Regional climate downscaling over the E. Mediterranean-Preliminary results

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Preliminary results of regional climate modeling over the E. Mediterranean with the RegCM model are presented. The model was driven by the Hadley Center global runs for the period 2071-2100 y, within the EU PRUDENCE project.
For the Chukorova Basin, southeast Turkey, there is a large difference for the rainfall changes between scenarios A2 and B2. This shows high sensitivity in RCM to specific greenhouse gases (GHG) scenarios.
A summary of tropical effects on E. Mediterranean climate is given. Teleconnections to El-Nino, Indian Monsoon and Hurricanes were found and need to be further investigated.

1. Description of the Regional Climate Model: ICTP-RegCM2

Results of regional climate simulations performed at the ICTP, Trieste, Italy with RegCM climate model under the EU PRUDENCE project are analysed below. The regional climate model RegCM used in PRUDENCE (Cristensen et al. 2002) was originally developed by Giorgi et al. (1993a,b) and then augmented as described by Giorgi et al. (1999) and Pal et al. (2000). The dynamical core of the RegCM is essentially equivalent to the hydrostatic version of the NCAR/Pennsylvania State University mesoscale model MM5. Surface processes are represented via the Biosphere-Atmosphere Transfer Scheme (BATS)and boundary layer physics is formulated following a non-local vertical diffusion scheme Giorgi et al. 1993a). Resolvable scale precipitation is represented via the scheme of Pal et al. (2000), which includes a prognostic equation for cloud water and allows for fractional grid box cloudiness, accretion and re-evaporation of falling precipitation. Convective precipitation is represented using a mass flux convective scheme (Giorgi et al. 1993b) while radiative transfer (Giorgi et al. 1999) is computed using the radiation package of the NCAR Community Climate Model, version CCM3. This scheme describes the effect of different GHG, cloud water, cloud ice and atmospheric aerosols. Cloud radiation is calculated in terms of cloud fractional cover and cloud water content, and a fraction of cloud ice is diagnosed by the scheme as a function of temperature.
In the following experiments horizontal resolution was 50 km. The area covered included Europe and the Mediterranean. These experiments were performed as part of the PRUDENCE project in which our group at Tel Aviv Univ. is an associate-member along with the ITCP group. Further details on the specific runs can be found in the PRUDENCE website: http://prudence.dmi.dk/.

2. RCM Results

Fig. 1a,b,c shows the results of DJF rainfall for the 3 runs: (a) control, (b) A2-scenario, (c) B2-scenario over the E. Mediterranean. In Fig 2a,b the rainfall-difference maps for the (a) A2-scenario, (b) B2-scenario are shown. In the A2-scenario which represents accelerated economical activity and GHG injections into the atmosphere, the whole EM and S. Turkey show rain decreases of up to 60-75%. This includes the Chukorova Basin.

In the B2-scenario however, there are rainfall increases over the Chukorova Basin (SE Turkey) of about 15-30%. It shows that SE Turkey region is very sensitive to the specific GHG scenarios.

As to summer surface (2m) temperatures (JJA), both scenarios (Fig. 3a,b,c) show significant increases. In the A2-scenario however, the increases over the Chukorova Basin are larger, i.e. 3.5-5.5°C, compared to about 2.5-3.5°C only in B2-scenario (Fig. 4).

3. Tropical Connection to Mediterranean

A review of tropical effects on Mediterranean rainfall and temperature was presented. The main conclusions follow:

- Tropical "remote" areas seem to play a major role in Mediterranean climate.
- Physical mechanisms for the teleconnections e.g., El-Nino, Indian Monsoon, Hurricanes, should be further investigated.
- A factor separation method is recommended to separate different contributions and potential

synergies among them by well-organized modeling experiments, e.g., Stein & Alpert (JAS,1993).

- Climate changes in aerosol forcing in the models probably play a significant role that should be explored by a more realistic inclusion of aerosols in our climate models.

4. Open Questions

- How does the El-Nino Dynamics affect positively the Med. climate? (Whole Mediterranean)?
- Dynamical mechanism for Indian Monsoon negative correlation to the following winter rainfall over the EM?
- What large-scale changes increase mid-latitu de/tropical interaction in form of Red-Sea Trough over the EM?
- Is there a climatic increase of Saharan dust transport to the Mediterranean?
- Influence of hurricane remnants of upper-level moisture and PV streamers on Mediterranean floods- Are this a rare occasion or a dominant factor in Med. floods?

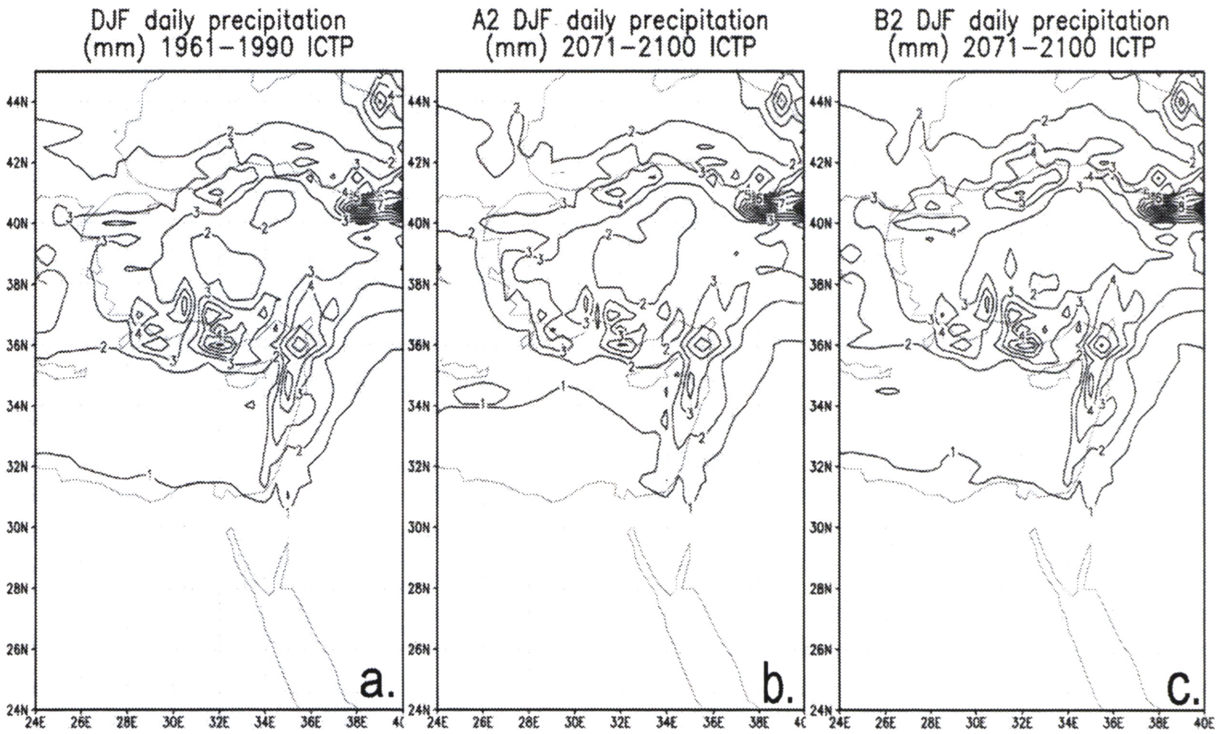

Fig 1.: Average daily precipitation in mm for the period December-January-February for (a) the control run 1960-1990 (b) A2 scenario 2070-2100 (c) B2 scenario 2070-2100

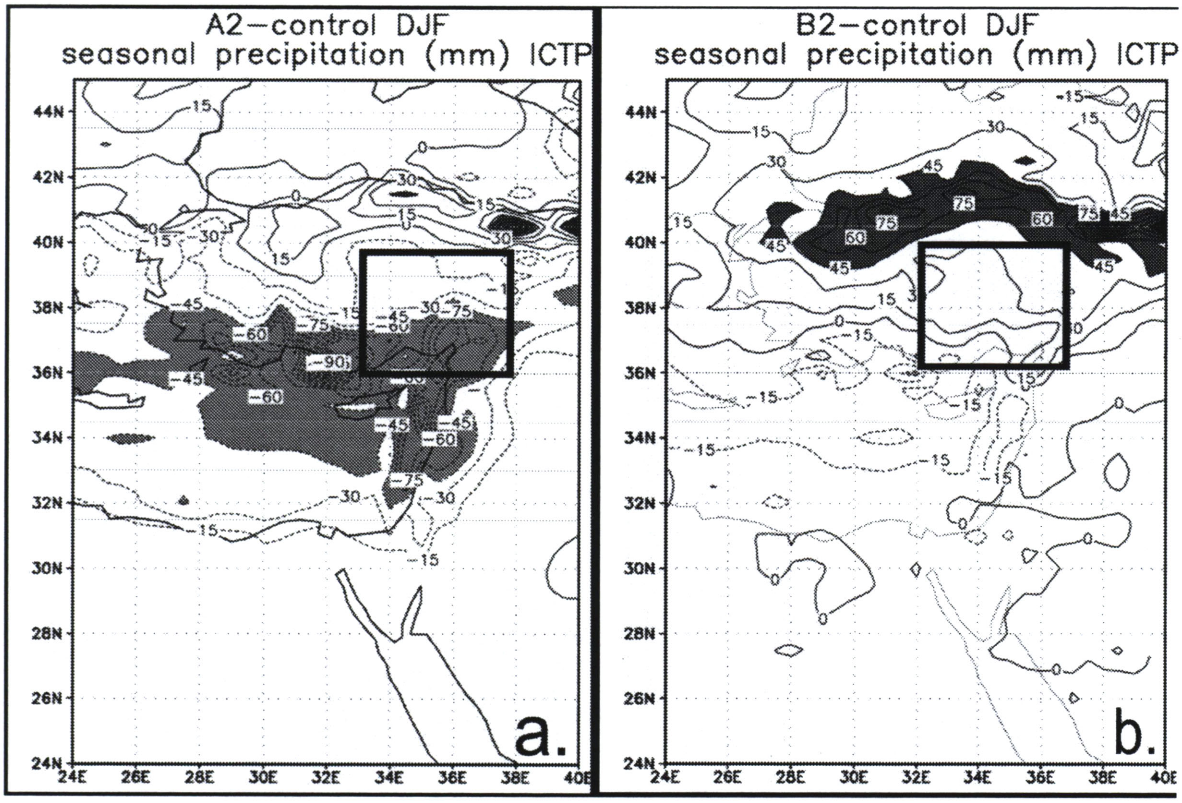

Fig. 2.: Difference in DJF average seasonal precipitation in mm between (a) A2 scenario and control run (b) B2 scenario and control run

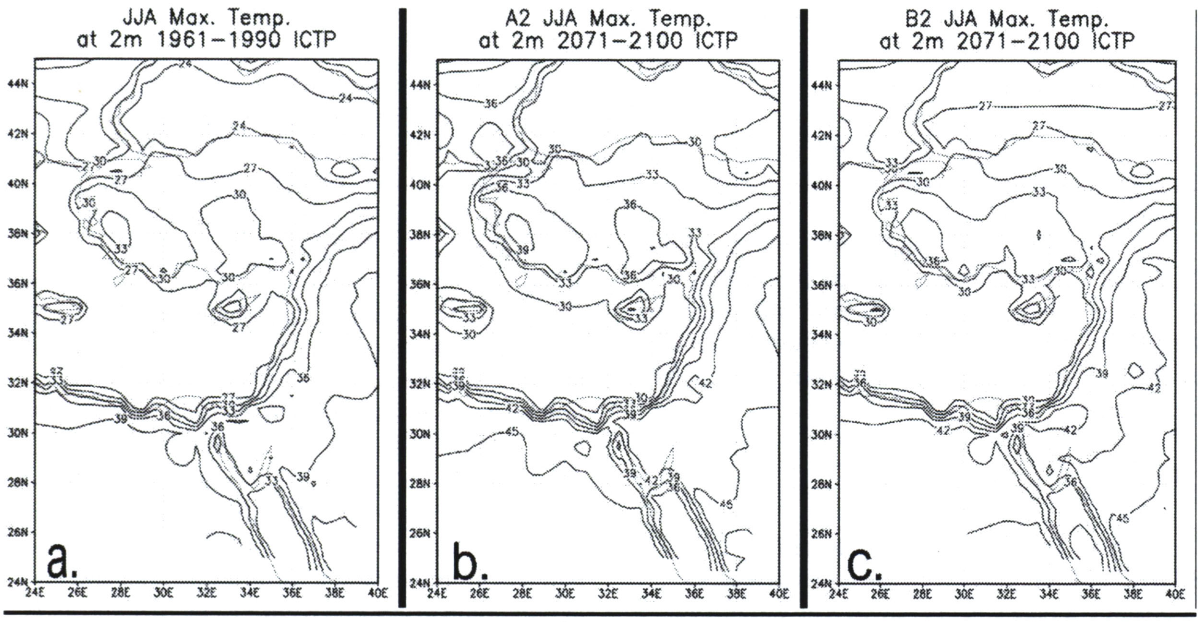

Fig. 3.: Average maximum temperature at 2m in ^{0}C for the period June-July-August for (a) the control run 1960-1990 (b) A2 scenario 2070-2100 (c) B2 scenario 2070-2100

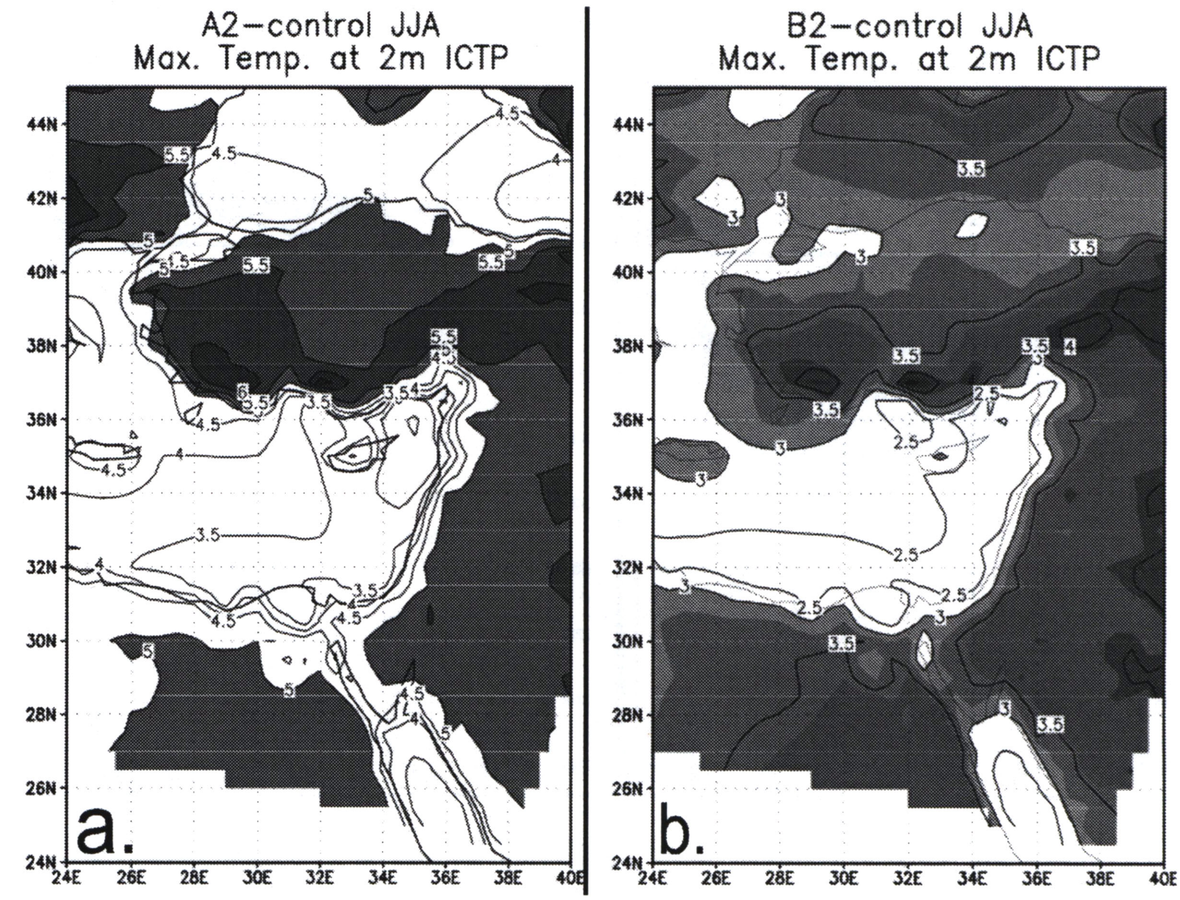

Fig. 4.: Difference in JJA average maximum temperature at 2m in ^{0}C between (a) A2 scenario and the control run (b) B2 scenario and the control run

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