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Investigating interactions of surface energy budget, boundary layer structure, and synoptic/orographic influences at climate monitoring observatories for the Study of Environmental Arctic Change (SEARCH)

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Several sites near the coast of the Arctic Ocean have been identified for enhanced instrumentation to monitor the changing Arctic climate and help understand the processes producing these changes. Beginning in 2004 remote sensors and in-situ instrumentation have been, and will be, installed at Alert (82.5˚N, 62.3˚W) and Eureka (80.0˚N, 85.9˚W) on Ellesmere Island in northern Canada. These enhancements are being made in collaboration with Environment Canada. The installations, to date, have included a Baseline Surface Radiation Network (BSRN) suite of instruments (http://bsrn.ethz.ch/), soil temperature probe to monitor active layer, and a sonic anemometer at Alert to measure the complete surface energy budget; and cloud radar and lidar systems at Eureka to monitor the cloud macro- and microphysical properties. Additional measurements at Alert include basic meteorological observations, spectral optical depth, and instruments that comprise a Global Atmosphere Watch (GAW) facility http://www.wmo.ch/web/arep/gaw/gaw_home.html – a condensation nuclei counter (CNC), a three-channel nephelometer and a Particle Soot/Absorption Photometer (PSAP) to monitor in situ aerosol properties. Plans for 2006 include the installation of an all-sky imager at Alert and instruments to monitor the complete surface energy budget and obtain higher-frequency tropospheric wind profiles at Eureka. In addition, meteorological stations have existed near both of these sites for many years, and include synoptic sounding measurements.

Preliminary analysis of the data has begun to identify the major processes affecting the boundary layers and the surface energy budgets at these complex-terrain sites. Data to compute surface energy budgets have been available from Alert, with varying degrees of completeness, since August 2004, while the cloud radar and lidar measurements at Eureka are available since August 2005. These have been combined with analysis of the historical and ongoing sounding data. Analyses suggest that the high meso-alpha scale terrain features (100-500 km) have a dominant influence to direct the synoptically-driven, boundary-layer airflow at both locations, and that this airflow is further modulated by the local terrain, which is especially significant at Eureka. The influences of the airflow and stability on the boundary-layer structure, surface energy budget and lower-tropospheric cloud observations are examined. The complexity of these sites is common to many land areas around the Arctic Ocean. Furthermore, the diagnosis and understanding of the atmospheric processes local to these sites are crucial for the future interpretation of how the trends in the near-surface, climatological measurements at these sites are related to Arctic and global changes.