Project No. 037005

CECILIA

Central and Eastern Europe Climate Change Impact and Vulnerability Assessment

Specific targeted research project

1.1.6.3.I.3.2: Climate change impacts in central-eastern Europe

D5.10: Report on local air-sea interaction changes on the western Black Sea coast under different climate conditions and their relevance to regional sustainable development

Due date of deliverable: 31st December 2009
Actual submission date: 15th November 2009

Start date of project: 1st June 2006

Duration: 43 months

Lead contractor for this deliverable: NMA

Project co-funded by the European Commission within the Sixth Framework Programme (2002-2006)		
Dissemination Level		
PU	Public	X
PP	Restricted to other programme participants (including the Commission Services)	
RE	Restricted to a group specified by the consortium (including the Commission Services)	
CO	Confidential, only for members of the consortium (including the Commission Services)	

1. Introduction

Local factors like topography and the vicinity of sea modulate the global climate change signal. Thus, high resolution regional experiments have to assess the influences of variability due local factors on the projection of climate change at smaller spatial scales. Coastal areas are particularly vulnerable to climate variability and change (IPCC, 2007). Key issues analyzed in the present report are changes in precipitation which further could be related to maritime storms and flooding. They have implications for coastal socio-economic activities and ecosystems. Flooding from rainstorms may become worse if higher temperatures lead to increasing rainfall intensity during severe storms. Shore erosion is another issue which could be related to high precipitation events.

2. Numerical experiments

The regional climate model we use is the RegCM originally developed by Giorgi et al. (1993a, b) and later upgraded as described in Pal et al. (2007). For the present experiment we use the standard version of the model (see Pal et al. 2007) with the Grell convection scheme and the resolvable precipitation scheme of Pal et al. (2000). The model domain covers the Romanian domain defined in CECILIA project at a grid point spacing of 10 km.

Regional climate experiments have been performed to isolate the effects of Black Sea SSTs on local climate and especially on precipitation. Firstly, a control simulation is performed (referred to as CTRL) for 15 summer and winter months. In the second set of simulations (referred to as WSEA) the surface temperature of the Black Sea is modified with a uniform temperature increase of 2 K and unchanged lateral boundary conditions.

The driving lateral boundary conditions are taken from the fields obtained with the regional model RegCM3 at 25km grid point spacing over the European domain. These European simulations are driven at the lateral boundaries by meteorological fields from a corresponding global simulation with the ECHAM5 model under forcing from the SRES-A1B IPCC greenhouse gas scenario.

The first 4 days are removed from the first month of the season in all model results to allow for model spin up. This is sufficient time for a balance to be reached between the lateral boundary forcing and the regional climate model dynamics.

3. Results

The WSEA experiments allow us to separate the local effects of the Black Sea SST from large scale effects and other influences. Note that the 2 K SST anomaly over the Black Sea is consistent with observations of SST interdecadal variability (Oguz et al., 2006).

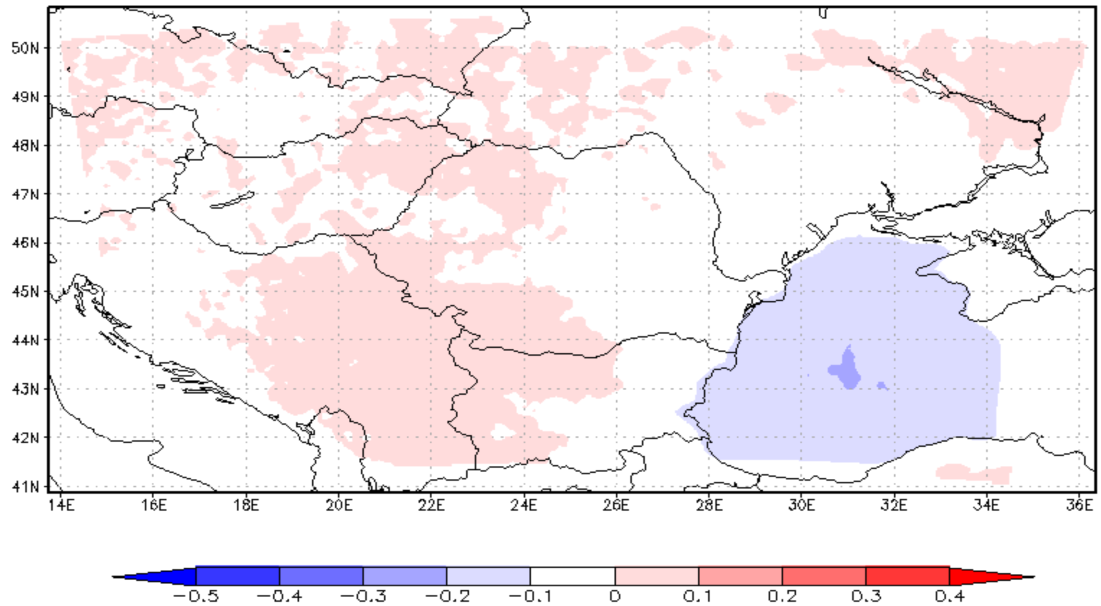

Figure 1. Atmospheric pressure difference between WSEA and CTRL experiments for the interval June-August 2095-2099 (in hPa) under conditions of A1B scenario.

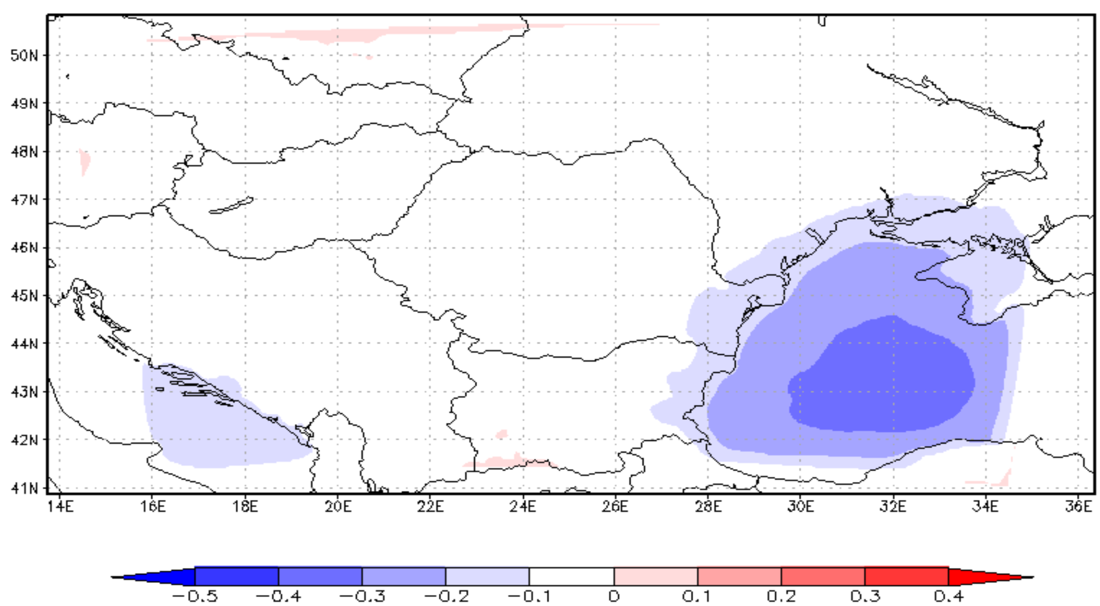

Figure 2. Atmospheric pressure difference between WSEA and CTRL experiments for the interval December-February 2094-2099 (in hPa). under conditions of A1B scenario.

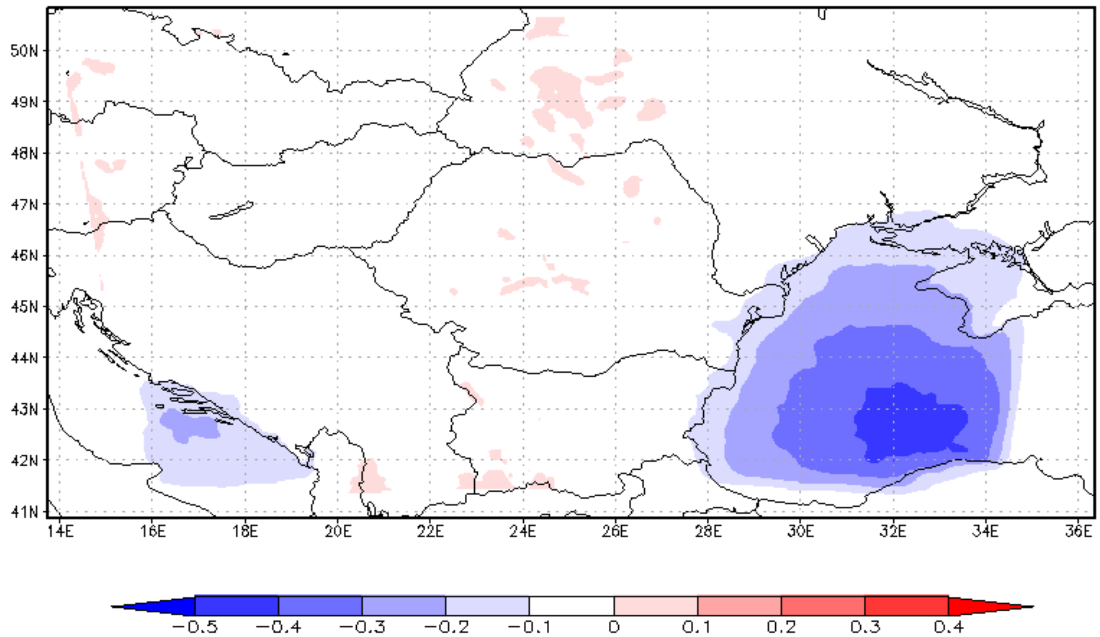

Figure 3. Atmospheric pressure difference between WSEA and CTRL experiments for the interval December-February 1970-1974 (in hPa) under present climate conditions.

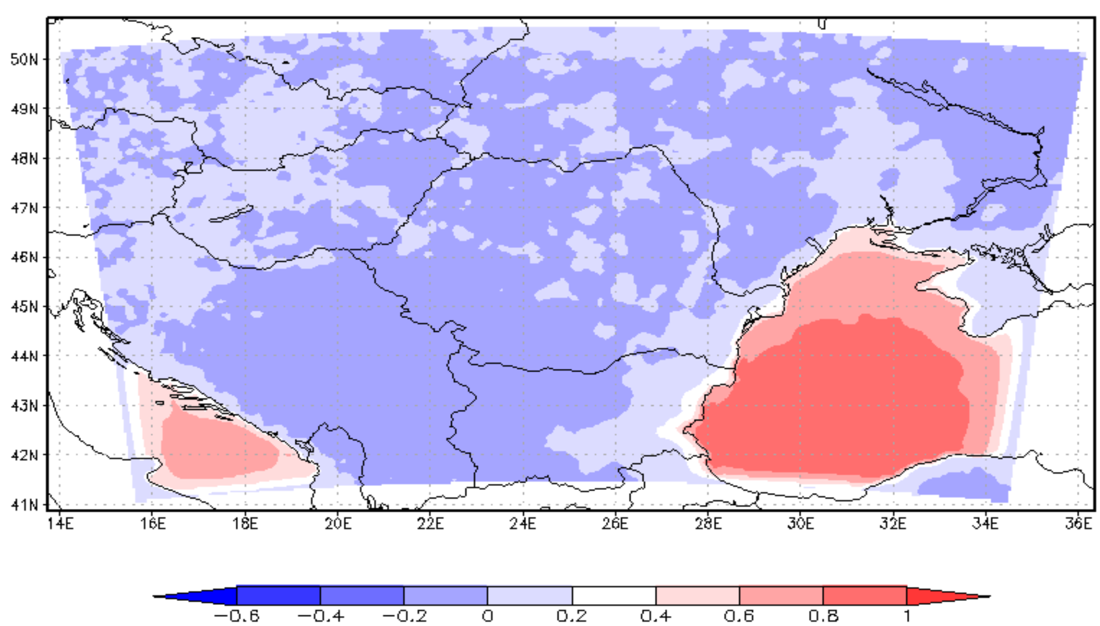

Figure 4. The difference of atmospheric temperature at the first model level between WSEA and CTRL experiments for the interval June-August 2095-2099 (in K) under conditions of A1B scenario.

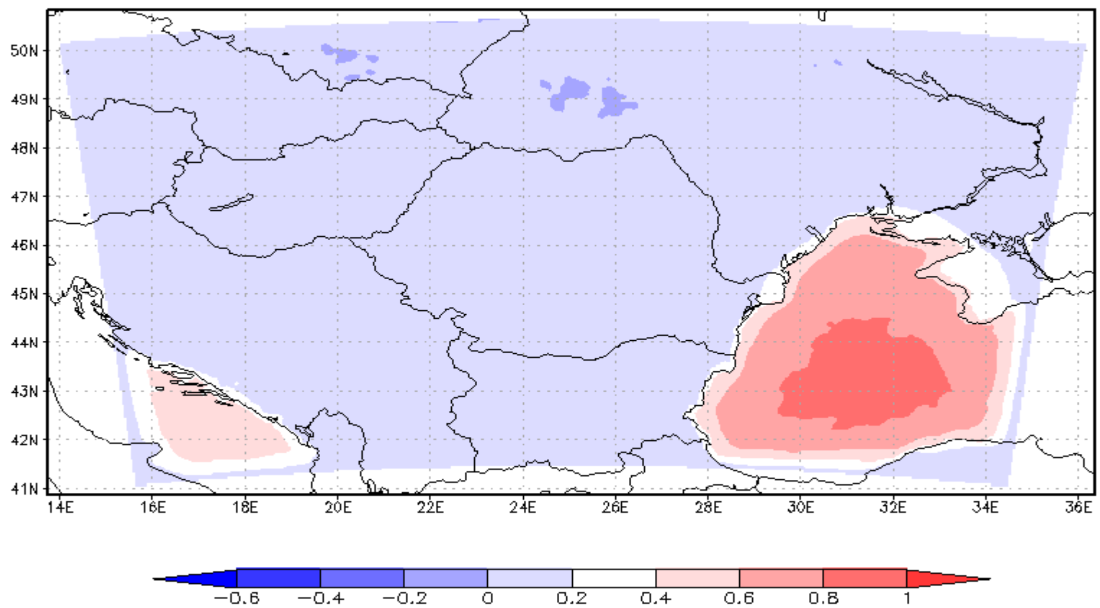

Figure 5. The difference of atmospheric temperature at the first model level between WSEA and CTRL experiments for the interval December-February 2094-2099 (in K) under conditions of A1B scenario.

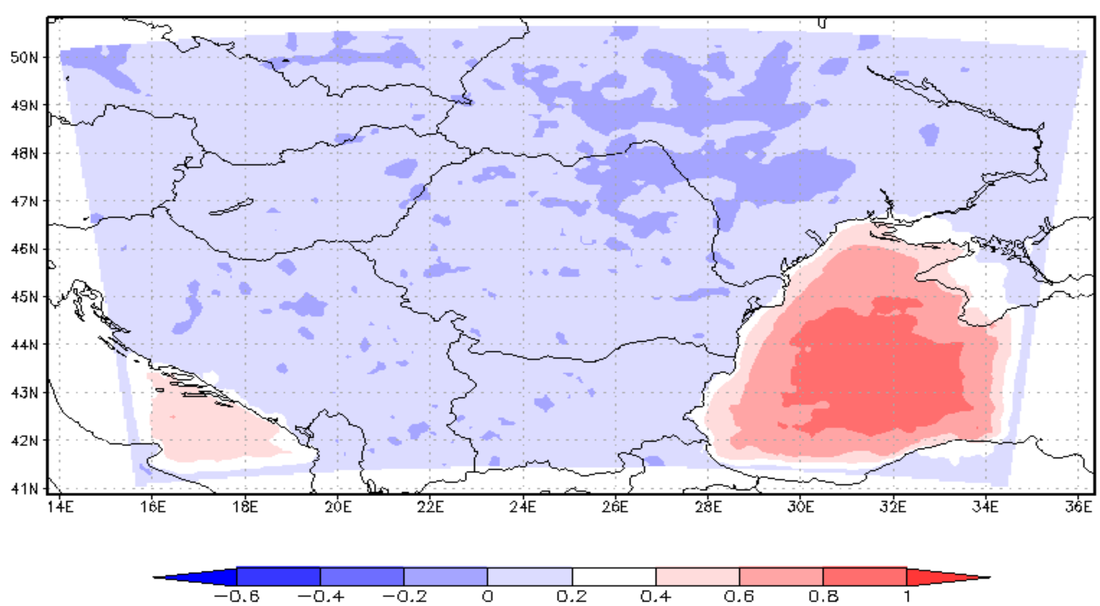

Figure 6. The difference of atmospheric temperature at the first model level between WSEA and CTRL experiments for the interval December-February 2094-2099 (in K) under present climate conditions.

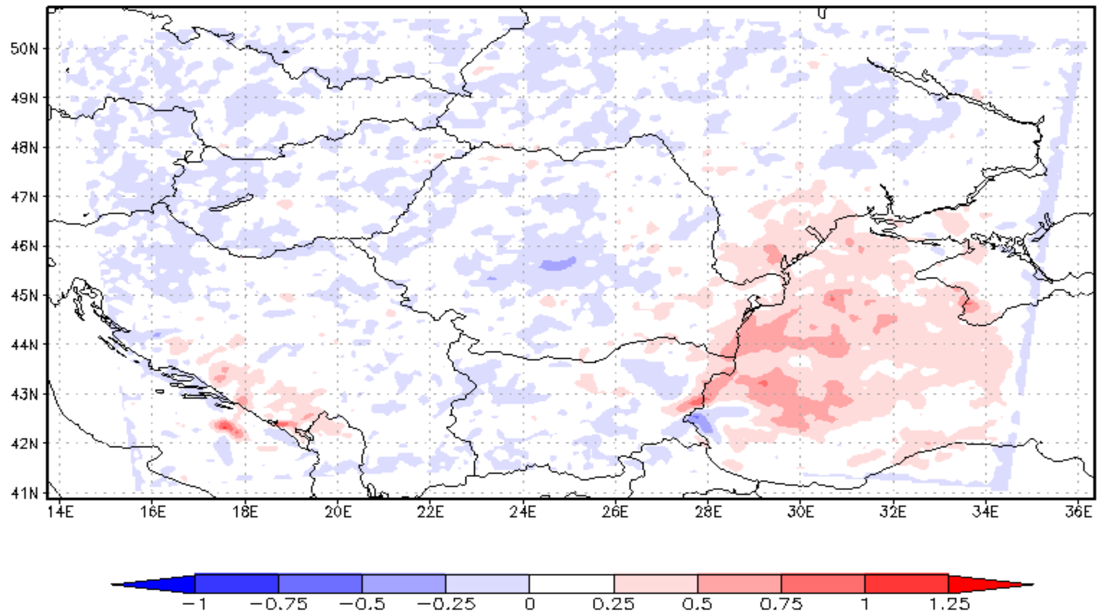

Figure 7. The difference of precipitation between WSEA and CTRL experiments for the interval June-August 2095-2099 (in mm/day) under conditions of A1B scenario.

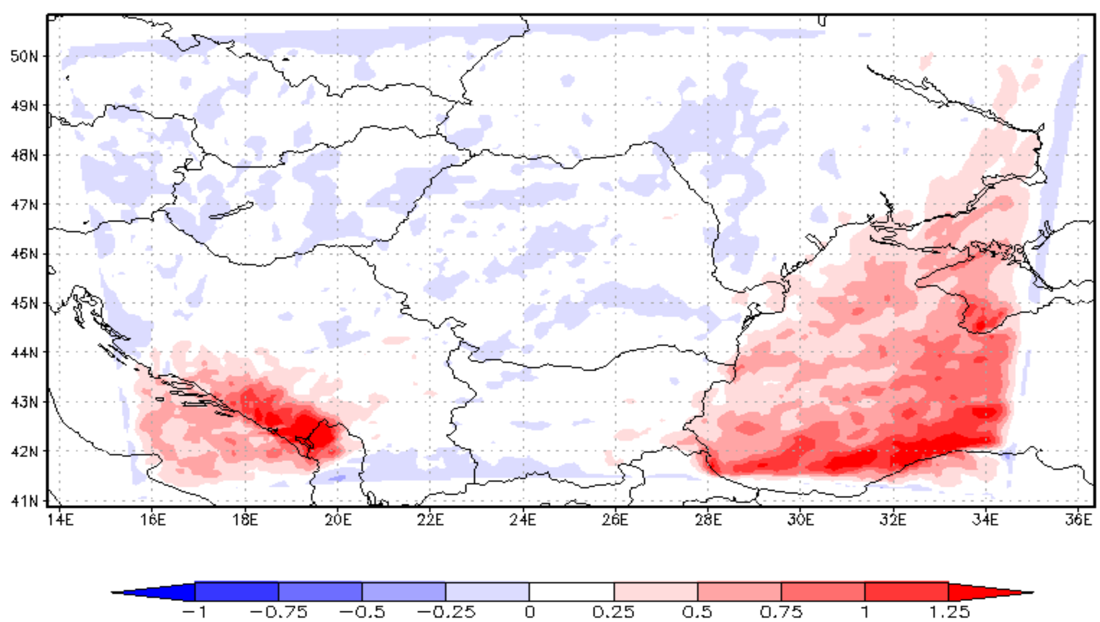

Figure 8. The difference of precipitation between WSEA and CTRL experiments for the interval December-February 2094-2099 (in mm/day) under conditions of A1B scenario.

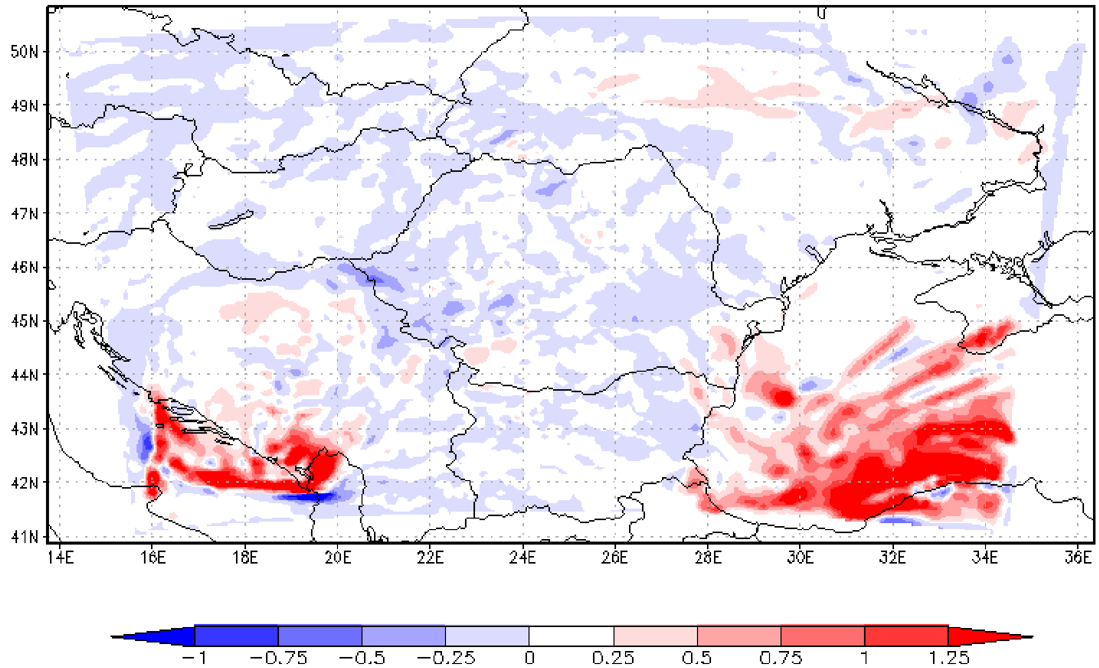

Figure 9. The difference of precipitation between WSEA and CTRL experiments for the interval December-February 1970-1974 (in mm/day) under present climate conditions.

4. Conclusions

- The results suggest the importance of a full Black Sea representation (coupled air-sea experiments) for local/coastal climate change assessment; further numerical experiments are needed.
- The effect of Black Sea SST variability seems to be mainly a local and thermodynamic one, particularly in summer. Air pressure changes take place especially over the sea area where the surface temperature was raised.
- In both summer and winter the most expose areas to SST influences (precipitation, winds) are the coastal areas.
- In summer, we could expect that Black Sea SST will rise as climate change is progressing, this could imply more precipitation especially over the coastal regions and Eastern Romania.
- In winter, there are indications of small changes in local atmospheric circulation due to larger changes in atmospheric pressure compared with the summer case. However, this effect seems to diminish under climate change conditions, probably due

to smaller thermal contrast. Further experiments are needed with larger simulation in order to assess in more detail this mechanism.

5. References

Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M. Tignor and H.L. Miller (eds.). Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 996 pp.

Giorgi, F., M. R. Marinucci, and G. T. Bates, 1993a: Development of a second generation regional climate model (REGCM2). Part I: Boundary layer and radiative transfer processes. Mon. Weather Rev., 121, 2794–2813.

Giorgi, F., M. R. Marinucci, G. T. Bates, and G. DeCanio, 1993b: Development of a second generation regional climate model (REGCM2). Part II: Cumulus cloud and assimilation of lateral boundary conditions. Mon. Weather Rev., 121, 2814–2832.

Oguz, T., J. W. Dippner, Z. Kaymaz, 2006: Climatic regulation of the Black Sea hydro-meteorological and ecological properties at interannual-to-decadal time scales. Journal of Marine Systems, 60, 235–254.

Pal, J. S., E. E. Small, and E. A. B. Eltahir, 2000: Simulation of regional scale water and energy budgets: representation of subgrid cloud and precipitation processes within RegCM. J. Geophys. Res. 105, 29579–29 594.

Pal, J.S., F. Giorgi, X. Bi, N. Elguindi, F. Solmon, X. Gao, S.A. Rauscher, R. Francisco, A. Zakey, J. Winter, M. Ashfaq, F.S. Syed, J.L. Bell, N.S. Diffenbaugh, J. Karmacharya, A. Konaré, D. Martinez, R.P. da Rocha, L.C. Sloan, and A.L. Steiner, 2007: Regional Climate Modeling for the Developing World: The ICTP RegCM3 and RegCNET. Bull. Amer. Meteor. Soc., 88, 1395–1409.