Ida-BD: pre- and post-disaster high-resolution satellite imagery for building damage assessment from Hurricane Ida

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Rapid and automated damage assessment of buildings and infrastructure in the aftermath of disasters is critical to expedite emergency response and resource allocation. Damage assessments done by ground crews can be time-consuming and labor-intensive. To expedite building damage assessments, several studies have implemented computer vision techniques on high-resolution aerial imagery and satellite imagery.

Every disaster event is new and unique, even though they may share some similar characteristics. For example, the building damage caused by a hurricane may not be the same as the damage caused by another hurricane in the future. Therefore, using models developed based on images from previous disaster events directly to assess the damage of a new event requires the models to be tested on new datasets to evaluate the adaptation performance of the models. In the literature, the majority of the existing models are built using a single dataset (xBD) and have not been tested on additional datasets that include newly damaged areas. Thus, we introduce a new dataset, Ida-BD, with 87 pre- and post-disaster image pairs with a very high resolution (0.5m/pixel) from Hurricane Ida 2021 in Louisiana, USA. Hurricane Ida brought the strongest winds on Louisiana's record and heavy rains, which lead to at least 18 billion estimated building damage costs and at least 30 fatalities in Louisiana.

Ida-BD is obtained from the WorldView-2 (WV2) satellite with very high-resolution images taken in Nov. 2020 and Jul. 2021 for pre-disaster and Sep. 2021 for post-disaster. The satellite imagery was collected close to New Orleans city in Louisiana, USA, one of the most impacted areas during Hurricane Ida in late Aug. 2021 (Figure 1). The WV2 satellite provides panchromatic images with spectral resolution of 450-800 nm and spatial resolution of 46 cm. The panchromatic images in this dataset were first orthorectified by Apollo Mapping, a mapping company, to 0.5m/pixel, and then we created 87 image pairs (pairs of pre- and post-disaster images at the same location) with a size of 1024 x 1024 pixels. The resolution of these images is finer than the ones in the xBD dataset. Similar to xBD, we use polygons to represent building segments and provide four damage categories. All annotations were done by the in-house team with quality control procedures using Labelbox. As shown in Figure 2. We first annotated building polygons in pre-disaster images to avoid incorrect building boundaries due to damage. Then, by overlapping the annotation of building boundaries, we classified building damage for each building based on post-disaster images. All annotations, building boundaries and damage levels, are reviewed several time by experts in the team. The comparison of damage class distribution in xBD and Ida-BD datasets is shown in Table 1. Ida-BD has more damage buildings at all levels in terms of pixel counts compared with xBD except the class of destroyed buildings.

Since the near real-time damage assessment face the scarcity of labelled datasets, already available datasets can be used for training and some domain adaptation techniques or fine-tuning can be applied to obtain satisfactory results on the newly damaged areas with scarce data. As a result, Ida-BD dataset can serve as a benchmark for domain adaptation from larger datasets like xBD.

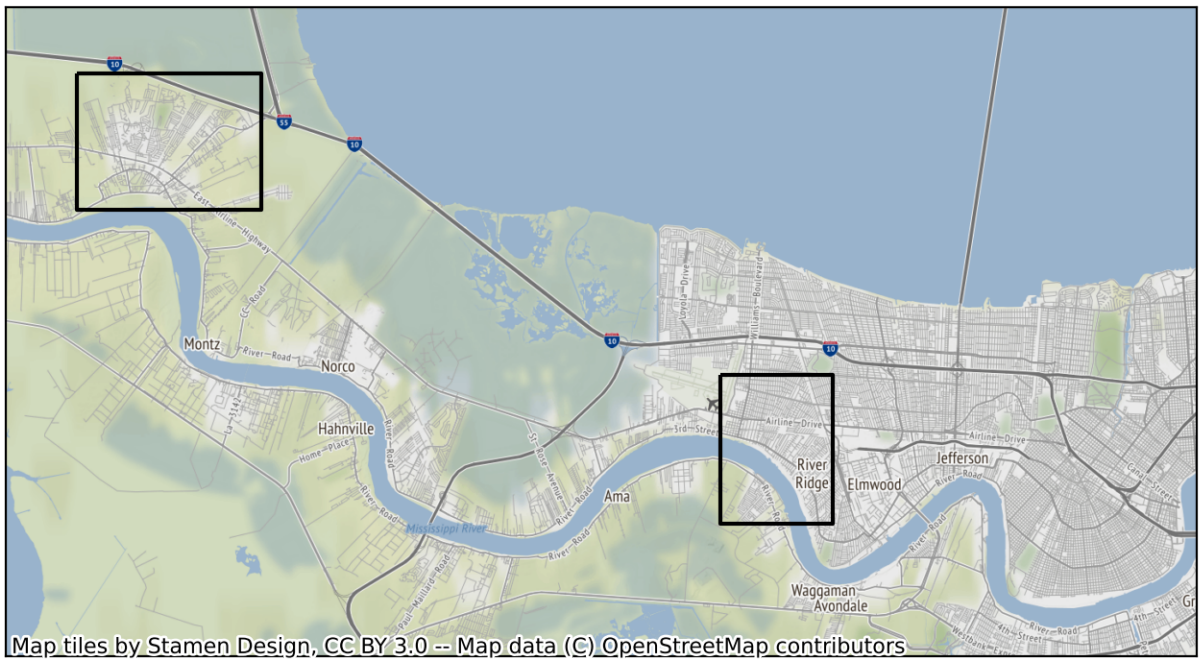

Figure 1. Location of Ida-BD near New Orleans city in Louisiana, USA.

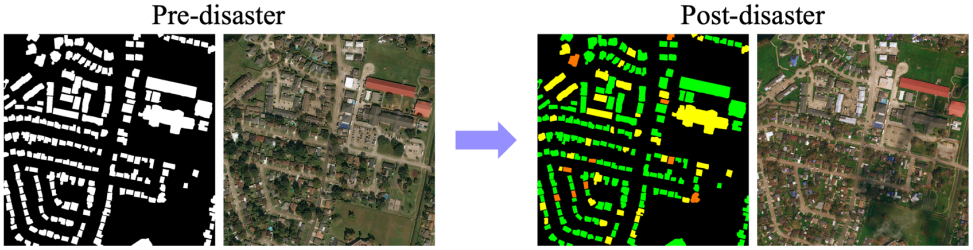

Figure 2. Example of the annotation of buildings and damage levels.

Table 1. Class-wise pixels count distribution in xBD dataset and Ida-BD dataset.

	0	1	2	3	4
xBD	96.1	2.7	0.1	0.1	0.1
Ida-BD	81.7	11.9	4.6	1.6	0.05

* The notation used: 0-Background, 1-No damage, 2-Minor damage, 3-Major damage, 4-Destroyed