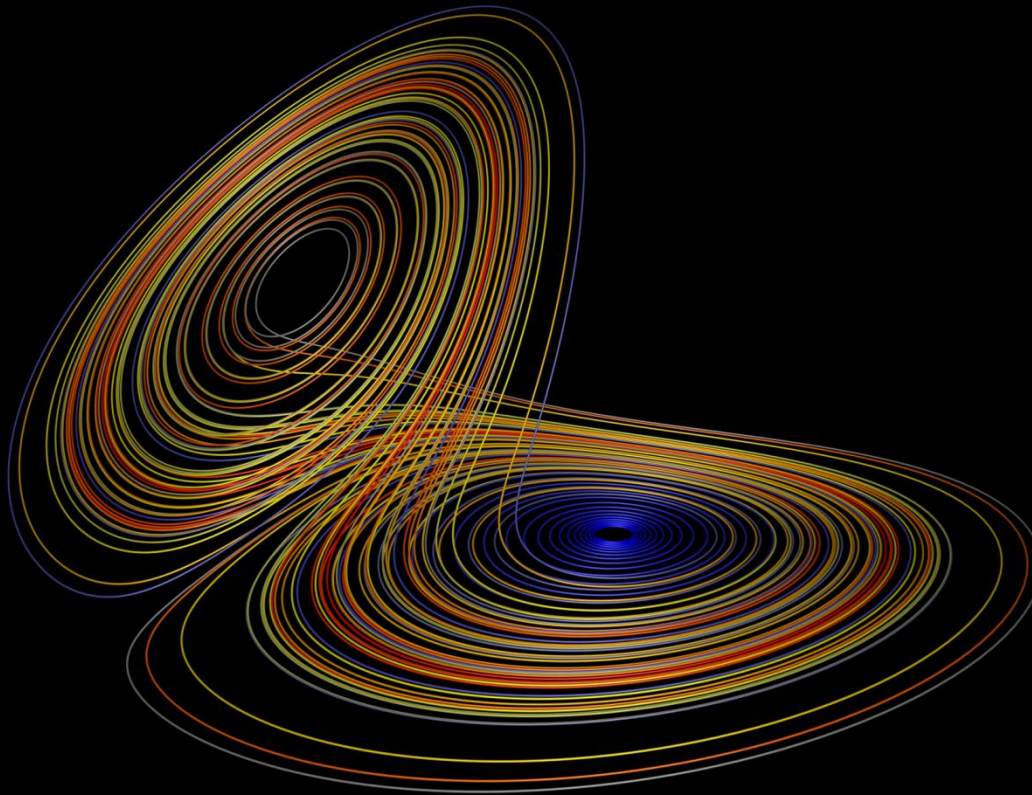
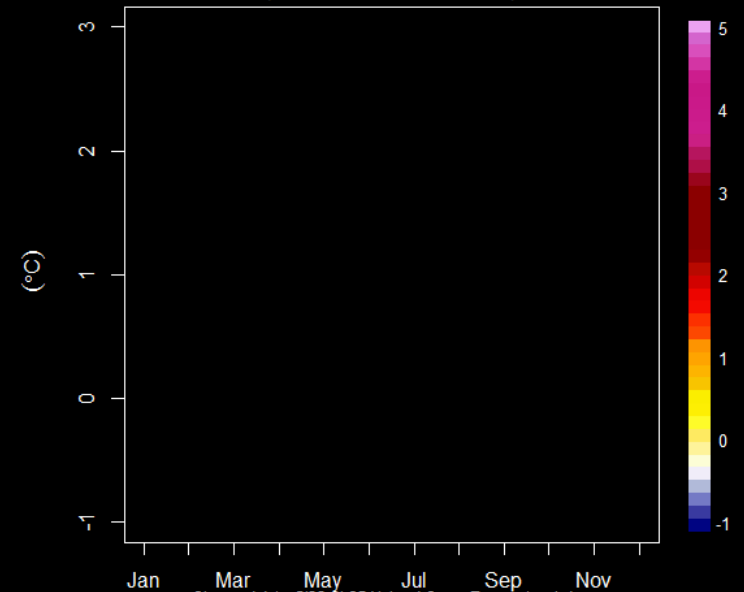


VÝZNAMNÉ ZMENY REŽIMU KLÍMY

A čo nás čaká ďalej ...



Observed (1880-2017) and projected (2017-2100) global climate change
(medium emissions scenario)



Observed data: GISS GLOBAL Land-Ocean Temperature Index
Projection: global mean temperature using CMIP5 model members, RCP4.5 scenario
All temperature anomalies are referred to 1880-1909 average
@ Claudio Cassardo, www.climalteranti.it

JOZEF PECHO

Slovenský hydrometeorologický ústav, Bratislava
Oddelenie meteorológie a klimatológie, KAFZM FMFI UK Bratislava



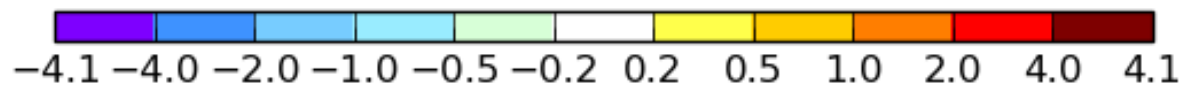
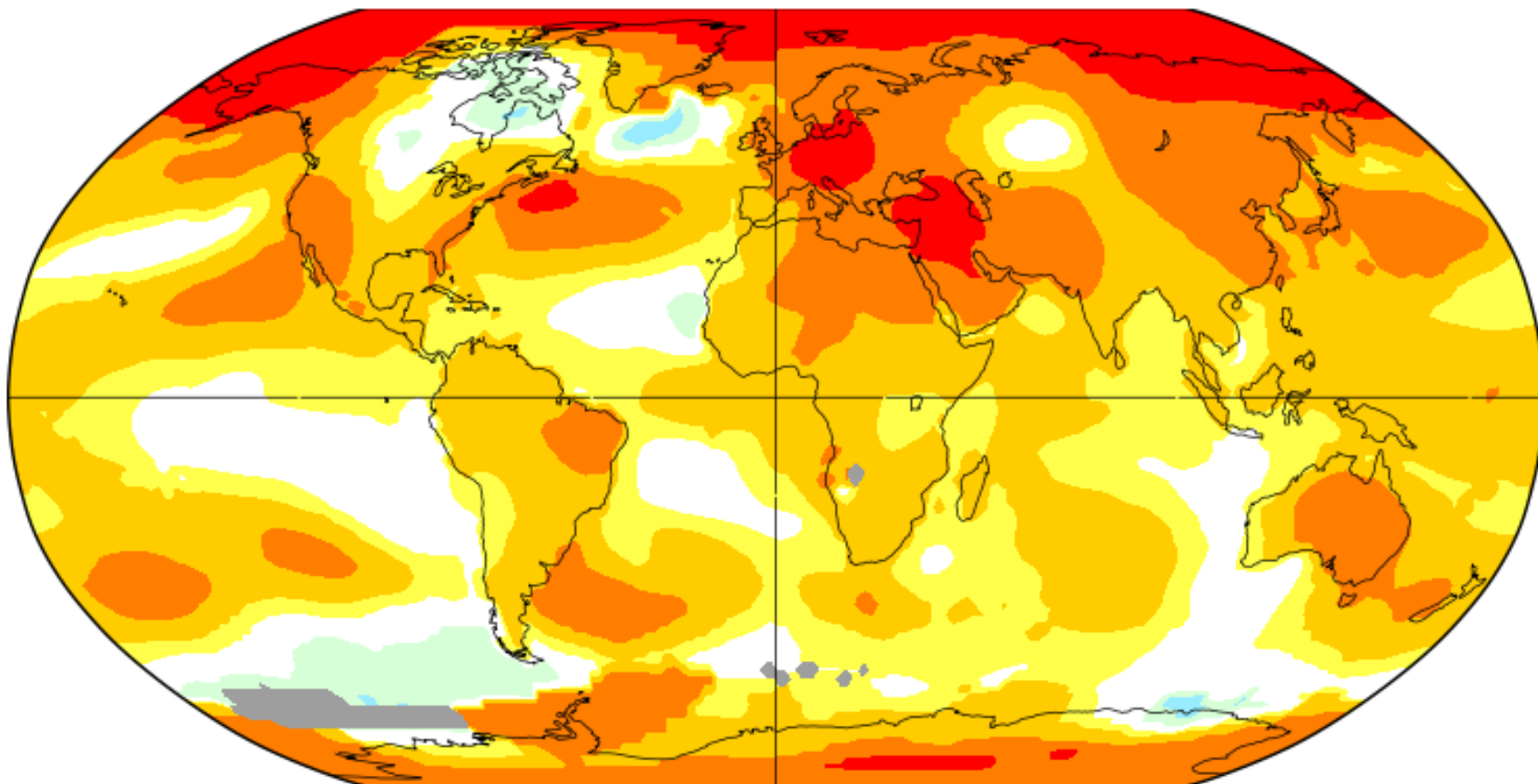
**ZVYKAJME SI NA NOVÝ NORMÁL
POČASIA A KLÍMY**

VELA MALÝCH „PREKVAPENÍ“ – ROK 2018

Annual J-D 2018

L-OTI(°C) Anomaly vs 1961-1990

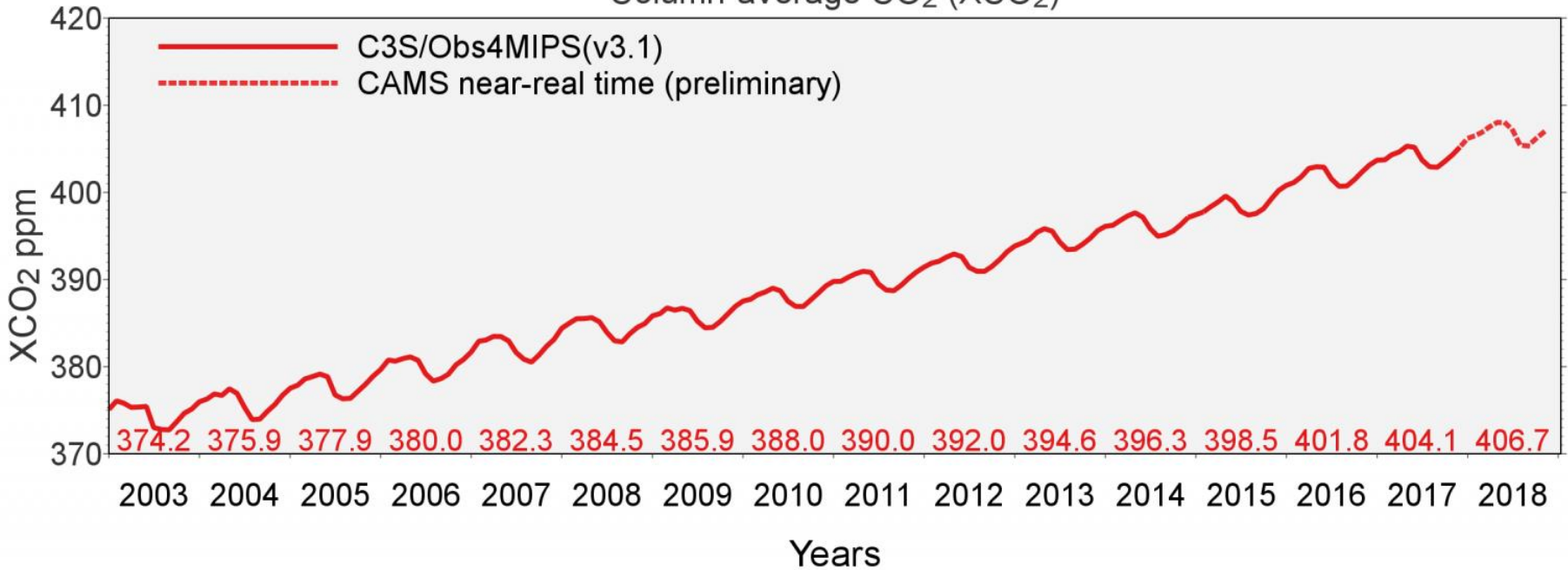
0.72



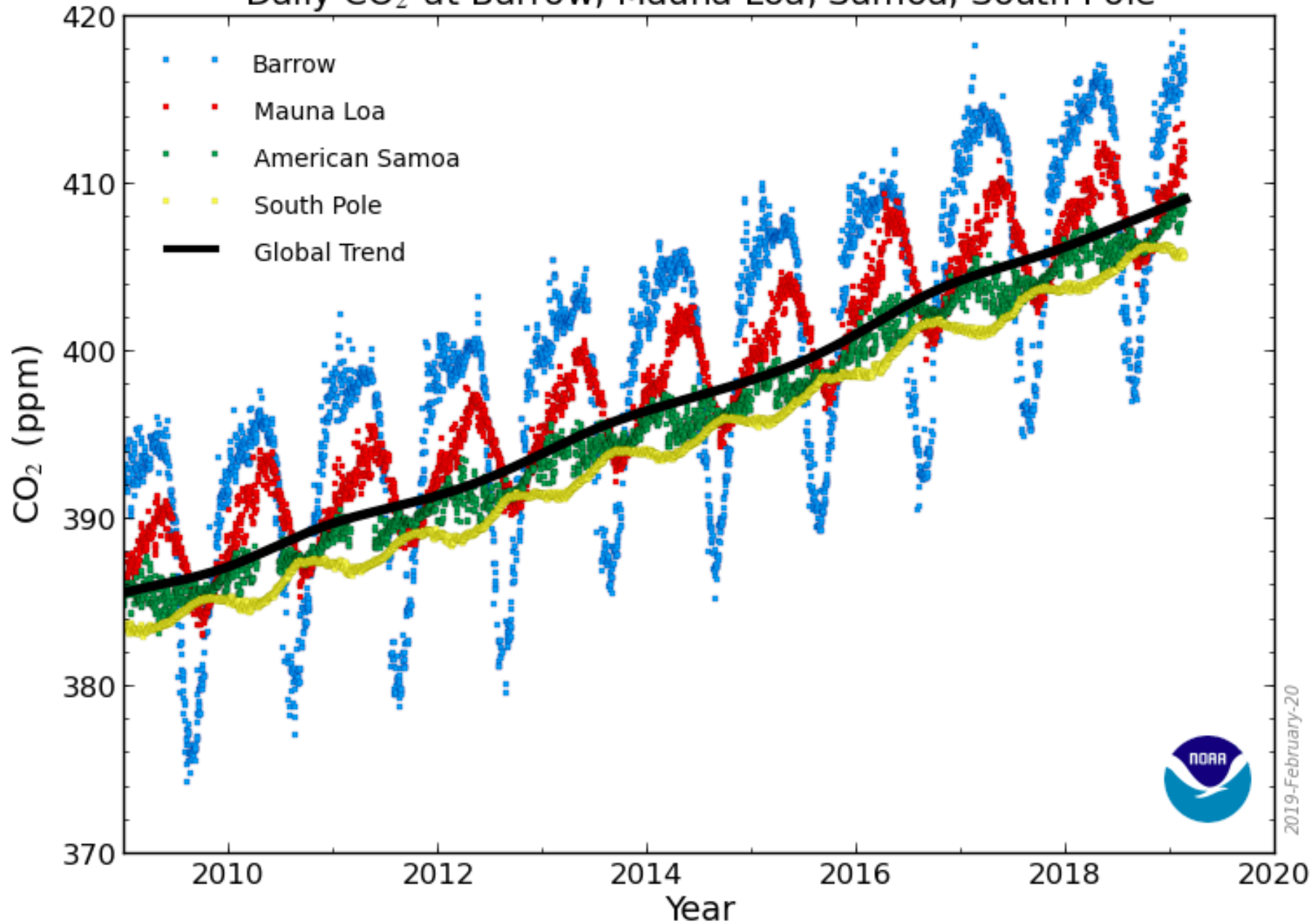
VELA MALÝCH „PREKVAPENÍ“ – ROK 2018

Global CO₂ concentrations from satellites

Column-average CO₂ (XCO₂)



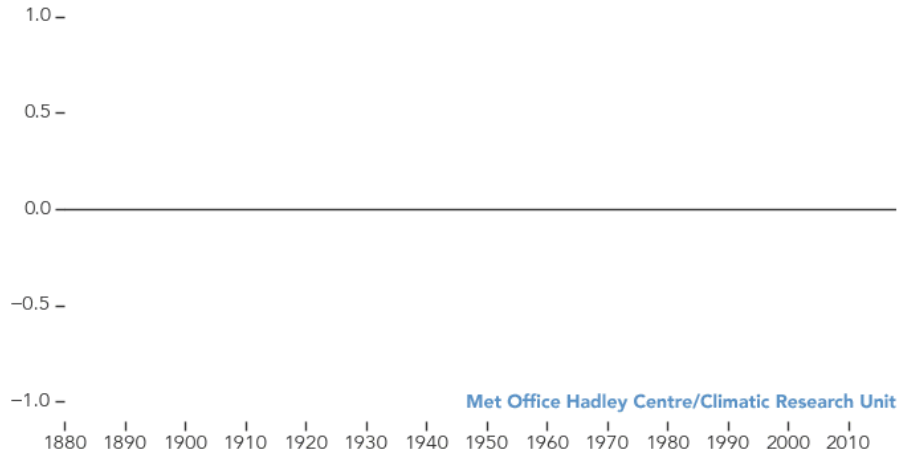
Daily CO₂ at Barrow, Mauna Loa, Samoa, South Pole



VELA MALÝCH „PREKVAPENÍ“ – ROK 2018

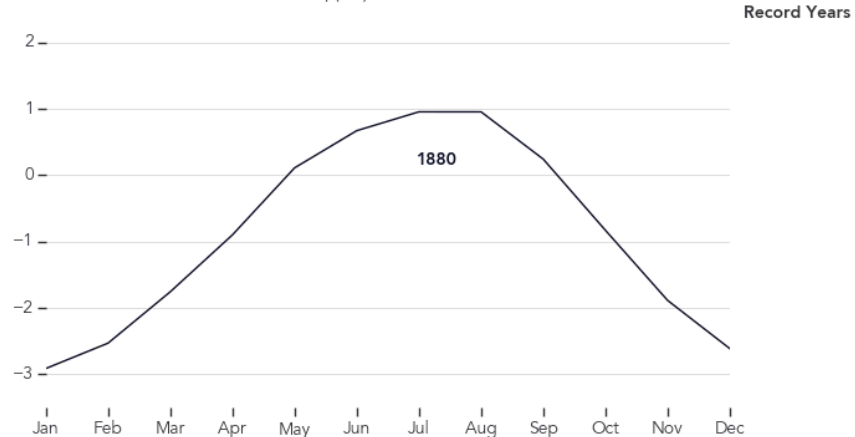
A World of Agreement: Temperatures are Rising

Global Temperature Anomaly (°C)

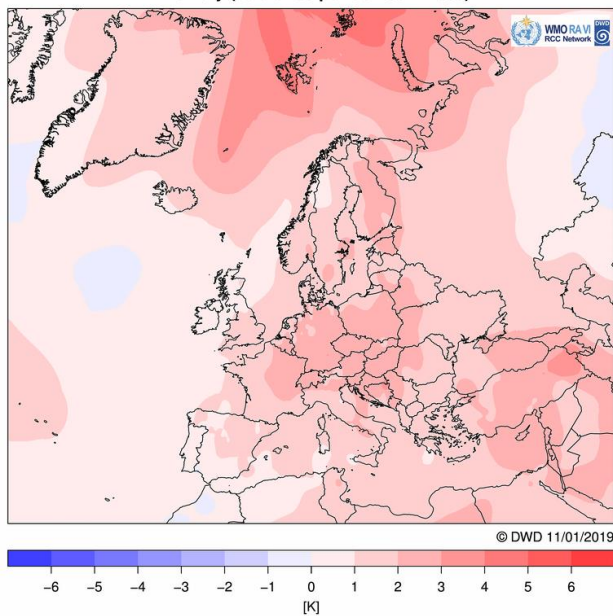


The Present is Warmer than the Past

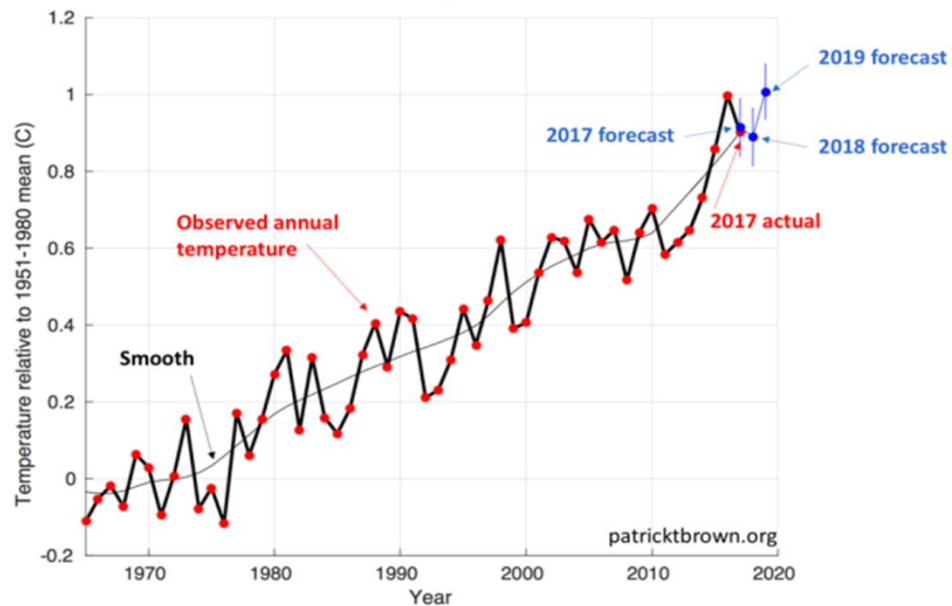
Difference from 1980-2015 annual mean, (°C)



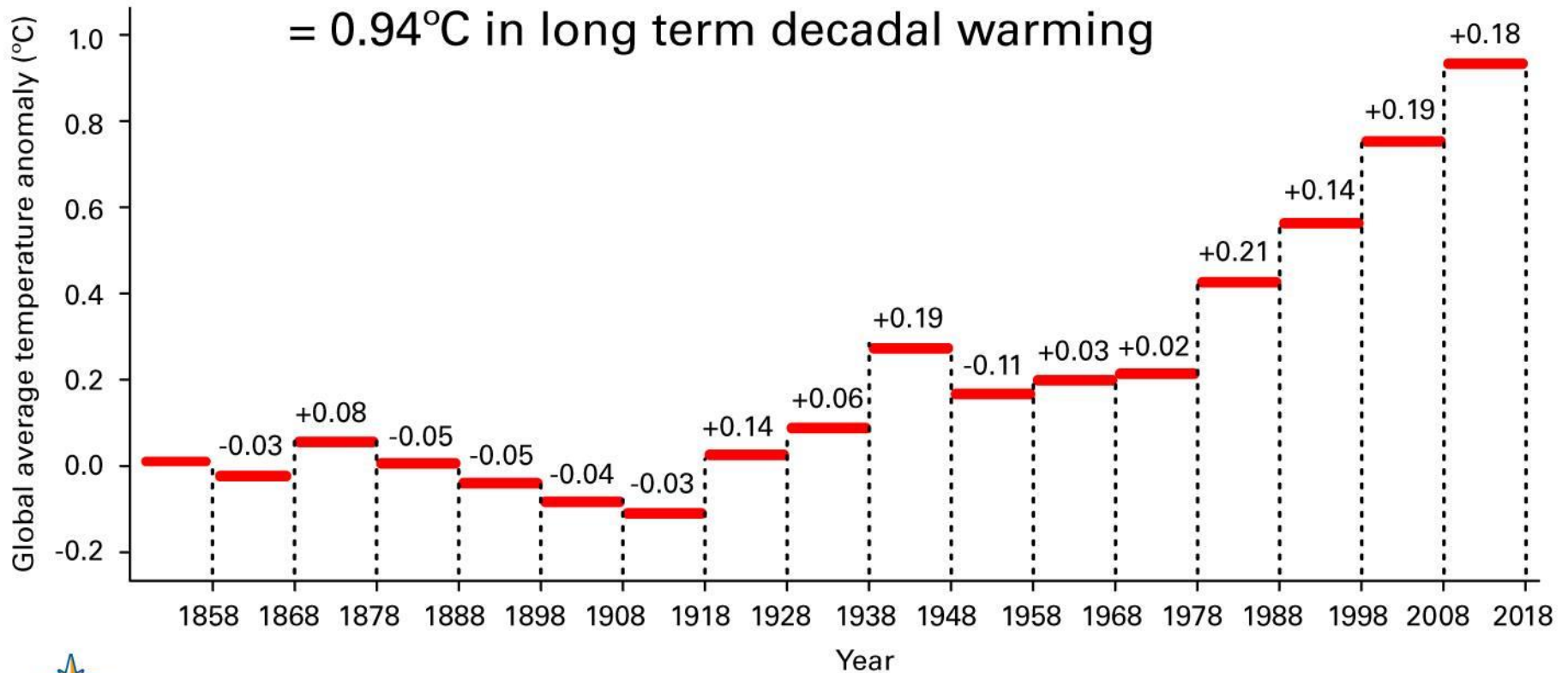
Temperature Year 2018
Anomaly (reference period 1961–1990)



Global Average Temperature



VELA MALÝCH „PREKVAPENÍ“ – ROK 2018

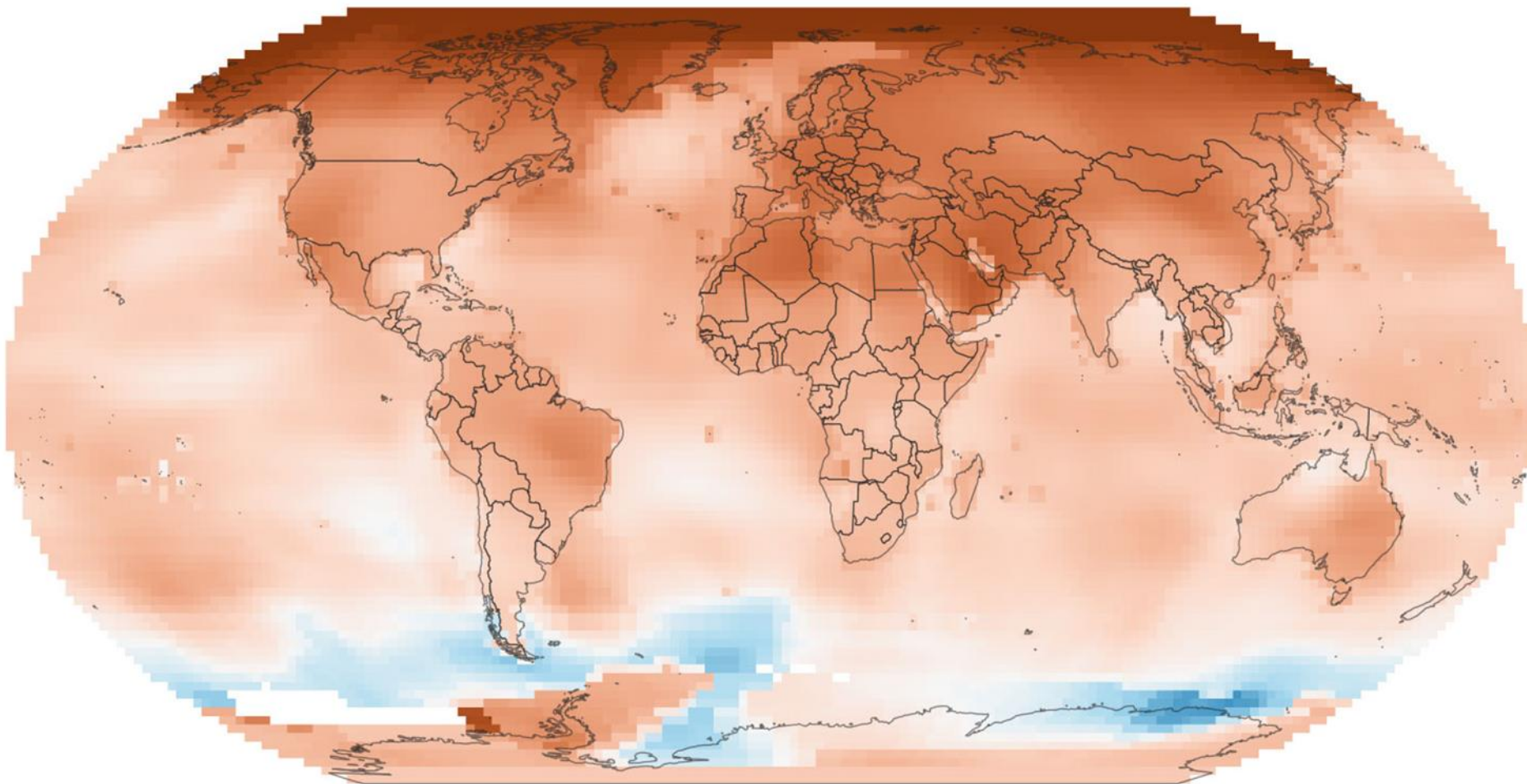
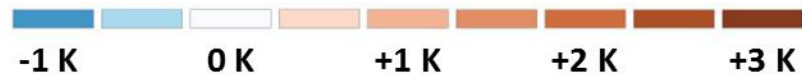


WORLD
METEOROLOGICAL
ORGANIZATION

WEATHER CLIMATE WATER

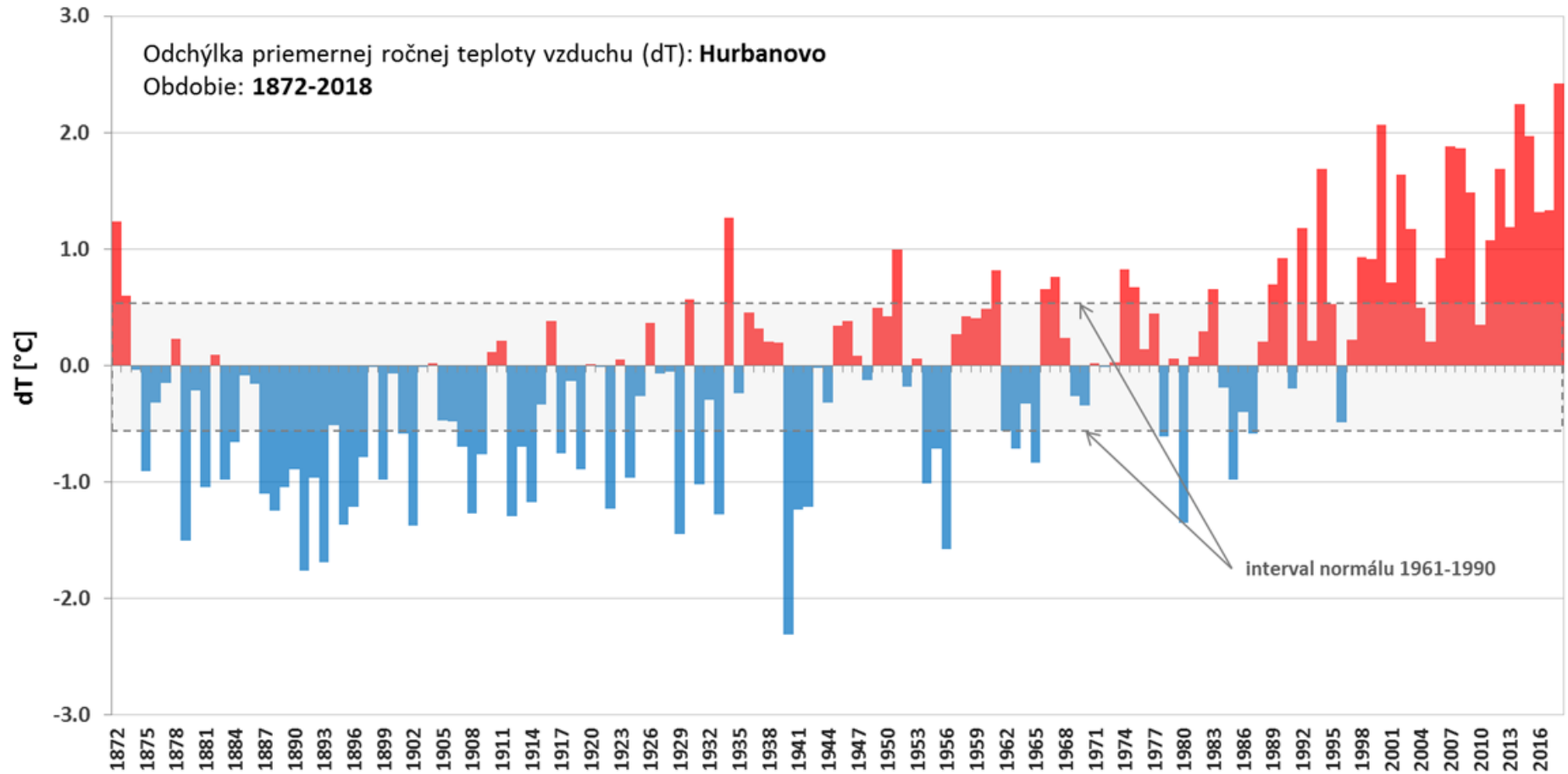
Trendy teploty: 1970 – 2018 (NASA GISS)

VELA MALÝCH „PREKVAPENÍ“ – ROK 2018



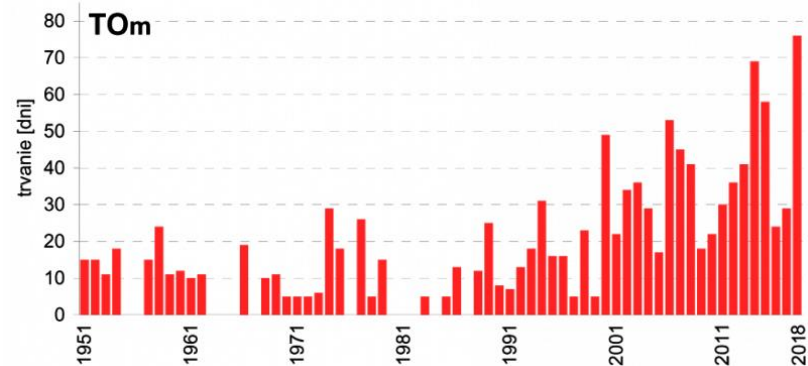
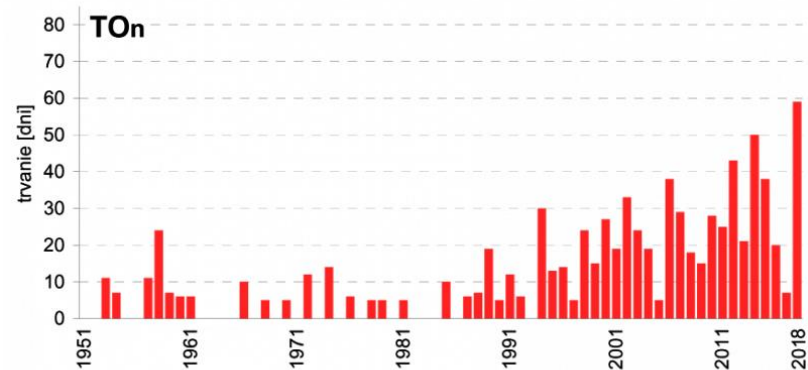
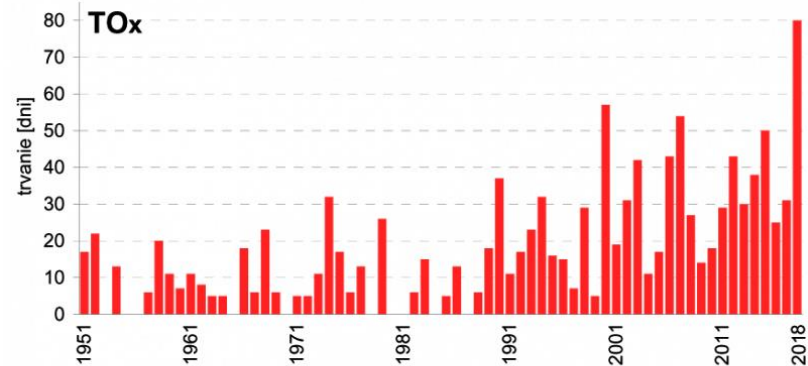
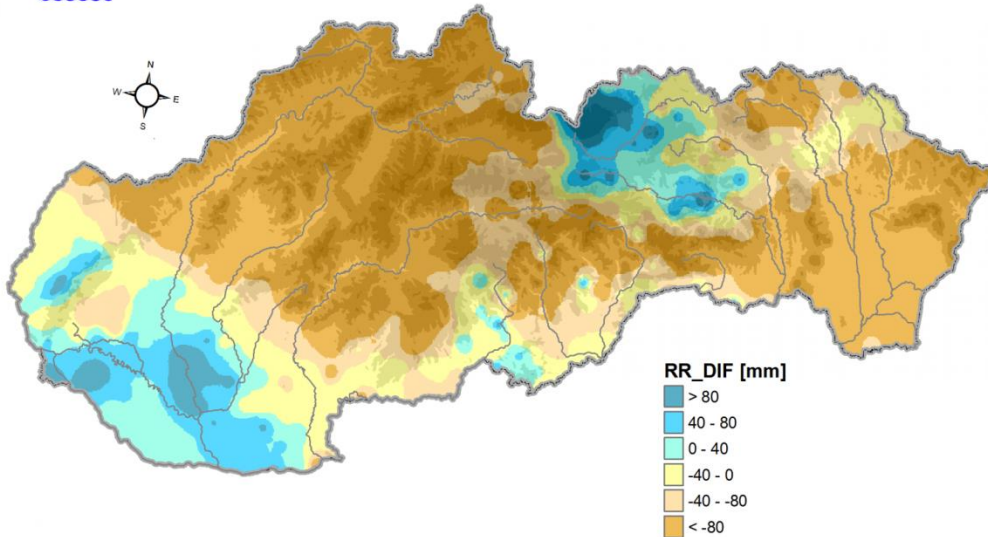
Trendy teploty: 1970 – 2018 (NASA GISS)

VEĽA MALÝCH „PREKVAPENÍ“ – ROK 2018



VEĽA MALÝCH „PREKVAPENÍ“ – ROK 2018

Prebytok (+), resp. deficit (-) atmosférických zrážok na Slovensku v mesiacoch január až november 2018



1. ODHADOVANÉ DOPADY SUCHA NA VÝNOS HLAVNÝCH PLODÍN

www.INTERSUCHO.sk

2. VODNÁ BILANCIA ZA POSLEDNÉ TRI MESAČE

3. AKTUÁLNY OBSAH PÔDNEJ VLHAY V ORNIČNEJ VRSTVE

1. bez vplyvu sucha chýba hlásenie
 sucho ovplyvnilo porast, strata výnosu do 10 %
 stredné poškodenie suchom, strata výnosu 10 - 30 %
 ťažké poškodenie suchom, strata výnosu 30 - 40 %
 extrémne poškodenie suchom, strata výnosu nad 40 %

bez vplyvu sucha jačmeň + pšenica + repka
 sucho bez vplyvu na výnos cukrová repa + zemiaky
 sucho znižuje výnos kukurica
 sucho zásadne znižuje výnos ovocné stromy
 výnos vínná réva
 lesy zelenina

2. extrémne suchno - deficit zrážok/intenzívne suchno s výraznými dopadmi
 veľké suchno - deficit zrážok s pozorovať negatívnymi dopadmi sucha
 priebeh skôr suchý, bez viditeľných dopadov
 normálny stav - priebeh skôr vlhší, bez negatívnych dopadov
 veľmi vlhko - s pozorovateľnými negatívnymi dopadmi
 extrémne vlhko - nadbytok zrážok s negatívnymi dopadmi

3. pôda na dotyk suchá a neformovateľná
 pôda na dotyk suchšia, bez znakov vlhkosti, sypké štruktúry
 pôda mierne vlhká, možno ju sformovať, ale súdržnosť je nízka
 pôda vlhká, dobre tvarovateľná
 pôda veľmi vlhká, lepší sa na prsty
 nedá sa hodnotiť

Vydané: 15.11.2018

Poskytovateľ údajov:

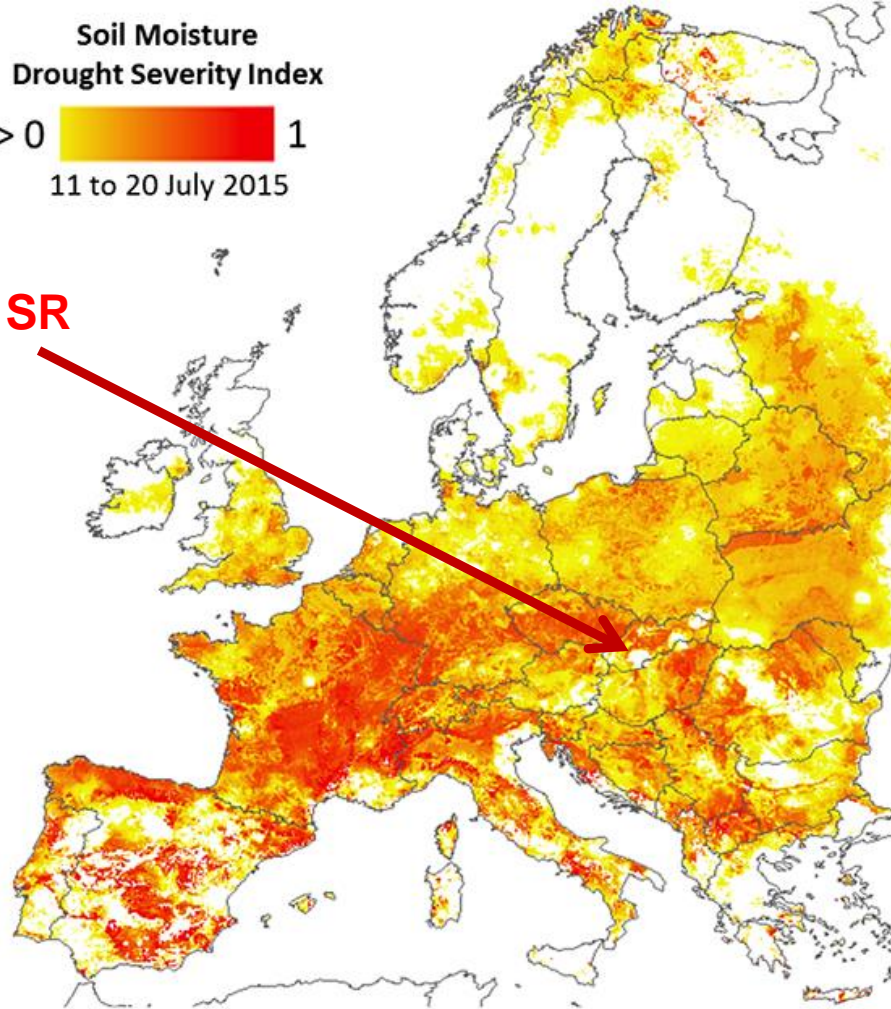
Spracovatelia:

PROBLÉMY S VODOU AJ V EURÓPE ?

Soil Moisture
Drought Severity Index

> 0 1
11 to 20 July 2015

SR

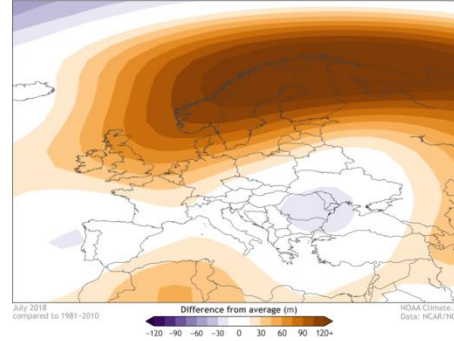


Resolution: 5x5 km

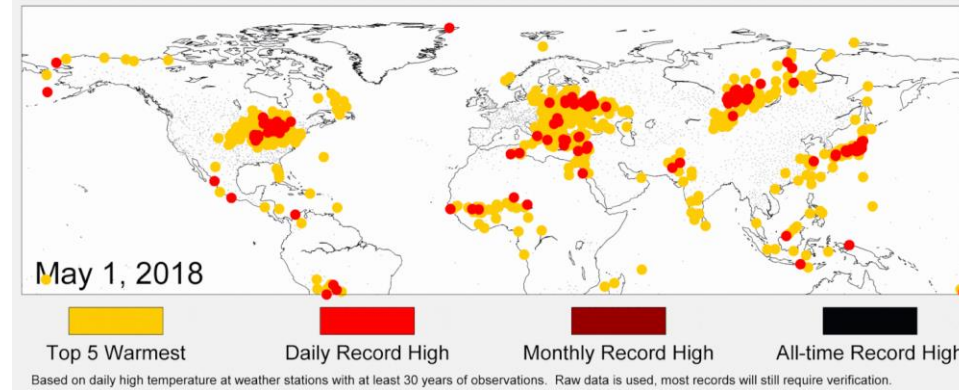
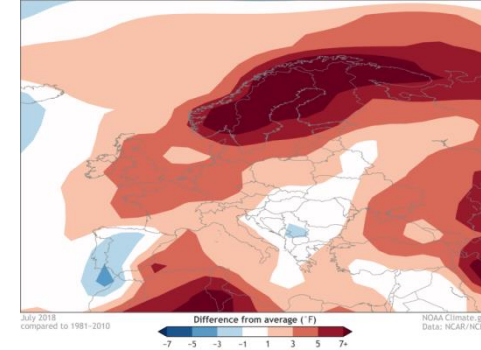


© European Union 2015
Joint Research Centre
European Drought Observatory (EDO)

Difference from average height of the 500-mb pressure level, July 2018



Difference from average surface temperature, July 2018



May 1, 2018

Top 5 Warmest

Daily Record High

Monthly Record High

All-time Record High

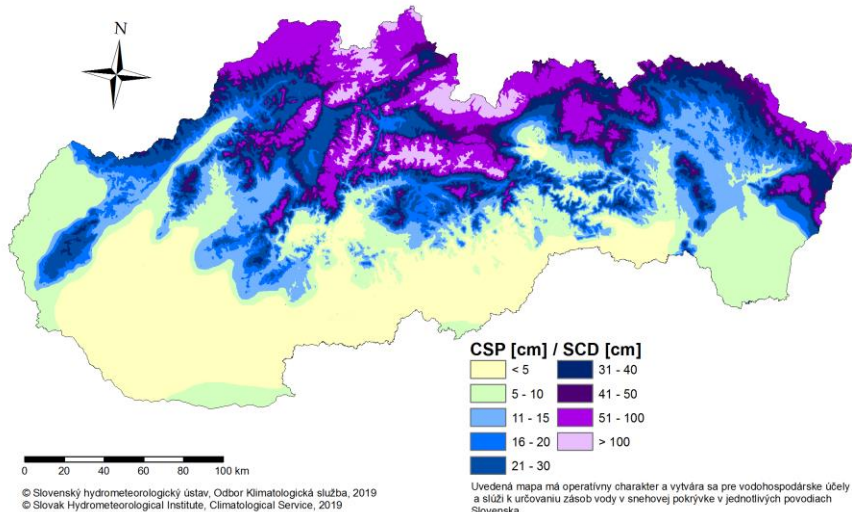
Based on daily high temperature at weather stations with at least 30 years of observations. Raw data is used, most records will still require verification.

PROBLÉMY S VODOU AJ V EURÓPE ?

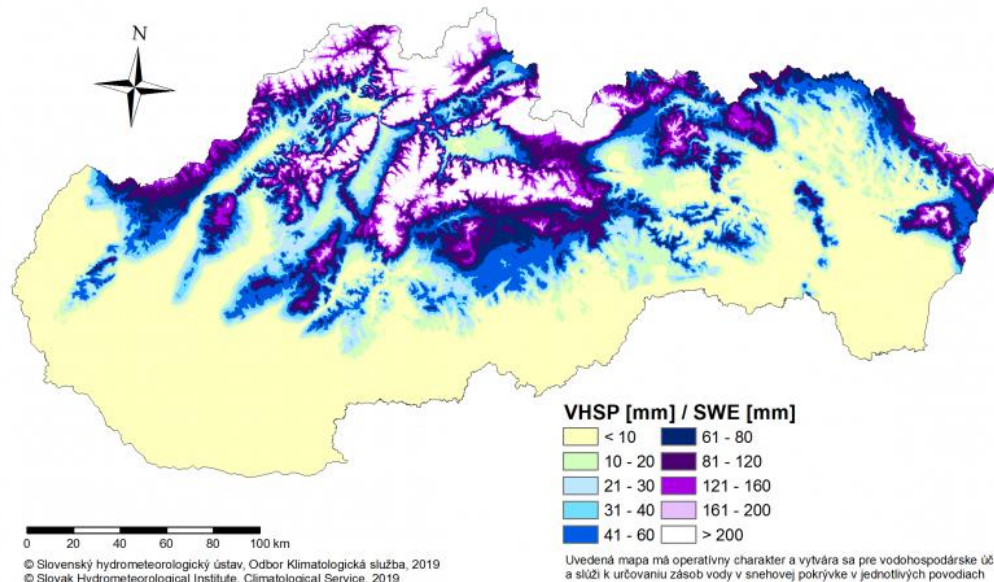


ZIMA 2018/2019

Celková výška snehovej pokrývky na Slovensku dňa 07.01.2019
Snow cover depth in Slovakia on 07.01.2019

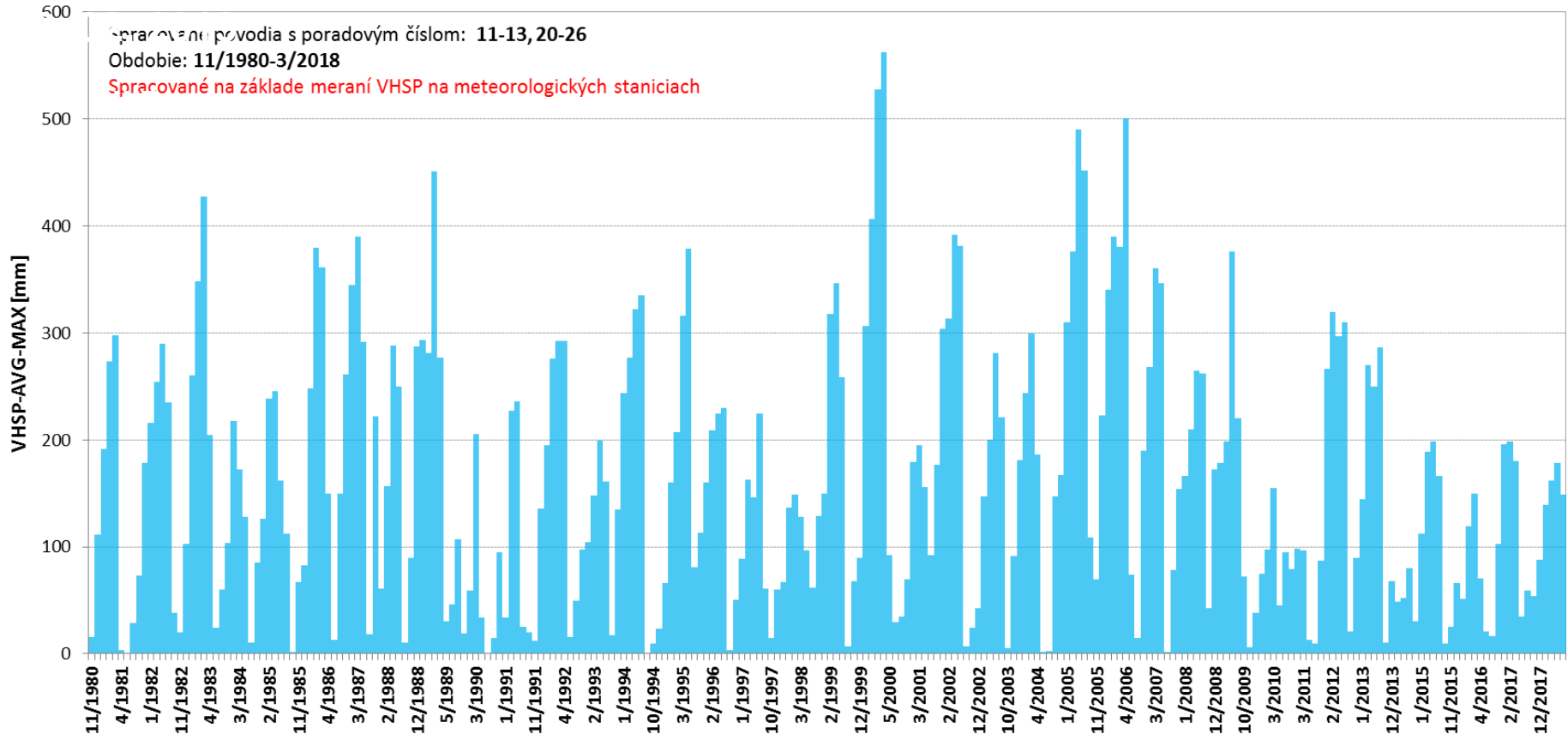


Vodná hodnota snehovej pokrývky na Slovensku dňa 18.02.2019
Snow water equivalent in Slovakia on 18.02.2019



ZIMA 2018/2018

Absolútne maximum vodnej hodnoty snehovej pokrývky [mm] na severnom a severozápadnom Slovensku (1980-2018)

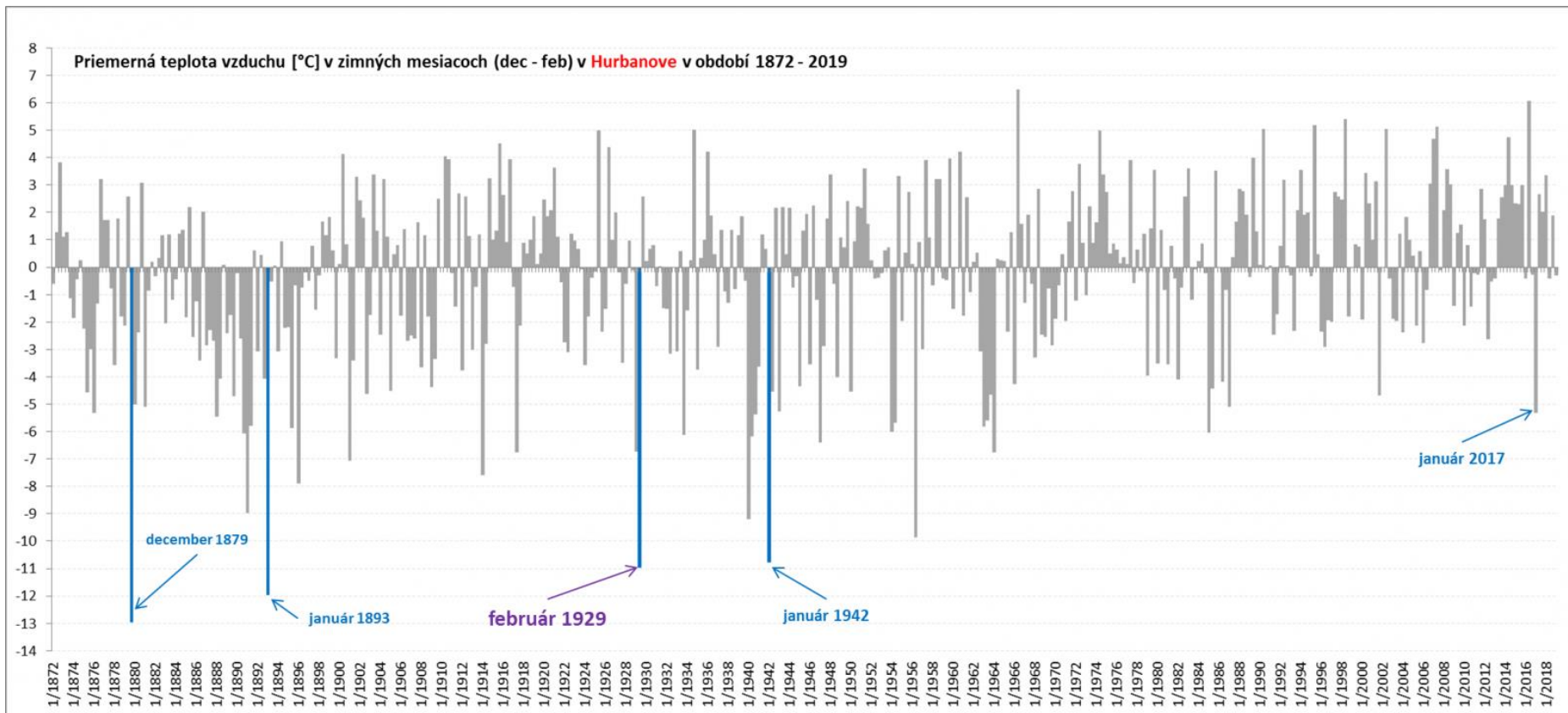


18. 02. 2019

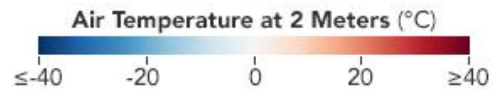
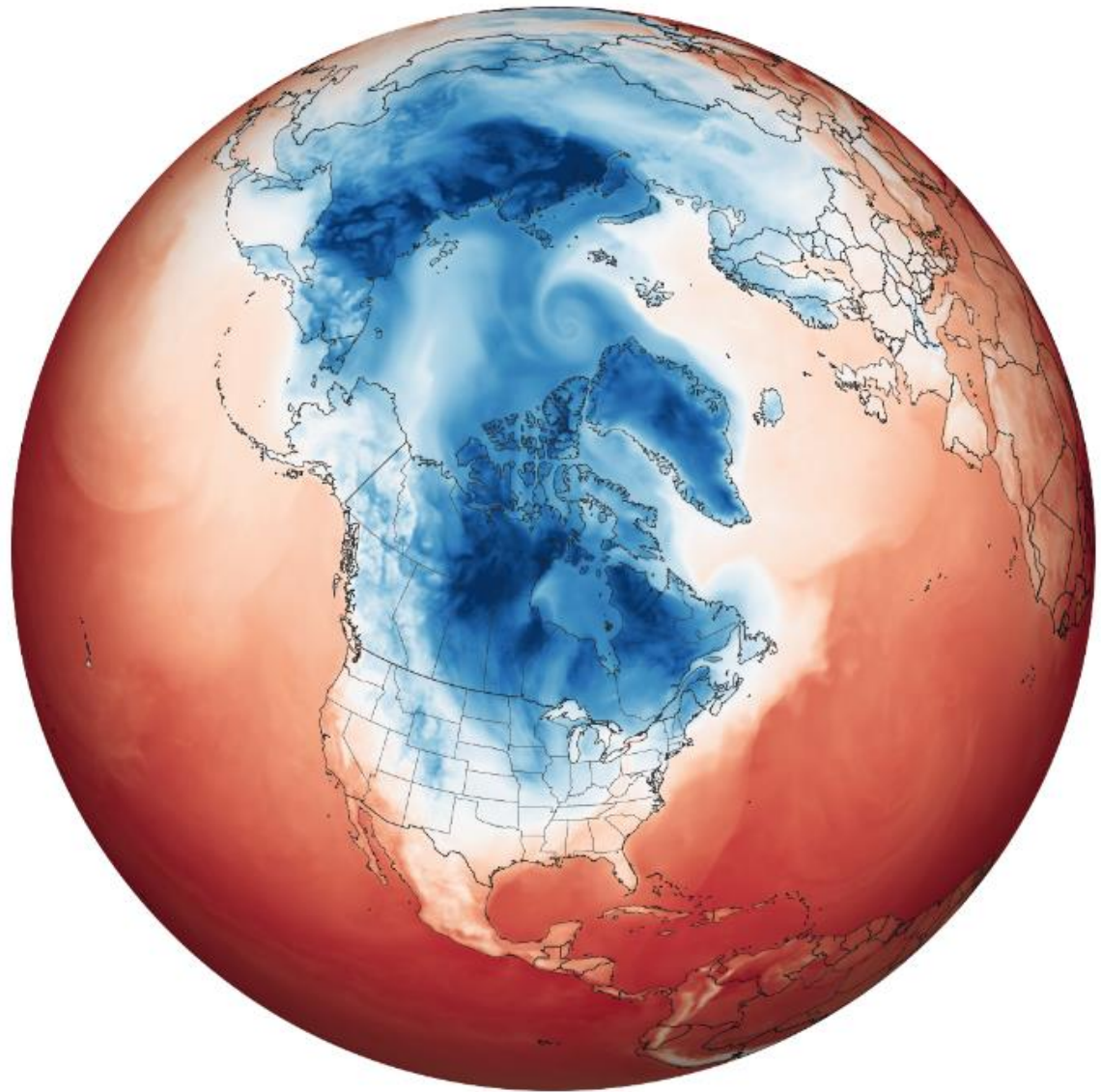
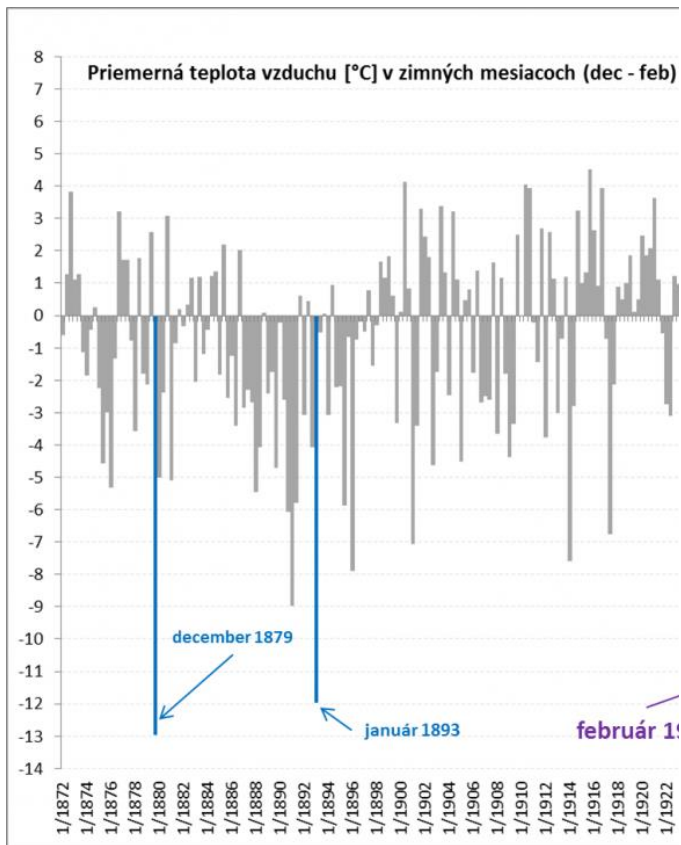
Zdroj: SWE



ZIMA 2018/2018



ZIMA 2018/2018



ZIMA 2018/2018

Selected Significant Climate Anomalies and Events January 2019

GLOBAL AVERAGE TEMPERATURE
January 2019 average global land and ocean temperature tied with 2007 as the third highest for January since records began in 1880.

ARCTIC SEA ICE EXTENT
January 2019 sea ice extent was 6.0 percent below the 1981–2010 average—the sixth smallest January sea ice extent since satellite records began in 1979.

NORTH AMERICA
Much of northern North America had near- to cooler-than-average conditions, while parts of western North America had warmer-than-average conditions. North America's average temperature for January was the coolest since 2011.

HAWAIIAN REGION
The Hawaiian region had its fifth warmest January on record.

CARIBBEAN ISLANDS
The January 2019 temperature across the Caribbean Islands was the 13th highest on record.

ASIA
Much of Asia had warmer-than-average conditions during January. The most notable temperature departures from average were present across parts of northeastern and southwestern Asia, where temperatures were 4.0°C (7.2°F) above average or higher.

SOUTH AMERICA
South America had its fifth warmest January on record. Warmer-than-average conditions were present across much of South America, with parts of southern Brazil experiencing record warm January temperatures.

AFRICA
Much of the southern half of Africa had much-warmer-than-average temperatures during January. Africa as a whole had its eighth highest (tied with 1985) January temperature on record.

AUSTRALIA
Australia had its warmest January on record. The national mean temperature for January was 0.99°C (1.78°F) higher than the previous record set in 2013.

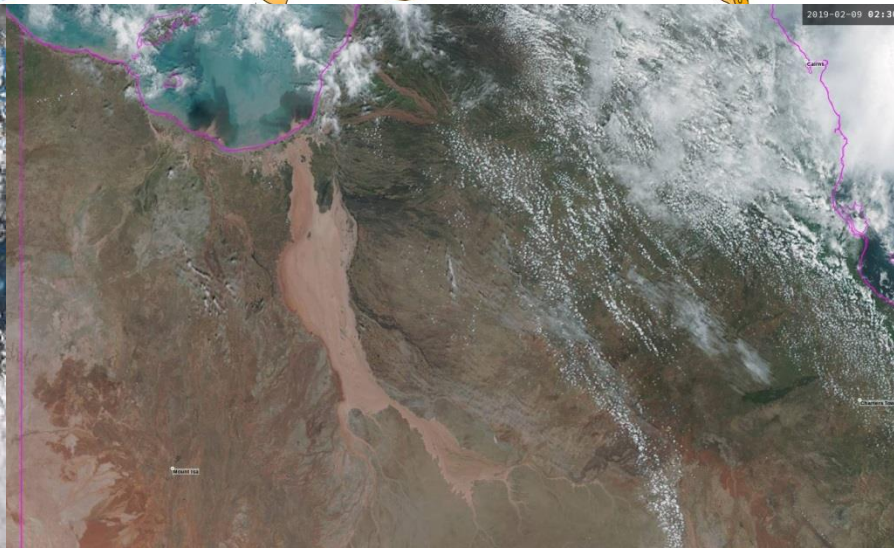
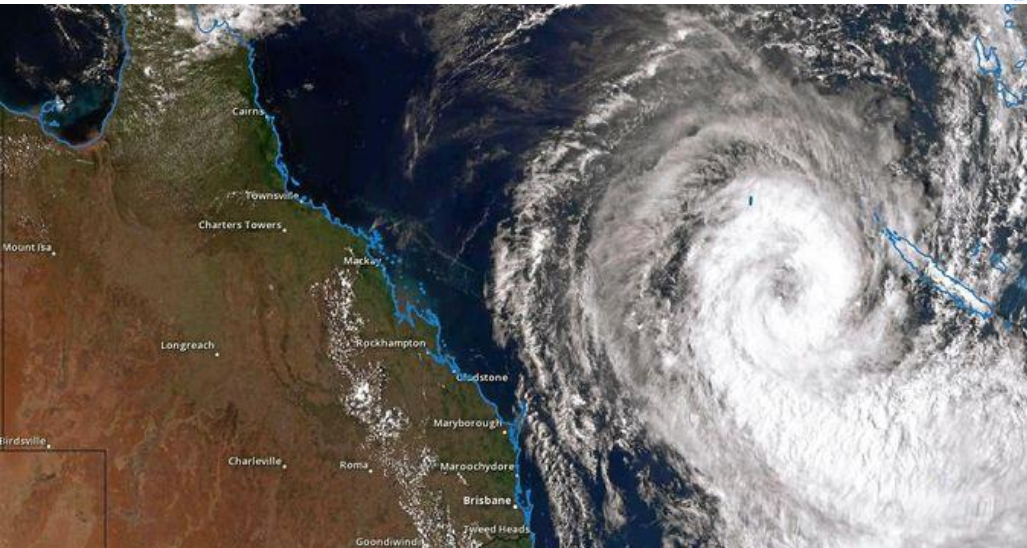
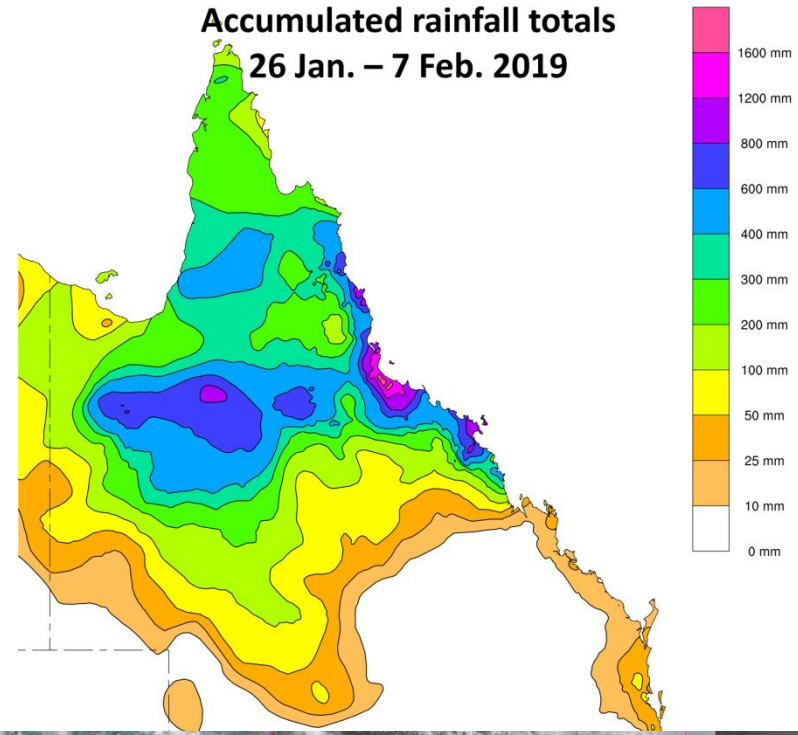
ANTARCTIC SEA ICE EXTENT
January 2019 sea ice extent was 23.4 percent below the 1981–2010 average—the second smallest January sea ice extent on record, behind 2017.

NEW ZEALAND
New Zealand had its third warmest January since national records began in 1909.

Please Note: Material provided in this map was compiled from NOAA's State of the Climate Reports. For more information please visit: <http://www.ncdc.noaa.gov/sotc>



Accumulated rainfall totals 26 Jan. – 7 Feb. 2019



2019-02-09 02:30

„BIG PICTURE“

ČASTO KLADENÉ OTÁZKY (FAQ)

Je súčasné otepľovanie spôsobené **výhradne ľudskými aktivitami**?

Ide o **najrýchlejšiu klimatickú zmenu** v známej geologickej histórii?

Ako sa súčasné otepľovanie (a klimatická zmena) **už stihlo prejaviť** na celoplanetárnej úrovni?

Je rýchlosť klimatickej zmeny pre ľudí a civilizáciu **nebezpečná**?

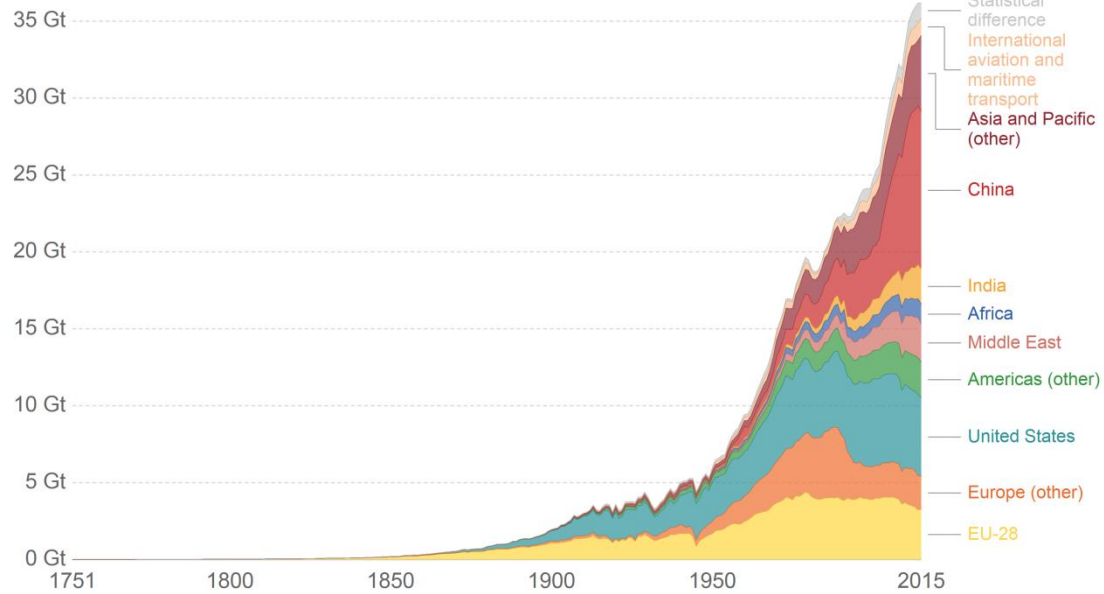
Sú projekcie budúcej klímy príliš **konzervatívne**?

Môže dôjsť v najbližšom období k tzv. **náhlej klimatickej zmeny** (zlomu)?

ČLOVEK: HLAVNÝ VINNÍK ?

Annual CO₂ emissions by world region

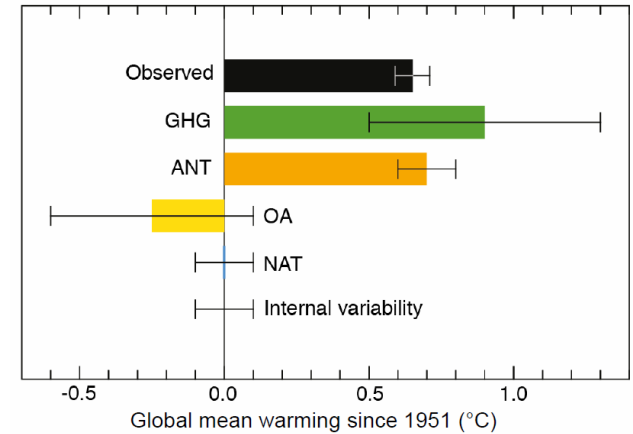
Annual carbon dioxide (CO₂) emissions measured in billion tonnes (Gt) per year



Source: Carbon Dioxide Information Analysis Center (CDIAC)

CC BY

Note: Emissions data have been converted from units of carbon to carbon dioxide (CO₂) using a conversion factor of 3.67. Regions denoted "other" are given as regional totals minus emissions from the EU-28, USA, China and India. Here, we have rephrased the general term "bunker (fuels)" as "international aviation and maritime transport" for clarity.



It is *extremely likely* that more than **50% of the warming since 1951** is due to the increase in greenhouse gases and other anthropogenic forcings together

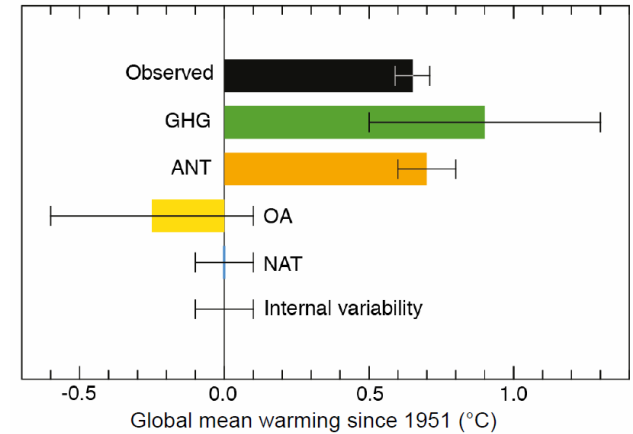
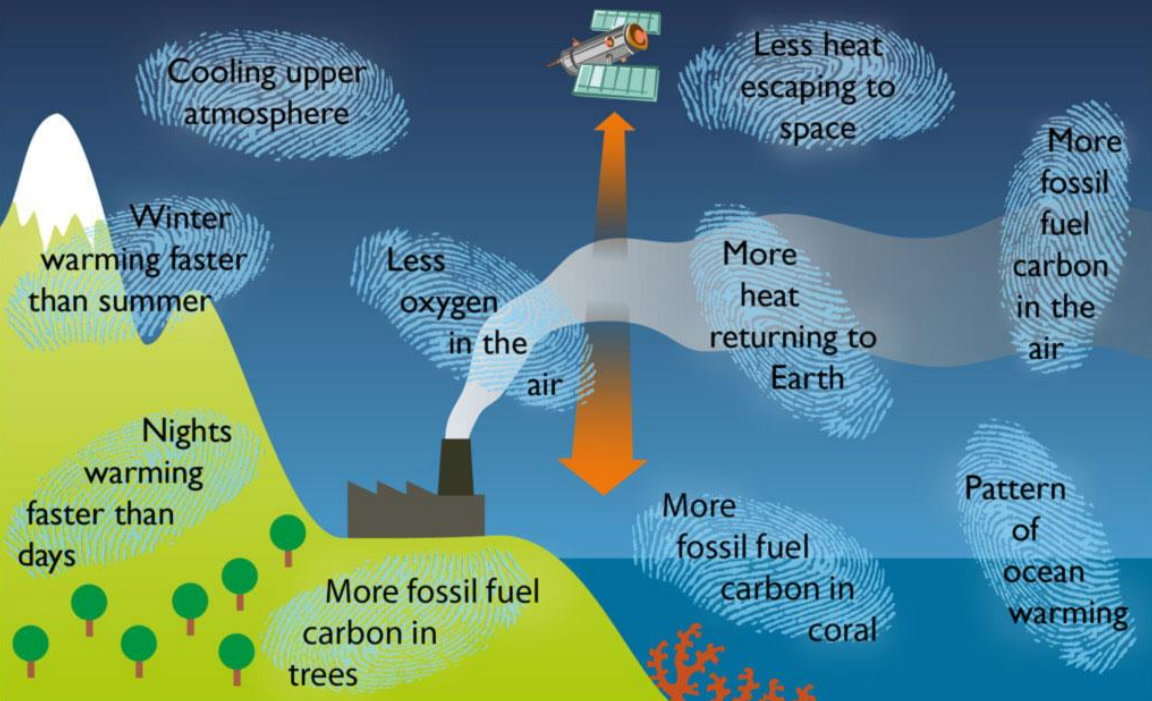
ČLOVEK: HLAVNÝ VINNÍK ?

Annual CO₂ emissions by world region

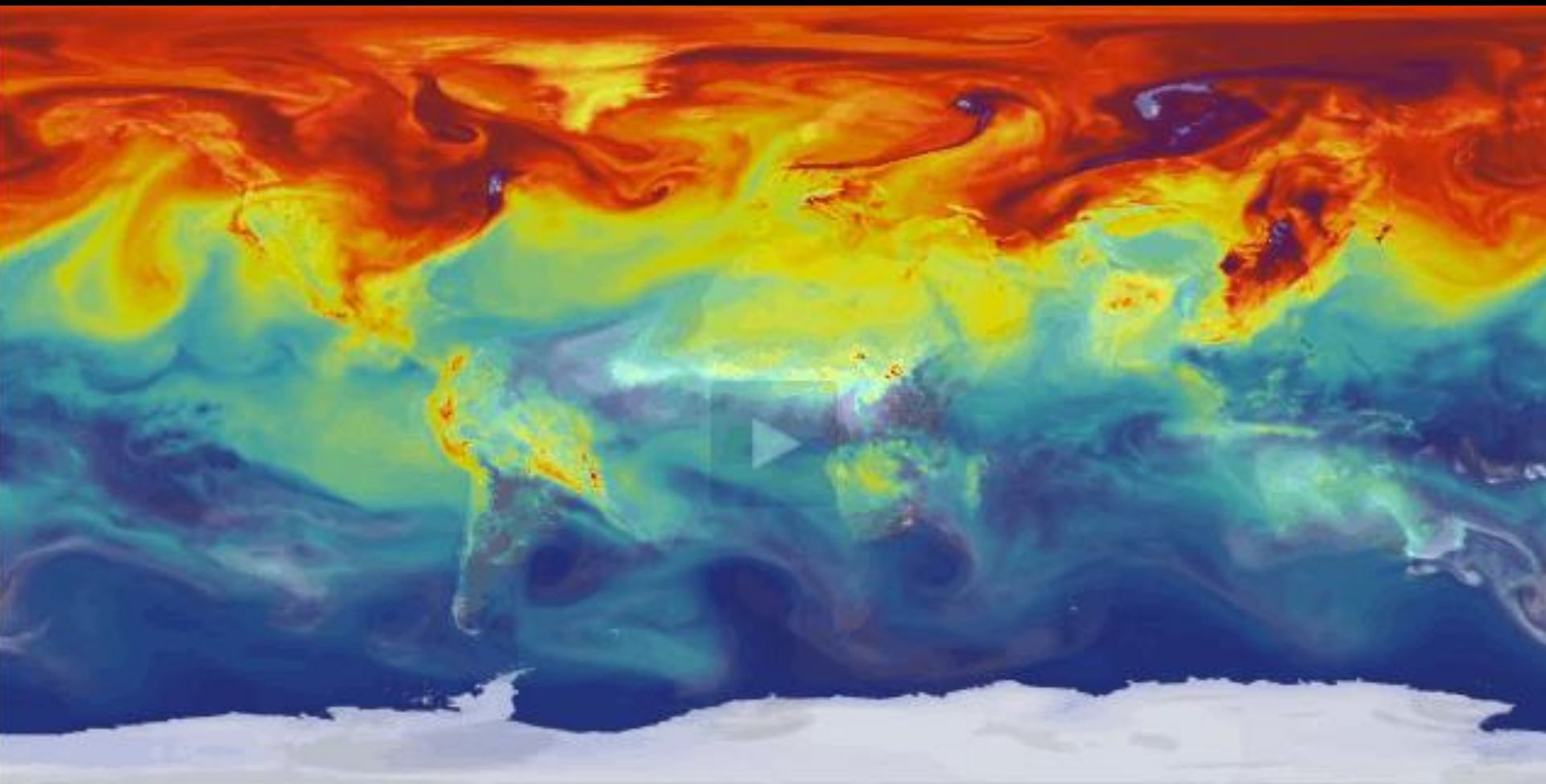
Annual carbon dioxide (CO₂) emissions measured in billion tonnes (Gt) per year



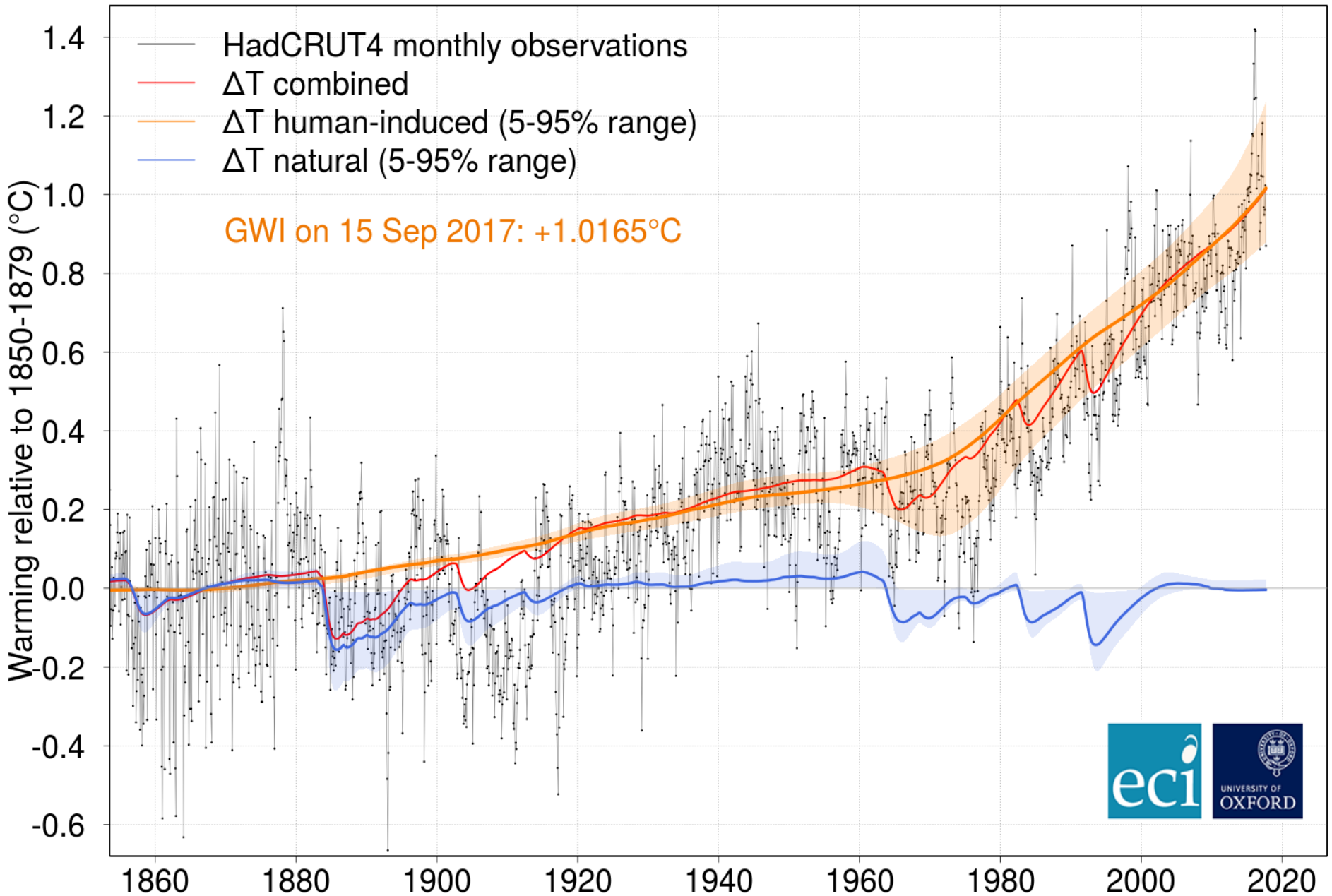
Human fingerprints are all over our climate



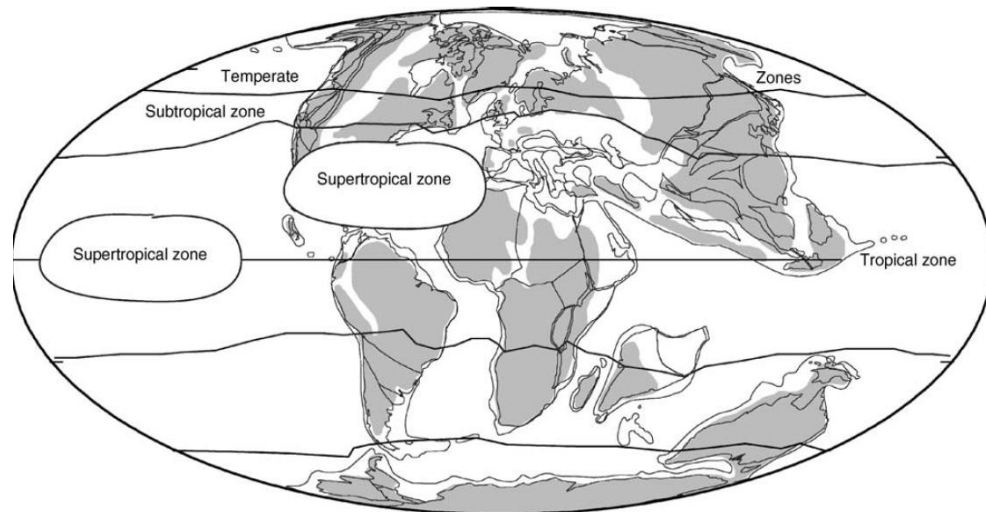
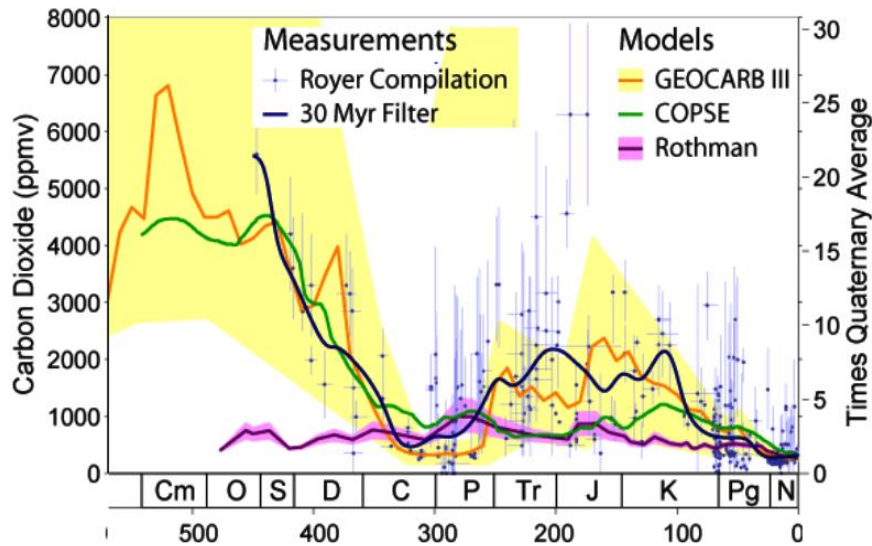
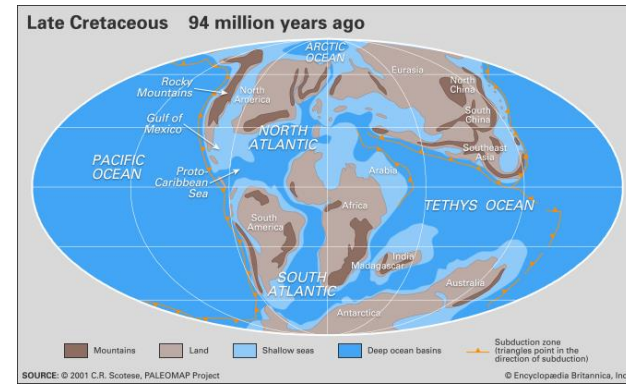
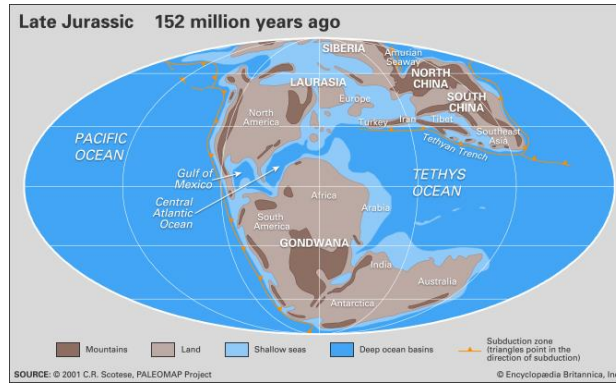
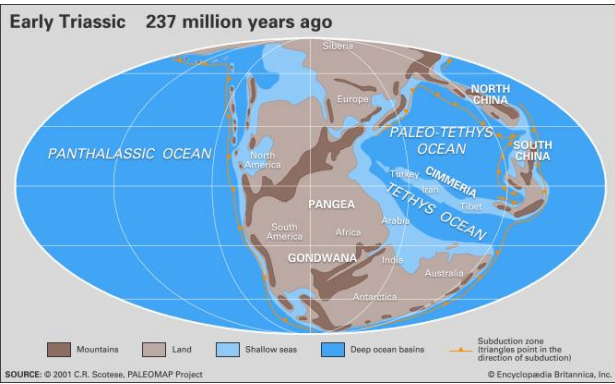
It is *extremely likely* that **more than 50% of the warming since 1951** is due to the increase in greenhouse gases and other anthropogenic forcings together



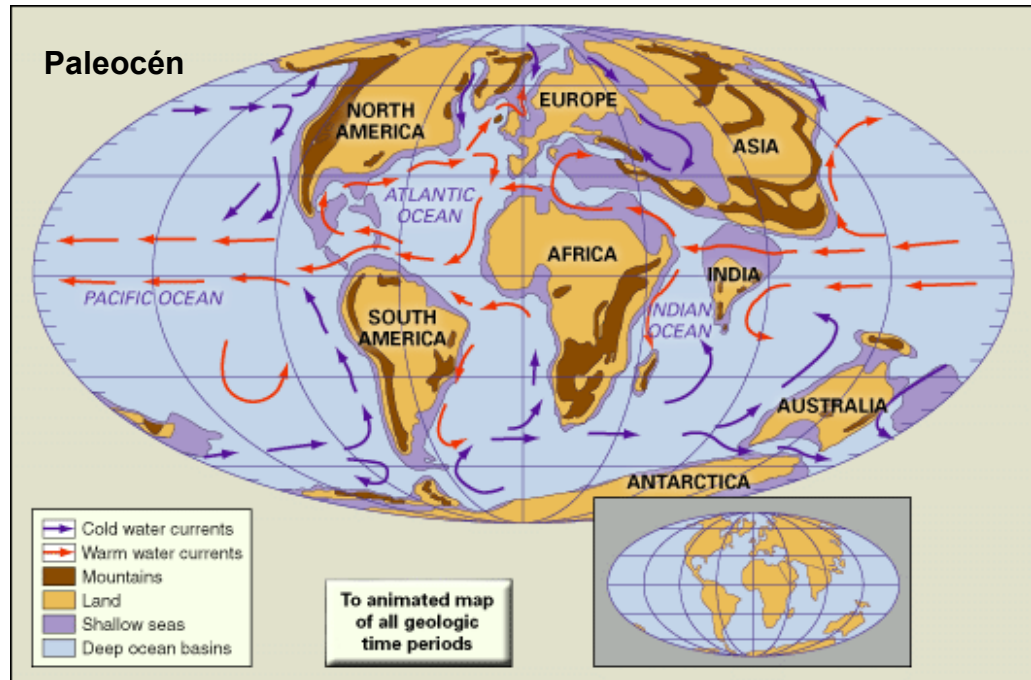
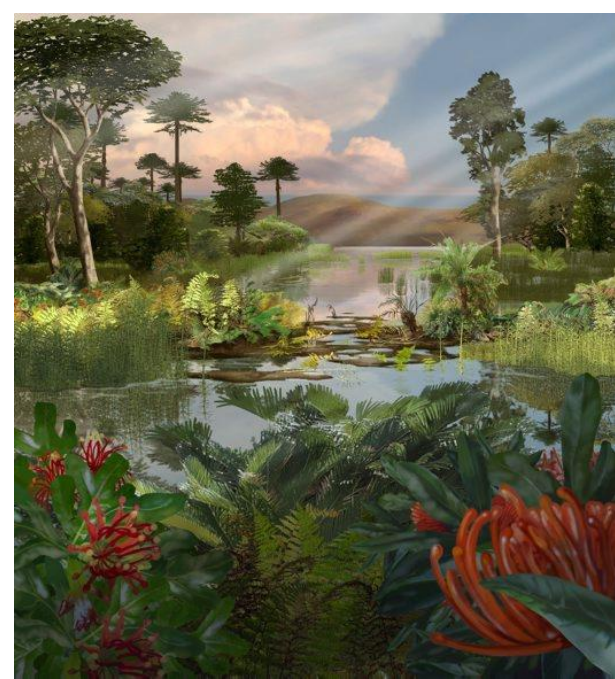
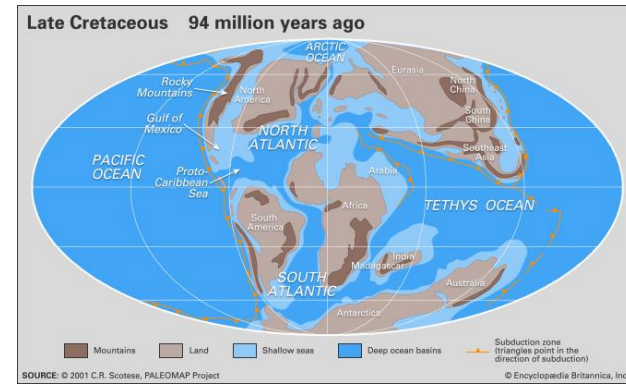
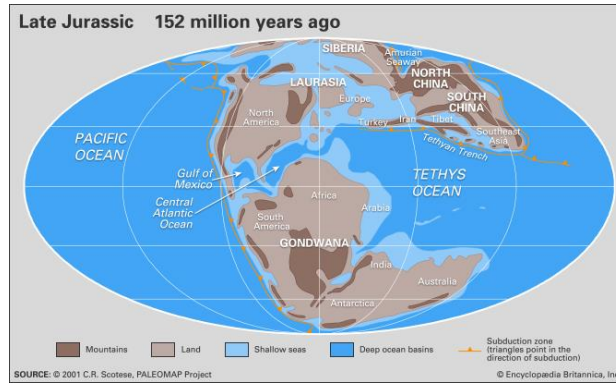
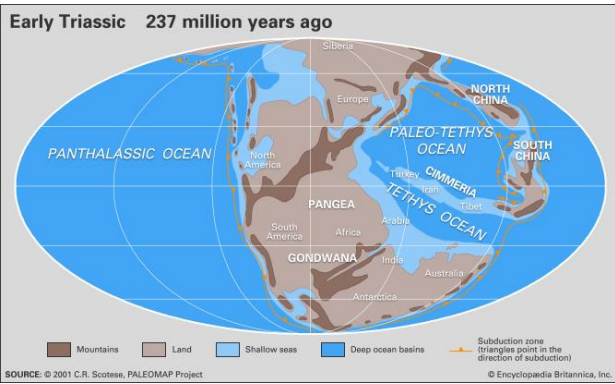
Global Warming Index based on HadCRUT4 - updated to Sep 2017



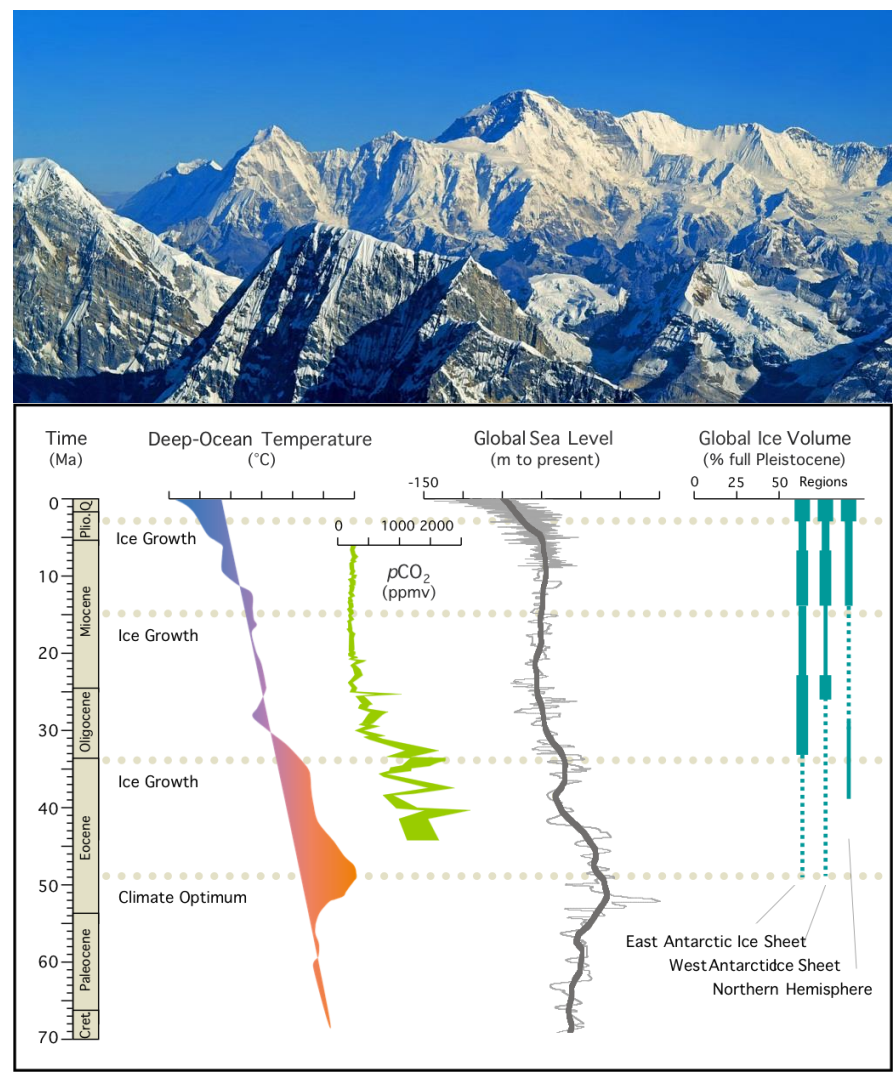
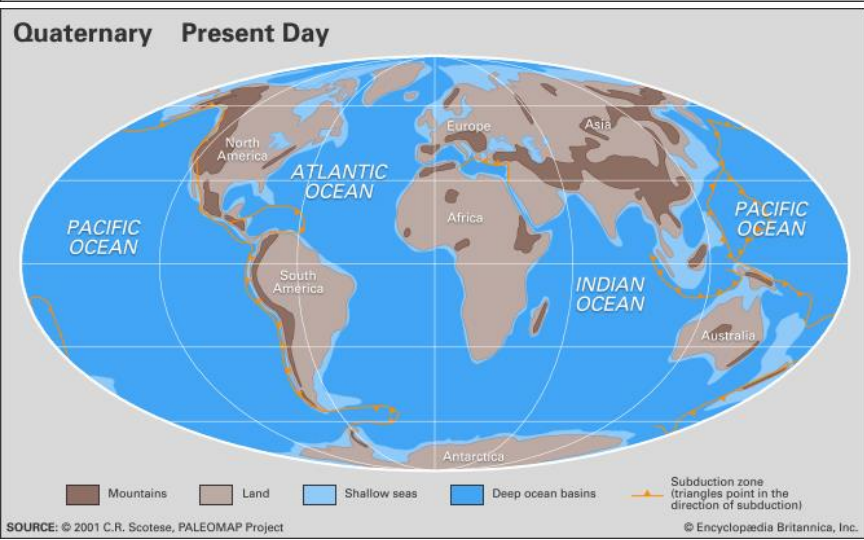
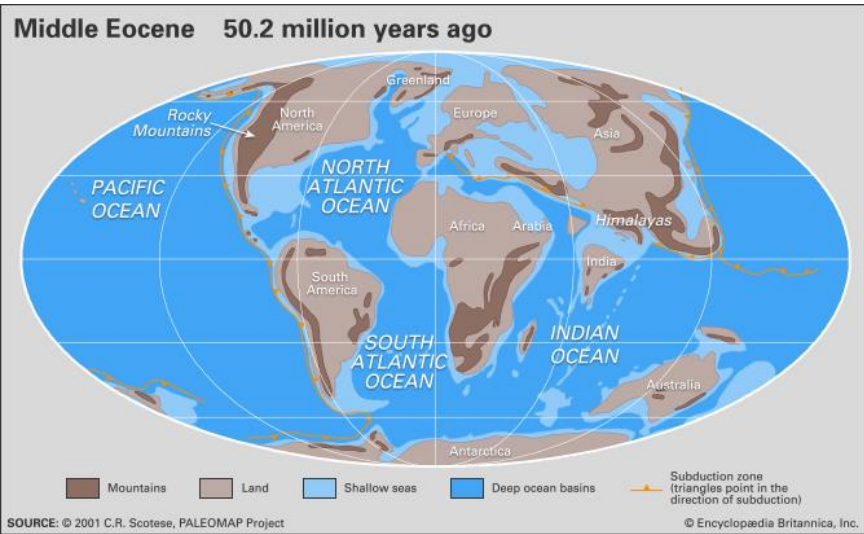
PLANETÁRNÝ „HOTHOUSE“



PLANETÁRNÝ „HOUSHOUS“

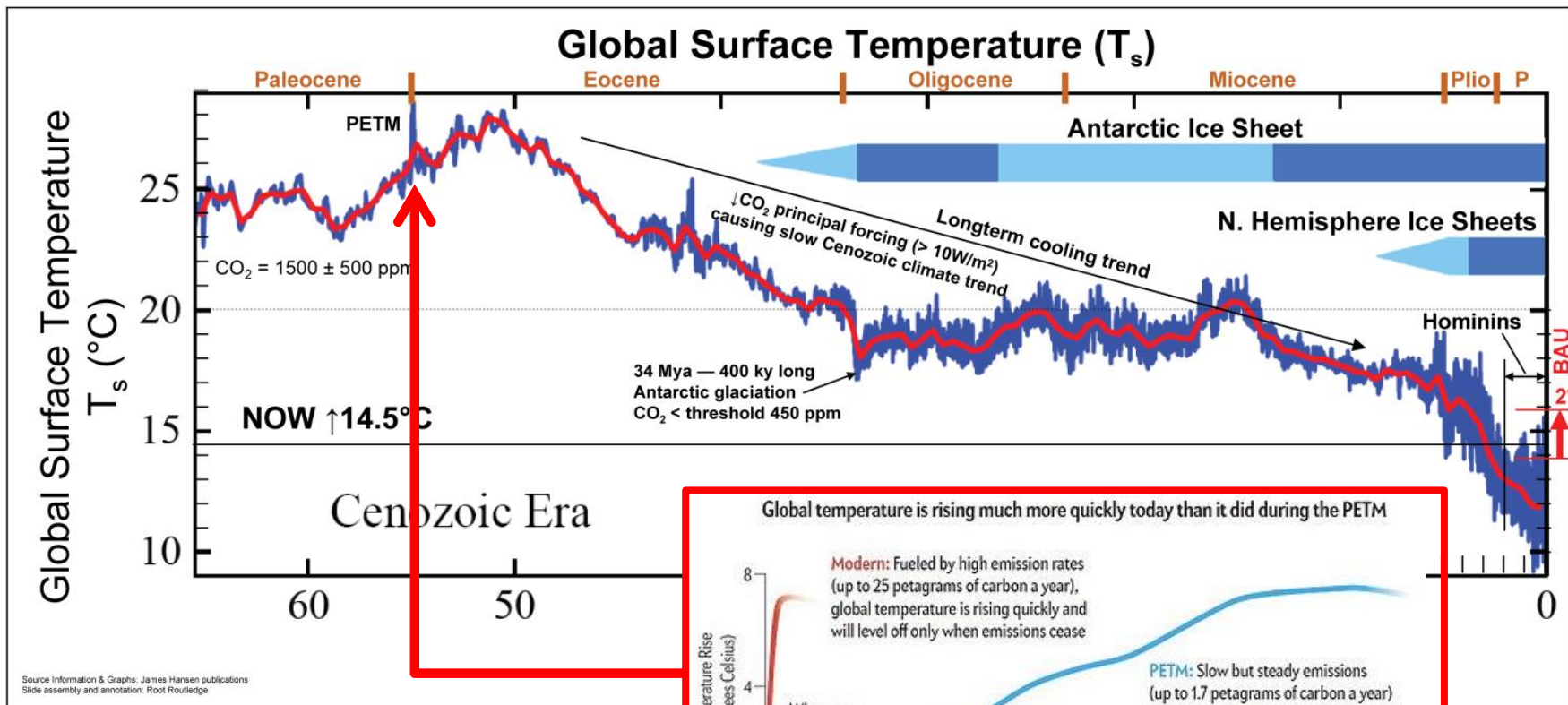


KENOZOICKÉ OCHLADZOVANIE

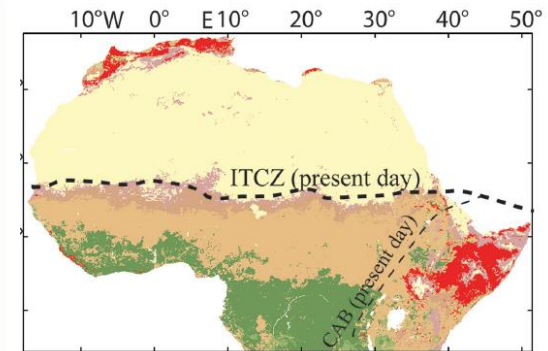
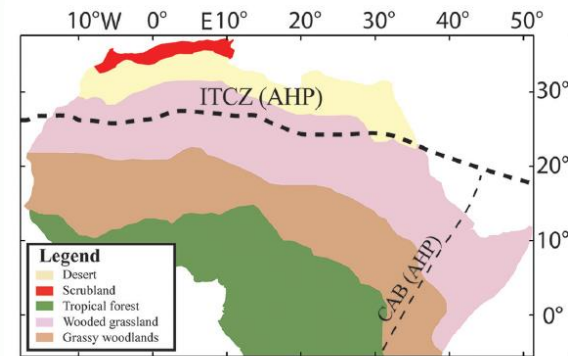
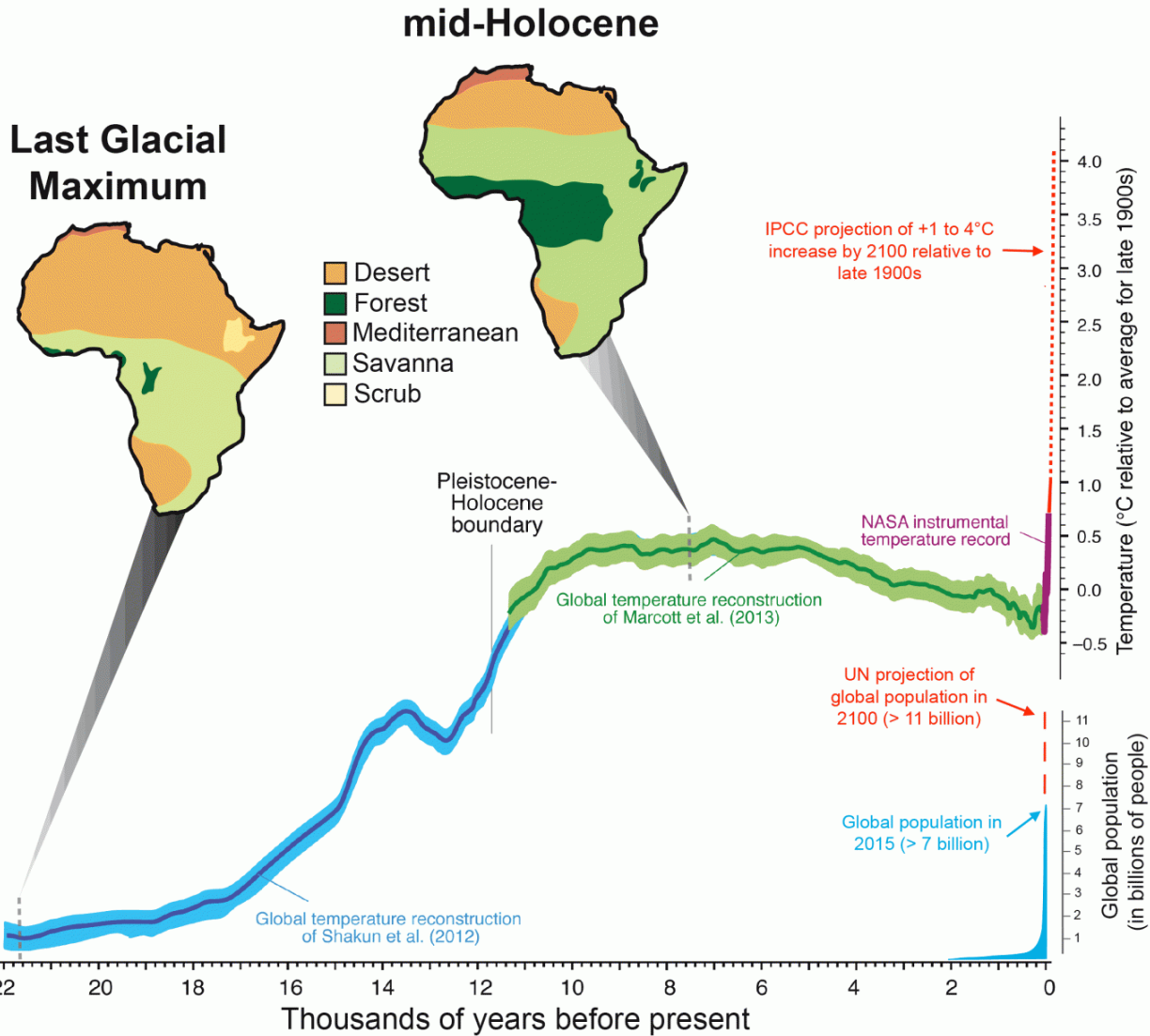


RÝCHLA ZMENA KLÍMY

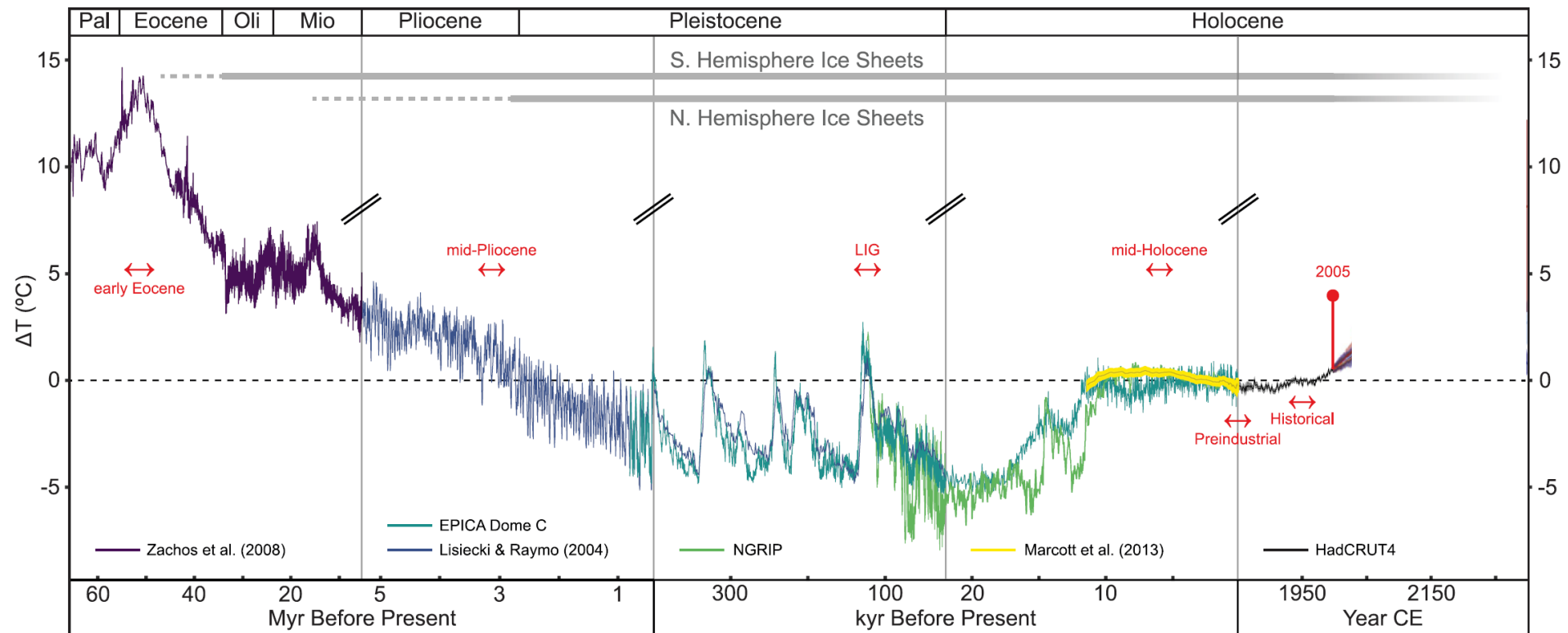
Zdroj: Goudie (1992) "Environmental Change", Oxford. U.P



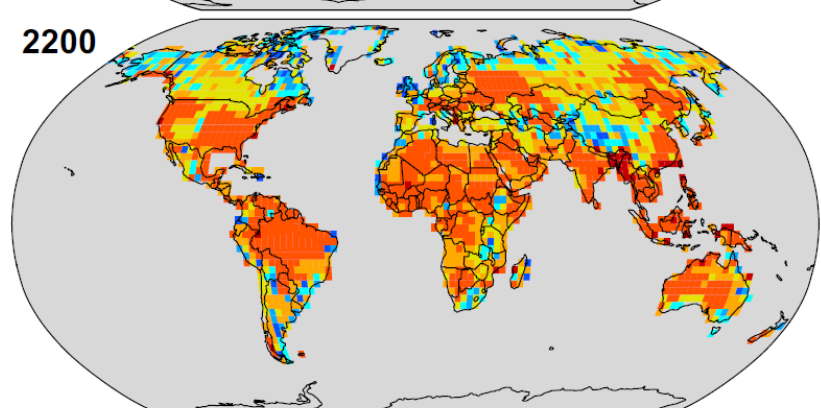
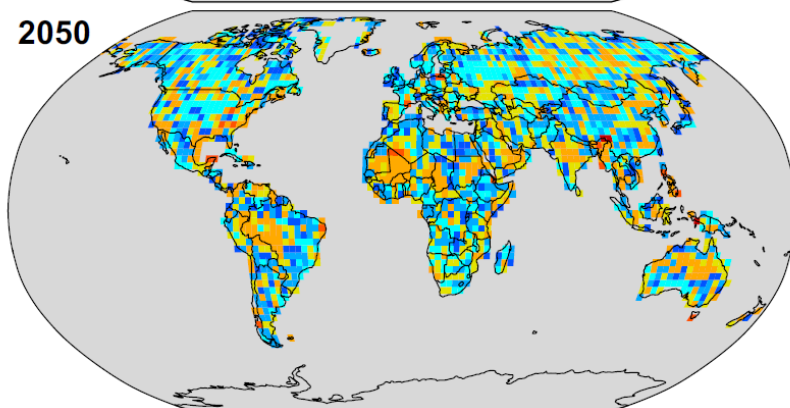
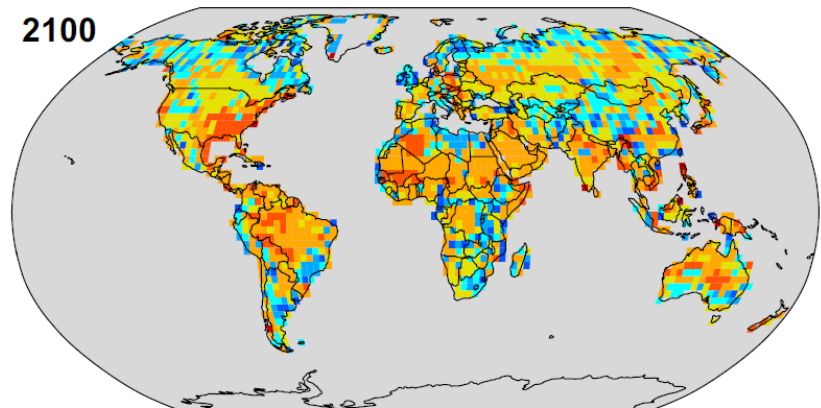
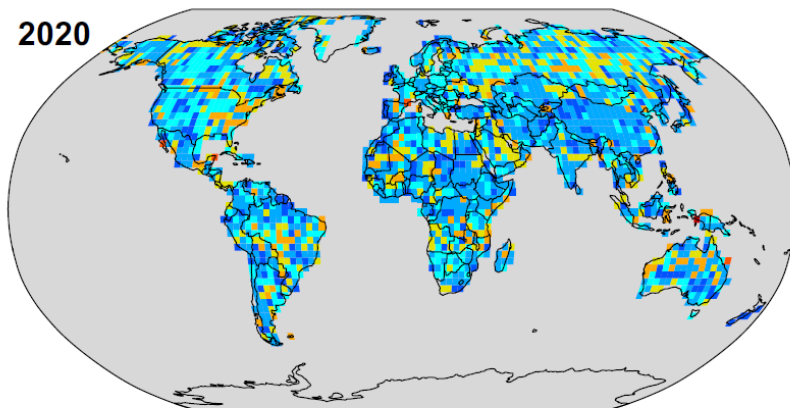
RÝCHLA ZMENA KLÍMY



RÝCHLA ZMENA KLÍMY



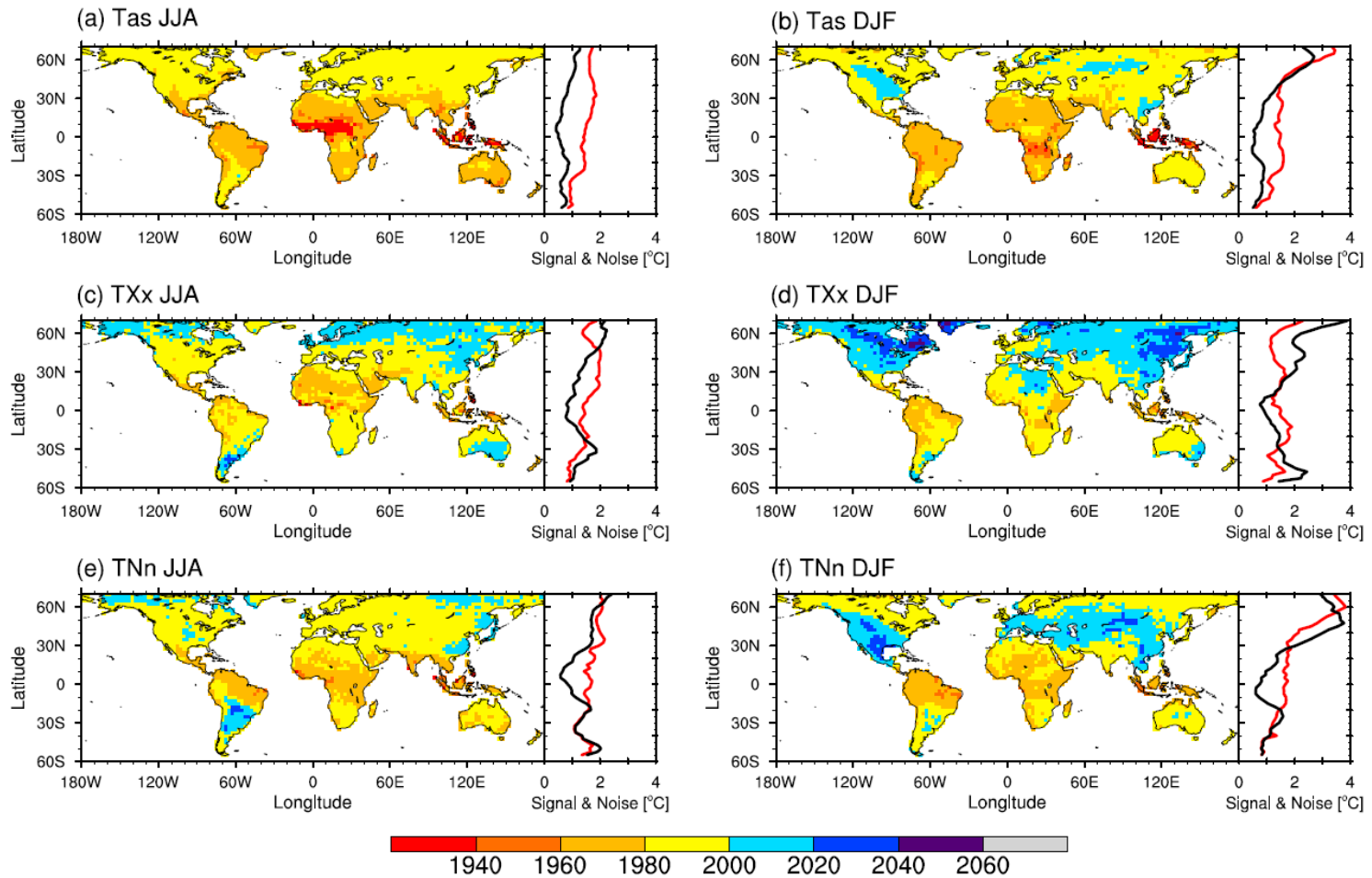
SPÄT DO EOCÉNU ?



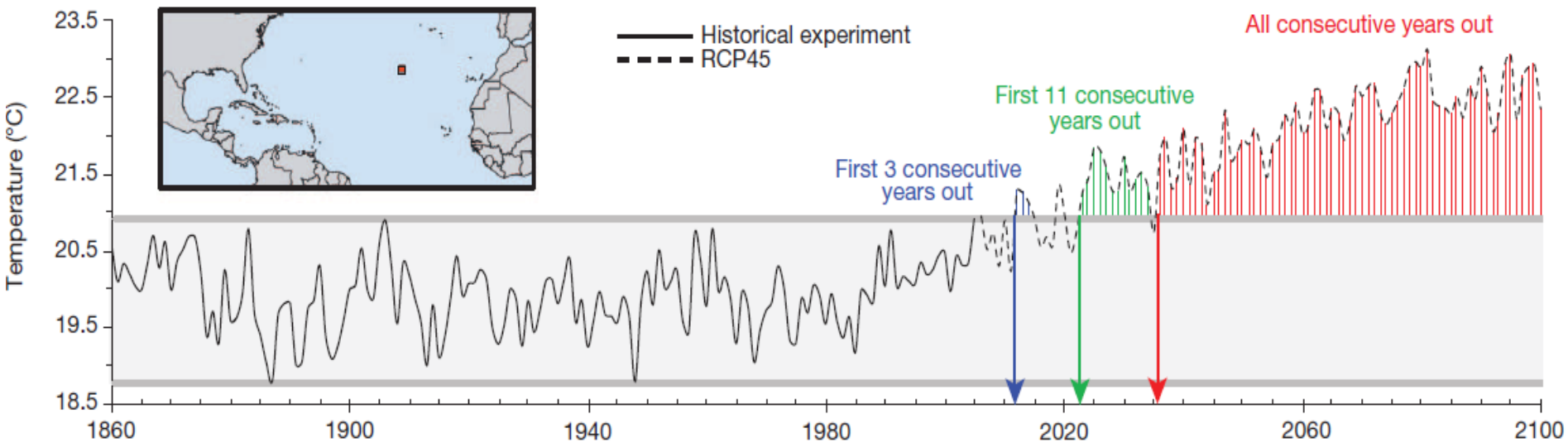
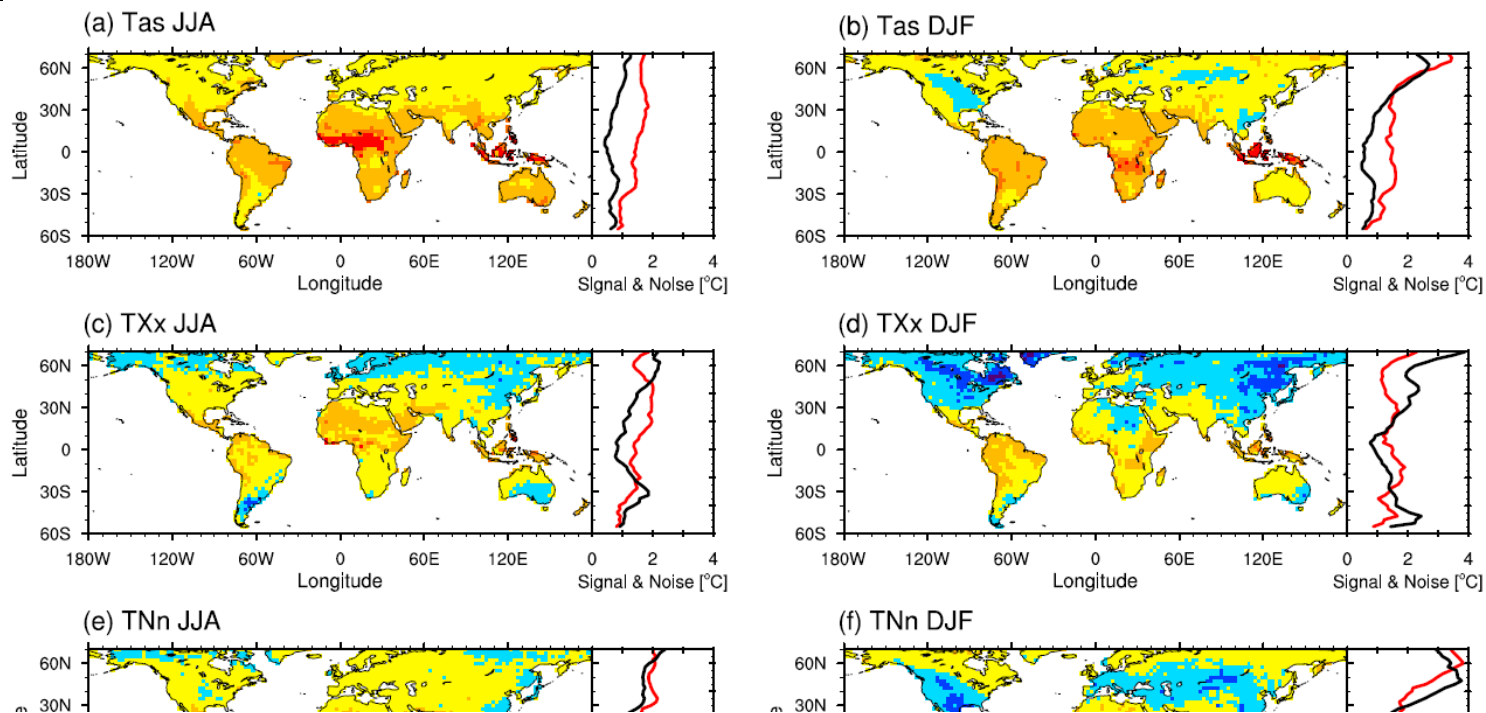
Eocén na Slovensku



POZOROVANÝ SIGNÁL ZMENY KLÍMY



POZOROVANÝ SIGNÁL ZMENY KLÍMY



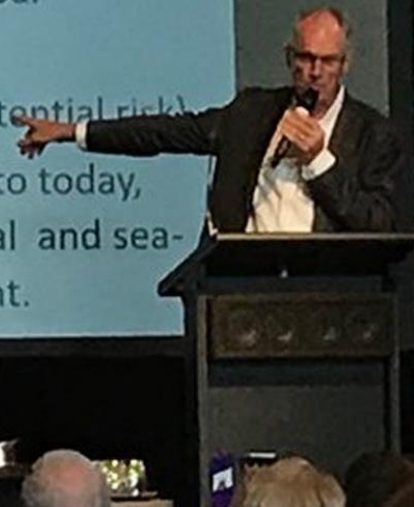
NEBEZPEČNÁ ZMENA KLÍMY?

EMERGENCY
ACTION
RESPONSE

The climate emergency at a glance

- $> 0.5^{\circ}\text{C}$ (Holocene range) is safe.
- 1.1°C is already dangerous.
- 1.5°C more significant tipping points in play.
- 2°C "hothouse Earth" threshold?
- 3°C "outright chaos".
- 4°C "Incompatible with organised global community."
- Paris outcome is presently $3\text{-}5^{\circ}\text{C}$ (existential risk)
- Mid-Pliocene CO_2 levels were similar to today, temps were $3\text{-}4^{\circ}\text{C}$ above pre-industrial and sea-level 25 (± 5) metres above the present.

<https://www.sciencemag.org/feature/2019/04/0904221033334>

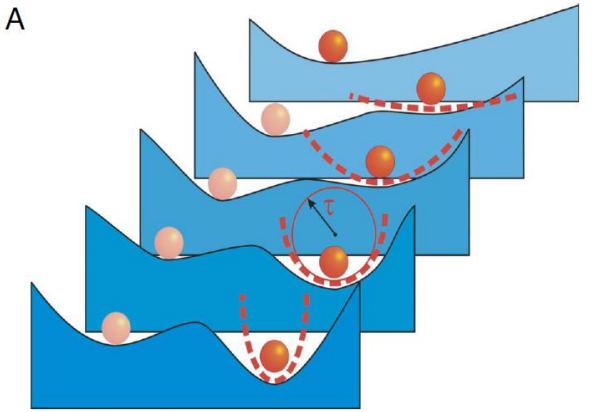
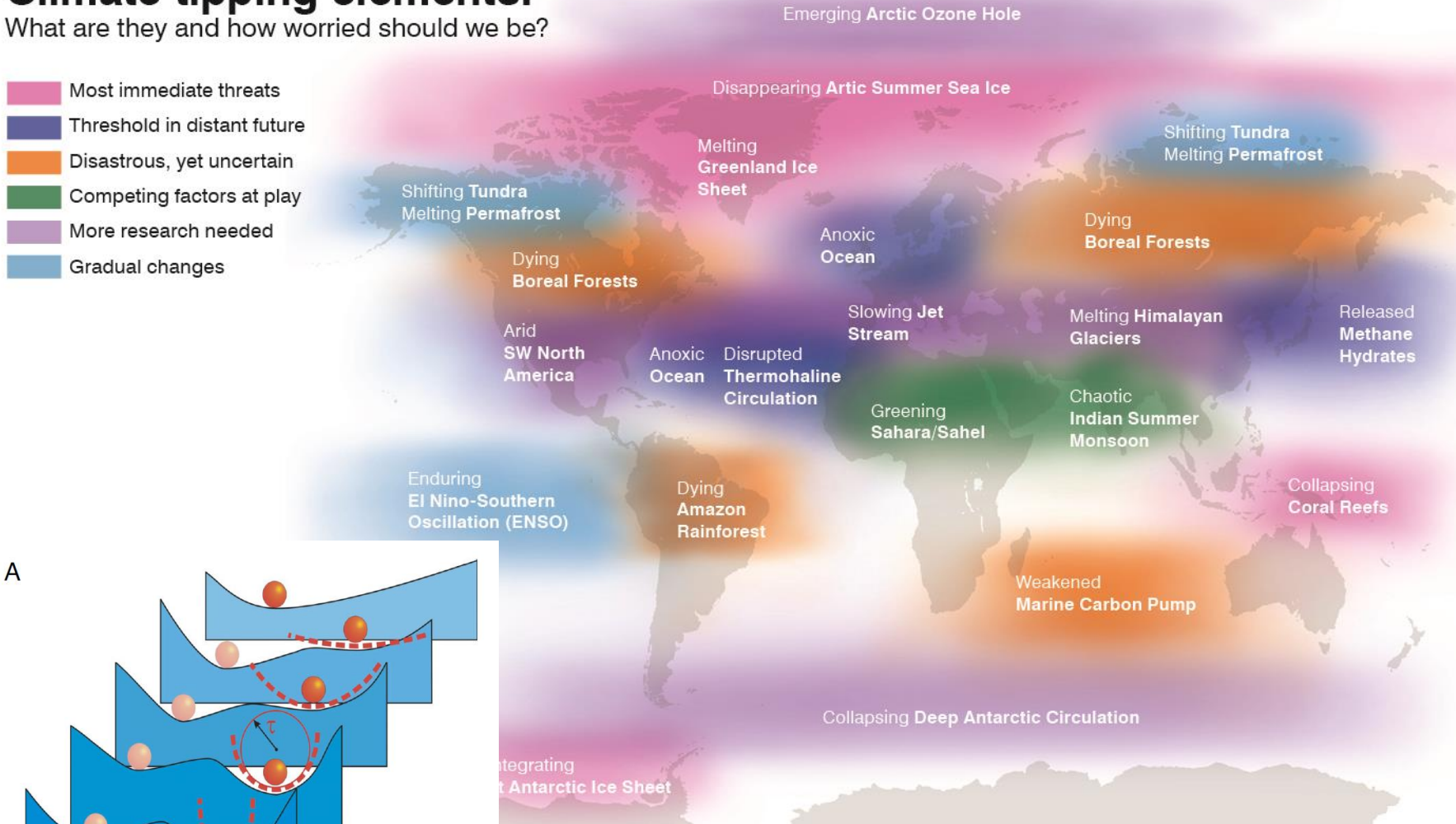


KLIMATICKÝ ZLOM?

Climate tipping elements:

What are they and how worried should we be?

- Most immediate threats
- Threshold in distant future
- Disastrous, yet uncertain
- Competing factors at play
- More research needed
- Gradual changes

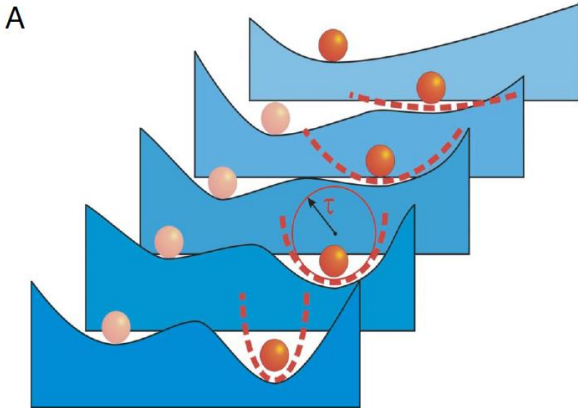


KLIMATICKÝ ZLOM?

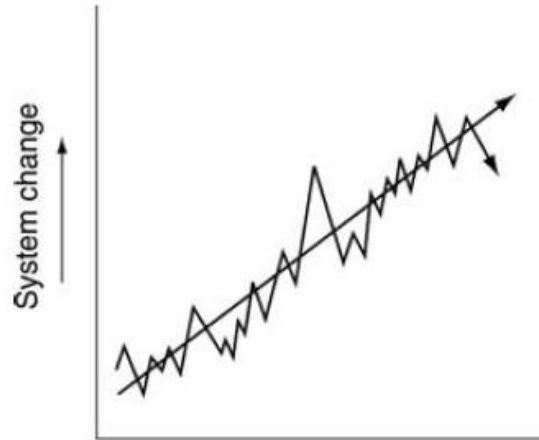
Climate tipping elements:

What are they and how worried should we be?

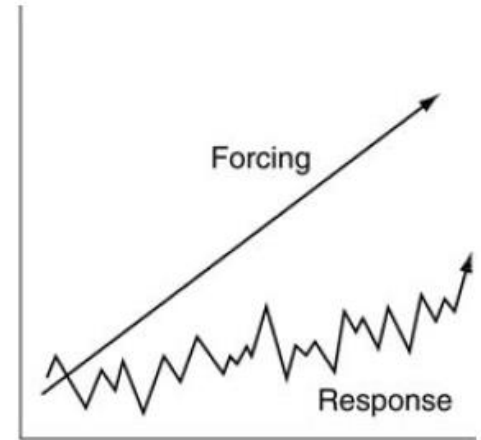
- Most immediate threats
- Threshold in distant future
- Disastrous, yet uncertain
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- More research needed
- Gradual changes



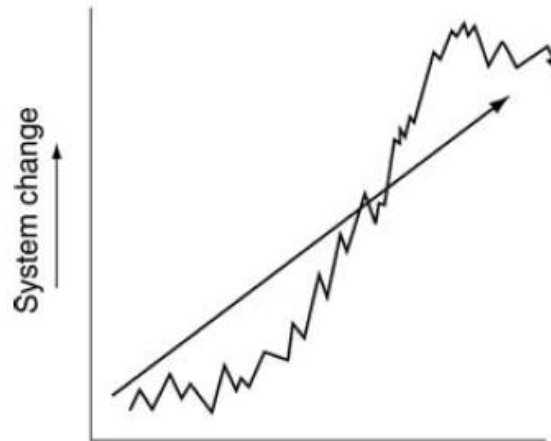
Emerging Arctic Ozone Hole



a

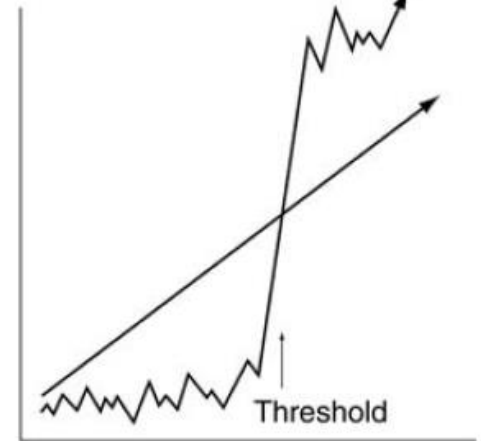


b



c

Time

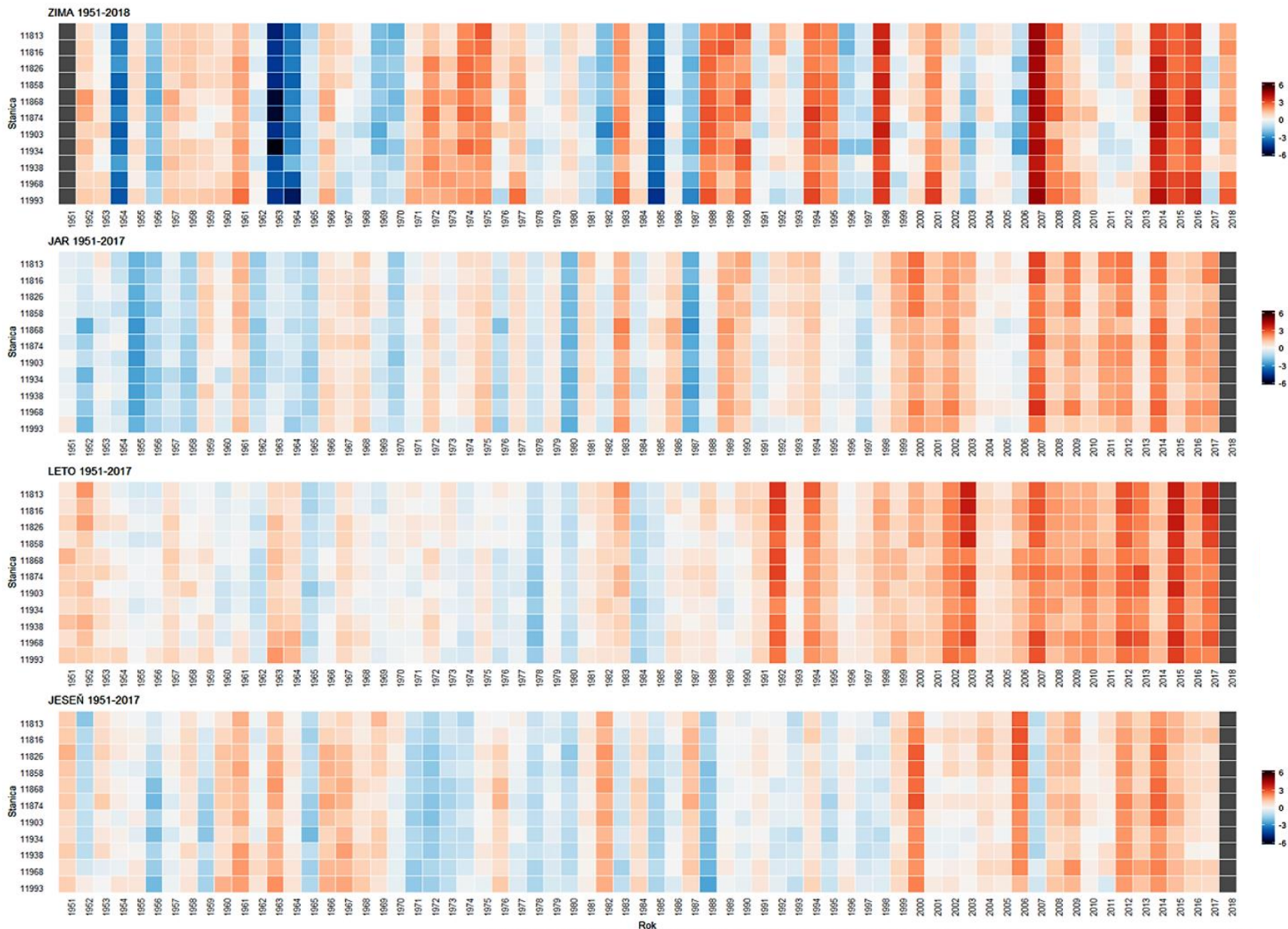


d

Time

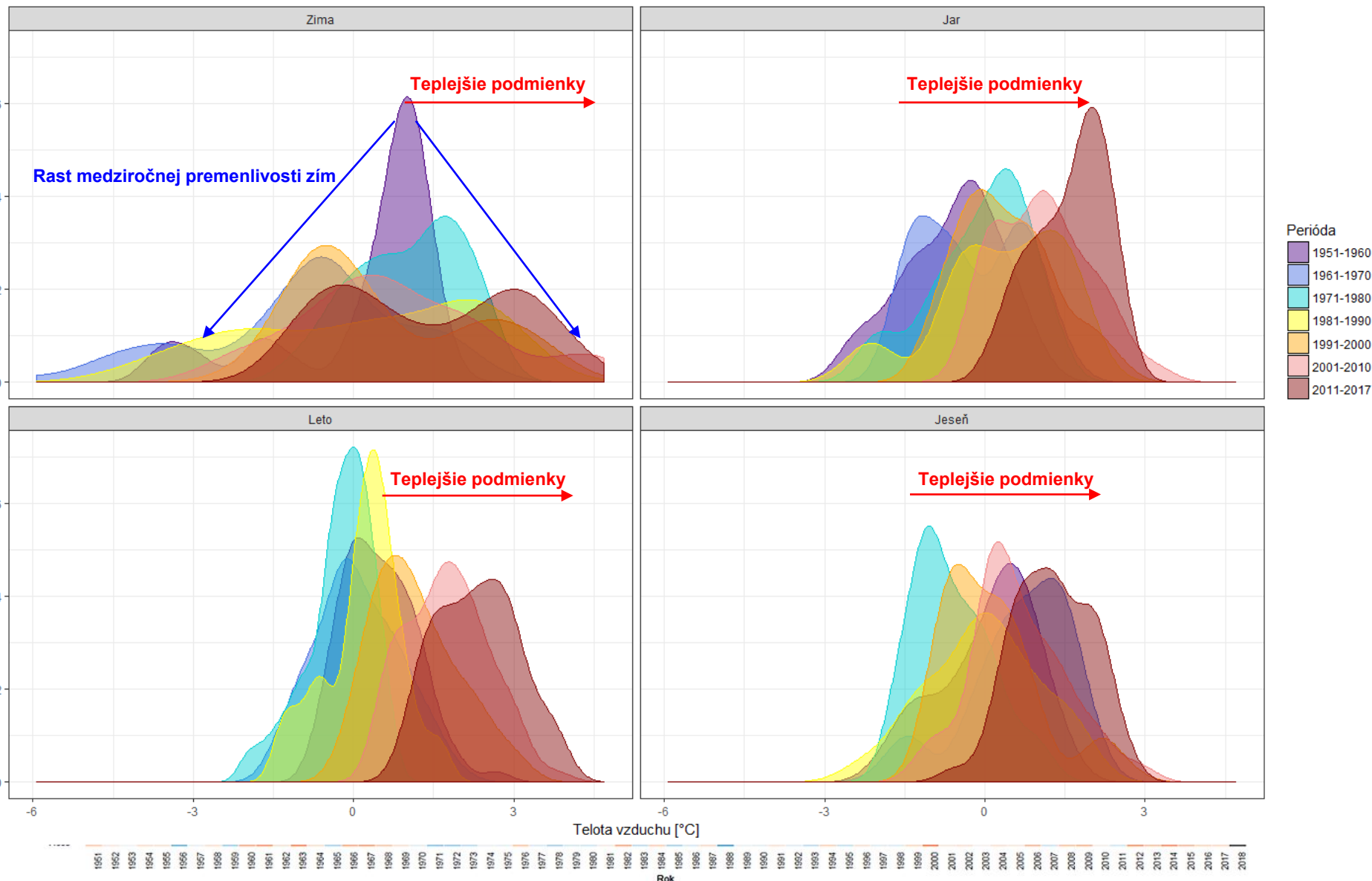
***ZMENA REŽIMU KLÍMY
NA SLOVENSKU***

ZMENA REŽIMU TEPLoty VZDUCHU



ZMENA REŽIMU TEPLoty VZDUCHU

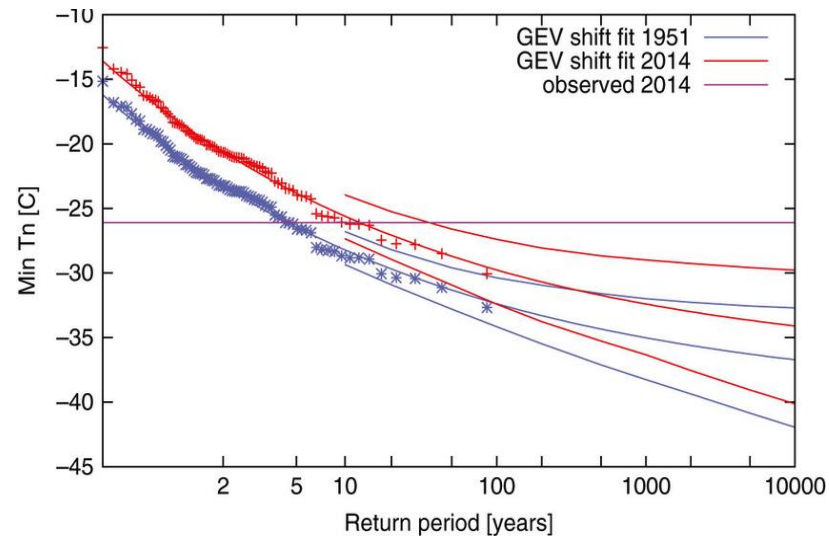
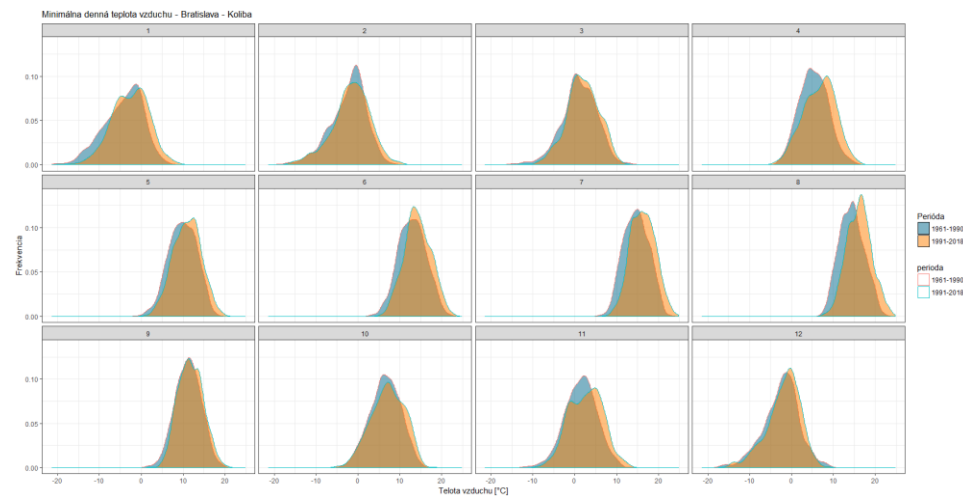
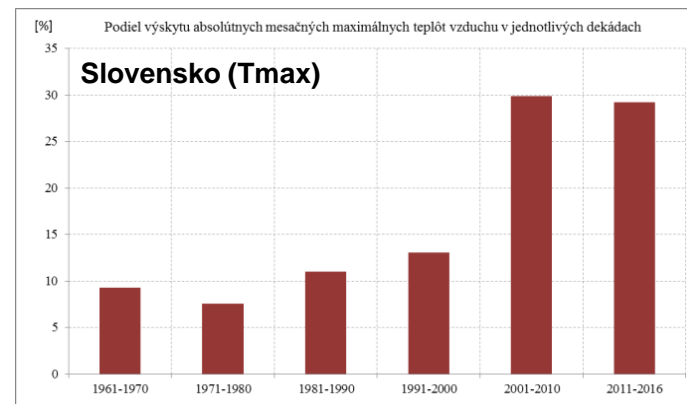
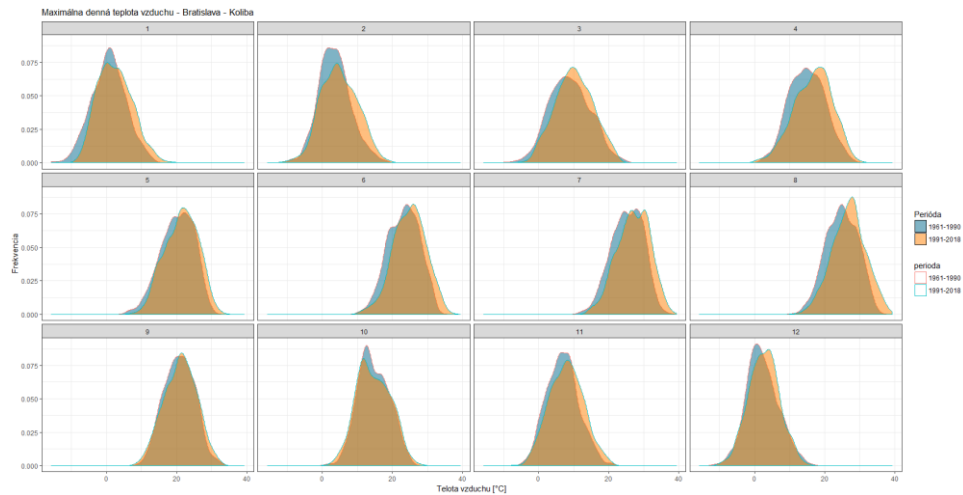
Odchýlka sezónnej teploty vzduchu na Slovensku



1961 1962 1963 1964 1965 1966 1967 1968 1969 1970 1971 1972 1973 1974 1975 1976 1977 1978 1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018

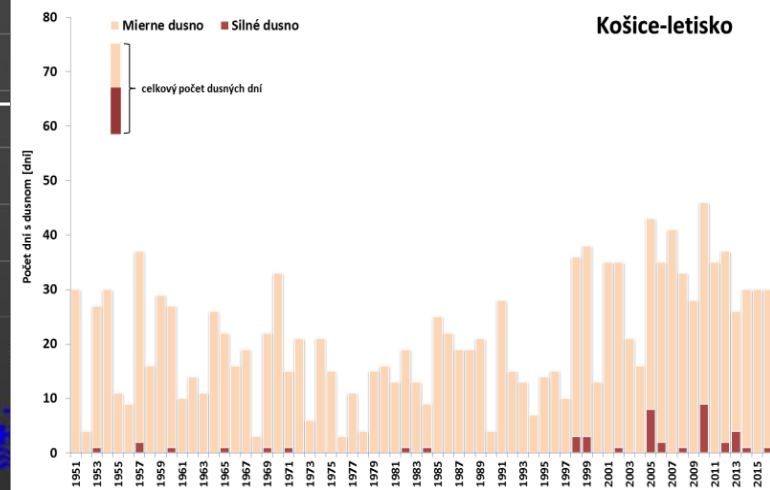
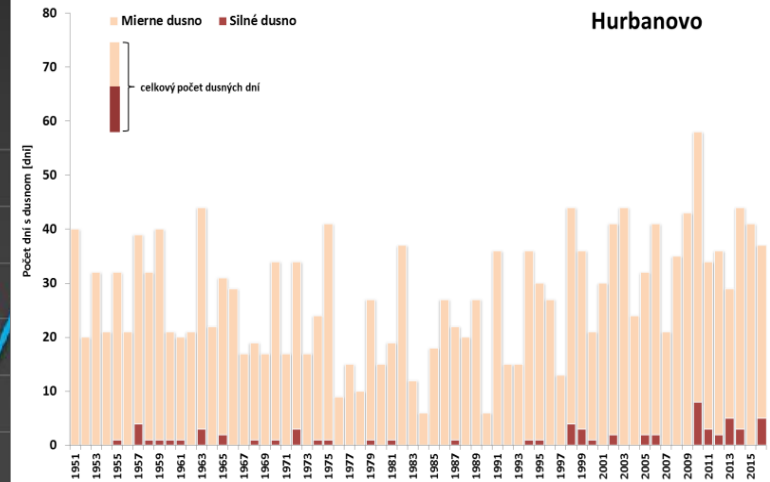
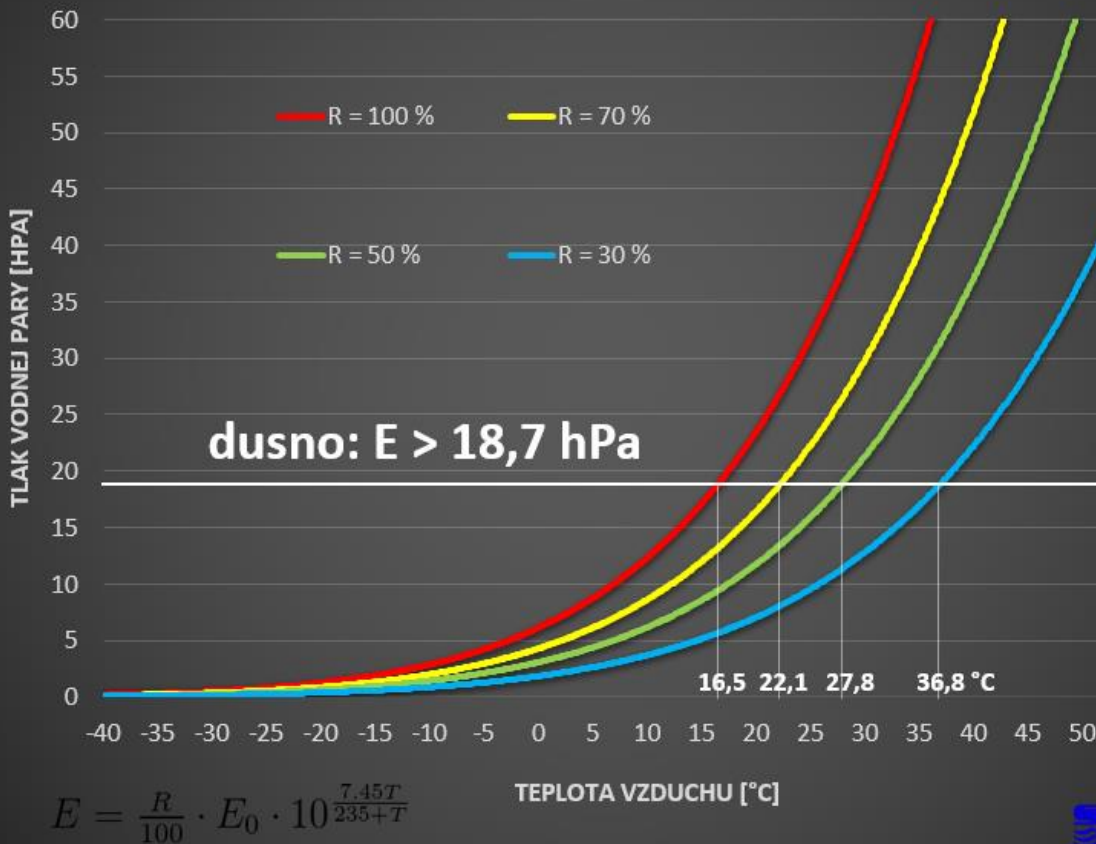
Rok
11813: BA-KOLIBA, 11816: BA-LETISKO, 11826: PIEŠŤANY, 11858: HURBANOVO, 11868: ORAVSKÁ LESNÁ, 11903: SLJAC, 11934: POPRAD, 11968: KE-LETISKO, 11993: KAMENICA N/CIR

ZMENA REŽIMU TEPLoty VZDUCHU



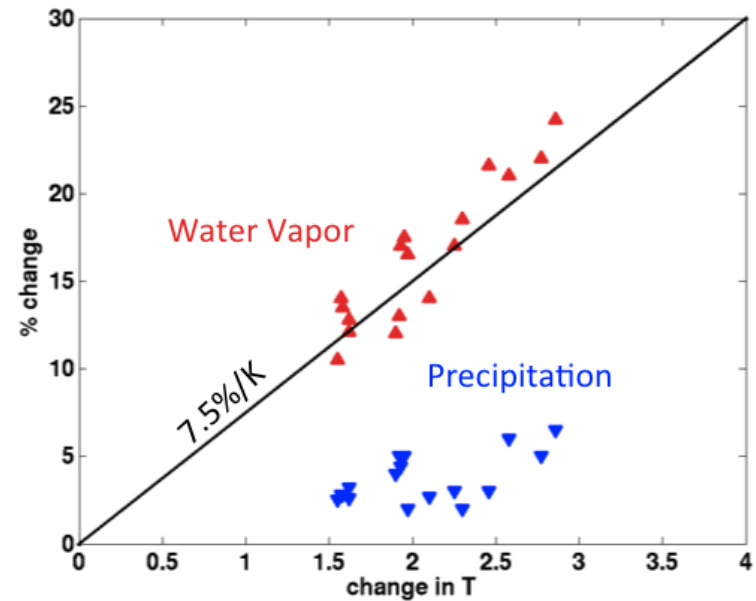
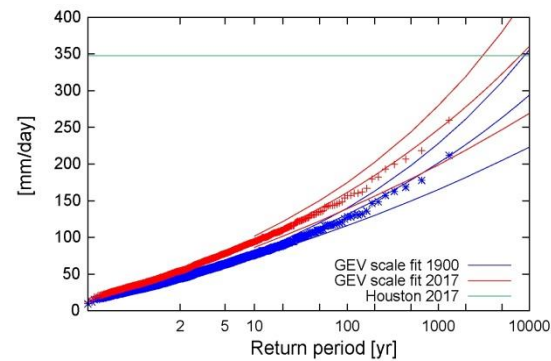
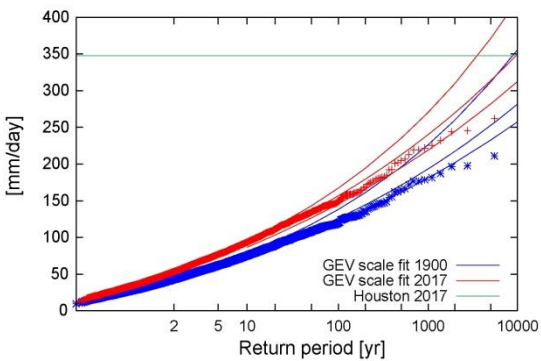
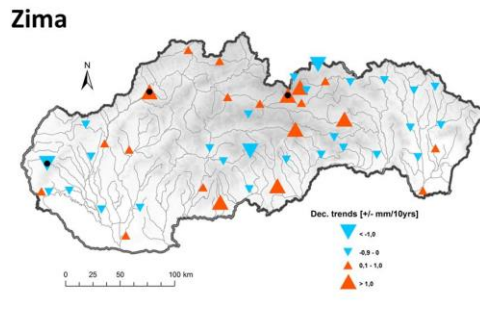
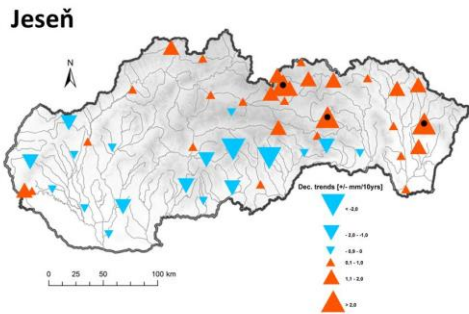
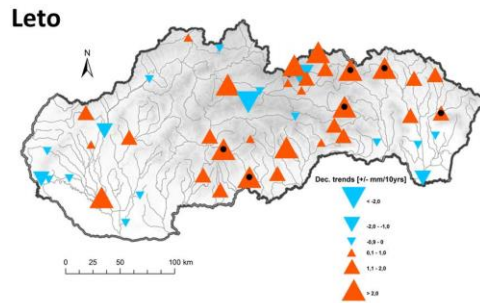
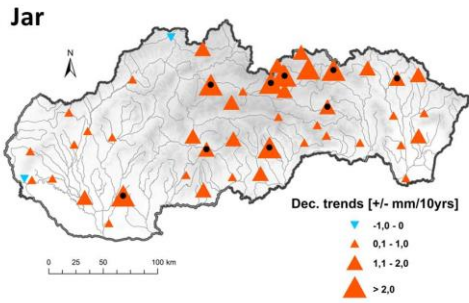
JE NA SLOVENSKU ČASTEJŠIE „DUSNO“

Závislosť tlaku vodnej pary od teploty pri danej relatívnej vlhkosti vzduchu

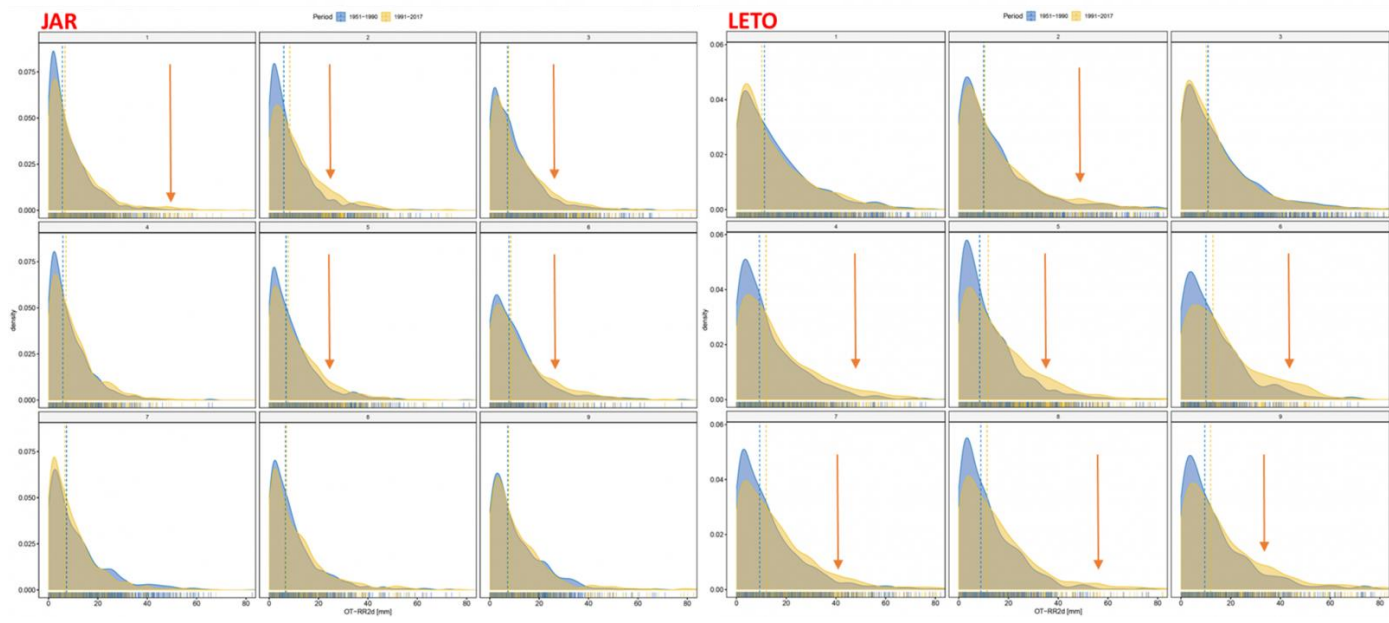
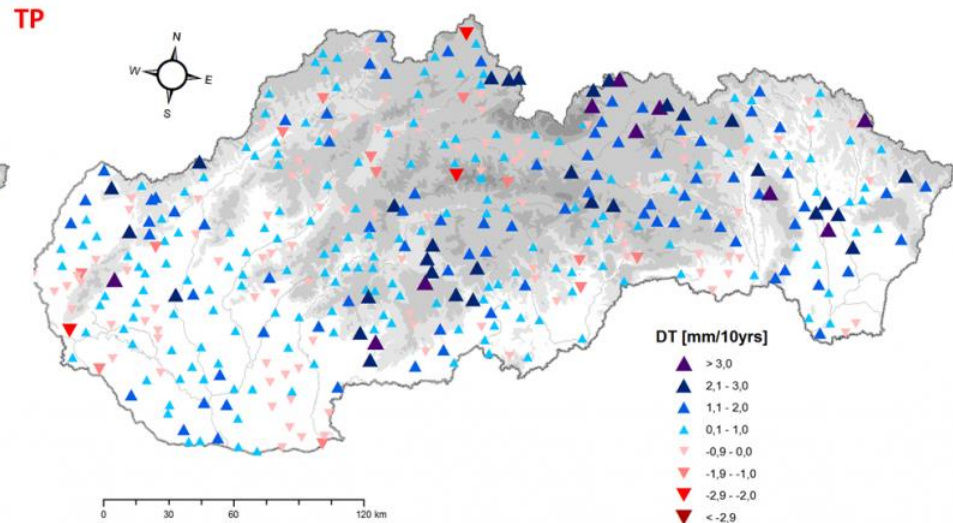
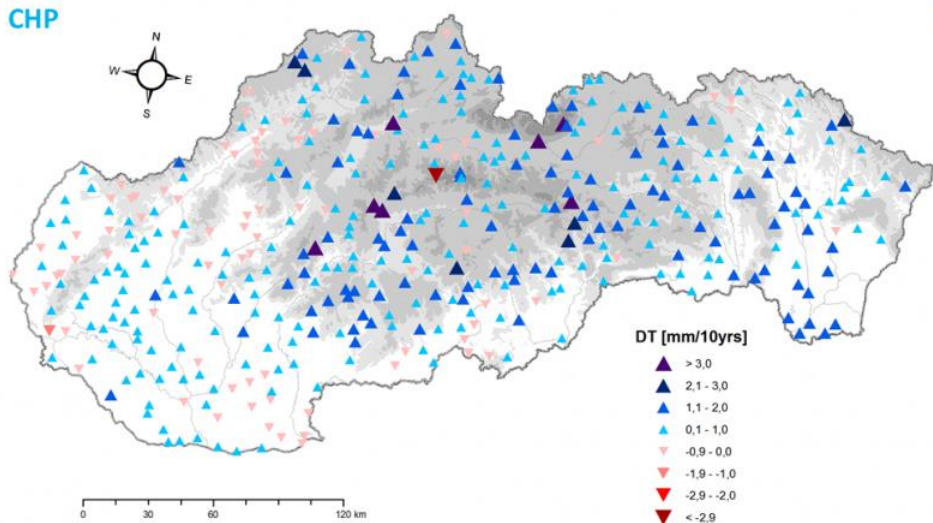




KEĎ PRŠÍ TAK LEJE

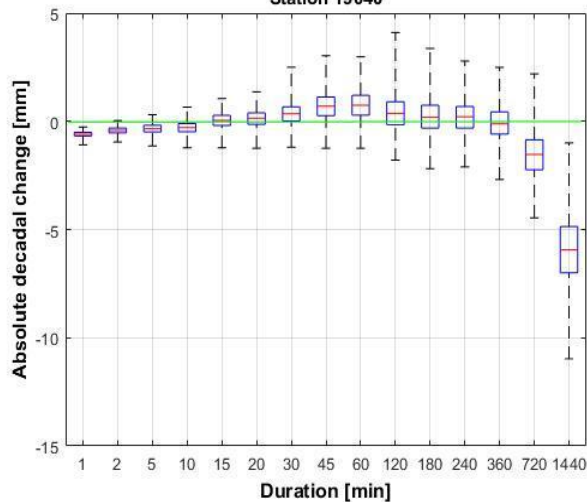


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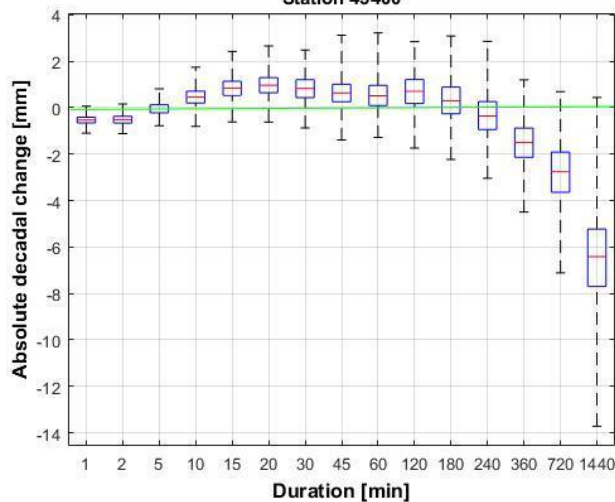


KEŽ PRŠÍ TAK LEJE

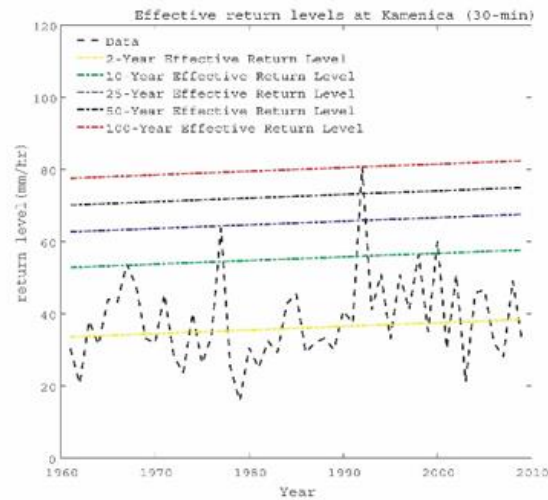
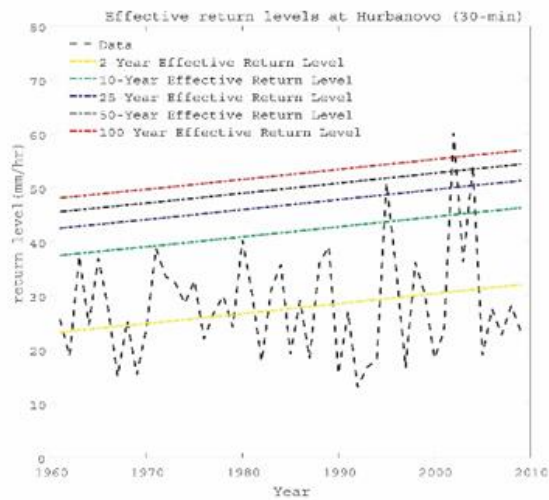
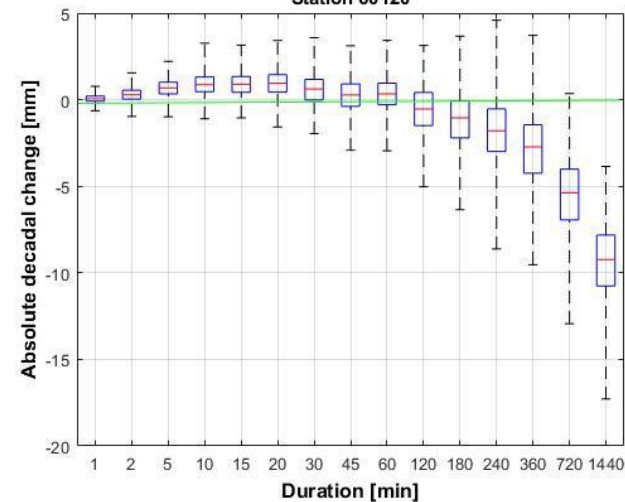
Station 19040



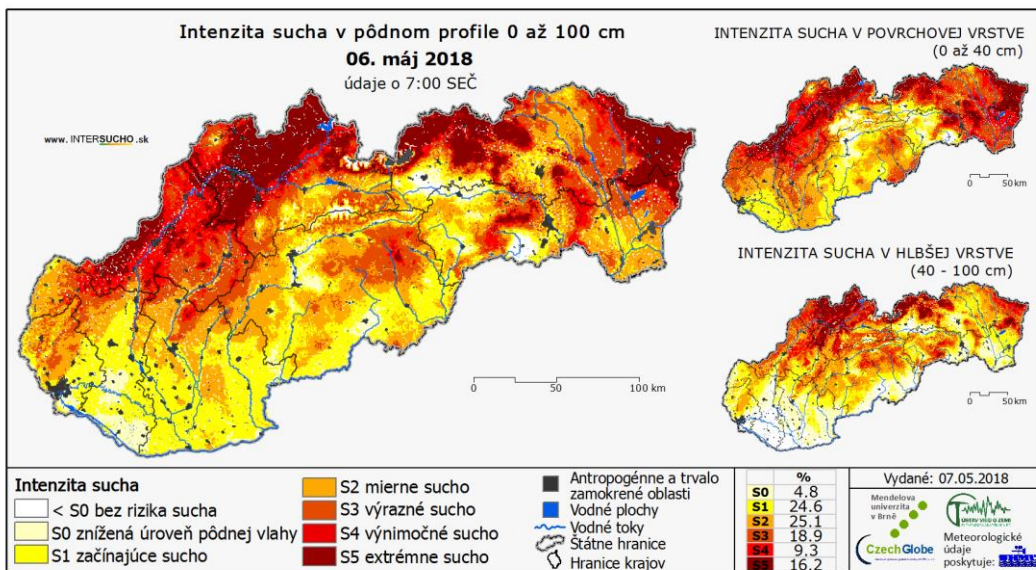
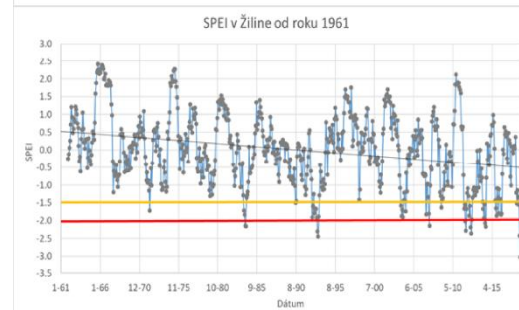
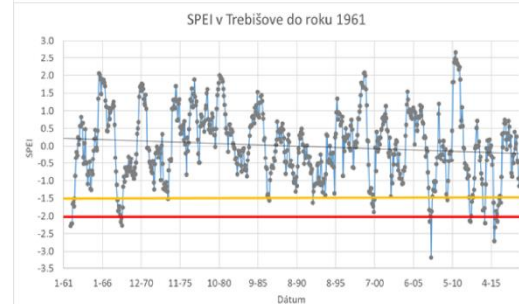
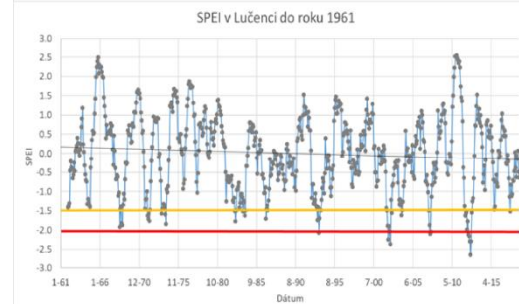
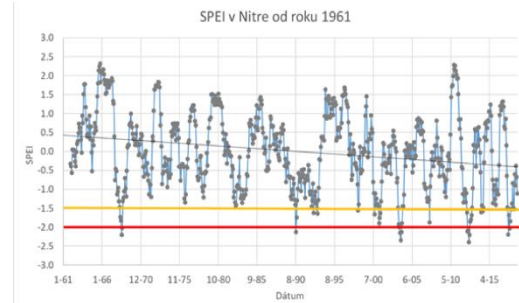
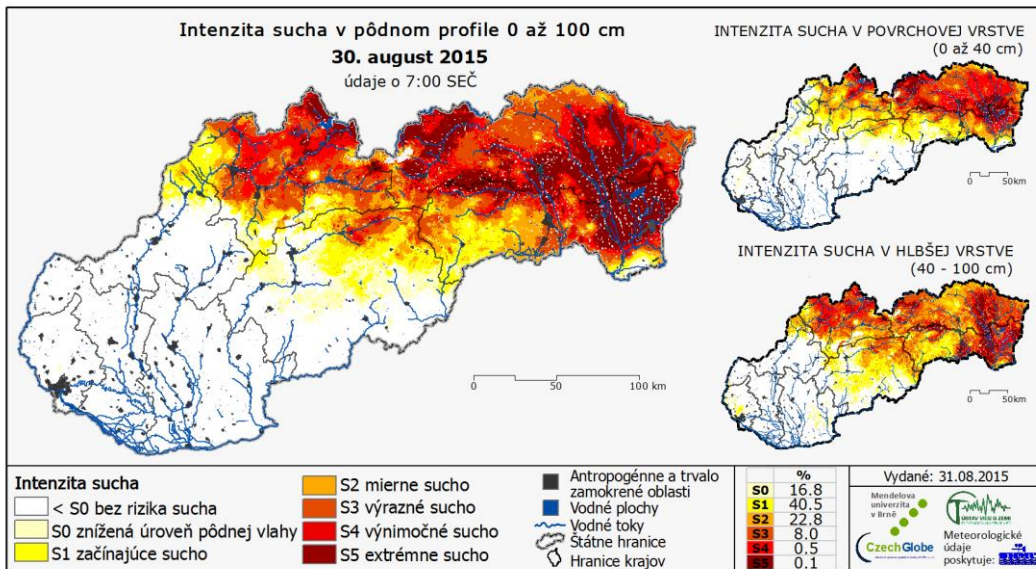
Station 43400



Station 60120



NÁRAST SUCHA ?

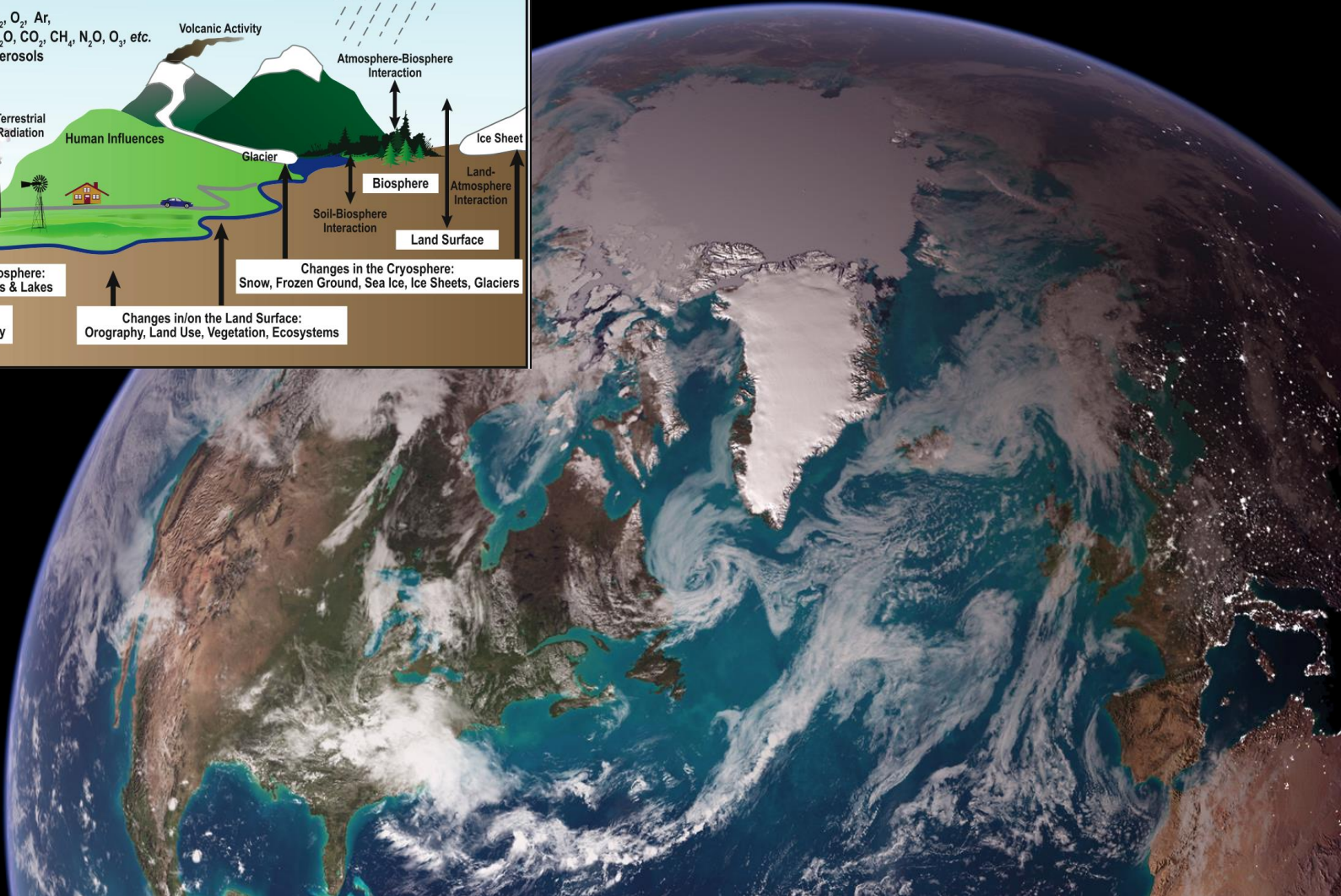
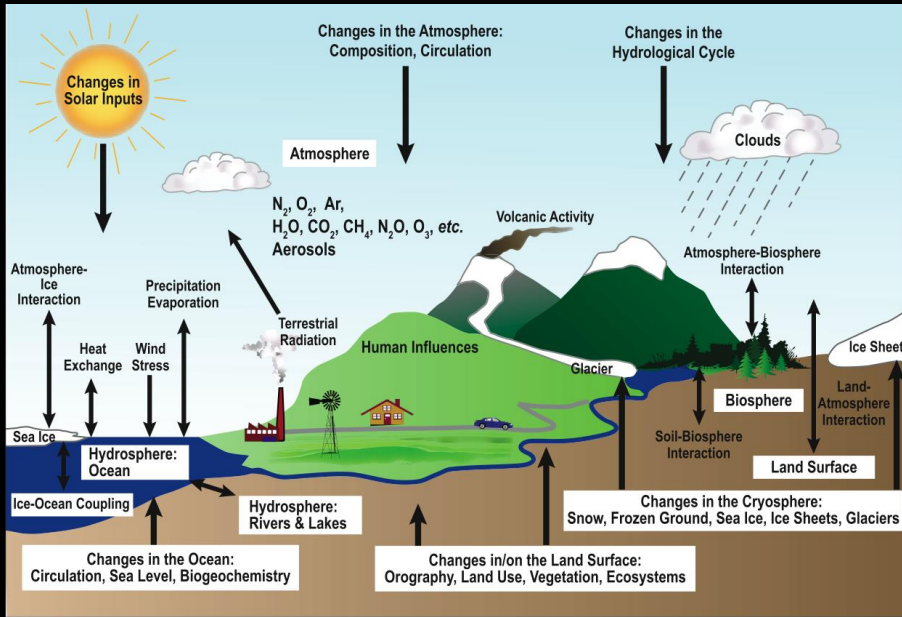


ČO NÁS ČAKÁ ?

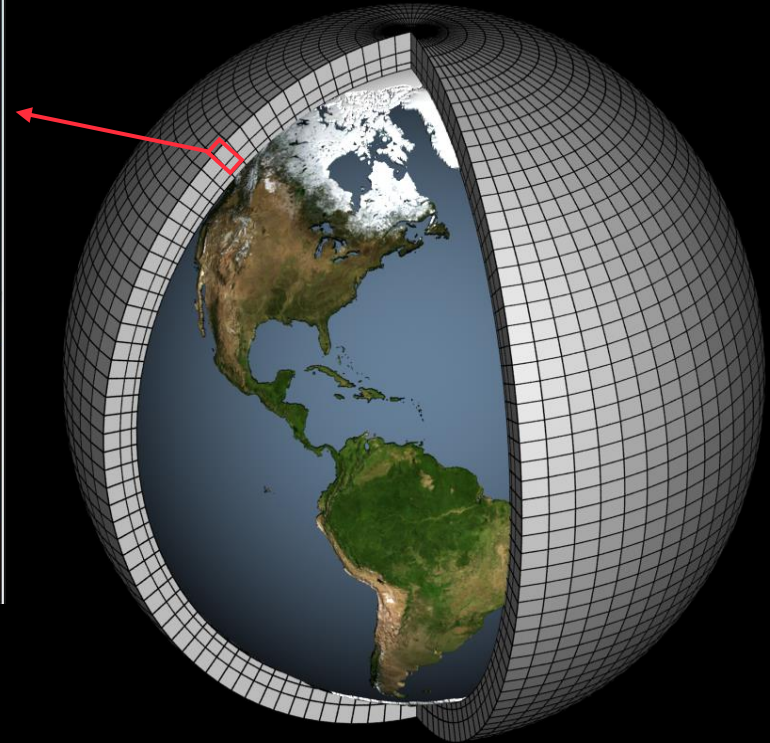
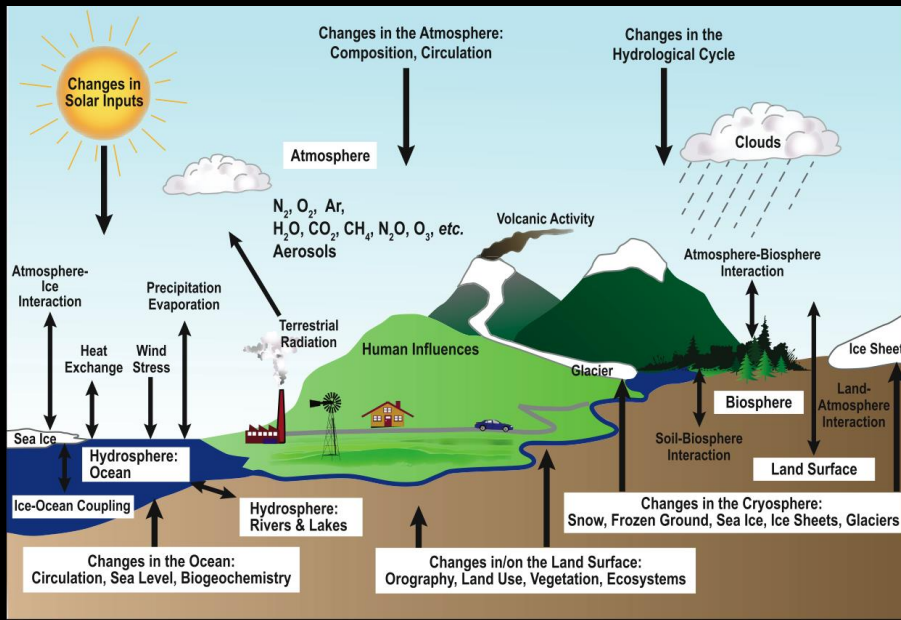
PREDIKTABILITA KLIMATICKÝCH MODELOV



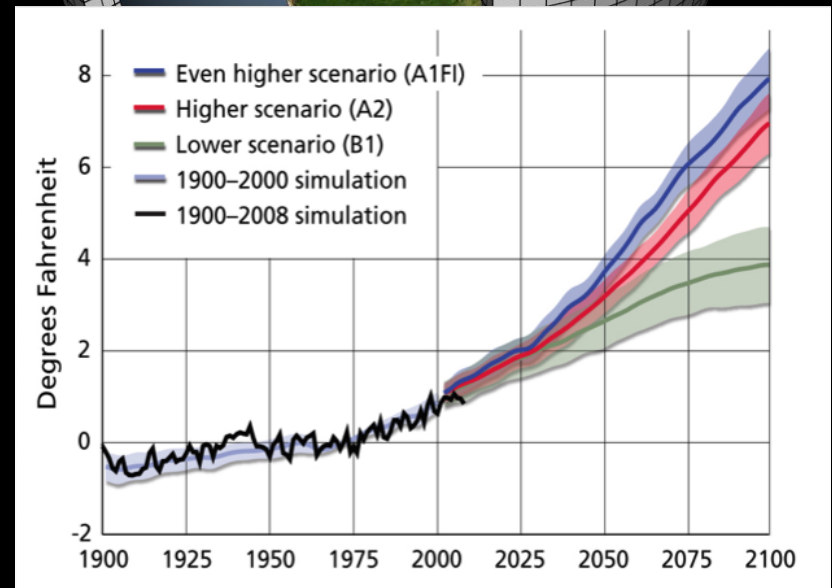
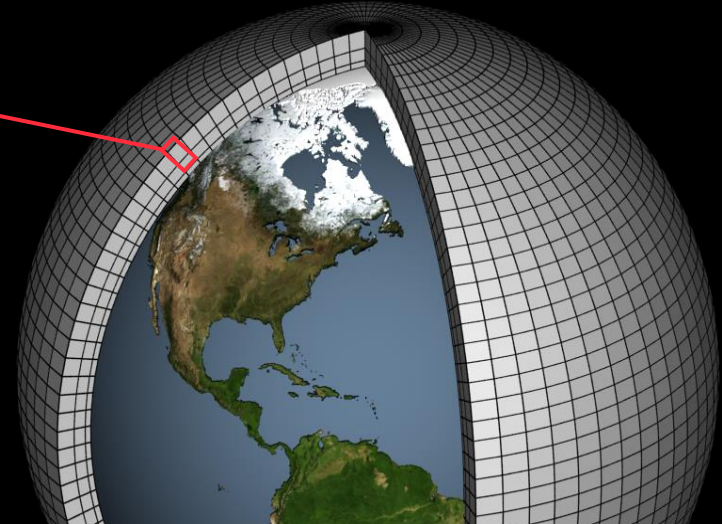
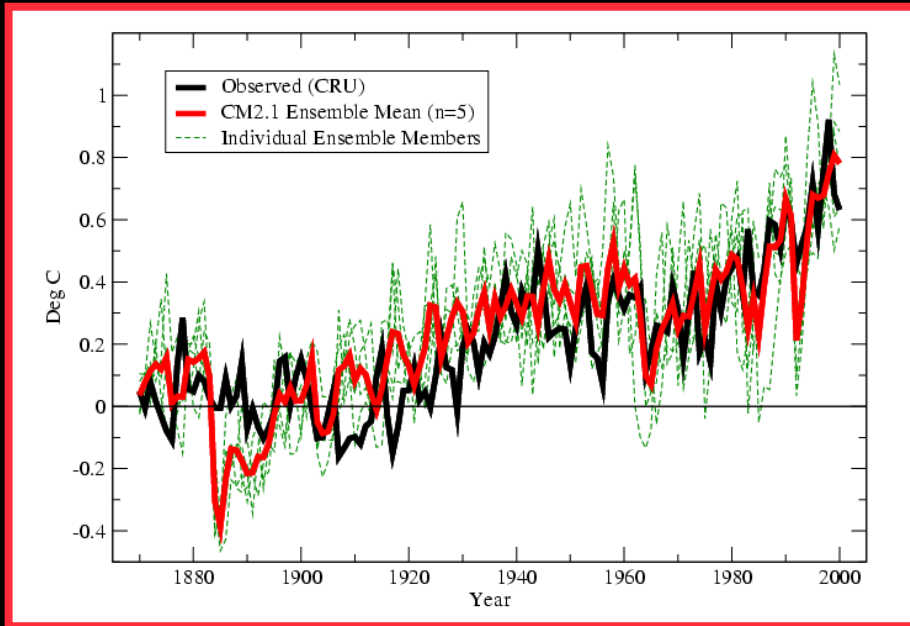
Veľká komplexnosť klimatického systému



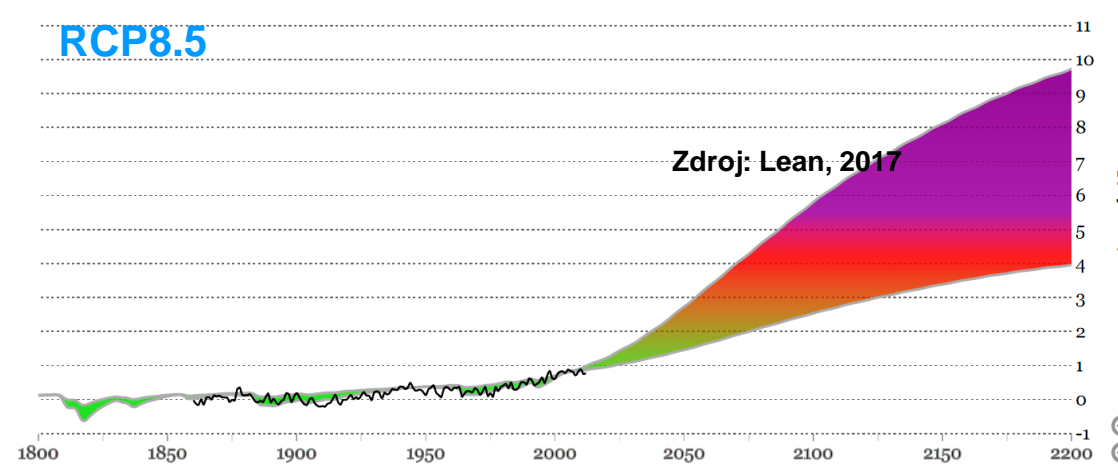
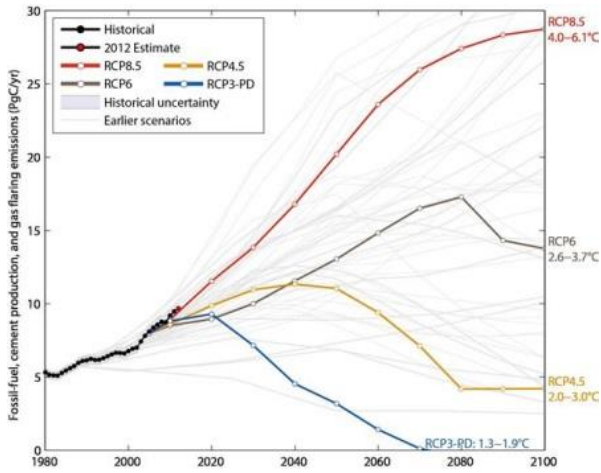
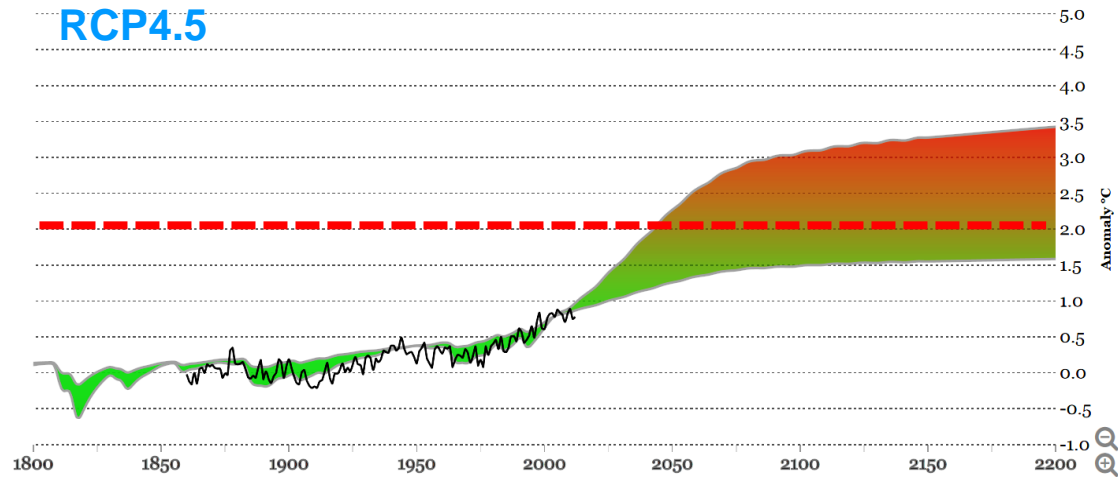
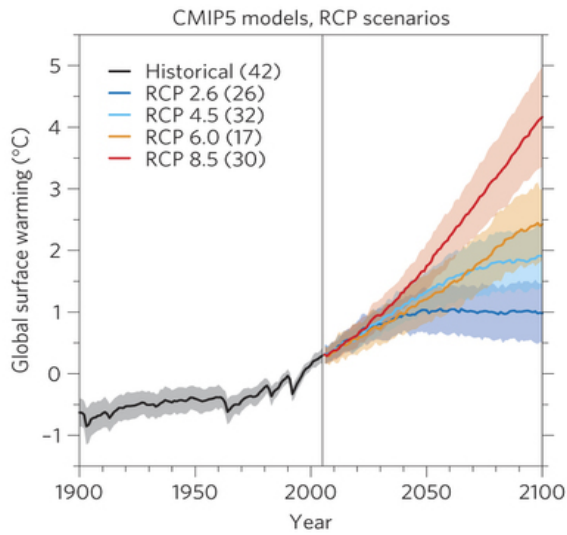
Globálne cirkulačné modely



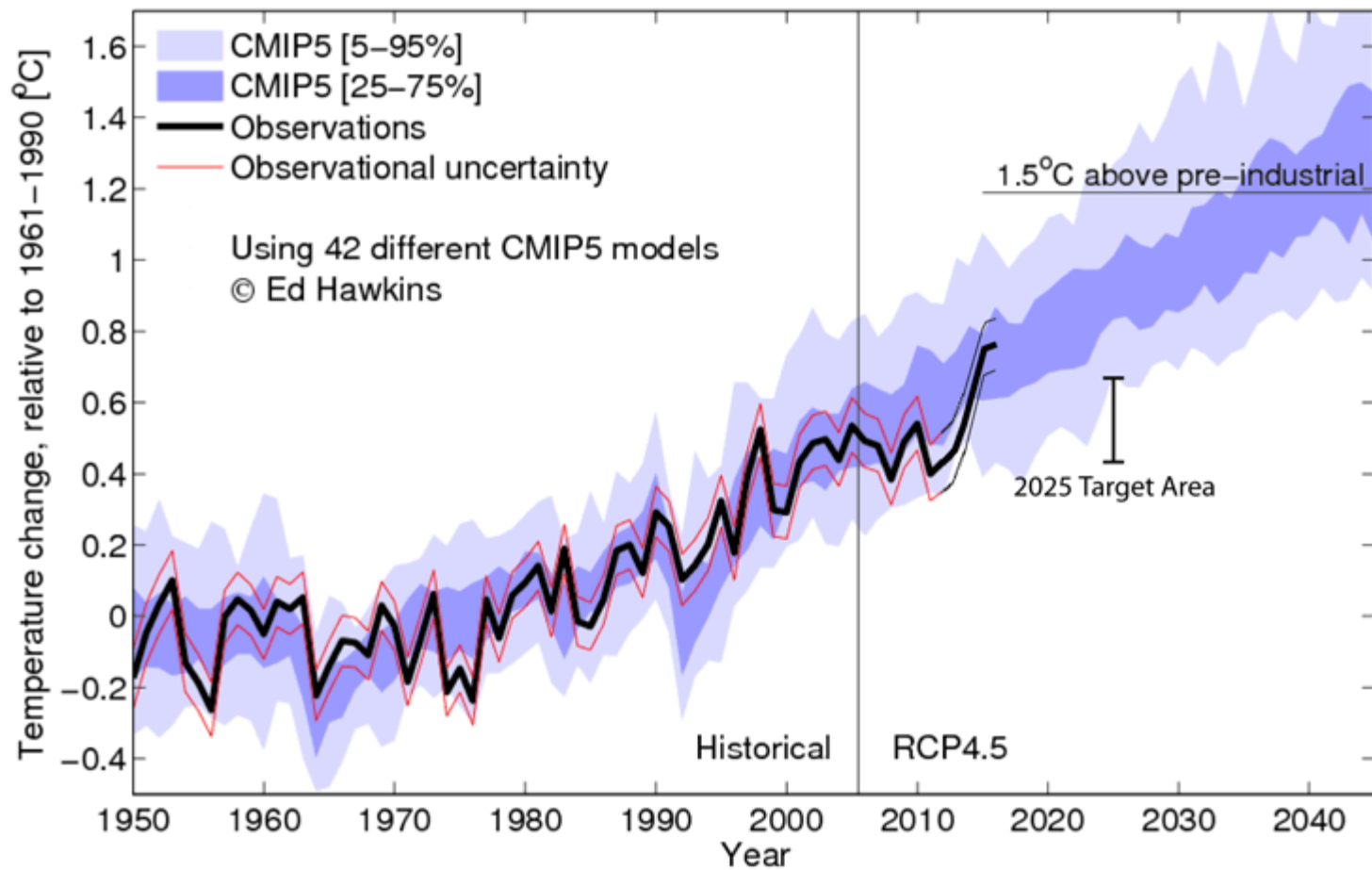
Globálne cirkulačné modely



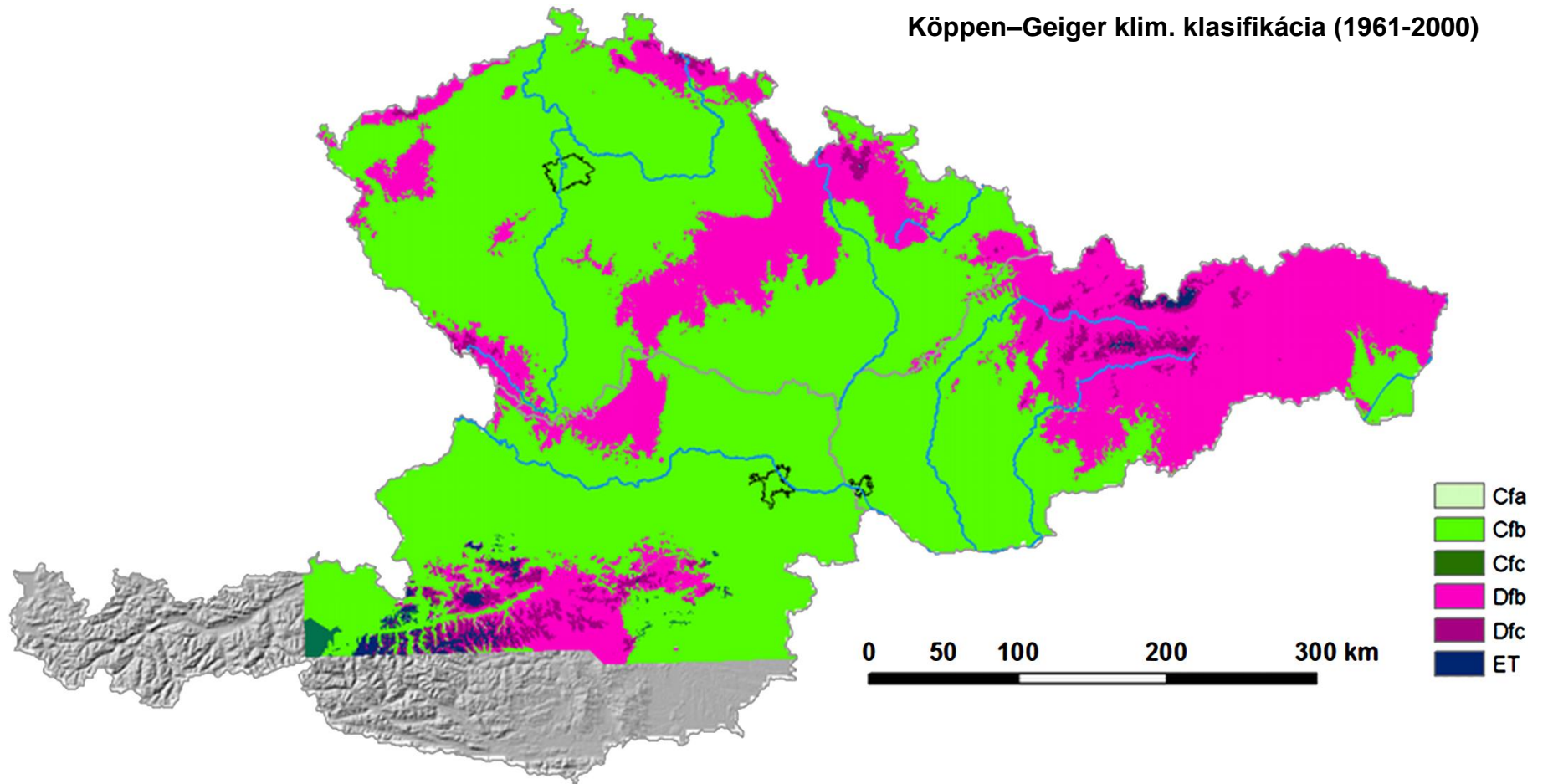
SCENÁRE KLIMATICKEJ ZMENY



GLOBAL TEMPERATURES: comparing CMIP5 & HadCRUT4



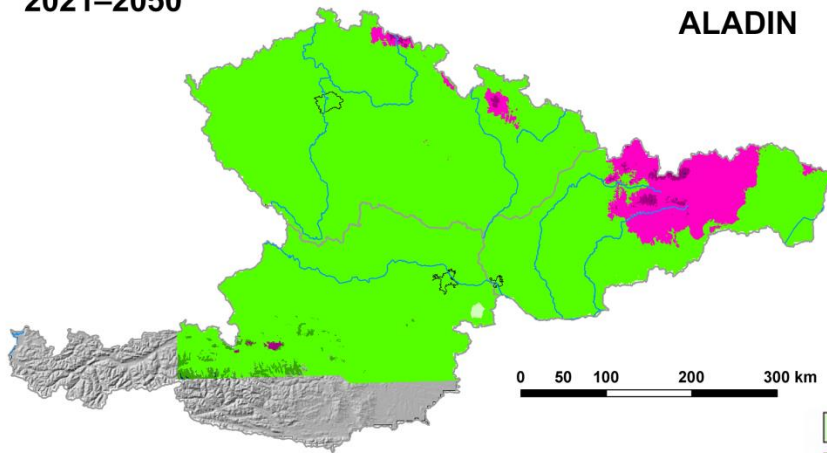
POSUN DO „STREDOMORSKEJ“ KLÍMY?



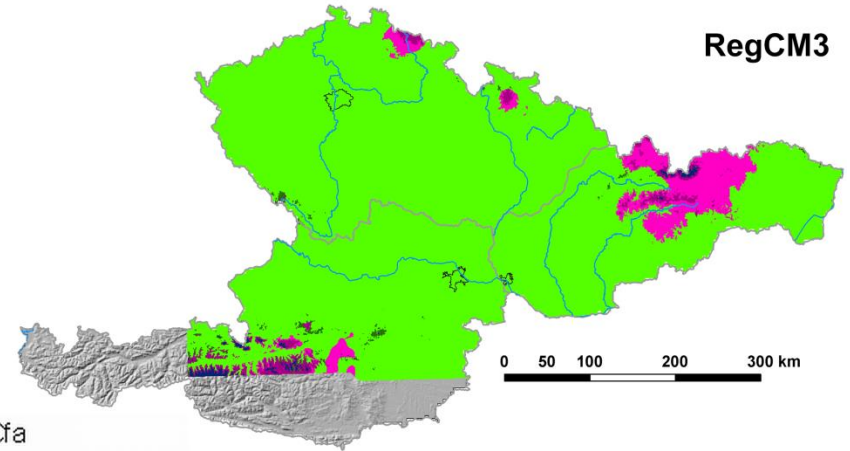
POSUN DO „STREDOMORSKEJ“ KLÍMY?

2021–2050

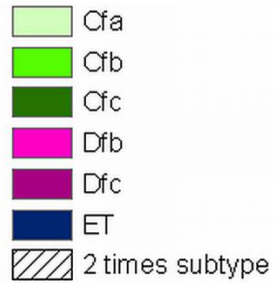
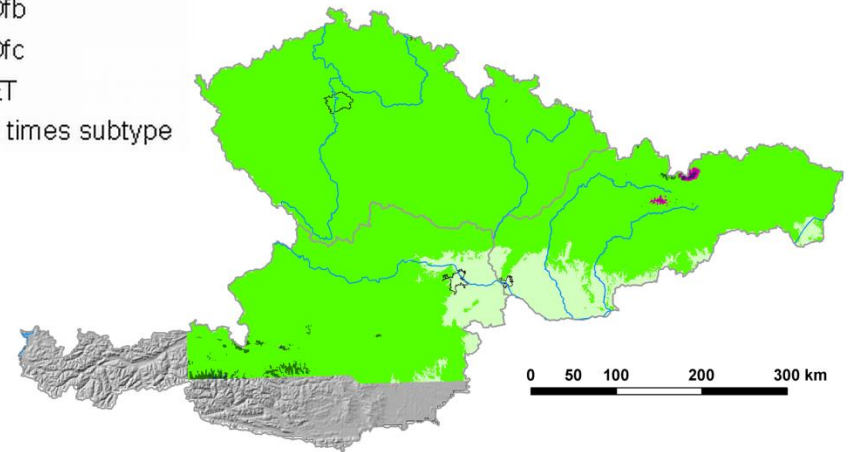
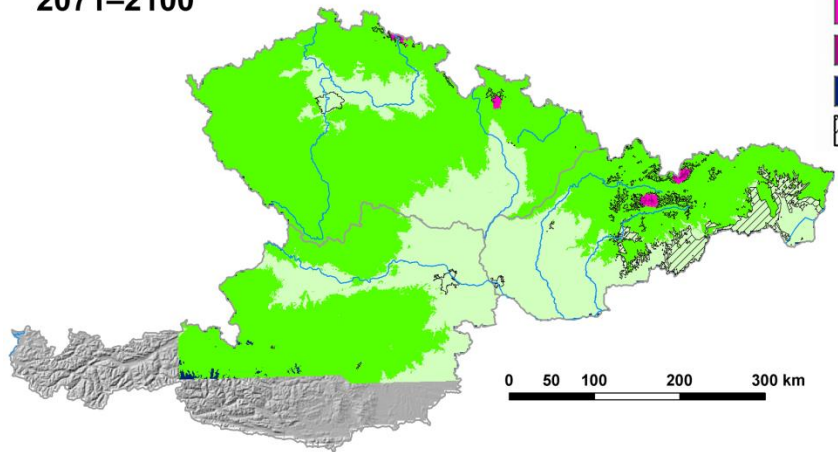
ALADIN



RegCM3



2071–2100



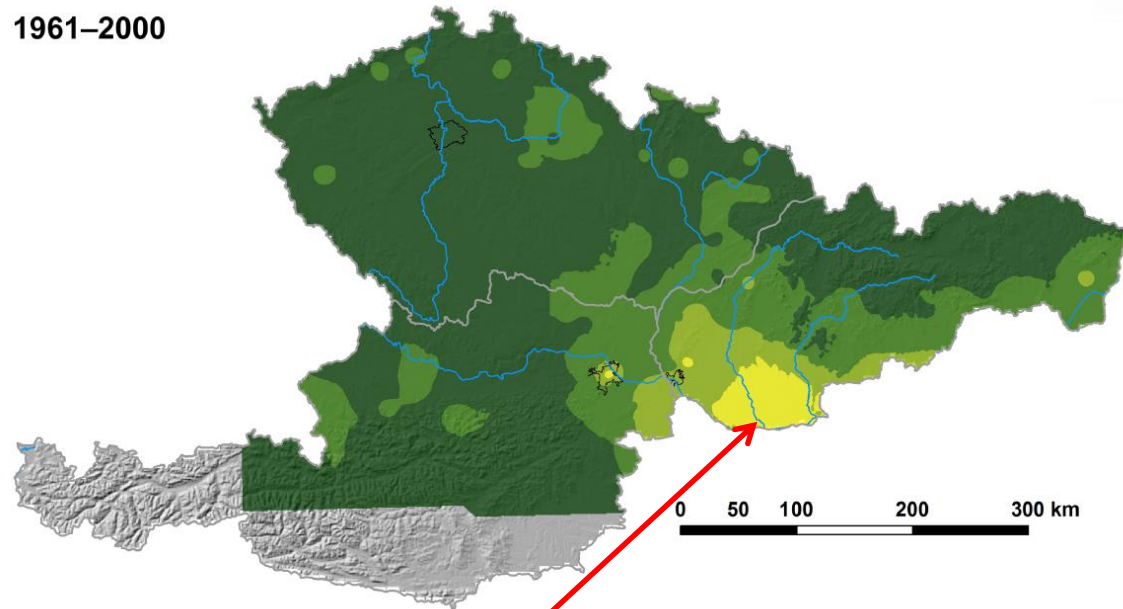
POSUN DO „STREDOMORSKEJ“ KLÍMY?

Pravdepodobnosť [%]



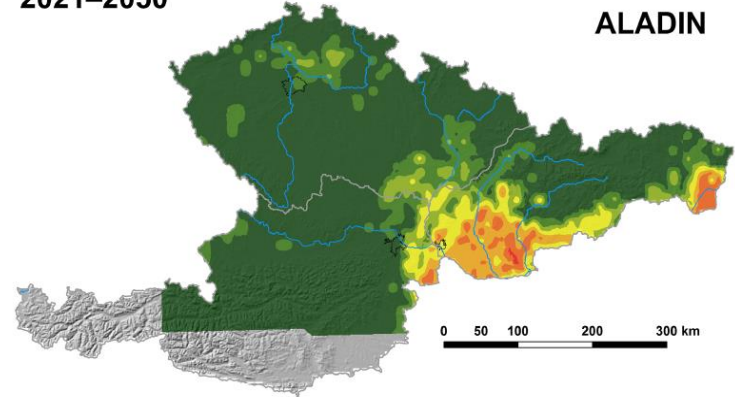
1 5 10 20 30 50

1961–2000

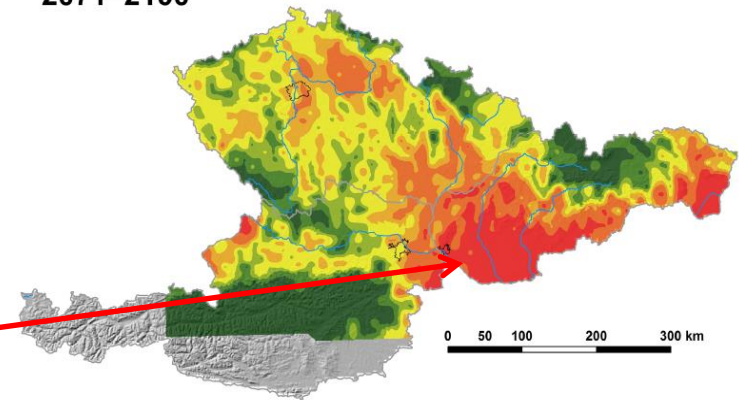


0 50 100 200 300 km

2021–2050



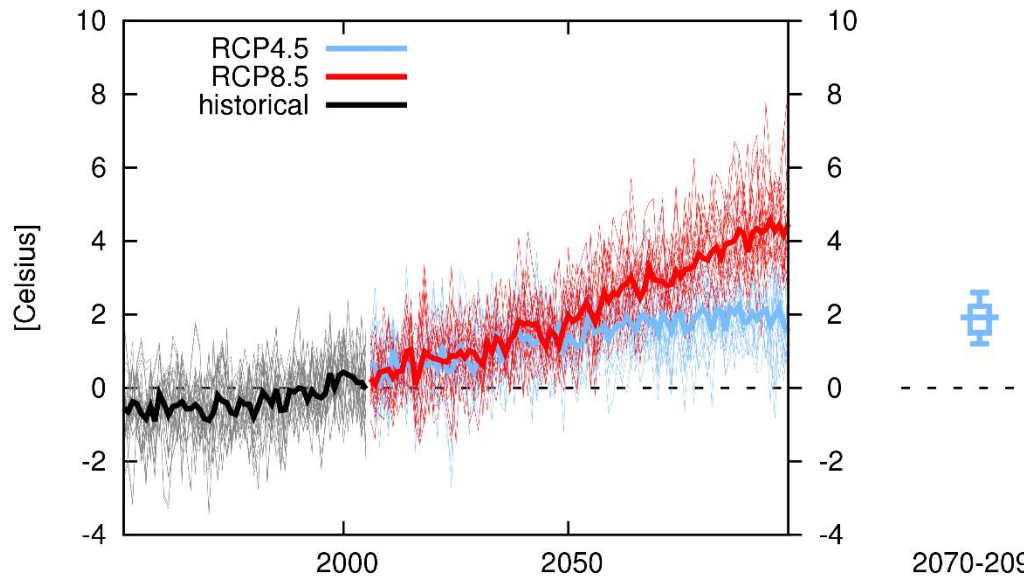
2071–2100



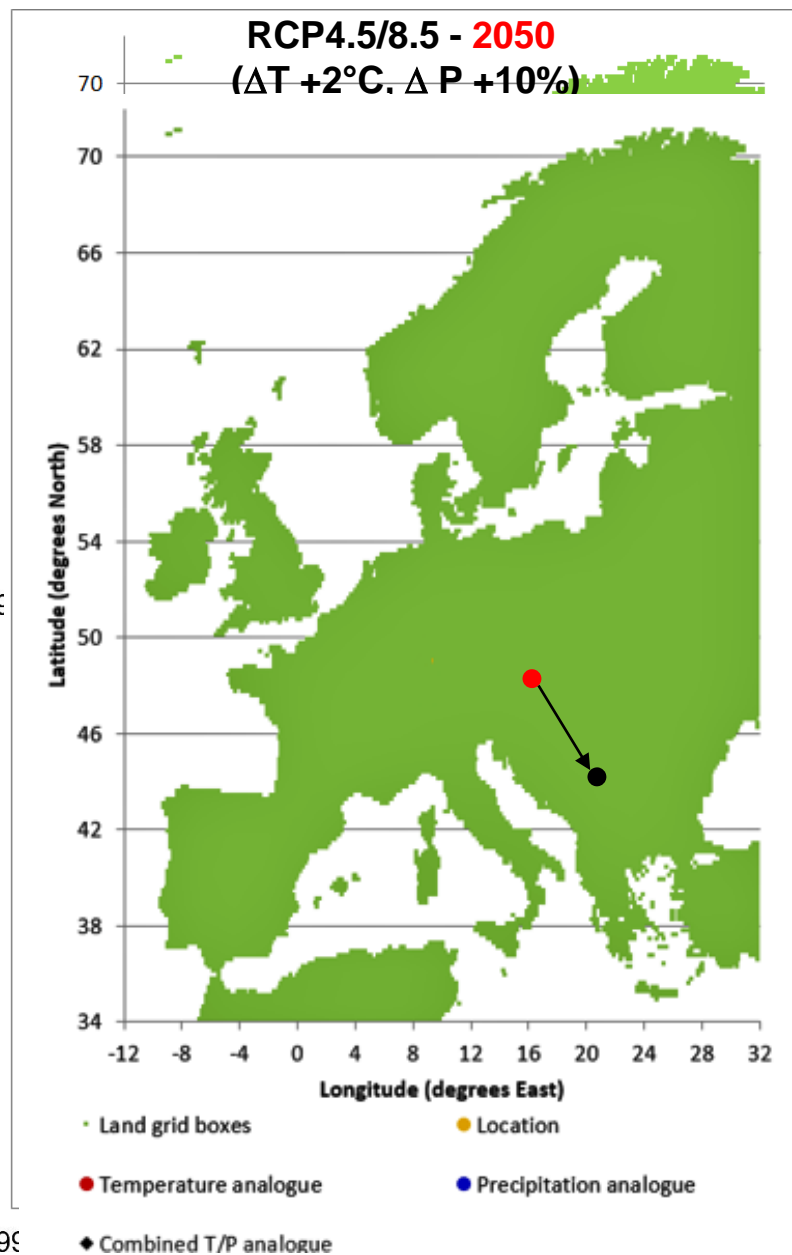
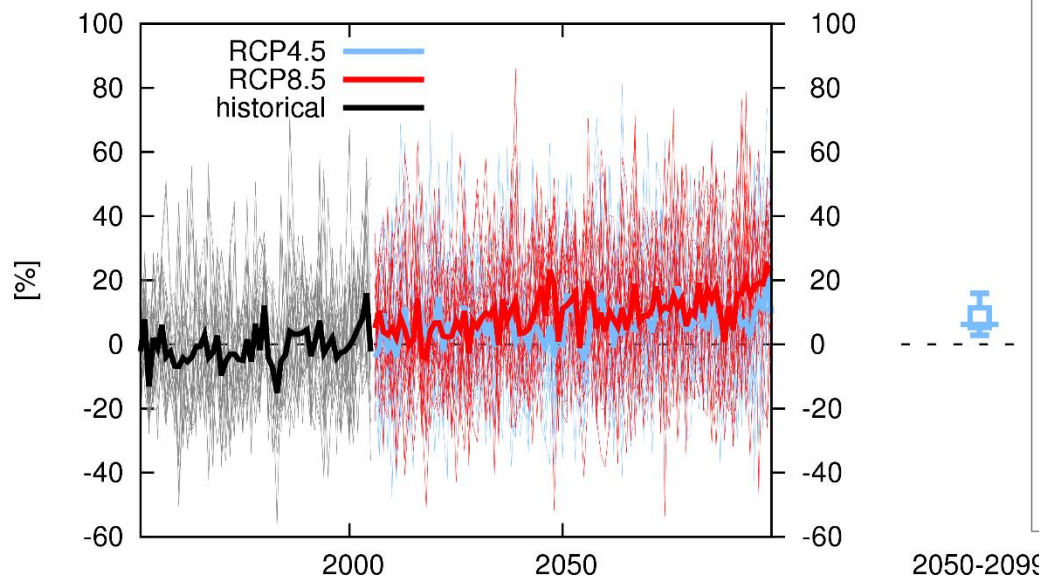
Csa klíma (substrapická suchá)

POSUN DO „STREDOMORSKEJ“ KLÍMY?

Temperature change 48.14N, 17.15E Jan-Dec wrt 1981-2010 CORDEX-EUR44

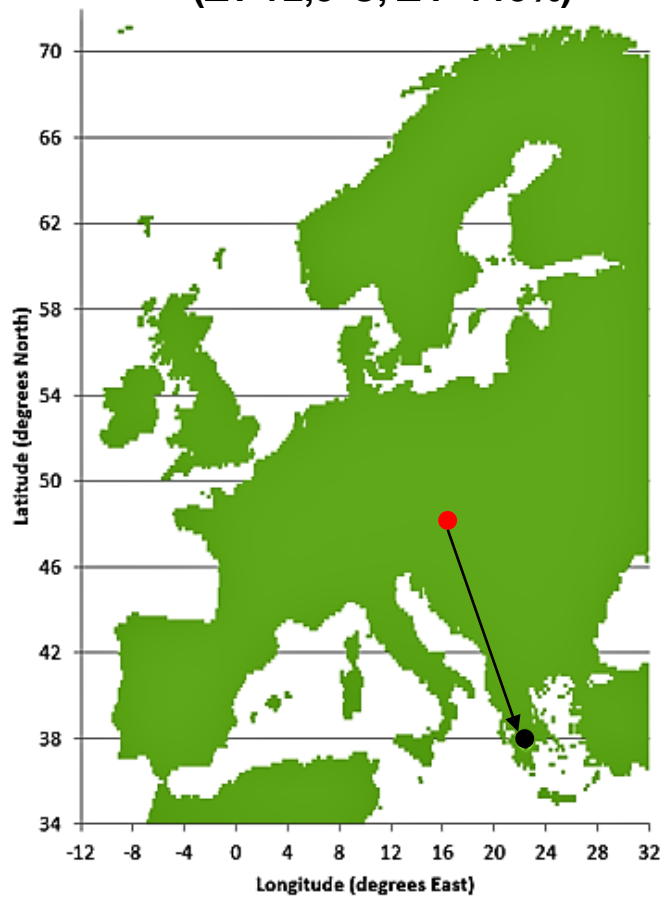


Relative Precipitation change 48.14N, 17.15E Jan-Dec wrt 1961-2010 CORDEX-EUR44



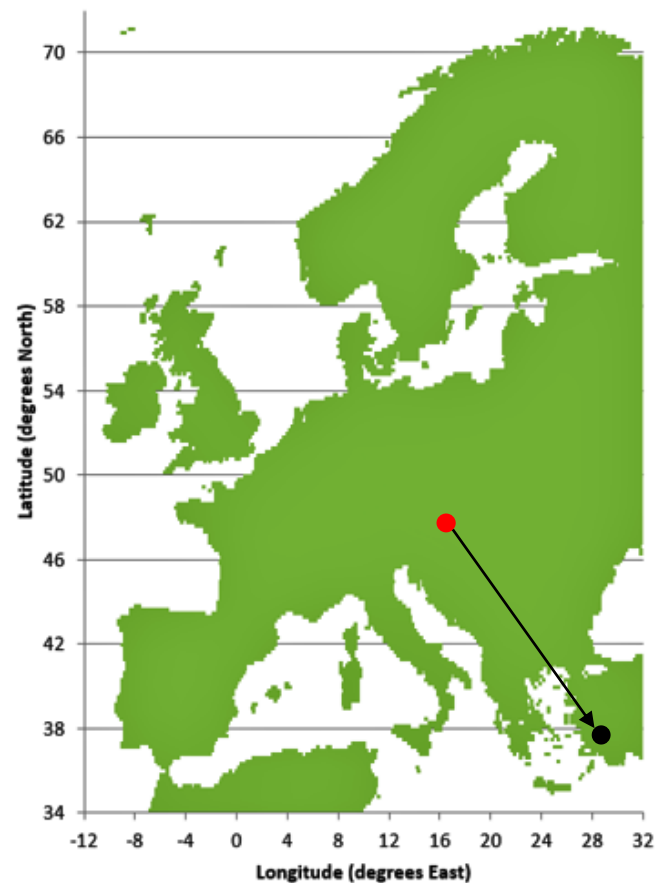
POSUN DO „STREDOMORSKEJ“ KLÍMY?

RCP4.5 - 2080
($\Delta T +2,5^{\circ}\text{C}$, $\Delta P +15\%$)



- Land grid boxes
- Location
- Temperature analogue
- Precipitation analogue
- ◆ Combined T/P analogue

RCP8.5 - 2080
($\Delta T +4,5^{\circ}\text{C}$, $\Delta P +25\%$)



- Land grid boxes
- Location
- Temperature analogue
- Precipitation analogue
- ◆ Combined T/P analogue

JE UŽ VŠETKO STRATENÉ ?

nd
II and III
) 총회

Forty-Eighth Session of the IPCC and
First Joint Session of Working Groups I, II and III
제48차 기후변화에 관한 정부간 협의체(IPCC) 총회

1-5 October 2018 | Incheon, Republic of Korea



Forty
First Joint
제48차

Mr. Abdou Waberi
Mr. Jian Liu
Ms. Elena Meresova
Ms. Kim Eunkyung
Mr. Hoesung Lee
Mr. Kim Jong-seok
Mr. Park Nam-chun
Mr. Yousef Nassef

**Forty-Eighth Session of the IPCC and
First Joint Session of Working Groups I, II and III**
1-5 October 2018 | Incheon, Republic of Korea

ipcc

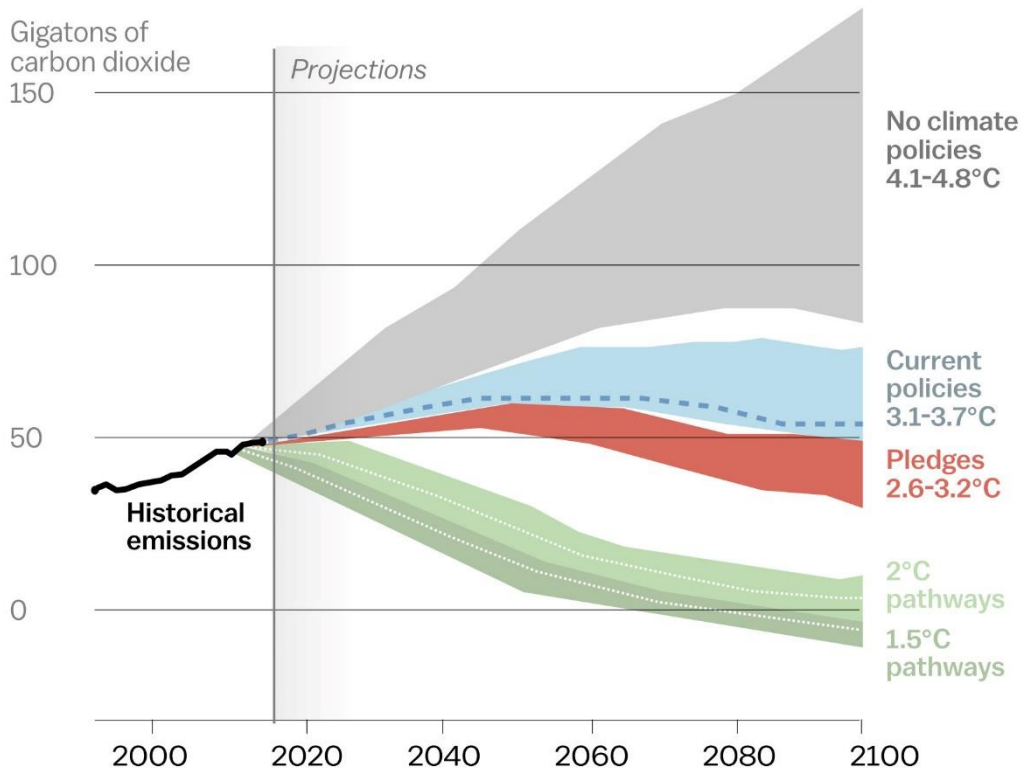
INTERGOVERNMENTAL PANEL ON
climate change



JE UŽ VŠETKO STRATENÉ ?

Effect of current pledges and policies

Global greenhouse gas emissions



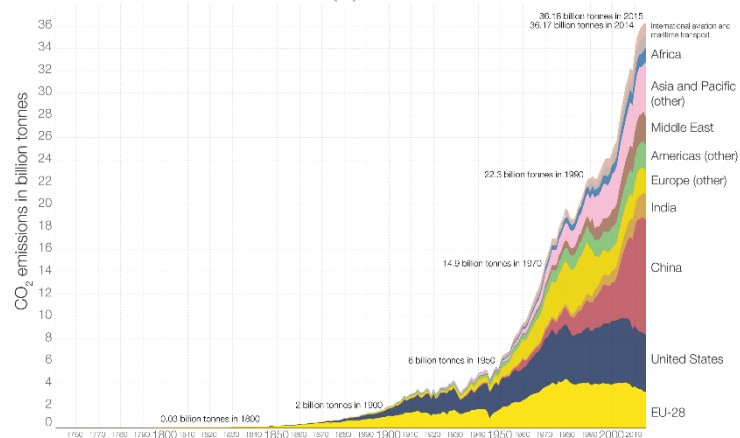
Source: Climate Action Tracker

Vox



Global CO₂ emissions by world region, 1751 to 2015

Annual carbon dioxide emissions in billion tonnes (Gt).



Data source: Carbon Dioxide Information Analysis Center (CDIAC); aggregation by world region by Our World in Data. The interactive data visualization is available at OurWorldinData.org. Thank you for finding the raw data and more visualizations on this topic.

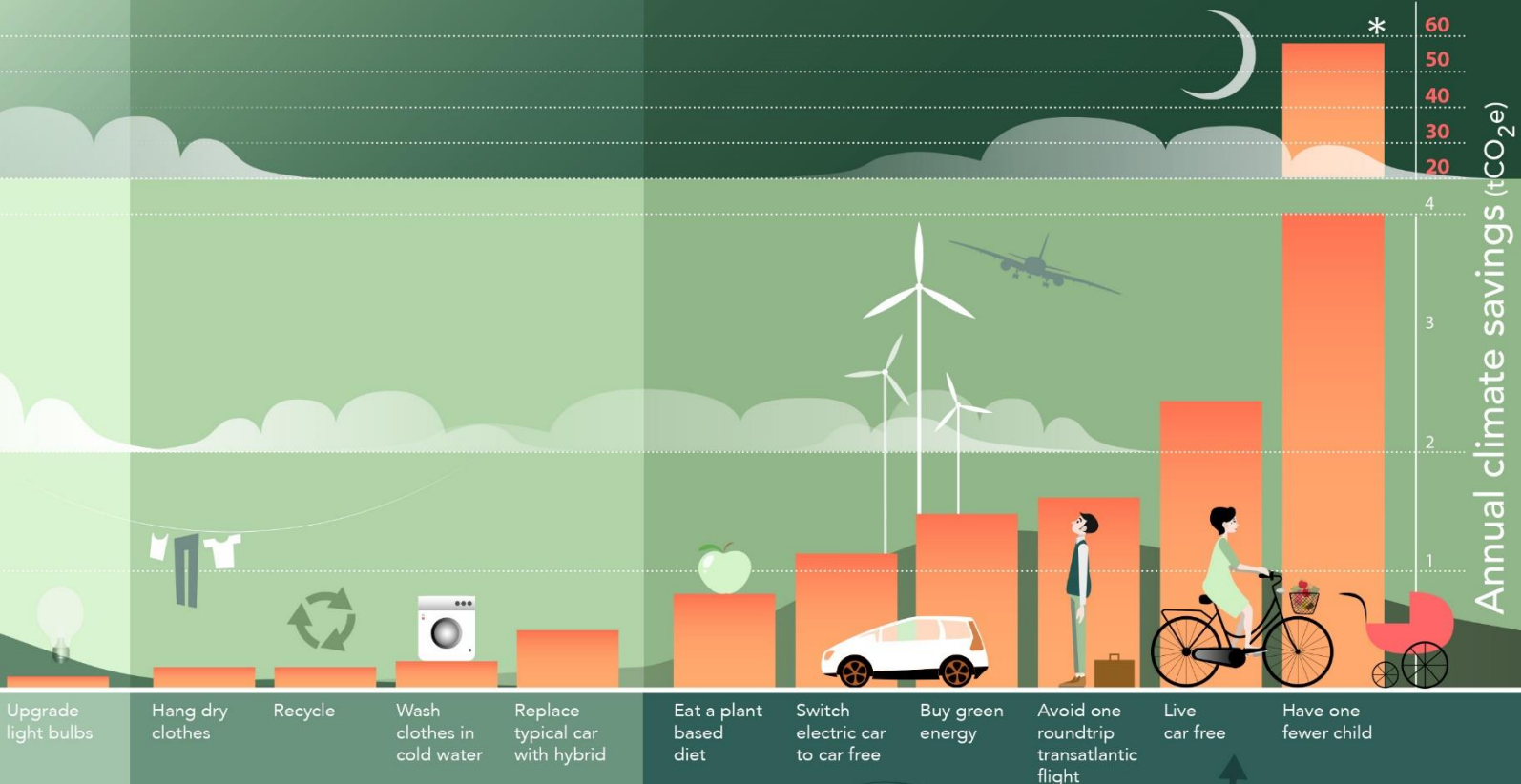
Licensed under CC-BY-SA.

OSOBNÁ UHLÍKOVÁ STOPA

Personal choices to reduce your contribution to climate change

* Cumulative emissions from descendants; decreases substantially if national emissions decrease.

Average values for developed countries, based on current emissions.



Low Impact

< 0.2 tCO₂e

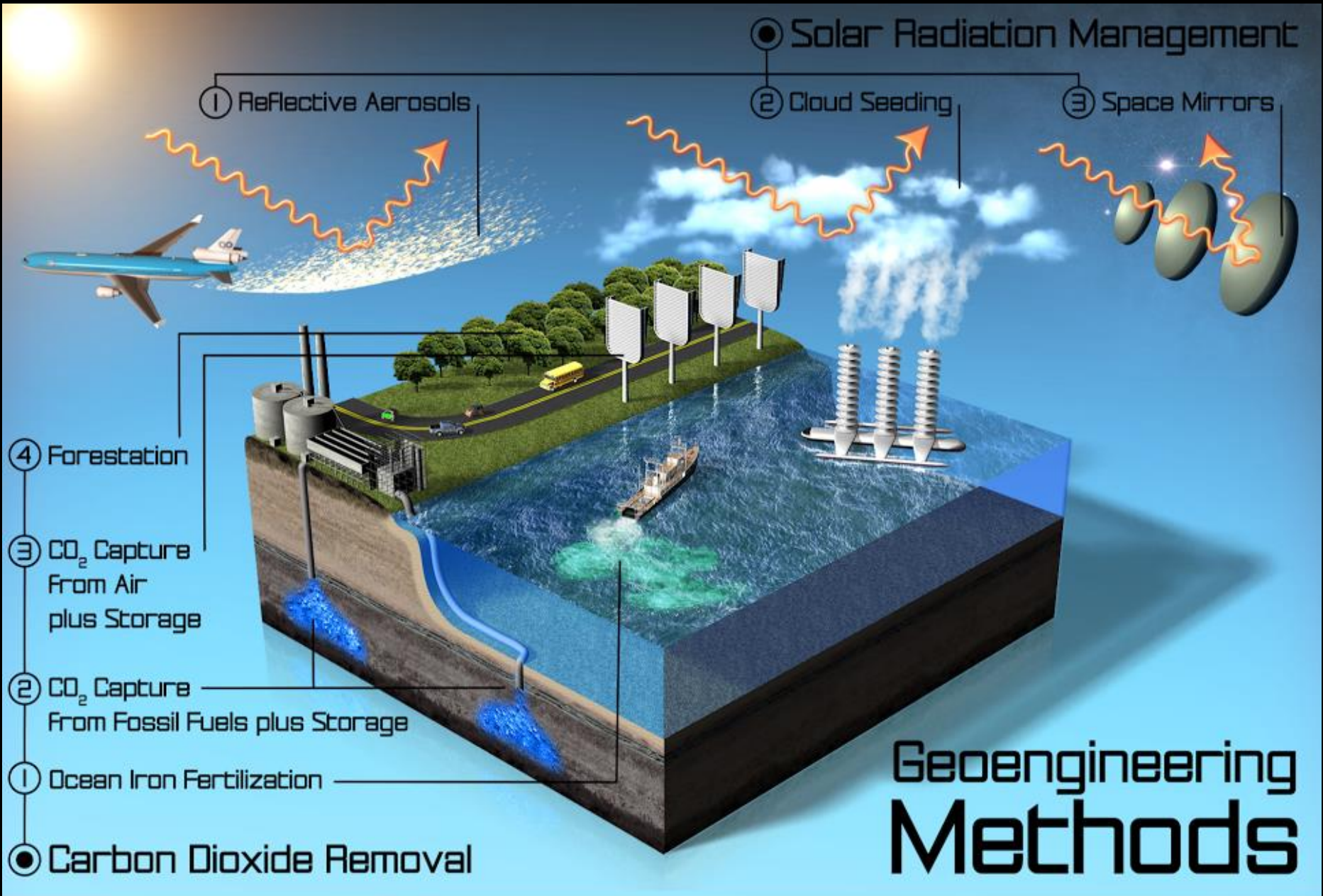
Moderate Impact

0.8-0.2 tCO₂e

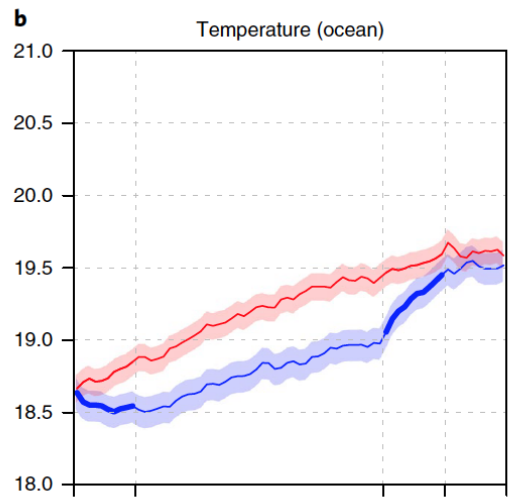
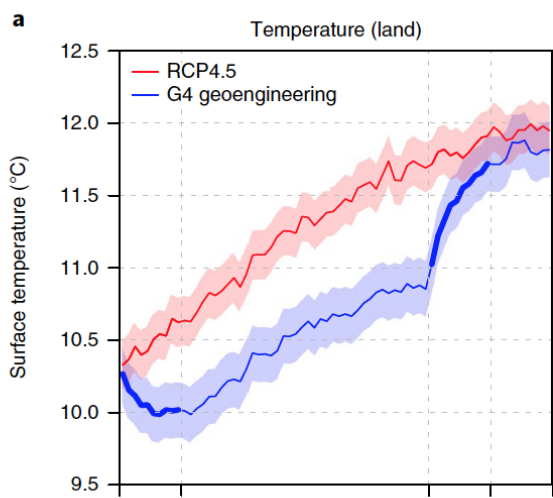
High Impact

> 0.8 tCO₂e

Annual climate savings (tCO₂e)

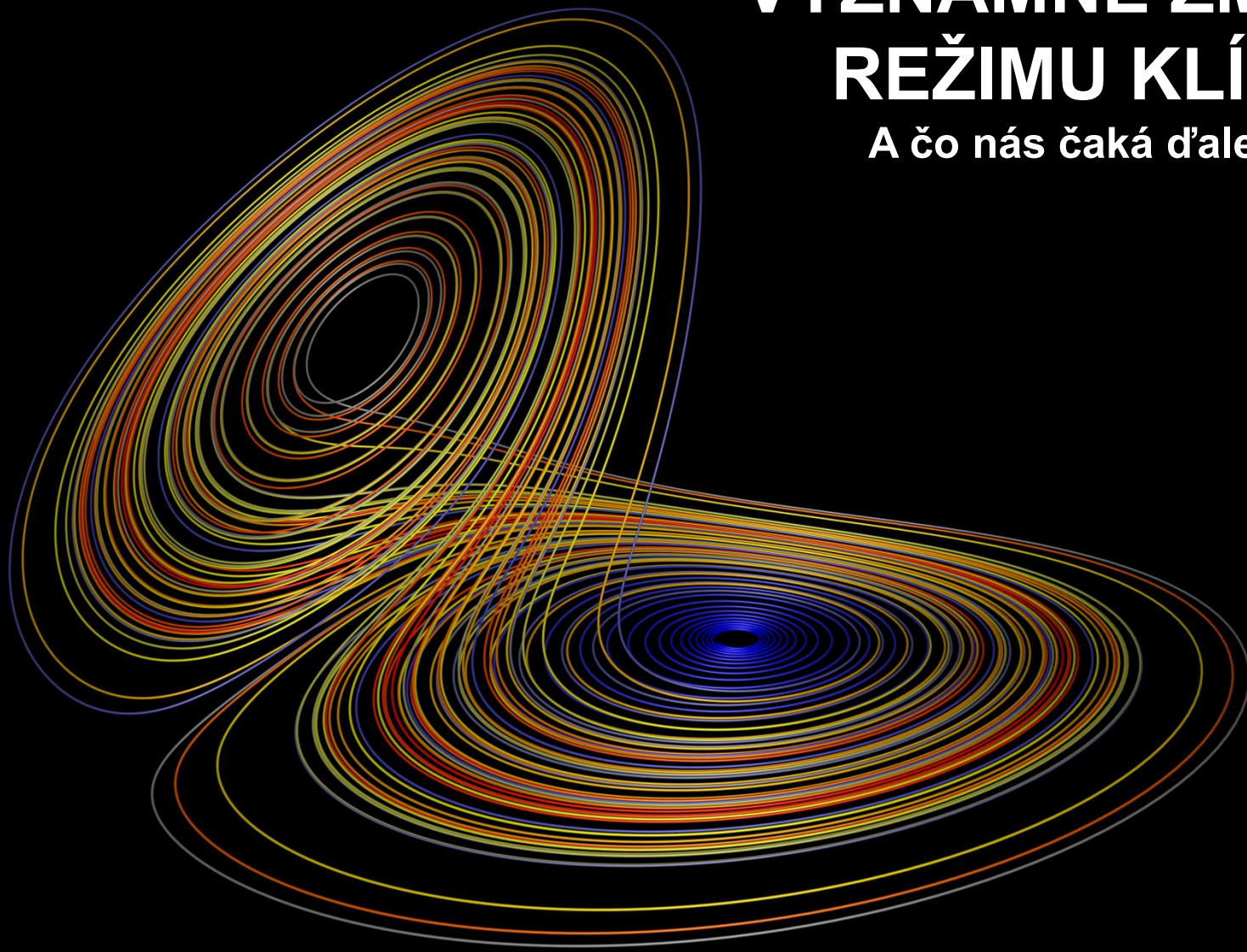


Geoengineering Methods



VÝZNAMNÉ ZMENY REŽIMU KLÍMY

A čo nás čaká ďalej ...



ĎAKUJEM ZA POZORNOSŤ