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Current and future droughts in the Southeastern Mediterranean

Tobias Törnros and Lucas Menzel
Heidelberg University, Dept. of Geography, Heidelberg, Germany (lucas.menzel@geog.uni-heidelberg.de)

The southeastern Mediterranean region (i.e. Israel, Palestine, Jordan and neighboring countries) increasingly suffers significant water stress. The semi-arid to arid conditions with low precipitation amounts, high temperatures and strong interannual climate variability recurrently trigger drought conditions. However, the complex political situation, showing a low degree of mutual cooperation, favors an unsustainable use of water resources and no long-term, cross-boundary water management plan exists.
In order to address the drought conditions under current and future climates in this region, the Standardized Precipitation-Evaporation Index (SPEI) was applied. In the first step, the SPEI was derived from spatially interpolated monthly precipitation and temperature data at multiple timescales: accumulated precipitation and monthly mean temperature were considered over a different number of consecutive months. To investigate the performance of the drought index, correlation analyses were conducted with simulated soil moisture and the Normalized Difference Vegetation Index (NDVI) obtained from remote sensing. A comparison with the Standardized Precipitation Index (SPI), i.e. a drought index that does not incorporate temperature, was also conducted. The results show that the choice of the SPEI/SPI timescale is crucial. In our study, the 6-month SPEI has the highest correlation with simulated soil moisture and best explains the interannual variation of the monthly NDVI. Although not extensively addressed, the SPI performs almost just as well and could be applied if temperature data are not available.
In the second step, the 6-month SPEI was derived from three climate projections based on the IPCC emission scenario A1B. When comparing the period 2031–2060 with 1961–1990, it is shown that the percentage of time with moderate, severe and extreme drought conditions is projected to strongly increase for all scenarios. Since agriculture is by far the most water demanding sector in the region, the impact of drought on agriculture was addressed. For this, the irrigation water demand during certain drought years was simulated with a hydrological model on a spatial resolution of 1 km. A large increase in the demand for irrigation water was simulated, showing that the agricultural sector is expected to become even more vulnerable to drought in the future.