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Drought, Water Scarcity and Climate Change

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A recent multi-model analysis using global hydrological model shows a decline of future available water resources by 10-50% in substantial parts of southern, western and central Europe. This implies that water scarcity (long-term unsustainable use of water resources) likely will increase. Additionally, there is some confidence that in southern and central Europe drought will intensify in the 21st century, hence impacts of drought will become more severe. The higher risk for water scarcity and drought calls for an intensified debate on the adaptation of land and water management in Europe. The debate requires a distinction to be made between drought and water scarcity because underlying processes are fundamentally different, which requires management to identify different measures. A case study will be presented demonstrating on how to distinguish between drought and water scarcity.
The impacts of drought usually exacerbate scarcity, which makes it necessary to have a comprehensive understanding of future drought risk to identify promising management options. Usually models are applied to project future changes in drought characteristics. The EU project WATCH provided gridded time series (0.5 degree) of a suite of global hydrological models forced by three GCMs. Several characteristics (e.g. change in areas with zero runoff, frequency, durations) of future drought have been derived and will be presented for the globe and Europe in particular. Model performance was evaluated by an intercomparison exercise, assuming that the more the models agree, the more likely they are providing a good representation of reality. Key drought characteristics (e.g. frequency, duration) have been mapped at the global scale and the results will be presented for the range of models included. The large-scale models were also assessed by comparing against an extensive dataset of streamflow observations in Europe. Modelled trends in annual, monthly and low flow simulated with large-scale models were compared with the observed trends and the results showed that the ensemble mean outperforms individual models. Maps displaying the model ensemble mean annual trend will be presented, which confirm the well-known pattern of contrasting trends in Europe (positive trends in northwest, negative trends in south and southeast). Positive (wetter) trends were slightly exaggerated, whereas negative (drier) trends were underestimated. Imperfect representation of stores in river basins causes a rather large spread of trends in monthly summer flows and low flow among the large-scale models. Together these studies confirm the importance of river basin characteristics in the transformation of meteorological into hydrological drought and the need for global hydrological models to improve on their process representation during dry period. Moreover, the debate on promising land and water management options to reduce future water scarcity and vulnerability to drought still has to face substantial uncertainties in model estimates.