



Exploration of drivers of the severe 1976, 1983, and 2003 droughts in Europe: an analysis with a climate model and an observation data set

Samuel Jonson Sutanto and Henny Van Lanen

Hydrology and Quantitative Water Management, Environmental Sciences Group, Wageningen University and Research, the Netherlands

In Europe severe droughts occurred in the year 1976, 1983, and 2003 with substantial impacts in some European regions. Some past studies point at certain hydro-meteorological factors that caused the increase of drought in these years. The goal of this study is, therefore, to further analyze what were the drivers of the severe droughts in Europe in 1976, 1983, and 2003. Droughts (meteorological, soil water) simulated with the ECHAM4 model were compared with those (meteorological) derived from observations. Observations were obtained from 213 in-situ meteorological measurements across over 11 European countries (NOAA stations). The meteorological drought indices SPI (Standardized Precipitation Index) and SPEI (Standardized Precipitation Evaporation Index) were used to analyze the severity and duration of droughts. Our results show that all three major drought events in these European regions were triggered by similar favorable conditions for drought. The high temperature anomaly and precipitation deficit during spring, which were followed by a soil water deficit were responsible for the severe droughts. The droughts in 1976 and 2003 were more severe than the 1983 drought due to continuous dry condition from spring till summer. In 1983, some precipitation during the summer prevailed development in a very severe drought. The intercomparison between the ECHAM4 model and the observations shows that the precipitation output from the ECHAM4 model cannot be used to reliably estimate the droughts, except in a few countries, such as Belgium, France, Germany, and Switzerland. The model produces higher drought severities compared to the observations. This points towards model deficiencies to reproduce precipitation, hence only observed precipitation was used to investigate drought triggers.