New Relevance for SAR

New Relevance for Synthetic Aperture Radar (SAR)

ASF Chief Scientist Franz J. Meyer answers seven questions about synthetic aperture radar (SAR)

Franz J. Meyer, ASF Chief Scientist

1. What do you most want the general public to know about synthetic aperture radar (SAR)?
My answer may be surprising: Not much! In fact, it is my hope that future SAR data products and services will require less and less SAR expertise from the end user and will be much easier to ingest and digest by the science community and the general public.

Sure, certain segments of our user community will always require under-the-hood knowledge to develop better SAR data processing techniques. This slice of the community is important as it helps us drive the technology forward. Yet if we want to successfully attract new users to the world of SAR, we need to streamline and simplify our product portfolio. Future SAR training should not focus on how SAR works but on all the cool things SAR can do for you.

When I give public presentations, I like to talk about the tremendous amount of information SAR can reveal about our planet. Showing off the science capabilities of SAR is always a lot of fun, and I admit I like the oohs and ahhs that some of my examples draw from the audience. In addition, I like to show applications to local problems my audience can relate to, such as recent local flooding, droughts, or forest fires. I want everybody to leave with the understanding that our work can make a difference in their personal lives.

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As a SAR scientist, I am sensing the pulse of the planet. Think about it: SAR is certainly among the most versatile Earth observation systems. For the last 25 years, SAR sensors have played a role in an enormous number of geoscientific discoveries. Scientists have been using SAR to study the ocean surface, characterize and track sea ice, document deforestation, and measure how seismic and volcanic forces deform the Earth.

A lot of what we know about the vast ice masses of Greenland and the Antarctic was brought to us by SAR. We've sent SAR sensors to Venus, Europa, and a long list of other planets. Future missions will expand the SAR portfolio even further.

2. If you could talk to young scientists considering the field of remote sensing, what would you say to them?
With few exceptions, remote sensing is a nearly indispensable skill set for most science disciplines. I would recommend that any aspiring geoscientist load up his/her course calendar with a diverse set of remote-sensing

classes. Traditional remote-sensing classes focusing on multispectral and radar remote sensing should be on top of the list. Classes on geospatial data analysis and geostatistics should also be in the mix. Remote-sensing expertise is relevant for a wide range of disciplines and opens up a range of employment opportunities in the future.

3. What's new in the synthetic aperture radar (SAR) world?
The SAR community is truly seeing the migration of SAR from a laboratory environment to more of an operational, production phase. We may be witnessing a similar transition in SAR that we saw in GPS technology 20 to 30 years ago, where that technology moved from being experimental to a globally accepted service.

We have new sensors that are better in providing large-scale datasets with high resolution. We also have systems with more frequent acquisitions, such as the European Space Agency's Sentinel-1A, which monitors the entire globe over a routine, pre-defined period. For most areas in the U.S., we have an acquisition every 24 days.

We also have SAR datasets that are affordable. NASA has long provided open access to its data, but it has been rare to find free and open access to radar data, much of which has come from non-U.S. sensors. Sentinel-1A is one of the first globally observing datasets that has a free and open data policy.

Not only that, we have future players emerging, such as NISAR(/news-notes/2016-spring/nisar-data/), a partnership between NASA and the Indian Space Research Organization (ISRO). NISAR, which is an acronym for NASA-ISRO Synthetic Aperture Radar, will provide high resolution images, very reliable high-frequency repeat, and free, unrestricted data access.

Overall, we are seeing a change from providing data, which is what we mostly did in the past, to providing what I would call information.

There also are more community tools to extract information from SAR data. We are working with the groups creating these tools to come up with standardized looks, feels, and training. We are quickly working toward a radar-for-the-masses model and a broader acceptance of this technology by people who are not radar experts. Overall, we are seeing a change from providing data, which is what we mostly did in the past, to providing what I would call information.

4. What do you mean by a shift from providing data to providing information?
Let me reference GPS again. Individual observations made by a GPS receiver are what I would call "data." To the end user, these data are not particularly useful. Instead, the GPS user is interested in position and motion information derived from the original data—where am I, how fast am I going.

The SAR community has traditionally focused on the distribution of data, mostly in the form of hard-to-interpret, complex matrices. Only recently has the community started to provide information layers along with these data. At ASF, we are providing SAR images fully geocoded, in meaningful radiometric quantities, and in easy-to-use GeoTIFF formats. This helps move our products much closer to the information domain and helps improve the user experience.

5. Tell us more about NISAR. How will NISAR affect NASA, ASF, and the synthetic aperture radar (SAR) community?
NISAR is the first long-term satellite mission that will collect SAR data at two frequencies (L-band and S-band) to answer a broader range of geophysical research questions that most previous SAR sensors. NISAR will operate for a planned mission duration of three years and will provide a rich amount of information on the dynamics of the solid earth, the cryosphere, and earth's vegetation cover.

ASF will be the curator of the NISAR datasets and provide access to these global archives. NISAR will benefit from NASA's forward-thinking data policy. NASA has always been on the leading edge when it comes to free and open data policies, and we have learned how beneficial open data access is for the acceleration of research. I'm sure that with NISAR, SAR technology-development will accelerate and lead to the broadening of the user community.

I think NISAR will be a game changer by providing full, global coverage with InSAR-capable image data about every 12 days. For certain areas, NISAR will also provide value-added products like deformation maps that will be processed operationally by either the NISAR project or ASF DAAC. Also, NISAR will provide L-band microwave data, a frequency that provides a lot of bang for the buck and can be used in many scientific disciplines.

6. What makes L-band radar so valuable?
Overall, L-band systems are among the most flexible radar systems available. The longer wavelengths of L-band allow for deeper penetration into—or through—vegetation canopies, which improves the sensor's ability to characterize both vegetation and surface properties. L-band also comes with improved abilities to measure surface deformation over large areas and long time scales. This means that L-band sensors are generally better at describing geodynamic processes such as earthquakes, volcanoes, sea- and land-ice motion, and permafrost decay.

7. What would you say about synthetic aperture radar (SAR) to someone who doesn't care much about science?
I would explain that due to recent technical advances, SAR has become a legitimate player in many applications fields outside the sciences. For instance, SAR systems already are in heavy use in disaster monitoring such as the mapping of oil spills, the tracking of floods, and the monitoring of forest fires. SAR can also provide information on global agricultural activity and can contribute to managing and ensure global food supply. Due to its day-and-night capabilities, of course, SAR also plays an important role in guaranteeing our national security. With a fleet of better and better sensors on the horizon (pun intended), the contribution of SAR to the safety and success of our day-to-day lives is only going to grow in the future.

Alaska Satellite Facility
2156 Koyukuk Drive
Fairbanks, AK 99775

(907) 474-5041
Contact Us