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New automatic tracking sun photometer SPTA for airborne and ground-based aerosol optical depth observation

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The Arctic environment is changing more rapidly than most other regions of the world. Surface observations are sparse, particularly over the central Arctic, where changes may be pronounced. Different variables, such as the surface-atmosphere radiation balance, cloud cover, aerosol properties, and trace gas concentrations are not easily monitored from space, especially the vertical structure. Our ability to understand present changes and to predict future developments are further complicated by two-way feedbacks and interactions between the sea ice cover and the atmosphere, affecting the radiation balance as well as the fluxes of momentum, heat, moisture, gases and aerosols.

We would like to present a new system – airborne photometer SPTA to monitor the vertical and horizontal distribution of the aerosol optical depth in the Arctic. The photometer is working in the spectral range from 360 to 1050 nm with 10 discrete channels. It is a full automatic tracked system with a time resolution for each aerosol spectra of 5 seconds. The system is for the airborne operation installed under a quartz dome with well-known transmission in the roof of the aircraft. The ground-based version, which is now developed, can be used as all-weather version for worldwide operation from ground as well as for ship operation.

The system was in operation during the Arctic spring campaigns PAMARCMIP 2011 and 2012 (Polar Airborne Measurements and Arctic Regional Climate Model Simulation Project) as well as the summer campaigns TIFAX (Thick Ice Feeding Arctic Export) 2010 and 2011. The was organized around the capacity of the AWI research aircraft POLAR 5 to provide unique data of aerosol, meteorological and atmospheric conditions, as well as sea ice thickness in a latitude band between about 65 and 85 degrees North, based on the pilot study in 2009. The last campaign in spring 2012 started in Longyearbyen (Svalbard, Norway), Svalbard till Resolute Bay (Nunavuut, Canada) via Station Nord (Greenland), Alert and Eureka (Nunavuut, Canada). Some aerosol measurements in 2011 were also coordinated with CALIPSO (global aerosol and cloud mapping) satellite over-flights [http://www.nasa.gov/mission_pages/calipso/main] in order to validate aerosol retrievals. Flight operations were conducted from as low as 200 feet altitude, when measuring sea ice thickness, up to 20.000 feet when profiling aerosols. Altitude during ferry legs was between 8.000 and 10.000 feet. First data sets from the last campaign will be present.