

Precipitation Monitoring and Future Precipitation Assessment Under Climate Change

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This presentation is linked to concept

**Development of regenerative water resources
in semi-arid regions**

**Methods and processes – synopsis of a package
solution**

by Dr. Günter Hahn
CEO Water Systems GmbH & Co. KG (i. GR)

28.3.2017, this conference

... a suggested project for Oman

And to

**Hydraulic Engineering Tools to
Model Flood Events and Water Intakes**

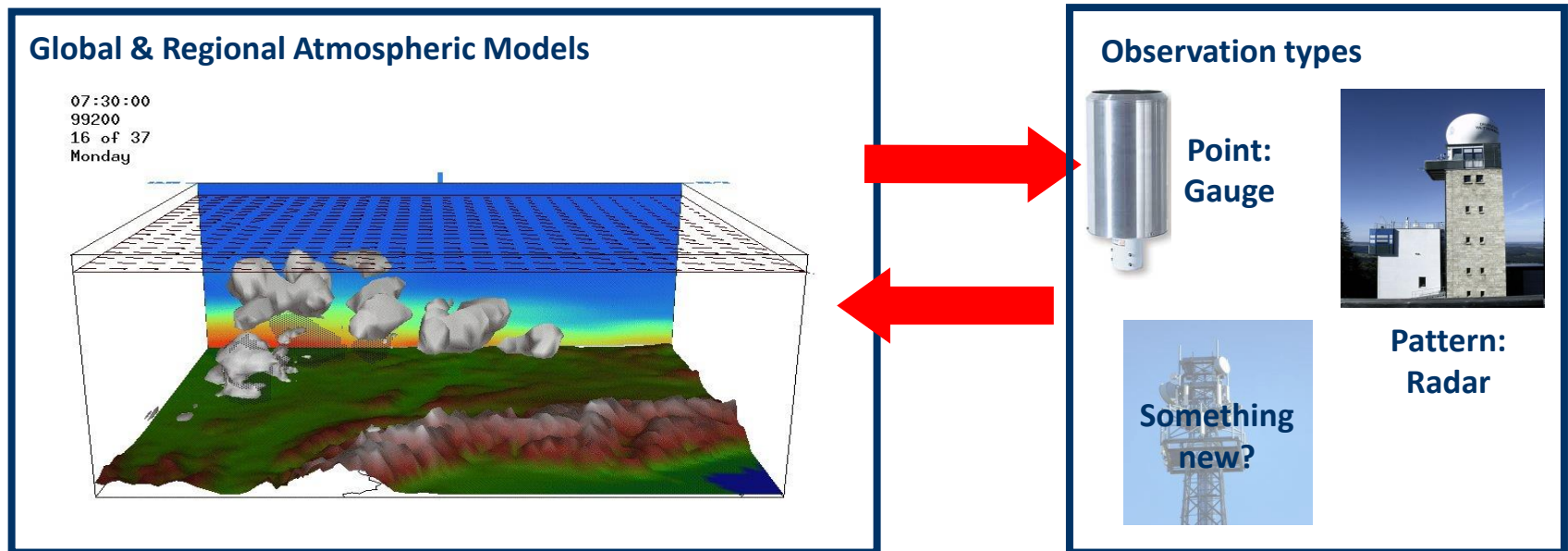
by Prof. Stephan Theobald
University of Kassel/Germany

30.3.2017, this conference

... a suggested project for Oman

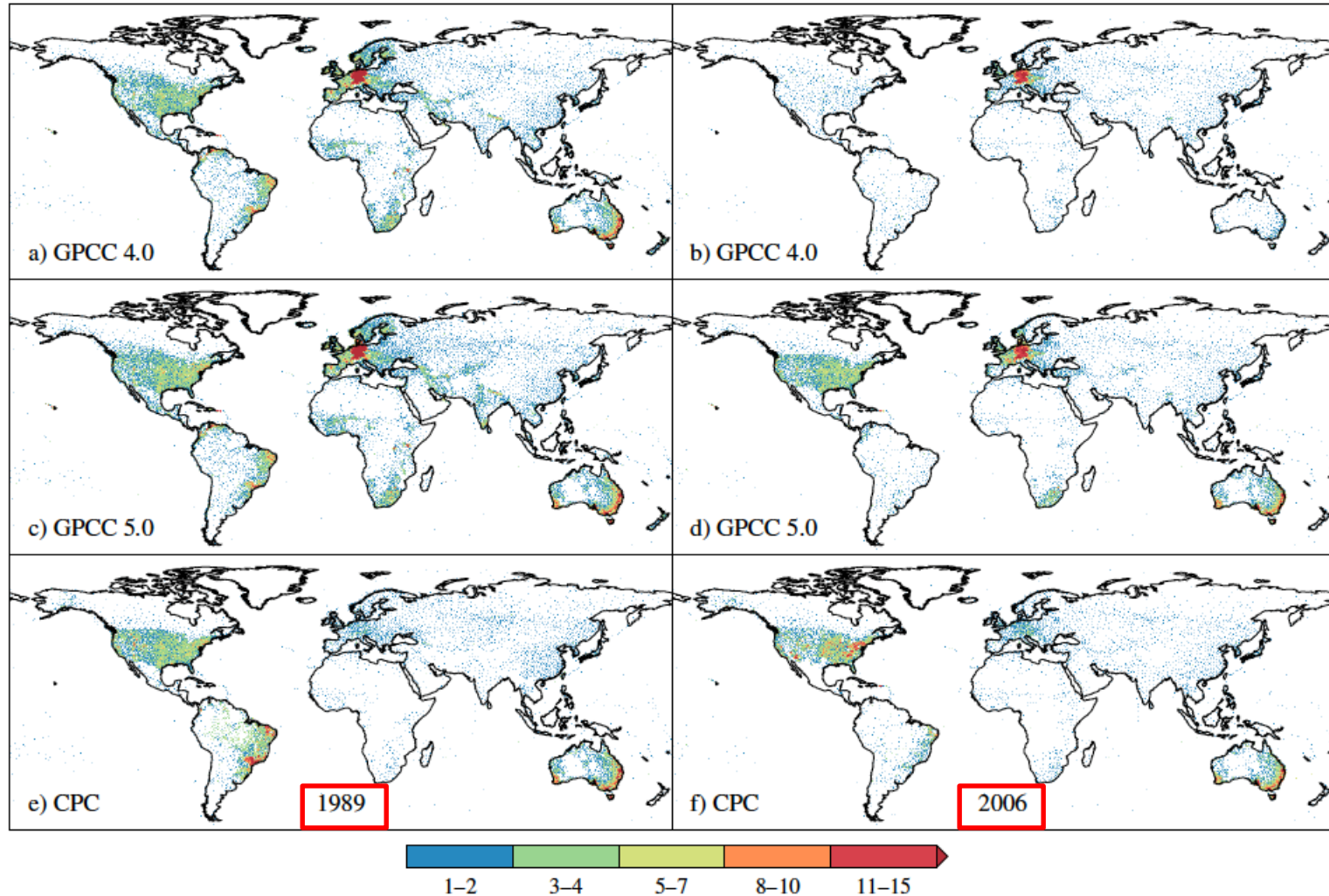
The Crux of Precipitation Quantification

- **Precipitation:** Crucial source of freshwater availability
- Derivation of **spatiotemporal rainfall fields** still highly **problematic**:
 - 1) High resolution regional climate modeling: extremely CPU intensive
 - 2) Limited observations: Gauges, Radar, satellites, ...
- **Expected future precipitation** crucial for **water management planning, investments & decision making**

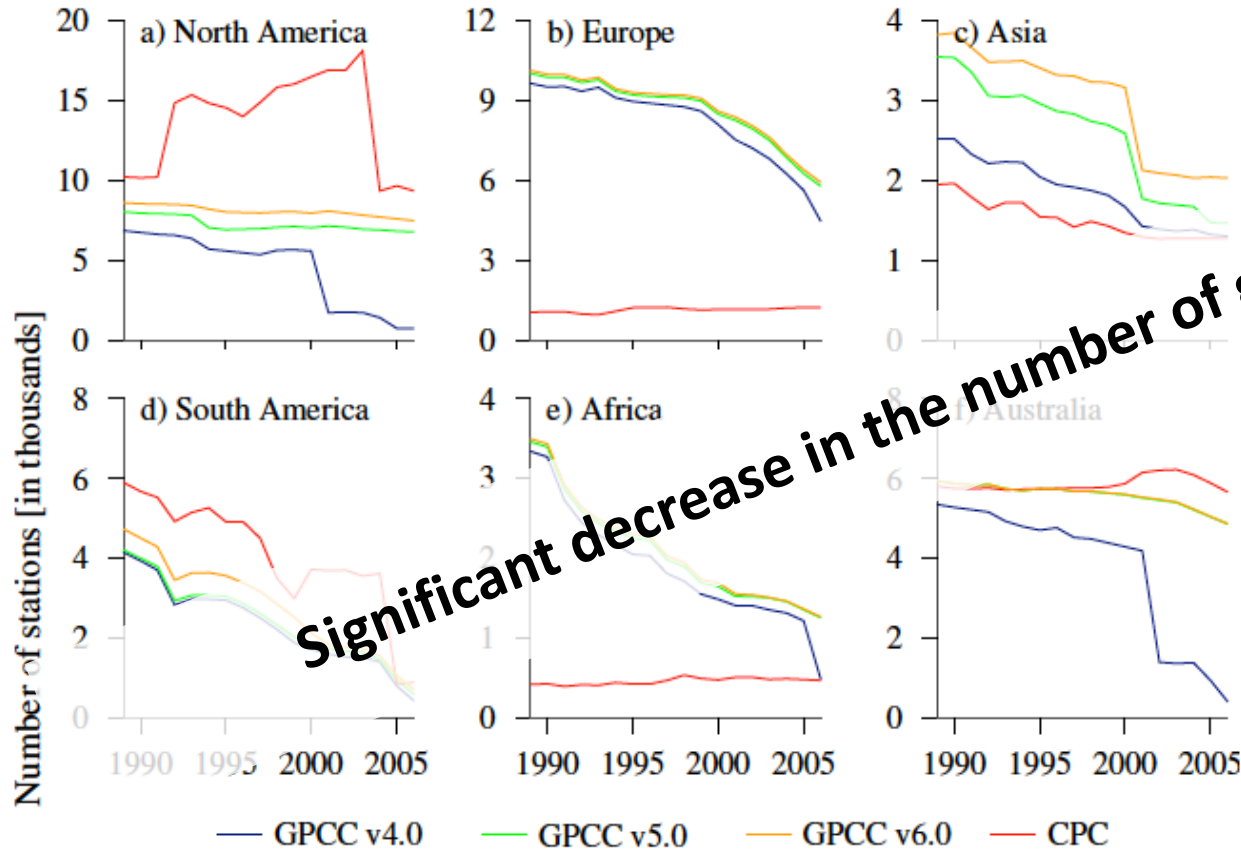


Rainfall Information Globally

Rainfall Gauges per Gridcell in Gridded Products

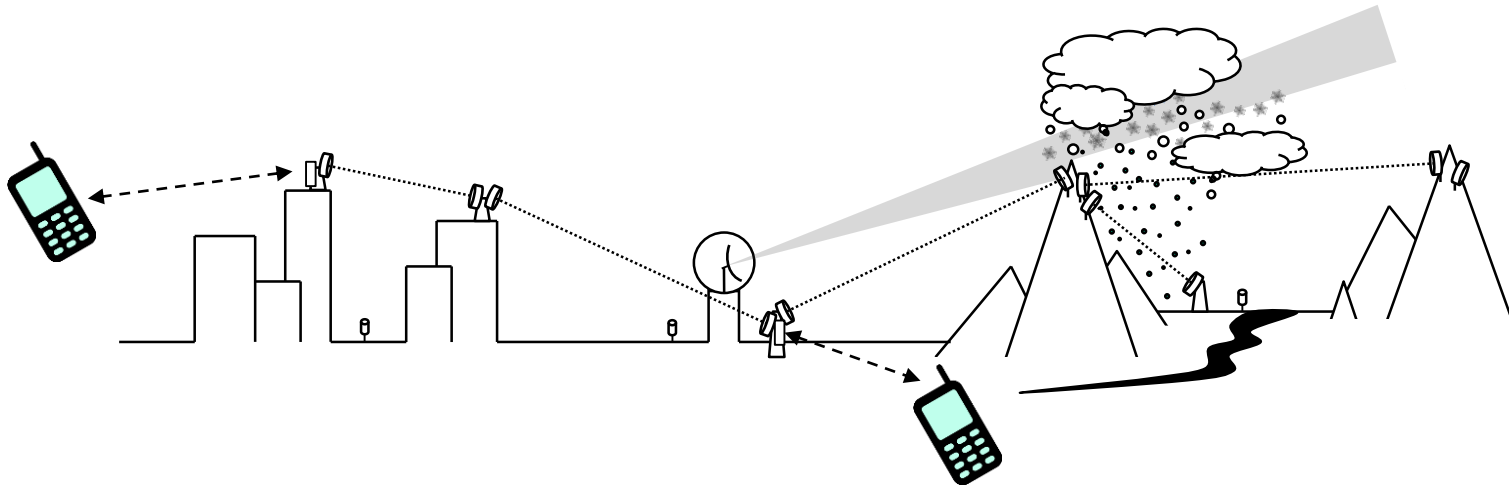





Significantly Varying Number of Original Data



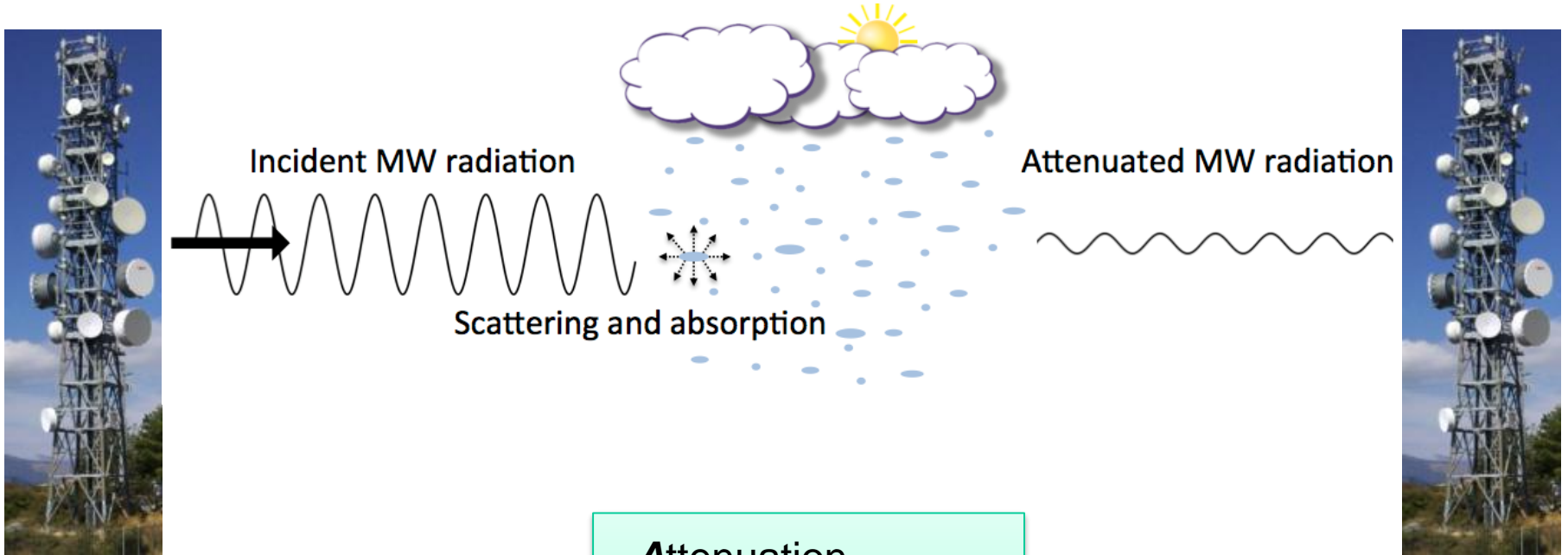
Continent	Area [10^6 km 2]
North America	19.3
Europe	5.7
Asia	37.4
South America	17.8
Africa	30.0
Australia	7.7

New: Commercial MW-links for Precipitation Quantification



-  Nearly linear $A-R$ relation
-  Line integral
-  Huge cost-free network

Physical Background: Attenuation Due to Rain

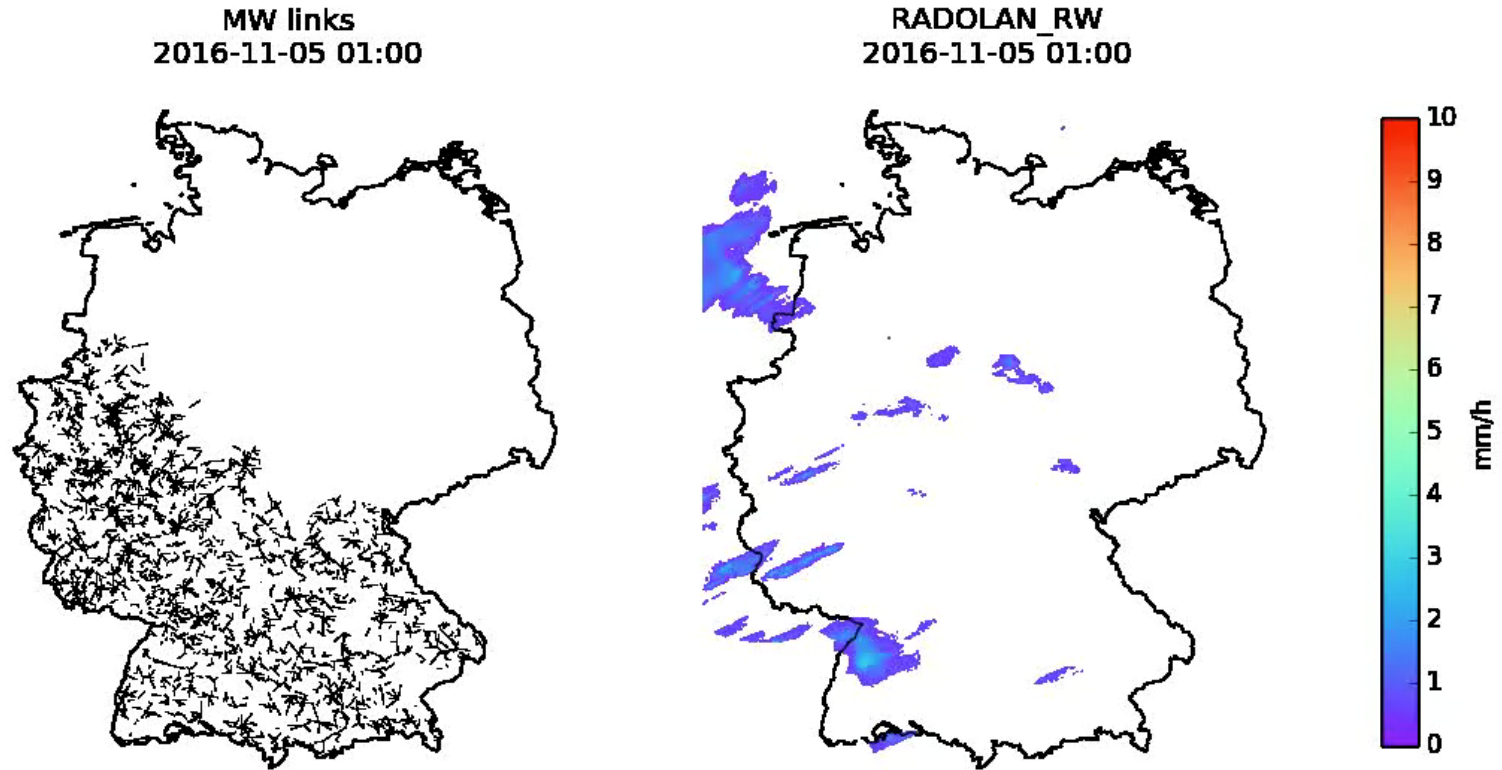


Attenuation

$$A = aR^b$$

Rainrate

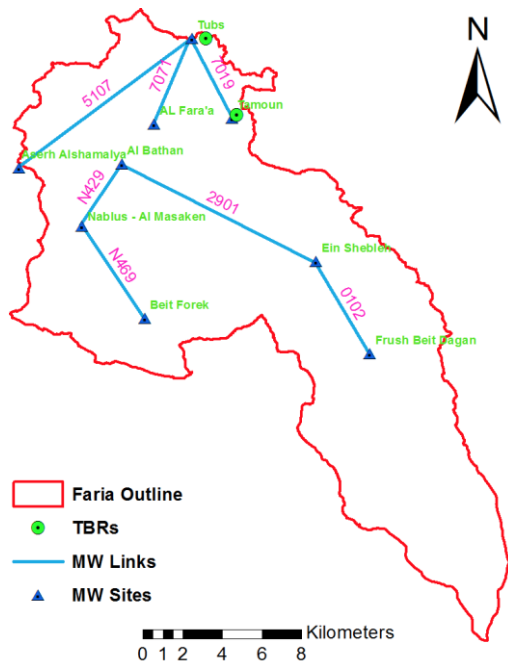
Recent Results for 3000 CMLs, Half of Germany



MW-link attenuation data
via cooperation with

ERICSSON 

First Analysis Palestine/Westbank: Wadi Faria



600 mm/a

100 mm/a



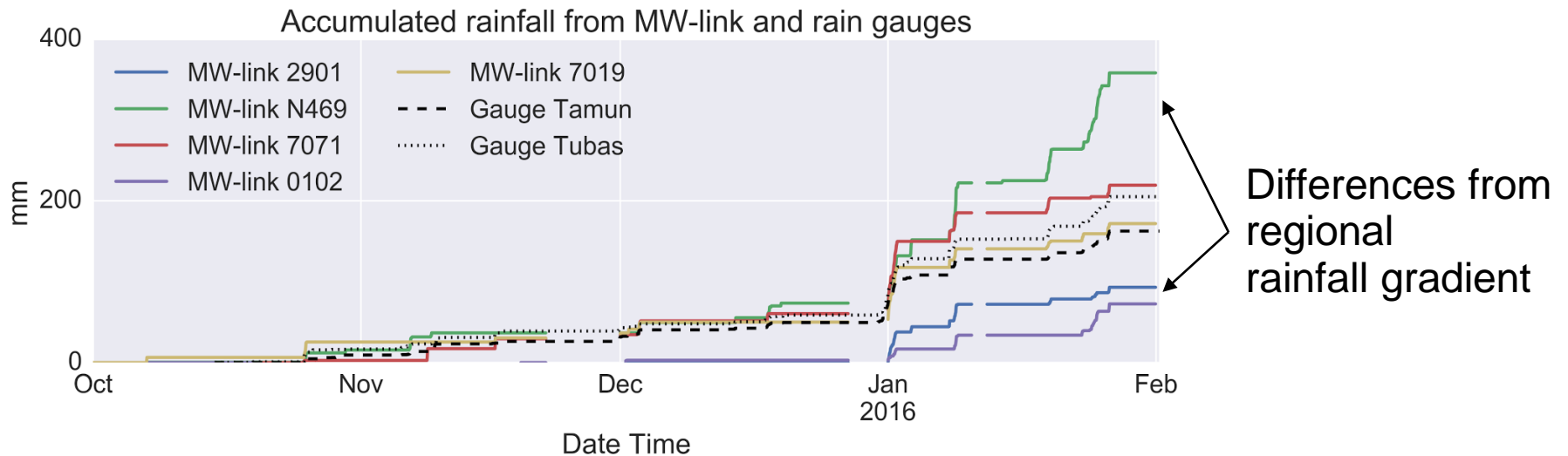
Wadi Faria:

- 7 Microwave links
- 2 Rain gauges
- Strong rainfall gradient

Nablus

Jordan river

First Analysis Palestine/Westbank: Wadi Faria



48 tipping buckets transferred and installed in Wadi Faria (November 2016)

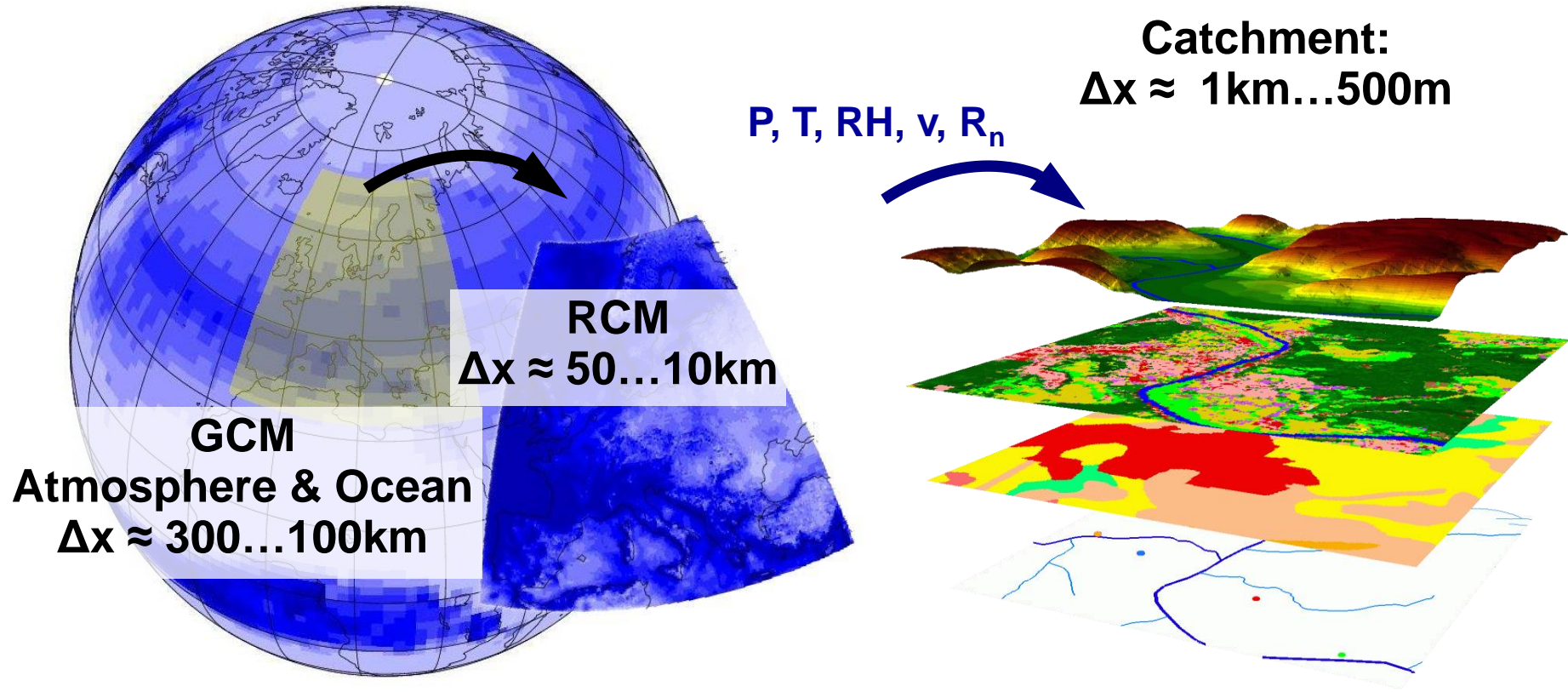
Expected Future Climate and Water Availability?

High Resolution Dynamical Downscaling of Climate Scenarios

Concept & Case Study Middle East



Coupled RCM-Hydrology Simulations for Middle East

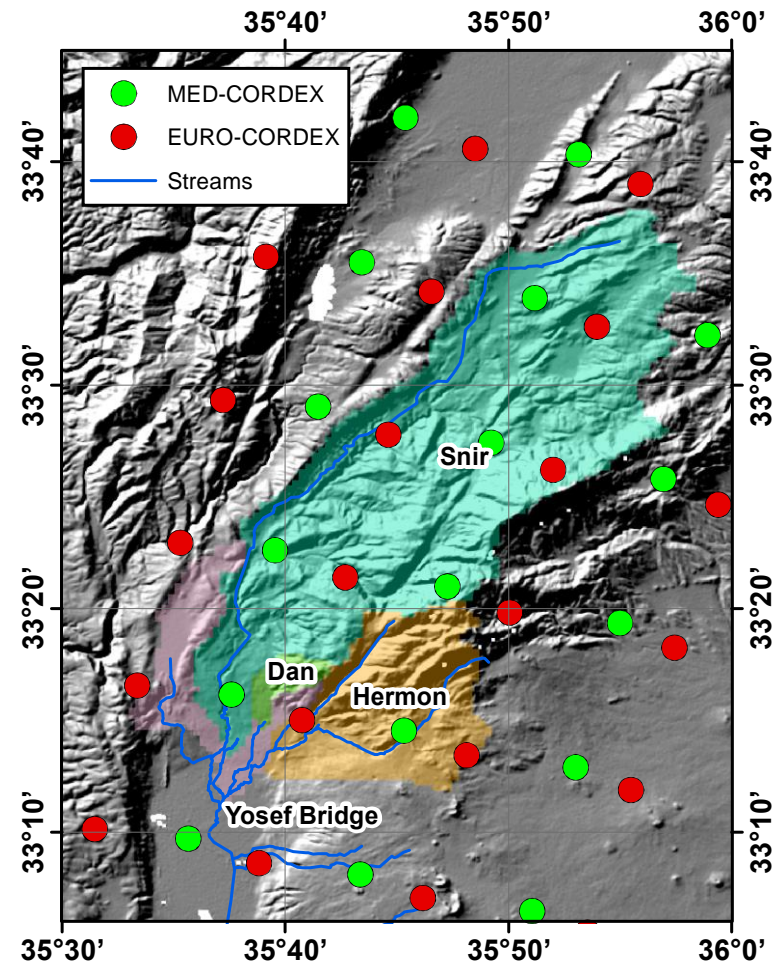


Mount Hermon

The Upper Jordan Catchment

- Complex terrain, partially karstic
- Outflow to Syria and Lebanon
- Water consumption
- Limited data

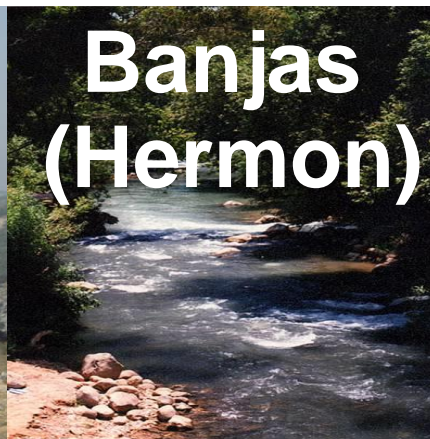
- Hydrology model
 - WaSiM (450 m, daily input)
- Input from CORDEX RCMs
 - CCLM/MPI-ESM-LR
 - RACMO22E/EC-EARTH
 - RCA4/HadGEM2-ES
 - WRF/IPSL-CM5A-MR
 - Aladin/CNRM



Golan



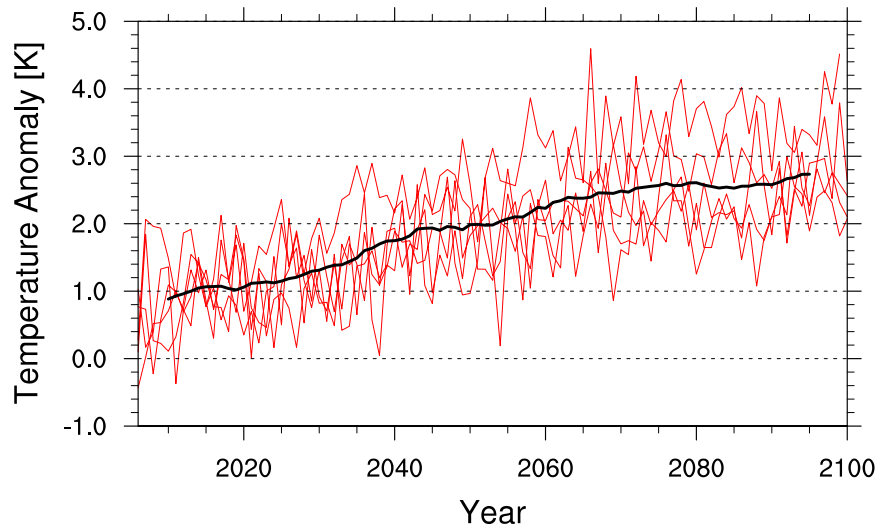
Banjas
(Hermon)



Upper Jordan



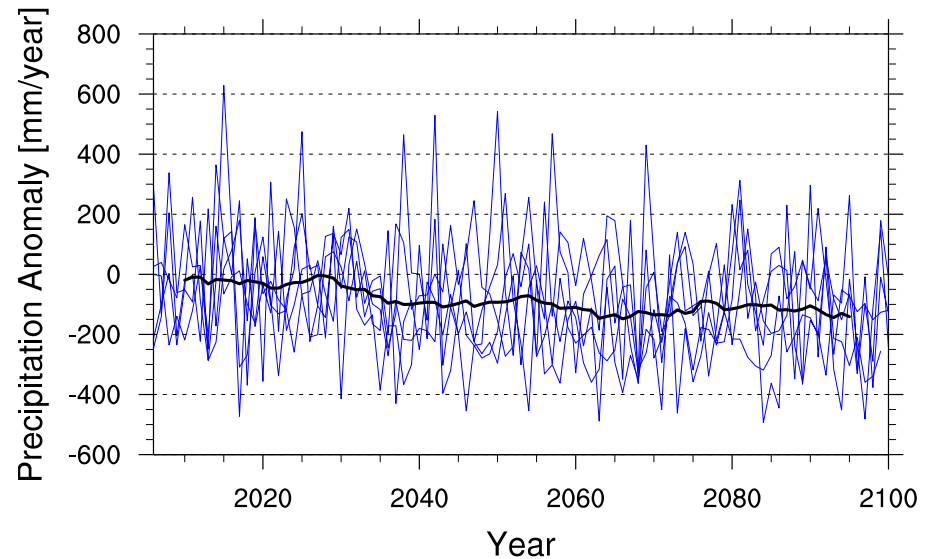
Simulated Future Temperature and Precipitation



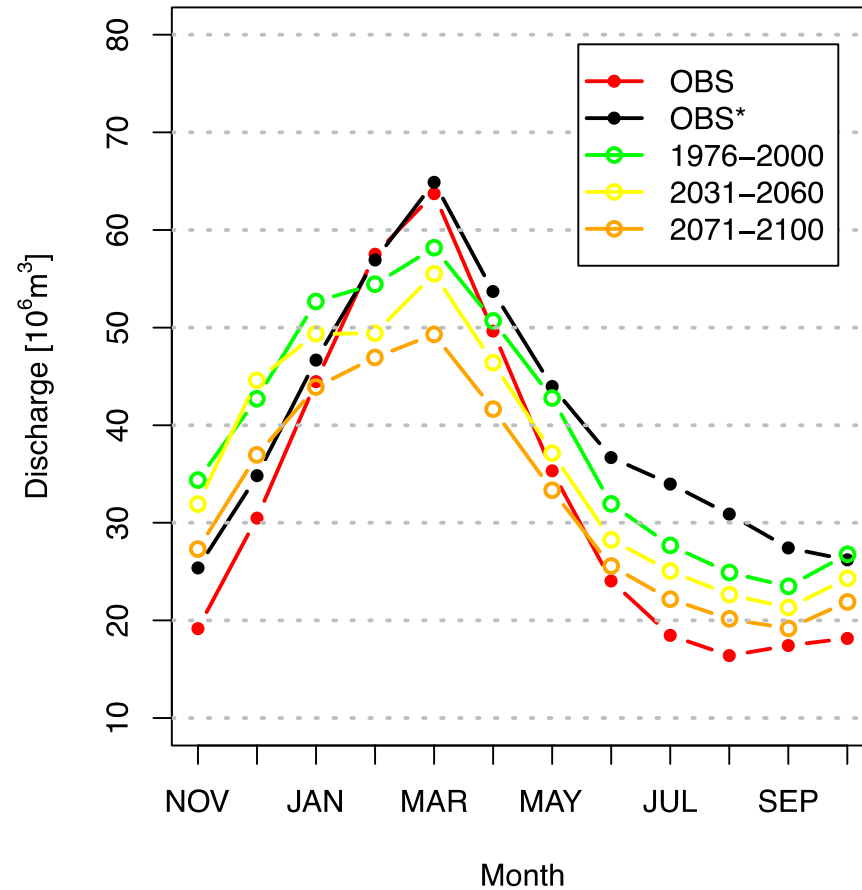
+2.6 K until 2100

-16.3 % precipitation (until 2060)

-22 % until (2100)



Discharge: Water Availability at Gauge Joseph's Bridge



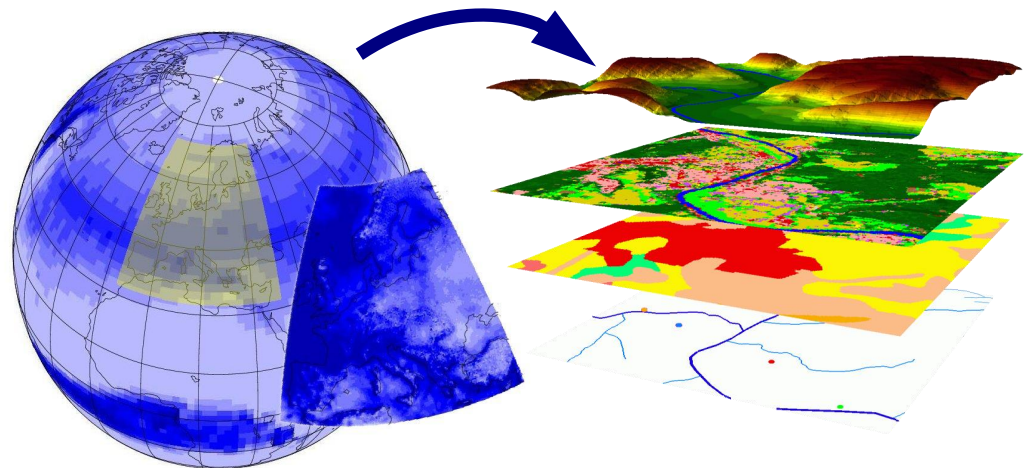
Ensemble mean:

-7.4 % less discharge until 2060

-17.5 % less discharge until 2100

Summary and Conclusions

- New method for **precipitation quantification via microwave links of commercial cellphone providers**: maintained network allows thousands of additional precipitation measurements countrywide
 - > **Application is ready for transfer to further regions, like *Gulf region***
 - > **Cooperation and commitment of cellphone providers?**
- Example for **impact of expected climate change on water availability in Middle East/Upper Jordan till 2100**
 - > **Methods available for similar investigations in the *Gulf region***





Thank You for Your Attention