DROUGHT MONITORING USING QUANTITATIVE PRECIPITATION ESTIMATION OVER NORTHEASTERN ARIZONA

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Introduction

The intent of this effort is to determine the standard precipitation index (SPI) for measuring drought severity using radar derived rainfall measurement products. The National Weather Service Multi-Radar Multi-Sensor (MRMS) QPE system [1] provides a radar-only rainfall product used in this analysis. This SPI is calculated over a domain that extends over northeastern Arizona which is located in the southwestern United States. Much of this region exists on the Colorado Plateau, such that it is prone to drought conditions due to orographic effects along mogollon rim as storms move from west to east. Reliable QPE is a challenge to obtain in this area due to beam overshooting (Figure 1). The area of study includes portions of southeastern Utah northeastern Arizona, southwestern Colorado and northwestern New Mexico. The surrounding NWS WSR-88D radars are KFSX located near Flagstaff, AZ, KICX near Cedar City, UT, KGJX near Grand Junction, CO and KABX near Albuquerque, NM, where the concentric circles indicate the 100 km and 200 km range rings, and the shaded area is the domain of this study. These radars are ingested by MRMS to produce QPE over this region. However, at far ranges from the radar sites, beam broadening and terrain obstacles make it difficult to assess the accuracy of rainfall measurements given by MRMS [2]. Calculation of the SPI is generally calculated using the monthly rain gauge accumulation value. In this work, the SPI is evaluated by aggregating MRMS rainfall into monthly accumulation. The SPI methods applied are given by Thom [3], Farahmand [4] and McKee [5], since it has been shown that the gamma distribution fits well to precipitation time series. SPI computed by transforming *H(x)* to standard normal distribution with mean of zero and variance of one. [4][5]

Figure 1 NE Arizona Domain

This approach is considered due to the lack of rain gauge data over the domain and thus the SPI is calculated for each radar pixel. The SPI values are such that positive values indicate wetter than normal and negative is drier than normal.

Methodology

QPE generated from individual radars are merged using the National Severe Storms Laboratory (NSSL) MRMS system. This mosaicking product ingests all NEXRAD data, such that the domain extends over the entire conterminous United States. The use of this MRMS for regional applications is possible, however the configuration is tedious and computational resources are substantial. Therefore the QPE for this domain is extracted from the complete rainfall map. The location of northeastern Arizona is such that radar measurements are compromised due to beam height as can be seen in Figure 1. The height of the beam center at ranges greater than 100 km begin to overshoot storm events, which are most likely to occur under 2 km. The majority of the area of interest is well beyond these distances and thus existing in a blind spot in regards to reliable radar measurements. The MRMS QPE product of interest is the radar-only. Since MRMS uses an approximately 1 km by 1 km grid point resolution. The SPI of interest will be the 3-month SPI, and the monthly accumulations are aggregated using the 24-hour precipitation totals.

The MRMS radar-only 24-hour accumulation output is a gridded product that covers the entire US, so only the grid points pertaining to the domain are kept for processing. Once the gauge latitude-longitude locations are known the SPI can be determined according to corresponding MRMS pixel location. Monthly accumulations were considered from January 2001 to May 2019.

EVALUATION

The 3-month SPI index calculated from MRMS QPE radar-only can be used to generate drought indices for this particular region that has very sparse gauge information. These results also indicate the challenges in determining accurate and reliable rainfall amount, since this is region is located at far distance from the NEXRAD radar locations.

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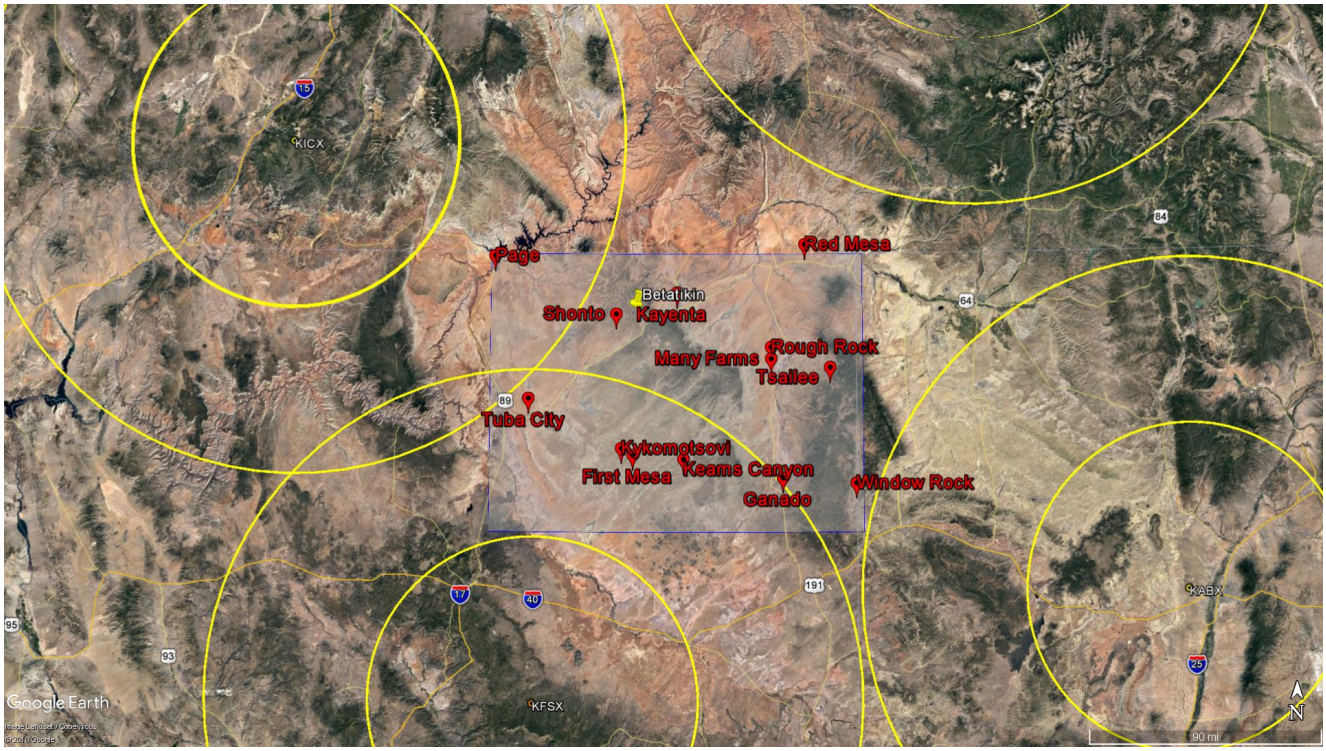
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