Pre-processing of the 2018 CaMI VSP and parameterization for DAS FWI

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NSERC CRSNG
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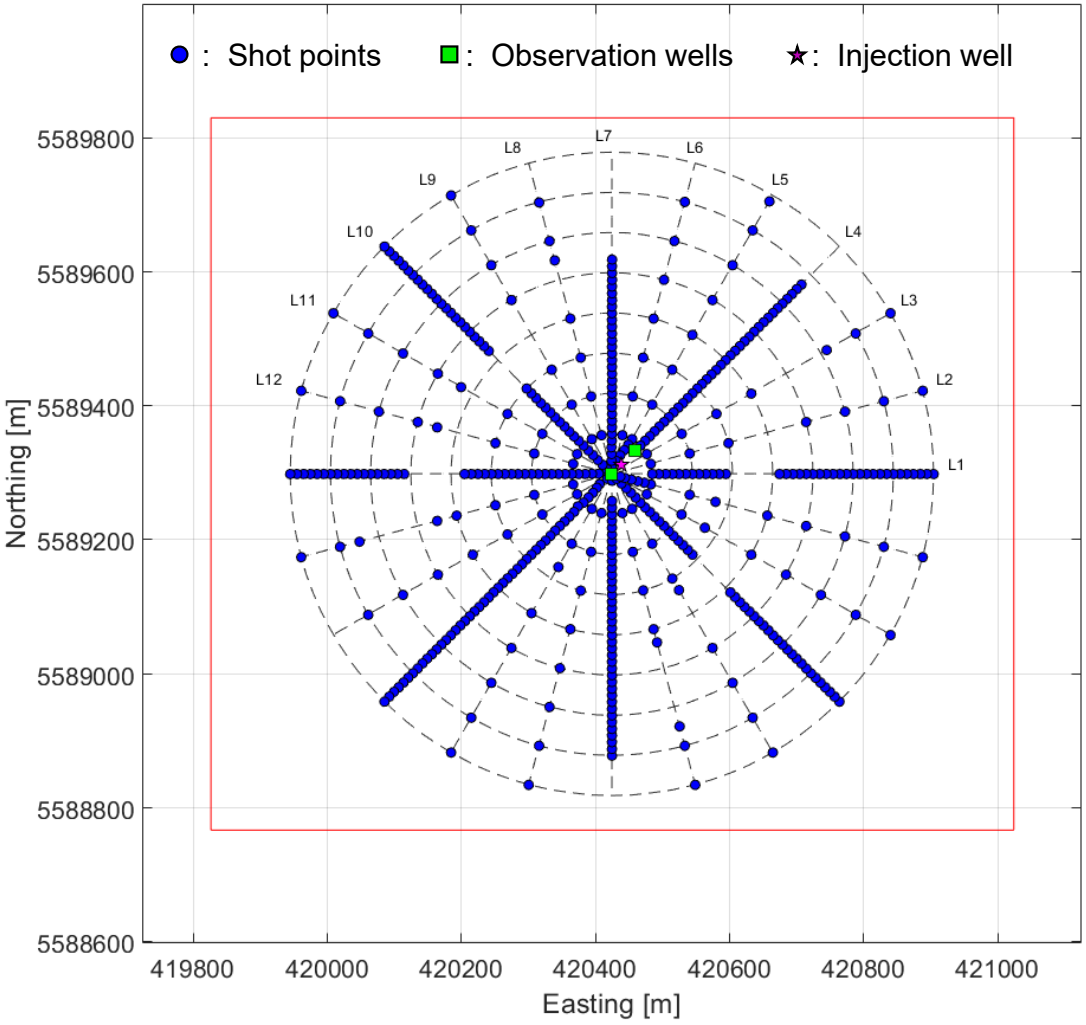
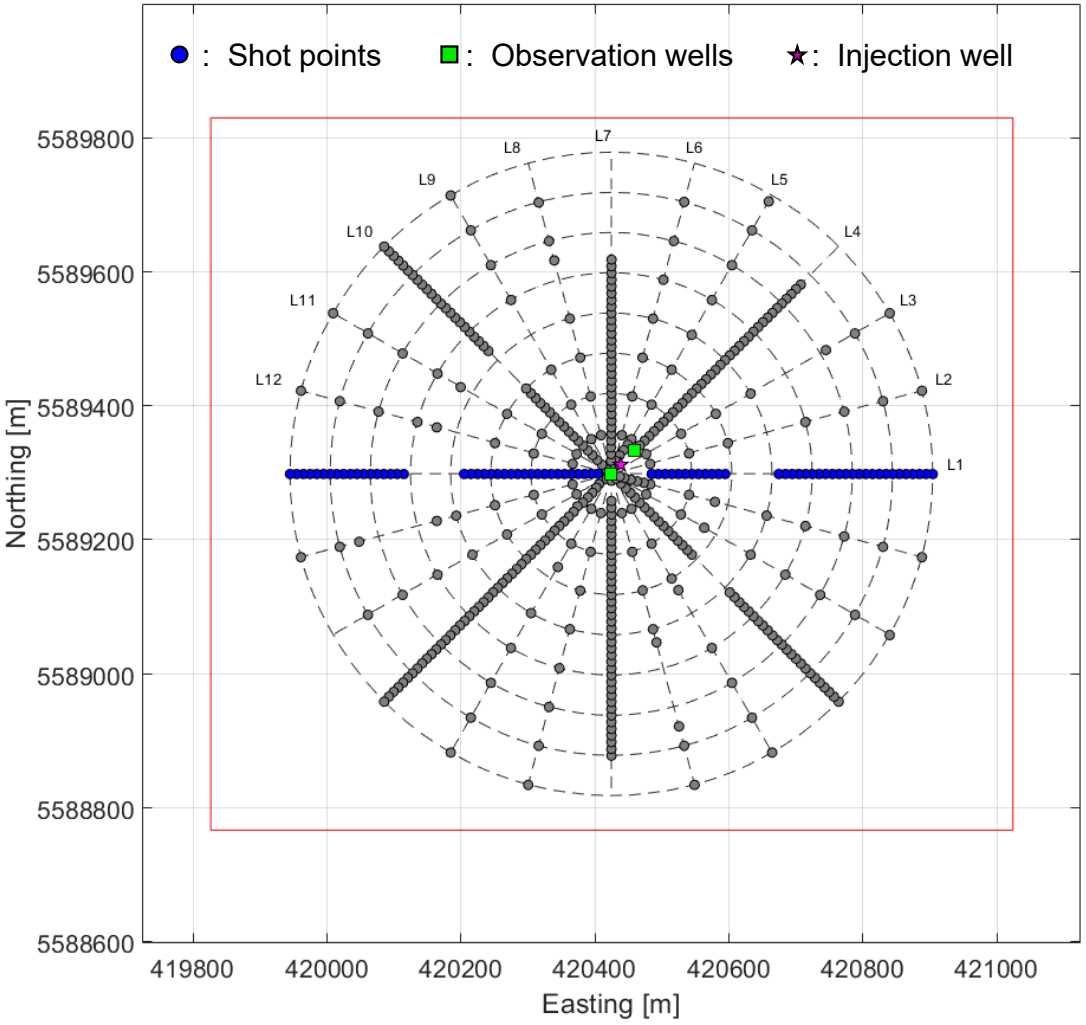
FACULTY OF SCIENCE
Department of Geoscience
Carbon Management Canada

2018 VSP survey and raw data



- In 2018 a 3D walkaway-walkaround VSP was acquired centered on the “geophysics well”.
- Data generated with Inova Geophysical UniVib
- Acquired using 296 accelerometers, straight fiber, and helical fiber

2018 VSP survey and raw data



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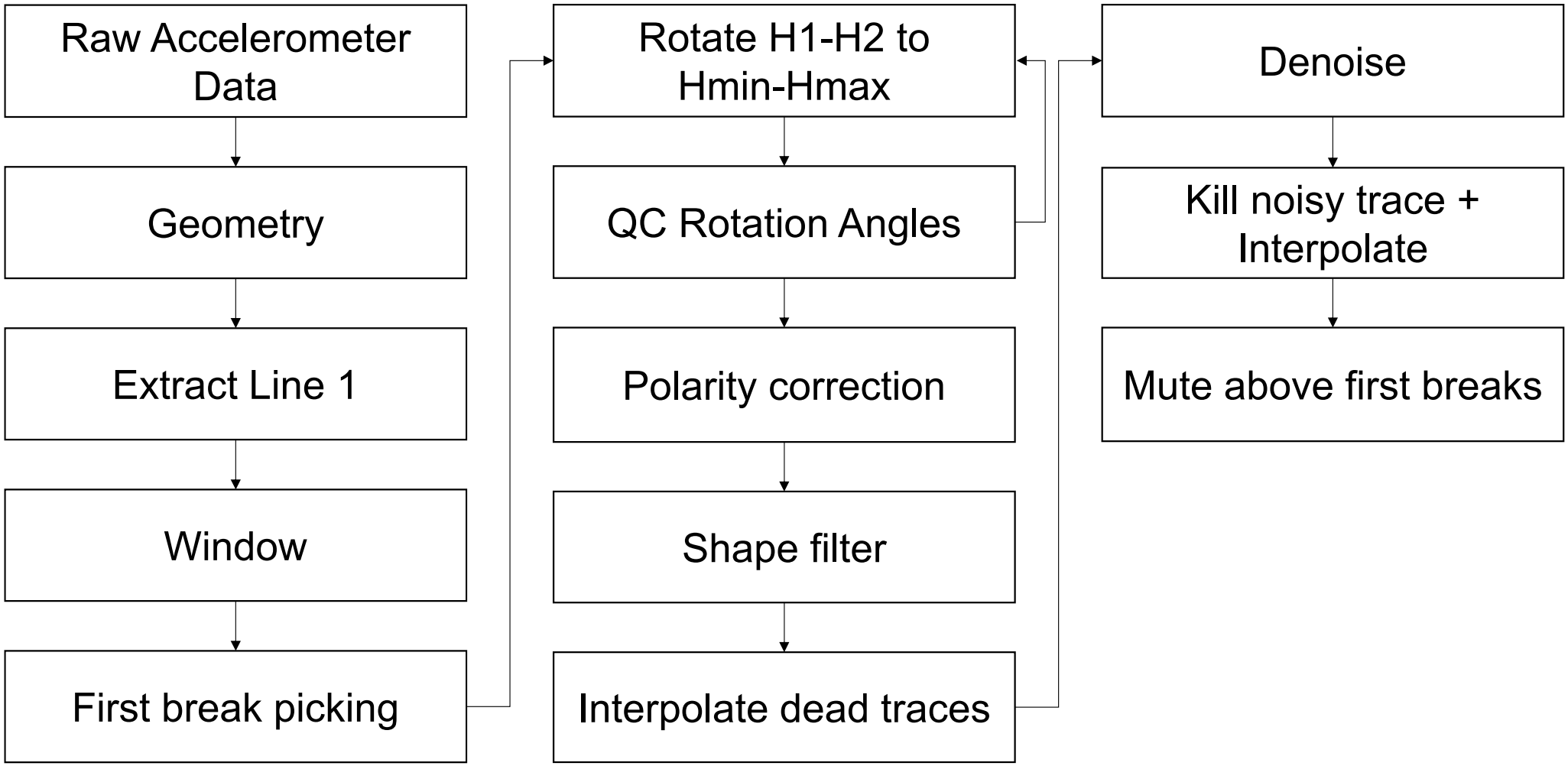
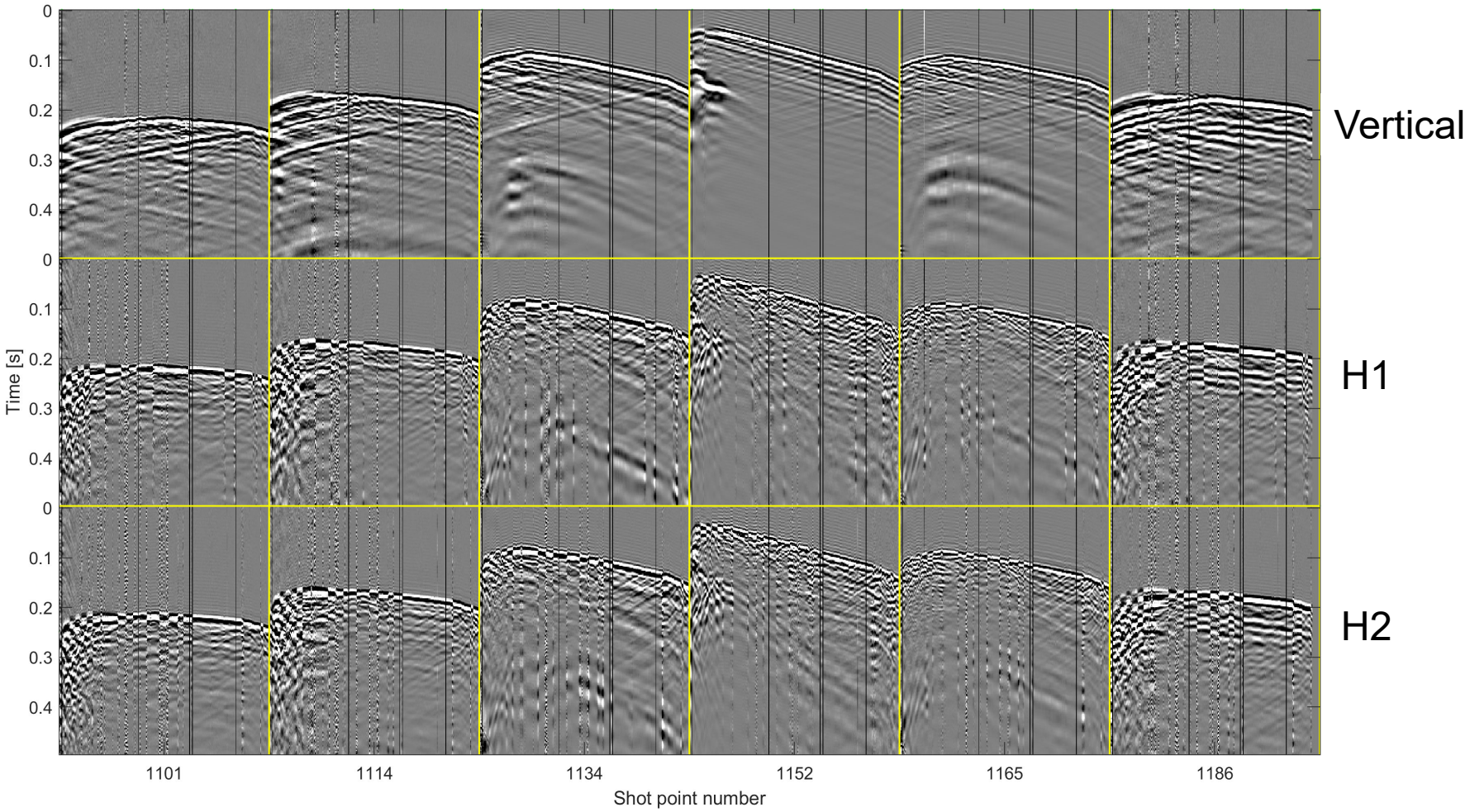
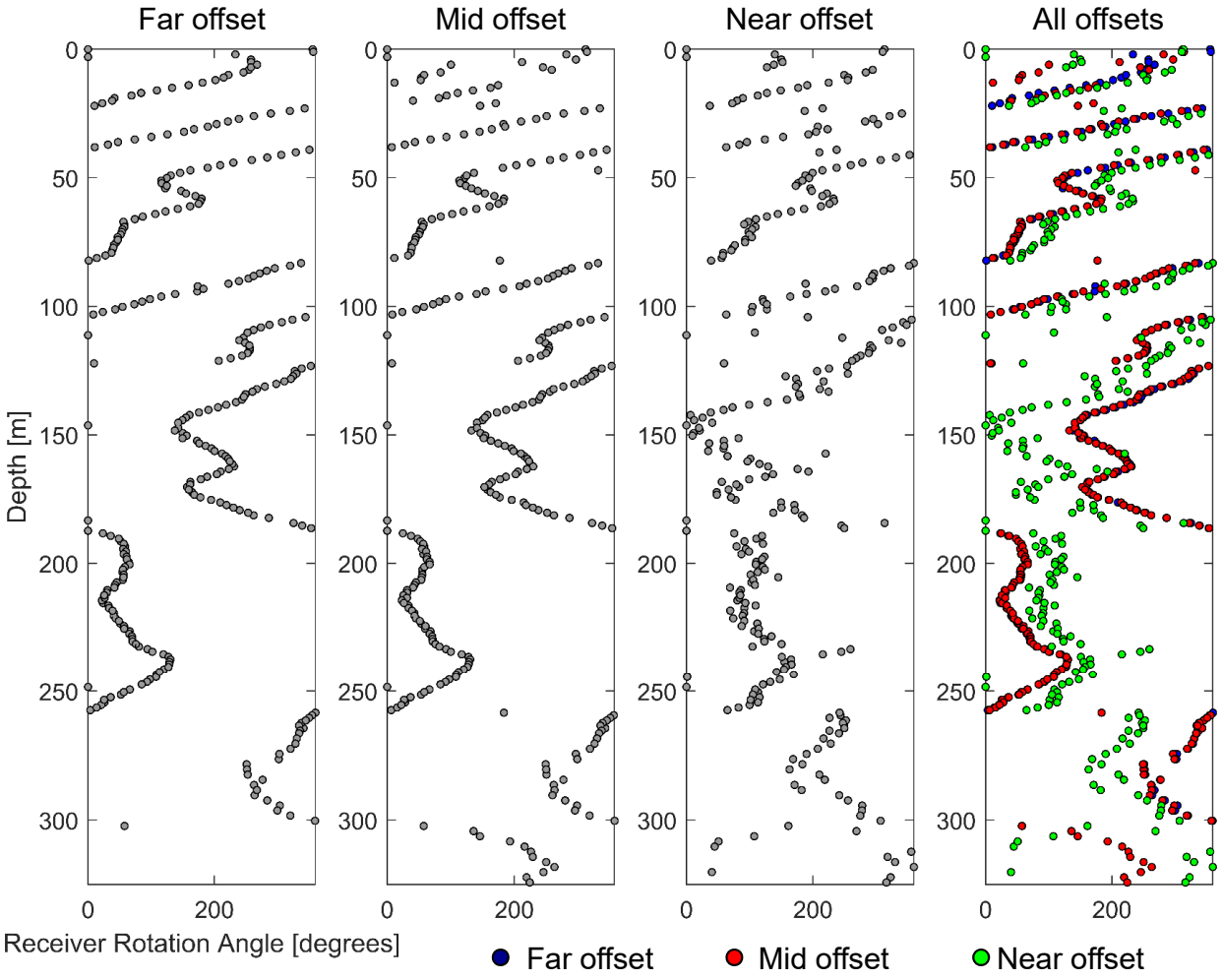
Accelerometer processing workflow



Raw accelerometer data

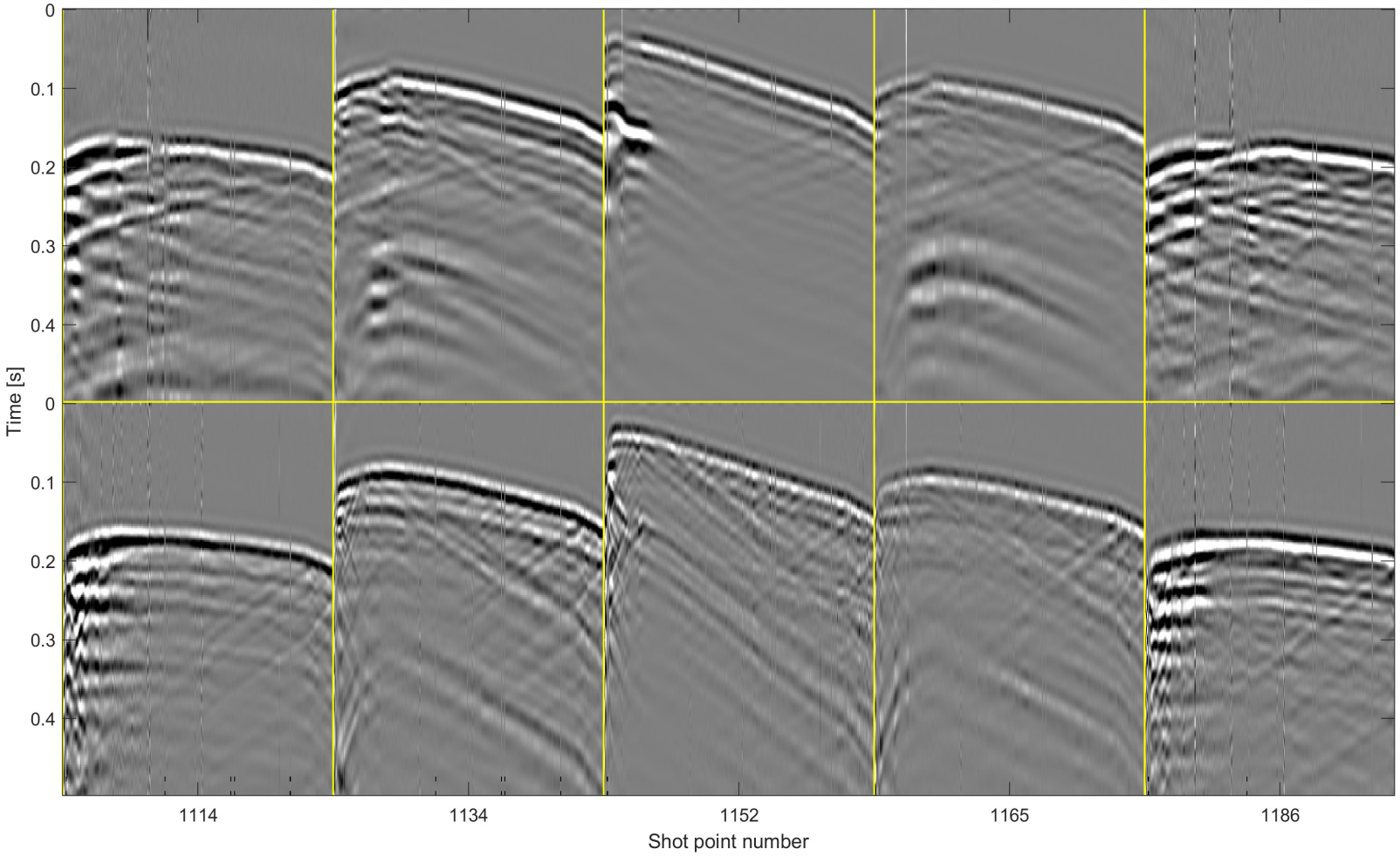


Rotation angles

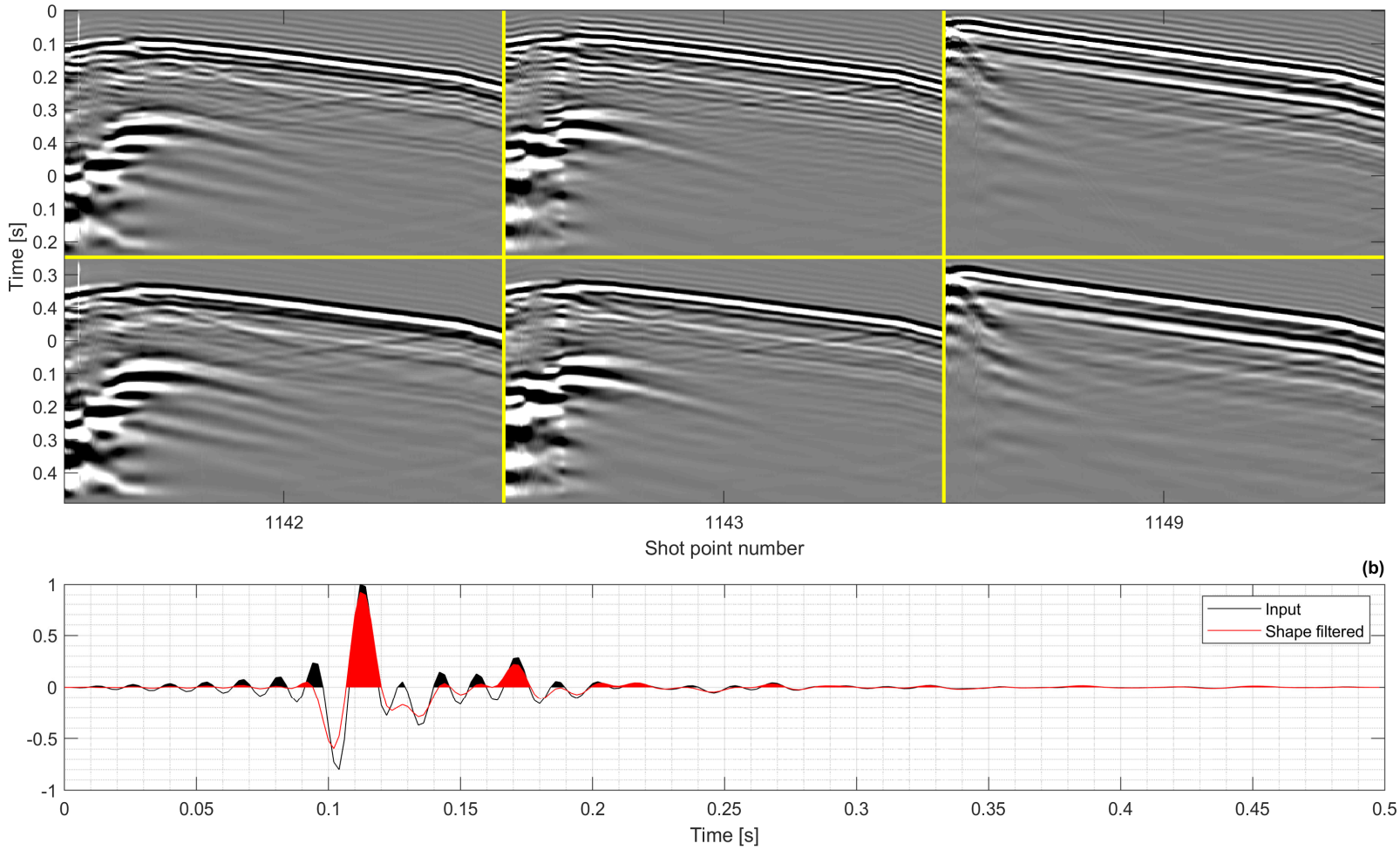


- Accelerometers clamped to well-bore
- Shot points on line 1 fall on same azimuth
- Expect rotation angles for each receiver to be approximately constant with offset.

Polarization coordinate rotation



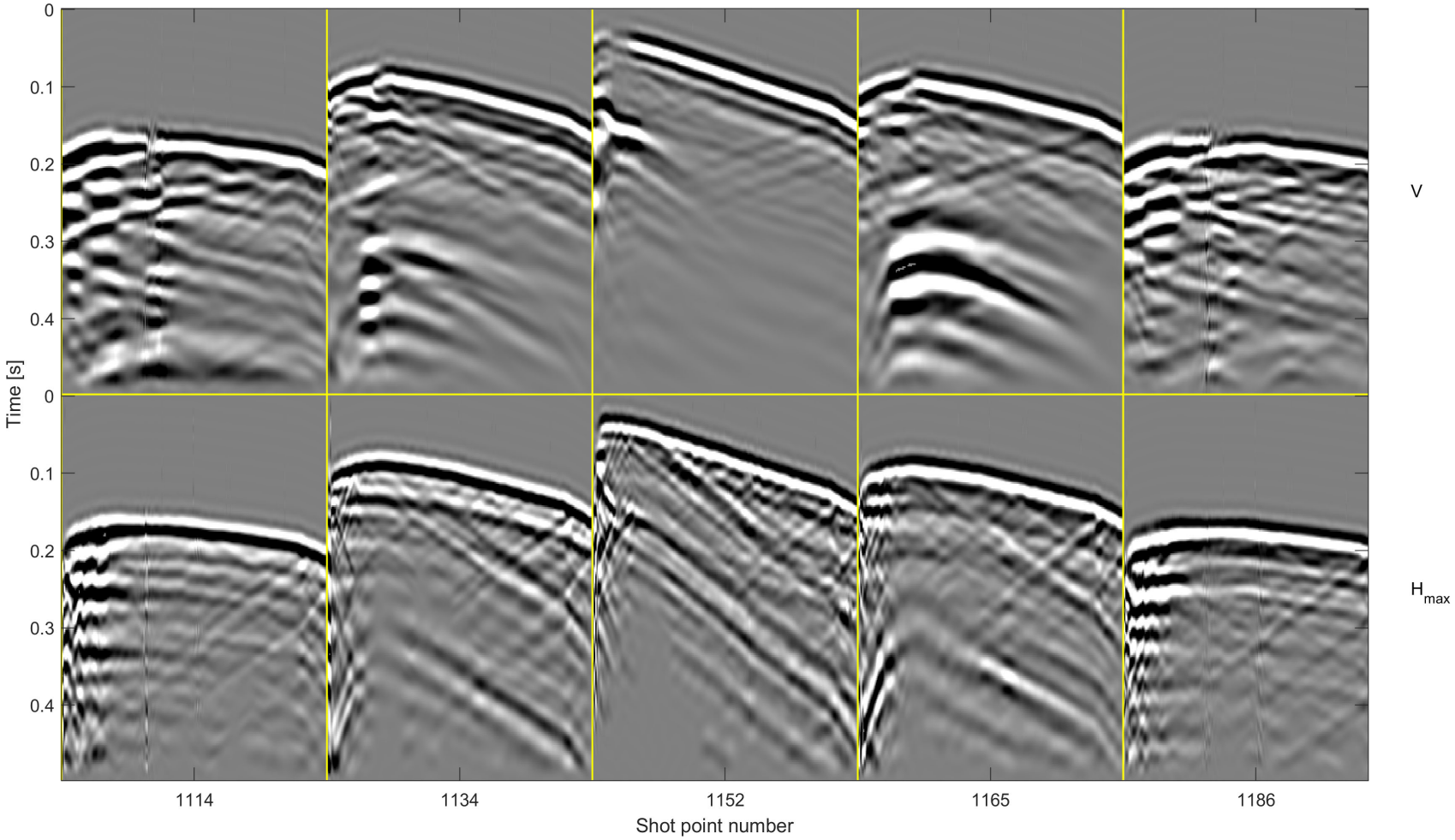
Shape filtering



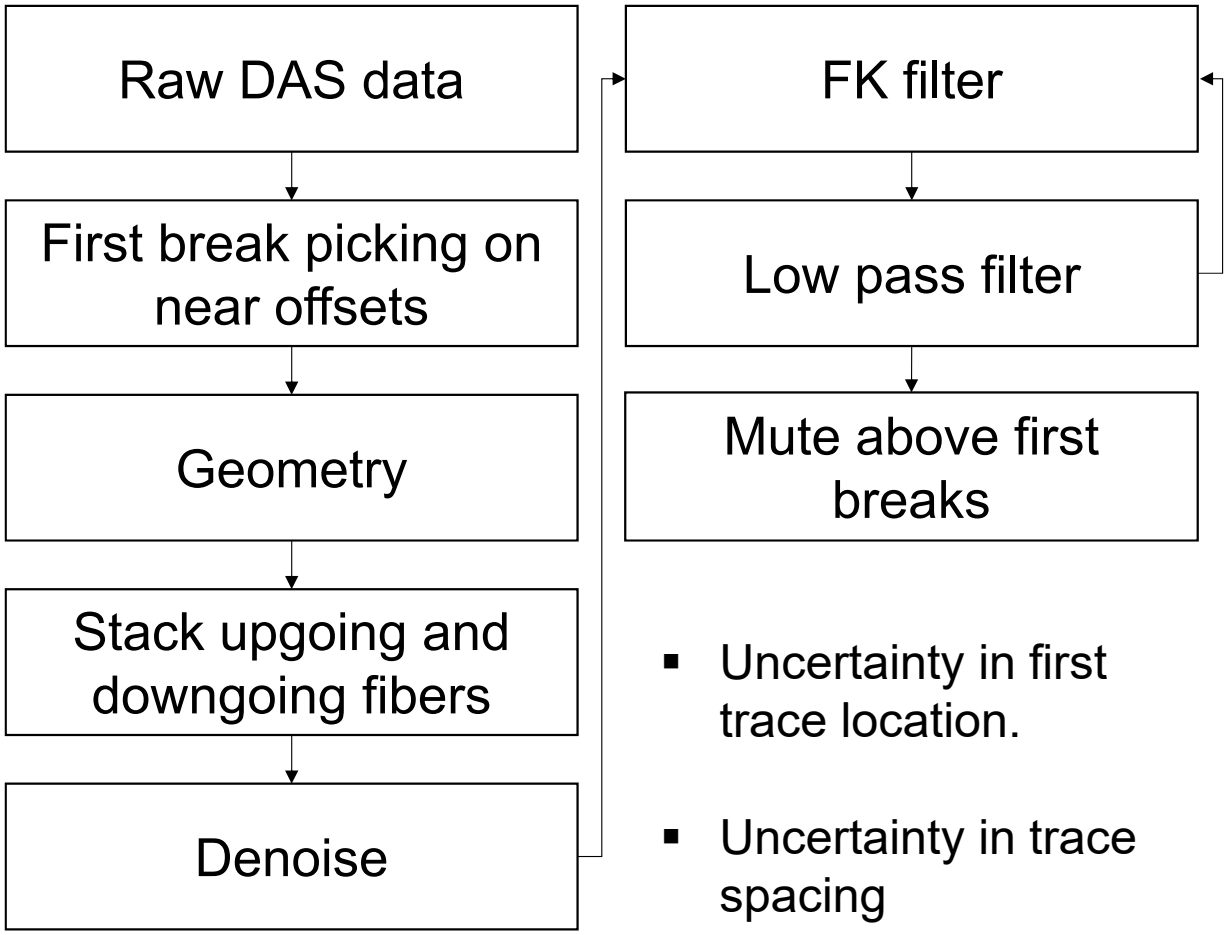
Input

Shape filtered

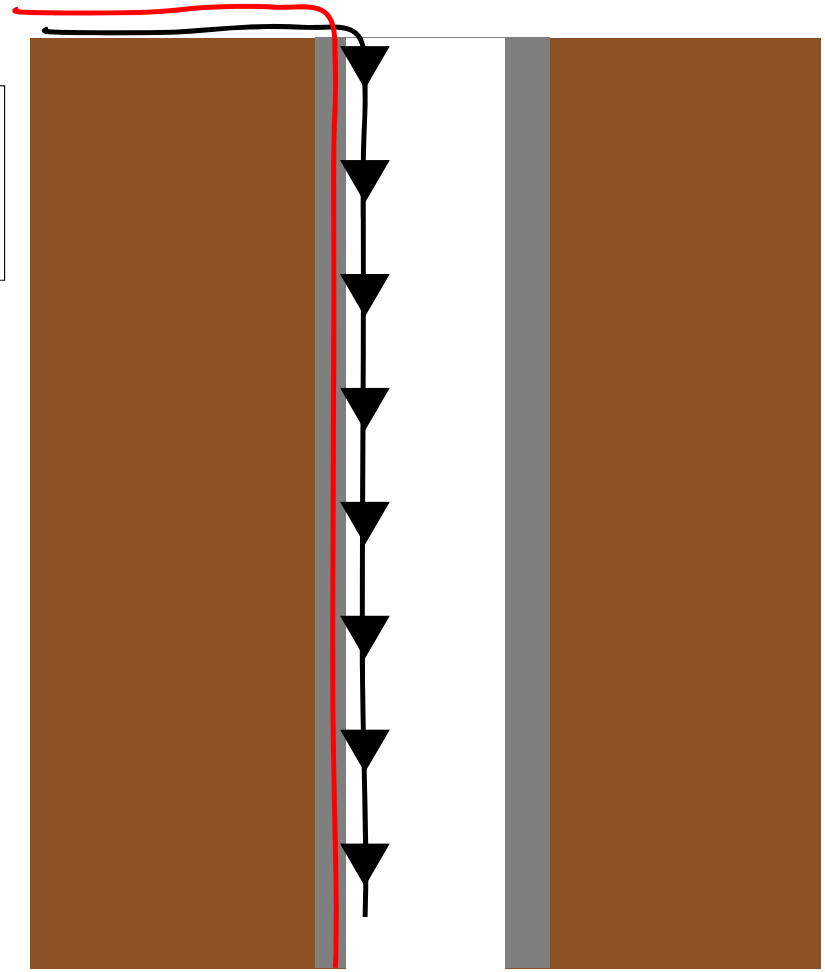
Final accelerometer processing



DAS processing workflow



- Uncertainty in first trace location.
- Uncertainty in trace spacing



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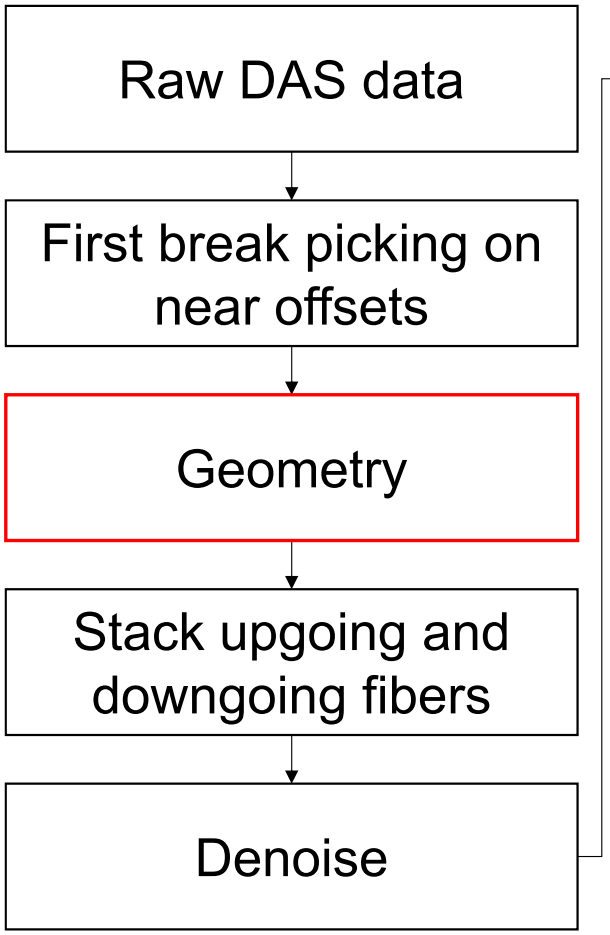

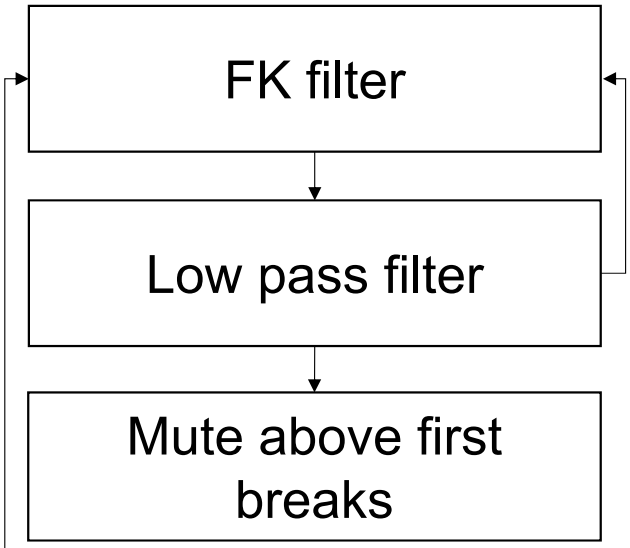

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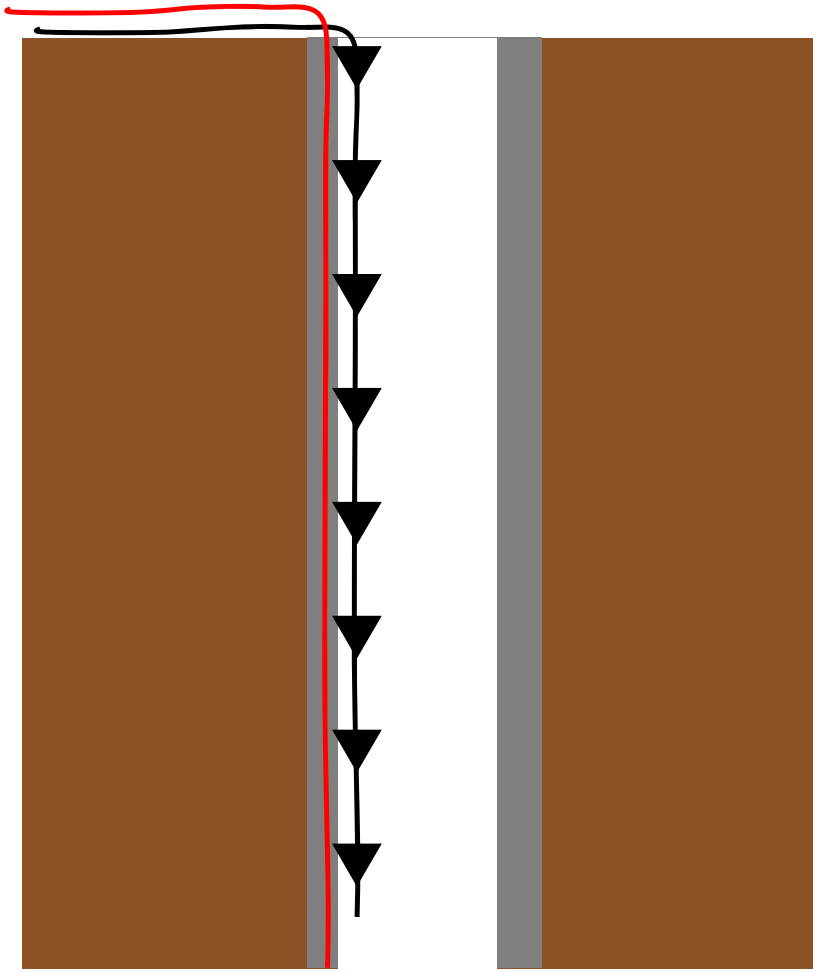
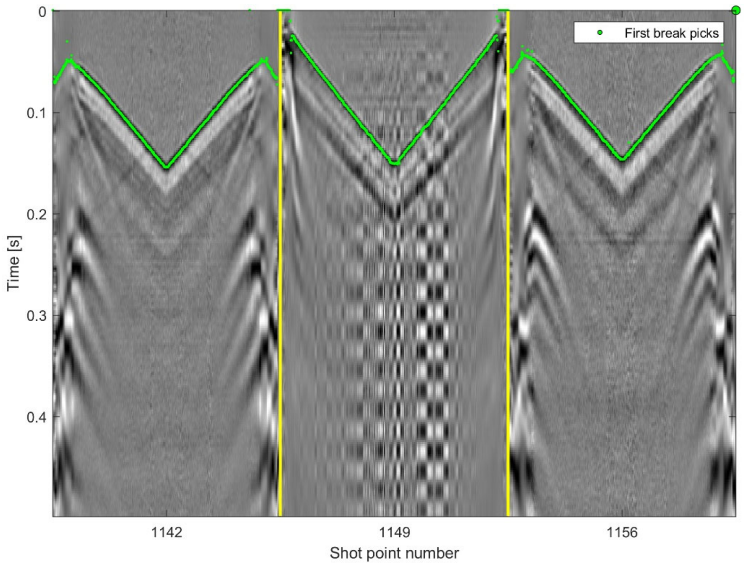
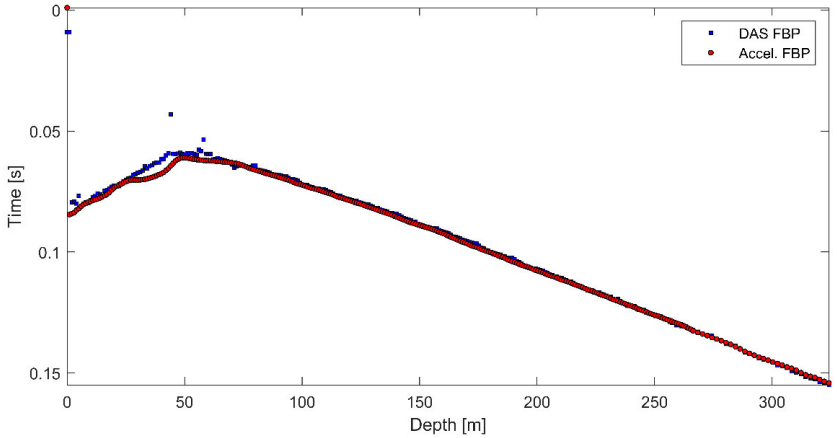
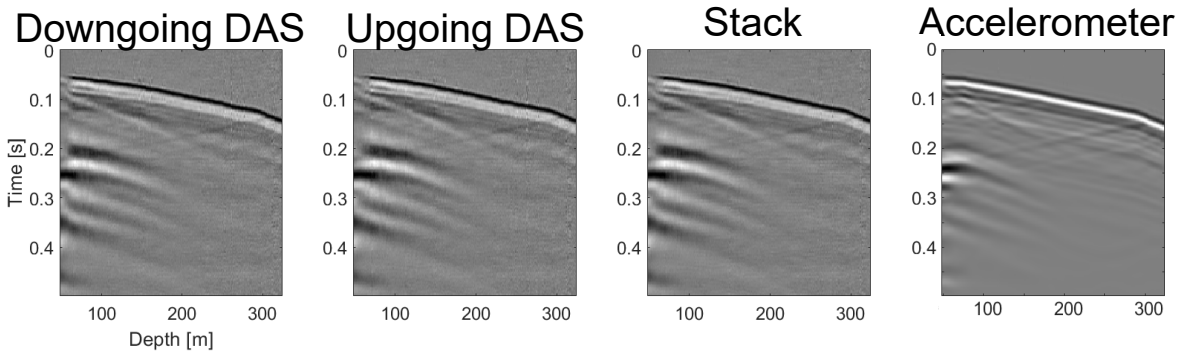
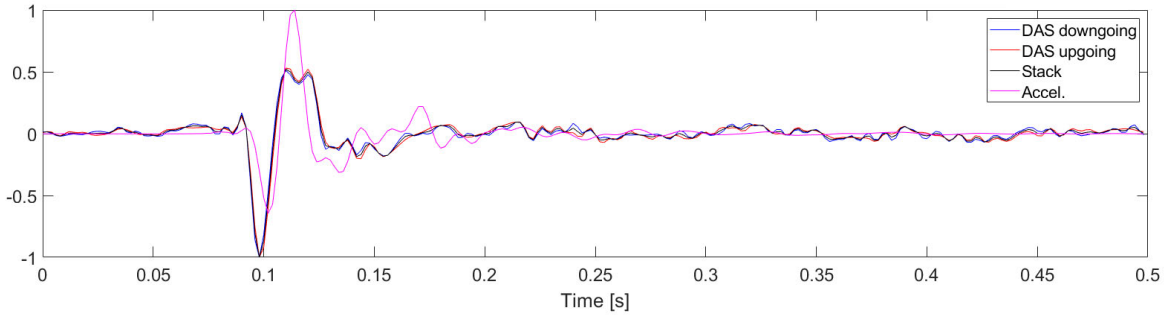


DAS geometry processing





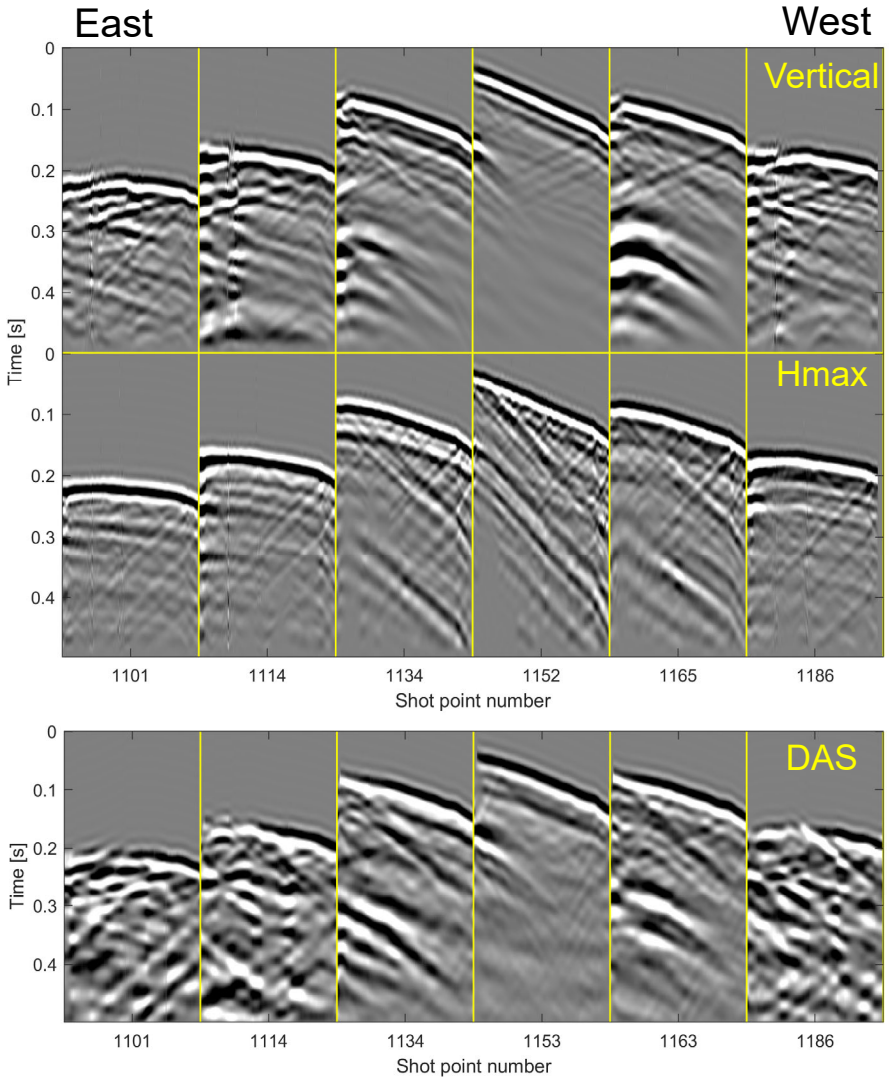




- Data driven method for depth registering DAS data
- Reduces uncertainty in DAS trace locations

Processed field data comparison

- Processed field data is relatively clean and shows strong upgoing wave motion.
- DAS data strongly correlated to vertical accelerometer data but lacks complexity of H_{max}.



Model parameterizations in FWI

- The way in which the subsurface is parameterized has a significant influence on parameter estimates in FWI
  - Parameterizations affect sensitivities and therefore parameter estimates.
  - Some parameterizations expose us to cross-talk.
  - Can lead to non-geologic updates

- Ideally prior information can be used to guide the model parameterization.
  - First break picks
  - Well log information
  - Prior geologic information

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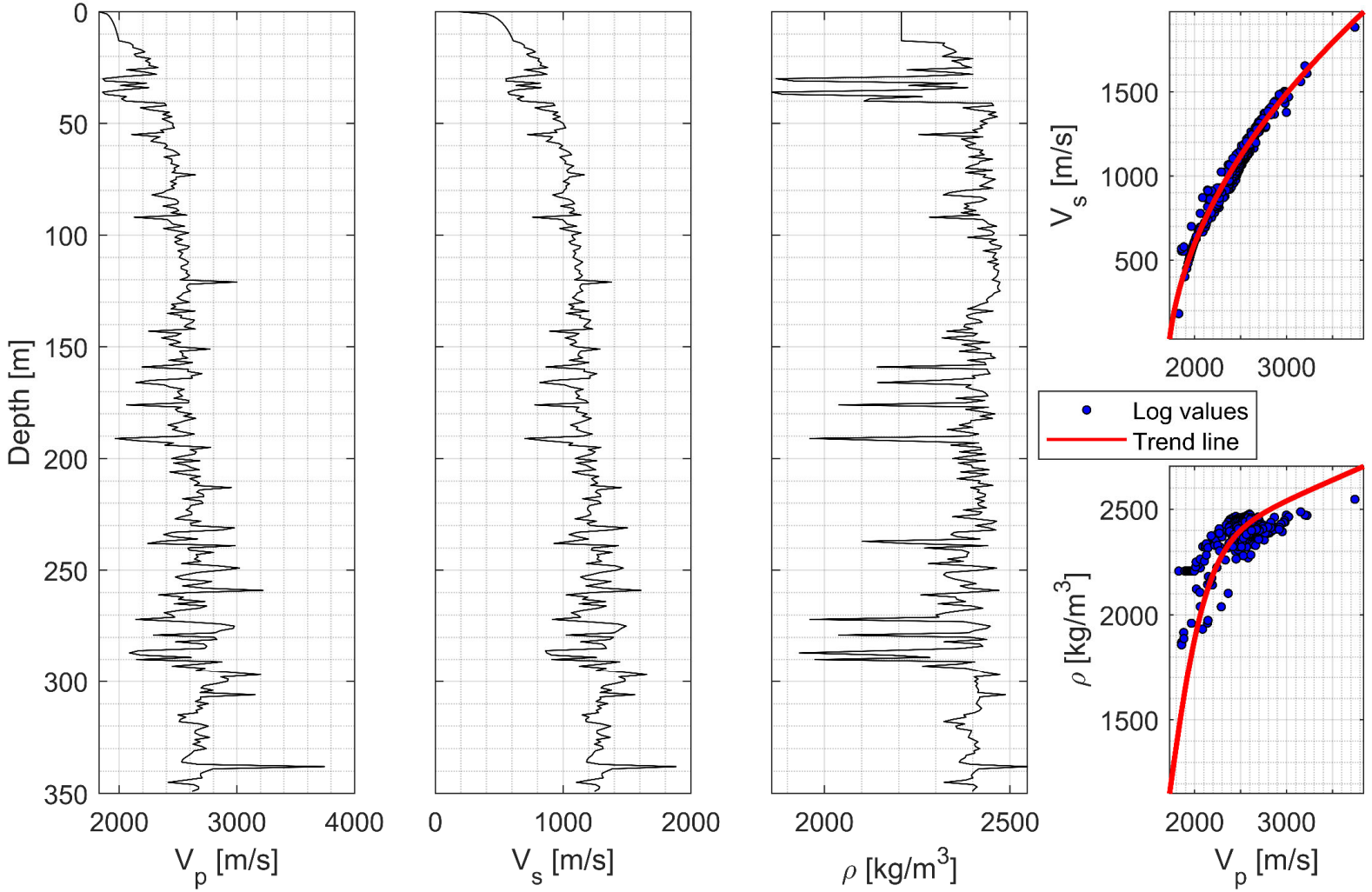
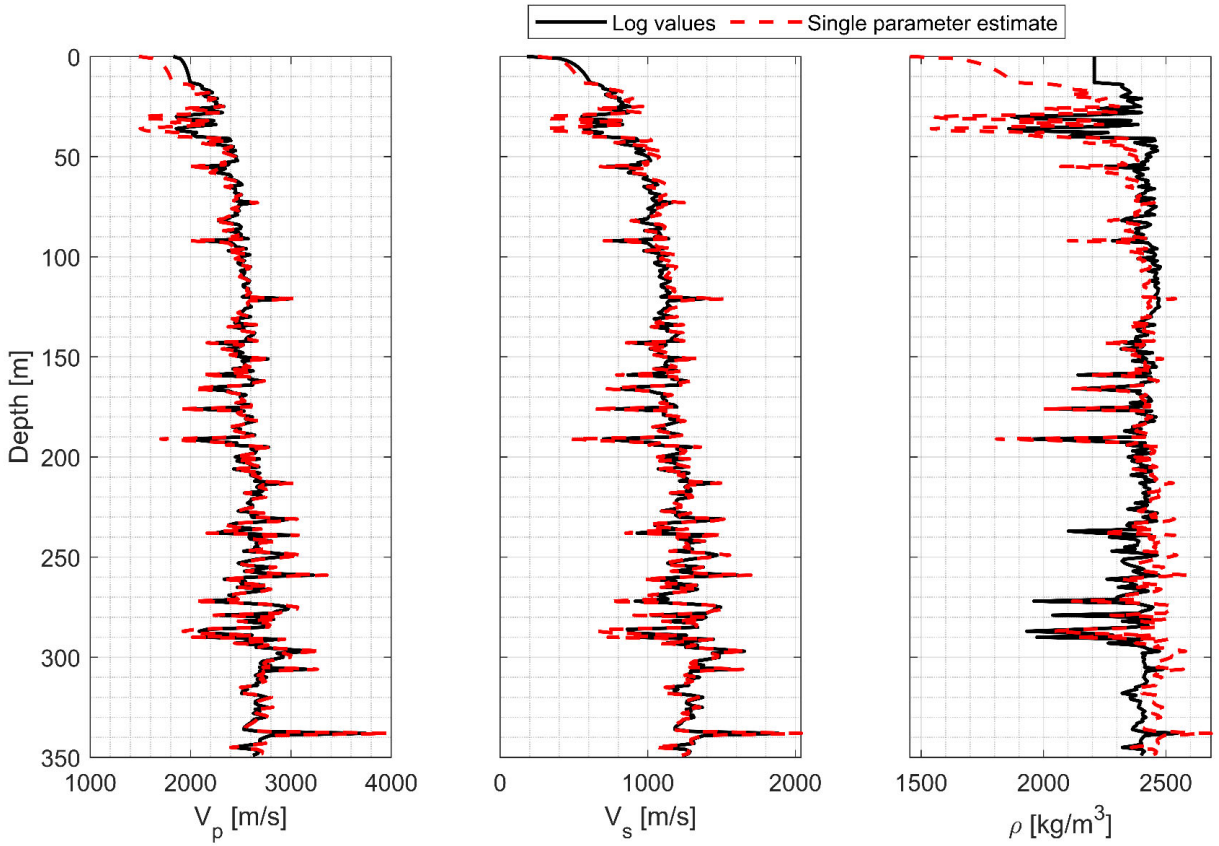


Model parameterization

- Well logs show that the majority of variance is described by one variable
- We characterize the model in terms of a single variable describing distance along the three-parameter trend line
- More parameters could be used to detect CO_2 induced changes



Summary

- In 2018 a 3D walkaway-walkaround VSP was acquired at the Containment and Monitoring Institutes Field Research Station.
- The accelerometer and DAS data were processed to prepare them for full waveform inversion.
- Well log information can be leveraged to parameterize the model and improve convergence.

Acknowledgements

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