Integrated Assessment of Climate Change and Land Use Impact on Runoff Dynamics in the Jhelum Basin

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This presentation participates in OSPP

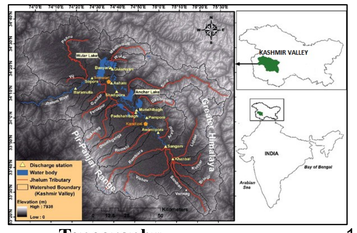
Outstanding Student & PhD candidate Presentation contest

Motivation

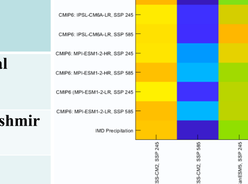
Lack of Localized Impact Assessment on **Runoff Dynamics in the Jhelum Basin**

- Climate changes are expected to alter river-flow conditions (**discharge, seasonality**).
- This study fills a crucial gap by providing localized hydrological impact assessments in the Jhelum Basin, enhancing understanding of climate change and land use effects on runoff dynamics.
- Key insights enable adaptive strategies for sustainable water management amid climate and land use changes.
- Integrating observed data and downscaled GCMs with SWAT and RUSLE enhances accuracy for proactive decision-making.

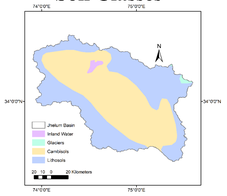
The Study Areas



Topography



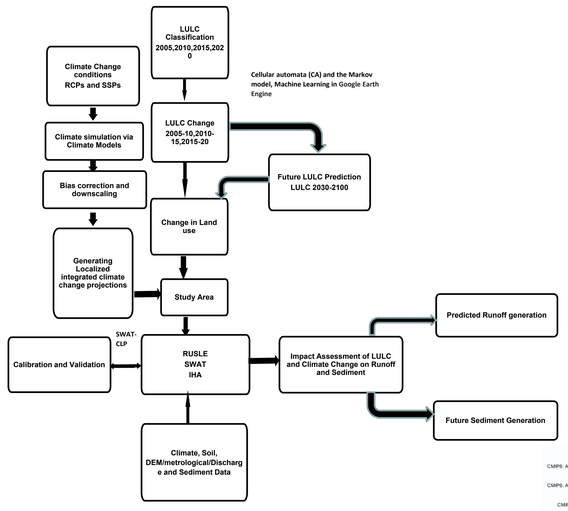
Soil Classes



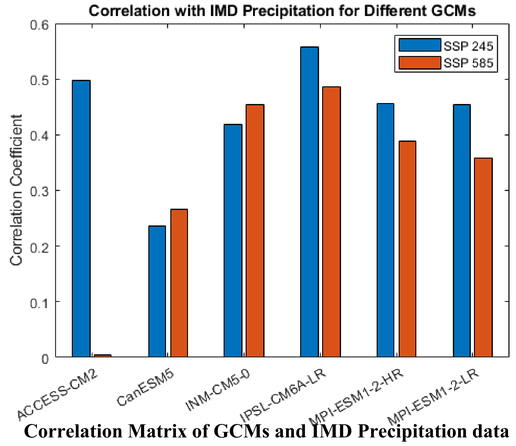
1.The Upper Jhelum Basin, characterized by diverse geographical features and originating from Verinag spring in Kashmir, comprises twenty-four catchment areas.

2.Climate change impacts, population growth, and land use changes in the region contribute to escalating flood risks and soil erosion, underscoring the urgency for thorough hydrological assessments and adaptive management strategies.

Strategy and methods



Correlation with IMD Precipitation for Different GCMs



Correlation Matrix of GCMs and IMD Precipitation data

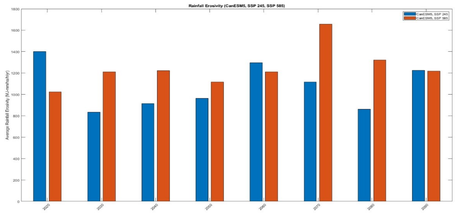
Details of different datasets applied for the study.

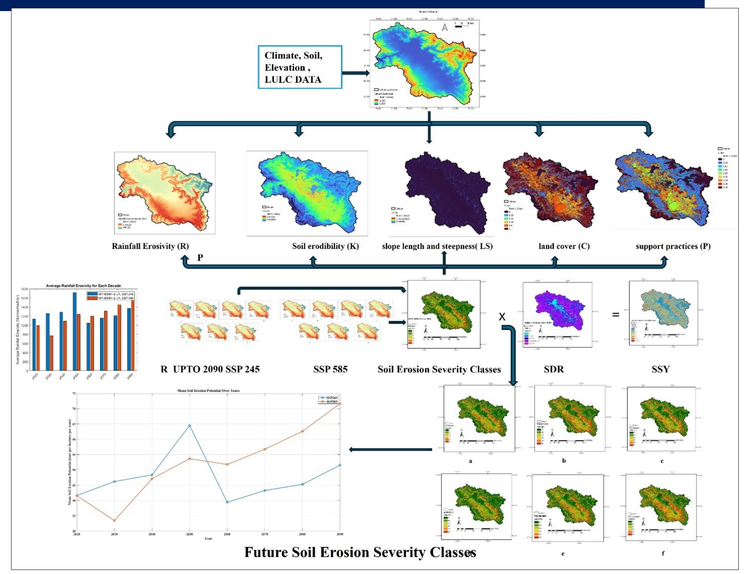
S.No	Data type	Specification	Range	Source
1	Rainfall	0.25° × 0.25°	1960-2020	Indian Meteorological Department (Daily)
2.	Discharge	Daily	1960-2020	IFC Department, Kashmir
3.	LULC	10 m	2017-2020	Sentinel-2 (ESRI)
4.	LULC	60m and 30m	1985, 1995, 2005	Landsat 4, Landsat 5
5.	LULC	50 K	2005-06, 2010-11, 2015-16	ISRO, Bhuvan
6	DEM	30m	-	SRTM

CMIP6 (Model)	Institution
ACCESS-CM2	Commonwealth Scientific and Industrial Research Organisation (CSIRO), Bureau of Meteorology, Australia
CanESM5	Canadian Centre for Climate Modelling and Analysis
INM-CM5-0	Institute for Numerical Mathematics (Russia)
IPSL-CM6A-LR	Institut Pierre-Simon Laplace (France)
MPI-ESM1-2-HR	Max Planck Institute for Meteorology (Germany)
MPI-ESM1-2-LR	Max Planck Institute for Meteorology (Germany)

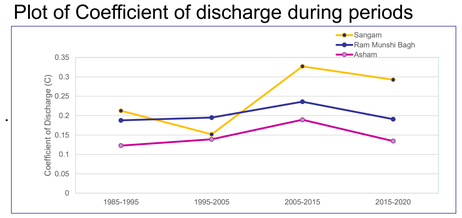
Results

	LULC Class	1985-1995	1995-2005	2005-2015	2015-2020
Sangam	Water/Snow/Ice	-0.10327	-0.10137	-0.36256	-0.35357
	Built Up	0.007731	0.040062	2.035131	0.829442
	Vegetation	0.002422	0.007966	-0.06153	-0.03278
	Others	0.825864	-0.2696	7.447138	0.103238
Ram Munshi Bagh	Water/Snow/Ice	-0.05595	-0.13669	-0.49003	-0.487
	Built Up	0.026276	0.037071	2.370349	0.348073
	Vegetation	0.000687	0.007408	-0.07313	-0.03623
	Others	0.59655	-0.1735	9.719969	0.396998
Asham	Water/Snow/Ice	-0.06354	-0.05371	-0.64385	-0.16586
	Built Up	0.026274	0.03606	2.315352	0.370436
	Vegetation	-0.00633	0.016	-0.05538	-0.04467
	Others	0.858408	-0.49879	5.604148	0.349774

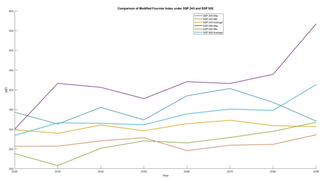


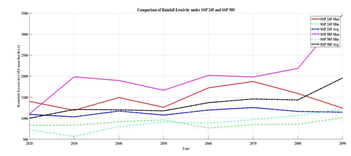


Plot of Coefficient of discharge during periods

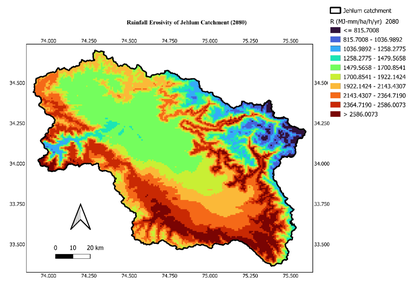


Variation in Rainfall Erosivity(R) over time

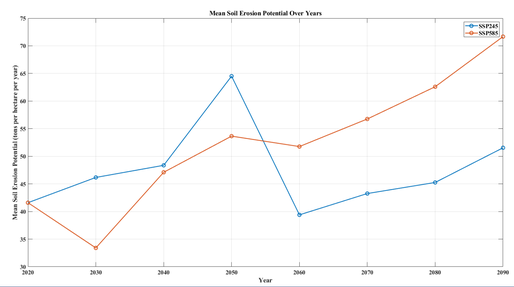




Rainfall Erosivity of Jehlum Catchment (2080)



Predicted soil erosion of Jhelum Catchment upto 2090 under SSP245 and SSP 585 scenerios



Summary

- **Study reveals LULC changes in Jhelum River & Kashmir Himalayas increase low flood frequency, alter flow regimes, urging integration into water management.**
- **Study forecasts Rainfall Erosivity values to rise from 798.804 (MJ-mm/ha/h/yr) in 2020 to projected 1551.57 by 2090 under SSP585, indicating substantial climate-induced soil erosion escalation in the Jhelum Catchment.**
- **This integrated assessment underscores the intricate interplay between climate scenarios and land use dynamics, revealing substantial shift in Jhelum Basin-runoff patterns.**
- **By providing valuable insights into future water resource dynamics, the study offers essential information for policymakers to formulate adaptive strategies in response to evolving runoff generation and water resource management challenges.**

References

1. Ul Islam, S., & Chakma, S. (2024). Impact of LULC changes on hydrological flow regimes and runoff coefficient in Upper Jhelum Basin, India. *Sustainable Water Resources Management*, *10*(1), 1-15.
2. Raj, R., Saharia, M., Chakma, S., & Rafieinasab, A. (2022). Mapping rainfall erosivity over India using multiple precipitation datasets. *Catena*, *214*, 106256.