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Climatic variability results in the persistence of transience in estimated erosion rates over millennial to million year timescales in glaciated landscapes

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Estimating erosion rate through geologic time is fundamental to quantifying landscape evolution and its response to climatic and tectonic forcing. Recent advances in geo-chronological dating techniques, together with the abundance of data worldwide, allows for quantification of erosion rates over diverse timescales (10ˆ1-10ˆ9 yrs). Here, using an unprecedented worldwide data compilation, we show that climatic variability introduces a timescale dependent bias (characterized by an inverse power-law trend of erosion rates on timescale of averaging) in estimated erosion rates that may obscure real temporal changes over millennial to million year timescales in glaciated landscapes. In fluvially dominated landscapes, comparison of multi-scale estimates of erosion rates may reveal real trends such as steady-state and slowly relaxing landscapes. Our analysis suggests that a mechanistic understanding of the effect of long-term climatic variability on landscape evolution is needed to detangle real and apparent changes in landscape-scale erosion rates in glaciated landscapes.