

Digital Elevation Models of Port Graham and Nanwalek, Alaska: Procedures, Data Sources, and Analysis

Prepared for the National Tsunami Hazard Mitigation Program (NTHMP) and the University of Alaska, Fairbanks (UAF) by the NOAA National Centers for Environmental Information (NCEI)

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Summary

In July of 2019, NOAA's National Centers for Environmental Information (NCEI) developed an integrated bathymetric–topographic digital elevation model (DEM) supporting the State of Alaska's tsunami hazard mitigation efforts. The 8/15 arc-second DEM covers the area immediately surrounding the communities of Port Graham and Nanwalek on the Kenai Peninsula in Southcentral Alaska. The extents of this DEM, procedures, data sources, and analysis are described below.

DEM Specifications

The Port Graham and Nanwalek DEM was built to the specifications listed in Table 1. Figure 1 shows the 8/15 arc-second DEM boundary.

Table 1. Specifications for the DEM.

<i>Grid Area</i>	<i>Port Graham and Nanwalek</i>
Coverage Area	151.71° to 152.05° W, 59.28° to 59.41° N
Coordinate System	Geographic decimal degrees
Horizontal Datum	World Geodetic System 1984 (WGS 84)
Vertical Datum	Mean Higher High Water (MHHW)
Vertical Units	Meters
Cell Size	8/15 arc-second or ~15 m

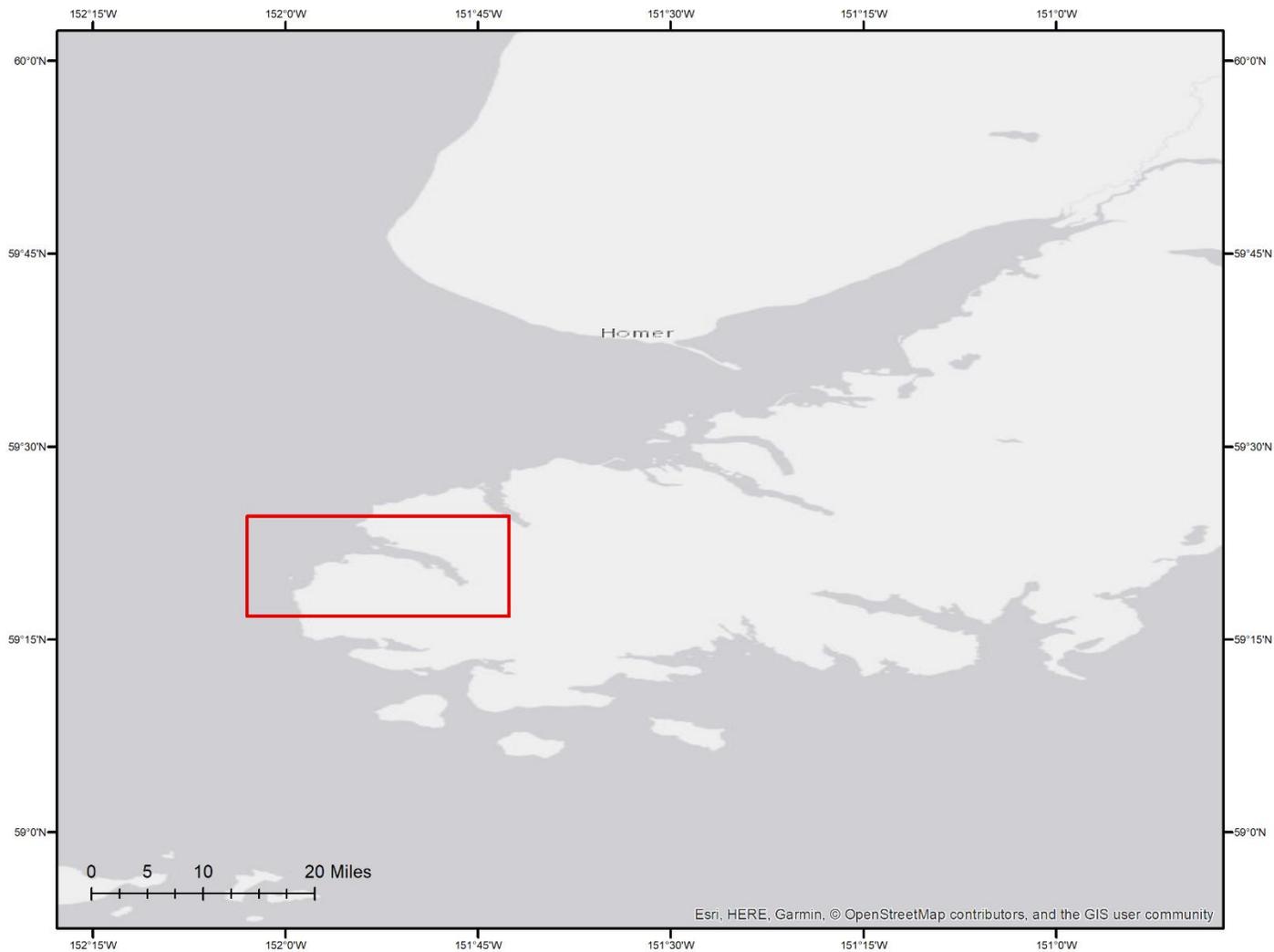


Figure 1. Map image of the 8/15 arc-second DEM boundary on the Kenai Peninsula, Alaska.

Data Sources and Processing

A NOAA electronic nautical chart (ENC) digital coastline for the two Kenai Peninsula communities was extracted via ENC Direct to GIS application and edited based on State of Alaska, Department of Commerce, Community, and Economic Development, Division of Community and Regional Affairs (DCRA) vector contours and ESRI imagery. The coastline was used as source data and to generate data masks for both bathymetric and topographic data. Figure 2 shows bathymetric and topographic source data coverage for the DEM.

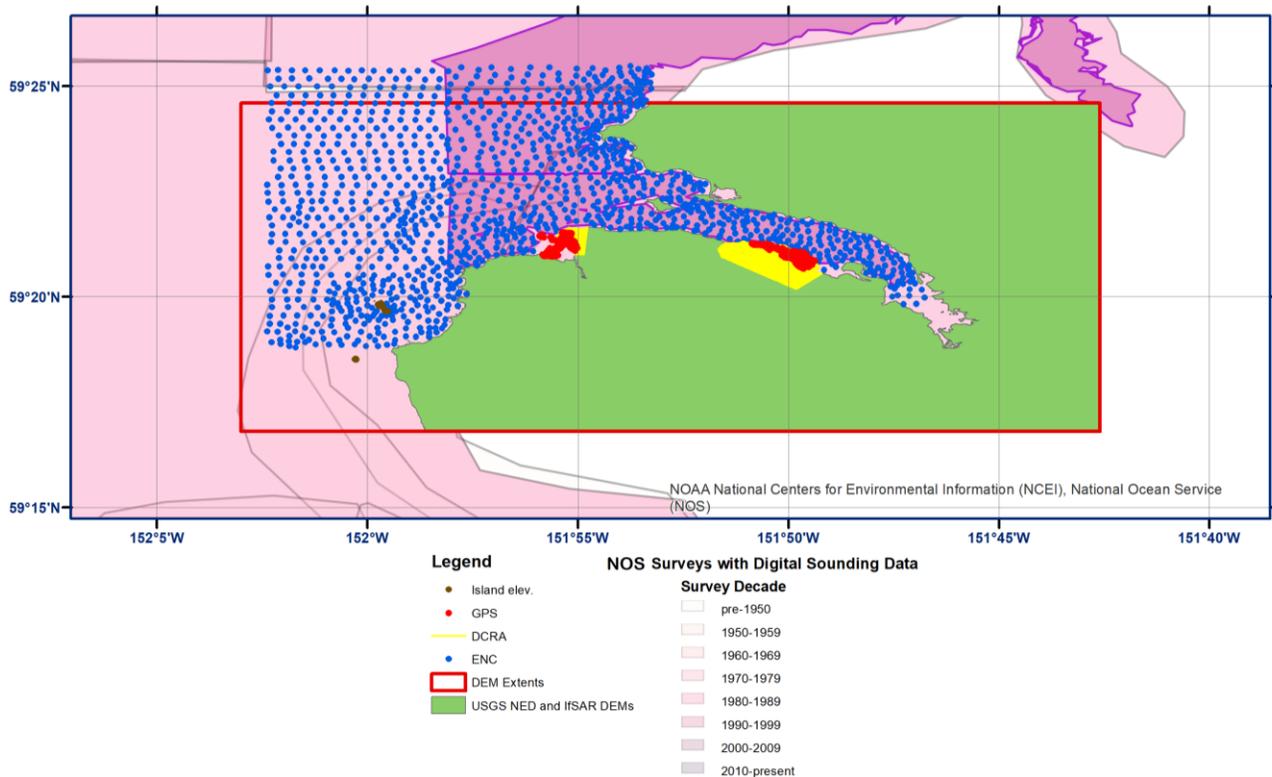


Figure 2. Source data spatial coverage for the 8/15 arc-second DEM on Kenai Peninsula Island, Alaska.

Bathymetry data used in the compilation of the Port Graham and Nanwalek DEM included: NOAA National Ocean Service (NOS) hydrographic surveys; ENC soundings; and DCRA vector contours (Tables 2-3). The small lagoon at Nanwalek was not completely resolved in any of the source bathymetry data and to enforce a ‘wet’ depth, points were added with elevations based on GPS and DCRA data.

Table 2: Bathymetric data sources used in DEM development.

<i>Source</i>	<i>Date</i>	<i>Data Type</i>	<i>Spatial Resolution</i>	<i>Horizontal Datum</i>	<i>Vertical Datum</i>
NOAA NOS	1980 to 2009	Hydrographic survey soundings and bathymetric lidar surveys	1:10,000 to 1:20,000	NAD 1927 or NAD 1983 UTM zone 5	MLLW
NOAA OCS	1998 to 2011	Extracted chart soundings	-	WGS 84 geographic	MLLW
DCRA	2005	SPOT elevation points and vector contours	10 foot contour interval		MHHW

Table 3: NOS hydrographic surveys used in DEM development.

<i>Survey ID</i>	<i>Date</i>	<i>Original Horizontal Datum</i>	<i>Original Vertical Datum</i>	<i>Scale</i>
H09878	1980	NAD 1927	MLLW	1:10,000
H09879	1980	NAD 1927	MLLW	1:20,000
H12089	2009	NAD 1983 UTM zone 5	MLLW	1:10,000
H12114	2009	NAD 1983 UTM zone 5	MLLW	1:10,000

Bathymetric data were transformed to WGS 84 and MHHW. Vertical datum transformations were based on the NOAA tide station (Table 4).

Table 4: Relationship between vertical datums in meters for the DEM region.

<i>Vertical Datum</i>	<i>#9455500 Seldovia, Cook Inlet</i>
MHHW	5.499
MHW	5.252
MSL	2.912
MTL	2.884
NAVD 88*	1.804
MLW	0.517
MLLW	0

*Geoid12A, The relationship to tidal datum is an estimation based on Alaska Tidal Datum Portal

Table 5 lists the topographic data used in developing the DEM were used in the Port Graham and Nanwalek DEM. A 5m IfSAR DSM from USGS was used extent of the DEM boundary along with the USGS IfSAR derived 1/3 arc-second DEM. Both were used to reduce the offset between the IfSAR data and the DCRA contour data. This offset was more pronounced at Port Graham. Additionally, the contour data were converted to points and surfaced further reducing the 'noise' or spikes in the DEM. Within the communities of Port Graham and Nanwalek, GPS points collected by and used as both a source data for the DEM and to estimate the conversion value for the other topographic datasets.

Table 5: Topographic data sources used in DEM development.

<i>Source</i>	<i>Date</i>	<i>Data Type</i>	<i>Spatial Resolution</i>	<i>Horizontal Datum</i>	<i>Vertical Datum</i>
UAF	-	GPS elevation points	varies	WGS 84 geographic	MHHW
USGS NED 1/3	2012	IfSAR Derived DEM	1/3 arc-second	NAD 83	NAVD 88
DCRA	2005	SPOT elevation points and vector contours	10 foot contour interval	NAD 83 State Plane Alaska 4 FIPS 5004 (feet)	MHHW
USGS	2012	IfSAR DSM	5 m	NAD 83 Alaska Albers Conical Equal Area	NAVD 88 (Geoid 2009)

Converting IfSAR DTM data to MHHW was completed using the constant value of -3.695 meters (Figure 3). A small adjustment of 0.156 meters to the -3.695 meters to compensate for the difference in Geoid 09 and 12A based on VDatum calculator.

[About the Alaska Tidal Datum Portal](#)

[Frequently Asked Questions \(FAQ\)](#)

[Alaska Tidal Datum Calculator](#)

This conversion calculator is provided as a convenience to facilitate access to vertical measurements that have been independently verified and are freely available from either [NOAA CO-OPS](#) or [NOAA NGS](#). For rigorous emergency, planning or construction purposes, users are strongly advised to consult these original sources to ensure accurate and up-to-date transformations. All calculations are based on single tide station offsets, elevations obtained using this method are only valid in the immediate vicinity of the original tide station.

The values in this conversion calculator were last updated January 2017.

Location:

Geodetic Elevation: (meters)

Local Tidal Elevation: (meters)

A summary of relevant information, including links to all of the published values included in this calculator, can be found in the [reference table](#). The table includes all Alaska tide stations with published local datums, however, tidal benchmarks or NAVD88(GEOID12A) tidal benchmark elevations are not available for all locations.

Conversion between local tidal datums and NGVD29 is not supported by the calculator at this time.

[Recommended External Resources](#)

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Figure 3. Alaska Tidal Datum Calculator results for DEM location.

DEM Development

The DEM was developed in two stages. GMT ‘surface’ command was used to generate a bathymetric pre-surface at the same resolution as the final DEM from the processed bathymetry data along with a coastline data file consisting of data points at 2 meter intervals set to zero elevation. The pre-surface bathy grid was smoothed using a Gaussian Blur python script before converting to an xyz data point file in the final DEM. The pre-surface data file, bathymetry data, and topographic data were gridded using MB-System ‘mbgrid’ with data gridding weight set to values in Table 6.

Table 6: Data hierarchy used to assign gridding weight in MB-System.

<i>Dataset</i>	<i>Relative Gridding Weight</i>
UAF GPS points	1000
NOS surveys (BAGs)	100
USGS NED 1/3 DEM	10
ENC soundings	1
DCRA elevation contours	1
IfSAR DSM	1
Bathymetric pre-surface	1

DEM Analysis

Once the Port Graham and Nanwalek DEM was generated, the grids were compared to the contour data, GPS points and for this area (Figure 4). Inconsistencies were evaluated and resolved based on most reliable data available.

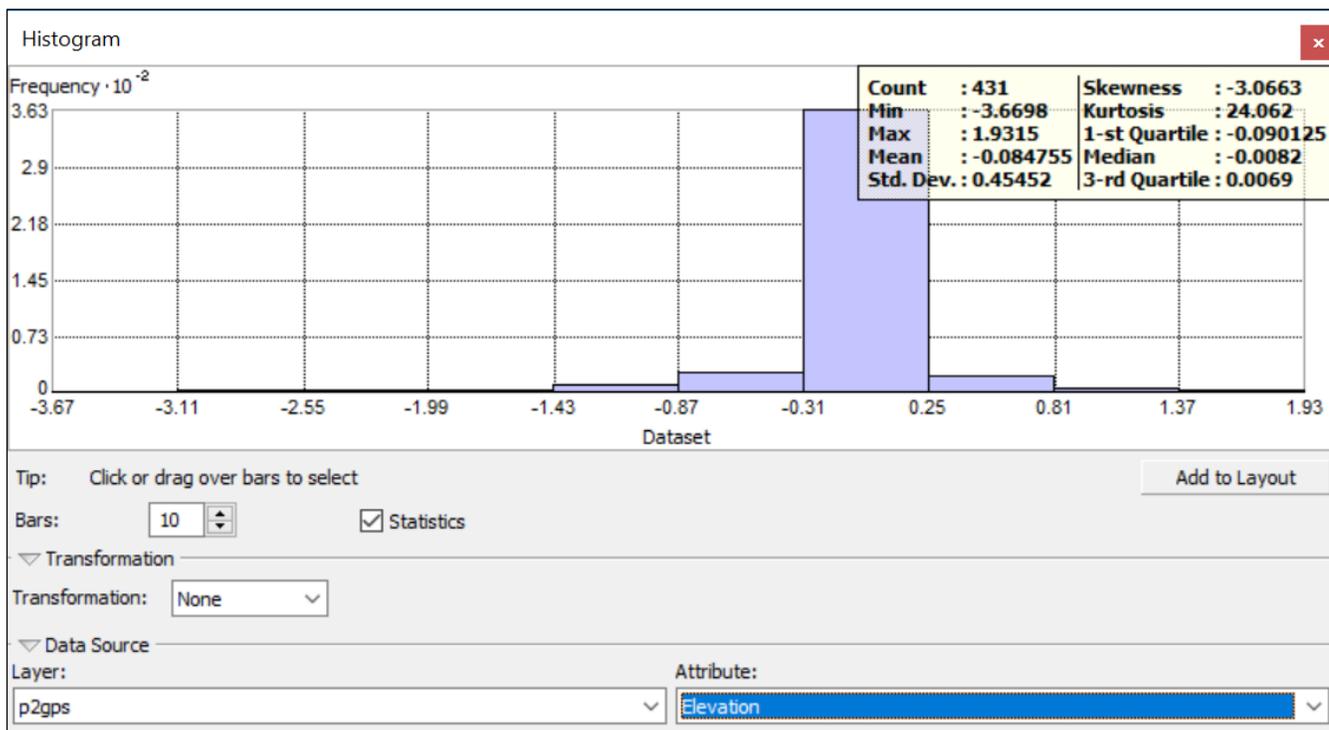


Figure 4: Comparison of UAF GPS to Port Graham/Nanwalek DEM.

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Reference

Alaska Division of Geological and Geophysical Surveys, Alaska Tidal Datum Portal. <http://dggs.alaska.gov/sections/engineering/ak-tidal-datum-portal/>. [Accessed June 2019].

USGS. USGS NED Digital Surface Model AK IfSAR - Chugach2 C308 2014 TIFF 2018. [Accessed June 2019].