POTSDAM INSTITUTE FOR CLIMATE IMPACT RESEARCH

P I K

Climate Change & Central Asia

Bijan Fallah et. al.

german cooperation
DEUTSCHE ZUSAMMENARBEIT

Implemented by:
giz

DKU DEUTSCH KASACHISCHE UNIVERSITÄT

GFZ Helmholtz Centre POTSDAM

MARTIN-LUTHER UNIVERSITÄT HALLE-WITTENBERG

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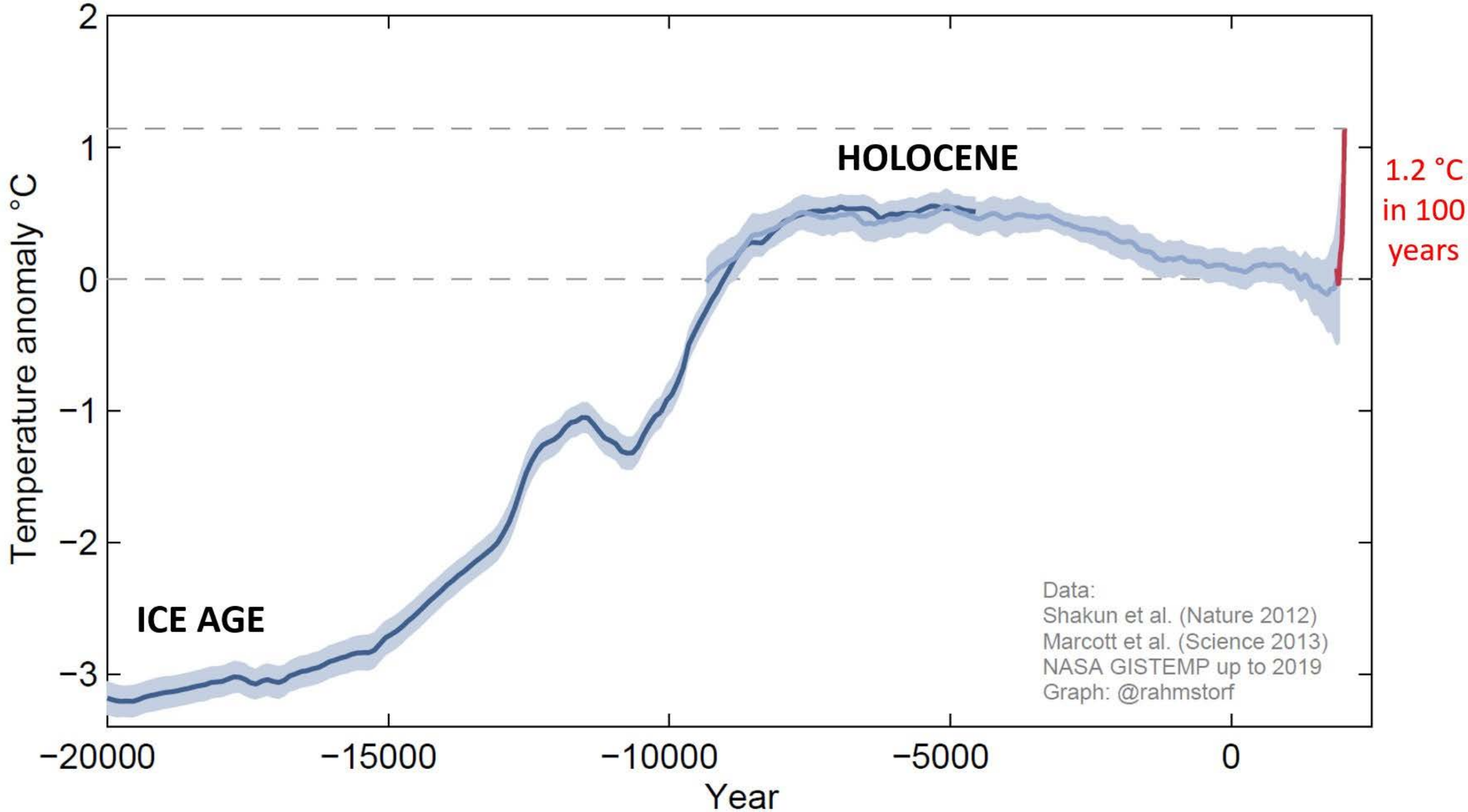
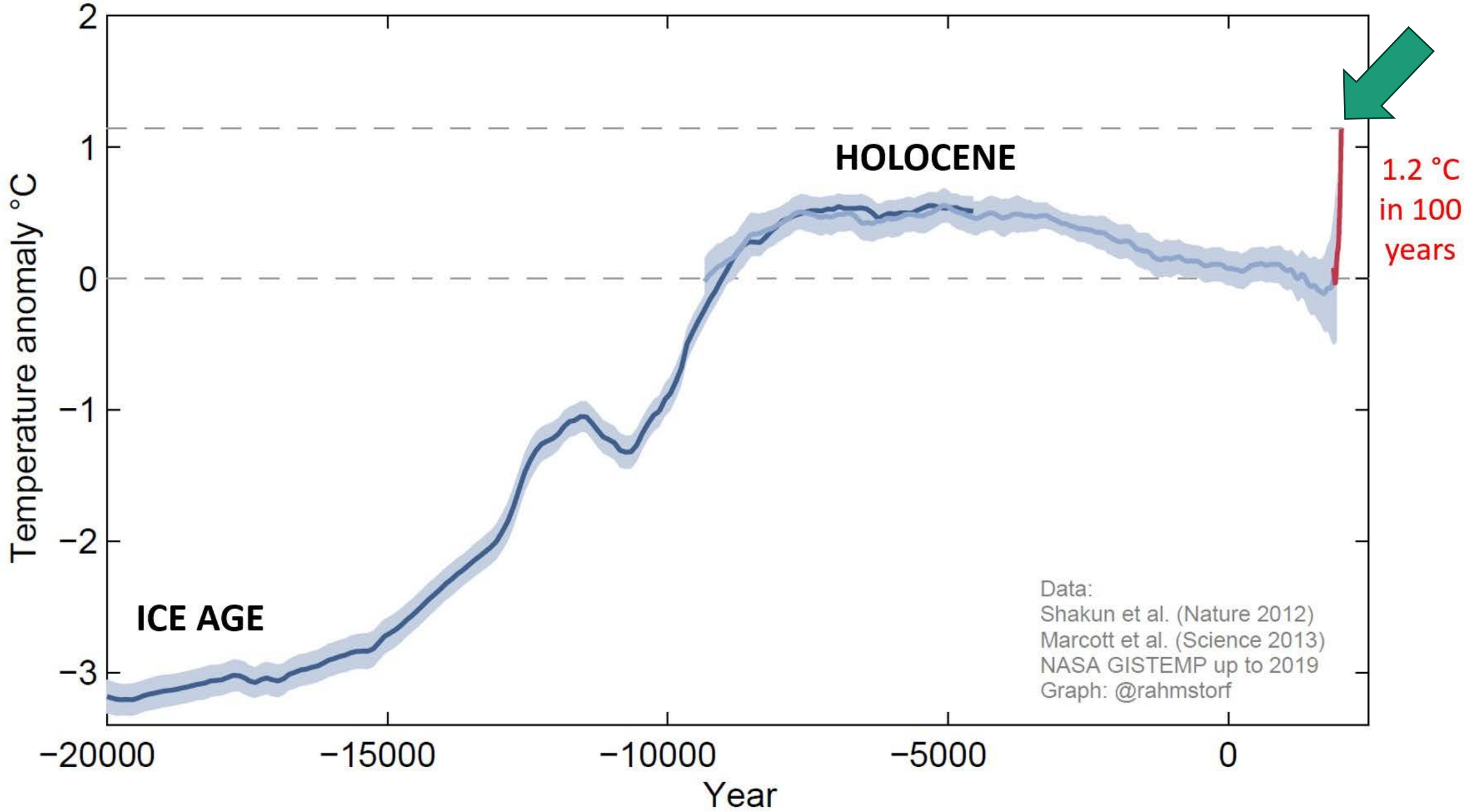
GLOBAL TEMPERATURE SINCE THE LAST ICE AGE

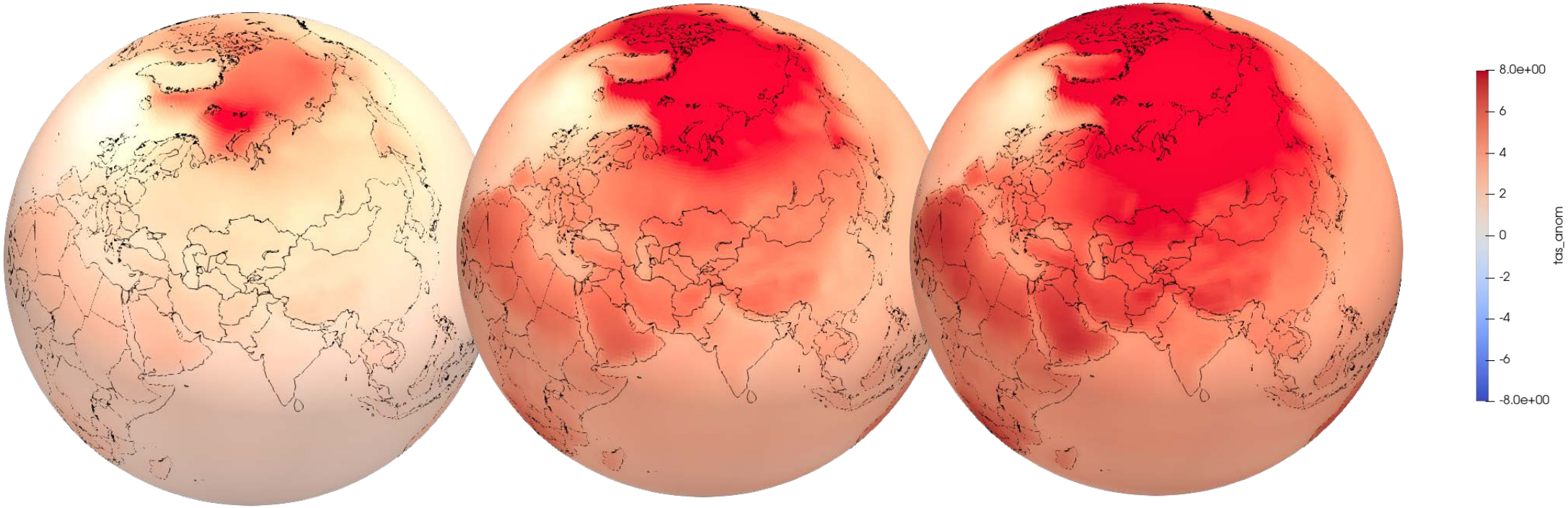


GLOBAL TEMPERATURE SINCE THE LAST ICE AGE



Projections - Temperature change

Long Term (2081-2100) SSPs (rel. 1850-1900) - Annual (33 models) climate change.



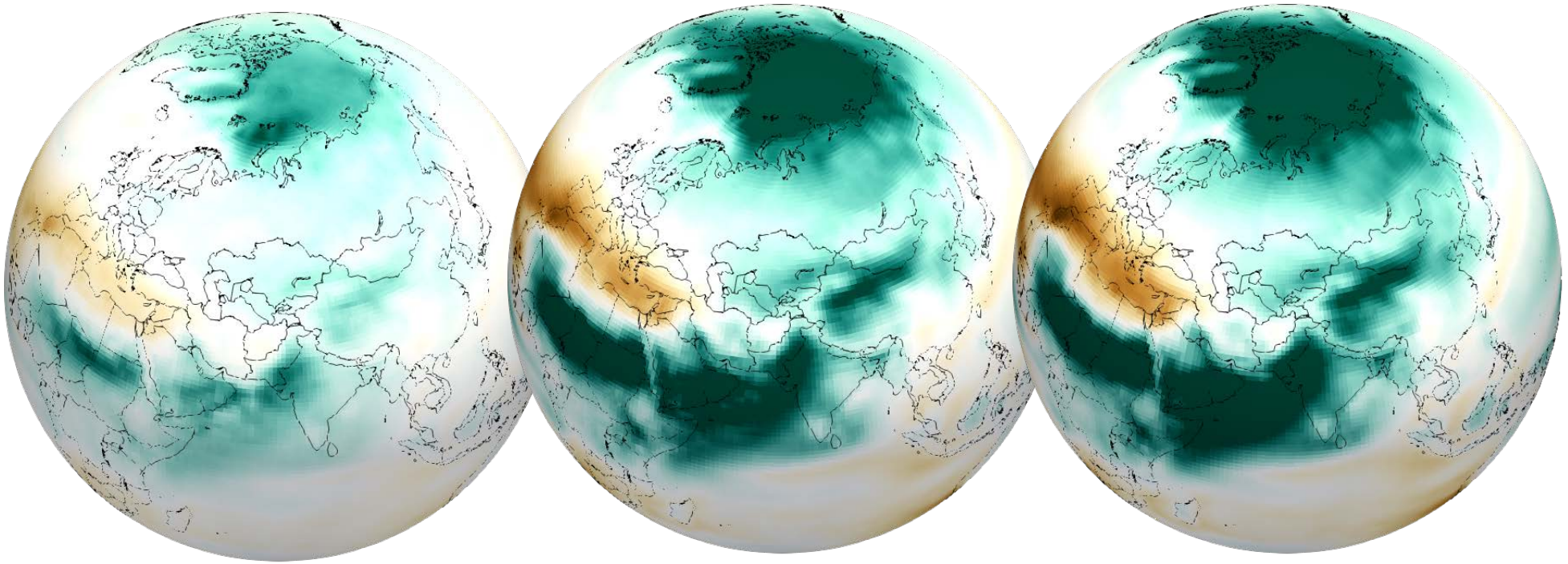
green and sustainable

unequal and polluting

fossil-fueled and competitive

Projections - Total Precipitation change

Long Term (2081-2100) SSPs (rel. 1850-1900) - Annual (33 models) climate change.



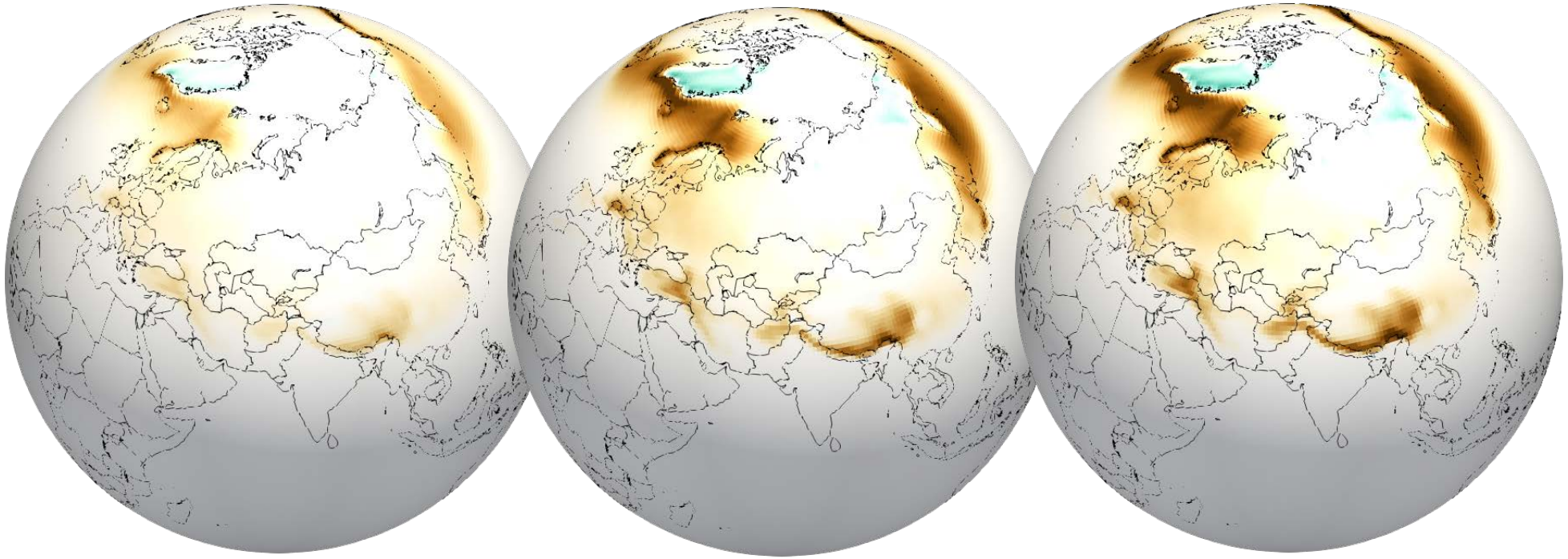
green and sustainable

unequal and polluting

fossil-fueled and competitive

Projections – Snow Fall change

Long Term (2081-2100) SSPs (rel. 1850-1900) - Annual (33 models) climate change.



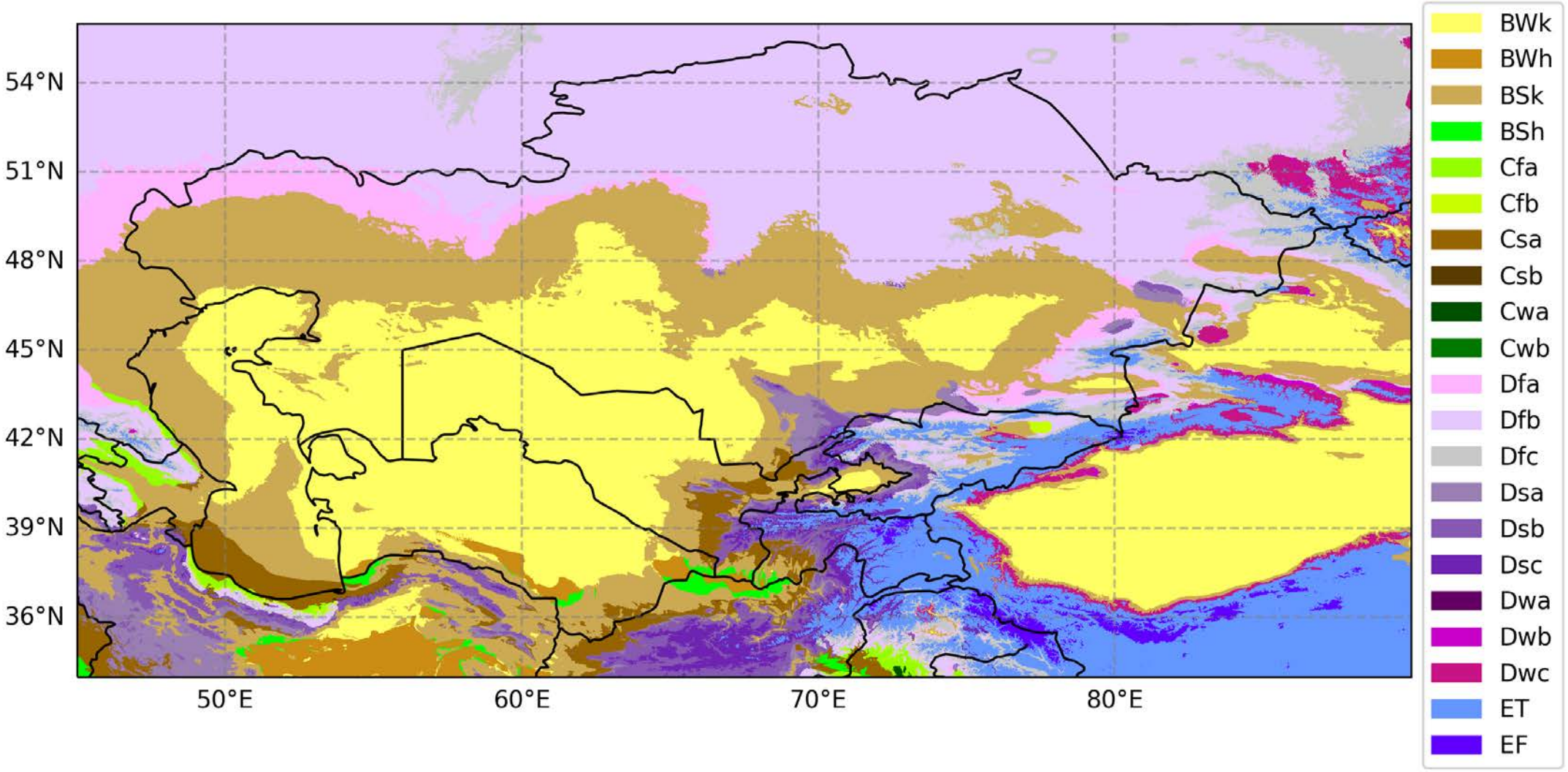
green and sustainable

unequal and polluting

fossil-fueled and competitive

Central Asian Region

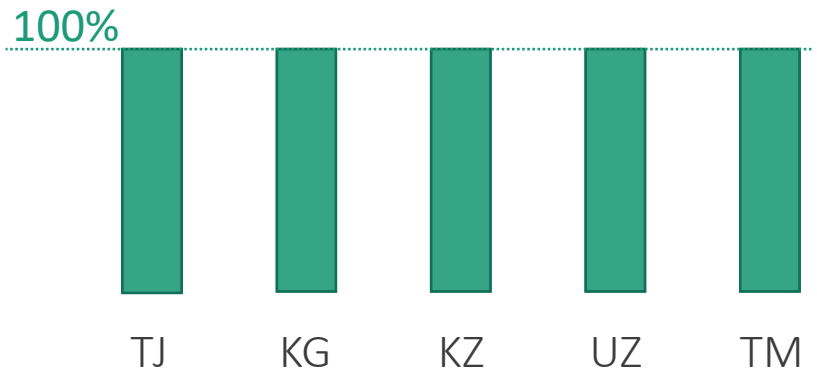
Koepen Climate Classification

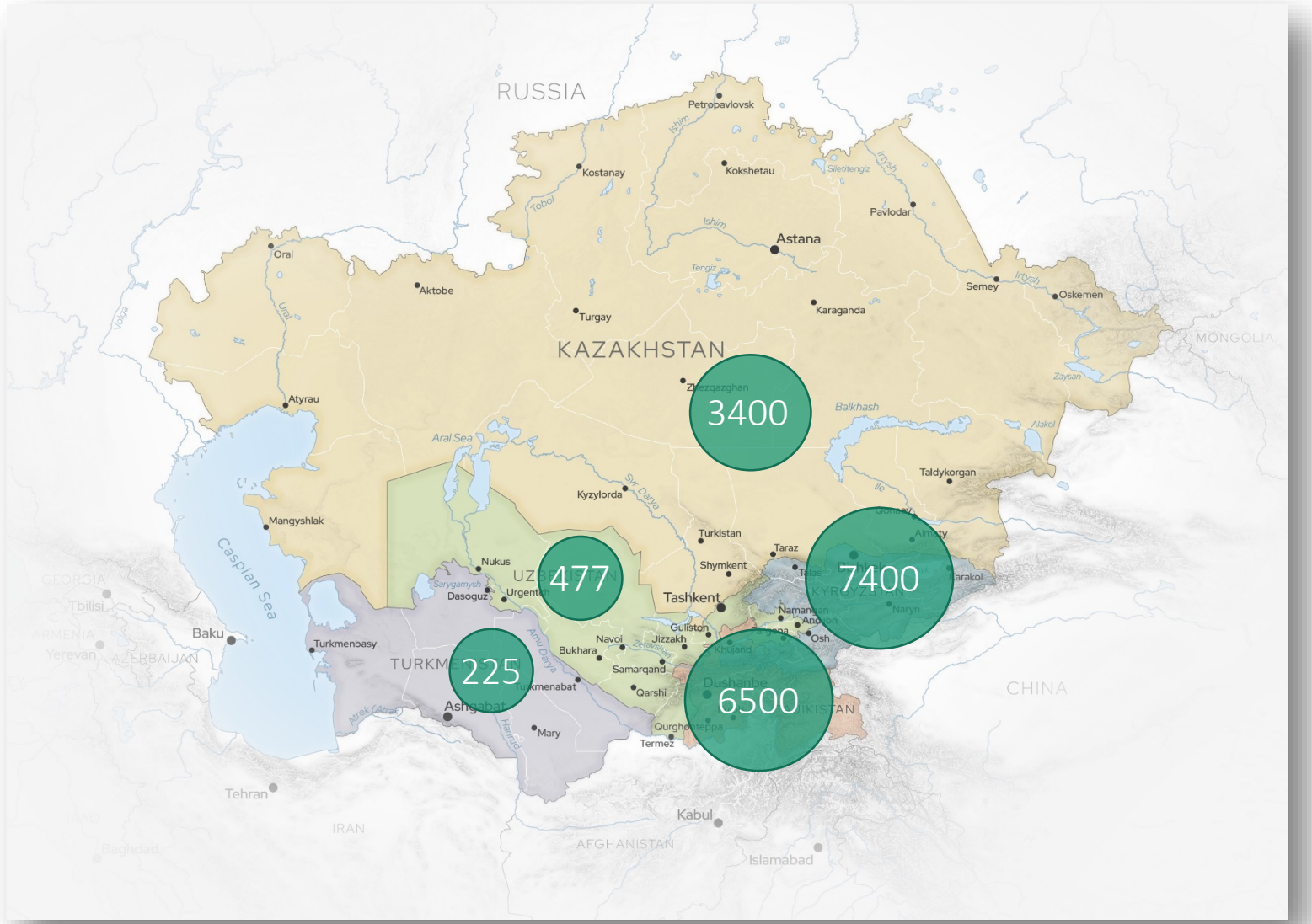


“Upstream” and “Downstream” countries

Renewable internal freshwater resources per capita (m^3) by country

Annual freshwater withdrawals, total (% of internal resources)

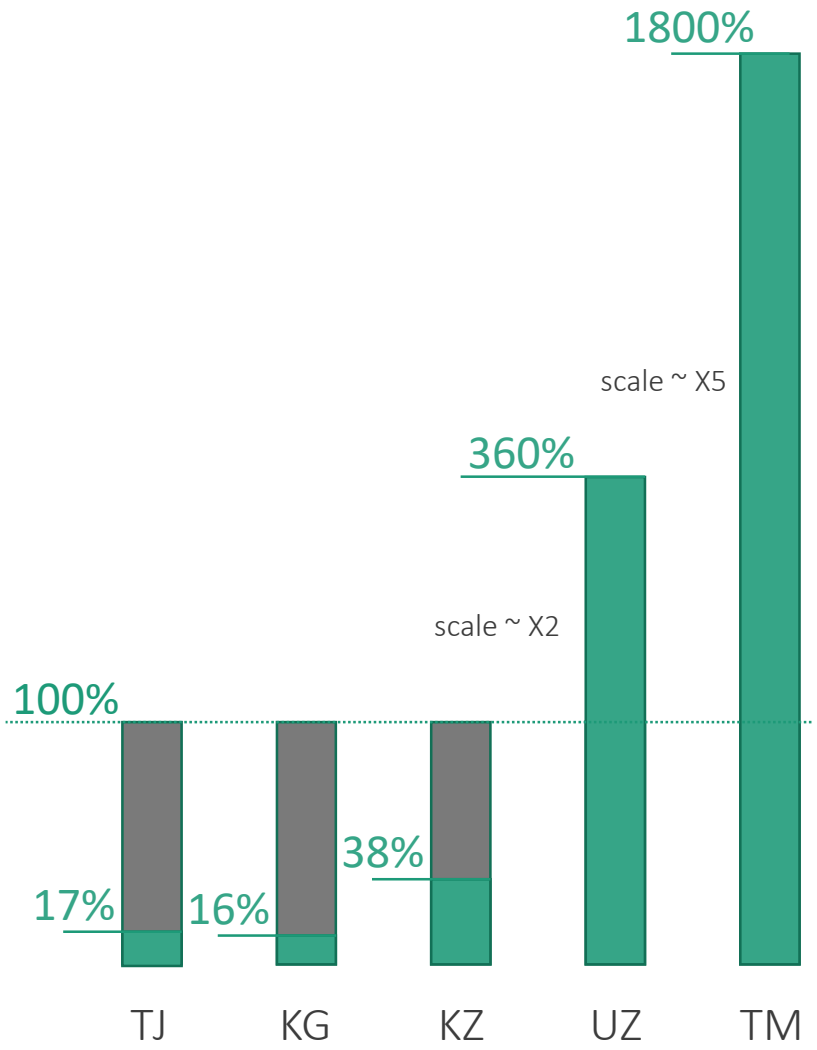


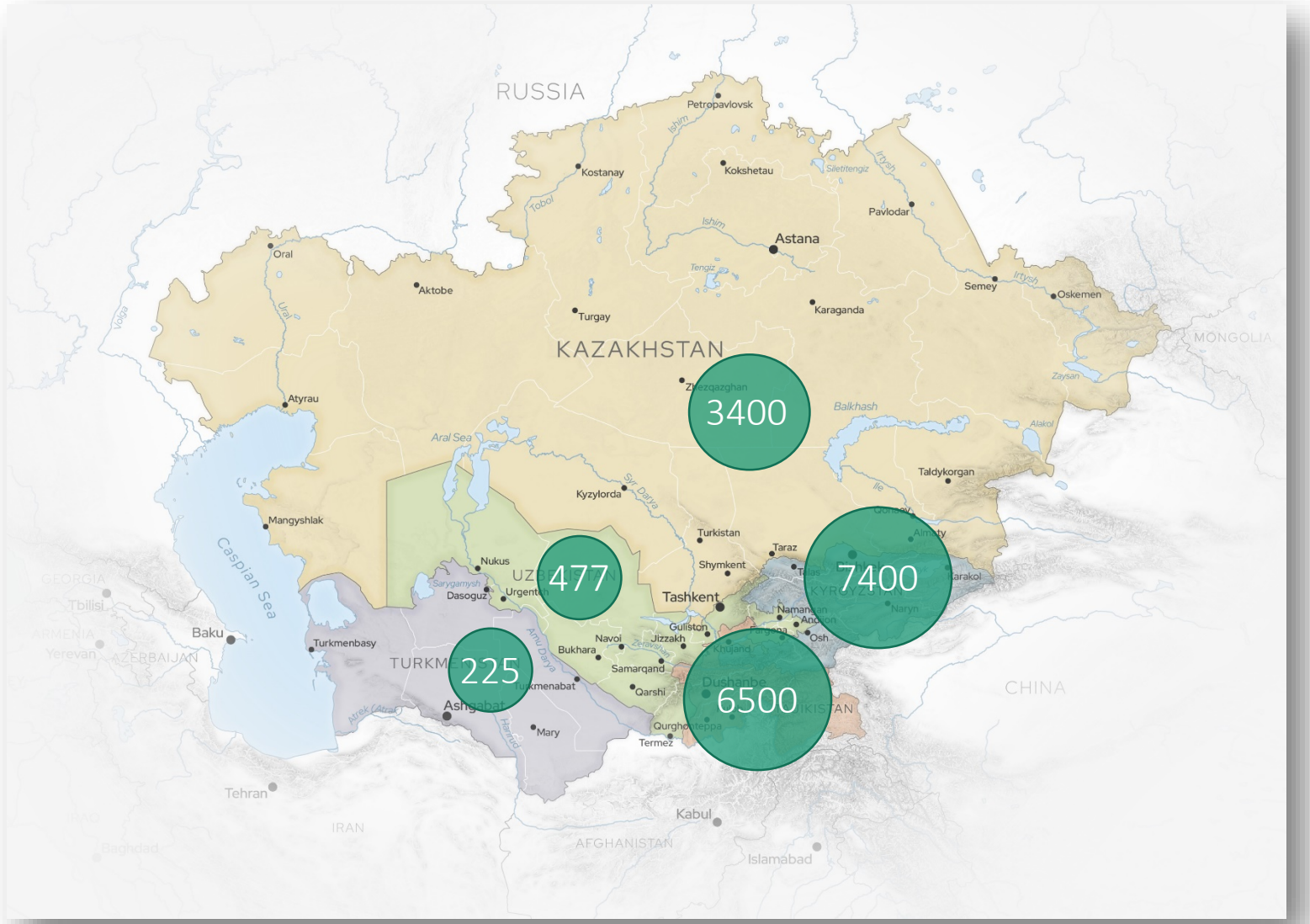


Green Central Asia

“Upstream” and “Downstream” countries

Annual freshwater withdrawals, total (% of internal resources)



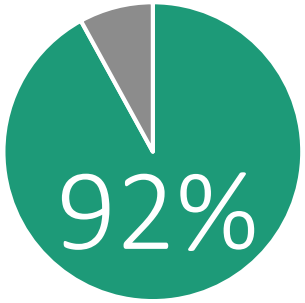


Green Central Asia

“Upstream” and “Downstream” countries

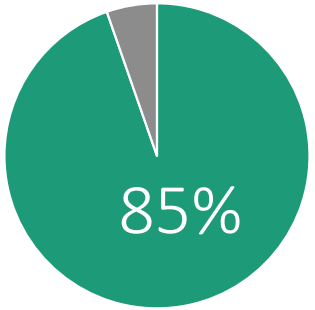
Water withdrawal for Agriculture

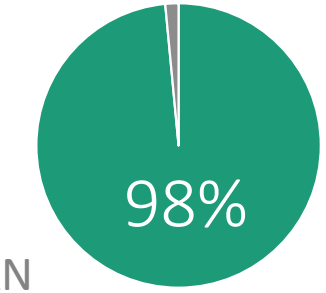
UZBEKISTAN



Share of hydropower in total electricity production,%

KYRGISTAN

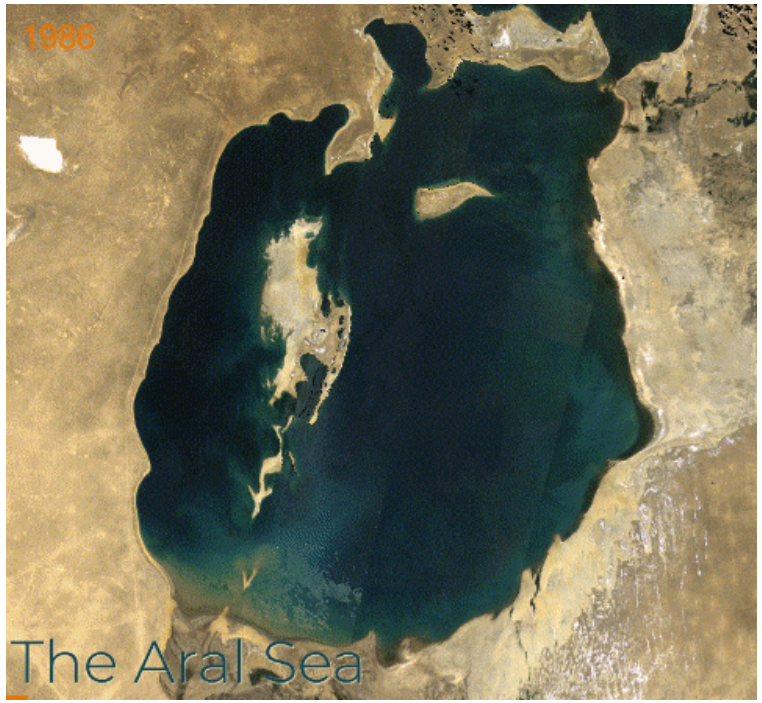




TAJIKISTAN

Green Central Asia

The result of intensive Irrigation



6%

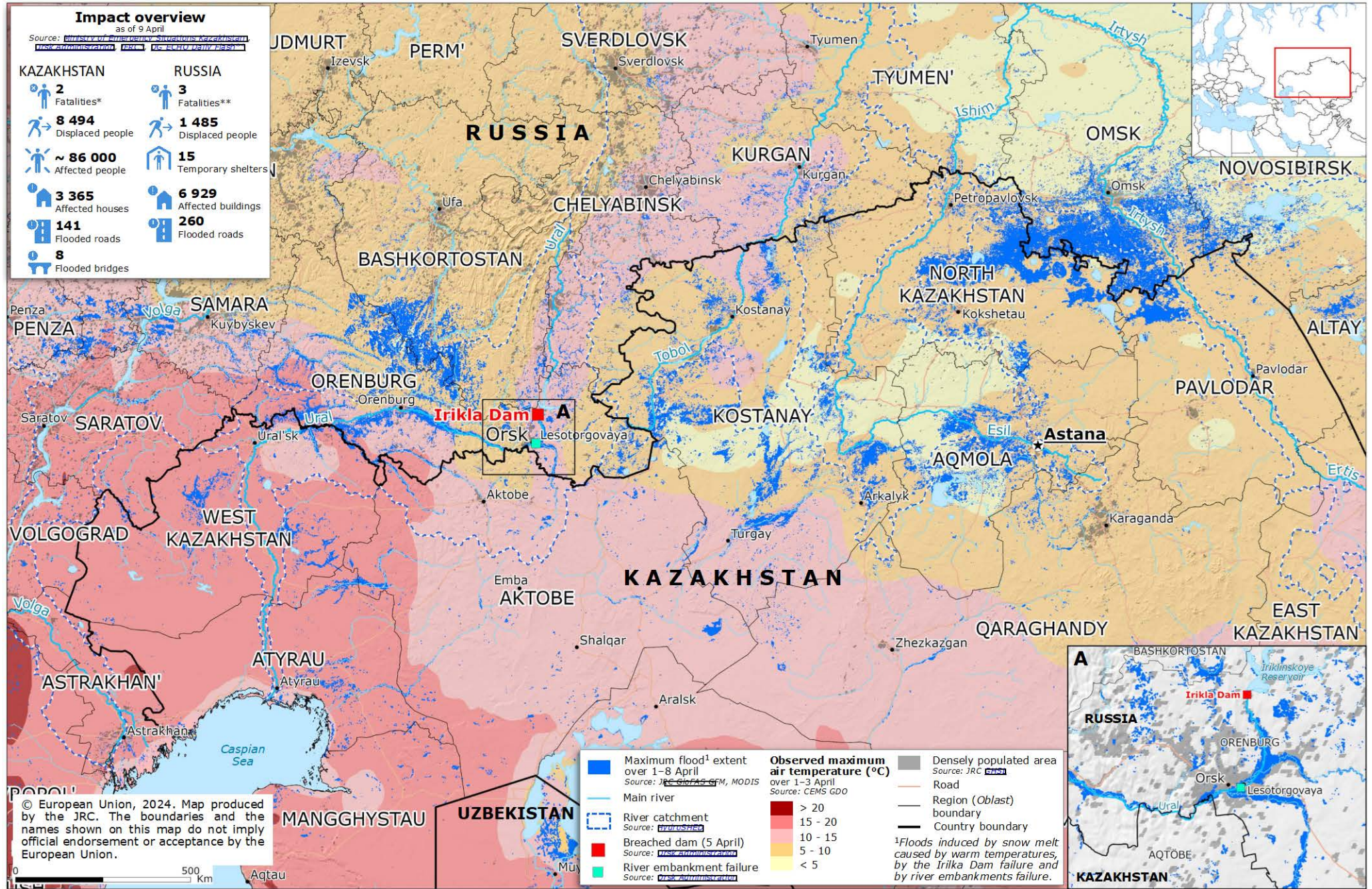
the water volume
compared to mid-XX

Photo source: https://www.burdgis.com/ https://kulturologia.ru/blogs and www.t-shevchenko.name

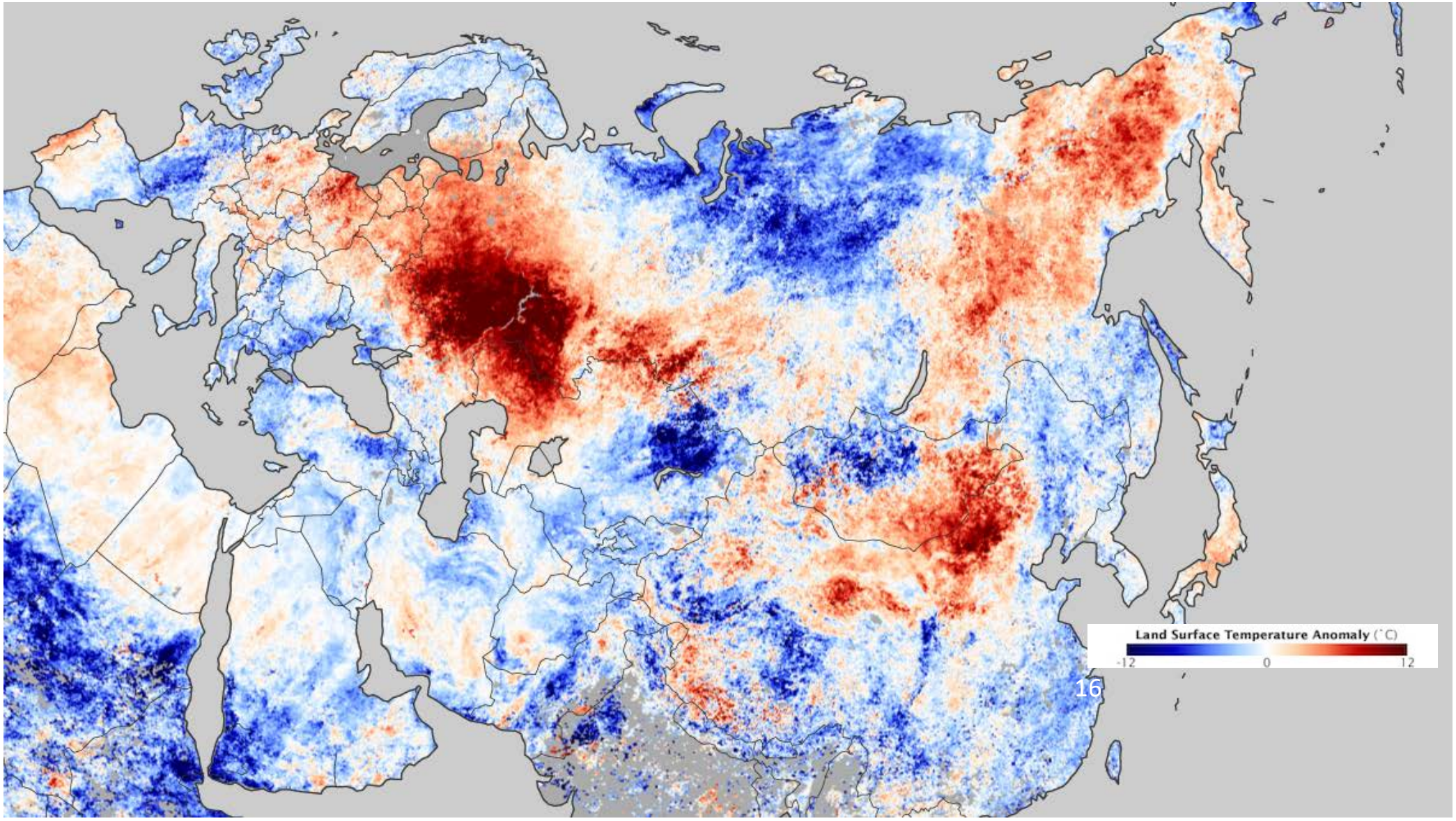
Emergency Response Coordination Centre (ERCC) – DG ECHO Daily Map | 09/04/2024

Russia, Kazakhstan | Floods

European Commission



Russian Heatwave 2010

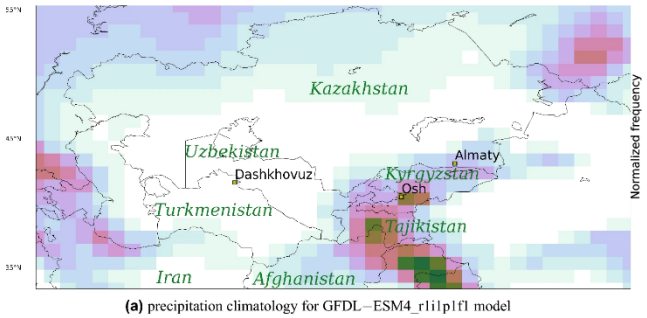


Challenges in studying the Climate change in CA

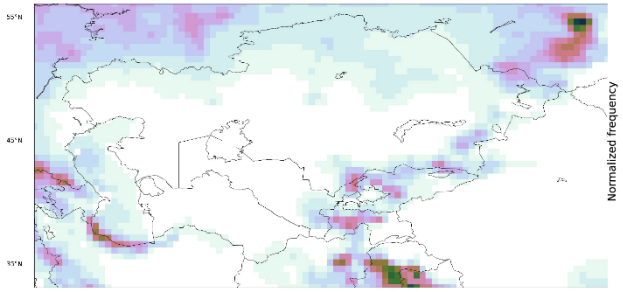
- Climate impact assessment needs local climate information

Global resolution

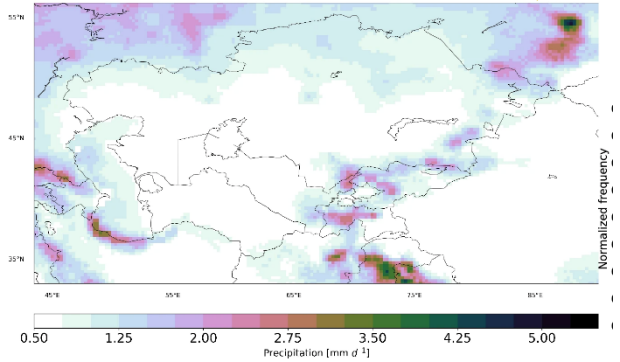
Regional resolution



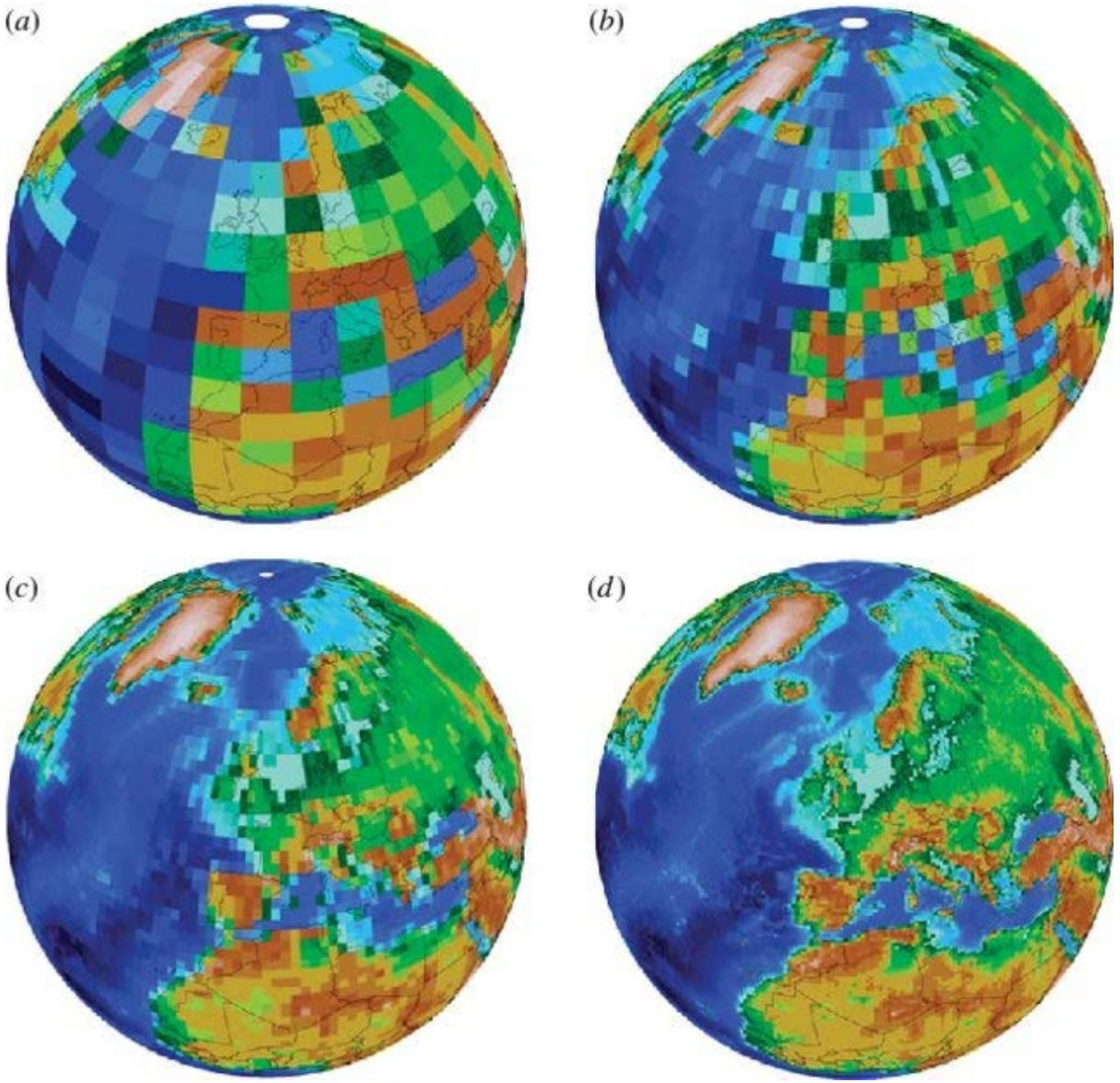
(a) precipitation climatology for GFDL−ESM4_r1i1p1f1 model



(c) precipitation climatology from ISIMIP for the GFDL−ESM4_r1i1p1f1 model



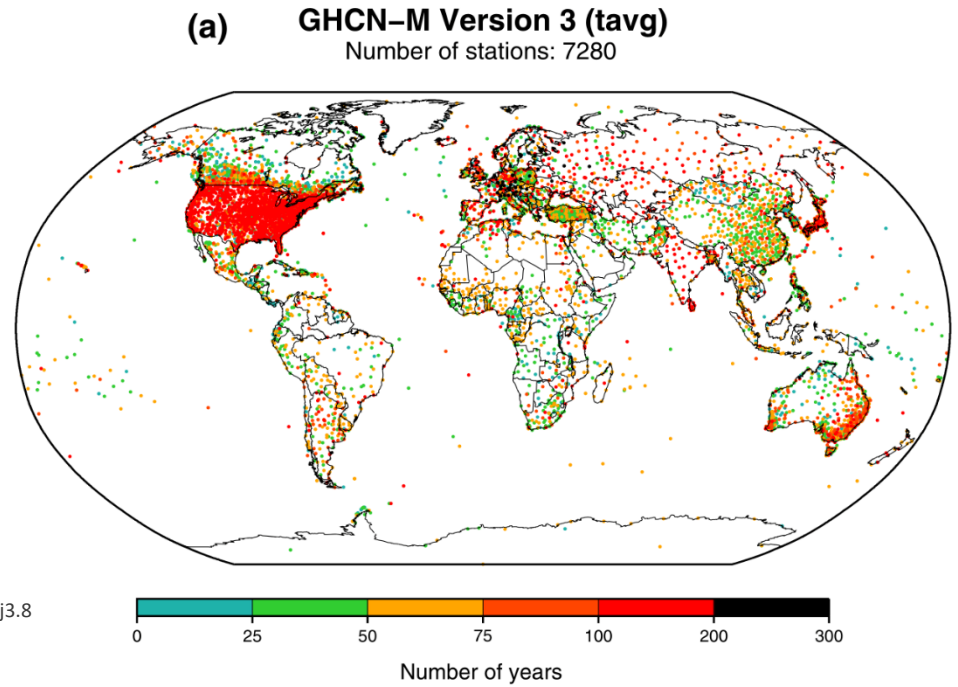
(e) precipitation climatology for the ISIMIP-BASD GFDL−ESM4_r1i1p1f1 model


(a)
(b)
(c)
(d)

Challenges

- Climate impact assessment needs local climate information

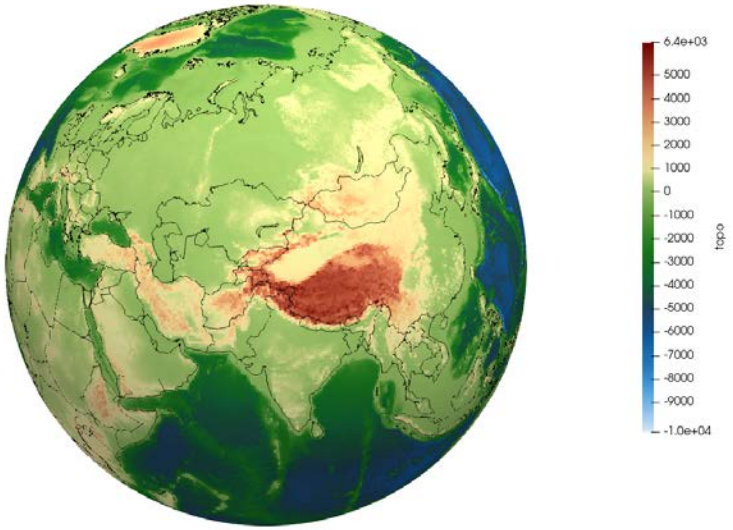
- Central Asia has a sparse climate observation network



https://rmets.onlinelibrary.wiley.com/doi/epdf/10.1002/gdj3.8

Challenges

- Climate impact assessment needs local climate information
- Central Asia has a sparse climate observation network
- The topography of CA is very complex



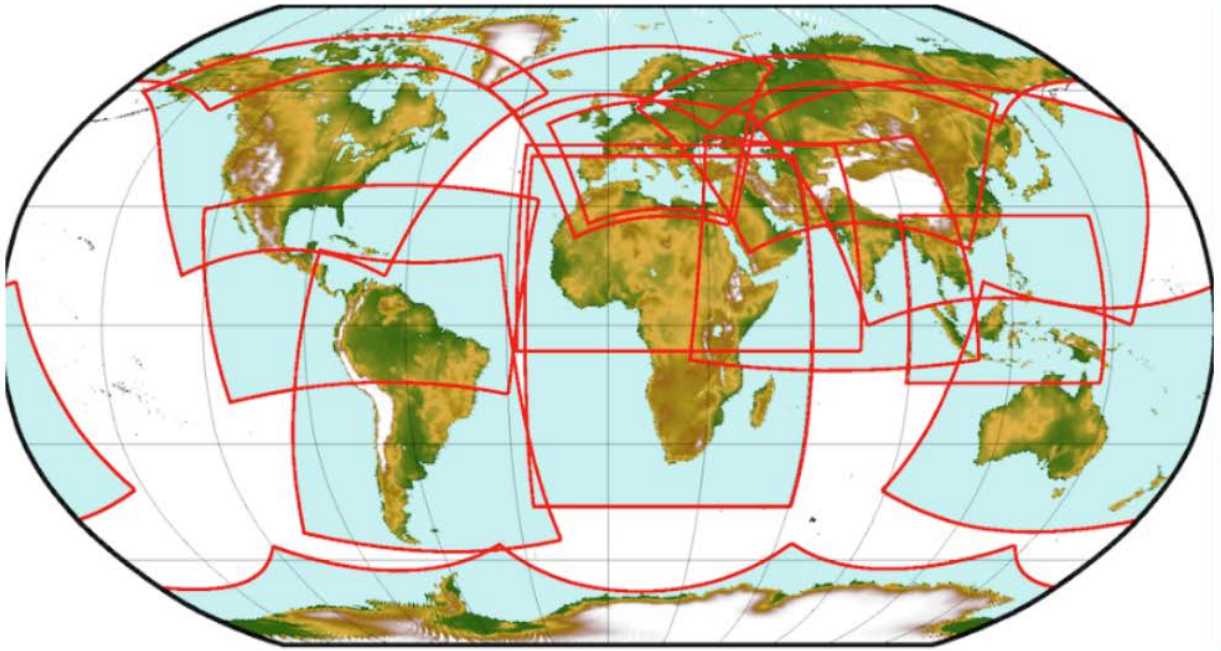
Challenges

- Climate impact assessment needs local climate information
- Central Asia has a sparse climate observation network
- The topography of CA is very complex
- Number of regional climate impact studies available in CA (only 0.24% of studies address climate change)

Challenges

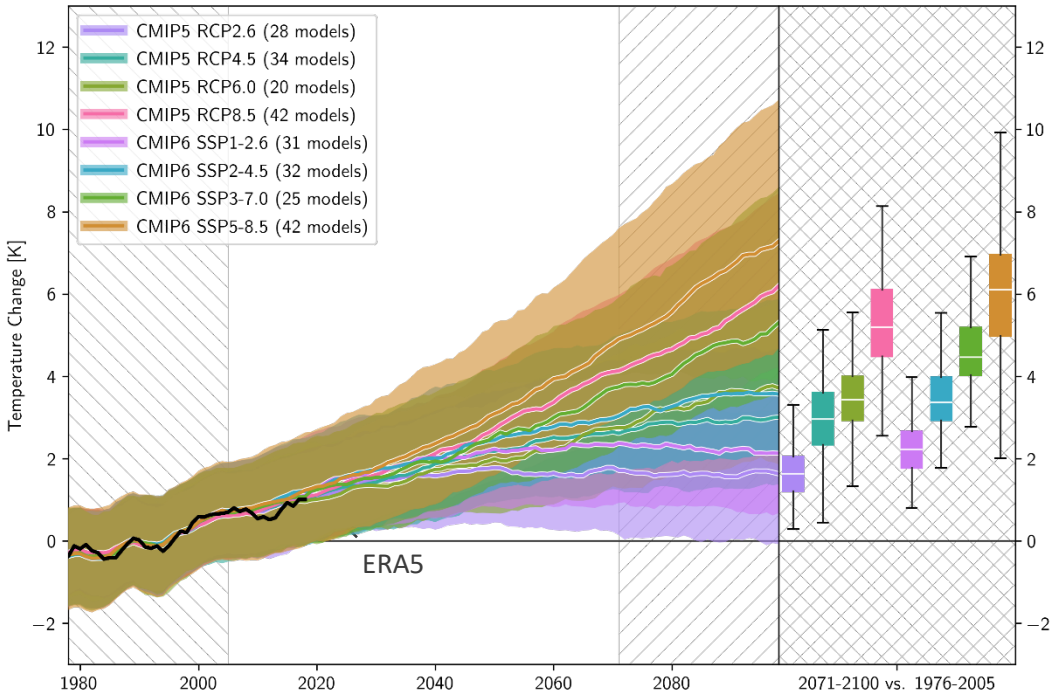
CORDEX CMIP6 downscaling plans

- Central Asia **8** simulations done by PIK
- Europe **193** simulations

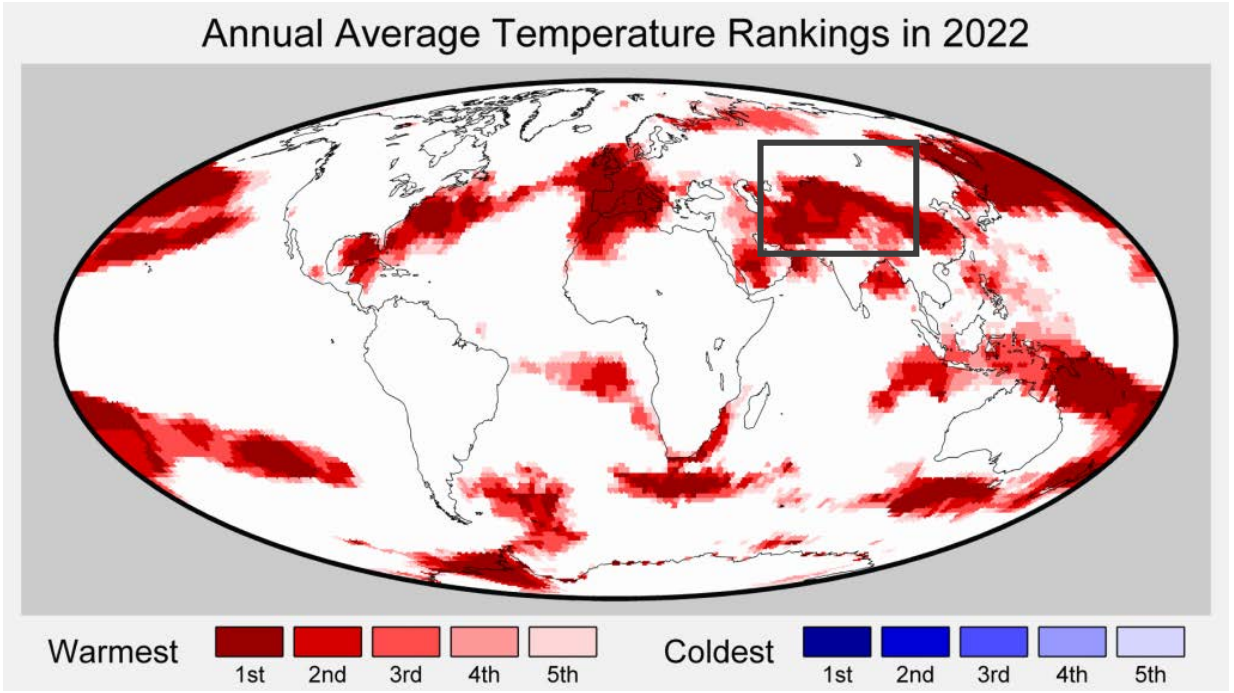


Region 1: South America
Region 2: Central America
Region 3: North America
Region 4: Africa
Region 5: Europe (EURO)
Region 6: South Asia
Region 7: East Asia
Region 8: Central Asia
Region 9: Australasia
Region 10: Antarctica
Region 11: Arctic
Region 12: Mediterranean (MED)
Region 13: Middle East North Africa (MENA)
Region 14: South-East Asia (SEA)

Warming trend in CA



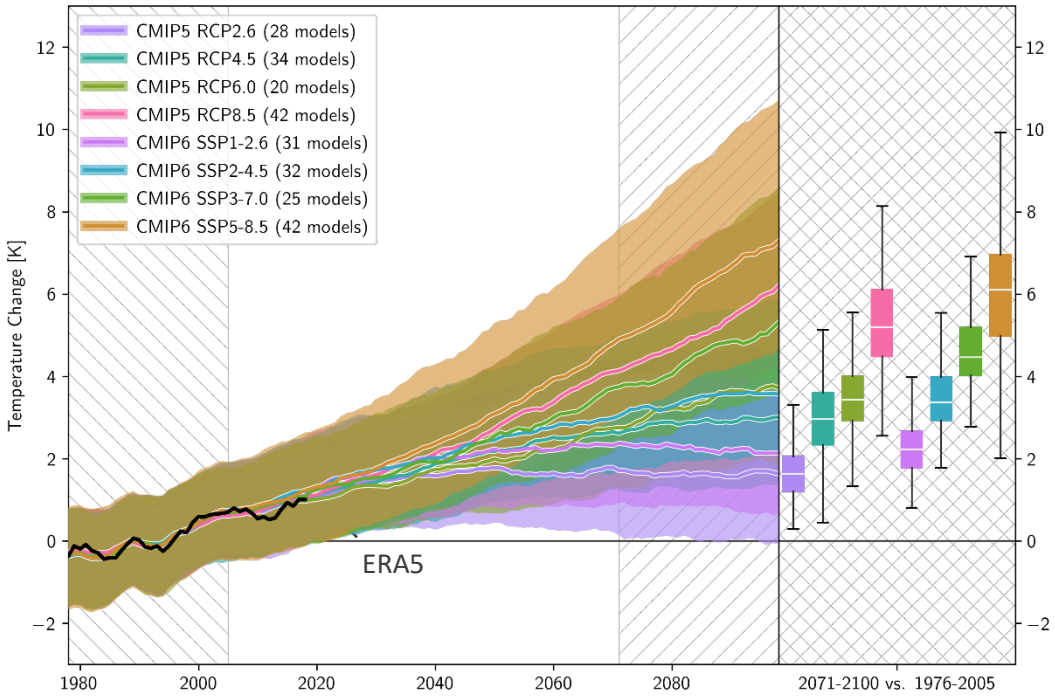
©Bijan Fallah, PIK



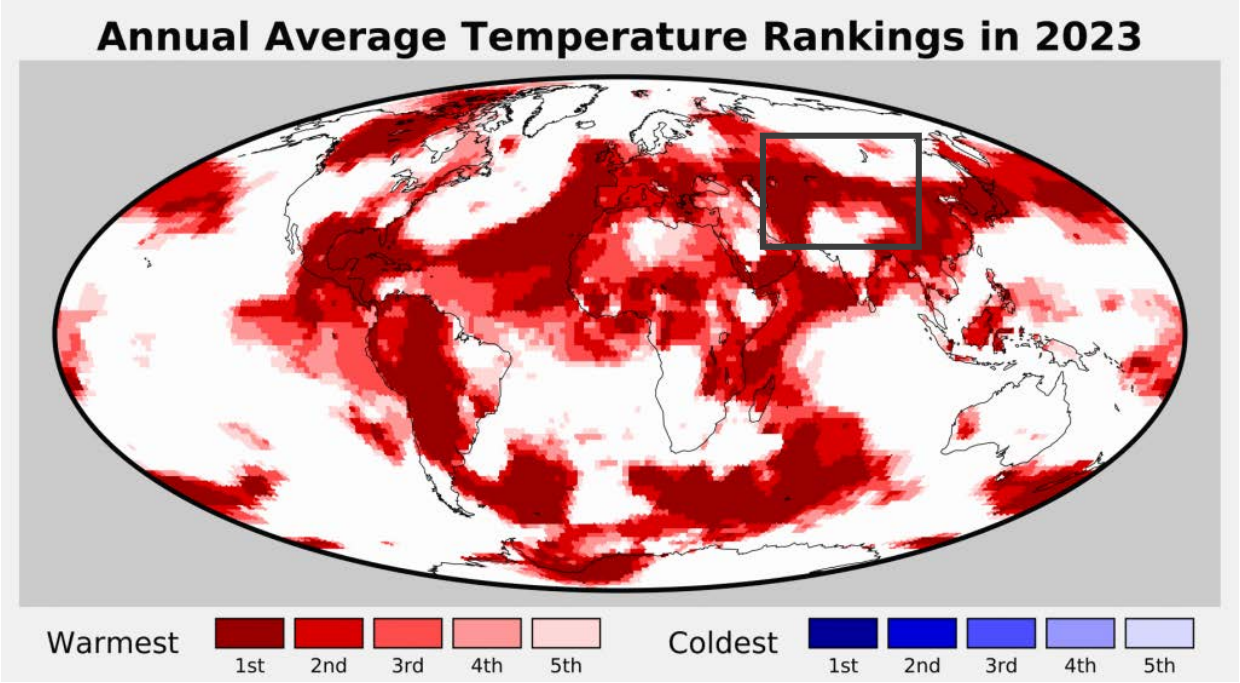
Since 1850

https://berkeleyearth.org/global-temperature-report-for-2022/

Warming trend in CA



©Bijan Fallah, PIK



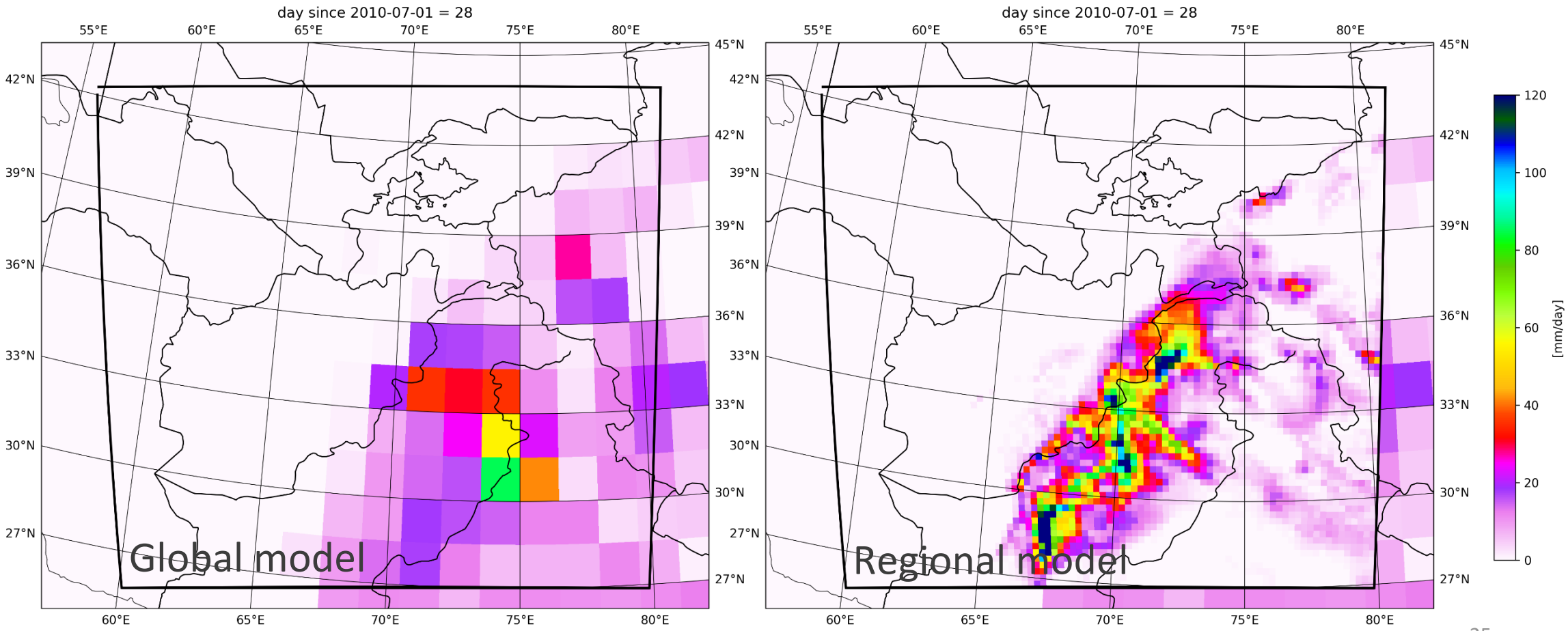
Since 1850

https://berkeleyearth.org/global-temperature-report-for-2022/

Challenges – Downscaling with regional models

What we have

What we need



Challenges – Downscaling with statistical models

What we have

What we need

4x4

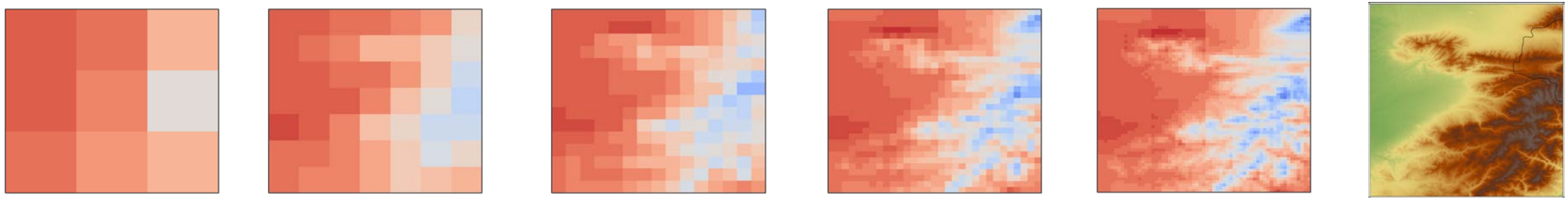
8x8

16x16

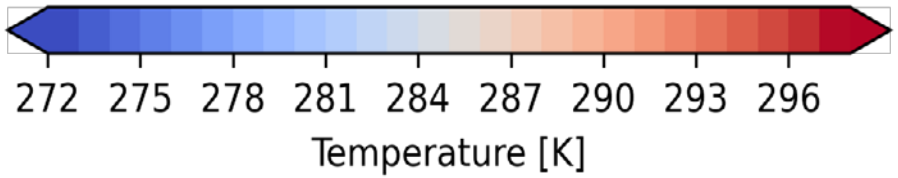
32x32

64x64

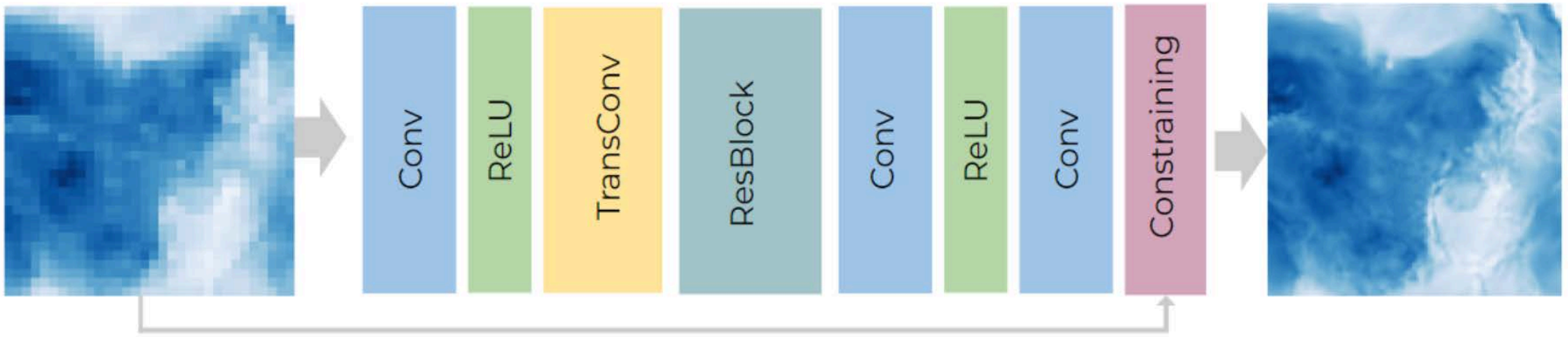
topography



Ensemble mean (5 ISIMIP3b models) of tas ssp585 2070-2100

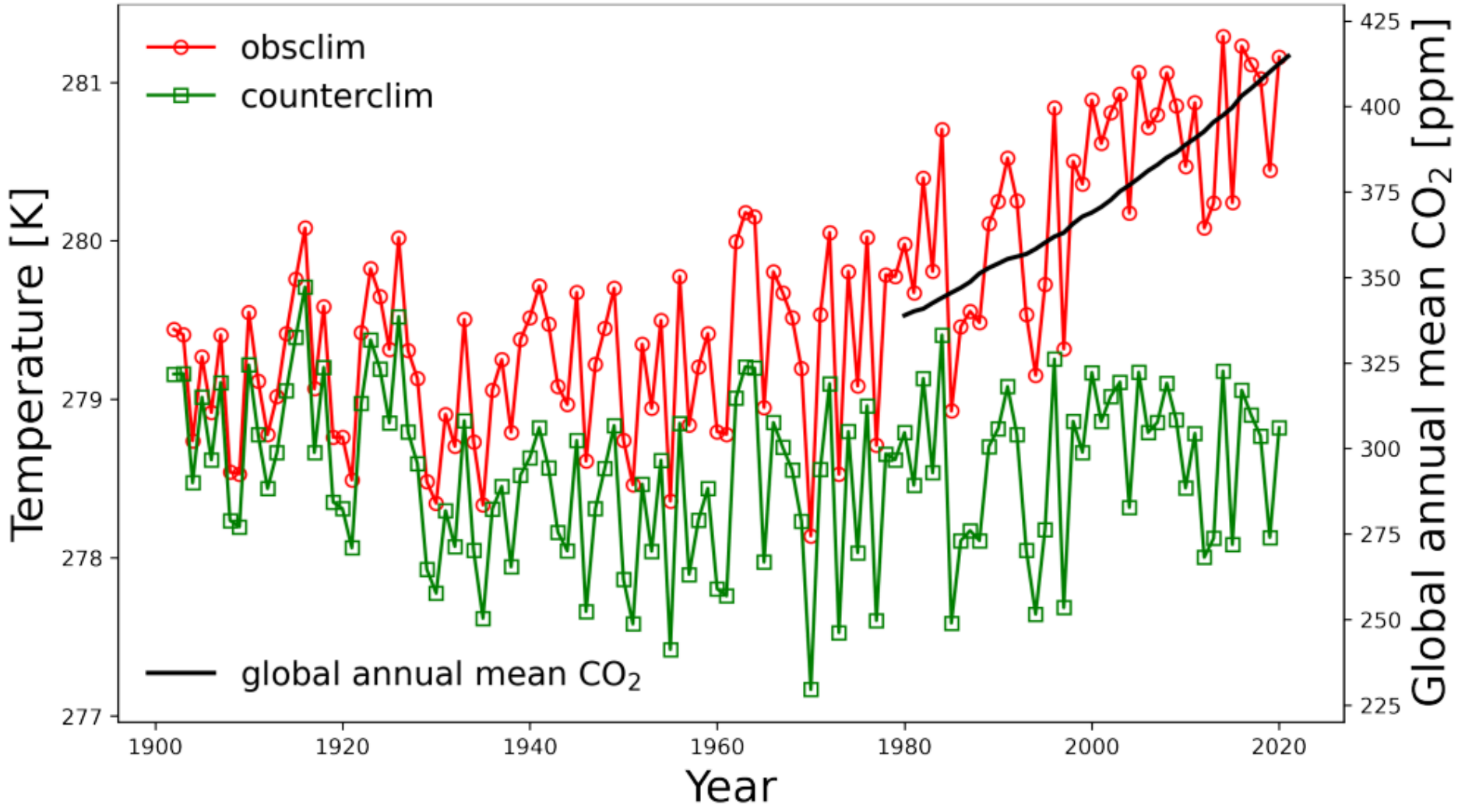


Artificial Intelligence : Deep Neural Nets

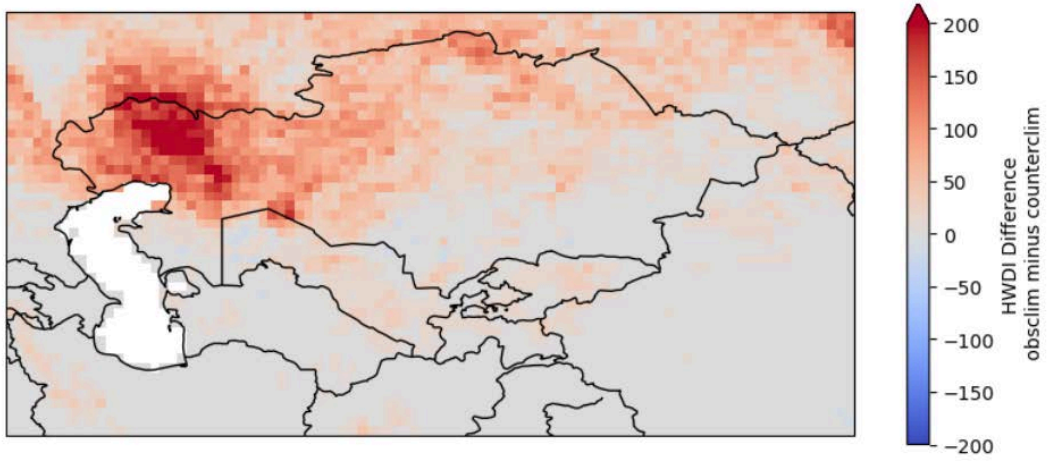


@Paula Harder

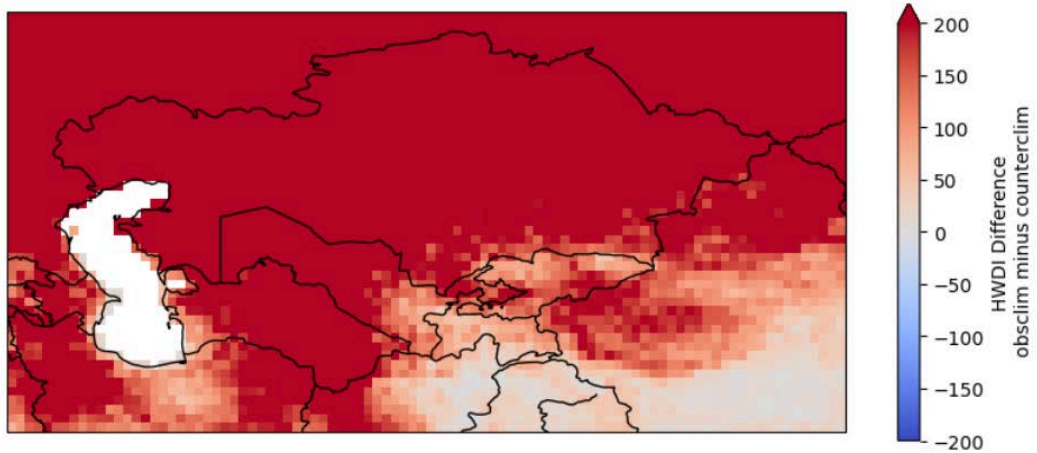
What do model tell us then?



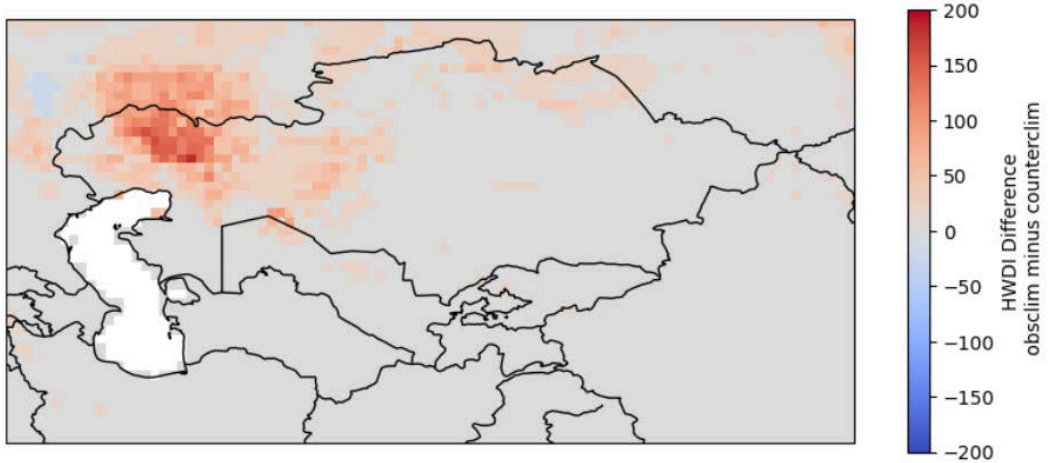
Heat Wave Duration index with human influence



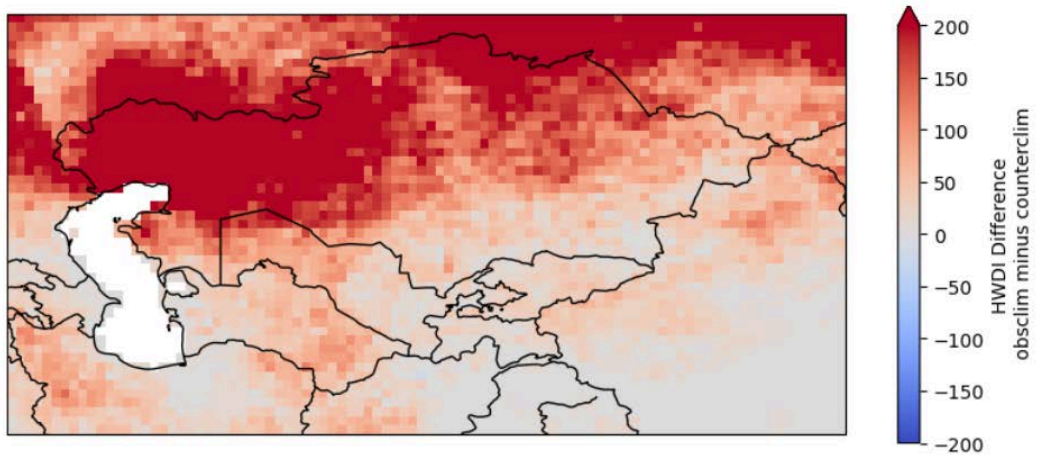
(c) $n\_day = 15$



(a) $n\_day = 5$

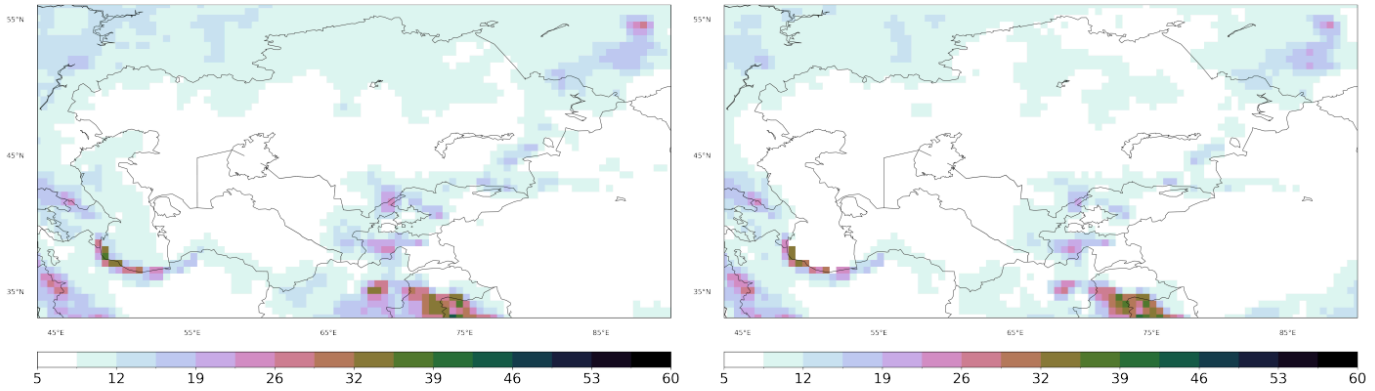


(d) $n\_day = 20$



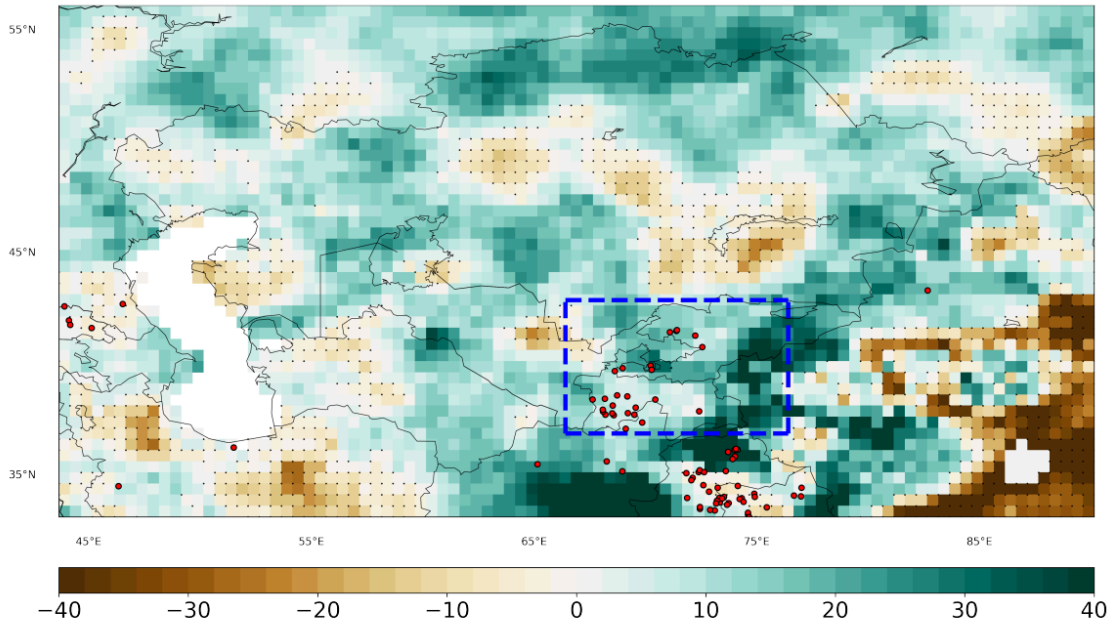
(b) $n\_day = 10$

Heavy Precipitation with human influence



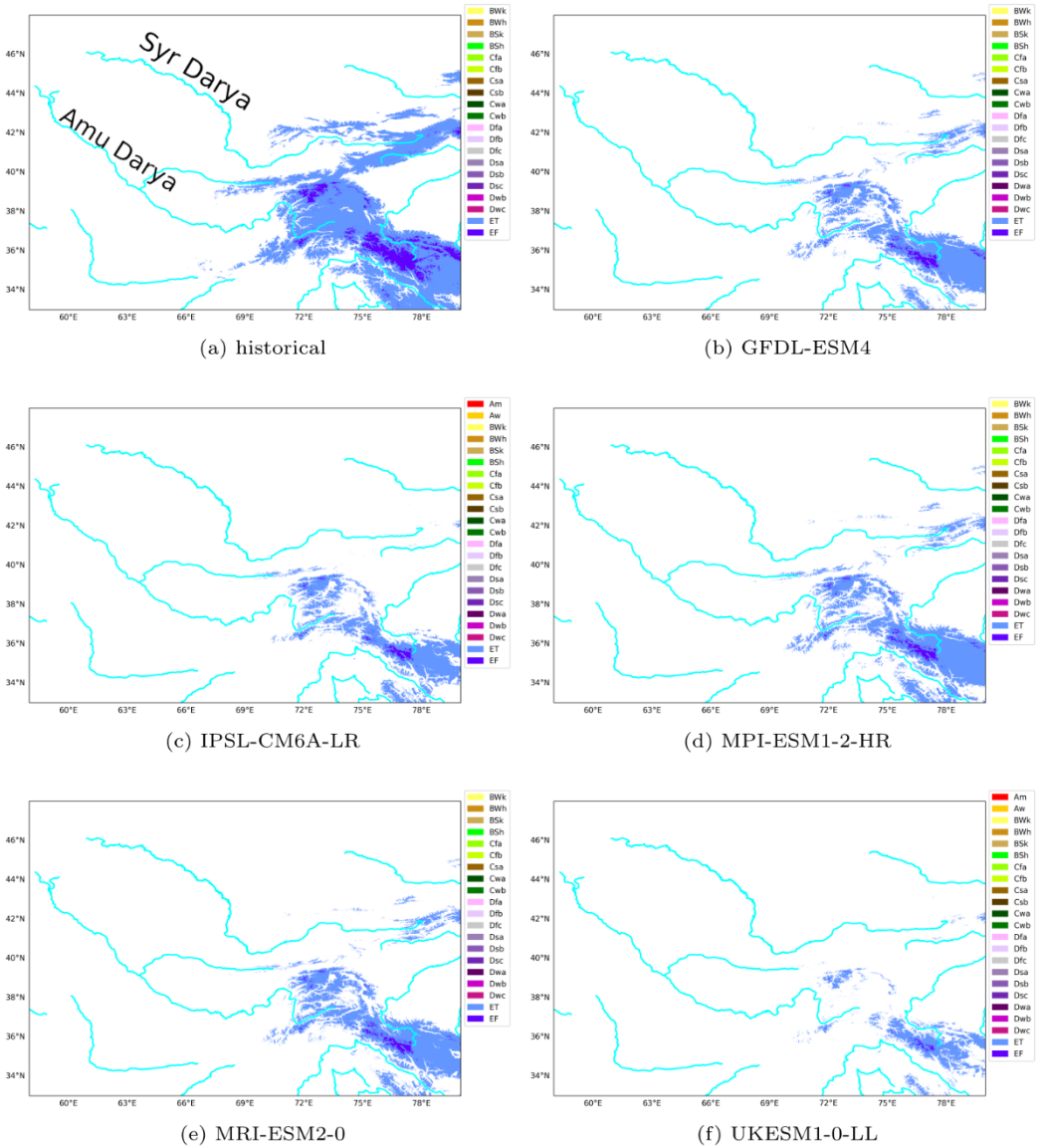
(a) PR98 of obsclim

(b) PR98 of counterclim



(c) PR98 change in % (obsclim minus counterclim)

Future of water resources based on our activity



(a) historical (b) GFDL-ESM4

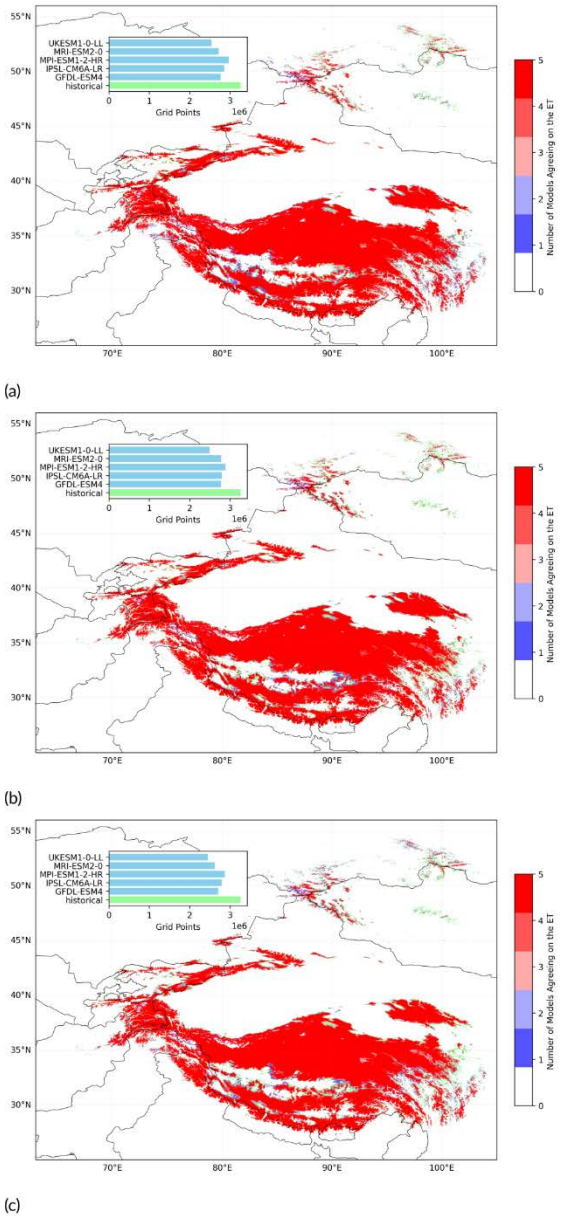
(c) IPSL-CM6A-LR (d) MPI-ESM1-2-HR

(e) MRI-ESM2-0 (f) UKESM1-0-LL

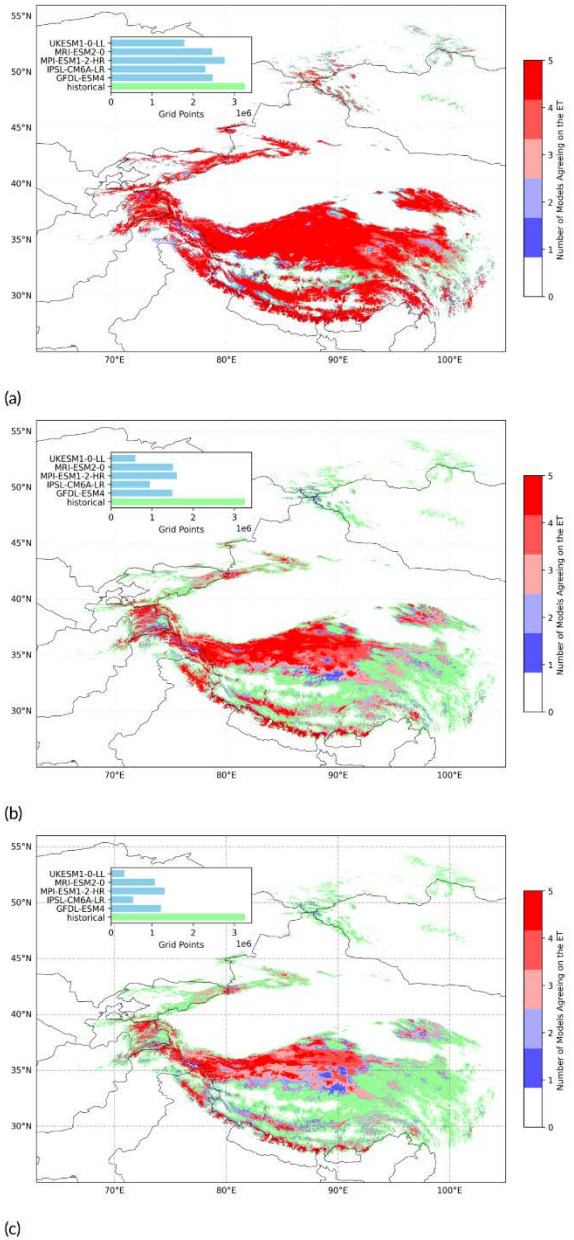
Fig. 14: Maps of two Köppen climate categories, i.e. ET and EF for a) historical period and at the end of the century (2071-2100) from 5 model simulations and under ssp585 scenario (b-f) in the two main rivers basins of Central Asia (Amu Darya and Syr Darya).

Future of water resources based on our activity

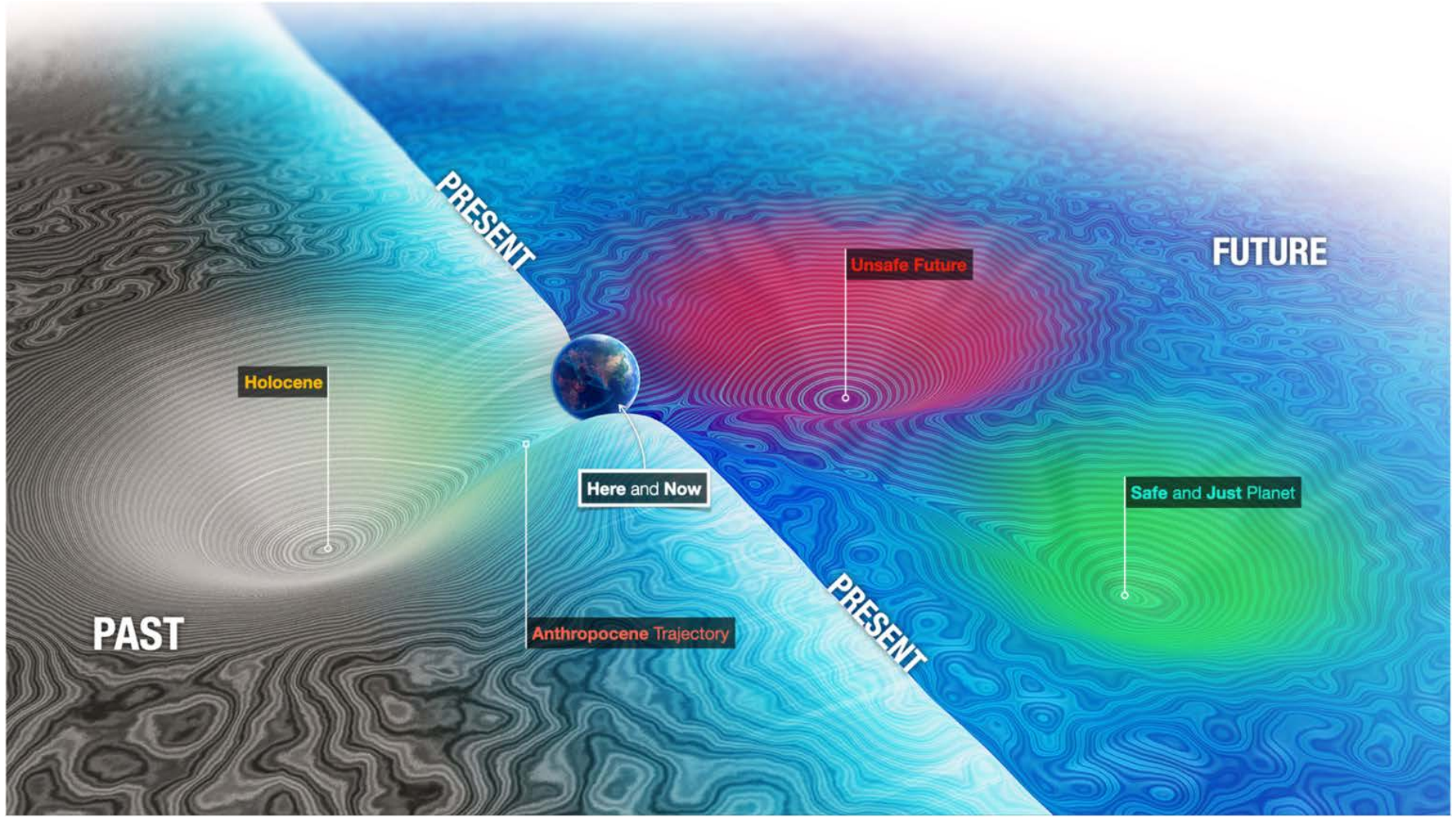
2011-2040



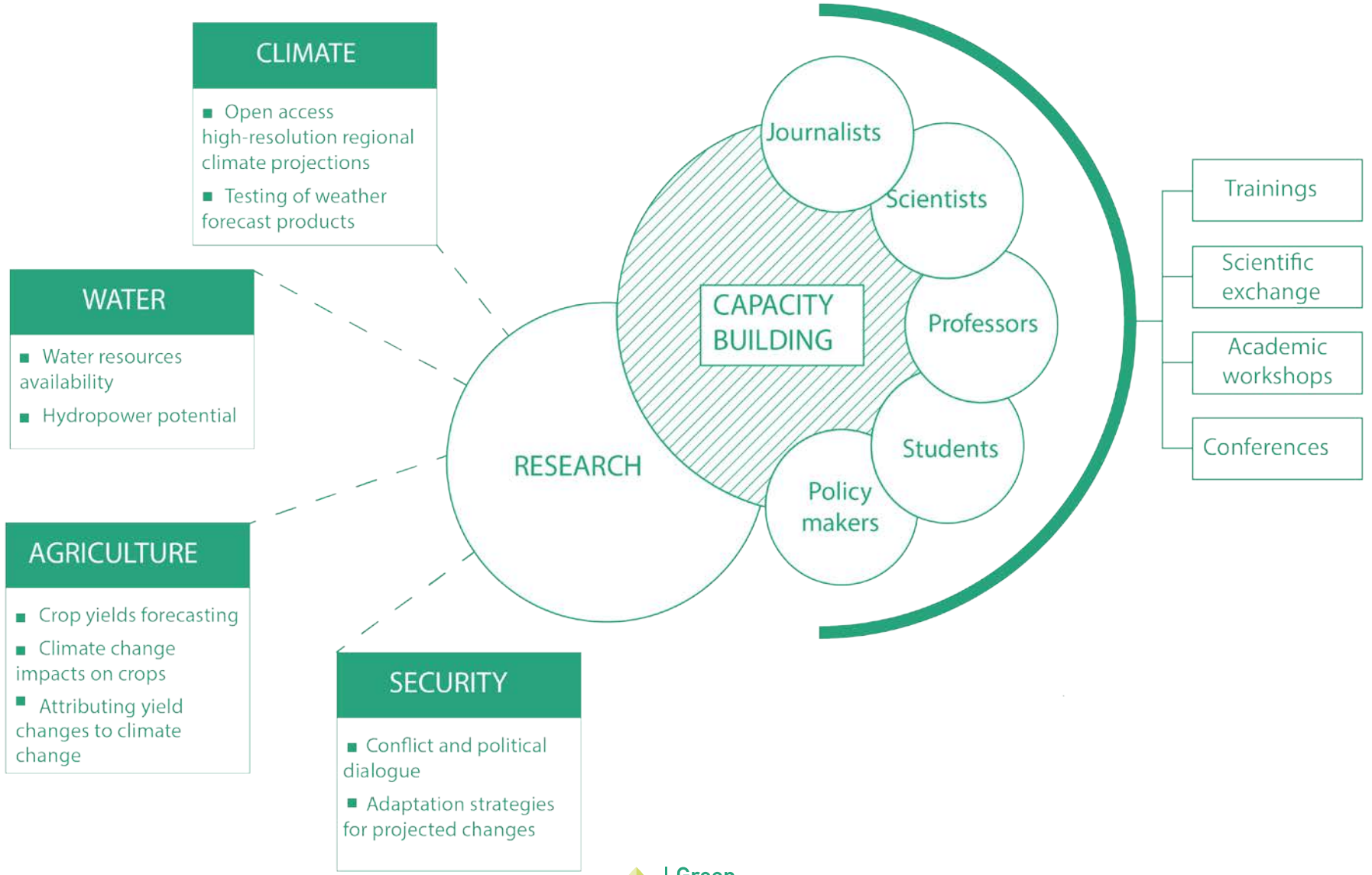
2071-2100



Where would we go?



Earth's Future, Volume: 9, Issue: 4, First published: 14 March 2021, DOI: (10.1029/2020EF001866)


CLIMATE
Open access high-resolution regional climate projections
Testing of weather forecast products
WATER
Water resources availability
Hydropower potential
AGRICULTURE
Crop yields forecasting
Climate change impacts on crops
Attributing yield changes to climate change
SECURITY
Conflict and political dialogue
Adaptation strategies for projected changes
RESEARCH
CAPACITY BUILDING
Journalists
Scientists
Professors
Students
Policy makers
Trainings
Scientific exchange
Academic workshops
Conferences

Capacity Building

LOCAL SCIENTISTS

Visits to PIK, 2 persons for 2 months per year

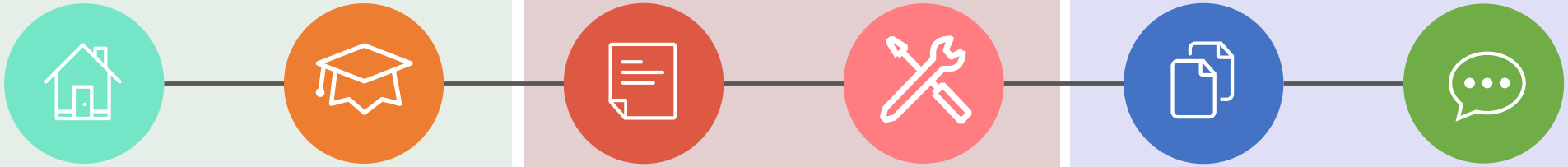
HMS

Capacity building workshops for technical staff

JOURNALISTS

Policy relevant messages

How to communicate the climate change issues



PhDs

Together with DKU

2 x 2 Months visits per year

UNIVERSITIES

Support in development of academic courses

POLICY MAKERS

Policy relevant messages

Green Central Asia

Capacity building events

8 

organized or co-organized events

5 

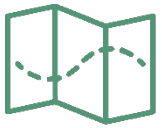
countries

>35 

institutions

>100 

participants

2 

field trips to Uzbekistan & Tajikistan

2 

two-months research visits from DKU

Focus groups

- *Scientists*
- *Students*
- *Water professionals*
- *National Ministries workers*
- *Young diplomats*
- *Young professionals*
- *Civil servants*
- *NGO and IGO workers*

Green Central Asia

Capacity building events - highlights

Field trip to the Aral Sea

Climate journalism workshop

Workshop about fostering peace through climate adaptation

Geographical representation of participants

Field trip to Pamir

Berlin Climate and Security Conference 2022

Green Central Asia

Capacity building events - highlights

Keynote by Dr Iulii Didovets at COP28

Berlin Peace Dialogue

Green Central Asia

ClimateImpactsOnline

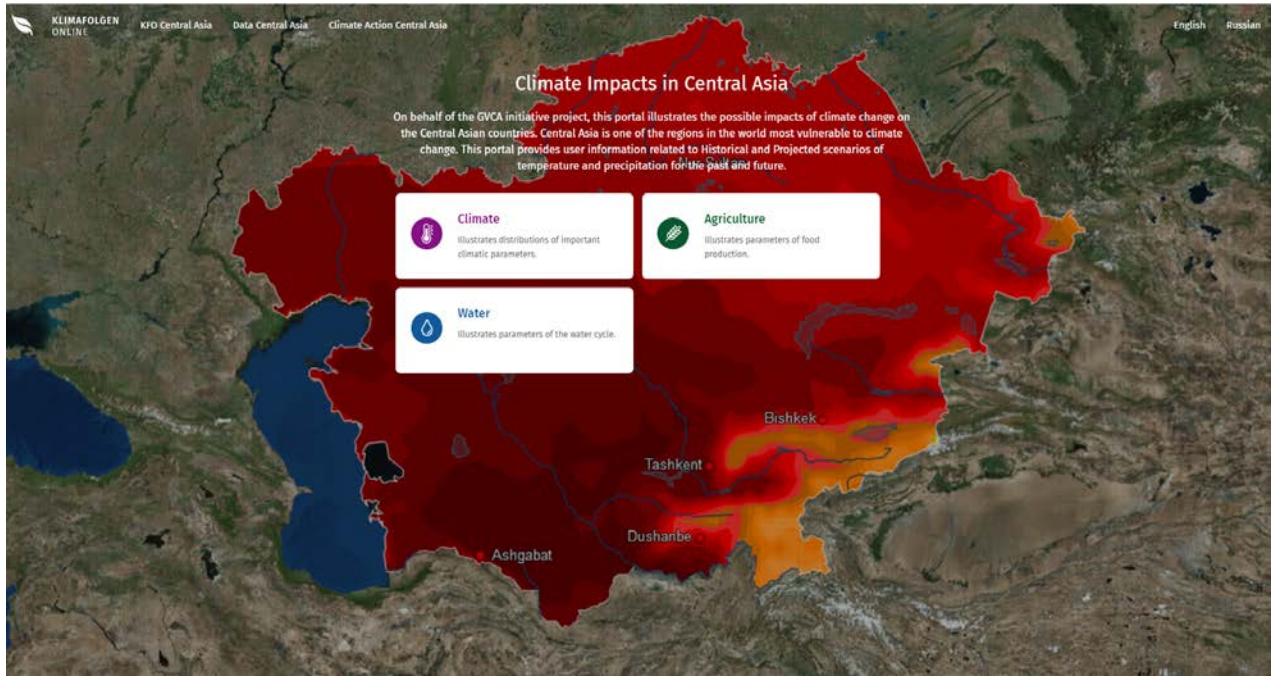
Central Asia

Covers five countries:

Kazakhstan, Uzbekistan, Tajikistan, Kyrgyzstan and Turkmenistan

Two main sectors:

Climate and Agriculture



+

and Energy

will be added soon

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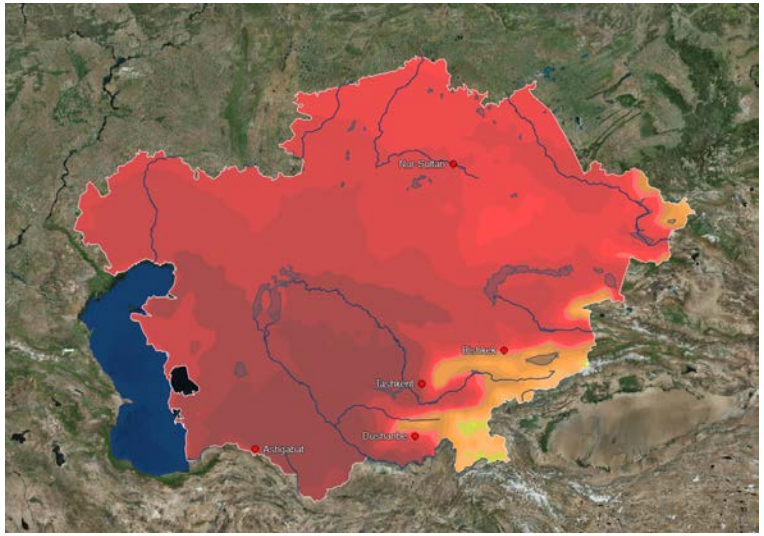
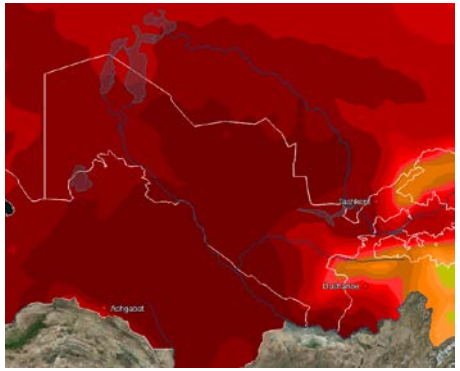
Three level of disaggregation

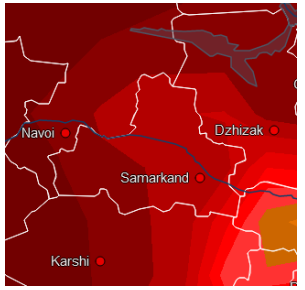
Central Asia



Countries



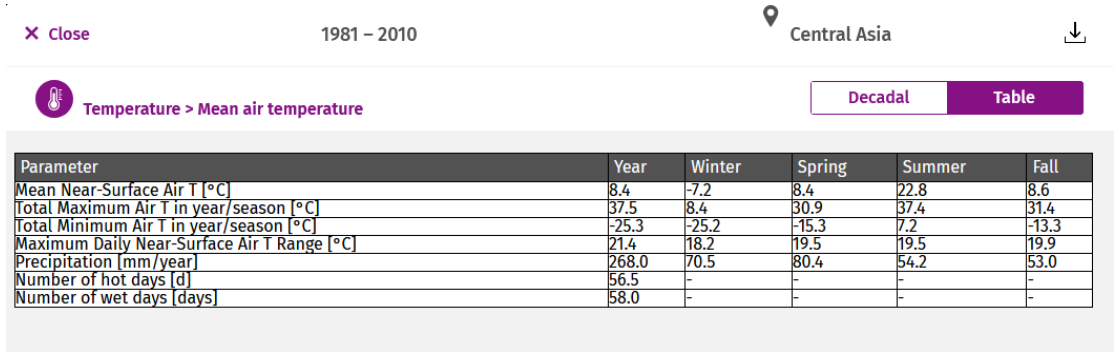
Regions



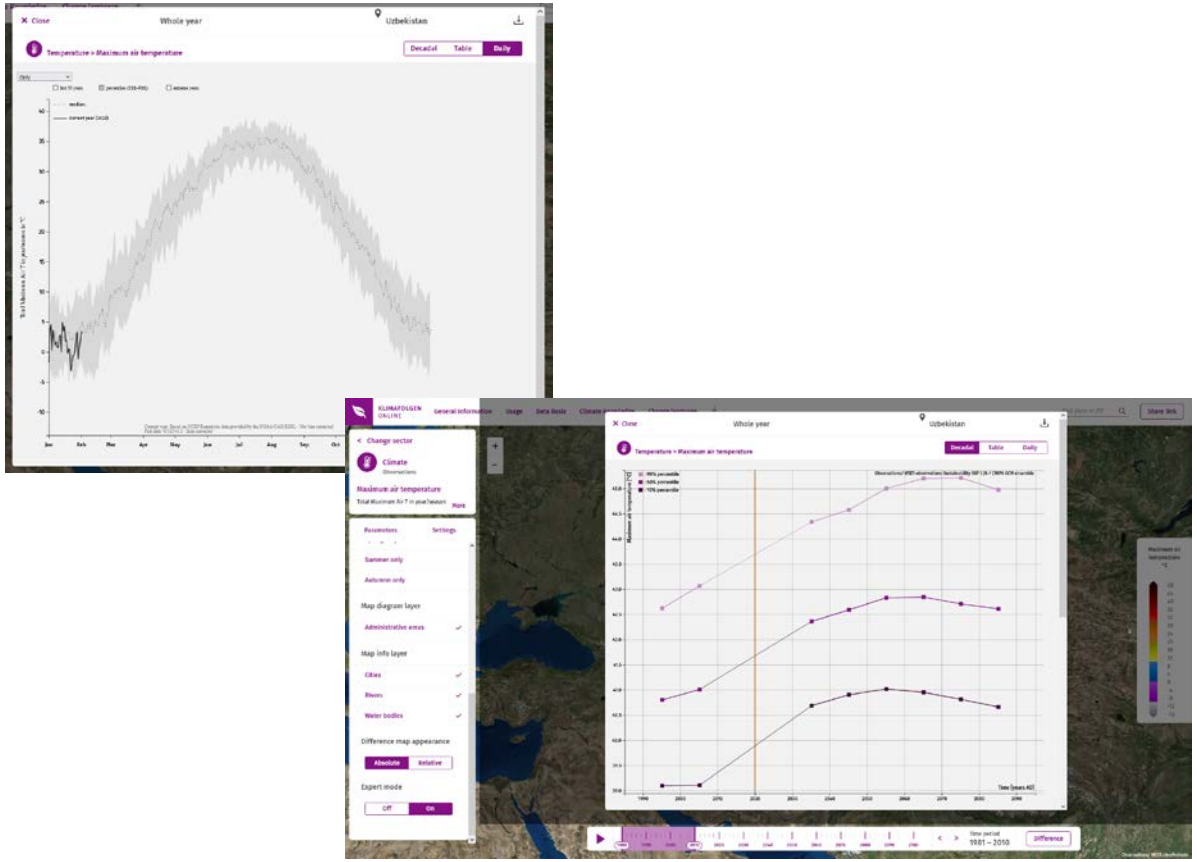
Data download

It’s possible to download for each region and time period data in form of:

- Vector figures
- Tables
- Netcdf files



Parameter	Year	Winter	Spring	Summer	Fall
Mean Near-Surface Air T [°C]	8.4	-7.2	8.4	22.8	8.6
Total Maximum Air T in year/season [°C]	37.5	8.4	30.9	37.4	31.4
Total Minimum Air T in year/season [°C]	-25.3	-25.2	-15.3	7.2	-13.3
Maximum Daily Near-Surface Air T Range [°C]	21.4	18.2	19.5	19.5	19.9
Precipitation [mm/year]	268.0	70.5	80.4	54.2	53.0
Number of hot days [d]	56.5	-	-	-	-
Number of wet days [days]	58.0	-	-	-	-



Green Central Asia

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Enhancing environment, climate and water resilience

Green Central Asia: Transboundary dialogue on climate, environment and security in Central Asia

Green Central Asia

Green Central Asia

Enhancing environment, climate and water resilience

Partners

PIK

Potsdam Institute for Climate Impact Research

german cooperation

DEUTSCHE ZUSAMMENARBEIT

Implemented by:

giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

DKU DEUTSCH KASACHISCHE UNIVERSITÄT

GFZ Helmholtz Centre Potsdam

MARTIN-LUTHER UNIVERSITÄT HALLE-WITTENBERG

Thank you

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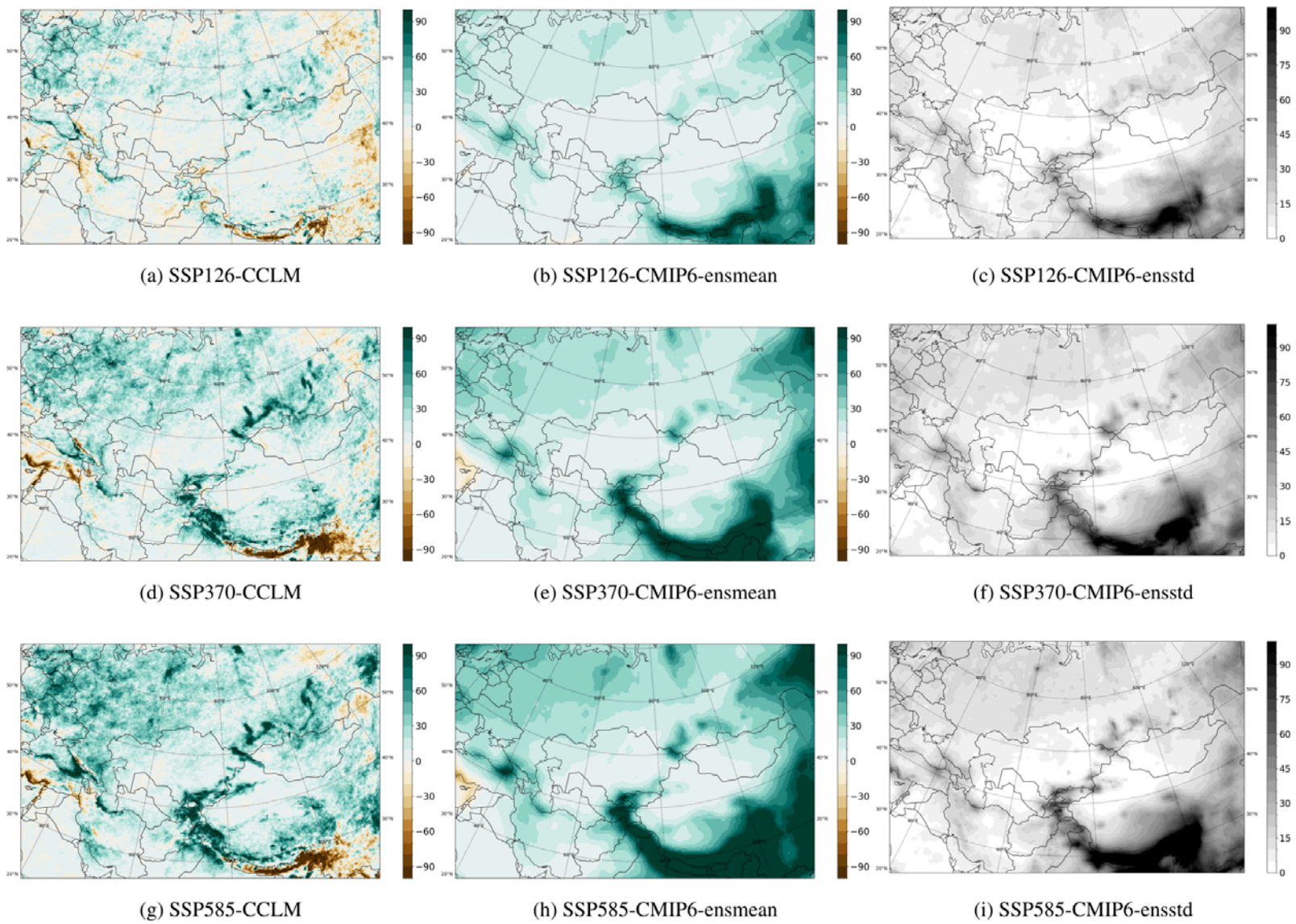
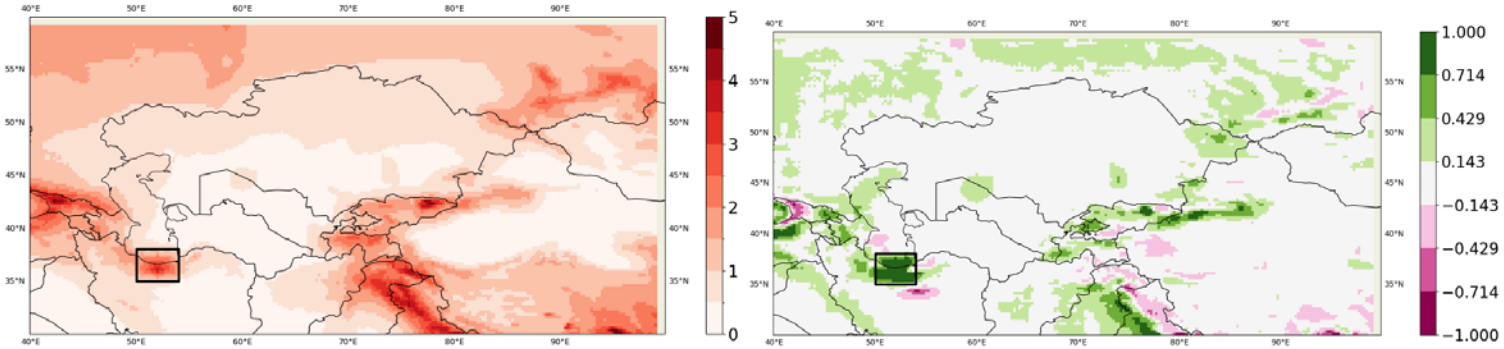
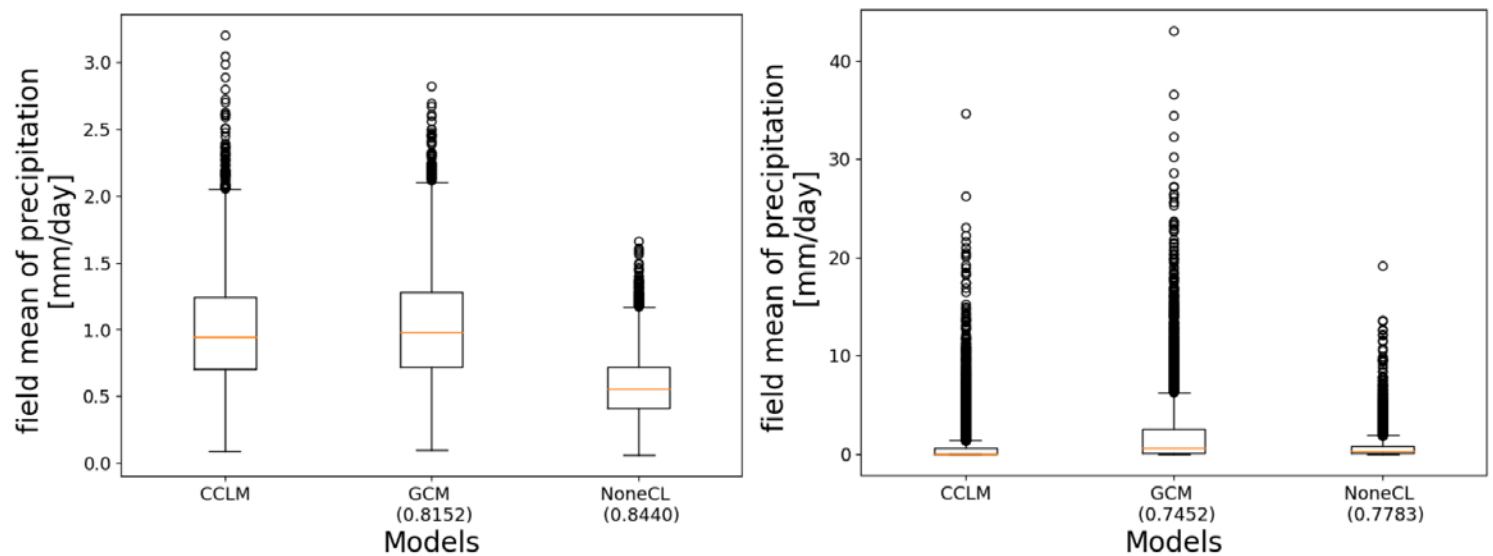


Figure 5. Changes in number of days with precipitation more than 20mm in the period with respect to 1985-2014 references for a,b) SSP126, d,e) SSP370 and g,h) SSP585 at the end of the century (2070-2099) from CCLM and CMIP6 GCMs' ensemble mean. The ensemble's standard deviations are shown in c,f and i.



(a) MAE(EC-Earth3-Veg, CCLM)

(b) AV NoCL



(c) CA

(d) Box

Figure 8. a) MAE of GCM (EC-Earth3-Veg) vs CCLM run. GCM is remapped bilinearly to the 0.25×0.25 grid. b) Added value (AV) or MAE reduction (MAE(EC-Earth3-Veg,CCLM) - MAE(CNN,CCLM) for unconstrained method. c) and d) boxplots of averaged daily precipitation over the CA domain and the black box shown in a and b over North of Iran. Numbers in the parenthesis indicate the correlation coefficients of each model with respect to CCLM.

Thanks

Green Central Asia

Dynamical Downscaling

- CCLM run over CA driven by historical (1985-2014) MPI-ESM-HR
- CCLM run over CA driven by ssp585 (2019-2099) MPI-ESM-HR
- CCLM run over CA driven by reanalysis (2000-2010) ERA5
- CCLM run over CA driven by ssp370 (2019-2099) MPI-ESM-HR
- CCLM run over CA driven by ssp126 (2019-2099) MPI-ESM-HR
- CCLM run over CA driven by reanalysis (1979-2019) EARInterim
- CCLM run over CA driven by ssp370 (2019-2033) EC-Earth3-Veg
- CCLM run over CA with historical (1984-1993) EC-Earth3-Veg