CHARACTERIZATION OF AEROSOL PHYSICAL AND OPTICAL PROPERTIES FROM A COMBINATION OF GROUND-BASED AND HAND-HELD SUS PHOTOMETER DATA OF SINGAPORE

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1. ABSTRACT

Atmospheric aerosols are among the major climate forcing agents. Although aerosol particles have a potential climate importance, they are poorly characterized and understood specially in regions where none or little measurements have been performed. The climate effects of aerosols depends strongly on their optical properties. Parameters such as aerosol optical depth, Angstrom exponent, size distribution are all of vital importance for atmospheric and remote sensing studies. However, the lack of extensive and reliable measurements in most regions, makes it di?cult to quantify the global impact of aerosols on Earths climate. Satellite remote sensing has the capability of providing a nonintrusive and global coverage of aerosol properties. However, the extraction of aerosols optical properties from remote sensing imagery has a limited accuracy and depend strongly on surface reectance which can be problematic on nonoceanic regions. Recent advance in satellite technology have resolved several issues related to satellite observations, but there still problems that need to be addressed such as the notorious discrepancies between the different satellite products. On the other hand, groundbased measurements via Sunphotometer or sky radiometers, offer a more reliable way to perform multispectral remote measurements of aerosol optical properties, but they lack the spatial coverage that satellite imagery can provide. Obviously, both of these methods, ground and space based, are complementary to each other since satellite based measurements rely strongly on ground data for calibration and validation purposes.

Since October 2006, Singapore has joined the Aerosol Robotic Network, AERONET, to monitor aerosol optical properties around this region. This initiative complements the already existing activities on satellite remote sensing performed at this institute (CRISP). From previous related works, it is known that Asian sources di?er from those in Europe or NorthAmerica. In Asia there are substantially more coal and biomass burning adding more absorbing soot and organic components to Asian and Pacic atmosphere. In Singapore, the sources of antrophogenic aerosols are mostly from fossil fuel burning (energy stations, incinerators, cars etc.) and from the industrial and urban areas. The proximity to the sea adds a possible oceanic source and depending on the time of the year, there can be a strong biomass component coming from forest res from various regions of the neighboring countries. In the present work, we use one year data record (level 1.5 and 2.0) of measured columnar atmospheric optical depth, spanning from Nov. 2006 to Oct. 2007 to study the monthly and seasonal variability of aerosol optical depth (AOD) and Angstrom exponent. We performed independent retrievals of these parameters (aerosol optical depth and Angstrom exponent) by using the photometer's six available bands covering from the near–UV to NIR (380 to 1080 nm). As a validation, our independent retrievals were compared with AERONET 1.5/2.0 level direct Sun product. Furthermore, we performed a survey of aerosol optical depth (AOD) and Angstrom exponent retrievals at several regions of Singapore. AOD measurements were performed with the help of a hand held Microtops II Sun Photometer, data samples were collected over three selected sites. Our early results indicate AOD levels were found to be mostly on the moderate region with values of $\tau_a < 0.4$ with slightly higher values found on the Aug.–Oct. 2007 period. Based on retrieved Angstrom exponent values combined with atmospheric optical depth, we identified sources of sea–salt, dust and urban pollution and dust–like aerosols particles. Most aerosols particles were found to belong to the fine mode, low optical depth regime resulting from urban pollution. Large, coarse mode particles (maritime and dust) types were similarly found and properly identified. There was some data points indicating the presence of particles resulting from bio–mass burning, this however could not be confirmed. Moreover, region–dependent

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results indicate the presence of dust at west and north–east regions. We also noticed that the dust signature at the north–east region were optically thicker than those found on the west side. A substantial presence of maritime aerosols, at the north–east region with a negligible contribution from the west region was found. However, most data points collected at the west and north–east areas indicate that most aerosols particles belong to the fine mode regime.