Evaluation of the integration between level 1 of South African National land cover classes and topographical data

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Abstract:

In the recent years, national land cover mapping has been enhanced due to an increase of freely available Earth Observation (EO) datasets together with fast computer processing power. The national land cover is currently mapped using Sentinel at 20m resolution. The land cover is defined as the observed and existing (bio)-physical cover on the Earth's surface. It includes vegetation and man-made features as well as bare rock, bare soil, and inland water surfaces (Desta, et al., 2019). However, topographical data is known to incorporate the forms of the Earth's surface and all physical features such as natural features and mad-made features.

EO datasets not only benefited national land cover mapping but also improved the topographical dataset capture. There has been limited studies on the benefit of dataset integration generated from the EO datasets specifically on national topographical and national land cover datasets. Data integration is the process that combines multiple datasets to provide a unified integrated environment. (Abdalla, 2016). The data integration in this study entails the comparison of data geometry, and position accuracy. (Keinan, et al., 2022). Data integration benefits include reduction of time and costs to generate or update datasets to decrease data redundancy capture.

In 2017 South African land cover classes and definitions were approved in terms of section 11(2) of the Spatial Data Infrastructure Act, 2003 (Act No. 54 of 2003). The land cover classes were developed into a 4-level hierarchical structure. The land cover classes, and definition document provide a guideline for consistent land cover future mapping at any scale. The developed hierarchal structure framework permits the vast volumes and varieties of datasets to be integrated. Land cover class definitions are aligned to the different national legislation especially level 1 classes. There are nine level 1 land cover classes namely: Waterbodies, Shrubland, Mine and Quarries, Cultivated Land, Forestry Land, Wetlands, Built-up, Barren Land and Grassland. The land cover classes mentioned above are generated through the application of different EO processing techniques. The land cover guideline document or standard ensures standardisation, consistency and transparency for land cover generation which offers an opportunity for data integration with the country's topographical dataset. The national land cover data is produced every five years and the land cover change every three years however some of the land cover classes on level one are updated every two years which is more frequent than the national land cover dataset.

Topographical datasets provide land information with high accuracy of defined feature classes with measurement size mapped at 1:50 000 scale. Topographical data represents high resolution database for vast applications. It is mapped using aerial imagery at 0.25m Ground Sample Distance (GSD). Updating the country's topographical database requires human resources, time, and continuous development of procedures that are relevant with latest technology and EO imagery.

It is fundamental that the National Departments explore robust methods, collaborate in data sharing to maximise the available geospatial data from limited resources in continuing producing the required update of national land cover dataset or any other datasets. The land cover and topographical datasets both represent land information that is man-made and natural. It is elementary that this study also considers the benefits that can be maximised from the topographical database in updating the national land cover / land cover change or in updating the topographical data itself.

There are a number of similar classes being mapped by both the land cover and topographical datasets. Therefore, this study seeks to assess and evaluate the data integration of all the nine level 1 South African national land cover class and the topographical database that is produced by National Department of Agriculture, Land Reform and Rural Development (DALRRD). This is one of many approaches to ensure adaptable, safeguarded data infrastructure that enables continuous improvement with limited data duplication however it continues to provide comprehensive improvement in providing services.