



‘Unlocking the archive’: Using photogrammetry of historic aerial photographs to extend the record of glacier change on the Antarctic Peninsula

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Changes to glacier fronts and ice shelves and glacier acceleration are well documented, but there is almost no data on mass changes for the more than 400 glaciers on the Antarctic Peninsula. Current research demonstrates that the Antarctic Peninsula is contributing to sea-level change at a similar rate to that of other fast-changing near-polar or large mountain-glacier environments such as Iceland, Patagonia and Alaska (Hock, 2009). Forecasting the future impacts of the Antarctic Peninsula ice sheet on sea level will require a much improved understanding of 20th Century and contemporary glacier mass changes. Satellite data has been used to calculate these changes over the last three decades, but methods to quantify this over a longer time scale have eluded researchers. However, there is an archive of aerial photography of the Antarctic Peninsula dating back to the 1940s, this has been largely ignored due to the range of technical problems associated with deriving quantitative data from historic aerial photographs. This presentation demonstrates how advances in photogrammetric processing and capture of modern aerial photography have allowed this archive to be ‘unlocked’.

Accurate photogrammetric reconstruction from aerial photographs traditionally requires known ground control points acquired in the field; in remote and inaccessible areas, such as the Antarctic Peninsula, this is often impossible and so has restricted the use of photogrammetric analysis of the available aerial photography. A method for providing control for historic photos without fieldwork on the ground, by linking them to a newly acquired, highly accurate photogrammetric model adjusted through direct kinematic GPS positioning of the camera was developed by Fox and Cziferszky (2008), and this is now being applied to a number of glaciers across the Antarctic Peninsula using Intergraph Photogrammetry Suite (Erdas LPS 2013) software. This presentation will outline the photogrammetric workflow and associated errors using an example glacier from the Antarctic Peninsula to highlight the suitability of this technique and demonstrate the data that can be obtained.

The photogrammetric technique that is being employed for this research allows accurate measurements of surface elevation change on glaciers on the Antarctic Peninsula over a 50 year-time span, enabling both spatial and temporal patterns of change and improving understanding of glacier response in this area. The use of this technique opens up possibilities for ‘unlocking the archive’ in other remote glacial areas where historic aerial photography exists but the collection of ground control points is limited.

References:

- Fox, A. J. and Cziferszky, A. 2008. Unlocking the time capsule of historic aerial photography to measure changes in Antarctic Peninsula glaciers. *Photogrammetric Record*, 23 (121): 51-68.
- Hock, R., de Woul, M., Radic, V. and Dyurgerov, M. 2009. Mountain glaciers and ice caps around Antarctica make a large sea-level rise contribution. *Geophysical Research Letters*, 36, L07501.