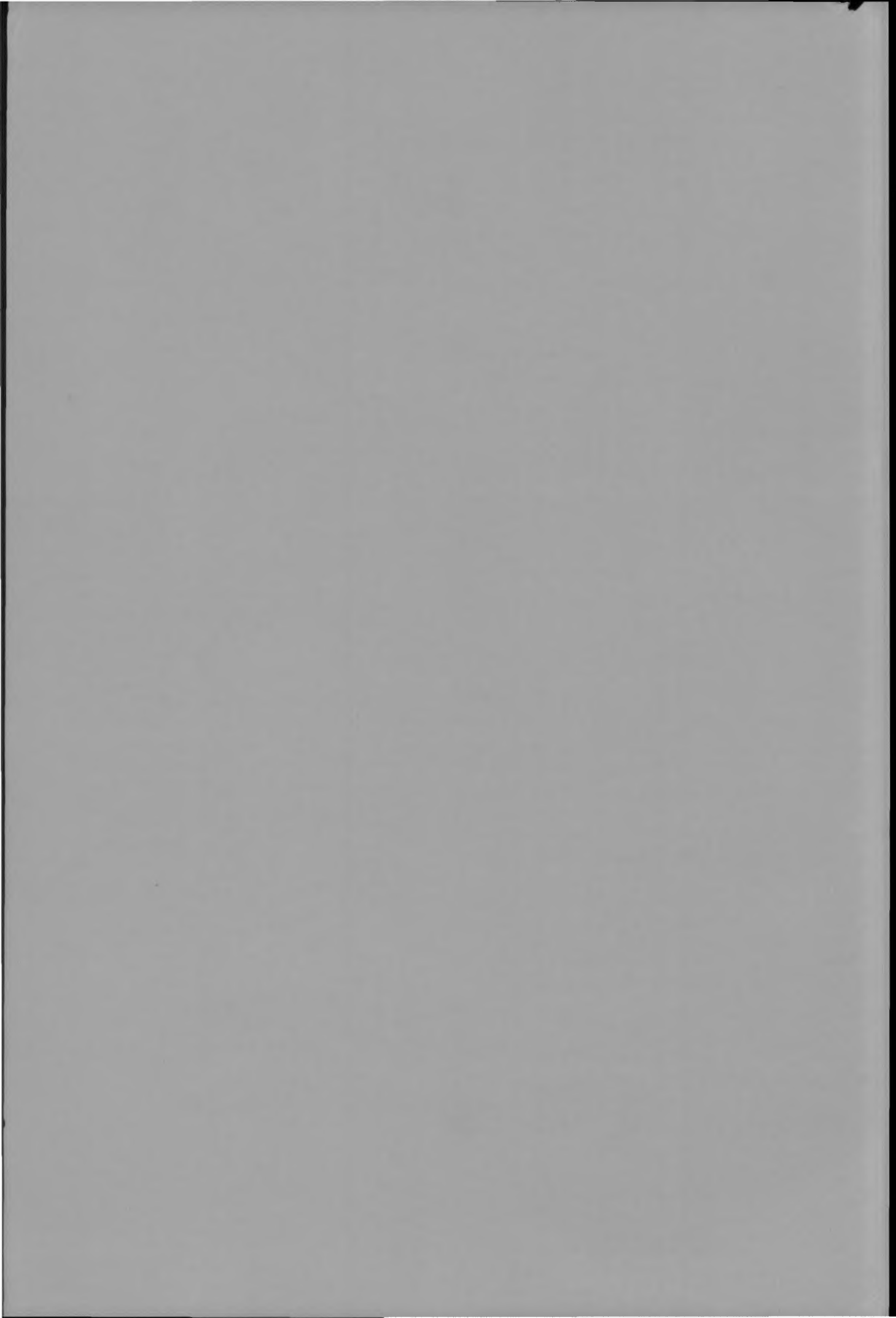


ESOWG 7
(ERS National & Foreign
Stations Operators
Working Group)
Toulouse
28-29 May 1998

ESA12a

This document contains copies of the viewgraphs used in each presentation, the agenda and a list of attendees.

This document is printed by the ERS Facilities Operations Section of the ERS Exploitation Division of ESA/ESRIN

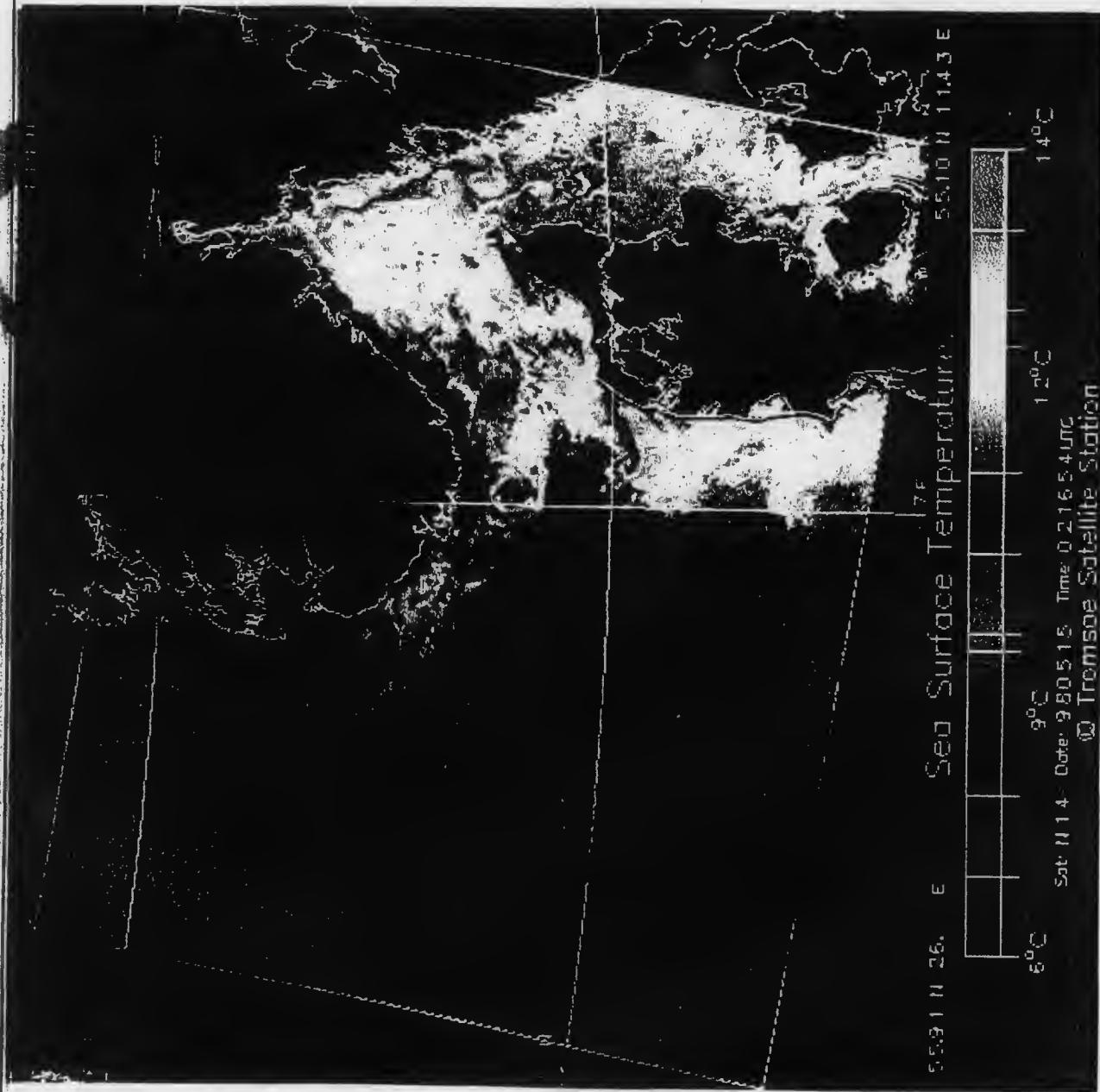


PRODUCTION OF SLOW MAPS (MEOS MAPP)



TROMSØ SATELLITE STATION





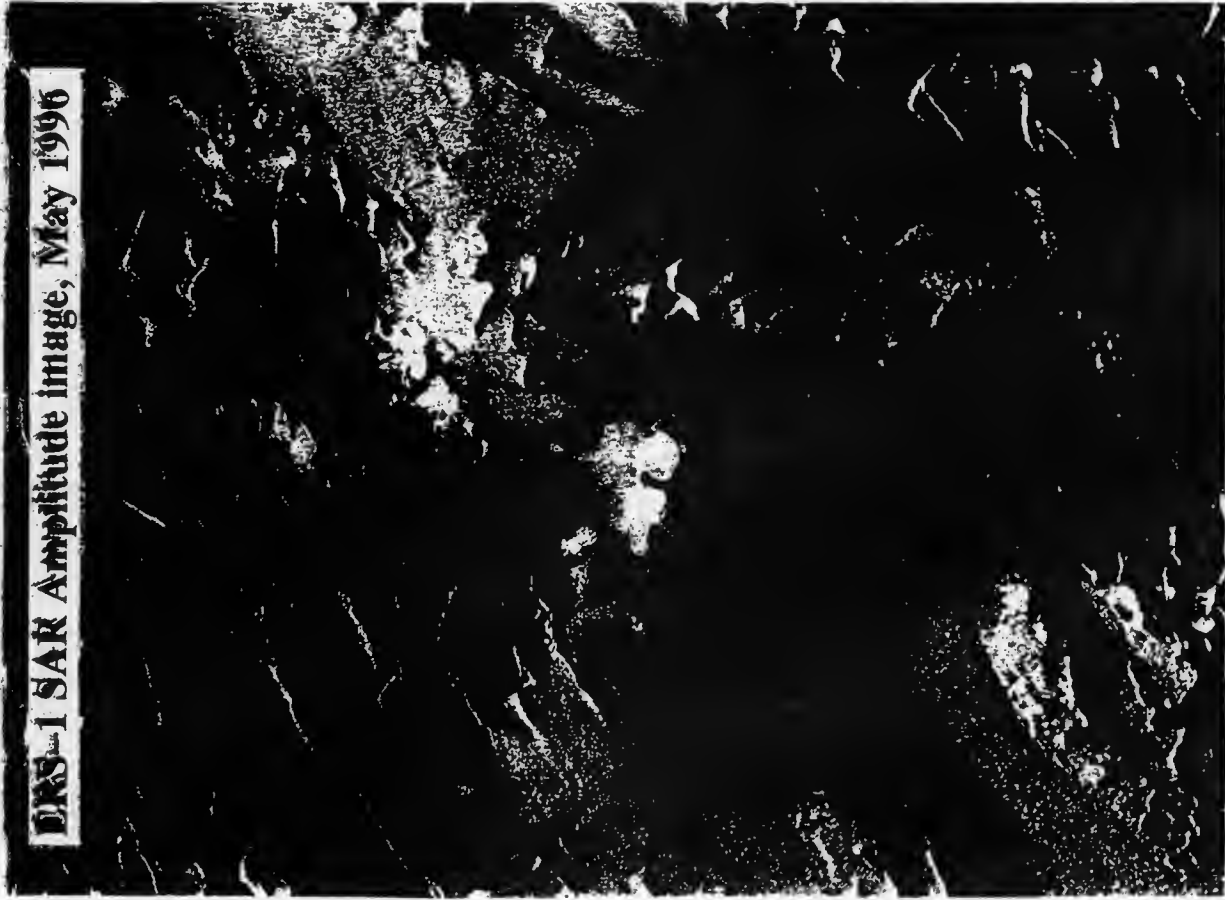
✓ Sea Surface
Temperatures in
the North Sea and
the Skagerak and
the Kattegat seas

✓ Acquisition date:
15. May 1998 at
02:16 UTC



ERS SAR images covering glaciers on Spitsbergen, Svalbard.

ERS-1 SAR Amplitude image, May 1996



ERS Tandem INSAR interferogram, May 1996



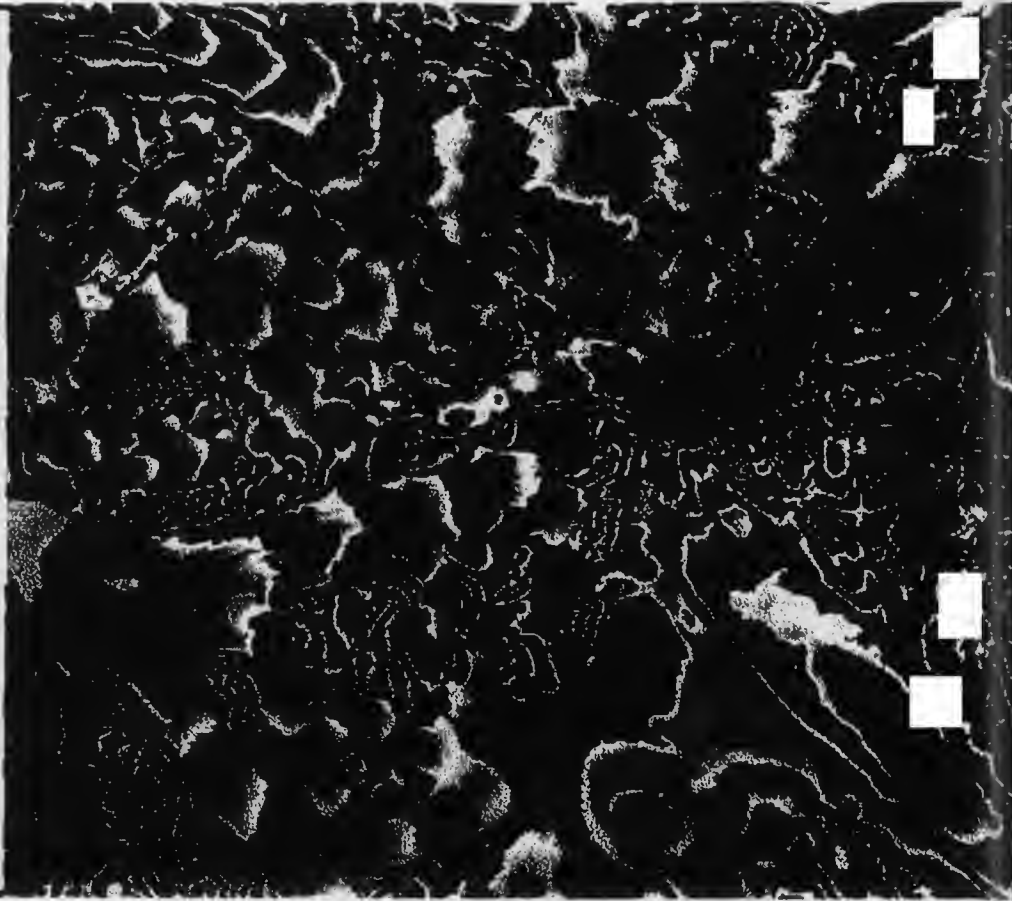
FORSVARETS FORSKNING SINSTITUTT

ERS SAR images covering glaciers on Spitsbergen, Svalbard.

ERS-1 SAR Amplitude Image, May 1996



ERS Tandem INSAR interferogram, May 1996



ERS-2 SAR

IMAGE

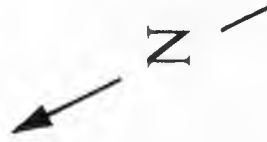
Svalbard/Edgeøya

Acquired 28.04.98

Image Centre:

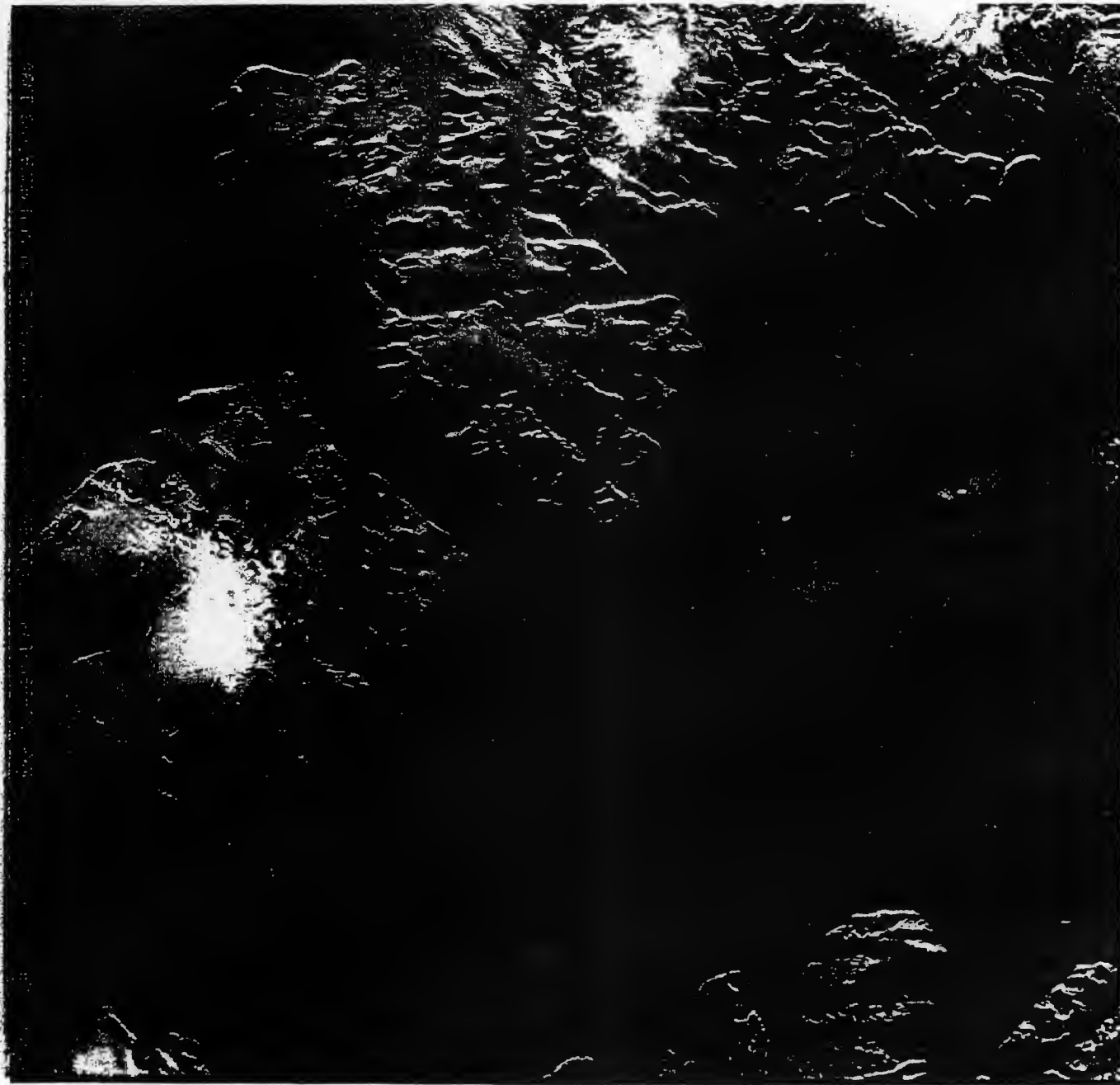
78.1 deg N

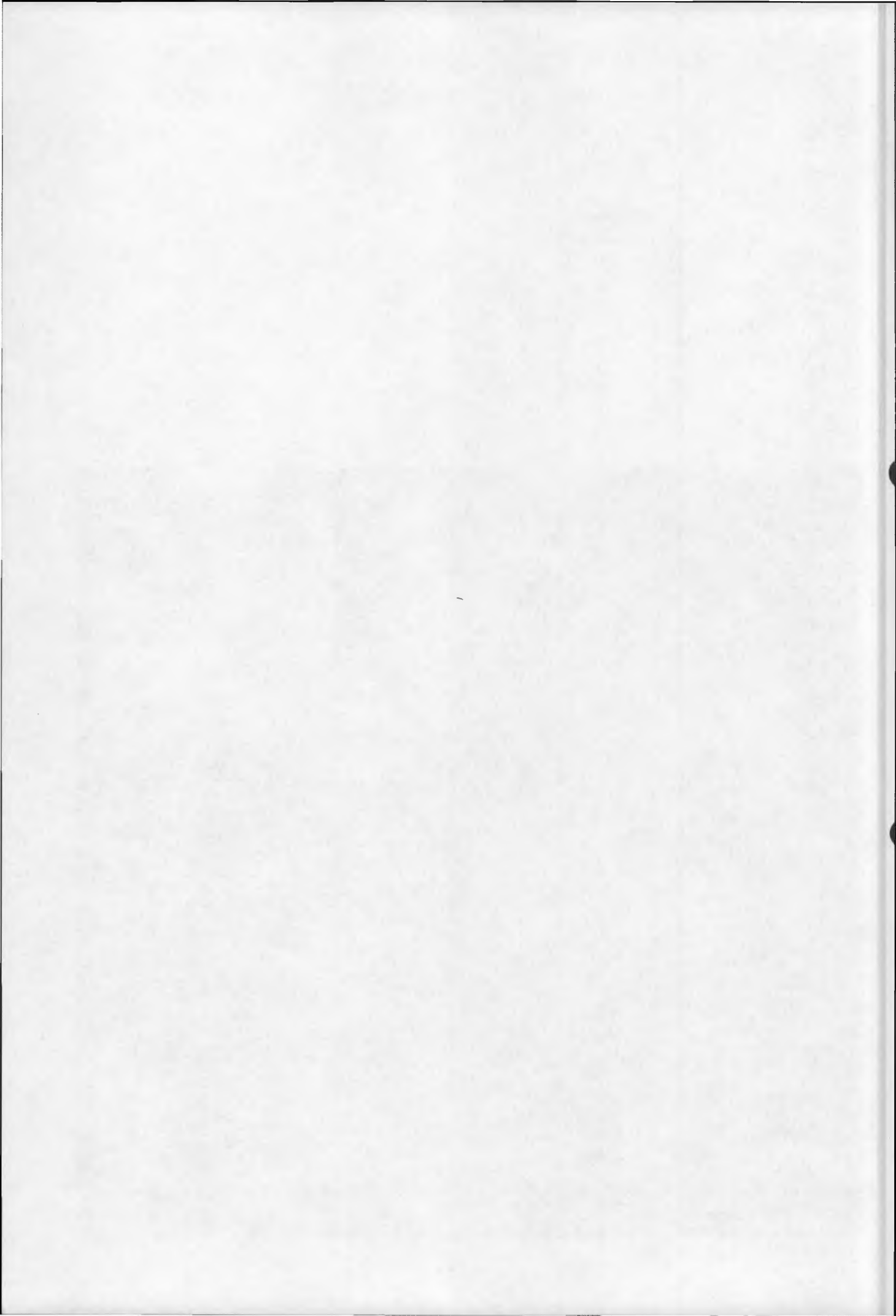
20.0 deg E



0 25 km

Copyright ESA, TSS, 1998





WEST FREUGH SATELLITE GROUND STATION

**The United Kingdom's National Ground Station
for the reception, processing and dissemination of data
from ERS-1/2 and Radarsat**

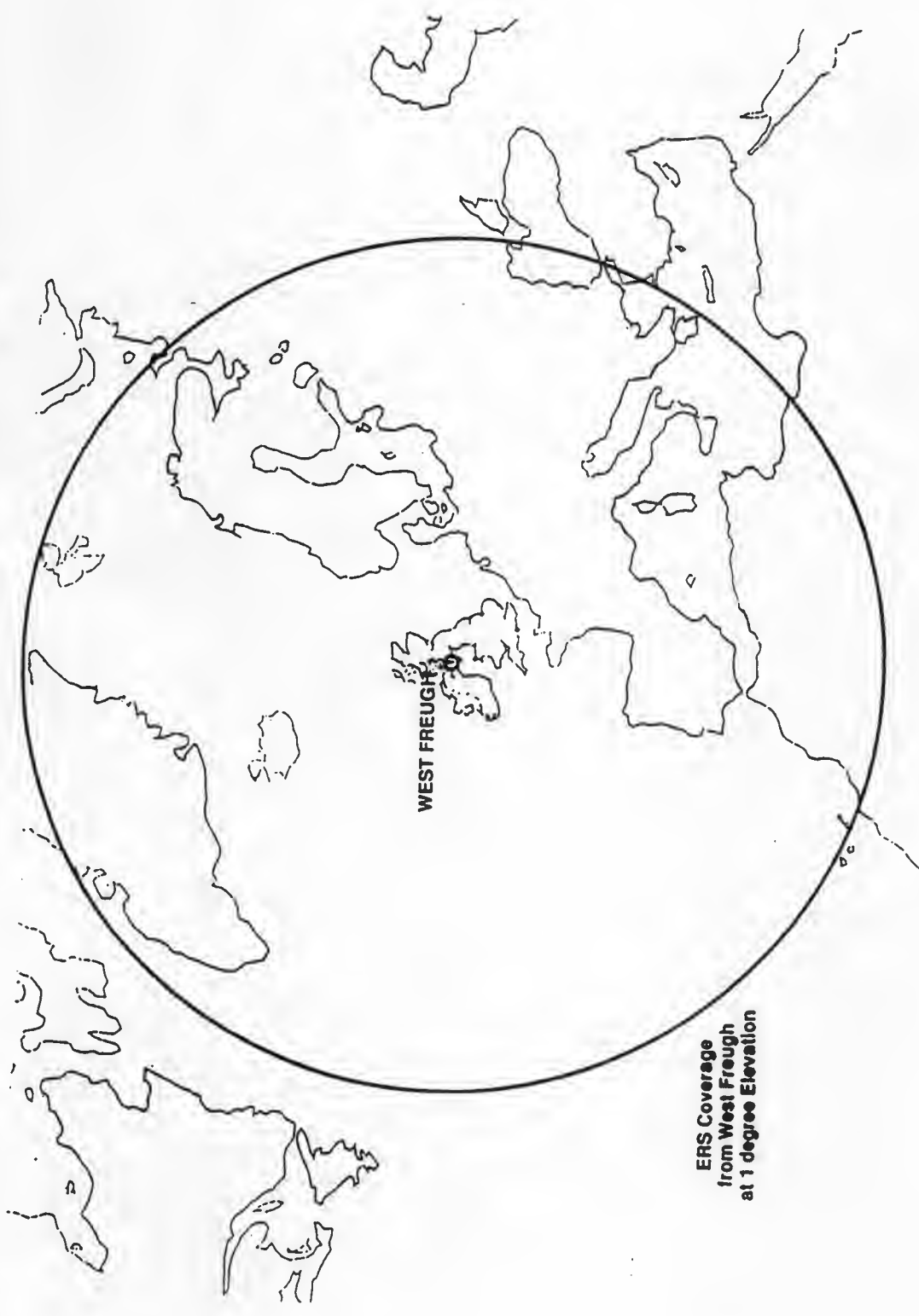
DERA

THE GROUND STATION MISSION

To provide remote sensing satellite data products in support of DERA space research for customers.

To provide data products and information to users, for research and operational applications.

DERA



ERS Coverage
from West Freugh
at 1 degree Elevation

FACILITIES

Datron 13 metre diameter antenna with 8025-8400 MHz reception capability (has sub-reflector for 2200-2300 MHz but feed not fitted)

Alcatel Bell high (105 Mbit/s) and low rate (15 Mbit/s) demodulators

Penny and Giles high and low rate tape recorders

Direct data capture systems

SAR data processing systems for ERS and Radarsat satellite data

Other workstations for providing additional processing for value added products

ON-SITE DATA PROCESSING CAPABILITY

Production of raw data products

Processing of ERS SAR data

Processing of selected ERS low rate data (ATSR)

Processing of Radarsat SAR data

Oil slick detection and tracking

DATA DELIVERY

Data products from West Freugh are available via:

Exabyte tape

CD-ROM (shortly)

FTP (DESNET and Internet)

HDDT (Selected SAR only)

DERA

RAIDS

(RApid Information Dissemination System)

Provides fast delivery of low resolution SAR images anywhere, within hours of reception from the satellite.

Images are downloaded via the Internet to suitably equipped users (modem, PC, software and password required)

Collaborative project with Matra Marconi Space and National Remote Sensing Centre.

STATUS - Operational.

DERA

DATA DELIVERY TIMES FROM WEST FREUGH

Small orders for electronic delivery via FTP and Internet are normally despatched within 12 hours. Orders required on Exabyte tape are normally despatched within 2 days.

These times can be shortened for pre-arranged small orders for fast delivery . The minimum time depends on:

Processing time for the particular product

The product size and complexity

The method and time for delivery

The size of the order

For example, an ERS PRI image can be ready for electronic delivery approx. 3 hours from the end of satellite pass. The transmission time depends on Internet traffic and is typically 5-6 hours, although equivalent datasets have been sent to the US in 1 hr 20 min.

FUTURE PLANS

ERS SATELLITES

Exploitation of low rate data

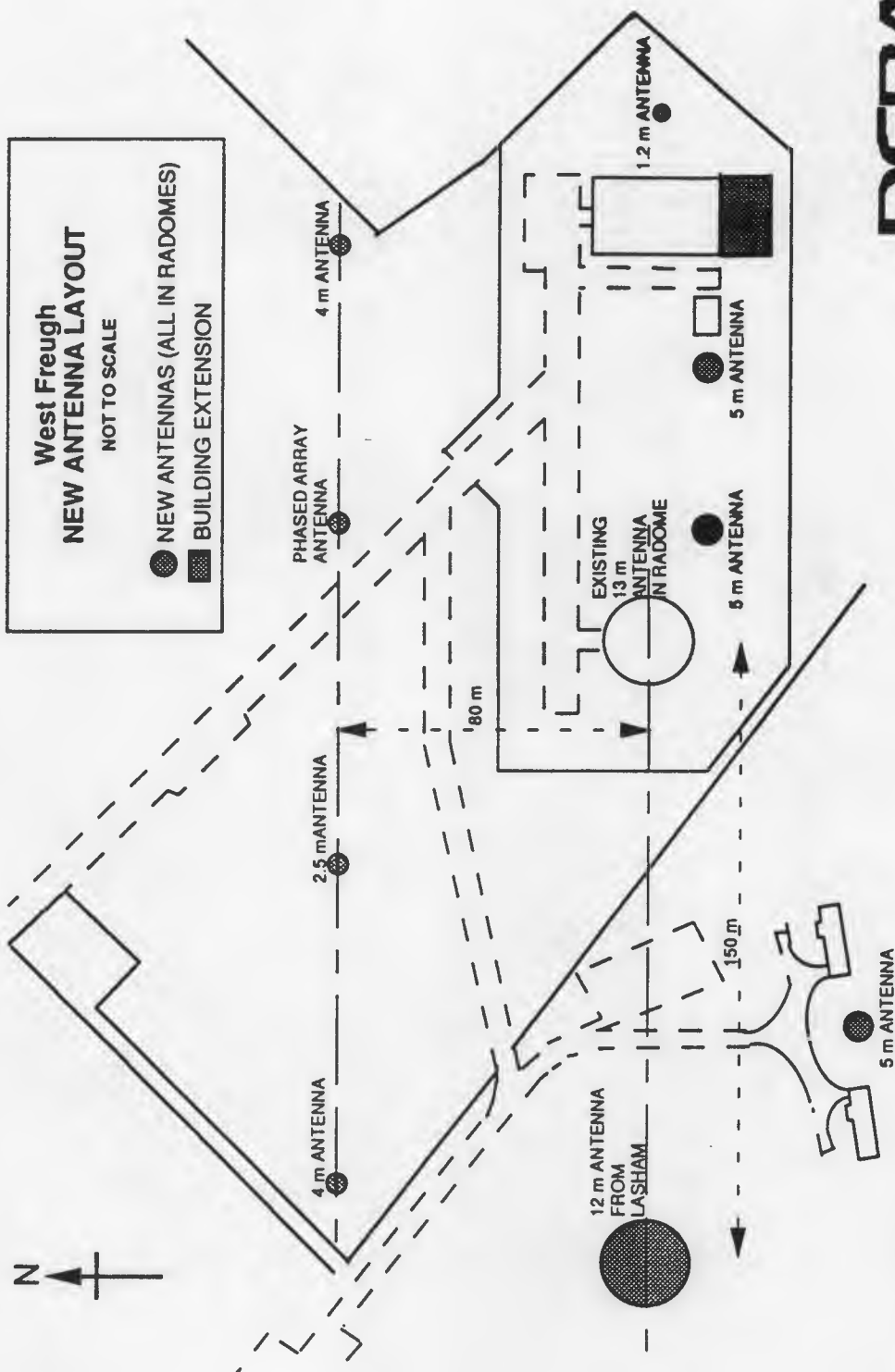
OTHER SAR SATELLITES:

Envisat (ESA)

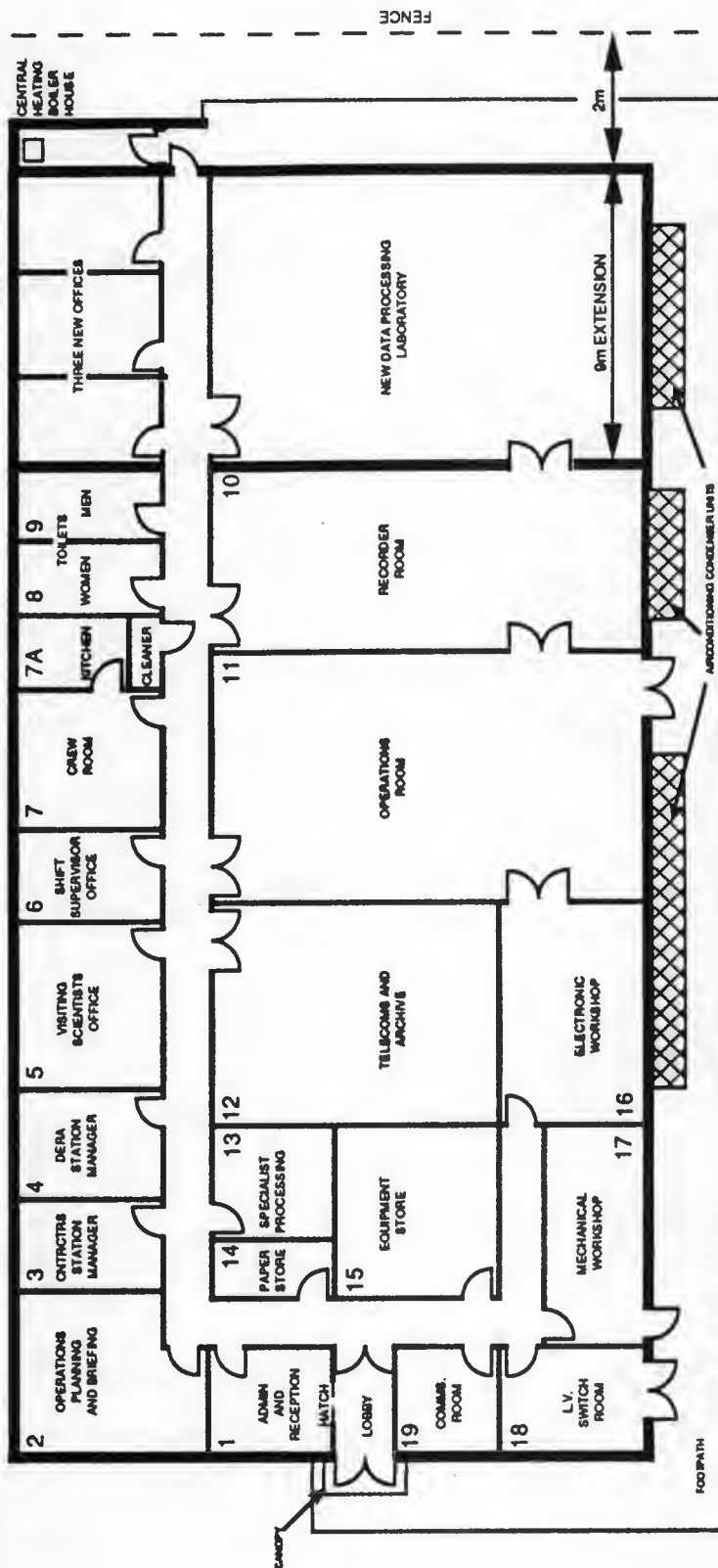
Radarsat 2 (Canada)

EXPANSION:

Consolidation of DERA ground stations



DERA



Not to scale

WEST FREUGH SATELLITE GROUND STATION
EXTENDED BUILDING FLOOR PLAN

DERA

Applications

Some of the applications currently supported by the DERA West Freugh and Lasham ground stations:

- * **Weather forecasting**
- * **Oil slick detection**
- * **Search and rescue**
- * **Oil exploration**
- * **Crop monitoring**
- * **Ice monitoring**
- * **Ship detection**
- * **Urban changes**
- * **Oceanography**

DERA

Alaska SAR Facility

Status Report

Greta Reynolds
ESOWG - Toulouse
28 - 29 May 1998

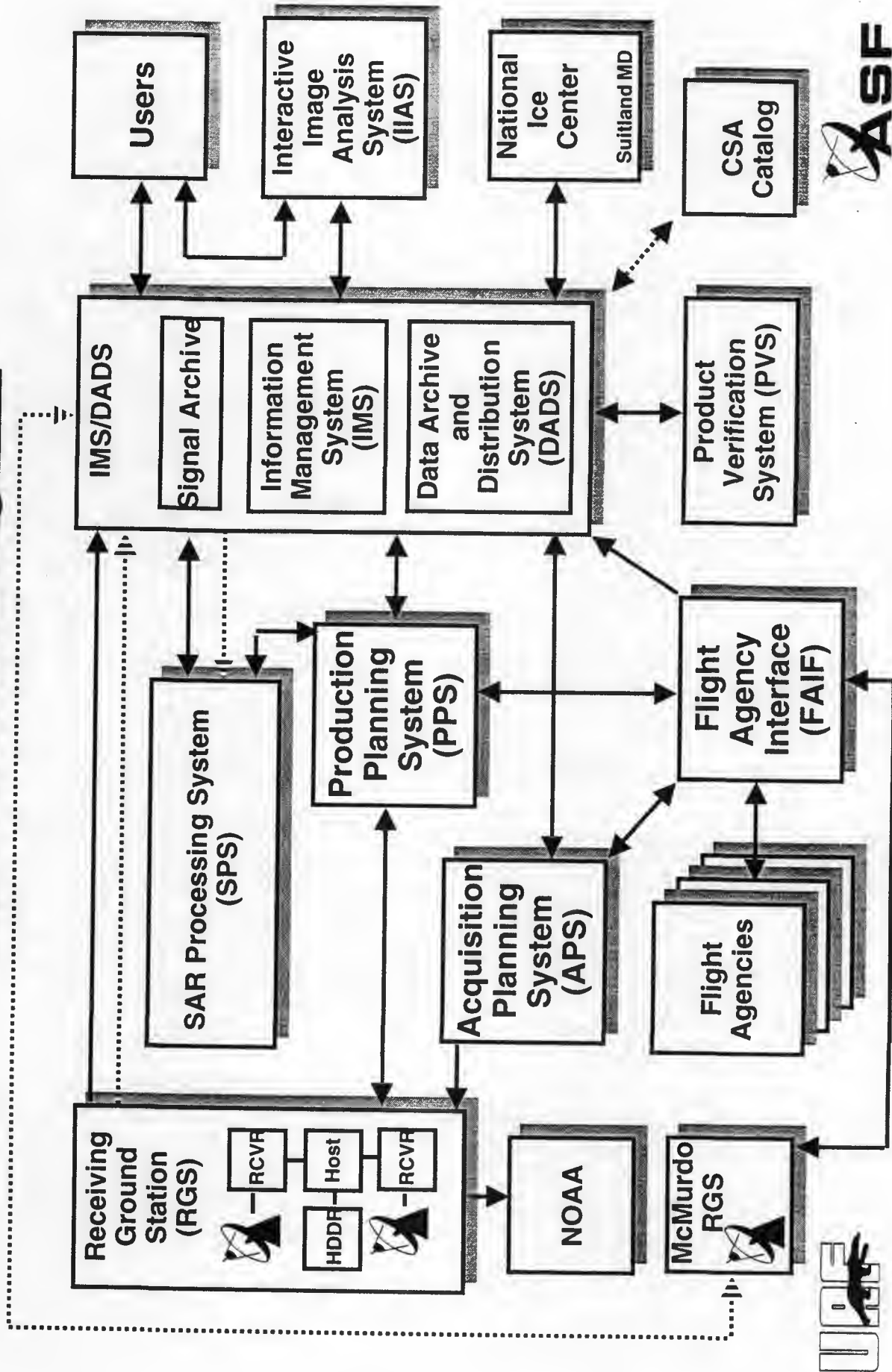


Overview

- **NASA sponsored ground station working under International MOAs**
- **Provide scheduling for ASF and McMurdo**
- **Provide processing, distribution and archiving capabilities for data acquired at ASF and McMurdo**
- **Support polar scientific research**
- **Provide operational support to US National Ice Center and NOAA**

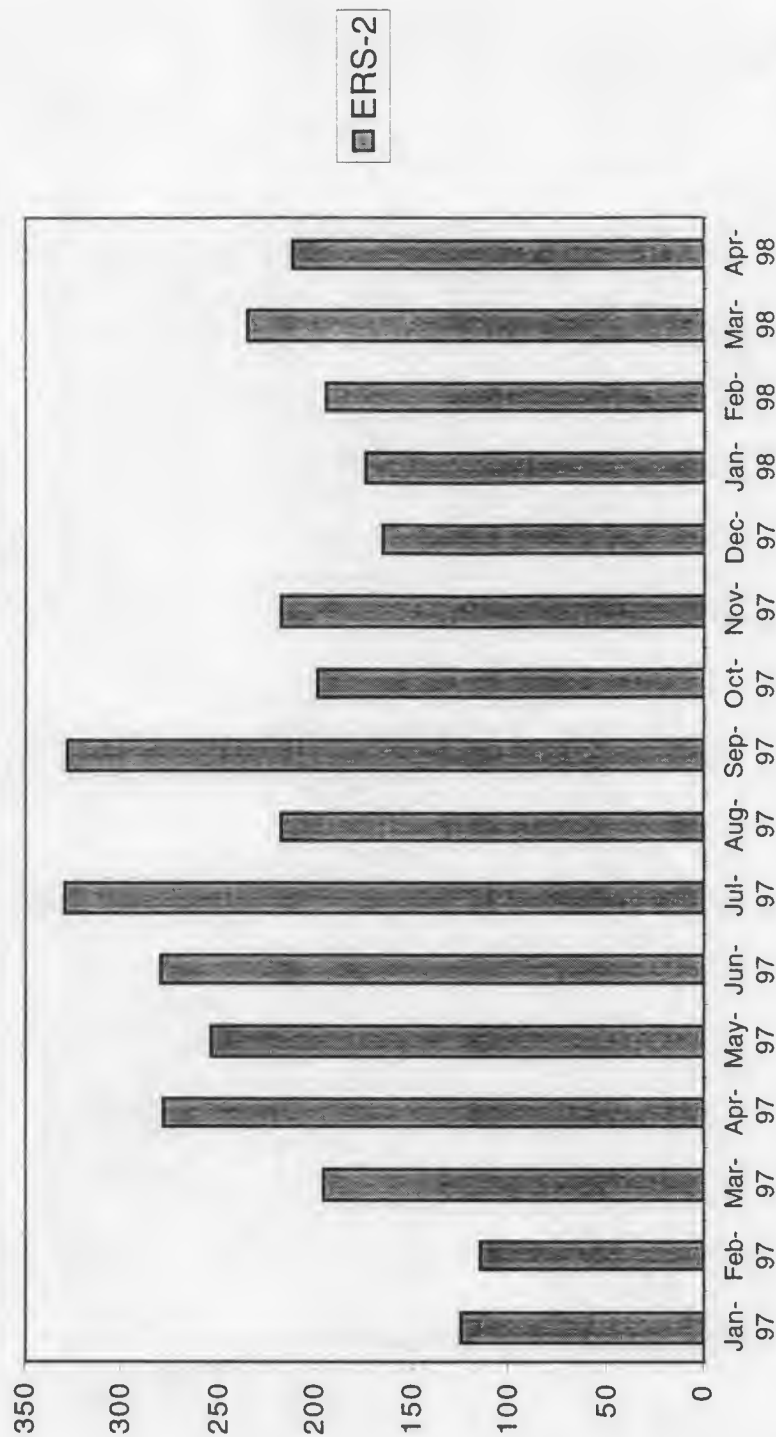


Functional Diagram



Acquisition

Minutes of ERS-2 Data Acquired

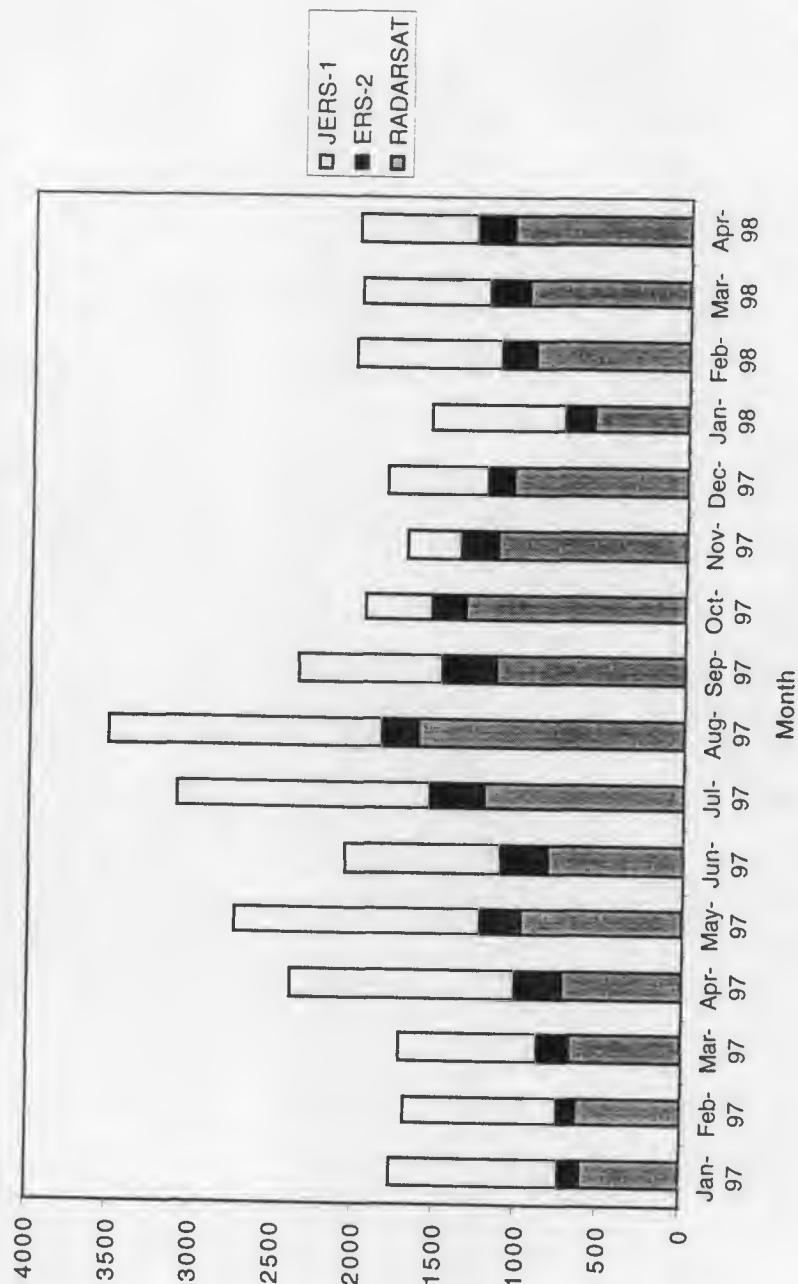


Acquisition

Date	ERS-2
Jan-97	125.6
Feb-97	114.3
Mar-97	196.2
Apr-97	278.6
May-97	254.3
Jun-97	280.3
Jul-97	329.9
Aug-97	217.6
Sep-97	328.9
Oct-97	198.9
Nov-97	218.3
Dec-97	164.9
Jan-98	174.8
Feb-98	194.4
Mar-98	235.2
Apr-98	211.6

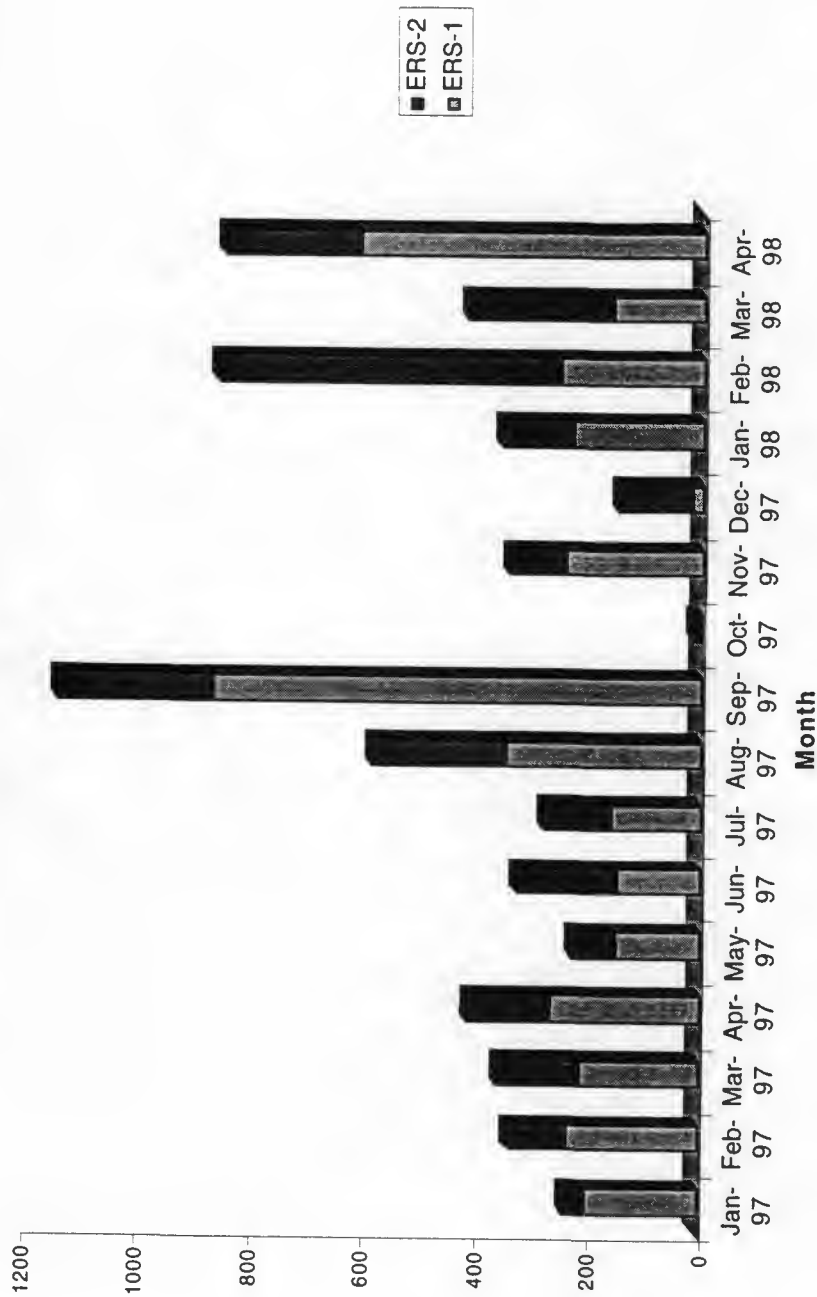
Acquisition

Minutes of SAR Data Acquired



Production

ERS Products Delivered



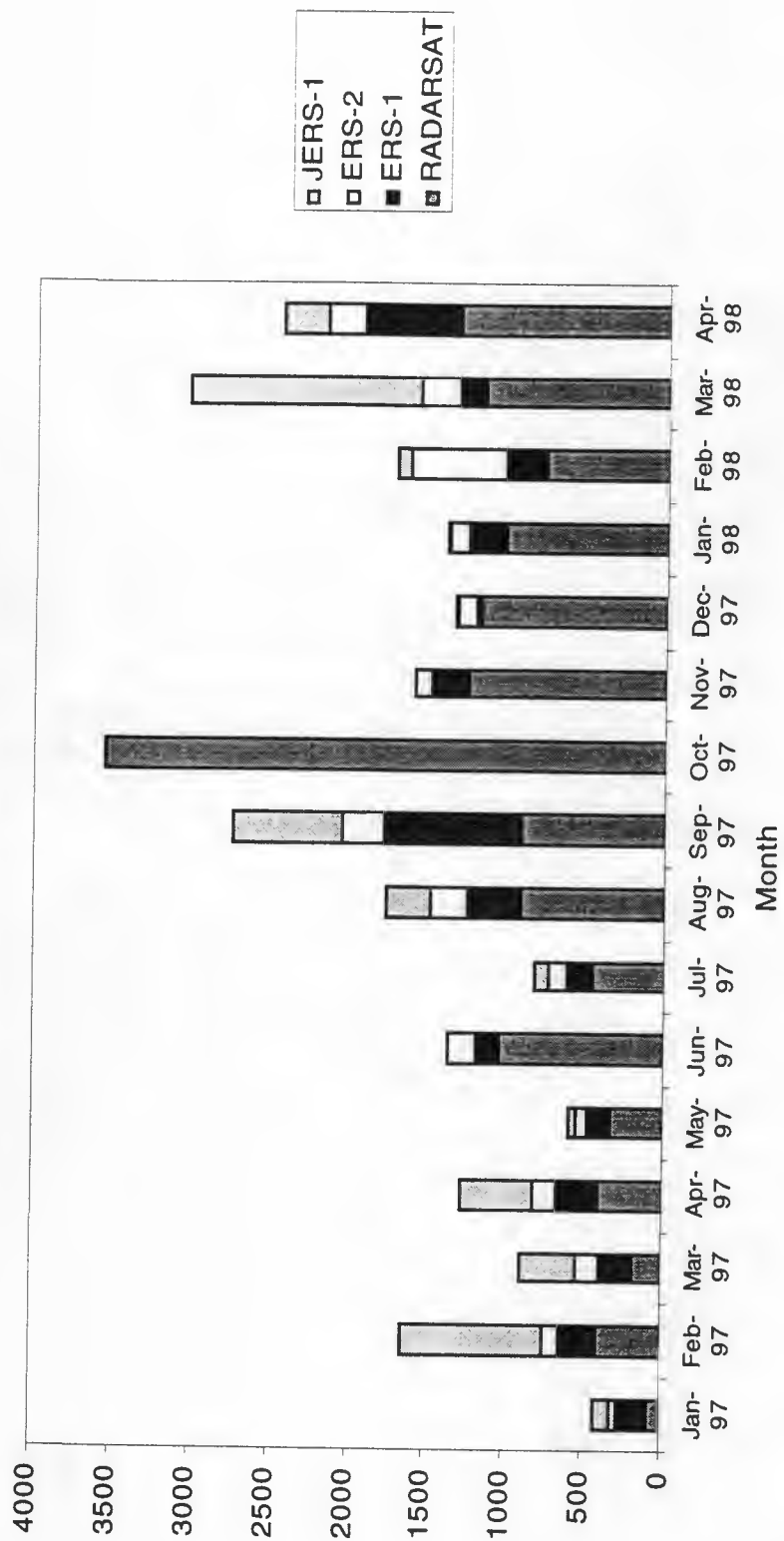
GJR7

Production

Date	ERS-1	ERS-2
Jan-97	198	38
Feb-97	234	99
Mar-97	208	147
Apr-97	265	143
May-97	147	79
Jun-97	144	178
Jul-97	157	118
Aug-97	343	237
Sep-97	862	274
Oct-97	5	8
Nov-97	241	98
Dec-97	20	127
Jan-98	228	124
Feb-98	252	603
Mar-98	161	253
Apr-98	606	238

Production

Total Number of Products Delivered



GJR9

Upgrades and changes

- Scanning and processing from various media
 - Sony ID-1
 - DCRSi
- 2 additional IBM SP-2 to be delivered in summer 1998
 - Total 5 with 40 nodes
- 300 TB robotic archive will be delivered summer 1998 to be used with Level 0 Processor (delivered late 1998)

Issues, concerns & comments

- Fixed ASF monthly reporting problem reported at 6th ESOWG
- Resolved McMurdo tape transcription issues
- REAQ file format issues for reporting McMurdo acquisitions
 - Large number of files to fix
 - Software engineers are working on fix
 - Anticipated delivery



Recent Studies using ERS

- Climate studies of Thaw Lakes on Alaska's North Slope
 - Determining bathymetry of lakes using ERS data and a numerical ice growth model
- Glacial Mapping from Interferometry
 - Measuring geophysical parameters on Alaskan glaciers relevant to mass balance and dynamics
- River Ice and Sea-ice processes
 - Combining ice motion vectors and interferometry to investigate landfast and pack ice dynamics and interactions
- Boreal Forest mapping and seasonal characteristics
 - Integrating boreal forest maps generated using ERS data with carbon-flux models to determine variability in growing season



season



Recent Studies (Con't)

- Mesoscale oceanic processes in coastal Alaska
 - SAR imaging of oceanic processes including internal waves, currents, fronts, ice-edge meanders, marine pollution, etc
- Generation of ERS mosaic of Alaska
 - Producing a large scale mosaic of Alaska using ERS-1
- NOAA Coastal Ocean Program
 - Monitoring coastal processes including wave and ice hazard warning, fisheries studies and regulation river ice-jam and flood warning



How to contact ASF

- Mission Planning/Acquisition Questions

Greta Reynolds

907-474-7869

voice

907-474-5195

fax

greynolds@santa.asf.alaska.edu

- Processing/Transcription Questions

Marc Forbes

907-474-7255

voice

907-474-5195

fax

marc@santa.asf.alaska.edu

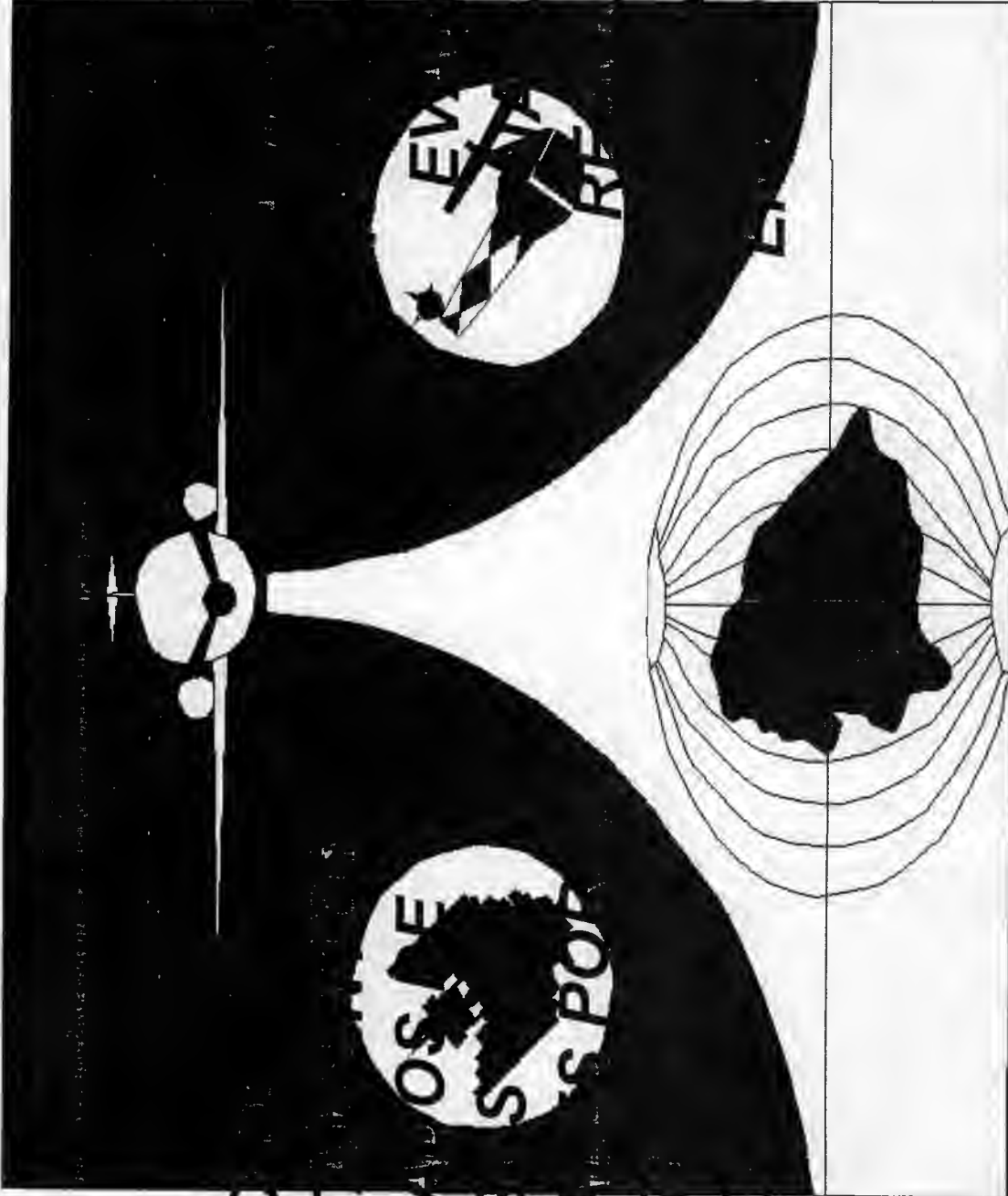
- Web-Site for ASF information (www.asf.alaska.edu)

- guides to data ordering, acquisition requests, SAR processing, interferometric work



CENTRO
 LEVANT
 INTEGRAL
 RECURS
 NATURAL
 SENSOR
 REMOT

DOW IN
 ACE TO
 UATE
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 JRCES
 ID
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CLIRSEN

COLOPAXI CROUND STATION

SLAVUS REPORT FOR BERS

1991

1992

1993

1994

1995

1996

1997

1998

1999

2000

2001

2002

2003

2004

2005

2006

2007

2008

2009

2010

2011

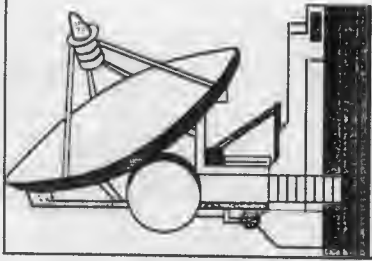
2012



ESOME 7th MEETING

COTOPAXI GROUND STATION OVERVIEW



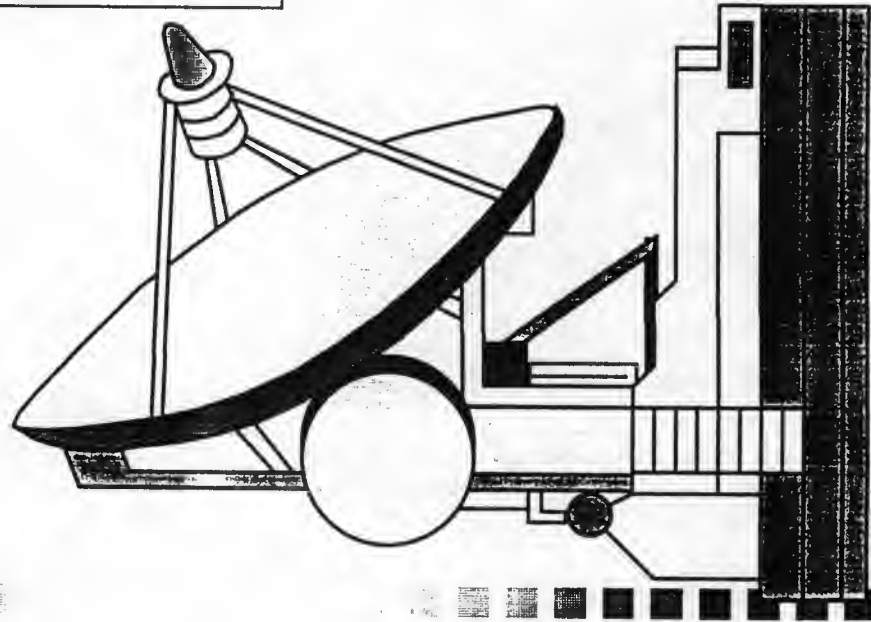


■ **Cotopaxi Ground Station is located
65 Km. South from Quito the
Ecuadorian Capital**

■ **Geographic location:**

◆ Latitude:	0° 37' 20" S
◆ Longitude:	78° 34' 42" W
◆ Altitude:	3.567 M.O.S.L

Cotopaxi Ground Station is equipped to receive, record, process and archive Earth observation satellites data.



**COTOPAXI GROUND
STATION**

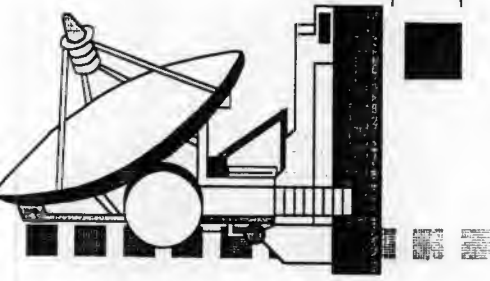
QUITO - ECUADOR

Currently it is operating with the sensors: TM
from Landsat-5, HRV from Spot 1 and 2 and
SAR from Ers 1 and 2

LANDSAT

ERS

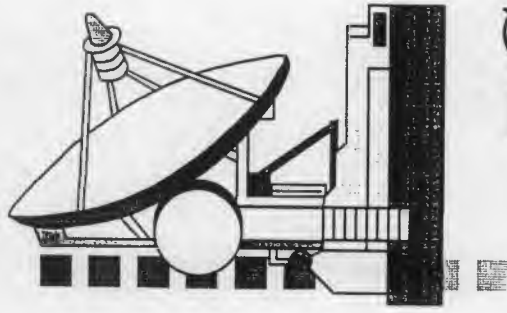
SPOT



■ Its capability could be modified in order to acquire telemetry data from similar satellites, as IRS, RADARSAT, etc.

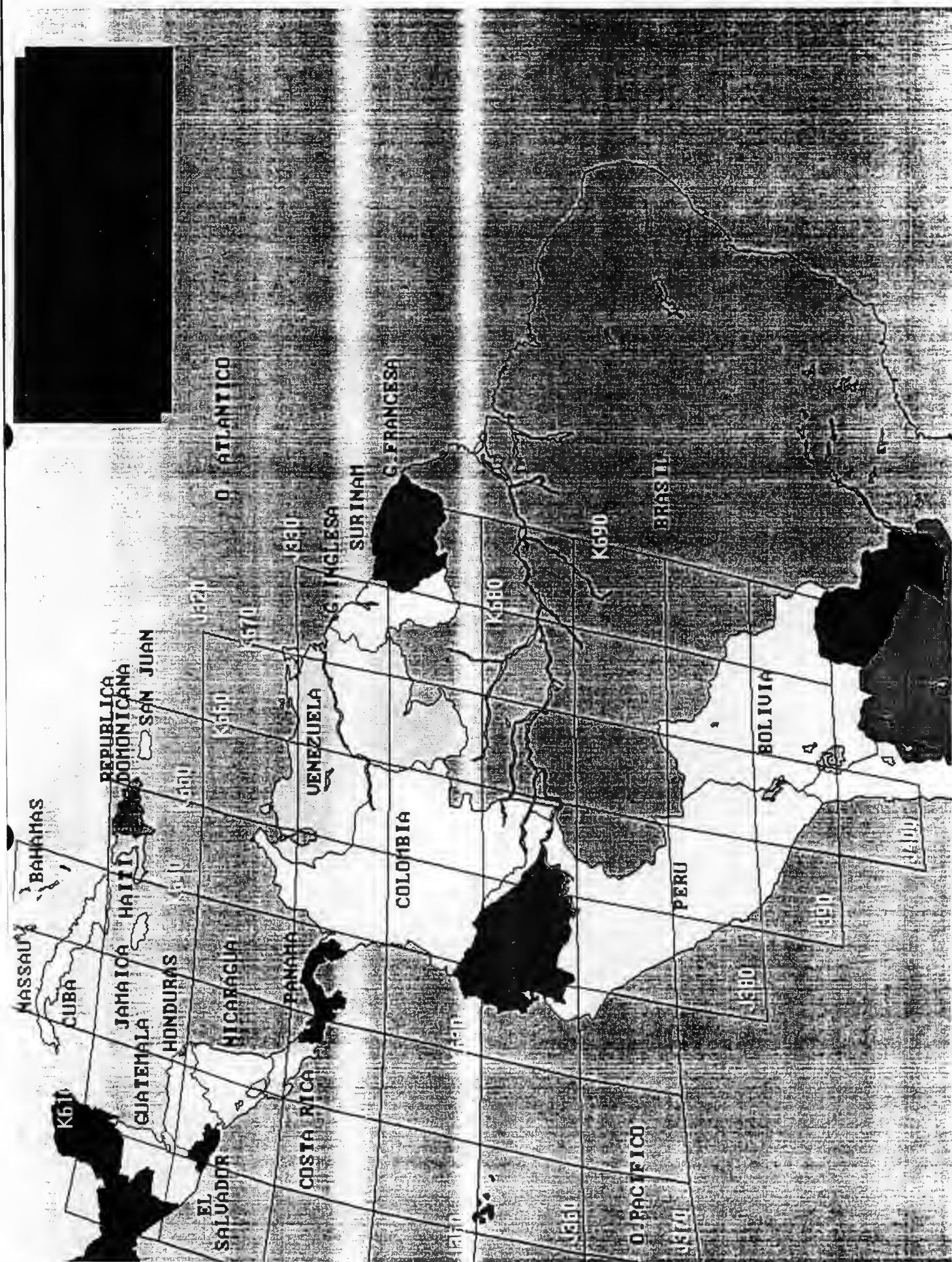
■ A NOAA (AVHRR) - SeaSTAR (SeaWIFS) capability was installed recently.





■ Cotopaxi Station antenna coverage is from Yucatan in Mexico to Antofagasta in Chile, almost the complete Caribbean Islands. It covers 25 Central and South American countries.





SAR ERS1 IMAGE
EAST OF CUBA



ACQUISITION DATE: 01-OCT-1991

ERS RECEPTION AND ARCHIVE

■ IN OCTOBER 1996 CLIRSEN AND ESA SIGNED A MODIFICATION TO THE EXISTING AGREEMENT CONCERNING THE DIRECT RECEPTION, ARCHIVING, PROCESSING AND DISTRIBUTION OF THE ERS-1 DATA IN ORDER TO EXTEND IT UNDER THE SAME TERMS AND CONDITIONS TO ERS-2 DATA AS WELL

■ ESA INSTALLED AT COTOPAXI
STATION A MULTIMISSION
PROCESSING SYSTEM. THIS SYSTEM
IS EXCLUSIVELY DEDICATED TO
INGEST AND PROCESSERS 1/2 DATA.

■ THE MULTIMISSIION PROCESSING SYSTEM
INSTALLED AT COTOPAXI GROUND
RECEIVING STATION BY ESA IS BASED ON
ONE SILICON GRAPHICS INDY,
CONNECTED TO A SILICON GRAPHICS
CHALLENGE WORKSTATION AND A
LARGE DATA STORAGE CAPACITY FOR
ARCHIVING, 2 DLT 7000 FOR DATA
TRANSCRIPTION AND COPY, AND ONE
EXABYTE DRIVE FOR S/W BACKUP AND
PRODUCTS DISTRIBUTION.

■ COTOPAXI GROUND STATION
PARTICIPATED IN A TANDEM OPERATION
WITH THE TWO ERS SATELLITES DURING
THE PERIOD OF SEPTEMBER-OCTOBER
1997.

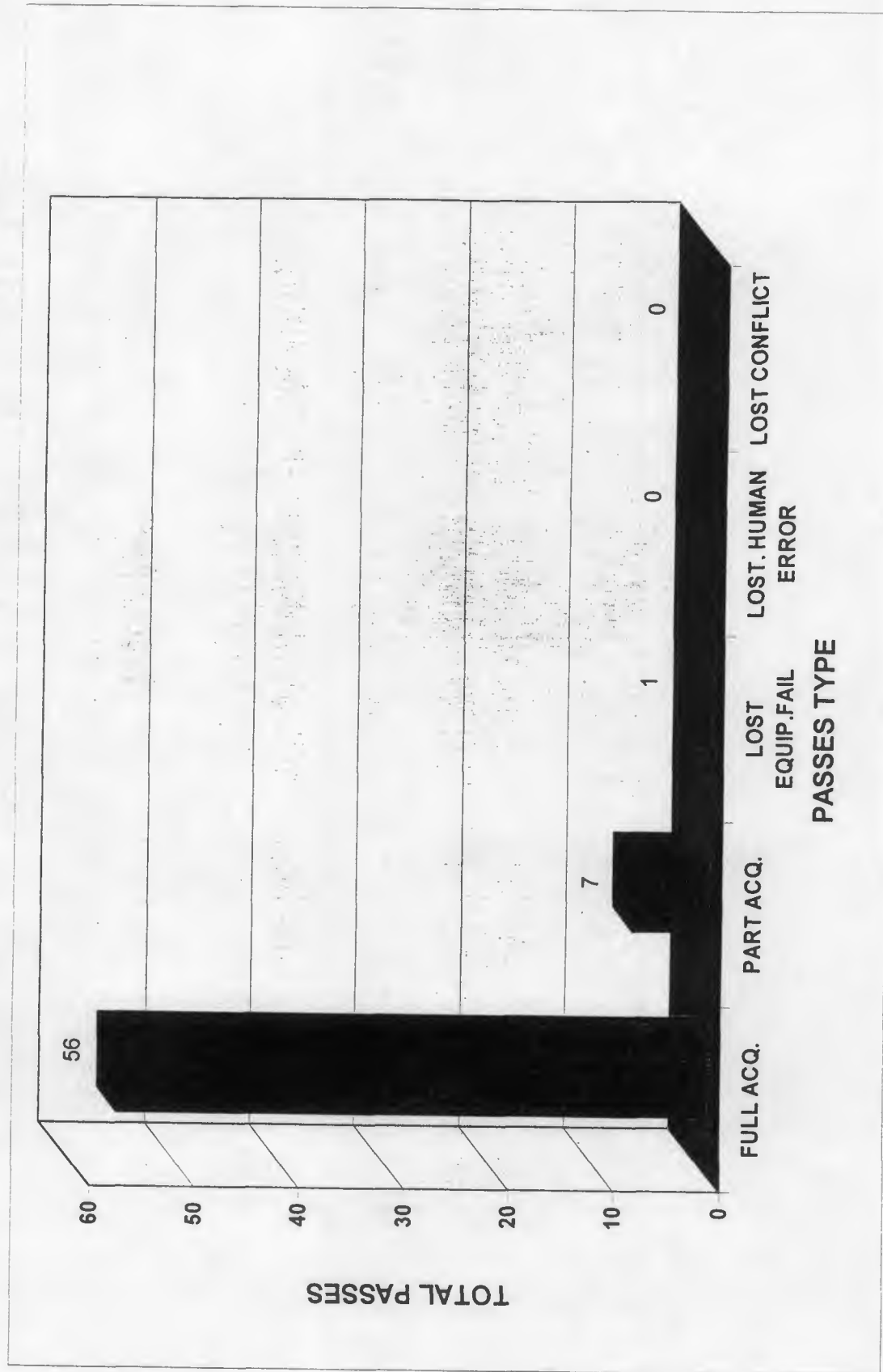
■ ALL ERS DATA RECEIVED AT COTOPAXI
IS TRANSCRIBED ON DLT AND SHIPPED
TO ESA/ESRIN. AT THE SAME TIME THIS
DATA IS RECORDED ON HDDT FOR ERS
DATA ARCHIVE FOR COTOPAXI STATION.

■ BEFORE AND AFTER THE TANDEM
CAMPAING, COTOPAXI STATION IS
SUPPORTING ANY ERS DATA
ACQUISITION OR PROCESSING AT ESA
REQUESTS, INCLUDING SOME ASCENDING
ERS 1-2 PASSES.

■ THE MMPS IS CONFIGURED IN SUCH A
WAY THAT IS CAPABLE TO INGEST ERS
DATA FROM THE COTOPAXI HDDT
RECORDING SUBSYSTEM IN ORDER TO
TRANSCRIBE THE COMPLETE COTOPAXI
ERS ARCHIVE ONTO DLT.

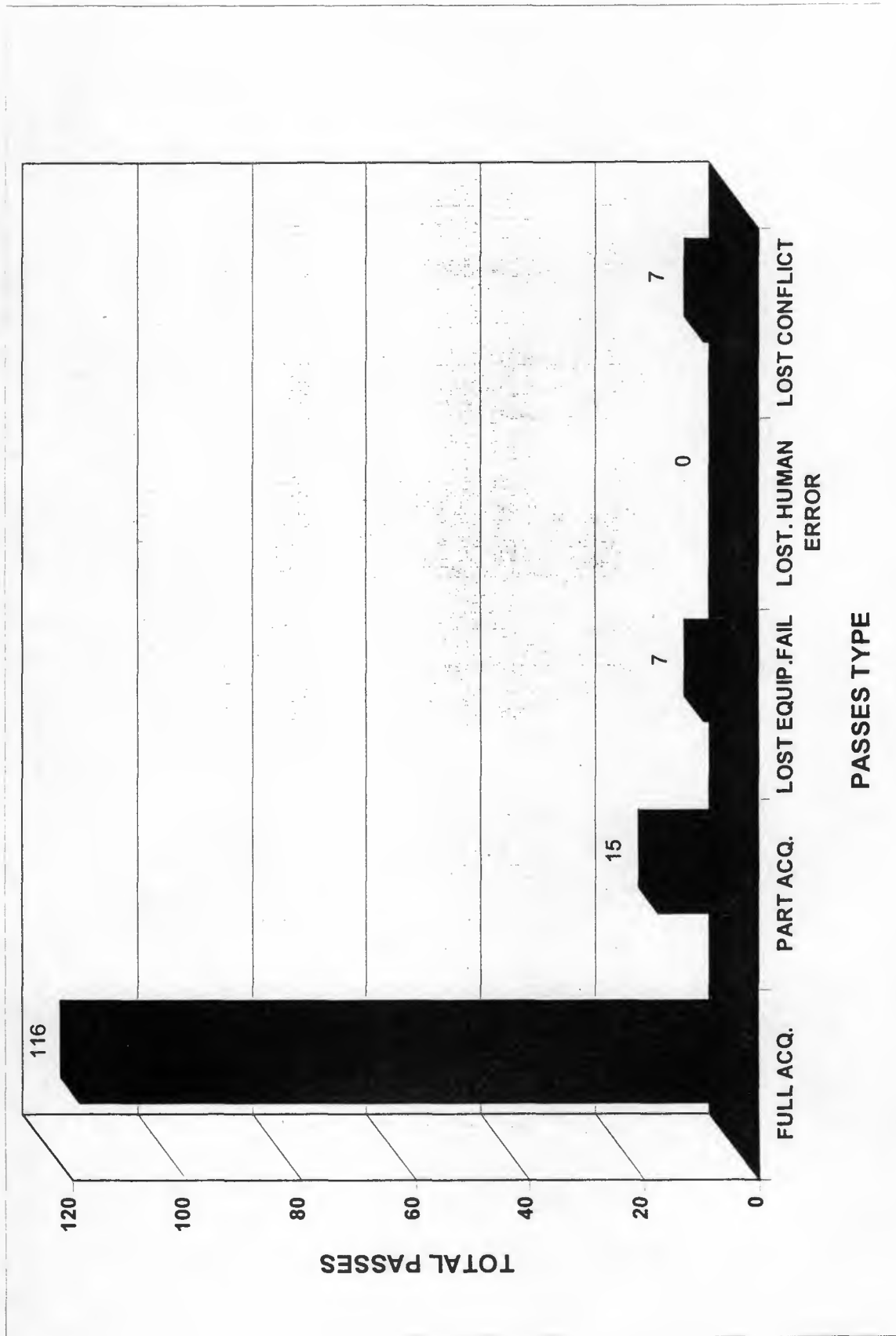
ERS 1

ACQUISITION FROM JAN-97 TO APR-98



ERS 2

ACQUISITION FROM JAN-97 TO APR-98



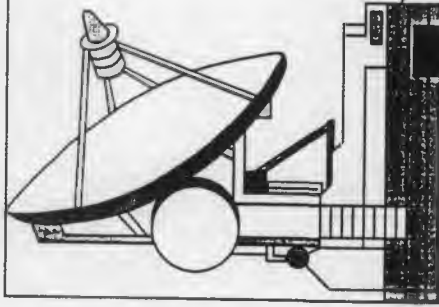
ERS PRODUCTION

- USING THE ESA MMPS, CLIRSEN HAD RECOVERED 32 ERS 1/2 FRAMES ON GEC IMAGES. ALL OVER ECUADORIAN TERRITORY. SOME OF THEM ARE USED TO MONITOR AND EVALUATE THE “EL NIÑO” PHENOMENON OVER COASTAL LANDS.
- 10 ERS GEC PRODUCTS WERE USED JOINTLY WITH THE UNITED NATIONS PROGRAM FOR DEVELOPMENT FOR A “EL NIÑO” RESEARCH PROJECT.

■ THESE 10 GEC PRODUCTS WERE
TRANSFERRED TO THE MDA SYSTEM
IN ORDER TO PRODUCE
PHOTOGRAPHIC IMAGES.

■ AN UNUSUAL INTEREST FOR ERS
IMAGES HAS ARISEN IN THE LOCAL
USERS.

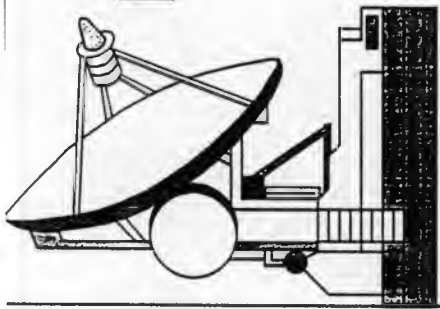
■ IT IS PLANNED TO TRANSCRIBE THE
WHOLE COTOPAXI STATION ERS
HDDT ARCHIVE ONTO DLT.



FINDINGS

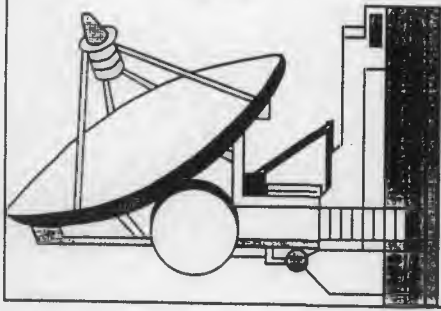
With the inclusion of the MMPS system, the problem that Cotopaxi Station had to process ERS imagery was overcome.

- The promotion to use ERS-SAR imagery in various applications within the country has been initiated.
- Interest in using ERS-SAR data has arisen.

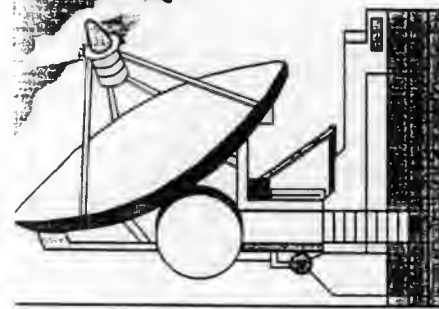


■ Hardware as well as software allowing interferometric applications using ERS-SAR data will be, possibly, installed at Cotopaxi Station

■ CLIRSEN is requesting collaboration from ESA through a course given to our technicians on use and application of ERS data in the various studies and researches we have ahead



- This training will have a multiplying effect on our country since technology transfer is one of CLIRSEN's functions and is continually practiced.
- CLIRSEN does not skimp on efforts to fulfill the commitment taken on, that is, the reception and recording of ERS 1/2 data according to given schedules and whatever the time.



■ Users can make all requests directly to:

e-mail:

clfrsen@univsatnet.net

phone :

593 - 02 - 5211259 / 5311113

fax:

593 - 02 - 5810066 / 549472

■ WEB Site: www.clfrsen.com

THANKS

CLC-CCOR



ESOWG

ESA

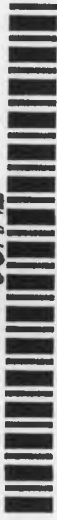
TOULOUSE - FRANCE

MAY 28 - 29 , 1998

COMISION NACIONAL DE ACTIVIDADES
ESPACIALES

ESTACION TERRENA
CORDOBA





CORDOBA GROUND STATION OVERVIEW

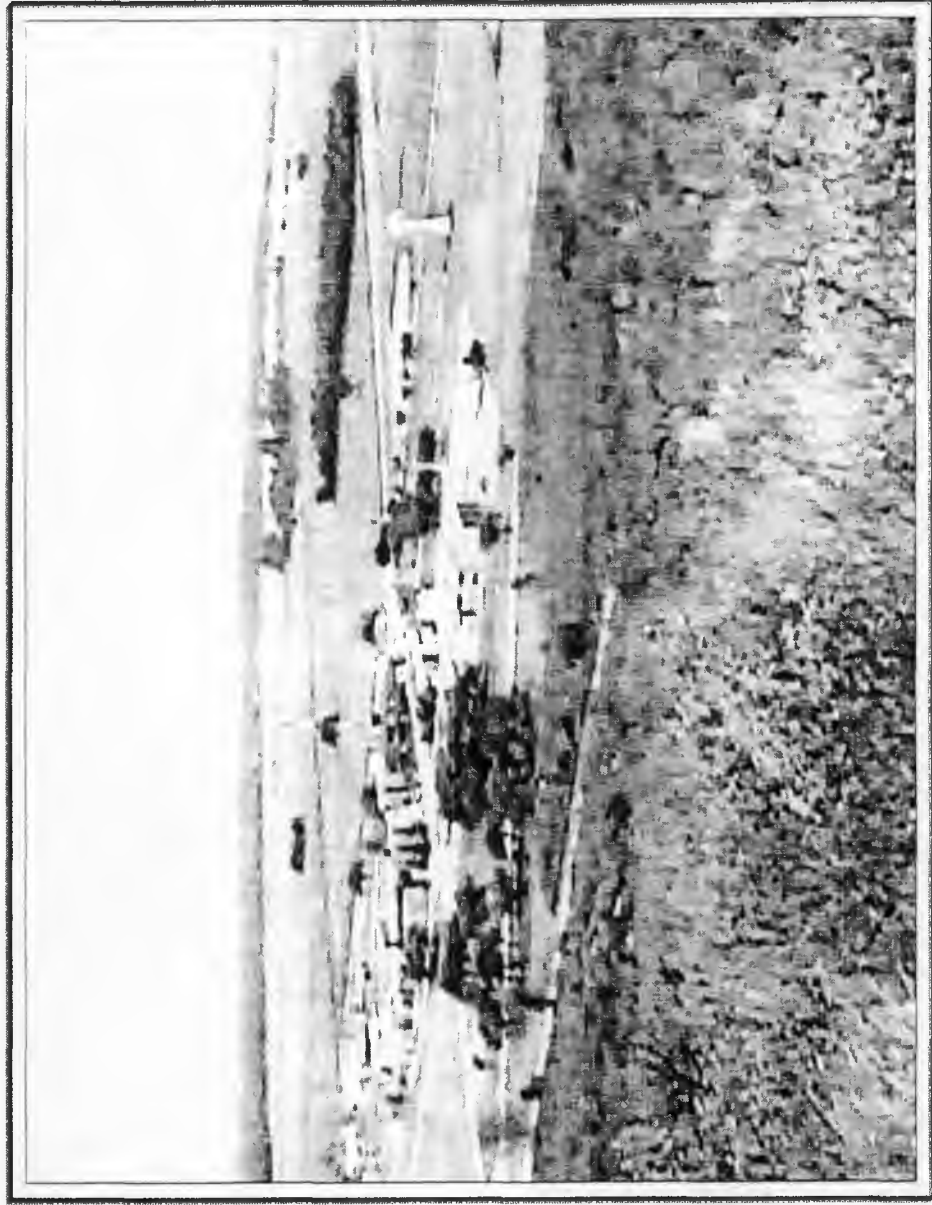
ESTACION TERRENA CORDOBA

Falda del Carmen, Provincia de Córdoba
República Argentina





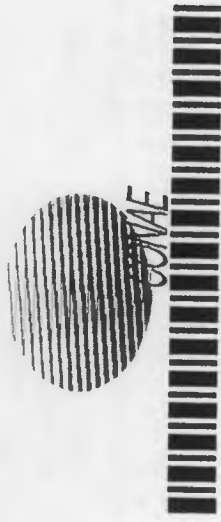
ESTACION TERRENA CORDOBA



COMISION NACIONAL DE ACTIVIDADES
ESPACIALES

ESTACION TERRENA
CORDOBA





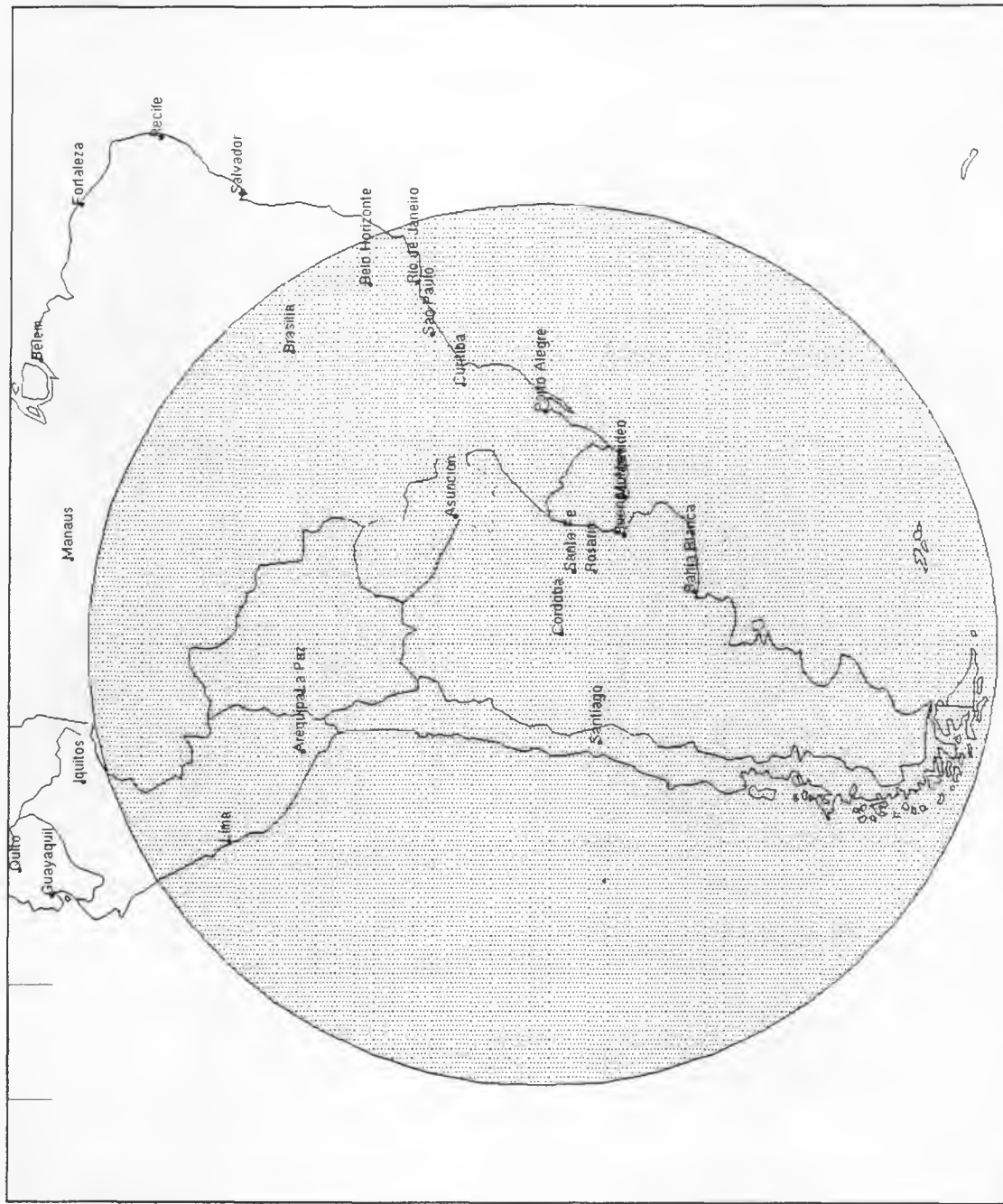
- Established in 1997 for Landsat, ERS and Spot data reception, processing and archiving.
- Provides coverage for Argentina, Uruguay, Brazil*, Paraguay, Bolivia, Perú* and Chile.
- Primary reception and archive facility for NOAA AVHRR and SEAWIFS data.

* partially





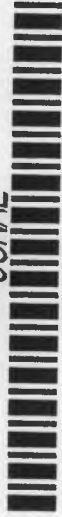
STATION COVERAGE MASK



COMISION NACIONAL DE ACTIVIDADES
ESPACIALES

ESTACION TERRENA
CORDOBA





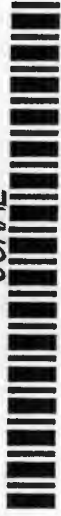
SATELLITE DATA RECEIVED

• ERS 1, 2	Direct Ingestion
• SPOT 1, 2	Direct Ingestion
• LANDSAT 5	Direct Ingestion
• NOAA AVHRR	Direct Ingestion



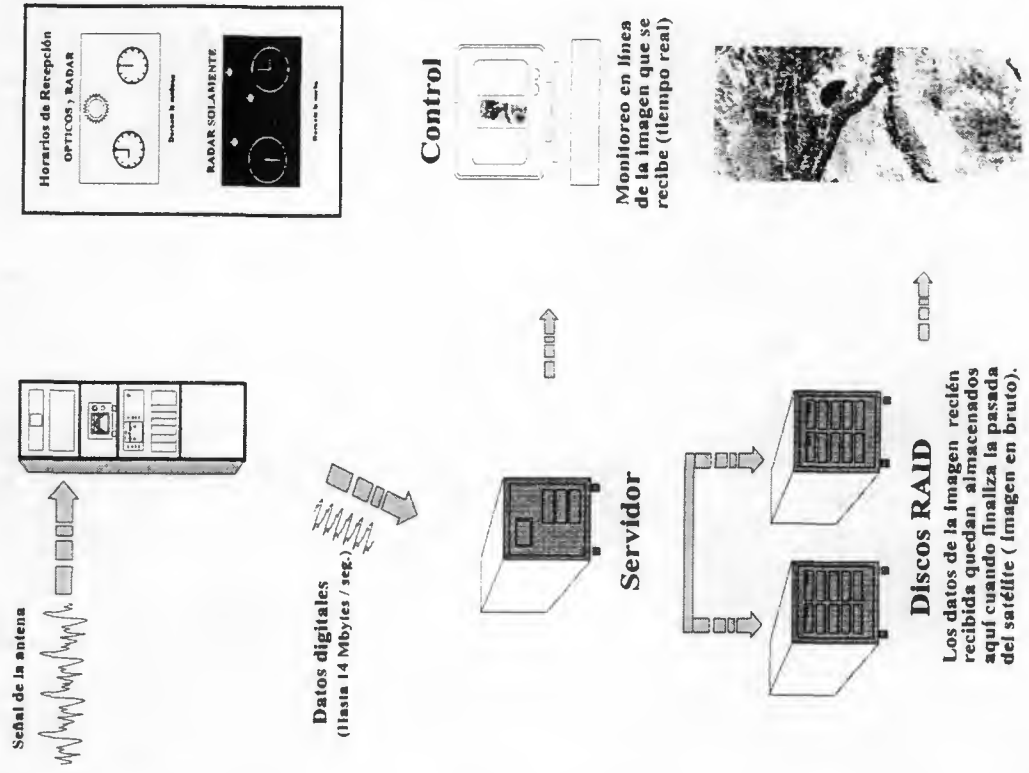


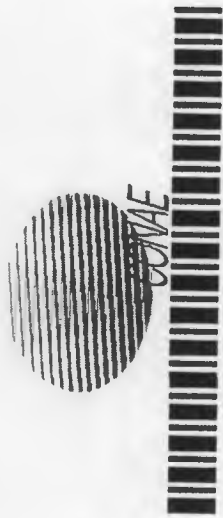
COMAE



STATION CONFIGURATION INGESTION

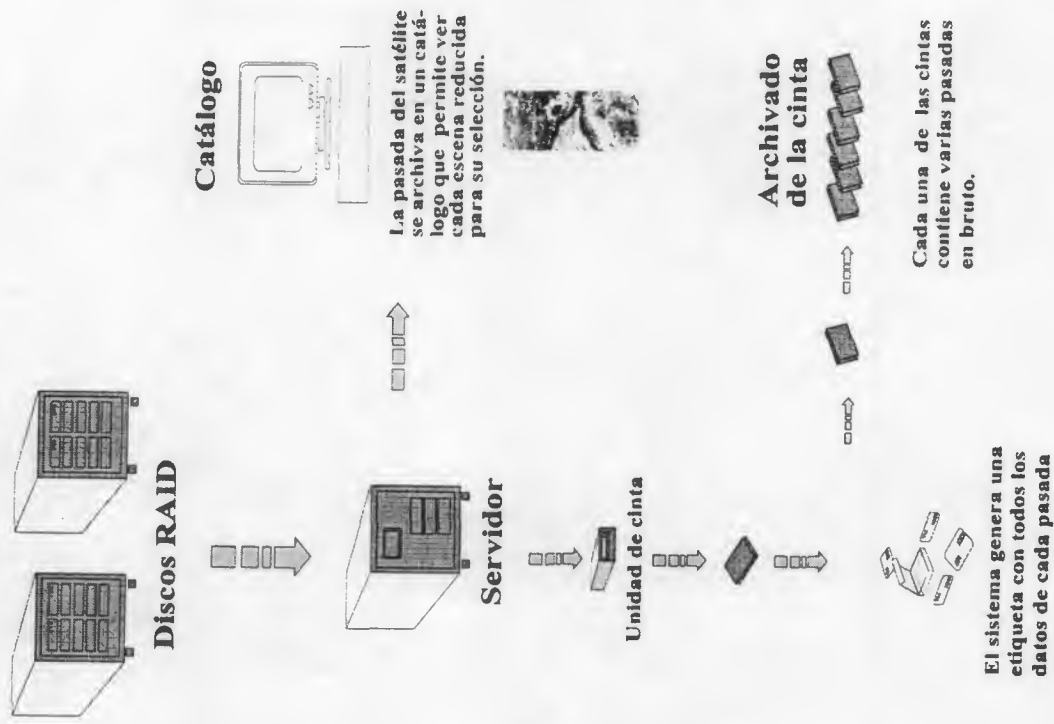
INGESTION





STATION CONFIGURATION TRANSCRIPTION

TRANSCRIPCION





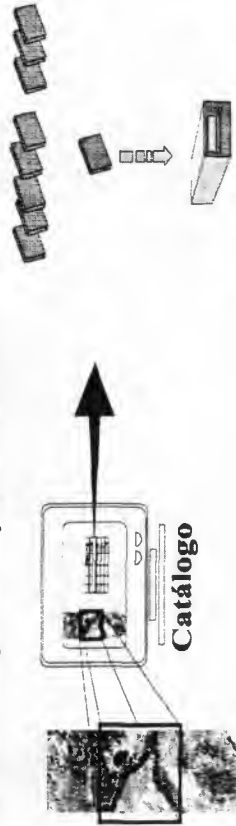
STATION CONFIGURATION PRODUCTION

PRODUCCION (PREPROCESAMIENTO)

La persona interesada en conseguir una imagen envía los datos necesarios a la Estación Terrena:

- Ubicación geográfica (latitud y longitud).
- Fecha de adquisición o período.
- Porcentaje de nubes (si específico período).

El operador de producción localiza en la base de datos del catálogo la escena y el Número de cinta.



El preprocesamiento es la operación que permite transformar la imagen en ruido en una imagen inteligible por el usuario. La exigencia para los dos procesadores del servidor es muy grande, en especial cuando se preprocesan datos de radar.



← PRODUCTO FINAL

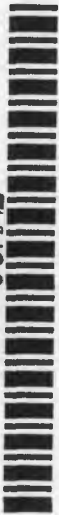
Unidad grabadora de CD-ROM

Control

Servidor

Unidad de cinta

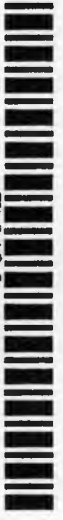




CLIENTS

Satellites Supported	Station	Industry	Government	Foreign
LANDSAT	5 %	20 %	65 %	10 %
SPOT	100 %	---	---	---
ERS	70 %	---	15 %	15 %
NOAA AVHRR	---	---	100 %	---





Acquisition Statistics

Satellites	Successful Transcriptions	Station	Losse Due To: Satellite	Conflict	Station Success
LANDSAT (1)	646	3 %	1 %	2 %	94 %
SPOT 1 (2)	1280 (4)	3 %	- - -	1 %	96 %
SPOT 2 (2)	208 (4)	3 %	- - -	1 %	96 %
ERS 1 (1)	60	10 %	- - -	1 %	89 %
ERS 2 (1)	200	15 %	- - -	1 %	84 %
NOAA	205	4 %	- - -	- - -	96 %
AVHRR (3)					

(1) 3 - 1997 TO 5 - 1998

(2) 1 - 1998 TO 5 - 1998

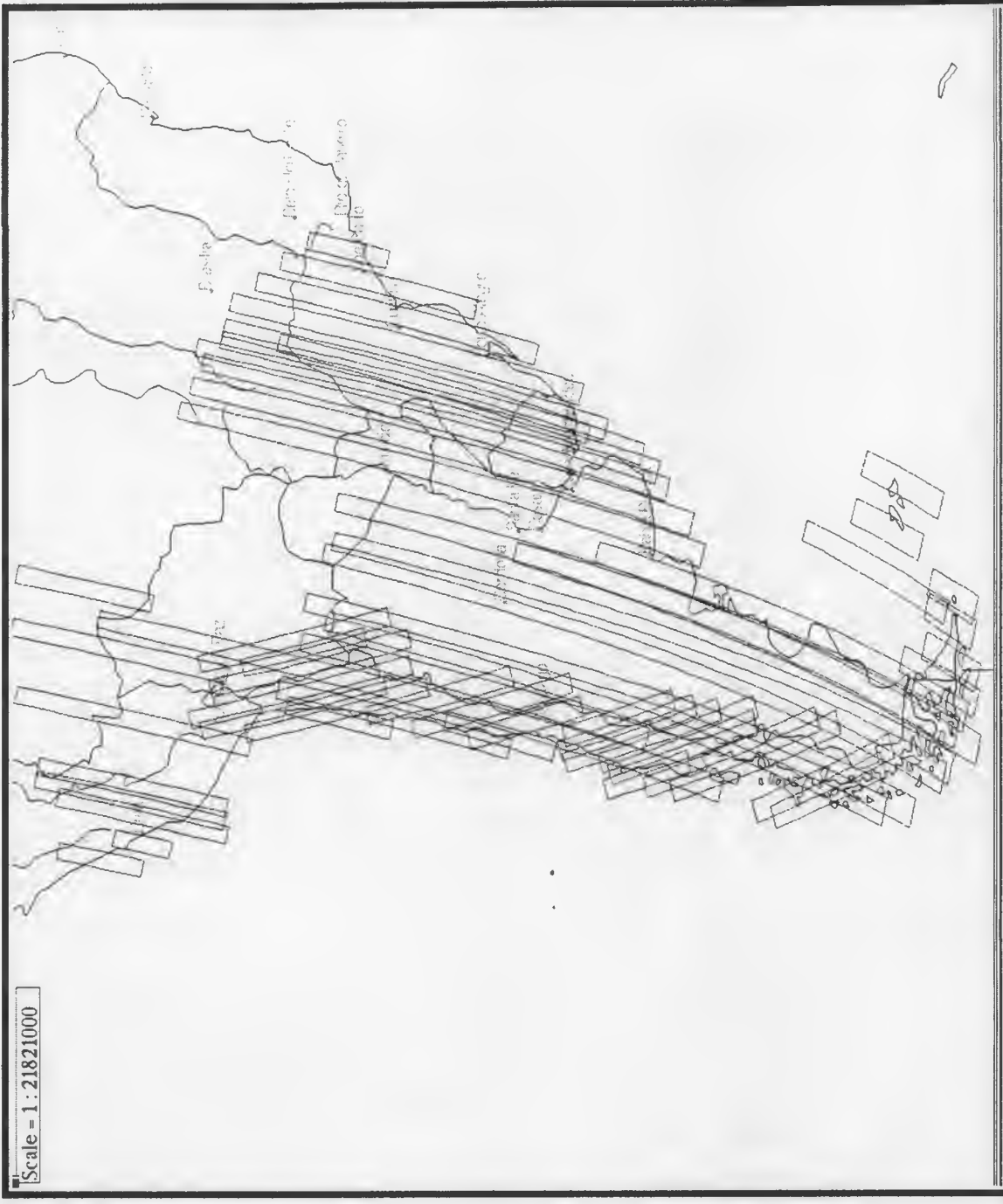
(3) 11 - 1997 TO 5 - 1998

(4) Segments





ERS 1



COMISION NACIONAL DE ACTIVIDADES
ESPACIALES

ESTACION TERRENA
CORDOBA





ERS 2



**COMISION NACIONAL DE ACTIVIDADES
ESPACIALES**



ERS 2

Goya - Resistencia
DATE April 1 998

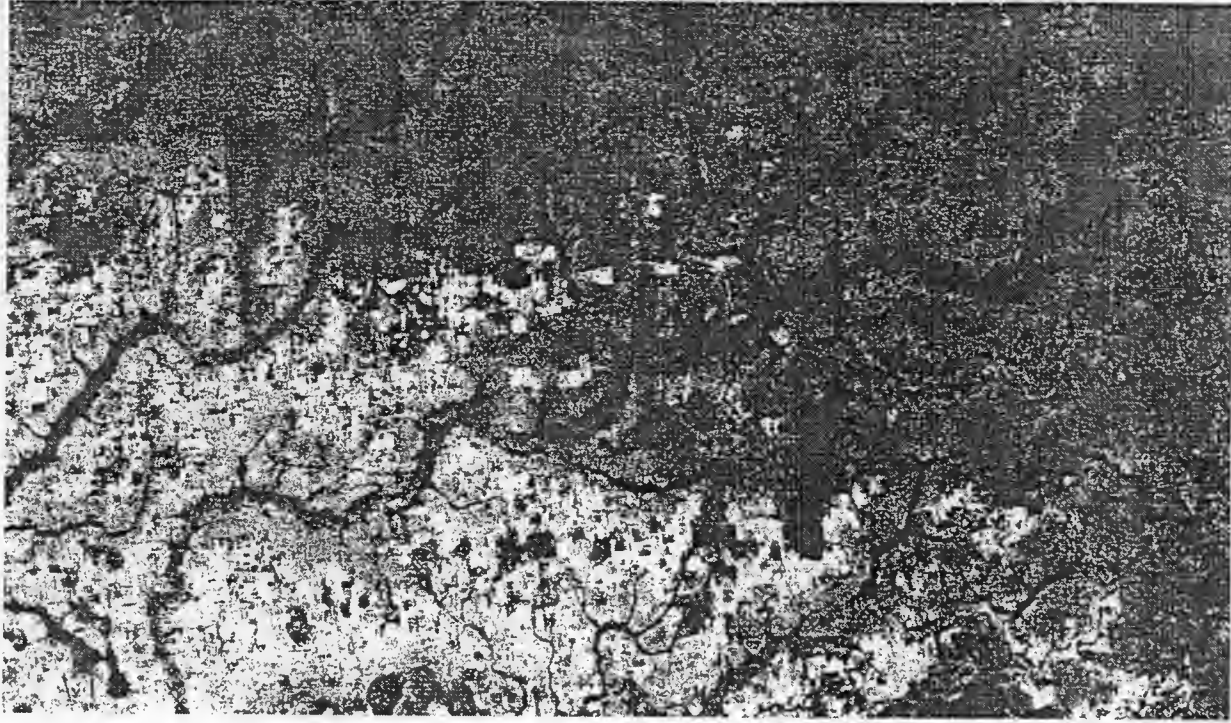
 Flooding





ERS 2

West of Paraná River
DATE Abril 1 1998
JPEG



COMISION NACIONAL DE ACTIVIDADES
ESPACIALES

ESTACION TERRENA
CORDOBA



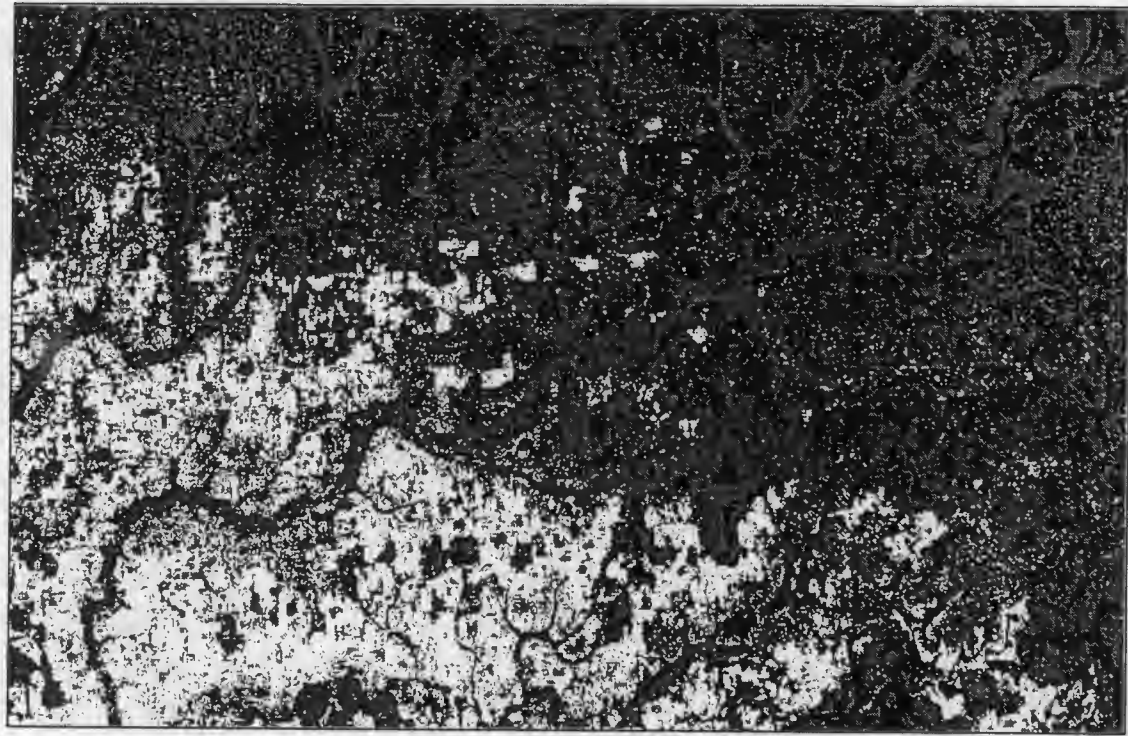


ERS 2

West of Paraná River

Multidate April'98 / October'97

JPEG





Comisión Nacional de Actividades Espaciales

Estación Terrena Córdoba

Centro Espacial Teófilo Tabanera

• Antonio Menescardi

E-mail = menes@conae.gov.ar

• Jorge Izaurralde

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• BUENOS AIRES

Tel: (54)-(01)-331-0074

Fax: (54)-(01)-331-3448

• CORDOBA

Tel: (54)-(0547)-20090

Tel/Fax: (54)-(0547)-25999

• MENDOZA

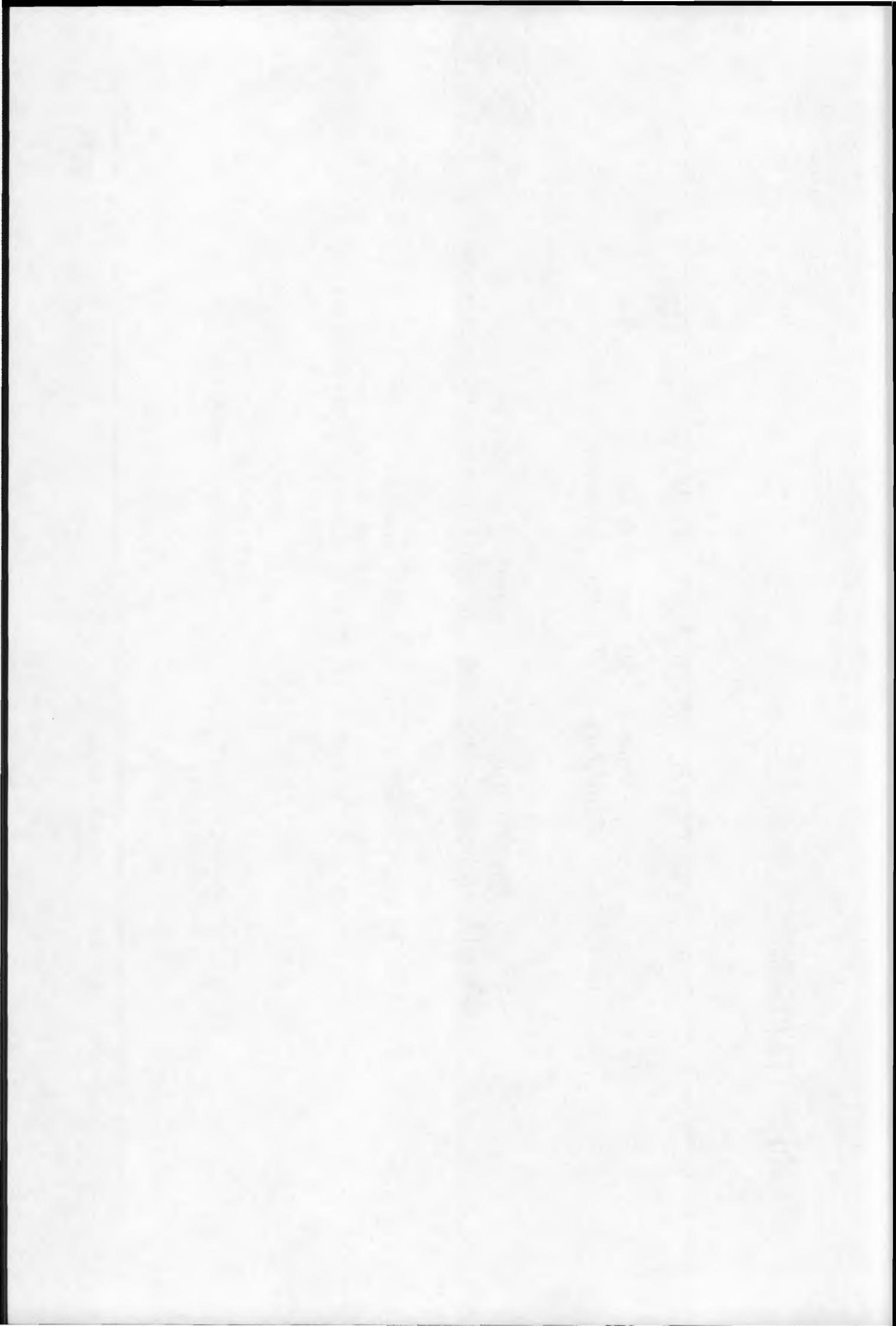
Tel: (54)-(061)-288654

Fax: (54)-(061)-288565

• INTERNET

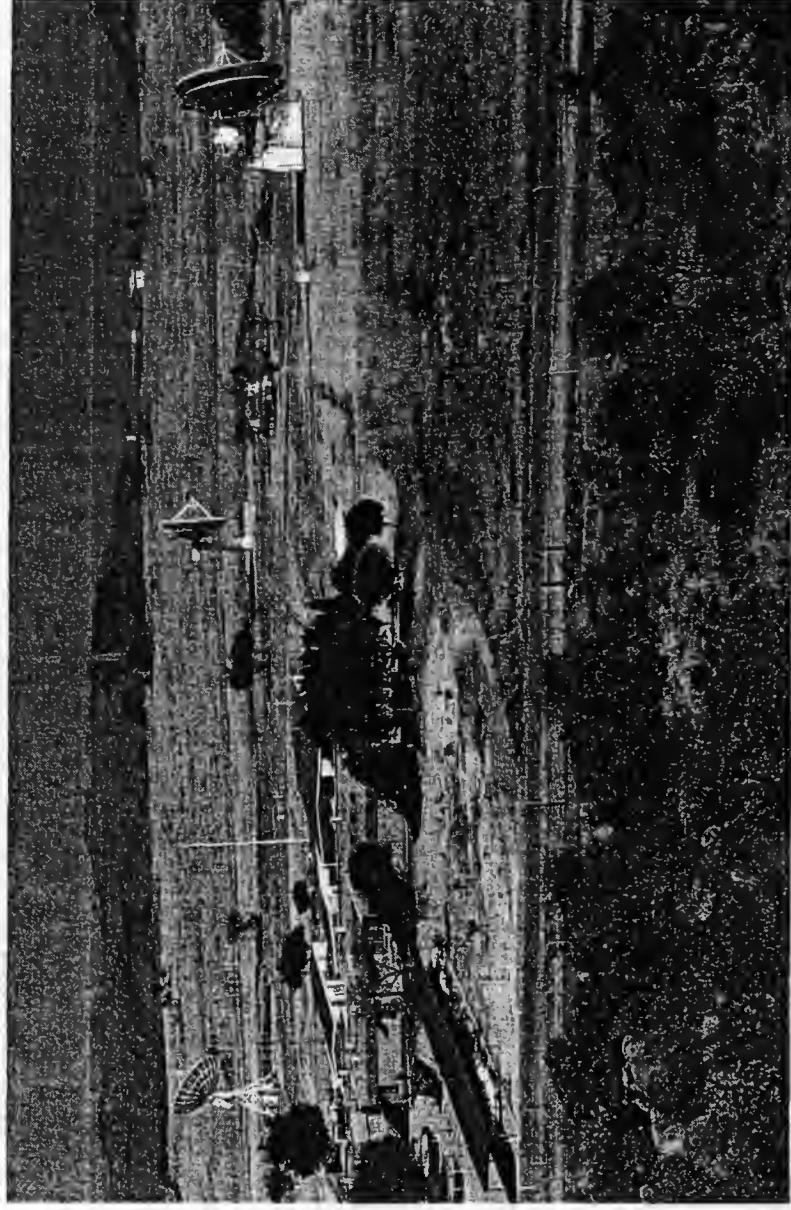
<http://www.conae.gov.ar>



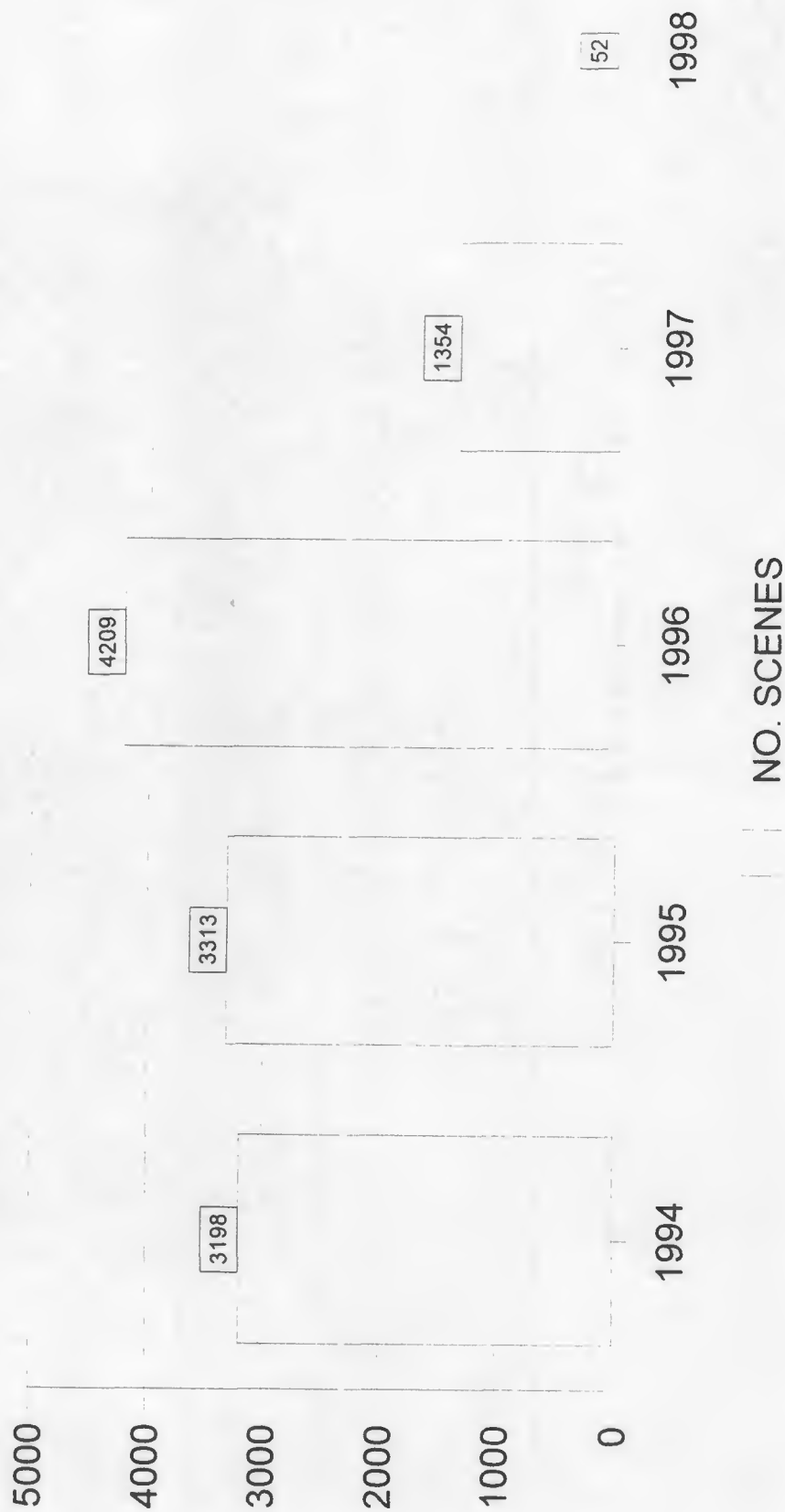


SAC/ESOWG-7

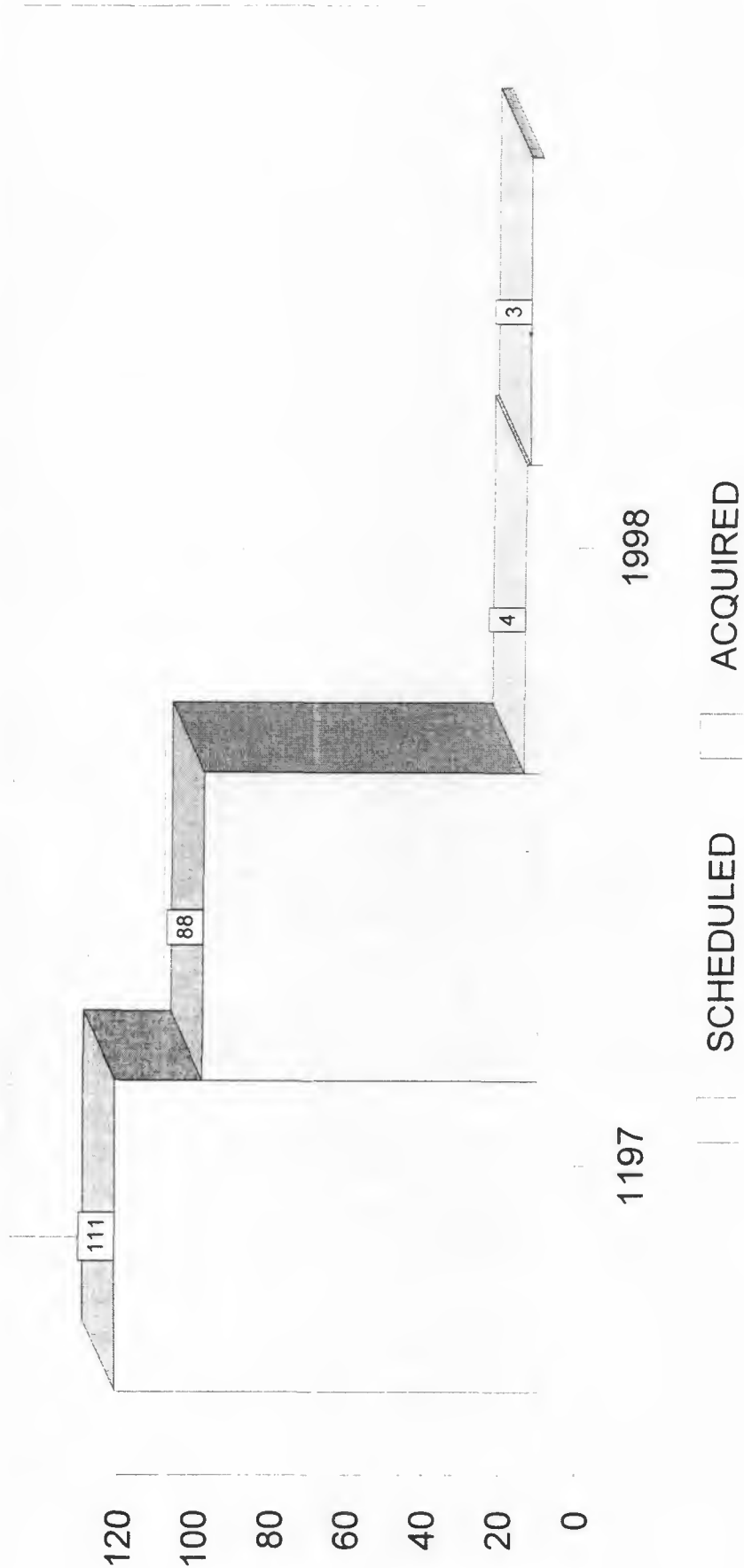
**PRESENTATION TO ESOWG-7
27 to 28 MAY, 1998
TOULOUSE, FRANCE
PRESENTED BY IKE MARAIS**



ERS ARCHIVE: 1994 TO 1998



DATA ACQUISITIONS



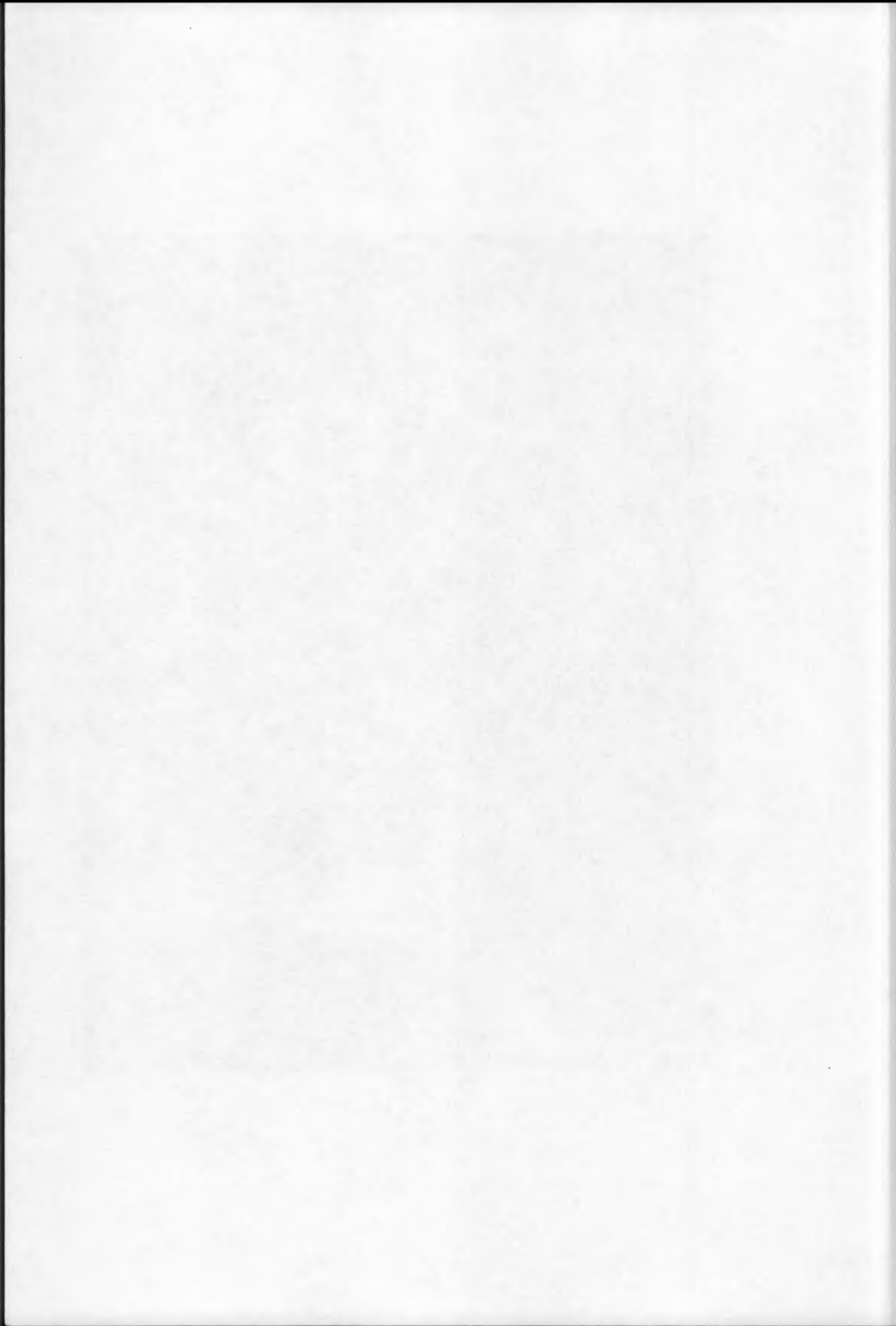
SAC HAPPENINGS

- **TT&C**
 - ▶ **CONTRACT WITH HUGHES**
 - ▶ **13.4m KU/KA BAND ANTENNA (TIW)**
 - ▶ **DISCUSSIONS WITH:**
 - **BOEING, LOCKHEED MARTIN, ISRO, NASA, CNES, DASA, RSA, ROCSAT, ACTEL**
- **NOAA/ORBVVIEW-2 SYSTEM**
- **ORBVIEW-2 RECEPTION: AUGUST 1997**
- **TRAINING INITIATIVE**
 - ▶ **GDTA, POST GRADUATE COURSES**
- **INVESTIGATION INTO:**
 - ▶ **ROBOTIC SYTEMS, ENTERPRISE STORAGE SYSTEMS**

SAC/ESOWG-7

KU/KA ANTENNA





GOSS XII & ESOWG VII



May 25 - 29, 1998
Toulouse, France

IAI MBT DIVISION
Electronics Group
ISRAEL AIRCRAFT INDUSTRIES LTD



ISA - IAI / MBT Station

Location : Tel Aviv, Israel
Operator : IAI / MBT
Distributor : ICTAF

Mission Profile :

- **Start operation :** Feb. 1991 (SPOT)
May 1995 (ERS)
- **SPOT IMAGE certification :** Apr. 1992
- **Acquisition capability :** SPOT, ERS
- **Future capability :** RADARSAT, EROS, IRS,
Others.

ISA - Israel Space Agency

ISA - IAI / MBT Station

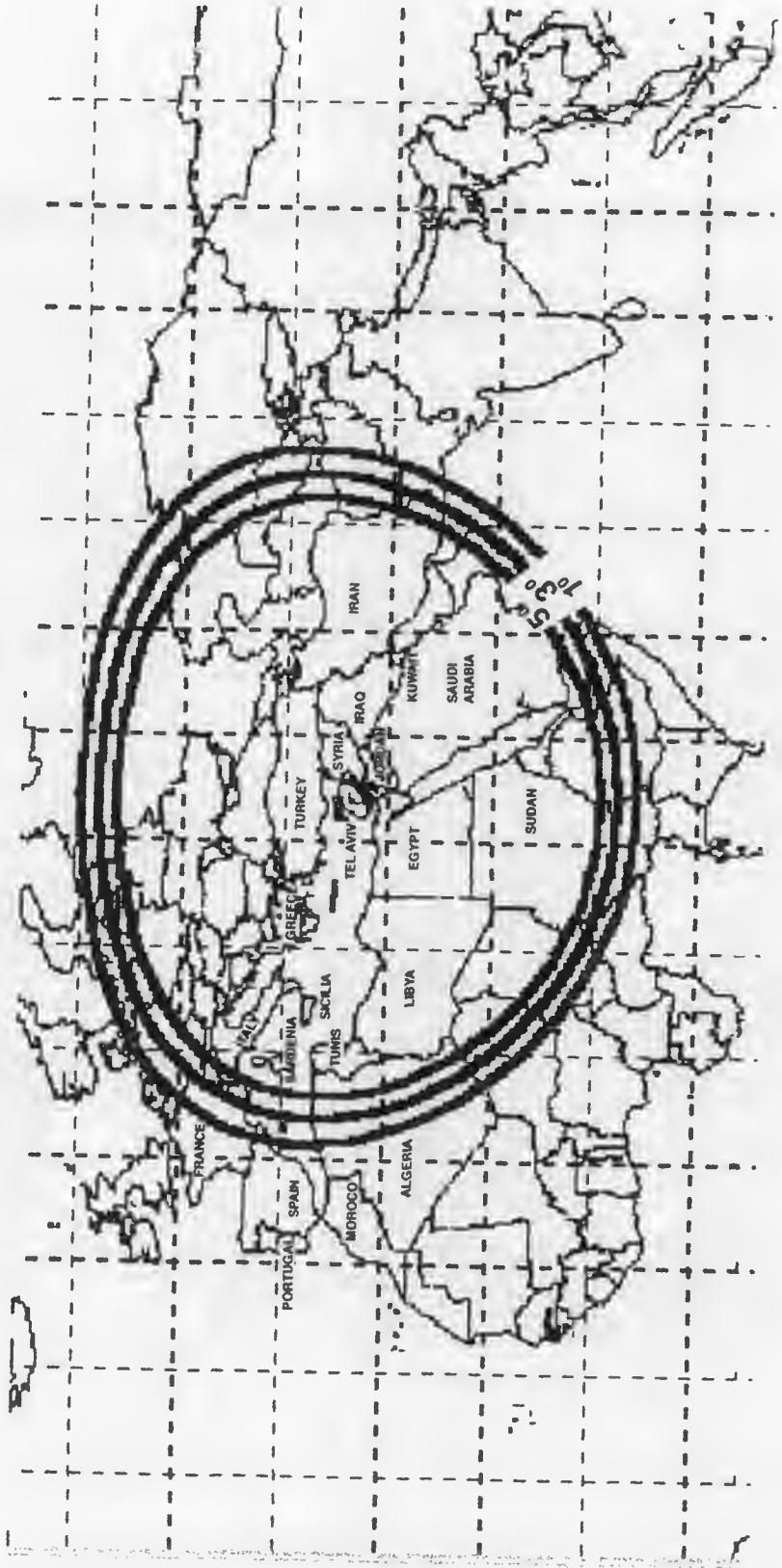


IAI MBT DIVISION
Electronics Group
ISRAEL AIRCRAFT INDUSTRIES LTD

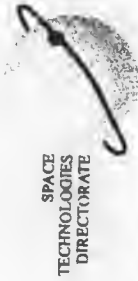
SPACE
TECHNOLOGIES
DIRECTORATE

ISA - Israel Space Agency

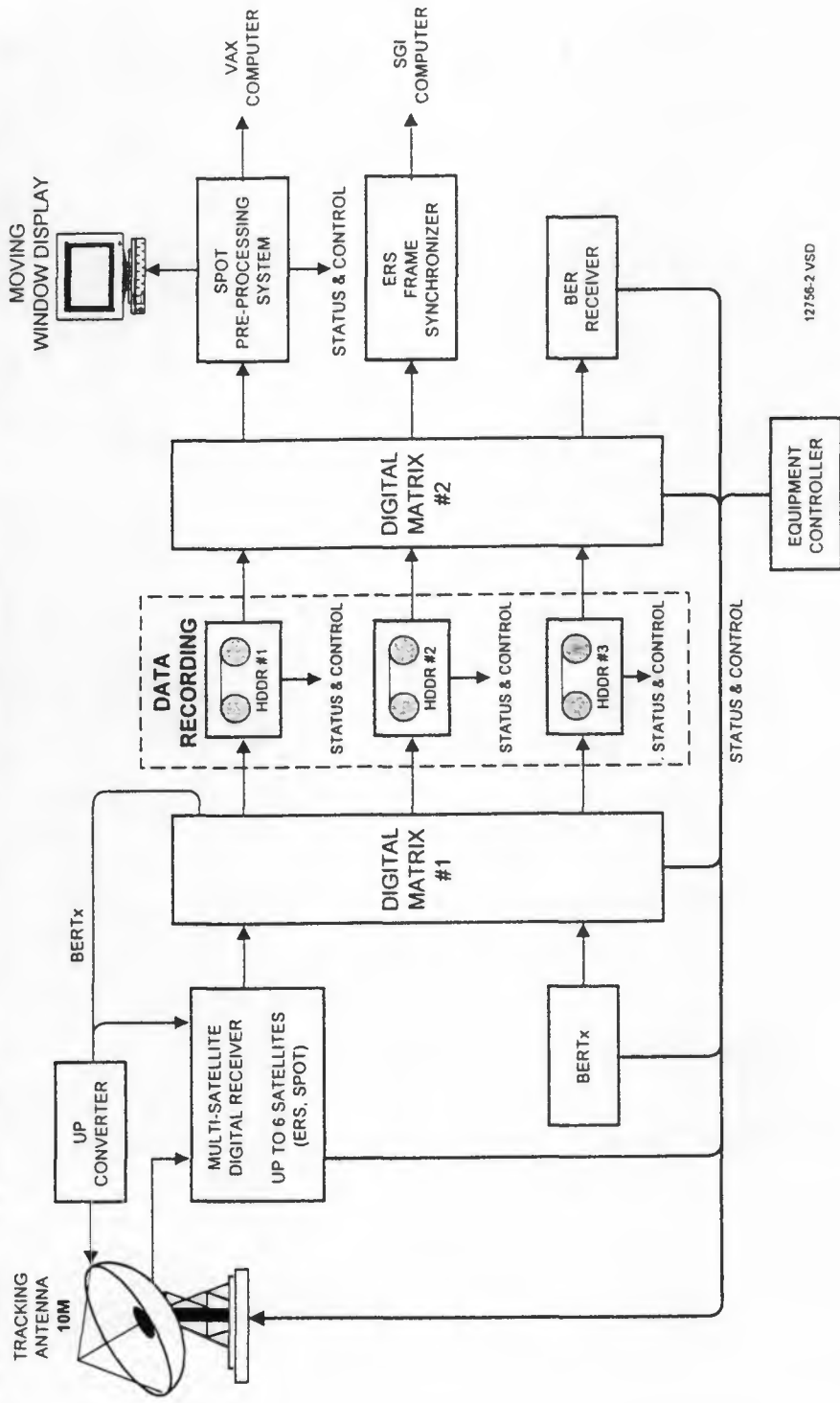
ISA - IAI / MBT Station Coverage



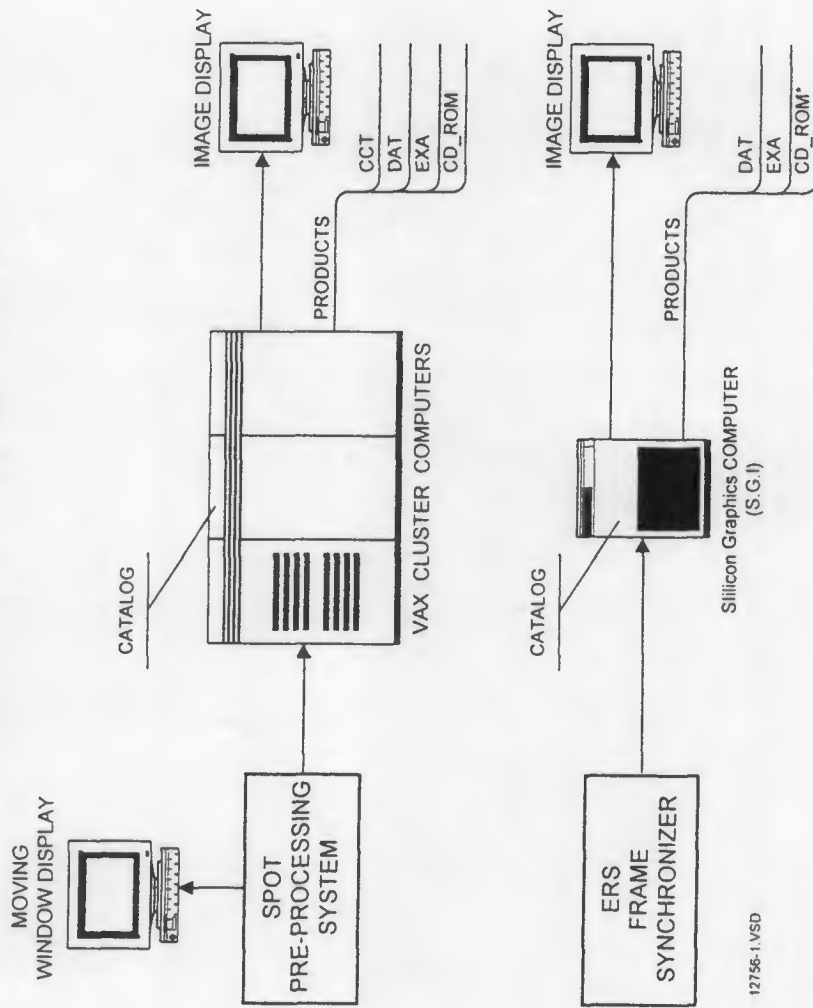
IAI MBT DIVISION
Electronics Group
ISRAEL AIRCRAFT INDUSTRIES LTD



Data Acquisition Segment - Block Diagram



Data Processing and Production Segment - Block Diagram



GOSS XII

Report

May 25 - 27, 1998
Toulouse, France



SPOT Production

- **Products**
 - ◆ Panchromatic (P) levels 0, 1A, 1B, 2A
 - ◆ Multispectral (XS) levels 0, 1A, 1B, 2A.
- **Deliverable on Media:**
 - ◆ CD ROM
 - ◆ DAT
 - ◆ Exabyte
 - ◆ 0.5 inch CCT
 - ◆ Hard copy

SPOT Data Archive

- **Based on DCRSi HDDTs**
- **HDDT data storage capability: 50GB
(2 hours of SPOT data acquisition)**
- **HDDT's volume in use: 60%**
- **Backup Media: DAT for processed scenes**



SPOT Catalogs

- **Station Raw Data Catalog**
 - ◆ Updated after each cloud assessment
 - ◆ Each scene is identified by parameters:
Mission KJ, Acq. Date, Pan or XS, HRV, HDDT No.,
Scene Coordinates (Center, north east, north west,
south east, south west), Scene Center time,
Cloudiness,...
- **DALI Catalog**
 - ◆ Update by the station (X25 Network)

Station Raw Data Catalog Printout

ACQUISITION DATE.....	20-8-97
RECORD SELECTED.....	1/7
MISSION.....	2
TRACK.....	118
FRAME.....	286
STATION.....	TLV
LOOKING ANGLE.....	-20.82
OPERATIVE MODE.....	PAN
INSTRUMENT.....	HRV2
CLOUD COVER IN NW-QUADRANT.....	1
CLOUD COVER IN NE-QUADRANT.....	0
CLOUD COVER IN SW-QUADRANT.....	1
CLOUD COVER IN SE-QUADRANT.....	0
NUMBER OF EXISTING PRODUCTS.....	0
CHANNEL NUMBER.....	2
CASSETTE IDENTIFIER.....	58
REVOLUTION.....	27
ACQUISITION (SATELLITE) TRACK.....	63
SEGMENT NUMBER.....	1
PASS STARTING TIME.....	08:16:19.000
PASS ENDING TIME.....	08:18:35.000
PASS START FEET NUMBER.....	569
PASS END FEET NUMBER.....	594
PASS START BLOCK NUMBER.....	3947887
PASS END BLOCK NUMBER.....	4140655
SCENE STARTING TIME.....	08:17:57.762
SCENE ENDING TIME.....	08:18:06.786
LOAD DATE.....	25/09/97
LOOKING ANGLE STEP.....	13
LATITUDE CENTER.....	31.94
LONGITUDE CENTER.....	34.98
LATITUDE CORNER NORTH-WEST.....	32.25
LONGITUDE CORNER NORTH-WEST.....	34.67
LATITUDE CORNER NORTH-EAST.....	32.16
LONGITUDE CORNER NORTH-EAST.....	35.41
LATITUDE CORNER SOUTH-WEST.....	31.72
LONGITUDE CORNER SOUTH-WEST.....	34.55
LATITUDE CORNER SOUTH-EAST.....	31.63
LONGITUDE CORNER SOUTH-EAST.....	35.28
DEVIATION LATITUDE.....	0.00
DEVIATION LONGITUDE.....	0.13
ORIENTATION.....	8.50
SUN AZIMUTH.....	135.03
SUN ELEVATION.....	64.67
INCIDENCE.....	23.68



SPOT Operation - 1997

➤ Acquired Satellites	SPOT1, SPOT2
➤ Number of Passes (*):	365
◆ SPOT1	168
◆ SPOT2	197
➤ Number of Scenes:	5691
➤ Cloudy Scenes	2933
➤ % of Cloudy Scenes	51

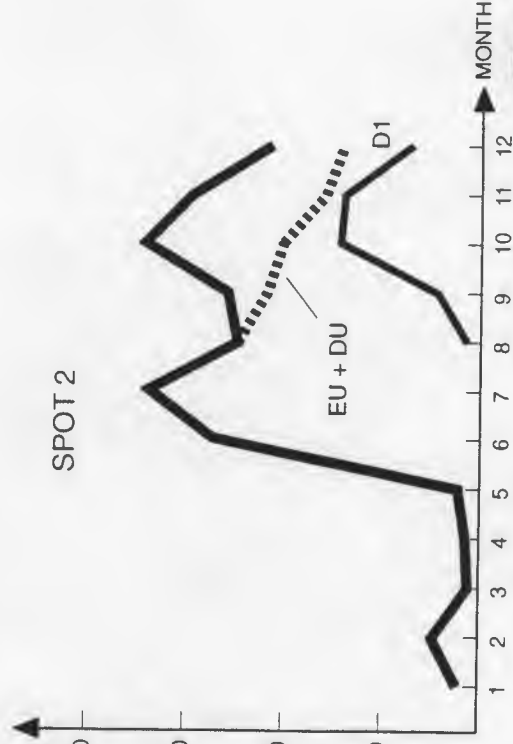
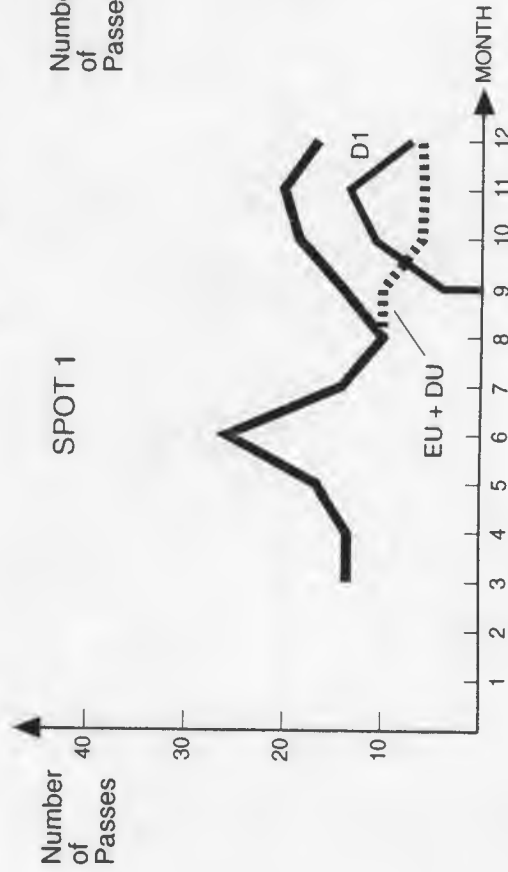
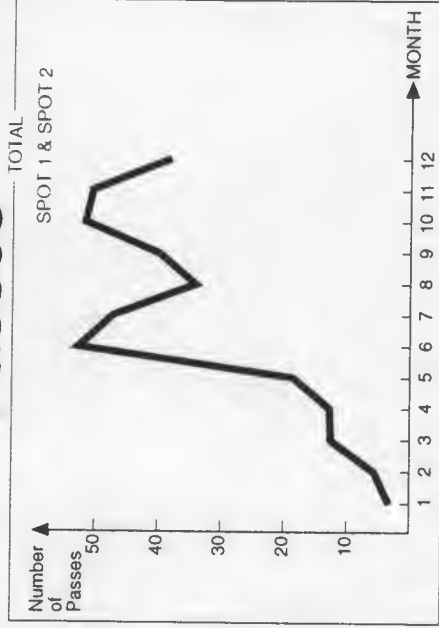
(*) 17 passes (5%) were not acquired due to malfunctions -
Satellite & Ground Station

SPOT Passes Not Acquired - 1997

FAILURE SOURCE	SPOT 1	SPOT 2	TOTAL
Satellite (NOX)	4	4	8 (47%)
Ground Antenna	1	2	3 (18%)
DCRSi	-	4	4 (23%)
Operator	2	-	2 (12%)
TOTAL	7	10	17

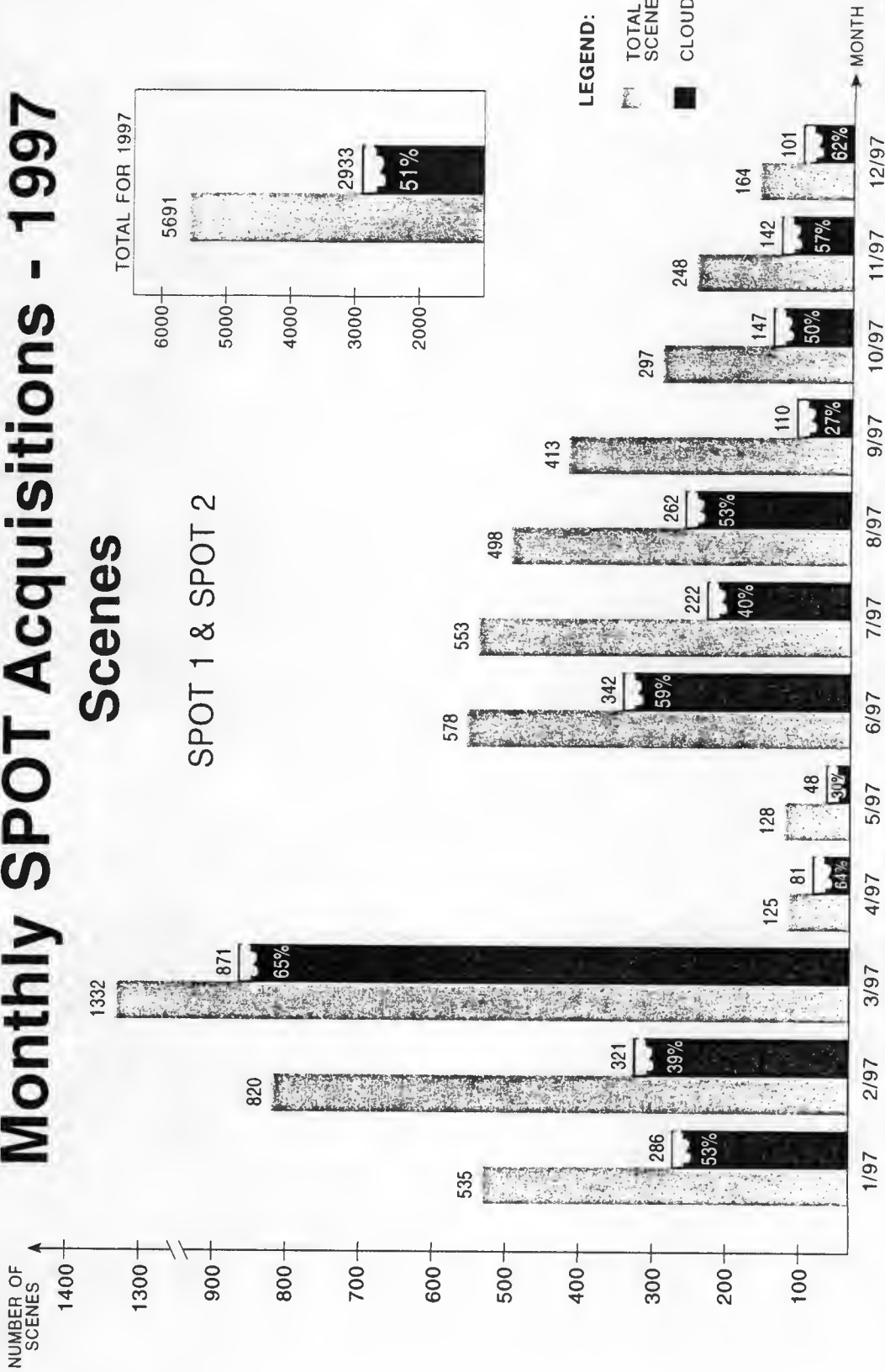
Monthly SPOT Acquisitions - 1997

Passes



Monthly SPOT Acquisitions - 1997

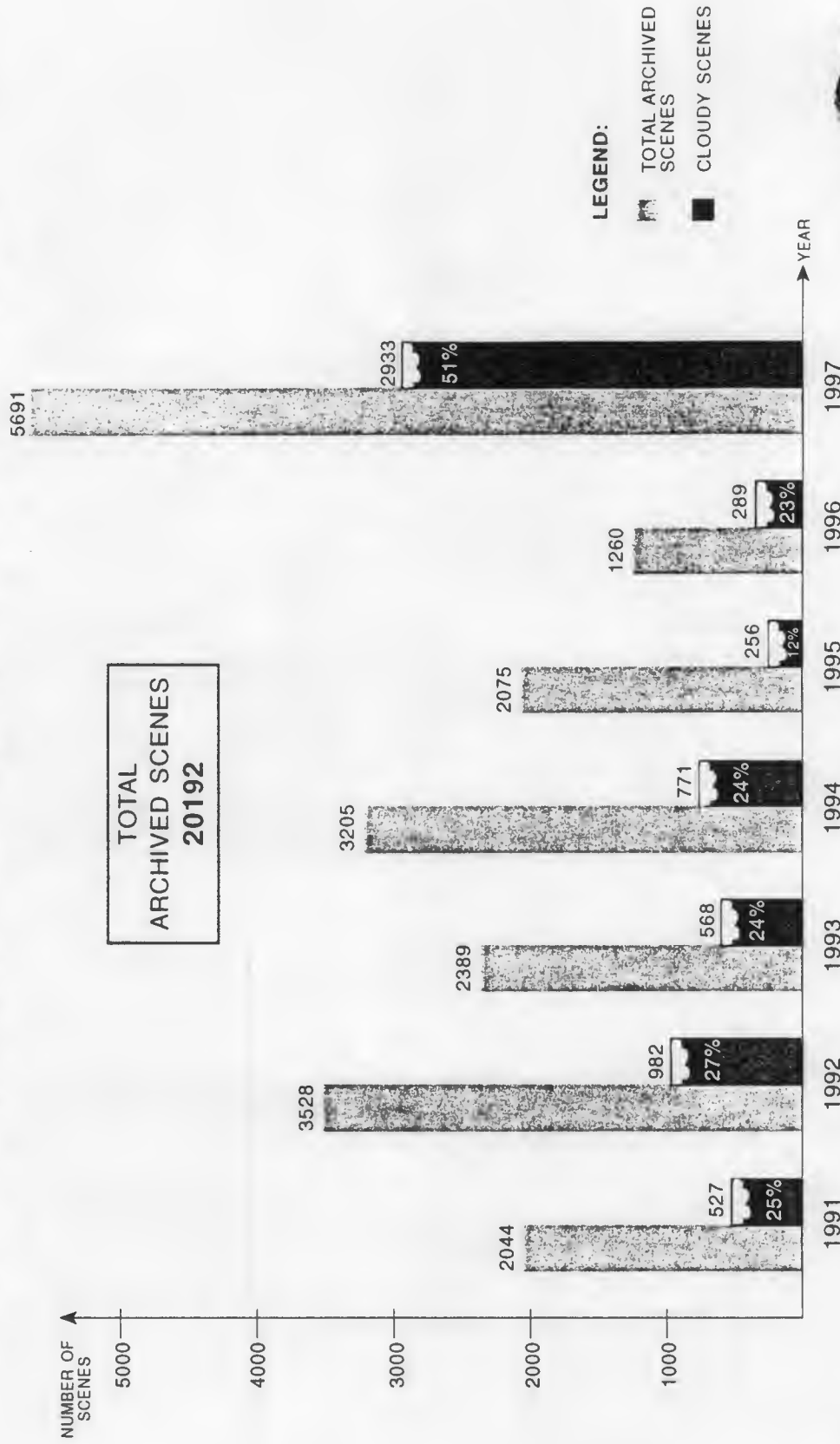
Scenes



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SPOT Scenes Acquired 1991 - 1997



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SPOT Commercial Activity - 1997

- **Marketing:** Media, direct contacts, etc.
- **Remote Sensing Seminar:** June 1997, TEL-AVIV
- **Special Projects :** FAS, CP
- **Pilot Project :** MAPPING
- **SPOT Data Distribution:**
 - ◆ 437 scenes
 - ◆ KUS\$.

SPOT PILOT PROJECT - 1997

Research No. 018-004

- **Subject:** Automatic generation of DEM using SPOT imagery in
Israel
- **Researcher:** Dr. A. Krupnik
- **Institute:** Research Center for Mapping and Geodesy Department
of Civil Engineering - Technion - Haifa - Israel
- **Results:** Automatic generation of DEM from SPOT images can be
obtained with very good accuracy.



STATION UPGRADE - 1997

- Improvement of delivery response time.
- Sony tape installation.
- Validity extension of SPOT Data Reception and Distribution Agreement.
- Feasibility study for SPOT 4 data reception and processing.



ISA - Israel Space Agency

ESOWG VII Report

**May 28 - 29, 1997
Toulouse, France**



ERS Production

- PRODUCTS
 - ◆ ERS.SAR.RAW
 - ◆ ERS.SAR.SLC
 - ◆ ERS.SAR.PRI
 - ◆ ERS.SAR.UI16
- DELIVERABLE ON MEDIA:
 - ◆ DAT
 - ◆ Exabyte
 - ◆ Hard Copy
 - ◆ CD ROM (in process)

ERS RAW Data Archive

- **Based on DCRSi HDDTs**
- **HDDT data storage capability: 50GB
(about 1 hour of ERS data acquisition)**
- **HDDT's Volume in use: 60%**

ERS Catalogs

- Station Catalog
 - ◆ Graphic catalog, when pointing out the requested area, a list of the acquired orbits is displayed.
 - ◆ Requested Orbit (Track), Frame can be selected
- DESCW ESA-ESRIN Catalog
 - ◆ Contains the acquired data by all ERS stations
 - ◆ Very useful and convenient
 - ◆ Enables to plan future acquisitions (from January 1998)

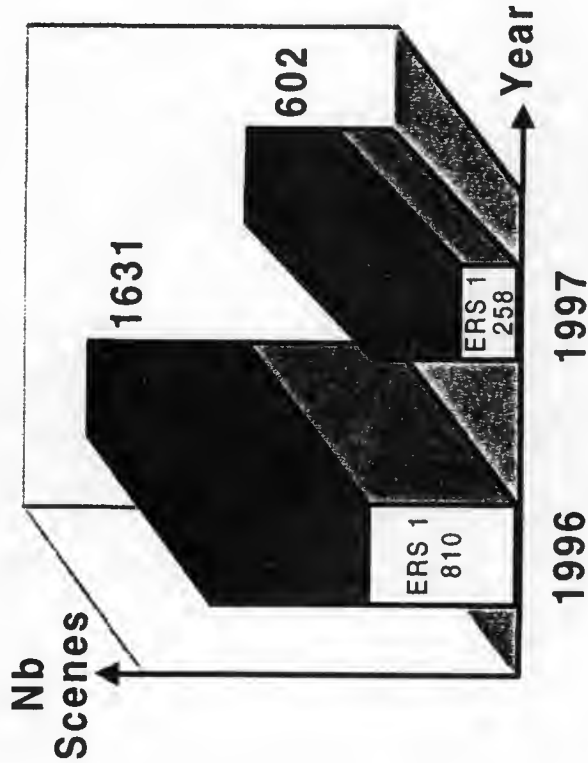
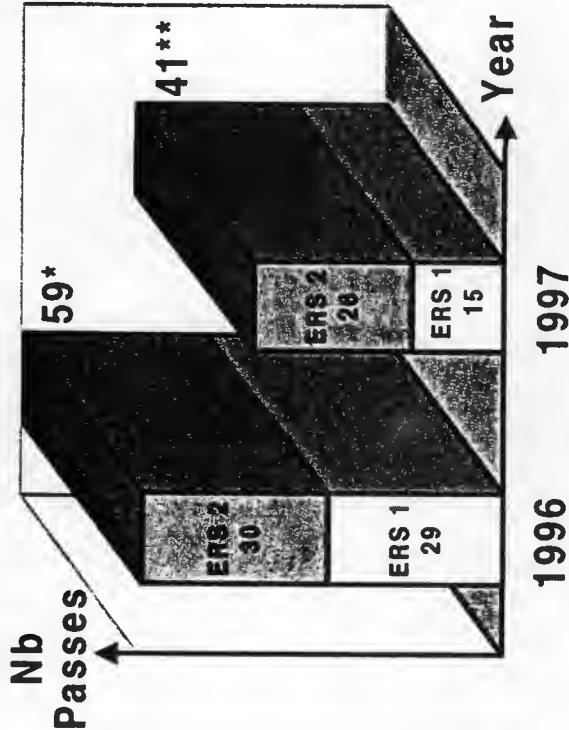
ERS Operation - 1997

➤	Acquired Satellites :	ERS1, ERS2
➤	Total Passes* :	41
◆	ERS1 :	15
◆	ERS2 :	26
➤	Number of scenes :	602
◆	ERS1 :	258
◆	ERS2 :	344

* 4 Passes not acquired due to ERS 2 Satellite not transmitting. (Orbits 11226, 11355, 11584 & 12693)



ERS Acquisitions 1996 - 1997



* 8 Passes partially or not acquired during 1996 (2 E1, 6 E2)
** 4 Passes not acquired (4 E2)

ERS Commercial Activity - 1997

- **Marketing :** Media, direct contacts, etc.
- **Seminar for potential customers :** JUNE 1997
- **Pilot Projects :** 2
- **ESA/ISA Agreement :** JAN 1997
- **ERS Products Price List:** Available
- **ERS Data Distribution :** ICTAF & EURIMAGE



ERS PILOT PROJECT I - 1997

ERS - Interferometric Method for Geology & Geomorphology Mapping

- **Project Theme:** Mapping of Geology, Geomorphology, and risks related to active faults and associated seismic activity in the Rift Valley.
- **Researcher:** Dr. A. Karnieli
- **Institute:** Ben Gurion University - Israel



ERS PILOT PROJECT II - 1997

SAR Applications in Semi-Arid Environments

- **Objectives:** ♦ Two parameters are being studied with the use of SAR
 - ★ Aerodynamic roughness
 - ★ Soil moisture
- ♦ Can we use ERS?
- **Researcher:** Dr. Dan G. Blumberg
- **Institute:** Ben Gurion University - Israel





ISRAEL AIRCRAFT INDUSTRIES LTD

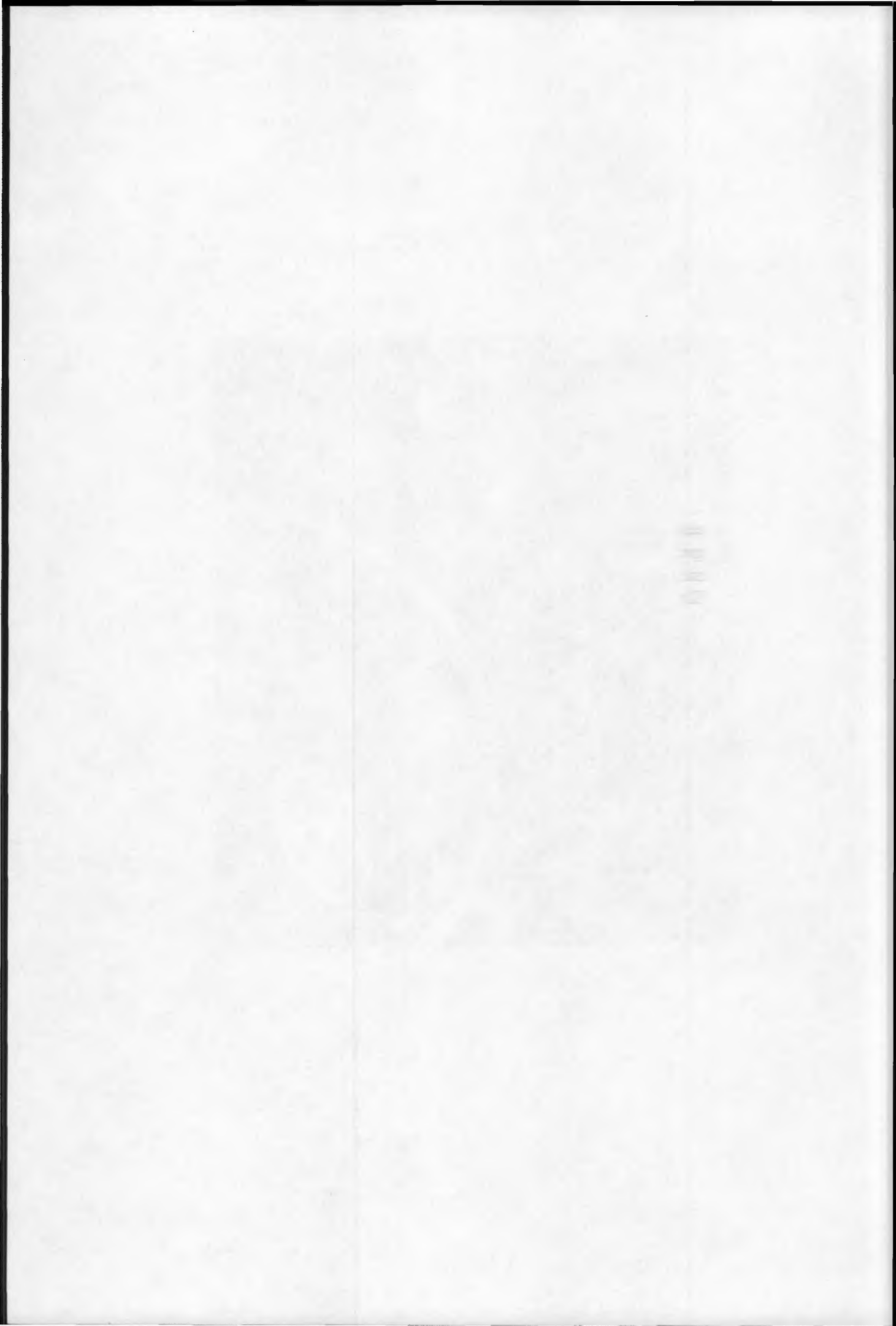
מבט

התעשייה האווירית לישראל בע"מ

Eearth Station Department



ISA
ISRAEL SPACE AGENCY





המרכז הבינתחומי לניתוח ותחזית טכנולוגית
ליד אוניברסיטת תל-אביב

INTERDISCIPLINARY CENTER FOR TECHNOLOGICAL ANALYSIS & FORECASTING
AT TEL-AVIV UNIVERSITY



1998 Price List

ERS SAR Imagery Products from the Israel Space Agency's Ground Station

This price list applies to products derived from data transmitted by the European Space Agency's (ESA) ERS SAR satellites and received at the Israel Space Agency (ISA) ground receiving station located near Tel-Aviv. ERS data reception at this station is by agreement between ISA and ESA. ICTAF has been appointed as distributor for this imagery.

Prices are in ECU and do not include dispatch and insurance.

ERS products are distributed on DAT or EXABYTE media.

Product	Product Description	Scene Area (km)	Price (ECU)
RAW	Annotated Raw Data as received by the satellite. • 5,616 samples in Range* x 26,800 samples in Azimuth*	100x110	1,200
PRI	Precision Image produced from three looks, with radiometric correction • Pixel size 12.5m in both dimensions. • 8,000 pixels per row x 8,200 rows	100x100	1,400
SLC	Single Look Complex quarter scene :Amplitude and phase data coded as complex numbers • Pixel size -7.9m in Range* x 3.9m in Azimuth * • 2,500 pixels per row x 15,000 rows	50x50	800
FDC (UI16)	Fast Delivery Image - three looks produced several hours after image reception • Pixel size - 20m' in range x 16m' in azimuth • 5,000 pixels per row x 6,300 rows	100x100	700

*Range -At right angles to the satellites' motion ; *Azimuth - in the direction of the motion

Time series of the same track and frame ;
at least one image from the archive

Multitemporal Set

Quantity	Price (ECU)
Series of 3 PRI	2,800
Each additional PRI	700

Interferometric Set

Quantity	Price (ECU)
Series of 3 RAW	2,400
Each additional RAW	600
Series of 3 SLC	1,600
Each additional SLC	400

Subscription Series

Special terms are offered for series of 10 or more consecutive scenes along the same track

Catalogue

Catalogue output of archived imagery, tracks, frames and orbits , is available at ICTAF upon request.

For orders or further details please contact:

Abraham Tal

ICTAF

Tel-Aviv University

Tel-Aviv, 69978, Israel

Tel: 972-3-6412882 or 6407586

Fax: 972-3-6410193

email: atal@eng.tau.ac.il

What is RSGS ?

- An unique operational National Civilian EO Ground Station in China
- Tasks :
 - Receiving, Processing, Archiving and Distributing the data of L5, ERS-1/2, JERS, Radarsat 1 at present
 - Being available soon for CBERS-1, L7 and SPOT 4
 - Radarsat 2 in 2001 ?
 - Sales representation for SPIN-2 high resolution (10m, 2m) image in China
 - R&D in the fields of : image processing & Application oriented product generation

China RSGS

OPERATION STATUS

- Direct Reporting to CAS**
- Supported by Other Chinese Departments**
 - * SSTC
 - * COSTIND
 - * SPC
 - * National Financial Ministry of China

- Operation Line Consisting of :

- * MiYun Receiving Station
- * Image Processing Facility
- * Optical-Chemistry Laboratory

China RSGS



ORA RICEZ. 25. GIU. 9:42

China Remote Sensing Satellite Ground Station

- 1. Reception of ERS-1/2 Satellite data by China RSGS**
- 2. Distribution of ERS-1/2 data by China RSGS**
- 3. Plan for ERS-1/2 Application Research and user service in 1998**
- 4. Problems in ERS data processing and copying**



China Remote Sensing Satellite Ground Station

Reception of ERS-1/2 Satellite data by China RSGS

1997 307 paths
1st Quarter, 1998..... 61 paths

RSGS

China Remote Sensing Satellite Ground Station

Distribution of ERS-1/2 data by China RSGS

**Distribution of ERS data for the project of cooperation
between ESA and China SSTC (State Science and
Technology Committee):**

Project 1(16 scenes)

**Rice Mapping and Crop Growth Monitoring with
Chinese Academy of Forestry**

Project 2(2 scenes)

**Flood Monitoring and Assessment with China Institute
of Water Resources and Hydropower Research**

RSGS

China Remote Sensing Satellite Ground Station

Project 3(2 scenes)

**Land Use Mapping with Chinese Academy of
Surveying and Mapping**

Project 4(11 scenes)

**Space Oceanography with Ocean University of
Qingdao**

RSGS

China Remote Sensing Satellite Ground Station

Plan for ERS-1/2 Application Research and User Service in 1998

- Make value-added image product for user .
- Start InSAR research in china.
- Continue the disaster monitoring and assessment project.
- Make extra-effort to support the ESA-SSTC cooperation project.

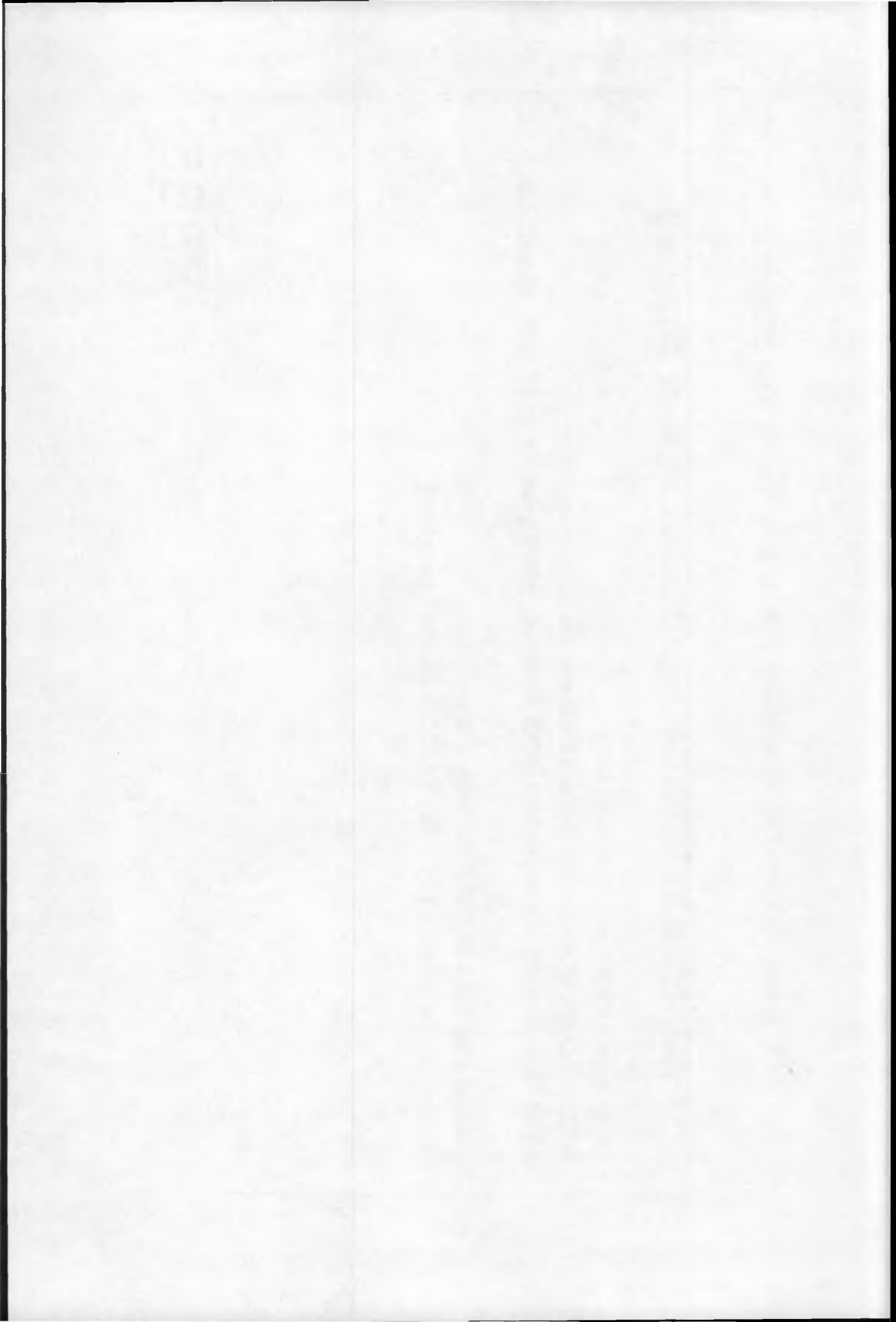
RS GS

China Remote Sensing Satellite Ground Station

Problems in ERS data processing and copying

- Only one HDDR available at DPF .
HDDT copying must be done at Miyun receiving station now.
HDDTs must be transported from Beijing Headquarter to Miyun by vehicle .**
- Image product is VMP format only.
Many users desire ERS SAR CEOS format product**

RS GS



Japanese Report
ERS National & Foreign Stations
Operators Working Group
MAY 28-29, 1998
Toulouse, FRANCE

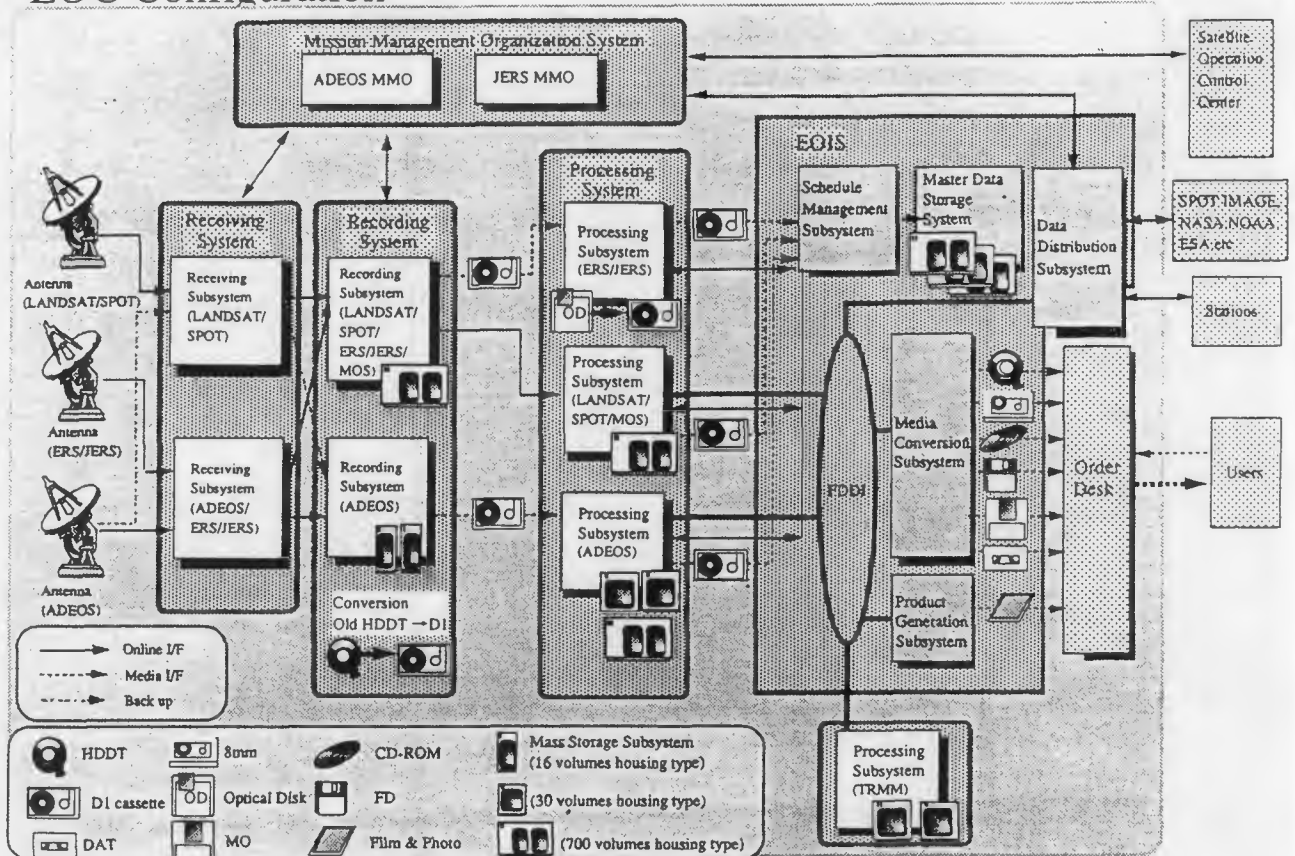
Takao Fukuda
EOC/NASDA
Tel. +81-492-98-1235
Fax. +81-492-98-1001
e-mail: FUKUDA@nsaeoc.eoc.nasda.go.jp

Contents

- EOC Overview
 - EOC configuration
- Present Status of Operations
 - Present Status
 - ERS data archiving
 - ERS data production
- ADEOS Anomaly
- TRMM Status
- EOC System Re-construction

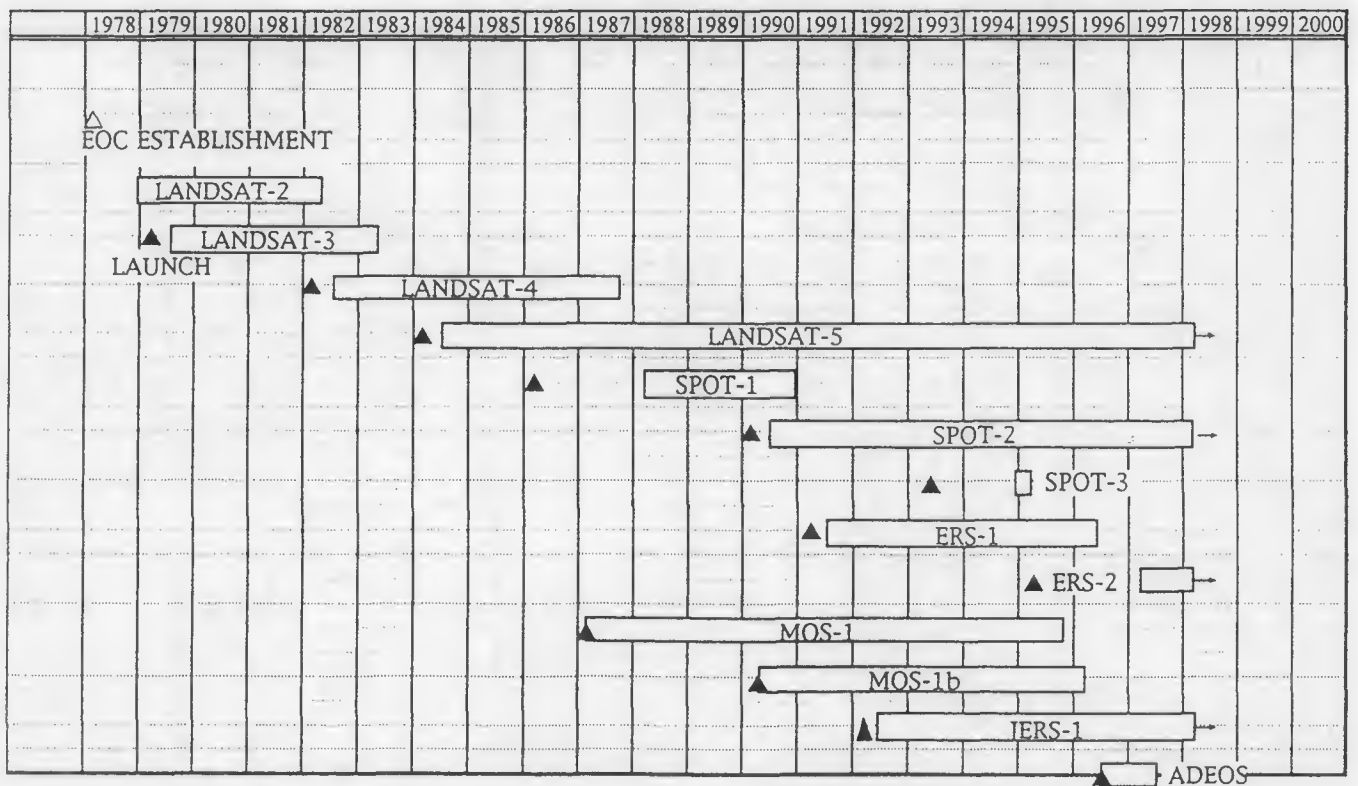
EOC Overview

EOC Configuration



3

EOC Overview



(TRMM data is received by NASA and transmitted to EOC) TRMM

4

Present Status of Operations

Data Reception

ERS-2
SPOT-2
LANDSAT-5
JERS-1

Processing and Archiving

ERS-1, 2
SPOT-1, 2, 3
LANDSAT-2, 3, 4, 5
MOS-1,1b
JERS-1
ADEOS
TRMM

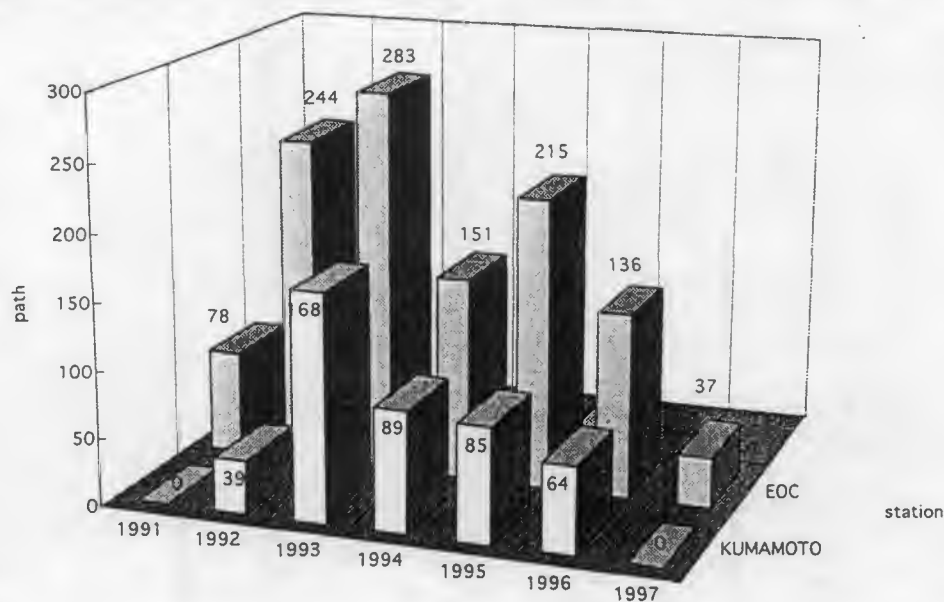
Present Status of Operations

- ERS-1& 2 -

ERS operation

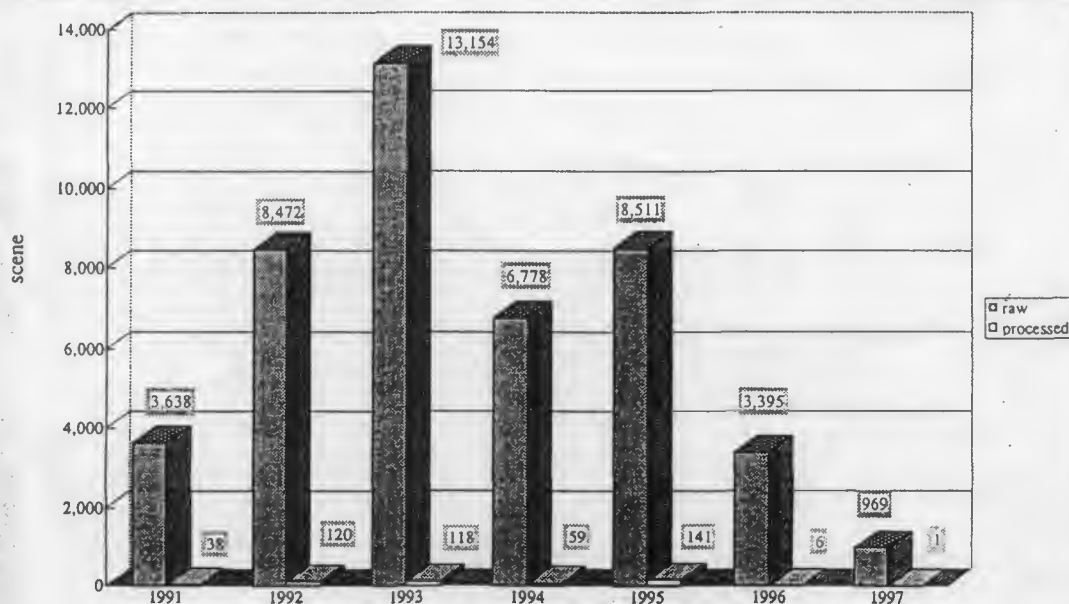
- Suspended the data reception of ERS1 from June 3, 1996 at EOC.
- For monitoring the serious oil spill from the tanker, which was occurred on Jan. 2, 1997, EOC received several pathes of ERS-2 in cooperation with ESA.
- MOU for ERS-2 data reception concluded with ESA on April 1,1997.
- At present, reception ,processing and archiving are performed satisfactorily.

Present Status of Operations - Acquisition Result -



7 Earth Observation Center / NASDA

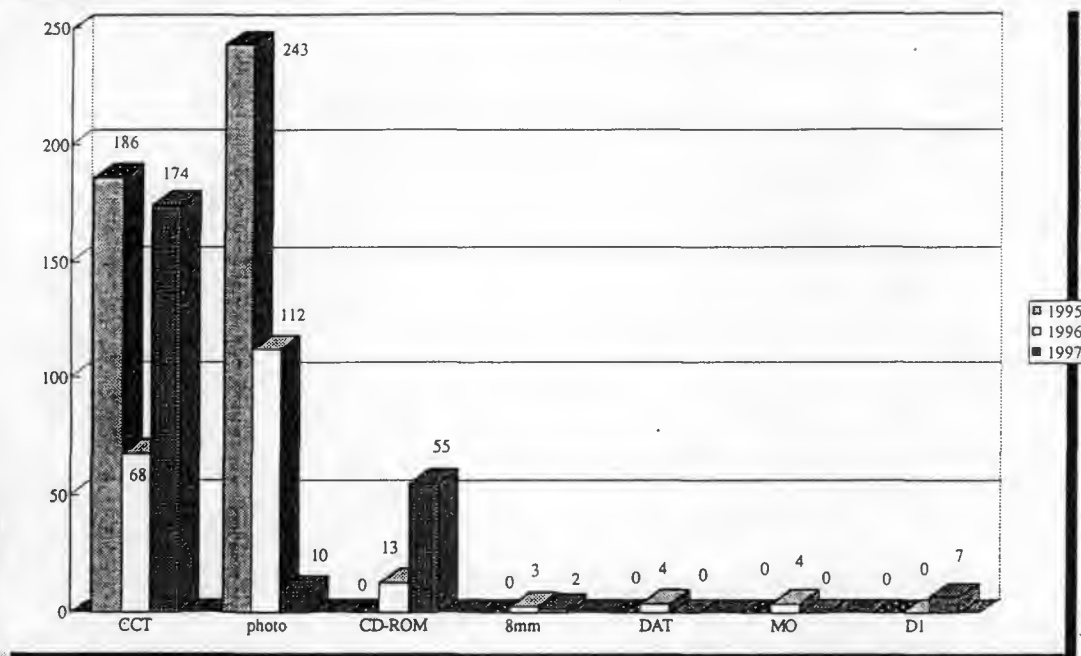
ERS data archiving



8 Earth Observation Center / NASDA

ERS Data Production

- Media -

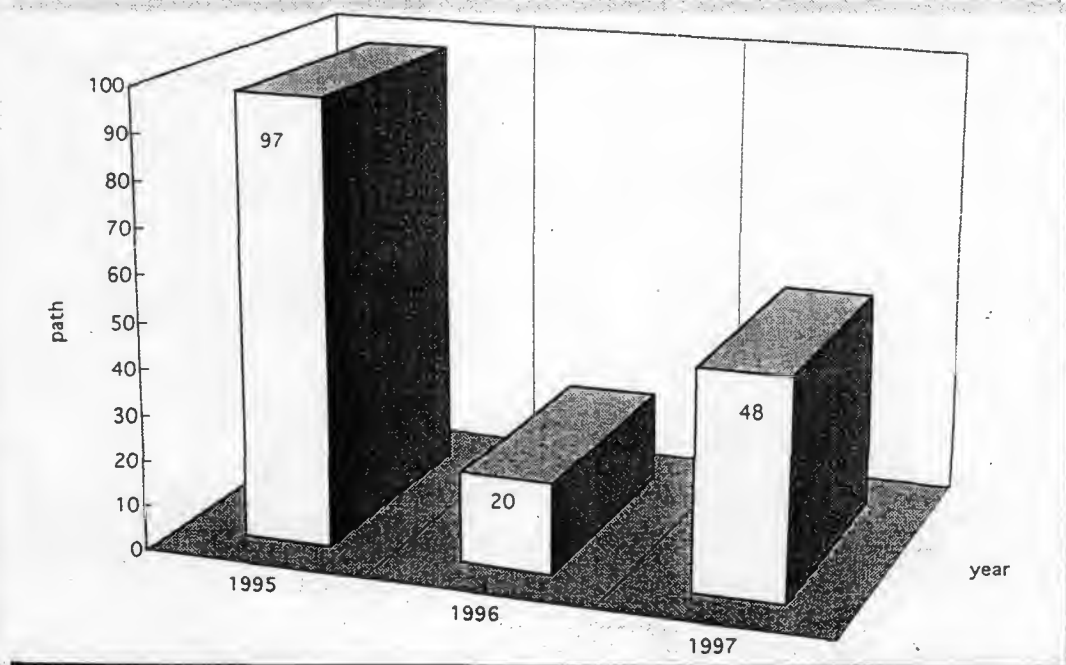


9

Earth Observation Center / NASDA

ERS Data Production

- HDDT copy for ESA -



10

Earth Observation Center / NASDA



Present Status of Operations

- Data acquisition & production -

1997.1.1 - 12.31

- 37 pathes were fully acquired at EOC & 0 pathes were acquired at KOMAMOTO st. .
- 44,917 scenes of raw data & 483 scenes of processed data are archived at EOC including scenes acquired at KUMAMOTO & SHOWA st. . (total scenes no. from 1991)
- New media ; CD-ROM, 8mm tape, DAT and MO were added to distribute to users.
- HDDT copy to ESA was 48 Paths.
(ERS1 ; 33 Paths & ERS2 ; 15 Paths)



ADEOS Anomaly

ADEOS History

- | | |
|---------------------------|---|
| • Aug.17,1996 | Launch |
| • Sep.21,1996-Nov.5,1996 | Mission instrument checkout |
| • Nov. 6,1996-Jun.30,1997 | Pre-Routine and Routine Operation |
| • Jun.30,1997 | Termination
(Solar array Paddle anomaly) |

ADEOS Anomaly

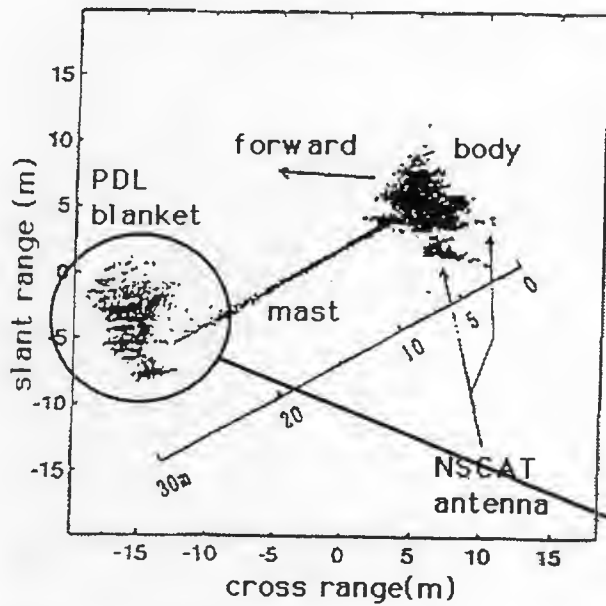


Fig.1 Image of ADEOS by radar.
(Source : FGAN-FHP is Image origination)

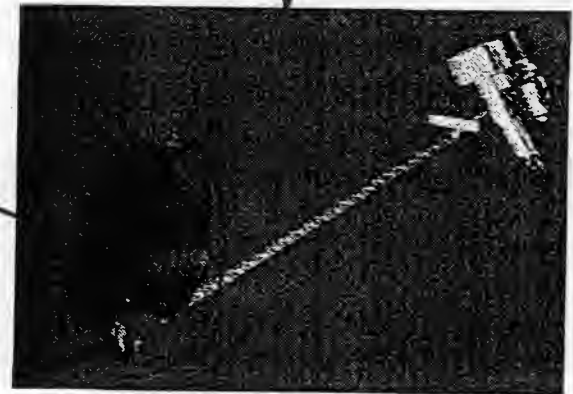
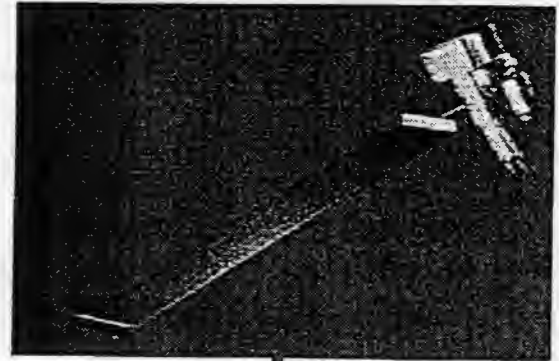
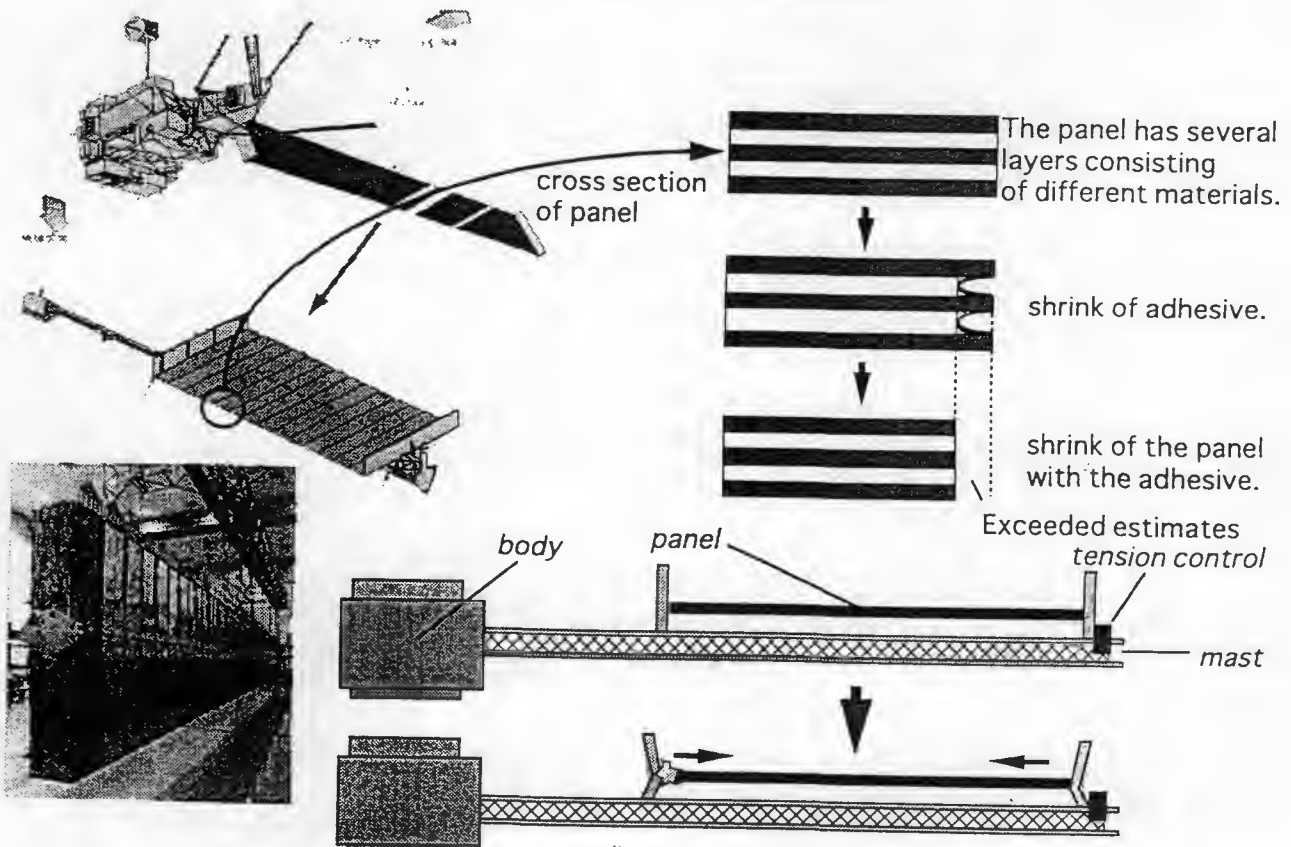
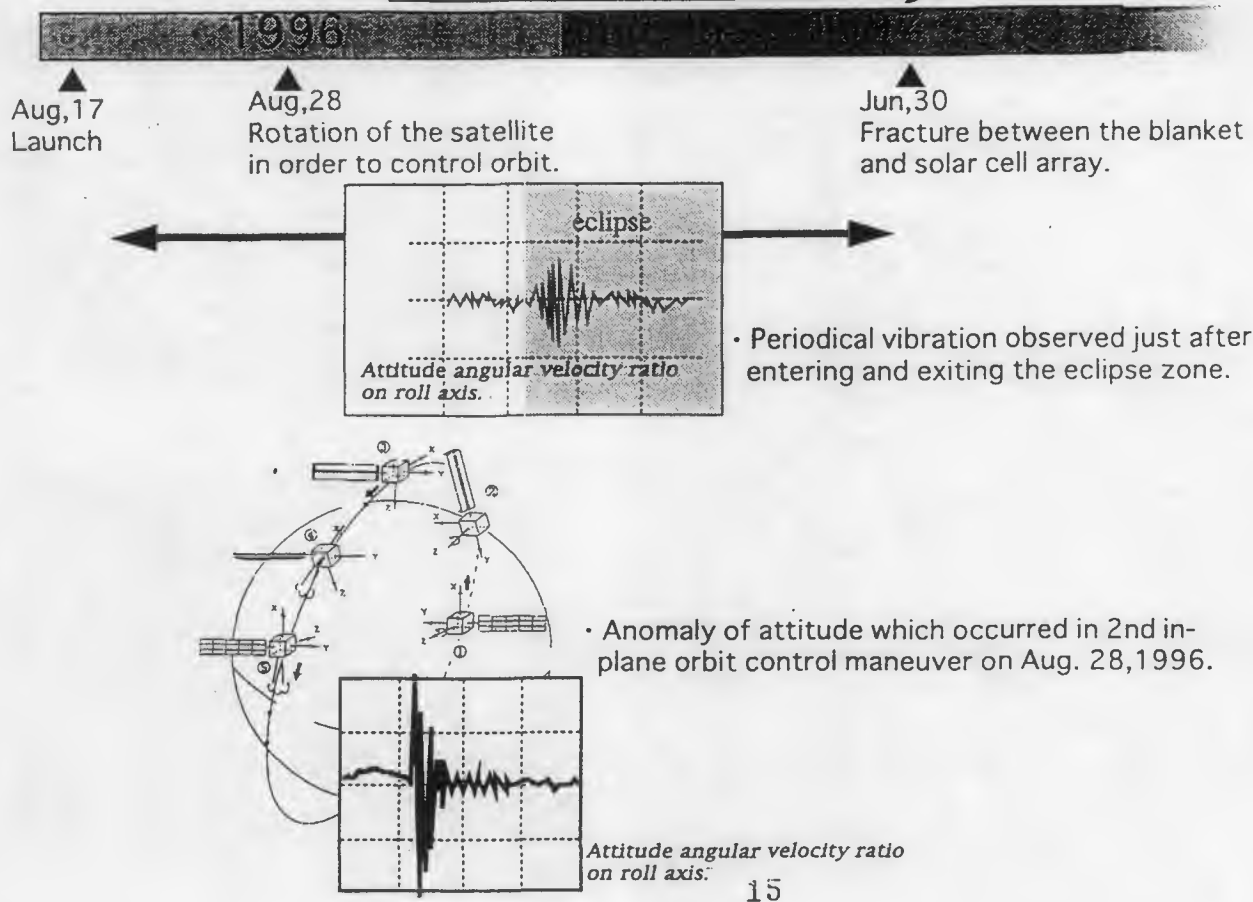


Fig.2 Assumption

ADEOS Anomaly



ADEOS Anomaly



15

1998 ERS National & Foreign Stations Operators Working Group

TRMM Status

○ Launched on Nov. 28, 1997 on H-II launch vehicle from the Tanegashima Space Center of Japan.

- 1 NASDA sensor & 4 NASA sensors
- NASDA sensor
 - : PR (Precipitation Radar)
- NASA sensor
 - : TMI (TRMM Microwave Imager)
 - : VIRS (Visible Infrared Scanner)
 - : CERES (Clouds and the EARTHs Radiant Energy System)
 - : LIS (Lighting Imaging Sensor)



TRMM Status

● Concept of PR

-The following are the major objectives of PR

To provide 3-dimensional rainfall structure

To achieve quantitative rainfall measurement over land
as well as oceans

To improve the accuracy of TMI measurement by
providing the rain structure information

● System parameters of PR

Radar type ; Active phased-array radar

Frequency ; 13.796&13.802GHz

Swath Width ; ~215Km

Observable ; From surface to a height of 15Km

Horizontal Range ; 250m Resolution ; 4.3Km(nadir)



TRMM Status

- The Pre-routine operation phase
Started on Feb. 1, 1998.
- Routine operation will start on Aug. 1 ,
1998.

Some information can be seen on the web ;
([http : //www.eoc.nasda.go.jp](http://www.eoc.nasda.go.jp))

EOC System Re-construction

1. Main theme

(1) Improvement of operating efficiency

- Promote automation in order to reduce human resource.
- Foster more promote Network online interface among EOC's system.
- Handle the mission and processed data as a file which promote non restricted archive media.

(2) Countermeasure for increasing archive data

- Change of the archiving policy

At present; RAW data, Level 0 data and Level 2 products(radiometric and geometric correction) are archived in mass storage.

Future; Basically Level 0 or Level 1-A data will be archived as an original data depending on the sensor.

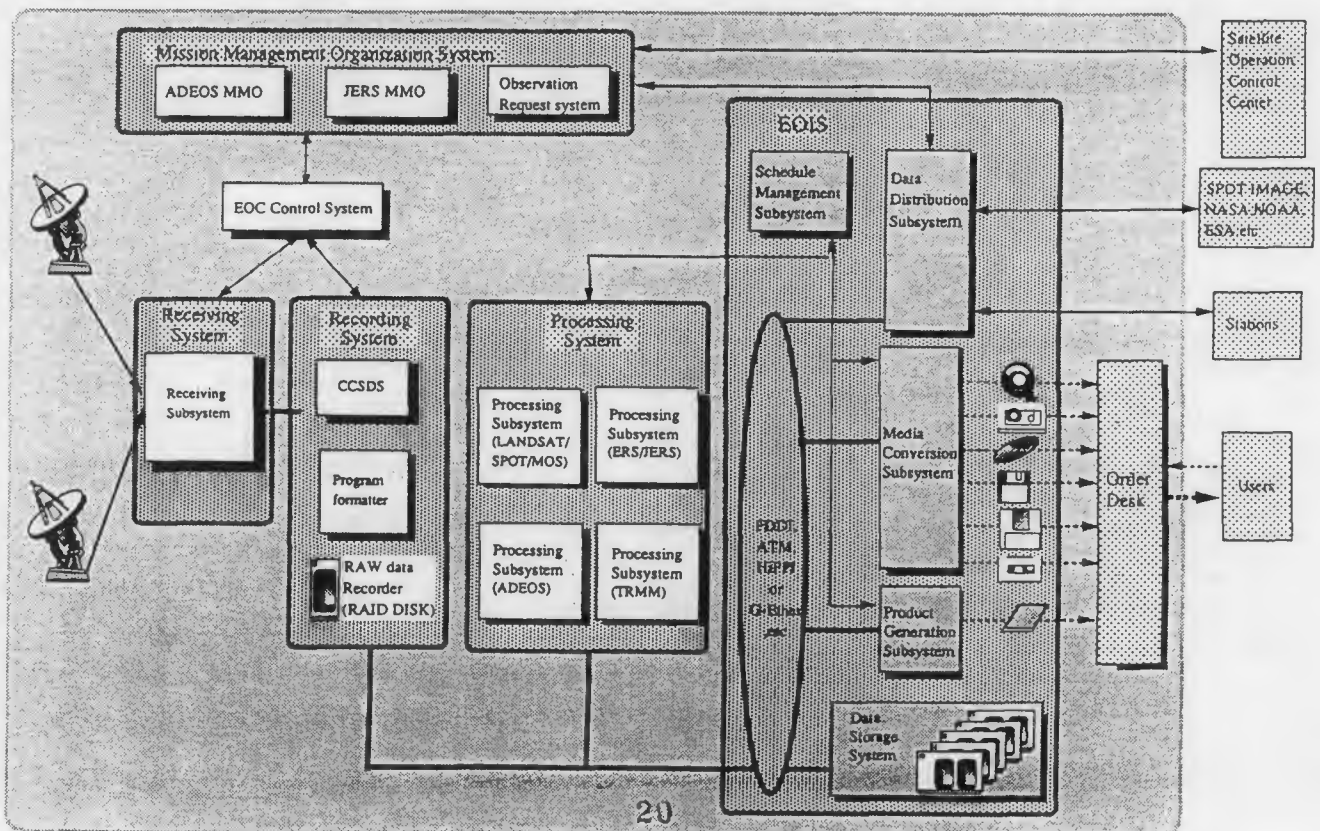
- Introduce new storage media and mass storage system .

More higher density, reliability and cost performance media.
ex.) DTF, DTL, D3 media.

13

EOC System Re-construction

System Overview

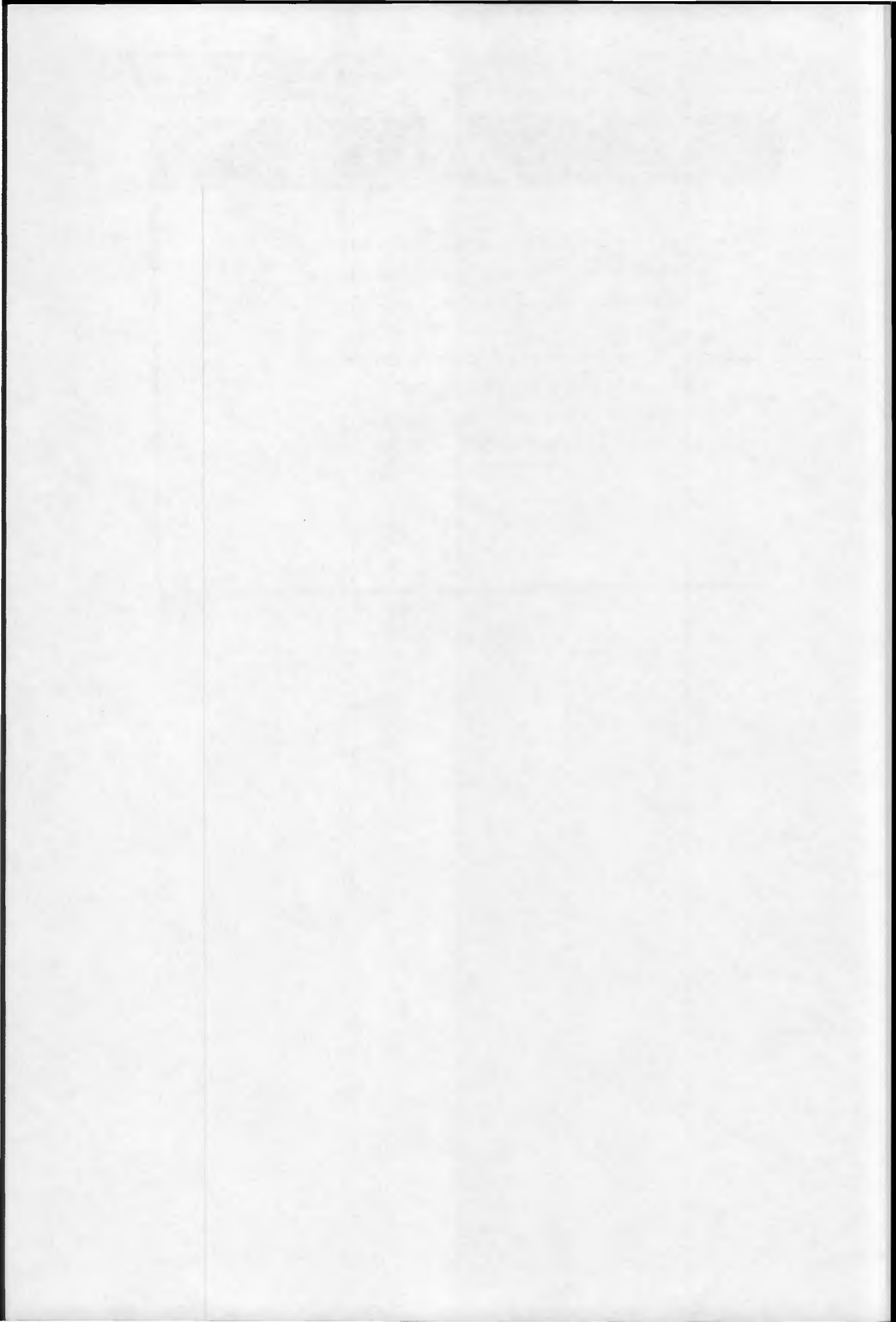


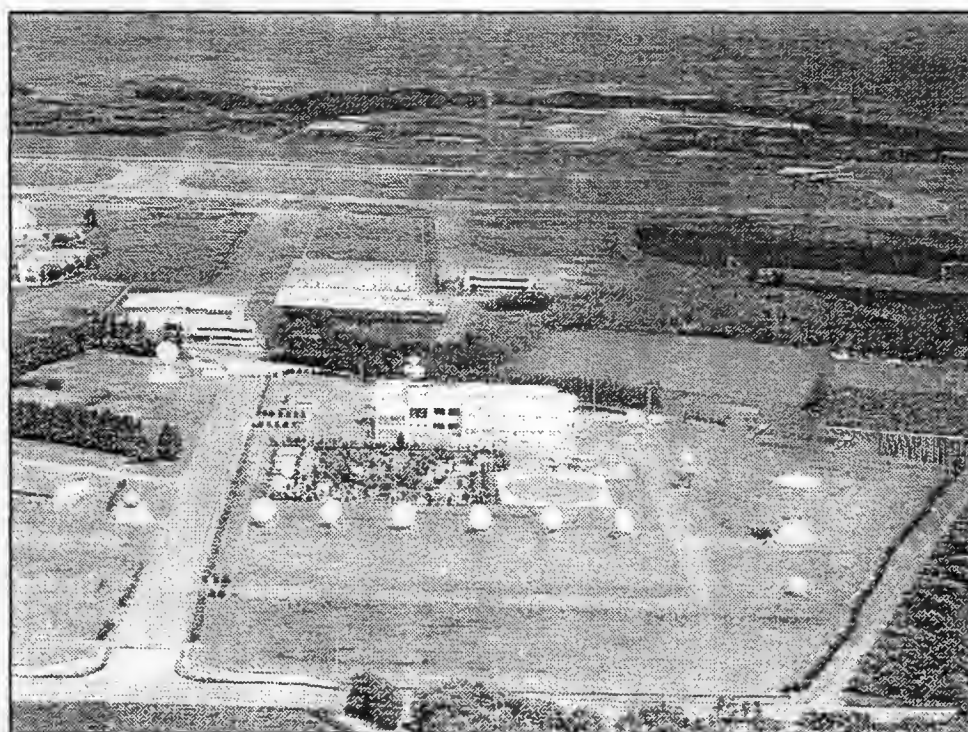
SAR Applications

EX1; Study on the relationship between back scattering coefficient of the SAR intensity images and surface condition of ice sheets and sea ice.

EX2; Generation of digital elevation model, estimation of flow rate of glacier and ice sheet, and determination of grounding line in Antarctica by means of SAR interferometry.

(by NIPR)





Features

- Multi satellite data receiving and processing system for JERS-1, IRS-1C&1D, RADARSAT, ADEOS (AVNIR) NOAA, SeaWiFS and GMS
- 24 Hour automates one man operation
- PC based system configuration

Target Satellites

MOS-1 ,1b
ERS-1
ADEOS

Finished

NOAA
SeaWiFS
GMS
JERS-1(OPS)

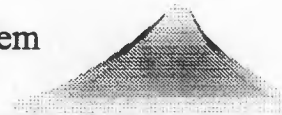
Receiving

ERS-2
RADARSAT
IRS-1C,1D

Planned (1998)

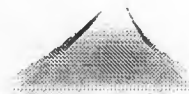
System summary

- High speed Interface Processor with D-1 rawdata recording
- Easy to format all sensor data by TSIC original programmable formatter
- Fully software based downlink data formatting system (direct downlink data formatter) for JERS-1(OPS) and ADEOS(AVNIR)
- File interface with NASDA EOC system



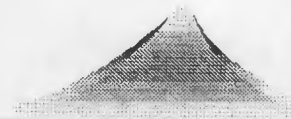
Data Reception Policy

- Build up sophisticated remote sensing technology for scientific research
- Collaboration with International organizations
- Data reception task share with NASDA
- Data distribution through NASDA / RESTEC
- Develop data processing and analyzing technology



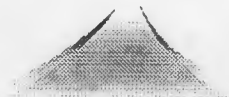
Data Products (Jun.1987-Apr.1998)

Received	ADEOS AVNIR	258 paths (15 D1-L cassettes)
	MOS1/MOS1B	5090 paths (783 HDDTs)
	JERS-1	406 paths (8 D1-L cassettes)
	ERS-1	406 paths (209 HDDTs)
	NOAA	24500 scenes
	GMS	42200 scenes



Data Products (Jun.1987-Apr.1998) cont'd

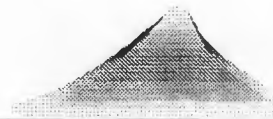
Processed	ADEOS AVNIR (Multi)	LEVEL0	206 paths
	ADEOS AVNIR (Pan)	LEVEL0	39 paths
	MOS-1,1b MESSR	LEVEL0	482 CCTs
	MOS-1,1b MESSR	LEVEL1	6 CCTs
	MOS-1,1b MESSR	LEVEL2	100 CCTs
	MOS-1,1b VTIR	LEVEL0	14 CCTs
	MOS-1,1b VTIR	LEVEL1	7 CCTs
	JERS-1 OPS(VNIR)	LEVEL0	170 paths



Recording Subsystem

Recording rate 105Mbps ERS AMI
60Mbps JERS-1 ,ADEOS

HDDR	Honeywell	HD-96
	Penny & Giles	SE-9000
	SONY	DIR1000



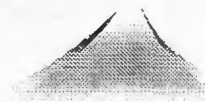
Processing Subsystem

HP-755 Workstation
JERS-1 SAR, ERS-1

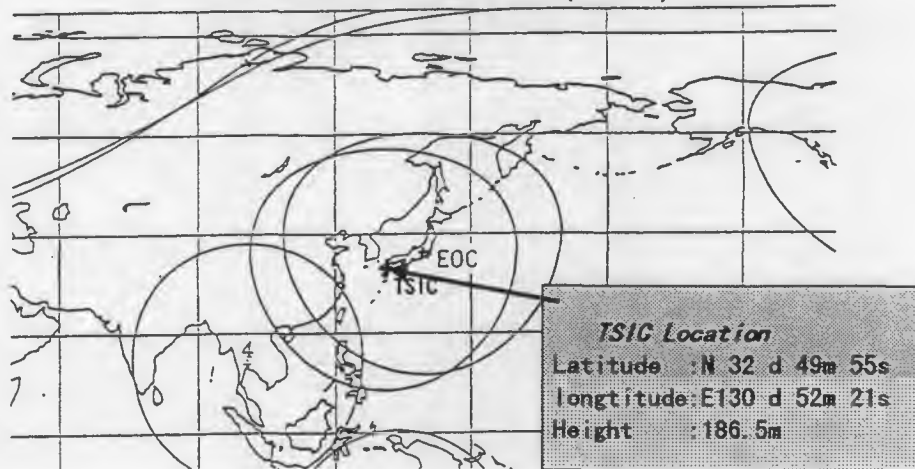
SUNspark station20 Workstation
NOAA AVHRR(Level0,1)
SeaWiFS (level0,1)

NEC NESDAS-210
GMS SVISSR(level0,1)

WindowsNT-PC(pentium PC)
ADEOS AVNIR(level0)
JERS-1 OPS(level0)



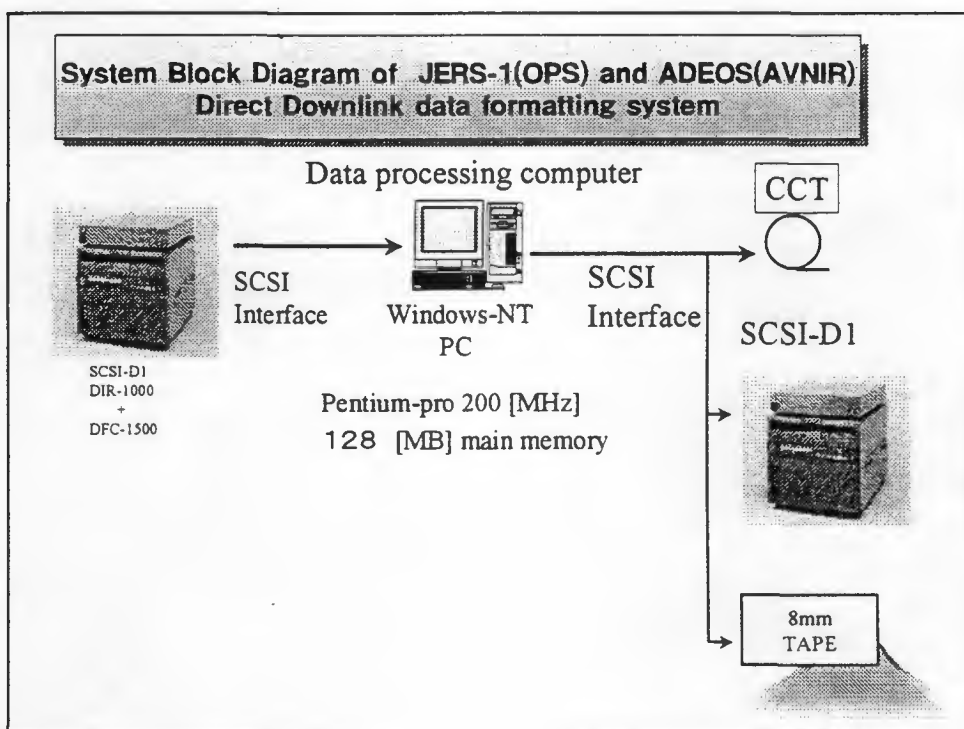
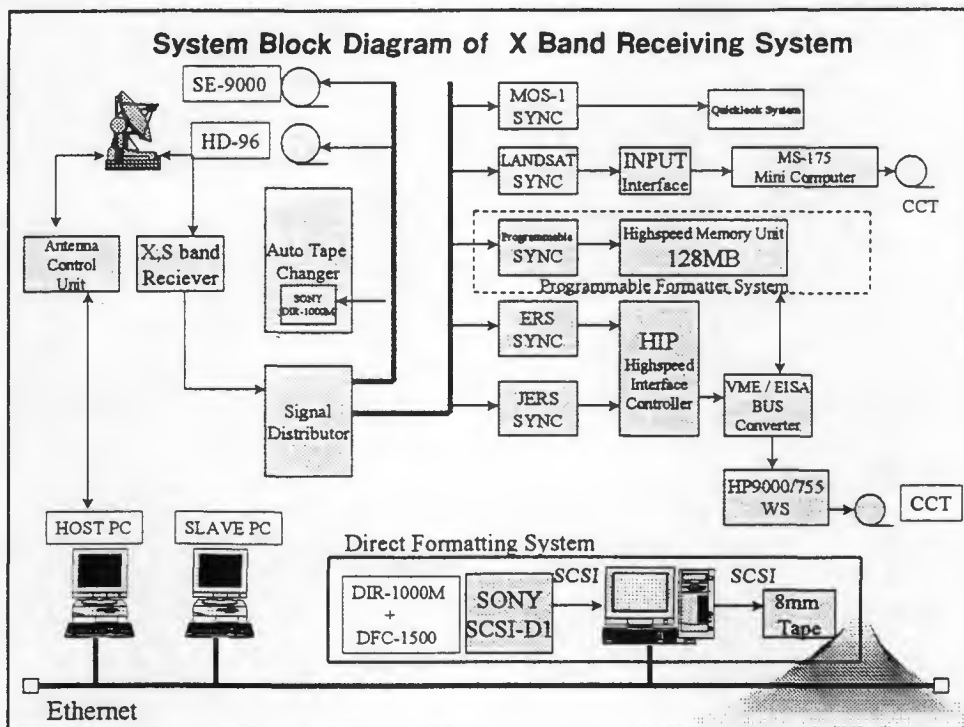
Coverage Map of Tokai University Space Information Center (TSIC)



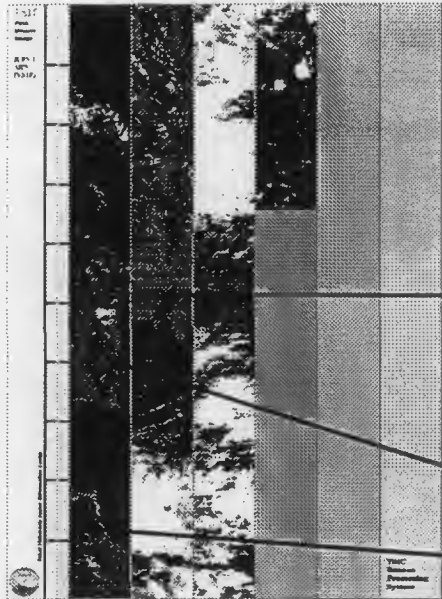
Antenna Subsystem



- Tracking satellites JERS-1 ADEOS
- Type Cassegrain
- Diameter 11m
- Azimut, Elevation, Cross Elevation
- Gain Xband 36dB/K
Sband 23dB/K



An Example browse image of JERS-1(OPS)

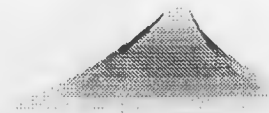


Processed by Direct downlink data formatter.

Tokyo

Hokkaido

Tohoku

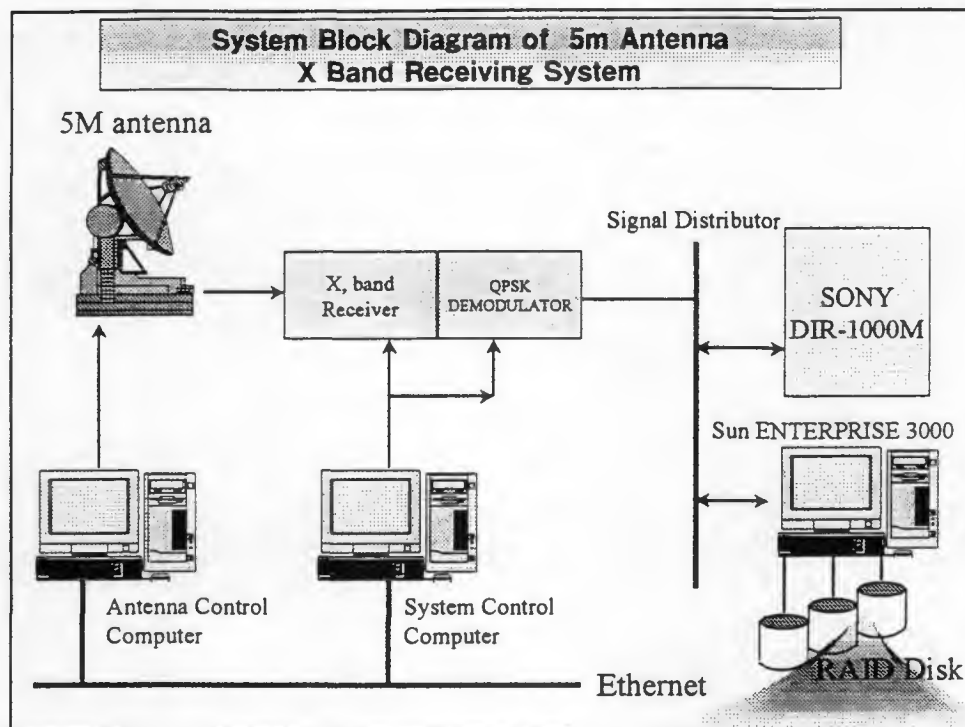


5m X-band Antenna



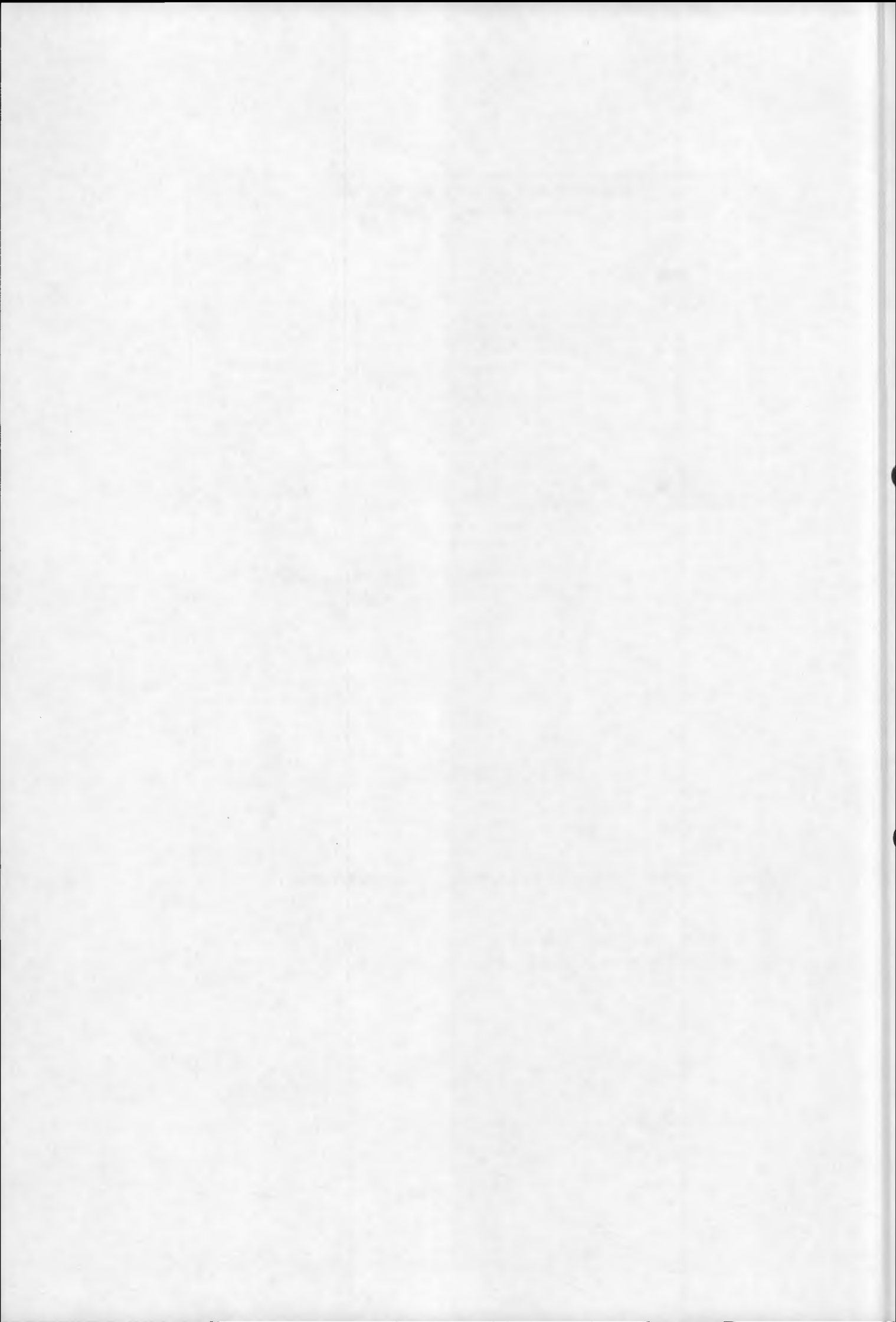
- Tracking satellites
JERS-1, IRS-1C & 1D
RADARSAT
- Tracking type :Program tracking
- Type Cassegrain
- Diameter 5m
- X-Y 2-Axis control
- Gain Xband 30-35dB/K
- Weight 5300 [Kg]





Future Plan

- New 5m antenna operation (1998-)
- Fully remote controlled data reception. (5m antenna system)
- Direct downlink data formatter for EOS-AM1(MODIS) data processing
(Fully software based downlink data formatting system)



Seventh ESOWG Meeting, May 28-29, 1998

Chung-Li Station Report

**A. J. Chen and L. C. Chen
NSC/NCU Satellite Remote Sensing Laboratory
Center for Space and Remote Sensing Research
National Central University
Chung-Li, Taiwan, R. O. C.**

Toulouse, France

I . Background:

1. Operating since June, 1993

Receivers for SPOT, ERS, Landsat and IRS-C

Station Coverage: Major Part of Western Asia Pacific

2. Standard Products:

--CCT, Film, CD-ROM media

--Bulk, Georeferenced, Geo-coded products (Levels 1-10)

3. Special Product

--Geocoded

--Radiometric Corrected, including Terrain Incident Angle

--16 Bits Data Depth

--Mask of Layover and Shadow Areas

4. Catalogue and Browse Images on Web Site

([//www.csrsr.ncu.edu.tw](http://www.csrsr.ncu.edu.tw))

5. One-Stop "Shopping"

--Data acquisition and processing

--User services

--Research and development

--Supporting facilities

--Total floor space: 8,000 m²



II . Data Reception

1. Acquired:

	ERS 1,2		Total	
	pass	sec.	pass	sec.
CY1996	212	271,826	1,883	509,391
CY1997	66	414,639	1,476	570,904

2. Failure:

	Operations		System		Others		Total	
	pass	sec.	pass	sec.	pass	sec.	pass	sec.
CY1996	5	1020	8	2,114	11	2,520	24	5,654
CY1997	2	330	20	6,509	12	3,562	34	10,401

* Others: Typhoon or No X-Band Downlink

3. Performance:

	Operational Success Rate	Data Loss	Availability
CY1996	99.74%	0.65%	99.32%
CY1997	99.86%	1.19%	98.53%

* Success Rate = Acquired Pass/(Acquired + Operations failure) pass

* Data Loss = 1- Acquired sec/(Acquired + Operations failure + System failure)sec

* Availability = Acquired pass/(Acquired + Operations failure + System failure)pass

III. Data Processing

Raw and Processed Scenes Archived

	Raw	Processed	
		Geoferenced	Geocoded
CY1996	589	589	11
CY1997	556	556	33

IV. Data Distribution

1. Revenue(ordered)

	Total	ERS
CY1996	NT\$21,304,477	NT\$403,600(3.24%)
CY1997	NT\$39,439,956	NT\$1,279,100(4.33%)

Exchange rate: NT\$/US\$=30.0-33.0

2. Product Profile:

Product Type		RAW	PRI	SLC	GTC
CY					
	CY1996	1	38	1	0
	CY1997	0	69	10	4

3. User Profiles:

Universities & Research Institutes: 9

Governmental Agencies: 1

V . Application Highlights:

1. Kuroshio Front Detection
2. Coastal Line Detection
3. Sea Surface Wind Retrieval
4. Sea Bottom Topography and Current Retrieval

VI. Future Plan

1. Reception Upgrade:

SPOT 4, EROS, Radarsat, Landsat 7

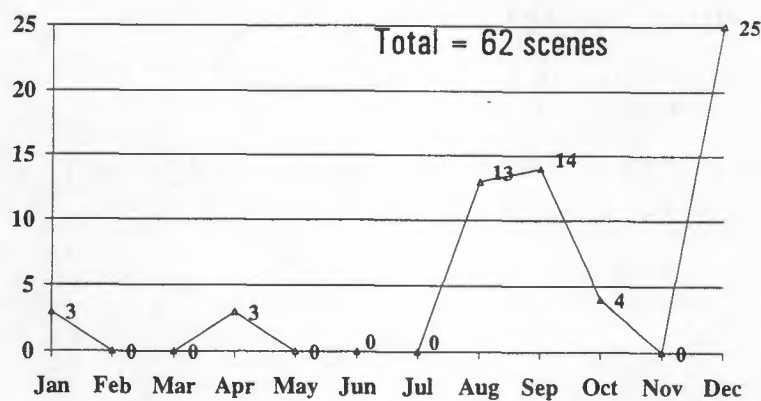
2. System Upgrade:

Direct Acquisition and Archiving System, SPOT Terminal, UNIX, Workstations.

3. Promotion:

- Solution provider
- General public

ERS DATA ACQUISITION IN CY 1997



The 7th ESOWG Meeting, Toulouse, May 28-29, 1998 National Research Council of Thailand (NRCT)

ERS DATA DISTRIBUTION IN CY 1997

ONLY 4 SCENES* ARE SOLD VALUE US\$ 3,560

**Excluding 86 scenes processed to support PIs but no report on this because NRCT has not yet received payment.*

The 7th ESOWG Meeting, Toulouse, May 28-29, 1998 National Research Council of Thailand (NRCT)



PROBLEMS

FAILURE OF THE PROCESSOR HARDWARE (ONYX), WAITING FOR REPARATION BY THE COMPANY BASED IN SINGAPORE (BECAUSE SERVICES BY ONYX IN THAILAND ARE NOT AVAILABLE) AND THE BUDGET.

The 7th ESOWG Meeting, Toulouse, May 28-29, 1998 National Research Council of Thailand (NRCT)

**Centre for Remote Imaging,
Sensing and Processing (CRISP)
National University of Singapore**

by

**KWOH Leong Keong
CHNG Ngi Kun**

e-mail : crsklk@leonis.nus.edu.sg

url: <http://www.crisp.nus.edu.sg>

7th ESOWG Meeting

Toulouse, France, May 28-29 1998



CRISP

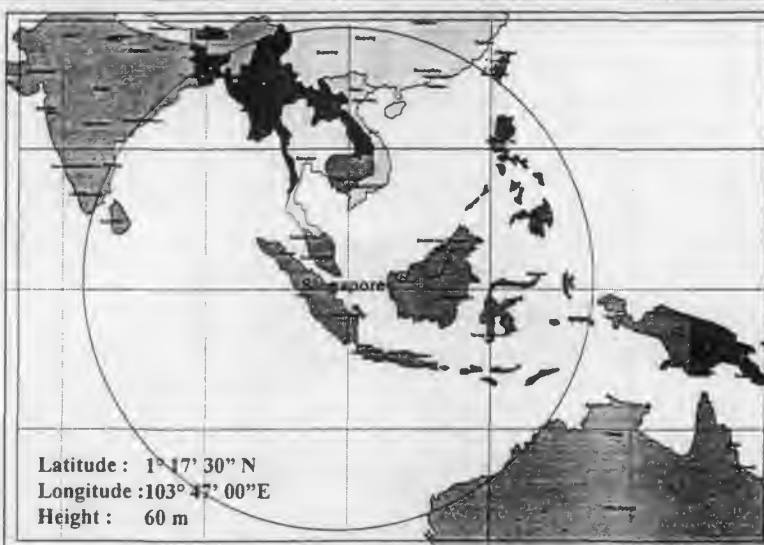
Centre for Remote Imaging, Sensing and Processing

- **Ground Station**
- **Data Acquisition**
- **Product Distribution**
- **Applications**
 - ERS Quicklook Mosaic
 - Rice Monitoring
 - Forest Fire Monitoring
 - Oil Pollution Monitoring



CRISP

Centre for Remote Imaging, Sensing and Processing

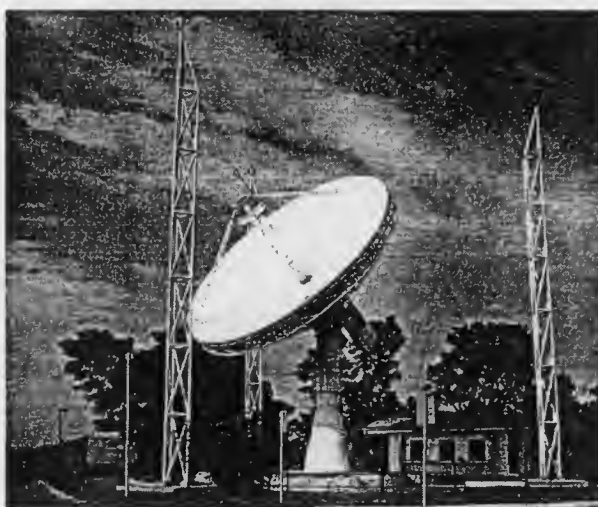


CRISP

Centre for Remote Imaging, Sensing and Processing

Data Acquisition Facility:

- Diameter of 13 m
- Reception of X-band signals (8.00 - 8.45 GHz)
- G/T of 35 db/K
- 7° tilt third axis
- Two data channels
- Receivers for SPOT, ERS and RADARSAT
- Two HDDRs
 - SONY DIR 1000M (up to 128 Mbits/sec)
- Data Archive Media - D-11 Cassettes



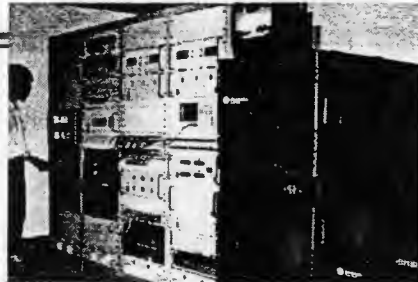


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Data Processing Facility:

- Main Server
 - one 4-CPU(R4400) SGI Challenge
- Workstations
 - three SGI Indigo2 (R4400)
 - 1 SGI Indy (R4600)
 - 1 SGI Octane (R 10000)
 - 1 SGI O2 (R 5000)
 - PCs
- Software -
 - SPOT - Datron, USA
 - ERS & RADARSAT - Spacetec, Norway



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Centre for Remote Imaging, Sensing and Processing

Processing Timings

ERS PRI on 4 CPU R4400 SGI Challenge

- 25 min

PRI on 1 CPU 175 Mhz R10000 SGI Octane (lowest end Octane)

- 28 min

$(\text{Price of Octane})_{1998} = (1/10 \text{ Price of 4 CPU Challenge})_{1994}$

Expect 4 CPU R1000 SGI to process PRI in about 7 min



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Centre for Remote Imaging, Sensing and Processing

Data Acquisition (1 Jan 97 to 31 Mar 98)

	SPOT	ERS	RSAT
Number of Passes Attempted	1265	299	383
Satellite Failure	19 (1.5%)	8 (2.7%)	19 (5.0%)
Station and Operation Failure	10 (0.8%)	1 (0.3%)	4 (1.0%)
Successful Acquisition	1236	290	360
Acquisition Success Rate(*)	99.2%	99.7%	98.9%
Acquisition Success Rate of 1996	96.7%	98%	--

(*) acquisition success rate excludes satellite failure



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Centre for Remote Imaging, Sensing and Processing

CRISP's Archive (up to May 1998)

- **SPOT 1,2,3** **145,000 scenes**
- **ERS 1,2** **13,000 scenes**
- **RADARSAT(*)** **5,000 scenes**

(RADARSAT scenes of duration depend on beammodes)

Quicklooks of SPOT, ERS and RADARSAT available in
CRISP's WWW -- <http://www.crisp.nus.edu.sg>

www.crisp.nus.edu.sg

Metacape - [Centre for Remote Imaging, Sensing and Processing, CRISP]

File Edit View Go Bookmarks History Database Window Help

Location: http://www.crisp.nus.edu.sg/

CRISP Catalogue Browse

Satellite Images Received by CRISP's Ground Station
Since 28 September 1995

(Coverage Area: South Asia and South-East Asia)

Choose the satellite data:

☐ SPOT	☐ ERS
☐ STEREO SPOT	☐ RADARSAT

Choose Java or non-Java version:

☐ Java Version	☐ Non-Java Version
---------------------------------------	---

And Log In:

User ID	
Password	
Enter Cancel	

CRISP Home Catalogue Research News Links

Centre for Remote Imaging, Sensing and Processing
National University of Singapore, Faculty of Science, Lower Kent Ridge Road, Singapore 119260
Telephone: (65) 674 3220, Fax: (65) 673 7717, E-mail: crisp@crisp.nus.edu.sg

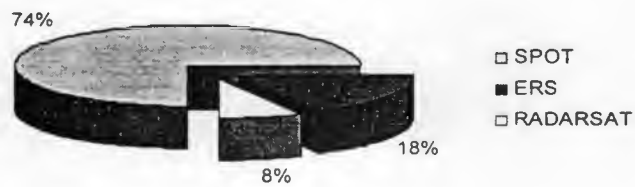
CRISP Catalogue Done



CRISP

Centre for Remote Imaging, Sensing and Processing

CRISP WWW Hits (1 Jan 98 - 5 May 98)



Excluding access by NUS users

Average access 240 per day

762 registered users from 34 countries



CRISP

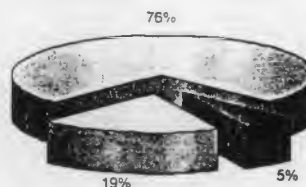
Centre for Remote Imaging, Sensing and Processing

'95Q4 & 1996



□ SPOT
■ ERS
□ RADARSAT

1997 & '98Q1



CRISP's Revenue from Data and Products

(Revenue '95Q4-1996) is one third (Revenue 1997-'98Q1)



CRISP

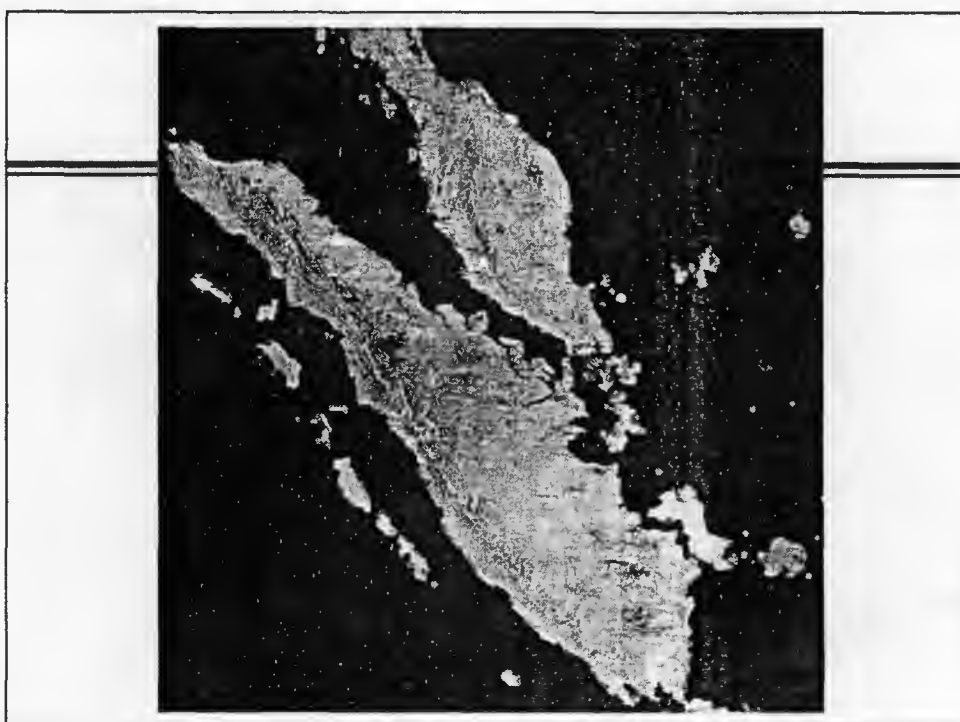
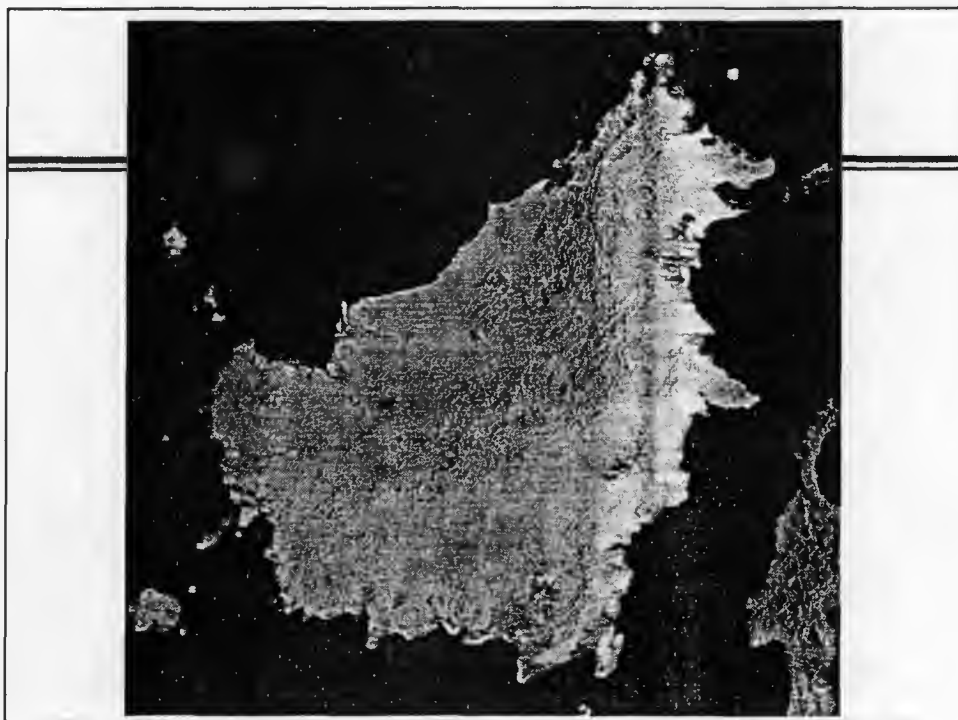
Centre for Remote Imaging, Sensing and Processing

ERS Data Product Distribution

(Number of scenes)

User Code	1996	1997	1998 Q1
Code C: ESA PI/PP, Campaigns etc	29	54	0
Code X: NFS Commercial Sales	1	27	2
Code E: ERSC Distributor	62	35	21

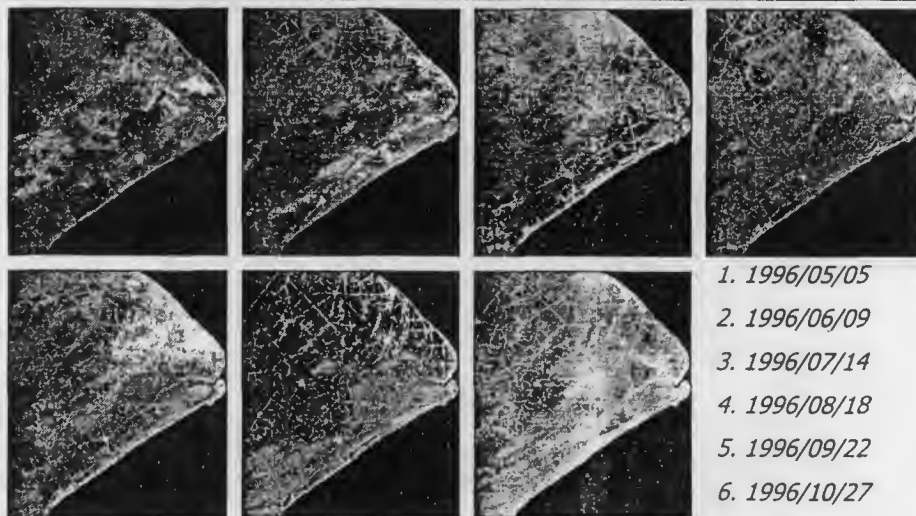
(Code X and Code E)	1997	1998 Q1
RAW (Raw Annotated)	23	5
SLC (Single Look Complex)	4	2
PRI (Precision Image)	35	16



Mekong Delta: Rice Cropping Systems

Cropping Type	Rice Seasons
Single Rainfed	<i>Mua</i>
Double Rainfed	<i>Dong Xuan - He Thu</i>
Double Irrigated	<i>He Thu - Mua</i>
Triple Irrigated-Rainfed	<i>Dong Xuan - He Thu - Mua</i>

Mekong Delta: ERS-2 Scenes



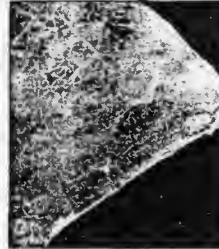
1. 1996/05/05
2. 1996/06/09
3. 1996/07/14
4. 1996/08/18
5. 1996/09/22
6. 1996/10/27
7. 1996/12/01

All images: Copyright ESA, 1996; acquired and Processed by CRISP, Singapore

Mekong Delta: Multitemporal SAR Colour Composite Image



R: May 5, G: Jun 9, B: Jul 14

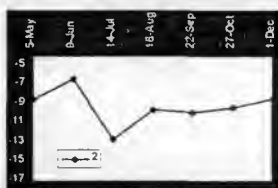


*R: Jul 14
G: Aug 18
B: Sep 22*

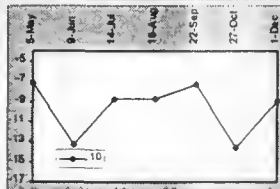


*R: Sep 22
G: Oct 27
B: Dec 1*

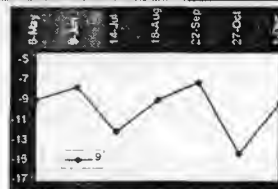
Backscatter Time Series (TCI Analysis) (Rainfed Rice Cropping Systems)



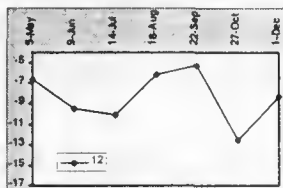
Single crop (M)



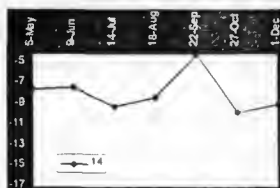
Double crop (HT-M) in Bac Lieu, WDSR



Double crop (Late HT-M) in Bac Lieu, dDSR



Double crop (HT-M) in Soc Trang, dDSR

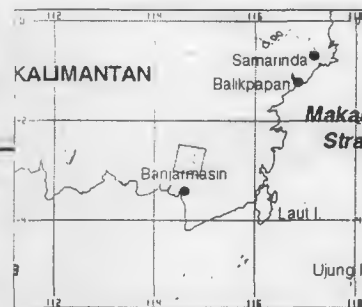


Double crop (HT-M) in Soc Trang, possibly mixed with other vegetation classes

Mekong Delta: Classification of Rice Cropping systems



-  *SC (M)*
-  *Shrimp-Rice (M)*
-  *DC (Irr DX-HT)*
-  *DC mixed (Irr. & r.f.)*
-  *DC (HT-M) Bac Lieu*
-  *DC (HT-M) Soc Trang*
-  *DC (HT-M) Bac Lieu*
-  *DC (HT-M) Soc Trang*

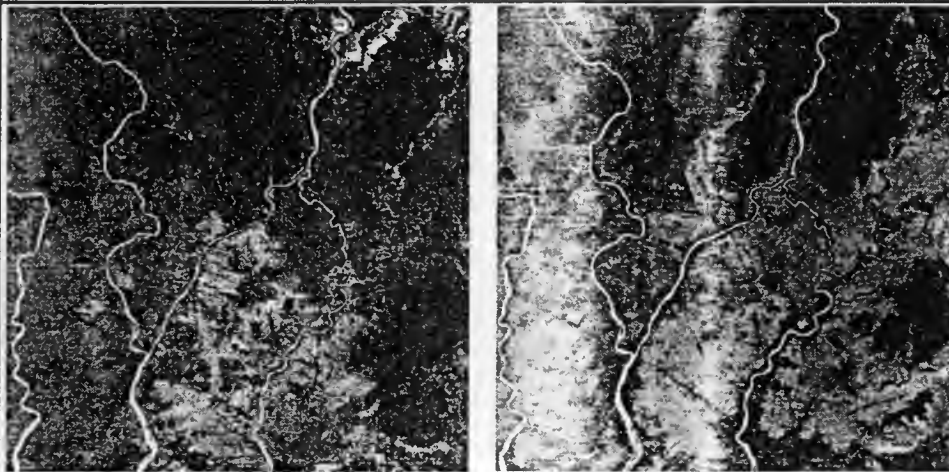


**1997 Plantation /
Forest Fire near
Banjarmasin,
Kalimantan**



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Colour Composite Image with Interferometric Coherence, ERS 1 and ERS 2 Intensity data. Left image acquired in April 1996. Right image acquired in October 1997. Large vegetation clearings is clearly visible between 1996 and 1997. Image is about 100km by 100km.



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A Case of Oil Pollution

- A ship discharged oil in international waters near Singapore in August 1996.
- Singapore government spent about S\$ 1 million to clean up the affected beaches.
- An ERS image clearly shows the ship discharging a 5-km long plume of oil.
- With the ERS image and other evidence, the culprits were convicted in court and fined a total of S\$ 1.25 million.



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Cracking an oily case with some help from above

THIS satellite photograph, taken from 785 km above the earth, shows an oil tanker called the Song San, anchored outside Singapore waters.

And oil flowing from it. With such photographs, the Maritime and Port Authority of Singapore (MPA) thought last August that it had solved the mystery of which ship had spilled the oil.

But the ship's owners denied causing the spill, which affected long stretches of Singapore's coast, including Sentosa's beaches.

Their denials started the MPA off on a four-month high-technology effort to crack the case.

First, it took the satellite photographs of the spill area and showed them to experts

Satellite picture helped to finger oil-spill ship

from various parts of the world for expert analysis.

These experts agreed that it was the Song San that had spilled the oil.

Next, oil samples from the water and from the ship were sent to the Department of Scientific Services for analysis.

Tests showed that the samples matched, meaning that the oil did, in fact, come

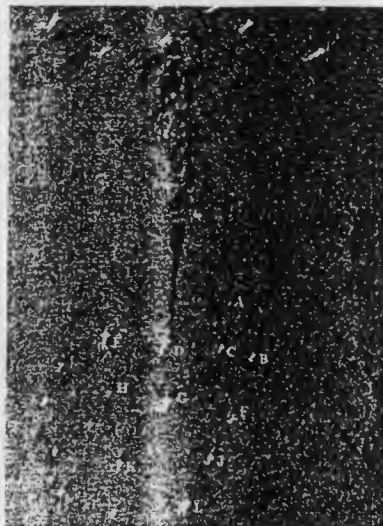
from the Song San. Investigators also used a computer system, whose software was developed within the MPA.

This system could simulate the path of oil slicks, both backwards and forwards in time, given wind and sea conditions.

All the slicks in question were traced back to the Song San.

The case ended when the courts meted out record penalties to the guilty parties earlier this month.

■ **Computer sleuth traced oil slick to its source: Page 27**



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Centre for Remote Imaging, Sensing and Processing

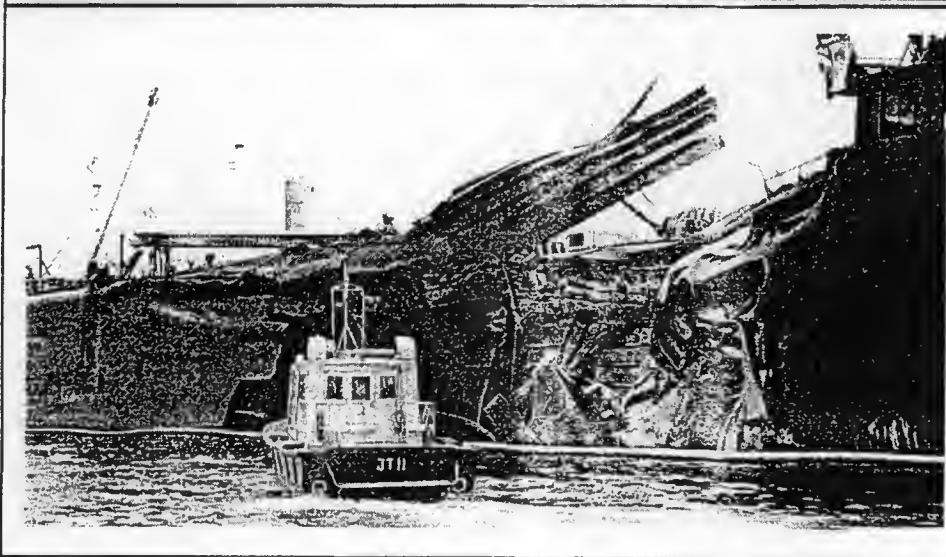
Tanker Collision on 16 October 1997

- About 25,000 tonnes of oil spilled into the sea
- Clean-operation successfully carried out
- SPOT image acquired on 17 October 1997 but hampered by prevailing forest fire haze
- ERS 1 and ERS 2 images acquired on 21 and 22 October 1997
- RADARSAT W1 image acquired on 26 October 1997 showing remnants of oil moving into the Malacca Straits

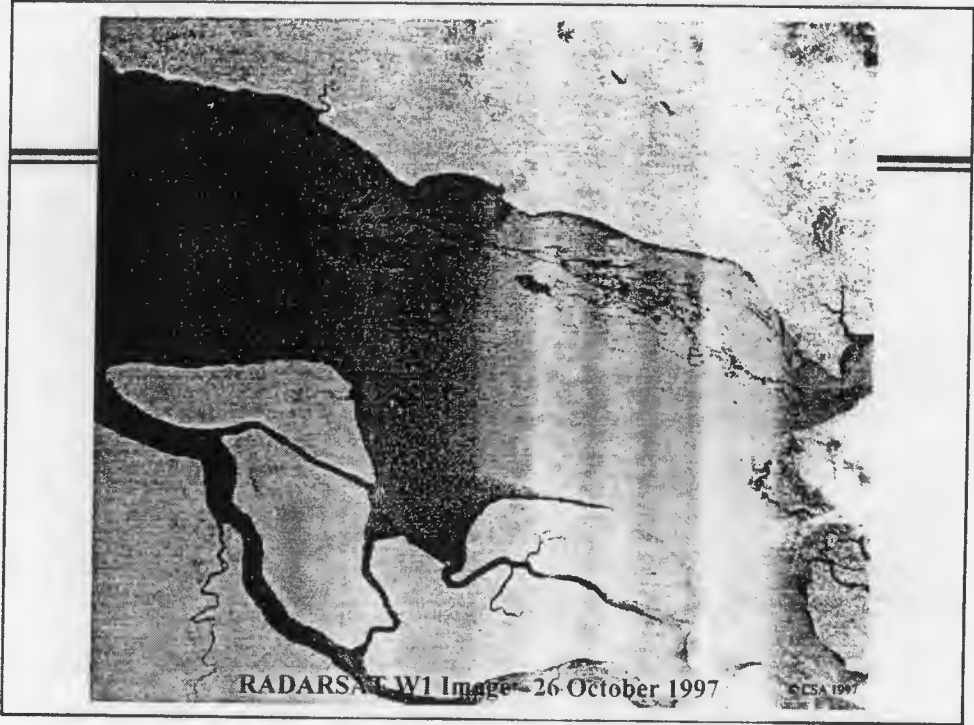


CRISP

Centre for Remote Imaging, Sensing and Processing



ERS 1 Image acquired on 21 Oct 1997





Australian Centre for Remote Sensing



Presenter: Paul Trickett

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Australian Centre for Remote Sensing
ACRES is a Business Unit of AUSIUS



Role of ACRES

■ to provide timely access to a range of quality remote sensing data products for Australia and its region through:-

- . direct reception
- . catalogue & archive
- . data processing
- . distribution network

Presenter: Paul Trickett

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Data received by ACRES

- SPOT - XS and Pan
- Landsat - TM
- ERS - SAR
- JERS - OPS and SAR
- NOAA AVHRR
- RADARSAT



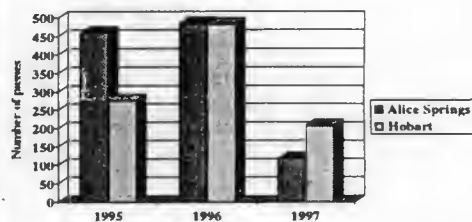
Presenter: Paul Trickett

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ACRES ERS Acquisitions



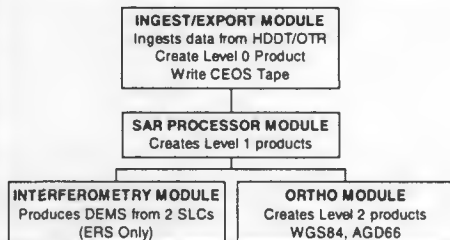
Presenter: Paul Trickett

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Vexcel SAR Processing System



Presenter: Paul Trickett

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1997 ERS Processing

- ACRES produces RAW, SLC and PRI products using the Vexcel system;
- Australian demand still modest - only 33 products delivered during 1997;

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Planned ERS developments

- Transcription of ERS SAR archive to optical tape nearly complete;
- Considering options for incorporation of meta-data and browse in digital catalogue
- Further market development efforts in concert with JERS and RADARSAT;
- Envisat support?

Presenter: Paul Trezise

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Other developments at ACRES

- Major upgrade of Alice Springs and Hobart acquisition facilities in progress;
- RADARSAT downlink agreement signed - "blue ribbon" certification imminent;
- ACRES processing centre moves to AUSLIG headquarters building;
- ARIES project at critical point;
- <http://www.auslig.gov.au>

Presenter: Paul Trezise

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Content

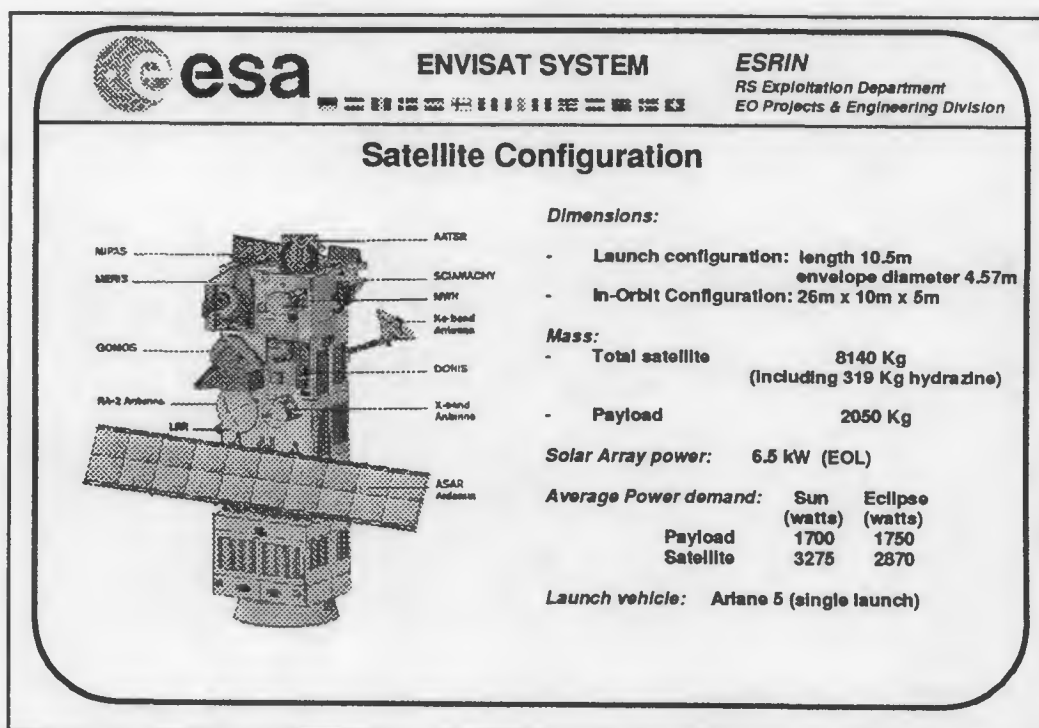
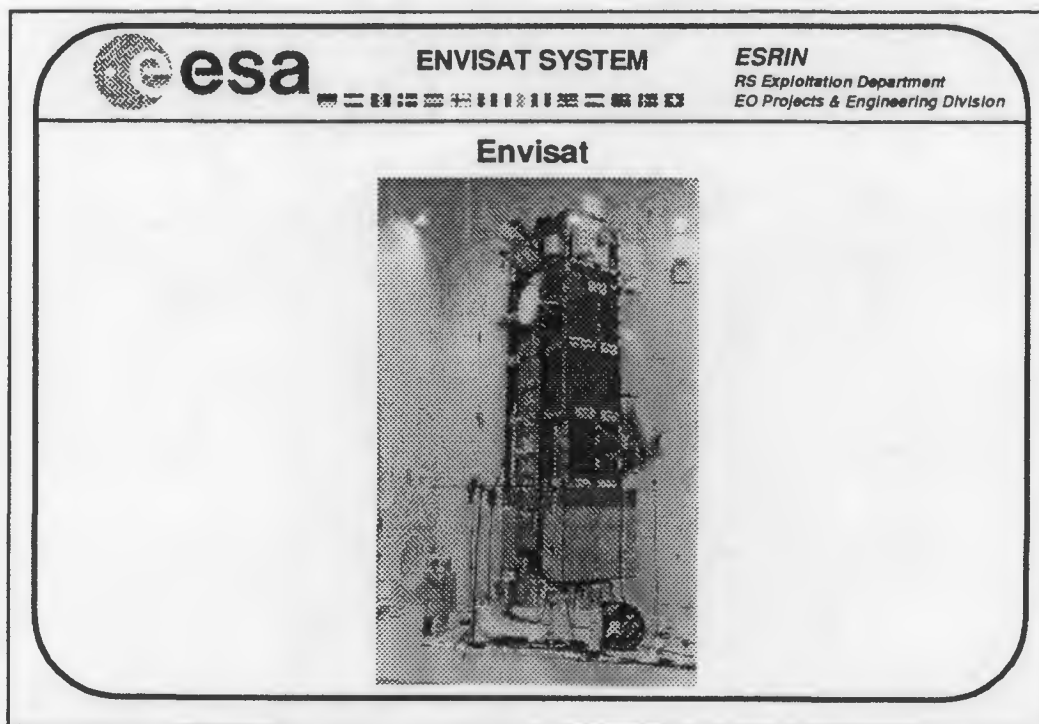
- ◆ System Overview
- ◆ Ground Segment Overview (Including Data Acquisition Scenarii)
- ◆ The PDS Architecture
- ◆ Products
- ◆ User Services
- ◆ Operation Concept and Data Policy

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System Overview



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Payload Composition

- ♦ **ESA Developed Instruments (EDI's)**
 - ♦ - MERIS Medium Resolution Imaging Spectrometer
 - ♦ - MIPAS Michelson Interferometric Passive Atmospheric Sounder
 - ♦ - ASAR Advanced Synthetic Aperture Radar
 - ♦ - GOMOS Global Ozone Monitoring by Occultation of Stars
 - ♦ - RA2 Radar Altimeter 2
 - ♦ - MWR Microwave Radiometer
 - ♦ - LRR Laser Retro Reflector
- ♦ **Announcement of Opportunity Instruments (AOI's)**
 - ♦ - SCIAMACHY Scanning Imaging Absorption spectrometer for Atmospheric Chartography
 - ♦ - AATSR Advanced Along Track Scanning Radiometer
 - ♦ - DORIS Doppler Orbitography and Radionavigation Integrated by Satellite

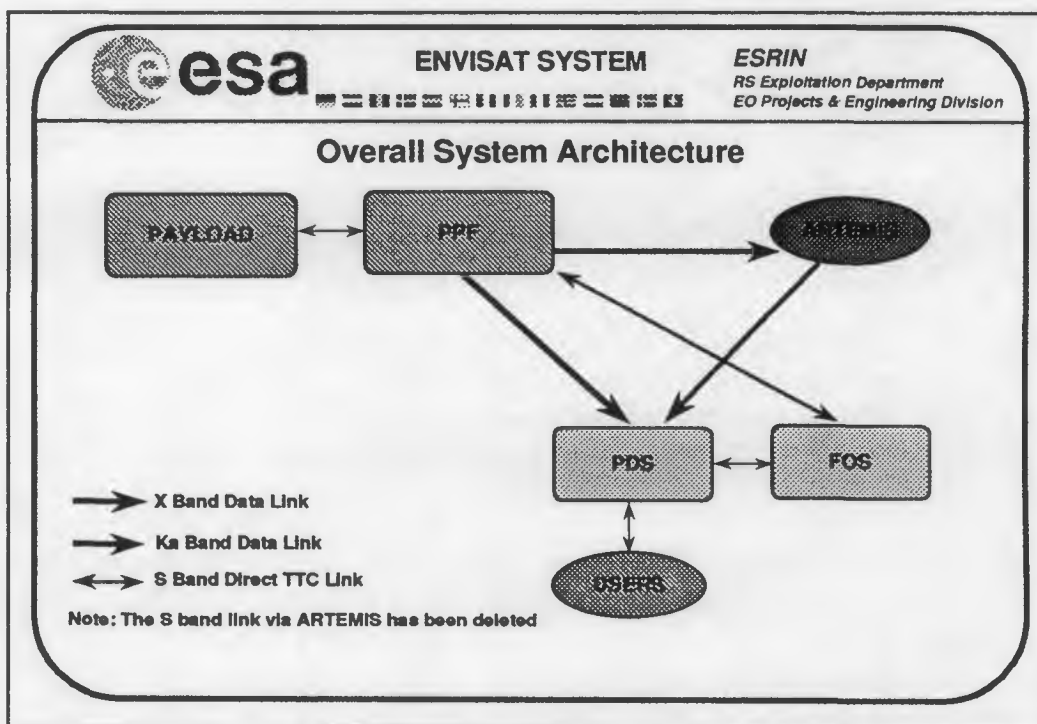
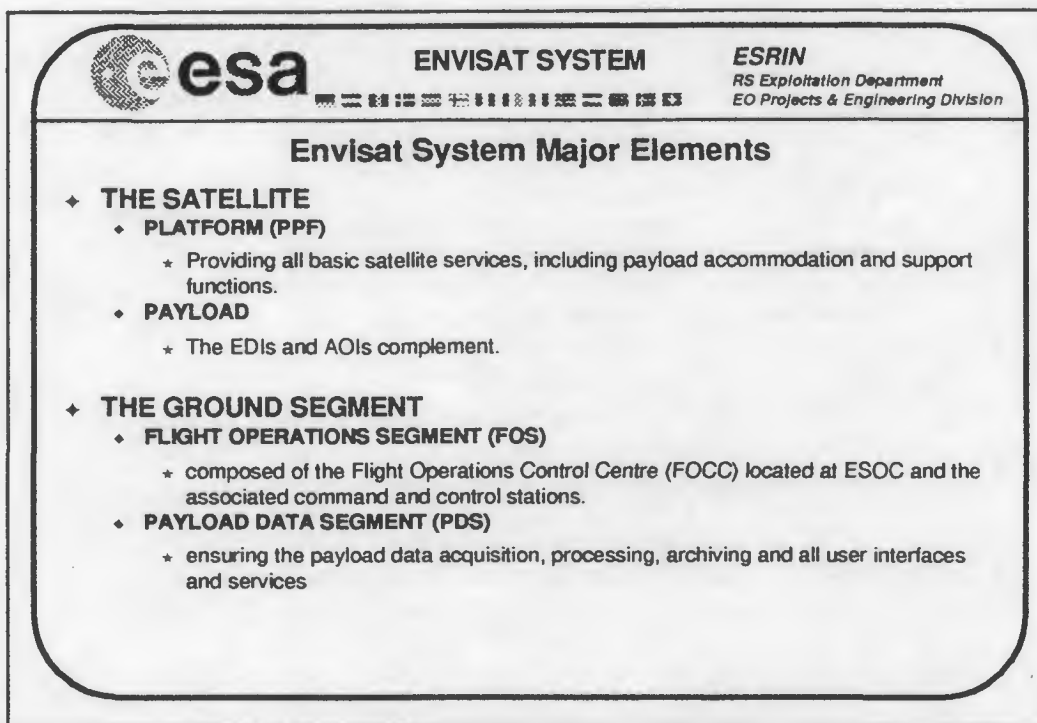
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Envisat Orbit

- ♦ **Direct injection of the satellite by the ARIANE 5 launcher on the selected Sun Synchronous orbit**
- ♦ **Selected reference orbit:**
 - ♦ mean altitude of 799.79 km,
 - ♦ 14 11/35 orbits per day
 - ♦ repeat cycle of 35 days (501 orbits).
 - ♦ 10:00 a.m. mean local solar time at the descending node
 - ♦ ground track maintained within ± 1 km from nominal (same orbit ground track as currently flown by ERS-1 and ERS-2)





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Global Mission Scenario

- ✦ The Global Mission operation includes all ENVISAT-1 instruments which have global coverage objectives and implies:
 - ✦ continuous operation of the low rate Instrument around the orbit (For MERIS, Sun illumination constraints limit the observation to about 43.5 minutes per orbit);
 - ✦ on board recording of all Instrument data;
 - ✦ data recorder playback at least once per orbit to ensure availability of FD products within less than 3 hours from observation;
 - ✦ systematic processing of all acquired data
- ✦ The global mission strategy will be defined in the High Level Operation Plan (HLOP) approved by the programme participants.
- ✦ The corresponding detailed operation requirements for the FOS and PDS are defined in the Reference Operation Plan (ROP).



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Regional Mission Scenario

- ✦ The Regional Mission includes:
 - ✦ the ASAR High Rate operations in wide swath mode and narrow swath modes
 - ✦ the MERIS Full Resolution (FR) mode
- ✦ Data rates implies real time transmission or recording on SSR
- ✦ Data acquisition will be based on user requests plus a background operation scenario.
- ✦ Strategy for handling user request will be based on the approved Data Policy and will be defined in HLOP; the result being implemented via detailed ROP rules.
- ✦ Data processing to high resolution product performed on user request.
- ✦ Data recovery assumes combined use of:
 - ✦ ESA X band stations;
 - ✦ Ka-band link via ARTEMIS;
 - ✦ X-band National and Foreign stations having an agreement with ESA.
- ✦ Simultaneous operation of Ka and X band channels will be possible

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Data Products

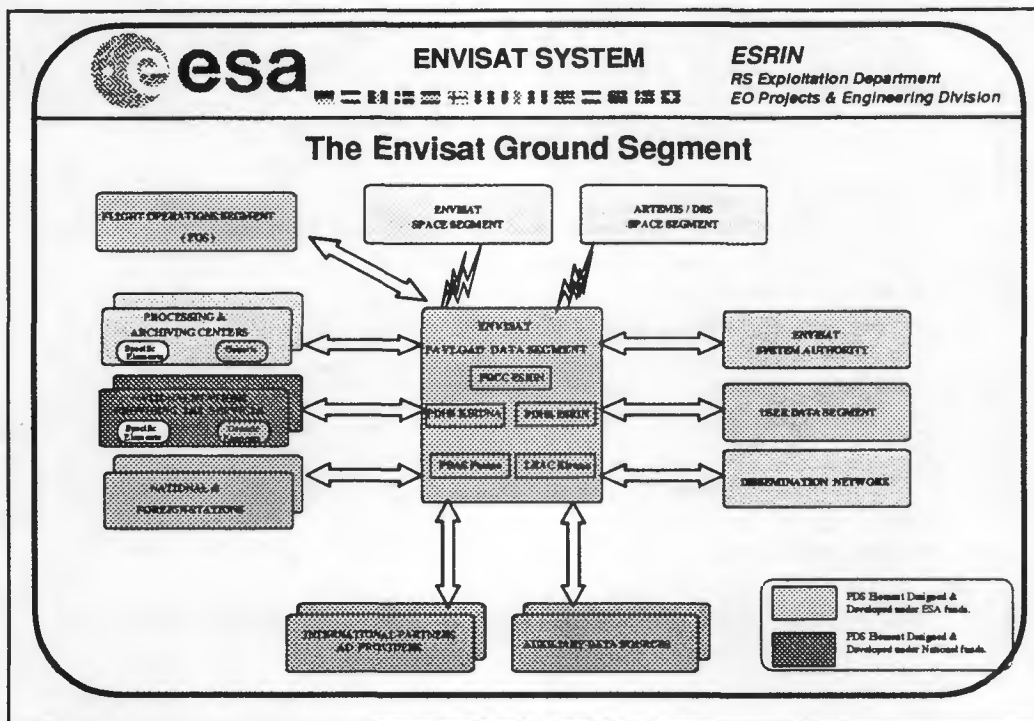
- ◆ **ESA PRODUCT LIST**
 - ◆ A complete list of ESA products has been defined with type of processing (Systematic or On Request), dissemination, time delivery, centre or station providing the service as well as algorithm development scheme. This list ensures coherency between Near real time and Offline products.
 - ◆ This list was approved as part of the ENVISAT-1 Ground Segment Concept.
 - ◆ Slight corrections have been made, due to Improved knowledge during the detailed definition phase
 - ◆ Involving: Expert Support Laboratories (ESLs), Supporting Industries and the Scientific Advisory Groups.
- ◆ **PRODUCT LEVEL DEFINITION**
 - ◆ **Raw Data** as received from the satellite (serial data stream, no demultiplex)
 - ◆ **Level 0** reformatted, time ordered (no overlap) satellite data, computer compatible format
 - ◆ **Level 1b** geolocated engineering calibrated product (Near Real Time and Offline)
 - ◆ **Level 2** geolocated geophysical product (Near Real Time and Offline)

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**Ground Segment Overview
(including Data Acquisition Scenario)**



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Flight Operations Segment (FOS)

- ♦ The FOS shall provide control of the satellite through all mission phases.
- ♦ The Flight Operation and Control Centre (FOCC) shall control all FOS operations:
 - ♦ Satellite operation planning based upon the observation plans prepared at the PDCC.
 - ♦ Mission planning Interface with ARTEMIS
 - ♦ Command & control of the Satellite, up-loading satellite operation schedules on a daily basis, via the reference TT&C station of Kiruna -Salmijarvi
- ♦ The FOCC shall also support:
 - ♦ satellite configuration and performance monitoring
 - ♦ software maintenance for PPF and payload elements
 - ♦ orbit prediction, orbit restitution and orbit maintenance.

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Payload Data Segment (PDS)

- ✦ The PDS shall provide:
 - all interfaces to the users from order handling to product delivery
 - all payload data acquisition for the global mission
 - all regional data acquisition performed by ESA stations
 - processing and delivery of all ESA Fast delivery products
 - data archiving, processing and delivery of all ESA offline products with the support of Processing and Archiving Centres (PACs)
 - interfacing to all national and foreign stations acquiring regional data
- ✦ All PDS centres and stations shall be coordinated by the Payload Data Control Centre (PDCC)
- ✦ located at Frascati.
- ✦ The PDCC shall ensure all mission planning interfaces with the FOCC.

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Global Mission Data Recovery (1)

- ✦ Nominal scenario based on Kiruna X- Band and ESRIN UET for ARTEMIS Ka- link
 - share of workload foreseen between the two PDHS: 7 consecutive orbits per day in each station
- ✦ Temporary unavailability of ARTEMIS, back up scenario is:
 - 9 to 10 orbits per day acquired at Kiruna,
 - the remaining orbits being recorded on board using the 3 tape recorders and the Solid State Recorder (SSR) in cascade, the corresponding data being acquired by deferred dumped the following day over Fucino PDAS station.
 - 100% of the Global Mission data can be recorded and dumped to the ESA stations; the products of the 4 to 5 deferred dump orbits will not available in NRT.

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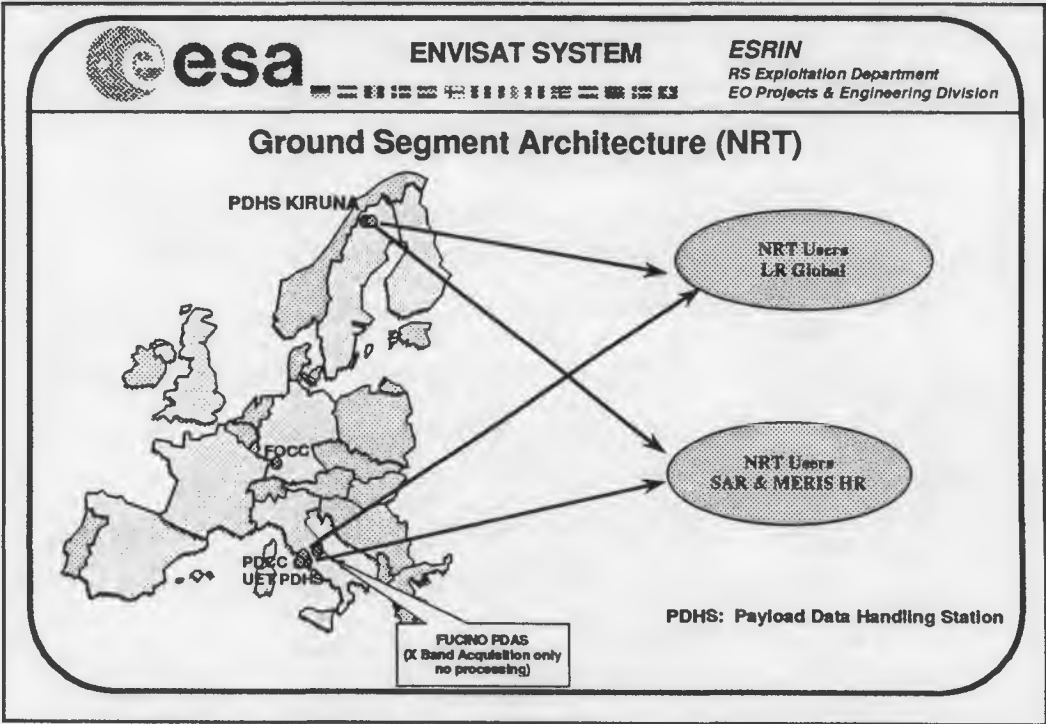
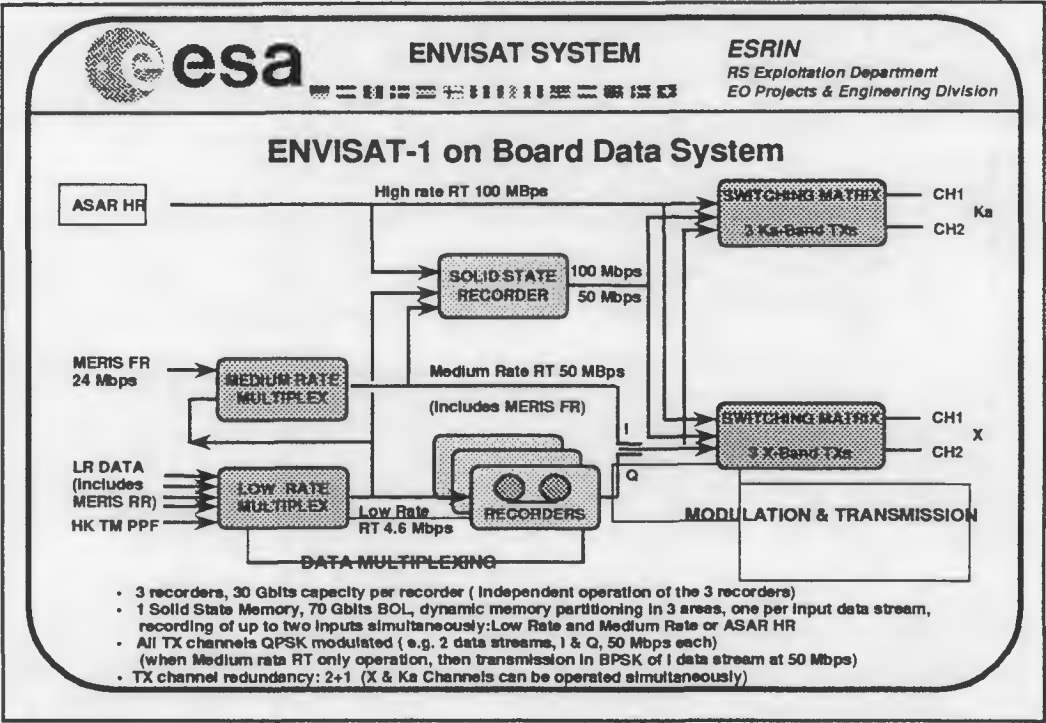
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ENVISAT is the first Earth observation satellite in orbit with a multi-sensor payload

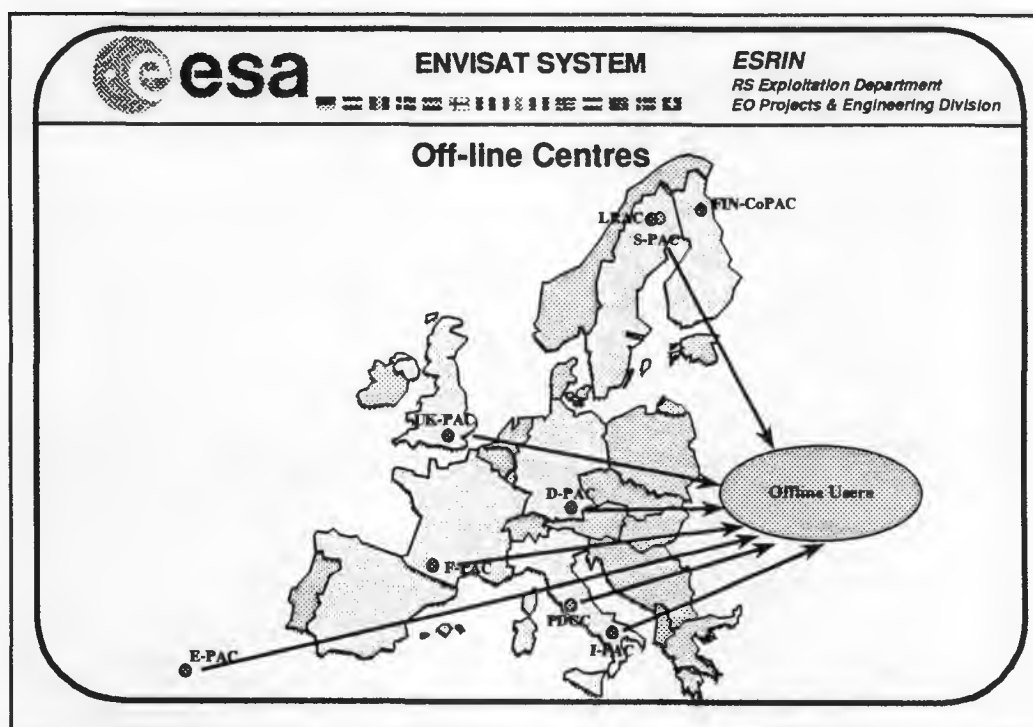
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Near Real Time Services

- ✦ Typically 3 hours from sensing for data used in forecasting or tactical operations,
(global and regional products produced and distributed systematically)

- ✦ Typically one to three days from sensing for applications requiring high resolution images (agriculture, forestry, soil moisture, etc ...) with production and delivery to users on request.

Note: all regional data (ASAR HR and MERIS FR) acquired at the two PDHSs are systematically processed in NRT as medium resolution stripes (150 m resolution for ASAR and 1200 m resolution for MERIS).





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Off-line Services

✦ **Continuity of services from Near Real Time to Off-line :**

- ✦ delivery a few days to weeks from data take;
- ✦ product commonalties (same format, same processing algorithms whenever possible);
- ✦ Off-line products will benefit from a posteriori knowledge of calibration, auxiliary data and precise orbit.



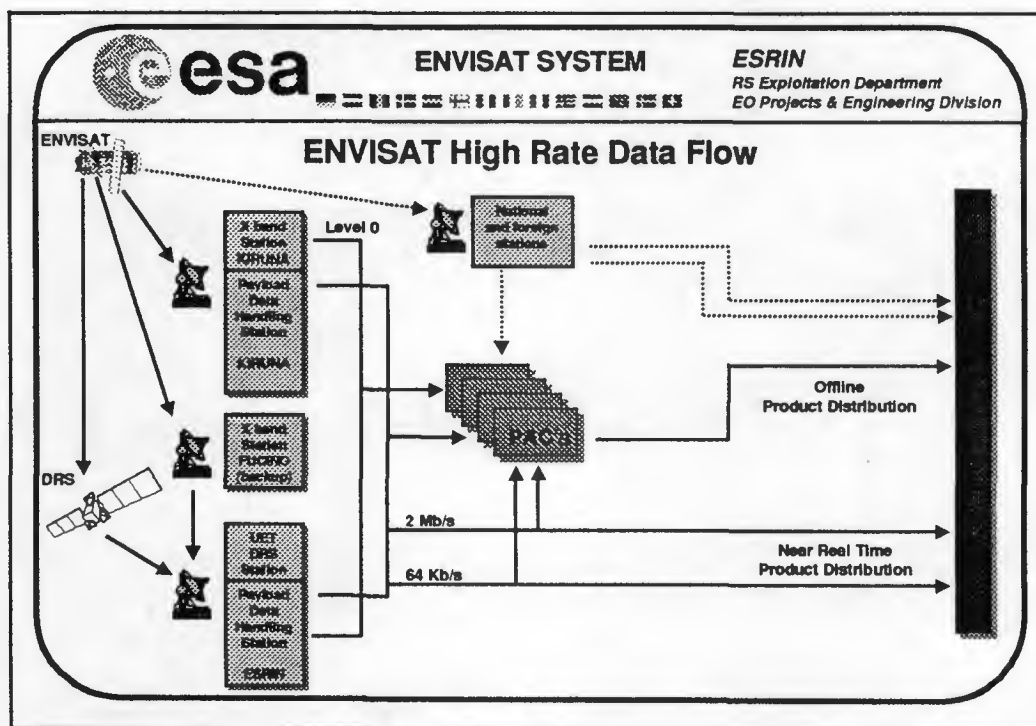
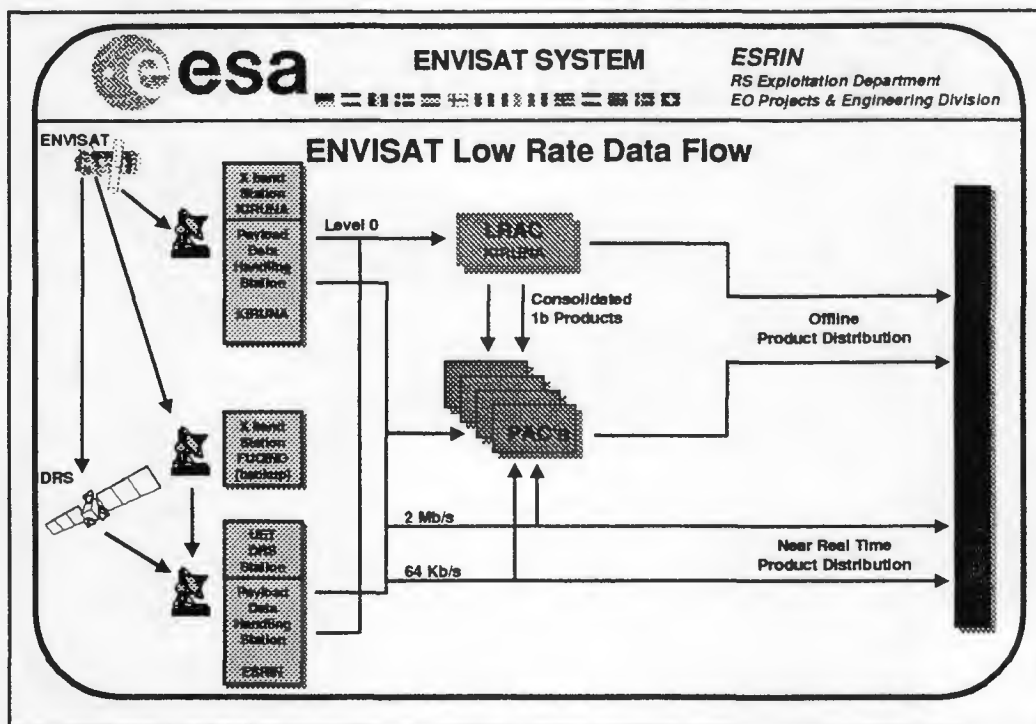
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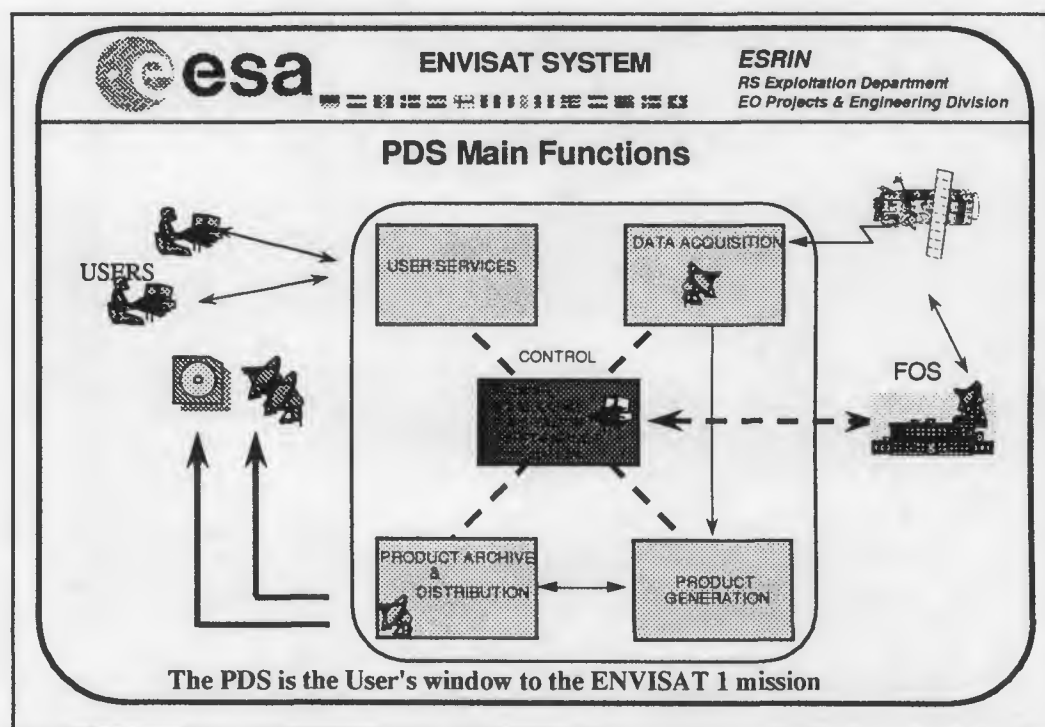
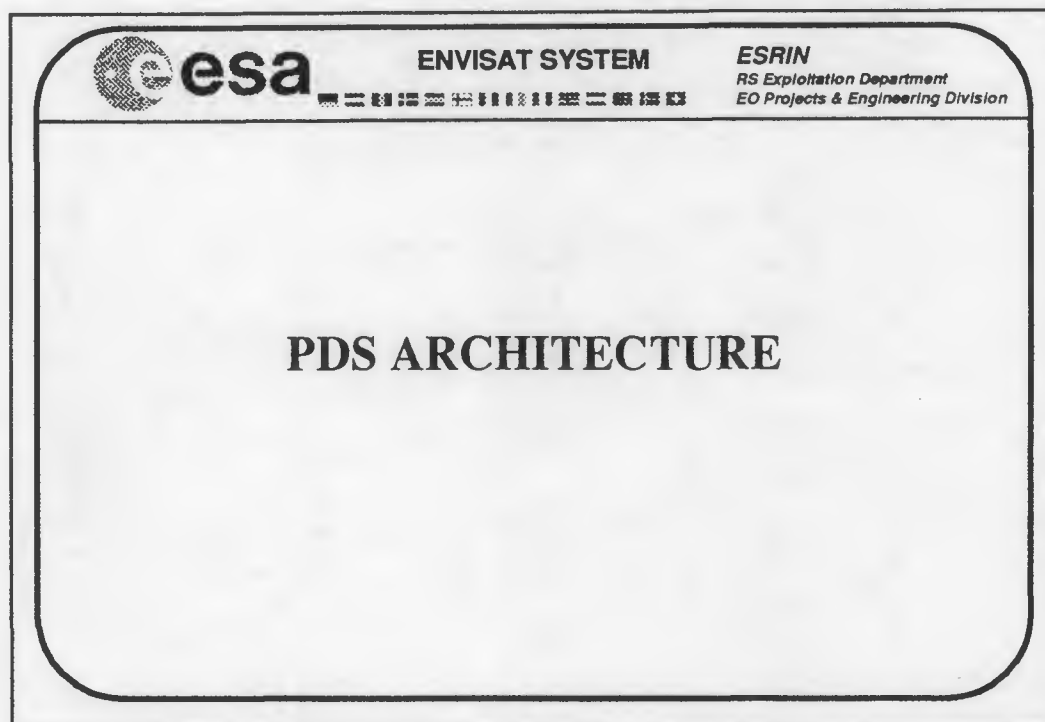

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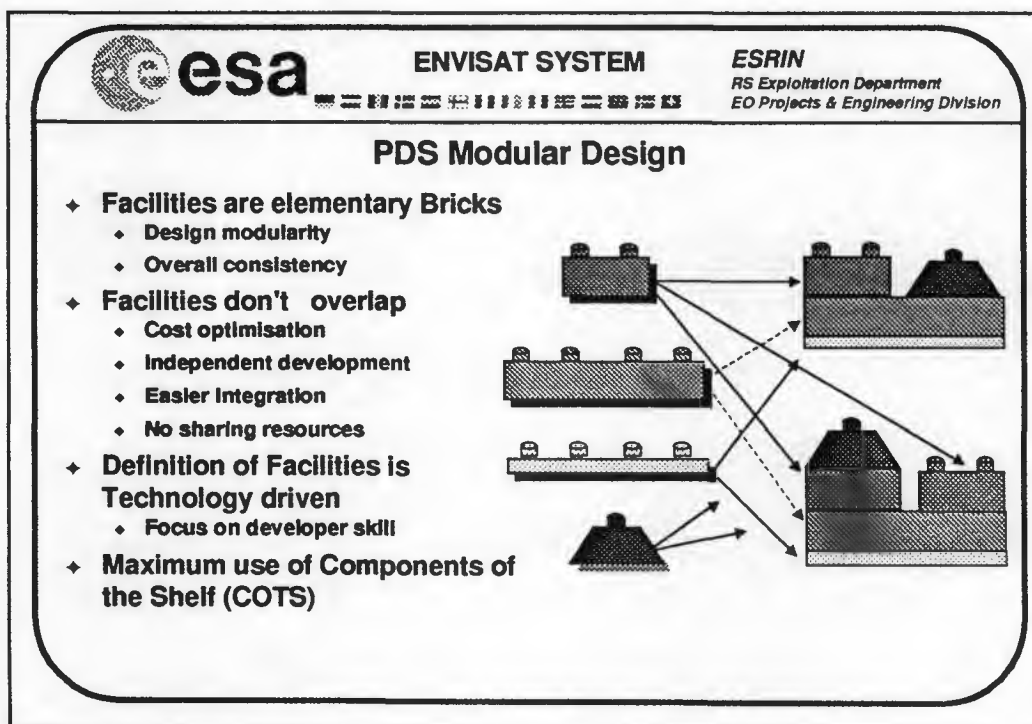
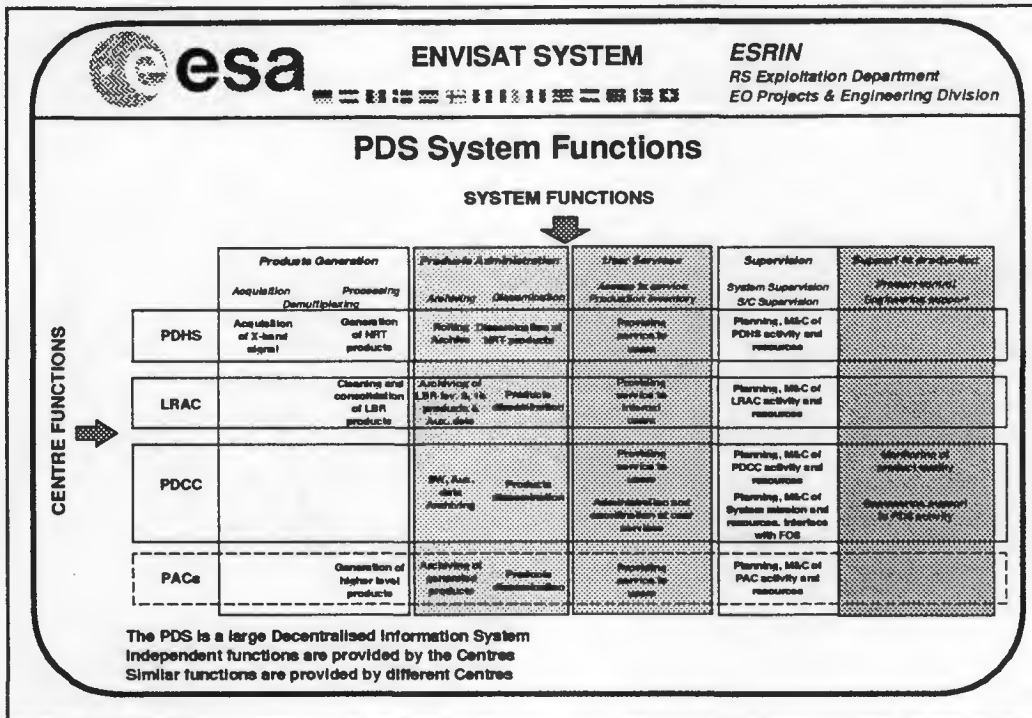
PAC Assignments

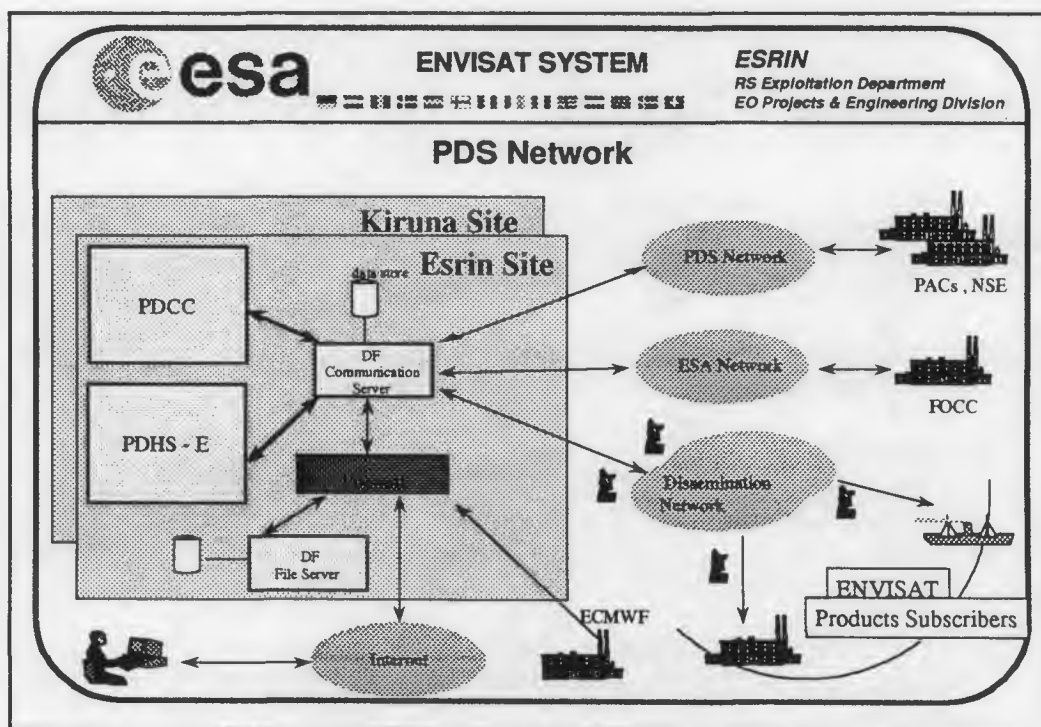
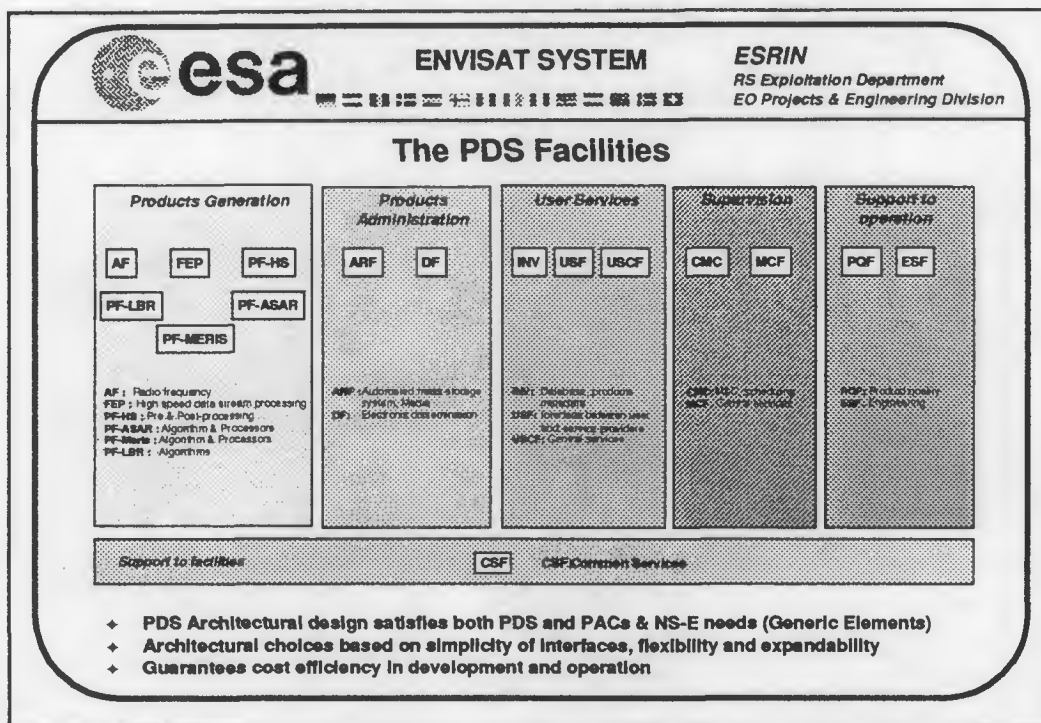
✦ ASAR HR	to be shared between UK-PAC, D-PAC and I-PAC
✦ MERIS FR	to be shared between UK-PAC, I-PAC and Maspalomas station
✦ ALTIMETRY	located at F-PAC
✦ ATMOSPHERE CHEMISTRY	located at D-PAC (with FIN-CoPAC for GOMOS processing)
✦ AATSR	located at UK-PAC
✦ MERIS LR global	located at S-PAC (Kiruna-Salmijärvi)

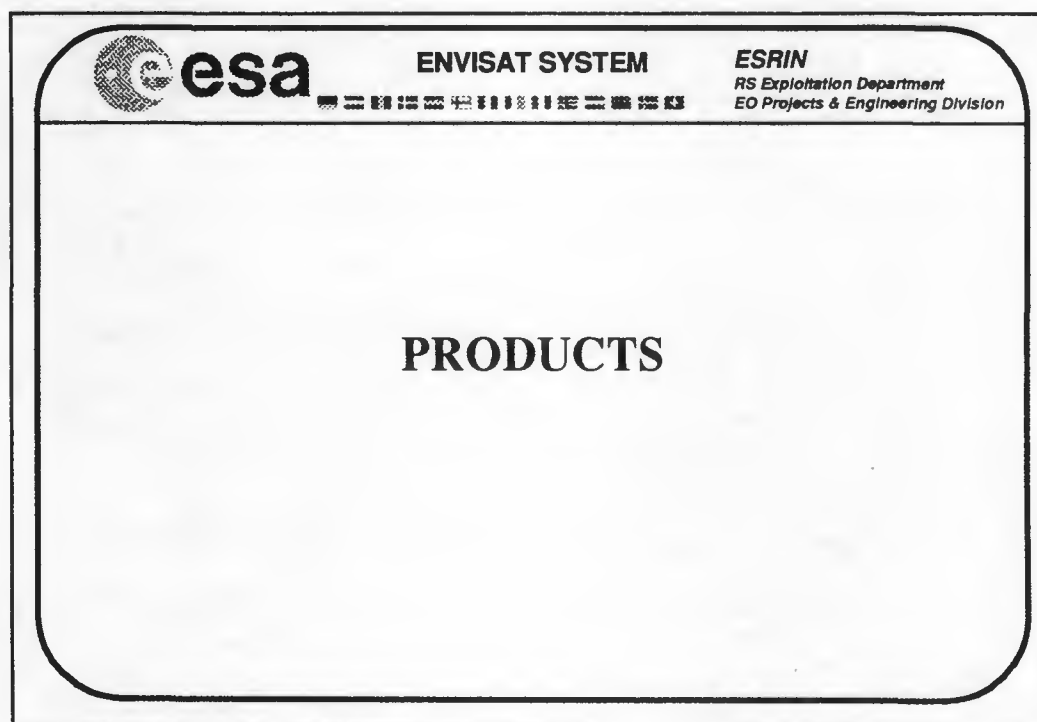
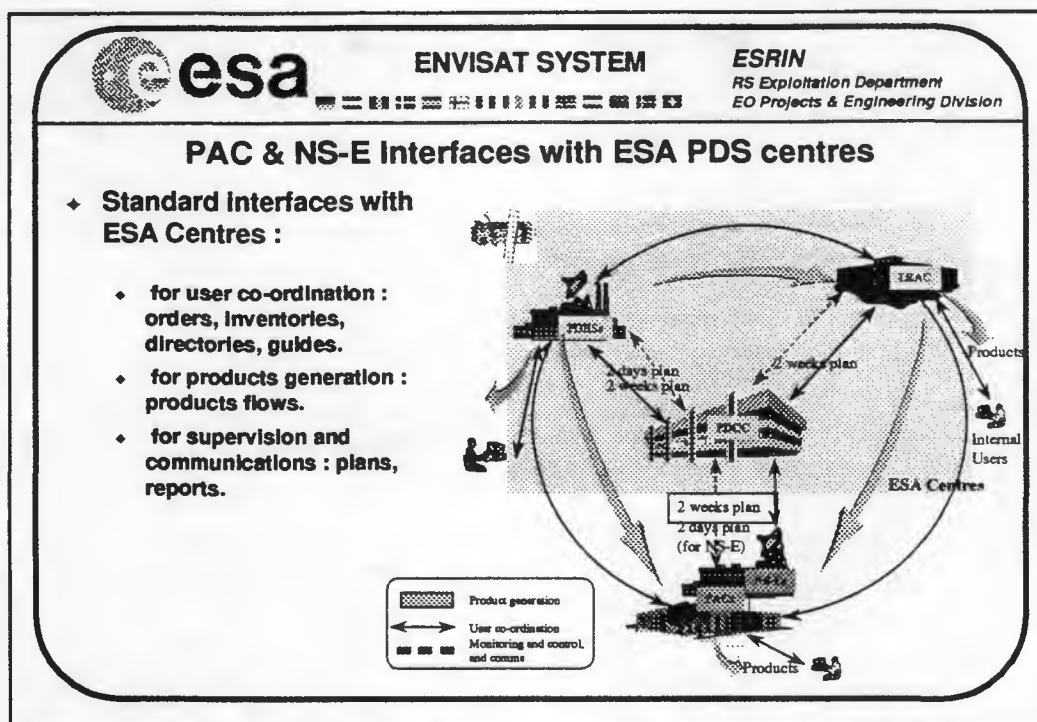
LBR Level 1B consolidation located at Kiruna, at ESA Low rate archiving Centre (LRAC)











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Product Definition Guidelines

- ♦ The list of products with corresponding objectives and content, summarised as one page per product, is provided in the

ENVISAT-1 Product Definition Guidelines, PO-TN-ESA-GS-002321 Issue 3.1

- ♦ The product evolution, since approval of the ENVISAT-1 Ground Concept approval, reflects:
 - ♦ - the need to identify precisely products according to Instrument modes;
 - ♦ - the need to differentiate between complete level 2 products and smaller subsets to be disseminated to operational Institutes in Near Real Time;
- ♦ The product list, its content and evolution, has been regularly presented and reviewed instrument per instrument with the corresponding SAGs.



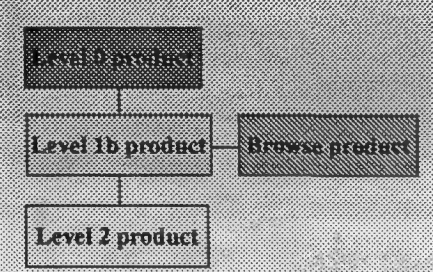
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Products List

- ♦ 74 different types of products to be generated
- ♦ 4 modes of generation
- ♦ generation in different Centers & Stations : PDHS, LRAC and PACs

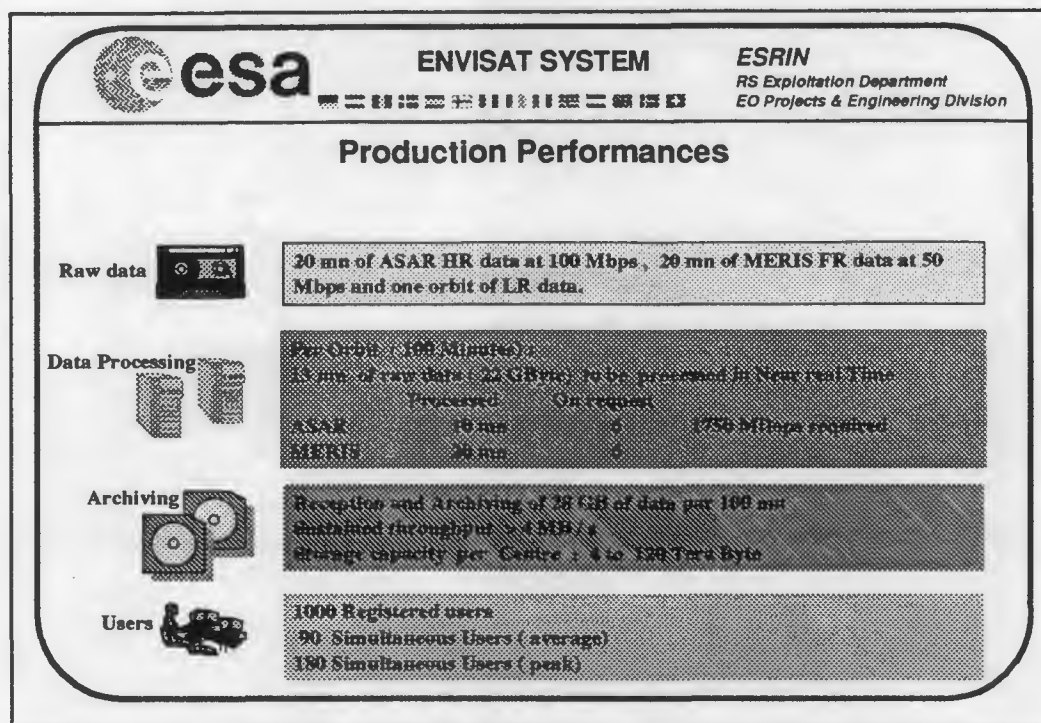
PRODUCT TREE STRUCTURE

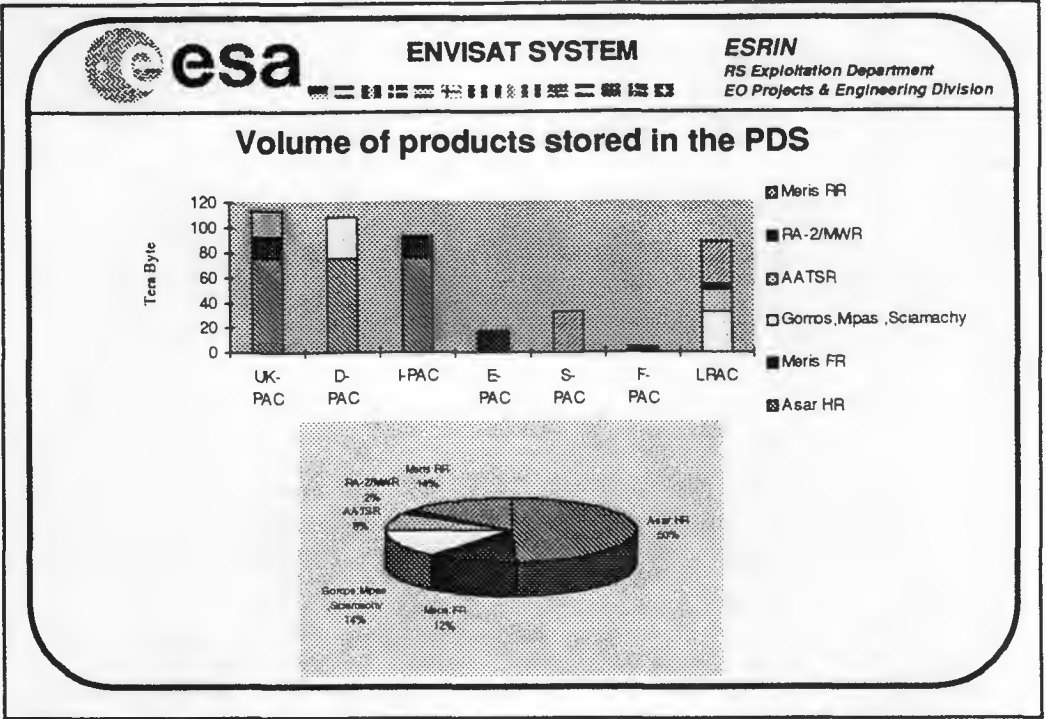


```

graph TD
    L0[Level 0 product] --> L1b[Level 1b product]
    L1b --> L2[Level 2 product]
    L1b --> B[Browse product]
        
```

Different generation mode	PDHS	LRAC	PAC
Systematic Near Real time (in 3 hours or 1 day)	X		
On request Near Real time (in 3 hours or 1 day)	X		
Systematic Off Line		X	X
On request Off Line	X		X







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GENERAL PRINCIPLES

- the product format is identical for all products
- the product headers are in an ASCII format
- a well defined structure :
KEYWORD and PARAMETERS
- a clear separation between auxiliary data and measurement data

AUXILIARY DATA STRUCTURE

Generic auxiliary data	Instrument specific auxiliary data
Orbit state vector	Instrument Configuration
Time conversion	Instrument parameters

GENERIC PRODUCT FORMAT

MAIN PRODUCT HEADER
SPECIFIC PRODUCT HEADER
AUXILIARY DATA SET
MEASUREMENT DATA SET



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Data Product Format

- ♦ 1 Product => 1 File
 - ♦ MPH Main Product Header
 - ♦ SPH Specific product header
- ♦ Data Sets:
 - ♦ SQADS Summary Quality Auxilliary Data Set
 - ♦ LADS Localisation Auxilliary Data Set
 - ♦ MDS Measurement Data Set(s) as many as necessary
 - ♦ ADS Auxilliary Data Set(s) as many as necessary
 - ♦ GADS Global auxilliary data Set(s), for auxilliary data not timely related to the MDS record time entries

All Data sets are filled with Data Set Records (DSR), each DSR starts with a time entry; the time entry permits correlation between all Data Sets at record level and permits subset extraction as defined hereafter. The GADS is an exception to this rule.



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Product Structure

Ascii Headers

MPH

SPH
DSDs including offsets, number and length of DS Records

DSD DSD DSD DSD ... DSD

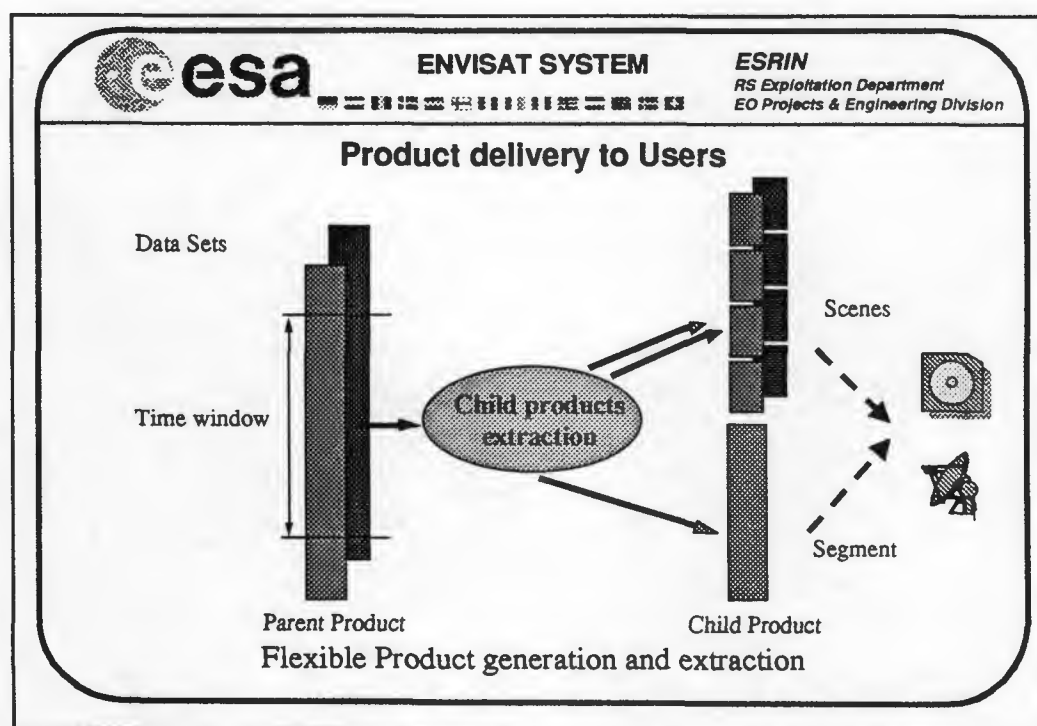
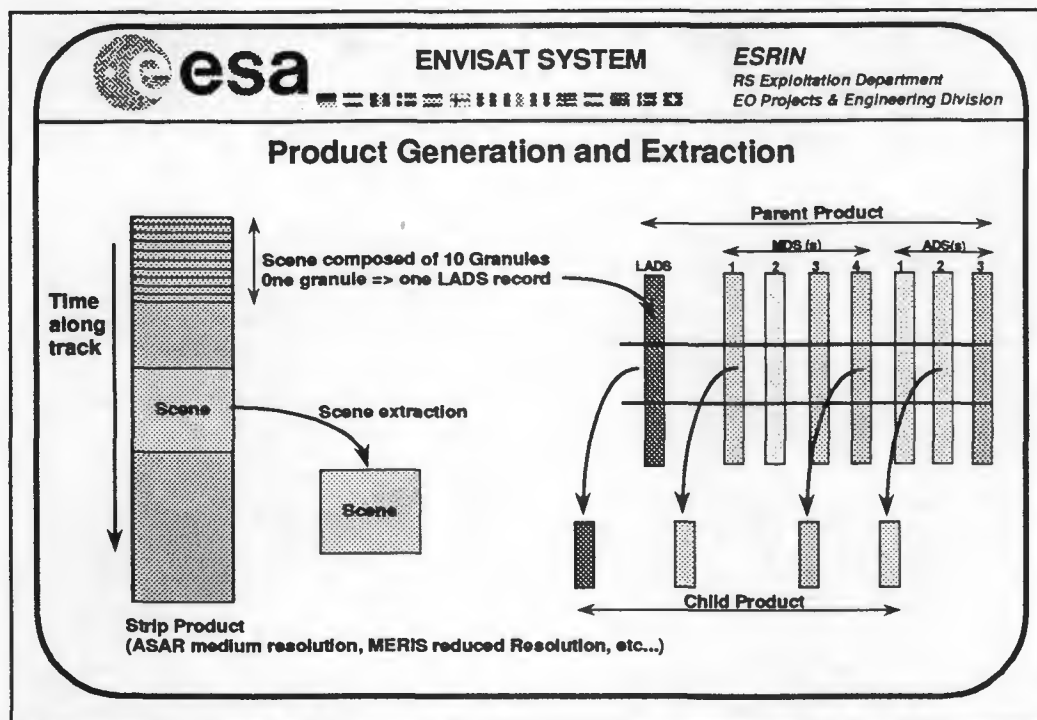
Binary Data Sets

GADS SQADS LADS ADS MDS

```

PRODUCT="ASA_APP_1PNPDK20001219..."
*****
TOT_SIZE=+0000000000267899212<bytes>
SPH_SIZE=+0000000099<bytes>
NUM_DSDES=+0000000017
DSD_SIZE=+0000000280<bytes>
NUM_DATA_SETS=+0000000011
*****
SPH_DESCRIPTOR="ASAR ALTERNING
POLARIZATION PRECISION IMAGE"
*****
DS_NAME="MDS_2ND_POLARIZATION"
DS_TYPE=M
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DS_SIZE=+0000000000133736000<bytes>
NUM_DSR=+0000000000
DSR_SIZE=+0000016717<bytes>

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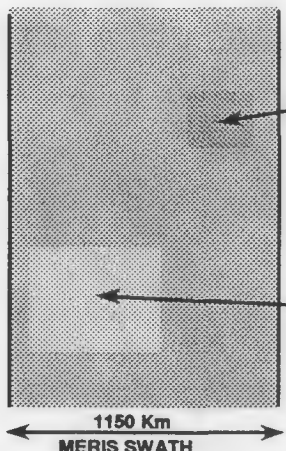




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Meris Full Resolution on Request Images



287 x 287 Km

575 x 575 Km

1150 Km
MERIS SWATH

Via the User Service facility, the users will be offered the capability to select the position of the requested image anywhere within the swath.

Orders will be accepted for both

- already acquired data
- or
- data to be acquired.

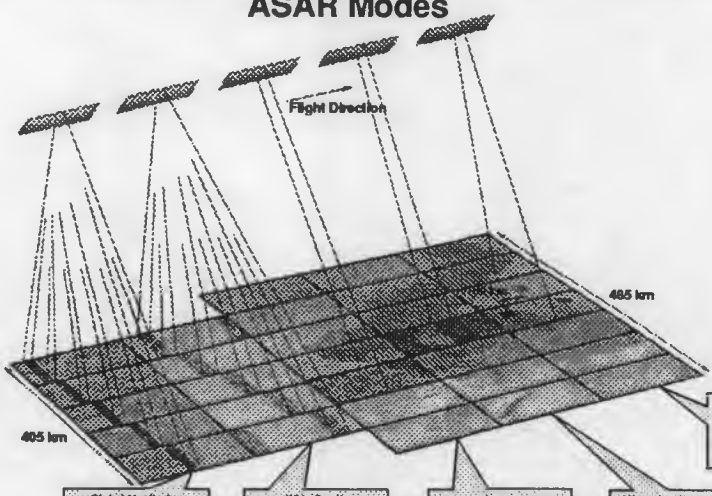
For data already acquired, the selection will be supported by the Browse Images displayed on the user screen. The user will then see the quality of the image before ordering (cloud cover, etc...).



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ASAR Modes



Global Monitoring
VV or HH
1000m resolution
405 km swath width

Wide Swath
VV or HH
150m resolution
485 km swath width

Image
VV or HH
30m resolution (PRG-CEC)
up to 10 km swath

Advanced Polarisation
VV/HH or VV/VH or HH/VV
30m resolution (PRG-CEC)
up to 10 km swath

Wave
VV or HH
4 km resolution (SLC)
6 x 8 km to 10 x 6 km
1/4 swath



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Stripline Products

- ♦ Stripline Products are generated along a complete segment or an orbit;
- ♦ Geometric and radiometric continuity are ensured along the complete segment or orbit;
- ♦ Scenes located anywhere within a stripline can be ordered, extracted and distributed via the PDS User Services.



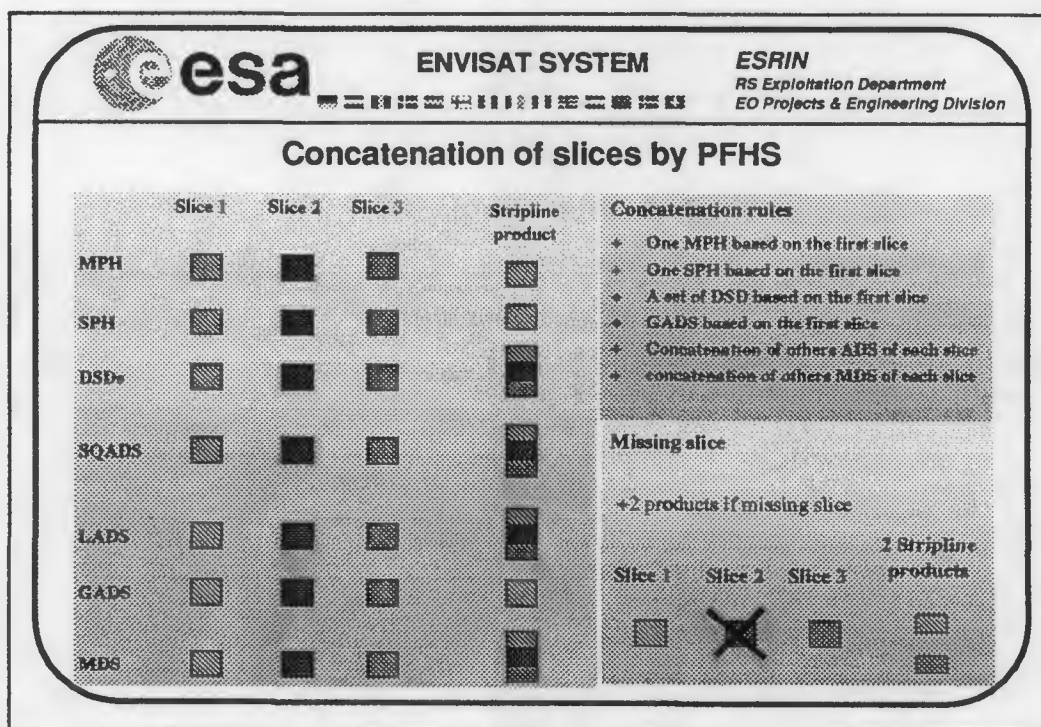
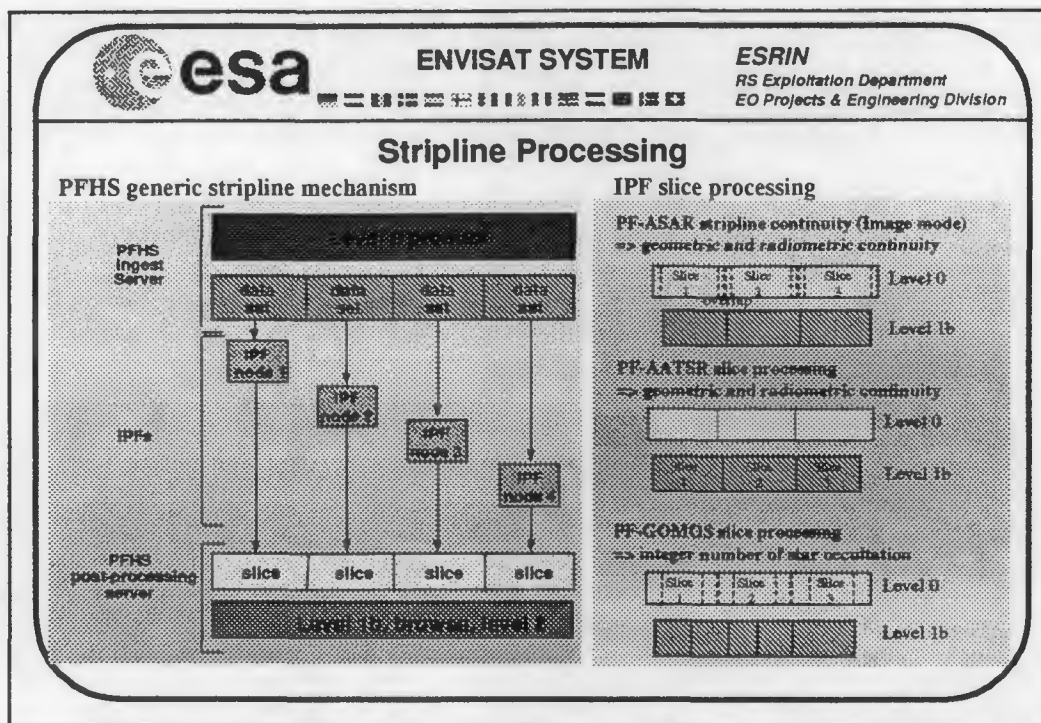
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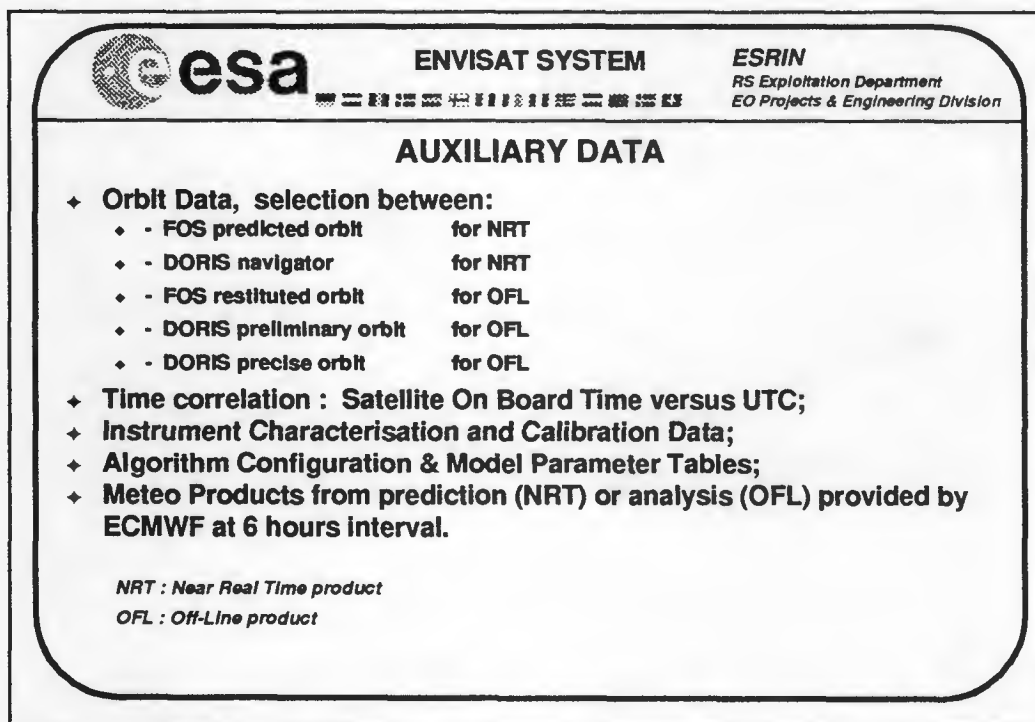
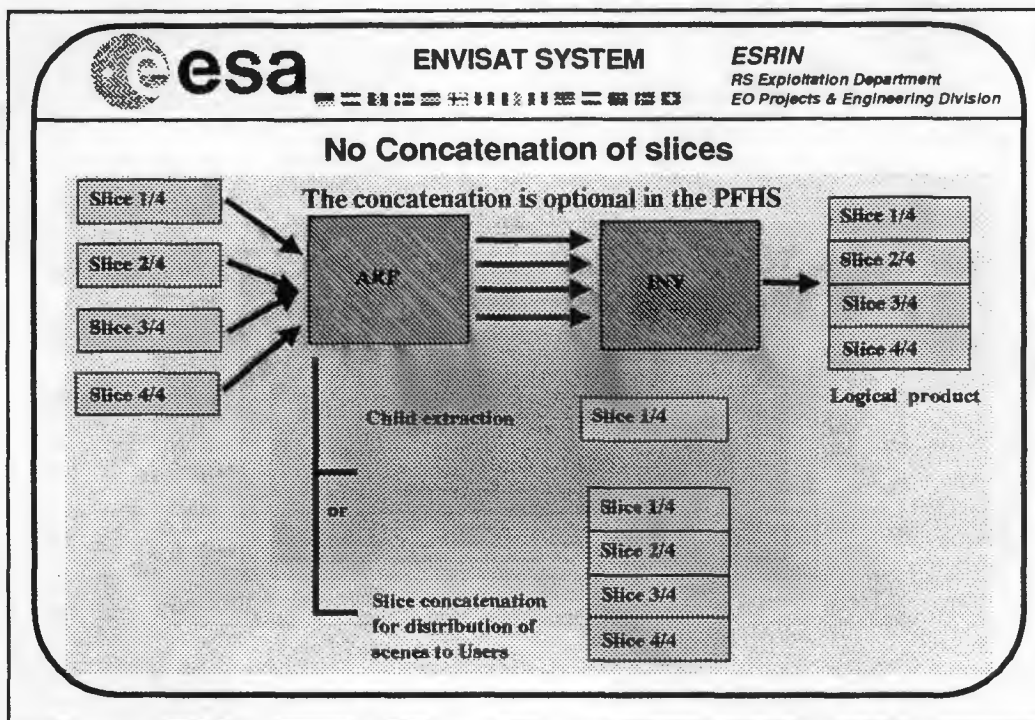
ESRIN

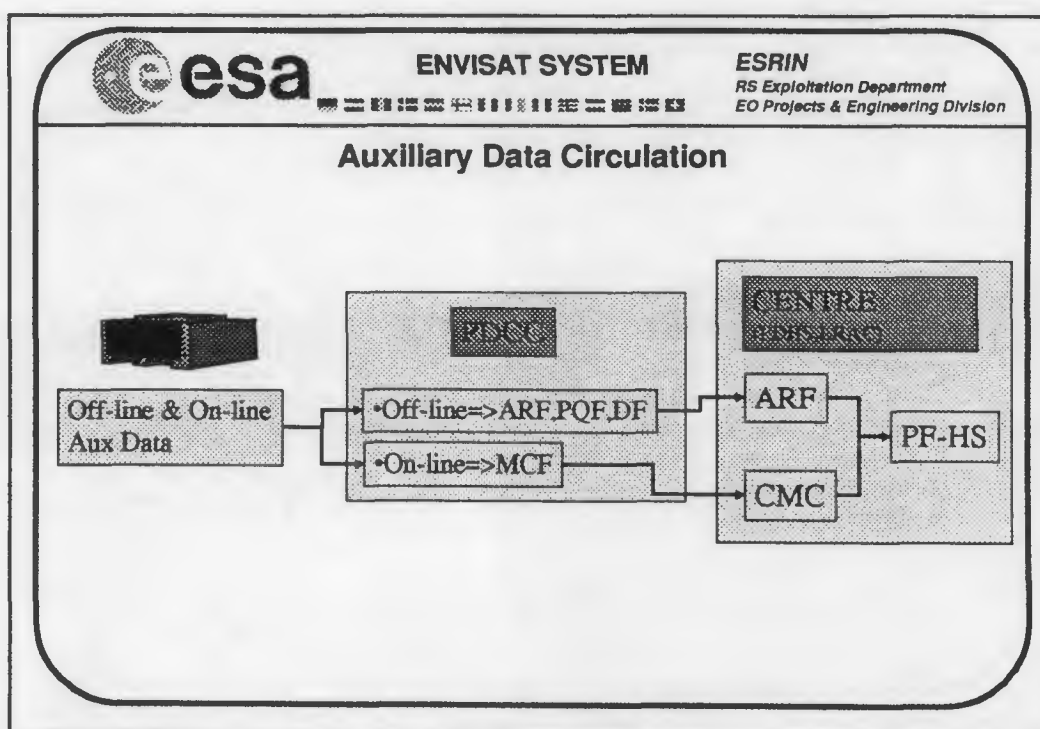
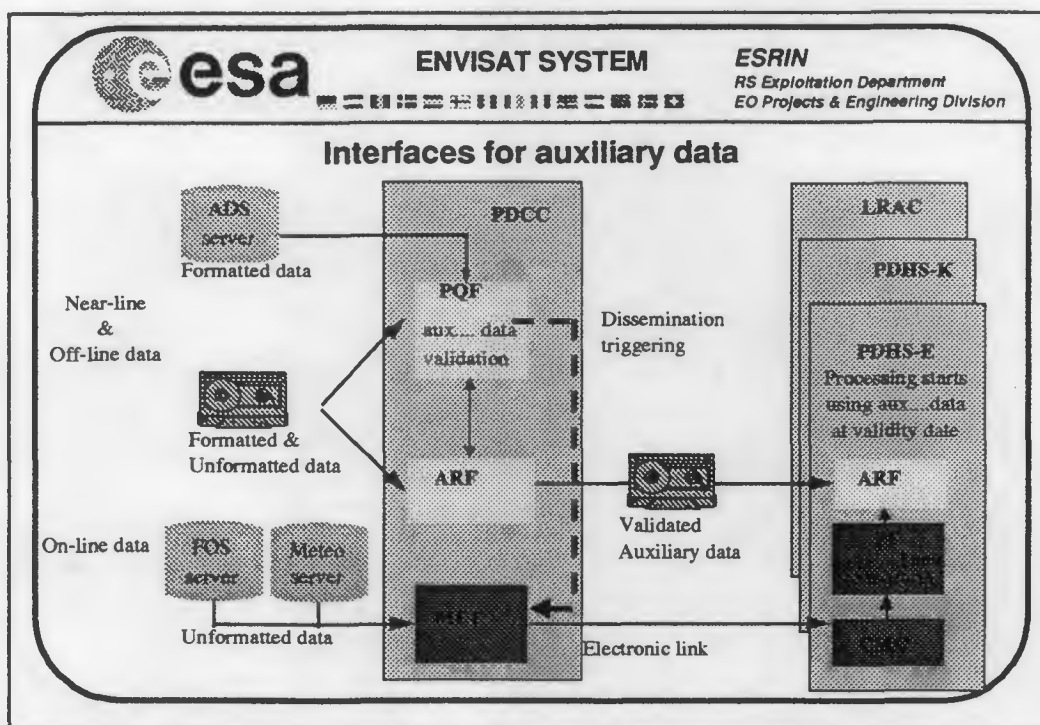
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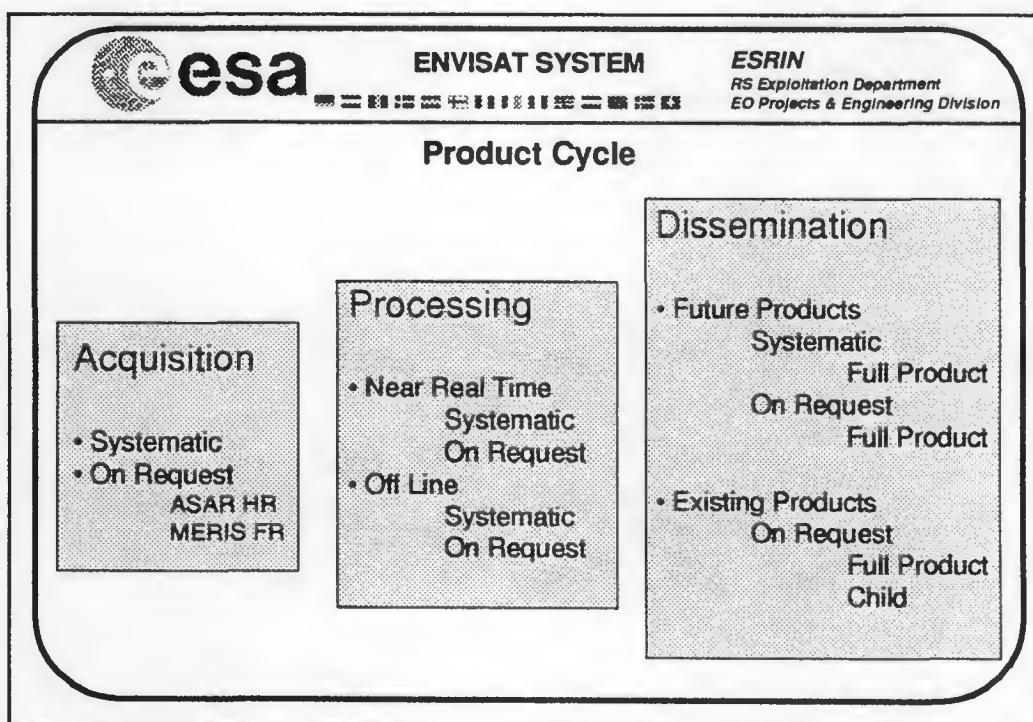
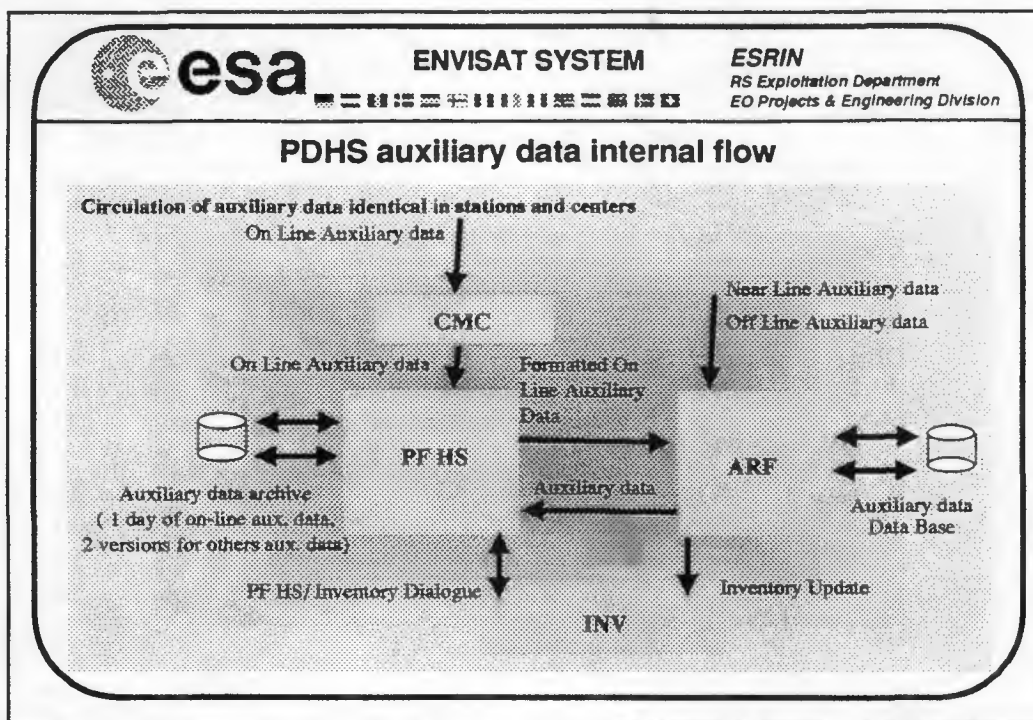
Child Product Concept

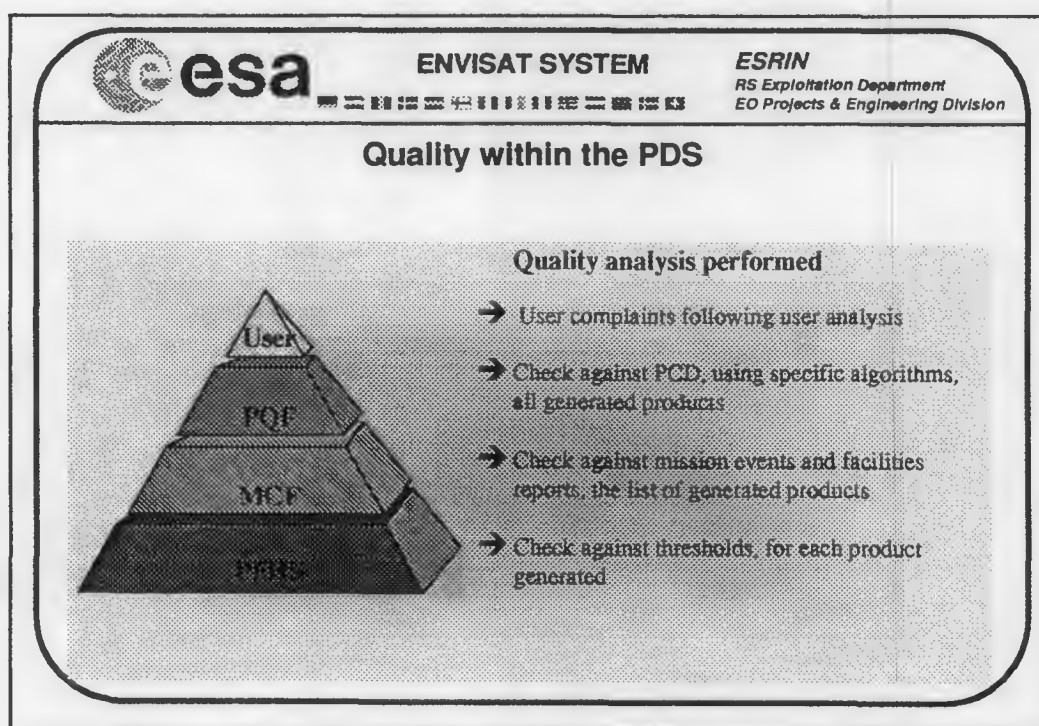
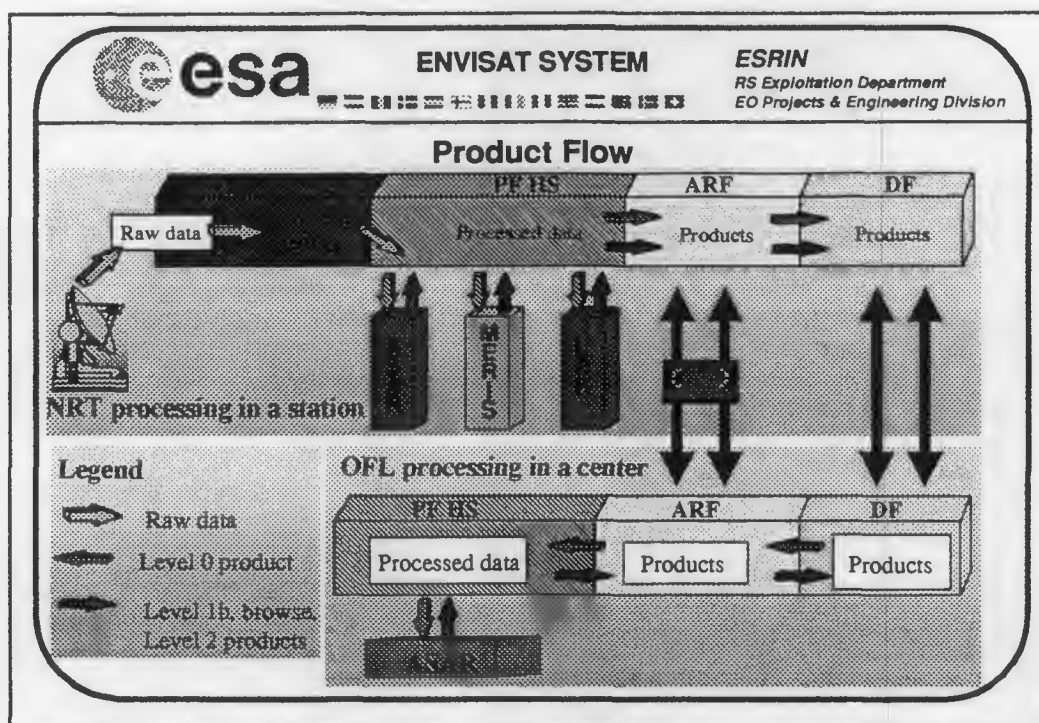
- ♦ The complete product is called Parent Product.
- ♦ A user can request a subset, "Child Product", to be extracted from the Parent Product.
- ♦ Extraction is possible by specifying:
 - ♦ Time window
 - ♦ Geographic zone (search using the LADS with the help of the PDS Inventory, including limb Instruments, which are geolocated using the observation tangent point)
 - ♦ data subset:
 - ★ Bands (for MERIS and AATSR)
 - ★ Species (atmospheric instruments)
 - ★ Star names (GOMOS)

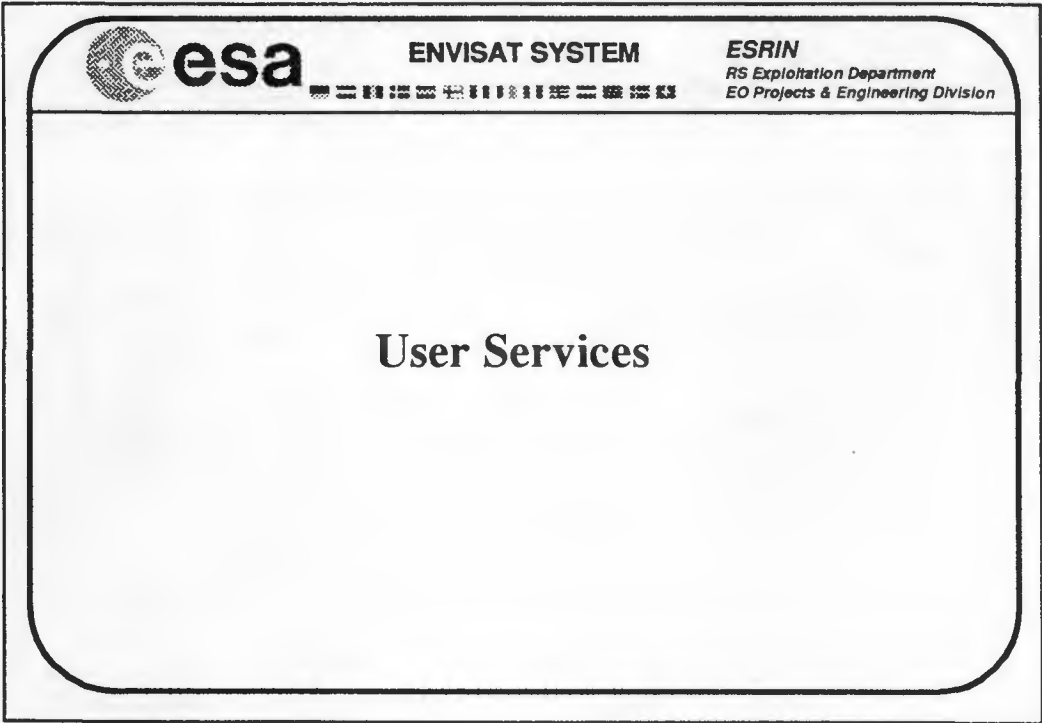
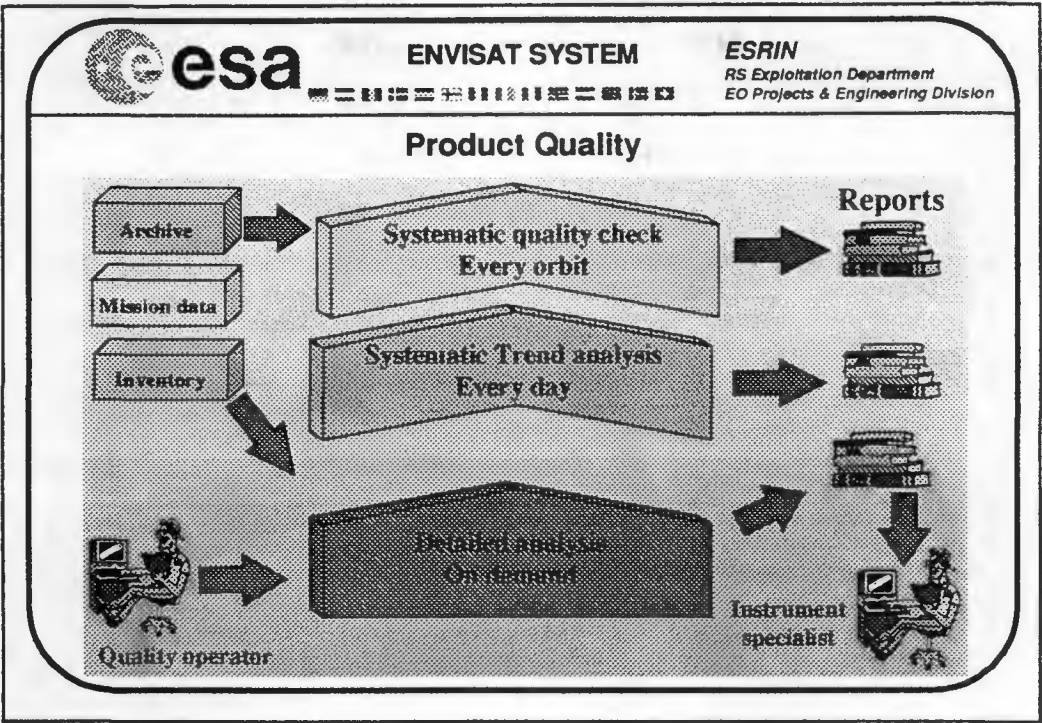














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User Services (1)

- ♦ The User Services will be accessible via INTERNET.
- ♦ Wherever the user enters the PDS, any station or centre offering ESA services, he will have access to:
 - a unified user interface (all stations and centres will be equipped with a standard User Service Facility);
 - a unified search mechanism to find all available products and to order them, without the need to know where the data are physically stored, all stations and centres being linked by a PDS Internal network,
 - on-line browse, for all Imaging Instruments, and possibility to obtain direct on-line delivery of small products.
 - a unified ordering interface, the order being processed automatically by the appropriate centre or station (ordering of products requiring specific data acquisition will be routed automatically to the PDCC).
 - Help Desk and Order Desk at the PDCC.



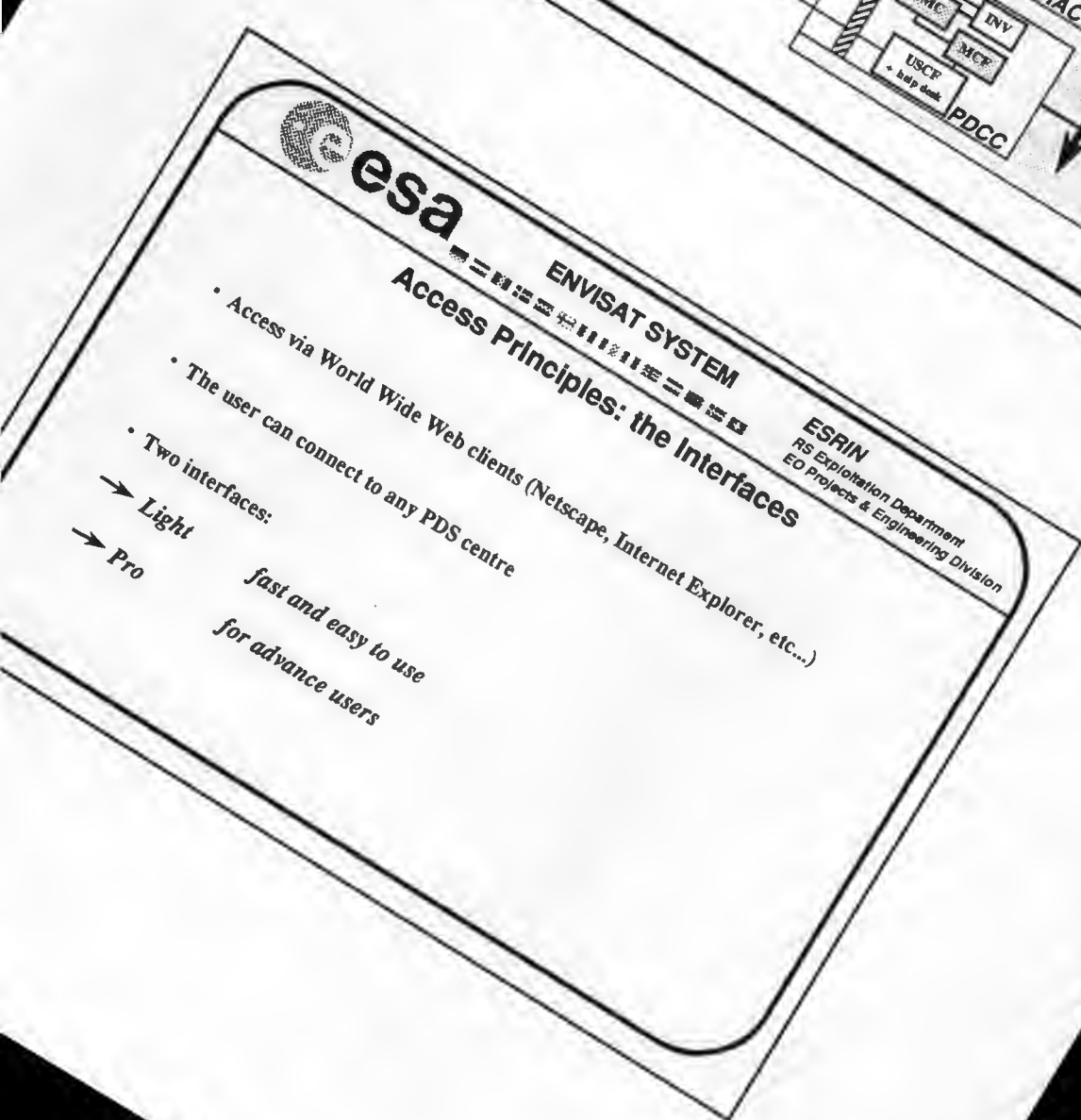
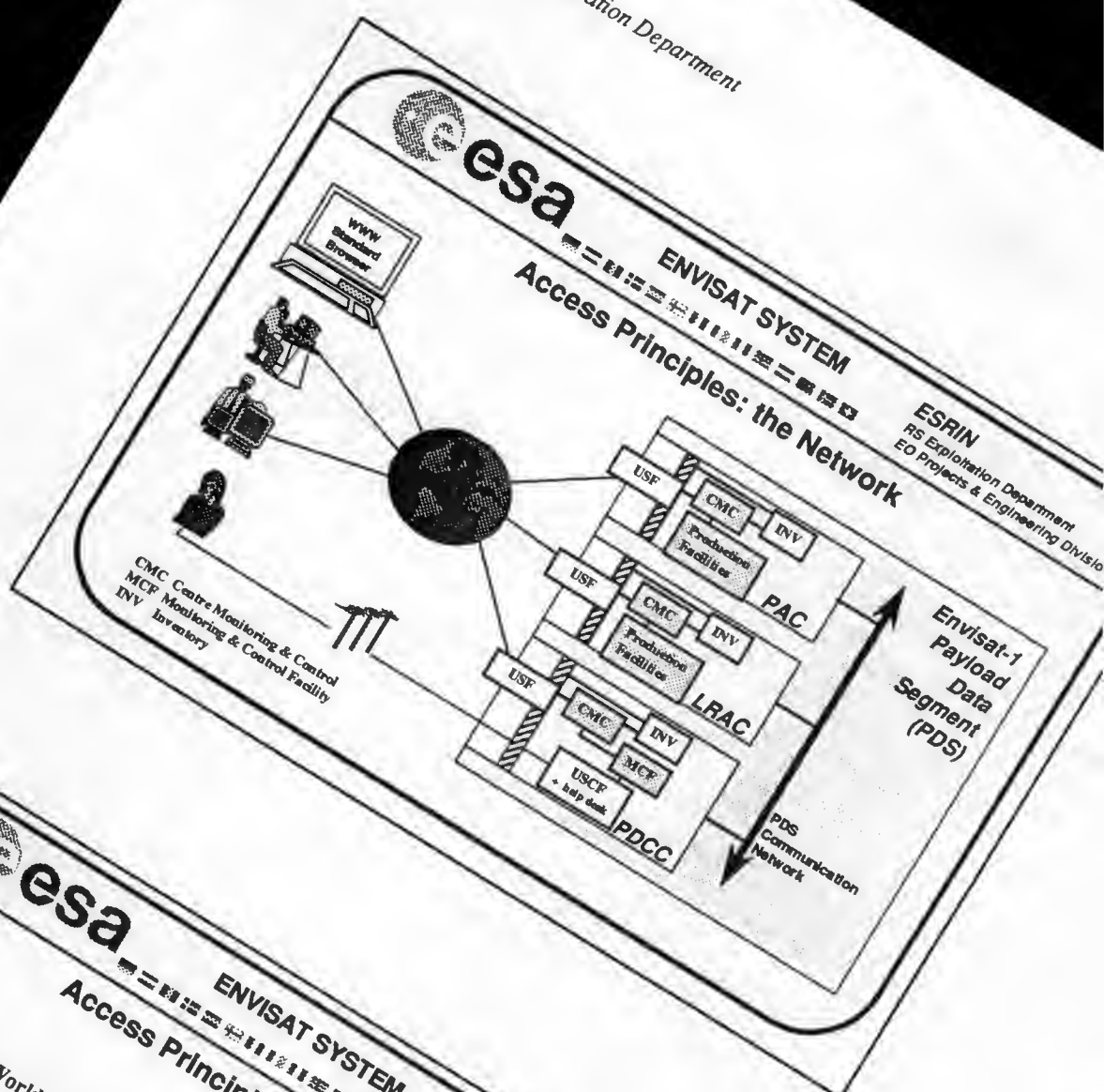
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User Services (2)

- ♦ All PDS products will strictly adhere to ENVISAT-1 PDS Standard formats (identical product formats for Near real time or Offline) and standard quality by use of the PDS Generic Processors.
- ♦ Software tools will be made available for opening the products.
- ♦ Product delivery will be made via satellite links (mainly NRT service), ground network when throughput is compatible with product size and Offline product delivery on standard physical media.





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Access Principles: User Registration

- ✦ The Envisat-1 User Services are grouped in two categories:
 - ♦ available to unregistered (anonymous) users
 - ♦ available upon registration
- ✦ Any user can in principle 'register' to any USF upon authorisation of the Envisat Mission Manager. No fee is required at registration.
- ✦ At registration the user is assigned to a user-class by allocation of a user-id.
- ✦ The user-class defines the domain of orders for future products
 - ♦ there will be several user classes within Category 1 use
 - ♦ the need for several user classes within Category 2 use is TBC
- ✦ A user can have several user-id, therefore can belong to several user-classes.



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The Services

Service Category	Service	Access
Consultation	Directory & Guide	Free
	Bulletin Board	Free
On-line retrieval	Browse products	Registered
	Inventory data	Free
Inventory search	Software tools	Free
	Inventory	Free
Order	Statistical Tools	Free
	Software tools	Registered
	Auxiliary data	Registered
	Archived products	Registered
	On demand products	Registered
	Future products	Registered
	Subscription to global products	Registered
	Special acquisition	Registered
Administration	Special dissemination	Registered
	User registration	Free
	User account management	Registered
	Issue complaints	Free
Local Tools	Unpack delivered products	Registered
	Visualise products	Registered
	Access local inventory	Registered



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Service Features

- ♦ **Inventory Search**
 - ♦ subscription
 - ♦ zone mapping
 - ♦ interferometry
 - ♦ conjunction (ASAR WS & MERIS FR)
- ♦ **On-line Browse**
 - ♦ all Imaging Instruments
- ♦ **Product Order**
 - ♦ on-line delivery of small products via ftp server
 - ♦ user orders monitoring via follow-ups generated at each step of the production
 - ♦ user order management: verify/modify/cancel
- ♦ **Application-to-application access**
 - ♦ use WWW scripts



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The products

INSTRUMENTS	MISSION	PLANNED BY	ORDER FOR ARCHIVED PRODUCTS	ORDER FOR FUTURE PRODUCTS
DORIS	GM Global Mission	FOS	Archived product, auxiliary data or Child or Scene	Order for systematically generated products or for scenes
RA-2, MWR				
AATSR				
SCHIAMACHY				
GOMOS				
MIPAS	BRM Background Regional Mission	RM Regional Mission		Order inducing specific acquisitions
MERIS RR				
ASAR LR				
ASAR HR				
MERIS FR				

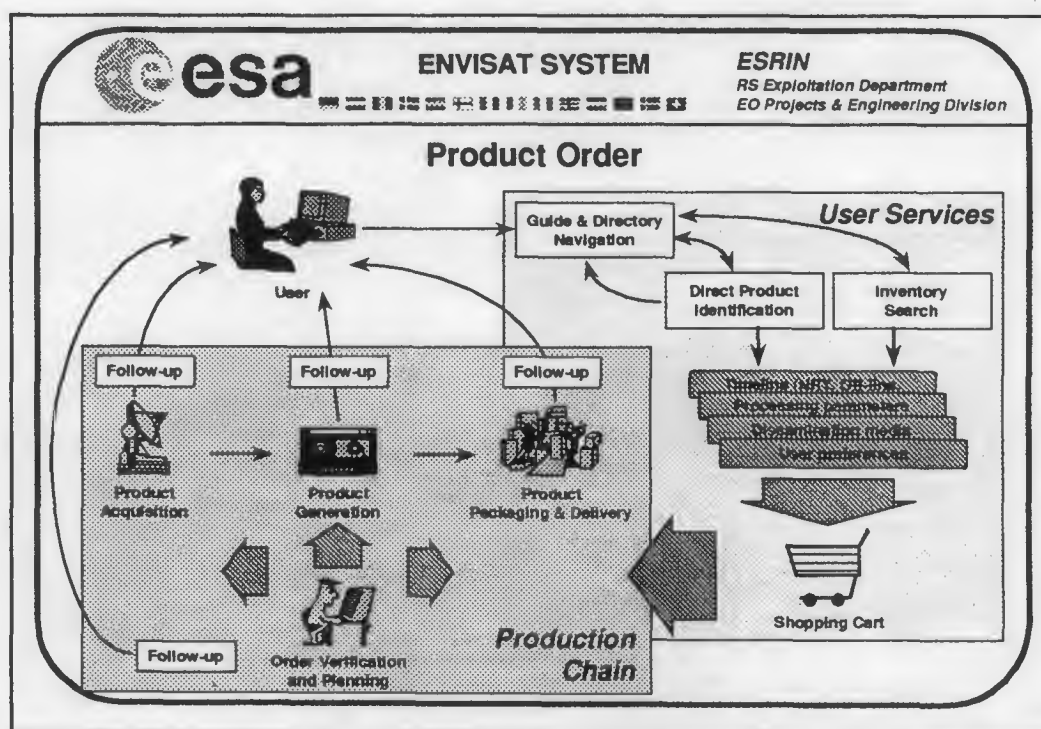
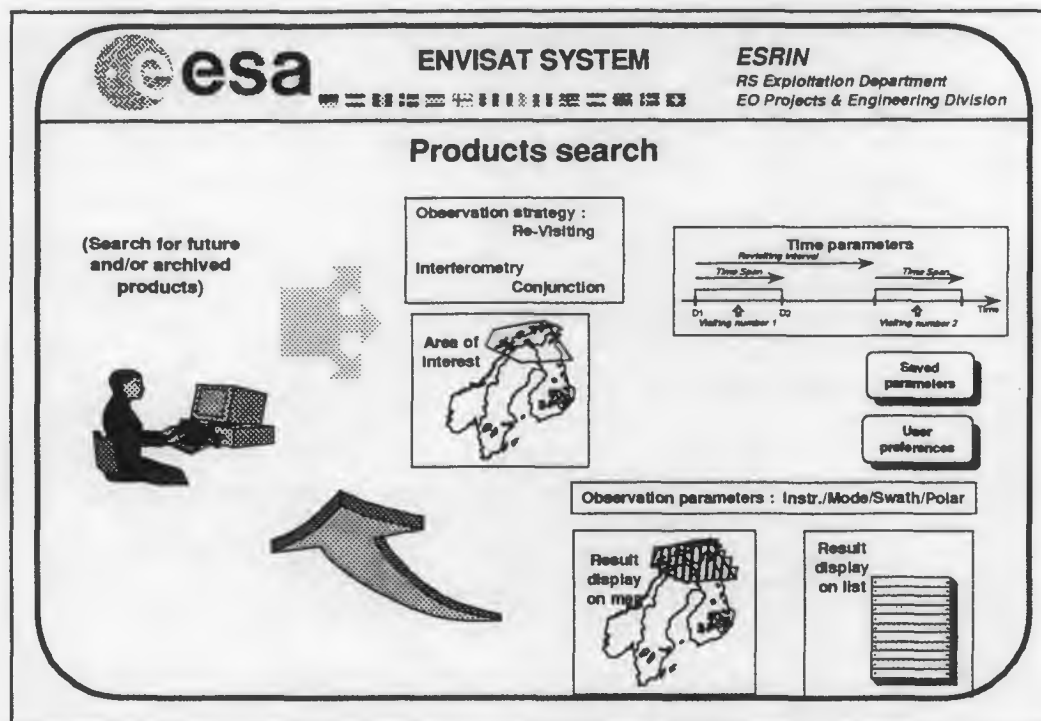
BRM = Background Regional Mission RM = Regional Mission

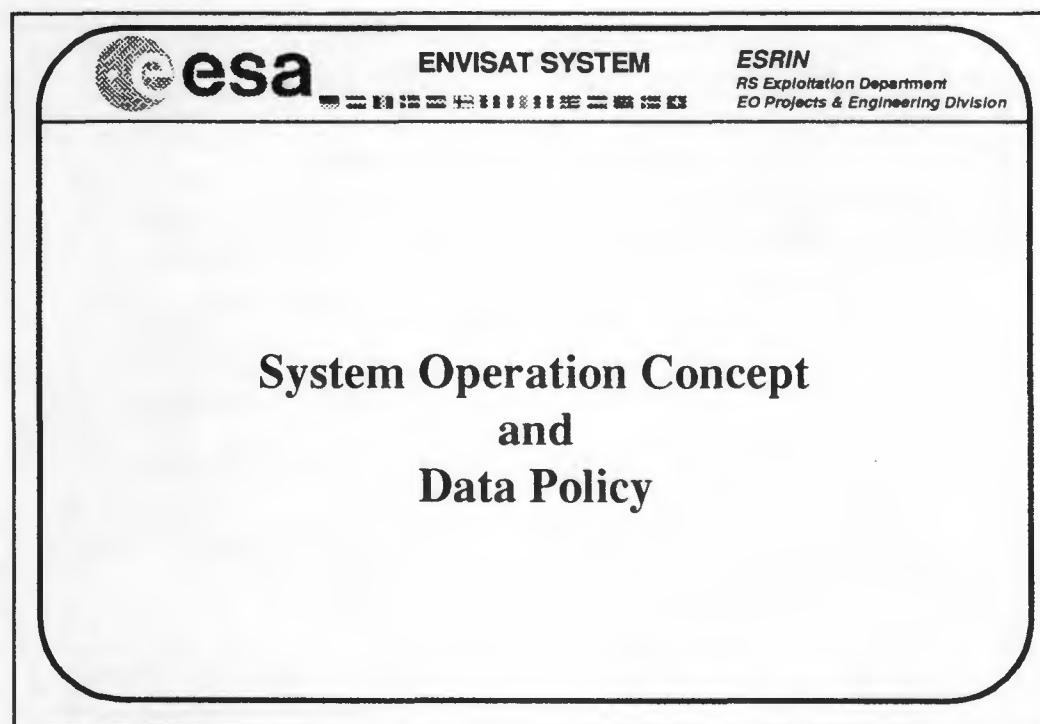
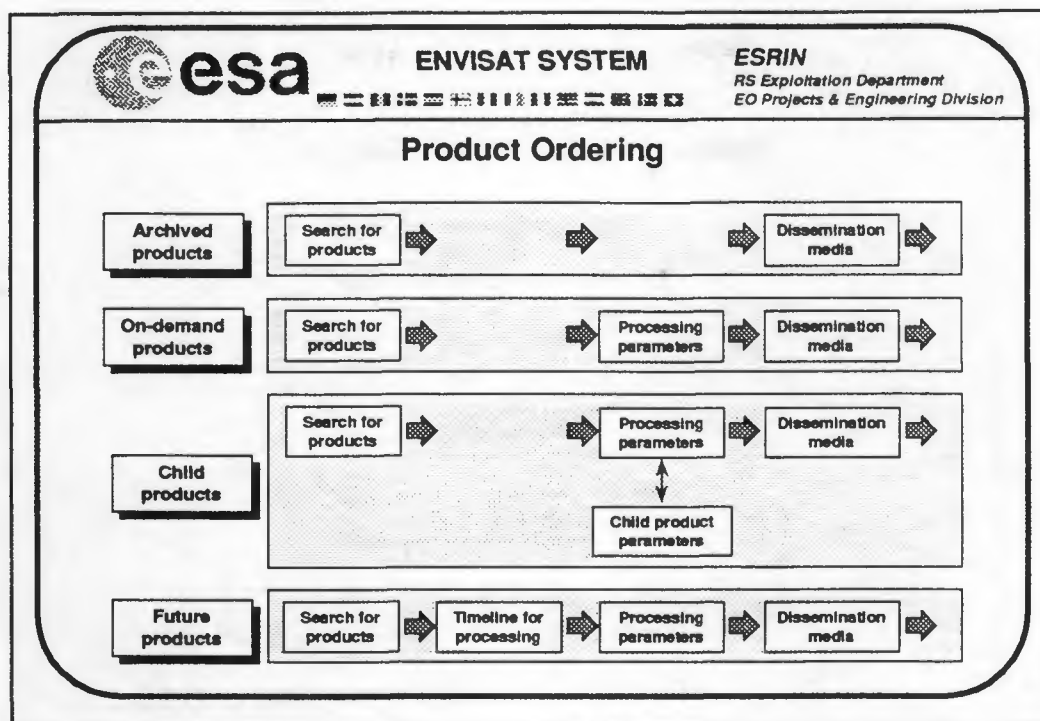
The user can:

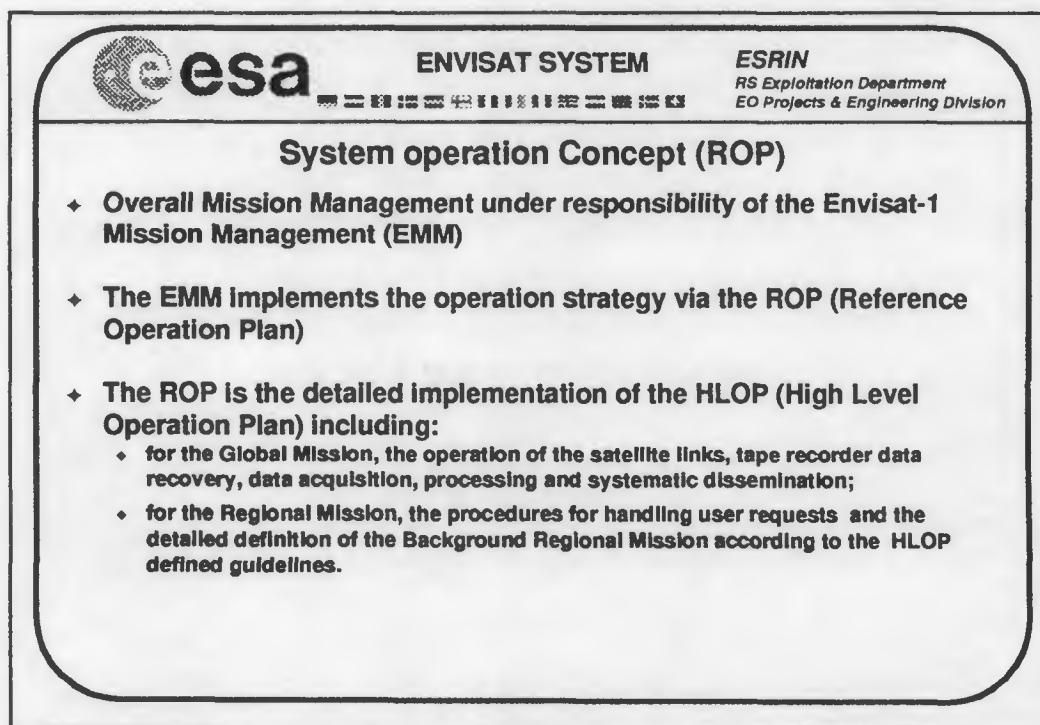
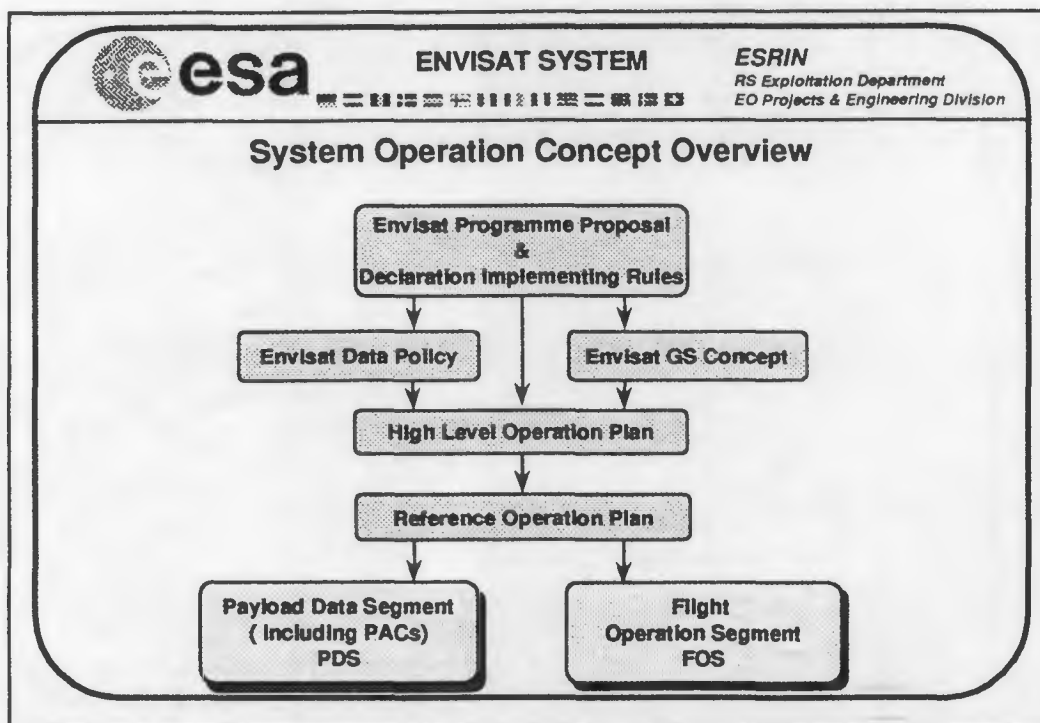
- order full product or a part of a product of interest.
- request repetitive (outstanding) order.
- request over past and future.

Any USF:

- can query any INV.
- has access to the planned instrument activities : POP.
- warns the user in case of conflict (RM orders)
- proposes alternatives to the user (RM orders).
- checks the order before sending it to the planning entity.







**esa**

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System operation Concept (Regional Mission)

- ♦ The Regional Mission is planned by the PDCC, registering and handling the user requests, merging them with the Background Regional Mission according to ROP procedures, building up the Preferred Exploitation Plan (PEP).
- ♦ The PEP is submitted to the FOCC which answers with the Detailed Mission Operation Plan (DMOP), including the Global and Regional Mission, describing the detailed satellite operation sequence.
- ♦ The PDCC plans the acquisition and NRT processing accordingly.

**esa**

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Categories of Use

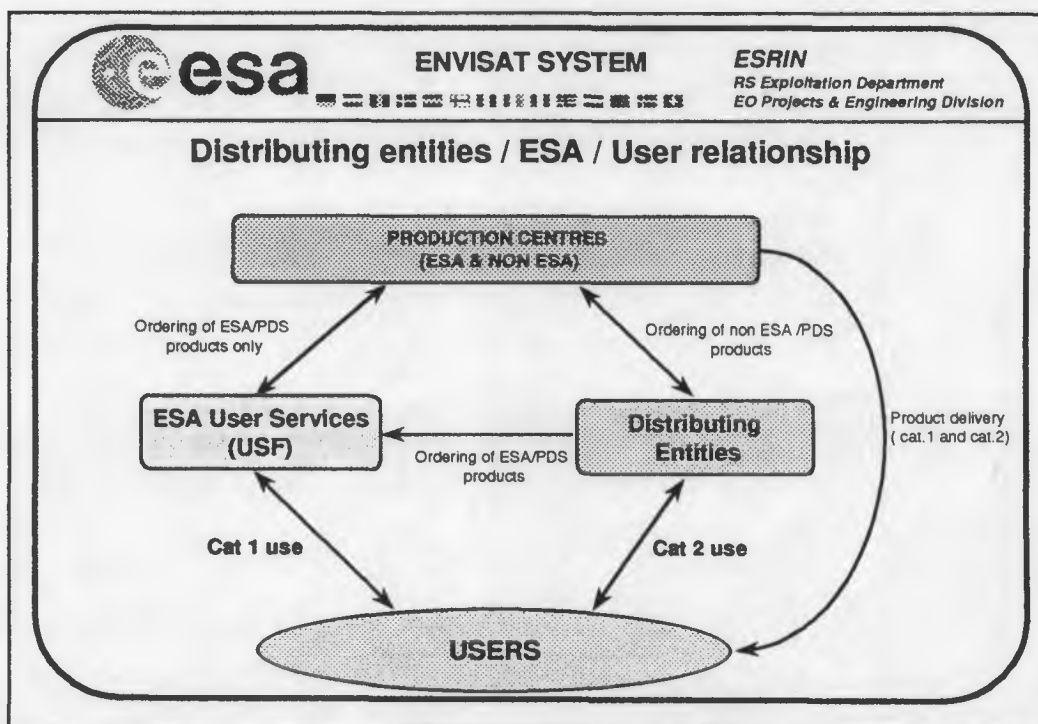
- ♦ **Category 1**
 - ♦ - Research and applications development supporting the mission objectives.This includes in particular:
 - ★ - ESA internal use for calibration , validation and Quality assurance
 - ★ - Research on long term issues of Earth System Sciences
 - ★ - Research in preparation for future operational use
- ♦ **Category 2**
 - ♦ - All other users not falling into category 1 , including operational and commercial use.

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Distribution

- ✦ **ESA retains overall policy and programmatic responsibility for distribution of data for category 1 use and will be the direct provider of the associated services from its own facilities.**
- ✦ **ESA will delegate to distributing entities the responsibility for the marketing and distribution of Envisat products and associated services for Category 2 use.**
- ✦ **Distributing entities will have access to the ESA Envisat facilities to serve user requests.**
- ✦ **Distributing entities may establish agreements with non ESA facilities to provide Envisat data in response to user requests**



7-th ESOWG, 28-29 May 1998

M.Meshkov (OKB MEI, RUSSIA)

Reports

Introduction

The area of water of the Arctic Ocean along the coast of Russia is accessible for all-the-year-round of navigation. However, the successful ecological and economic activity, including sea transportation, is possible only at regular observation of the state of the environment of this region. Thus the information about the basic navigating parameters of an ice cover, determining the possibility, safety and efficiency of polar navigation is the most important.

The effective ice-information provision can be achieved by use of space systems of radar tracking and, particularly, synthetic aperture radar (SAR). The space filming of ice conditions of the basin of the Arctic Ocean has direct application for provision of safe navigation on the course of the North Sea way, fishing trade and safety of other kinds of activity.

In conditions of a long polar night and powerful cloudy cover in Polar Regions the basic means of tracking from space is SAR. The radar-tracking means provide the tracking at all kinds of weather and independence of illumination, that especially is important for work of operative system of monitoring of ices.

At the moment the European space vehicles ERS-1, 2, completely equipped by radar SAR, function on sun-synchronous orbits. The existing reception stations of data from ERS have zones of radio visibility, not covering a large part of the Arctic North Sea way. According to the decision of RSA-ESA (Paris, on March 24-25, 1997) within the limits of the project "Icewatch" the decision on accommodation in Russia of reception stations of the data of SAR ERS is accepted. Accommodation of such a station in North-east Siberia allows to block by a zone of radio visibility the Arctic north sea way from the Novaya Zemlya up to Chukotka.

1. Assignment of data reception station and its tasks.

According to the protocol of negotiations RSA-ESA (Paris, on March 24-25 this year) within the limits of the project "Icewatch" in the east-Siberian part of Russia is planned to built the reception station of the data from SV ERS-1, 2.

SV ERS-1, 2 are equipped by a complete set of the equipment of remote sensing and, particularly, by radar with synthetic aperture (SAR) of high resolution. The received data is planned to use for observation over sea ice conditions along the North Sea way.

The problems, solvable by station during its operation, will be specified in accordance with development of commercial activity along the North Sea way.

At the first stage of operating system development the radar SAR ERS-2 and non-coherent side-looking radar (SLR) "Ocean-0" will be used as a information sources. That radars complement each other successfully relating to resolution and search (scan) band. SLR data will be used for large-scale scanning over a wide band and SAR data - for detail analysis of ice condition (small-scale scanning) over more narrow band at the key points of North Sea way with the most critical conditions for navigation. Complex use of that radar images considerably increases the informativity (data output) during the process of recognition of ice age, channels and spreading. A weekly scanning by means of SLR "Ocean-2" is supposed over the whole route of North Sea way and reception of 6 - 10 frame blocks (from 2 to 5 SAR ESA-2 shots) of priority images (the most important) of North Sea routes.

Note: see Technical Notes on ICEWATCH project (Russian Party)

"Information systems developed for dangerous events monitoring by use of satellite data (ice condition and floods mapping at Pole regions)",

Science-Industry Joint "Planeta", OKB MEI, 1997.

Putting into operation that system is supposed in 2000 (the 2-nd stage) when Russian artificial Earth satellites "Resourse/Arctics" and European ENVISAT will be launched to the orbit. SARs of that satellites will provide radar images reception over a wide view band 450 km with the resolution of 200-300 m. The operating system of 2-nd stage will provide the daily reception of North Sea way space frames. That radar images will be transmitted for some users in quasi-real time: to ice-breakers, Navi-mission Staffs, Steam - navigation offices, Ice Center at Dikson and Arctic and Ant-arctic Scientific Research Institute.

2. Foundation and selection of station location on Russia territory

2.1. As probable locations of data reception station on territory of East Siberia it is possible to examine towns Tixi and Yakutsk because of their location in relation to the course of the North Sea way. However the location of the station in Tixi is more preferable, than in Yakutsk, proceeding from the zone of radio visibility SV ERS (fig. 1.). The zone of radio visibility from Yakutsk does not cover the region of Chukotka on East, though is crossed the zone of visibility from the locality Tramsyo on West.

Zones of radio visibility SV ERS under the elevation angle 5 from localities of a possible location of the station in Tixi, Yakutsk and on Dikson are shown on fig.1. Zones of radio visibility of data of reception stations, located in Tramsyo (Norway) and Fairbanks (ALASKA, USA) are also shown.

From fig. 1 it is follows, that, by locating data reception station in Tixi, we can receive the most optimum variant of observation of the course of the Northern Sea way along the whole territory of Russia taking into account the possibility of reception of the data from station, located in Norway.

A zone of visibility from the station ' Bears lakes ' situated near Moscow, where it is supposed to carry out the tests of an experimental sample of data reception station is shown on fig. 1.

3. Geographical place and administrative submission of the city.

Tixi is a town in Republic Saha (Yakutya), with number of the inhabitants about 10 thousand people. It was based in 1932 as trans-shipment seaport in a gulf of the sea Laptev, near to the mouth of the river Lena in connection with development of Northern Sea way.

The urban administration is subordinated directly to Government of Republic Saha.

In 4 kilometers from Tixi there is an airport, capable to receive all types of planes, including large transport. Passenger flights connect Tixi to Moscow and Yakutsk.

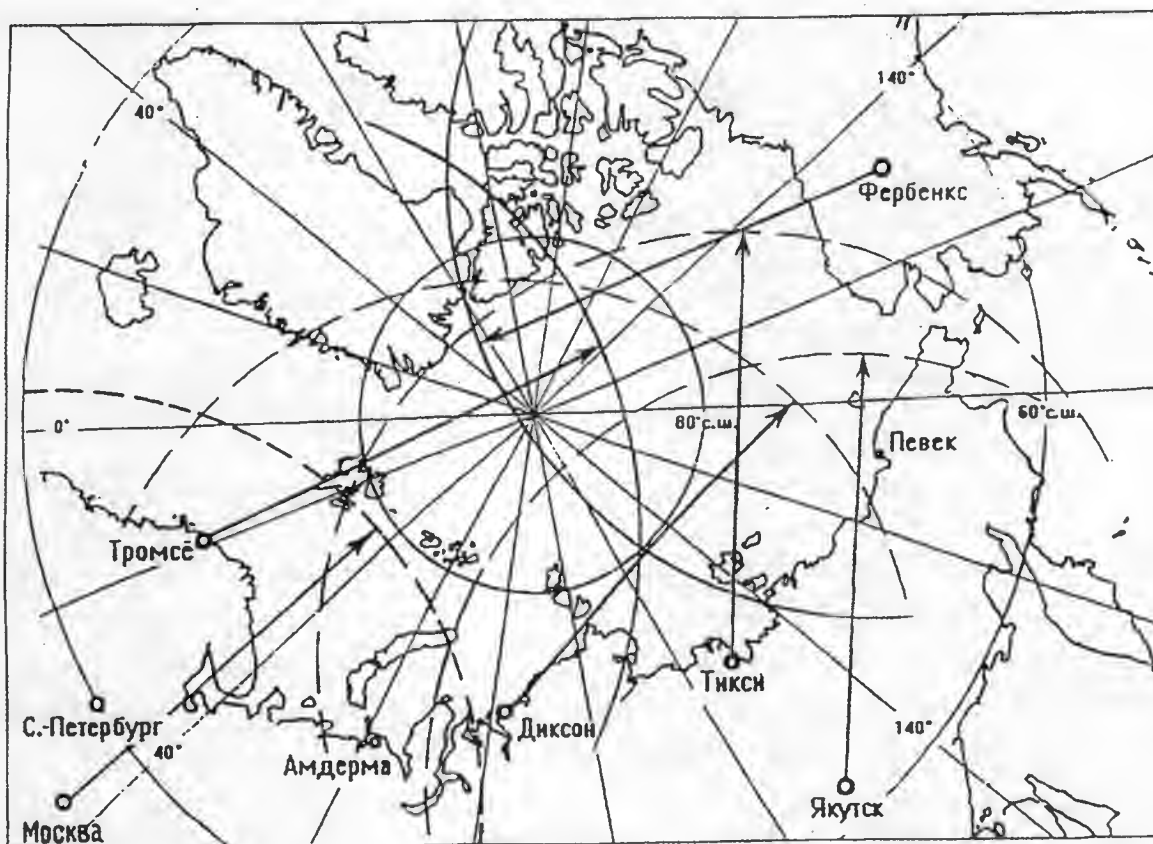


Рис. 1.

The climatic conditions can be characterised by following average data:

- warmest month July / August
- the maximum temperature in August 7,5 C;
- the highest registered temperature 34 C;
- the lowest registered temperature in August -4 C
- the most cold month January
- the minimum temperature in January -33.3C;
- the highest registered temperature in January -4 C;
- the lowest registered temperature in January -52C;
- the average annual level of precipitation 375 mm;
- - the maximum average speed of a wind 36 m/s;

In the town there is a personnel highly skilled in the field of radio engineering and electronics.

The electric supply of the town is performed from diesel station with general power up to 10 MW.

In the town there is a station of space communication Orbit-2.

4. Analysis of data reception station specifications.

4.1. Under the proposal of the RSA the OKB MEI have begin designing and creation of a sample of reception station of radar-tracking survey SV ERS-1, 2.

The design works should satisfy to a number of conditions and to pass a few stages, major of which are:

- Minimization of cost of the equipment and putting into operation of the sample of station;
- High degree of automatization of the control of basic systems and devices of station to reduce the charges on its operation;
- Increased reliability of the work of station in conditions of the North and remoteness from the enterprises, capable to carry out difficult repair jobs;
- Necessity of step adjustment of debugging and all-round infield tests of the sample of station on the branch of OKB MEI "Bears lakes" near Moscow before sending on the place of installation and putting into operation;
- Attachment with the unique hardware-software terminal equipment, delivered by ESA, and its competent operation.

The work at small elevation angles, connected with the maximum extent of the channel board - Earth, deterioration of the noise characteristics of ground station, imposes the rigid requirements to parameters by the antenna system and to the noise characteristics of receipt-conversion route of reception station. Hence, Q (G/T), i.e. ration of factor of amplification of the antenna to noise temperature, brought to the input of system, should be maximum.

Also it is necessary to minimize errors of pointing of the antenna on SV, connected with the programm control and the influence of disturbing factors of weather character. In this connection it is necessary to consider variants of creation of reception station with antennas with diameter $d_1 = 4,68$ m and $d_2 = 7$ m and final decision about using of this or that antenna must be accepted in view of all factors important for work.

We shall carry out the calculation of the energy ratio, using the ratio of powers.

Taking into account a quality of noise band of a reception path value $F_{III} = F_{cycle}$, it is possible to replace E/N_0 by the ratio of powers of a signal (P_c) and noise (P_{III}), taken in specified noise band: $E/N_0 = P_c/P_{III}$

When calculations are carried out the data of ERS on board equipment, distributed by ESA as official "Programs ERS-2" are used.

The calculation is carried out for two variants of the antenna system with diameter of a reflector $d_1=4,68$ m and $d_2=7,0$ m..

Results of the calculation and the initial data, on the basis of which calculations are carried out, are shown in tab. 1. Besides the ratio of powers of signal and noise also data of the energy stock above the minimum level, equal to 12 dB, depending on the elevation angle are given for two variants of the antenna system. The minimum level of signal / noise ratio is defined by the threshold ratio on the input of the demodulator, equal to 6 dB, and by the theoretical stock, equal to 6 dB on losses in the atmosphere with intensive rainfalls.

Presence of the specified energy stock allows to use reception station ERS practically on the whole path of North sea way from the Barents sea up to Alaska, including the Bering on Straits fig. 1. The antenna system of the station of reception of the information of ERS can use a reflector with diameter 4,68 m or 7 m.

Table 1.

Elevation angle, degrees	5	10	20	30	41	69,6	90
Slant range, km	2840,7	2419,4	1812,1	1434,7	1175,0	872,9	824,5
The effective area of Antenna ($d_1=4,68\text{m}$), m^2	8,6	8,6	8,6	8,6	8,6	8,6	8,6
The effective area of Antenna ($d_2=7\text{m}$), m^2	19,25	19,25	19,25	19,25	19,25	19,25	19,25
Polarization losses, dB	0,4	0,4	0,4	0,4	0,4	0,4	0,4
Antenna losses, dB	0,5	0,5	0,5	0,5	0,5	0,5	0,5
Atmosphere losses, dB	0,8	0,8	0,8	0,8	0,8	0,8	0,8
Noise temperature of the station ($d_1=4,68\text{m}$), K	170	150	140	132	132	132	132
Noise temperature of the station ($d_2=7\text{m}$), K	153	143	135	132	132	132	132
KHД of the onboard antenna	4,786	4,467	3,334	1,698	0,758	0,331	2,63
Power of the onboard transmitter, W	12,5	12,5	12,5	12,5	12,5	12,5	12,5
Losses in cables, dB	0,1	0,1	0,1	0,1	0,1	0,1	0,1
Indefiniteness of measurements, dB	0,36	0,36	0,36	0,36	0,36	0,36	0,36
Power of own noise of the station ($d_1=4,68\text{m}$), dB	$2,6 \cdot 10^{-13}$	$2,28 \cdot 10^{-13}$	$2,12 \cdot 10^{-13}$	$2,0 \cdot 10^{-13}$	$2,0 \cdot 10^{-13}$	$2,0 \cdot 10^{-13}$	$2,0 \cdot 10^{-13}$
Power of own noise of the station ($d_2=7,0\text{m}$), dB	$2,32 \cdot 10^{-13}$	$2,17 \cdot 10^{-13}$	$2,05 \cdot 10^{-13}$	$2,0 \cdot 10^{-13}$	$2,0 \cdot 10^{-13}$	$2,0 \cdot 10^{-13}$	$2,0 \cdot 10^{-13}$
The signal / noise ratio ($d_1=4,68\text{m}$), dB	11,50	13,46	16,29	18,57	20,30	22,88	23,38
The signal / noise ratio ($d_2=7\text{m}$), dB	15,49	17,18	19,93	22,08	23,80	26,38	26,88
Surpassing of the minimum level ($d_1=4,68\text{m}$), dB	-0,5	1,46	4,29	6,57	8,30	10,88	11,38
Surpassing of the minimum level ($d_2=7\text{m}$), dB	3,49	5,18	7,93	10,07	11,80	14,38	14,88

Block diagram of data reception station for remote control of ERS-1,2

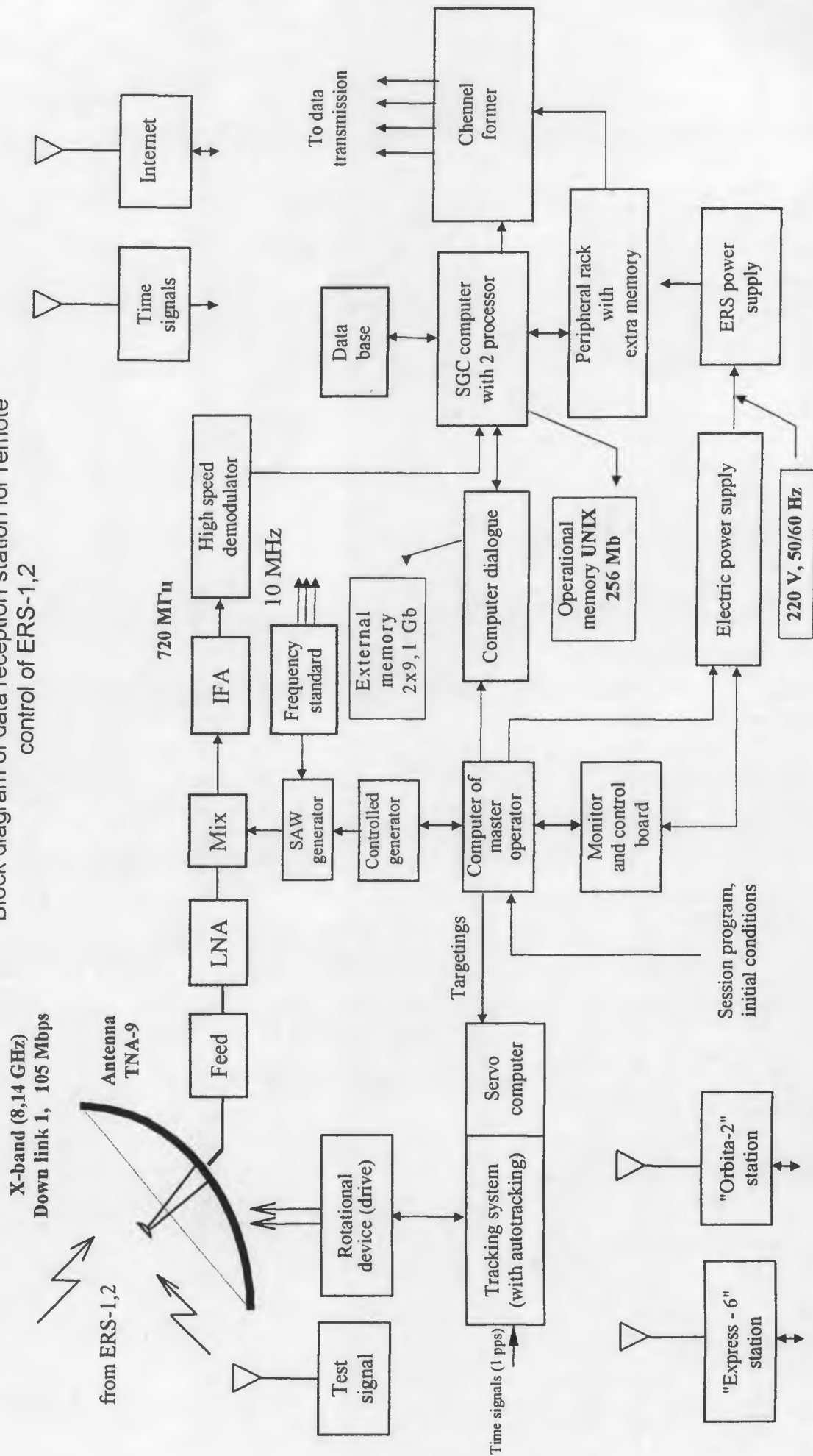


Fig. 2.

The block diagram of data reception station is given on fig. 2.

As the reception antenna X of the range of a Radio line 1 (8,14 GHz) it is supposed to use the reflector antenna, designed in the OKB MEI with cooperation with the adjacent enterprises. The diameter of a reflector - 4,68 m or 7 m depends on financial possibilities of the Customer.

The reflector antenna together with support-rotational device, illuminator and converter on intermediate frequency 720 MHz structurally represents an independent structure.

Control of the position of the antenna with the help of the guidance system during data reception from SV ERS-1, 2 is carried out in accordance with the program, designed in PC-H on targeting as a state vector. It is assumed to receive the targeting on a network of Internet with the subsequent correction. To use the maximum energy potential of the radio channel it is assumed to use in the pointing system, so-called, extreme automatic device on base of PC-H.

The block diagram of the reception path of the station is carried out with single transformation on intermediate frequency 720 MHz. The value of the intermediate frequency is determined by the requirement of the input of the high-speed demodulator, delivered by ESA.

The equipment, delivered by ESA, provides the high-speed demodulation of the received signal, registration and accumulation of the high-speed flow (105 Mbit/s) on memory units of high data density. The capacity of data saved thus by one session can make 12 GB. With the help of back-end processors the high-speed flow of SAR is operatively processed with reduction of resolution up to 80 m, is collected and is archived in the appropriate format. The capacity of the archived data, received by one session, can make 3 Mbytes.

In order to reduce considerably the capacity of used carriers during the registration of SAR received primary (raw) data flow it is supposed to adopt the high performance adaptive algorithms to provide 3 to 10 times reduction of digital data with 100% guaranty for their no loss decompression.

That technique is based on application of set of adaptive compression algorithms operating with variable-length input data words. Cascade arrangement of that algorithms gives a unique ability to extract redundant information from any input data flow.

The linear algorithms have an ability to operate with any file standards. During the operation with that algorithms there is no need to carry out the first stage of file preparation (transformation).

Using of four-level phase manipulation in the information channel imposes rather rigid requirements on through amplitude-phase frequency characteristic of the route (APFC).

The non-uniformity of the peak characteristic in the pass band should be no more than 0,1 - 0,5dB, non-uniformity of group time delay in the pass band - any more than 1,5 - 3,0 ns. For fulfillment of these requirements the filter, ensuring fulfillment of these requirements, should be entered in structure of the demodulator.

In cascades of a reception route, previous to the demodulator, it is necessary to have such a stock on the pass band, so that the non-uniformity of their APFC in the band of the received signal will not influence the general characteristic of the route.

It is accepted to consider, that a sufficient stock will be band widening in 2-3 times in comparison with $F_{0,7} = F_{\text{TAKT}} / 2$,

Where $F_{0,7}$ - pass band of the radio route on level 3 dB, F_{TAKT} - symbolical frequency of the radio message.

The widening of the band in a linear route before the demodulator is allowable in limits of its dynamic range. The characteristics of the demodulator have defined its dynamic range equal to 40dB. As due to change of position of the space vehicle the amplitude of an input signal changes on 27 dB, it is possible to consider the widening of the noise band, varying the value of an input signal on 3 dB is allowable.

Block-diagram of receipt-conversion device

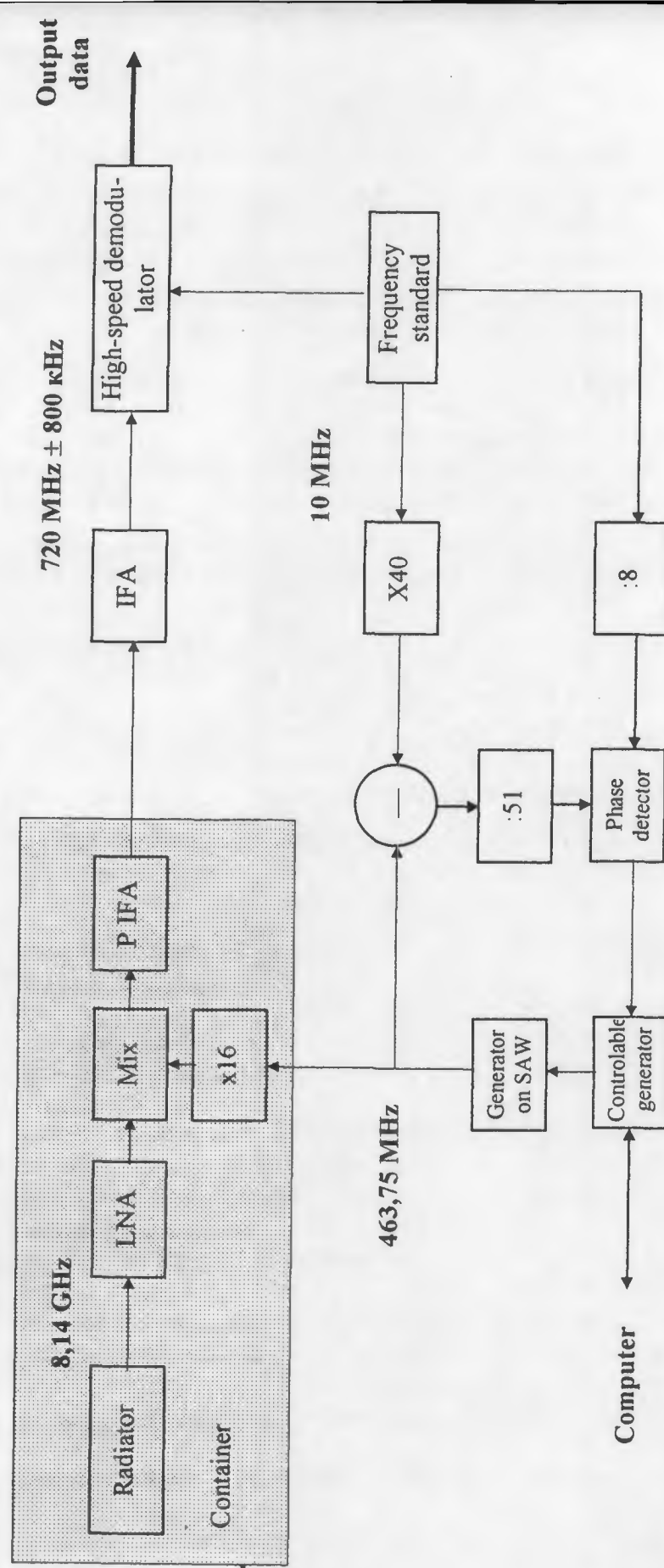


Fig. 3.

5. Technical data of receipt-conversion device.

Average frequency of an input signal	8140 MHz
Width of the spectrum of an input signal	~ 60 MHz
Noise temperature of a reception route, brought to the input of the antenna	~ 130 To
Noise band of a reception route before the demodulator	~ 150 MHz
Frequency of an oscillator signal	7420 MHz
Instability of the frequency of oscillator from all disturbing factors	10^{-7}
Short-term instability (1s)	10^{-10}
Level of secondary components in the spectrum of oscillator at disturbance:	
More than 1 kHz	not worse - 130 dB
More 10 kHz	not worse - 160 dB
Phase fluctuations of the oscillator (3σ)	No more than 0,1.
Interval of working temperatures of the microblock, placed in the container of illuminator	50 C
Input frequency of the demodulator	720 0,8 MHz
Range of an input signal	(- 10... - 50) dB m
Input resistance	50 Ω
Time of capture in the circuit $\Phi A\Pi$ of the demodulator	No more than 300 ms
Range of search by frequency:	800 kHz, 200 kHz, 50 kHz.
Demodulator losses in the including differential decoding losses	No more than 2 dB
The threshold ratio E/N	worse 6 dB
Kind of modulation	QPSK, NRZ-M
Output resistance of signals of the information and synchronization (in levels of ЭСЦЛ)	75 Ω
Data transfer rate	105 Mbit/sec
Control of work of the demodulator:	Local and Remote.

6. Guidance system

The guidance system is intended for control of a position of the antenna and provides control modes PROGRAM, HAND-OPERATED and HALF-AUTOMATIC DEVICE.

Structurally the elements of guidance system are allocated on the antenna to a post, in a hardware cabin and in a basic building.

The antenna can rotate in limits:

- On azimuth 330 degrees, On elevation angle from minus 5 degrees up to + 94 degrees.

The guidance system provides the following maximum parameters of a movement of the antenna:

In a mode the PROGRAM -

- On azimuth - speed up to 18 degrees /s, acceleration up to 3 degrees/s², third derivative up to 0,3 degrees/s³
- On a elevation angle - speed up to 9 degrees / sec, acceleration up to 3 degrees/s², third derivative up to 0,3 degrees/s³.

In a mode HAND-OPERATED - on azimuth and elevation angle - speed up to 3 degrees /s;

In a mode the half-automatic DEVICE - on azimuth and elevation angle - speed up to 10 degrees/s, fast rearrangement with speed up to 20 degrees/s.

For maintenance of protection of metalloconstructions from overloads the restriction of moment on shaft of each executive motor and electronic braking at the approach to extreme points of a rotation range is provided.

The errors, which can be reach by work of guidance system in the mode PROGRAM, are characterized by the following values (maximum value):

- On azimuth - 1,5 angle minutes (static error), 6,2 angle minutes (dynamic error) On an elevation angle - 1,5 angle mines. (Static error), 7,0 angle mines. (Dynamic error).

7. Equipment delivered by European Space Agency.

Under the mutual agreement PKA and ESA for compectation of east-Siberian data reception station ERS the enterprises of European Space Agency plan to put in OKB MEI the following equipment:

a) Demodulator Bell Telephone MGF (BTM) for high-speed channels ERS-1, 2. The demodulator is fed from a source with the following parameters:

- Voltage of a network - 220 V or 110 V, 20;
- Frequency of a network - from 40 Hz up to 440 Hz;
- Input - 100 W;
- Weight - 30 kg.

b) Computer Sillcon Graphics Challenge. Two central processors with operating system UNIX and memory of 256 Mbytes;

c) Workstation Sillcon Graphics Indy with an external disk of memory 29,1 GB. The station provides the dialogue interface between the operator and machine;

d) Additional peripheral support, consisting of a file 10 4,3 GB disks, two disk drives DLT 7000 and one exabite disk drive;

e) Cable for connection of the demodulator to platform UNIX, and also for connection to the peripheral equipment.

The whole equipment is mounted in two supports of the small size, here are included one monitor and one desktop working interface station.

8. Technical data of the station

Carrying frequency of a received signal	8,140 GHz.
Width of a spectrum of a signal	110 MHz.
Polarization	Circular of right rotation.
Speed of data transmission	105 Mbit/s
Kind of modulation of an input signal	QPSK NRZ-M quadrant phase manipulation without returning to zero).
Diameter of the reflector of the antenna	$d_1=4,68$ m or $d_2=7,0$ m..
The maximum range of data reception	2840 Km.
Working zone of tracking on an elevation angle at program control of the antenna	From 50 up to 850.
Width.of the pattern:	
	For d_1 0,540,
	For d_2 0,360.
The effective area of the antenna:	
	For d_1 8,6 m ² ,
	For d_2 23,0 m ² .
Noise temperature of a reception route	130 K.
Q of the antenna:	
	For d_1 28 dB/T _O
	For d_2 32,3 dB/T _O
Limits of rotation of the antenna:	
	On an elevation angle From -3° up to 92°,
	On azimuth 330°.
Modes of guidance of the antenna:	"Hand-operated", "Half-automatic", "Program".
The maximum working speeds of rotation of the antenna:	
	On azimuth 18°/s,
	On an elevation angle 9°/s,
At acceleration 3°/s ² and the third derivative 0,3°/s ³ .	
Static error of guidance of the antenna in a mode "Program":	
Without wind load	1,0 angle Mines.,
At speed of a wind 15 m/s	1,5 angle Mines.
Dynamic error of guidance of the antenna in mode "Program":	
Without wind load	3,0 angle Mines.
The power supply of station is performed from 3 phase network	380 V, 50Gz.
Power consumption:	Average 60 kW,
	Peak (during 15 sec) 120 kW.
Time of initial heating of thermostats	2 Hours,
Time of readiness of the station	15 Mines.
Time of continuous work	8 Hours.

9. Conclusions

1. The whole performed work confirms the possibility of using of THA-9 antenna with reflector of diameter 4.68m as a adjusted base of data reception station SAR SV ERS-2.
2. All elements of data reception station can be adjusted after fitting out by demodulation and decoding equipment, manufacturing and assembling of receiving route on the firing ground 'Bears lakes', it will allow to minimize the efforts on putting into operation of the reception station in Tixi.
3. The operation of antenna post with all completing devices was checked during the experiment.
4. Measured value of noise temperature of the antenna corresponds to calculated value $T_A=130K$.
5. Measured value of effective surface of the antenna corresponds to calculated value $S_\phi=8.6m^2$.

QUESTIONS AT THE END OF REPORT

1. Regime of Tromsø (Norway) station operation in LINK-1 (SAR) during the nearest 6 months within a compatible radio-visibility zone of Bear's Lakes site (Moscow suburb).
- 2 When we can get the documentations of high-speed demodulator:
 - technical requirements;
 - technical description;
 - maintenance manual.
- 3 Have the high-speed demodulator been tested (field tests) as a component of ground reception station SAR ERS ? Any test reports ?
- 4 We need to know the full and right name of modulation technique in LINK-1 (OQPSK NRZ-M or QPSK - Gray code ?)
- 5 Needful reliability per information bit at demodulator output with SAR resolution 100 m.
- 6 What synchronization modes can be provided by the demodulator at the threshold: $E/N_0 = 6$ dB.
- 7 Full structure of information frame at demodulator output.
- 8 The records of application data (time of ascension node point intersection in whole days (MJD) and mks (from UTC midnight), orbit loop number, SV coordinates and its velocity vector components) in the form of text.
- 9 Standard files: Predicted_Orbit and Predicted_MMCC_Orbit containing SV state vector for that orbit loop.
- 10 Antenna targetings calculated for that state vector (time, azimuth, elevation) at three points - entry into the visibility zone at elevation $\sim 15^\circ$, culmination zone, exit from the visibility zone at elevation $\sim 15^\circ$) within topo-centric coordinate system oriented in relation to geodetical zenith.
- 11 Precise coordinates (addresses) needful for reception (INTERNET) of state vector parameters in order to define the targetings of ground station at "Bear's Lakes" site.
- 12 If any auto-tracking mode (at ground stations) over the angular coordinates ?
- 13 Have the rest equipment supplied to "Bear's Lakes" site by ESA been adjusted (tuned up); terms of delivery; composition of software (what resolution of processing, ? may be $\Delta = 100$ m) ?





ESOWG 7
(ERS National & Foreign
Stations Operators
Working Group)
Toulouse
28-29 May 1998

This document contains copies of the viewgraphs used in each presentation, the agenda and a list of attendees.

This document is printed by the ERS Facilities Operations Section of the ERS Exploitation Division of ESA/ESRIN

ESOWG 7

Index

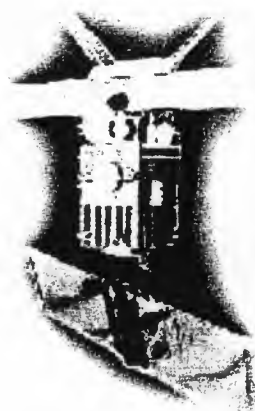
AGENDA

LIST OF MEETING ATTENDEES

VIEWGRAPH PRESENTATIONS



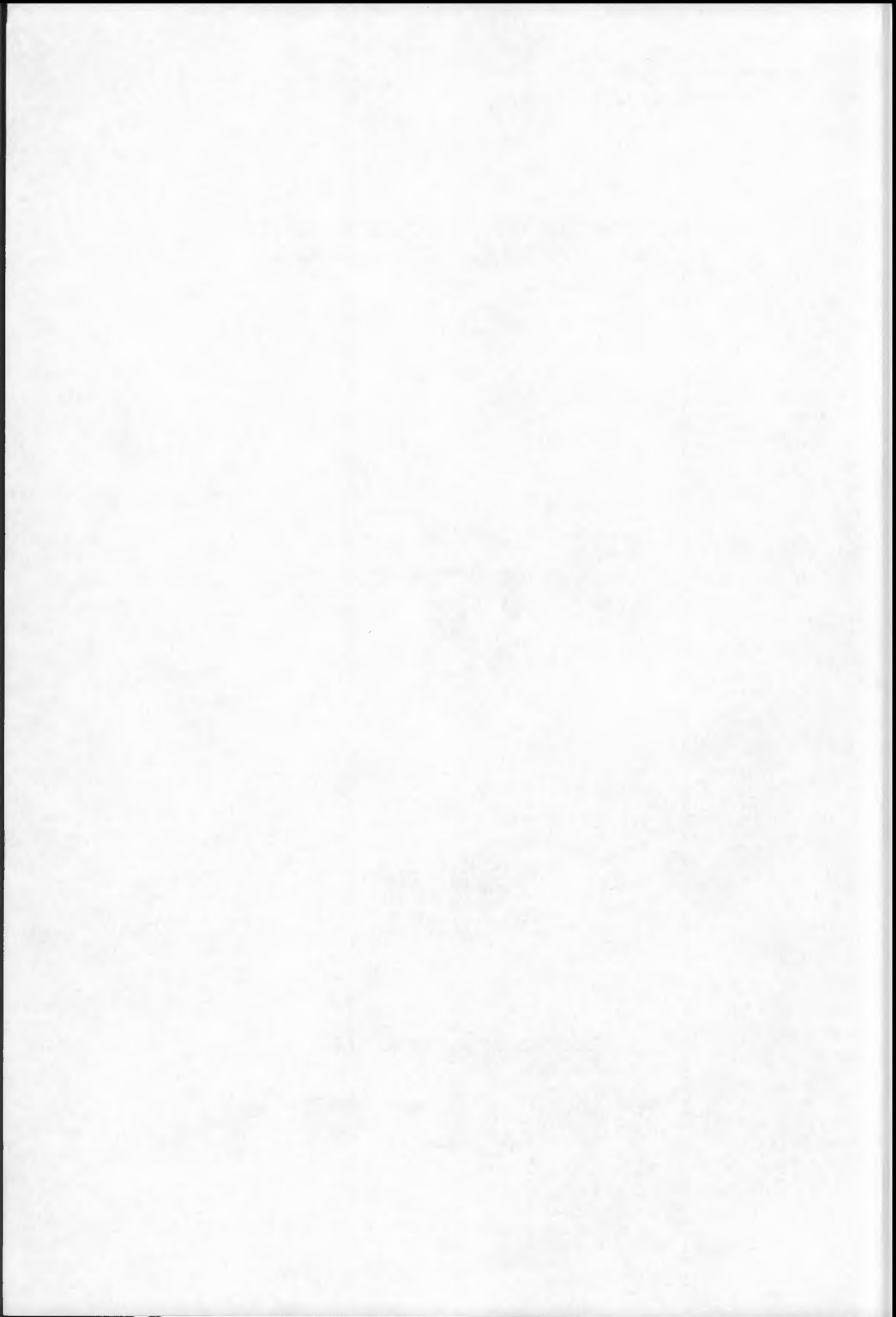
WELCOME TO THE 7TH ESOWG MEETING
(ERS STATIONS OPERATORS WORKING GROUP)



AGENDA

TOULOUSE, 28 AND 29 MAY 1998





FIRST DAY - 28TH MAY 98

08H30 REGISTRATION

09H00 WELCOME AND AGENDA REVIEW

V. BERUTI - ESA

• **SESSION 1 - THE ERS SYSTEM STATUS**

09H15 ERS PROGRAM AND GROUND SEGMENT STATUS

V. BERUTI - ESA

09H30 ERS-1 AND ERS-2 SATELLITES STATUS

M. CANELA - ESA

10H00 COFFEE BREAK

• **SESSION 2 - THE NATIONAL & FOREIGN STATIONS, PARTNERS OF THE GROUND SEGMENT**

10H20 OPERATIONAL ISSUES

J.C. BIGOT - ESA

USER SERVICES TOPICS

S. JUTZ - ESA

10H45 ERS CONSORTIUM PRESENTATION

A. URDIROZ - SPOT IMAGE

• **SESSION 3 - SAR APPLICATIONS**

11H00 UTILIZATION OF ERS IN OPERATIONAL APPLICATIONS

PH. BALLY - SPOT IMAGE

12H00 INTERFEROMETRY SAR APPLICATIONS

H. LAUR - ESA

12H30 LUNCH

• **SESSION 4 - REPORTS FROM ERS NATIONAL & FOREIGN STATIONS (15' EACH)**

14H00 GATINEAU & PRINCE-ALBERT - CANADA

T. FEEHAN - CCRS

14H15 O'HIGGINS, LIBREVILLE, NEUSTRELITZ, KITTAB, ULAN BATOR - GERMANY

K. REINIGER - DLR

14H45 PORTABLE STATION IN BANGLADESH - UK & THE NETHERLANDS

W. LOOYEN - NLR

I. DOWNEY - NRI

15H15 TROMSOE - NORWAY

A. ROGNES - NSC

15H30 WEST-FREUGH - UK

M. PEARSON - DERA

M. LLYOD - DERA

15H45 FAIRBANKS AND MACMURDO - USA

G. REYNOLDS - ASF

C. LINGLE - ASF

16H00 COFFEE

16H30 COTOPAXI - ECUADOR

F. VALENCIA - CLIRSEN

E. LASCANO - CLIRSEN

16H45 CORDOBA - ARGENTINA

A. MENESCARDI - CONAE

J.A. IZAURRALDE - CONAE

17H00 JOHANNESBURG - SOUTH-AFRICA

I. MARAIS - CSIR/SAC

17H15 TEL-AVIV - ISRAEL

N. ITTAH - ISA

17H30 ADJOURN





SECOND DAY - 29TH MAY 98

• SESSION 5 - REPORTS FROM ERS NATIONAL & FOREIGN STATIONS (15' EACH)

09H00 BEIJING - RSGS
 09H15 HATYAMA, KUMAMOTO, SYOWA - JAPAN
 09H45 CHUNG-LI - CSRSR/NCU
 10H00 BANGKOK - THAILAND
 10H15 COFFEE
 10H45 SINGAPORE - REP. OF SING.
 11H00 ALICE-SPRINGS AND HOBART - AUSTRALIA

X. PAN, L. TANG - RSGS
 T. FUKUDA - NASDA
 K. CHO - TOKAI UN.
 A. J. CHEN - CSRSR/NCU
 N. SRIPUMIN - NRCT
 RANGSIKABHUM - NRCT
 L.K. KWOH - CRISP
 P. TREZISE - ACRES

• SESSION 6 - FUTURE OF EO AT ESA AND CONCLUSION

11H30 ENVISAT MISSION & SYSTEM
 11H50 FUTURE OF EARTH OBSERVATION AT ESA
 12H10 OPEN DISCUSSIONS
 QUESTIONS & ANSWERS
 13H00 ADJOURN AND LUNCH

P. GILLES - ESA
 M. ALBANI - ESA
 V. BERUTI - ESA
 JC. BIGOT - ESA





ESOWG 7 -List of Attendees		
Surname	First Name	Company
Albani	M.	ESA-ESRIN
Atzmon	D.	IAI-MBT
Bally	Ph.	Spot Image
Ben-Yossef	E.	IAI-MBT
Beruti	V.	ESA-ESRIN
Biasutti	R.	Eurimage
Bigot	J.C.	ESA-ESRIN
Canela	M.	ESA-ESTEC
Cattaneo	F.	ESA-ESRIN
Chen	A.J.	CSRSR
Chng	N.K.	CRISP
Cho	Kohei	NASDA/RESTEC
Di Domenico	L.	Eurimage
Downey	I.	NRI
Engel	P.	RADARSAT
Feehan	T.	CCRS
Fukuda	T.	NASDA/RESTEC
Hodge	R.	Spot Image Corporation
Ittah	N.	Israel Space Agency
Izaurrealde	J. A.	CONAE
Jutz	S.	ESA-ESRIN
Kou	L.	RSGS
Kwoh	L.K.	CRISP
Lascano	E.	CLIRSEN
Laur	H.	ESA-ESRIN
Lingle	C.	University of Alaska
Lloyd	M.	DERA
Looyen	W.	NLR
Marais	I	CSIR
Mechkov	M.	OKB-MEI
Menescardi	A.	CONAE
Missling	K-D.	DLR
Nabet	E.	Spot Asia PTE Ltd.
Nanz	T.	Spot Image Corporation
Nelson	C.	Spot Image Corporation
Noguchi	M.	Nasda/RESTEC
Pan	X.	RSGS
Pearson	M.J.	DERA
Perminita	L.	Planeta
Rangsikanbhum	T.	NRCT
Reiniger	K.	DLR
Reynolds	G.	University of Alaska
Rognes	A.	Tromsoe Sat. Stn.
Rufo	R.	Eurimage
Sripumin	N.	NRCT
Strikovskiy	H.	IAI-MBT
Tang	L.	RSGS
Trezise	P.	ACRES
Valencia	F.	CLIRSEN
Van Zyl	A.	CSIR
Yokotsuka	H.	NASDA/RESTEC



EUROPEAN SPACE AGENCY

**ERS Stations Operators Working
Group**

**ESOWG
7th Meeting**

Toulouse, France
28-29 May 1998

ERS 1/2 SATELLITES ESA GROUND SEGMENT

STATUS

ERS-1/2 GROUND SEGMENT ROLE

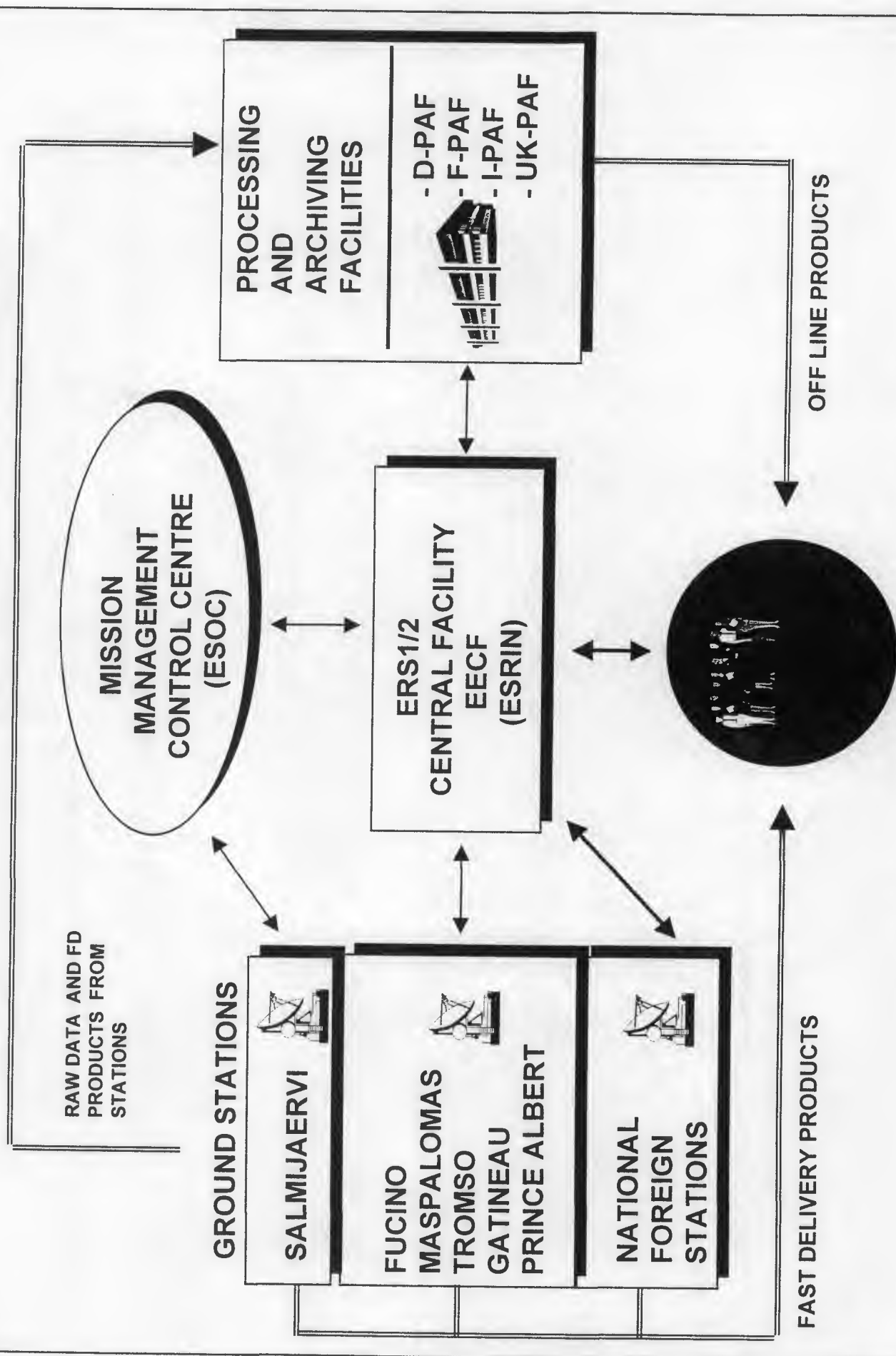
✦ Ensure GLOBAL LBR MISSION WITH EMPHASIS ON OCEAN

APPLICATION

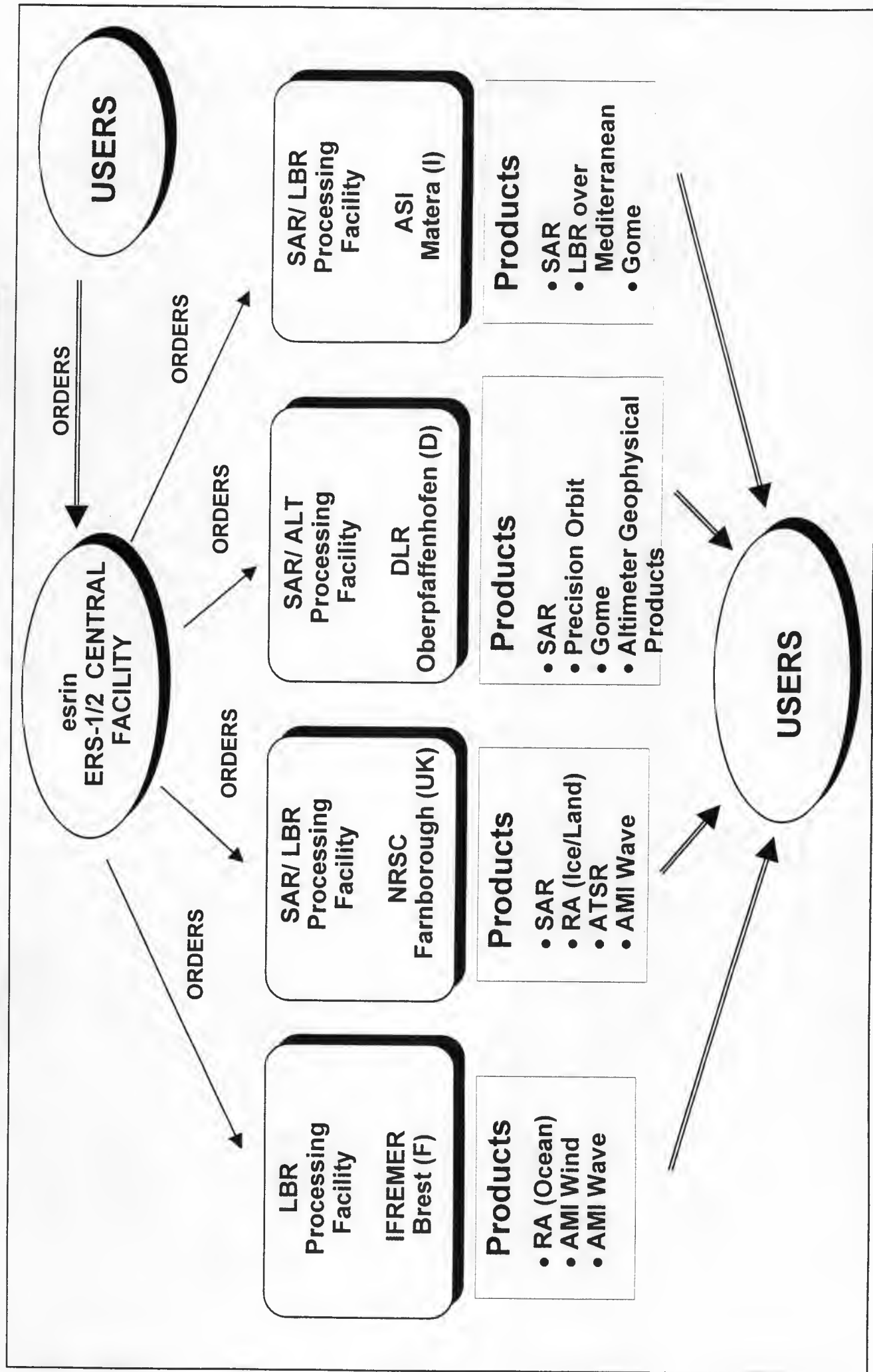
✦ Ensure REGIONAL SAR SERVICE OVER EUROPE

✦ Ensure ACCESS TO SAR DATA TO NATIONAL AND FOREIGN STATIONS

OVERALL ERS-1/2 GROUND SEGMENT SCHEME



ERS-1/2 PAYLOAD DATA PRODUCTION SCHEME



ERS-1/2 ESA GROUND SEGMENT UPGRADES

- **DUPLICATED THE SAR PROCESSORS AT UK/D/I-PAF'S ON DEC ALPHA PLATFORM WITH A NEW UPGRADED VERSION OF MDA VMP S/W**
- **FACILITIES CONSOLIDATION ACTIVITIES TO BE ENDED WITHIN 1998**
- **ENHANCEMENTS PLANNED FOR 1999 (direct ingestion, SAR browse, IQL)**
- **SYSTEMS FOR TRANSCRIPTION OF SAR HDDT'S TO SONY DIR1000 OR DLT OPERATIONAL AT ALL SITES**
- **LBR DIRECT INGESTION (1998)**
- **ATSR REAL TIME SERVICES AT TROMSO STATION**
- **LOW RATE ARCHIVING SYSTEM ON DLT (operational from mid 1998)**
- **COMPACT DIRECT INGESTION AND TRANSCRIPTION SYSTEMS FOR REMOTE CAMPAIGN OPERATIONS (Malindi, Tiksi, Kourou, Ecuador, etc.)**
- **UPGRADE OF PLATFORMS AND SERVICES (user services and product control services)**

ESA ERS1/2 SAR VALIDATED PRODUCTS

	D-PAF	UK-PAF	I-PAF	ESRIN (BACK UP)
PRI	X	X	X+x	X
RAW	X	X	X+x	X
SLC-I	X	X	X	X
SLC	X	X	X	X
GEC	X	X	x(**)	x(#)
GTC02	x		x(**)	
GTCO4(*)	x			

X = Standard ESA processing
x = National processor
 (*) GTM= GEOCODED IMAGE WITH USER SUPPLIED DEM
 (**) I-Paf geocoding
 (#) S-Geos or Matra

NATIONAL STATIONS:

- TROMSOE (N)
- WESTFREUGH (UK)
- GATINEAU (CND)
- PRINCE ALBERT (CND)
- MATERA (TELESPAZIO, I)
- O'HIGGINS (D, ANTARCTICA, campaign only)
- LIBREVILLE (D, GABON, campaign only)
- NEUSTRELITZ (D)
- AUSSAGUEL (F, campaign only)
- ULAN BATOR (D, MONGOLIA)
- KITTAB (D, UZBEKISTAN)

ERS1/2 NATIONAL AND FOREIGN STATIONS

FOREIGN STATIONS WITH ERS MOU SIGNED:

- COTOPAXI (ECUADOR)
- HIDERABAD (INDIA)
- ALICE SPRINGS, HOBART (AUSTRALIA)
- HATOYAMA (JAPAN)
- KUMAMOTO (JAPAN, Tokai University)
- SYOWA, ANTARCTICA (Polar Instit., JAPAN)
- FAIRBANKS (USA)
- CUIABA (BRASIL)
- PRETORIA (SOUTH AFRICA)
- TAIPEH RS RESEARCH
- PARE PARE (INDONESIA)
- NORMAN (USA)
- UNIVERSITY OF BEIJING
- MCMURDO (ANTARCTICA, US)
- SINGAPORE
- BANGKOK (THAILAND)
- TEL AVIV (ISRAEL)
- MALINDI (Italian University, KENIA)
- CORDOBA (ARGENTINA)
- KOUROU (esa/d, Guiana)

STATION WITH NO ERS MOU SIGNED:

- RIYADH (SAUDI ARABIA)
- TIKSI (RUSSIA)

NEW NON ESA MISSIONS (1998/1999)

- **SeaWiFS (operation started in August 1997 in mid 1997)**
- **IRS-P3 MOS (operations started in summer 97)**
- **LANDSAT 7 (launch now planned by early 99)**
- **MODIS (to be launched in late 98)**

**ERS-1 & 2
OPERATIONS
&
IN ORBIT PERFORMANCE
STATUS**

ERS Ground Segment Mtg

Miguel Canela - ESTEC - LR

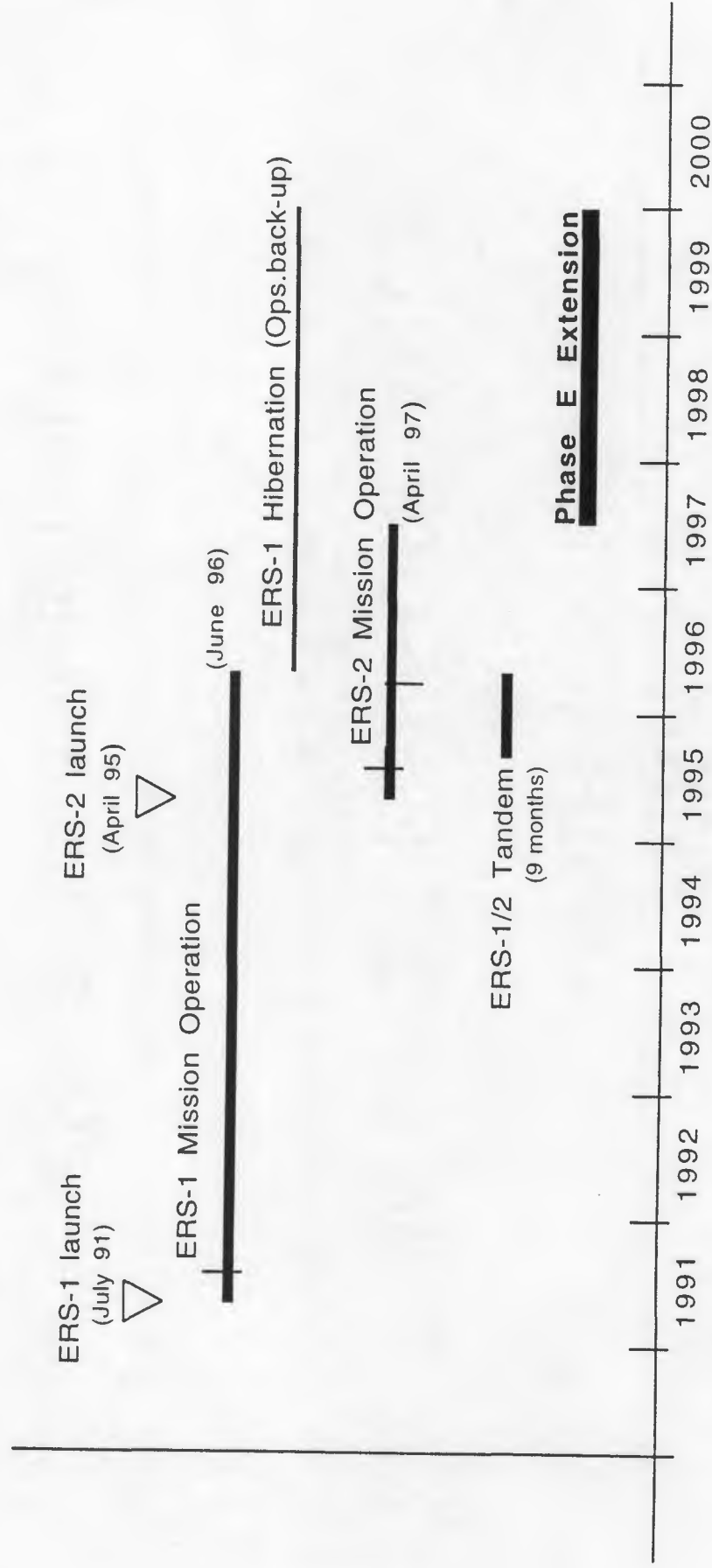
May, 1998



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ERS-1 & ERS-2 OPERATIONS

Ground Stations Mtg.
May, 1998

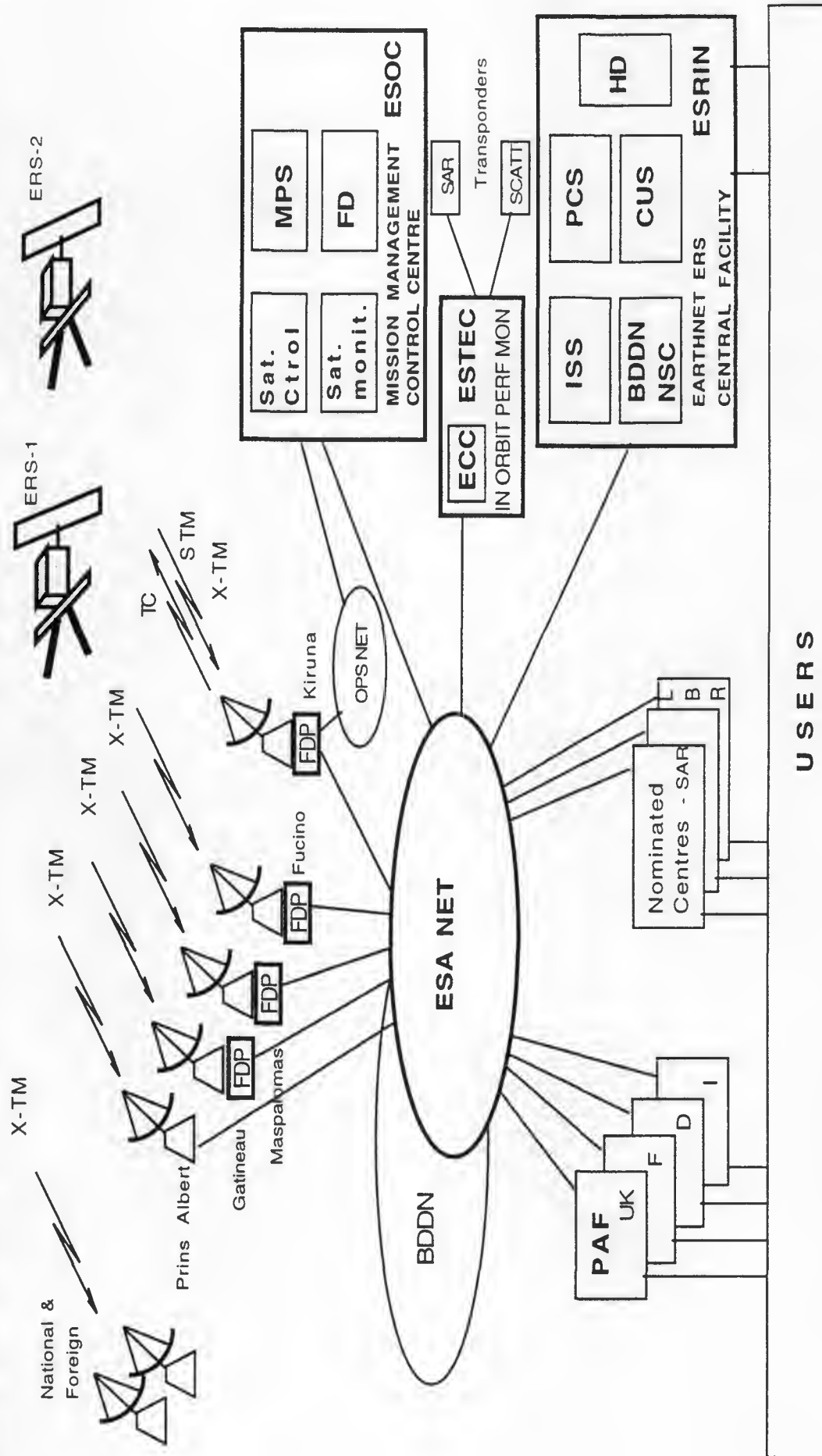




ERS GROUND SEGMENT

PAGE

May, 1998



ERS-2 In Orbit Performance

- **Platform:**

- All the subsystems are working nominally
 - » Power, Thermal, AOCS, Data Handling, RF
 - » Special care with Gyros maintenance
 - » Digital Earth Sensor blinding (mask - solved)

- **Payload:**

- All instruments are operational and controlled by the Mission Planning System.
-

ERS-2 In Orbit Performance

- **No major or minor anomalies have taken place from Feb. 97 up to now.**
-
- **All Gyros (except #1) are declared available for piloting and for coherence check**
- **Gyro 3 showed low noise during September check-out, but it has disappeared in following checks.**
- **Small degradation of the AMI TWT is observed.**

ERS-1 KEEP ALIVE SCENARIO

- **Hibernation:**
 - Activities reduced to Thermal and Power keeping
 - Payload in Stand-by or Heating mode
 - Orbit Control in parallel with ERS-2
 - Quick re-activation possible (planning constraints)
 - Preservation of life limited items
- **Payload check-out every two cycles (70 days)**
- **ERS-2 reduced Back-up**
- **Special SAR campaigns are acceptable with important operation constraints**

ERS-1 In Orbit Performance

- **Major Failure in Solar Array:**
 - **40% Power Drop**
- **All the instruments are working nominally.**
- **Small mech. & electronic degradation**
- **ATSR:**
 - channels 11 and 12 working in low resolution
- **PRARE: failed short time after launch**

ERS-1 In Orbit Performance

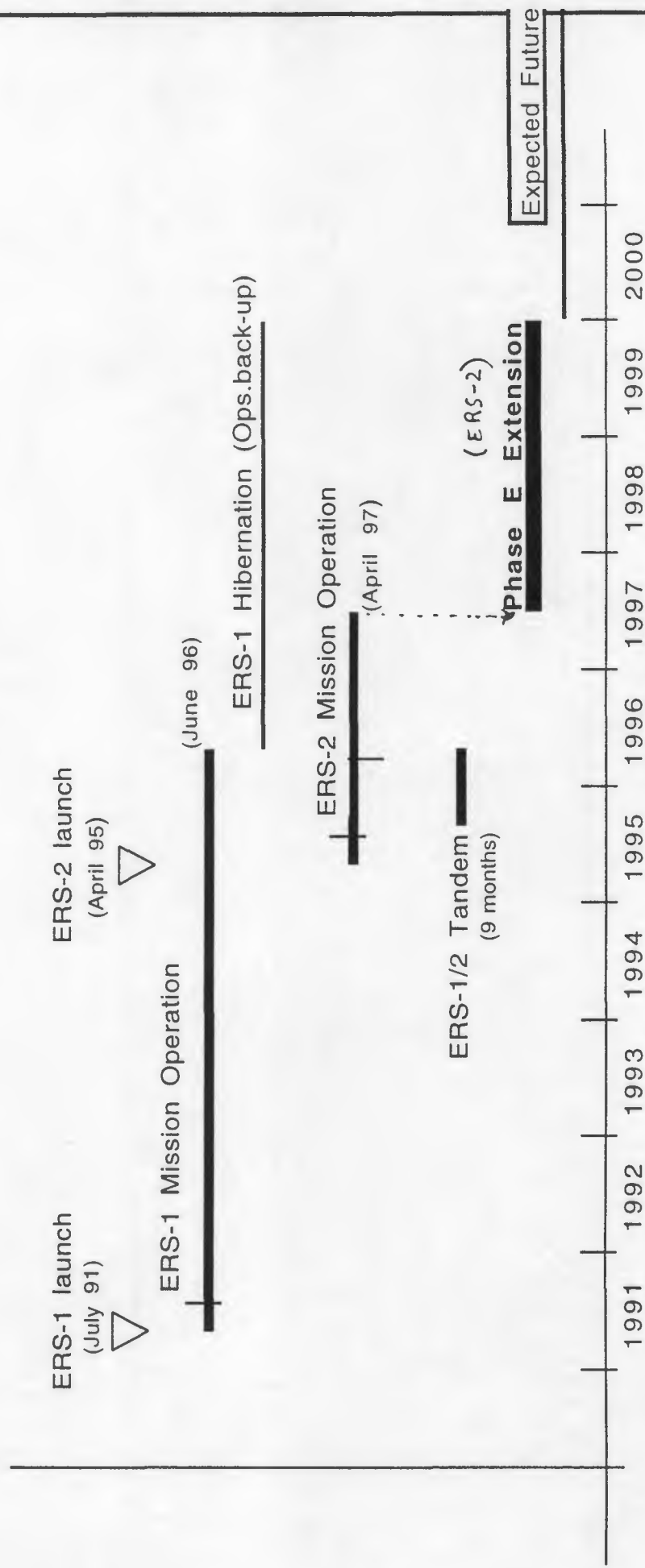
- **SOLAR ARRAY (SA) POWER ANOMALY:**
 - The solar array output power suddenly degraded by 38 %
 - The output voltage is stable since then
- **Investigation results:**
 - 4 of 10 sections of the SA are not functioning properly
 - Recovery to the nominal power level is not possible
 - Assuming no further degradation, remaining possible instrument/mission scenarios are being analysed
- **Probable Impact:**
 - ERS-1 no longer able to provide full back-up to the mission
 - SAR Interferometry is restricted.
 - The keep alive scenario has been re-defined

	ERS-1	ERS-2
OPERATIONAL STATUS	Hibernation (ERS-2 Back-up) + SAR Tandem Campaigns	OPERATIONAL
MPF	Very small degradation POWER REDUCED IN 40 %	Good performance, but AOCS weak: - 1 gyro dead (=> Safety Sw reinforced)
IDHT	TWT 1 (HR) at end of life TWT 2 & 3 (HR, LR) operational TAPE Rec. Limiting life item	Good performance
AMI . SAR . SCATT	Very small degradation	Good performance, in spite of: - excess of reflected power problem (solved in Nov. 1995) - Cal DC/DC Converter and Scatt Electronics redundant side selected - TWT aging (under investigation)
RA	Very small degradation	Good performance
ATSR . IRR . VIS	Important degradation on coolers. Reduced performance N.A.	Acceptable performance - Debris in Scan mirror mechanism blocked the operation for 6 months
MWR	Very small degradation	Good performance but: - sky horn cal. Channel 23.8 degraded
GOME	N.A.	Good performance
PRARE	failed short after launch	Good performance



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ERS-1 & ERS-2 OPERATIONS





Conclusion and objectives

- Serve the AO3 (quality and quantity);
 - Preparation for a commercial exploitation of the ERS data together with the ERS consortium (sales to double ?) in order to develop the use of Radar in your territory;
 - Transition from "best effort" to "secured or best service":
 - » Consolidate offered data-set
 - » Eliminate single-point-of-failures
 - » Ensure product delivery times (using electronics links...)
 - » Ensure product quality (quality checks before dispatch)
 - To prepare together a fruitful ENVISAT mission, strengthen our relationships through partnerships...
 - To strengthen our dialogue
 - Your comments, questions and proposals are welcomed...
-



- Is it a challenge, a myths ... ?

- » www.year2000.com
- » www.ibm.com/year2000
- » www.microsoft.com/year2000
- » and many more...



Portable Station Offer

The offer is growing fast:

- MDA (Fast Tracs)
- NRi/NLR (Rapids)
- MS&I (Eagle Vision)
- Iosat (Sentry)
- Vexcel, Kongsberg/Spacetec, etc... ?

Antenna between 2.7m up to 4.5 or 5m

All portable and modular

Based on Direct ingestion, Raid techno...

ERS, SPOT, LANDSAT, RADARSAT, JERS



Portable Station

Background

- This is a future trend in the reception of RS satellites;
- Compact, miniaturized, easy expandable and modular, low cost, ...
- For campaign basis such as hazard and risk management, civil protection, military purposes, etc...
- Already existing mobile stations:
 - Bangladesh for NL (NRL) & UK (NRI) (2.7m antenna) used in the frame of a DUP project - Flood monitoring;
 - Ulan-Bator and Kittab for Germany (DLR) - (4m antenna), UB being used for the Boreal forest campaign...



Interfaces with stations

Operational Procedure

- In the case you're using the FTP Protocol:
- We set up a private account in our FTP Server at ESRIN (ersiss.esrin.esa.it) where we will put the Acquisition schedule, predicted Orbit, and Time Correlation Files. At any time you can FTP/get the files and delete after successful transfer.
- You can find the files name and format specification in the "EECF to National and Foreign Stations Interface Specifications"
- You will FTP/put the Acquisition Report files on another directory of the same account where we will pick it up.
- In case of network problems, you shall contact our 24 hours operator for requesting the FAX transfer (Telephone: +39 6 9416710 or +39 6 94180692, FAX: +39 6 94180202)



Interfaces with stations

Background

- access our FTP Server for getting the ERS schedules and auxiliary data:
 - Acquisition Schedules (SHAQ);
 - Time Correlation (PATC) and predicted orbit (ORRE);
- FTP Server is: [ersiss.esrin.esa.it](ftp://ersiss.esrin.esa.it)
- allowing FTP connections only from authorized machines at network level



Validation of NFS products

part I I

- Deliverables to ESA

- Information on the SAR processor
- Detailed SAR products spec.
- Detailed Validation report
- Sample of the products

- Deliverables to NFS

- Methodology to calculate K
- List of SAR quality parameters
- Antenna pattern correction for ERS-1/2
- Reference images (Flevoland)



Validation of NFS products

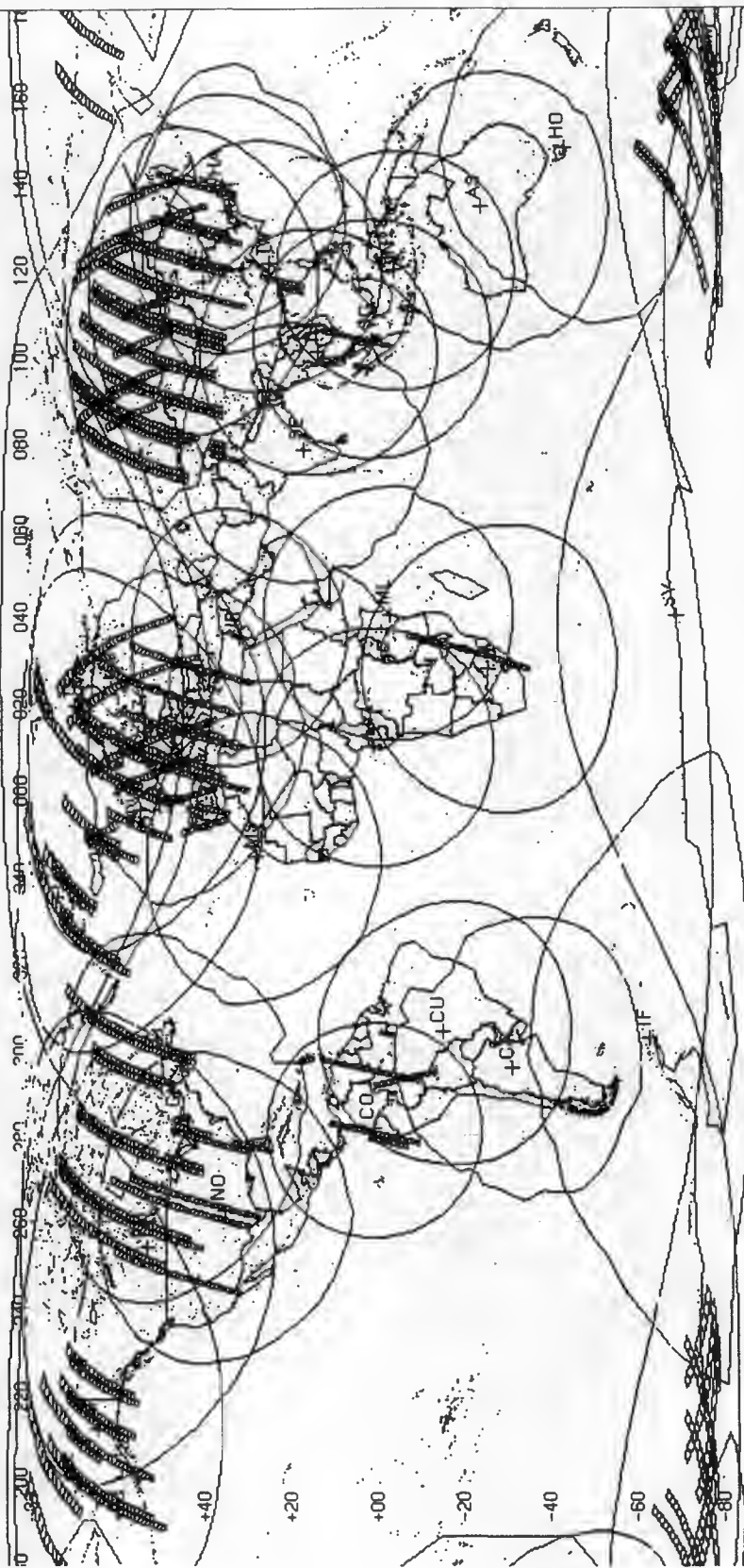
part I

- Responsibilities
 - NFS to demonstrate SAR quality products
 - ESA to endorse SAR products for release
- Objectives
 - Calibration of SAR processor (Calibration constante K to calculate, antenna pattern correction to apply)
 - Validation of products (parameters to be evaluated, eventually format)
- Operational document given
- Reference images available on request
- support available on request



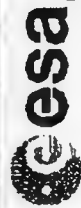
SAR acquisition plan

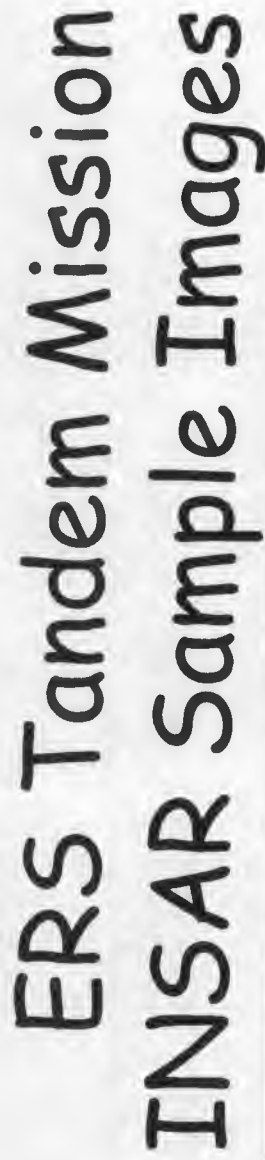
25 May 98 - 31 May 98



> E2/SAR, Orbits: 16175 (25-MAY-1998) - 16273 (31-MAY-1998)

ESOWG VII, Toulouse, 28-29 May 1998





ILU (Interferometric Land-Use Image)



**Acquired by
Malindi Station
in Kenya
(University di Roma)**

ERS-1 orbit 32459
29 Sept. 98
ERS-2 orbit 12786
30 Sept. 98

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ERS Tandem Mission INSAR Sample Images

IBP (Interferometric "Browse" Product)

ILU (Interferometric Land-Use Image)



Processed
by the
IQL processor
at ESRIN

Acquired by
Malindi Station
in Kenya
(University di Roma)

ERS-1 orbit 32459
29 Sept. 98
ERS-2 orbit 12786
30 Sept. 98

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The IQL

The sample images have been generated at ESRIN by a prototype Interferometric Quick-Look (IQL) Processor which handles complete strips of SAR acquisition. These samples have been processed from a 1 cycle-mission, Sept. - Oct 97, during which both the ERS-1 and ERS-2 satellites were flying in "tandem-mode" observing the same part of the ground with a 1-day interval. There are two different types of image that are available from this IQL processor:

IBP (Interferometric "Browse" Product):

The IBP image shows the interferometric phase projected on a colour wheel and the average intensity image on a grey-scale elsewhere. This image is useful to quickly assess the quality of the interferometric fringes, which might, for example be used to make digital elevation models (DEM's).

Each cycle of the colours represents a change in the ground height which is dependent on the satellite geometry.

ILU (Interferometric Land-Use Image):

The ILU image is an RGB image where the separate channels have been coded such that: **Red** = Interferometric coherence, **Green** = Average intensity of the two acquisitions, **Blue** = Intensity change between the two acquisitions. This image is useful to quickly assess the suitability of the interferometric pair for discrimination between different land use types.

In addition, this particular RGB combination has been chosen so that the land use types are coloured in a manner which might be found in a photographic image. In this way the ILU images can be thought of as a form of "colour SAR image".

A simplified understanding of the relation between the ILU image colours and the land surface type is as follows:

Green areas correspond to heavily vegetated (forests) or layover areas.

Blue areas correspond to water surfaces (sea & inland water).

Red areas correspond to bare rock and stable agricultural fields.

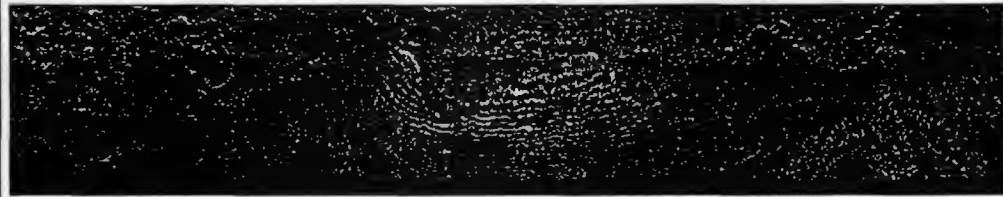
Yellow areas correspond to urban centres.



SAR interferometry INSAR

SAR Interferometry (INSAR) is currently a hot topic which is rapidly evolving thanks to the spectacular results achieved in various fields such as the monitoring of earthquakes, volcanoes, land subsidence and glacier dynamics, also in the construction of Digital Elevation Models (DEM's) of the

Earth's surface and the classification of different land types. A sample of interferometric images obtained with the Synthetic Aperture Radar (SAR) instrument on-board the ESA ERS satellite are displayed here as examples





- Methodology -

Interferometry (not only for DEM but as well for vegetation and agriculture)

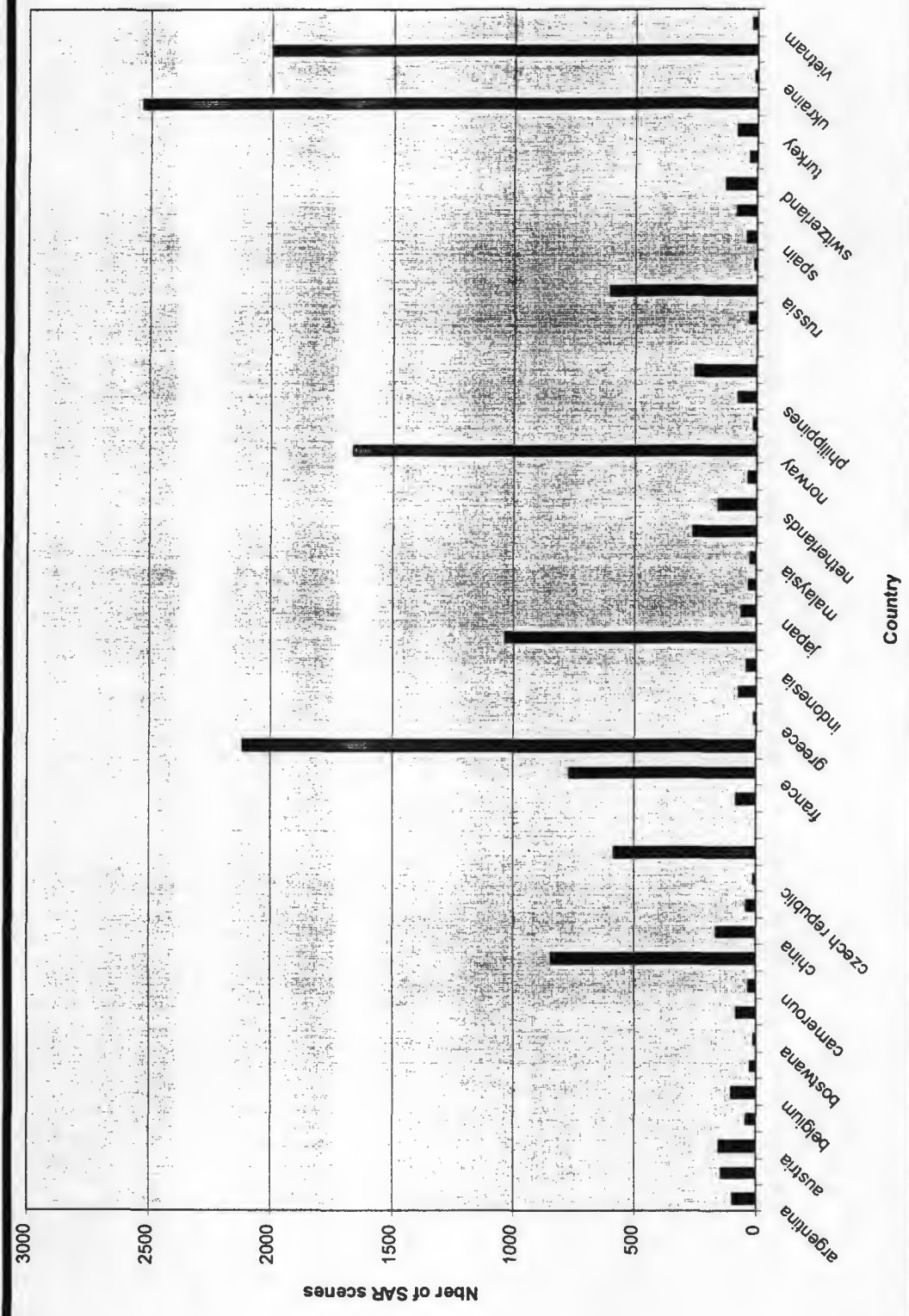
- Applications -

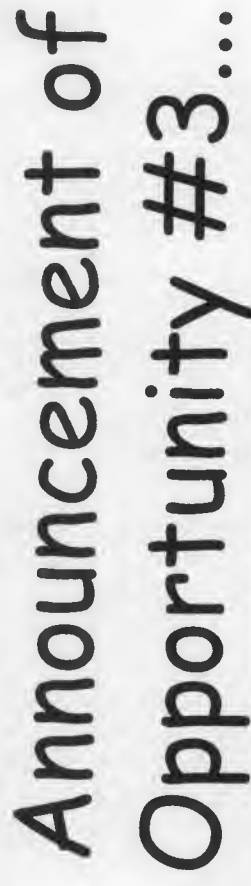
Large project with large data needs concerns:

- Ice mapping over Antarctica and Greenland (some 12 user groups);
- Boreal Forest Mapping in Siberia;
- Forest fires in Indonesia/Borneo and South America;



Currently assigned SAR data quantities per Country





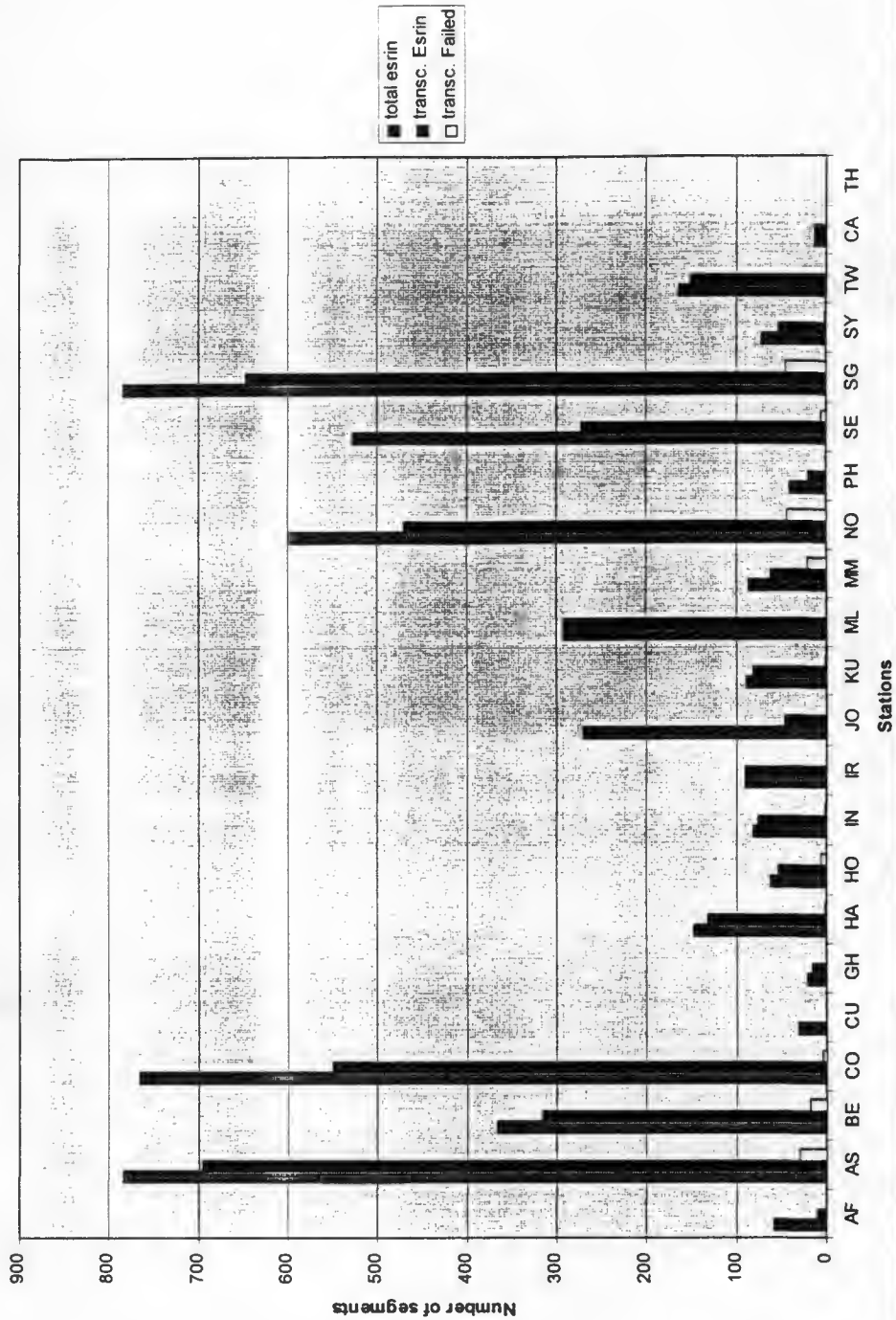
- AO3 released in Sept 97; AO3 starting summer 98;
- 318 proposals from 45 countries reviewed;
- 47000 SAR scenes requested (greatly exceeds the production capacity);
- 2/3 of the total number of proposals addresses the use of archived data;
- 250 proposals might be accepted with an allocation of some 14000 SAR scenes;
- 80 % SAR, 20 % LR

ESOWG VII, Toulouse, 28-29 May 1998



NFS Tandem SAR data transcribed onto DLTs at ESA

Foreseen to be completed 98 in July 98



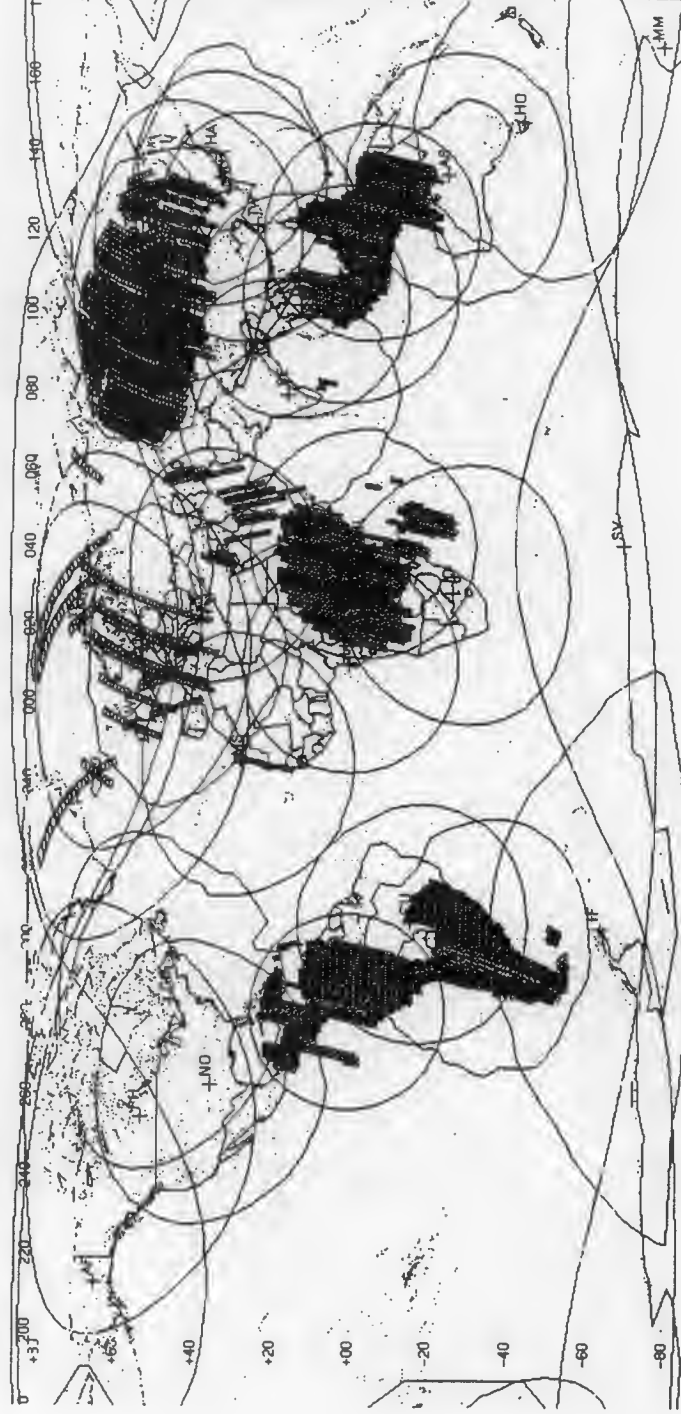
ESOWG VII, Toulouse, 28-29 May 1998



E1/E2 Tandem Pairs acquired during Tandem campaign in 97

One cycle - 22 Sept 97 to 27 Oct. 97

Over Cordoba, Cotopaxi, Malindi, Pare-Pare, Tel-Aviv and Ulan-Bator





New stations coming up ...



...

Kourou*

Matera*

...

Istanbul

...

Russia*

Kittab

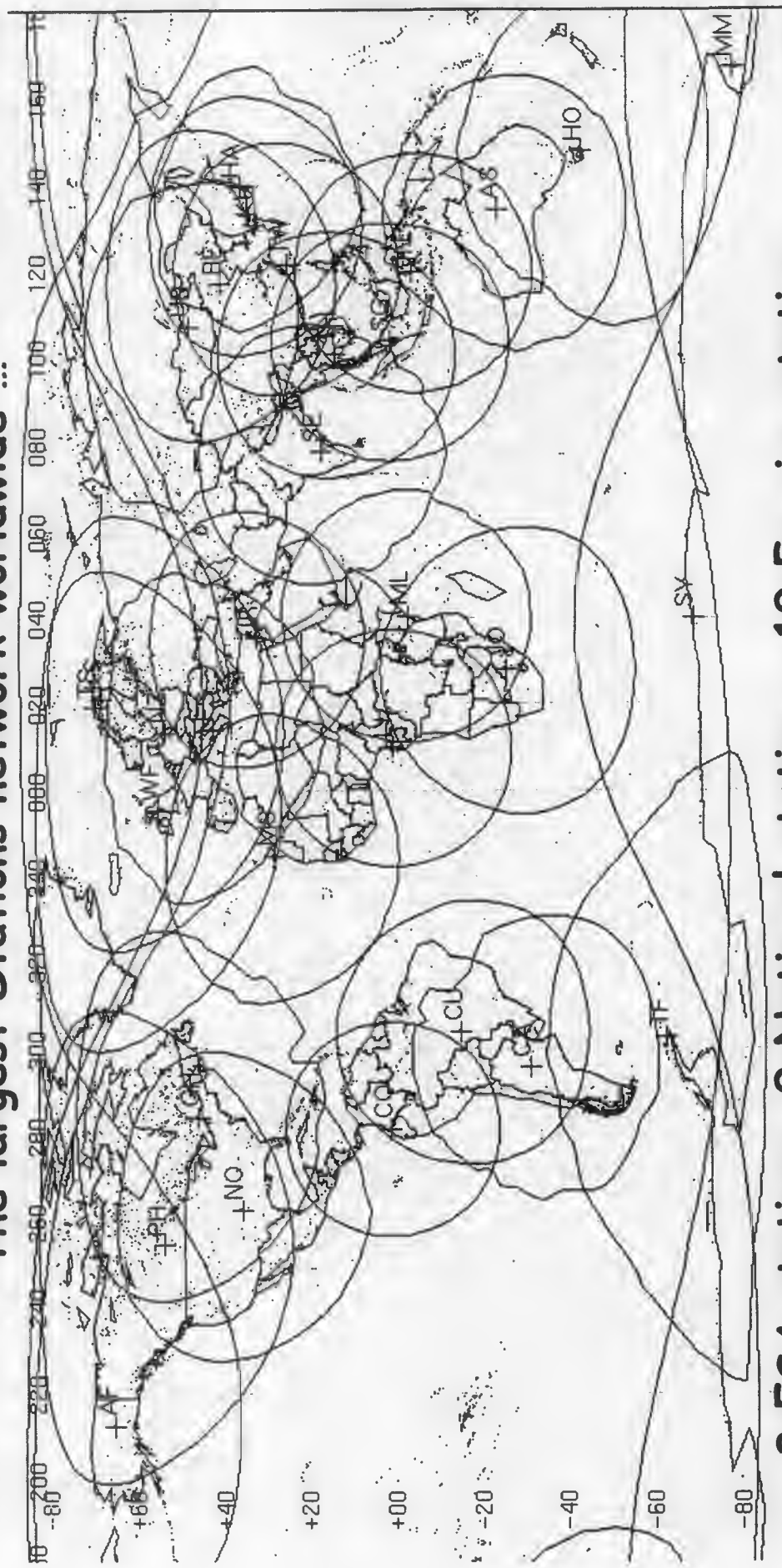
Bangladesh

* with ESA compact station



Current geographical coverage

The largest Stations network worldwide ...



3 ESA stations, 9 National stations, 19 Foreign stations ...



SAR main events

1st January 97 - 30 April 98

- Successful introduction of new SLCI user product for interferometric applications;
- First release of SAR interferometry images using the Interferometric Quick-Look processor IQL;
- New ERS Home page: <http://earth1.esrin.esa.it/ERS/>;
- New DESCW catalogue with a lot of enhancement;
- Quick-Looks available on the SAR product catalogue;
- Earthnet Online now directly accessible through very high speed networks;
- 3rd ERS symposium in Florence (Italy);
- Third ERS Announcement of Opportunity;
- Envisat AO open (up to the 2nd June 98 !);
- Indonesia and Brazil fires (Nov 97);
- Floods monitoring in Portugal (11/97) in Germany and Poland (summer 97), Red River (USA-Canada, April 97);
- Earthquake planning with ERS-2 over Foligno in Italy (Autumn 97);



Main Achievements since last 6th ESOWG meeting

- ESOWG VII, Toulouse, 28-29 May 1998



Topics to be discussed

- Main achievements since the last ESOWG meeting;
- SAR events;
- 31 stations worldwide;
- New stations coming up...;
- 2nd Tandem coverage;
- Transcription of NFS SAR data;
- AO3 status;
- Important and interesting issue with Interferometry...;
- Interfaces with stations;
- Growing interest with mobile or portable stations;
- Y2k compliance...;
- Conclusions.



The National & Foreign stations partners of the ground segment

By
Jean-Charles Bigot
ESA/ESRIN

ERS User Services Mission Planning Status and News

ESOWG 7
Toulouse 28-29-May-1998

Simon Jutz APP-AEU
Remote Sensing Exploitation Department

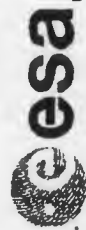


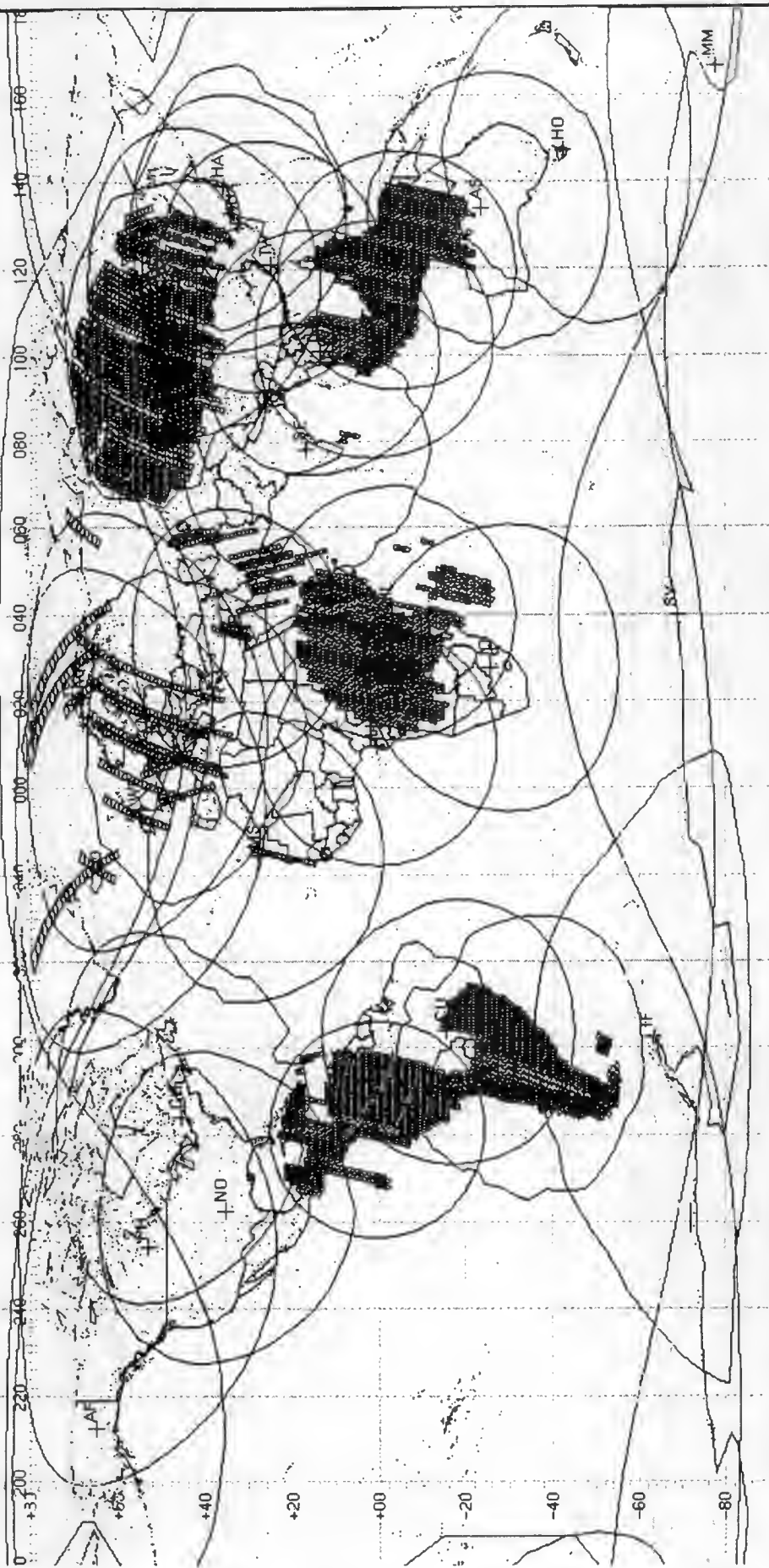
ESRIN - usERServices

ERS-1&2 Mission Phases

<i>Mission Phases</i>	<i>Start</i>	<i>Cycle</i>	<i>SAR Mission Objectives</i>
ERS-1 (Launch / Payload switch-on)	17-Jul-91		
A Commissioning	25-Jul-91	3 days	all instruments; until 10-Dec-91
B Ice	28-Dec-91	3 days	ice & pollution; interferometry possibil.
R Roll-tilt (Experimental)	02-Apr-92	35 days	Different SAR incidence angle (35 deg)
C Multi-disciplinary	14-Apr-92	35 days	AO; land & ice mapping; consistent set
D 2nd Ice	23-Dec-93	3 days	see Phase B
E Geodetic	10-Apr-94	168 days	radar-altimetric mission; SAR as C
F Shifted Geodetic	28-Sep-94	168 days	8 km shift vs. phase E for denser grid
G 2nd Multi-disciplinary	21-Mar-95	35 days	see Phase C
G Tandem	17-Aug-95	35 days	Interferometry & mapping
G Back-up	2-Jun-96	35 days	regular instruments check-outs and Tandem campaign (22/09-29/10/97)
ERS-2 (Launch / Payload switch-on)	21-Apr-95		
A Commissioning	02-May-95	35 days	SAR commissioning
A Tandem	17-Aug-95	35 days	see ERS-1 Tandem Phase G
A Multi-disciplinary	3-Jun-96	35 days	see ERS-1 Phase C; Tandem campaign (22/09-29/10/97)

Note: 3 days = 43 orbits; 35 days = 501 orbits; 168 days = 2411 orbits

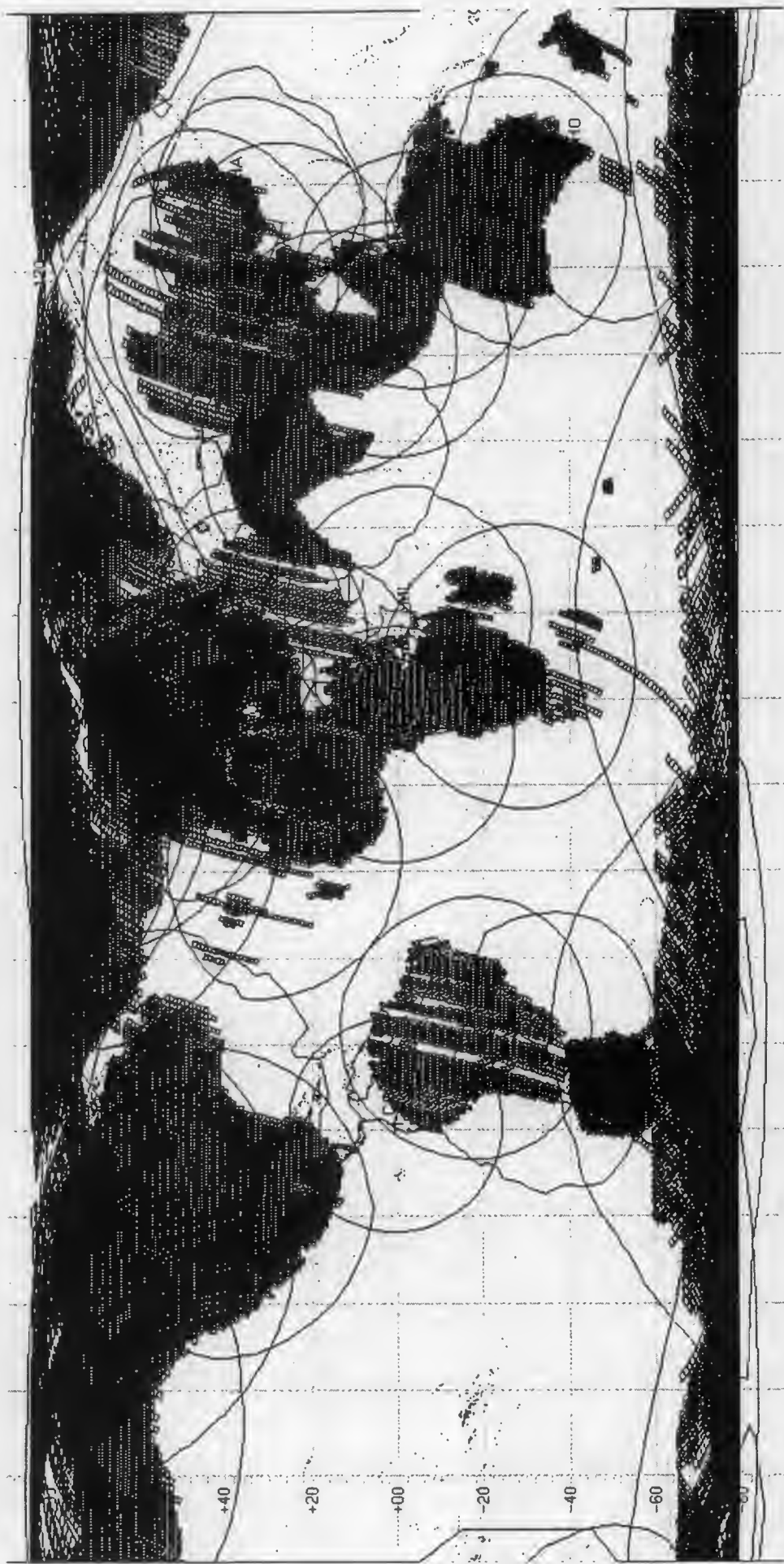




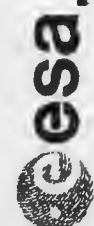
LEITEZ TANDEN PAIRS ACQUIRED AT STATIONS DURING TANDEN CAMPAIGN SEP-OCT 1997



ESRIN - usERServices



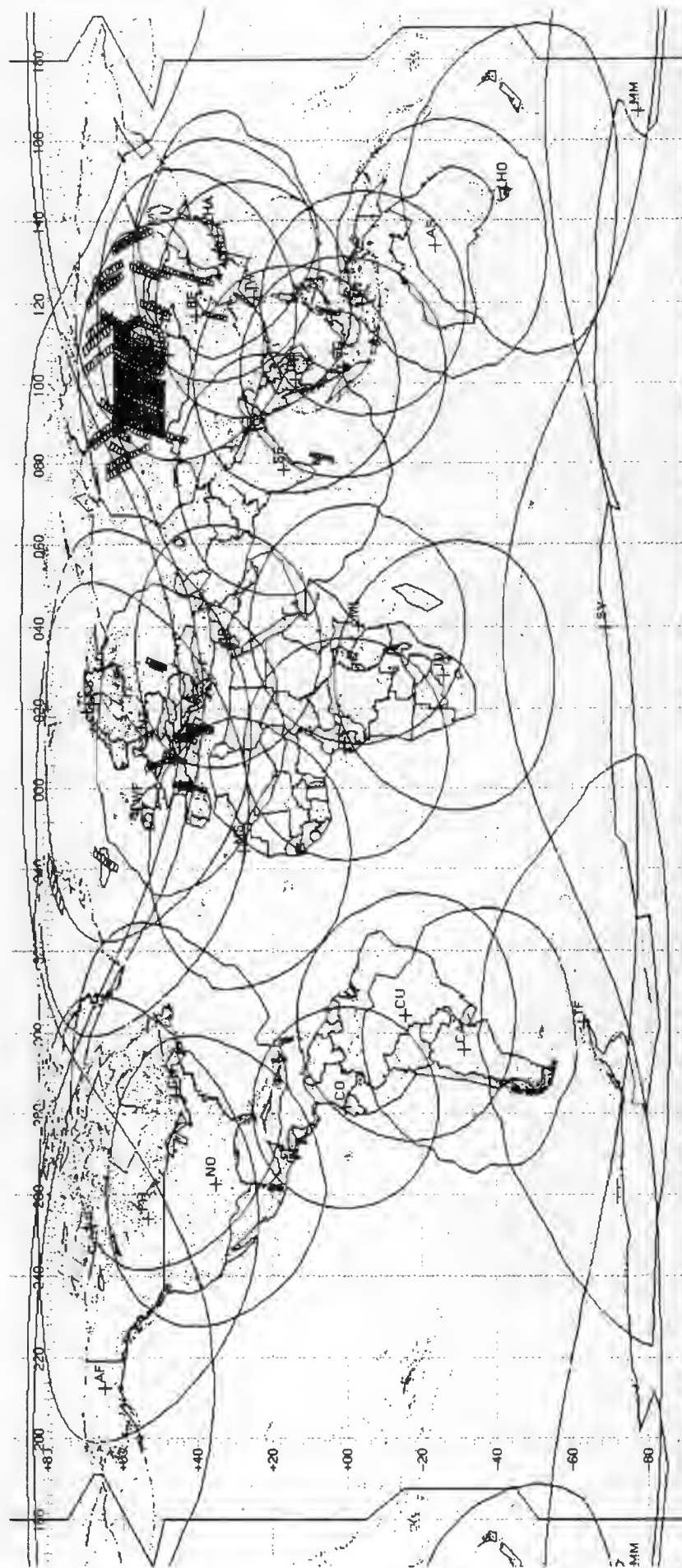
ET/E2 TANDEN PARS ACQUIRED AT STATIONS FROM DEC 195 TO MAY 19



CONNECTIONS

ESRIN - usERServices

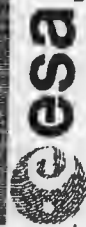
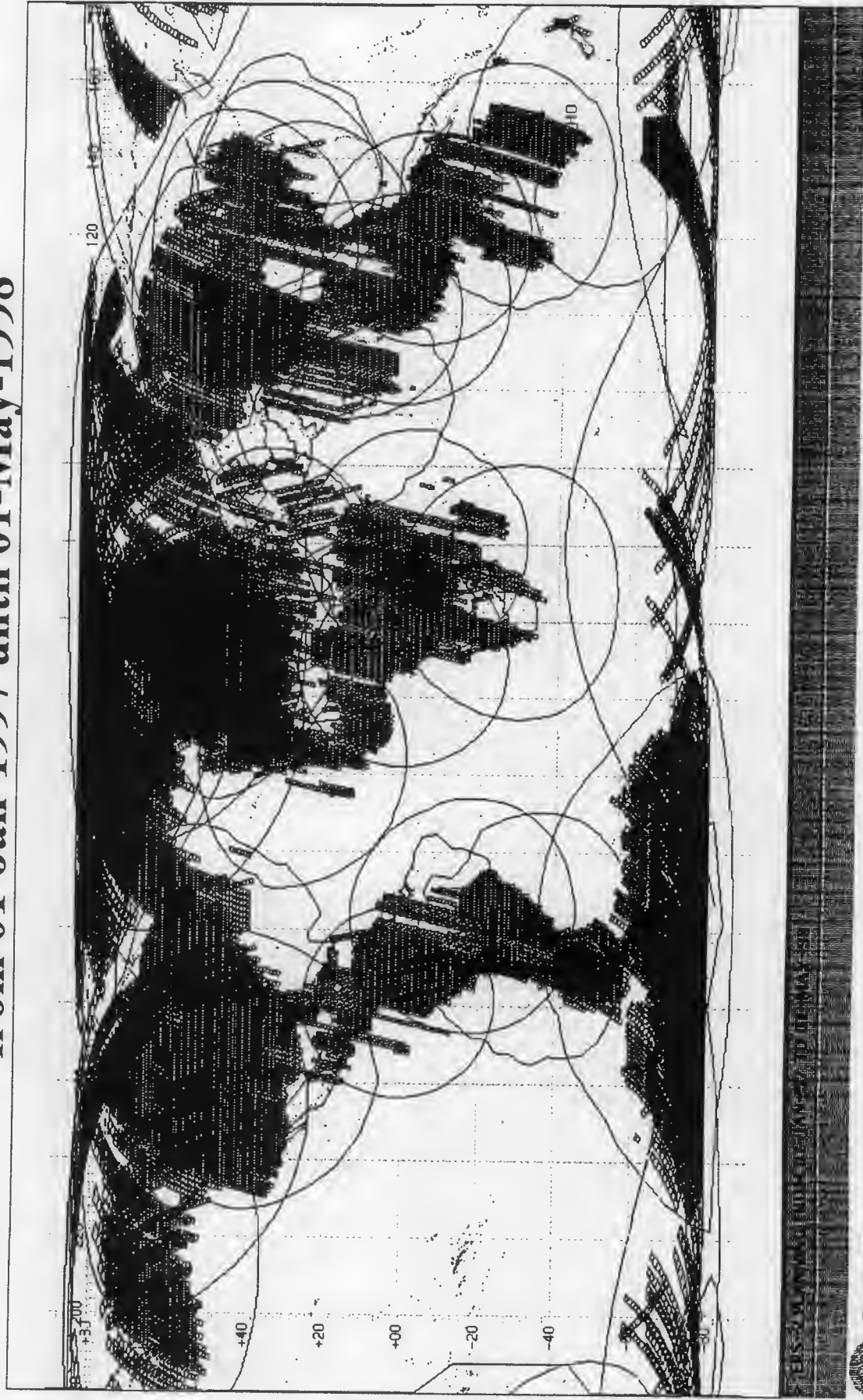
ERS-1 SAR ACQUISITIONS from 01-May until 21-Jun-1998



ESRIN - usERServices

ERS-1 SAR ACQUISITIONS

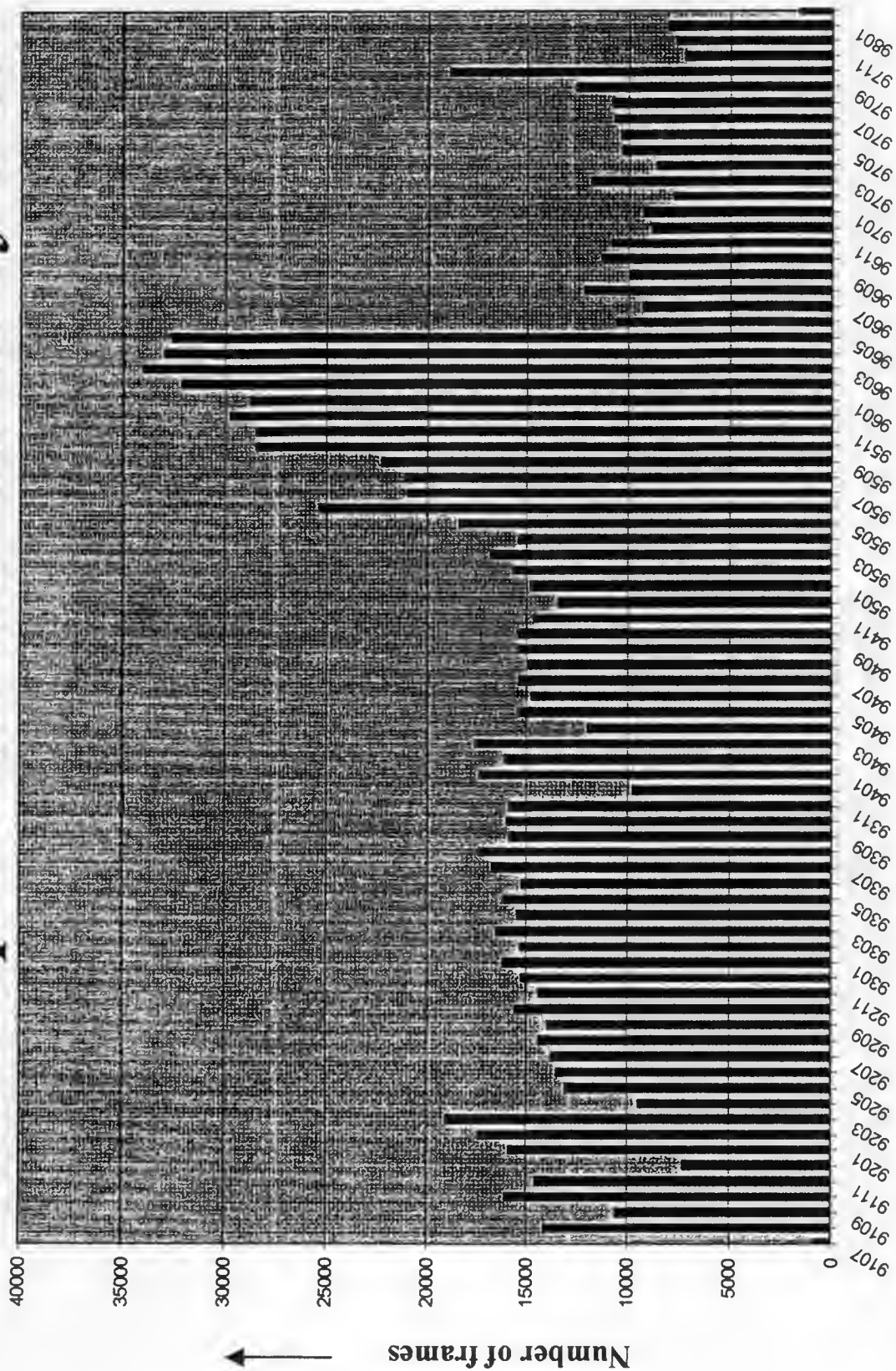
from 01-Jan-1997 until 01-May-1998



ERS-1 SAR ACQUISITIONS 01 JAN 1997 - 01 MAY 1998

ESRIN - usERServices

ERS Acquisition Worldwide by Time

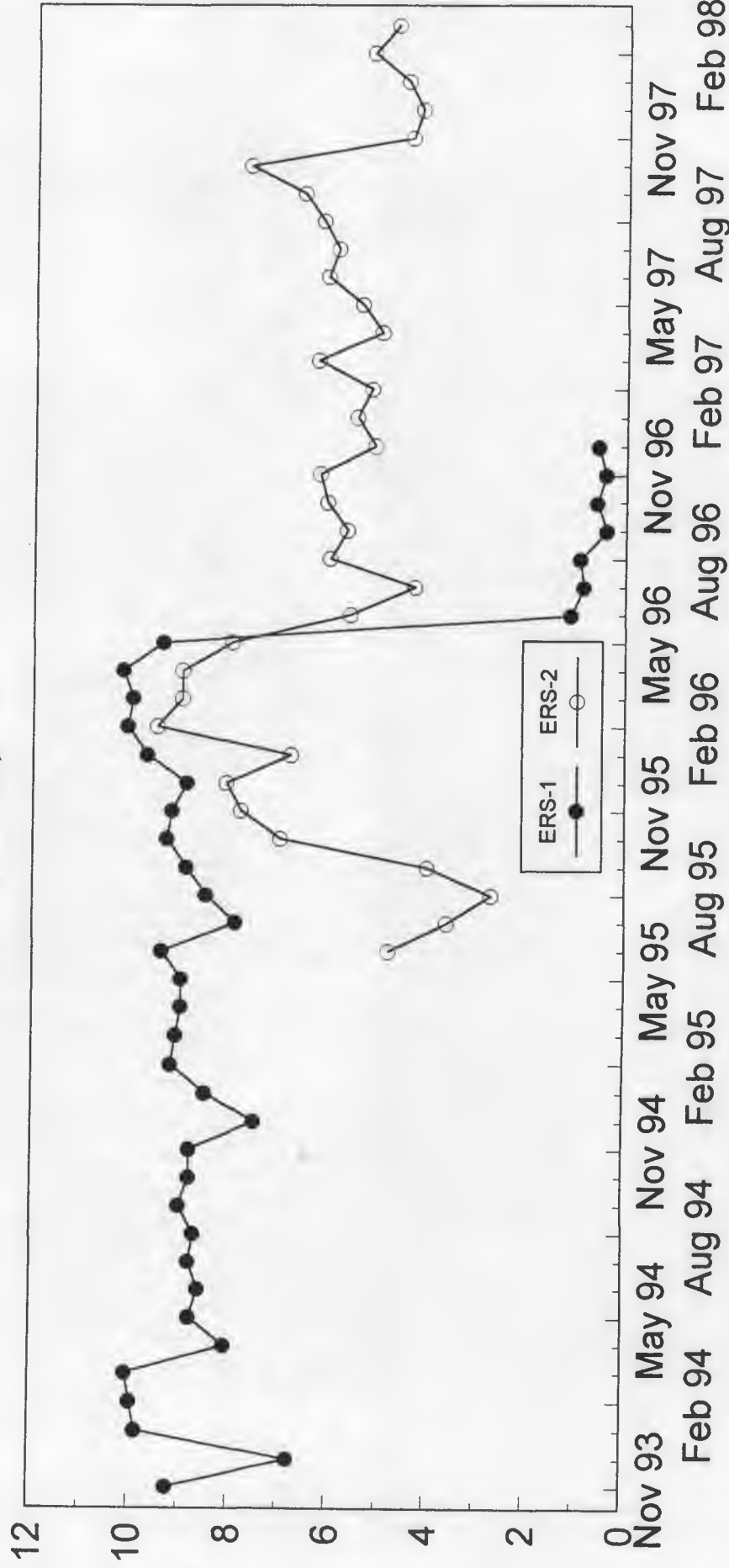


Acquisition Time

ESRIN - usERServices

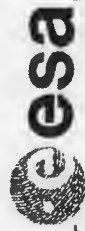
ERS SAR DUTY CYCLE

(minutes)



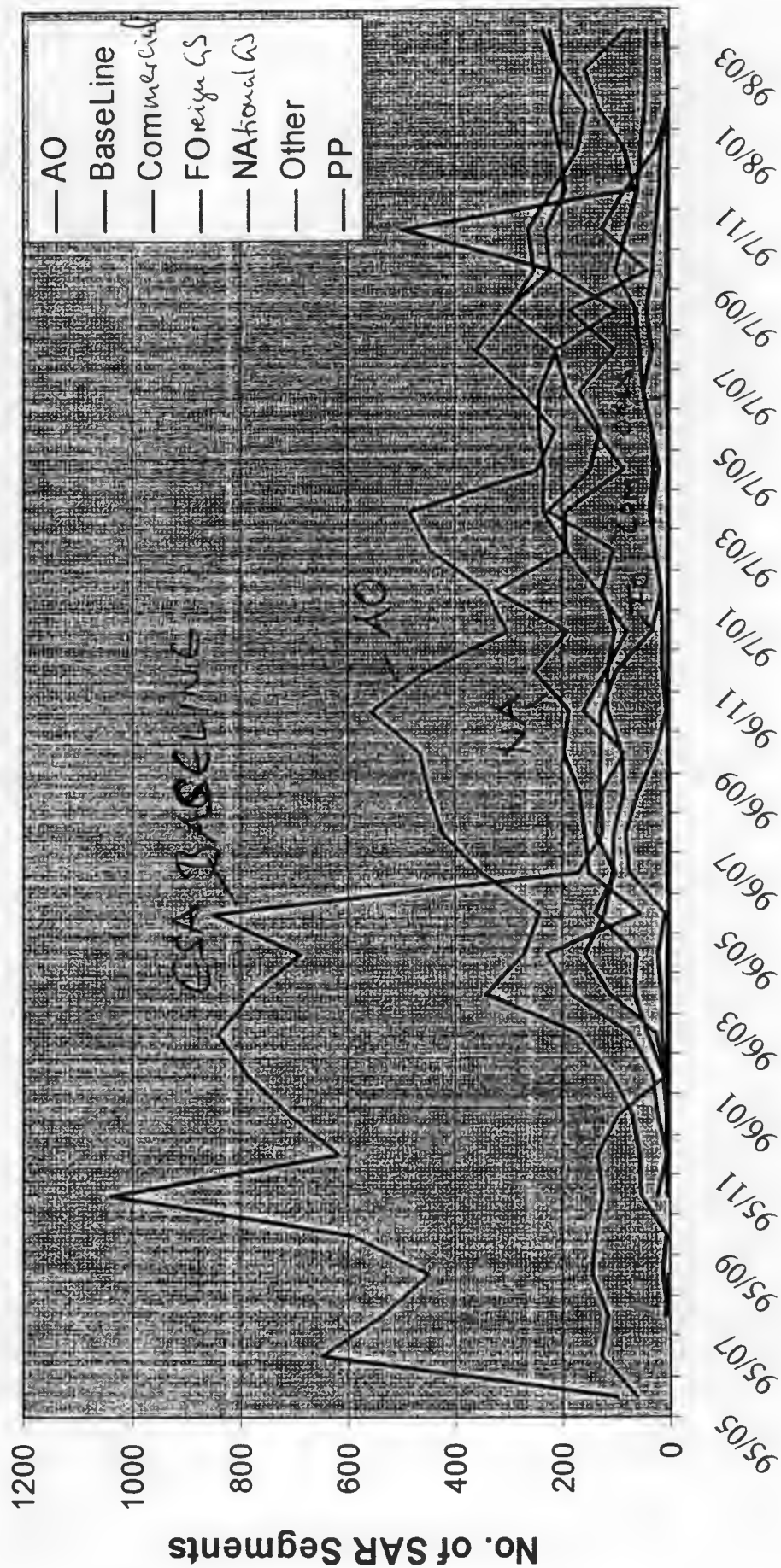
Notes: Dec 93: IDHT TWT failure

Dec 94: Long instrument thermal calibration



ESRIN - usERServices

ERS-2 SAR Segments by User Category from May/95 until Mar/98



months '95-'98



ESRIN - usERServices

SAR Frames Acquired

(as of end of March'98)

GROUND STATION	ERS-1 PHASES A-G	ERS-2 PHASE A	TOTAL
Alice Springs	22646	9809	32455
Bangkok	5838	1030	6868
Beijing	8044	16505	24549
Chung-Li	3791	2955	6746
Cordoba	1212	2035	3247
Cotopaxi	8503	2064	10567
Cuiaba	19362	6597	25959
Fairbanks	211827	35981	247808
Hatoyama	20691	829	21520
Hobart	3343	6009	9352
Hyderabad	24079	4748	28827
Johannesburg	6058	4737	10795
Kumamoto	14203	0	14203
McMurdo	13262	16570	29832
Norman	2674	2502	5176
Parepare	7522	1750	9272
Singapore	3826	9155	12981
Syowa	6524	1589	8113
Tel Aviv	1149	1220	2369
TOTAL FOREIGN	384554	126085	510639

GROUND STATION	ERS-1 PHASES A-G	ERS-2 PHASE A	TOTAL
Fucino	100659	57477	158136
Kiruna	257970	91712	349682
Maspalomas	33486	8442	41928
TOTAL ESA	392115	157631	549746
Aussaguel	4843	0	4843
Gatineau	101321	35603	136924
Libreville	5865	4991	10856
Malindi	1505	1684	3189
Neustrelitz	3819	14784	18603
O'Higgins	38040	24216	62256
Prince-Albert	150405	45851	196256
Tromsoe	218430	67826	286256
Ulan Bator	2841	2699	5540
West Freugh	53929	36333	90262
TOTAL NATIONAL	580998	233987	814985
GRAND TOTAL	1357667	517703	1875370

Distinct frames 848500 323439 1171939
 Distinct/Grand Total 62.50% 62.48% 62.49%



ESRIN - usERServices

NEW TOOLS for EO USERS

Display Earth Remote Sensing Swath Coverage for Windows (DESCW) updates:

- DESCW for Windows95
- Interferometric Baseline Window
- Quality Parameters for ERS data and Information on Stations' Campaigns
- new missions: ENVISAT ASAR Narrow and Wide Swath, MERIS, AATSR
- Backweb option
- new User Manual
- Year 2000 compliant
- available soon: Landsat 7 coverage, Search Tool for interferometric pairs,
File interface for inventory exchange between ground stations and satellite operators

Earthnet Online:

- New ERS mission page
- INSI: Interferometric SAR Sample Images
- online: ESA Multimission Remote Sensing Product Catalogue with ERS-1/2, Landsat, Jers-1, NOAA, Nimbus-7, IRS-P3, SeaStar missions
- many new Web pages on applications, e.g.: *Sea and Space* project brings the frontiers of technology into schools with lessons, exercises, fieldwork



ESRIN - usERServices

DESDAT windows Application

Full Map:1

Scene List

Scene	Date	Time	Lat	Long	Alt	Mag
001	E1	205709	022	2655	00	19970311 10-19
002	E1	205709	022	2673	00	19970311 10-19
003	E1	205711	022	2655	00	19970311 10-19
004	E1	205711	022	2673	00	19970311 10-19
005	E1	205711	022	2655	00	19970311 10-19
006	E1	205711	022	2673	00	19970311 10-19
007	E1	205711	022	2655	00	19970311 10-19
008	E1	205711	022	2673	00	19970311 10-19
009	E1	205711	022	2655	00	19970311 10-19
010	E1	205711	022	2673	00	19970311 10-19
011	E1	205711	022	2655	00	19970311 10-19
012	E1	205711	022	2673	00	19970311 10-19
013	E1	205711	022	2655	00	19970311 10-19
014	E1	205711	022	2673	00	19970311 10-19
015	E1	205711	022	2655	00	19970311 10-19
016	E1	205711	022	2673	00	19970311 10-19
017	E1	205711	022	2655	00	19970311 10-19
018	E1	205711	022	2673	00	19970311 10-19
019	E1	205711	022	2655	00	19970311 10-19
020	E1	205711	022	2673	00	19970311 10-19
021	E1	205711	022	2655	00	19970311 10-19
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050	E1	205711	022	2673	00	19970311 10-19
051	E1	205711	022	2655	00	19970311 10-19
052	E1	205711	022	2673	00	19970311 10-19
053	E1	205711	022	2655	00	19970311 10-19
054	E1	205711	022	2673	00	19970311 10-19
055</						

DESCW: EO Missions

Missions and Filters

Selected Missions

Miss	Date range	Orbit range	Track range	Frame range	Product	Status	Pass	Mission dependent	Phase(s) CODE
E1	19920414 19940927	3901	16745 0 0	9 7209	all	all	Both		

Mission and Sensor

ERS-1 SAR
ERS-1 ATSR
ERS-2 SAR
ERS-2 ATSR
JERS-1 SAR
JERS-1 VNIR
Landsat5
ENVISAT ASAR Narrow Swath
ENVISAT ASAR Wide Swath
ENVISAT MERIS
ENVISAT AATSR

Add

Remove

Mission Filters

Date Range: 19920414 Date Start: 19940927 Date End: 19940927

Orbit Range: 3901 Orbit Start: 16745 Orbit End: 16745

Track Range: 0 Track Start: 0 Track End: 0

Frame Range: 9 Frame Start: 7209 Frame End: 7209

☐ Only Data Archived to ESA

Inventory: ALL

System File: [Browse]

Status: ☒ Acquired ☐ Planned ☐ Visible

Pass: ☒ Asc ☒ Desc

Station: Fucino, Kiruna, Mas Palomar, Gaineau, Libreville, Prince Albert, O'Higgins, Tromsø, West Freugh, Neustadt, Fairbanks, Alice Springs, Beijing, Cotopaxi

Phase: A 7/91 - 12/91, B 12/91 - 3/92, C 4/92 - 12/93, D 12/93 - 4/94, E 4/94 - 9/94, F 9/94 - 3/95, G 3/95 - 7/96

OK Cancel Help



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Submit your Envisat AO proposal

Hot News



- DO NOT MISS
- Earthnet online BackWeb



ESA Remote Sensing Missions

- ERS home page



Remote Sensing Products & Images



Remote Sensing over the World



ESA Multimission Remote Sensing Product Catalogue

SOFTWARE
ALGORITHMS
(INTERCOMPARISON)
DATA SAMPLES



www.esa.int

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Location: <http://earth1.esa.int/ERS/>

What's New? What's Cool? Destinations: Net Search People E-News

ESA ERS Home Page

[ERS Page Control Tool](#)

[All News](#)

[The ERS Satellites](#)

- [Instruments Design](#)
- [Ground Segment](#)
- [Satellites Design](#)

[Mission & Applications](#)

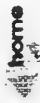
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- [Instruments in operation](#)
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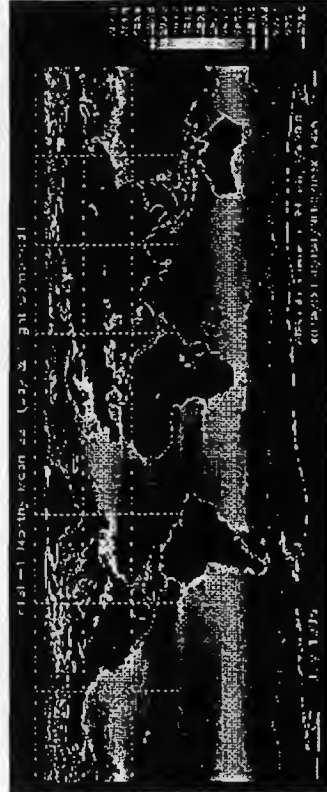
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to the ESA ERS home page

Click on the above items to go to the appropriate News



Click on the image for more information on El Nino



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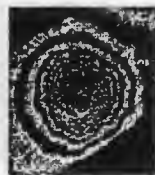
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INSAR Sample Images

[ESA Copyright Page](#)

Welcome to the ERS Tandem Mission INSAR Sample Images

SAR Interferometry (INSAR) is currently a hot topic which is rapidly evolving thanks to the spectacular results achieved in various fields such as the monitoring of earthquakes, volcanoes, land subsidence and glacier dynamics, also in the construction of Digital Elevation Models (DEM's) of the Earth's surface and the classification of different land types. A sample of interferometric images obtained with the Synthetic Aperture Radar (SAR) instrument on-board the ESA ERS satellite are displayed here as examples.

The sample images have been generated at ESRIN by a prototype

Geographical Location

World
Africa
Arctic
Asia
Europe

Sat1/orbit/Sat2/orbit/First-frame/Last-frame

ERS1_20551_ERS2_878_2187_2223
ERS1_21159_ERS2_1486_729_747
ERS1_21660_ERS2_1987_747_747
ERS1_21943_ERS2_2270_2305_2637

[Add Map](#)

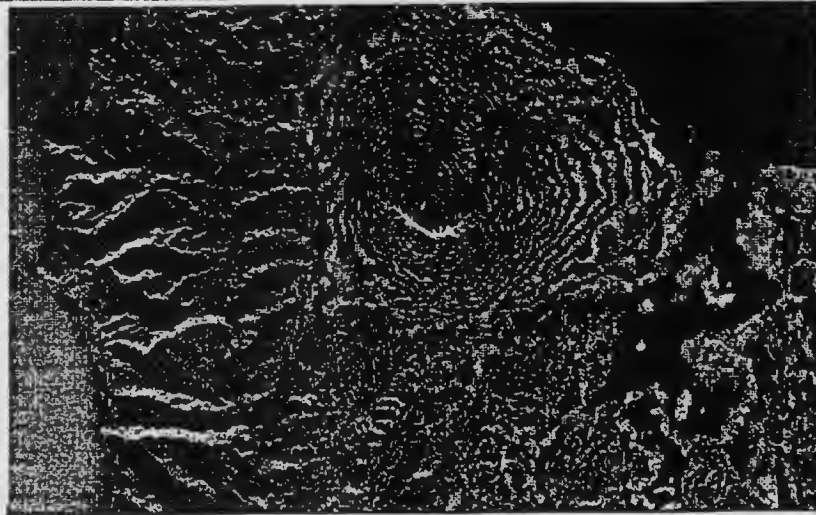
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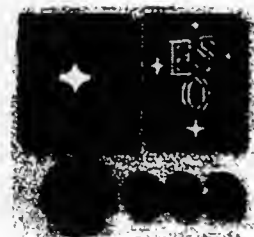
[ILU Images](#)



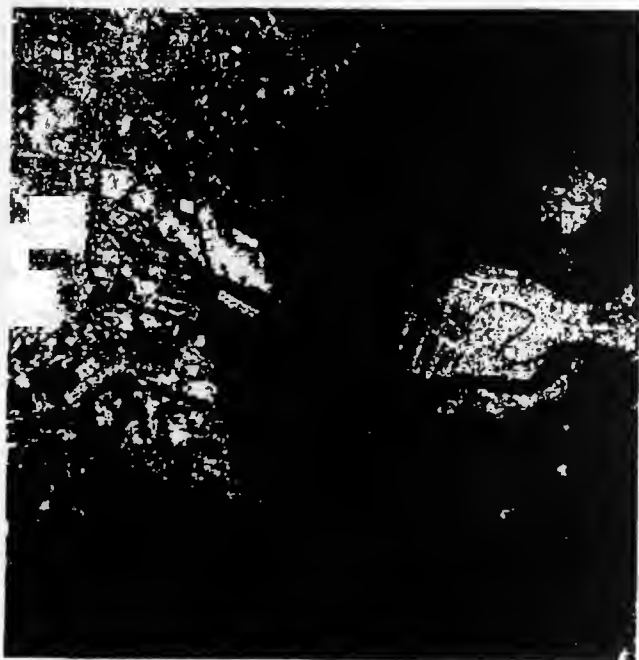
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Sea and Space



Welcome to Sea and Space



Venezia (Venice) - city in the sea.

The work of participants will eventually be featured here.

About

Sea & Space National Contact Addresses
National Brochures

Participants
[Joining] [Bulletin Board]

Remote Sensing
[lessons & exercises]

Navigation
[lessons & exercises] [fieldwork]

Water, Water, Everywhere!
Oceans of Water

CONTEST

Glossary
FAQs & Links

A Brief Introduction to Sea & Space

Sea & Space International Steering Committee

Press Release about Sea & Space

NOTICES

Webmaster

ERS and ENVISAT WEB Pages

- <http://www.esrin.esa.it>
- <http://earthnet.esrin.esa.it>
- <http://envisat.estec.esa.nl>
- <http://www.esa-a0.org>

CONTACT POINTS at ESRIN

- ▼ **FIRST LEVEL HELP DESK (Multimission, Information / Documentation / Order - any user)**
 - E-mail: eohelp@esrin.esa.it Tel.+39-6- 94180-777 Fax-272
- ▼ **ESA HELP DESK (Information / Documentation - any user)**
 - A. Celentano, M-T. Ferri Tel.-740/-780 Fax-272
- ▼ **ERS ORDER DESK (Orders from PIs / PPs and Nat./Foreign Stations)**
 - L. Fontebasso, R. Guerrieri, R. Scipioni Fax-292
 - F. Cattaneo (tape shipment requests), S. Lufrano Tel.-754/-791/-767
Tel.-749/-761
- ▼ **CORE SERVICES**
 - M. Sansone (Acquisition Planning) Fax-280
 - E. Ippolito (Production Planning) Tel.-774
Tel.-759
 - C. Fonti, A. Iacobacci (Stations' Report Monitoring, CUS Catalogue) Tel.-755/-758
 - R. Mosti (ISS Manager, Data Transfer) Tel.-766
 - ERS/ISS Operators (Schedule Transmission) Tel.+39-6-9416710 Tel.-692 Fax-202
- ▼ **CUSTOMER SERVICE of ERSC members (Commercial Users)**
 - EURIMAGE: Tel.+39-6- 94180-752/-760/-741 Fax +39-6-9416109 and -9416772
 - RADARSAT Int.: Tel. +1-604-2440400 Fax +1-604-2440404 (Richmond, Canada)
 - SPOTIMAGE: Tel. +33-5-62194040 Fax +33-5-62194051 (Toulouse, France)



ESRIN - usERServices



ESOWG Meeting

May 28-29th, 1998



SUMMARY

ERS-Consortium

Sales statistics

Service provided to clients

Technical restrictions to sales & Economical aspect

ESOWG Meeting

May 28-29th, 1998



ERS-Consortium

Eurimage : Europe, North Africa, Middle East

Radarsat International : Canada & USA

Spot Image : Latin America, Asia (Spot Asia) ,

Australia (Spot Imaging Services), Africa

France (sub-distributor to Eurimage)

SPOT Image/SICORP , Eurimage, RSI : USA

SPOT Image interface with DRS for the ERS-Consortium

ESOWG Meeting

May 28 - 29, 1998



SPOT
IMAGE

Sales per product type & media for 1997

- PRI
- GEC
- SLC
- RAW
- LBR

46



- Exagytes
- CD-Roms

60 %



6

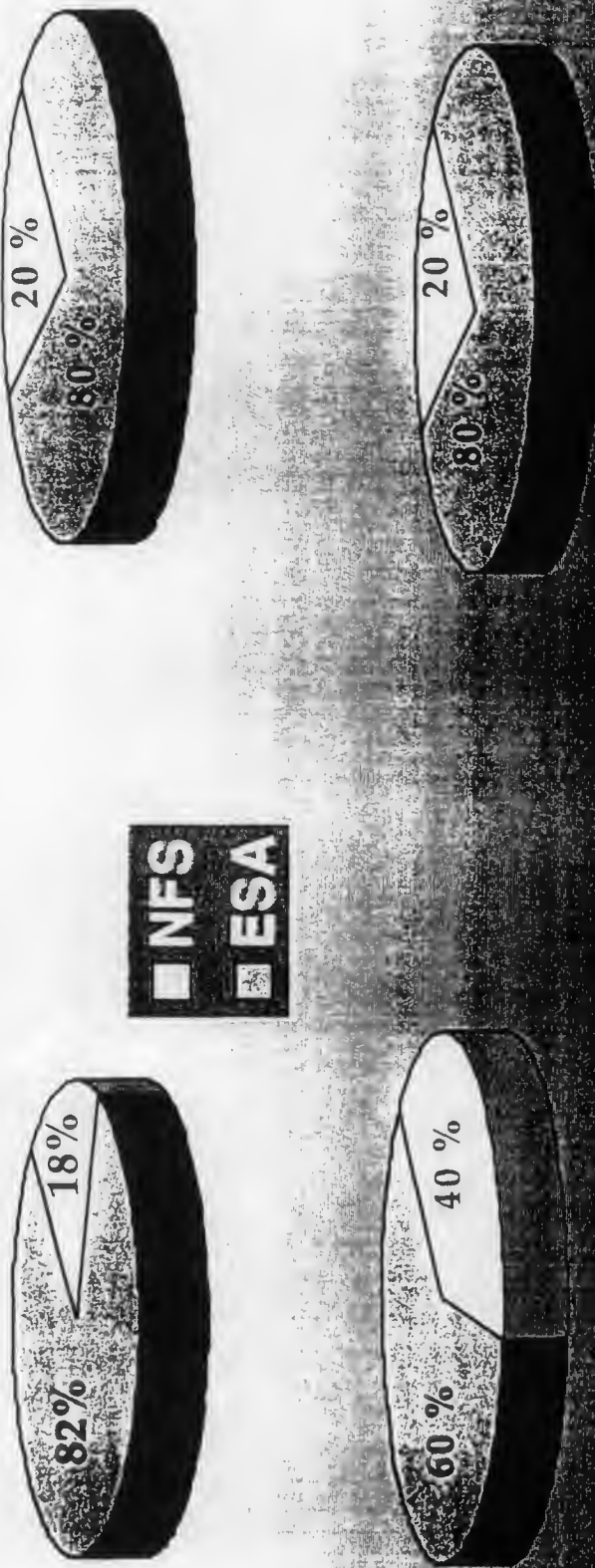
ESOWG Meeting

May 28 - 29, 1998

S P O T
I M A G E



Products ordered to ESA & to national and foreign Stations (percentage)



ESOWG Meeting

May 28 - 29, 1998



SPOT
IMAGE

Number of products per station - Period 1994-1997

□ 1994
□ 1995
□ 1996
■ 1997

60

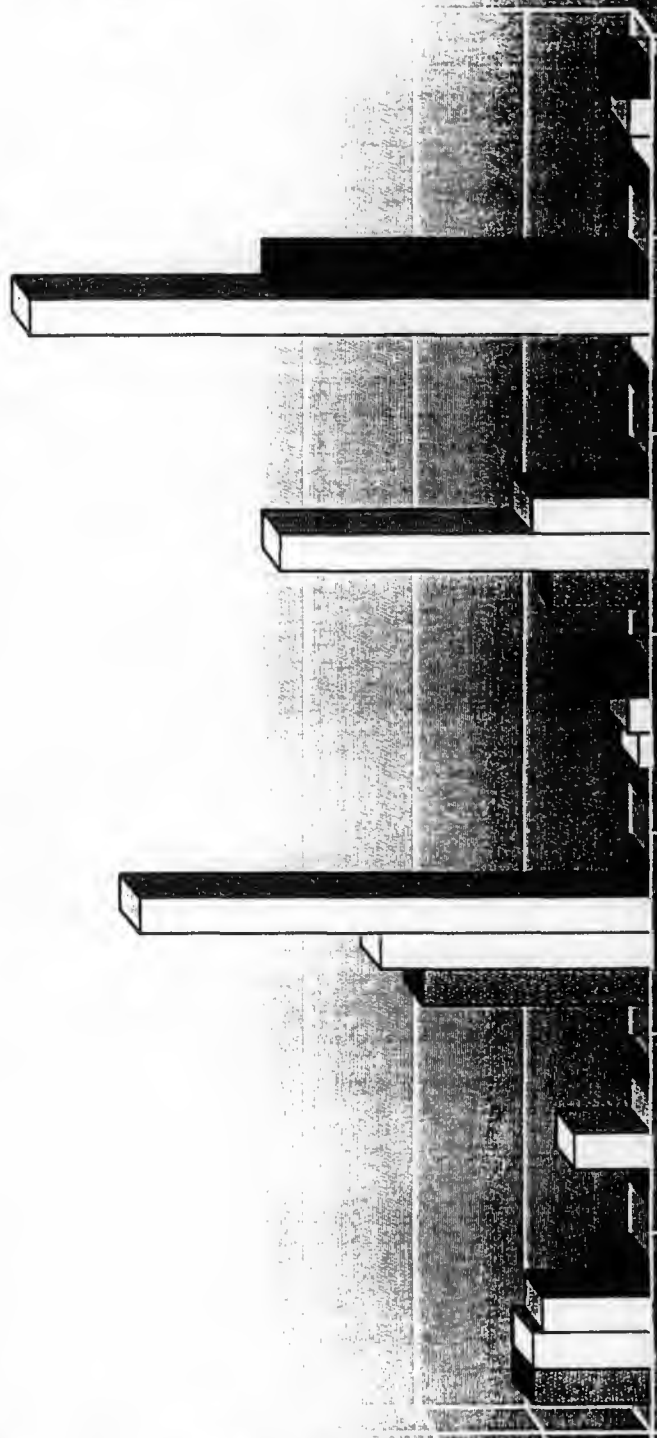
50

40

30

20

10



ESOWG Meeting

May 28-29th, 1998



Service provided to clients today

Catalog information :

- * DESCW (hddt from DRS archived by ESA)
- * CUS (availability of the data to be checked with the DRS)
- * DRS catalog (fax or mail messages)
- * DRS Internet web sites

Quick-looks (weather & location of image check)

* print sent by fax (poor quality) or mailed (too long)

* via Internet

ESOWG Meeting

May 28-29th, 1998



Service improvements

 Administrative follow-up :

Acknowledgment of orders & shipping information

 Delivery time :

NFS have considerably improved delivery time

NFS propose a rush (+50%) and urgent (+30%) processing service when needed

 Catalog alternatives :

In case of a quality problem, the NFS propose alternative scenes thus reducing delays for our clients

ESOWG Meeting

May 28-29th, 1998



Technical restrictions to sales

Commercial users need one product specification whatever the processing entity

National users will not face this problem except when they need data from an area covered by another NFS

Some applications require specific product specifications only processed by ESA PAFs : SLC Interferometry for example

ESOWG Meeting

May 28-29th, 1998



Contractual aspects

Consortium orders

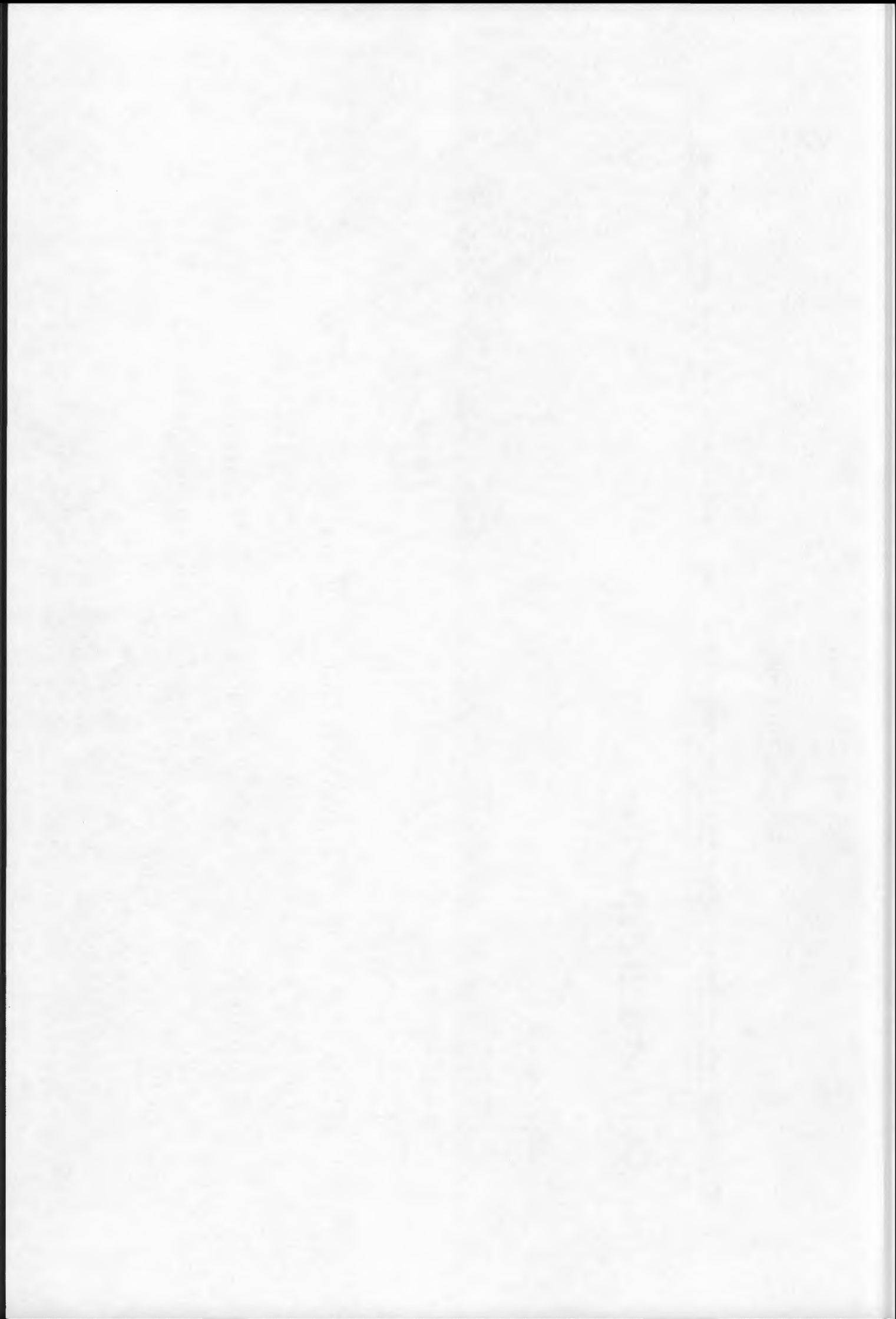
SPOT Image places the orders to the NFS for the Consortium members who are charged directly by the NFS

ESA archive

More and more scenes are made available to our clients by ESA PAFs thanks to the NFS efforts in copying their archive

Leading to a direct competition between partners

A solution must be found to satisfy all parties involved in the distribution and promotion of ERS data



SPOT and ERS SAR data

May 1998

S P O T
IMAGE



SPOT IMAGE and radar

- Current status:

- 1- Spot Image and the distribution of SPOT and radar data**
- 2- Complementarity between SPOT and space-borne SAR data**
 - 2.1) Localisation using ERS ; rectification of SPOT using ERS**
 - 2.2) The contribution of coherence imagery for mapping and thematic mapping**
- 3- Examples of operational applications combining optical and radar**
- 4- On going research and development within the radar scientific community and with our industrial partners**

SPOT and ERS SAR data

May 1998



**SPOT
IMAGE**

SPOT IMAGE: 10 years experience of distribution

- **Providing SPOT and Radar imagery world-wide**
- **Member of the ERS Consortium for ERS SAR**
- **Distributor for RADARSAT SAR data**
- **3 subsidiaries: USA, Australia and Singapore**
- **80 SPOT IMAGE distributors on 5 continents**

The SPOT IMAGE approach of service:

- ⇒ **a commercial Distribution Network**
- ⇒ **a dedicated Customer Service**
- ⇒ **a Project Department**
- ⇒ **a Radar Applications team**
- ⇒ **a Products and Services Development team**

SPOT and ERS SAR data

May 1998



**S P O T
I M A G E**

- **SPOT imagery:**

A reference in the field of geographic information

- ◇ **high resolution optical data**
- ◇ **operational and flexible system**

- **SAR systems offers unique capabilities:**

- ◇ **all-weather, day-and-night acquisitions**
- ◇ **excellent geometric and radiometric accuracy**

⇒ providing multi-source solutions to user needs

SPOT and ERS SAR data

May 1998



SPOT
IMAGE

SPOT IMAGE: three systems for a better service

- the **SPOT** system

Unrivaled acquiring capabilities

3 satellites in operation: SPOT-1,2,4

On board recording capabilities of SPOT-4

- the **ERS** system

The ERS-2 satellite in operation

> 2 million archived scenes

Tandem capabilities combining ERS-1 and ERS-2

- the **RADARSAT** system

1 satellite with operational capabilities in the radar domain

Flexibility of acquisition modes

On board recording capabilities of RADARSAT

SPOT and ERS SAR data

May 1998

S P O T
I M A G E



- **SPOT and Radar:**

A portfolio that takes into account user's needs

- ◇ **independently, optical and radar data may be needed**
- ◇ **optical and radar can be combined at various levels**
- ◇ **projects to make the references of space-borne SAR**
- ◇ **operational provision chains for products & services**

- **Complementarity between SPOT & SAR:
What is the status ?**

SPOT and ERS SAR data

May 1998



• Complementarity between SPOT & SAR

Principle of complementarity: Redundancy and Synergy

- Redundancy

*ERS Multi-band amplitude/coherence imagery
Fine Mode RADARSAT*

- Synergy by complementarity

*Localisation using ERS
Radargrammetry using RADARSAT
Fine Mode RADARSAT*

- Synergy by combination

*Combination of SPOT XS, ERS Multi-band amplitude/coherence imagery
and RADARSAT SAR*

The KEY ASPECTS:

- . Do technically feasible methods exist ?
- . What is the operational level ?

SPOT and ERS SAR data

May 1998

SPOT
IMAGE



• Complementarity between SPOT & SAR

The principles of complementarity are twofold:

Redundancy and Synergy

1) Redundancy:

- radar imagery as a surrogate to SPOT data
*when acquisitions are made difficult
due to illumination conditions (clouds)*
- radar to provide equivalent information in equivalent conditions
radar data in SPOTVIEW format by Spot Image

SPOT and ERS SAR data

May 1998

SPOT
IMAGE

• Complementarity between SPOT & SAR

- Redundancy and Synergy -

2) Synergy:

- based on double coverage by both radar and SPOT data
synergy by complementarity in the information chain
synergy by combination of radar and optical data
- radar and SPOT data to provide the needed information on an operational basis

SPOT and ERS SAR data

May 1998

S P O T
IMAGE



• Complementarity between SPOT & SAR

Synergy by complementarity:

- each data source exploited for its specific contribution to the information chain performances**

e.g.

- i) . the geometry of SAR**
 - . the information content of SPOT (P, XS)**
- ii) . acquisition capabilities of SAR in the short term**
 - . flexibility and control of the SPOT system**

• Complementarity between SPOT & SAR

Synergy by combination:

- each data source exploited in parallel with the objective to generate dual products or fused products

- ✓ providing dual data products

e.g. image maps package based on

- *SPOTVIEW Plus products*
- *ERS SAR products in SPOTVIEW format:*

- MAPPING AND MONITORING OF ILLICIT CROPS IN THE TROPICS -

SPOT and ERS SAR data

May 1998

SPOT
IMAGE



• Complementarity between SPOT & SAR

Synergy by combination:

- each data source exploited in parallel with the objective to generate dual products or fused products
- ✓ providing thematic products by multi-sensor image fusion
e.g. forest pre-inventory maps and yield maps by fusion of:
 - SPOT XS data
 - ERS Multiband amplitude/coherence data
 - RADARSAT SAR data

- TROPICAL FORESTRY PACKAGE FOR LOGGING COMPANIES -

SPOT and ERS SAR data

May 1998



**SPOT
IMAGE**

• Complementarity between SPOT & SAR

Spot Image SPOT & Radar products/services offer:

- Redundancy**

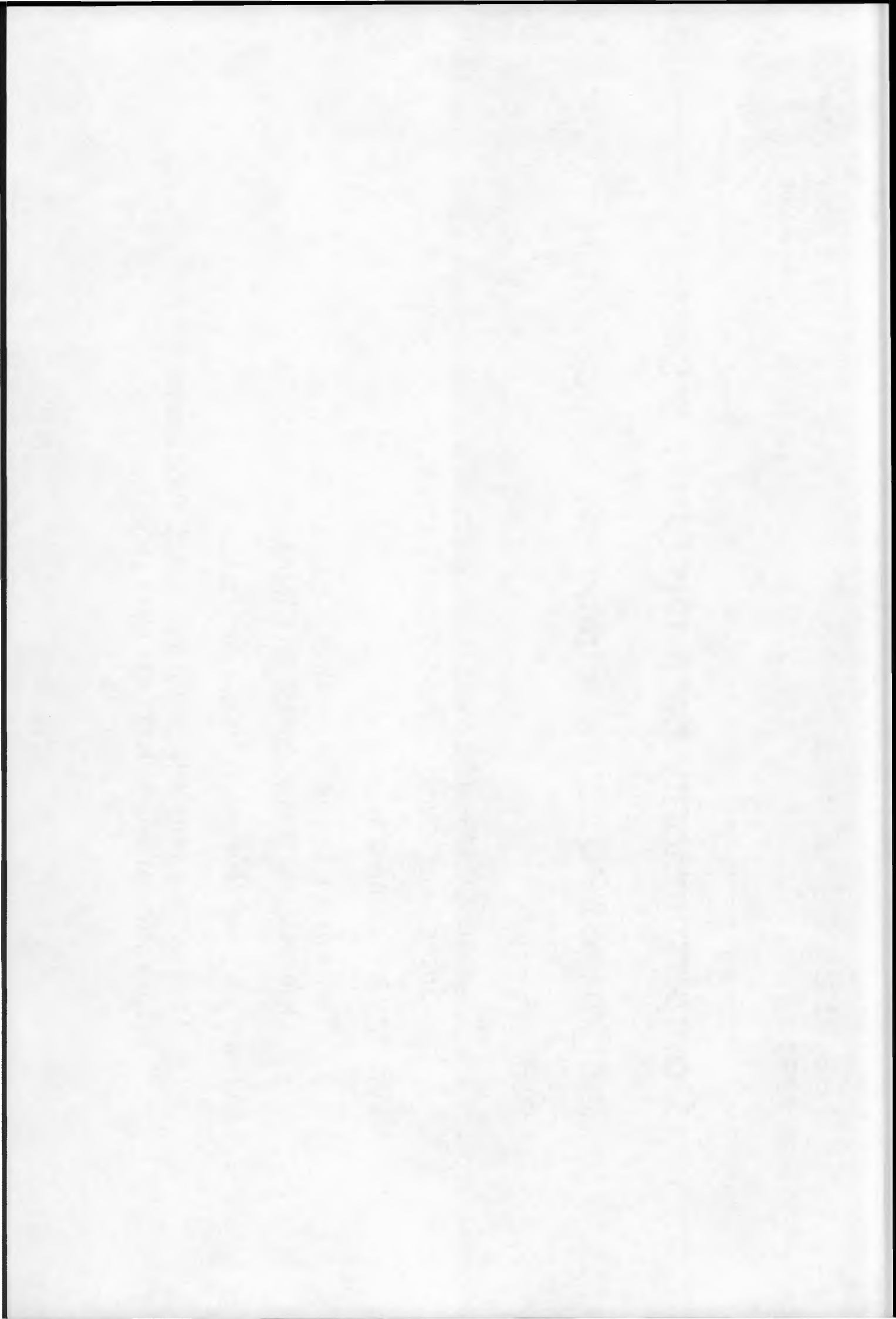
Technically feasible methods exist: YES
Operational level: SEMI-OPERATIONAL

- Synergy by complementarity**

Technically feasible methods exist: YES
Operational level: OPERATIONAL

- Synergy by combination (e.g. data fusion)**

Technically feasible methods exist: Not mature
Operational level: NOT OPERATIONAL



ERS SAR Imagery

Tropical Forestry

V1.FO 1

S P O T
I M A G E



ERS SAR data for Tropical Forestry

ERS SAR Imagery

Tropical Forestry

V1.FO 2

S P O T
I M A G E

ERS SAR imagery for forestry and land use applications

➤ Objectives:

- Forest / non-forest maps
- Plantation monitoring
- Deforestation monitoring
- Forest fires monitoring



➤ 2 approaches:

- Multitemporal analysis
- Interferometric approach

ERS SAR Imagery for Forestry and land use application

- Scattering effect of the SAR signal (C-band) is composed:
 - Volume scattering: upper layer of the canopy: leaf and stem
 - dense canopy : rain forest, dense plantation (biomass >50t/ha)
 - Multiple-bound scattering: leaf, stem and trunk
 - less dense canopy: young plantation, shrubs, ...
 - Surface scattering : depends on surface roughness and soil moisture
 - bare soil, water bodies



Multitemporal Analysis

- Which information can be retrieved ?
 - From the backscatter intensity
- ✓ Thematic information:
 - Land cover type, surface roughness, soil moisture
- ✓ Relief information:
 - Terrain relief induces radiometric distortions (which masks thematic information)

Multitemporal Analysis

- Which information can be retrieved ?
 - From the backscatter intensity change (ratio image)
- ✓ Thematic information:
 - Temporal change of the target
 - Change in land use, flooding, clear cuts ...
 - Time interval between the 2 acquisitions should be chosen in relation with the required information:
 - . Long time interval for very stable target: forest;
 - . Short time interval for plantation with rapid growth cycle)
- ✓ Relief information:
 - Relief distortions are removed (ratio image)
 - Remaining radiometric distortions are removed



An example: Forest Monitoring in Indonesia

Tropical forest: one of the major natural resources of Indonesia covering about 60% of the total area

Most of existing forests destroyed:

- shifting cultivation,
- logging,
- (semi) permanent settling of transmigrated population,
- a region characterized by rapid depletion of the rain forest.



An example: Forest Monitoring in Indonesia

ERS SAR data to Map and Monitor

Deforestation in South-Sumatra

◆ Objectives:

- ✓ Forest/non forest discrimination
- ✓ Forest/non forest map
- ✓ Deforestation monitoring

ERS SAR Imagery

Tropical Forestry

V1.FO 8

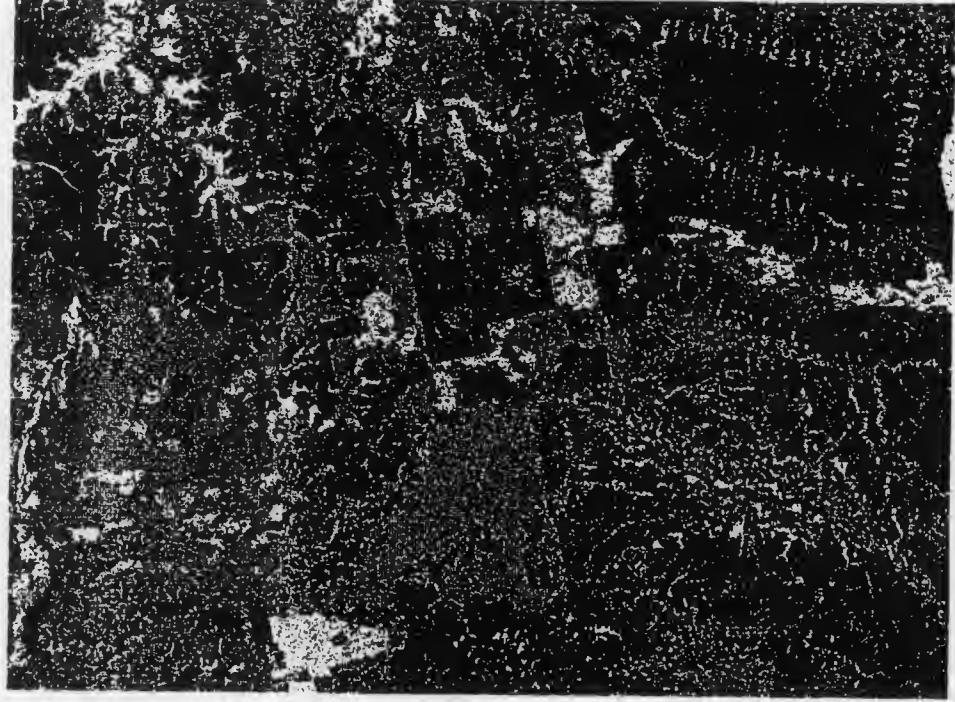


SPOT
IMAGE

An example: Forest Monitoring in Indonesia

Forest/non-forest
map over
a region of
South-Sumatra
(extract)

Green: forest



© esa 1997 - processed by CESBIO

CESBIO Project

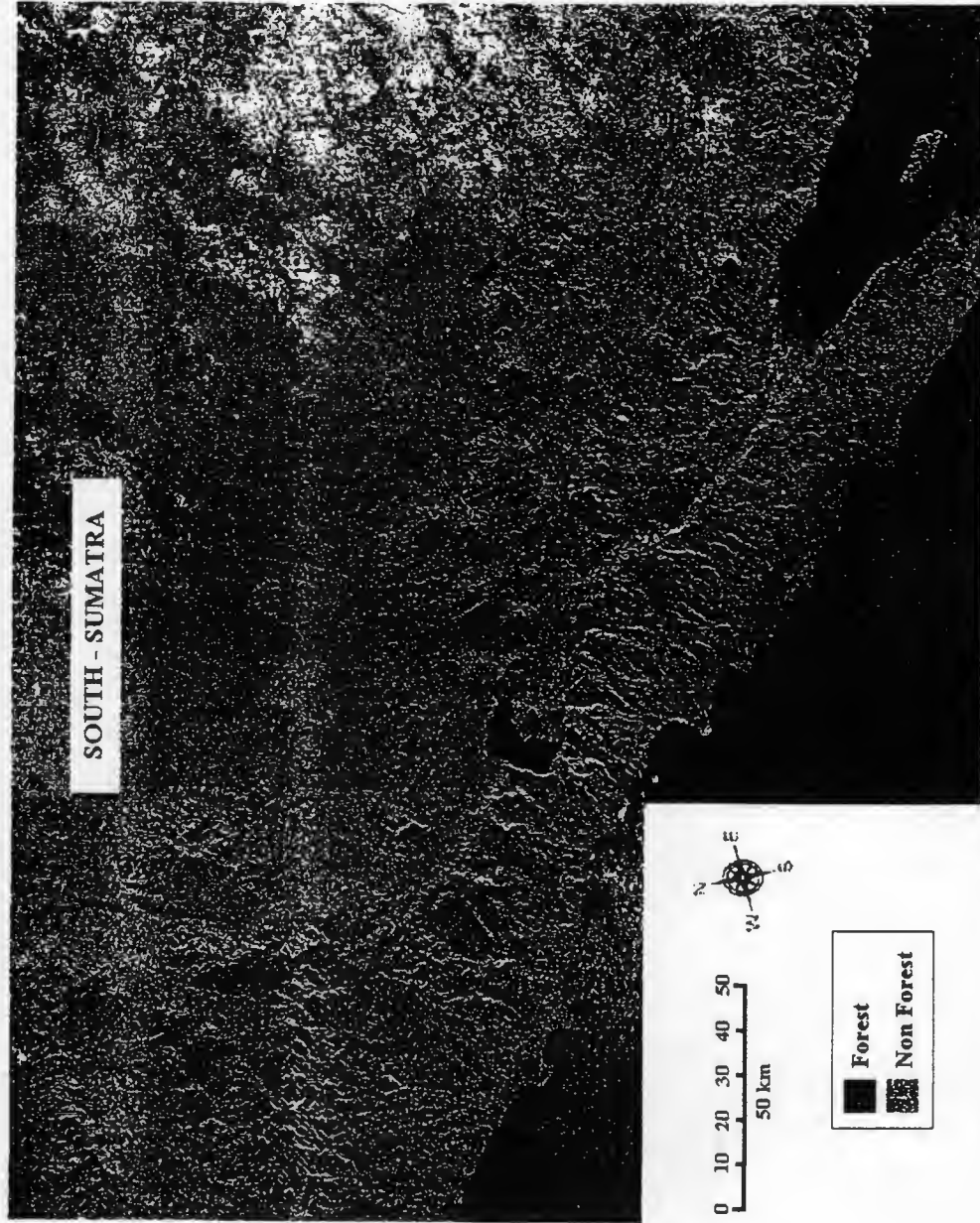
High resolution mapping of deforested areas



An example: Forest Monitoring in Indonesia

MOSAIC of
South-Sumatra
200x300 km

Green: forest



CESBIO Project

Regional Scale Deforestation Monitoring using ERS

ERS SAR Imagery

Tropical Forestry

V1 . FO 10

S P O T
I M A G E



Multitemporal Analysis

A proven and valuable method but with some constraints:

- From the backscatter intensity
 - ✓ Various land cover types with similar backscatter intensity: misclassification between rain forest and oil palm plantation
 - ✓ Saturation of radar signal for high biomass: a limitation for forest and plantation monitoring
 - ✓ Very sensitive to environmental conditions: soil moisture

- From the backscatter intensity change
 - ✓ Various land cover types with low growth cycles: forest, old plantation
 - ✓ Very sensitive to environmental conditions: drop or increase of backscatter intensity due to moisture content. Intensity not related to expected behaviour



Multitemporal Analysis (for tropical areas)

Level of satisfaction:

- Forest / non-forest maps : medium
- Plantation monitoring : poor
- Deforestation monitoring : good
- Forest fire monitoring : good



Very sensitive to environmental condition which could highly affect expected results



ERS interferometry for Land Use & Forestry

- Interferometry as a technique
 - ⇒ for tropical rain forest monitoring:
 - ⇒ Coherence imagery using radar phase information
- Exploiting archives from the tandem mission:
 - ⇒ 1 day time interval between ERS acquisitions



ERS Interferometry for Forestry

- Generation of coherence maps (SLC or RAW image pairs)
- Coherence is related to geometry of the target
- Coherence level used as an indicator for:
 - discrimination of vegetated areas
 - classification purposes
- Improvement of classification
 - using the backscatter intensity (PRI images)
 - using backscatter intensity change (between 2 dates)

ERS SAR Imagery

Tropical Forestry

V1 . FO 14



S P O T
I M A G E

Average amplitude Date t_1

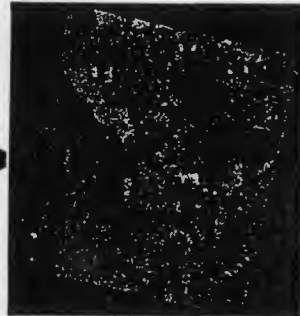


Provide information on
backscatter intensity

INSAR Coherence Date t_1



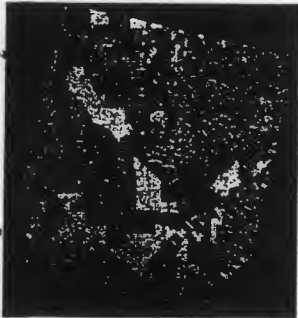
Provide information on
stability of the target



Composite SAR/INSAR
product date t_1

Provide additional information on
temporal change in backscatter intensity
between t_1 and t_2

Amplitude Date t_2



Provide information on
backscatter intensity
for date t_2



Composite SAR/INSAR
product (date t_1 and t_2)

Coherence at Date t_1 obtained from
tandem pair (1 day of interval)



Interferometric Approach: use of coherence imagery

- Coherence value mainly depends on:

- Baseline

Baseline should be small: up to 400 m

- Temporal change of the target

Small time gap between the 2 acquisitions: tandem, 3-day cycle

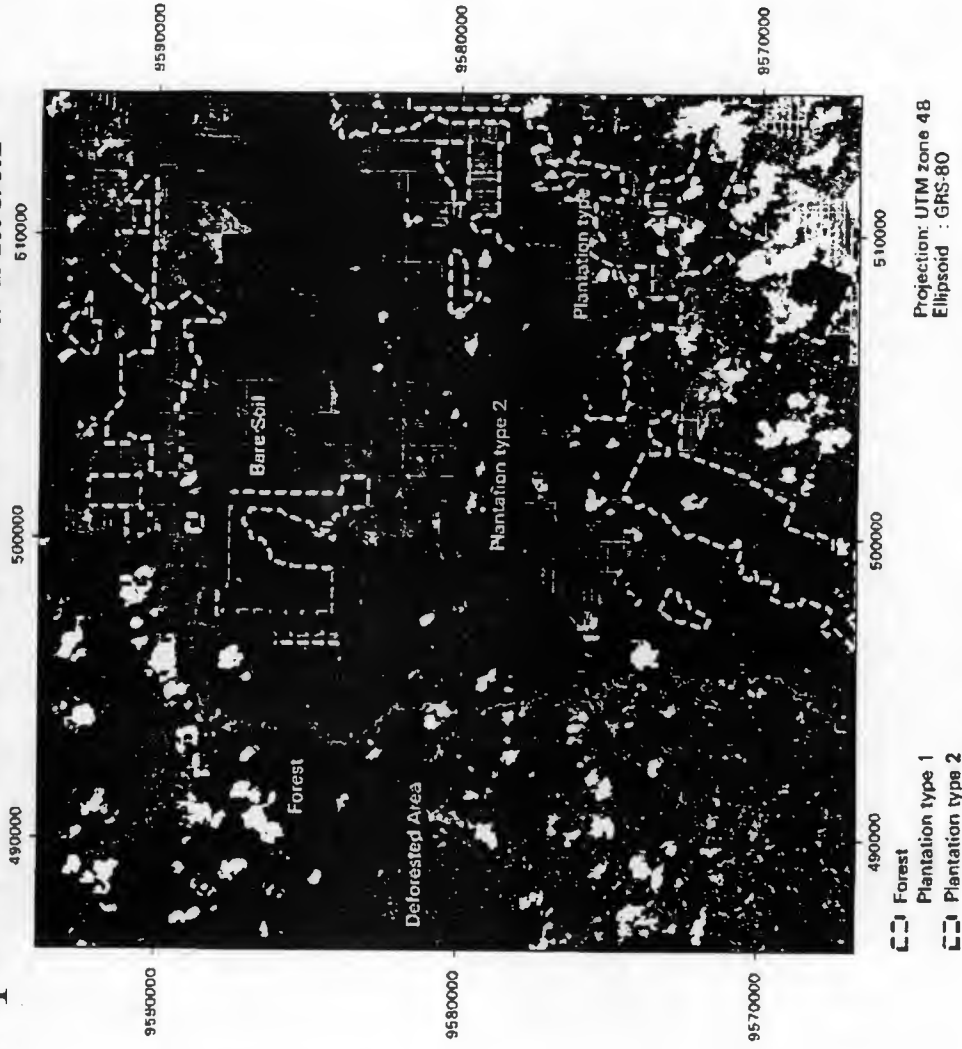
- Noise inherent to SAR system



• Interpretation of coherence image:

- Sea : lowest value
(radar signal completely decorrelated)
- Forest : low (volume scattering)
- Plantation : wide range of values
- Bare soil : high (stability of the target)
- Built-up areas : high (stability of the target)
- Results have pointed out the necessity to reduce the time gap between the 2 acquisitions in order to minimise the temporal decorrelation

Forest Mapping: A comparison between SPOT and Radar



SPOT XS
level 2A

(96/04/08)
K/J:280/357

With limits of
Land-use classes

SPOT XS . level 2A . K/J: 280/357 . Date: 96/04/08
© esa 1997 - processed by CRISP

ERS SAR Imagery

Tropical Forestry

V1.FO 18

SPOT
IMAGE

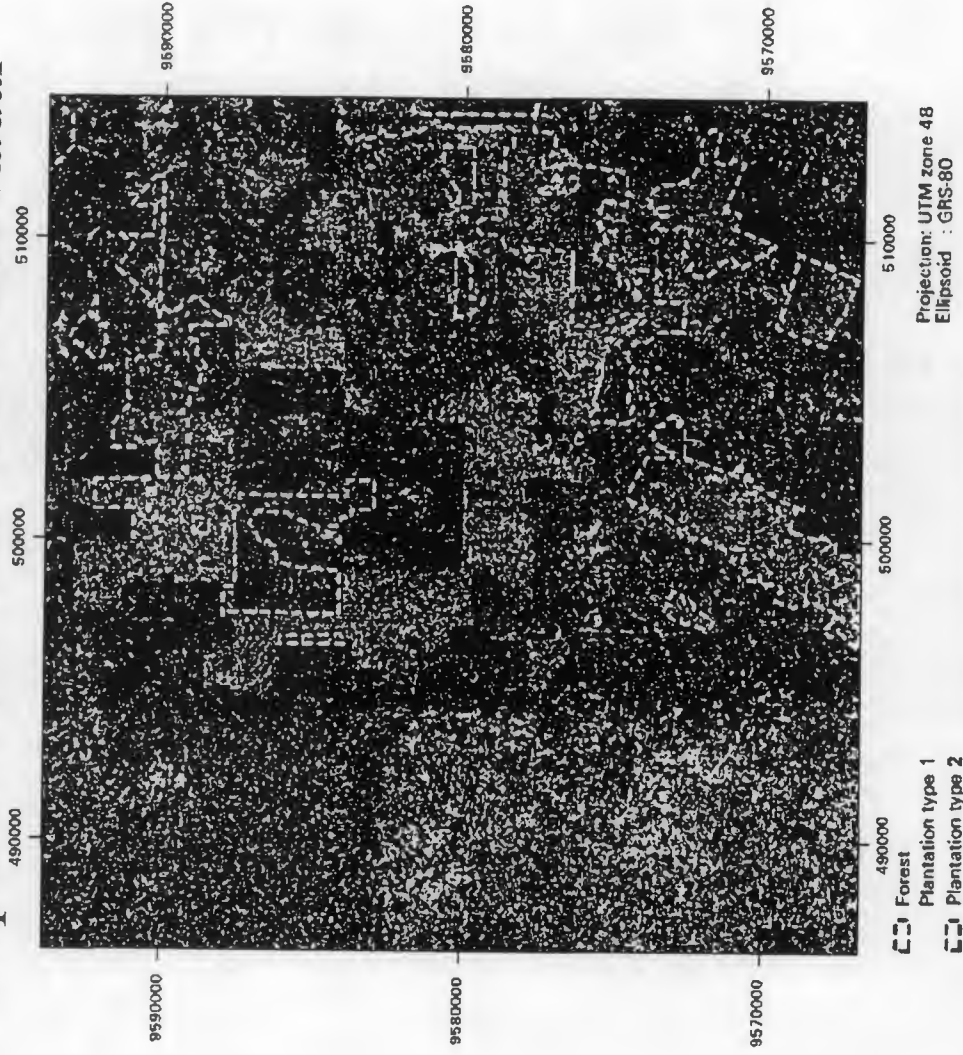
Forest Mapping: A comparison between SPOT and Radar

Colour composite
ERS-derived images

Cyan:
Coherence using
the image pair (SLC)

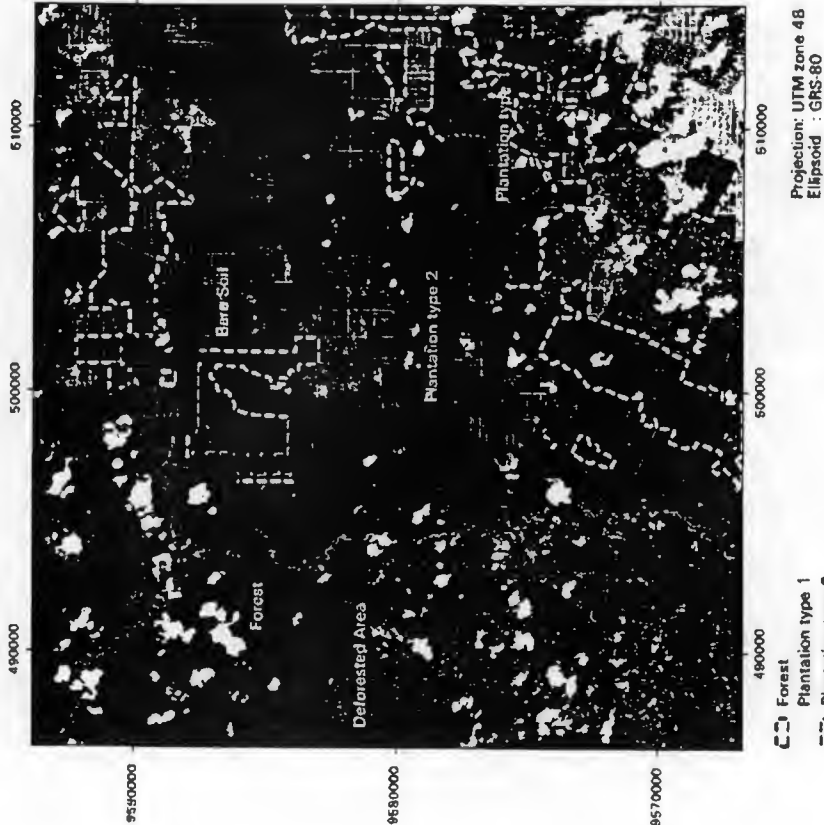
Magenta:
ERS-1 96/05/17
(amplitude)

Yellow:
ERS-1 96/05/18
(amplitude)



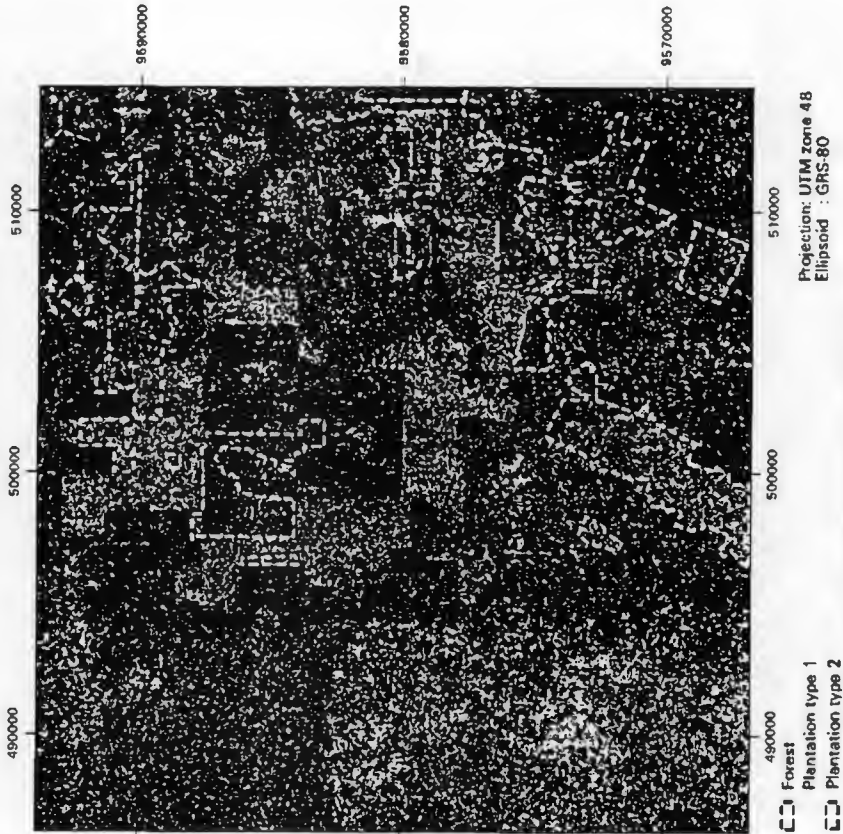


Forest Mapping: A comparison between SPOT and Radar



© esa 1997 - processed by CRISP
SPOT XS level 2A. K/J: 280/357. Date: 98/04/08

SPOT XS level 2A



Color Composition: R: Coherence M0/98
G: ERS-1 86/05/17 B: ERS-2 86/05/18
© esa 1997 - processed by CRISP

Coherence (Cyan)
2 dates amplitude (Magenta and Yellow)

ERS SAR Imagery

Tropical Forestry

V1 . FO 20

S P O T
I M A G E

Forest Mapping Using Coherence Imagery

West of Pekanbaru, Sumatra

- User needs for forest management
 - Identification of Clear Cuts
 - Identification of Plantation type / growth stage
 - Monitoring of logging activities
- Remote Sensing Data
 - 2 ERS SLC Scenes (tandem Mission)
 - SPOT XS Scenes over cloud free areas



ERS Mosaic (acquired and processed by CRISP)

FOREST MANAGEMENT

ERS-2 SAR.PRI Image

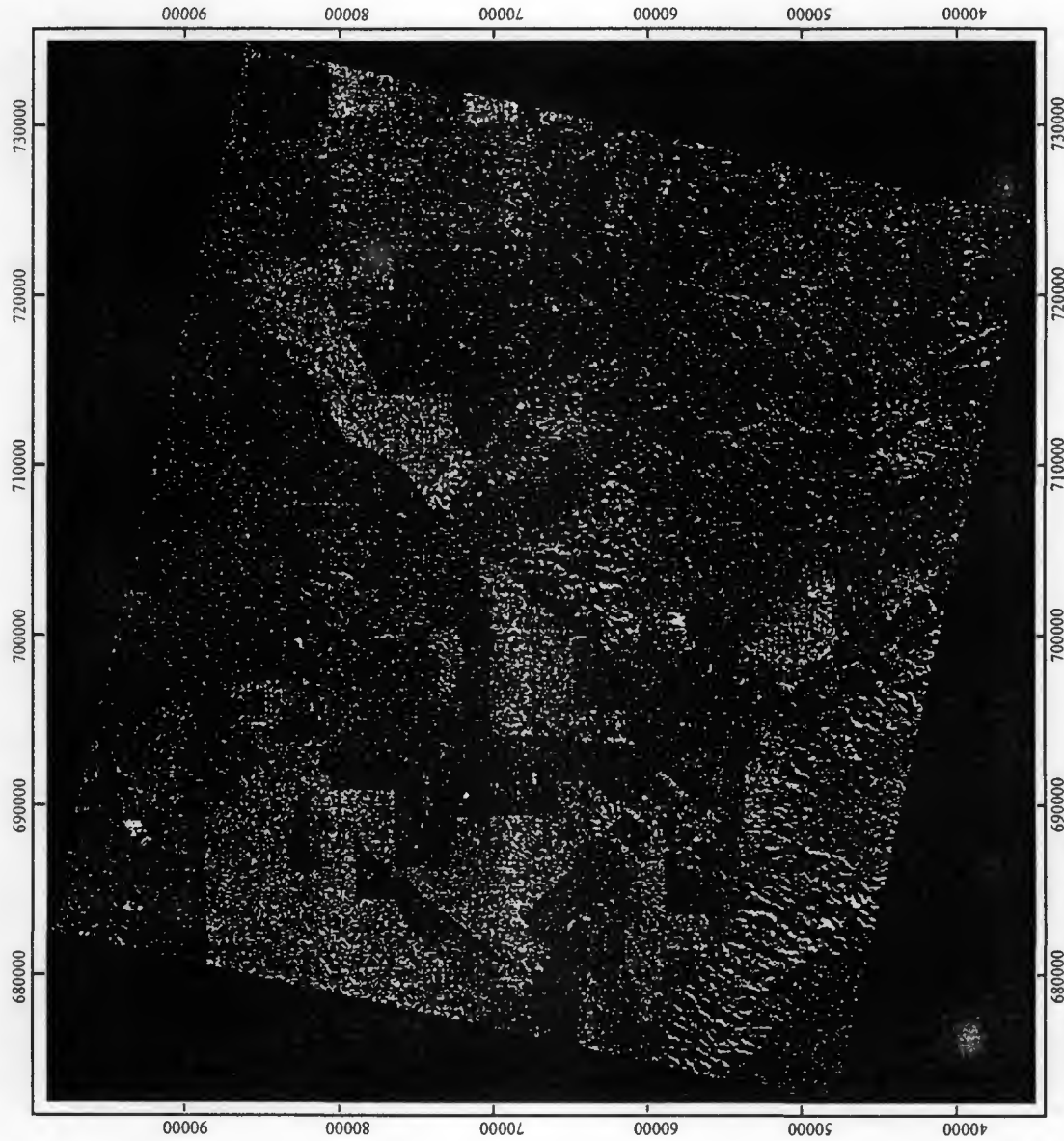
West of Pekanbaru, Sumatra

Amplitude Image
ERS-2 SAR.PRI Image

Date: 96/05/11
Orbit / Frame: 05526 / 3591



Projection: UTM, zone 47
Spheroid: GRS 1980



FOREST MANAGEMENT

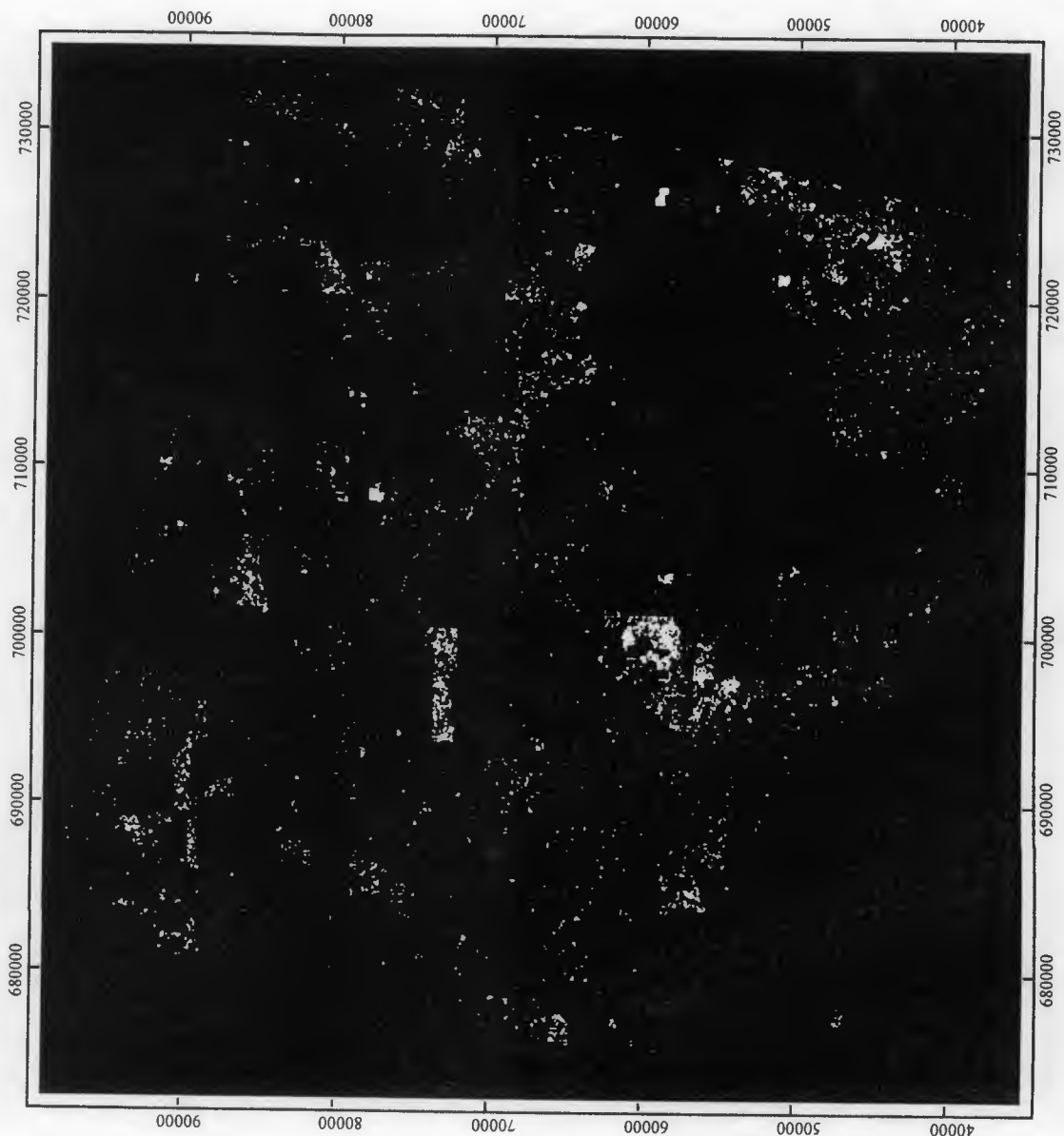
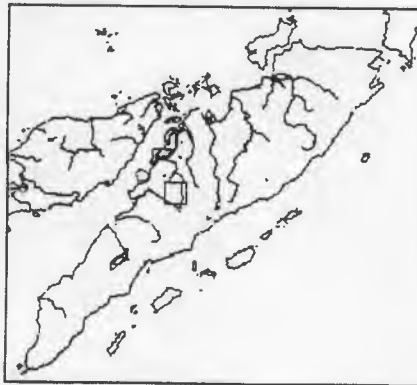
Coherence Image

West of Pekanbaru, Sumatra

Coherence image

ERS-1/2 tandem pair

- . ERS-1 SAR.SLC . Date: 96/05/10
Orbit / Frame: 25199 / 3591
- . ERS-2 SAR.SLC . Date: 96/05/11
Orbit / Frame: 05526 / 3591



Projection: UTM, zone 47
Spheroid: GRS 1980

FOREST MANAGEMENT ERS-1/2 SAR/INSAR DATA

West of Pekanbaru, Sumatra

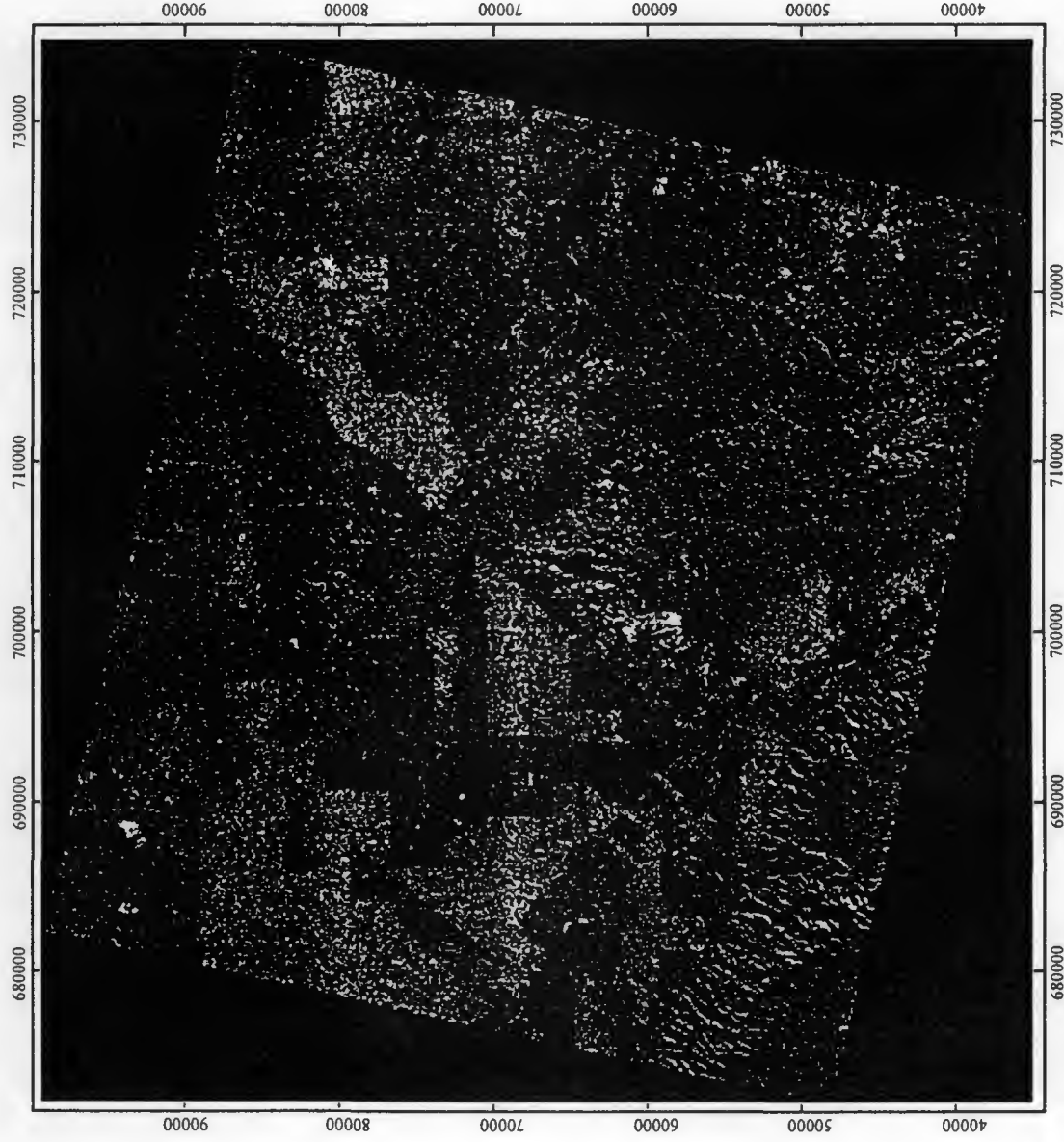
Red: Coherence image . ERS-1/2 tandem pair
ERS-1 SAR.SLC . Date: 96/05/10
Orbit / Frame: 25199 / 3591
ERS-2 SAR.SLC . Date: 96/05/11
Orbit / Frame: 05526 / 3591

Green: ERS-2 SAR.PRI Date: 96/08/24

Blue: ERS-2 SAR.PRI Date: 96/05/11



Projection: UTM, zone 47
Spheroid: GRS 1980



ERS SAR Imagery

Tropical Forestry

V1 . FO 24

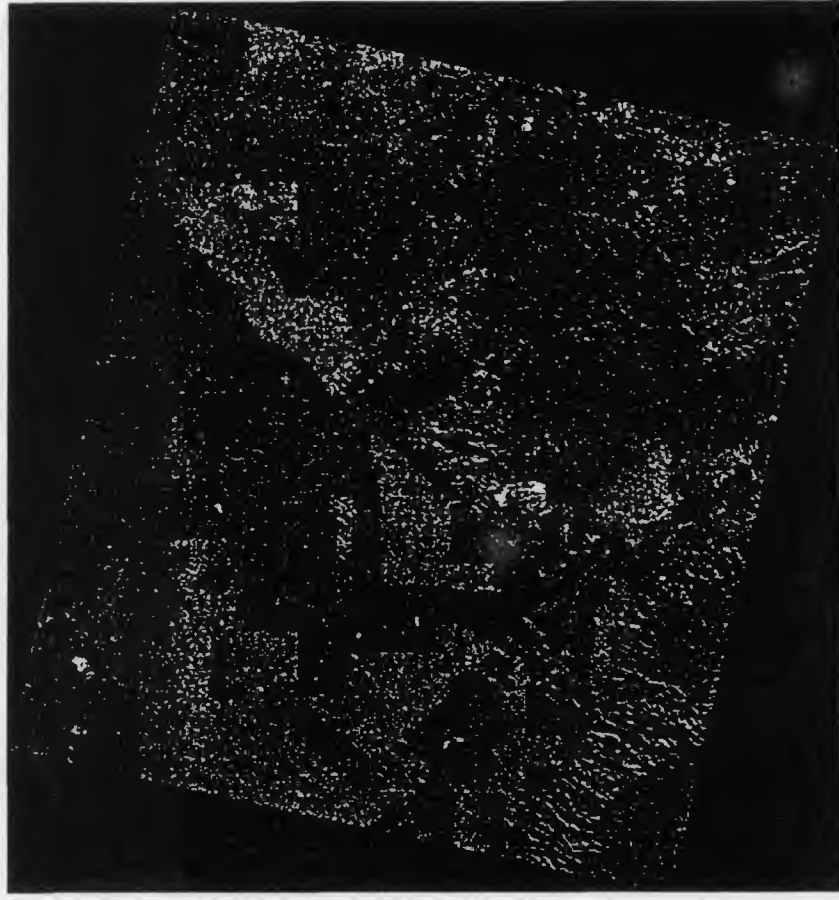
S P O T
I M A G E

A value added product derived from SAR imagery

SAR Amplitude Image



SAR/INSAR Product



FOREST MANAGEMENT

Multispectral SPOT Scene

West of Pekanbaru, Sumatra

K / J: 269 / 348
Date: 96/08/19
Time: 03:59:06 (UTC)

Processing level: 2A



Projection: UTM, zone 47
Spheroid: GRS 1980



ERS SAR Imagery

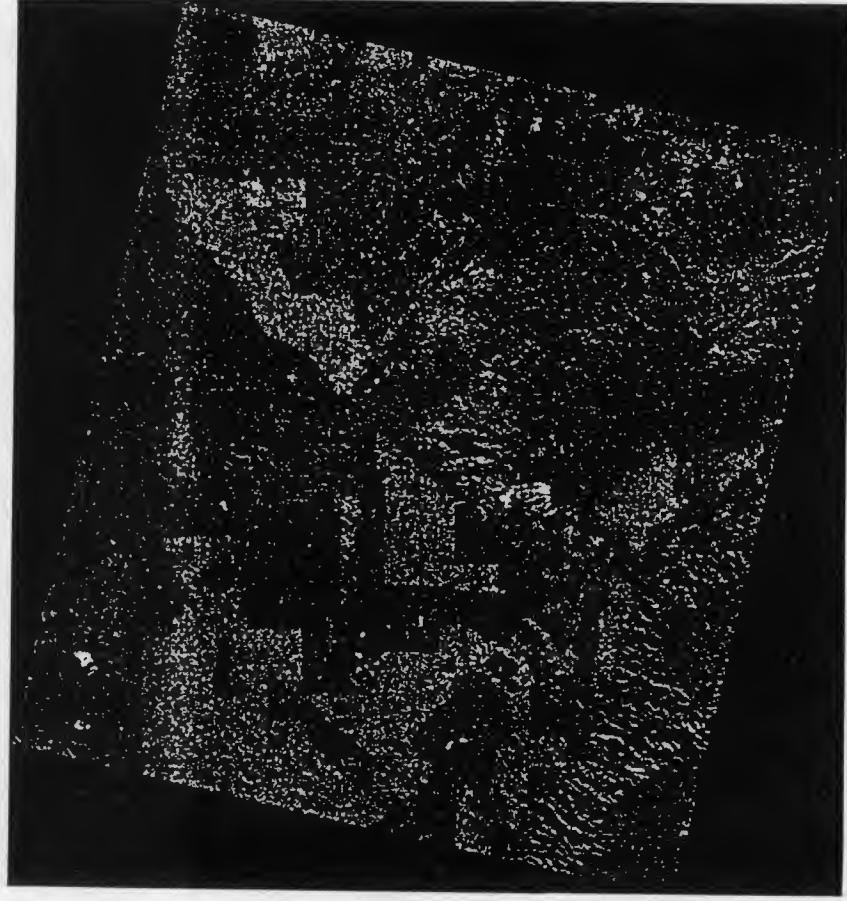
Tropical Forestry

V1 . FO 26



Complementarity between SPOT and SAR/INSAR product

SAR/INSAR Product



SPOT XS image



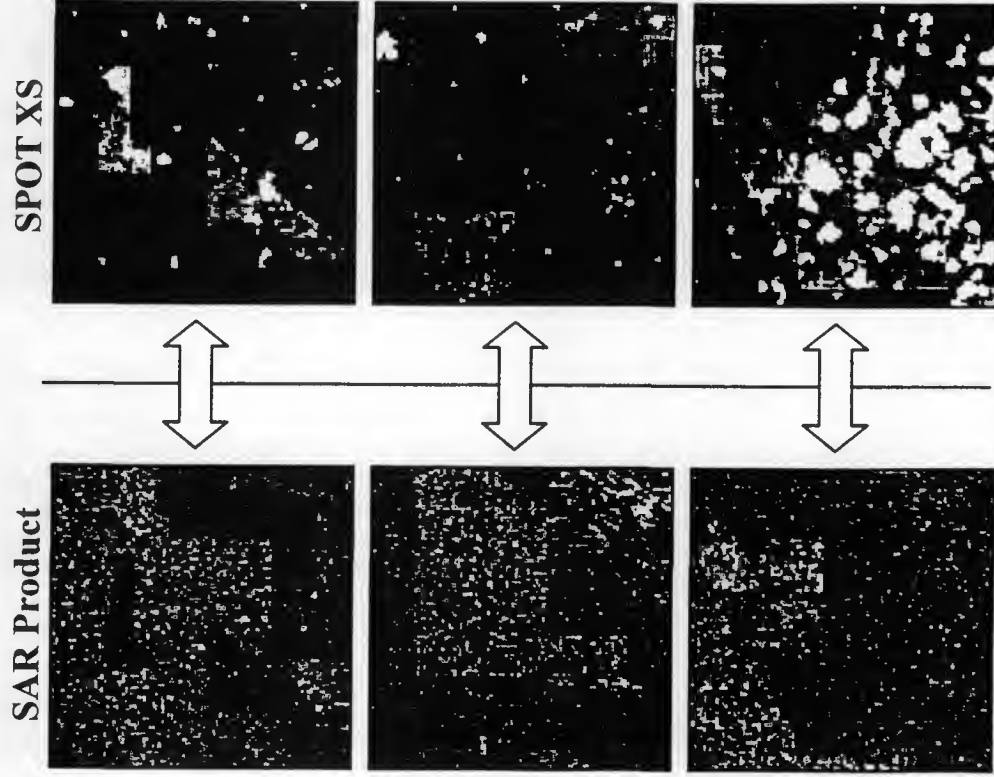


To Demonstrate the complementarity SPOT & SAR/INSAR Product

✓ Identification of Clear Cuts

✓ Identification of Plantation type
and growth stage

✓ Cloud Free/all-weather System



ERS SAR Imagery

Tropical Forestry

V1 . FO 28

S P O T
I M A G E

Data Fusion: An example of merge between SPOT and SAR/INSAR product

- Clouded areas in SPOT scene could be replaced by SAR/INSAR product
- Possible combination:
 - SPOT XS: using XS3 and XS2
 - SAR/INSAR Product:
 - coherence image derived from ERS tandem pair
 - Amplitude image

Remarks:

- Resolution decreases in SAR/INSAR product, but:
- Good continuity of feature patterns from SPOT to SAR/INSAR product (clear cut boundaries)



SPOT XS
(XS3, XS2, XS2)

SAR/INSAR
product

ERS SAR Imagery

Tropical Forestry

V1 . FO 29

S P O T
I M A G E

ERS interferometry (Coherence) for Clear-Cut Identification

ERS Amplitude Image



ERS SAR PRI Image
ERS acquisition of 21 Feb. 1994
Region: tropical forest, South America
Copyright ESA,
Processed by ESA and Spot Image

ERS SAR Imagery

Tropical Forestry

V1 . FO 30



S P O T
I M A G E

ERS interferometry (Coherence) for Clear-Cut Identification

SPOT



SPOT XS space image at 1:25000 scale
Region: tropical forest, South America
Copyright CNES, processed by Spot Image

F O R E S T R Y U S I N G E R S

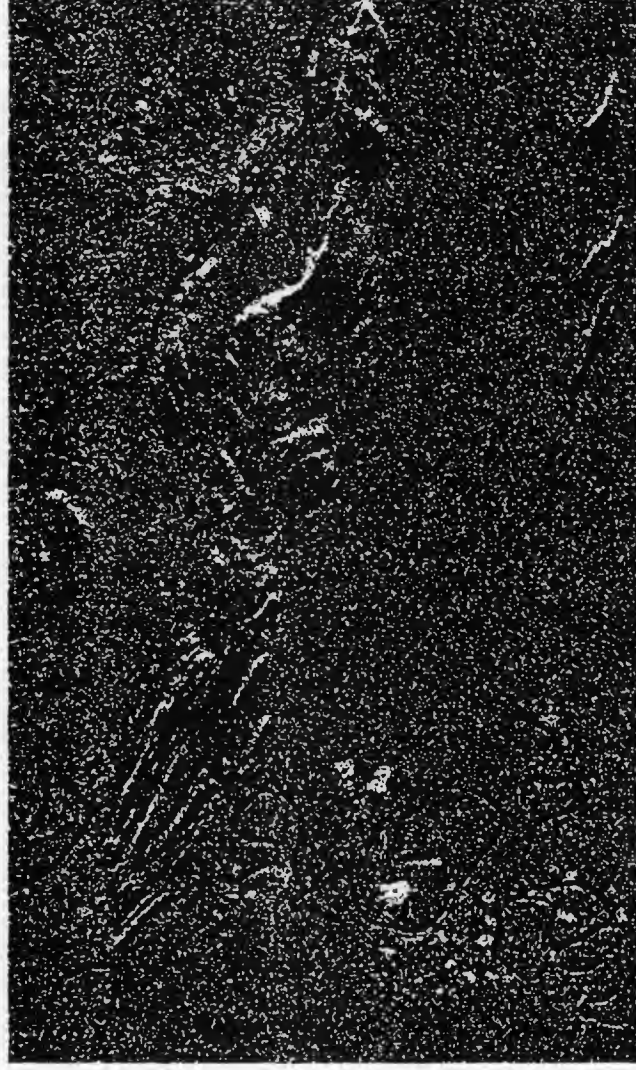
ERS SAR Imagery

Tropical Forestry

V1 . FO 31

S P O T
I M A G E

ERS interferometry (Coherence) for Clear-Cut Identification



Interferometric Product

Multiband ERS INSAR Product

Displaying:

Red: interferometric coherence

Green: average amplitude

Blue: amplitude ratio

ERS acquisitions of 21 and 24 Feb. 1994

Region: tropical forest, South America

Copyright ESA,

Processed by ESA and Spot Image

ERS SAR Imagery

Tropical Forestry

V1 . FO 32



S P O T
I M A G E

Complementarity SPOT XS and SAR/INSAR Products

SAR/INSAR Product



Multiband ERS INSAR Product

Displaying:

Red: interferometric coherence

Green: average amplitude

Blue: amplitude ratio

SPOT XS



SPOT XS space image at 1:25000 scale

Region: tropical forest, South America
Copyright CNES and ESA

ERS SAR Imagery

Tropical Forestry

V1 . FO 33

S P O T
I M A G E



SPOT IMAGE

5 rue des Satellites

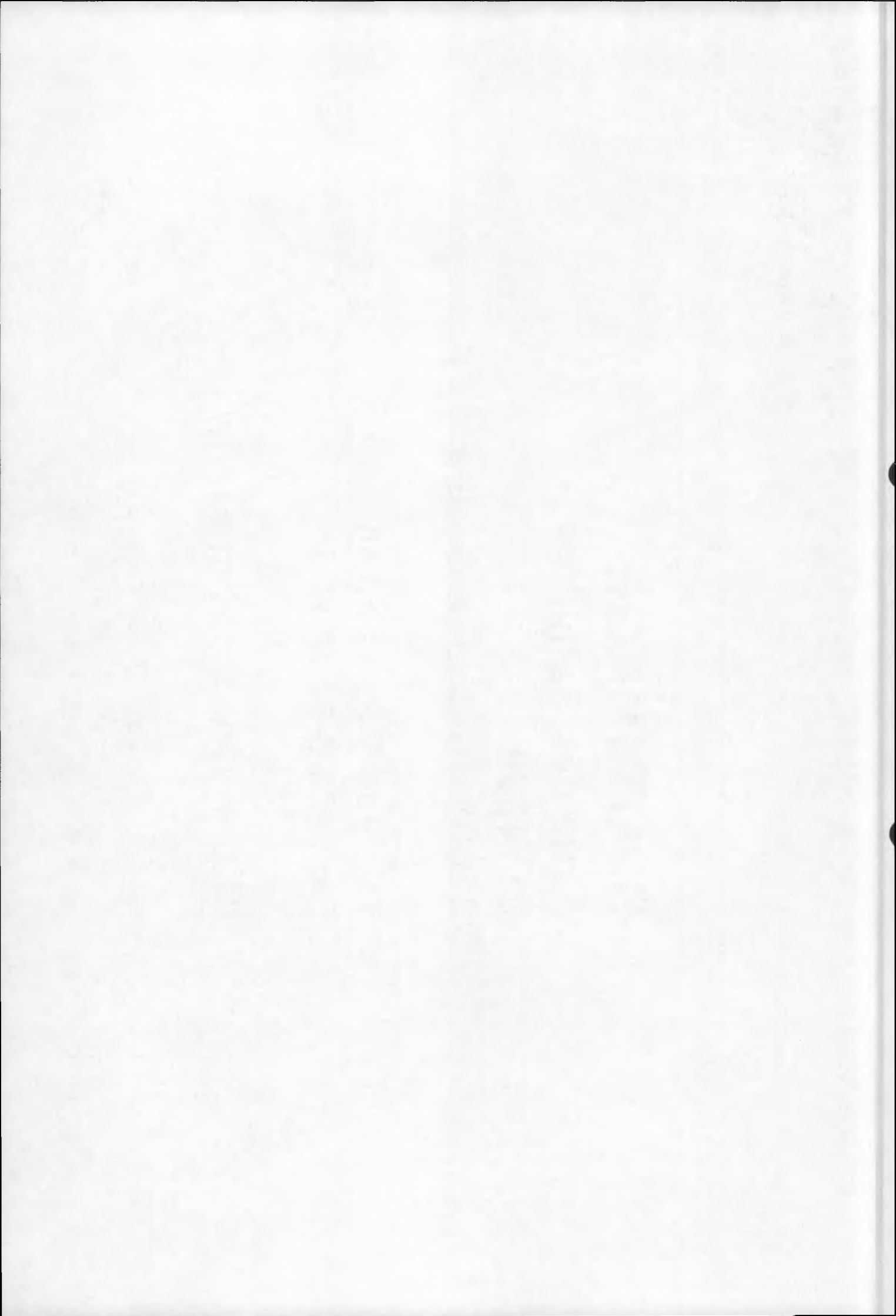
BP 4359

31030 Toulouse Cedex 4 - France

Tel: +33-5-62 19 40 40

Fax: +33-5-62 19 40 11

<http://www.spotimage.fr/>





An operational use of ERS SAR: Generation of Ground Control Points and Registration of SPOT images

ERS SAR Data

GCPs & Registration of SPOT images

V1.LO 2

S P O T
I M A G E



CONTEXT :

For Mapping purposes:

- Need accurate cartographic information (tropical area, remote site)
- Need Network of Ground Control Points
- GPS campaigns: expensive, time consuming, not always possible

ERS SAR Data

GCPs & Registration of SPOT images

V1.L0 3



SPOT
IMAGE

OBJECTIVES : Use of ERS as a passive positioning system for localisation purposes

- Use of high quality of ERS SAR geometry
- Exploit ERS to generate Ground Control point Networks
- To minimize GPS campaigns thus reducing costs and time delays
- Use the Ground Control Network to improve SPOT geocoding

ERS SAR Data

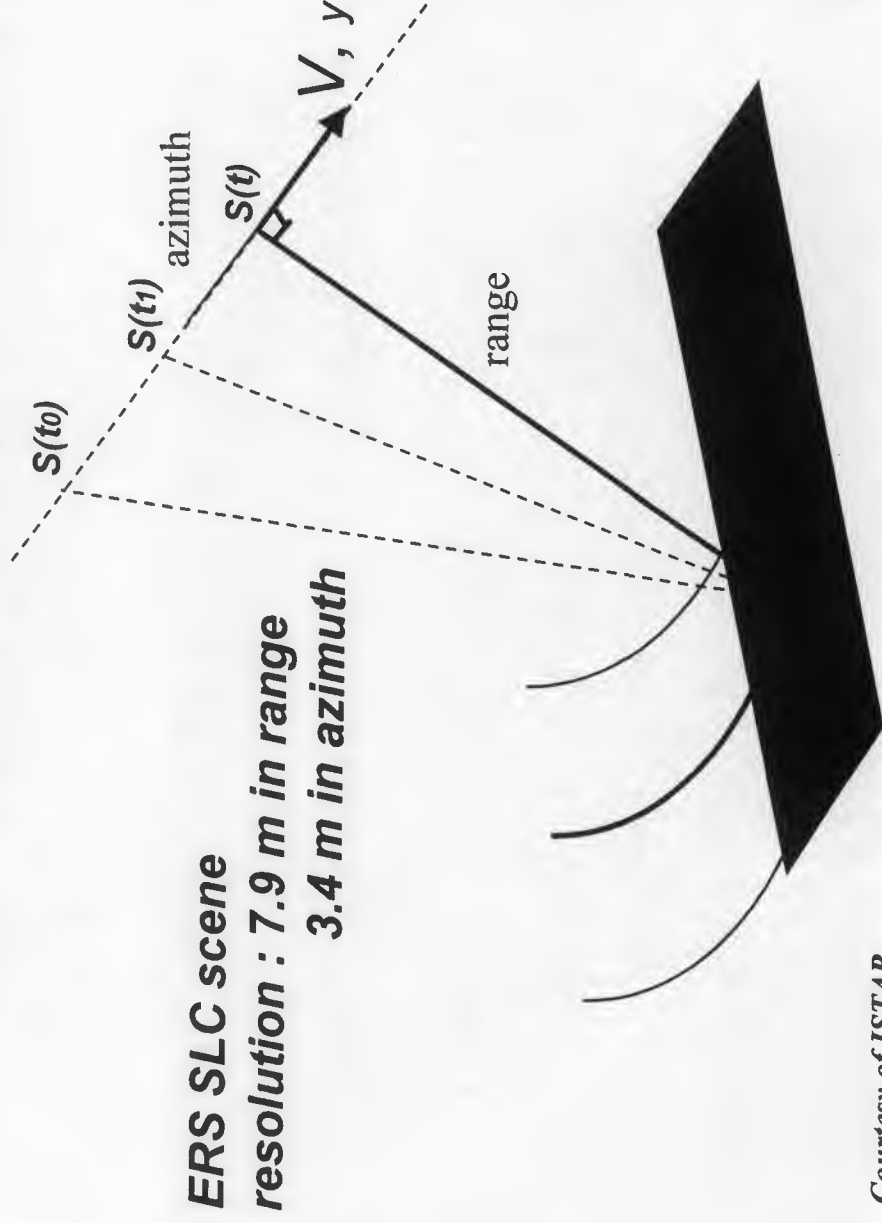
GCPs & Registration of SPOT images

V1.LO 4



Geometric quality of ERS SAR imagery

→ example of detected SLC imagery



Localisation of a target
in ERS scene requires:

- satellite position
- signal propagation
time between satellite
and target

ERS localisation error
 $r = 20 \text{ m}$ $a = 40 \text{ m}$
without any GCPs

ERS SAR Data

GCPs & Registration of SPOT images

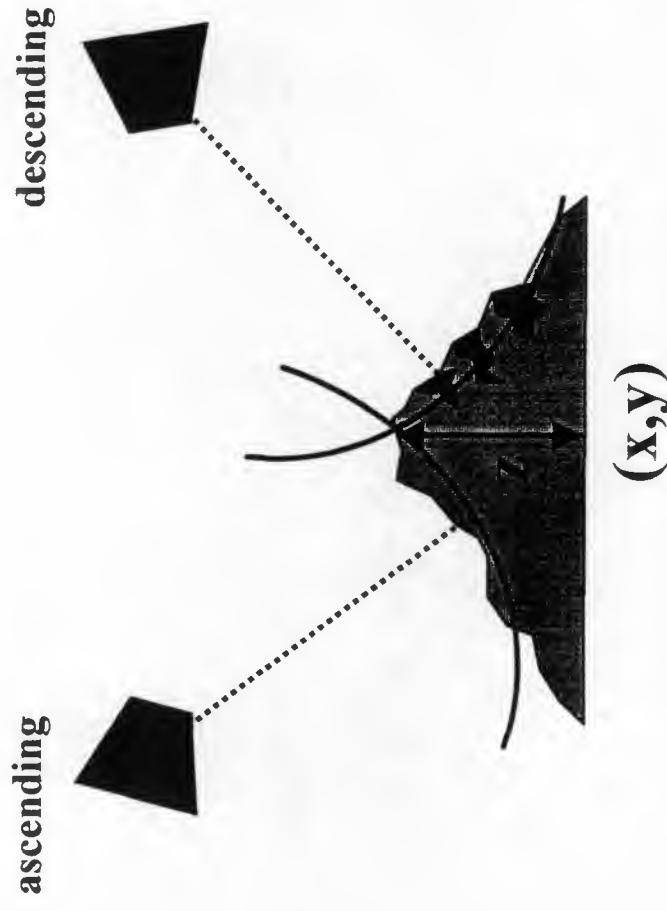
V1.L0 5

SPOT
IMAGE

Generating Ground Control Networks: Combining ascending and descending ERS acquisitions to extract ground control points (x,y,z)

Using :

- ERS SAR ascending & descending data
- parametric models of SAR acquisition
- orbit data



ERS SAR Data

GCPs & Registration of SPOT images

V1.L0 6



SPOT
IMAGE

Generating Ground Control Networks

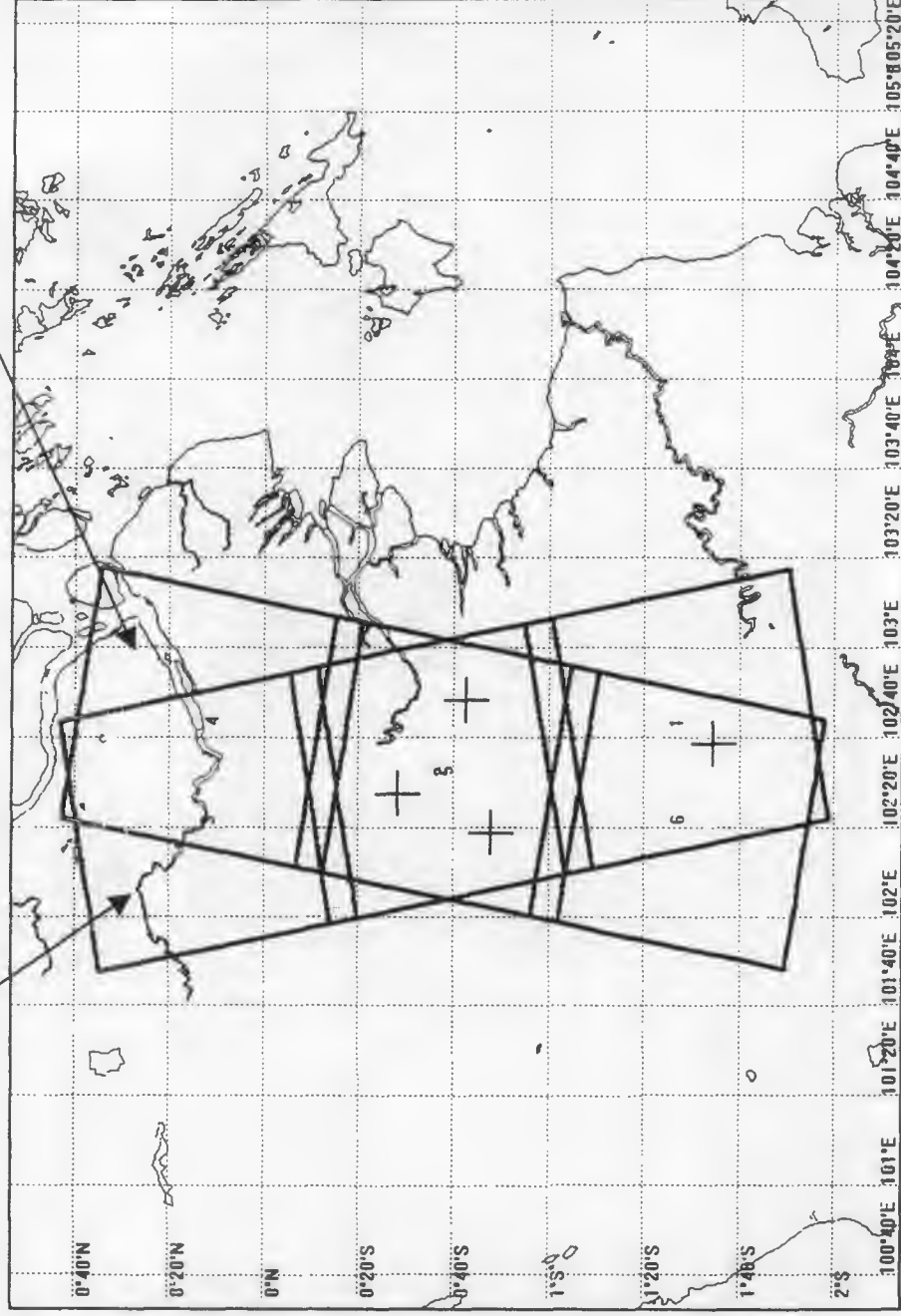
↘ Use ascending and descending SAR data

↘ Identification of image to image tie points

↘ Calculate (x,y,z) coordinates using parametric models

Ascending pass

Descending pass



ERS SAR Data

GCPs & Registration of SPOT images

V1. LO 7

Generating Ground Control Networks :

Results

Analysis of accuracy of ERS-extracted GCPs (comparison with GPS and map measurements):

27m RMS absolute planimetric (x,y) accuracy

34m RMS absolute altimetric (z) accuracy

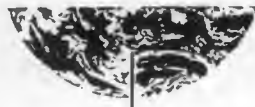
- Accuracy can be improved using a few GPS measurements
- Extent of ERS geometric performances to whole segments: applicable in operational projects



ERS SAR Data

GCPs & Registration of SPOT images

V1. LO 8



SPOT
IMAGE

Using ERS for localisation: space-triangulation

Technique to geocode a whole set of contiguous scenes

▲ : GCP

(from GPS campaigns or
1:50 000 topomaps)

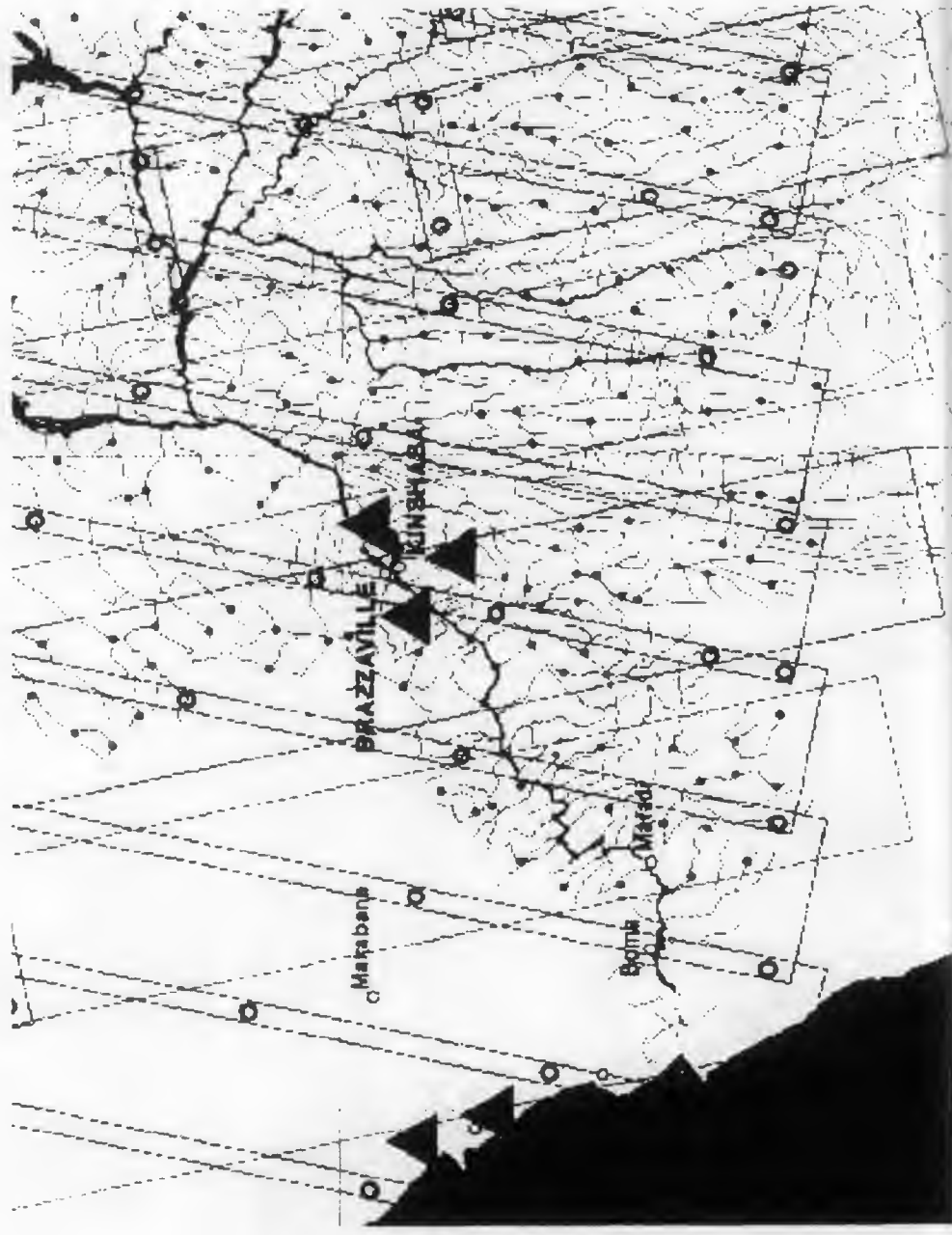
○ : ERS/ERS Tie Points

• : ERS derived GCPs

Estimated location accuracy
performances for whole
ERS SAR dataset:

Altimetry: 10m RMS

Planimetry: 15m RMS



Courtesy of IGN-Espace

ERS SAR Data

GCPs & Registration of SPOT images

V1.LO 9



Geometric performances of ERS imagery

- ⇨ using single images
- ⇨ ERS rectification error as function of number of GCPs

number of GCPs	0	1	2	3	6	9	12	24
rms x	18,7	20,3	18,5	18,4	20,8	18,4	20,7	18,5
rms y	39,7	19,4	19,1	19,9	19,5	20,4	19,1	19,1

- ⇨ SPOT rectification error as function of number of GCPs

number of GCPs	0	1	2	3	6	9	12	24
rms x	403	24,5	11,7	12,9	11,7	9,1	9,3	9,3
rms y	147	19,1	9,1	7,4	7,3	6,7	6,8	6,6

ERS SAR Data

GCPs & Registration of SPOT images

V1. LO10



Geometric performances of ERS imagery

⇨ using segments

⇨ ERS segment (450 km) rectification error as function of number of GCPs

number of GCPs	0	1	2	3	6	9	12	24
rms x	24,7	19,0	19,4	20,7	19,0	18,9	18,9	18,8
rms y	43,2	27,4	25,3	24,7	24,6	24,7	24,9	24,6

⇨ SPOT segment (500 km) rectification error as function of number of GCPs

number of GCPs	0	1	2	3	6	9	12	24
rms x	300	24,9	20,3	18,9	15,4	16,1	15,3	12,9
rms y	700	22,5	28,1	21,0	16,9	15,9	14,1	13,2

ERS SAR Data

GCPs & Registration of SPOT images

V1.LO11



ERS segments & auxiliary data:

Using a GCPs network derived from ERS localisation method:

⇒ SPOT images can then be registered to:

20m RMS accuracy in along-track direction

20m RMS accuracy in cross-track direction

BUT, dependent upon:

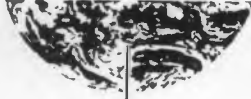
- accuracy of auxiliary data (GPS measurement, maps)
- Identification of ground control points on both ERS and SPOT imagery (landscape, relief)

ERS SAR Data

GCPs & Registration of SPOT images

V1 . LO12

S P O T
I M A G E



Conclusion: Exploit ERS SAR location accuracy

☞ for registration of SPOT imagery in areas lacking existing or accurate maps

☞ To reduce the GPS campaigns in remote areas

ERS SAR Data

GCPs & Registration of SPOT images

V1 . LO13

S P O T
I M A G E



SPOT IMAGE

5 rue des Satellites

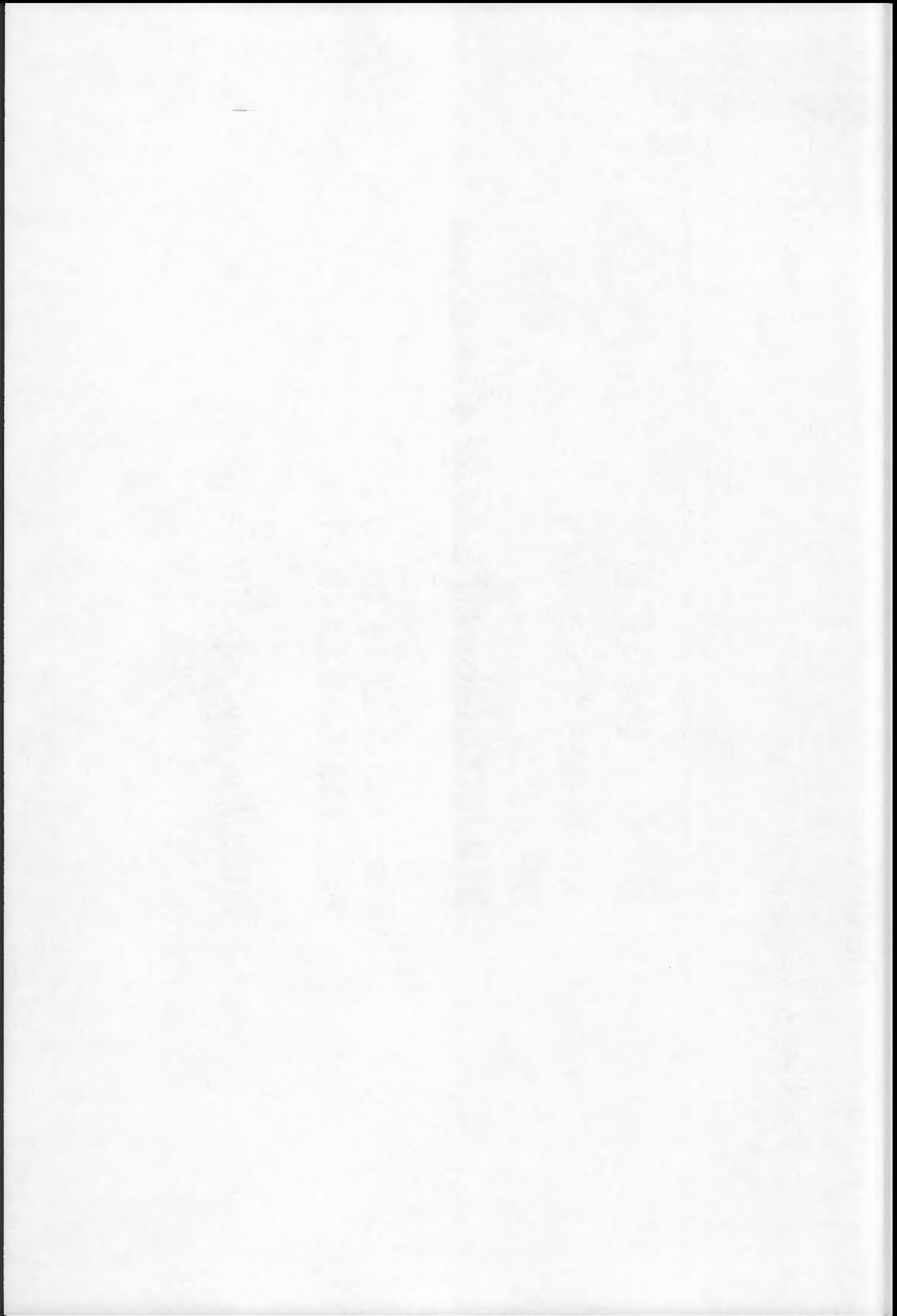
BP 4359

31030 Toulouse Cedex 4 - France

Tel: +33-5-62 19 40 40

Fax: +33-5-62 19 40 11

<http://www.spotimage.fr/>



Interferometry SAR applications

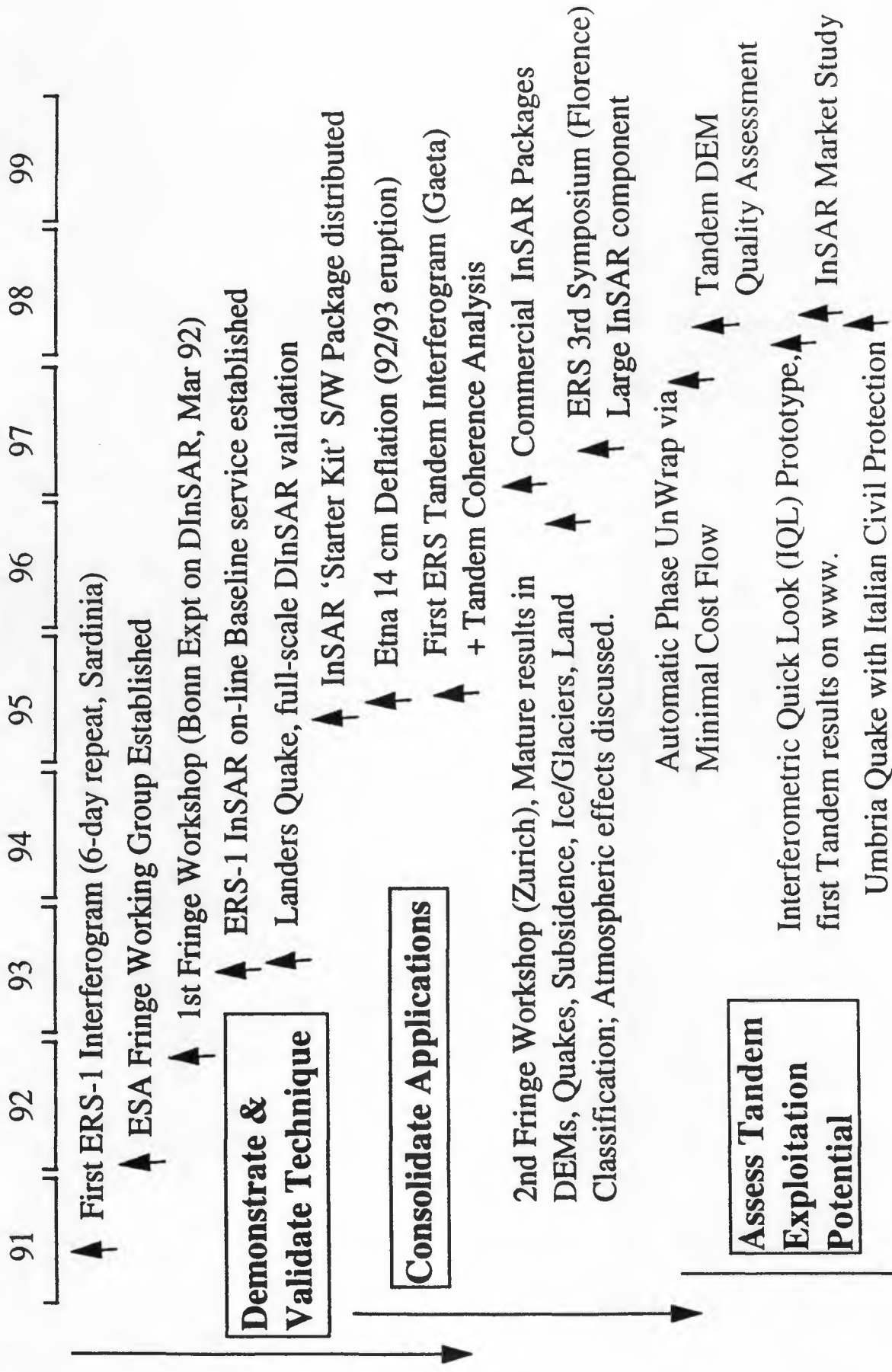
H. LAUR

**European Space Agency
Directorate of Application Programmes
Remote Sensing Exploitation Department
ESRIN**

Main Action Lines (91 - 99)

- Demonstrate & Validate InSAR Technique with ERS (91 - 96),
- Consolidate Applications (95 - 99),
- Assess ERS Tandem Exploitation Potential (96 - 99),

Key Milestones



Current Status of Results : Tandem

- DEM's :-
 - average coherence improved with Tandem (~0.7),
 - theoretical relation of DEM accuracy vs coherence is confirmed,
 - Stable Atmosphere -> approx. 10m rms DEM for coherent surfaces
 - (best case : 3 m Belgium, 4.7 m Marrakech),
 - changing atmosphere -> degrades by factor of 2 (eg > 20 m rms),
 - useful quality indicators of atmospheric conditions,
 - Meteosat / GOES / GMS + ground-based weather stations
 - enlarged exploitation calls for fully qualified data set, therefore ->
 - IQL to be used to identify coherent surfaces in Tandem archive :-
 - starting May 98 for Foreign stations data at ESRIN, 20-30 strips now on www.
 - starting May 98 for N. American archive at CCRS ;
(IQL analysis done at Atlantis, 200 strips, 90 % of continent, 10 % of archive,
formal procedures to fully ensure integrity of archive, all raw data + QL's ESA property)
 - PAF Archives according to demand & availability of resources.

Current Status of Results : Tandem

- Ice/Glacial Motion :

- Fast Ice Flows (~ 1 m / day) measurable only with Tandem,
- Fine scale 3-D vector flow patterns (Ascending + Descending) for few sites in Antarctica + Greenland, agrees well with in-situ,
- substantially enhances understanding of glacial dynamics,
- Project for DEM + Ice Flows of entire Antarctica + Greenland continents in the AO3; of great scientific interest for study of Ice Mass-Balance.

- Land Use / Classification :-

- requires Tandem (heavy vegetation remains incoherent),
- Forest/Non-Forest detection at 90% confidence validated few sites, Europe
- growing potential for thematic mapping yet to be fully exploited,
- sample IQL browse images, worldwide, 20-30 strips now on www.

Current Status of Results : 35-day

- Several applications reaching maturity; InSAR provides valuable supplement to limited ground-based data,
- **Quakes / Tectonic :-**
 - Post-seismic effects at Landers : several small surface ruptures due to fault slips,
 - Grevena ('95, Greece) : detailed comparison to geological model,
 - Umbria ('97, Italy) :-
 - National Geophysical Institute (ING) + Italian Civil Protection,
 - results even under difficult conditions (small quake, mountainous, vegetated),
 - ING will use InSAR in future Quake monitoring.
- **Volcanos :**
 - Etna (Italy) :-
 - evidence of inflation in 96/97 following the 92/93 eruption,
 - evidence of deflation in Mar 98 following the Jan 98 event,
 - systematic monitoring with ERS-2 planned

Current Status of Results : 35-day

- Land Subsidence :-
 - Growing exploitation within areas of Geology/Exploration, Urban Risk. Examples include :-
 - Bell-Ridge (oil-extraction; USA),
 - Selby (Coal Mining; UK),
 - Los Angeles (Water extraction)
 - Paris (metro construction)
 - Katowice (Coal Mining, Poland)

Concluding Remarks

- Specific Applications require future Tandem data,
- 35-day needed for many Long Term Monitoring Apps,
- Still important to enlarge Tandem Archive (eg DEM's),
- Data Quality Evaluation : Key Issue for Exploitation.



***ERS National and Foreign
Stations
Operators Working Group
ESOWG-7***

Toulouse, France

28-29 May 1998

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CCRS Ground Systems Overview

- **Gatineau Satellite Station**
Cantley, Quebec
- **Prince Albert Satellite Station**
Prince Albert, Saskatchewan
- **Satellite Acquisition Services**
Ottawa, Ontario

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Gatineau Satellite Station



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Gatineau Satellite Station

- Established in 1985 for SPOT data reception.
- Full Eastern and Central Canada coverage.
- Primary reception, archiving and processing facility for ERS SAR data.
- Archiving facility for RADARSAT data.

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Prince Albert Satellite Station



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Prince Albert Satellite Station

- Established in 1972 for ERTS (Landsat) data reception, processing and archiving.
- SPOT capability added in 1986.
- Provides full Western and Central Canada coverage.
- Primary Reception and Archive facility for Landsat, SPOT and NOAA AVHRR data.

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Station Coverage Mask



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Satellite Acquisition Services



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Satellite Acquisition Services

- Established in 1985 to co-ordinate operations of Prince Albert and Gatineau Receiving Stations.
- Provides a single interface between CCRS and Satellite Operators - CSA, ESA, SPOT IMAGE S.A. and EOSAT.
- Provides order desk for ERS SAR non-commercial products.

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Satellite Data Received

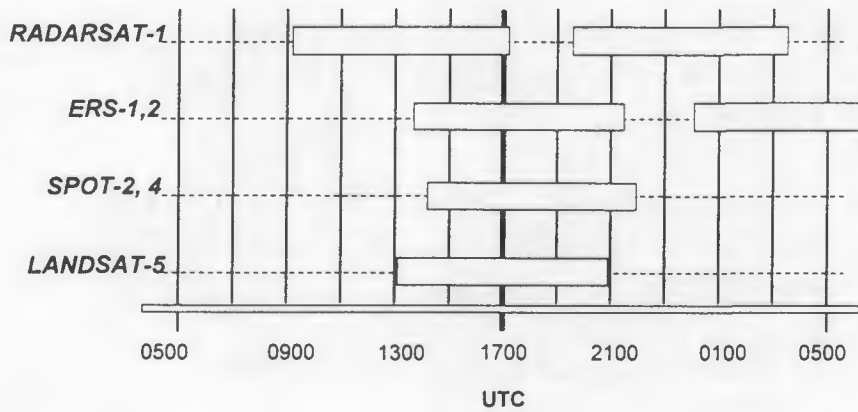
- | | |
|----------------|--------------------------------|
| • ERS-1, 2 | <i>Real-Time SAR & LBR</i> |
| • RADARSAT-1 | <i>Real-Time, Play-Back</i> |
| • SPOT-1, 2, 4 | <i>Real-Time</i> |
| • LANDSAT-5 | <i>Real-Time</i> |
| • NOAA | <i>Real-Time</i> |

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Satellite Timetable



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Ground System Operations

Prince Albert

Data Reception

RADARSAT
SPOT
LANDSAT-5
ERS SAR
ERS LBR (ESA)
NOAA AVHRR

Archive

SPOT
LANDSAT
NOAA

Clients

CSA
RSI
SICORP
ESA
Eurimage
SPOT Image

Ottawa

SAS

CCRS Order Desk

Gov't Users

RADARSAT, ERS SAR
NOAA AVHRR Products

Gatineau

Data Reception

RADARSAT
SPOT
LANDSAT-5
ERS SAR
ERS LBR (ESA)

Archive

RADARSAT
ERS SAR

ERS Processing

SAR
LBR (ESA Contract)

Satellite Operators

CSA
SPOT IMAGE S.A.
ESA
EOSAT, NOAA

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Data Processing

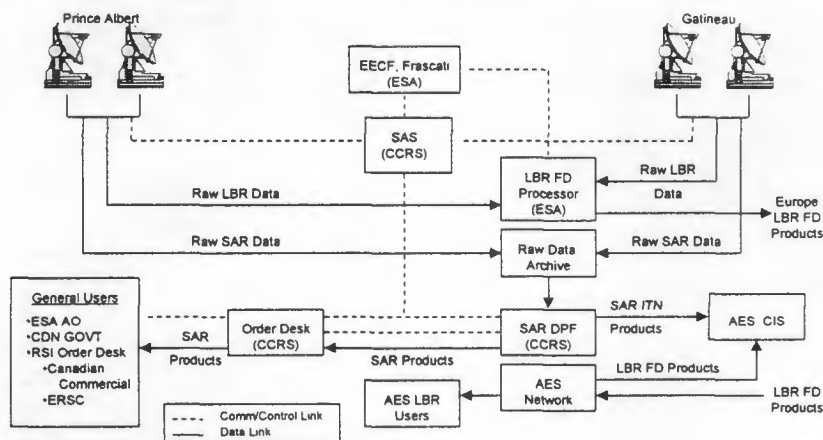
- ERS Low Bit-Rate Processing
 - ESA-owned FDPC system
- Quick-Look processing
 - FASTSCAN for RADARSAT
 - SQUIS for SPOT
 - CHIP for LANDSAT
- Scene Processing
 - SARDPF for ERS
 - GSAR5/GTS for ERS ...coming soon!

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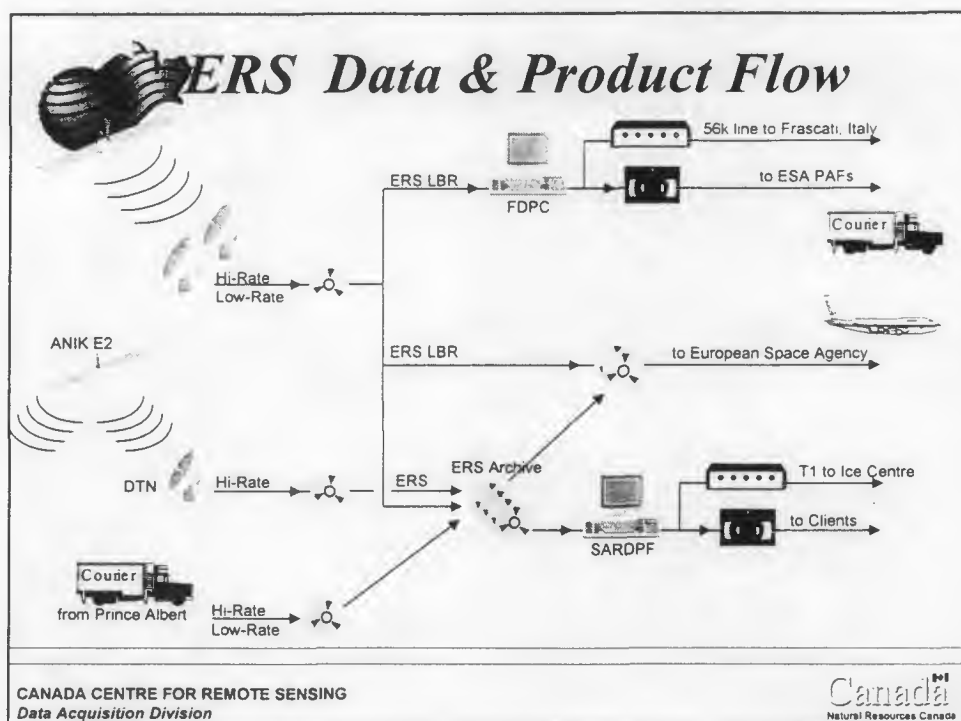


ERS Data Flow



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DTN Receiver/Demod Equipment

- C-Band Receivers
- Demodulators
- Redundant systems
- Remote control from Allan Park, Ontario
- \$300/hr link cost
- Installed & maintained by Telesat Canada

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Digital Transfer Network



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CCRS Operations

- Reception and Archiving of raw SPOT HRV data.
- Reception and Archiving of raw LANDSAT TM and MSS data.
- Reception, Archiving and Processing of raw ERS SAR data.

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CCRS Operations (cont'd)

- Support RSI in the commercial exploitation of Remote Sensing with the acquisition of raw SPOT and Landsat data and the acquisition and processing of ERS SAR data.
- Reception and Dissemination to SICORP of raw SPOT HRV data acquired over the U.S. (SICORP Contract).
- Provide Eurimage, SPOT Image and SICORP with ESA SAR Data products of North America.

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CCRS Operations (cont'd)

- Reception, processing and dissemination to ESA of ERS LBR data.
- Reception and Archiving of RADARSAT data (CSA).
- Operation of RADARSAT Calibration Transponders (CSA).
- Launch support services to CNES

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Other CCRS Operations

Launch Support Services to CNES

- ARIANE Launch Vehicle S-Band Telemetry
 - ARIANE V59 September '93
 - ARIANE V72 (ERS-2) April '95
 - ARIANE V75 July '95
 - ARIANE V107 (SPOT-4) March '98
- Satellite LEOP S-Band Telemetry
 - SPOT-3 September '93
 - HELIOS-1A July '95
 - SPOT-4 March '98
- Agreements with CNES/CST and CNES/CSG in place for continued launch support operations.

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1997 Acquisition Statistics

Satellite	Successful Acquisitions	Losses Due to..				Station Success
		Stations	Satellite	Conflict	SAS	
ERS-1 SAR	2	0	0	0	0	100.00%
ERS-1 LBR	74	0	3	0	0	100.00%
ERS-2 SAR	1,445	2	19	0	0	99.86%
ERS-2 LBR	1,247	2	3	0	0	99.84%
RADARSAT RT	2,640	2	105	0	1	99.93%
RADARSAT PB	1,178	0	47	0	1	100.00%
LANDSAT-5	966	1	5	1	1	99.90%
SPOT-2 CDN	840	0	31	0	0	100.00%
SPOT-2 US	887	0	33	0	0	100.00%
NOAA-14	1,304	2	0	0	0	99.85%
TOTAL	10,583	9	246	1	3	99.92%

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1998 Acquisition Statistics

First Quarter

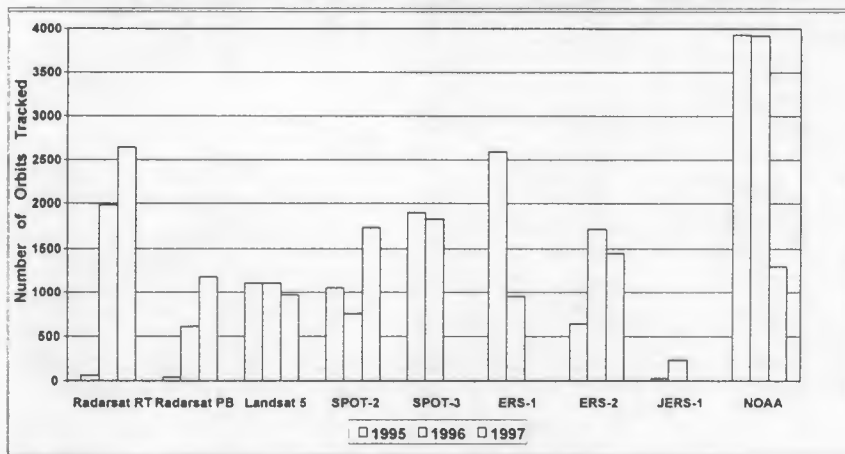
Satellite	Successful Acquisitions	Losses Due to..				Station Success
		Stations	Satellite	Conflict	SAS	
ERS-1 SAR	0	0	0	0	0	
ERS-1 LBR	15	0	3	0	0	100.00%
ERS-2 SAR	276	2	0	0	0	99.28%
ERS-2 LBR	307	0	0	0	0	100.00%
RADARSAT RT	554	0	19	0	0	100.00%
RADARSAT PB	292	0	10	0	0	100.00%
LANDSAT-5	76	0	2	0	1	100.00%
SPOT-2 CDN	52	0	1	0	0	100.00%
SPOT-2 US	218	0	0	0	0	100.00%
NOAA-14	150	1	0	0	0	99.34%
TOTAL	1,940	3	35	0	1	99.85%

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Combined Reception at Prince Albert and Gatineau Stations

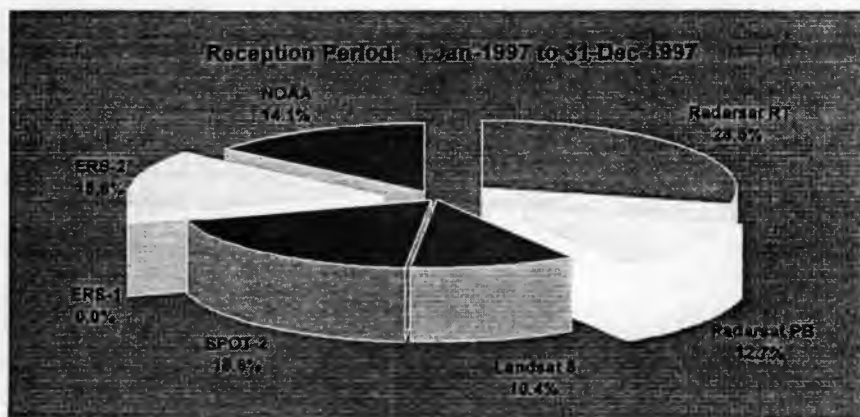


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Combined Reception for Prince Albert and Gatineau Stations



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ERS-1 & 2

SAR Reception and Processing

Orbits Received	1996	1997	1998 Q1
PASS	1575	698	112
GSS	961	728	162
Total	2536	1426	274
Scenes Processed	1996	1997	1998 Q1
RSI	150	130	43
Eurimage			9
ESA PI's	224	115	0
Paying Gov't	27	6	0
CCRS Internal	319	438	16
Ice Centre	1006	520	42
Total	1726	1209	110
Data to ESA	1996	1997	1998 Q1
No. of Orbits Copied	141	257	44

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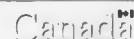


1998 Q1 ERS SAR Production

Satellite	RAW	SGF	SLC	MLD	ITN	Total
ERS-1	19	17	0	0	0	36
ERS-2	29	0	3	0	42	74
Total	48	17	3	0	42	110

RAW - Raw signal data
SGF - Fine resolution (25m), Geo-referenced
SLC - Single Look Complex
MLD - Multi-Look Detected
ITN - Image Transfer Network to Ice Centre - T1 Link
Coarse resolution (100 m), Geo-referenced

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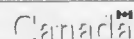


1997 ERS SAR Production

Satellite	RAW	SGF	SLC	MLD	ITN	Total
ERS-1	119	10	1	39	0	169
ERS-2	355	9	1	155	520	1040
Total	474	19	2	194	520	1209

RAW - Raw signal data
SGF - Fine resolution (25m), Geo-referenced
SLC - Single Look Complex
MLD - Multi-Look Detected
ITN - Image Transfer Network to Ice Centre - T1 Link
Coarse resolution (100 m), Geo-referenced

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1996 ERS SAR Production

Satellite	RAW	SGF	SLC	MLD	ITN	Total
ERS-1	302	98	1	195	857	1453
ERS-2	156	32	0	50	149	387
Total	458	130	1	245	1006	1840

RAW - Raw signal data
SGF - Fine resolution (25m), Geo-referenced
SLC - Single Look Complex
MLD - Multi-Look Detected
ITN - Image Transfer Network to Ice Centre - T1 Link
Coarse resolution (100 m), Geo-referenced

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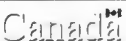

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Canadian Commercial Product Distribution

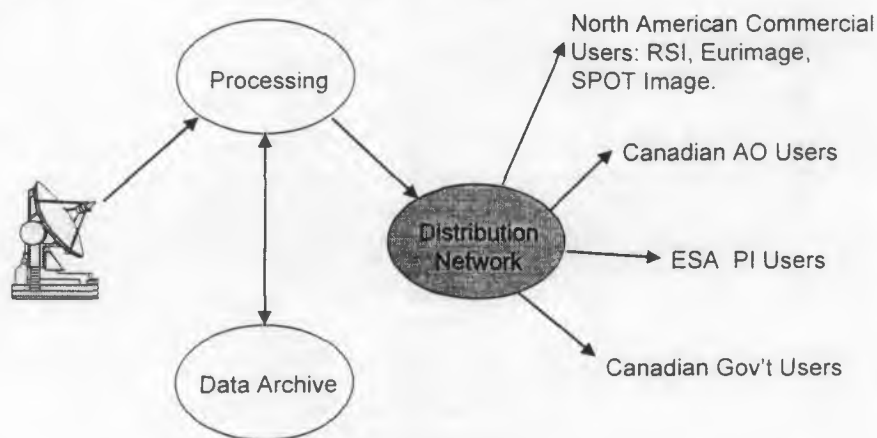
- RADARSAT International, Inc.
 - Processing and Distribution
 - SPOT
 - LANDSAT
 - RADARSAT (RSI CDPF plus Globally)
 - Distribution (CCRS Processing)
 - ERS SAR

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ERS-1 & 2 Data Distribution



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ERS SAR Marketing and Sales

RADARSAT International Inc. (RSI)

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ERS-1 & 2 Status Update

- ERS-2 SAR Reception, Archiving and Processing continued from termination of tandem mode.
- ERS-2 operations for ice monitoring continue at reduced level following RADARSAT commissioning.

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ERS-1 & 2 SAR Data Distribution

- CCRS responsible for distribution of all data received at GSS and PASS for National and Canadian AO users.
- CCRS in conjunction with ESA, responsible for distribution of Canadian data to ESA AO PI's.

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ERS-1 & 2

Data Distribution (cont'd)

- CCRS has an arrangement with RADARSAT International Inc. for the distribution of Canadian data to commercial users.
- Under the authority of ESA, CCRS provides North America ERS SAR Data Products to RSI, SPOT Image and Eurimage for commercial marketing and distribution.



CCRS Archive Operations Status



Canadian Earth Observation Data Archive

DATA HOLDINGS

Mission	Period	Data Volume in Terabytes			
		HDDT	Optical	D1	Total
LANDSAT MSS	1972-1998	27	0	0	27
LANDSAT TM	1982-1998	15	47	0	62
NOAA AVHRR	1983-1998	2	0	0	2
SPOT	1986-1998	1	21	5	27
ERS-1/2 SAR	1991-1998	0	70	4	74
RADARSAT	1996-1998	0	34	0	34
SEASAT	1979	1	0	0	1
MOS-1/1b	1988-1993	1	0	0	1
JERS-1	1992-1996	0	2	0	2
Total		47	174	9	230

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Archive Operations Status

- SONY D1
 - 96 Gigabyte Cassettes
 - 1/5 the cost/Gigabyte compared to Optical
 - I/O Rate exceeds all satellite downlink rates
 - Large supportable installed base world-wide
- Migration of all data on Optical Tape to SONY D1 magnetic media starts May 1, 1998

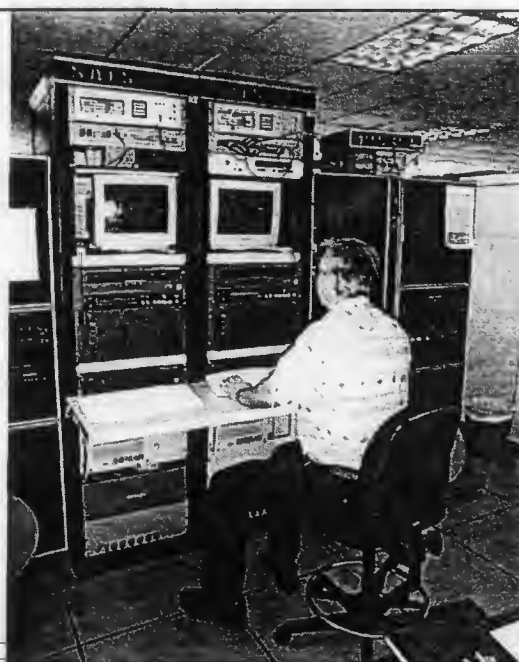
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SATS

*Serial Archive
Transcription System*



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CARCH



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SATS

Metrum HD96 recorder

Real-time sync detector



SONY D1 recorder

CREO optical recorder

PC controller

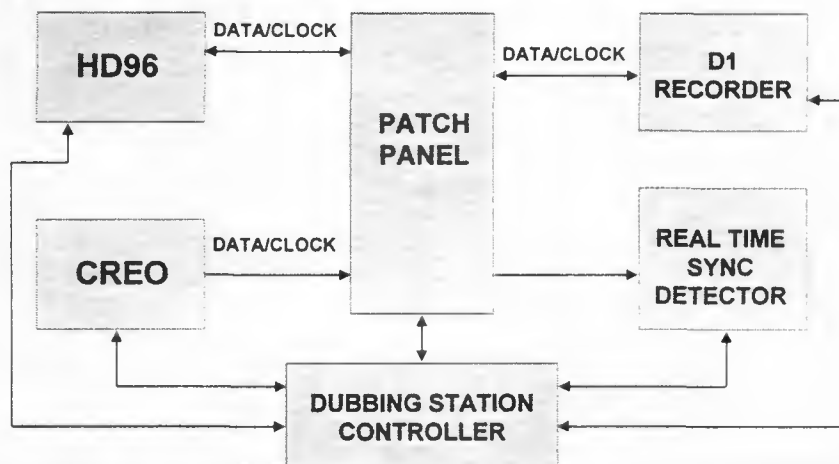
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Full Archive Transcription System

(HD96-CREO-SONY D1)



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D1 Tape Archiving Program

- All data from Optical Satellites are archived at Prince Albert.
- All data from SAR satellites is archived at Gatineau.
- Archiving involves copying the original data from HDDT and CREO/ICI optical media to SONY D1 media.

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Archive Storage - History

- 1972 to 1982 - Magnetic Tape Recorders
 - Ampex FR1928 (LANDSAT)
- 1982 to 1992 - Magnetic Tape Recorders
 - Honeywell HD96, HD96e
- 1992 to 1998 - CREO Optical Tape Recorder
 - Optical Media no longer available
- 1998 onwards - SONY D1 media
 - 1/5 the cost of CREO media

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Recent Developments

- GSAR - Workstation SAR processor for ERS
- GTS - Generic Transcription System
- SATS - Serial Archive Transcription System
- Major upgrade of older 10-meter Gatineau Antenna System
- Real-Time Sync Detector - RTSD

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GSAR

- Workstation SAR processor
 - Based on Atlantis Scientific Advanced Precision Processor (APP) software
 - Silicon Graphics "Octane" Processor
 - CDROM, Exabyte, FTP products
 - 35 minutes per full-resolution product

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Generic Transcription System **GTS**

- Features
 - PC / Win NT system using RAID technology
 - Multi-mission functionality - ERS, LANDSAT, SPOT...
 - Real-time ingest of ERS downlink data from (currently 1/2 real-time)
 - Generates RAW CEOS Level 0 products on Exabyte and CD-ROM
 - Serves as front end to GSAR workstation processor

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Generic Transcription System

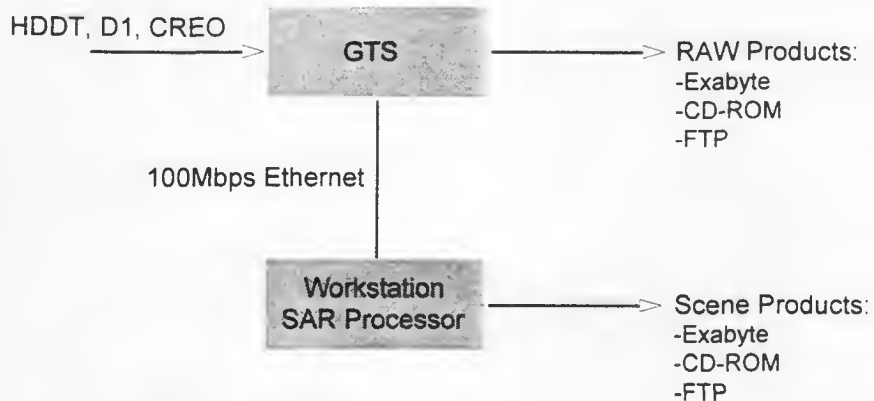


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New ERS Processing System

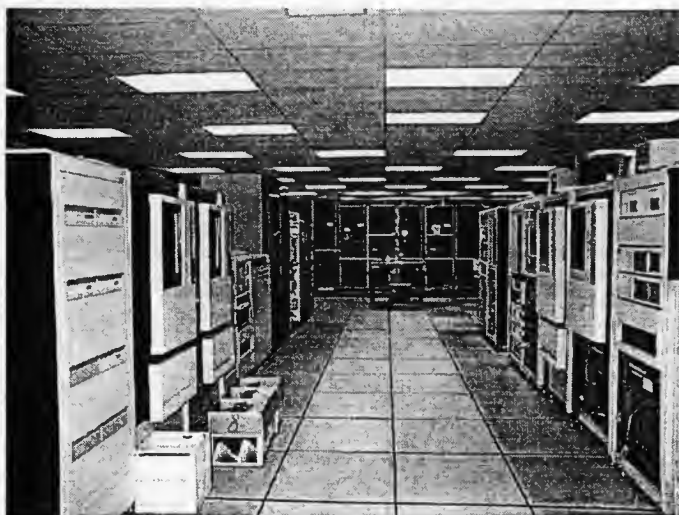


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SARDPF - old



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SARDPF - new!



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Digital Browse

- LANDSAT and SPOT
 - Imagery available on CCRS WWW Server October 1st, 1995
 - 1991 to present available
- NOAA AVHRR
 - Imagery available on CCRS WWW Server April 1, 1996
 - 1991 to present available
- RADARSAT coming soon

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File Edit View Go Window Help

Bookmarks Location <http://ccrs.csi.crc.ca/rcan/qc/cu/rdb/rmwj/rmwj.html>

Canada Centre for Remote Sensing

CCRS Earth Observation Catalogue

Search Submit Data Entry Contact Help

[New Search](#)

Swath details

Date: 1998-05-03

Time: 12:19:12

Orbit: 13019

Segment: 1

Beam: W2

Mode: ☐ Use Automatic Scrolling

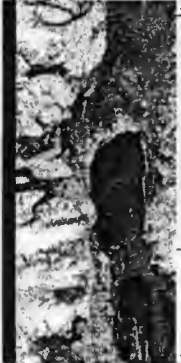
Asc/Desc: DESCENDING

Scene Center

Latitude: 079d48'06"N

Longitude: 071d24'09"W

Time: 12:19:12.92



[Home](#) [Index & User Services](#) [Data Holdings](#) [FAQs](#)

[Comments/Corrections/Help](#) Let me know

Revised October 2, 1997.

CANADA CENTRE FOR REMOTE SENSING
Data Acquisition Division



ISAMS

**ISAMS = *Integrated Satellite Acquisition
Management System***

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Data Acquisition Division

Canada
Natural Resources Canada



ISAMS

- Automated Interface
 - Satellite Operating Agencies, CCRS Stations - Programming, Scheduling and Reporting.
- Conflict Resolution
 - CCRS Stations / Antennas; User Requests; Satellites
- GUI - Swath Planning
 - Multiple Satellites; User Request Overlay
- Order Desk Support
 - Order Tracking; Swath Planning; Conflict Resolution

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ISAMS Phase I

- System Design
 - VAX Based - C, ORACLE, X-Windows Terminals
- RADARSAT Functionality (CDROC)
 - Completed December 1994
- Full Functionality
 - Completed March, 1996
 - Minor Enhancements in Progress
- Co-operative Development
 - CCRS & CALIAN Technical Services Ltd.

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ISAMS Phase II

- All-satellite, fully integrated system.
- Designed to facilitate all of the SAS responsibilities from the order entry process through to the reception/acquisition planning.
- Consolidates all relevant data into a relational database management system.

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ISAMS Phase II (cont'd)

- Involves the generation and conversion of messages and files for interfaces to the Satellite Operating Agencies.
- Implementation of Phase II started in April 1997.
- Modifications for new FAS system at SPOT Image May 1997
- Enhancements for SPOT-4 April 1998

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ISAMS Phase III (CEOSAMS)

- RFP issued in February 1998.
- Proposals received from bidders March 1998.
- Will provide the following functionality:
 - Direct interface to CEONet.
 - Online Management reporting.
 - Users can monitor the status of their own requests.
 - More automation and artificial intelligence for better operations and conflict resolution.
 - Increased efficiency and reduced costs.

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Developments in Progress

Canadian Earth Observation Projects

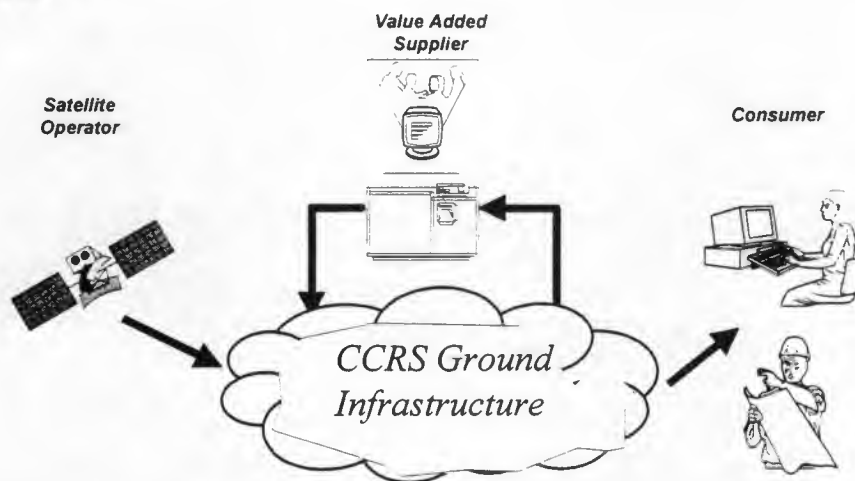
- CEOArch - online satellite data archive
- CEOCat - catalogue of archives
- CEOSAM - data acquisition management (ISAMS Upgrade)
- CEOSWAN - station wide area network(T1)
- CEONet - Client interface, online ordering
 - <http://ceonet.ccrs.nrcan.gc.ca/>

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Data Acquisition Division

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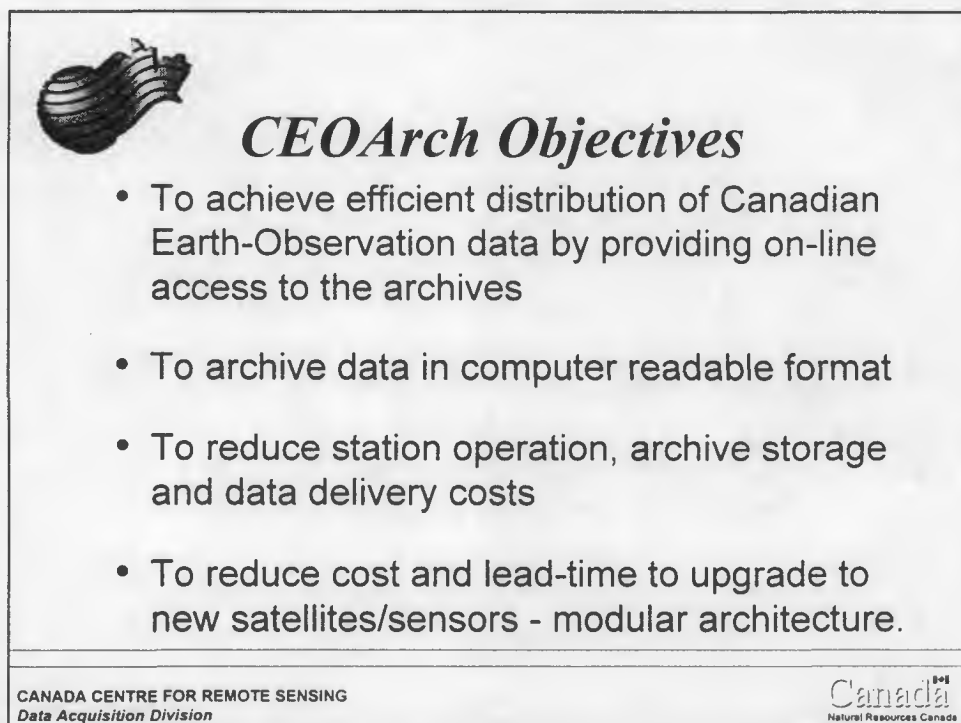
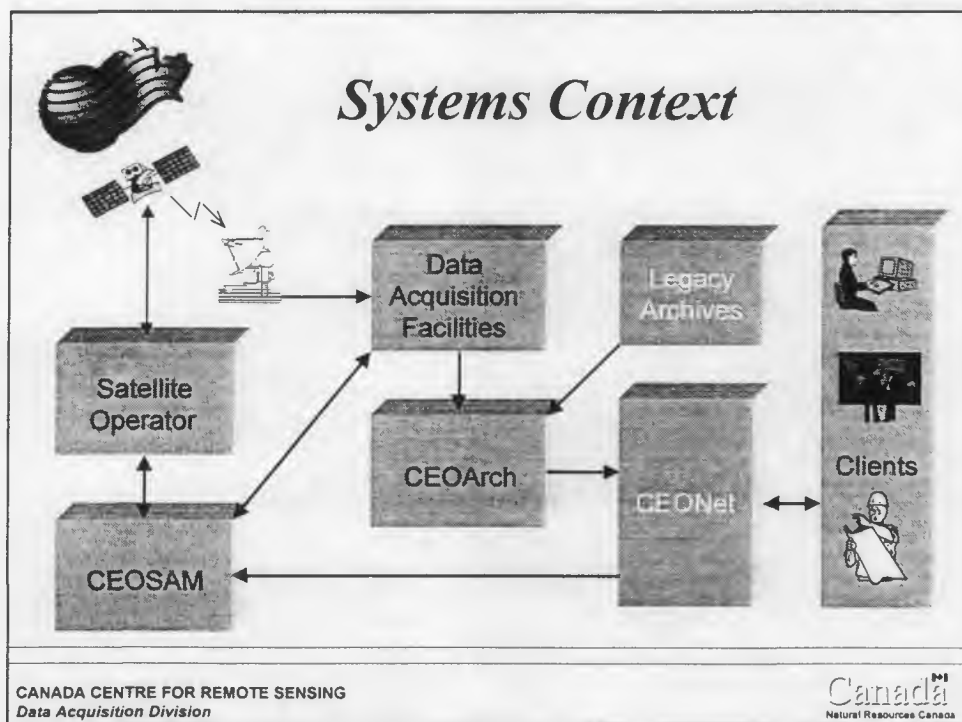


Context



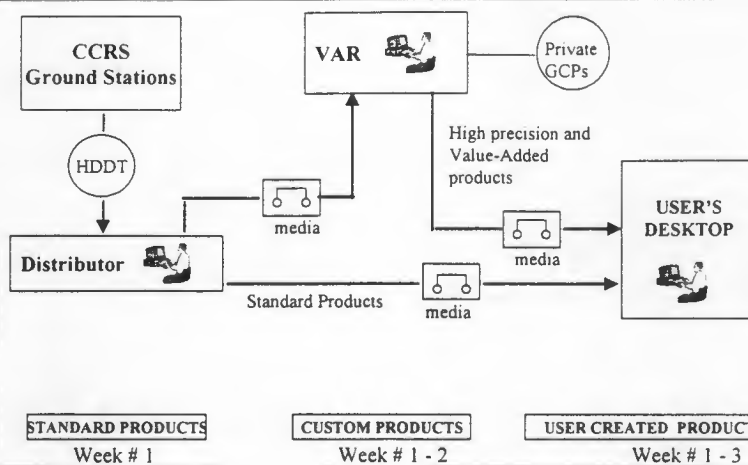
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Natural Resources Canada





Current Data Flow

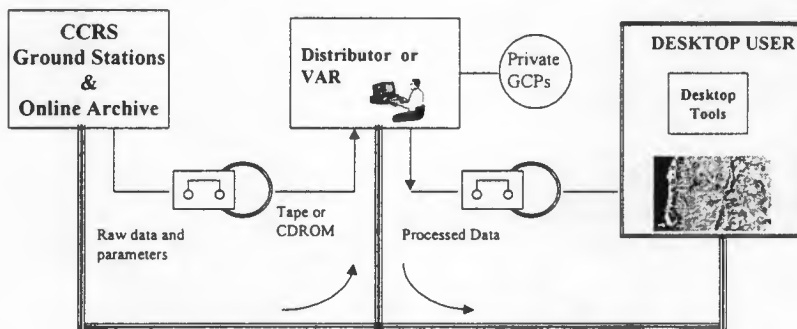


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1999 Data Flow



2 - 6 hours

2 - 12 hours

2 - 24 hours

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CEOArch Functionality

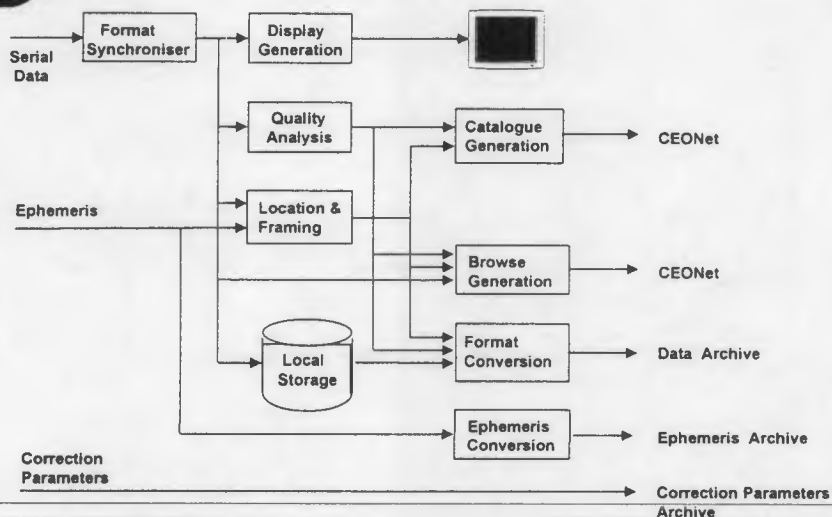
- Initially (1999):
 - SPOT-1,2,3
 - LANDSAT-4,5 TM
 - SPOT-4
- Potential:
 - LANDSAT-7
 - ARIES, other Smallsats
 - ERS
 - ENVISAT
 - RADARSAT
 - SPOT-5

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CEOArch Pre-processor Subsystem

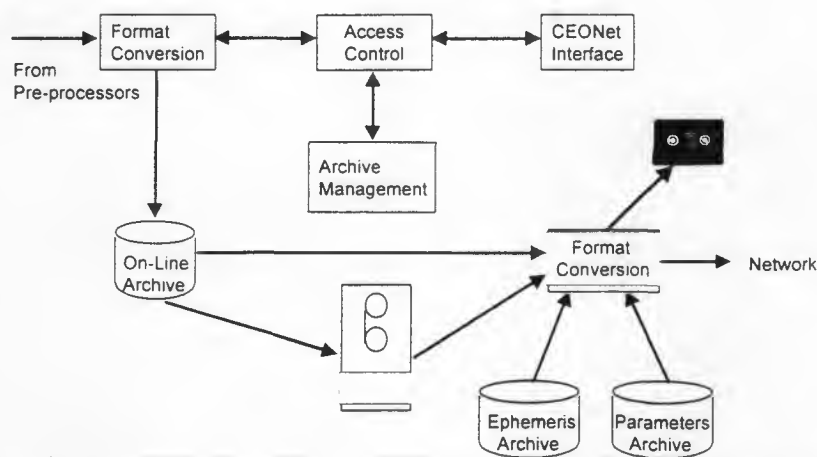


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CEOArch *Data Archive Subsystem*

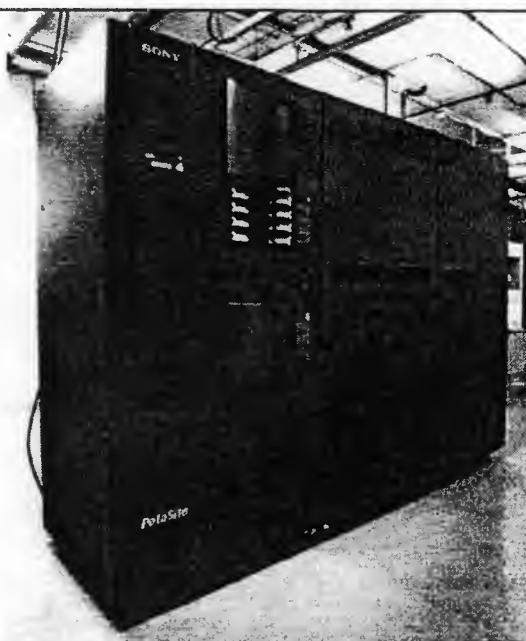


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SONY *Petasite* *data storage*



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ERS SAR Marketing and Sales

RADARSAT International Inc. (RSI)

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Data Acquisition Division

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Natural Resources Canada

Canadian Trade Shows 1998

January

Cordillian Roundup - *Vancouver, BC*

March

Canadian Hydrographic Conference - *Victoria, BC*
PDAC - *Toronto, ON*

April

Aboriginal Forestry in Canada - *Vancouver, BC*
GIS '98 - *Toronto, ON*

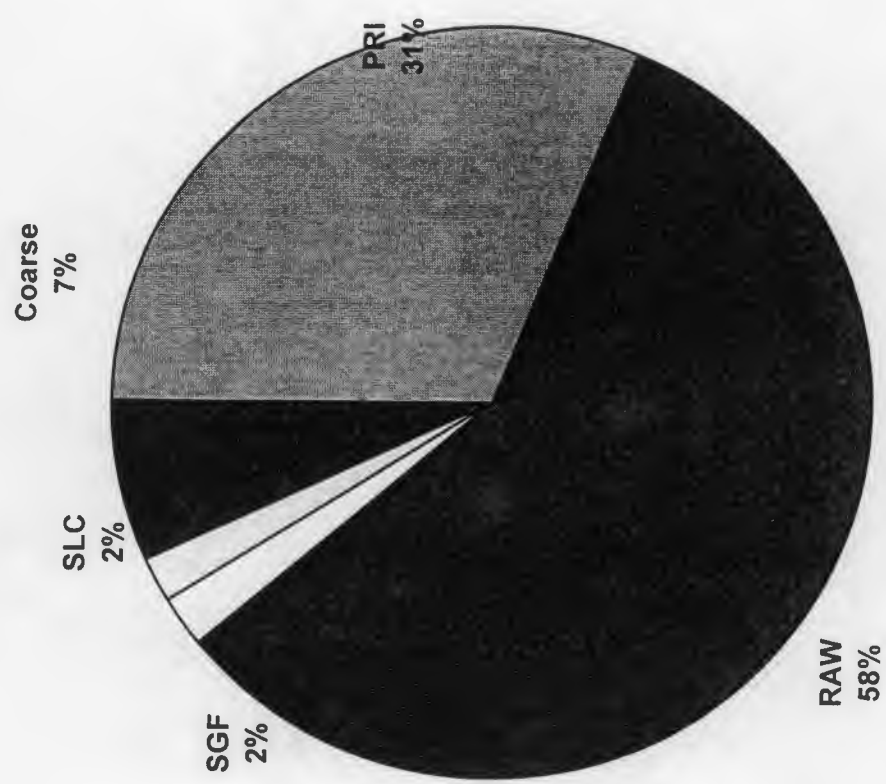
May

Canadian Remote Sensing Symposium - *Calgary, AB*

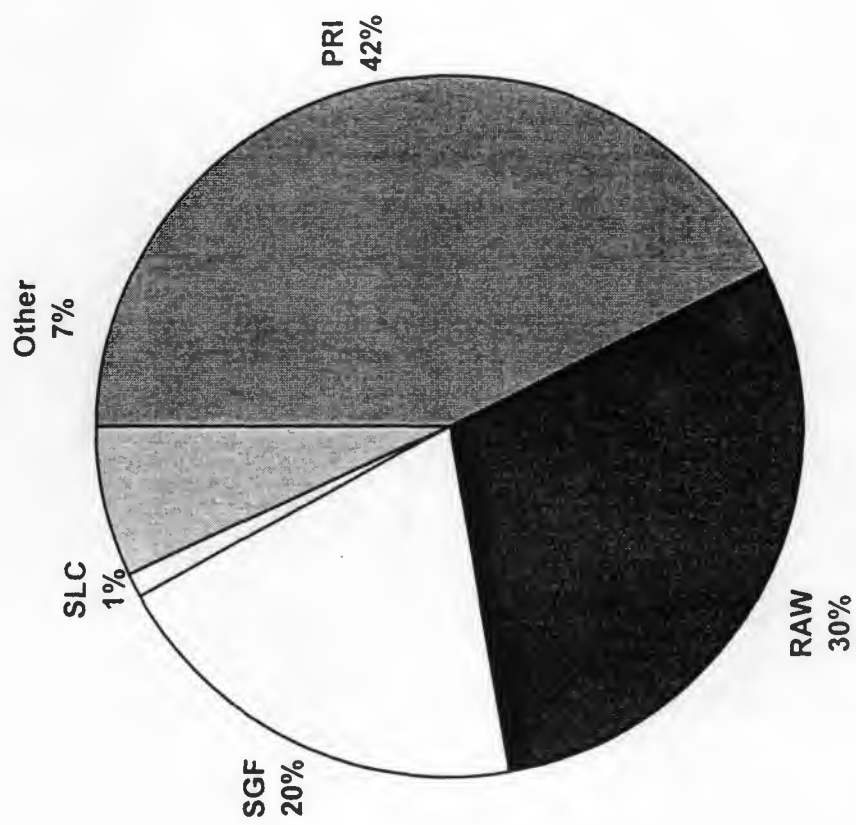
June

ER Mapper User Group - *Calgary, AB*
SDI - *Ottawa, ON*

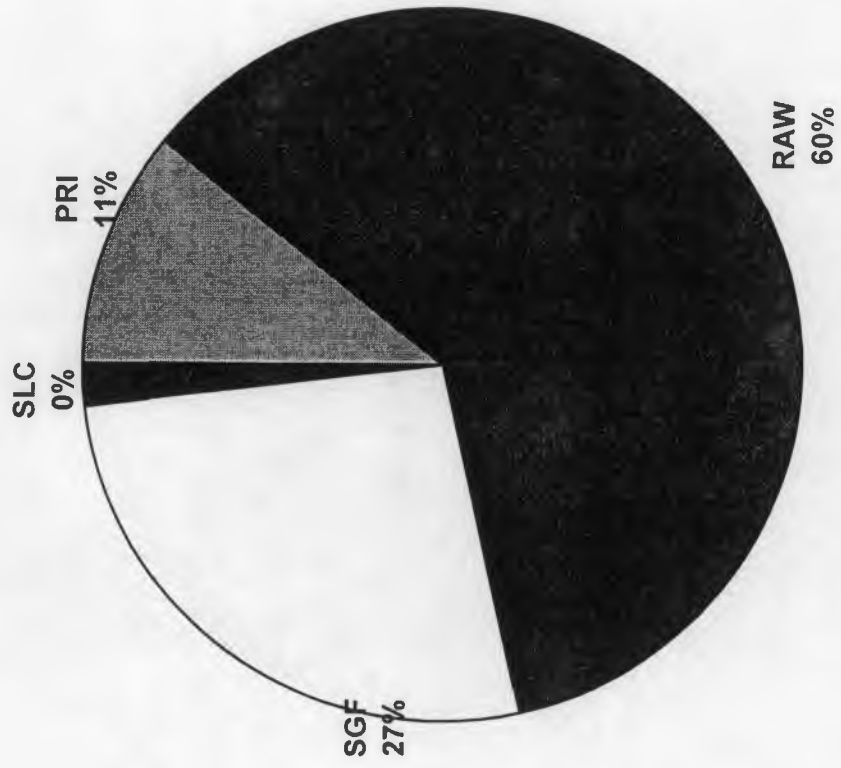
1997 ERS Sales by Processing Levels



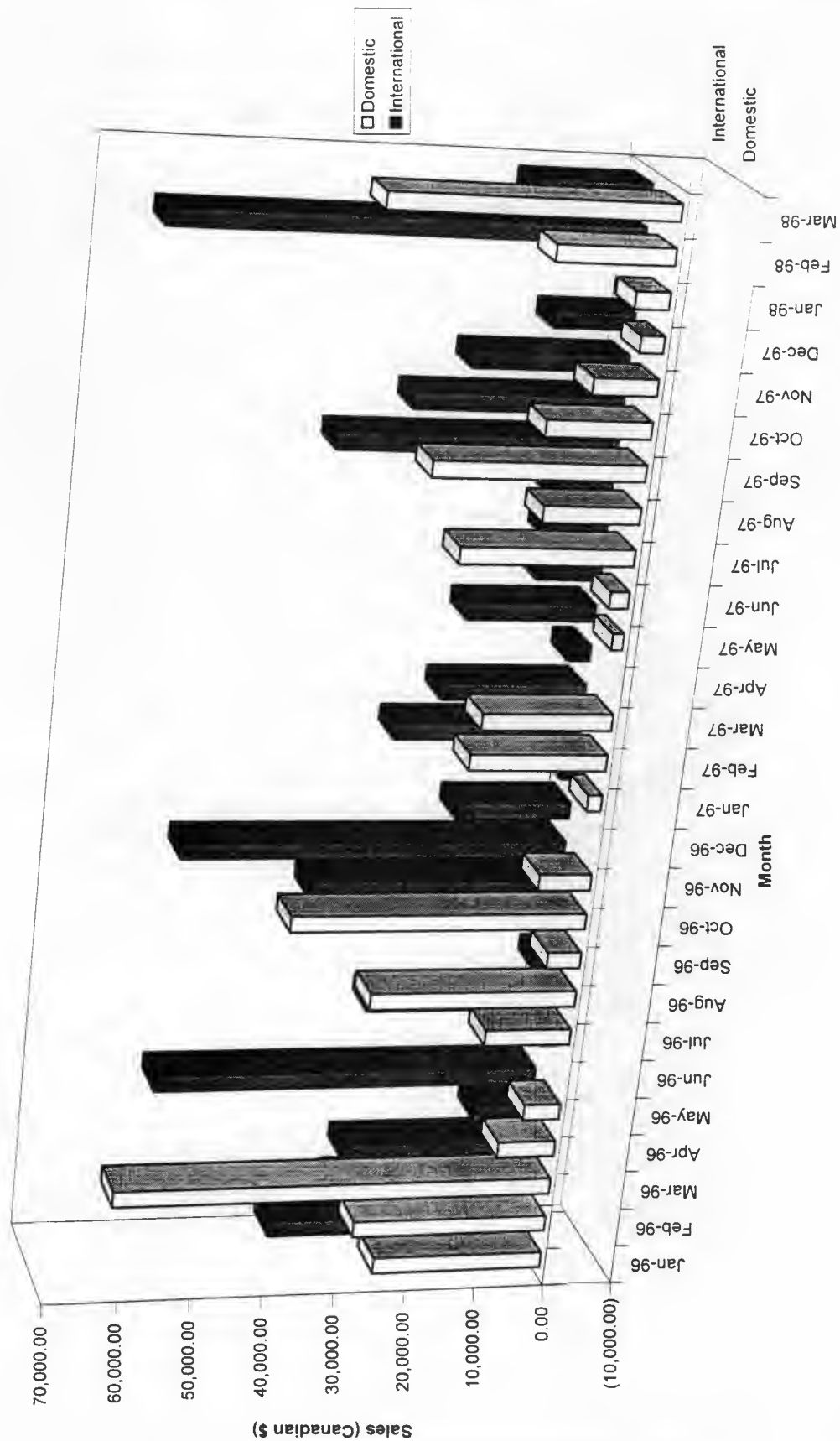
1996 ERS Sales by Processing Levels



Q1 1998 ERS Sales by Processing Levels



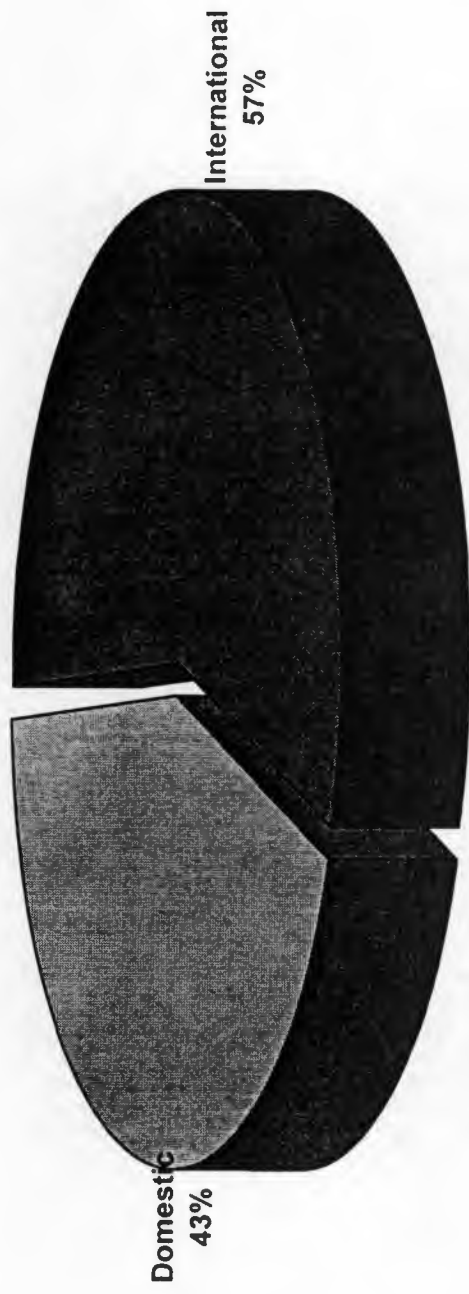
Total ERS Sales 1996-1998



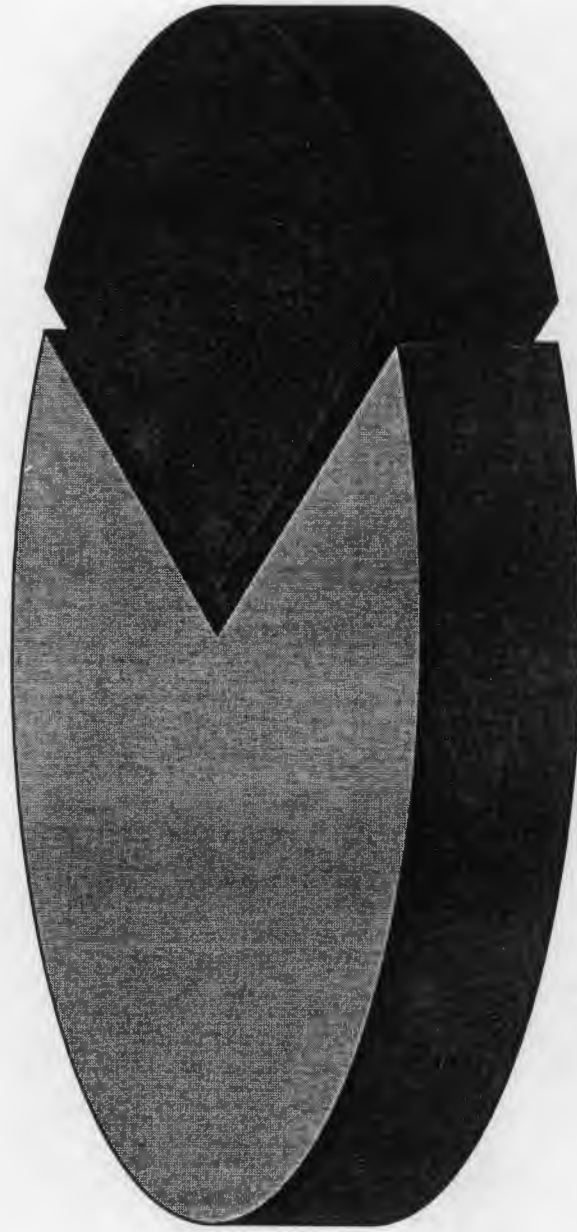
1997 ERS Sales - Domestic vs. International



1996 ERS Sales - Domestic vs. International

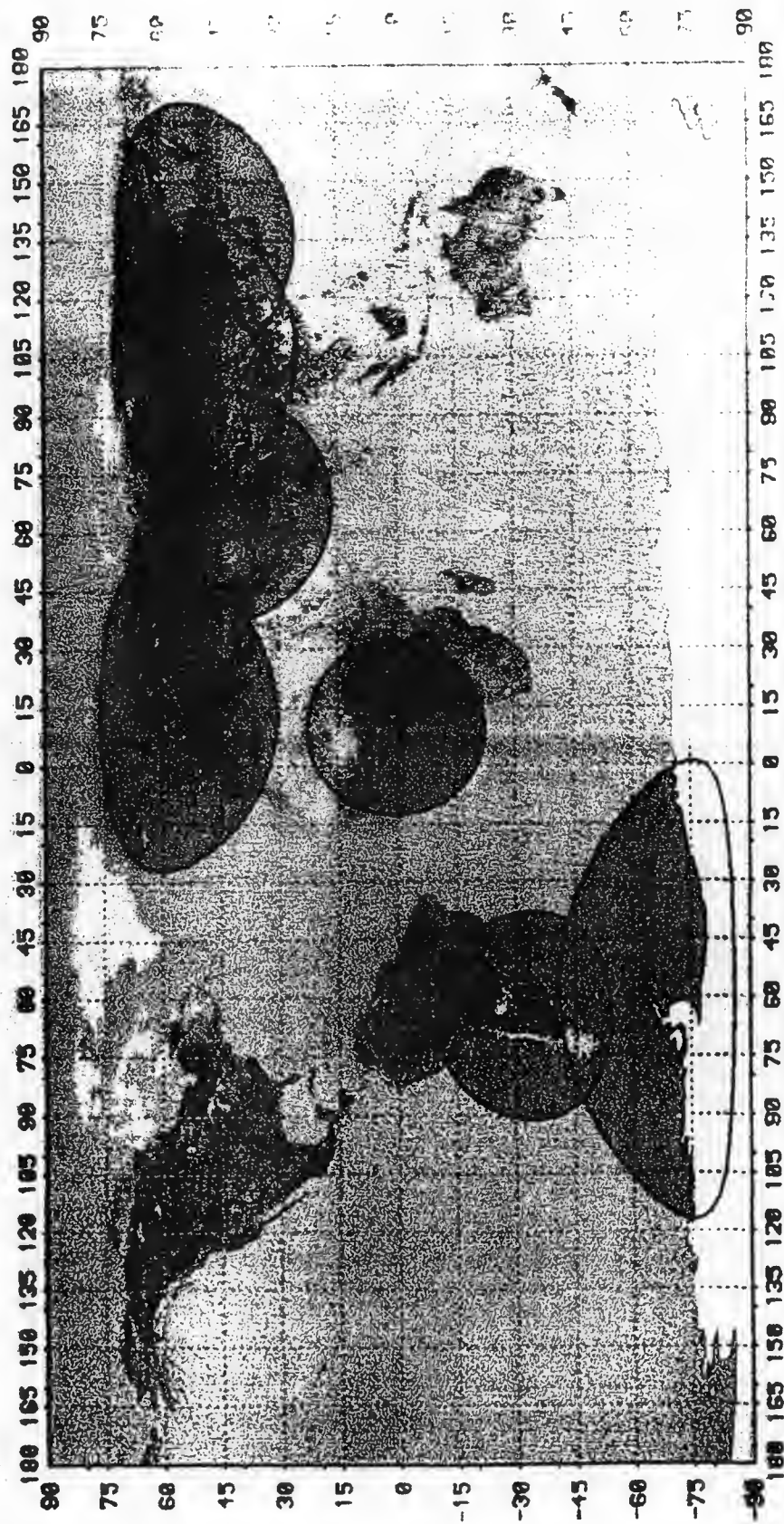


Q1 1998 ERS Sales - Domestic vs. International



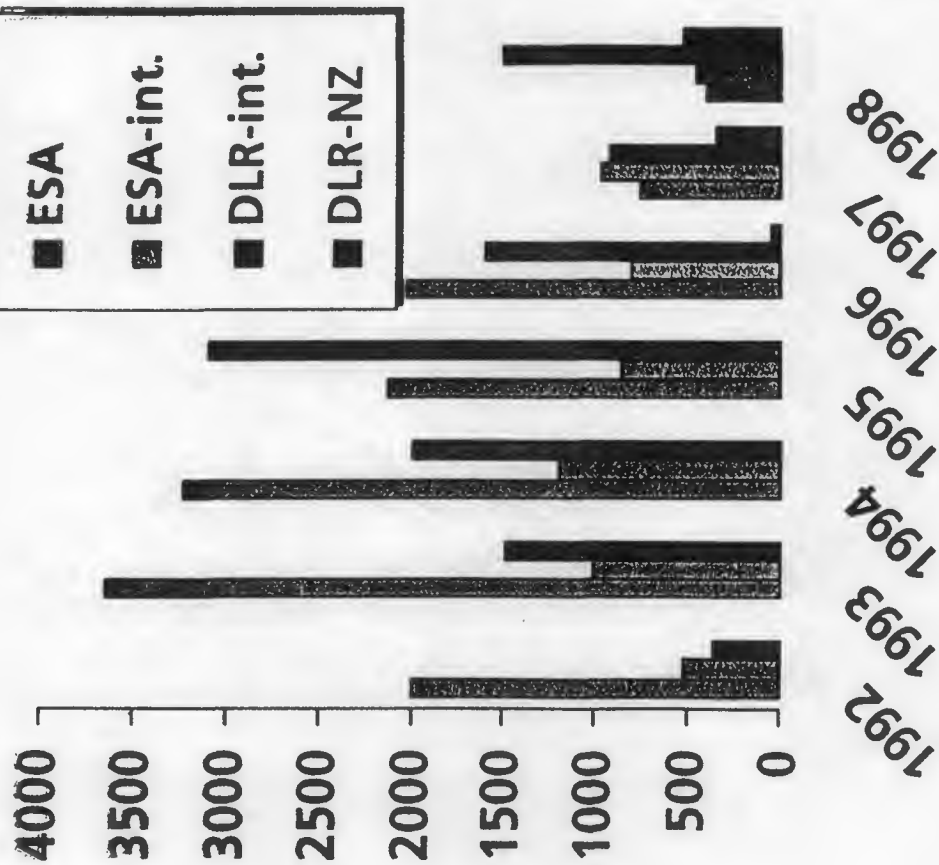
Domestic
67%

International
33%





■ ESA-Europa
■ Neustrelitz
■ Gabun
■ Mobile
■ Antarktis
■ ESA-Intern.



ERS-SAR Szenen
in D-PAF Archiv

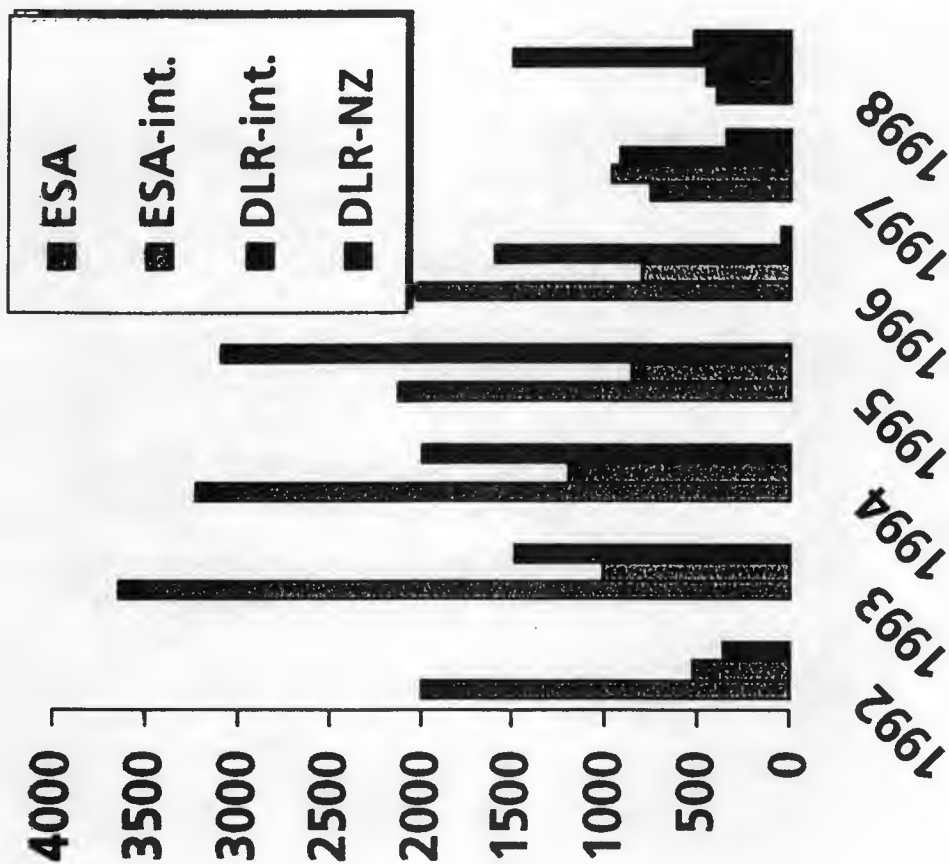
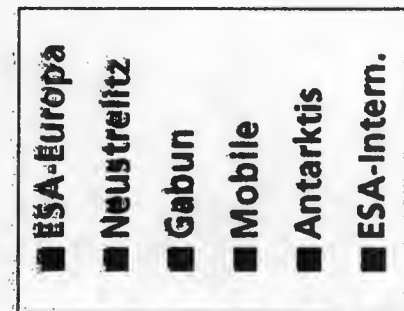
Erzeugte ESA Standardprodukte
im D-PAF



DLR



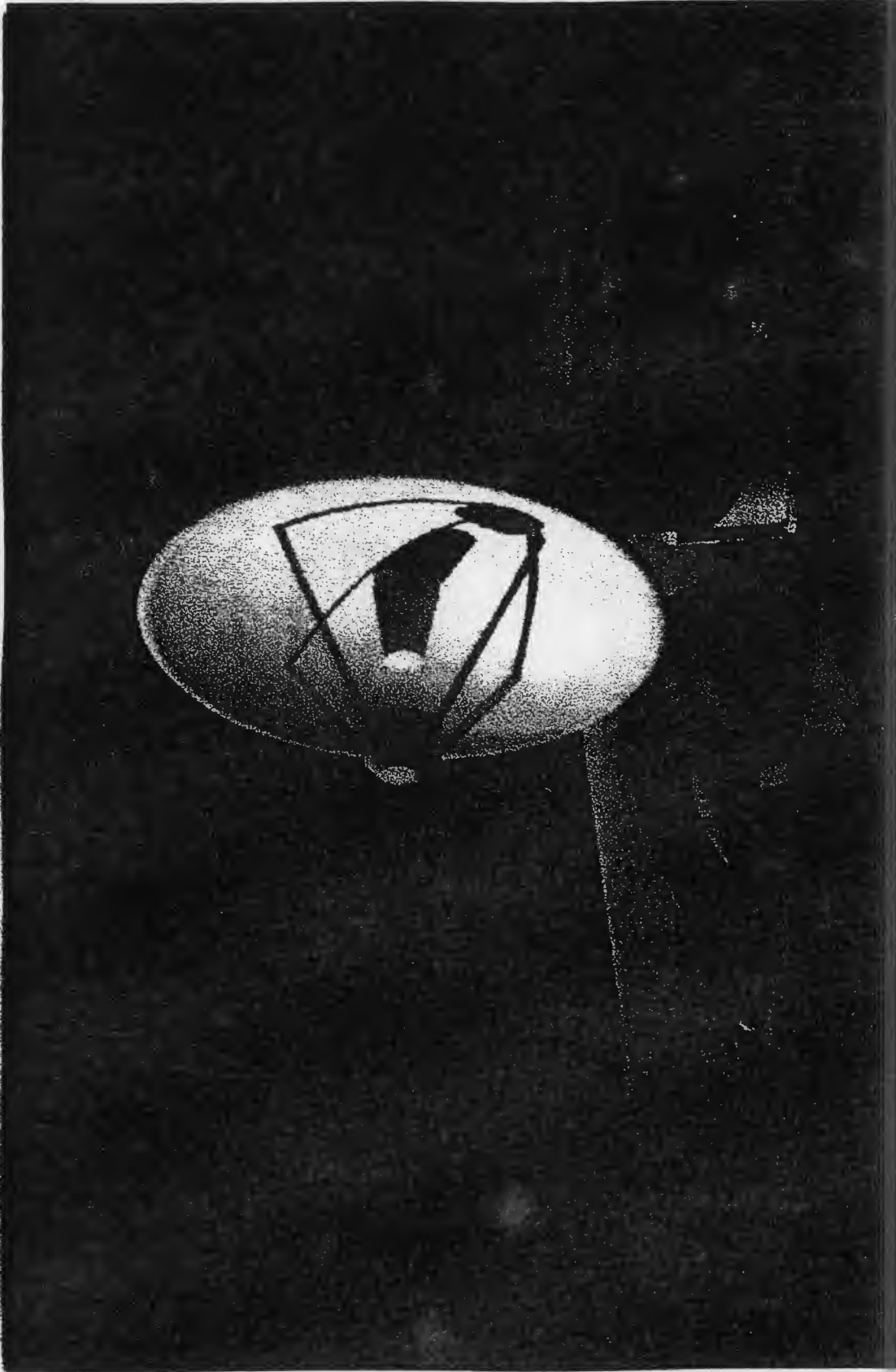
ERS-SAR Szenen
in D-PAF Archiv

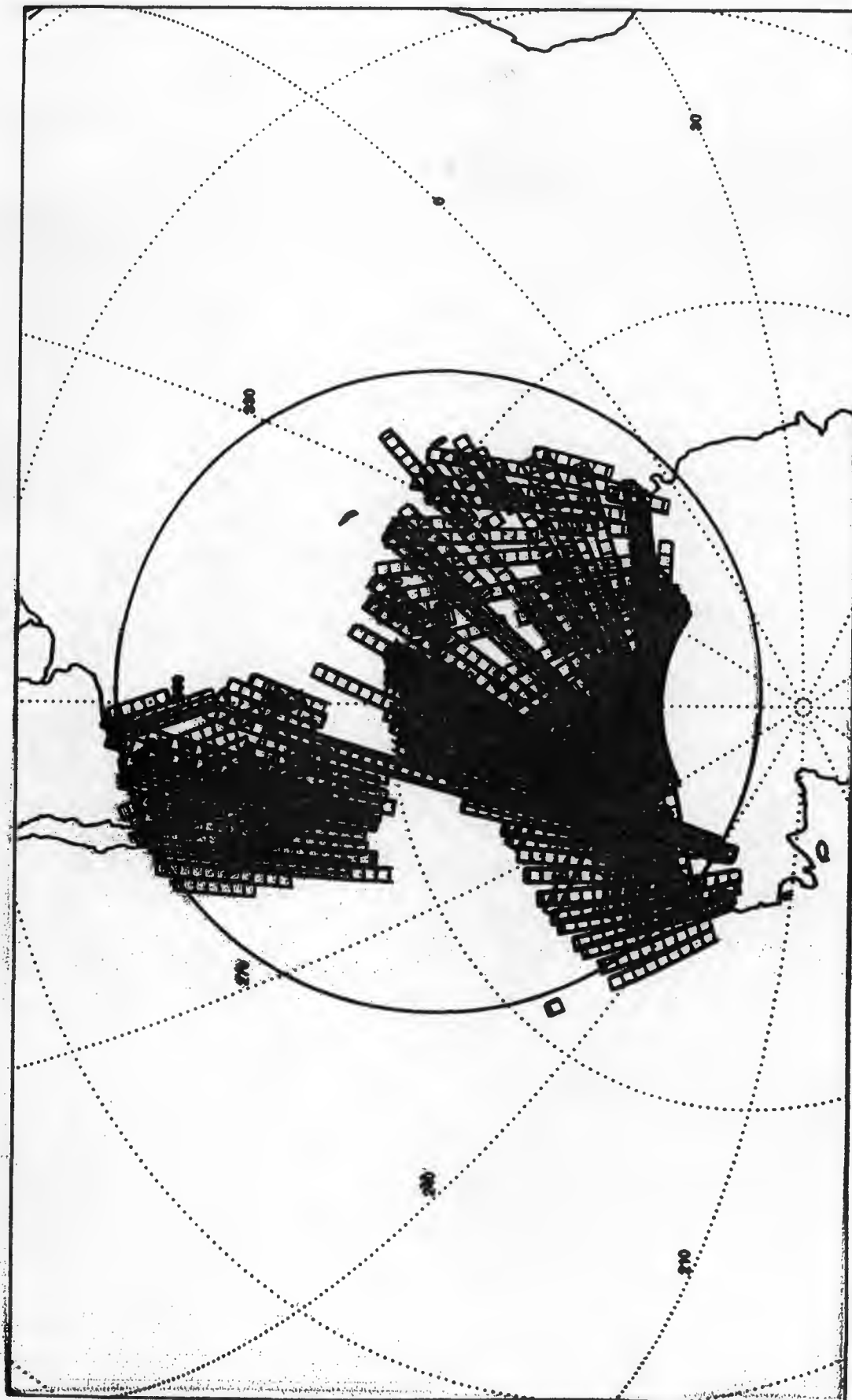


Erzeugte ESA Standardprodukte
im D-PAF



Deutsche Forschungsanstalt für Luft- und Raumfahrt e.V.





PLAUSIBLE BEZUGSWEISE: RAUMFLUCHTVERSUCH - RAUMFLUCHTVERSUCH, PROGRAMM VON

OTHER BALLOONFLAGEBANDS DATE: 27.08. - 18.07.1997

DIFFERS



ERS-SAR total Acquisitions from Libreville

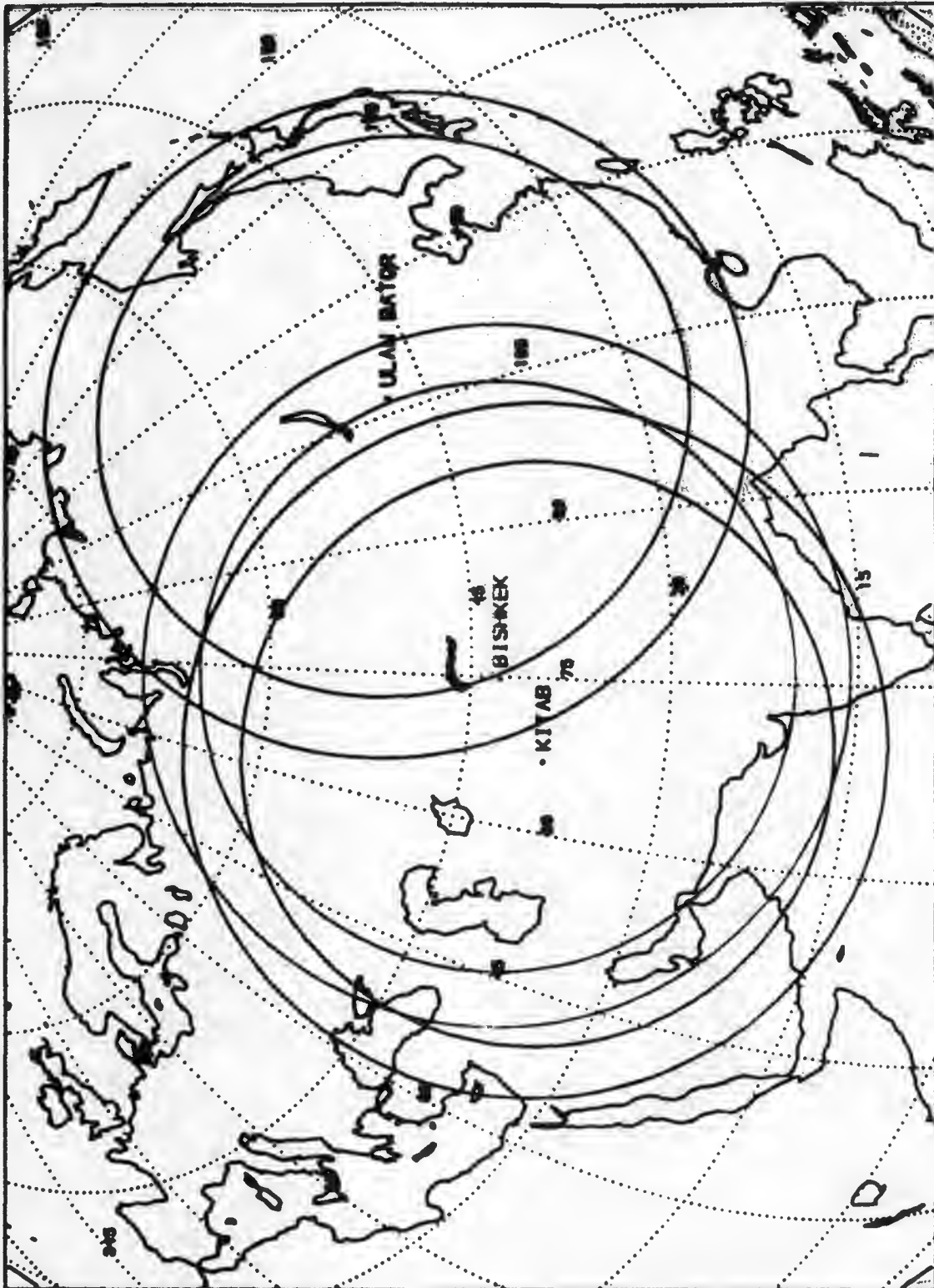


Period of Acquisition: July 1994 - June 1997

- Single cover
- Double cover
- Multiple cover



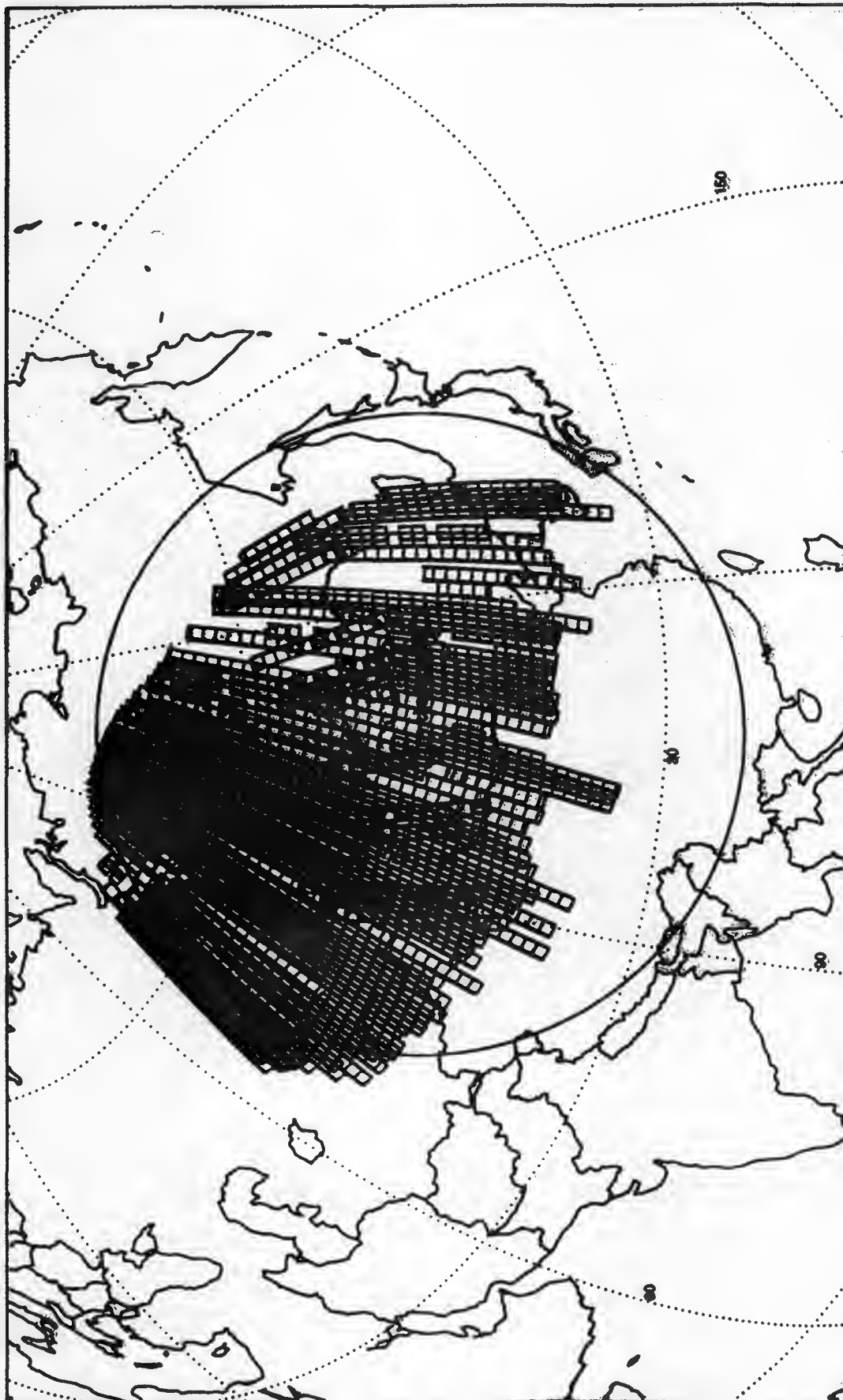
DLR



Mobile Groundstation in Kitab, Ulan Bator, Bishkek - Visibility Circles 0.5 deg



Screeningreport from Ulaanbaatar

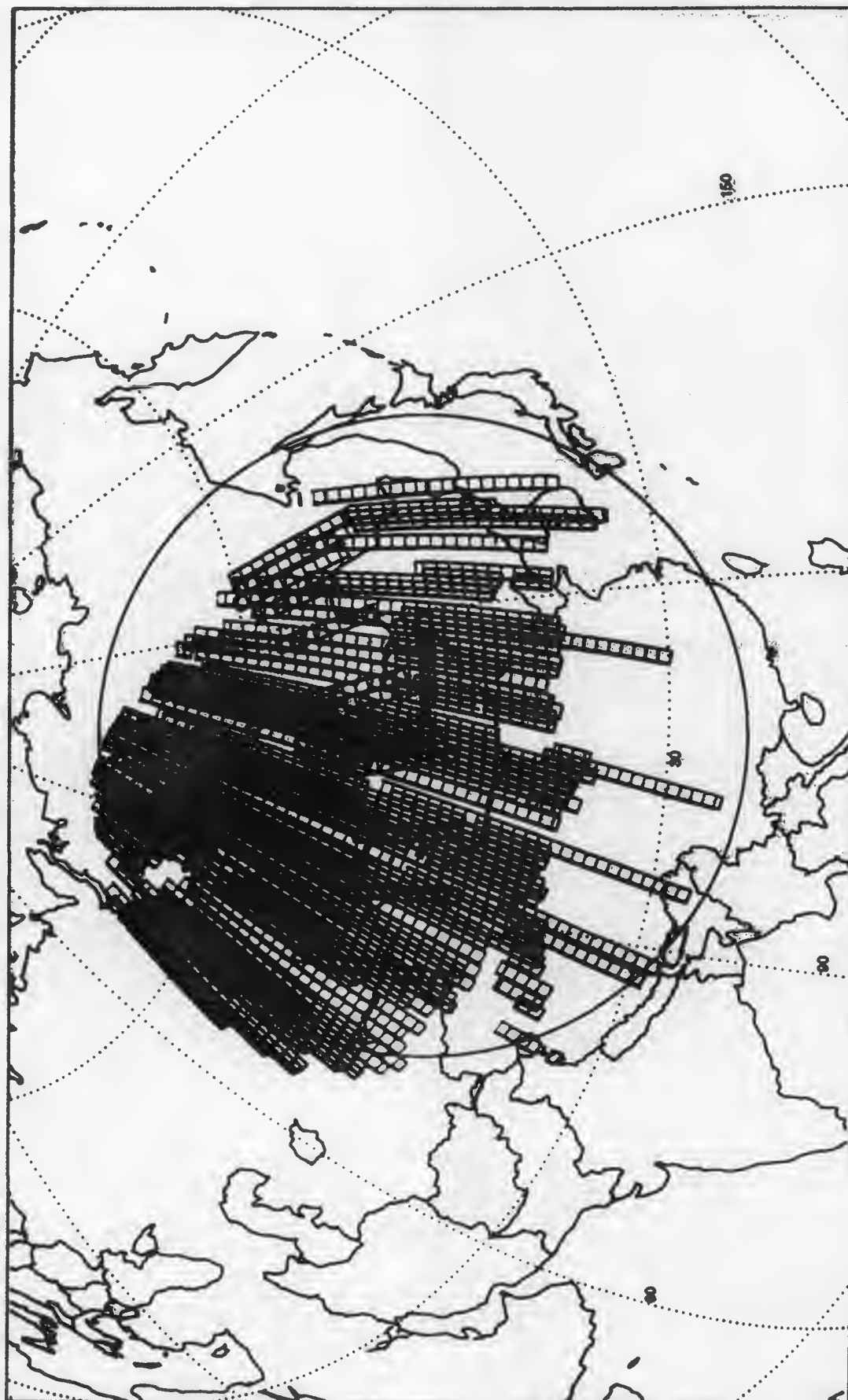


DLA-0800 OBERPFAFFENHOFEN, RAUMF. UOBETRIEB - RAUMF. UODYNAMIK, PROGRAMM VICI
1989 JANUAR 2-10 (VICKS)

DFD-BS

ERS1 SAR-COVERAGEBANDS DATE: 17.09. - 27.10.1997

Screeningreport from Ulaanbaatar



DFD-BS

ERS2 SAR-COVERAGEBANDS DATE: 17.09. - 27.10.1997

SIBERIA: SAR Imaging for Boreal Ecology and Radar Interferometry Applications

Objectives: 1) forest mapping for sustainable development, 2) biomass estimation for climate monitoring, 3) digital elevation generation for monitoring and mapping.

Intensity



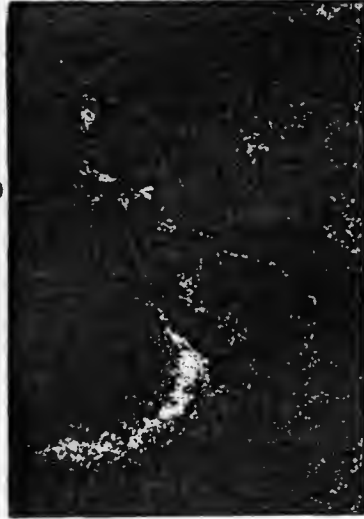
Coherence



Vegetation Structure

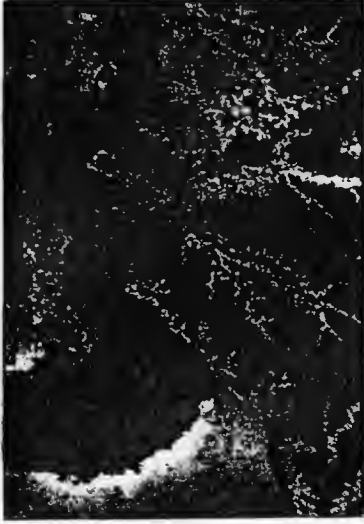


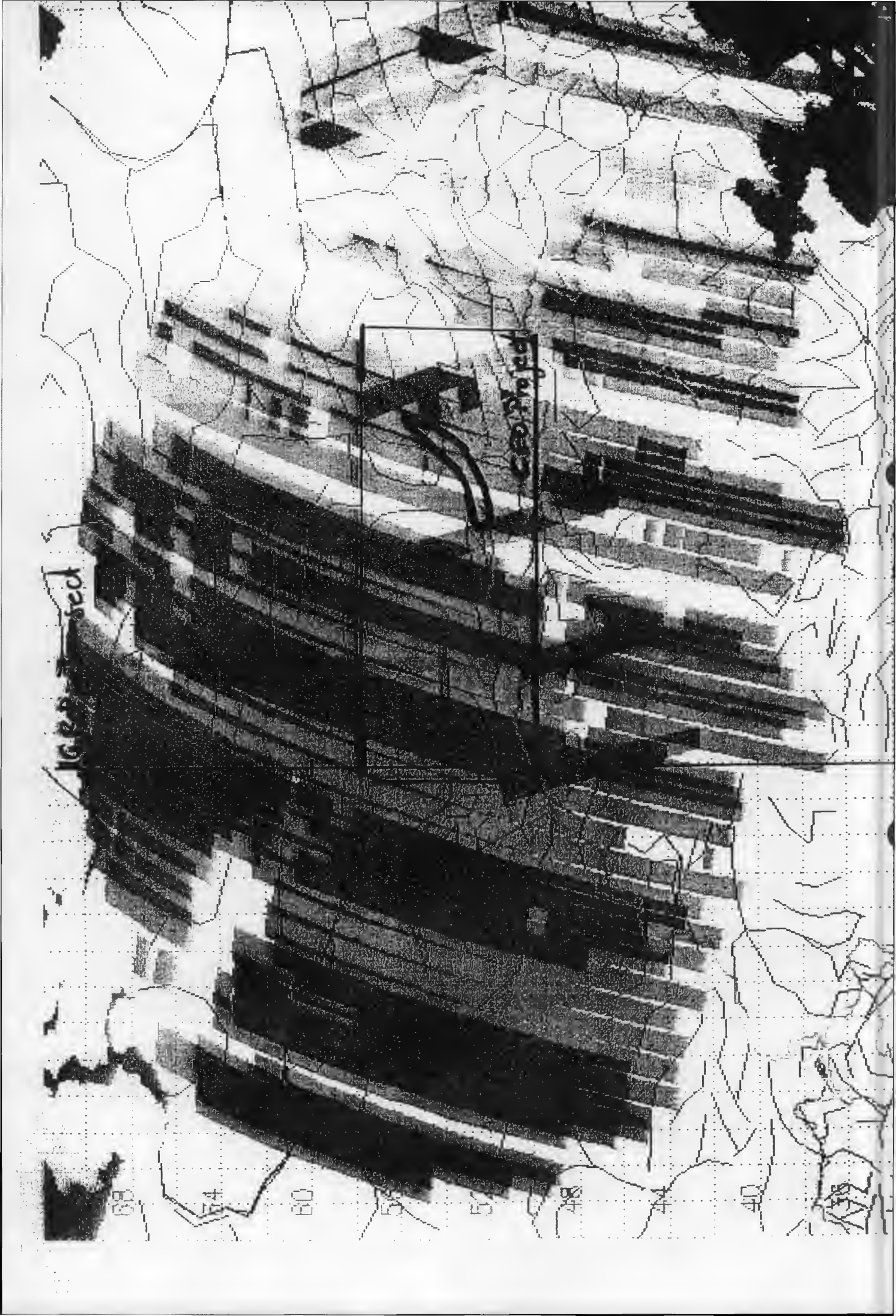
Interferograms



for

DEM Generation





Intensity - Coherence Composite





ERS-1 intensity



ERS-1 intensity

ERS Tandem Interferogram



Decorrelation
due to dense forest

ERS-SAR Total Acquisitions from Neustreitz

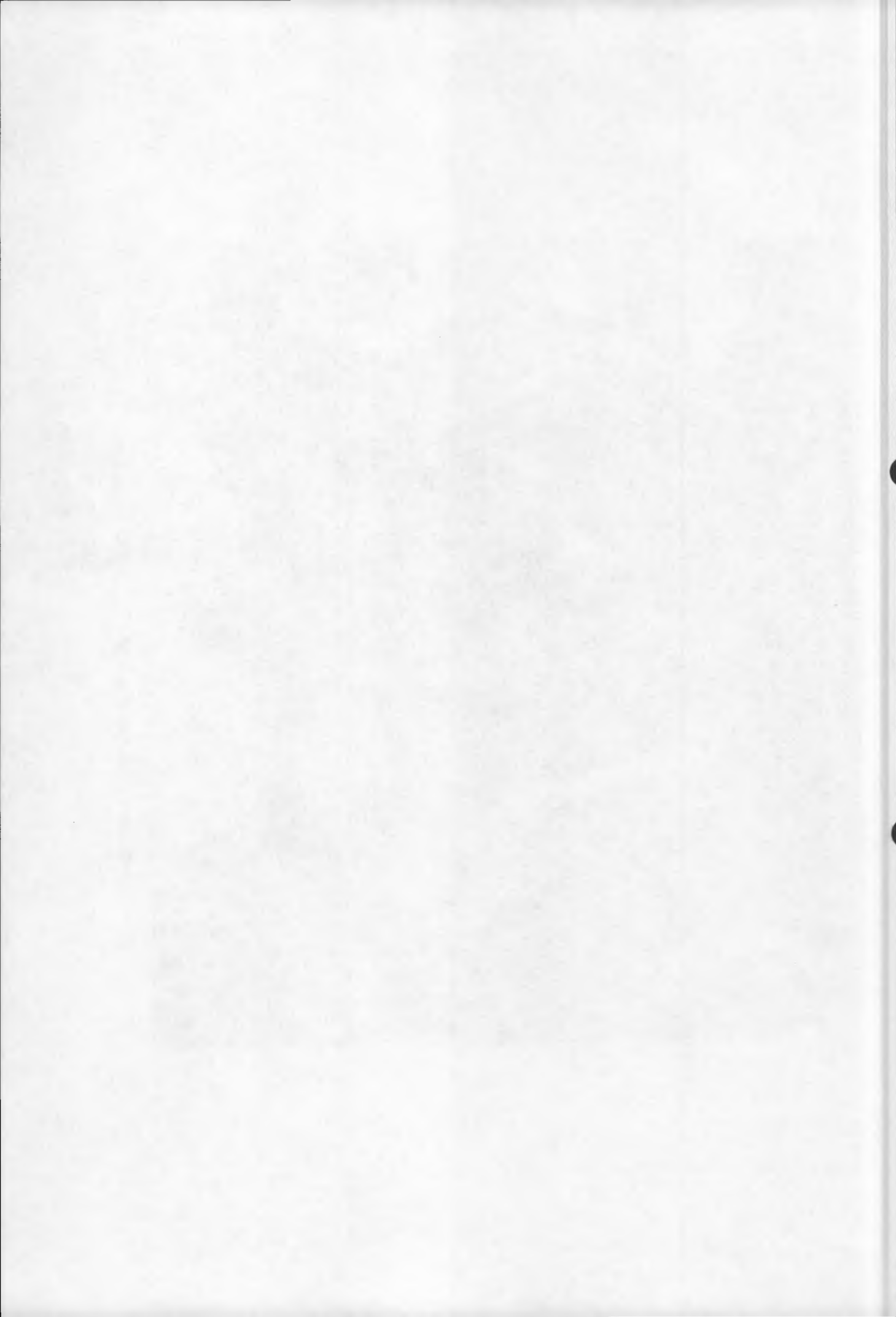


Period of Acquisition: Nov. 1996 - Dec. 1997

- Single cover
- Double cover
- Multiple cover



DLR



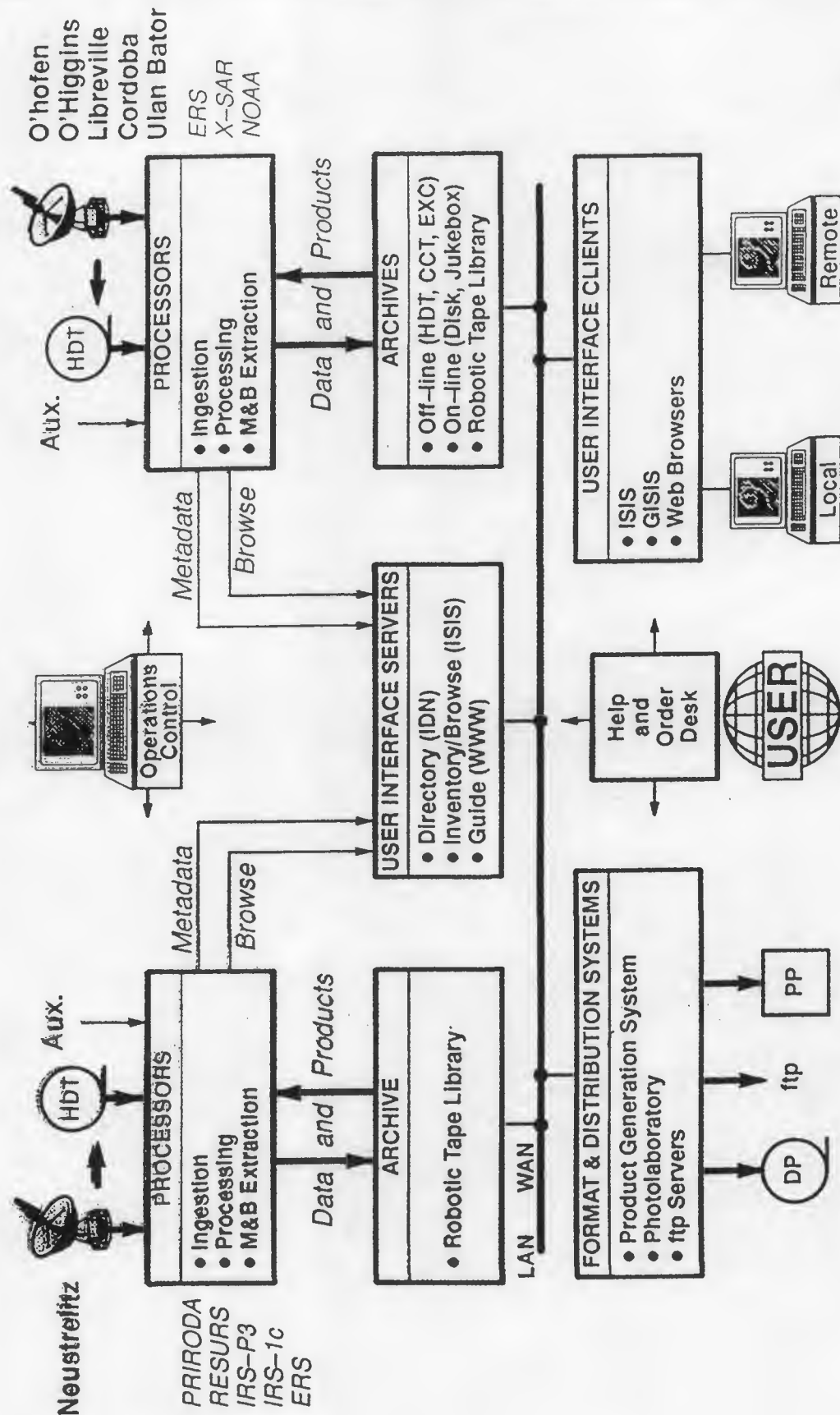
CONF 71444E

Overview of DLR - DFD / Neustrelitz Ground Segment Activities Third Party Missions

J. Schwarz; H.-D. Bettac; K.-D. Mißling
German Remote Sensing Data Center

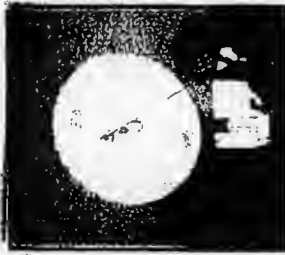
7th ESOWG Meeting
28th - 29th May 1998
Toulouse, France

DFD Earth Observation Ground Segment: Major Components and Data Flow



DFD Earth Observation Ground Stations Coverage

/neustrellitz.html



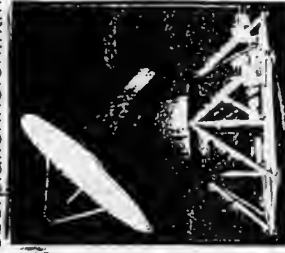
GNIRS-1

/neustrellitz_2.html



GNIRS-2

/oberpfaffenhofen.html

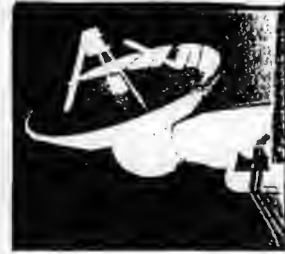


GNRS



GMRS-1

/cordoba.html



GARS

/higgstation.html



GTRS

/libreville.html



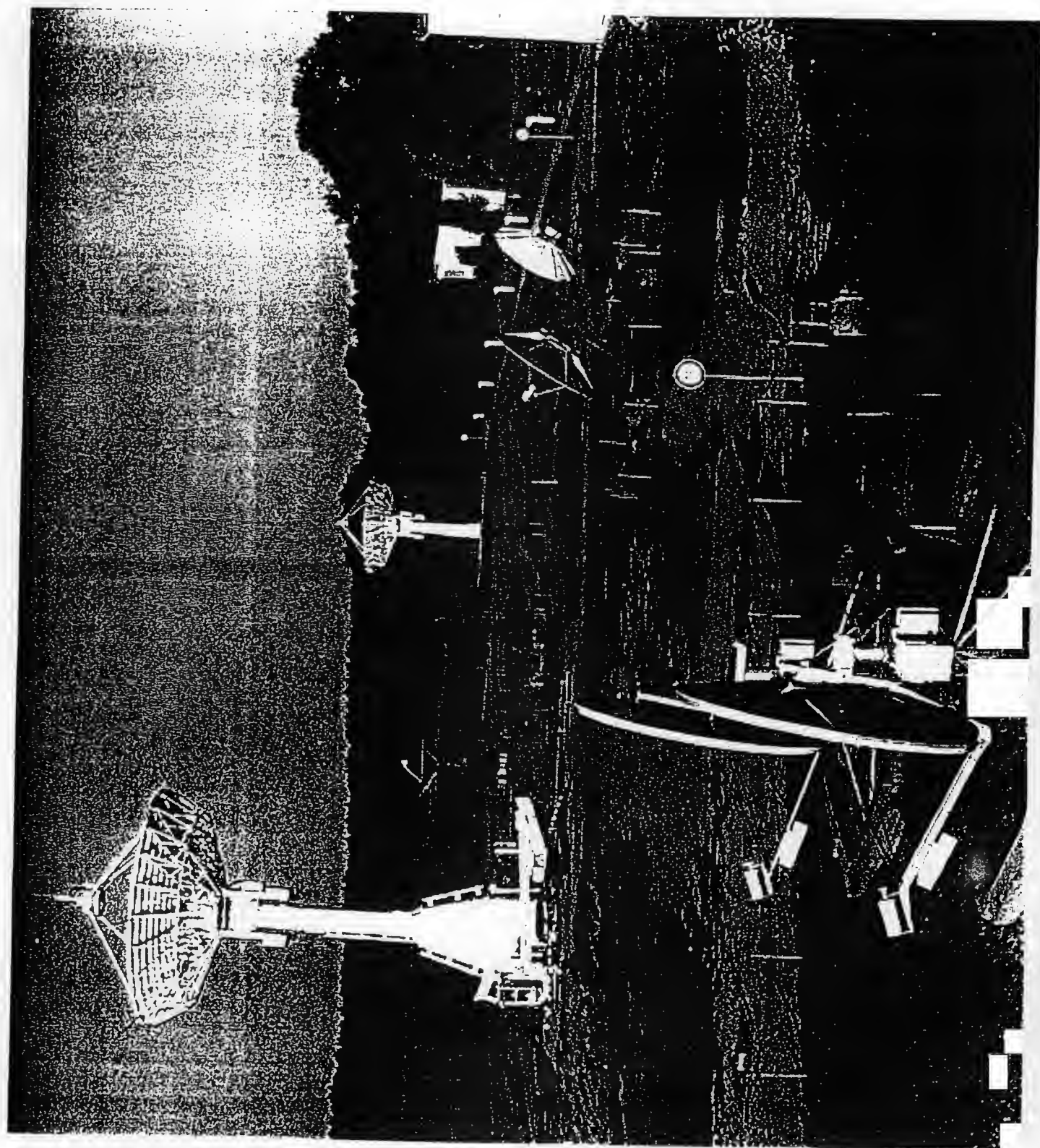
GMRS-2

/ulanbator.html

Deutsches Zentrum für Luft- und Raumfahrt e.V.

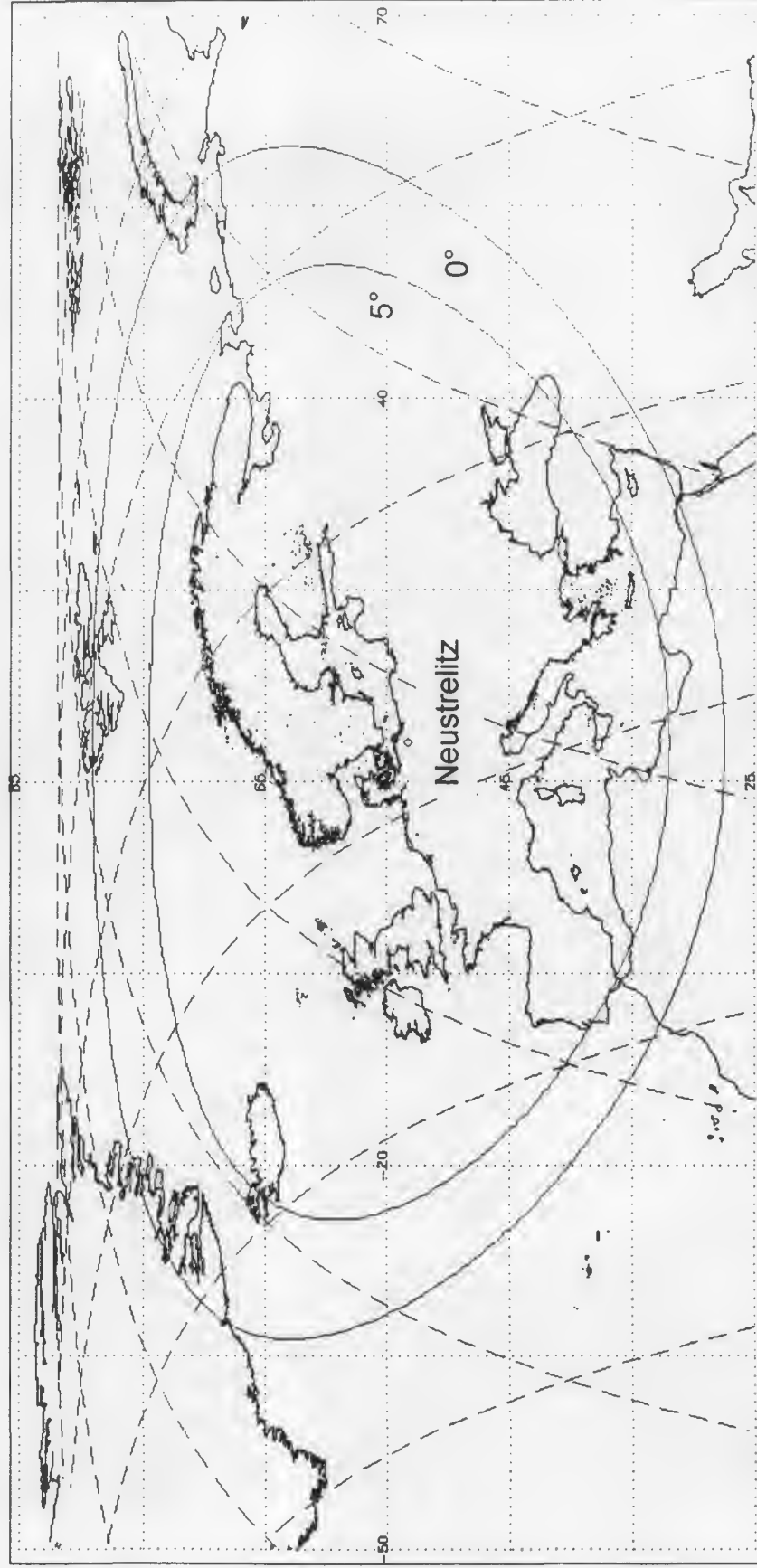
DFD Earth Observation Ground Station Characteristics Summary

Station Parameters	GNSSR-1 German National Receiving Station 1	GNSSR-2 German National Receiving Station 2	GARS German Antarctic Receiving Station	GTHS German Transportable Receiving Station	GMRS-1 German Mobile Receiving Station 1	GMRS-2 German Mobile Receiving Station 2	GNSS German National NOAA Station
Location							
- City/State-Name	Neustrelitz	Neustrelitz	O'Higgins	Libreville	Cordoba	Ulan Bator	Oberpfaffenhofen
- Country	Germany	Germany	Antarctic Peninsula	Gabon	Argentina	Mongolia	Germany
- Latitude	N 53° 19' 48"	N 53° 19' 48"	S 63° 19' 12"	N 00° 18' 00"	S 31° 31' 12"	N 47° 55' 31"	N 49° 09'
- Longitude	E 13° 04' 28"	E 13° 04' 28"	W 57° 54' 01"	E 09° 15' 05"	W 64° 27' 50"	E 106° 57' 33"	E 11° 28'
- Altitude	78 m	78 m	12 m	50 m	730 m	1450 m	582 m
Type of Station	stationary	stationary	stationary	transportable	mobile (temporary)	mobile	stationary
Operations Concept	permanent, 24 hours/day multimission	permanent, 24 hours/day multimission	campaigns, (110d/y) multimission	campaigns, (70d/y) multimission	campaigns, multimission	campaigns, multimission	permanent, 24 hours/day
Satellites	ERS, IRS-1B/C(D), MOMS/PRIRODA, IRS-P3, Resurs-01, (Landsat 7)	ERS, IRS-1B/C(D), MOMS/PRIRODA, IRS-P3, Resurs-01, (Landsat 7)	ERS, Radarsat, JERS, Landsat 5, VLBI operations, NOAA	ERS, Radarsat, JERS, Landsat 5, SPOT 1-3	ERS, Radarsat, Landsat 5, (IRS-1C)	ERS, Radarsat, JERS, Landsat 5	NOAA TIROS-N
Reflector	Parabola, 7.3 m diameter	Parabola, 7.3 m diameter	Parabola, 9 m diameter	Parabola, 8 m diameter	Parabola, 4 m diameter	Parabola, 4 m diameter	Parabola, 2.4 m diameter
Downlink Freq. Band	L/S/X-band	L/S/X-band	L/S/X-band	L/S/X-band	X-band	X-band	L-band
Pedestal	E/Az, ± 7° tilt angle	E/Az, ± 7° tilt angle	(E)/Az, + 9° tilt angle	E/Az	E/Az	E/Az	E/Az
System G/T	L-band ≥ 13.5 dB/K S-band ≥ 17 dB/K X-band ≥ 31.5 dB/K	L-band ≥ 13.5 dB/K S-band ≥ 17 dB/K X-band ≥ 31.5 dB/K	L-band ≥ 14 dB/K S-band ≥ 19 dB/K X-band ≥ 33 dB/K	L-band ≥ 13 dB/K S-band ≥ 16 dB/K X-band ≥ 32 dB/K	X-band ≥ 29.5 dB/K	X-band ≥ 29.5 dB/K	L-band ≥ 12 dB/K
Tracking Capability	auto / program tracking	auto / program tracking	auto / program tracking	auto / program tracking	program tracking	program tracking	program tracking
Time Reference	GPS, IRIG-A	GPS, IRIG-A	GPS, IRIG-A, Caesium, MASER	GPS, IRIG-A	GPS	GPS	DCF 77
Recording Systems	DCRSI, DIR1000M, DAS	DCRSI, DIR1000M, DAS	HD101e, DAS, DIR1000M	HD101e, (DIR1000M)	DAS	DAS	direct ingestion
Station Manager	D. Bettac	D. Bettac	K. Reiniger	K. Reiniger	K. Reiniger	K. Reiniger	K. Reiniger



LANDSAT 7

Empfangsbereich Neustrelitz

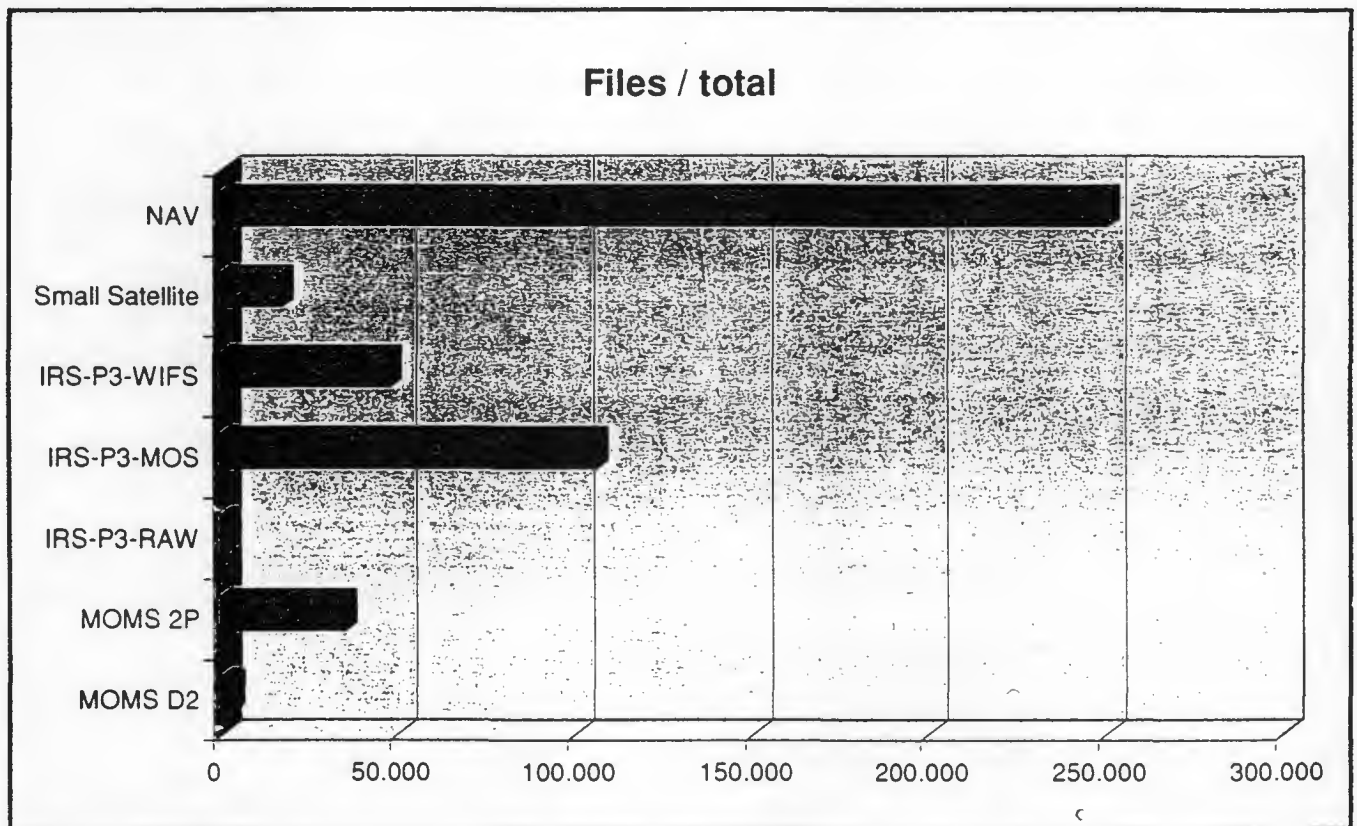


Jahresübersicht 1997 für empfangene Pässe

	ERS-1	ERS-2	IRS-1D	IRS-1C	IRS-P3	Coronas	Sich-1	Ocean	Priroda/ MOMS
Januar	-----	83	-----	27	97	6	6	18	5
Februar	-----	39	-----	33	89	9	4	11	3
März	-----	-----	-----	62	105	11	6	14	1
April	-----	2	-----	74	95	9	6	10	-----
Mai	-----	1	-----	67	96	-----	2	10	-----
Juni	-----	24	-----	69	28	-----	3	6	1
Juli	-----	19	-----	70	-----	-----	4	9	-----
August	-----	25	-----	80	68	9	7	5	-----
September	-----	10	-----	69	101	-----	7	14	-----
Oktober	2	22	-----	70	70	-----	2	17	
November	-----	8	14	58	-----	-----	4	20	2
Dezember	-----	10	39	40	100	2	5	24	1
Summe	2	243	53	719	849	46	56	158	13
Durchgänge									
Gesamt	2139								

DFD-Neustrelitz: Archived Files (01.04.1998)

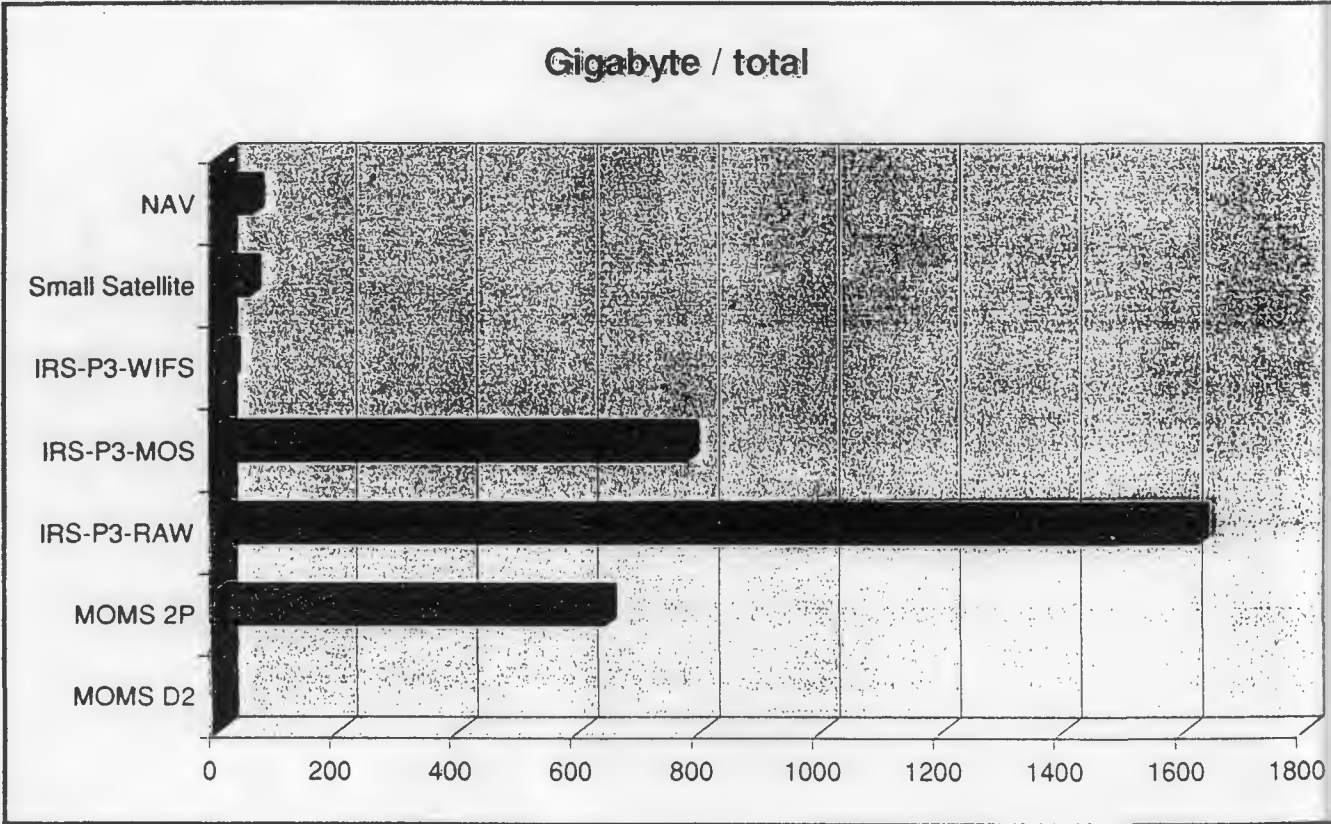
MOMS D2	MOMS 2P	IRS-P3-RAW	IRS-P3-MOS	IRS-P3-WIFS	Small Satellite	NAV
					-KORONAS-F -KORONAS-I -APEX -OKEAN -PRIRODA -Airborne	-GPS -GLONASS
3.110	35.028	2.014	105.858	47.733	17.067	250.270



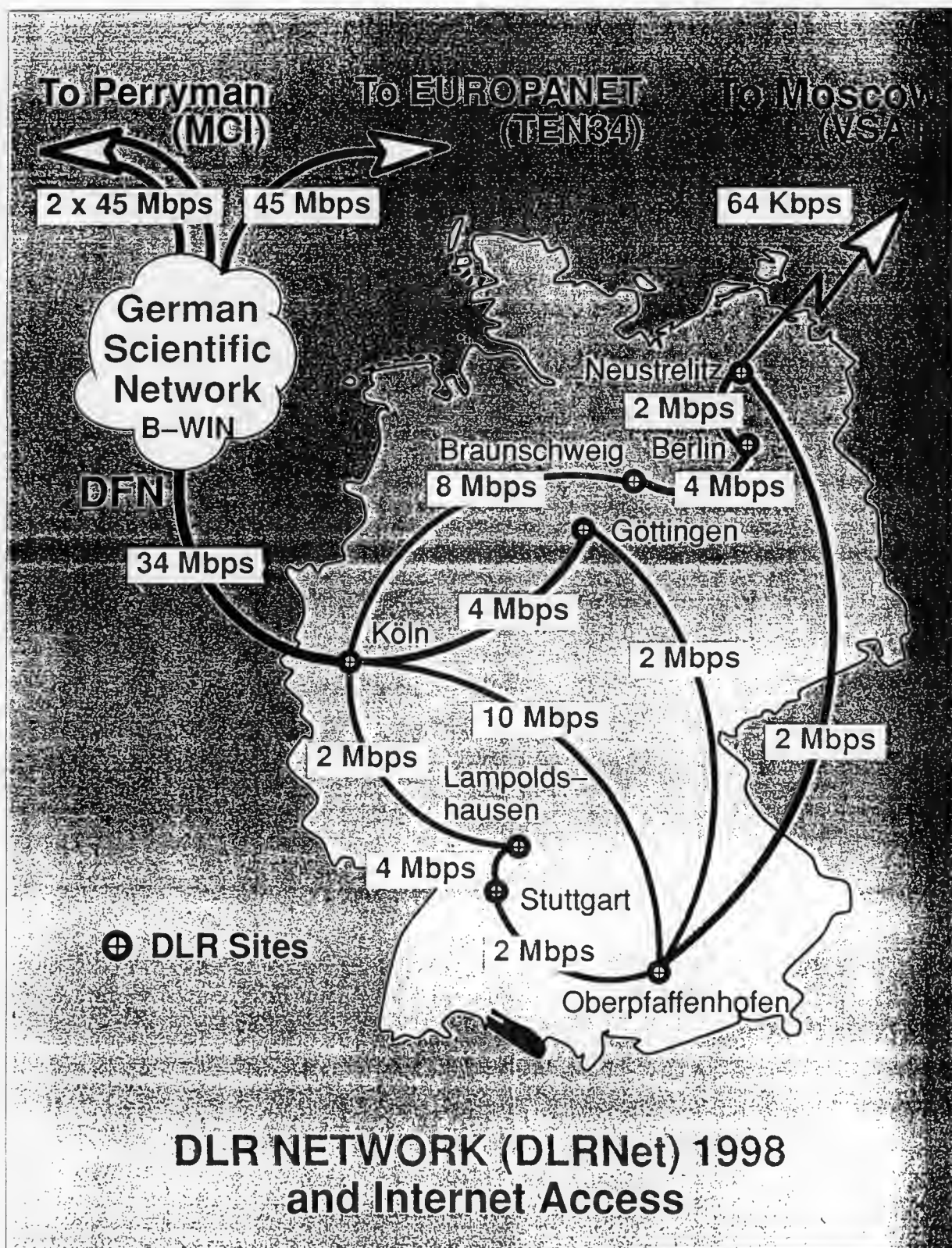
5771 I 100 / 1000000000

DFD-Neustrelitz: Archived Data (01.04.1998)

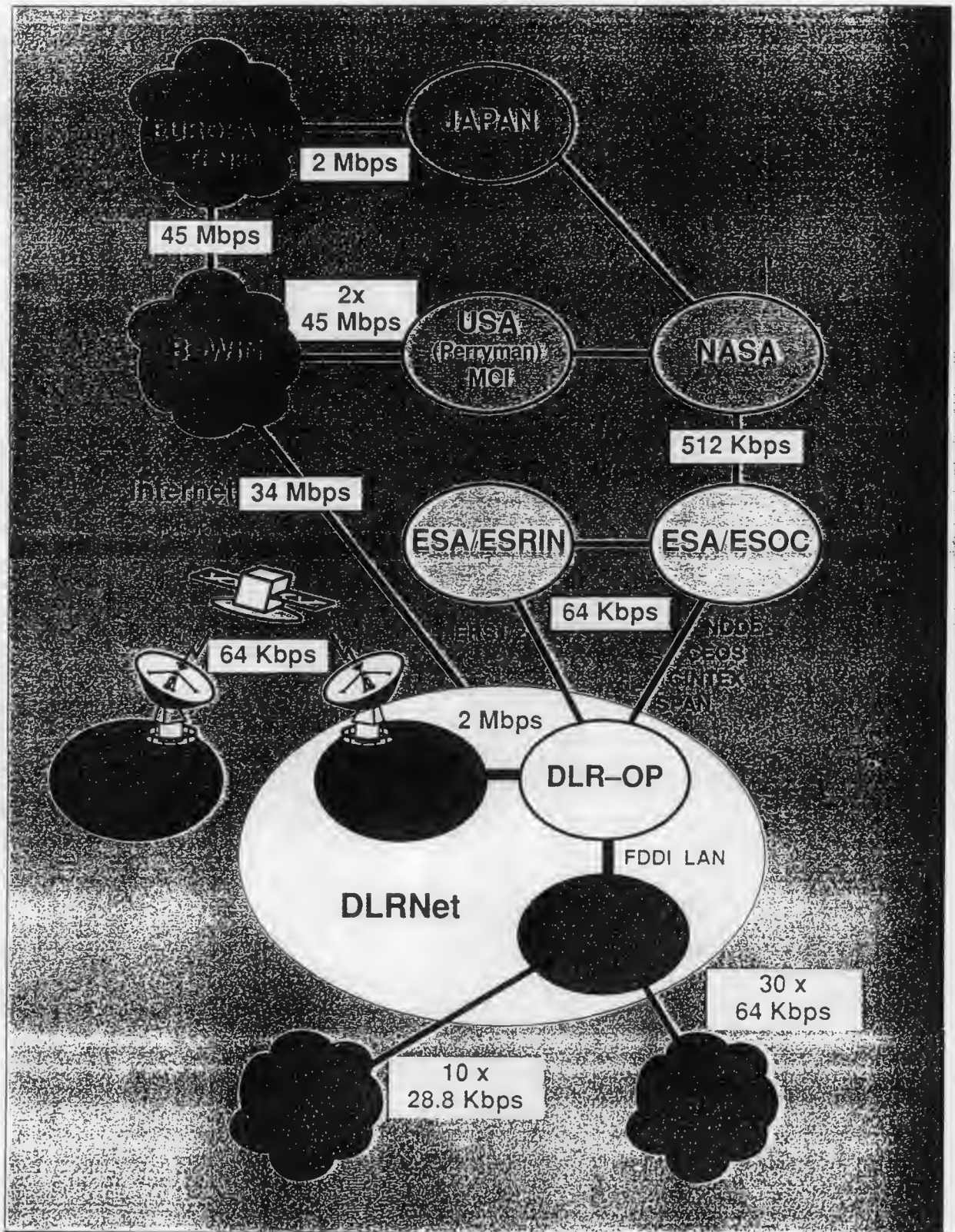
MOMS D2	MOMS 2P	IRS-P3-RAW	IRS-P3-MOS	IRS-P3-WIFS	Small Satellite	NAV
					KORONAS-F KORONAS-I APEX OKEAN PRIRODA Airborne	GPS GLONASS
Gbyte: 112,8	642,8	1.622,8	776,2	18,8	52,6	57,6

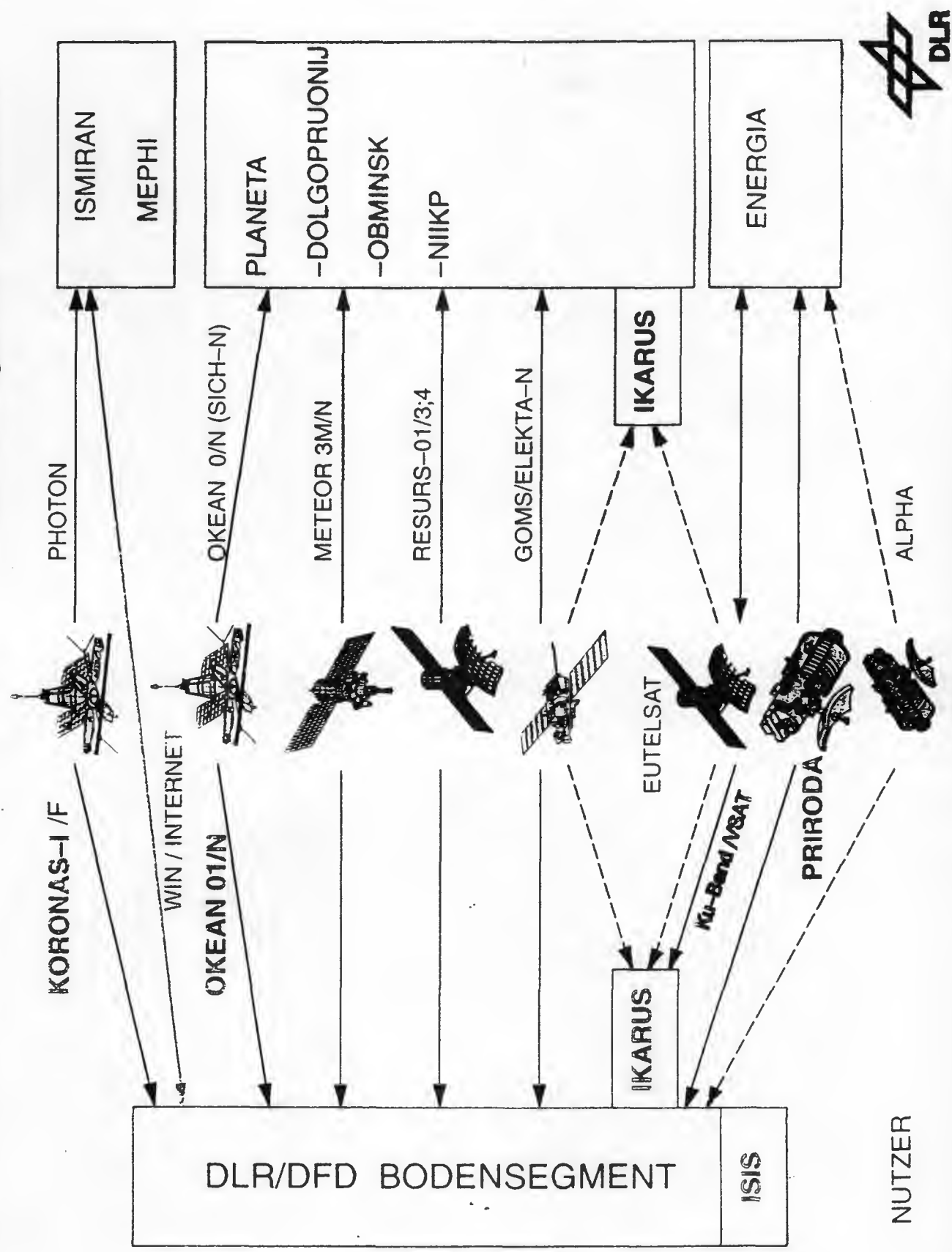


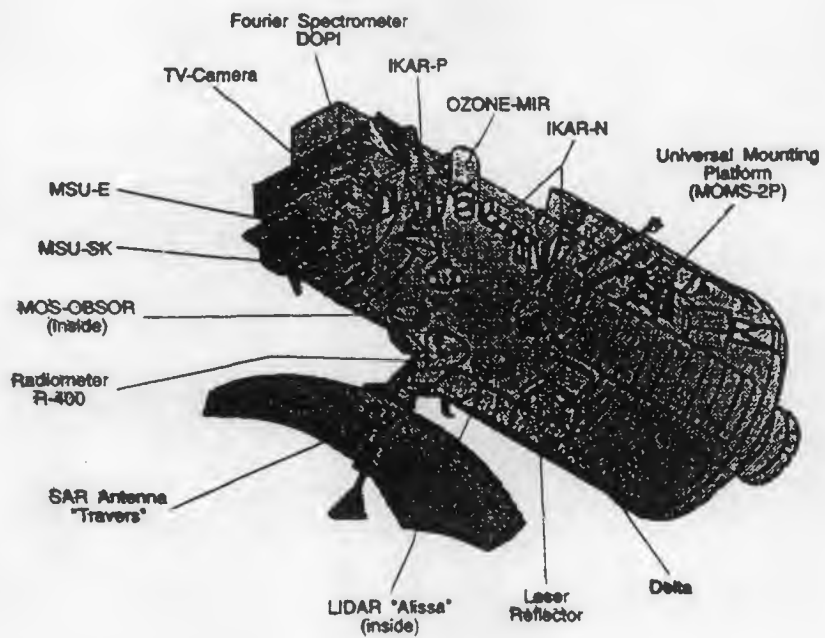
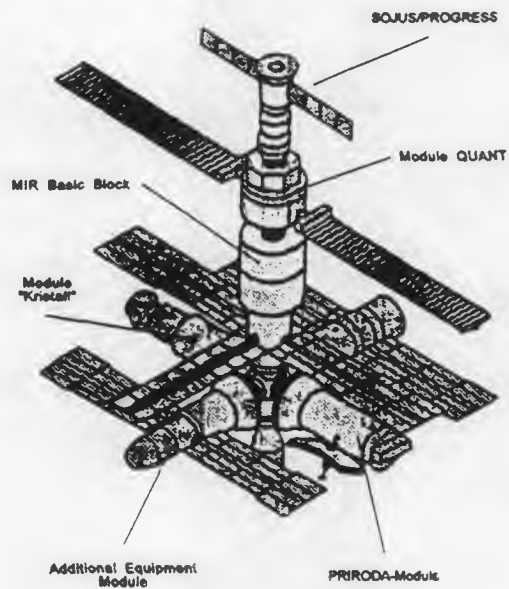
DLR NETWORK 1998 and INTERNET ACCESS



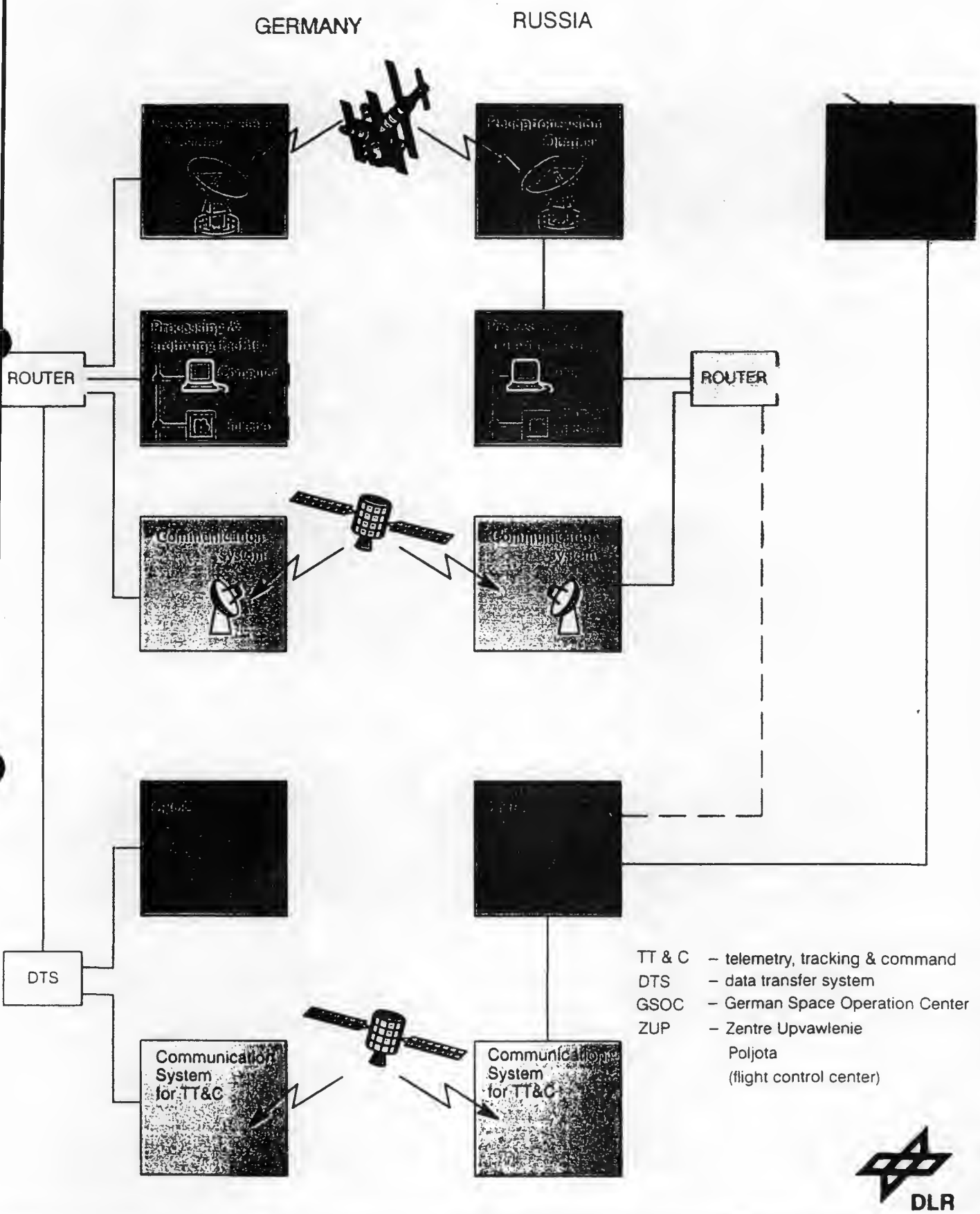
DLR NETWORK and GLOBAL CONNECTIVITY







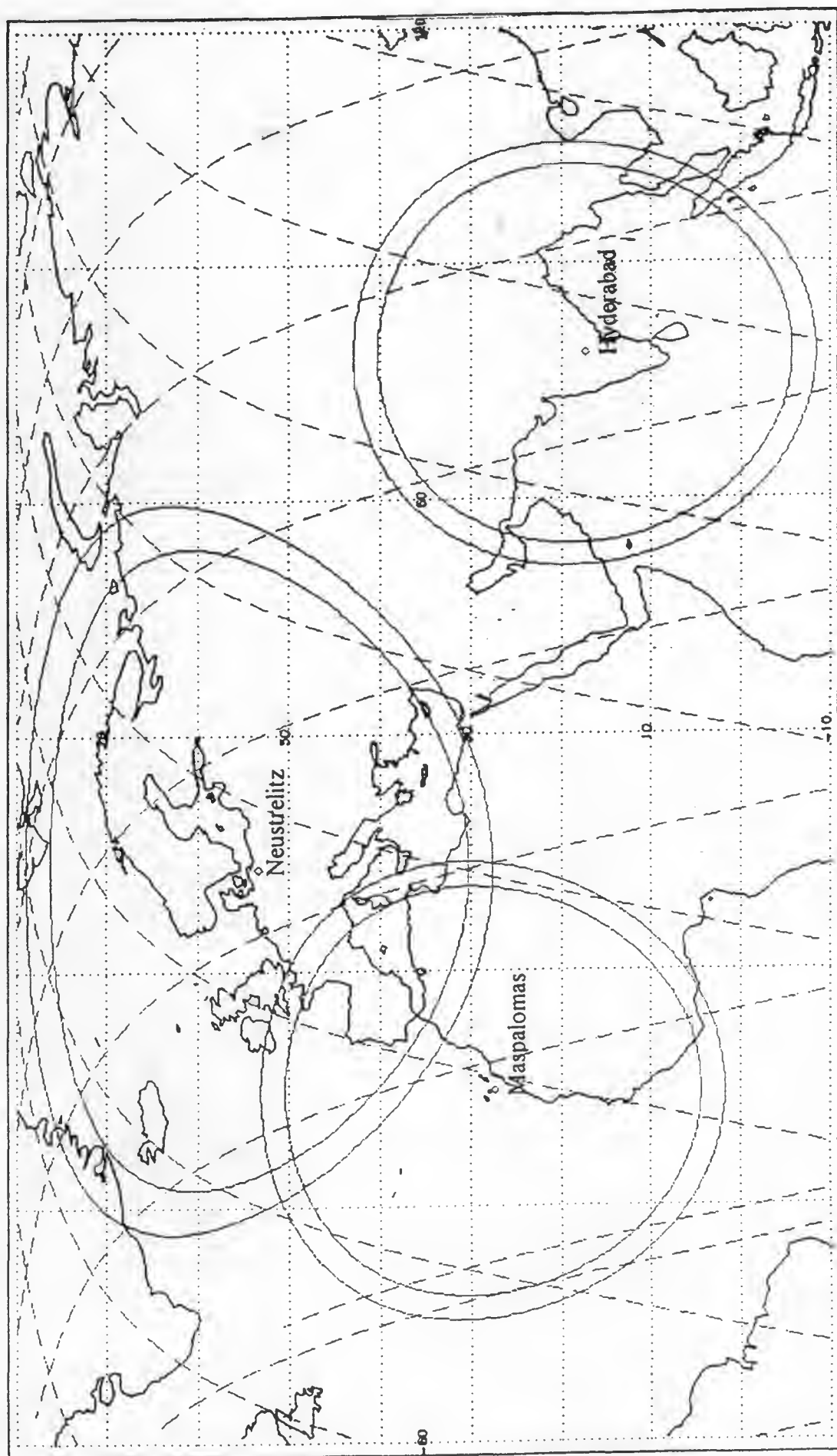
Deutsche Forschungsanstalt für Luft- und Raumfahrt e.V.
Distributed Ground Segment for MOMS-2P



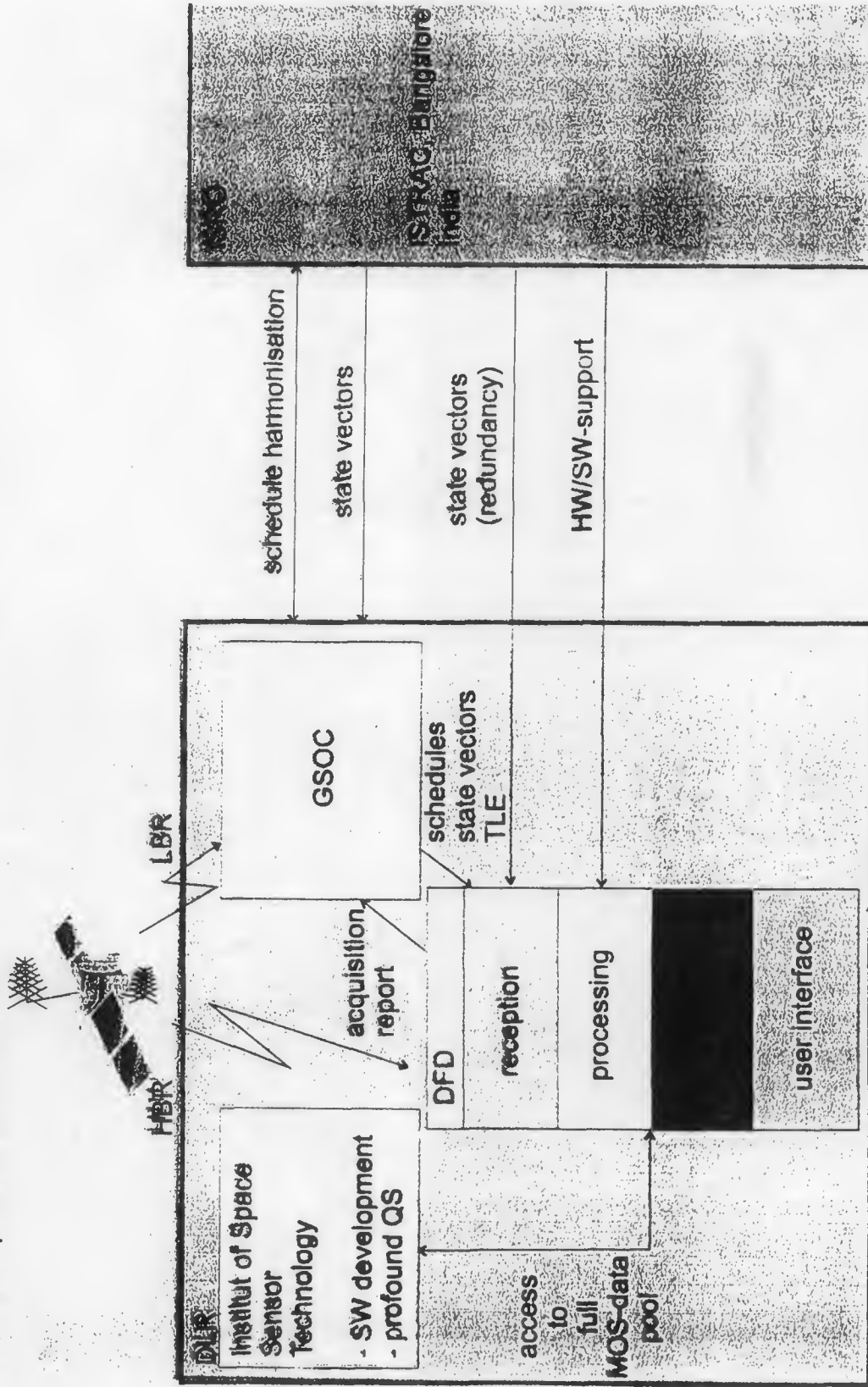


France: MOMS-2P image, color composite, Mode C (multispectral and high resolution), IHS-integration, Pixel size 6 m x 6 m, acquisition date: 29.10.1996
This MOMS image is an example of integrating the high resolution channel with the multispectral image data with lower resolution for improving the interpretation possibilities. It shows a rural area in southern France near the city of Perigueux. Even single trees can be seen clearly, as well as houses and small streets.

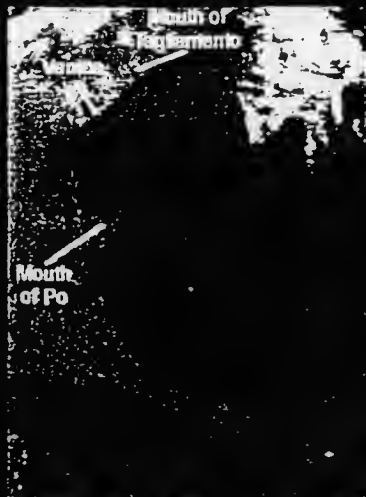
IRS Empfangsbereich für 2 und 5 Grad Elevation



German Ground Segment for MOS (IRS-P3)-Data Present Operational Scenario



Deutsche Forschungsanstalt für Luft- und Raumfahrt e.V.
 Institut für Weltraumsensorik



Color Composite MOS-B



1.6 μm MOS-C

MOS-RS, Path 30
 17.05.1996
 Northern Adriatic Sea
 Derived Parameters



Pigment

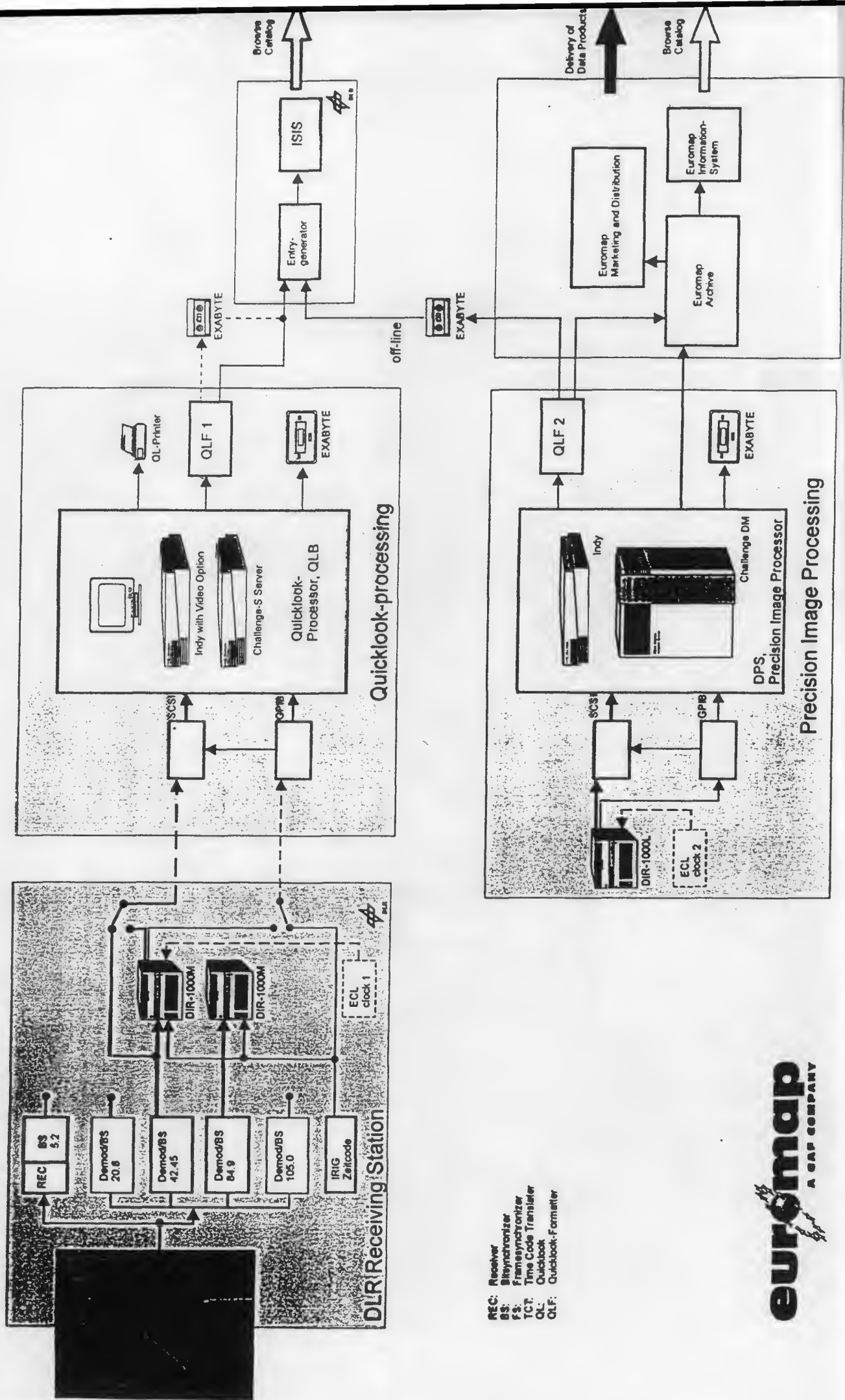


Suspended Matter



Atmospheric Turbidity

low high



REC: Receiver
 BS: Bit Synchronizer
 FS: Frame Synchronizer
 TCT: Time Code Transfer
 QL: Quicklook
 QLF: Quicklook-Formatter

euromap
 A GAP COMPANY



RAPIDS

Real-time Acquisition and Processing - Integrated Data System



UK Department For International Development (DFID)



British National Space Centre (BNSC)



University of Greenwich



Netherlands Agency for Aerospace Programmes (NIVR)



Netherlands Remote Sensing Board (BCRS)



RAPIDS

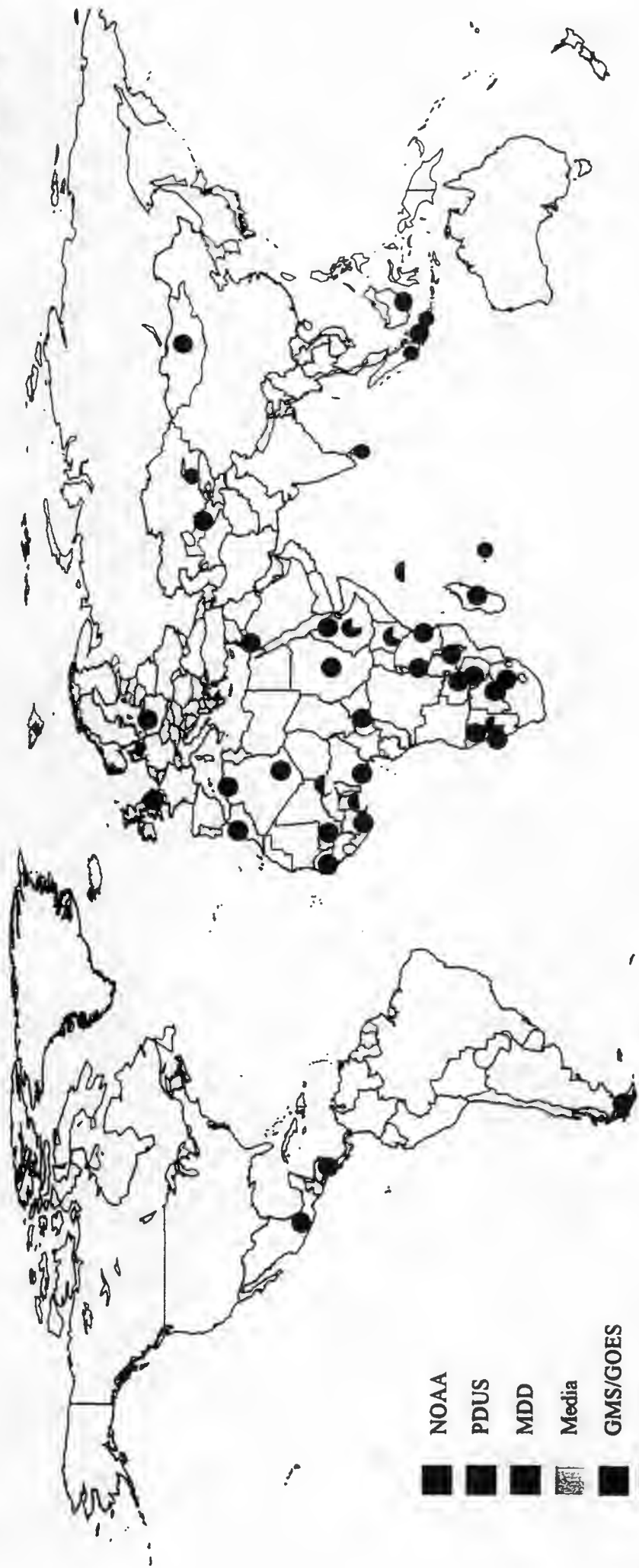
Real-time Acquisition and Processing - Integrated Data System



Something about the Team:

Environmental Sciences Department: ESD's mission is to research, develop, deliver and support environmental information systems capable of capturing and analysing physical, chemical and biological data for the effective management of natural resources in developing countries. The experience of staff covers remote sensing technology and image analysis, applied geography, agro-meteorology, meteorology and climatology, ecotoxicology, residue chemistry, pest forecasting, limnology, wildlife and range ecology, botany and ornithology

BURS: specialises in the production of high quality receivers to collect data from geostationary and orbiting satellites involved in Earth observation. The BURS team have supplied receivers for more than ten years and have an extending range of capabilities from slow data rate systems of a few kilobits per second (e.g. Meteosat DRS receivers from DCP text data) to systems able to receive data at more than 100 megabits per second (e.g. ERS SAR). The Company's main focus and interest is in high-quality manufacture and software development for specific scientific applications.



- NOAA
- PDUS
- MDD
- Media
- GMS/GOES
- Planned Sites

LOCAL APPLICATIONS OF REMOTE SENSING TECHNIQUES

LARST

Installed Base, 1996

RAPIDS

Real-time Acquisition and Processing – Integrated Data System



NLR Remote Sensing Department and Avionics Department: By the integration of user aspects with the development of new remote sensing and information technology and facilities, NLR contributes to the creation of a strong Dutch position on a growing international remote sensing market. This is achieved through technology transfer within national and international consortia. NLR Remote Sensing Department's mission statement is to provide operational support to users (users, government, industry) of earth observation data.

REMOTE SENSING AND EARTH SCIENCES

Report Advises Improving Imagery Distribution

Japanese Agency Calls for Earth Observation Overhaul

By J. KALLENDER
Space News Staff Writer

— Japan's Earth observation program needs an overhaul that should include a much better system for distributing satellite imagery to the people who use it, according to a new report by the country's Science and Technology Agency.

The 100-page report, "An Evaluation of the Development and Prospects for Earth Observation," dated April 1, recommends four major changes:

- A greater emphasis on software development.
- Development of a broader range of spacecraft sensors.
- Improved data management and distribution systems to support researchers.
- Increased emphasis on public relations.

Acknowledging that such changes will have to be made within the current limited budget, the Space Activities Commission recommended that the National Space Development Agency of Japan (NASDA) pay for the increased spending on software by reducing expenditures for hardware like satellites.

NASDA traditionally has used most of its Earth observing budget for hardware, said Ryuschi Setjia, deputy director of the space policy division in the Science and Technology Agency.

Japanese officials said the report was part of a long-term review process and was not prompted by recent complaints from the international scientific community about delays in acquiring data from NASDA's latest remote-sensing spacecraft, Advanced Earth Observing Satellite (Adeos), which was launched in August 1996. Researchers are experiencing delays of up to 45 days getting images from several of those satellites' sensors, including the NASA-built Ocean Color and Temperature Scanner.

"We had to study these issues following principles laid down in [1994's] fundamental policy review to develop more flexibility in our Earth observation goals," said Mitsugi Chiba, director of the policy division.

The report recommends that NASDA use the planned Mission Demonstration Satellite program to speed up the development of cheaper and smaller-scale satellite platforms.

"We will need many spacecraft."

'Nowadays NASDA [officials] are realizing that they need to listen to the opinions of the actual users.'

— Yoshitomi Yasuoka

Some Ground Stations Stifle Imagery Industry

By PETER B. de SELDING
Space News Staff Writer

PARIS — Slow and disorganized data processing at ground stations in the Third World is a major roadblock to the wider commercialization of satellite imagery, according to the owners of three Earth observation satellites.

While they did not single out any specific ground station, officials said facilities in Central and South America, and in South and East Asia often are reluctant to help customers or unaware of how to go about it. The result, the officials said, is that these stations sell few images, making it more difficult for them to win continued government aid from their local governments.

Addressing the Eomark 95

conference March 8 here on expanding the commercial use of satellite imagery, operators of the U.S. Landsat, French SPOT and European ERS-1 satellites said they would like to reduce their dependence on these ground stations. But they said they could not do so without sacrificing the speedy delivery of images that some customers demand.

Earth observation satellites offer global coverage and depend on worldwide networks of ground stations to take down satellite data. Most satellites have on-board tape recorders, but these machines have limited capacity. In addition, holding images until the satellite passes over a reliable ground station forces occasionally unacceptable delays in the transmission of imagery to customers.

"We at Landsat have had problems with some receiving stations," said Alexander J. Tuya-hov, NASA's deputy director for operations and data in the office of Mission to Planet Earth. "Some of these stations really should get their data out quicker."

'Simply launching a piece of space hardware for the technological glamour is not enough today to tap public funds or commercial capital.'

— Jean-Marie Luton

A NASA/NOAA/University review meeting held on February 7, 1995 in preparation for the planned conference has convinced us that the construction, deployment, and operation of even the wide-band systems required for reception of NASA's direct broadcast data stream will be relatively easy and affordable due to recent technological developments in the industry. It is likely that moderately-low-cost systems will be produced by commercial developers, making access to the new data possible for many users.

The NOAA Direct Broadcast Program will also provide information concerning the evolution of its operation system to any users requesting that information.

We appreciate your continued interest in the NASA and NOAA Direct Broadcast activities.

Sincerely,
James C. Dodge
James C. Dodge
Science Division
Office of Mission to Plant Earth

NASA LETTER
20/3/95

Influence of Ground Stations Growing

By PETER B. de SELDING
Space News Staff Writer

AGUSTIN, Spain — Operators of ground stations that receive and sell satellite imagery are eyeing a new business opportunity with the old supplier-customer relationship is ill-suited to the emerging commercial market.

Competition in the industry is expected to increase substantially in the next two years as private companies begin launching space-based remote sensing of imagery. As new sources of imagery become available, ground station operators will begin canceling some of the existing contracts that they believe hinder their ability to maximize profits.

their imagery. Such fees are now common.

Jacques Mouysset, chairman of Spot Image of Toulouse, France, said about a quarter of the company's 1996 revenue of 215 million French francs (\$41.5 million) comes from these fees. Spot Image commercializes Spot satellite imagery.

Most of the ground stations rely on their national governments for the \$10 million to \$20 million investment in antennas and recording equipment it took to set up operations. Almost all of them receive imagery from several satellites, including U.S. Landsat and Indian IRS-1C spacecraft and Canada's Radarsat.

Third World Ground Stations Curb Growth

IMAGERY, From Page 3

no tape recorders on board its Radarsat spacecraft, but that the satellite would need a high level of cooperation from distant ground stations to deliver images quickly.

Gerard Brachet, chairman of SPOT Image of Toulouse, France, which operates the SPOT satellites, said his company has come across numerous ground-station operators who are "uninterested in doing a good job, or technically unable."

Brachet, who since September has also been director of agency, CNES, said SPOT Image has given up on some ground stations.

"This has been a grave disillusionment for us," Brachet said. "We have come to the conclusion that in some parts of the world it is better not to go through a receiving station. It is actually sometimes easier and quicker for us to download the data in Toulouse and then ship the image to the customer ourselves."

By BEN IANNOTTA
Special to Space News

KEY WEST, Fla. — The market for remote-sensing satellite ground stations is expected to grow during the next several years but industry officials are deeply divided over just how large an expansion to expect.

Officials at Datron-Transco of Simi Valley, Calif., are betting on an explosion in the market as developing countries purchase receiving stations to link them to the best Earth imagery available.

Datron officials hope these sales will propel them into an arena that has been dominated by two companies since the 1970s: Macdonald, Dettwiler and Associates Ltd. (MDA) of Richmond, British Columbia, and Matra Cap Systemes of Velizy, France.

"I think the market will become bigger than most people realize," said Datron-Transco President Don Rondeau. "Most new markets are felt to be limited to what you can see today. I think there will be new countries coming on line [to receive satellite imagery] as countries become more economically sound."

Currently only about two dozen countries around the world have remote-sensing receiving stations.

MISMATCH OF SUPPLY AND DEMAND

Nri

BURS

□ Data policies have not adapted to our unlimited ability to generate digital data

□ Need to optimise benefits through the best combination of public and private enterprise

□ Space business thinks big: Data users think small,

□ Regional centres see big data archives:

Users need cheap data now,

□ Specialists speak jargon: Users dream friendly

□ Modern technology is ideal for large numbers of small user-friendly, local growth centres.

DESIGN CRITERIA

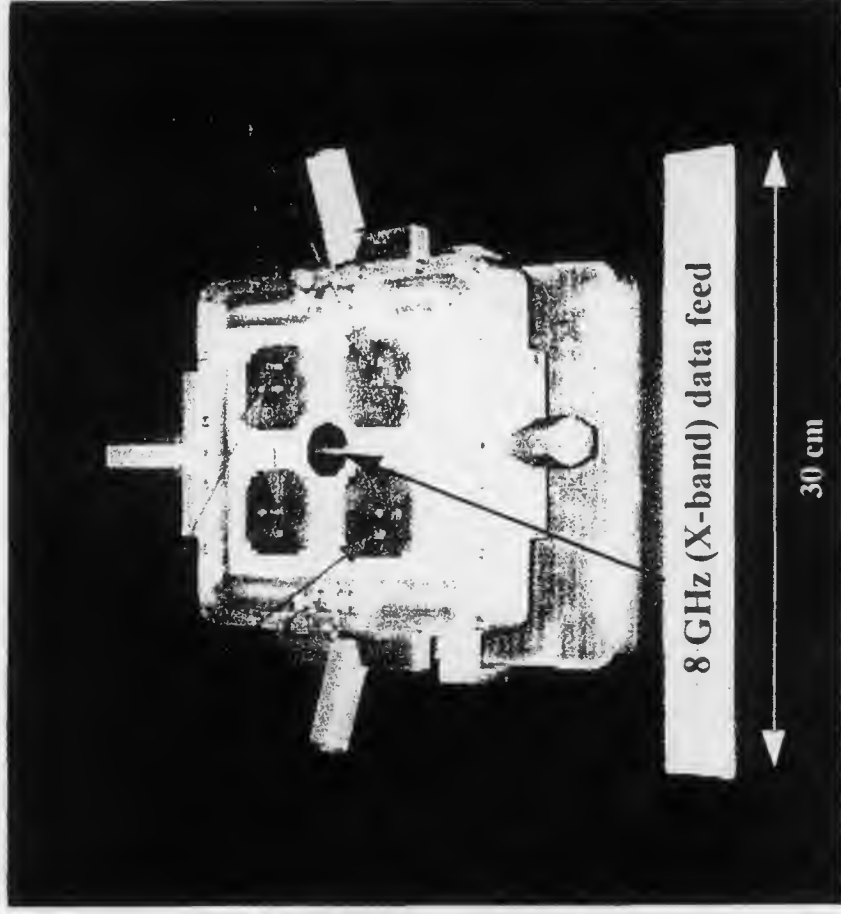
BURS

Cost-effective, local receiver to capture data from satellites transmitting 10 - 30 m resolution data on X-band (8 GHz) :-

- ◆ **Automatic operation:** to be managed by the end user, without regular technical support;
- ◆ Ability to collect data for the **principal area around the user;** site, where the satellite is at relatively high elevation;
- ◆ **Flexibility** to receive data from a range of satellites;
- ◆ **PC technology** for management, control, data capture and processing.
- ◆ **Small** - minimum physical size for **ease of transportation.**

TRACK or POINT ?

- ◆ These requirements quickly led to the decision to build a **fully tracking system**.
- ◆ The alternative of trying to point a large dish accurately enough for X-band reception would require high precision engineering and the need for excellent and up-to-date positioning knowledge.



Automatic Tracking Antenna Head



RAPIDS System deployed at NLR facilities, Marknesse, Netherlands. Photograph: Courtesy of NLR

RAPIDS

Real-time Acquisition and Processing - Integrated Data System



RAPIDS

Includes:

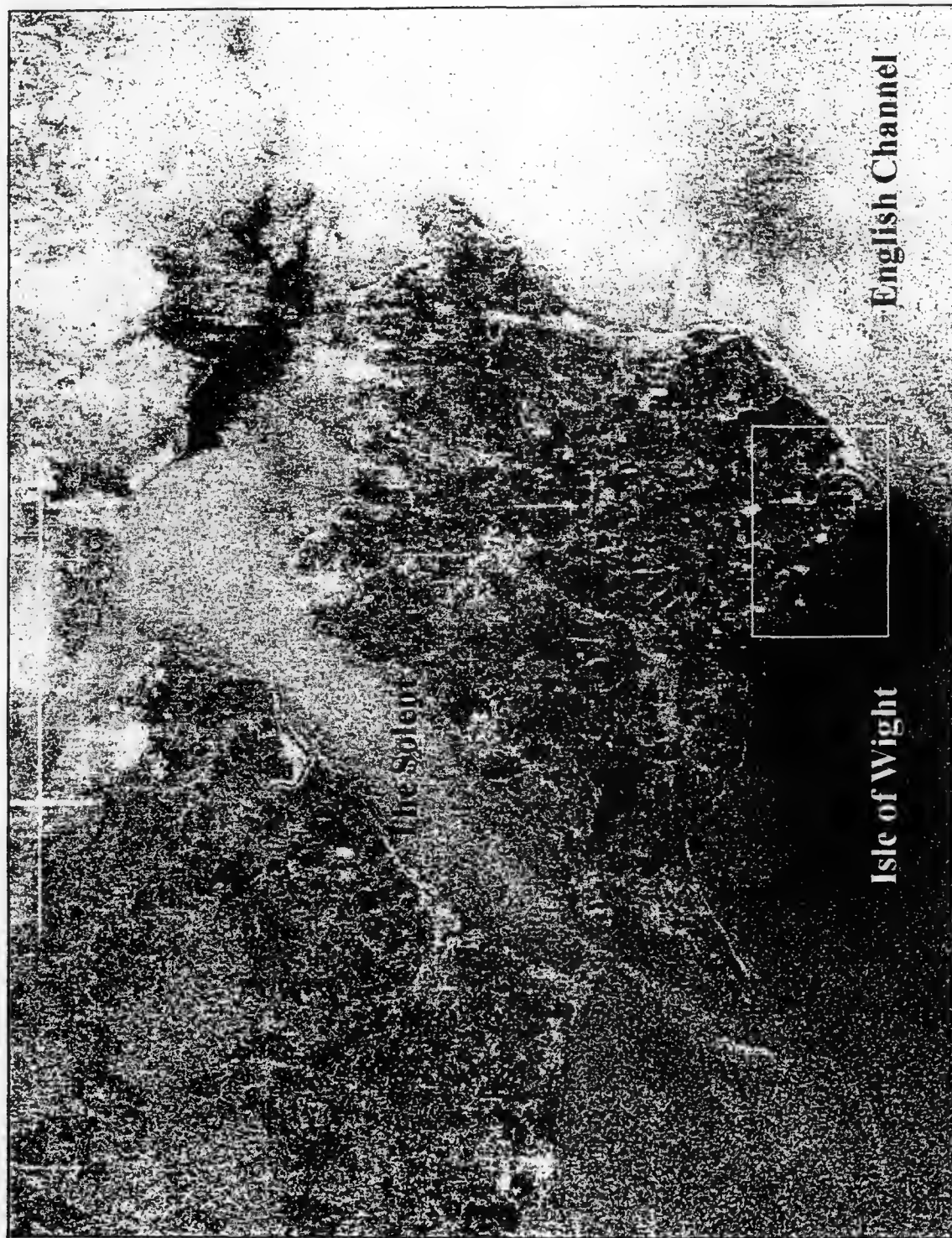
5 High end PC's (1 Orbit planning PC, 1 tracking PC, 2 capture PC's, 1 processing PC), Trailer, Antenna, Cabling, Demodulator, Power generator

Orbit planning software, Optical data processing software, SAR processing software, Capture software, Dish control software

Training, support (1 year)

Shipment

Costs: 300.000 UK pound

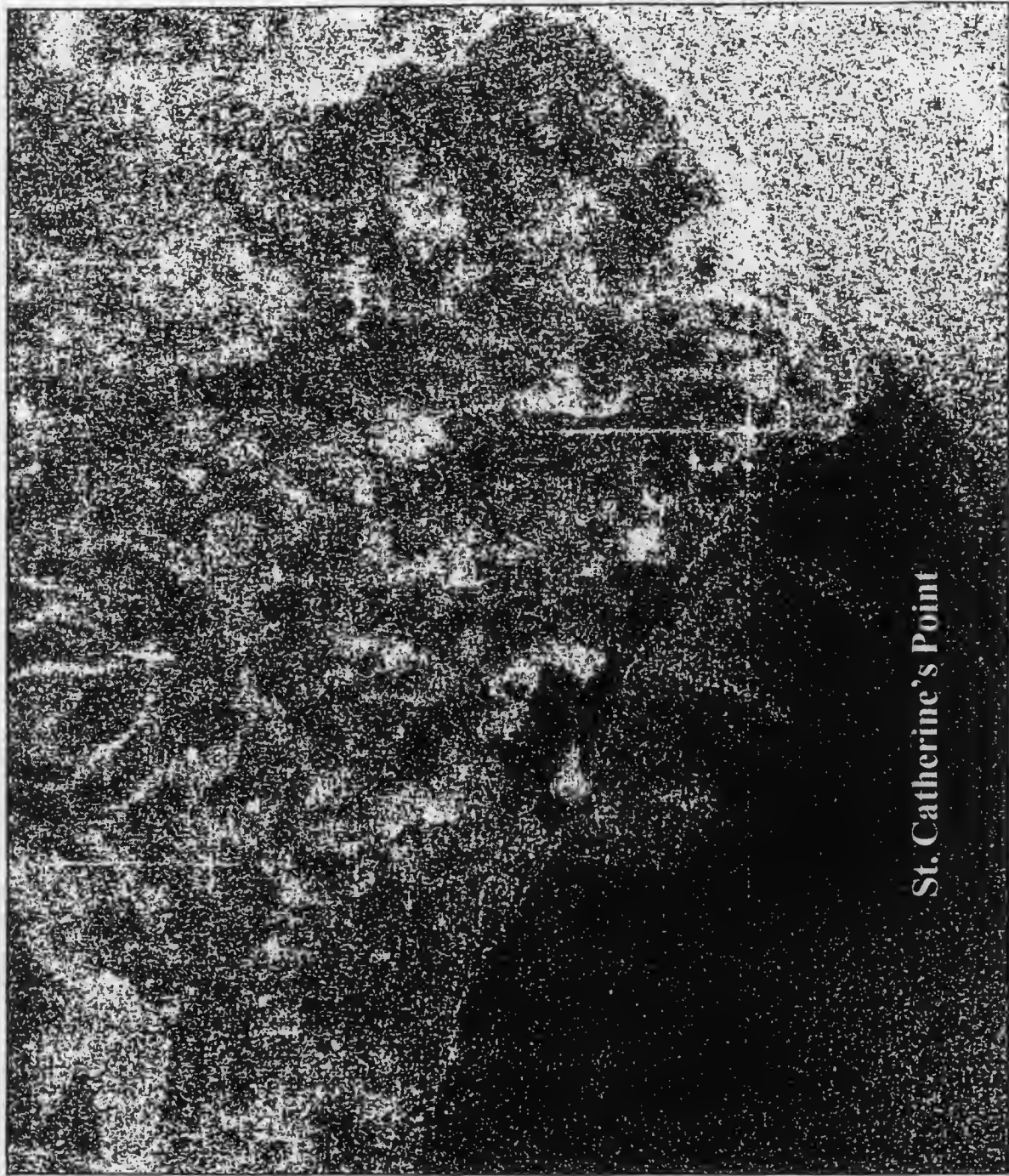


ERS-2 SAR data of the Isle of Wight area, 100m pixel.

Raw data captured by BURS in May 1996, SAR processing into an image by the NLR QSAR system.

© Raw Data ESA

© BURS/NRI 1997



St. Catherine's Point

ERS-2 SAR data of the southern Isle of Wight area, 25m pixel.

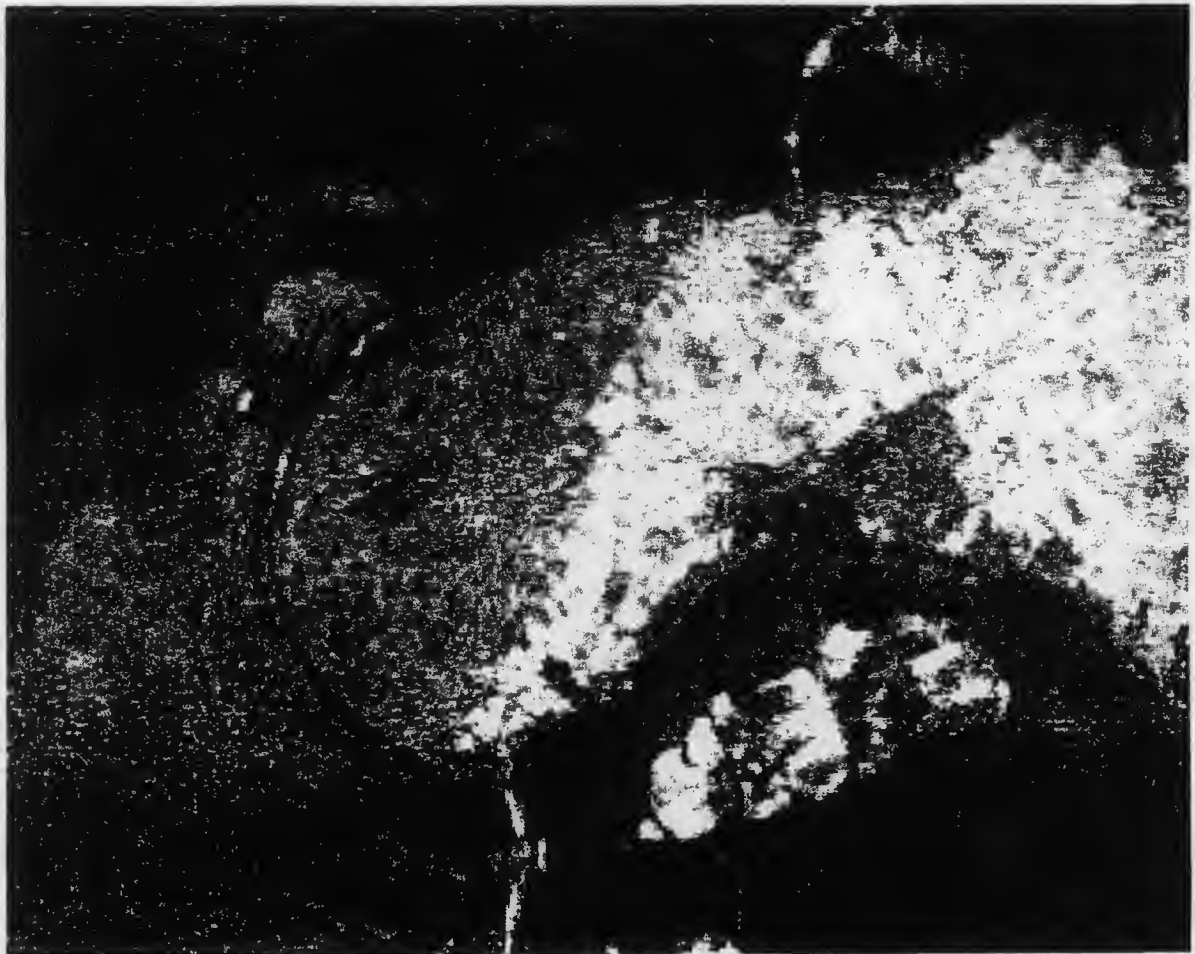
Raw data captured by BURS in May 1996, SAR processing into an image by the NLR QSAR system.

© Raw Data ESA

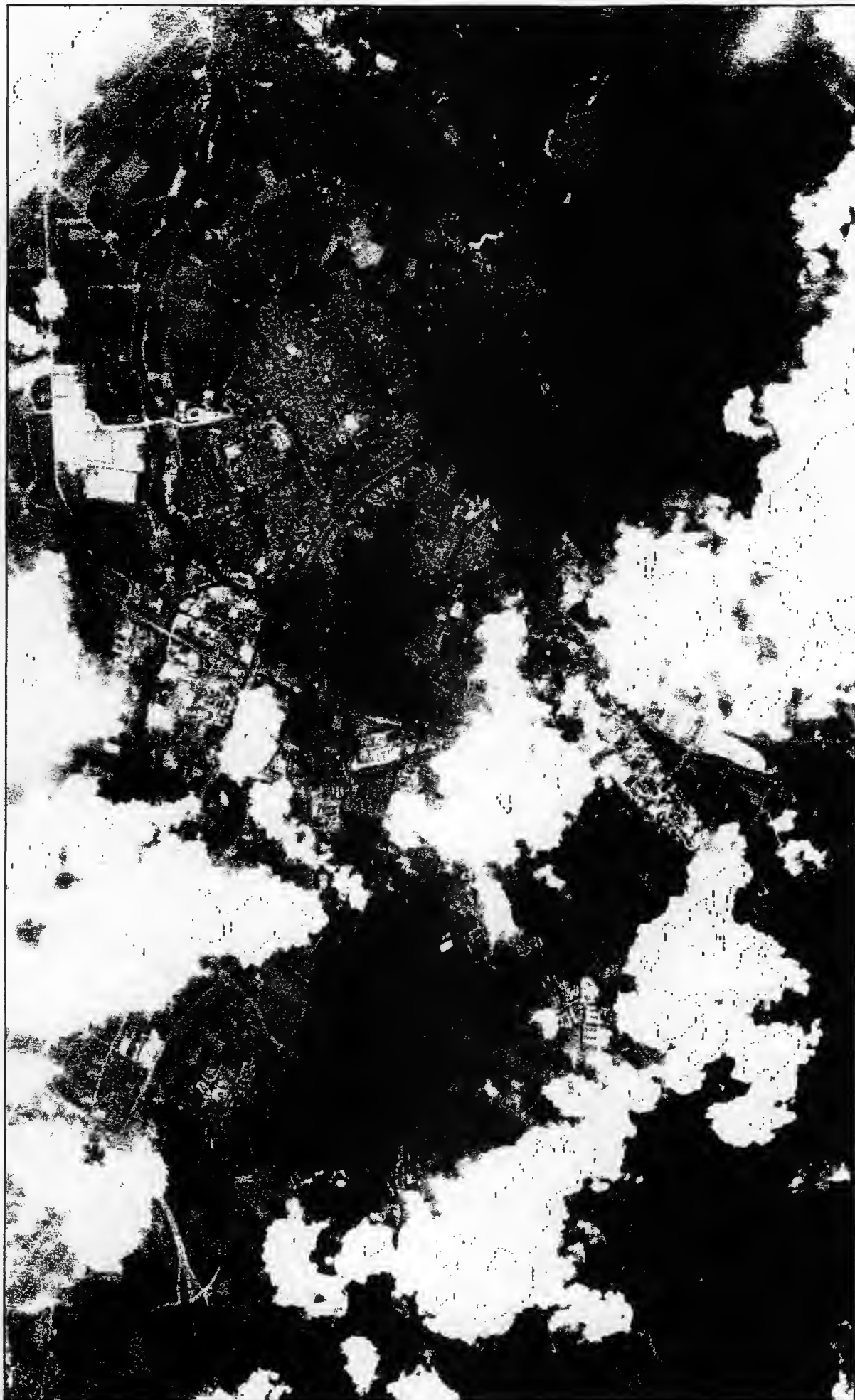




SPOT-XS image extract of Schouwen-Duiveland island, Netherlands acquired by RAPIDS on 19th March 1998. Processed by QOPT, © SPOT 1998



ERS SAR image extract of Schouwen-Duiveland island, Netherlands acquired by RAPIDS on 29th December 1997. Processed by QSAR, © ESA 1997



SPOT-4 Panchromatic image extract of Zwolle, Netherlands
acquired by RAPIDS on 16th April 1998 © SPOT 1998



On-going projects

1. ESA Data User programme: Flood monitoring and mapping in Bangladesh

Planned for this year, postponed to next monsoon season, duration: 6–9 months.

Objective: rapid response to floods

main user/operator: Environment and GIS support Project for Water Sector Planning (EGIS), supported by SPARRSO and MOWR.

2. Several projects in Indonesia: forest monitoring, coastal zone monitoring, rice monitoring

Planned for later this year, duration: 4–6 weeks

Objectives: rapid damage assessment, rapid response to coastal problems, rapid response to changes in rice production estimates

main user/operator: BPPT/Lapan, Tropenbos



RAPIDS

Real-time Acquisition and Processing – Integrated Data System



On going projects (2)

3. NLR facility

Operating since november 1997, waiting approval from ESA

**objectives: near real-time service to Dutch users in collaboration with NPOC
operator: NLR**



RAPIDS

Real-time Acquisition and Processing – Integrated Data System



Introduction to the system

RAPIDS: acquires satellite data and processes satellite data

Acquisition and processing of: ERS-1, ERS-2, SPOT-1, SPOT-2 and JERS

Data quantities: approx. 900 Mb of SPOT data (some 45.000 lines – 900 km strip)
approx. 620 Mb of ERS data (some 83.000 lines – 350 km strip)
approx. 700 Mb of JERS data

on one capture PC

Coverage: SPOT: North Denmark – Spanish border
ERS and JERS – North Germany – Mid-France

Data "types": ERS: SAR + Low Bit Rate data
SPOT: Pan + XS (from HRV-1 and HRV-2)
JERS: OPS + SAR



RAPIDS

Real-time Acquisition and Processing – Integrated Data System



Design philosophy

To meet local needs for timely environmental data

More cost-effective than large receiving stations

Local area (no horizon – to horizon)

PC-based

Low running costs, marginal capital costs



RAPIDS

Real-time Acquisition and Processing – Integrated Data System



Key features:

Small antenna size

Reliable data capture

Hydraulic tilt dish control

Trailer based

Self checking electronics

Easy to handle

Designed to fit in a standard shipping container

TROMSØ SATELLITE STATION

BY

ANDERS RØGNES,

QUALITY ASSURANCE MANAGER

Content of presentation

- ✓ Introduction/background
- ✓ 1997 operation statistics
- ✓ SAR production system
- ✓ Activities & Applications
- ✓ Future perspectives

TROMSØ SATELLITE STATION

- ACTIVITIES -

- ✓ 24 hours near real-time services
 - COSPAS/SARSAT operations
 - Satellite image data handling
- ✓ EO application development
 - Marine, near real-time (NRT) services
 - Off-line analysis of archived data
 - Data for education and training
- ✓ Satellite data reception
 - ERS (National station having MoU with ESA)
 - RADARSAT ground station & distributor
 - JERS, NOAA, SeaWiFS
- ✓ Development and operations of SvalSat



TROMSØ SATELLITE STATION

ERS ACTIVITIES

- ✓ **National ground station**
 - MoU for ERS-1 & ERS-2
 - Distribution agreement with Eumimage
- ✓ **Acquisition of all passes within visibility**
- ✓ **Data distribution & VA services according to MoU**
- ✓ **Archival strategy**
 - Rolling archive raw data 2-6 months
 - Permanent LRI image + interpretation information
- ✓ **ESRIN Operations contract**
 - SAR FD products to ESA approved projects
 - Oil Spill Technical Support



TROMSØ SATELLITE STATION

- ACQUISITION STATISTICS 1997 -

	ERM-2	JERS	TIROS
Planned passes	1465	147	2144
Acquired passes	1398	386	2093
% Acquired	95,4	86,4	97,6
% Station losses	1,8	11,2	2,4
% Satellite losses	2,8	2,4	



TROMSØ SATELLITE STATION

- PRODUCTION STATISTICS 1997 -

ERS SAR products:	FM	LR	Raw	Total
(# scenes)	44	7593	19	7656
(% scenes)	0.5	99.2	0.3	

Usage category:

E-external	1555	(20.4 %)
C ESA PI (ESA/HRKA, AO Latvia/oil spill)	452	(5.6 %)
X National commercial	2537	(33.3 %)
I- nternal (TSS archive, system cal/val.)	3112	(40.7 %)



TROMSØ SATELLITE STATION

ERS PROCESSING SYSTEM

- ✓ **SAR System (Upgraded 1/98)**
- **Direct Ingest Server (DIS) replaces HDDT operations**
- **DLT storage of all received raw data for TBD months**
- **Acquire all passes within circle of visibility**
- **New SAR processor**

Commercial hardware (Silicon Graphics, Origin 200)

Software developed by Kongsberg Spacetec

100x100 km scene processing time < 5 minutes

- **Distribution: (DLT), Electronically, CD-ROM**



TROMSØ SATELLITE STATION

ERS PROCESSING SYSTEM

- ✓ "Existing" SAR Products
 - FRI: Full resolution (30 meter)
 - LRI: Low-resolution (100 meter)
 - Raw data
 - TSS NRT format: Image data + simplified header
 - LRI based O/L, distribution e-mail (SARA)
- ✓ New products
 - SLC: Single look-complex
 - FDC (U16): Fast delivery
 - PRI: Precision Image
 - Slant range projection
 - According to ESA specifications, CEOS format
 - FDC, PRI Spatial averaging 2 - 6



TROMSØ SATELLITE STATION

- FUTURE ESA PERSPECTIVES -

✓ Development of applications/customers

- New initiatives & Data provision
- Approval/Cooperation - ESA, Eurimage

✓ ERS activities

- Continue FD SAR support to approved project
- Re-start ATSR-2 NPT operations from mid-98 (??)

✓ ENVISAT

- National station, appointed distributor
- ASAR operations

National processor, All image modes

Relying on experience from ERS and RADARSAT

✓ Earth Watch ??



OIL SPILL SERVICE END USER REQUIREMENTS

- **SLICK OBSERVATION TIME, POSITION, EXTENT, VOLUME**
- **PROBABILITY ESTIMATE: HIGH, MEDIUM OR LOW**
- **IDENTIFICATION OF THE DISCHARGE SOURCE**
- **DISCRIMINATION OF TYPES/CATEGORIES OF SURFACE SPILLS**
- **EARLY WARNING: < 1-2 HOURS**
- **PRIORITY OF SELECTED NATIONAL COASTAL WATERS**
- **COVERAGE AT LEAST 2-3 TIMES A WEEK**
- **INFORMATION ON ACQUISITION, AND PROCESSING/ANALYSIS SCHEDULE**



Oil Spill Detection Using Satellites

- **TSS activity:**

- Detection of possible oil spills at sea within coverage area by use of satellite radar data

- **Offering**

- Provision of information about oil spills within less than 2 hours after acquisition.
- Low-cost infrastructure (fax, phone, PC tool)
- 24 hours operations (data analysis, information distribution)
- Special agreements on demonstrations

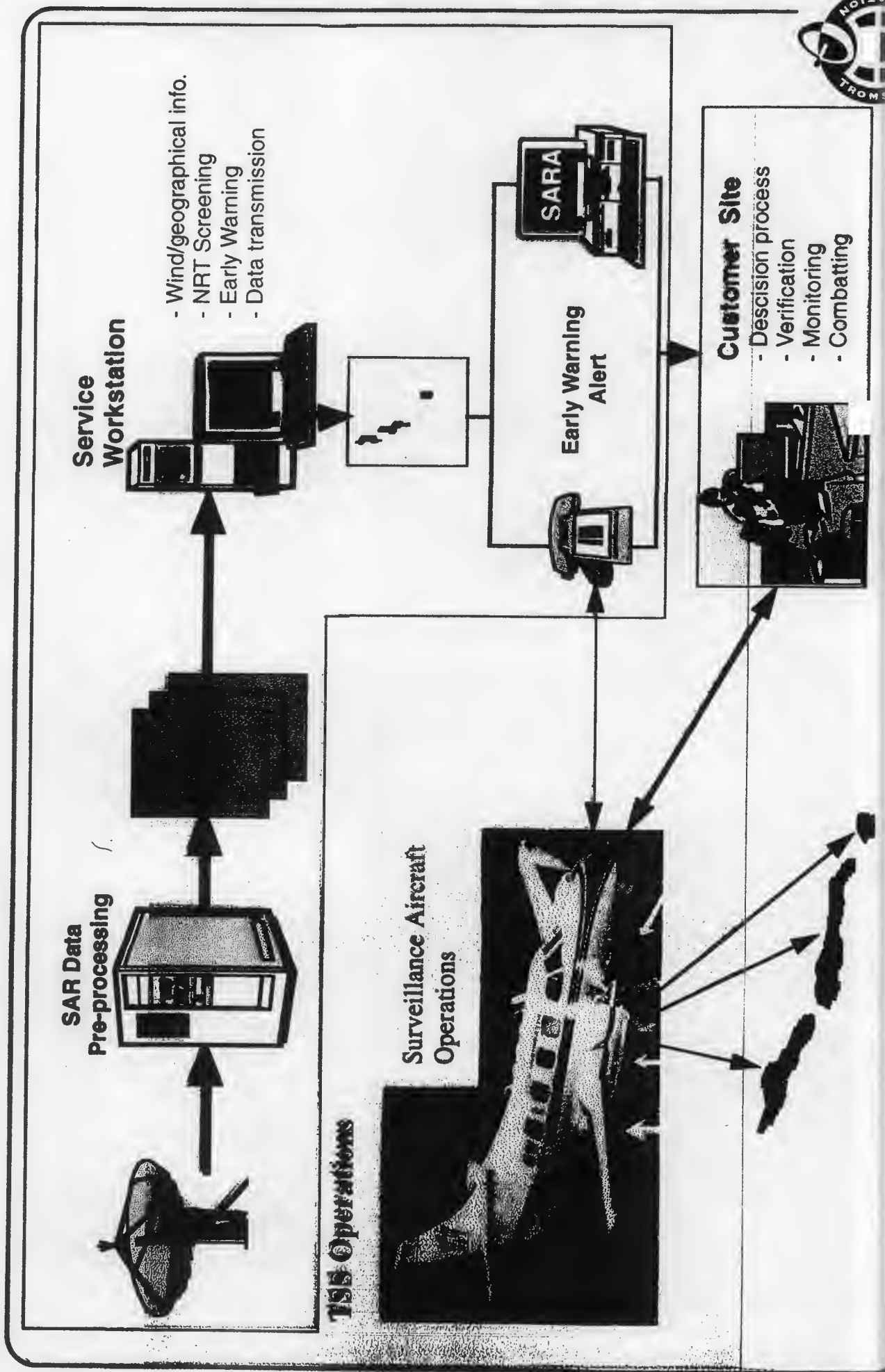


Oil Spill Detection Using Satellites

• Information provided:

- Latitude/longitude of possible oil spill in degrees and minutes
- Estimated size of polluted area
- Date and time for acquisition
- Probability level (low, medium or high. See below)
- Wind speed and direction
- Source type and position (if available) (e.g. ship, platform - see below, etc.)
- If available the name of platform or the geographical name in the case of release from on-shore sites
- Satellite Q/L image, if required





PC TOOL, SARA

- ✓ Tool for information and picture tool image reception.
- ✓ Functions for image management, simple analysis and information handling.
- ✓ PC requirements:
 - 386 processor or higher, min 4 Mb RAM
 - Recommended: 486 or higher, 8 Mb RAM
 - At least Microsoft Windows 3.1 or 3.11
 - 15-bit (or better) graphic card
 - 2 Mb disk space (SARA s/w), additional Mb for Images
 - MAPI based electronic mail system
(Microsoft Mail, Winix, Mailmax, 400, On Mail)
- ✓ Provided free of charge from TSS

OIL SPILL SERVICE COVERAGE AREA



ROUTINE ANALYSIS AREA



Tromsø Satellite Station



N 55° 17' E 007° 28'

ERS-1 SAR IMAGE
OF AN OIL SPILL

31 MARCH 1996
20:45:00 UTC

© TSS/ESA 1996

FLIGHT
DIRECTION

N

LOOK
DIRECTION

SCALE: 1CM = 7,4 KM



THE SNOWMAP SERVICE AT TSS

- ✓ **Snowmaps produced operationally at TSS**
- ✓ **Currently based on optical data from NOAA AVHRR**
- ✓ **NOAA AVHRR processing chain and image value adding environment (MEOS) developed by Kongsberg Spacetec AS**
- ✓ **Snowmaps are input to a decision support utility for pc developed by Cap-Gemini Norway AS**
- ✓ **Customers: Hydro power plants, Flood Monitoring Authorities, Media (TV-stations, Newspapers)**
- ✓ **Future: Improved optical sensors (AVHRR/3, MODIS MERIS), SAR instruments**

