Crustal Structure in the Pantanal and Chaco Basins from Receiver Function

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1. INTRODUCTION

Crustal structure is an important parameter in global and regional tectonic studies. Many models of crustal thickness have been developed in South America, such as Assumpção et al (2013). Nevertheless, due to the low coverage of stations, there is a lack of information in some areas, that present poor lateral resolution and larger uncertainties.

We calculated the Moho depth (H) and Vp/Vs (K) ratio beneath the stations of the Brazilian permanent network (RSBR), and temporary stations of the FAPESP Thematic Project: Pantanal-Chaco- Parana Basins: Crust and Upper Mantle Seismic Structure and Evolution.

• RECEIVER FUNCTION

Receiver function is a widely used method to obtain main features of the crust (e.g. Moho depth) and upper mantle. Zhu and Kanamori (2000) proposed a method (Equation 1) that uses the arrival time of Ps phase (t_1) and the forward reverberations: Ppps (t_2) and Ppss (t_3) to obtain crustal thickness and Vp/Vs (Figure 1).

$$s(H,k) = w_1 * t_1 + w_2 * t_2 - w_3 * t_3 \qquad (1)$$

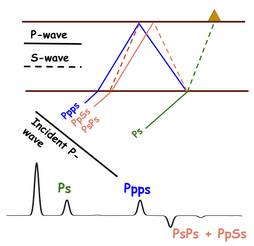

Figure 1: Receiver function scheme

2. METHODOLOGY

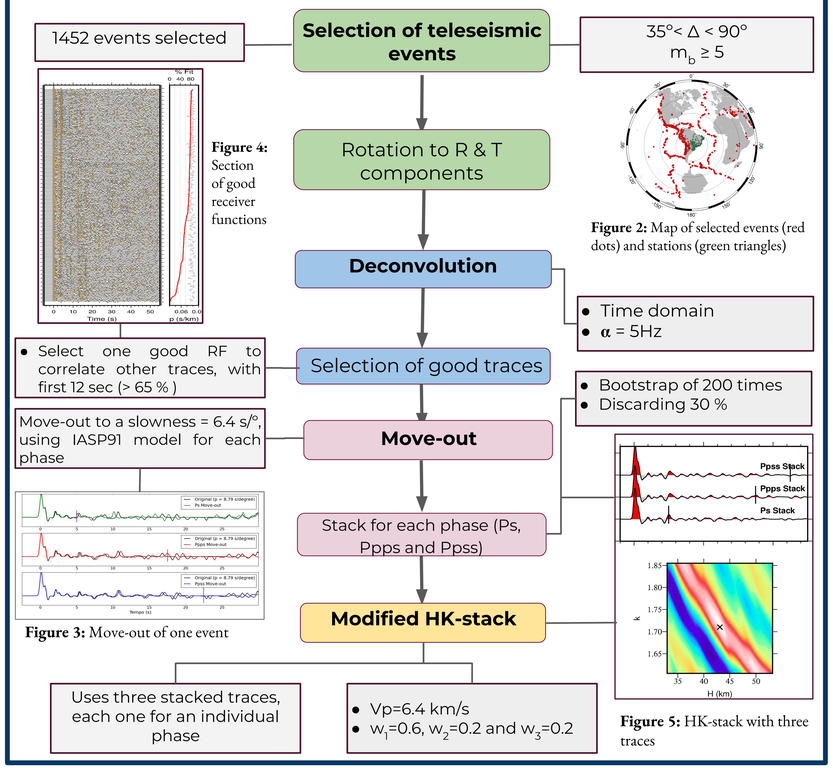

Figure 4: Section of good receiver functions

Figure 2: Map of selected events (red dots) and stations (green triangles)

Figure 3: Move-out of one event

Figure 5: HK-stack with three traces

3. CRUSTAL THICKNESS (H) AND Vp/Vs RATIO (*k*)

Figure 6 shows the new results of crustal thickness in Brazil. This updated version fills some gaps of the previous model (Assumpção et al, 2013).

- Pantanal basin (Pt) has thin crust (~32 km), while the surrounding points present Moho depth greater than 38 km.
- The Chaco basin has an average crustal thickness ~39 km.
- The Pantanal and Chaco basins have thick sediment layers, which are under study.
- Thicker crust in Parana basin, and thinner crust in coastal areas

Values of Vp/Vs are shown in Figure 7.

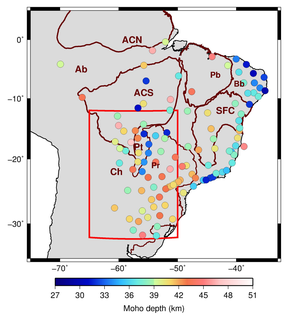

Figure 6: Updated Moho depth in Brazil. Red rectangle highlights Pantanal , Chaco and Parana basins

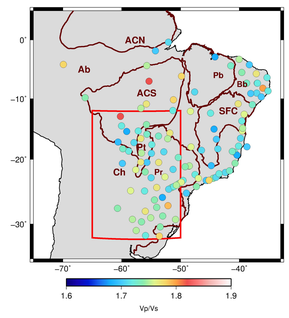

Figure 7: Vp/Vs (k) ratio in Brazil. Red rectangle highlights Pantanal, Chaco and Parana basins

ACN: North Amazonic craton
ACS: South Amazonic craton
Ab: Amazonic basin
Pb: Parnaiba basin
Bb: Borborema province
SFC: São Francisco craton
Pt: Pantanal basin
Pr: Parana basin
Ch: Chaco basin

Comparing results of Moho depth (H) and Vp/Vs ratio (k) using the normal and modified HK-stack are shown in Figures 8a and 8b. Values obtained with both methods do not vary significantly. **Modified HK-stack presents smaller uncertainties .**

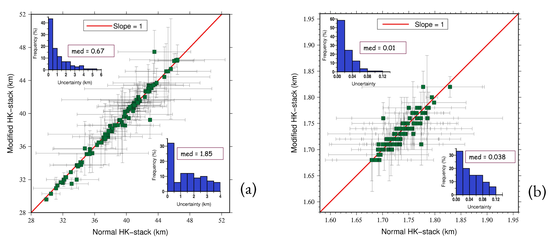

Figure 8: Comparison between normal and modified HK-stack. Uncertainty histograms of both method are shown.
(a) Moho depth and
(b) Vp/Vs ratio.

• H and *k* from preliminary results of Vs

Crustal thickness and Vp/Vs at Chaco, Pantanal and Parana basins using a modified HK-stack method with preliminary results of S-wave velocity (Vs) from Ambient Noise Tomography (ANT), instead of an average Vp (Figure 9a and 9b).

In both cases, results are similar for H and *k*. Differences found are within the uncertainties. However uncertainties are lower when we use an average Vp (Figure 10a and 10b).

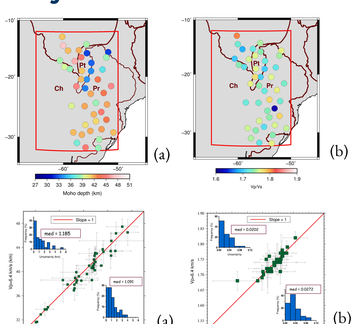

Figure 9: Moho depth (a) and Vp/Vs ratio (b) using alternative S-wave velocity model from ANT

Figure 10: Comparison between assumed Vp=6.4 km/s and preliminary S-wave velocity
(a) Moho depth and
(b) Vp/Vs ratio

4. UPDATED CRUSTAL THICKNESS MODEL

Last crustal thickness model of South America (Figure 11a), developed by Assumpção et al (2013), shows an average crustal thickness of 39 ± 5 km, while the present work has a mean Moho of 38.8.

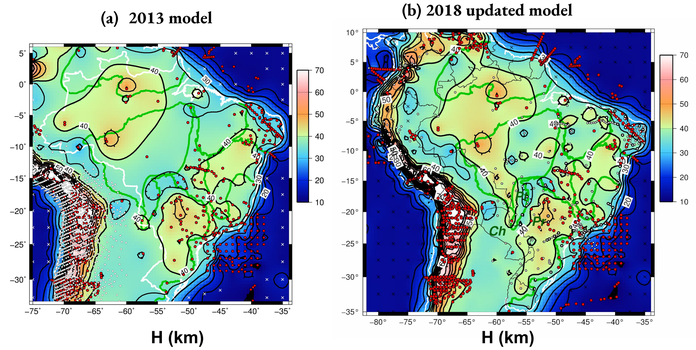

Figure 11: Crustal thickness model of South America.

• H and *k* in Borborema Province by Luz et al (2015)

Results of Luz et al (2015) for the crustal thickness (H) and Vp/Vs ratio (*k*) in the Borborema Province (Northeast Brazil) are close to our results. Nonetheless, values of *k* are more scattered than H (Figure 11a and 11b).

Uncertainties obtained at present work are smaller (Figure 12a and 12b).

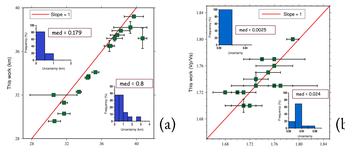

Figure 12: Comparison of Borborema province results between Luz et al (2015) and present work.
(a) Crustal thickness. (b) Vp/Vs ratio.

5. IMPORTANT REMARKS

- Modified HK-stack method shows smaller uncertainties due to the SNR gain of the stack; and no systematic error was observed.
- Results obtained in Parana basin, Borborema province, and São Francisco craton agree with previous work (Assumpção et al, 2013 and Luz et al, 2015). It shows that our method is reliable.
- Gaps in important areas, as Chaco and Pantanal basin, were filled. This new data will be significant in future tectonic and seismicity studies.
- We have generated new data of Vp/Vs ratio in Brazil and surrounding areas. Some regional consistency can be observed.

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