EVALUATING HISTORICAL DROUGHT USING DIFFERENT INDICES AND DATA PROCESSING SCHEMES

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Abstract The aim of the research is to evaluate historical droughts using drought indices under different data processing schemes. The most widely used drought indices, the Standardized Precipitation Index (SPI), the Effective Reconnaissance Drought Index (eRDI), and the Streamflow Drought Index (SDI), were used. Two data processing systems were used for the drought analysis: (1) weighted mean area using a Thiessen polygon of drought indices calculated at individual meteorological stations; and (2) drought indices calculated from initially area - weighted averages. The study shows that there is no disagreement in the data processing schemes, but with uncertainty considering the results may be different.

Keywords: drought indices, historical drought, data processing systems.

Methods

Drought is a natural phenomenon significantly affecting society, economy, and the natural environment.

Precipitation deficit leads to:

- Meteorological drought
- Meteorological drought propagates to land processes resulting in soil moisture deficient, and streamflow and groundwater reduction.

The study area is the Pilica River which drains from an area of 8665 square kilometers.

Hydrometeorological data:

- Hydrological data: Flow at Bialobrzegi gauging station.
- Meteorological data: nine meteorological stations.
- Missing meteorological variables were filled by using the normal ratio method.

Drought characterizations were conducted using the drought indices method as per Tigkas et al. (2015) using the three most widely used indices.

- The Standardized Precipitation Index.
- The Enhanced Reconnaissance Drought Index.
- The Streamflow Drought Index.

Data processing schemes

- Weighted mean using a Thiessen polygon of drought indices calculated at individual meteorological stations; and
- Drought indices calculated from initially area - weighted averages of precipitation and evapotranspiration.

Results

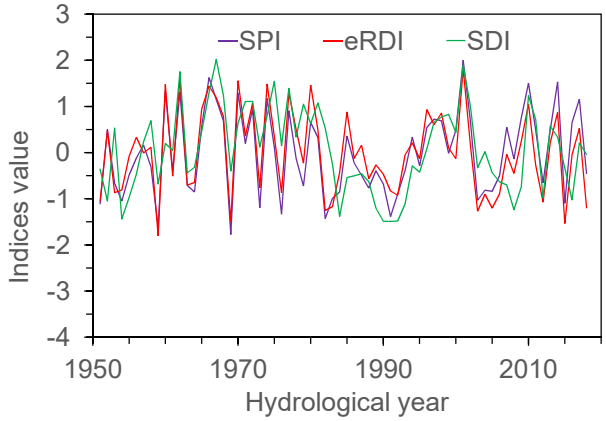

Figure 1: Historical drought indices for the Pilica River from 1951 to 2019.

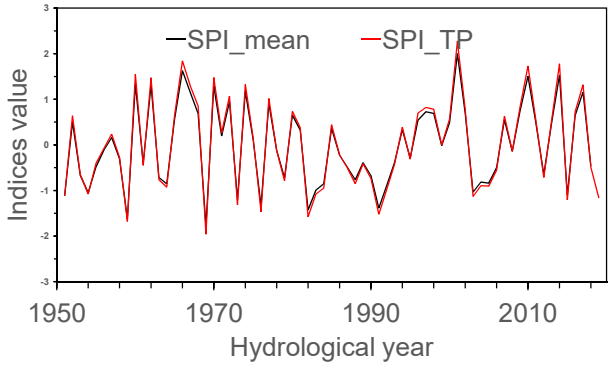

Figure 2: 12-months time scale historical SPI for mean and Thiessen Polygon data processing schemes.

Conclusions

Historical droughts have happened in the study area, specifically.

- Meteorological droughts: 1959, 1969, 1976, 1982, 1991, 2003, 2015, 2019.
- Agricultural droughts: 1959, 1969, 1982-83, 2003, 2015, 2019.
- Hydrological droughts: 1952, 1984, 1989-93, 2008, 2019.
- The two data processing schemes gave similar result, but with uncertainty considered the results may be different.
- Further works are planned to include uncertainty analyses

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