International Workshop on Wildfire Modeling & Al





NATIONAL ACADEMIES Sciences Engineering Medicine



Can AI Enhance Wildfire Risk Awareness?

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Living in a green forest is beautiful

Forests provide stunning scenery, fresh air, and a close connection to nature among others ecosystem services

Green is relaxing

Green spaces reduce stress and improve mental health

People don't usually consider the flammability of their surroundings

Many people enjoy forests without realizing the fire risk, especially in dry seasons. Fire awareness is crucial for safety.

Wildfire Susceptibility - From statistical analysis (2007) to ML application (2019)

Learning past fires to the static "*probability*" of witnessing fire, given the geophysical and topographic characteristic of each pixel.

Wildfire polygons

Observations

Predisposing

factors

- Liguria Region dataset 1997 -2017
- Summer and winter fires

Geophysical

- Land use / vegetation cover
- Vegetation of single pixel and neighboring vegetation
- DEM (elevation, slope, aspect)

Anthropic

 Distance from anthropic elements: roads, settlements, crops. tracks...



Ensemble of decision

trees

RANDOM FOREST







by Marj Tonini ^{1,*} ⊠ ⁽⁰⁾, Mirko D'Andrea ² ⊠ ⁽⁰⁾, Guido Biondi ² ⊠, Silvia Degli Esposti ² ⊠, Andrea Trucchia ² ⊠ ⁽⁰⁾ and Paolo Fiorucci ² ⊠



OUTPUT (susceptibility maps)





90% of the total area is covered with vegetation

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Al-informed Fuel Map

Research Question:

How to obtain a fuel map that can help improve wildfire scenarios for Wildfire Risk Management?

Main characteristics required:

- identify areas with higher wildfire risks, highlighting the ability to discriminate within the territory
- Large scale availablity data, overcoming limitations from intensive data collection (usual fuel map approach)

Idea:

Using information on past wildfires, to project their characteristics and identify where fuel is more or less prone to fire.



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| | grassland (G) | broadleaves (B) | shrubs (S) | conifers (C) |
|--------|--|---|---|---|
| low | G1 : low intensity surface fire, low likelihood | B1 : medium intensity forest fire, low likelihood | S1 : high intensity bushfire, low likelihood | C1 : high intensity forest fire, low likelihood |
| medium | G2 : low intensity surface fires, medium likelihood | B2 : medium intensity forest fire, medium likelihood | S2 :high intensity bushfire, medium likelihood | C2 : high intensity forest fire, medium likelihood |
| high | G3 : low intensity surface fire, high likelihood | B3 : medium intensity forest fire, high likelihood | S3 : high intensity bushfire, high likelihood | C3 : high intensity forest fire, high likelihood |







Mirko D'Andrea

1.0 = x Low intensity surface fires with low likelihood

O

2.0 = x Low intensity surface fires with medium likelihood

0

- 3.0 = x Low intensity surface fires with high likelihood
- 4.0 = x Medium intensity forest fires with low likelihood (broadleaves forests)
- 5.0 = x Medium intensity forest fires with medium likelihood (broadleaves forests)
- 6.0 = x Medium intensity forest fires with high likelihood (broadleaves forests)
- 7.0 = x High intensity bushfire with low likelihood
- 8.0 = x High intensity bushfire with medium likelihood
- 9.0 = x High intensity bushfire with high likelihood 10.0 = xHigh intensity forest fires with low likelihood (coniferous forests)
- 11.0 = xHigh intensity forest fires with medium likelihood (coniferous forests) 12.0 = xHigh intensity forest fires with high likelihood (coniferous forests)

(1)

്

2

20 km

demetra

CO 2023 FUEL MAP ITALIA

Two large WUI areas

3000 ha

å

(1)

0

Thousands of tourists in summer season

-OF

310

0

demetra

RISICO 2023 FUEL MAP ITALIA

CIMO R E S E A R C F O U N D A T I O

Mirko D'Andrea

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Producing scenarios to increase awareness





+ Add boundary condition



- WUI are not well defined
- Fuel continuity is not considered in urban areas

Wind gusts 20 m/s

FFMC 3%

Broadleaves Shrubs No Vegetation Grass Mediteranean Confer Crops Non fire-prone Veg. Vegetation

Urgent need

Unstance 4km Reclassify fuels in urban areas leveraging on AI and Sentinel 2 data

completed



Burned area h 478 ha in 3 have

Increasing awareness in fire management

ML applied to Support decision-making for the management of aerial firefighting operations







ML-informed probability map for request of aerial firefighting operations

Some results

Operational tool



Performance on validation dataset:



Performance on may 2023 -> july 2024



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Thanks for your attention

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