

Drought analysis report

Introduction

The chosen study region is Fresno, California within the time range from the start of 2021 to the end of 2022. The state of California is known for its naturally dry, hot summers and wet, mild, winters. However, due to the 2021 winter months being abnormally dry, the state experienced intense drought stress, with [CalMatters](#) reporting the summer of 2021 as “the worst year in the instrumental record” based on drought severity index reporting. The objective is to analyze the temporal drought patterns within 2021 and 2022 in Fresno, California.

Methods

The GRIDMET dataset is used for drought analysis. GRIDMET offers high spatial resolution of 4 km, daily updates, and a temporal coverage that spans from 1979 to present. The analyzed drought indices from its dataset are standardized precipitation index (SPI), evaporative drought demand index (EDDI), standardized precipitation evapotranspiration index (SPEI), and Palmer Drought Severity Index (PDSI). SPI measures precipitation for detecting general trends or anomalies over time. SPEI is precipitation minus evapotranspiration and for drought assessment. EDDI measures atmospheric evaporative demand for determining moisture stress. PDSI is Palmer soil moisture balance for determining long-term drought severity.

The Multi-Index Drought Analysis extracts all of the aforementioned indices from January 2021 to December 2022 for Fresno, California as shown in Fig. 1. The SPI values for the previous 90 days (SPI-90d) were compared against SPI values for June 2021 as shown in Fig. 2. The PDSI values for the previous 90 days (PDSI-90d) were compared against PDSI values for June 2021 as shown in Fig. 3.

Results

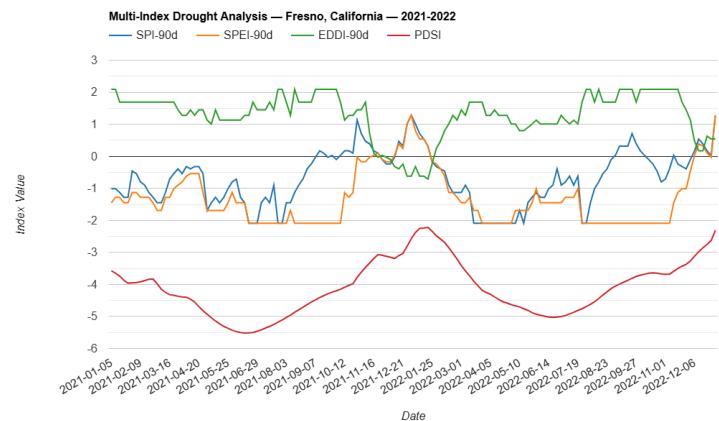


Fig. 1. Multi-Index Drought Analysis for Fresno California from 2021 to 2022 from GRIDMET

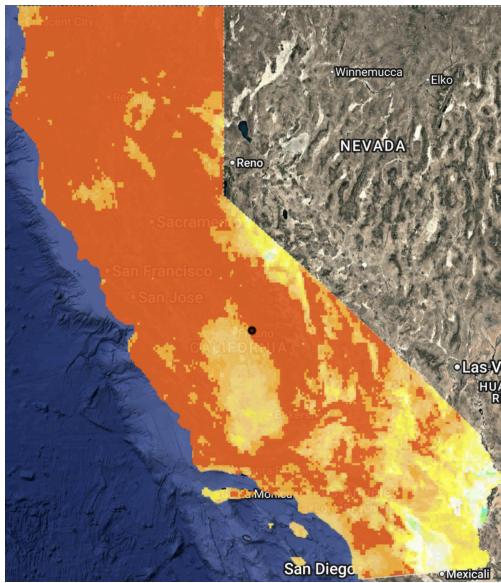


Fig. 2. SPI 90 day for June 2021 from GRIDMET

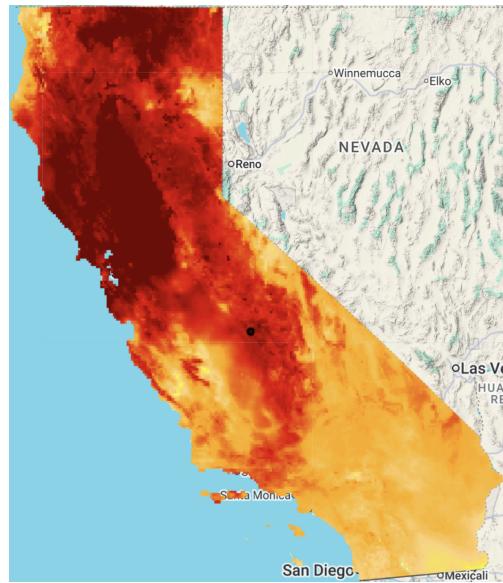


Fig. 3. PDSI 90 day for June 2021 from GRIDMET

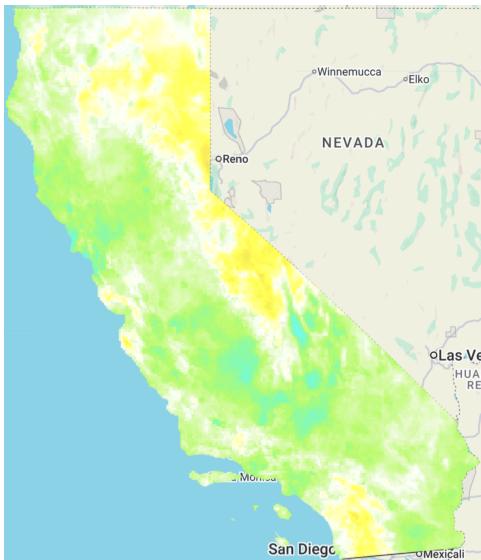


Fig. 4.1. SPI 30 day for Summer 2021 from GRIDMET

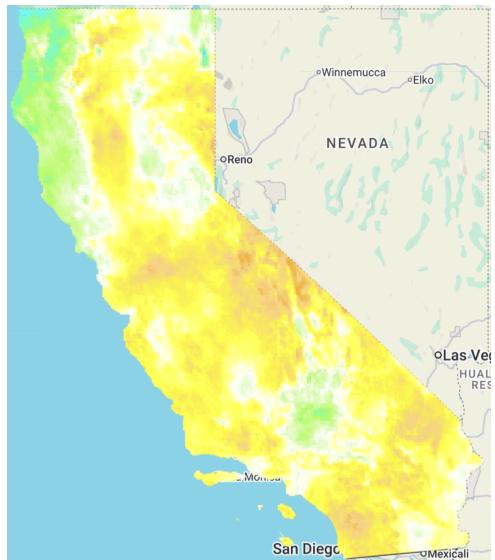


Fig. 4.2. SPI 90 day for Summer 2021 from GRIDMET

Fig.1 suggests that through 2021 and 2022, there were long periods of severe to extreme with a brief incipient wet spell during the second winter from around 2021-11-01 to 2022-02-01. The most severe drought occurred within the month of June 2021 when SPI-90d and SPEI-90d were both at a minimum of around -2.0 and the PDSI was at a minimum of -5.5. For SPI-90d and SPEI-90d, -2.0 values indicate extreme drought. For PDSI, the -5.0 value indicates long-term extreme drought conditions. Despite this, the EDDI value at the time was between 1.1-1.5, which typically suggests slightly wet conditions according to GRIDMET classification.

Discussion and Conclusion

A possible interpretation for why the EDDI value was between 1.1-1.5 in June 2021 while all other drought indices had values that indicated severe drought could be that the study area was experiencing a situation where there is enough heat to cause high evaporative demand—hence, high EDDI values—but not enough moisture to satisfy the demand. This would negate the GRIDMET classification of slightly wet conditions but instead suggest that extreme drought conditions was induced by the high and unmet evaporative demand. Satellite-based drought monitoring could have inaccuracies and inconsistencies due to the complex nature of calculating precipitation from satellite images only. However, by utilizing the several drought indices provided by GRIDMET and applying current knowledge and reasoning on the nature of droughts, scientists can identify cases where traditional metrics may underestimate drought risk and better manage water resources for the long-term.