Rainfall-Runoff Estimation in Pakistan Using Google Earth Engine

MARIA MUSHTAQ

Date

1/12/2024

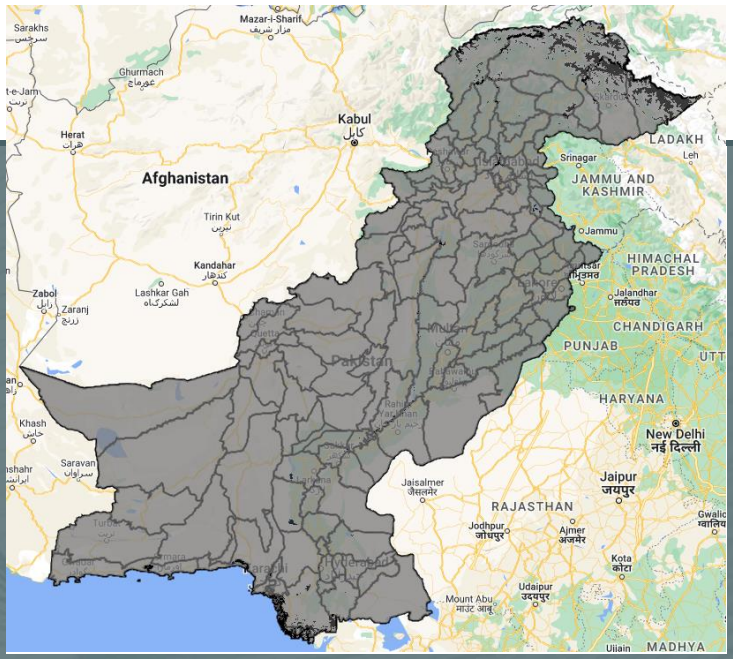
Course title

Water Resources Management and Engineering

MR. MUHAMMAD ALI AZMAT

INTRODUCTION

This study focuses on estimating rainfall-runoff in Pakistan using the Soil Conservation Service Curve Number (SCS CN) method implemented in Google Earth Engine (GEE). The SCS CN method considers land cover, soil properties, and antecedent moisture conditions (AMC) to predict runoff volumes. The key datasets utilized include MODIS for land cover, USDA for soil texture, and CHIRPS Daily for rainfall.



Datasets

1. **Land Cover:** MODIS imagery for the year 2019 was employed to identify land cover types.
2. **Soil Texture:** The USDA dataset was used to determine soil texture classes.
3. **Rainfall:** CHIRPS Daily dataset provided precipitation data covering the period from January 1, 2019, to January 1, 2022.

Curve Number Calculation:

The SCS CN method requires assigning curve numbers based on land cover and soil properties. A GEE script was developed to create a composite image combining land cover and soil texture, from which curve numbers were derived using conditional expressions.

Rainfall Data Processing:

The CHIRPS Daily dataset was preprocessed within GEE to match the required time scale and resolution. Daily rainfall images were then aggregated to represent the AMC conditions.

Antecedent Moisture Condition (AMC):

AMC refers to the moisture state of the soil before a rainfall event. In this study, AMC was determined by summing daily precipitation over a specific time window, enhancing the model's ability to represent varying soil moisture conditions.

SCS CN Method Implementation:

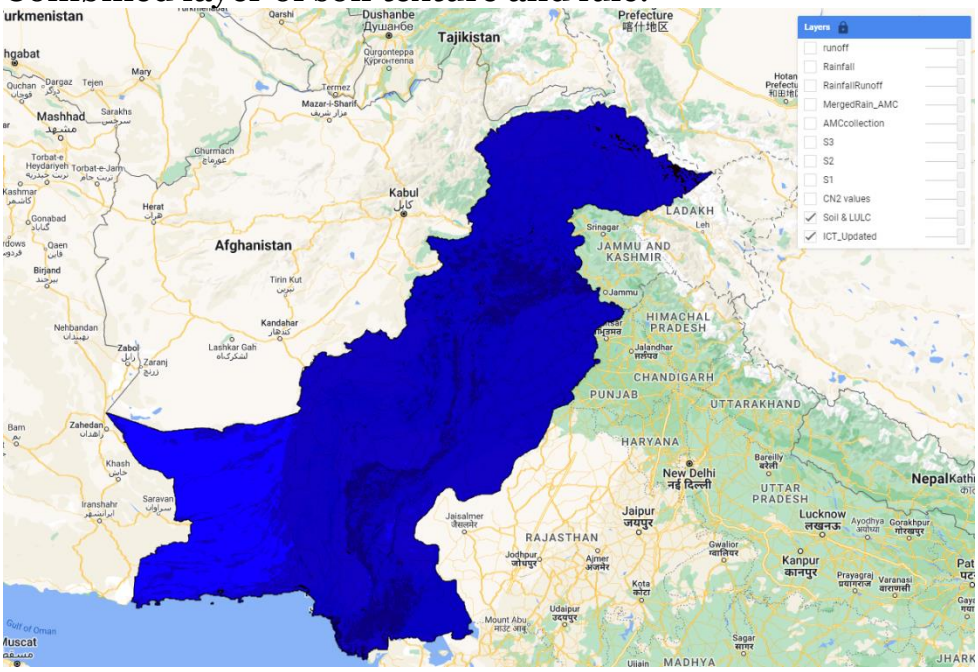
A GEE script was developed to implement the SCS CN method, calculating runoff for each time step based on the derived curve numbers and AMC conditions.

Runoff Calculation and Summation:

Runoff volumes were calculated for each time step using the SCS CN method within GEE. The cumulative runoff volumes over the study period were then determined.

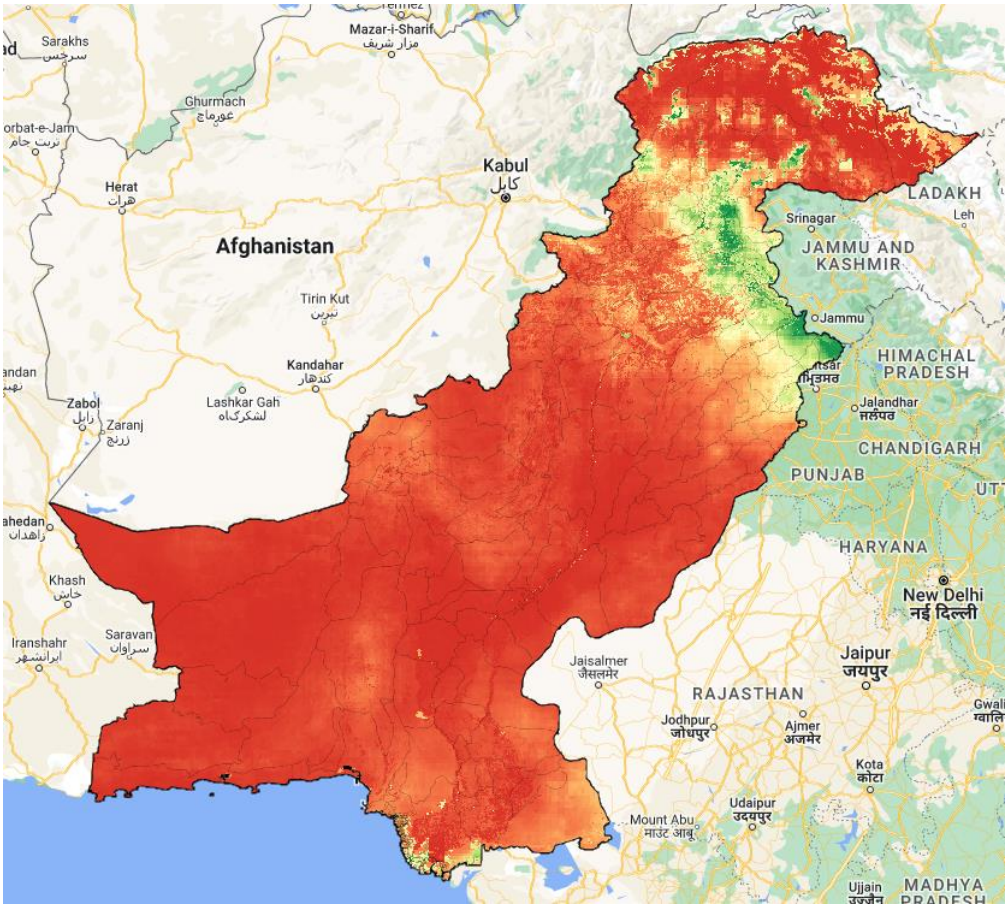
Visualization and Analysis:

GEE's visualization tools were utilized to represent the results spatially and temporally. The maps displayed land cover, soil texture, curve numbers, and runoff across the study area.
Combined layer of soil texture and lulc:



Curve numbers:

Runoff:



Results:

The study successfully implemented the SCS CN method in GEE, providing insights into the spatial and temporal variability of runoff in Pakistan. The visualization tools and time series charts facilitate a comprehensive understanding of the rainfall-runoff relationship.

Conclusion:

This report outlines the methodology and outcomes of estimating rainfall-runoff in Pakistan using the SCS CN method and GEE. The integration of diverse datasets and the implementation of hydrological modeling contribute to a better understanding of water dynamics in the region. This study lays the groundwork for further research and water resource management in Pakistan.

Rainfall-Runoff Estimation in Pakistan Using Google Earth Engine