Updates on biomass burning in relationship with vegetation type

S05P10

M. Adam[1], K. Fragkos[1], S. Solomos[2], L. Belegante[1], D. Ene[1], V. Nicolae[1], L. Janicka[3], V. Amiridis[4]

[1] National Institute of Research and Development for Optoelectronics - INOE 2000, 409 Atomistilor St, Magurele, Romania

[2]Research Centre for Atmospheric Physics and Climatology, Academy of Athens, Athens, Greece

[3]Faculty of Physics, University of Warsaw, 02-093, Warsaw, Poland

[4]Institute of Astronomy, Astrophysics, Space Applications & Remote Sensing, National Observatory of Athens, Athens, Greece

Context

Follows the study by Adam et al. over biomass burning measured by lidars in EARLINET and [1-2].

Objectives

- ❑Find a relationship between land cover type and smoke intensive parameters retrieved from lidar measurements

Input

- ➢INOE 2000 multiwavelength Raman lidar data (26/108 3+2+1 datasets selected, having 39 layers)
- ➢HYSPLIT ensemble backtrajectories [3]
- ➢MODIS FIRMS and land cover data [4-5]

➢Methodology

- ➢Quality control (QC) data
- ➢Determine intensive parameters (*IPs*) from 3+2+1 data
- ➢Assess aerosol layers [6]
- ➢Compute ensemble HYSPLIT backtrajectories:
  - at least 30 trajectories at altitudes inside the layer
  - compute mean trajectory using HYSPLIT 'cluster analysis'
- ➢Get fire's location along the mean trajectory
- ➢Asses injection height I_h [7]
- ➢Evaluate land cover type

Challenges

- ❖accuracy backtrajectory
- ❖accuracy injection height
- ❖lidar data availability for statistics
- ❖assess 'mixed smoke'

Case study

Lidar measurement: 27 June 2016, ~18:00 UTC

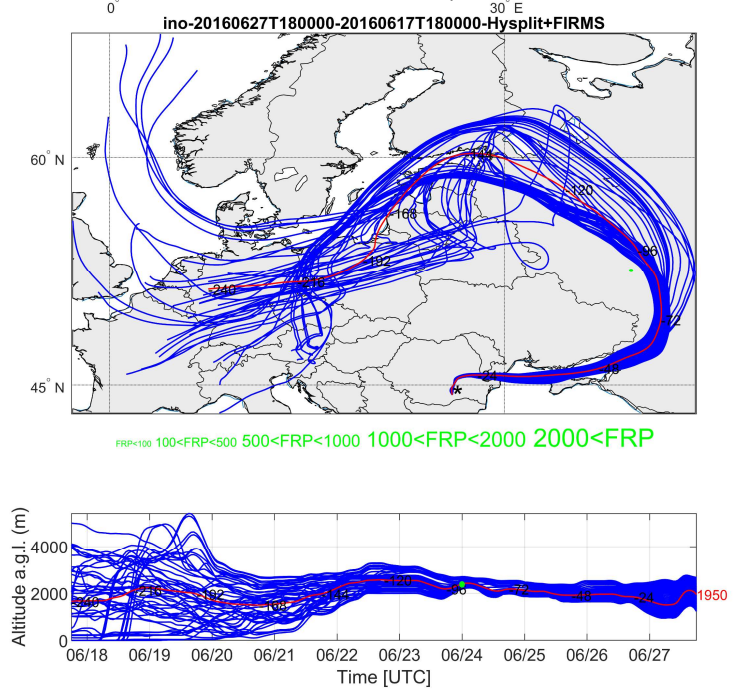

Fig. 1. HYSPLIT Ensemble trajectories (along with the mean trajectory in red) arriving at Magurele at every 50 m between 1323 and 2723m height, 27 June 2016, 1800UTC. The lower plot shows the altitudes of the air mass a.g.l. The location of the fires is shown in green.

Table 1. Intensive parameters for the layer at 1323-2723m.

LR@ 355 [sr]	LR@ 532 [sr]	EAE@ 355/532	BAE@ 355/532	BAE@ 532/1064	PLDR@ 532 [%]
63 ± 0.6	41 ± 2.5	1.45 ± 0.15	0.37 ± 0.04	1.6 ± 0.03	2.4 ±0.1

Two fires were observed in W Russia (3.85km apart) ~ 90h back, detected twice. First fire has FRP 53.7MW and the second has FRP 13.5MW. For the second, the highest land cover type (40%) is urban.

Table 2. Air mass and fires' coordinates corresponding to smoke lidar measurement at ~18:00 on 27 June 2016.

Time air mass	LON air mass	LAT air mass	ALT air mass	Time fire	LON fire	LAT fire	FRP [MW]	I_h [m]
24/06 00:00	40.833	52.927	2395	23/06 23:58	39.6375	52.5489	53.7	4118
24/06 00:00	40.883	52.927	2395	23/06 23:58	39.5806	52.5493	13.5	2403
23/06 23:00	40.721	53.089	2360	23/06 23:58	39.6375	52.5489	53.7	4118
23/06 23:00	40.721	53.089	2360	23/06 23:58	39.5806	52.5493	13.5	2403

LR@532<LR@355 and EAE >1,4 => fresh smoke [8].

Next steps:

Statistics over 39 layers:

- Layers affected by the fires (I_h>altitude air mass)
- Calculate predominant vegetation type *PVT* [2] as the vegetation type with ≥ 50% coverage
- *PVT – IPs* relationships

Table 3. Land cover for fires' location.

#	Vegetation type	Fire I [%]	Fire II [%]
1	Water	0	0
2	Grasses or cereal	14	12
3	Shrubs	0	0
4	broadleaf crops	0	0
5	savannah	11	5
6	evergreen broadleaf forest	0	0
7	deciduous broadleaf forest	41	22
8	evergreen needleleaf forest	32	21
9	deciduous needleleaf forest	0	0
10	Unvegetated	0	0
11	Urban	2	40

Acknowledgements: Romanian National contracts 18N/08.02.2019, 19PFE/17.10.2018 and PN-III-P2-2.1-PED-2019-1816.

Contact: mariana.adam@inoe.ro

References

1) Adam et al., *Atmos. Chem. Phys.*, 20, 13905–13927, 2020
2) Adam et al., ELC 2020, S03P036, 2020
3) Rolph et al., *Environ. Modell. Soft.*, 95, 210–228
4) https://lpdaac.usgs.gov/products/mcd12c1v006/ (MCD12C1v006)
5) https://firms.modaps.eosdis.nasa.gov/
6) Adam et al., ELC2021, S02P12
7) Amiridis et al., *Atmos. Chem. Phys.*, 10, 11567–11576, 2010.
8) Nicolae et al., *J. Geophys. Res.*, 118,2956-2965, 2013.