

# Thwaites MELT Accumulation Radar

---

John Paden, Fernando Rodriguez, Carl Robinson, Alejandra Escalera, Richard Hale, Krishana Karidi,  
Cameron Lewis, Bradley Schroeder, Jiaxuan Shang, Hara Talasila, Tom Jordan, Keith Nichols

Center for Remote Sensing of Ice Sheets, University of Kansas, Lawrence, USA  
British Antarctic Survey, Cambridge, UK

July 12, 2019



# Accumulation Radar

- Accumulation rate is a key variable in interpreting surface elevation measurements and in determining the mass input
- 600-900 MHz frequency
  - Large bandwidth and smaller antenna size
  - Disadvantages due to:
    - increased ice attenuation
    - increased ice scattering leading to clutter and signal extinction
    - decreased conductive reflections

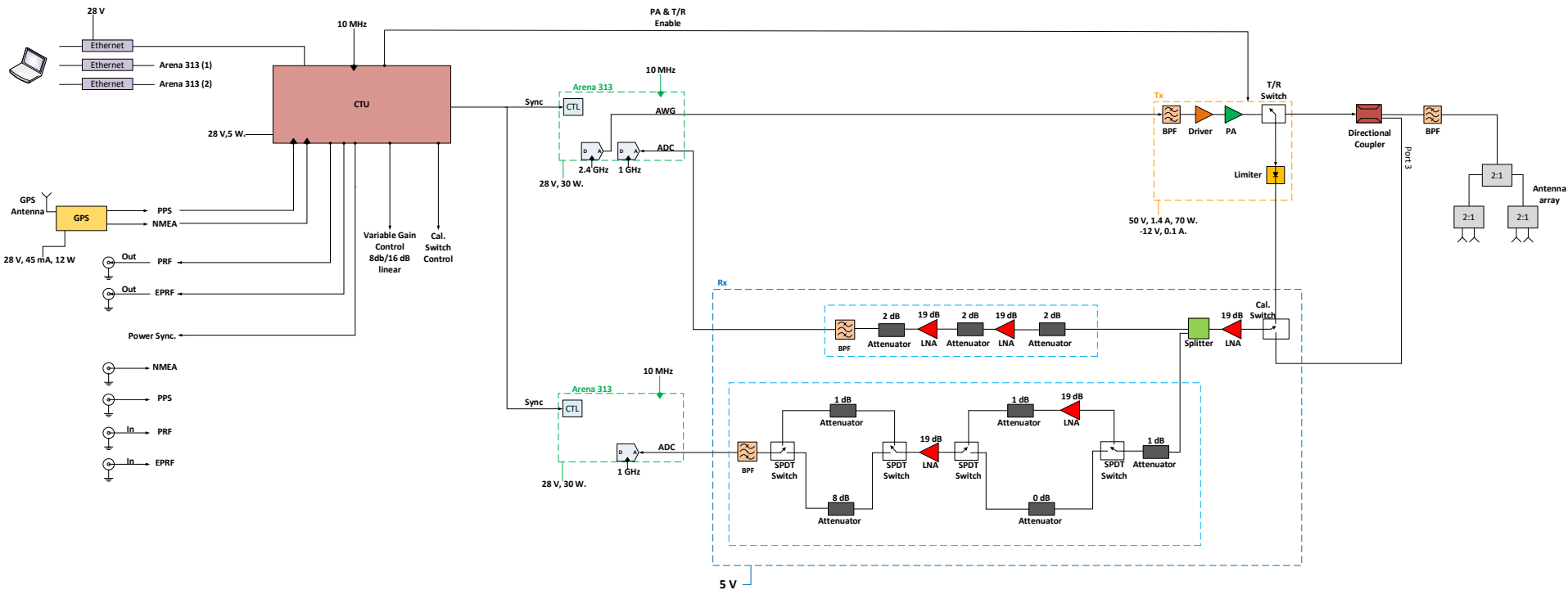


# Modifications

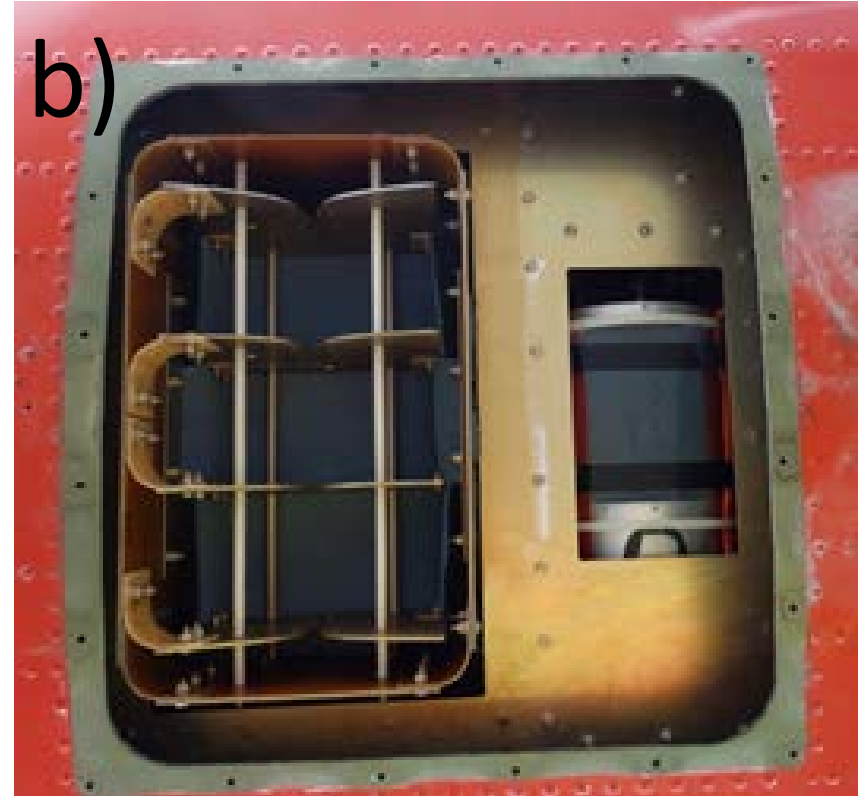
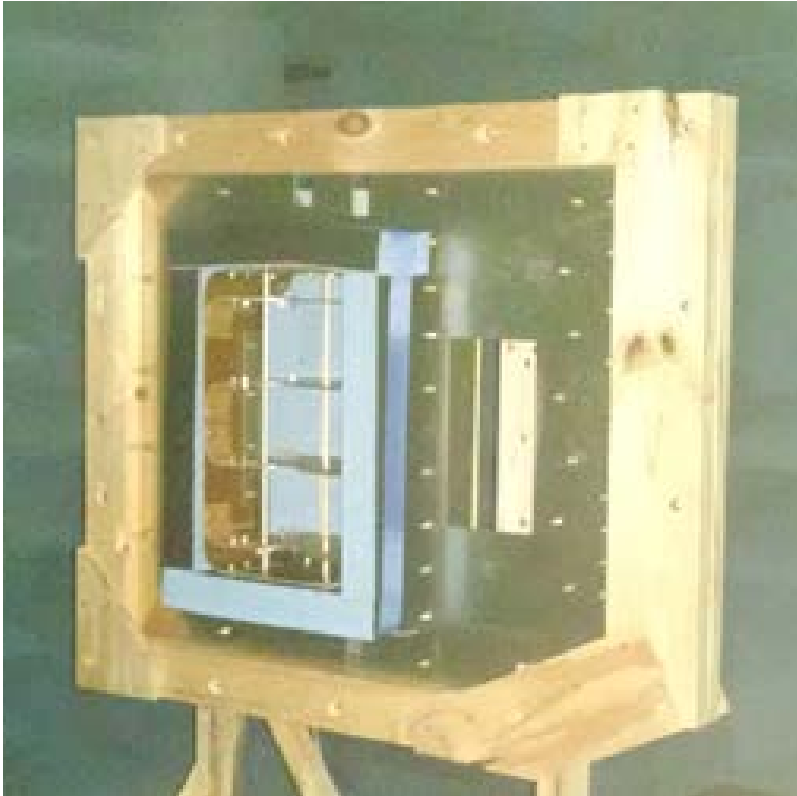
- Compact size, low power:
  - 30 lbs electronics, single 3U 19” rack box, 150 W
- Increased transmit power: 400 W peak
  - Sounded 1600 m ice ~consistently
- Low gain and high gain channel simultaneously captured so full dynamic range of ice surface and bottom can be captured each pulse
- Shielded housing for antenna
- Calibration loop for amplitude/phase monitoring with transmit path



# Block Diagram

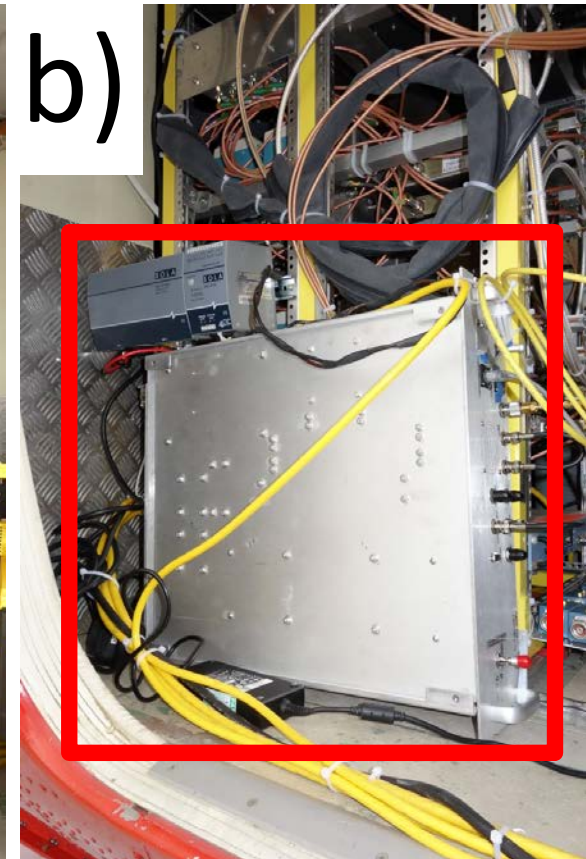
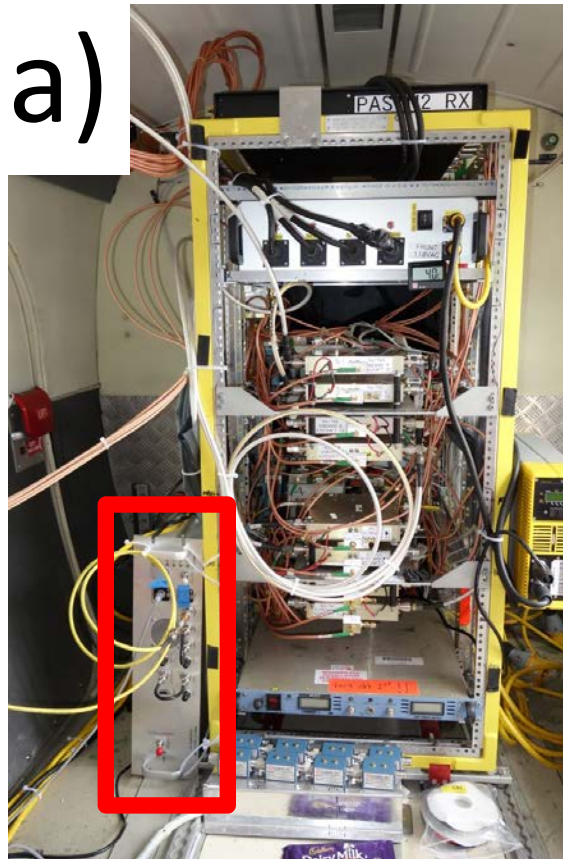


# a) Anechoic Chamber b) Installed on BAS TO



# Installed on BAS Twin Otter

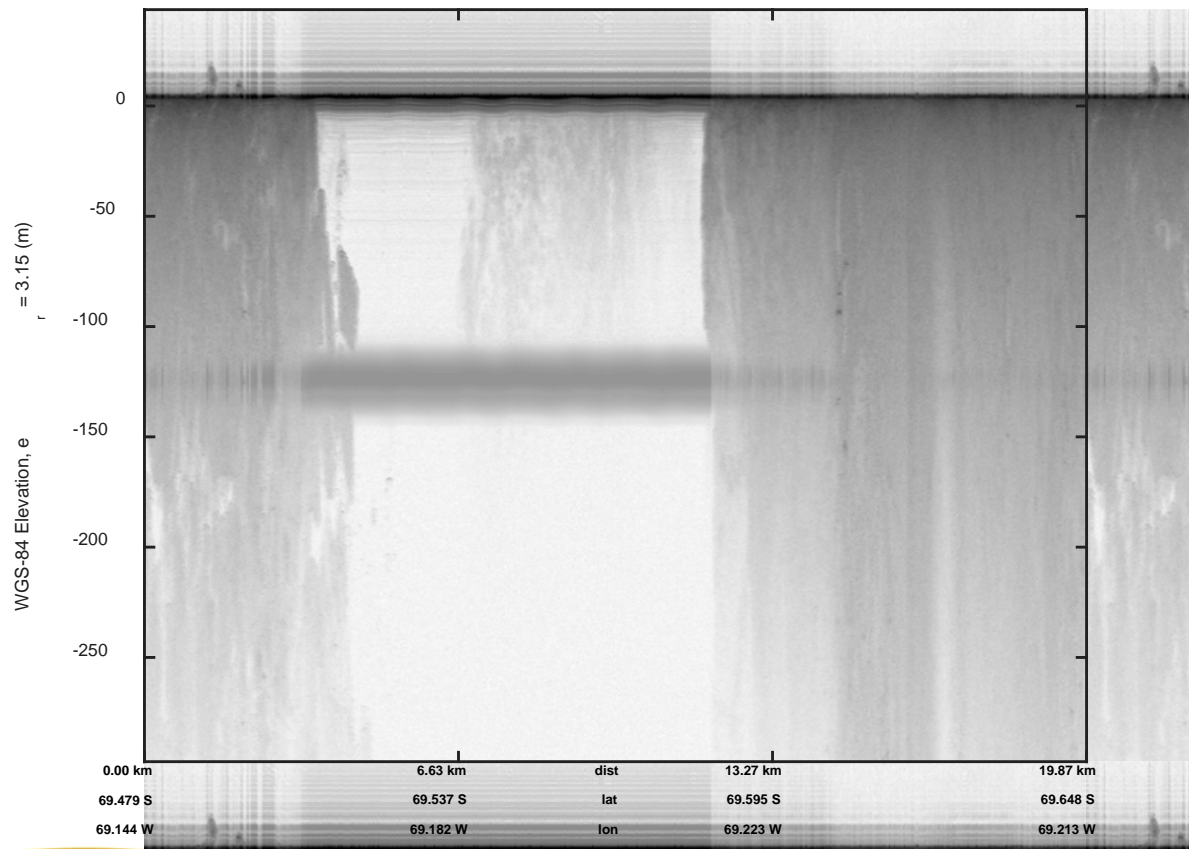
- 3U mid-depth chassis
- 5.25" x 19" x 18.5"
- 30 lbs electronics
- 28 VDC aircraft power (100 W)
- Red box is accumulation radar





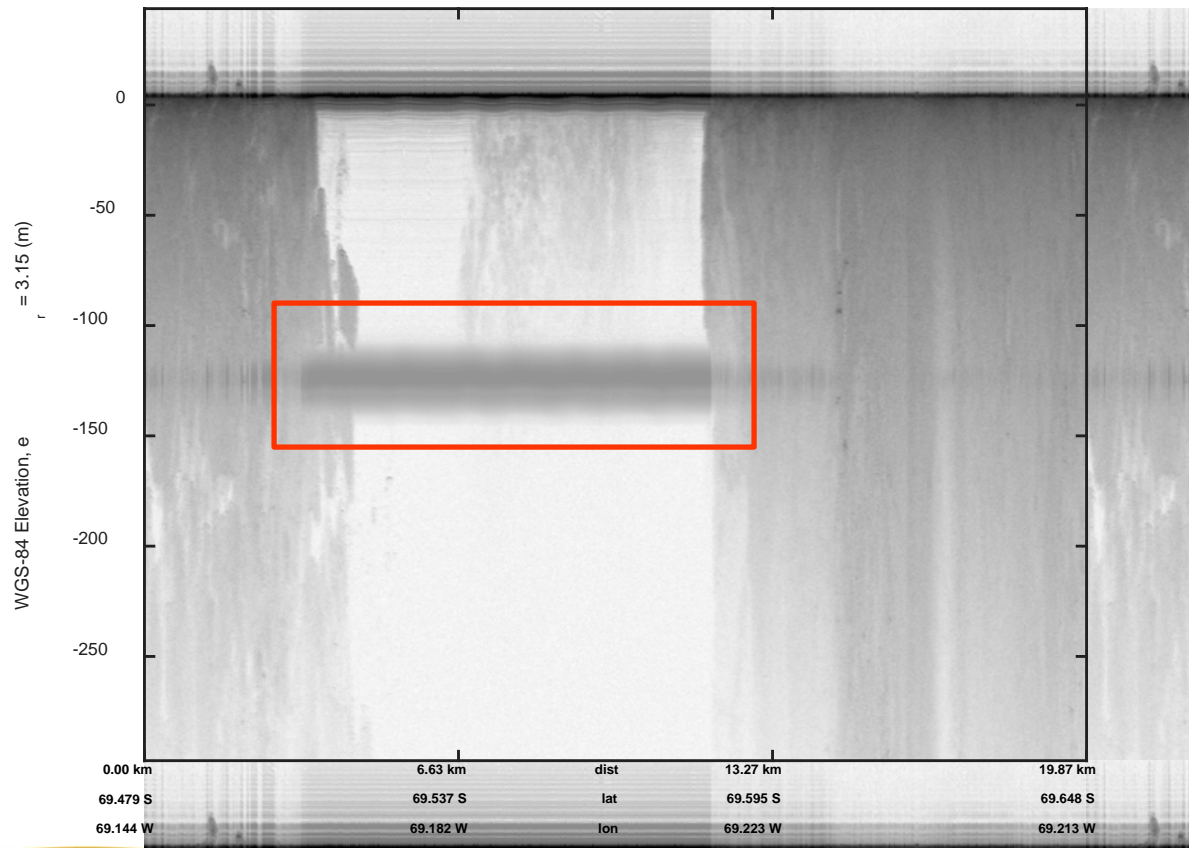
# Issue...

accum 2018 Antarctica TObas 07-Feb-2019 16:52:41 to 16:57:44



# Issue...

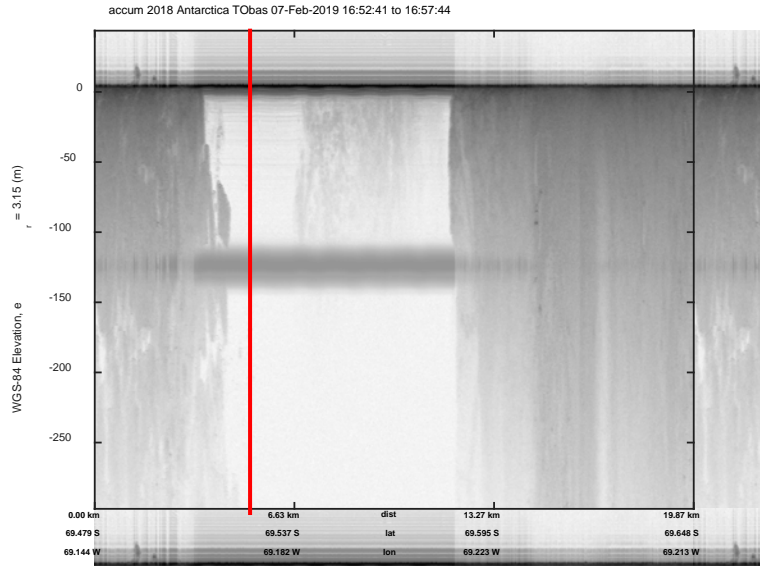
accum 2018 Antarctica TObas 07-Feb-2019 16:52:41 to 16:57:44



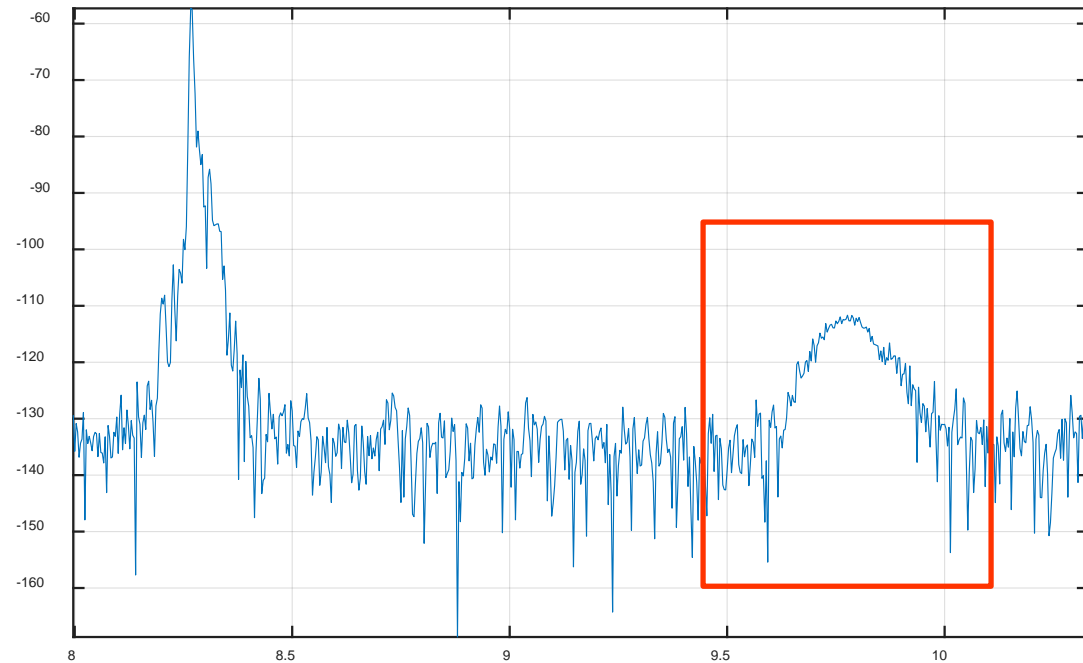


# Pulse Compression

A-scope  
(single column  
marked in red)

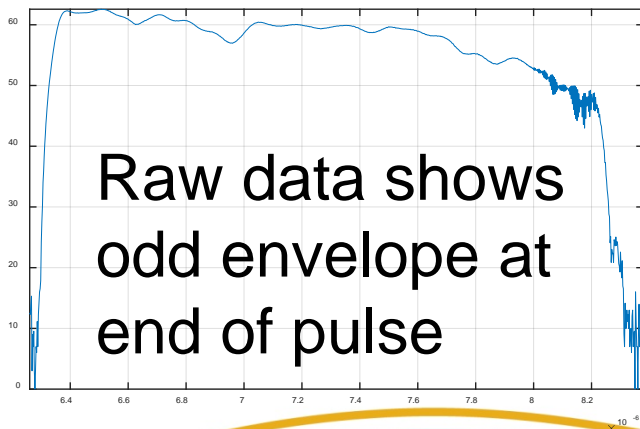
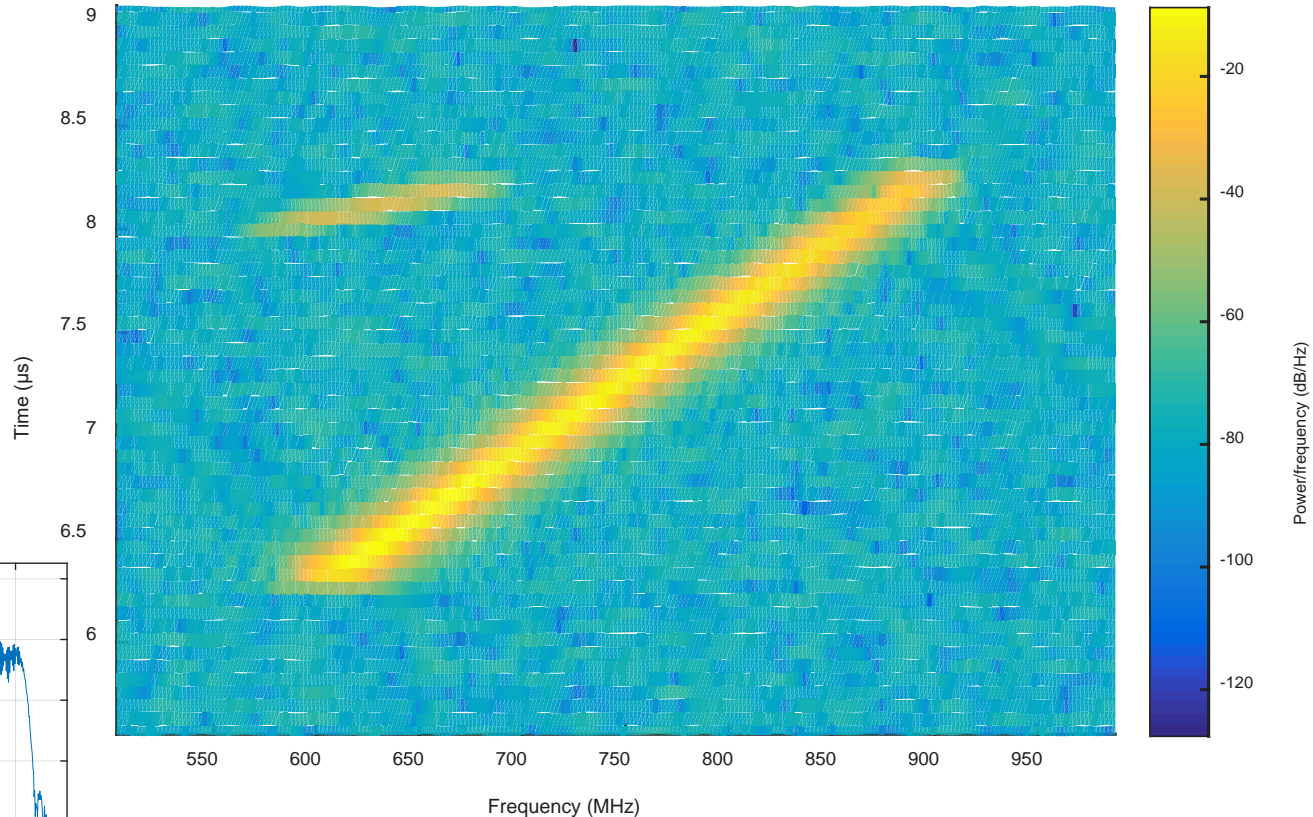


Echogram



# Time-Frequency Polynya

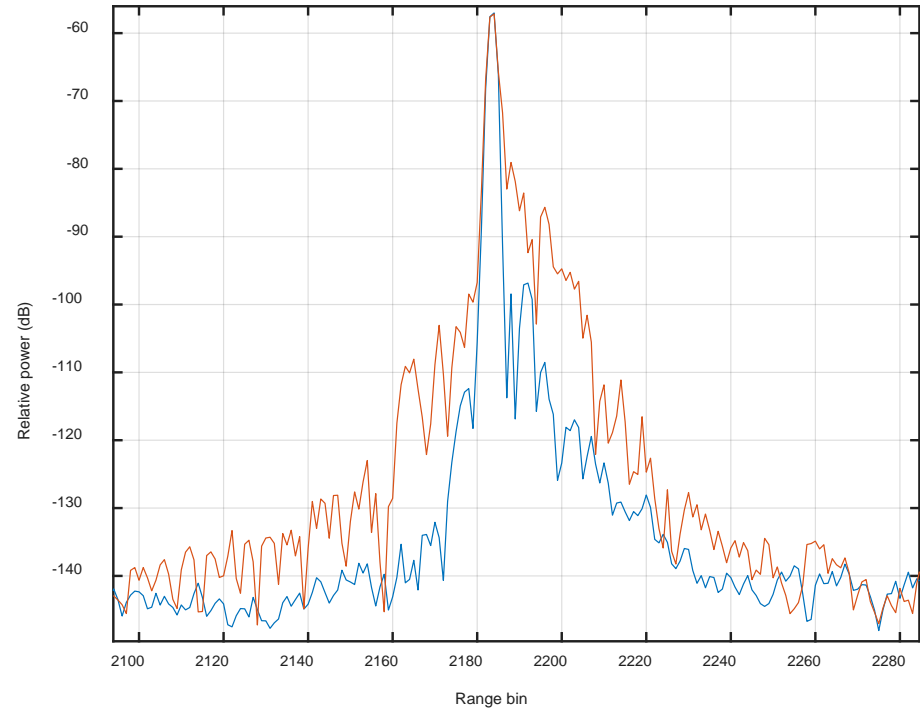
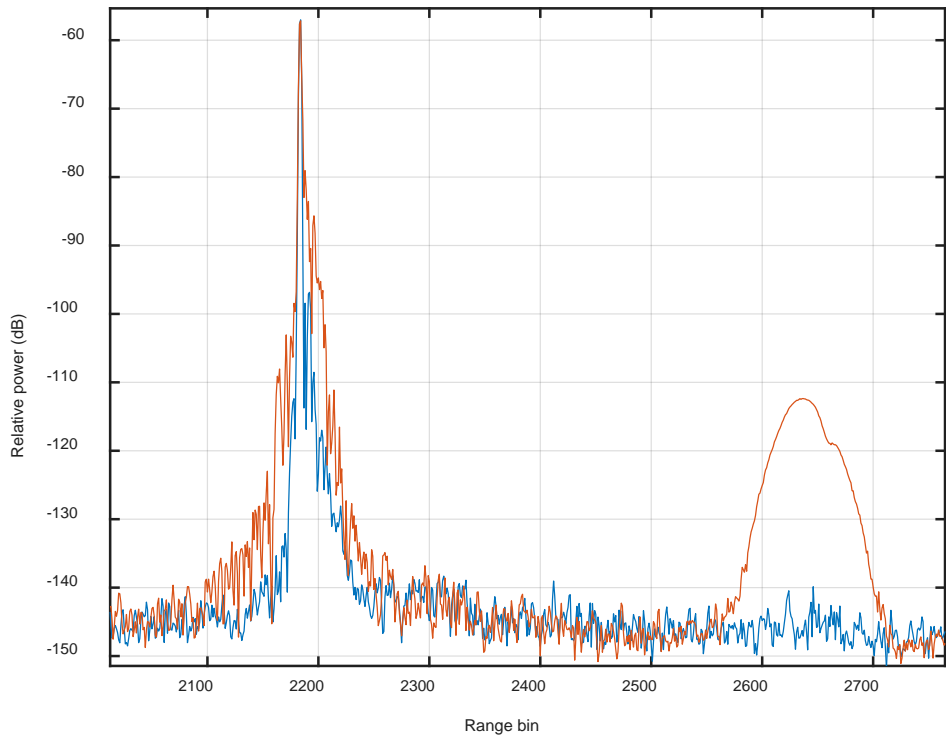
- Time-frequency analysis over sea ice polynya
- Third harmonic aliasing on transmit?



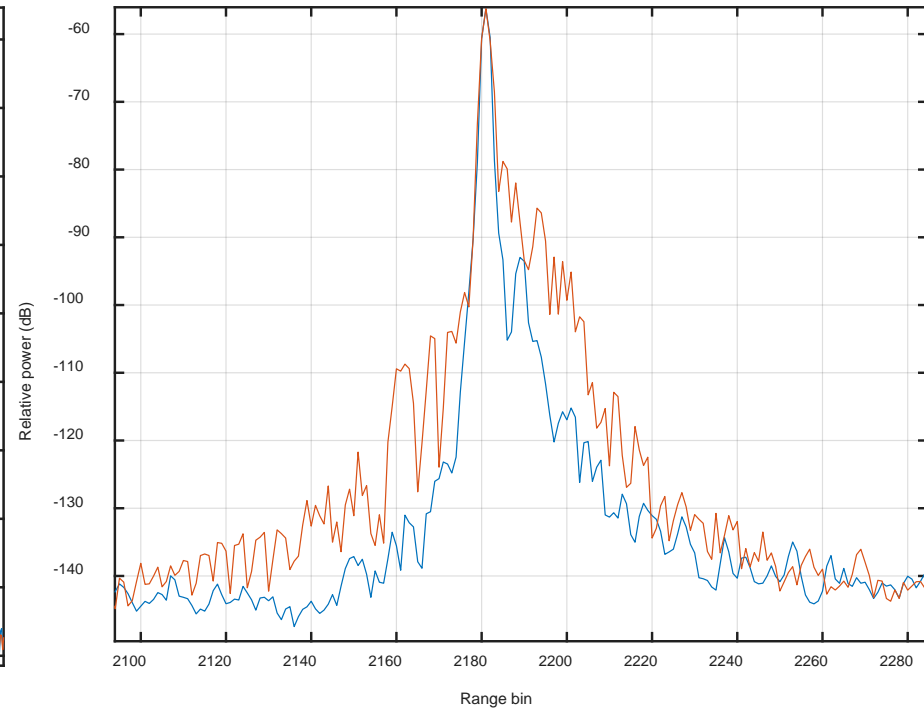
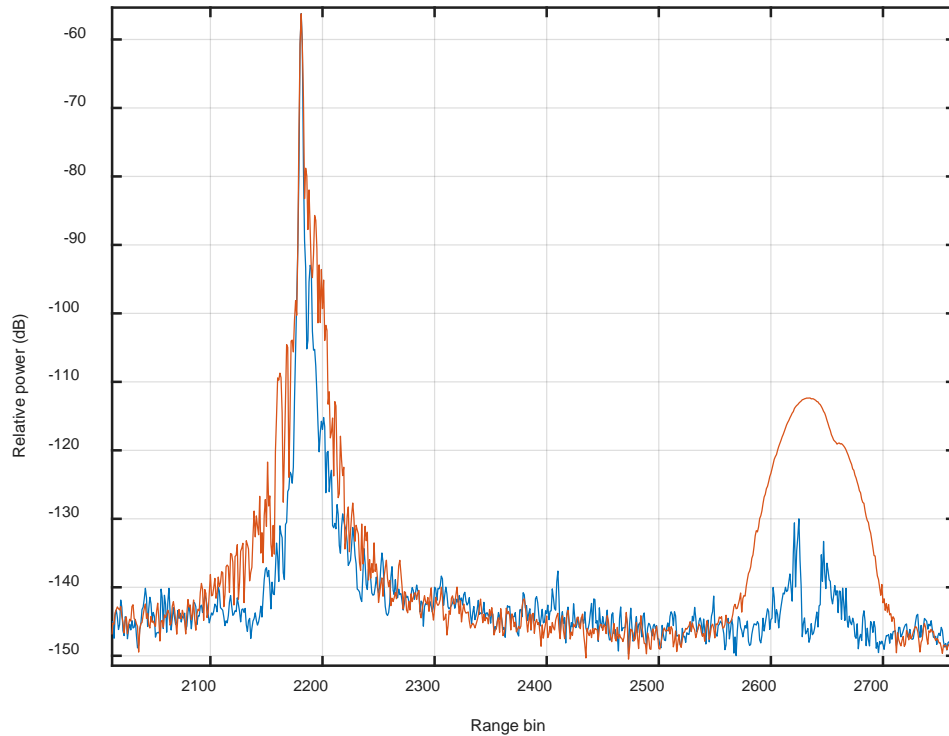
Raw data shows  
odd envelope at  
end of pulse



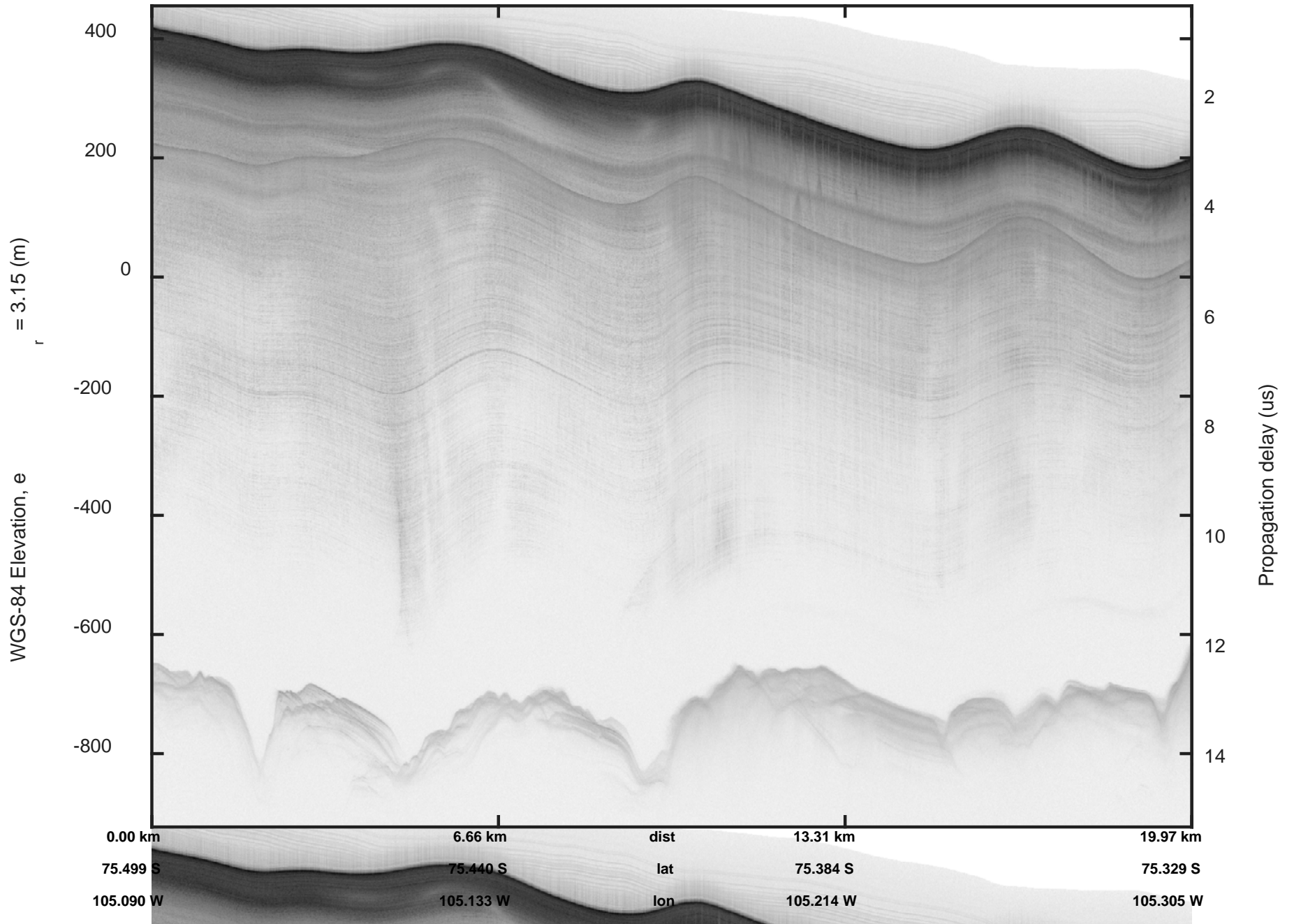
# Deconvolved



# Deconvolved... more realistic

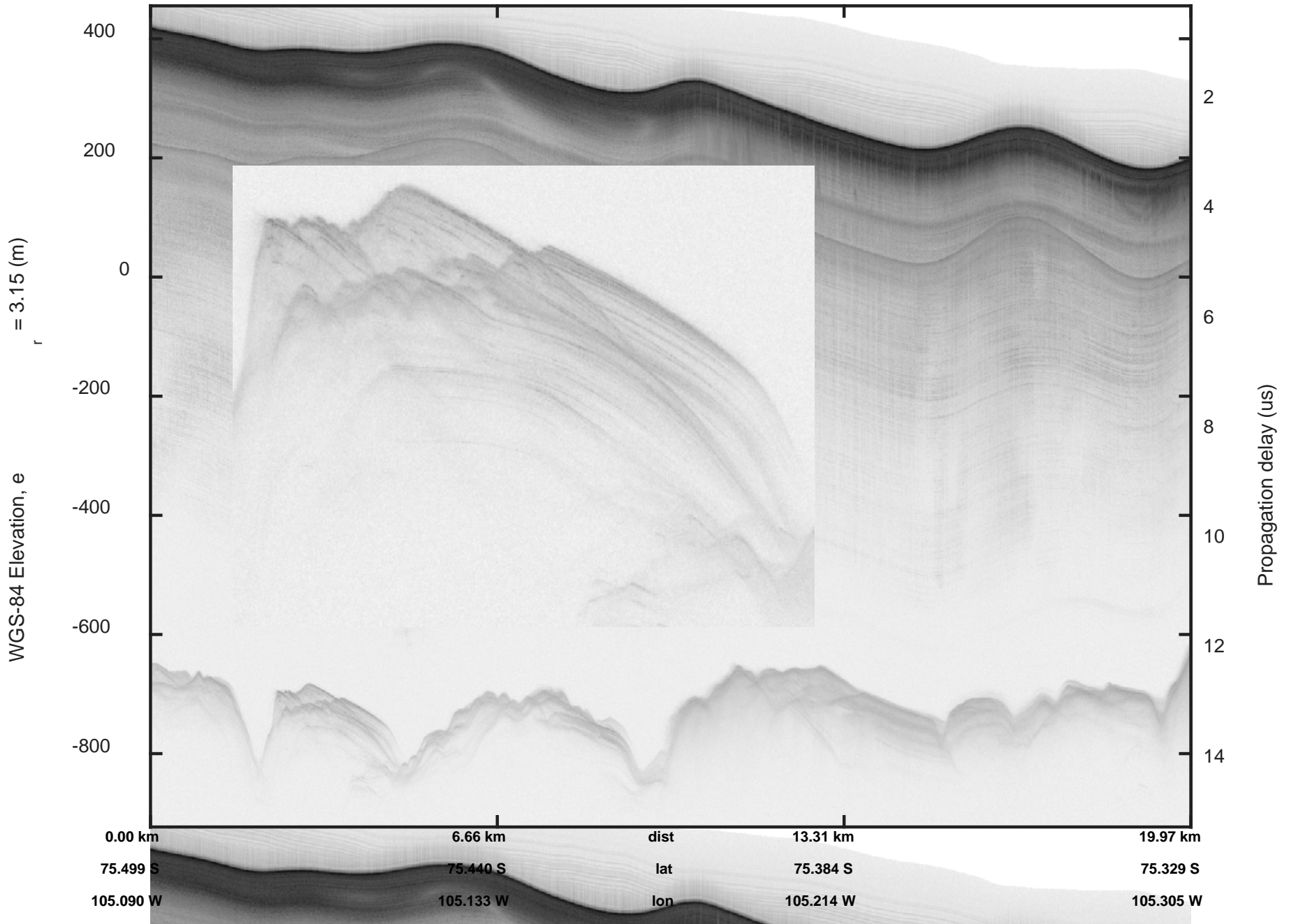


accum 2018 Antarctica TObas 01-Feb-2019 16:45:45 to 16:51:24

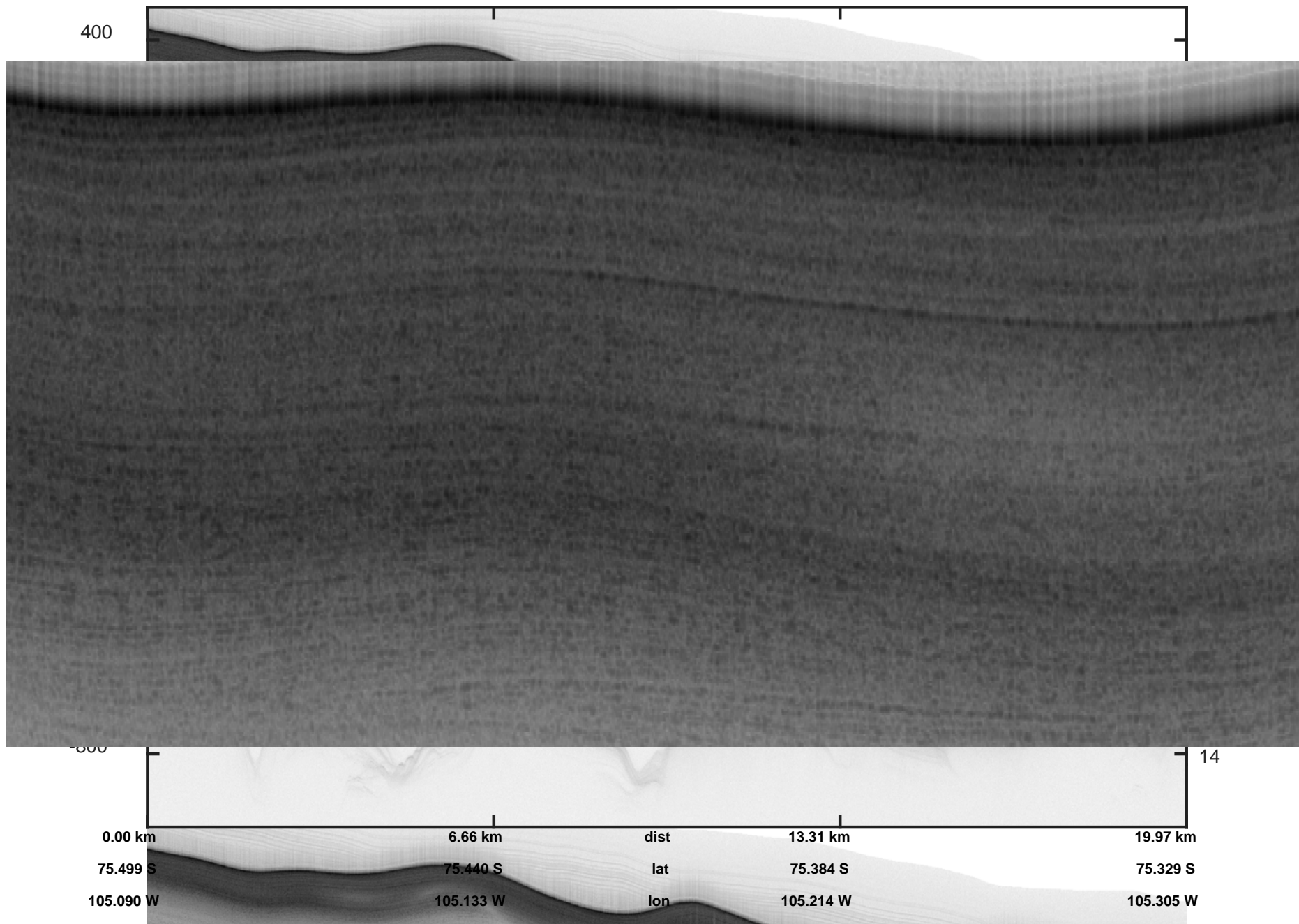




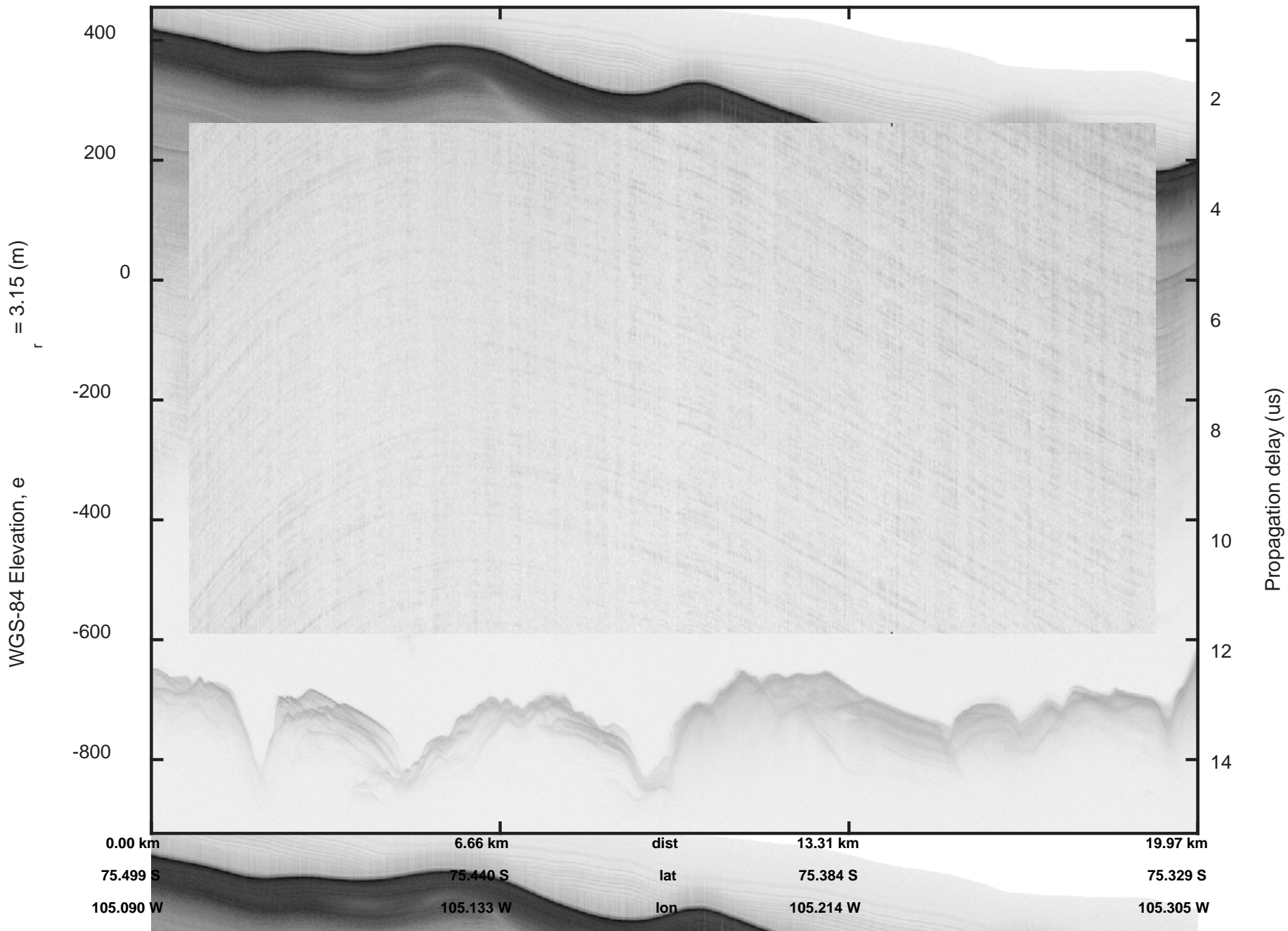
accum 2018 Antarctica TObas 01-Feb-2019 16:45:45 to 16:51:24



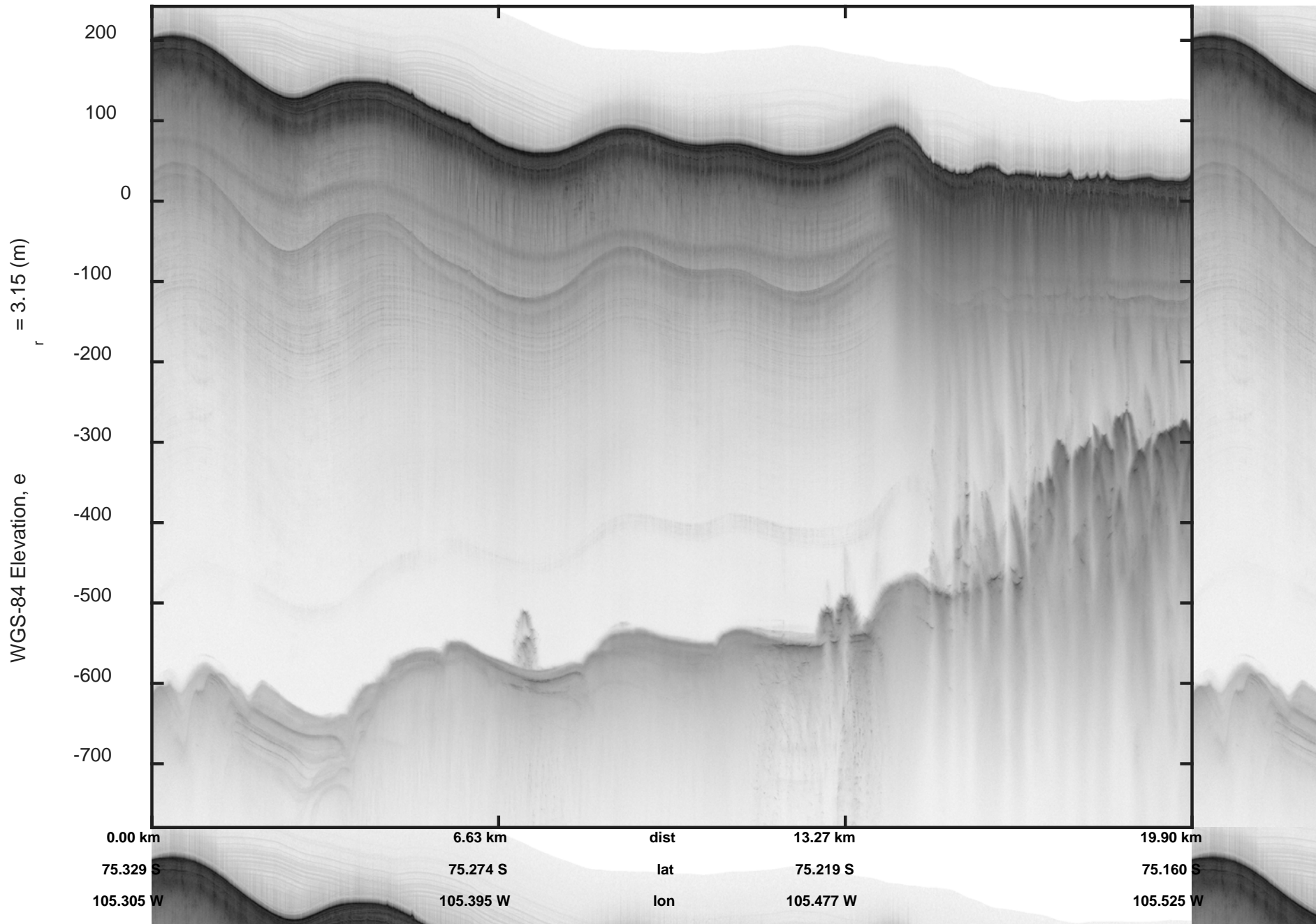
accum 2018 Antarctica TObas 01-Feb-2019 16:45:45 to 16:51:24



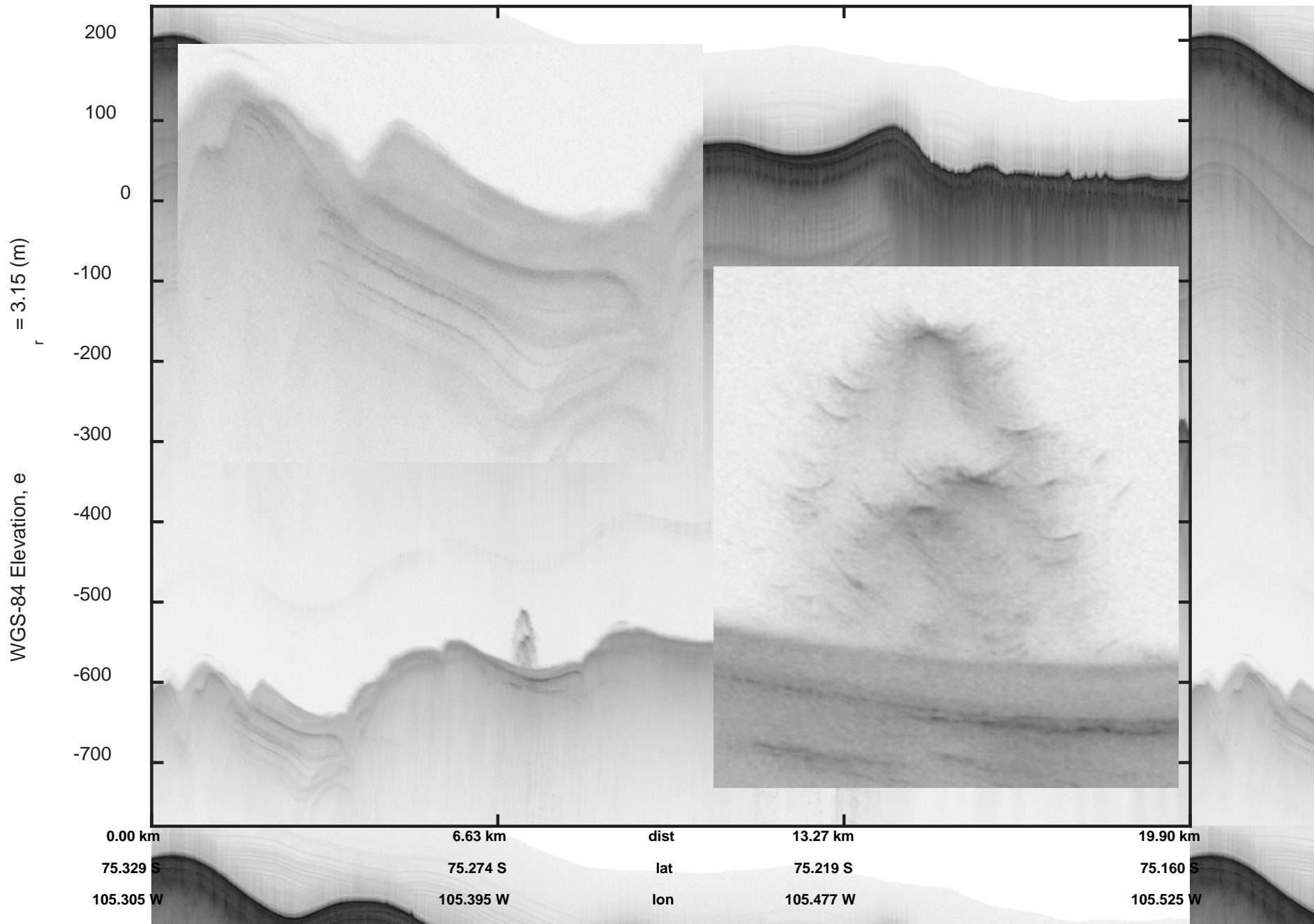
accum 2018 Antarctica TObas 01-Feb-2019 16:45:45 to 16:51:24



accum 2018 Antarctica TObas 01-Feb-2019 16:51:25 to 16:57:19

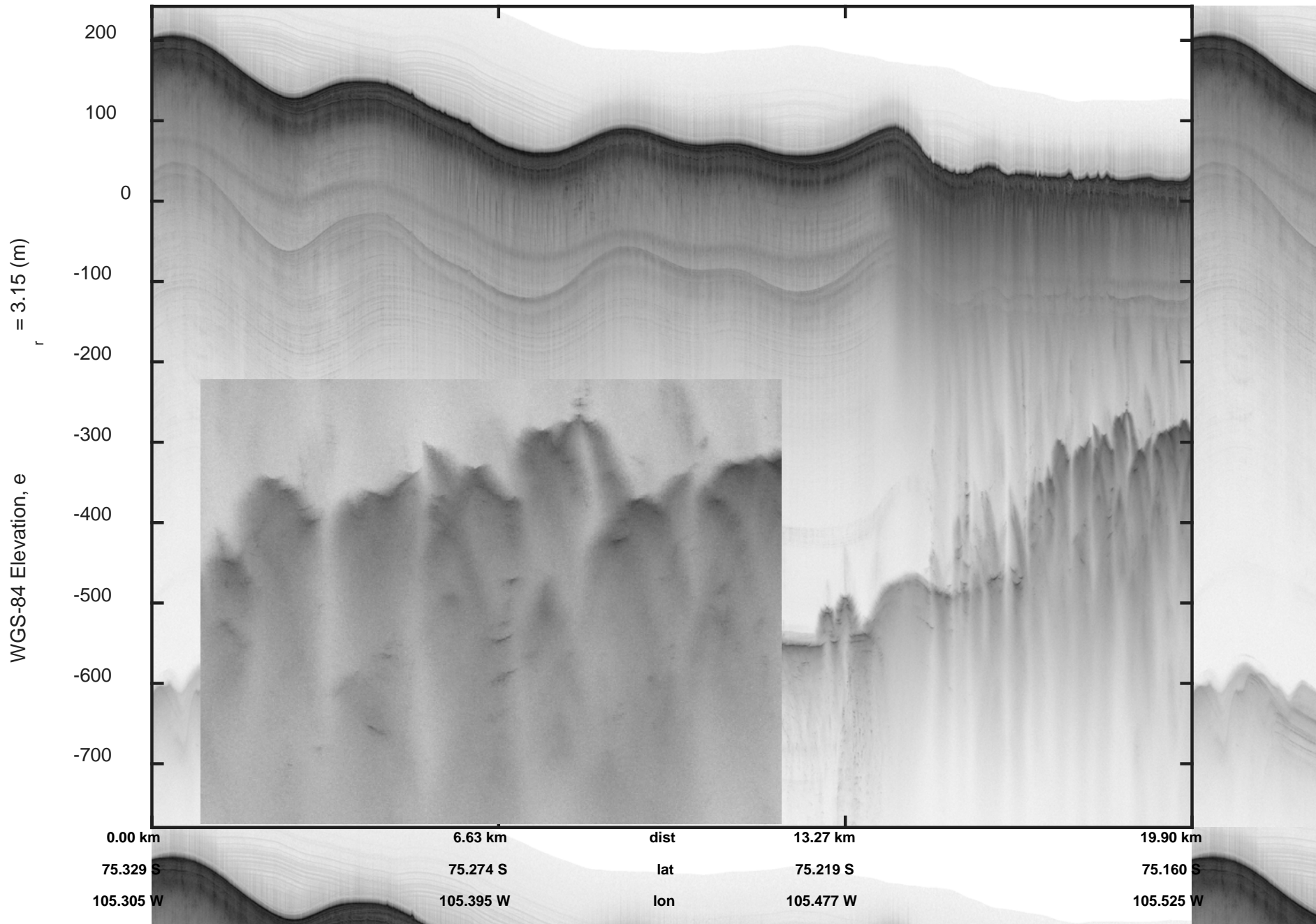


accum 2018 Antarctica TObas 01-Feb-2019 16:51:25 to 16:57:19

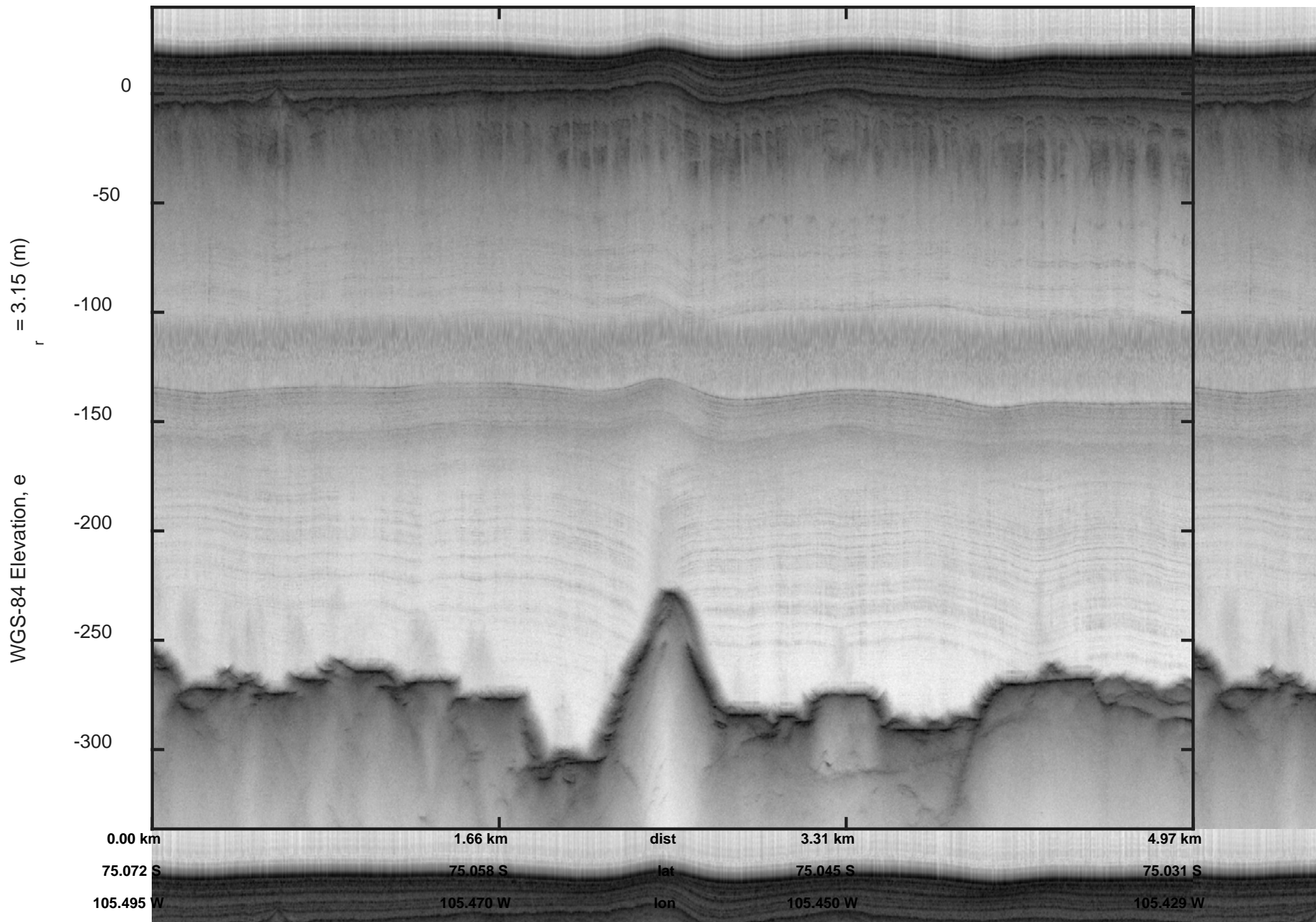




accum 2018 Antarctica TObas 01-Feb-2019 16:51:25 to 16:57:19



accum 2018 Antarctica TObas 01-Feb-2019 17:00:30 to 17:02:05



# ACKNOWLEDGEMENTS

The radar data used in this work were collected as a part of the NSF-NERC Thwaites Initiative. The radar system and SAR processing software were developed with support from the University of Kansas, NSF grant ANT-0424589, and NASA Operation IceBridge grant NNX16AH54G. We also acknowledge the contributions of many CReSIS faculty, staff, and students who contributed to the radar system development and to the BAS aircraft operations team for flying and supporting the mission.

# THANK YOU! QUESTIONS?

