Penetration at radar wavelengths is a function of many factors (moisture, structure, canopy density, land cover type, slope, incidence angle, position in swath, resolution, post processing).

This illustration is often accepted to represent signal penetration into the canopy, but in reality – focusing on the X and P bands, penetration is deeper.
This initial effort (Red & Blue Shapes) in 2010 has a total of ~28 1° X 1° cells

Approximately 157,434 km² (60,785 mi²) = 8.5% of Alaska

<5% voids in the data required data acquisition from 5 different look directions.

Average Vendor Price = $34.73/km² / .39 mi²

The data was collected in WGS84 (GPS constellation for navigation). Output products have NAD83 (Vertical) & NAVD88 (Horizontal) datum applied using GEOID09
Intermap maximizes data collection by using Ultra-Long lines (ULL) which can be in excess of 700 km = greater data collection per sortie.

The STAR system is able to adjust its antennae angle while on-line to compensate for drift (from track) caused by winds aloft.
# Alaska Data Products

<table>
<thead>
<tr>
<th>Product</th>
<th>Brief Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>DSM</td>
<td>High Resolution DSM with 5 m posts, Alaska Albers 15’ X 15’ tiles</td>
</tr>
<tr>
<td>DTM</td>
<td>High Resolution DTM with 5 m posts, Alaska Albers 15’ X 15’ tiles</td>
</tr>
<tr>
<td>ORI</td>
<td>Contrast-stretched ORI (or similar product) magnitude with 5 m pixels or better, Albers, 15’ X 15’</td>
</tr>
<tr>
<td>Metadata</td>
<td>FCDC-compliant metadata files and swath locator diagram</td>
</tr>
<tr>
<td>Quarter Cells</td>
<td>Resampled edge-matched bare earth quarter cells (30’ by 30’) in geographic projection at 0.4 arc/second X 0.8 arc/second post spacing in HRTe3 format.</td>
</tr>
<tr>
<td>Void Mask</td>
<td>Void mask and a list of ancillary sources to fill voids shall be generated for each surface and resolution</td>
</tr>
<tr>
<td>Slope Mask</td>
<td>Slope mask to define accuracy categories and edit criteria</td>
</tr>
<tr>
<td>Reports</td>
<td>Monthly progress reports; Certified USO 9001 data-quality report information</td>
</tr>
</tbody>
</table>
Alaska Cell #:11

Area of slopes < $10^\circ$: 3468km$^2$ (62%)

Area of slopes $10^\circ$ - $20^\circ$: 1562km$^2$ (28%)

Area of slopes > $20^\circ$: 441km$^2$ (8%)
Percentage of Void Data

Alaska Cell #:11

- Total land area of 5551 km²
- 1.28% Void (71.58 km² of the cell area is decorrelated)
- None of the 15’ tiles exceed a decorrelation value of 5%
- Majority of decorrelation corresponds to the mountain range in this block
The vertical accuracy of the DTM is 0.63m RMSE or 1.04m LE90%.

ICESat typically has a 25 cm RMSE (<5cm mean) in bare ground unobstructed areas.

<table>
<thead>
<tr>
<th>Number of VCPs</th>
<th>DSM</th>
<th>DTM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>0.14</td>
<td>0.05</td>
</tr>
<tr>
<td>Max +</td>
<td>1.62</td>
<td>1.58</td>
</tr>
<tr>
<td>Max -</td>
<td>-1.58</td>
<td>-2.10</td>
</tr>
<tr>
<td>Std dev</td>
<td>0.61</td>
<td>0.63</td>
</tr>
<tr>
<td>RMSE</td>
<td>0.62</td>
<td>0.63</td>
</tr>
<tr>
<td>90 Percentile</td>
<td>1.05</td>
<td>1.04</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Slope (degrees)</th>
<th>Alaska Accuracy Requirement 90% Confidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-10</td>
<td>3m</td>
</tr>
<tr>
<td>10-20</td>
<td>6m</td>
</tr>
<tr>
<td>20-30</td>
<td>9m</td>
</tr>
<tr>
<td>30+</td>
<td>12m</td>
</tr>
</tbody>
</table>
Data Processing is 3D

- IES allows for fully **interactive** 3D editing of DEMs
- **Multiple ancillary** data sources can be loaded and manipulated simultaneously

Left Monitor (Stereo)
Pilot Cell #11

64 Tiles in one 1° X 1° cell, plus 36 surrounding tiles for a total of 100 tiles.

Some of the tiles are partial on the west side.
Although not required by contract, Intermap applied the same editing rules to this project as we applied to the lower 48 (😊).

Every posting receives a classification: **Water**, **Transportation** or **Terrain** (Terrain is classified in three groups to assist the edit tools: **Bald**, **NotBald** or **PreFITs**).

- All Water meeting core specifications will be classified and flattened.
- Airports are flattened and classified as Transportation.
- Drainage features are hydro enforced (Hydro-enforcement was applied to the DTM5s and DSMs, but not required as part of the project).
- Obstructed areas (e.g. vegetation) are rebuilt using SSE & ancillary data.
- Embankments are maintained.

Tile edges are tied to all surrounding tiles

Quality control and error checking are critical
Key 1: Terrain Classification

Isolated Vegetation classified as **NotBald**

Bare ground classified as **Bald**

Large areas of obstruction classified as **PreFITS**

The editors have special draw tools that allow them to manipulate, change or create mask areas according to the terrain so that the best possible edit is run for each area.
Key 2: Breaklines
Key 3: Editing Rule sets: Water Edit Example

Removing Radar Artifacts in the DSM

- Water is flattened
  - Rivers are stepped in 10cm steps
- Radar blunders are removed

Before Editing

After Editing
Areas of Obstruction are removed in the DTM

**DSM to DTM**
- A DTM is created by removing vegetation and man-made constructs
- A variety of techniques can be used
  - Interpolation
  - DEM substitution and correction

Completed DSM

Completed DTM
Editing Single Line Drain (SLD)

The contours show where the SLD is flowing in the unedited DTM.

A breakline must be added so that the contours follow the actual path of the SLD.
Single Line Drain (SLD) becomes a breakline

The actual SLD path is determined by checking the ORI
Edited path of SLD

Adding a breakline has corrected the path of the SLD

The contours now follow the actual path of the drain
Handling Obstructed and Void Areas

The acquisition plan is designed to minimize the percent of void data in the output product.

We have a fully integrated terrain solution (FITS) that can utilize modified DSM data or ancillary data to fill in voids and to help recalculate the terrain surface beneath vegetation canopies.

e.g. Before the “Void Infill” process has been automatically run, void areas have an interpolated appearance.
Terrain Solution

- We use a modified version of our multiple DSM passes or ancillary data to rebuild the DTM in areas of void and obstruction.

- We will use available ancillary data as a last resort.

- **e.g. After** the “Void Infill” process has been automatically run, the ancillary DEM has a more natural appearance.
Before Smoothing

Transition area between classifications

Small bumps

Grid-Like pattern is an Ancillary data artifact
After Smoothing

All small artifacts have been removed by smoothing!!
ORI Example – 62.5 cm pixels & 5 m DSM/DTM
ORI Example – 62.5 cm pixels & 5 m DSM/DTM
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Questions?

Ltighe@intermap.com

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Intermap Data Collection