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Atmospheric research program in Ny-Alesund by the Korea Polar Research Institute

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Korea Polar Research Institute (KOPRI) has established Dasan Station in April, 2002. KOPRI has launched an atmospheric research program in Ny-Alesund under the project 'Integrated research on the composition of polar atmosphere and climate change, COMPAC'. This program mainly focuses on the measurements and numerical simulations of climate variations over polar region. One of the main topics is obtaining observational proof of feedback mechanisms between climate systems, which include atmosphere, marine biosphere, cryosphere, human activity, etc. To achieve the goal, KOPRI is operating 3 working programs, **(1) Meteorological observations, (2) CO_2 and energy exchange studies over tundra ecosystem in Svalbard, and (3) Aerosol and biogenic gas measurements in and around Ny-Alesund**.

(1) Meteorological Observations

Meteorological observations including wind speed and direction, air temperature, air pressure and relative humidity have been automatically made on the top of the Dasan Arctic station building since 2005.

(2) CO_2 and energy exchange studies over tundra ecosystem in Svalbard

A Flux tower was established about 70 m south of the Korean Dasan Arctic station in Ny-Alesund, Svalbard in summer of 2003. An eddy covariance system, consisting of three-dimensional sonic anemometer (CSAT3, Campbell Scientific, USA) and open-path H_2O/CO_2 gas analyzer (LI7500, LI-COR, USA) was installed at the tower of 3.5m height above the ground. The sampling rate is 20 Hz, and the half-hourly averaged turbulent statistics are calculated on-line and stored in a data logger (CR5000, Campbell Scientific, USA). A net radiometer (CNR-1, Kipp&Zonnen, the Netherlands) is installed at 2.2 m height. Soil heat flux plates (HFP01SC, Hukseflux, the Netherlands), soil temperature probe (TCAV, Campbell Scientific) and soil moisture probes (CS615, Campbell Scientific, USA) are buried at 0.1m below the ground surface. To evaluate the role of soil to the net ecosystem exchange of CO_2 in summer season, soil CO_2 efflux within the major footprint area of the tower CO_2 flux measurements were executed in July of 2007 and 2008. Soil CO_2 efflux were measured at 16 sampling locations in the plot (30 m x 30 m) using a closed-dynamic chamber system (LI-6400

with LI-6000-9 soil chamber, LI-COR, Inc., USA). In the meanwhile, borehole temperatures have been measured at three points with three depths (0.15, 0.55 and 1.09 m) to better understand the thermal dynamics at the active layer since September of 2002. Meteorological data obtained from the Dasan station are used for quality control of the flux data and the evaluation of the meteorological conditions.

KOPRI eddy flux data together with other available data will be used to evaluate the surface energy budget related with the change of thermal properties at the active layer and the permafrost, which is also related with greenhouse gas emissions from methane hydrates released from thawing permafrost and the CO_2 exchange between the atmosphere and tundra ecosystem.

Based on the preliminary results on the CO_2 exchange, the tundra ecosystem plays a role as a weak sink for the atmospheric CO_2 in summer season. In the meanwhile, the soil CO_2 efflux in 2007 and 2008 years ranged from 0.3 to 0.7 μmol m^{-2} s^{-1} and means of that were 0.6(±0.07) μmol m^{-2} s^{-1} (2007) and 0.5(±0.13) μmol m^{-2} s^{-1} (2008). The flux site will be registered as a site under the FLUXNET (http://daac.ornl.gov/ FLUXNET/) and report the long term behavior of tundra ecosystem under relatively warm high Arctic area in terms of the exchanges of CO_2, energy and mass, responding to climate change.

In the future, we'll conduct (1) long-term monitoring for exchanges of CO_2, energy and mass, (2) quantifying of methane emission in thawing season, (3) analyzing on soil C cycling (e.g. rate of turnover) and (4) investigating of response of the active layer and the permafrost to global warming.

(3) Aerosol and biogenic gas measurements in and around Ny-Alesund

KOPRI has installed ultra-fine Condensation Particle Counter (CPC) at Corbel Station (TSI CPC model 3776) in 2006. This program was developed with a collaborative work with IPEV and Stockholm University. IPEV has been operating CPC 3010, of which cut-off diameter 10 nm, and KOPRI's additional CPC 3776 with cut-off diameter 2.5 nm has provided supplementary information on the small particle formation from the fjords. In 2009, KOPRI is planning to install Optical Particle Counter (OPC) at Corbel. OPC measures a particle number size distribution from 0.1 micron. With this additional input, relationship between wind speed and climatologically meaningful particle characteristics can be derived.

In April, 2007, KOPRI installed commercially available Cloud Condensation Nuclei Counter (CCNC, DMT) at the Zeppelin station. The CCNC measures the number of particle which can grow into CCN size for super-saturations of 0.2%, 0.4%, 0.6%, 0.8% and 1.0%. The CCNC has been set to scan the whole super-saturation range with a time resolution of 30 minutes. It is found that during spring time, more than 70 % of

total particles can be activated to form clouds with super-saturation of 0.1 %.

In July 2007, biogenically drive atmospheric Dimethylsulfice (DMS) measurement has been launched at the Zeppelin station. This system is now being under repairing stage and is scheduled to be re-installed at the Zeppelin station in February 2009.

Simultaneous measurements of aerosol properties and biogenic gases from the Zeppelin station will significantly contribute to the better understanding of (i) the air-sea interchange of the trace gas, and (ii) the feedback between climate systems, especially for unpolluted Arctic environments, below and above the cloud level.

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