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Parametric Analysis and Geospatial Inventory of Afghanistan's Glaciers

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A parametric analysis of more than 500 glaciers in six areas of Afghanistan was conducted. The six areas were selected to provide a representative topographic and geographic transect across the glacier-bearing regions of eastern Afghanistan. The selected locations extend from the eastern end of the Pamir Mountains in the Wakhan Panhandle, to northeast of Kabul, to south of Bamyan. This area assessment is an intermediate step in what will be a systematic investigation of the distribution, behavior, and characteristics of all of Afghanistan's glaciers.

Using algorithms and a Geographic Information Systems (GIS) approach developed by Manley (2008) to 'better understand environmental controls on glacier distribution and geometry,' a large multiparameter dataset was constructed to facilitate this characterization. Data sources include: ASTER and Landsat 7 Thematic Mapper images and image mosaics; a Digital Elevation Model (DEM) and topography derived from Shuttle Radar Topography Mission (SRTM) data and 1:200,000-scale Soviet General Staff Sheets (1978–1997); and cultural data extracted from the Afghanistan Information Management Service (AIMS) website.

Parameters derived for each glacier include: location (latitude and longitude of the centroid grid cell), elevation (minimum, maximum, median, and average elevation); elevation range; snowline minimum elevation; length; width; area; perimeter; average slope angle; average aspect; a compactness parameter; length/width ratio; an area-altitude parameter; a debris-cover vs. bare ice and/or snow coefficient; and a thermokarst pit/lake parameter. Parameters derived for each basin include: basin area; basin elevation range; a basin coefficient; backwall height; and divide maximum elevation. Additionally, a visual determination was made of the number and elevation range of glacier-free cirques in each basin and glacier-free valleys in each area. Lastly, proglacial lakes, ice marginal lakes, and supraglacial lakes associated with each glacier, cirque, or valley were characterized.

In addition to the detailed statistical assessment, a visual assessment of the data revealed that: every valley glacier examined show evidence of recent thinning and retreat; some of the large glaciers have recently separated into as many as a half dozen or more, smaller individual valley glaciers; many empty cirques and small glacier remnants are present at lower elevations; many glaciers have significant debris-covered lower reaches, hosting numerous supraglacial lakes and thermokarst pits; and tarns and moraine-dammed lakes are present in many valleys and drainages, however their numbers are few when compared to that of the supraglacial lakes.