Impact of Climate Change on Water Availability in the Near East

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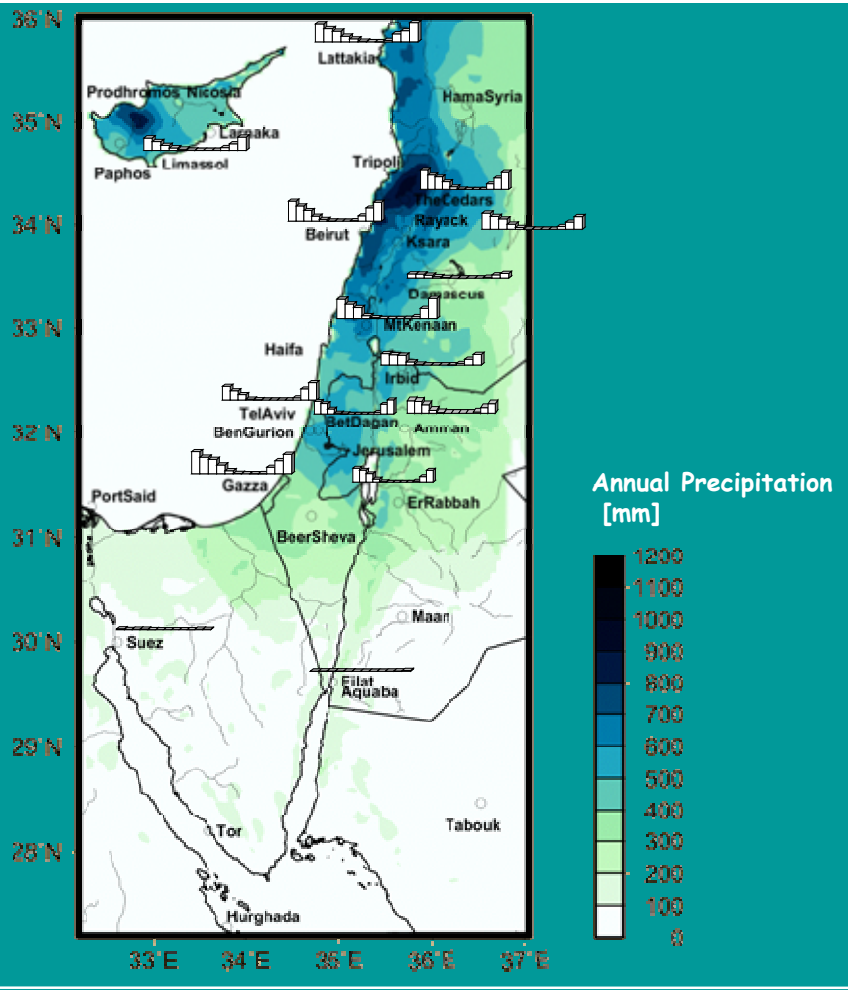
Motivation

- Sufficient freshwater availability central prerequisite for agricultural & industrial development in water scarce environment of Near East & Eastern Mediterranean
- Political peace strongly linked to satisfactory compliance of increasing water demands
- Sustainable management of water resources requires scientific sound decisions on future freshwater availability, in particular under global climate change and increasing greenhouse gas emissions

Climate in the Eastern Mediterranean & Jordan River Basin

- Sharp climatic gradients: humid Mediterranean ↔ arid climate

- High resolution information required

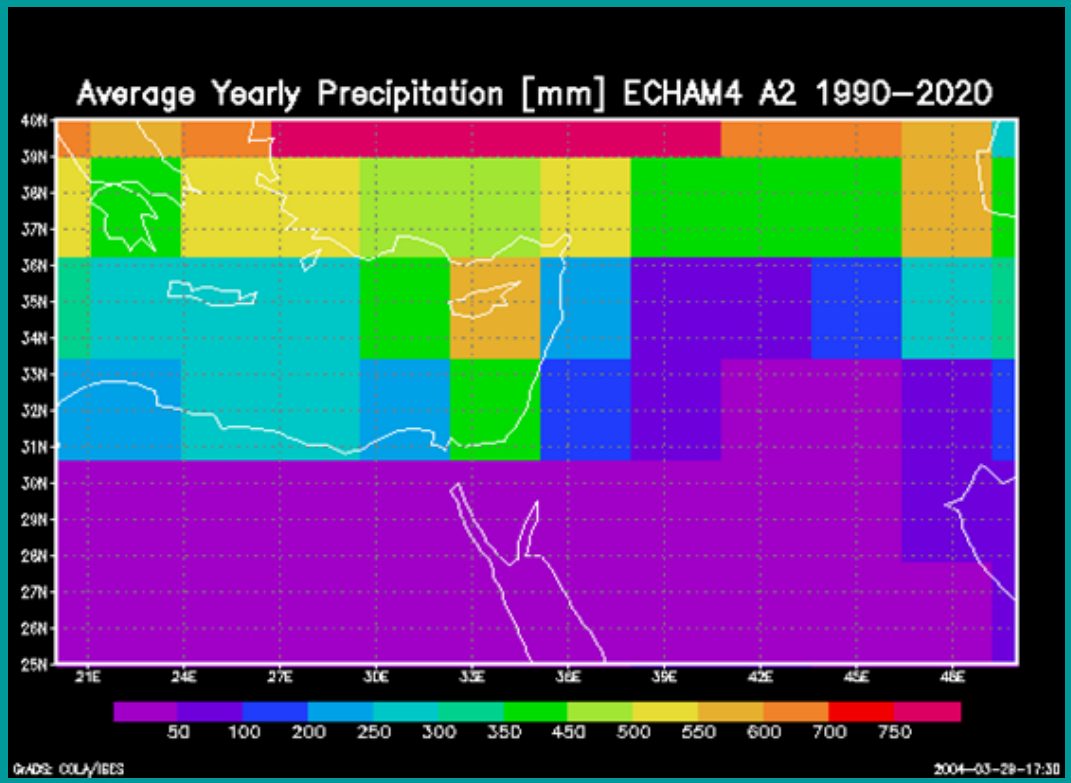


Jordan catchment

Jordan & Mt Hermon

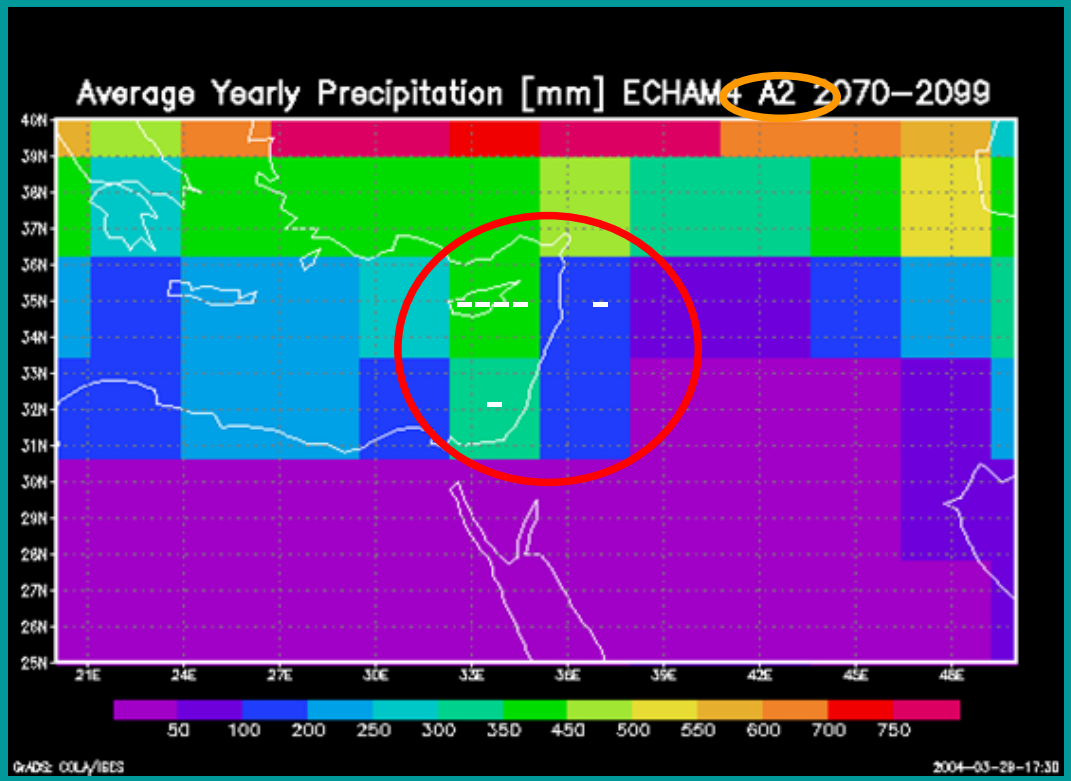
How does global warming and greenhouse gas emissions impact regional climate in the Eastern Mediterranean/Near East?

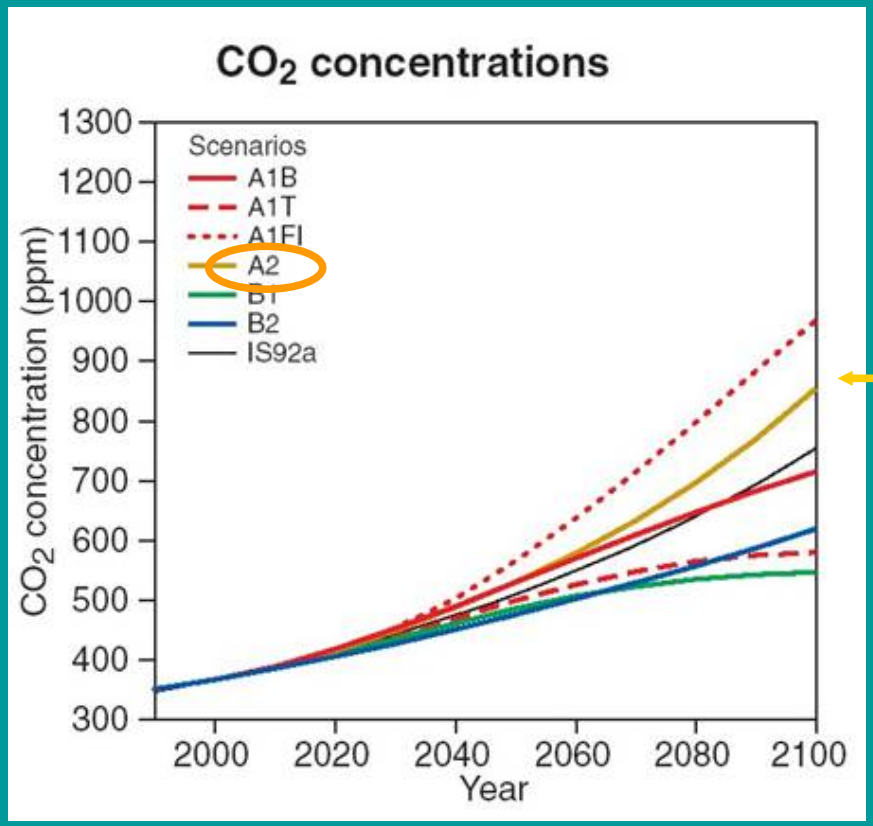
Global Climate Scenarios: Change in Precipitation



ECHAM4 global climate model
- present situation (1990-2020) -

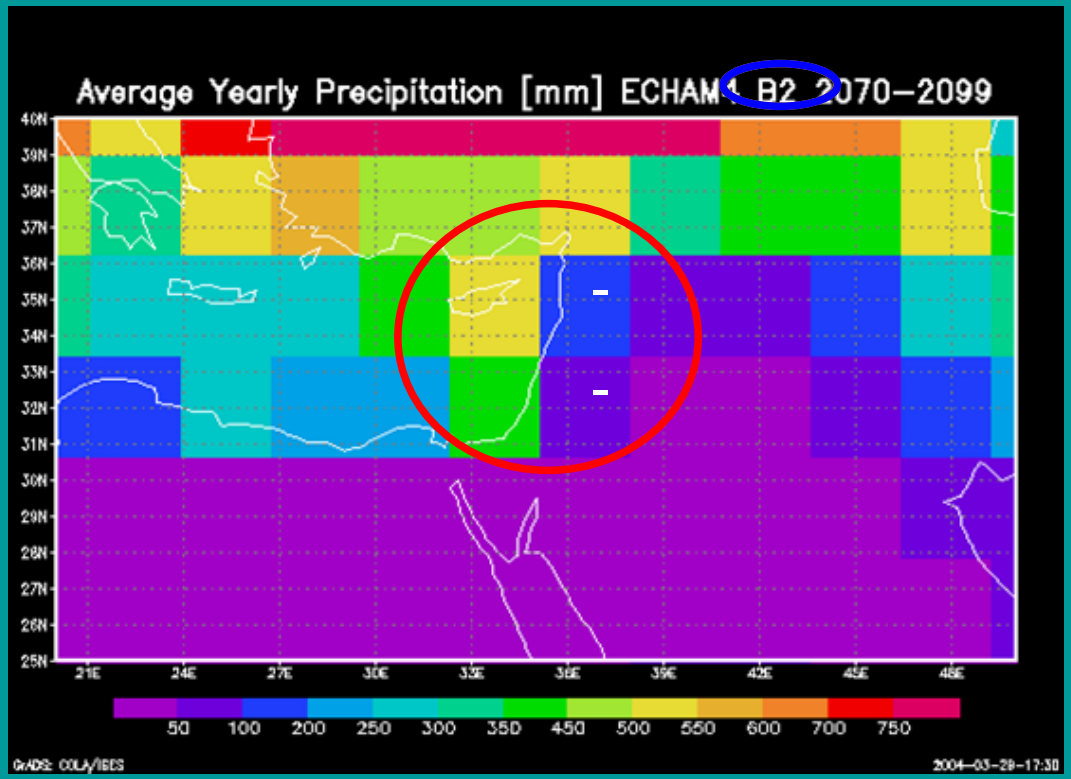
Global Climate Scenarios: Change in Precipitation

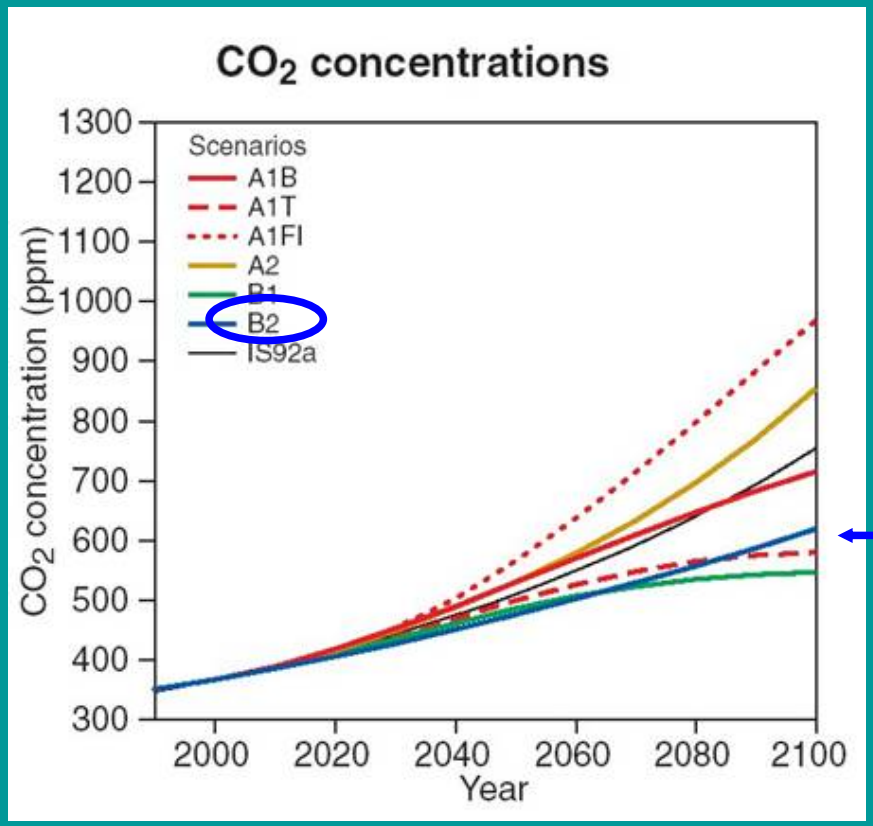




ECHAM4 global climate model
- Future scenario A2 (2070-2099) -

Global Climate Scenarios: Change in Precipitation





ECHAM4 global climate model
- Future scenario B2 (2070-2099) -

Resolution much too coarse for hydrological impact analysis

Method: *Explicit dynamical downscaling of global meteorological fields*

Intermediate results

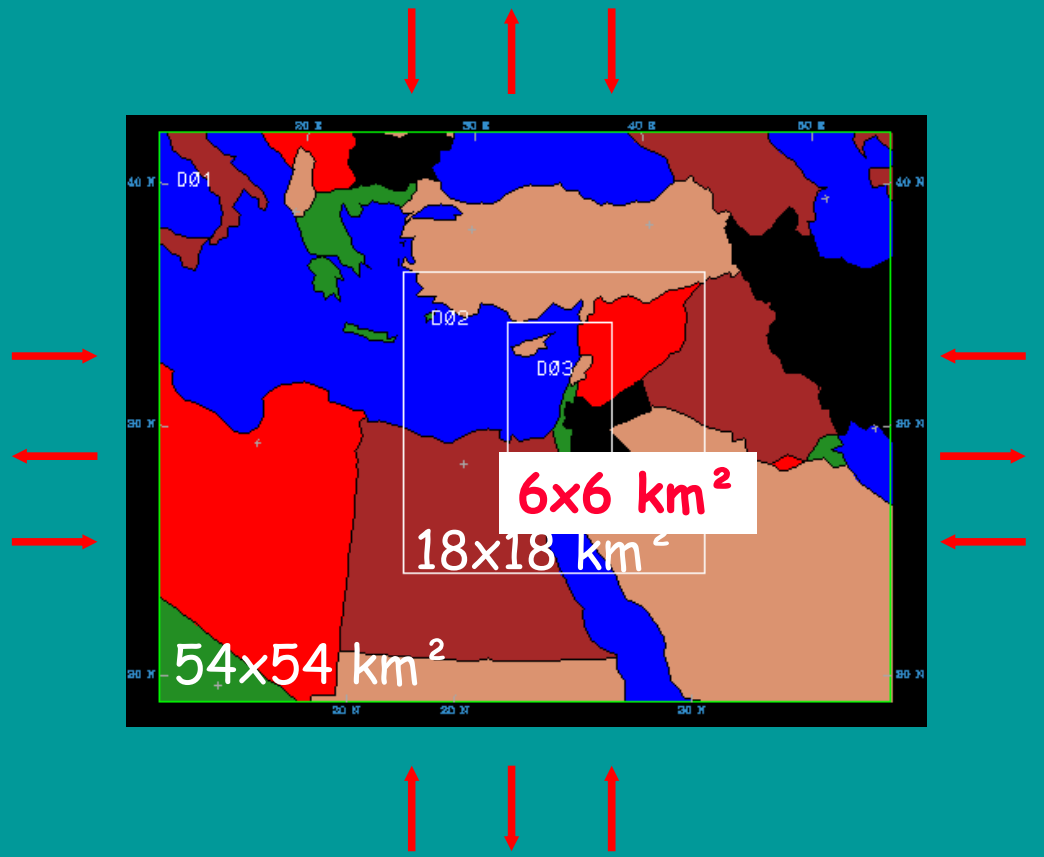
- Two nesting steps (grid size of 54, 18km)
- 25 levels
- CT & B2 scenario ECHAM4 data
- 30 years (1961-1990 & 2070-2099)

Current status

- 60 y simulations
- ~30000 cpu h
- ~5 Tbyte disc space

Next Steps

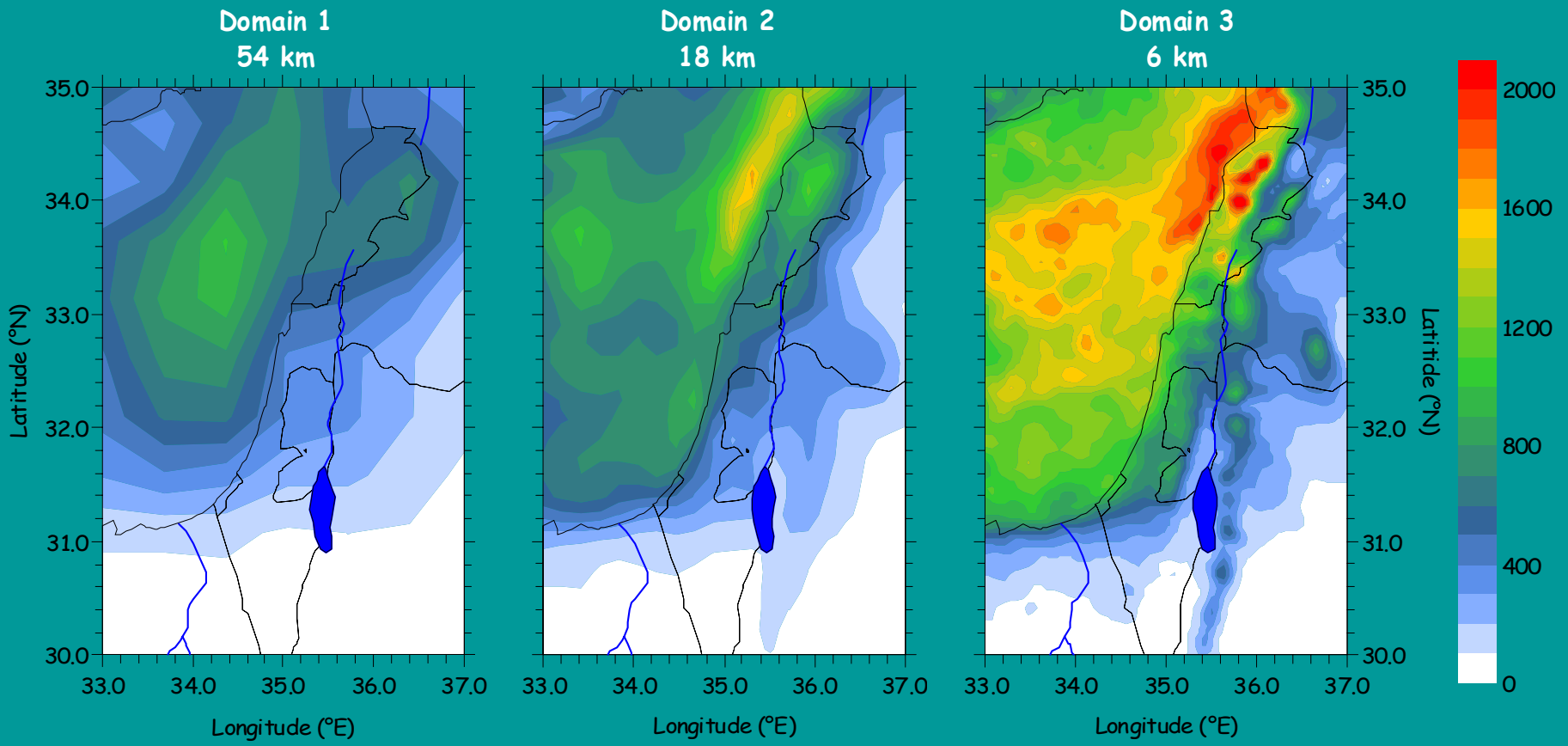
- Nesting step with 6km
- Additional scenario A2
- Alternative GCM (HadCM3)



High resolution required for reproduction of orographically induced local phenomena

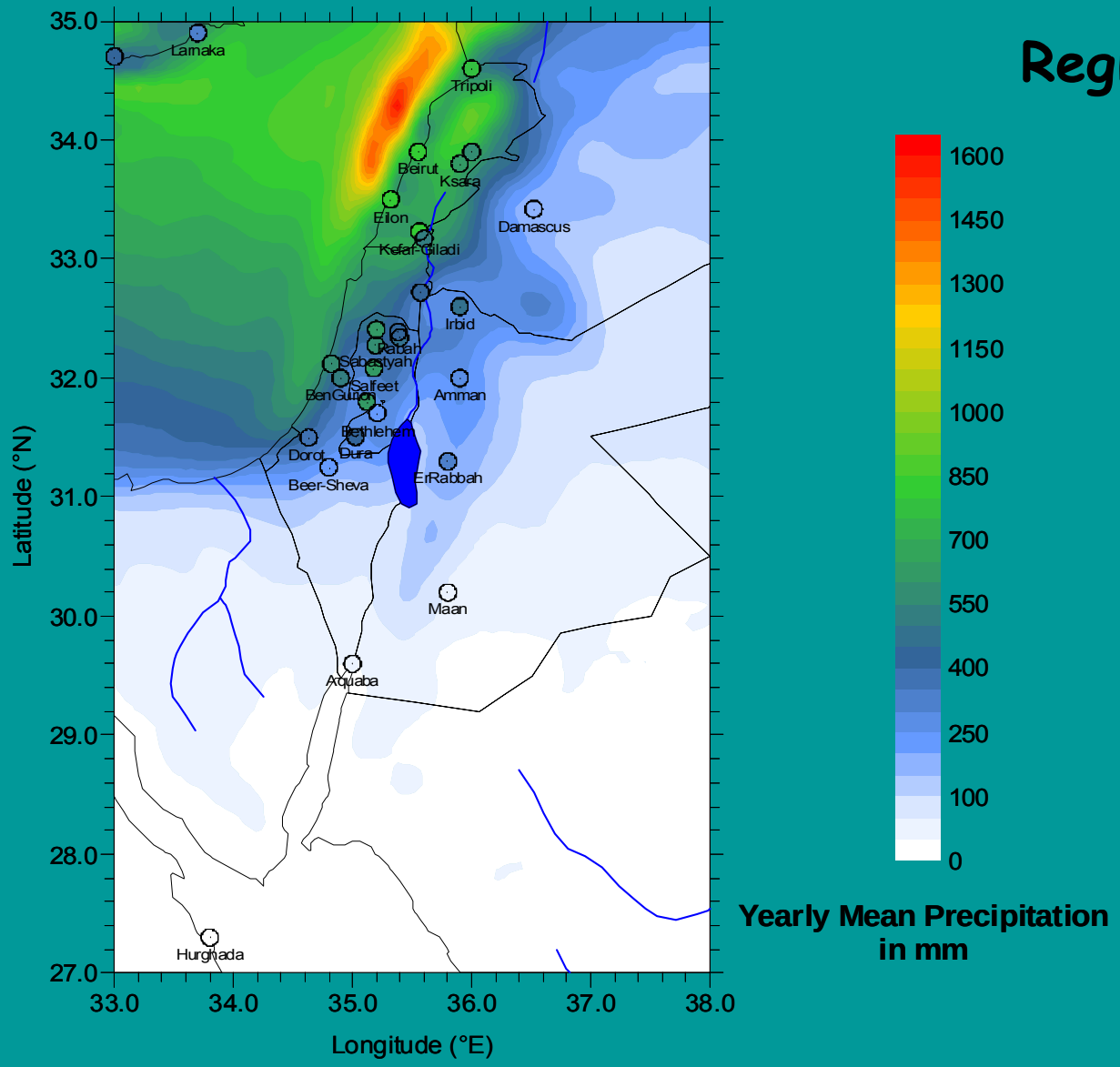
Regional Climate Simulations

Dynamical downscaling of global climate model information



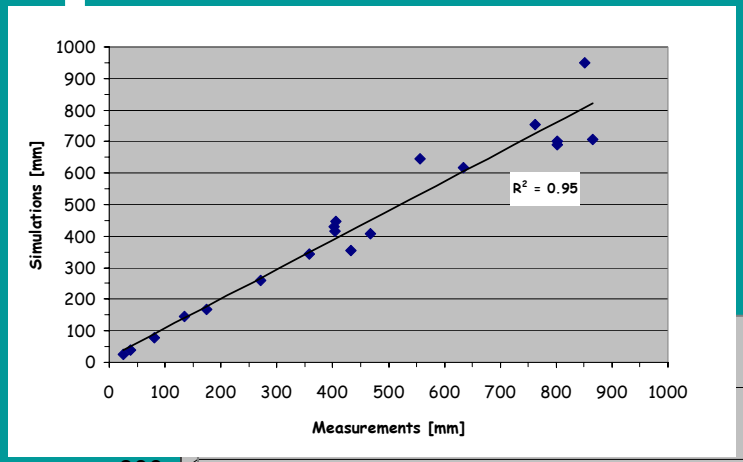
Yearly Mean Precipitation 1961-1962

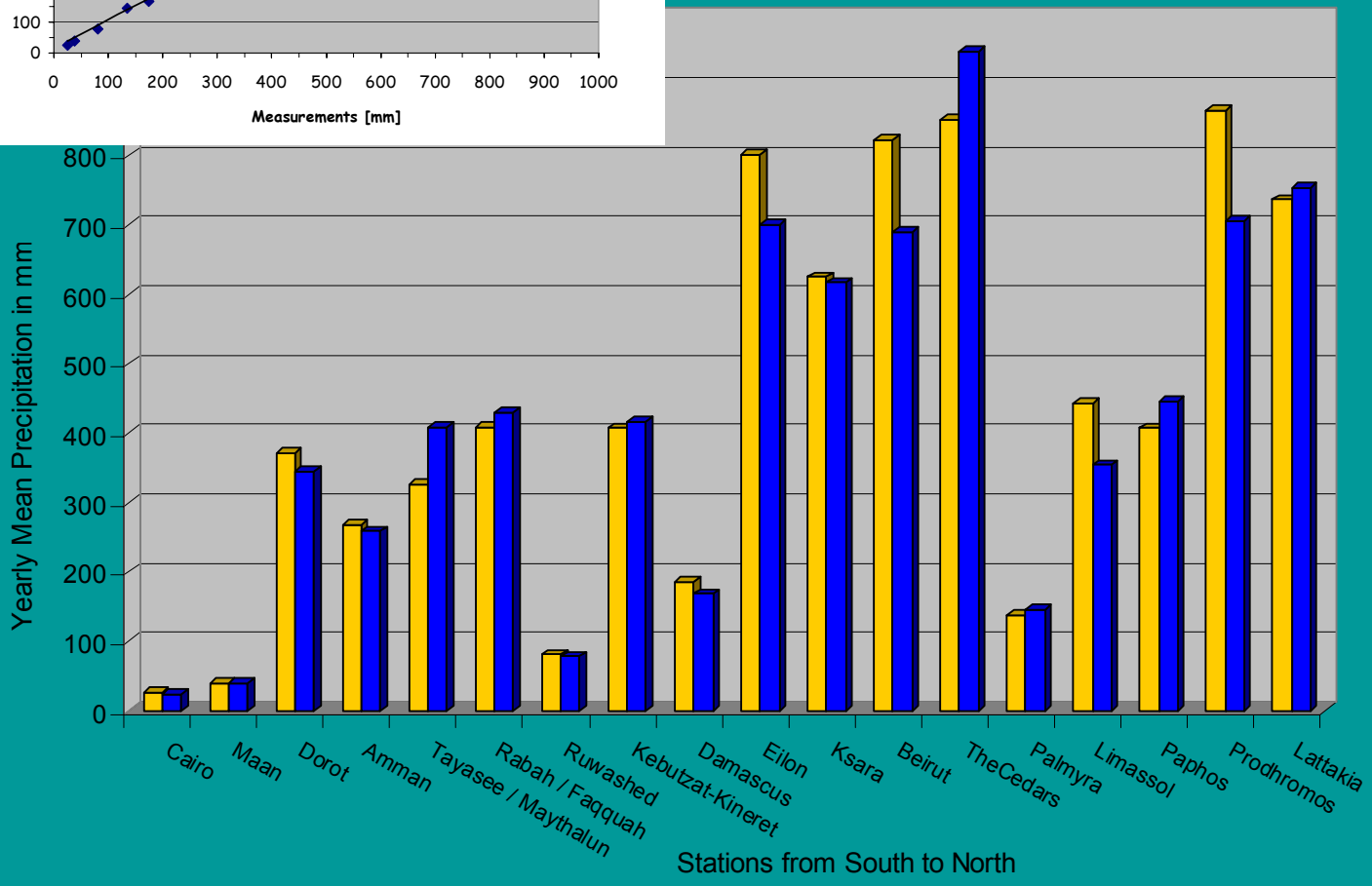
Selected Results
Regional Climate Modelling



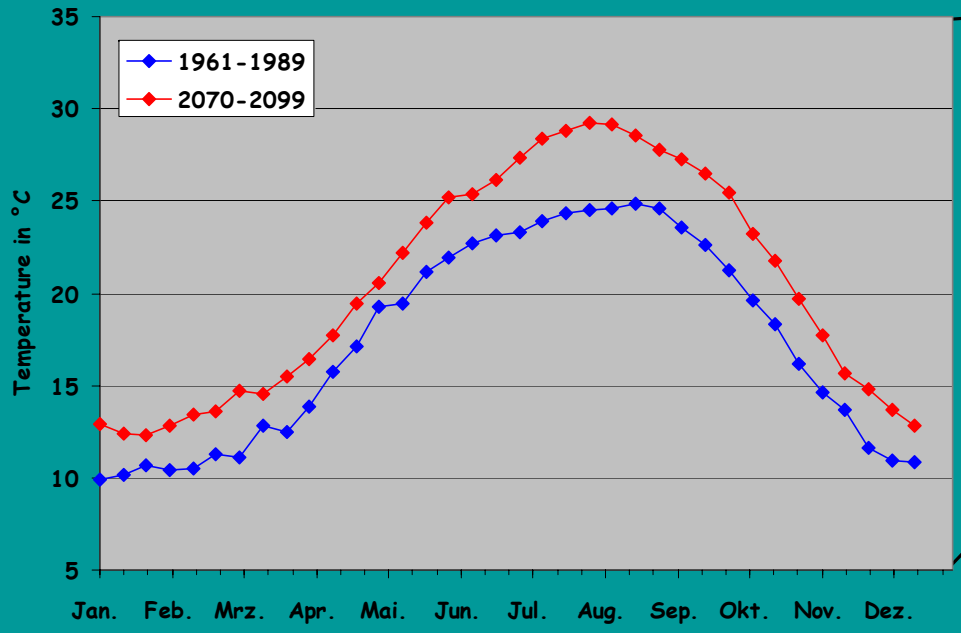
Simulated yearly mean precipitation (18 km resolution) superimposed with yearly mean measurement data (1961-1990)

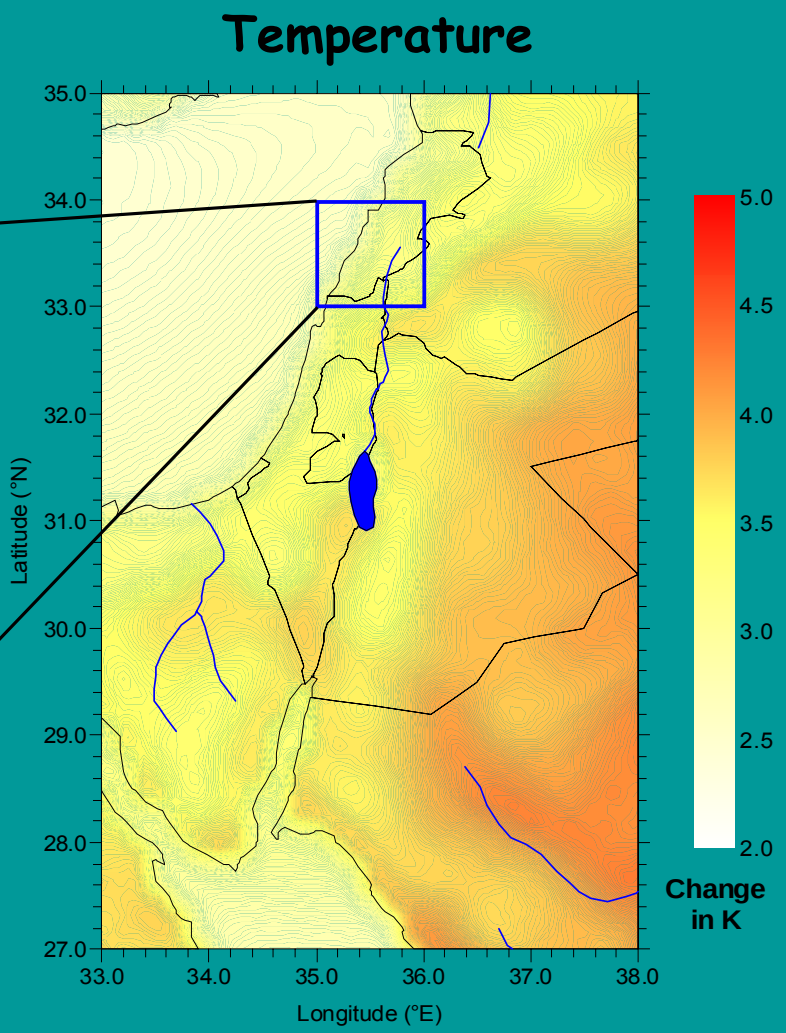
Selected Results
Regional Climate Modelling



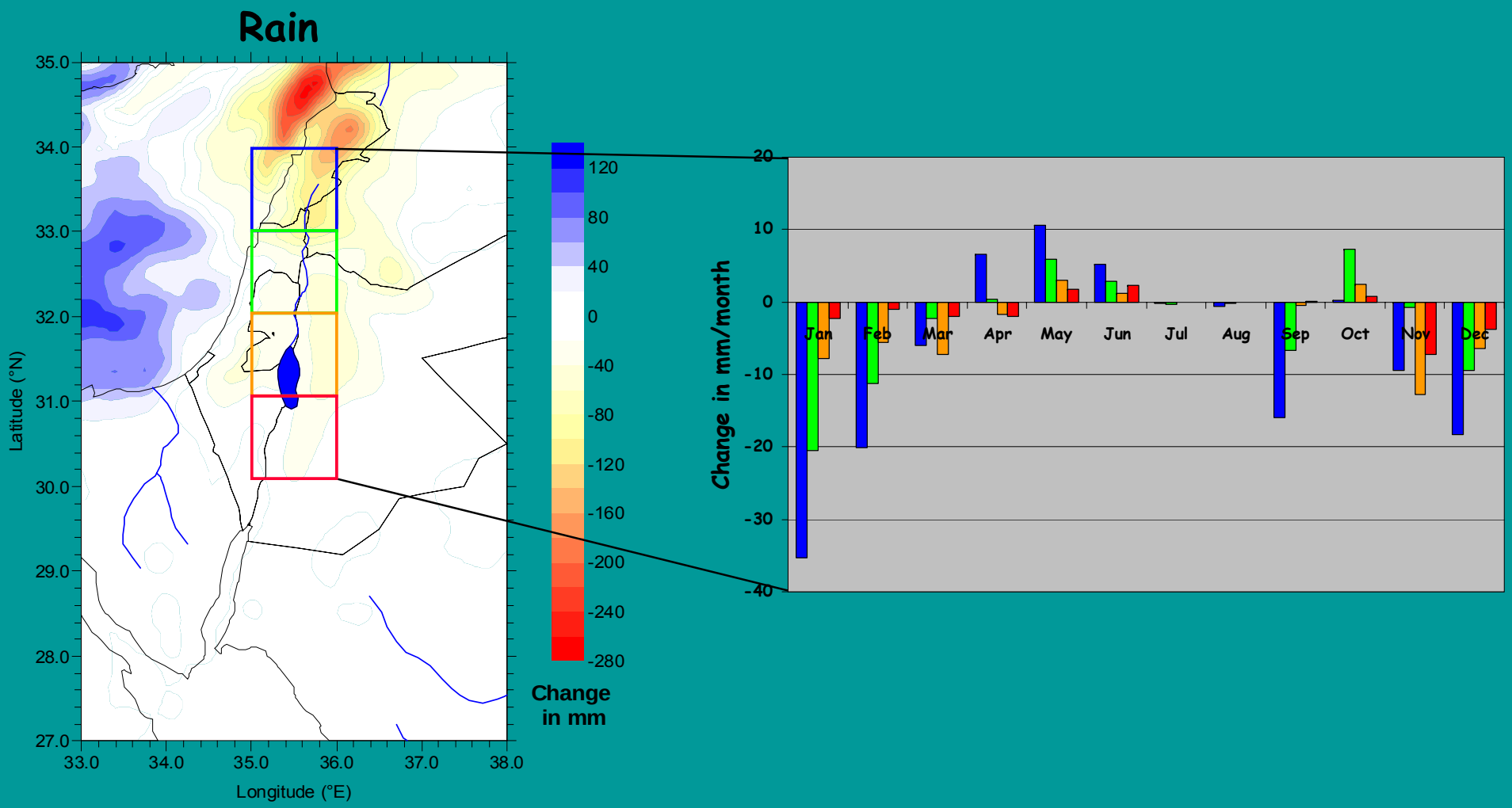


Comparison of long term measurements (>20 years between 1961-1990) and high resolution simulations (18 km, ECHAM4 control run 1961-1990) within the Eastern Mediterranean





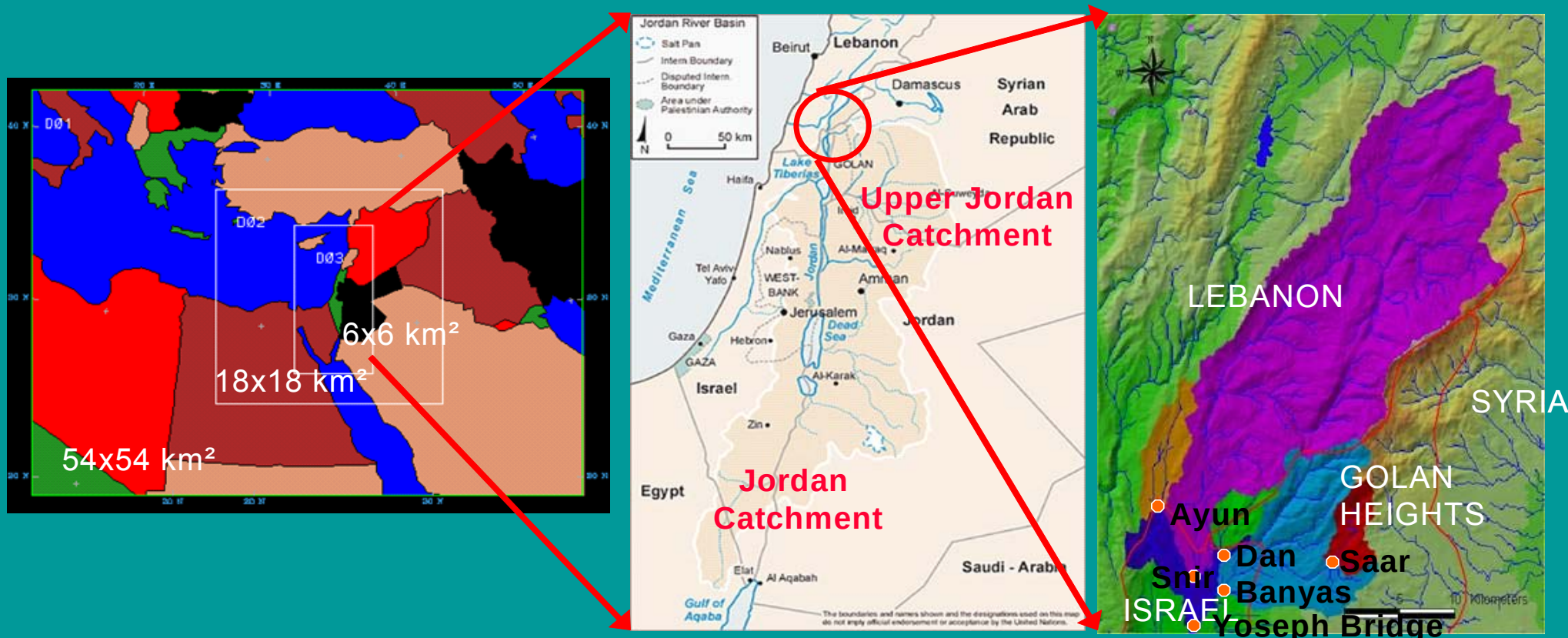
Difference of simulated yearly mean values between the future ECHAM4 scenario B2 (2070-2099) and the ECHAM4 control run (1961-1990) based on a grid size of 18km resolution



Difference of simulated yearly mean values between the future ECHAM4 scenario B2 (2070-2099) and the ECHAM4 control run (1961-1990) based on a grid size of 18km resolution

How does this atmospheric change translate into change in terrestrial water availability in the Upper Jordan Catchment?

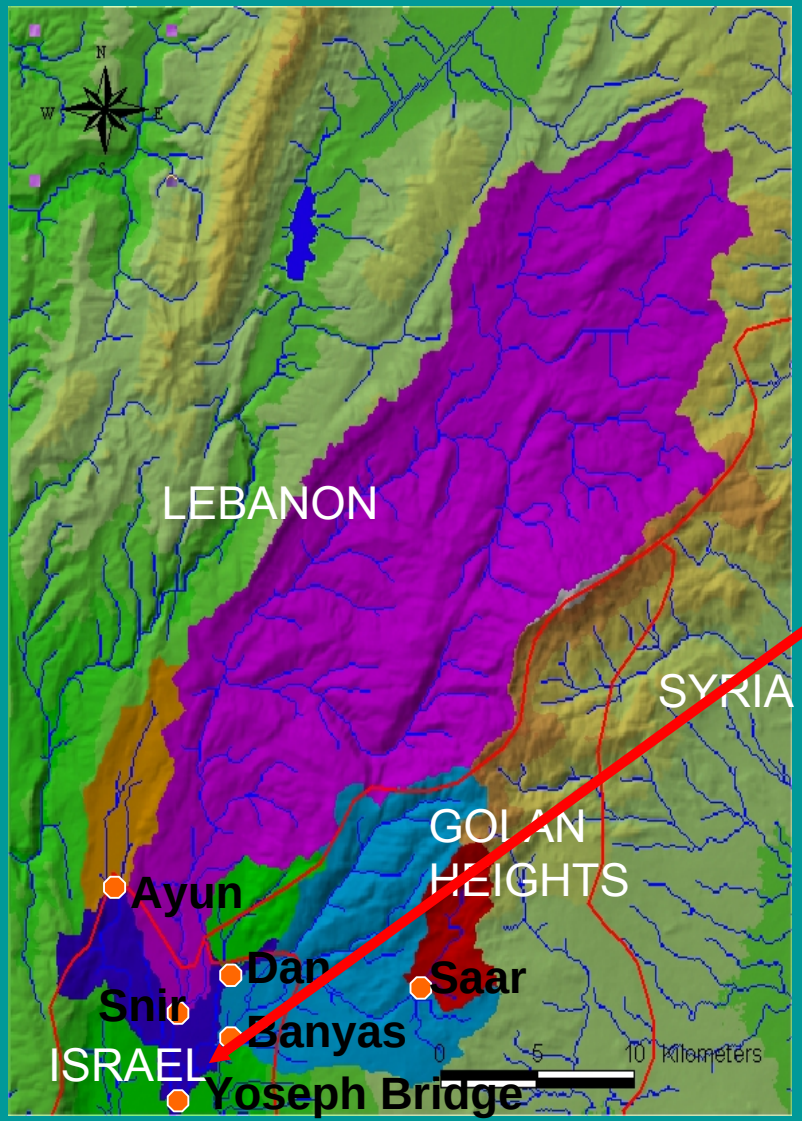
What is the Impact of Expected Atmospheric Change on Terrestrial Water Availability?

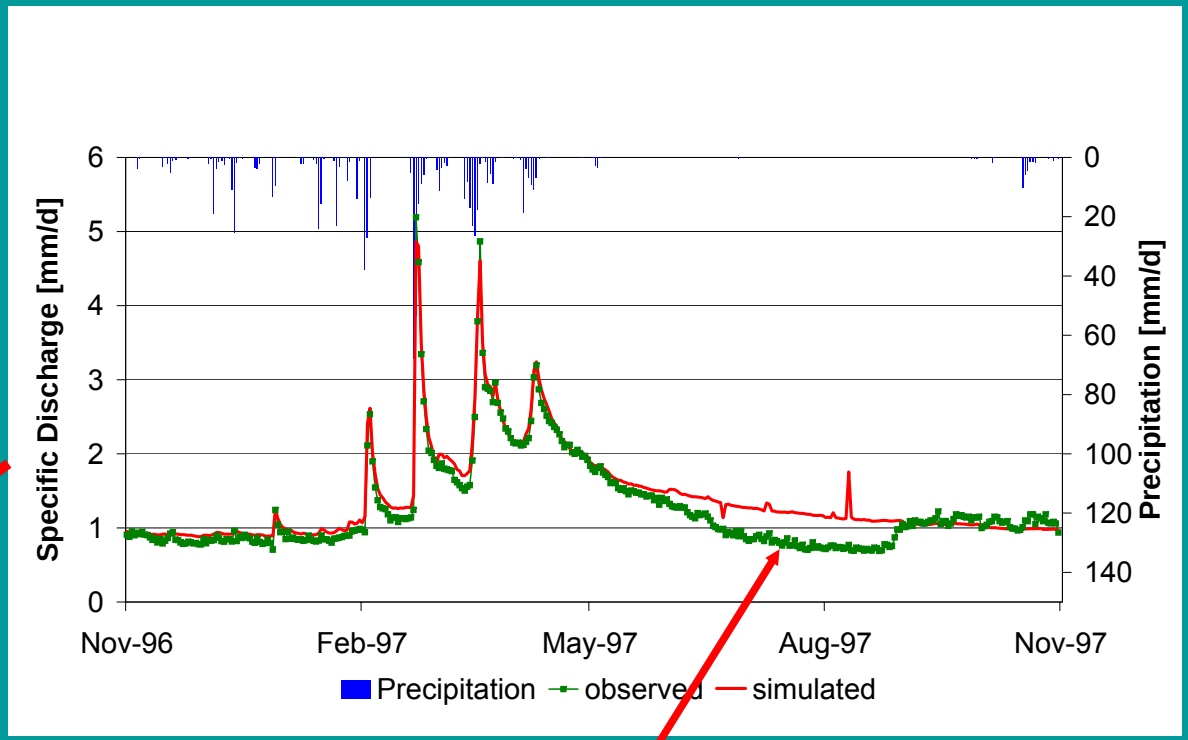


High resolution dynamical downscaling of global climate scenarios

Distributed hydrological modeling of surface and subsurface water balance in 90 m resolution

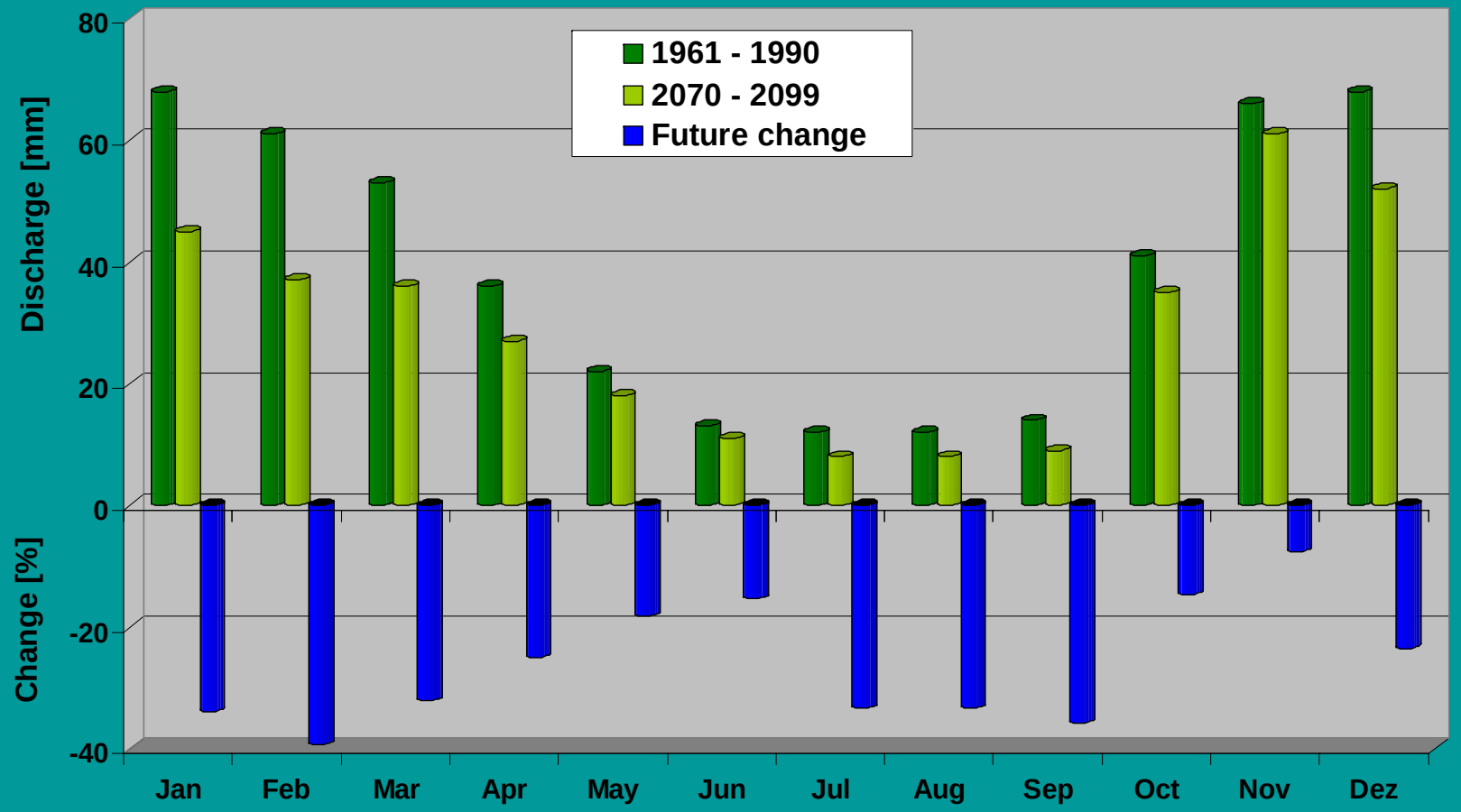
Selected Results Hydrological Modelling





Technically bypassed water not yet accounted for

Selected Results - Hydrological Modelling



Monthly mean discharge for the Upper Jordan Catchment
(control run and future scenario B2)

Summary & Conclusions

- Regional climate simulations indicate
  - decrease of annual precipitation up to 40%
  - increase of mean annual temperature up to 4°C
- First time that physically based distributed hydrological model is setup for Upper Jordan catchment
  - reasonable agreement between observed an simulated runoff in calibration period
- Next steps, e.g.
  - Simulation of different regional climate model scenarios (e.g. HADLEY, ECHAM4-A2)
  - Analysis of extreme events

Thank you for your attention

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