ВЛИЯНИЕ НА ЭВОЛЮЦИЮ УРОВНЯ КАСПИЙСКОГО МОРЯ МНОГОЛЕТНИХ ИЗМЕНЕНИЙ РЕЖИМА ВЕТРА НАД ЕГО РЕГИОНОМ В 1948–2017 гг.

EFFECT OF LONG-TERM VARIATIONS IN WIND REGIME OVER CASPIAN SEA REGION ON THE EVOLUTION OF ITS LEVEL IN 1948–2017

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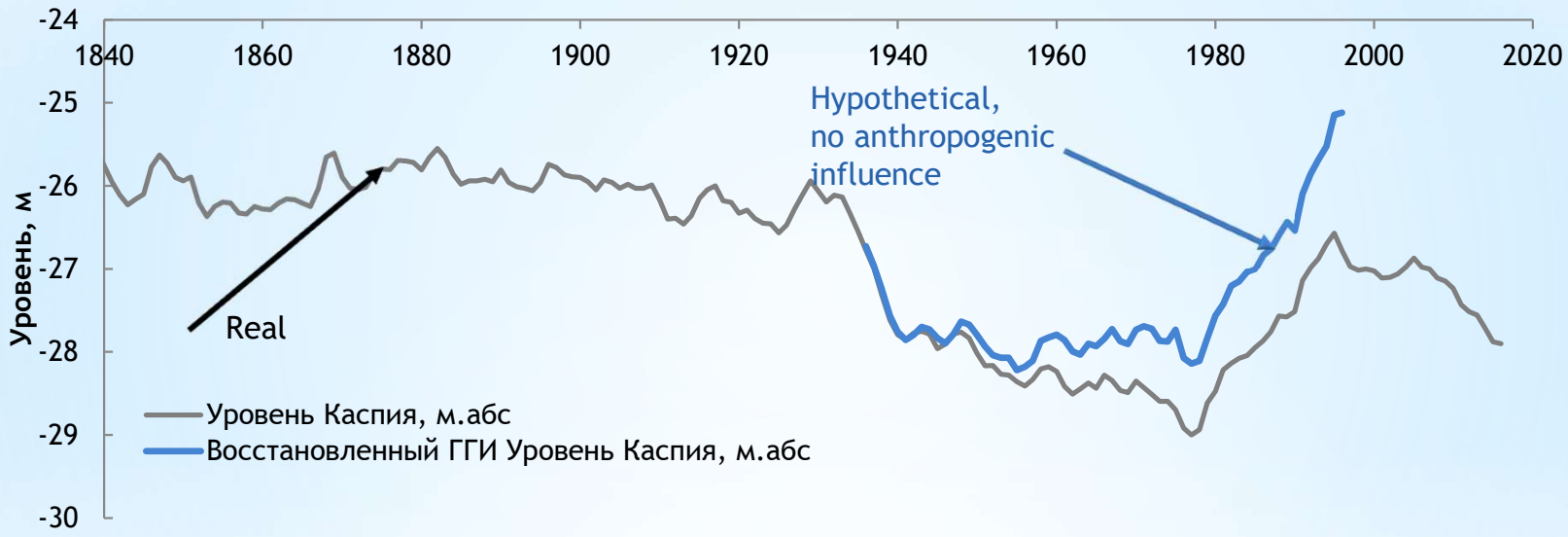
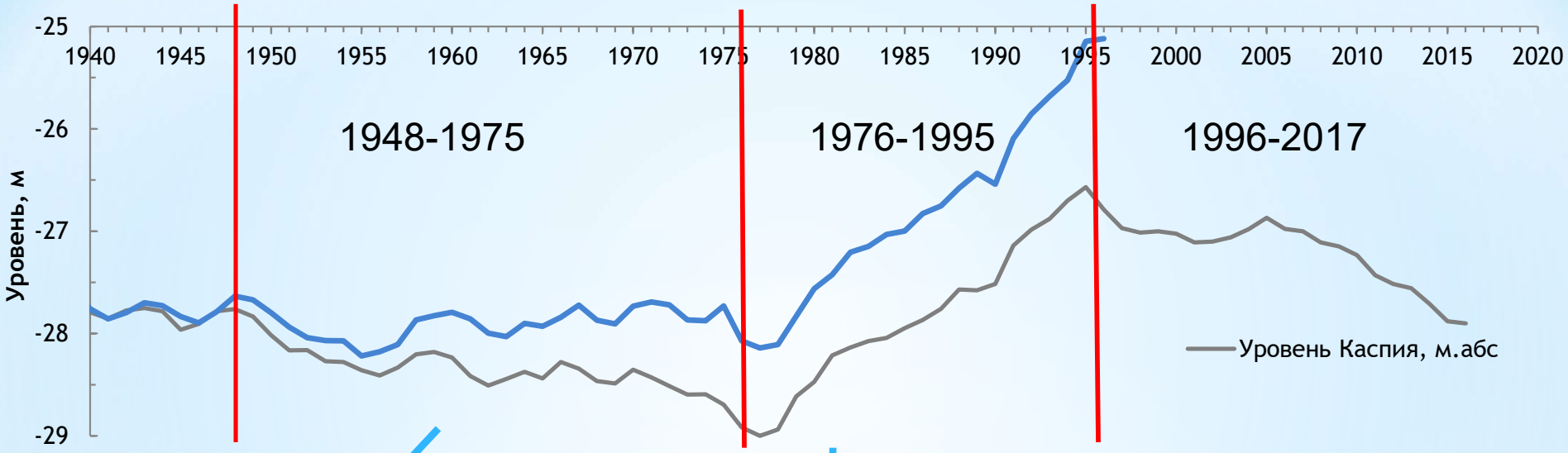
Caspian Sea (CS) level variations from 1840 to 2017, m (Baltic height system)

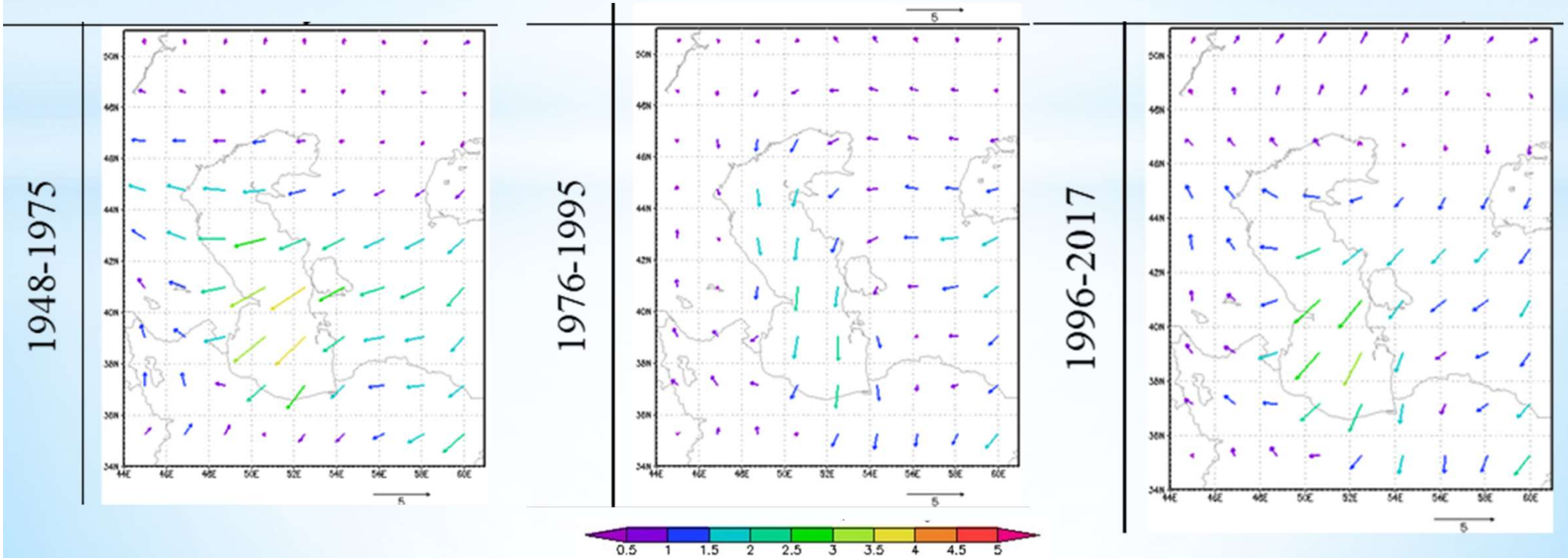


За период инструментальных наблюдений в колебаниях уровня КМ неоднократно отмечались периоды его спада и подъема, обусловленные сочетанием климатических и антропогенных факторов. При этом, повышение уровня КМ на 2.4 м в 1977-1995 гг. было самым продолжительным за весь период инструментальных наблюдений. Аналогичные изменения уровня наблюдались и ранее: в 1862-1869, 1873-1878, 1914-1917 и 1925-1929 г. – 0,5–1 м. Начиная с 1996 г. по настоящее время уровень КМ понижается.

По данным [*Шикломанов И.А., Георгиевский В.Ю. Влияние хозяйственной деятельности на водный баланс и изменение уровня Каспийского моря / Гидрологические аспекты проблемы Каспийского моря и его бассейна. Санкт-Петербург: Гидрометеоиздат, 2003*] климатообразующие изменения уровня КМ в XX в. происходили в пределах от -25.0 до -28.0 м БС. В отсутствии антропогенного влияния к концу века уровень достиг бы отметок на ~1.5 м выше наблюдаемых. Изъятия вод с 1940-х гг. способствовали снижению уровня моря, но основные изменения уровня КМ обусловлены климатическими факторами.



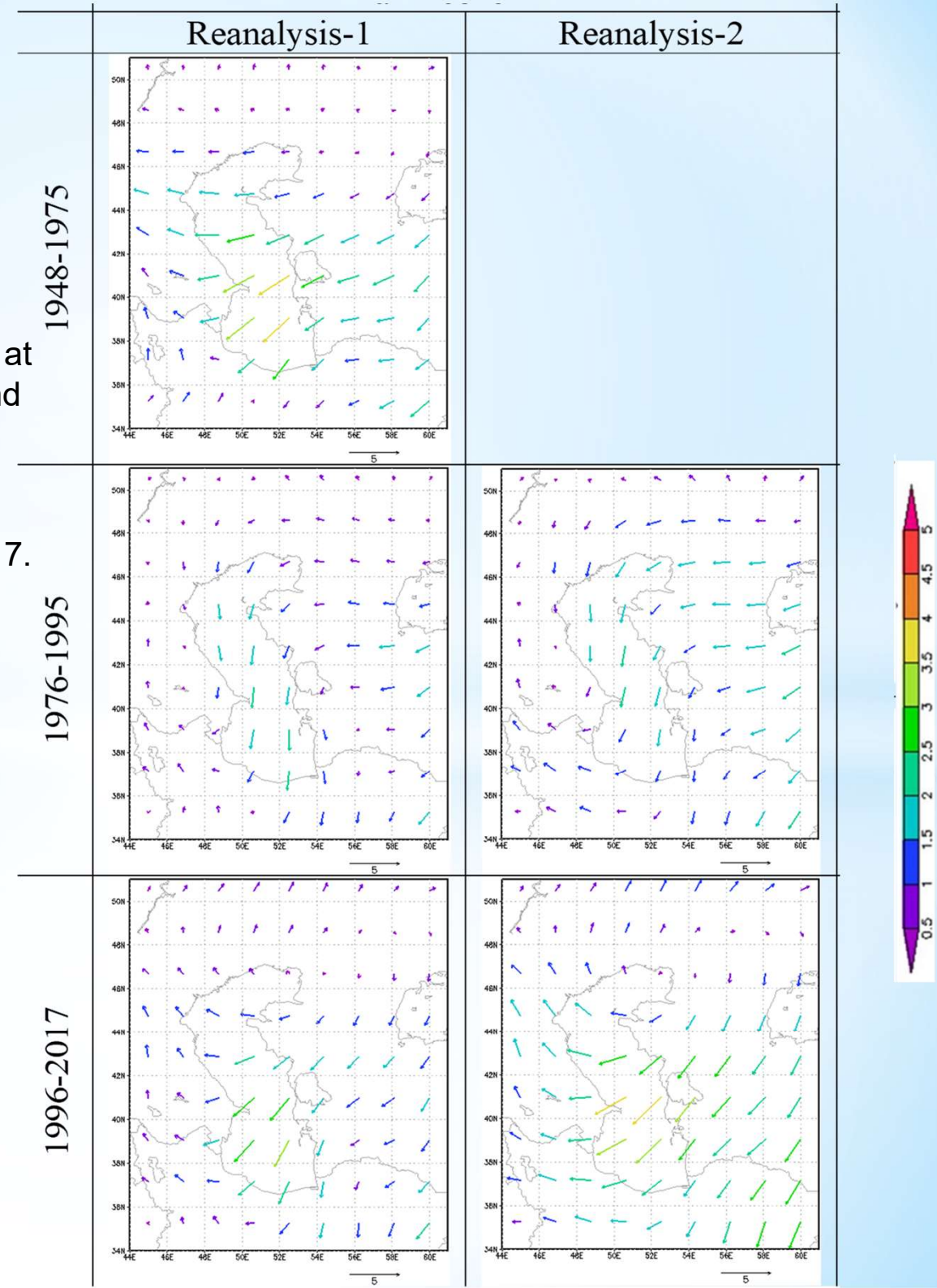
Surface wind over CS region. Atmospheric reanalysis NCEP/NCAR for 1948–2017 (R-1).



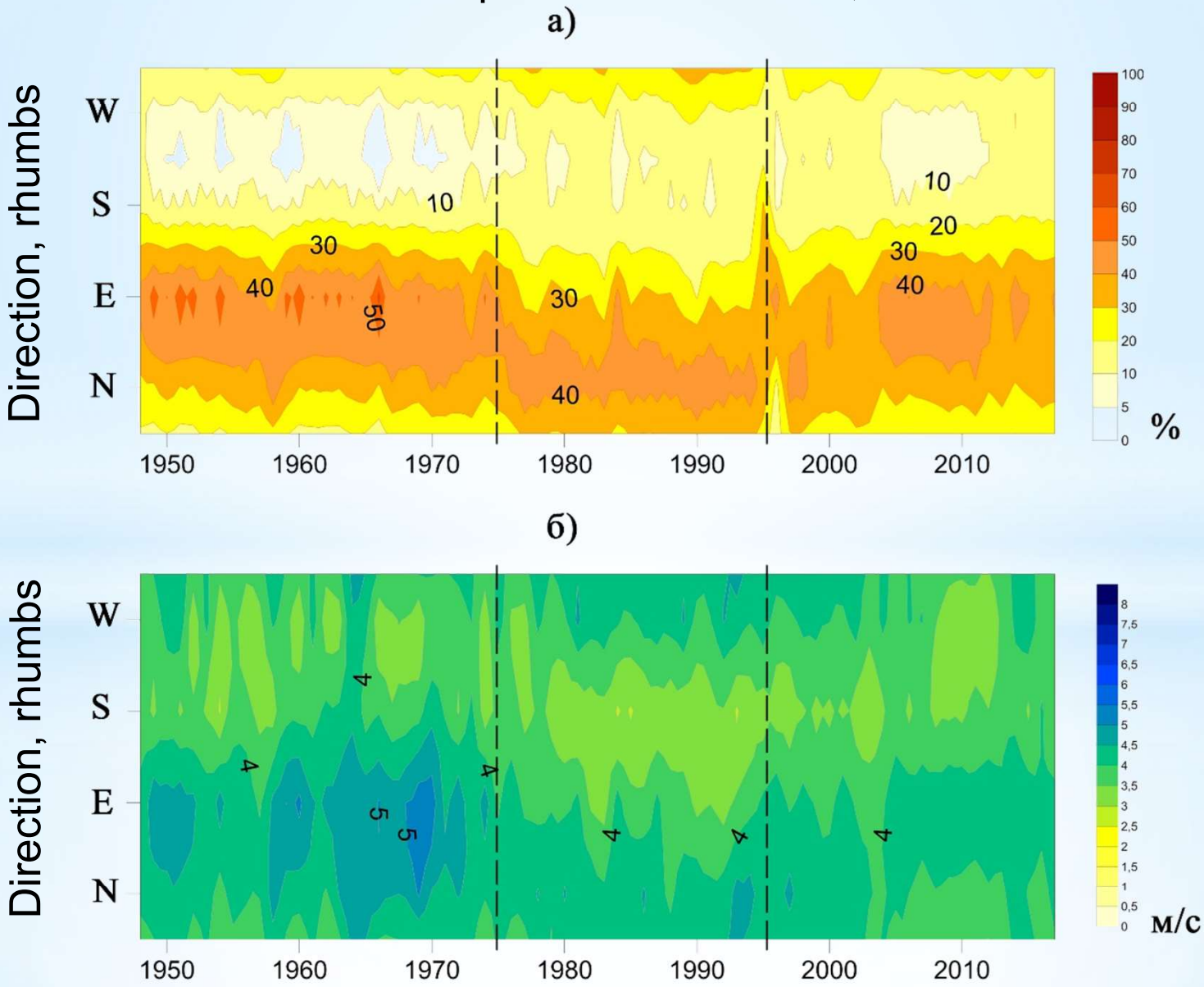
Wind regime is changed in 1976–1995

Evolution of wind regime over the Caspian Sea at 10 m by reanalysis data NCEP/NCAR (R-1) and NCEP/DOE (R-2).

Surface wind fields (m/s) are averaged over periods 1948–1975, 1976–1995, and 1996–2017.



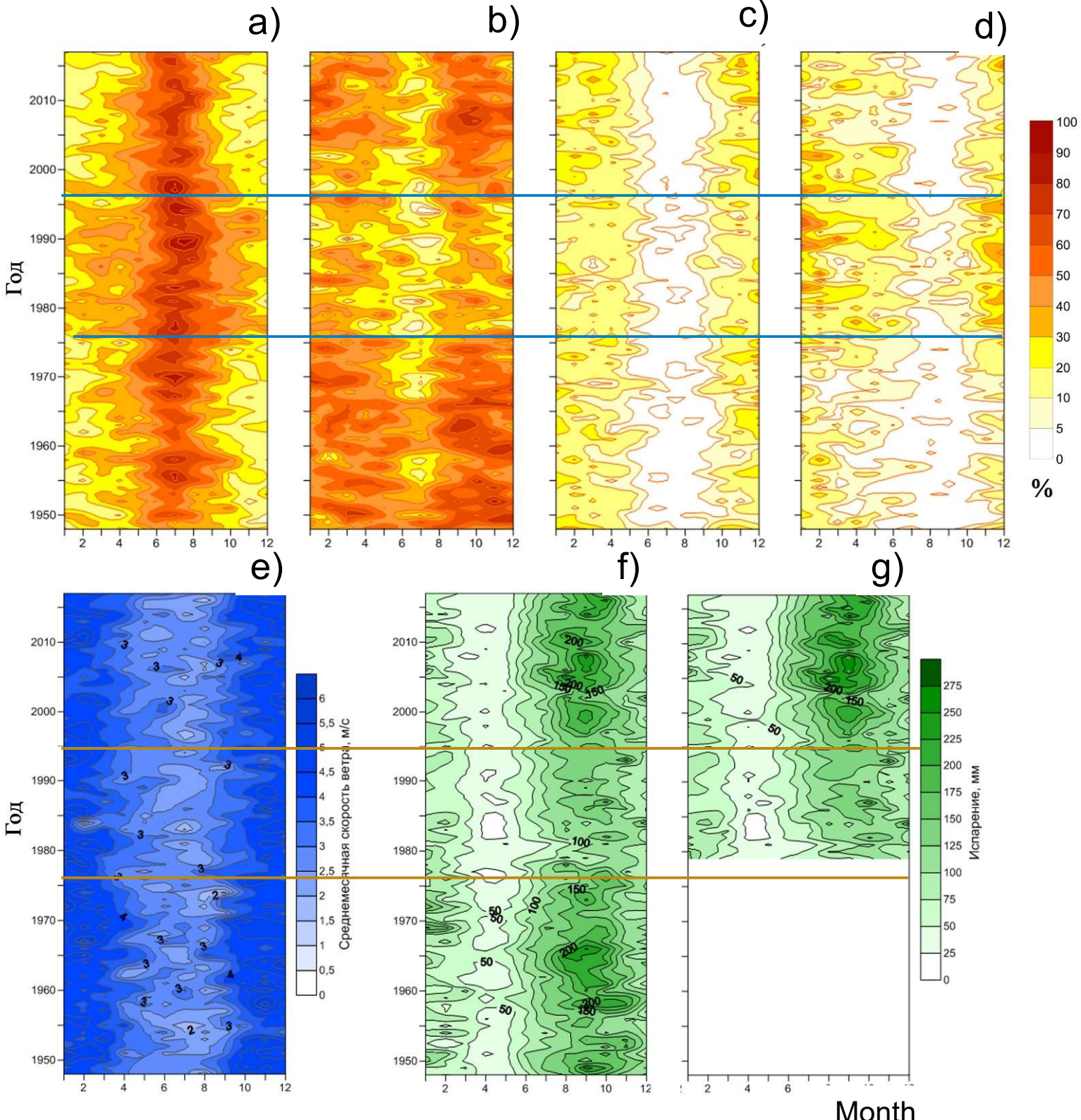
Time variations of (a) the normal annual recurrence, %, and (b) the speed of wind averaged over CS water area, by rhumbs.
The vertical dashed lines show periods 1948–1975, 1976–1995 и 1996–2017.

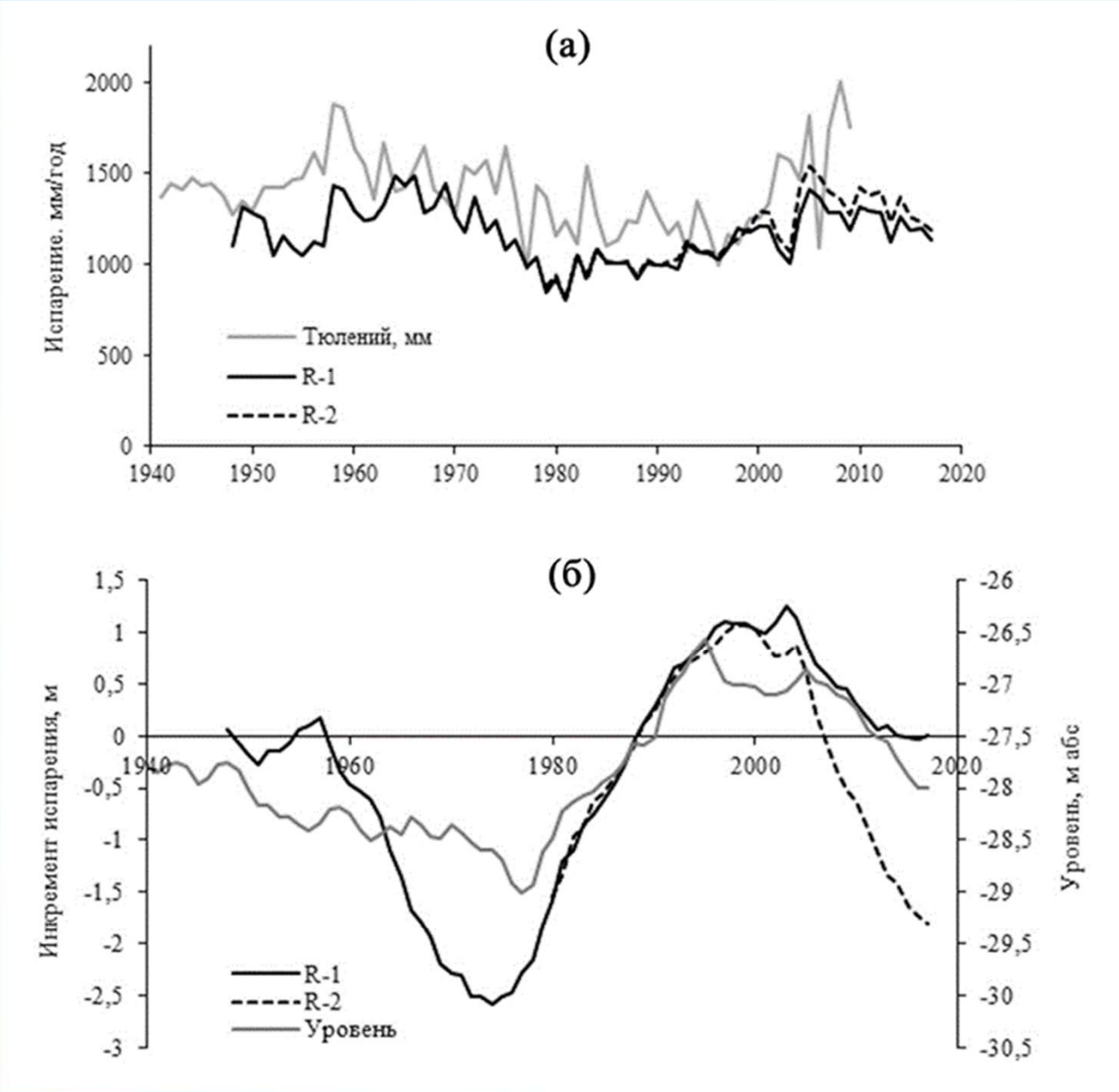


Пунктирными линия обозначены периоды 1948-1975, 1976-1995 и 1996-2017 гг.

Normal monthly values of recurrence, %, by rhumbs,
(a) Recurrence of winds of the northern rhumb,
(b) the same for eastern,
(c) southern, and
(d) western rhumbs.

(e) wind speed, m/s, with direction not taken into account and evaporation, mm/month, averaged over CS water area.
[(f) evaporation by data R-1,
(g) evaporation by data R-2.]





(a) Evolution of the mean annual evaporation near Tyulenii Island, averaged over CS water area in period from 1948 to 2017, calculated by reanalysis data R-1 and R-2 vs
evaporation, calculated by the observations at st. Tyulenii Island.

(b) Evolutions of dimensional increments of evaporation over CS, calculated by reanalysis data of R-1 and R-2, taken with inverse sign vs
CS level variations over the same period.

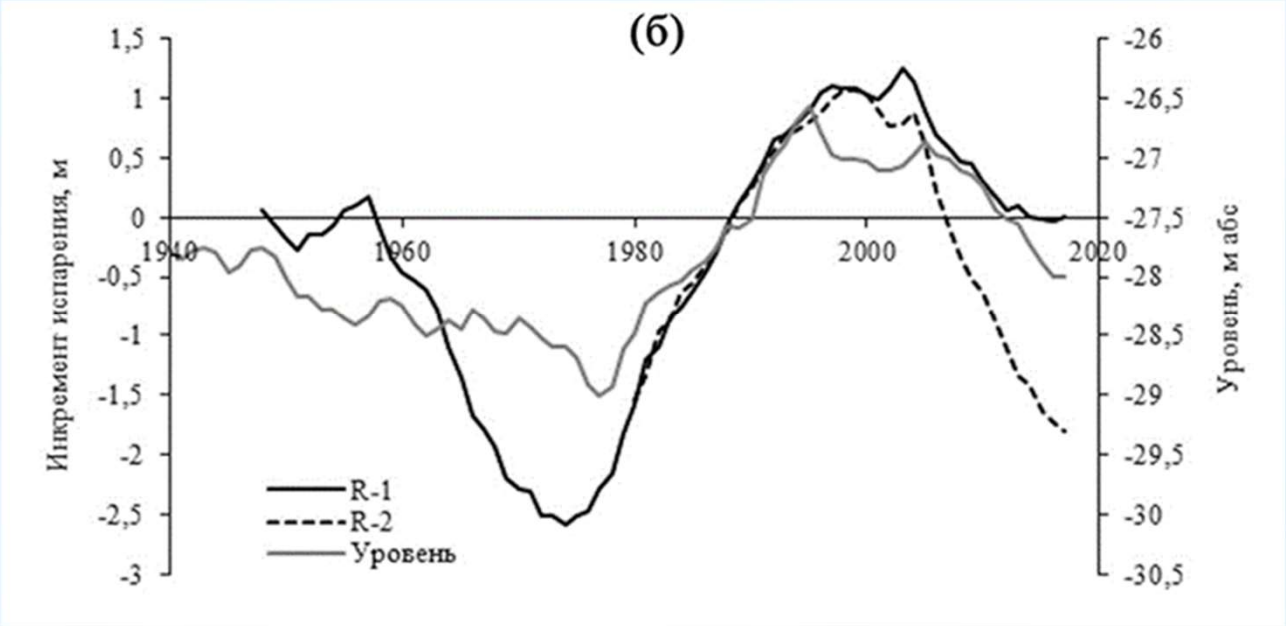


Рис. 1. Совмещенные графики изменения уровня Каспийского моря *H* (*1*; правая шкала)) и разностно-интегральной кривой притока (*2*; левая шкала).

(М.В. Болгов и др., 2018)

CONCLUSIONS

CS level variations are shown to be closely correlated with long-term variations of the characteristics of surface wind field in the sea region, because the latter regulate the rate of evaporation from sea surface.

Quasi-sixty-year cycles are clearly seen in the time variations of the level and nonnormalized increments of evaporation in 1948–2017. The data of atmospheric reanalyses R-1 and R-2 were used to identify the transformation features of the surface atmospheric circulation in CS region. The nature of these regional changes in the atmospheric circulation, caused by the transformation of atmospheric circulation over Eurasia as a whole, will be the focus of future studies.

The comparison of the long-period variations of CS level and space-and-time variations of the regional atmospheric circulation, which contribute much to the formation of CS water balance, gives a new confirmation of their dependence on climate changes.

The change in the atmospheric circulation regime, which, in particular, determines the change in the direction and speed of air masses, their humidity, as well as the intensity of the Volga runoff, is the main factor in the fluctuations in the level of the CS.

Thank you for the attention!