3D Fréchet Kernels of Component-Differential Traveltimes and Z/H Amplitude Ratios

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Motivations

- Bypass the problem of nonlinear clock drift in OBS data
- Extend data utilization
- Improve model resolution and accuracy: 1D -> 3D

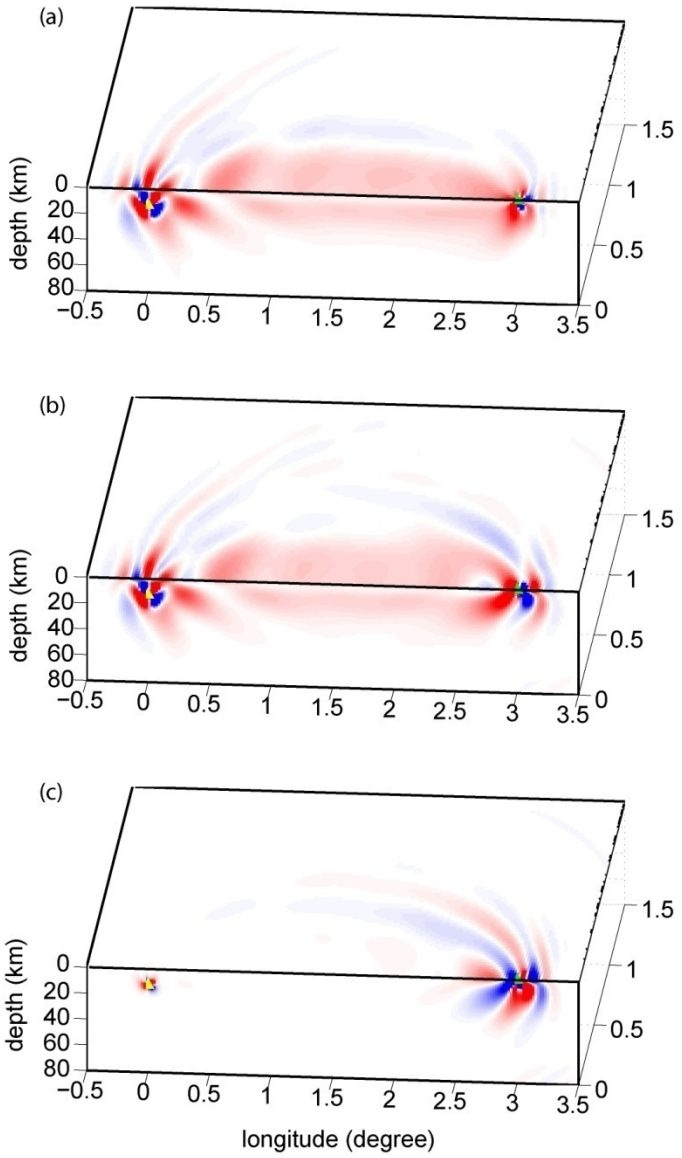
An example: 3D Component-Differential Kernels of Traveltime-delays to Vs

$$\delta t_Z = \int K_{V_s}^{Z}(\boldsymbol{r})\delta V_s dV$$

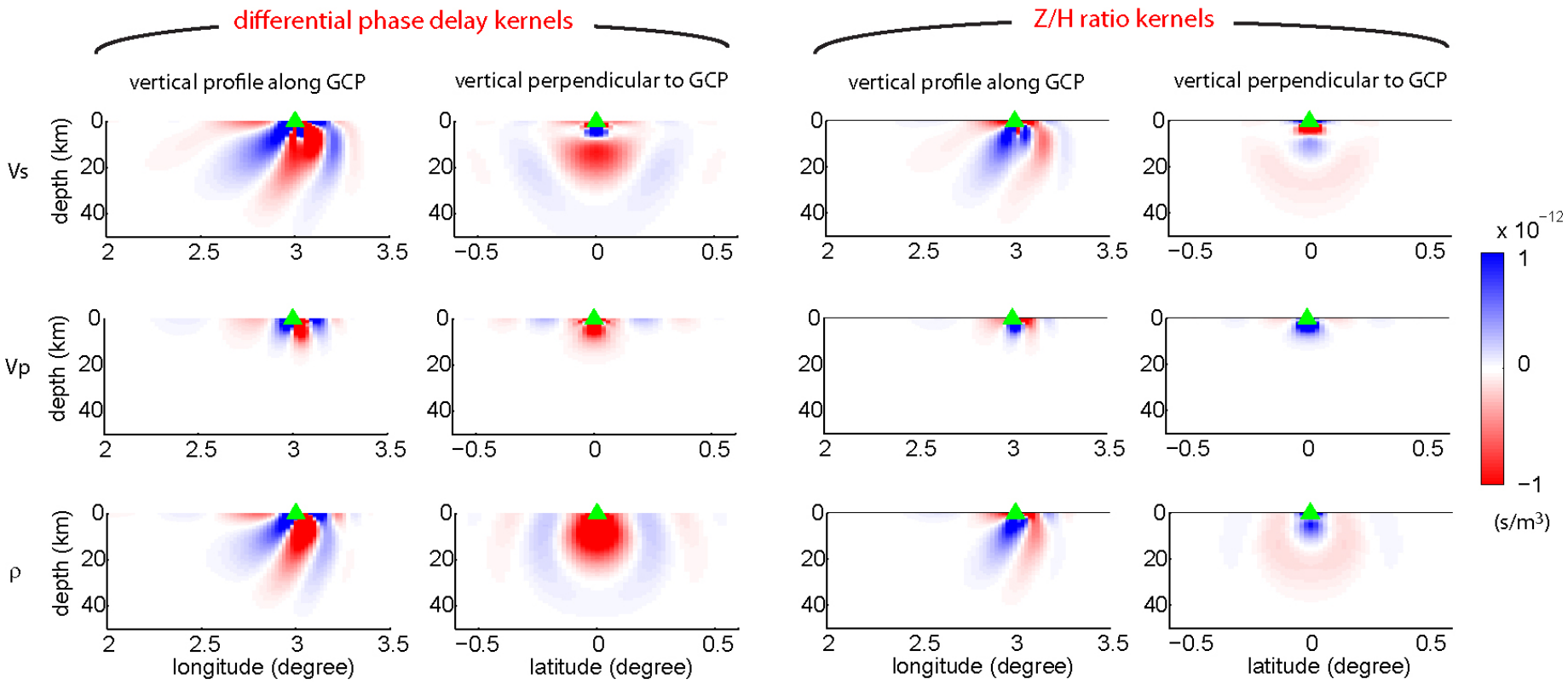
Traveltime delay kernel perturbation

$$\delta t_R = \int K_{V_s}^{R}(\boldsymbol{r})\delta V_s dV$$

$$\delta t_Z - \delta t_R = \int \left[K_{V_S}^{Z}(\boldsymbol{r}) - K_{V_S}^{R}(\boldsymbol{r})\right]\delta V_s dV$$



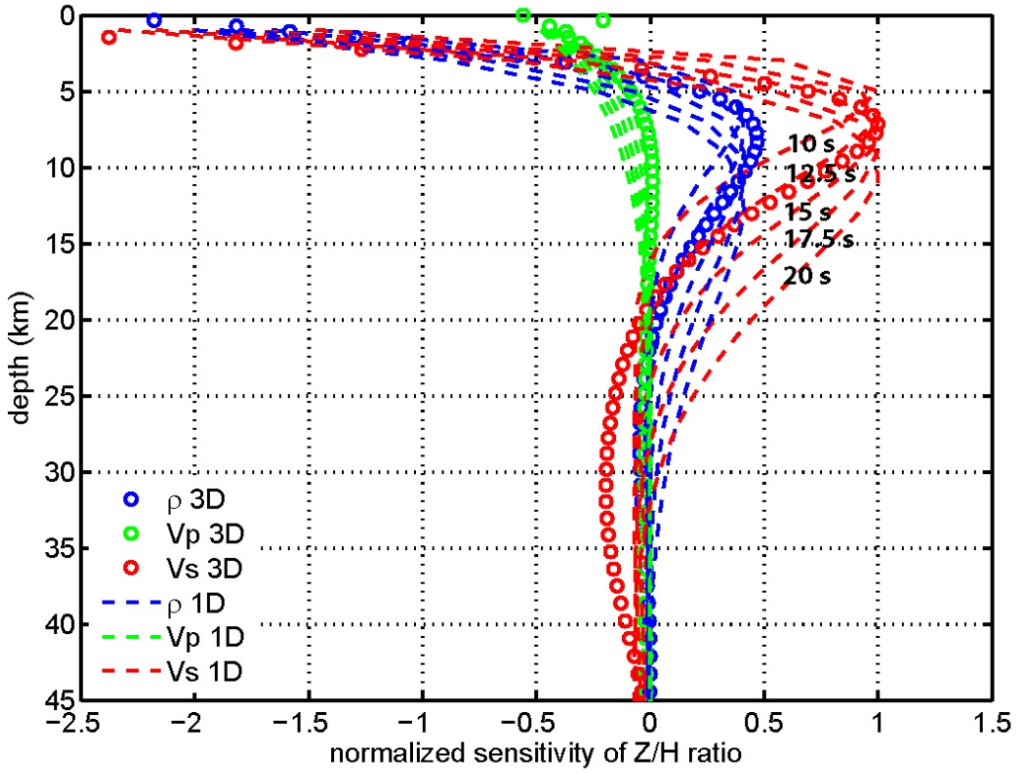
Differential Kernels on the receiver side



10-20 s Rayleigh Waves. Source is at (0°, 0°)

Z/H ratio kernels

3D versus 1D



the 3D kernels are calculated for the periods of 10-20 s

Conclusion

- The Rayleigh- and P-wave Z/H ratios and component-differential traveltimes provide both vertical and lateral constraints on the 3D structure near the receiver.
- There is a strong tradeoff between Vs and ρ. Ignoring ρ in inversion may lead to significant biases in the model.
- The 3D kernels can be a powerful tool in high-resolution seismic tomography, and can be particularly useful to bypass the timing issue in OBS data.

Future work

Applying the 3D kernels to OBS tomography studies.