Review of Turowski et al. (2023) A process-based model for fluvial valley width

The authors seek to understand how valley width develops under different climate, tectonic, and lithologic conditions by formulating a deterministic equation for valley width. By developing an equation, the authors allow individual components of the system to be analyzed. As an example, the authors show how analysis of their valley width equation reconciles research showing that lithology controls valley width and research demonstrating a lack of lithologic control.

This manuscript is well reasoned and is in a near publishable state. The work is a significant contribution to geomorphology and, as the authors point out, could have implications for ecology, archaeology, and fish biology. I have a few comments that represent minor edits.

In line 145, the authors state that channels change direction when there is too much sediment from the opposite bank to transport. Please provide observations or citations to support this. While it makes intuitive sense, this assumption underlies the derivation for λ, and so I'd like to see more formal support for it.

The confined and unconfined valley width formulations assume that valley widening occurs separately from incision; the authors further suggest in line 465 that "valley widening occurs during times when there is no active bedrock incision, and the bedrock floor of the valley is covered by sediment" (also stated in line 63). However, actively meandering bedrock channels show evidence for both lateral widening and vertical incision during the same period (e.g., Limaye and Lamb, 2016; Merritts et al., 1994). In this case, lithology affects vertical incision rates, and is not just a factor in the erodibility of valley walls. I think (if I am reasoning this correctly) that this does not affect your ultimate statement in line 470 that lithology affects the speed of widening but not the steady state width. However, I suggest revising the statements in line 465 and line 63 to acknowledge that bedrock rivers can simultaneously incise and migrate laterally.

In unconfined valley settings and wide confined valleys, meander migration and cutoffs result in rapid switches in channel position as well as upstream migrating knickpoints (e.g., Finnegan and Dietrich, 2011). Those stochastic knickpoints may affect valley width by first causing an increase in transport capacity, followed by an increase in bank height and increased lateral sediment supply once the knickpoint has passed. Could this process have a significant effect on the analytic valley width solution?

Line 331: Citation needed to say that erosion rates are a good proxy for uplift in the Himalayas

Last, the authors describe the model as process-based (title, line 226), deterministic (line 441), and physics-based (line 613), and should choose a consistent terminology. I do not agree that this is a process-based model, as it does not include processes of valley widening beyond broad consideration of the effects of sediment supply vs transport (i.e., a process-based model might be more focused on meander process). Particularly since many of the variables in the three

study sites are estimated empirically, I suggest describing this as an 'empirical and deterministic' model.

References:

Finnegan, N. J. and Dietrich, W. E.: Episodic bedrock strath terrace formation due to meander migration and cutoff, Geology, 39, 143–146, https://doi.org/10.1130/G31716.1, 2011.

Limaye, A. B. S. and Lamb, M. P.: Numerical model predictions of autogenic fluvial terraces and comparison to climate change expectations, Journal of Geophysical Research: Earth Surface, 121, https://doi.org/10.1002/2014JF003392, 2016.

Merritts, D. J., Vincent, K. R., and Wohl, E. E.: Long river profiles, tectonism, and eustasy: A guide to interpreting fluvial terraces, Journal of Geophysical Research: Solid Earth, 99, 14031–14050, https://doi.org/10.1029/94JB00857, 1994.