Remote-sensed time series of rapid terrace formation in the Laguna del Viedma valley (Patagonia)

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The Patagonian Andes were subject to a range of geophysical drivers of landscape incision during the Last Glacial Inter glacial Transition and Early Holocene, including tectonic and isostatic uplift, and base level fall triggered by rapid lake drainage events. Deciphering the drivers of river system response during this period is complex, and magnitudes and timescales of landscape change are poorly constrained. Herein, a remotely sensed time series of modern lake elevation change and terrace development is investigated for the Laguna del Viedma valley (Argentina) as a modern analogue of Late Quaternary landscape evolution. The aim of the research was to constrain the timing of terrace formation following lake-level fall of the Laguna del Viedma over a ~35 year period from 1985-2019. The objectives were to: 1) use satellite imagery from the period 1985-2019 to document landform, glacier and lake changes in the study area; 2) use remotely sensed imagery to map the landforms of the Laguna del Viedma valley; and 3) analyse terrace elevations using GIS. In total 7 terrace surfaces were distinguished by remotely sensed geomorphological mapping. The highest, and vegetated, T1 terrace surface (+75 m) was likely formed at the end of the last Holocene neoglacial advance. Viedma glacier recession at this time caused the abandonment of an ice-lateral spillway and allowed a subglacial drainage pathway leading to less stable lake level elevations and terrace formation. Whether the abandonment of T1 was associated with the 4 ka or 0.15 ka neoglacial termination constrains ~45 m of incision, at a rate of 0.01-0.33 m/yr, down to the T3 floodplain level by 1985. There then followed ~20 m of incision to the T4 level, which must have occurred by 2006, constraining a minimum rate of incision of 0.95 m/yr. The time series demonstrates rapid terrace formation occurred by vertical incision and lateral erosion, with mass movements contributing to lateral terrace recession. The implications of the data-set are discussed within the context of the Late Quaternary palaeohydrology of Patagonia where lake level falls of 10s to 100s of metres occurred within most large river systems from 42-52 °S demonstrating that base level falls from lake drainage, and catastrophic floods events, were likely a major driver of landscape change in the region.