

# Regional scale seasonal and sub-seasonal weather forecast

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## Summary

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*Under global warming, exacerbated weather and ocean conditions are expected. The importance of sub-seasonal and seasonal weather predictions is continuously increasing worldwide. Climate warming has resulted in a steady increase of air temperature globally. Ocean heat content of the Baltic Sea has responded to the global warming trend. Main aim of the research is to prepare and validate seasonal forecasts for the Baltic Sea region by dynamical downscaling of global seasonal predictions. The data used for the study consists of ERA5 climate reanalysis database and ECMWF seasonal forecasting system's SEAS5 data.*

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| Research field:       | Earth sciences  |
| Supervisors:          | Prof. Dr. Urmars Raudsepp<br>Aarne Männik   |
| Availability:         | This position is available.   |
| Offered by:           | School of Science<br>Department of Marine Systems   |
| Application deadline: | Applications are accepted between June 01, 2024 00:00 and June 30, 2024 23:59 (Europe/Zurich) |

## Description

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Seasonal weather forecast on regional scale is needed for economy and society. Currently 10-day weather forecast is available with satisfactory accuracy and certainty. 7-months global low-resolution ensemble seasonal weather prediction is provided by ECMWF. Regional scale seasonal weather predictions with increasing accuracy and decreasing uncertainty is developing. Concurrently, artificial intelligence methods evolve with a very high speed and are implemented in the preparation of seasonal forecasts of the Earth system components.

Main aim of the study is to prepare seasonal predictions of the Earth system components in the Baltic Sea region with tailored products for wind and solar energy sector. Dynamical downscaling of seasonal predictions of the SEAS5, ECMWF's fifth generation seasonal forecasting system is one possibility to obtain regional sub-seasonal and seasonal weather predictions on regional scale. For the downscaling of the atmospheric fields with refined spatial resolution the numerical atmospheric model is used. ECMWF SEAS5 51-member ensemble relevant parameters (near surface temperature, winds, heat fluxes, solar radiation etc.) will be used for the Baltic Sea region. A seasonal forecast is produced each month. The forecasts have an initial date of the 1st of each month and run for 7 months. The ensemble members are obtainable from the ECMWF MARS archive system.

AI model will be developed and implemented and coupled with numerical model to increase accuracy of dedicated seasonal predictions.

### *Responsibilities and (foreseen) tasks*

- Learning about and using ERA5, SEAS5 databases and regional atmospheric numerical model. Extracting atmospheric data from databases, preparing boundary fields for regional model, setting up and running the model in the test mode. Reasonability check of the model results.
- Analysis of ERA5 reanalysis data for preparation of dedicated products for wind and solar energy sector. Implementation of the machine learning model for prediction of selected atmospheric parameters. Evaluation of the predictions, improvement and finalisation of the models.
- Production of the seasonal predictions of atmospheric fields of the Baltic Sea region for the actual future +7 month. Evaluation of the seasonal predictions on the actual time frame using available measurements. Clustering of prediction errors using K-means unsupervised machine learning algorithm.
- Comparison of downscaled predictions and AI model produced predictions.

### *Applicants should fulfil the following requirements:*

- a master's degree in physics, oceanography, data analysis or mathematics
- a clear interest in the topic of the position
- excellent command of English

- strong and demonstrable analytical skills
- capacity to work both as an independent researcher and as part of an international team

*(The following experience is beneficial: )*

- Basic knowledge of numerical modelling
- Basic knowledge of machine learning
- Programming in Matlab or Python
- Some experience of working with big data
- Some experience in HPC

*We offer:*

- 4-year PhD position in one of the leading research departments in oceanography and related numerical modelling in Estonia
- The chance to do high-level research in cooperation with European research institutes in the framework of the Copernicus Marine Service
- Opportunities for conference visits, research stays and networking with leading universities and research centers in the fields of oceanography

#### *About the research group*

Research Group on Modelling and Remote Sensing of Marine Dynamics, Tallinn University of Technology, School of Science, Department of Marine Systems.

The research group is conducting oceanographic process research based on scientific analysis to find cause-and-effect relationships. Innovative (operational) methods for monitoring the marine environment and analyzing changes are being developed, incl. weather forecasting and climate models applied to supercomputers, to elucidate the mechanisms of atmospheric and ocean interactions; and machine learning based algorithms for satellite image processing and model data analysis. The research group has a long experience in developing applications / methods of operational oceanography, the outputs of which are information provided to the public and public authorities on water level variability, ice conditions and other parameters of marine physics. The research group is making a significant contribution to the pan-European Copernicus program. In scientific process research and applied research, the strength of the research team is the use of big data (mass processing) for climate studies and statistical analysis of the properties of the marine environment, as well as for finding dynamic relationships.

*(Additional information)*

For further information, please contact Prof. Urmas Raudsepp, [urmas.raudsepp@taltech.ee](mailto:urmas.raudsepp@taltech.ee)



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