RescueNet: Joint Building Segmentation and Damage Assessment from Satellite Imagery

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Motivation

- Directing Humanitarian Aid and Disaster Response (HADR) operations in the immediate aftermath of natural disasters
- Existing multi-stage approaches for building damage assessment are not end-to-end trainable, and suffer from poor overall results

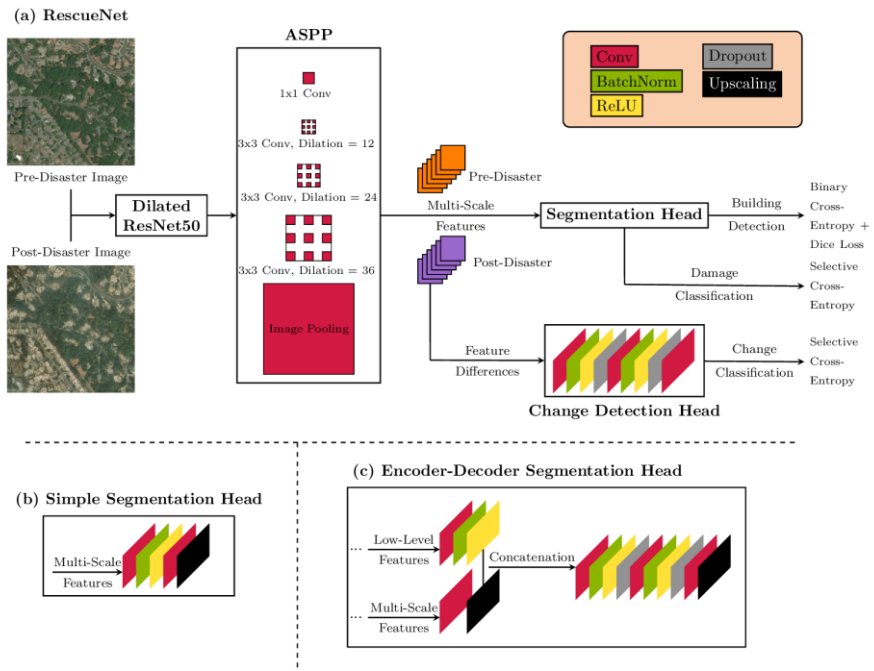
Method

- Multi-scale Feature extraction using ResNet50 backbone
- Parallel Segmentation and Change Detection heads
- Novel Localization Aware Loss

Localization Aware Loss

$$L(y_i, \hat{y_i}) = \begin{cases} -log(\hat{y_{il}}) + \sum_{k \in C} -log(\hat{y_{ik}}) & \text{if } y_{il} = 1 \\ -log(1 - \hat{y_{il}}) & \text{if } y_{il} = 0 \end{cases}$$

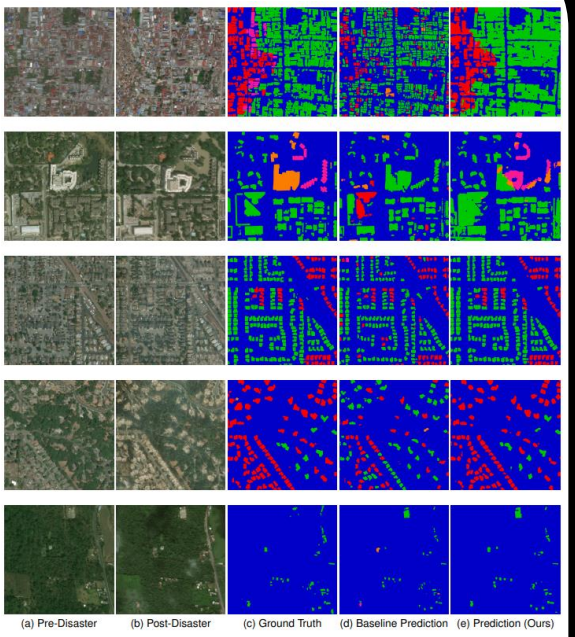
RescueNet Architecture



xBD Dataset

- Pre- and Post-Disaster Images (N= 9,000)
- 4 damage levels: `undamaged`, `minor`, `major`, and `destroyed`
- Multiple disaster types, such as, hurricanes, volcanic eruption, earthquakes, from locations across the world.

Qualitative Results



Overall Result (XView2 Metric)

Model	Localization Score	Damage Score	Overall Score
Ours	0.84	0.74	**0.77**
Baseline [1]	0.79	0.03	0.26

Class wise F1-Scores

Damage class	Baseline (Our Split)	RescueNet (Ours)
undamaged	0.7211	0.8832
minor	0.0235	0.5628
major	0.0105	0.7711
destroyed	0.4262	0.8079
Harmonic Mean	0.0282	0.7348