ALASKA: HOW AMERICA’S LAST FRONTIER WAS MAPPED WITH IFSAR

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ABSTRACT

In over 50 years of statehood, Alaska was never mapped to National Map Accuracy Standards (NMAS) at any scale. When the U.S. Geological Survey (USGS) produced 1:63,360 scale (1” = 1 mile) topo quadrangles in the 1960s, the marginalia did not include their normal reference to the NMAS because USGS had almost no survey control, GPS and analytical block triangulation hadn’t been invented yet, and cloud-free aerial photography was not available. The National Elevation Dataset (NED) mapped some mountains a mile or more in the wrong place, and NED DEMs weren’t accurate enough for orthorectification of imagery. In 2008, Dewberry prepared the *Alaska DEM Whitepaper* that recommended aerial IFSAR for creating the DEM foundational layer needed for production of digital orthophotos, update of the hydrography, transportation and other layers. When USGS’ 3D Elevation Program (3DEP) was formed, Alaska became the 3DEP’s highest priority. Aerial IFSAR acquisition began in 2010 and will be completed in 2019-20. This paper describes the various technical and budgetary challenges encountered and overcome leading to what is widely considered today to be a major success story. This paper will also include a review of two climbing expeditions by the Dewberry team to the peak of Denali, America’s highest mountain, to accurately survey its elevation with GPS and to measure the depth of ice and snow at the peak with ground penetrating radar (GPR). The IFSAR mapping program was a successful collaboration between the State of Alaska, USGS, other federal agencies and the Dewberry team that included Intermap Technologies, Inc., Fugro EarthData Inc., JOA Surveys, LLC, and CompassData, Inc. Together, we are proudly mapping America’s Last Frontier.

KEYWORDS: Alaska, IFSAR, NED, 3DEP, GPS, GPR

INTRODUCTION

Since becoming a State in 1959, Alaska was never mapped to NMAS standards at any scale and remains the only state that has never had statewide orthoimagery produced to ASPRS accuracy standards. USGS had produced topo quadrangle maps of Alaska, but they were not the 7.5-minute quads produced elsewhere in the U.S. at a scale of 1:24,000. Instead, Alaska’s quad maps were produced at a scale of 1:63,360 (1” = 1 mile) and the legend did not say these maps were produced to National Map Accuracy Standards. Why? … Because they had been produced in the 1950s and 1960s without the benefit of photo-identifiable survey ground control, prior to the invention of GPS technology, and prior to the invention of stereo photogrammetric block triangulation. It would be decades before the invention of airborne GPS and IMU technology required for direct-georeferencing, commonly used today.

At the Alaska Surveying and Mapping Conference in 2008, vendors were given the opportunity to provide 10-minute presentations on how they would propose to map Alaska. Ten other firms gave presentations on how they would use their imaging satellites or aerial sensors to map Alaska; but Dewberry used its 10 minutes to emphasize the importance of Digital Elevation Models (DEMs), stating: “Don’t put the cart before the horse. An accurate DEM is foundational to all other layers of The National Map. The DEM layer must come first.”

Having served as the editor and primary author of the 1st and 2nd editions of ASPRS’ *Digital Elevation Model Technologies and Applications: The DEM Users Manua*l, the author emphasized the need to first identify Alaska’s DEM user requirements and applications before determining which DEM technology would be best for satisfying Alaska’s requirements. That DEM Users Manual would become the key to Dewberry’s proposed solution.

THE ALASKA DEM WHITEPAPER

Alaska contracted with Dewberry to prepare what became known as the *Alaska DEM Whitepaper*. Alaska’s mapping challenges were formidable. Alaska covers 10 UTM zones. The entire state has few roads and most villages are served by small airstrips. Small airplanes are not powered to fly over mountains; instead they fly through the valleys where visibility is often very poor, emphasizing the importance of accurate DEMs for flying under Instrument Flight Rules (IFR) rather than Visual Flight Rules (VFR). Alaska has America's tallest mountains and more miles of shoreline than the rest of the U.S. combined. Alaska is heavily impacted by climate and sea level changes, post-glacial rebound, changing gravity and changing elevations. Alaska has America's worst geodetic network and geospatial infrastructure. Furthermore, many areas have persistent cloud cover, fog, smoke or haze that prevents the acquisition of cloud-free aerial imagery from aircraft or satellites. The sheer size and remoteness of Alaska, and all the technical and environmental issues, made it a major challenge to map America's Last Frontier.

Figures 1 and 2 summarize major mapping problems in Alaska. Figure 1 demonstrates the difficulty in trying to produce orthoimagery in Alaska when some mountains in the NED were mapped a mile in the wrong location. Everyone knows that rivers should flow through valleys – not uphill as shown in Figure 1. Furthermore, the NED failed International Civil Aviation Organization (ICAO) and Federal Aviation Administration (FAA) minimum accuracy requirements for commercial overflights. Figure 2 maps the high number of aviation accidents in Alaska between 2001 and 2005; the red dots show aviation accidents that were fatal. Many aviation accidents are attributed to pilot error, but the pilots lacked accurate mapping data. By November of 2008, FAA would be in violation of ICAO Area 1 requirements, and in violation of Area 2 requirements in November of 2010. Commercial flights could be banned unless a corrective plan was in place. Aviation safety was clearly a driving force in Dewberry's recommendation for Alaska statewide mapping with aerial IFSAR. Stakeholders recognized the need to minimize the risks caused by horizontal and vertical errors in the DEM and produce statewide DEMs with accuracies comparable to 20' contours or better statewide.

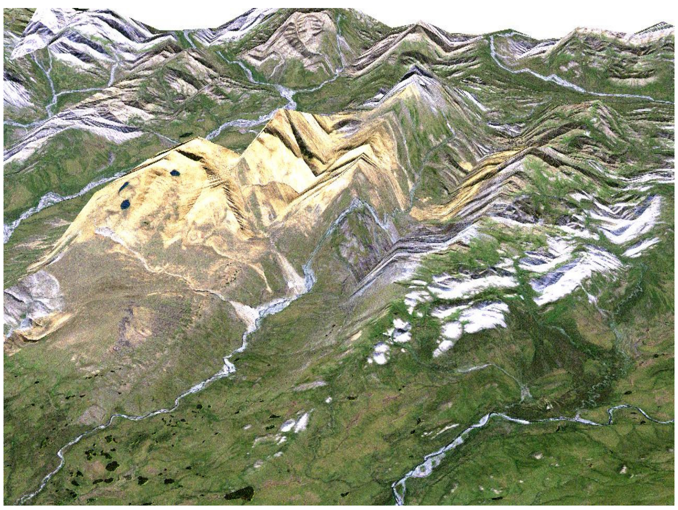


Figure 1. Accurate orthophotos cannot be produced when the NED maps mountains a mile of more in the wrong location

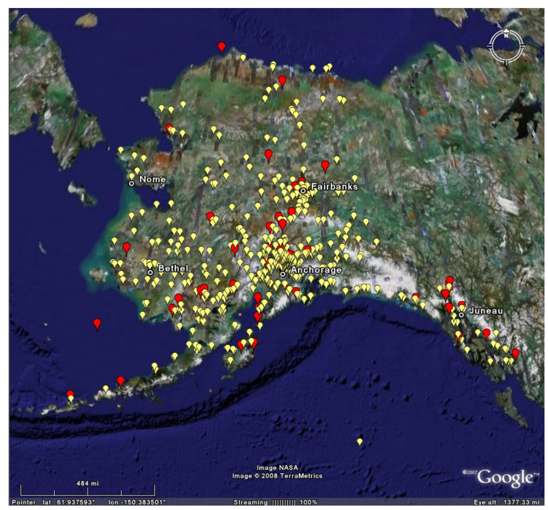


Figure 2. Pilot error contributed to a high aviation accident rate in Alaska between 2001 and 2005

The Alaska DEM Whitepaper documented three major consensus points, agreed to unanimously by all members of the National Digital Elevation Program (NDEP) and National Digital Orthophoto Program (NDOP) which met jointly in Anchorage in September of 2008 and reviewed the draft *Alaska DEM Whitepaper*:

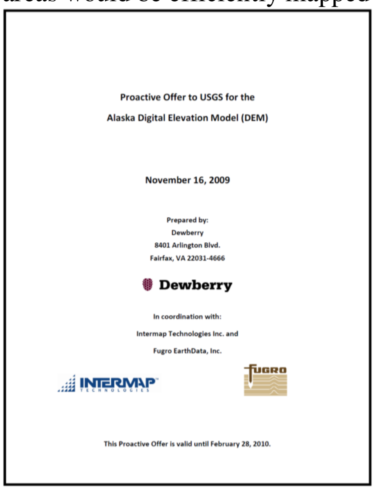
1. There was no time to waste: Alaska would be in violation of ICAO Area 1 requirements by 11/20/2008 and ICAO Area 2 requirements by 11/20/2010. Alaska's mapping needs have been neglected for 50 years; unmet needs in Alaska were dire, especially aviation safety.
2. Decision-makers must remain true to Alaska's requirements: Alaska needed statewide DEMs with 20' contour accuracy or better. Alaska needed both DSMs and DTMs; mountain peaks, ridgelines and hydrology were very important. Alaska needed technology that could map through clouds and overcome adverse weather conditions. Alaska needed cost-effective mapping technologies.
3. Stakeholders must find a timely, cost-effective solution: Only airborne mapping options could satisfy Alaska's technical and accuracy requirements; and only IFSAR could map through clouds. Airborne IFSAR costs are significantly less than aerial LiDAR or photogrammetry. Multiple contracting options are available to obtain the most cost-effective solution for timely delivery of quality products. Both federal and state funding would be required.

FUNDING STRATEGIES AND PLANS

After the *Alaska DEM Whitepaper* was published in September of 2008, members of the Alaska Statewide Digital Mapping Initiative (SDMI) asked USGS to task Dewberry to develop a funding strategy and to manage the statewide IFSAR mapping, using Dewberry's Geospatial Products and Services Contract (GPSC) with USGS.

USGS tasked Dewberry to prepare the *Alaska DEM Funding and Implementation Plan* that Dewberry delivered in May of 2009; it documented potential funding partners, but at that time, required funding was still unknown.

In September of 2009, Dewberry met with Fugro EarthData and Intermap Technologies to develop a plan for mapping Alaska as cost-effectively as possible with aerial IFSAR. In November of 2009, Dewberry submitted an unsolicited proposal to USGS (Figure 3) based on an Area of Responsibility (AOR) proposal from Fugro that it map the 23% of the state that is most difficult (pink in Figure 4) with its GeoSAR system that utilizes P-band and X-band IFSAR and a LiDAR Profiler, with Intermap mapping the less-difficult 77% of the state (green in Figure 4) with its X-band IFSAR STAR system. The combined statewide total cost estimate was $77.3M, assuming large, contiguous areas would be efficiently mapped in two years.


Proactive Offer to USGS for the
Alaska Digital Elevation Model (DEM)

November 16, 2009

Prepared by:
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Dewberry

In coordination with:
Intermap Technologies Inc. and
Fugro EarthData, Inc.

This Proactive Offer is valid until February 28, 2010.

Figure 3. The Dewberry Team's cost estimate was for $77.3M statewide

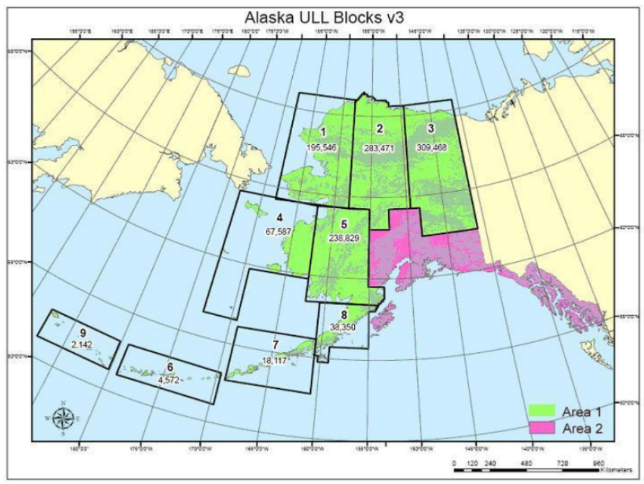

Figure 4. Fugro would map the most difficult 23% of the state (pink) and Intermap would map the less difficult 77% of the state (green)

Table 1. Comparison of Fugro and Intermap Advantages and Disadvantages

	Advantages	Disadvantages
Fugro	• GeoSAR system collects data to the left and right as it flies; greater efficiency • X-band considered best for DSMs and P-band considered best for DTMs in heavily-forested terrain • LiDAR profiler expected to reduce need for ground control in remote, inaccessible areas.	• Little experience in large-scale production of IFSAR DSMs, DTMs, Ortho-rectified Radar Images (ORIs) • P-band interferes with communications; illegal for large-scale use in lower 49 states • No standard GeoSAR DEM products or SOP for producing them • Reliance on LiDAR profiler could be problematic where areas are cloudy or foggy
Intermap	• Three IFSAR aircraft in 2009 • Mature production process and Product Handbook for standard hydro-enforced DTMs and DSMs • Standard ORIs, DSMs and DTMs met or exceeded USGS' requirements for a mid-accuracy DEM • Confident it could mass-produce standard IFSAR products in Alaska as it had already done for NEXTMap®USA, NEXTMap®Europe, NEXTMap®Britain	• STAR system based on X-band IFSAR only, designed for mapping DSMs but with proven algorithms for producing DTMs that would meet accuracy specifications in terrain that was not too steep or heavily forested. • STAR system maps to only one side of the aircraft, requiring more flight lines • Most of Intermap's interferometric data processing and product generation would need to be performed overseas (Indonesia) by their experienced IFSAR processing team, requiring official DOI approval

INITIAL IFSAR TASK ORDER

Dewberry received its first IFSAR task order from USGS in January of 2010. The task order specified ORIs with ≤5-meter pixels; 1:24,000-scale horizontal accuracy; DSMs and DTMs with 5-meter posts; 20’ contour accuracy DTM vertical accuracy (LE90 ≤ 3m for 0-10° slopes, larger for steeper terrain); hydro enforcement to meet or exceed USGS specifications; independent accuracy testing; Alaska Albers projection; resampled 30’ x 30’ quarter cells (4 per 1-degree cell); 15’ x 15’ tiles (16 tiles per 1-degree cell); a second HRTe3 format for NGA; FGDC compliant metadata (3 formats); and ellipsoid heights in addition to orthometric heights NAVD88.

The SDMI had prioritized 38 1-degree cells and wanted to maximize the number of cells mapped with (unspecified) funds available. The cells straddled the Fugro/Intermap assigned Areas of Responsibility shown in Figure 4. This request started intense competition between Fugro and Intermap – both wanting to map all funded cells themselves. Furthermore, the $1M in ARRA funding could not be used for Intermap labor in Indonesia; ARRA funds could only be spent on American labor to stimulate the U.S. labor market.

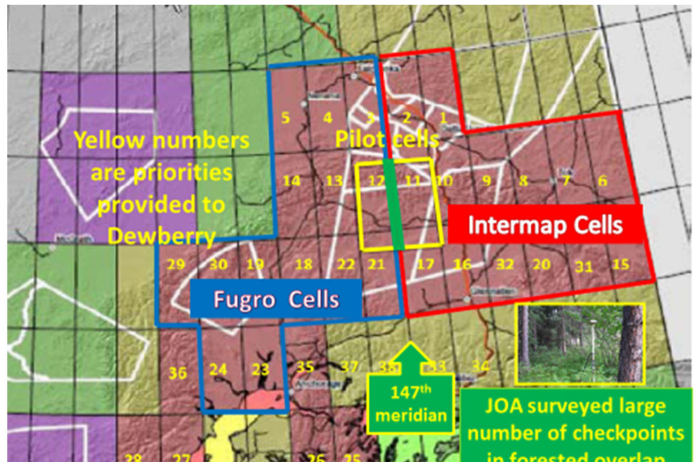

Figure 5. Initial task order in which 28 of 38 prioritized 1-degree cells were funded, allowing direct comparison of Fugro and Intermap data in overlap area along the 147th meridian.

Originally, Intermap’s cost proposals were much lower than Fugro’s, regardless of the number of cells mapped. Not knowing the funds available, Dewberry went through dozens of pricing alternatives and three best and final offers from Intermap and Fugro, for different numbers of cells each, before determining (with USGS) that a total of 28 cells could be mapped with the funds available, i.e., 14 by Fugro (blue outline in Figure 5) and 14 by Intermap (red outline in Figure 5). Ultimately, by retaining P-band licensing rights that USGS agreed to, Fugro had lowered their pricing significantly.

For this and every subsequent task order, USGS knew to the penny what Dewberry paid Fugro and Intermap, and USGS knew additional costs for JOA’s survey of QA/QC checkpoints and for Dewberry’s management and QA/QC. Cells 11 and 12 (yellow box in Figure 5) were pilot cells, and both firms mapped a 70 km^2 overlap area on both sides of the 147th meridian (wide green bar in Figure 5) so that both firms would map the same terrain for Dewberry and USGS to directly compare the two DTMs in forested areas using checkpoints surveyed by JOA Surveys. Intermap’s data passed accuracy tests easily, but Fugro had difficulties that caused delays while they developed a P-band/X-band hybrid model for DTM production. Numerous other technical issues needed to be resolved between procedures used by Intermap and Fugro:

- Data would be produced to the Alaska Albers projection, then converted to multiple file formats required by USGS and the National Geospatial-Intelligence Agency (NGA)
- Different deliveries by 1-degree and quarter-cell (30’ x 30’)
- Delivery of elevation data in both orthometric heights and ellipsoid heights
- Different ORI resolutions (62.5-cm for Intermap; 2.5-m for Fugro)
- Different hydro mask criteria for double-line streams and lakes when exceeding USGS specs
- Different hydro-enforcement procedures for monotonicity
- Different procedures for data voids, data smoothing, and edge-matching

This task order started the acquisition of additional cells on speculation as Fugro collected 24 cells (4 rows x 6 columns) to efficiently acquire data in a large contiguous, rectangular block rather than the inefficient, odd-shaped area outlined in blue in Figure 5 for funded cells; it would be several years before those “spec cells” would be funded. Because its standard products exceeded the USGS specifications, Intermap delivered ORIs with 62.5-cm pixel resolution (compared with the 5-meter USGS specification); Intermap created hydro masks for double-line streams ≥20 meters wide (compared with the 50-meter USGS specification); and Intermap created hydro masks for lakes ≥400 m^2 (compared with the 7,500 m^2 USGS specification.). Dewberry started contracting with JOA Surveys to survey QA/QC checkpoints on speculation to have checkpoint 3-D coordinates available when needed because it never knew for sure what areas would be mapped next.

SUBSEQUENT IFSAR TASK ORDERS

Task Orders, 2010 to 2018

Table 2. IFSAR Task Orders and Values

Year	Number	Area (mi^2)	Value		Year	Number	Area (mi^2)	Value
2010	2	60,785	$5,467,645		2015	3	74,634	$7,099,458
2011	1	13,304	$1,235,785		2016	4	80,574	$7,607,357
2012	3	113,851	$9,044,577		2017	4	90,955	$9,326,428
2013	3	77,995	$7,015,032		2018	4	52,652	$7,199,472
2014	4	59,238	$6,671,272		TOTALS	28	623,988	$60,667,026

As of the end of 2018, the Dewberry team has acquired the Alaska mainland and Eastern Aleutians. Fugro had acquired IFSAR data for that portion of the state mapped in blue at Figure 6, and Intermap has acquired IFSAR data for the portion mapped in pink. The remaining area, mapped in brown, will be acquired in 2019 for final deliveries in 2020. Figure 7 shows the 1,044 QA/QC checkpoints surveyed by JOA Surveys throughout the state.

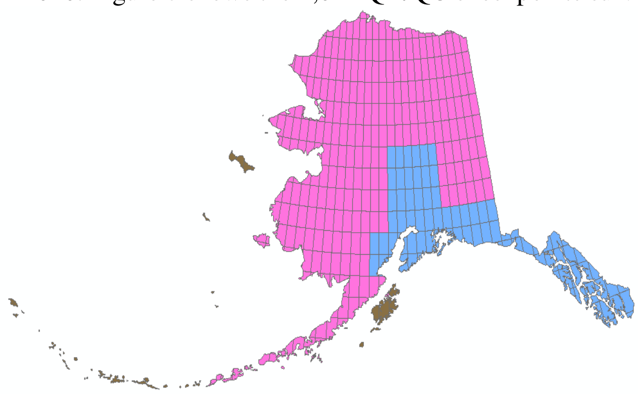

Figure 6. Fugro mapped the area in blue; Intermap mapped the area in pink; and the area in brown remains to be mapped in 2019.

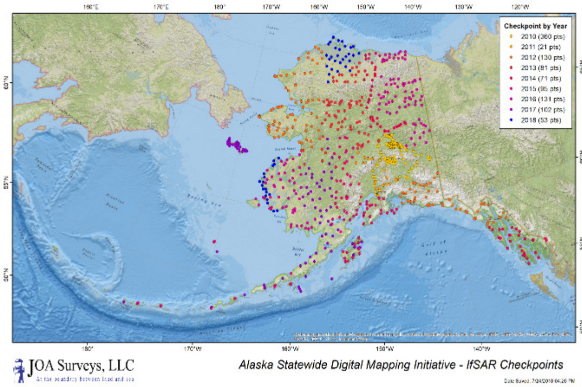

Figure 7. JOA Surveys surveyed 1,044 blind QA/QC checkpoints for Dewberry's absolute accuracy testing of DTMs delivered by Fugro and Intermap.

Speculative Acquisition

Between 2011 and 2018, as funds became available from different stakeholders, Dewberry often received IFSAR task orders with inefficient project areas such as that shown in Figure 8 where funding was available only for the three Copper River cells and the irregular area comprising Glacier Bay National Park. Because acquisition costs would be very high in later years to fill in the gaps and acquire IFSAR data for areas previously unfunded, Fugro ended up acquiring ~71% of its entire AOR on speculation valued at ~$9.2M, and Intermap acquired ~20% of its AOR on speculation valued at ~$7.0M. Dewberry also paid JOA Surveys, on speculation, to survey approximately 50% of its QA/QC checkpoints in advance, not knowing what areas would be funded in the coming year for IFSAR acquisition and data delivery.

In total, Dewberry, Fugro and Intermap risked approximately $17M in speculative funding, not paid for until subsequent years, in order to significantly reduce total costs to stakeholders.

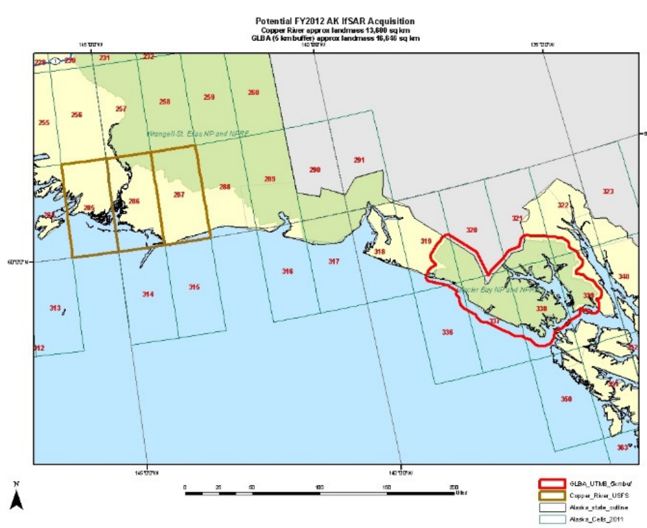

Figure 8. This task order for three Copper River 1-degree cells and the irregularly-shaped Glacier Bay National Park epitomizes the inefficient project areas as funding became available from diverse stakeholders.

IFSAR Advantages Compared with Alternative Technologies

Figures 9 through 14 demonstrate IFSAR advantages in different areas. Figure 13 is especially telling as it demonstrates the major advantage of IFSAR for mapping hydrographic features of critical importance in Alaska.

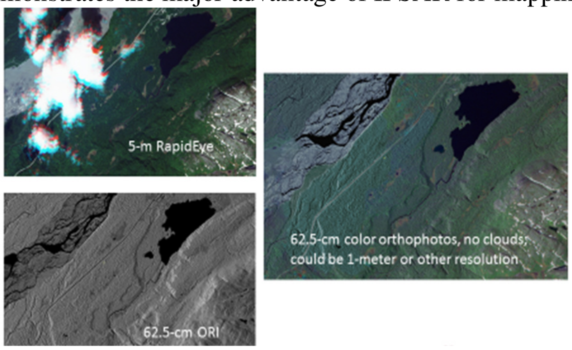

Figure 9. How to map through clouds with hi-resolution IFSAR ORIs and low-resolution satellite imagery.

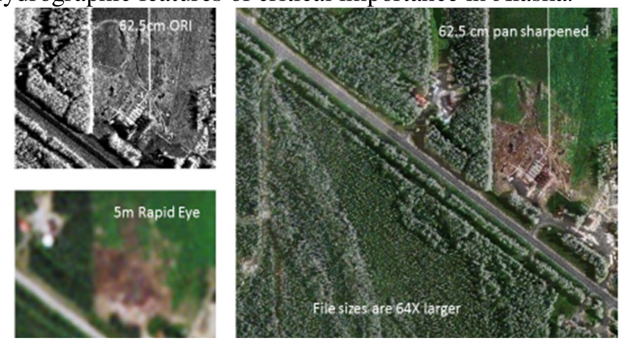

Figure 10. How to pan-sharpen 5-m color satellite imagery with 62.5-cm grey-scale IFSAR ORIs.

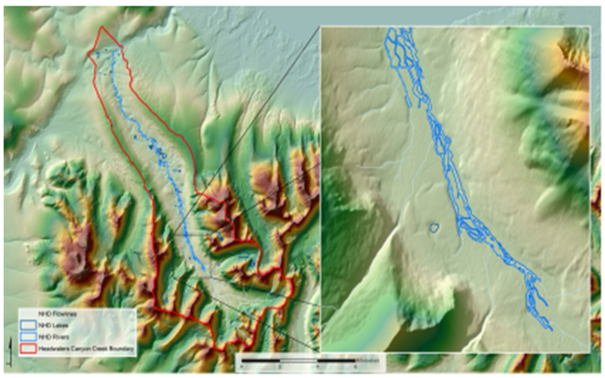

Figure 11. How to use IFSAR data to produce hi-resolution National Hydrography Datasets (NHD+).

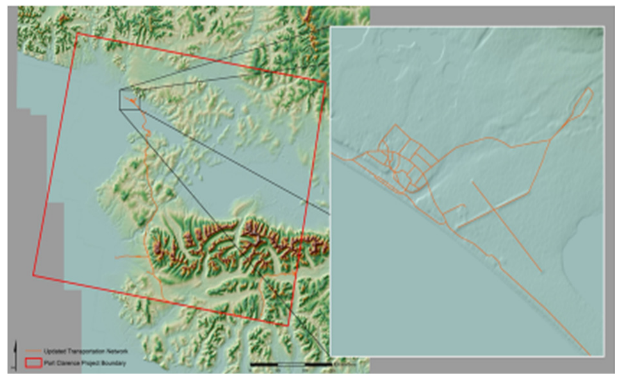

Figure 12. How to use IFSAR to update transportation and other mapping layers.

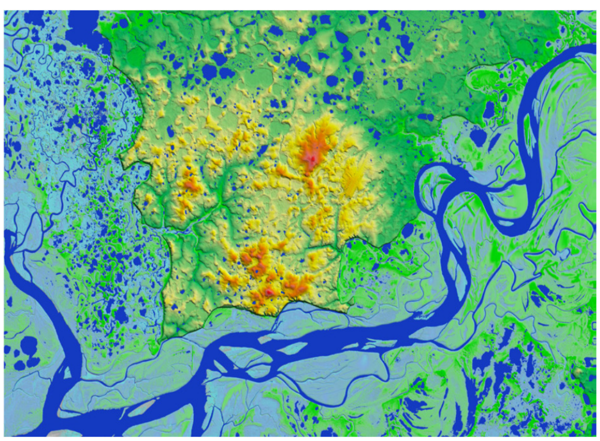

Figure 13. How the 5-m IFSAR DEM is superior to the NED. This is the same area as in Figure 14.

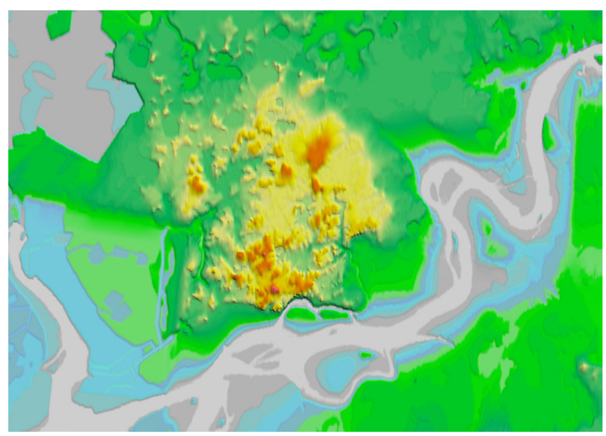

Figure 14. How the 60-m NED DEM is inferior to the IFSAR. This is the same area as in Figure 13.

Table 3. Absolute accuracies compared with LE90 standard of 3 meters for slopes of 0-10 degrees

Absolute Accuracies Tested	Fugro (more-difficult areas)	Intermap (less-difficult areas)
RMSEz	1.66 m	0.55 m
LE90 at 90% confidence level	2.73 m	0.89 m
ACCz at 95% confidence level	3.25 m	1.06 m

IFSAR Disadvantages Compared with Alternative Technologies

Aerial IFSAR delivers mid-accuracy DEMs, identified as Quality Level 5 (QL5) in USGS' 3D Elevation Program (3DEP), and compared with high-accuracy QL0, QL1 or QL2 LiDAR in the 3DEP. However, IFSAR is the only technology that maps through clouds, and it is significantly less costly than LiDAR which can be extremely expensive in remote areas with persistent clouds, fog or haze.

Recognizing that synthetic aperture radar (SAR) is potentially impacted by "layover," Fugro and Intermap both specify lower confidence in elevations on sloped terrain steeper than 20°. Layover occurs when the slope of the terrain is greater than the angle the incident radiation makes with respect to the vertical, as is the case for the nearly 80° slope near the peak of Denali (formerly Mt. McKinley). When the IFSAR elevation for the peak of Denali was significantly lower than expected, Dewberry first draped a satellite image on top of the IFSAR DSM (Figure 15) and compared it with a fly-by photograph of Denali (Figure 16); when no obvious discrepancy could be observed, Dewberry decided it needed to mount GPS and ground penetrating radar (GPR) expeditions of Denali, executed in 2015 and 2016 by two different 4-person teams, each headed by Blaine Horner.

Figure 15. Satellite image draped over IFSAR DSM.

Figure 16. Fly-by photo of Denali peak

Figure 17. Blaine Horner (left) led a Denali GPS expedition in 2015 and a Denali GPR expedition in 2016

Figure 18. Blaine's team twice carried 750 pounds of equipment from this base camp (7,000') up to the peak

Figure 19. Denali's 2015 GPS elevation = 20,310'

Figure 20. Denali's 2016 GPR ice/snow depth = 6.1 m

FUNDING

The total cost to date for mapping the easier 98% of Alaska on the mainland and eastern Aleutians is $60.667M. The remaining 2% (by area) will be much more costly per square mile because it includes Kodiak Island plus the Western Aleutians and other remote islands where it is very expensive to install IFSAR prism reflectors using ship-based helicopters. Although multiple alternative technologies are currently being analyzed by Dewberry and USGS, it is expected that all remaining islands can be mapped in 2019-2020 for approximately $4.594M, bringing the total cost for statewide IFSAR mapping to $65.261M, a major cost saving compared with Dewberry's 2009 cost estimate of $77.3M. Dewberry, Fugro and Intermap took exceptional steps to reduce costs while investing ~$17M to acquire large, efficient areas on speculation when stakeholder funding was available only for small, inefficient areas.

Ultimately, however, it was the diverse group of stakeholders, led by USGS, which paid for the IFSAR mapping of Alaska. Table 4 compares land ownership percentages in Alaska, and percent of funding to date by various stakeholders.

Table 4. IFSAR Mapping Partnership Contributions

Land Ownership	Percent of Land Owned	Percent of IFSAR Funding
State of Alaska	24.1%	21.44%
Bureau of Land Management	22.1%	5.25%
Fish & Wildlife Service	21.1%	1.53%
National Park Service	14.1%	4.90%
Alaska Native Corporations	10.5%	0.00%
U.S. Forest Service	6.0%	2.87%
Other Private	1.6%	0.00%
Department of Defense	0.5%	3.86%
U.S. Geological Survey	0.0%	54.20%
Natural Resources Conservation Service	0.0%	5.95%
TOTALS	100.0%	100.00%

PUBLIC VALUE

When asked to write a paragraph regarding the value of the Alaska IFSAR mapping program, Kevin T. Gallagher, USGS Associate Director, Core Science Systems, was gracious in providing a detailed explanation of the value to the public:

"Elevation is a basic control in nature. The shape and features of the land control water and form watersheds, create distinct ecosystems, regulate temperature and climate and influence natural resources. In a modern world, elevation impacts almost every aspect of contemporary society, include civil engineering, infrastructure development, aviation safety, agriculture, natural hazards, transportation, and flood prediction, to name a few.

"For years Alaska has been known as the "Last Frontier." Cold winters, difficult terrain, unpredictable weather conditions, and continuous cloud cover have made mapping a significant challenge and contributed to a situation in which, mapping in the State significantly lagged the rest of the Country. In 2008 efforts began, through the Alaska Statewide Digital Mapping Initiative, and subsequently, the Alaska Mapping Executive Committee, to map the State using modern methods.

"Recognizing that Alaska represents a treasure of natural resources, a home to metropolitan, rural and indigenous communities and essential national infrastructure (such as the Alaska pipeline), momentum gathered around a major effort to create a detailed elevation map for the State. In addition to the abundance of natural resources and beauty, it was recognized that Alaska was changing rapidly. Energy and mineral development, shoreline erosion, glacial retreat, and permafrost melt were among the recognized trends. Other important issues such as resource management, aviation safety, forestry, and disaster preparedness were also recognized.

"A partnership formed between the State, the Federal Government and Industry to tackle the job of mapping. From 2010-2018 this productive partnership (still ongoing) has successfully mapped 98% of the State using interferometric synthetic aperture radar (IFSAR), resulting in the production of Digital Surface Models, Digital Terrain Models and Orthorectified Radar Images that together address the critical mapping needs of all parties. These needs include flood modeling, flight safety, precision forestry, landslide modeling, critical minerals assessments, natural resource assessments, and transportation and infrastructure development. And while the data that has been collected has significant value today, it will be even more valuable 20, 30 or 50 years from now as it will provide a baseline for which changes can be measured. For example, changes in shoreline, glacial mass, subsidence and hydrologic regime.

"Perhaps most significantly, this data and information is provided to the world, license-free, in the public domain, for its use and application in all areas previously mentioned as well as recreation and scientific research. With the acquisition of detailed elevation data, work is proceeding on the development of new topographic maps for the State which will be free and open for public use. These maps are easily downloaded electronically and used for a wide variety of applications from recreational, to city planning, to emergency response. Lastly data layers such as hydrography, roads, trails, boundaries and other data layers will be enhanced because of the new, more detailed elevation data.

"In summary, the detailed mapping of elevation in the State of Alaska significantly improves the economy, quality of life and safety of our largest State. It raises Alaska to the modern mapping standard and it opens the door for the next chapter in the future of Alaska, a future that recognizes Alaska as a natural resource wonder, a thriving economy and strategic national security interest."

SUMMARY

The Dewberry Team is grateful for having the challenging but rewarding opportunity to map America's Last Frontier. Now, when users drape satellite imagery over an IFSAR DSM or DTM, everything fits as it should. Compare Figure 21 with Figure 1, and it's easy to see the importance of getting the base topo layer correct before proceeding with other layers of a mapping program. The DSM is ideal for orthorectification of aerial or satellite imagery, and the hydro-enforced DTM is ideal for production of NHD+ and other derivative products.

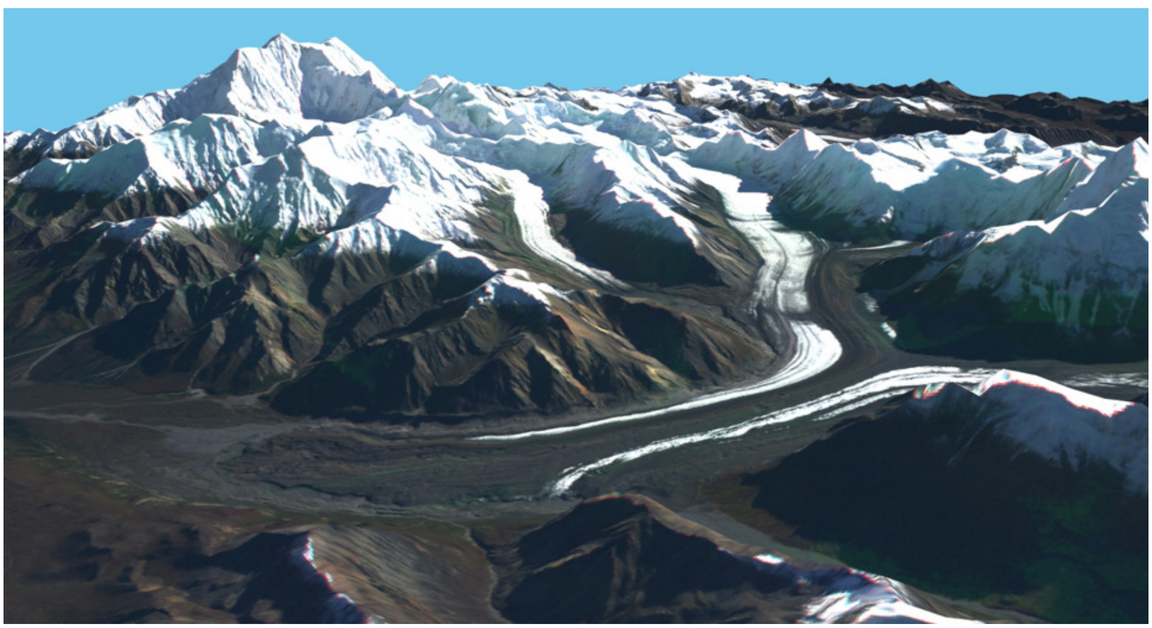

Figure 21. Satellite image draped over the IFSAR DSM of Mt. Hayes. Everything fits perfectly. Compare this image with Figure 1 which demonstrates why the topographic (DEM) layer must be correct before proceeding with the mapping of other layers.

The author wishes to give a special "shout out" to Blaine Horner who was selected by the Denali National Park mountaineering rangers to receive the 2016 Mislow-Swanson Denali Pro Award for life-saving efforts while on his 2016 expedition to perform a GPS survey of Windy Corner and a GPR survey of Denali's peak. While on this expedition, Blaine sacrificed his own goals to assist two injured climbers to high camp following their potentially-fatal fall above Denali Pass on June 23, 2016. The other three team members of the 4-person team completed the GPR mission while Blaine diverted his personal attention to save the lives of others.