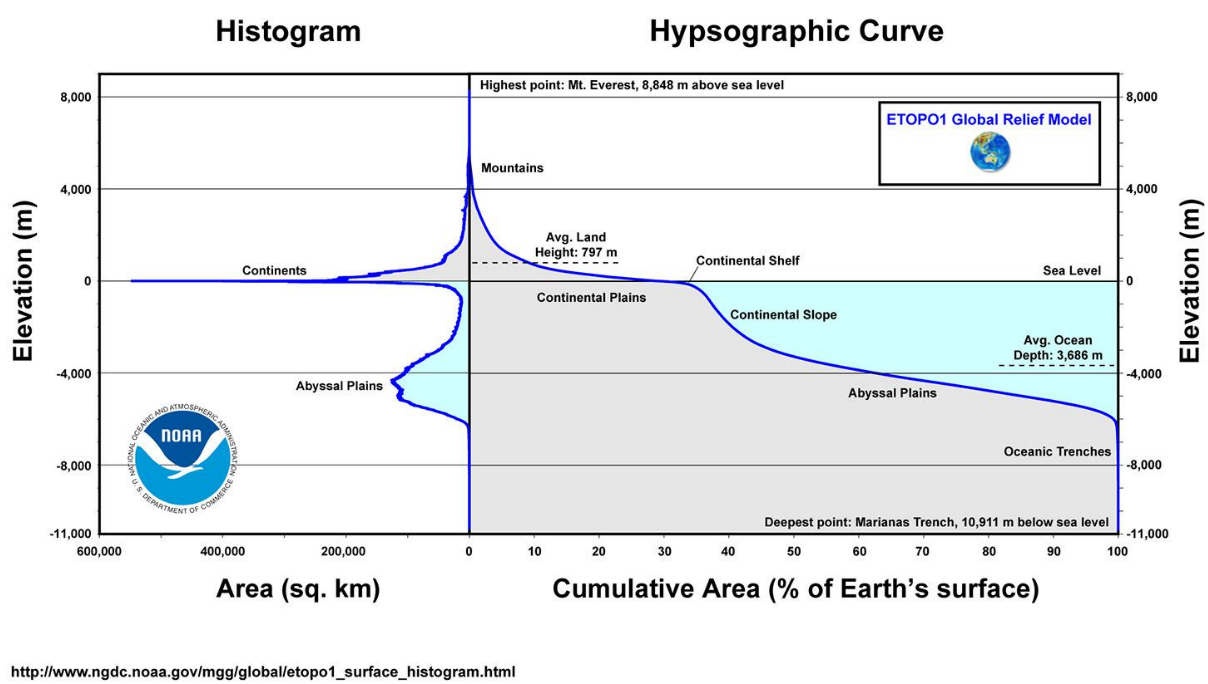
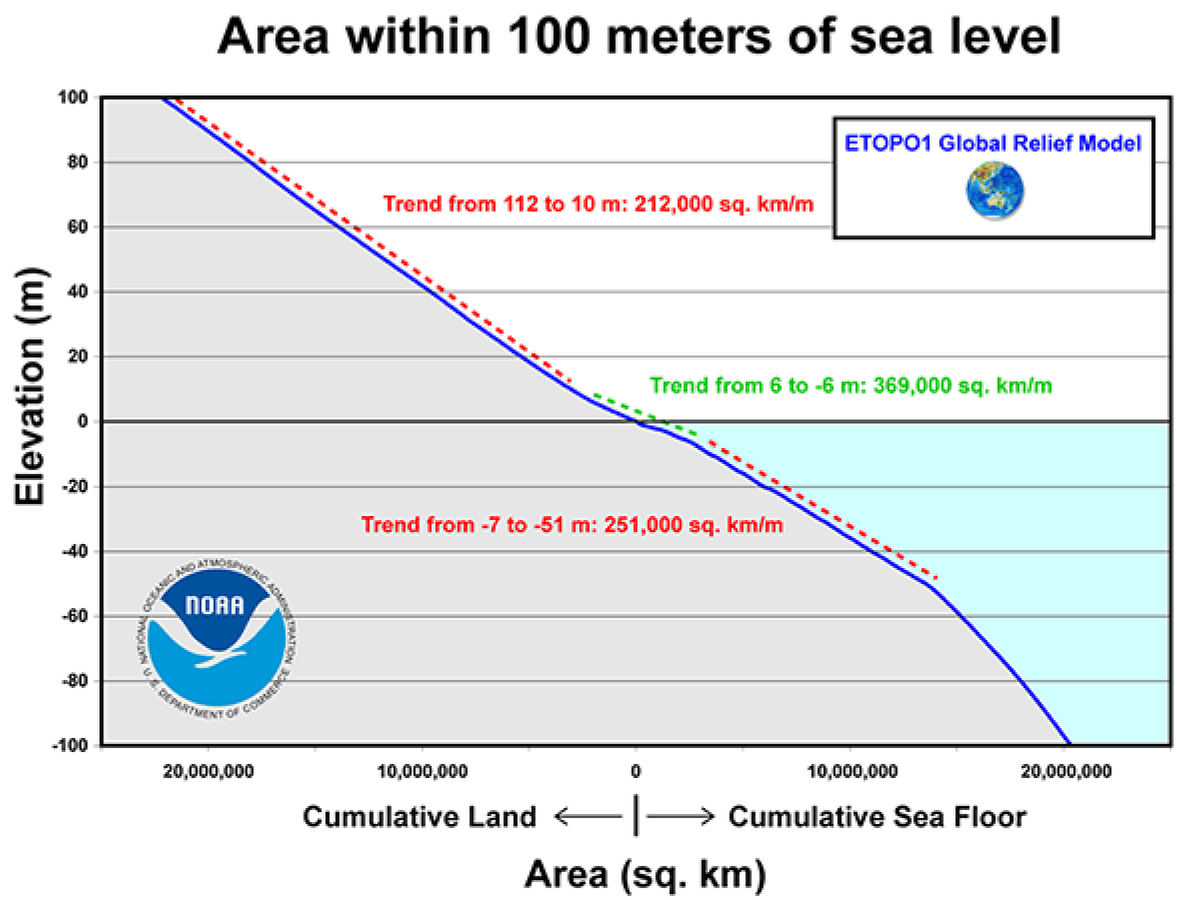
Hypsographic Curve of Earth's Surface from ETOPO1

NCEI calculated a histogram (distribution of elevations) and hypsographic curve (cumulative elevations) of Earth's surface (Figure 1) using the Ice Surface version of ETOPO1. The histogram reveals two primary elevation groupings: the continents, several hundred meters above sea level, and the oceanic abyssal plains, roughly 4,300 meters below sea level. This distribution indicates that the crust of the ocean floor is fundamentally different from the continents, a distinction that has been confirmed by countless research studies. The dramatic steepening of the hypsographic curve at mountains and oceanic trenches can only be maintained by a dynamic Earth. On geologic timescales, such features would quickly erode or fill in with sediments.



Coastal Hypsographic Curve

Figure 2 shows an enlarged hypsographic curve spanning the coastal zone (-100 to 100 m elevation). While ETOPO1 does not resolve meter-level variations, the curve nevertheless reveals three distinct trends between 112 and -51 meters of elevation.



Histogram Calculation

The histogram was determined using Equation 1 to calculate the area of each cell, which were grouped by elevation and summed (Table 1). ETOPO1 elevation values are to the nearest meter, with an accuracy no better than 10 meters. In deep ocean areas, depths are accurate to tens of meters at best. The hypsographic curves (Figs. 1 and 2) were smoothed to remove anomalies, and show the proportion of Earth's land and sea floor areas.

Equation 1

$$dA = a2\ cos[\o\ (1 - e2)]\ d\o\ dl\ /\ (1 - e2\ sin2\o)2$$

where:

- Latitude (ø) = latitude of cell's center (in radians)
- Unit of Latitude (dø) = 1 arc-minute (0.0166667 degrees)
- Unit of Longitude (dl) = 1 arc-minute (0.0166667 degrees)

The WGS84 spheroid was used for values of Earth's radius and eccentricity:

`Equatorial radius (a)` = 6378.137 km
`Eccentricity (e)` = 0.08181919

Citation

Eakins, B.W. and G.F. Sharman. Hypsographic Curve of Earth's Surface from ETOPO1, NOAA National Geophysical Data Center, Boulder, CO, 2012

Reference

Amante, C. and B. W. Eakins, ETOPO1 1 Arc-Minute Global Relief Model: Procedures, Data Sources and Analysis. NOAA Technical Memorandum NESDIS NGDC-24, 19 pp, March 2009. [http://www.ngdc.noaa.gov/mgg/global/relief/ETOPO1/docs/ETOPO1.pdf]