Biomass Burning Recorded By Lidar In Relationship With Vegetation Type

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This research goes beyond the preceding studies on biomass burning (BB) measurements in EARLINET (to be submitted in two parts at ACP). A short introduction was given at 29th ILRC (Adam et al., 2019). In the preceding studies, the main approaches to data interpretation were the following. Vertical profiles of aerosols from 13 EARLINET stations during the 2008-2017 period were analysed. The recorded layers were labelled as smoke layers if fires were found along the backtrajectories within one hour and withing 100 km around the airmass pass. The data interpretation was based on aerosol intensive parameters (IPs). Three main directions were investigated: a) BB events recorded by two stations, b) long range transported smoke from N America and c) analyses based on four geographical regions. The investigation of IPs versus BB continental source region was performed. One of the main findings was that in most of the cases "mixed smoke" (smoke coming from several fire sources) was detected.

The present study envisages establishing relationships between the IPs and the vegetation type for BB events. The developed methodology can be applied to any other station in EARLINET and beyond. The main objectives are:

- Establish a method to characterize the "mixed smoke" events and thus the main burnt vegetation type from which the air-masses are originated.
- Investigate if there is a distinct relationship between BB from various vegetation types and IPs.

The methodology is based on the following datasets and approaches:

-Use of the land cover data (type MCD12C1v006) as provided by MODIS (https://lpdaac.usgs.gov/products/mcd12c1v006/) for each year of the period analysed.
-Use of the available IPs from lidar measurements over 2008-2017 period from Bucharest station.
-Use of the FIRMS database (https://firms.modaps.eosdis.nasa.gov/) to account the fires contributing to the measured smoke.

Note that previously, HYSPLIT backtrajectories were used to identify smoke source(s) (https://www.ready.noaa.gov/hypub-bin/trajtype.pl?runtype=archive).

For the present study, a simplified version is shown. Thus, we use the average values for land cover over entire 2008-2017 period. The chosen land cover dataset is 'Land_Cover_Type_3_Percent' (see Table 5 on https://lpdaac.usgs.gov/documents/101/MCD12_User_Guide_V6.pdf) which provides 11 types of vegetation type (Table 1). All the fires recorded for each specific measurement (identified by time and layer) were available from the previous study. A new criterion is introduced to double check if all the fires contributed to the airmass. Thus, the injection height was computed based on fire radiative power provided by FIRMS, a.t. the empirical formulation by Amiridis et al. (2010). Those backtrajectory points corresponding to altitudes above the injection height were eliminated (660 fires from 2625 total). For each fire location, the vegetation type was extracted. The land cover datafile provides percentages of each vegetation type. We determined the 'predominant vegetation type' (PVT) as the one for which the coverage percentage was > 50 %. The other cases were labelled as mixed (no vegetation type was more than 50 %) and we added the index 12 in Table 1. Note that the small percentage for water comes from areas on sea border (pixel area covering both water and land).

Table 1. Vegetation type.

#	Vegetation type	%
1	Water	0.51
2	Grasses or cereal	42
3	Shrubs	0
4	broadleaf crops	41
5	savannah	6
6	evergreen broadleaf forest	0.1
7	deciduous broadleaf forest	2.2
8	evergreen needleleaf forest	0.2
9	deciduous needleleaf forest	0
10	unvegetated	1.6
11	urban	0.76
12	mixed	6.1

The location of the fires for Bucharest station is shown in Fig. 1. The histogram shows that most of the fires are confined in E Europe. An example of the land cover for grasses or cereal along with the location of the fires, is shown in Fig. 2. Figure 3 shows PVT at the fires' location. The two most PVT found are

grasses or cereal (42 %) and broadleaf crops (41 %). Now we estimate the mean type of the burnt vegetation for each measurement. For each measurement, all the contributing fires and corresponding PVT were selected. The overall predominant vegetation (OPVT) type is taken as the most frequent value of all PVTs. Figure 4 shows the histogram of IPs versus OPVT. As seen, most of the measurements are related with BB from grasses or cereal (type 2) and broadleaf crops (type 4). We had 123 smoke layers examined (corresponding to 84-time stamps) while 1122 fires detected 1965 times contributed to these measurements. Note that a fire can be seen more than once along backtrajectory. OPVT ranked from 31.3 % to 100 % coverage (with 70 % average). The number of events is limited (see histograms). Comparing the two most contributing vegetation types (2 and 4), the first remarks are the following: LRs are slightly larger for type 2. BAE@355/532 has a broader range for type 2 while BAE@5321064 has a broader range for type 4. EAE shows slightly larger values for type 4. One case with depolarization > 0.1 was observed for type 2.

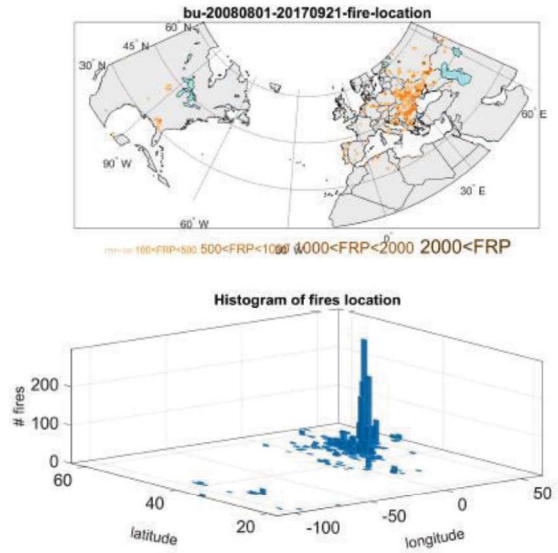

Figure 1. Histogram of the fires' location.

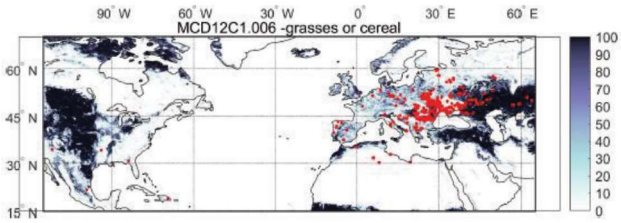

Figure 2. Land cover for grasses and cereals (%). In red, fires' location.

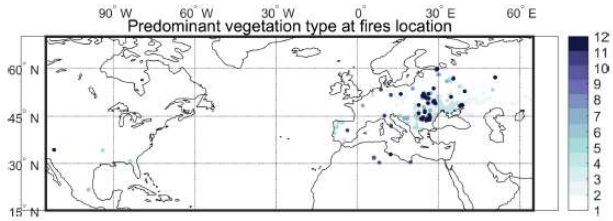

Figure 3. Predominant vegetation type at fires' location. See Table 1 for index description.

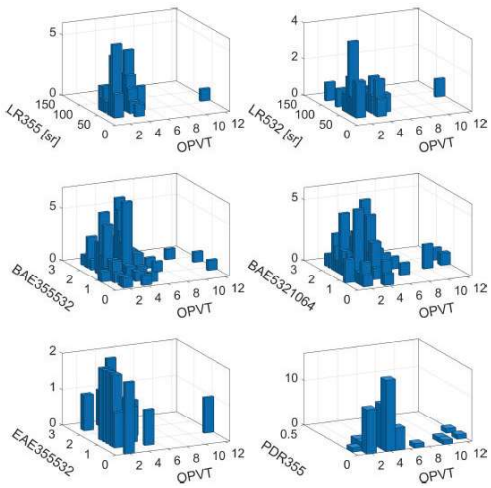

Figure 4. 2D histogram of IPs versus overall predominant vegetation type. See Table 1 for index description.

In the current scenario, the vegetation type is taken as an average over entire analysed period. Then, for each fire location, the predominant vegetation type is determined. Next, for each measurement, the most frequent value of all land covers (corresponding to all the contributing fires) is calculated. The overall predominant vegetation types are the grasses/cereals and broadleaf crops. The median of IPs values for categories 2 and 4 show larger values for category 4 except for LR@532.

Acknowledgements

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