

# Generating high-resolution digital elevation models for wetland research using Google Earth™ imagery – an example from South Africa

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## Abstract

Digital elevation models (DEM) generated in geographical information systems (GIS) have proven to be useful tools in hydrological research, aiding, amongst others, the delineation of catchment areas, identification of drainage patterns and flow pathways as well as for runoff determinations. They are of particular value in areas of comparatively flat topography, where such tasks are often difficult to perform. However, owing to the fact that elevation differences in wetlands typically fall below or just into the range of contour intervals of standard topographic maps being generally 20 m, and 5m for some areas, the latter fail to give enough detail. This means that sufficiently detailed relief information is often difficult to obtain for wetland research. Site-specific, high-resolution relief surveys are too expensive, relative to many research budgets, to constitute a viable alternative. Based on an approximately 12 km<sup>2</sup> study area surrounding a karst-related peatland, this paper presents a method to retrieve the required high-resolution elevation data at 1 m intervals, at low cost, from satellite imagery in Google Earth™. The paper describes procedures used to capture and process the data using GIS ArcDesktop™ to produce a high-resolution contour map and DEM. For quality assurance purposes the generated map is visually compared to 5 m and 20 m contour intervals of standard topographic maps (1:50000) issued by the Chief Directorate Surveys and Mapping (CDSM). After correcting an off-set of 5 m it was found that the deviation of the generated contour map based on Google data from CDSM contours was in the same order as the deviation between the 2 CDSM contour sets. Finally, all 3 contour maps were compared to a contour map of 0.5 m-interval resolution specifically generated for the study area using aerial photography from an airborne survey. This too confirmed the overall good reliability of the generated, Google Earth™-based, contour map. Although Google Earth™'s contour models are based on data of the Shuttle Radar Topography Mission (SRTM), the direct use of freely available SRTM data for localised, high-resolution DEM yielded unsatisfactory results. This may be due to (unspecified) procedures, or unknown data sources employed by Google Earth™ that enhance the quality of relief data. With updating intervals of 2 to 4 years, satellite imagery in Google Earth™ offers the additional advantage of containing much more recent information on relevant hydrological features than the outdated topographic maps available for the study area. It is concluded that the presented method allows the generation of high-resolution DEMs especially for areas of flat topography where adequate relief information is either not available or too costly to generate. These DEMs are useful for further wetland research.

**Keywords:** digital elevation model, DEM, Google Earth, GIS, wetland, hydrology, relief, contour intervals, Gerhard Minnebron peatland, SRTM, topographic maps