

# Digital Elevation Models of Port Alexander and Wrangell, Alaska: Procedures, Data Sources, and Analysis

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## Summary

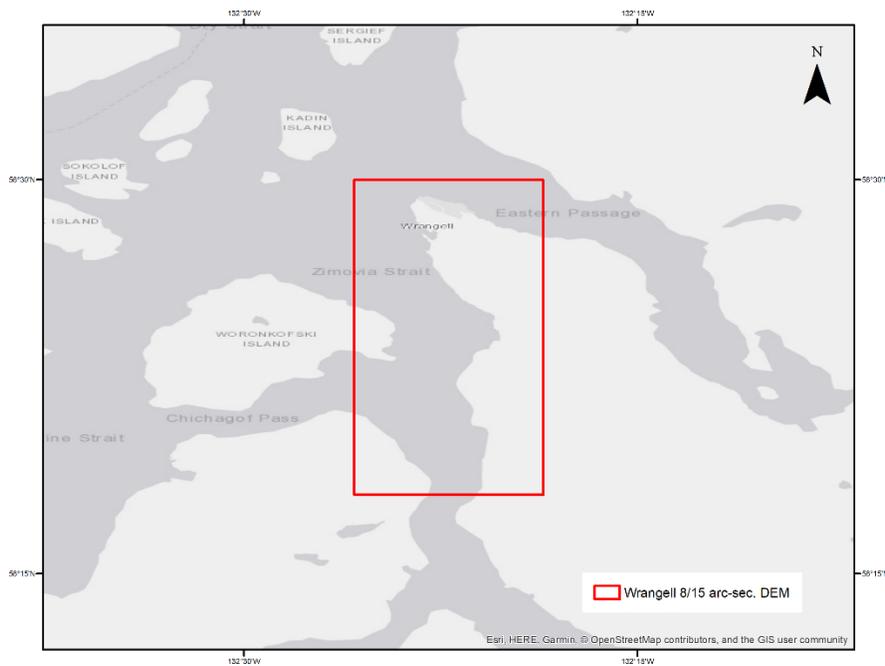
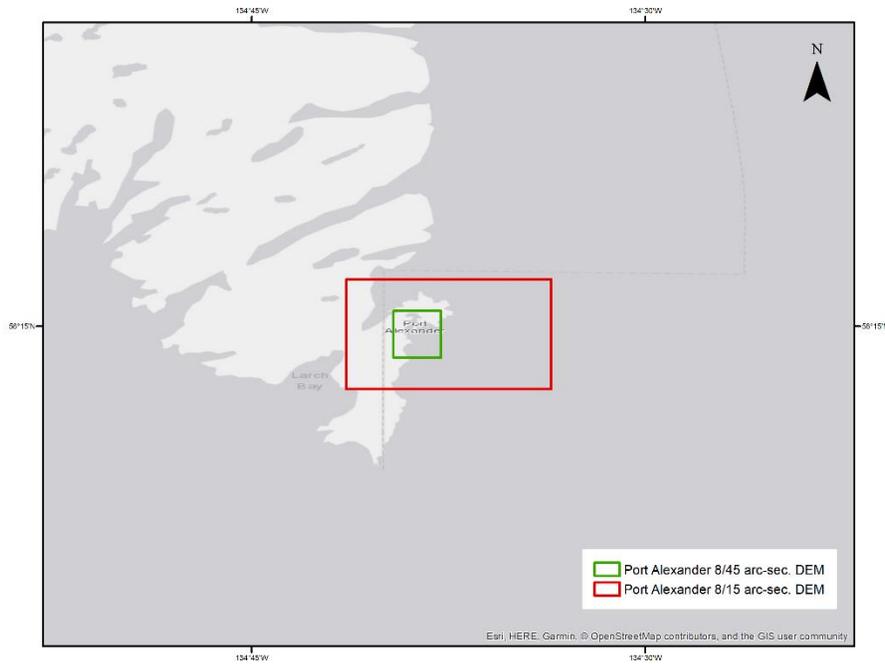
In November of 2018, NOAA's National Centers for Environmental Information (NCEI) developed three integrated bathymetric–topographic digital elevation models (DEMs) supporting the State of Alaska's tsunami hazard mitigation efforts. The 8/15 and 8/45 arc-second DEMs cover the area immediately surrounding the communities of Port Alexander and Wrangell. The extents of these DEMs, procedures, data sources, and analysis are described below.

## DEM Specifications

The Port Alexander and Wrangell DEMs were built to the specifications listed in Table 1. Figure 1 shows the 8/15 arc-second DEM boundaries in red and the 8/45 arc-second DEM boundary in green.

**Table 1. Specifications for the DEM.**

<i>Grid Area</i>	<i>Port Alexander</i>	<i>Port Alexander</i>	<i>Wrangell</i>
Coverage Area	166.42° to 166.66° W, 53.80° to 53.94° N	166.42° to 166.66° W, 53.80° to 53.94° N	132.31° to 132.43° W, 56.30° to 56.50° 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	8/45 arc-second or ~5 m	8/15 arc-second or ~15 m



**Figure 1.** Map images of the 8/15 arc-second DEM boundaries in red and the 8/45 arc-second DEM boundary in green.

## Data Sources and Processing

A NOAA electronic nautical chart (ENC) digital coastline was edited based on high resolution imagery, U.S. Army Corps of Engineers (USACE) harbor survey drawings, and topographic contour data from the DCRA to be used as source data as a data mask for both bathymetric and topographic data.

Bathymetry data used in the compilation of the Port Alexander and Wrangell DEMs included NOS hydrographic surveys, NOAA Electronic Navigational Chart (ENC) soundings, and USACE project survey maps (Tables 2-3). The USACE Alaska District provided project condition survey maps for both Port Alexander and Wrangell however since high resolution NOS BAG data were available for same spatial coverage in Port Alexander only the Wrangell project maps were used.

**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	1954 to 2013	Hydrographic survey soundings	< 10 meters to several kilometers	NAD 27 or NAD 83 geographic	Mean Lower Low Water (MLLW)
NOAA OCS	2006 to 2015	Extracted chart soundings	50 to ~700 meters	WGS 84 geographic	MLLW
USACE	2015	Harbor condition survey	meter	NAD 83 Alaska State Plane 10 (feet)	MLLW

**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>
H08148	1954	NAD 27	MLLW	20000
H08621	1961	NAD 27	MLLW	10000
H11048	2001	NAD 83 UTM Zone 8	MLLW	10000
H11049	2001	NAD 83 UTM Zone 8	MLLW	10000
H11053	2001	NAD 83 UTM Zone 8	MLLW	10000
H11403	2005	NAD 83 UTM Zone 8	MLLW	10000
H12372	2011	NAD 83 UTM Zone 8	MLLW	10000
H12374	2011	NAD 83 UTM Zone 8	MLLW	10000
H12531	2013	NAD 83 UTM Zone 8	MLLW	5000

Bathymetric data were transformed to WGS 84 and MHHW as needed and where more recent, higher resolution data existed, older data were edited. Vertical datum transformations were based on the NOAA tide stations (Table 4).

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

<i>Vertical Datum</i>	<i>Port Alexander #9451054</i>	<i>Wrangell #9451204</i>
MHHW	3.329	4.864
MHW	3.070	4.595
MTW	1.755	2.528
MSL	1.747	2.519
MLW	0.440	0.460
NAVD88	0.358	-
MLLW	0.000	0.000

Table 5 lists the topographic data used in developing the DEM were used in the Port Alexander and Wrangell DEMs. The lfsar topographic DTM tiles were downloaded and provided full coverage of the both regions.

Converting the IFSAR to MHHW was completed using VDatum and the Alaska Tidal Datum Portal. Closer to the communities of Port Alexander and Wrangell, GPS points collected by UAF and in Port Alexander contour data from DCRA were used. NCEI digitized additional points based on USACE project drawings as a recently developed small boat harbor in the Wrangell Harbor was not resolved completely in the IFSAR data.

**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>
DCRA	2008	Vector contours	10 foot contour interval	NAD 83 State Plane Alaska 1 FIPS 5001 feet	MLLW
UAF	2012	GPS elevation points		WGS 84 geographic	MHHW
Alaska	2012	IFSAR DTM	5 m	NAD 83 CORS96 Alaska Albers	NAVD 88 Geoid 09

## DEM Development

The DEMs were 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. After the initial development process was completed, a review of the Wrangell DEM showed that the harbor jetties and breakwater were not fully resolved. Additional data points were added and the width of the features were buffered to ensure the features would be present in the final DEM products. In the Port Alexander DEMs, additional bathymetric data points based on NOAA charts were added to restrict areas with large gaps in data interpolating to overly deep cell values near shore.

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

<i>Dataset</i>	<i>Relative Gridding Weight</i>
USACE hydrographic condition survey (Wrangell only)	1000
DCRA topographic contours (Port Alexander only)	100
UAF GPS points	100
NOS surveys (Wrangell/Port Alexander)	10/100
Extracted ENC soundings	1
IFSAR DTM	1
Bathymetric pre-surface	1

# DEM Analysis

Once the Port Alexander and Wrangell DEMs were generated, the grids were compared to the contour data, GPS points and NGA monuments for this area. Inconsistencies were evaluated and resolved based on most reliable data available.

## Acknowledgements

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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 October 2018].

VDatum Version 3.8. NOAA National Ocean Service (NOS), National Geodetic Survey (NGS), Office of Coast Survey (OCS), and the Center for Operational Oceanographic Products and Services (CO-OPS). <https://vdatum.noaa.gov/welcome.html>. [Accessed May 2018].