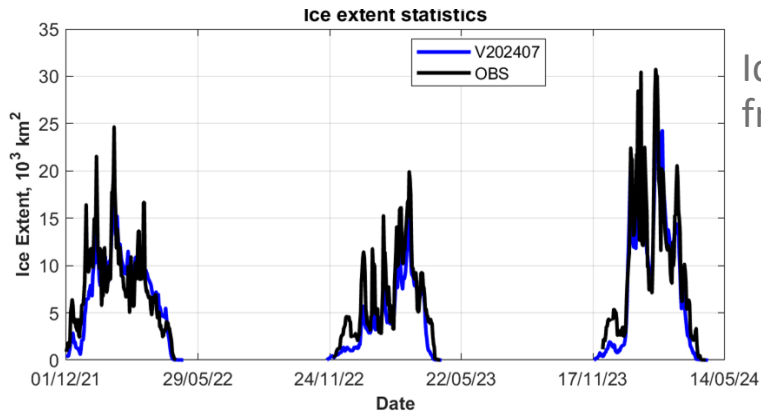
NEMO-EST product specifications

- Geographical coverage: [21.55°, 30.37°; 56.94°, 60.71°]
- Horizontal grid: 529x455 cells (0.5NM=1/120° ~925 m) ~510x420 km (2 times higher resolution than CMEMS BAL MFC NRT product)
- 110 z layers (depth: 0.5m – 135m) (2 times higher resolution than CMEMS BAL MFC product)
- Layer thickness 0.5m down to 65m depth, 0.5 – 2.0m down to 136m
- Ocean boundary from CMEMS BAL MFC NRT product
BALTICSEA_ANALYSISFORECAST_P
HY_003_006



- Marine forecast engine updated to NEMO 4.2v and daily cycle on ATOS established
- Forecast length extended to 5 days
 - Forcing input of new HRES (4 km) atmospheric forcing implemented
 - New copernicus client data transfer for boundaries adopted
- Catch-up simulation 2021-2024 conducted.
- Daily operational datastream from ATOS to local datacenter established

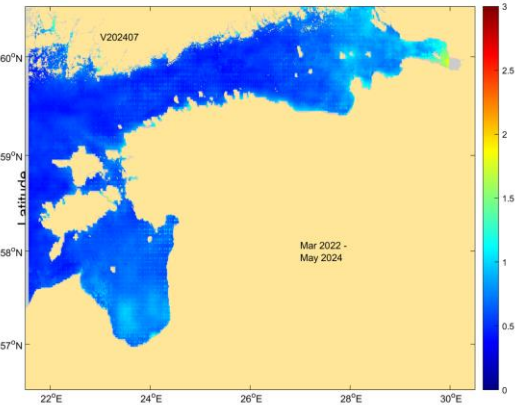
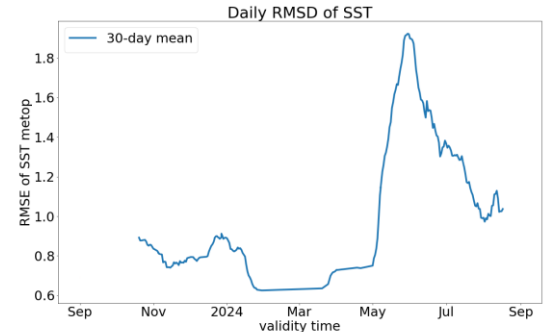
- Class 4 metrics are operationally calculated and monitored
 - Sea level (moorings)
 - Temperature (SST satellite, SST FerryBox)
 - Salinity (SSS FerryBox)
 - Ice concentration (ice charts)
- Quality Information Document (QUID) is in preparation
- Product User Manual (PUM) is in preparation



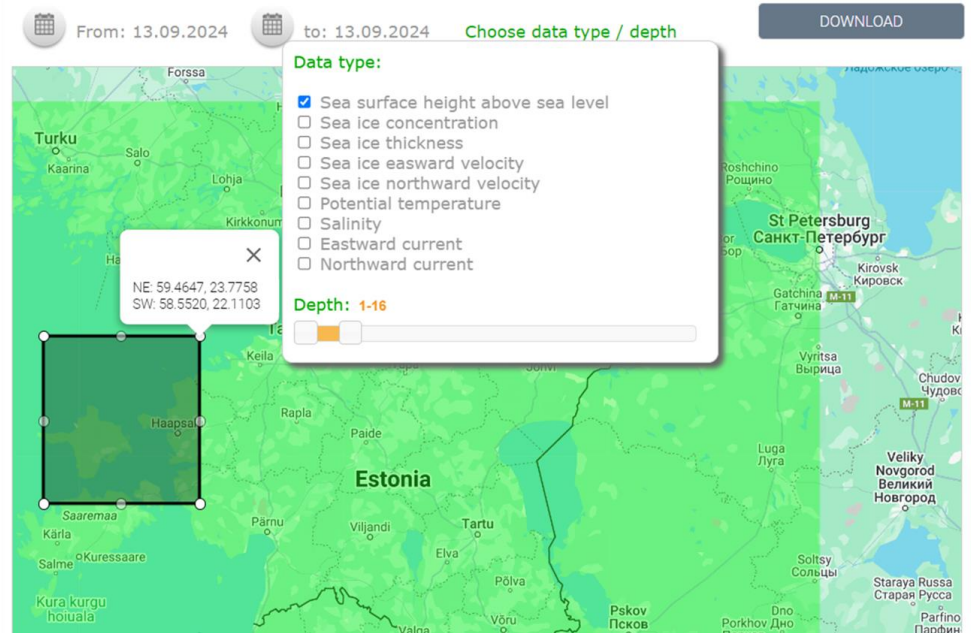
Ice extent validation
from QUID

SST RMSE during
spring months from
QUID

Operational daily SST RMSE



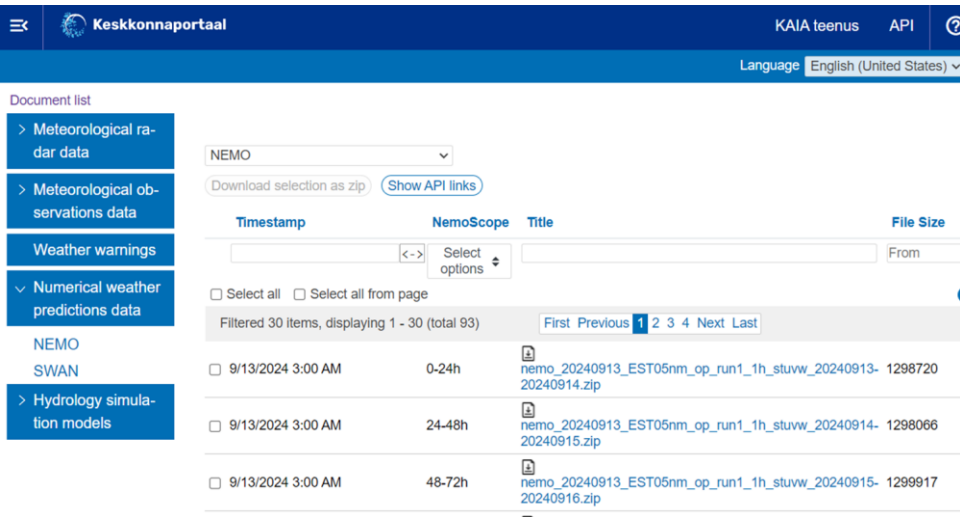
- Operational archive established
- THREDDS server set up for dissemination
- Web interface for data download
 - <https://emis.msi.ttu.ee/?lang=en>
- 6 months of data delivered to MOi
- Sea forecasts visualized in Estonian Environment Agency Web
 - https://www.ilmateenistus.ee/meri/mereprognosisid/sea-level/?lang=en#layers/sea_level
- Digital product data files available at Estonian Environment Agency data dissemination service (KAIA)
 - <https://avaandmed.keskkonnaportaal.ee/dhs/Active/documentList.aspx?ViewId=40a63be9-52d3-4833-b9f6-1d6617a8fff5>



<https://emis.msi.ttu.ee/?lang=en>

Digital data download on Estonian Environment Agency opendata service KAIA

<https://avaandmed.keskkonnaportaal.ee/dhs/Active/documentList.aspx?ViewId=40a63be9-52d3-4833-b9f6-1d6617a8fff5>

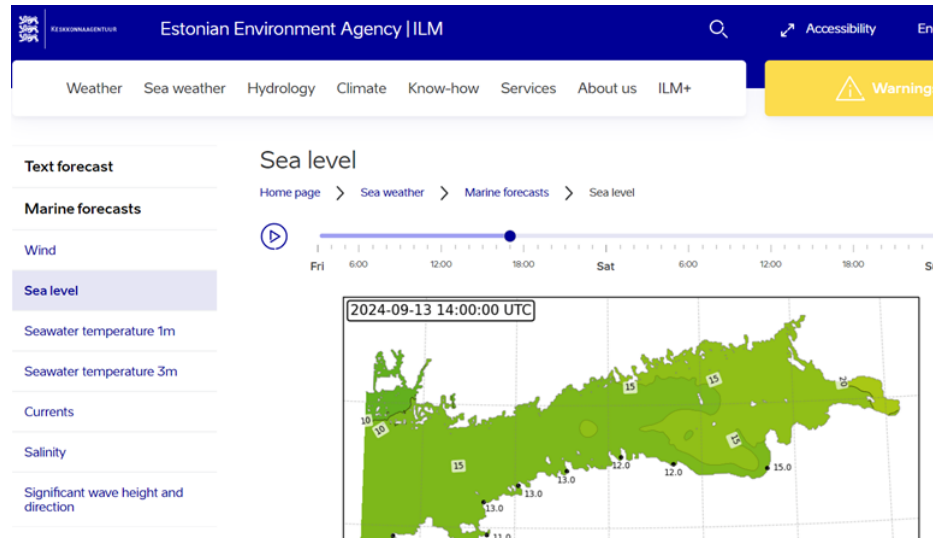


The screenshot shows the 'Keskkonnaportaal' website with a search for 'NEMO'. The results table is as follows:

Timestamp	NemoScope	Title	File Size
9/13/2024 3:00 AM	0-24h	nemo_20240913_EST05nm_op_run1_1h_stuvw_20240913-20240914.zip	1298720
9/13/2024 3:00 AM	24-48h	nemo_20240913_EST05nm_op_run1_1h_stuvw_20240914-20240915.zip	1298066
9/13/2024 3:00 AM	48-72h	nemo_20240913_EST05nm_op_run1_1h_stuvw_20240915-20240916.zip	1299917

Data visualization on Estonian Environment Agency Webpage

https://www.ilmateenistus.ee/meri/mereprognosisid/sea-level/?lang=en#layers/sea_level



The screenshot shows the 'Estonian Environment Agency | ILM' website. The 'Sea level' visualization is active, displaying a map of Estonia with sea level contours. The selected time is 2024-09-13 14:00:00 UTC. The map shows contours ranging from 10.0 to 15.0. The interface includes a timeline and various forecast options like 'Text forecast', 'Marine forecasts', 'Wind', 'Sea level', 'Seawater temperature 1m', 'Seawater temperature 3m', 'Currents', 'Salinity', and 'Significant wave height and direction'.

- ▶ Energy Security: LNG terminals and pipelines are critical for reducing energy dependence in Estonia and Finland, especially post-2022.
- ▶ MetOcean Data: Essential for planning, construction, and operation of marine infrastructure (wind, waves, sea levels, currents, sea ice).
- ▶ Key Analysis: Extreme value analysis for Floating Storage and Regasification Unit (FSRU) mooring terminal design.
- ▶ Environmental Forecasting: High-resolution forecasts needed to predict extreme conditions and ensure safe operations.

Benefits for users

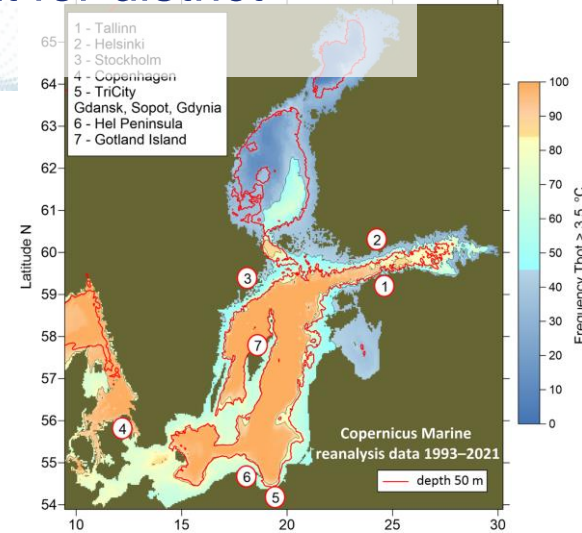
- High resolution near real time marine physics forecasts for the north-eastern Baltic Sea
- High resolution multi year marine physics analysis for the north-eastern Baltic Sea
- Tailored MetOcean analysis for the north-eastern Baltic Sea



Use Case 2. Extraction of marine heat for district heating using seawater heat pumps

Frequency of occurrence of suitable bottom waters for Seawater Heat Pumps ($T_{bot} > 3.5^\circ\text{C}$)

- ▶ Seawater heat pumps (SWHP) extract marine heat for district heating, offering a renewable alternative to fossil fuels.
- ▶ SWHP systems reduce greenhouse gas emissions, aiding in climate change mitigation and energy sustainability.
- ▶ These pumps work even in cold seawater, as seen in operational projects like Stockholm's and Esbjerg's systems.
- ▶ Data from Copernicus Marine Service helps in site planning and technical optimization.
- ▶ Tallinn Bay is particularly suited for SWHPs due to favorable marine conditions.



NATURAL RESOURCES & ENERGY



CLIMATE & ADAPTATION



COASTAL SERVICES

Benefits for users

Industry and public services dealing with energy and civil engineering in relation to district heating using seawater heat pumps, will obtain information:

- Initial baseline info about coastal sections where using seawater heat pumps may be feasible;
- Oceanographic information for engineering design studies of marine seawater heat pumps;
- Information about environmental aspects that have to be considered in the design and decision phase of heat pump installations;
- Operational on-site oceanographic information to support optimized technical operations of the heating systems.



Thank You

