WATER AUTHORITY

Climate Trends in Israel and Effects on Water Resources

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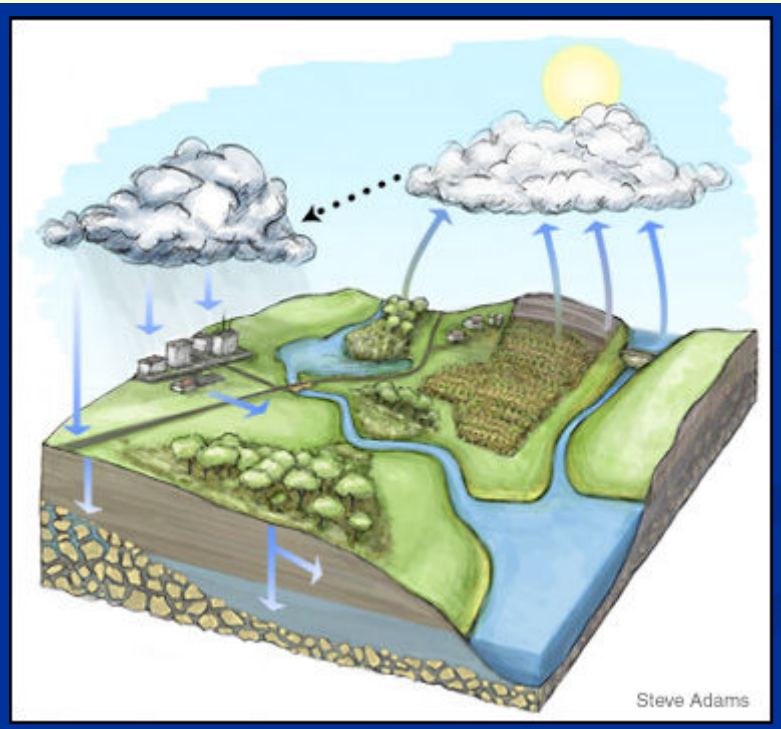
Israeli Water Authority



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- Climate and hydrological observations in Israel.
- Projected changed and the effect on water resources.
- Cooperation between the Water Authority and governmental offices and Academic institutions: Ministry of Environment, Ministry of Agriculture, Tel Aviv University, Hebrew University.

Tools that are being use in the Water Authority

- Seasonal precipitation models - NCEP / NCAR
- Climate models - Tel Aviv University (Prof. P. Alpert).
- Stream flow - IHS, The Lake Kinneret Limnological Laboratory (Dr. Alon Rimmer)
- Aquifers recharge: HUJI (Prof. H. Gvirtzman)
- Evaporation / Lake Kinnert salinity - The Lake Kinneret Limnological Laboratory (Dr. Alon Rimmer)

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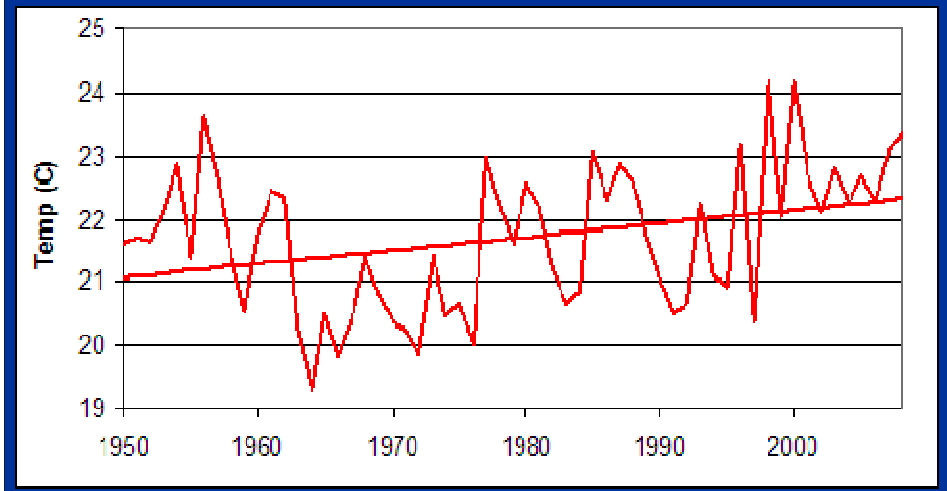
- What do we know until now ?
- What are the forecasts that we have for the coming decades ?

Temperatures:

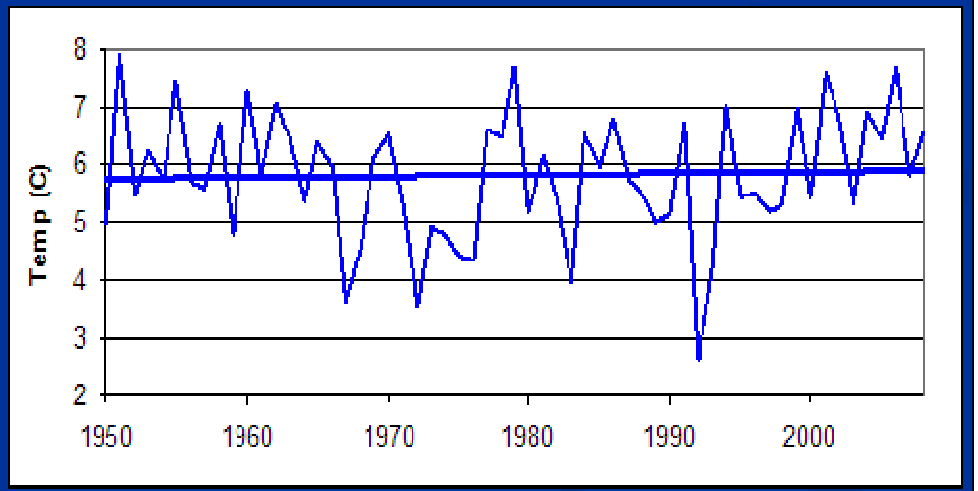
There is a wide agreement that temperatures increased in Israel during the last decades, especially in the summer

Increase in summer , no trend at winter

1 degree increase in the summer



Stability in the winter

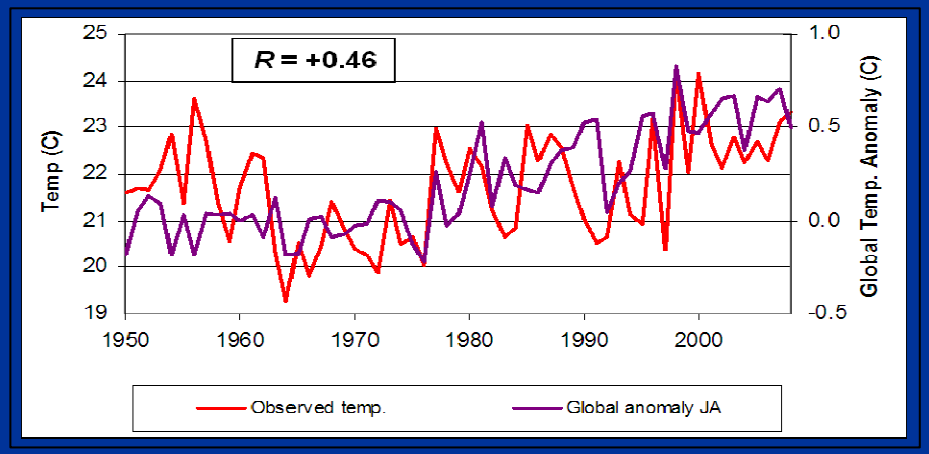


Ziv et al., J. Roy. Met. Soc. 2010

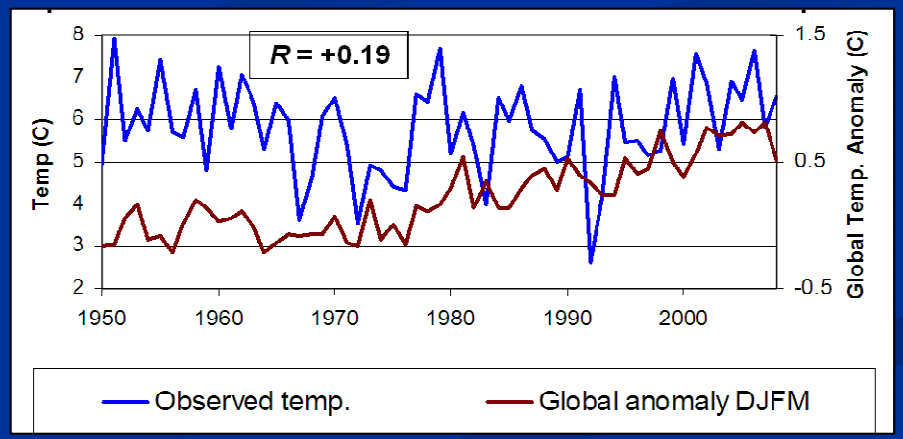
Temperatures

The temperatures in Israel with respect to the Global temperatures

Summer



Winter

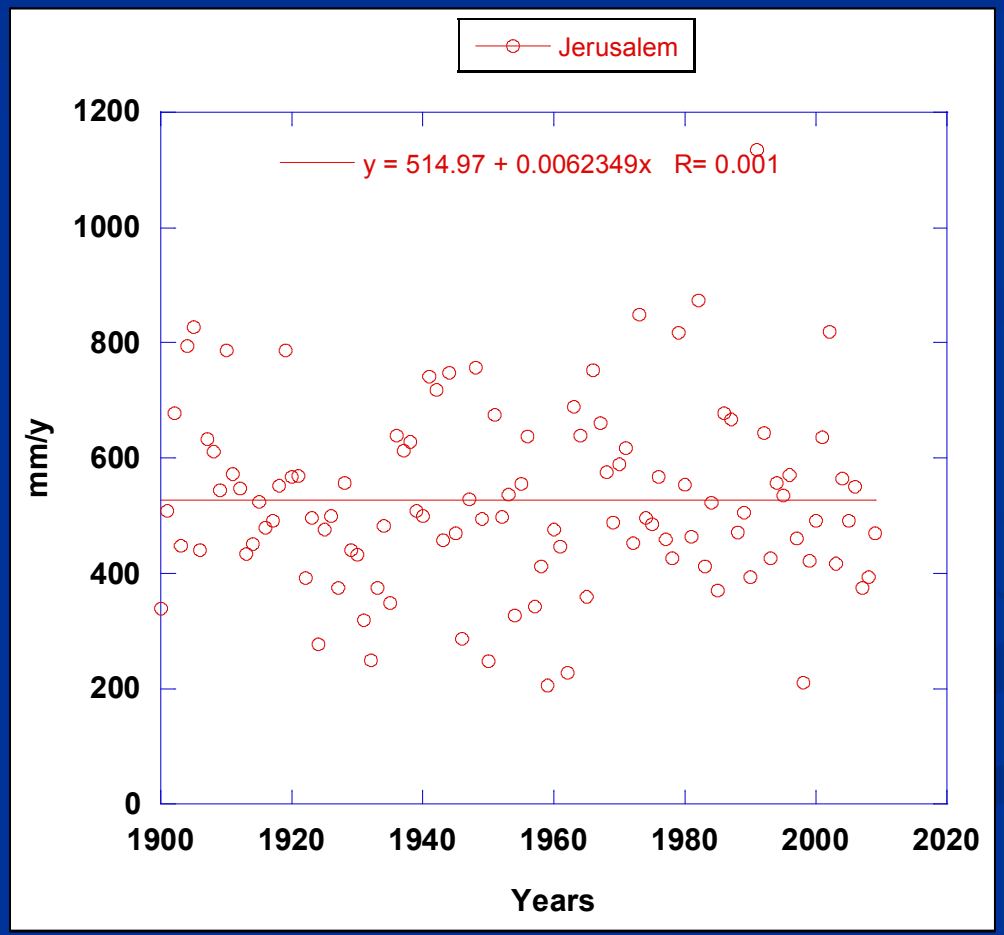


Ziv et al., J. Roy. Met. Soc. 2010

Precipitation:

No clear trend was found. Several studies showed different trends for different places (coast, inland, north vs. south, the hilly areas vs. the plain).

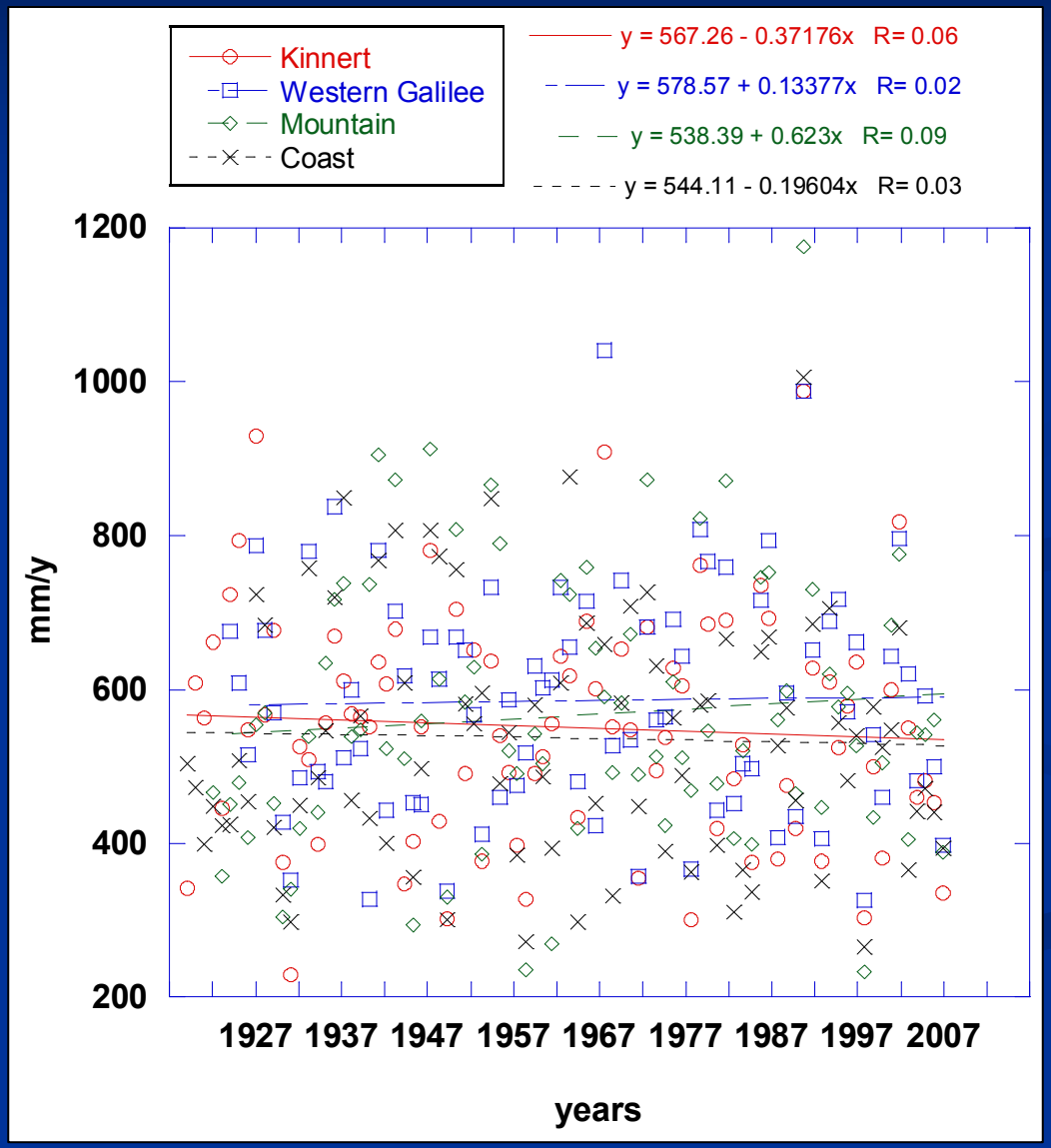
Time series for 13 rain gauges with long record of measurement since 1920



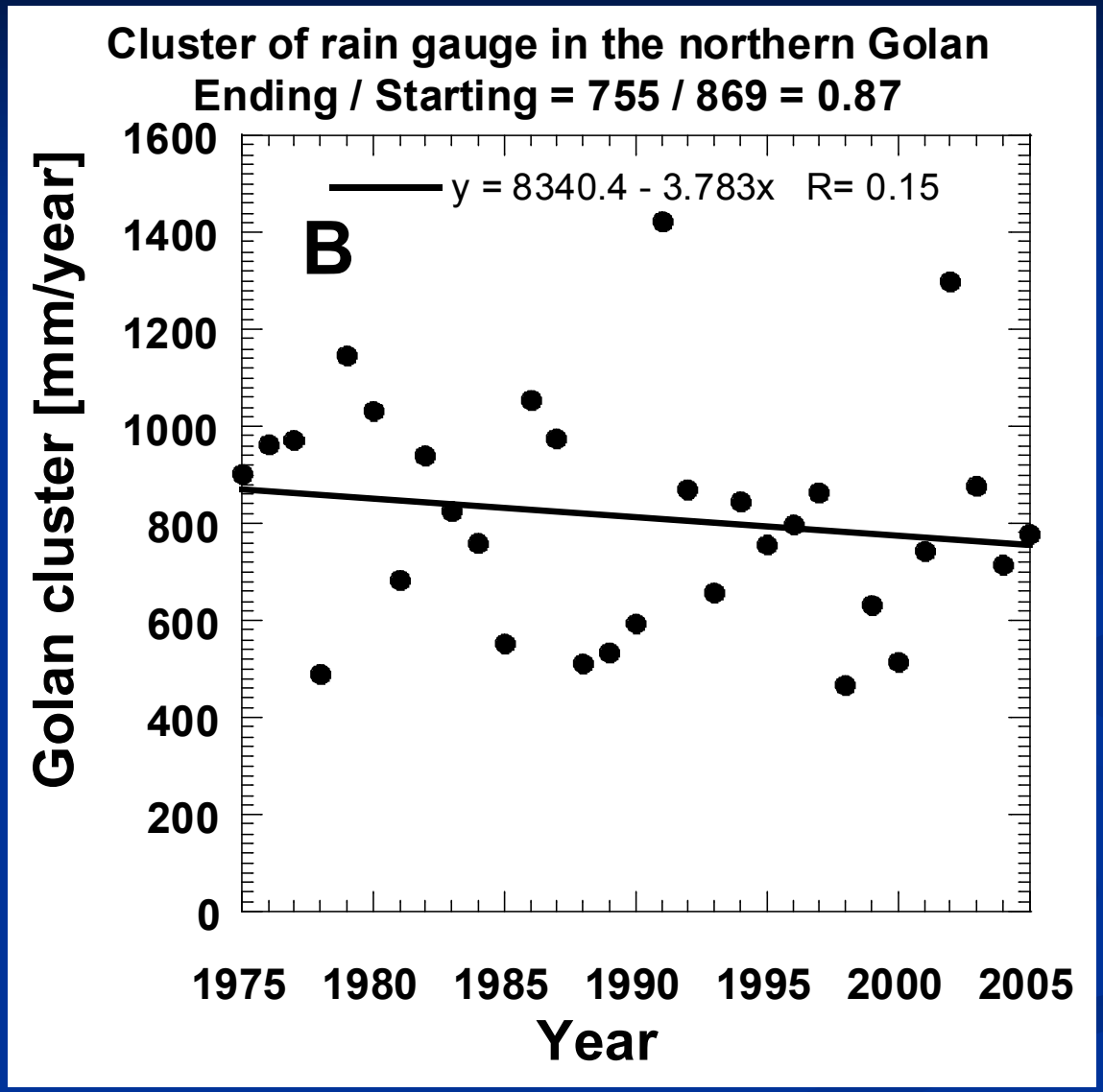
Precipitation trends in the major Aquifers in Israel:

Kinnert, Western Galilee, Mountain, Coastal Aquifer

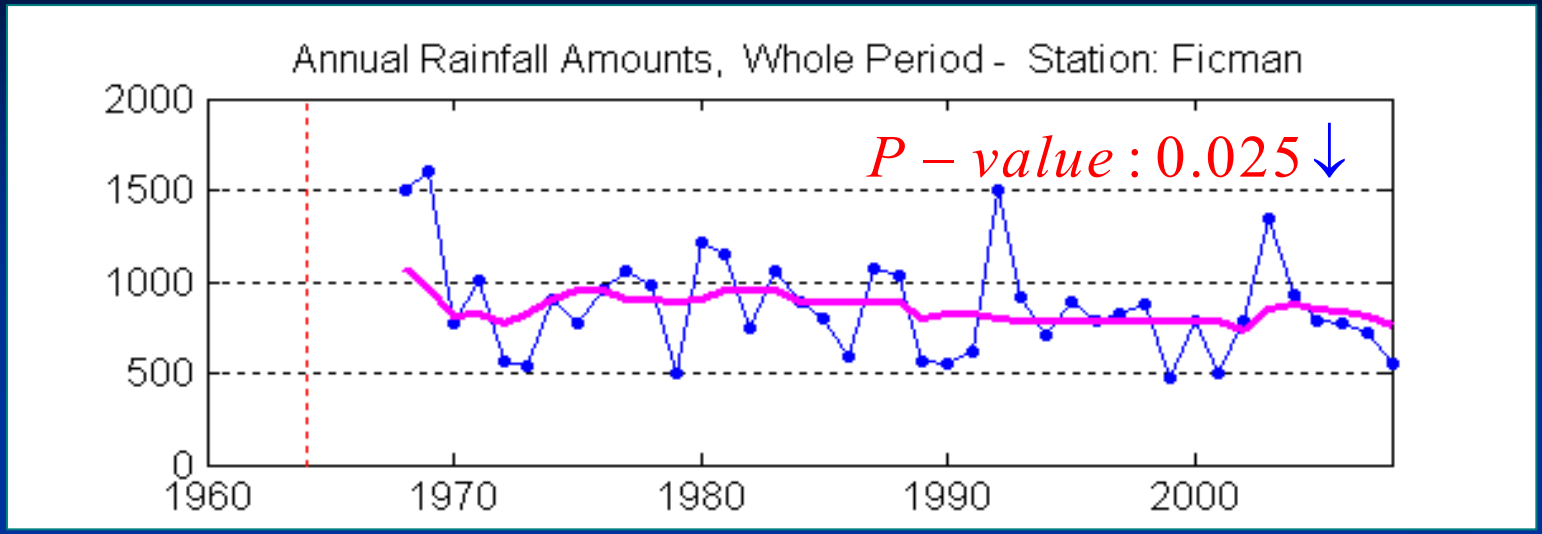
- Slight decrease in the Kinnert basin
- Stable trend in the Galilee, Mountain and coast

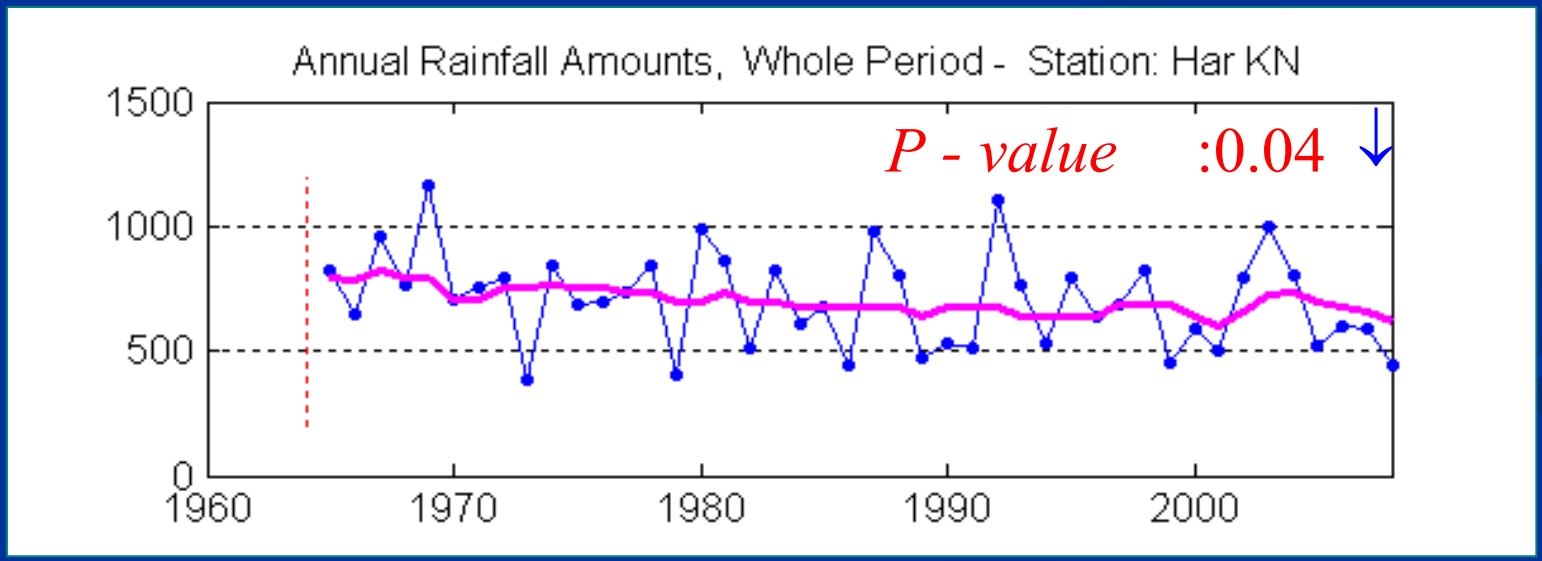


Decreasing trend at hilly rain gauges, Northern Israel



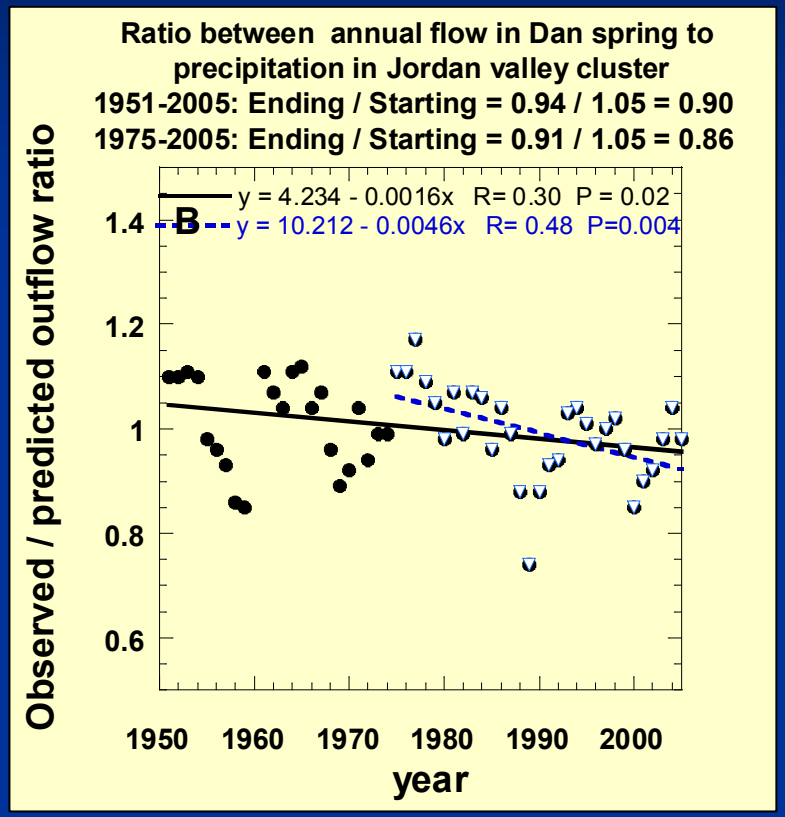
Statistically significant decrease in annual precipitation in the Kinnert basin

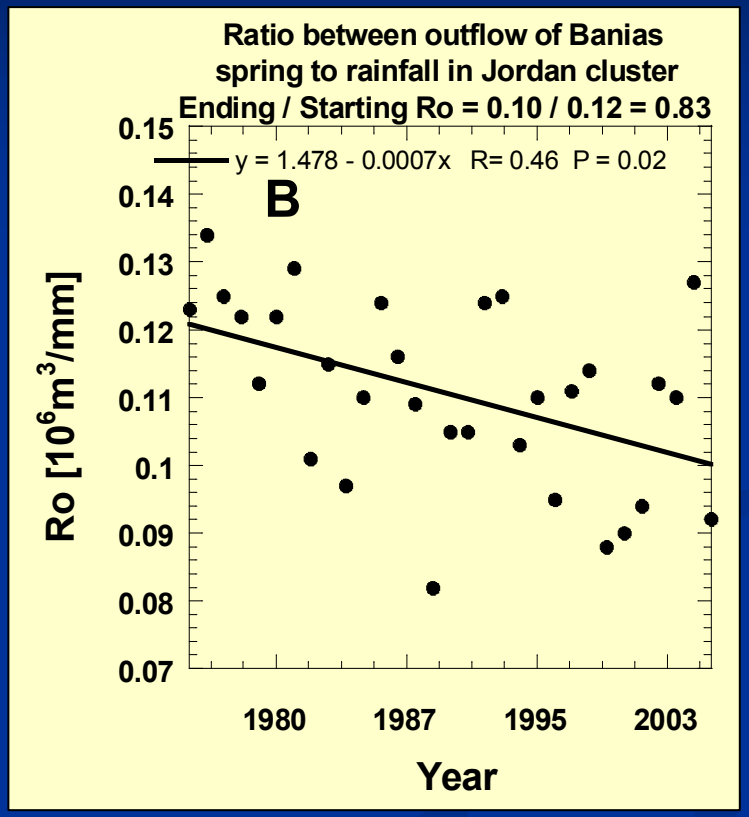




Rom and Givati, 2009

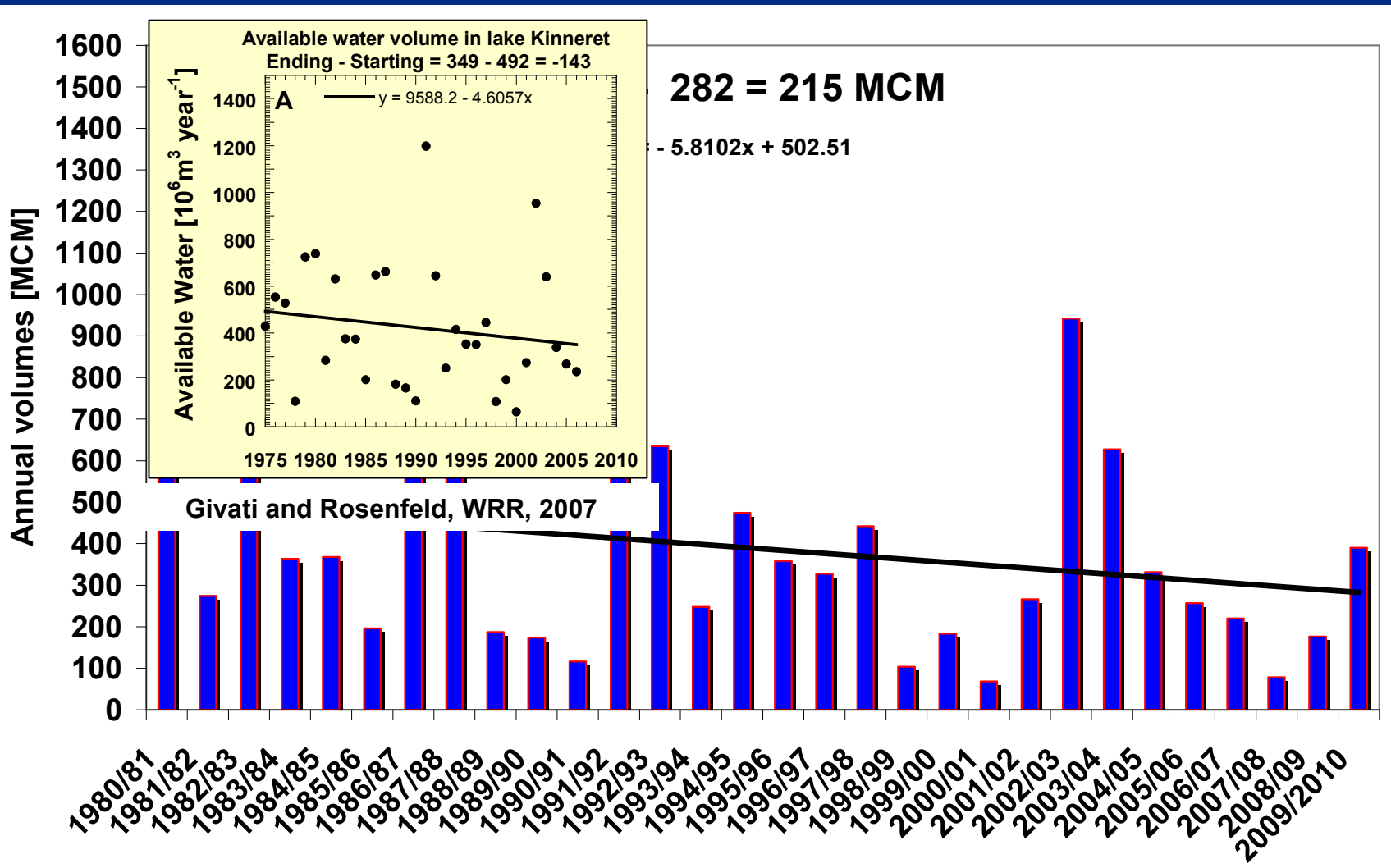
Decreasing trend in the major water resources of Israel: Precipitation and spring flow in the upper Jordan River basin



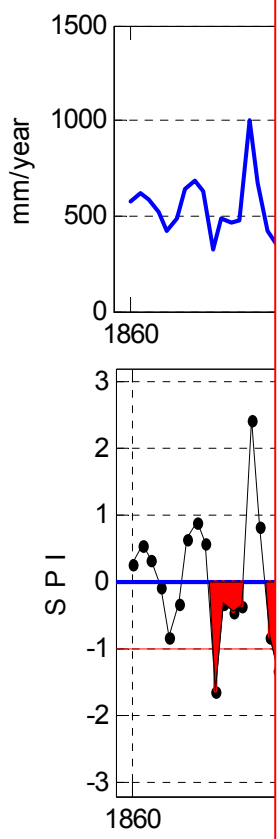


Givati and Rosenfeld, WRR, 2007

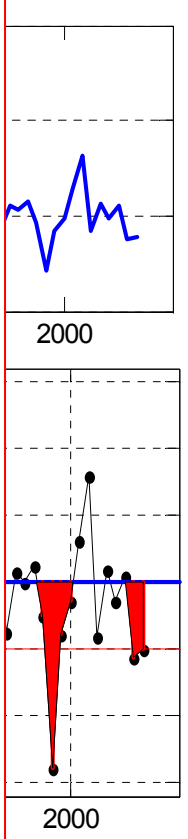
Decreasing trend in available water volume into the Lake of Galilee



Using the SPI Drought Index in order to calculate drought duration and intensity



num	start	end	year	durtn	DM	Deficit
1	1869	1872		4	2.7342	440.2
2	1875	1876		2	2.1241	325.1
3	1898	1901		4	1.8907	322.2
4	1922	1927		6	5.019	774.3
5	1929	1935		7	8.1267	1192.9
6	1945	1947		3	2.3941	360.65
7	1949	1950		2	2.6026	356.1
8	1954	1954		1	1.5534	221.55
9	1957	1962		6	8.6135	1179.3
10	1965	1965		1	1.2757	189.55
11	1983	1985		3	2.0954	339.65
12	1997	2000		4	4.3222	611.2
13	2007	2008		2	2.1338	328.1

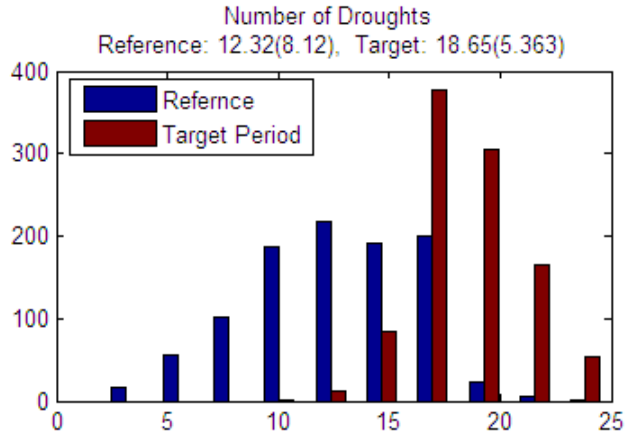


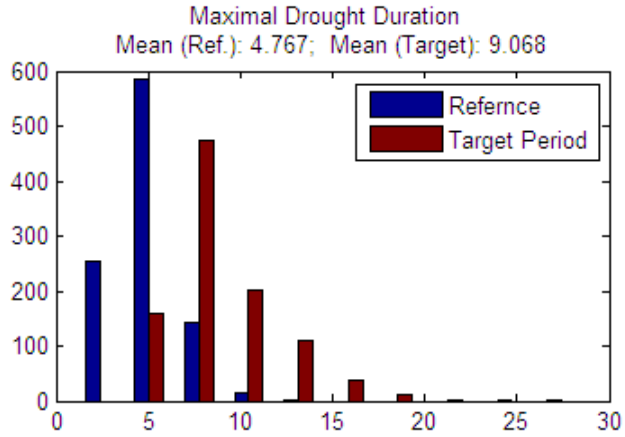
Rom and Givati, 2009

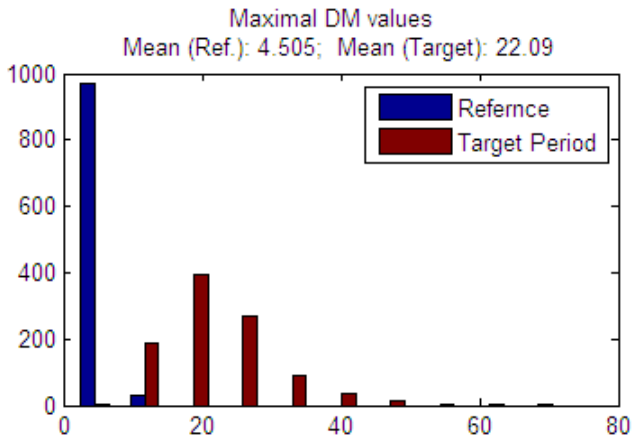
Future Projections

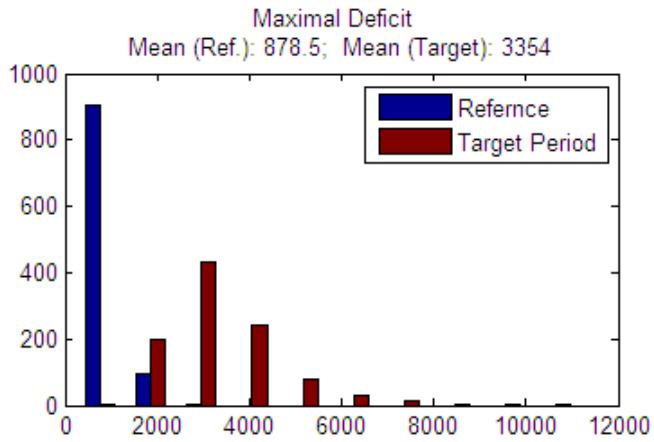
- Precipitation
- Drought index
- Incoming water to Lake Kinnert
- Evaporation
- Recharge in Aquifers

Effect of possible climate change scenarios in Israel on droughts



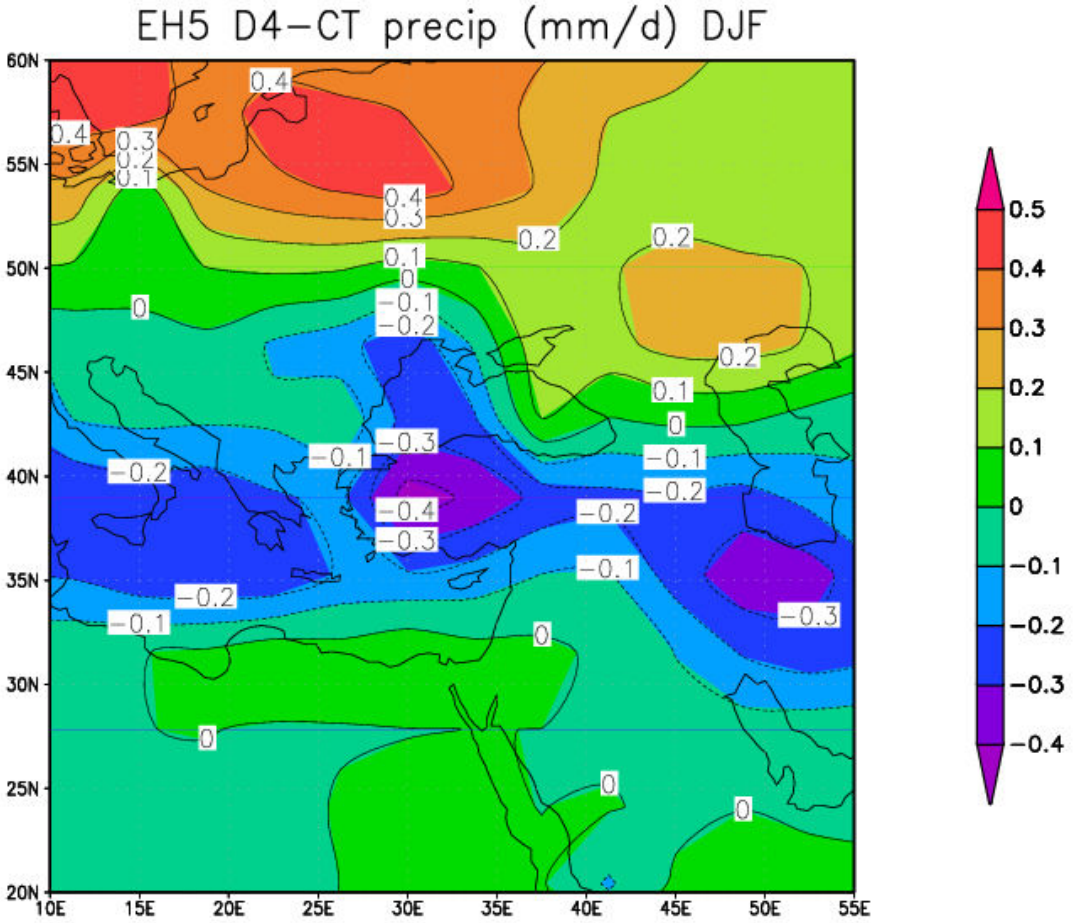






Rom and Givati, 2009

Climate Modeling in Israel

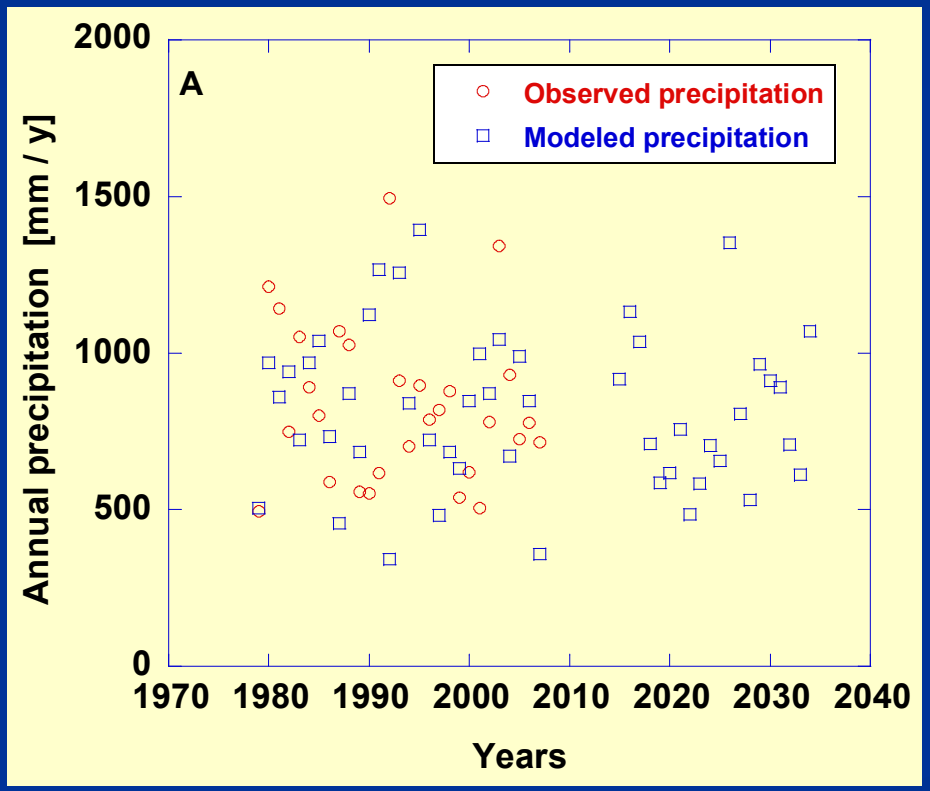


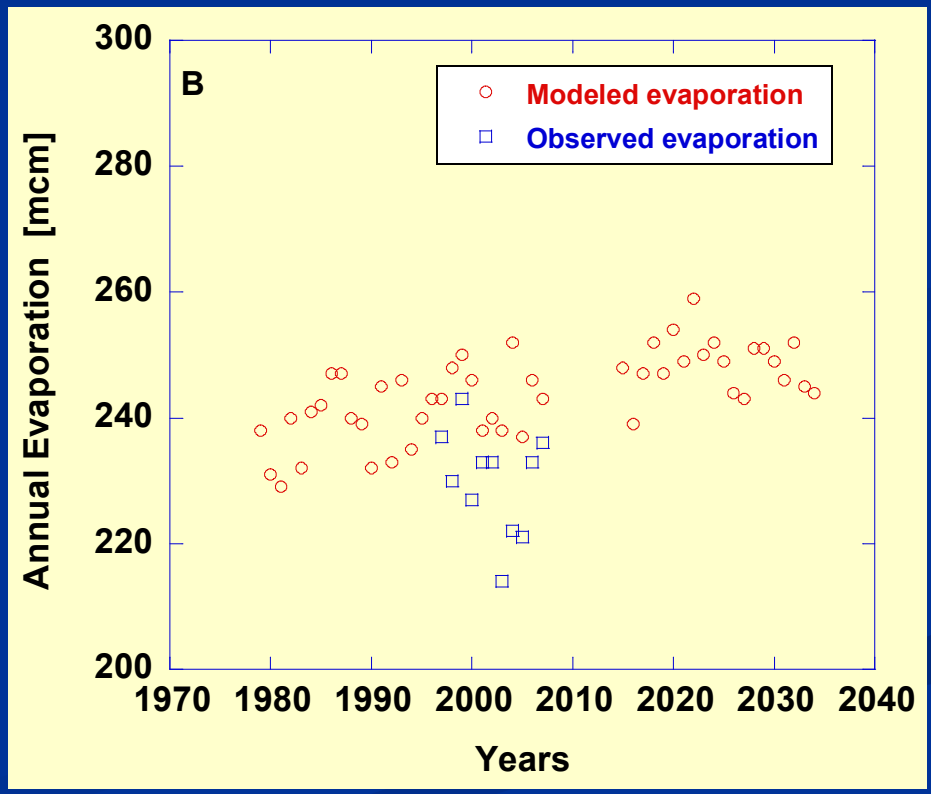
Trends of mean seasonal precipitation in (%)

Alpert P., S.O. Krichak, 2009

Modeling future available water in Lake Kinnert

Calculated precipitation (A) and (B) evaporation for the period 2015-2034 based on statistical downscaling (TAU) form Kitoh et. al ,2008 climate model





Givati et al., 2010. Water Resources Research (in review)

Summary of the climate, Hydrological, evaporation and salinity concentration models and the effect on water availability in Lake Kinnert

Period	1979 – 2007 Observed	1979 – 2007 Modeled	2015 – 2034 Modeled	Future Change	Future Change [%]
Average Precipitation [mm]	835	832	802	-30	-4%
Std Precipitation [mm]	271	263	228	-35	-13%
Average Incoming water [mcm]	663	664	620	-44	-7%
Std Incoming water [mcm]	273	256	246	-10	-4%
Average Evaporation [mcm]	230	238	249	11	5%
Average Available water [mcm]	408	401	345	-56	-14%
Std Available water [mcm]	273	272	250	-22	-8%
Average Cl Concentration in the lake (mg/l]	233	234	277*	43	18%