Seismic Full Waveform Inversion for imaging firn: Pine Island Antarctica

Emma Pearce[1*] Adam Booth[1] Sebastian Rost[1] Alex Brisbourne[2] Paul Sava[3] Bryn Hubbard[4] Ian Jones[5]

1.University of Leeds
2.British Antarctic Survey
3.Colorado School of Mines
4. Aberystwyth University
5. ION Geophysical

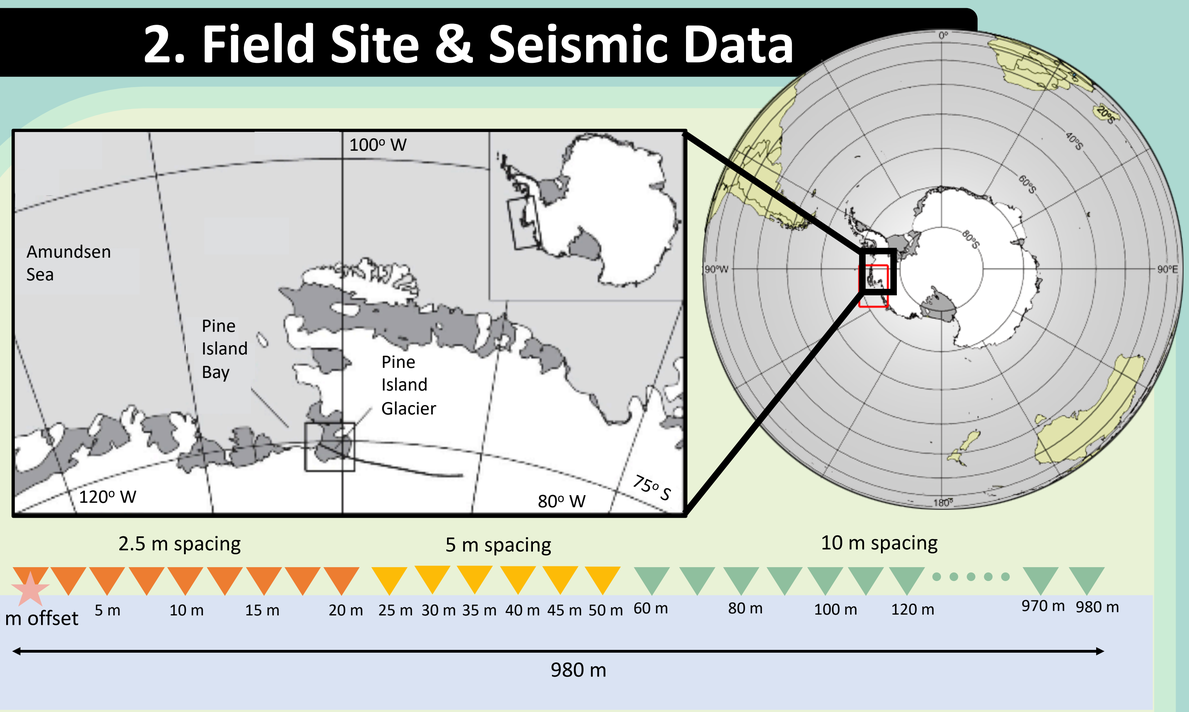
eeevep@leeds.ac.uk
@emm_pearce

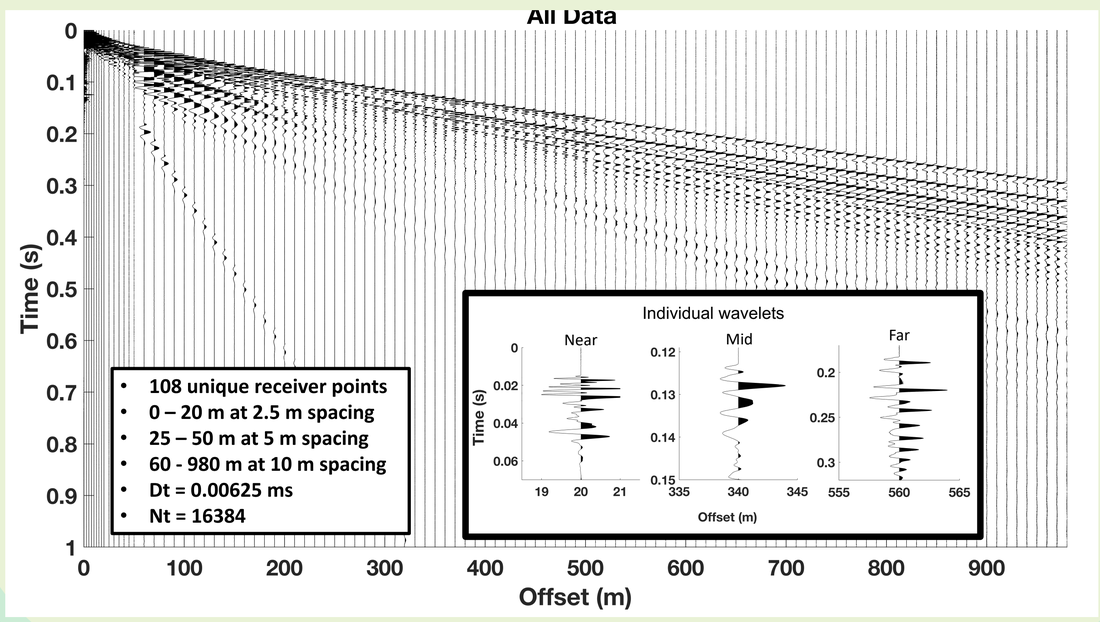
1. Introduction

- Firn gives insight into past climate conditions.
- Due to changes in the firn's physical properties with depth, active seismic techniques can be used to recover the firn profile

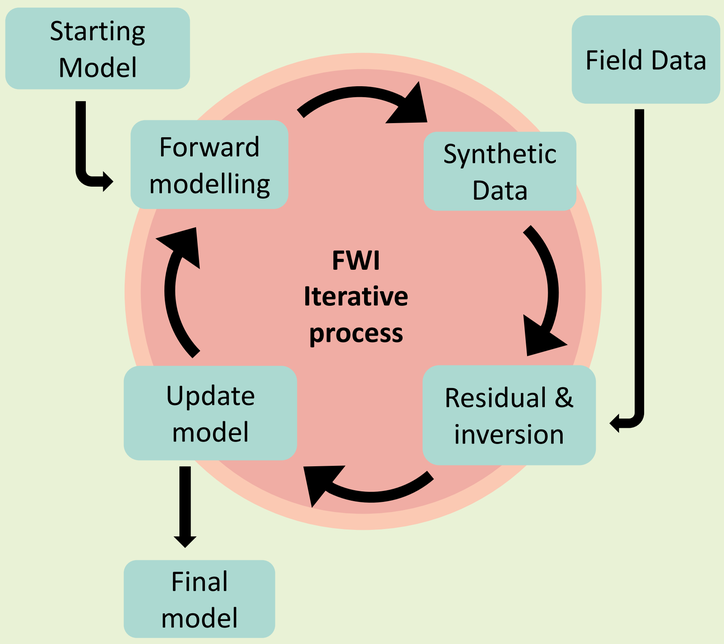
- Current seismic techniques (Herglotz-Wiechert) are limited by the assumptions of simple physics.
- Full Waveform inversion can mitigate these limitations and provide improvements to seismic imaging

2. Field Site & Seismic Data





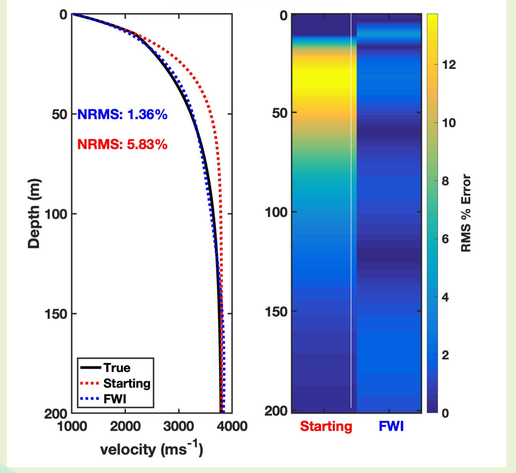
3. Full Waveform Inversion

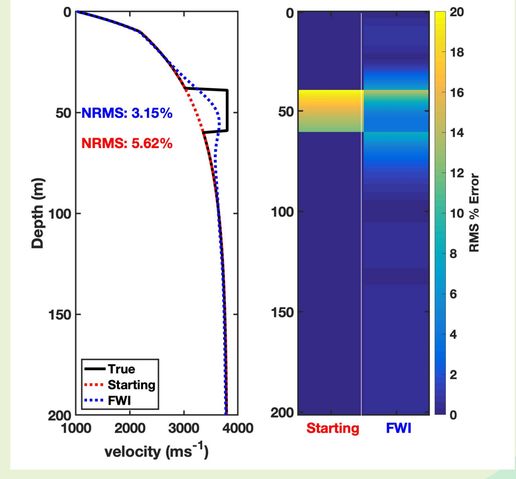


4. Synthetic Results

1. Synthetic FWI tests show FWI can improve velocity models when the starting model is incorrect

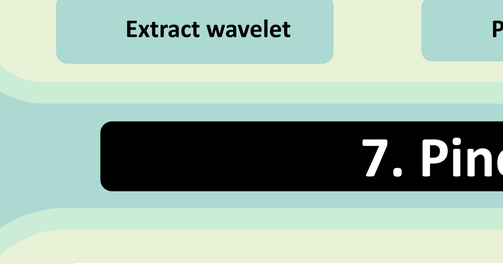
2. Synthetic tests show FWI able to detect ice slabs varying from 10 m to 80 m thick at depths of 20 m to 100 m

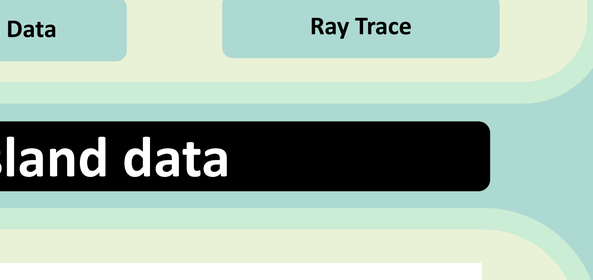




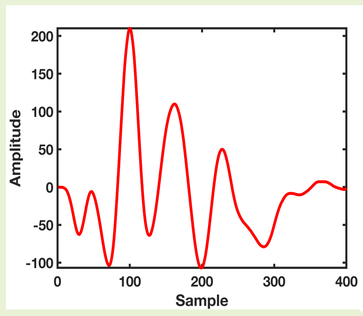
5. Starting model

1. first break picking the seismic data
2. Use Herglot-Wiechert inversion
3. Converting the density core to velocity Kohnen 1974
4. Combine top of density with HW model

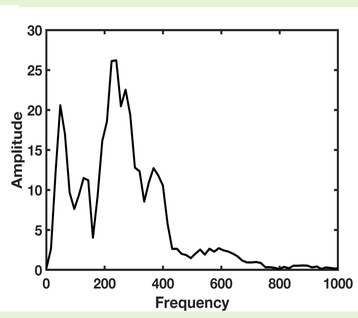




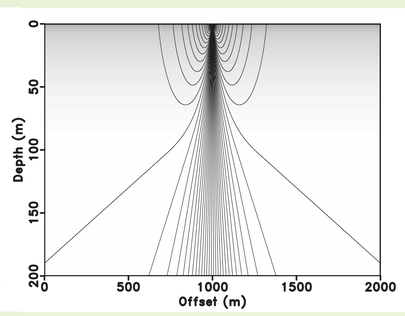
6. Prerequisites



Extract wavelet

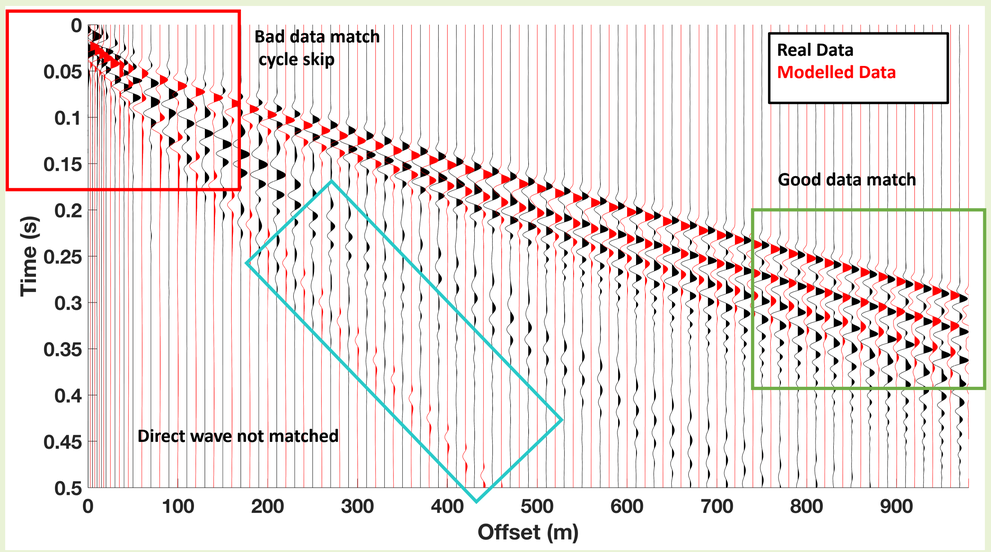


Process Data



Ray Trace

7. Pine island data



8. Conclusions

- FWI can control or improve upon current seismic imaging techniques for firn modelling, however, the transition to field data proves less simple!
- FWI shows promising results in the synthetic models, where the source wavelet is known, and the data is clear and noise free.
- Here it can control or improve upon current seismic imaging techniques.
- The transition to filed data is an ongoing process.
- Extracting a sufficient source wavelet, and obtaining a best guess model is naturally less simple than in the synthetic scenario, proving problematic for FWI at this stage.

For a live commentary of this presentation, I will be presenting at the IGS seminar on the 5th May