ISC LOCALIZATION USING JB AND Ak135 VELOCITY MODEL: A COMPARISON IN THE ANDEAN REGION BETWEEN LATITUDES FROM 19°S TO 45°S

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ABSTRACT

The Andean Region between from 19°S (South of Bolivian Orocline) to 45°S present a active continental margin, where the oceanic Nazca Plate subduce the continental South American Plate, developing Andean Orogeny and thickening continental crust.

Interplate seismic activity is concentrated in the east of Chile and southeast of Bolivia, at shallower depths of ~45Km. Plate subducted seismicity is extended from west of Argentina and center of Bolivia toward east, in correlation with a changing depth from 100Km to 650Km. Crustal seismicity is mostly located in Chile and west of Argentina between latitudes 31°-35°S.

Traditionally, ISC use Jeffreys-Bullen (Jeffreys and Bullen, 1940) global velocity model for entire Earth. As a part of Modernizing Location Method program, ISC have relocated 507 earthquakes in the here considered region using the more precise ak135 velocity model (Kennett et al., 1995).

As result of comparing both set of hypocenters, we observed systematic localizations variation. In general, and for all depths, when the model ak135 is used, it can be seeing a great dispersion variations on the localizations related to the JB model. There average depth differences is ~7Km, mostly deeper for the ak135. May be JB present propagation velocities in means slightly faster than ak135. That is particularly certain for hypocenters of 100Km depth or more, where differences between both set are around 7Km and with relativity little dispersion. The same occur with concerning on differences in latitude and longitude, where those are relativity little.

Specifically, a set of crustal earthquakes distributed over the interested region shown offset in the differences in depth, either nulls or ~ 2.5Km, likely due localization algorithms, but not related to the model velocity. Nevertheless in general, locations for earthquakes with depth less than 45Km show a great dispersion in the differences of depth determinations. It is consistent with velocities of different lithospheres, continental and oceanic, more over the Andean root velocity anomaly might be introducing a significant variations in the locations close to it (Engdahl, 1998).

Region and general differences in both localizations

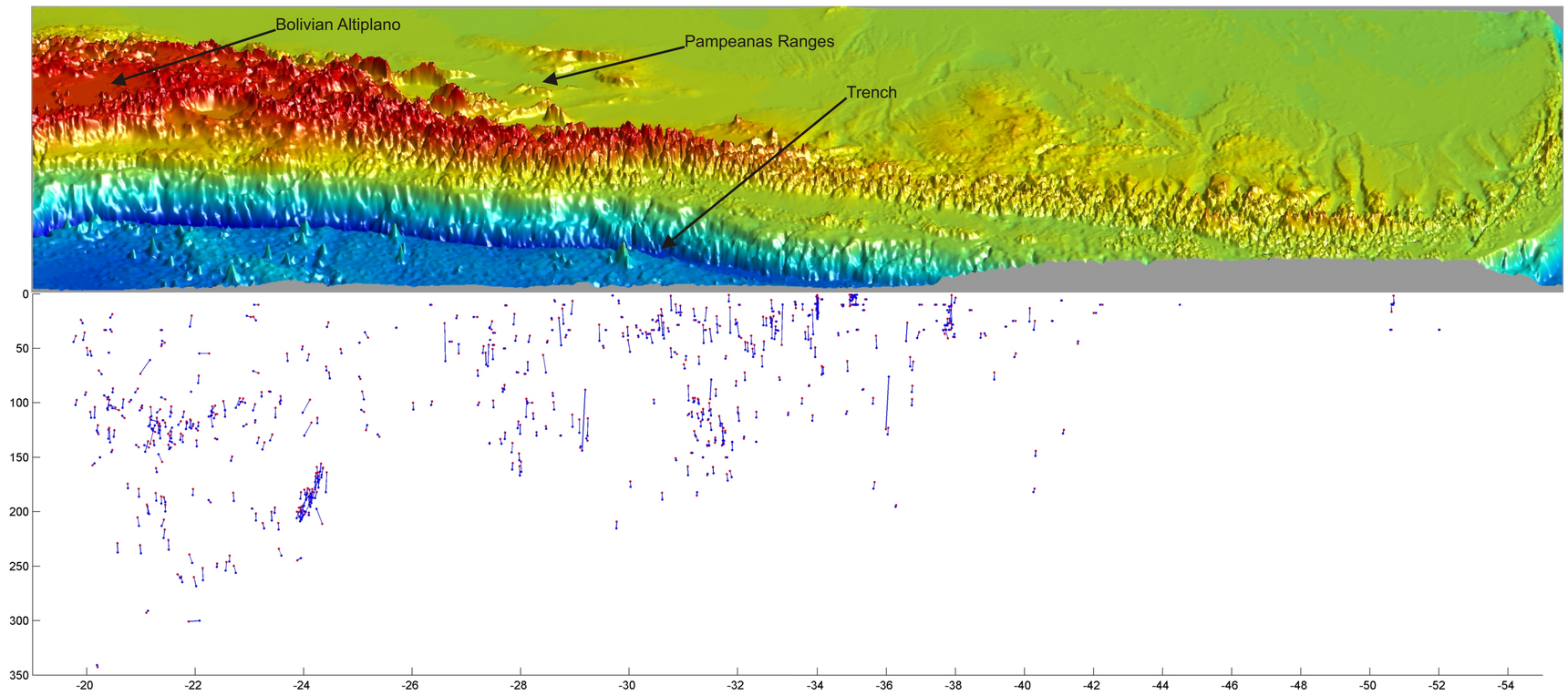

Figure 1. Region of interest and principal geological references.
Blue points correspond to hypocenters located using ak135 velocity model and red points for the others using JB. Blue segments are differences between both sets (shifts) of hypocenters showing a sistematic error pattern in depth.

Sismicity

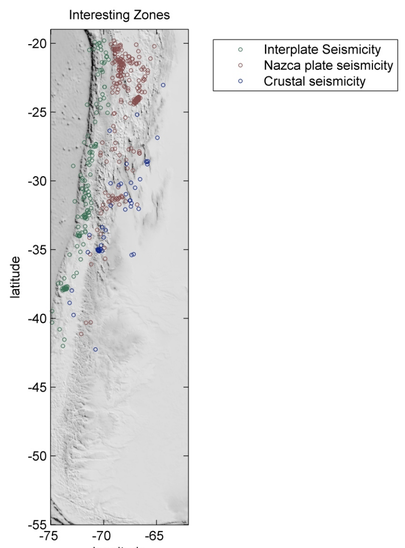

Figure 2. We separate hypocenters into tree groups: Hypocenters in the forearc Andean region (depth from 0 to 50 Km), hypocenters of subducted Nazca Plate (depth from 50.1 to 400 Km) and hypocenters related to backarc crustal sismicity (depth from 0 to 50 Km).

General Perfomance

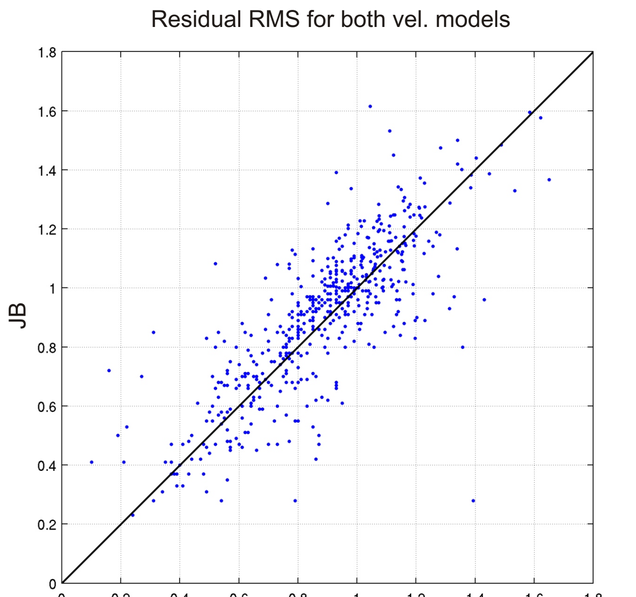

Figure 3. Residuals RMS indicate the accurate to estimate phase arrival times for both models. On average, localizations using JB present higher values of residual RMS than the other using Ak135.

Conclusions

There is tendency for the depth shifts to become smaller from 70 to 350 Km and also to reduce its dispersion.

The small shift for depths > 50 Km may be a indication that the JB o ak135 velocity models do not perform very differently at those depths.

Horizontal shifts are very small

Differences in locations from JB and ak135 at depth < 50 Km have systematics shift in the forearc of the Andes and others systematic shift in the backarc. These are probably an effect of Andean root witch is not taken account by the models.

Comparative

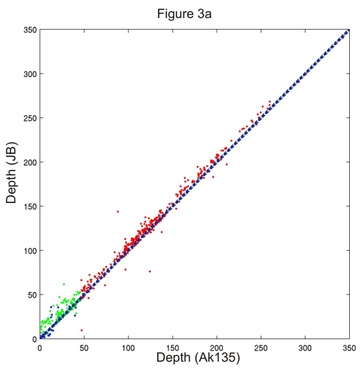

Figure 4. JB vs. Ak135 localizations. In green, forearch sismicity. In red, Naza plate seismicity. In blue, backarc crustal sismicity. Note the high variance in sistematic differences in depth (Figure 4a). The very small variance in latitude (figure 4c). Smallest variations are seen in longitude (Figure 4b).

Shifts in lat. y lon.

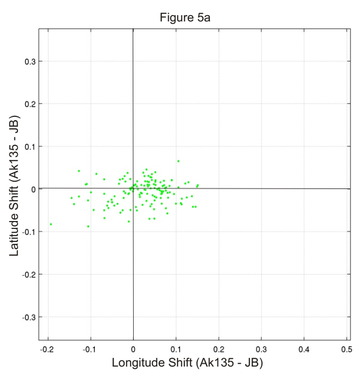

Figure 5. Epicenter shifts for the tree groups. We see that, on average, Ak135 shifts toward east for forearc events (Figure 5a). For backarc events, (Figure 5b) Ak135 shifts some epicenters toward west. Nazca plate events do not show shift in any particular direction.

Shifts in depth

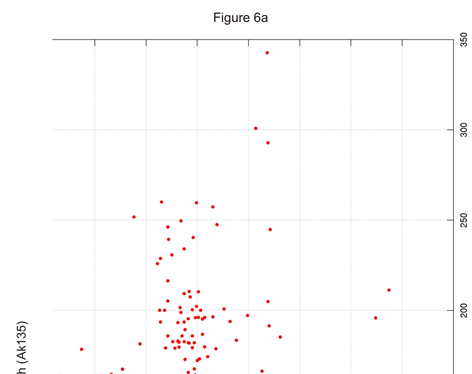

Figure 6. Ak135 depth shifts relative to JB (Figura 6a). Histogram shows that many hypocenters do not change in depth for the two velocity models and others change in a same value. The others shifts describe a gaussian like distribution (Figure 6b).

Histograms of shifts

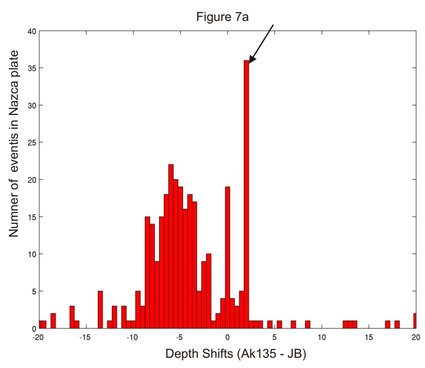

Figure 7. Histograms for the tree groups. Note that backarc and forearc events show similar histograms and they don't show gaussian like distribution (Figure 7b and 7c). Nazca plate events histogram presents equal shifts and also gaussian like distribution (Figure 7a).

References

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