

## 22<sup>ND</sup> COHERENT LASER RADAR CONFERENCE LANDSHUT, GERMANY, 23–28 JUNE 2024

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## i. Introduction / Event Description

In the summer of 2023, huge wildfires in Canada led to the injection of a remarkably high concentration of biomass burning aerosol in the atmosphere. These aerosol masses reached the city of Thessaloniki (Greece) at the end of August 2023, were they conducted with use of the Thessaloniki Lidar system (THELISYS) capable of measuring vertical profiling and interpreted with available information from the AERONET columnar products. In 31st of August 2023, a thick smoke layer was observed in the troposphere between 6-10km over Thessaloniki. Our results confirmed the main typical features of aged Biomass Burning (BB) particles, i.e., the decreased Angström exponent after long-range transport, enhanced depolarization ratio ( $\delta p 532$ ), in accordance with previous reported studies. These observations are indicative of almost aspheric smoke particles, probably because of aging processes.



Figure 1. A pyrocumulonimbus fire event over British Columbia. Visible image from VIIRS true-color image with fire spots obtained by FIRMS on August 26, 2023.

NOAA HYSPLIT MODEL Backward Trajectories ending at 16:00UTC 31 Aug 2023



Figure 2. (Left) 7-d HYSPLIT back trajectories arriving at Thessaloniki, Greece on 31 August 2023 at 16:00 UTC. (Right) Spatial distribution of TROPOMI UVAI (340/380 nm) on 31 August 2023, over Eastern Europe during the smoke plume transport.

- The HYSPLIT backward trajectories provide an impression of the upper tropospheric air flow between North America and central Europe during the 7 days from 25 to 31 August 2023. The smoke traveled for about 7 days from central-western Canada to Europe.
- ✤ UV Aerosol index (AI) maps show a large region with increased AI values [presence of absorbing] aerosols] obtained by TROPOMI/S5P over Greece extending from about 38 to 48° N and 15 to 26° E on 31 August (early afternoon).

Acknowledgements: We acknowledge partially support of this work by the project "PANhellenic infrastructure", and Innovation Infrastructure", and Innovation Infrastructure for Atmospheric Composition and climatE change" (MIS 5021516) which is implemented under the Action "Reinforcement of the Research and Innovation Infrastructure", and Innovation Infrastructure for Atmospheric Composition and climatE change" (MIS 5021516) which is implemented under the Action "Reinforcement of the Research and Innovation Infrastructure", and Innovation Infrastructure for Atmospheric Composition and climatE change "(MIS 5021516) which is implemented under the Action "Reinforcement of the Research and Innovation Infrastructure", and Innovation Infrastructure and Innovation Infrastructure for Atmospheric Composition and climatE change "(MIS 5021516) which is implemented under the Action "Reinforcement of the Research and Innovation Infrastructure", and Innovation Infrastructure and Innovation and climatE change "(MIS 5021516) which is implemented under the Action "Reinforcement of the Research and Innovation Infrastructure", a climatE change and a climatE climatE cl funded by the Operational Programme "Competitiveness, Entrepreneurship and Innovation" (NSRF 2014-2020) and co-financed by Greece and the European Regional Development Fund). The presenter would like to acknowledge funding for the participation at ILRC from the COST Action HARMONIA (International network for harmonisation of atmospheric aerosol retrievals from ground-based photometers), CA21119

## A long-range smoke transport from Canadian forest fires to the Eastern Mediterranean during August 2023

## Date: 31-08-2023/Orbit number: 30477



![](_page_0_Figure_21.jpeg)

shaded areas represent the detected smoke layer.

- AERONET data evidence a progressive increase in the fine-mode aerosol fraction in the atmospheric column, large dominance of the small particles in agreement with the lidar observations.
- \* The representative of pure brown carbon or black carbon cores.
- The highest aerosol optical depth is registered at 14:30 with a value of 1.08 (340 nm), along with increased FMF levels close to 1.

ii. Ground-based Aerosol Monitoring / Analysis and Results

Figure 4. Mean vertical profiles of Baer, AEb at 355, 532, 1064 nm and depolarization ratio at 532nm obtained by the THELISYS on 31 August 2023, [15:45-16:41UTC]. The red-

considered

![](_page_0_Figure_31.jpeg)

![](_page_0_Picture_32.jpeg)

THELISYS Time-Height Cross Section-Channel ID: 1064nm (31 August 2023) 0.5 ਲ

Figure 3. Temporal evolution of the Range-corrected (1064nm) backscatter signals obtained by THELISYS lidar

A first signature of a stratospheric aerosol layer was observed over the LAP station, on 31 August 2017. This aerosol layer is clearly addressed in the map of the range corrected lidar signals (RCS) registered at 532 nm reported extending over an altitude range going from 5,5 to 11 km.

> ✤ A pronounced elevated layer was detected in the altitude range of 6-11km, with maxima peaking at about 8km and backscatter values of 7.76, 4.97 and 3.30 Mm<sup>-1</sup>sr<sup>-1</sup> at 355, 532 and 1064 nm, respectively.

The mean values regarding the AEb within the smoke layer were about approx. 1.2 (532/1064nm), 1.1 (355/1064nm) and 0.8

The mean particle depolarization ratio of 0.13 at 532 nm suggests the predominance of non-depolarizing smoke particles.

The enhanced particle depolarization ratio of about 0.15 are clear indications for aged smoke on the mid/upper tropospheric altitudes

FMF-500nm -0.8 🚆 -0.4 5

AERONET – Thessaloniki site, Greece (Lat:40.63N, Lon: 22.96E) AOD and FMF values Lev. 2.0 (31 August 2023)

Figure 5. Time series of AOD (500nm) and Fine-Mode-Fraction (FMF) at Thessaloniki site, 31<sup>st</sup> of August.