BRIEFING / 1.3

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GLOWA Jordan River

Simulating expected climate change in the Jordan River region using Regional Climate Models

Key findings

- Trend analysis showed a statistically significant increase in temperatures of 1°C over the past 50 years.
- Until the year 2060, mean annual temperatures are expected to increase by 2°C with an increase in warm spell length
- Decrease in order of 10% in mean annual precipitation with increased frequency of strong precipitation events is expected for large parts of the Jordan River region until 2060
- Precipitation decrease is expected to continue with higher levels of significance until the year 2100

Overview and Objectives

The Jordan River basin is located within the Mediterranean climate zone. In this water scarce environment, the availability of sufficient amounts of water is critical for development and, potentially, a source of regional conflicts.
According to the latest report from the International Panel on Climate Change (IPCC), released in 2007, semiarid regions such as the Mediterranean are likely to experience a decrease in water resources due to climate change. This IPCC statement is based on data obtained from several Global Climate Models (GCM) and different emission scenarios. In order to investigate the impacts of climate change for the Jordan River region in detail, the resolutions of these GCMs are too coarse. Since the region is characterized by sharp gradients of main climate variables, especially rainfall, much higher spatial resolutions are required. These are obtained from Regional Climate Models (RCM) that dynamically downscale the coarse information of the GCM considering local topography, highly resolved land use and soil properties as well as more suitable model parameterizations.

Research Methods

The GLOWA Jordan River project research team performed a number of regional climate simulation experiments. Three RCMs were evaluated and applied in transient simulations of the future climate conditions in Eastern Mediterranean with boundary conditions from two global models employing the A1B emission scenario. In summary, an RCM ensemble consisting of five members was analyzed to access expected future trends and their respective uncertainty.

Regional climate models first have to demonstrate their performance to reproduce the current climatic condi-

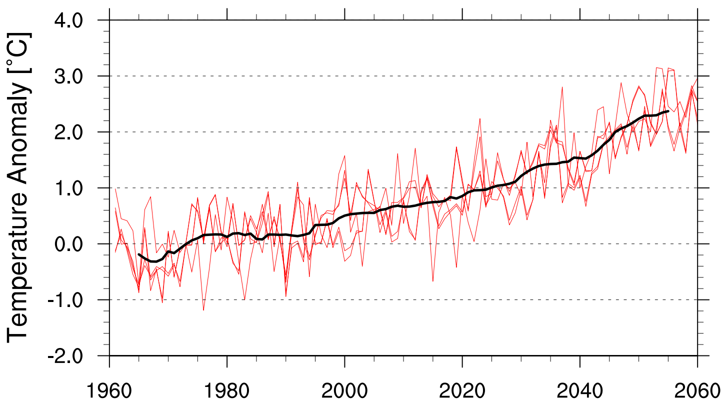

Figure 1: Multi model annual mean temperature anomalies from 1961-1990 mean. Thin red lines show the single model realizations and the black line the multi model 10 years. running mean.

Teams of researchers from Germany, Israel, Jordan and the Palestinian Authority work on how best the hazards posed by global change to the future of the Jordan River basin can be faced and overcome.

www.glowa-jordan-river.de

The GLOWA Jordan River project is part of a larger research initiative launched by the German Federal Ministry of Education and Research under the title "Global Change and the Hydrological Cycle".

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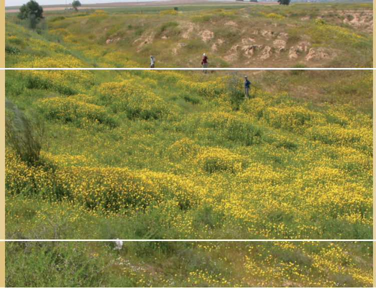

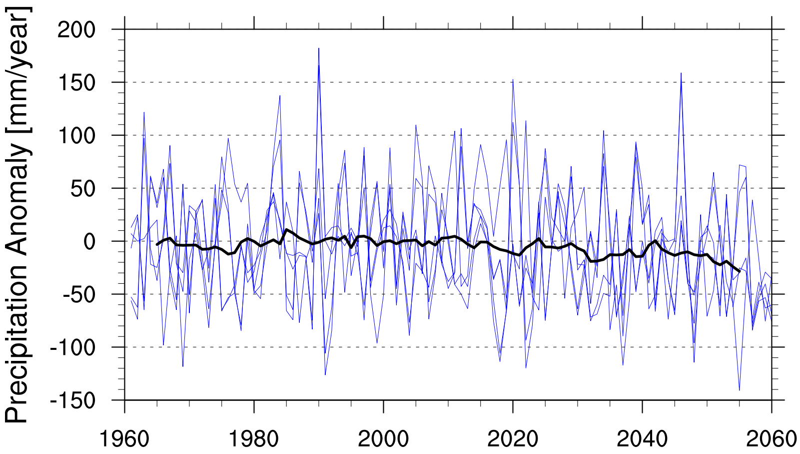

Figure 2: Multi model precipitation anomalies from 1961-1990 mean. Thin blue lines show the single model realizations and the black line the multi model 10 years running mean.

tions. For that purpose, simulations of the recent climate, represented by the period 1961-1990, were compared to data sources like reanalysis data from numerical weather prediction or long-term observation data from climate stations within the Jordan River region. It could be shown that results of the climate simulations are in reasonable agreement with observed data for the most important climate variables like precipitation and temperature.

Although there are differences between the single ensemble member simulations of derived future climate conditions, all applied RCMs reveal similar trends. Mean annual temperatures are steadily increasing. Until the year 2060, an increase of up to 2 °C can be expected (see Figure 1) with an increase in warm spell length. Analyses of future precipitation show in all cases a reduction of rainfall until 2060 by 10% (see Figure 2) and also reveal a higher inter-annual variability for large parts of the region. Furthermore, changes in the temporal distribution of precipitation can be expected: drought periods will likely become more intense and severe rainfall events more frequent, despite the reduction of total precipitation amounts (see Figure 3).

Conclusions

The results of the climate simulations show that significant changes in climate conditions have to be expected in the Jordan River region. Performed climate change simulations reveal that decreasing precipitation rates and increasing temperatures are likely to reduce the discharge of the Upper Jordan River, and thus additionally increase the pressure on freshwater availability in the region.

All results of the future climate simulations were provided as input to further impact studies addressing hydrological processes, land use changes as well as economic and ecological implications performed by several research groups within the GLOWA Jordan River project.

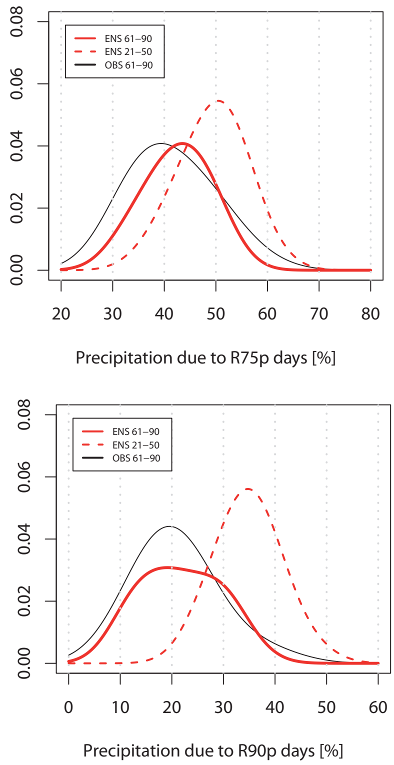

Figure 3: Probability distributions of observed (OBS) and simulated multi model mean quotient of precipitation amount on days with precipitation over the 75 percentile and 90 percentile and the total amount for the period October-April.

References

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