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FABDEM - A 30m global map of elevation with forests and buildings removed

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Digital Elevation Models (DEMs) depict the elevation of the Earth's surface and are fundamental to many applications, particularly in the geosciences. To date, global DEMs contain building and forest artifacts that limit its functionality for applications that require precise measurement of terrain elevation, such as flood inundation modeling. Using machine learning techniques, we remove *both* building and tree height bias from the recently published Copernicus GLO-30 DEM to create a new dataset called FABDEM (Forest And Buildings removed Copernicus DEM). This new dataset is available at 1 arc second grid spacing (~30m) between 60°S-80°N, and is the first global DEM to remove *both* buildings and trees.

Our correction algorithm is trained on a comprehensive and unique set of reference elevation data from 12 countries that covers a wide range of climate zones and urban types. This results in a wider applicability compared to previous DEM correction studies trained on data from a single country. As a result, we reduce mean absolute vertical error from 5.15m to 2.88m in forested areas, and from 1.61m to 1.12m in built-up areas, compared to Copernicus GLO-30 DEM. Further statistical and visual comparisons to other global DEMs suggests FABDEM is the most accurate global DEM with median errors ranging from -0.11m to 0.45m for the different landcover types assessed. The biggest improvements were found in areas of dense canopy coverage (>50%), with FABDEM having a median error of 0.45m compared to 2.95m in MERIT DEM and 12.95m for Copernicus GLO-30 DEM.

FABDEM has notable improvements over existing global DEMs, resulting from the use of Copernicus GLO-30 and a powerful machine learning correction of building and tree bias. As such, there will be beneifts in using FABDEM for purposes where depiction of the bare-earth terrain is required, such as in applications in geomorphology, glaciology and hydrology.