ANALYSIS OF A GLOBAL GENERAL CIRCULATION MODEL OUTPUT IN POLAND

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Climate impact studies at regional or local scales are sometimes performed by analyzing the output of GCM experiment at grid points in, or neighboring, the region of interest. The applicability of such approach has been tested with the output of an atmosphere-ocean GCM, the ECHAM-LSG model[1] with a horizontal resolution of about 5.6^{o}x5.6^{o}, in Poland.

Fig 1a and 1b show the mean annual cycle of surface-air temperature and precipitation as observed in 5 stations in Poland (from NCAR World Station Climatology) and as simulated in a control and a $2xCO_2$ GCM experiments. The amplitude of the temperature annual cycle is overestimated by about 5 K in the model, being colder in winter (DJF) and warmer in summer (JJA) than the observed values. The $2xCO_2$ experiment produces warmer temperatures by about 2 K throughout the year. A big model deficiency is observed in the simulated precipitation. The annual cycle is completely wrong. In winter the model produces too much precipitation, although the observed data may be an underestimation of precipitation because of the occurrence of snowfall. In summer, when rainfall is to a great extent caused by local convective activity, the model is too dry. Almost no precipitation change is observed in the $2xCO_2$ experiment.

To investigate the causes of this deficient simulation of summer rainfall, the field correlation between observed average summer precipitation in Poland and the large scale SLP field (NCAR analyzed data) is compared with a similar calculation using the model output (Fig 2a and 2b). In both cases Polish summer rainfall anomalies are associated with a low-pressure cell over Central Europe. However, the pattern derived from observations has a large-scale character, whereas the model pattern looks noisier. Furthermore, the model produces spurious correlations over the North atlantic and Greenland which are as high as those over Poland. It is concluded that the model does not correctly capture the relationship between Polish rainfall and the large-scale atmospheric circulation.

Grid point values from GCM outputs should be then taken with care when constructing climate impact scenarios.

(1) U. Cubasch, K. Hasselmann, H. Hock, E.Maier-Reimer, U.Mikolajewitz, B.Santer and R. Sausen. Max-Planck-Institut Report No.67

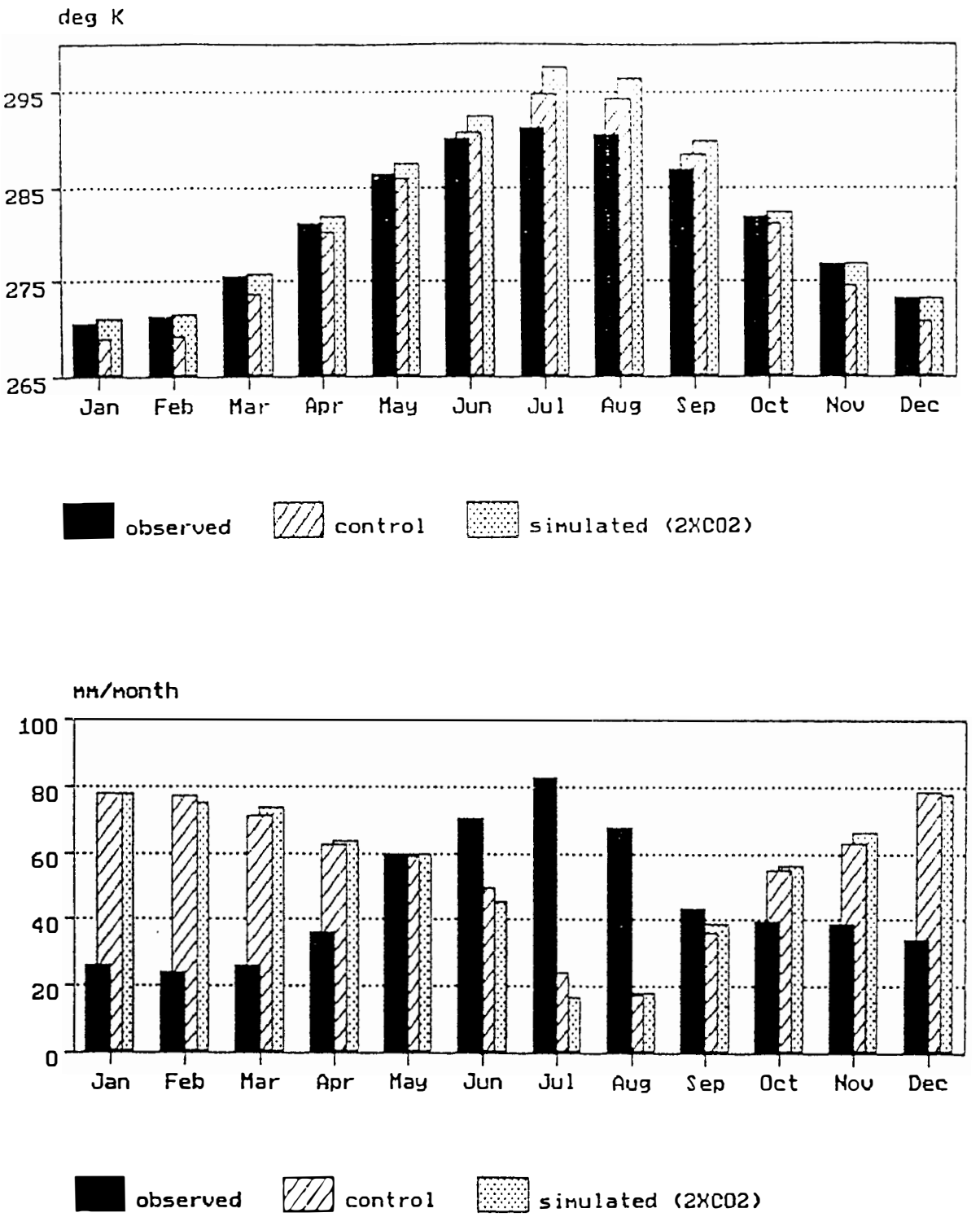

Figure 1. Mean annual cycle for 2-m air temperature (upper panel) and precipitation (lower panel) derived from observations (NCAR World Surface Station Climatology), from the GCM control run and for the CO_2 experiment.

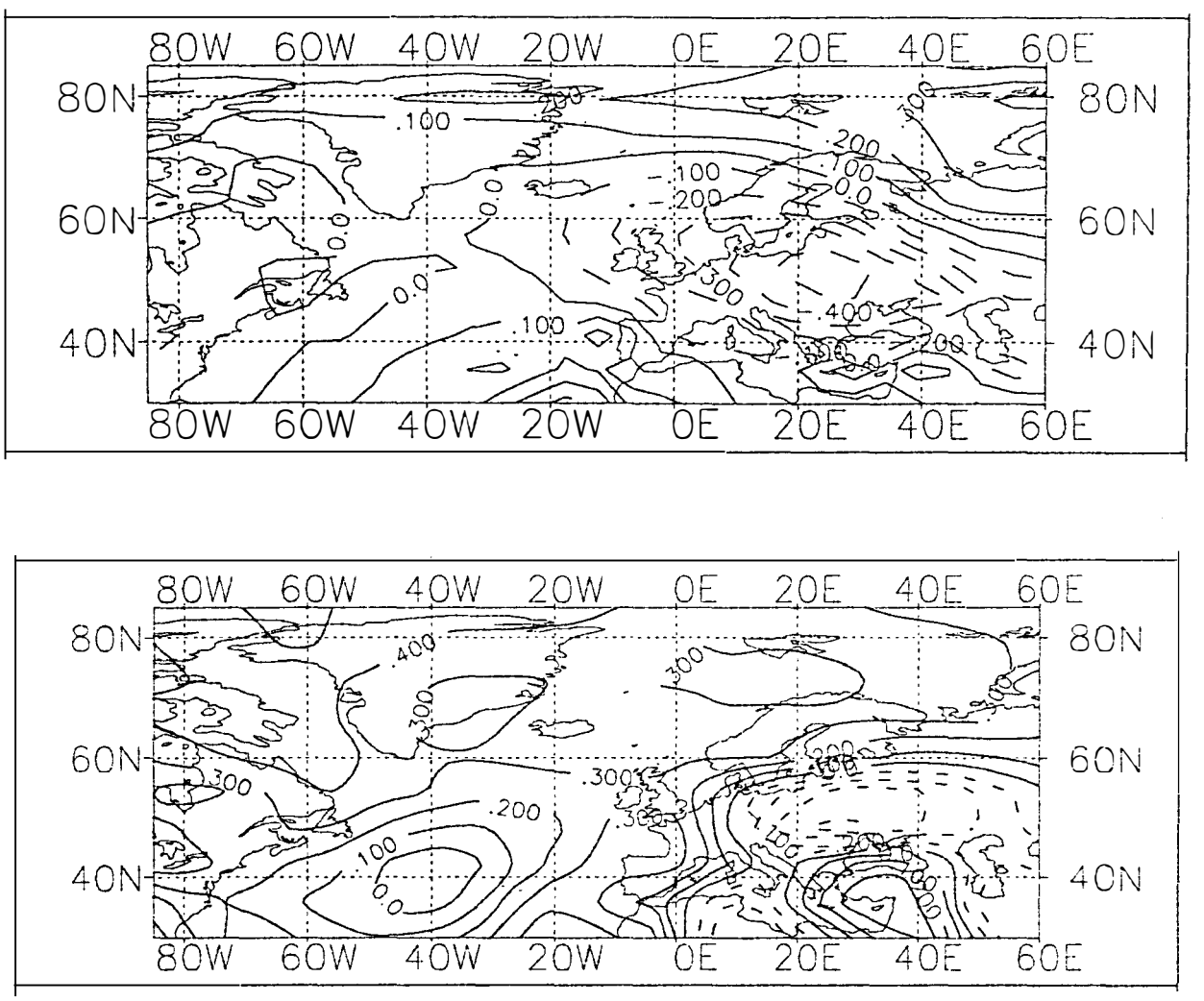

Figure 2. Point correlation between average summer (JJA) rainfall in Poland and the simultaneous SLP field derived from: analyzed data (NCAR SLP analysis, upper panel) and from the GCM control run (lower panel).