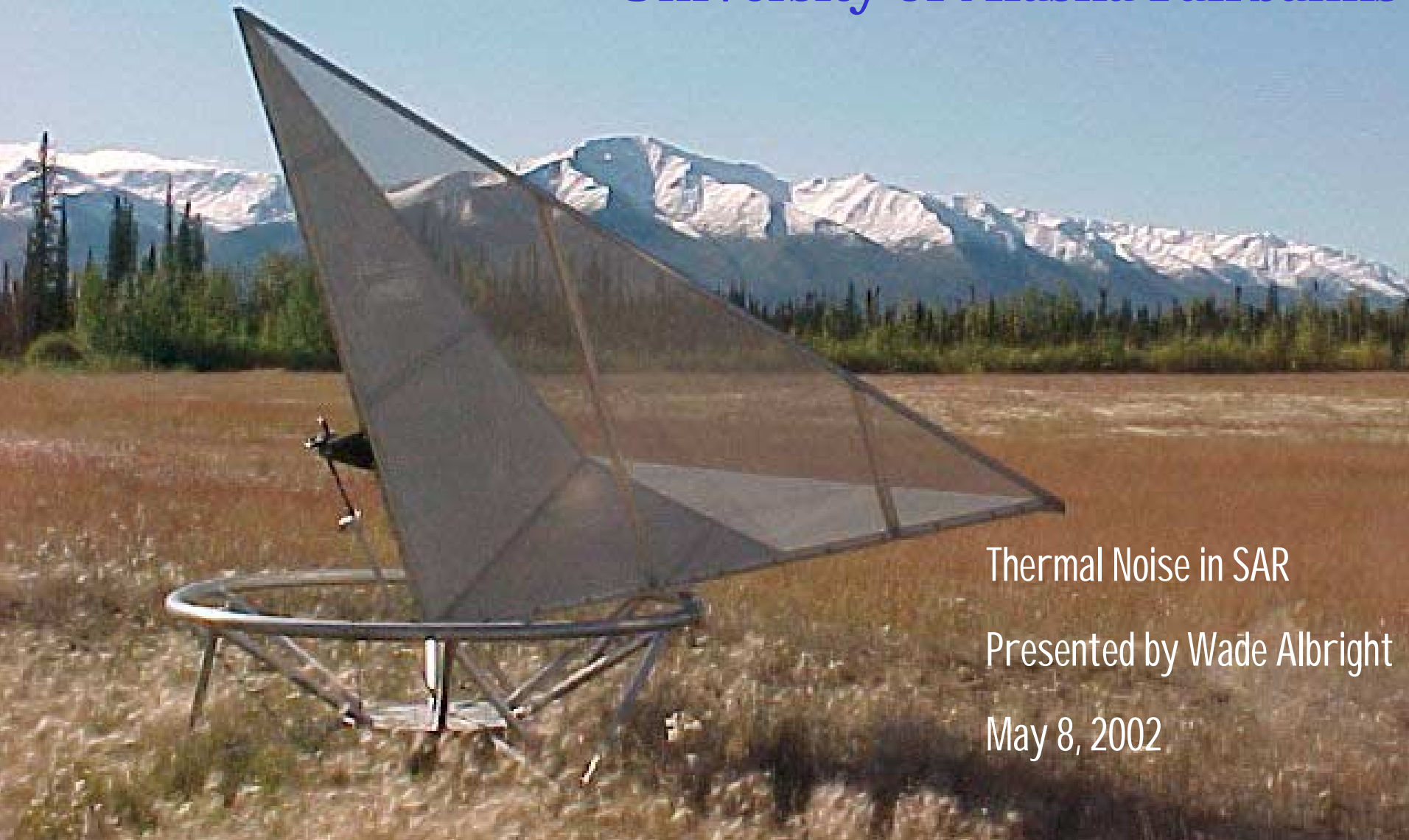


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Thermal Noise in SAR

Presented by Wade Albright

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Outline

- What is Thermal Noise
- Why Determine Noise levels
- Methods used
 - Empirical
 - Theoretical
- Comparison
- Conclusion

SAR Noise Floor

BLUF: Thermal Noise is Always Present, and Unless We account for it, the data is suspect



What is Thermal Noise?

- Caused by microscopic motions of electrons due to temperature
- Due mostly to internal circuitry of satellite
- Random
- Pervasive in all frequencies

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Why Determine Noise?

- Can be a significant portion of the data when imaging dark targets
- So that it may be subtracted from the image
- User is then sure effects in image are real

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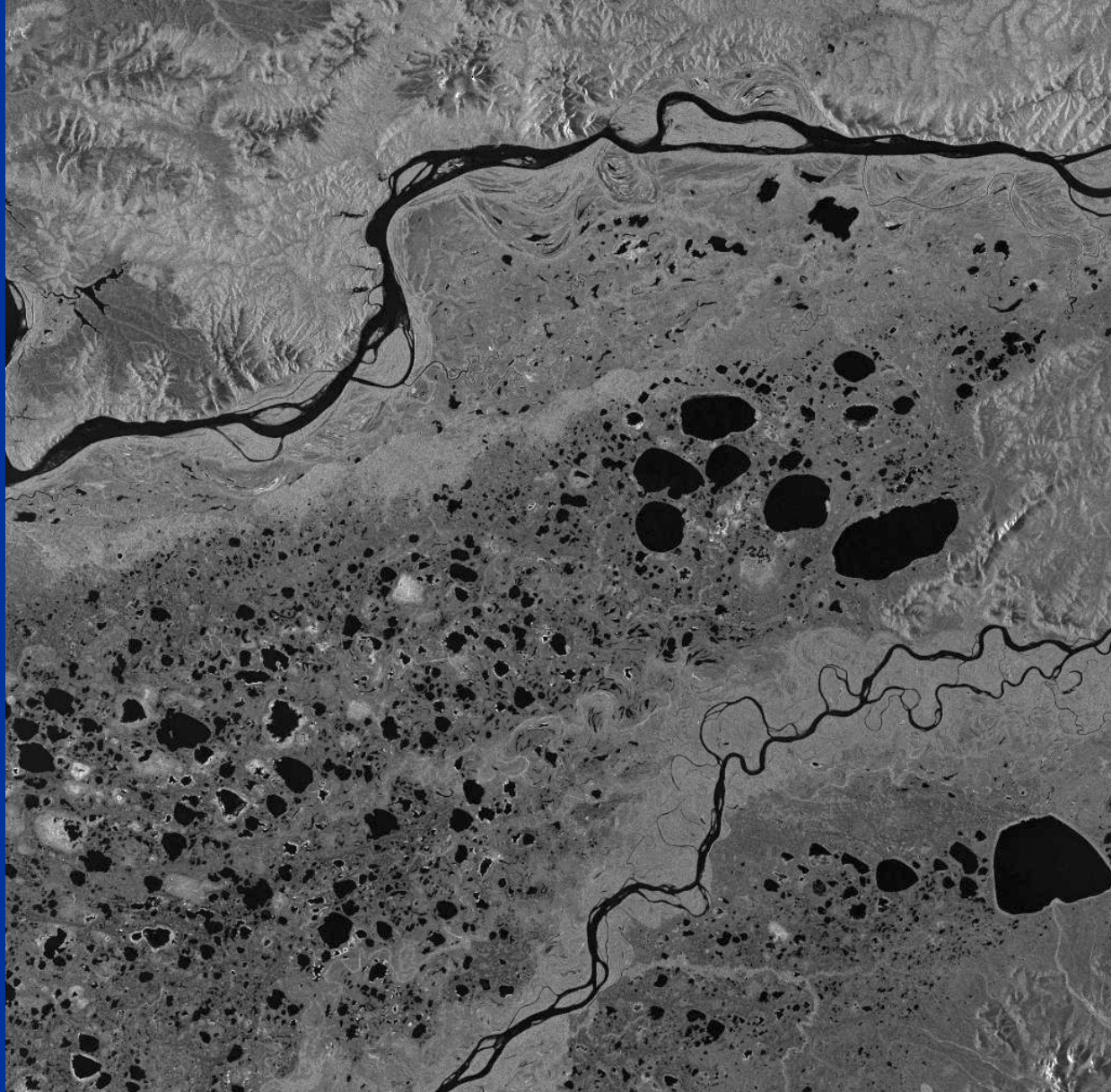


Empirical Noise Determination

- Image an area with very dark targets
 - Calm lakes
 - Rivers
 - Large areas of asphalt
- Assume no signal is returned from dark target
- Pros
 - Easy
 - Occurs after processing
 - Comparable results
- Cons
 - Few suitable target areas
 - Making assumptions
 - Unknown variables?

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Sample Targets



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Theoretical Noise Determination

- Metadata values are used to calculate the noise floor values
- Pros
 - Any image may be used
 - Comparable results
- Cons
 - Only one measurement made by responsible agency

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Theoretical Noise Determination

Based on this equation:

$$N_{\sigma} = n_r + 30 * \log(r_s / r) - 2 * G_r + 10 * \log(\sin(I))$$

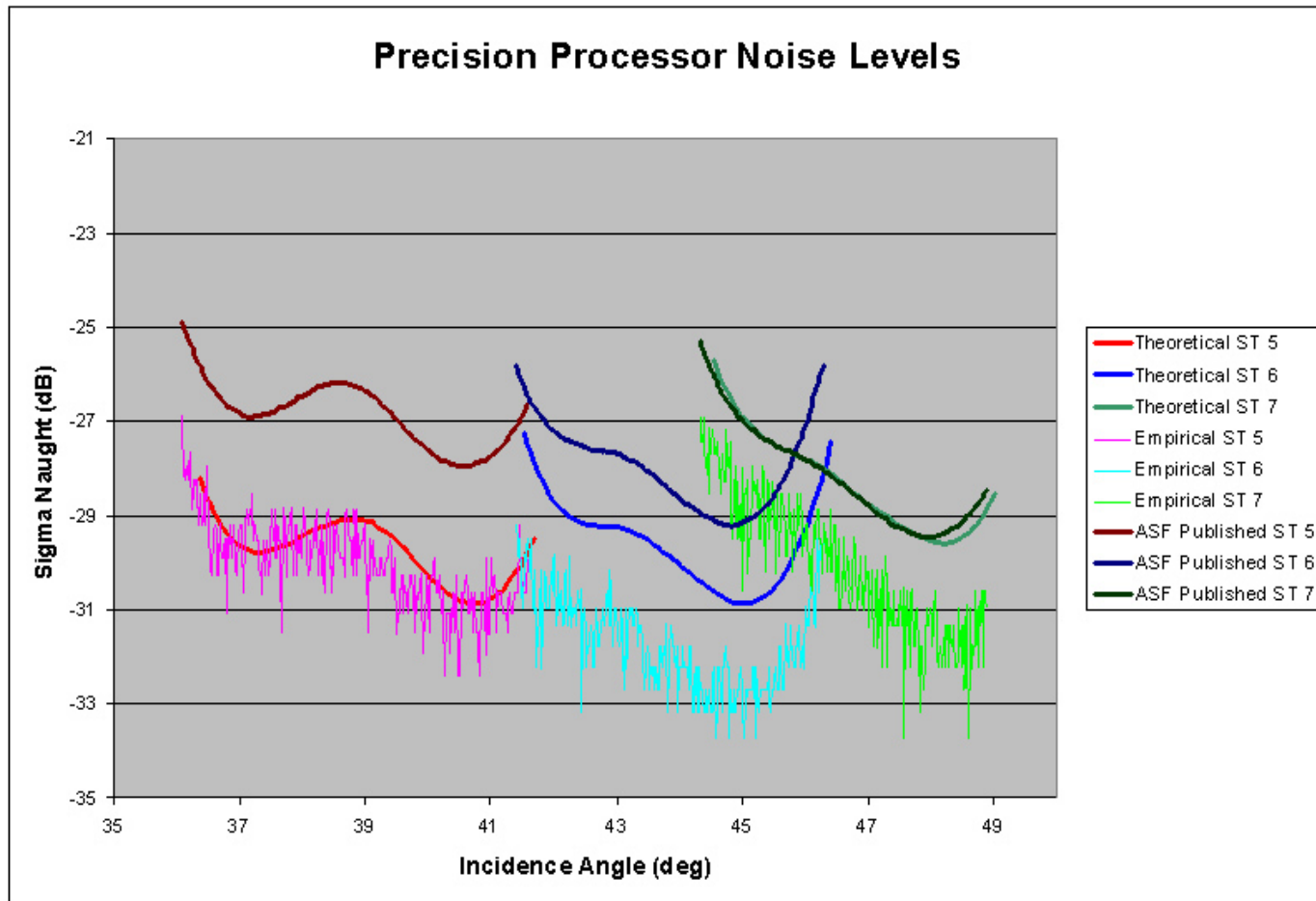
- Need

- Noise reference level
- Slant range
- Reference range
- Antenna pattern correction
- Incidence angle



Varying Noise Levels

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Conclusion

- Thermal noise in SAR imagery is caused by microscopic motion of electrons due to temperature.
- Only by accounting for thermal noise can the user be sure the effects seen in the imagery are real.

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Questions?

