Vertical Distribution and Columnar Optical Properties of Springtime Biomass-Burning Aerosols over Northern Indochina

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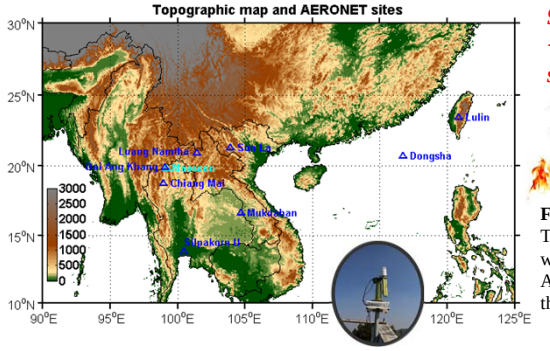
Motivation and Introduction

Northern Indochina is a region with a considerable amount of smoke aerosols because of the prevalence of man-made fires. In this study, we evaluated aerosol optical properties and vertical structure of biomass-burning aerosols over northern Indochina by using ground-based remote sensing data obtained from the 7-SEAS/BASELInE in 2014. We deployed one MPLNET lidar and four AERONET Sun-sky radiometers for the first time to characterize aerosol features over a region encompassing northern Thailand, Laos, and Vietnam.



9 AERONET sites + one MPLNET site are used

Figure 1. Topographic map with the location of AERONET sites in the study domain.

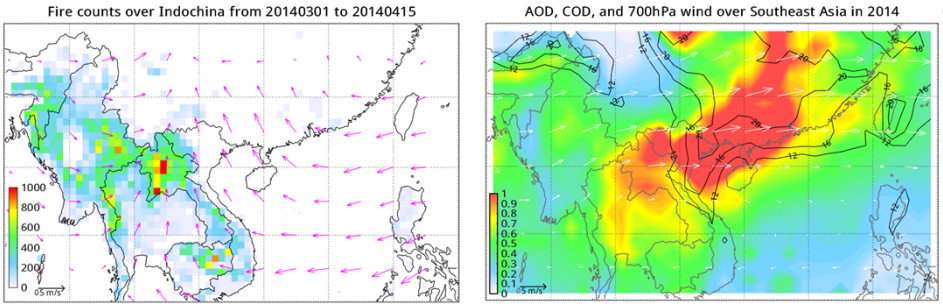


Figure 2. Maps of (a) 0.5°x0.5° gridded total fire counts , and (b) 1°x1° aerosol optical depth (shaded) and cloud optical depth (contour) at wavelength 550 nm obtained from the MODIS instrument aboard the Terra satellite during March 1 and April 15 2014 . The 1°x1° NCEP reanalysis 925 hPa and 700 hPa winds (vector) are also shown in the figure.

"The high AOD over northern Indochina is due to the intense fire activities and the accumulation of aerosols"

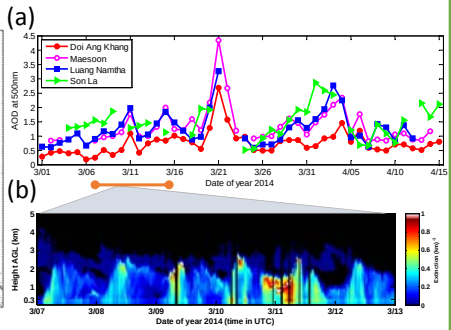


Figure 3. (a) Time series of daily AOD_{500} at four AERONET sites over northern Indochina from March 1 to April 15, 2014. (b) Time series of aerosol extinction profiles at Doi Ang Khang from March 7 to March 12, 2014.

"the presence of widespread smoke haze from ground-based measurements and satellite-based retrievals"

MPL

"New Micropulse lidar"
527 nm backscatter + depol channel

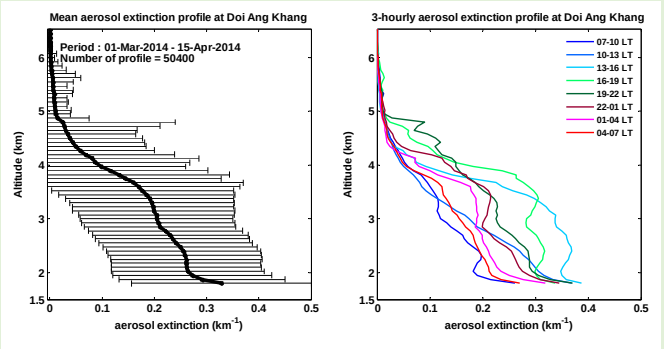


Figure 4. (a) mean aerosol extinction profile with stand deviation and (b) mean 3-hr aerosol extinction profiles in local time during March 1 and April 15, 2014.

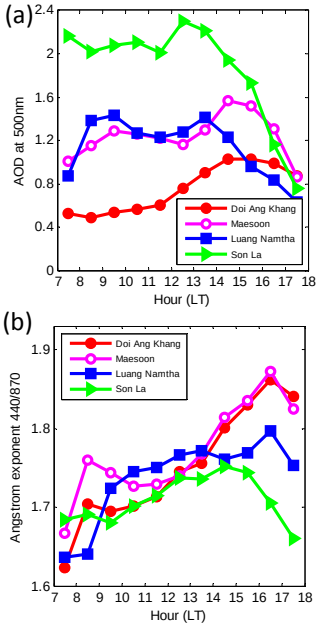


Figure 7. Daytime diurnal variability of (a) AOD at 500nm, and (b) Angstrom exponent (440-870nm) obtained from four AERONET sites from March 1 to April 15, 2014.

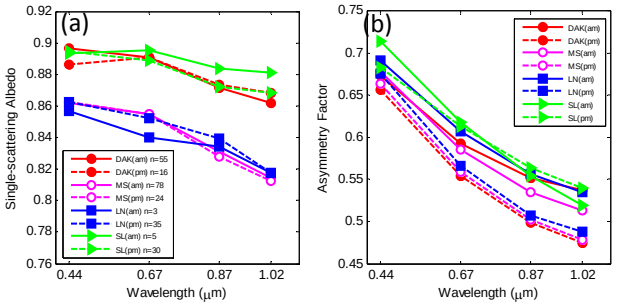


Figure 6. AERONET retrieval of aerosol optical properties, (a) single-scattering albedo, and (b) asymmetry factor as change with wavelength obtained from four sites over northern Indochina during March 1 and April 15, 2014.

"Slightly stronger absorption (ω_{440} of 0.86) is observed over the Thai-Laos valley"

"Abundant fine mode (η_{500} of 0.96 and $\alpha_{440/870}$ of 1.72) mixture of black carbon and brown carbon particles (α_{abs} of 1.5) with strong absorption (ω_{440} of 0.88)"

Table 2. Aerosol optical properties from worldwide biomass-burning source regions.

Region	Fire Type	ω 440/675/870/1020 nm	$\alpha_{abs440-870}$	$\alpha_{440-870}$*	η_{500}*	Reference
Northern Indochina	Forest and agricultural	0.88/0.87/0.85/0.84	1.5	1.8	0.95	this study
Amazon	Forest	0.93/0.92/0.90/0.89	1.5	1.9	0.92	Giles et al. (2012)
Australia	Forest	0.85/0.83/0.82/0.81	1.4	1.5	0.79	Giles et al. (2012)
North America	Boreal Forest	0.95/0.96/0.96/0.95	1.8	1.5	0.96	Giles et al. (2012)
Africa	Savanna	0.87/0.83/0.80/0.77	1.2	1.9	0.92	Giles et al. (2012)

* calculated from AERONET inversion data set

Acknowledgements
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