# Meteorological drought change evaluation using comparative standardized precipitation index with d4PDF future and past experiments

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Meteorological drought defines a baseline for the other droughts, such as hydrological, agricultural, and socio-economic droughts. Meteorological drought indices are simply derived using only the meteorological variables, such as precipitation and temperature. The standardized precipitation index (SPI) is used by national meteorological and hydrological services around the world to characterize the meteorological droughts on multiple timescales longer than 1 month. The SPI is computed as follows. The cumulative distribution function (CDF) of the gamma distribution is fitted with the aggregated precipitation dataset at a desired timescale. The fitted CDF is converted to the standardized normal distribution, and the SPI value is computed as the standard score, or Z-score, of the corresponding precipitation. Due to the standardization, the 50th percentile value of precipitation is converted to SPI=0, and the 84.13th and 15.87th percentile values are converted to SPI of +1 and -1, respectively. The SPI values less than -1 are generally treated as the meteorological drought.
The comparative SPI (cSPI) is an extension of the SPI and was developed for meteorological drought assessment under climate change as well as monitoring drought hazards by dividing the input dataset of precipitation into the reference and target datasets. The CDF parameters are estimated with the reference dataset, and the precipitation of the target dataset is converted to the Z-score of the standardized normal distribution related to the CDF using the parameters estimated from the reference dataset. This cSPI approach enables us to estimate the shift of the central condition of the target dataset and the probability changes of dry and wet conditions in the target dataset on the basis of the reference dataset.
The d4PDF (database for Policy Decision-making for Future climate change) consists of three sets of experiments using a general circulation model with 60-km horizontal grid developed by Meteorological Research Institute of Japan: historical climate experiment (100 runs, 60 years from 1951 to 2010), non-warming past experiment (100 runs, 60 years), and +4K future climate experiment (90 runs, 60 years). We compute cSPI of the non-warming past and +4K future climate experiments on the basis of 100 members of the historical climate ensemble experiment, respectively. We demonstrate the changes in the central conditions and in the probabilities of dry and wet conditions with cSPI due to the anthropogenic global warming in future (+4K vs. historical) and past (non-warming vs. historical) climate experiments.

References:
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