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The Sediment Delivery Problem Revisited.

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Understanding the sediment delivery process at the drainage basin scale is a continuous challenge in erosion and sedimentation research. Area-specific sediment yield (SSY; t/km2/yr) is often assumed to decrease with increasing drainage basin area (A). As the measurement of A is relatively simple, this assumption is frequently used for prediction of SSY in un-gauged basins. However, over the last two decades several studies reported a positive or non-linear relation between A and SSY. Various authors have suggested diverse explanations for these opposing trends. We provide an overview of the different observed trends and summarise the explanations for each trend. Furthermore, three typical trends are identified to conceptualise the main driving forces of the relation between A and SSY. First of all, it is emphasised that erosion and sediment deposition processes are scale dependent, and going from small (<m2) to larger areas (km2) more erosion processes become active leading to a rise in SSY with increasing A. However, for larger areas (>km2) erosion rates generally decrease and deposition in sediment sinks increases due to decreasing slope gradients, and so SSY decreases with increasing A. Next, land cover conditions and human impact determine if hillsope erosion is dominant over channel erosion or vice versa. In the first case SSY is expected to decrease with increasing A, while in the latter case SSY will show a continuous positive relation with A. Only for very large areas (A>˜104 km2) a decrease in SSY is observed when drainage density decreases or channel banks are stabilised. Finally, spatial patterns in lithology, land cover, climate or topography can cause SSY to increase or decrease at any basin area and can therefore result in non-linear relations with A. Altogether, with increasing A often first a rise and then a decrease in SSY is observed. The decrease can be absent or can be postponed within a region due to local factors of which lithology, land cover, climate and topography are

the most important ones. The large regional, local and even temporal variability in the trend between A and SSY implies that prediction of SSY based on A alone is troublesome and preferably spatially distributed information on land use, climate, lithology, topography and dominant erosion processes is required.