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The potential of remote sensing data in rain gauge network optimization in the arid regions

Silas Michaelides[1,2], **Mona Morsy**[3,4,5], Ruhollah Taghizadeh-Mehrjardi[4], Thomas Scholten[4], Peter Dietrich[4,5], and Karsten Schmidt[4]

[1]Cyprus University of Technology, Limassol, Cyprus.
[2]ERATOSTHENES Centre of Excellence, Limassol, Cyprus.
[3]Geology Department, Faculty of Science, Suez Canal University, Ismailia, Egypt.
[4]Geosciences Department, Faculty of Science, Tuebingen University, Tuebingen, Germany.
[5]Department of Monitoring and Exploration Technologies, Helmholtz Center for Environmental Research, Leipzig, Germany

Water scarcity is a growing concern in arid and semi-arid regions of the World, locations where groundwater is the main source of freshwater. In order to preserve local water budgets, it is critical that accurate climatic data be acquired. Unfortunately, the majority of these arid regions feature a very limited number of rain gauges, reducing the reliability of the data produced. The present study offers a series of steps for overcoming the issue of data scarcity. Once resolved, this could then promote greatly needed hydrological studies on topics such as the spatiotemporal distribution of rainfall, the mitigation of flash floods hazards, or the minimization of soil erosion. In the present study, the DEM file and GPM (IMERG) data were used to identify the most suitable locations for a new network of rain gauges at the Eastern side of the Gulf of Suez. These two datasets were clustered using k-means clustering to produce an elbow graph whose elbow-shaped region offered several possible options for the number of optimum clusters at the test site. The authors chose three different cluster sizes (3, 6, and 9) and calculated the possible centroids for each size. Calculations resulted in 3 centroids, 6 centroids, and 9 centroids. These centroids were tested using the empirical cumulative distribution function (ECDF), once the sum of the GPM (IMERG) scenes, the scene limits, and the elevation map limits were determined. This test revealed gaps in all centroids mentioned. Consequently, the authors established nine clusters as the optimal size. Nine centroids were therefore taken, along with the existing five gauges, as a basis for standard error kriging. This allowed the authors to gradually minimize error via looping. The newly added points were tested with an ECDF. The complete spectrum of rainfall and elevation was efficiently covered by the 31 proposed rain gauge locations, and the five existing gauges.