Deblending RTM in receiver domain

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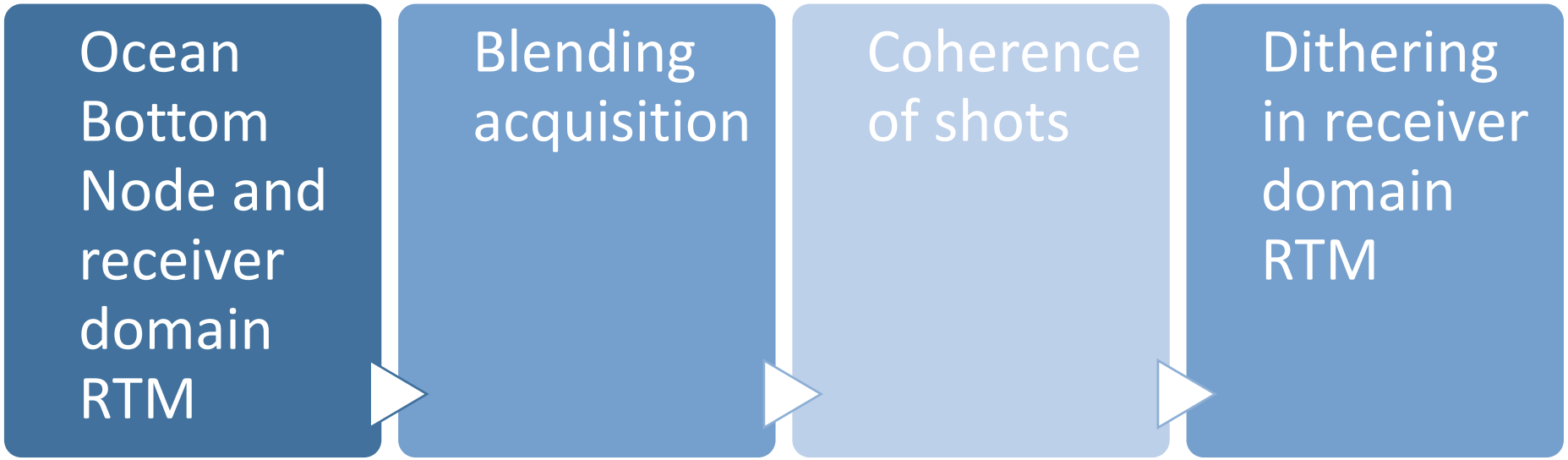
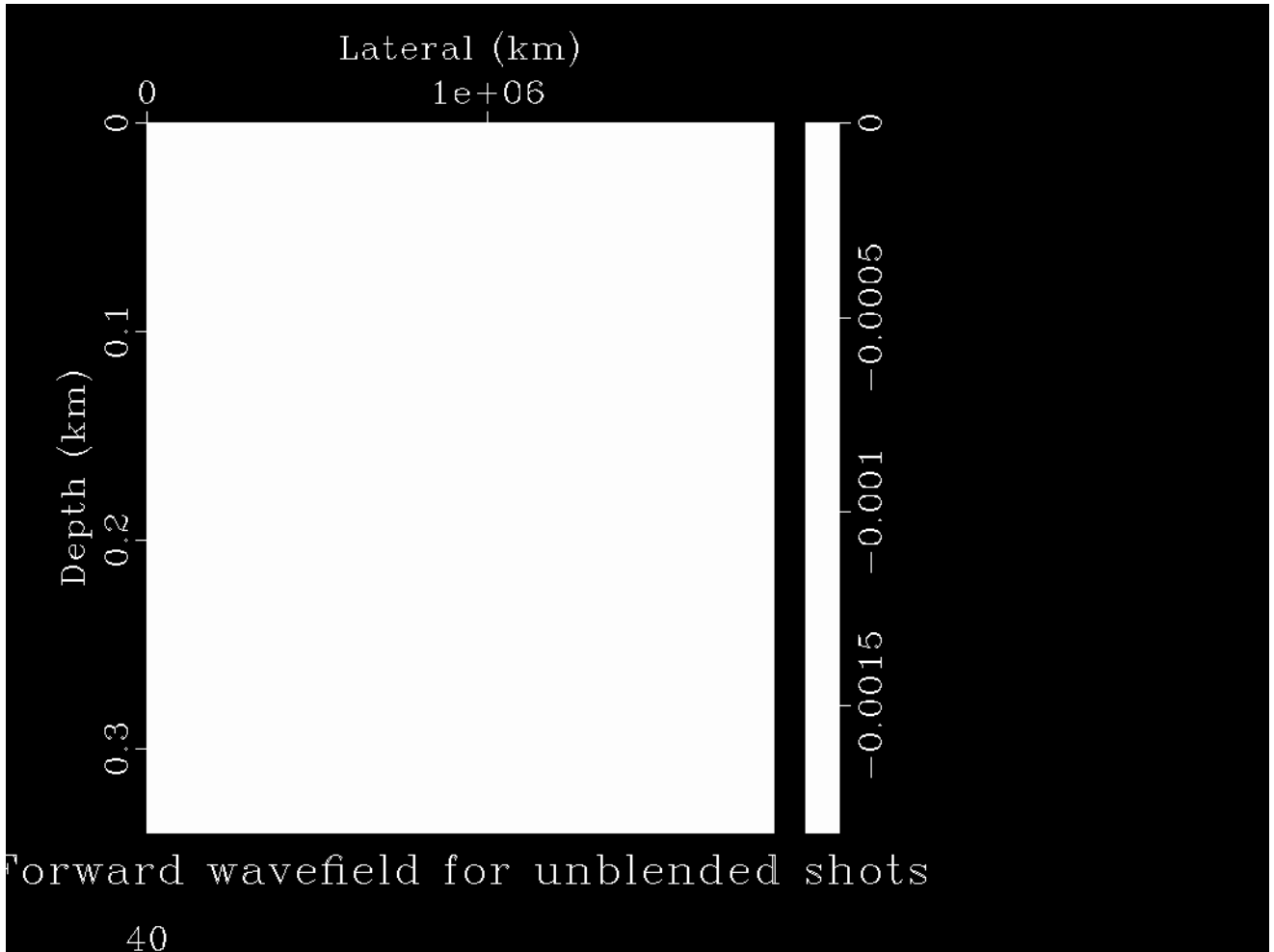
Outline


Ocean Bottom Node and receiver domain RTM
Blending acquisition
Coherence of shots
Dithering in receiver domain RTM

Ocean Bottom Node and receiver domain RTM

Reverse Time Migration in shot domain

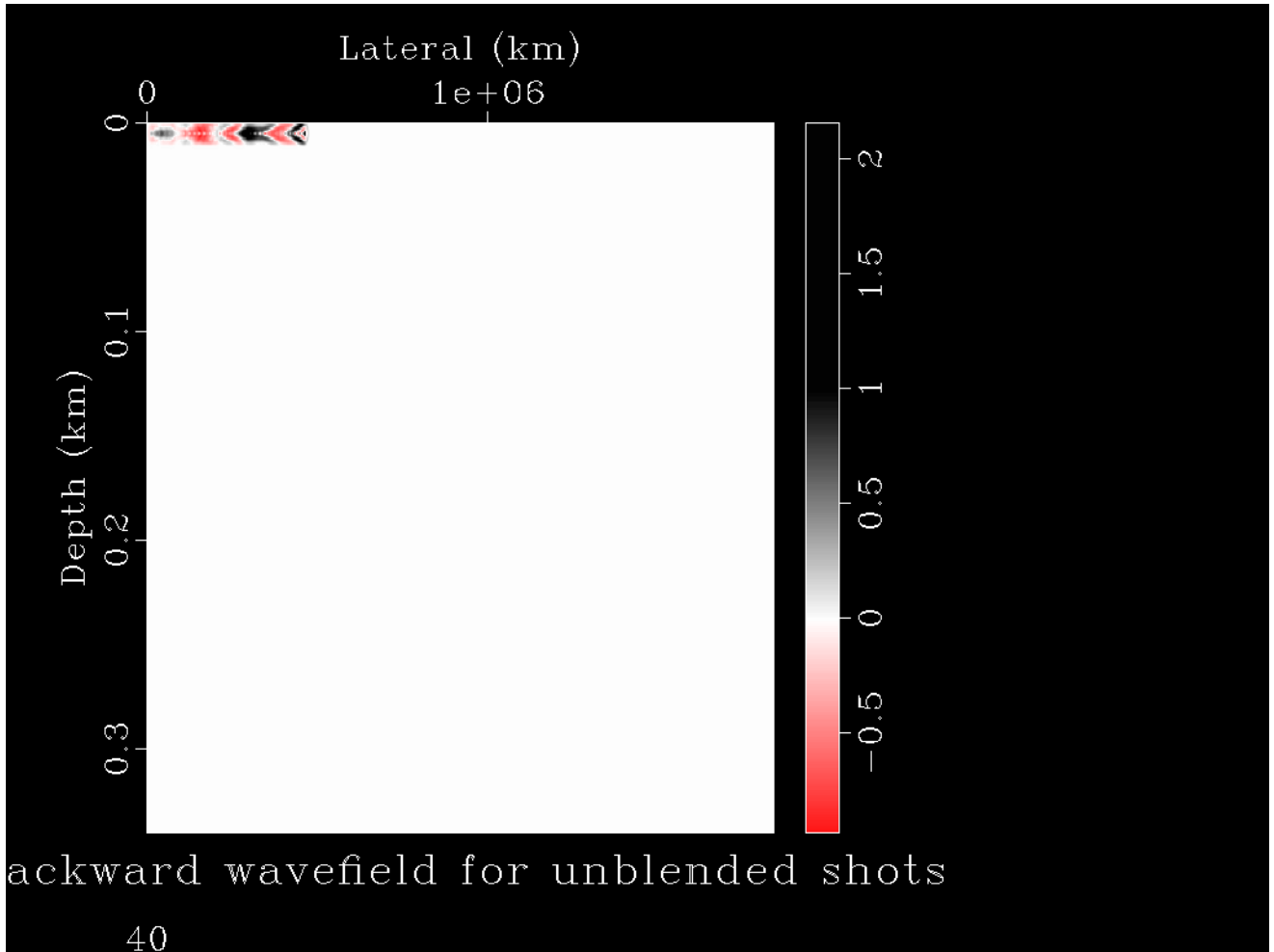
1.inject source in forward wavefield



Ocean Bottom Node and receiver domain RTM

Reverse Time Migration in shot domain

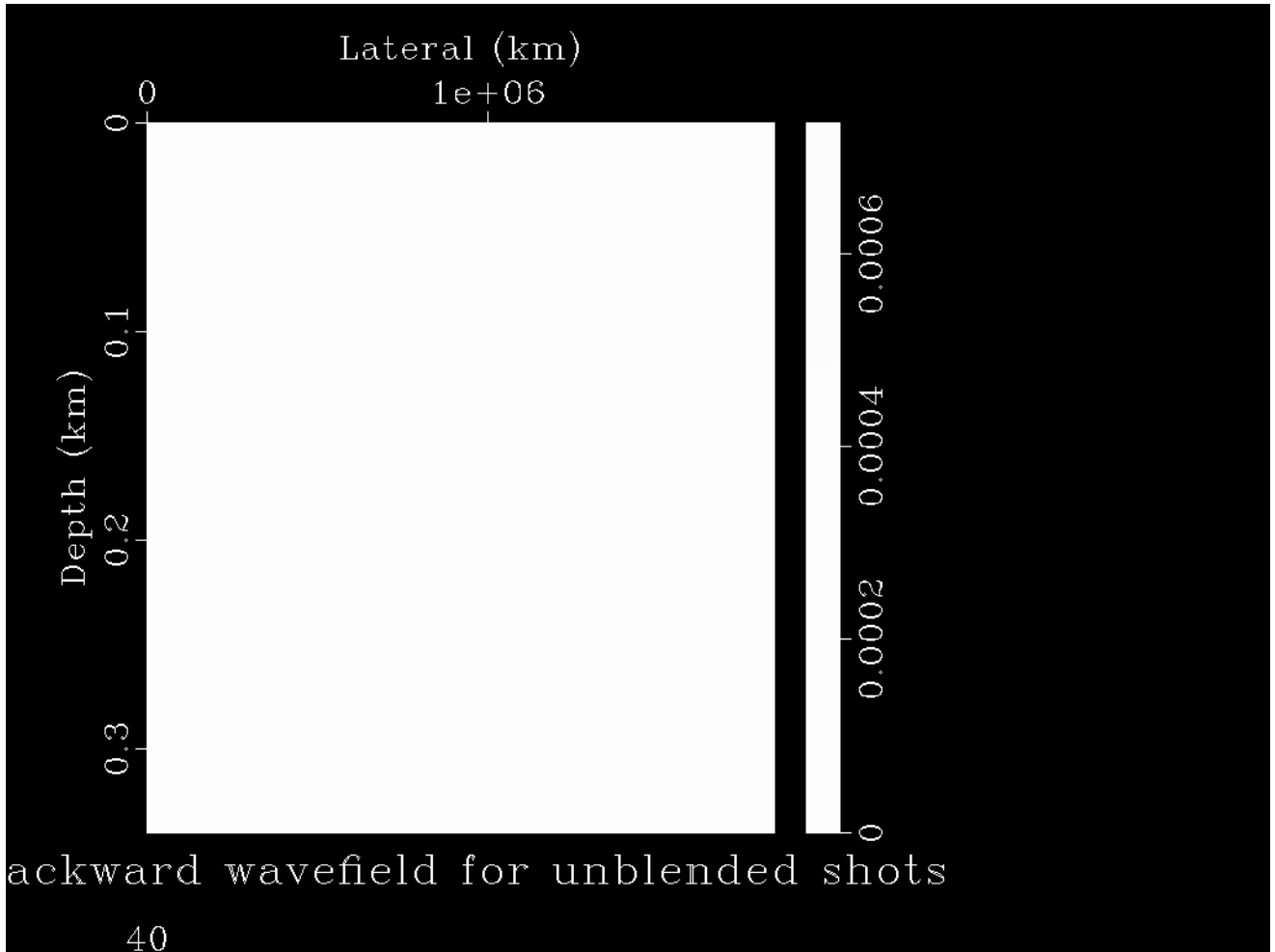
2.inject data in backward wavefield



Ocean Bottom Node and receiver domain RTM

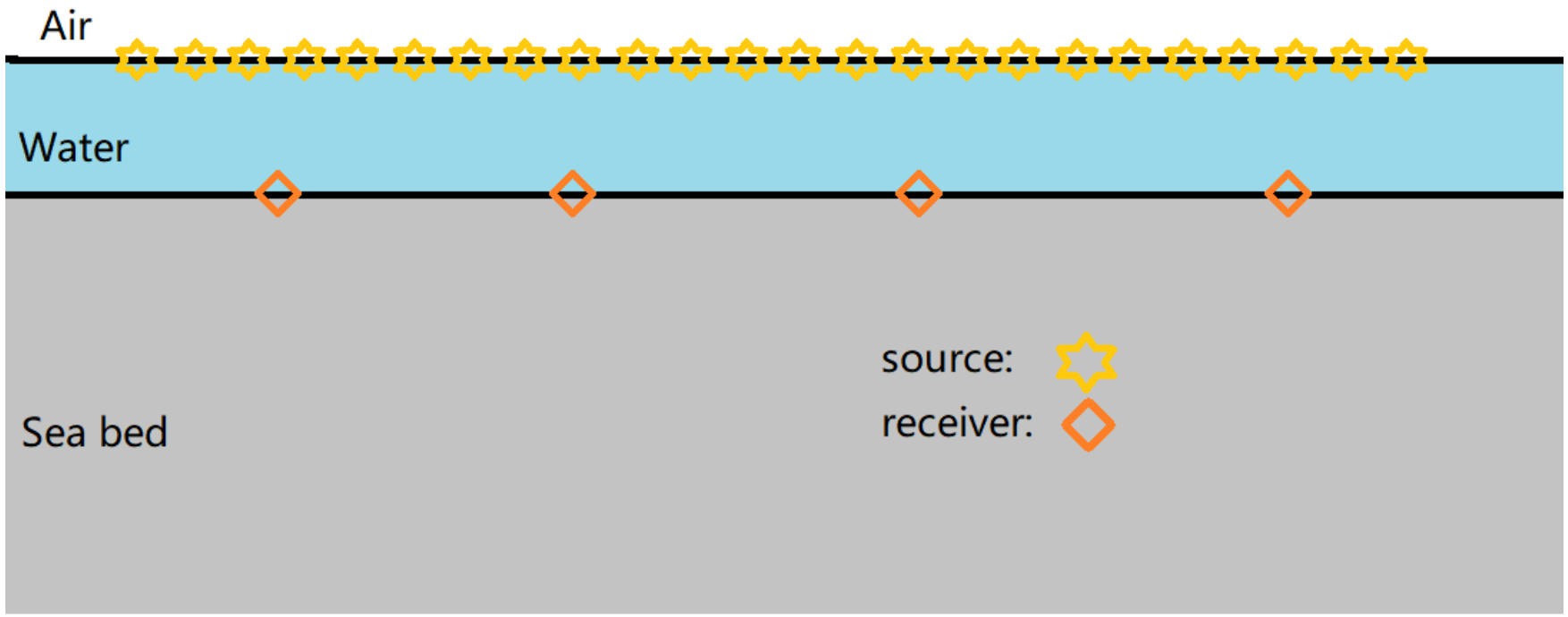
Reverse Time Migration in shot domain

3.Cross-correlation of the two wavefields



Ocean Bottom Node and receiver domain RTM

Ocean Bottom Node / OBN / Nodes



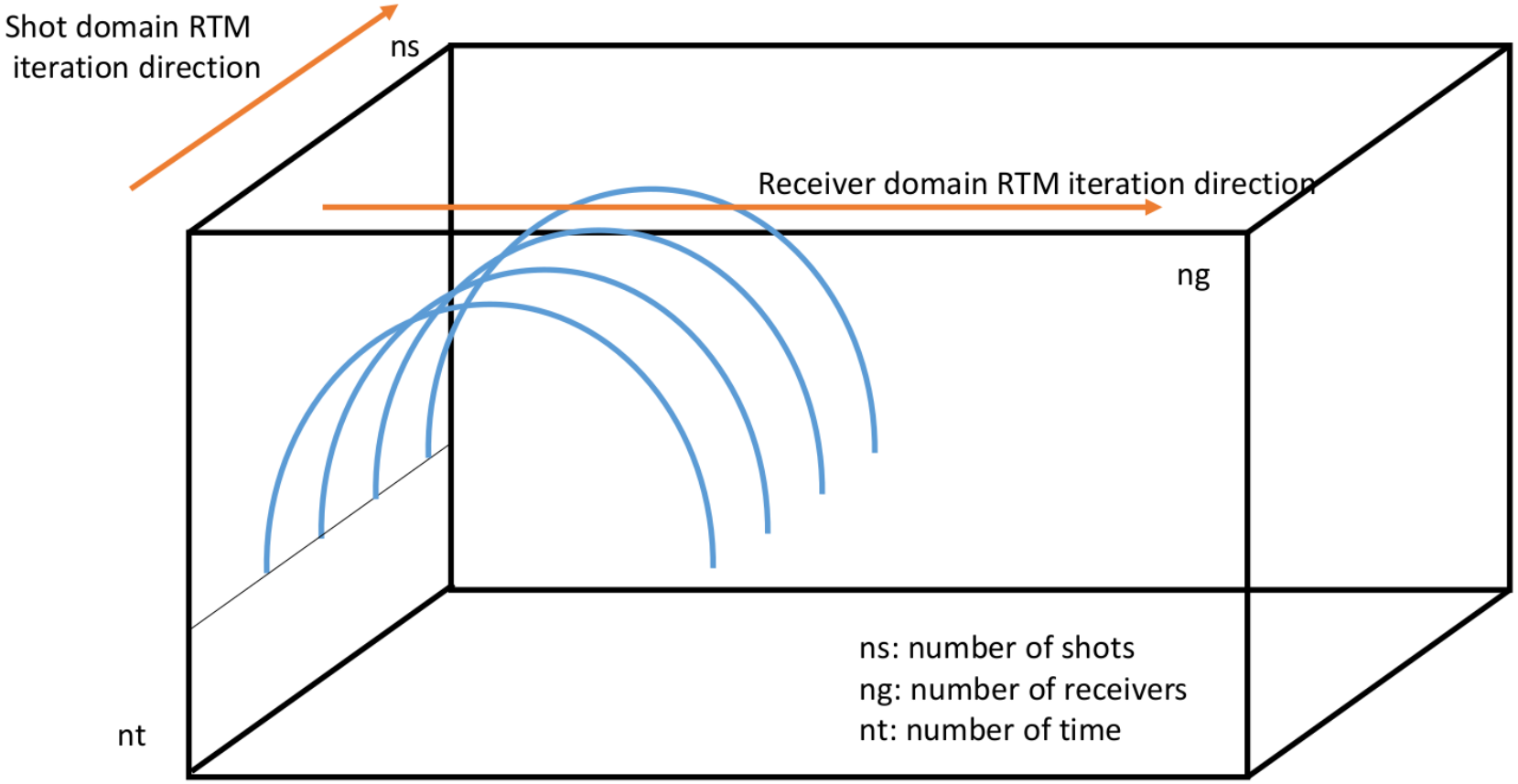
Ocean Bottom Node and receiver domain RTM

Why Ocean Bottom Node?

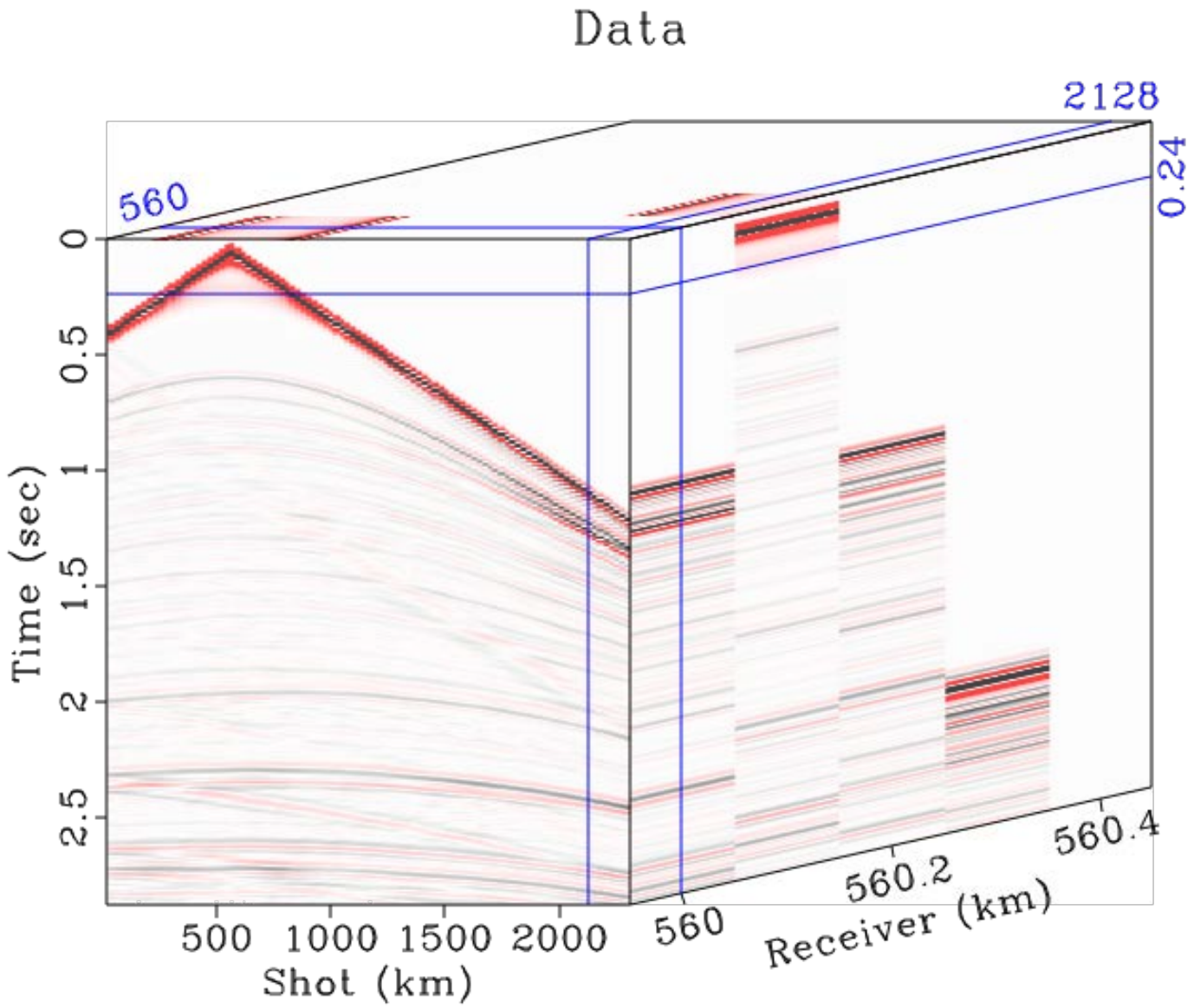
- quieter on the seabed than water surface.
- acquire wide azimuth and long offset data more cost “effectively”.
- better coverage in areas around platforms.
- record shear-waves.
- multiple attenuation by separating upcoming and down-going wave-fields

O.I. Barkved, 2012, Seismic Surveillance for Reservoir Delivery From a Practitioner’s Point of View, EAGE Publications, 130

Receiver domain RTM

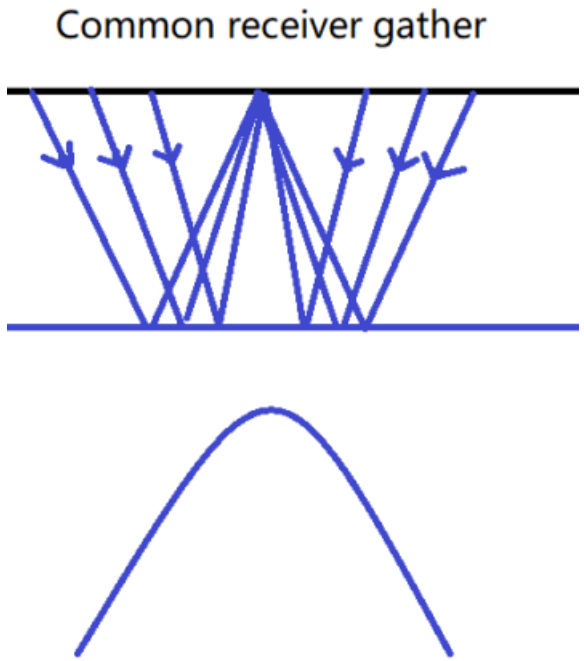


Ocean Bottom Node and receiver domain RTM



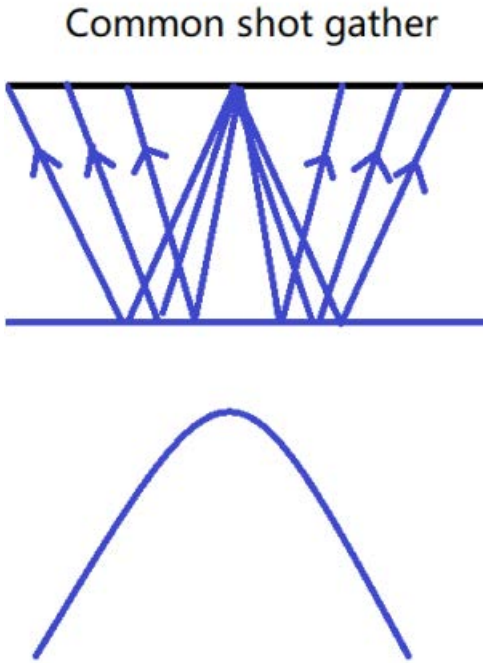
Ocean Bottom Node and receiver domain RTM

Common receiver gather is the data gathered from one receiver.



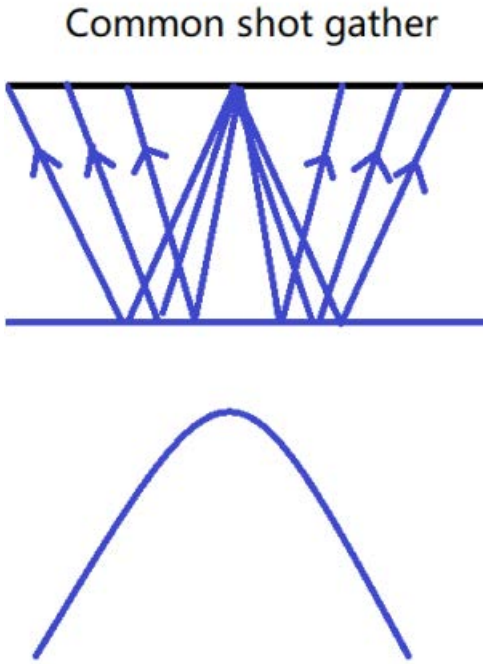
Ocean Bottom Node and receiver domain RTM

Utilizing the principle of reciprocity, the locations of shots and receiver are exchanged in the Common Receiver Gather.



Ocean Bottom Node and receiver domain RTM

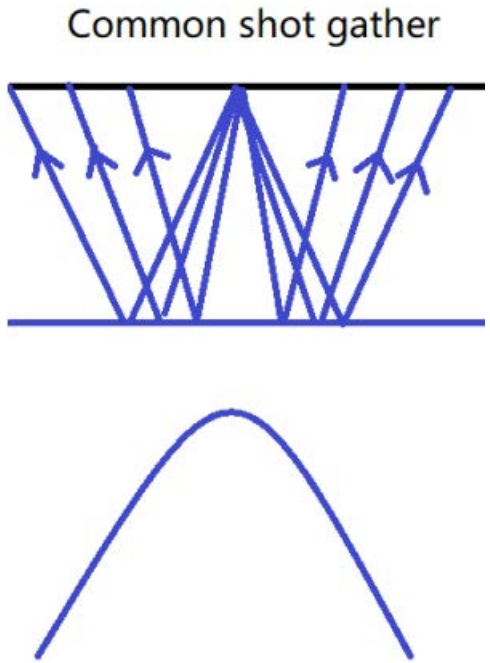
The seismic traces acquired from the one receiver corrsponding to each shots are assigned to the location of the shots. In the receiver domain RTM, the traces are injected in the backward propagation.



Ocean Bottom Node and receiver domain RTM

In the receiver domain RTM, the cross-correlation of froward and backward wavefield is computed for every receivers.

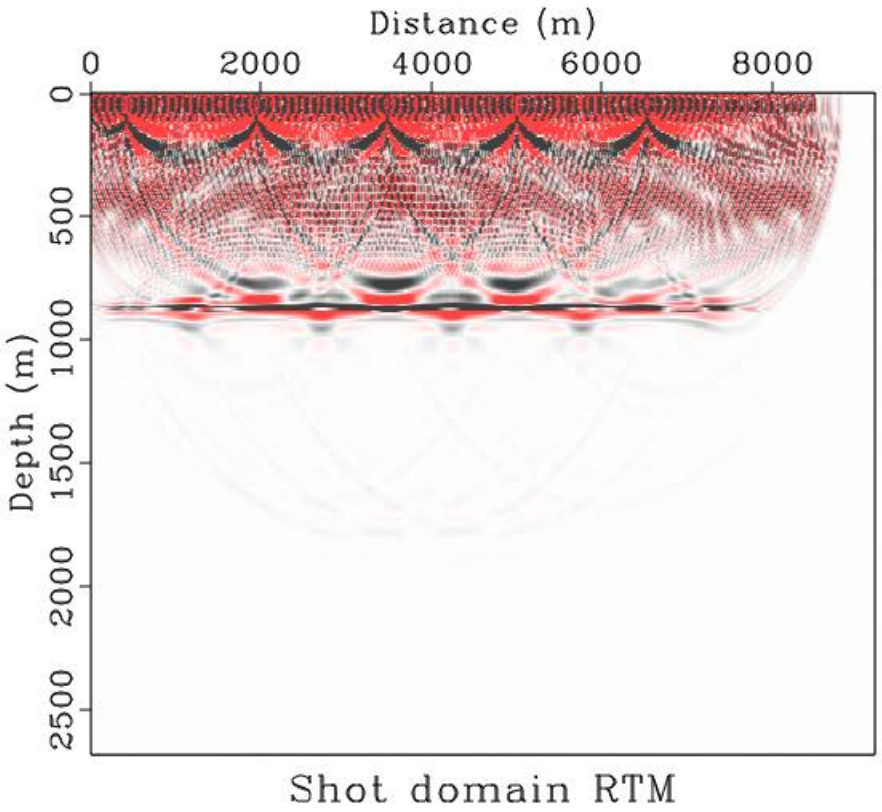
The traces from one receiver are injected in the backward wavefield propagation in in iteration.



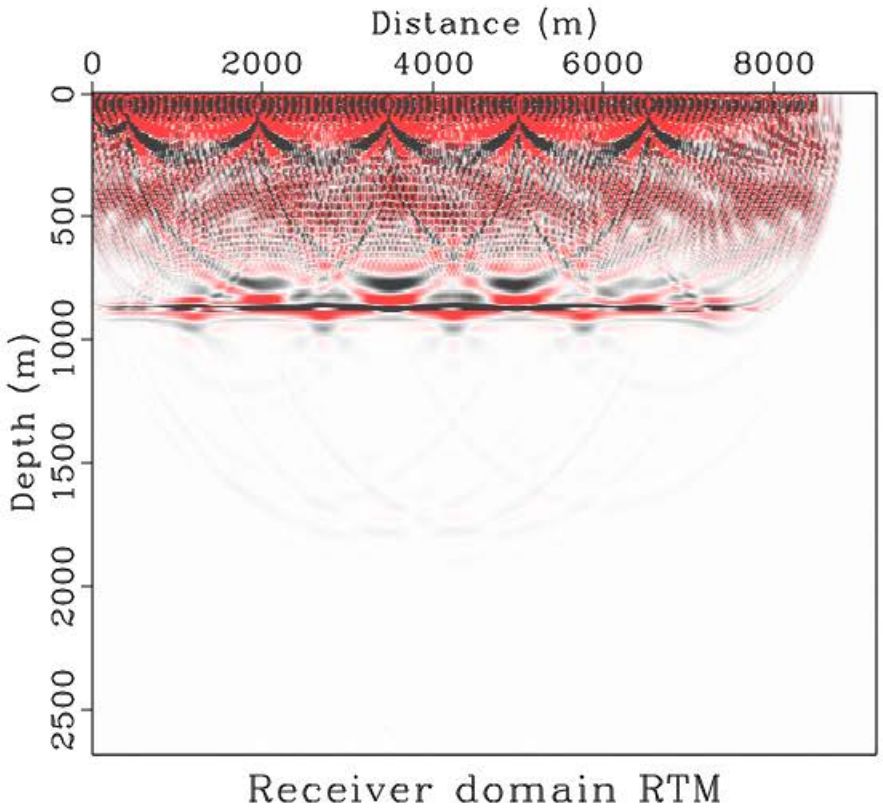
Ocean Bottom Node and receiver domain RTM

RTM in shot and receiver domain?

Two-layer model, unblended data



Shot domain RTM

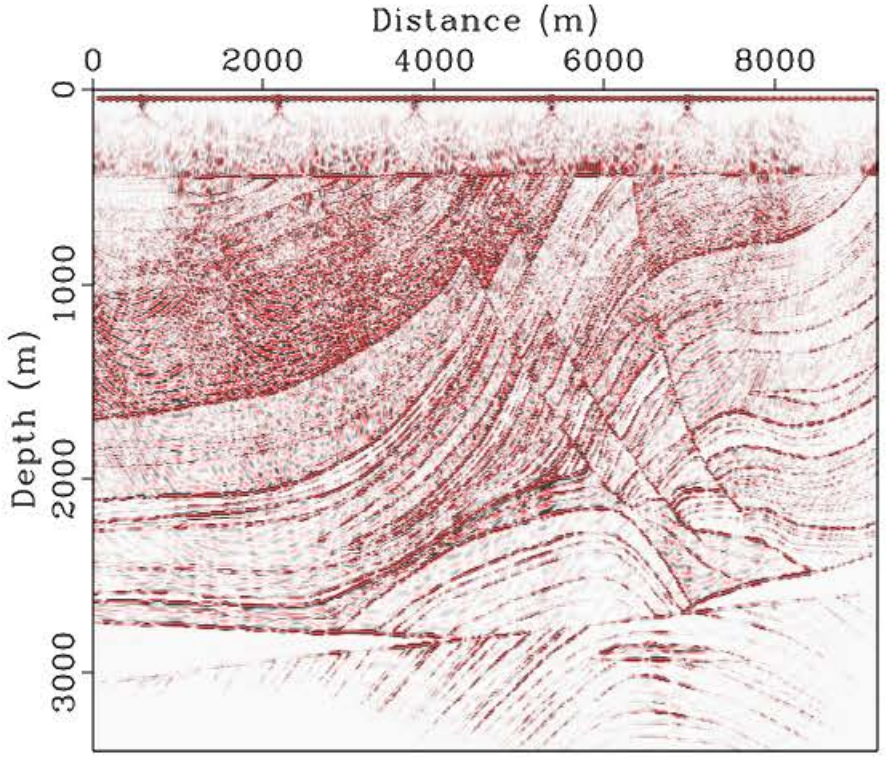


Receiver domain RTM

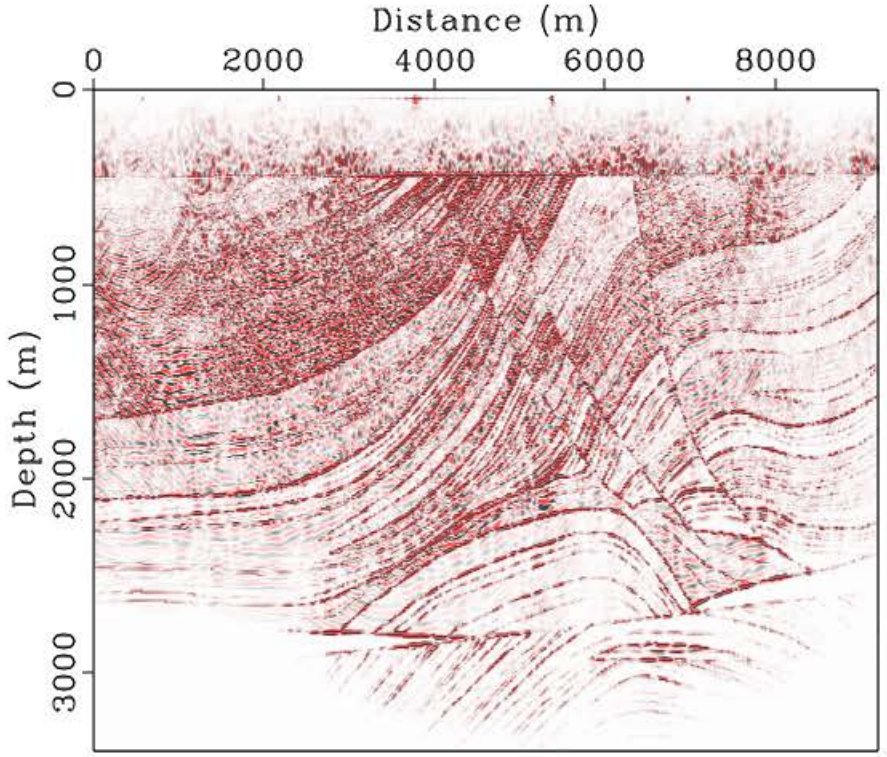
Ocean Bottom Node and receiver domain RTM

RTM in shot and receiver domain?

Two-layer model, marmousi data



BLended shot domain RTM for marmousi model



Blended receiver domain RTM for marmousi model

Ocean Bottom Node and receiver domain RTM

Receiver domain RTM

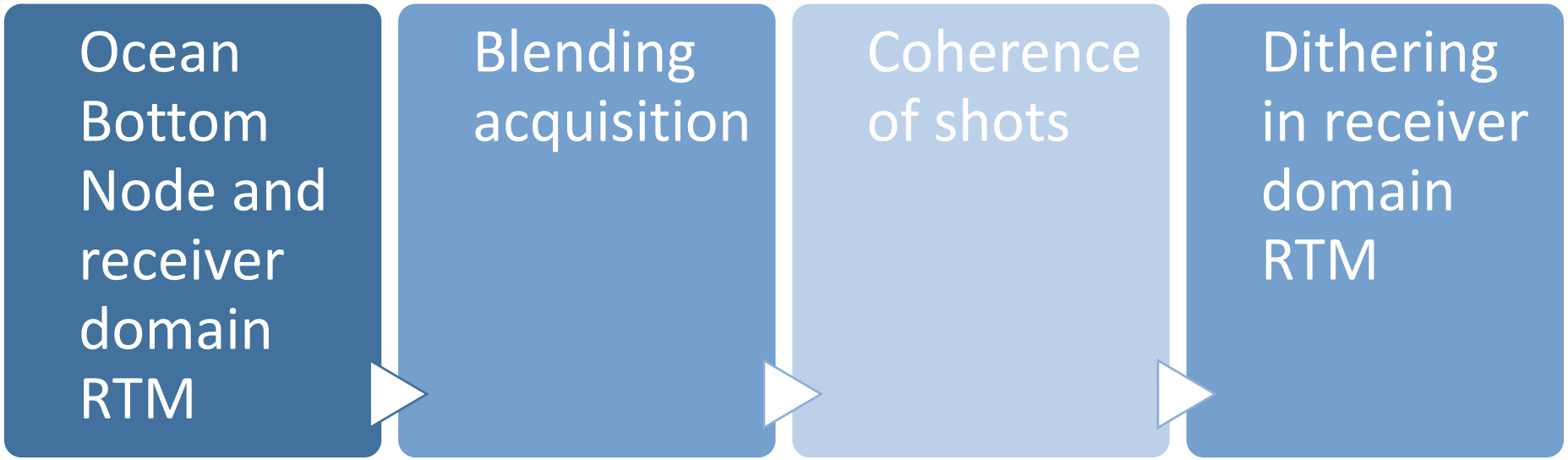
Computation of Shot domain RTM is proportional to #sources.

Computation of Receiver domain RTM is proportional to #receivers.

OBN has many sources and few receivers->

Receiver domain RTM saves computation in OBN.

Outline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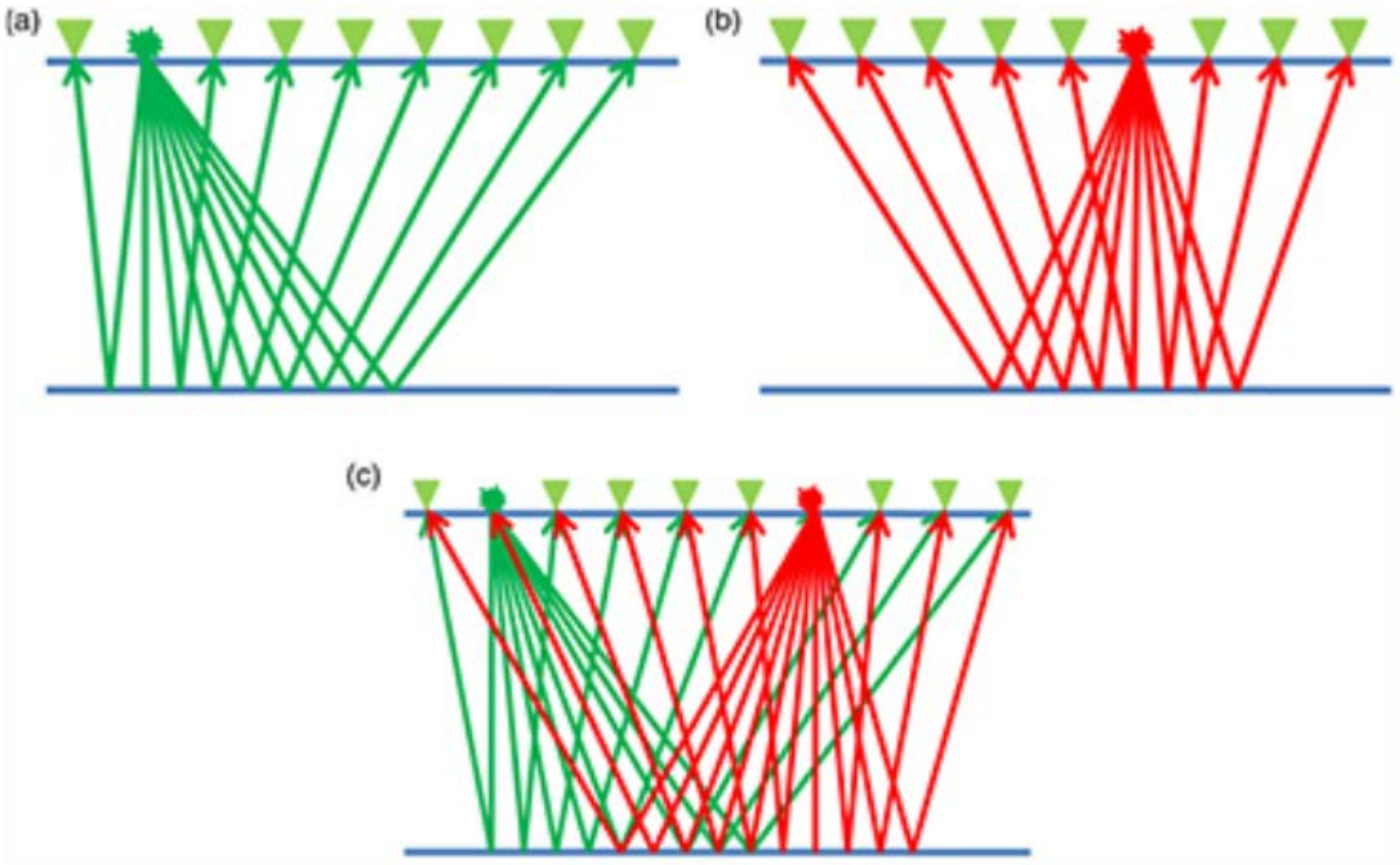
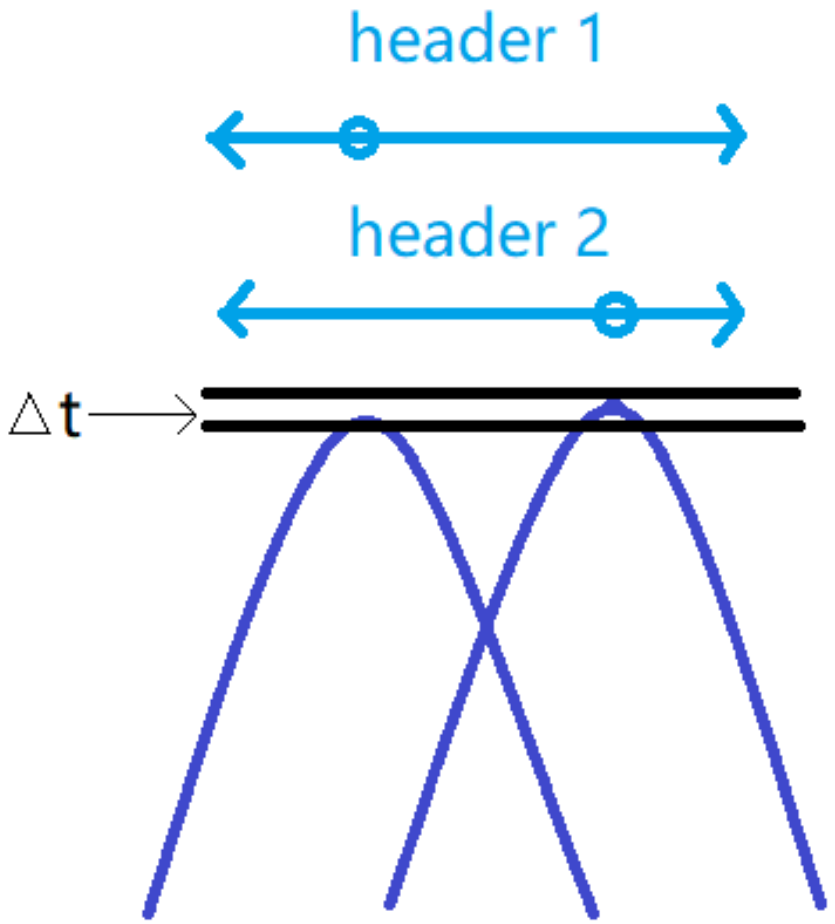
Blending acquisition: simultaneous shooting



Beasley, C. J., Chambers, R. E., and Jiang, Z., 1998, A new look at simultaneous sources, in SEG Technical Program Expanded Abstracts 1998, Society of Exploration Geophysic
Journal of Geophysics and Engineering, Volume 12, Issue 2, April 2015, Pages 167–174, https://doi.org/10.1088/1742-2132/12/2/167

Blending acquisition

Information we get that can distinguish them are multiple sets of headers and the time delay between sources.



Blending acquisition

Why blending acquisition?

0. Data acquisition is by far the most expensive part of seismic methods.
1. acquire more data without increasing the acquisition cost
2. decrease the acquisition time and therefore greatly

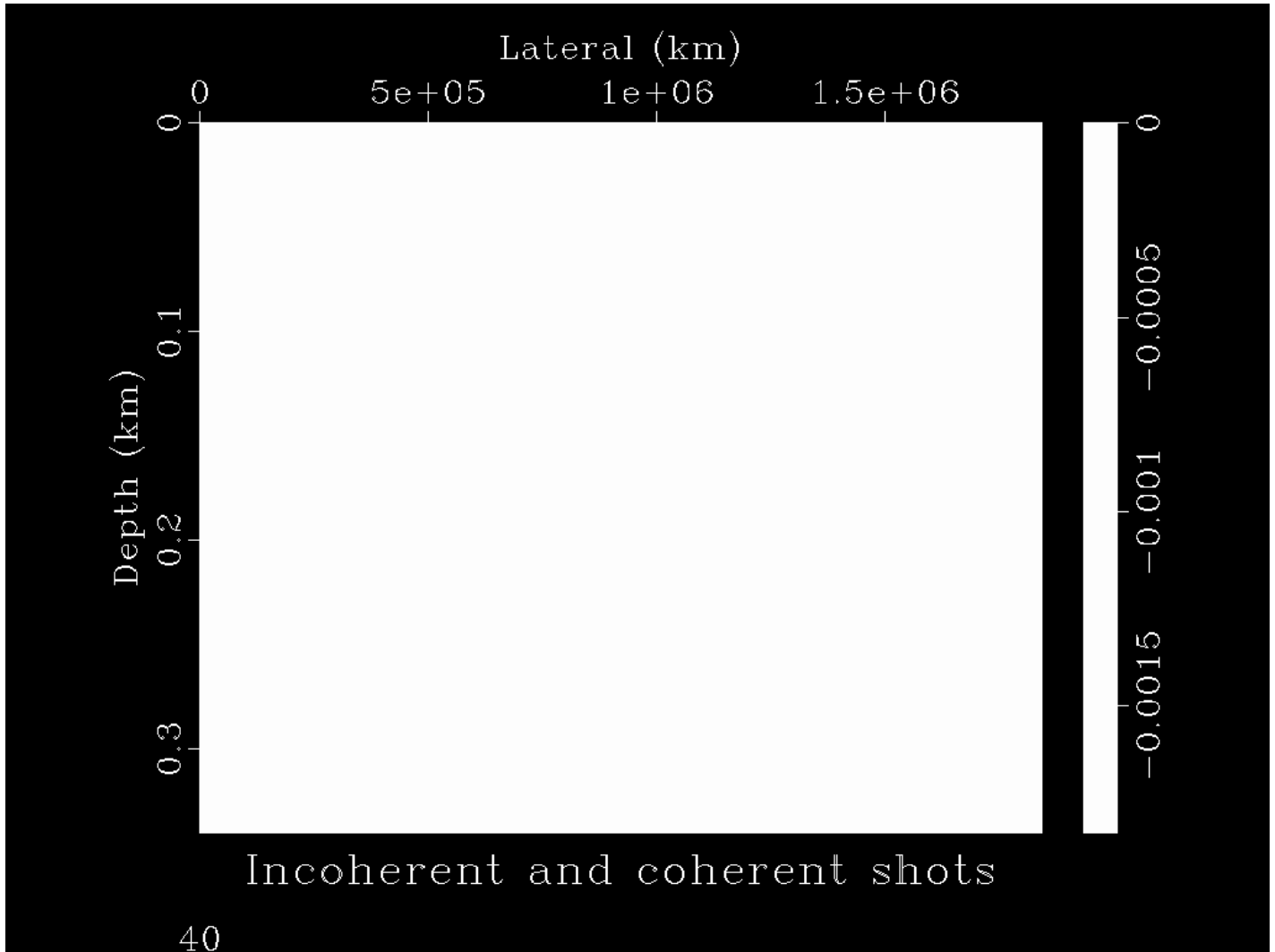
reduce the cost of information

Trad, D., 2018, Compressive sensing, sparse transforms and deblending.

Blending acquisition

Blended RTM in shot domain.

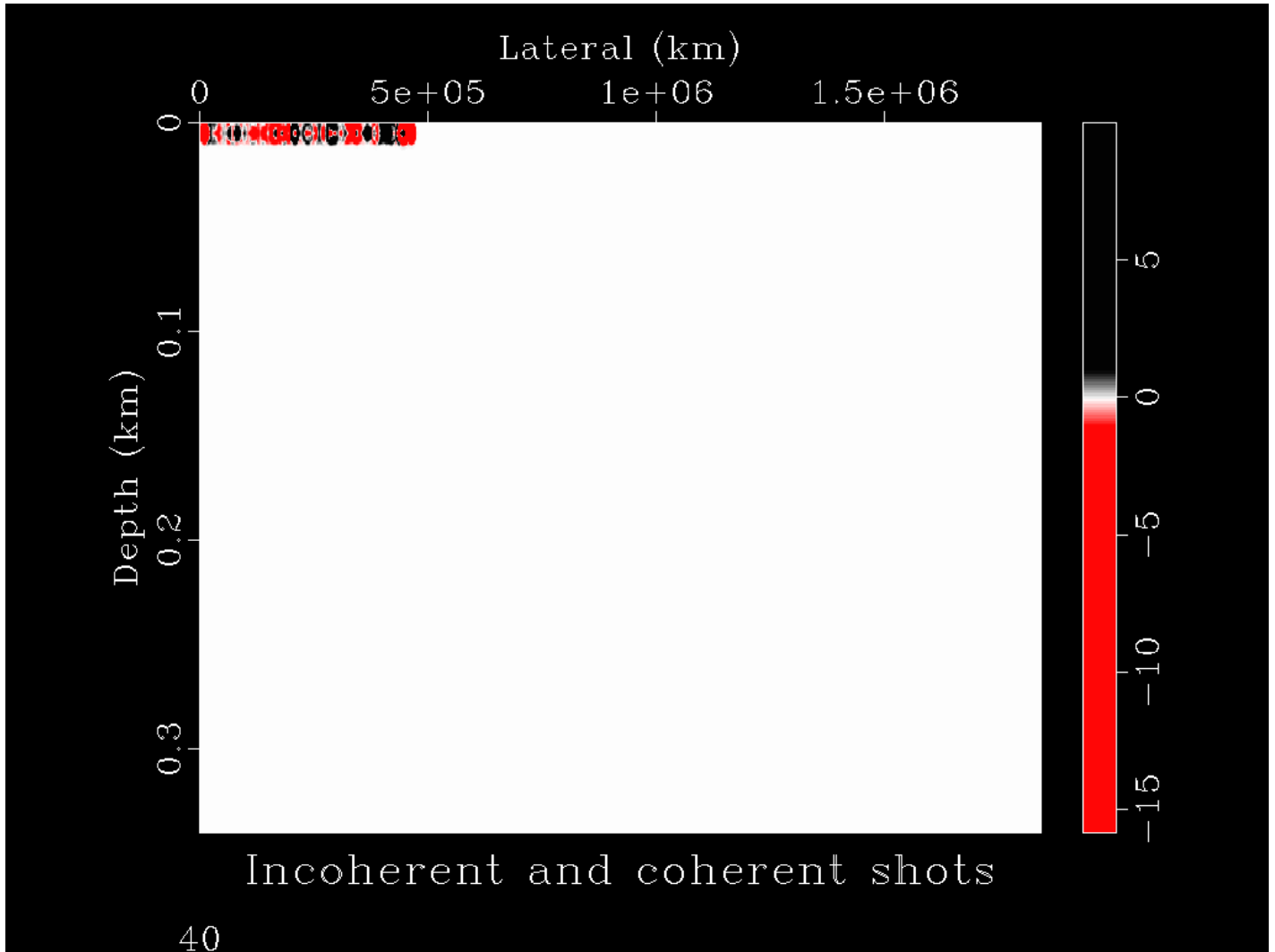
1.inject sources in forward wavefield



Blending acquisition

Blended RTM in shot domain.

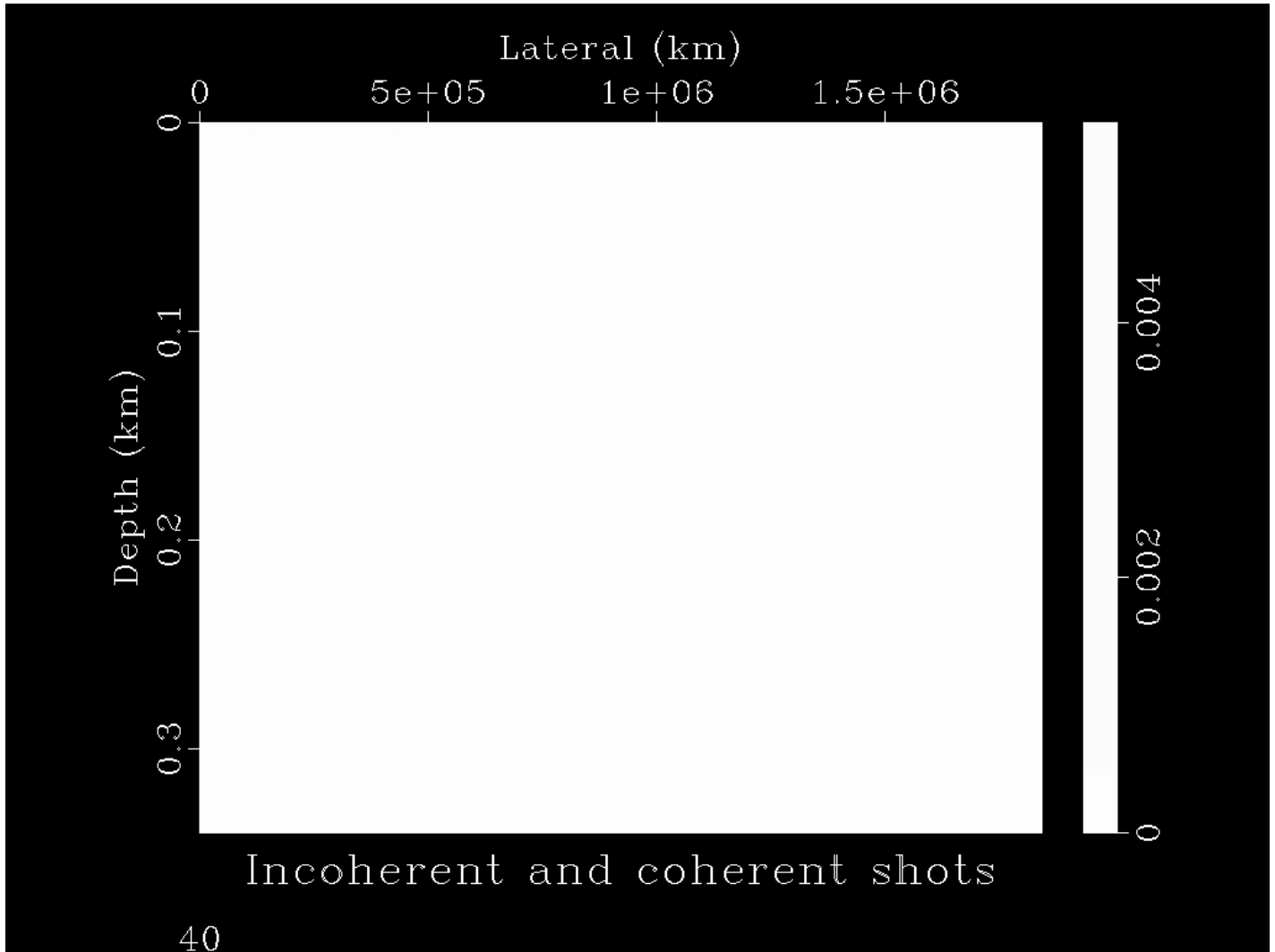
2.inject data in backward wavefield



Blending acquisition

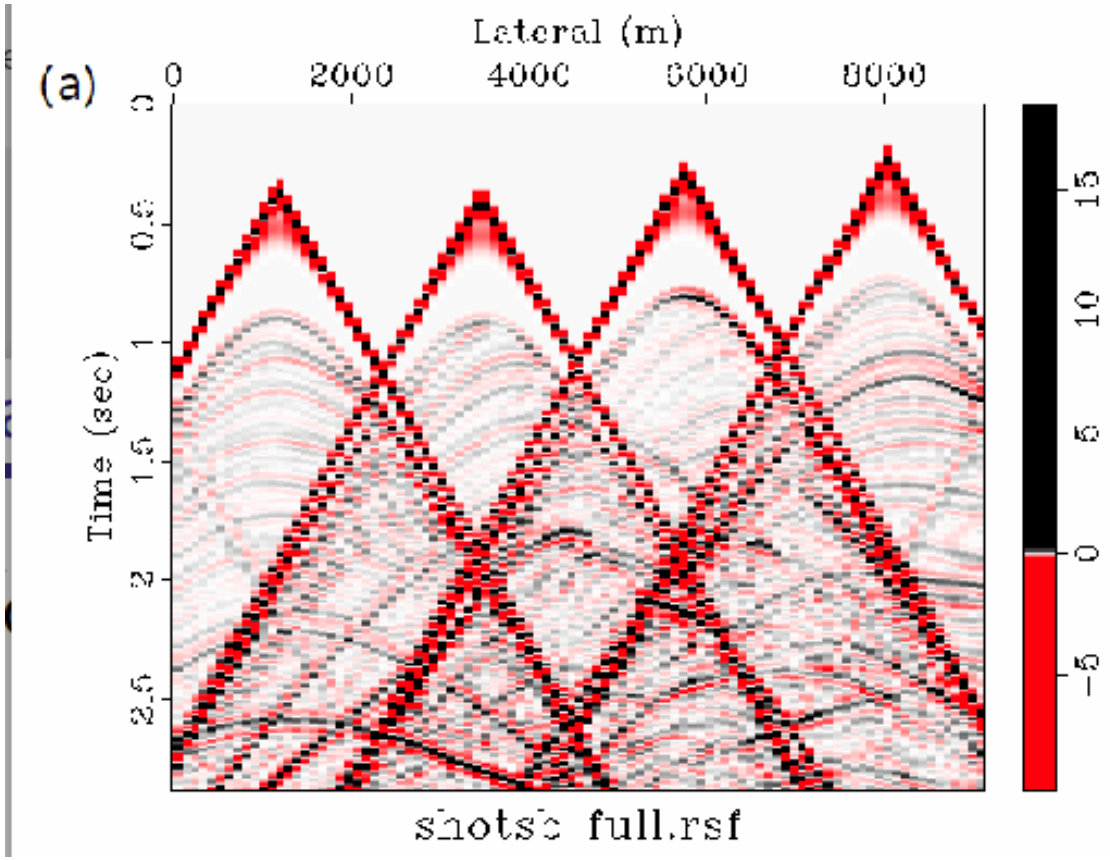
Blended RTM in shot domain.

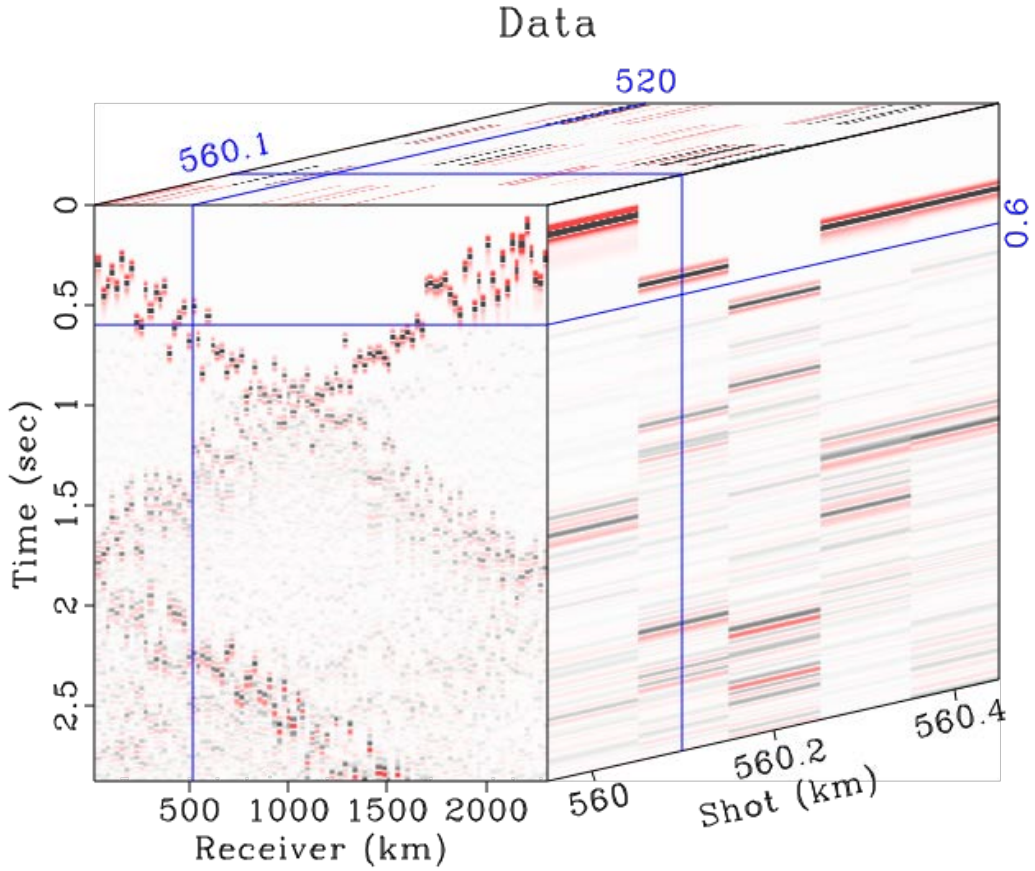
3.Cross-correlation of the two wavefields



What is deblending?

Each single shot in every “Supershot” has its own delay time.



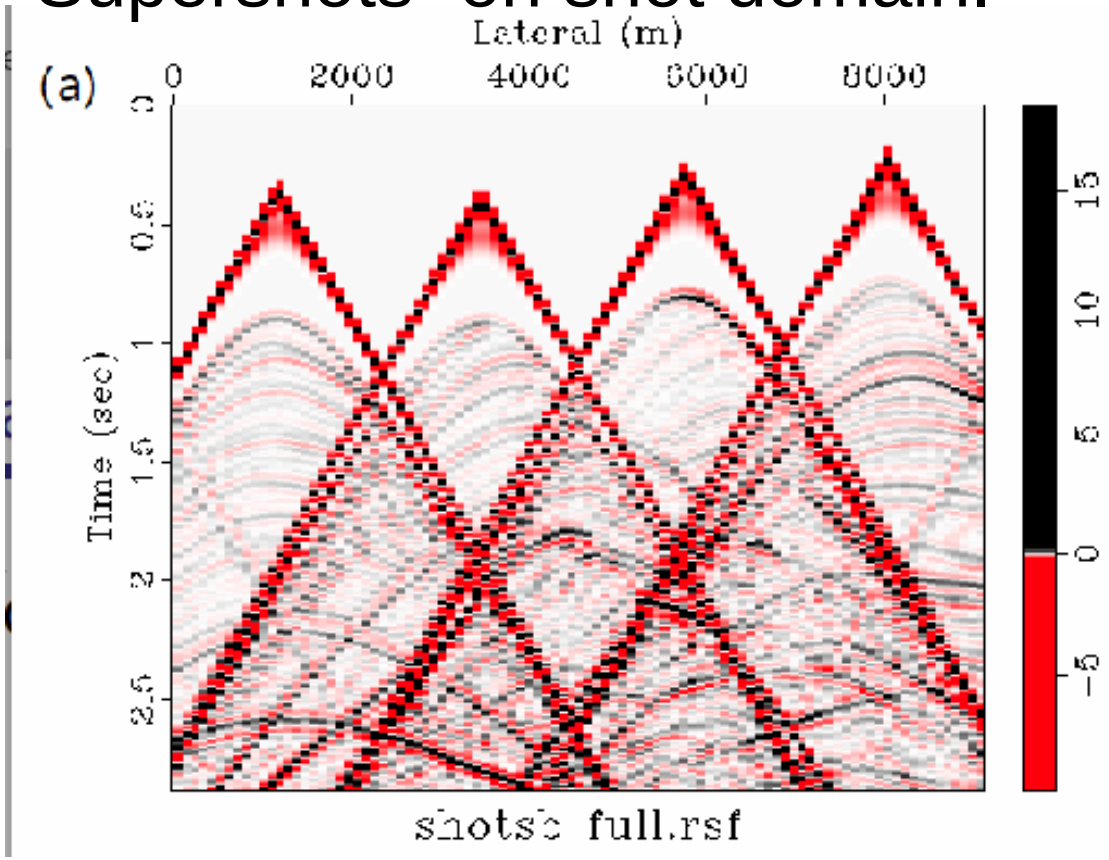


What is deblending?

Blended RTM in shot domain.

Pseudo-deblending

Shift target shot's delay time as zero for each shot inside "Supershots" on shot domain.

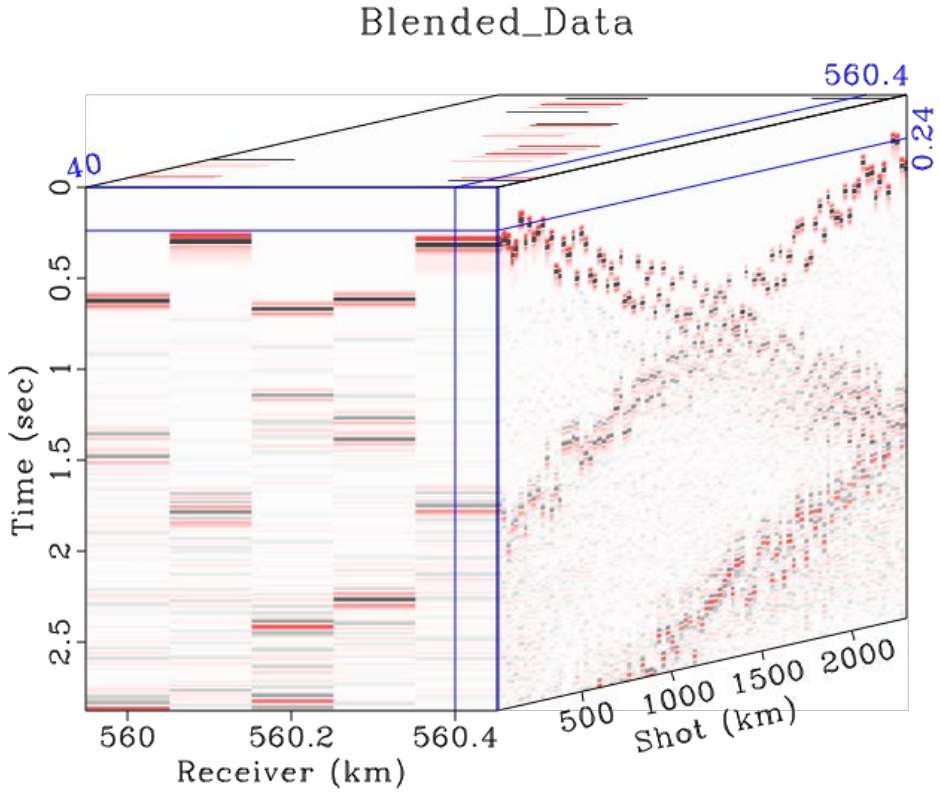


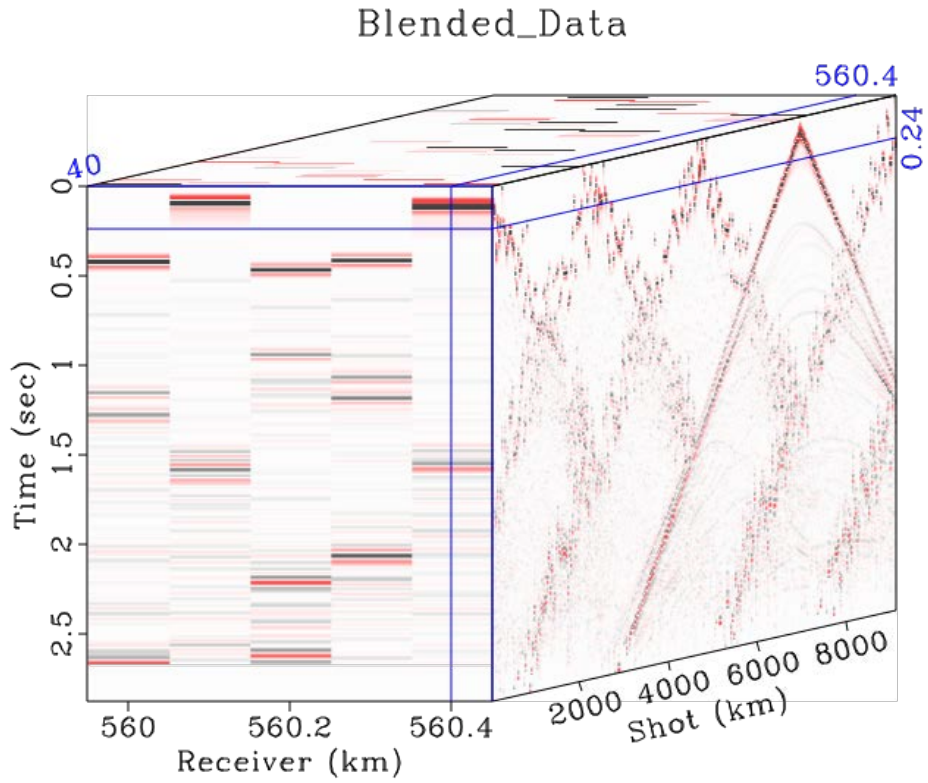
Blending acquisition

Pseudo deblending extents the data size *nblended* times,

where *nblended* is the number of simultaneous shots in each supershot.

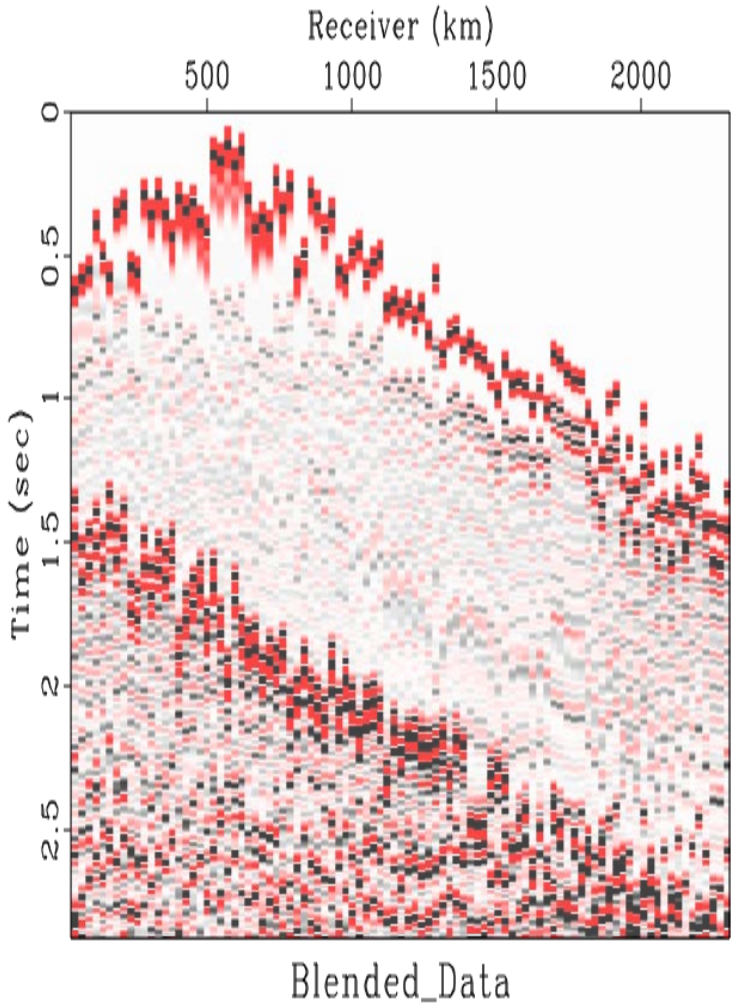
After shifting, the target shot becomes coherent and other shots remain incoherent.

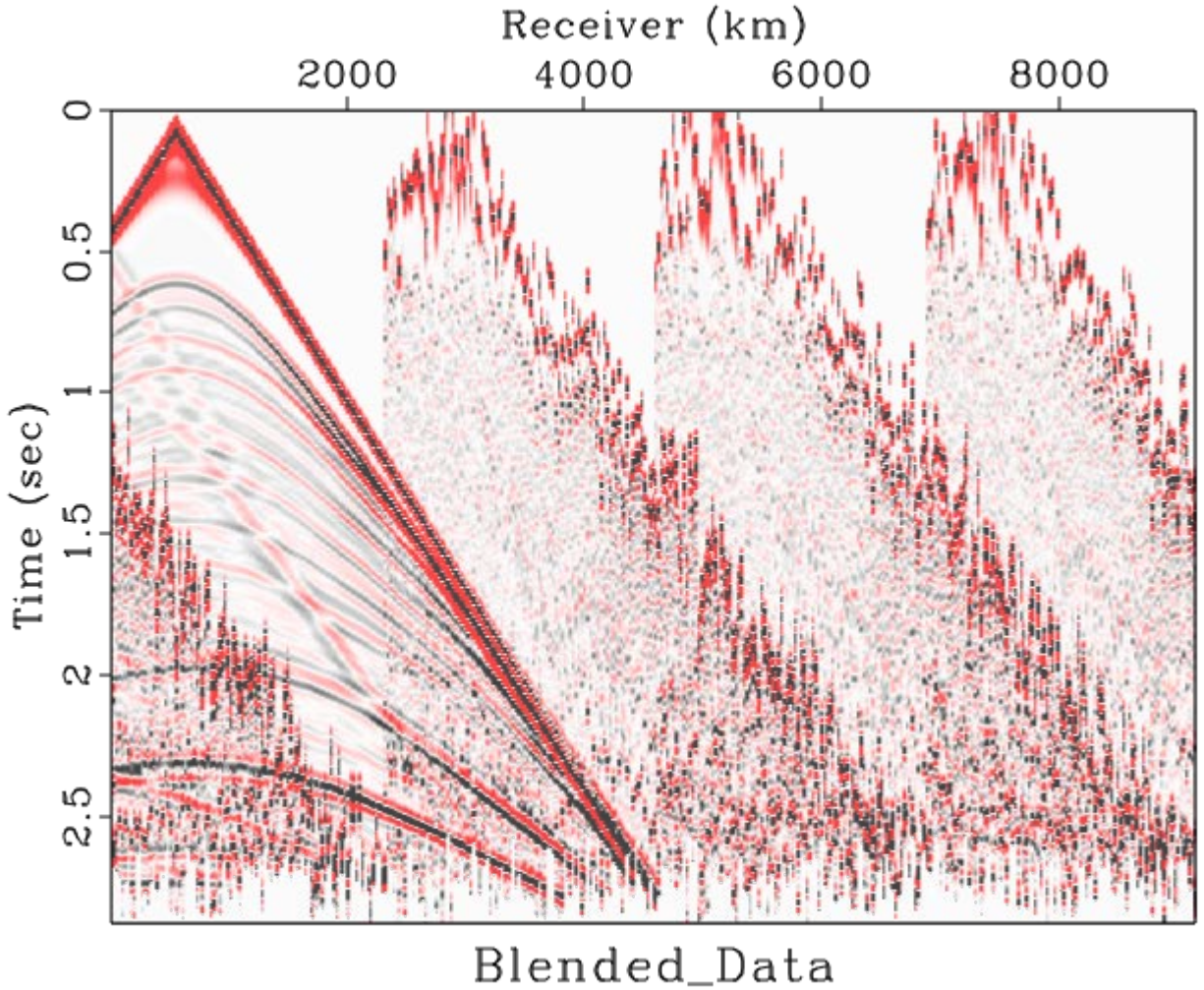




Blending acquisition

Extending and shifting/dithering:



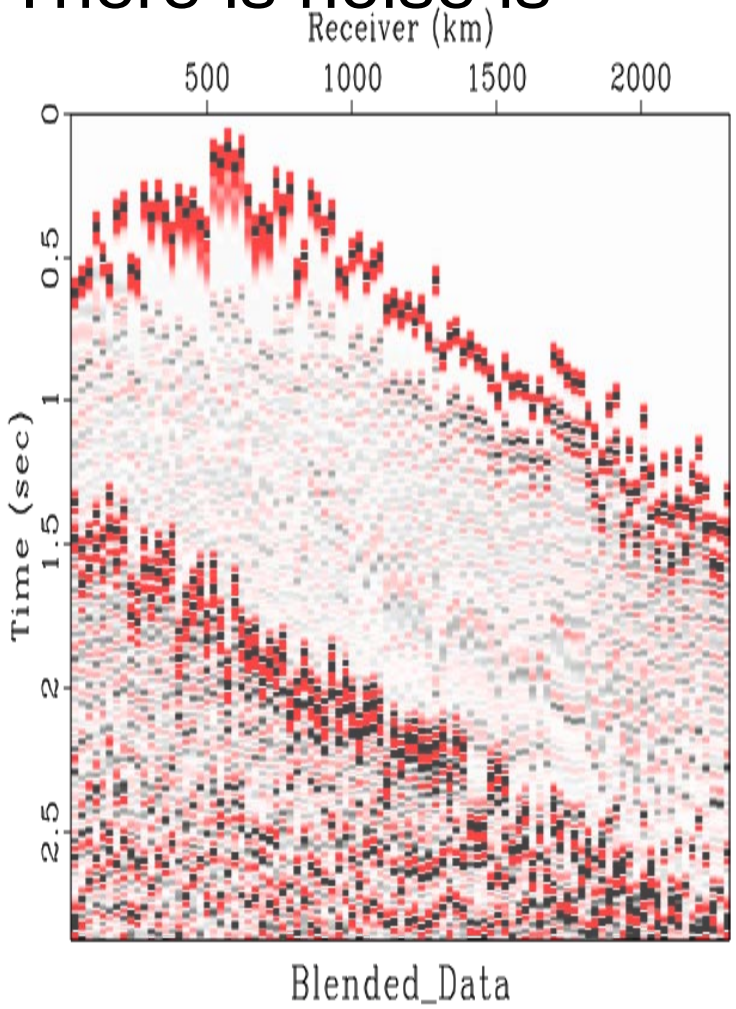


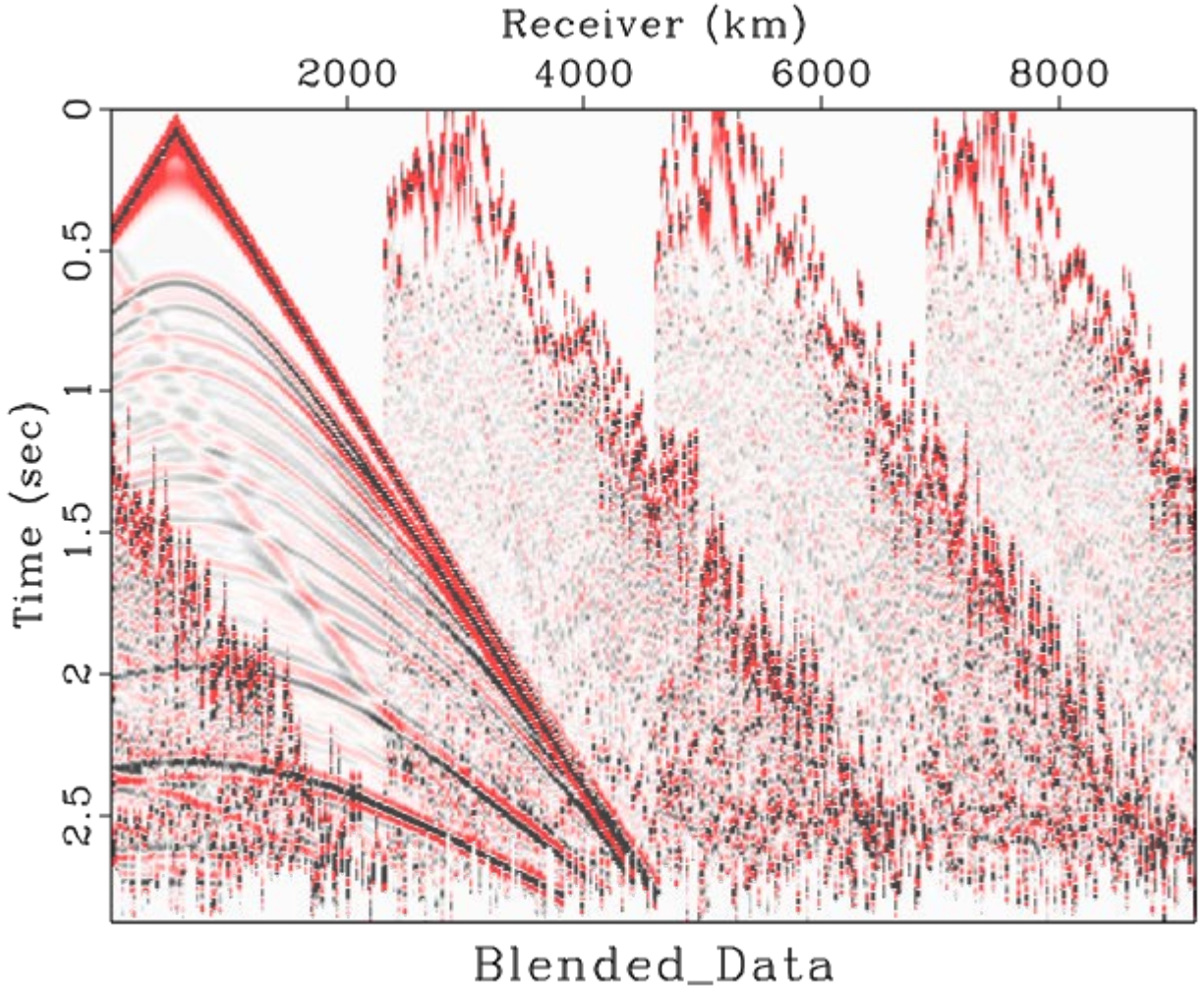
Blending acquisition

Extending and shifting/dithering:

Target shot is coherent and unwanted shots are incoherent

There is noise is





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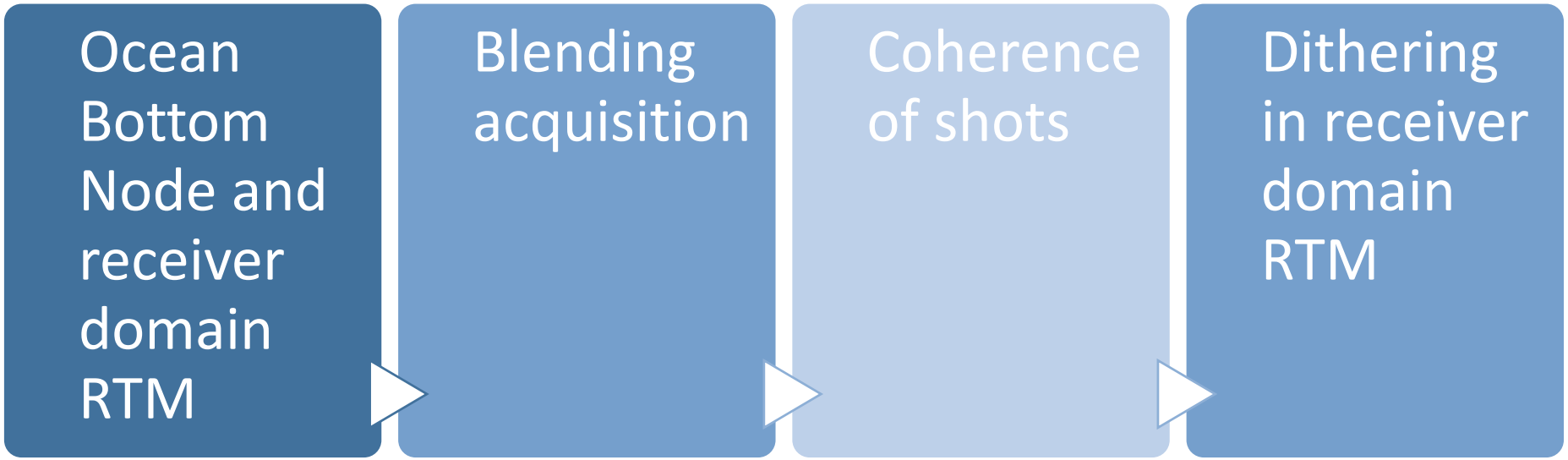
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Coherence effects on RTM imaging condition

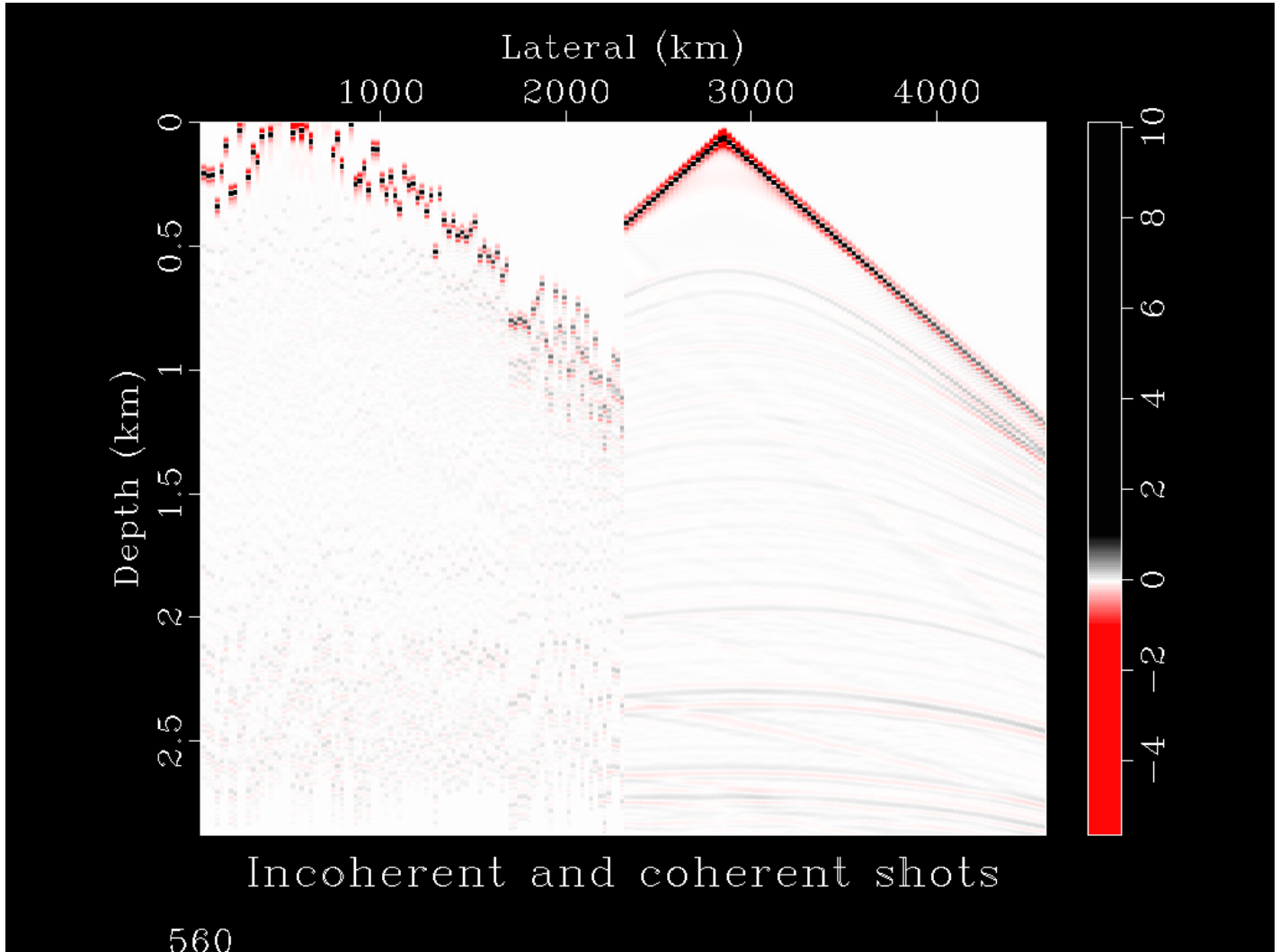
In blended receiver domain RTM, target shot is coherent and unwanted shots are incoherent.

RTM imaging condition amplifies coherent shots while cancels incoherent shots

Therefore blended RTM could remove the noise of blending.

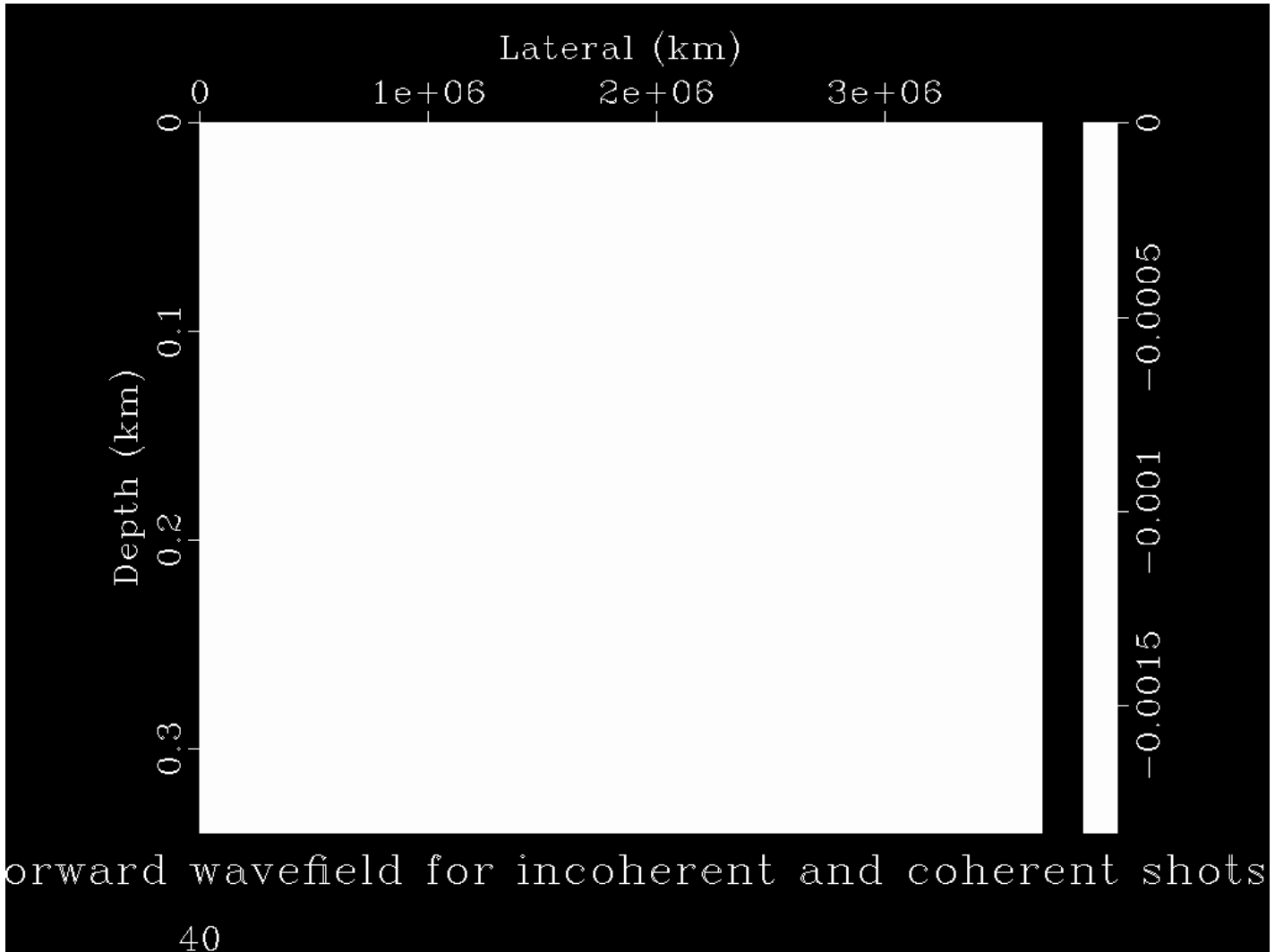
Coherence of shots

Coherency effects in RTM,



Coherence of shots

Coherency effects in RTM



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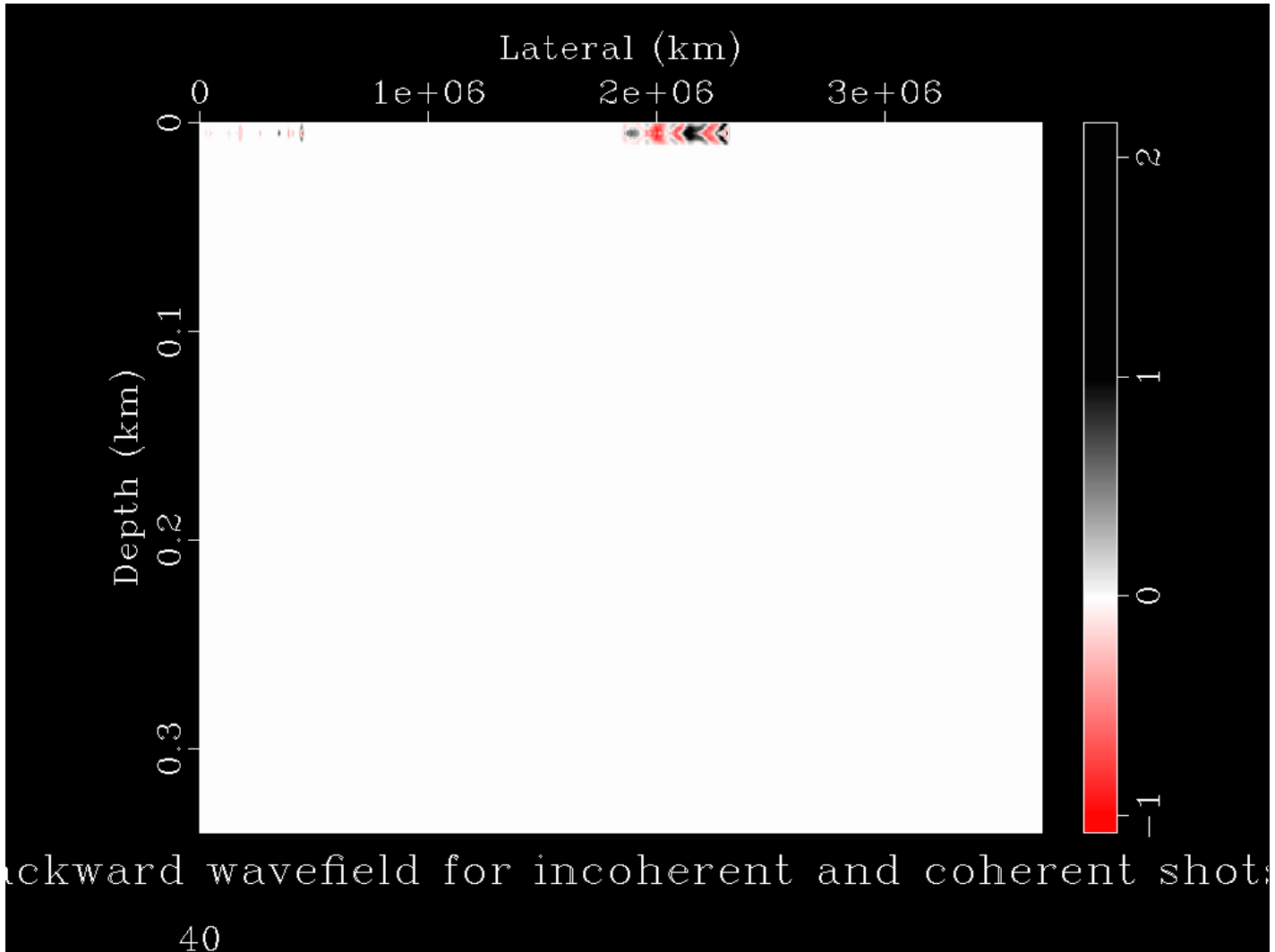

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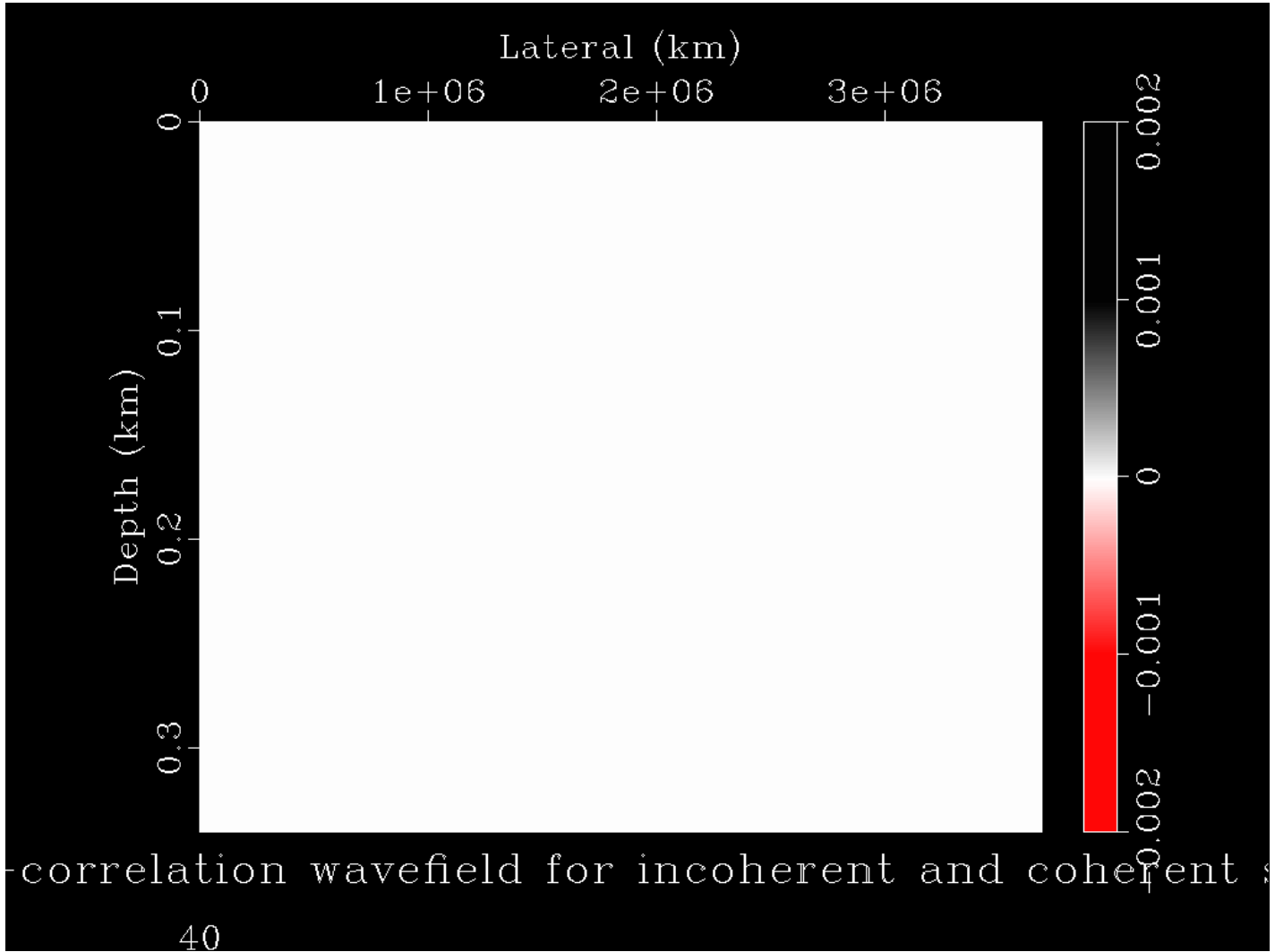

Coherence of shots

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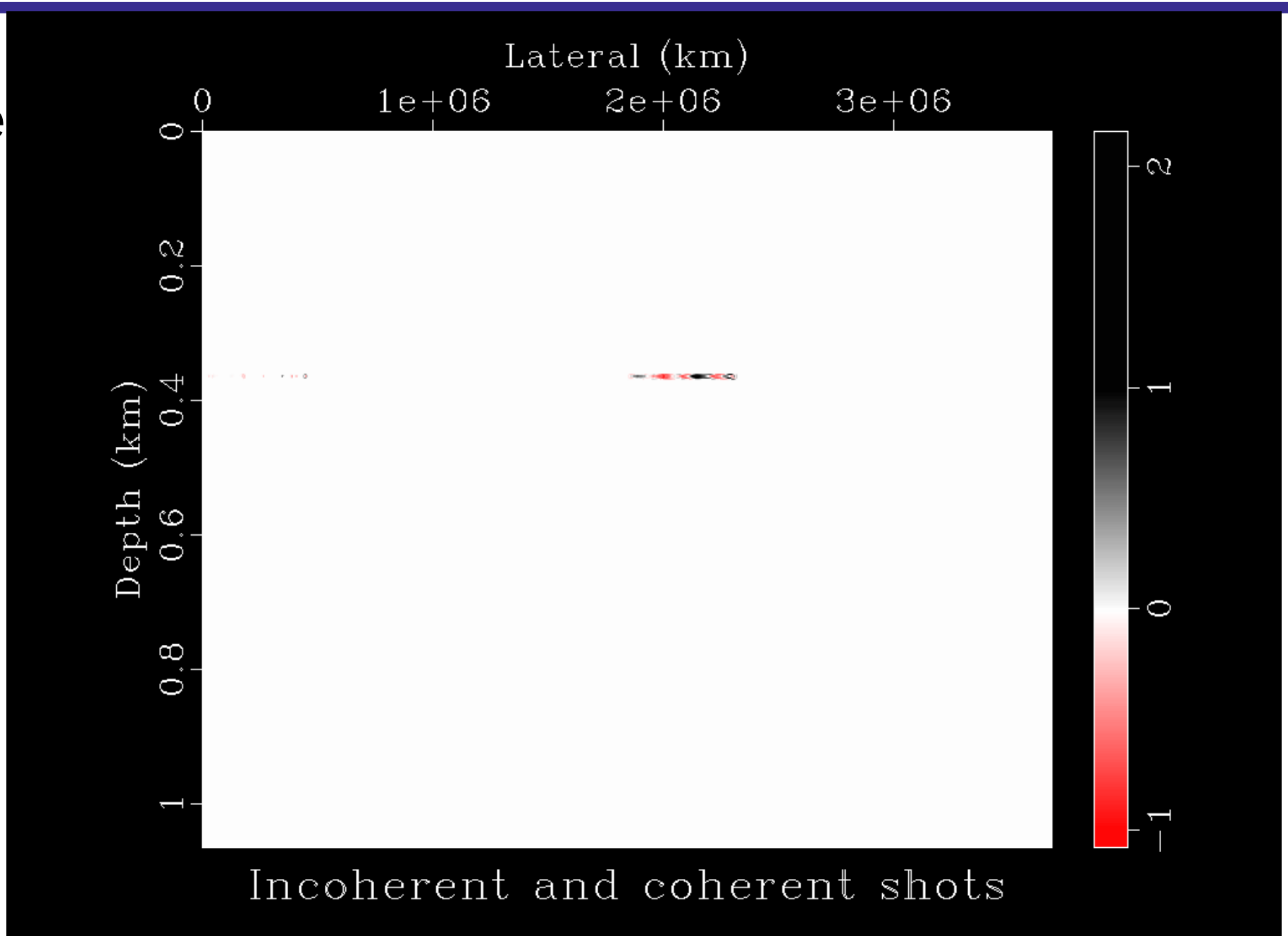

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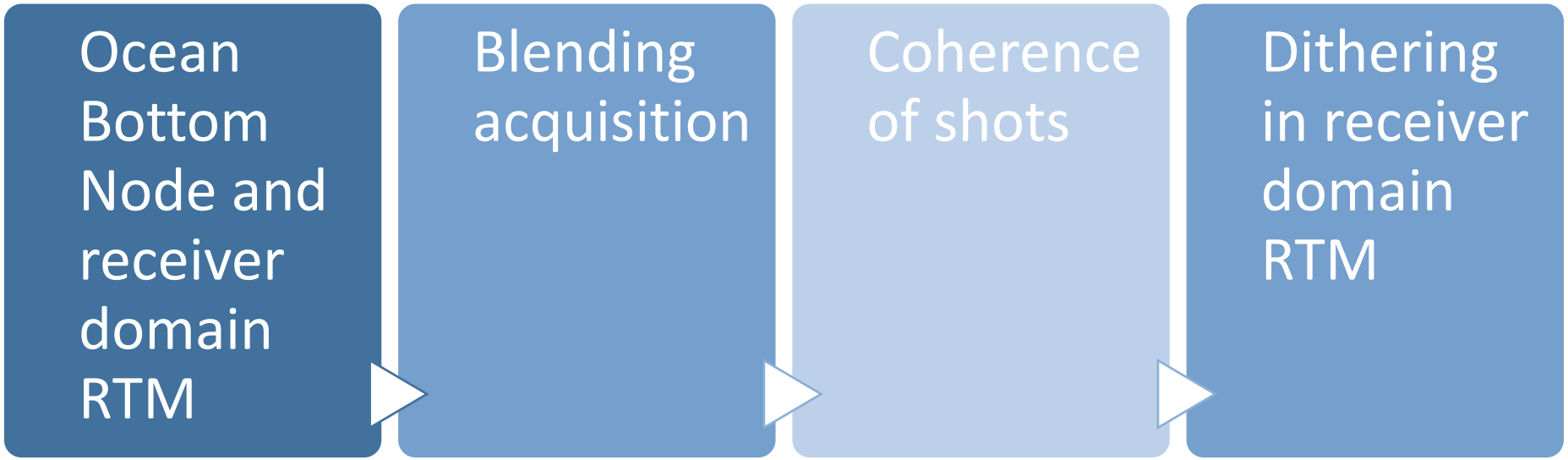
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There are many ways to apply the delay time into RTM:

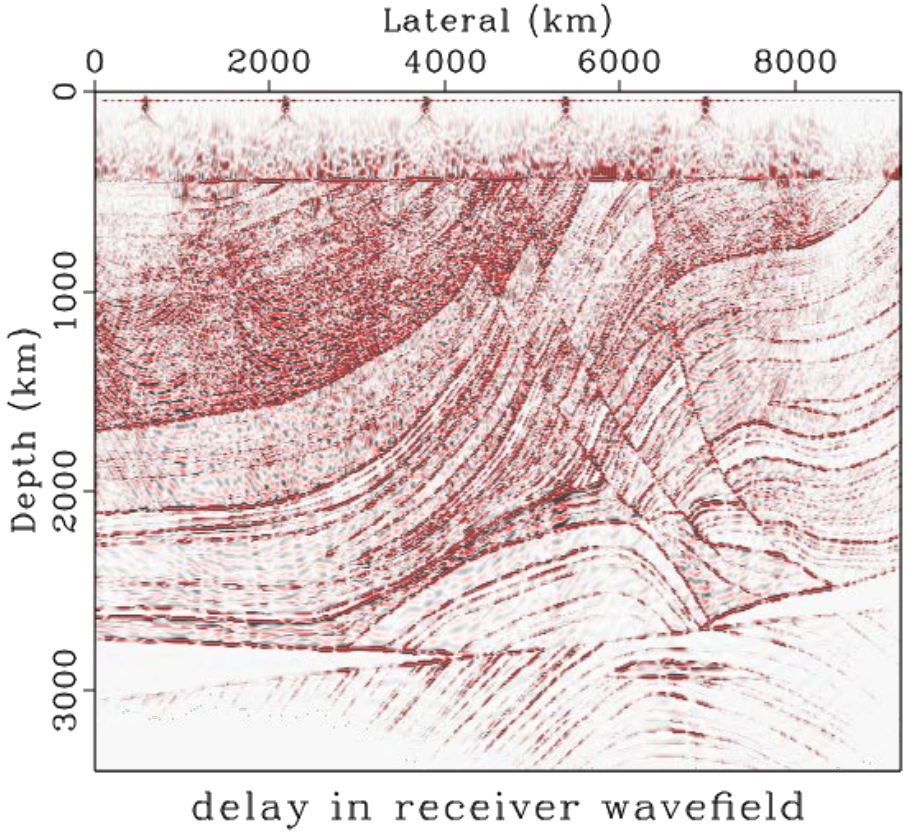
Time delay to insert source in forward wavefield

Time delay to insert data in backward wavefield

Dithering in receiver domain RTM

Time delay to insert source in forward wavefield: No

Time delay to insert data in backward wavefield: Yes



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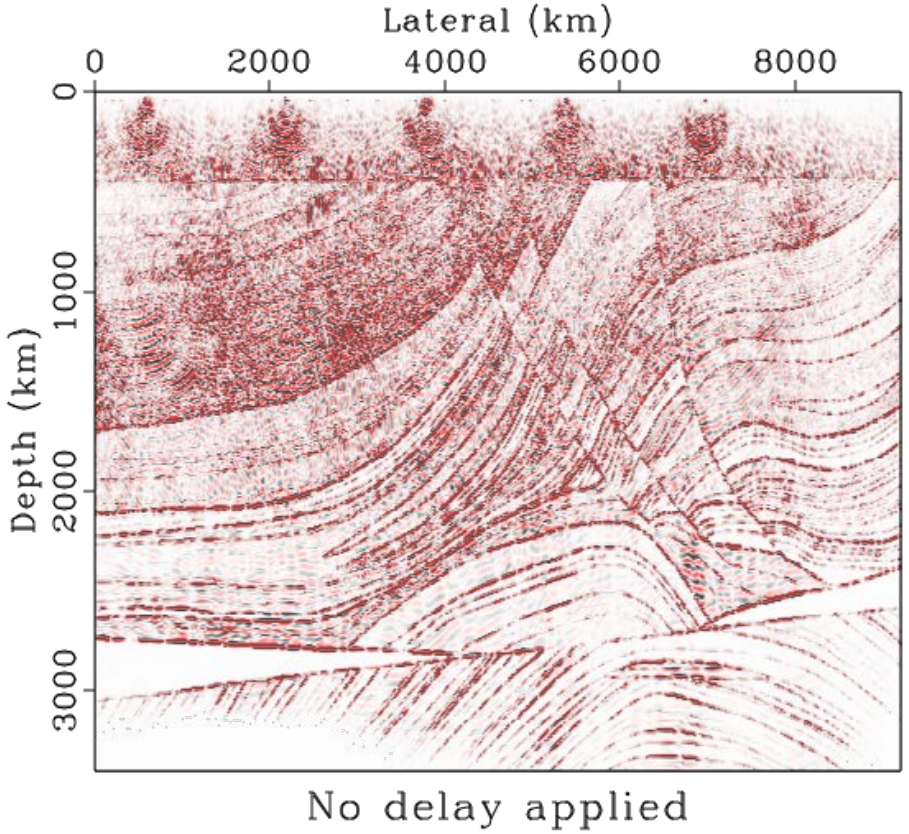

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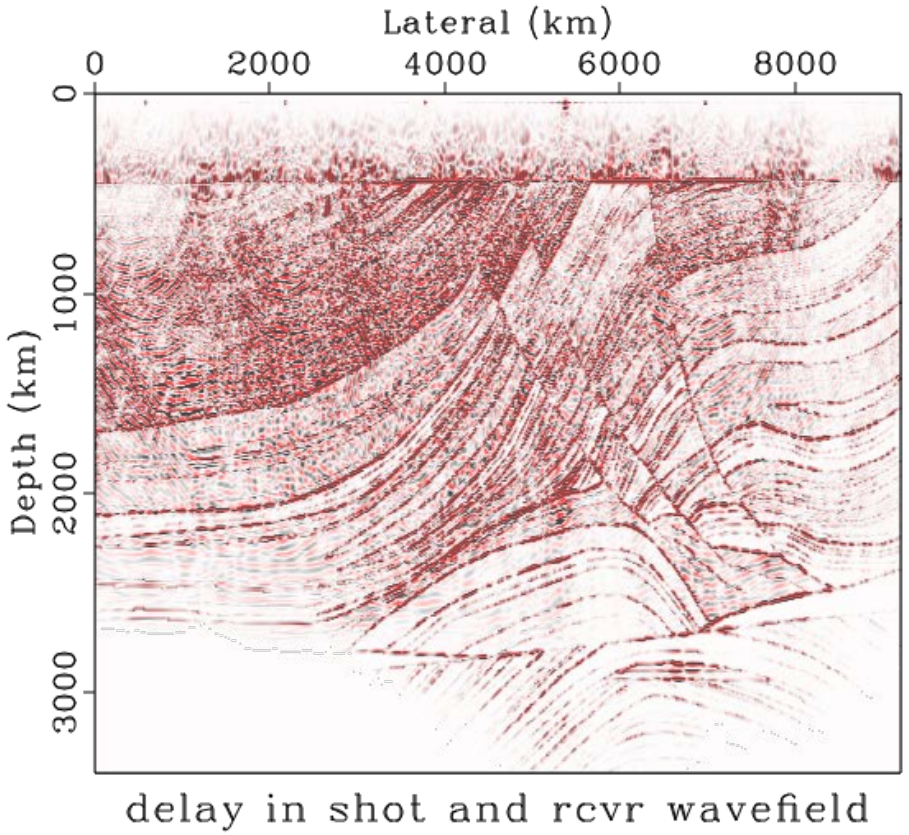

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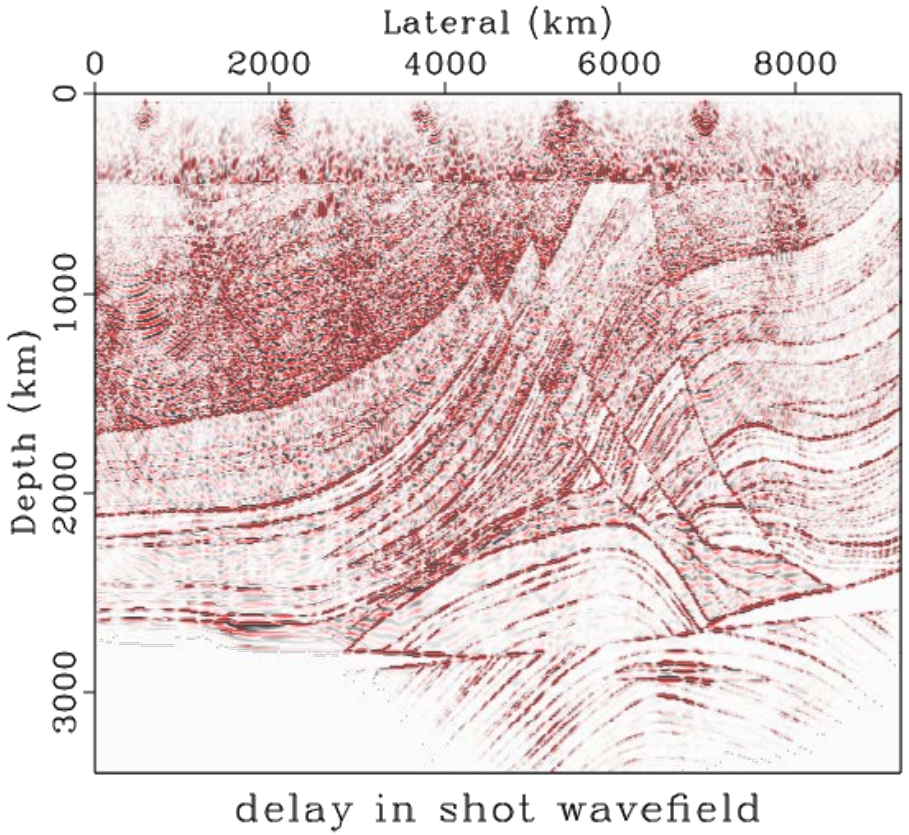


Conclusion

Receiver domain RTM saves computation for OBN.

Blended acquision saves acquisition time and cost.

RTM attenuates incoherent shots

Dithering in blelnded receiver domain RTM is effctive in deblending

Future work

Apply LS in Blended RTM in receiver domain

Connection between dithering and datum

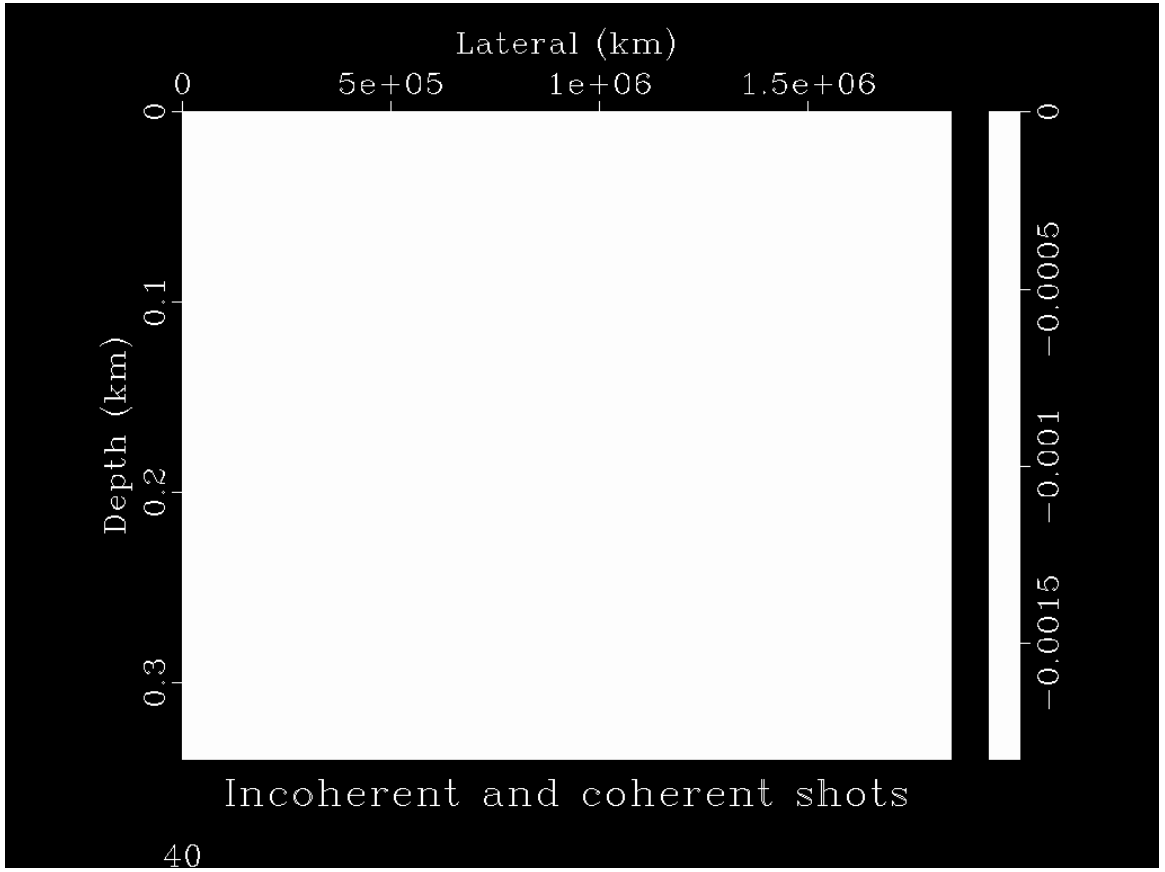
Deblending RTM in Common Receiver Gather utilizing dithering

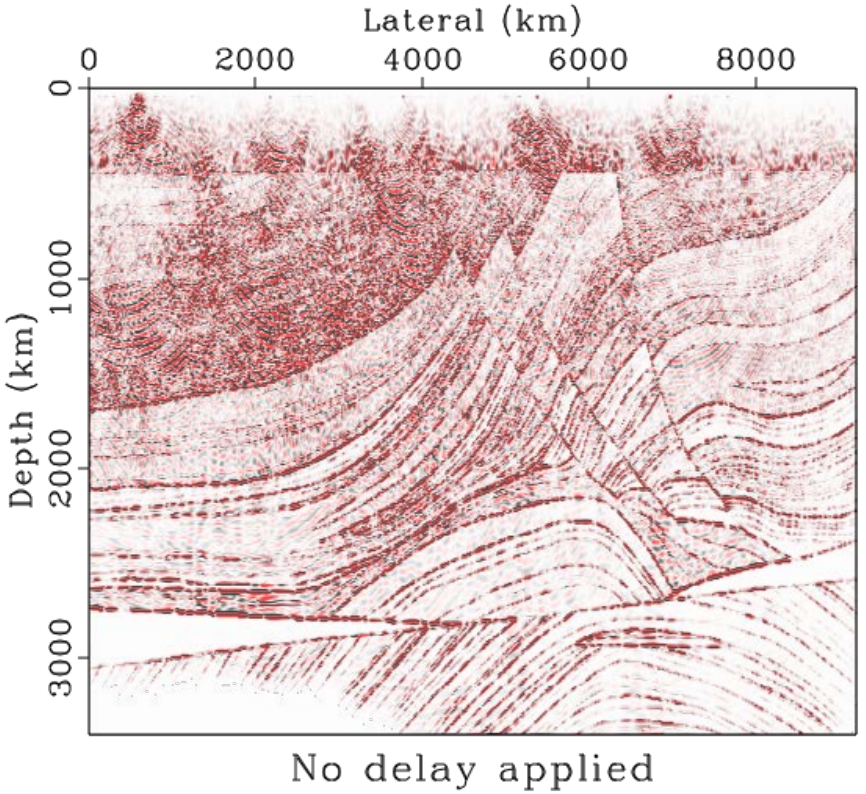
->Deblending RTM in Common Offset Gather

->Deblending RTM in Common Angle Gather

Future work

In blended receiver domain RTM, apply multiple sources in the forward wavefield.





Questions?