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Christoph Beck, Jürgen Grieser

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## **Hydroclimatic variations in Europe since 1951 as reflected by shifts of Köppen Climate types**

C. Beck (1), J. Grieser (1)

(1) Global Precipitation Climatology Centre (GPCC), Deutscher Wetterdienst, Offenbach, Germany (christoph.beck@dwd.de)

European spatio-temporal climate variations during the second half of the 20th century are investigated by applying the Köppen climate classification (Köppen, 1936) to observed monthly precipitation and temperature data taken from the CRU TS 2.1 data set (Mitchell and Jones, 2005) provided by the Climatic Research Unit (CRU, University of East Anglia, Norwich, GB) and the VASCLimO v1.1 data set (Beck et al. 2005) available from the Global Precipitation Climatology Centre (GPCC, Deutscher Wetterdienst, Offenbach, Germany), respectively. Both data sets cover the period from 1951 - 2000 and provide data for the global land areas on a  $0.5^\circ$  by  $0.5^\circ$  lat./lon. grid.

To analyse the spatio-temporal variations of Köppen climate types during the 1951 - 2000 period the classification scheme has been applied to monthly mean values determined for sliding 15-year intervals. For each of these 36 intervals the areas that are designated to each Köppen climate type have been calculated and continuous time series of the varying relative area occupied by the certain types have been obtained.

Focusing on the European continent a long term increase of the area occupied by temperate C climates on the cost of boreal D climates appears as the most important climate shift affecting up to 10% of the European land area.

With respect to redistributions between climate types characterizing hydroclimatic conditions at first an expansion of dry B climates thereby substituting mainly temperate C climates during the period 1951 to 2000 has to be stated. However, the further differentiated subtypes of the B climate show distinctly differing behaviour. Whereas the area occupied by the desert subtype BW slightly decreases subtype BS (representing steppe) exhibits pronounced increasing tendencies.

Looking at long-term variations of subtypes of the temperate C climate representing sufficient precipitation throughout the year (Cf) and dry summer (Cs), respectively, it turns out that the long term positive trend in area occupied by C climates relies solely on concomitant temporal variations of Cf whereas Cs features a long term trend of the opposite sign.

In summary these results can be interpreted as an eastward expansion of oceanic climate conditions in Europe since 1951 on the one hand and a spread of dry climates mainly in south-western and south-eastern European regions on the other hand implying respective long-term changes of hydroclimatic conditions (e.g. water availability) relevant for the natural and social systems within the affected regions.

#### References:

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