

The Wolf Creek Research Basin



Wolf Creek is near Whitehorse, Yukon, in the Boreal Cordillera Ecozone.

- 190 km² of boreal forest, sub-alpine taiga, tundra, lakes, rocks and snowfields
- superb **northern environmental laboratory** with good logistics.

Milestones

■ Research infrastructure (towers, meteorological and streamflow stations) established in 1993 by **Indian and Northern Affairs Canada (INAC) and National Hydrology Research Centre - NHRC** (ECS-Saskatoon), funded through the Arctic Environmental Strategy and EC Climate Change research funds.

× Infrastructure and data maintained by INAC and NHRC.

× Four studies carried out jointly by INAC and NHRC.

■ Adopted in 1994 by the **Global Energy and Water Cycling Experiment - GEWEX** (ECS/AES Saskatoon/Downsview) as part of its Canadian programme to help develop and verify simulations of energy and water balance under stress from climate change.

× Seven university & government studies supported by NSERC/GEWEX

■ Joined the **Ecological Monitoring and Assessment Network (EMAN, ECS Burlington)** in 1997; focus broadened to an ecosystem approach.

× **P&Y Region (EC)** begins **forest biodiversity** studies in 1997, under the Smithsonian Institution/UNESCO Man and the Biosphere programme.

× **P&Y and NHRC** in partnership with **Yukon Government** begin studies on **climate change impacts** on alpine ecosystems under the International Tundra Experiment, 1998.

■ Adopted by National Water Research Institute (ECS-NHRC, Saskatoon), 1998 as a benchmark basin for evaluation of **land use impacts** on hydrology and aquatic ecosystems in northern Canada.

Highlights

- Five years of operation with dramatic growth in research and monitoring of climate change, water resources, ecosystem health, biodiversity, aquatic impacts.
- In 1998 there are 21 cooperative studies underway. Partners: EC, INAC, AgCan, Yukon Govt., 8 universities, Yukon College.
- Recognised nationally and internationally as an ecosystem laboratory.

Wolf Creek Research Basin Projects and Activities: 1998



Hydrometric Network Operation

Indian and Northern Affairs Canada (Whitehorse)

3 Nested hydrometric stations (14.5, 71, 195 km²) are operated on Wolf Creek at the Alaska Highway, at the outlet of Coal Lake and in upper Wolf Creek as well as the Granger Basin tributary station (4.3 km²). These stations run year round.

Meteorological Network Operation

Indian and Northern Affairs Canada (Whitehorse)/Environment Canada (National Hydrology Research Centre-Saskatoon)

Meteorological stations were established in each of the three major ecosystems (forest, taiga, alpine). Monitored parameters include: air temperature, rainfall, snowfall, wind speed, humidity, incoming and outgoing short-wave radiation, net radiation, barometric pressure, snow depth, blowing snow transport, soil moisture, soil temperature and soil heat flux.



Yukon Component of the Canadian GEWEX Enhanced Study (CAGES)

Environment Canada (Atmospheric Environment Branch, Edmonton)

Climate stations have been installed at Wolf Creek (taiga ecozone) and at MacMillan Pass to produce a more comprehensive data set for the process study of atmospheric vapour, precipitation, snowcover, radiation, snowmelt, evaporation and stream discharge. This information contributes to the MAGS (Mackenzie GEWEX Study) study that is the Canadian contribution to GEWEX (Global Energy and Water Cycle Experiment).



Partitioning of Energy and Water in Boreal and Alpine Ecosystems

Environment Canada (National Hydrology Research Centre – Saskatoon)

Energy and water balance studies help to characterise the evaporation loss and climate of the basin as affected by its vegetation cover. These studies help to determine the role of northern vegetation in controlling hydrology and climate and the sensitivity of northern basins to disturbance from forest clearing and climate change.

Parameterization of Evapotranspiration Using Remotely Sensed Data

Environment Canada (National Hydrology Research Centre – Saskatoon)

Arctic/alpine environments are known for low evapotranspiration rates. Vapour transfer characteristics, soil heat storage relationships, radiation balance and surface temperature relationships have been developed for ecosystem meteorological stations and aggregated over the watershed using remotely sensed data.

Biome-scale Representation of Snow Cover Development in Boreal and Tundra Ecosystems

Environment Canada (National Hydrology Research Centre – Saskatoon)

Blowing snow in alpine areas and snow interception and subsequent sublimation to water vapour in forest areas are dramatic snow processes that affect the water and energy cycles in Wolf Creek. Alpine snow covers in exposed areas can lose up to 80% of snowfall to blowing snow but drift areas can gain 180% of snowfall due to snow redistribution. There are in-transit losses of snow to sublimation during blowing snow. Evergreen forests intercept about 50% of snowfall. This intercepted snow is partly sublimated with annual sublimation losses of 35%-40% of annual snowfall.

Snow Ecosystem Impacts

Environment Canada (National Hydrology Research Centre – Saskatoon)

Snow provides the majority of water for streamflow runoff in the north, carries contaminants and nutrients and strongly affects the winter habitat of northern plants and animals. These studies examine the role of snow in affecting the aquatic and terrestrial ecosystem and the sensitivity of snow to changes in vegetation cover and climate.

Snow Processes

University of Saskatchewan (Saskatoon), Hadley Centre for Climate Change and Prediction (Bracknell, UK)

The processes and energetics of snow accumulation, areal ablation of snowcover, snowmelt and infiltration into frozen soils are being examined in order to improve models of hydrology and climate in the North.

Parameterization and Spatial Variability of Snowmelt Infiltration to Frozen Ground

University of Saskatchewan (Saskatoon)

A parametric relationship for estimating point source infiltration rates to frozen soil is being field-tested. A methodology for upscaling infiltration rates to a hillslope scale using hydrophysical parameters will be developed.

Effects of Seasonal Frost and Permafrost on Hydrology of Subarctic Slopes

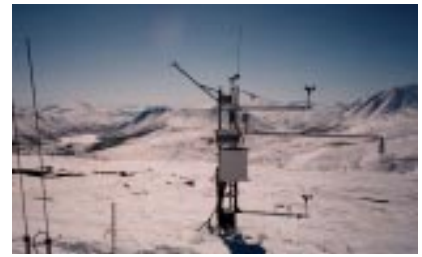
McMaster University (Hamilton)

The thermal and soil moisture characteristics of opposing north facing (permafrost) and south facing (seasonal frost) are being monitored for modeling purposes.

Development of Digital Elevation Drainage Network Model (DEDNM)

University of Saskatchewan (Saskatoon) / Environment Canada (National Hydrology Research Centre – Saskatoon)

The project objectives are to delineate hydrologically significant watershed segments from digital elevation models and use these for parameterization and scaling purposes. This will be coupled with NHRC's SLURP Hydrological Model. Basic relationships between vegetation indices, leaf area index, land cover and evapotranspiration are being explored to develop an evapotranspiration component for the SLURP model using remotely sensed data.





Development of WATFLOOD Hydrological Model

University of Waterloo (Waterloo)

The WATFLOOD continuous simulation hydrological model is being calibrated and tested at Wolf Creek.

Testing of the UBC Watershed Model

University of British Columbia (Vancouver)

The UBC Watershed Model is a semi-distributed model that requires only temperature and precipitation inputs. Runoff is calculated for four components: fast runoff, interflow, upper groundwater and deep groundwater. The model application in the North is being tested at Wolf Creek.

Soil Temperature Monitoring

Agriculture and Agri-Food Canada (Whitehorse)

Soil temperature sensors have been installed near meteorological stations for soil classification and long-term monitoring of climate change.



Soil, Vegetation and Permafrost Characteristics along a Series of Transects

Agriculture and Agri-Food Canada (Whitehorse), University of Quebec, YTG Renewable Resources (Whitehorse), Environment Canada (Canadian Wildlife Service – Whitehorse) and Yukon College

Geophysical, soil and vegetation sampling techniques will be used to characterize conditions within each vegetation zone as defined by the Wolf Creek Basin ecological stratification map. The map will be ground-truthed and revised and a plant species list will be developed for each zone and entered into the Man and the Biosphere (MABFlora) international database.

Temporal Trends in Organochlorines and Metals in Aquatic Ecosystems

Yukon Contaminants Committee (Whitehorse), Fisheries and Oceans (Winnipeg), University of Waterloo, YTG Fisheries

Coal lake sediment cores are being analysed for organochlorine and metals levels by Fisheries and Oceans Canada (Winnipeg) to determine past and current levels. Snow has been analysed for organochlorines. Organochlorine and metals levels are being determined for fish.

Palaeoenvironment Reconstruction in the Wolf Creek Basin

University of Ottawa

Lacustrine sediments, pollen, macrofossils are being analyzed from Coal Lake sediment cores and compared with results from the Kluane region.



Smithsonian/Man and the Biosphere Forest Biodiversity Plots

Environment Canada (Canadian Wildlife Service – Whitehorse), YTG Renewable Resources (youth crew), DIAND Forest Resources, Whitehorse Chamber of Commerce, and Yukon College

Tree species composition, forest structure and growth characteristics are being monitored using an international protocol in the mature white spruce/feathermoss forest type. Further long-term monitoring plots are being established in other forest types.

Forest Age Structure and Climate History

Yukon College, Environment Canada (Canadian Wildlife Service – Whitehorse)

Tree cores are being taken in conjunction with the forest biodiversity plots. Growth rings will be analyzed for age and annual growth characteristics. A past climate record will be developed and compared with studies in the Mackenzie Delta and Northern Yukon.

Breeding Bird and Insect Monitoring

Environment Canada (Canadian Wildlife Service – Whitehorse) and INAC Forest Resources (Whitehorse)

Plots and transects have been established to measure forest, taiga and tundra breeding bird diversity and density and to obtain relative measures of insect diversity and density at forest sites.

Ptarmigan Studies in the Subalpine

Yukon College, FH Collins High School (Whitehorse)

Ptarmigan populations are being monitored and habitat relationships studied. Studies are built on previous work near the watershed.

Response of Alpine Tundra Communities to Manipulations of Temperature and Snow Accumulation

YTG Renewable Resources, Habitat Section, Environment Canada (Canadian Wildlife Service – Whitehorse, and National Hydrology Research Centre – Saskatoon)

An International Tundra Experiment (ITEX) site is being established in conjunction with the alpine meteorological station. The experimental design includes small-scale temperature manipulation and herbivore exclusion, with the addition next year of snow depth manipulation. The site will monitor alpine tundra plant community structure and production in relation to climate variables.

Fish Monitoring

YTG Fisheries

Fish densities, parasite loads and metals levels are being monitored along all reaches of the creek.

Benthic Invertebrate Studies

Environment Canada (Environmental Protection – Whitehorse)

Emergence traps are used to assist in identification of benthic invertebrates. Some sampling has been done with the assistance of YTG youth crews and data are in a Yukon-wide database.

Salmon Habitat Rehabilitation and Stock Recovery

Yukon Fish and Game Association, Fisheries and Oceans Canada, Streamkeepers Association (Whitehorse)

Release of hatchery fry and stream rehabilitation is re-establishing the historic chinook salmon run in lower Wolf Creek. Monitoring and education are components of these projects.

