Forest fuel assessment by LiDAR data. A case study in NE Italy

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Wildland fuels mapping

Land management in fire-prone areas beneficiates from information on wildland fuels distribution to prioritise interventions, but fuel maps are not always available due to the high costs of field sampling.

In the CROSSIT SAFER Project[1], aerial Laser Scanner (ALS) data were tested for predicting forest fuels attributes across 3 pilot areas: an Alpine basin, a coastal wildland-urban interface and a karstic highland (Fig.1).

Field and LiDAR data

Standard wildland fuel parameters were collected in field sampling plots (n=18) distributed across several forest types (Fig. 2). Low density (avg. 4 pts/m^2) discrete return ALS data were available from a 2006 flight: after their classification, elevation metrics were calculated with FUSION[2] through its QGIS[3] plugin.

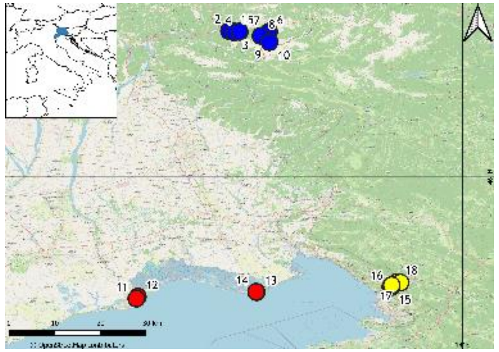

Fig. 1 Position of the sampling points in the three study areas: Alpine basin (blue), karstic highland (yellow), coast interface (red).

Fig. 2 Field sampling in the Alpine basin.

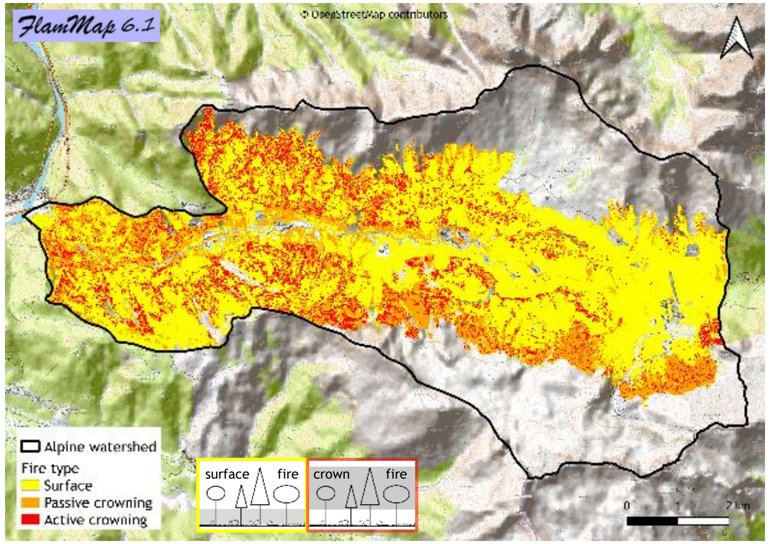

Fig. 4 Fire type map obtained from FLAMMAP simulation on the Alpine basin study area using the ALS data as inputs.

Statistical modelling

Field (dependent variable) and ALS data (independent variables) were associated via linear multiple regressions in R[4], selecting the model minimising the error of k-fold cross validation (leave-out p = 0.25) (Fig. 3).

Fire behaviour simulations

Some models were used to infer wall-to-wall informative layers for FLAMMAP[5], a wildland fire simulation software. The outputs obtained from ALS data preserve the heterogeneity of forest fuels parameters (canopy height, canopy cover,…), resulting in more objective simulations (Fig. 4).

Results and perspectives

Results indicate, despite the small sample size, that ALS data can become a standard tool in wildland fuels mapping and management, as suggested by previous studies. Possible improvements to our procedure would be to estimate likewise the canopy bulk density and to differentiate the regression models according to the fuel type.

Today, ALS data are becoming increasingly available, and their adoption in land management of fire-prone areas can represent an opportunity to retrieve precious information while reducing the amount of fieldwork.

References

1. www.ita-slo.eu/en/crossit-safer
2. forsys.sefs.uw.edu/fusion/fusionlatest.html
3. www.qgis.org
4. https://www.r-project.org
5. www.firelab.org/project/flammap

Model eq.	Canopy depth ~ cubic mean + % returns > mean
R^2adj	0.70
RMSE	1.45 m

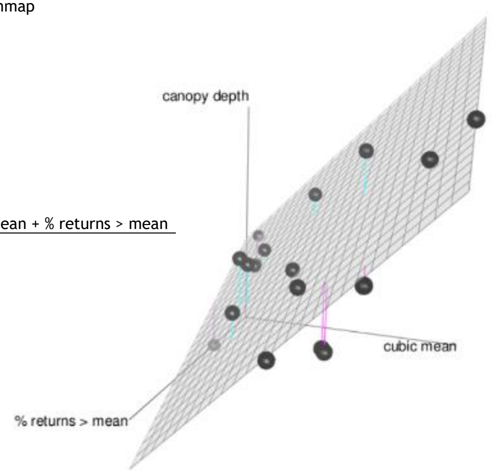

Fig. 3 Regression of canopy depth (field data) on cubic mean and percentage of returns above mean (ALS data).