CBERS Program Update Jacie´2011

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Overview

- CBERS 3 and 4 characteristics
  - Differences from previous CBERS satellites (CBERS 1/2/2B)
    - Geometric processing
    - Radiometric processing
  - General and camera specific changes
- CBERS 3 launch schedule
- CBERS for Africa update

CBERS 3 and 4 sun synchronous orbit

- Semi-major axis (average): 7148.8 Km
- Inclination: 98.5 (o)
- Eccentricity: 1.0x10-3
- Argument of Perigee: 90 degrees
- Local Time at descending node: 10:30 AM
- Orbital period: 100.26 minutes
- Repeat cycle: 26 days
- Revolution/Day: 14 + 9/26
- Distance inter ground track at equator: 107.4 km
- Time interval between adjacent tracks: 3 days
- Local time stability at descending node mean: +- 5 min.
- Orbit traces stability at the equator: +- 5 km

Attitude and Orbit Control System (AOCS)

- Starting in CBERS 2B
  - GPS
  - Star Sensors
  - Same satellite control mechanism used in CBERS 1/2
    - Informational only, not in the satellite control loop
- CBERS 3 and 4
  - New Star Sensors to avoid South Atlantic Anomaly (SAA) related problems
  - AOCS software upgraded to use GPS and Star Sensor information
  - Better position and pointing accuracy
    - Attitude knowledge ≤0.03 deg (3 sigma)
  - Without GPS and SS (degraded mode)
    - Attitude knowledge ≤0.15 deg (3 sigma)

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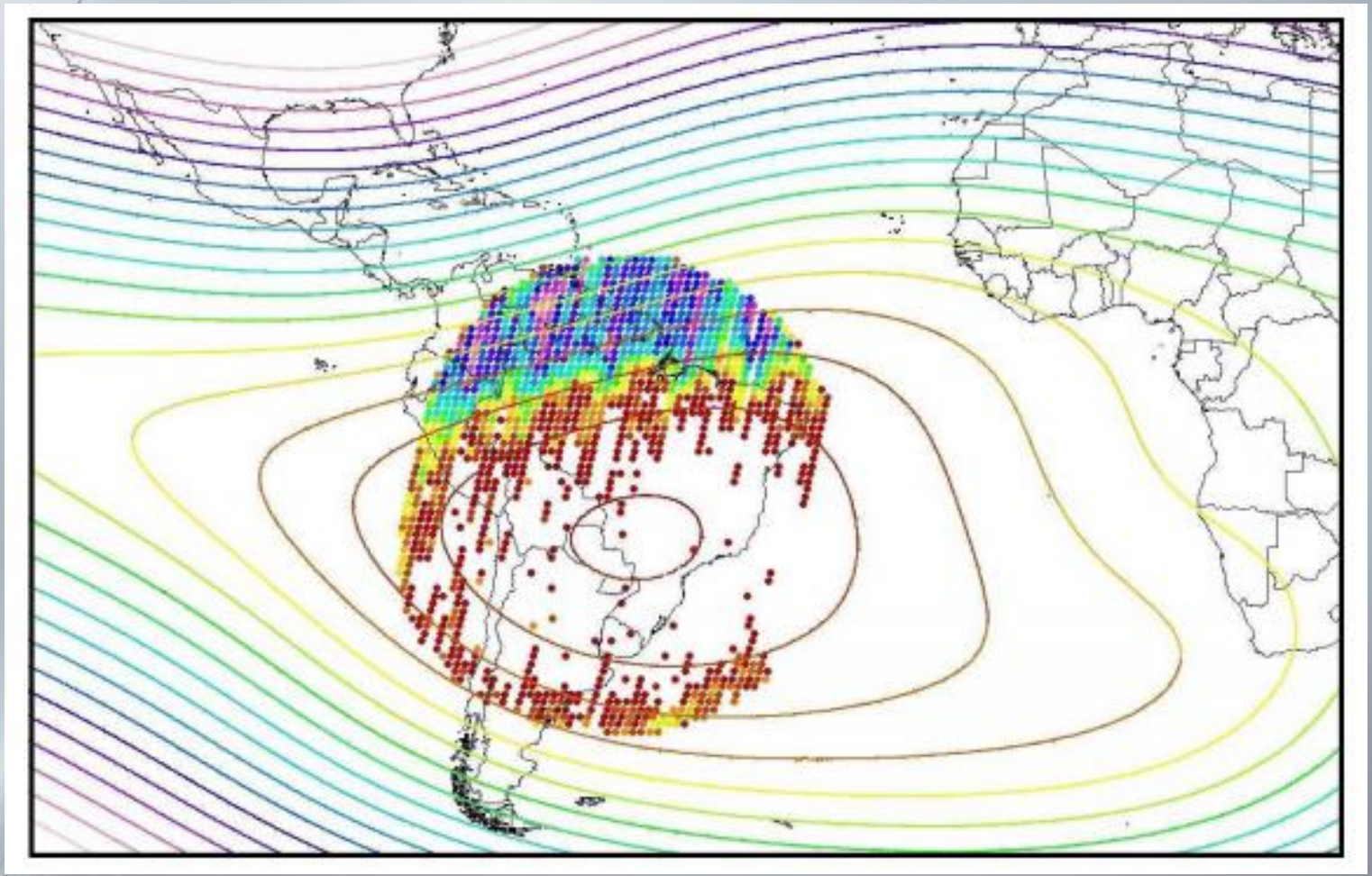
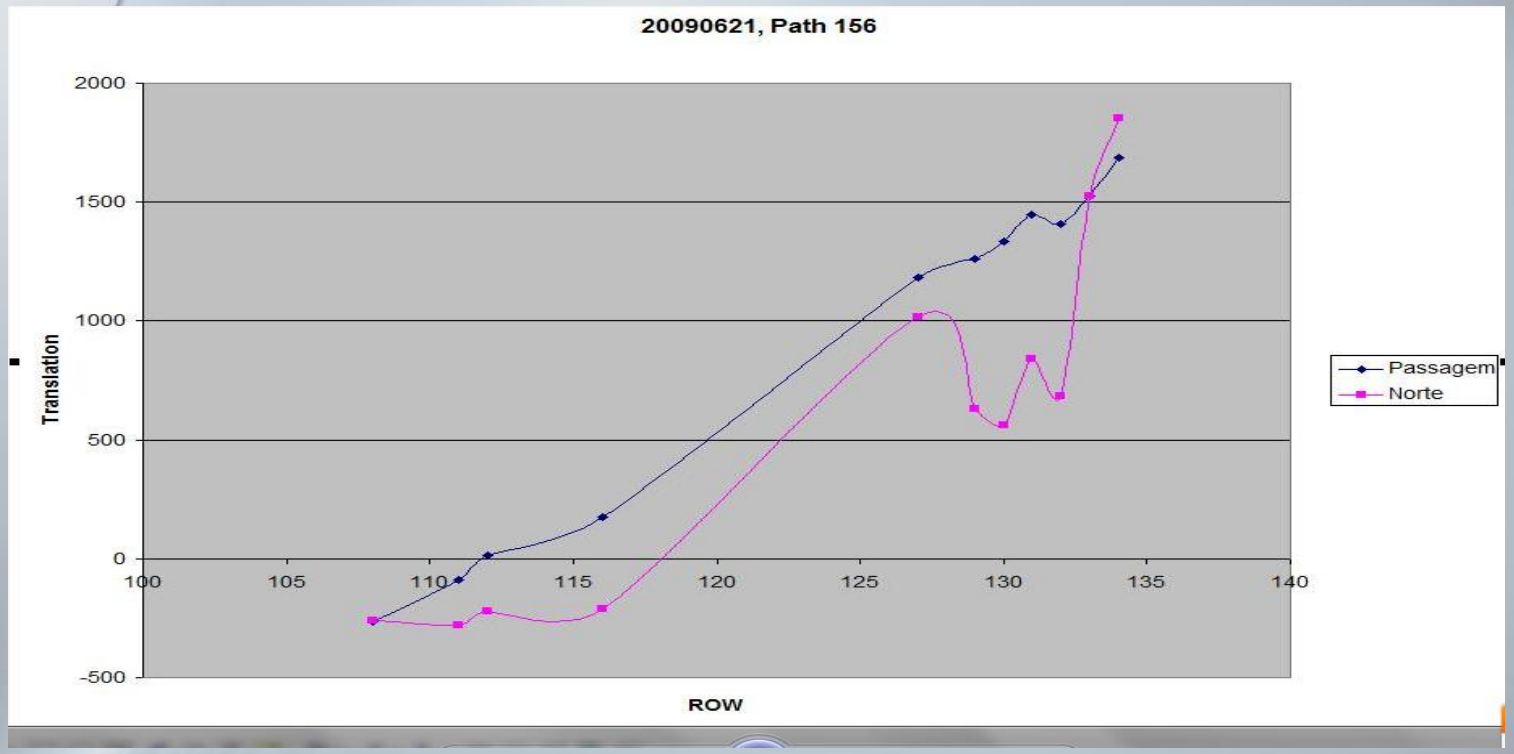
Star sensor data and the SAA



CB2B Translations along track example (L1G)



- Translation in meters
- Harder to make automatic registration with ground control chips

Better time stamping for image lines

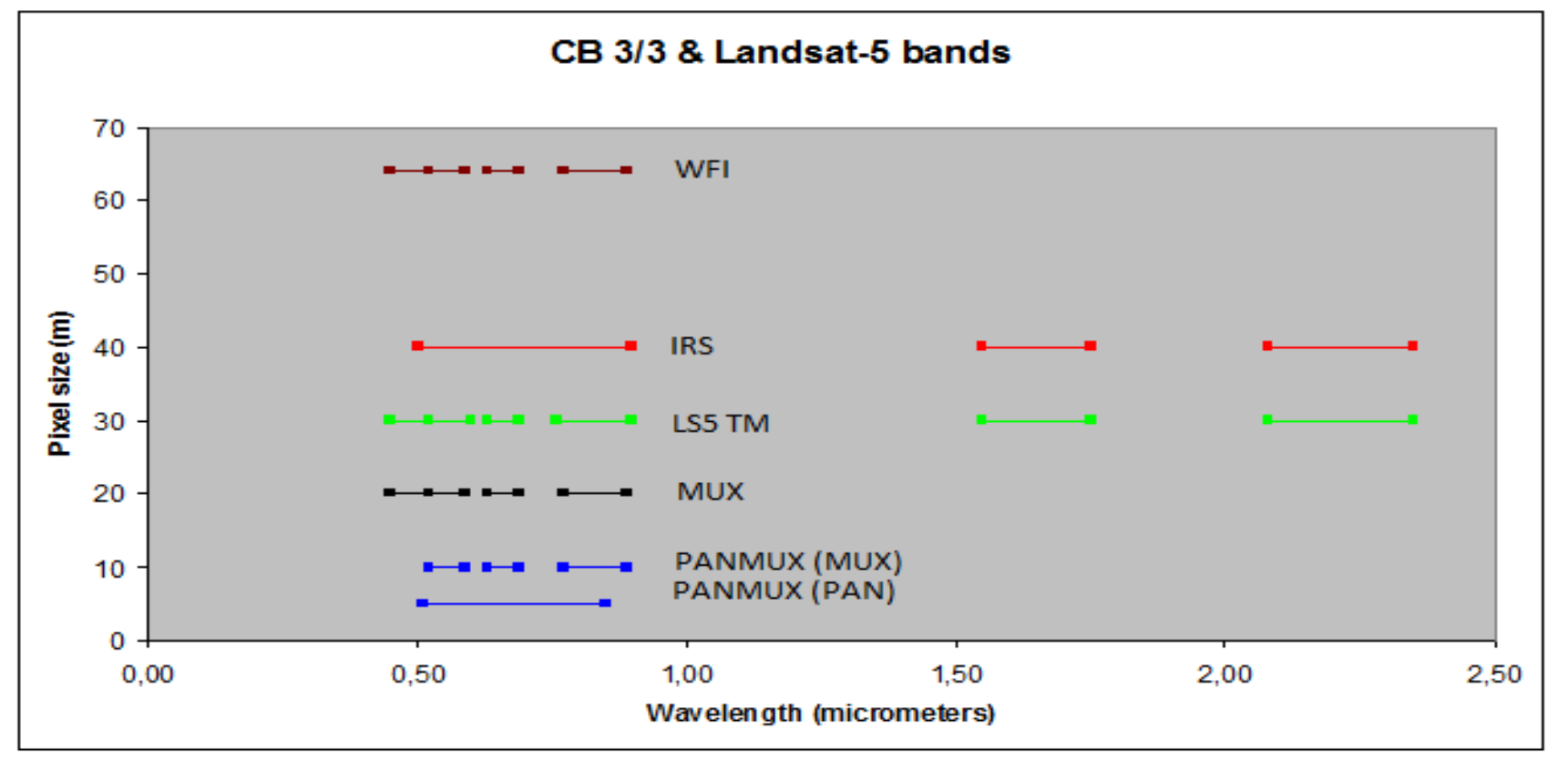
- CBERS 1/2/2B
  - A new timestamp was generated every 2-3 seconds
  - No practical image line counters, small ranges
- CBERS 3/4
  - Will transmit the GPS time of the first image line acquisition for all cameras
  - Line counters with sufficient range to cover all pass
  - Precise frame period

CBERS 3 / 4 payload overview

	MUX	WFI	IRS	PANMUX
Country	Brazil	Brazil	China	China
Type	Push-broom	Push-broom	Scanning mirror	Push-broom
Swath (Km)	120	866	120	60
Revisit (days)	26	5	26	52 (*)
Quantization (bits/pixel)	8	10	8	8

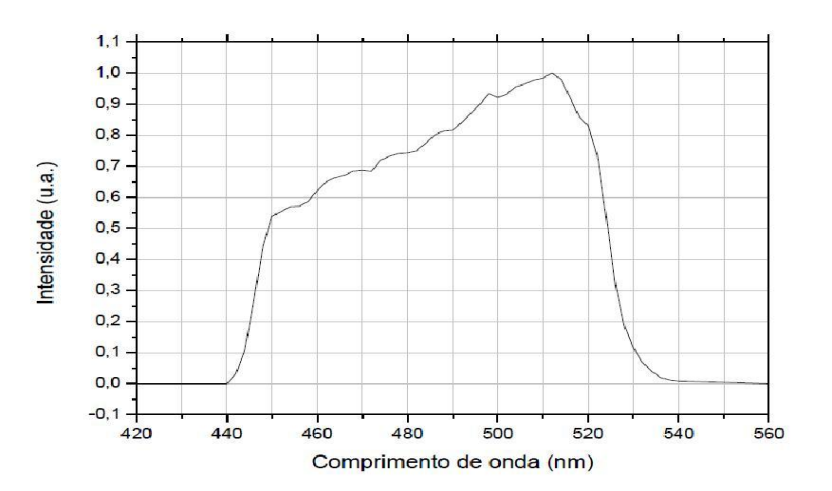
(*) Mirror may be used to revisit the same place within 3 days if necessary

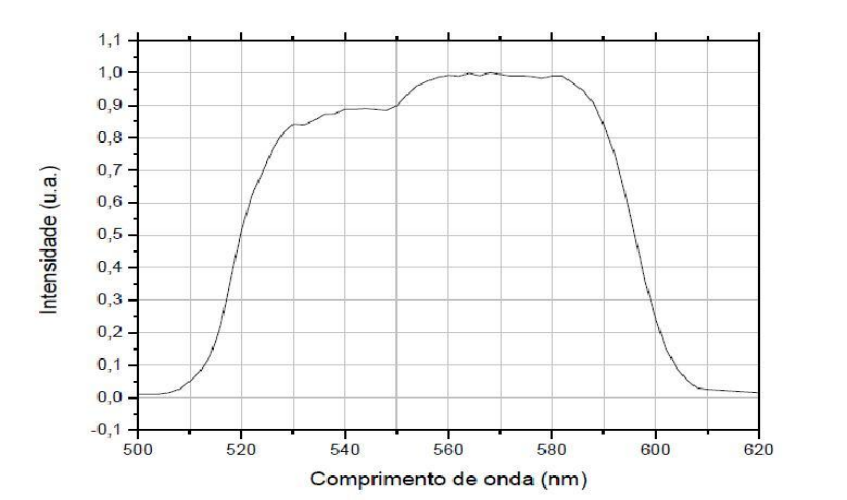
CBERS 3/4 bands resolution and wavelengths

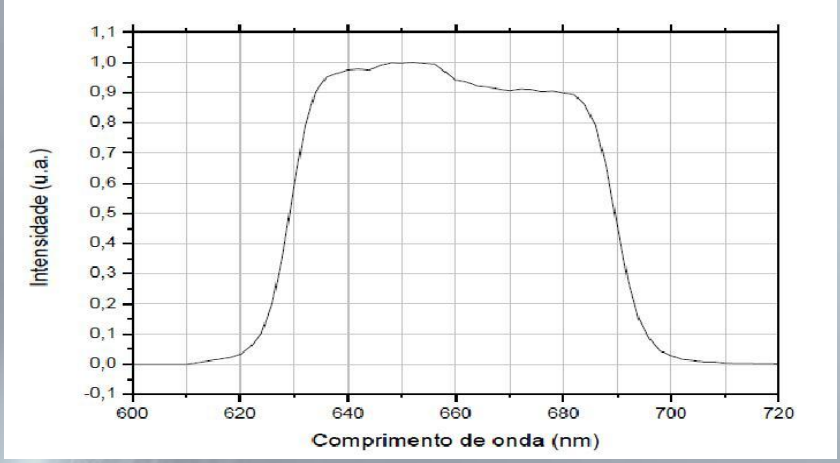


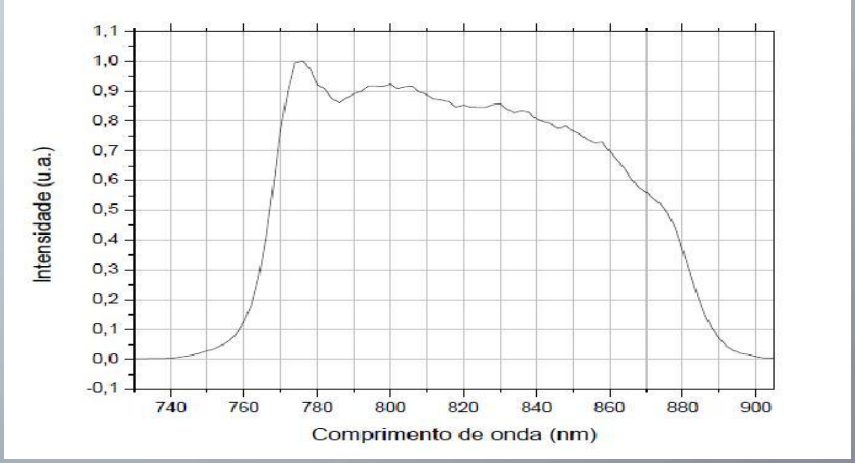
IRS also has a thermal band in 10.4 – 12.5 range, 80m

MUX and WFI filters response





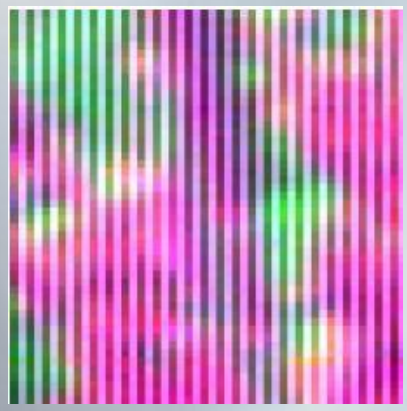




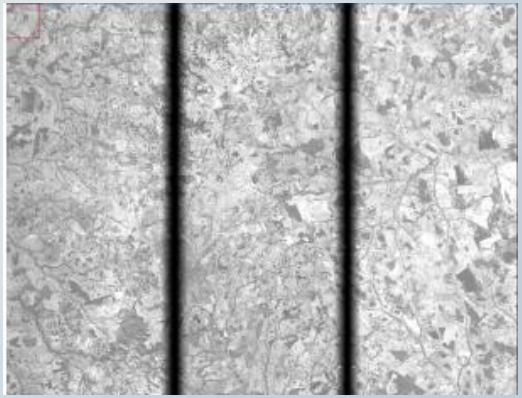
MUX

- Replaces CBERS 1/2/2B CCD camera
- Differences
  - Positive
    - Single CCD array for each band instead of 3 arrays for each band;
    - No odd/even striping effect
    - Internal calibration (LED based)
    - Focal plane position adjustment
    - Individual gain adjustment
  - Negative
    - No panchromatic data
      - May use PANMUX data, but swath is half of the MUX scene
- Challenges
  - No beam splitter: difference of up to .5 s between acquisition times for different bands

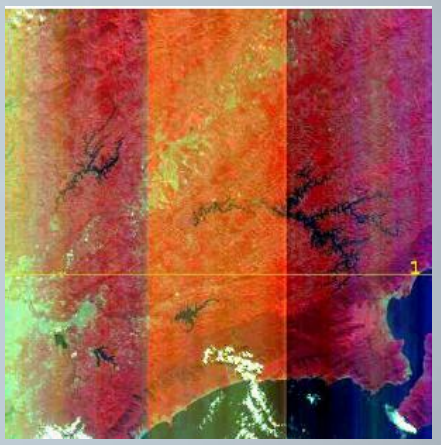
CBERS 1/2/2B CCD artifacts



Odd/Even striping

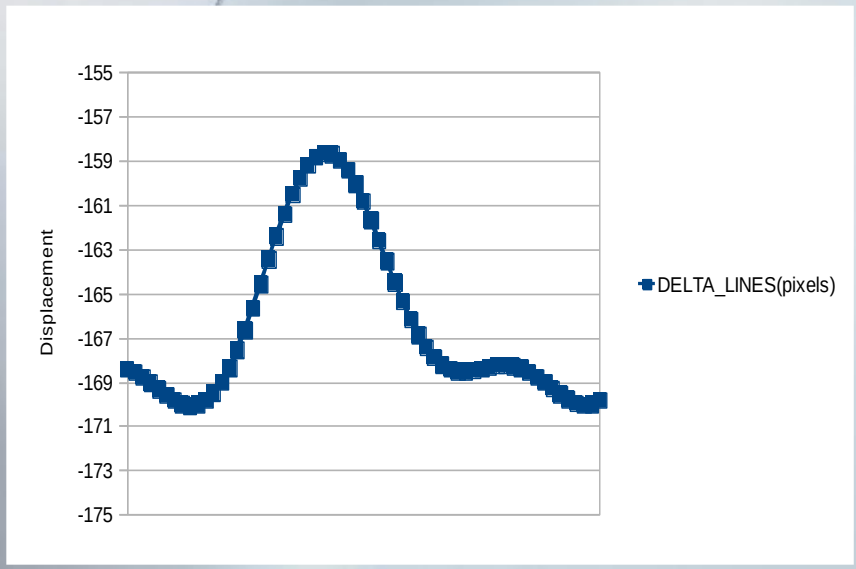


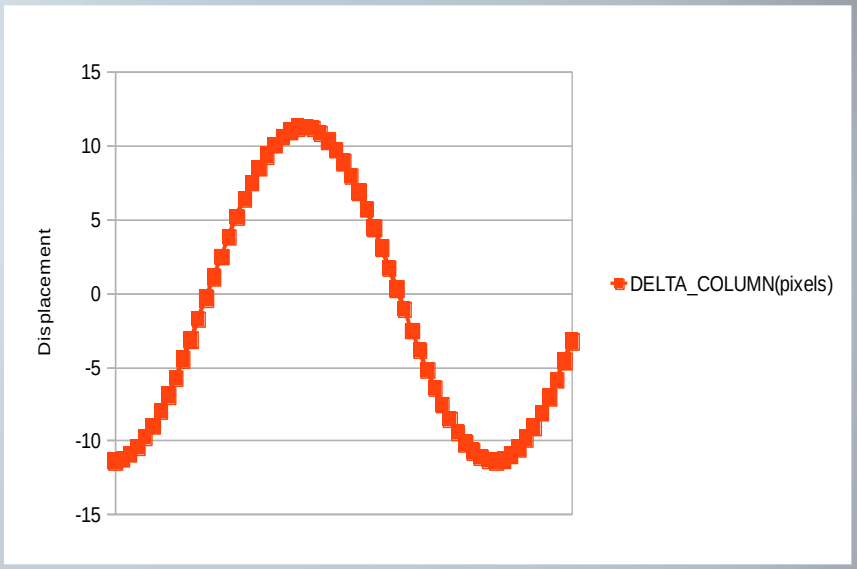
Inter array processing



Distinct behavior for each Array, for each band

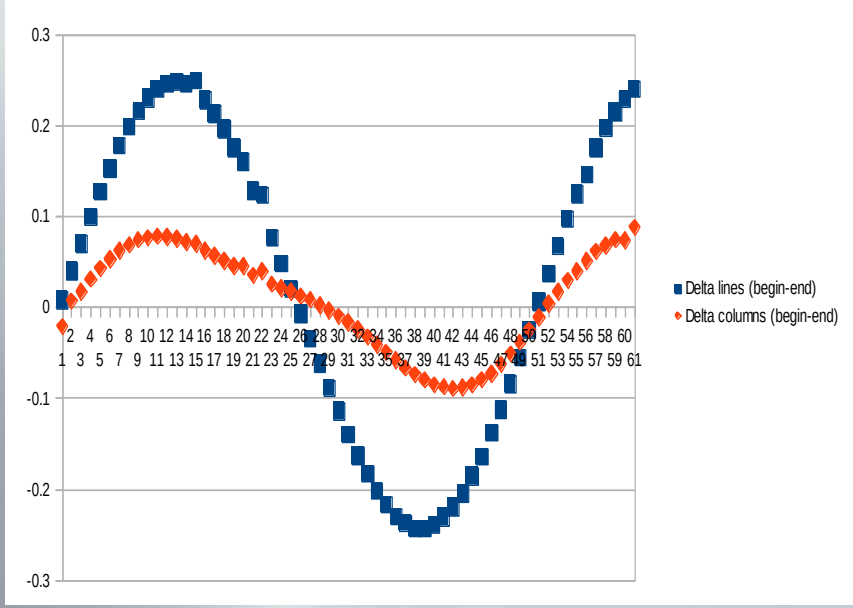
Simulation for MUX center pixel registration (worst case)

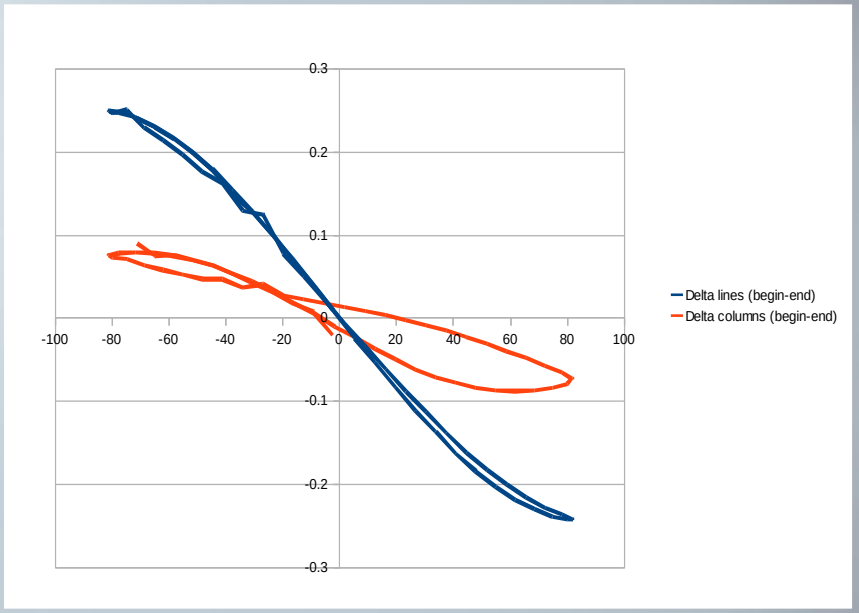




- Displacements must be computed according to the latitude
  - L0R will need to use position and attitude data
- What about variation within the scene lines?
  - Graphs above consider central pixel only

Simulation for MUX displacements for initial and final pixels

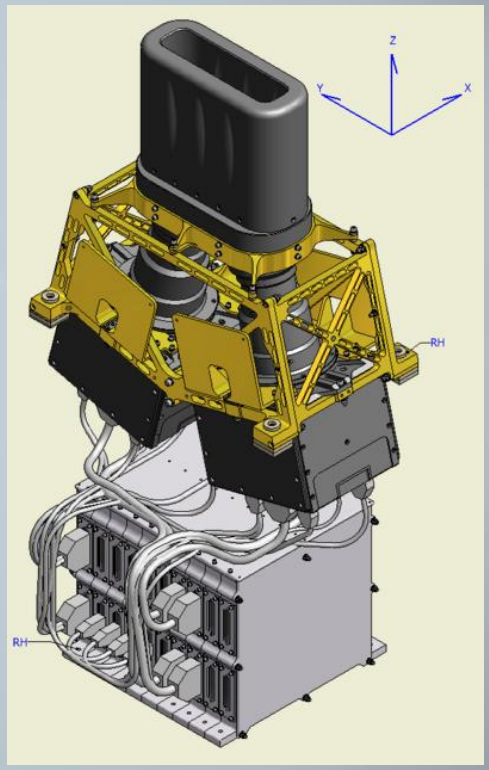




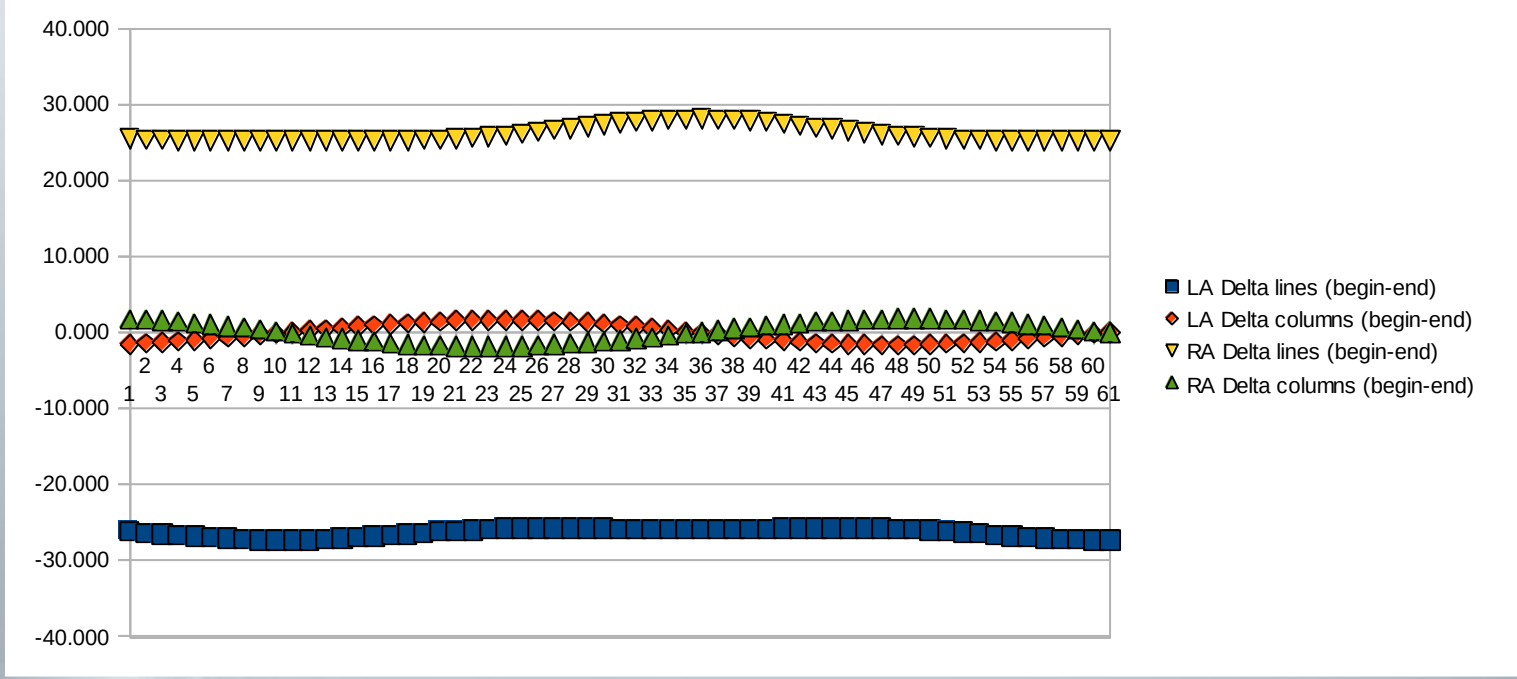
- Up to 0.25 pixels difference for line displacement
  - More critical in high latitudes
- Data above is for a single typical orbit
  - Changes are not significant if satellite nominal orbit is maintained

WFI

- Replaces CBERS 1/2/2B WFI camera
  - Two distinct optical systems
- Differences
  - Positive
    - 10 bits quantization instead of 8 bits
    - Better resolution, 64m instead of 260m
    - 4 spectral bands instead of 2
    - No odd/even striping effect
    - Internal calibration (LED based)
    - Individual gain adjustment
- Challenges
  - No beam splitter: difference of up to 1.9 s between acquisition times for different bands



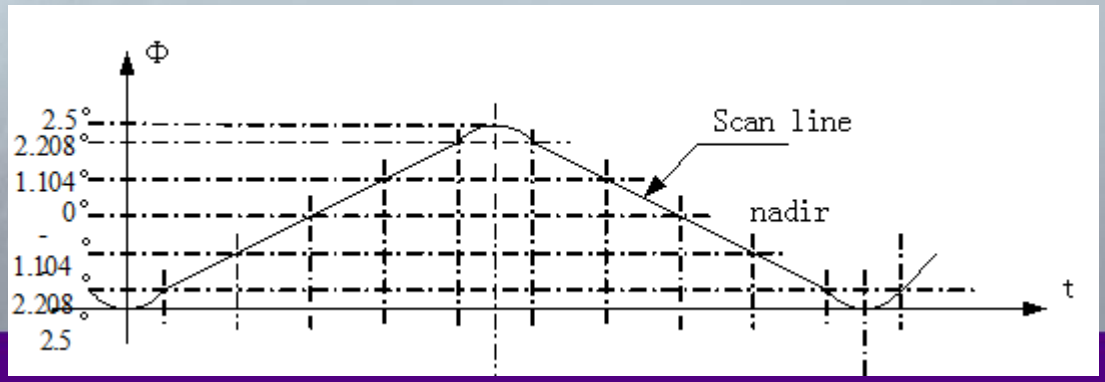
Simulation for WFI displacements for initial and final pixels, For left and right cameras



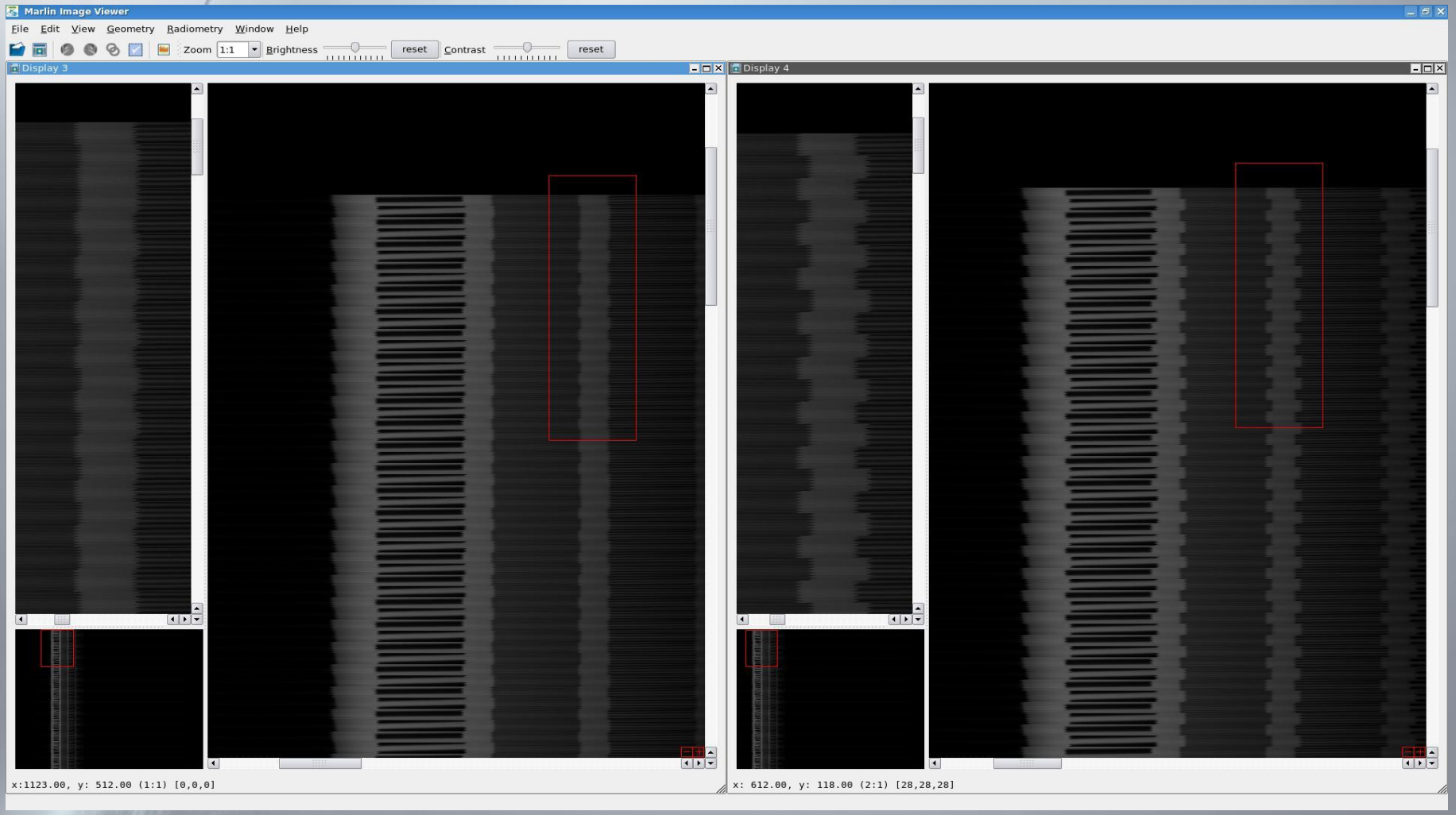
- Combined with the panoramic effect the changes in displacement values between initial and final pixels is up to 30 pixels for lines
  - Unfeasible to generate a L0R product with simple translations

IRS

- Replaces CBERS 1/2 IRS
- Differences:
  - Positive
    - Better spatial resolution, 40m instead of 80m (80m instead of 160m for thermal)
- Challenges
  - Same model for scanning mirror movement
    - Linear within 4 defined sections
    - Problems in matching direct and reverse scans in CBERS 1 and 2



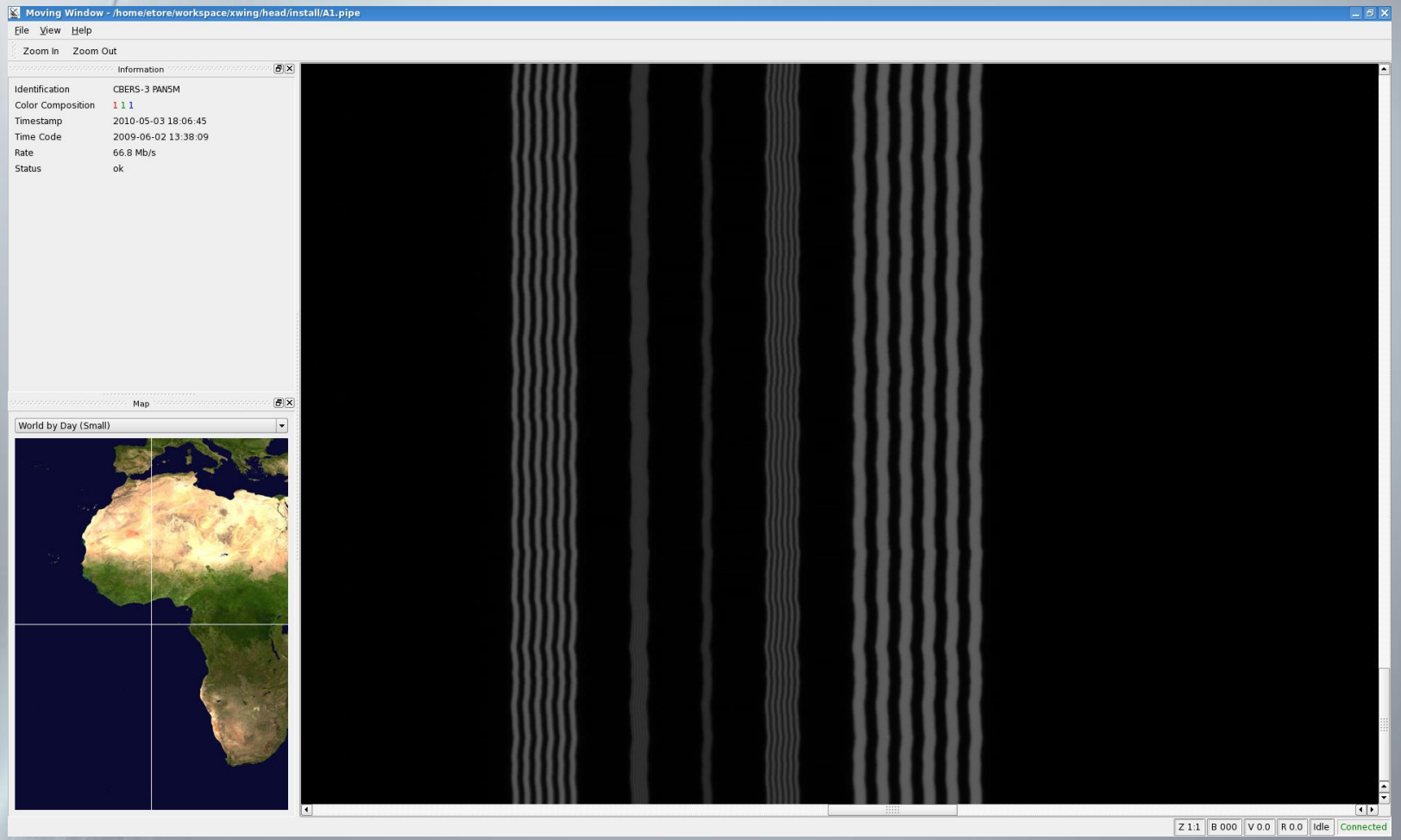
IRS scan match test



PANMUX

- No similar camera in CBERS 1/2/2B
- Bands
  - 3 Multi-spectral (10m resolution)
    - Uses beam splitter to separate spectral bands
  - 1 Panchromatic (5m resolution)
  - Individual gain adjustment
- Focal plane position adjustment
- Internal calibration
- Challenges
  - Impact from IRS scanning mirror movement
  - Around 4s difference acquisition time between PAN and MUX bands
  - Panchromatic band data will be compressed (line based DPCM algorithm)

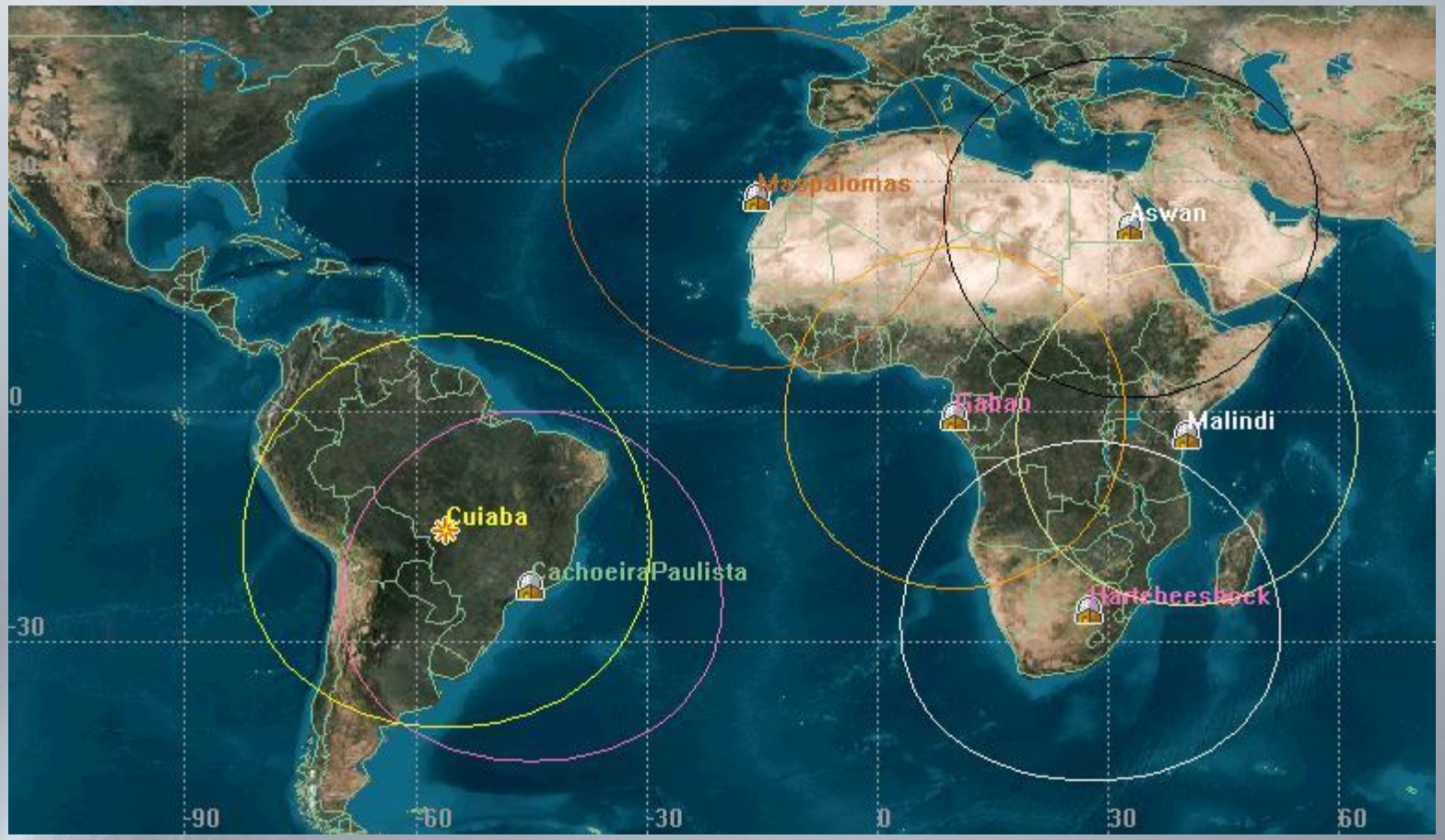
IRS interference in PAN5m imaging



CBERS 3 launch schedule

- Satellite to be integrated and tested until Dec. 2011
- Wait for a launch window in the first semester of 2012
  - Launch from China using a Long March rocket

CBERS for Africa planned ground stations



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Questions?