EGU24-15439, updated on 21 Jul 2024
https://doi.org/10.5194/egusphere-egu24-15439
EGU General Assembly 2024

Utilizing historical aerial imagery for change detection in Antarctica

Felix Dahle, Roderik Lindenbergh, and Bert Wouters
TU Delft, Civil Engineering, Geoscience and Remote Sensing, Netherlands (f.dahle@tudelft.nl)

Our research explores the potential of historical images of Antarctica for change detection in 2D and 3D. We
make use of the TMA Archive, a vast collection of over 330,000 black and white photographs of Antarctica taken
between 1940 to 1990. These photographs, available in both nadir and oblique, are systematically captured
from airplanes along flight paths and offer an unprecedented historical snapshot of the Antarctic landscape.
Detecting changes between past and present observations provides a unique insight into the long-term impact
of changing climate conditions on Antarctica's glaciers, and their dynamical response to ice shelf weakening and
disintegration. Furthermore, it provides essential validation data for ice modelling efforts, thereby contributing
to reducing the uncertainties in future sea level rise scenarios.

In previous work, we applied semantic segmentation to these images [1]. By employing classes derived from this
segmentation, we can focus on features of interest and exclude images with extensive cloud coverage, enhancing
the accuracy of change analyses. In the next step, we geo-referenced the images: We assigned the images to
their actual position, scaled them to their true size, and aligned them with their genuine orientation. This
presents novel opportunities for detecting environmental changes in Antarctica, particularly in the retreat of
glaciers and sea ice.

Furthermore, the combination of these two steps allows for the first time a large scale reconstruction of these
images in 3D through Structure from Motion (SfM) techniques, which enables further multidimensional change
detection by comparing historical 3D models with contemporary ones. Due to the high number of images,

manual processing is impractical. Therefore, we are investigating the possibility of automatizing this process.
We utilize MicMac, an open-source software developed by the French National Geographic Institute for the creation of the 3D models. Its high modularity allows for necessary customizations to automate the SfM process effectively. Further adaptions are required due to the poor image quality and monotonous scenery. By comparing historical 3D models with contemporary ones, we can assess alterations in elevation due to factors such as glacial isostatic adjustments and glacier retreat.

We have already employed geo-referenced images for detecting changes on the Antarctic peninsula and are in the process of creating initial 3D models. Our presentation will outline the workflow we developed for this process and showcase the initial results of the change detection, both in 2D and 3D formats. This approach marks a significant step in understanding and visualizing the impacts of climate change on the Antarctic landscape.

Acknowledgements
This work was funded by NWO-grant ALWGO.2019.044.

References
[1] F. Dahle, R. Lindenbergh, and B. Wouters. Revisiting the past: A comparative study for semantic segmentation of historical images of Adelaide Island using U-nets. ISPRS Open Journal of Photogrammetry and Remote Sensing, 11:100056, 2024.