

## ***Interactive comment on “Impact of Hurricanes Irma and Maria on the PTWC Tsunami Warning Capability for the Caribbean Region” by Victor Sardina et al.***

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This paper discusses the considerable impact of the hurricanes in the Caribbean region to PTWC's seismic network which jeopardize PTWC's abilities in early determination of earthquake magnitude, especially essential in the issuance of the local tsunami warnings, and elaborates on remedy actions. Two parameters, data latency and azimuthal gap has been investigated in order to assess the degree of the loss in tsunami warning capabilities. Authors present detection delays of at least 15 seconds throughout at least 85% of the Caribbean reaching more than 30 seconds to affect 28% and 34% of the region for P and S wave detections, respectively, and azimuthal gaps starting from

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180 degrees and exceeding even 270 degrees have been identified as the conditions of criticality. Authors argue that longer delays appear heavily concentrated within the area monitored by the PTWC in the eastern Caribbean.

As remedy actions, authors investigated the effect of i) reducing the number of P-phase picks required for event detection, and ii) reducing the number of S-phase picks required for preliminary ML magnitude computation, where i) results in a significant reduction of the P-wave detection times from a maximum additional delay of 163 seconds to the 66 seconds, and ii) results in reduction on the S-wave detection times from a maximum additional delay of 273 seconds to the 120 seconds. It is understood that still approximately 2 min delay in PTWC's response times should be considered despite the remedy actions considered. In their conclusions, the authors also suggest the network operators to consider to hurricane-proof at least a subset of their seismic stations, so as to maintain a minimum earthquake monitoring and local tsunami warning capability even if impacted by category 5 hurricanes when reinstalling damaged stations and rebuilding the supporting infrastructure.

The authors address an important challenge of an operational tsunami warning system in a multi-hazard context. A short discussion on the ML uncertainty as a result of reduced number of stations/phase readings, as ML is as a fast magnitude estimate suitable for the region complements also the detection and location of earthquakes, could support the valuable study provided by the authors. It would also be advisable to provide a bit more information on the reasons of the station availability (instrument damage, power outage, communication lines etc.) and average recovery times based on actual experiences, and preferably not only related to the seismic network but also sea-level network, if possible.

In their conclusion, the authors correctly point out that the devastating impact of hurricanes on the PTWC local tsunami warning capabilities at the local level highlights the vital, and potentially lifesaving role of educating the population to self-evacuate in the event of prolonged or strong ground shaking instead of waiting for official tsunami mes-

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sages. It would be advisable to elaborate more on this important conclusion, due to the fact that this might be the one and only solution applicable to the local tsunami risk, even if the seismic networks perform in full. Caribe Wave tsunami exercises successfully conducted since 2011, for example, where the last one was conducted on 14 March 2019 with more than 830,000 participants, is probably the most important remedy action which could be referred to in this paper in addressing the technical/operational challenges of a local tsunami warning system to complete the end-to-end chain.

The Sendai Framework for Disaster Risk Reduction 2015-2030 recognizes the benefits of multi-hazard early warnings systems and places them in one of its seven global targets, namely to substantially increase the availability of and access to multi-hazard early warning systems and disaster risk information and assessments to people by 2030. Even though this falls out of the scope of this study, the authors in their conclusion may consider to provide a short elaboration on this aspect, specifically the need to analyse the feasibility and advantages of possible coupling the hurricane- and tsunami warnings in the multi-hazard context, especially in this region, to be addressed by another future publication perhaps. One should not forget the remaining big question: what happens if a tsunami occurs in this region during one of the peak moments of a hurricane? Even the means of self-evacuation may not exist anymore in such apocalypse scenario. . .

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