Measurement of the across-track slope of the marine geiod with SAR-interferometric altimeter.

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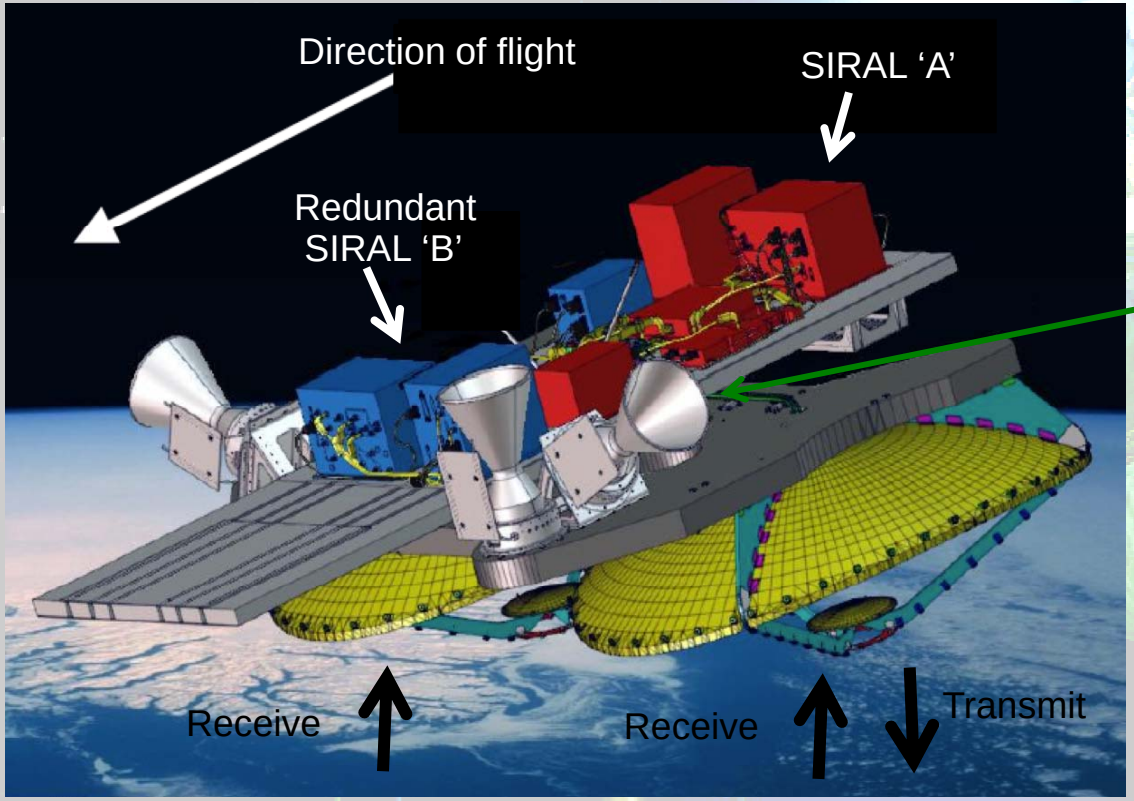
The CryoSat-2 Payload and Operating Modes.



- **"SARIN mode"**

  Illuminated area narrowed along-track by synthetic aperture processing & second receiving antenna forms an across-track interferometer. Star trackers determine baseline orientation.

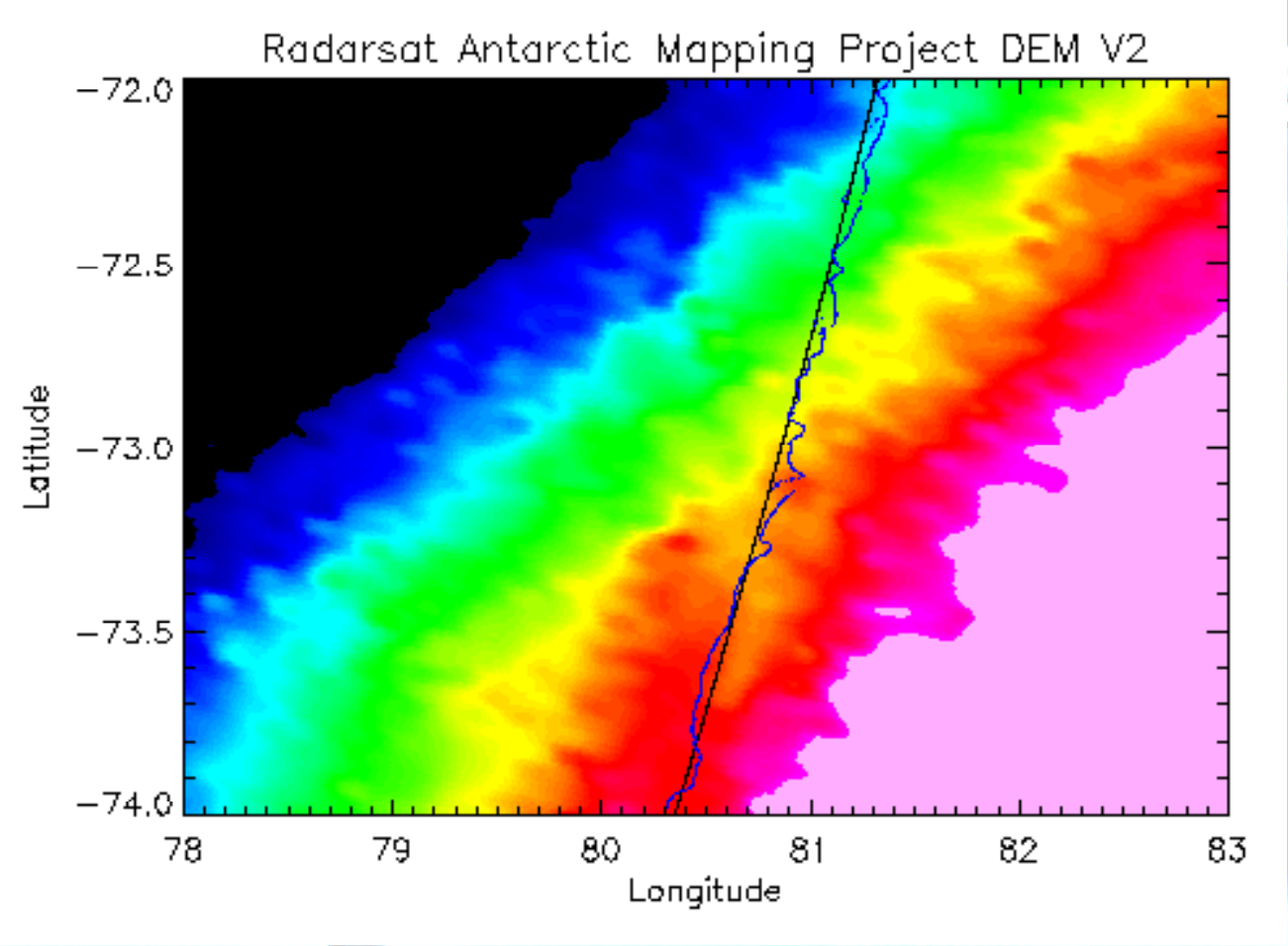
- "SAR mode" (SAR)

  Illuminated area narrowed along-track by synthetic aperture processing

- "Low resolution mode" (LRM)

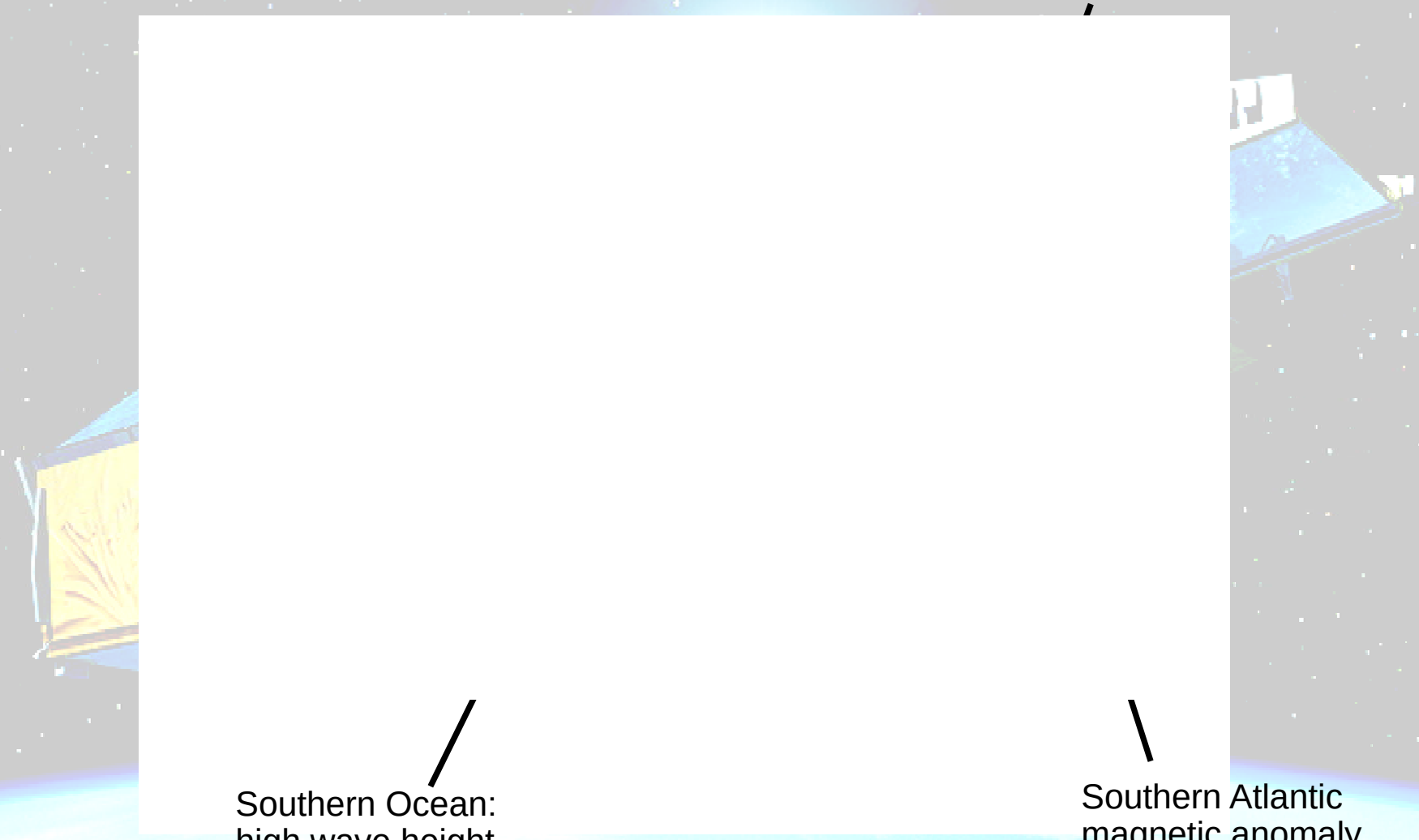
  Conventional pulse-limited altimeter but with a slightly elliptical antenna

Elevation retrieval from combined range and angle measurement, East Antarctica, March 2011



Calibration of the interferometer

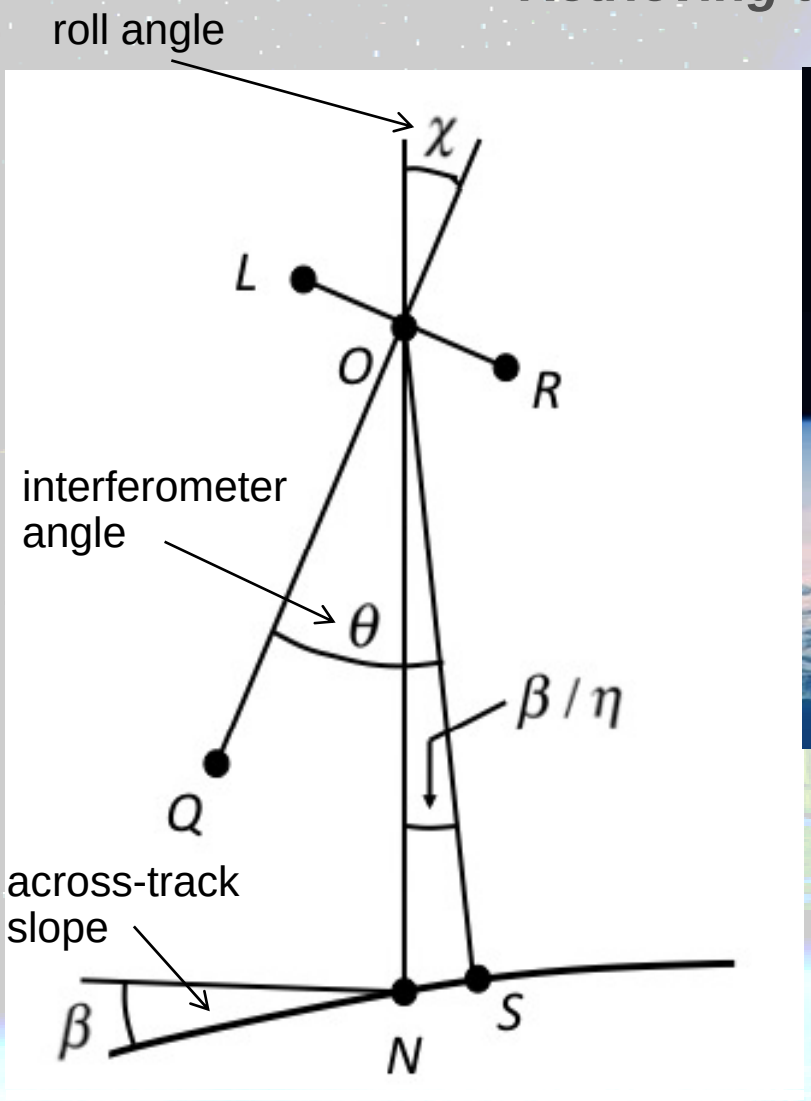
East of ocean mesoscale

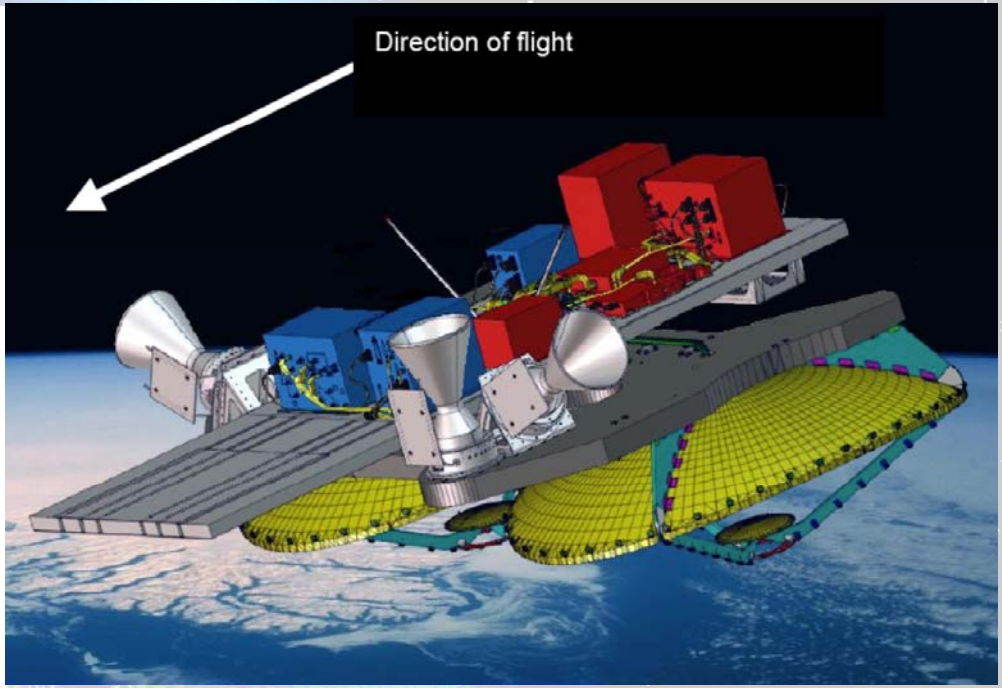


Southern Ocean:
high wave height

Southern Atlantic
magnetic anomaly

Retrieving the interferometer angle

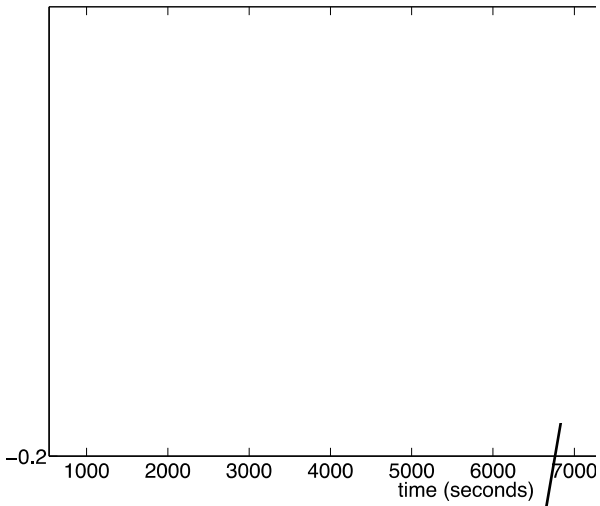




$$\sin(\theta) = Arg(\Psi(0)) / k_0 B + \varphi_d$$

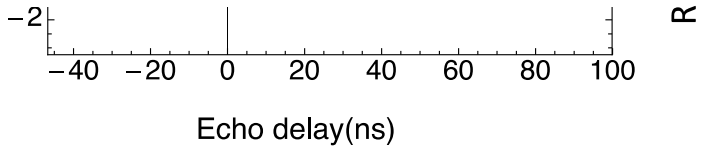
$$\theta \approx \chi + \beta / \eta$$

Measuring the roll angle

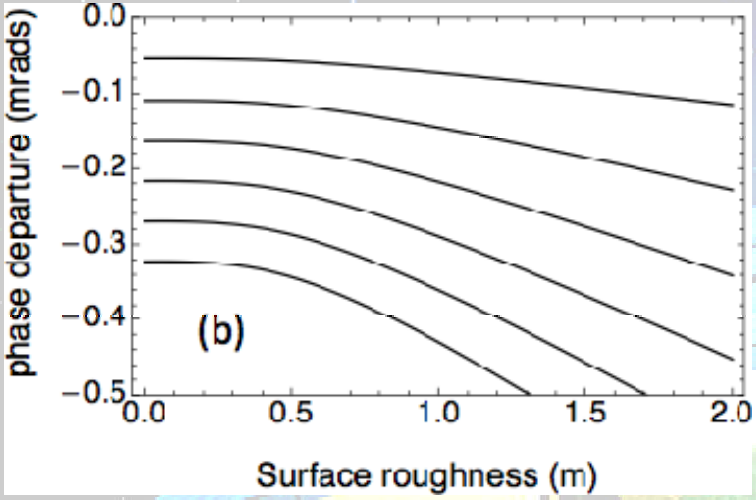


Southern Atla
magnetic ano

Measuring the interferometer

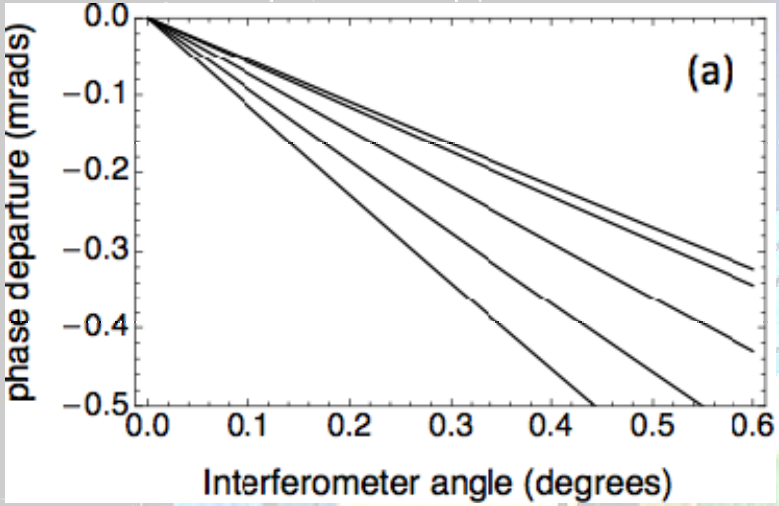


Removing SWH dependence



surface roughness (m)

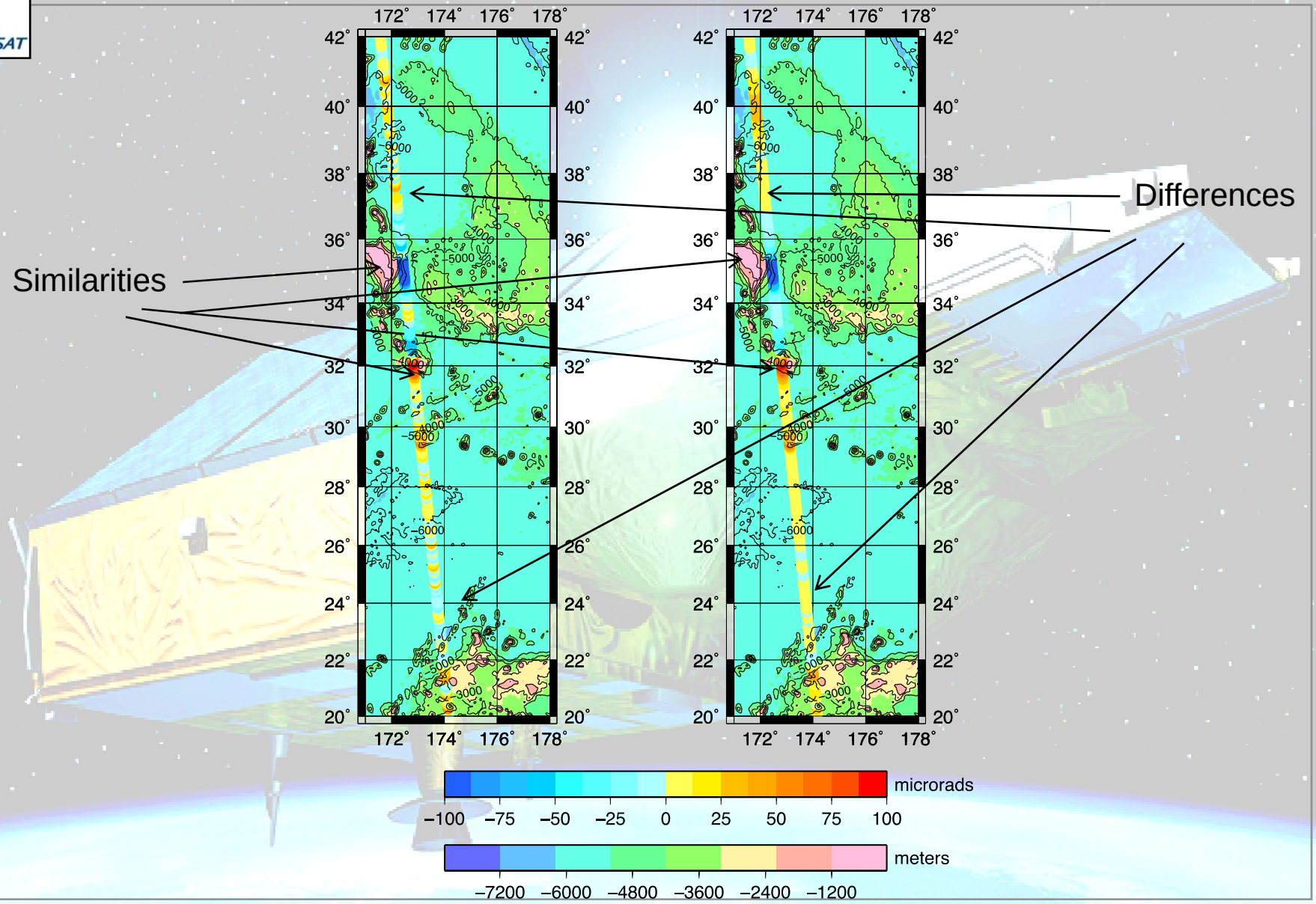
Calibration as a function of θ_m



Measured scale factor:
0.973

Theoretical scale factor:
0.970

g ( )


Similarities
Differences
172° 174° 176° 178°
42° 40° 38° 36° 34° 32° 30° 28° 26° 24° 22° 20°
microrads
−100 −75 −50 −25 0 25 50 75 100
meters
−7200 −6000 −4800 −3600 −2400 −1200

First instantaneous ocean surface vector gradient:

Performance and Residual Errors

	σ_r	$\sigma_r/\sqrt{(N_a-1)}$	$\bar{\varepsilon}_r$
SIRAL 'A'			
1595	20.4	0.6	3.4
1599_a	23.4	0.7	4.2
1599_b	20.0	0.8	-3.7
1600	22.6	1.2	-18.1
1601	20.5	0.6	3.1
1607	22.1	0.9	8.6
1610	21.6	0.8	-8.8
SIRAL 'B'			
1192_a	24.5	0.8	16.0
1192_b	25.6	1.3	
2100	19.1	0.7	
2103	25.8	1.0	
2119	22.8	0.9	
2120	25.0	1.0	

Julian hour

Summary

- We have successfully calibrated the interferometer – the residual errors contributing a negligible 0.14 mm height error.
- We find that the accuracy of the across-track slope estimate of the marine geoid to be 26 microradians at 10km, far exceeding the specification of 200 microradians. As we are only *picking* the phase value at the retracking point, we believe that further work at fitting the full echo could lead to an improvement in accuracy – 10 microradians being a reasonable estimate.
- Finally, CryoSat-2 was not designed for the purposes of estimating across-track ocean slope – however we believe our work has demonstrated the potential capability of a normal-incidence interferometric configuration which has not been previously recognised. Our results demonstrate that it is reasonable to suppose that such configurations may achieve the 2 microradian requirement for measuring ocean mesoscale features.