

Droughts in East European Plain since the middle of 20th century: regional changes and mechanisms

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In continental regions of North Eurasia, drought historically was regarded as one of the most dangerous natural calamities.

In the past it always led to low harvests, hunger, fires, diseases, uprisings, etc.

Nowadays, the consequences of droughts are not that terrible, but it is still one of major threats for nature and society.



In 2010, numerous forest and peat fires occurred, dozens of villages burned down (and are now abandoned).

Breath/heart problems resulted in doubling the mortality.

Harvests were record low in many regions.





Bridge in Tomsk,
end of July, 2012

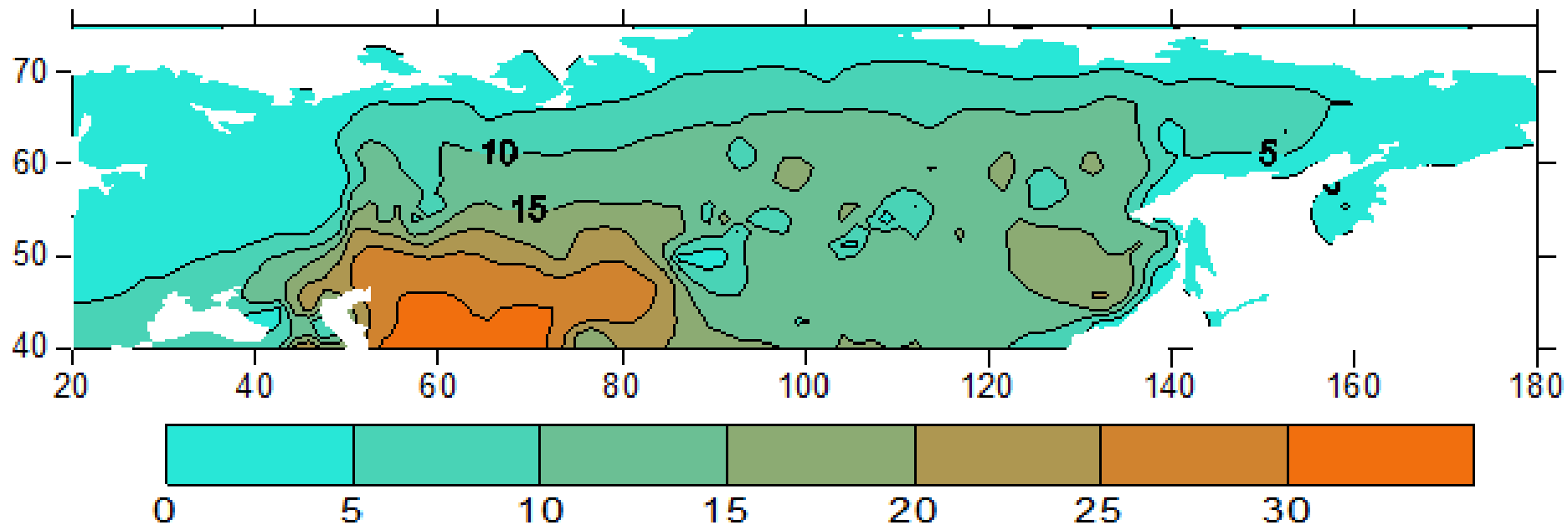
In 2012, severe drought with numerous forest fires took place in Western Siberia, some temperature records were re-established.

What is atmospheric drought?

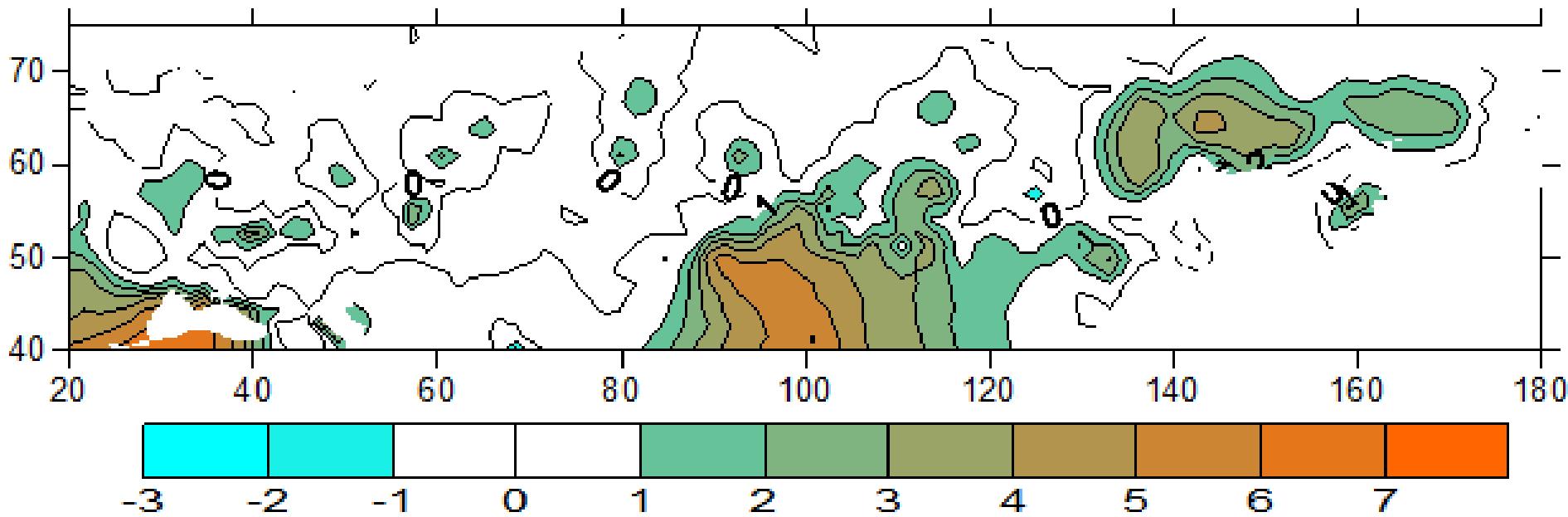
A combination of high air temperature and low precipitation, e.g.:

Daily precipitation below 5 mm, combined with maximum daily air temperature above 25°C or 30°C, depending on the location.

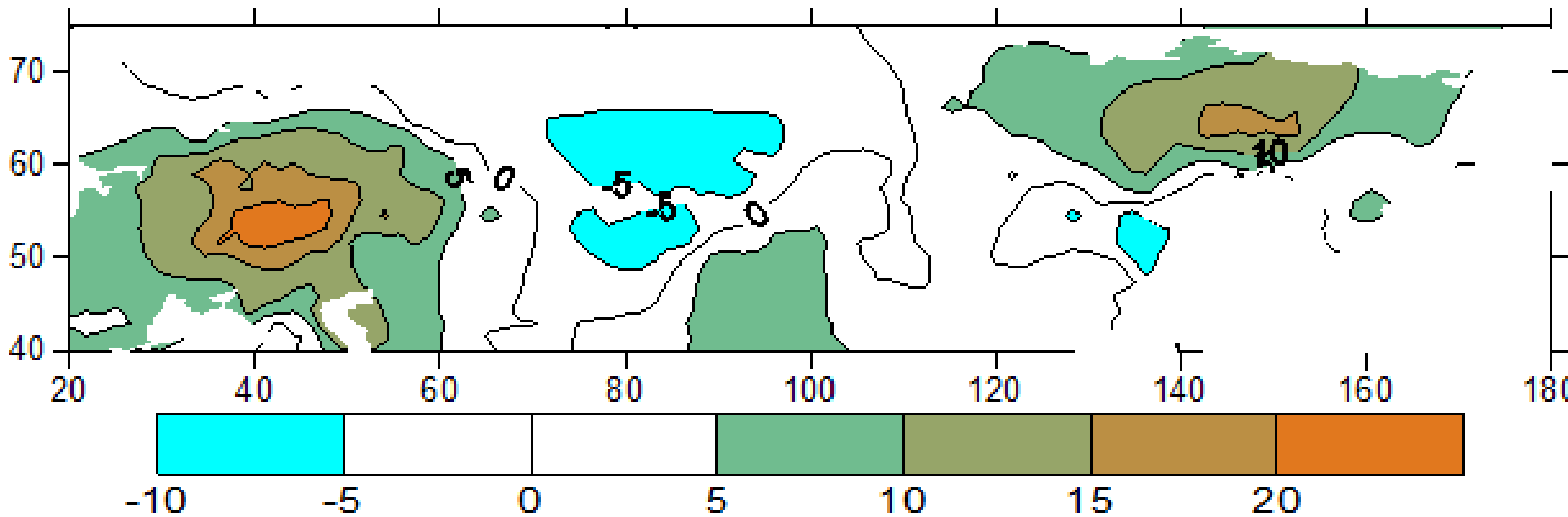
A measure of meteorological conditions suitable for soil droughts.



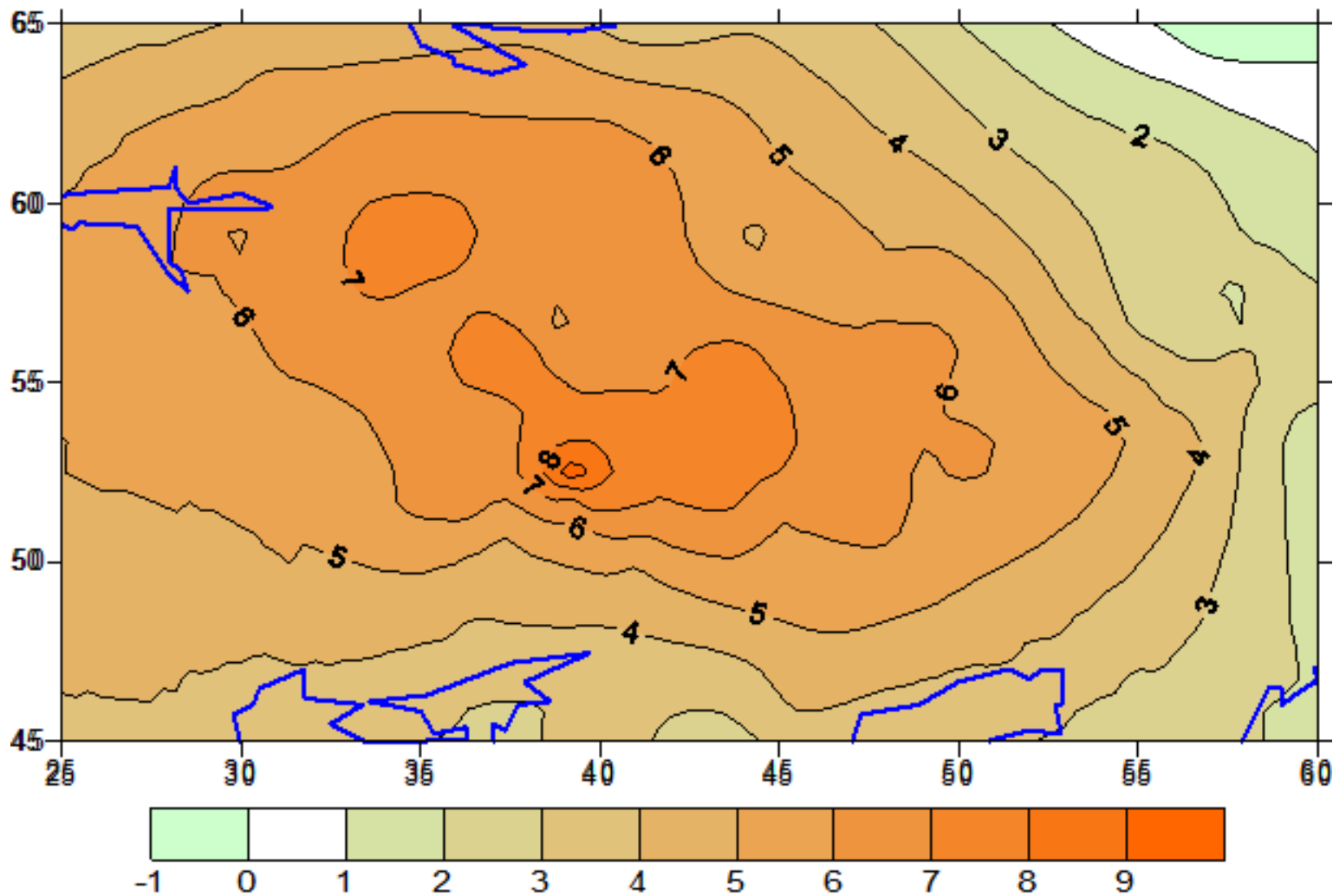
Number of days with atmospheric drought in July
in the “base” period (1951-1980) in North Eurasia



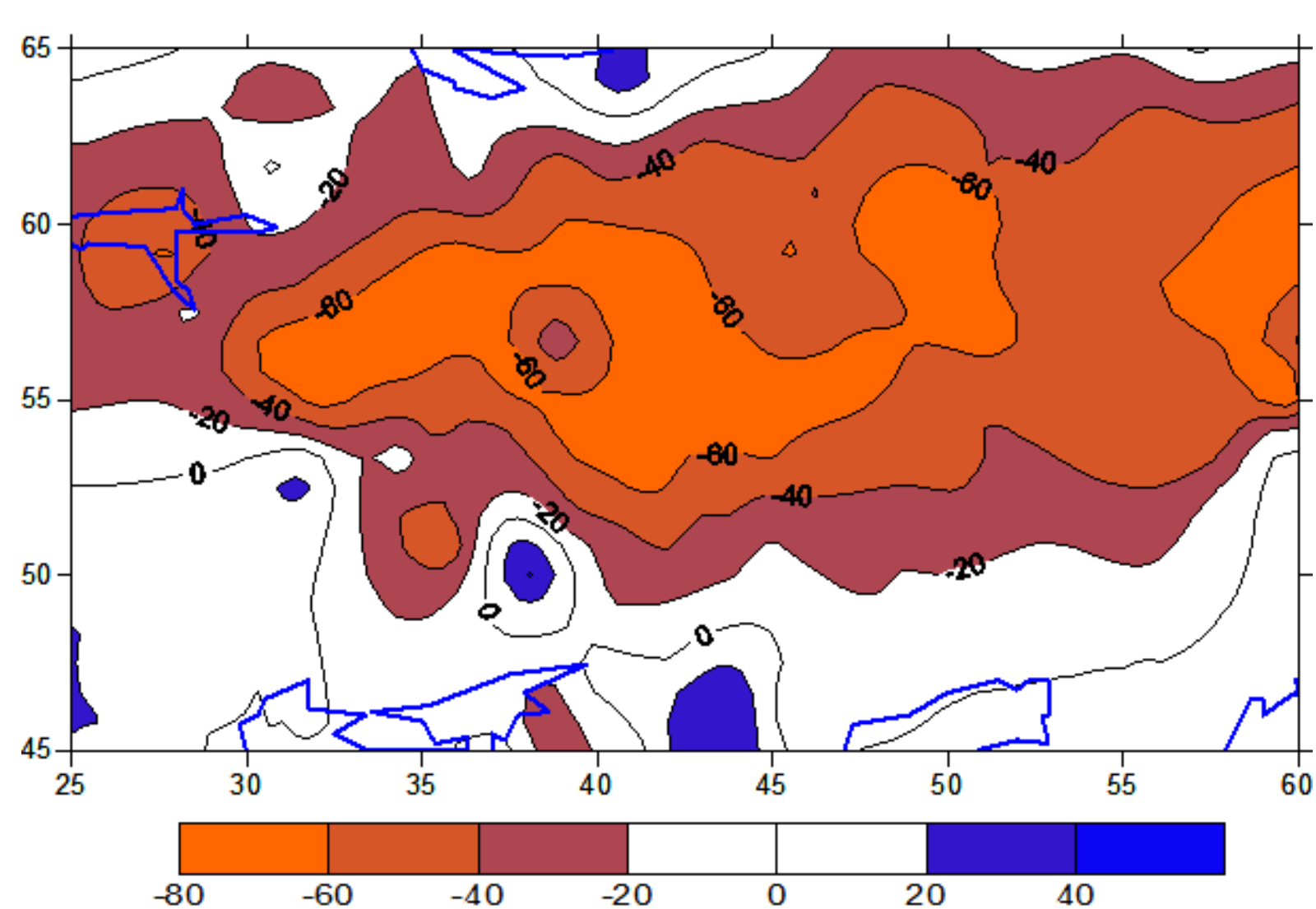
Number of days with atmospheric drought in July
in the global warming period (1989-2010),
difference with the “base” period 1951-1980



Number of days with atmospheric drought in July in 2010, difference with the “base” period 1951-1980

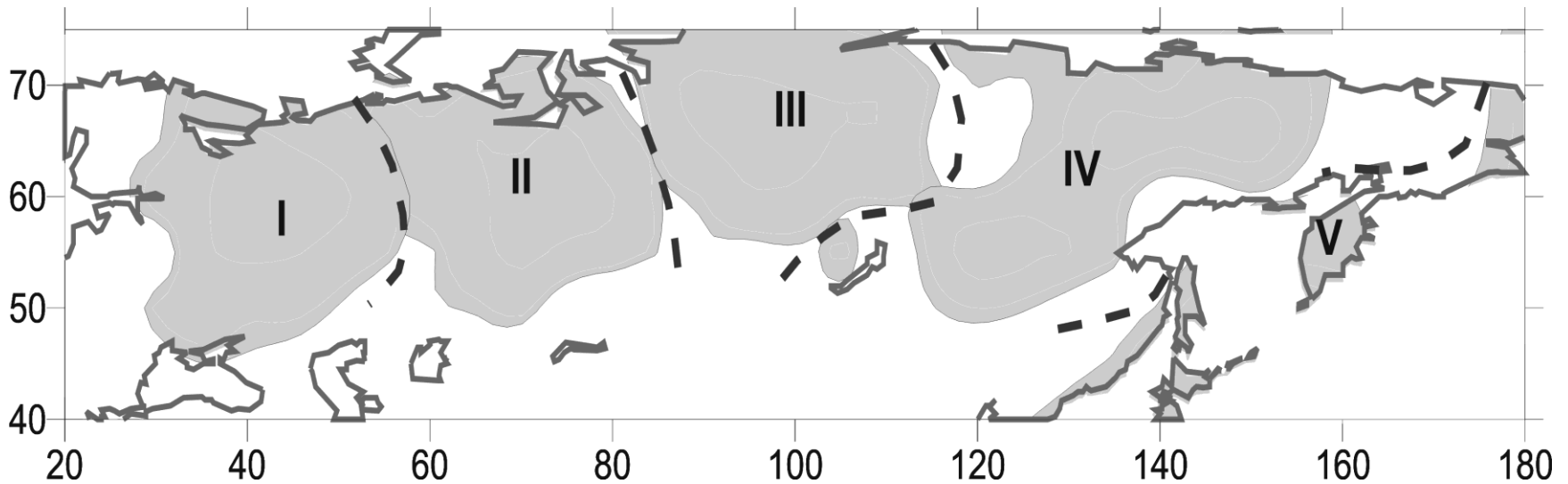


Air temperature anomaly in East Europe in 2010 as compared to the 1951-1980 mean

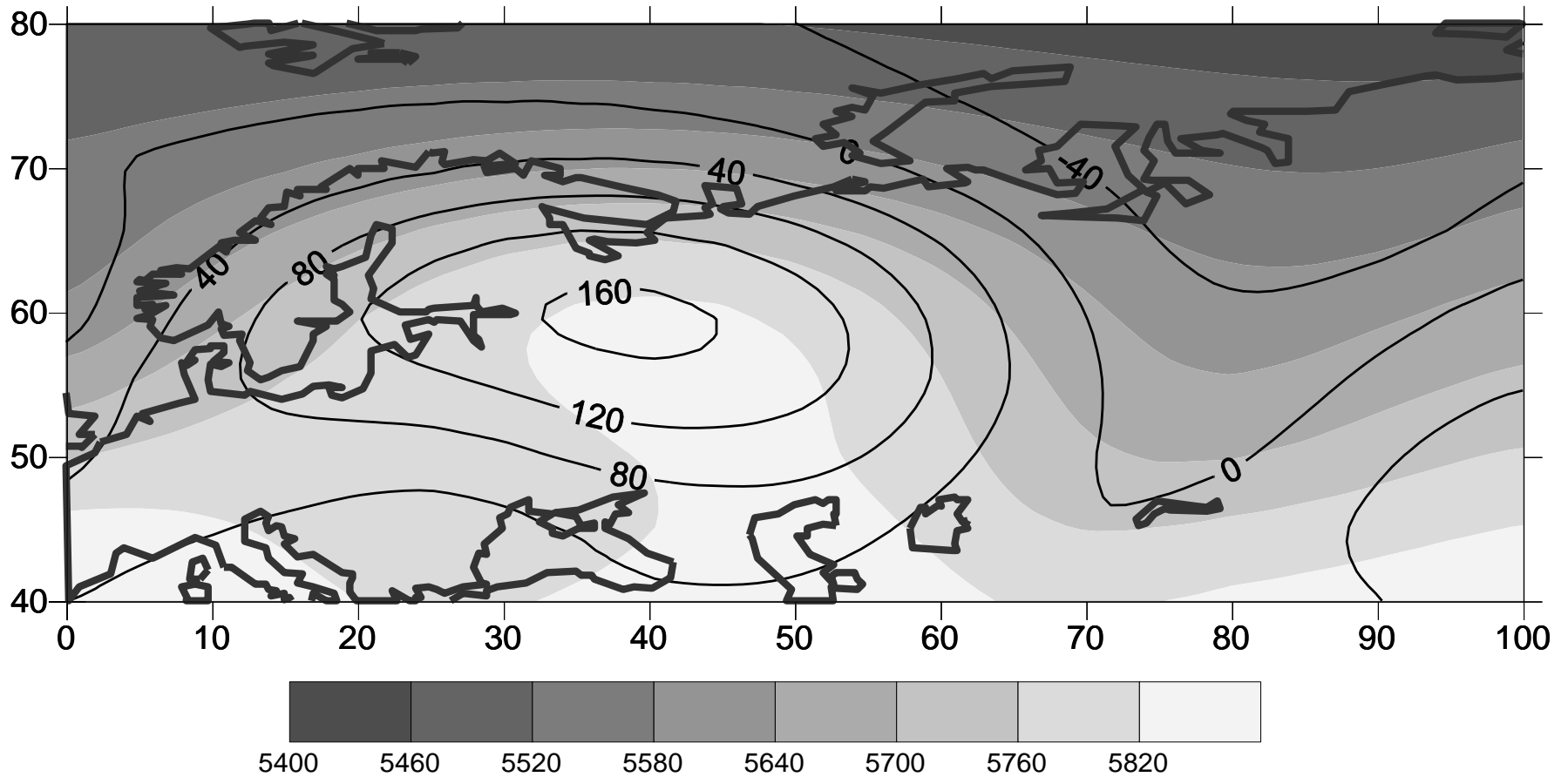


Precipitation anomaly in East Europe in 2010
as compared to the 1951-1980 mean

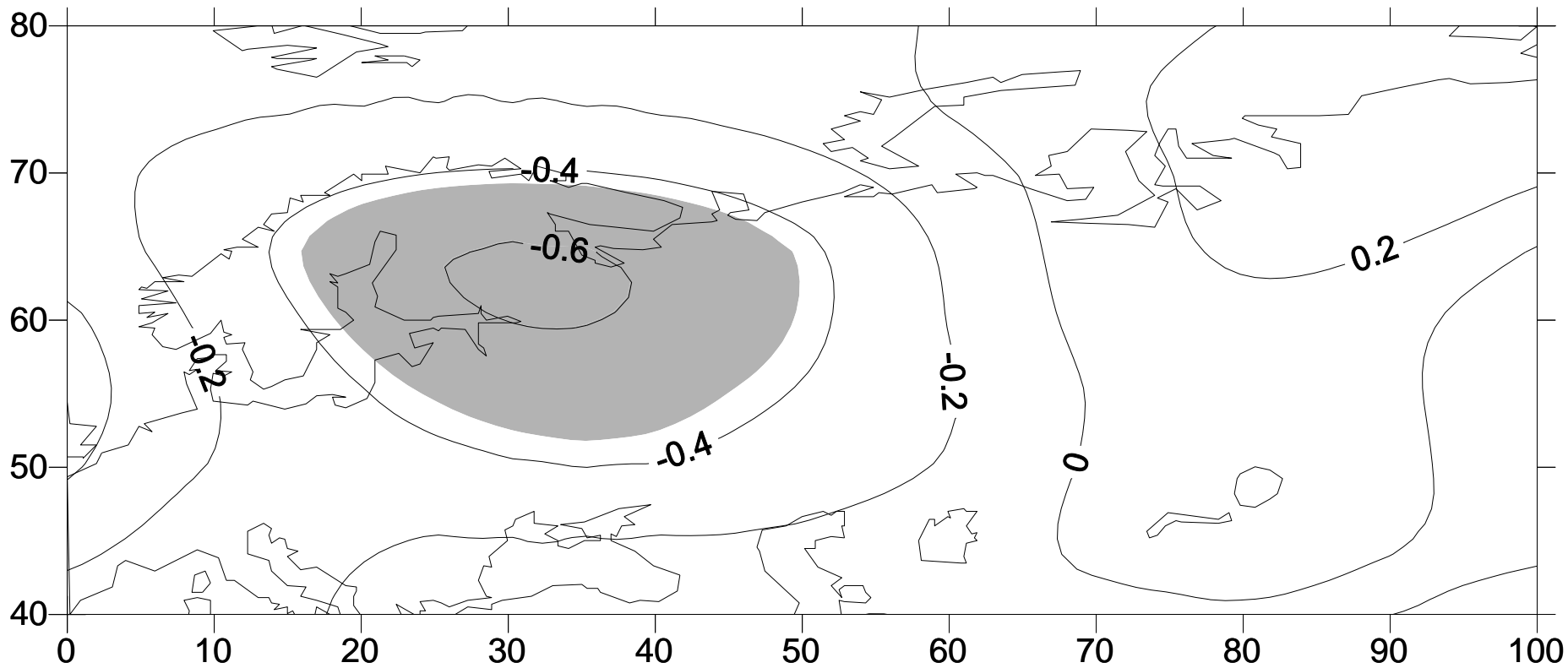
Large-scale atmospheric circulation as a mechanism of major droughts



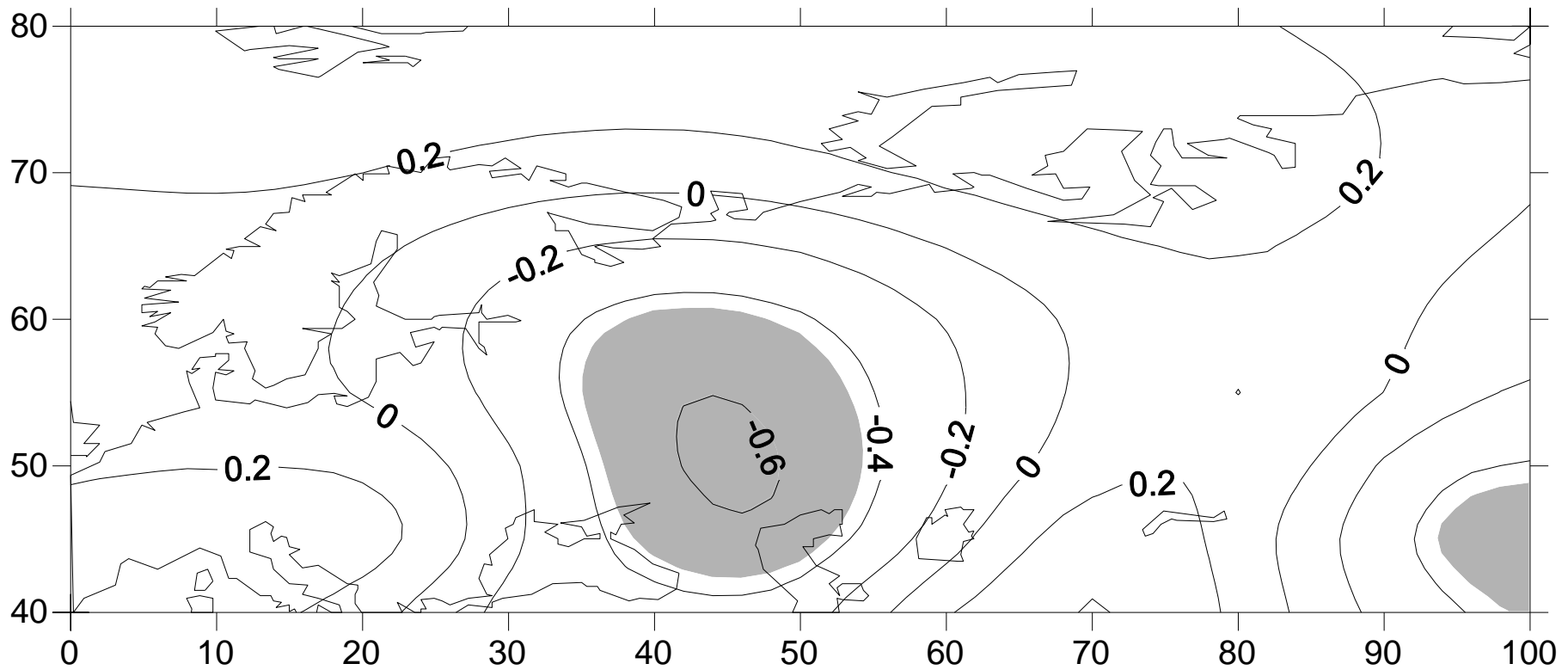
Borders of the regions (dashed lines), homogeneous by fluctuations of mean summer air temperature in North Eurasia.



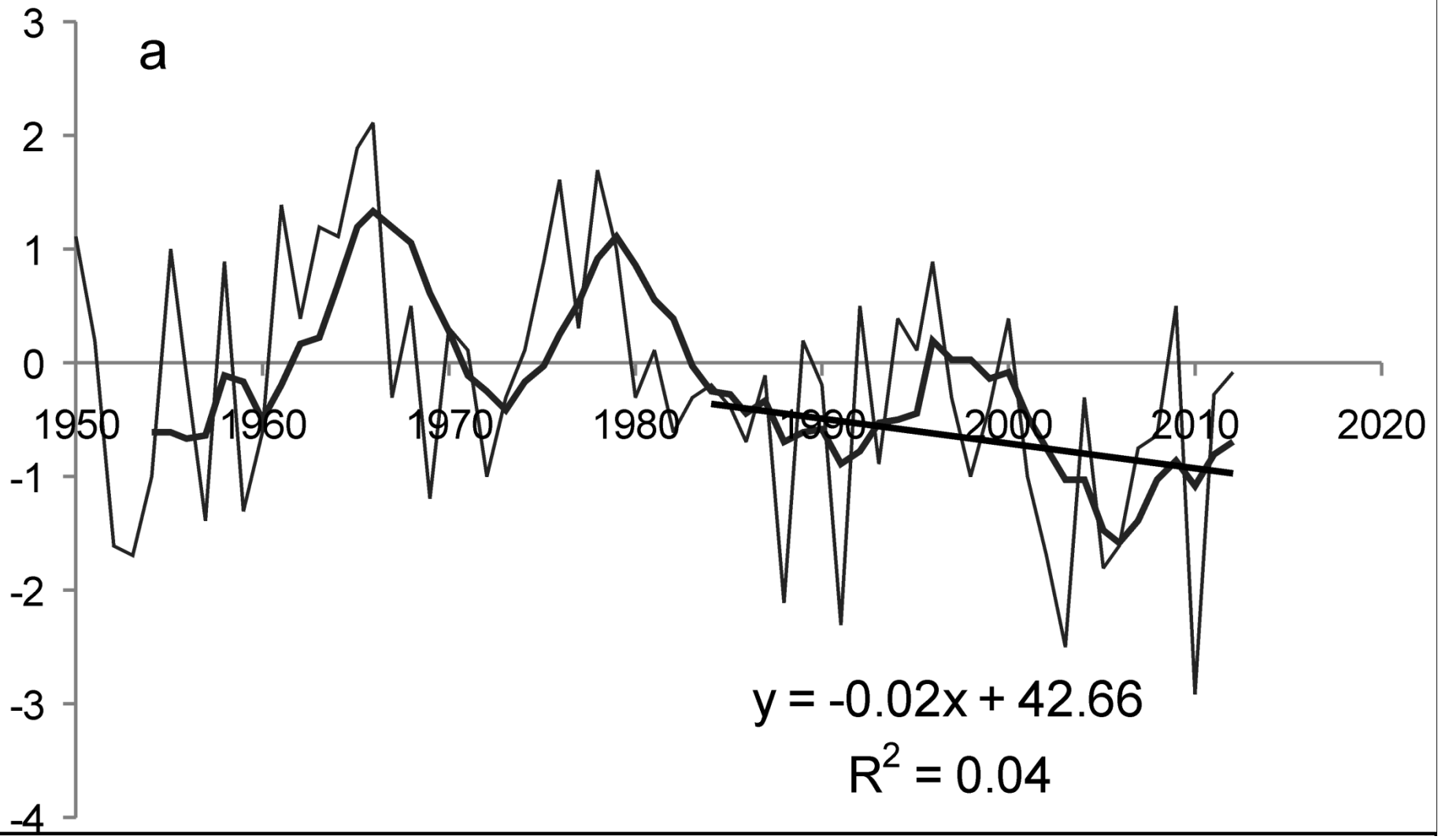
Absolute height of the 500 hPa geopotential field (grey gradations) and its anomaly (isolines, as compared to mean for 1950-2010) in July 2010



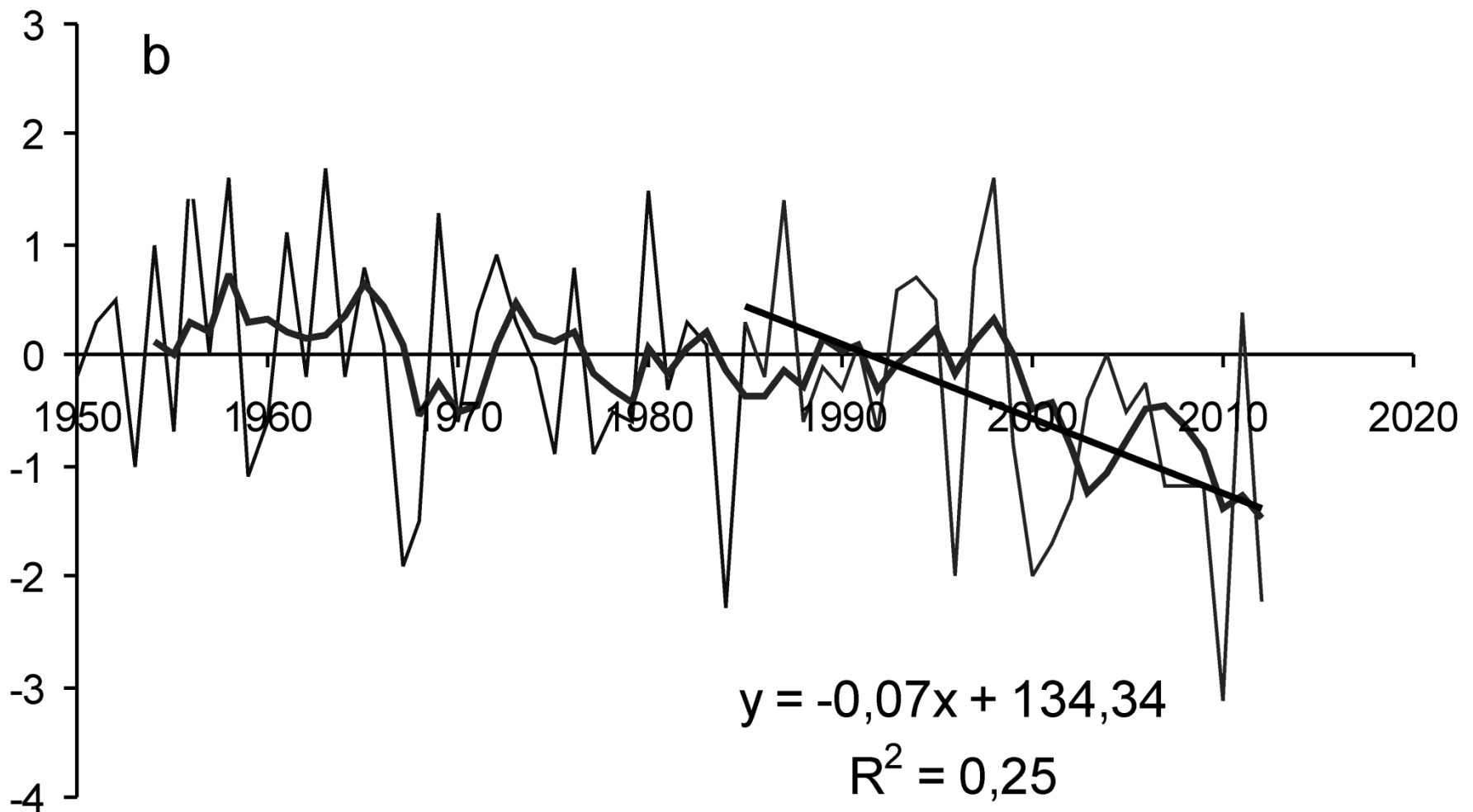
Linear correlation between the West Pacific (WP) index and 500 hPa geopotential height in July for 1985-2010. Statistically significant correlation pattern is highlighted in grey.



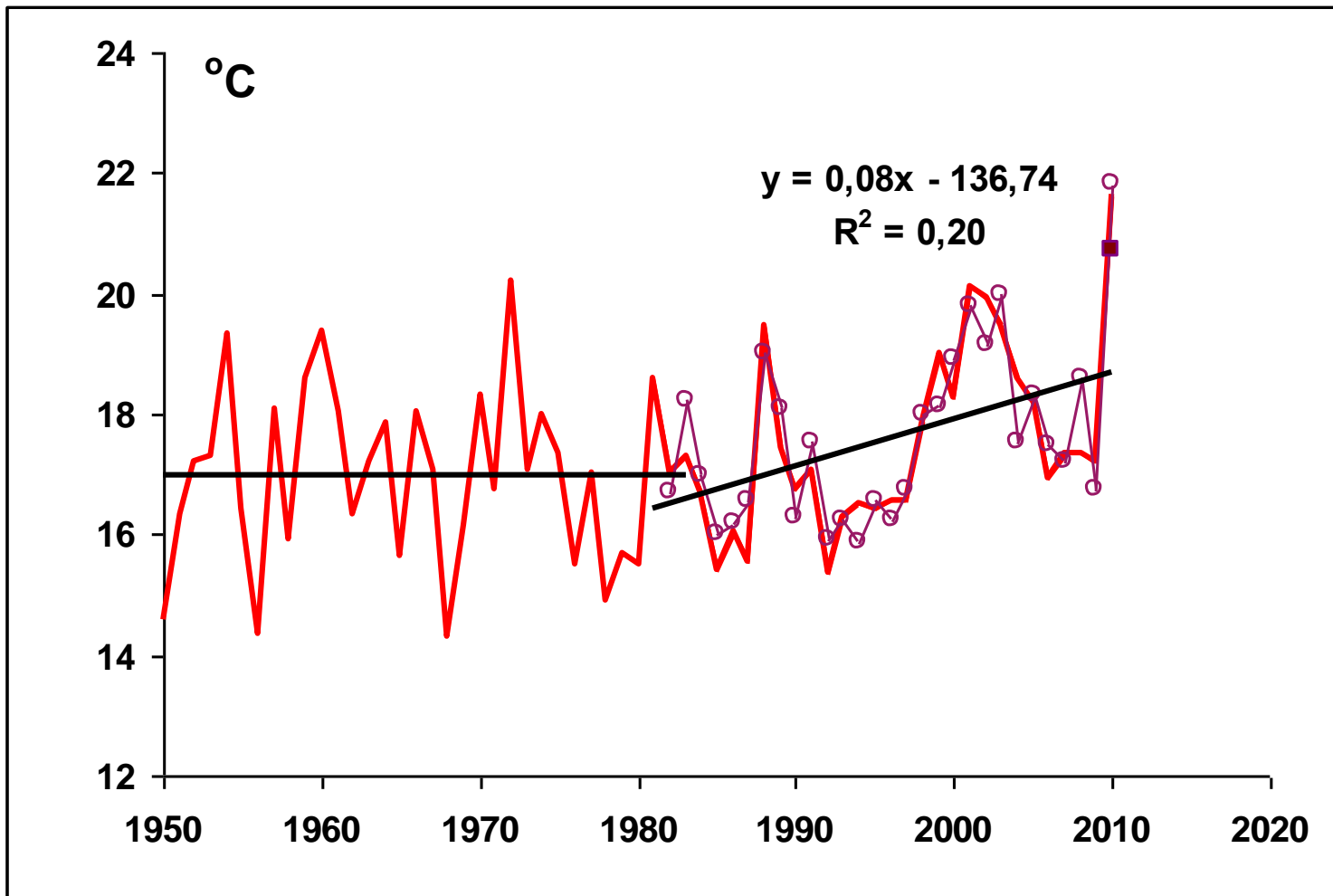
Linear correlation between the WP index in May and 500 hPa geopotential height in July for 1985-2010. Statistically significant correlation pattern is highlighted in grey.



Variations of WP teleconnection index in July in 1950-2012



Variations of WP teleconnection index in May in 1950-2012



Variations of mean July air temperature averaged over East European Plain. Purple curve is air temperature calculated by regression on West Pacific circulation index (not involving 2010 data).

Conclusions

There is no distinctive trend in atmospheric droughts frequency over North Eurasia; the 2010 event was an outstanding event beyond any trends.

However, there is a distinctive trend of summer air temperature in the East European Plain since 1985.

The trend and 2010 drought to a significant extent are explained by the West Pacific circulation mechanism variations in July and May. The trend can be regarded as weakening of zonal circulation and more frequent blocking events after mid-1980s.

Thank you!