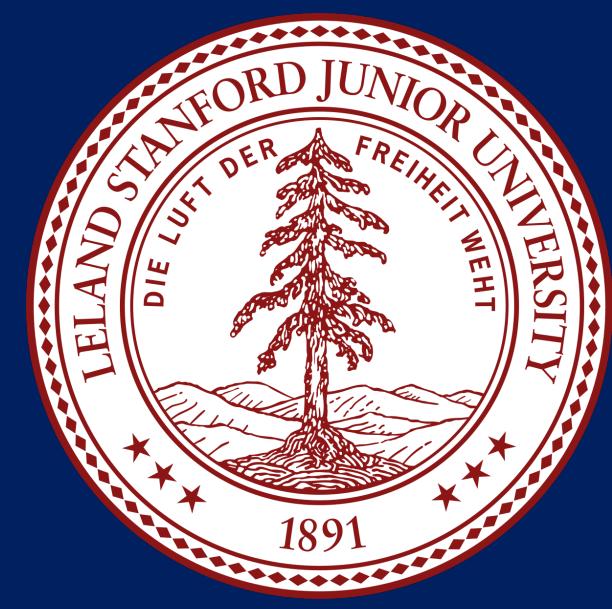


# Informing Bistatic Radar Experiments at Thwaites Glacier Using Bistatic Data from Greenland and West Antarctica



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## Objective

1. Determine one-way depth-averaged attenuation rates using a long-offset bistatic radar configuration and post-synchronizing processing chain
2. Improve mission planning and data collection methods for 2021 Thwaites Eastern Shear margin tomographic experiments based on results from 2019 surveys



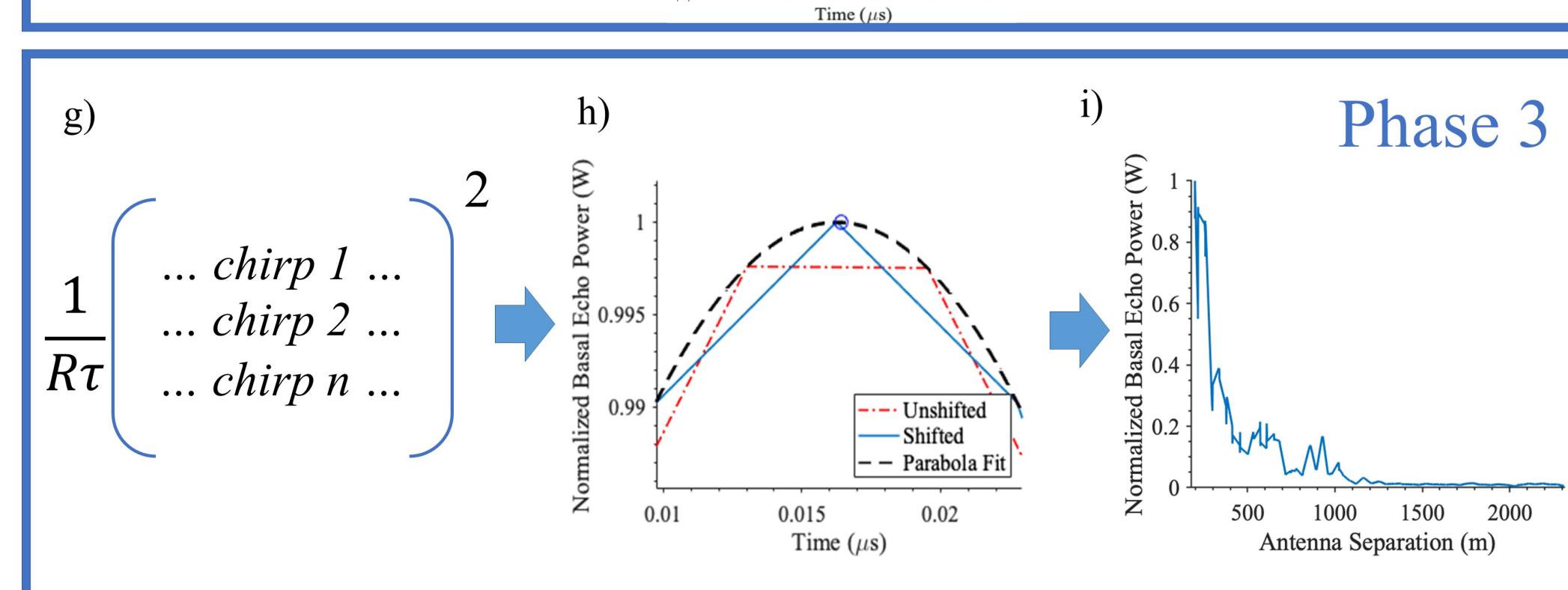
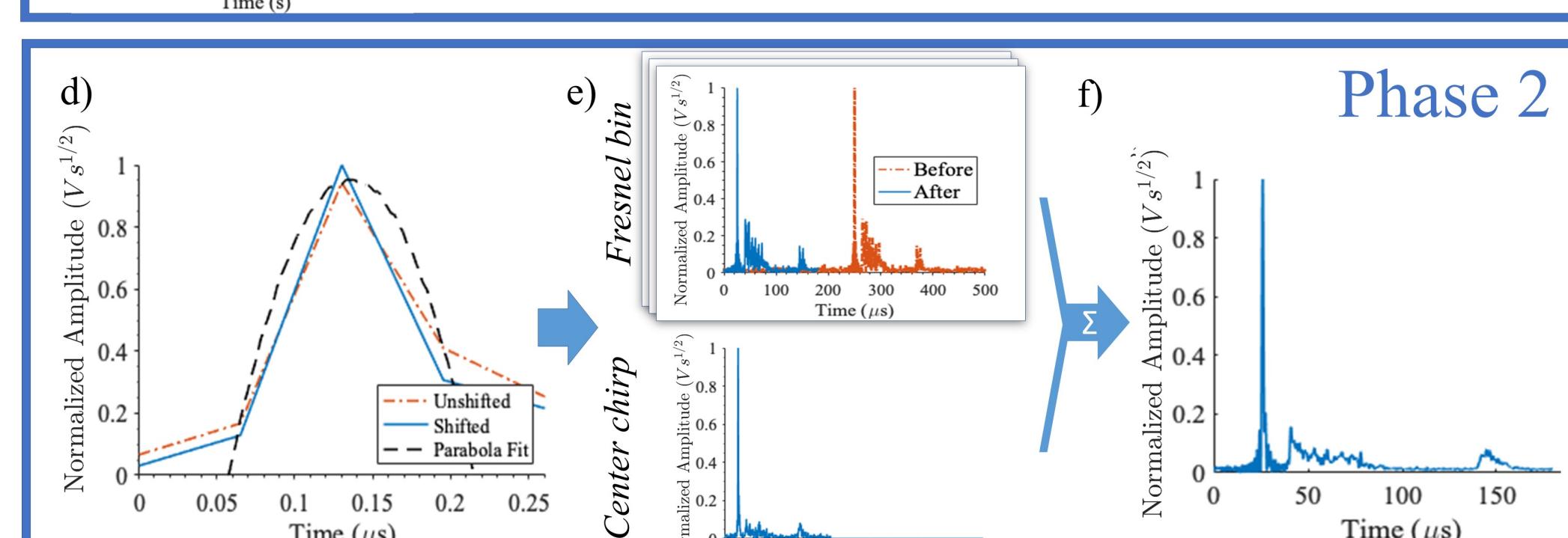
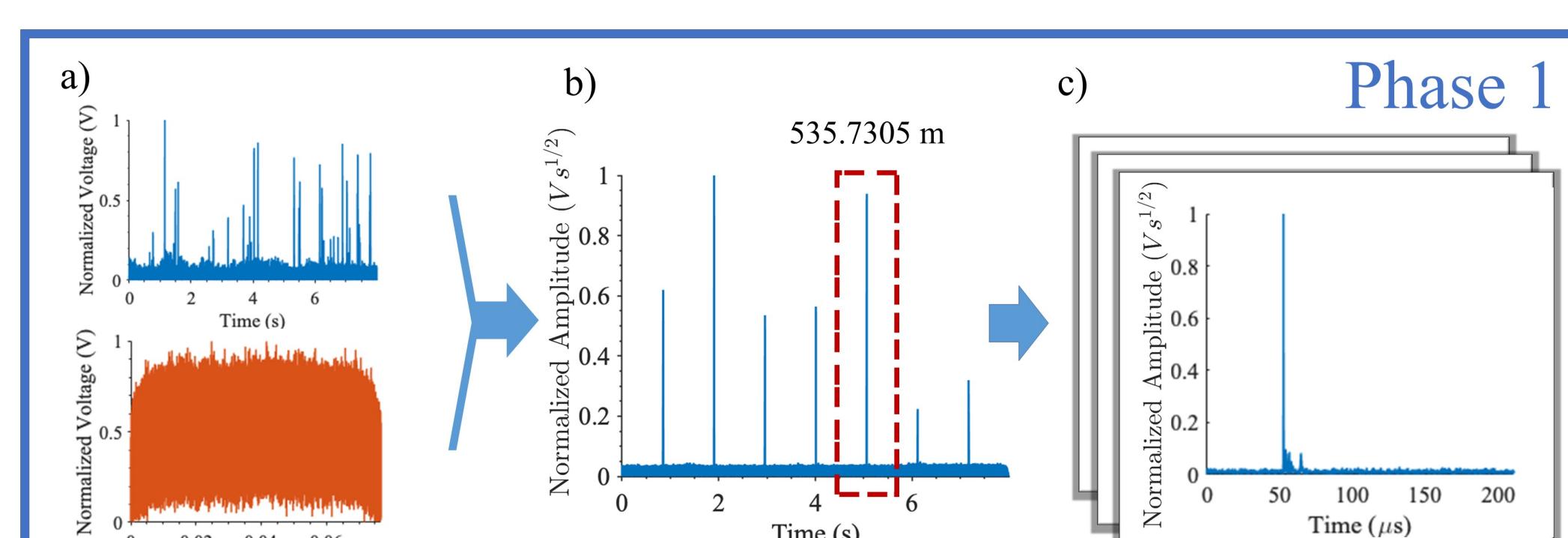
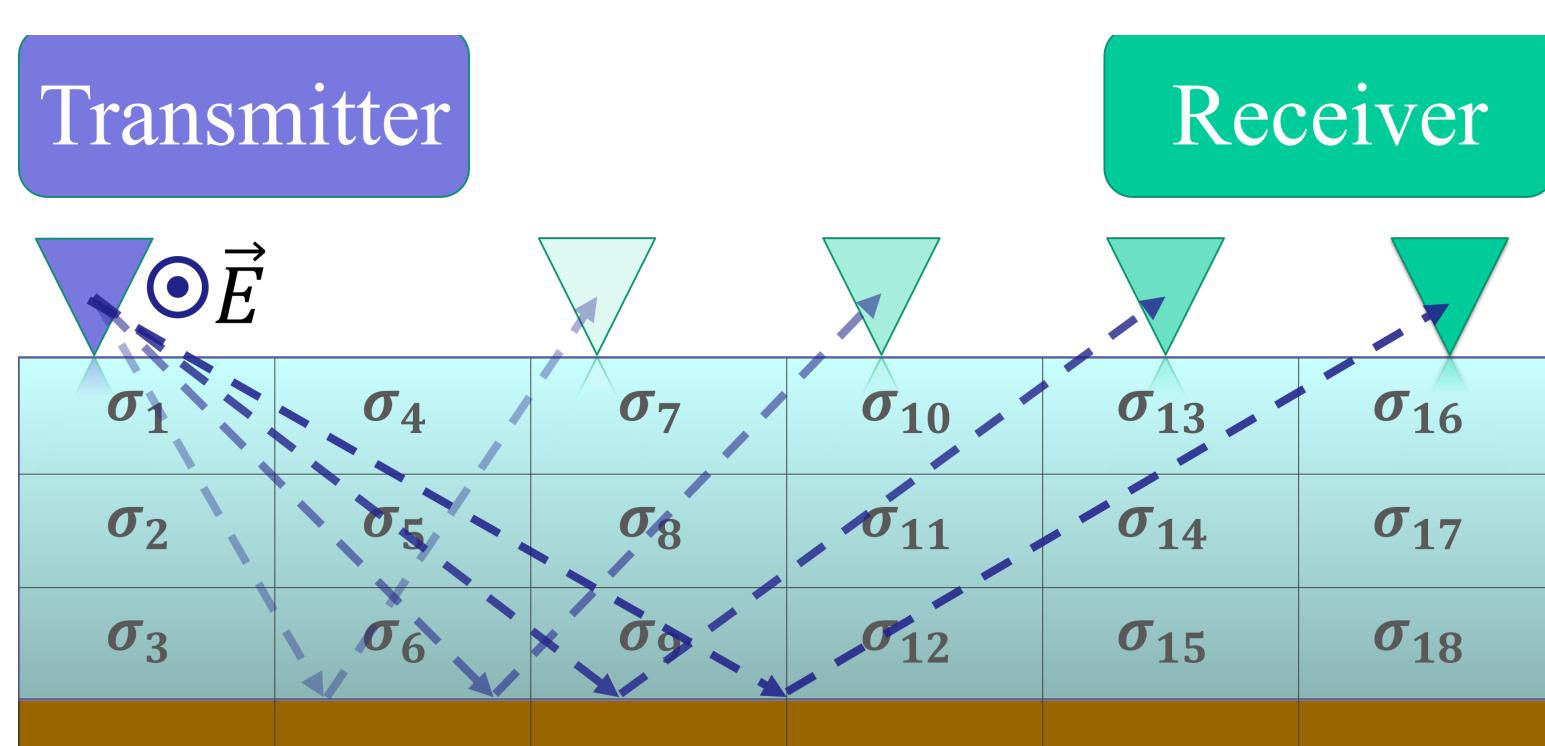
Store Glacier, Greenland 2018



Thwaites Glacier, Antarctica 2019

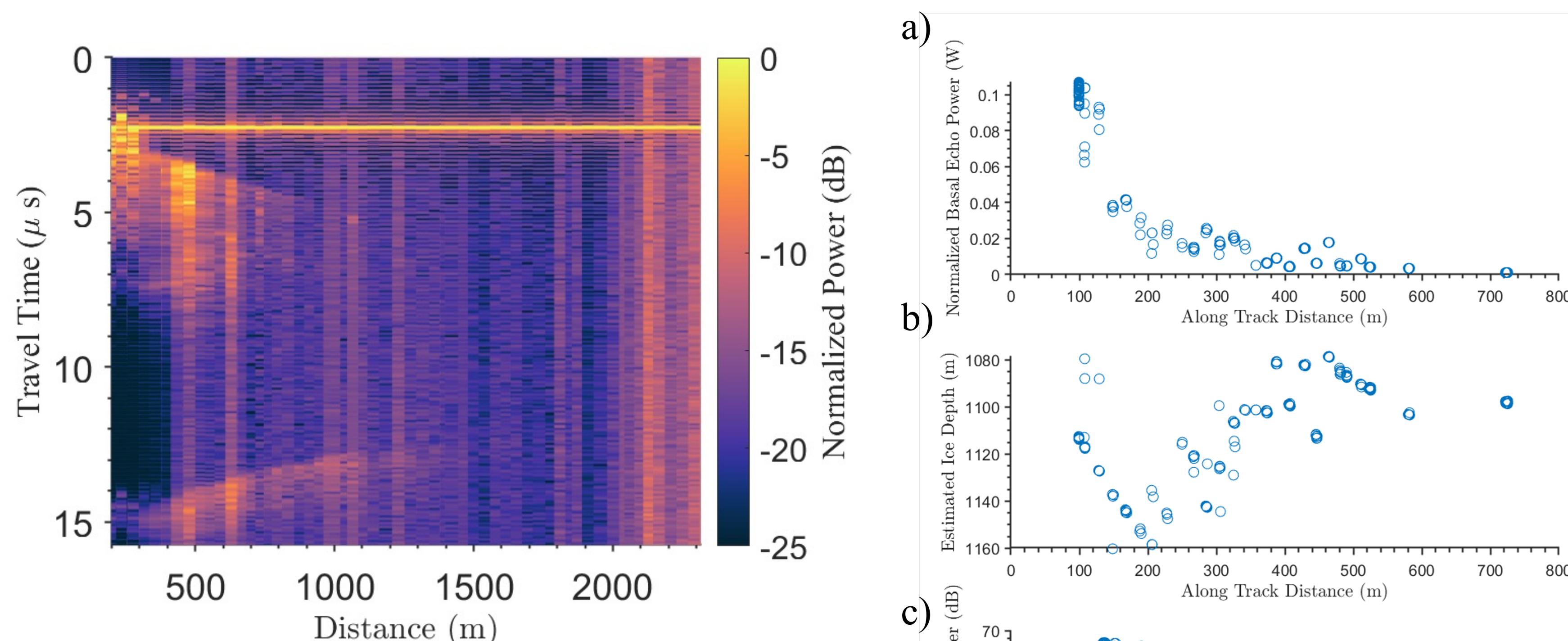
## Methods: Post-synchronized bistatic radar

1. Collect



2. Process

## Results: Detection of 1-Way Depth-Averaged Attenuation Rates at Store Glacier

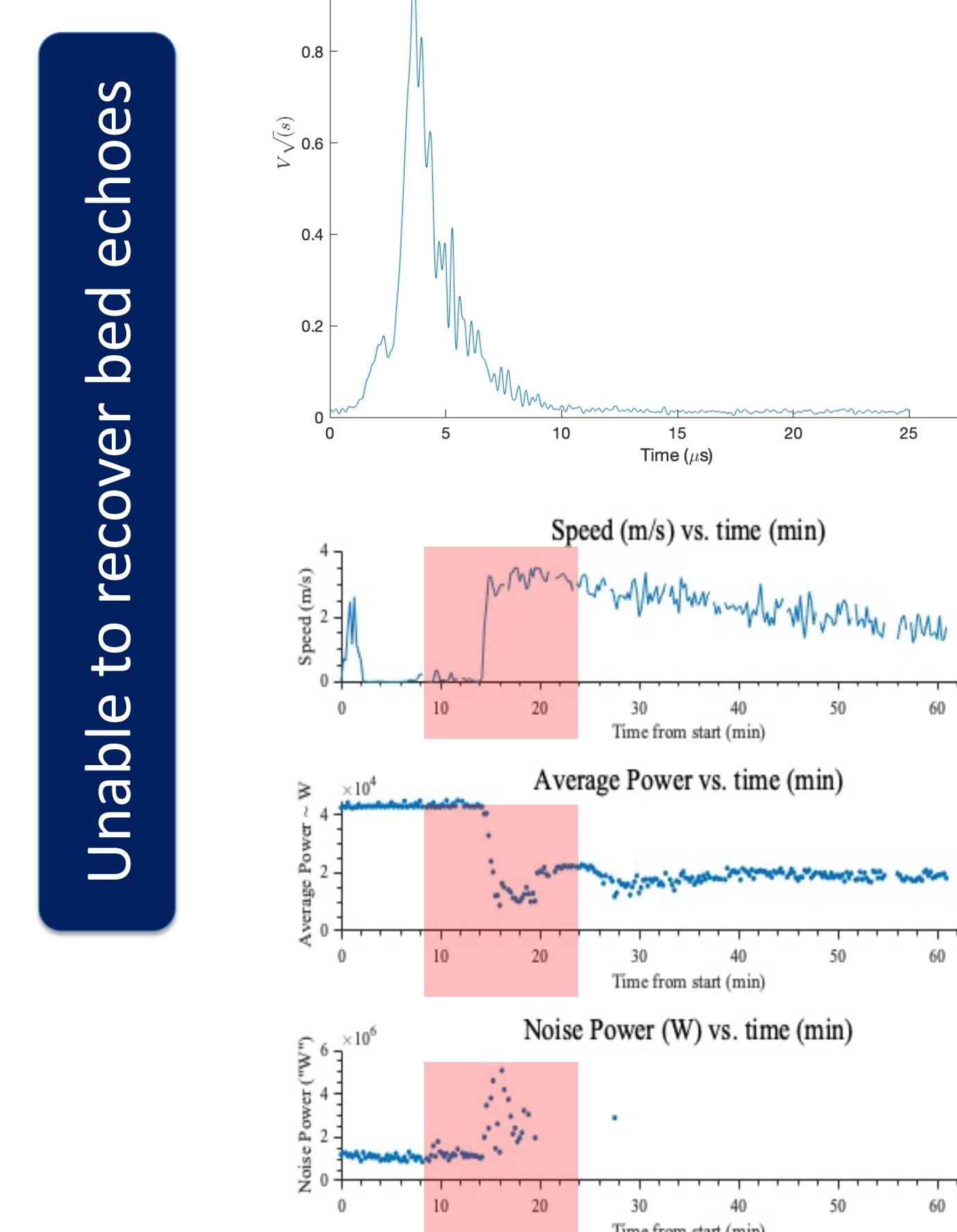


### Experimental Setup

Sampling Rate	15.36 MHz
Center Freq.	330 MHz
Max. Offset	2400 m
Start ice depth	1098 m
Max. Chirps	521

Attenuation Rate: -43.3 dB / km

## Results: Min. Attenuation Rates at Thwaites Glacier



Unable to recover bed echoes

### Experimental Setup

Sampling Rate	15.36 MHz
Center Freq.	320 MHz
Max. Offset	6000 m

### Estimated Min. Atten. Rates dB/km

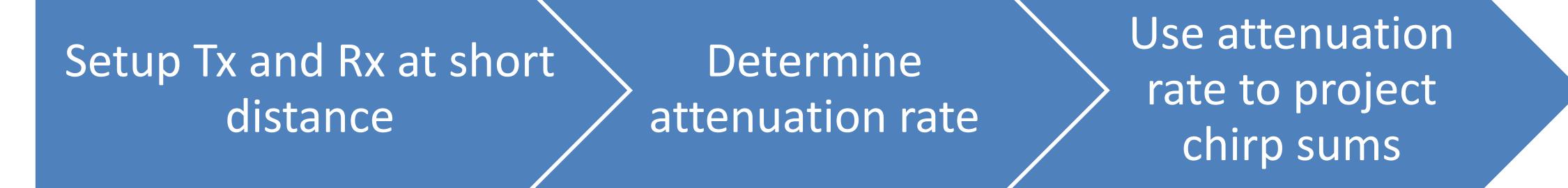
Bed Material	Min. Attenuation
Frozen Till	-20.66 dB / km
Wet Till	-27.05 dB / km
Seawater	-28.30 dB / km

### Takeaways:

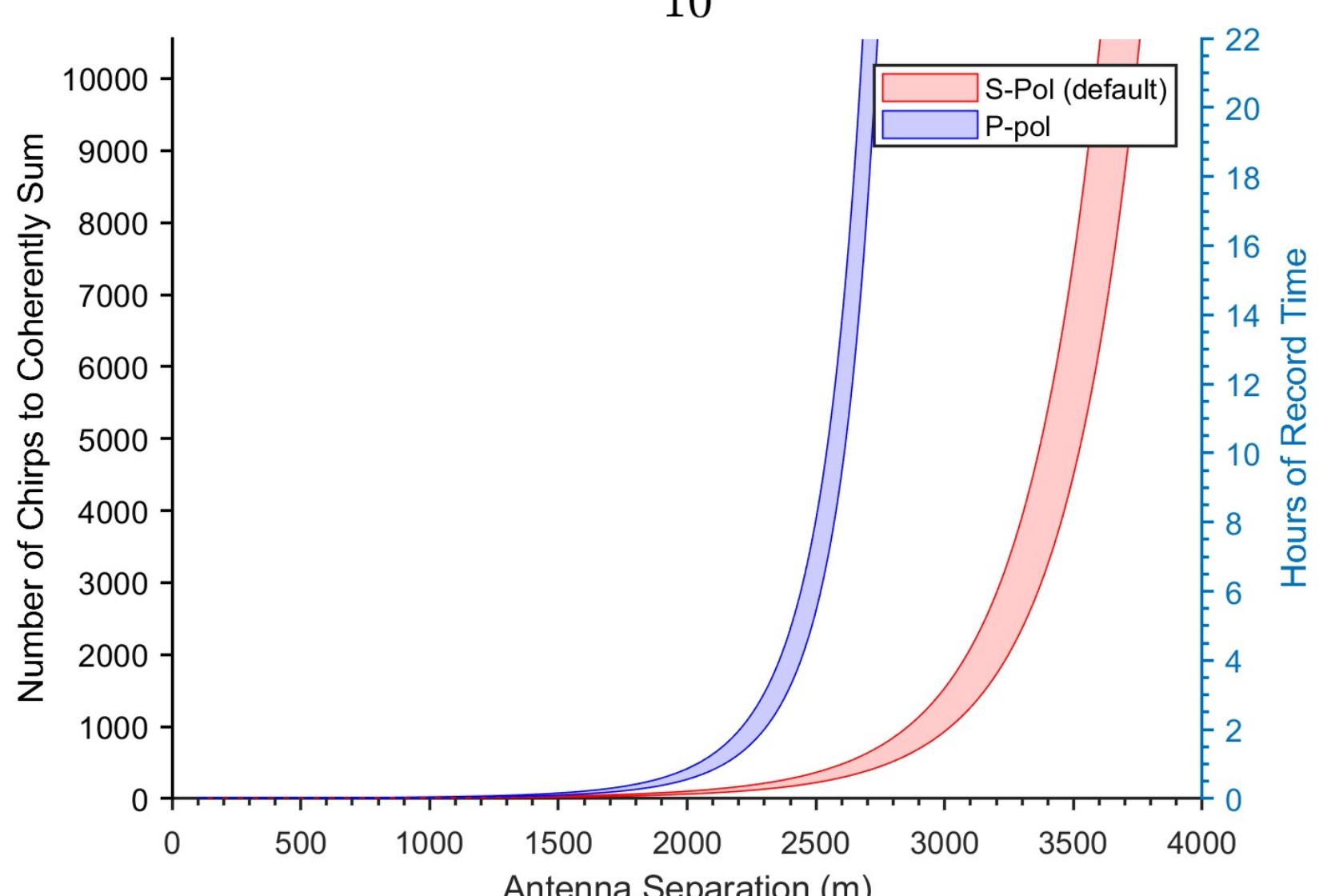
- [1]
- Use static configurations
  - Sum more chirps at longer offsets
    - Use larger bandwidth

## Future Work: Depth-Averaged to Depth-Dependent Attenuation Rates

### Proposed Field Protocol:



Estimated Chirp Sums at SNR of: 10



Method will be deployed at 2021 Thwaites experiments!

## Conclusion

1. Validated post-synchronized bistatic radar system to calculate depth averaged attenuation rates
2. Determined that static setups with higher chirp volume are best to get conclusive results at thicker ice sheets
3. Proposed method to collect depth-dependent attenuation rate data at future experiments



Check out the processing chain Github and hardware manual

[https://github.com/bienert/Bistatic\\_Radar](https://github.com/bienert/Bistatic_Radar)

## References

- [1] M. E. Peters, D. D. Blankenship, and D. L. Morse, "Analysis techniques for coherent airborne radar sounding: Application to West Antarctic ice streams," *Journal of Geophysical Research: Solid Earth*, vol. 110, no. B6, 2005.