Coastal Digital Elevation Models (DEMs) to Support Storm Surge and Wave Inundation Modeling

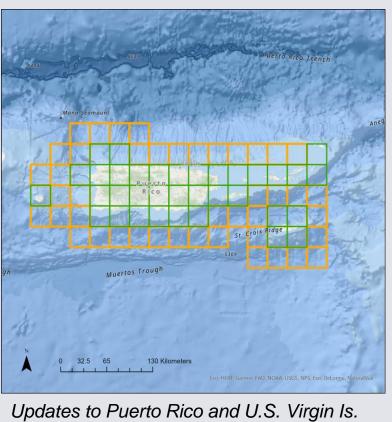
Kelly Carignan^{1,2}, Kelly Stroker², Christopher Amante^{1,2}, Matthew Love^{1,2}, Michael MacFerrin^{1,2}, Elliot Lim^{1,2}, Nic Arcos² ¹Cooperative Institute for Research in Environmental Sciences (CIRES) at the University of Colorado Boulder ²National Oceanic and Atmospheric Administration (NOAA) National Centers for Environmental Information (NCEI), Boulder, CO

Introduction

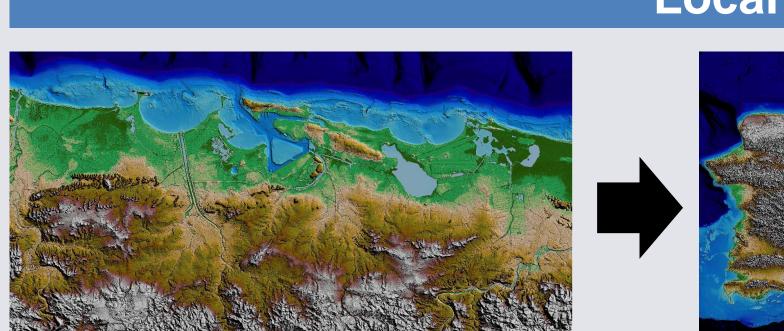
Coastal flooding can cause fatalities, damage to property, and economic disruption. The speed and height of ocean waves are controlled by ocean depth, and the inland extent of flooding is primarily determined by the coastal land topography. Therefore, accurate, integrated bathymetric-topographic digital elevation models (DEMs) are needed to determine the timing and extent of coastal flooding. The National Oceanic and Atmospheric Administration (NOAA) National Centers for Environmental Information (NCEI), through its partnership with the University of Colorado Boulder via the Cooperative Institute for Research in Environmental Sciences (CIRES), develops DEMs to support storm surge and wave inundation modeling for the Consumer Option for an Alternative System To Allocate Losses (COASTAL) Act and the National Tsunami Hazard Mitigation Program (NTHMP).

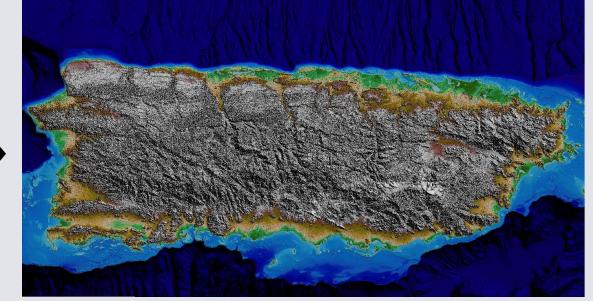
Seamless DEM coverage of the Nation

NOAA NCEI is generating multi-resolution tiled coastal DEMs for the U.S. Atlantic, Gulf. and Pacific Coasts, Hawaii, Puerto Rico, U.S. Virgin Islands, American Samoa, Guam, and the Commonwealth of the Northern Mariana Islands (CNMI) in support of the COASTAL Act and National Tsunami Hazard Mitigation Program.









The NCEI Coastal DEM Team is working towards a comprehensive, continuously-updated DEM (CUDEM) program with local, high resolution 1/9th and 1/3rd arc-second tiles that are incorporated into regional-scale Coastal Relief Models and into the ETOPO Global Relief Model. Regional and global-scale products will be updated annually as new local, high resolution DEM tiles are completed.

NCEI Bathymetry Viewer - Discovery and Color Shaded Relief: ://www.ncei.noaa.gov/maps/bathymetry/?layers=DE

NOAA OCM Data Access Viewer - Download: ://coast.noaa.gov/dataviewer/index.html#/lidar/search/

Coastal DEM development toolchain using Free Open-Source Software (FOSS)

NOAA NCEI coastal DEM development, processing and analysis utilizes a FOSS toolchain enabling an open and reproducible approach to the development of coastal DEMs.

DEM development software:

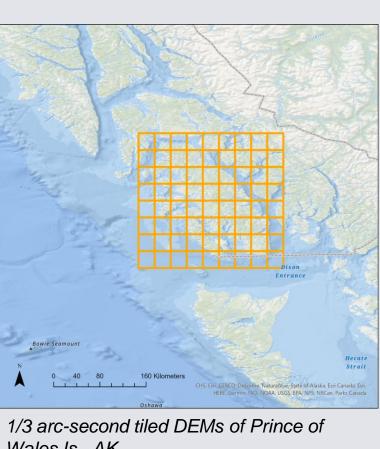
- GNU/Linux
- GMT • GDAL
- MB-System
- Python
- CIRES GeoMods

ttps://github.com/ciresde

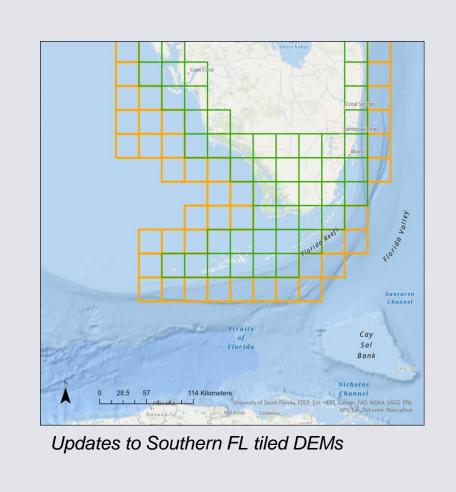


NOAA National Centers for Environmental Information www.ncei.noaa.gov

"The CUDEM framework consists of systematic tiled geographic extents, spatial resolutions, and horizontal and vertical datums to facilitate rapid updates of targeted areas with new data collections, especially post-storm and tsunami events. The CUDEM framework also enables the rapid incorporation of high-resolution data collections ingested into local-scale DEMs into NOAA NCEI's suite of regional and global DEMs."

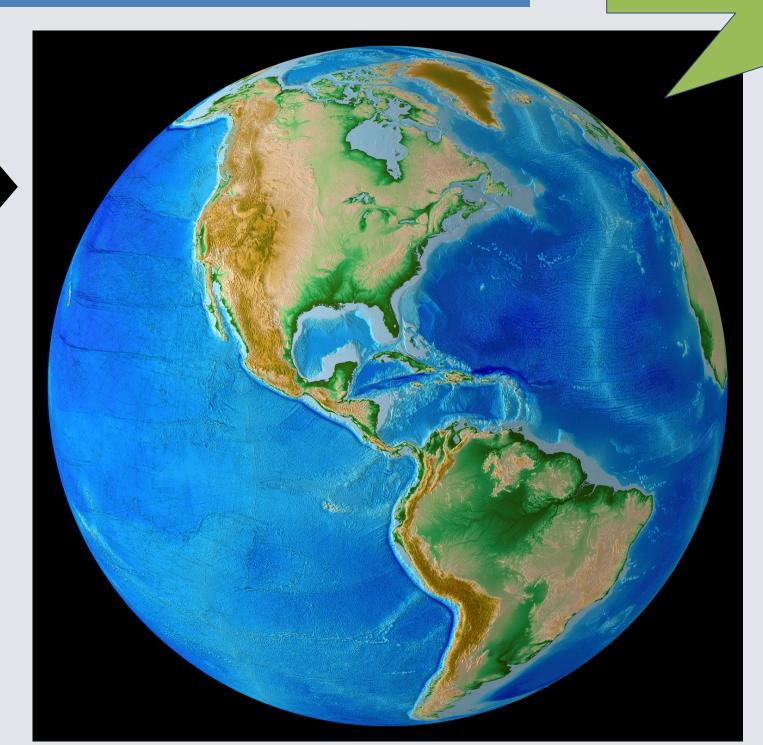


Wales Is., AK



ETOPO 2022!

Local > Regional > Global



Spatial Metadata

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README.md	readme figure1	last month	☆ 5 stars
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🗅 setup.py	no tqdm, cliprogress threads	last month	Report repository

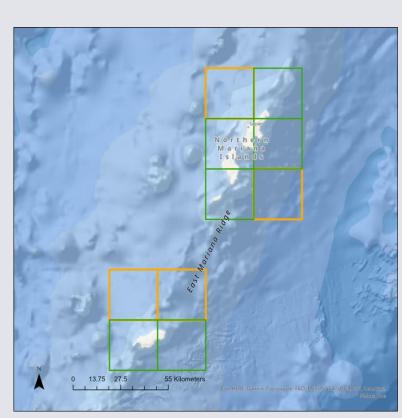
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This work is supported in part by the NOAA Cooperative Agreements with CIRES, NA17OAR4320101 and NA22OAR4320151, NA19NES0220001 Hurricane Supplemental: Enhanced NCEI Data Management Tools, and U.S. Geological Survey under Grant/Cooperative Agreement No. G22AC00053

CIRES Rendezvous 2023

NCEI CUDEM Framework

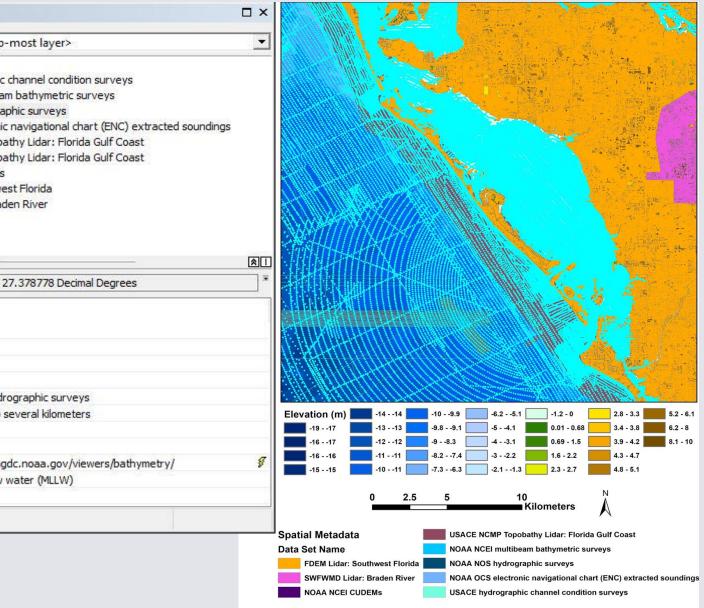
Amante, C.J.; Love, M.; Carignan, K.; Sutherland, M.G.; MacFerrin, M.; Lim, E. Continuously Updated Digital Elevation Models (CUDEMs) to Support Coastal Inundation Modeling. Remote Sens. 2023, 15, 1702. https://doi.org/10.3390/rs15061702



1/9 and 1/3 arc-second tiled DEMs of Commonwealth of the Northern Mariana Is

See Mike MacFerrin's poster for more details!

Spatial Metadata is being generated to indicate locations of source measurements used in the development of DEMs and provide important information including data collection agency, year of collection, and measurement technology.

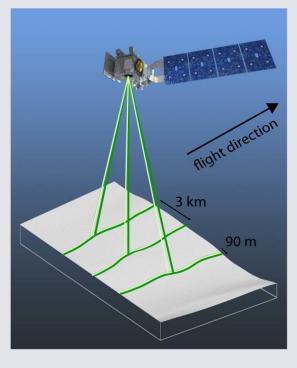


Spatial Metadata for Sarasota, Florida showing source datasets overlaid on the 1/9th arc-second DEM.

DEM validation tool

NASA's Ice, Cloud and land Elevation 2 Satellite (ICESat-2)

- Photon-counting, point clouds over orbital passes
- Filter photons not passing QC checks
- Filter out non-land photons



Spatial Metadata available at NOAA Digital Coast: 1/9th Arc-Sec DEMs:

noaa.gov/htdata/raster2/elevation/NCEI_ninth_Topobathy_2014_8483/ninth_spat 1/3rd Arc-Sec DEMs: t.noaa.gov/htdata/raster2/elevation/NCEI_third_Topobathy_2014_8580/third_spatial_meta.zip

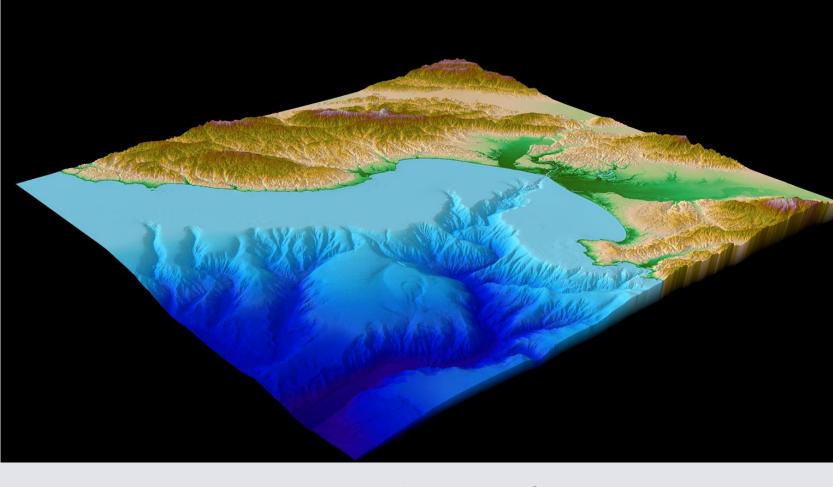
DEM Uncertainty

Ongoing Research: Estimating DEM Uncertainty

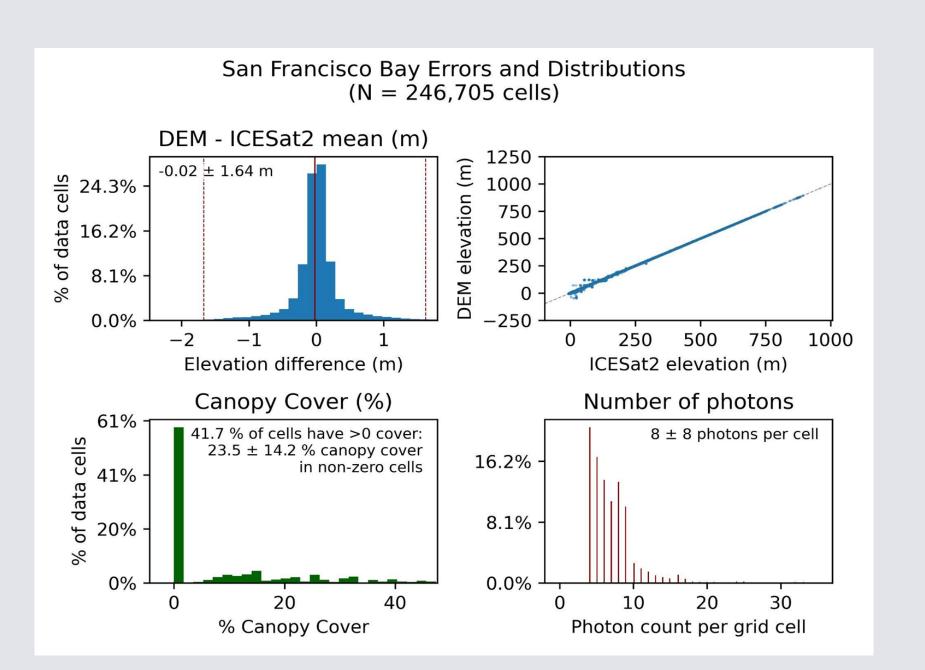
DEM of SW Florida (left) and accompanying uncertainty surface (right) that estimates potential DEM deviations from the actual seabed or land surface.

NCEI is collaborating with the USGS on estimating DEM uncertainty.





Perspective view of the Monterey, CA DEM tps://www.mdpi.com/2072-4292/15/6/1702



Example of the validation results for the San Francisco Bay DEM tiles.

Elevation (m) Total Uncertainty (m)

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