FUTURE GLOBAL DISTRIBUTIONS OF CAPE AND CIN

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(15 September 2009)

I. INTRODUCTION

Convective available potential energy (CAPE) is used to categorise and forecast convective storms. Convection might be inhibited by positive values of convective inhibition (CIN) which defines the energy needed to reach the CAPE layer. Therefore, CIN indicates the probability of convection occurring, while CAPE determines the intensity of convection (Colby, 1984).

During the last decades CAPE and CIN reveal trends in ERA-40 re-analysis data (Riemann-Campe et al., 2009) which are reproduced by simulations with the coupled atmosphere-ocean general circulation model ECHAM5/MPIOM. Here, the impact of increasing greenhouse gases during the upcoming decades is assessed by the analysis of global distributions of CAPE (100 hPa mixed layer, pseudo-adiabatically) and CIN computed in the scenarios A1B and B1 for the years 2001 until 2100.

II. DATA & METHODOLOGY

Six-hourly values of the coupled atmosphere-ocean model ECHAM5/MPIOM (Roeckner et al., 2003) are used in the spectral truncation T63 (horizontal resolution ~ 1.875) to compute CAPE and CIN for 1900-2100. The global distributions of these variables in the future climate scenarios B1 and A1B (2001-2100) are compared with those of the present-day climate (simulation 20C, 1900-2000). Trends are estimated by subtracting the seasonal mean of the time range 2071-2100 from the seasonal mean of the time range 1901-1930. The differences are applied to mean values of CAPE and CIN as well as to their 95th, 80th, 60th, 40th, 20th and 5th percentiles.

III. RESULTS & CONCLUSIONS

The general patterns of the differences between present-day and future climates show a general increase of CAPE and CIN over all continents and ocean basins with the exception of Greenland and Antarctica. The differences are stronger pronounced in the A1B scenario than in the B1 scenario due to the stronger pronounced increase in greenhouse gasses. The analyses of the changes in the different percentiles reveal for CAPE and CIN that the higher the percentiles the stronger the changes over time. The magnitude of the difference as well as the spatial extent is strongest in the 95th percentile (FIG. 1 and 2).

The differences in CAPE are in general positive and occur over the continents. Negative differences are visible mostly over the ocean basins of the southern hemisphere and over the eastern North Atlantic between 50° and 60° North. The magnitude and the spatial extent of the

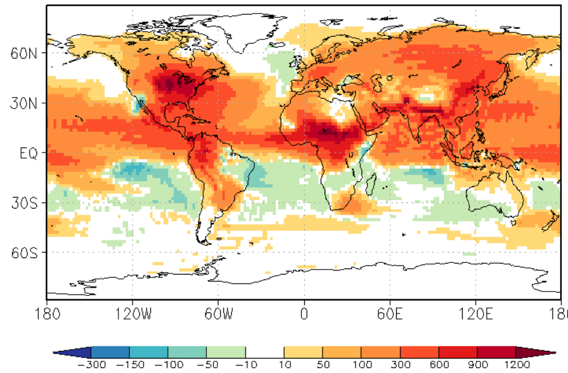

FIG. 1: Difference of JJA mean of 95th-percentile of CAPE in J/kg between scenario A1B (2071-2100) and scenario 20C (1901-2000). Positive numbers indicate an increase of CAPE with time.

differences change with season. The strongest positive differences in CAPE occur over the Central USA, the centre of Africa, and in Asia south of the Tibetan Plateau during June, July and August (JJA). The strongest negative difference in CAPE occurs over the southern hemispheric eastern tropical Pacific during December, January and February (DJF).

In comparison with the differences in CAPE are those in CIN also present over all continents and over all ocean basins, with the exception of Greenland and the Antarctic. However, the spatial extend of the differences are not as pronounced in the higher latitudes. In addition, the negative differences occur in very few and small regions only. In general, regions with a positive difference in CAPE show also a positive difference in CIN. This positive

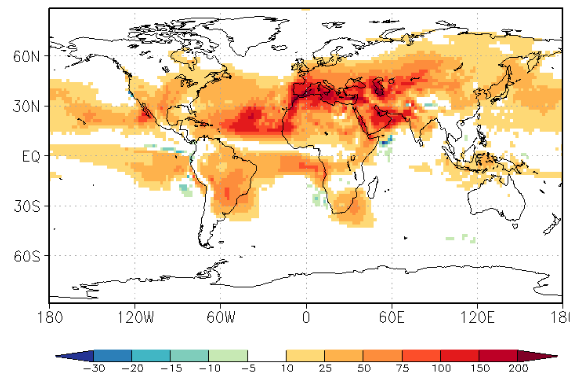

FIG. 2: Difference of JJA mean of 95th-percentile of CIN in J/kg between scenario A1B (2071-2100) and scenario 20C (1901-2000). Positive numbers indicate an increase of CAPE with time.

difference leads not only to an increase in potential convection but also in boundary layer stability, which prevents the development of convection. As the differences in CIN are mostly positive, regions with a decrease in CAPE reveal not only a decrease in potential convection but also in the likeliness of convection development. However, the regions of strongest differences in CIN are usually not concordant with the regions of strongest differences in CAPE. The strongest positive difference in CIN occurs in the Mediterranean during JJA, while the strongest negative difference in CIN is visible over the southern hemispheric eastern tropical Pacific.

IV. AKNOWLEDGMENTS

Thanks to Frank Sielmann for his support in CAPE calculations, and to DKRZ, DWD, and ECMWF for the data. KRC acknowledges the support by IMPRS-ESM.

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