Climate changes in the Mid-East and some Water Management lessons from GLOWA-Jordan River Project

Pinhas Alpert

**Department of Geosciences,
Faculty of Exact Sciences
Tel-Aviv University**

Part a:

Uncertainties in Regional Climate Predictions

Mid-East, Mediterranean in 21st Century

Part b:
An Integrated Approach to Sustainable Management of Water Resources under Global Change

Central Question:

How can the benefits from the region´s water be maximised for *humans and ecosystems* under global change?

Pinhas Alpert, Israeli coordinator

Project Head
Prof. Dr. Katja Tielboerger
University of Tübingen,
Germany

www.glowa-jordan-river.de

Federal Ministry
of Education
and Research

Outline

1. Global Uncertainty - Carbon dioxide expected to cross 400 ppm in 2016- 13 June news

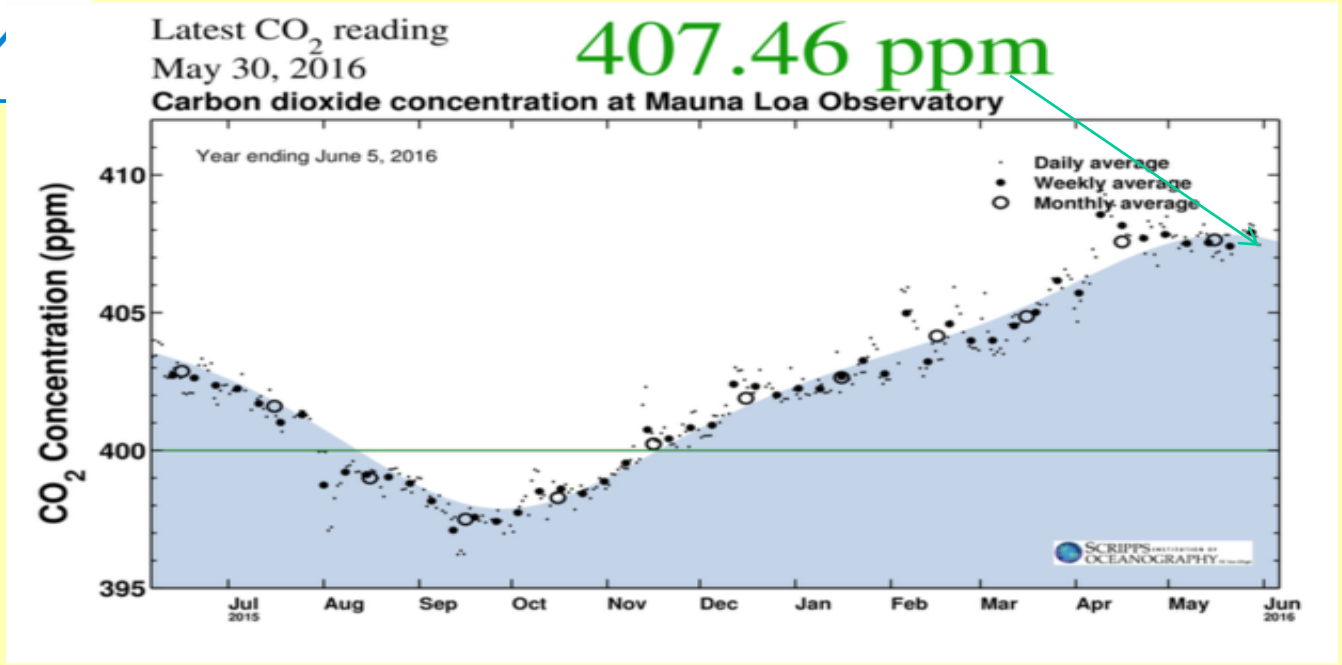
2. Why RCM Ensembles? RCM uncertainties

3. Global Ensemble for the E. Med: CMIP5 uncertainty

4. Cyclones Predictions: CMIP3 uncertainty

5. Observed Israel Rainfall Trends 1952-2014

Conclusions



Met. Off. used a seasonal climate model to predict sea-surface temperatures in the Eastern Pacific - where the El Niño shows itself most obviously - and then linked these to a statistical relationship with CO2 to generate levels would probably look like in 2016 . This gives **a 2016 average of 404.45, with a September low of 401.48 +-0.53ppm. Team** already had

GLOWA

une 2016 13 BBC with a Met office announcement

http://www.bbc.com/news/science-environment-36521075

Carbon dioxide spike expected in 2016

13 June 2016 Last updated at 16:24 BST

Twenty-sixteen will very likely mark the **first time the atmospheric concentration of CO2, as measured atop Hawaii's famous Mauna Loa volcano, stays above 400 parts per m**

study finds.

Why Ensembles?

Uncertainty in IPCC scenarios
Uncertainty in Global models (GCMs)
Uncertainty in Regional models (RCMs)

In the memory of our beloved friend
and colleague
Rana Samuels-Ofran

who will always be missed

Academic work of Rana
at Tel-Aviv University

GLOWA-2

- 4 climate models (18-25 km horizontal resolution)
  - Japanese Met Office 20km
  - ECHAM-RegCM
  - ECHAM-MM5 Run 1
  - HADLEY-MM5 Run 1
- Future Scenario Used: SRES A1B scenario
- Observed Data is taken from 13 Stations in Israel

Ensemble of High-Resolution Climate Runs (RCM)

Rainfall Parameters

- Amounts:

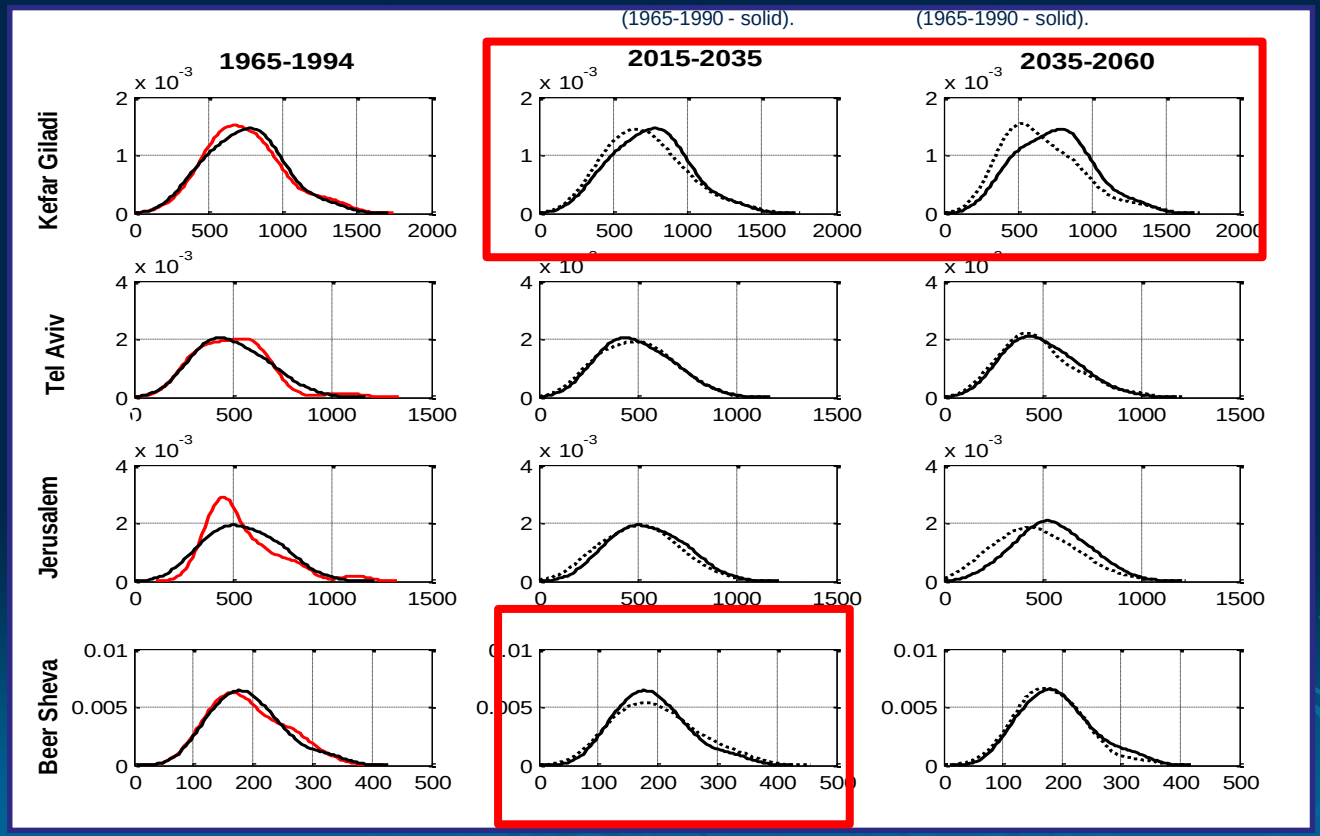
  Total yearly rainfall in mm

- Wet Spells:

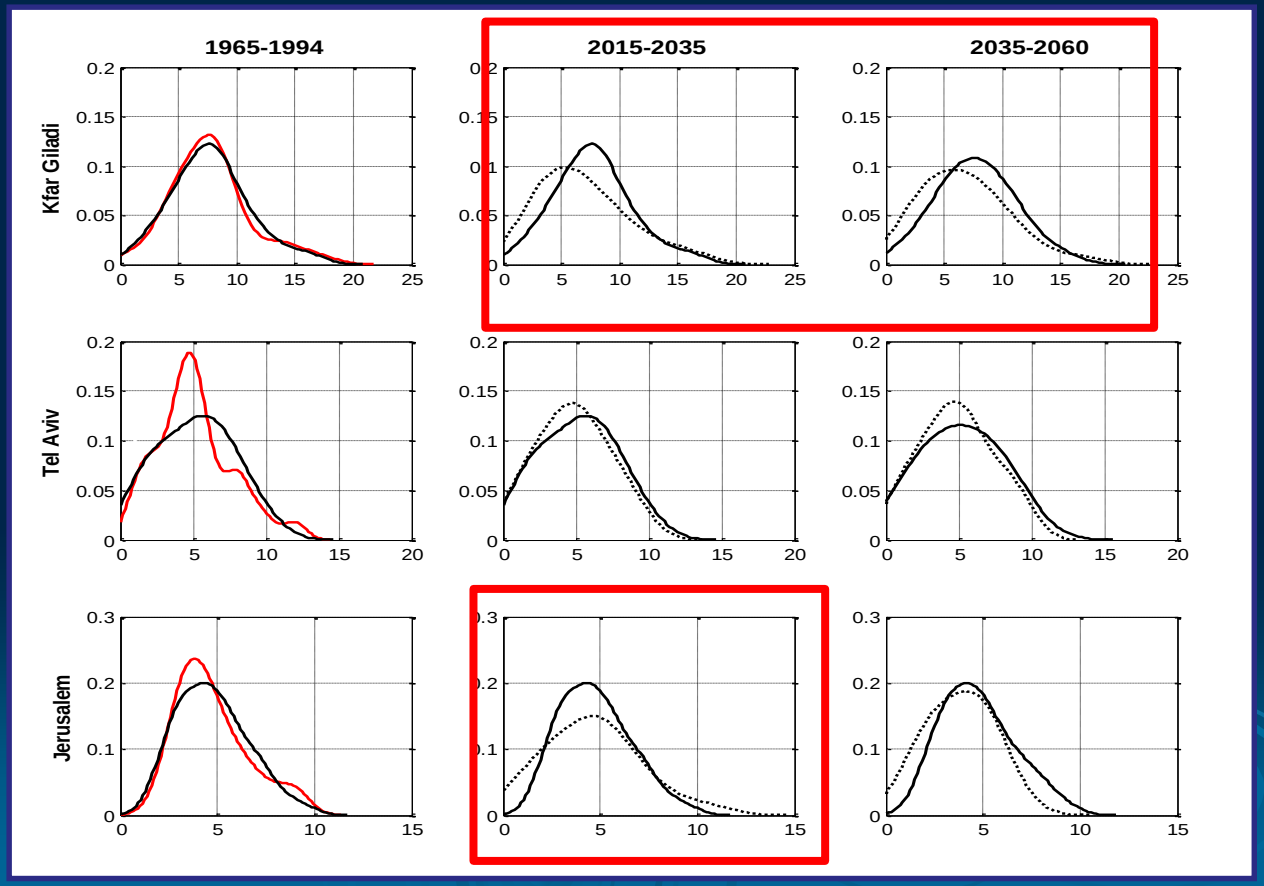
  The number of three day wet spells within a wet season

R. Samuels, M. Harel and P. Alpert, "A new methodology for weighting high resolution model simulations to project future rainfall in the Middle East", Climate Research, doi: 10.3354/cr01147, 57, 51–60, 2013.

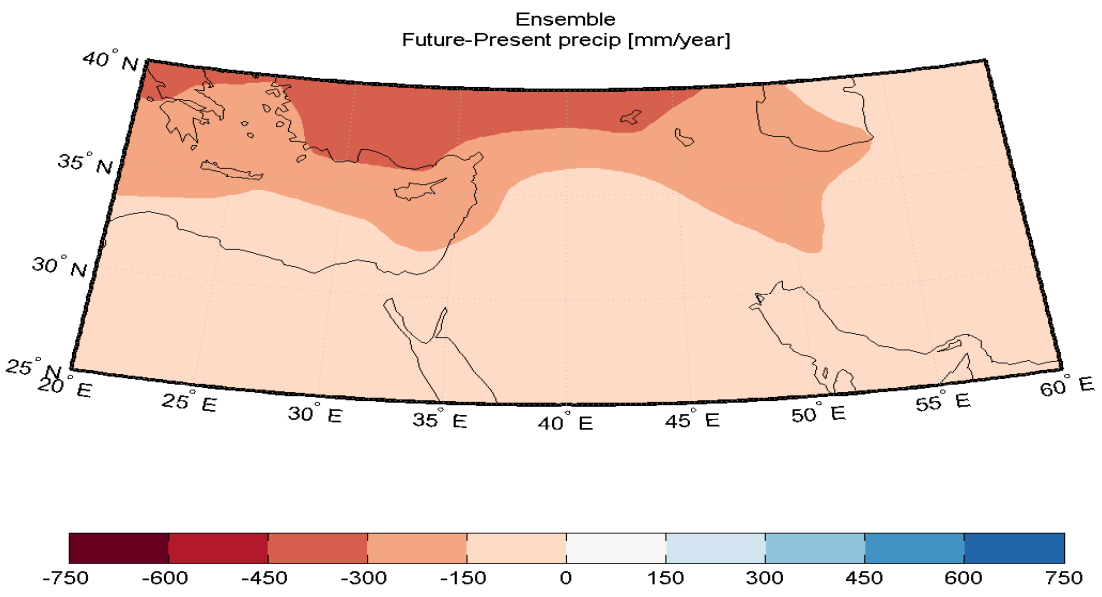
Change in JSD calculated PDF over time for Average Annual Amounts



Change in JSD calculated PDF over time for Number of Wet Spells



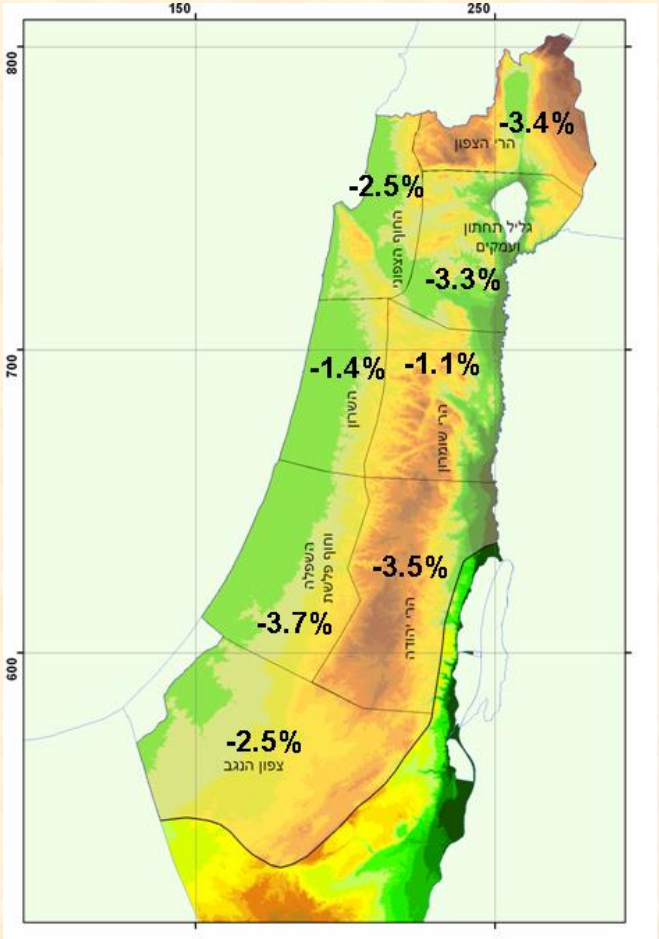
Future-Present [mm/year]



Observed Precipitation Trends in Israel during

1975-2010 &

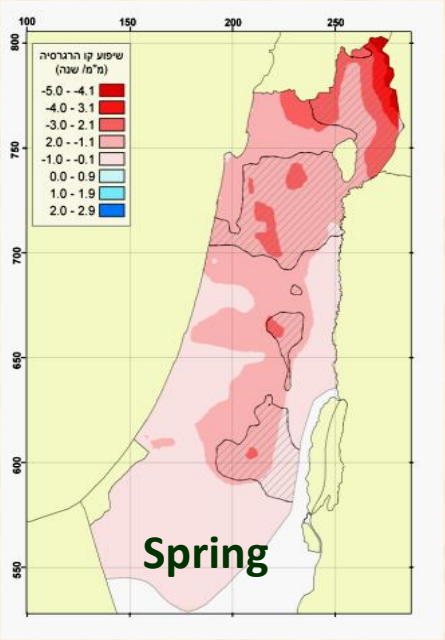
1952 – 2015

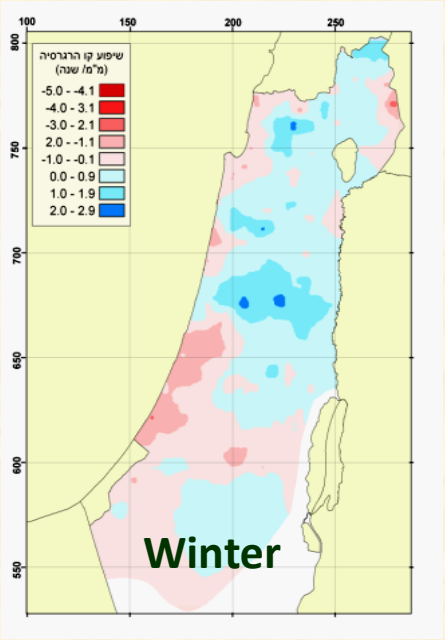


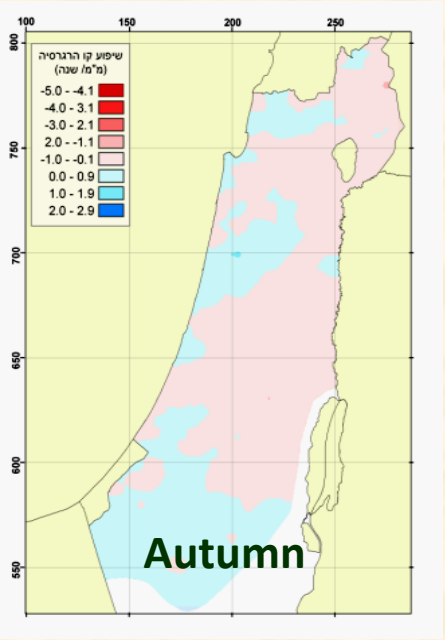
Linear Annual rainfall trends in sub-regions (%/decade) 1975-2010 Trends-not significant

B. Ziv, H. Saaroni, R. Pargament T. Harpaz and P. Alpert, "Trends in Rainfall Regime over Israel, 1975-2010, and their Relation to the Variations in the Synoptic Systems and Large-Scale Oscillations", For a Special Issue on The climate of the Mediterranean region: recent progresses and climate change impacts in the Regional Environmental Changes Journal, DOI 10.1007/s10113-013-0414-x, 2013.

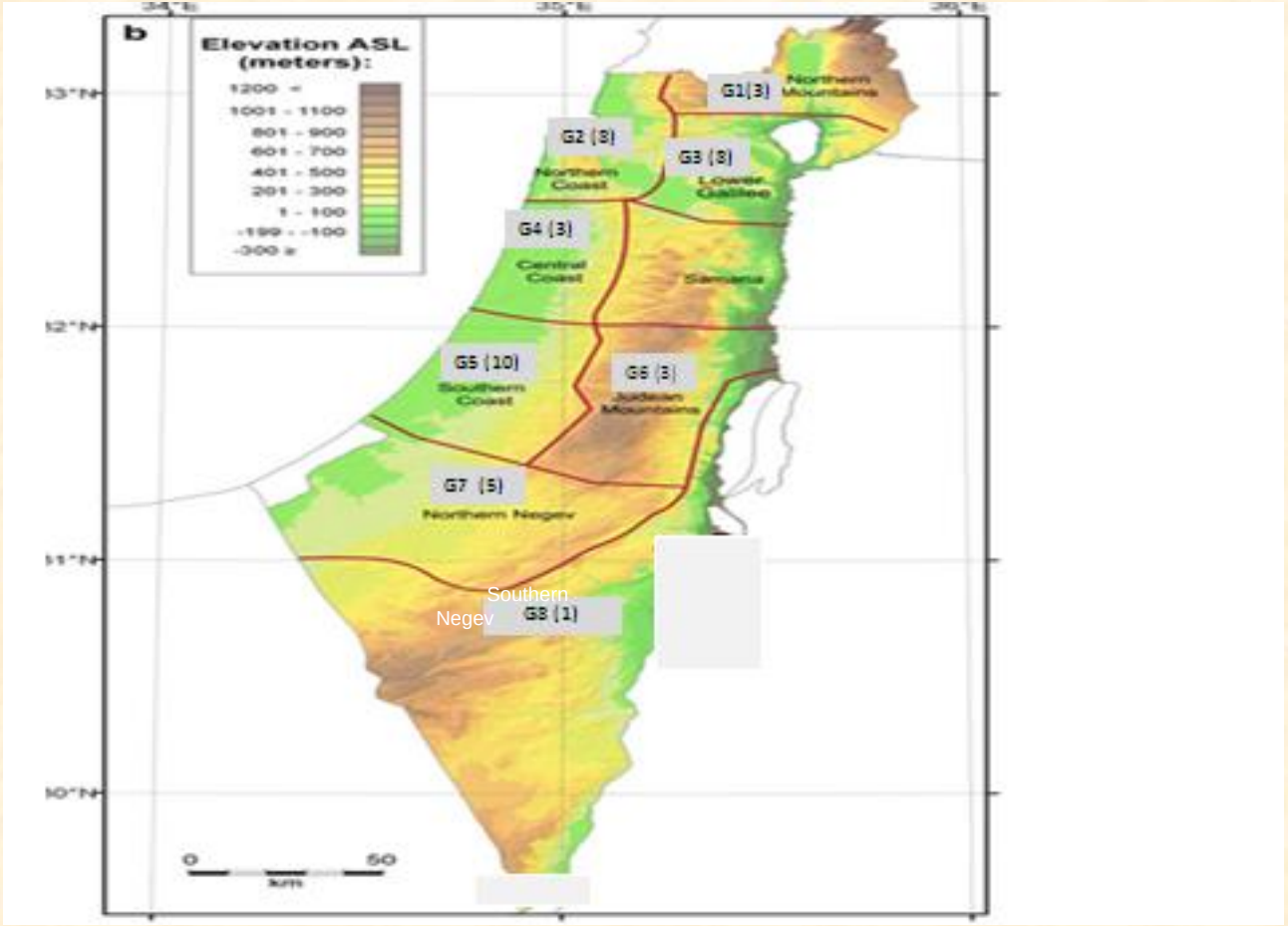
Geographic distribution of Rainfall Trends in 3 seasons

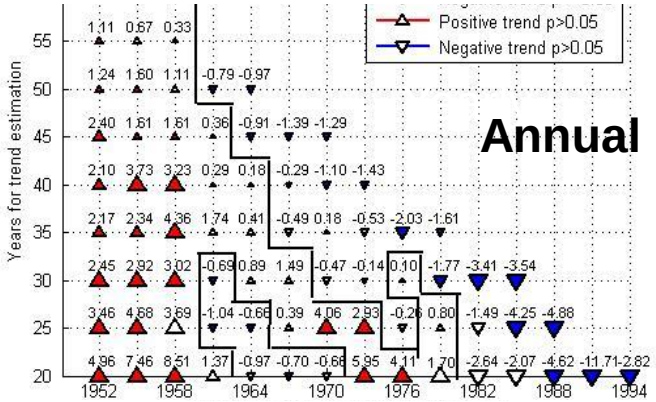


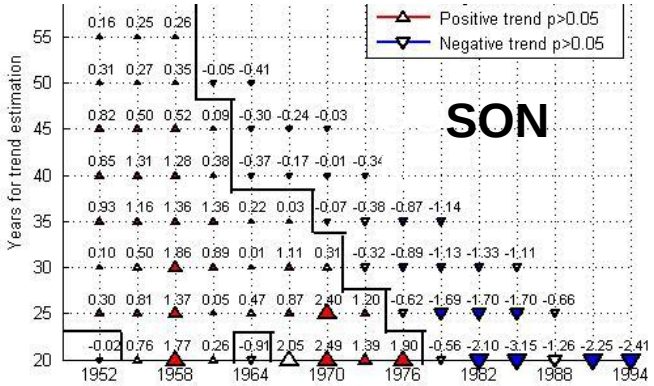


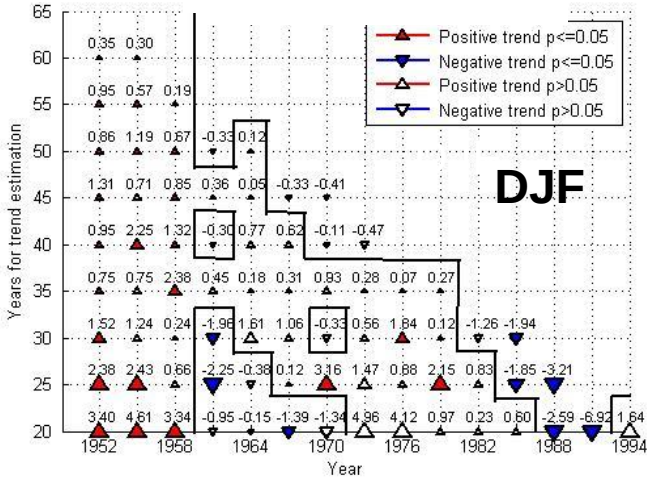


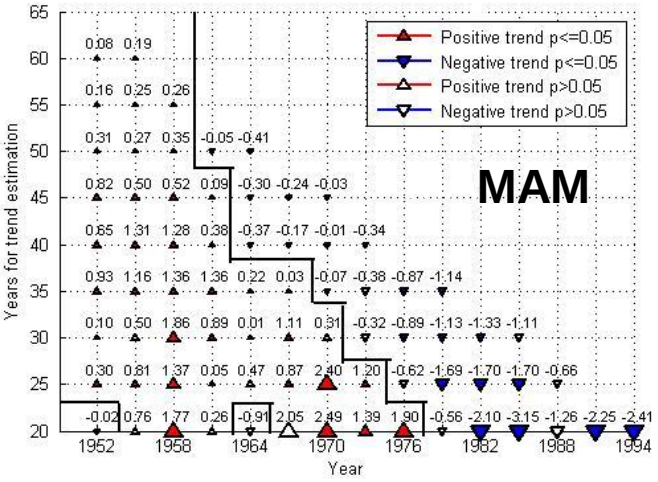
Spring- rainfall drops


b
Elevation ASL (meters):
1200 <
1001 - 1100
801 - 900
601 - 700
401 - 500
201 - 300
1 - 100
-199 - -100
-300 >
G1(3)
Northern Mountains
G2 (3)
Northern Coast
G3 (3)
Lower Galilee
G4 (3)
Central Coast
Samaria
G5 (10)
Southern Coast
G6 (3)
Judean Mountains
G7 (5)
Northern Negev
Southern Negev
G8 (1)
13°N
12°N
11°N
10°N
0
50
km


Annual
Positive trend p>0.05
Negative trend p>0.05
Years for trend estimation


SON
Positive trend p>0.05
Negative trend p>0.05
Years for trend estimation


DJF
Positive trend p<=0.05
Negative trend p<=0.05
Positive trend p>0.05
Negative trend p>0.05
Years for trend estimation
Year


MAM
Positive trend p<=0.05
Negative trend p<=0.05
Positive trend p>0.05
Negative trend p>0.05
Years for trend estimation
Year

Main Coclusions

- 2016- 1st year CO_2 to exceed 400 ppm the entire year
- Numbers of cyclones across the whole Mediterranean drop; it is consistent and includes both periods of mid & end 21st Century. Also, intensity of cyclones drop
- Large standard deviations among the 15 CMIP3 & 23 CMIP5 models
- Portrait Analysis of CMIP5 show: Total Precipitation decreases (2020-2049) by about 10-20%; some extreme indicators increase e.g. Consequtive dry days (CDD)
- Spring & autumn rainfall dropped in last 50 y

GLOWA – Jordan River

Part b:

An Integrated Approach to Sustainable Management of Water Resources under Global Change

Central Question:

How can the benefits from the region´s water be maximised for *humans and ecosystems* under global change?

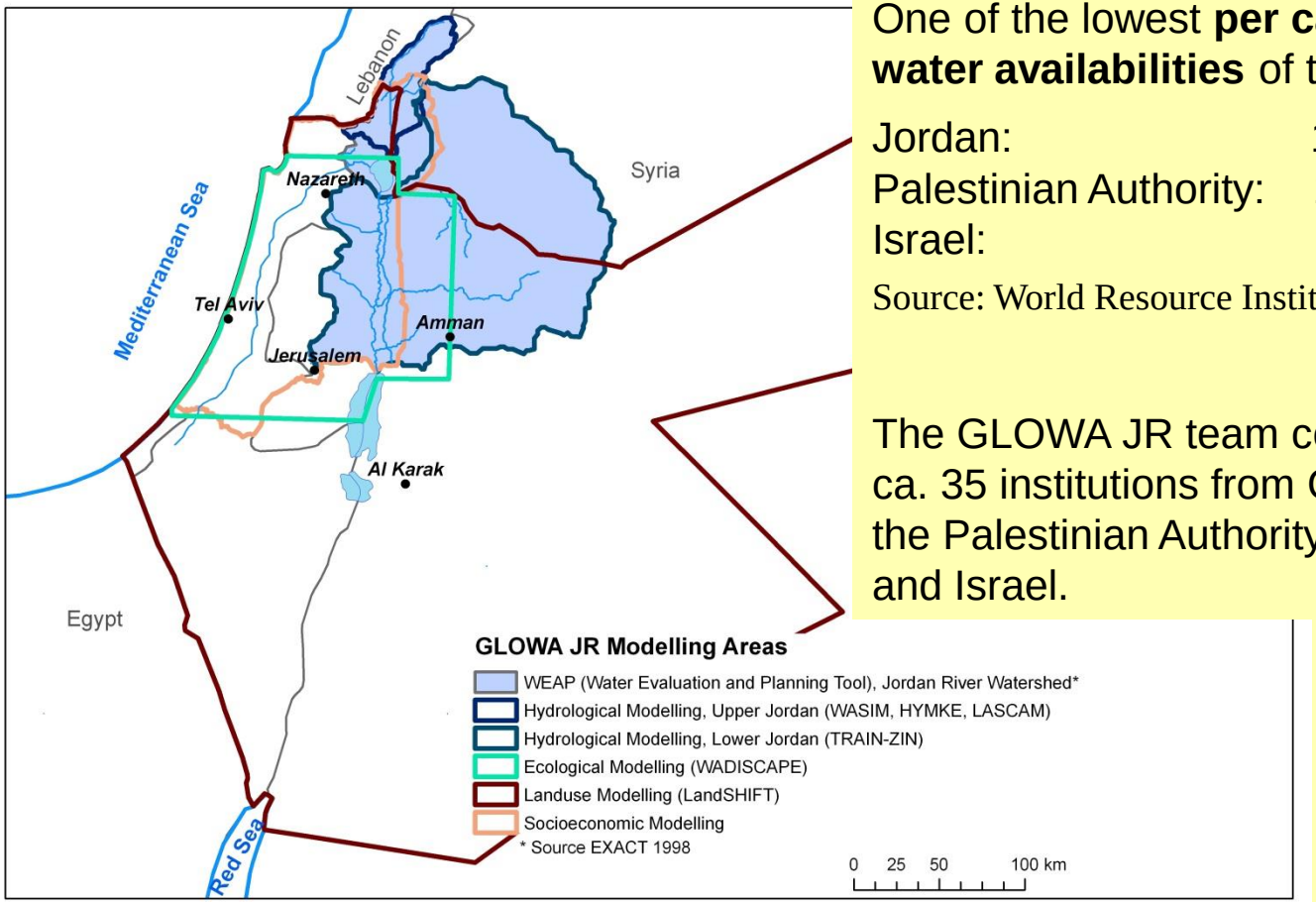
Pinhas Alpert, Israeli coordinator

Project Head
Prof. Dr. Katja Tielboerger
University of Tübingen,
Germany

www.glowa-jordan-river.de

Federal Ministry
of Education
and Research

GLOWA JR Region & Team



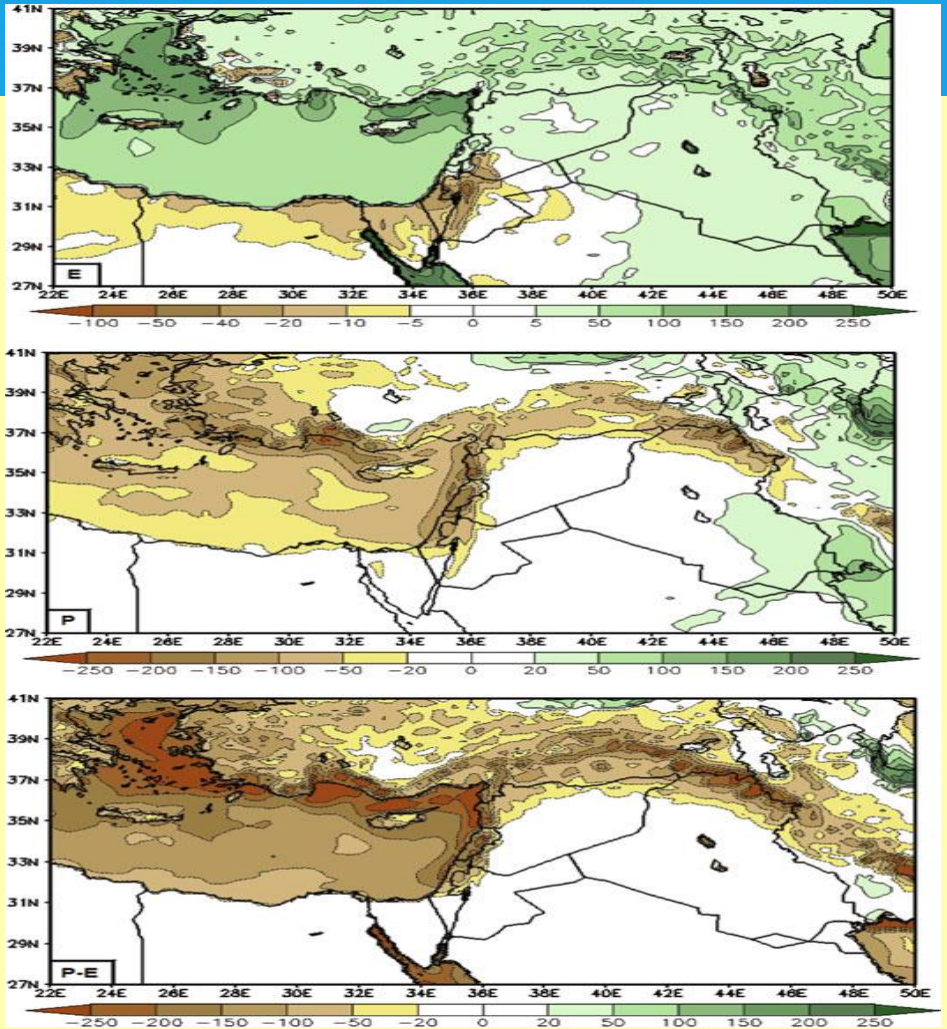
One of the lowest **per capita water availabilities** of the world:

Jordan:	148 m³/a
Palestinian Authority:	203 m³/a
Israel:	240 m³/a

Source: World Resource Institute 2007

The GLOWA JR team consists of ca. 35 institutions from Germany, the Palestinian Authority, Jordan and Israel.

. Alpert, F. Jin and A. Kitoh, "The Projected Death of the Fertile Crescent", Chapter 9 in the book "A World after Climate Change and Culture-Shift", Jim Norwine Editor, Springer, pp. 193-204, 2013.



Difference of seasonal (October-April) total evaporation (E), precipitation (P), and precipitation minus evaporation (P-E) between the future (2075 to 2099) and current (1979 to 2007)

Goal

Provide *scientific support* for improved Integrated Water Resource Management (IWRM) under global change conditions.

Key Questions

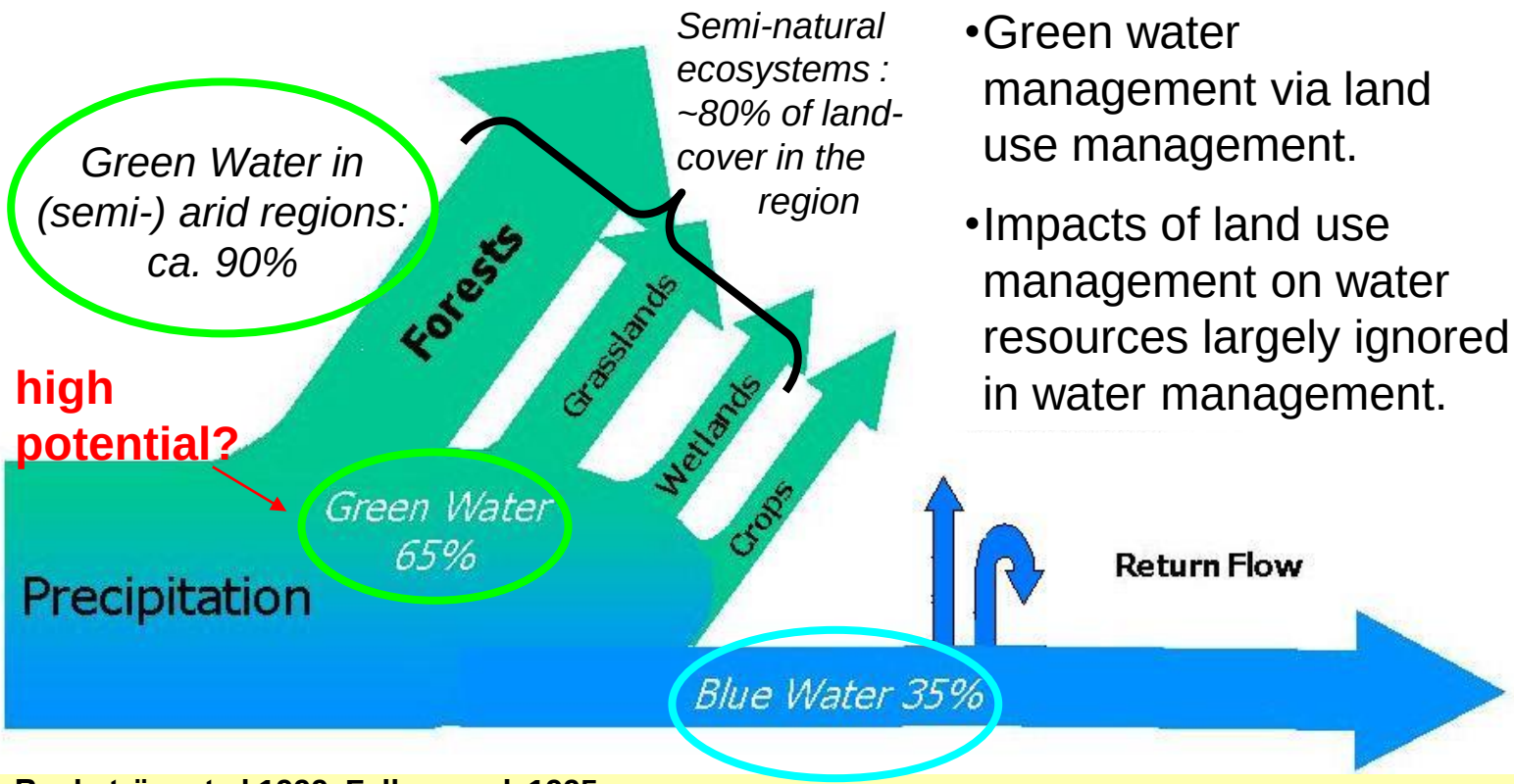
How can various **„new“ BLUE WATER** sources contribute to future water resource needs?

How can **land use** planning, i.e. **GREEN WATER management**, become an integral part of water management?

What will be the effect of **CLIMATIC EXTREMES** on the regional water balance and sustainable management of water resources?

Why the Green-Blue Water Approach?

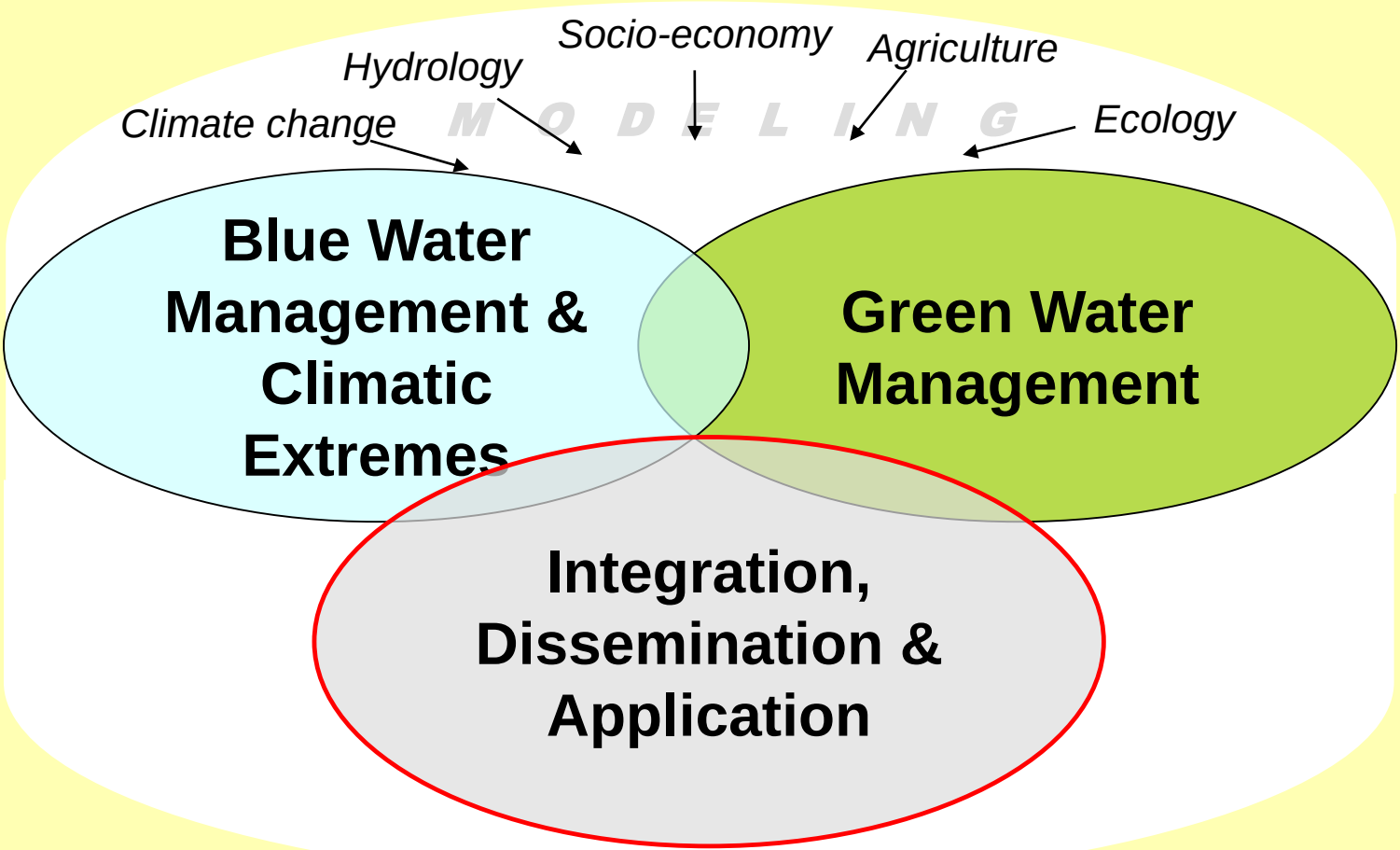
Green-blue water globally



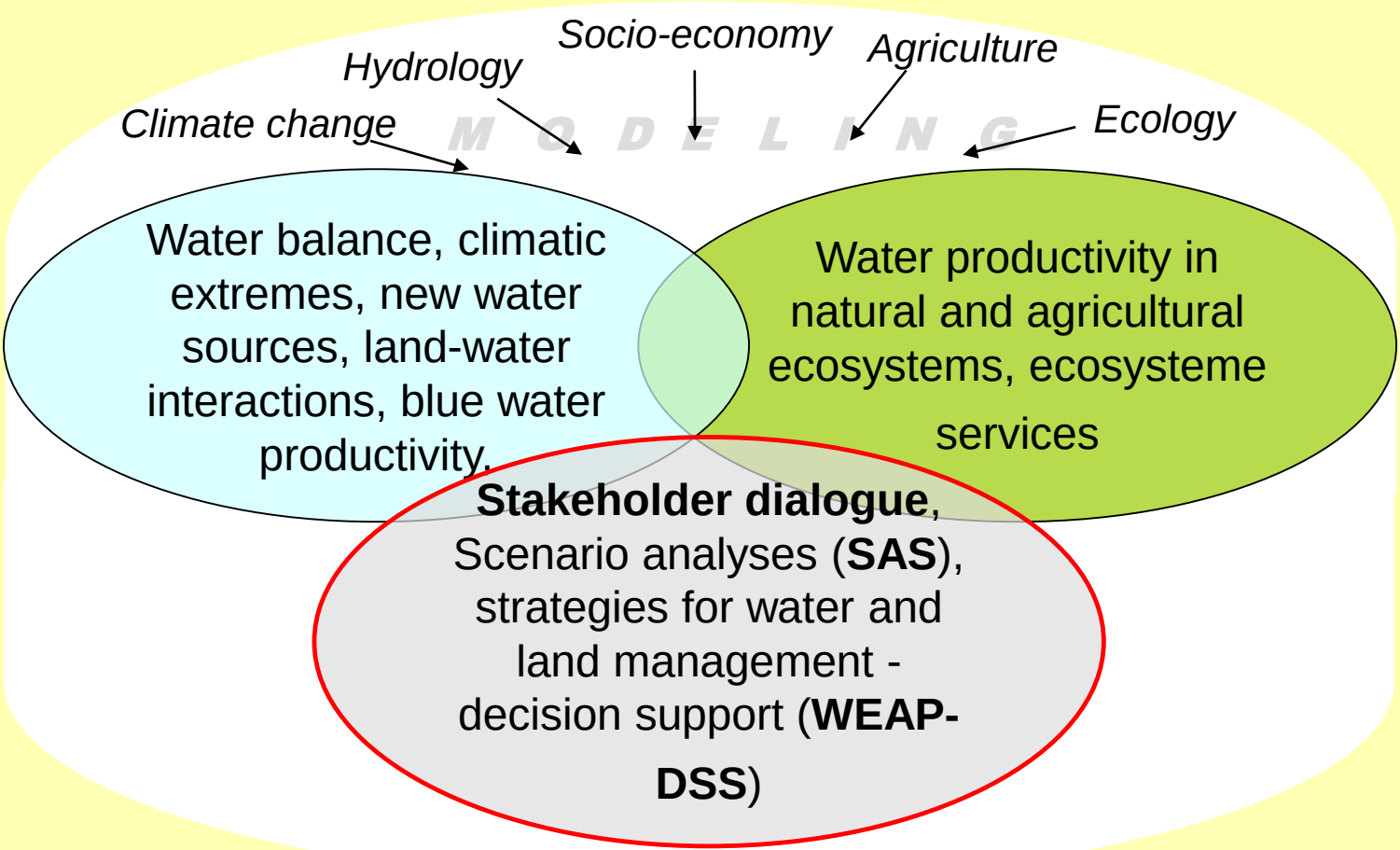
- Green water management via land use management.
- Impacts of land use management on water resources largely ignored in water management.

Rockström et al 1999, Falkenmark 1995

Structure


Socio-economy
Hydrology
Agriculture
Climate change
MODELING
Ecology
Blue Water Management & Climatic Extremes
Green Water Management
Integration, Dissemination & Application

Structure


Socio-economy
Hydrology
Agriculture
Climate change
Ecology
MODELING
Water balance, climatic extremes, new water sources, land-water interactions, blue water productivity.
Water productivity in natural and agricultural ecosystems, ecosysteme services
Stakeholder dialogue, Scenario analyses (SAS), strategies for water and land management - decision support (WEAP-DSS)

Integration Tool: SAS for Scenario Analyses

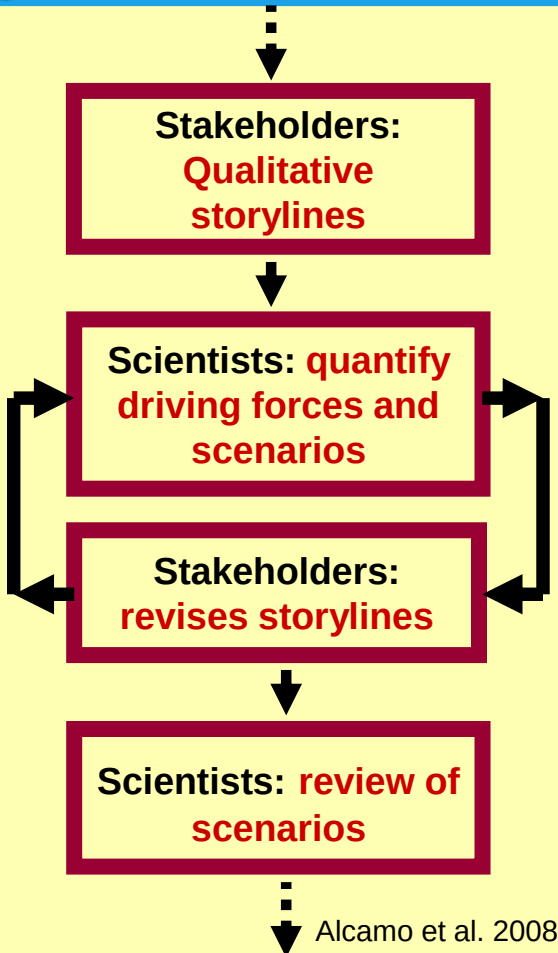
Story **A**nd **S**imulation approach

Output/Goal

- Set of comprehensive, coherent realistic scenarios about how the future may unfold.
- Strategies for managing water under climate change that take into consideration the uncertainties covered by the developed scenarios

Approach

- **iterative process** engaging stakeholders and scientists
- Incorporates **qualitative** information (stakeholder knowledge) and **quantitative** information (model calculation) and combines their advantages



Alcamo et al. 2008

Integration Tool: WEAP – decision support

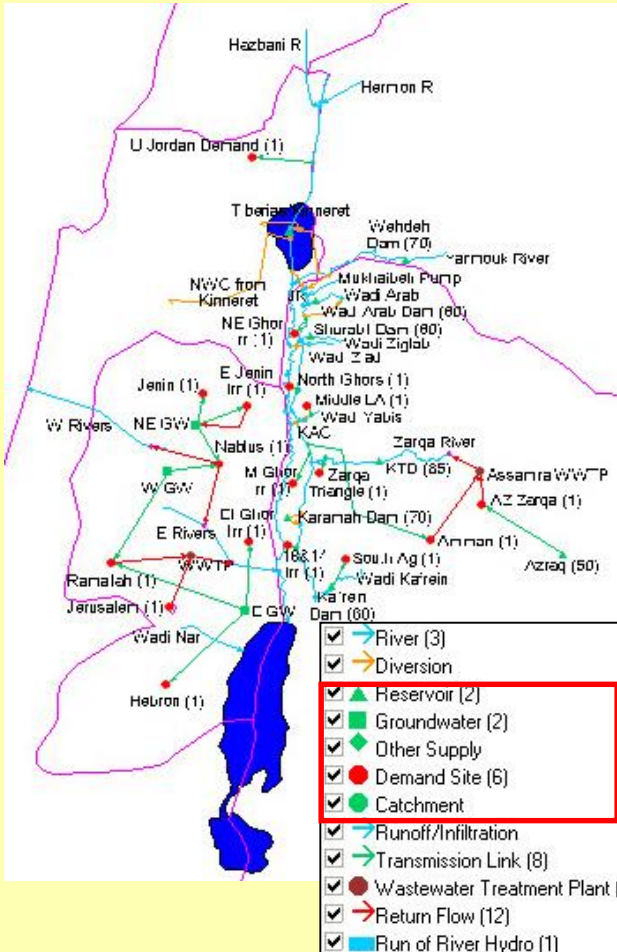
Water **E**valuation **A**nd **P**lanning Tool

Output/Goal

- Decision support in water management.
- Exploration of global change scenarios and their consequences on the water system.
- Explore new ideas within water management on adapting to global change.

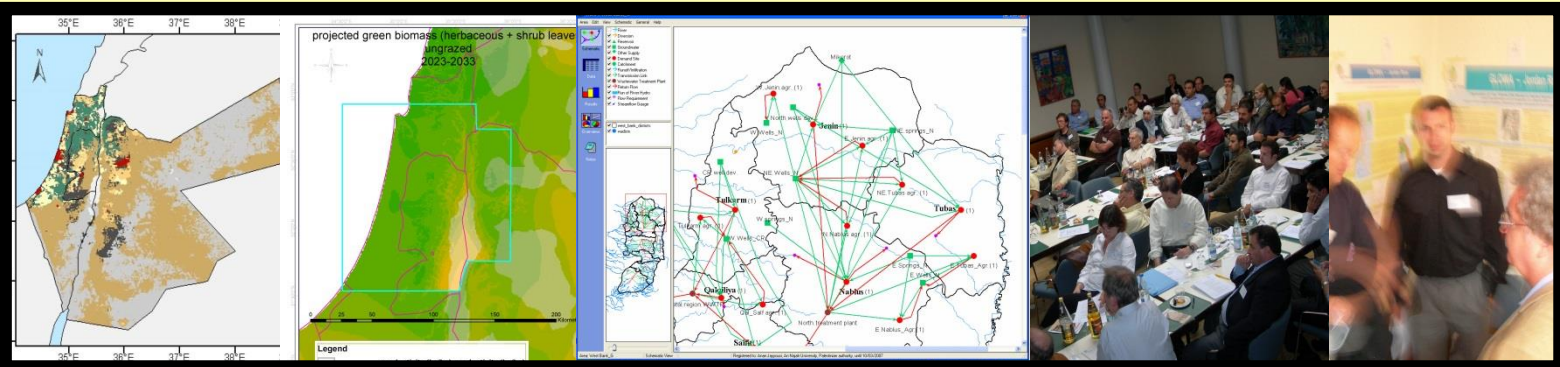
Approach

- WEAP represents the water system at the **appropriate** level of complexity.
- WEAP development in a nested approach: local community ⇨ sub-catchment scale ⇨ national scale ⇨ regional scale.



Three phases from 2001-2011 – Major Products

- WEAP established as dynamic decision-support tool in key national water management institutions.
- Regional change scenarios, Scenario-Viewer, SAS know-how.
- Policy relevant products: Impact of climate and land use change on water availability, water demand, biodiversity, erosion risk, water productivity, ecosystem services...
- Transboundary dialogue between scientists & stakeholders.
- Results and approach transferable to other semi-arid regions.



Capacity Building

Numbers of graduating students from GLOWA-JR

	Germans	Israelis	Jordanians	Palestinians	Total
Ph. D.	25	27	1	0	53
M. Sc.	4	46	11	14	75
Diploma	13	-	-	-	13
B. Sc.	9	2	-	-	11
Total	51	75	12	14	152

The Team

Israeli

Tel Aviv University, Dept. of Geophysics and Planetary Science, Tel-Aviv
Arava Institute for Environmental Studies
Ben Gurion University of the Negev, Jacob Blaustein Institute for Desert Research, Wyler Department of Dryland Agriculture, Sede Boqer Campus
Galilee Technology Center (MIGAL)., Research Group Limnology and Ecology of Wetlands and Freshwater, Kiryat-Shmona
Hebrew University of Jerusalem Dept. of Agricultural Economics and Management, Rehovot
Hebrew University of Jerusalem, Dept. of Geography, Mt. Scopus, Jerusalem
Israel Oceanographic and Limnological Research, The Lake Kinneret Limnological Laboratory
STAV-GIS Ltd.
Tel Aviv University, Dept. of Molecular Biology and Ecology of Plants, Tel-Aviv
Tel Aviv University, Dept. of Zoology, Tel-Aviv
Tel Hai Academic College, Department of Environmental Sciences, Upper Galilee
University of Haifa, Dept. of Geography and Environmental Studies, Mount Carmel, Haifa
University of Haifa, Natural Resource & Environmental Research Center (NRERC), Mount Carmel, Haifa
Weizmann Institute of Science, Dept. of Environmental Sciences and Energy Research (ESER), Rehovot
TAHAL

GLOWA

German

Karlsruhe Institute of Technology, Institute for Meteorology and Climate Research, Atmospheric Environmental Research Divison (IMK-IFU), Garmisch-Partenkirchen
Ruhr-University Bochum, Dept. of Soil Science and Soil Ecology, Bochum
University of Freiburg, Inst. of Hydrology, Freiburg
University of Hannover, Inst. of Environmental Planning, Hannover
University of Heidelberg, Professorship for Physical Geography, Heidelberg
University of Kassel, Center for Environmental Systems Research (CESR), Kassel
University of Potsdam, Research Group Plant Ecology & Nature Conservation, Potsdam
University of Tübingen, Department of Plant Ecology, Tübingen
Leibniz-Centre for Agricultural Landscape Research (ZALF) e.V., Institute of Landscape Systems Analysis, Müncheberg

Jordanian

Arab Technologist for Economical and Environmental Consultation (ATEEC), Amman
Mu'tah University, Faculty of Social Science, Dept. of Geography, Karak
Jordan Valley Authority
Ministry of Water and Irrigation

GLOWA

Palestinian

Al-Quds University Abu Deis, Department of Biology, Jerusalem
An-Najah National University, Water and Environmental Studies Institute (WESI), Nablus
Biodiversity & Environmental Research Center (BERC), Nablus
House of Water and Environment (HWE), Ramallah
Palestine Hydrology Group (PHG), Jerusalem
Association for Integrated Rural Development (ARID), Ramallah
University of Bethlehem, Water & Soil Environmental Research Unit (WSERU)
Ministry of Agriculture
Palestinan Water Authority