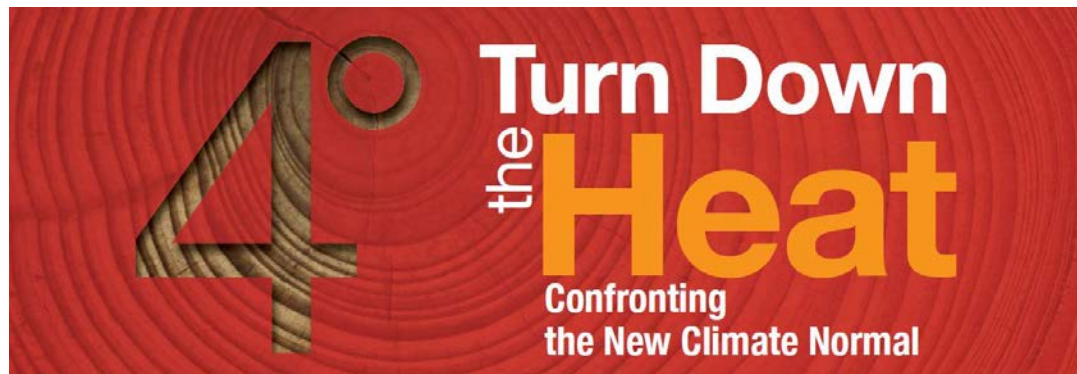




POTSDAM INSTITUTE FOR  
CLIMATE IMPACT RESEARCH



Hans Joachim Schellnhuber, Christopher Reyer, Bill Hare, Katharina Waha, Ilona M. Otto, Olivia Serdeczny, Michiel Schaeffer, Carl-Friedrich Schleußner, Diana Reckien, Rachel Marcus, Oleksandr Kit, Alexander Eden, Sophie Adams, Valentin Aich, Torsten Albrecht, Florent Baarsch, Alice Boit, Nella Canales Trujillo, Matti Carlsburg, Dim Coumou, Marianela Fader, Holger Hoff, Guy Jobbins, Lindsey Jones, Linda Krummenauer, Fanny Langerwisch, Virginie Le Masson, Eva Ludi, Matthias Mengel, Jacob Möhring, Beatrice Mosello, Andrew Norton, Mahé Perette, Paola Perezniето, Anja Rammig, Julia Reinhardt, Alex Robinson, Marcia Rocha, Boris Sakschewski, Sibyll Schaphoff, Jacob Schewe, Judith Stagl, Kirsten Thonicke.

Vienna, 11-3-2015

## Key message

**→ Climate extremes threaten agriculture, energy & health in Western Balkans**

# The Trinity of the Turn Down the Heat Series



# Statistics TDTH3

- Authors: **43**
- References: **~1,300**
- WB core team: **13**
- Scientific reviewers: **24**
- WB review team: **94**
- WB media report: *"In the first two days, the report was mentioned in over 240 media outlets in 17 languages with over 55 original stories in English."*
- Downloads English full report: **5,666** (1,635 in first 48 hours)

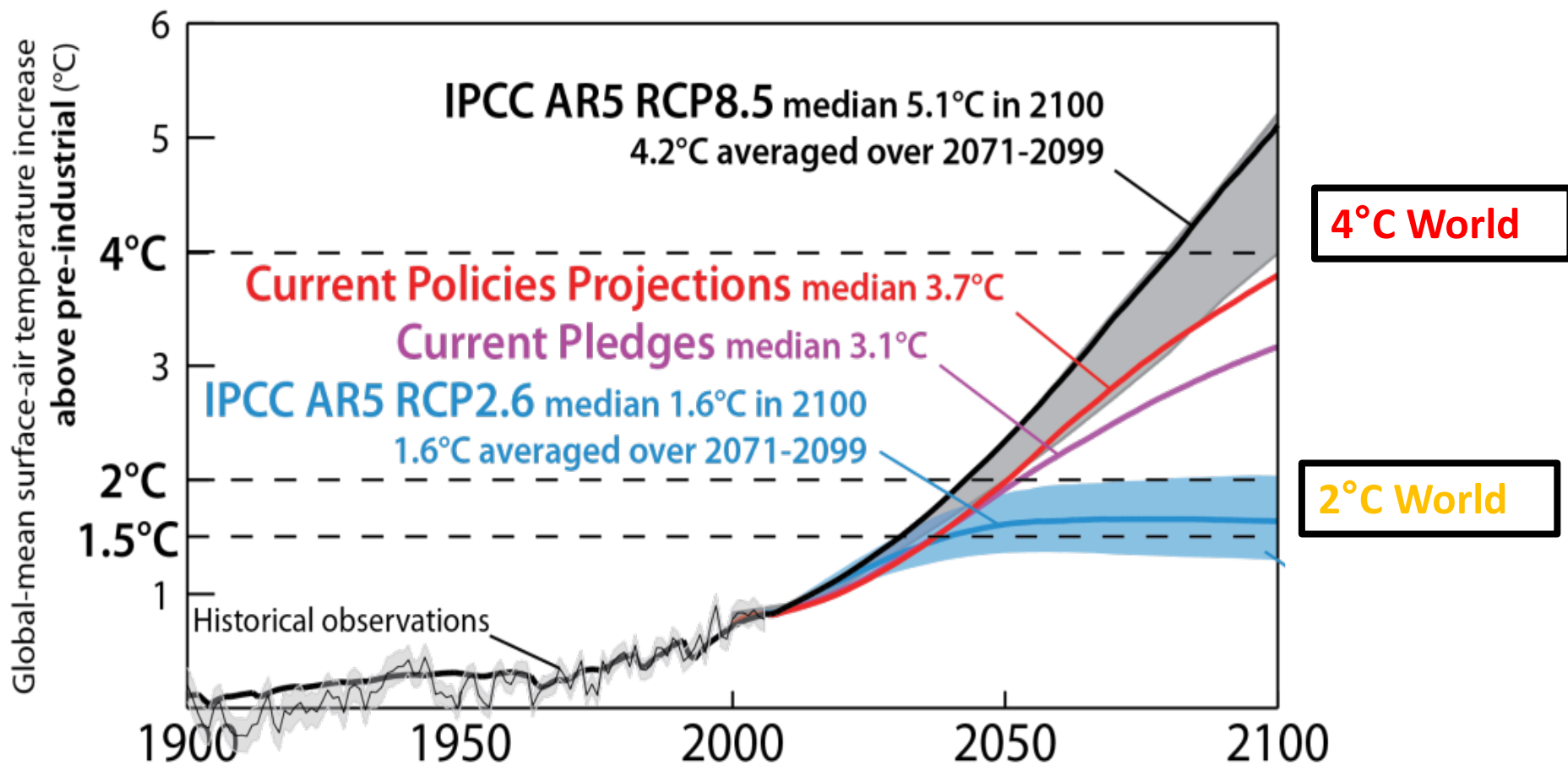
The screenshot shows the World Bank website interface. At the top, there's a navigation bar with 'THE WORLD BANK' logo and a search bar. Below that, a red 'News' banner is visible. The main content area features a 'FEATURE STORY' titled 'World Is Locked into ~1.5°C Warming & Risks Are Rising, New Climate Report Finds' dated November 23, 2014. To the right of the article, there are sections for 'Most Popular' and 'Most Recent' news items. A large infographic is displayed below the article title, titled 'GLOBAL IMPACTS IRREVERSIBLE CHANGES'. The infographic includes the following text: 'WEATHER EXTREMES ARE ALREADY AFFECTING LIVES AROUND THE WORLD, DAMAGING CROPS AND COASTLINES, AND PUTTING LIVELIHOODS AT RISK.' It also states: 'EVIDENCE SUGGESTS THE WORLD IS ALREADY LOCKED INTO ABOUT 1.5°C WARMING'. Below this, three circular icons represent: '1.5°C WARMING above pre-industrial times', 'GLOBAL SEA LEVEL RISES MORE THAN 30 CM BY 2100', 'DROUGHTS BECOME MORE SEVERE', and 'ALMOST 90% OF CORAL REEFS AT RISK OF EXTINCTION'.



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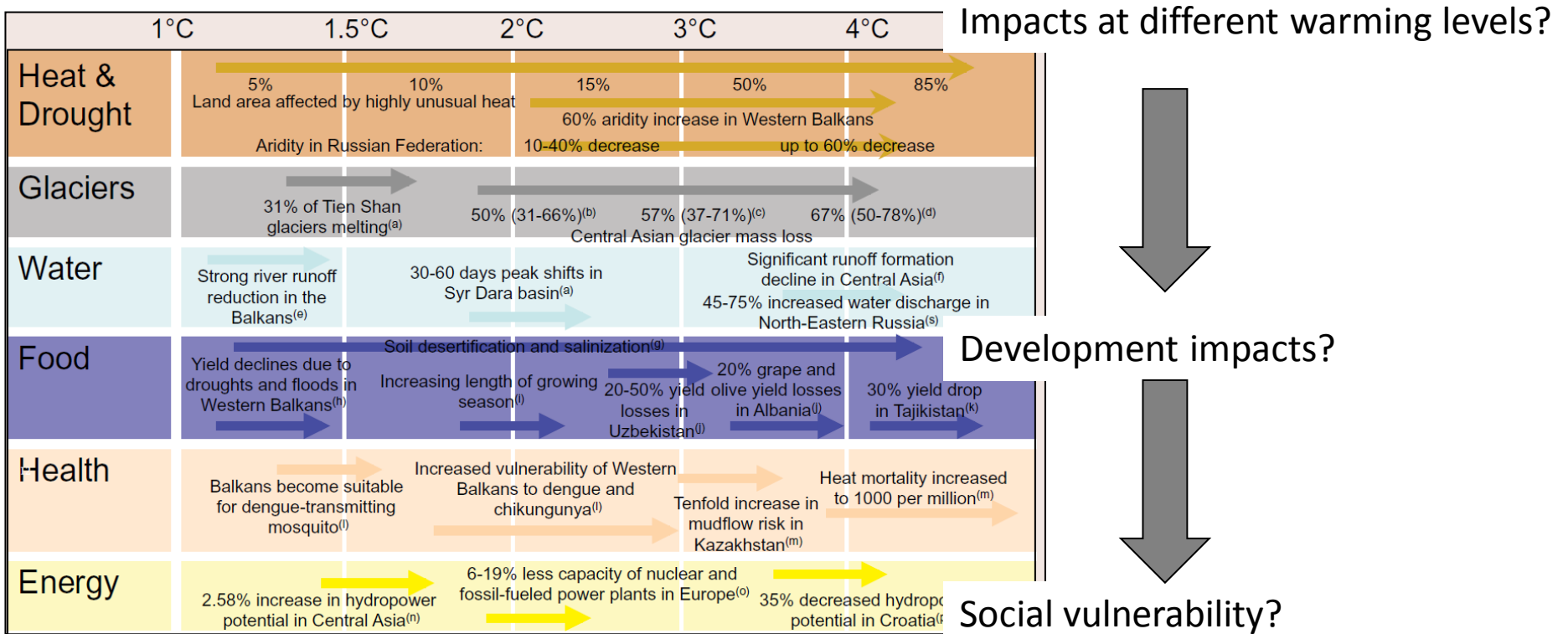


# Setting the Scene: Warming Levels





# Key Questions & Scope TDTH3

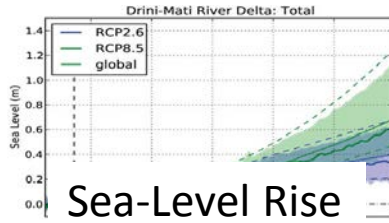
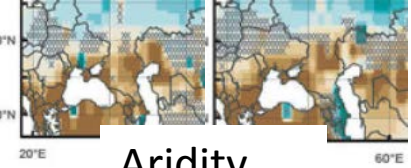
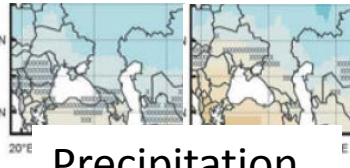
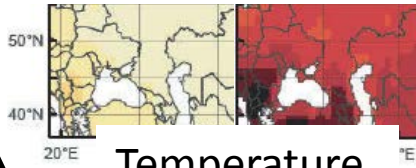


➔ based on IPCC's AR5 but risk perspective

# TDTH3 Western Balkans on 1 slide

Physical Impacts  
Ecological Impacts  
Human Impacts

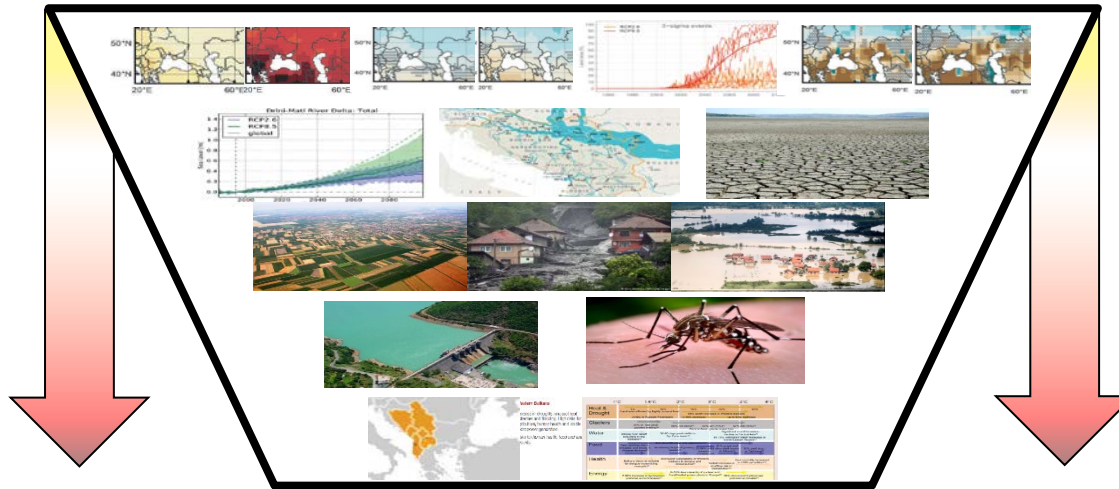
Quantitative  
Qualitative



	1°C	1.5°C	2°C	3°C	4°C	5°C
<b>Heat &amp; Drought</b>	5% Land area affected by high annual heat	15% Land area affected by high annual heat	35% Land area affected by high annual heat	50% Land area affected by high annual heat	65% Land area affected by high annual heat	80% Land area affected by high annual heat
<b>Glaciers</b>	5% of the total glacier ice melt	15% of the total glacier ice melt	35% of the total glacier ice melt	50% of the total glacier ice melt	65% of the total glacier ice melt	80% of the total glacier ice melt
<b>Water</b>	30% less water available in the Balkans	40% less water available in the Balkans	50% less water available in the Balkans	60% less water available in the Balkans	70% less water available in the Balkans	80% less water available in the Balkans
<b>Food</b>	Heat stress on crops increases	Heat stress on crops increases	Heat stress on crops increases	Heat stress on crops increases	Heat stress on crops increases	Heat stress on crops increases



# Pre-existing vulnerabilities & development challenges



## Socio-economics

- transition of economies
- up to 45% rural population
- impacts from floods in past
- minorities and women particularly vulnerable to extremes

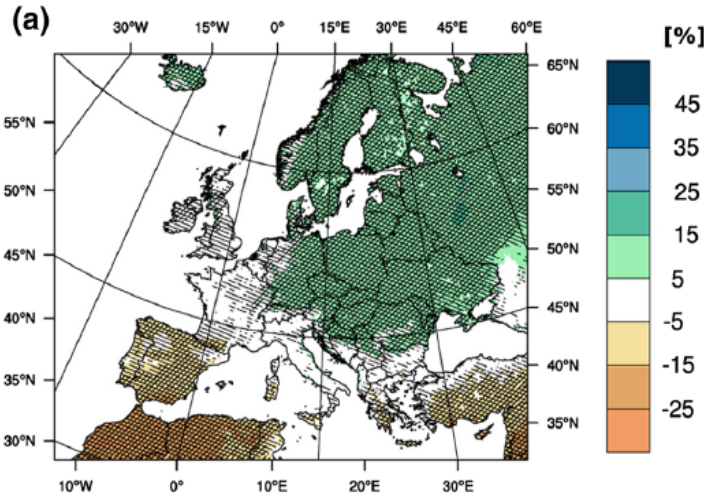
## Agriculture

- mostly rainfed crops
- employs 18-58% of working population
- contributes 17% of GDP

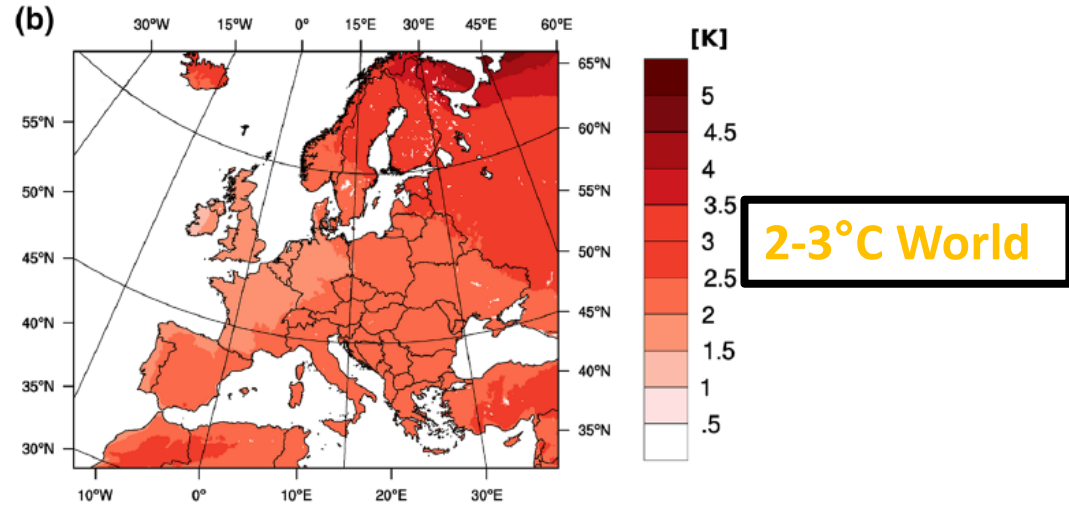


# Changes in mean temperature larger than global average

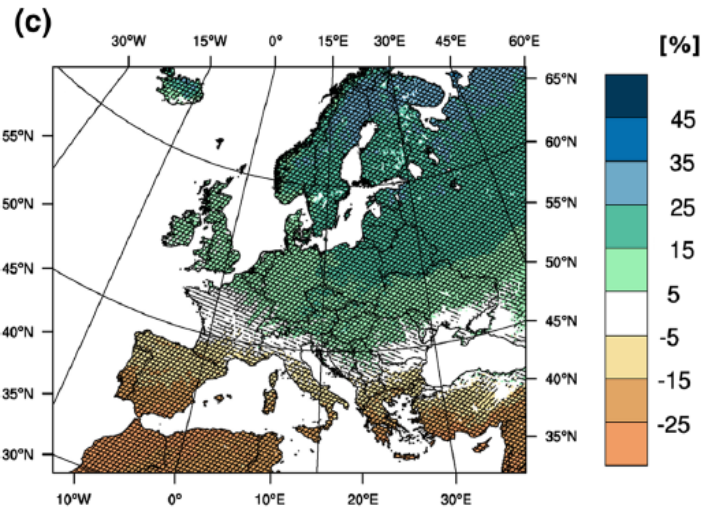
Precipitation



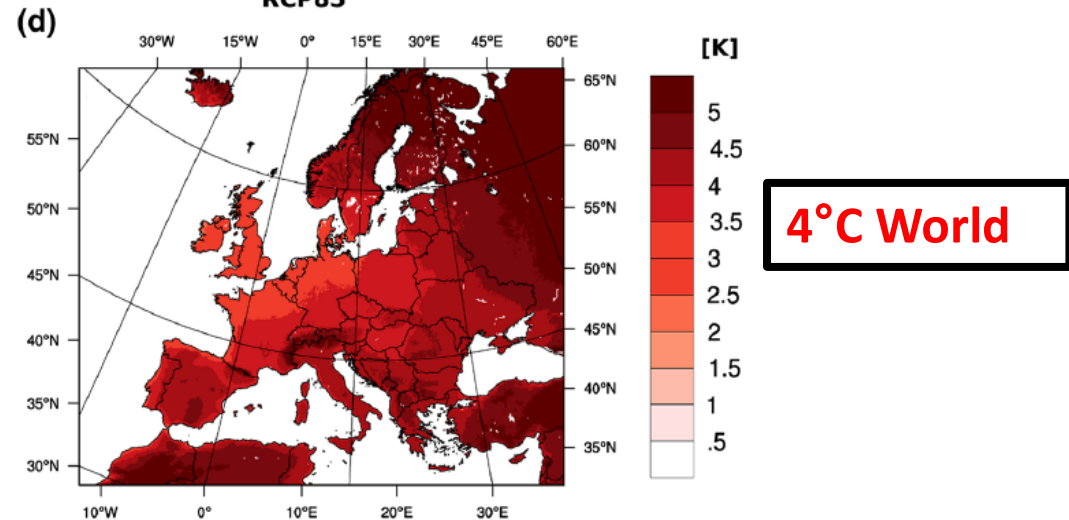
Temperature



RCP85



RCP85



/: significant  
 \: robust

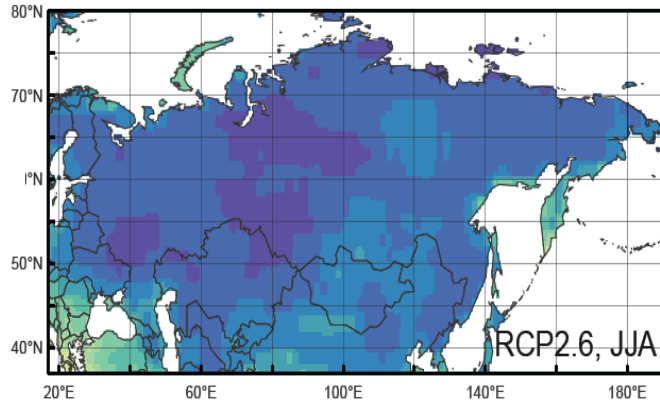
Changes are Significant  
 Changes are Robust

Jacobs et al. 2014

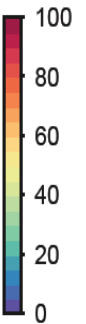
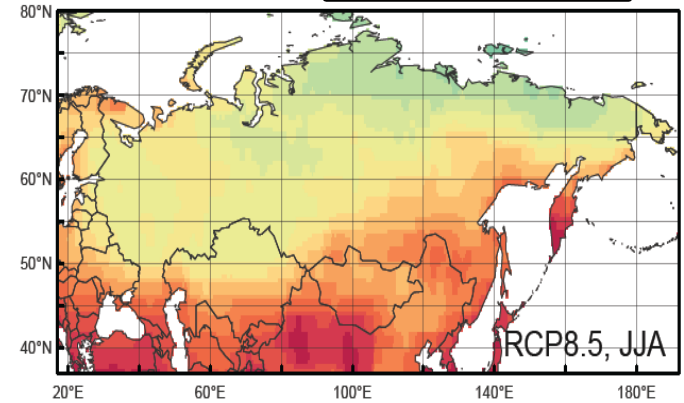
# Heat Extremes ECA

Highly Unusual

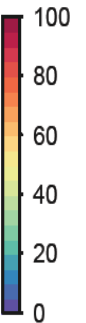
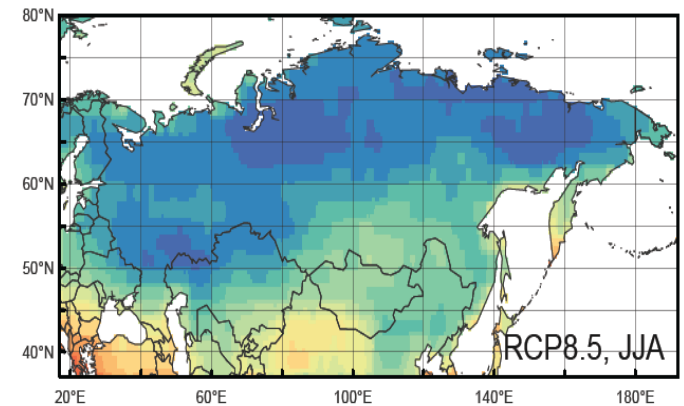
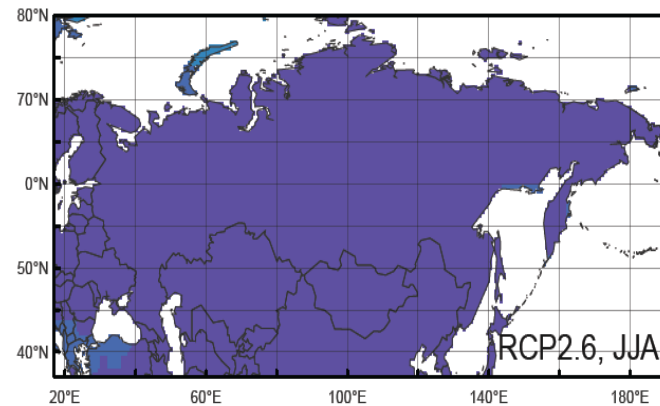
2°C World



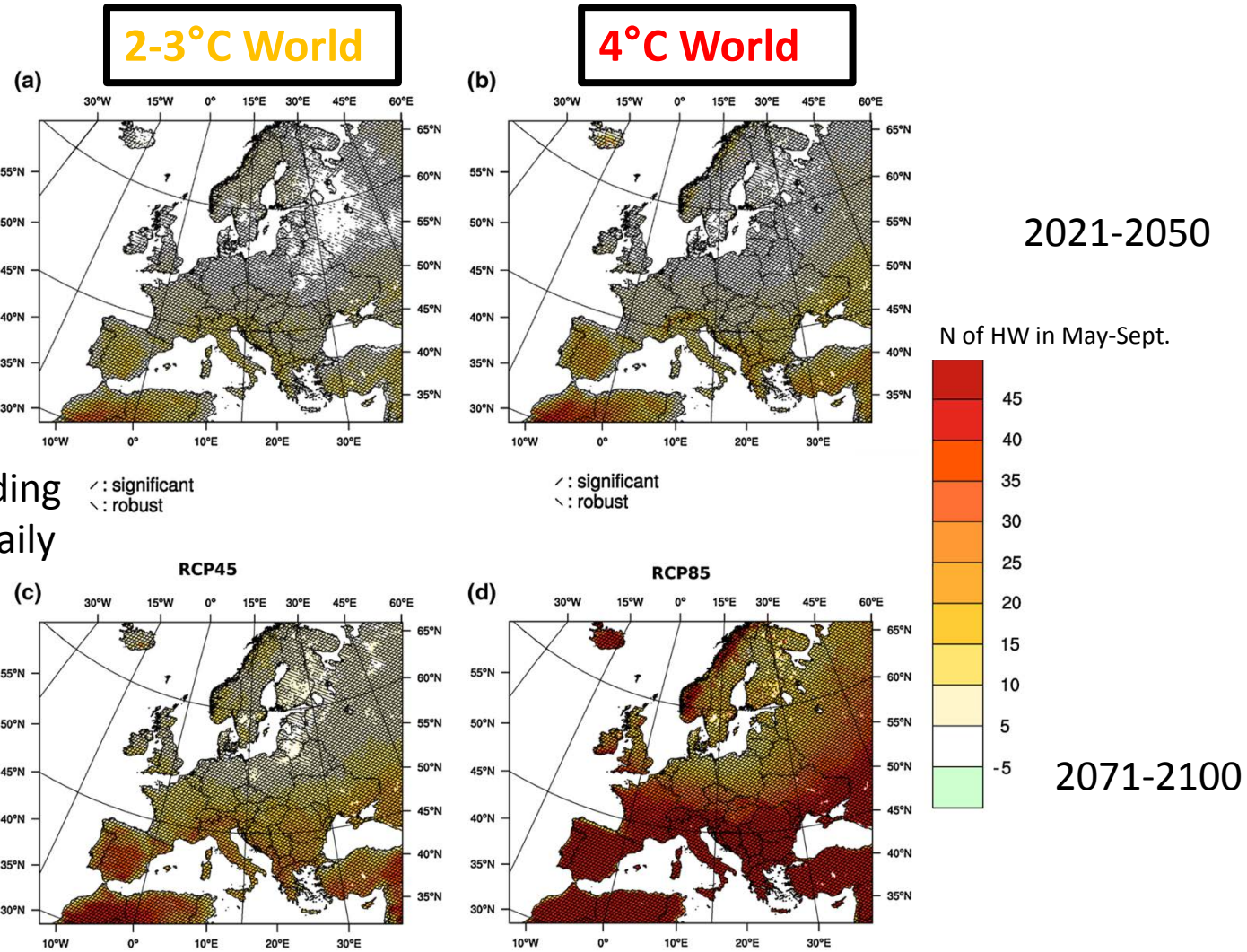
4°C World



Unprecedented



# Increasing Heat Waves compared to 1971-2000

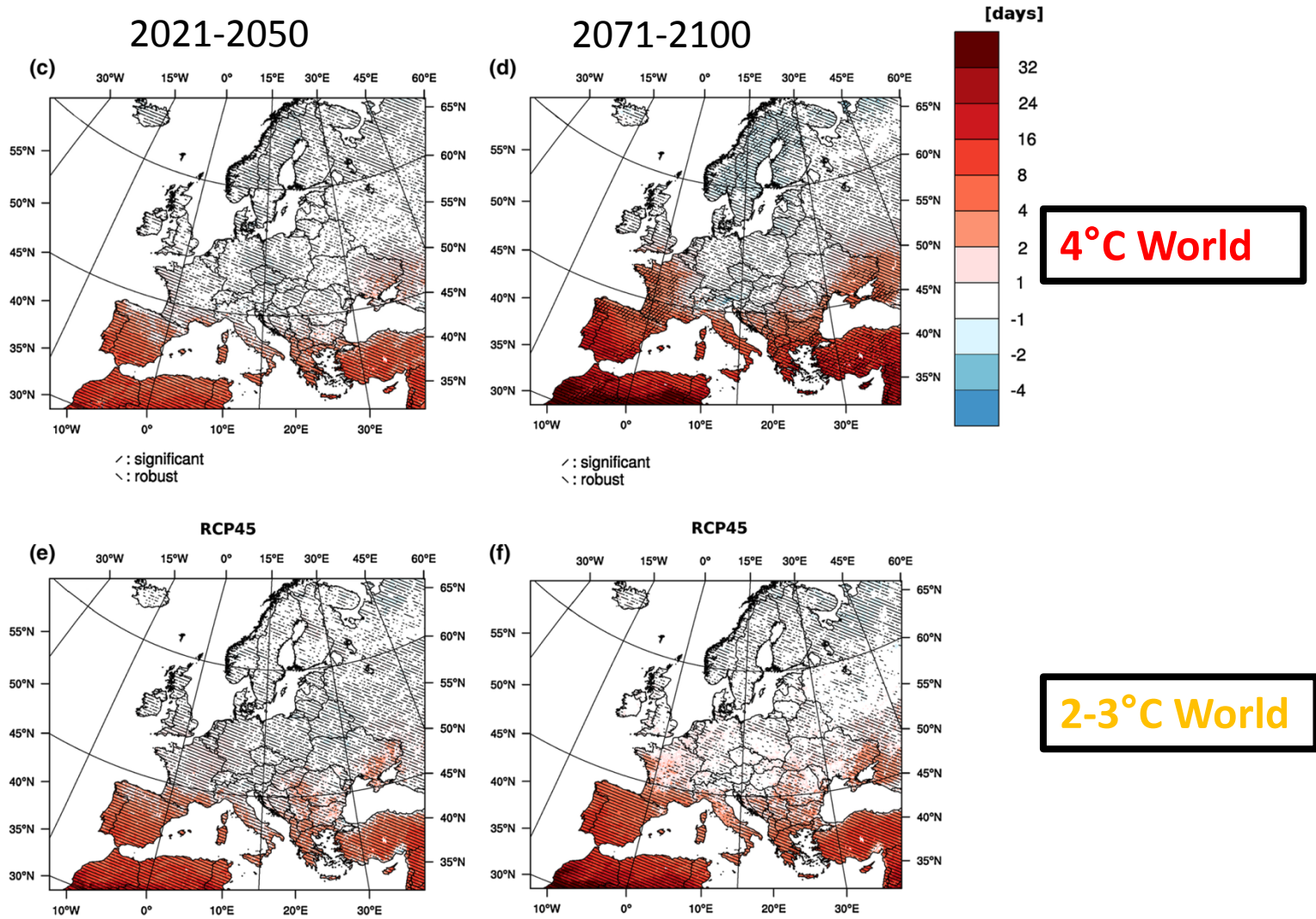


Heat waves = >3 consecutive days exceeding the 99th percentile of daily maximum temperature (May to September)



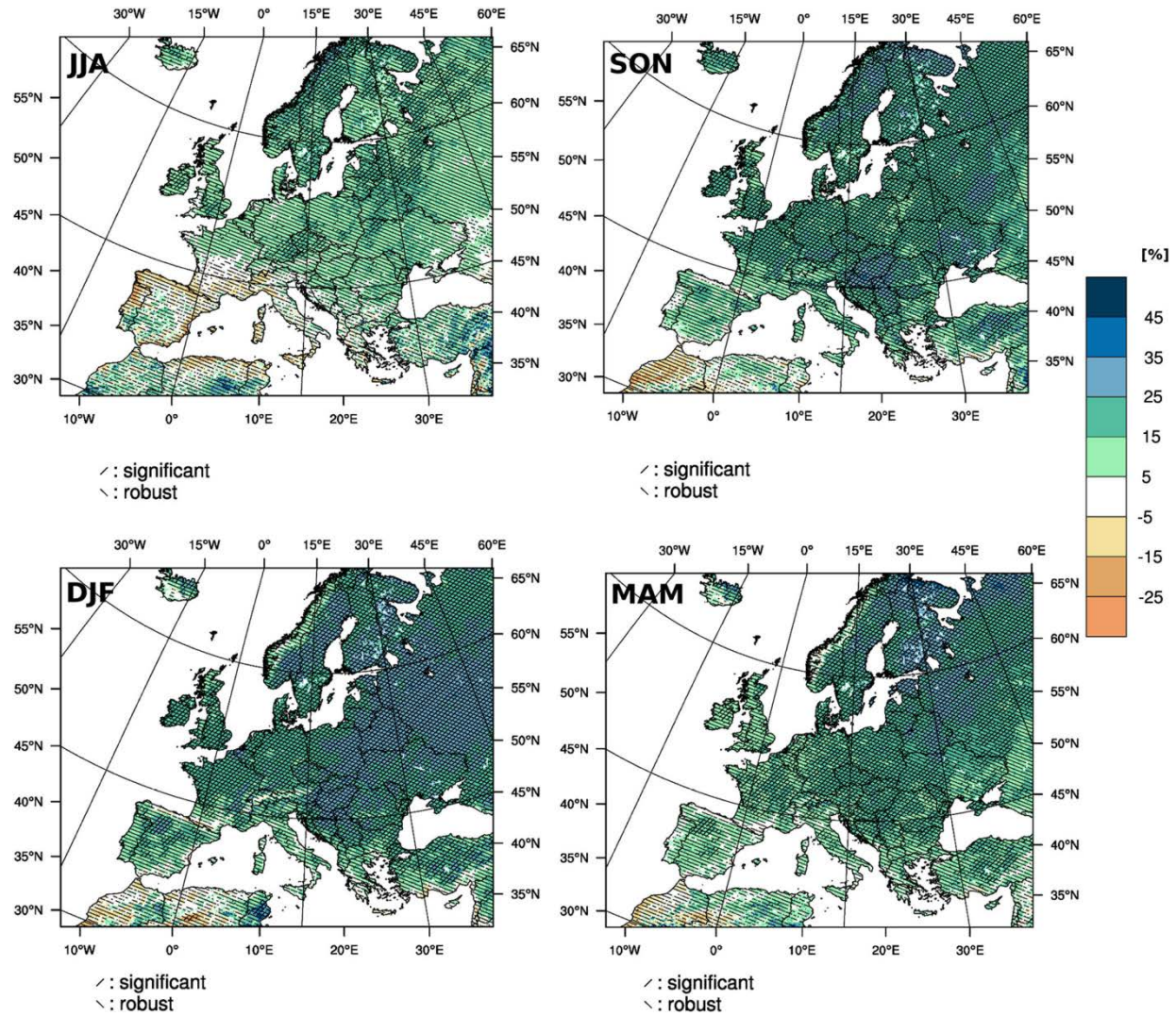
# Longer dry spells compared to 1971-2000

Dry spells= 95th percentile of the length of all identified dry spells (at least 5 consecutive days with daily precipitation below 1 mm)



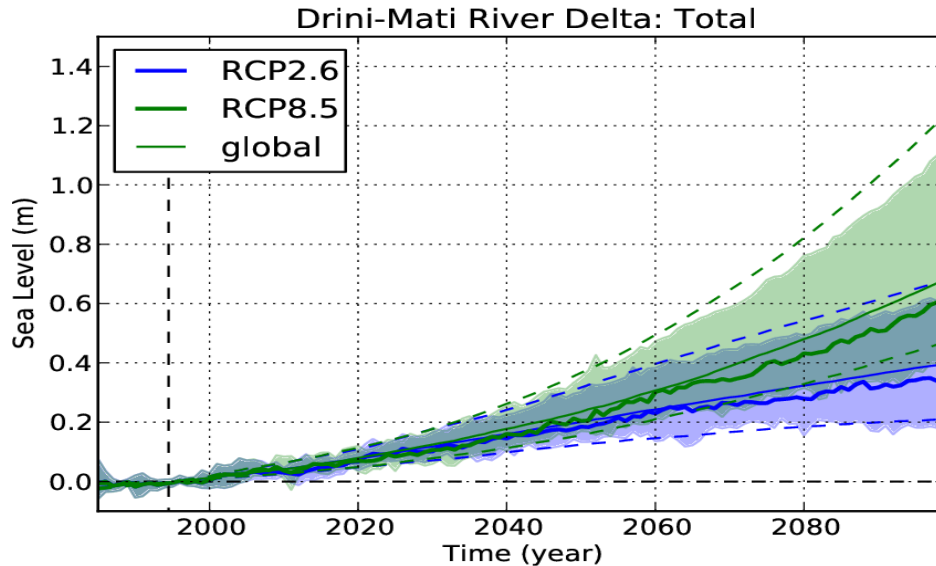
# Heavy precipitation in a 4°C world

Heavy precipitation = intensity of the 95th percentile of daily precipitation





# Sea-level rise in the Western Balkans



**Table 5.3:** Sea-level rise (SLR) projection for the Drini-Mati River Delta.

	RCP2.6 (1.5°C WORLD)	RCP8.5 (4°C WORLD)
SLR in 2081–2100	0.32 (0.21, 0.54)	0.52 (0.37, 0.9)
SLR in 2046–2065	0.21 (0.17, 0.32)	0.26 (0.21, 0.39)
Rate of SLR in 2081–2100	3.0 (–1.5, 5.8)	10.1 (5.9, 19.6)
Rate of SLR in 2046–2065	4.6 (0.6, 7.1)	7.6 (5.3, 12.1)

Sea-level rise for the Drini-Mati River Delta in Albania for 1.5°C world (green) and 4°C world (blue)

➔ but sea-level-rise projections methodologically challenging!

# Risks of decreasing water availability

- Water availability threatened in summers and as temperatures rise toward 4°C.
- Shifts in the timing of water flows lead to a higher risk of drought, with consequences for crop yields, urban health, and energy generation.
- Winter and spring flood risk is expected to increase slightly along the Danube, Sava and Tisza rivers.



# Risks to agricultural productivity

- Yield losses of up to 50% for maize, wheat, vegetables and grapes at 2°C warming in Macedonia
- Maize (-11%), grapes (-20%) or olives (-20%) at 2°C warming in Albania
- The risks of reduced crop yields and production losses increase rapidly above 1.5°-2°C warming.
- Increasing droughts and flooding events represent a major risk for agriculture in the Western Balkans.
- → but also yield increases → depending on region and crop modelling methods!
- → lack of studies for livestock

# Energy

- Heterogenous energy mix in Western Balkan countries
- Thermal power plants: higher river water temperature & altered river flows → decreased production
- Hydropower: decreased production (southern Europe & Croatia)



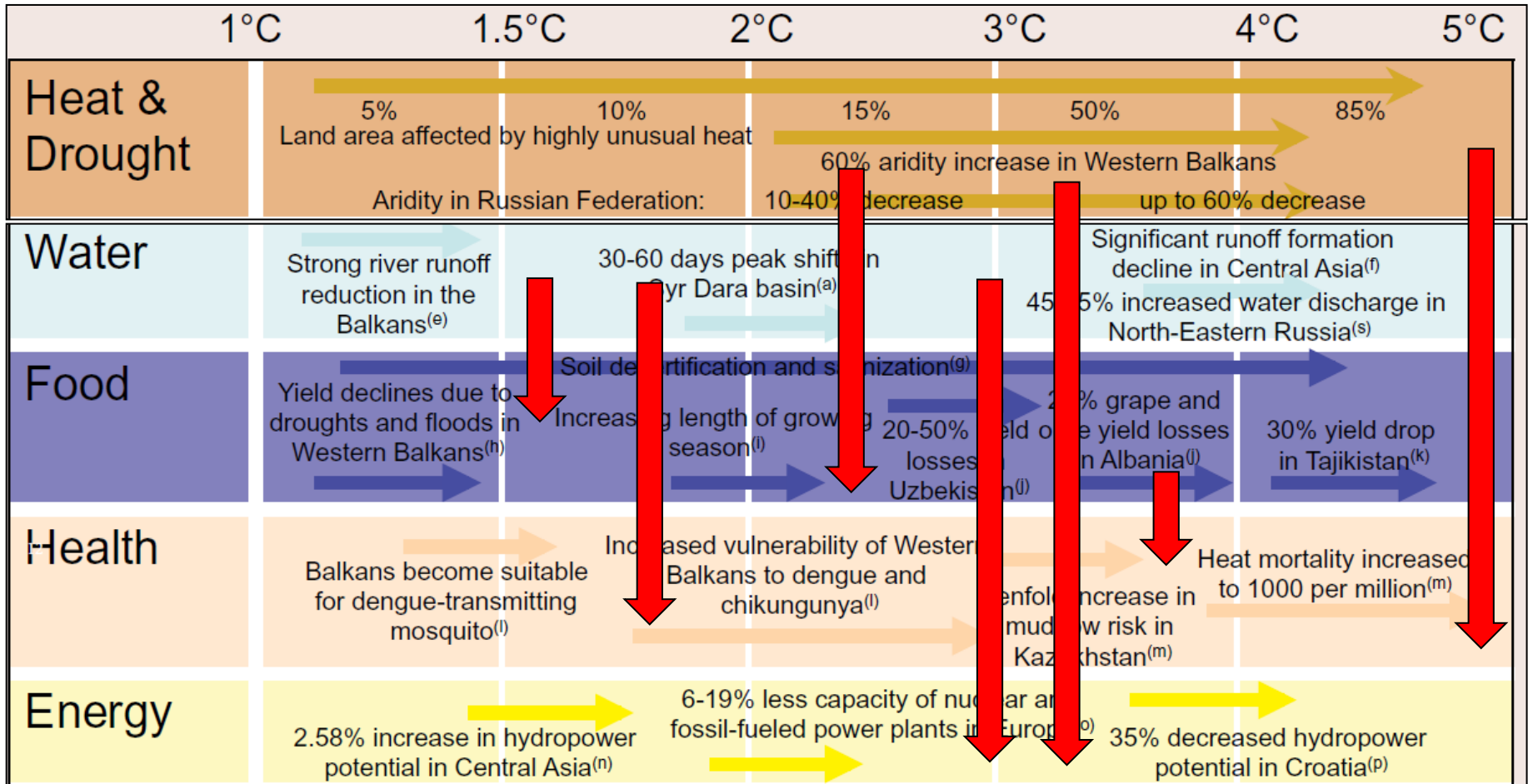
# Human Health

- spread of Tick-Borne Encephalitis
- Dengue & Chikungunya fever → increasing climatic suitability for *Aedes Albopictus*
- Higher temperatures increases risks of salmonellosis, although general trend is declining
- Mortality from heat waves

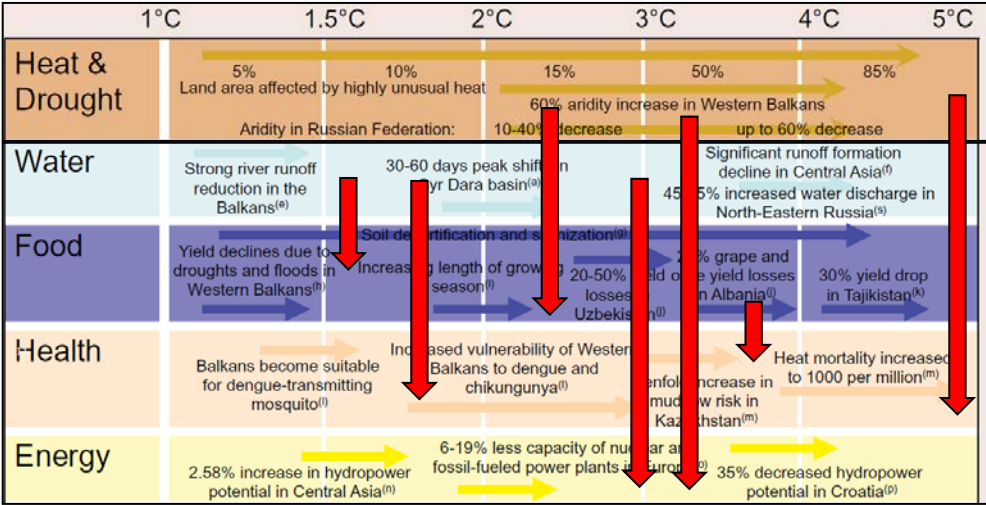




# Cascading Impacts Western Balkans



# Risks for development Western Balkans



## Development Narratives:

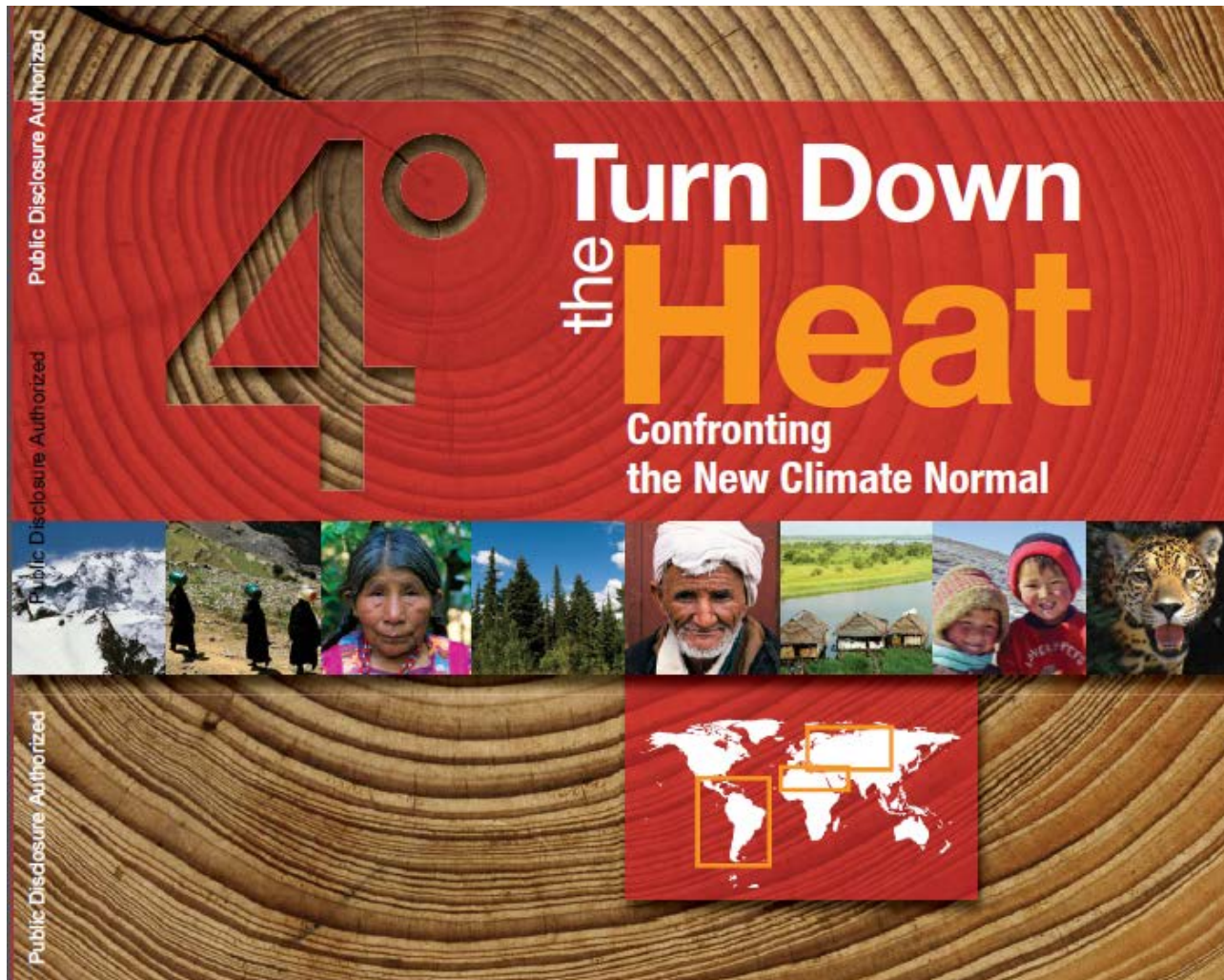
- Climate extremes threaten agriculture, energy & health
  - Drought risk, floods
  - Country/crop-specific agricultural risks
  - Conventional and hydropower energy generation at risk
  - Heat waves & new diseases challenge public health



# TDTH3 Conclusions

- **Climate that is now considered unusual becomes the „new climate normal“**
- **2°C is „no picknick“ but a 4°C world seriously challenges promoting human development & ending poverty**
- **Social Vulnerability: Poor, elderly, and children often hit hardest**
- **Key Research Gaps:**
  - **Key assumptions not clear: e.g. is a 2°C warming in 2050 giving the same impact as 2°C in 2100?**
  - **Mixing of model uncertainty and scenario uncertainty**
  - **Cross-sectoral integration still a challenge**

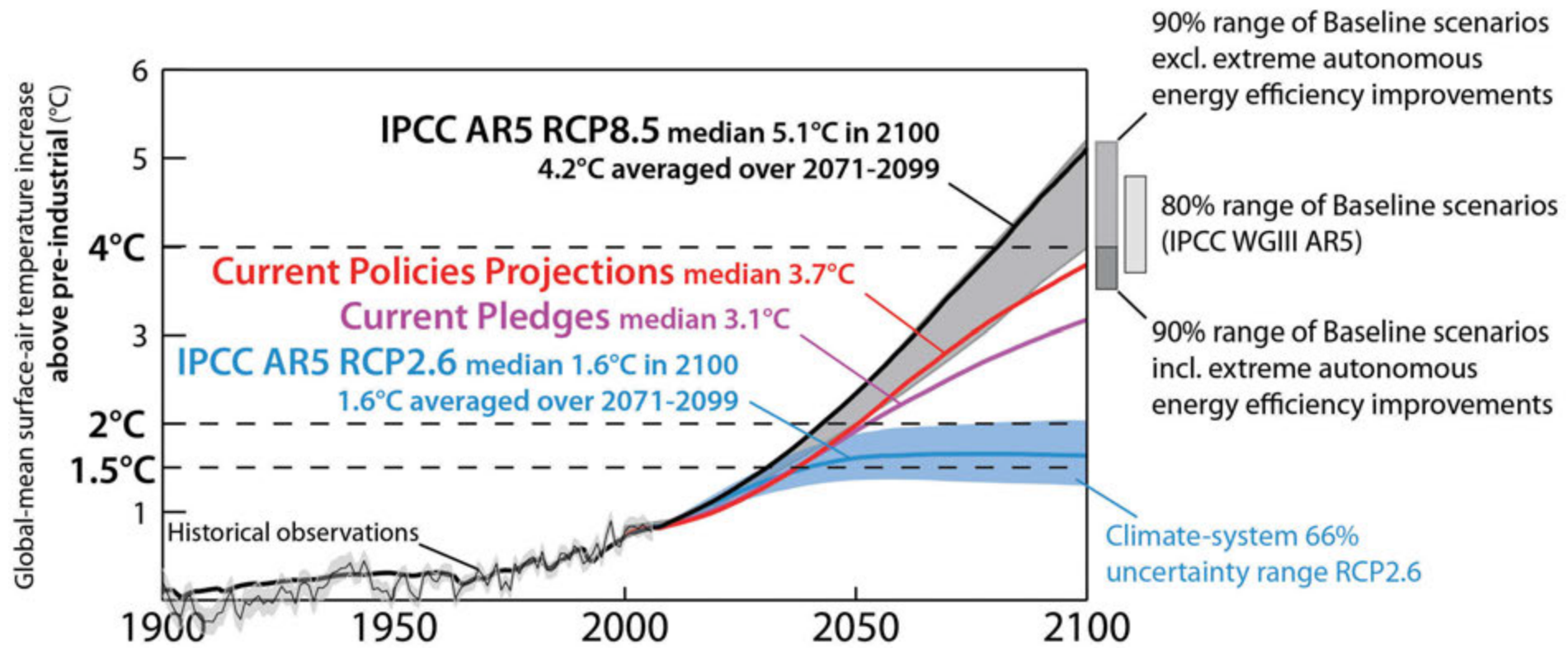
Thank you!



# Selected Key Findings Across the Regions

- Extreme heat events are occurring more frequently. The occurrence of record-breaking monthly mean temperatures has been attributed to climate change with 80 percent probability.
- Extreme precipitation has increased in frequency and intensity in many places.
- A robust drying trend has been observed for already drought-prone regions such as the Mediterranean.
- A significant increase in tropical North Atlantic cyclone activity has been observed and is affecting the Caribbean and Central America.

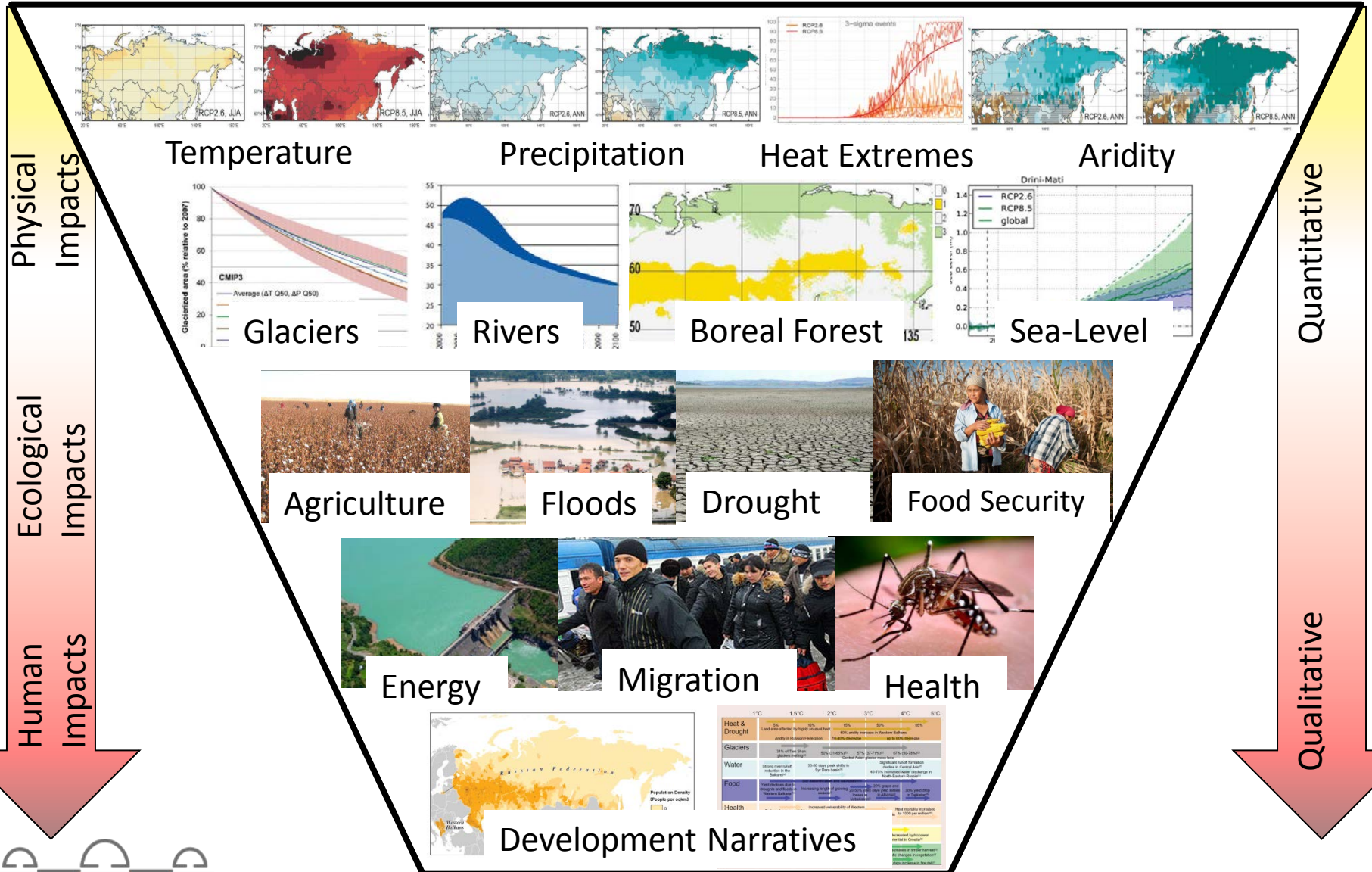




# Lessons for impact science – Key Research Gaps

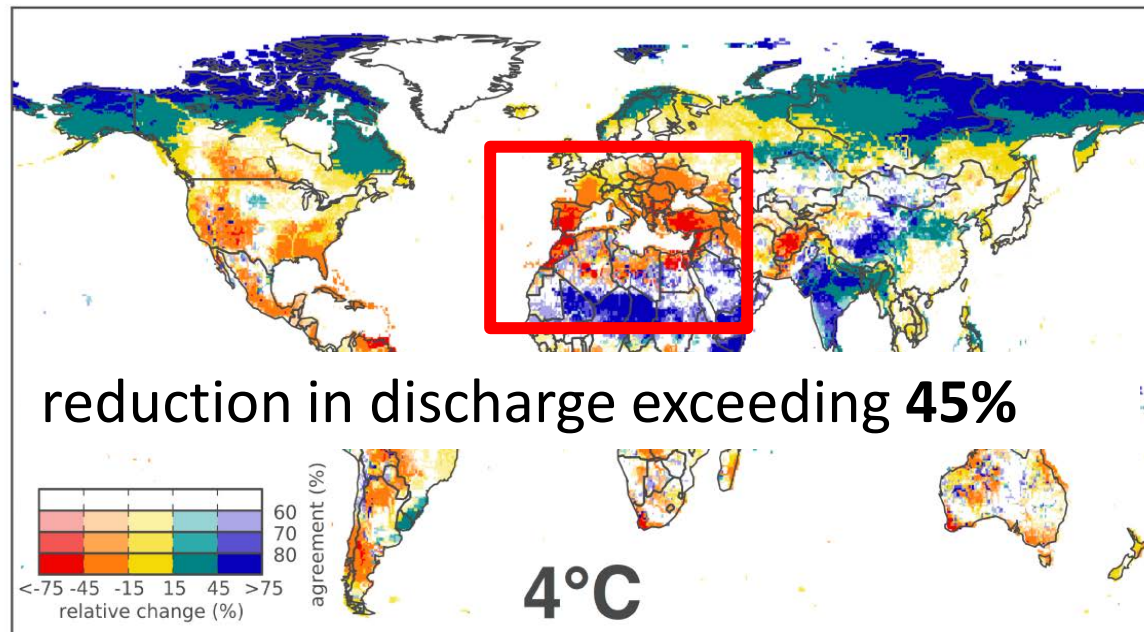
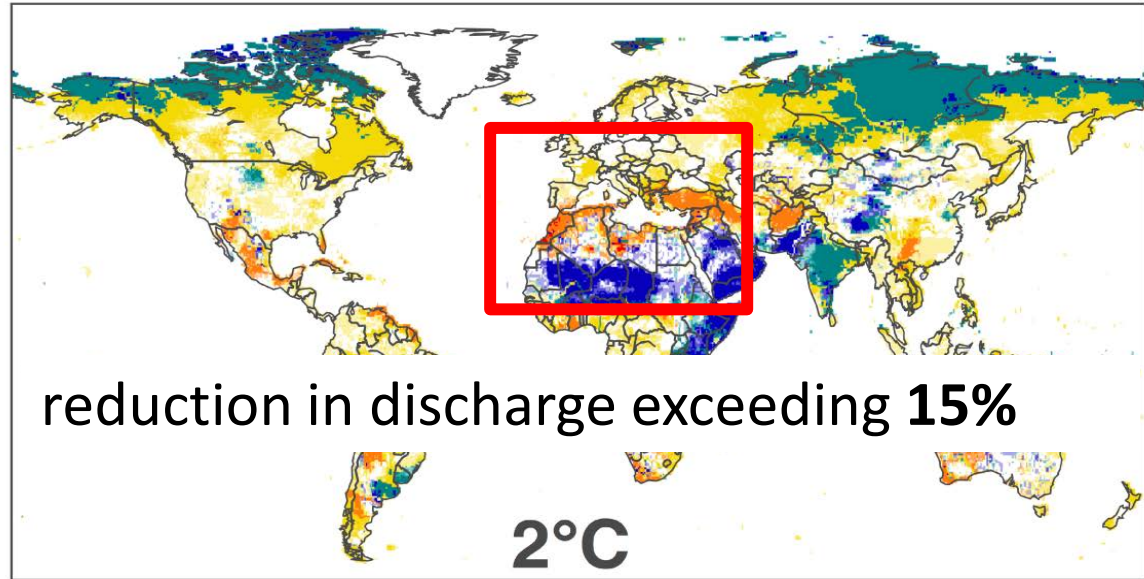
- Warming levels often not reported and sometimes not even GCM/RCMs, scenario or time periods
- ➔ Model improvement & more standardized comparisons/assessments needed

# TDTH3 Europe/Central Asia on 1 slide



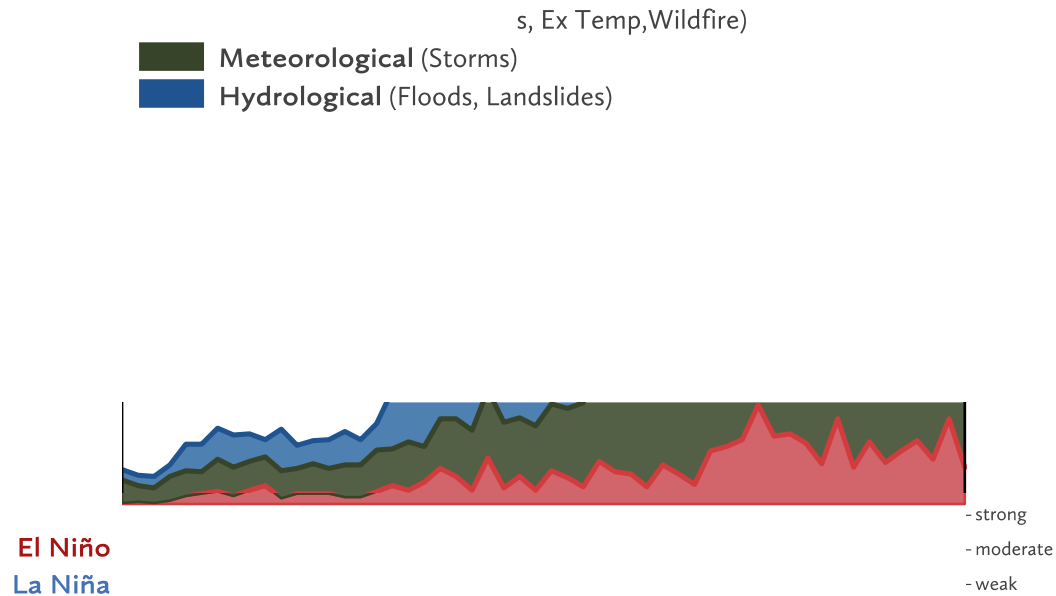
# Water Resources

→ reduced irrigation potential



Relative change in annual discharge in the 2080s relative to 1986-2005.

# Increase in climate-related disasters



Upper panel: Number of climate-related disasters from 1960-2013 (based on the EM-DAT database). A robust increase in all types of climate-related disasters is observed. Lower panel: El Niño and La Niña events identified on the basis of the Niño 3.4 sea-surface temperature index.



# Highly Unusual and Unprecedented Heat Extremes

## *Highly Unusual* at present

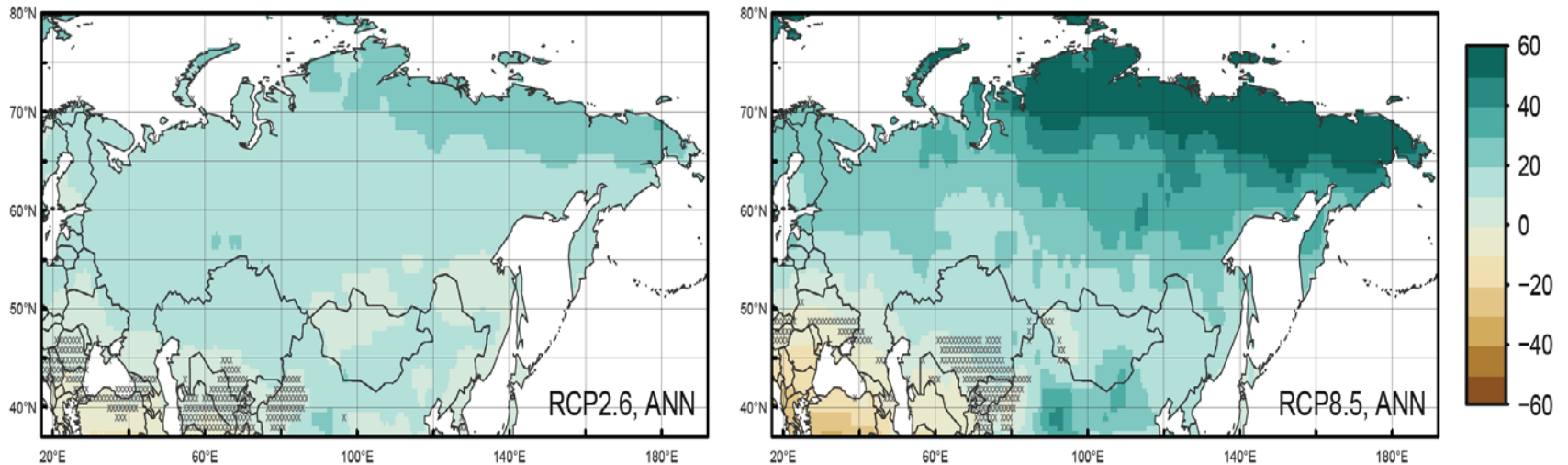
- 3-sigma Events—Three Standard Deviations Outside the Normal
- For a normal distribution, 3-sigma events have a return time of 740 years.
- *Extreme* monthly heat
- Projected to become the norm over most continental areas by the end of the 21st century

## *Unprecedented*

- 5-sigma Events—Five Standard Deviations Outside the Normal
- For a normal distribution, 5-sigma events have a return time of several million years.
- Essentially absent at present
- *Unprecedented* monthly heat: new class of monthly heat extremes
- Projected to become common, especially in the tropics and in the Northern Hemisphere mid-latitudes during summertime

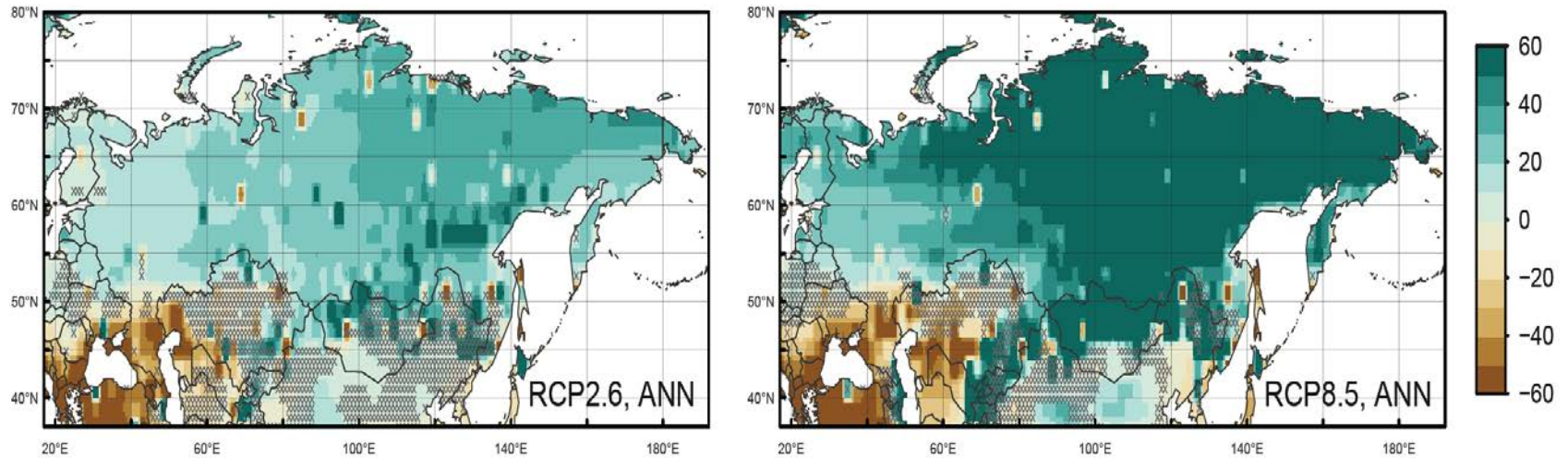


# Precipitation Changes ECA



Annual precipitation changes for ECA in a 2° C world (left) and a 4° C world (right) by 2071-2099

# Aridity in ECA



Percentage change in Aridity Index for ECA in a 2° C world (left) and a 4° C world (right) by 2071-2099

# Social Vulnerability

**There is clear evidence that climate change is already affecting livelihoods and wellbeing in parts of the three regions and is likely to do so to a significantly greater extent if more extensive climate change occurs**

- Shocks and stresses related to climate change can undermine poverty reduction and push new groups into poverty. Informal settlements on flood plains and steep hillsides in many Latin American cities and the Western Balkans, for example, have been severely affected by floods and landslides in recent years.**
- The impacts of climate change will often be most severely felt by poor and socially excluded groups, whose capacity to adapt to both rapid- and slow-onset climate change is more limited.**
- Climate change may lead to displacement and also affect patterns and rates of migration.**

# Consequences for development

- **Climate change poses a substantial and escalating risk to development progress that could undermine global efforts to eliminate extreme poverty and promote shared prosperity.**
- **Without strong, early action, warming could exceed 1.5-2°C and the resulting impacts could significantly worsen intra- and inter-generational poverty in multiple regions across the globe.**
- **Amplified risk are emerging from multi-sectoral impacts in particular connected to food security due to projected large and severe crop yield losses for warming levels above 2°C.**



# Compounding Risks – ECA (Central Asia)

- **Crop productivity is expected to be negatively impacted by increased heat extremes and variability of supply/demand for water that poses substantial risks to irrigated agricultural systems.**
- **Rural populations that are especially dependent on agriculture for food are likely to be increasingly vulnerable to any reductions in agricultural yields and nutritional quality of their staple food grains.**
- **Unstable water availability is likely to increase the challenge of competing requirements for hydropower generation and agricultural production at times of rising overall demand due to projected population and economic growth in Central Asia.**