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Tracking Instrumental Issues in the Brazilian Seismographic Network (RSBR)

Diogo Coelho (Observatório Nacional), Gilberto Leite Neto (Observatório Nacional), André Nascimento (Observatório Nacional), Sergio Fontes (National Observatory (Brazil)), Ítalo Maurício (Observatório Nacional), Eveline Sayão (Observatório Nacional), Marcelo Bianchi (IAG - Universidade de São Paulo), George Sand Leão Araújo de França (IAG/USP), Marcelo Assumpção (Universidade de São Paulo), Aderson Nascimento (Federal University of Rio Grande do Norte), Eduardo Menezes (Universidade Federal do Rio Grande do Norte), Marcelo Rocha (Universidade de Brasília), Diogo Albuquerque (Braskem)

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The Brazilian Seismographic Network (RSBR) is one of the most extensive networks in South America. It has been in operation since 2011, thanks to the joint efforts of four institutions: the National Observatory (network code ON), the University of Brasilia (BR), the University of São Paulo (BL), and the Federal University of Rio Grande do Norte (NB). Due to the network's heterogeneous nature, the relatively large number of stations (96), and the large volume of available data (nearly 15 years), keeping track of instrumental issues over time presents a significant challenge. Knowing when and at which station such issues occurred is crucial for making data processing more efficient, as it allows for better handling of problematic data. Furthermore, having regular and automatic data quality assessment is essential for quickly identifying and implementing the necessary equipment corrections. To resolve that, we are automatically evaluating station orientation, clock stability, and gain across 15 years of data from the RSBR. For each station, we used seismograms from earthquakes listed in the GCMT catalogue ($M_w \geq 6$) at $\Delta \leq 100^\circ$ and $140^\circ \leq \Delta \leq 180^\circ$. We first check for timing instability for each station by calculating the time difference between observed and theoretical P-wave arrival times. While observed arrival times are determined through the Akaike Information Criterion (AIC), the predictions are set using the ray-tracing algorithm TauP. After that, sensor misorientation (Θ) is determined after grid-searching Θ, aiming at maximising the cost function. It also ensures the data meets quality control standards: high signal-to-noise ratio in the vertical component, high correlation between the radial and vertical elements, and low transverse-to-radial and radial-to-vertical amplitude ratios. Additionally, we check for anomalous amplification factors in components of each station by computing the ratio between pairs of components (N/Z, E/Z and N/E). Our Θ estimates are similar to those of a previous study, but we were able to track instrumental changes over time automatically. For the ON subnetwork, we observed sensor misorientations at stations CMC01, CAM01, GDU01, MAN01, NAN01, and TER01 until 2016/2017. From that point onward, our results reflect the corrected instrument orientations following field interventions. For the BL subnetwork, we observed that stations ITQB and CNLB are misoriented by more than 10º. BR stations, BOAV, MACA, MCPB, PTLB, and VILB also presented misorientation during operation time; from these, only BOAV, VILB and PTLB were corrected. Inconclusive results were found for stations CZSB and TMAB, also from the BR network, which could be related to complex instrumental issues. The NB subnetwork did not show considerable misorientation, but, like the other subnetworks, it showed problems regarding the gain. Apparent clock instability was observed at ABR01 starting in 2020, with data showing significant time discrepancies (60 s on average), possibly indicating a GPS-related issue. In 2020, NBCL records showed delays of up to 40 seconds. However, this issue appears to have been resolved, as data from 2021 onward shows minimal time discrepancies. The automated approach effectively tracks long-term instrumental issues, ensuring RSBR data reliability. Future implementations will focus on periodic diagnostics.