

The impact of the Black Sea on regional climate

V.V. Efimov, A.E. Anisimov

efimov@alpha.mhi.iuf.net

anisimov1@mail.ru

Marine Hydrophysical Institute of the Academy of Sciences of Ukraine

Goals and motivation

- regional climate modeling with focus on effects introduced by local features (Black Sea basin, Crimean & Caucasian Mountains)
- region under consideration is omitted from most of papers dealing with regional climate studies. For example, the IPCC line “separating” Europe to North and South splits the territory of Ukraine in the middle
- the lack of long-period observational datasets in the region makes the regional climate simulations more essential

ERA-40 reanalysis

ECMWF spectral model

1958 - 2001

$\sim 2.5^\circ \times 2.5^\circ$

60 vertical levels

\Rightarrow

PRECIS RCM

HadRM3P model

(based on HadAM3P)

$\sim 0.22^\circ \times 0.22^\circ$

19 vertical levels

4-layer soil model

Model run (not in this poster)

HadAM3P model

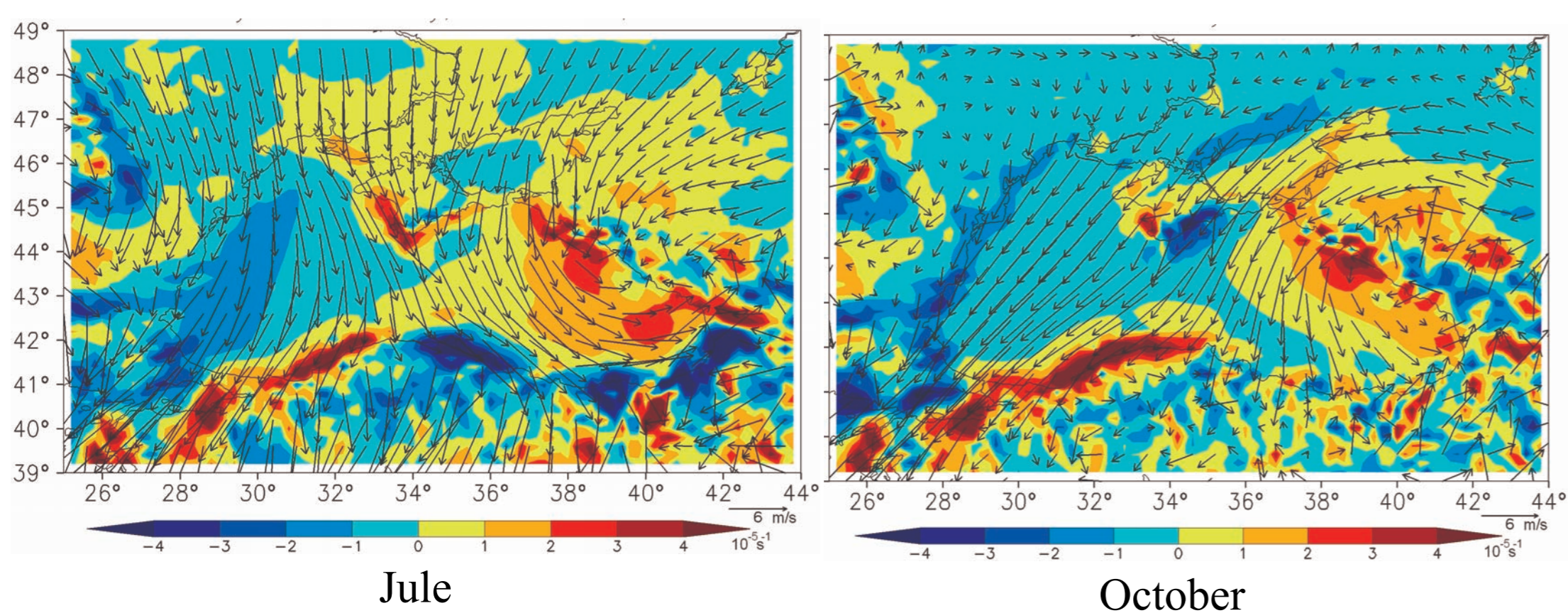
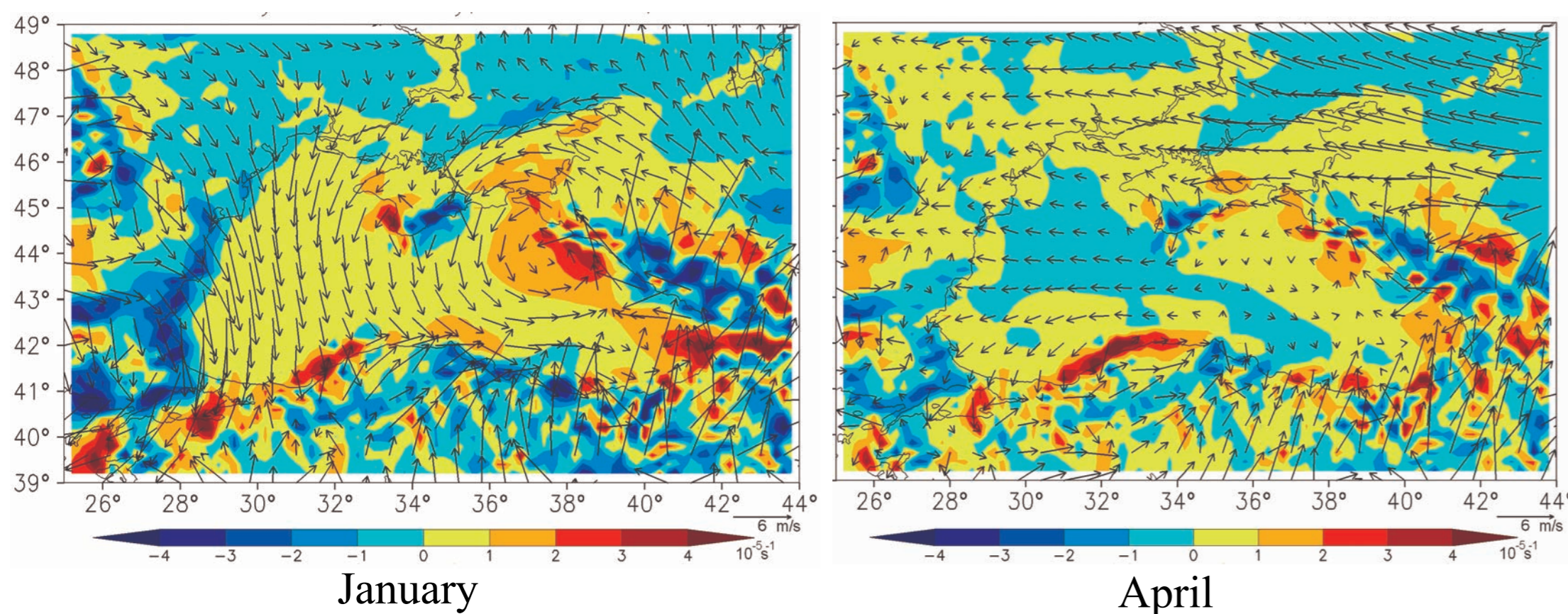
1961-1990 & 2071-2100

$\sim 1.252^\circ \times 1.875^\circ$

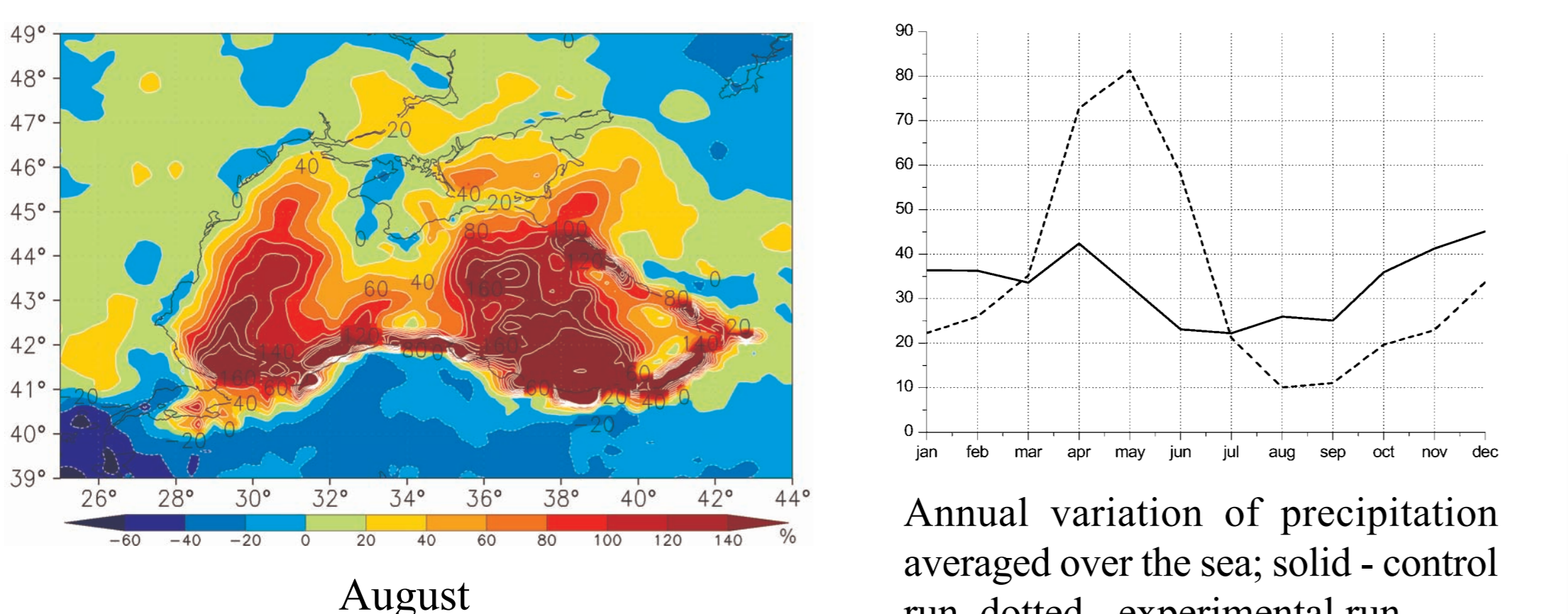
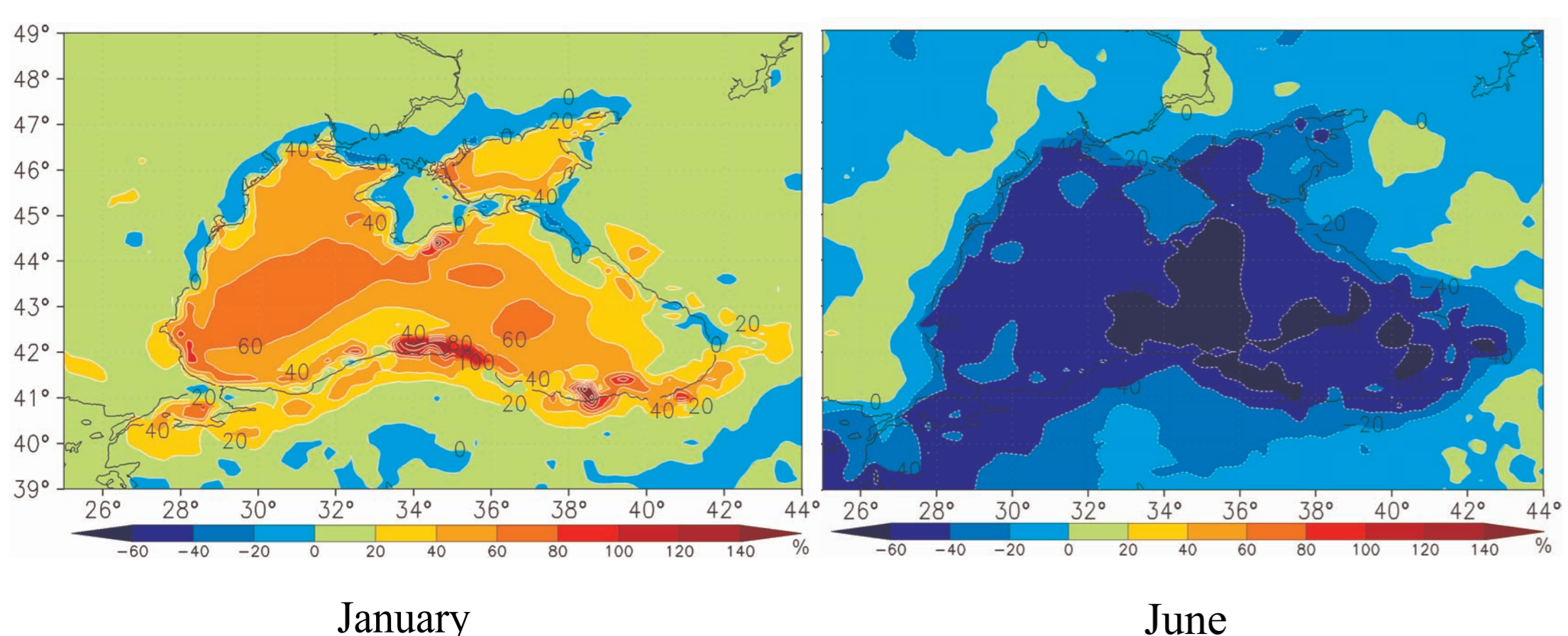
60 vertical levels

4-layer soil model

The control experiment was the regional reanalysis with input conditions from ERA-40. **To assess the impact of the Black Sea on regional climate, series of sensitivity experiments for the period of 1981-2000 were performed. The surface boundary conditions were altered by replacing the points corresponding to the Black Sea and Azov Sea basins by land points.** Thus, the difference between two fields can be interpreted as perturbation introduced by the sea.



Downscaled ERA-40 1958-2001 wind circulation and vorticity

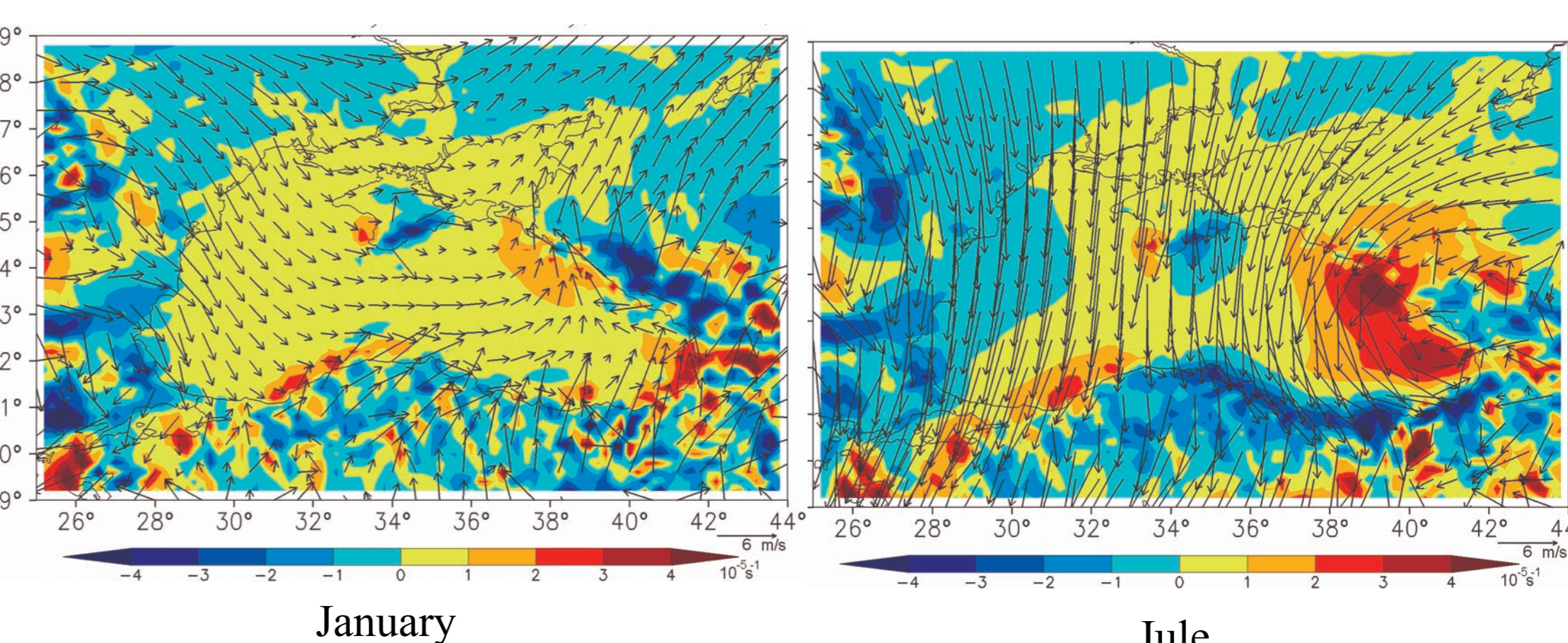


The difference between precipitation regimes in the experimental run and control simulation, computed as a percentage of the control run (1981-2000)

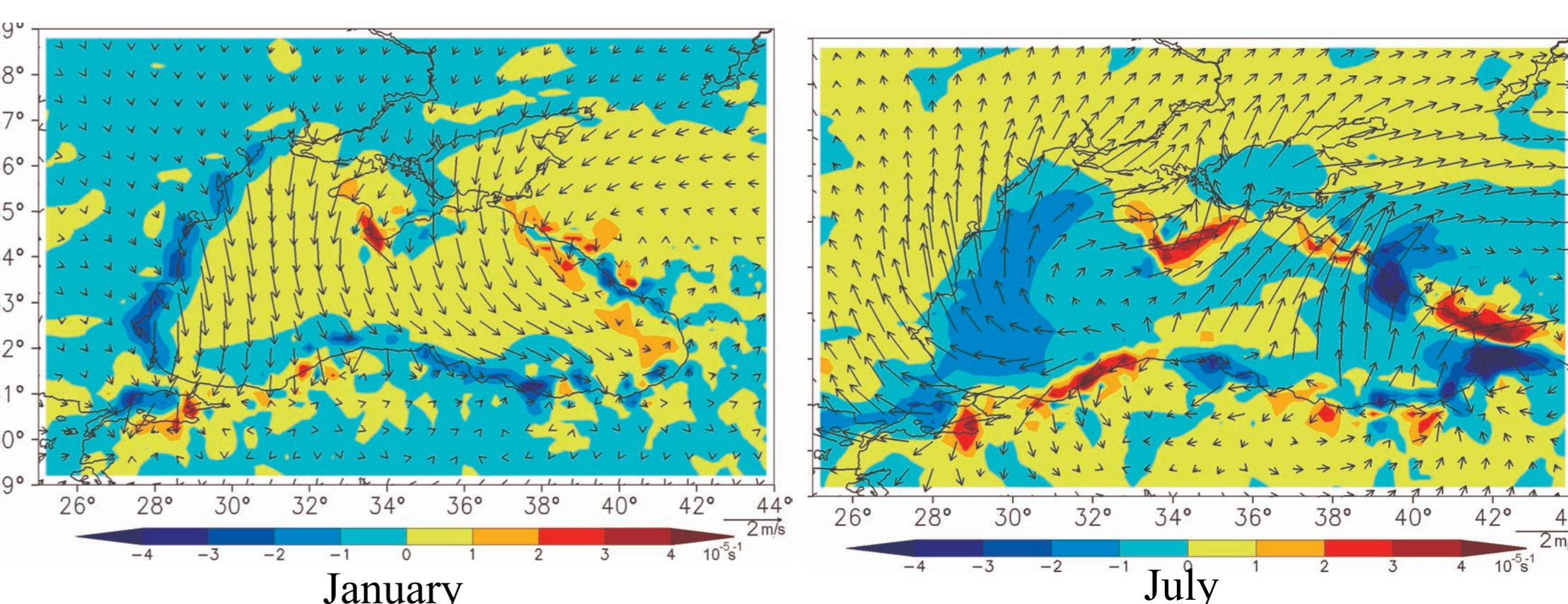
Publications

V.V.Efimov, A.E.Anisimov. Climatic characteristics of wind variability in the area of Black Sea – regional reanalysis of atmospheric circulation. *Izvestiya, Atmospheric and Oceanic Physics*, 2011

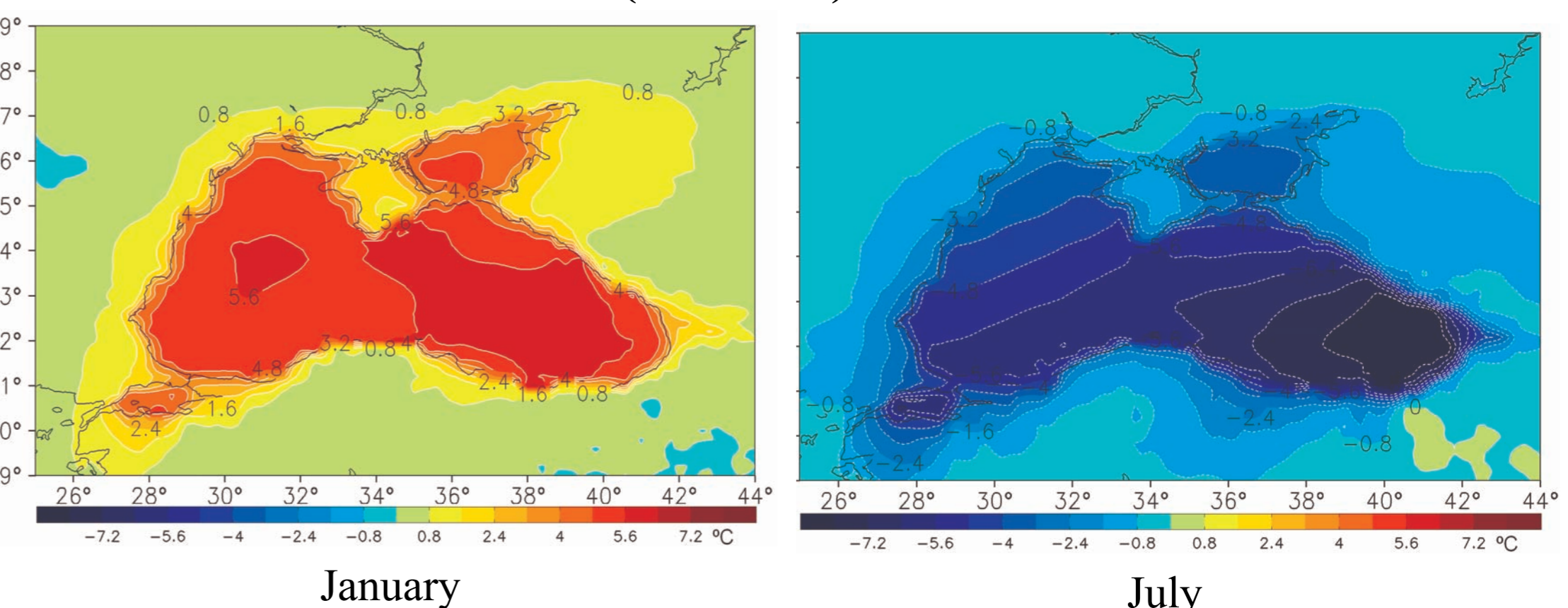
Reanalysis of atmospheric circulation for the area of Black Sea with increased spatial resolution of 25×25 for the period of 1958-2001 is performed. Climatic wind fields are estimated, as well as their spatial structure and seasonal variability. Mesoscale areas of cyclonic and anticyclonic vorticity connected with edge effect and orography are discussed. To isolate the monsoon mechanism in annual variation of vorticity, numerical experiments on sensitivity of regional atmospheric circulation to perturbation of sea surface temperature are performed. Large-scale regional features of above-sea wind in different seasons are discussed. Numerical estimates of vorticity and stress of wind speed are given. Large annual averages of vorticity, comparable with seasonal variation, show that wind circulation is responsible for the generation of seasonal variation and annual cyclonic water circulation in the Black Sea.



Wind circulation and vorticity in the experimental run with altered lower boundary (1981-2000)



Wind circulation and vorticity difference between the experimental run and control simulation (1981-2000)



2m temperature difference between the experimental run and control simulation (1981-2000)

V.V. Efimov, A.E. Anisimov. *The impact of the Black Sea on regional climate. Physical Oceanography*, 2011 (submitted).

The formation of wind above the Black sea is dependent on many physical factors. One of the most important is monsoon mechanism, associated with seasonal changes in land-sea buoyancy contrasts. To isolate the effects, induced by this mechanism, numerical experiments on sensitivity of regional model of atmospheric circulation to changes in lower boundary conditions were produced. It is shown that their influence is limited to the lower part of the atmosphere. The sea introduces the additional cyclonic circulation in summer and anticyclonic in winter, with summer influence being more pronounced. This perturbation is not limited by the sea basin itself, but extends up to few hundred kilometres from the coast.