

Digital Elevation Models of Adak and Atka, Alaska: Procedures, Data Sources, and Analysis

Prepared for the National Tsunami Hazard Mitigation Program (NTHMP) by the NOAA National Centers for Environmental Information (NCEI)

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Summary

In February of 2017, NOAA's National Centers for Environmental Information (NCEI) developed two integrated bathymetric–topographic digital elevation models (DEMs) of Adak and Atka, Alaska for the National Tsunami Hazard Mitigation Program (NTHMP) and University of Alaska, Fairbanks (UAF). The 8/15 arc-second DEMs will be used to support modeling tsunami generation, propagation, and inundation. The DEMs cover the communities of Adak and Atka on their respective islands, part of the Andreanof Islands in the Aleutian Chain of Alaska. The extents of these DEMs, procedures, data sources, and analysis are described below. The methodologies used by NCEI in developing DEMs are described in the NGDC Technical Report of Kodiak, Alaska (Carignan et al., 2013).

DEM Specifications

The Adak and Atka DEMs were built to the specifications listed in Table 1. Figure 1 shows the previously developed 8/15 arc-second Adak DEM boundary in green and the 8/15 arc-second Atka DEM boundary in red.

Table 1. Specifications for the 8/15 arc-second Adak and Atka, Alaska DEMs.

Grid Area	Adak, Alaska	Atka, Alaska
Coverage Area	176.49° to 176.69° W, 51.82° to 51.97° N	174.00° to 174.26° W, 52.07° to 52.30° N
Coordinate System	Geographic decimal degrees	Geographic decimal degrees
Horizontal Datum	World Geodetic System 1984 (WGS 84)	World Geodetic System 1984 (WGS 84)
Vertical Datum	Mean Higher High Water (MHHW)	Mean Higher High Water (MHHW)
Vertical Units	Meters	Meters
Cell Size	8/15 arc-second	8/15 arc-second
Grid Format	ASCII raster grid	ASCII raster grid

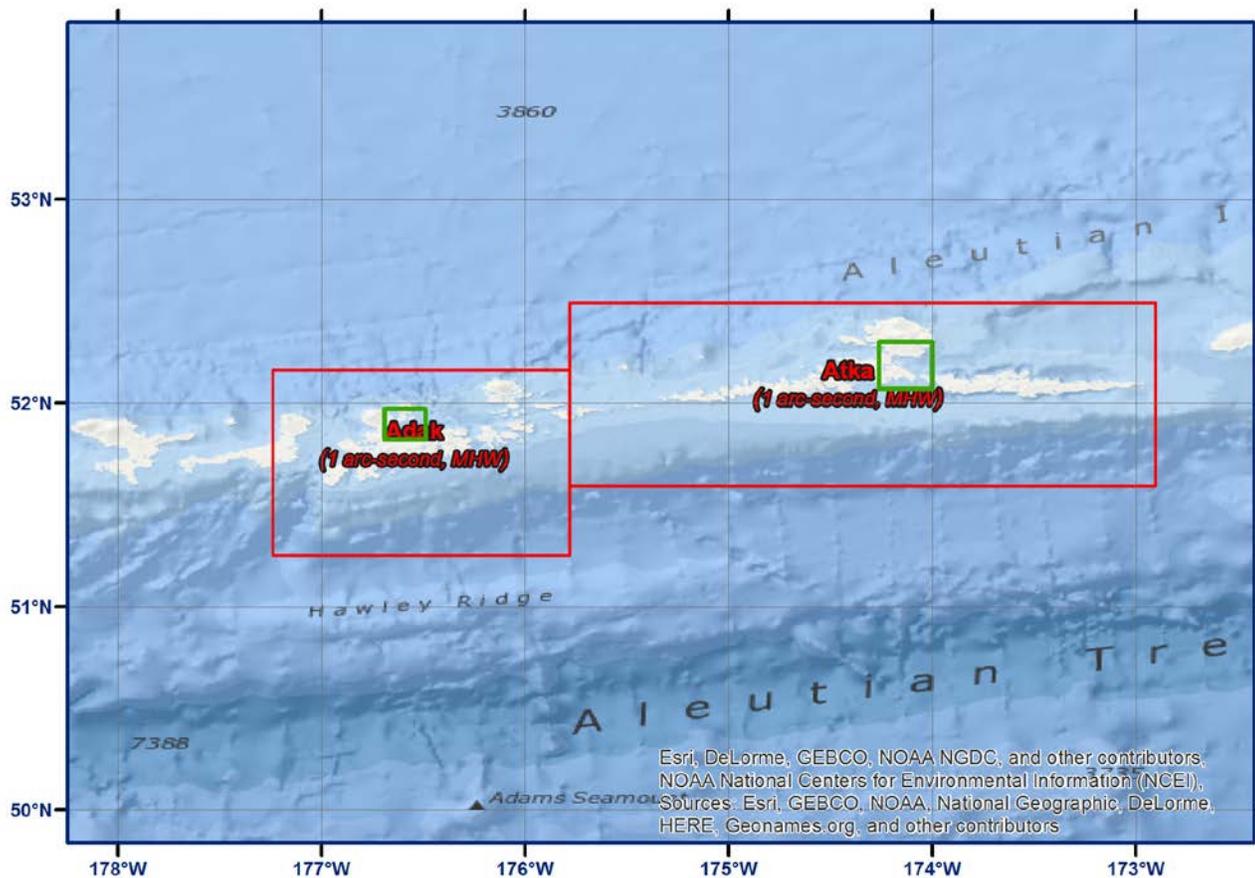


Figure 1. Map image of the geographic extents for the Adak and Atka DEMs in green and older NCEI 1 arc-second DEMs in red.

Data Sources and Processing

Data used in developing these DEMs were provided by UAF, the Alaska Department of Commerce, Community, and Economic Development Division of Community and Regional Affairs (DCRA), the University of Minnesota Polar Geospatial Center, USGS/NASA, and NOAA. Figures 2 and 3 show the source data coverage for the Adak and Atka DEMs.

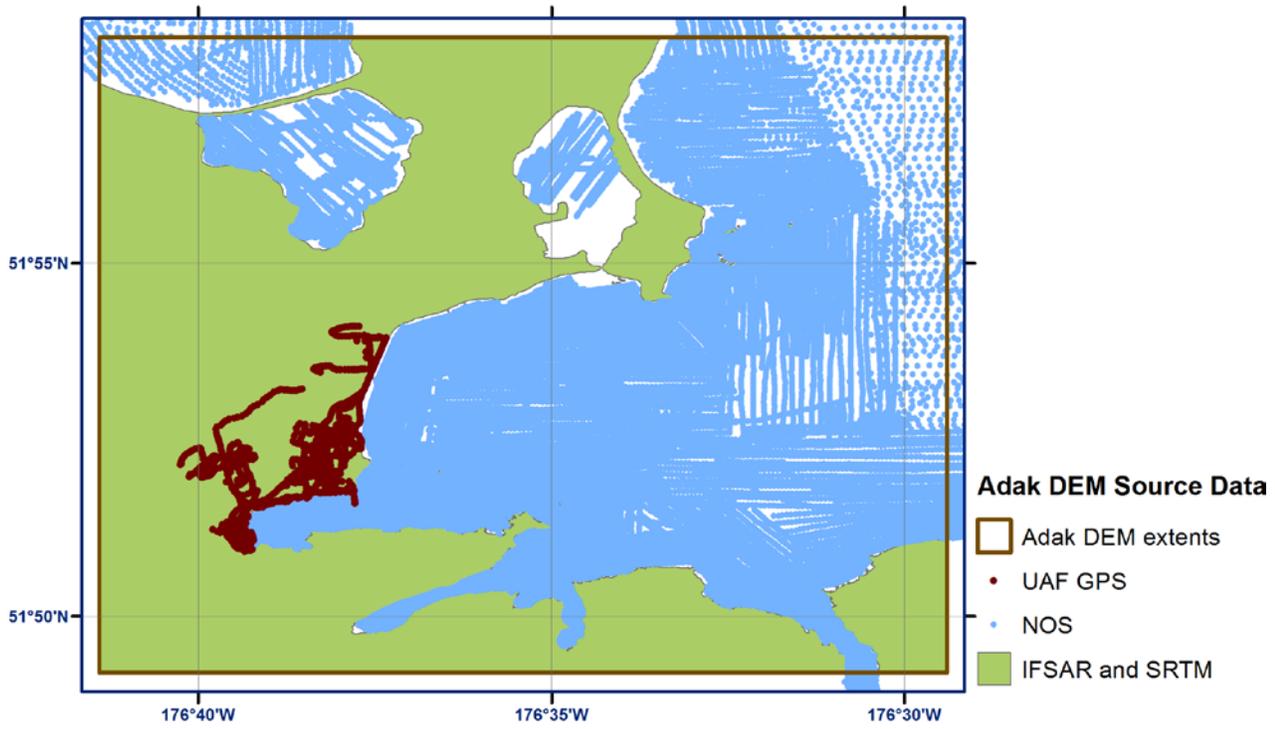


Figure 2. Source and coverage of the datasets used in compiling the Adak DEM.

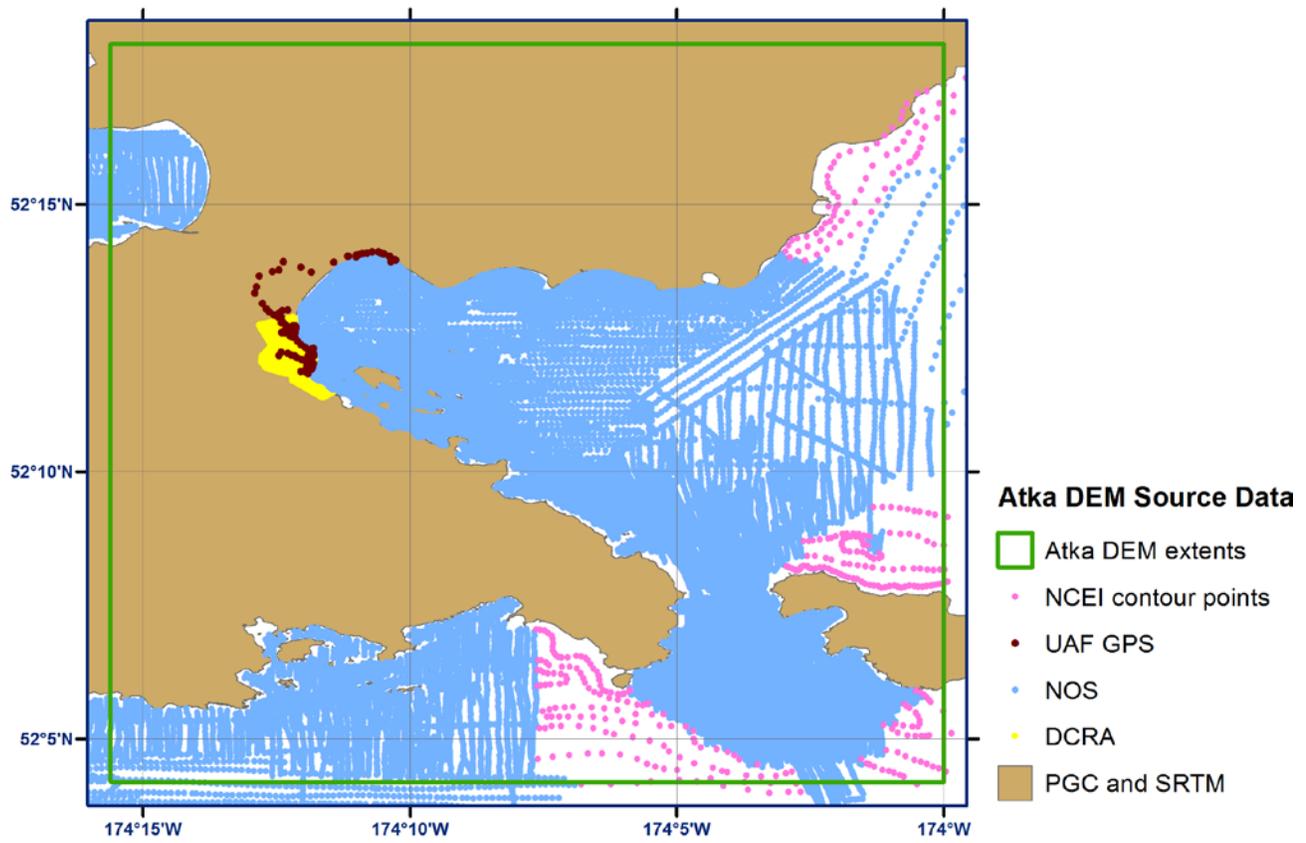


Figure 3. Source and coverage of the datasets used in compiling the Atka DEM.

Table 2 lists the bathymetric data source used in the Adak and Atka DEM. Table 3 lists the NOS surveys used in the surface that are located within the new DEM boundaries. The NOS hydrographic survey data were extracted from NEXT, NCEI Data Extract System (<http://www.ngdc.noaa.gov/next-web/cart.html>). The NOS survey data were transformed to WGS 84 and MHHW as needed using NOAA tide station #9462955 conversion value (Table 4). Three gaps in NOS hydrographic survey data west of Cape Utalug and northeast of Cape Kudugnak on Atka Island and the northern shore of Amlia Island were filled in with elevation points derived from manually digitized estimated contours (Fig.3). The contours were estimated based on nautical chart #16490, Nazan Bay and Amlia Pass. The points were transformed to a TIN then smoothed using Global Mapper and ArcGIS tools to ensure a smooth transition. A bathymetric pre-surface grid at XXX arc-second was generated and an xyz file of the coastline set to zero elevation. The surface was clipped to the coastline before using as an input in the final grid.

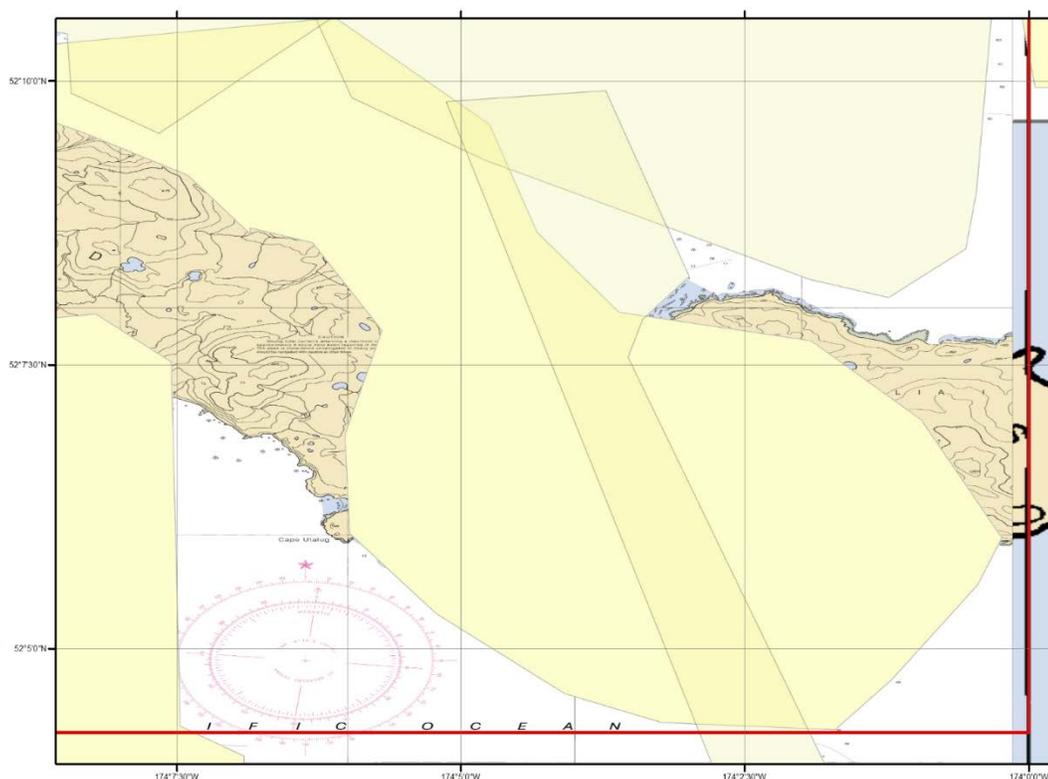


Figure 4. Gaps in NOS hydrographic survey data around Atka Island. Yellow polygons where survey data exist.

Table 2: Bathymetric data sources used in generating the Adak and Atka DEMs.

<i>Source</i>	<i>Date</i>	<i>Data Type</i>	<i>Spatial Resolution</i>	<i>Original Horizontal Datum</i>	<i>Original Vertical Datum</i>
NOAA NOS	1934 to 1988	Hydrographic survey soundings	1 meter to several kilometers	Early Alaska Datum or NAD 1927	Mean Lower Low Water (MLLW)

Table 3: NOS hydrographic surveys used in generating the Adak and Atka DEMs.

<i>Survey ID</i>	<i>Date</i>	<i>Scale</i>	<i>Original Horizontal Datum</i>	<i>Original Vertical Datum</i>
H05643	1934	5000	Early Alaska Datums	Mean Lower Low Water
H05644	1934	20000	Early Alaska Datums	Mean Lower Low Water
H06845	1943	20000	Early Alaska Datums	Mean Lower Low Water
H06851	1943	20000	Early Alaska Datums	Mean Lower Low Water
H06852	1943	10000	Early Alaska Datums	Mean Lower Low Water
H06883	1933	10000	Early Alaska Datums	Mean Lower Low Water
H06884	1933	6000	Early Alaska Datums	Mean Lower Low Water
H06886	1933	6000	Early Alaska Datums	Mean Lower Low Water
H06890	1933	15000	Early Alaska Datums	Mean Lower Low Water
H06892	1934	30000	Early Alaska Datums	Mean Lower Low Water
H06910	1943	10000	Early Alaska Datums	Mean Lower Low Water
H06915	1943	5000	Early Alaska Datums	Mean Lower Low Water
H06916	1943	4800	Early Alaska Datums	Mean Lower Low Water
H06917	1943	10000	Early Alaska Datums	Mean Lower Low Water
H06924	1943	5000	Early Alaska Datums	Mean Lower Low Water
H06971	1943	4800	Early Alaska Datums	Mean Lower Low Water
H07078	1945	10000	Early Alaska Datums	Mean Lower Low Water
H07079	1945	10000	Early Alaska Datums	Mean Lower Low Water
H07084	1945	5000	Early Alaska Datums	Mean Lower Low Water
H07182	1946	20000	Early Alaska Datums	Mean Lower Low Water
H07605	1946	30000	Early Alaska Datums	Mean Lower Low Water
H07825	1951	2500	Early Alaska Datums	Mean Lower Low Water
H07995	1952	100000	Early Alaska Datums	Mean Lower Low Water
H08070	1953	10000	Early Alaska Datums	Mean Lower Low Water
H08145	1954	20000	Early Alaska Datums	Mean Lower Low Water
H08147	1954	10000	Early Alaska Datums	Mean Lower Low Water
H08236	1955	20000	Early Alaska Datums	Mean Lower Low Water
H08240	1955	25000	Early Alaska Datums	Mean Lower Low Water
H08454	1958	480	Early Alaska Datums	Mean Lower Low Water
H08475	1958	20000	North American Datum 1927	Mean Lower Low Water
H08476	1959	10000	North American Datum 1927	Mean Lower Low Water
H10282	1988	5000	North American Datum 1927	Mean Lower Low Water

Table 4: Relationship between MHHW and other vertical datums in the Adak and Atka region (meters).

<i>Vertical Datum</i>	<i>Adak Island, Sweeper Cove #9461380</i>	<i>Atka, Nazan Bay #9461710</i>
MHHW	1.131	1.031
MHW	1.055	0.967
MSL	0.649	0.592
MTL	0.613	0.562
MLW	0.172	0.157
MLLW	0.0	0.0

Topographic data used in developing the Adak and Atka DEM are listed in Table 5. Three topographic datasets were used for the Atka DEM, the DCRA DTM data, the PGC DSM, and SRTM 1 v3. The DCRA data were transformed to WGS84 and the elevation values were converted to meters with FME. The vertical datum was converted using VDatum to change from Geoid 99 to Geoid 12A then from Geoid 12A to MHHW by subtracting 0.7655 m based on a conversion value from the Alaska Tidal Portal. The PGC Arctic DSM was mosaicked and transformed to WGS84 in ArcGIS. The elevation values for the DSM were then converted first from the ellipsoid to orthometric NAVD88 Geoid 12A by subtracting 8.189 m based on the average differences in elevation at NGS monuments. The elevation value was then converted to MHHW by subtracting 0.766 m to (AK Portal). The Arctic DSM was further clipped to the coastline to remove errors in water and small errors in the data were edited manually.

For the Adak DEM, IfSAR and the SRTM v.3 were used. Using VDatum, the IfSAR data were converted from NAVD 88 Geoid 99 to NAVD 88 Geoid 12A. Then from Geoid12A to MHHW by subtracting 0.8332 m from the Alaska Tidal Portal.

Once the conversion for all the topographic data were complete, the MHHW versions of the data files were compared to UAF's GPS data to assess accuracy. For both DEMs, the SRTM 1 second version 3 data were used to fill in any gaps or voids in the Arctic DSM and the IfSAR.

Table 5: Topographic data sources used in compiling the Adak and Atka DEM.

<i>Source</i>	<i>Date</i>	<i>Data Type</i>	<i>Spatial Resolution</i>	<i>Horizontal Datum</i>	<i>Vertical Datum</i>
SRTM 1 v.3	2001	Topographic DEM	1 arc-second	WGS 84 geographic	WGS84/EGM96 Geoid
PGC Arctic DSM	2016	Optically Derived DSM	5 meters	WGS 1984 NSIDC Sea Ice Polar Stereographic North	WGS84 Ellipsoid
UAF		GPS points	varies	WGS 84 geographic	MHHW
GINA/USGS	2000	IfSAR DSM	5 meters	WGS 84 UTM Zone 1 North	NAVD 88 Geoid 99
DCRA	2006	DTM points	2 foot contour interval	NAD 83 AK State Plane Zone 10 FIPS 5007 (feet)	NAVD 88

DEM Development

Development of the Adak and Atka DEM followed procedures documented in NGDC Technical Report of Kodiak, Alaska (Carignan et al., 2013). Gridding weight was modified to Table 6.

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

<i>Dataset</i>	<i>Relative Gridding Weight</i>
UAF GPS	1000
NOS hydrographic surveys	10
IfSAR	1
Bathymetric pre-surface	1
Coastline	1
SRTM 1 Ver.3	.1

Table 7: Data hierarchy used to assign gridding weight in MB-System for Atka DEM.

<i>Dataset</i>	<i>Relative Gridding Weight</i>
UAF GPS	1000
DCRA DTM points	100
NOS hydrographic surveys	10
PGC Arctic DSM	10
Bathymetric pre-surface	1
Coastline	1
SRTM 1 Ver.3	.1

DEM Analysis

The completed 8/15 arc-second Adak and Atka DEM were compared to nautical charts, topographic maps, and high resolution imagery. Inconsistencies were evaluated and resolved based on most reliable data available.

Acknowledgement

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VDatum Version 3.6. NOAA National Ocean Service (NOS), National Geodetic Survey (NGS), Office of Coast Survey (OCS), and Center for Operational Oceanographic Products and Services (CO-OPS). <https://vdatum.noaa.gov/welcome.html>.