

Efforts on the downscaling of CMIP6 (in Central Asia)

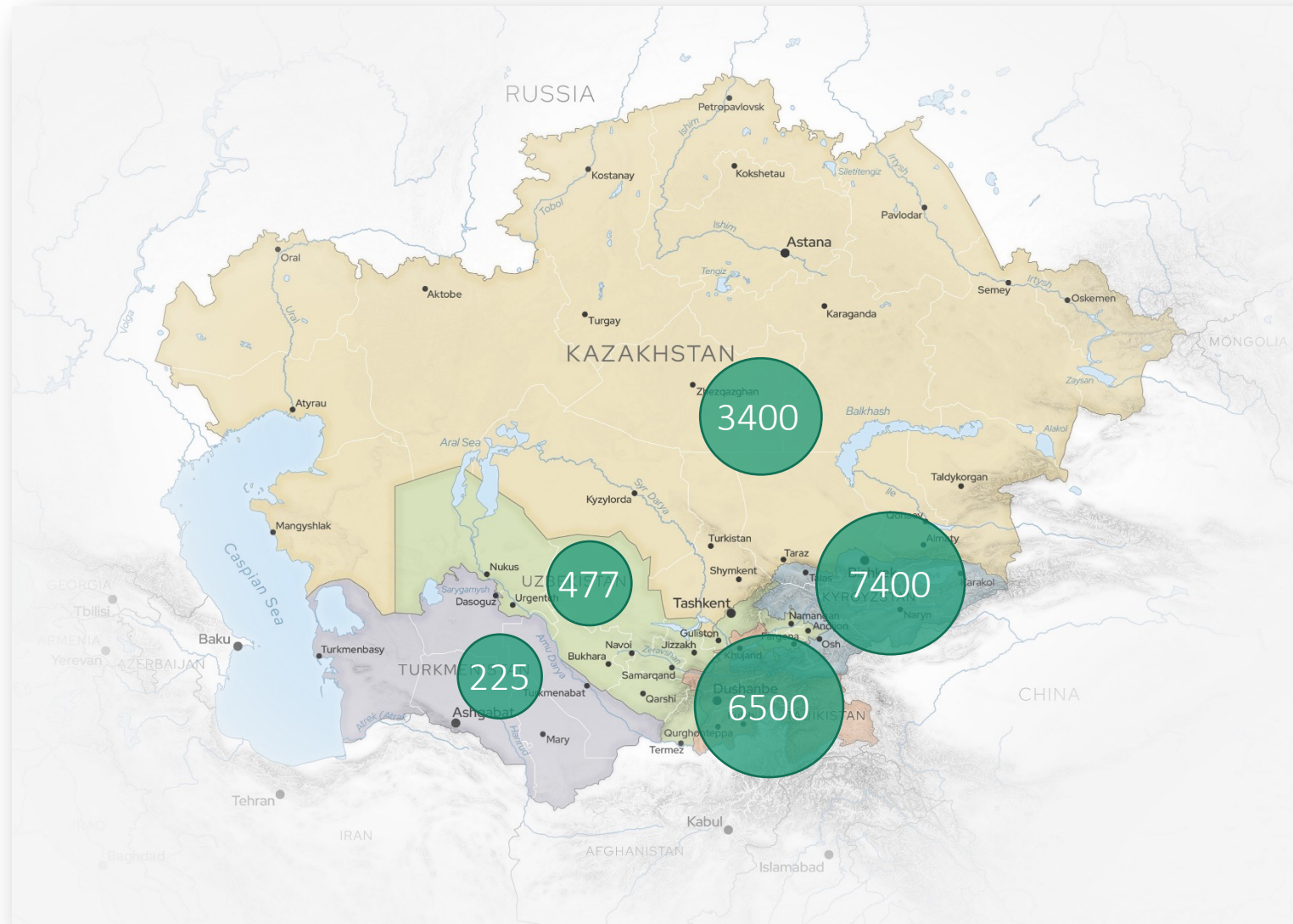
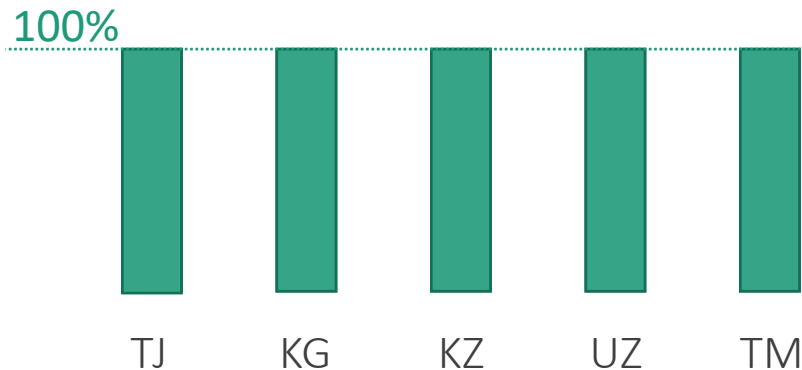
Bijan Fallah et. al.



“Upstream” and “Downstream” countries

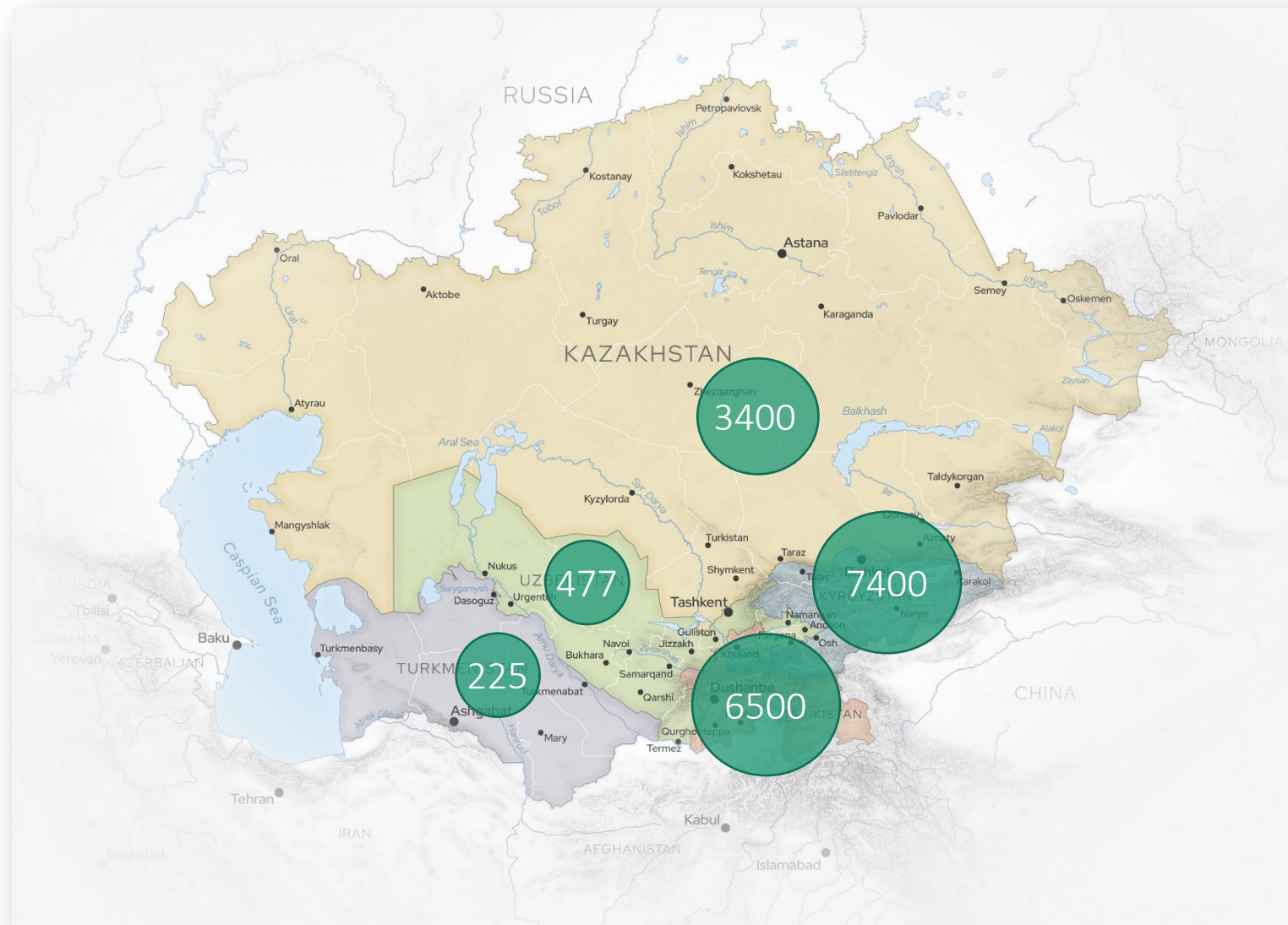
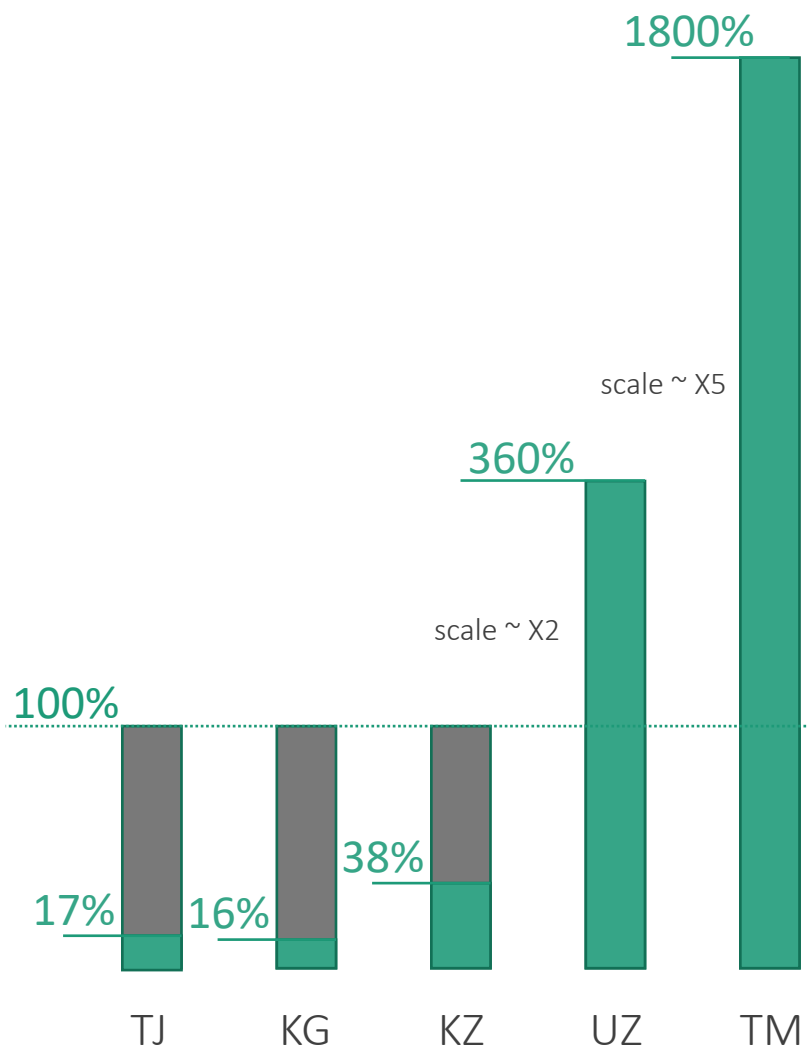
Renewable internal freshwater resources per capita (m³) by country

Annual freshwater withdrawals, total (% of internal resources)



“Upstream” and “Downstream” countries

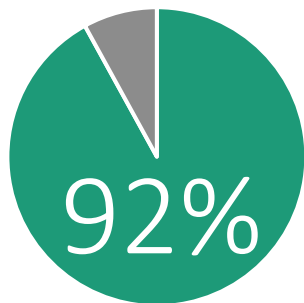
Annual freshwater withdrawals,
total (% of internal resources)



“Upstream” and “Downstream” countries

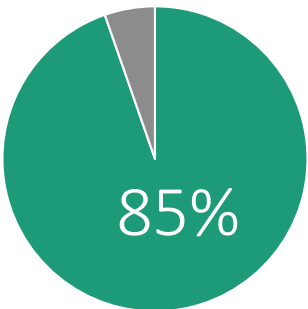
Water withdrawal for
Agriculture

UZBEKISTAN

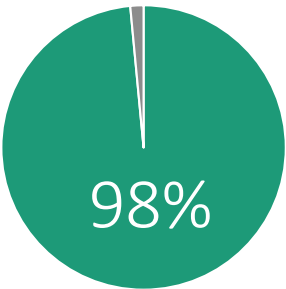


Share of hydropower in total
electricity production, %

KYRGISTAN



TAJIKISTAN

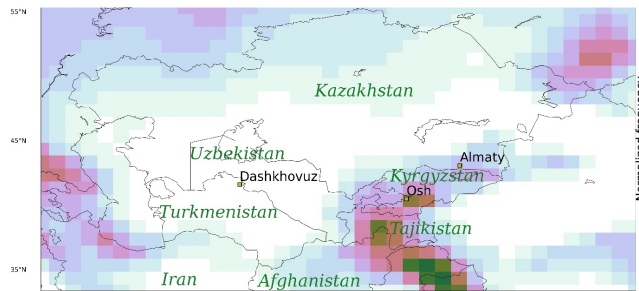


Challenges

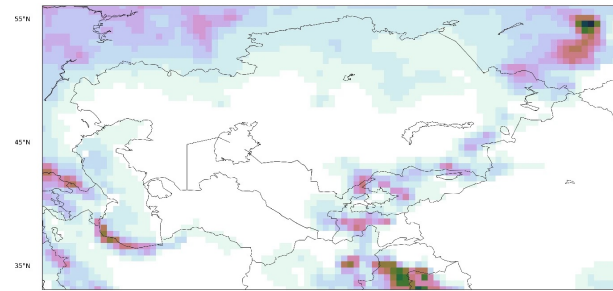
- Climate impact assessment needs local climate information

Global resolution

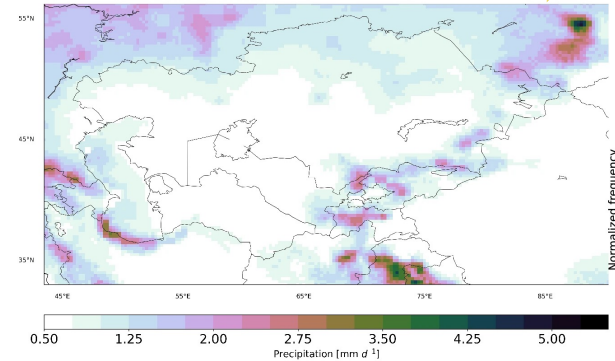
Regional resolution



(a) precipitation climatology for GFDL-ESM4_r1i1p1f1 model



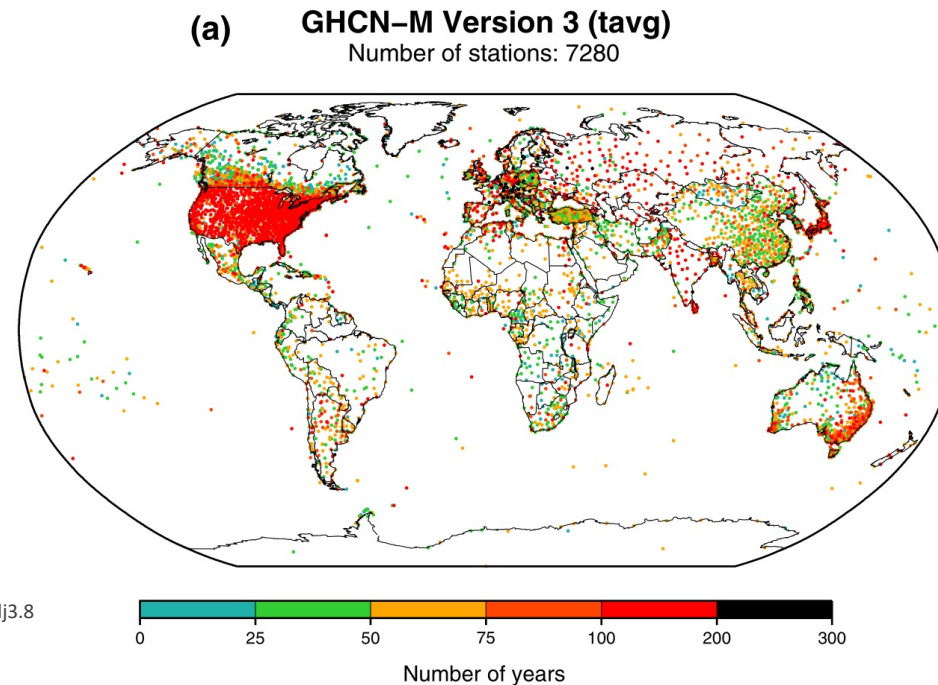
(c) precipitation climatology from ISIMIP for the GFDL-ESM4_r1i1p1f1 model



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

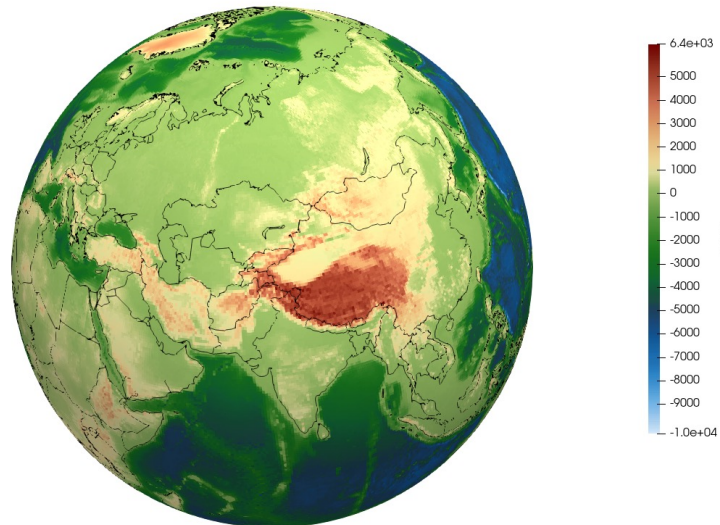
Challenges

- Climate impact assessment needs local climate information
- Central Asia has a sparse climate observation network



Challenges

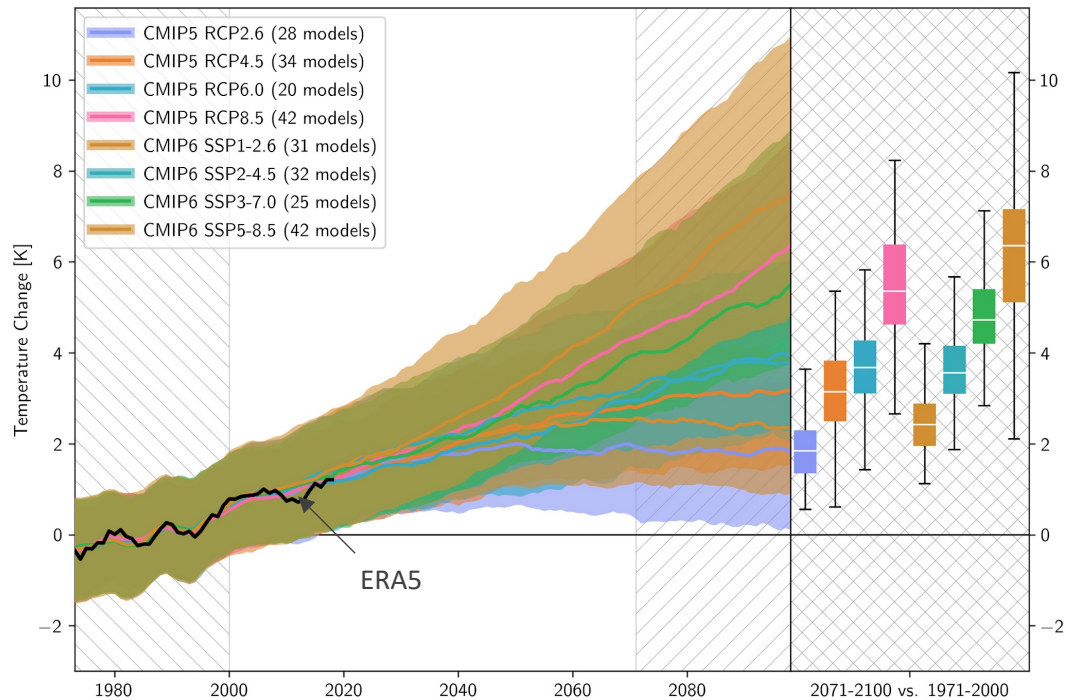
- Climate impact assessment needs local climate information
- Central Asia has a sparse climate observation network
- The topography of CA is very complex



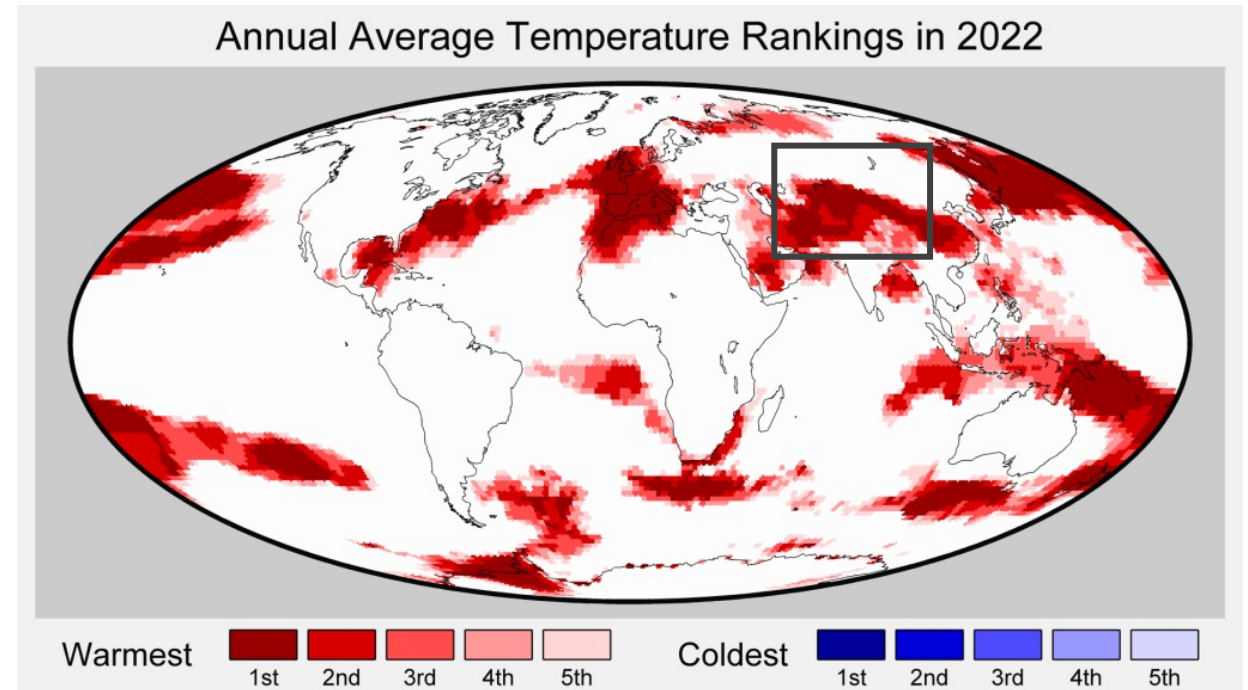
Challenges

- 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)

Warming trend in CA



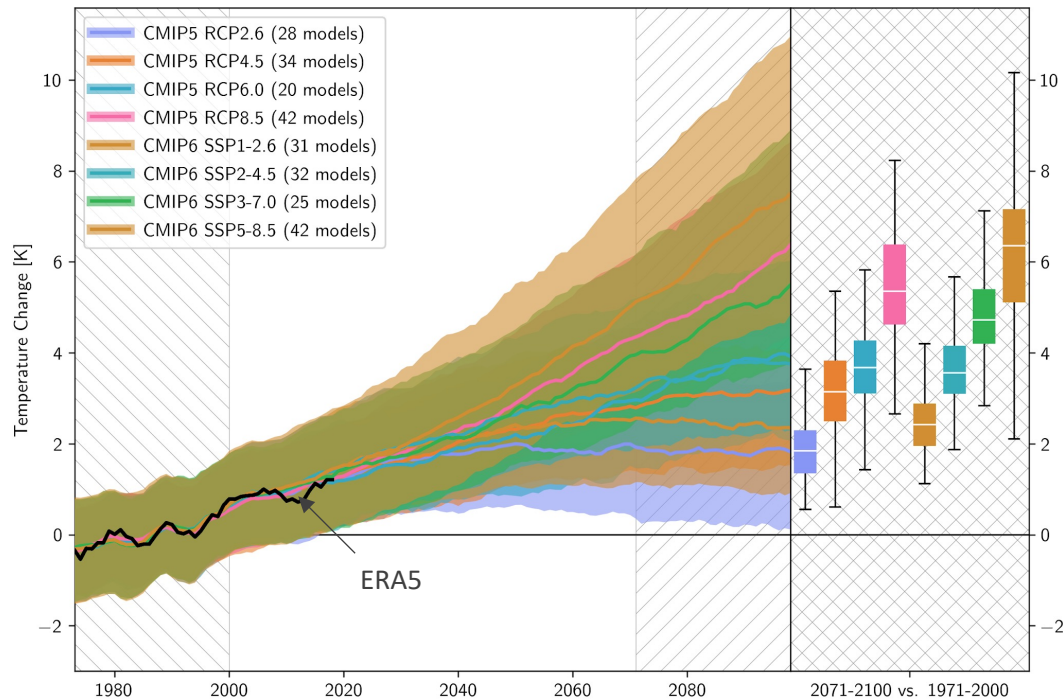
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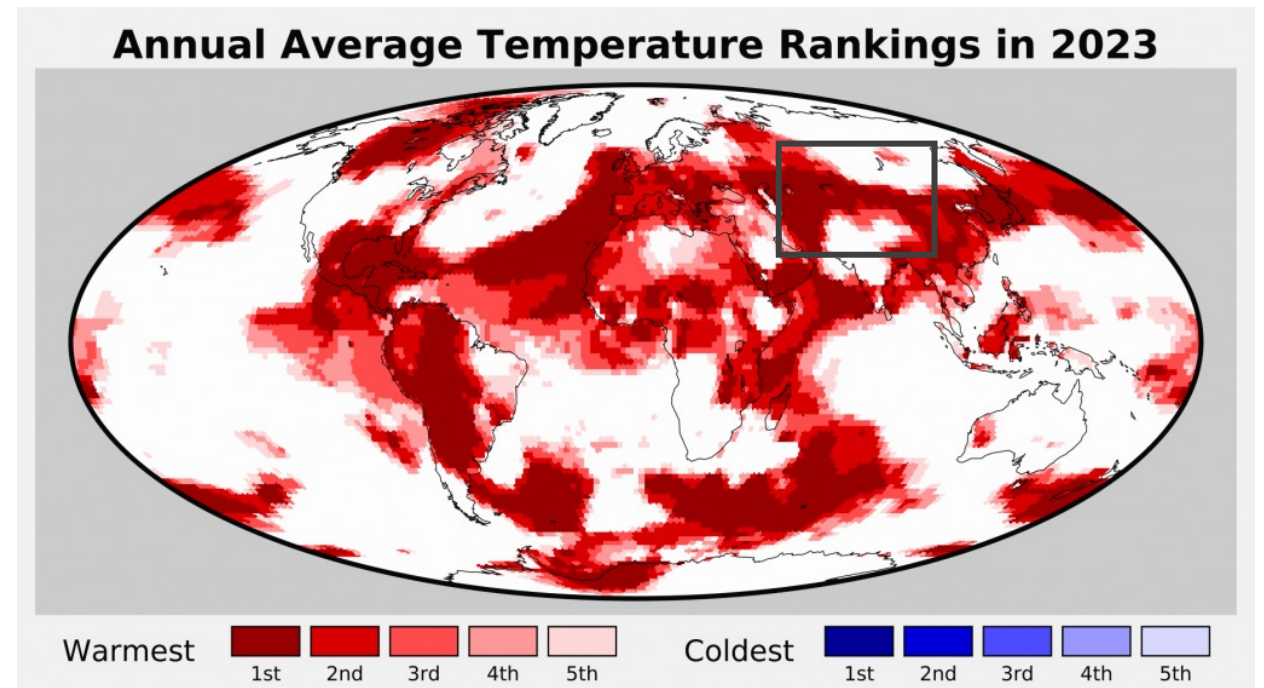
Since 1850

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

Warming trend in CA



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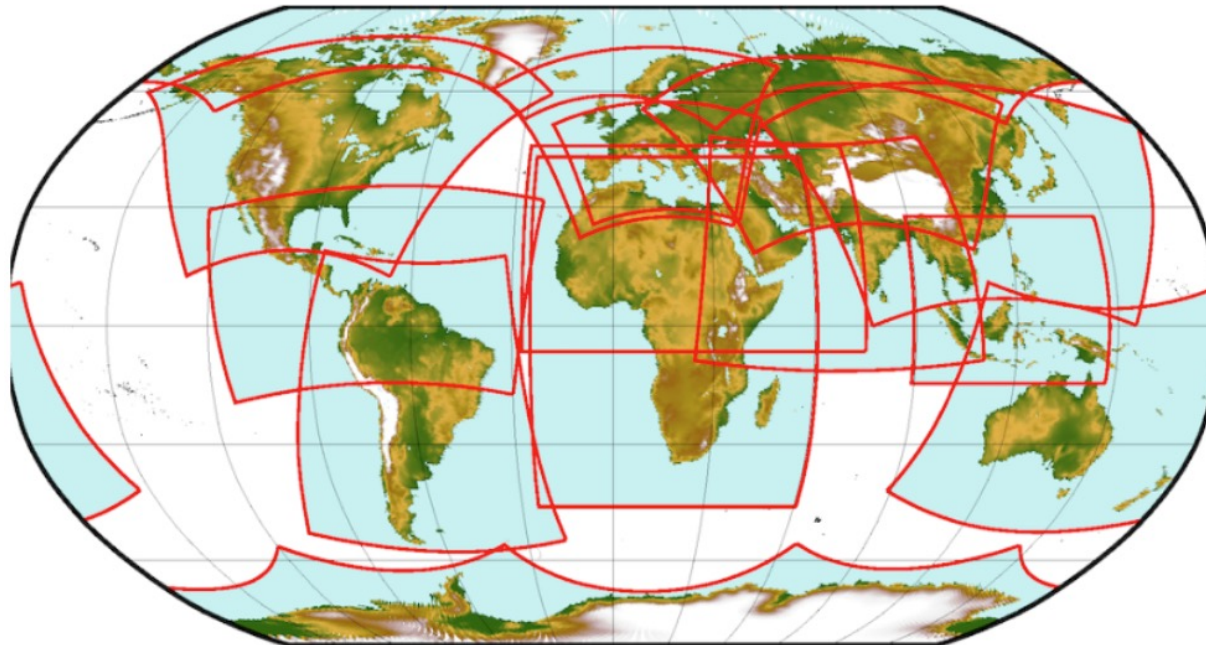
Since 1850

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Challenges

CORDEX CMIP6 downscaling plans

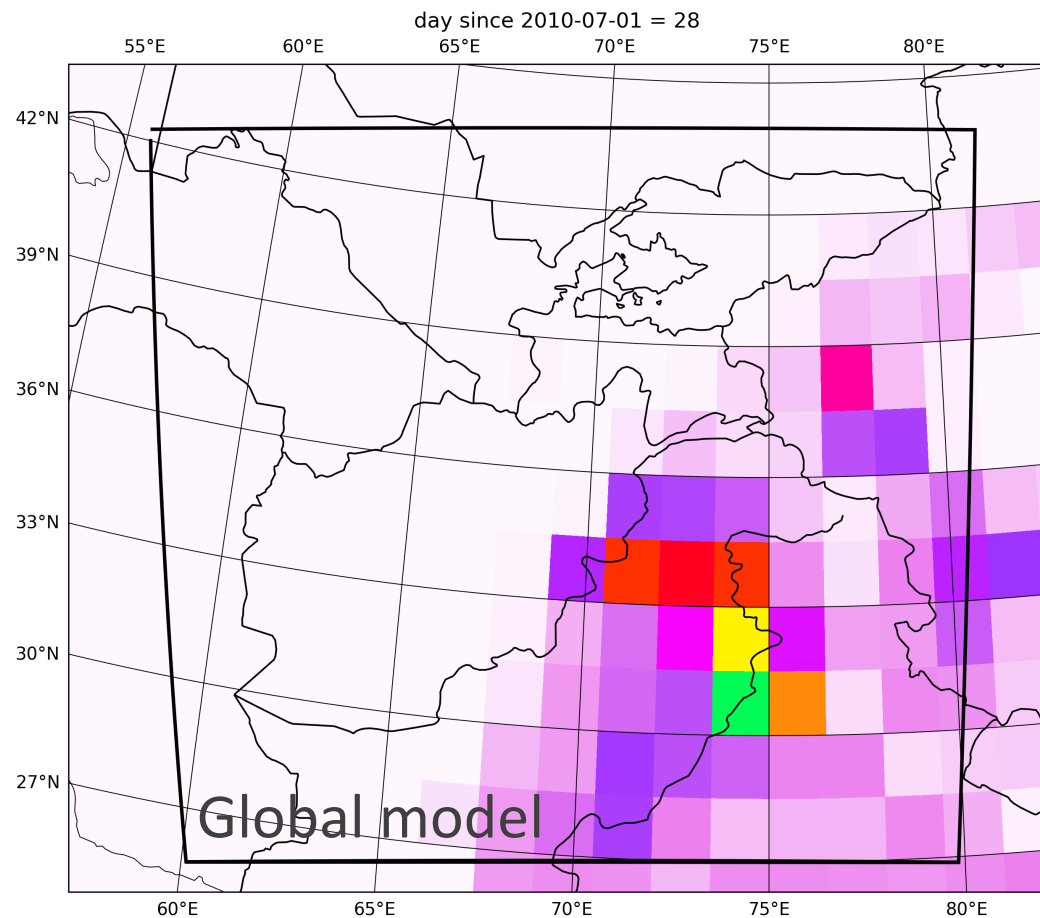
- Central Asia 8 simulations done by PIK
- Europe 193 simulations



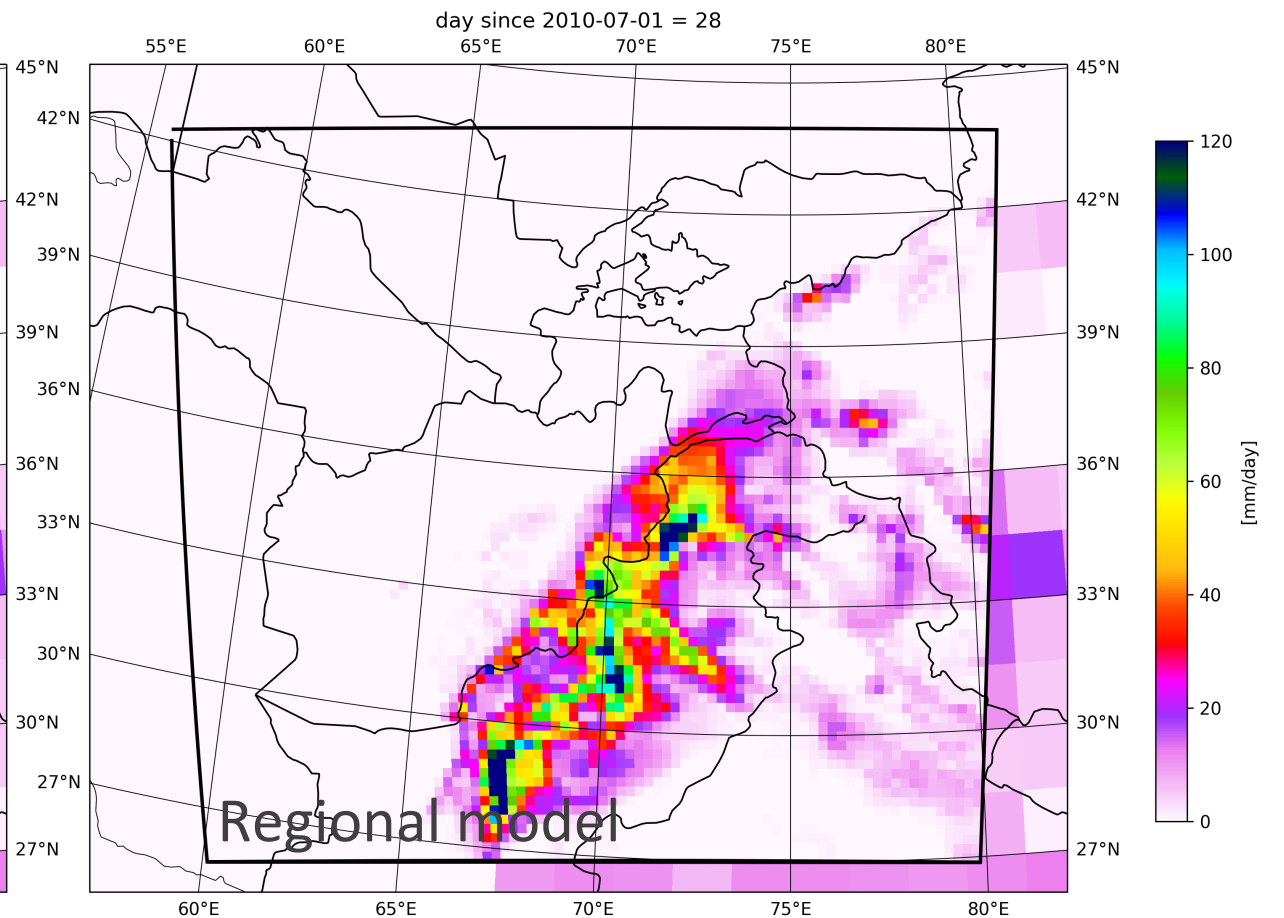
- Region 1: South America
- Region 2: Central America
- Region 3: North America
- Region 4: Africa
- Region 5: Europe (EURO)
- Region 6: South Asia
- Region 7: East Asia
- Region 8: Central Asia
- Region 9: Australasia
- Region 10: Antarctica
- Region 11: Arctic
- Region 12: Mediterranean (MED)
- Region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

Challenges – Downscaling with regional models

What we have



What we need



PDF of precipitation for maximum daily values in the Free Zone

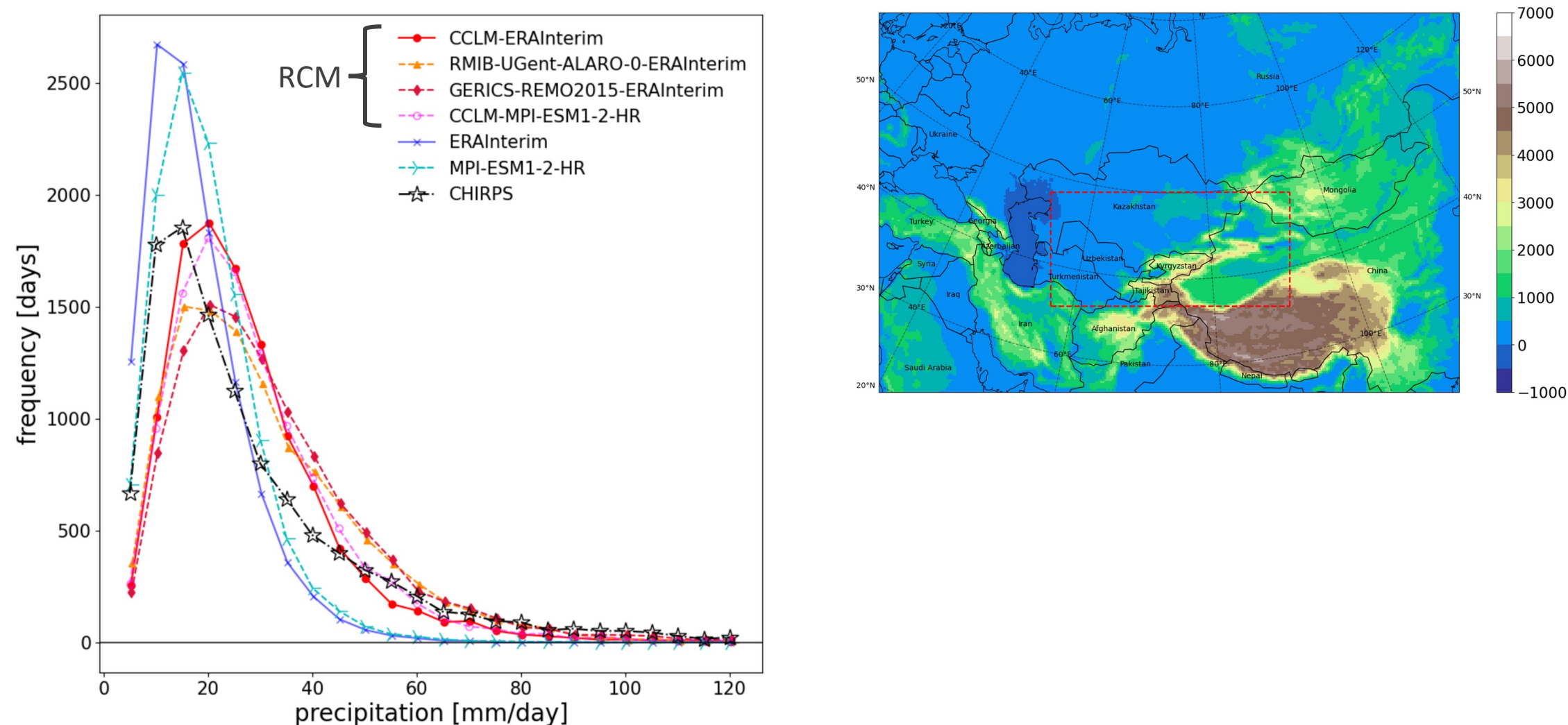
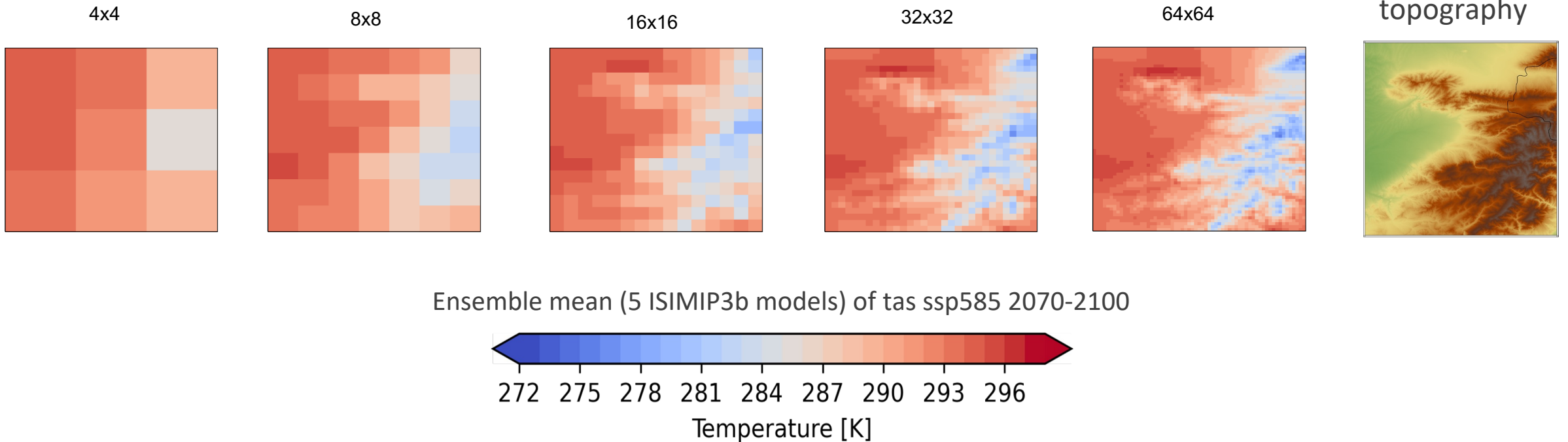


Figure 4. Precipitation distribution of maximum daily values in the free zone shown in Fig.1.a from different RCMs, GCMs and CHIRPS for the period 1985-2014.

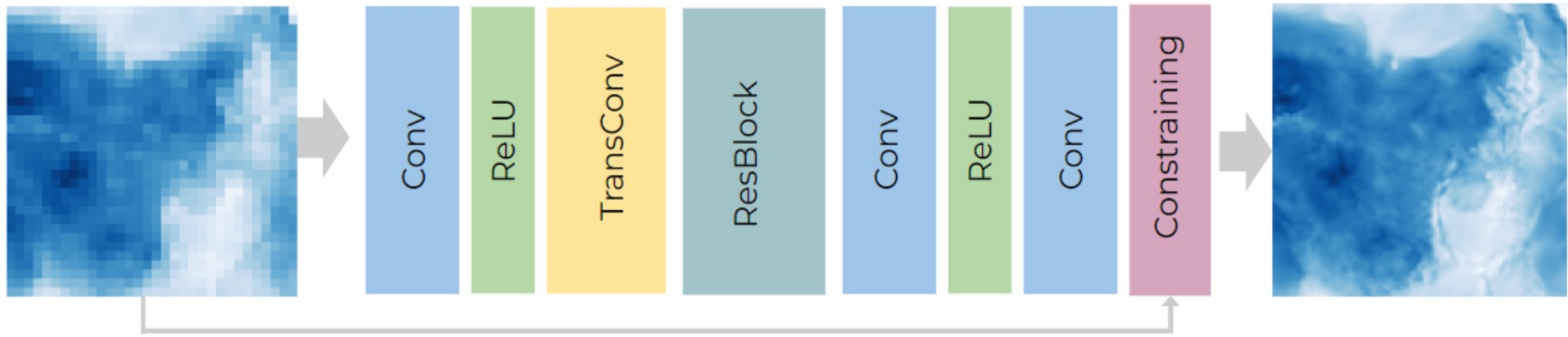
Challenges – Downscaling with statistical models

What we have

What we need



Deep Neural Nets



@Paula Harder

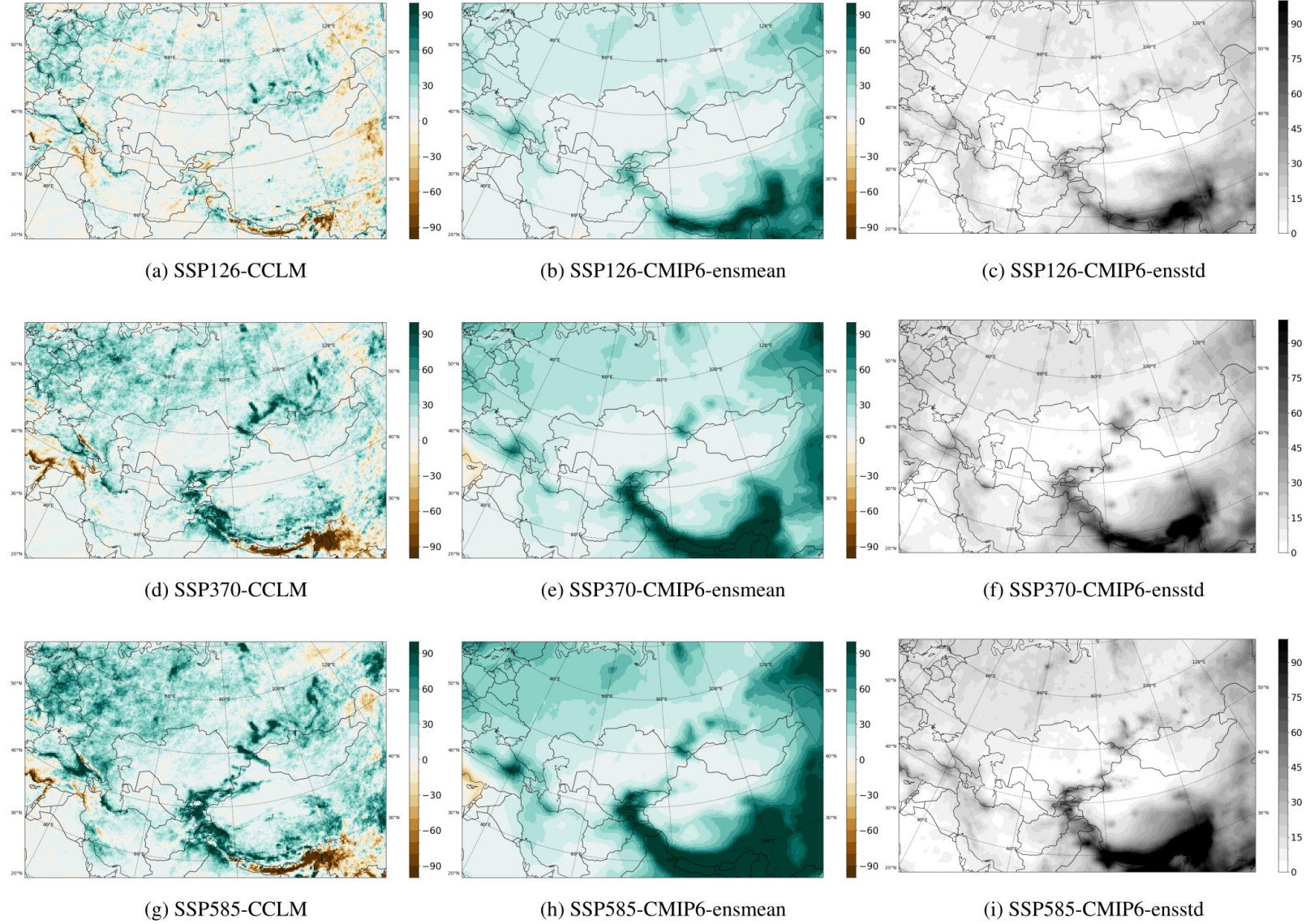


Figure 5. Changes in number of days with precipitation more than 20mm in the period with respect to 1985-2014 references for a,b) SSP126, d,e) SSP370 and g,h) SSP585 at the end of the century (2070-2099) from CCLM and CMIP6 GCMs' ensemble mean. The ensemble's standard deviations are shown in c,f and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

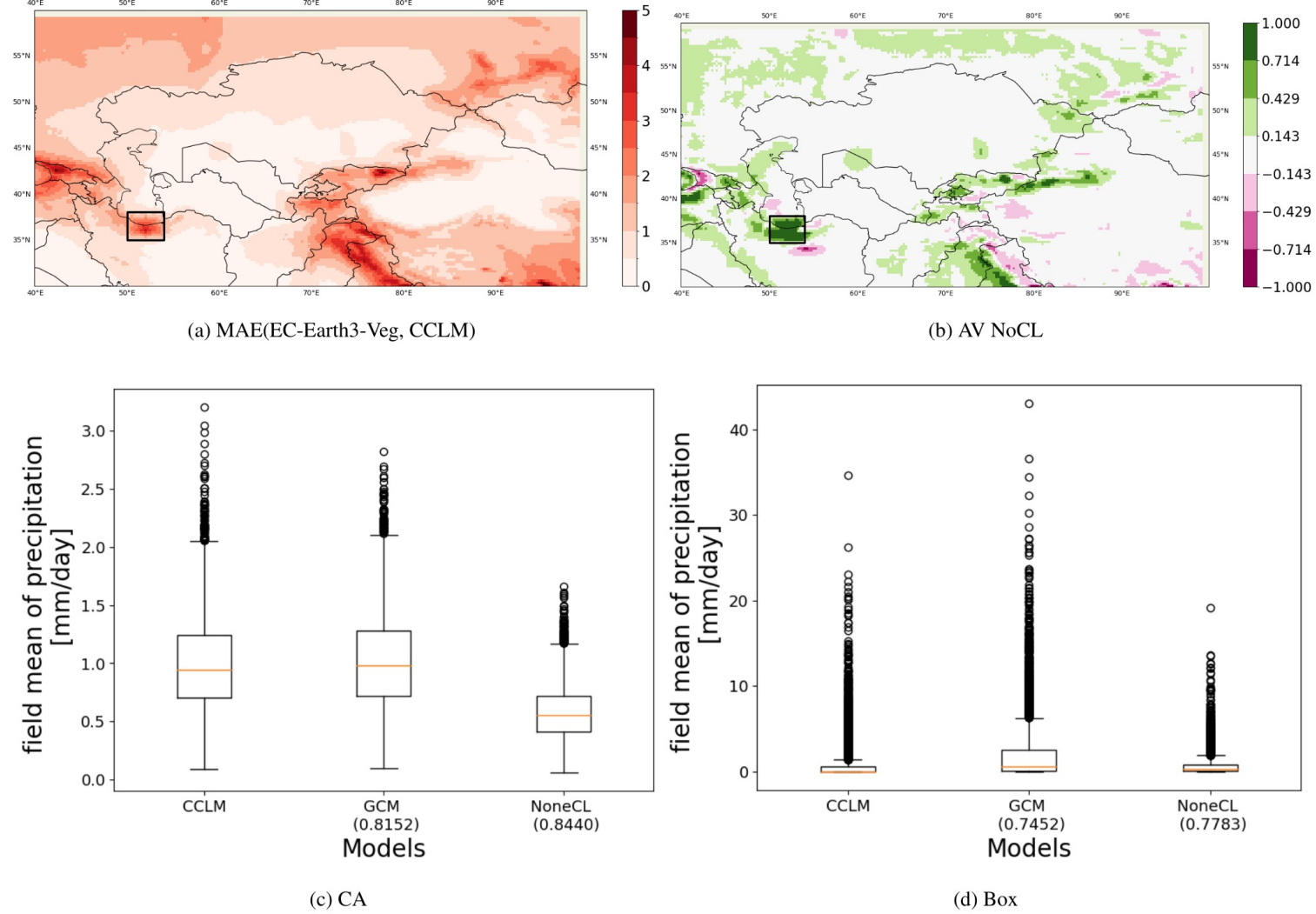


Figure 8. a) MAE of GCM (EC-Earth3-Veg) vs CCLM run. GCM is remapped bilinearly to the 0.25×0.25 grid. b) Added value (AV) or MAE reduction ($\text{MAE}(\text{EC-Earth3-Veg}, \text{CCLM}) - \text{MAE}(\text{CNN}, \text{CCLM})$) for unconstrained method. c) and d) boxplots of averaged daily precipitation 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.

Thank you

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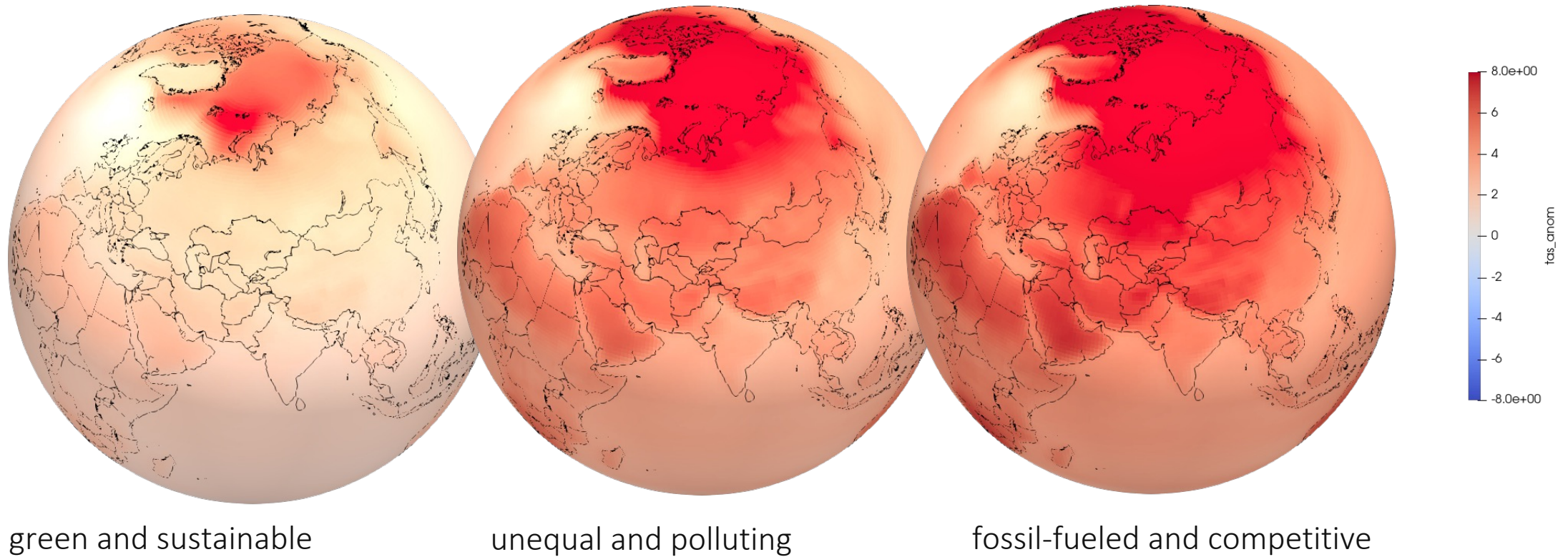
Fred Hattermann



Thanks

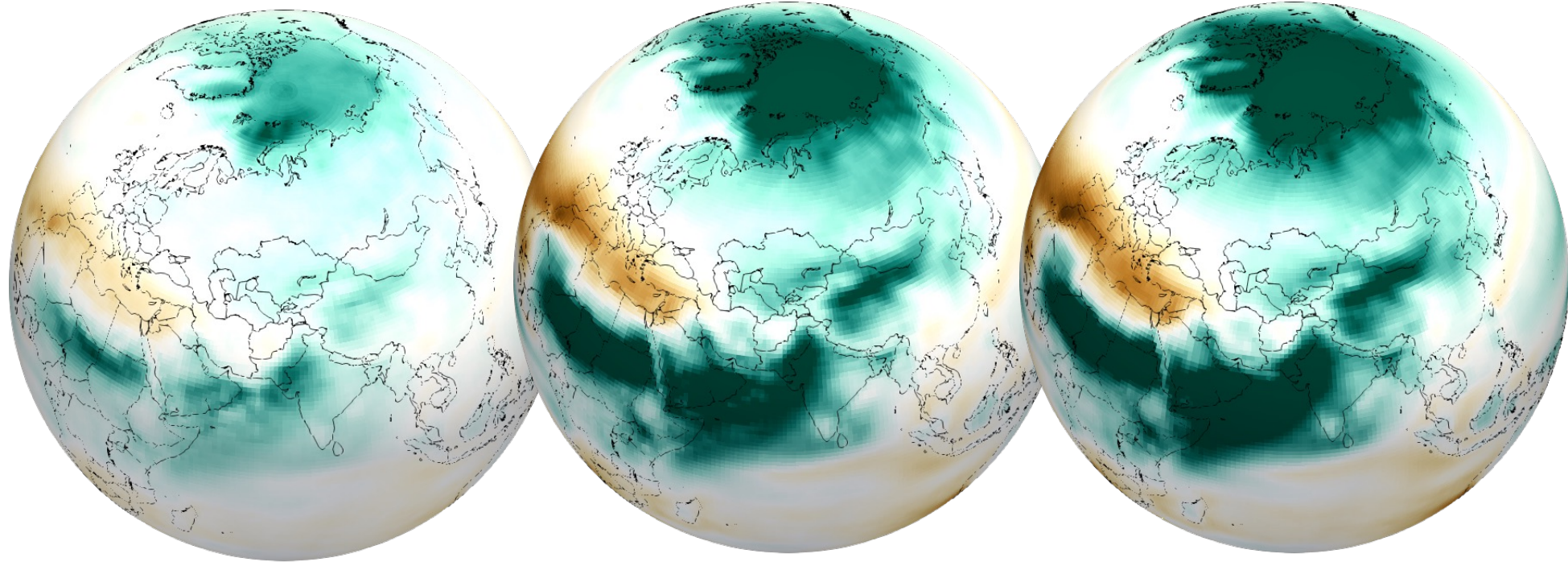
Projections - Temperature change

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



Projections - Total Precipitation change

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



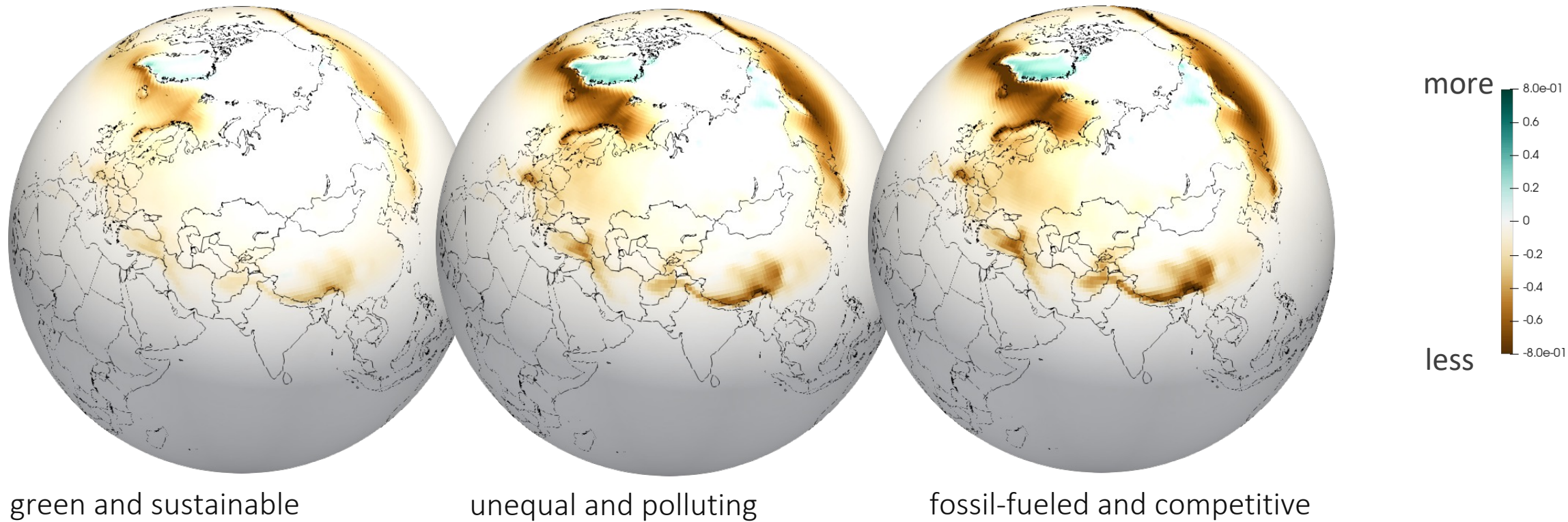
green and sustainable

unequal and polluting

fossil-fueled and competitive

Projections – Snow Fall change

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



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) ERAInterim
- CCLM run over CA driven by ssp370 (2019-2033) EC-Earth3-Veg
- CCLM run over CA with historical (1984-1993) EC-Earth3-Veg