Linking Estonia and Latvia
Part-financed by the European Regional Development Fund

GULF OF RIGA AS A RESOURCE FOR WIND ENERGY

Project #EU34711

Results of the work package II "Wind energy fields and ice conditions" as of September, 2012 by University of Latvia (wind energy fields by regional climate models and operational weather models), University of Tartu (wind energy fields by WASP model and operational weather models) and Marine Systems Institute (ice conditions, wind energy fields by operational weather models).

INTRODUCTION

The project objectives are to provide decision makers and potential developers of wind parks in the Gulf of Riga with reliable marine wind information from high resolution remote sensing data, coastal wind measurements and ensemble of Regional Climate models. Wind fields are being complemented with the information on the habitat areas for seals and wintering, migrating and breeding birds. Local people and authorities are being involved in the active process of suitable areas' selection for potential development of wind parks through mapping their attitude and considering the requirements of the areas for renewable energy.

The project partners are Marine Systems Institute at Tallinn University of Technology (MSI, lead partner), Tartu University (TU), Estonian University of Life Sciences, University of Latvia (UL), Latvian Institute of Aquatic Ecology, Latvian Fund for Nature, Estonian Fund for Nature.

The objective of the work package II (WP2) is to provide high-resolution maps of relevant wind parameters and ice conditions for the area of Gulf of Riga. WP2 is partnered by MSI, TU and UL (the lead partner for WP2).

This document summarises the results achieved in WP2 within 22 months of the project.

THE MAIN RESULTS

Four methods of the wind fields' assessment in the Gulf of Riga are implemented by the project partners:

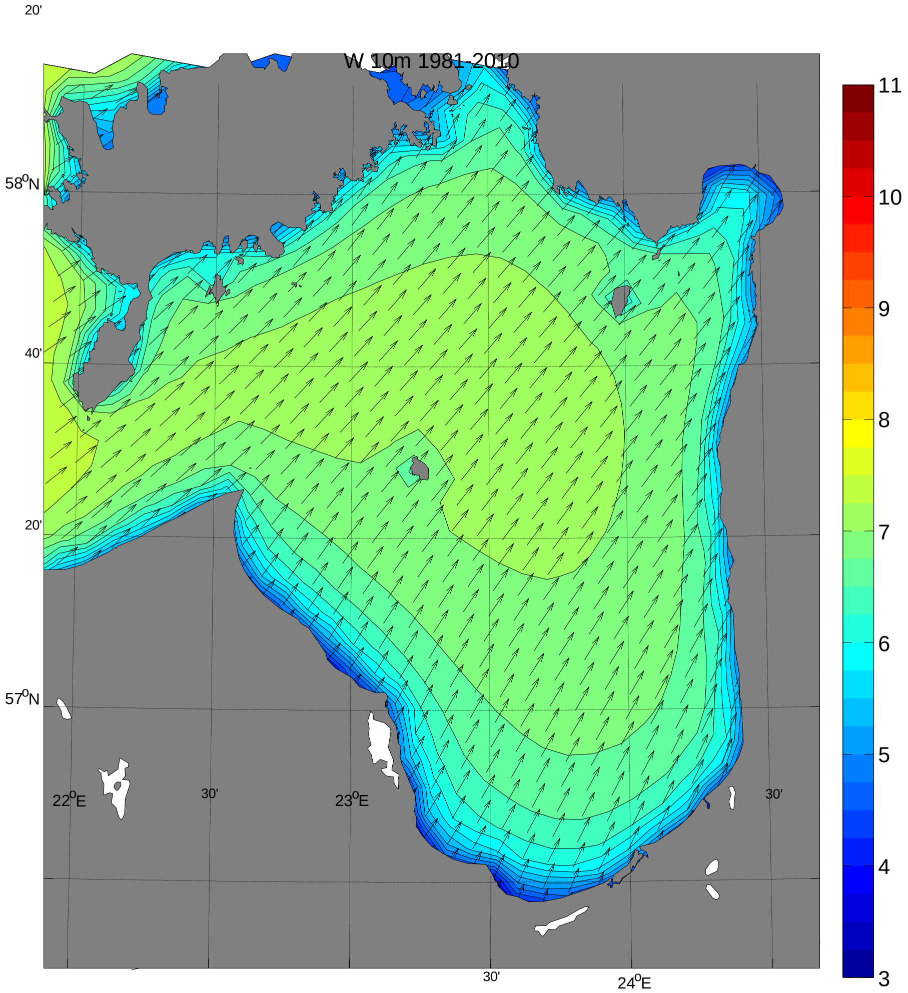

Fig. 1. Yearly average wind speed and wind direction at 10 m height. Contemporary climate.

1. Modelling of the wind fields by WASP software on the basis of long-term observations.

2. Analysis and processing of high resolution satellite images with subsequent derivation of wind fields.

3. Analysis of archives of operational weather forecast models in the area of interest.

4. Derivation of wind field statistics from the ensemble of regional climate models including downscaling these models for the area of interest.

The comparison of all four methods is of a scientific interest and forms a subject of an on-going research. The wind fields presented in this document are the output of WP2 for the spatial planning tool and thus form the practical result of WP2.

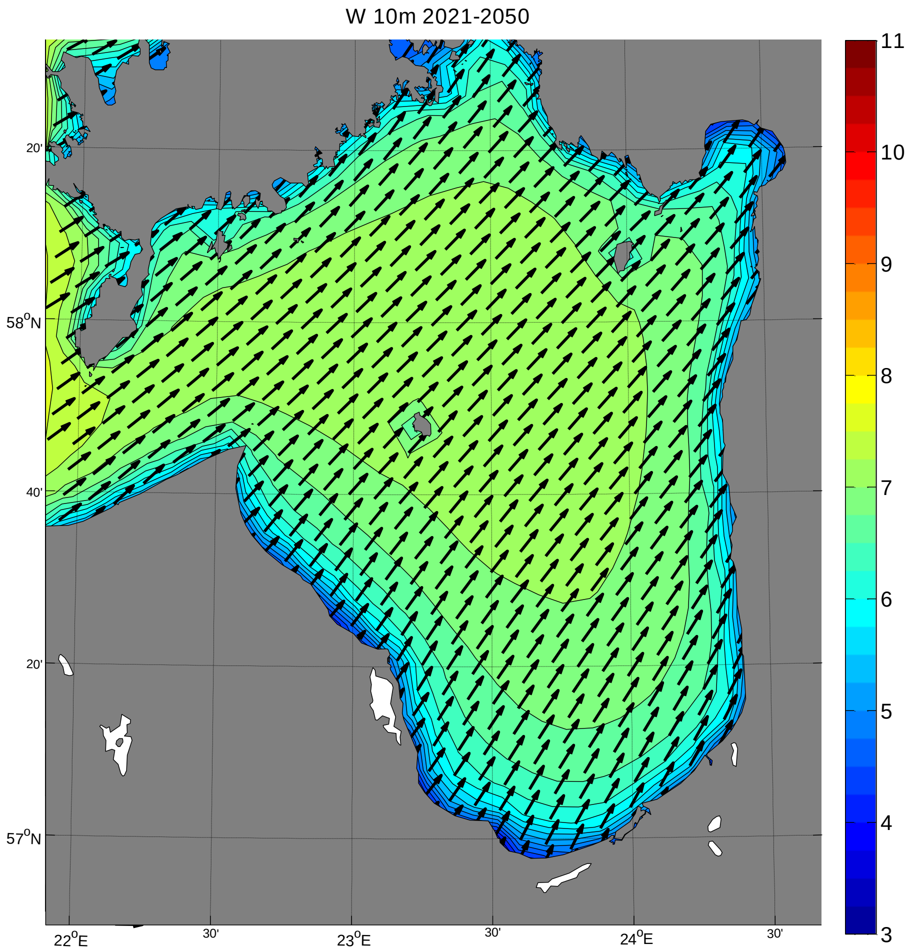

Fig. 2. Yearly average wind speed and wind direction at 10 m height. Future climate.

They are derived, as follows:

1. Contemporary climate corresponds to years 1981-2010 whilst the future climate is assumed as projections for years 2021-2050.

2. Wind data from Regional Climate models (RCM) summarised in the EC project ENSEMBLES are used.

3. The ensemble of RCMs outputs is processed selecting ensemble mean for each derived parameter.

The bias correction of RCMs and enhancement of spatial resolution is performed via the original statistical downscaling method. The reference for downscaling is an operational HIRLAM weather model by Danish Meteorological Institute.

The ice conditions are summarised from the analysis of satellite imagery for years 2001-2011.

This document contains the following information:

1. Distribution of mean annual 10 m and 100 m wind speed (Figs. 1-3) and energy density (Figs. 4-5) for contemporary and future climatic conditions.

2. Distribution of mean monthly 10 m (Figs. 6, 8) and 100 m (Figs. 7, 9) wind speed (Figs. 6-7) and energy density (Figs. 8-9) for contemporary climatic conditions.

Ice conditions for mild, medium and severe winters (Figs. 10-12).

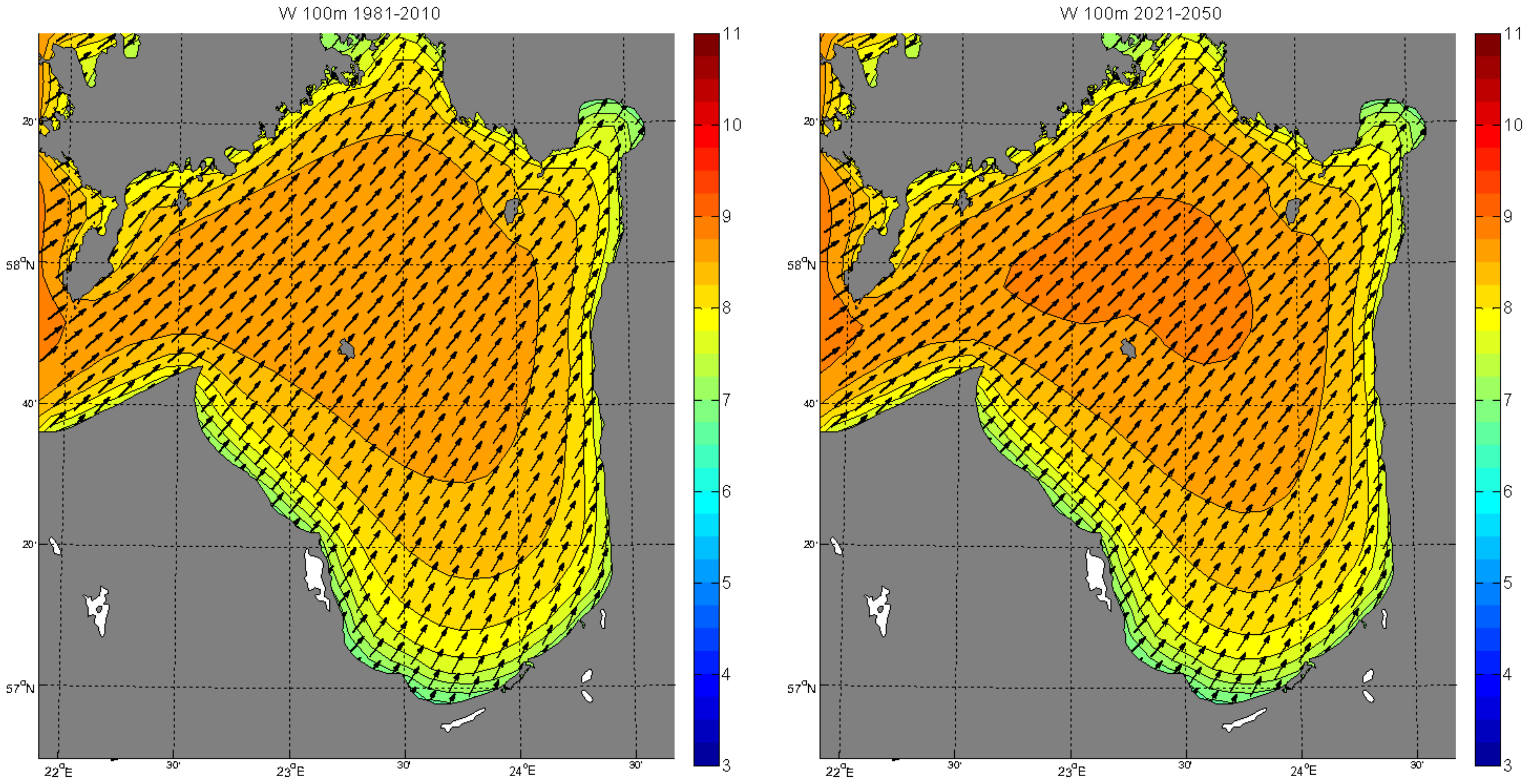

Fig. 3. Yearly average wind speed and wind direction at 100 m height. Contemporary climate (left) and future climate (right).

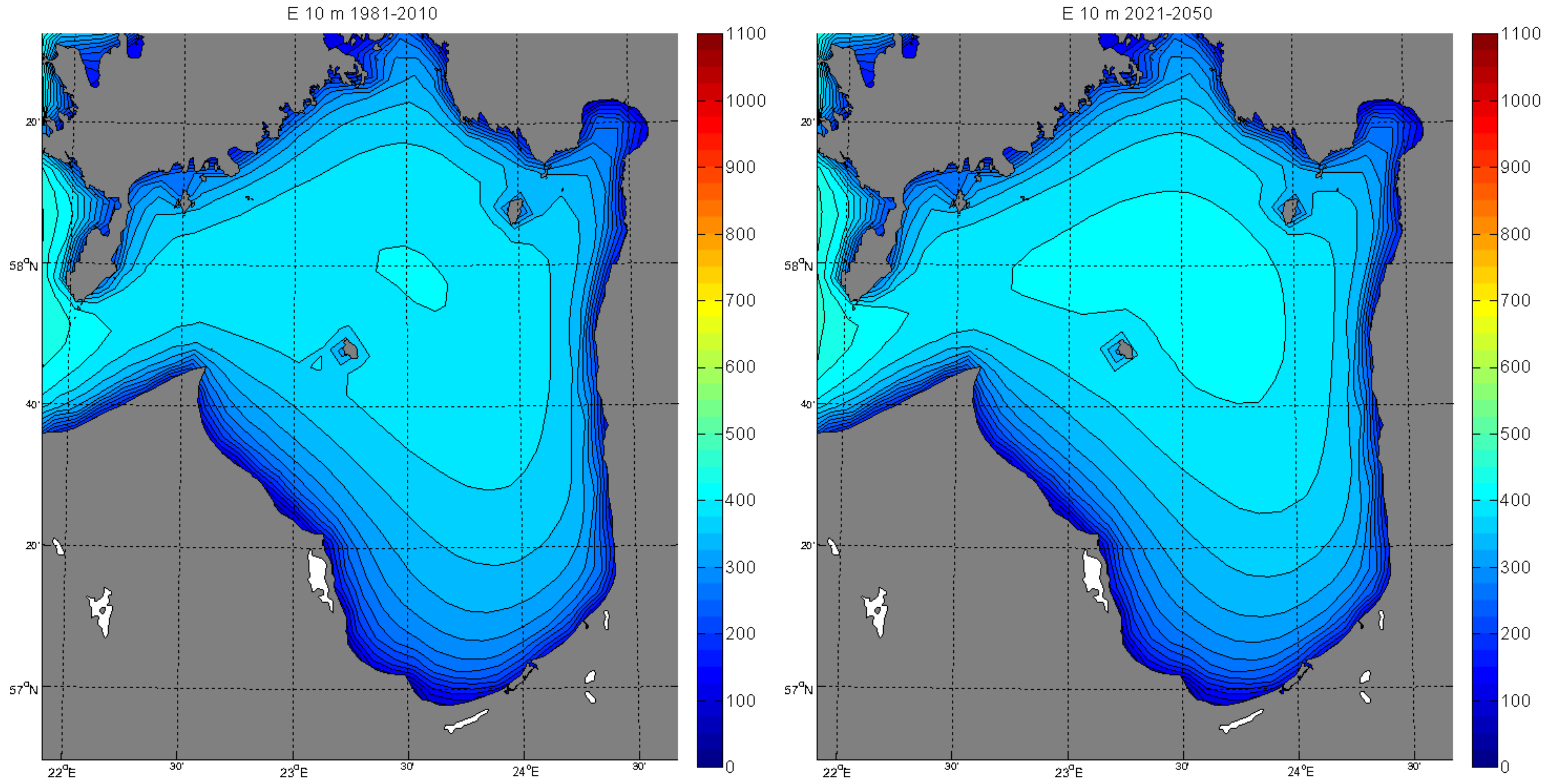

Fig. 4. Yearly average energy density at 10 m height. Contemporary climate (left) and future climate (right).

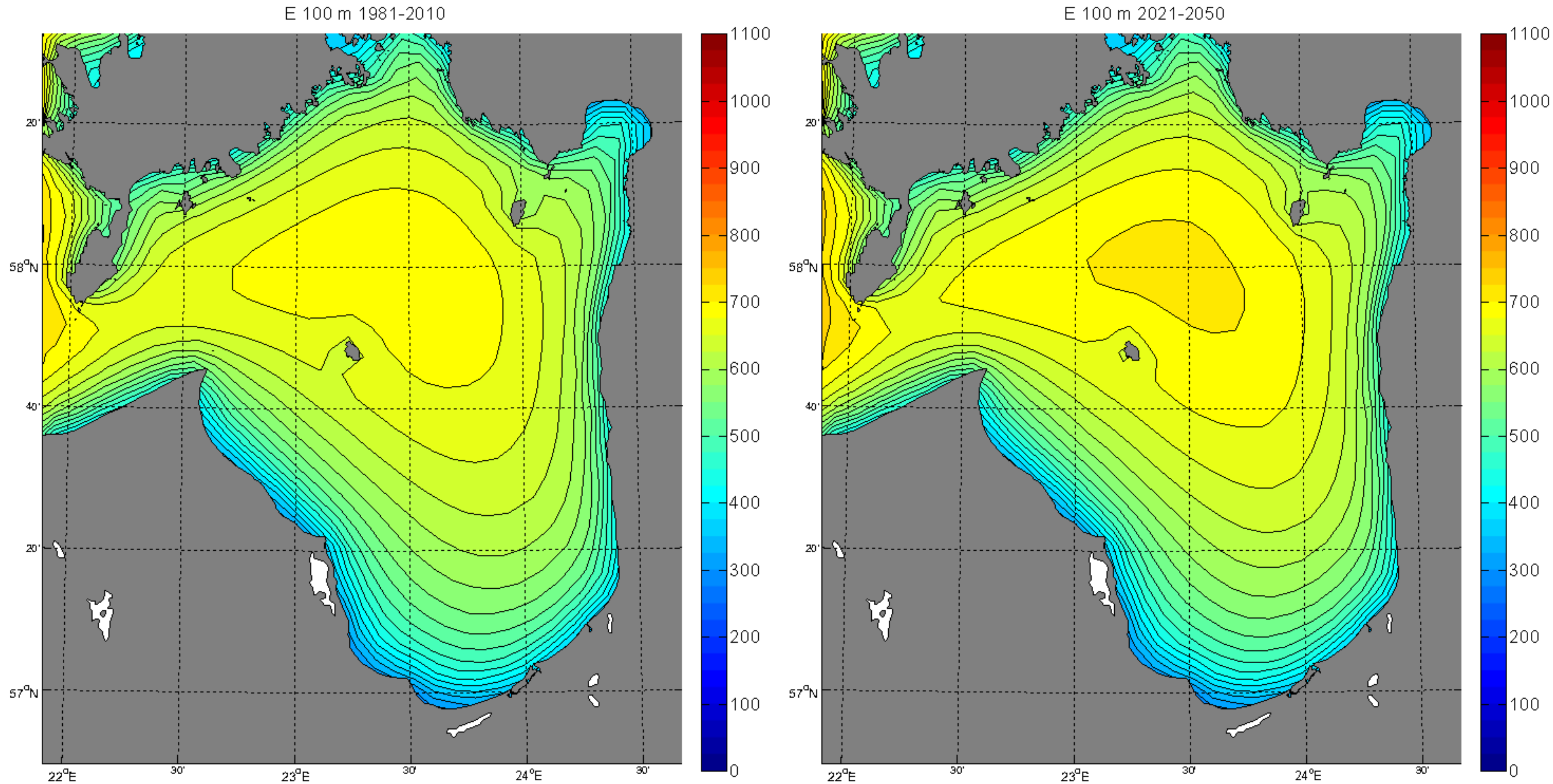

Fig. 5. Yearly average energy density at 100 m height. Contemporary climate (left) and future climate (right).

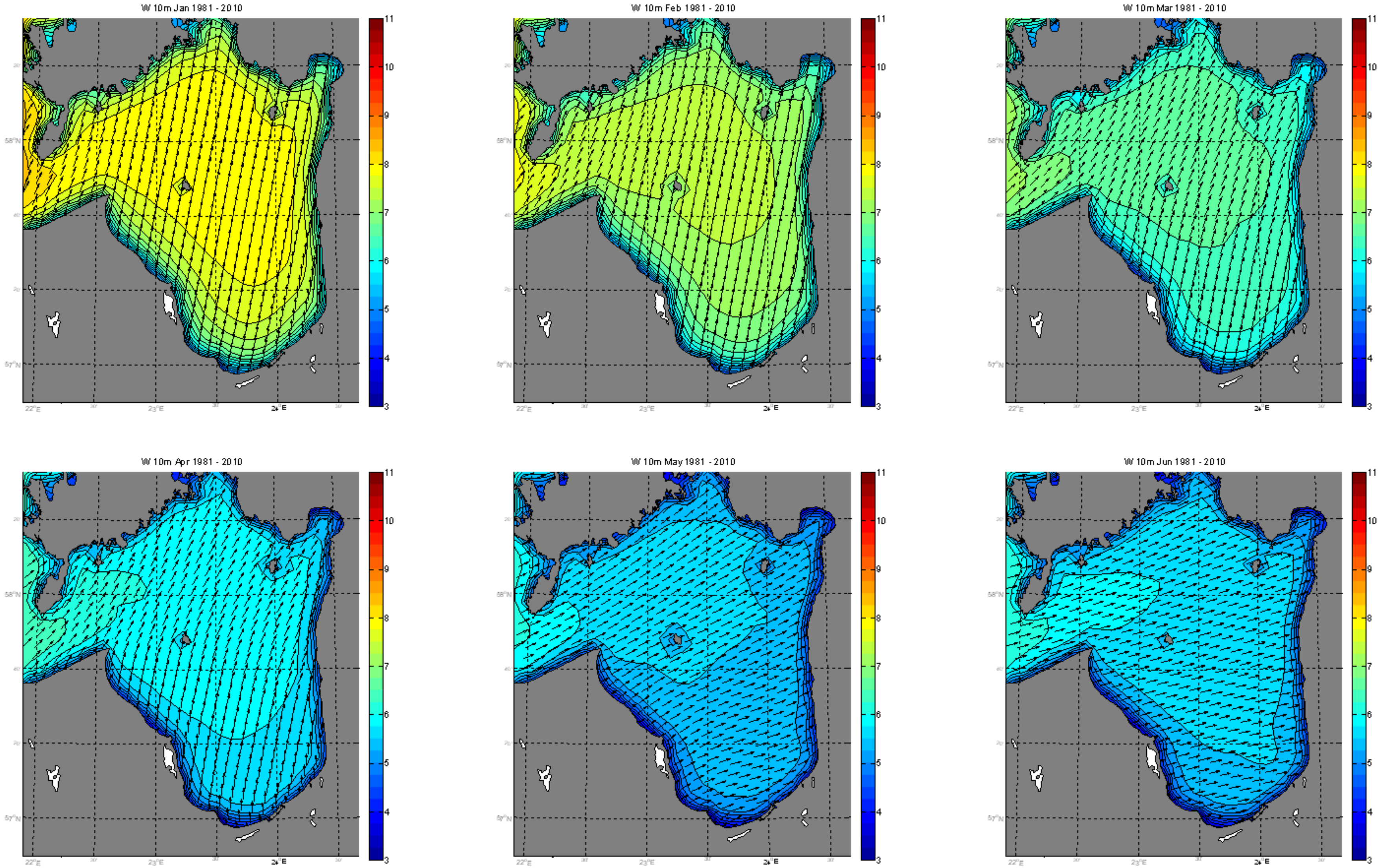

Fig. 6. Monthly average wind speed and wind direction at 10 m height, contemporary climate.

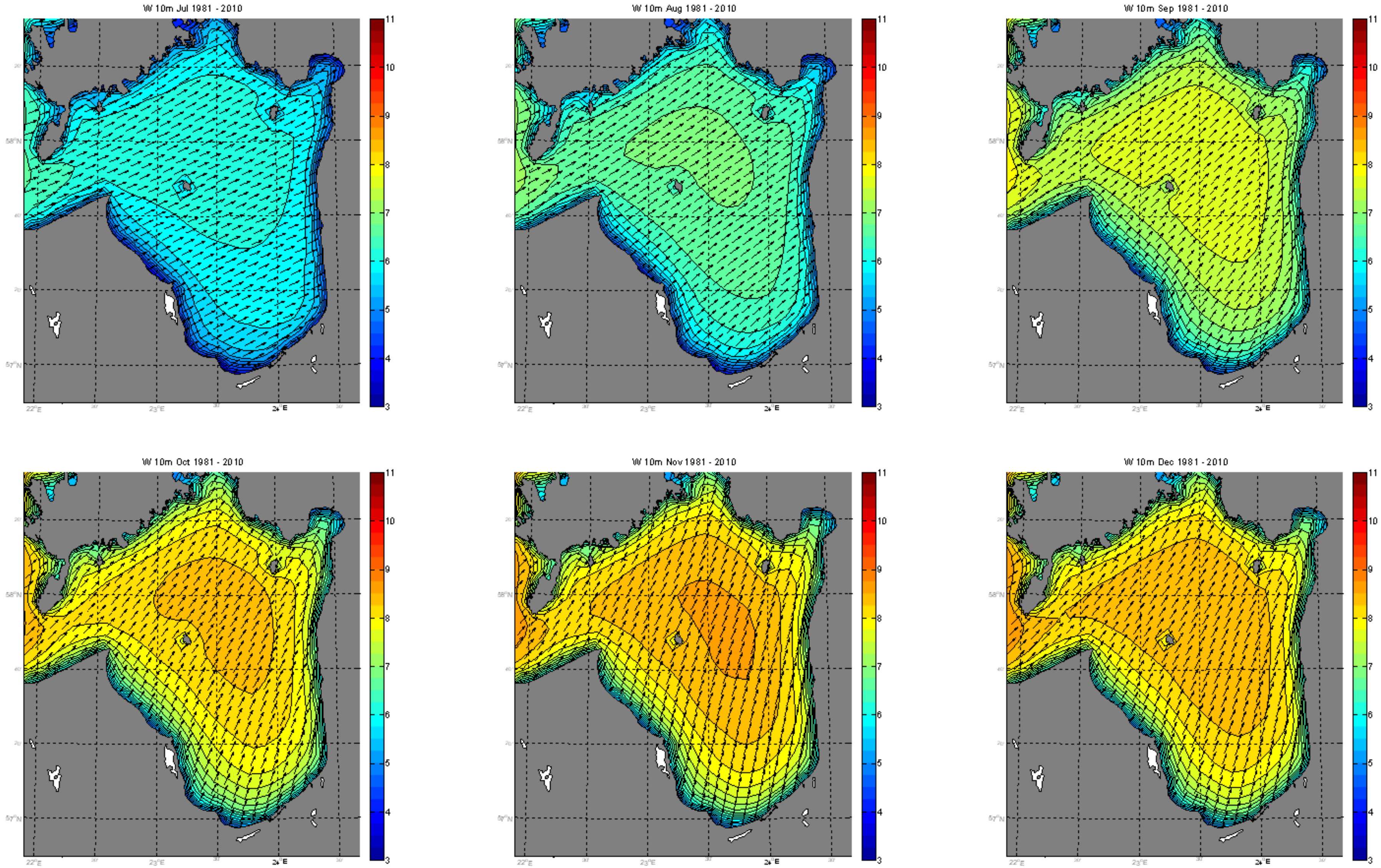

Fig. 6 (continued). Monthly average wind speed and wind direction at 10 m height, contemporary climate

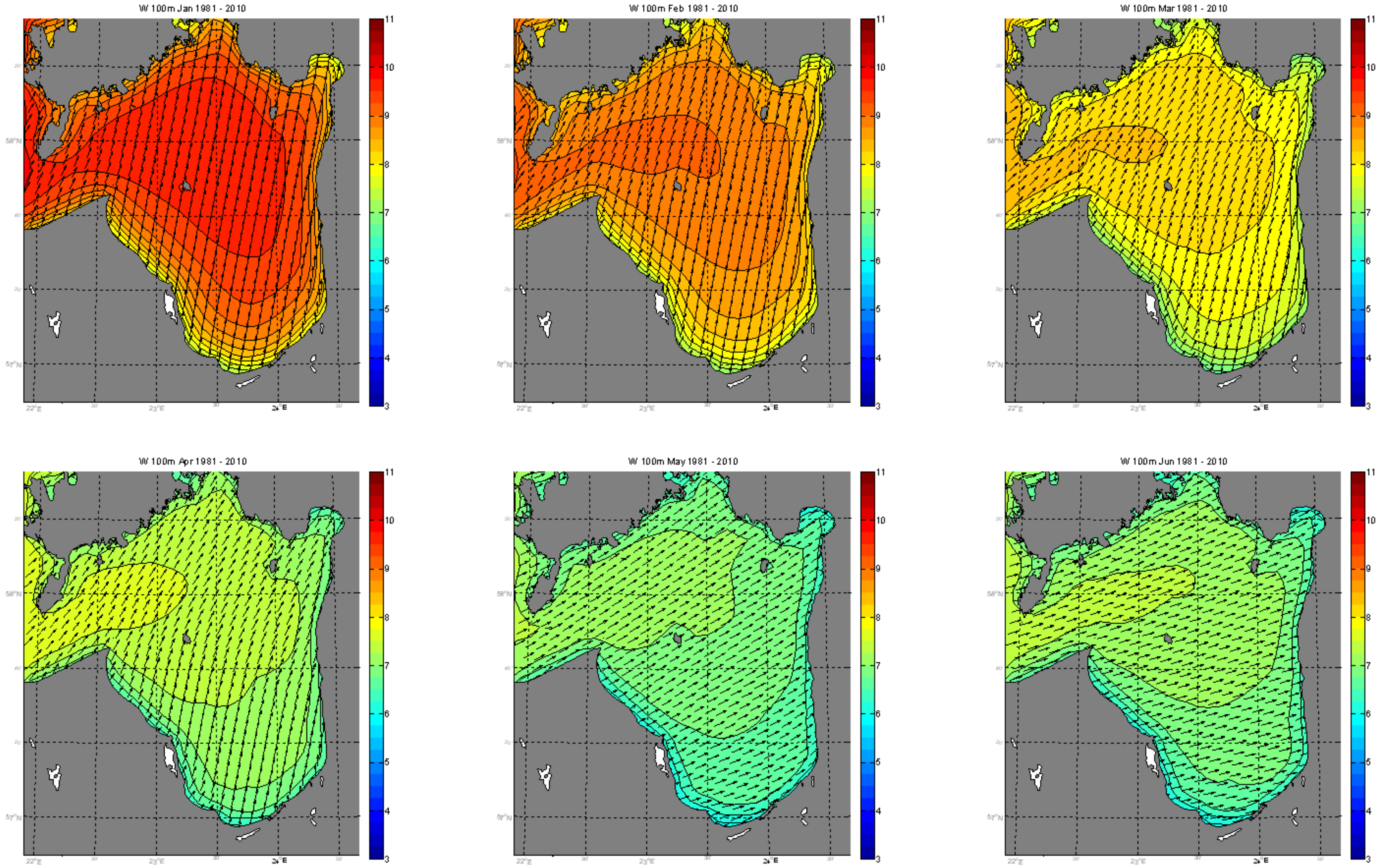

Fig. 7. Monthly average wind speed and wind direction at 100 m height, contemporary climate.

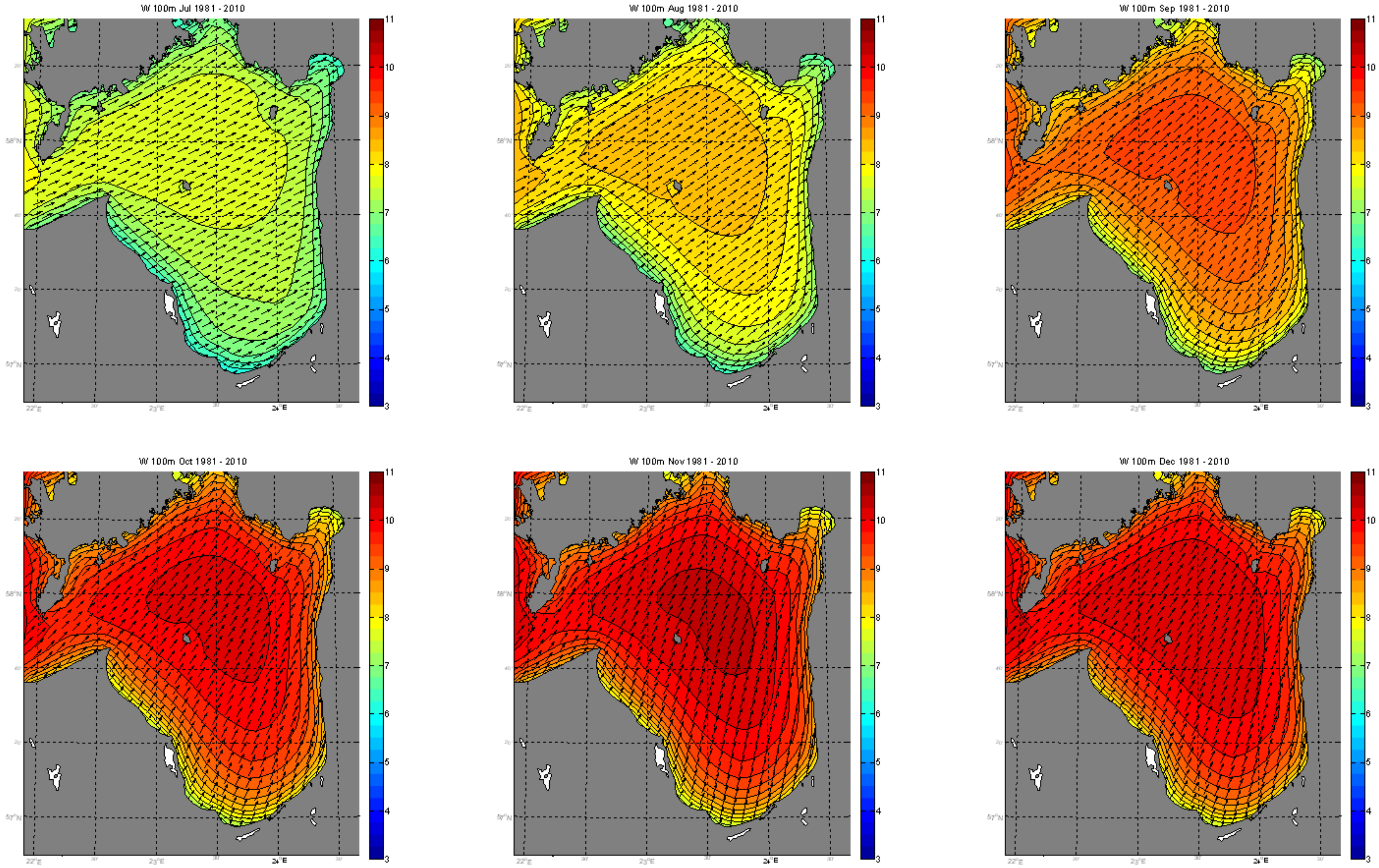

Fig. 7 (continued). Monthly average wind speed and wind direction at 100 m height, contemporary climate.

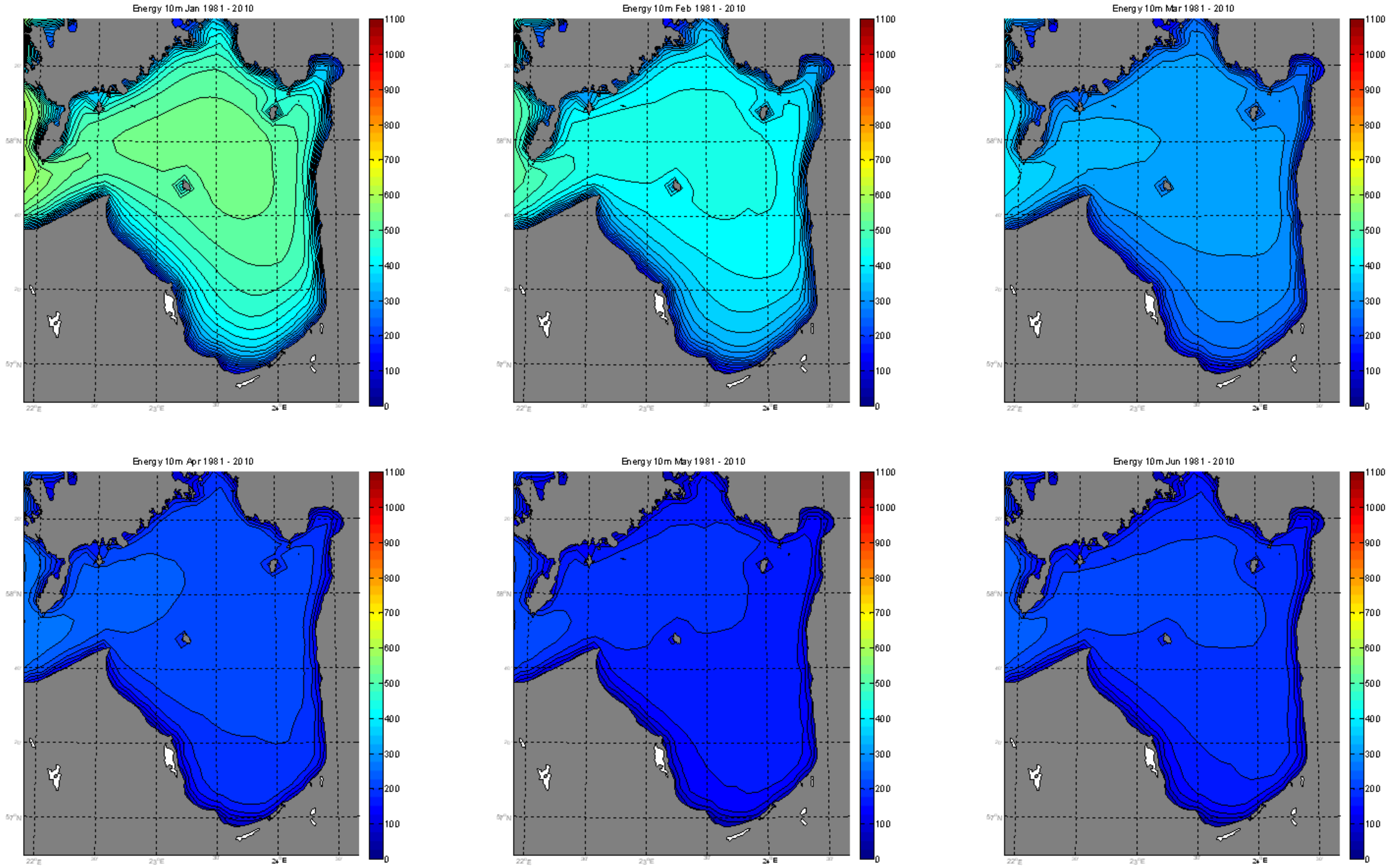

Fig. 8. Monthly average energy density at 10 m height, contemporary climate.

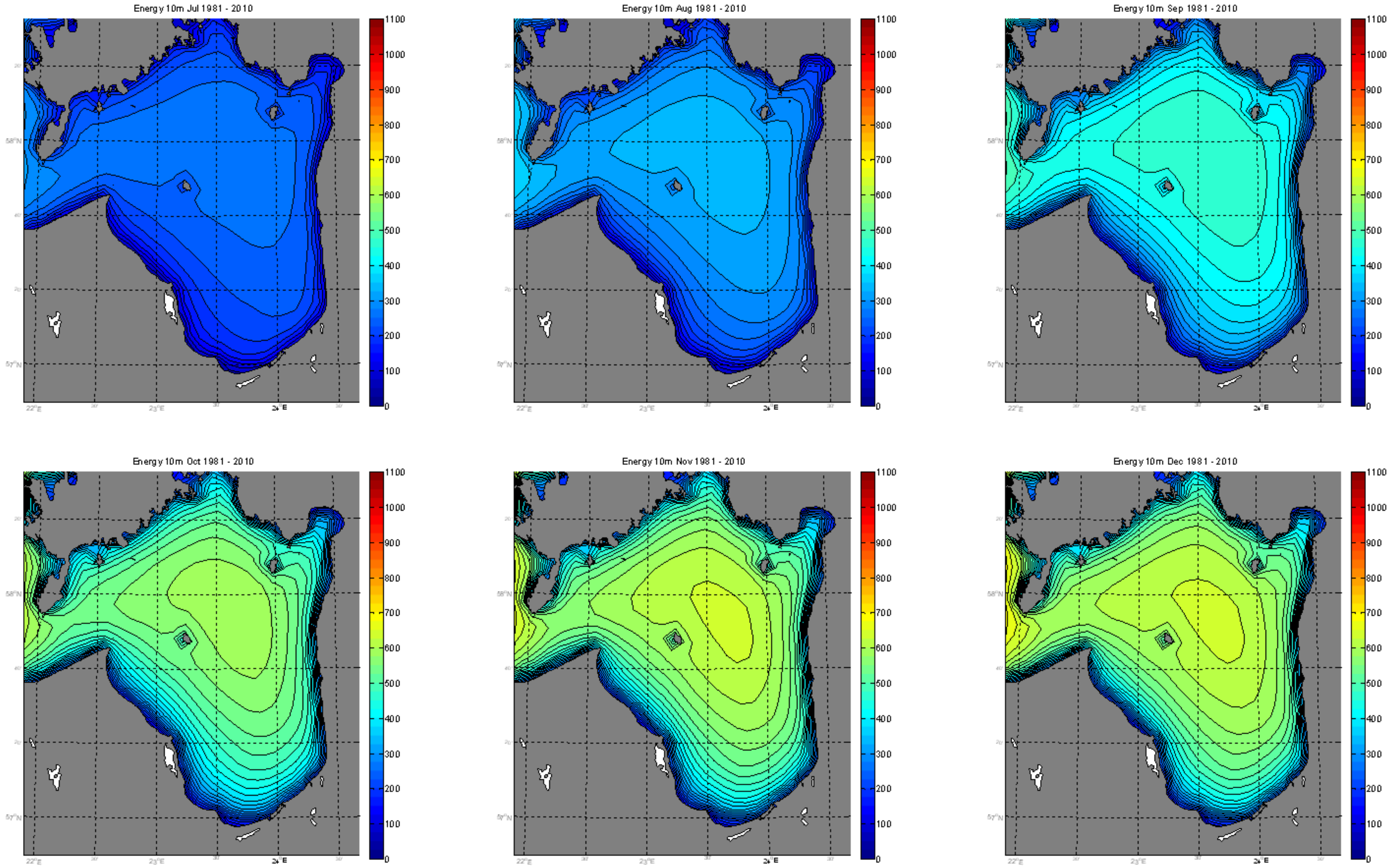

Fig. 8 (continued). Monthly average energy density at 10 m height, contemporary climate.

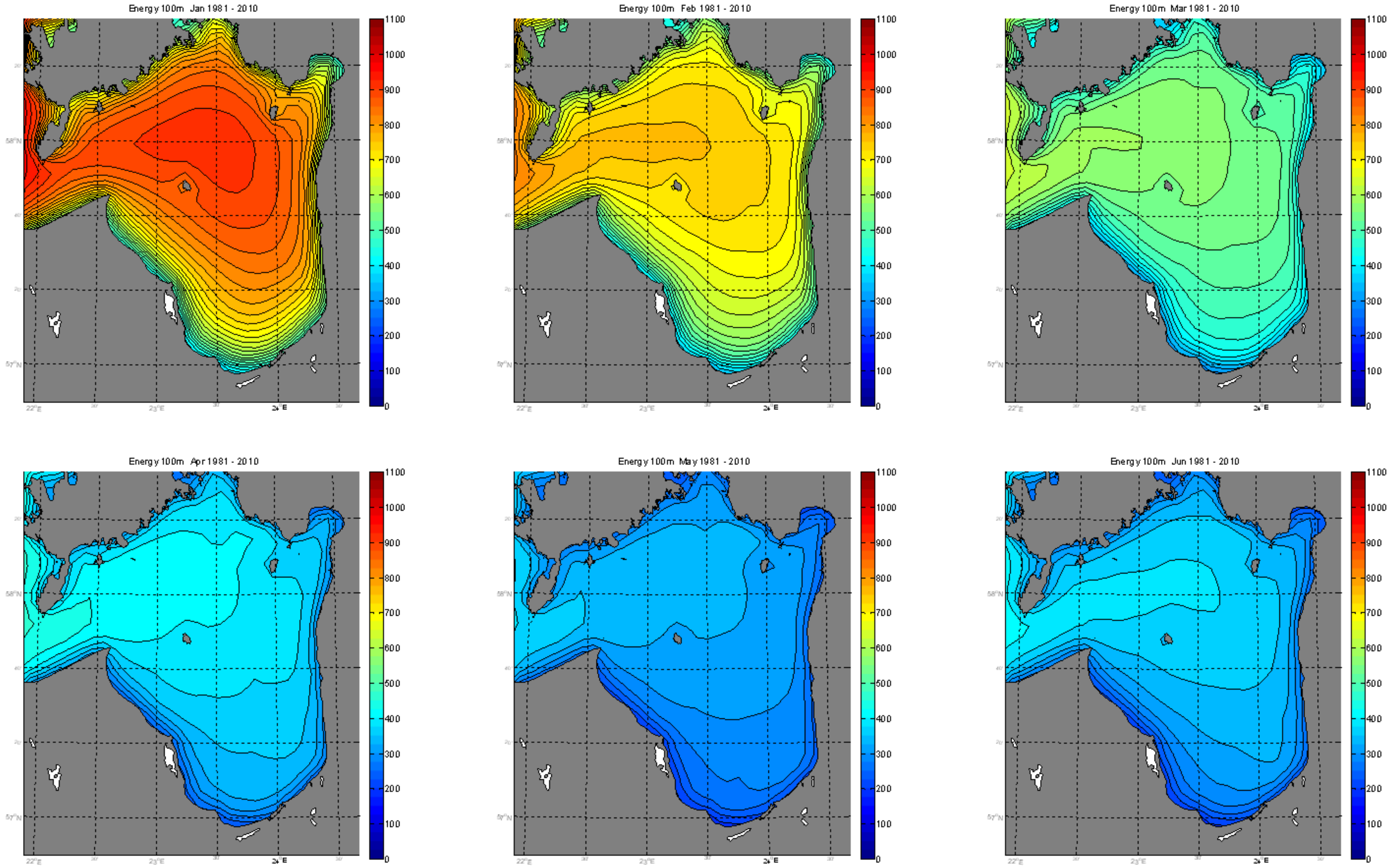

Fig. 9. Monthly average energy density at 100 m height, contemporary climate.

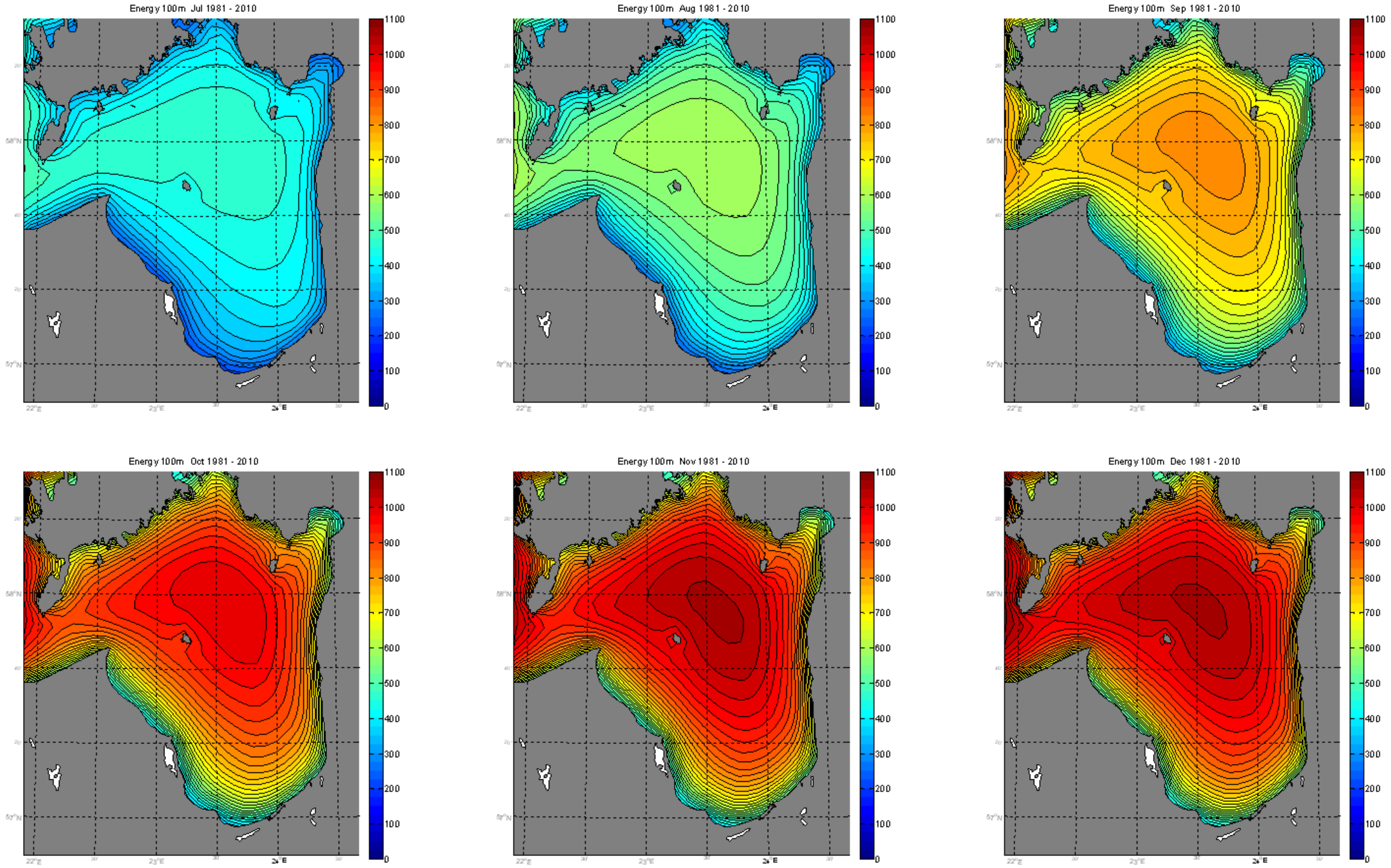

Fig. 9. (continued). Monthly average energy density at 100 m height, contemporary climate.

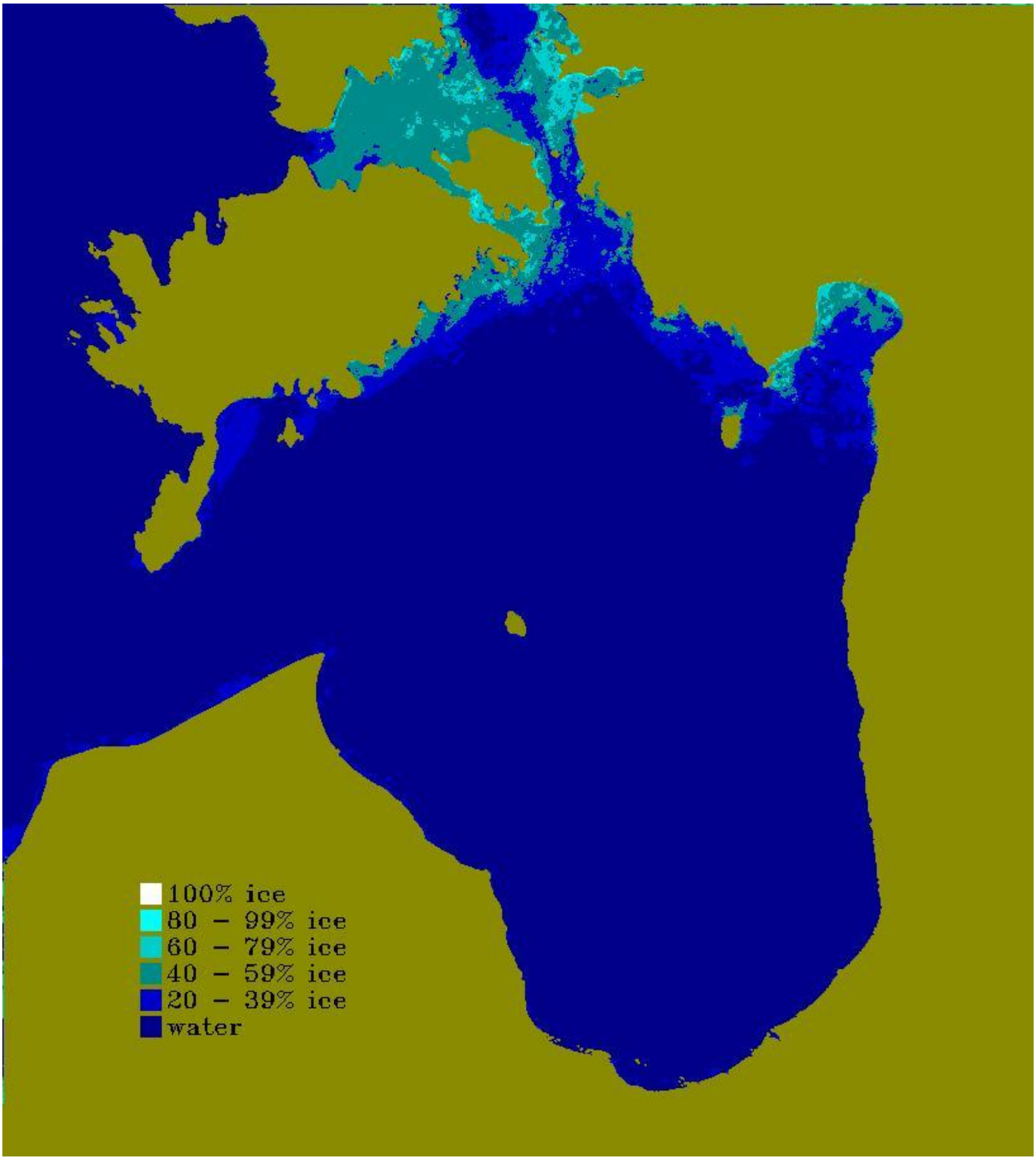

Fig. 10. Ice conditions – mild winter.

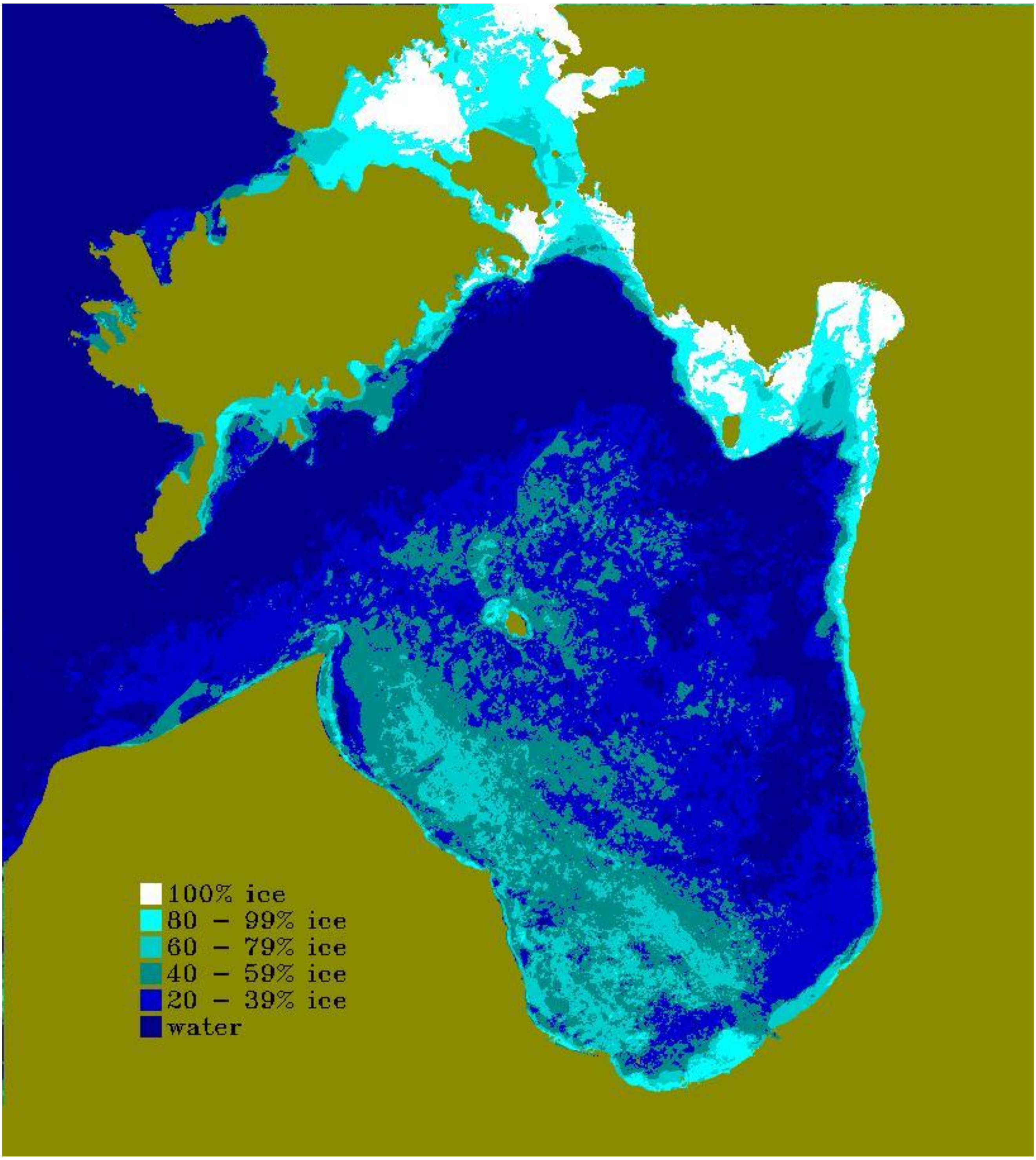

Fig. 11. Ice conditions – medium winter.

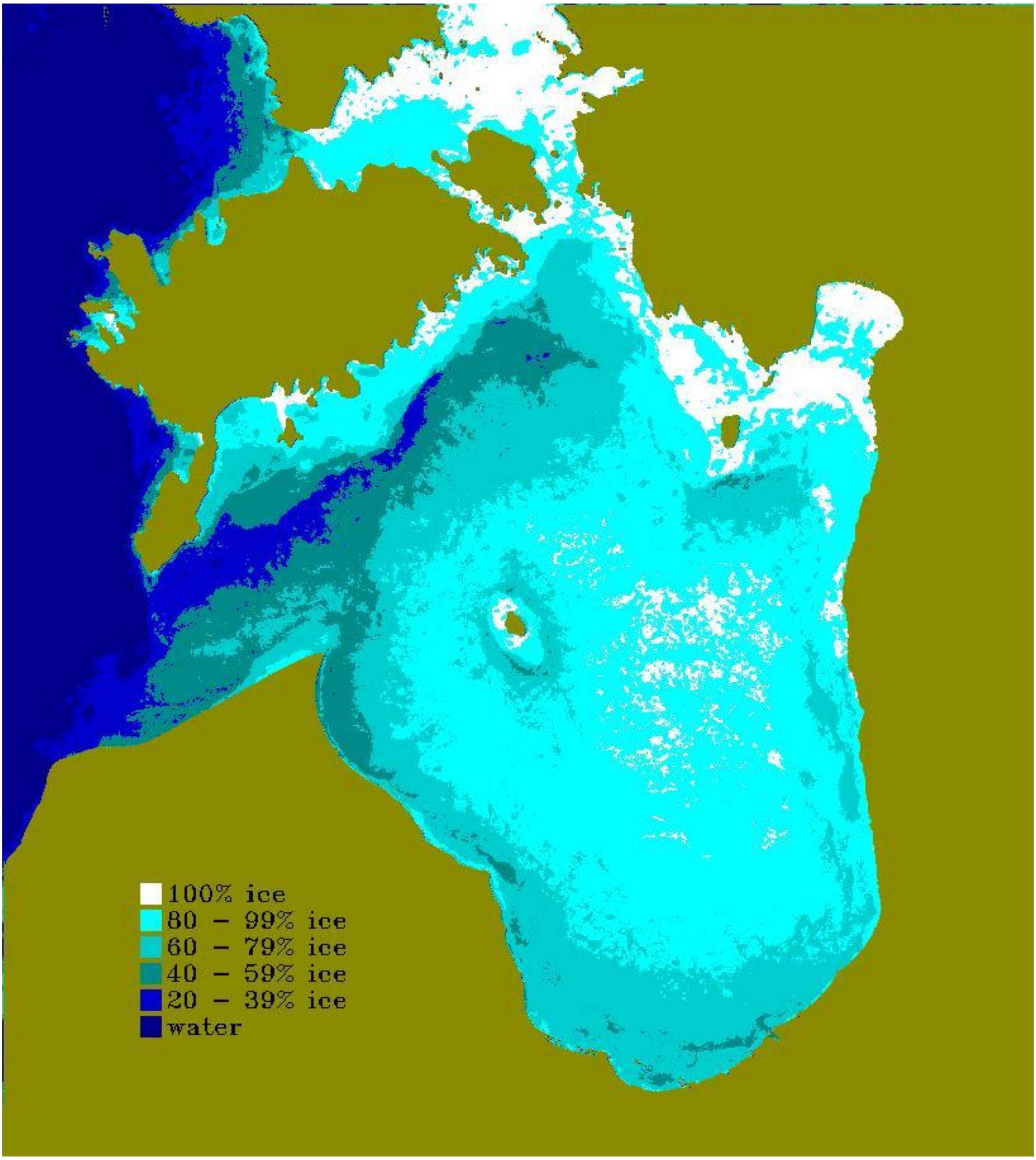

Fig.12. Ice conditions – severe winter.

CONCLUSIONS

The main conclusions related to the wind and ice fields are, as follows:

1. The average wind field over the Gulf of Riga is rather uniform except in the distinct zones of wind speed reduction along the coastline.

2. The wind speeds are higher in the northern part of the Gulf.

3. The coastal zones of wind gradient are wider at the western coast of the Gulf of Riga.

4. The effect of islands cannot be neglected.

5. The wind speed has distinct seasonal differences throughout the year; the most windy is November and the less windy – May.

6. There are no significant changes expected in the future wind climate except for slight increase of average wind speed.

7. The ice conditions are varying on interannual basis in the Gulf of Riga. One may distinguish the clustering of ice patterns which are characteristic for mild, average or severe ice conditions.

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