Alaska SAR Facility
Geophysical Institute
University of Alaska Fairbanks

SAR IMAGE QUALITY

Presented by

Jeff Lipscomb (7767)

April 10, 2002

Outline

- Calibration

- What do we mean by "image quality?"

- Why do we care?

- How do we measure it?
  - Tools
  - Results

- Discussion

SAR image quality

BOTTOM LINE – The four elements of Image Quality and how they are used

CALIBRATION

- Use a common scale as an example: adjust to known "calibration" weights
- For SAR data, **Radiometric Calibration** adjusts antenna pattern to known backscatter
- **Noise Floor** Analysis
- **Image Quality** is an analysis, with no adjustments to anything inherent in the process
  - Impulse Response Functions
  - Geolocation

SAR image quality

WHAT IS IMAGE QUALITY?

SAR image quality

- Point target analysis
- Analysis of measured results for known point targets against a specification.
  - Resolution
  - Peak to Side Lobe Ratio (PSLR)
  - Integrated Side Lobe Ratio (ISLR)
  - Geolocation Accuracy

UNIVERSITY OF ALASKA
FAIRBANKS

ASF

POINT TARGET DJR-4

SAR image quality

RESOLUTION

SAR image quality

- Resolution – In Azimuth & Range – is the distance between two objects on the ground at which the images of the objects appear distinct and separate.

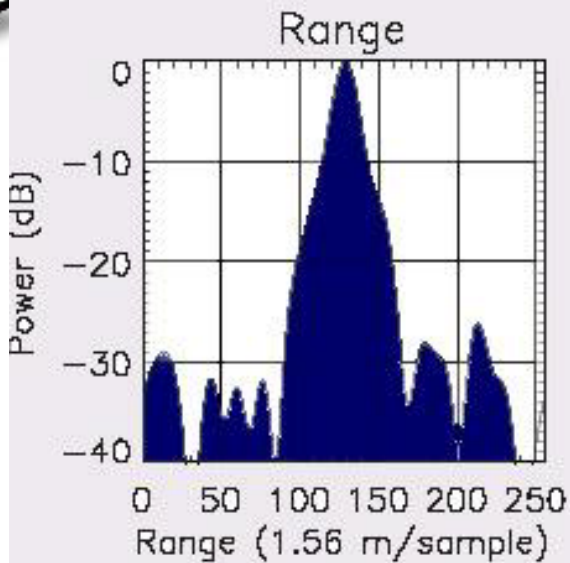- Resolution is measured 3dB down from the top of the main lobe of the impulse response

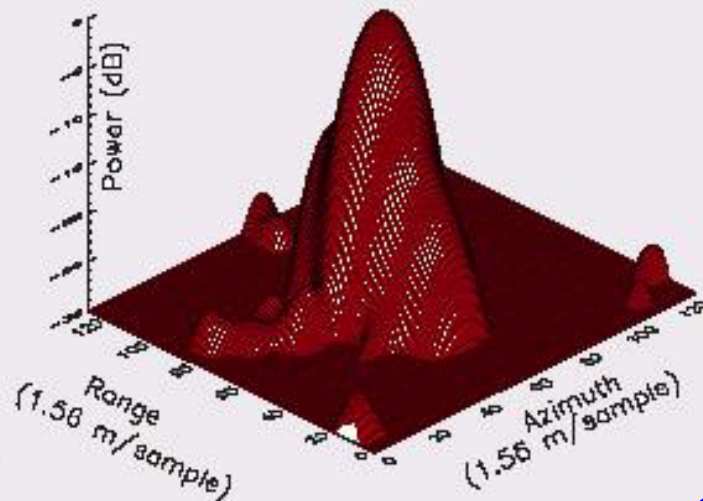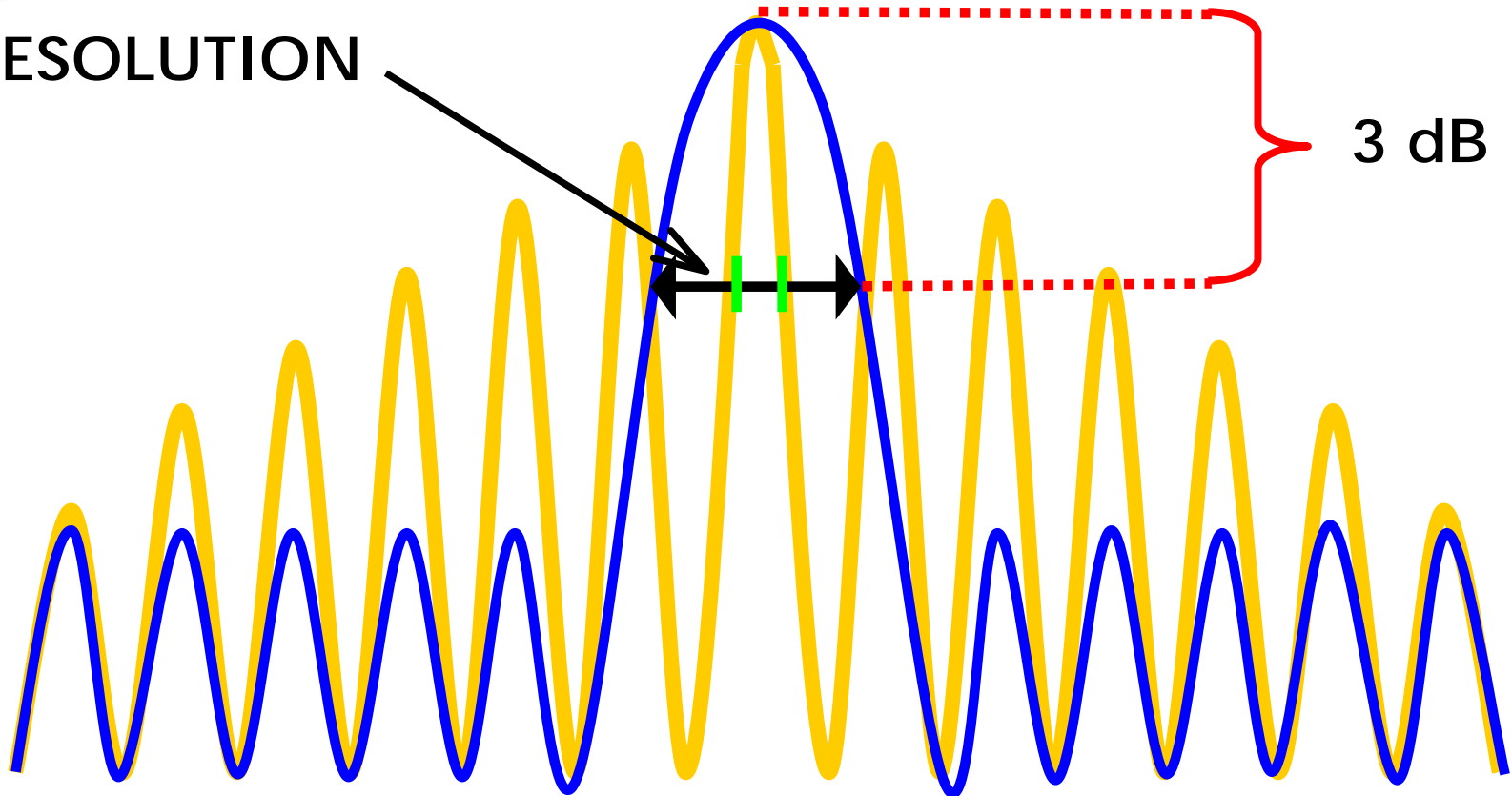# KAISER WEIGHTED IMPULSE RESPONSE
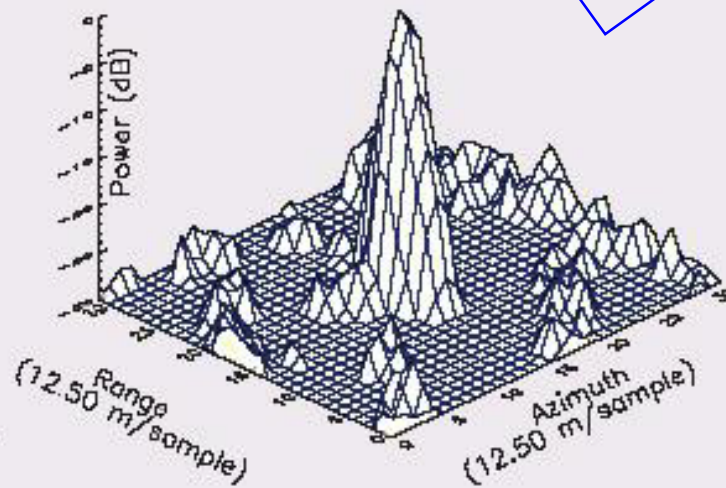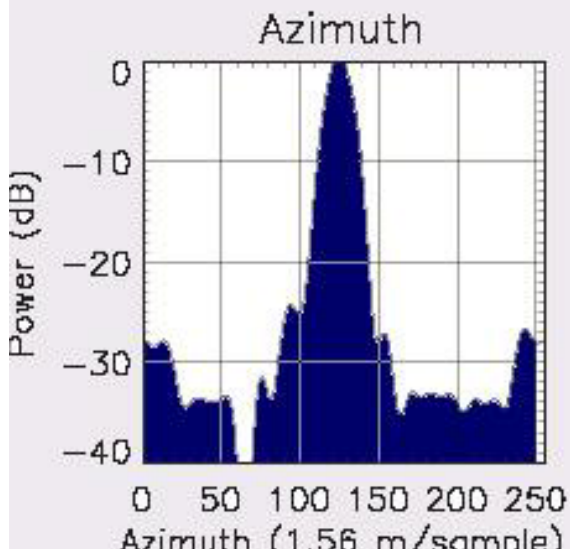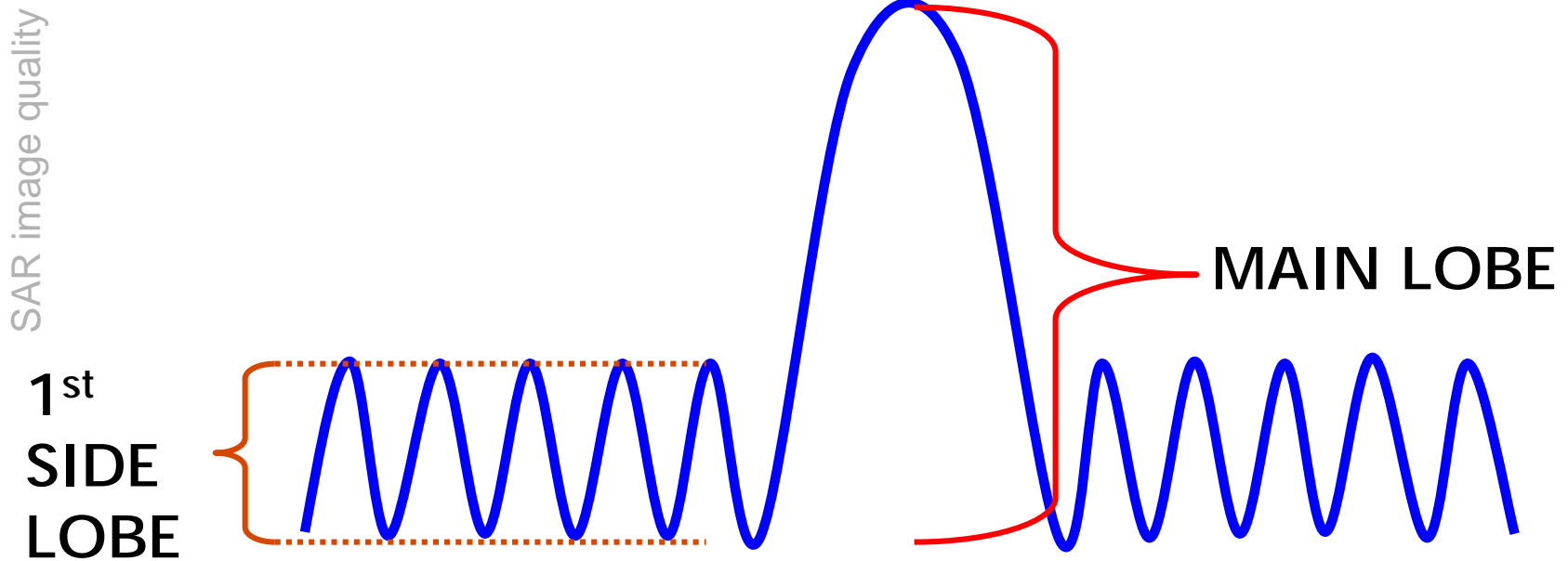
SAR image quality

PVS OUTPUT

Side Lobes & Weighting

PSLR

- Peak to Side Lobe Ratio – Ratio between the returned signal of the main lobe and that of the first side lobe of the point target.

SAR image quality

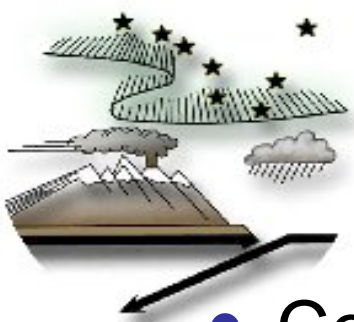**MAIN LOBE**

1st SIDE LOBE

ISLR

- Integrated Side Lobe Ratio – Ratio between the returned energy of the main lobe and that integrated over several (usually 10-20) lobes on both sides of the main one

SAR image quality

INTEGRAL OF MULTIPLE SIDE LOBES

MAIN LOBE
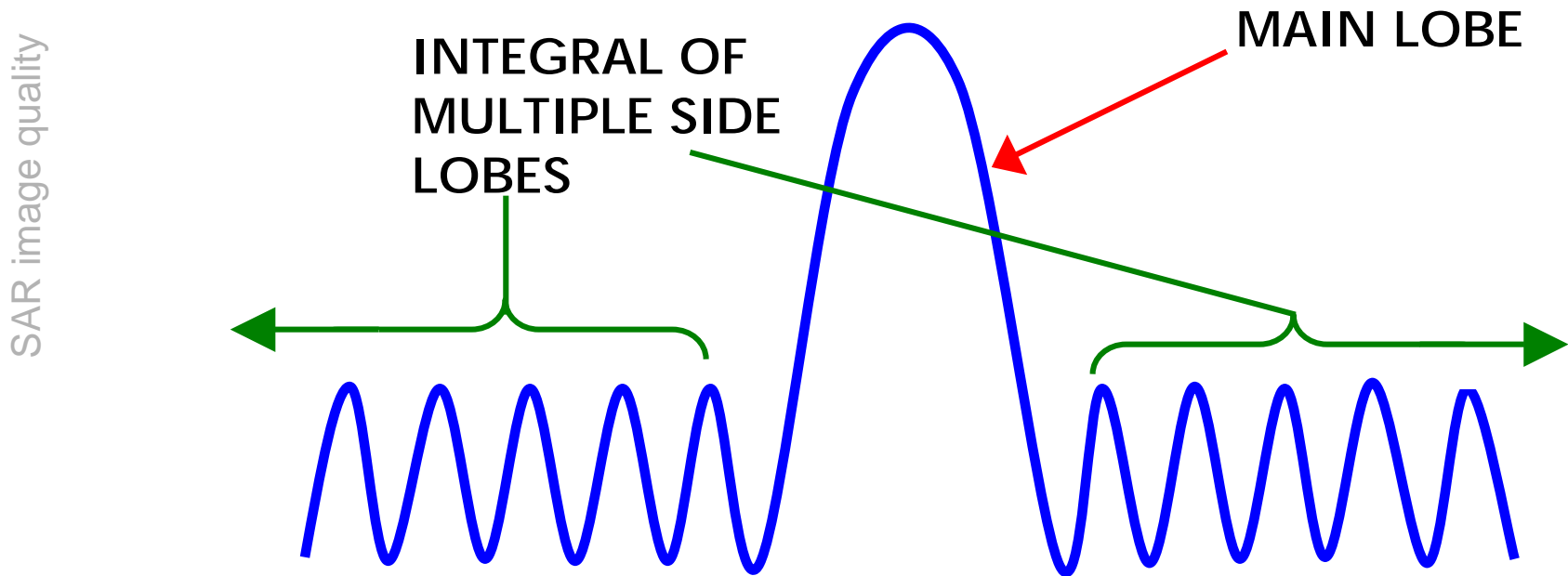
GEOLOCATION

- Corner reflector locations are ground truthed using differential GPS measurements.

- The Delta Junction image is processed to zero elevation. Elevations for each corner reflector are then calculated during geolocation measurement.

- Geolocation accuracy is determined by comparing the measured locations of the target returns in the SAR image and the known locations of corner reflectors deployed in Delta Junction.
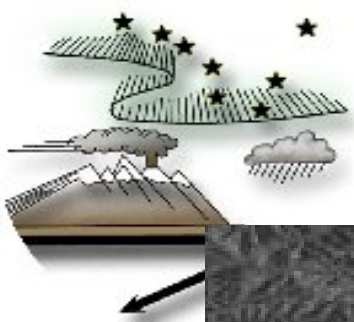
SAR image quality
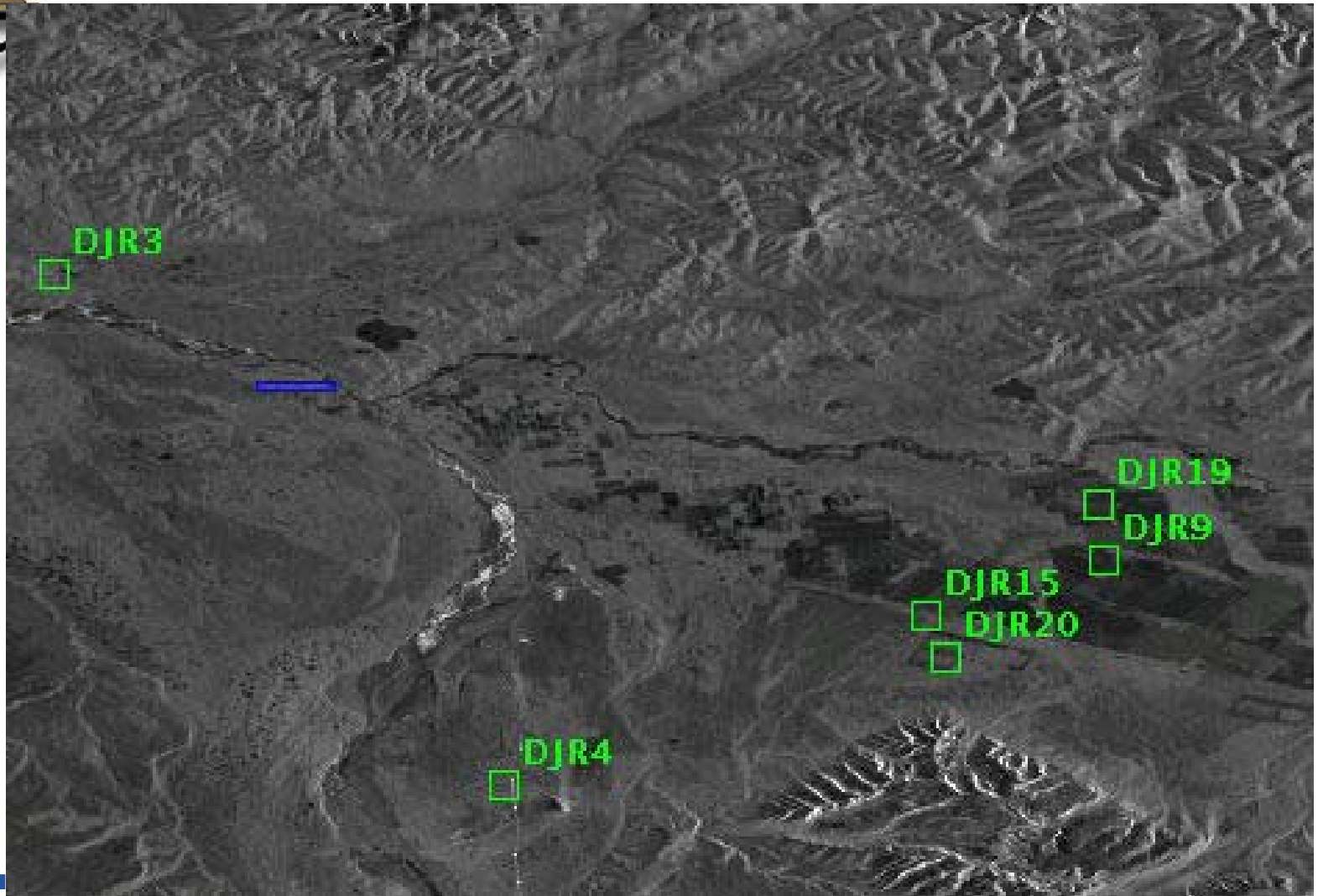
GEOLOCATION ERROR

SAR image quality

- Absolute geolocation error is the number of meters that the image differs from the ground truth locations in the range and azimuth directions.

- Relative geolocation error is the standard deviation of the absolute errors about the mean.

PVS – Target Selector

SAR image quality

SO WHAT?

SAR image quality

- That's all very interesting, but how does it translate into something useful for our customers?

IMAGE QUALITY = MISSION ACCOMPLISHMENT
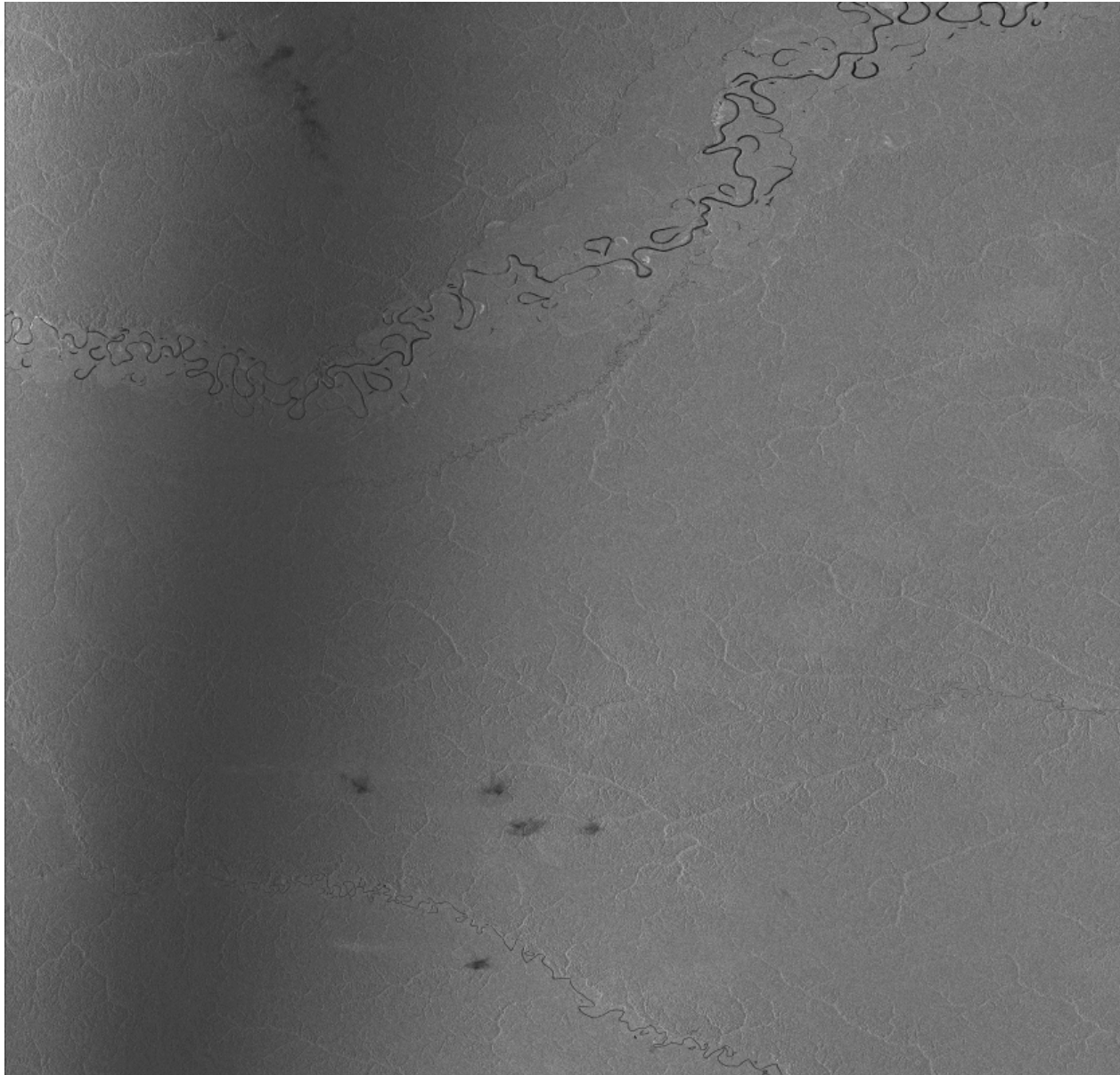
SAR image quality

- Pretty is as pretty can be measured!

- Indicators
  - Processor working correctly
  - Space agency parameters are valid
  - Calibration tools functioning properly

- Results of Image Quality analysis used by
  - Developers
  - Quality Assurance
  - Customers

Clutterlock Issue

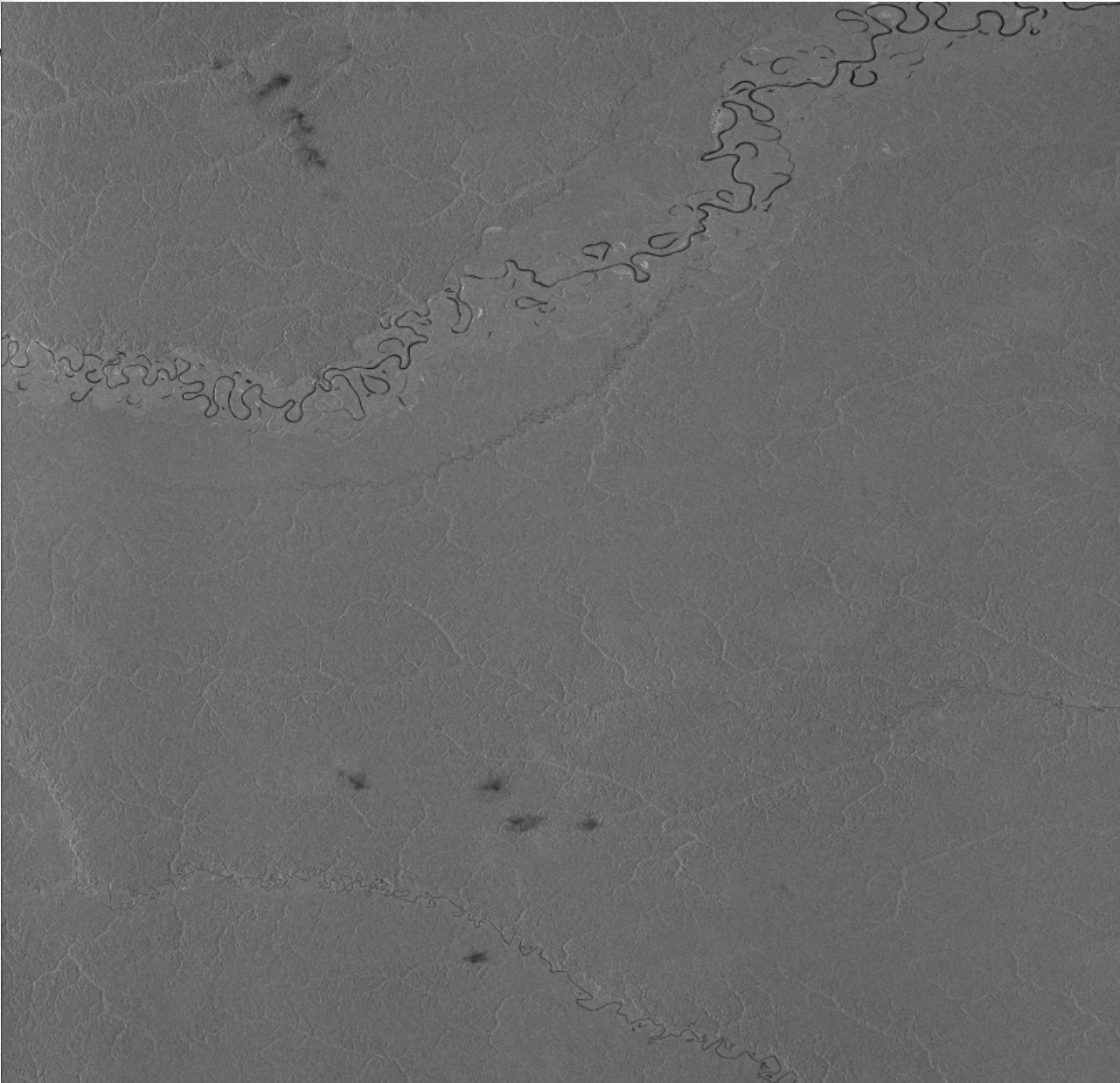SAR image quality

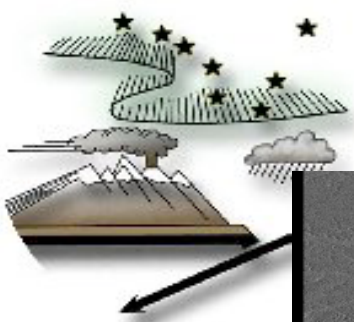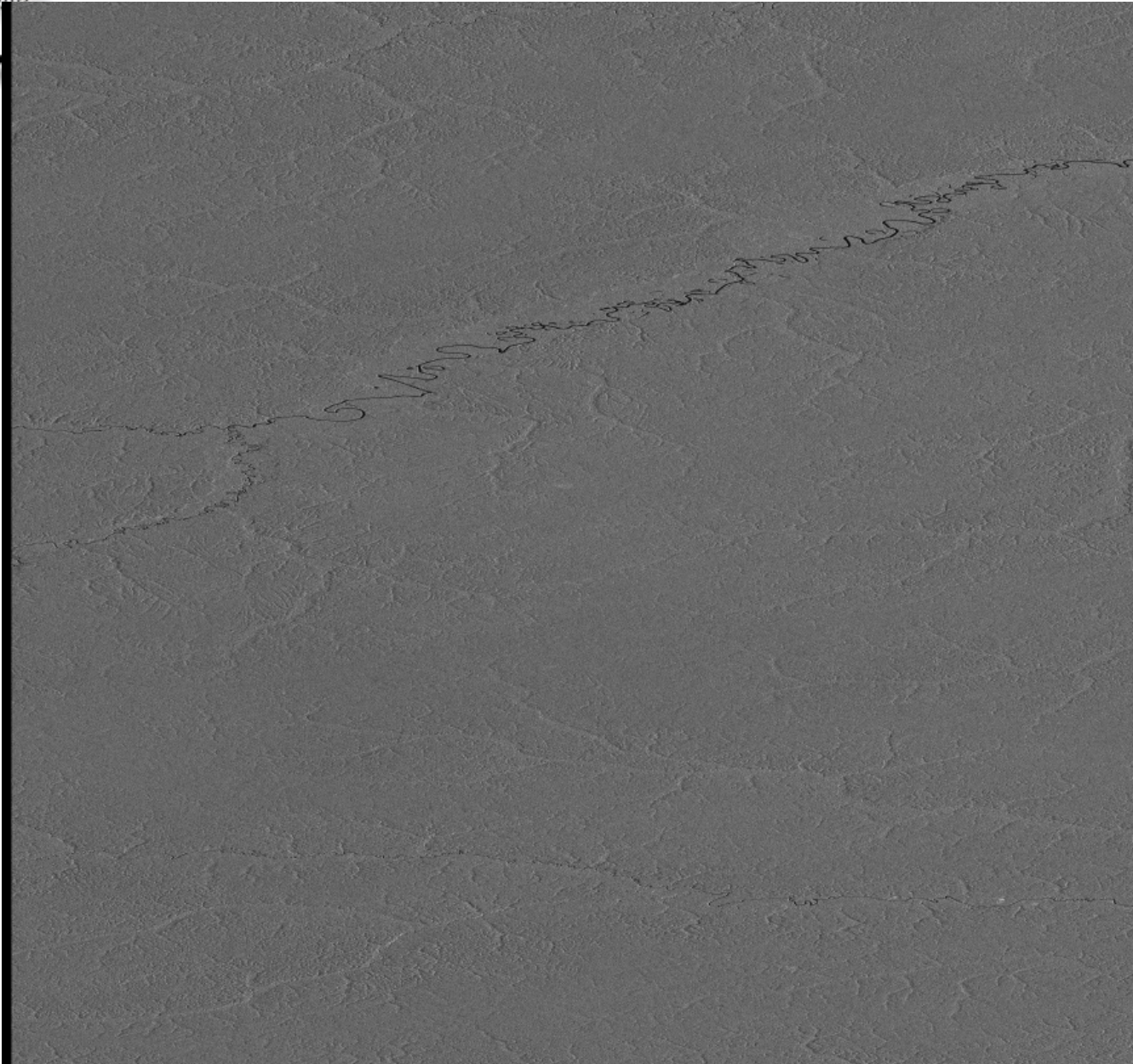SAR image quality
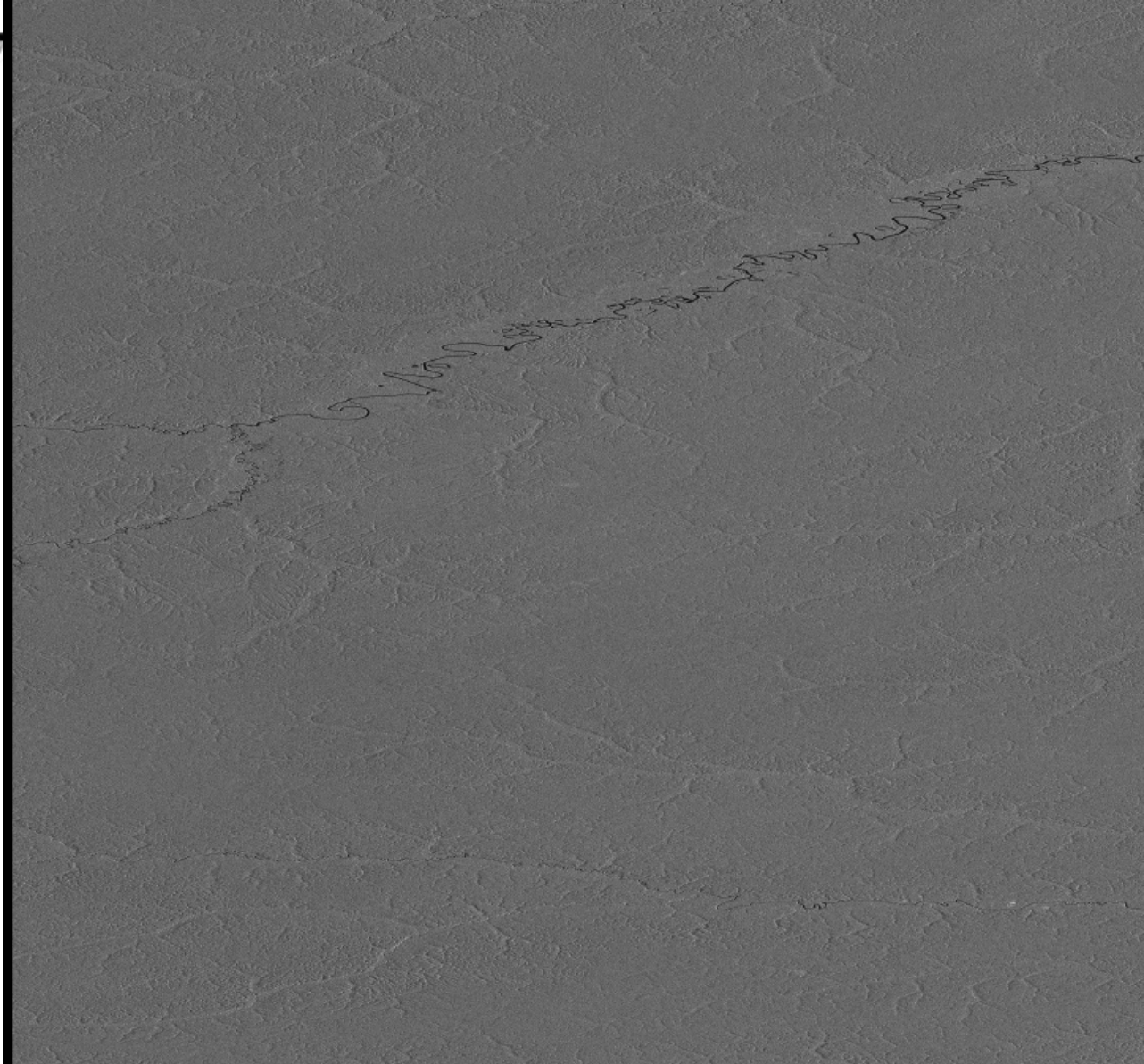
PBW – 900Hz

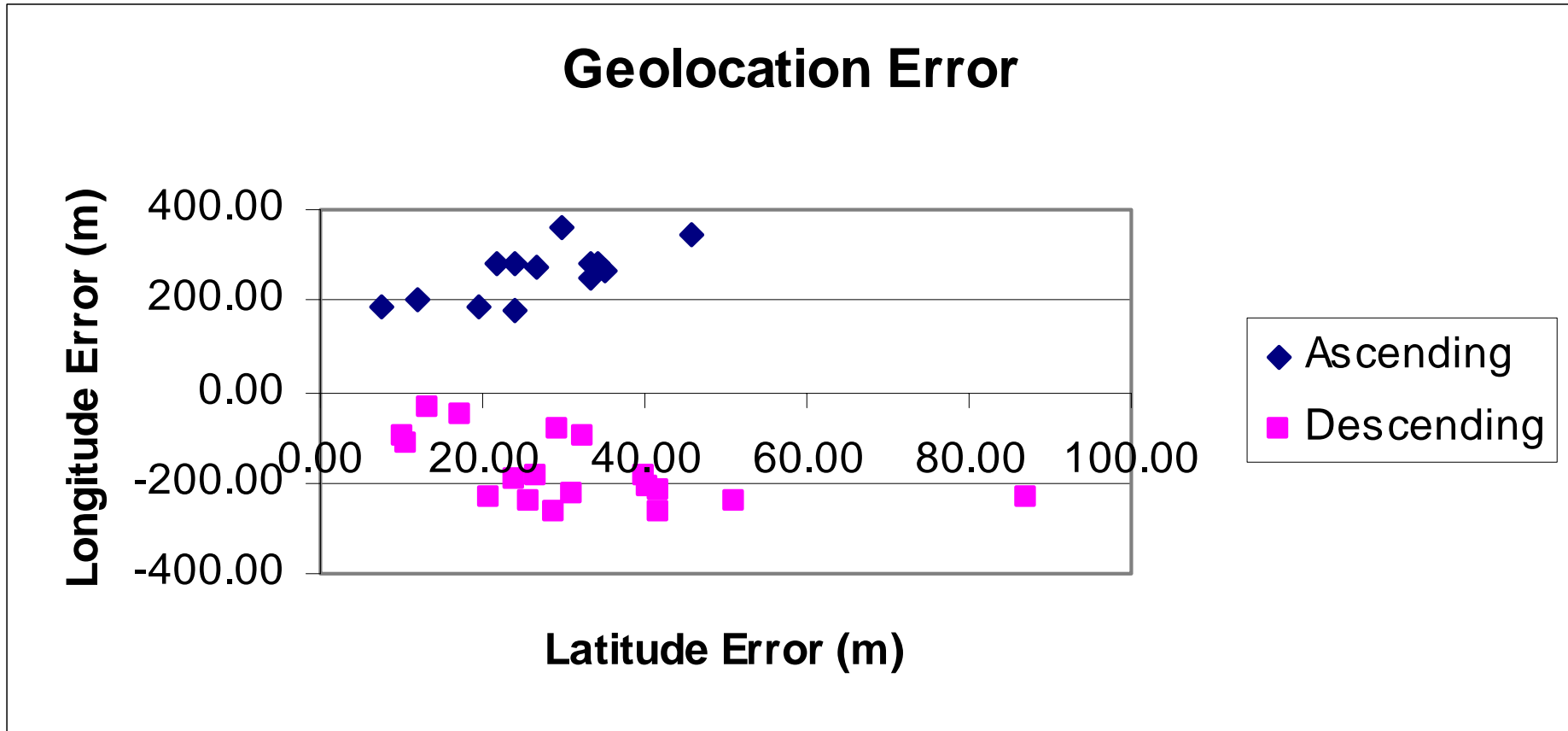SAR image quality

PBW – 1250Hz

SAR image quality

Echo Time Delay

WHERE'S THE MAGIC?

- ## In the TOOLS!!!
  - Product Verification System (PVS – JPL)
  - Point Target Information tool (PTINFO - Vexcel)
  - SAR Processing Calibration Kit & EvaluationTool (SPROCKET - ASF)
  - EXCEL – Bill Gates

- ## …And in what we do with the results
  - Meets Specification – report all is well
  - Issues – determine causality, responsible party implements fix
  - Alas! If a code fix, calibration or validation begins anew

SAR image quality

UNIVERSITY OF ALASKA
FAIRBANKS

CONCLUSION

SAR image quality

- REMEMBER: Resolution

                                            PSLR

                                            ISLR

                                            Geolocation

- This portion of "calibration" isn't really calibration
- The solutions to problems found are implemented elsewhere
- IMAGE QUALITY ANALYSIS allows us to identify problems before production, saving time and money

QUESTIONS?
COMMENTS?
OBSERVATIONS?