An Alaska SAR Facility overview in the Radarsat Era

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ABSTRACT

With the successful launch of Radarsat in November of 1995, the Alaska SAR Facility (ASF) at the University of Alaska, Fairbanks (UAF) will soon bc handling SAR data from four operational satellites (ERS-I, ERS-2, JERS-1, and Radarsat) at the same time. Coming upon the conclusion of 3 years of intensive planning, design, and implementation activities, ASF will bc ready mid-1996 to fulfill its role in providing SAR data acquisition, processing, and archive services in support of the Science community.

ASF has been in operations since 1991; initially supporting ERS-1 users. It has grown from the simplicity of handling just one satellite, E RS - 1, into a complex organization dealing with multi-national data providers and users. It has also gradually over the years expanded its services and is becoming more user driven in the form of its operations.

This paper chronicles the progression and development of the ASF; with special attention given to its organization and structure in the current Radarsat era. Special treatment is given on describing in detail the end to end system data flow and operations scenarios which serve to provide the Science users insight into full y exploiting the ASF capabil i tics.

INTRODUCTION

The Alaska SAR Facility (ASF) performs as the ground data system for the acquisition, processing, archives, and distribution of Synthetic Aperature Radar (SAR) and SAR related products for the science community whose interest include polar oceanograpy, glaciology, geology, hydrology, and ecology. ASF is a cooperative facility between National Aeronautics and Space Adminstration (NASA) and University of Alaska, Fairbanks (UAF) in which Jet Propulsion Laboramry (JPL) has the system engineering responsibilities. [1]

Currently, ASF maintains support for three research-oriented satellites which carry a SAR instrument. First was the European Space Agency's (ESA) first Earth Remote Sensing satellite (1?}< S-1) which was launched in 1991. The second was the National Space Development Agency (NASDA) of Japan's Earth Resources Satellite (J ERS - 1) which was launched in 1992. The third was ERS-2, which is the follow-on to ERS-1 and was launched in the spring of 1995. On November 4, 1995, Canadian Space Administration (CSA) launched RADARSAT which provides SAR daia for scientific applications and for operational missions.

Although the original intensions by ESA were to replace ERS- 1 operations with ERS-2, ESA and the science community have found the usc of tandem operations of the two SAR instruments is providing a great wealth of information. This wealth comes at the cost of doubling the volume of data.

The JERS- 1 primary mission of 3 years to map the earth's land surfaces have been achieved by NASDA; however many new science projects have coJnc to take advantage of the L-band SAR data. The volume of new JERS- 1 data has not diminished with lime

These satellites continue to challenges ASF in order 10 meet further demands of science users and operational missions to take advantage of plethora of capabil i ties. These capabilit ics include synergism from multi-satellites, added look angles, and ScanSAR mode.

Additionally, ASF as one of the Distributed Active Archive Centers (DAAC) supports interdisciplinary earth science research for the Earth Science Data and Information System (ESDIS), and with that selection ASF has faced requirements as a DAAC which include standards and interoperability within the NASA Earth Science community. [2]

RADARSAT

ASF expects to acquire 120 minutes of data per day and process upon demand up to 80 minutes of that to SAR images and related products. Radarsat distinguishes itself from HRS-1, E RS-2, and JERS-1 with the special feature to electronically steer the radar beam in many angles, resolutions, and footprints. Onc of these major modes is called ScanSAR mode in which the beams arc combined in various ways 10 achieve a wider swath (up to 500 KM) at the sacrifice of spatial resolution. Similar to JERS-1, Radarsat has an on-board recorder which will allow it to save the observation data nearly anywhere on the earth and downlink it later when it passes one of the receiving stations.

McMURDO STATION

The National Science Foundation in conjunction with NASA has installed a receiving station at the US facility in McMurdo, Antartica. The antenna schedules arc managed by Wallops Flight Facility (WFF); however ASF continues to bc the. main interface to the flight agencies for SAR data. Therefore, integrated schedules and satellite orbit information is provided by ASF to WFF on a daily basis. Once the data is collected 10 tape al McMurdo, the reception and tape in forma-t ion arc sent from McMurdo via WFF to ASF. ASF then reports to the flight agencies on the reception activities. The recorded tapes arc sent in bulk at a later date to ASF for processing.

FRAMES

Up until now ASF SAR data were divided into images somewhat arbitrarily based on when the first data observations were made which caused overlaying image.s from repealing orbits into a patchwork. ASF now has defined frames which arc fixed to earth lat i tude so that i m ages from repeating orbi ts will have the same center latitude and longitude. The center latitudes of the images will be fixed relative to the equator at approx imately 40 KM spacing between image centers. For 100 KM size images, it is necessary only to order every other frame. For the largest images Of 500 KM, it is necessary only to order every 10th frame and still retain a fair overlap between adjacent images.

END-TO-END DATA FLOW

The end-to-end dataflow has two major flows: first, the user can request data acquistions, and second the user can request data products for frames. Fig. 1 provides a block diagram of the ASF for the Radarsat era.

Because Data Acquisition Requests (DARs) parameters include times and areas which can map to many frames that may never get scheduled, ASF has chosen to wait until a DAR is "planned" before the ASF catalog is populated with frames. Frame is the unit of data which can bc ordered from ASF.

The DAR data flow is very simple. The users enter their DARs into the ASF using the User Client software provided as an extention to the EOS Data information System (EOSDIS) Information Manage.ment System (IMS) Version O (V0) user interface. This is a unique feature for ASF to the EOSDIS IMS V0 user interface. The DAR is tracked as a user order and assigned a unique order id. The Acquistion Planning Subsystem (APS) retrieves the DARs and with directives from the Acquisition Planner maps the DARs to specific swaths of SAR data that meet the user requirements. These swaths arc then sent as request m the flight agencies (ESA, NASDA, or CSA). Once tbc agencies have planned tile swaths, ASF then provides the frames which arc computed from the swaths in the ASF catalog, At this point (anywhere from 1 to 8 weeks in advance of the event), the user will bc able to order products for the frames that arc found in the catalog. This feature is onc of the main capabilities of the new system that was not available in the older versions of ASF. in the old system, the user needed to wait until the data was collected and processed before the frames appeared in the catalog.

At about 1 day to 1 week in advance of the data observation, the fore.ign flight agencies wiii send schedules of datatakes for ASF and McMurdo to the Fligh Agency Interface Function. These arc then turned into a set of integrated schedules by the APS and sent to the appropriate ante.nna system along with the predicted slate vectors. Once lhc antenna systems have captured the. data to a recording med ia, the user request for the. DAR is complete.

Any time after the frame.s have been catalogued in the IMS, a user through the user client for the EOSDIS IMS V() searches the catalog, identifies the desired frames, and selects Onc of the many data sets and packaging options. In Table 1, the list of data sets that arc available from ASF in mid-1996 arc given. , The list will change anti grow as ASF continues to evolve.

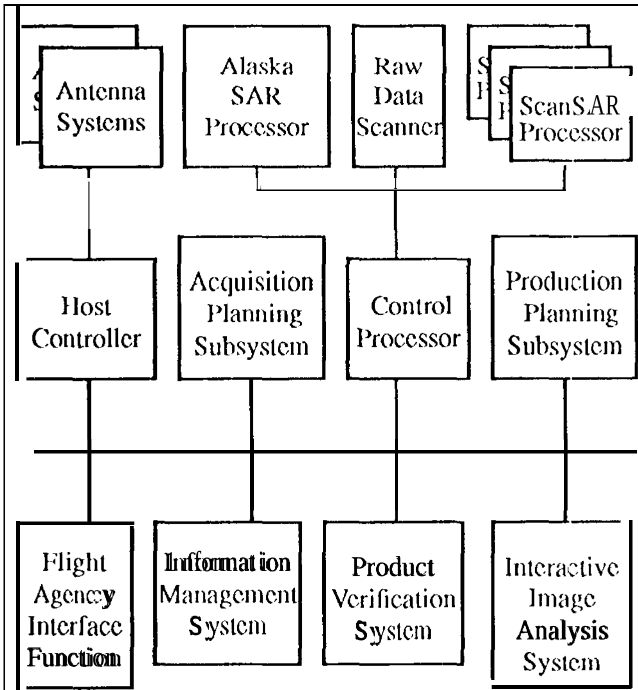

Fig. 1. Block Diagram of ASF for the Radarsat era.

Table 1: Available ASF data sets in 1996

	ERS-1	ERS-2	JERS-1	Radarsat	
				Continuous	ScanSAR
. SD	x	x	x		
Complex	x	x	x	x	
Raw Signal Data	x	x	x	x	x
Low Res	x	x	x	x	x
Full Res	x	x	x	x	x
Medium Res					x
Geocoded low res					x
Geocoded full res					x
Geocoded medium res					x
Terrain-corrected low res					x
Terrain-corrected full res					x
Terrain-corrected medium res					x
Ephemeris	x	x	x	x	x
Ice motion vectors	x				
Ice classification	x				
Wave spectra	x				

Processing package specify processing options, media type, and media format. Processing options are as follows: normal, quicklook, low gain, slant range, subframes, cal-uncomp, cal-comp, or some combination of these. For geocoded and terrain corrected images, the following projections are possible: Universal Transverse Mercator (UTM), Polar Stereographic (PS), and Lambert. Nolan of these options are available for every data set. Data sets can be ordered with various media types as follows: ESA_DCRSi, NASDA_HD_96, RSAT_HD_96, 4-MM 2 GBytes, 4 MM 5 GBytes, 8 MM 2 GBytes, 8 MM 5 GBytes, 9 track 1600 IN'], 9 track 6250 BPI, DISK (electronic/ network transfer), dry silver film/paper, and B&W photo film/ paper. Again not all media is available with all data sets or with all processing options. Media formals include: CEOS SAR tape, tape archive (tar), CEOS SAR file, 8x10 print, 8x10 posi(ive/negative transparencies, 20x24 2x enlargements, 20x24 5x enlargements. Again not all formats are applicable to all data sets, processing options, and media types,

The I MS will send the request for frames to the Production Planning Subsystem (PPS) which will queue the request until al I materials necessary for processing are available locally. IMS will also semi request for scanning of tapes to the PPS as the tape.s become available locally.

The Control Processor, which provides control of the resources of the processors retrieves jobs from tile PPS queue and executes the job on onc of the processors. The Alaska SAR Processor provides SAR products for ERS-1, ERS-2, JERS - 1, and continuous mode Radarsat. The Raw Data Scanner provides scanning of raw data to verify the actual good data that is available, and it aiso decodes Radarsat ScanSAR data to time-orxicrcd, non-redundant Level O data. The ScanSAR Processors provide SAR products from the decoded ScanSAR data. Once tile products are produced by the processors, the Control Processor provides a quality control function that allows the Production Operator to visually inspect the image and the vital metadata. After the inspection, the product is sent 101 MS for distribution to the user.

CONCLUSION

ASF has eliminated the Level 1 archive, but has provided visibility into the planned datatakes and into the Level O archive. With judicious processing of only data that is ordered for processing, ASF expects to be able to meet the user needs with similar timeliness. The fixed frames will allow users to get repeated orbits with high degree of overlap.

ACKNOWLEDGMENT

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