Climate Change/Global warming Effects on Potato Diseases/Pests - 18 Nov 2013, Jerusalem Dan Panorama

Climate Changes over Israel & Mediterranean; Recent Observations and Future Predictions

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Outline

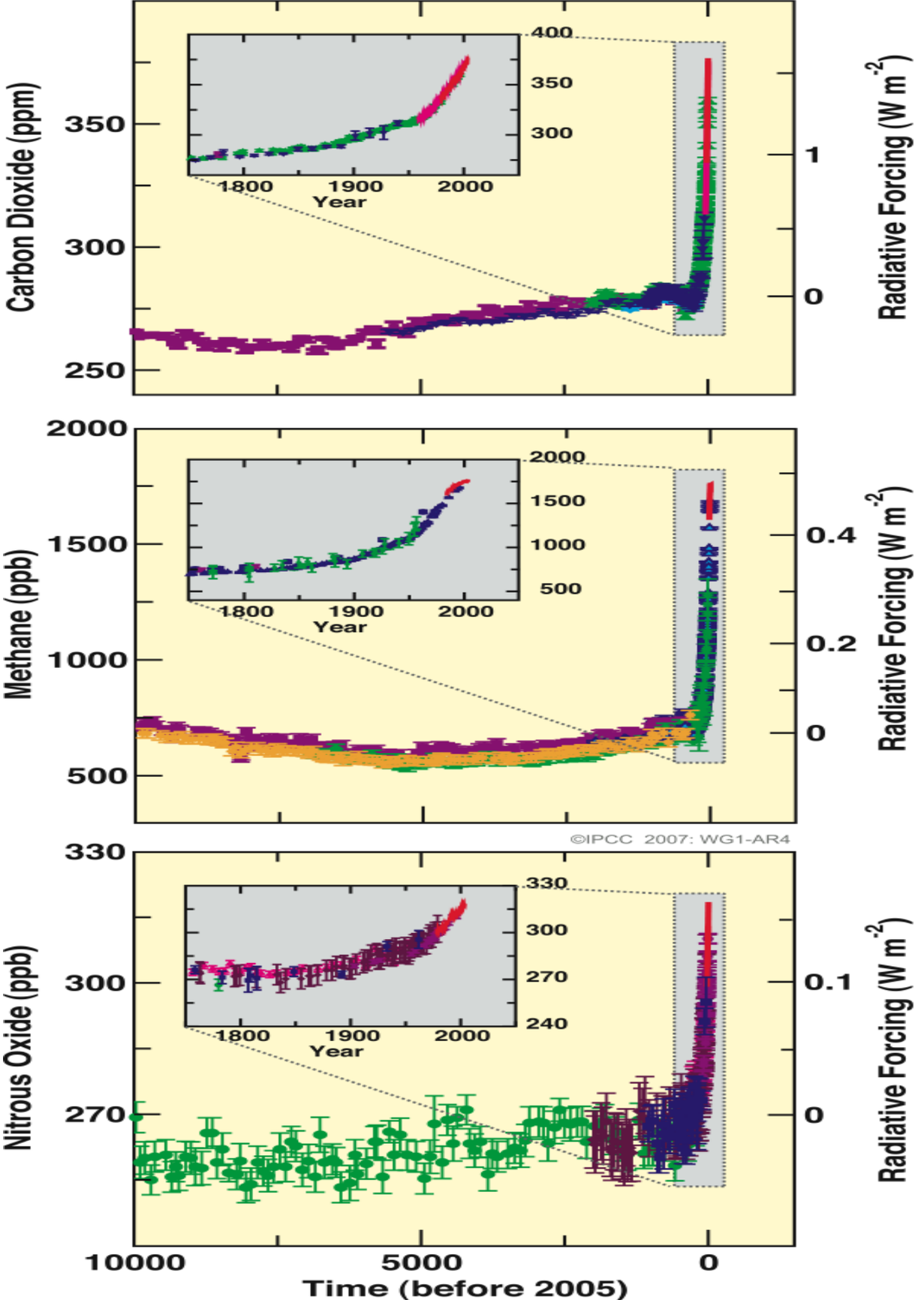
1. Global Warming- Short
2. Climate Trends over the Mediterranean & Middle-East
3. Global super high-resolution run- Water Budget analysis
4. Observed Trends & extremes in Israel
   2010-1975
5. Extremes in Regional Climate Change Simulations
6. Trends in dust events

Conclusions

CO_2

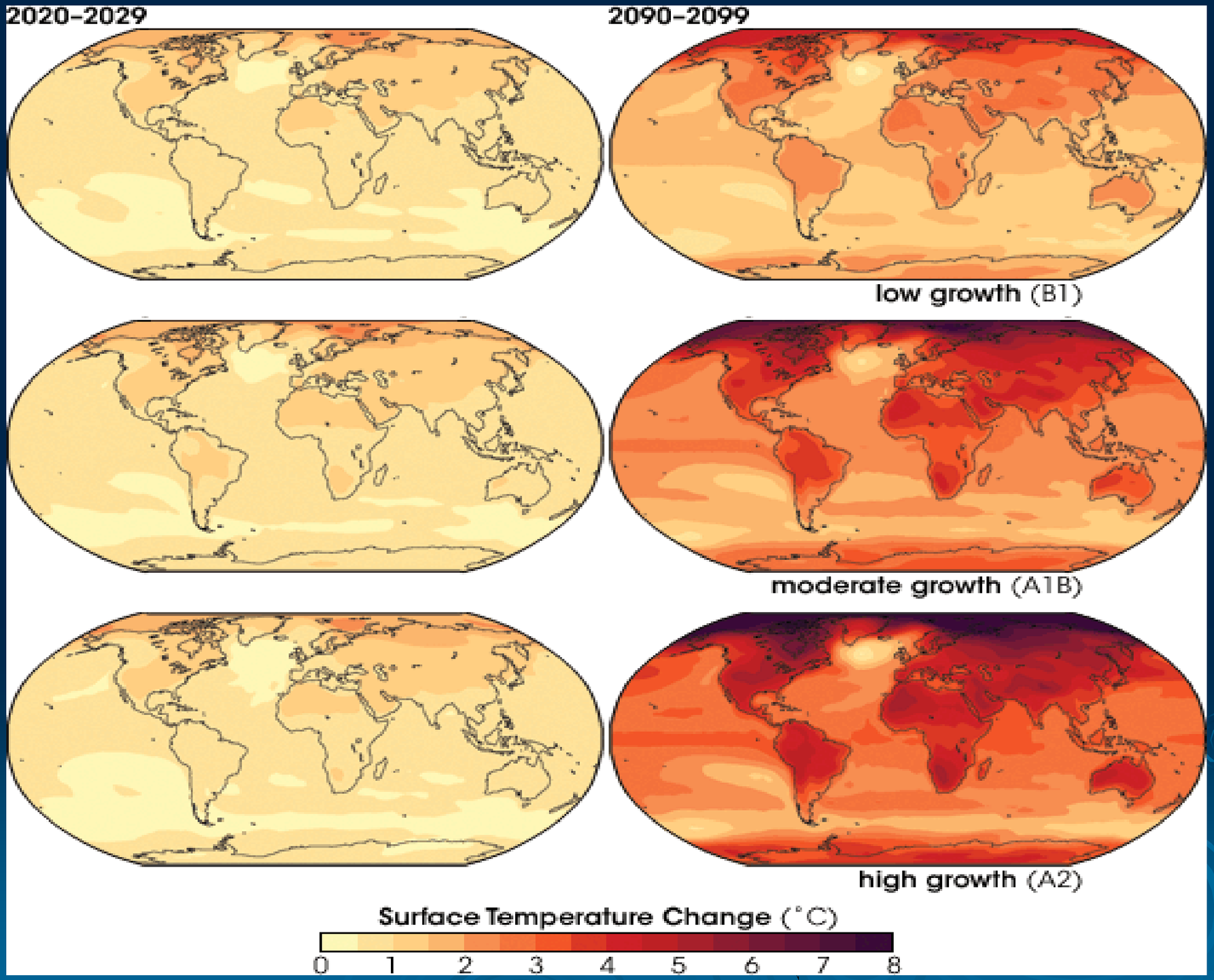
Methane

N_2O



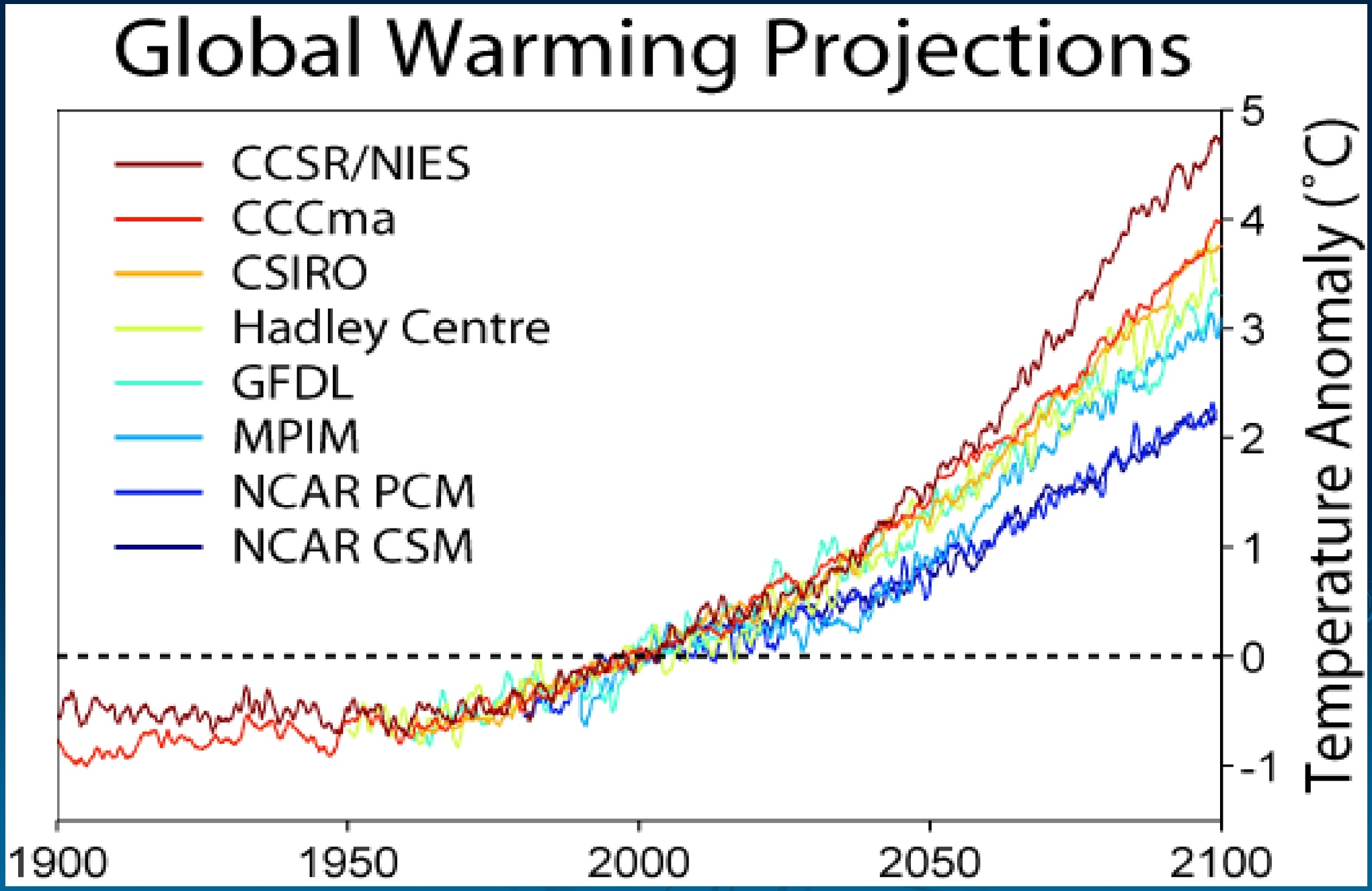
Graph for 10,000 years showing the huge jump in ALL greenhouse
gases at the time of the industrial revolution.

Surface Temperature Change under 3 SRES scenarios

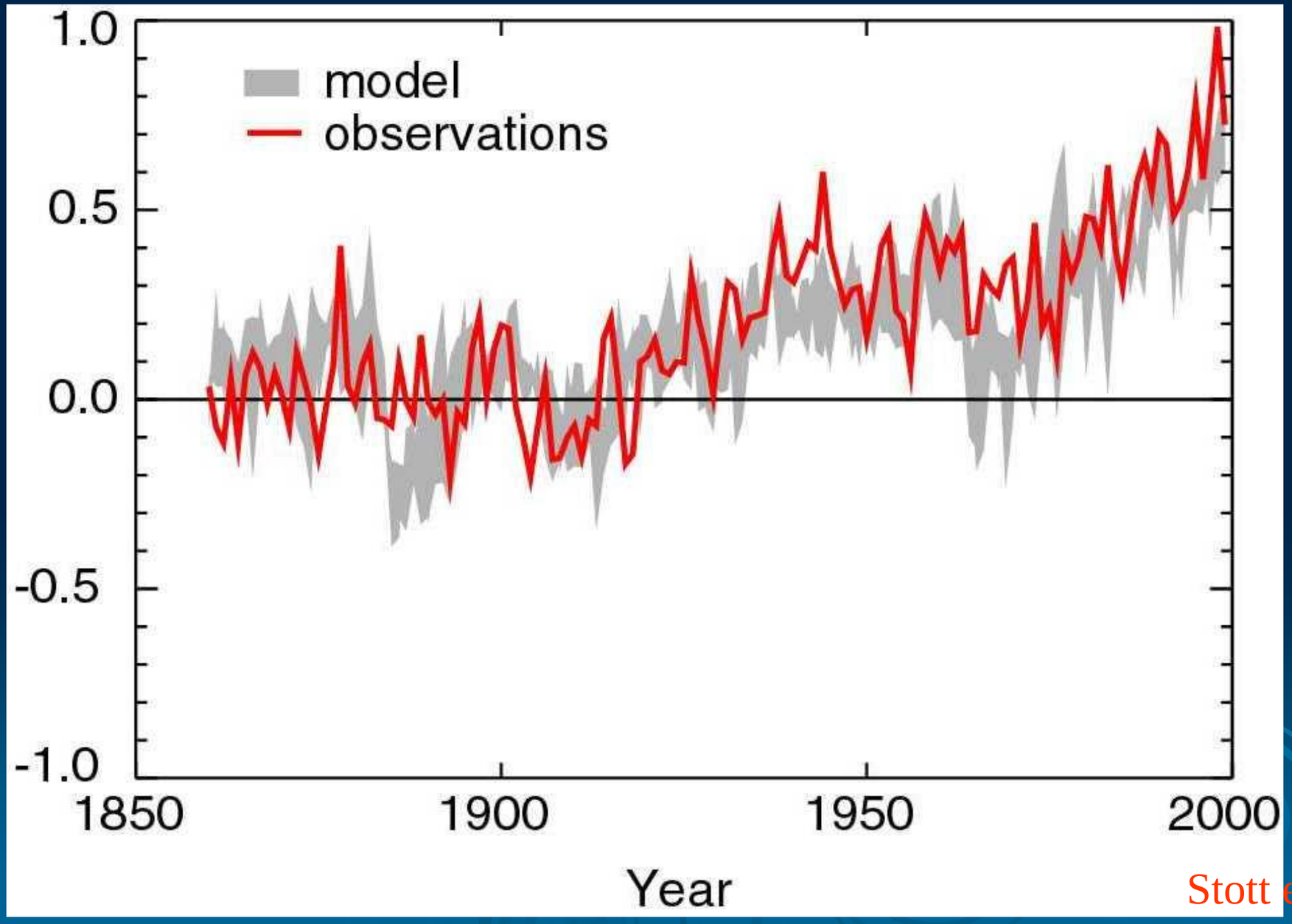


) based on IPCC Fourth Assessment Report (2007 ,NASA Earth Observatory :Source

19 IPCC models (100-200km resolution) – Range of results

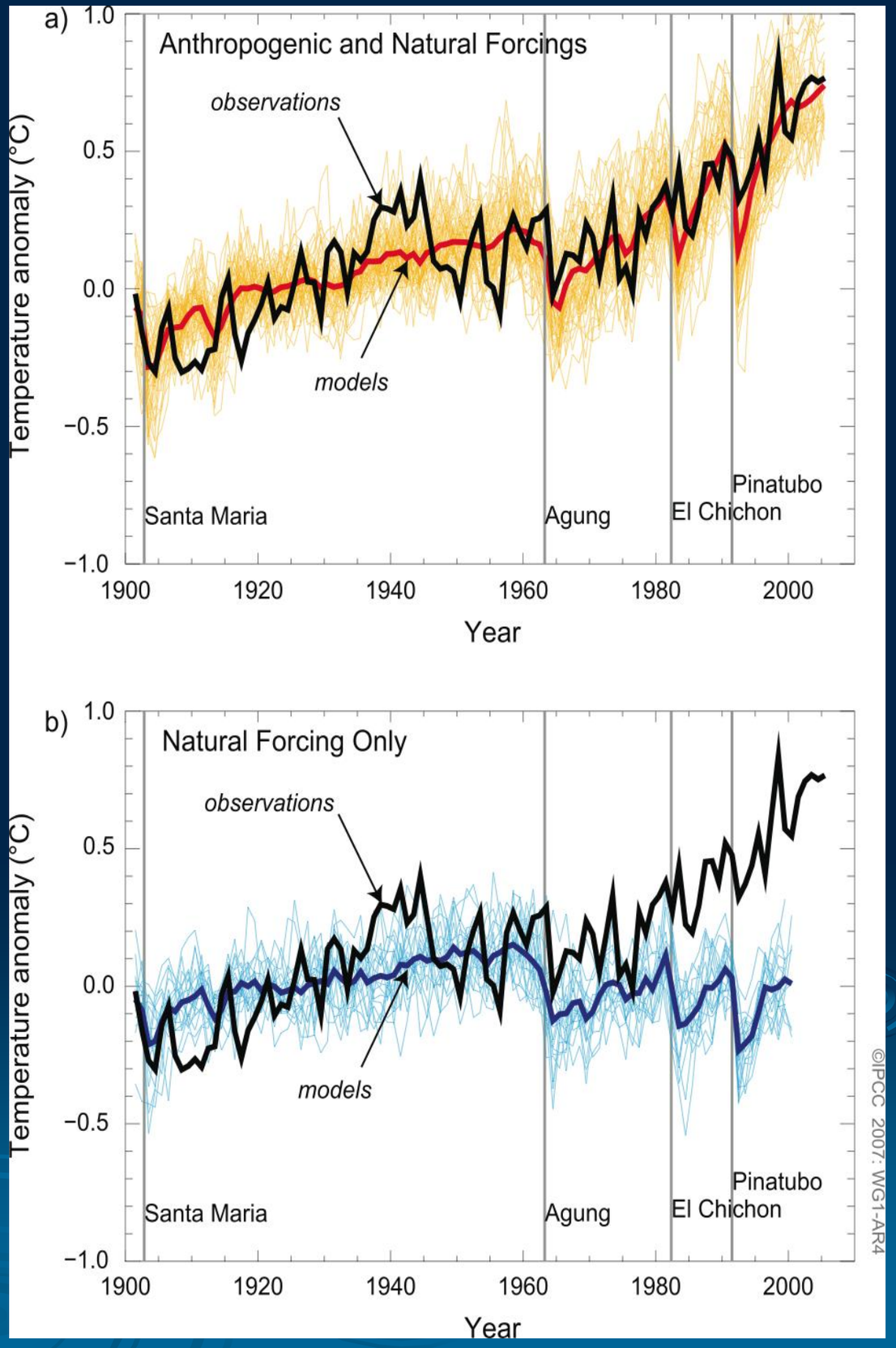


Global mean temperature from an ensemble of 4 simulations using natural and anthropogenic forcing



Stott et al, Science 2000

Models with only natural forcings cannot reproduce the observed temperature trend after 1950



Thanks to our Regional Climate group

- Dr. S.O. Krichak,
- Dr. R. Samuels,
- J. Fengjun,
- J. Breitgand

Three higher resolution models are being evaluated

1. 50 km interval RCM- RegCM3 (TAU Research Group).
   period run: 1960-2060

2. 25 km interval RCM- RegCM3 (TAU Research Group).
   period run: 1960-2060

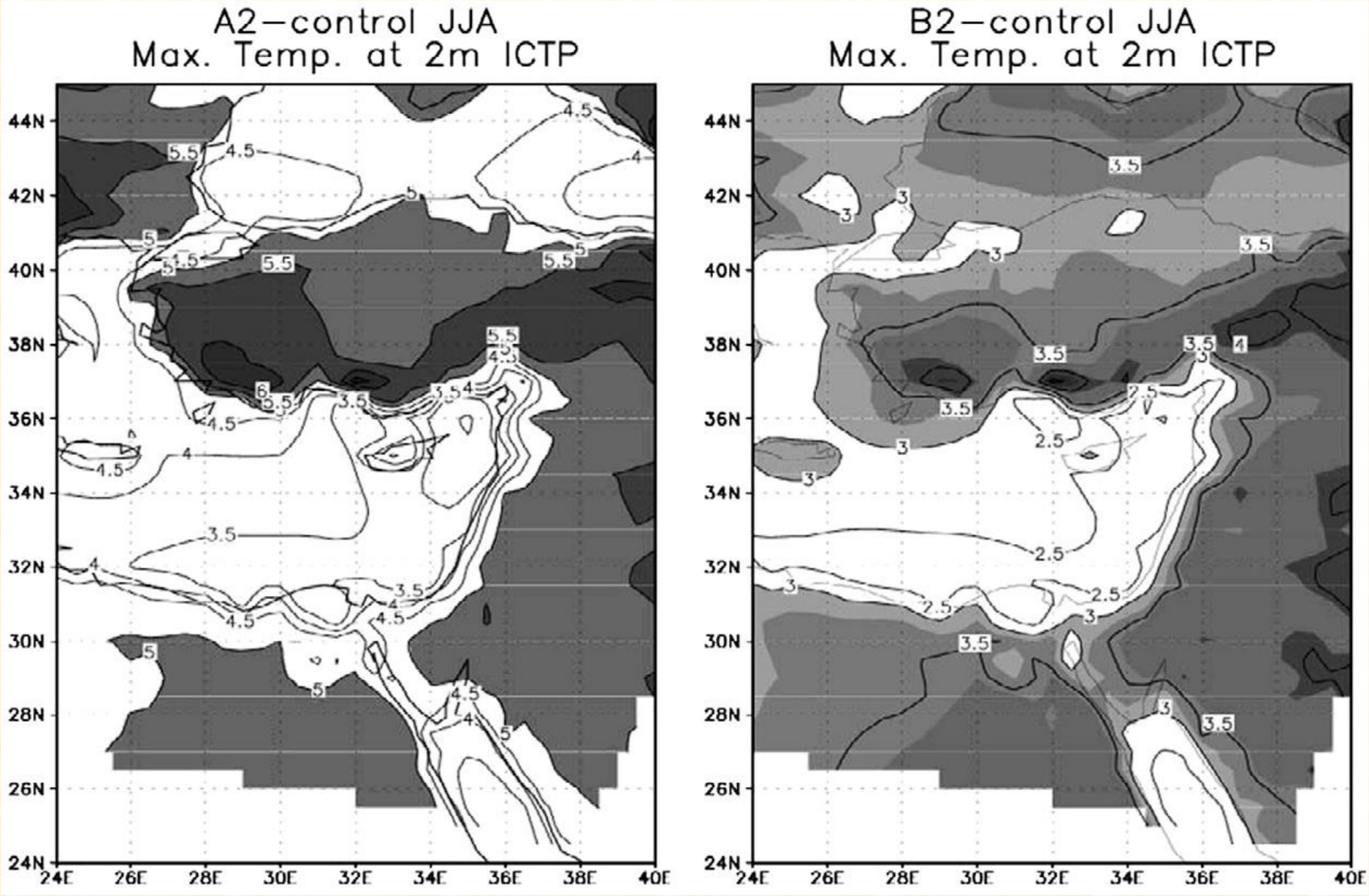
3. 20 km interval GCM (Japanese Research Group + TAU)
   Future runs (time-slices): 2015-2035 & 2075-2099

   I'll start first with our TAU earlier time-slices run (2071-2100)
   vs. (1961-1990)

Year **2008-9** :

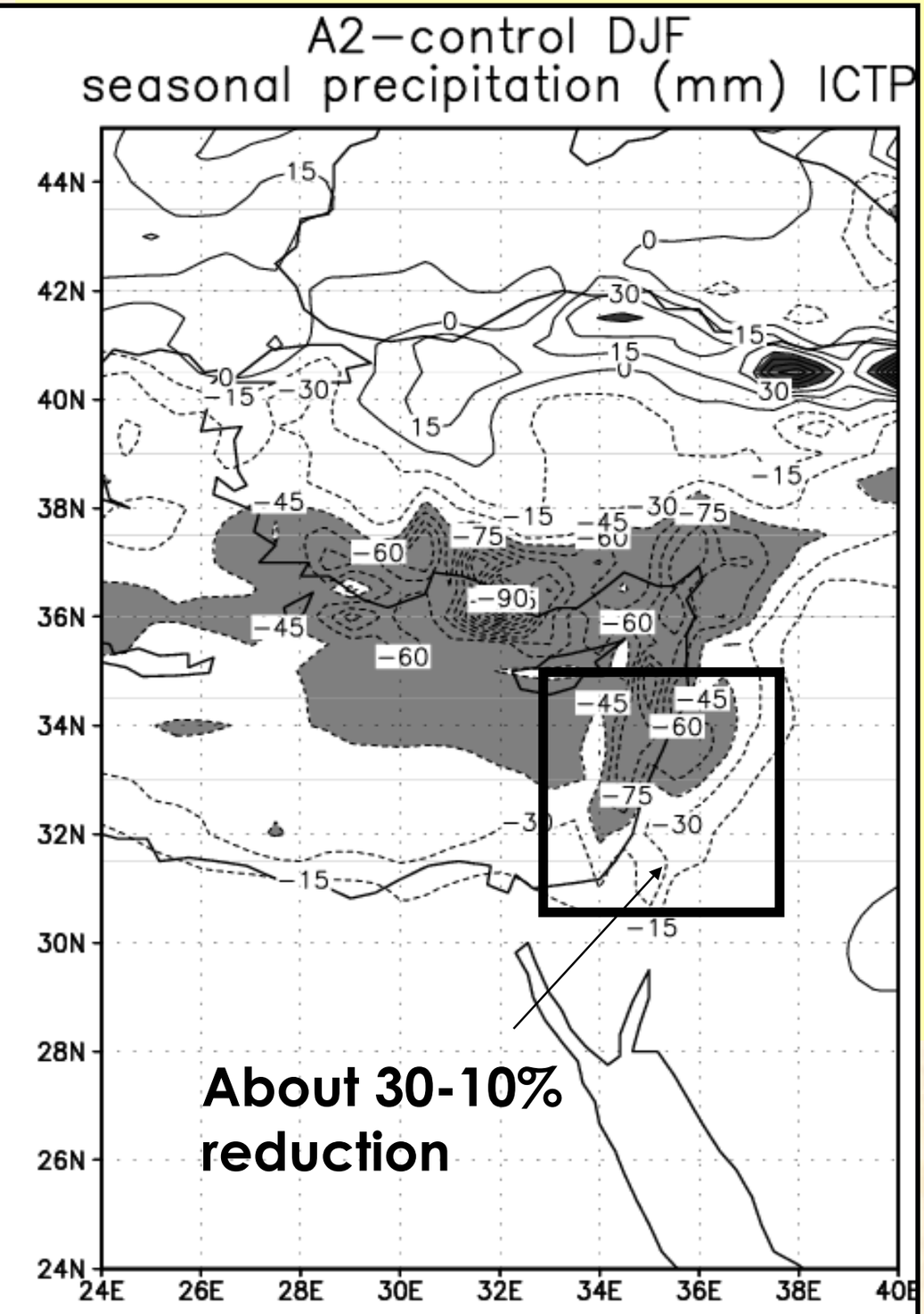
Regional Climate Model
A2 and B2 2071-2100
Earlier RCM Runs

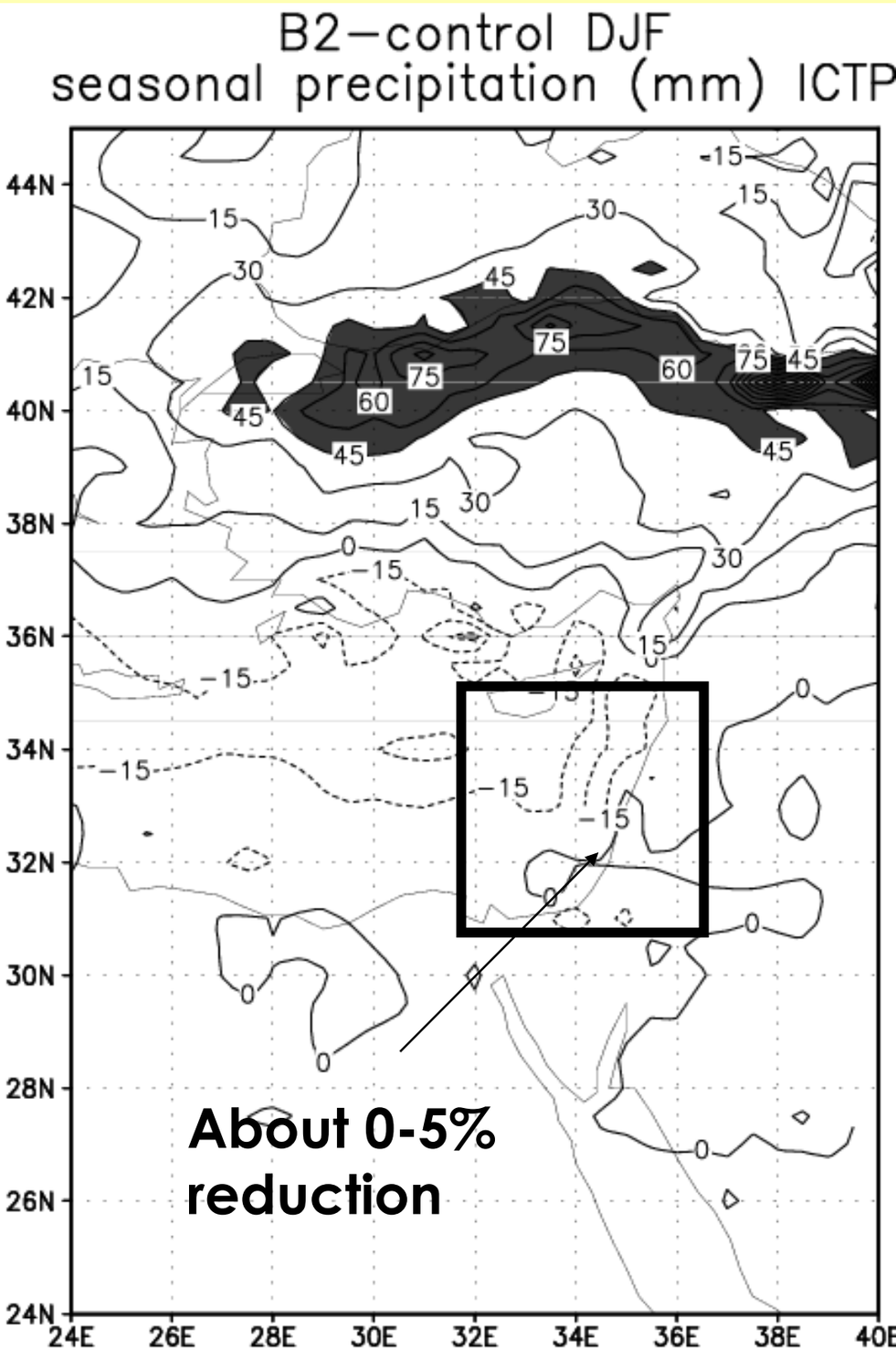
RCM 2071-2100



P. Alpert, S. O. Krichak, M. Dayan and H. Shafir, "Climatic trends over the Eastern Mediterranean: past and future projections", CLIVAR Exchanges, 11, 2, 12-13, April 2006.

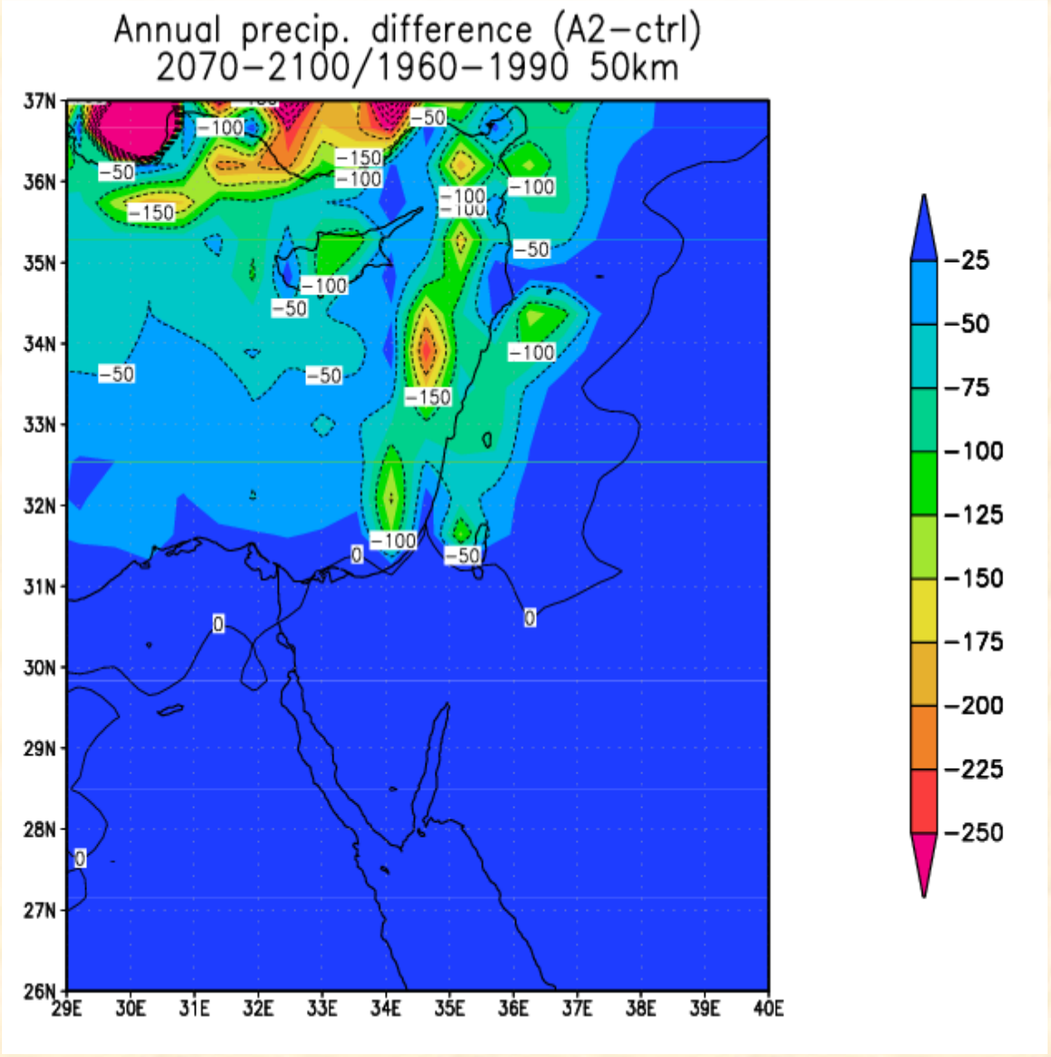
Winter (DJF) Rainfall Differences





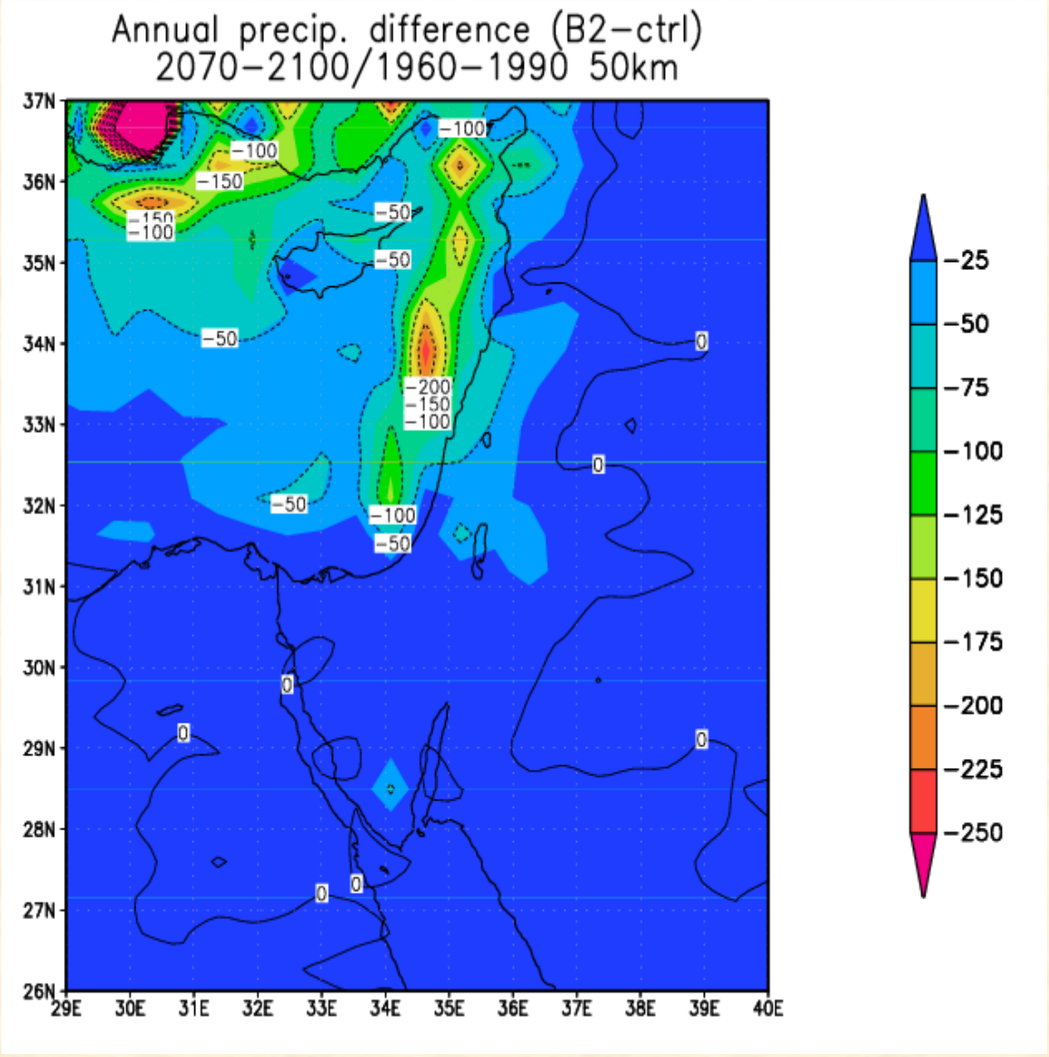
Precipitation difference 2071-2100 vs 1961-1990 control run vs. scenarios

A2



50-100 mm/y ↓

B2



~50 mm/y ↓

Year **2009-10**:

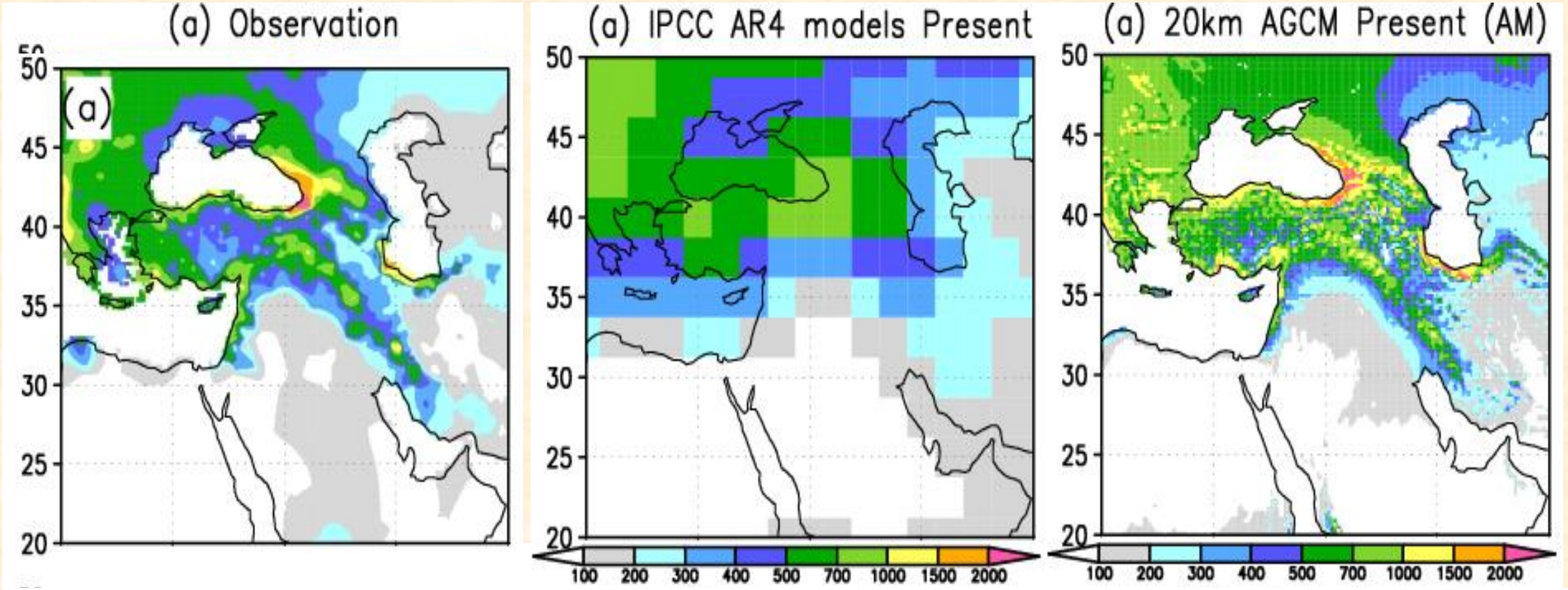
Global Super High-Resolution Run the Water Budget analysis

Global super high-resolution run

Kitoh, Yatagai and Alpert, 2008: First super-high-resolution model projection that the ancient "Fertile Crescent" will disappear in this century. Hydrological Research Letters, 2, 1-4, DOI: 10.3178/HRL.2.1, 2008.

Der-Spiegel Report, April 2008

Annual Rainfall-Middle East Observations & Models

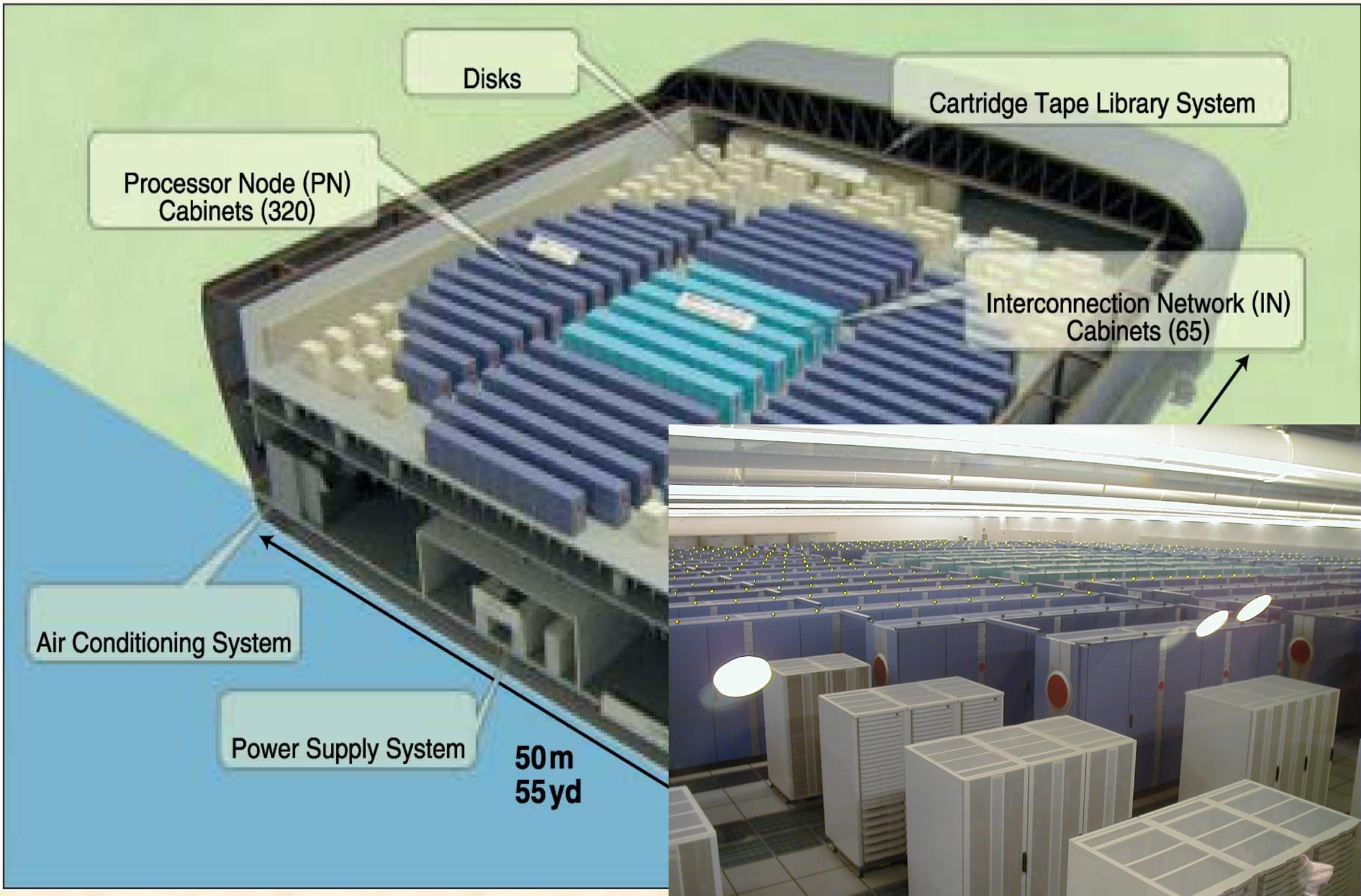


EMclim **IPCC AR4 models** **20km AGCM**

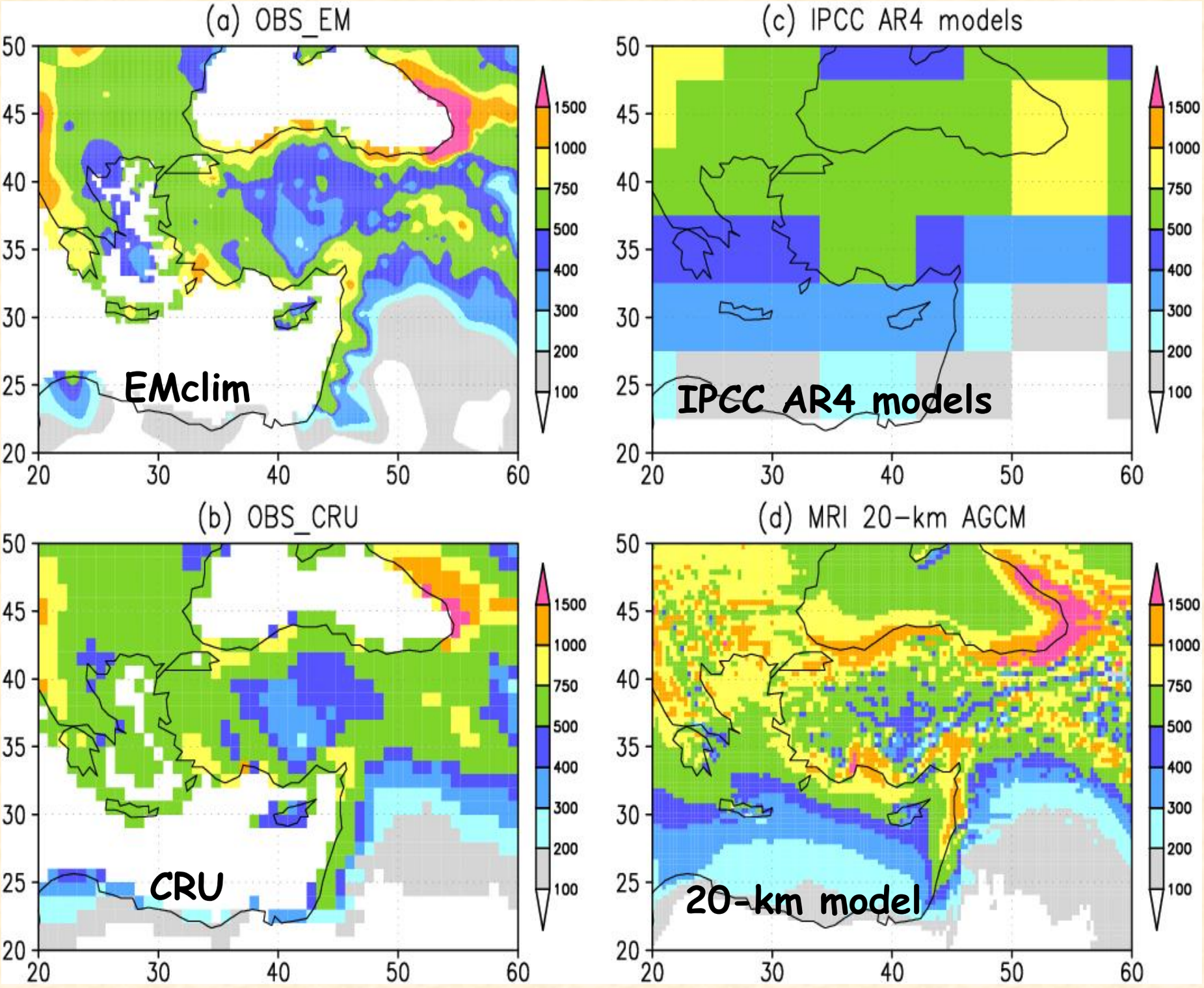
Kitoh, Yatagai and Alpert, 2008: First super-high-resolution model projection that the ancient "Fertile Crescent" will disappear in this century. Hydrological Research Letters, p.1-4, 2008

A. Yatagai, P. Alpert and P. Xie, "Development of a daily gridded precipitation data set for the Middle East, Advance in Geosciences., 12, 1-6, 2008.

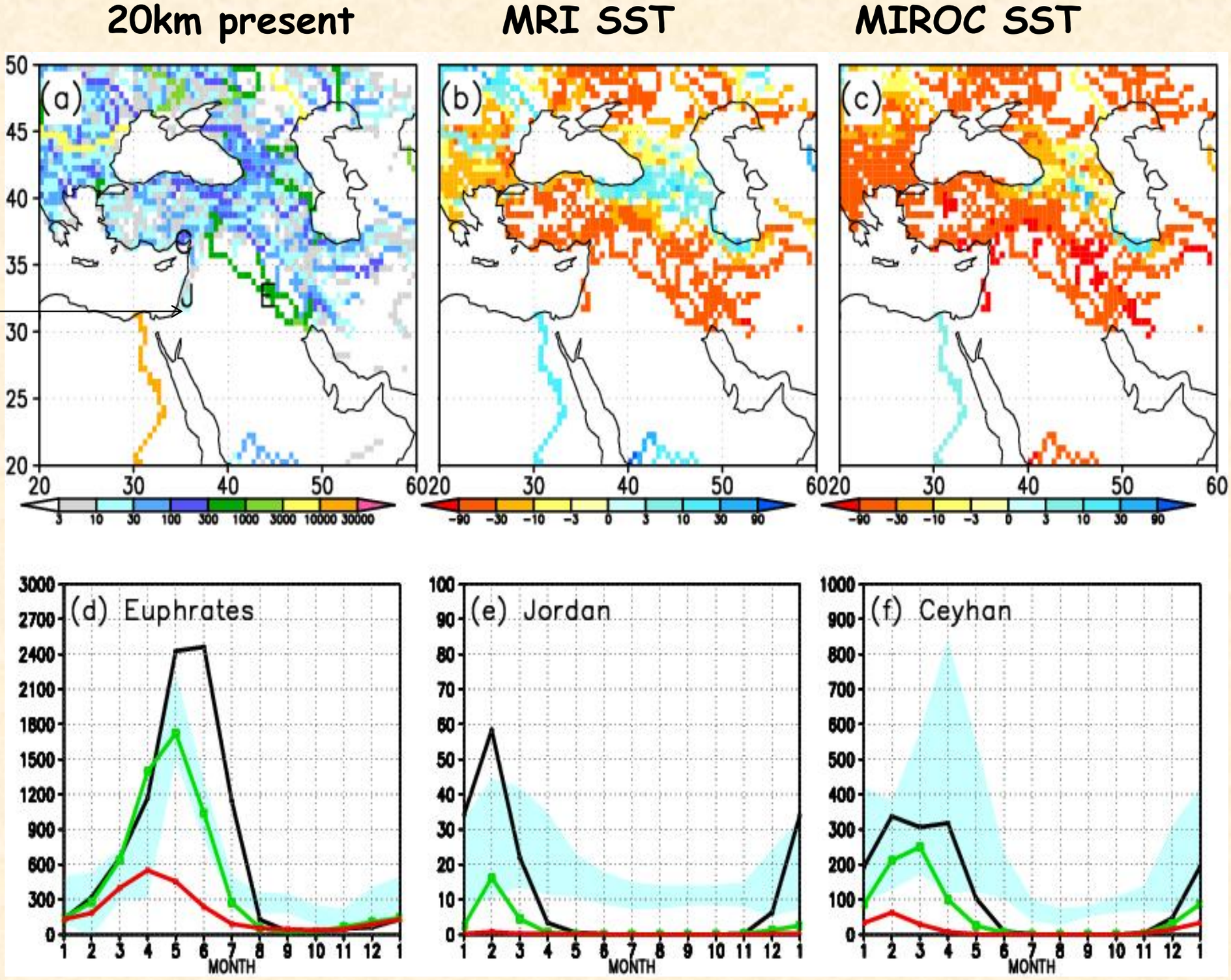
The Earth Simulator



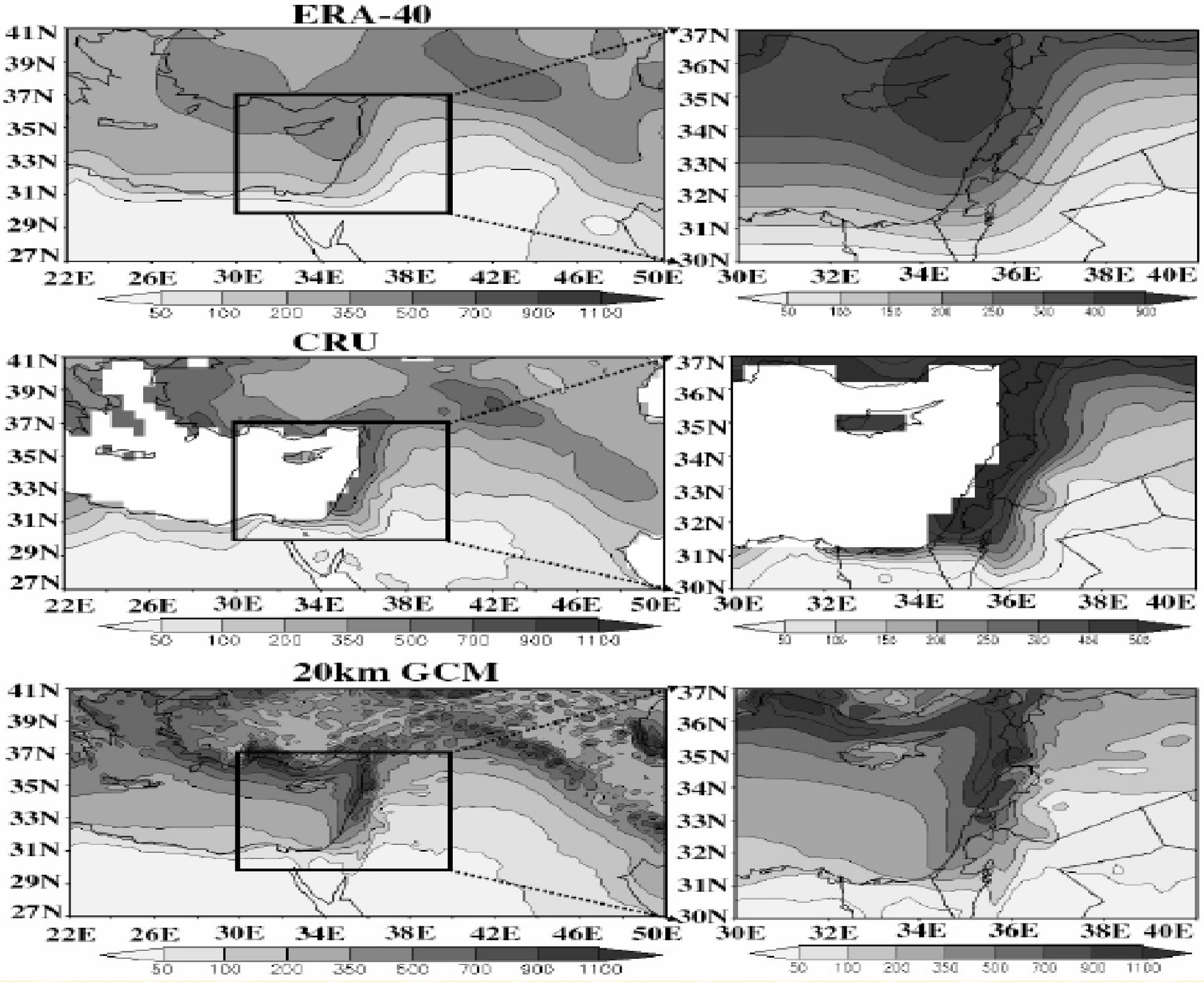
Annual Precipitation (mm/year) left panels-OBS



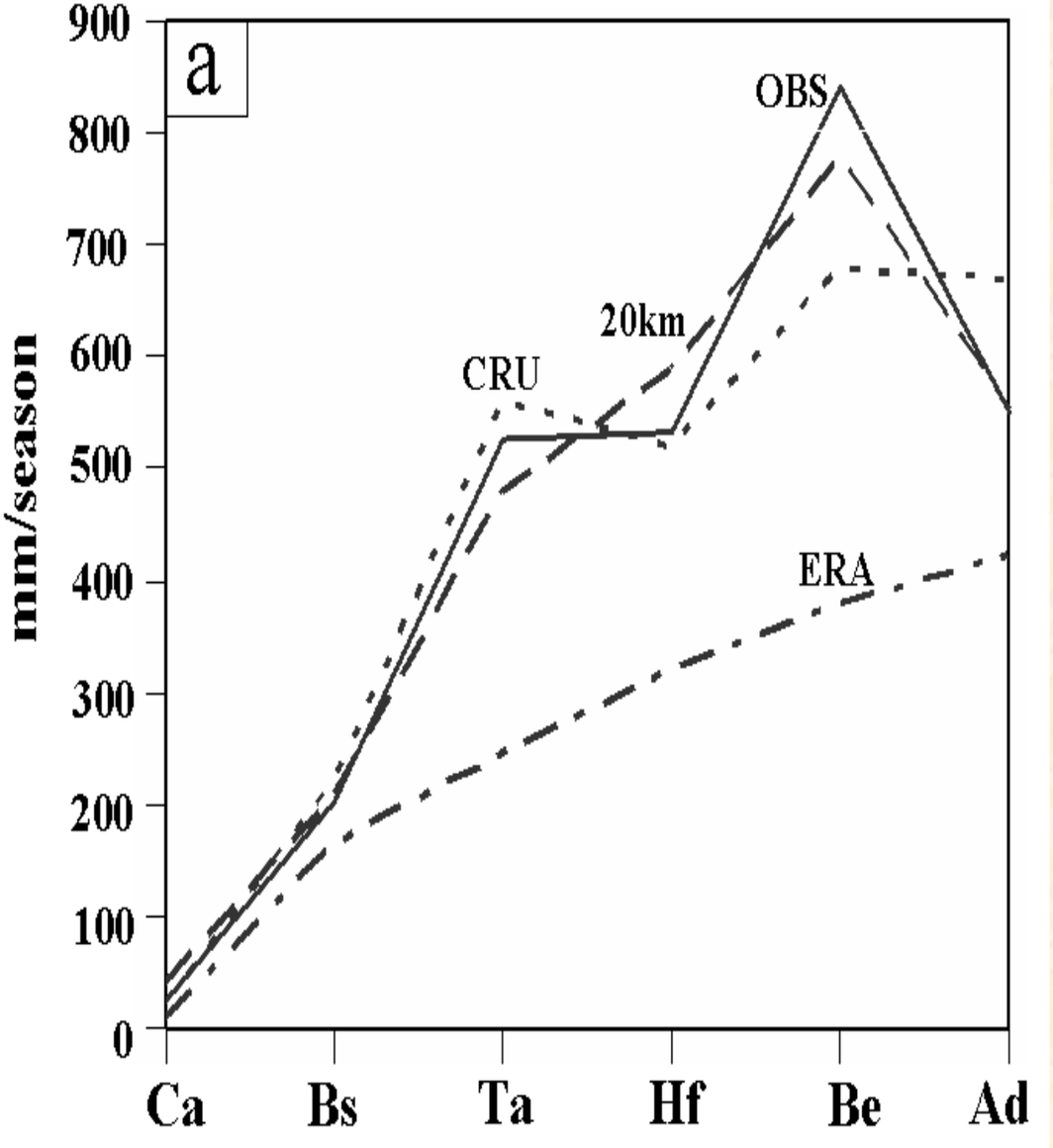
2081-2100 changes Streamflow in (m^3/s)

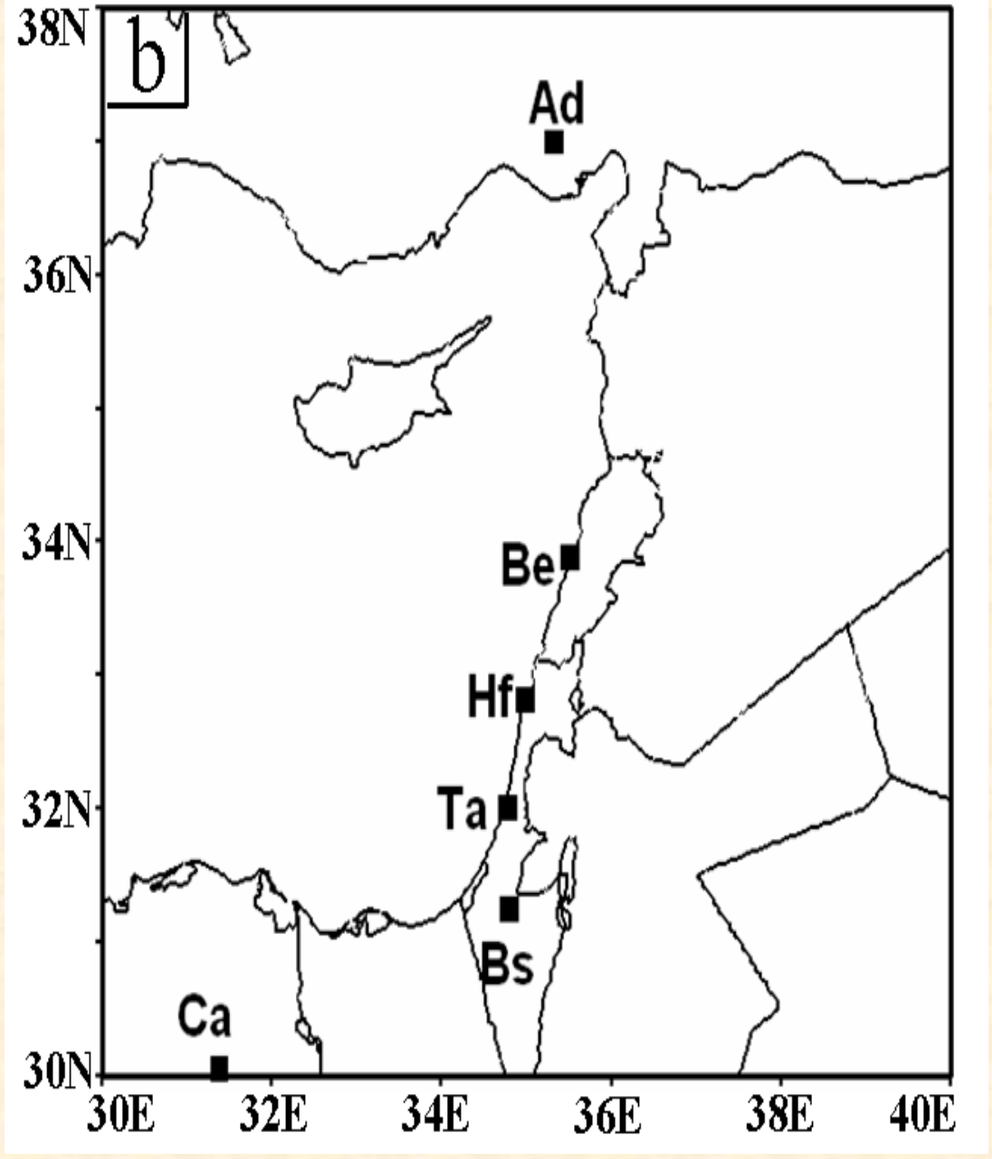


Total seasonal (Oct-Apr) average precipitation for 1979-2002



Comparison of average total observed seasonal P

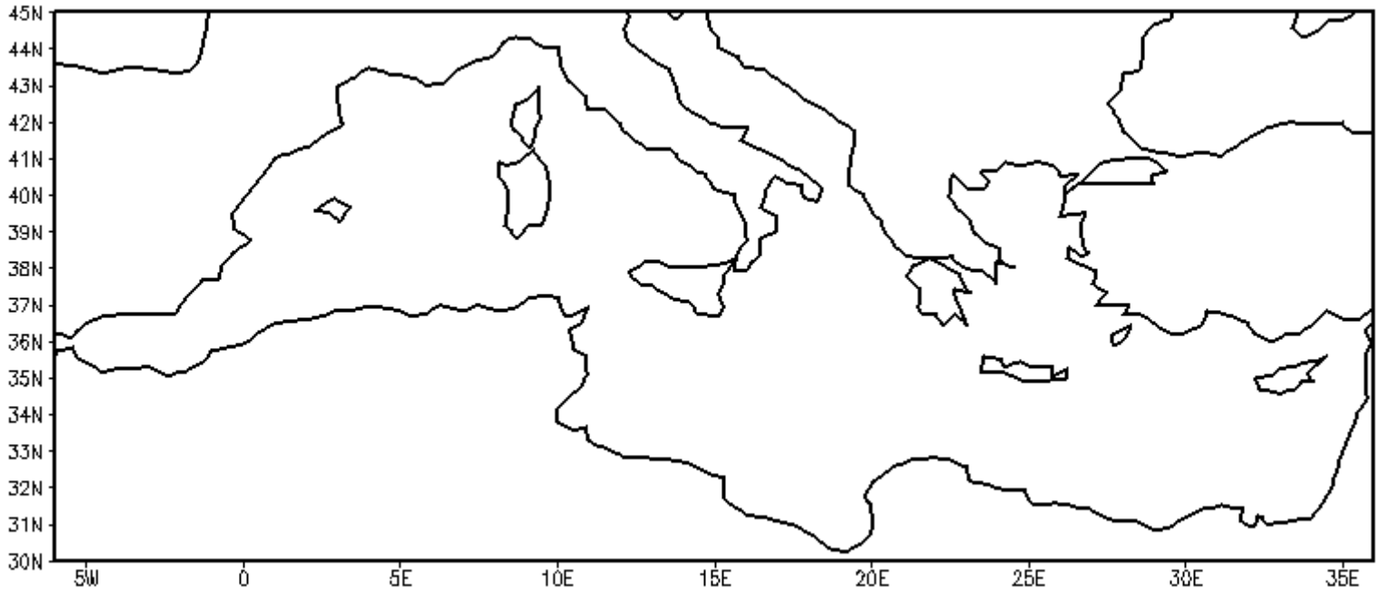


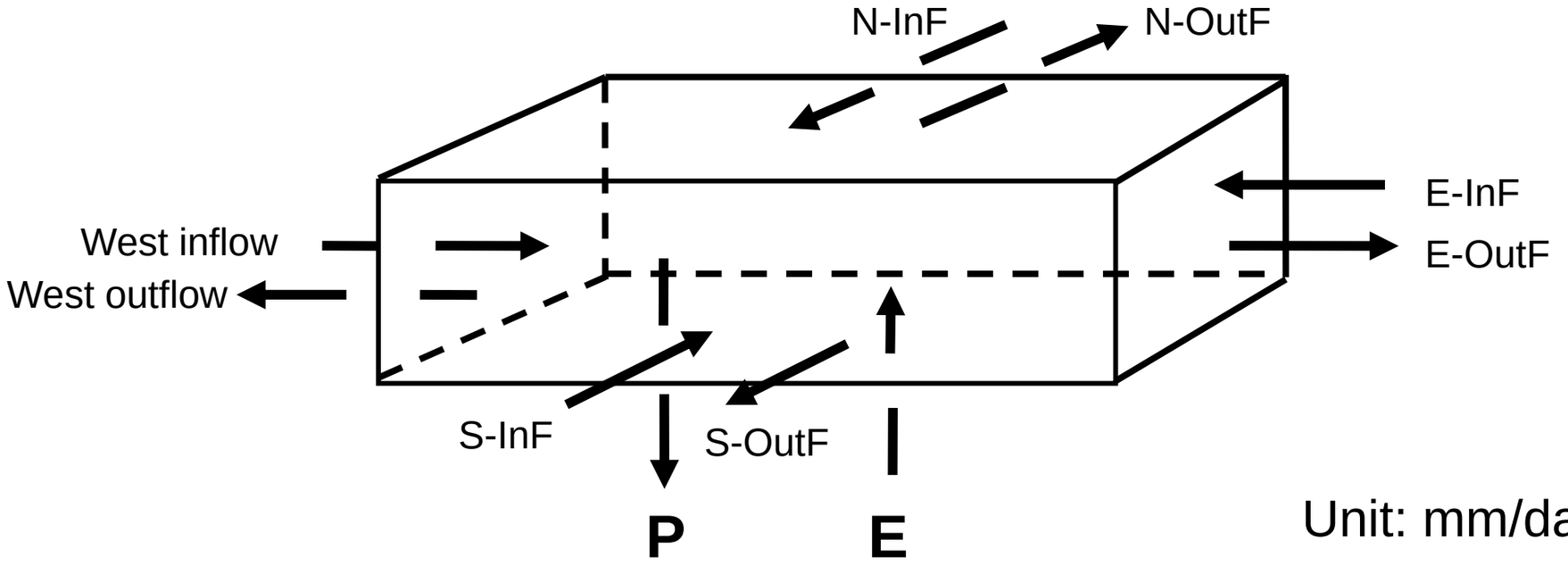


The six stations are from south-to-north, Egypt---Cairo (Ca,); Israel---Beer-Sheva (Bs), Tel-Aviv (Ta), Haifa (Hf); Lebanon---Beirut (Be) and Turkey---Adana (Ad). Unit: mm/season.

Water Budget components for different rainfall categories

Sketch map





Unit: mm/day

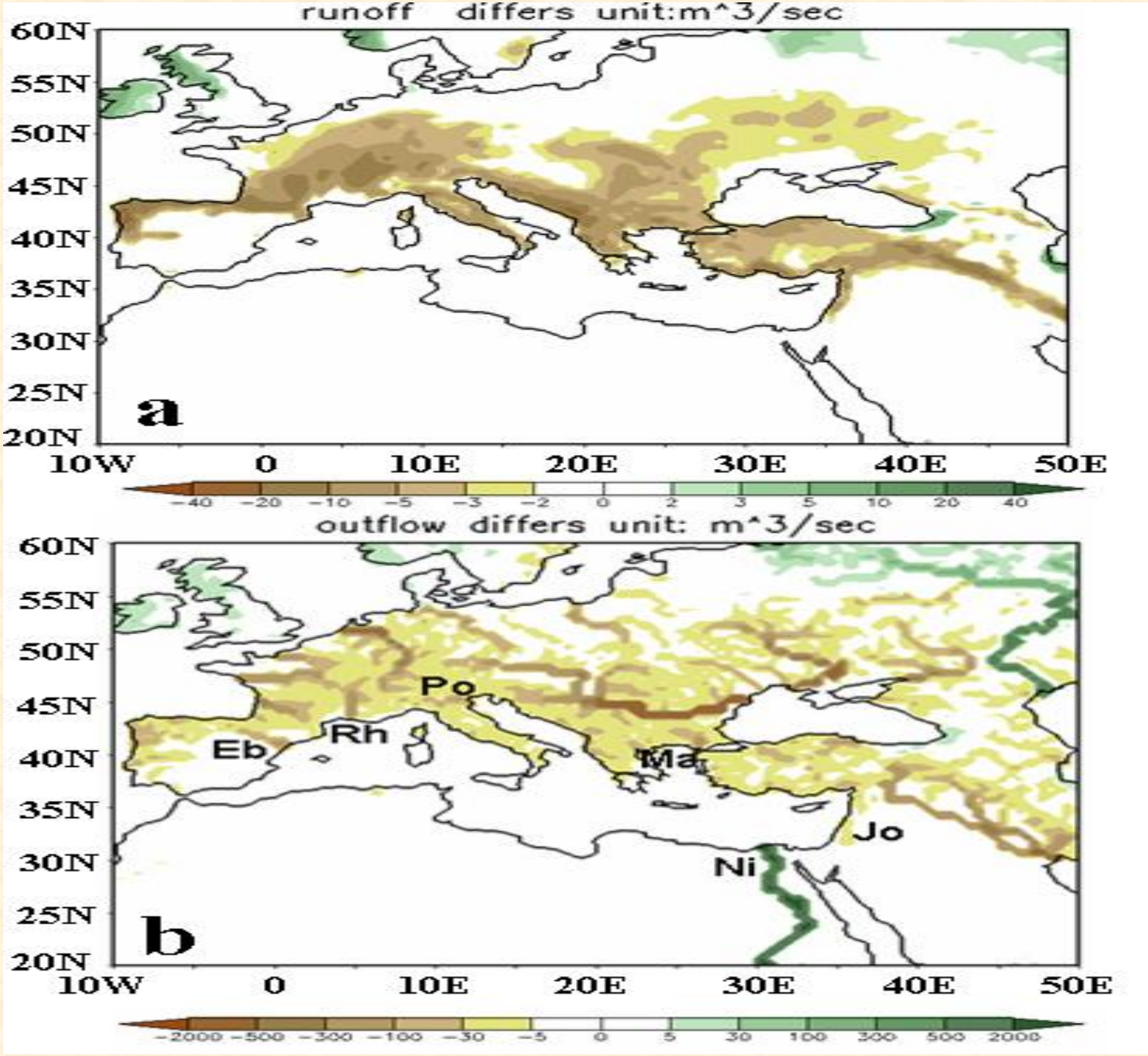
P Categories	1	2	3	4	5
Amount P	P<1	1<=P<1.5	1.5<=P<2	2<=P<2.5	P>=2.5

Five precipitation categories based on monthly averages in (mm/d) over the whole Mediterranean- current & future

Precipitation categories	Current			Future		
	months	percentage	Aver_P	months	percentage	Aver_P
P<1	7	5%	0.90	19	13%	0.75
1.5>p>=1	41	24%	1.29	33	23%	1.26
2>p>=1.5	54	32%	1.76	61	42%	1.72
2.5>p>=2	46	27%	2.24	23	16%	2.17
P>=2.5	20	12%	2.72	8	6%	2.75
Sum	168 (28 y)	100%	1.85 (Mean P)	144 (24 y)	100%	1.62 (Mean P)

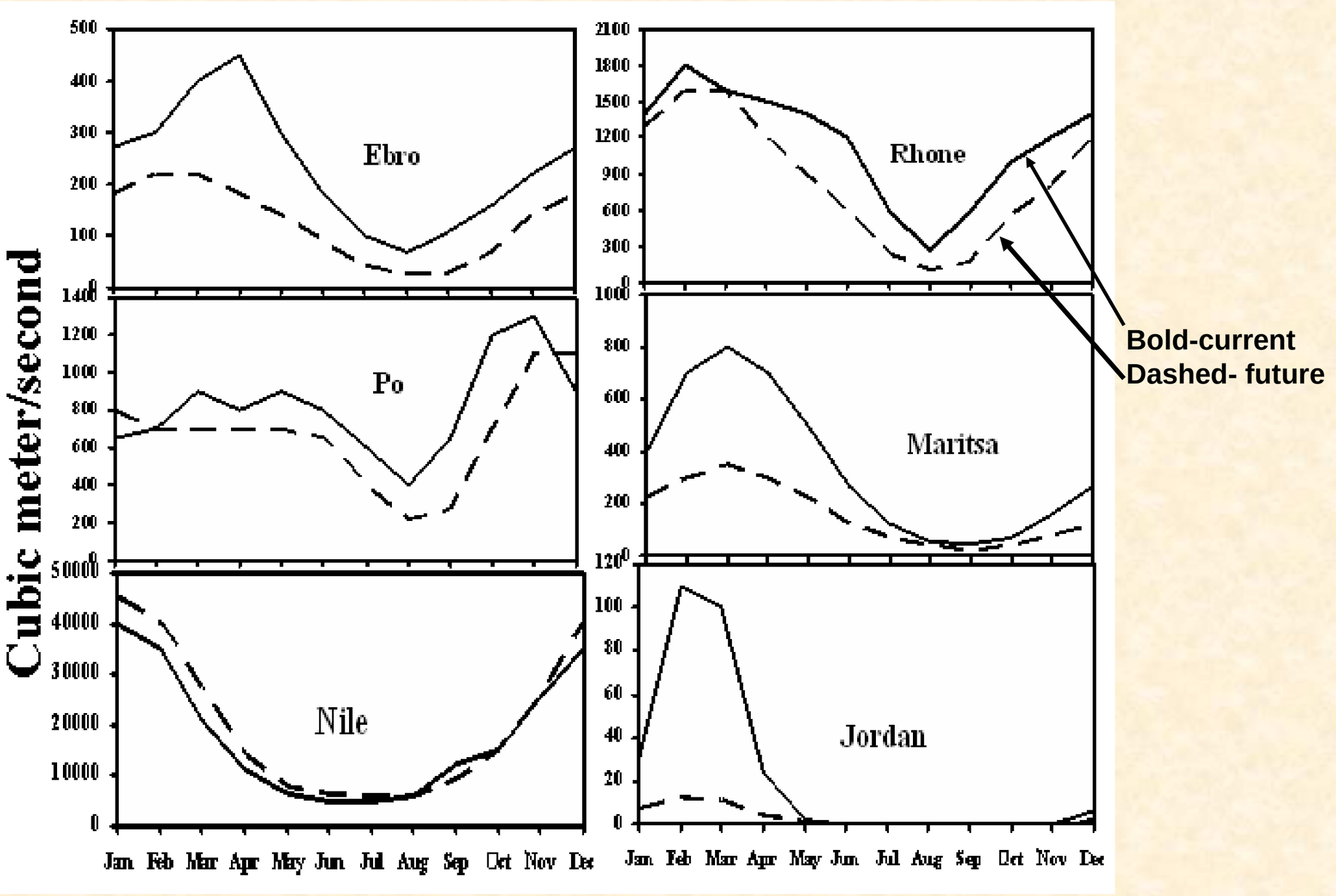
Results and discussions

Changes of runoff and river discharge by 1979-2003 compared to (2075-2099).



(a) runoff (b) river discharge. Six rivers are marked as Ebro (Eb), Rhone (Rh), Po (Po), Maritsa (Ma), Jordan (Jo) and Nile (Ni). Unit: (m^3/s).

Seasonal changes of monthly mean river discharge of six rivers (1979-2003; bold), compared to (2075-2099; dashed).



Except to the Jordan River, all rivers flow into the Mediterranean (m^3/s). Bold lines are for current climate, while dashed for the future.

Year **2011**

Ensemble of High-Resolution Climate Runs-

Chosen Rainfall Parameters

- Amounts:

  Total yearly rainfall in mm

- Wet Spells:

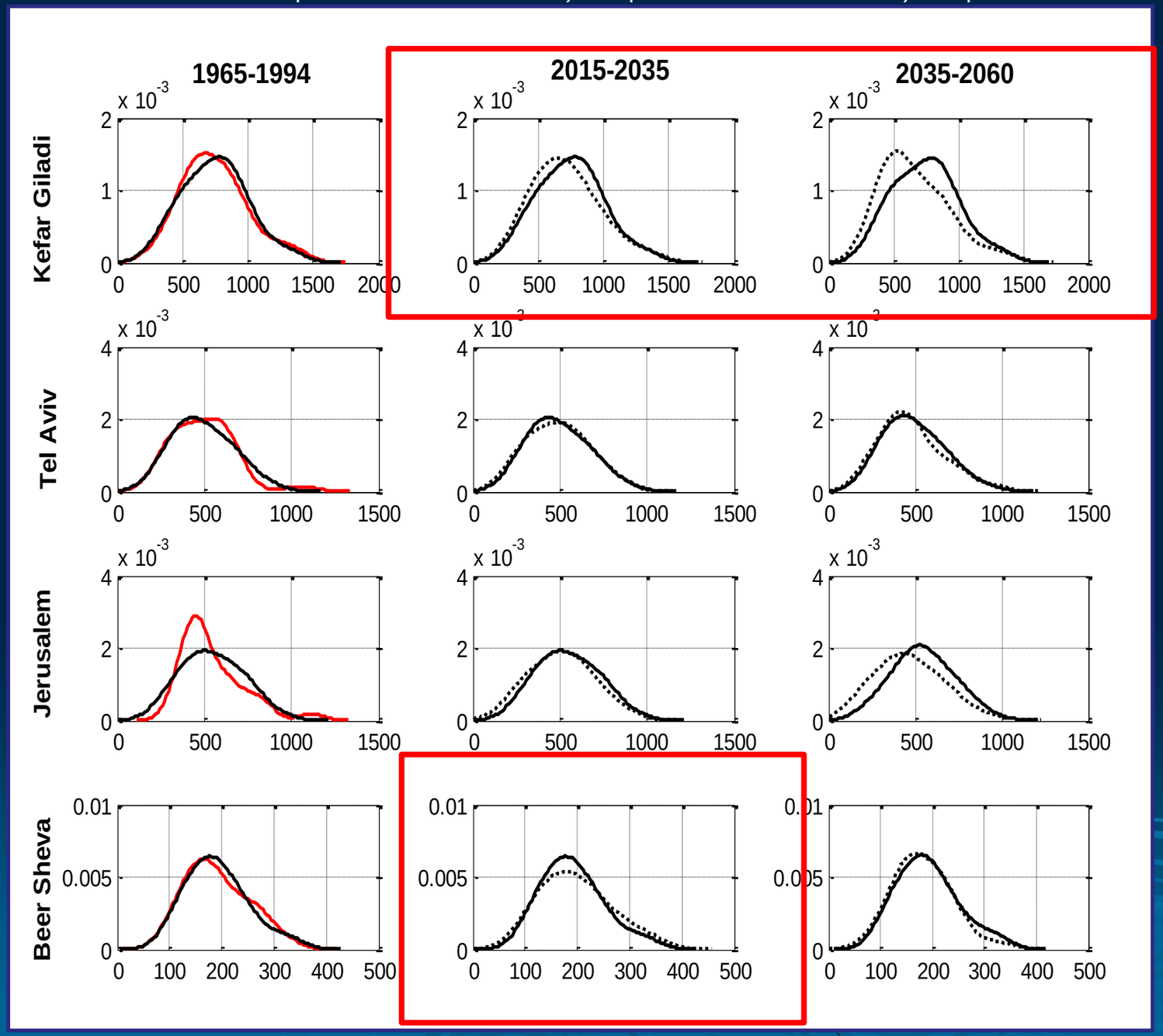
  The number of three day wet spells within a wet season

Change in JSD calculated PDF over time for Average Annual Amounts

shows observed data (red) and calculated past

near future (2015-2035 - dashed) and past calculated

far future (2035-2060 - dashed) and past calculated

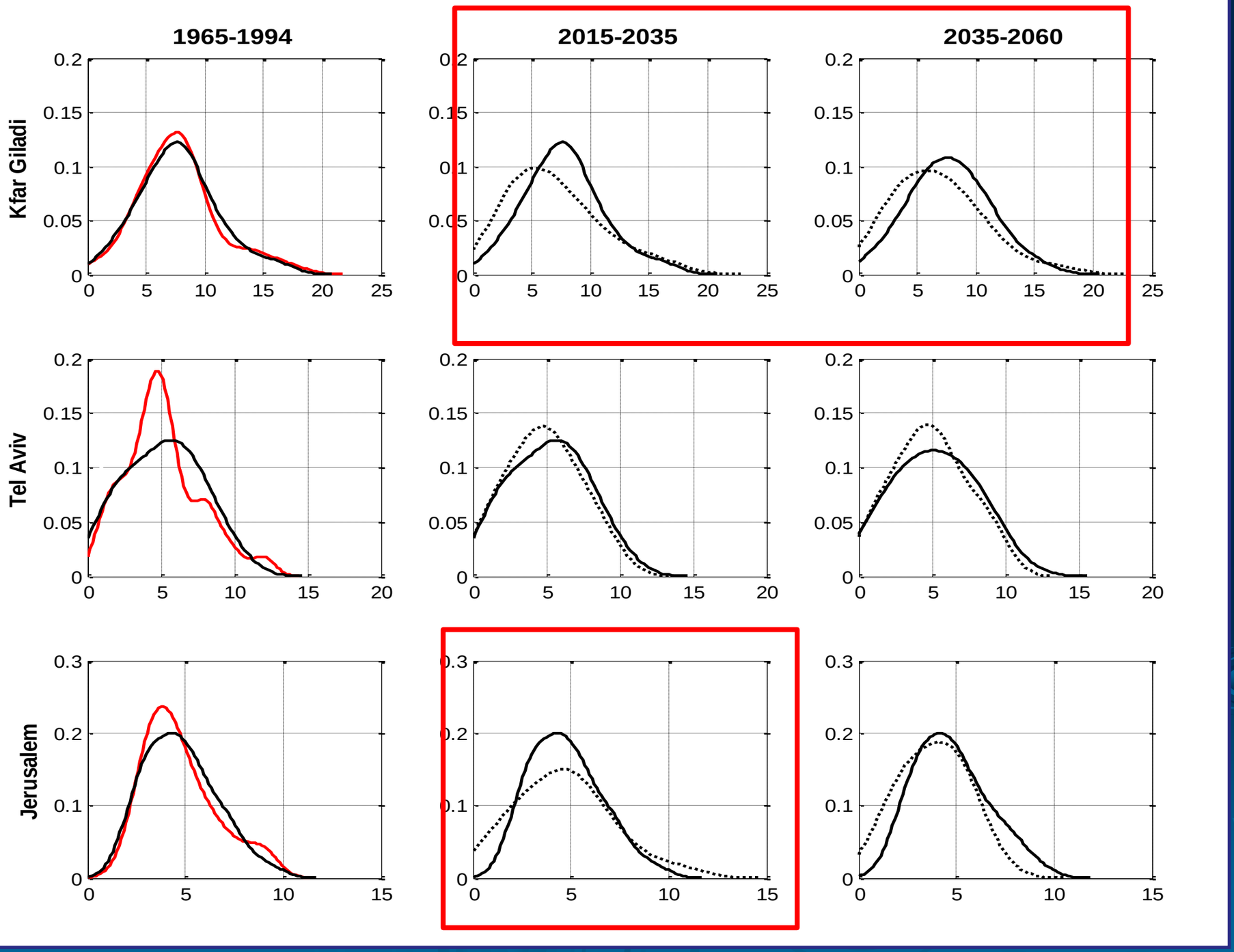


Change in JSD calculated PDF over time for Number of Wet Spells

shows observed data (red) and calculated past

near future (2015-2035 - dashed) and past calculated (1965-1990 - solid).

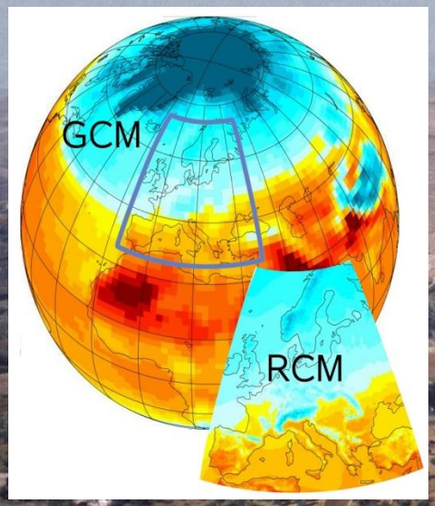
far future (2035-2060 - dashed) and past calculated (1965-1990 - solid).



Number of Spells

GLOWA Jordan River

Final Conference Limassol, Cyprus, 2011



Jordan River

GLOWA

Climate Change Simulations for the Jordan River Area

G. Smiatek, H. Kunstmann, A. Heckl
KIT/IMK-IFU, Germany

S. Krichak, P. Alpert, R. Samuels
Tel Aviv University, Israel

Tel Aviv University

Karlsruhe Institute of Technology

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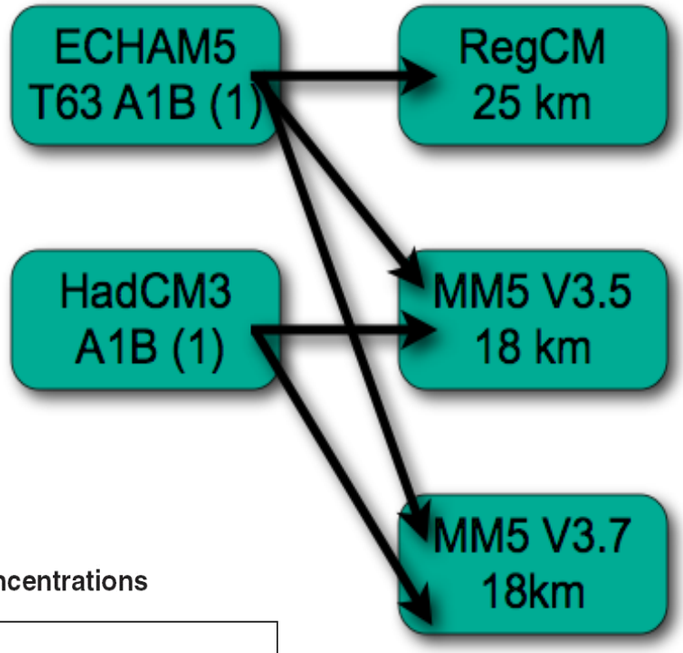
Federal Ministry of Education and Research

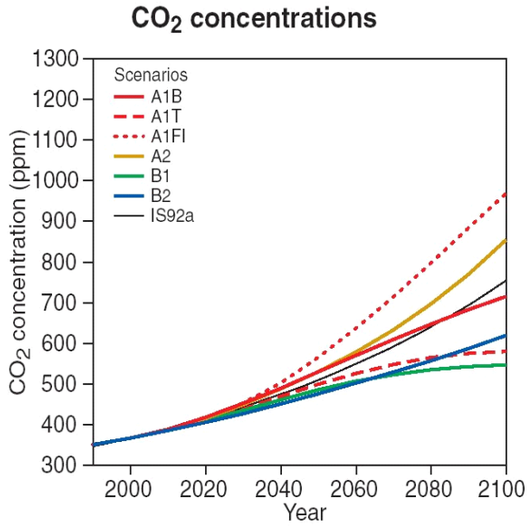
Simulation Procedure

Applied RCM models:
1.RegCM3
2. MM5 V. 3.5 with OSU soil-vegetation -atmosphere transfer model
3. MM5 V. 3.7 with NOAH LSM

AOGCM driving data :
1. HadCM3 (Hadley Centre, UKMO)
2. ECHAM5 (MPI, Hamburg)

SRES Scenario: A1B
Time Period: 1960- 2060 (2100)

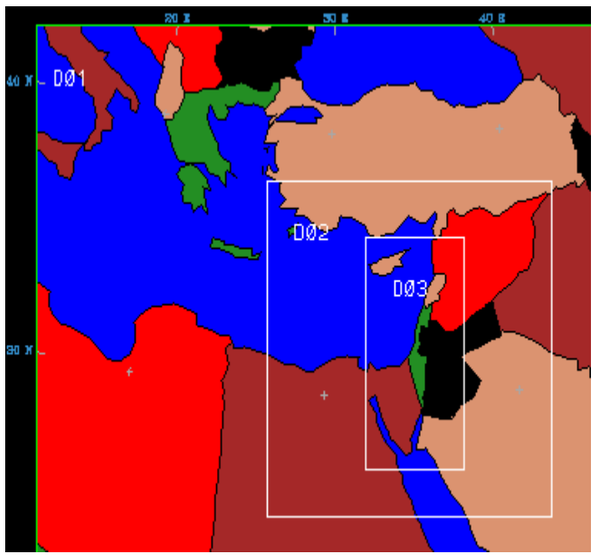




Resolution and Domain Configuration

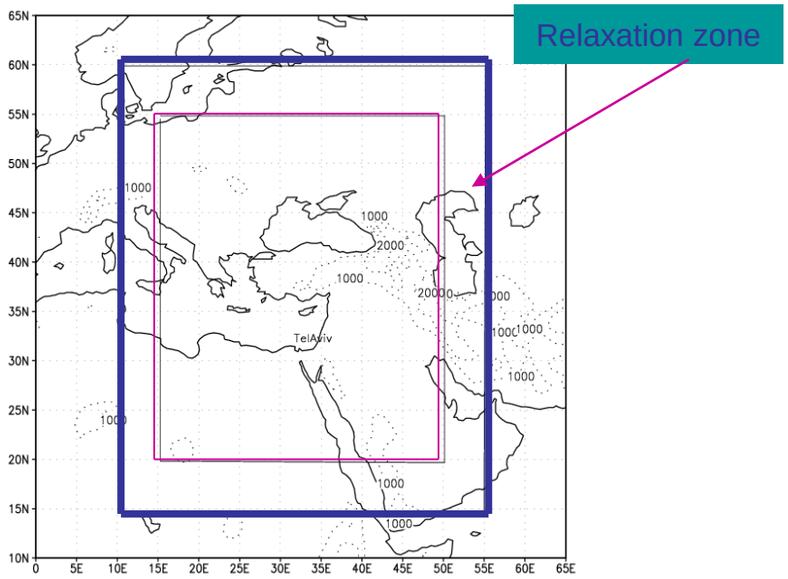
- MM5 (KIT), RegCM3 (TAU)

MM5v3.5 & MM5v3.7



Two nested domains
D01 – 54 km/25L; D02 -18 km/25L

RegCM3



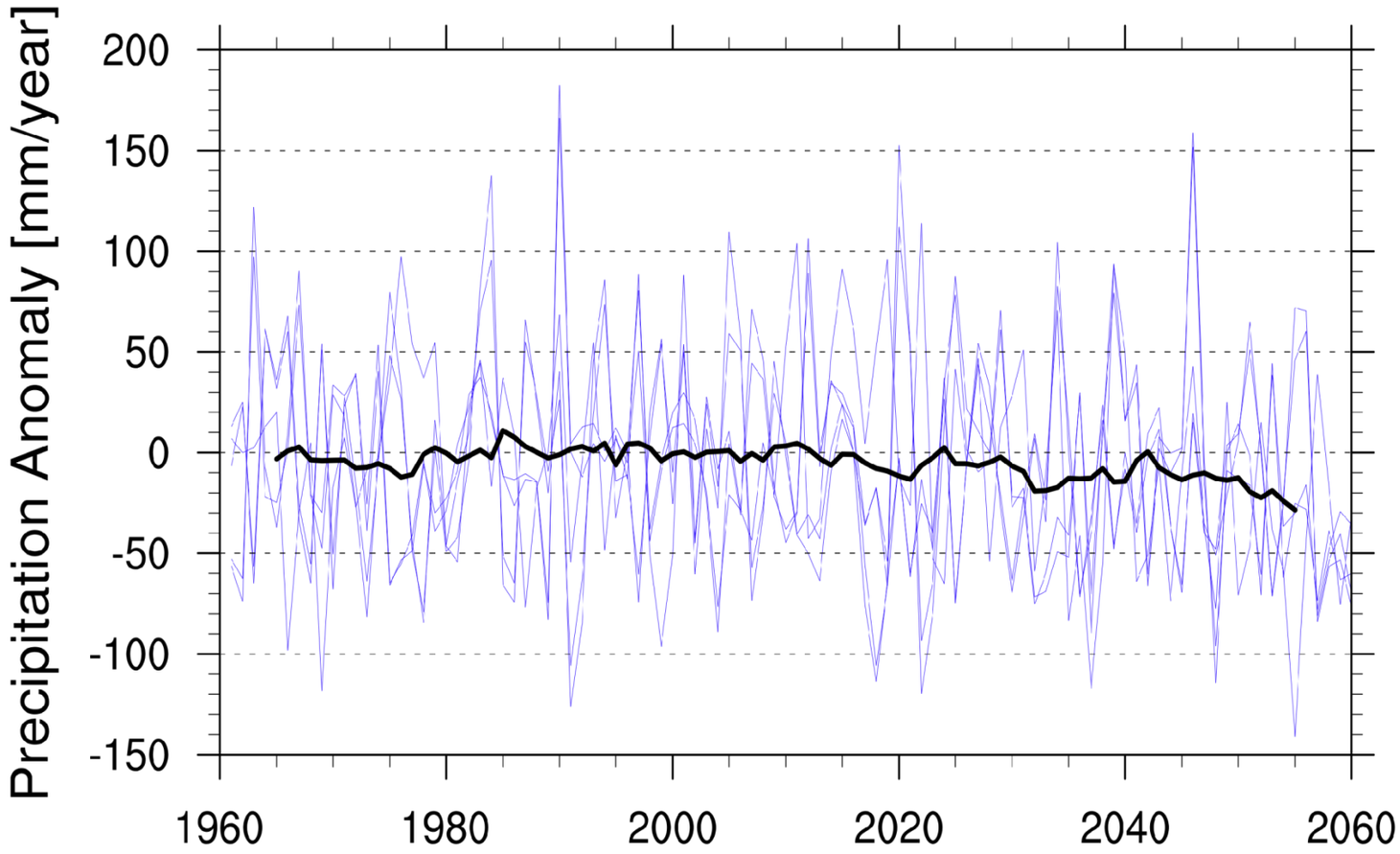
One domain
25 km/18L

Model Simulation Results

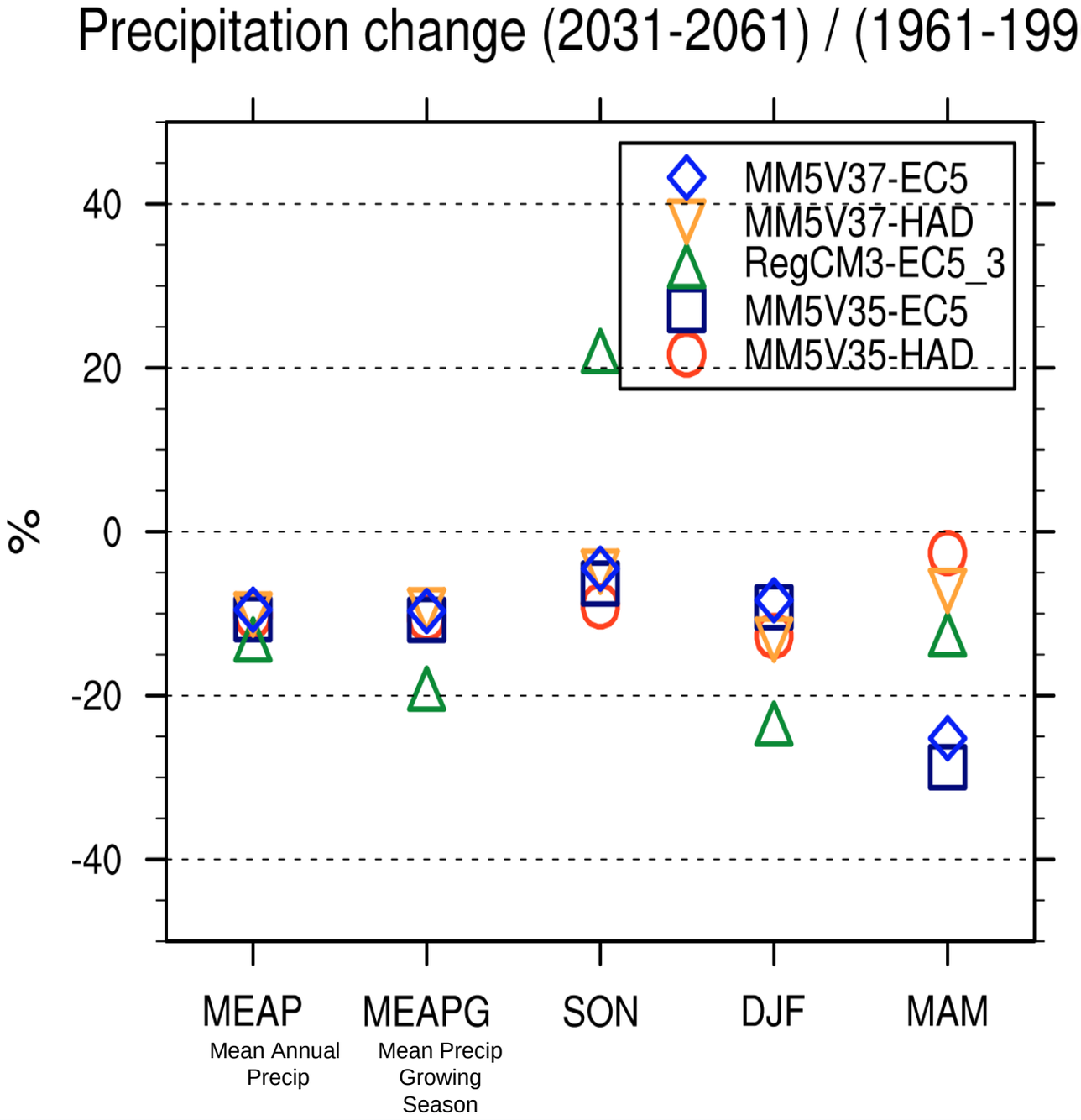
PRECIPITATION

Simulated Future Climate

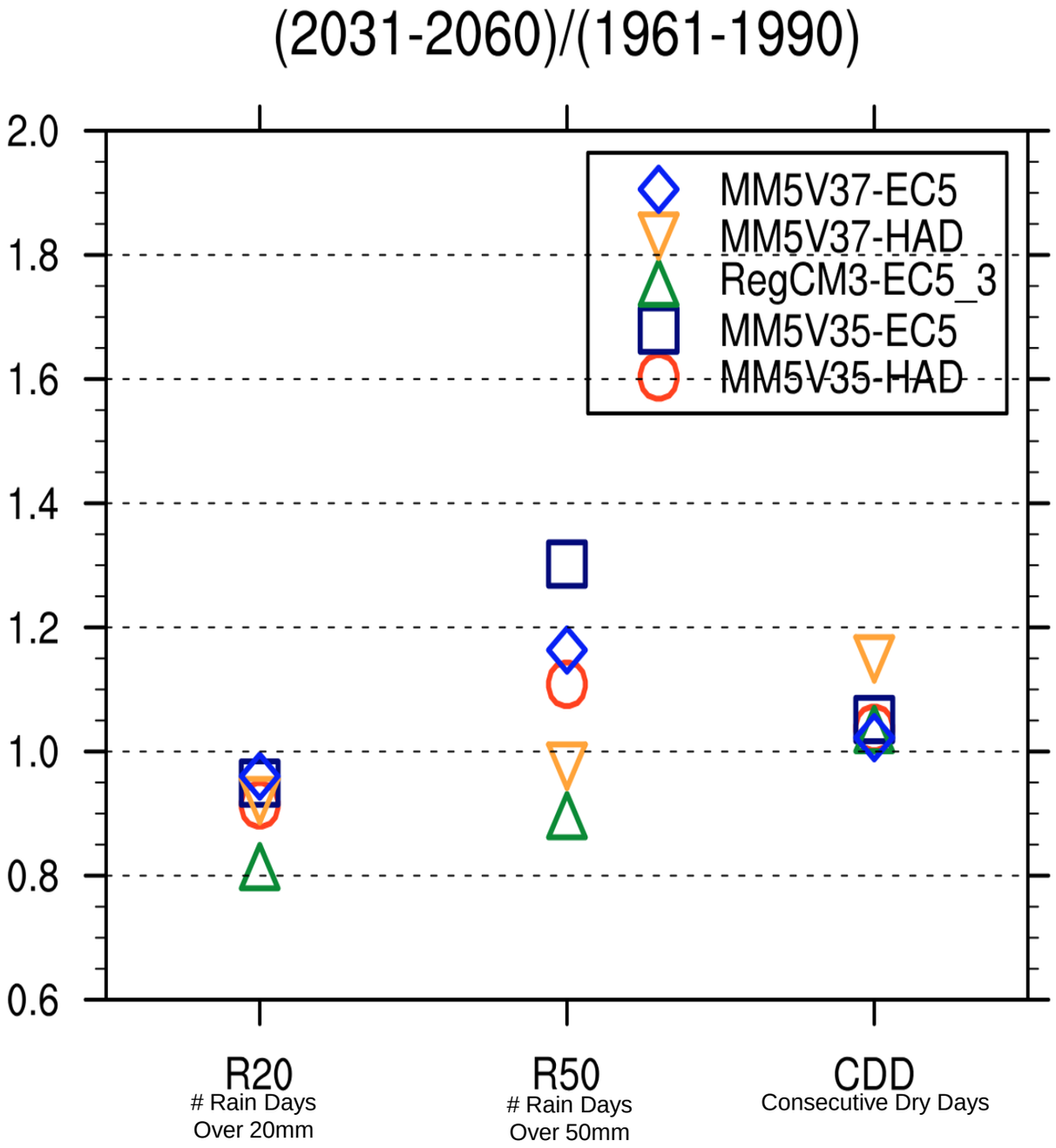
Precipitation Anomaly from 1961 – 1990, mean



Precipitation indicators: Seasonal Mean



Precipitation indicators: Extremes



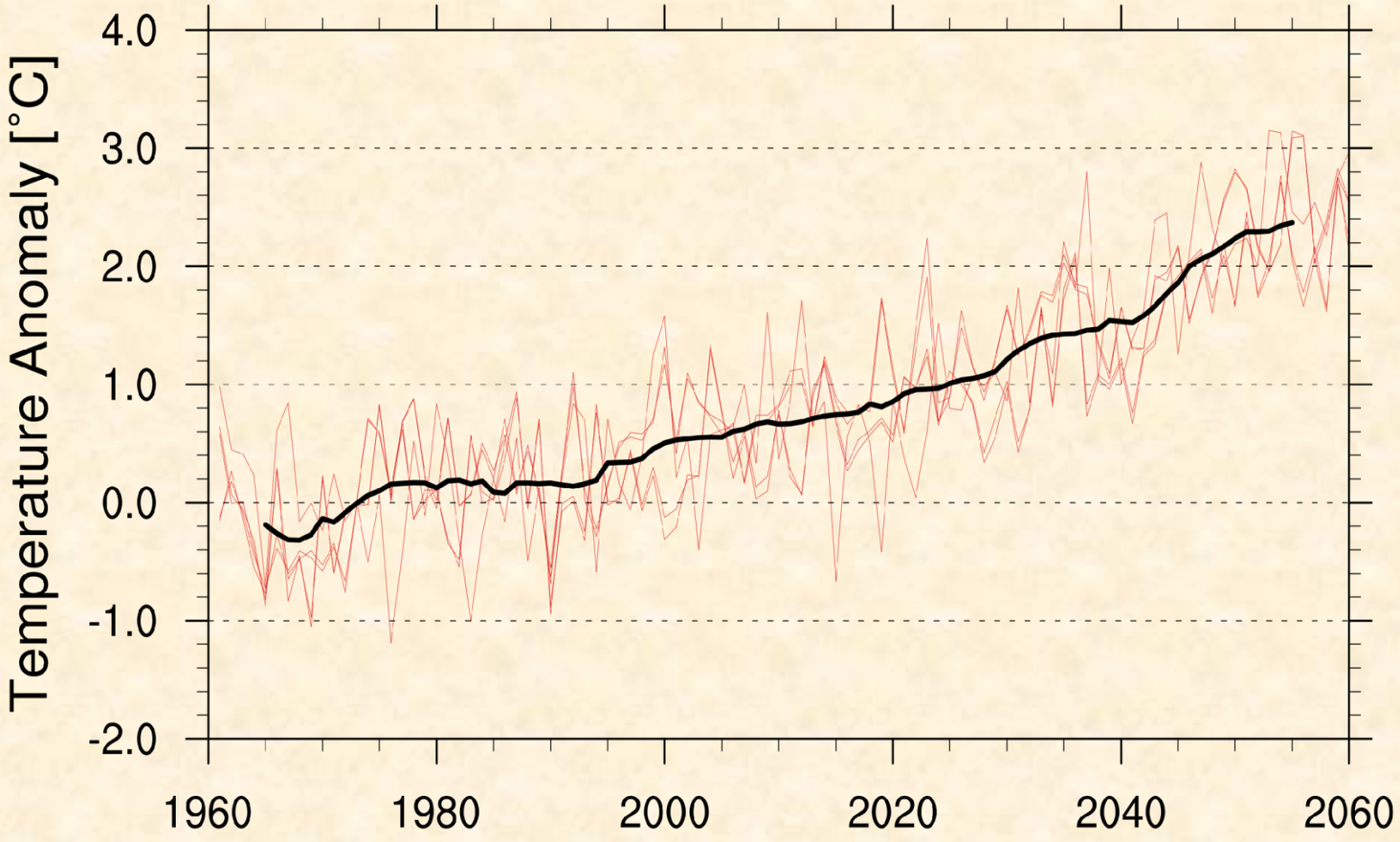
Model Simulation Results

TEMPERATURE

Simulated Future Climate

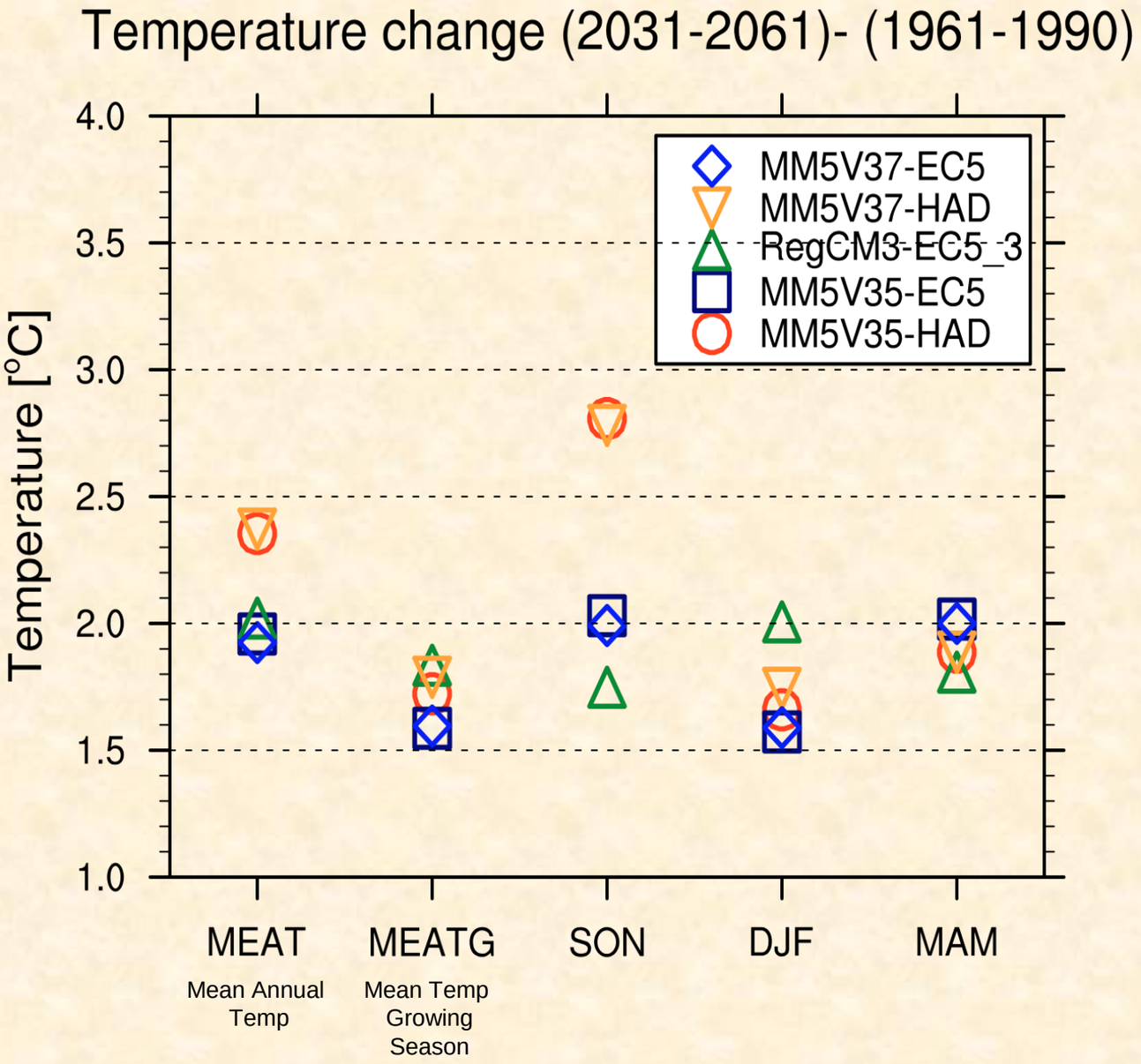
Temperature Anomaly 1961 – 2060,

Control 1961-1990

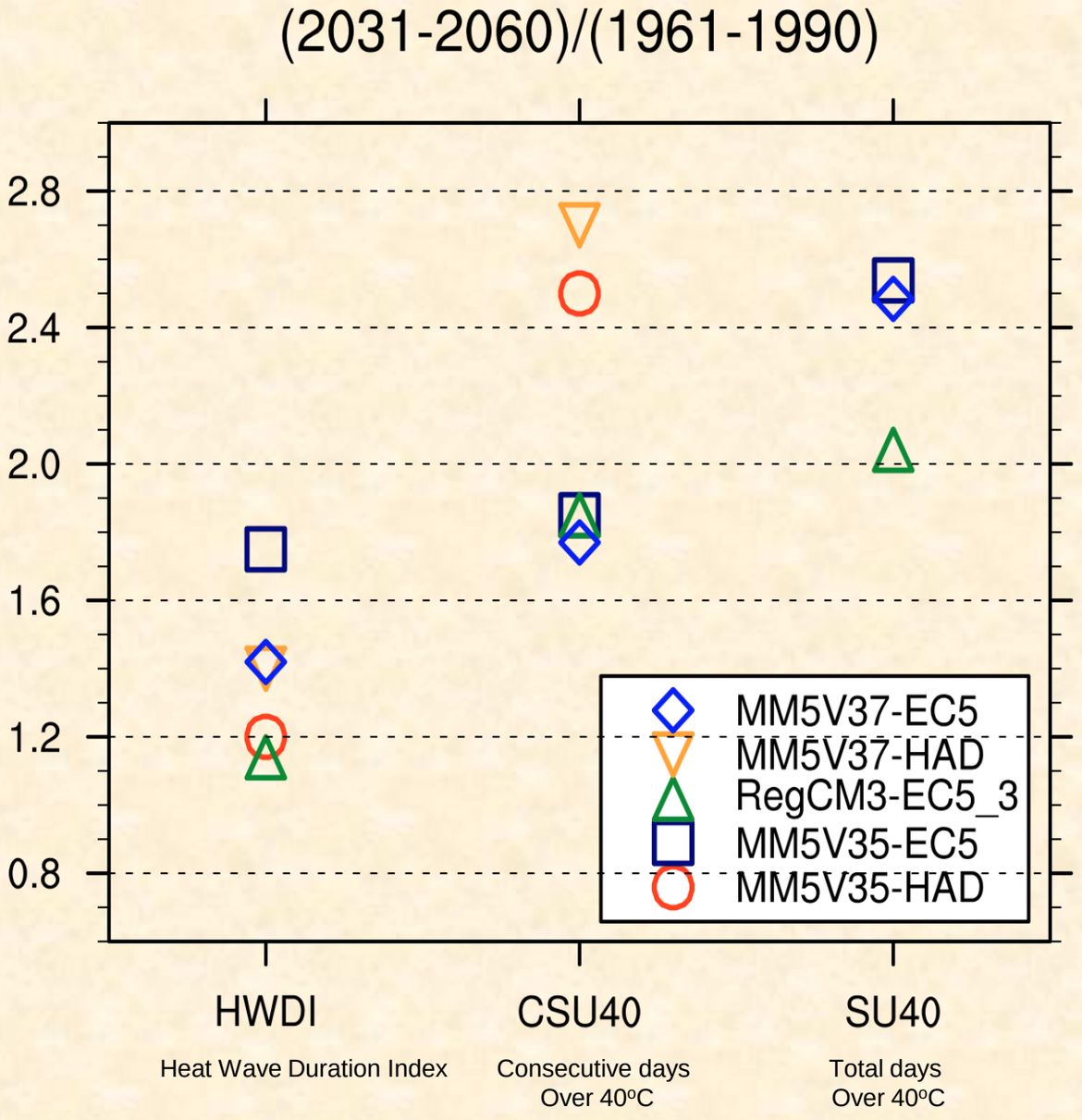


G. Smiatek, H. Kunstmann, A. Heckl, S. Krichak, P. Alpert, R. Samuels

Temperature Indicator: Area Mean



Temperature Extremes: Area Mean



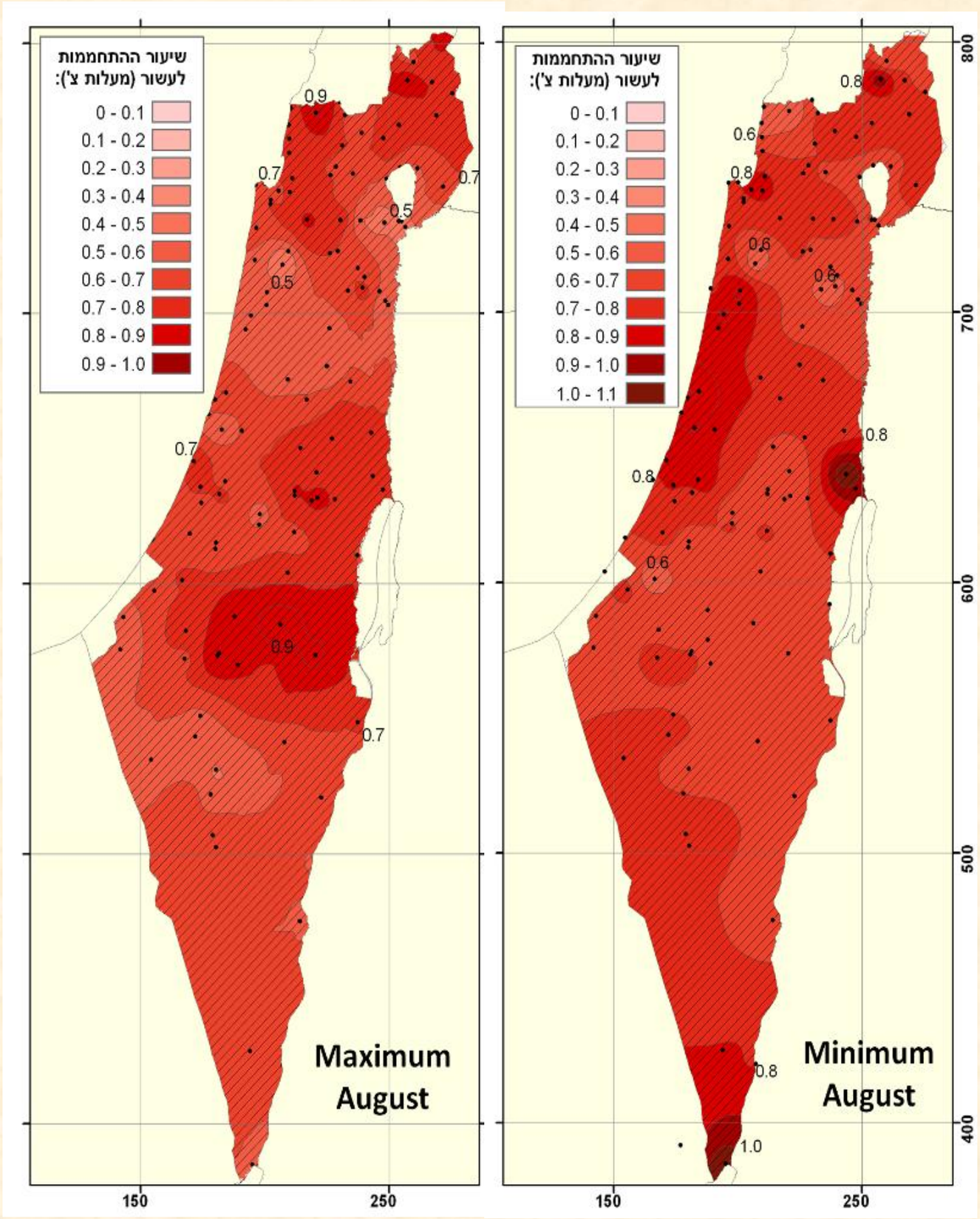
Conclusions

Performed climate change simulations

- For the period 2021-2050 :
  - Increase of the mean summer (JJA) temperatures up to 3 ° C
  - Increase of the mean annual temperatures up to 2 ° C
  - Decrease of the annual mean precipitation in range of 10 to 20 %
- Increase in extreme events – temperature and precipitation
- High variability between model simulations provides a range as well as ensemble results
- Multiple data sets available for GLOWA partners and stakeholders

Observed Trends & extremes in Israel 2010-1975

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.



T min & T max trends In August 1975-2010 (deg/decade)

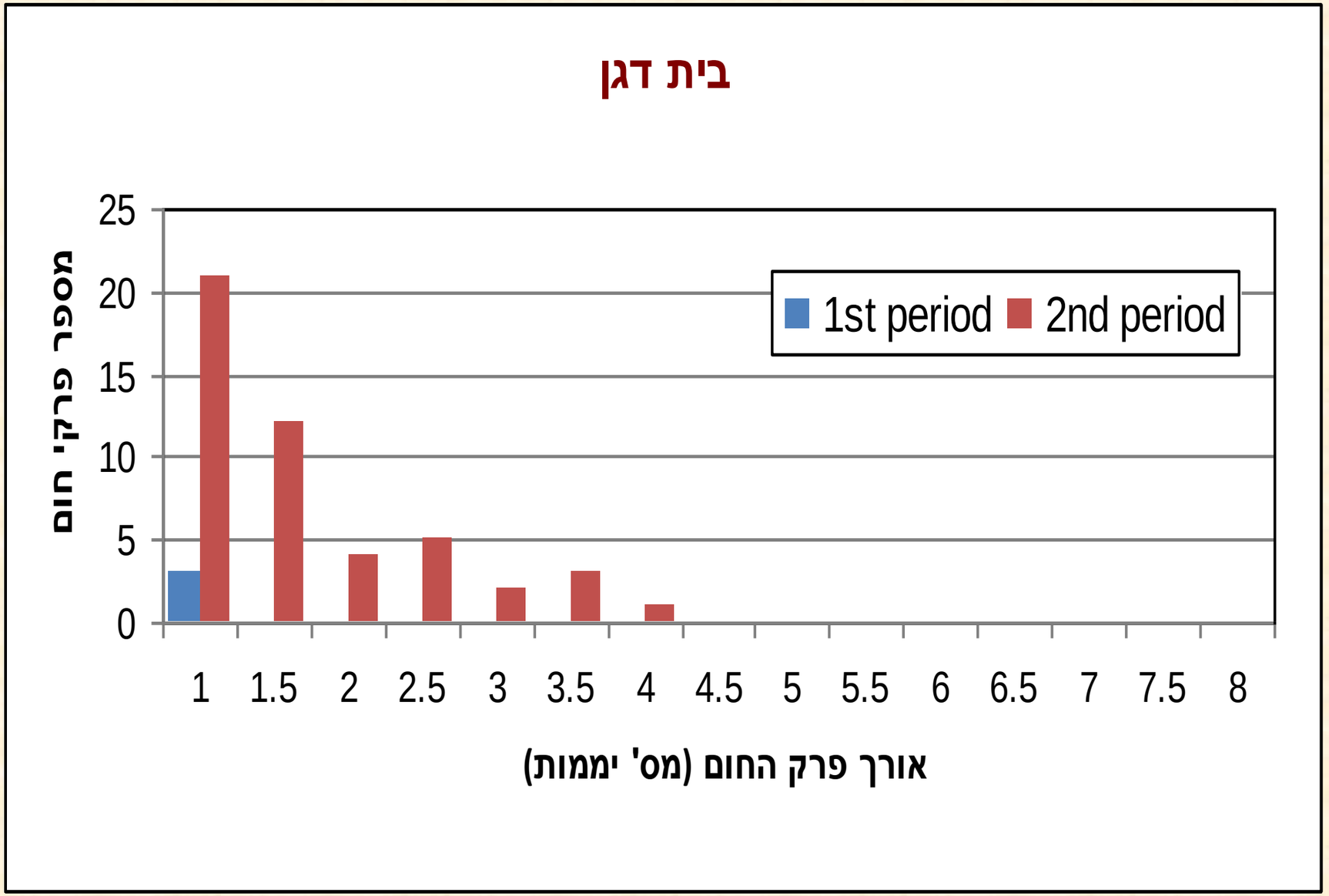
Trends in number of Hot Days (March-Nov)

Eilat	Sde-Boqer	Ein-Hachoresh	Bet-Dagan	Jerusalem	Knaan Mount	Masada	Threshold	
172.8	50.6	13.7	16.0	11.3	11.9	145.1	> 33	Number of hot days above different thresholds
130.0	9.9	4.3	4.5	1.5	1.5	90.6	> 36	
69.5	1.1	1.0	1.1	0.0	0.0	23.1	> 39	
68.0						2.6	> 42	
+2.4	**+7.6**	**+2.0**	**+3.2**	**+2.8**	**+2.6**	+3.4	> 33	Trends (days/decade)
+5.0	+1.0	+0.7	+0.5	-0.1	+0.2	**+9.7**	> 36	
+8.2	+0.1	+0.0	-0.0	+0.0	+0.0	**+5.6**	> 39	
+8.9						+0.6	> 42	

95% significance bold

בכל האזורים מספרם של הימים החמים עולה. המגמה מובהקת בגבול השרב (33°C), בשיעור העולה על 5% לעשור ברוב האזורים

Number of Heat Waves vs. length (d) for July-August



Upper percentile

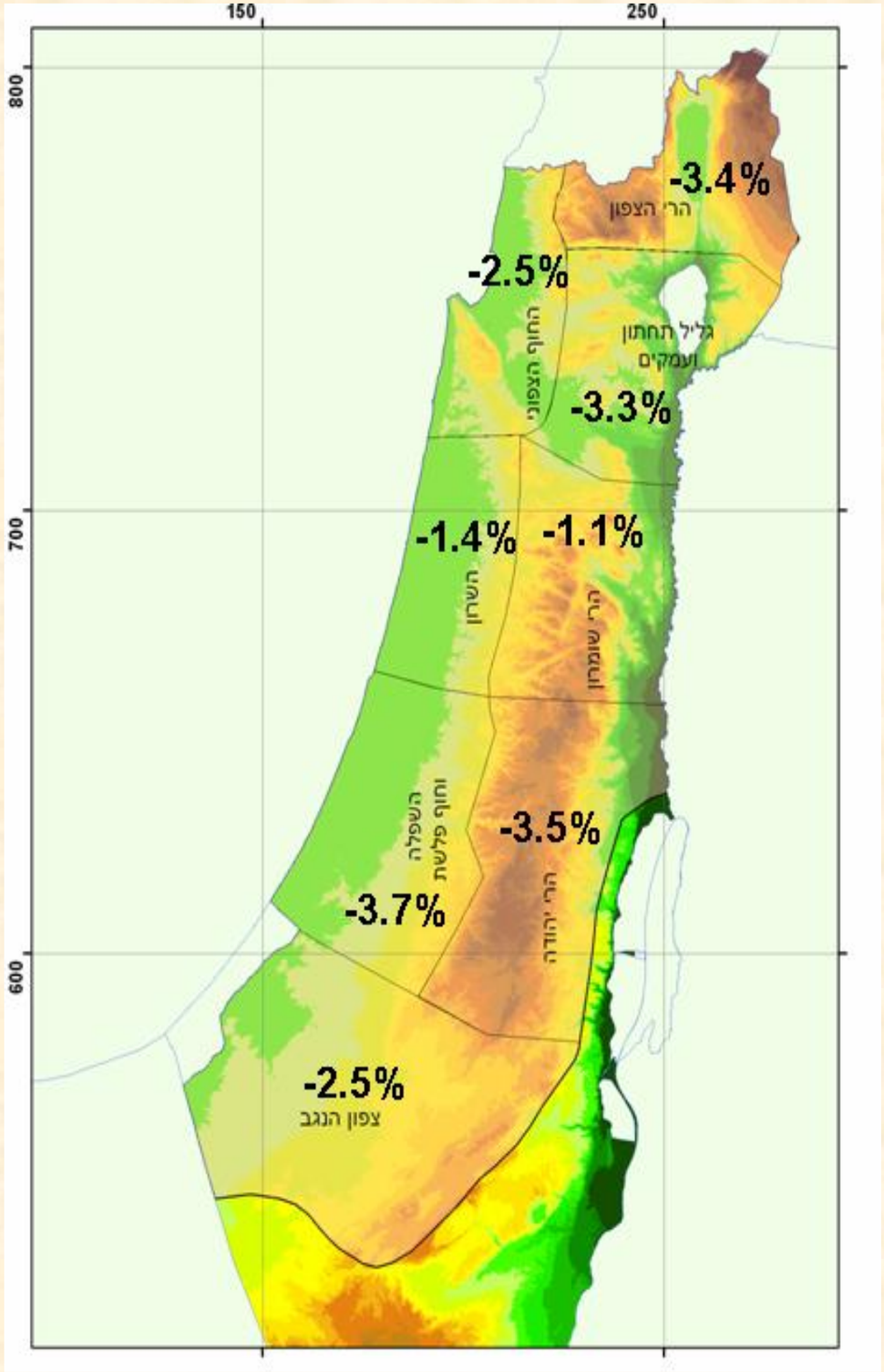
T- value

T_{max}= 32.7°C

T_{min}= 23.4°C

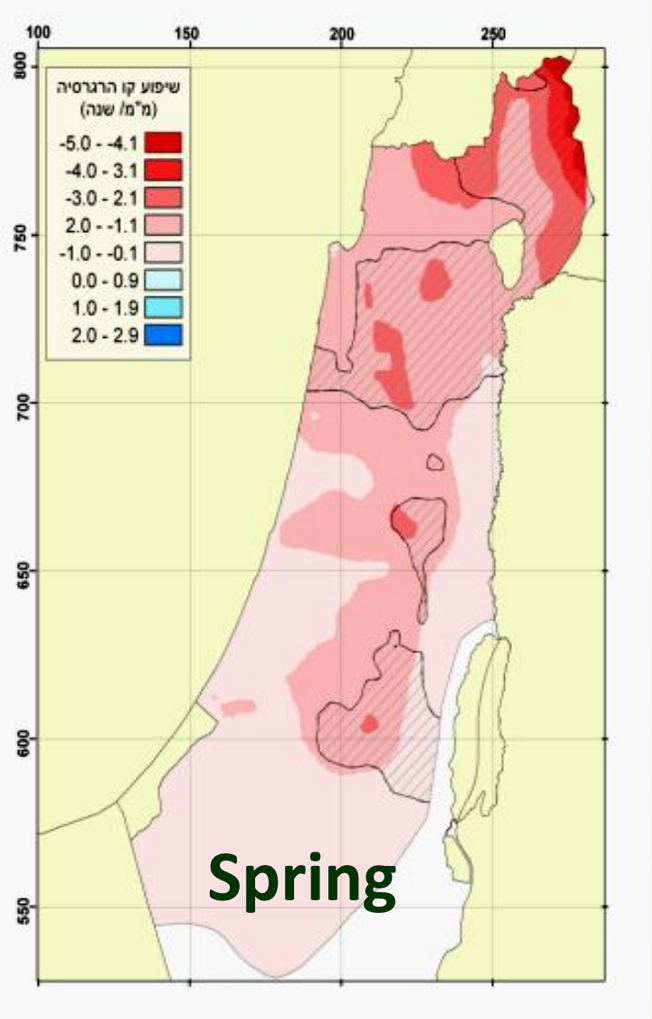
More Heat Waves & Longer

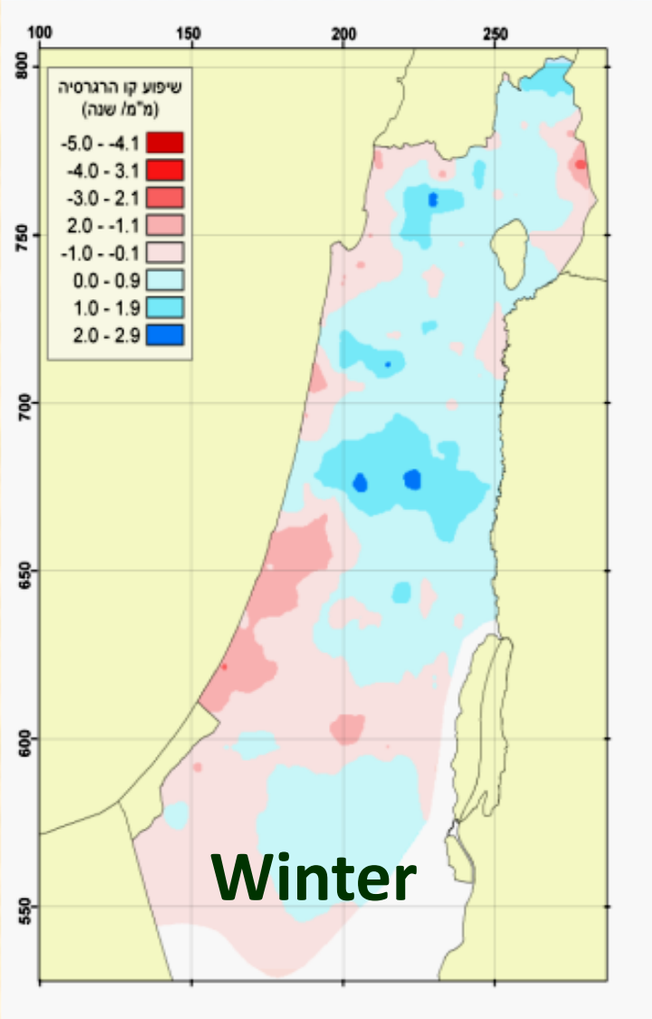
Bet-Dagan 1992-2009 & 1975-1992

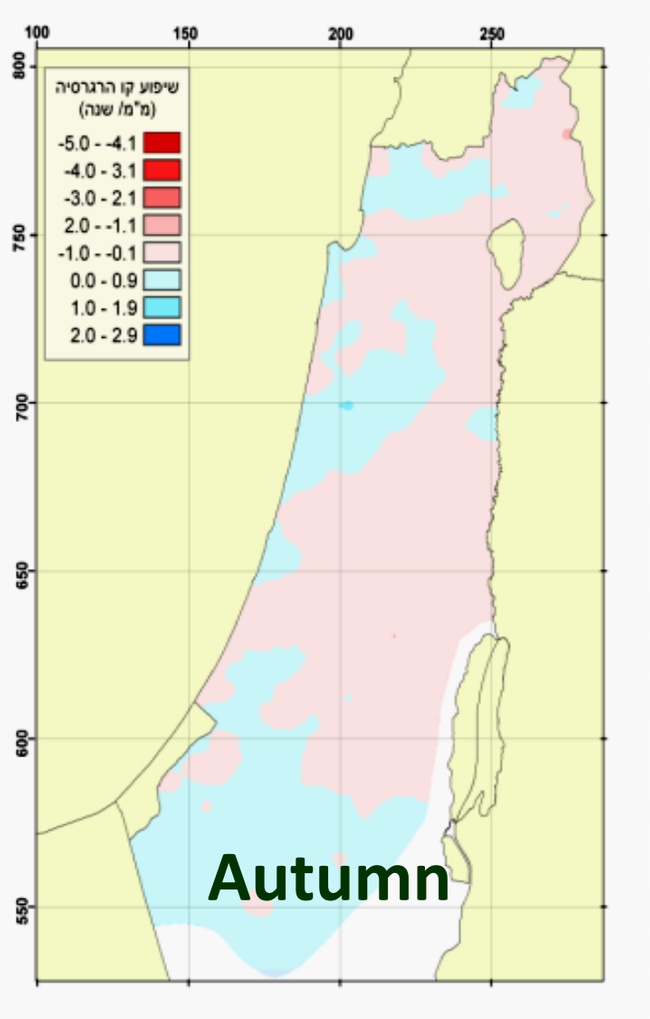


Linear Annual rainfall trends in sub-regions (%/decade) Trends-not significant

Geographic distribution of Rainfall Trends in 3 seasons







Spring- rainfall drops

Trends in dust events

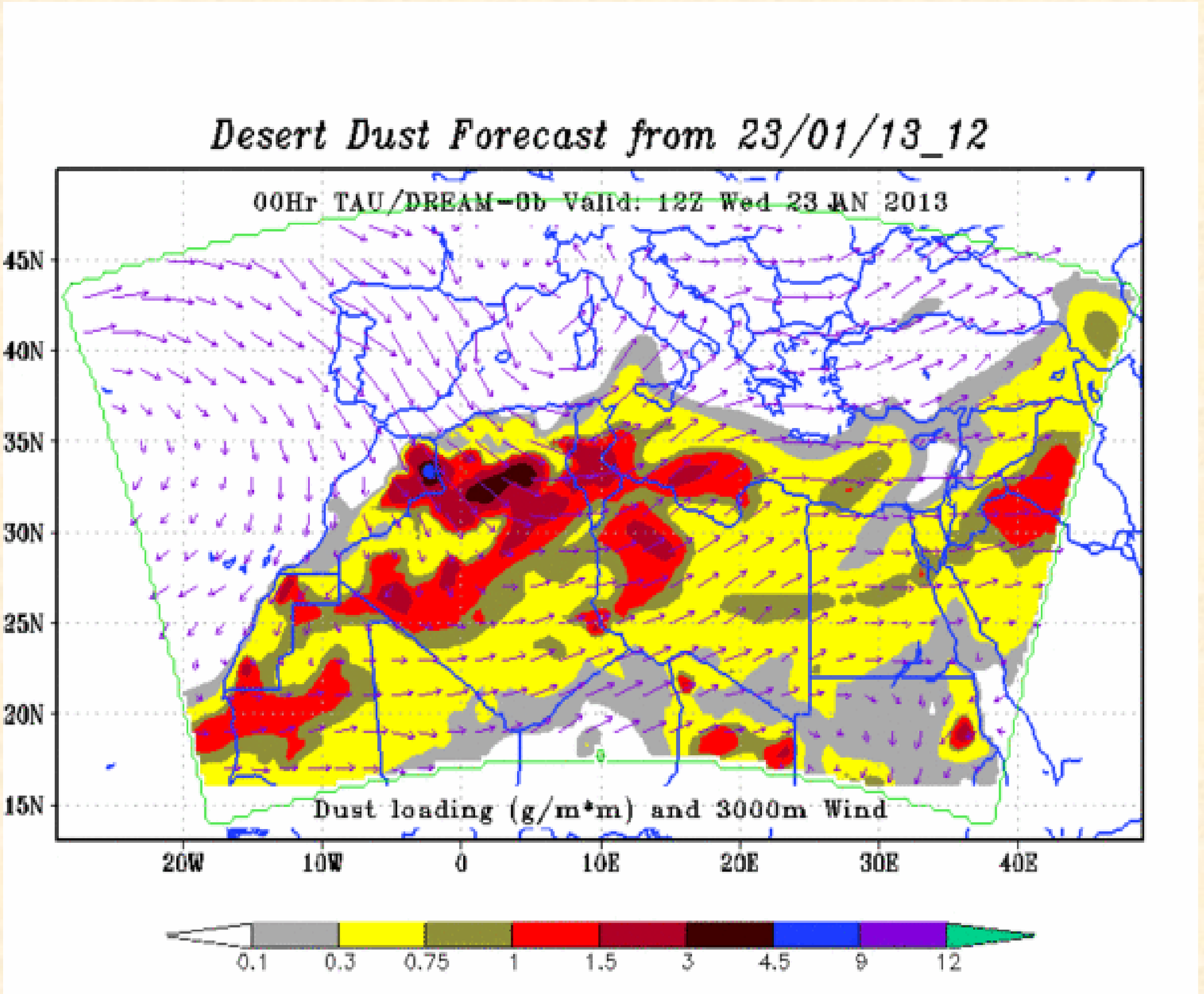
E. Ganor, I. Osetinsky, A. Stupp, and P. Alpert, "Increasing trend of African dust, over 49 years, in the eastern Mediterranean", J. Geophys. Res., 115, D07201, doi:10.1029/2009JD012500, 2010.

Sand storm Nizana 18/4/12

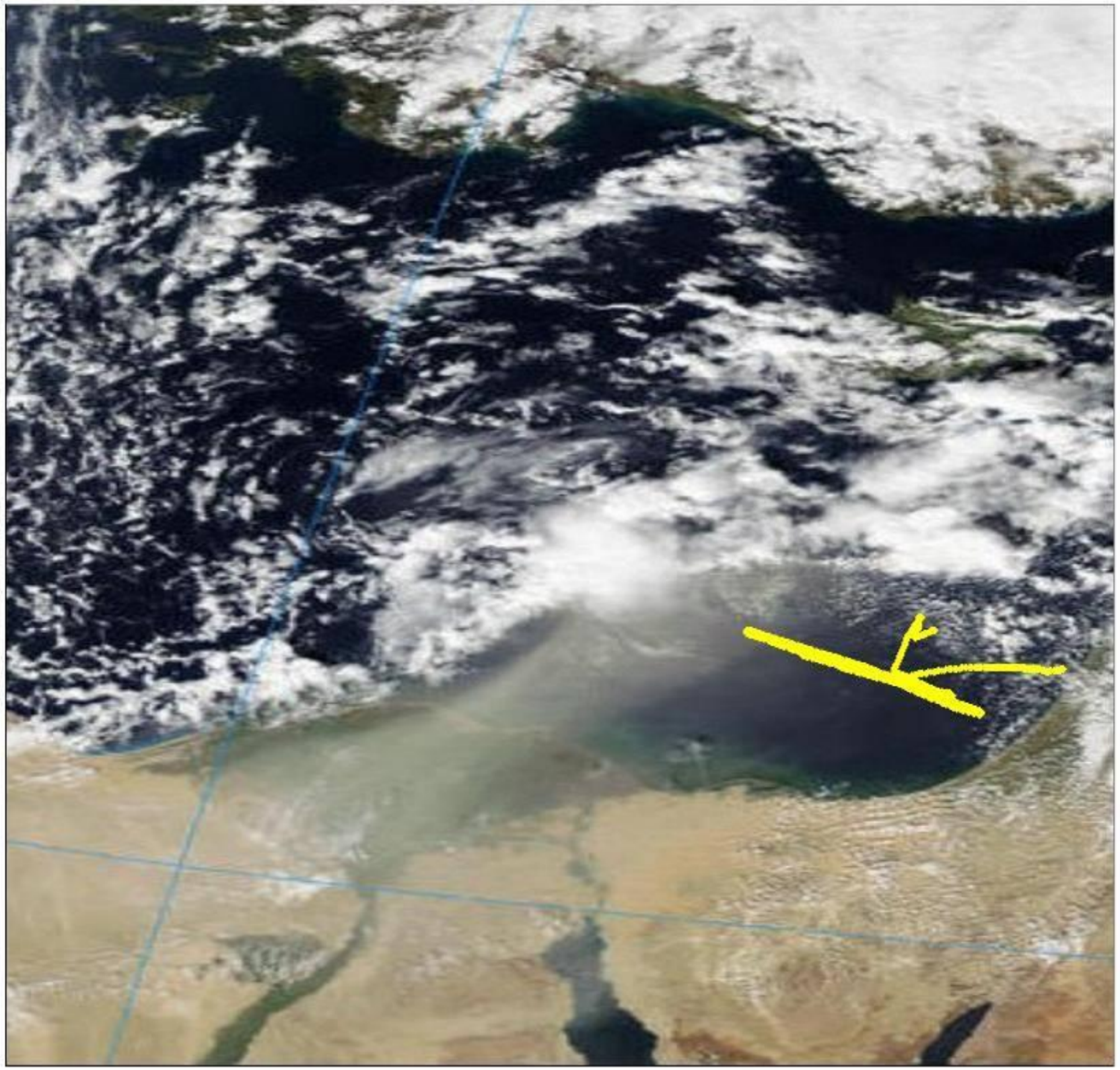
עדי טופר

Dust in Tel-Aviv

http://wind.tau.ac.il/dust8/dust.html



Dust over Israel During Columbia Flight

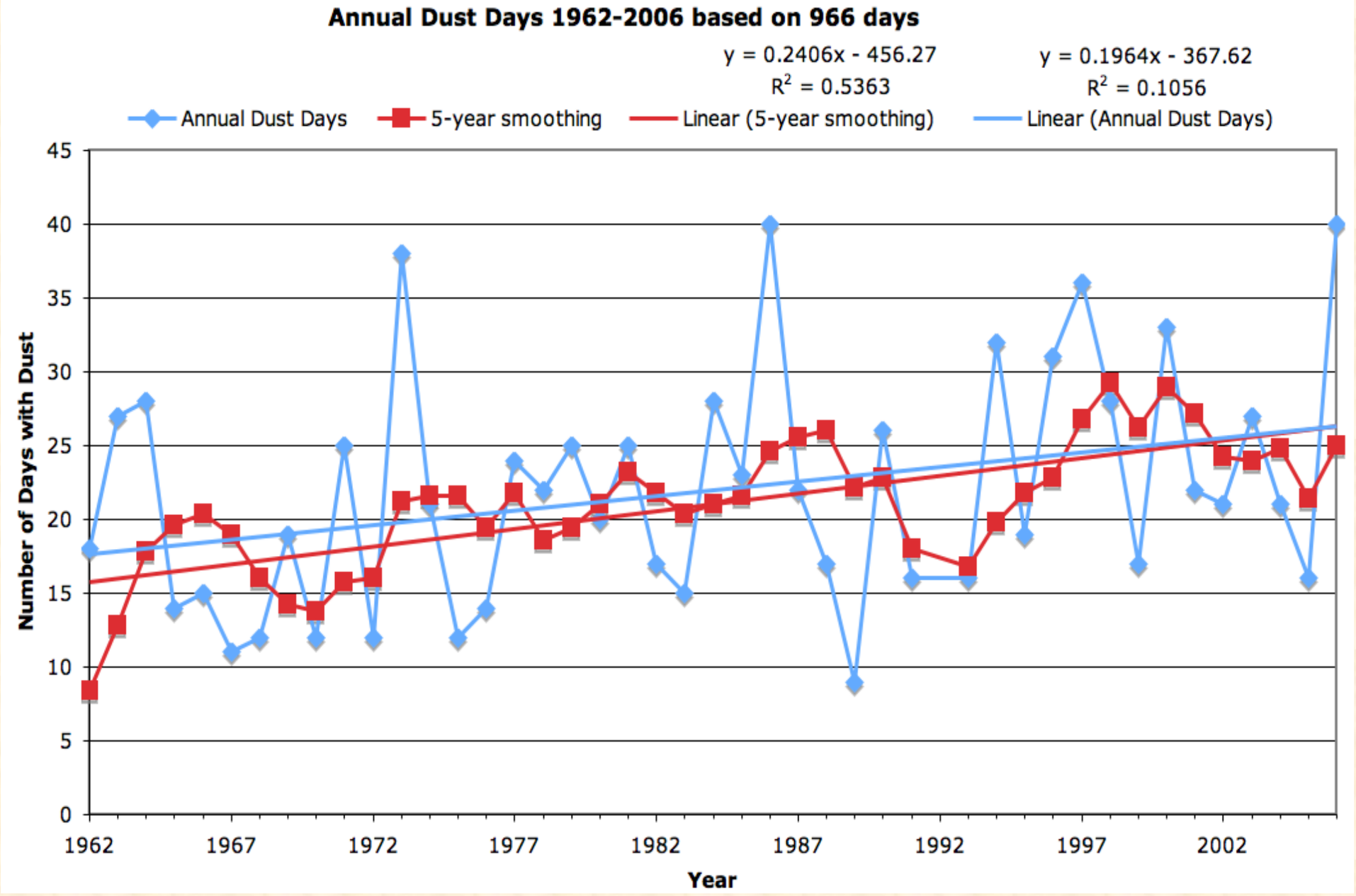


MODIS image of the Eastern Mediterranean from 28.01.03, the yellow line shows the airplane track

P. Alpert, S.O. Krichak, M. Tsidulko, H. Shafir and J.H. Joseph, "A dust prediction system with TOMS initialization" Mon. Wea. Rev., Vol. 130, No.9, pp. 2335-2345, 2002.

Number of days with Dust Events in Tel-Aviv per year has increased 1958-2006

with a slope of 2.4 days per decade, from 18 days in 1962 to 40 days in 2006 (16 to 26 smoothed fit).



Summary

- **Global and regional multi-model evaluation indicate strong warming and drying of the Mediterranean region.**
- **Best models currently for Israel at the 20/50 km scale. Good for temperature. For precipitation, sometimes still need bias correction primarily due to orographic effects**
- **Temperature: 1-2 degree increase shown in both global and local models. Japanese model shows higher increase in summer, RegCM shows higher increase in winter.**
- **Precipitation: Japanese and RegCM both show increased interannual variability and probability of multi-year droughts. Different timescale of when precipitation decreases.**
- **Additional information from other climate models will improve our ability to answer questions such as "what is the probability that there will be a multi-year drought or severe heat wave in the coming decade?" and help inform our planning, policy and adaptive response.**

Thank you!