



Changes of hydro-meteorological extremes in western and central Europe based on “critical” circulation types derived from NCEP and HadAM3P data

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During the last two decades western and central Europe faced several severe winter storms and major river floodings. The European winter storms in Denmark, France, Germany, Spain and Switzerland in Dec. 1999 and the major river floods in Germany, Belgium, France, and Netherlands in Dec. 1993, Jan. 1995 and Jan. 2003 caused economic losses of 23 billion US-\$. A fuzzy rule based, discharge optimized method for an objective classification of circulation pattern (CP) was developed using SLP data from NCEP reanalysis and HadAM3P control (1960-1990) and scenario (2070-2100) runs. Besides the subjective CP indices the objective method allows to detect CPs that are "critical" for European hydro-meteorological extremes. It will be demonstrated that all the winter storms and most of the major river floods in Southwest and Western Germany were produced by a few types of zonal circulations across Europe. The time series of the frequencies and the maximum persistence of the subjective (1881-2005) and objective (1958-2001) classified "critical" CPs show significant increasing trends and step changes for the winter months (Dec.- Feb.) during the recent three decades. As a consequence the mean and long lasting extreme winter precipitation has increased highly significant in most parts of Southwest Germany. During the observation period (1926-2004) nearly all extreme floods including the floods of Feb. 1990, Dec. 1993, Jan. 1995, Feb. 1997, Oct. 1998, and Jan. 2003 for nearly all major river basins in Southwest Germany have been caused by heavy, long lasting rainfall during zonal circulations, especially the type "West cyclonic" (Wz) in winter.

It will be demonstrated if the “critical” CPs derived from HadAM3P control run show similar changes compared to the “critical” CPs derived from NCEP-SLP data. Additionally the results of a comparison of the time series analysis of “critical” CPs derived from HadAM3P-SLP data for the control ensemble runs and scenario ensemble runs will be presented. The extreme river floods in Southwest Germany of the last 3 decades and the severe winter storms of 1990, 1999 and 2002 have been answers of the climate system to an already changed winter climate in large parts of Europe. The comparison of the “critical” CPs derived from the control and scenario ensemble runs will indicate whether we have to face more severe hydro-meteorological extremes in winter in the future