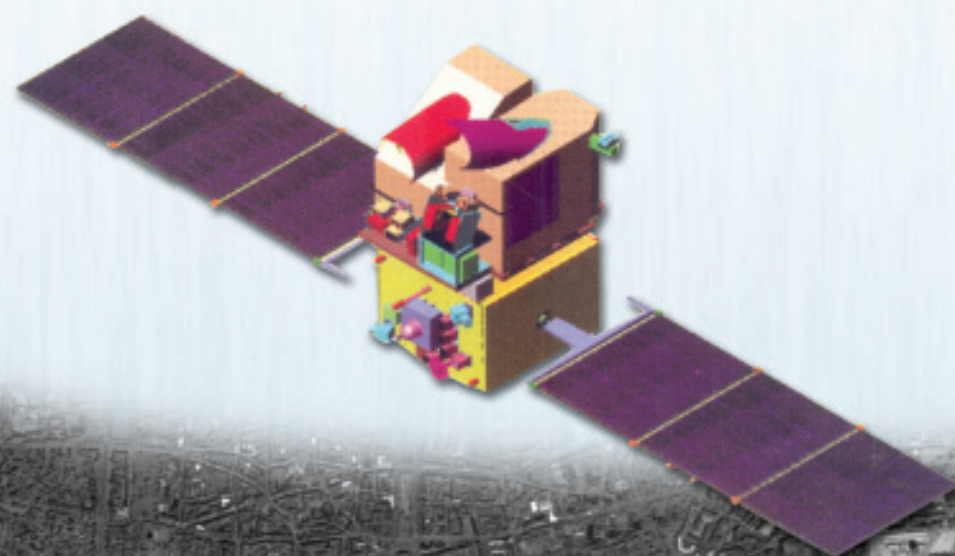


CARTOSAT - 1

A global IRS Mission for large scale mapping and Terrain Modelling applications



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ISO 9001 : 2000

National Remote Sensing Agency

CARTOSAT - 1

Introduction

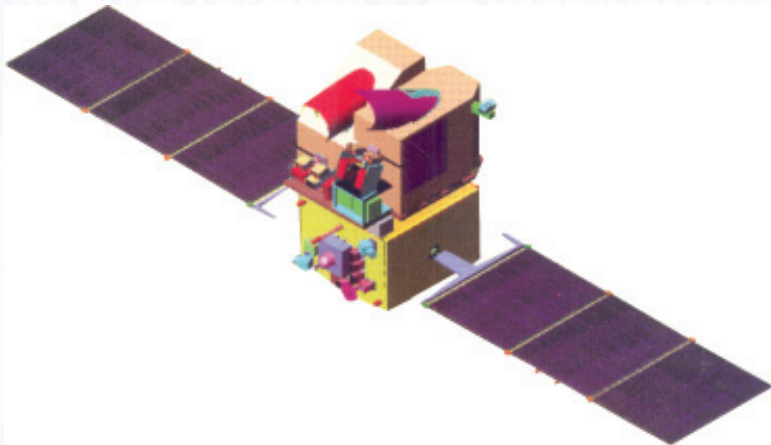
Department of Space (DOS), Government of India has a glorious history of having launched a series of satellites for Earth's resource management and monitoring. These satellites have been very successful in providing data in various scales ranging from 1:1 Million upto 1:12,500 scale.

Each of the IRS Missions ensured data continuity while introducing improvements in the spatial, spectral and radiometric resolutions. Hitherto, the best spatial resolution offered from the IRS satellites is 5.8m in both Panchromatic and multispectral mode.

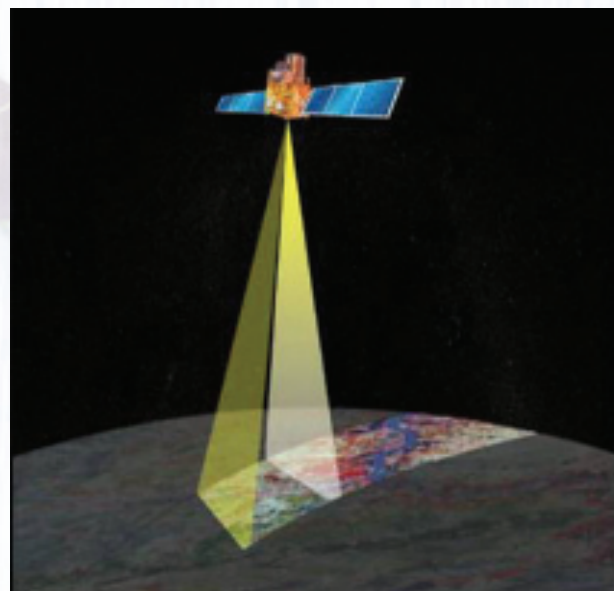
There is now an increasing demand for large scale and topographic mapping. To meet this requirement. DOS has launched the **Cartosat-1** satellite which is dedicated to stereo viewing for large scale mapping and terrain modelling applications.

Globally there are many satellite systems which provide high resolution data to meet the requirements for geo-engineering and cartographic applications. The Cartosat-1 satellite has a number of advantages over these systems in that it provides high resolution near-instantaneous stereo data with a spatial resolution of 2.5m and 10bit quantization. The Cartosat-1 carries two Panchromatic cameras, which generate stereoscopic image of the area along the track.

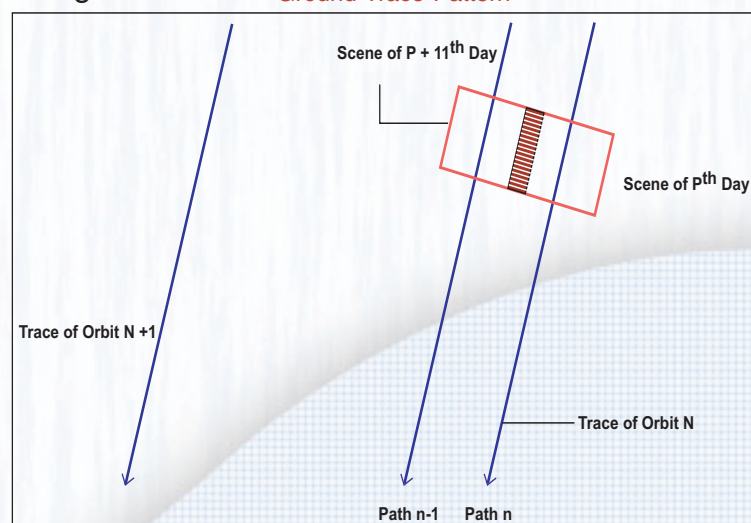
Cartosat - 1



Along track stereo viewing



Ground Trace Pattern



Orbit and Coverage

Cartosat-1 is a global mission. The nominal life of the mission is planned to be five years. The satellite was launched by the indigenously built Polar Satellite Launch Vehicle (PSLV - C5). The satellite covers the entire globe in 1867 orbits with a repetivity of 126 days. Adjacent paths are covered with a separation of eleven days.

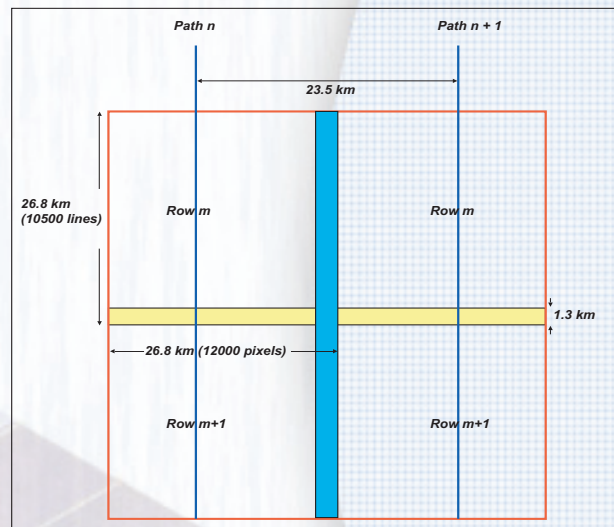
Orbit Specifications

S.No	Parameter	Specifications
01	Orbit	Polar Sun Synchronous
02	Orbital Altitude	618 km
03	Orbits / cycle	1867
04	Semi Major Axis	6996.14 km
05	Eccentricity	0.001
06	Inclination	97.87 °
07	Local Time	10:30 AM
08	Revisit	5 days
09	Repetition	126 days
10	Orbits / day	14
11	Orbital Period	97 minutes

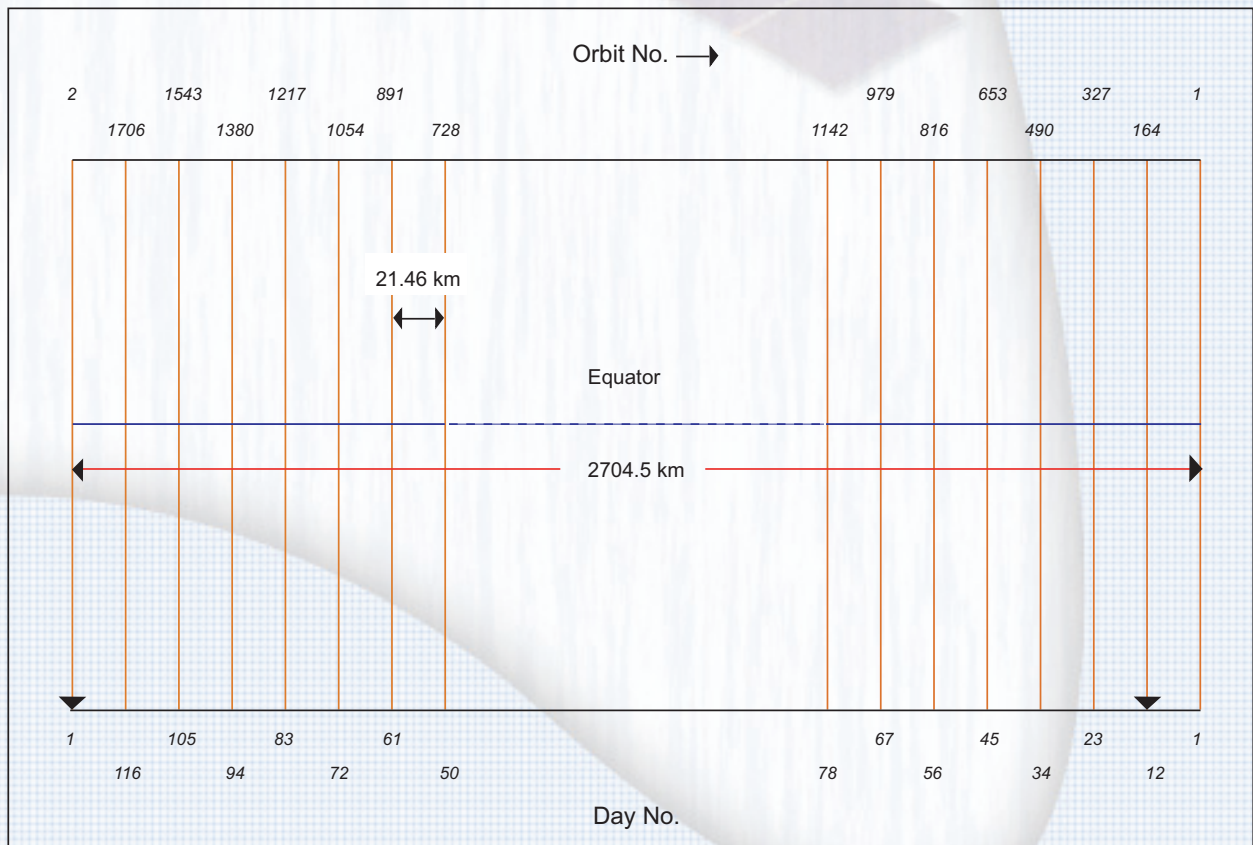
Payload

The Cartosat-1 satellite has two panchromatic cameras with 2.5 m spatial resolution, to acquire two images simultaneously, one forward looking (FORE) at +26 degrees and one aft of the satellite at -5 degrees for near instantaneous stereo data. The time difference between the acquisitions of the same scene by the two

Stereo Scene Layout



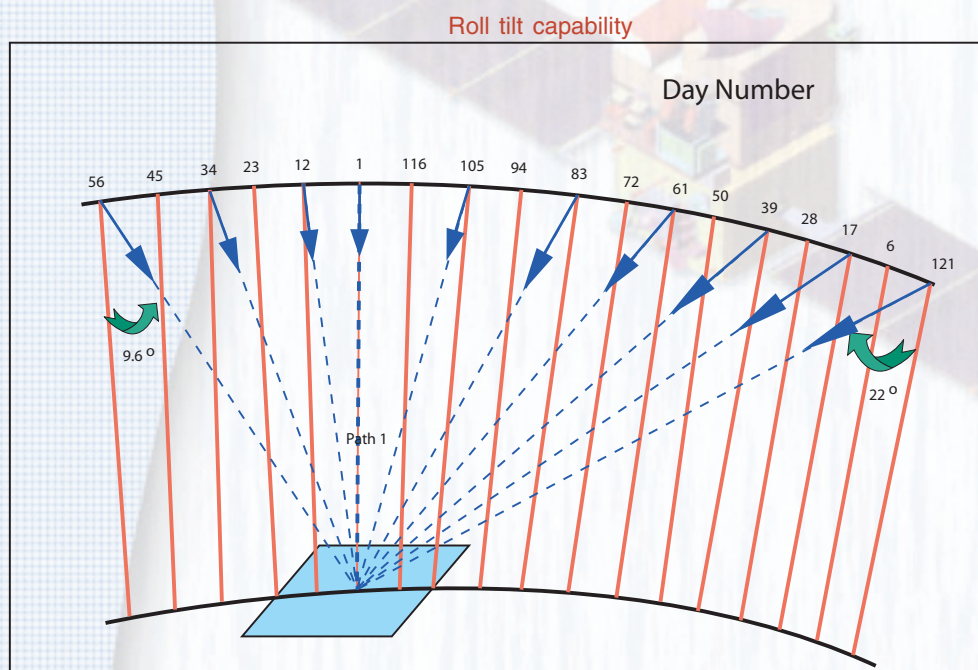
Orbit and coverage pattern



cameras is about 52 seconds. The spacecraft body is steerable to compensate the earth rotation effect and to force both Fore and Aft cameras to look at the same ground strip when operated in stereo mode. Simultaneous stereo pair acquisitions are of great advantage since the radiometric parameters of the images will be identical. The stereo pairs have a swath of 26 km and a fixed B/H ratio of 0.62. Apart from the stereo mode, the satellite is also equipped to operate in the wide swath mode. When operated in this mode the satellite can be maneuvered such that image strips will fall side by side so that wider

Payload Specifications

S.No	Parameter		Specifications
01	Swath	Fore	29.42 km
		Aft	26.24 km
02	IGFOV	Fore	2.452 m (Across track)
		Aft	2.187 m (Across track)
03	Ground sample distance		2.54 m (Along Track)
04	Spectral band		0.5 – 0.85 microns
05	Quantisation		10 bits (1024)
06	Number of detectors		12 K
07	Pixel size		7 x 7 micron
08	Integration time		0.336 ms
09	Focal length		1945 mm
10	Data rate per Camera		336 Mbps
11	Data compression Ratio		3.22:1(nominal)depends on terrain
12	Type of compression		JPEG
13	Data rate transmitted to ground		105 Mbps/camera



swath images of 55 km are obtained by the cameras. The spacecraft also has a facility to provide various pitch-biases to vary the look angle conditions of the stereo pair.

The satellite covers the same area in a specified interval of 126 days. Cartosat-1's roll tilt capability can be used to increase this viewing frequency, which varies with latitude. The revisit capability at equator is 5 days.

Data Handling system

The data rate requirement for 2.5 m resolution system is about 336 Mbps for a 10 bit quantization. This high bit data is compressed by 3.2:1 by JPEG compression technique. A spherical Phased Array Antenna with steerable beam is used to transmit the data to the required ground station. A solid state recorder with 120 Gb capacity to store about 9 minutes of Payload data is available for global operation of the payloads.

Cartosat - 1 Products

Cartosat-1 data products are of two categories.

- * Standard product (radiometrically corrected, georeferenced)
- * Precision product (ortho rectified product)

Standard products are generated after accounting for radiometric and geometric distortions while precision products are ortho rectified. Ortho rectified products are corrected for terrain distortions and camera tilt effects with the help of control points and using Stereo Strip Triangulation (SST) based DEM (only for Indian region). All Cartosat -1 data products are supplied with 10 bit radiometry for both PAN Fore and Aft cameras.

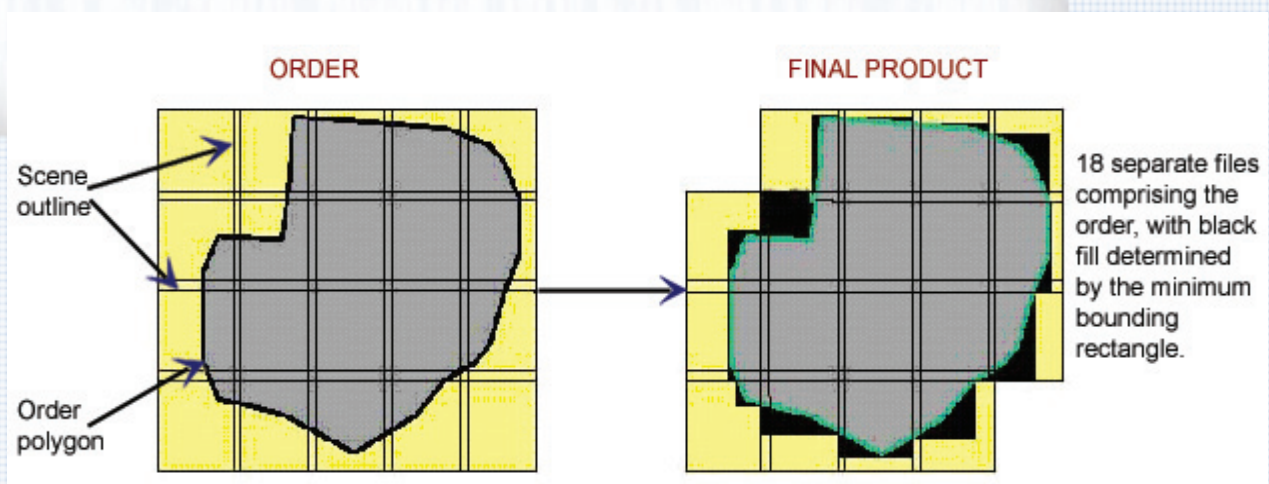
Area of Interest (AOI) based standard products

One or more scenes covering the user's area of interest, specified as a single polygon in the form of an ESRI shapefile, are provided as tiled products (not mosaiced). The user-specified polygon (order polygon) is padded outside with extra buffer distance to ensure the area coverage, considering the accuracy specifications of the system corrected product. The modified polygon boundaries are used to define each constituent full/sub-scene product. The different tiles are not radiometrically matched. The minimum order area is 25 km x 25 km. The location accuracy of these products is better than 250m. All AOI based products are provided as digital products (CD/DVD) only. AOI products are available for only radiometrically corrected or Geo-referenced data.

Standard Products

S. No	Type of Product	Correction applied
01	Radiometrically corrected / Basic Stereo	Stagger corrections, line loss corrections, radiometric correction at scene level
02	Standard Georeferenced	Radiometric and geometric corrections (north-oriented) at scene level using System knowledge
03	Orthokit products (Mono / Stereo)	Radiometric corrections along with Rational Polynomial Coefficients (RPCs)
04	Ortho product	Terrain corrected products using TCPs and DEM from SST software (only for Indian region)

Outline of AOI Product (Multiple Scenes)



Standard Products Specifications

S. No	Area Coverage (Scene based / Float)	Level of Processing	Digital data Format	Media	Accuracy specifications		Remarks
					Location Accuracy	Internal Distortion	
01	Scene/float Mono/Stereo*	RAD	LGSOWG	CD-ROM/DVD/Disk	250m	Terrain dependent	Basic stereo pair
02	Scene/float (Mono/Stereo) *	RAD	Orthokit ###	CD-ROM/DVD/Disk	250m	Terrain dependent	RAD product with RPC file
03	Scene/float (Mono) *	Standard § Corrections Applied ##	LGSOWG* GeoTIFF Fast Format	CD-ROM/DVD/Disk	250m	Terrain dependent	Geo - Referenced product
04	Scene/float Mono *, AOI §	Standard Corrections Applied #	GeoTIFF	CD-ROM/DVD	250m	Terrain dependent	Geo - Referenced product

Includes AOI

All standard corrections products are Geo-Referenced.

Include RPC file and Meta file.

§ Minimum area of AOI is 25*25 Sq km, supplied with Meta file.

* Restricted Area Masking is done, wherever required.

Orthokit Products

Ortho kit products are supplied with only radiometric corrections. A file consisting of the rational polynomial coefficients (RPC) is also provided for further processing at user's end. An orthokit product consists of an image file (GeoTIFF format), an RPC file (text file) and a metadata file.

Orthokit products facilitate the user to produce high precision products by using control points / external DEM in the commercially available off-the-shelf (COTS) software. It is recommended to use software packages, certified by Department of Space, for better results.

Stereo Products

Scene based stereo products are supplied with only radiometric corrections. Stereo data are supplied as digital products only. These products can be supplied in LGSOWG format and in GeoTIFF format with RPCs.

In the case of stereo data in LGSOWG format, radiometrically corrected data from both Fore and Aft cameras are provided. Stereo data in GeoTIFF format comprise of radiometrically corrected data from both Fore and Aft cameras and an RPC file.

These products facilitate the user to produce high precision products and extract digital elevation models (DEM). The location accuracy of the products is better than 250m. It is recommended to use software packages, certified by Department of Space, for better results.

Precision geo-referenced products

These are mosaiced and ortho rectified products. These products can be supplied with different area coverages – 7 ½' x 7 ½' (both Survey of India (SOI) mapsheet based and floating), 5' x 5', 3.75' x 3.75' and 2.25' x 2.25'. All these products are supplied as a single product. Best efforts are made to provide the data with seamless radiometry in case the area is covered on two different dates. The location accuracy of these products will be better than 25m. For global users, these products can be supplied with the help of GCPs provided by the user.

Precision (Ortho) Products

S. No	Area Coverage	Level of Processing	Digital data Format	Media	Accuracy specifications		Remarks
					Location Accuracy	Internal Distortion	
01	Mapsheet based/Float 7.5' * 7.5' *	Precision (ortho) Terrain corrected	GeoTIFF	CD-ROM	≤ 25m	Around 10m	Using DEM and TCPs
02	Float 5' * 5' *	Precision (ortho) Terrain corrected	GeoTIFF	CD-ROM	≤ 25m	Around 10m	Using DEM and TCPs
03	Float 3.75' * 3.75' *	Precision (ortho) Terrain corrected	GeoTIFF	CD-ROM	≤ 25m	Around 10m	Using DEM and TCPs
04	Float 2.25' * 2.25' *	Precision (ortho) Terrain corrected	GeoTIFF	CD-ROM	≤ 25m	Around 10m	Using DEM and TCPs

Note:

All the Geocoded products ortho corrected.

* Restricted Area Masking is done, wherever required.

Services

Various services provided include :

1. On-line Digital browse facility
2. On-line data ordering facility
3. On-line Payload programming request placing facility
4. Data dissemination in near real-time through network

On-line Digital browse facility

The on-line digital browse service facilitates easy location and selection of available data. Data availability can be queried based on AOI, city name, Survey of India mapsheet, polygon, district name, state name, location on a map or by inputting a shape file. This facility can be used as a stand-alone service or as an integral part of the on-line data ordering facility.

<http://www.nrса.gov.in>

On-line data ordering facility

This facility enables the user to place requests for products on-line based on the type of product required. Users need to specify their area of interest in terms of point, Survey of India mapsheet, polygon, district name, state name, location on a map or by inputting a shape file; period of interest and type of product. Browse images which meet the user input are fetched and presented to the user. Users can select the scenes which suit their requirement and save the details. Users can view the list of scenes selected and the corresponding graphic display.

In addition to on-line ordering, this facility enables the users to get information on their product status and accounts status.

<http://www.nrса.gov.in>

On-line Payload programming request placing system

The existing data may not cover the user's area of interest, may be cloudy or otherwise not meet the user's requirement. In such cases, users can request for programmed

Digital Browse Queries

NRSA - Browse Queries Home - Netscape

Back Forward Reload Home Search Helpscope Print Security Shop Stop

nrsa National Remote Sensing Agency
Civil Resources for Planet Earth
Department of Space, Govt. of India

Image Search

Geographical Area Based Query

[Help](#)

By Date

By Path

By Polygon

By MapSheet

By Location Name

By Point

Browse Home

Satellite: Sensor: Area Around the Point: Km

LAT - LONGS of the POINT in ☒ Decimal ☐ Deg Min Sec

(max.xcoord) (max.ycoord)

Top Left Latitude NORTH Longitude EAST

Bottom Right Latitude NORTH Longitude EAST

Submit Reset

data. Such requests also can be placed on-line. A request placed for payload programming, is first checked for feasibility of acquisition and a proposal is sent to the user. On obtaining the user confirmation, data are programmed and acquired. Acquisition plan is prepared based on the priority of the request and cloud cover conditions of the area requested. On successful acquisition, data are generated after user confirmation. A maximum of three attempts are made within the requested period. Users can view the proposal and request the status on-line.

<http://www.nrса.gov.in>

Data dissemination in near real-time through network

In order to deliver data within a few hours of acquisition a web based ftp site is maintained which enables the user to download the data using Internet. The user is given an account based on user name and password. All the users who want to avail this facility should be registered with NDC.

The registration is done offline. The users need to write to NDC or mail to NDC for registering themselves. While ordering the data, the user needs to specify whether the data has to be transferred through net or not. As soon as the data are uploaded to the ftp server, the user gets a mail with his password. The user needs to key in the password while downloading the data.

As the data to be transferred is voluminous, it takes a long time for the transfer. Therefore provision exists to compress the data and put on the net. Option to select the ratio of compression and the software to be used for compression is given to the user while placing the order.

How to avail these facilities ?

Users can avail these facilities by registering themselves with the services. All the services are made available without any service fees.



Cartosat - 1 Data Distribution

Various sources of Cartosat-1 data worldwide are as follows :

1. Indian users and users from neighbouring countries covered by Indian ground station, can procure Cartosat -1 data products from NDC.
2. International users can get Cartosat-1 data products from the following source :

Antrix Corporation Ltd.
Antariksh Bhavan, New BEL Road,
Bangalore - 560 094,
Karnataka, India

e-mail : antrix@bgl.vsnl.net.in
Phone : +91 80 2341 6274
: +91 80 2217 2189
Fax : +91 80 2341 8981
Web site: www.antrix.org

3. IRS International Ground Stations operating in various parts of the World.

4. It is possible to provide raw data for the user specified areas and period of interest along with the data processing software. This concept is known as virtual station. For such data requirements, users can contact Antrix corporation.

For specific information on availability of an IGS or data of a particular location, users may contact Antrix Corporation Ltd. - the commercial wing of DOS.

Data down link access

Antrix Corporation Ltd., Department of Space, is responsible for data distribution outside the Indian visibility cone. For data down link access, users can contact Antrix Corporation Ltd.

Upgradation / Establishment of Ground Station

Antrix Corporation Ltd. has the required expertise to upgrade the existing ground station having X-band (8 to 8.4 GHz) reception capability to receive Cartosat-1 data or set up an entirely new reception and

processing facility. Antrix shall announce from time to time other agencies authorised to provide reception capability for Cartosat-1.

General terms and conditions of supply of data products

Orders

The order will be entertained only when the required information is furnished in full and payment made in advance. Once the order is processed, NDC sends a confirmation copy to the purchaser. Order once processed and confirmed cannot be amended or cancelled unless technical problems are encountered during data generation. NDC reserves the right to refuse/cancel any order in full or part.

Price

The price applicable to each order is the one in effect on the date of confirmation of the order at NDC. NDC publishes a price list of data products at periodic intervals.

Payments

All orders must be accompanied by full advance payment for processing to be initiated.

For Indian users, payment may be made by demand draft in Rupees payable to **National Remote Sensing Agency, Hyderabad – 500 037, Andhra Pradesh, India.**

For foreign users, within the Indian ground station coverage payment may be made by telecredit in US\$ payable to **ANZ GRINDLAYS BANK, Account no Madras 001313.0001 chips 232293** for credit to NRSA, Hyderabad. India.

For continued operation, a standing account can be opened by users by depositing a suitable amount. The user may add to the balance or obtain a refund of the balance at any time. Processing of data at any time will

be limited to the balance amount in user's account. Same organisation/individual can open more than one account if required.

Conditions of sale

All products are sold for the sole use of purchasers and shall not be loaned, copied or exported without express permission and only in accordance with terms and conditions if any, agreed with the NRSA Data Centre, National Remote Sensing Agency, Dept. of Space, Govt. of India.

Complaints and inspection

No complaint related to the quality and/or quantity of the products will be entertained unless the complaint is lodged at NDC within 30 days from the date of despatch. On acceptance of the complaint, products can be returned after confirmation by NDC. If the rejections are accepted by NDC, all attempts will be made to provide similar/ equivalent data products.

The purchaser is responsible for any use of the data products purchased from NDC, which has no liability or responsibility for the fitness of the products for any particular use. Consequently, the purchaser waives all claims against NDC.

In general, all the data products will be despatched by registered insured post/air parcel. Products can be despatched by Courier service/speed post or through FTP site as specific request and at NDC's discretion.

Supply of data products on the price list are governed by these general terms. No contrary terms or conditions of the purchaser are binding on the NRSA Data Centre. Completed order form and payment may be mailed to:

NRSA Data Centre
National Remote Sensing Agency
Balanagar, Hyderabad – 500 037.
Phone:040 – 23878560, 23884423,
23884424
Fax :040 – 23878664/23878158
E.mail : sales@nrса.gov.in
Web site: www.nrса.gov.in



Cartosat - 1 Image - Adana, Turkey



