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Climate Adaptation and Disaster Assessment using Deep Learning and Earth Observation

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Due to anthropogenic climate change, the frequency and intensity of natural disasters is only increasing. As supercomputing capabilities increase in an era of computational geosciences, artificial intelligence has emerged as a key tool in assessing the progression and impact of these disasters. Recovery from extreme weather events is aided by machine learning-based systems trained on multitemporal satellite imagery data. We work on shifting paradigms by seeking to understand the inner decision-making process (interpretability) of convolutional neural networks (CNNs) for damage assessment in buildings after natural disasters, as these deep learning algorithms are typically black boxes. We compare the efficacy of models trained on different input modalities, including combinations of the pre-disaster image, the post-disaster image, the disaster type, and the ground truth of neighboring buildings. Furthermore, we experiment with different loss functions, and find that ordinal cross entropy loss is the most effective criterion for optimization. Finally, we visualize inputs by creating gradient-weighted class activation mapping (Grad-CAM) on the data, with the end goal of deployment. Earth observation data harnessed by deep learning and computer vision is not only useful for disaster assessment, but also in understanding the other impacts of our changing climate from marine ecology to agriculture in the Global South.