Geophysical Research Abstracts
Vol. 13, EGU2011-7416-2, 2011
EGU General Assembly 2011

Assessing droughts in Europe using Standardised Precipitation Index (SPI) and Regional Climate Models (RCMs)

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Recent developments in climate modelling suggest that global warming will have influence on droughts in many European regions. ENSEMBLES project (van der Linden and Mitchell, 2009) has produced harmonised climate data from a range of Regional Climate Models (RCMs). RCMs outputs are freely available to research communities and with these data various climate change impacts studies have been made. We used these data for studying climate change impact on droughts.

Until now various studies have been assessing future droughts in Europe using one climate model and one drought indicator (Piani et al, 2010; Warrant et al, 2009; van der Linden and Mitchell, 2009). In this study we have complemented existing studies by using 8 RCMs and calculated Standardised Precipitation Index (SPI) (McKee, 1993) over Europe. SPI is simple drought indicator using precipitation as a single input. The way the SPI is calculated, namely the accumulation of precipitation over different time scales and its normalization, makes the index rather smooth and auto-correlated. In this study we have calculated only 12 months SPI (SPI-12) between 1961 and 2100 on monthly time step and 0.25 degree spatial resolution using precipitation from each RCM. Droughts are presented as extreme cumulative precipitation deficit over 12 months, which according to the SPI definition corresponds to SPI-12 below -1.5.

Droughts were assessed in three future periods (2011 – 2040, 2041 – 2070, and 2071 – 2100) separately. Using ensemble of regional climate models allowed us to study not only mean values of drought indicator, but also its spread and therefore uncertainty. Results have been presented in the form of drought probability maps.
Preliminary results show that droughts estimated from ensemble of RCMs and SPI-12 need to be studied with the degree of reluctance. In the first step raw precipitation from RCMs had to be corrected for bias using model hindcasts and precipitation observations.
After using bias corrected precipitations, calculations are showing that the European area affected by extreme droughts will increase gradually in next 100 years and number of drought events will also gradually increase. However, spread of the drought indicator (SPI-12 below -1.5) over Europe towards the end of the century is extremely high and therefore droughts cannot be predicted with the high confidence level.