Quantifying hydrogeomorphic and climatic controls on soil erosion and sediment dynamics in large Himalayan basins

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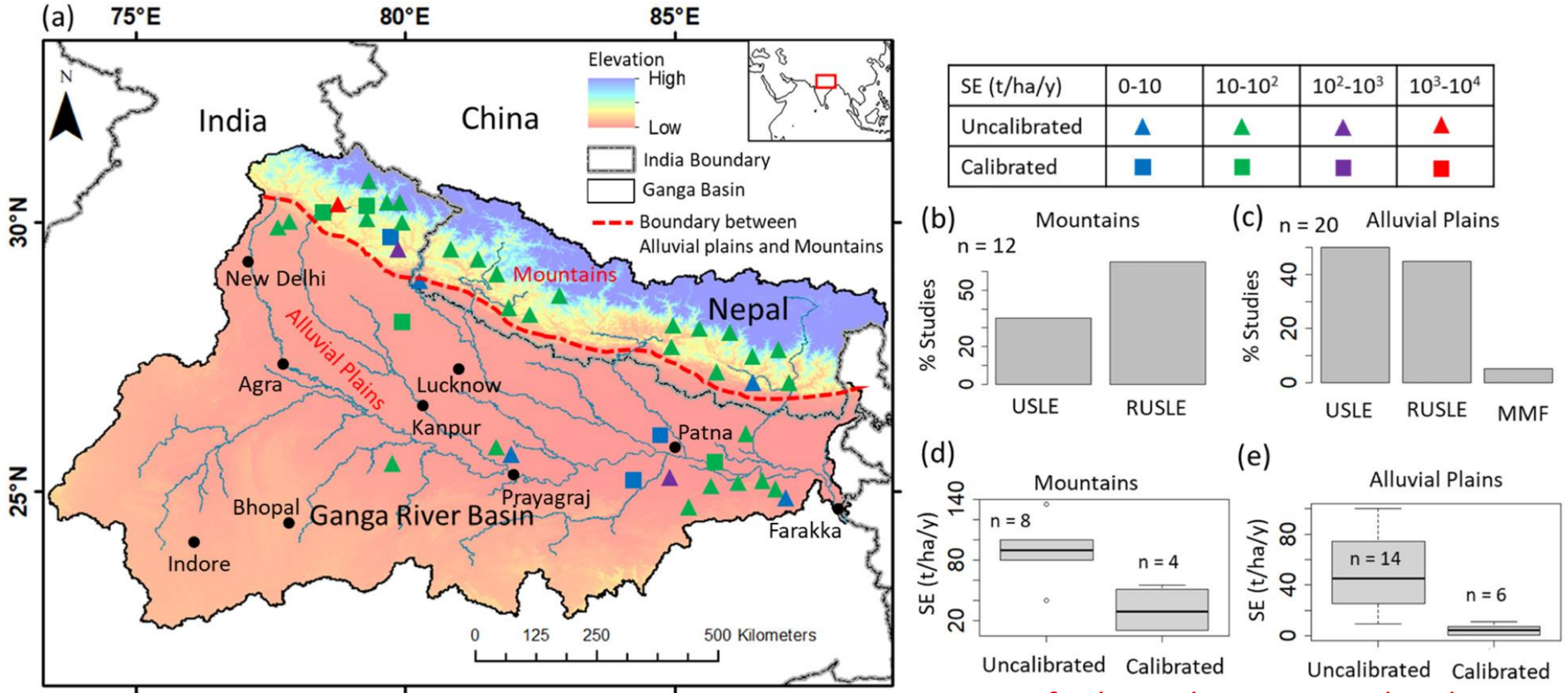
Introduction

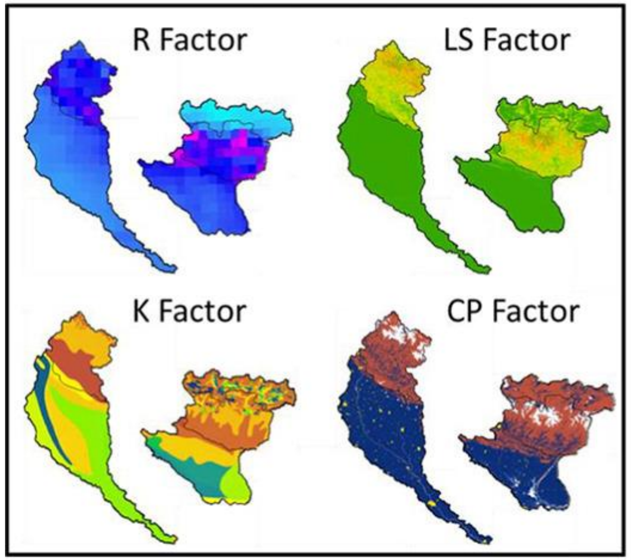


Research Questions

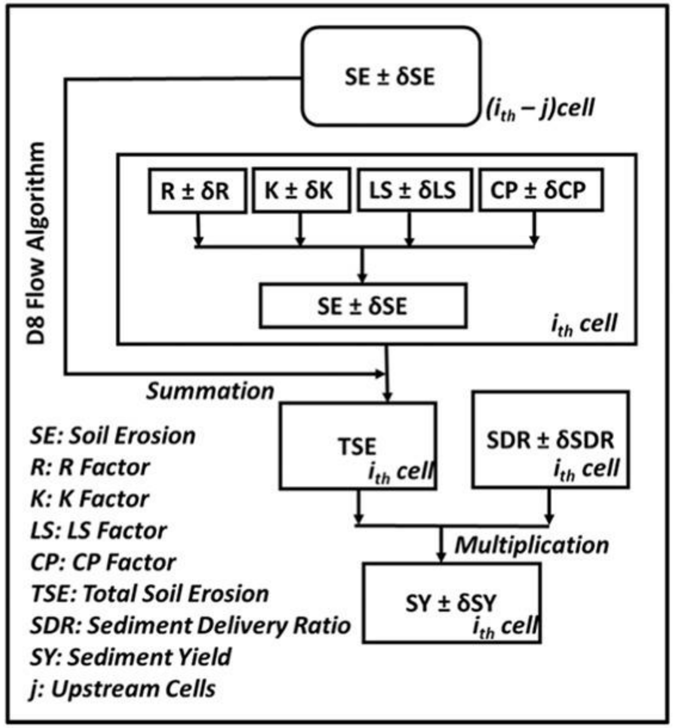
- Sediment production and transport rates are relatively higher in the Himalayan basins compared to other similar-sized river basins in the world
- Very few studies have quantified the soil erosion and sediment yield in the Himalayan basin
- Calibrations using ground observed values are rarely done

- To quantify the soil erosion and sediment yield in two hydro-geomorphologically diverse Himalayan River basins
- To calibrate and validate the estimated sediment yields using ground observations
- To propose region-specific equations for sediment yield quantification
- To apply the uncertainty method for assessing the precision of modelled results

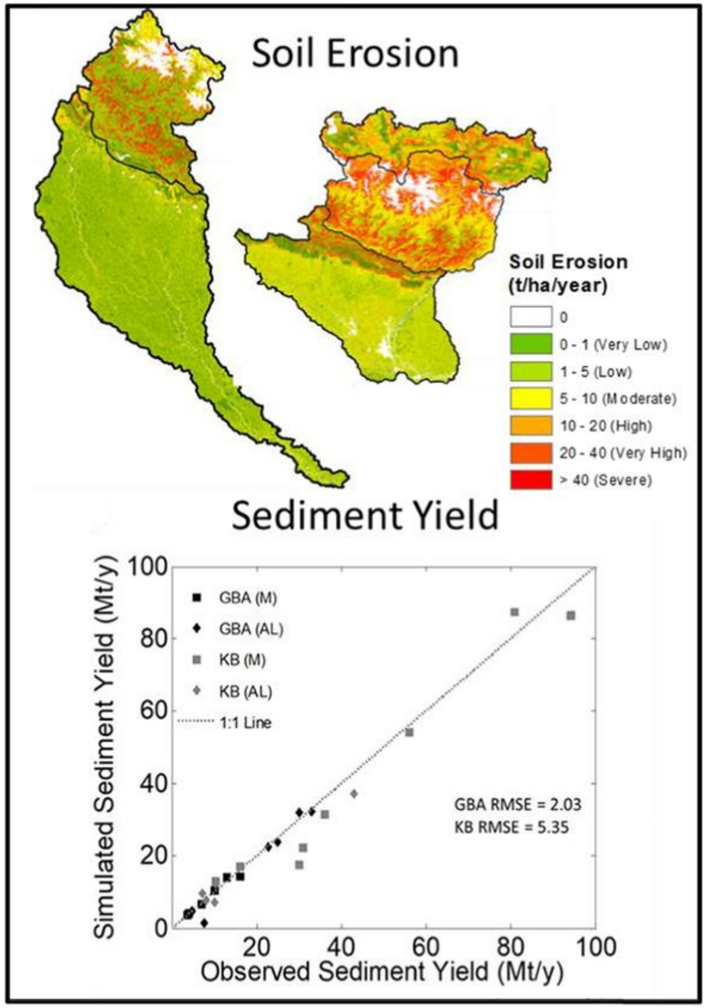
Approach and Methodology



Input Data



Methodology



Results

$$SE = R\ K\ L\ S\ C\ P$$

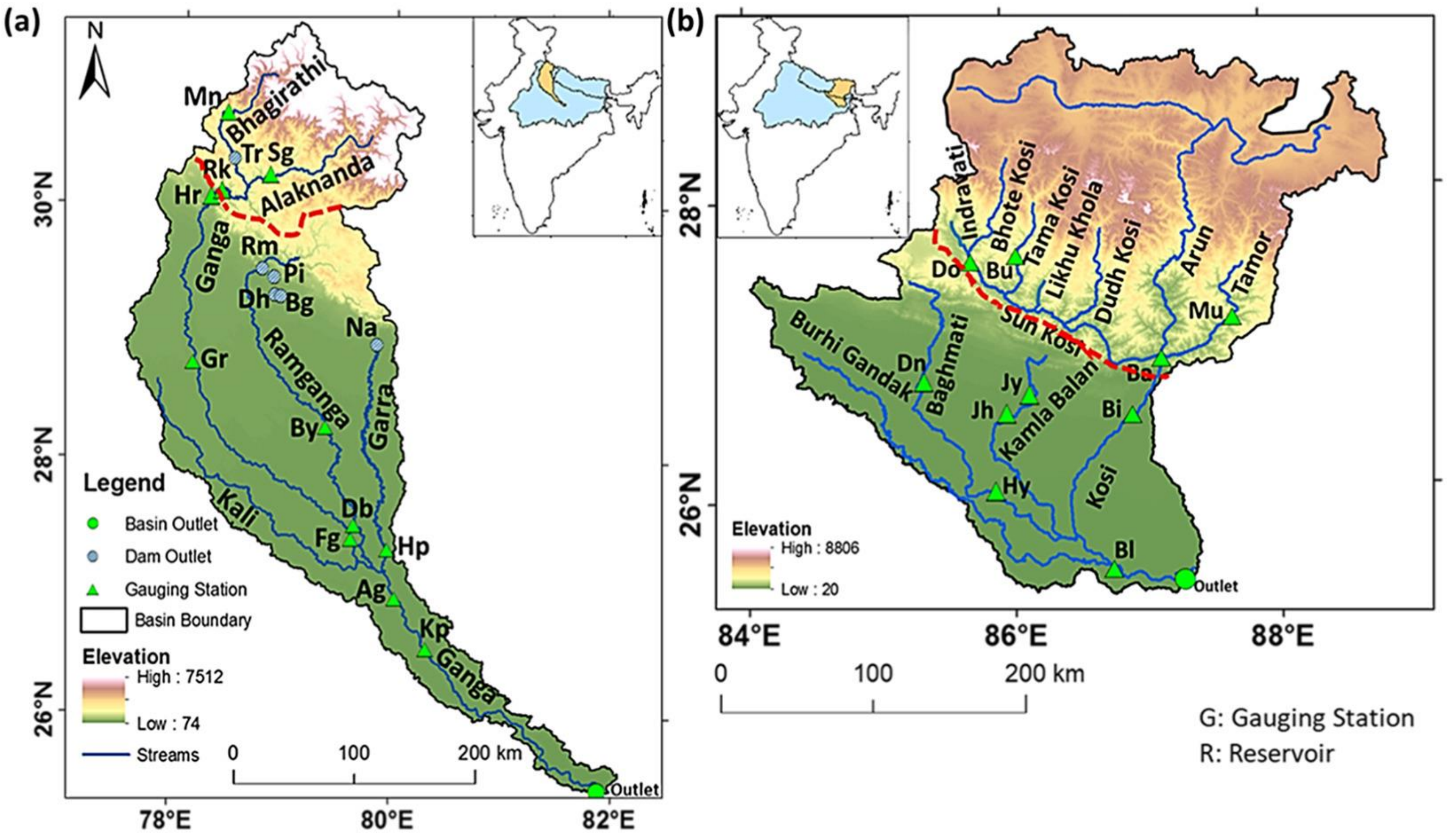
$$SDR = aA^b$$

$$\frac{\delta SE}{SE} = \sqrt{\left(\frac{\delta R}{R}\right)^2 + \left(\frac{\delta K}{K}\right)^2 + \left(\frac{\delta LS}{LS}\right)^2 + \left(\frac{\delta CP}{CP}\right)^2}.$$

$$SY = SE \times SDR$$

SE – Soil Erosion Rates (t/ha/y); R – Rainfall Erosivity; K – Soil Erodibility; LS – Topographic Steepness; CP – Crop Practice Factor, SY – Sediment Yield (Mt/y)

Study Regions – Ganga basin (west) and Kosi basin (east)



Basin Area

GBA – 87,600 km^2

KB – 88,000 km^2

Q_{mean}

GBA – 632 m^3/s

KB – 2036 m^3/s

Sediment Load

GBA – 33 Mt/y

KB – 42 Mt/y

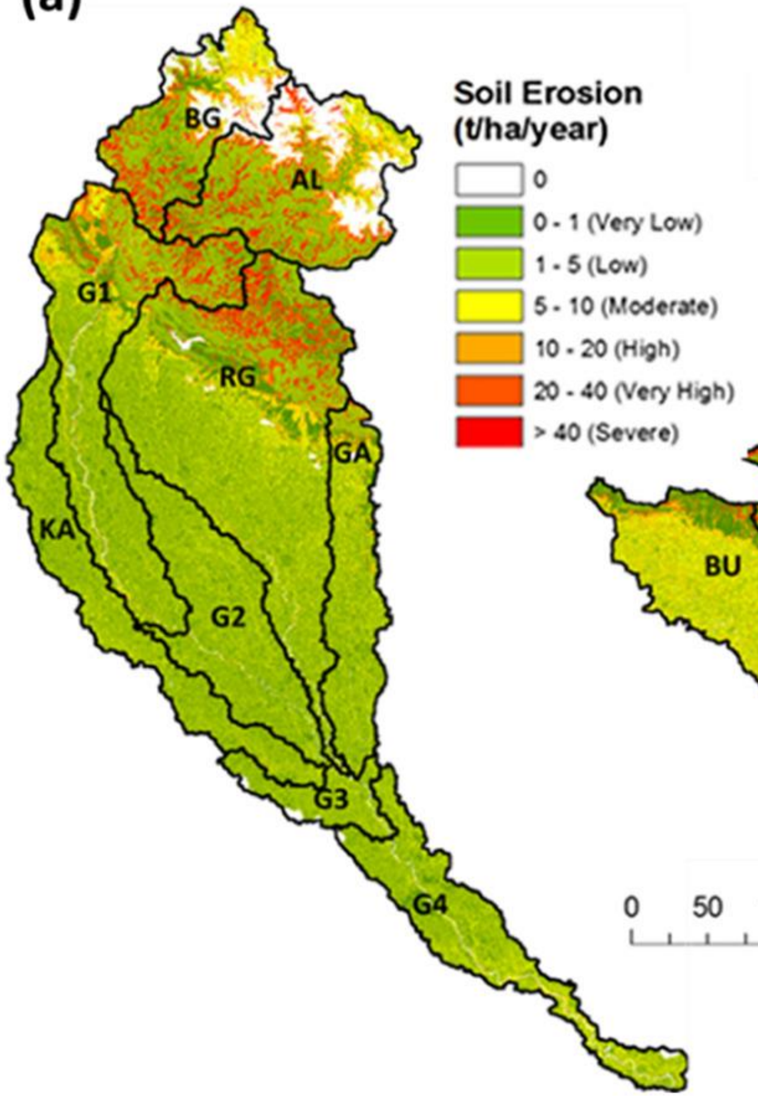
Rainfall (mm)

GBA – 600-1400

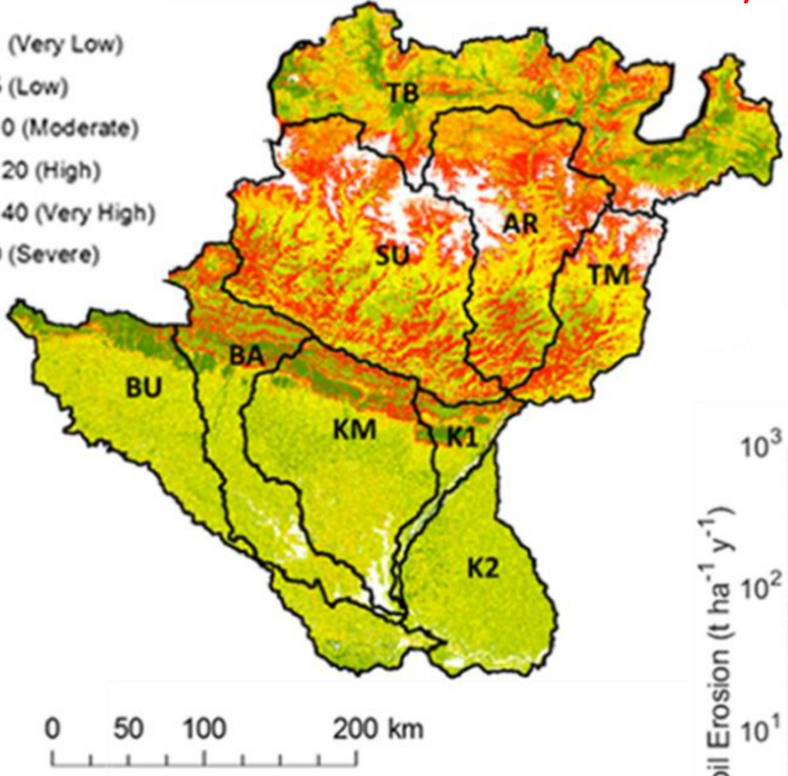
KB – 900-1600

Soil Erosion Estimates

(a)



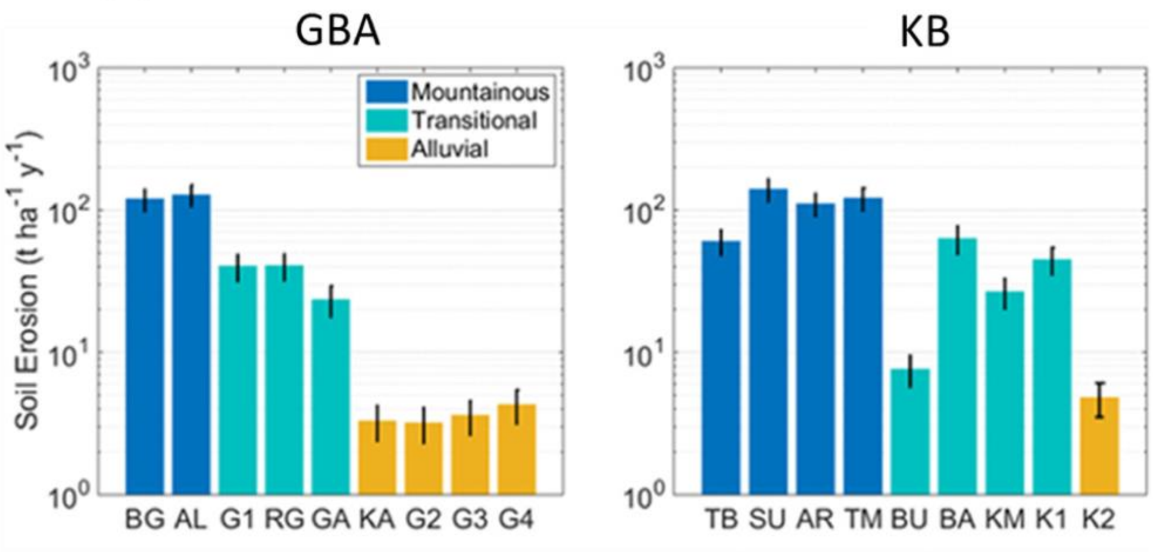
(b)



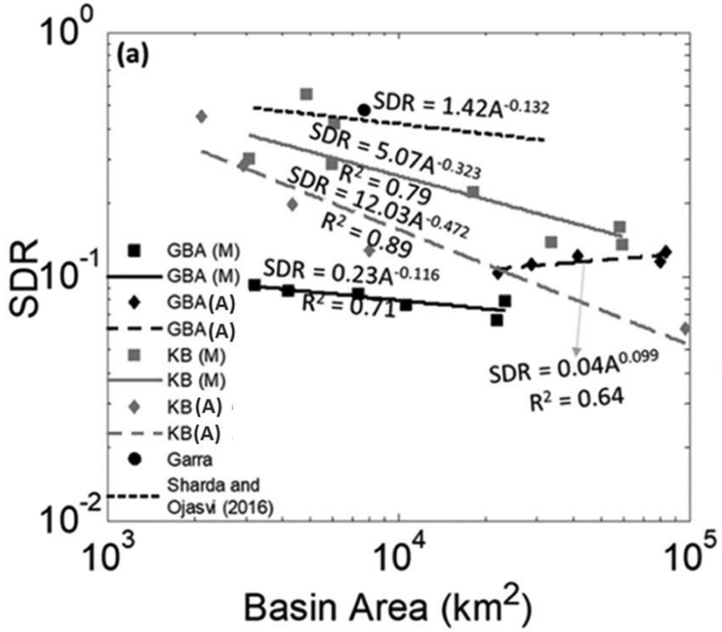
- We estimate the total soil erosion of ~404 Mt/y and ~724 Mt/y for the GBA and KB, respectively
- The estimated average soil erosion rates are 45.5 t/ha/y and 70.4 t/ha/y for the GBA and the KB

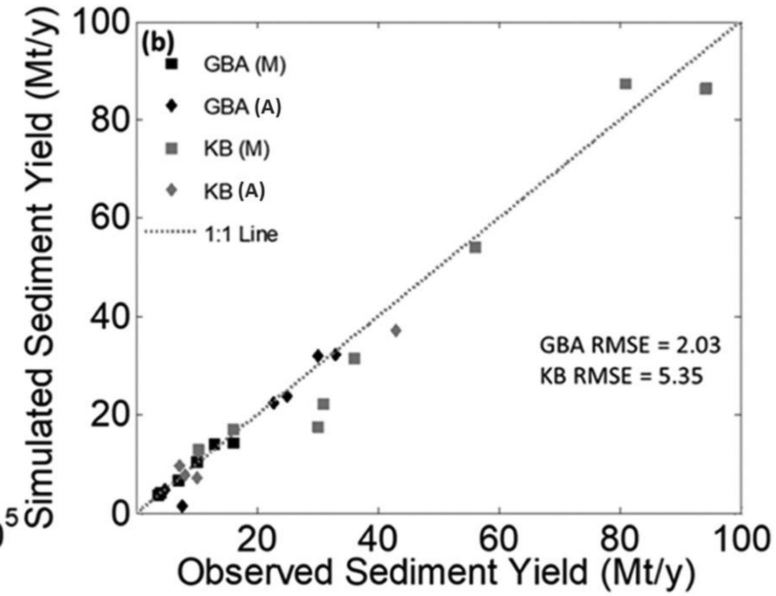
- Overall, the mountainous and alluvial sub-basins of the KB have higher soil erosion rates
- These variations in soil erosion rates are primarily attributed to differences in hydrogeomorphology

(c)

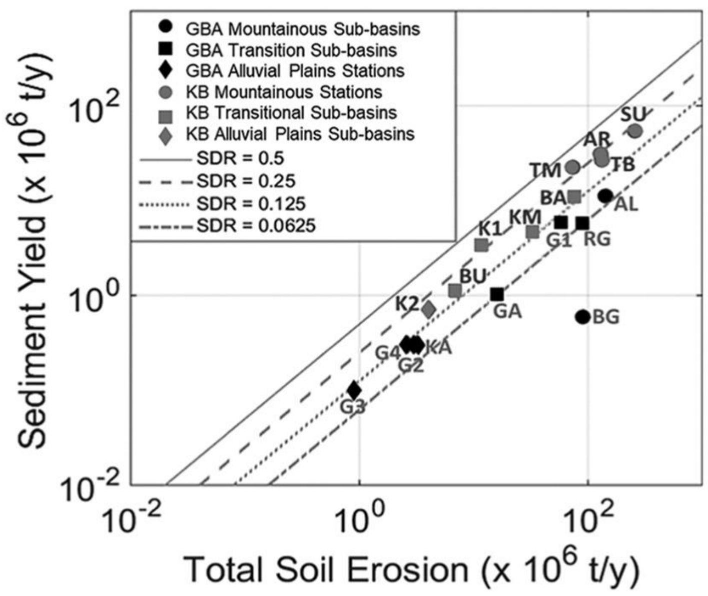


Model Calibrations and Intra basin Comparison

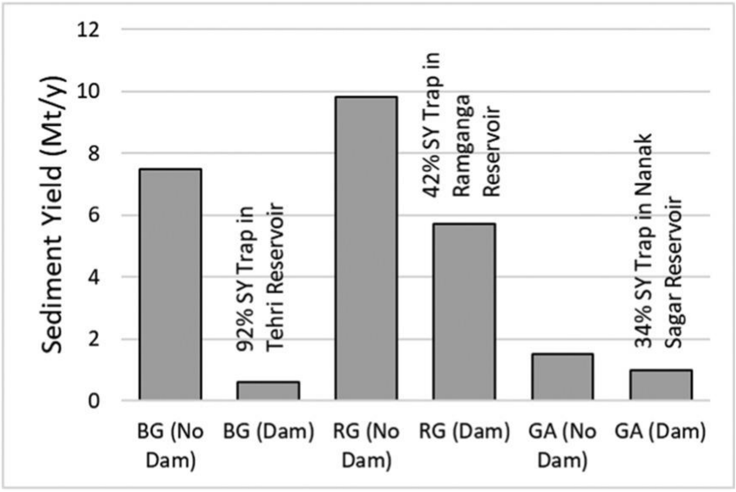




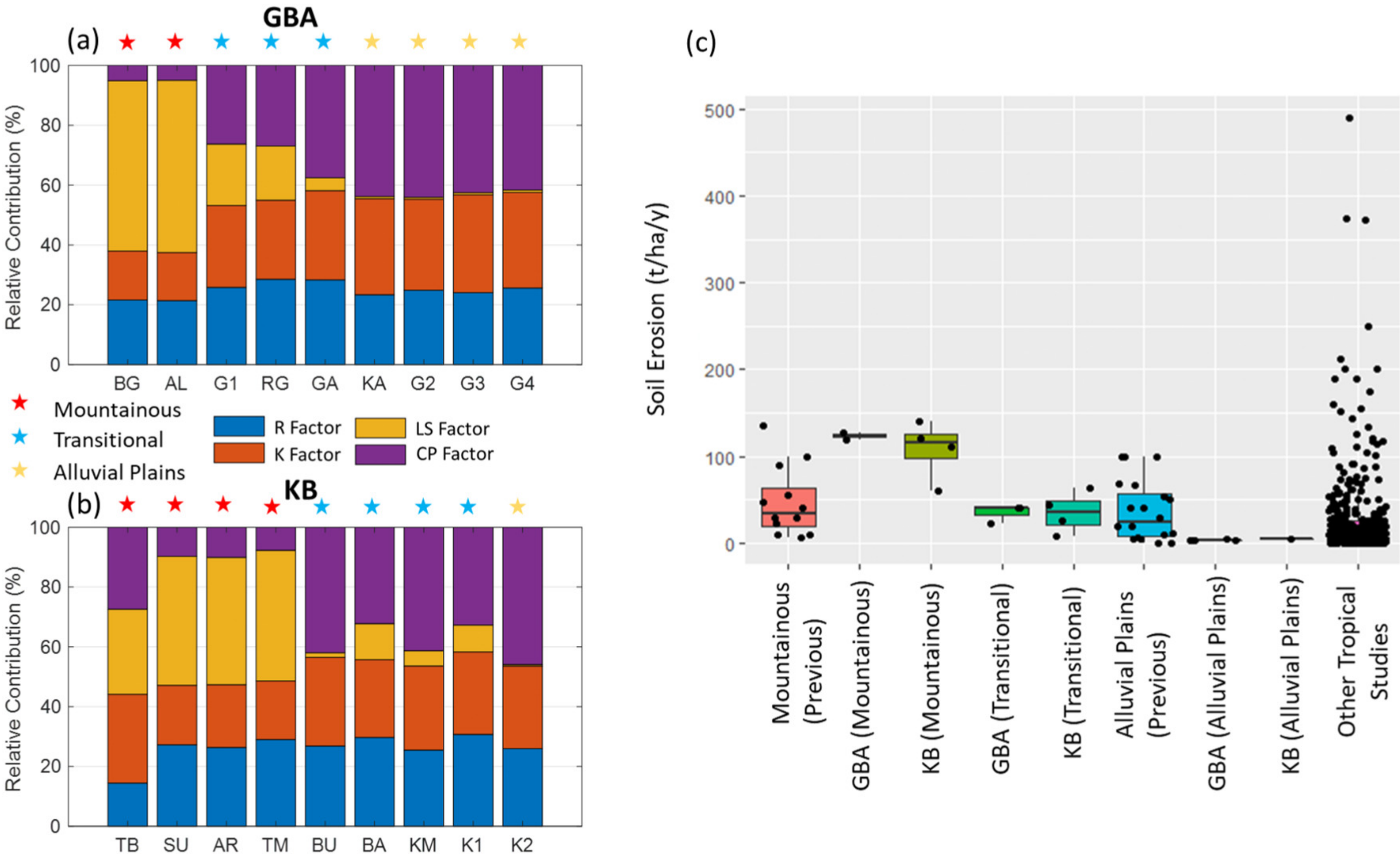
(a)



(b)



Conclusions



- LS and R factors primarily govern the soil erosion rates in the mountainous regions
- CP and K factors influence the soil erosion rates in the alluvial plains regions
- Sediment yield from the mountain exit and alluvial plains are relatively higher for the KB than the GBA
- There is strong role of dams and reservoirs in the sediment transport behavior of the GBA

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