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Development of global damage functions for drought loss estimation

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Droughts are the result of a combination of factors that start from a deficit in precipitation over a prolonged period of time or from the inadequate timing or ineffectiveness of precipitation, often combined with high temperatures and increased water demands that might lead to significant water deficits, including low flows over affected river basins. Because of their very nature droughts are known to affect wide areas and a large number of people over long periods. The social impact of droughts can affect population health and safety, can cause conflicts between people when water restrictions are required and could trigger unwanted migrations.

Direct drought damages can occur during and immediately after a drought event and are measured in physical units (e.g. reduction in yield in kg/ha, reduction in energy production in kWh). Their monetary value, the related loss, is expressed in terms of replacement costs according to prices prevailing just before the event. However, since most of the related impacts are mainly indirect and non-structural, it is difficult to evaluate and quantify the damages caused by specific drought events.

In order to assess the potential impact of an ongoing or possible future drought event, quantitative information on drought vulnerability is required. In this study we derive relations between drought severity and losses based on past events for different regions of the world. Droughts events were defined over the period 1981-2010 from a dataset of daily streamflow data modelled with the global LISFLOOD hydrological model. A low-flow index was developed based on the total water deficit below the 95th river flow percentile. Baseline annual damages were obtained by the integration of drought events recorded in different disaster datasets. Recorded losses have been adjusted for changes in exposure, economic growth and inflation.

Differences in the resulting damage functions can be explained by the specific drought vulnerability or adaptive capacity of each country. Due to the scarcity of impact data linked to extreme climate events, a bootstrap resampling was performed to assess the potential uncertainties associated with the sample size. This approach helps communicating potential drought impacts and related uncertainties to end users and policy makers in support to the development of drought management plans and long-term adaptation measures.