Council Science Field Report 2000

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UAF ATLAS homepage http://www.lter.uaf.edu/ATLAS

The Council Sites

The Council sites represent a toposequence from tundra through a gradient of shrub tundra to mature spruce forest. The seven sites include a white spruce forest, woodland, shrub, low shrub, tundra and barren. In addition, an area of burned tundra between Council and Quartz Creek was studied. See site details section or our web site (www.lter.uaf.edu/ATLAS) for more information.

Measurements

Vegetation

In the Council grids, the following were measured: community composition, vegetation height, LAI before and after leaf-out (using Licor 2000), percent cover of vascular species and moss, and spruce density and height. In 1999, peak-season harvests of above and belowground biomass and productivity (not including roots) were conducted at 10 random points within the grid in the tundra, low shrub and woodland sites. A 20x50cm grid was used in the understory, while a 1mx1m grid was used for the tall shrubs. In 2000, harvests occurred in the forest, shrub, barren, and burned and adjacent unburned tundra sites.

Eddy covariance measurements

Measurement of surface exchanges of heat, water, momentum and CO_2 were made using eddy covariance techniques on 10m and 20m (at the forest) towers.
The towers were established at the tundra and spruce forest sites and represented the two ends of the vegetation continuum studied during 1999 and thus provided a further year of data, including a reduced climate data set from the 1999-2000 winter. In addition, measurements were begun at the beginning of May to capture the transition through snowmelt. In collaboration with Sturm and Hinzman, snow properties and melt characteristics were measured in Council and Ivotuk providing an important link between these two study areas. Sturm conducted eddy covariance measurements at Ivotuk for May and June. At the spruce site measurements of CO_2 storage were again made in 2000, and an additional eddy covariance system was also established below the spruce canopy to assess the contribution of the shrub understory to the above canopy latent heat

flux. This represented part of a wider effort to resolve the individual contributions of the ground surface and vegetation strata to ecosystem level evapotranspiration, which involved the use of lysimeters to measure ground surface evaporation and sap flow sensors to measure the contribution of the spruce canopy. A mobile system continued to be used in 2000 to collect data from transitional ecosystem types and included the burned tundra and shrub ecosystems also characterized in 1999. Additionally, the mobile tower was set up at several other surface types not studied last year, including a second, drier tundra site, a thermokarst lake, and a barren/heath site.

Climate measurements

Climatic data were also collected at each site and included temperature, relative humidity, and wind speed at two levels, wind direction, incoming and outgoing long and short-wave radiation, photosynthetically active radiation, net radiation, rainfall, barometric pressure, soil temperature (top 10cm integrated), soil heat flux (10cm depth), and volumetric soil water content. In addition, soil and moss thermal properties continued to be measured.

Permafrost measurements

Four "soil climate" sites established during summer 1999 at the locations of the flux measurement tower locations (C1, C2, C3, C4) continued to operate during the 2000 campaign, and will remain installed in their present locations over the longer term. At each site air and ground temperatures (including ground surface and 10 to 11 depths down to 80 to 104 cm) as well as soil moisture at three depths will continue to be recorded hourly. Two Optical StowAway micro-loggers were installed within two separate thermokarst depressions at the depths of 1.0 m and 0.77 m (the bottom of the active layer in these depressions). The temperature data from these loggers will show if the active layer in the depressions will refreeze completely during the next winter. During the 2000 field season, temperature and soil moisture data were collected from all sites, processed and prepared to transfer to the JOSS database. The data show that permafrost is present only at the tundra (C2) and woodland (C4) sites and absent (at least within the upper several meters) at white spruce forest (C1) and shrub (C3) sites. One additional thermistor probe (12 thermistors within upper 1.5 m) was installed at the tundra site in a thermokarst depression to monitor the temperature regime and thermokarst development process.

Boundary layer studies

An NCAR integrated sounding system (ISS) was used in conjunction with a tethered balloon system to simultaneously characterize boundary layer profiles and development over both tundra and spruce ecosystem types in order to better understand potential influences of vegetation on larger scale climate. Soundings conducted in Late July and early August of 1999 were hampered by the onset of moist, cloudy conditions which were typical of that time of year. The 2000 soundings were undertaken earlier (6/29/00-7/10/00) to take advantage of fine weather and

optimum boundary layer development during the earlier stages of the field campaign. Data from the upper air soundings will also be used in conjunction with the Radio Acoustic Sounding System (RASS) to develop a better water vapor transport parameterization in the regional climate model (ArcSYM) and to investigate the influence of surface fluxes of heat and moisture in boundary layer development in the Arctic. In 2000, an additional ISS was established on the tundra between the original tundra site and the forest in order to provide data against which a 2 dimensional large eddy simulation model intended to improve boundary layer parameterization in the ARCSym model can be validated.

Student Participation in the Council Research Program

In 2000, two college students and three local high school students joined the research team at Council, participating in the collection of field data and interacting with visiting investigators. In addition, the students were responsible for the design and implementation of their own research project. Erin Kenney undertook a project investigating historical changes in vegetation at the research sites and the perceptions of a number of Council residents with respect to these and possible climatic changes. As the research component of his honors year, Chris Wendt, from Monash University in Melbourne, Australia, used sap flow sensors to assess the contribution of the canopy species (Picea glauca) to ecosystem level evapotranspiration. Chase Grey, a high school student from Nome, used small lysimeters to assess the moisture contribution of the forest floor. Chase also assisted Larry Hinzman□s group in monitoring stream flow in the Melsing Creek and soil moisture measurements on the large grid. Cheryl Johnson, also from Nome, investigated the species diversity and community composition in the Council grids using a minimal area technique. Henry Titus, a high school student from nearby White Mountain working with the ATLAS program for his second year, continued his work evaluating microscale variability in soil surface temperatures and moisture in a white spruce forest.

Site Details

WHITE SPRUCE FOREST (C1)

Location: N 64º 54.456□ W 163º 40.469□

Elevation: 275 feet

Slope: 3.3% (3º)

Aspect: 140 º TN

Data dates: 6/18/99-8/22/99, 5/13/00-8/28/00

WOODLAND (C4)

Location: N 64º 53.997□ W 163º 39.863□

Slope: 5.6 % (5º)

Aspect: 140 º TN

Data dates: 6/19/99-7/13/99

SHRUB SITE (C3)

Location: N 64º56.141 W 154º44.142

Elevation: 450 feet

Slope:6.6 % (6.0 º)

Aspect: 160º TN

Data dates: 8/4/99-8/22/99, 5/9/00-6/19/00

LOWSHRUB (C5)

Location: -

Elevation: 270 feet

Slope: ~9º

Aspect: 236º TN

Data dates: 7/14/99-7/27/99

TUNDRA SITE (C2)

Location: N 64º50.499□ W163º41.591□

Elevation: 160 feet

Slope: flat

Aspect: flat

Data dates: 6/18/99-8/22/99, 5/13/00-8/27/00

ISS DRY TUNDRA SITE (C8)

Location: N 64º52.920□ W 163º40.840□

Elevation: 160 feet

Slope: flat

Aspect: flat

Data dates: 6/18/99-8/22/99, 5/13/00-8/27/00

BARREN SITE (C6)

Location: N 64º43.550□ W 163º56.589□

Elevation:

Slope

Aspect

Data dates: 8/01/00-8/15/00

BURN SITE (C7)

Location: N 65º12.147□ W 164º18.477 (scar length 3.15 km and 1.3 km wide)

Elevation: 450 feet

Slope: 6% (5º)

Aspect: 315 ºT

Data dates: 07/28/99-08/03/99, 07/14/00-07/31/00

LAKE SITE (C9)

Location: N 64º 52.842□ W 163º 41.411□

Elevation: 160 feet

Slope: 0% (0º)

Aspect: 0

Data dates: 07/28/99-08/03/99, 07/14/00-07/31/00