



Supplement of

Flood exposure and structure damage under deterministic design-storm and stochastic storm transposition rainfall scenarios: a case study in South Louisiana, USA

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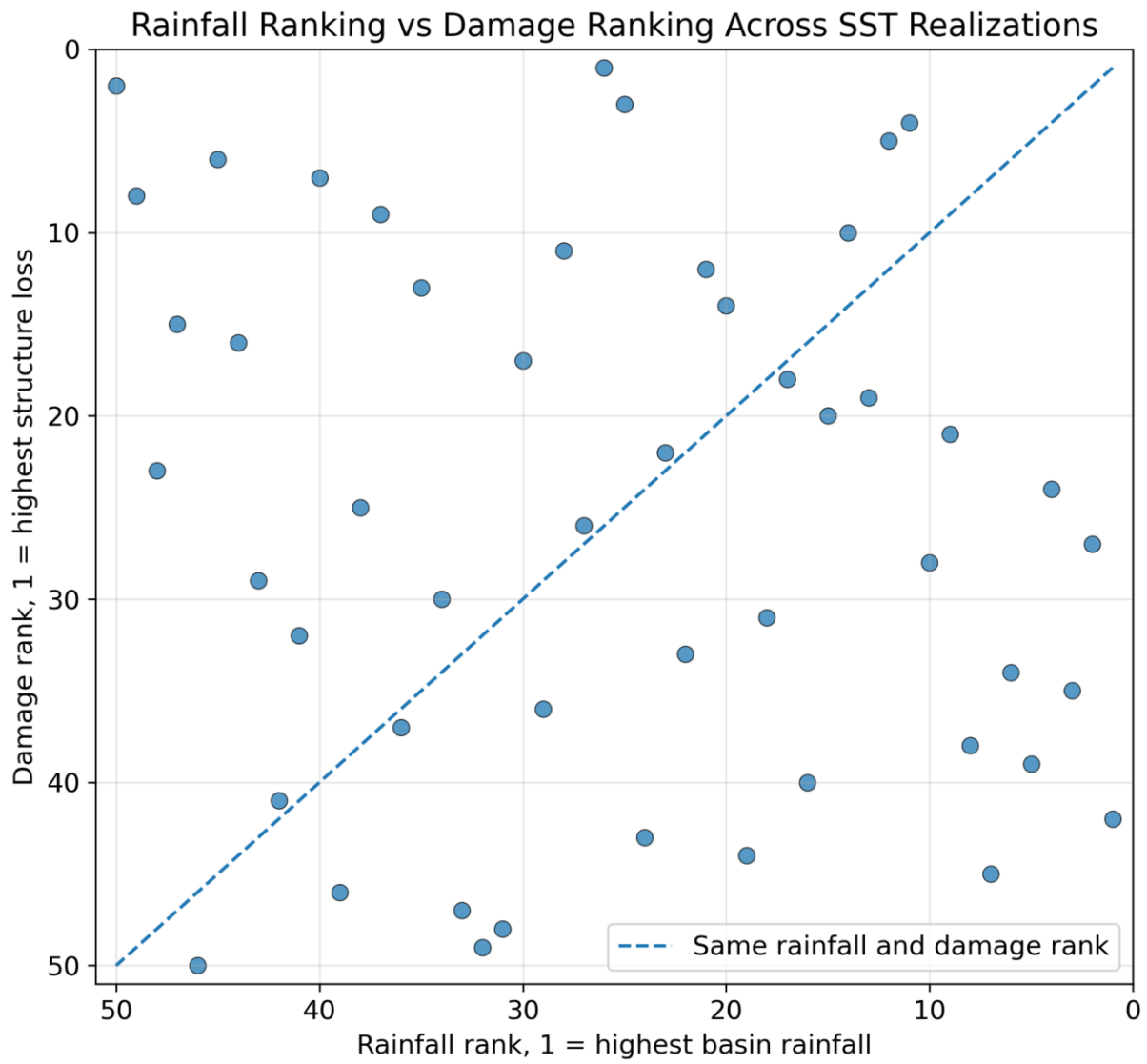


Figure S1. Comparison of basin-average rainfall-depth rank and total structure-damage rank across the 50 SST realizations. The dashed 1:1 line indicates perfect agreement between rainfall-volume ranking and damage ranking.

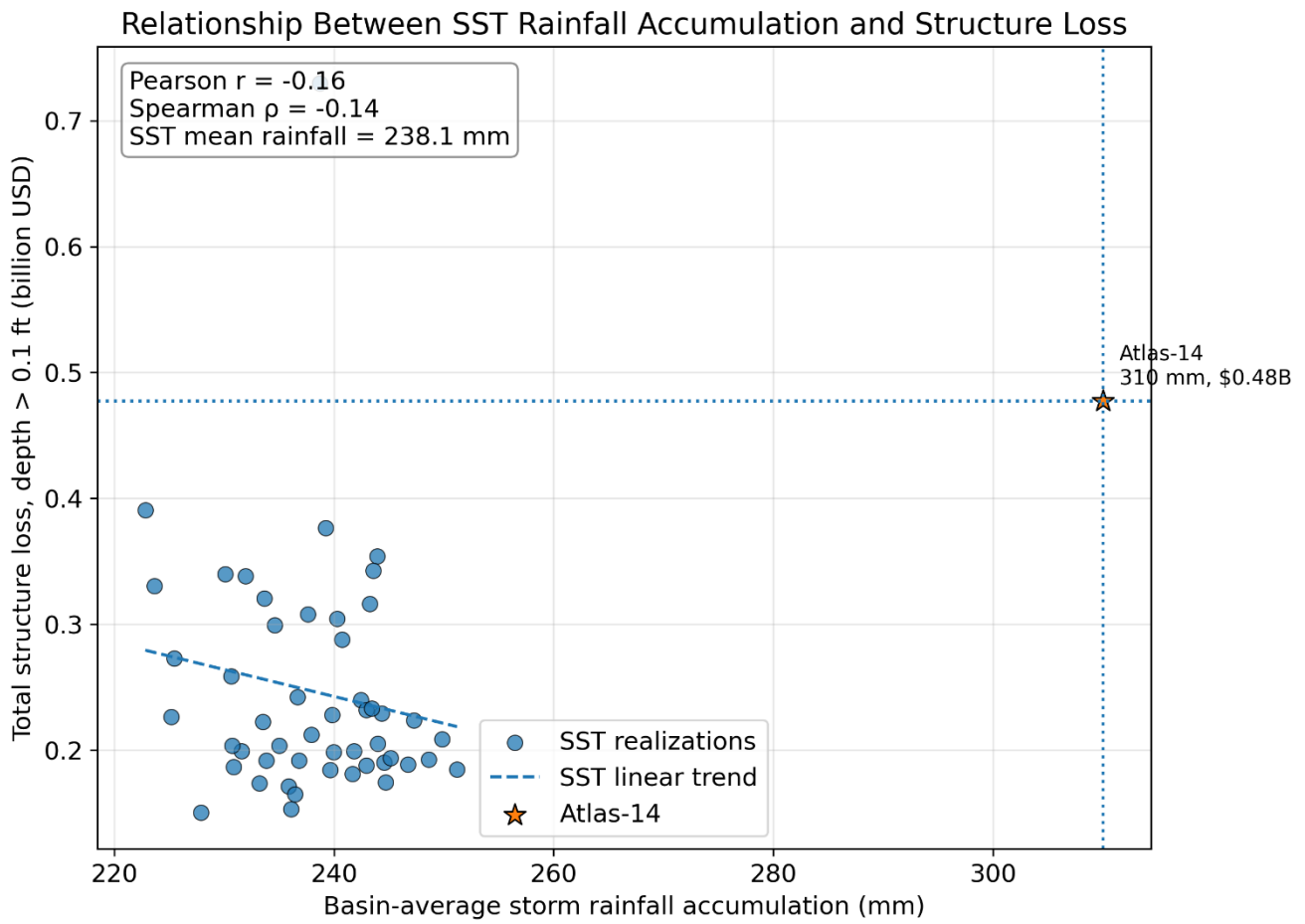


Figure S2. Relationship between basin-average 24 h rainfall accumulation and total structure loss for the 50 SST realizations, with the baseline Atlas-14 scenario shown for reference. The vertical and horizontal dotted lines mark the TP40-adjusted Atlas-14 areal rainfall depth of 310 mm and the corresponding Atlas-14 structure loss of approximately \$0.48B.

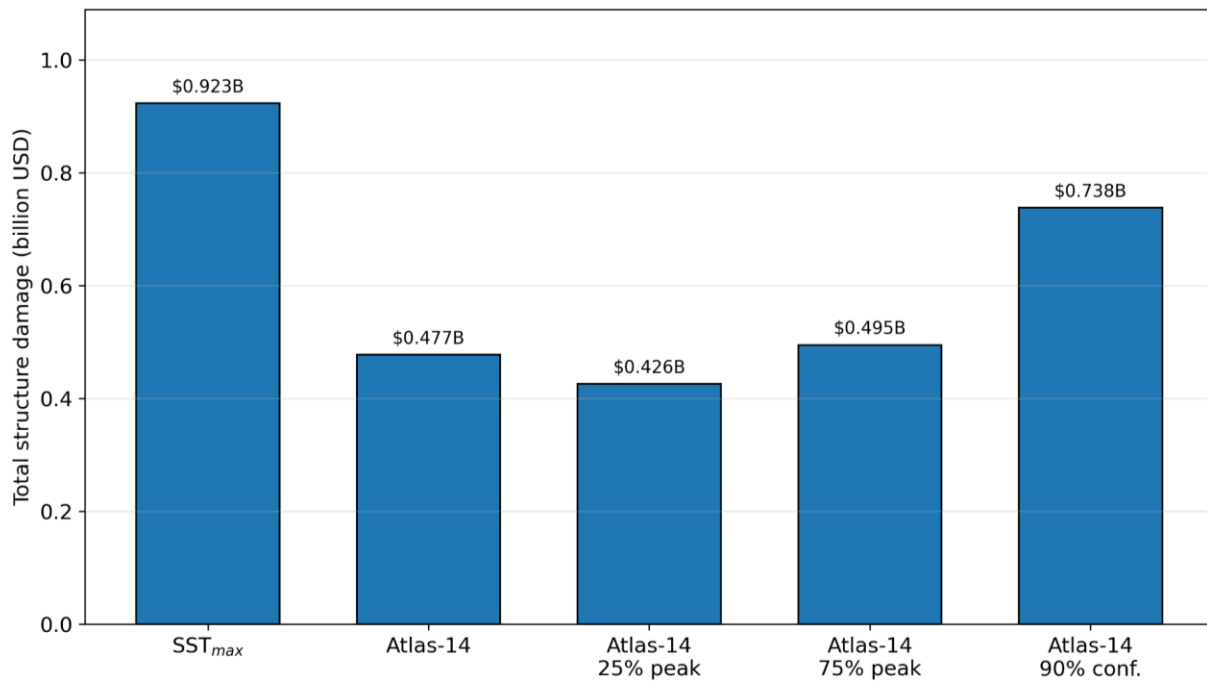


Figure S3. Total structure damage for SST_{max}, the baseline Atlas-14 scenario, Atlas-14 temporal peak-placement variants, and the upper 90% confidence-bound Atlas-14 scenario using a flood-depth threshold of 0.03 m. The upper 90% confidence-bound Atlas-14 scenario increases damage relative to the baseline Atlas-14 case, while the 25% and 75% peak-timing variants produce smaller changes.

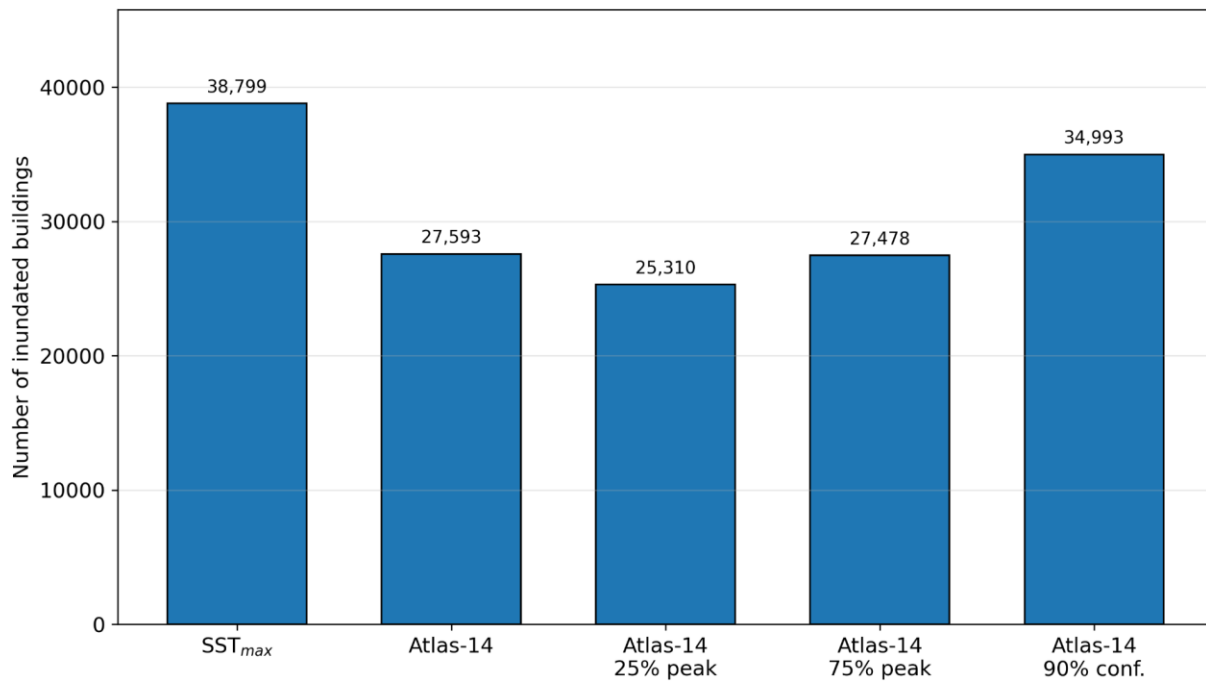


Figure S4. Number of inundated buildings for SST_{max} , the baseline Atlas-14 scenario, Atlas-14 temporal peak-placement variants, and the upper 90% confidence-bound Atlas-14 scenario using a flood-depth threshold of 0.03 m. The upper 90% confidence-bound Atlas-14 scenario increases the number of inundated buildings relative to the baseline Atlas-14 case, while the temporal peak-placement variants produce smaller changes. SST_{max} remains larger than all Atlas-14 cases.

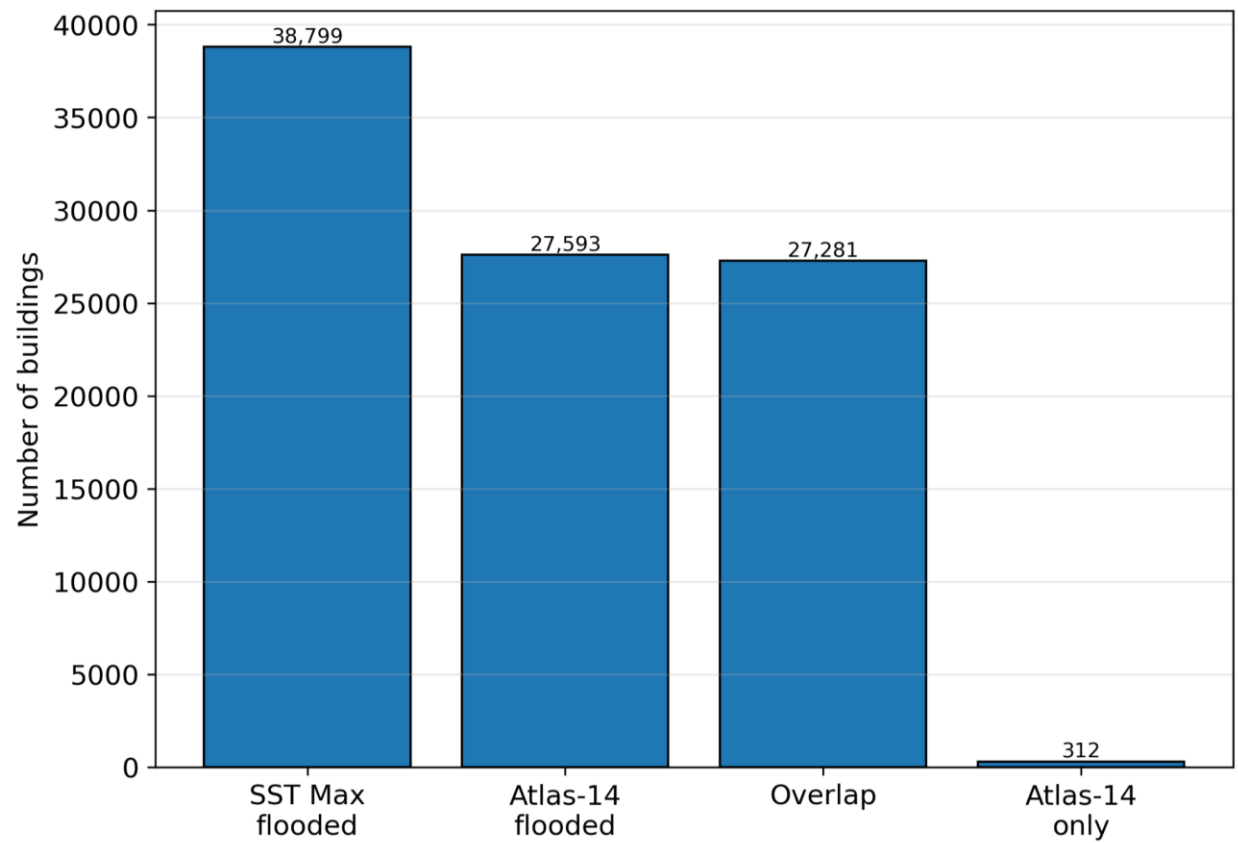


Figure S5. Comparison of inundated-building counts for SSTmax, the baseline Atlas-14 scenario, the overlap set, and the Atlas-14-only set using a flood-depth threshold of 0.03 m. The Atlas-14-only group includes buildings inundated by the baseline Atlas-14 scenario but not by SSTmax. This group contains 312 buildings, which is small relative to the SSTmax, Atlas-14, and overlap totals.

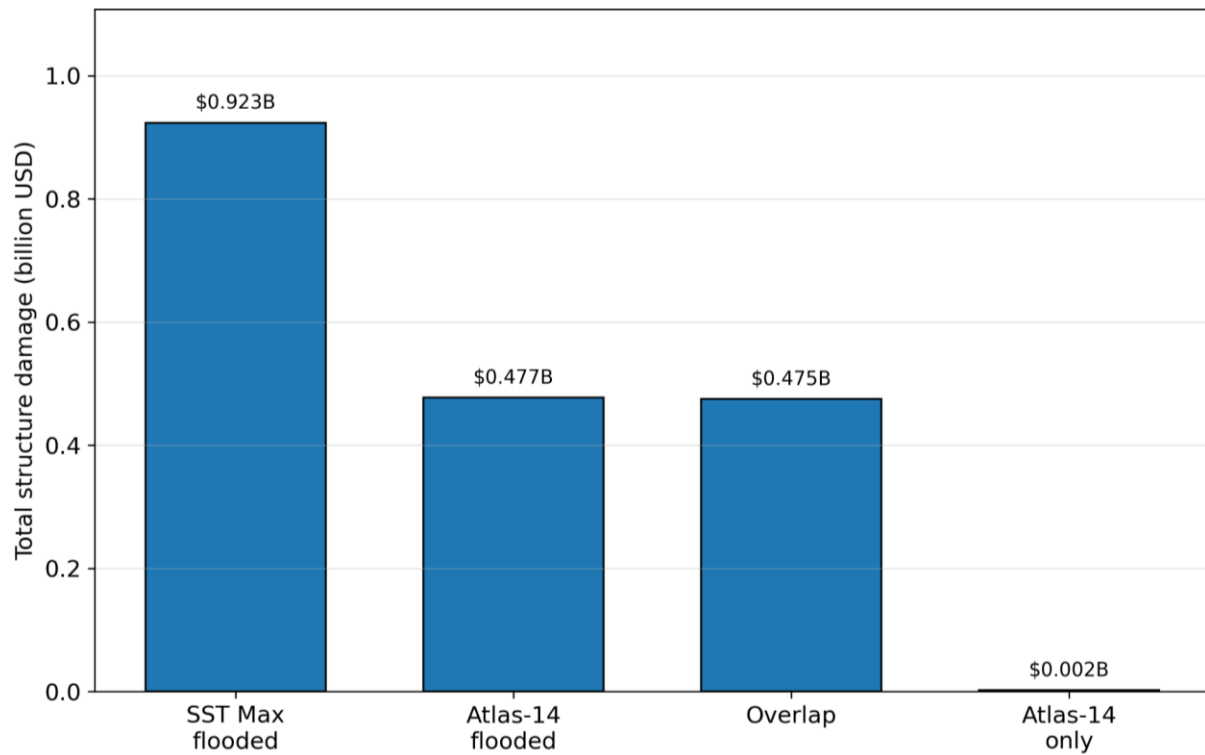


Figure S6. Comparison of total structure damage for SSTmax, the baseline Atlas-14 scenario, the overlap set, and the Atlas-14-only set using a flood-depth threshold of 0.03 m. The Atlas-14-only group contributes approximately \$0.002B, or just over \$2M, in structure damage, indicating that most Atlas-14 damage occurs within the overlap set.

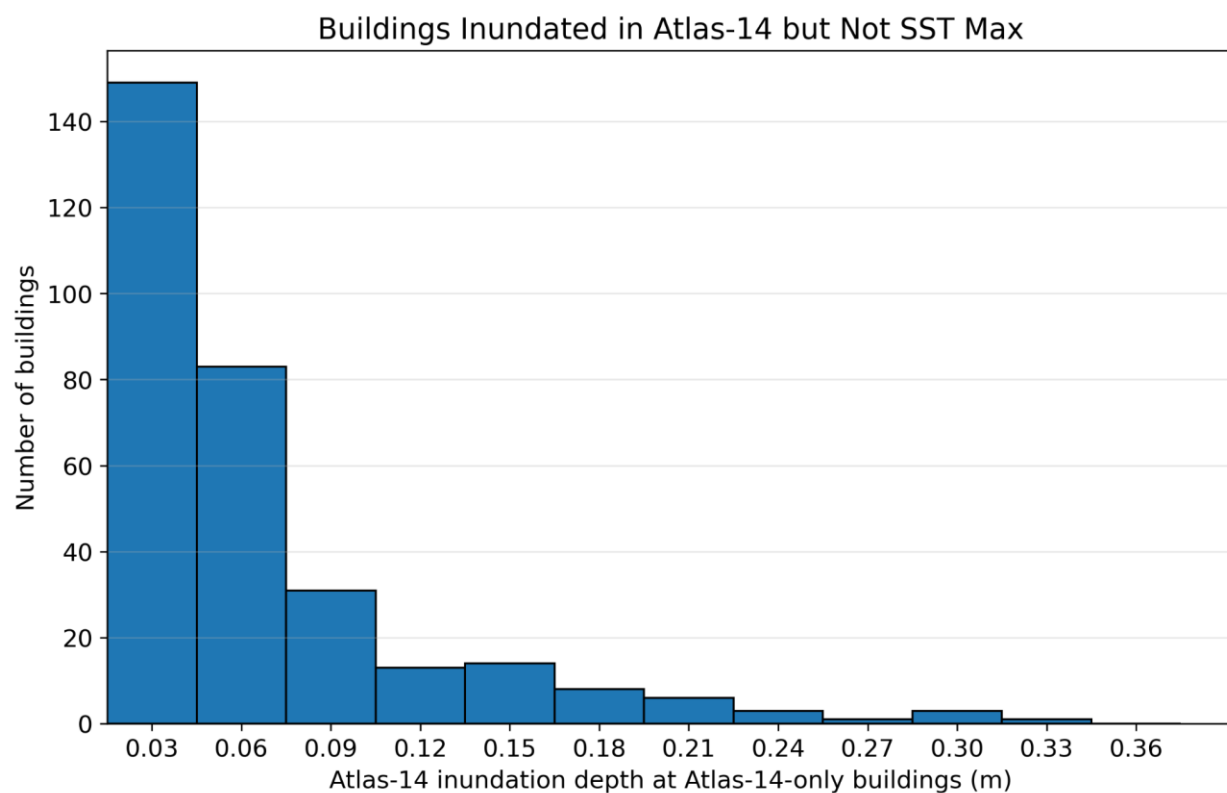


Figure S7. Inundation-depth distribution for the 312 Atlas-14-only buildings, defined as buildings inundated by the baseline Atlas-14 scenario but not by SSTmax. Approximately 50% of Atlas-14-only buildings have inundation depths of 0.03 m or less, and approximately 75% have depths of 0.06 m or less.

Supplementary Tables

Table S1. Summary of event-level model performance based on LWI calibration and validation criteria.

Event	Phase	Stage/WSE PPCC ≥ 0.9	Stage/WSE RMSE% ≤ 15%	Stage/WSE PBIAS ≤ 10%	Flow PPCC ≥ 0.7	Flow RMSE% ≤ 20%	Flow PBIAS ≤ 15%
Hurricane Gustav 2008	Calibration	5 of 5 100%	4 of 5 80%	4 of 5 80%	1 of 2 50%	1 of 2 50%	2 of 2 100%
October 2015	Calibration	5 of 5 100%	4 of 5 80%	5 of 5 100%	2 of 2 100%	1 of 2 50%	1 of 2 50%
August 2016	Calibration	4 of 5 80%	5 of 5 100%	5 of 5 100%	2 of 2 100%	1 of 2 50%	1 of 2 50%
May 2017	Calibration	5 of 5 100%	5 of 5 100%	5 of 5 100%	2 of 2 100%	1 of 2 50%	1 of 2 50%
Hurricane Barry 2019	Calibration	5 of 5 100%	5 of 5 100%	4 of 5 80%	2 of 2 100%	2 of 2 100%	2 of 2 100%
Hurricane Laura 2020	Calibration	5 of 5 100%	5 of 5 100%	4 of 5 80%	2 of 2 100%	1 of 2 50%	2 of 2 100%
May 2020	Validation	3 of 5 60%	4 of 5 80%	3 of 5 60%	2 of 2 100%	1 of 2 50%	1 of 2 50%
Hurricane Delta 2020	Validation	5 of 5 100%	4 of 5 80%	4 of 5 80%	2 of 2 100%	1 of 2 50%	2 of 2 100%

Note: Values indicate the number and percentage of evaluated gauges that met the relevant LWI target for each metric. Stage/WSE performance was evaluated using five gauges, while discharge performance was evaluated using two gauges. The cells indicate that the metric meets or exceeds the 50% event-level criterion.

Table S2. Summary of station-level model calibration and validation statistics for the Vermilion regional model.

Event	Phase	Stage PPCC	Stage RMSE%	Stage PBIAS%	Flow PPCC	Flow RMSE%	Flow PBIAS%
Hurricane Gustav 2008	Calibration	0.95-0.98	1.85-12.36	-5.32 to -0.09	0.81-0.96	13.35-31.04	-15.08 to -7.18
October 2015	Calibration	0.94-0.98	2.17-15.58	-4.61 to 9.73	0.90-0.91	13.78-36.98	-20.12 to 4.29
August 2016	Calibration	0.89-0.97	2.18-8.90	-4.92 to 2.60	0.90-0.95	17.97-24.02	-15.77 to 8.89
May 2017	Calibration	0.97-0.99	1.80-9.46	-6.98 to -0.27	0.97-0.97	12.76-32.87	-28.95 to -2.49
Hurricane Barry 2019	Calibration	0.96-0.99	2.77-9.32	-4.32 to 6.47	0.92-0.96	10.31-21.42	-1.75 to -1.24
Hurricane Laura 2020	Calibration	0.99-1.00	1.80-12.41	-8.29 to 11.55	0.95-0.98	11.89-22.34	-6.98 to 4.90
May 2020	Validation	0.67-0.95	3.03-56.00	1.14 to 54.40	0.87-0.90	11.07-33.89	0.30 to 20.66
Hurricane Delta 2020	Validation	0.94-0.99	2.01-20.79	-5.32 to 19.14	0.91-0.97	9.04-23.44	0.69 to 1.64

Note: Values are shown as minimum-maximum ranges across the evaluated gauges for each event. Stage/WSE statistics are reported across five USGS stage gauges, and discharge statistics are reported across two USGS flow gauges. RMSE is reported as standardized RMSE percentage, and PBIAS is reported as percent bias. Negative PBIAS indicates underestimation and positive PBIAS indicates overestimation.