Development of Wide range Single-Particle Soot Photometer (W-SP2) and Aircraft Observations over the Arctic in Spring 2008

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Black Carbon (BC) emitted from incomplete combustion of fossil fuel and biomass strongly absorbs sunlight and affects earth climate. [Foster et al. 2007]. Especially, radiation budget of polar region is highly sensitive to presence of light-absorbing aerosols like BC because of long slant pass length of sunlight and high surface albedo both of which amplify amount of light absorbed by aerosols. Atmospheric aerosol with diameter (D) range of 100-1000 nm (i.e., accumulation mode) is important for considering the climate effects because of its abundance and high efficiency of interaction with visible sunlight.

Single-Particle Soot Photometer (SP2: Droplet Measurement Technology Inc. Boulder, CO) is a recently developed instrument to measure size of scattering aerosols (i.e., non-absorbing aerosols), size and coating thickness of BC by combining the laser-induced incandescence and laser-light scattering techniques [Stephens et al., 2003, Baumgardner et al., 2004, Schwarz et al., 2006, Gao et al., 2007, Moteki and Kondo, 2007, Moteki and Kondo, 2008]. For previous version of the SP2, detectable size ranges of BC and scattering aerosols were limited to D=100-400 nm and D=200-450 nm, respectively, because of only single channel of Analog to Digital Conversion (ADC) for each of scattering and incandescence channels. In this study, we introduced dual ADC channels with different signal amplification factors for detections of incandescence and scattering, to extend detectable size ranges of BC and scattering aerosols. As a results, the detectable ranges are extended to D=100-1000nm and 200-700 nm for BC and scattering aerosol, respectively. We validated functionality of the newly-developed Wide range SP2 (W-SP2) in laboratory experiment.

The W-SP2 was flown on a DC-8 aircraft over the Arctic in this spring during the Arctic Research of the Composition of the Troposphere from Aircraft and Satellites (ARCTAS) campaign coordinated by NASA-Earth Science Project Office. Initial analysis of data obtained by the W-SP2 during ARCTAS will be shown in this presentation.