Responses to Reviewer #1 comments:

Thank you for the critique of this manuscript, it is much appreciated. We have responded to all of your comments below. Responses are in bold Italics. All line numbers in the responses relate to the updated document (once the revised manuscript is prepared).

This is an excellent piece of research and a great contribution to the scientific community. The paper is well written and lays out the problem and new research appropriately. I particularly like the inclusion of the limitations section so readers know when they can and cannot use the fragility functions.

Below are my minor comments and questions:

Line 40: add another ")" after the Koshimura et al., 2009 reference

Line 44: Removed "(" before the reference

Line 49: delete "field"

Line 53: removed "field"

Line 110: change "infrastructural" to "infrastructure"

Line 115: changed "infrastructural" to "infrastructure"

Line 147: delete extra ")" after the NZTA, 2014 reference

Line 152: deleted ")"

Lines 169, 190 and Figure 4 and 6 captions: it took me a while to realise that the area shown in Figure 4 and 6 is not the whole study area for the Tohoku event. Particularly when I was comparing the data in Figure 5a which shows thousands of bridges and Figure 6 which shows 20+ bridges. I would suggest at line 169 and line 190 in new sentences state the Figure 4 (Figure6) show an example of observes damage levels for roads (bridges) in the town of Ishinomaki within the study area. Or incorporate something similar into the Figure 4 and 6 captions.

Lines 174-175: "(Figure 4)." changed to "Figure 4 shows an example of observed damage levels for roads in the town of Ishinomaki within the study area."

Lines 197 - 198: "(Figure 6)." changed to "Figure 6 shows an example of observed damage levels for bridges in the town of Ishinomaki within the study area."

Line 208 and Figure 7 caption: incorporate a similar phrase "DL0 had a count of 573 road sections (too many to represent in Figure 7a), with five having a culvert." into the caption of Figure 7.

Figure 7 caption: "Note: DL0 had a count of 573 road sections (too many to represent in Figure 7a), with five having a culvert." Added.

Lines 214-215: "This was observed for road assets in Coquimbo as damage levels reduced with distance from the coast." Is this the only reason for this trend? Could it be caused by other effects such as change in inundation depth, topography, change in road construction?

We agree with your criticism; however, we do point out in lines 212-215 that distance from a coastline is not directly linked to observed damage, but rather the deteriorating wave energy and, therefore, hazard intensity. This is the reason we do not develop

any kind of vulnerability function for 'distance from coastline'. We have added more description to lines 225-226 around this: "Since distance from the coastline is not a direct impact causing process, therefore, the analysis is not conducive with fragility functions, so none are developed". We also acknowledge this as a limitation on Lines: 398-401 "Whereas the more localised data of Illapel has more consistent quantities of data across the range of inundation depths but is also limited by the overall data size. For example, the dataset did not warrant the comparison of different coastal settings since only flat topography was represented in the study area, which is also noted by Aránguiz et al., 2018 in the context of building vulnerability."

Line 218: add "s" after "function"

Line 226: "s" added

Line 219: In terms of the debris based level of service, was any consideration given to areas that, pre-tsunami, might have had a higher concentration of maternal that could become debris e.g. construction sites, industrial area, etc? These areas might have higher density of debris post-tsunami compared with the method you used.

Although site-specific debris origin is not specifically considered, as that is beyond the scope of this work, the authors are aware of this. More context has been added to Lines 238-240 in consideration of this point. "The local sea port, of which are typically well-defined regions of debris origin (Naito et al., 2014), was located along the South-West to North-West inundated coastline."

Line 222: change "assets" to "asset's"

Line 230: apostrophe added

Line 225: change "levels of service" to "service levels (SL)"

Line 233: changed "levels of service (Table 2)" to "service levels (SL), as defined in Error! Reference source not found."

Lines 227-229: the sentence starting with "To account for potential horizontal…" seems to be missing some words before or after the brackets. I don't know what is trying to be said to offer a rewrite.

Thank you, this was an oversight, "was used" has been added to Line 237

Line 247: spell out "CDF"

Line 257: "CDF" changed to "cumulative distribution function"

Line 282: delete "even"

Line 292: removed "even"

Line 286: Start a new sentence after "(Figure 13b)"

Line 296: full stop added

Lines 298-299: Can you explain why these did not warrant the development of fragility functions?

It is because distance from a coastline is not a hazard intensity as such and is not the process resulting in damage directly. We have added more clarity around this: "(Sub-section 2.2.2)" moved to the end of sentence (Line 209) and more explanation is

now provided in subsection 2.2.2 (Lines 225-226). More content around the small sample sized used is also added to line 463-465 "particularly as the small sample size at Coquimbo reduces the ability to derive a robust statistical sample. Therefore, the observation remains qualitative and the parameters require further investigation from future events"

Line 326: delete "also"

Line 339: deleted "also"

Line 337: "at around 2m" on Figure 19a it looks a lot less than 2m, maybe 0.2m?

Thank you, this was an oversight. "~0.08" changed to "~0.09" (Line 348), "2m" is changed to "0.03 m" (Line 350), and "4m" is changed to "3m" (Line 351)

Lines 338-339: the sentence starting with "However, the least squares regression…" is this correct? Looking at Table 3 it seems the coastal plains r2 values are lower than the valleys.

Thank you, you are correct about the r2 values being lower for coastal plains for the mixed construction roads, this was an oversight. The sentence "However, the r^2 values for coastal valleys are particularly low, so the comparisons between each coastal setting my not be entirely representative of true vulnerability" is meant for the next paragraph regarding varied construction type and the influence on vulnerability in each topographic setting. It has been moved to lines 359-360 and "However, the r^2 values for coastal plains are lower than coastal valleys and, therefore, may not be as representative of true vulnerability" has been added to lines 351-352.

Line 348: add references for "previous studies"

Line 363: reference added

Line 405: change "behave" to "have"

Line 406: changed "behave" to "have"

Line 420: change "may a" to "may be a"

Line 422: changed "may a" to "may be a"