The long-term trends in blocking event frequencies in the Euro=Atlantic sector of NH midlatitudes

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OUTLINE

1. Motivation
2. Data
3. Methods
4. Average frequencies of blocking days
5. Long-term blocking trends
6. Summary

Data

Daily geopotential heights of 500 hPa level (G500) from the period 1951-2023 were used.
Data were taken from the ERA5 dataset (https://cds.climate.copernicus.eu). (Hersbach et al., 2020).
Data cover the area 15°N - 90°N and 179.75°W - 180°E

Monthly values of Greenland Blocking Index (GBI) were taken from https://psl.noaa.gov/gcos_wgsp/Timeseries/Data/gbi.mon.data (Hanna, E. et al., **2016**)

Monthly values of SCAND index (SCAND) were taken from https://ftp.cpc.ncep.noaa.gov/wd52dg/data/indices/tele_index.nh (Barnston, A.G.& Livezey, R.E. **1987)**

Methods: blocking diagnosis (after Anstey et al., 2013)

A two-dimensional blocking index derived from daily 500 hPa geopotential height, G500, according the method of Tibaldi and Molteni [1990] was used.
At each gridpoint with longitude λ (179W – 180E) and latitude ϕ (30N – 75N) southward and northward meridional gradients were calculated:

$$GHGS(\lambda,\phi) = G500(\lambda,\phi) - G500(\lambda,\phi-\Delta\phi)$$

$$GHGN(\lambda,\phi) = G500(\lambda,\phi+\Delta\phi) - G500(\lambda,\phi)$$

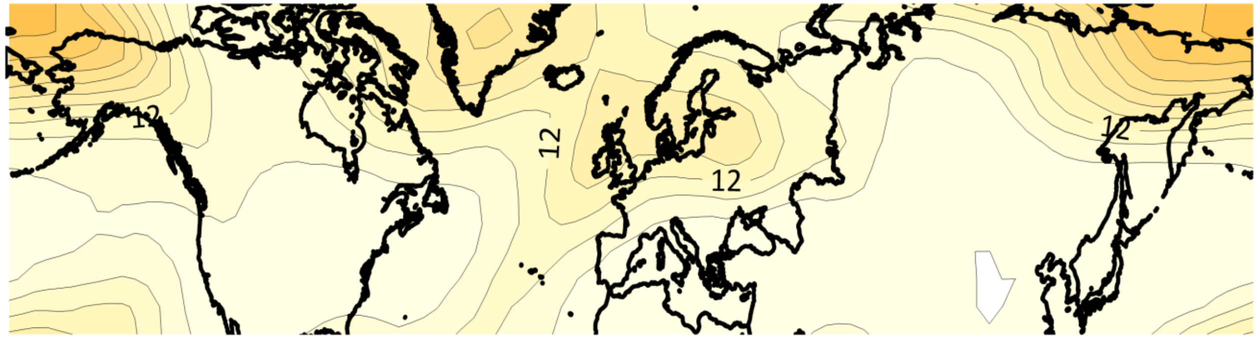
where $\Delta\phi=15°$.

An "instantaneous blocking" (IB) event is defined to occur when two conditions are fulfilled:

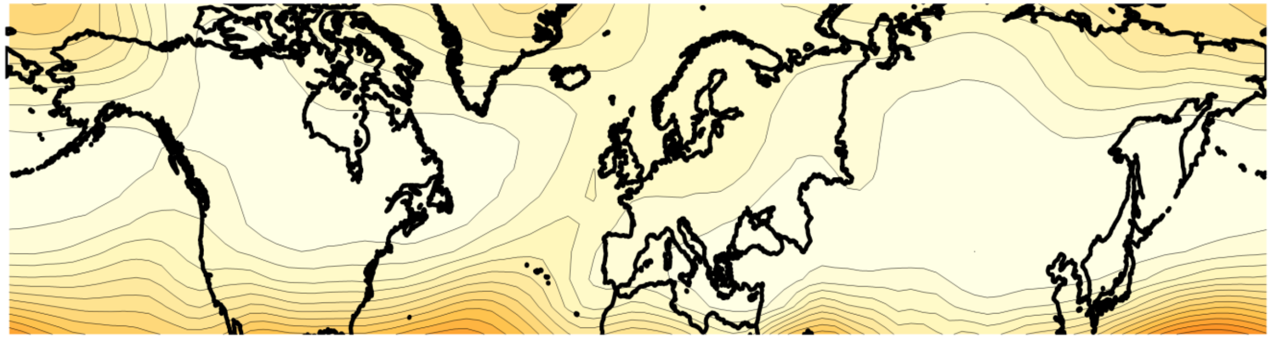
- ***GHGN < –10 m/° latitude, indicating strong westerlies poleward of ϕ***
- ***GHGS > 0, indicating reversal of the climatological gradient of G500 with easterlies equatorward of ϕ***

The IB index is 1 when these two conditions are satisfied and 0 otherwise.

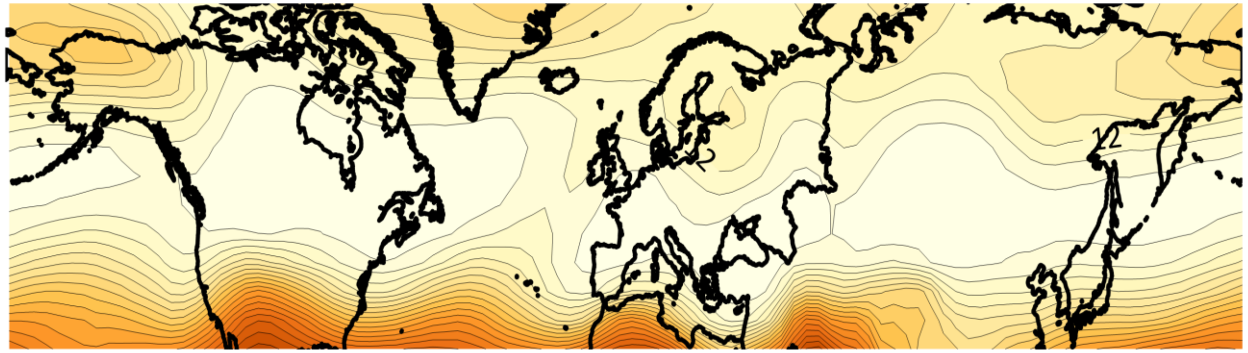
Seasonal average blocking days



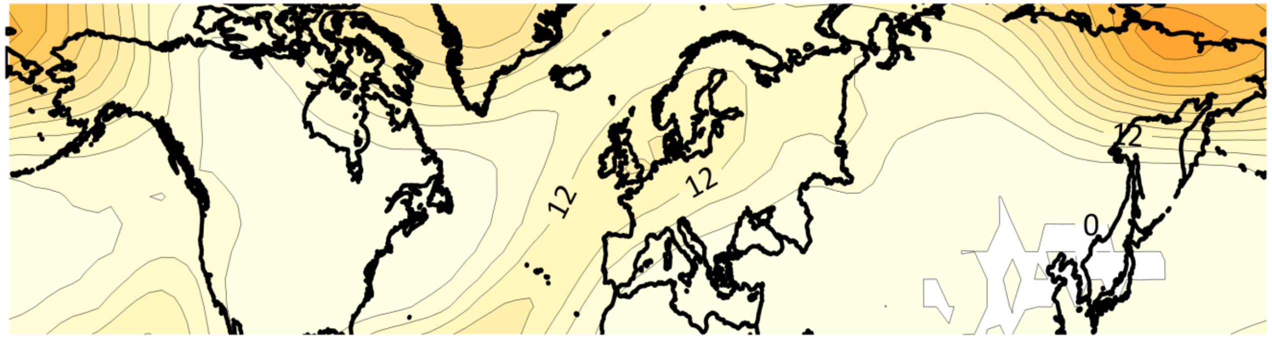
Spring



Autumn



Summer



Winter

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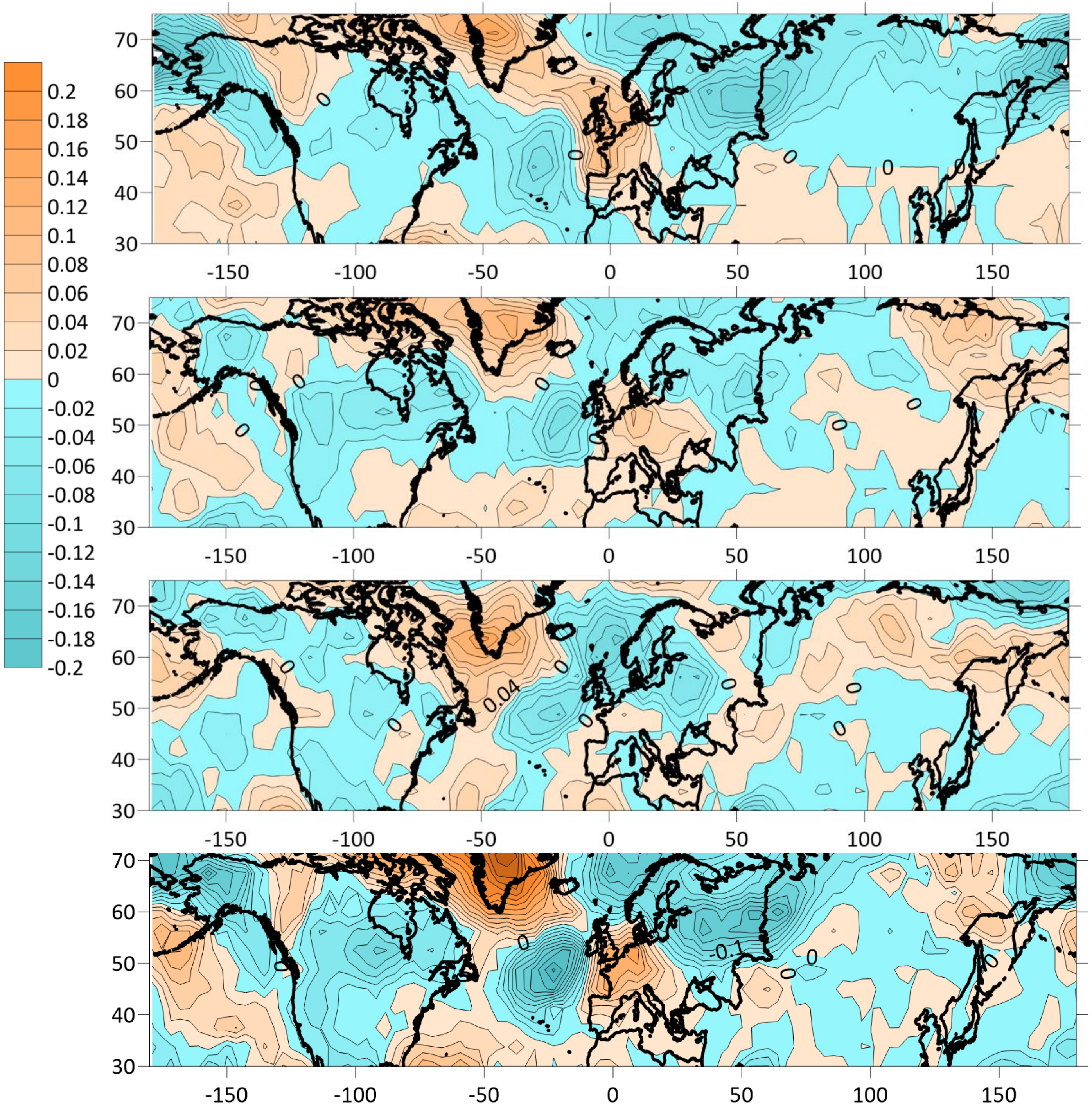
Spring trends 1980-2023

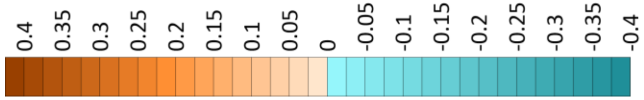


MARCH

APRIL

MAY

Spring



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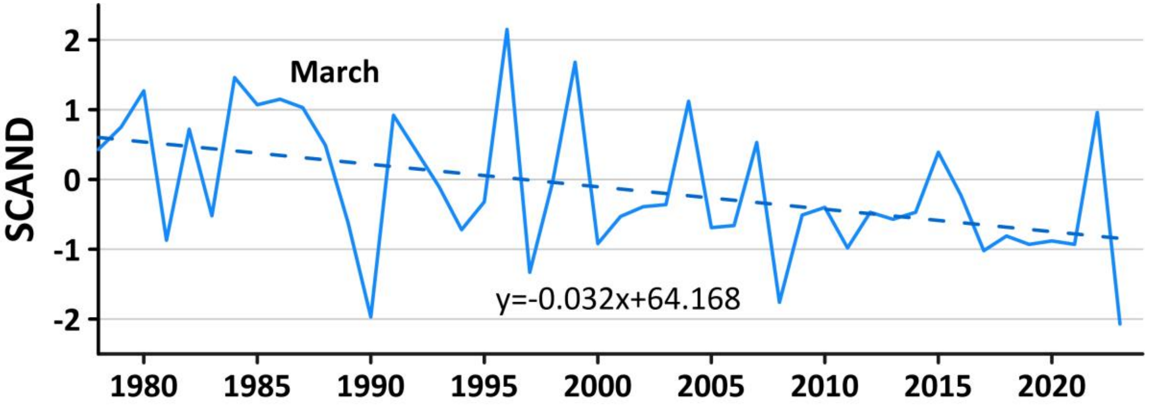
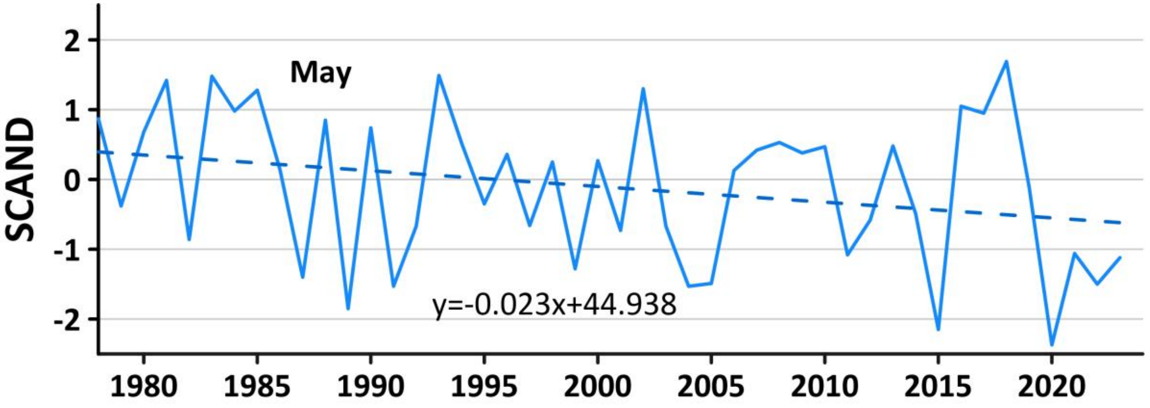
SCAND trends

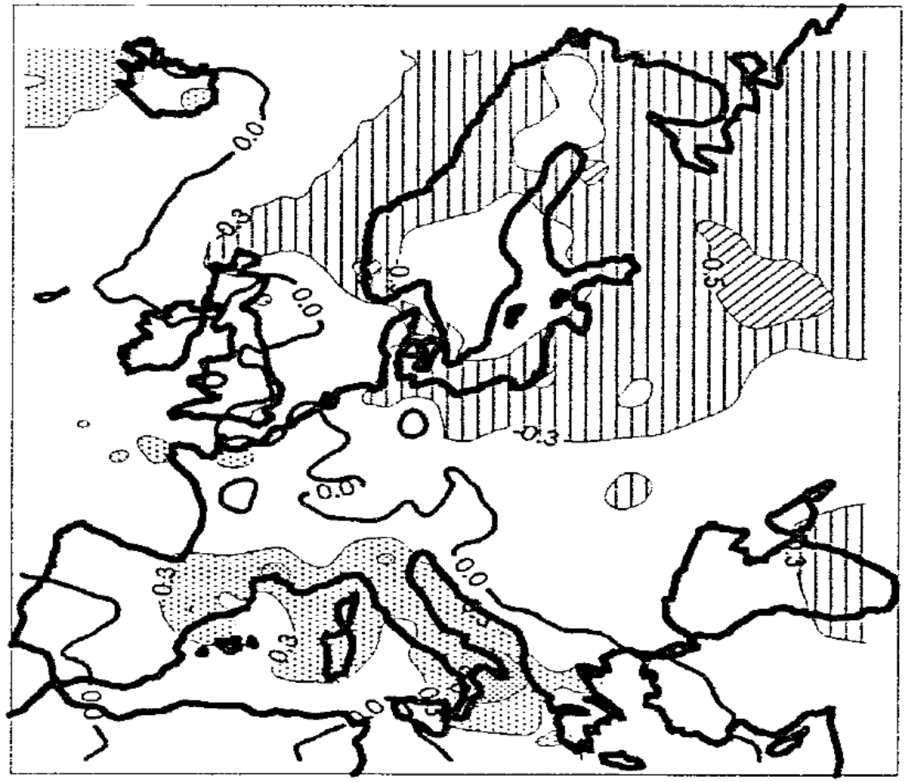


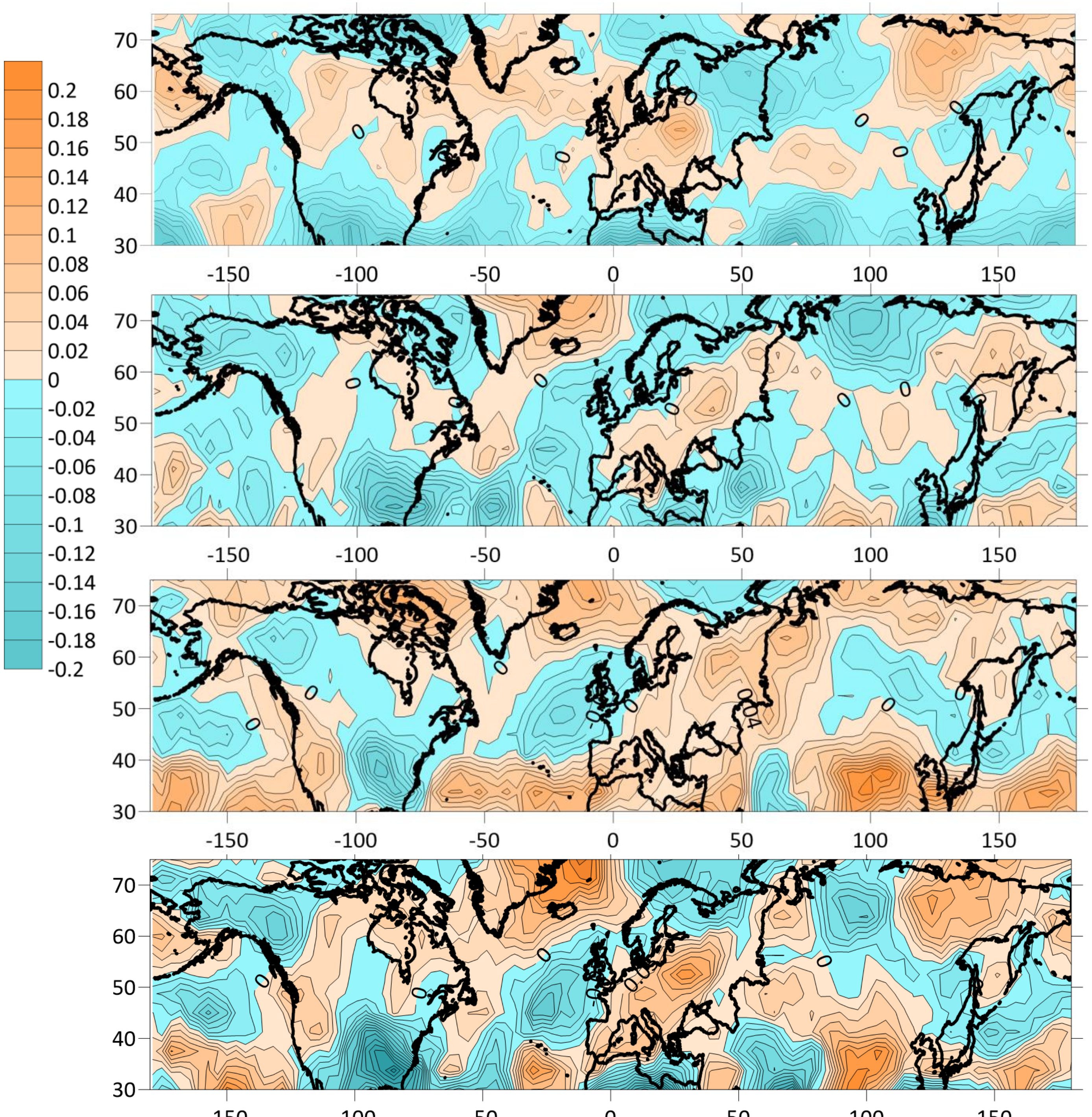
R^2=20%



R^2=8%

The SCAND pattern influence on precipitation. Correlation coefficients between the Scand index and the precipitation totals (Wibig, 1999)



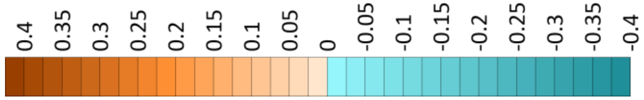


JUNE

JULY

AUGUST

Summer



Summer trends 1980-2023

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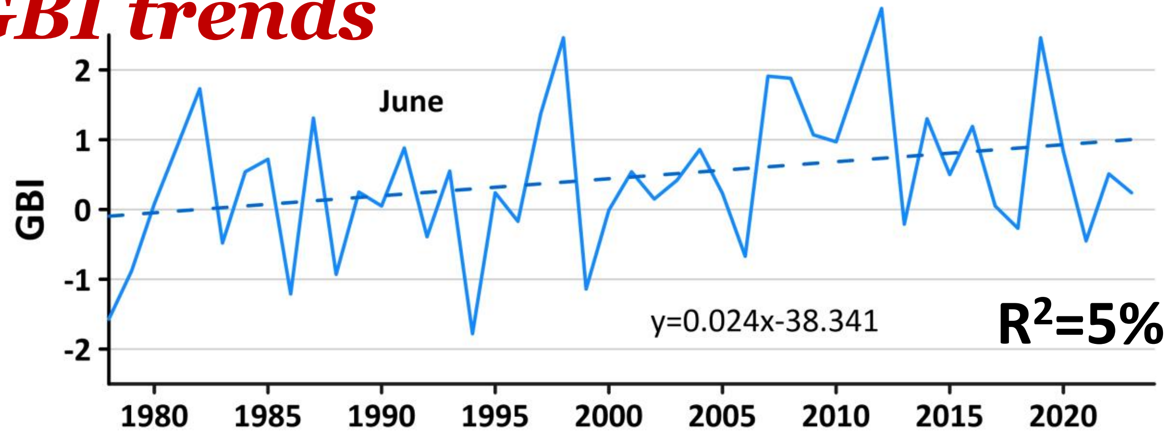
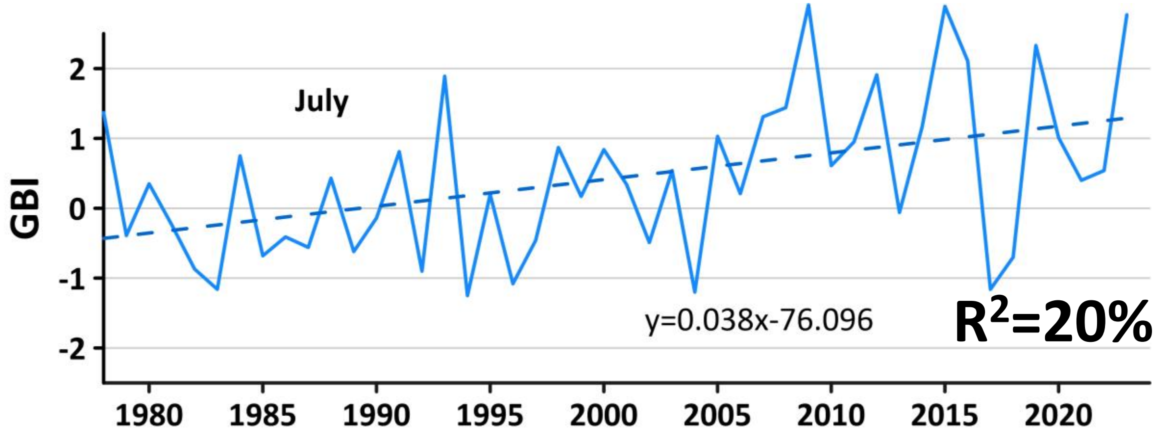
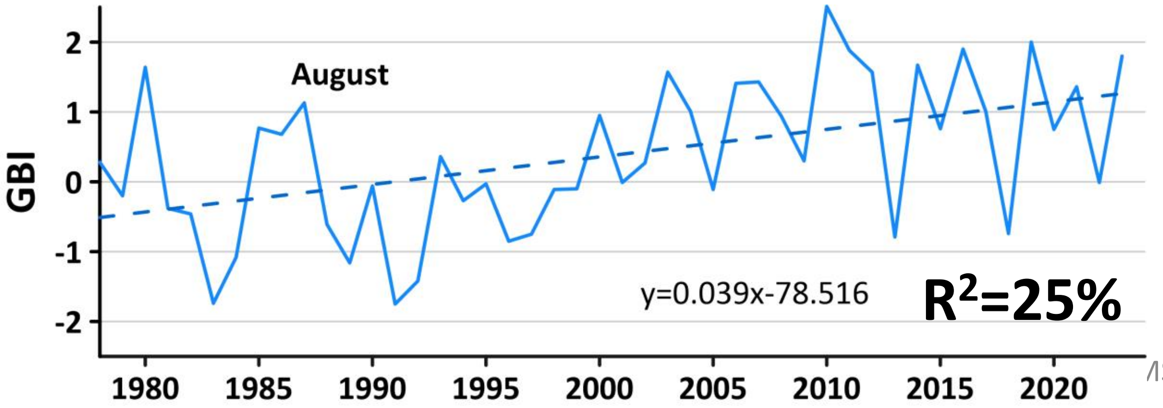
GBI trends







Corelation coefficients between monthly dry day frequencies(DDF) averaged over all stations in Poland and GBI

Month	DDF - GBI
Jan.	-
Feb.	-
Mar.	-
Apr.	-
May	-0.25
Jun.	-0.29
Jul.	-0.27
Aug.	-0.37
Sep.	-0.26
Oct.	-
Nov.	-
Dec.	-

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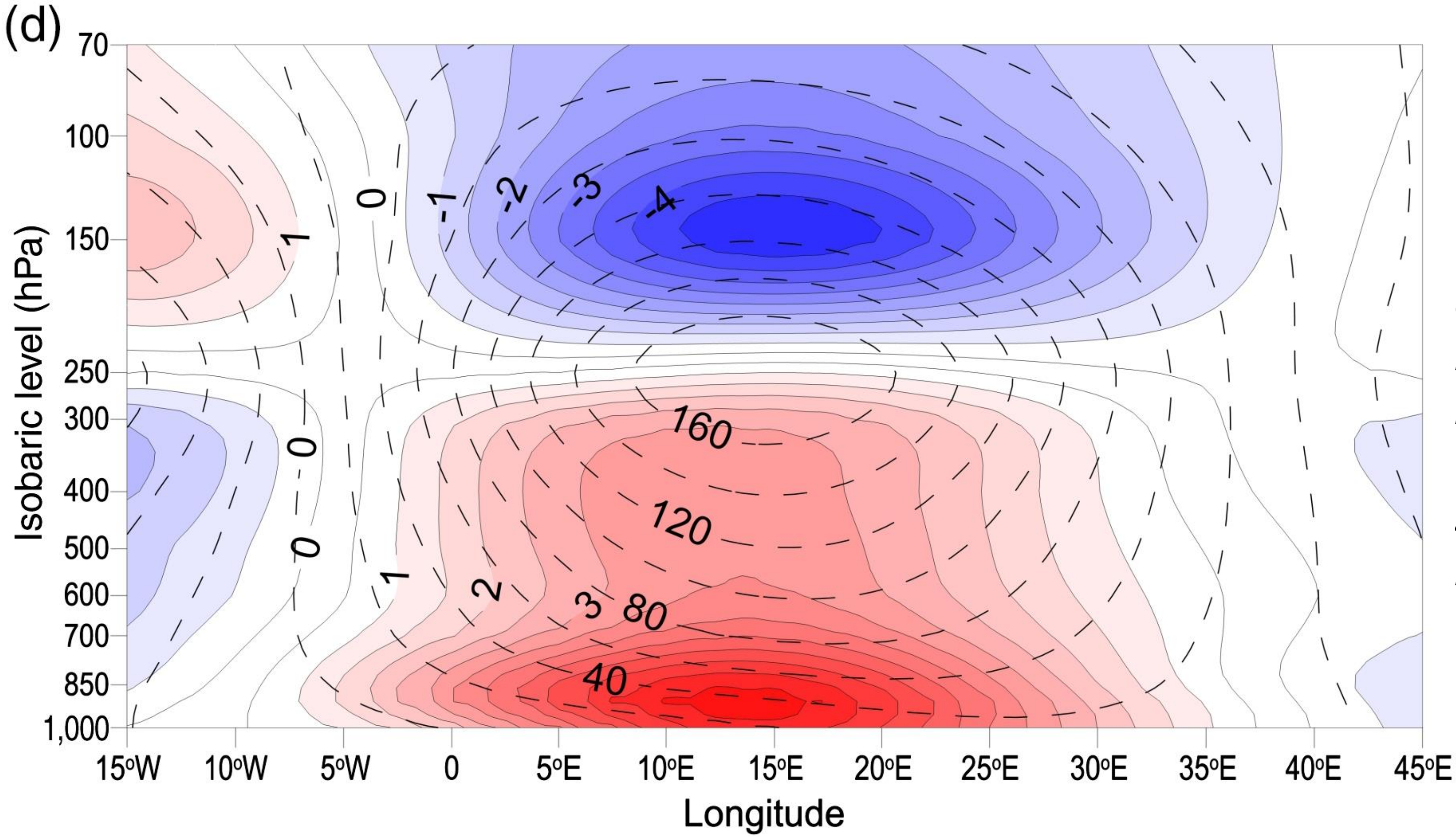
Heat waves in Central Europe



Vertical cross-sections through the troposphere with mean anomalies of heights of isobaric surfaces (dashed lines) and air temperature (colour scale) along latitude 52.5N during the analysed heat waves

Tomczyk, Bednorz, DOI: 10.1002/joc.6067

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DOI: 10.1002/joc.8555

RESEARCH ARTICLE

International Journal of Climatology RMetS

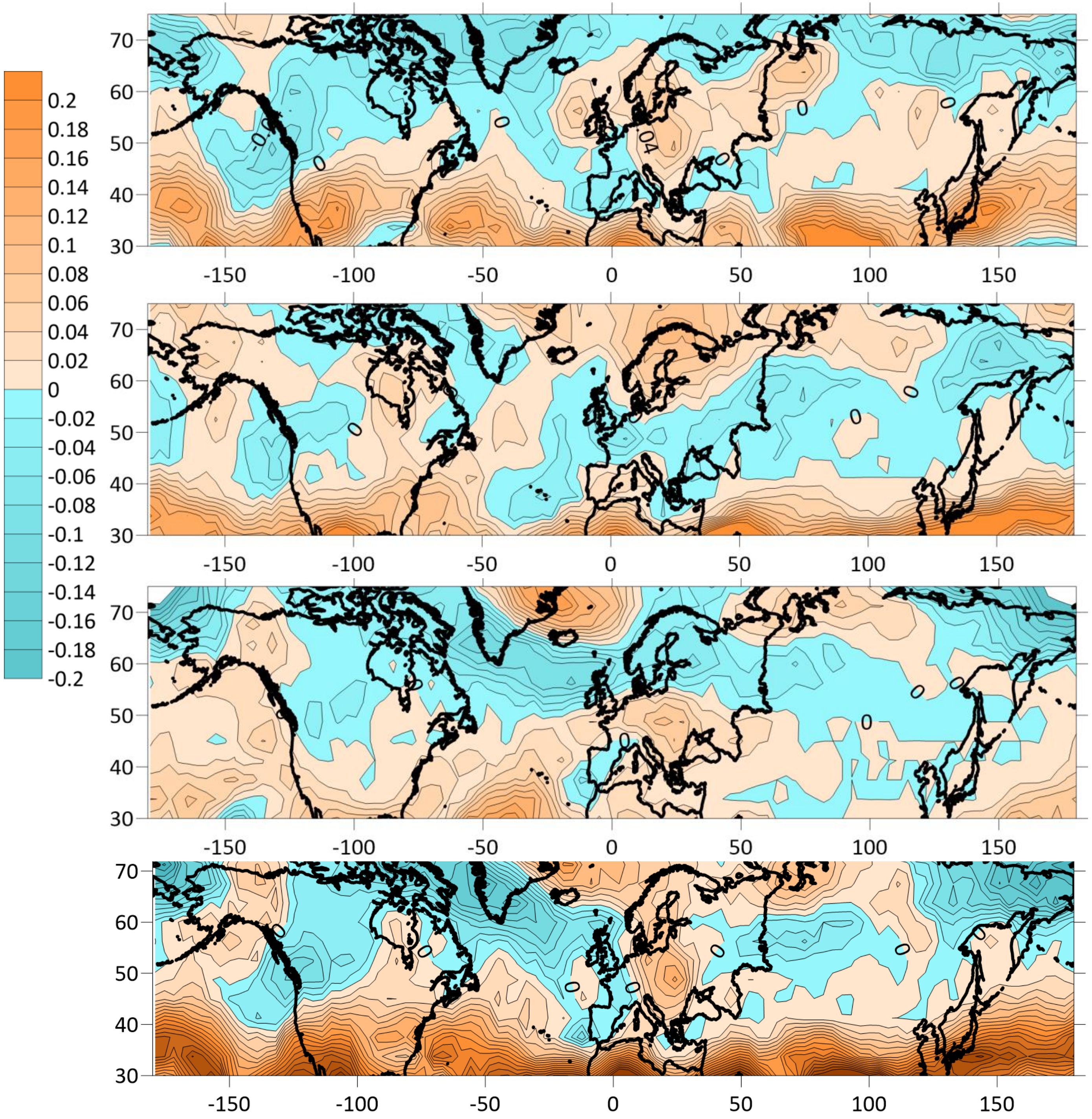
Relations between selected elements of climate and an increase in soil moisture deficit in the warm half-year in East-Central Europe between 1971 and 2020

Krzysztof Bartoszek[1] | Dorota Matuszko[2]

Mean values of the analysed variables and their mean relative anomalies from norm (in %) on days with blocking situations over East-Central Europe for each decade. (April-September 1971-2020)

	Soil moisture		Low cloud cover		Maximum temperature		Solar radiation		Relative humidity	
	Mean ($m^3 \cdot m^{-3}$)	Diff. %	Mean (%)	Diff. %	Mean (°C)	Diff. %	Mean ($MJ \cdot m^{-2}$)	Diff. %	Mean (%)	Diff. %
1971–1980	0.269	0	15.7	−45	20.4	+11	19.2	+17	48.2	−13
1981–1990	0.267	−1	17.3	−39	20.2	+9	19.1	+17	48.9	−12
1991–2000	0.263	−2	13.5	−53	21.3	+15	20.2	+23	46.0	−17
2001–2010	0.246	−4	14.2	−53	21.8	+17	19.9	+23	46.2	−17
2011–2020	0.240	−9	11.1	−60	22.9	+22	20.7	+26	43.1	−21

Autumn trends 1980-2023

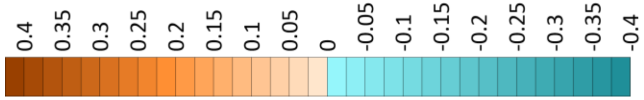


SEPTEMBER

OCTOBER

NOVEMBER

Autumn



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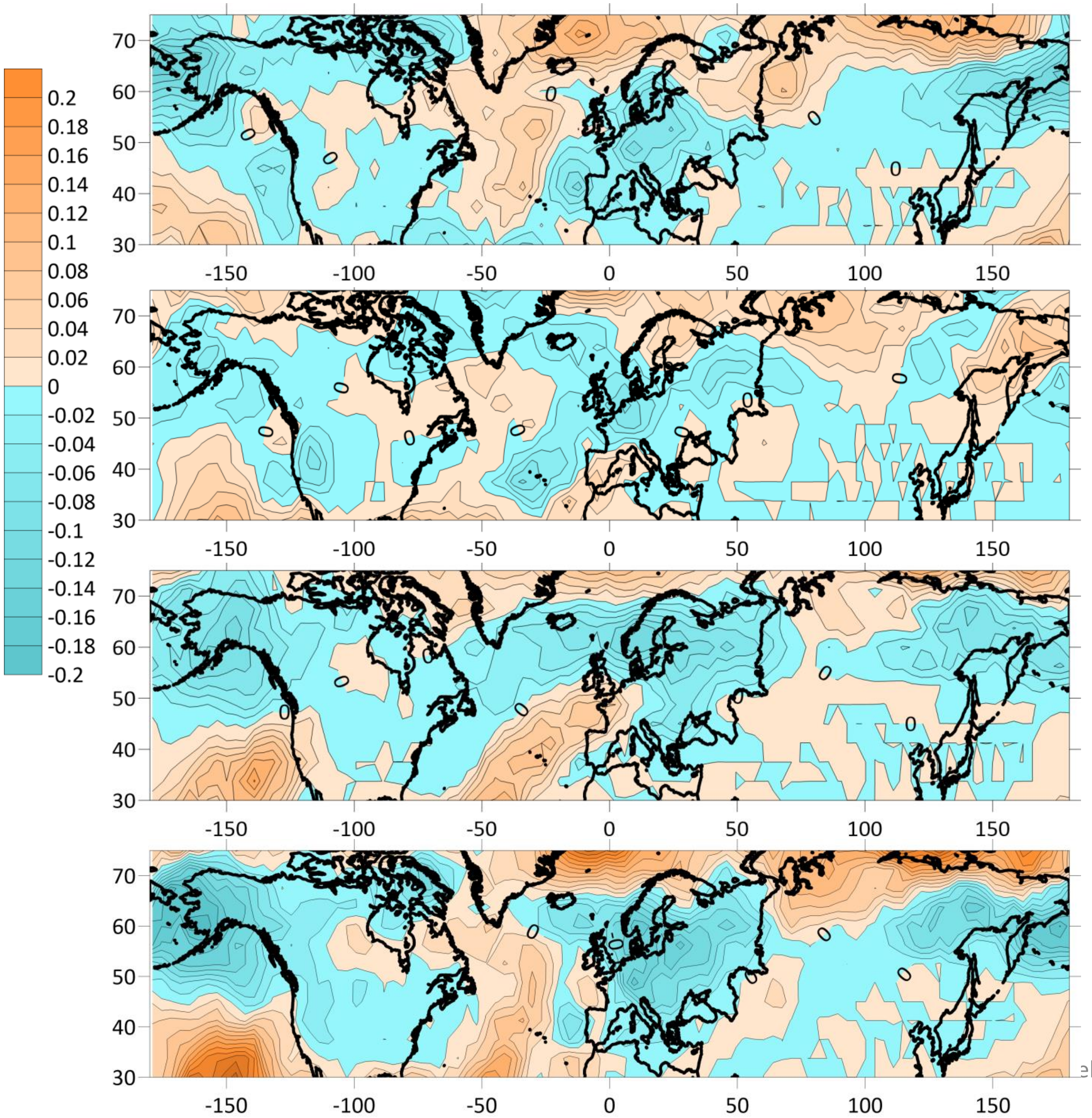
Winter trends 1980-2023

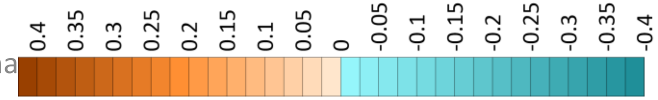


DECEMBER

JANUARY

FEBRUARY

Winter



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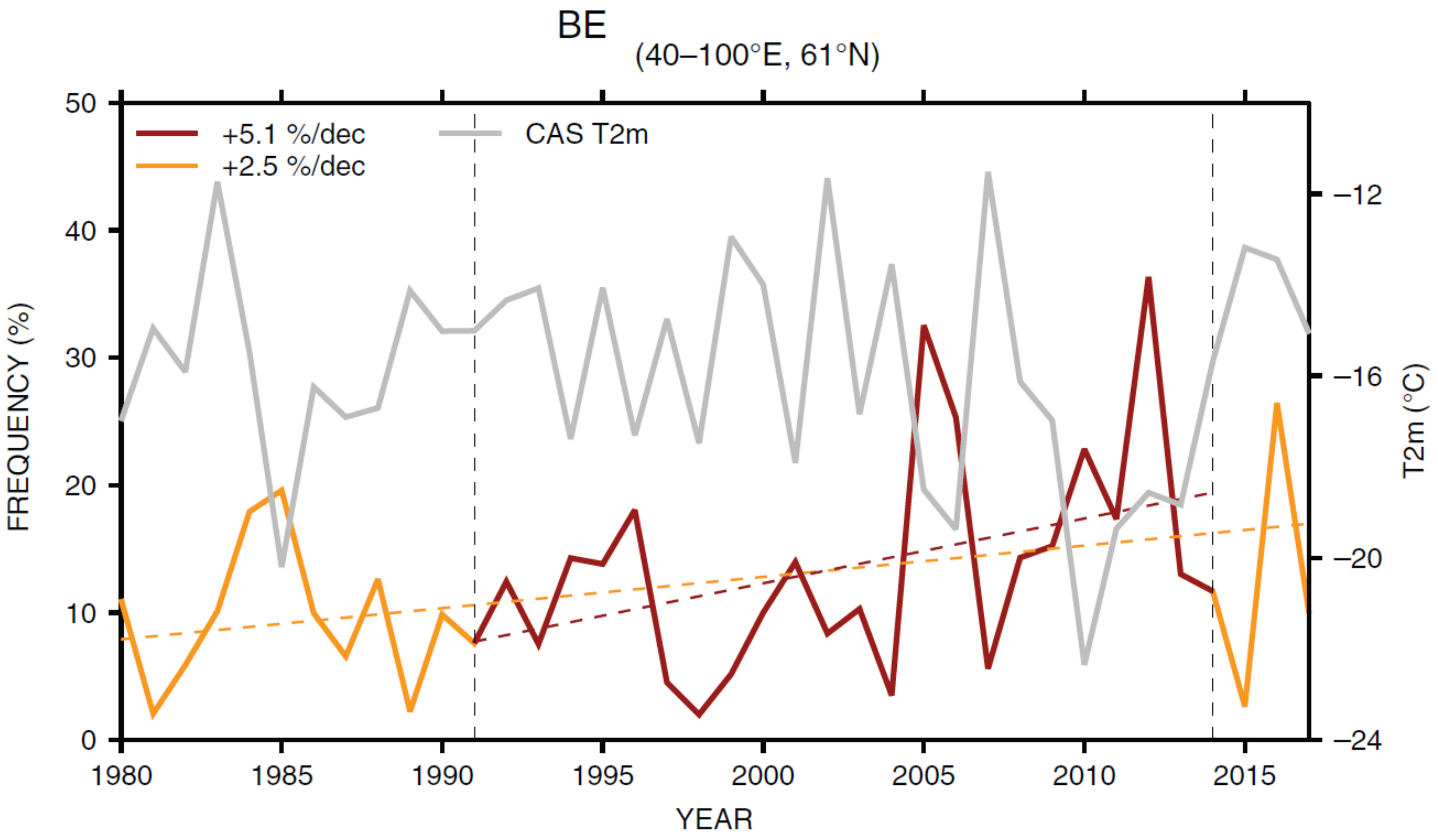
DOI: 10.1002/qj.3784

Quarterly Journal of the Royal Meteorological Society RMetS

RESEARCH ARTICLE

On the role of Ural Blocking in driving the Warm Arctic–Cold Siberia pattern

Evangelos Tyrlis[1] | Jürgen Bader[1,2] | Elisa Manzini[1] | Jinro Ukita[3] |
Hisashi Nakamura[4] | Daniela Matei[1]



Evolution of area-averaged DJF mean T2m over CAS (60–100◦E, 50–60◦N; grey line) and BE frequency (Ural blocking episode [UBE] frequency; orange line) over the region 40–100◦E, 61◦N during the period 1979–2017; the period 1991–2014 is shown in red.

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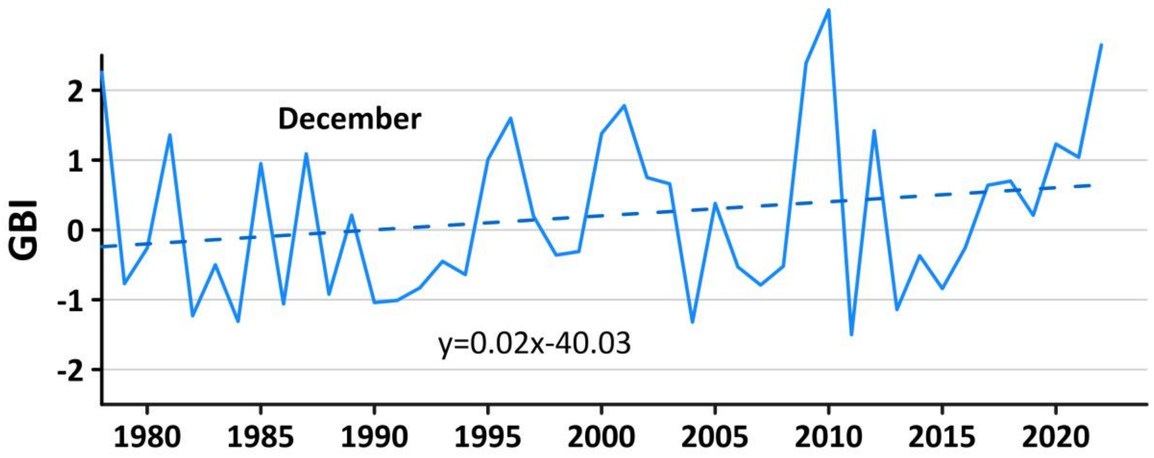
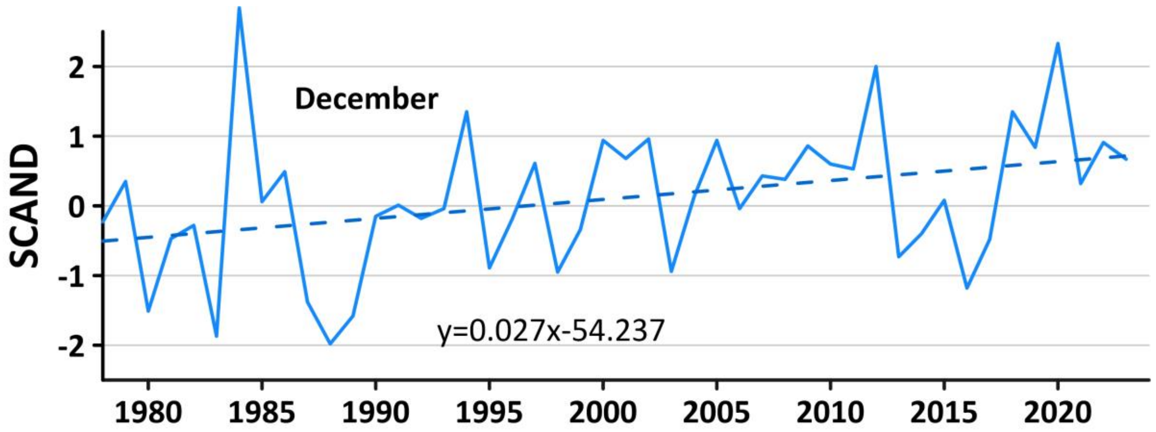
GBI & SCAND trends



R^2=5%



R^2=13%

Correlation coefficients between SCAND index and selected precipitation characteristics

Month	Precipitation totals	Dry days frequency	Wet days frequency
January	-0.50	0.60	-0.53
February	-0.54	0.49	-0.58
March	-0.36	0.30	-0.38

Wibig, 2024

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Summary

- **Spring**: More blocking days over Greenland and western Europe, less over Scandinavia
- **Summer**: More blocking days over western and central Europe, but also over Greenland and eastern Syberia. It corresponds with more heat waves in Europe, lower cloud cover and humidity and more hours with sun.
- **Autumn:** More blocking days over central Europe and Ural (Ural blocking) and over southern latitudes. It mean that in the south summer conditions last longer . Increased Ural blocking cause earlier winter in central Siberia with more snow
- **Winter:** Increased frequency of Ural blocking, means enhanced WACE pattern. More blocking days in December over Greenland and Scandinavia, corresponds to warmer and drier December in the northern and eastern Europe.

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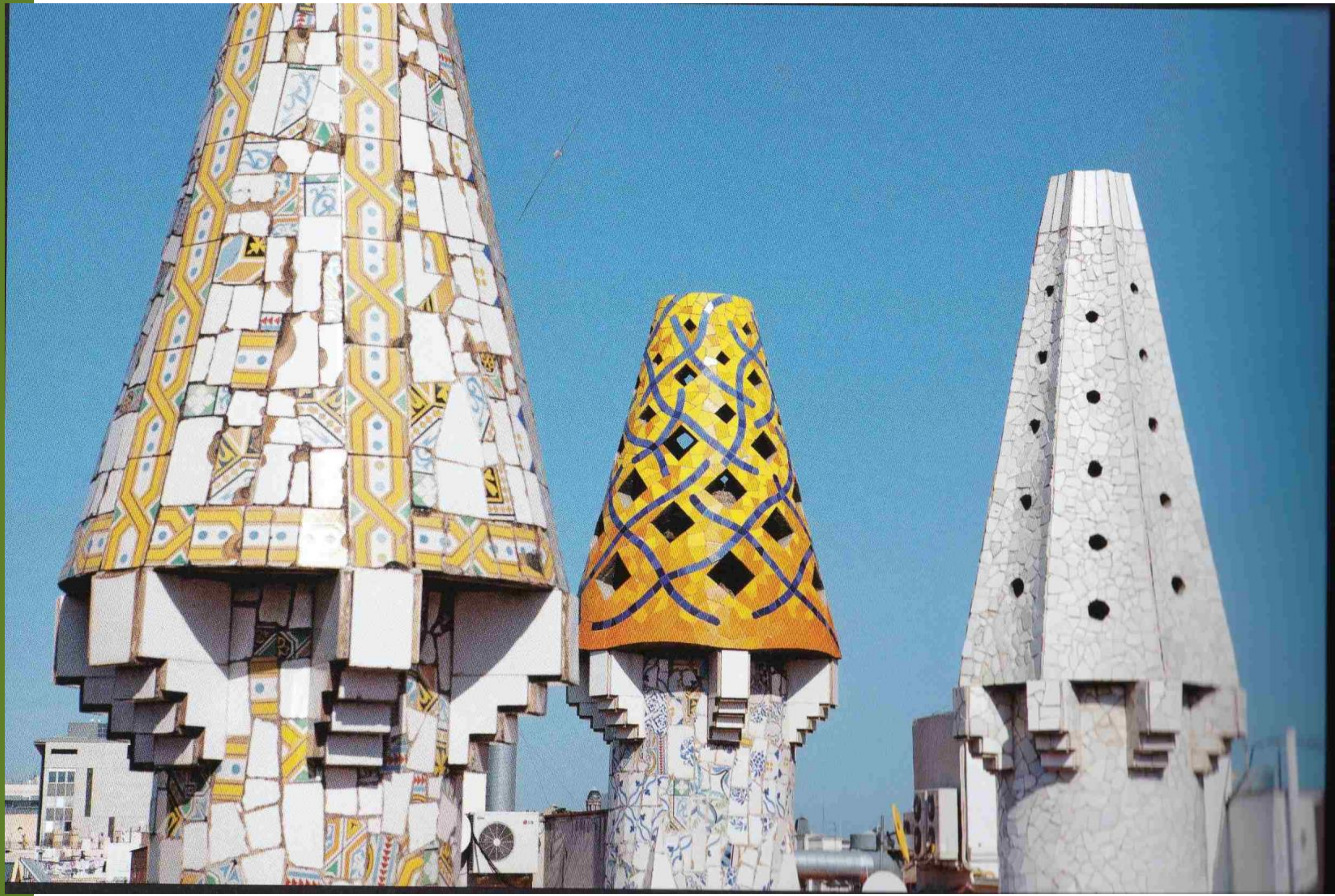
Thanks for your attention



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