



INTERNATIONAL ATOMIC ENERGY AGENCY
UNITED NATIONS EDUCATIONAL, SCIENTIFIC AND CULTURAL ORGANIZATION
INTERNATIONAL CENTRE FOR THEORETICAL PHYSICS
I.C.T.P., P.O. BOX 586, 34100 TRIESTE, ITALY, CABLE CENTRATOM TRIESTE



H4.SMR/383 - 08

WORKSHOP ON REMOTE SENSING TECHNIQUES
WITH APPLICATIONS TO AGRICULTURE, WATER
AND WEATHER RESOURCES

(27 February - 21 March 1989)

GROUND RECEIVING STATIONS

AND

DATA DISTRIBUTION SERVICES

JURG LICHTENEGGER
ESA/Earthnet Programme
ESRIN
C. P. 64
00044 Frascati
ITALY



WORKSHOP ON REMOTE SENSING TECHNIQUES WITH
APPLICATIONS TO AGRICULTURE, WATER AND
WEATHER RESOURCES, TRIESTE, 27/2-21/3/89

LECTURE NOTES

GROUND RECEIVING STATIONS AND
DATA DISTRIBUTION SERVICES

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ESRIN C.P.64
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INTRODUCTION:

The Remote Sensing Concept

- Application specific systems and sensors
- spacial, spectral, temporal resolution

Futur Concepts

- similar but refined and with all weather capability



TODAY'S MISSIONS AND ORGANIZATIONS

Systems

- operational
- experimental

Owners and Distributors

Data Access

- on line/off line catalogue and ordering access
- quicklook
- CCT and full resolution photo-products



TODAY'S MISSIONS AND ORGANIZATIONS cont.

Accounting

- principal investigator status (see AO)
- standing order
- pre-payment
- post-payment

The Example: ESA and its Earthnet Programme

- Objectives
- Mission handled: Landsat etc.
TIROS-N Earthnet Concept
- ERS-1 system

Operational Earth Observation Satellites

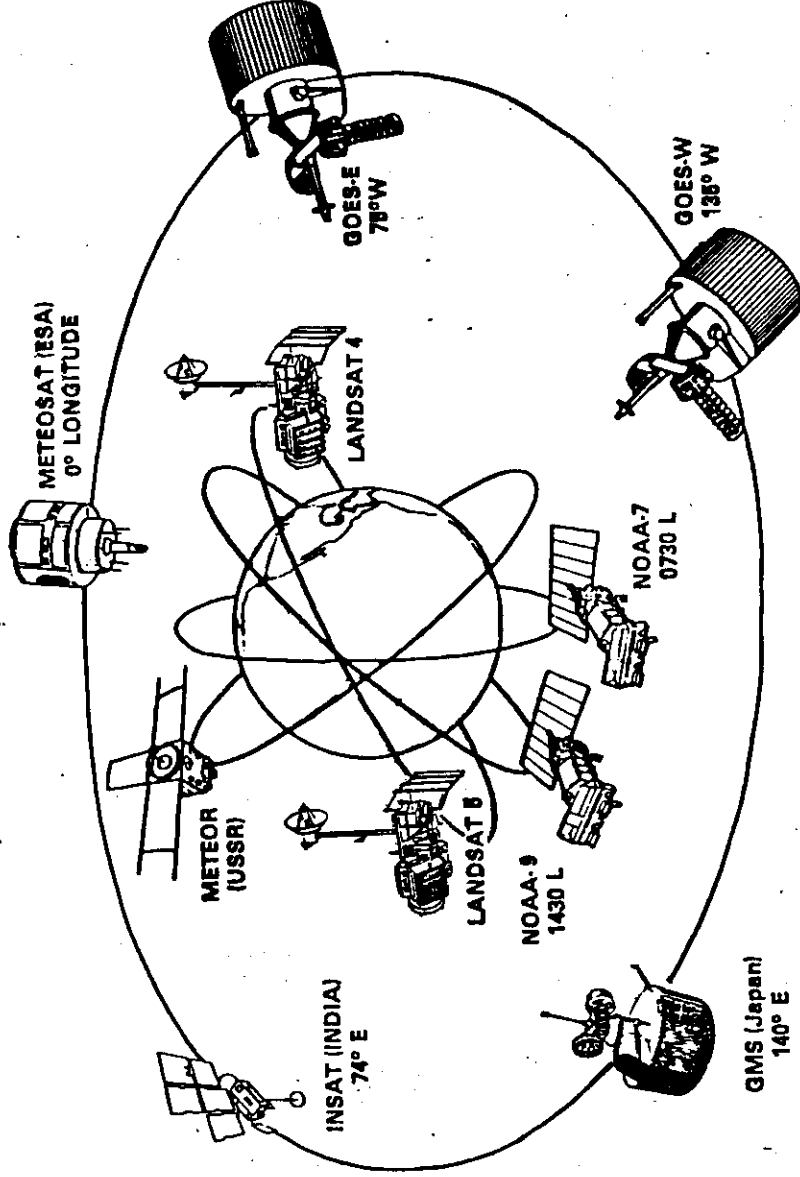
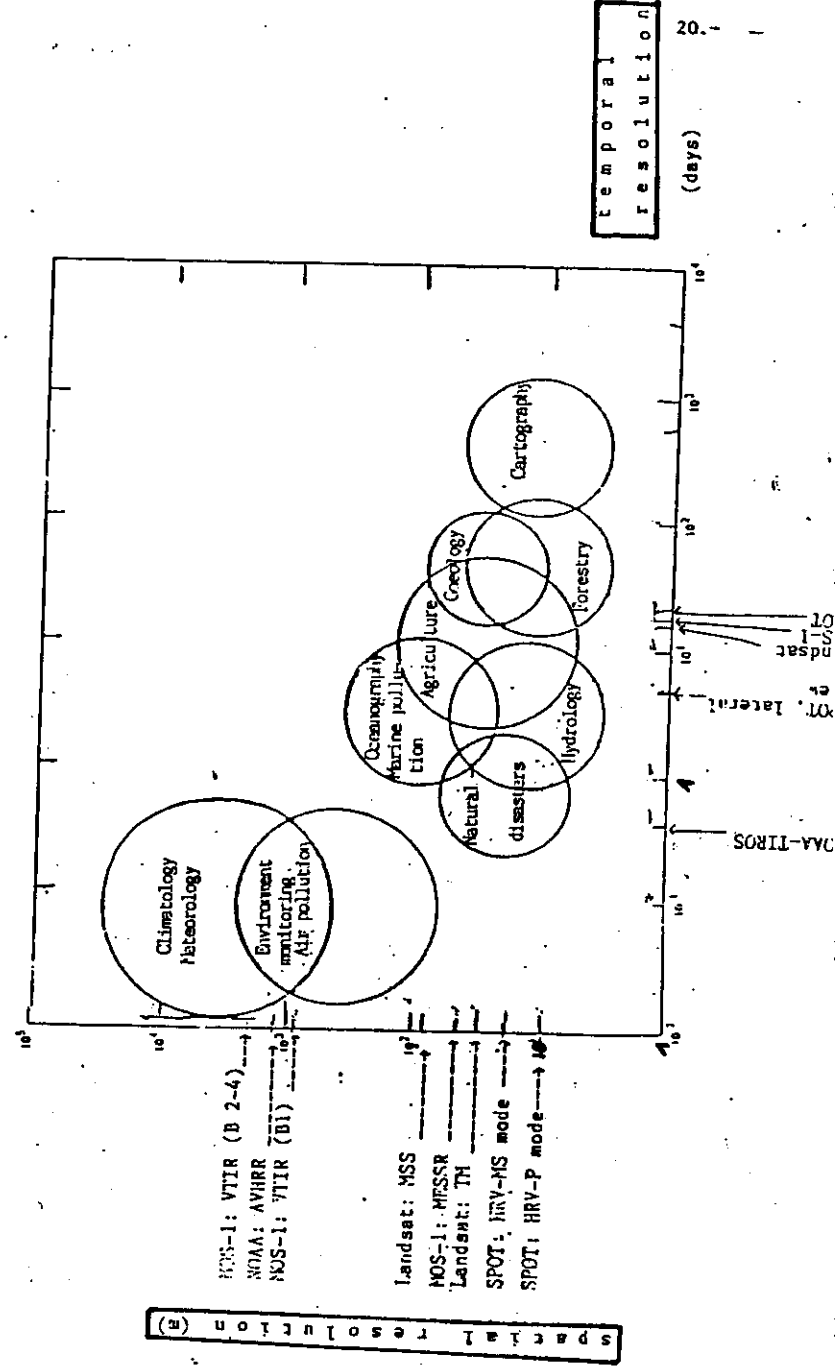


Figure 4 - Suitability of selected satellites for main applications (adapted from Frayssé, G., 1983, Fig. 4, P 298).



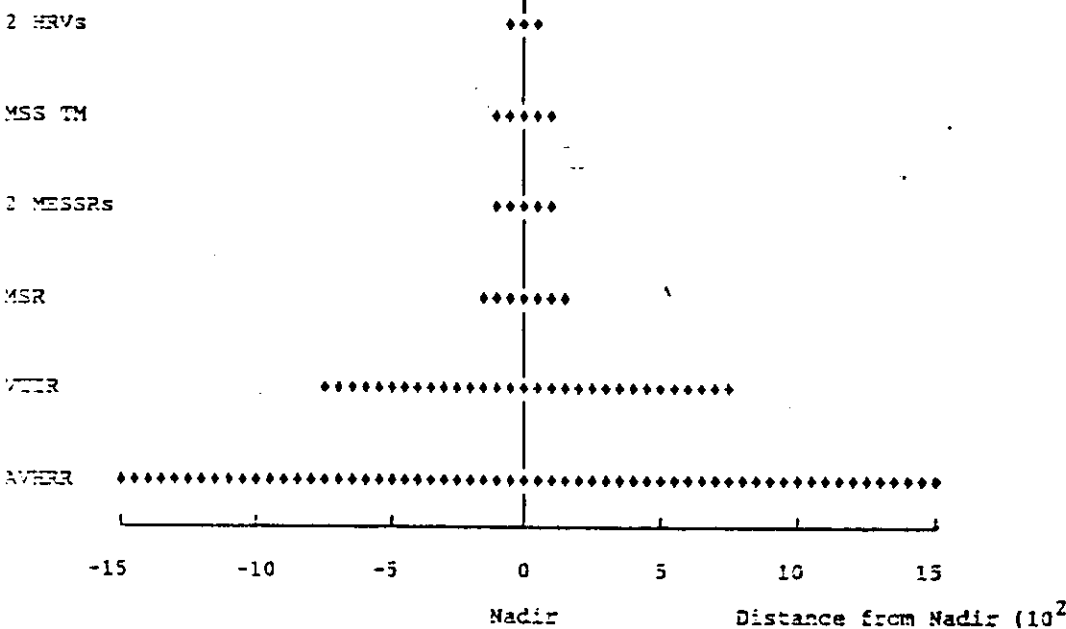


Fig. 2-1: Comparison of swath width of selected sensors.

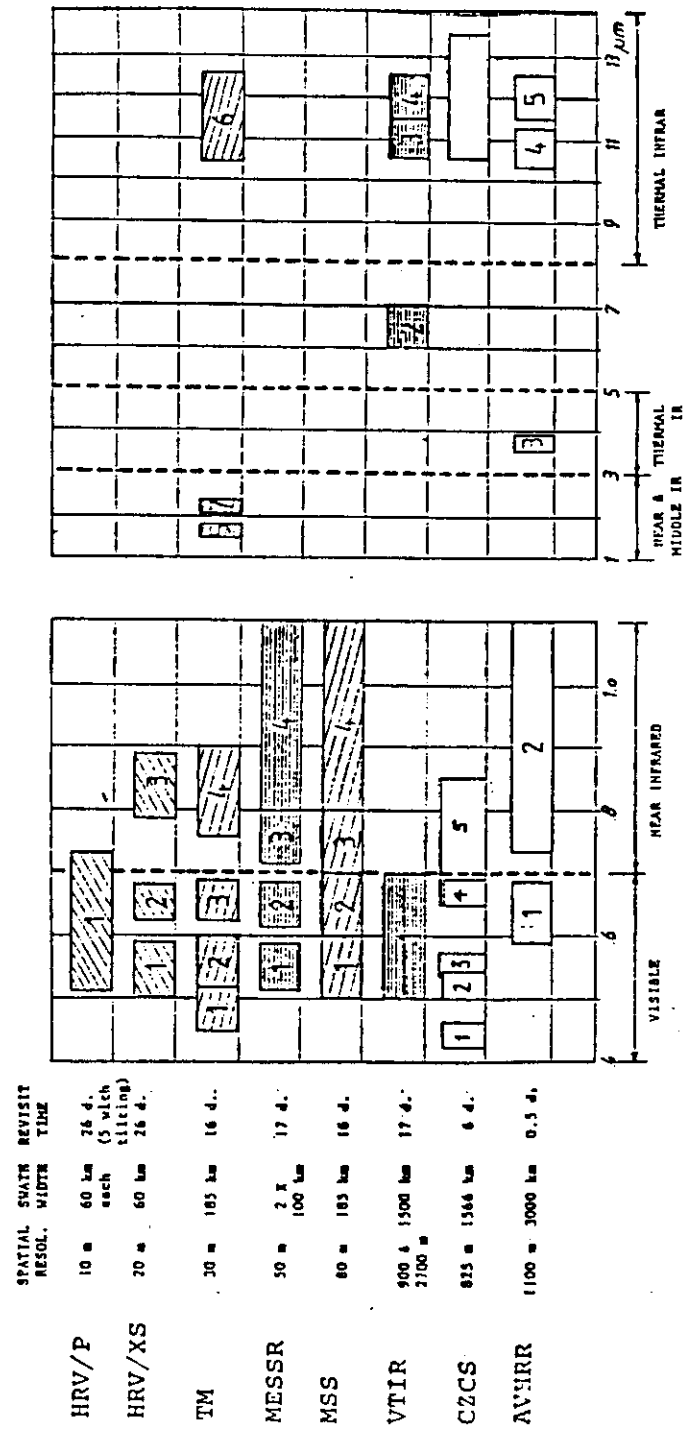
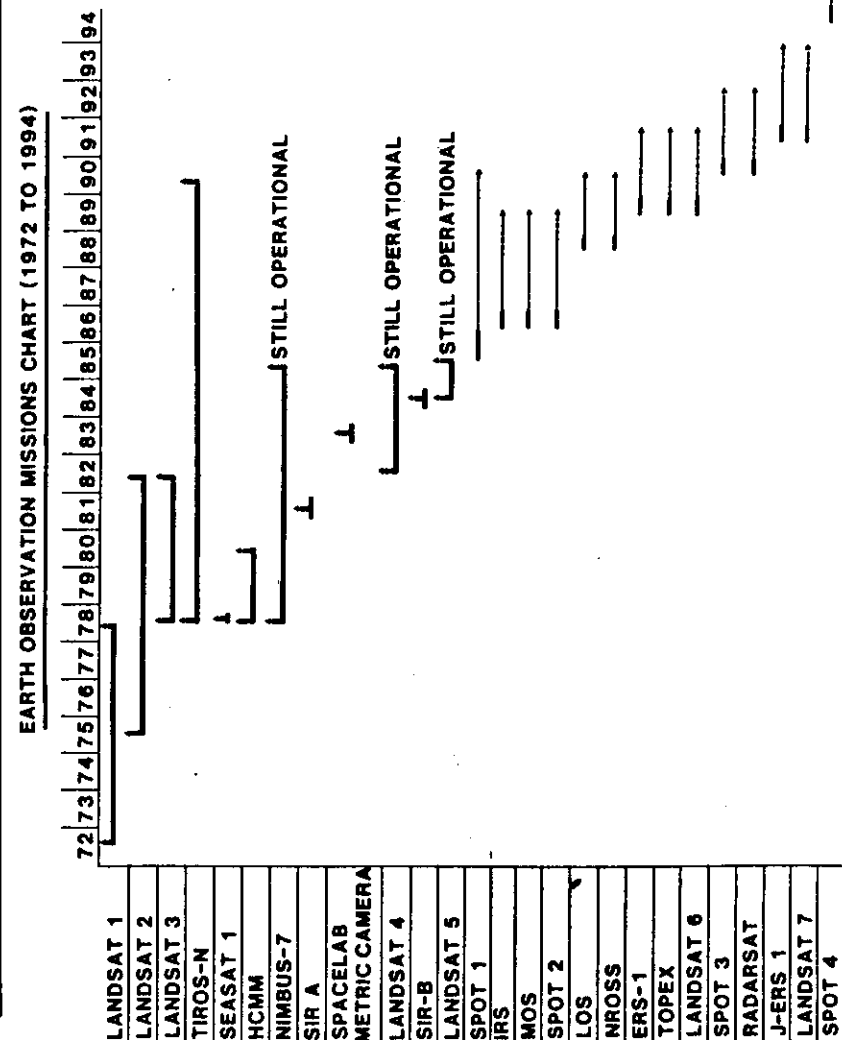
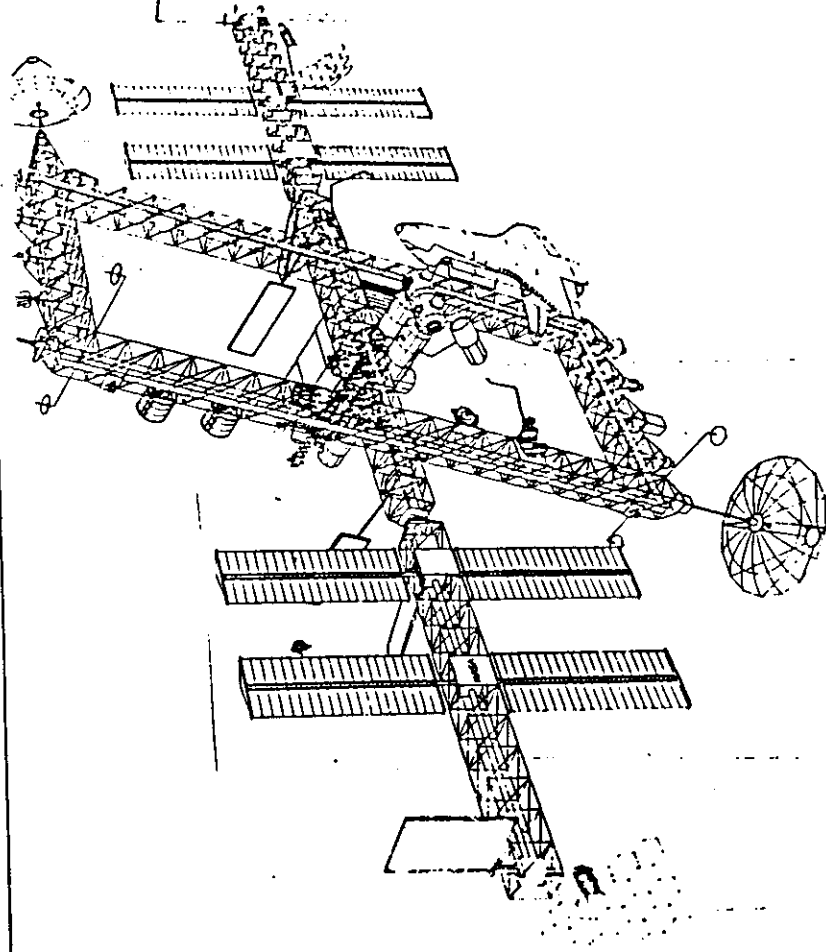
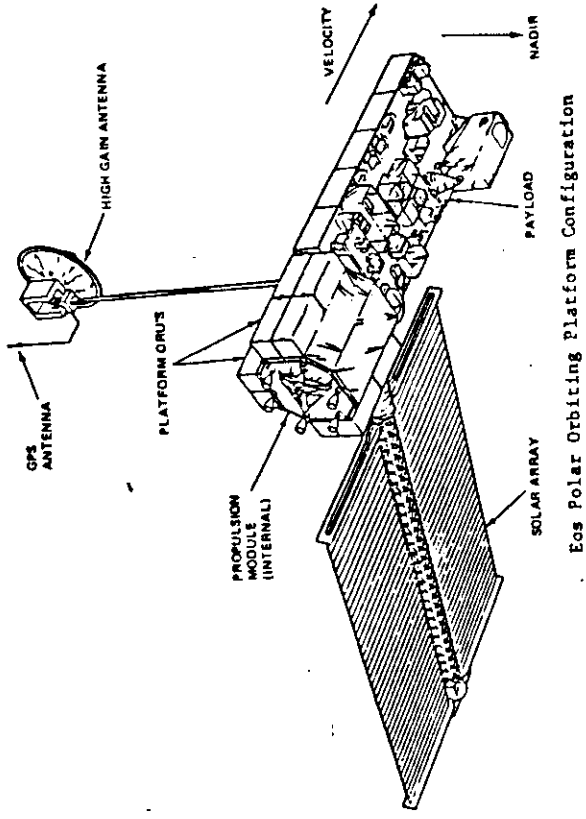


TABLE 4 Summary of Specification of Proposed Sensors

Field	Sensor	Spectrum/ Frequency	Resolution	Obs. width	Obs. frequency
Oceanography	MSS	0.45 - 1.1 μm 10.4 - 12.5 μm	100 m - 1 km	300 km	1 - 7.5 days
	SAR	1.3 GHz			
Fisheries	MSS	0.44-0.54 μm 0.54-0.62 μm 0.62-0.69 μm 0.70-0.86 μm	10 - 50 m	90 - 180 km	2/day (coastal area) 7.5 - 15 days (off shore)
	VIIR	0.50-0.70 μm 10.5-12.5 μm	0.5 - 1.0 km	1500 km	Daily
Agriculture	MSS	0.45-1.75 μm	1 m (rice crop inventory) 20 - 100 m	100 km 200 km	7 days (crop- inventory) 90 days (soil)
	Camera	Color IR			
Forestry	MSS	0.45-1.75 μm	30 - 100 m	200 km	90 days
Land-use, Geology & Resources	MSS	0.45-1.75 μm	30 - 50 m	200 km	90 days
	Camera	Color IR		"	"
	VIIR	0.4-0.7 μm 10.5-12.5 μm		"	"
	SAR	1.3 GHz			
Water Resource	MSS	0.45-1.1 μm	50 - 100 m 10 m (water- quality)	200 km	1 - 2 days
	SAR	1.3 GHz			
	DCS				
Environment	MSS	0.45-1.1 μm	50 - 100 m	200 km	1/day
	Laser- Radar		50 - 100 m	100 km	3/day
	SMMR				
Meso- Meteorology	MSS	0.45-1.1 μm 10.4-12.6 μm	100 m	300 km	1/day
	VIIR	0.49-0.94 μm 10.5-12.5 μm	0.5-1 km	1500 km	1/day

Remark. MSS: Multi Spectral Sensor, SAR: Synthetic Aperture Radar, ALT: Altimeter
VIIR: Visible & Thermal Infrared Radiometer, DCS: Data Collection System,
SMMR: Scanning Multichannel Microwave Radiometer





Space Station Phase 2 Configuration

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LECTURE NOTES

GROUND RECEIVING STATIONS AND
DATA DISTRIBUTION SERVICES

by
Jürg Lichtenegger ESA/Earthnet Programme
ESRIN c.p.64
I-00044 Frascati

MISSIONS AND ORGANIZATIONS

- Operational Earth Observation and Weather Satellites
(choice)

- LANDSAT:

Owner: NOAA, Washington USA
Operator and Distributors: EOSAT (see address on viewgraph)
Further Distributors: - appointed by EOSAT
 - Landsat acquisition station owners
 (see addresses on viewgraph)

- SPOT:

Owner and Operator: CNES, Toulouse France
Distributor: SPOTIMAGE, 16 bis av. Edouard.-Belin.
F-31030 Toulouse Cedex France

Further Distributors: - appointed by SPOTIMAGE
 - SPOT acquisition stations

- TIROS-N

Owner and Operator: NOAA Washington
Distributor: NOAA NESDIS, National Climatic Data Center
Satellite Data Services Division
Room 100, World Weather Building
Washington, DC 20233 USA
tx. 248376 OBSWUR

Further Distributors: For ESA-stations: Earthnet, Frascati.
Many more receiving stations located
at national meteorological services.

- METEOSAT

Owner and Operator: ESA
Distributor: ESA/ESOC MEP/Data Service
Robert-Bosch-Str.5
D-6100 DARMSTADT
Germany

Further Distributor: Many receiving stations often located
at met.service.

LECTURE NOTES (cont.)

GROUND RECEIVING STATIONS AND
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- GOES

Owner and Operator: NOAA
Distributor: NOAA NESDIS (Address see above)

- Experimental Earth Observation Missions (choice)

- SEASAT/NIMBUS/HCMH

Owner and Operator: NOAA Washington
Distributor: NOAA NESDIS (see address above)
Further Distributors: ESA-stations: Earthnet, Frascati.

- in connection with the Space Shuttle flights

- METRIC CAMERA

Distributor: DLR, DFD,
D-8031 Oberpfaffenhofen
Germany tl 08153-28885
tf 08153-281137
tx 5270287 dadf d

- SHUTTLE IMAGING RADAR (SIR-A and SIR-B)

Distributor: National Space Science Data Center
GSFC, Code 601
Greenbelt MD 20771 USA
tl 301-286-6695

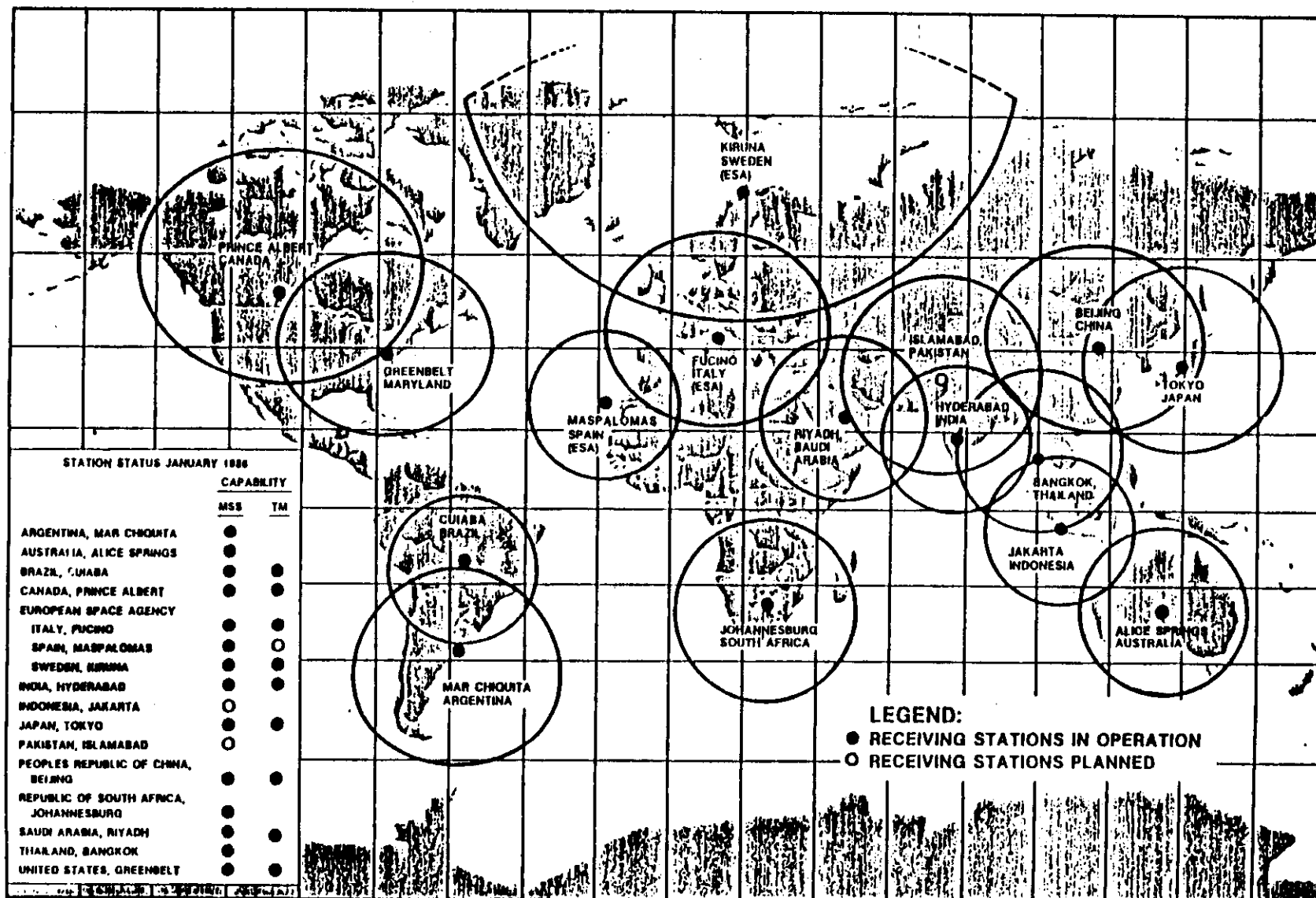
- SPACE SHUTTLE EARTH OBSERVATIONS HAND-HELD
PHOTOGRAPHY:

Distributor: USGS EROS Data Center
Sioux Falls, SD 57198 USA
tl 605-594-6151



4300 Forbes Boulevard,
Lanham, MD 20706 USA

LANDSAT 4/5 COVERAGE



Landsat Receiving Station Capabilities

Station	Date Established	Reception And Processing		Status	Data Distribution Center
		MSS	TM		
Argentina	Dec. 1980	X		Off-line	Comision Nacional de Investigaciones Especiales (CNIE) Centro de Procesamiento, Avenue Dorrego 4010 1425 Buenos Aires, Argentina Tel.: 722-5108; Telex: 17511 LANBA AR
Australia	Nov. 1980	X		TM upgrade scheduled	Australian Center for Remote Sensing (ACRES) P.O. Box 28 Belconnen, Act 2616, Australia Tel.: 062-52 4411; Telex: 61510 ACRES AA
Brazil	May 1974	X	X	Operational	INPE-DCI Caixa Postal 01, Cachoeira Paulista, SP CEP 12630, Sao Paulo, Brazil Tel.: (125) 611507; PBX: (125) 611377; Telex: 1233562 INPE BR
Canada	Aug. 1972	X	X	Operational	Canada Centre for Remote Sensing (CCRS) 2464 Sheffield Road Ottawa, Ontario, Canada K1A 0Y7 Tel.: 613-952-2717; Telex: 0533777 CA
People's Republic of China	Dec. 1986	X	X	Operational	Academy of Sciences, Landsat Ground Station P.O. Box 2434, Beijing, China Tel.: 284861; Telex: 210222 RSGS CN
ESA (3) Fucino Kiruna Maspalomas	Nov. 1982 Apr. 1975 Mar. 1983 Spring 1984	X X X X	X X X X	Operational Operational Operational Seasonal operation	ESA-ESRIN, Earthnet User Services C.P. 64, 00044 Frascati, Italy Tel.: 39-6-9401360 or 39-6-9401216 Telex: 610637 ESRIN I
India	Jan. 1980	X	X	Operational	National Remote Sensing Agency (NRSA) Department of Space, Balanagar Hyderabad - 500 037, Andhra Pradesh, India Tel.: 262572 X 62, 63; Telex: 01556522 NRSA IN
Indonesia	July 1982	X	X	Off-line TM upgrade announced	Indonesian National Institute of Aeronautics and Space (LAPAN) JL Pemuda Persil No. 1, P.O. Box 3048 Jakarta, Indonesia Telex: 49175 LAPAN IA
Japan	Jan. 1979	X	X	Operational	Remote Sensing Technology Center of Japan (RESTEC) Uni-Roppongi Bldg., 7-15-17 Roppongi Minato-Ku, Tokyo 106, Japan Tel.: TOKYO 3-403-1761; Telex: 2426780 RESTEC J
Pakistan	TBD	X	X	Scheduled mid-1987	Pakistan Space and Upper Atmosphere Research Commission (SUPARCO) 43-1/P-6 Pecks, P.O. Box 3125, Karachi-Az, Pakistan Telex: 25720 SPACE PK
Saudi Arabia	Jan. 1987	X	X	Operational	King Abdulaziz City for Science & Technology P.O. Box 6086, Riyadh 11442, Saudi Arabia Tel.: 01-478-8000; Telex: 201590 SJ
South Africa	Dec. 1980	X			National Institute for Telecommunications Research Attn: Satellite Remote Sensing Center, P.O. Box 3718 Johannesburg 2000, Republic of South Africa Tel.: 27-12-26-5271 Telex: 3-21005 SA
Thailand	Nov. 1981	X		TM upgrade scheduled	Remote Sensing Division National Research Council of Thailand (NRCT) 196 Phahonyothin Road, Bangkok Bangkok 10900, Thailand Telex: 82213 NARECOU TH; Tel.: 5791370-9 Cable: NRC BANGKOK
United States	July 1972	X	X	Operational	Earth Observation Satellite Company (EOSAT) 4300 Forbes Blvd., Lanham, MD 20706 Tel.: (301) 552-0500 or 800-344-9933 Telex: 277685 LSAT UR



GEOSYNCHRONOUS : EQUATOR, 0°W 36.000 Km

METEOSAT 1 : LAUNCHED LATE 1977
FAILED NOVEMBER 1979

METEOSAT 2 : LAUNCHED 1981
OPERATING WELL.

SENSORS :

- 2 CHANNELS VISIBLE 0.4-1.1
- 1 CHANNEL THIR, 10.5-12.5
- 1 CHANNEL IR "WATERVAPOR" 5.7-7.1

SIMULTANEOUSLY ONLY 2 CHANNELS CAN OPERATE BY ROTATING SATELLITE.
100 RPM : 2500 LINES, 2500 PIXELS

RESOLUTION : 5Km AT SUBSAT.P.
IF BOTH VIS. CHANNELS 2.5Km

GEOMETRIE : SUPERIMPOSITION WITH REF. MAP ON SCREEN



GEOSYNCHRONOUS : EQUATOR, 75° W 36.000 Km
EQUATOR, 135° W

GOES : (GEOSTATIONARY OPERATIONAL ENVIRONMENTAL SATELLITE)

SENSORS : VISSR (VISIBLE AND INFRARED SPIN SCAN RADIOMETER)
8 VISIBLE CHANNELS SELECTABLE
6 IR CHANNELS

RESOLUTION : 1Km IN VIS
7 OR 14Km IN IR

FURTHER SENSORS : SPACE ENVIRONMENT

MONITOR :

- X-RAY
- ENERGY PARTICLE SENSOR
- PROTONS AND ALPHA DETECTOR
- MAGNETOMETER

DCS (DATA COLLECTION SYSTEM) :

BROADCAST : TO STATION WITHIN RANGE.

EXPERIMENTAL MISSION

LARGE FORMAT CAMERA :

ON SHUTTLE MISSION STS 17, 5-13.10.84

INCLINATION : 57°

CHARACTERISTICS :

30.5 CM FOCAL LENGTH, F/6.0 APERTURE

80 LP/MM AWR

FILM FORMAT SIZE = 23 X 46CM

10 TO 80° OVERLAP

2255 FRAMES ACQUIRED (BW, COL., CIR)

IMAGE SCALE : 1:970.000 OR 1:728.000 DEPENDING ALTITUDE (296 KM OR 222 KM)

GROUND RESOLUTION : 8 TO 25M/LP DEPENDING ON FILM TYPE AND ALTITUDE

DATA AVAILABILITY :

CATALOGUE, MICROFICHES, COPIES THROUGH EDC, SIOUX FALLS, SOUTH DAKOTA, U.S.A.

THE SPACELAB MISSION

METRIC CAMERA

OBJECTIVES :

- COMPILING TOPOGRAPHIC AND THEMATIC MAPS ESPECIALLY IN UNPOPULATED OR LESS DEVELOPED REGIONS OF THE WORLD
- UPDATING AND REVISING TOPOGRAPHIC AND THEMATIC MAPS IN POPULATED AND DEVELOPED AREAS IN THE WORLD

USING CONVENTIONAL PHOTOINTERPRETATION METHODS AS WELL AS CONVENTIONAL PHOTOGRAMMETRY.

TECHNICAL CHARACTERISTICS :

A MODIFIED ZEISS RMK A 30/23 - BUILDER : GERMAN AEROSPACE RESEARCH ESTABLISHMENT - DFVLR; AND GERMAN INDUSTRY.

FOCUS : 305 MM

FOR HEIGHT = 250KM, SCALE 1 : 820,000

IMAGE SIZE : 23CM X 23CM (COVERING 189 X 189KM)

RESOLUTION : 39 LINE PAIRS PER MM, EQUIVALENT TO 21M ON GROUND

POSITIONAL ACCURACY : $\pm$ 5-10M

ELEVATION ACCURACY : $\pm$ 20-35M

OVERLAP : UP TO 80%

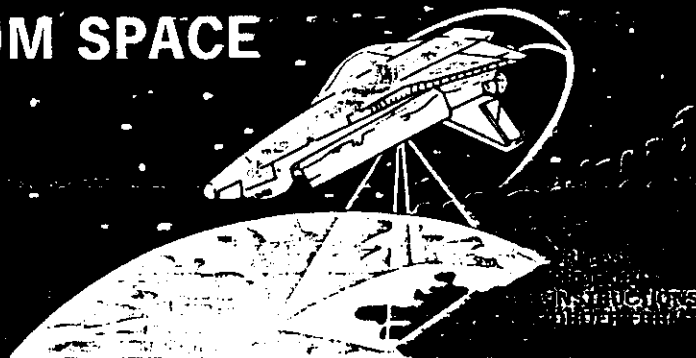
SHUTTER : 1/500 TO 1/1000 SEC
AT 7.55 KM/SEC 15M TO 7.5M

MAGAZIN : 150M FILM 550 IMAGES

FILM : B/W KODAK DOUBLE-X AEROGRAPHIC 2405
CIR KODAK AEROCROME IR 2443

HIGH RESOLUTION PHOTOS FROM SPACE

Large Format Camera



LFC DEPT.
CHICAGO AERIAL SURVEY, INC.
2140 Wolf Road
Des Plaines, IL 60018 USA

Full Rate
U.S. Postage
PAID
St. Petersburg, FL
Permit No. 1080

Phone (312) 298-1480
TELEX 754439 UD

- Imagery from space, useable with many conventional mapping instruments.
- Including black and white, color, and color infrared high resolution photos.
- Individual frames cover up to 65,000 sq.mi. (167,000 sq. km.)
- Stereo coverage with up to 80% overlap.

CAS

CHICAGO AERIAL SURVEY, INC.

NPOC Meeting Dublin
September 1984

SIR-A/B

	<u>SIR-A</u>	<u>SIR-B</u>
System	STS 2	STS 17
Duration	12 Nov.-14 Nov. 81	5 Oct.-11 Oct. 84
Orbit Inclination	38°	57°
Swath	up to 40.8 N	
Altitude	258 Km	225 Km
Frequency	L-band	L-Band
Peak Power (kW)	1	1
Bandwidth (MHz)	6	6
Incident Angle	50°	15° to 65°
Range Resolution (M)	38	110 to 30
Azimuth Resolution (M)	38	30
Swath Width (Km)	50	30 to 55
Number of looks	6	6
Antenna	Fixed	Fold and Tilt
Data handling	Optical	Digital and Optical
Digitization (Bits per Sample)	N/A	6
Data collection	Film	Via TDRSS and Film
Bit Rate (mbps)	N/A	46
Data Processing	Optical	Digital and Optical
Data Collection Time (hrs)	8	25 Digital and 8 Optical
Modes and Configuration Control	By Command or Programming	
Data Availability	Now *	Winter 84/85

* at:

NATIONAL SPACE SCIENCE DATA CENTER

Request Coordination

Code 601

GSFC

Greenbelt MD 20771

UNITED STATES OF AMERICA



earthnet

THE PROGRAMME OBJECTIVES

- PREPARATION OF A EUROPEAN USER COMMUNITY AND PROMOTION OF THE USE OF SATELLITE REMOTE SENSING DATA
- DEVELOPMENT OF THE USER COMMUNITY'S CAPABILITY TO HANDLE NEW AND MORE SOPHISTICATED SENSORS
- AVAILABILITY OF REMOTE SENSING DATA OVER THE AREAS OF MAIN INTEREST TO EUROPEAN USERS IN A CONTINUOUS AND RELIABLE FASHION
- INCREASE IN THE AGENCY'S KNOW-HOW IN THE FIELDS OF HIGH DATA RATE ACQUISITION AND PREPROCESSING
- PREPARATION OF THE GROUND SEGMENT OF THE EUROPEAN REMOTE SENSING SATELLITE PROGRAMME

3



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THE EARTHNET PROGRAMME

LOCATION: ESRIN, Frascati (Rome), Italy

TERMS OF REFERENCE: acquisition, archiving, pre-processing and distribution of
satellite remote sensing data

PARTICIPATING COUNTRIES: all ESA Member and Associate Member States plus
Canada

RESPONSIBILITIES: programme management, network monitoring, user interface,
data dissemination, preparation of future activities

START OF ACTIVITIES: 1978 as optional Programme. Since 1980 part of
mandatory activities of the Agency



earthnet

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-

3



earthnet

THE EARTHNET NETWORK CHARACTERISTICS

1. THE NETWORK IS DECENTRALISED AND RELIES ON NATIONAL FACILITIES INTEGRATED INTO IT
2. DATA ACQUISITION, ARCHIVING AND PRE-PROCESSING IS HANDLED AT THE STATIONS. (FOR ERS-1, ARCHIVING AND OFF-LINE PROCESSING WILL BE PERFORMED IN AD-HOC FACILITIES)
3. DATA ARE ARCHIVED IN RAW FORM. PRE-PROCESSING IS HANDLED UPON USER REQUEST
4. QUALITY CONTROL OF PRODUCTS AND SOFTWARE MAINTENANCE FOR THE NETWORK ARE CARRIED OUT AT THE FACILITIES IN FRASCATI

4



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THE DATAPRODUCTS AVAILABLE AT EARTHNET

- digital data (Computer Compatible Tapes - CCTs) in either raw or System Corrected form
- data in photographic form — Black and White films or prints, colour composites of various three-band combinations, optical enlargements on different scales

51



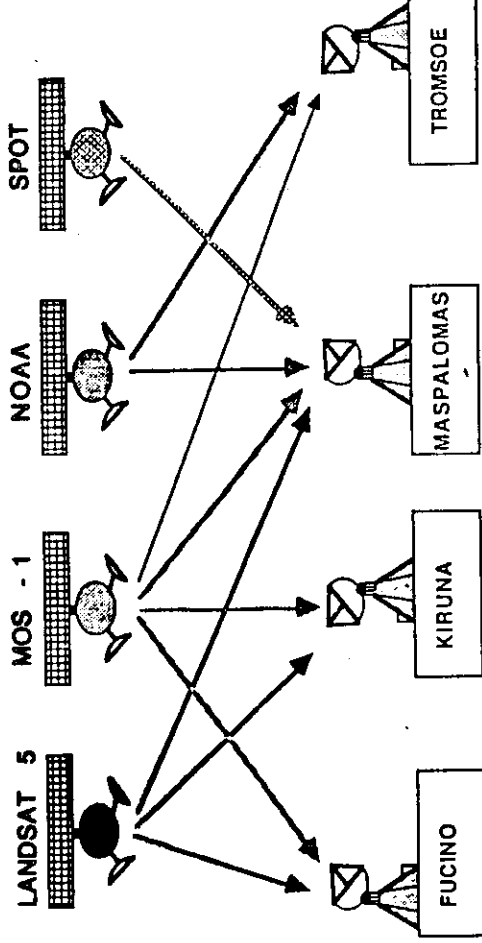
earthnet

THE BROWSE FACILITIES AT EPO, FRASCATI

The Browse Facilities maintain complete, up-to-date files of Incoming data in "quick look" form to aid users in

- assessing specific coverages
- selecting cloud-free imagery
- placing orders for data reproduction on Computer Compatible Tapes or films

The facilities also include microimage catalogues of Earthnet Landsat and Seasat acquisitions, as well as the Spacelab Metric Camera microfiches and the US Eros Data Center Landsat microfiche collection related to data from the different Ground Stations around the World.

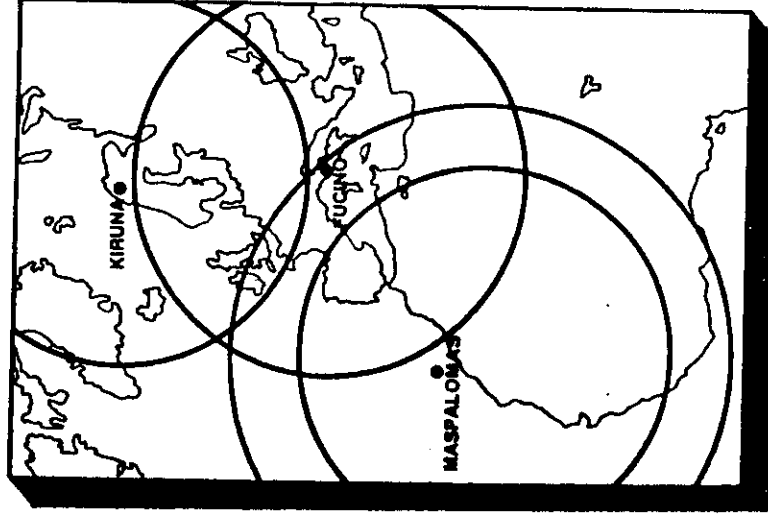


	LANDSAT 5		MOS -1				SPOT		NOAA 9/10	
	TM	MSS	MESSR	MSR	VTIR		HRV		AVHRR	
FUCINO	X	X	X	X	X					
KIRUNA	X	X	X	X	X					
MASPALOMAS	X	X	X	X	X		X		X	X
TROMSOE										



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EARTHNET GROUND STATIONS COVERAGE



- FUCINO LANDSAT COVERAGE ZONE
- KIRUNA LANDSAT COVERAGE ZONE
- MASPALOMAS NIMBUS-7 COVERAGE ZONE
- MASPALOMAS LANDSAT COVERAGE ZONE

EARTHNET NETWORK AND MISSION HANDLED

	LANDSAT-5	MOS-1	TIROS	SPOT-1	ERS-1
FRASCATI	X	X	X	(1)	X
FUCINO	X	X			X
KIRUNA	X	X		(4)	(2)
MASPALOMAS	(1)	X	X	(1)	X
TROMSO		X	X		(4)
GATINEAU	(4)			(4)	X
FARNBOROUGH			X		X
OBERPFAFFENHOFEN					X
BREST					X
LANION			(3)		X
DUNDEE			(3)		X
ROME			(3)		X

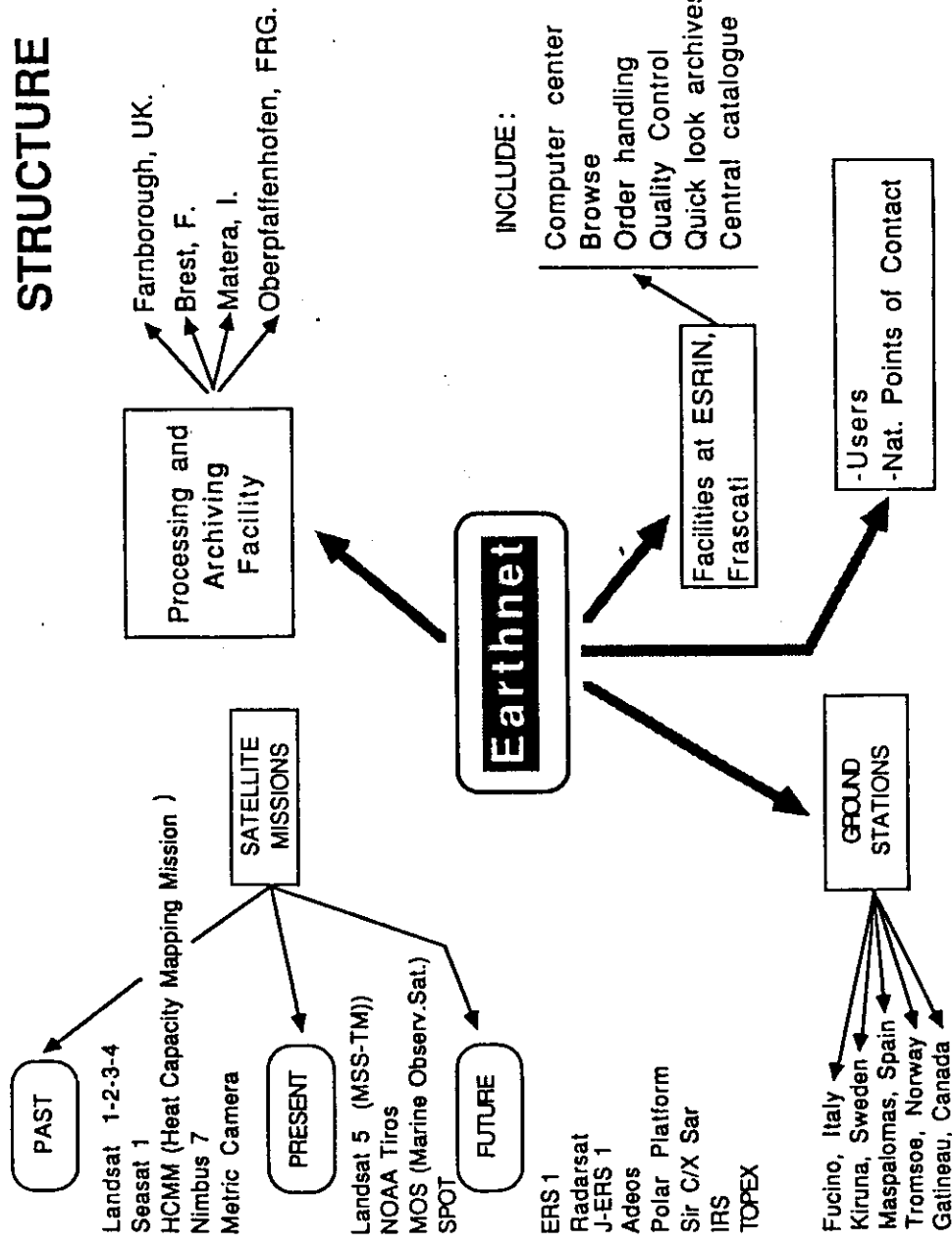
X = EARTHNET

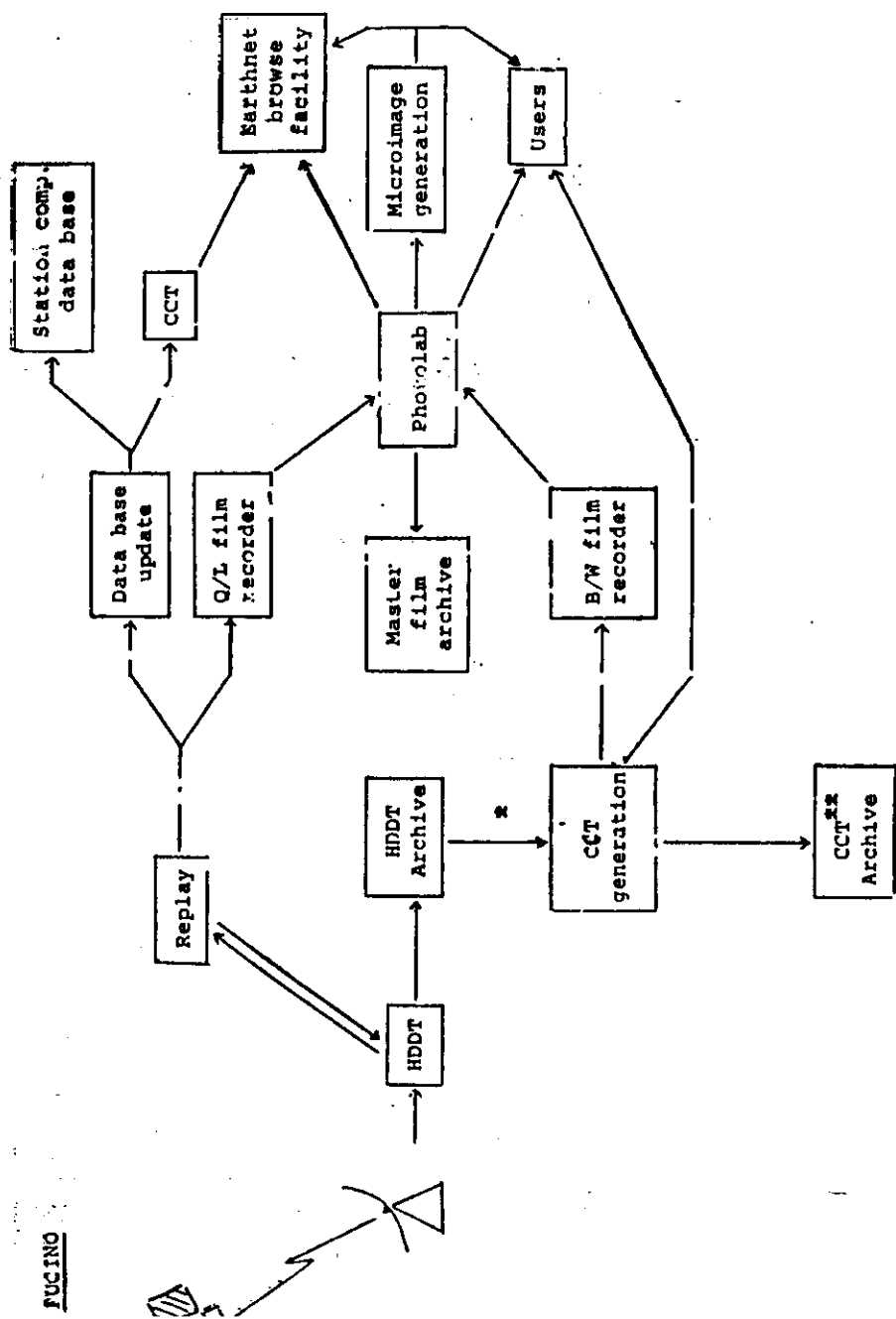
(1) = ESA-EEC AGREEMENT

(2) = ESOC

(3) = TO EPO ARCHIVE

(4) = NATIONAL / FOREIGN





* upon request

** only CCT needed for generation of photoproducts are archived.

TMFRPH1 Thematic Mapper Full Resolution Phase 1

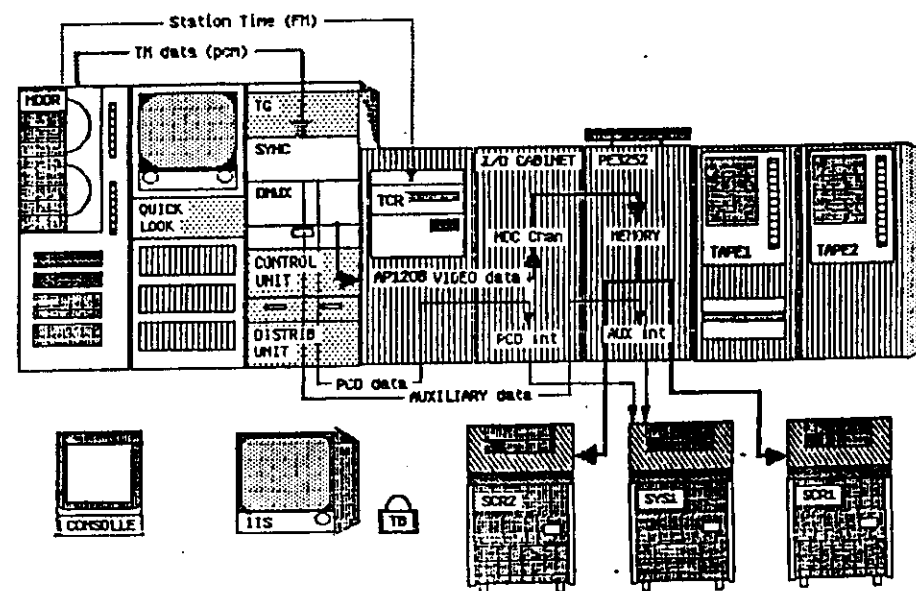


Fig. 2.13.a - TMFRPH1 data flow

TMFRPH2 Thematic Mapper Full Resolution Phase 2

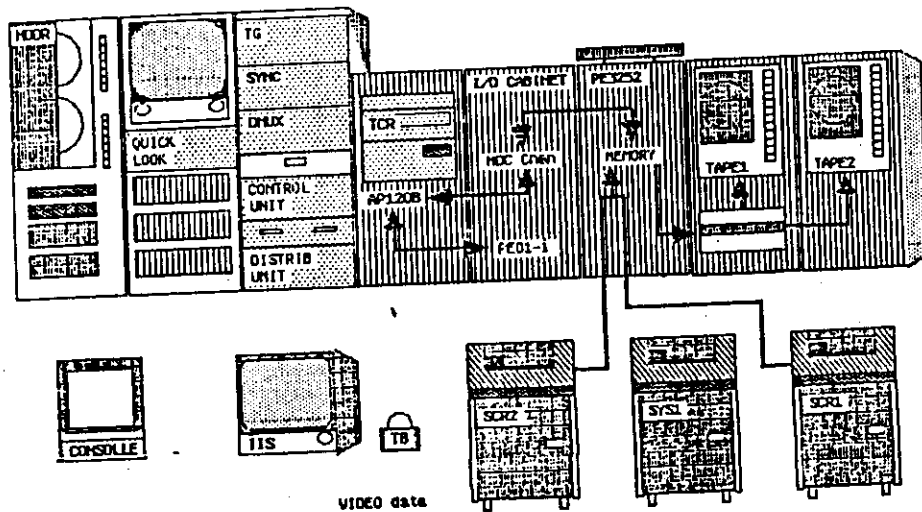


Fig. 2.21.a - TMFRPH2 data flow

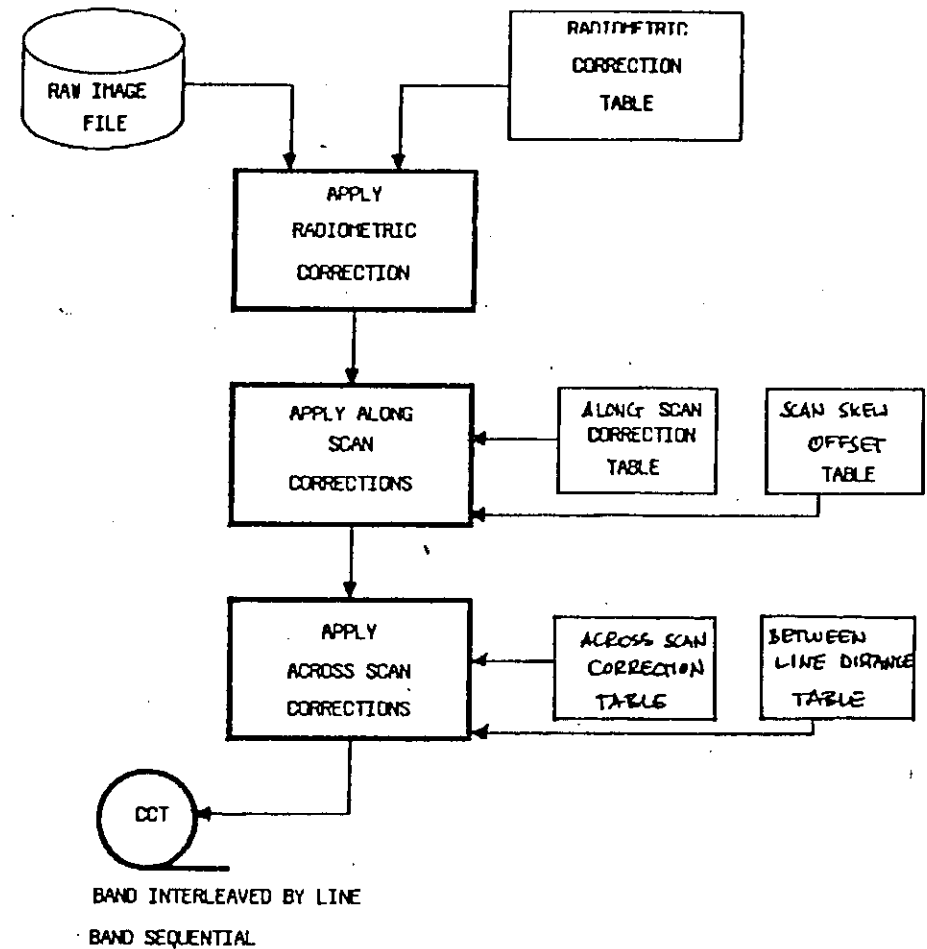


FIG. 6 TM CCT Production Data Flow

EARTH OBSERVATION PAYLOAD DATA ARCHIVED BY EARTHNET

SAT. MISSION	DATE	SCENES/ORBITS	ARCHIVE	LOCATION
LANDSAT MSS	1975 -	494.910	SC	KIR-MAS-FUC
LANDSAT TM	1982 -	176.136	SC	KIR-MAS-FUC
SEASAT	JUN-OCT 78	2.600	OB	FNB
NIMBUS	1978-1986	3.425	OB	MAS
HCMM	1978-1980	1.500	OB	FUC
TIROS	1986 -	4.027	OB	MAS-TRO
MOS-1	1987 -	92.300	SC	KIR-MAS-FUC-TRO
SPOT	1987 -	5.000	SC	TOU

Legend:	FUC:	Fucino	TRO:	Tromso
	KIR:	Kiruna	TOU:	Toulouse
	MAS:	Maspalomas	FNB:	Farnborough
	SC:	Scenes	OB:	Orbits
	MSS:	Multispectral Scanner		
	TM:	Thematic Mapper		
	HRV:	Haute Resolution Visible		
	CZCS:	Coastal Zone Color Scanner		

EXAMPLE OF A LEDA - SEARCH ON ESA/IRS (QUEST)

INPUT : B13
 File 13, LEDA 1972-TODAY
 (ESA/EARTHNET CATALOGUE)
 Connection with LEDA in progress
 L E D A 5
 WELCOME TO EARTHNET COMPUTERISED CATALOGUE
 ENTER CATALOGUE SERVICE REQUIRED
 FOR LANDSAT CATALOGUE ENTER : LA
 FOR TIROS CATALOGUE ENTER : TI
 FOR GENERAL HELP INFORMATION : H
 AVAILABLE OPTIONS : LA TI H
 DEFAULT : LA >

INPUT : LA

LEVEL 1 : TOP LEVEL MENU

YOU ARE IN THE LANDSAT CATALOGUE
 ENTER ACTIVITY MODE :
 AVAILABLE OPTIONS : SI GS OD NW LO H
 DEFAULT : GS >

INPUT : GS

LEVEL 2 : GEOGRAPHIC SELECTION

ENTER GEOGRAPHIC SELECTION MODE. THE RESULTING GEOGRAPHIC
 AREA IS THE SUM OF SUCCESSIVE SELECTIONS. YOU MAY LOOP ON
 THE FOLLOWING CHOICES:
 AVAILABLE OPTIONS: RT TF PN RF PO SH LI SC CS AC SE H
 DEFAULT: SE>

GEOGRAPHIC POLYGON AREA DEFINITION

INPUT : PO

GEOGRAPHIC POLYGON. ENTER FIRST OR NEXT CLOCKWISE POINT OF
 POLYGON COORDINATES LAT, LON (HUNDREDTHS OF DEGREE). AFTER
 THE LAST POINT ENTER <<CR>>:

INPUT : 4000,800+4100,900+4000,1000+

I NEED 4-8 SECONDS FOR GEOGRAPHIC COVERAGE COMPUTATION.

NUMBER OF LAST SELECTED FRAMES : 13
NUMBER OF TOTAL SELECTED FRAMES : 13

ENTER GEOGRAPHIC SELECTION MODE. THE RESULTING GEOGRAPHIC AREA IS THE SUM OF SUCCESSIVE SELECTIONS. YOU MAY LOOP ON THE FOLLOWING CHOICES:
AVAILABLE OPTIONS: RT TF PN RF PO SH LI SC CS AC SE H
DEFAULT: SE>

SHOW LIST OF TRACK/FRAMES

INPUT : SH

SELECTED GEOGRAPHIC AREA EXPRESSED IN TRACK-FRAME
WRS : 1 TRACK = 206 FRAMES FROM 32 TO 32
WRS : 1 TRACK = 207 FRAMES FROM 31 TO 32
WRS : 1 TRACK = 208 FRAMES FROM 31 TO 32
WRS : 1 TRACK = 209 FRAMES FROM 31 TO 32
WRS : 2 TRACK = 192 FRAMES FROM 31 TO 32
WRS : 2 TRACK = 193 FRAMES FROM 31 TO 32
WRS : 2 TRACK = 194 FRAMES FROM 31 TO 32

.....
INPUT : SE

LEVEL 3: IMAGE PARAMETER SELECTION

ENTER IMAGE PARAMETER SELECTION:
THE IMAGE SELECTION IS MADE ON THE "AND" OF ALL POSSIBLE PARAMETER; DEFAULTS ARE ALREADY SET. YOU MAY LOOP ON THE FOLLOWING CHOICES :

AVAILABLE OPTIONS : DD SN CC MA MS MV ST EL AZ LI SH SC CS
OU H
DEFAULT : OU >

SET DATE LIMITS

INPUT : DD

ENTER STARTING, ENDING DATE (YYMMDD, YYMMDD).
TO RETURN TO MAIN MENU ENTER <<CR>> :

INPUT : 810501,810701+820301,820501+

.....

SET CLOUD COVER LIMITS

INPUT : CC

ENTER 4 MSS QUADRANTS CLOUD COVER RANGE (4 MINIMA, 4 MAXIMA):

INPUT : 0,0,0,0,0,0,0,0+DF

I NEED (ABOUT) 11 SECONDS FOR IMAGE SELECTION

SUBJECT COVERAGE

ESA/Earthnet covers areas within a radius of 2500 km around each station. The coverage therefore extends from the polar zones (Greenland, Iceland, Svalbard), Scandinavia and Western Soviet Union to West and North African countries, the Middle East and part of Saudi Arabia. The EROS Data Center catalogue has a worldwide coverage.

SOURCES

The following imaging sensors are acquired: ESA/Earthnet: Multispectral Scanner (MSS) on all satellites, Return Beam Vidicon (RBV) on Landsat 3, Thematic Mapper (TM) on Landsat 4 (December '82 to February '83) and Landsat 5 (April '84 onwards). EROS Data Center Catalogue (including Landsat stations worldwide): MSS on Landsat 1 to 5, RBV on Landsat 3, TM-data Landsat 4,5.

USER AIDS

The Leda User Manual is available from the file supplier.

ESA QUEST AVAILABILITY

File number	13
Time span	EROS Data Center: 1972 to present Fucino : 1975 to present Kiruna : 1978 to present Maspalomas : 1984 to present
File update	1400 refs/week
File size	1.100.000 (December 1987)

ON-LINE TUTORIALS

?FILE13	?COMMANDS.13	?OUTPUT.13	?NPOC
?GENERAL.13	?FURTHER.INFO.13	?AVAILABILITY.13	?ADDRESSES

SAMPLE RECORD (each record 75 characters)

MIS	TRK	FRM	STZ	SENS	DATE	CLOUD	COV	ACQ	-VIS	LAT	-LON	-C.F.	ELEV	AZIM	NO.
4	200	25	FO	MSS	820814	0	4	0	2	0	3	5028/	144	4818/13962	1
4	200	25	FO	MSS	830222	0	0	0	0	0	0	5028/	140	2463/14939	2
4	200	25	FO	MSS	830716	0	0	0	0	0	3	5028/	130	5460/13502	3

NUMBER OF RETRIEVED IMAGES = 9

ENTER FURTHER SELECTION MODE :
AVAILABLE OPTIONS : YE NO
DEFAULT : NO >

INPUT : NO

LEVEL 4: OUTPUT PRESENTATION ON TERMINAL

ENTER OUTPUT PRESENTATION MODE :
AVAILABLE OPTIONS : TT SR LP SE PS H
DEFAULT : TT >

INPUT : <<CR>>

MIS	TRK	FRM	STZ	SENS	DATE	CLOUD	COV	ACQ	VIS	LAT	LONG	ELEV	AZIM	NO
2	206	32	FO	MSS	810616	0	0	0	0	3	4020	1111	5937	11412 1
2	206	32	KI	MSS	810616	0	0	0	0	1	4020	1110	5890	11328 2
3	206	32	FO	MSS	820409	0	0	0	0	3	4020	1117	4814	13336 3
2	208	31	FO	MSS	810531	0	0	0	0	3	4161	874	5857	11972 4
3	208	32	FO	MSS	820411	0	0	0	0	3	4020	830	4883	13290 5

EXIT

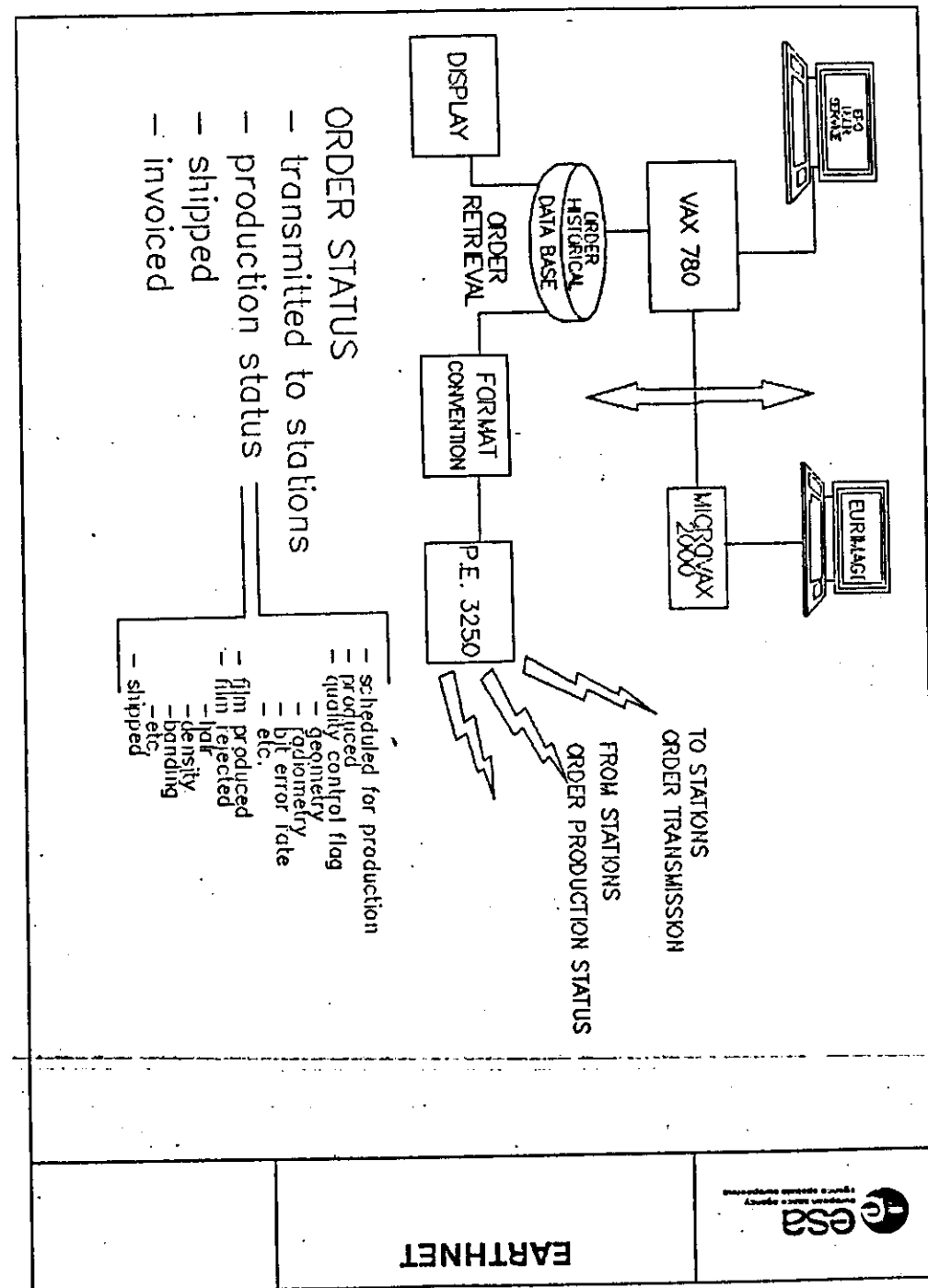
INPUT : LOGOFF

LEDA session terminated

-----14Dec88 10:39:55 User04341--
0.70 AU 2.11 Minutes in File 13
0.35 AU Telecomm charge
1.05 AU approx Total

ESA-QUEST session terminated at 10:40:01

DEC 1987



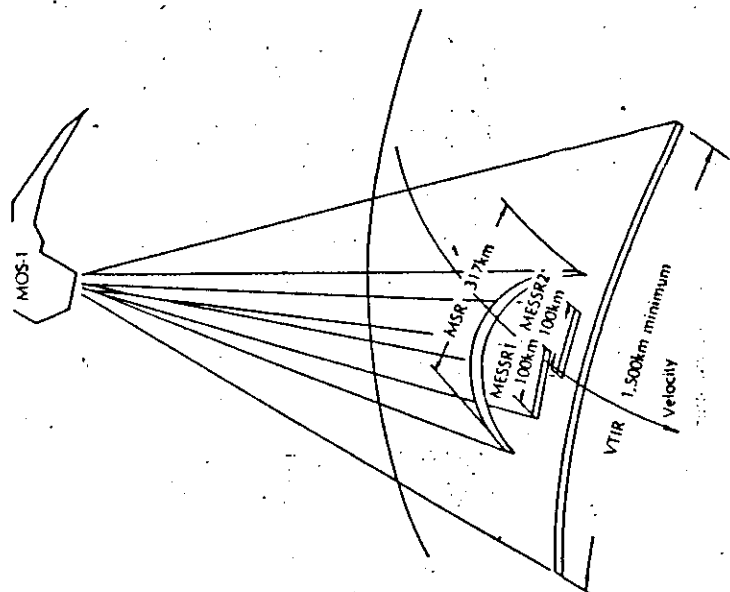


Fig. 2-1 Radiometer Observation Width

TABLE 3 - MOS-1 payload characteristics

ITEM / OBSERVATION EQUIPMENT	MESSR	VTIR		MSR	
OBJECTIVE	sea surface color, vegetation, land use, etc	suspended sediment,	stratospheric water vapor, Earth and sea surface temperatures, etc.	water vapor content, liquid water content, ice, snow, etc.	
OBSERVATION WAVELENGTH (nm)	0.51 - 0.59 0.61 - 0.69 0.73 - 0.80 0.80 - 1.1	0.5 - 0.7	6 - 7 10.5 - 11.5 11.5 - 12.5	-	
OBSERVATION FREQUENCY (GHz)	-	-	-	23.8 ± 0.2	31.4 ± 0.25
BEAM WIDTH	-	-	-	1.89 ± 0.19	1.31 ± 0.13
INTEGRATION TIME (msec)	-	-	-	10 & 47	10 & 47
IFOV (km)	0.05	0.9	2.7	32	23
SWATH WIDTH (Km)	100 (each optic)	1500		317	
SCANNING METHOD	electronic: pushbroom	mechanical: rotating mirror		mechanical: conical scan	
SCANNING PERIOD	7.6 msec	1/7.3 sec		3.2 sec	
DYNAMIC RANGE/ANTENNA RECEIVER				30 - 300K/Offset Cassegrain	
POLARIZATION				Dicke	Dicke
RECEIVER SENSITIVITY				Horizontal	Vertical
DETECTOR	2,048-element CCD	Si-PIN diode	HgCdTe	-	
RADIOMETRIC RESOLUTION: S/N	39dB - 15dB	35dB (A1b.=80%)	-	-	
NE ΔT	-	-	(0.5K at 300K)	1K	1K
QUANTIZATION LEVEL	64 (6 bits)	256 (8 bits)		1024 (10 bits)	
DATA RATE	9 Mbit/sec	0.8 Mbit/sec		2 Kbit/sec	

HCMM

OBJECTIVES

- 2 SPECTRAL CHANNELS
0.5 - 1.1 μ M VIS
10.5 - 12.5 μ M IR
- 16 DAY REPEAT CYCLE
- ALTITUDE : 620 KM
- 500 M RESOLUTION
- 716 KM SWATH WIDTH
- ACQUISITION AT HOTTEST AND COLDEST MOMENT OF THE DAY : 2 AM
2 PM
- FEASIBILITY OF USING DAY/NIGHT THERMAL INFRARED REMOTE SENSING DATA FOR :
 - ROCK TYPE DISCRIMINATION AND MINERAL RESOURCE LOCATION
 - MEASURING PLANT CANOPY TEMPERATURES TO DETERMINE EVAPOTRANSPIRATION AND PLANT STRESS
 - MEASURING SOIL MOISTURE
 - MAPPING THERMAL AFFLUENTS
 - MAPPING SNOW FIELDS

2

NIMBUS-7 CZCS

OBJECTIVES

- 6 SPECTRAL CHANNELS
 - 0.433 - 0.453 μ M CHLOROPHYLL
 - 0.510 - 0.530 μ M CHLOROPHYLL
 - 0.540 - 0.560 μ M YELLOW SUBST.
 - 0.660 - 0.680 μ M CHLOROPHYLL
 - 0.700 - 0.800 μ M SURFACE VEG.
 - 10.5 - 12.5 μ M SURFACE TEMP.
- ALTITUDE : 955 KM
- $\pm$ 6 DAY REPEAT CYCLE
- 825 M RESOLUTION
- 1566 KM SWATH WIDTH
- REMOTE SENSING OF OCEANS AND COASTAL AREAS. ALL SENSOR PARAMETERS OPTIMISED FOR USE OVER WATER
- MEASUREMENT OF WATER COLOUR AND TEMPERATURE
 - PRIMARY PRODUCTION
 - SEDIMENT TRANSPORT
 - POLLUTION
 - DYNAMICS OF ESTUARIES AND COASTAL REGIONS
 - SALINITY CURRENTS
 - CHLOROPHYLL CONCENTRATION



earthnet

NIMBUS 7 (cntd)

THE PAYLOAD

CZCS coastal-zone colour scanner
ERB earth radiation budget
LIMS limb infrared monitor for the stratosphere
SAM-II stratospheric aerosol measurement (II)
SAMS stratospheric and mesospheric sounder
SBUV solar and backscatter ultraviolet spectrometer
TOMS total ozone mapping spectrometer
SMMR scanning multichannel microwave radiometer
THIR temperature humidity infrared radiometer

The **CZCS** instrument is devoted to ocean and coastal-zone water monitoring.

The **CZCS** Experiment is designed to measure water colour and temperature providing quantification and qualification of suspended materials

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earthnet

THE SEASAT-1 SYNTHETIC APERTURE RADAR (SAR*) MISSION

Satellite launched on June 26, 1978, failed on Oct. 9, 1978
Data recording by Earthnet at Oakhanger Station, UK, run by Royal Aircraft Establishment.
2500 non-SAR orbits (VIRR, SMMR, ALT, SASS) plus 53 SAR orbits acquired during the satellite lifetime

SPACECRAFT MAIN FEATURES

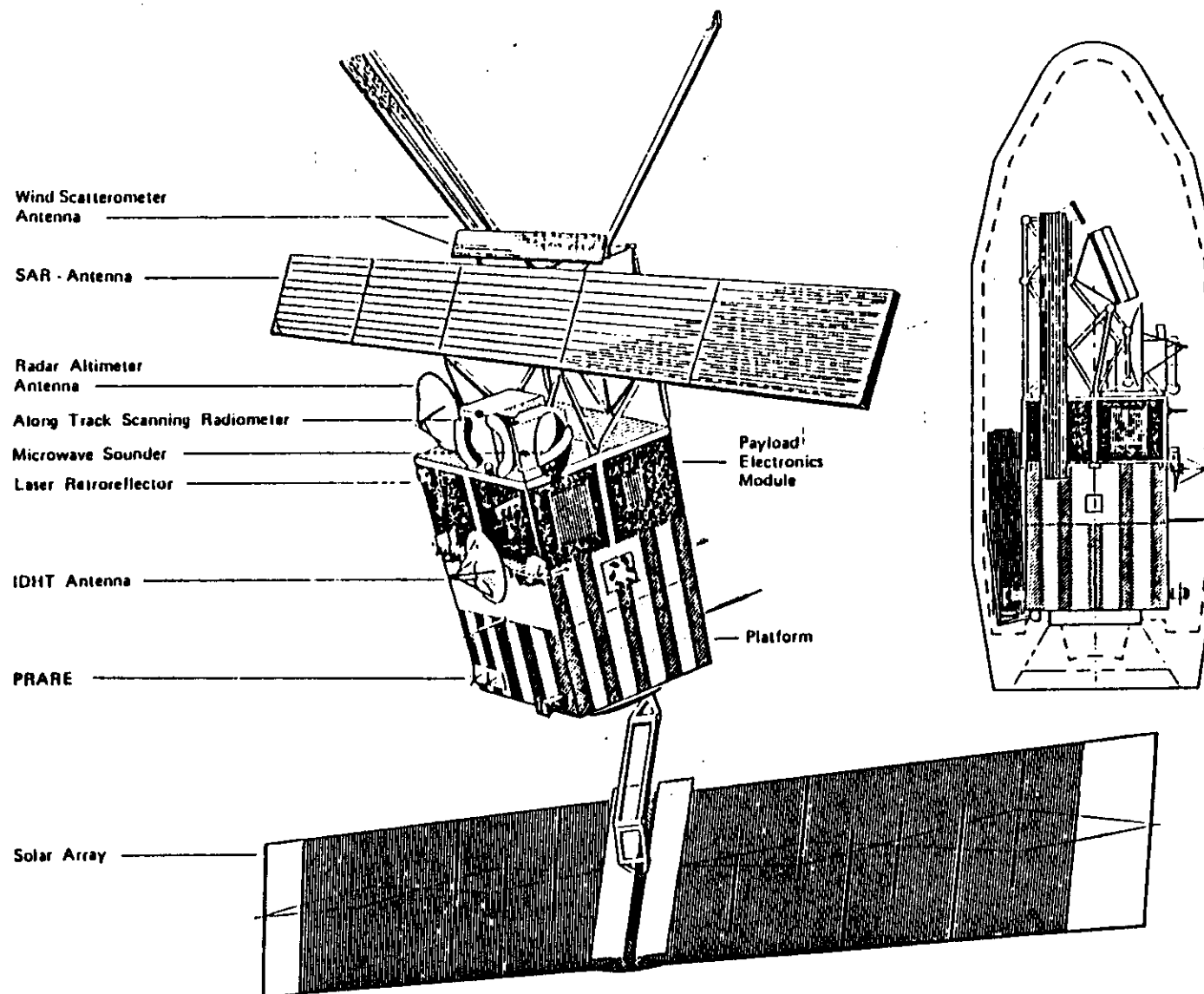
ALTITUDE: 800 km
SWATH WIDTH: 100 km (from 240 to 340 km north or right side of track)
DATA RATE: 110 Mbit/sec
DEPRESSION ANGLE: 70 degree
WAVELENGTH: L-band (21.9 cm)
SIGNAL BANDWIDTH: 19 MHz
POLARISATION: HH
SURFACE RESOLUTION: 25m x 25m

* An imaging side-looking radar designed to study ocean wave patterns, sea and fresh water, ice, etc.

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SATELLITE IN FLIGHT & LAUNCH CONFIGURATION





ERS 1

FIRST EUROPEAN SPACE AGENCY REMOTE SENSING SATELLITE

OVERALL MISSION CAPABILITIES

DEVELOP/PROMOTE ECONOMIC-COMMERCIAL APPLICATIONS
INCREASE THE SCIENTIFIC UNDERSTANDING OF OCEAN PROCESSES
MONITORING OF POLAR REGIONS
CONTRIBUTION TO WORLD CLIMATOLOGY RESEARCH PROGRAMME

OBJECTIVES

OCEANOGRAPHY :

- SURFACE WINDS
- SEA STATE (WAVES, TIDES)
- MAJOR OCEAN CURRENTS
- SEA SURFACE TEMPERATURE

POLAR REGIONS :

- ICE SHEET DYNAMICS
- SEA ICE STUDIES
- GLACIOLOGY (SNOW-INLAND ICE)

POTENTIAL APPLICATIONS

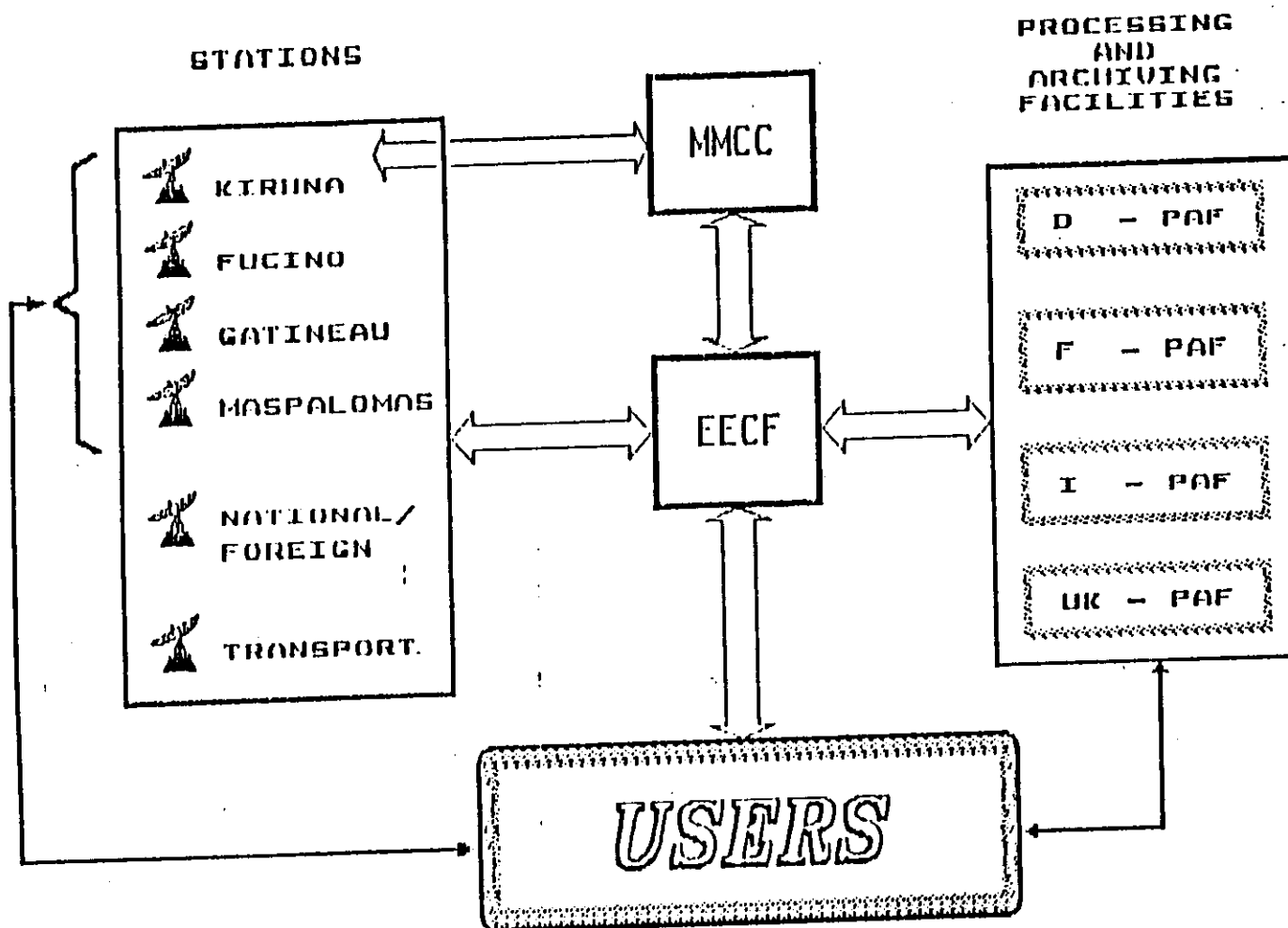
- CONTRIBUTION TO MARINE FORECASTS
- SHIP ROUTING
- APPLICATIONS TO OFF SHORE ACTIVITIES
- SEA ICE/COASTAL PHENOMENA OBSERVATION
- ALL WEATHER HIGH SPATIAL RESOLUTION IMAGERY

INSTRUMENTS

- WIND AND WAVE SCATTEROMETER
- SAR
- RADAR ALTIMETER
- SCIENTIFIC PACKAGE



ERE-1 GROUND SEGMENT CONFIGURATION



THE LBR SENSORS

WIND SCATTEROMETER

It measures the wind field with
50 Km RESOLUTION and 500 km swath

WAVE SCATTEROMETER

It measures wave spectra in 5 x 5 km
regions at 200 km sampling intervals

RADAR ALTIMETER

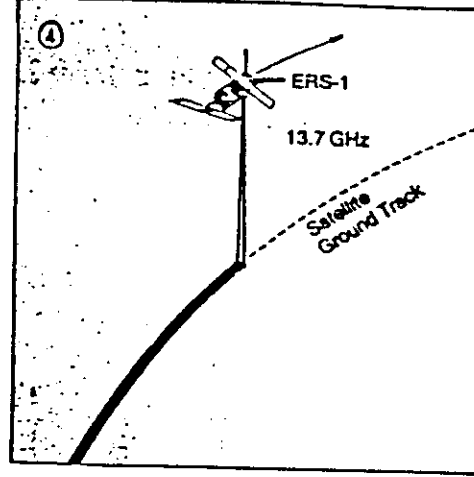
It measures ocean and ice topography
plus SWH (Significant Wave Height) and
wind speed at nadir

ALONG TRACK SCANNING RADIOMETER/M

It measures SST (Sea Surface
Temperature)
with 1 km resolution and 500 km
swath
and water vapour content at nadir

SAR SENSOR

C-BAND, VV POLARISATION, 100 km
SWATH
30 M RESOLUTION

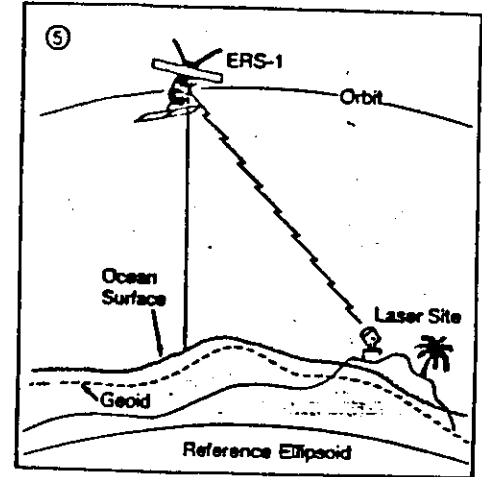


④ Radar Altimeter

The Radar Altimeter is a nadir looking active micro-wave instrument. Over ocean it is used to measure the significant waveheight, the wind speed, and the mesoscale topography. Over ice it is used to determine the ice surface topography, ice type, and sea/ice boundaries.

⑤ Laser Retroreflector

The Laser Retroreflector will permit the accurate determination of the satellite height by the use of Laser Ranging Stations. The measurements will be utilized for the calibration of the Radar Altimeter in zenith overflight and for improvement of the satellite orbit determination with respect to the radial component during normal satellite tracking.

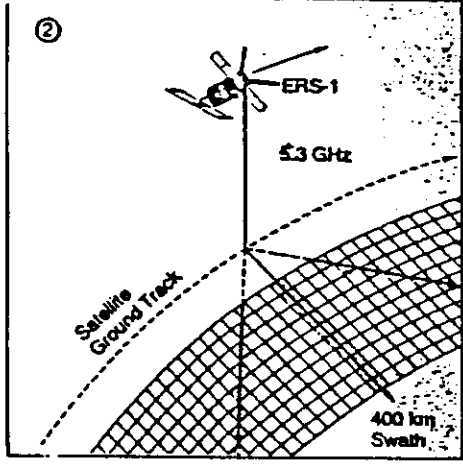
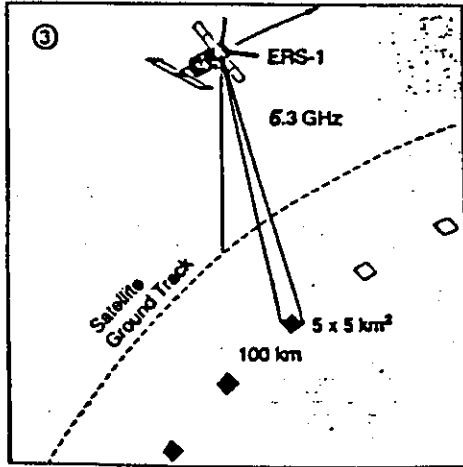
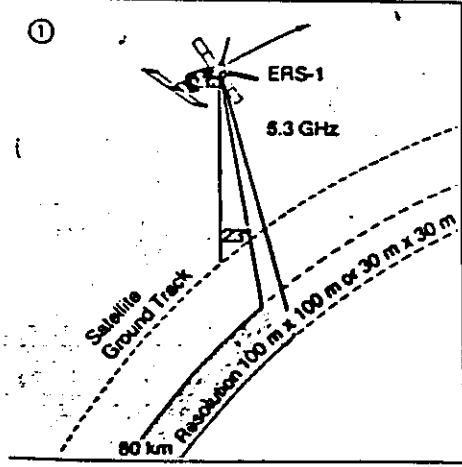


Instruments

Active Microwave Instrument

The Active Microwave Instrument (AMI) is a remote sensing radar, operating in C-band and capable of performing three distinct functions corresponding to desired measurements and output products:

- ① Image Mode: When operating in the image mode the AMI performs as a synthetic aperture radar (SAR) producing high quality wide swath imaging over ocean, coastal zones and land.
- ② Wind Mode: While operating in the wind mode, the instrument will act as a scatterometer and measure the change in radar reflectivity of the sea surface due to the perturbation of the surface by the wind close to the sea.
- ③ Wave Mode: When operating in wave mode, the instrument will measure the change in radar reflectivity of the sea surface due to the ocean surface waves.



European space agency

EARTHNET PROGRAMME OFFICE

Page:

Date:

SYNTHETIC APERTURE RADAR SPECIFICATIONS

SPATIAL RESOLUTION

SWATH

RADIOMETRIC RESOLUTION

INCIDENCE ANGLE ON THE GROUND

FREQUENCY

MEAN RF POWER

DATA RATE

100m x 100m OR 30m x 30m

> 80KM (TO BE MAXIMISED)

1dB FOR 100m x 100m AT - 18dB

2,5dB FOR 30m x 30m AT - 18dB

23°

5,3 GHZ IN HH POLARISATION

<300 W

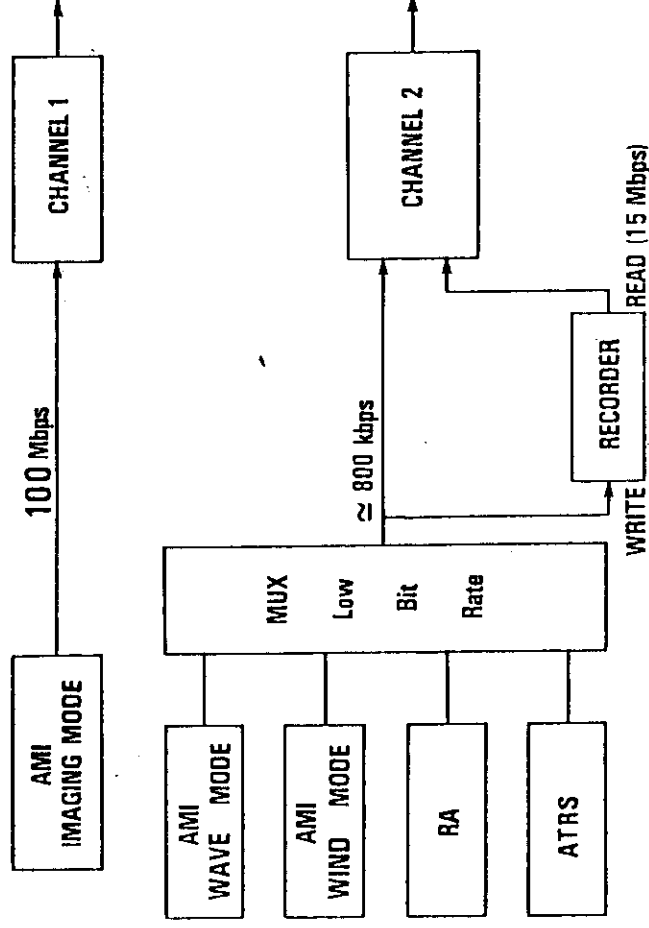
<100Mbps



INSTRUMENT DATA HANDLING AND TRANSMISSION

RECORDING CAPACITY : 5 G bits (ONE ORBIT OF LOW BIT RATE DATA)

X BAND TRANSMISSION



RADAR ALTIMETER SPECIFICATIONS

SIGNIFICANT WAVE HEIGHT (ONE/SECOND)

FOOT PRINT 1,6 - 20 km (DEPENDENT ON
SEA STATE)
RANGE OF MEASUREMENT 1 - 20 m
MEASUREMENT ACCURACY $\pm 0,5$ m OR $\pm 10 \%$

POTENTIAL APPLICATIONS

SEA/LAND ICE TOPOGRAPHY
SEA SURFACE WIND SPEED

TECHNICAL CHARACTERISTICS

RADAR FREQUENCY	13,7 GHz	PRF 1000 Hz
ANTENNA DIAMETER	1m	
EFFECTIVE PULSE DURATION	3 ns	
TRANSMITTER PULSE LENGTH	5 or 100 μ s	
REQUIRED SIN	5 dB	
MASS	< 100 kg	
DATA RATE	< 10 kbps	(SMOOTHED MODE)
DC POWER CONSUMPTION	< 100 W	

LASER RETROREFLECTORS FOR

RA CALIBRATION
ACCURATE ORBIT DETERMINATION

**WAVE SCATTEROMETER SPECIFICATIONS**

	WAVE DIRECTION	WAVE LENGTH
RANGE OF MEASUREMENT	0 - 180 DEGREES	100 - 1000 m
MEASUREMENT ACCURACY	± 20 DEGREES	± 25 %

INCIDENT ANGLE = 23°
POLARISATION HH
FREQUENCY 5,3 GHz
MEAN RF POWER < 100 W
WIND AND WAVE SCATT

WIND AND WAVE SCATTEROMETER

* MAY BE OPERATED IN PARALLEL WITH
WIND SCATTEROMETER : POWER
CONSUMPTION IN COMBINED MODE IS < 580 W TOTAL

**WIND SCATTEROMETER SPECIFICATIONS**

	WIND DIRECTION	WIND SPEED
RANGE OF MEASUREMENTS	0 - 360 DEGREES	4 - 24 m/s
MEASUREMENT ACCURACY	± 20 DEGREES	± 2 m/s OR ± 10 %

SWATH WIDTH 400 km (25° TO 55° INCIDENCE ANGLE)
SPATIAL RESOLUTION 50 × 50 km²
FREQUENCY 5,3 GHz
POLARISATION 3VV ANTENNA BEAMS
DC POWER CONSUMPTION 520 W
DATA RATE 1 kbps



ATSR (ALONG TRACK SCANNING RADIOMETER)

SCIENTIFIC PAYLOAD

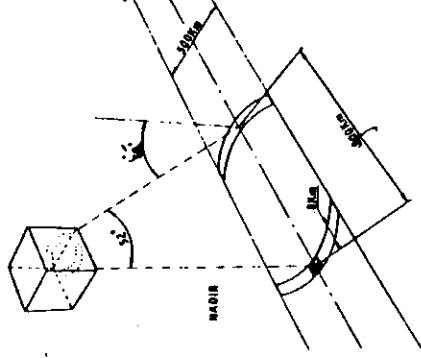
FROM RUTHERFORD APPLETON LAB (UK)

OBJECTIVES

- SST $\pm$.5K ABSOLUTE ACCURACY
OVER AREA OF 50 km² AND
COVER CLOUD UP TO 80 %
- NEAT = .5K FOR #1 km² PIXEL
- WATER VAPOR CONTENT
- AEROSOL STATISTICS

METHOD :

THE SAME PIXEL IS VIEWED FROM TWO
DIRECTIONS NADIR AND 60° AND ATMOSPHERIC
CORRECTION IS DERIVED FROM THE TWO
MEASUREMENTS.



EXPERIMENT DESCRIPTION

3 CO REGISTERED IR CHANNELS : 3.7 μ m ; 11 μ m ; 12 μ m
VISIBLE CHANNEL POSSIBLE
PIXEL SIZE : 800 m AT NADIR
SWATH 500 km
CONICAL SCANNING
ACTIVE COOLING (STIRLING CYCLE)



ERS-1 GROUND SEGMENT

EPO IS IMPLEMENTING :

A. UPGRADING OF REAL TIME STATIONS :

- FUCINO (EARTHNET)
- MASPALOMAS "
- GATINEAU (CCRS)

ERS-1 PROJECT ONLY RECHARGED FOR
MISSION SPECIFIC EQUIPMENTS

B. PROCESSING AND ARCHIVING FACILITIES

- BREST (F)
- OBERPFAFFENHOFEN (D)
- FARNBOROUGH (UK)
- FUCINO/MATERA (I)

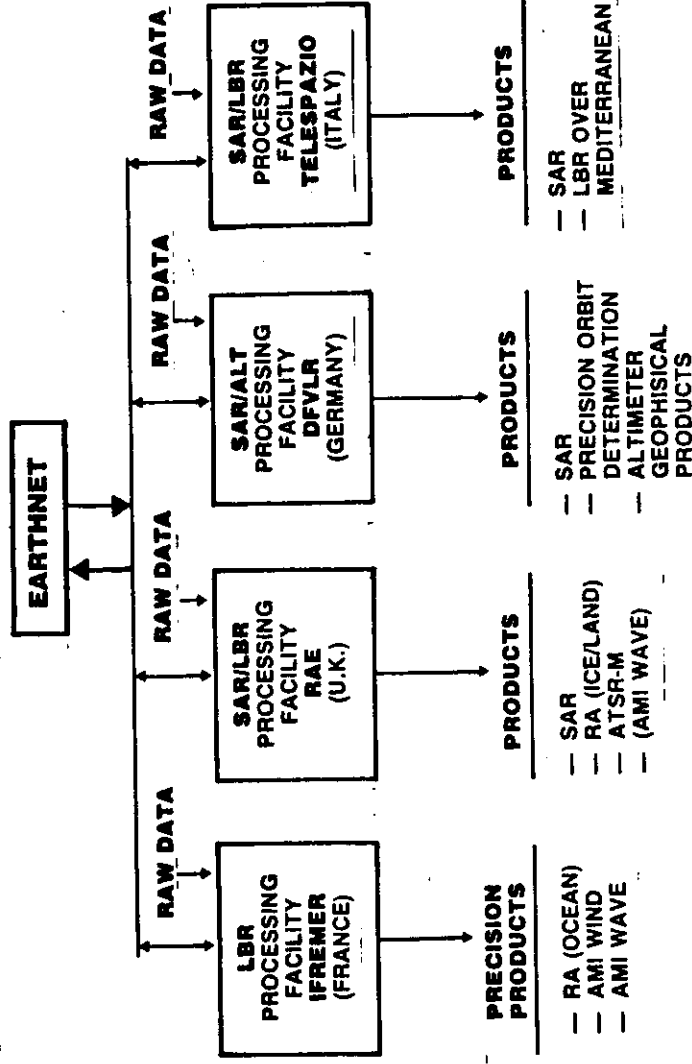
FUNDS: EARTHNET (20%); NATIONAL (80%)

C. THE EARTHNET ERS-1 CENTRAL FACILITY IN FRASCATI



earthnet

LAYOUT AND MANAGEMENT OF ERS-1 OFFLINE PROCESSING FACILITIES



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European space agency

Page:

EARTHNET PROGRAMME OFFICE

Date:

ERS - 1

PRECISION PRODUCT/SPECIAL GEOCODED PRODUCTS

RESOLUTION : 30M RANGE

8 - 30M AZIMUTH

SIZE : 100 X 100 KM / MAP SCALE 1:200.000

CALIBRATED

GCP + DTM APPLIED AND MOSAICKING FOR MAPS

3 LOOKS

LOCATION ACCURACY : 30M RANGE AND AZIMUTH