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Apprehensive Drought Characteristics over Iraq: Results of a Multidecadal Spatiotemporal Assessment

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Drought is an extreme climate phenomenon that happens slowly and periodically threatens the environmental and socio-economic sectors. Iraq is one of the countries in the Middle East that has been dealing with serious drought-related issues in the 21st century. Here, we investigate meteorological drought across Iraq from 1948 to 2009 at a 0.25° spatial resolution. The Standardized Precipitation Evapotranspiration Index (SPEI) has been utilized as a multi-scale drought index accounting for the effects of temperature variability on drought. Four of the main characteristics of drought including extent, intensity, frequency, and duration are studied, and the associated spatiotemporal patterns are investigated for each case. Results revealed a significant drought exacerbation over Iraq during the period of 1998–2009. Two significant drought periods of 1998–1999 and 2007–2008 are identified during which severe to extreme droughts covered about 87% and 82% of Iraq, respectively. Analyzing the trends of drought intensity reveals that the central and southwestern parts of Iraq have experienced aggregated intensifying patterns among other regions. In general, droughts are found to be more frequent but shorter at the western, central, and southeastern parts of Iraq.

### Study Area

- Iraq is located in the southwestern Asia.
- Area ~ 435,000 km².
- 60% of the country receives less than 100 mm/year (southern parts of Iraq), whereas the mountains regions (northeastern parts of Iraq) receive the highest amount of precipitation up to 1200 mm/year.
- Summers are dry, but in the northern parts and extremely hot (higher than 48°C) across the rest of Iraq. Spring and fall are very short in Iraq.
- The Tigris watershed is about 371,562 km² that surrounds about 38% of Iraq.
- The Euphrates watershed is about 579,314 km² and covers about 49% of Iraq.
- Gold cells covering the basin for each dataset:
  - 0.25 Deg. → 2132 grids

### Data

- The Global Land Data Assimilation System Version 2 (GLDAS-2) monthly data with a 0.25° spatial resolution is used in this study.
- The components of GLDAS-2 are the GLDAS-2.0 that is forced entirely with the Princeton meteorological forcing data and the GLDAS-2.1 that is forced with a combination of model and observation-based forcing datasets.

### Results

- Severe drought reaches its maximum in the late 1990s with about 87% drought extent recording the worst drought in Iraq by the end of the 20th century.
- The 2007–2008 period seems to be the worst drought with about 55–82% of Iraq experiencing extreme droughts.

### Conclusion

- A drying trend is detected over Iraq with severe to extreme drought conditions governing the first decade of the 21st century.
- The worst drought condition has occurred during 2007–2008 when severe and extreme drought covered about 25% and 60% of Iraq, respectively.
- The intensity of drought has exacerbated during the past decades, with the most aggravation happening in the central regions of Iraq.
- Droughts are found to be more frequent but shorter at the western, central and southeastern parts of Iraq.

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### Reference