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Key Points:
- The tropical high-mountain lakes show power-law lake-size distributions truncated at both ends similar to those found in temperate ranges
- The marked relief limits the size of the largest lakes at high altitudes, whereas ponds are particularly prompt to a complete infilling
- Lake volume scales to lake area according to a larger coefficient than found in other lake areas of glacial origin but gentle relief

Supporting Information:
- Supporting Information S1

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Abundance and morphometry changes across the high-mountain lake-size gradient in the tropical Andes of Southern Ecuador

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Abstract The number, size, and shape of lakes are key determinants of the ecological functionality of a lake district. The lake area scaling relationships with lake number and volume enable upscaling biogeochemical processes and spatially considering organisms' metapopulation dynamics. These relationships vary regionally depending on the geomorphological context, particularly in the range of lake area <1 km^2 and mountainous regions. The Cajas Massif (Southern Ecuador) holds a tropical mountain lake district with 5955 water bodies. The number of lakes deviates from a power law relationship with the lake area at both ends of the size range; similarly to the distributions found in temperate mountain ranges. The deviation of each distribution tail does not respond to the same cause. The marked relief limits the size of the largest lakes at high altitudes, whereas ponds are prompt to a complete infilling. A bathymetry survey of 202 lakes, selected across the full-size range, revealed a volume-area scaling coefficient larger than those found for other lake areas of glacial origin but softer relief. Water renewal time is not consistently proportional to the lake area due to the volume-area variation in midsize lakes. The 85% of the water surface is in lakes $>10^4$ m^2 and 50% of the water resources are held in a few ones ($\sim$10) deeper than 18 m. Therefore, midlakes and large lakes are by far more biogeochemically relevant than ponds and shallow lakes in this tropical mountain lake district.

1. Introduction

Many ecological processes in lakes scale with size [*Fee*, 1992; *Post et al.*, 2000]. Lake-size distributions play a pivotal role from biogeochemistry to community ecology; e.g., for upscaling metabolism or emission processes to regional and global contexts or investigating species distribution and metacommunity dynamics. Based on this interest, the estimation of the number of Earth's lakes indicated that they could be power law distributed across the full-size gradient [*Downing et al.*, 2006]. In the initial data sets used, nonetheless, there was a cutoff for small lakes or were operatively underrepresented. Consideration of a broader size range has shown that small lakes deviate from the power law distribution and are less abundant than previously expected, although they still dominate inventories [*Cael and Seekell*, 2016]. Consequently, there is a current need to investigate the regional patterns of small water bodies (subkilometer scales) and unveil the geomorphological processes that may drive and constrain them.

Remote lakes, defined as those in which human activities in the catchment are not the primary drivers of their dynamics, are of interest for tracking the footprint of global change at regional and planetary scales [*Hobbs et al.*, 2010; *Catalan et al.*, 2013]. Many of these lakes are of glacial origin and located in high mountains all over the planet and Arctic and subarctic regions. They are typically relatively small [*Catalan et al.*, 2009] and thus their abundance may likely deviate from the general Earth's scaling [*Cael and Seekell*, 2016]. In the case of mountain lakes, the relieve imposes additional topographical limitations that cause deviations from lake-size distributions in flatter regions [*Seekell et al.*, 2013]. There is an increasing relevance of high-mountain lakes in the assessment of global change, including climatic [*Smol*, 2012; *O'Reilly et al.*, 2015],