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Glacial and glacially conditioned lake types in the Cordillera Blanca, Peru: A spatiotemporal conceptual approach

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Abstract

The article presents a conceptual approach for the spatiotemporal distribution pattern of principal lake types in the context of the glaciation history in the Cordillera Blanca. The tropical mountain range hosts one of the main concentrations of proglacial lakes in high-mountain settings worldwide, which have formed as a result of the dominant trend of modern glacier retreat. In the 20th century, glacial lake outbursts have severely affected large settlement areas in the Rio Santa Basin. Additionally to the striking newly emerged lakes, geomorphological evidence of paleolakes is found throughout the middle and lower valley sections. Based on empirical data from field research in over 20 valleys and the analysis of air and satellite images, the study provides a genetic classification of major lake types and a generalized model for the distribution of the present lakes and paleolakes. The origin of the lakes and their recurrent distribution pattern are associated with the individual stages of the Pleistocene to modern glaciation and their corresponding geomorphological landforms. Apart from the individual lake, the focus is put on the spatial arrangement of the lakes to each other based on a holistic landscape assessment. Implications are drawn for the hazard potential, in particular in terms of outburst cascades involving two or more lakes. On a supraregional scale, a clustering of certain lake types occurs in different mountain ranges of the Andes according to their specific topographical and glaciological settings. Even though the glaciated areas have all been subject to major ice losses, only some mountain regions are prone to form moraine-dammed lakes such as in the Cordillera Blanca. The key controlling factors for their formation are highlighted from a glacial-geomorphological point of view. The distribution of principal types of glacial lakes is outlined in a N–S profile along the Andes.