Francesco Franchina - INAF OACT
USCVIII - Galzignano Terme

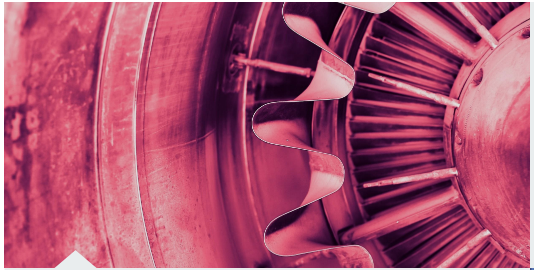
15 ottobre 2024

INAF
ISTITUTO NAZIONALE
DI ASTROFISICA

HaMMon

Hazard Mapping and vulnerability Monitoring

Introducing HaMMon



Funded by PNRR

Backed by ICSC’s spoke 3

Industrial Project

Capitalizing the acquired skills applying them to real world’s issues

15 partners

Public bodies and private companies across Italy

Goals

Facing the hazardous and

extreme events **more frequent**

due to the **Climate Change**

Work Packages

- 0 Management
- 1 Technological infrastructure to run and deploy the applications
- 2 Post-event analysis
- 3 Seasonal forecasts and weather generator
- 4 Building features extraction from images
- 5 Vulnerability curves for earthquakes and landslides

Work Packages involving INAF

0 Management

1 Technological infrastructure to run and deploy the applications

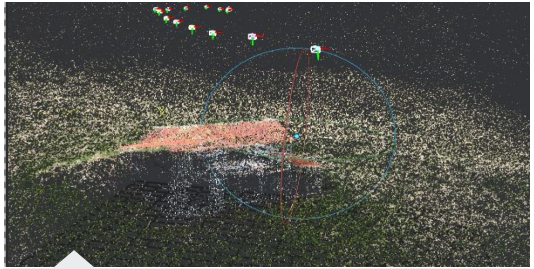
2 Post-event analysis

3 Seasonal forecasts and weather generator

4 Building features extraction from images

5 Vulnerability curves for earthquakes and landslides

Which are the goals?



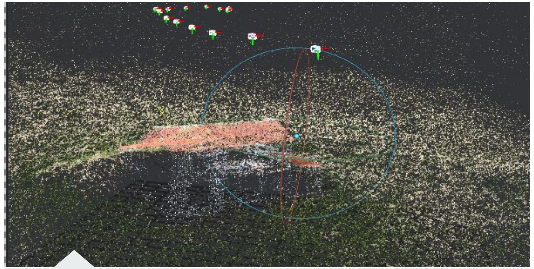
WP2

Carry on assessment activities on the Digital Twin

WP4

Getting better estimates on the danger to which building are exposed

Which are the tasks?



WP2

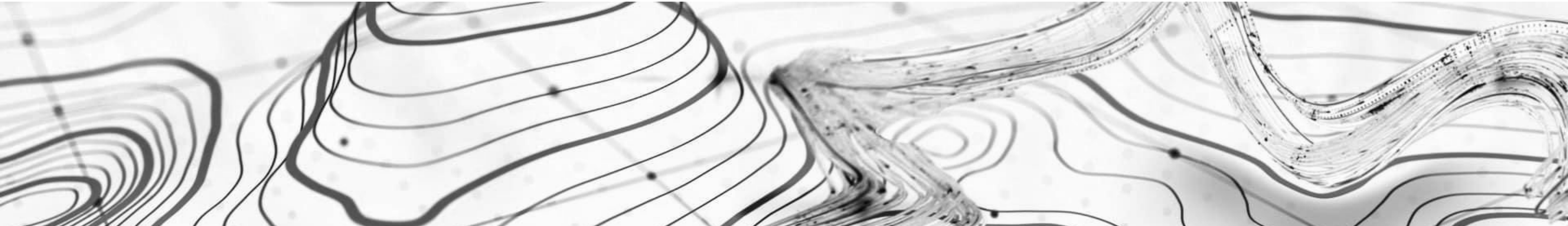
- Flying drones to take pictures
- Segmenting the pictures automatically
- Doing photogrammetry
- Finalizing the Digital Twin

WP4

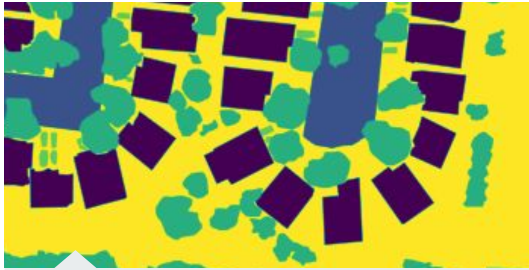
- Modelling the vulnerability curves
- Collecting aerial images
- Doing feature extraction

Listen to Nicoletta Sanvitale for more info!!

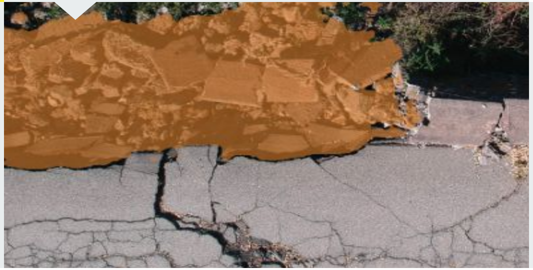
Digging deeper into WP2



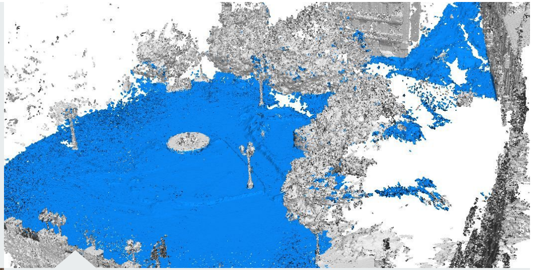
Why Segmenting?



Estimating areas



Shape-aware



Estimating volumes
(with photogrammetry)

How to segment?

Tiramisù

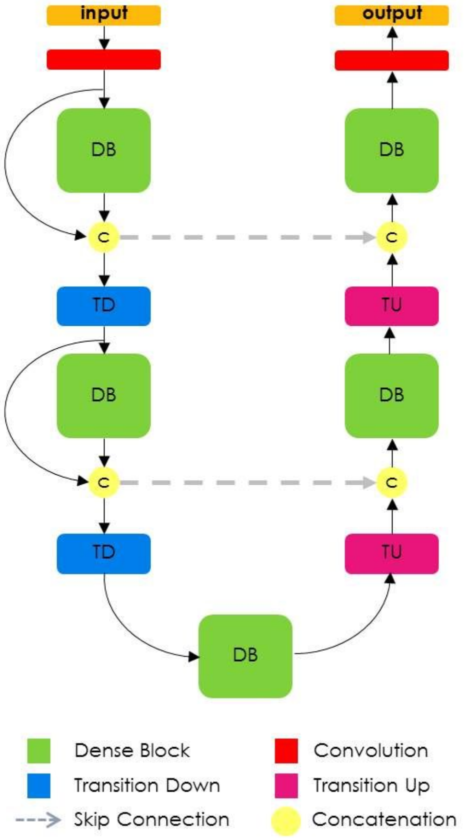
Fully Convolutional Densely Connected U-Net https://arxiv.org/abs/1611.09326

How to segment?

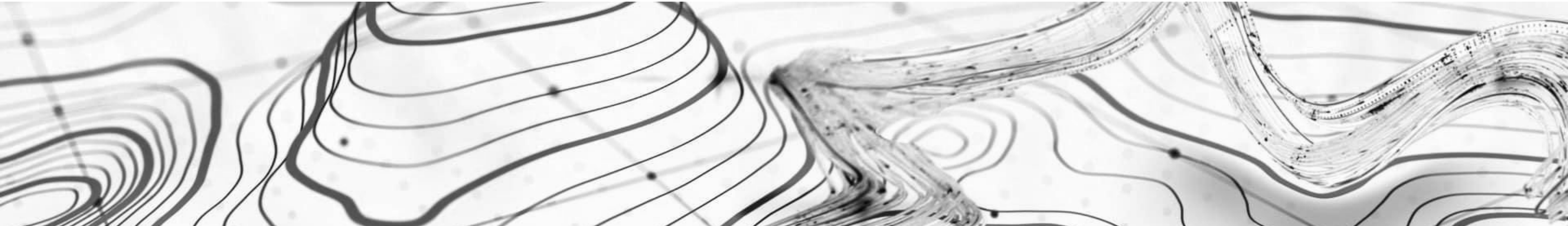
Tiramisù

Fully Convolutional Densely Connected U-Net

- The Dense Blocks accumulate different feature maps for the input
- The Transition Down decrease size and increase feature space
- The Transition Up decrease feature space and increase size
- The Skip Connections force conditioning on the output



Experimental setup



FloodNet dataset

- Images from a drone survey made in 2017
- Presents damages left from Harvey hurricane
- Taken in Texas and Louisiana (USA)

2.343

Labelled images

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Class of objects

Background, Building-flooded, Building-not-flooded, Road-flooded, Road-not-flooded, Water, Tree, Vehicle, Pool, Grass

13GB

of Hi-Res images

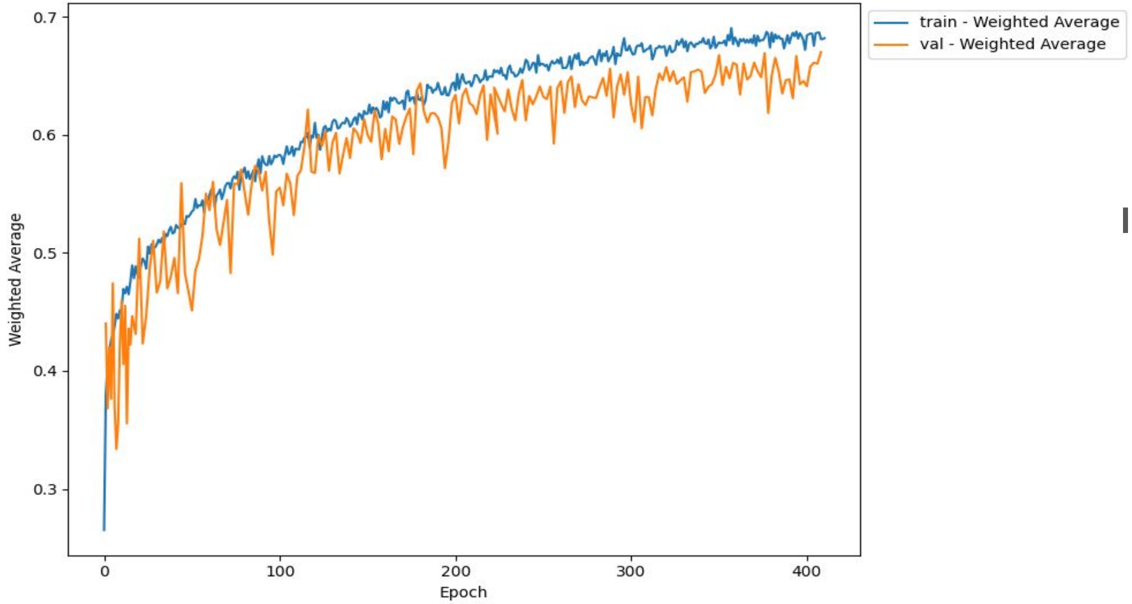
Training architecture

- The architecture is a Kubernetes cluster provided by the WP1
- The training runs on two nVidia Tesla V100 32GB
- The network storage is modular and shared

Training setup

- Random crops of the dataset images at 600x600 px
- Data augmentation (flipping, scaling)
- ~ 400 epochs
- Average training time of around 100 hours

Results so far

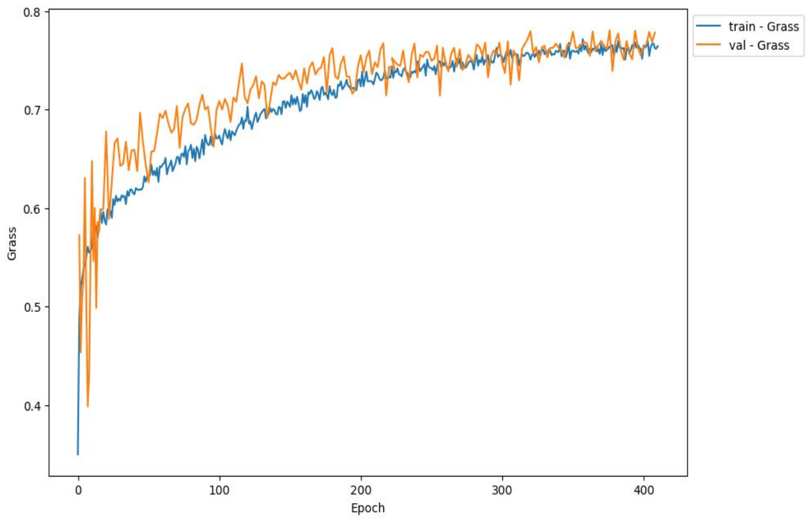


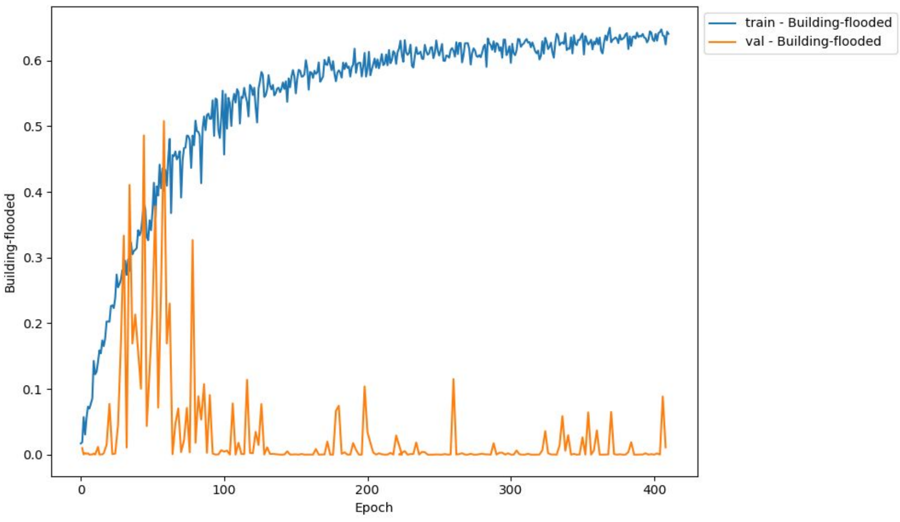
Weighted average of the

IoU of the different classes

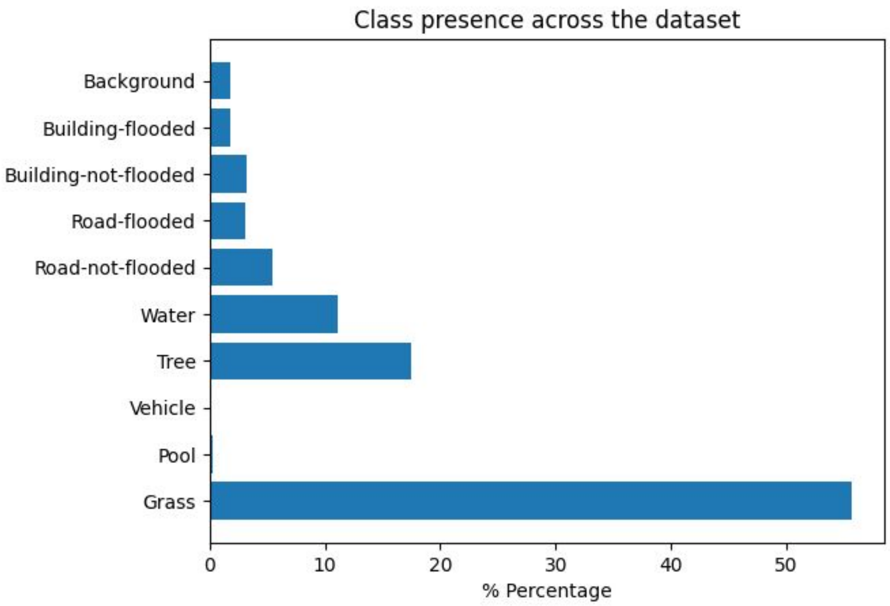
Promising but...

Results so far





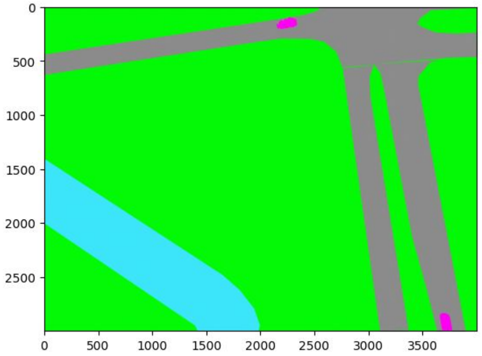
Results so far



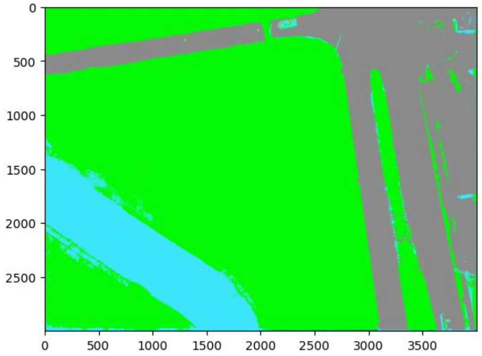
Some classes are practically missing!

Results so far

Image

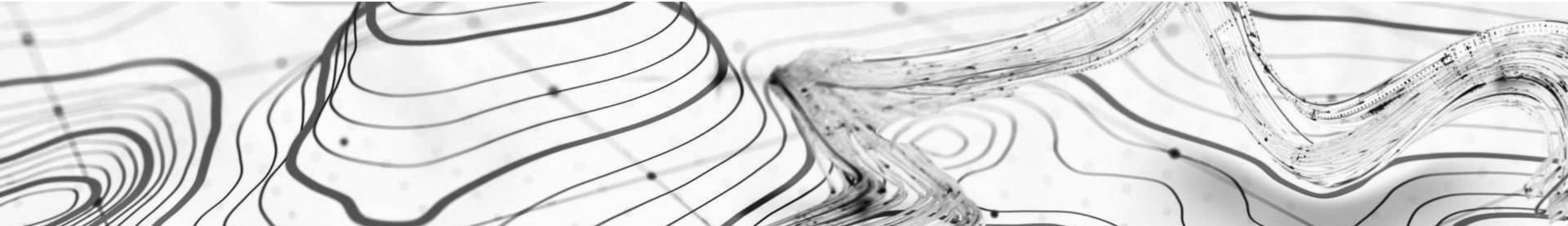


Ground Truth



Prediction

What we are improving



Transfer-learning

on RescueNet dataset

- Images from a UAV made in 2018
- Presents damages left from Michael hurricane
- Taken in different USA locations

4.494

Labelled images

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Class of objects

Background, Water, Building_No_Damage, Building_Minor_Damage, Building_Major_Damage, Building_Total_Destruction, Vehicle, Road-Clear, Road-Blocked, Tree, Pool

22.6GB

of Hi-Res images

Hi-Res inference

CPU/GPU

Heterogeneous computing

12MP

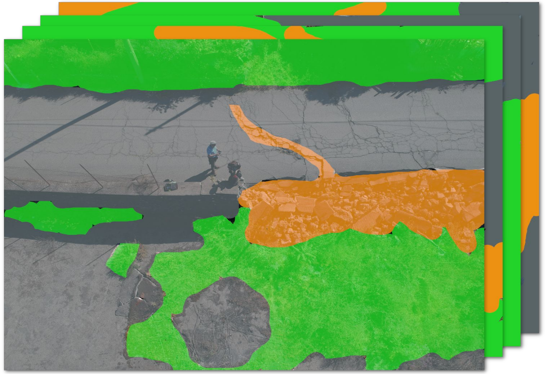
3000x4000 px

1 min

per image

Digital Twin augmentation

+



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↑ Tiramisù

TEAM

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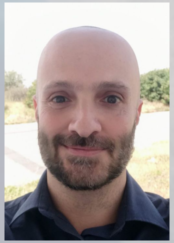

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Thank you.