Mapping high elevation spatial snow depths using tri-stereo optical satellite imagery

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Within the semi-arid Andes of Central Chile (33 - 36°S), the mountain snowpack represents a significant socio-economic importance and a sharp contrast to the limited, seasonally-dependent precipitation occurring at low elevations. Recent 'mega-drought' years have heightened the importance of water storage in the Central Andes, though there remains much uncertainty as to the quantity and spatial distribution of the high altitude snowpack. Despite a sound knowledge of snow processes, highly complex terrain and data scarcity generate difficulties for numerical modelling attempts, which may rely upon simple assumptions. These assumptions regularly fail to capture the heterogeneity of spatial snow depths that can be dictated by interaction of topographical and meteorological factors, which then translates into uncertainty of the simulated seasonal hydrograph response.

Measurement strategies for deriving spatial snow depth are numerous but can be limited by accessibility (Probe measurements), cost, range (airborne Light Detection and Ranging (LiDAR)), ground control (Airborne Structure from Motion), topographic shadowing (terrestrial LiDAR) or spatial resolution (gridded satellite products). Accordingly, we explore a recently developed methodology for deriving spatial snow depth from optical stereo image triplets of the French (CNES) Pléiades 1A and 1B satellites, following the approach of Marti et al. (2016). The method shows merit and here we highlight the advantages and drawbacks compared with alternative measurements/estimations.