Dear reviewer, dear Jim,

Thank you for your constructive feedback. We have worked on the two main comments you have pointed out. Our response is listed in blue.

The authors present a well-crafted, well-written investigation of recent changes to two fans of the Himalayan Terai region, with specific focus on the evolution of the Karnali River from a two-branch to a single-branch system. The topic is of considerable interest, and the manuscript is in pretty good shape – I found only a very few minor issues to comment on throughout.

Nonetheless, I think that the authors need to do a better job on two aspects of the study. First, their study would be clearer and make more sense to the reader if it was presented as a hypothesis-driven investigation. Second, the available data to test their leading hypothesis (which they present as a "finding" in the discussion) is quite limited, and I think they should explicitly acknowledge that additional work would be desirable to provide a more comprehensive test.

On the first point: the introduction reads as if the authors are going to just look at some data and see if anything interesting emerges. But I am sure that they had some specific ideas about why a fan system could evolve from a 2-channel to a single-channel system, and that these ideas guided their data collection. The paper would be much improved if specific hypotheses were offered at the outset, and the data collection effort was presented as an effort to test these hypotheses. As written, the author's main conclusion is presented first at the end of the Results section, which is really too late to introduce this. Better to see specific hypotheses at the beginning of the paper, and then explain which of these hypotheses are supported by the author's data.

On the second point: the only real support available that I could discern for the idea that one of the channels was "plugged" by coarse bed material in 2009 is the large grain size at the outside of a bend near the head of the fan. This seems like minimal support to me: ideally some evidence of the deposit itself might be available, or some other supporting evidence. I would like the authors to either more clearly summarize the existing evidence (in case I have missed something), and then discuss additional evidence would could (should?) be collected before accepting this working hypothesis (e.g., before and after topographic surveys, field mapping of the coarse deposit from 2009, and so on). This discussion would strengthen the scientific impact of the author's work.

These suggestions are important, and perhaps constitute a significant revision of the presentation, but should be easily accomplished and really only a minor effort for the authors. I have indicated major revisions, but I think they will be easily accomplished and the present manuscript greatly improved as a result.

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Response to Comment 1

Observations on the gradually declining discharge in the eastern Geruwa branch on the fluvial fan of the Karnali river system have motivated this study. The research question that our study has aimed to answer is:

> What are the causes of the flow partitioning at the river bifurcation on the Karnali fluvial fan to increasingly disfavor its eastern Geruwa branch since 2009?

To answer this question, we formulated the following sub-questions:

A. How has the flow partitioning at the Chisapani bifurcation on the Karnali fluvial fan developed over the past centuries?
B. How do the hydrogeomorphic characteristics of the Karnali fluvial fan compare to those of other fluvial fans in the Himalayan foothills, in particular the Koshi fluvial fan in eastern Nepal?*
C. Does the monsoon-dominated hydrograph at Chisapani (located right upstream of the bifurcation) show deviations from its regular variability?
D. What role have water intakes had on the flow partitioning between the two branches of the fluvial fan?
E. What role have the embankments along the two branches of the fluvial fan had on the flow partitioning?
F. What role has the elevated land to the east of the Karnali River and downstream of the Chisapani bifurcation had on the flow partitioning?
G. What can explain the *gradual* decline of the flow discharge into the Geruwa since the 2009 season?

*We have chosen for a comparison of the Karnali and Koshi fluvial fans as the latter is one of the most studied systems in this region.

Our data collection has been guided by the above questions rather than by one hypothesis or a set of hypotheses. We will adjust the Introduction section to include this information.

Response to Comment 2

We agree on your point that images of the bed surface sediment provide limited evidence in support of our hypothesis. Unfortunately, our domain of interest is a protected and data scarce area. We do not have data from topographic surveys or surface sediment samples from the past.

Following your question, we have investigated remotely sensed data of the area in more detail. We have analyzed satellite images and global DEM data sets from before and after 2009. We have considered SRTM 30m Global DEM data, which represents earth surface elevation from 2000, as well as the composite Copernicus 30m Global DEM collected over the period 2011-2013. Most of the Copernicus data for the Karnali fluvial fan stems from 2011. These two DEM data sets are the only ones available to us.

In addition to DEM data, we have analyzed Landsat images from 2000, 2009 (before the monsoon season), and 2011 to extract land cover and stream network information, both under low discharge conditions at Chisapani (Figure 1).

In 2000, the Geruwa branch carried a significant portion of the water discharge, and under low flow conditions at least two channels supplied water to the eastern Geruwa branch from an outer bend at Dolphin Point in the upstream Karnali River (Figure 1A). By 2009 (yet before the double monsoon peak), a new eastern channel has formed near the eastern fan boundary (Figure 1B). In 2011, this eastern channel supplying water to the Geruwa branch ceased to exist (Figure 1C). Under low flow conditions, only one channel still supplies water to the Geruwa branch, and it has narrowed since

2009. As a result, a large part of the Chisapani water discharge is transported through the Kauriala branch.

The disappearance and decline of the eastern channels between 2009 and 2011 reflect the decline of river discharge into the Geruwa branch, which seems to be associated with sediment deposition in the channel taking off from the outer bend at Dolphin point.

We have computed the difference in surface elevation between the composite Copernicus DEM (2011-2013) and the SRTM DEM (2000) (Figure 1D-E). In 2011 the upstream zone of the Geruwa branch has become elevated compared to 2000 (Figure 1E). Our domain of interest is unvegetated, which implies that DEM surface elevation data reflecting canopy elevation for vegetated areas does not affect estimates. Sediment deposition between 2011-2013 and 2000 and the resulting elevation difference across the upstream region of the Geruwa branch seem to have restricted the water discharge into the Geruwa branch.

In addition, we have analyzed grain size distributions of the bed surface sediment. To this end, we have determined surface grain-size distributions from images taken at various locations along the fluvial fan (Figure 2). We have used Segmenteverygrain (Sylvester et al., 2025) , a python-based tool, to determine surface sediment grain size from the images. The results indicate that the surface sediment across the outer bend at Dolphin Point and the upper reach of the Geruwa branch consists of a large amount of boulders compared to other locations.

The increase in bed level and boulder deposition across the upstream end of the Geruwa branch underline our hypothesis that a self-reinforcing mechanism was triggered (a) where boulders carried during peak flood discharge are deposited right downstream of the Karnali outer bend across the upstream end of the Geruwa branch; (b) deposited boulders, unable to move further downstream under these peak discharges, increase riverbed level across the upstream Geruwa branch, (c) this subsequently reduces the flow entering this branch; (d) this reduced flow limits the further transport of boulders into the Geruwa branch and (e) enhances further boulder deposition in the subsequent flood season.

We will include the above information in the manuscript.

Our response to detailed comments in blue:

Comment 3. Line 20. Should probably cite Figure 1 somewhere in this paragraph.

We will update the manuscript.

Comment 4. Line 51. In the paragraph above on anthropogenic stresses, land-use is not mentioned. Perhaps it should be included in the paragraph above, or, if it is not important here, not mentioned at all…???

Thank you, we will address aspects related to land use.

Comment 5. Line 67. Include: Section 6, which presumably interprets information from the previous sections and leads to the conclusions of Section 7.

We will refer to Sections 6 and 7.

Comment 6. Introduction, general comment. I think it would be helpful to present some specific hypotheses to test. This would provide context for the methods. Otherwise, why investigate flow characteristics, dynamics, channel properties, and so on? Presumably these investigations are designed to answer specific questions derived from the authors' hypotheses....and the reader should know what these questions and hypotheses are.

We refer to our response to Comment 1.

Comment 7. Line 208. The hypothesis to be tested should be presented in the introduction, and specific methods available to test it should be outlined in the methods. Evidence from grain size only is somewhat weak, it seems to me. Is the hypothesis supported by topography analyses, or are these data insufficient or unavailable?

We refer to our response to Comments 1 and 2. We will implement the associated changes in the manuscript.

Comment 8. Line 215. But little direct evidence besides grain size has been presented for this. I think it remains a "working hypothesis", rather than a "finding". This may be semantics, but nonetheless important.

We refer to our response to Comment 2.

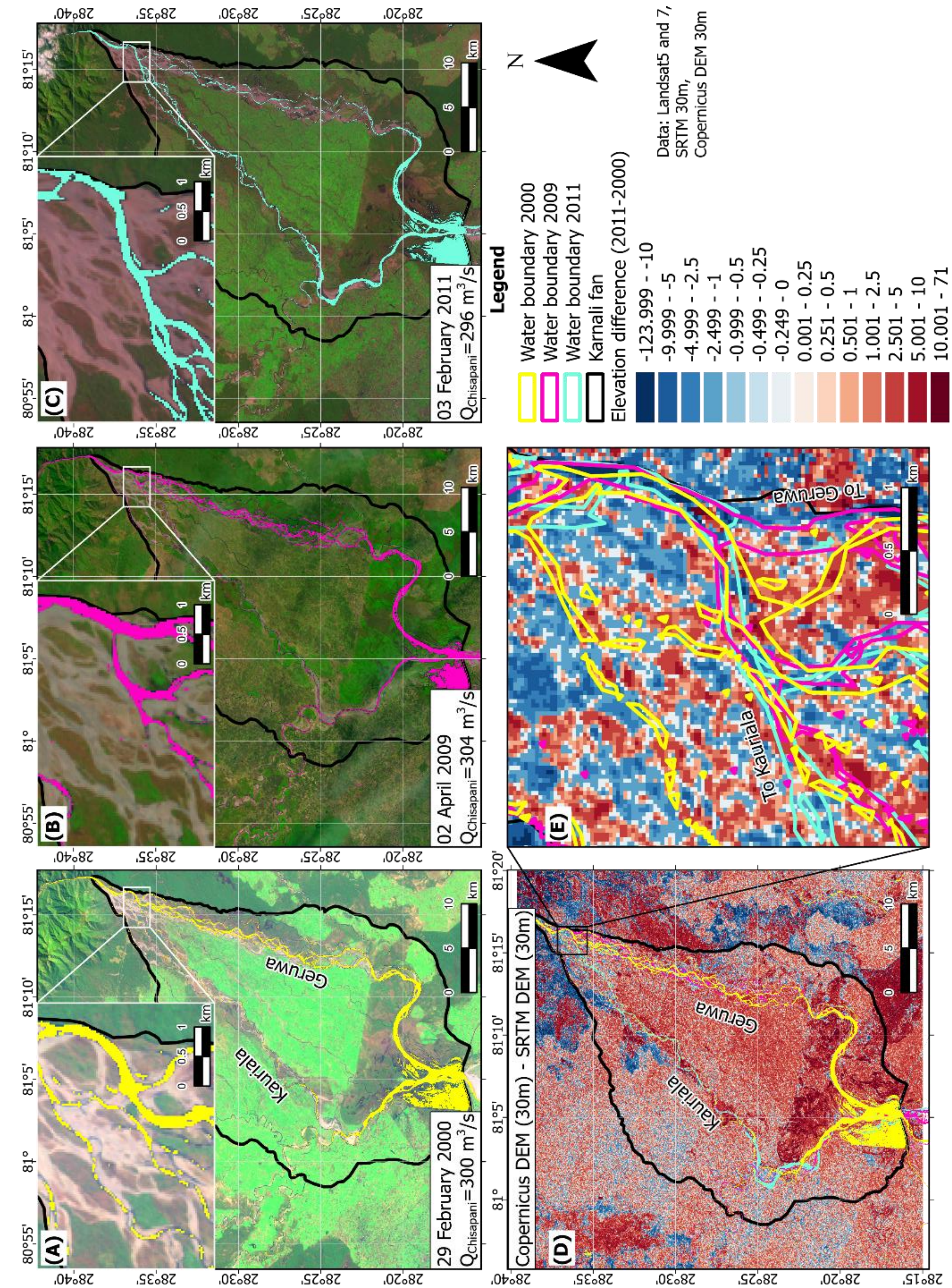

Figure 1: Wetted surface area indicating river channels across the Karnali fluvial fan in the years (A) 2000, (B) 2009, and (C) 2011. Data relate to low flow conditions: 300 m^3/s in 2000, 304 m^3/s in 200, and 296 m^3/s in 2011. The inset at the top-left corner of each map shows the Dolphin point bend right upstream of the Geruwa branch, where the flow partitions between the Geruwa and Kauriala branches. (D) Difference in surface elevation across the Karnali fan between 2011-2014 (Copernicus DEM) and 2000 (SRTM DEM); (E) Inset of the elevation difference map at Dolphin point region or upstream end of the Geruwa branch with river channel outlines for the years 2000, 2009, and 2011.

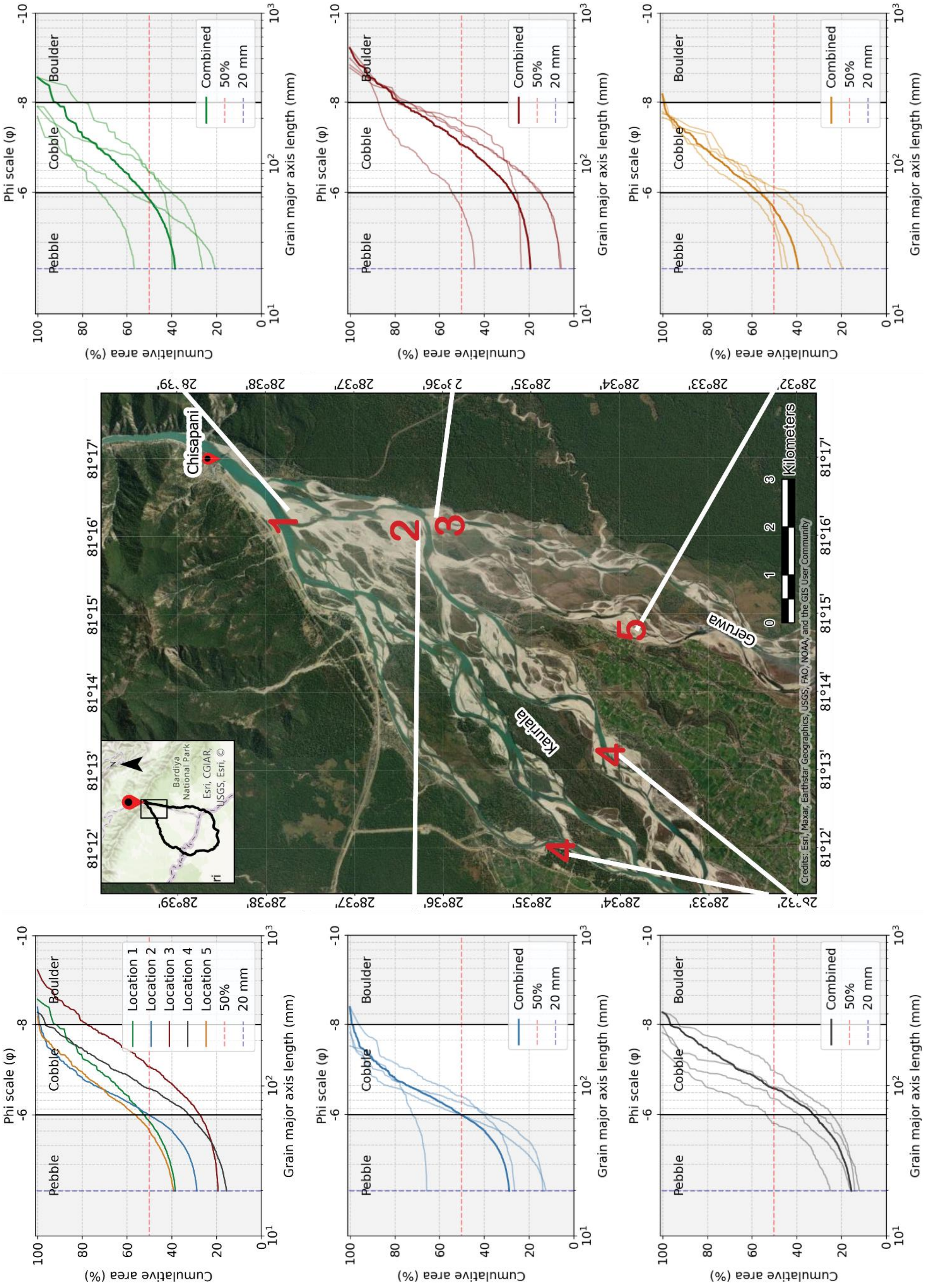

Figure 2: Grain size distributions of the surface sediment obtained from image analysis at various locations across the Karnali fluvial fan. Only grains with a major axis length larger than 20mm could be distinguished.

References

Sylvester, Z., Stockli, D. F., Howes, N., Roberts, K., Malkowski, M. A., Poros, Z., Martindale, R. C., and Bai, W.: Segmenteverygrain: A Python module for segmentation of grains in images, Journal of Open Source Software, 10, 7953, https://doi.org/10.21105/joss.07953, 2025.