Klima danas i sutra - globalno i u Hrvatskoj

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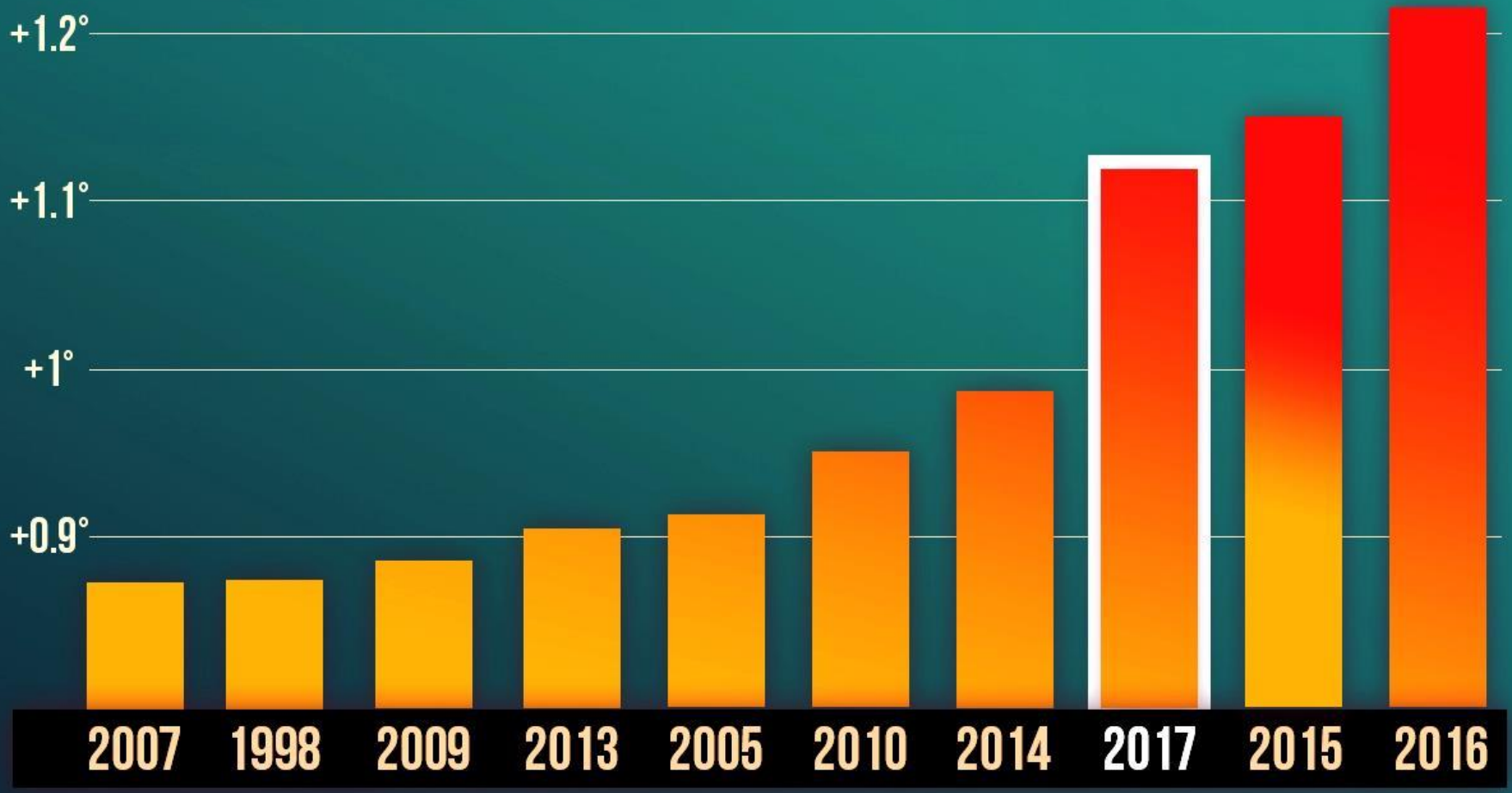
10 HOTTEST YEARS GLOBALLY

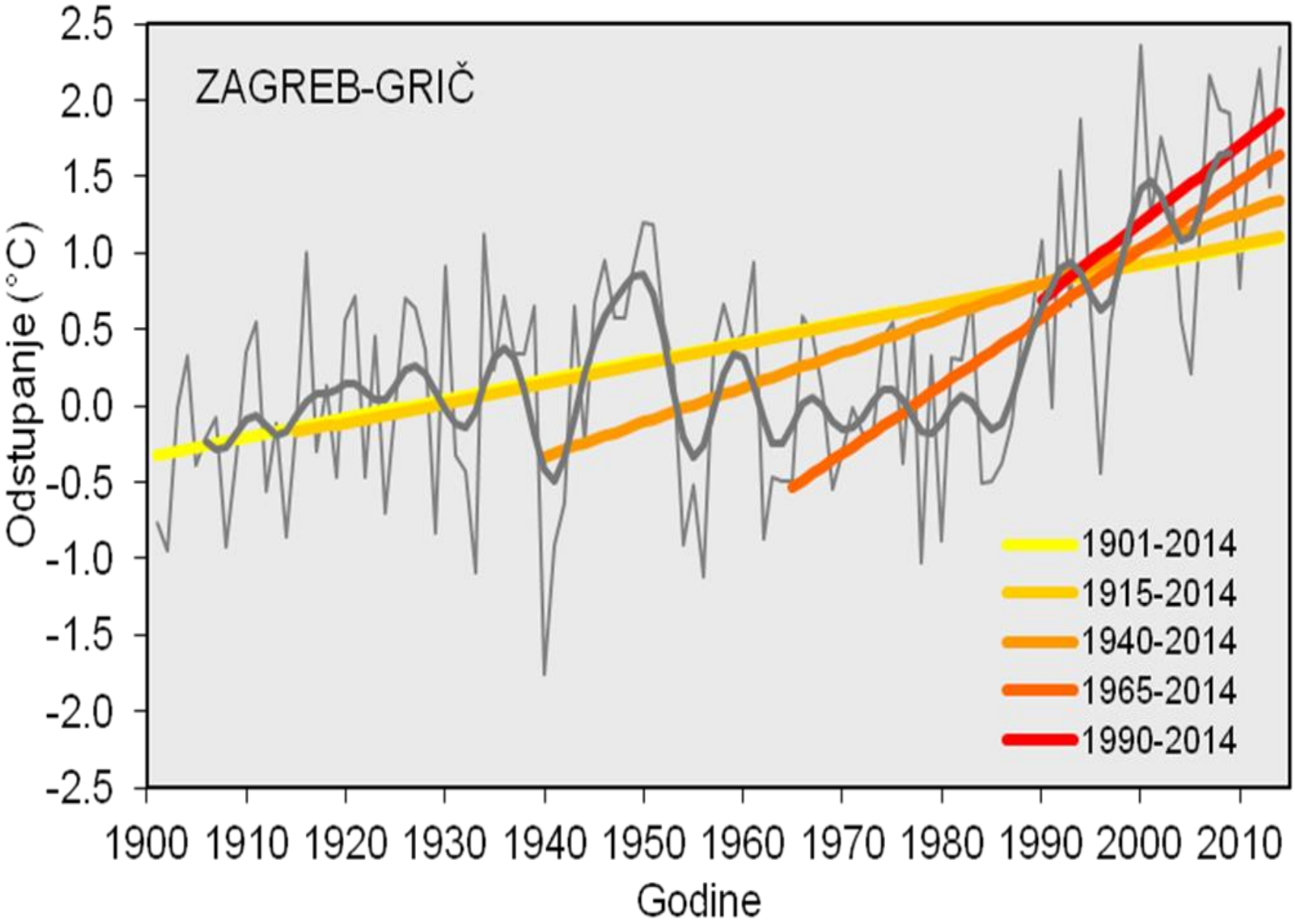
TEMPERATURE ANOMALY (°C)

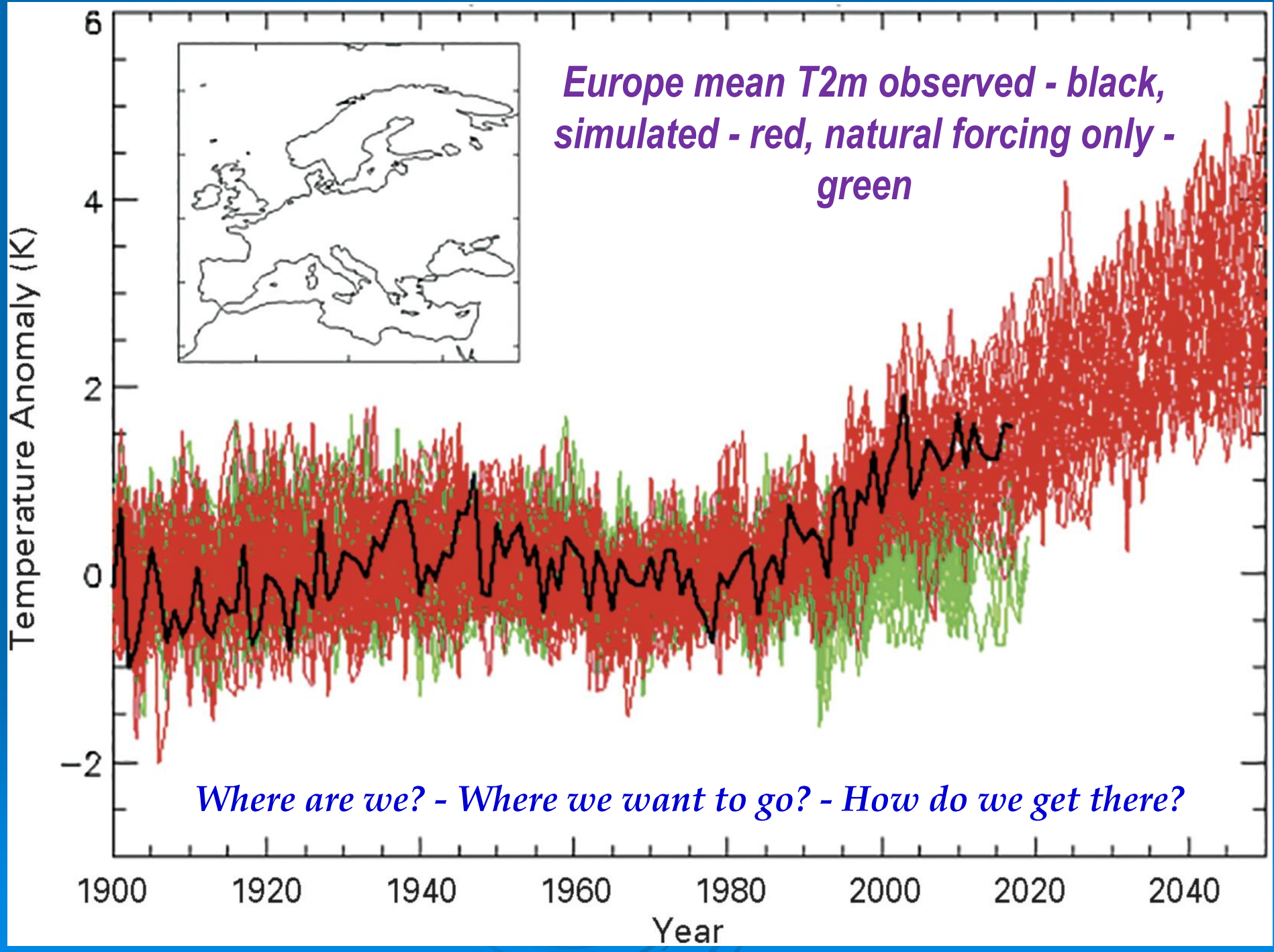


Source: NASA GISS & NOAA NCEI global temperature anomalies (°C) averaged and adjusted to early industrial baseline (1881-1910). Data as of 1/18/18.

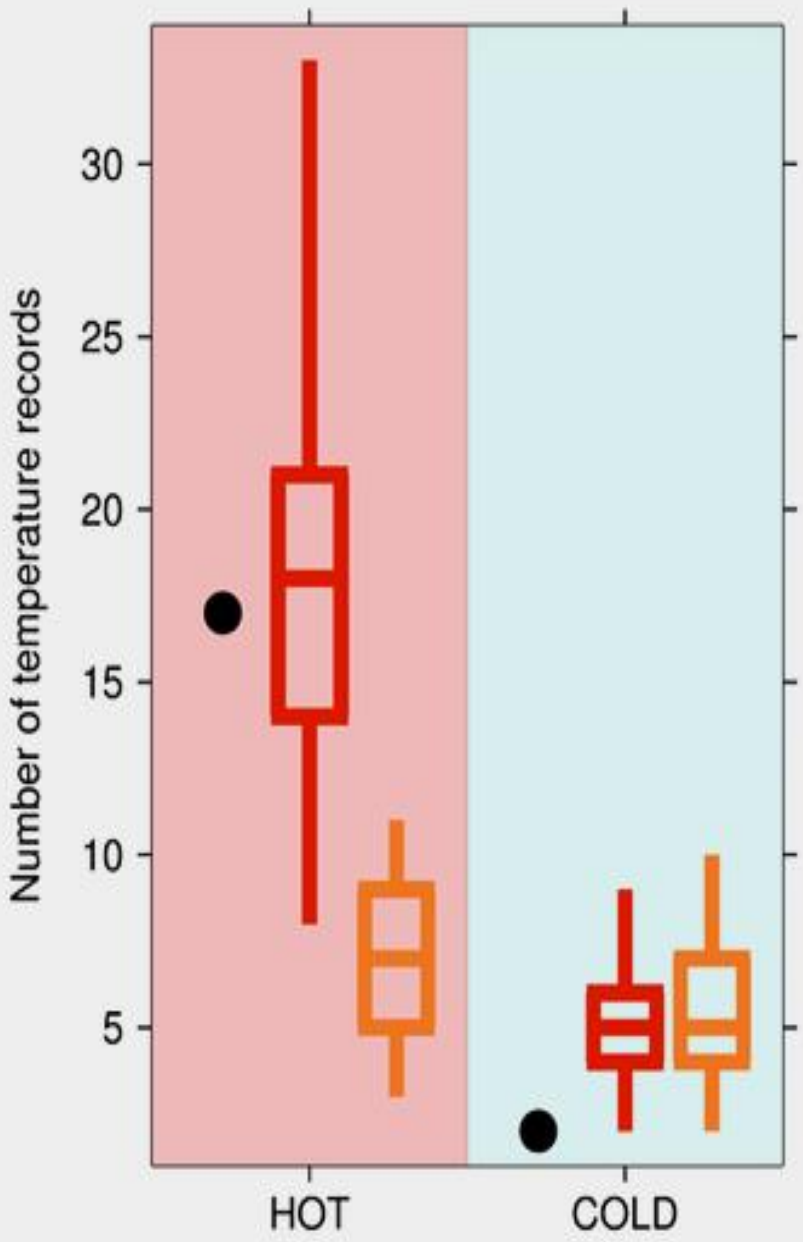
CLIMATE CENTRAL

Domaći neprekinuti podaci (od 12.1861.)




Europe mean T2m observed - black, simulated - red, natural forcing only - green
Where are we? - Where we want to go? - How do we get there?
Temperature Anomaly (K)
6
4
2
0
−2
1900
1920
1940
1960
1980
2000
2020
2040
Year

Number of global annual temperature records (1861-2005)



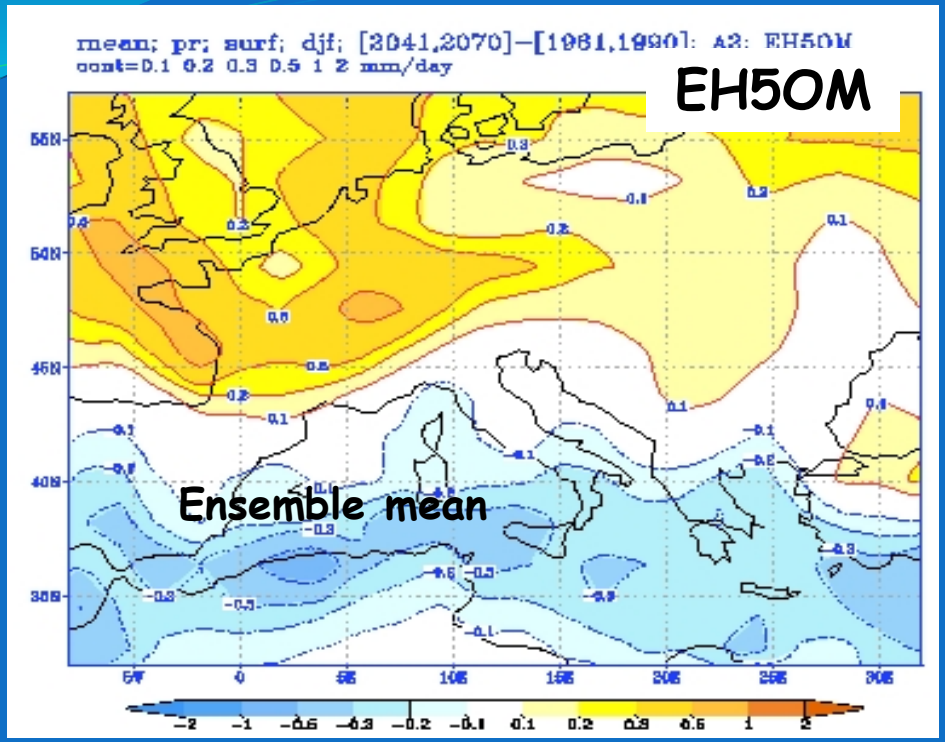
- Real-world observations
- Climate models (Human + Natural)
- Climate models (Natural only)

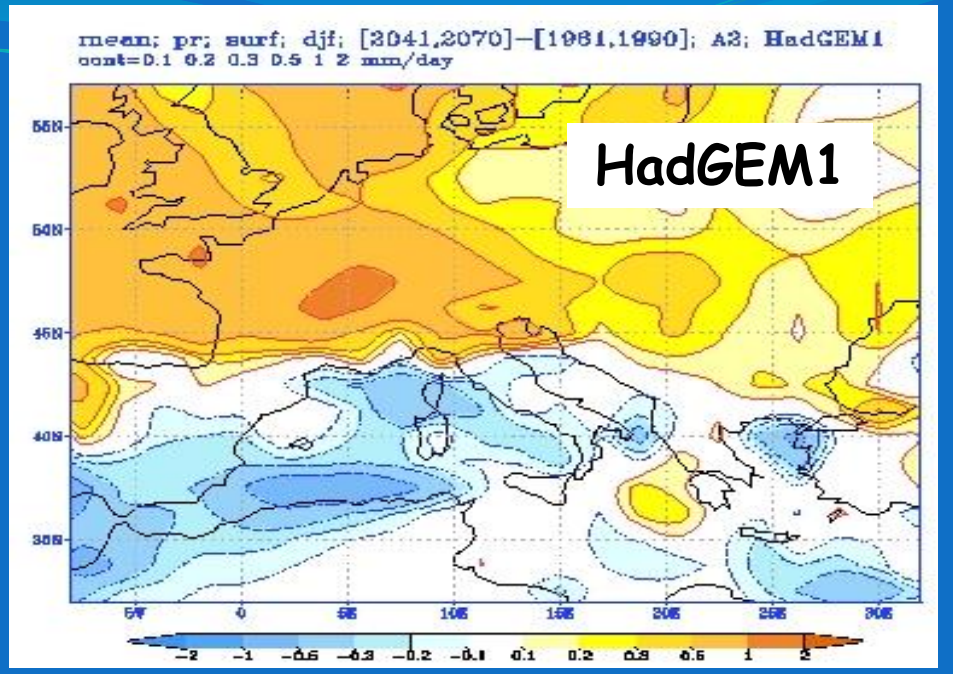
Warmer climate has more energy, more water vapor & clouds:

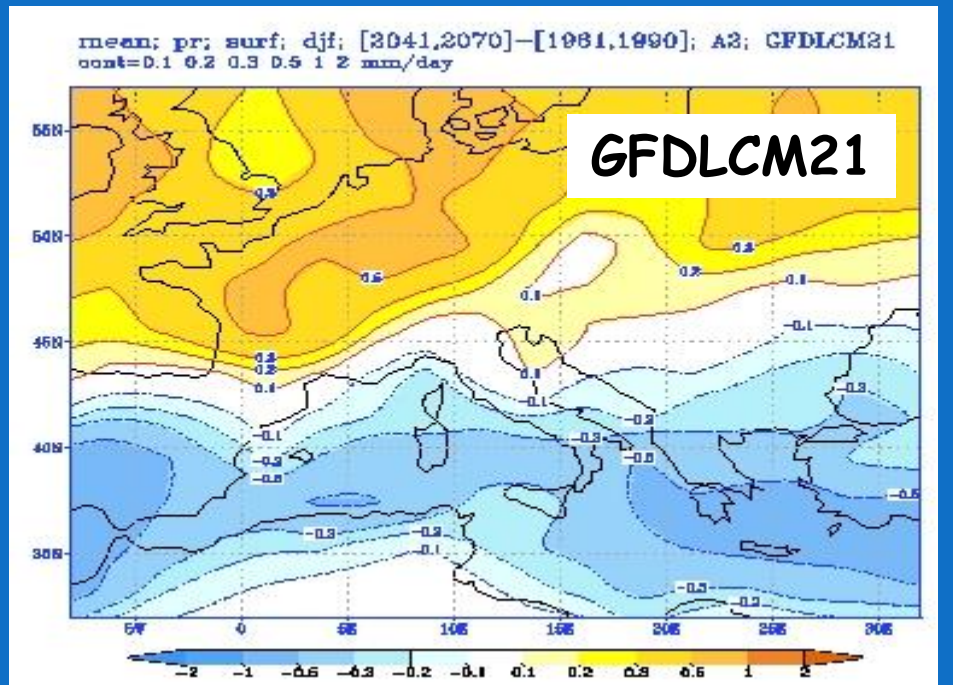
potential for extremes

more rapid changes in weather regimes

Precipitation, winter (2011-2040) - (1961-90) reanalysis obs.





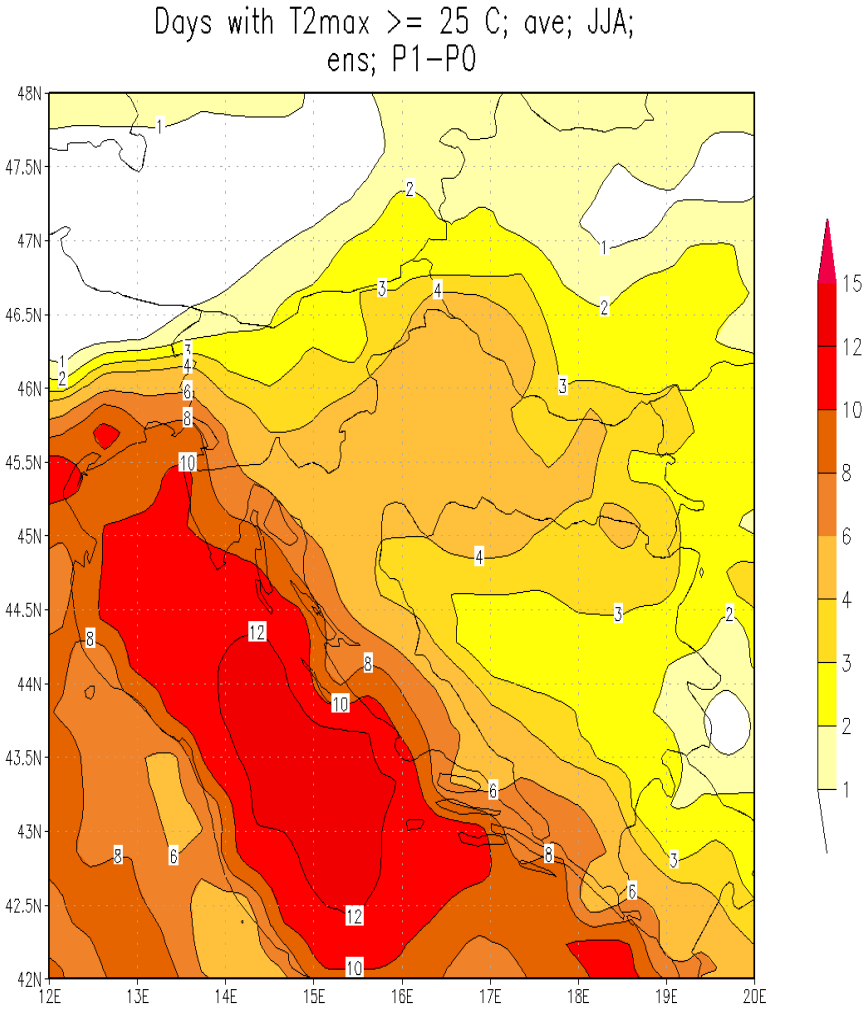


Dipolna kontinentalna struktura raspodjele oborine sada i u skoroj budućnosti

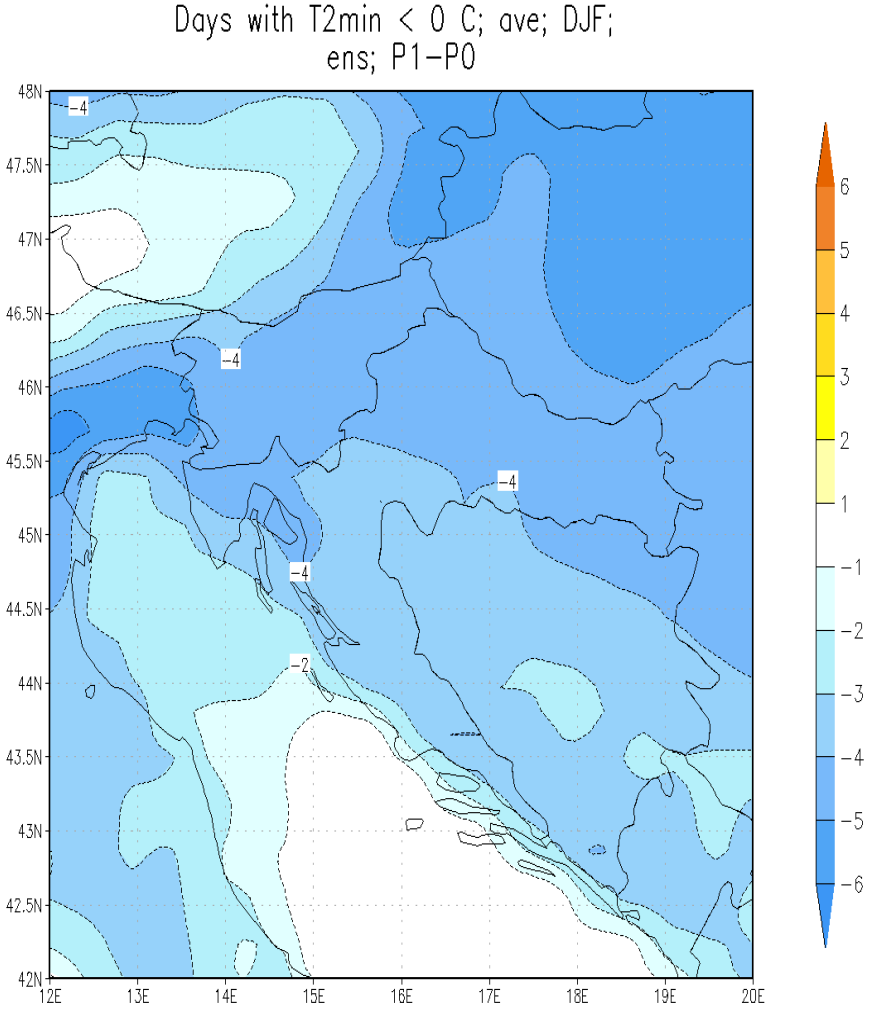
A2 scenario, gruba rezolucija; novije simulacije – detaljnije, no ista osnovna poruka

Extreme Events

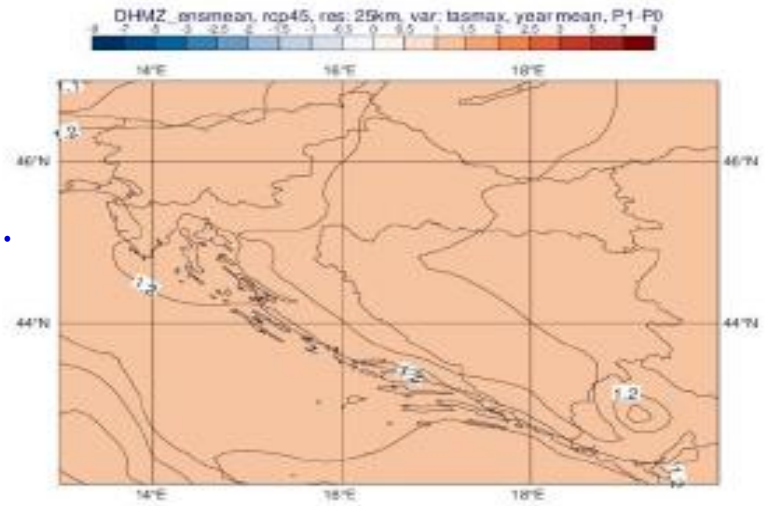
No. Summertime Warm Days



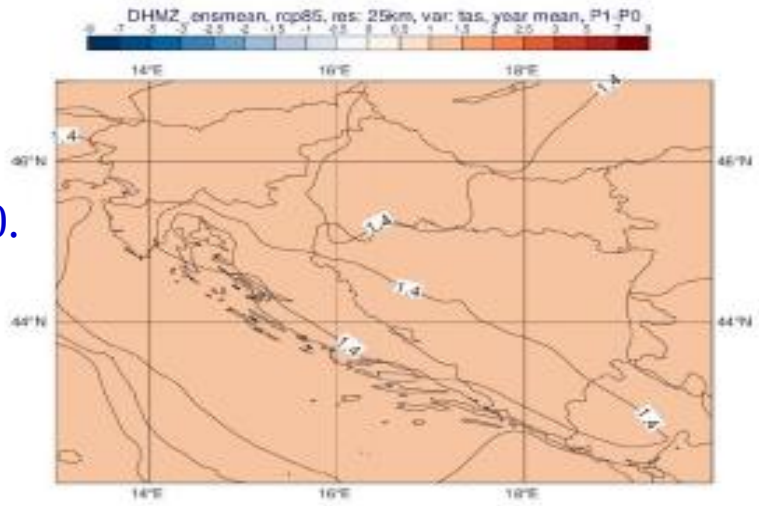
No. Wintertime Cold Days



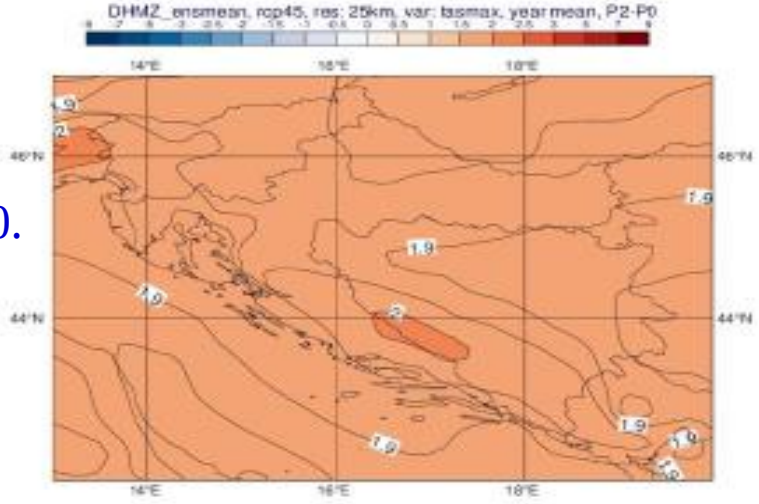
2011-40.
RCP4.5



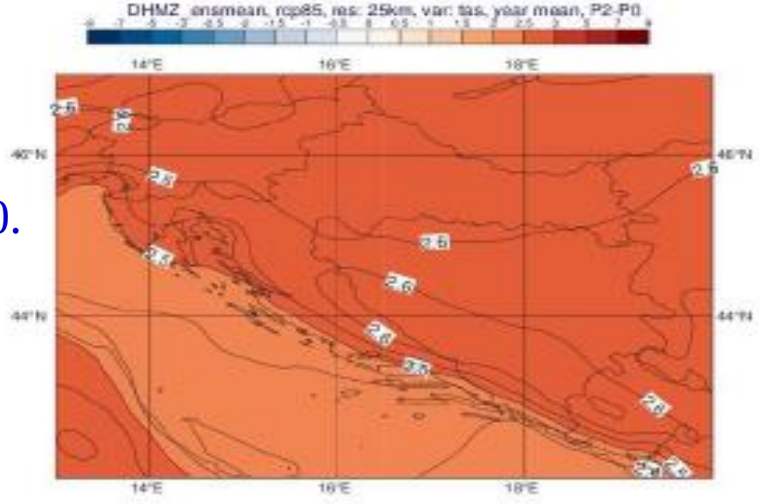
2011-40.
RCP8.5



2041-70.
RCP4.5

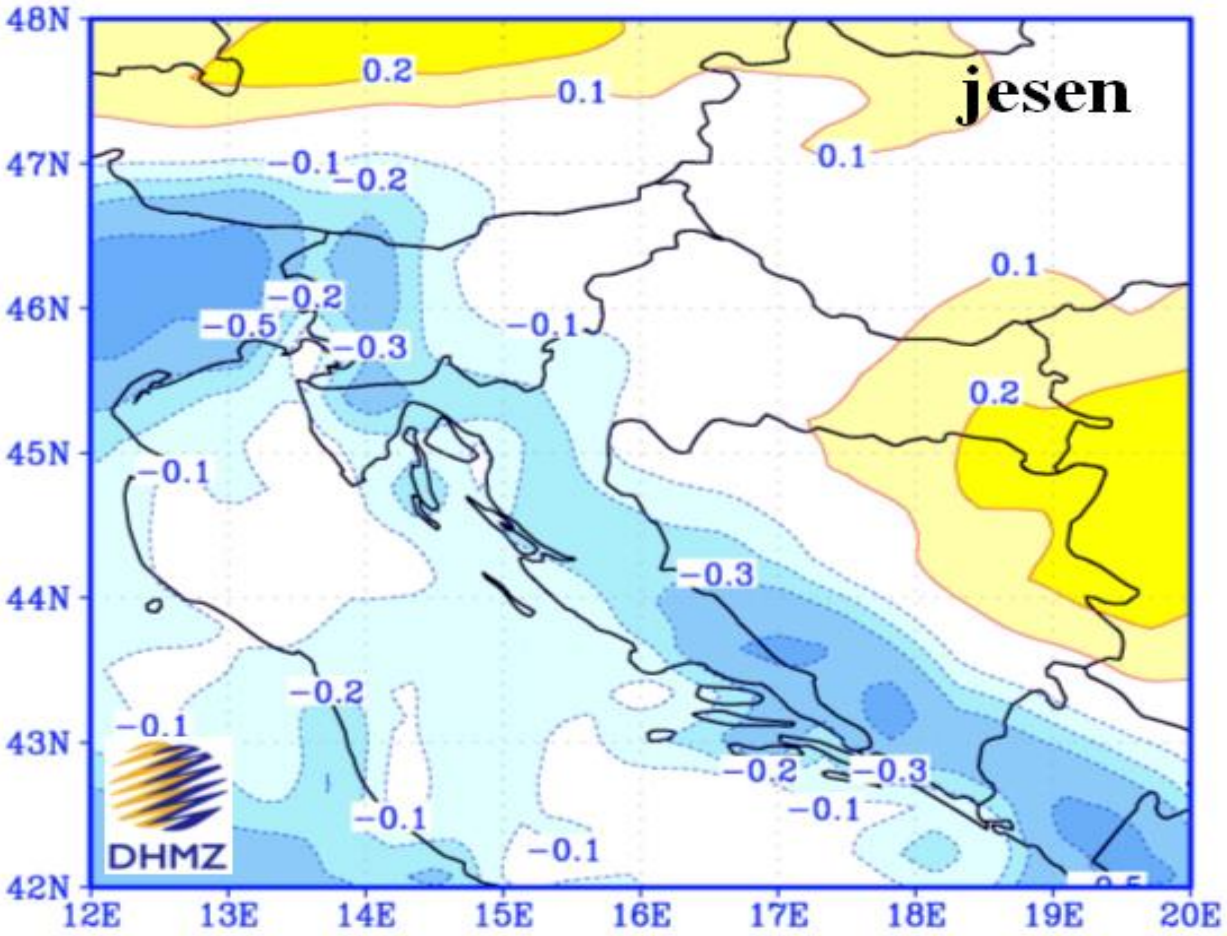


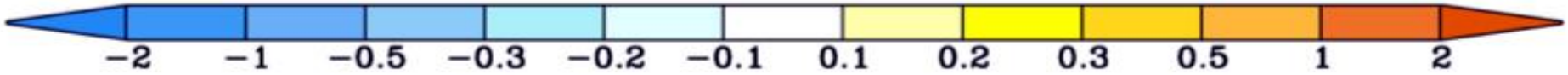
2041-70.
RCP8.5



Slika 7: Promjena srednje godišnje maksimalne temperature zraka na 2 m (°C) u odnosu na referentno razdoblje 1971.-2000. u srednjaku ansambla iz četiri integracije RegCM modelom. Gore: za razdoblje 2011.-2040. godine; dolje: za razdoblje 2041.-2070. godine. Lijevo: scenarij RCP4.5; desno: scenarij RCP8.5.

DHMZ → MZOE, *11.2017*; *http://prilagodba-klimi.hr/wp-content/uploads/docs/Dodatak_Klimatsko_modeliranje_VELEbit_12.5km.pdf*
Autori: **Branković, Srnec, Stilinović, Güttler**





*Promjena oborine u Hrvatskoj, **mm/dan**, 2011-2040. god. u odnosu na 1961-1990. god. prema rezultatima srednjaka ansambla **RegCM**, **A2** scenarij emisije plinova staklenika **za jesen.***
-Simulacije oborine su manje pouzdane no simulacije T2m.

Očekivani i uočeni utjecaji ovih klimatskih promjena - najosjetljivije Sredozemlje

Arctic region
Temperature rise much larger than global average
Decrease in Arctic sea ice coverage
Decrease in Greenland ice sheet
Decrease in permafrost areas
Increasing risk of biodiversity loss
Some new opportunities for the exploitation of natural resources and for sea transportation
Risks to the livelihoods of indigenous peoples

Atlantic region
Increase in heavy precipitation events
Increase in river flow
Increasing risk of river and coastal flooding
Increasing damage risk from winter storms
Decrease in energy demand for heating
Increase in multiple climatic hazards

Mountain regions
Temperature rise larger than European average
Decrease in glacier extent and volume
Upward shift of plant and animal species
High risk of species extinctions
Increasing risk of forest pests
Increasing risk from rock falls and landslides
Changes in hydropower potential
Decrease in ski tourism

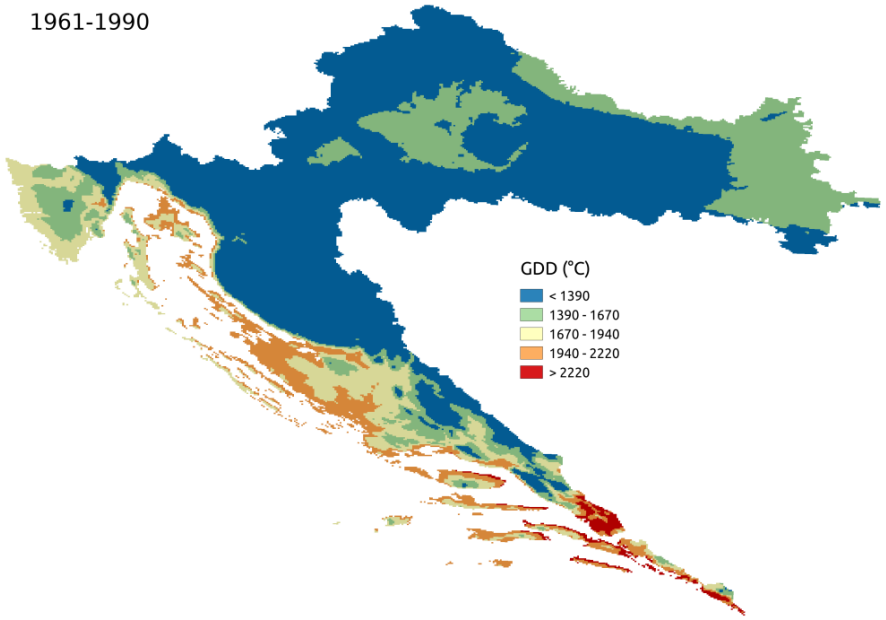
Coastal zones and regional seas
Sea level rise
Increase in sea surface temperatures
Increase in ocean acidity
Northward migration of marine species
Risks and some opportunities for fisheries
Changes in phytoplankton communities
Increasing number of marine dead zones
Increasing risk of water-borne diseases

Boreal region
Increase in heavy precipitation events
Decrease in snow, lake and river ice cover
Increase in precipitation and river flows
Increasing potential for forest growth and increasing risk of forest pests
Increasing damage risk from winter storms
Increase in crop yields
Decrease in energy demand for heating
Increase in hydropower potential
Increase in summer tourism

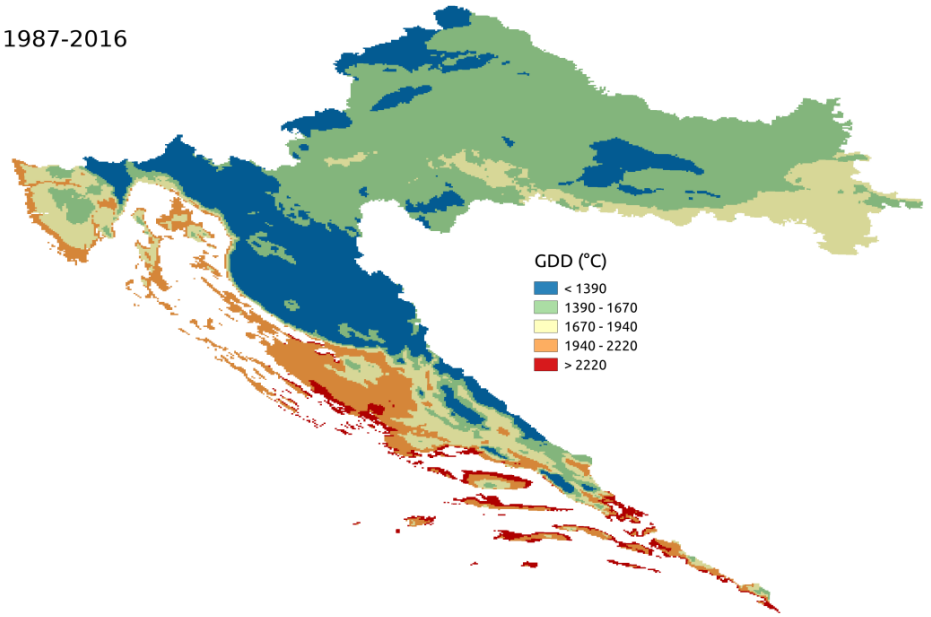
Continental region
Increase in heat extremes
Decrease in summer precipitation
Increasing risk of river floods
Increasing risk of forest fires
Decrease in economic value of forests
Increase in energy demand for cooling

Mediterranean region
Large increase in heat extremes
Decrease in precipitation and river flow
Increasing risk of droughts
Increasing risk of biodiversity loss
Increasing risk of forest fires
Increased competition between different water users
Increasing water demand for agriculture
Decrease in crop yields
Increasing risks for livestock production
Increase in mortality from heat waves
Expansion of habitats for southern disease vectors
Decreasing potential for energy production
Increase in energy demand for cooling
Decrease in summer tourism and potential increase in other seasons
Increase in multiple climatic hazards
Most economic sectors negatively affected
High vulnerability to spillover effects of climate change from outside Europe

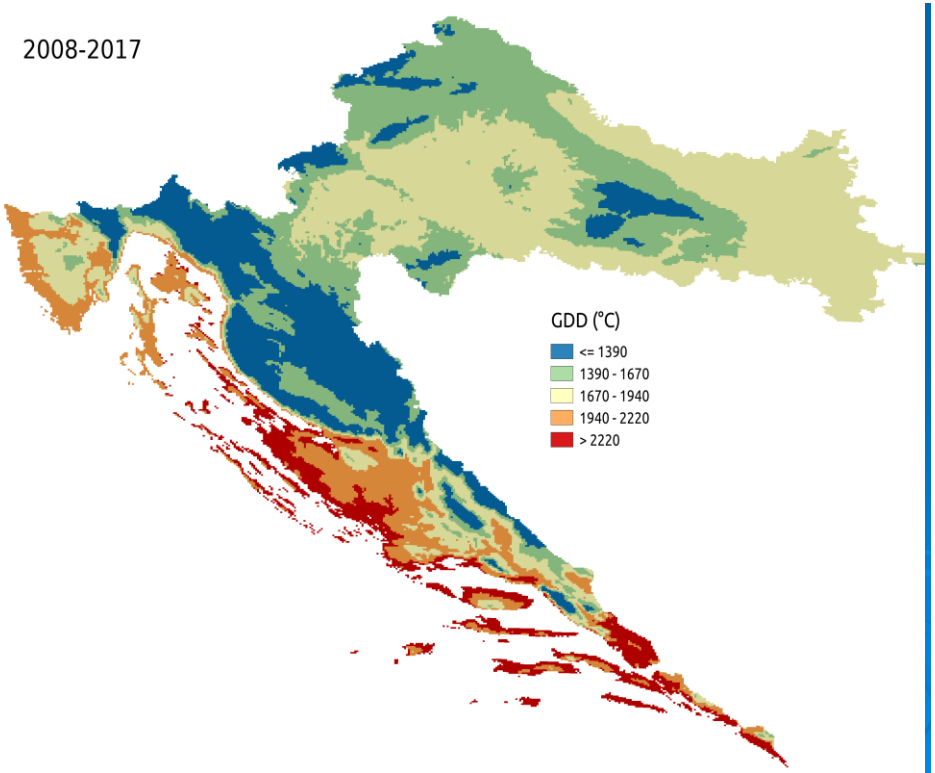
1961-1990



1987-2016

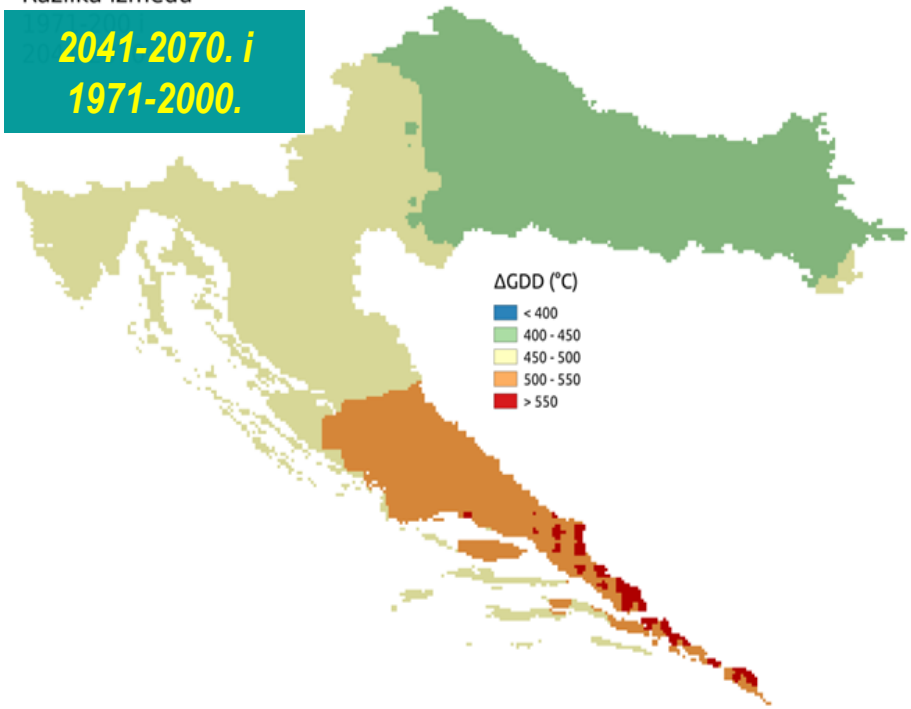


2008-2017



Razlika između

2041-2070. i
1971-2000.



Zaključci

- Uzlazni trendovi prizemne temp. i projekcije u budućnost su neobične i neobjašnjive prirodnom klimatskom varijabilnošću na više od 99 % pouzdanosti

- Projekcije se osnivaju na scenarijima plinova staklenika i vezama tih koncentracija s temp. pomoću modeliranja i simulacija

- Uključeno: rast čovječanstva, ekonomski razvoj, tehnološke promjene, socijalne interakcije --> nužno: "meka klimatologija"

- I pored velikih prostorno-vremenskih varijacija, globalno zatopljenje je stvarnost te prelazi iznos i brzinu prirodnih uobičajenih promjena tijekom zadnjih više od $\mathbf{8 \cdot 10^5}$ godina

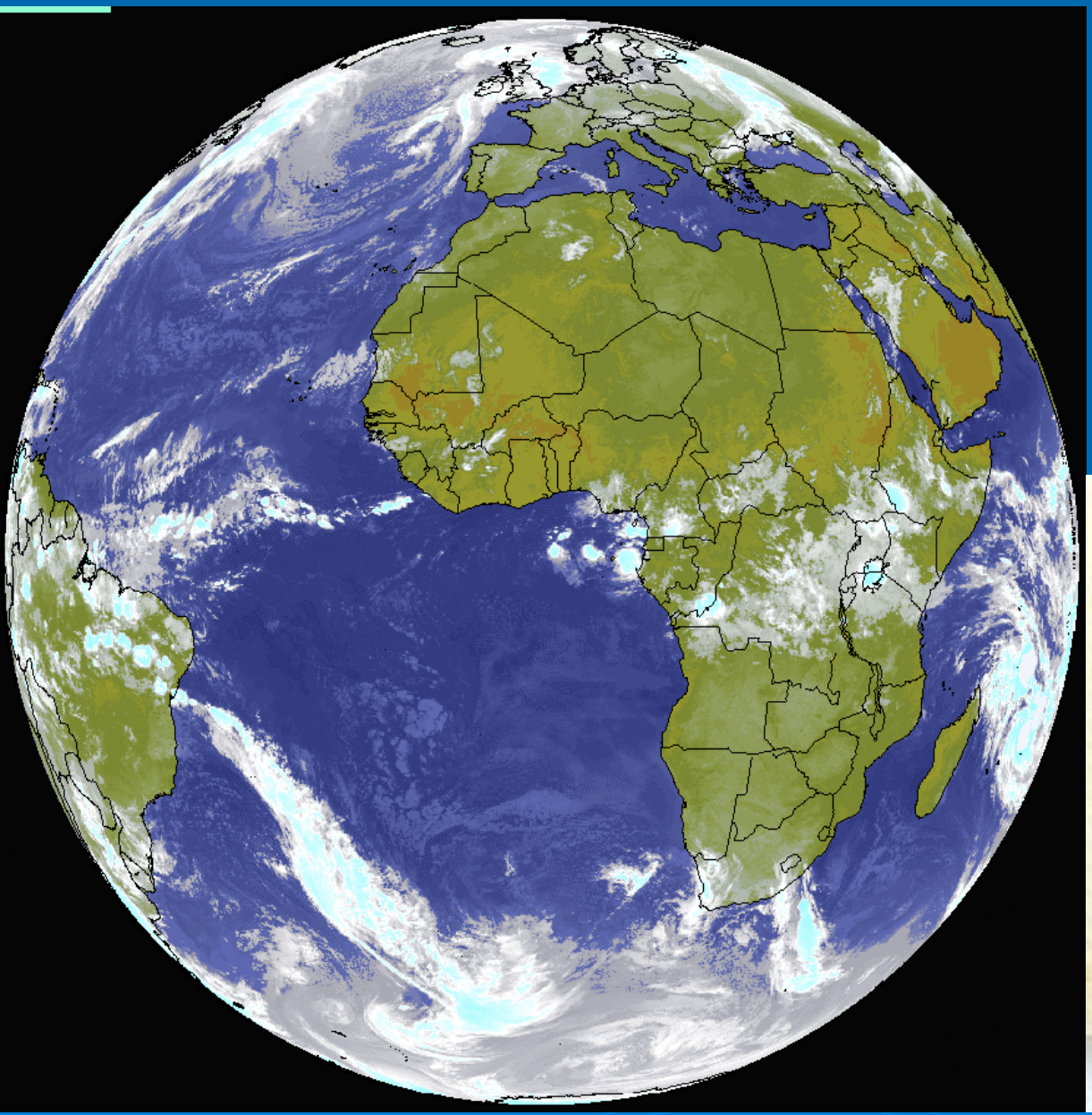
Zaključci - nastavak

- Hitne akcije: smanjiti emisije plinova staklenika da se pokuša ne prijeći globalni scenario od $\langle T2m \rangle \approx +2^{o}C$ **do 2100**. god

- Promoviranje i korištenje humanijih tehnologija, obnovljivih izvora energije (ali i što još?), zdravije **hrane i vode**, …

- **Polja Hrvatske brzo prelaze u više, tj. klimatski toplije klase. Pitanje tla (erozija, kem. i biol. degradacija; tople noći,…)?**

- Ide: pouzdane regionalne klimatsko-ekonomske projekcije uz pripadnu prostorno-vremensku varijabilnost za iduće dekade **poljoprivrede, energetike**, turizma, prometa, **obrazovanja**, …



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bgrisog@gfz.hr

Agroklimatska mjera - Growing Degree Day (GDD) ≈ Winkler Index

Winkler index

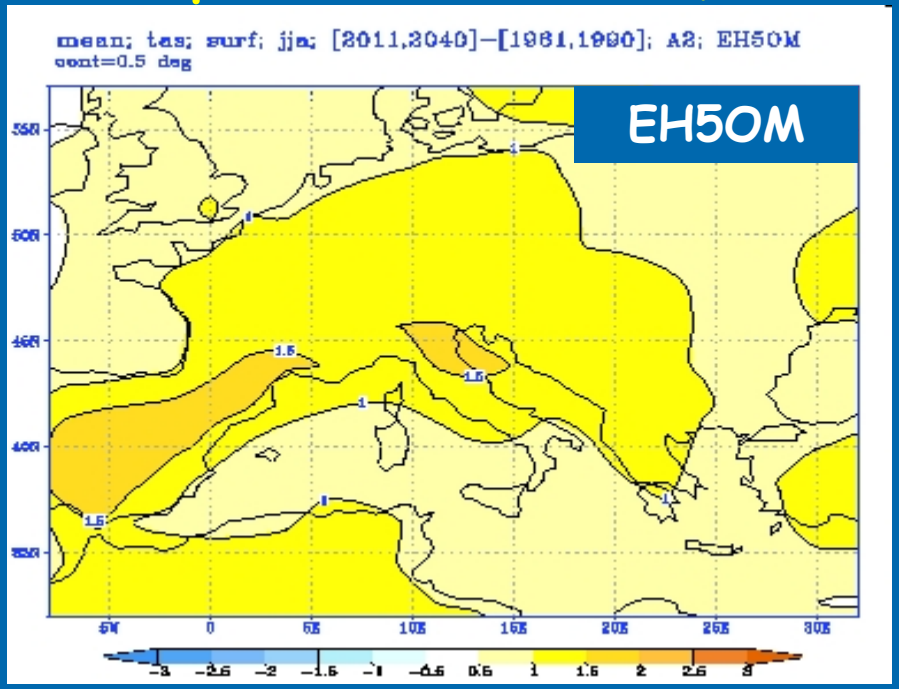
Region/class	°F units	°C units	General ripening capability and wine style
Region Ia	1500–2000	850–1111	Only very early ripening varieties achieve high quality, mostly hybrid grape varieties and some *V. vinifera*.
Region Ib	2001–2500	1111–1389	Only early ripening varieties achieve high quality, some hybrid grape varieties but mostly *V. vinifera*.
Region II	2501–3000	1389–1667	Early and mid-season table wine varieties will produce good quality wines.
Region III	3001–3500	1668–1944	Favorable for high production of standard to good quality table wines.
Region IV	3501–4000	1945–2222	Favorable for high production, but acceptable table wine quality at best.
Region V	4001–4900	2223–2700	Typically only suitable for extremely high production, fair quality table wine or table grape varieties destined for early season consumption are grown.

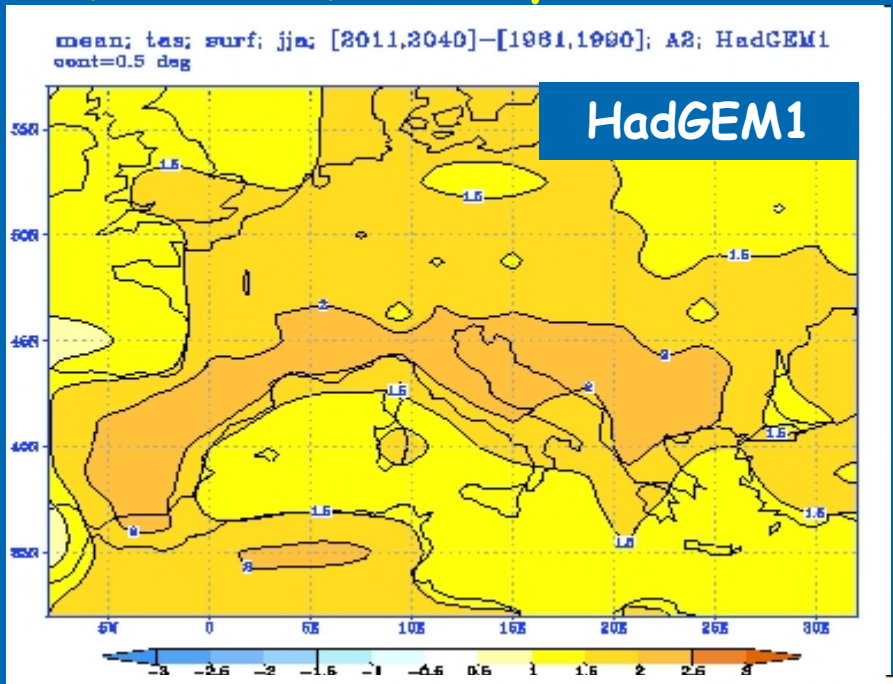
The system was originally developed for and is used officially in California and was based on the general ripening capabilities and wine styles[1][2] that can be achieved in the climate due to heat accumulation (growing degree-days). The general ripening capabilities include hybrid grape varieties through early season, mid-season, and late season ripening *V. Vinifera* and even table grapes in the warmest areas of Region V. The general wine styles include lighter, more subtle wines with lower alcohol and brighter fruit aromas and flavors (including Champagne and other sparkling wines) found in cooler climates (Regions Ia, Ib, II and lower III) to bolder, bigger wines often with higher alcohol and lush, darker fruit aromas and flavors that are found in warmer climates (Region III, IV and V). Region V was stated as also having a tendency to be more suitable to higher production wines, Sherry and other fortified wines.[1][2]

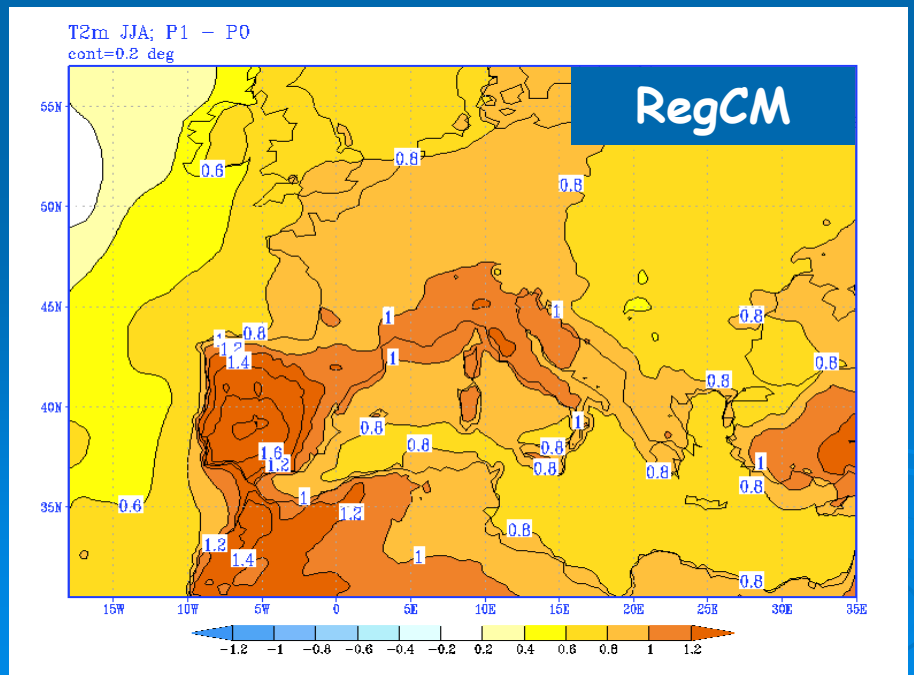
Globalni problemi izvora energije

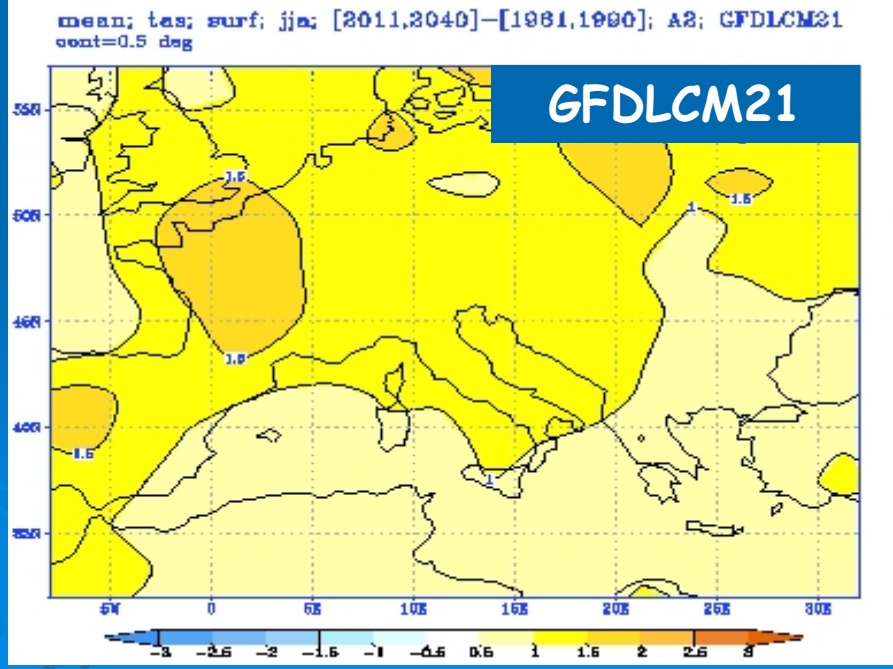
- *Jesu li obnovljivi izvori energije dostatni za čovječanstvo već krajem 2030-ih (da ne prijeđemo globalnih +2^{o}C)?*
- *Što može zamijeniti termoekektrane (ugljen, mazut) i fisiju (atomske elektrane)?*
- *Treba revalorizirati izvore energije za idućih 30-40 god: nove tehnologije, rizici, učinkovitost, otpad, reciklaža,…*

Temp. at 2m, Summer (2011-2040) - (1961-90) reanalysis obs.

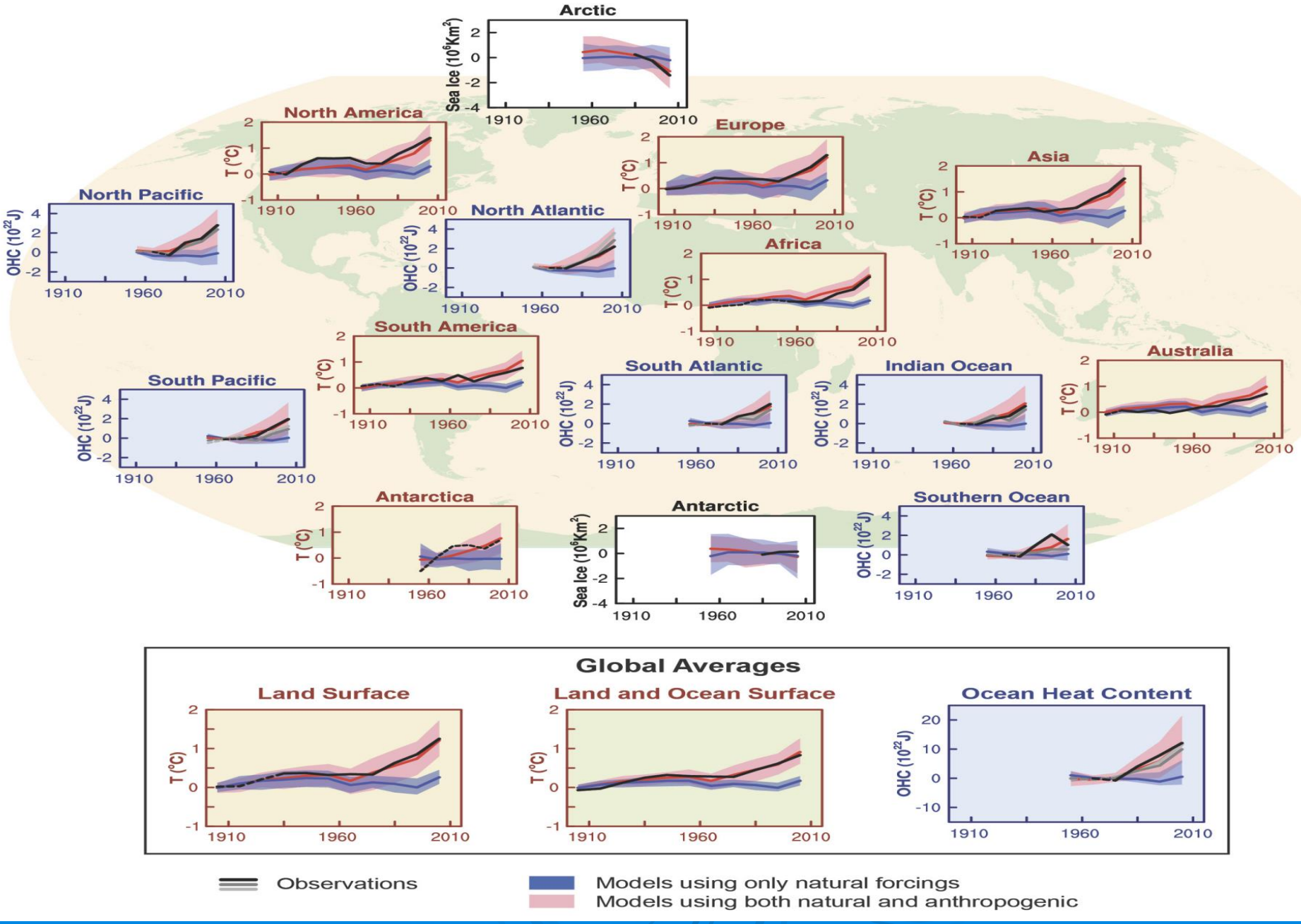






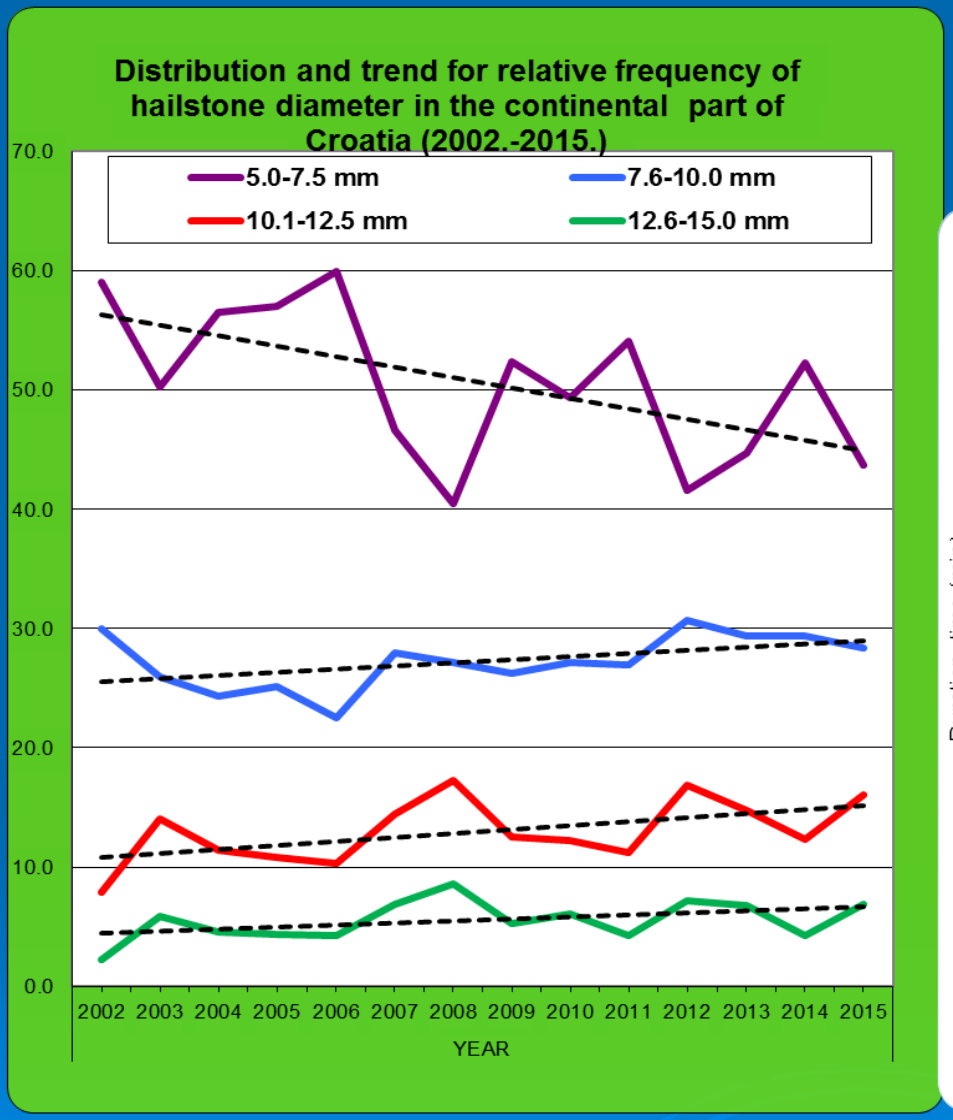


5th IPCC, late 2013 - numerical simulations

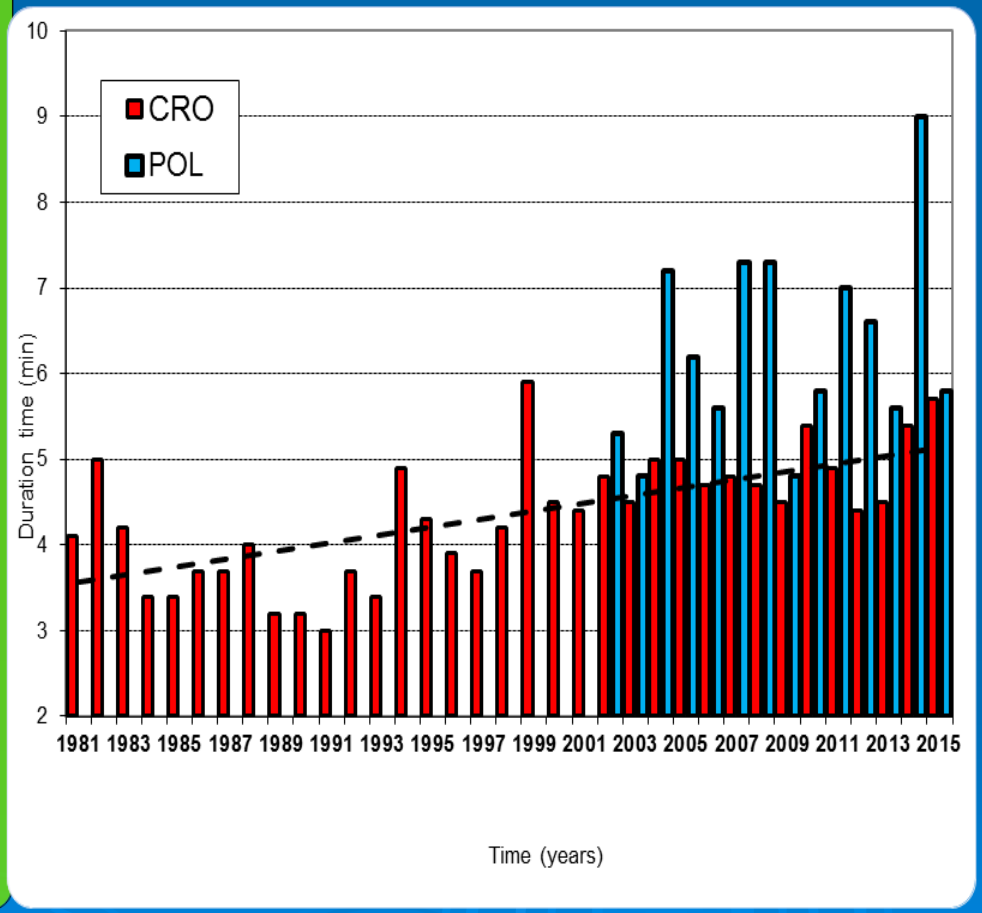


HAIL EPISODES IN CROATIA

= Počakal, Večenaj, Mikuš-Jurković, Grisogono, ***Int. J. Clim. 2018***: …on hail climatology & orography…



Average duration of hail episodes: continental Croatia: 4.3 min in 1981-2015, red & 6.3 min over the Polygon (NW Croatia), 2002-2015, blue.



*-There is **positive trend** in the mean duration of hailstone events in cont. Croatia…*

-But typical, standard climate models don't have those variables included yet - should be there!