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Introduction

ETOPO1 (right) is the National Centers for Environmental Information (NCEI)'s publiclyavailable, seamless, global topo-bathy elevation dataset at 1 arc-minute spatial resolution. It has been used for years for tsunami propagation modeling, climate modeling, and other scientific mapping objectives. Advances in and spaceborne data collection and processing now enable products with higher accuracy and spatial resolution than ever before. ETOPO 2022



combines disparate publicly-available land and ocean topography datasets, converts them to common grids and reference elevations, and uses advanced data-assimilation, error-minimization, and validation techniques to produce the next generation seamless publicly-available global elevation raster using a free open-access license. Here we outline the datasets and techniques being used to build ETOPO 2022 for release next year.

Datasets and Processing Summary

The following public datasets are being integrated into ETOPO 2022 (more may be added as available):





NOAA National Centers for Environmental Information www.ncei.noaa.gov

ETOPO 2022: An Updated NOAA Global Relief Model

Error Detection, Data Correction, and Validation

ICESat-2 Validation & Bias/Artifact Detection





ICESat-2 photon point clouds are validated and filtered using a partially-connected neural network on high-accuracy, highresolution lidar-derived DEMs to reduce photon artifacts. Then each input global input DEM source is validated against ICESat-2 orbit tracks to identify artifacts and biases in the DEM source using a convolutional neural net over each type of data source to remove vegetation and urban structure biases.

For ocean bathymetry, ICESat-2 is used in shallow, low-turbidity waters. Multi-beam sonar is used to estimate uncertainties in deeper regions where higher-resolution measurements are unavailable.

After error corrections, data from all available sources are assimilated into each ETOPO grid. A consensus and error-minimization algorithm is used to determine the final elevations recorded in the ETOPO product.

evation (m)



ETOPO Deliverables

In October 2022, the new ETOPO release will seamlessly represent global topography and bathymetry at a spatial resolution of 15 arc-seconds. The elevation product will be accompanied by uncertainty estimates, datasource attributions, water masks, and other applicable metadata, as well as grids for translating ETOPO to various popular global vertical datums. Further releases may include higher-resolution products as they become available. The ETOPO 2022 dataset will be publicly available for all scientific, commercial, or personal use (excluding navigation).

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Upper left: Copernicus DEM over eastern Massachusetts with ICESat-2 orbit tracks. **Upper right:** ICESat-2 photon cloud, south-to-north, orbit track in bold red on the left. *Center left:* Copernicus DEM errors from canopy-cover and urban structure biases over

Lower left: Copernicus DEM error summaries over New England. Similar analyses and corrections are performed over each input dataset before combining into final ETOPO cells.

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