

### 1. Introduction

- Tributaries of large rivers that maintain elements of their natural flow regime are critical to the success of river management (Pracheil et al., 2009).
- The use of relatively unregulated tributaries to mitigate the adverse effects of mainstem river alteration, has recently been proposed as a new strategy for river ecosystem restoration (Moyle & Mount 2007).
- Despite evidence that tributaries are critical sources of flow, habitat, and sediment for degraded large rivers, a clear understanding of how they can revive anthropogenically stressed and sediment-starved mainstems remains limited.
- The Yamuna River is the largest tributary of the Ganga River and is characterized by a high-relief, tectonically active, high-precipitation Himalayan hinterland, as well as a relatively stable, low-relief cratonic hinterland.

### 4. Methodology

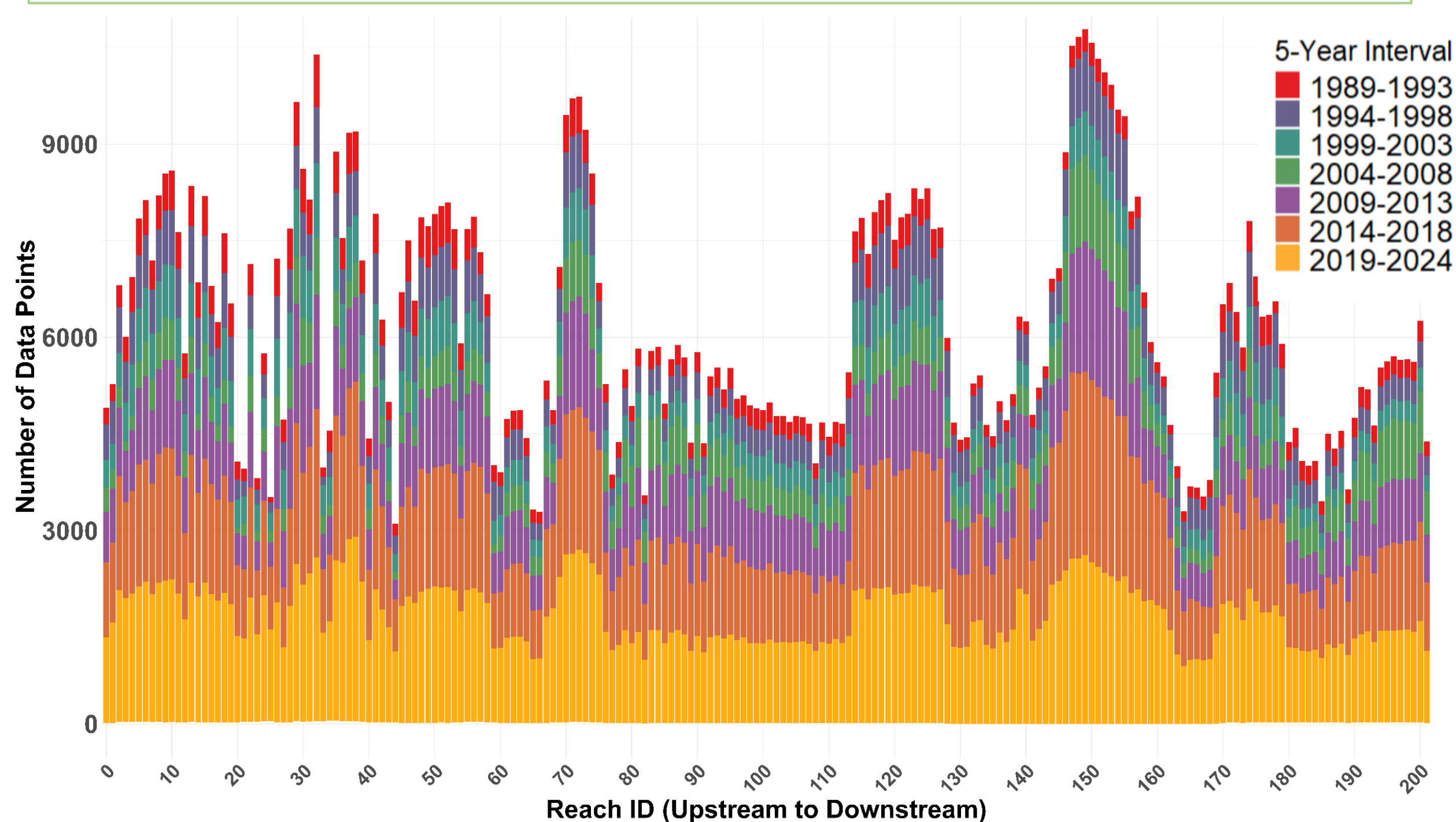
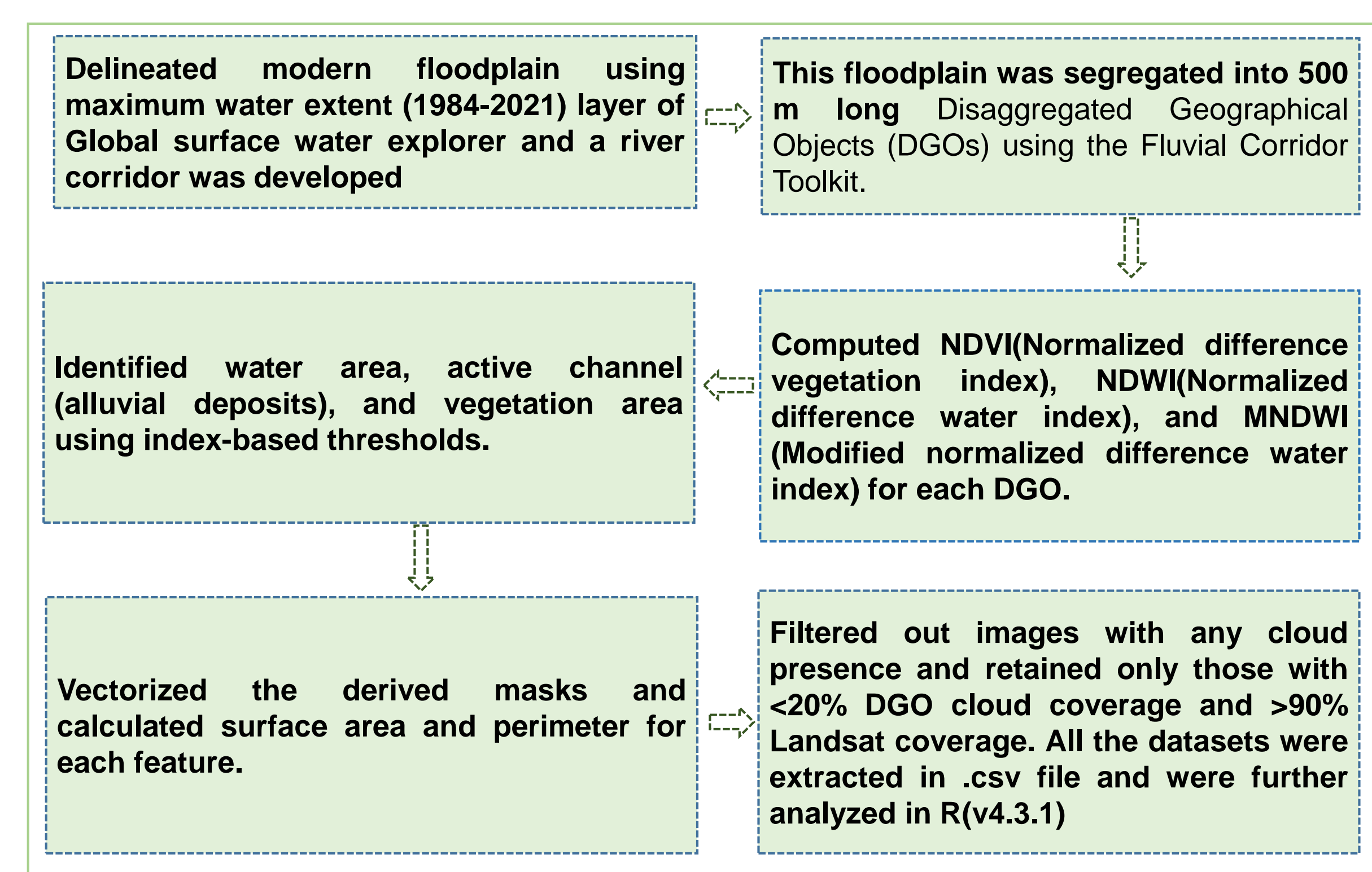


Fig.1 Availability of Remote sensing datasets for each Reach ID. Landsat archives data from 1989-2024 was used for the analysis. Here, each Reach ID represents a river length of 5 Km. Inconsistent and relatively low datasets were found for the period 2004-2008

### 6. Conclusion

- In the Himalayan hinterland, the river is severely impacted by anthropogenic drivers, leading to pronounced channel narrowing.
- A pronounced widening of the active channel (~2-3 fold) after the confluence with the cratonic tributaries demonstrates their vital role in replenishing sediment and restoring geomorphic dynamism to the mainstem.
- These cratonic inputs not only stabilize channel form but also revive geomorphic processes that had diminished in the Anthropogenically stressed sediment-starved mainstem and emerge as an essential driver of basin-scale recovery.

### 2. Objective

- To identify the controls of change in the morphodynamics of the mainstem from the mountain front to its confluence with major tributaries.
- To assess the role of low-relief hinterland in reviving the Anthropogenically stressed Himalayan river.

### 5. Results

#### 5.1 Spatial-Temporal Variations of Riverscape metrics in the Whole length of the Yamuna

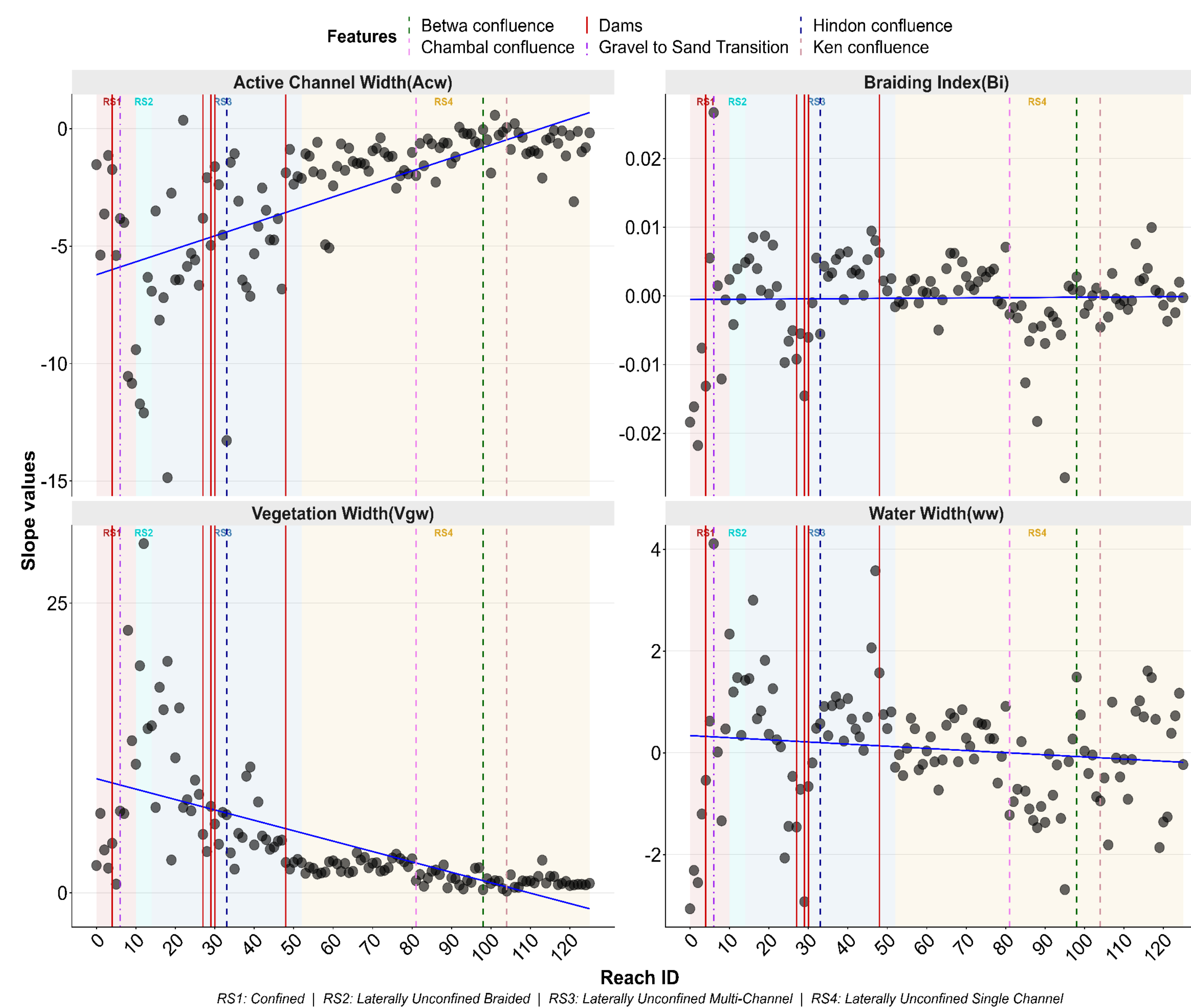


Fig.6 Longitudinal variations of temporal slope values from the mountain front (Reach ID=0) to its confluence with the Ganga River (Reach ID=125). Each Reach ID represents a river length of 10km. Slope values represent the rate of change of the median values for each riverscape metrics over time by ID.

### 7. References

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Moyle, P. B., & Mount, J. F. (2007). Homogenous rivers, homogenous faunas. *Proceedings of the National Academy of Sciences*, 104(14), 5711-5712.

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Wohl, Ellen & Bledsoe, Brian & Jacobson, Robert & Poff, N. & Rathburn, Sara & Walters, David & Wilcox, Andrew. (2015). The Natural Sediment Regime in Rivers: Broadening the Foundation for Ecosystem Management. *BioScience*. 65. 10.1093/biosci/biv002.

### 3. Study Area

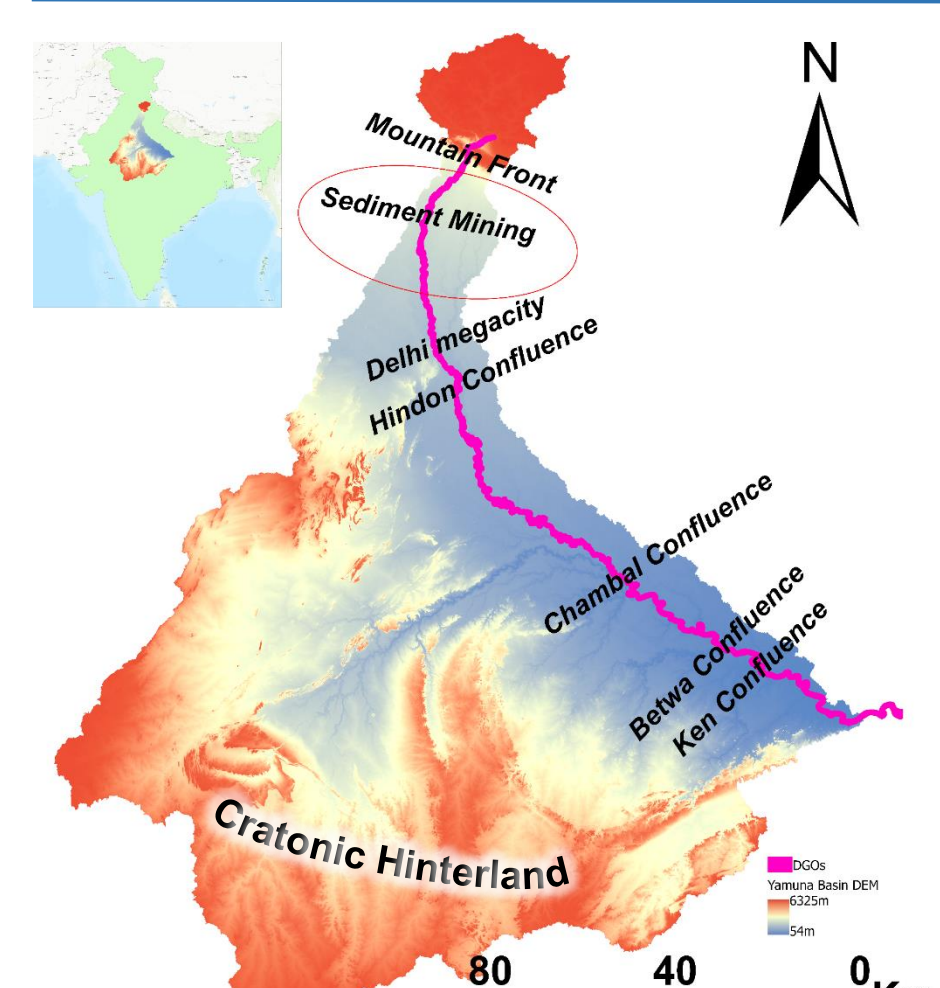


Fig.2 Location Map of tributaries



Fig.3 Basin wise distribution of Tributaries

- Yamuna Basin area-  $3.66 \times 10^5$  km<sup>2</sup>
- Chambal Basin area-  $1.43 \times 10^5$  km<sup>2</sup>
- Betwa Basin area-  $4.3 \times 10^4$  km<sup>2</sup>

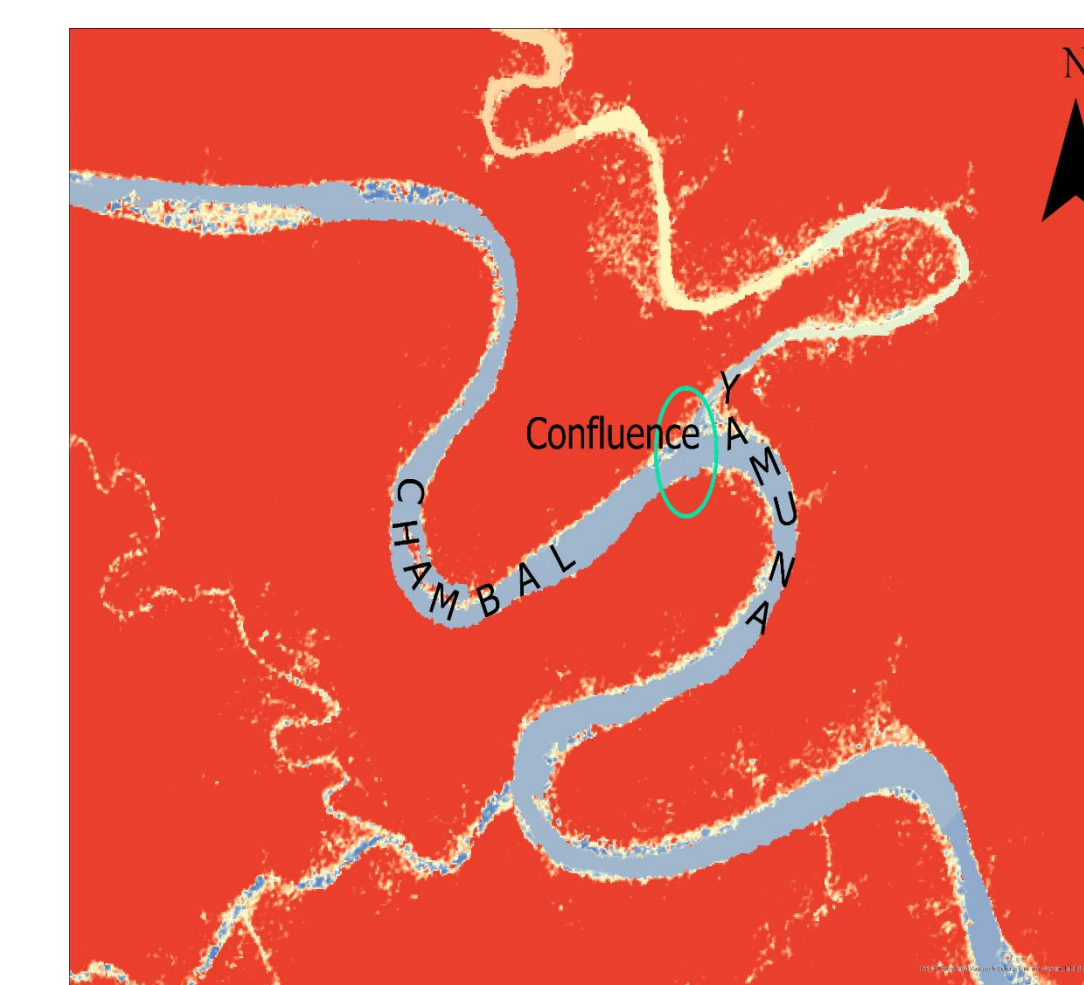


Fig.4 Yamuna Chambal Confluence



Fig.5 Yamuna Betwa Confluence

#### 5.2 Cratonic Contribution

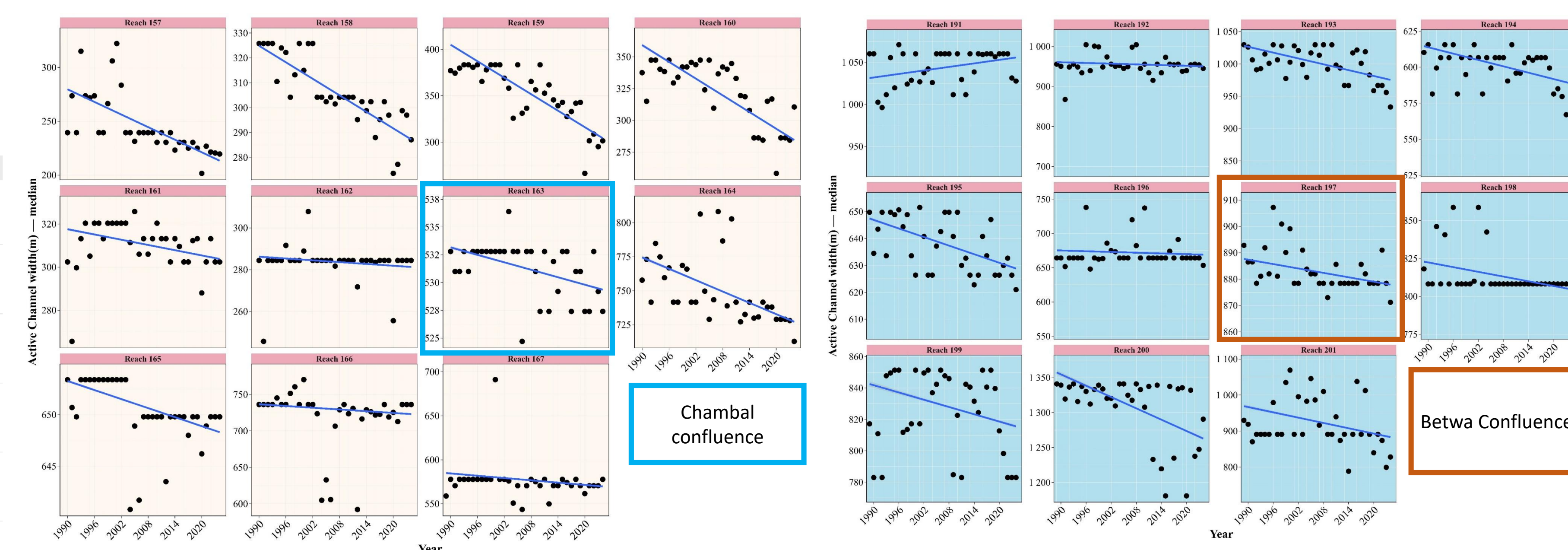


Fig.7 Impact of Yamuna-Chambal Confluence on Active channel width. The magnitude of the active channel width has changed 2-3-fold after the confluence.

Fig.8 Impact of Yamuna-Betwa Confluence on Active channel width. Magnitude of Y-axis has changed after the confluence.

#### 5.3 Himalayan Contribution

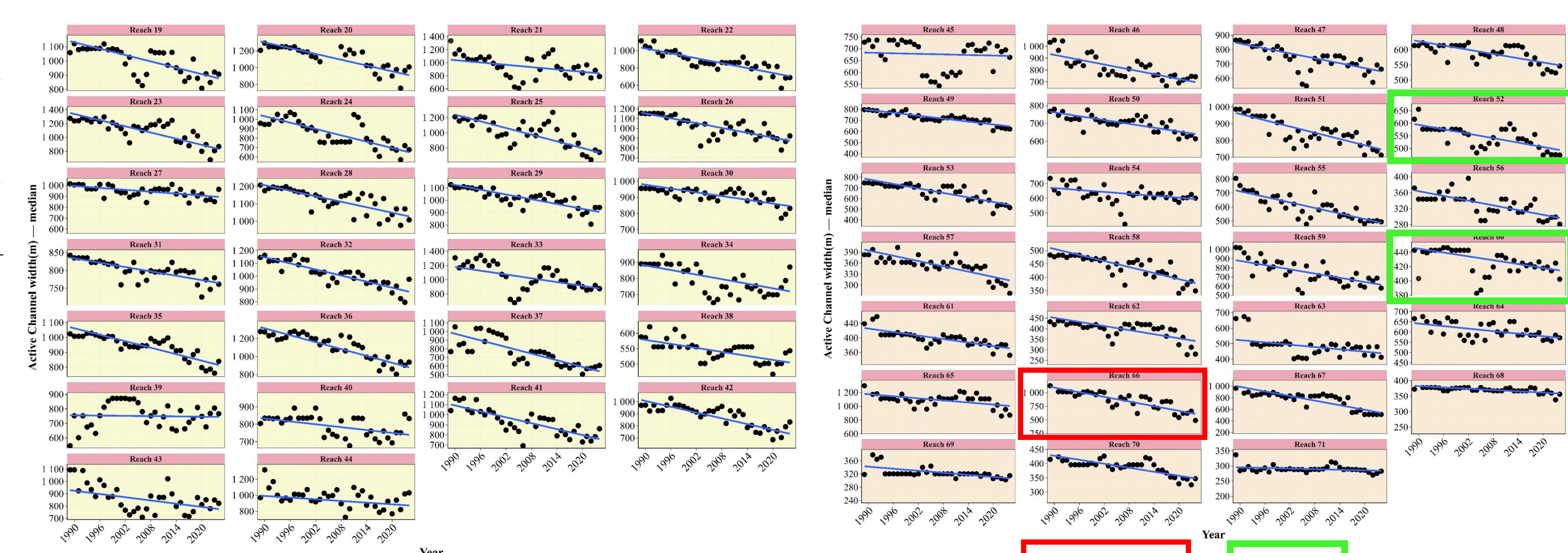


Fig.9 Impact of Sediment mining on the active channel width in the downstream of mountain front. This reach is 45 Km downstream of mountain front.

Fig.10 Impact of Delhi megacity on the active channel width

### 8. Acknowledgement

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