



# CEOS WGCV-26 Plenary Canada Report

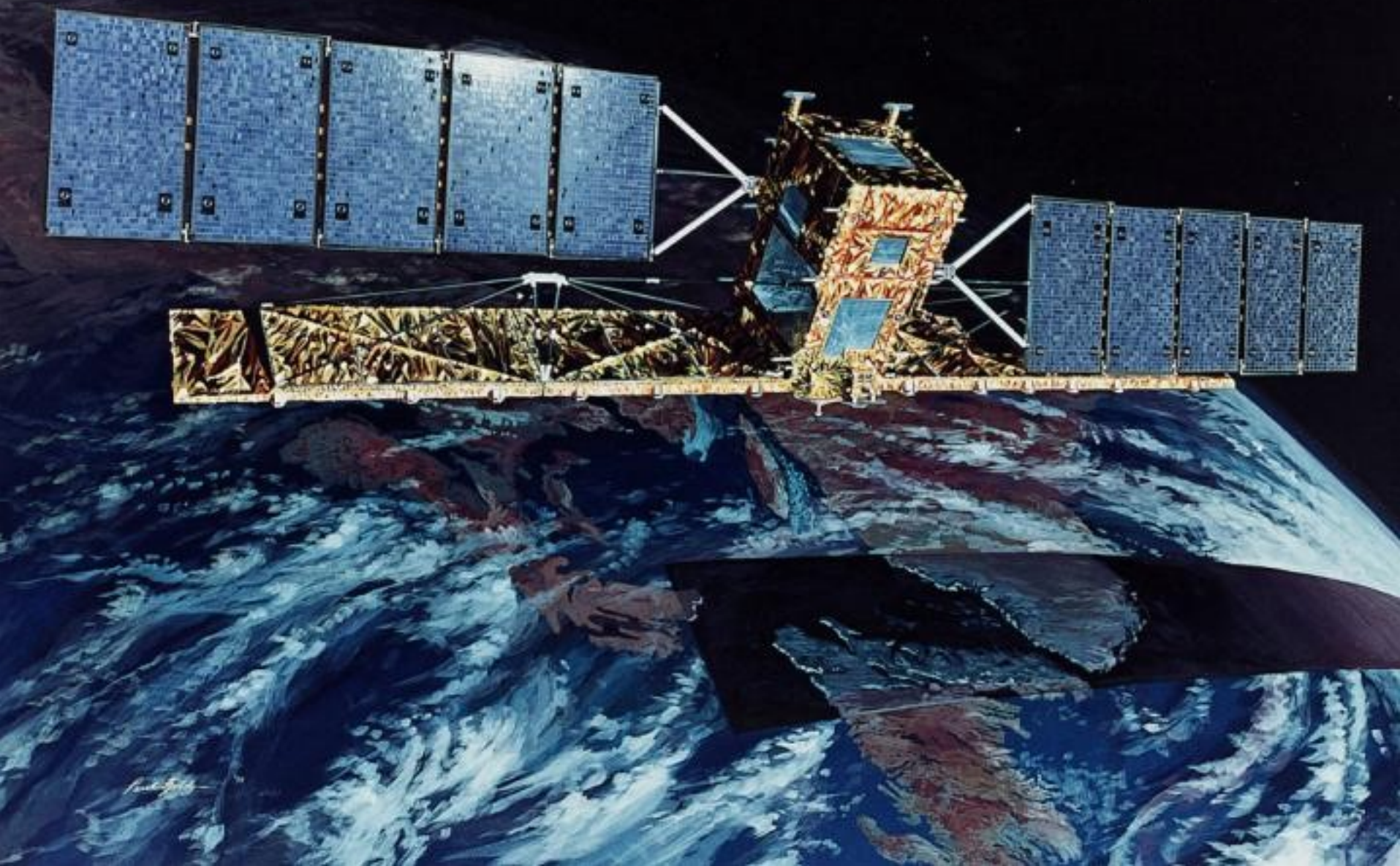
## RADARSAT-1 Performance

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Satellite Operations  
Canadian Space Agency  
Saint-Hubert, Canada



# RADARSAT-1







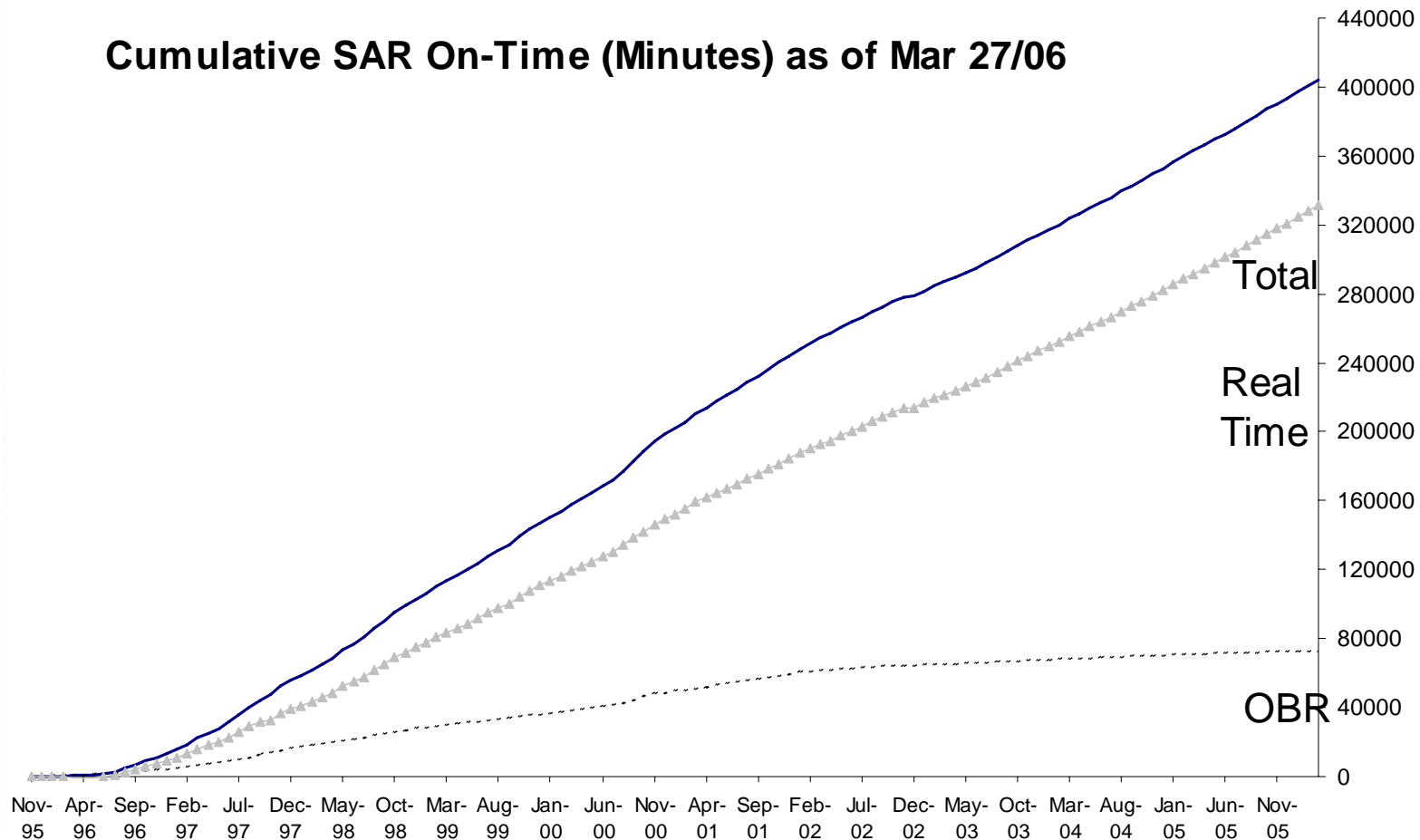
# Operational Statistics (as of 27-Mar-06)

- Number of Order Desks 5
- Total number of requests (Apr 96-Mar 04) 230,730
- Total amount of SAR time used 404,174 minutes
  - CGOD 6,799
  - US 185,750
  - MCS/CAS 99,812
  - RSI 70,746
  - CIS 41,067
- Number of Orbits completed 54,255
- Number of Receiving Stations 32
- Number of Archive Centers 22
- Number of Emergency Events 169  
(including Charter events)



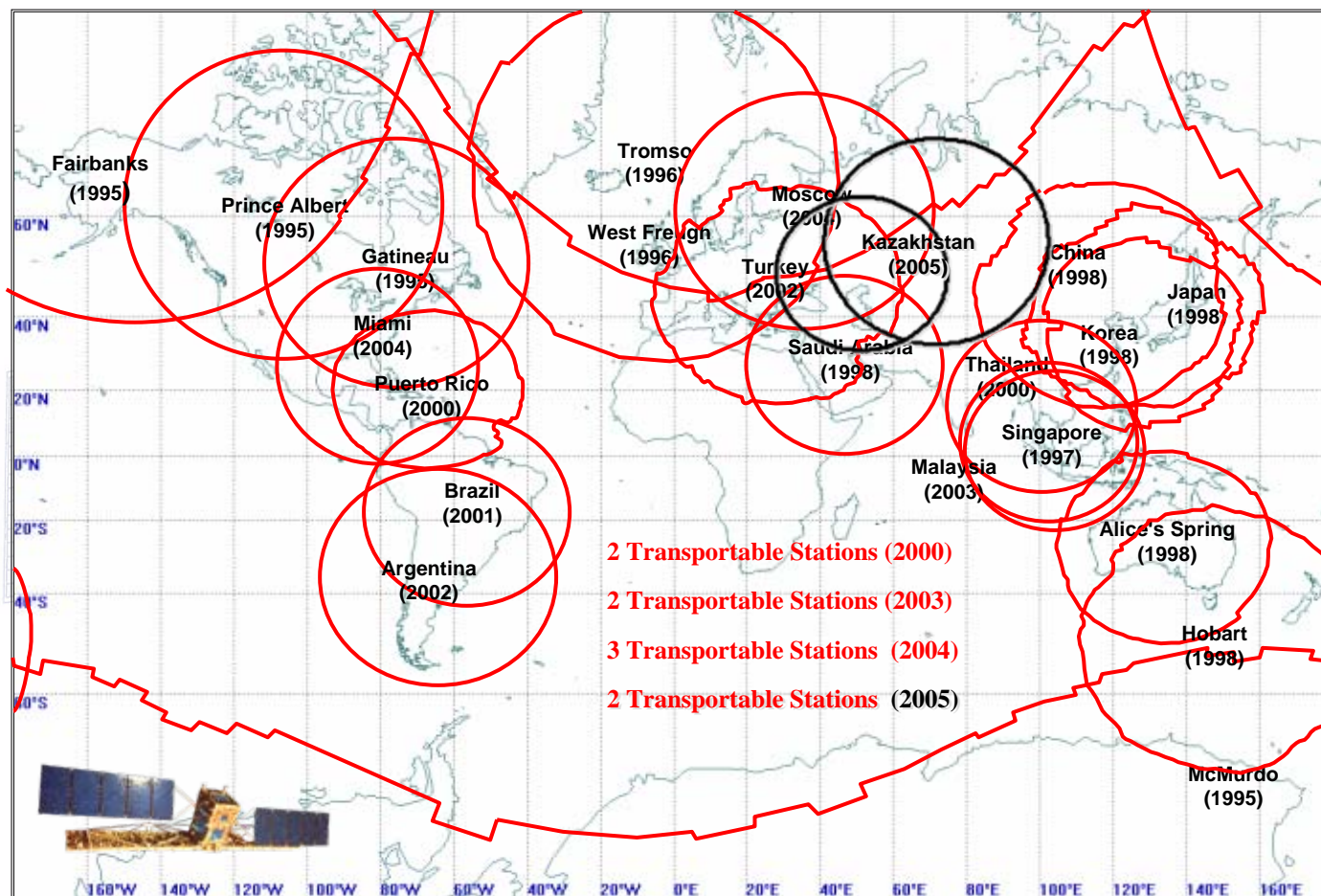
# Operational Statistics

**Cumulative SAR On-Time (Minutes) as of Mar 27/06**





# RADARSAT-1 Reception Coverage



2005

2004

2003

2002

2001

2000

1999

1998

1997

1996

1995

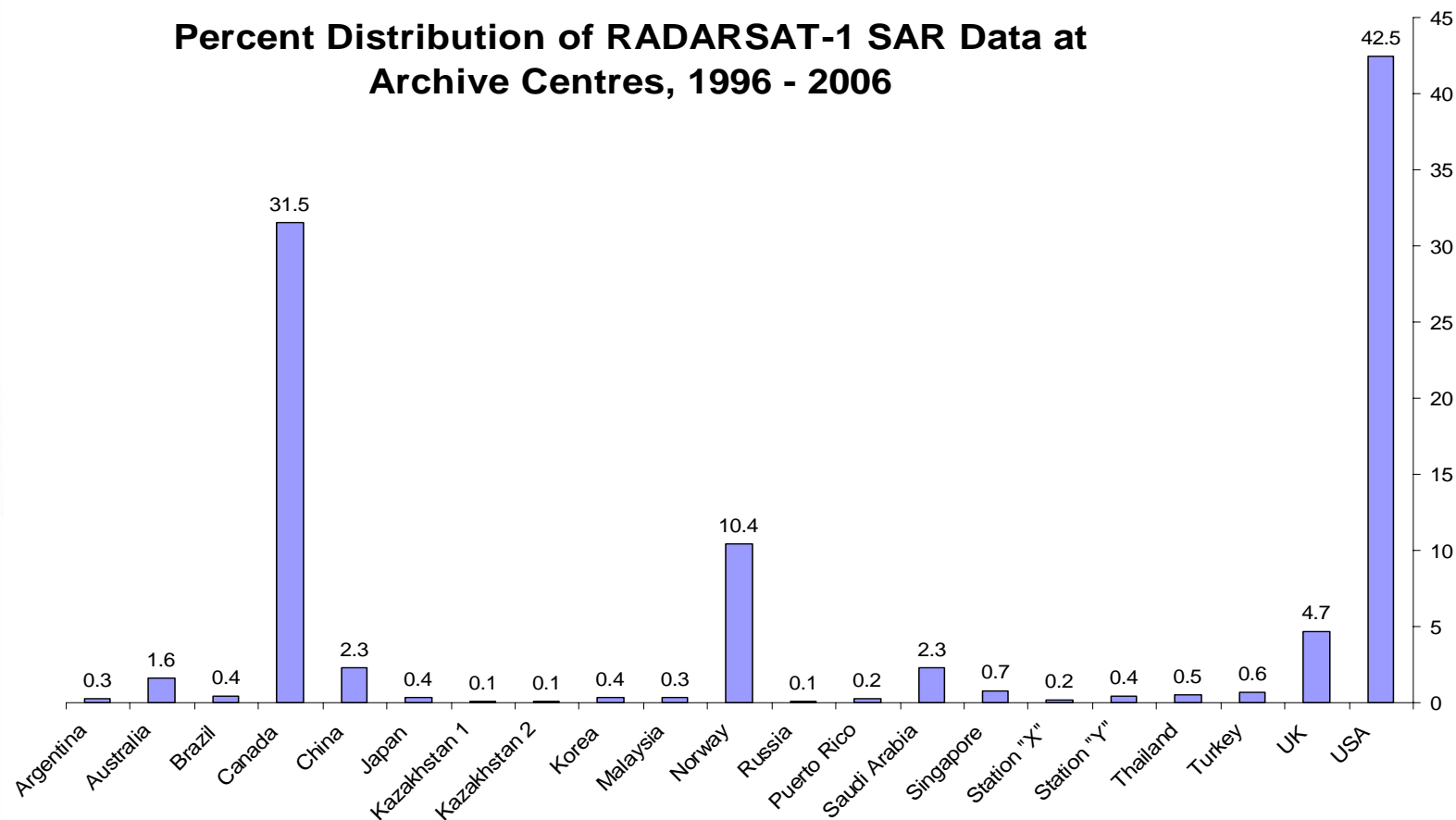
- Data Reception Facilities: 32 (including 9 transportable stations)
- Data Archiving Facilities: 22
- Actually under certification: 0





# Operational Statistics

**Percent Distribution of RADARSAT-1 SAR Data at Archive Centres, 1996 - 2006**



Source: based on Minutes of SAR downlinked to each Data Reception Facility. Data at portable stations is assumed to be transferred to Canada.



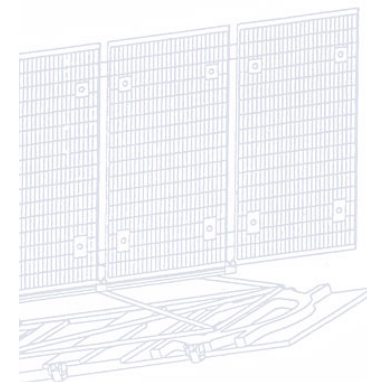
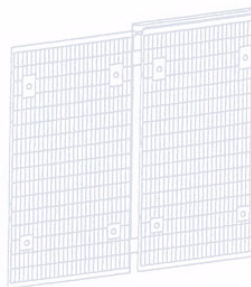
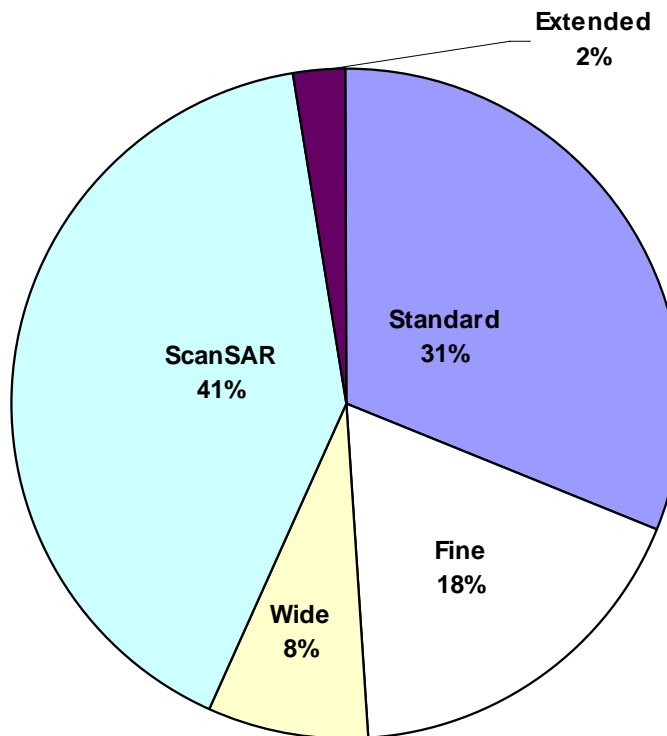
Canadian Space  
Agency

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Canada

# Operational Statistics

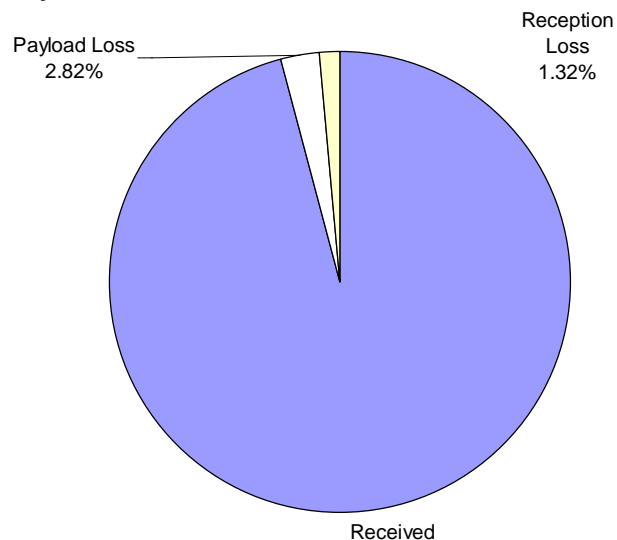
Beam Usage Distribution



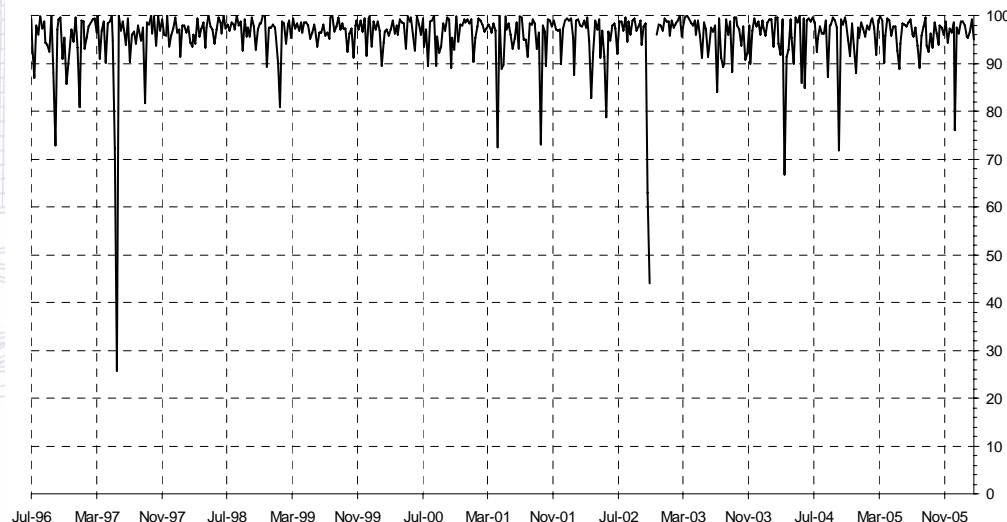


# Operational Statistics

**System Performance: Jul 1996 - Mar 2006**



**RADARSAT-1 Weekly System Performance: July 31/96 to Mar 27/06**



**System Performance is defined as the % of planned requests which were properly executed by the payload and successfully received by the reception facilities**





# International Charter “Space and Major Disaster”

- Charter operations are based on a concept of joint mission planning operation
- Currently involving CSA, CNES, ESA, ISRO, NOAA, CONAE, DMC-II and USGS
- Data Acquisition by SAR and Optical sensors
- 24 hours a day World Wide Surveillance



## Since the beginning:

	FY00-01	FY01-02	FY02-03	FY03-04	FY04-05	FY05-06
Charter events:	8	6	13	22	23	25
RADARSAT-1 Events:	7	6	11	11	16	19
RADARSAT-1 Frames:	19	33	33	30	67	47

## In 2006 (to date):

- **4** - Charter events
- **4** - RADARSAT-1 Events
- **15** - RADARSAT-1 Frames

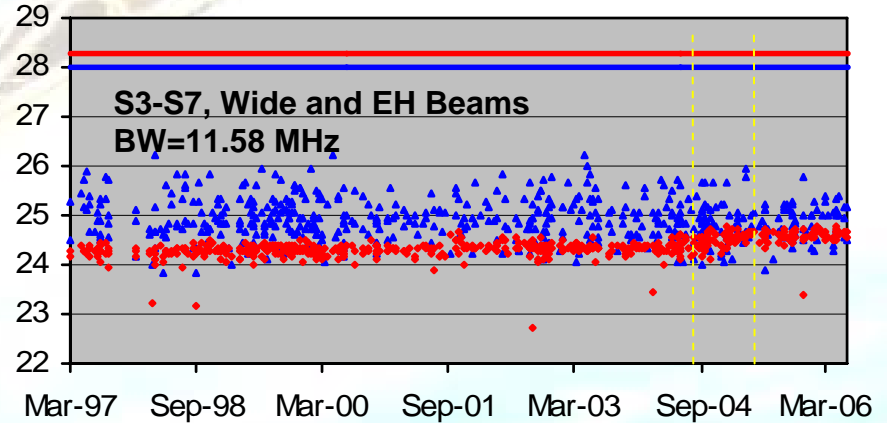
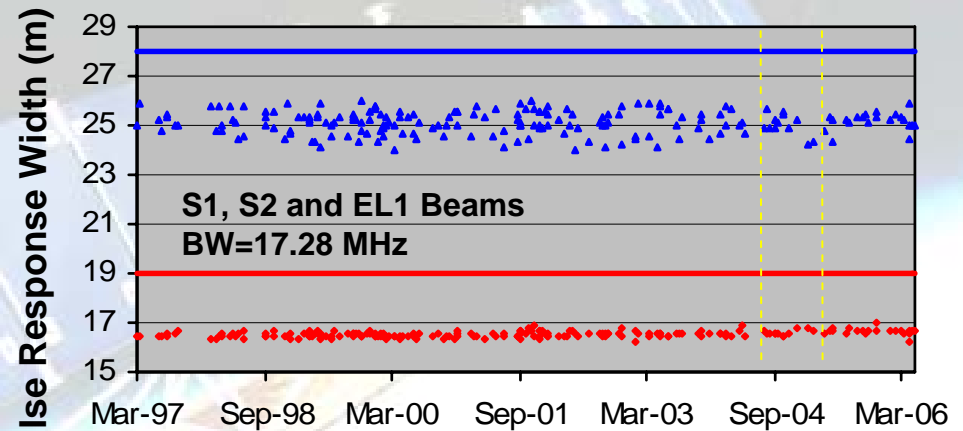
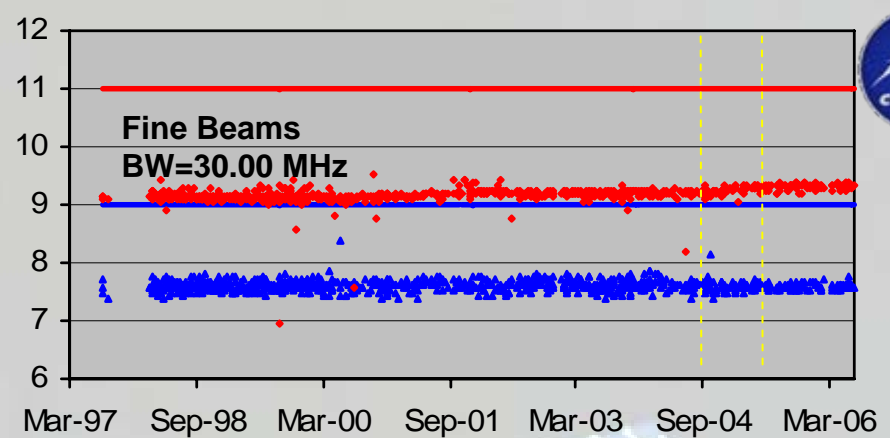
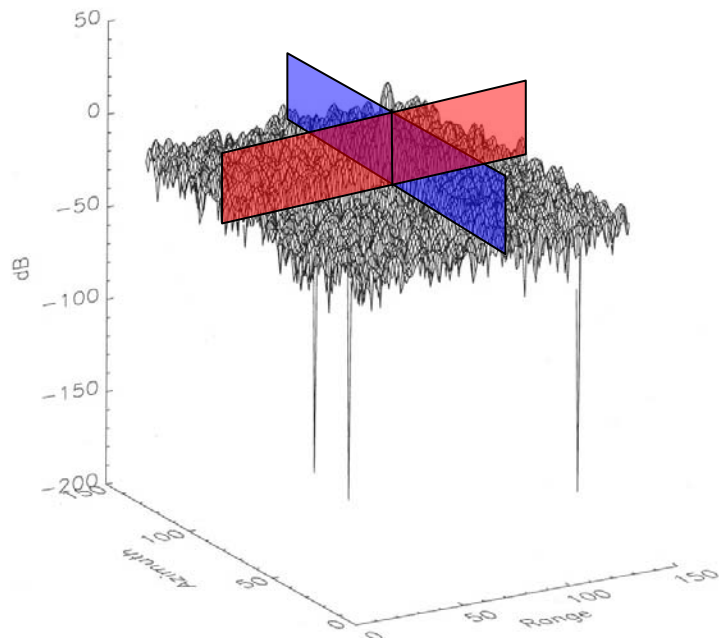


<u>Location</u>	<u>Type</u>	<u>Date</u>
Germany	Flood	01-Apr.
Czech Rep.	Flood	04-Apr.
Czech/Austria	Flood	07-Apr.
Hungary	Flood	15-Apr.

## Impulse Response Parameters

3dB Impulse Response Width  
in **Range**  
in **Azimuth**

⇒ Spatial Resolution



Acquisition Time (UTC)



## Impulse Response Parameters

Peak Side Lobe Ratio (dB)  
in Range  
in Azimuth

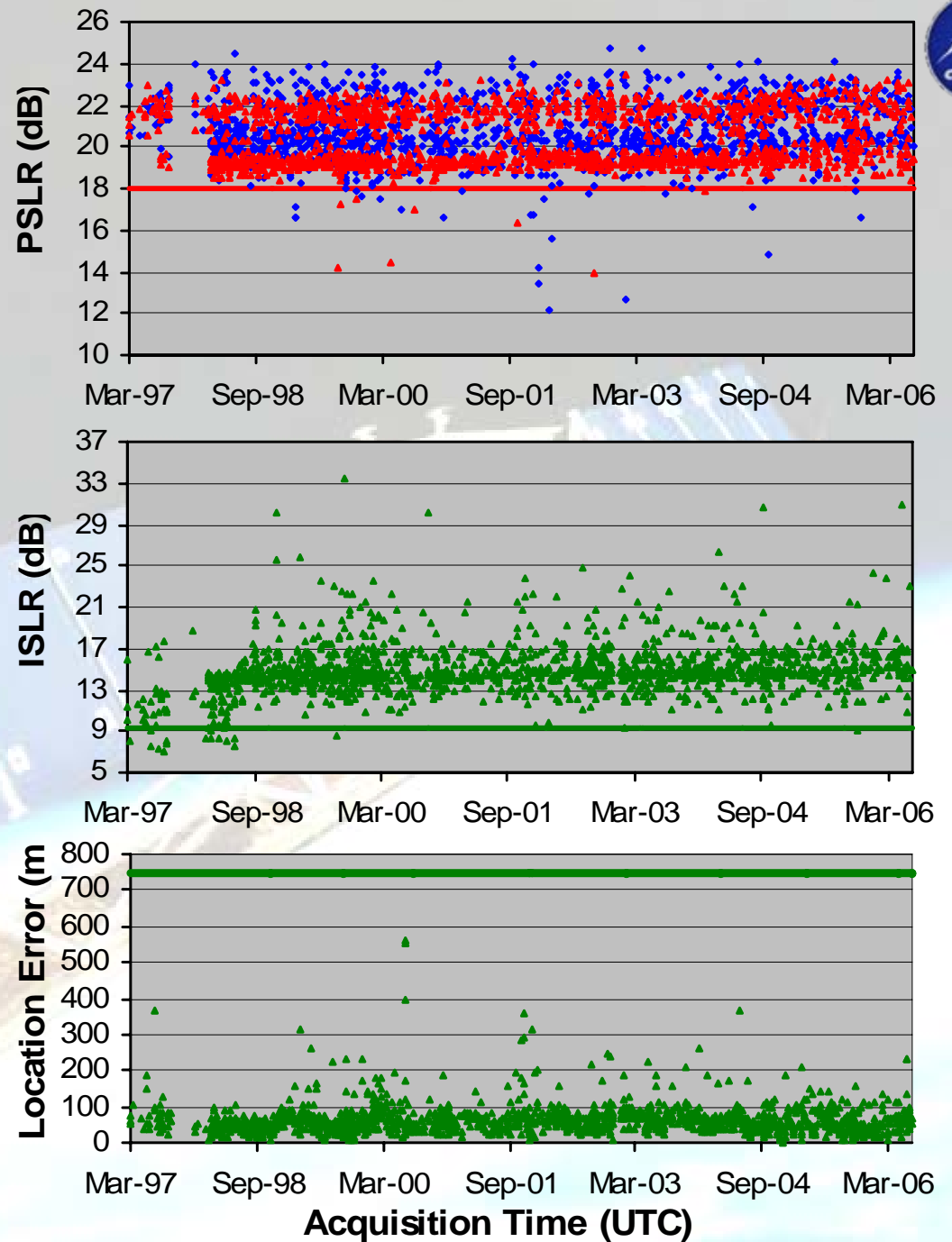
⇒ Focusing

2D Integrated Side Lobe Ratio (dB)

⇒ Energy Concentration in Main Lobe

Absolute Location Error (m)  
Based on predicted orbit data

⇒ Geometrical Registration

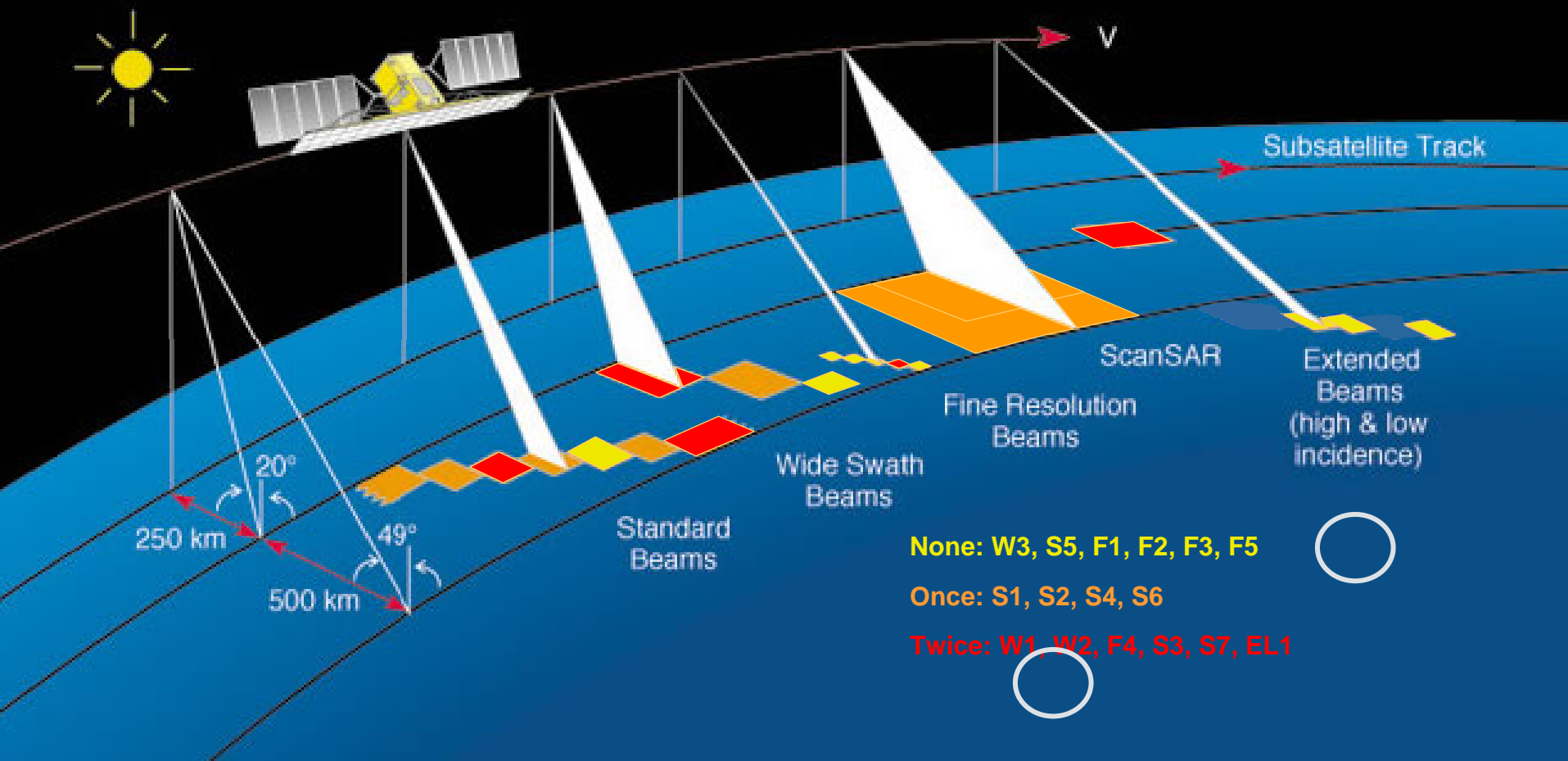




# Radiometric Recalibrations

## Pattern Shape Recalibrations Since 1998

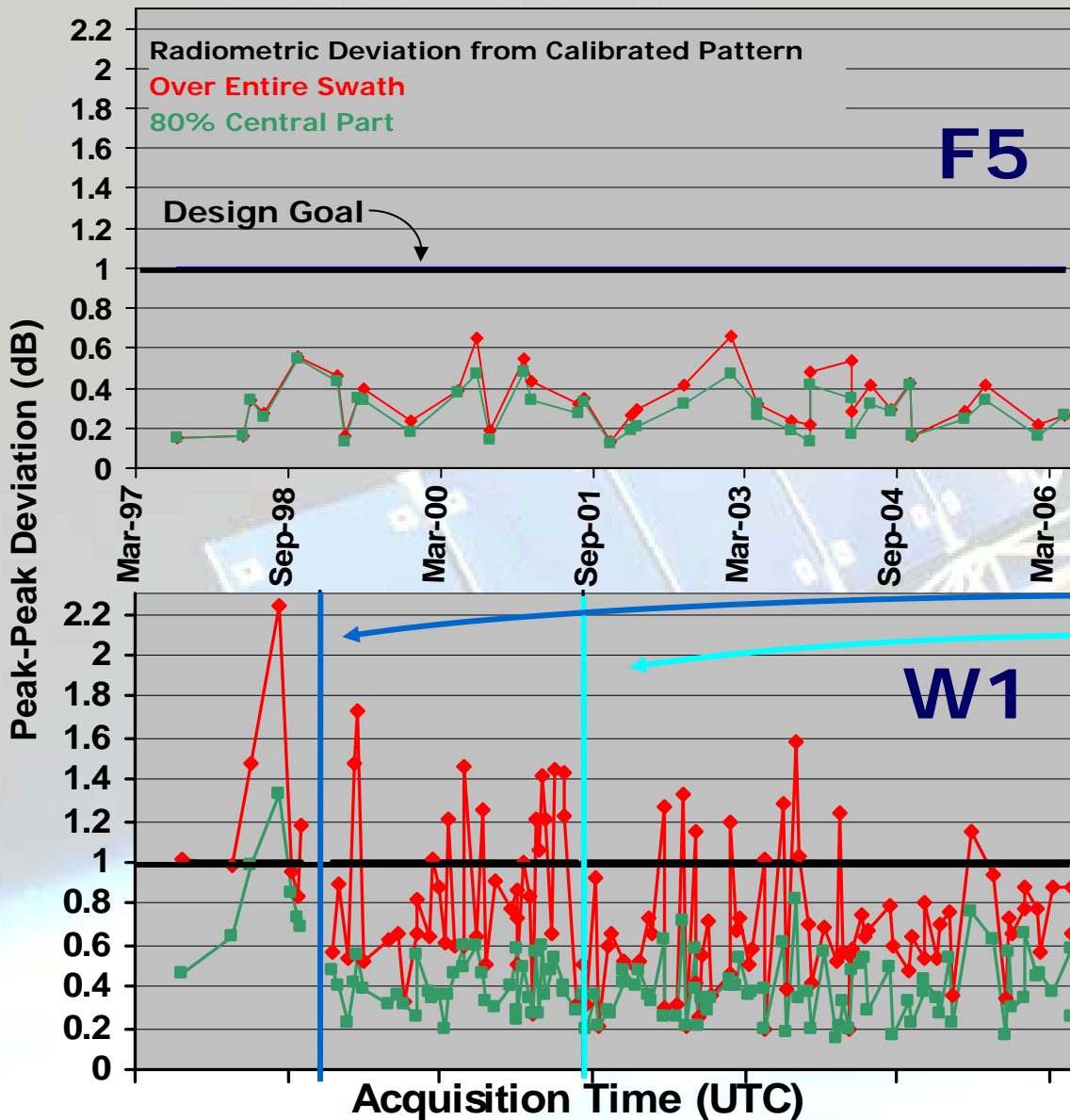
Update of Payload Parameters File with new calibrated elevation pattern



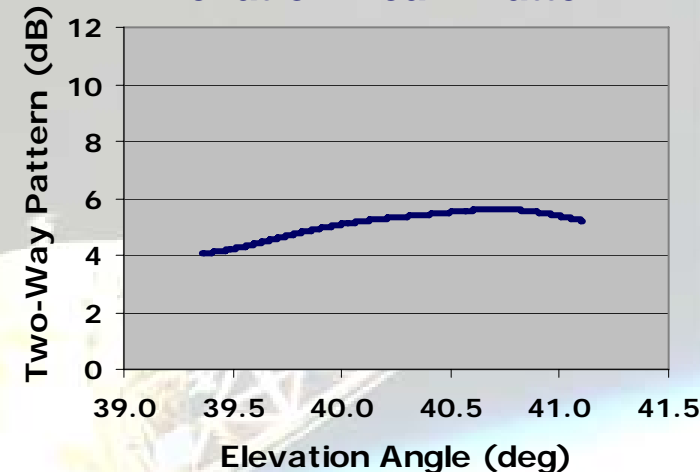
# Radiometric Recalibration Examples - Beams F5 and W1



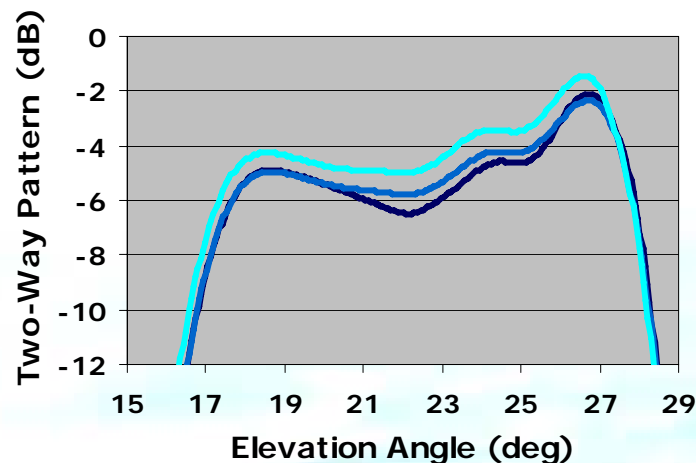
## Radiometric Monitoring History



## Elevation Beam Pattern



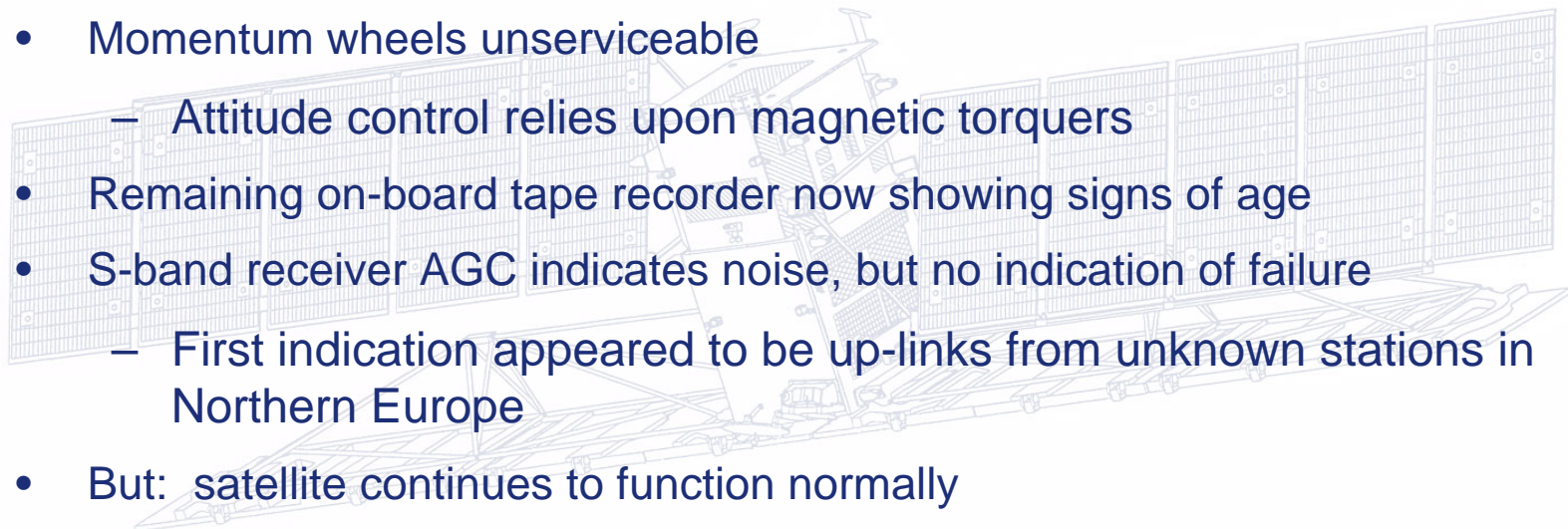
Original Calibration – Feb 97  
First W1 Recalibration – Dec 98  
Second W1 Recalibration – Jul 01





# RADARSAT-1 Spacecraft Status

- Almost all redundancy lost or non-functional
  - Some payload unit functionality likely recoverable, TBC
- Consumable life (power, propellant, switching cycles) still extensive
- Momentum wheels unserviceable
  - Attitude control relies upon magnetic torquers
- Remaining on-board tape recorder now showing signs of age
- S-band receiver AGC indicates noise, but no indication of failure
  - First indication appeared to be up-links from unknown stations in Northern Europe
- But: satellite continues to function normally





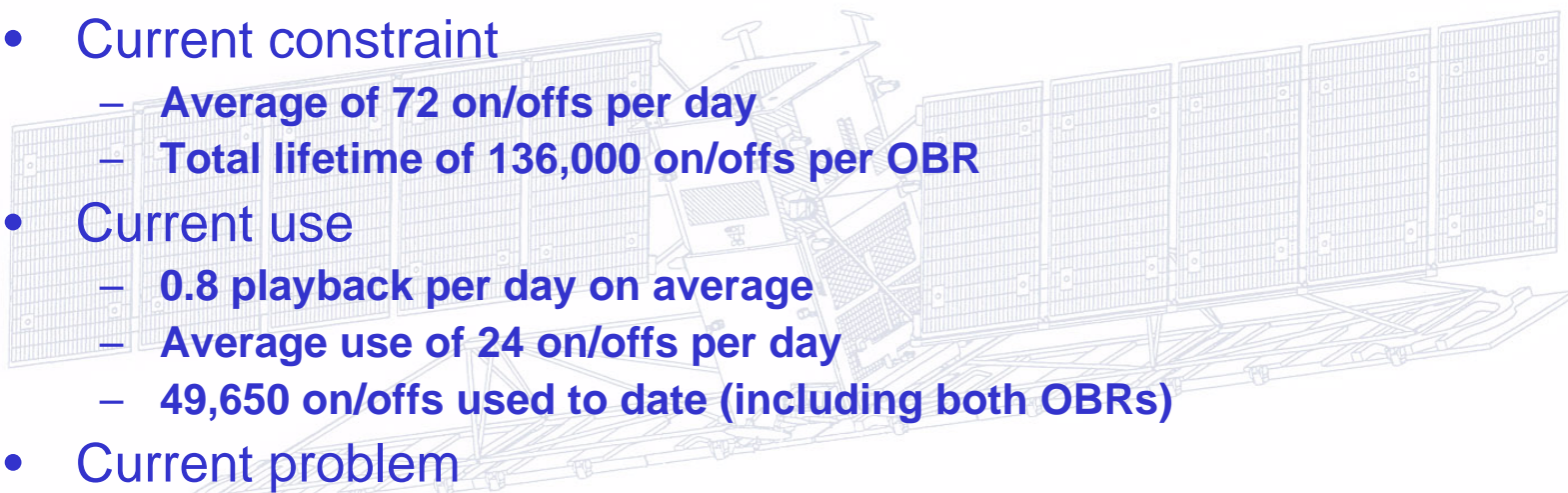
## **RADARSAT-1 Spacecraft Status – Attitude Control**

- Momentum wheels bearings failed due to friction build-up and overheating
- Considerable engineering effort required to implement control scheme relying entirely upon magnetic torque
- Wheels still available for short periods: restricted to reorientation manoeuvres
- Used in May 2004 to recover from large over-thrust
- May be used again to reduce altitude at end of life
- Still some risk during eclipse season if sun sensor lost:
  - Would put satellite out of service until the end of the season
  - Resolution requires flight S/W modification
  - Awaiting US export license for compiler, to make upgrade



## On-Board Recorder (OBR)

- Current OBR Operational Baseline
  - 1 playback per day on average
  - Playbacks at GSS and PASS (ASF used exceptionally)
- Current constraint
  - Average of 72 on/offers per day
  - Total lifetime of 136,000 on/offers per OBR
- Current use
  - 0.8 playback per day on average
  - Average use of 24 on/offers per day
  - 49,650 on/offers used to date (including both OBRs)
- Current problem
  - OBR2 not operational
  - OBR1 showing aging effect





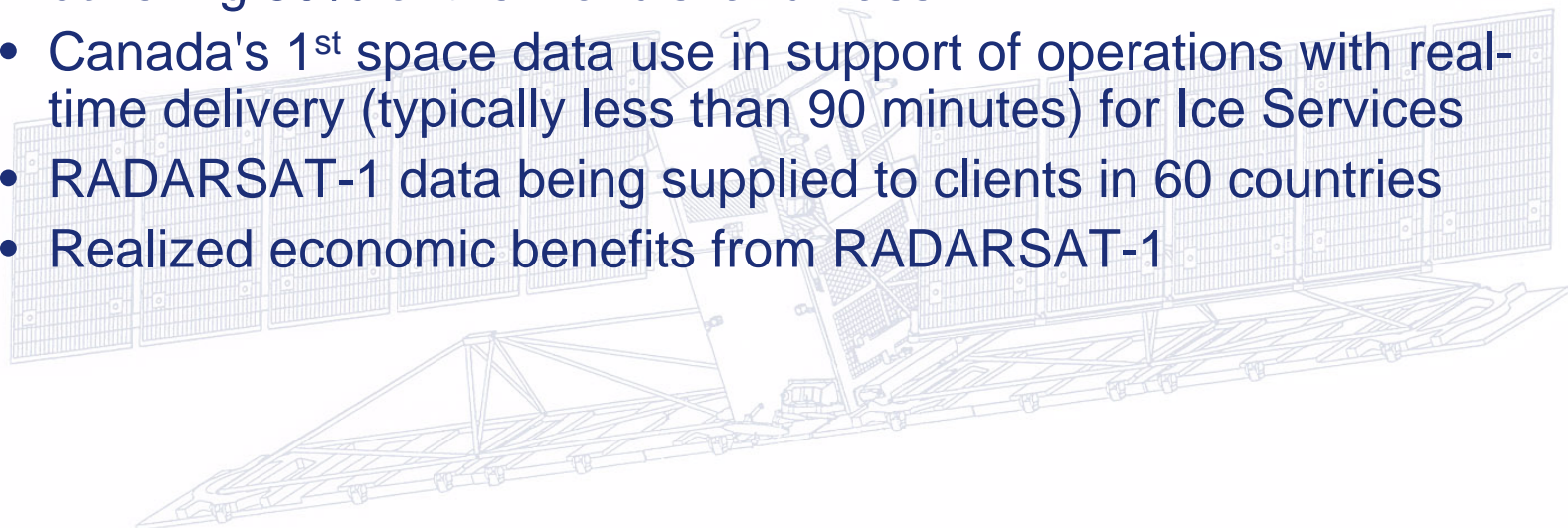
## Conclusions (1)

- Planning/tasking of Canada's first EO and the world's first multi-mode operational SAR system, maintaining an average system performance better than 95%
- World's largest uniform global radar image data archives
  - First complete radar stereo coverage of the world's landmass
  - Complete Interferometric coverage of Canada and of selected sites around the world
- First complete high-resolution coverage of Antarctica
- Canada's lead in international space-based disaster management (International Charter & DMISCO)
- Improved orbit maintenance to meet new requirement of interferometry



## Conclusions (2)

- Product quality and calibration fully maintained
- International network of RADARSAT-1 data receiving stations covering 80% of the world's landmass
- Canada's 1<sup>st</sup> space data use in support of operations with real-time delivery (typically less than 90 minutes) for Ice Services
- RADARSAT-1 data being supplied to clients in 60 countries
- Realized economic benefits from RADARSAT-1





- 2006
- RADARSAT-1 is in its
- eleventh year of operations!





Questions?

