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Variations in runoff from partially-glacierised basins along the Himalayan arc

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Rivers draining from Himalayan headwater basins, in which precipitation is enhanced orographically, deliver large quantities of runoff to tributaries of the major rivers of the Indo-Gangetic plain. Strong regional climatic variation along the Himalayan arc leads to increasing impact on runoff of monsoonal precipitation from west to east. Relationships between climate and runoff, which vary also with percentage basin glacierisation, prove difficult to assess in the Himalaya, as a result of scarcity of available data, particularly in the upper Ganga basin in the central Himalaya. Attempts to model runoff responses to climatic warming are limited by lack of field measurements, but summer precipitation in the Indian and Nepal Himalaya appears to stave off reduction of meltwater discharge with glacier decline in the central and eastern Himalaya by comparison with the drier Karakoram in the west (Rees & Collins 2006). Available datasets are examined with a view to assessing variations in seasonal distribution and annual total runoff from basins with differing proportions of glacier cover located in areas with varying degrees of monsoonal influence distributed along the Himalayan arc. In the Karakoram, in headwater tributaries of the Indus, runoff increases from April to annual maxima in July or August, and the strength of correlation between runoff and April/May through September/October air temperatures increases with increasing glacierisation. In the central and eastern Himalaya, in tributaries of the Ganga, runoff rises from April to a June peak, before being reduced as occurrence of summer snowfall raises albedo and cloud cover reduces energy availability for melt. From August discharge increases again to a late summer high, before declining as radiation decreases. Correlation between runoff and annual and summer precipitation totals show limited variation with percentage glacierisation. Icemelt is subdued during the longer monsoon, and the extent to which runoff from summer rain compensates for loss of melt declines where basin ice-cover is larger. Downstream influence of meltwater runoff on annual total discharge extends further where summer rainfall amounts are not great. In monsoonal areas, snow and icemelt influences from headwaters extend downstream in spring and autumn before and after the incidence of summer precipitation. Records of river flow are generally short making estimation of the deglaciation discharge dividend problematic.