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An improved velocity model for routine hypocenter location in Central Brazil.

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T1.2-P9

1. Introduction

Brazil is located in the stable continental interior of South American plate. The seismicity distribution is not uniform and in general it is characterized by low seismicity (M<3.5). In the last century occurred only two dozen events of magnitudes above 5, two of which with magnitudes larger than 6. The Brazilian Seismic Catalog, Figure 1, was initially compiled by Berrocal et al. (1984) and it is maintained by a pool of institutions SIS-UnB, IAG-USP, UFRN, CPRM and ON. The catalog is very heterogeneous and the location quality for some events is unknown.

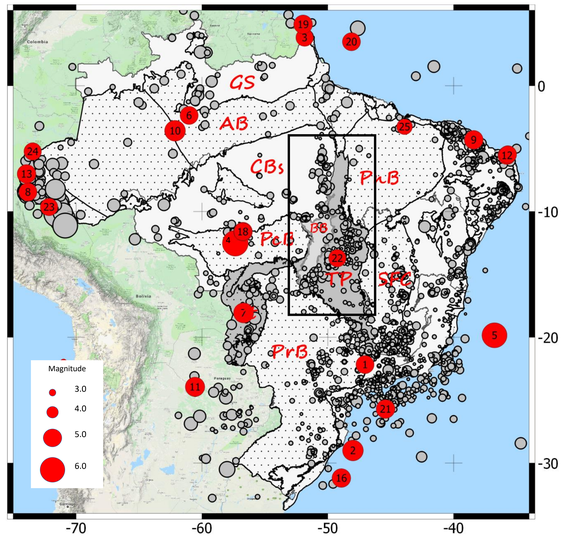


Figure 1 - The Brazilian earthquake catalog (1720-2019) historical and instrumental events.

A better and more uniform monitoring started after the establishment of the Brazilian Seismograph Network (RSBR), after 2014, the detection threshold in the Amazon region dropped from M4.5 to M3.5.

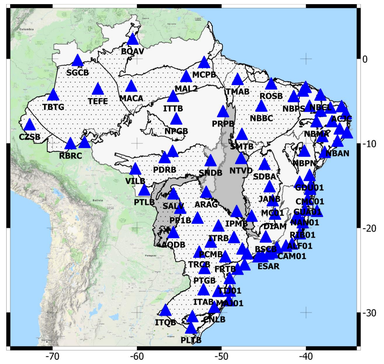
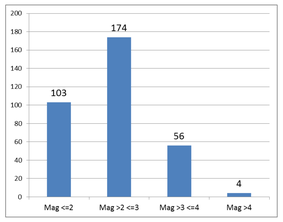


Figure 2 – Brazilian Seismograph Network (RSBR).

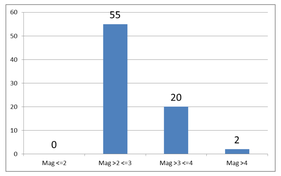
2. Study area and data

In this study, we propose a new 1D velocity model for the central Brazil, black rectangle Figure 1. From the catalog, we have selected 77 high quality events, Figure 3, with a total of 967 - P wave observations from 78 stations, Figure 4.



Events - 1rs Criteria:
- Within the area;
- Period of 2010-2019;

Total of events = 337

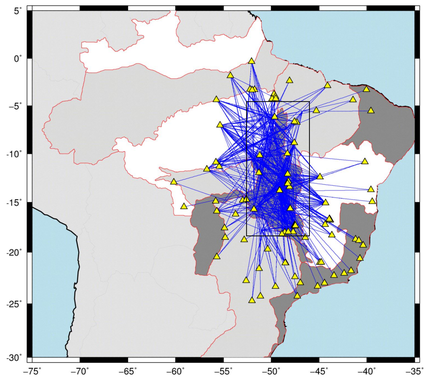


Events - 2nd Criteria:
- Azimuthal gap < 180°;
- Detections (P) > = 6;

Total of events = 77

Figure 3 - Selection criteria.

Figure 4 - computed source-station rays.



The stations used in this work are from the RSBR and up to the distance of 1200 km, Figure 5.

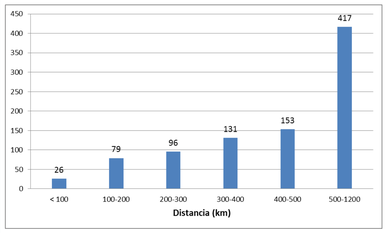


Figure 5 - Distance source-station rays.

Rays:
- Events = 77
- All Stations = 78
- Refraction = 752
- Other = 60
- Rays total = 967

3. Methodology

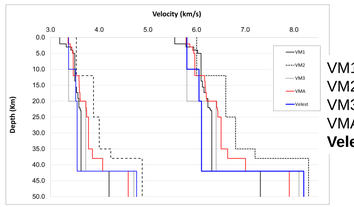
Location error is associated to:
- Arrival time reading errors (picking);
- Seismic network configuration
- Velocity model uncertainty (pour)

Code VELEST:
- Invert simultaneously for 1-D velocity and hypocentral parameter;
- Establish a 1-D model with station correction.

(Kissling et al., 1995)

A series of coupled hypocenter-velocity-model non-linear inversions were performed with the code VELEST searching the model space for best performing results.

In contrast to the new network, for earthquake location, the generic model continued to be used despite being based on the limited data set previously available. In this study, we started with four velocity models used in the area, Figure 6.



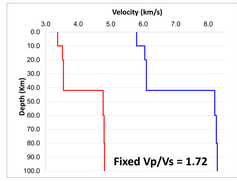
VM1 = Dias (Dias et al., 2016)
VM2 = Barros (Barros et al., 2016)
VM3 = NewBR (Assumpção et al., 2010)
VMA = Average (VM1, VM2, VM3)
Velest = obtained model

Figure 6 - Velocit model used in this work.

4. Results

The optimum obtained velocity model (1D) with 7 layers, Figure 7a and the respective stations residuals, Figure 7b .

a)



Depth	Velocity (P)	Velocity (S)
0.0	5.80	3.37
10.0	6.05	3.52
20.0	6.10	3.55
42.0	8.20	4.77
60.0	8.25	4.80
80.0	8.28	4.81
100.0	8.30	4.83

b)

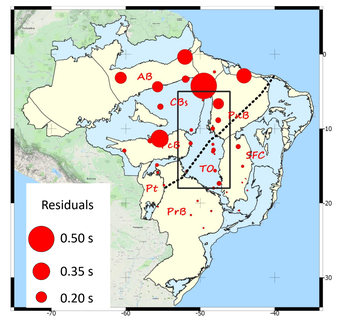


Figure 7 - a) Obtained model. b) resulted stations residuals (s).

a)

c)

b)

Figure 8 - a) Brazilian catalog open circles and events occurred after 2010 red circles. b) relocated events with the new model and, c) relocated aftershock events from the Mara Rosa 2010 event.

5. Discussion/Conclusion

1) The rays covers most of the working area to obtain a 1-D + station corrections;

2) The relocation improved the events location;

3) With the existing network it is not possible to determine event depths, hence it is necessary to improve the station coverage;

4) For further studies it is necessary to test the model with reference event like GT5 and/or controlled mining blasts;