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Analysis of Glacial Valley Morphology and Erosion Using DEM Data: Kananaskis, Canadian Rockies, Canada

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Prior studies have shown that the morphology of glacial valleys demonstrates a significant degree of regularity in cross-section form, although no such analysis has been undertaken for the Canadian Rockies. Our study area, located in Kananaskis, Alberta, Canada, covers approximately 150 km2 and is characterized by high mountain relief, with elevations ranging from 1300m to 3500m. About 76% of the area has slope values greater than 20 degrees. LiDAR data in LAS format were used to create a 10m DEM, from which a total of 140 cross sections oriented orthogonal to the valley centerline were defined. The cross-section valley profiles are located throughout a number of drainage basins and cover a range of stream orders. Cross-section locations were chosen to avoid the complicating influence of tributary valleys. In addition to drainage basin characteristics, variables defined for each individual valley cross section include width, relief, and cross-section area. These data were then used to evaluate cross-section geometry. Valley width, valley depth and cross-sectional area are all related to stream order and watershed area. Two models have been developed in the literature to describe the morphology of glacial valley cross sections, the power-law model and the quadratic model (e.g., Li et al., 2001). The power-law model shows a good fit to our cross-section profiles, a finding in agreement with other studies in the published literature. In particular, our results show that the power-law model derived for our study area fits the Rocky Mountain glacial valley development model, which indicates overdeepening processes by an alpine glacier. In this project, one possible limitation is that cross-section profiles were derived from DEM data, which represents the present-day form of the valley surface, so the profiles do not reflect the true cross-section valley forms as influenced by glacial erosion. There are a few possible solutions to account for valley fill in the curve fitting procedures and these are explored. Furthermore, we utilized the results of the quadratic model for several cross sections to estimate valley fill thickness. Estimates of valley fill thickness range from about 20m to 60m.