Record of Images

A supplement to EOQ 59
June 1998

ERS Products and Services from ESRIN

The Hyderabad Ground Station
India's Contribution to Earth Observation

The National Remote Sensing Agency (NRSA) has been active in space-borne remote sensing for over two decades. During this time it has grown significantly in the number and variety of remote-sensing data products handled. In the late 1970's, NRSA started with optical remote-sensing data (acquired from the EROS data centre) from Landsat-1and -2 satellites and has relied on image analysis for the utilisation of such data.

Which missions are handled?
NRSA established its ground station for space-borne remote sensing in 1979 and presently has three antennas. One is used exclusively for the IRS (Indian Remote Sensing) satellite series. Another terminal is used for the NOAA meteorological satellites. NRSA has also established an airborne remote sensing facility consisting of a multi-spectral scanner, aerial cameras and airborne geophysical sensors, etc.

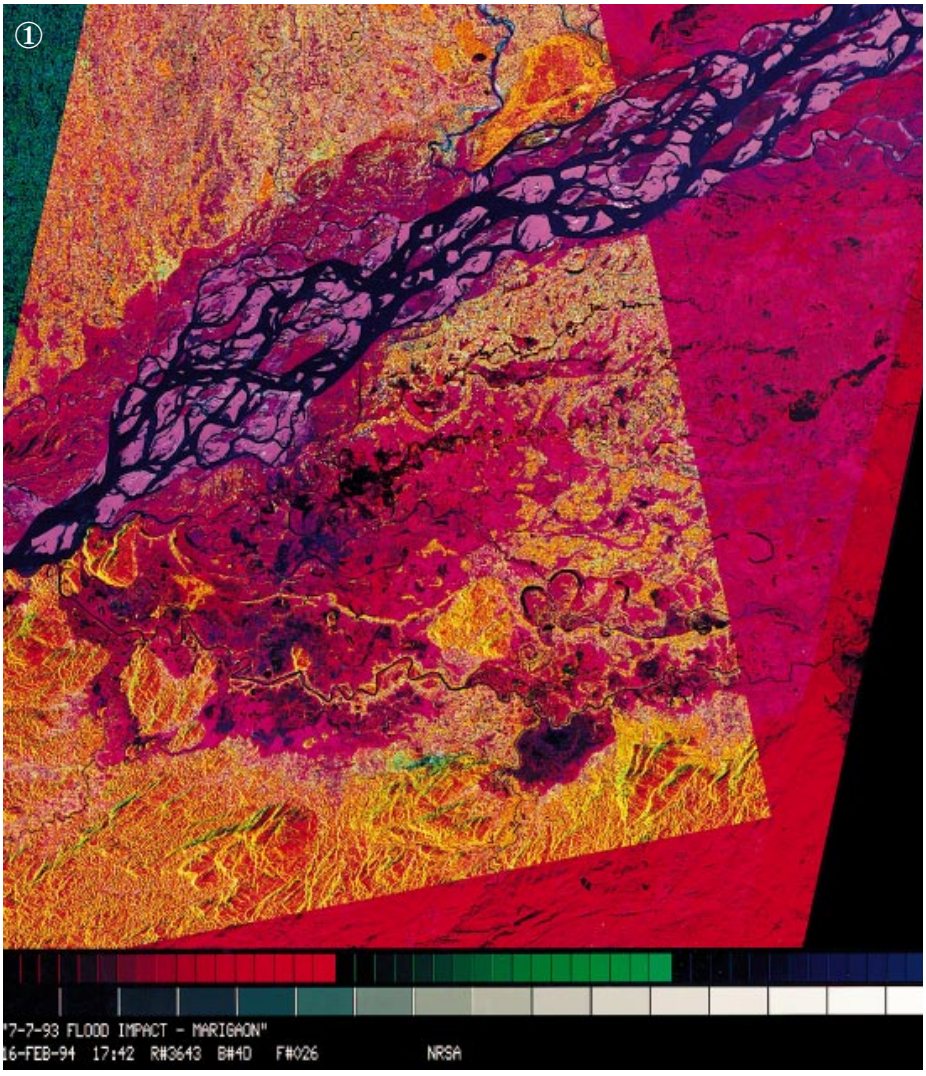
Initial efforts in the acquisition of microwave remote-sensing data were directed towards the development of airborne imaging radar (SLAR) systems at NRSA and SAC. Two X-band real-aperture side-looking radars have been developed at NRSA and SAC. These radars were used in experimental data acquisition exercises during the mid 1980's. The radars were installed in two aircraft, the DC-3 and HS 748, available at NRSA. SIR-A made a single pass over India, a few scenes were acquired by the SIR-B mission, and SIR-C conducted some pilot experiments in India.

During the late 1980's, the development of an airborne C-band-system was initiated. This radar, which is presently undergoing test flights, is installed on a Superking B-200 aircraft and has a resolution of 5 m in 7-look mode. The polarisation can be HH or VV depending upon the type of antenna mounted.

The next opportunity for routine acquisition of microwave imagery over the Indian region was only available with ERS satellites.

How is it operated for ERS?
The ERS-1 mission began in August 1991. NRSA established the processing facility for ERS-1 before satellite launch, so that data could be utilised from the onset of the mission. In the meantime, NRSA has also been receiving ERS-2 data since April 1995.

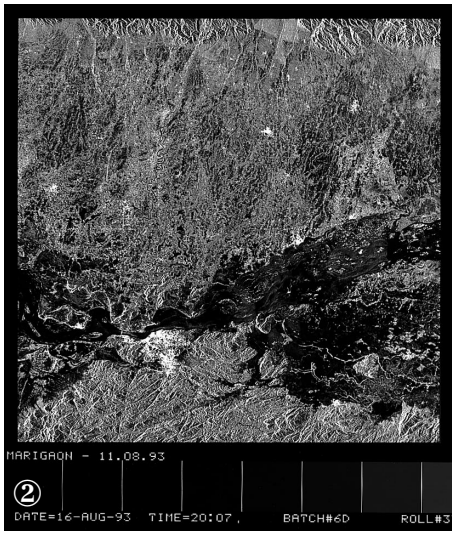
Time composite image of the flood situation in the Brahmaputra basin, taken by IRS-1B (pre-flood: red, 7 July 1993) and ERS-1 (post-flood: green, 16 February 1994).



In the tandem mission orbital configuration, ERS-1 follows ERS-2 with a gap of 24 hours. This means that the time interval between successive acquisitions is shorter and the number of acquisitions in a cycle is doubled. NRSA has an archive of two cycles of ERS-1 and ERS-2 data during the tandem operations, i.e. 24 March to 2 June 1996 for the Indian region. In the context of operational microwave remote sensing, ERS satellites have been the most significant missions.

NRSA established a data processing facility for ERS data products generation in 1991. The standard four-look product was the first of its kind.

Antenna field of the Hyderabad ground station.



ERS-1 SAR image of the flood situation in the Brahmaputra basin on 11 August 1993.

The processing was based on a MicroVAX super-mini computer with a FPS 5300 array processor. In 1995, ERS data processing was switched over to a SUN 4/280 Sparc server-based system, with a PARAM 16-node parallel computer based on transputers for computation intensive tasks.

Which products are provided?

In addition to standard products, several other products are now also being generated. One example is the 16-bit product, where each pixel is represented by 16 bits in order to completely cover the dynamic range of the processed SAR data.

In order to generate the interferogram, it is necessary to have ERS data in complex form. Such a product is known as a Single-Look Complex (SLC) image. In multi-look images, several looks are incoherently averaged and, hence, the phase information will become corrupted. NRSA generates single-look complex products from ERS-1/2 SAR data and each product covers approximately 60 x 60 km (quadrant). Currently, geocoded products are also being generated. These products correspond to a 15' x 15' map sheet of Survey of India and, therefore, are obviously north-oriented products.

Some of the operational tasks for which ERS data is being used are flood monitoring, Kharif crop status monitoring and ocean-state-related applications. The data is also experimentally used for a combination of optical data and interferometry-related applications.

SAR data acquisition is only carried out as per user request. The requests received from users for the acquisition of the SAR image-mode data are sent to the European Space Agency for payload programming. ESA confirms the date of acquisition and sends corresponding state vectors which are required for data acquisition by the NRSA data-receiving station. The data is recorded onto high-density digital tapes and stored in the NRSA archives.

Status of the project

The use of ERS-1 SAR data for operational flood mapping started in 1992 for floods in Jammu & Kashmir and Andhra Pradesh. The SAR data was found to be very useful, especially during adverse cloud conditions. During 1993, SAR data was extensively used for near real-time flood monitoring in Ganga, Brahmaputra and the Indus basins covering the states of Assam, Bihar, Jammu & Kashmir and Pubjab. The SAR data was digitally analysed and flood boundaries were delineated. The extent of flood inundation was estimated. The information was provided to concerned departments in near real-time. Furthermore, the SAR data was merged with optical data and topographical data for better assessment of flood damages.

Type	Processing level	Enlargement	Scale	Media
Digital	Raw, Standard & SLC	-	-	CCT, 8 mm DAT, CD-ROM
Photo	Standard	1X	1:500,000	Print
		2X	1:250,000	Print
		4X	1:125,000	Print

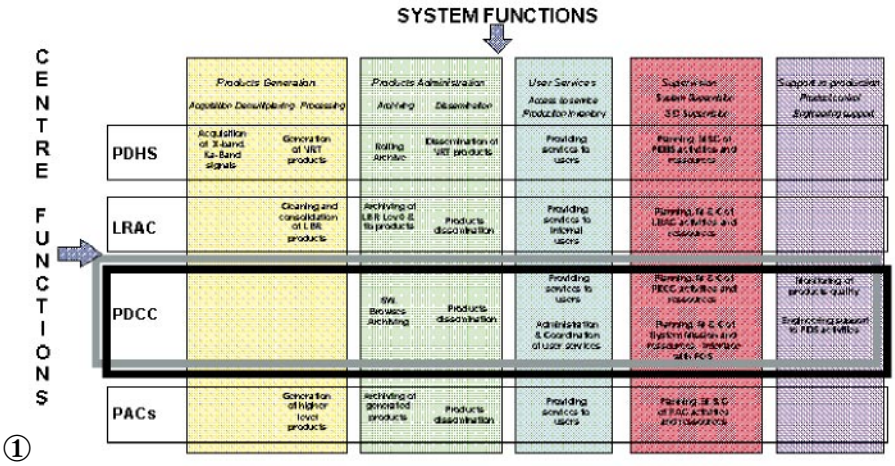
Results achieved so far
Perhaps for the first time in the world, ERS-1 SAR data was used on an operational basis for the near real-time monitoring of floods. ERS-1 SAR data was integrated with GIS from which damage statistics were assessed at a sub-district level and sent to user departments, including District Collectors. Flood impact was also studied by using ERS-1 SAR along with pre-flood IRS/Spot data.

Envisat Countdown

As a continuation to the Envisat feature in EOQ 58, in this article we will present the Payload Data Control Centre (PDCC). In addition, the PDS Monitoring and Control will be further described. The PDCC, located at ESRIN, is responsible for the instruments and ground segment planning, as well as the overall PDS monitoring and control. It also coordinates user services, and provides quality and engineering support for the products.

What are the PDS facilities?
Each PDS centre (station) has to fulfil a set of services as described in Figure 1. It can be seen that many common functions need to be implemented in different centres. For example, the PDHSs, PACs and LRAC have to process instrument data to generate Envisat products. User services shall be identical at all centres, and the level of quality and of the service shall be independent of the centre that the user accesses.

The major design driver has been to define a modular architecture requiring a minimum set of facilities. These facilities will be assembled to construct the different centres and will be available to the PACs.



① *PDS main functions*

The PDCC architecture
The PDCC is composed of the following facilities (Fig. 2):

The Product Quality Facility (PQF): The PQF provides off-line product quality monitoring and expertise on products and algorithms for the PDS. The PQF analyses quality trends of PDS production and assesses the quality of the products by means of adequate algorithms.

The Archiving Facility (ARF): The ARF provides archiving services for all the products generated and received by the PDS.

The Dissemination Facility (DF): The DF provides for the communication of facilities within centres, and the interconnection of centres. The DF is also responsible for the distribution of products to users and PACs.

The User Services Facility (USF): The USF is the unique user access point to the system. It provides services (consultation, retrieval, inventory, order, etc.) to the user in a transparent way.

The User Services Co-ordination Facility (USCF): The USCF takes care of the user administration and user services coordination.

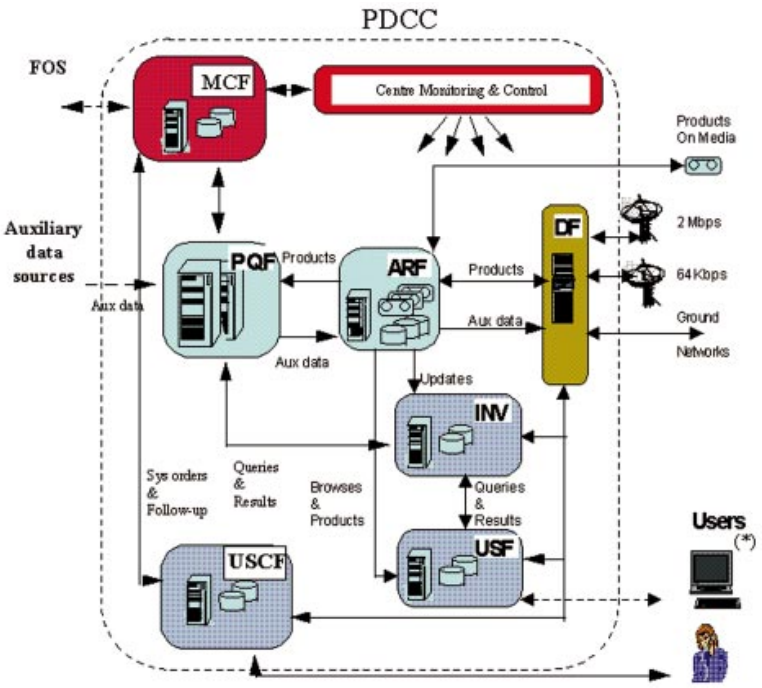
The INVentory (INV): The INV provides information on archived products in order to help a user to select products. It offers a unique application interface for querying a set of distributed databases.

The Monitoring & Control Facility (MCF): The MCF supports the tasks that are at the system responsibility level. It defines and maintains a consistent mission plan, including Spacecraft and Ground-Segment (G/S) operations. It performs overall monitoring and control. For industrial reasons, this facility has created a spin-off, the GSP, responsible for PDS production and dissemination planning.

The Centre Monitoring & Control (CMC): The distributed Centre Monitoring and Control (CMC) supports all monitoring and control tasks that are at the centre responsibility level, including centre scheduling, and centre monitoring and control.

The Engineering Support Facility (ESF): The ESF provides software maintenance, and configuration and logistic management. It also provides a reference platform to allow new software testing and problem troubleshooting.

The Monitoring and Control Facility explained
In this section, we will describe one of the PDCC main facilities in more detail: the MCF responsible for planning and PDS monitoring and control. This is a



② *Overview of the PDCC architecture*

purely functional description of the facility. The final implementation and customisation of the MCF is dependent upon the decision taken by the mission authorities.

The MCF regularly plans the centres according to the nature of the operations they perform and closely coordinates with the FOS. This enables adequate PDS centre autonomy (to handle local user requests and contingency measures) and possible optimisation of the operations proposed to the FOS. Asynchronous plans are also provided, when needed, to support non-nominal operations.

The MCF monitors all PDS centres independent of their function. A centre's production and performance is reported by simple and unique interfaces to the MCF. The PDS resources are monitored through a unique interface, at a configurable rate, dependent on the centre's operations time criticality.

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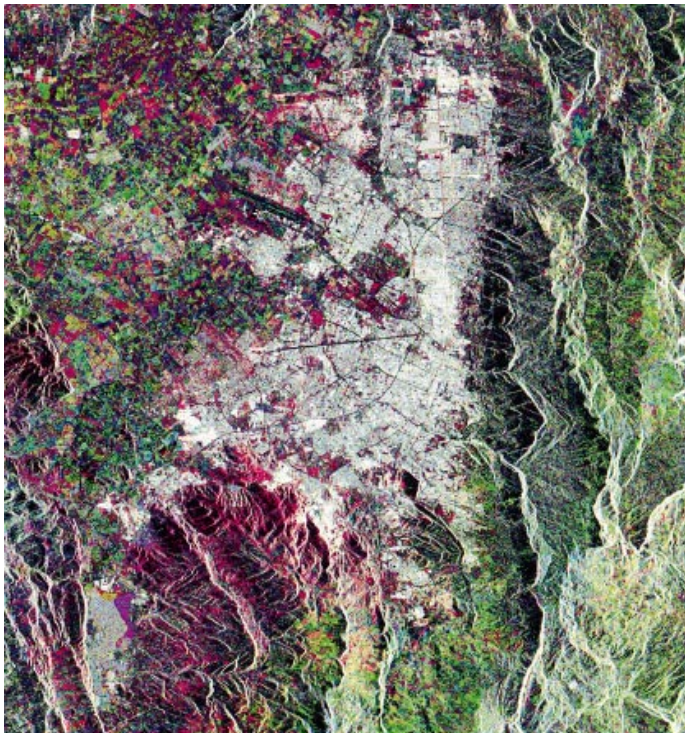

ERS-1 SAR multitemporal colour composite image
This image of Santa Fé de Bogotá is generated from three SAR images acquired at the Cotopaxi ground station (Ecuador) on 17 October 1997 (red), 11 August 1997 (green) and 17 February 1993 (blue).

Eurimage Training Courses 1998

7-10 July - Seminar on Topography and Geomorphology Applications of ERS SAR Interferometry Technique

22-24 September - Seminar on Remote Sensing Applications to Marine Environment: from ERS to Envisat through dedicated EO sensors

24-26 November - Seminar on Land Use and Land Cover Applications of ERS SAR and other Complementary Spaceborne Sensors

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