Paper Title: Characteristics and Composition of Atmospheric Aerosols in Phimai, Central Thailand during BASE-ASIA

Authors:

Can Li (can.li@nasa.gov)

Si-Chee Tsay (si-chee.tsay@nasa.gov)

N. Christina Hsu (christina.hsu@nasa.gov)

Jin Young Kim (jykim99@gmail.com)

Steven G. Howell (showell@soest.hawaii.edu)

Barry J. Huebert (huebert@hawaii.edu)

Qiang Ji (qiang.ji@nasa.gov)

Myeong-Jae Jeong (mjeong@gwnu.ac.kr)

Sheng-Hsiang Wang (sheng-hsiang.wang@nasa.gov)

Richard A. Hansell (richard.a.hansell@nasa.gov)

Shaun W. Bell (shaun.w.bell@nasa.gov)

To be submitted to:

Atmospheric Environment

Popular summary:

Atmospheric aerosols play an important role in the Earth's climate system, and can also have adverse effects on air quality and human health. The environmental impacts of aerosols, on the other hand, are highly regional, since their temporal/spatial distribution is inhomogeneous and highly depends on the regional emission sources. To better understand the effects of aerosols, intensive field experiments are necessary to characterize the chemical and physical properties on a region-by-region basis.

From late February to early May in 2006, NASA/GSFC's SMARTLabs facility was deployed at a rural site in central Thailand, Southeast Asia, to conduct a field experiment dubbed BASE-ASIA (Biomass-burning Aerosols in South East-Asia: Smoke Impact Assessment). The group was joined by scientists from the University of Hawaii and other regional institutes. Comprehensive measurements were made during the experiment, including aerosol chemical composition, optical and microphysical properties, as well as surface energetics and local meteorology.

This study analyzes part of the data from the BASE-ASIA experiment. It was found that, even for the relatively remote rural site, the aerosol loading was still substantial. Besides agricultural burning in the area, industrial pollution near the Bangkok metropolitan area, about 200 km southeast of the site, and even long-range transport from China, also contribute to the area's aerosol loading. The results indicate that aerosol pollution has developed into a regional

problem for northern Indochina, and may become more severe as the region's population and economy continue to grow.

Abstract:

Comprehensive measurements of atmospheric aerosols were made in Phimai, central Thailand (15.183°N, 102.565°E, elevation: 206 m) during the BASE-ASIA field experiment from late February to early May in 2006. The observed aerosol loading was sizable for this rural site (mean aerosol scattering: 108 ± 64 Mm^{-1}; absorption: 15 ± 8 Mm^{-1}; PM_{10} concentration: 33 ± 17 $\mu g \cdot m^{-3}$), and dominated by submicron particles. Major aerosol compounds included carbonaceous (OC: 9.5 ± 3.6 $\mu g \cdot m^{-3}$; EC: 2.0 ± 2.3 $\mu g \cdot m^{-3}$) and secondary species (SO_4^{2-}: 6.4 ± 3.7 $\mu g \cdot m^{-3}$, NH_4^+: 2.2 ± 1.3 $\mu g \cdot m^{-3}$). While the site was seldom under the direct influence of large forest fires to its north, agricultural fires were ubiquitous during the experiment, as suggested by the substantial concentration of K^+ (0.56 ± 0.33 $\mu g \cdot m^{-3}$). Besides biomass burning, aerosols in Phimai during the experiment were also strongly influenced by industrial and vehicular emissions from the Bangkok metropolitan region and long-range transport from southern China. High humidity played an important role in determining the aerosol composition and properties in the region. Sulfate was primarily formed via aqueous phase reactions, and hygroscopic growth could enhance the aerosol light scattering by up to 60%, at the typical morning RH level of 85%. The aerosol single scattering albedo demonstrated distinct diurnal variation, ranging from 0.86 ± 0.04 in the evening to 0.92 ± 0.02 in the morning. This experiment marks the first time such comprehensive characterization of aerosols was made for rural central Thailand. Our results indicate that aerosol pollution has developed into a regional problem for northern Indochina, and may become more severe as the region's population and economy continue to grow.