

# Modernization of Canadian Digital Topographic Data

Heather McGrath<sup>a,\*</sup>, Mikhail Sokolov<sup>a</sup>, Jean-Sebastien Moreau<sup>a</sup>, CharlesPapasodoro<sup>a</sup>,  
Mozhdeh Shabazi<sup>a</sup>

<sup>a</sup> Canada Center for Mapping and Earth Observation (CCMEO), Natural Resources Canada  
heather.mcgrath, mikhail.sokolov, jean-sebastien, charles.papasodoro mozhdeh.shabazi, @nrcan-rncan.gc.ca

\* Corresponding author

© His Majesty the King in Right of Canada, as represented by the Minister of Natural Resources, 2025.

**Keywords:** Digital elevation models, digital terrain model, terrain mapping, super resolution, data fusion

**Abstract:** Canadians have been without a current Canada-wide digital terrain model since the prior product was not updated since 2011. Natural Resources Canada's elevation data team has been active with the acquisition of high-resolution data, leveraging lidar data and optical satellite imagery. However, this initiative will take several more years before achieving complete coverage across all of Canada's land mass. Satellite derived elevation models are numerous, providing global coverage. These models are surface models, containing vegetation and man-made infrastructure. Many applications require a terrain model, which represents 'bare-earth' elevation. In this project, we started with a global surface model, i.e. Copernicus GLO-30, and performed numerous spatial operations to extract a terrain model from it, through the inclusion of auxiliary datasets such as settled areas and forest heights, to create a modified Copernicus terrain model. Data fusion was then performed to include down sampled lidar-derived high-resolution terrain data where available, as this data is of better vertical accuracy. The result is a new, modern, and supported 30m resolution raster, which will be updated as new lidar data are released. The vertical accuracy of the 30m MRDTM is compared to the high-resolution data, before it's fused into the MRDTM, and to a variety of RTK control points in vegetated and non-vegetated regions. Results indicate the MRDTM is a significant improvement over the previously available national elevation datasets.

The second phase of this project takes this 30m raster and applies super-resolution techniques to generate a 15m national terrain dataset. Using 1-meter High-Resolution Digital Elevation Models(HRDEMs) from across Canada, a super-resolution neural network was trained to enhance the resolution of a digital elevation model. In testing, the DEMs were downsampled to 16-meter and 8-meter spatial resolutions to create two new finer resolution datasets. The trained model was then applied to the 30-meter MRDTMs, producing 15-meter super-resolved model of both Digital Surface Models (DSMs) and Digital Terrain Models (DTMs). The accuracy of the resulting super-resolved products was compared to the original high-resolution data, before being fused into the MRDTM, as well as to a variety of RTK control points in both vegetated and non-vegetated regions. The comparison showed improvements in RMSE and LE90 validation metrics, demonstrating the effectiveness of this super-resolution method in enhancing the spatial detail and accuracy of national terrain data.

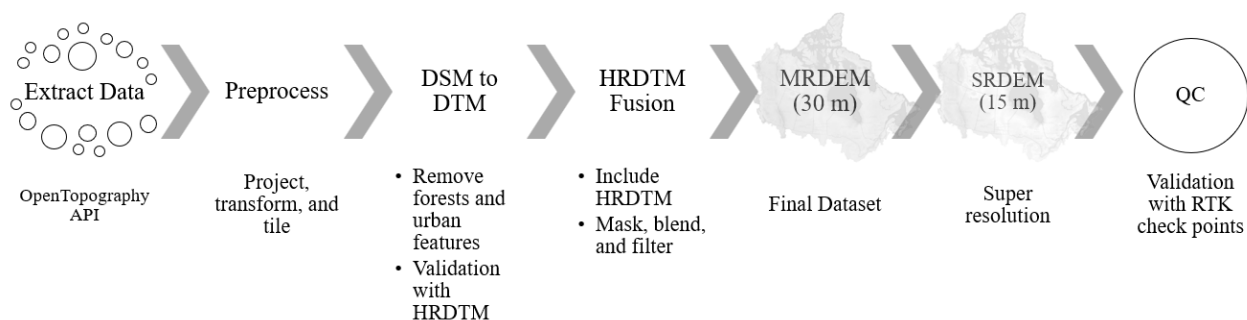


Figure 1. Overview of the process from data extraction to final outputs