

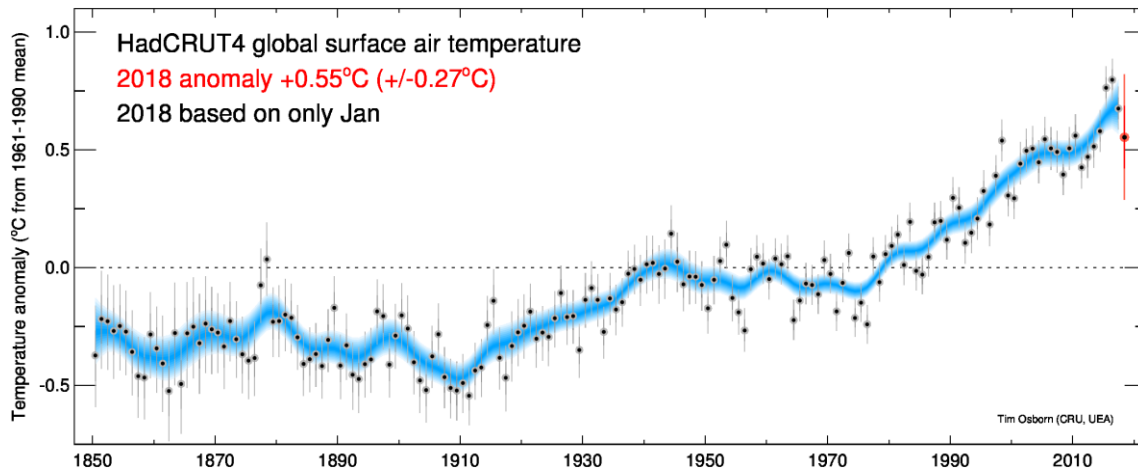
The background of the slide is a photograph of a sunset over an industrial city. The sun is a large, bright yellow-orange orb in the center of the sky, casting a warm glow. Below the horizon, several industrial buildings with smokestacks are visible, with dark smoke rising from them. The sky is filled with soft, orange and yellow clouds.

# KLIMATICKÁ ZMENA JEJ PREJAVY A DOPADY NA SLOVENSKU

**JOZEF PECHO**

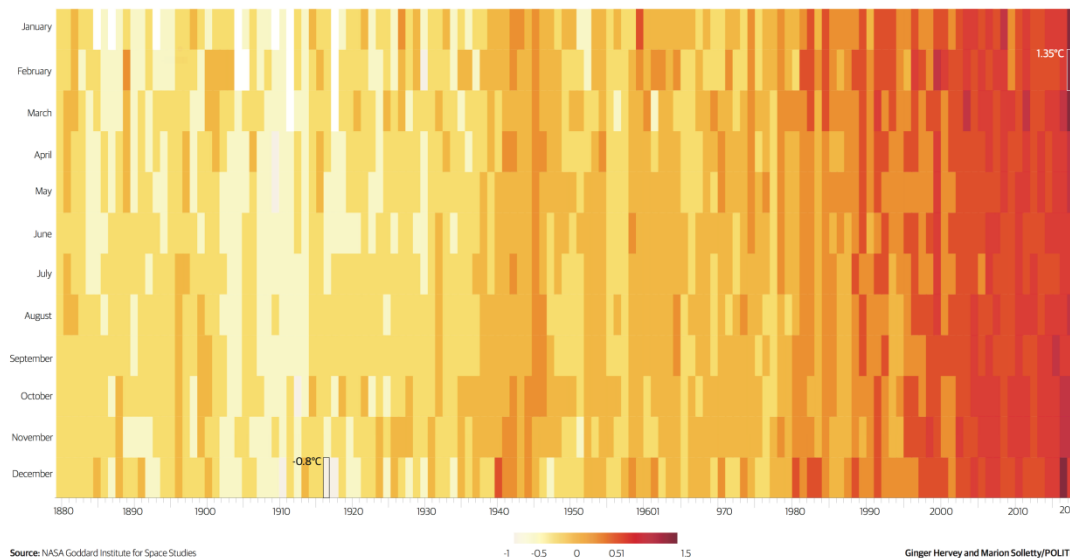
Slovenský hydrometeorologický ústav, Bratislava

# ZEM AKUMULUJE ČORAZ VIAC TEPLA



## Global temperatures increasing

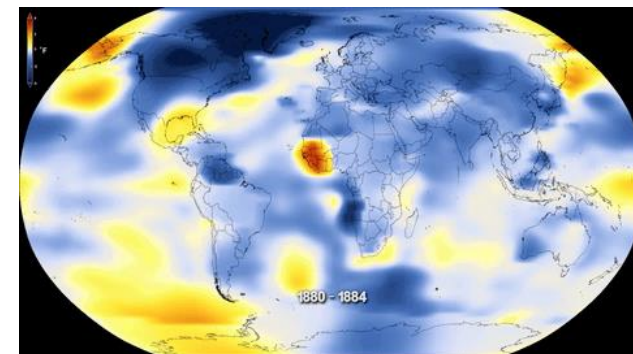
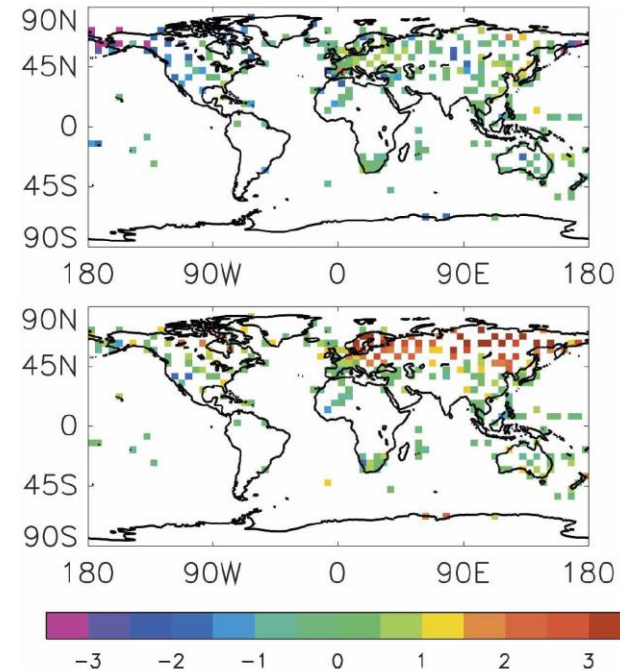
Global temperatures rose by roughly 1°C since the late 19th century. This graph shows the increase in global temperature, sea and land combined, relative to 1951-1980 average temperatures.



Source: NASA Goddard Institute for Space Studies

-1 -0.5 0 0.5 1.5

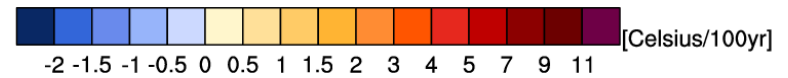
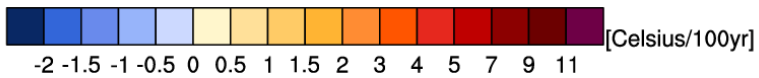
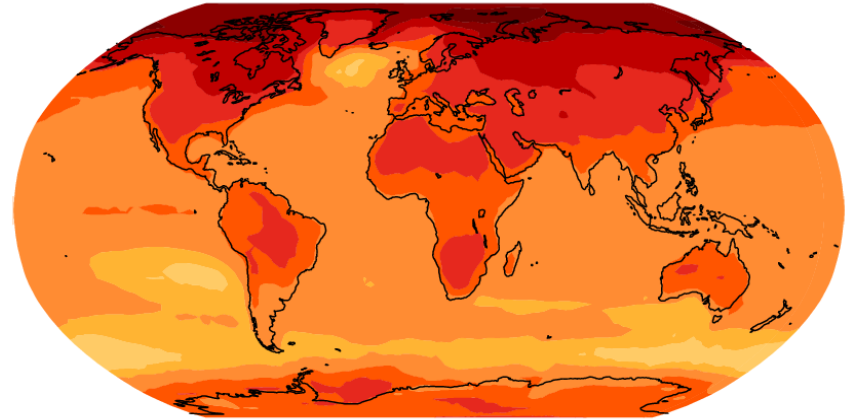
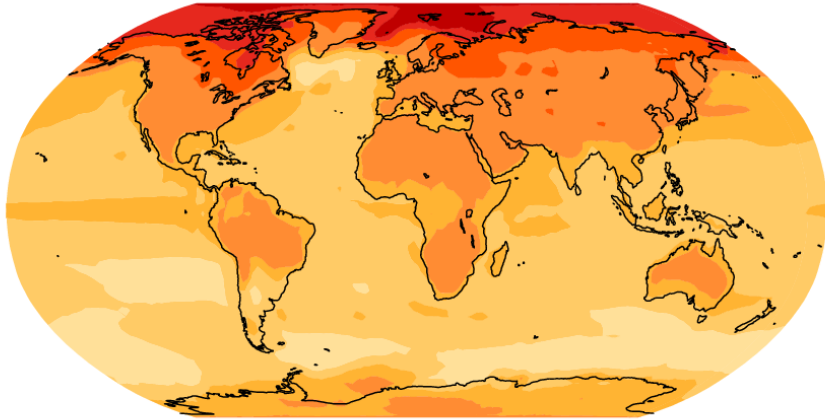
Ginger Hervey and Marion Soleyry/POLITICO



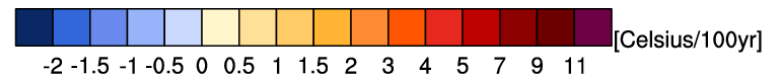
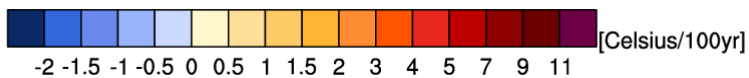
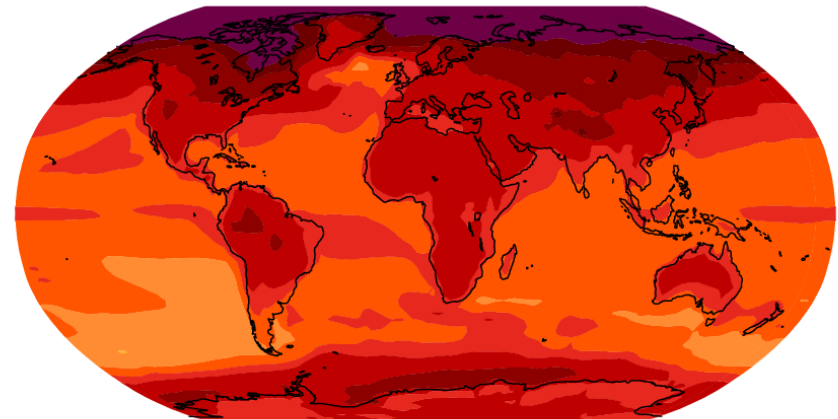
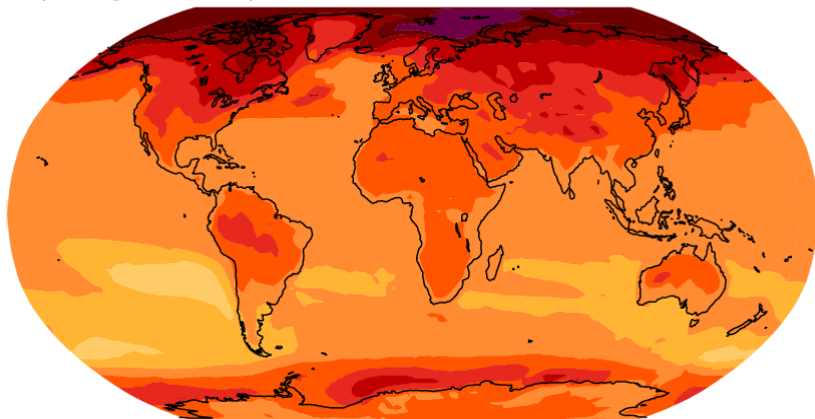
Zdroj: Met Office

# ZEM AKUMULUJE ČORAZ VIAC TEPLA

50% rcp45 regression temperature on time 1951-2099 Jan-Dec full CMIP5 ensemble 50% rcp85 regression temperature on time 1951-2099 Jan-Dec full CMIP5 ensemble

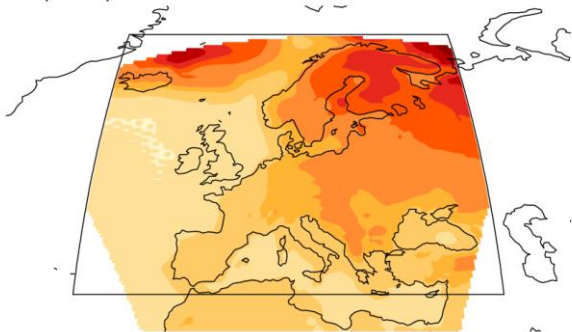


97% rcp45 regression temperature on time 1951-2099 Jan-Dec full CMIP5 ensemble 97% rcp85 regression temperature on time 1951-2099 Jan-Dec full CMIP5 ensemble

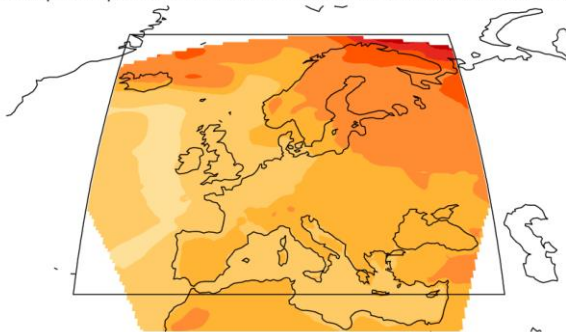


# ZEM AKUMULUJE ČORAZ VIAC TEPLA

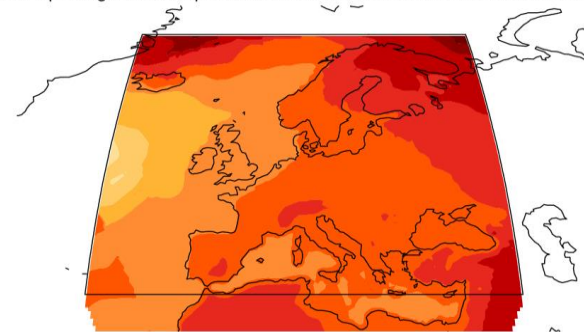
975% rcp45 temperature 2011-2030 minus 1981-2010 Dec-Feb CORDEX-EUR44



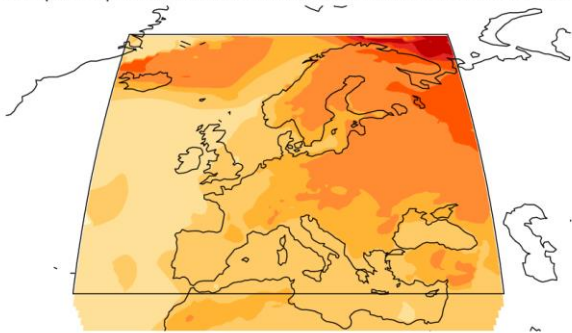
975% rcp45 temperature 2021-2050 minus 1981-2010 Jan-Dec CORDEX-EUR44



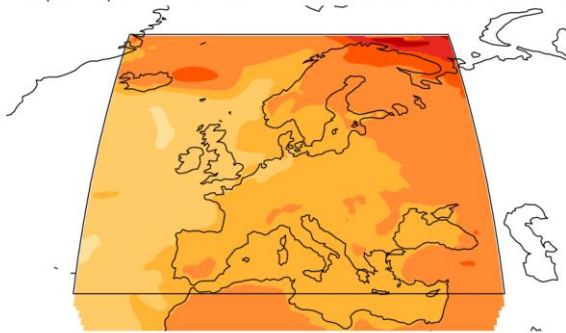
50% rcp85 regression temperature on time 1951-2099 Jan-Dec CORDEX-EUR44



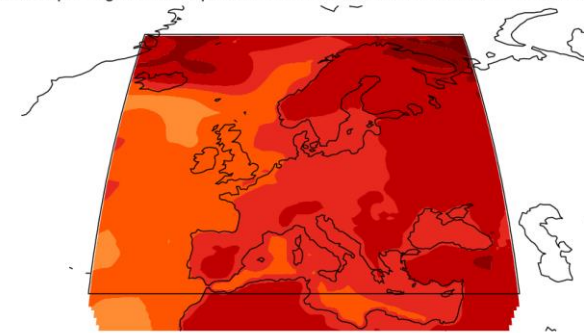
975% rcp85 temperature 2011-2030 minus 1981-2010 Dec-Feb CORDEX-EUR44



975% rcp85 temperature 2021-2050 minus 1981-2010 Jan-Dec CORDEX-EUR44



975% rcp85 regression temperature on time 1951-2099 Jan-Dec CORDEX-EUR44



# NEOTEPLUJE SA VŠADE ROVNAKO

Annual Mean Surface Temperature Anomaly (°C) Relative to 1951-1980 Mean

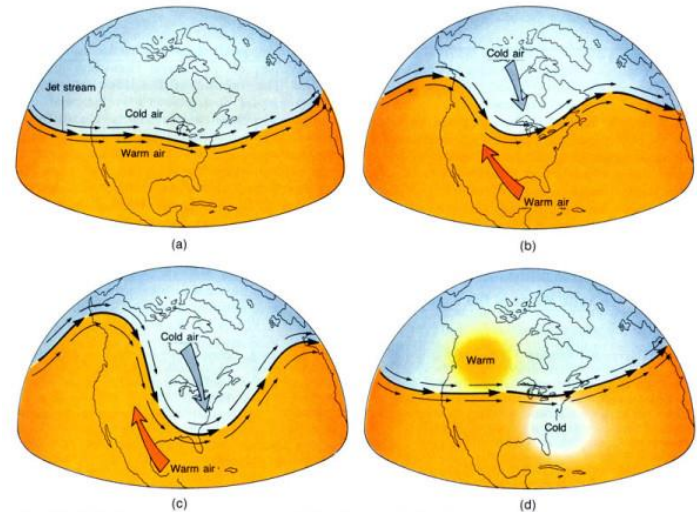
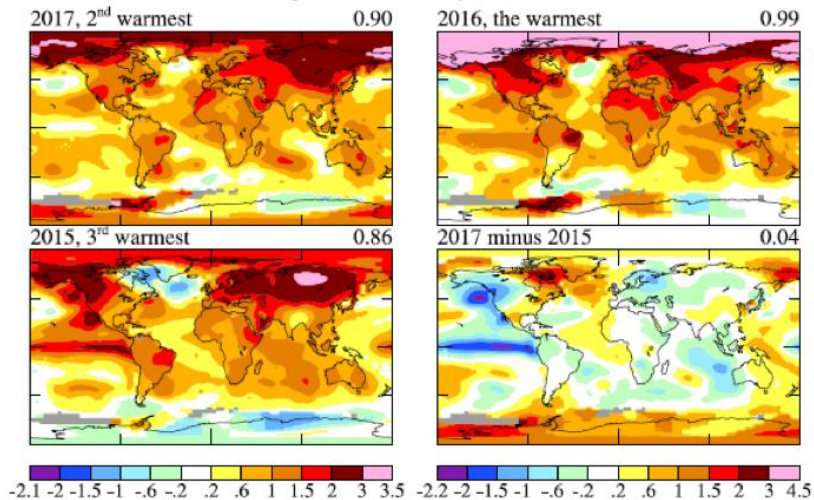
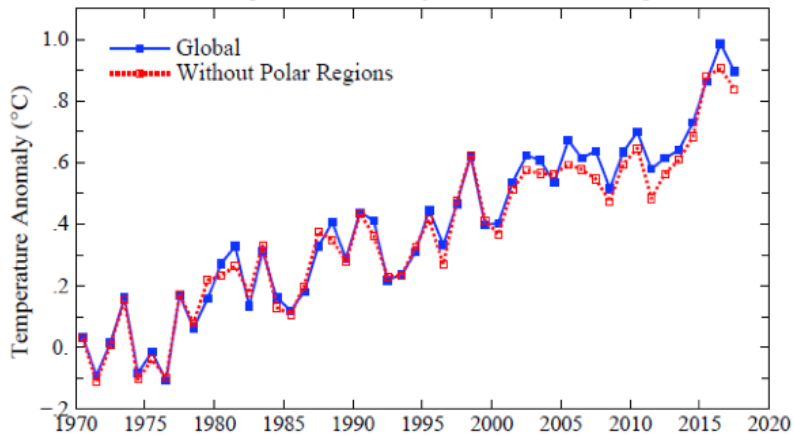
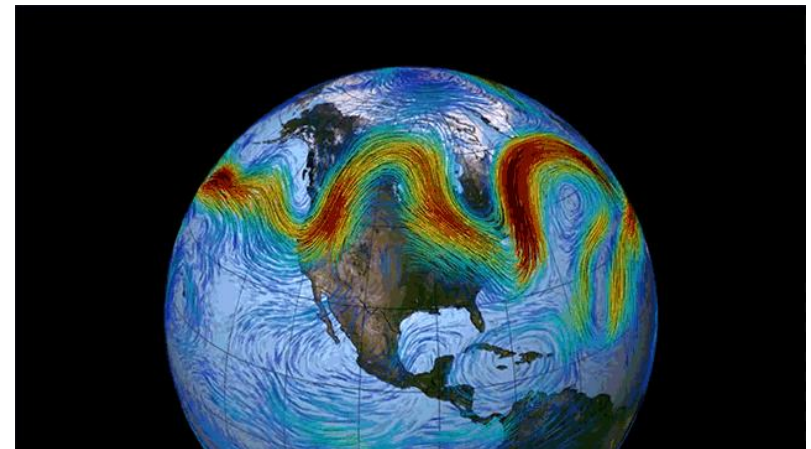


Figure 8-9 Cyclic changes that occur in the upper-level airflow of the westerlies. The flow, which has the jet stream as its axis, starts out nearly straight and then develops meanders that are eventually cut off. (After J. Namias, NOAA)

Surface Temperature Anomaly: 12-Month Running Means

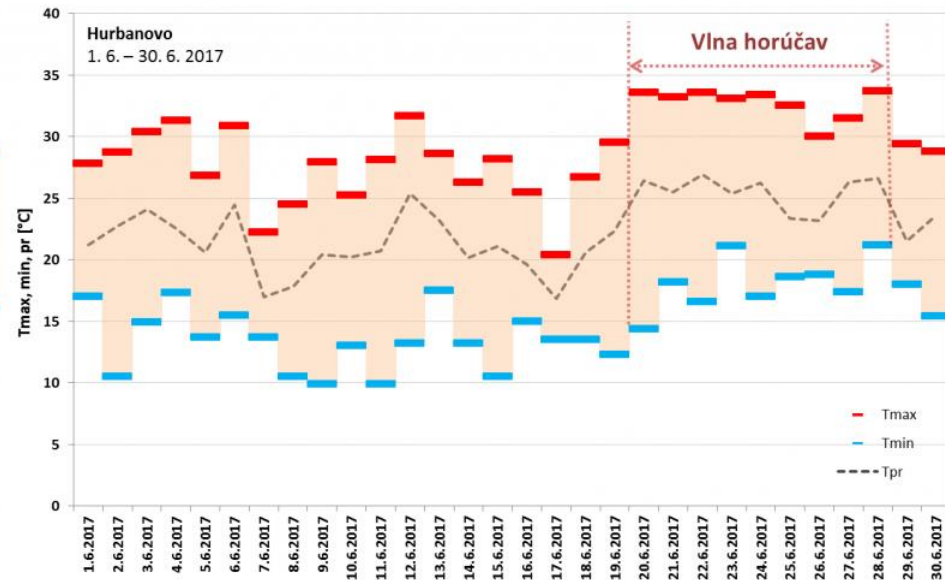
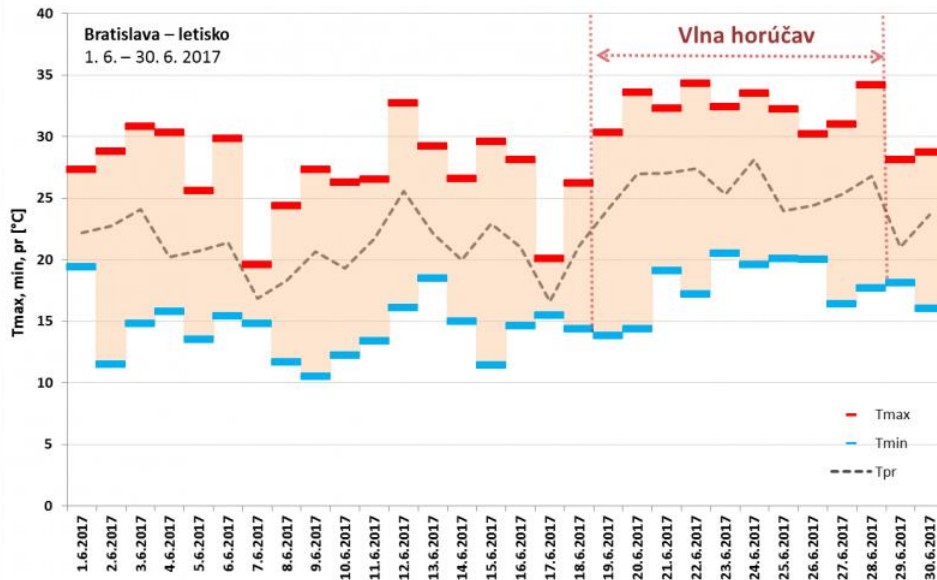
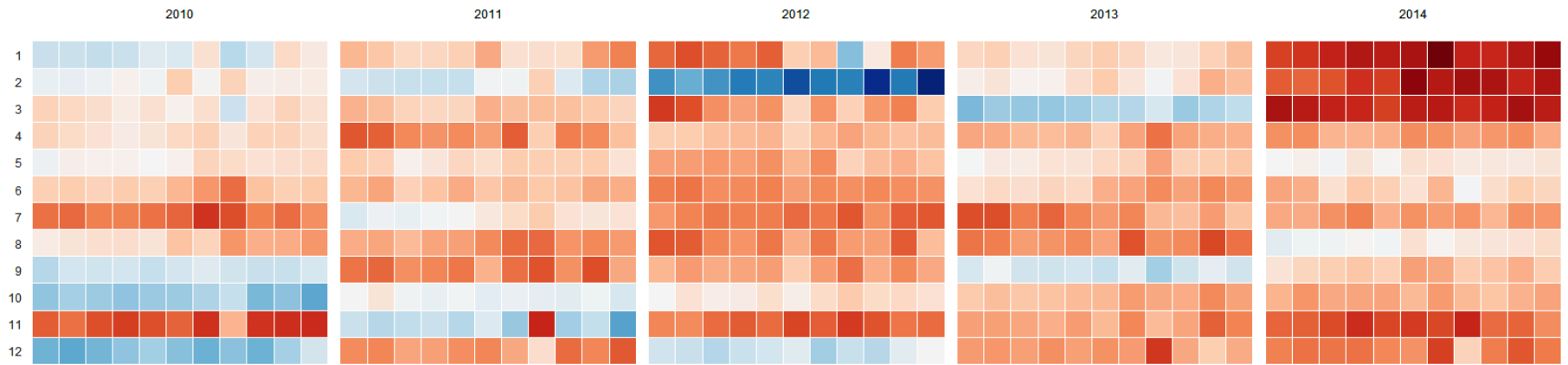


Zdroj: WMO, NASA GIS, NOAA, ECMWF, Met Office, JMA



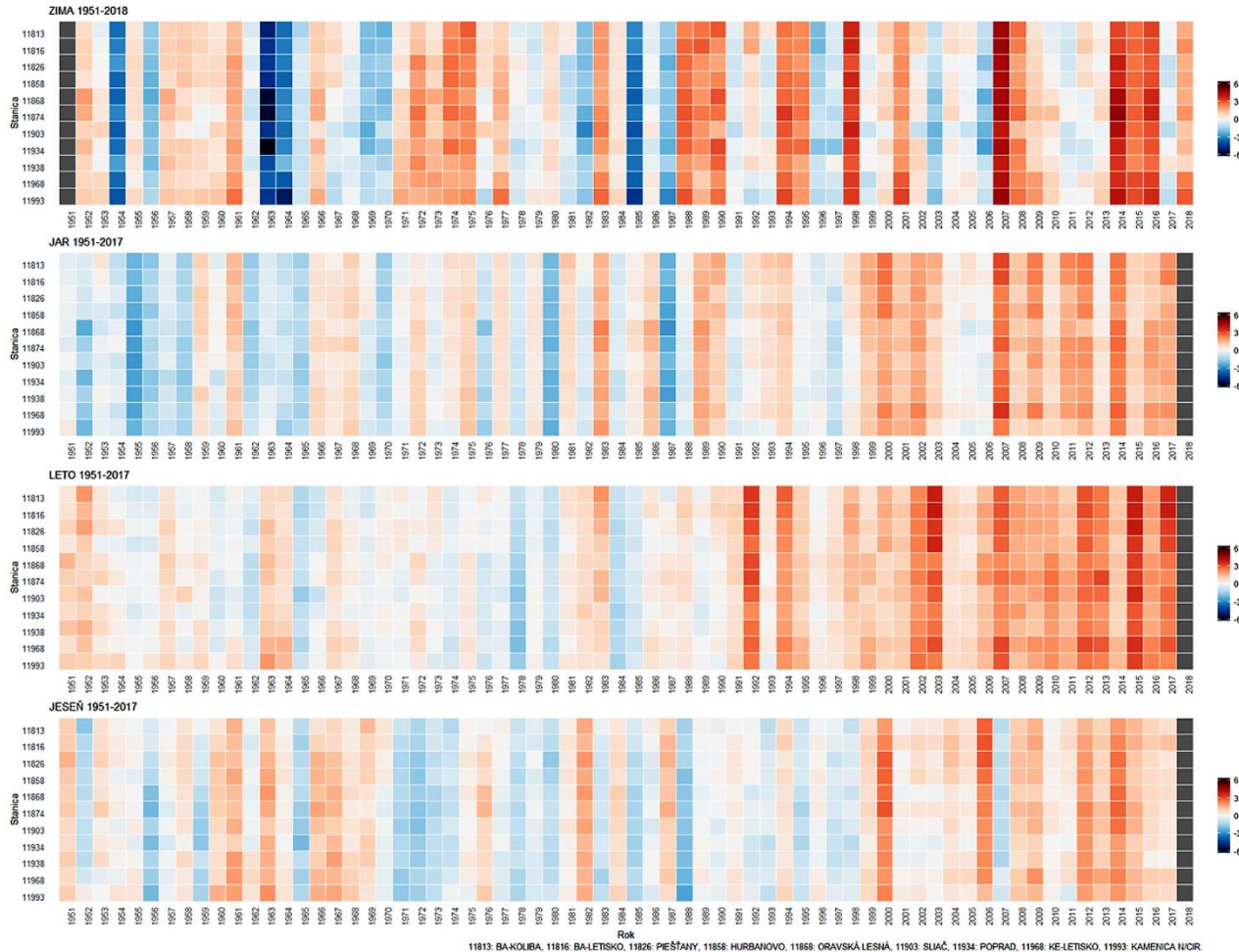
# ROK 2018

Odchýlka priemernej mesačnej teploty vzduchu od normálu 1961-1990 v období rokov 2010 a 2018

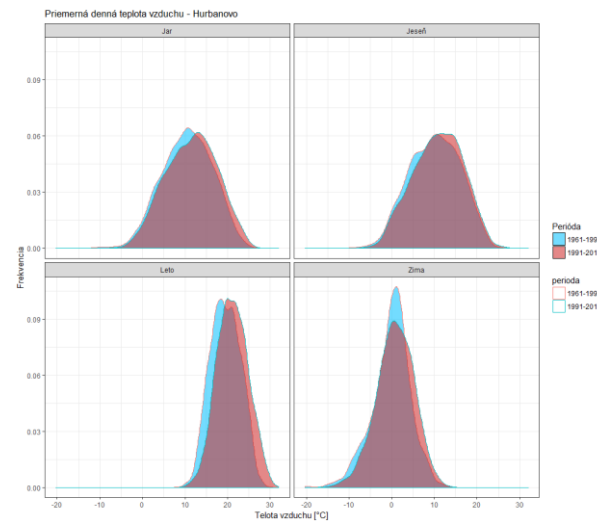
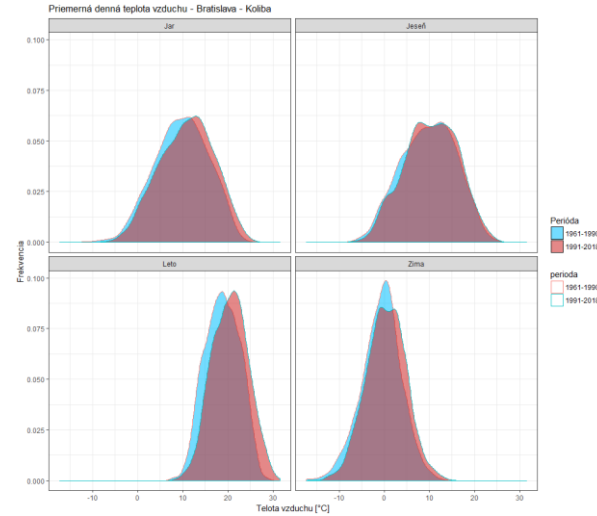


11813: BA-KOLIBA, 11816: BA-LETISKO, 11819: J. BOHUNICE, 11826: PIEŠŤANY, 11858: HURBANOVO, 11868: ORAVSKÁ LESNÁ, 11903: SLIAČ, 11930: L. ŠŤÍT, 11934: POPRAD, 11968: KE-LETISKO, 11993: KAMENICA N/CIR.

# ZMENA KLÍMY NA SLOVENSKU



11813: BAKOLUBA, 11816: BALETSKO, 11826: PIEŠŤANY, 11858: HURBANOVO, 11868: ORAVSKÁ LEŠNÁ, 11903: SLAČ, 11934: POPRAD, 11968: KE-LETISKO, 11993: KAMENICA N/CR



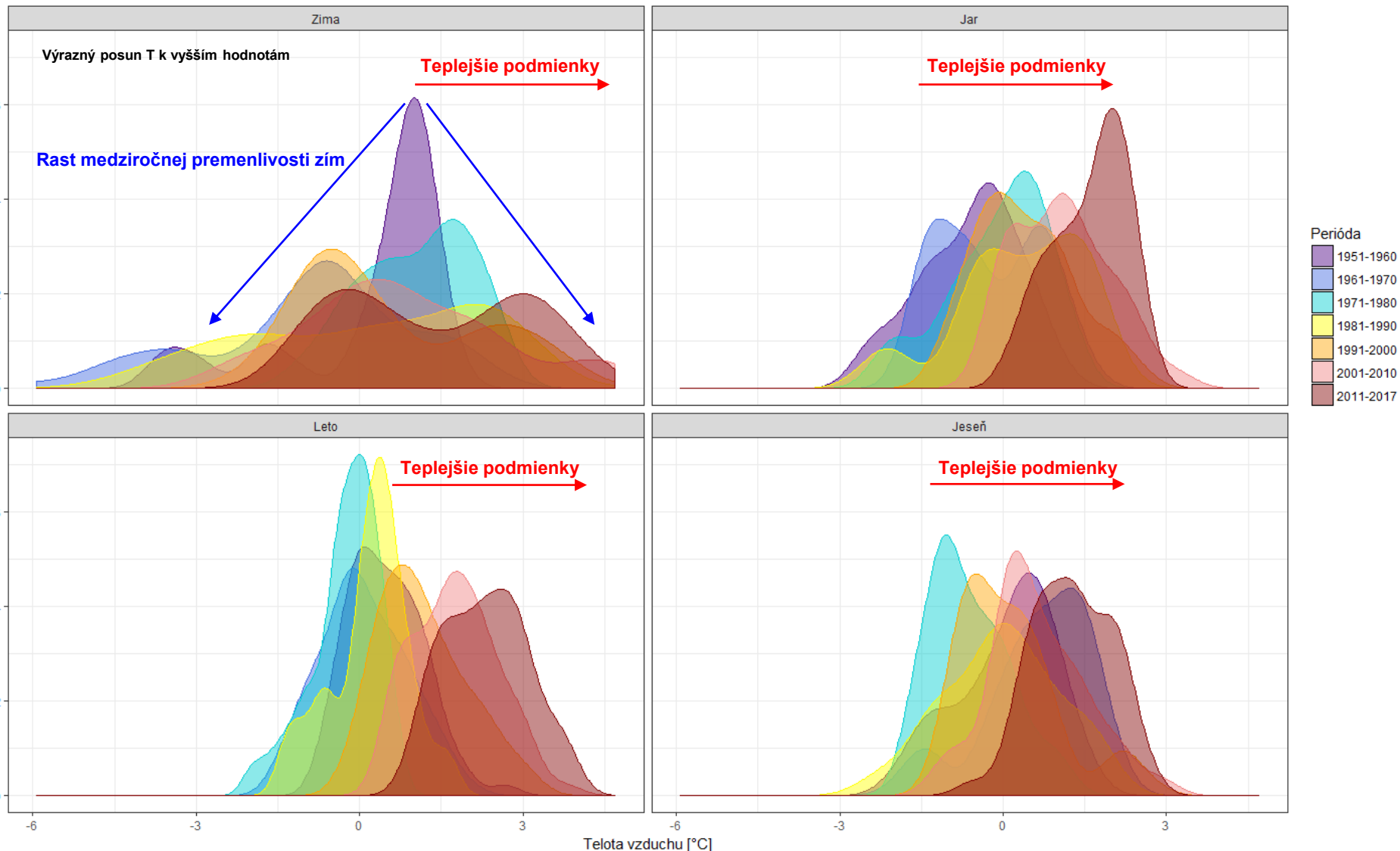
Zdroj: SHMÚ

Mestské osrovy tepla 04.06.2018



# ZMENA PRIEMERNÝCH TEPLOTNÝCH PODMIENOK

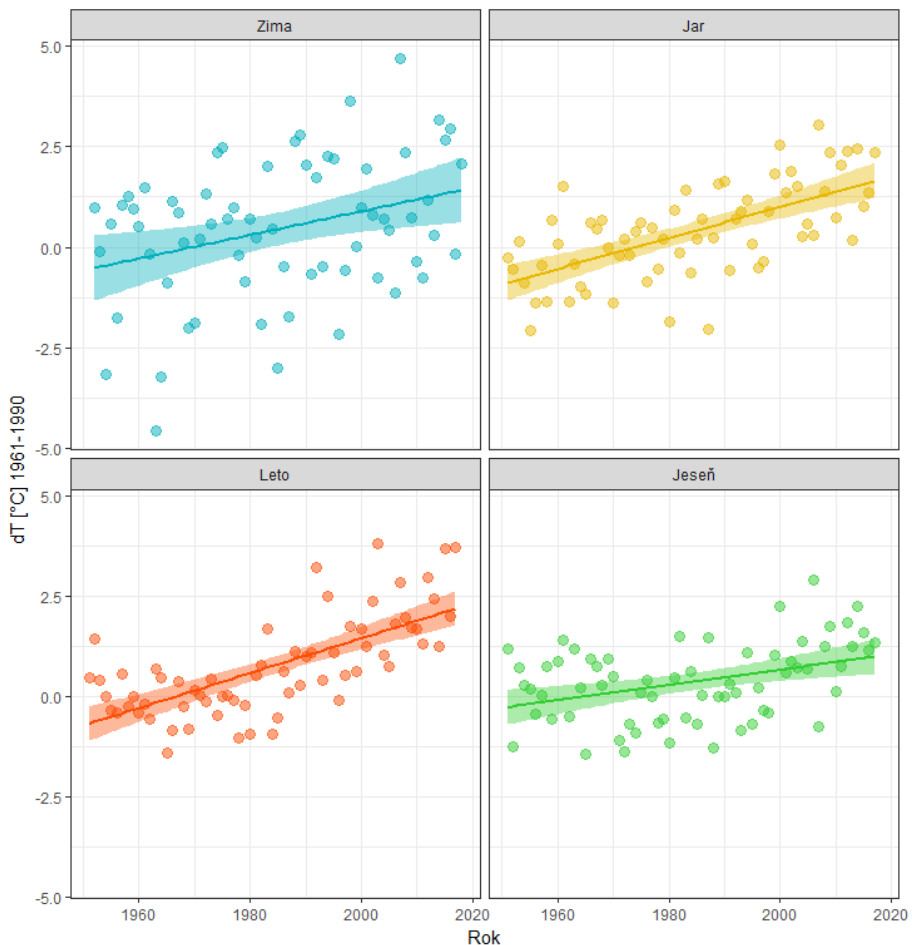
Odchýlka sezónnej teploty vzduchu na Slovensku



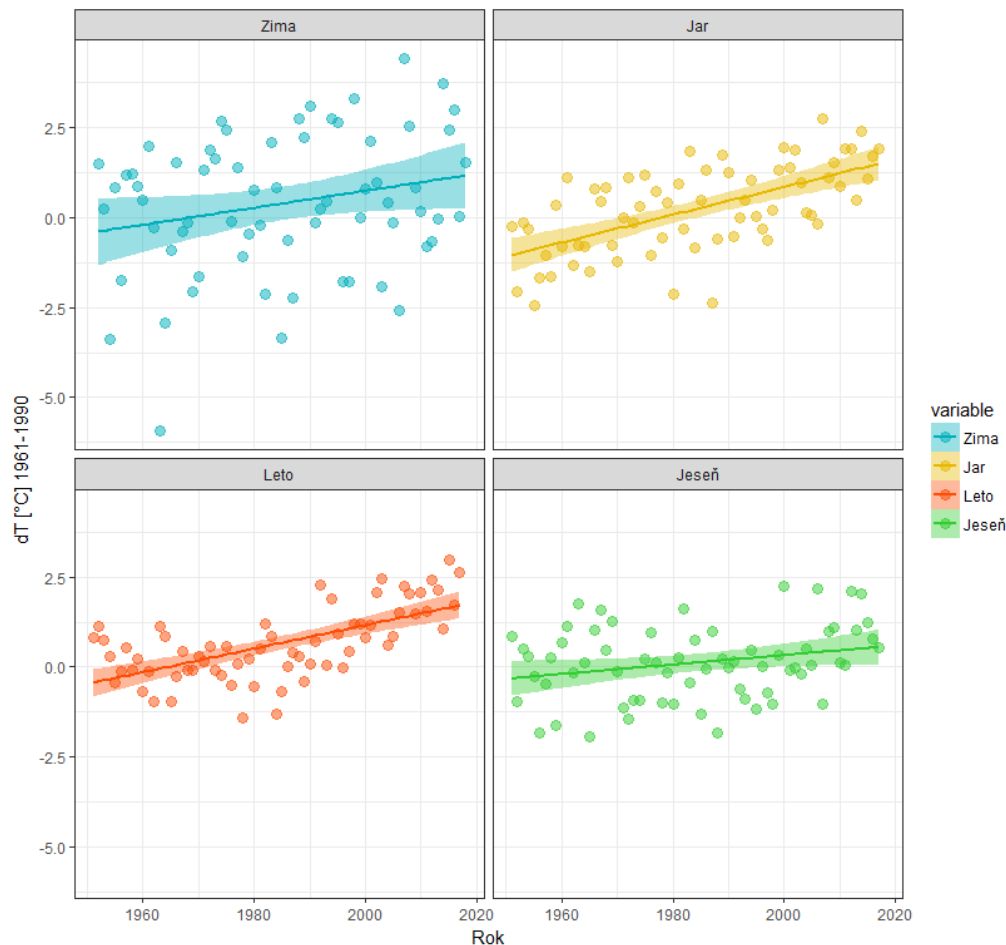


# ZMENA PRIEMERNÝCH TEPLOTNÝCH PODMIENOK

Odchýlka sezónnej teploty vzduchu - Bratislava-letisko

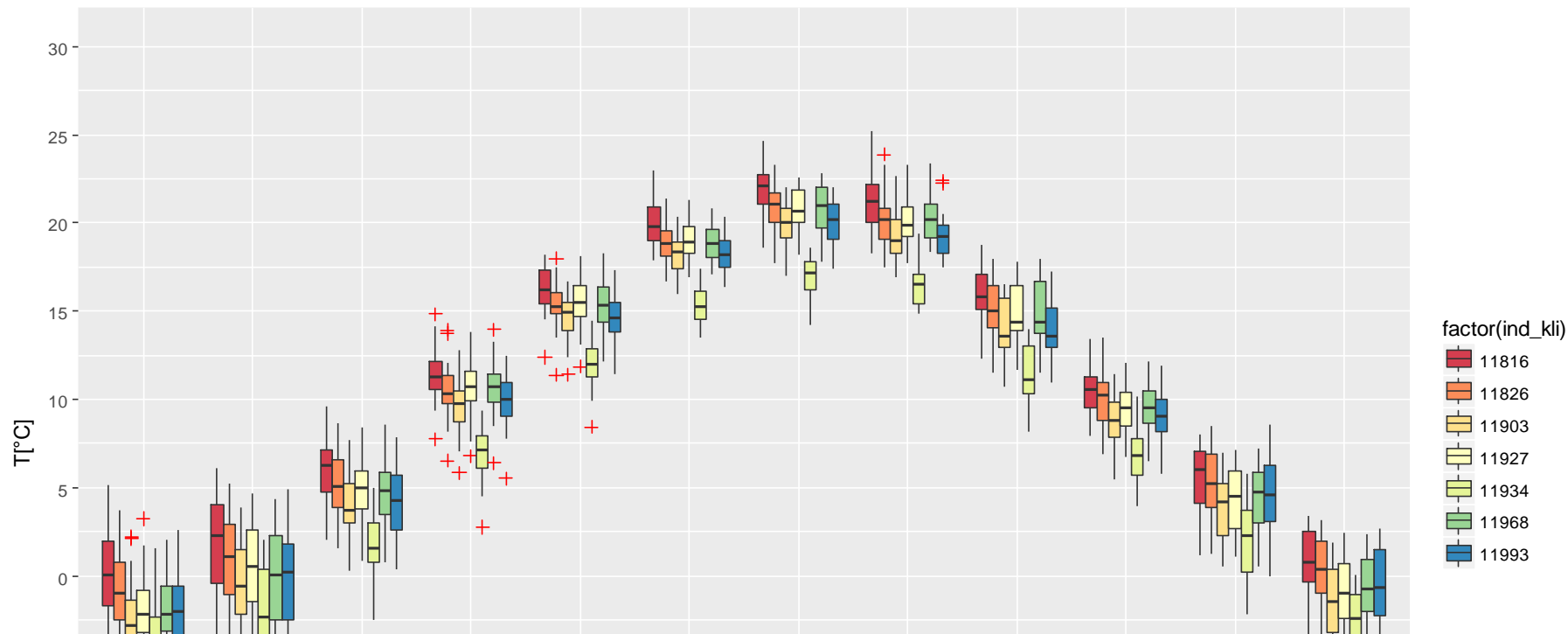


Odchýlka sezónnej teploty vzduchu - Poprad



# ZMENA PRIEMERNÝCH TEPLOTNÝCH PODMIENOK

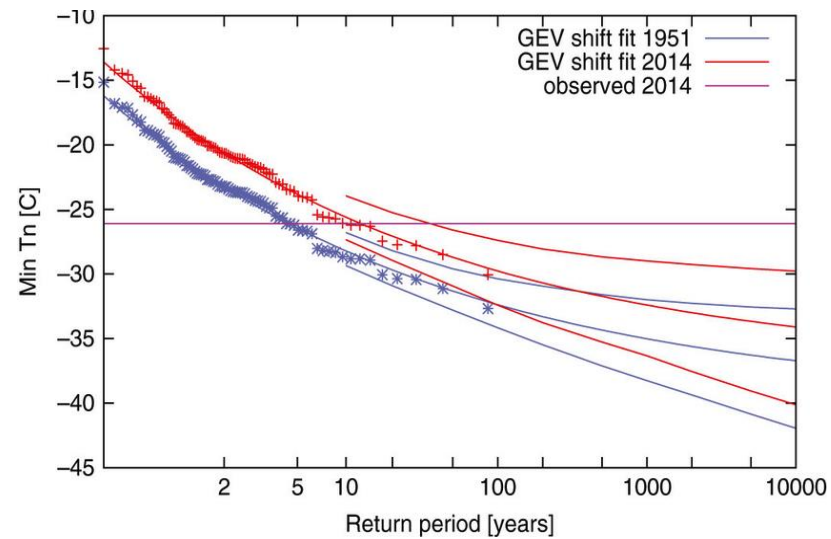
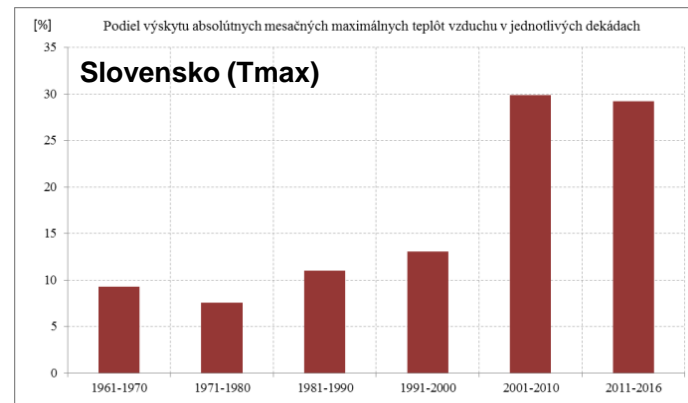
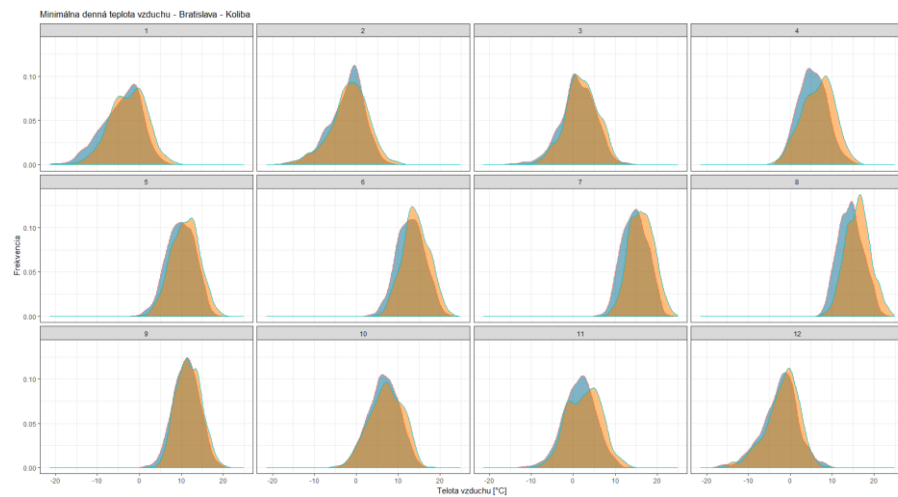
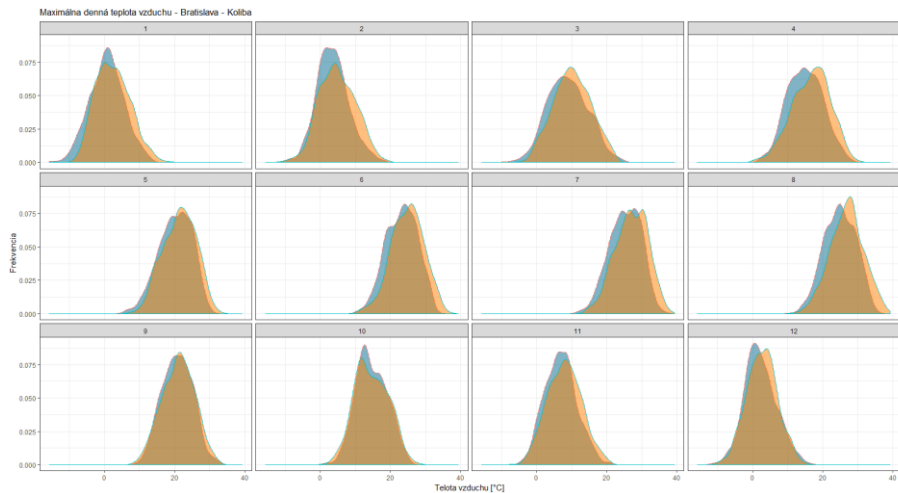
Priemerná mesačná teplota vzduchu v období 1991-2017



Tpr

	Jan	Feb	Mar	Apr	Maj	Jun	Jul	Aug	Sep	Okt	Nov	Dec	Zima	Jar	Leto	Jeseň	Rok
Bratislava-letisko	1.5	1.1	1.5	1.5	1.5	1.6	2.1	2.1	0.9	0.8	0.8	0.2	1.0	1.5	1.9	0.8	1.3
Piešťany	0.9	0.6	0.9	1.1	1.3	1.2	1.9	1.9	0.7	0.4	0.6	0.0	0.4	1.1	1.6	0.6	1.0
Sliach	1.3	0.7	1.1	1.4	1.5	1.4	1.9	2.0	0.9	0.6	0.5	-0.2	0.6	1.3	1.7	0.7	1.1
Boľkovce	1.3	0.6	0.8	0.9	1.0	0.9	1.2	1.4	0.4	0.3	0.3	-0.4	0.4	0.9	1.2	0.3	0.7
Poprad	1.1	1.0	1.4	1.4	1.5	1.2	1.5	1.7	0.4	0.4	0.6	-0.1	0.6	1.4	1.5	0.5	1.0
Košice-letisko	1.5	1.0	1.6	1.6	1.5	1.4	1.8	2.0	0.9	0.7	0.8	0.2	0.8	1.6	1.7	0.8	1.2
Kamenica n/C	1.5	0.9	1.2	1.0	1.2	1.1	1.6	1.6	0.5	0.5	0.4	0.1	0.7	1.1	1.4	0.5	1.0

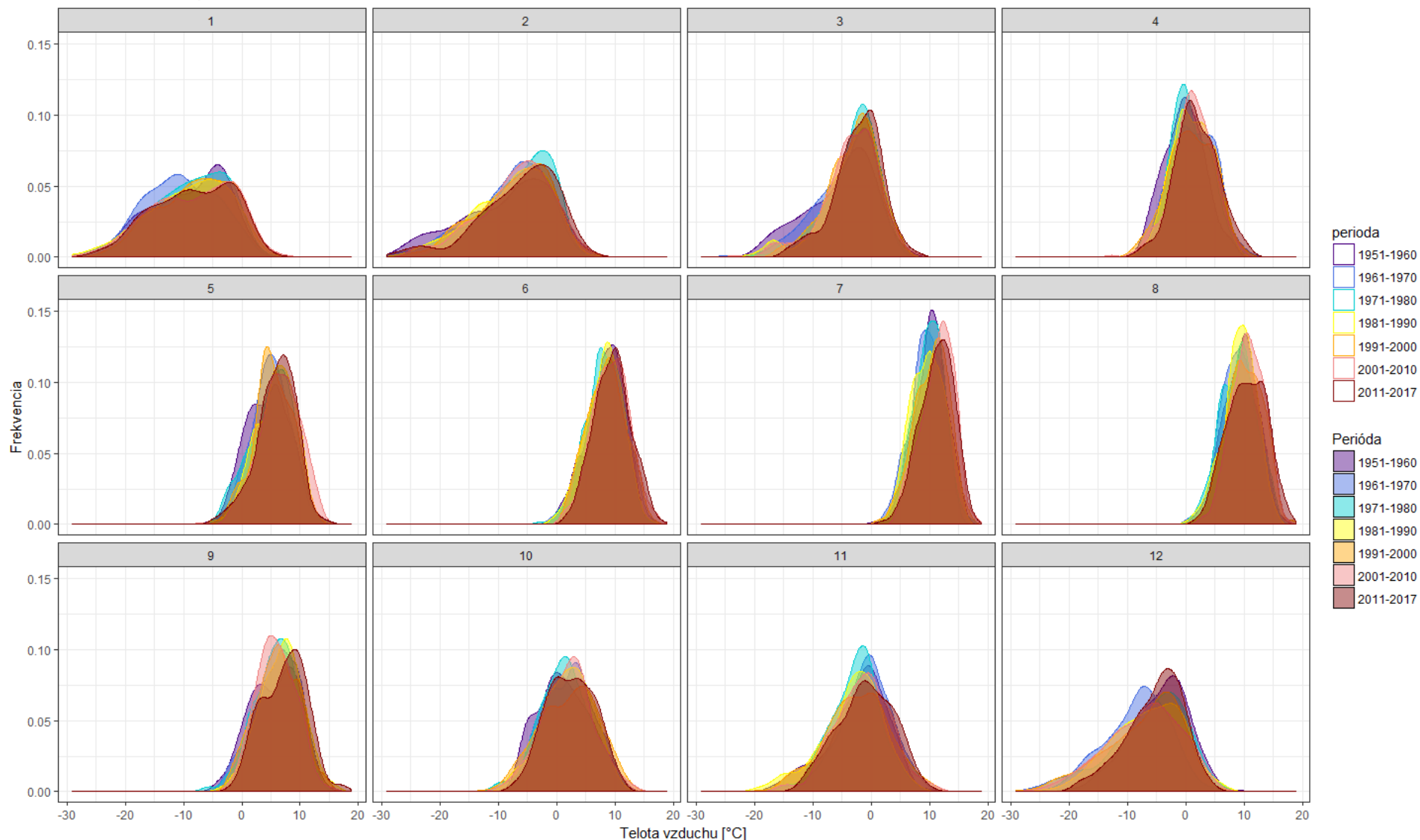
# ZMENY EXTRÉMOV TEPLoty VZDUCHU



Zdroj: SHMÚ

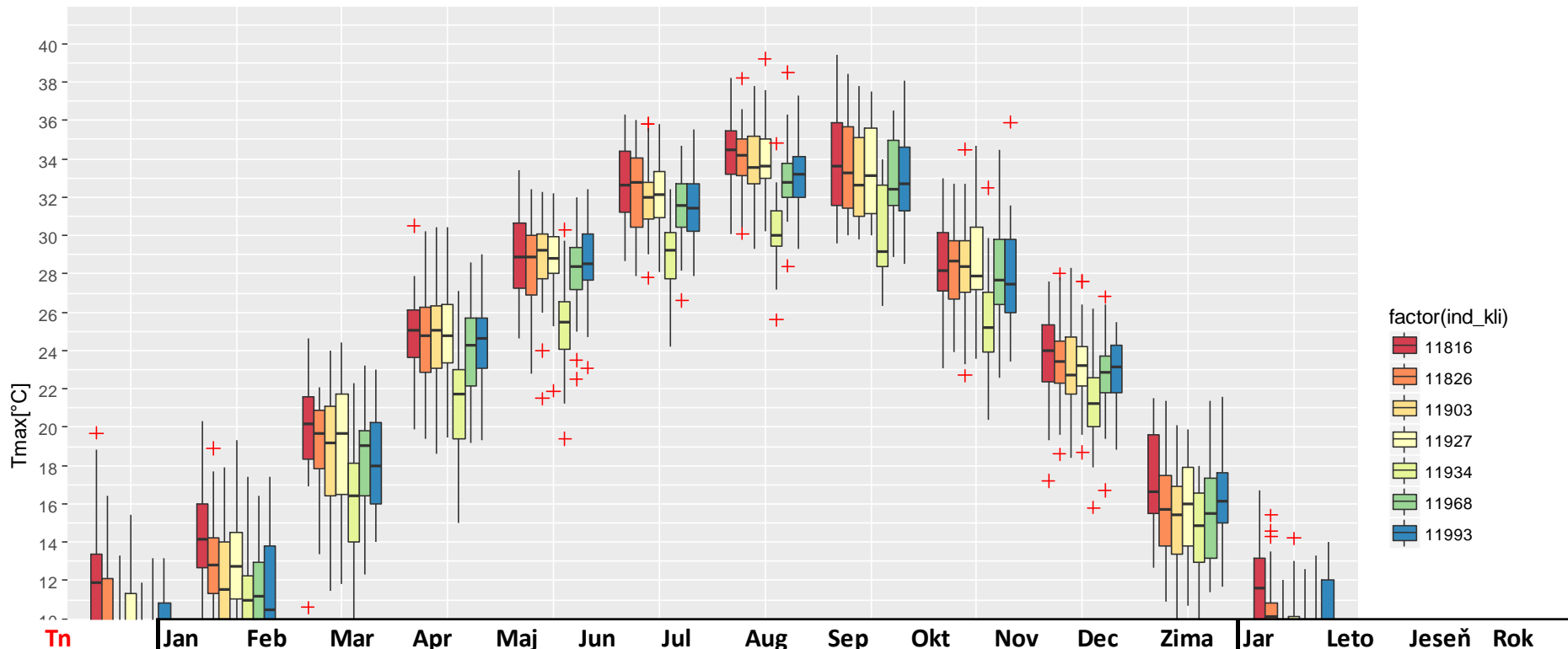
# ZMENA EXTRÉMOV TEPLoty VZDUCHU

Minimálna denná teplota vzduchu - Bratislava-letisko



# ZMENA PRIEMERNÝCH TEPLOTNÝCH PODMIENOK

Mesačné maximum teploty vzduchu v období 1991-2017



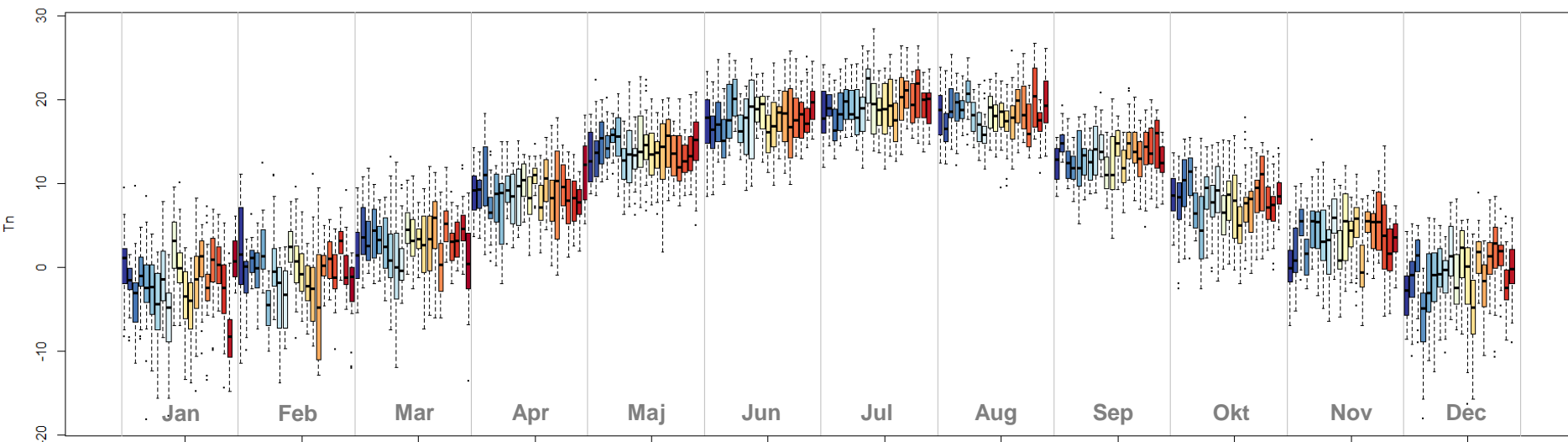
- factor(ind\_kli)
- 11816
  - 11826
  - 11903
  - 11927
  - 11934
  - 11968
  - 11993

Tn	Jan	Feb	Mar	Apr	Maj	Jun	Jul	Aug	Sep	Okt	Nov	Dec	Zima	Jar	Leto	Jeseň	Rok
Bratislava-letisko	1.4	0.7	1.3	1.2	1.7	1.5	2.1	2.2	1.4	1.3	0.6	0.1	0.8	1.4	1.9	1.1	1.3
Piešťany	0.8	0.2	0.6	0.5	1.0	0.7	1.5	1.5	1.1	0.8	0.3	-0.2	0.2	0.7	1.3	0.7	0.7
Sliac	1.6	0.4	0.5	0.7	1.3	0.8	1.7	1.7	1.2	1.2	0.3	-0.2	0.6	0.8	1.4	0.9	0.9
Boľkovce	1.5	0.3	0.3	0.3	0.7	0.4	1.0	1.1	0.7	1.0	0.1	-0.4	0.4	0.6	0.9	0.6	0.8
Poprad	1.2	0.6	1.2	0.6	1.1	0.7	1.1	1.2	0.6	0.5	0.3	-0.3	0.5	1.0	1.0	0.5	0.7
Košice-letisko	1.8	0.7	1.1	1.1	1.3	1.1	1.7	1.8	1.0	1.0	0.4	0.1	0.8	1.2	1.5	0.8	1.1
Kamenica n/C	1.8	0.6	1.0	0.2	0.6	0.5	1.0	0.8	0.4	0.8	0.0	-0.1	0.7	0.6	0.8	0.4	0.6

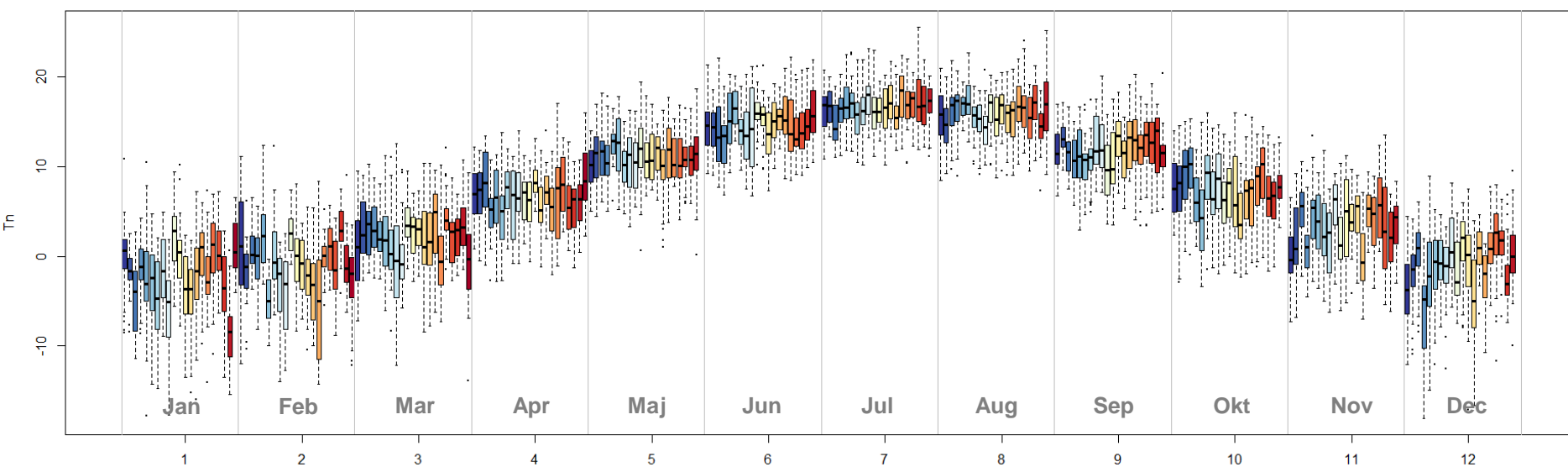


# ZMENA POČETNOSTÍ DNÍ SO ŠPECIF. TEPLOTOU

Denná minimálna Tn - Bratislava-letisko (1998-2017)

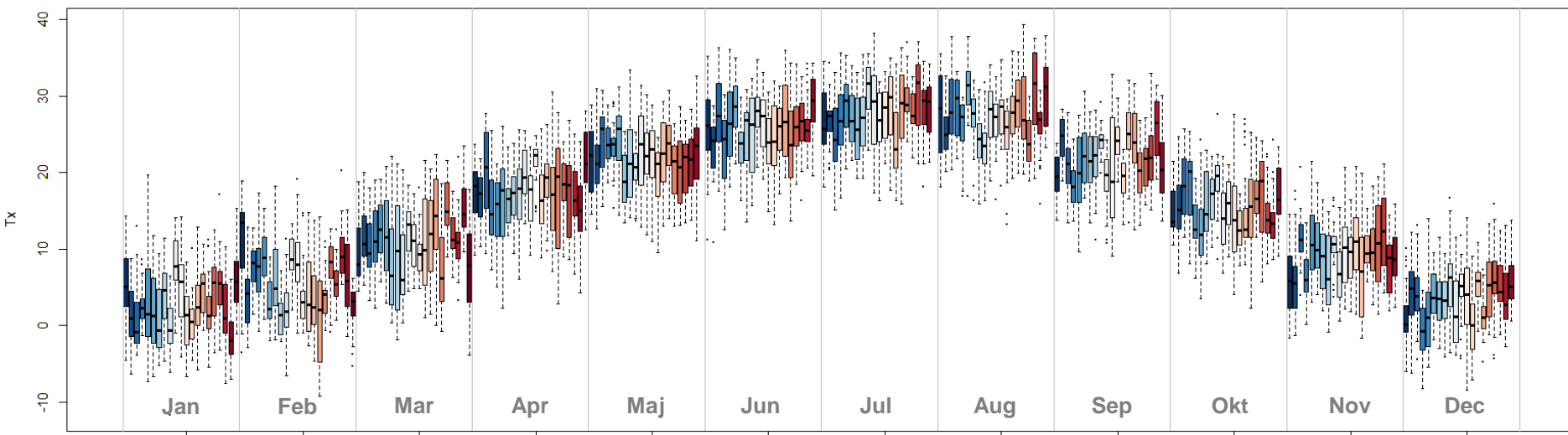


Nočná minimálna Tn - Bratislava-letisko (1998-2017)

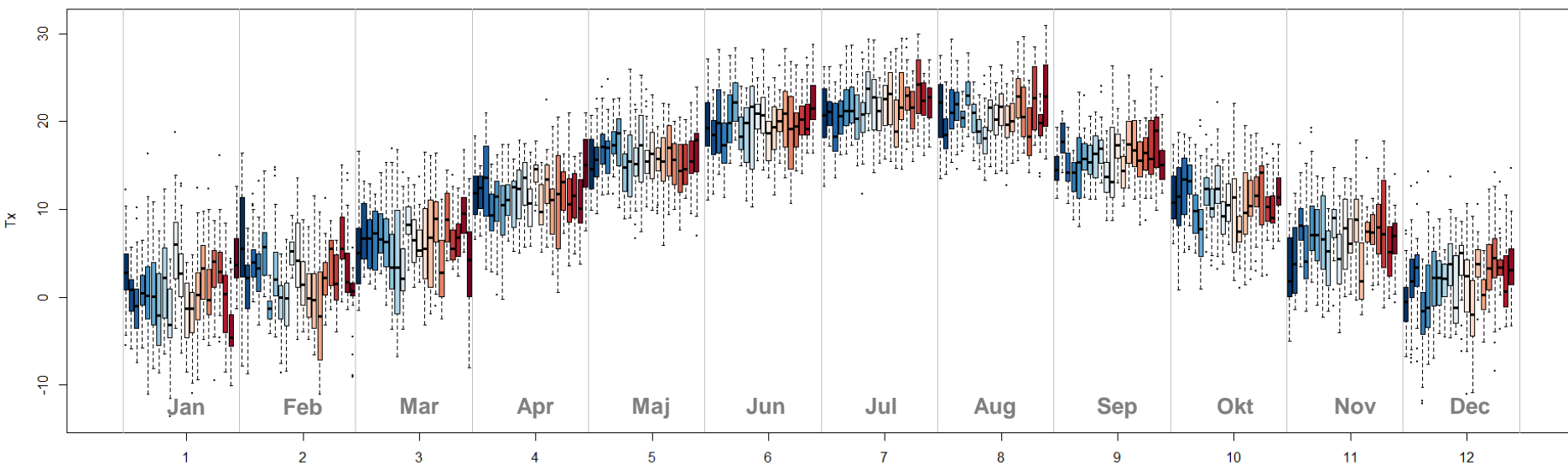


# ZMENA POČETNOSTÍ DNÍ SO ŠPECIF. TEPLOTOU

Denná maximálna Tx - Bratislava-letisko (1998-2017)



Nočná maximálna Tx - Bratislava-letisko (1998-2017)

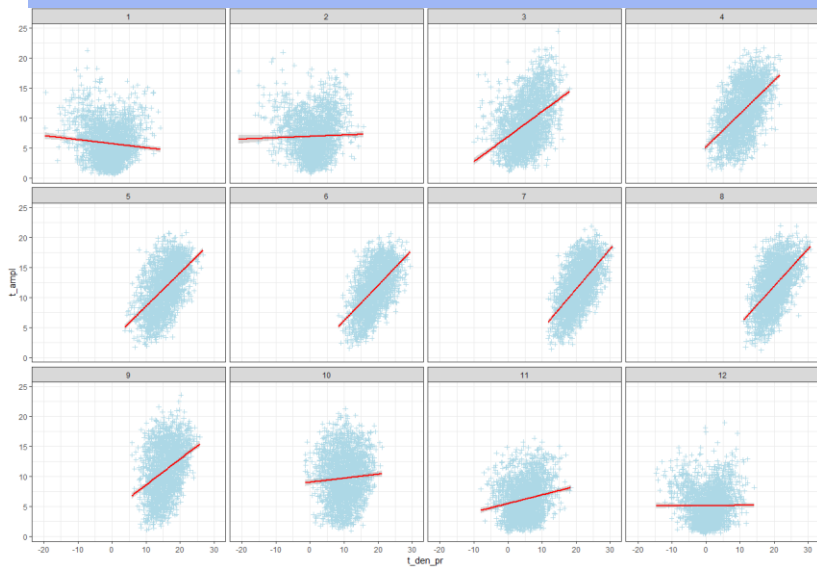
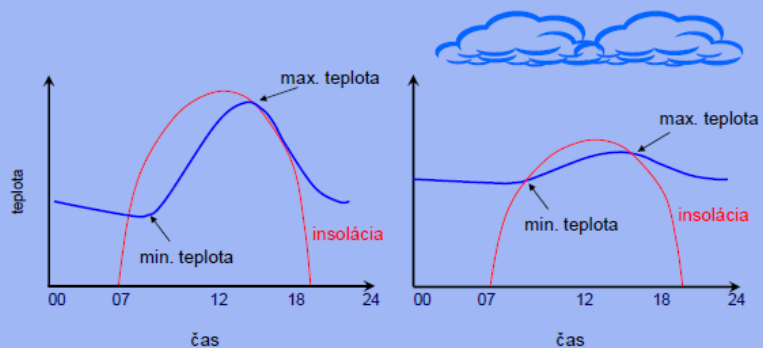


# DENNÁ AMPLITÚDA TEPLoty VZDUCHU

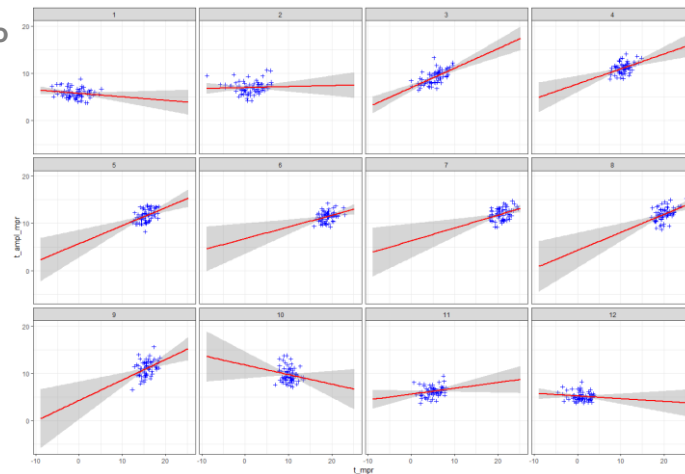
## Zmena teploty - denná zmena

• *Denná zmena teploty*

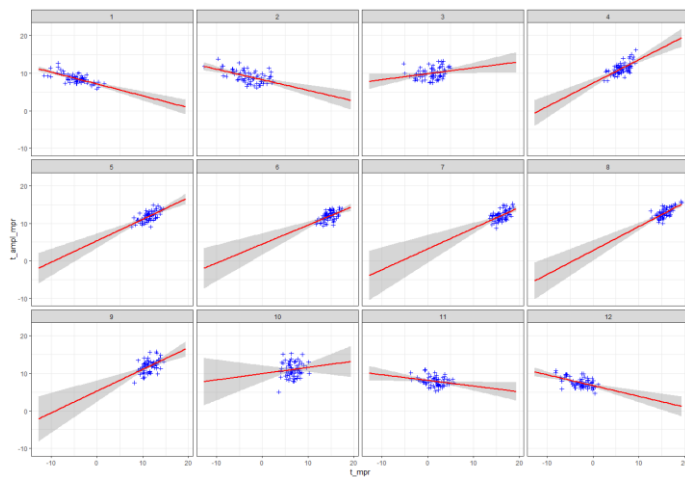
• *Sezónna zmeny teploty*



## Bratislava-letisko

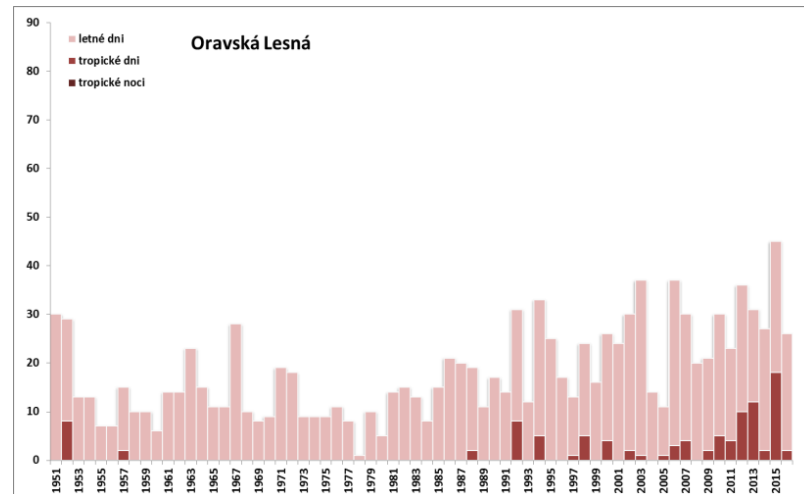
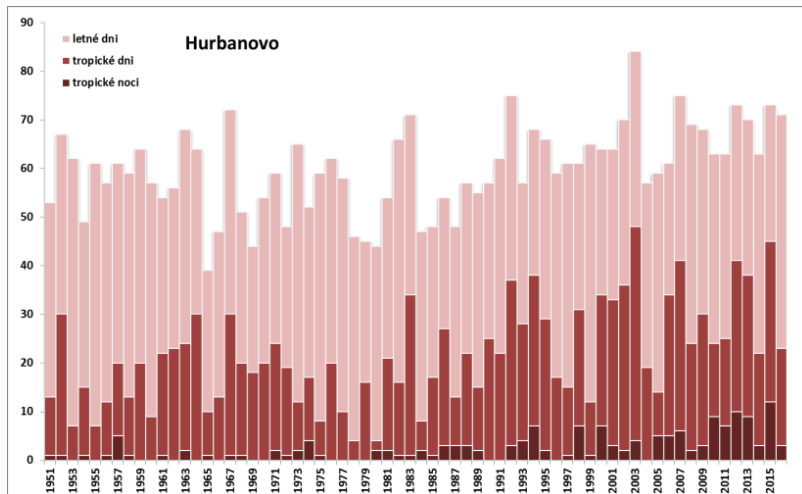
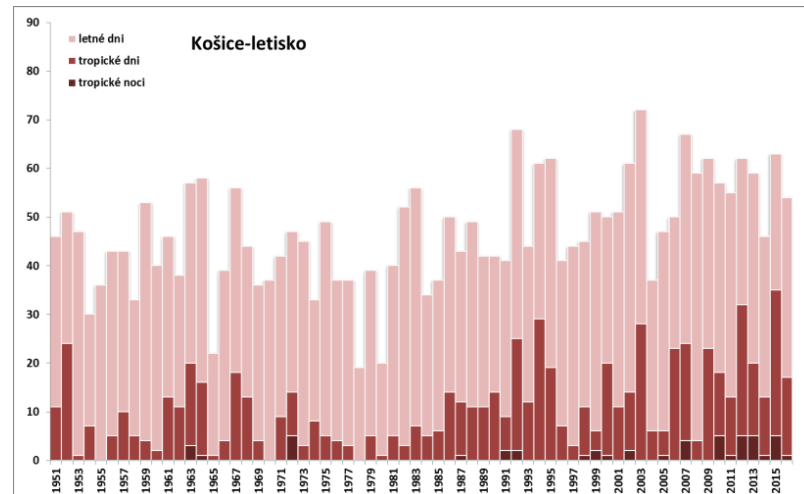
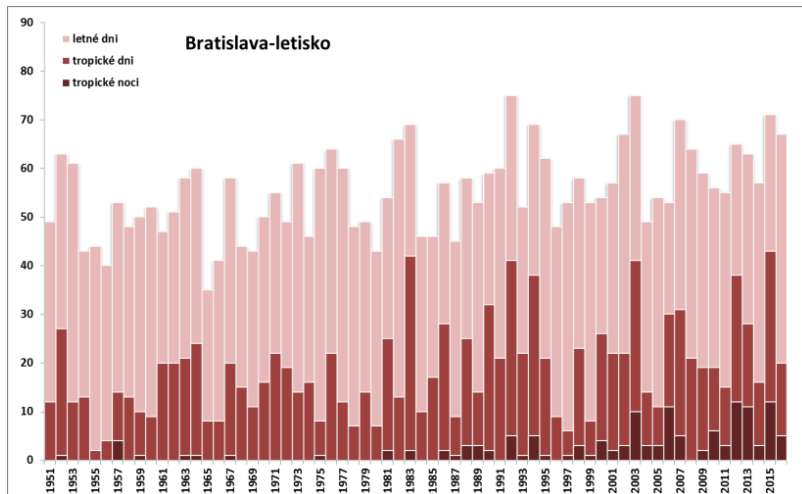


## Poprad





# RAST POČTU TROPICKÝCH DNÍ A NOČÍ (SLOVENSKO)

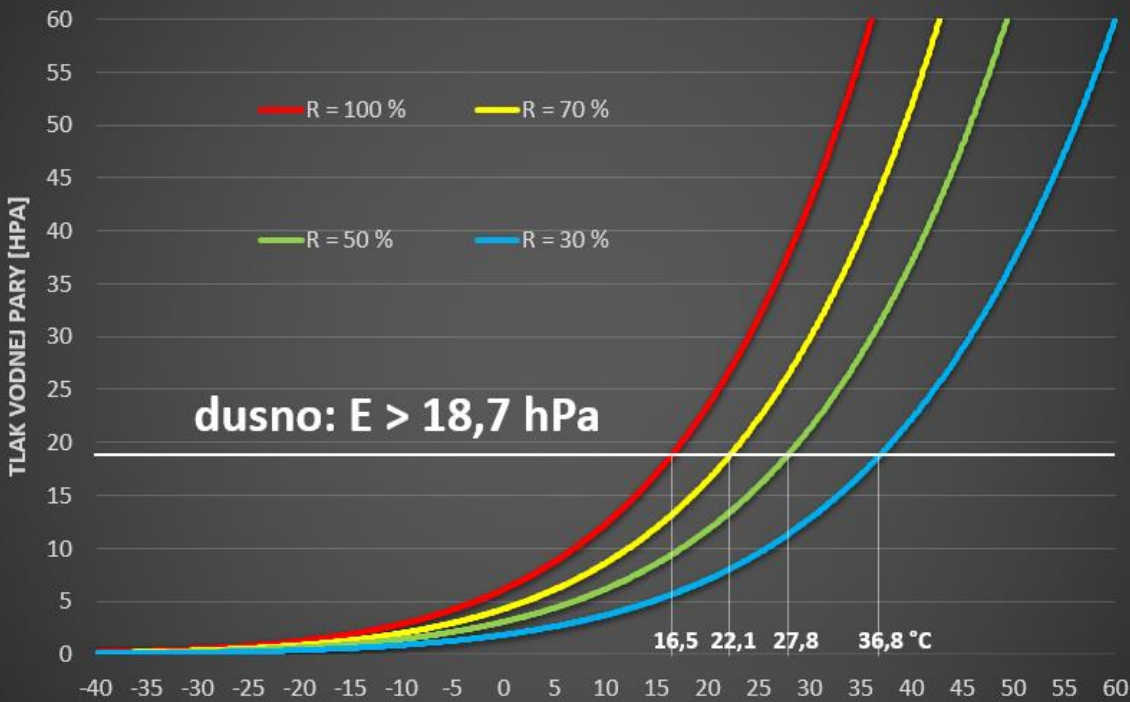


Zdroj: SHMÚ



# RAST POČTU DUSNÝCH DNÍ (SLOVENSKO)

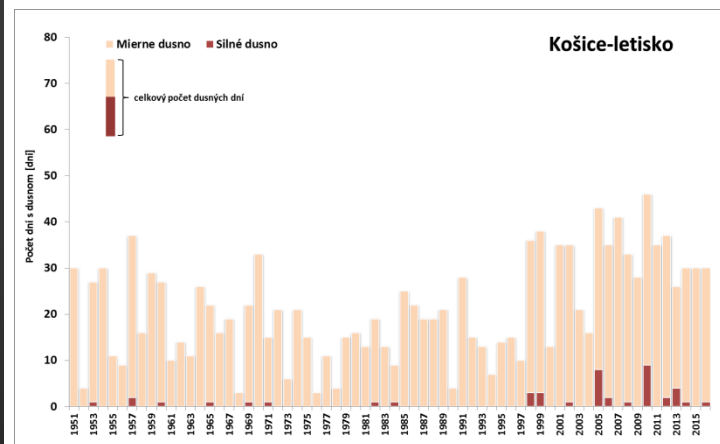
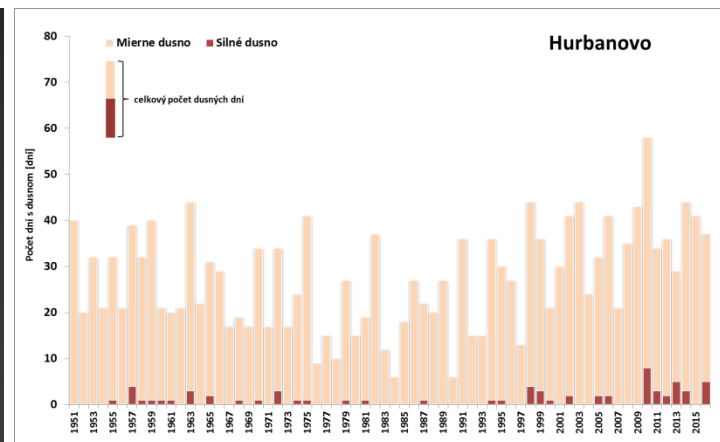
Závislosť tlaku vodnej pary od teploty pri danej relatívnej vlhkosti vzduchu



**dušno:  $E > 18,7$  hPa**

$$E = \frac{R}{100} \cdot E_0 \cdot 10^{\frac{7.45T}{235+T}}$$

TEPLOTA VZDUCHU [°C]

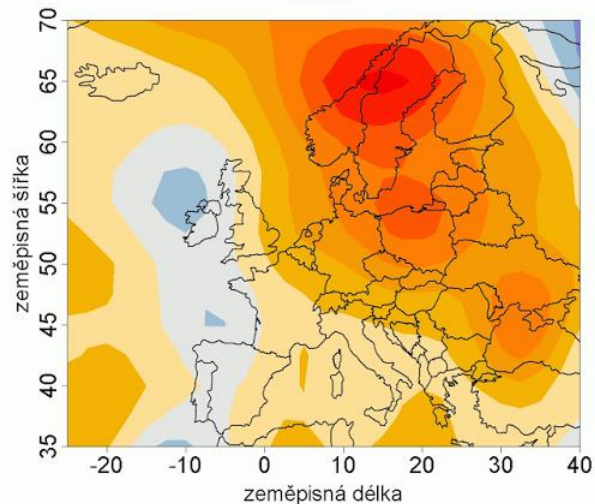


Zdroj: SHMÚ

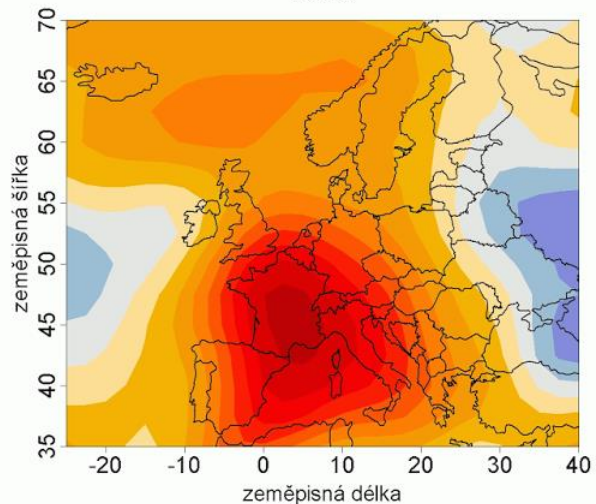


# VLNY HORÚČAV A ICH DOPADY

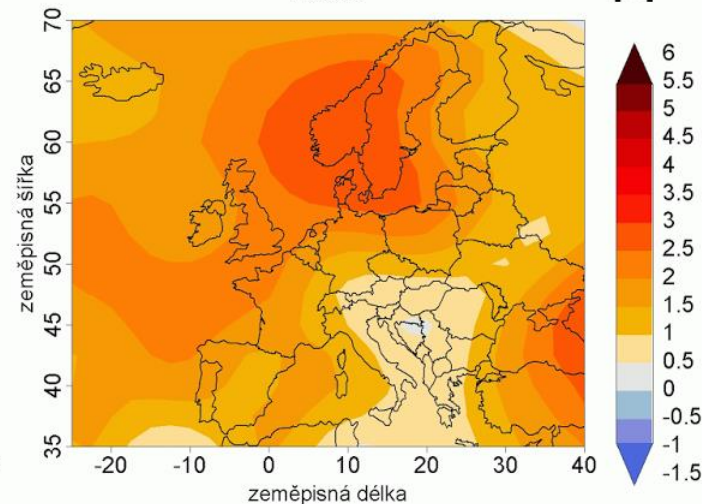
2002



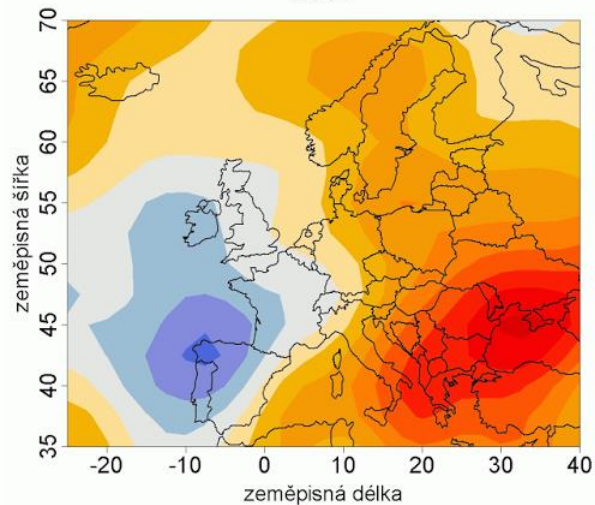
2003



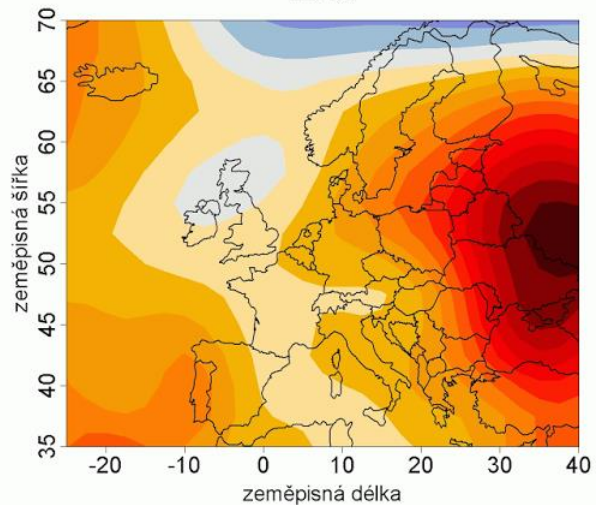
2006



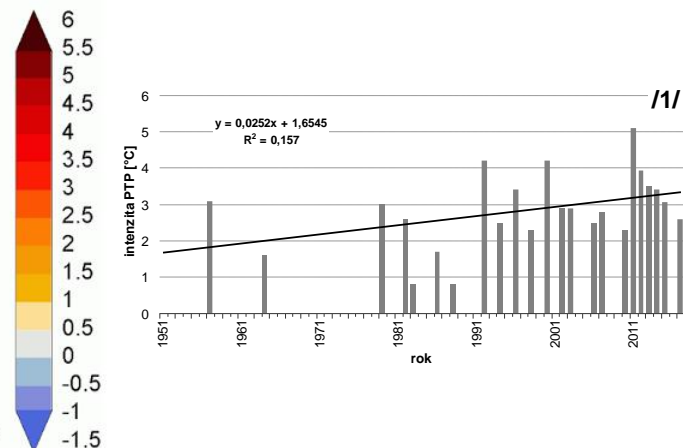
2007



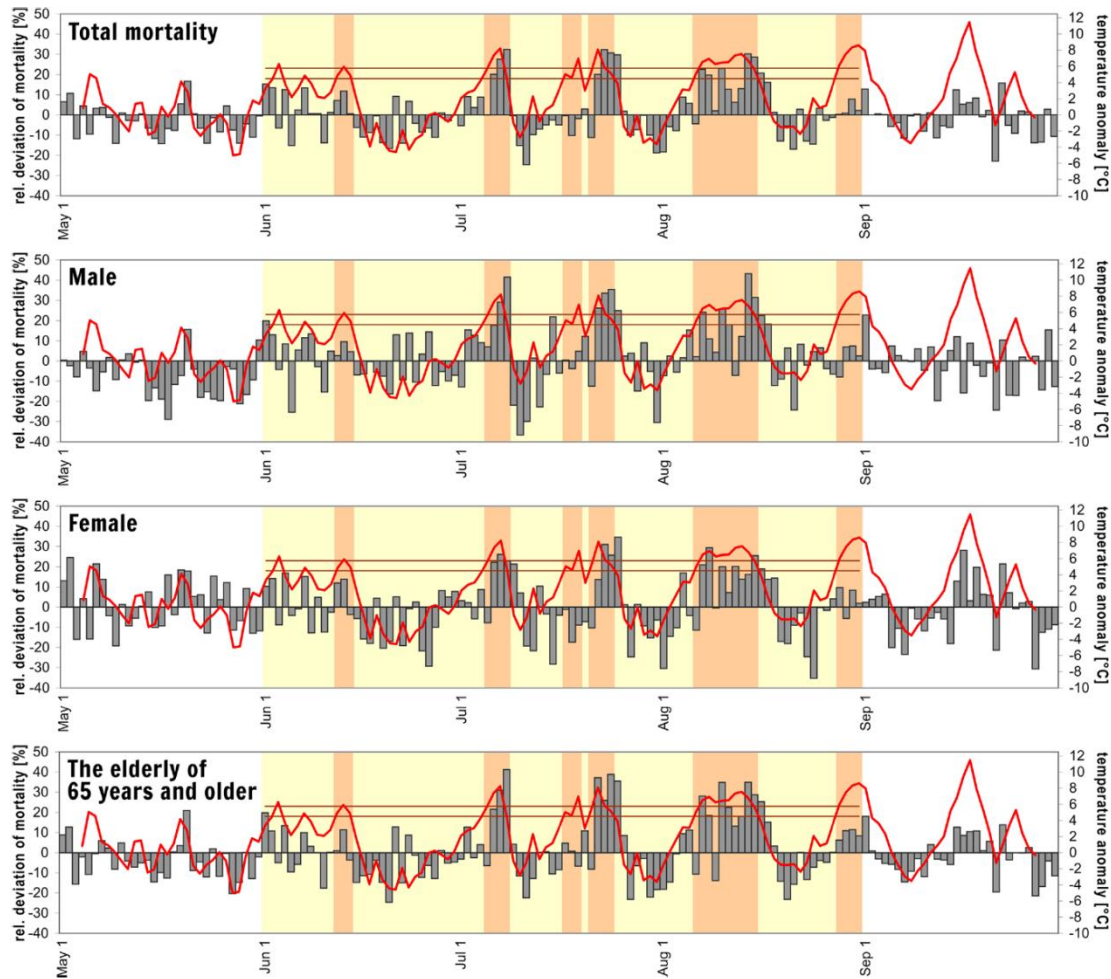
2010



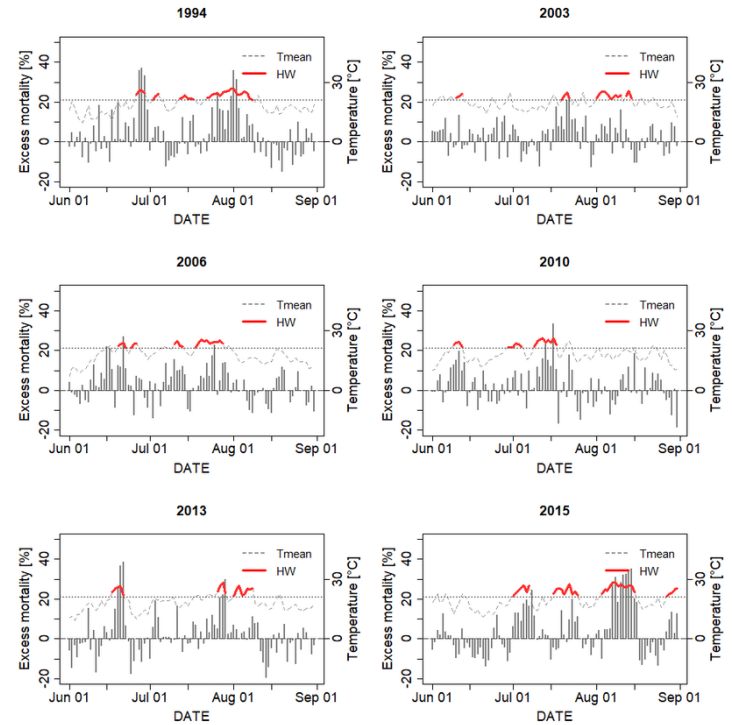
[°C]



# VLNY HORÚČAV A ICH DOPADY




Zdroj: Výberči et al. 2017 (SR)



Zdroj: Urban et al. 2017 (ČR)

# Leto 2015

Soil Moisture  
Drought Severity Index  
> 0  1  
11 to 20 July 2015

## Vlny extrémnych teplôt

Na viac ako 2/3 územia SR najteplejšie leto od začiatku meteorologických pozorovaní

Rekordný počet supertropických dní a tropických nocí

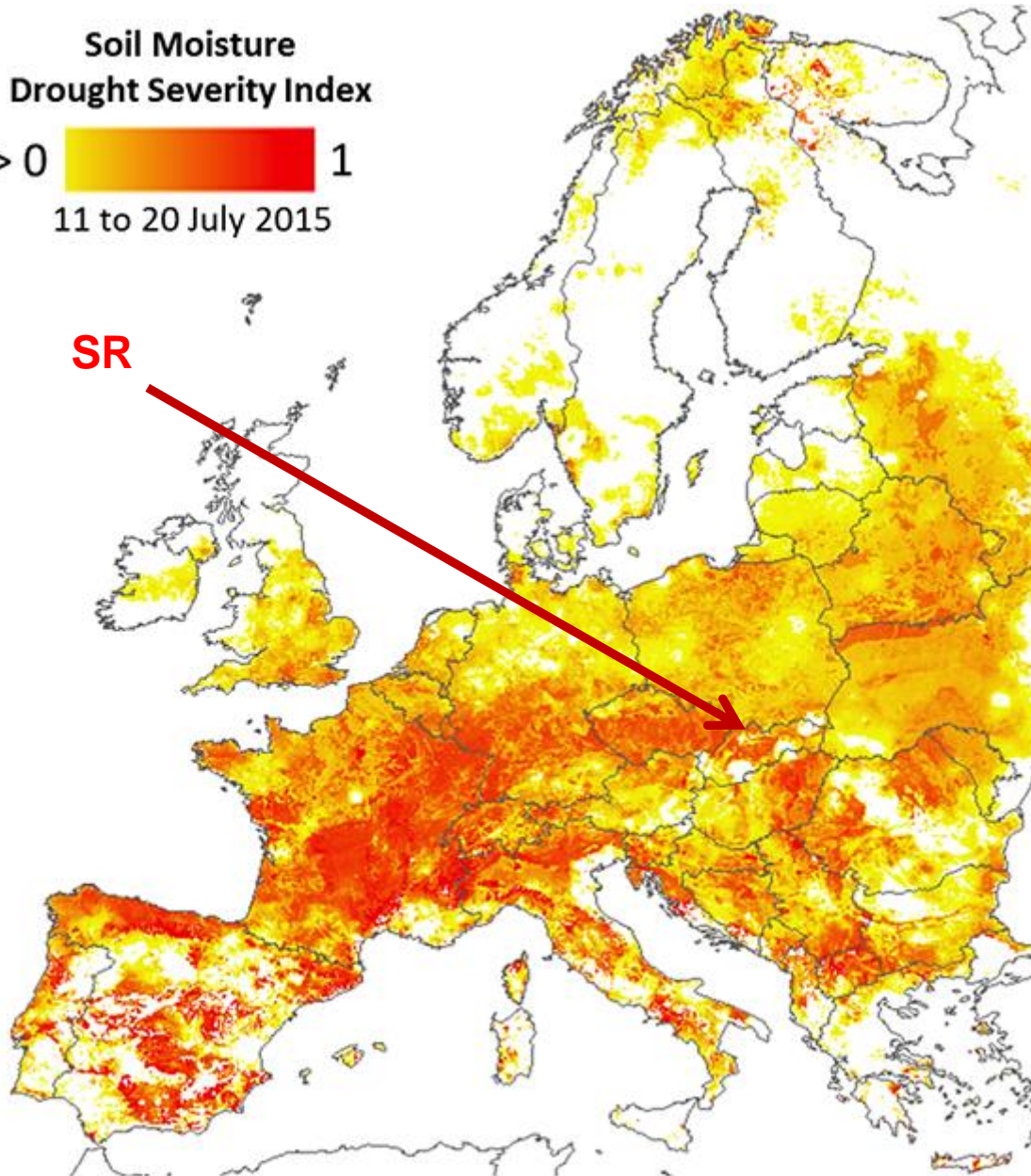
## Sucho

Najväznejšie sucho aspoň od roku 2003 (miestami od roku 1947)

Sucho od roku 2011 (je na ceste mega-sucho?)

## Čo nás čaká?

Okolo roku 2030-2040 leto 2015 bude novým normálom

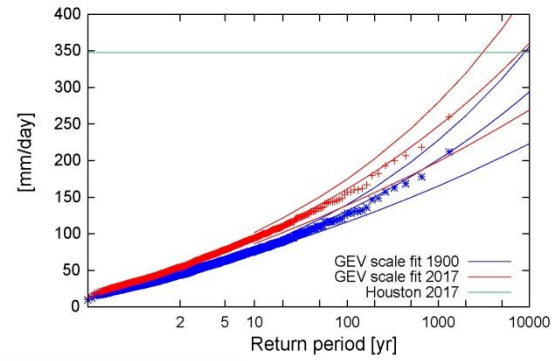
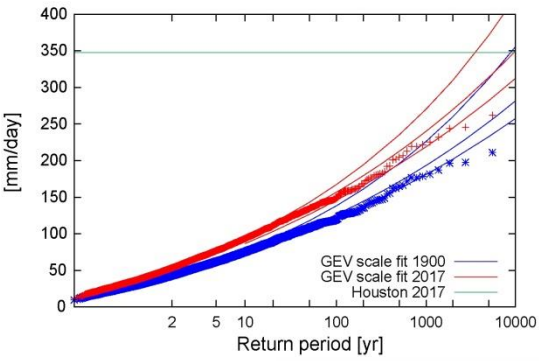
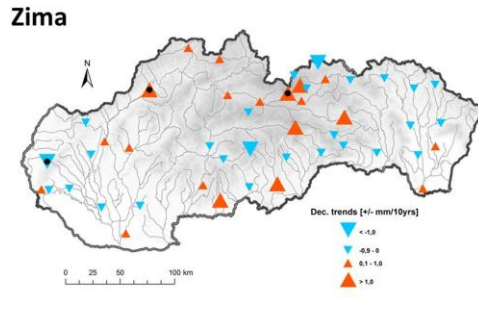
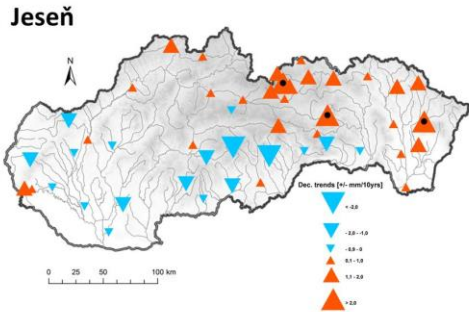
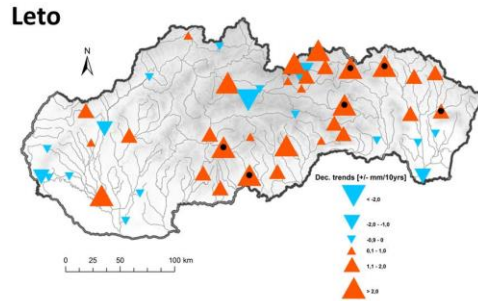
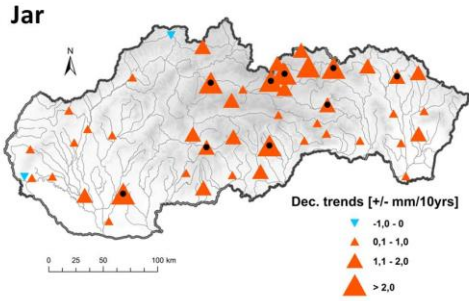


Resolution: 5x5 km

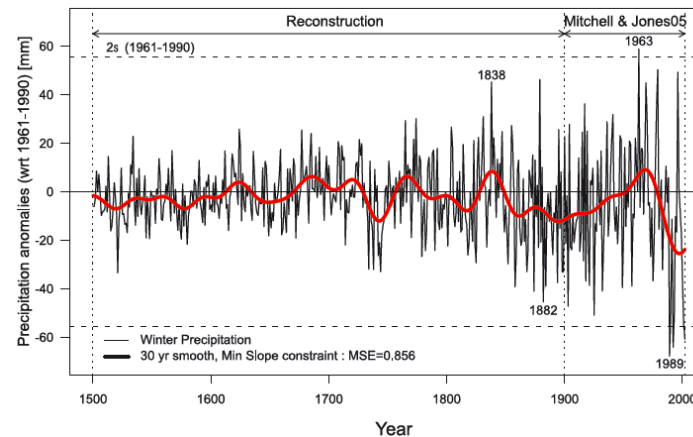
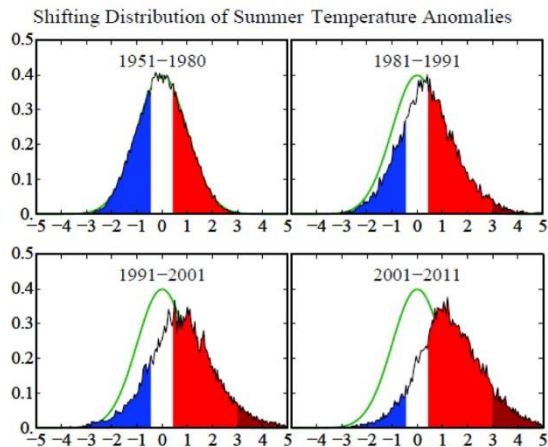
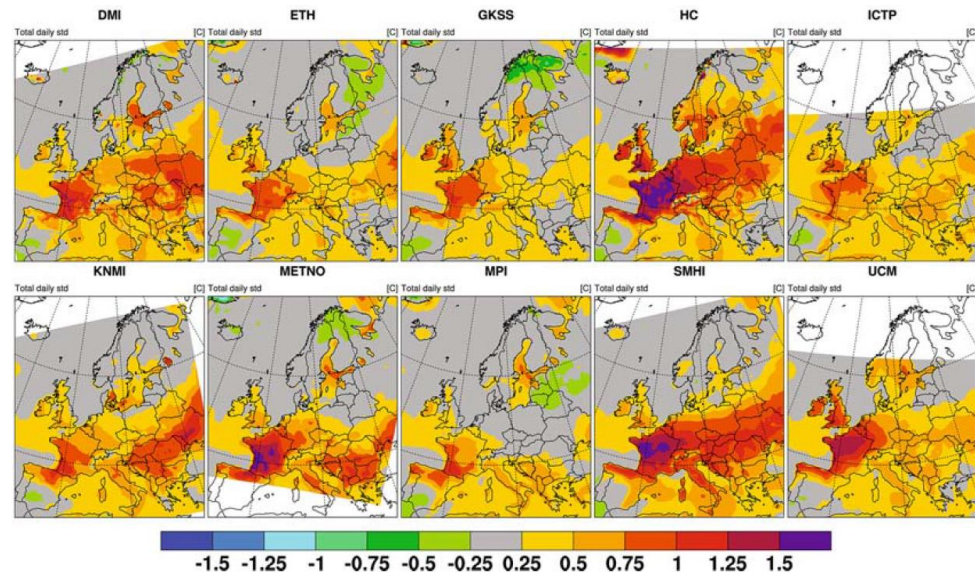
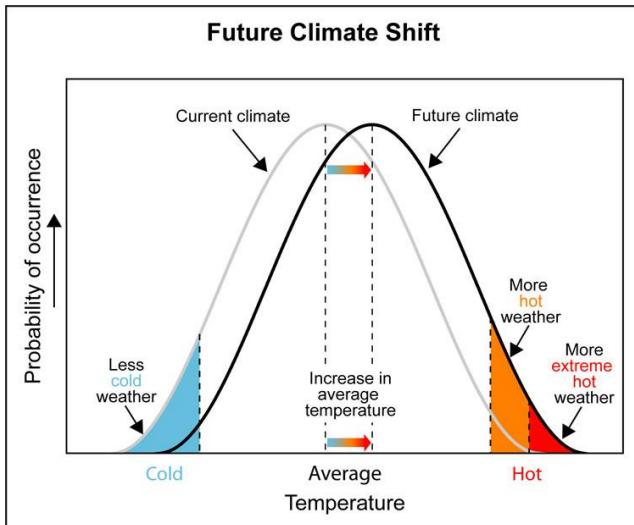


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# KEĎ PRŠÍ TAK LEJE

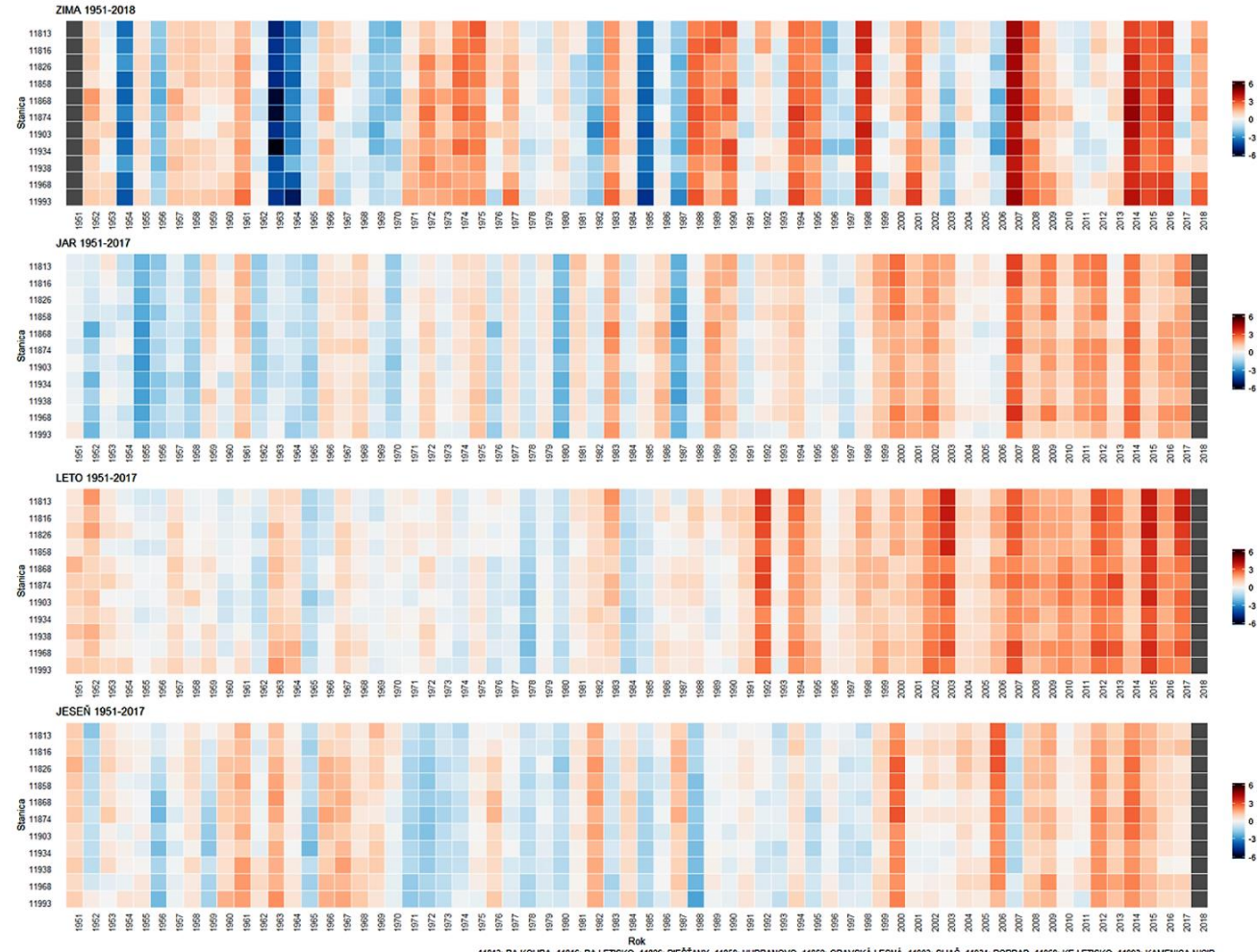
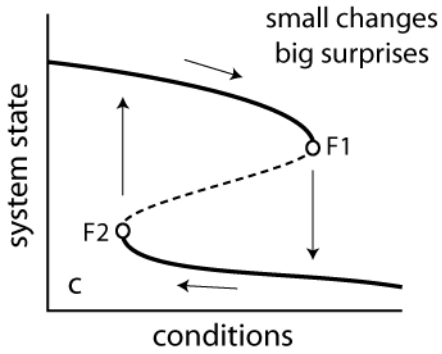
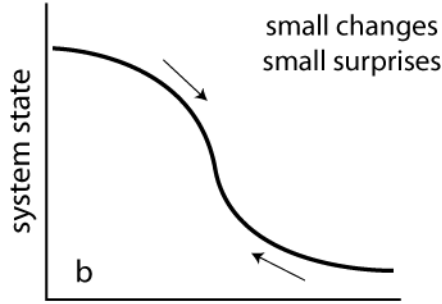
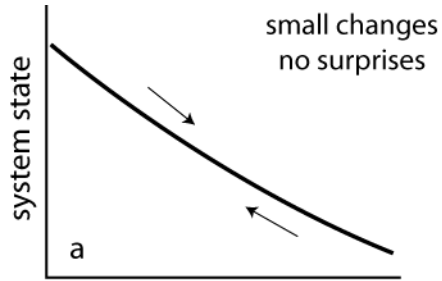


# RAST PREMENLIVOSTI TEPLoty A ATM. ZRÁŽOK



Fisher et al. 2004, Hansen et al. 2011; Luterbacher 2005

# RAST AUTOKORELÁCIE EXTRÉMOV



11813: BA-KOLIBA, 11816: BA-LETISKO, 11826: PIEŠŤANY, 11858: HURBANOVO, 11868: ORAVSKÁ LEHŇ, 11903: SLIAC, 11934: POPRAD, 11968: KE-LETISKO, 11993: KAMENICA I/OCR



**ĎAKUJEM ZA POZORNOSŤ**

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