

ANSWER TO REVIEWRS

Journal: NHESS

Author (s): Contreras-Jara et al.

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Title: “Indirect Costs of Floods: A Case Study of Highways Road Users”

Iteration: First review

Reviewer #2

#	Comment	Answer
R2-1	This study presents a method/procedure that integrates hydrologic and hydraulic flood modeling with road and bridge vulnerability analysis and traffic modeling to estimate user-related costs. The framework is applied to the Aconcagua Bajo watershed in Chile, analyzing floods of varying exceedance probabilities (2-100 year return periods) and their effects on bridges, roads, and overall traffic efficiency. Overall, this study is comprehensive, and the findings are meaningful for accurately estimating indirect costs due to floods. However, I still have several comments and suggestions for improving the current work.	We thank Reviewer 2 for the constructive comments that have helped improve its clarity and methodological transparency.
R2-2	1) Line 17: “EUC” stands for expected road user cost or expected user cost? Please make sure it is consistent throughout the manuscript, and write the full name for its first appearance and use the acronym afterwards, e.g., “EAD” in Lines 94 and 109, why “HMH” stands for hazard modeling, and so on. Also, it is suggested to add a list of all the acronyms to the appendix part.	We standardize the term through the paper using “Expected User Cost” (EUC). The same criterion has been applied to all other acronyms (e.g., EAD, HMH).
R2-3	2) Line 25: Floods can be also caused by rapid snowmelt.	Snowmelt has been added as a flood-triggering mechanism in the revised manuscript at Line 27 of the new version as follows: “Floods are primarily caused by rainfall, and in mountain watersheds, by rapid snowmelt, which, increases.....”
R2-4	3) Equation (3): The second term on the right-hand side of the equation should be $P(h_{j+1})$ instead of $PD(h_{j+1})$.	We thank the reviewer for catching this typo. The notation has been corrected in Eq. (3) of the revised manuscript.
R2-5	4) Equation (4): Please make it clear that $T_1 > T_2 > T_3$.	We introduce in the right-hand side of Eq. (4) the aclaration “where $T_1 > T_2 > \dots > T_3$.”
R2-6	5) Sections 5.1 and 5.2: What is the spatial resolution of the DEM data used in hydrological and hydraulic modeling?	The hydraulic model was built using the ALOS PALSAR DEM (12.5×12.5 m, JAXA 2011). We introduce the resolution in lines 170, 314, 343 and 372.
	How were the model parameters, such as the Manning’s roughness coefficients, calibrated in this study?	This clarification was introduced in revised version in lines 345 – 346. “Manning’s roughness coefficients were assigned based on land use/land cover

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		classification derived from satellite imagery, following Chow (1959)...”.
R2-7	6) Section 5.2: It should be noted that the uncertainty in the hydraulic modeling process determines the accuracy of the model outputs. Thus, it is suggested to employ the probabilistic flood inundation maps instead of the deterministic maps for the future analysis if possible. Please refer to the paper below. Reference: “Uncertainty analysis and quantification in flood insurance rate maps using Bayesian model averaging and hierarchical BMA” (https://doi.org/10.1061/JHYEFF.HEENG-5851)	We acknowledge that probabilistic flood inundation mapping would reduce uncertainty in model outputs. However, the deterministic approach adopted in this study is consistent with network-level flood risk analyses, where the primary objective is to evaluate system-wide user cost impacts across multiple return periods rather than to characterize inundation uncertainty at individual locations. The use of probabilistic flood maps is recognized as a valuable direction for future work, and this limitation has been incorporated into the Discussion section of the revised manuscript, citing the reference suggested by the reviewer (Huang & Merwade, 2023).
R2-8	7) Table 5: What do the terms, H _{av} and L, stand for?	The definitions of H _{av} (average water depth in flooded roads, in m) and L (total length of flooded roads, in m) have been added below Table 5 of the revised version.
R2-9	8) Figures 3 and 4: Please add a scale bar to the maps. For some reason, the inundation extents under different flood scenarios in Figure 4 look quite similar.	A scale bar has been added to Figures 3, 4, and 5 in the revised manuscript. Although the flood maps for different return periods look similar because of the map scale, the simulations produced different water depths for each flood scenario.
R2-10	9) Section 7.4: It would be helpful to add a conceptual sketch of the mechanism of the traffic assignment model.	We introduce a diagram (Figure 2) in the revised version, between lines 236 and 238.
R2-11	10) Figure 6: To avoid confusion, it is suggested to change the horizontal axis to the exceedance probability of return periods in years.	A panel was introduced in figure 7 fo the revised manuscript, presenting the results with the horizontal axis expressed in return period (years), complementing the original figure which retains the annual exceedance probability axis.
R2-12	11) Lines 400-406: It is also important to note that the uncertainty in model calibration/evaluation should not be ignored, given the sampling uncertainty over limited space and time. Please refer to the paper below for more information about the limitations of some commonly used evaluation metrics in flood modeling. Reference: “Beyond a fixed number: Investigating uncertainty in popular evaluation metrics of ensemble flood modeling using bootstrapping analysis” (https://doi.org/10.1111/jfr3.12982)	This has been acknowledged in the Discussion section of the revised manuscript, and the suggested reference (Huang & Merwade, 2024) has been incorporated.
R2-13	12) Lines 450-457: This paragraph is similar to the paragraph above and thus redundant. It is suggested to remove it.	We agree. The redundant paragraph at Lines 450–457 was removed.
R2-14	13) Line 497: The terrain data are “digital terrain models” or “digital elevation models”?	To avoid confusion, the sentence at line 497 was removed.

