

FREQUENTLY ASKED QUESTIONS

GEOSAR

1) What is GeoSAR?

GeoSAR is an airborne radar mapping system that rapidly produces highly detailed DEMs and radar imagery of unmatched quality over regions previously considered inaccessible due to cloud cover, dense vegetation, and rugged terrain. It is the world's only radar mapping system that collects X-band (top surface) and P-band (foliage penetration) interferometric synthetic aperture radar (IFSAR) data simultaneously in a single pass along each flight line from both sides of the aircraft. GeoSAR is available worldwide exclusively from EarthData.

2) What deliverables are produced from GeoSAR data?

GeoSAR provides up to eight unrestricted-use products from X-band, P-band, and lidar data, all from the same flight:

- 1.25- to 3-meter-posted X-band orthorectified radar image and 5-meter-posted DEM
- 1.25- to 5-meter-posted P-band orthorectified radar image and 5-meter-posted DEM
- lidar-derived multiple-return terrain profiles with a vertical accuracy of 35 centimeters and a horizontal accuracy of 3 meters
- lidar-derived ground control with a vertical accuracy of 35 centimeters and a horizontal accuracy of 3 meters
- 50-centimeter resolution X- and P-band all-aspect imagery (circular collect)

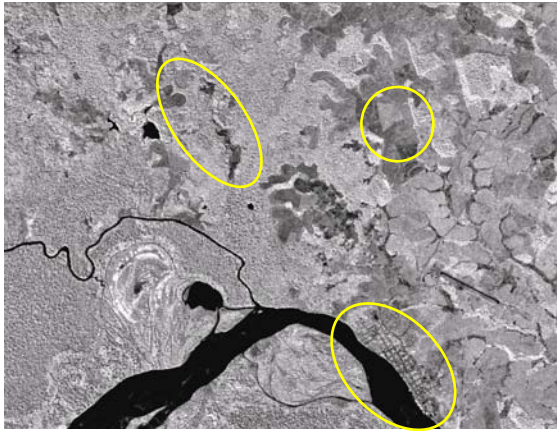
EarthData can deliver these products at a finer pixel resolution and a denser post-spacing if required.

3) What are the differences between X-band and P-band data?

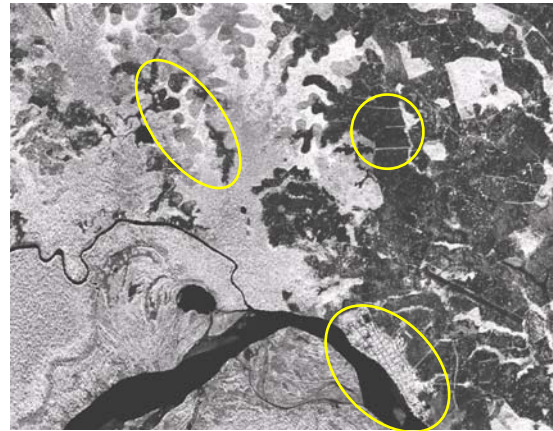
In the top dataset, GeoSAR's X-band (9630-9790 MHz, or 3-centimeter wavelength) scatters off the first surfaces of vegetation, buildings, and bare earth, making the 3-meter-posted X-band image rich in first-surface details.

GeoSAR's unique P-band (270-430 MHz, or 85 cm wavelength) penetrates foliage and scatters off substructure, showing details otherwise hidden beneath foliage, such as road networks, buildings, trails, and other features not apparent in the X-band data. Edges of features such as rivers and roads are more evident in the P-band image because the longer wavelength penetrates vegetation overhanging the feature edges. In addition, P-band reveals many subtle physical aspects of soils and other non-vegetated ground surfaces, including compactness and moisture. The absence of vegetation in the P-band DEM results in a smooth appearance that more closely resembles the terrain relief.

The GeoSAR reflectance, or magnitude, images shown below were acquired simultaneously near the Colombia-Peru border.



X-band image



P-band image

As seen above, the outlined areas indicate corresponding features in the images and reveal the distinct differences between X- and P-band data. X-band data (left) reveals texture variations that support vegetation and other characterizations. P-band data reveals substructure hidden beneath canopy, including man-made features such as buildings and fences, as well as areas with varying vegetation density and moisture content.

4) What advantages does GeoSAR provide customers, compared to other IFSAR systems?

GeoSAR maps above and beneath foliage. With its simultaneous X- and P-band data collection, GeoSAR is the world's only system that can map through both clouds and vegetation interferometrically. This unique capability makes it especially valuable for equatorial regions and large land expanses characterized by dense vegetation and inhospitable terrain where one pass along each flight line acquires full coverage over areas where maps are often outdated or nonexistent.

GeoSAR collects up to 8 looks of every point on the ground. In addition to redundant collection from GeoSAR's configuration, flight plans are designed to acquire multiple (as many as eight) and opposite looks of each point on the ground. This redundant coverage mitigates the risk of losing data in shadows and voids, which means customers receive more complete and more accurate elevation datasets.

GeoSAR collects a lidar terrain profile to improve data quality. Lidar continuous nadir terrain profiles are used to improve the quality and accuracy of GeoSAR data. The lidar data helps locate bare-earth, thus confirming height data and improving the overall accuracy and quality of GeoSAR deliverables. The profiles also eliminate the need for establishing ground control, which can be a costly, time-consuming, and potentially dangerous activity.

GeoSAR datasets are reliable and efficient. GeoSAR's standard-setting redundancy ensures high-quality, reliable data. In addition, GeoSAR ISO9001:2000-certified production processes are stable and reliable and mandate quality control throughout all production stages. Customers can depend on the accuracy of the GeoSAR products they receive.

GeoSAR performs circular collects. Though GeoSAR is best suited to large-area collections, the system performs extremely well in circular collections, or 360-degree circular flight lines, that target a small area of interest or, perhaps, a small country.

GeoSAR customers own their data. EarthData does not license data. GeoSAR customers own their data without restriction on its use.

5) What advantages does GeoSAR provide customers compared to satellite systems?

As an airborne system, GeoSAR offers the flexibility of collecting data when conditions are optimal. The radio frequencies used by GeoSAR pass through clouds and can collect data day or night. These capabilities permit flexibility in working with air traffic controllers to schedule aerial missions during any time of day to accommodate congested or restricted airspace and in scheduling missions amid adverse weather patterns. In addition, GeoSAR flight plans over large areas are designed to complete collections in consecutive sorties, rather than in temporally dispersed coverages, as dictated by satellite orbital patterns. Flying at an average height of 40,000 feet above mean terrain, GeoSAR collects up to 288 square kilometers of data per minute through clouds, which means that large areas can be covered in a few weeks instead of several months or years.

GeoSAR also provides a much higher level of detail and accuracy than imagery collected from most existing remote sensing satellites such as Landsat, Spot, Radarsat, Envisat, etc.

6) What are the applications of GeoSAR data?

EarthData's objective in developing the GeoSAR system was to create a cost-effective mapping tool that would enable its customers to have access to current, accurate, and detailed geospatial data for areas where using conventional mapping techniques was either impossible or cost-prohibitive. GeoSAR data products will support any number of applications in GIS, infrastructure development, transportation, geospatial intelligence (military mapping), environmental protection/natural resources management, and other disciplines. Examples include:

- Mapping: image rectification, map updating, 3D visualization
- Hydrology: watershed delineation, flood risk mapping
- Natural resources: timber management, monitoring of agricultural yields, water conservation
- Environmental stewardship: deforestation prevention, preservation of coastal environments (e.g., mangroves, wetlands, etc.)
- Oil and gas exploration and production: geological interpretation, seismic mission planning, and pipeline routing
- Mineral prospecting and extraction
- Economic development: land-use management and planning, urban encroachment studies, infrastructure development, and transportation
- Public works: infrastructure planning, corridor mapping for transportation and utilities
- National security: emergency preparedness, disaster response and relief, detection of illegal activities, reconnaissance and mission planning
- Tourism development and archaeology: site exploration and identification, preservation of cultural heritage and archaeological features

GeoSAR, with its ability to rapidly and efficiently produce highly accurate geographic information, is an especially valuable tool in regions where economic development and poverty alleviation are critical development issues. GeoSAR products serve as a basis for many economic development choices – for example, how to balance the construction of power plants, highways, and other essential infrastructure against the protection of natural resources; how to sustain forests while harvesting lumber; what to do about coastal erosion, urban sprawl, and agricultural output.

7) Can you acquire GeoSAR data anywhere in the world?

GeoSAR is the ultimate tool for capturing a highly accurate and data-rich volume of geospatial information over a large land expanse that may be otherwise impossible to reach and/or map using conventional means.

Except for local airspace restrictions or the lack of adequate airport facilities within flying distance, GeoSAR can acquire data anywhere in the world.

However, GeoSAR is especially well-suited for equatorial regions around the world where dense vegetation and year-round cloud cover make using conventional mapping techniques impossible or cost-prohibitive. GeoSAR is capable of mapping thousands of square kilometers during each sortie, day or night, and in almost any weather condition to deliver mapping data of a scale, accuracy, and completeness never before possible for this type of environment.

To find out if GeoSAR collections offer benefits for your project area, please contact a GeoSAR representative at EarthData International.

8) You mention that this system is the only one of its kind in the world. What makes GeoSAR unique and what benefits do these unique features convey to clients?

Four capabilities make GeoSAR unique:

GeoSAR is the world's only single-pass simultaneous interferometric X- and P-band data collection radar system.

GeoSAR is the only IFSAR system that simultaneously collects interferometric X-band data and interferometric P-band data in a single pass along each flight line. This avoids the potential of mis-registration after acquisition since GeoSAR's bands are collected simultaneously and are thus perfectly co-registered during acquisition. Unlike other systems which fly single-band X- and P-band IFSAR systems on separate aircrafts, GeoSAR's dual-band capability reduces time and cost in flight planning, mobilization, aerial missions, equipment maintenance, labor costs, as well as data processing and production. The single-pass, dual-band, dual-sided data collection feature of GeoSAR also reduces shadow, layover, and other artifacts, which in turn reduces processing and, consequently, time and expense. GeoSAR's dual-band, dual-sided, single-pass X- and P-band interferometric capability collects almost an order of magnitude more interferometric data per flight hour (using a single airplane) as the competition covers per flight hour (using two different aircraft) – yielding the benefits of additional cost- and time-savings plus the benefits of consistently high-quality data.

GeoSAR is the world's only dual-sided radar collection system.

GeoSAR is the only system that collects data from both sides of the aircraft along each flight line. What's more, GeoSAR collects data from two X-band and two P-band antennas on each side of the aircraft. This means that GeoSAR can collect more data (more than 4 times more data) in the same amount of flying time as other systems.

GeoSAR is the only radar system with a lidar nadir-terrain profiler.

GeoSAR is the only radar system equipped with a lidar profiler. Mounted on the GeoSAR aircraft, the profiler provides a continuous high-accuracy nadir-terrain profile for each flight line. The profiles: (1) provide additional ground control and a direct measurement of foliage density (tree height) which increases accuracy; (2) help to ensure that even tiny gaps in a canopy structure can be exploited to capture bare-earth heights under trees, improving the completeness and accuracy of the dataset; (3) provide information about vegetation and biomass; and (4) aid in mosaicking.

Lack of a lidar profiler or similar sensor in other commercial IFSAR systems either reduces ground control available from the flight or requires that control be established on the ground, which presents additional costs and risks. Installation of ground control is expensive (and extensive) in the typically large areas that warrant IFSAR data collection, plus serious risks to equipment, crews, and mission success can be involved in establishing ground control for collections over areas within hazardous terrain or hostile environments.

GeoSAR is the only system to collect 8 looks of every pixel on the ground.

GeoSAR is the only system that provides up to 8x redundant data collection, which ensures nearly 100% project-area coverage. Redundant collection reduces sampling noise and provides data otherwise obscured by



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foliage, shadows, and layover – which translates into consistently higher quality data and time-savings through a lesser likelihood of reflights (with redundant data, “we already have it in the can”).