Born and ray-theory seismograms in 2D heterogeneous isotropic models

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Structure of the speech

1 Differences in the methodology

Corrections of the direct waves

Waves diffracted from the edges
1. Differences in the methodology

2. Corrections of the direct waves

Structure of the speech
1. Differences in the methodology
2. Corrections of the direct waves
3. Waves diffracted from the edges
1 Differences in the methodology
2 Corrections of the direct waves
3 Waves diffracted from the edges
We compare: Born seismograms & differences between the ray-theory seismograms in partially perturbed models and the background model. (corrections of the direct waves)

Abscissae in the seismograms:
- travel times (computed in the background model) of the diffracted waves
- the waves are diffracted from the edges of the block containing the perturbation
- colours of the abscissae (block has 4 edges):

<table>
<thead>
<tr>
<th>Edge</th>
<th>left upper</th>
<th>left lower</th>
<th>right upper</th>
<th>right lower</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colour</td>
<td>green</td>
<td>pink</td>
<td>yellow</td>
<td>blue</td>
</tr>
</tbody>
</table>
Differences in the methodology
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Exceptional blocks

- most blocks: 4 edges
- exceptional blocks:
  - Block 3, Block 16: 3 edges (no problem, the same color palette)
  - Block 10: 5 edges (no diffracted waves from 2 edges located at the upper model boundary)

Figure: Blocks in model P1I.
Current section

1. Differences in the methodology
2. Corrections of the direct waves
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Figure: Vertical components of the Born (red) and ray-theory (black) seismograms computed in model P1-10-10% scaled by $1 \times 10^4$. 
Figure: The ray diagram of the direct wave computed in the background model, depicted together with the blocks in model P1I.

rays travel through Blocks 10, 12, 14, 15, 16

corrections of the direct waves in models P1-10-10%, P1-12-10%, P1-14-10%, P1-15-10%, P1-16-10%
Figure: Vertical components of the Born (red) and ray-theory (black) seismograms computed in model P1-12-10% scaled by $1 \times 10^3$. 
Figure: Vertical components of the Born (red) and ray-theory (black) seismograms computed in model P1-14-10% scaled by $1 \times 10^3$. 
Figure: Vertical components of the Born (red) and ray-theory (black) seismograms computed in model P1-15-10% scaled by $2 \times 10^5$, between $x_1 = 31.5$ km and $x_1 = 34$ km scaled by $2 \times 10^3$ km.
Figure: Vertical components of the Born (red) and ray-theory (black) seismograms computed in model P1-16-10% scaled by $1 \times 10^6$, at $x_1 = 28.5$ km scaled by $1 \times 10^5$, at $x_1 = 29$ km scaled by $1 \times 10^4$, between $x_1 = 29.5$ km and $x_1 = 34$ km scaled by $1 \times 10^3$. 
Figure: Vertical components of the Born (red) and ray-theory (black) seismograms computed in model P1-3-10% scaled by $1 \times 10^6$. 
Figure: Vertical components of the Born (red) and ray-theory (black) seismograms computed in model P1-4-10% scaled by $4 \times 10^4$. 
Corrections also in P1-3-10% and P1-4-10%?

- no rays crossing Block 3 or Block 4, see figure with direct rays
- rays incident at the receivers situated on the left-hand side of the model, extended model $\Rightarrow$ OK
- amplitudes of the wavegroups grow from $x_1 = 19.5$ km to $x_1 = 16$ km (length of the affected ray grows)
1. Differences in the methodology
2. Corrections of the direct waves
3. Waves diffracted from the edges
• triplication: receivers between $x_1 = 24$ km and $x_1 = 27$ km; no abscissae

• diffractions from the edges:
  • green abscissae (left upper edge) $x_1 \leq 20.5$ km - 1st elementary wave
  • blue abscissae (right lower edge) $x_1 \leq 21$ km - 2nd elementary wave
Figure: Vertical components of the Born (red) and ray-theory (black) seismograms computed in model P1-7-10% scaled by $1 \times 10^5$. 
Diffractions from the edges:

- Not clearly visible.
- Yellow abscissae (right upper edge) between $x_1 = 29.5$ km and $x_1 = 31$ km - 2nd elementary wave
Figure: Vertical components of the Born (red) and ray-theory (black) seismograms computed in model P1-9-10\% scaled by $1 \times 10^4$. 
yellow abscissae (right upper edge) \( x_1 \geq 27.5 \text{ km} \) - 1st elementary wave (receivers between \( x_1 = 16 \text{ km} \) and \( x_1 = 27 \text{ km} \), arrive first)

green abscissae (left upper edge) between \( x_1 = 22 \text{ km} \) and \( x_1 = 23.5 \text{ km} \) - 2nd elementary wave, reflected from the left interface (receivers between \( x_1 = 24 \text{ km} \) and \( x_1 = 27.5 \text{ km} \))
Figure: Vertical components of the Born (red) and ray-theory (black) seismograms computed in model P1-11-10% scaled by $1 \times 10^4$. 
very simple ray diagram: one arrival (2nd elementary wave)

diffractions from each of the four edges of Block 15
Figure: Horizontal components of the Born (red) and ray-theory (black) seismograms computed in model P1-15-10% scaled by $2 \times 10^5$, the seismograms between $x_1 = 31.5$ km and $x_1 = 34$ km scaled by $2 \times 10^3$ km.
Concluding remarks

Born seismograms contain

- reflected waves
- diffracted waves (caustics, edges of the block - continue to the shadow zone)
- corrections of the direct waves
I would like to thank

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