ALASKA COASTAL PROFILE TOOL (ACPT)

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Digital Data Series 7 v.2

DGGS staff collecting coastal profile in Tununak, Alaska, on September 13, 2022.

2025
STATE OF ALASKA
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF GEOLOGICAL & GEOPHYSICAL SURVEYS

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Suggested citation:
Horen, K.C., Nieminski, N.M., and DGGS Staff, 2025, Alaska Coastal Profile Tool (ACPT): Alaska Division of Geological & Geophysical Surveys Digital Data Series 7 v.2, 3 p. https://doi.org/10.14509/31747

ALASKA COASTAL PROFILE TOOL (ACPT)

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INTRODUCTION

The Alaska coastal profile database, developed in collaboration with the Alaska Ocean Observing System, serves as a tool for integrating shoreface elevation measurements collected by various stakeholders since the 1960s, many of which are unpublished or inaccessible. Since May 30, 1975, Alaska Division of Geological & Geophysical Surveys (DGGS) staff and others have compiled statewide elevation profiles to preserve historical coastal data, establish a centralized repository for future datasets, and support consistent, accurate, and repeatable observations along existing profiles. These shore-normal measurements are especially valuable when sites are revisited seasonally or interannually, helping to document change and assess vulnerability in Alaska's dynamic coastal environments. The database accommodates diverse data collection methods, including differential leveling, survey-grade global positioning system (GPS), and digital elevation model extraction. It incorporates contributions from community-led efforts and state, federal, and academic partners. For this version 2 release, DGGS integrated previously stored data with post-update acquisitions and reprocessed the data to improve the reliability of comparative analyses and the precision of future datasets. The database will be updated as new data become available, ensuring that derived products evolve. Its open-access design encourages broad participation in community-based coastal monitoring and fosters a deeper understanding of shoreline change across the state. This data collection is released as a Digital Data Series product with an open end-user license. Data are available to view on the DGGS website at https://doi.org/10.14509/31747.

DATA PRODUCTS

- Methods report
- Profile Points feature class
- Profile Lines feature class
- Profiles feature class

METHODS

This database was initiated in 2014 with coastal elevation profiles compiled from various original, published and unpublished measurements in the Alaska coastal zone. DGGS field measurements are collected with a survey-grade Differential Global Positioning System (DGPS), and either post-processed against a static base station or positions are calculated with real-time kinematic (RTK) methods in conjunction with a published or known control point. Data derived from digital elevation model (DEM) surfaces have been extracted along established profile locations at 1 m intervals in ArcGIS. Additional field information for the survey data was manually added to the dataset in ArcGIS. All positional information has been transformed into the WGS84 horizontal datum for interactive, online mapping applications. All data sets are visually checked for qualitative positional consistency.

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In cooperation with the Alaska Ocean Observing System (AOOS), DGGS designed a universal repository to house these coastal measurements. The database is paired with an interactive map interface that enables easy access to existing profile locations. The database was designed to accommodate data sets collected with differing techniques, including differential leveling, survey-grade GPS, or extraction from digital elevation models. The readily accessible nature of this database is intended to promote partner and local involvement in community-based coastal monitoring, and we anticipate it will be updated periodically as additional data become available.

For this 2025 update, DGGS gathered data from the existing database and data collected after the most recent update and reprocessed these data to improve the accuracy of comparisons and the quality of future acquisitions. Observations were organized by collocation, meaning all measurements associated with a given individual profile were grouped across time. For each profile, DGGS calculated the centroid (the mean coordinate of all observations) and applied principal component analysis (PCA) to determine the data's primary axis. We normalized the coordinates of each observation relative to the profile centroid and constructed a two-dimensional, symmetric covariance matrix to describe their distribution. Eigendecomposition of this matrix yielded eigenvectors (major and minor axes of the distribution) and eigenvalues (variance magnitudes along each axis). DGGS then identified the observations farthest from the centroid, and—because profile observations are numbered monotonically during collection and pre-processing—we designated the observation with the smaller index as the profile origin, establishing the direction of increase along the primary axis. Finally, we calculated linear distances for each observation relative to this axis and the start and end coordinates of the computed profile. Including the computed profile provides both a reconciliation with past data collected with lower precision and a means to improve the precision of future collections by establishing defined profiles for them.

DISCUSSION

The accuracy of observations may vary by collection method and/or source. DGGS staff performed visual qualitative assessments of all data to ensure reasonableness and, where possible, quantitative comparisons. Horizontal and vertical accuracy are included as attributes of individual points in the Profile Points feature class.

Horizontal accuracy

Horizontal point location accuracy is highly dependent on the data-collection method. For DGPS data, horizontal accuracies are reported as the Root Mean Square (RMS) error of the post-processed positions (typically less than 10cm). For DEM-derived profile elevation data, the horizontal positional accuracy depends on the point data's ground spacing. For elevation profiles obtained with various types of differential leveling techniques, the geographic accuracy of the entire profile location (approximately 10 cm to 1 km) is much poorer than the relative horizontal accuracy of the individual elevation points along each profile. Every effort has been made to infer appropriate horizontal accuracy for these varying methodologies based on all available information associated with the original data set.

Vertical accuracy

Vertical point location accuracy is highly dependent on the data-collection method. For DGPS data, vertical accuracies are reported as the Root-Mean-Square (RMS) error of the post-processed positions (typically less than 10 cm). For DEM-derived profile elevation data, vertical positional accuracy depends on the reported vertical accuracy of the underlying data source. For elevation profiles obtained with various types of differential leveling techniques, the vertical accuracy of the entire profile location (approximately 10 cm to 1 m) is much poorer than the relative horizontal accuracy of the individual elevation points along each profile. Every effort has been made to infer appropriate vertical accuracies for these varying methodologies based on all available information associated with the original data set.

Data Consistency and Completeness

Gaps in profile data occur when DGPS points fail to be post-processed. This is generally due to receiver malfunctions or fewer observed satellites. When viewing profile elevation data, these gaps typically appear as unsampled sections. Older data, especially DGPS acquisitions, are generally less precise in adherence to individual profile geometry because these surveys were typically performed without the aid of defined profile transects to "stake out." Newer data (typically post-2020) are more consistent with the profile geometry to which they are related. However, moderate imprecision remains possible, even with the aid of a defined profile transect.

ACKNOWLEDGMENTS

This work was made possible with U.S. Geological Survey, Coastal Marine Hazards Resource Program funding through an Alaska Climate Adaptation Science Center funding opportunity. The views and conclusions contained in this document are those of the author and should not be interpreted to represent the opinions or policies of the Alaska Division of Geological & Geophysical Surveys, the U.S. Geological Survey, or the U.S. Government. Mention of trade names or commercial products does not constitute endorsement by the Alaska Division of Geological & Geophysical Surveys, the U.S. Geological Survey, or the U.S. Government.