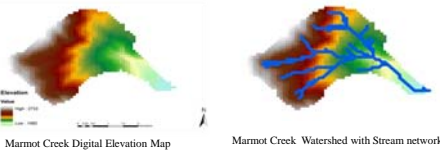


Introduction

The Marmot Creek basin is located at longitude 115°09'15"W and latitude 50°56'57"N about 110 kilometers southwest of Calgary, Alberta. Marmot Creek feeds the Kanaskis River and the Bow River system from the Rocky Mountains, Alberta. In the Marmot Creek system, snowfall including mixed snow and rain, accounts for the bulk of the precipitation—70 to 75 percent. It has permanent meteorological stations at elevations from 1450m to 2500m collecting precipitation, snow depth, soil moisture, soil temperature, short and longwave radiation, air temperature, humidity wind speed, and turbulent fluxes of heat and water vapour. Streamflow and groundwater levels are observed by the federal and provincial governments. Stream flow in this basin is maximum in spring and early summer whenever a heavy spring rain follows a period of warm weather causing the winter snowpack to melt quickly. Minimum flow occurs in late March (Telang et al., 1982). In this study the main focus is to simulate streamflow using Distributed Hydrologic Soil Vegetation Model (DHSVM) .



DHSVM holds research interest for many reasons. The first and most attractive feature of DHSVM from a research perspective is that it is a physically-based, fully-distributed model. The distributed nature addresses the spatial variability of landscape features and meteorological conditions presented by mountainous, forested terrain. The level of detail found in the multi-layer canopy, soil, wind profile, and snowpack representations used in DHSVM are superior to the landscape representations in other widely used hydrologic models. This level of detail should hypothetically enhance DHSVM's ability to address the actual physical processes driving the hydrologic cycle at the watershed scale.

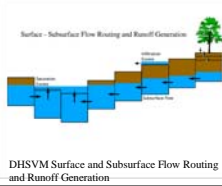
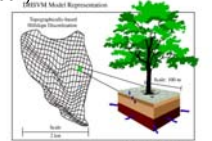
Objective

The purpose of this research is

- > To assess the hydrologic variables of mountainous, snow-dominated catchment Marmot Creek, Alberta.
- > To assess the model performance using various spatial scale inputs
- > To build a continuous simulation model to understand hydrological processes in Marmot Creek basin using DHSVM.

DHSVM Model description

DHSVM is a physically based, spatially distributed hydrology model that simulates watershed hydrology through a multilayer grid system at the pixel level. Each pixel in the grid is assigned various characteristics such as soil type, vegetation type, elevation, slope, depth to water table. This model was developed at the University of Washington (Wigmosta et al., 1994).

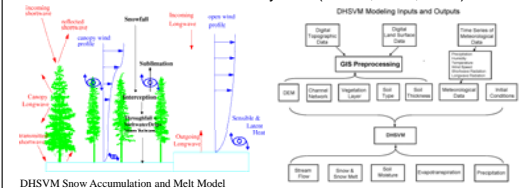


DHSVM Model Representation of the 1-D Vertical Water Balance

DHSVM Surface and Subsurface Flow Routing and Runoff Generation

DHSVM Model Description

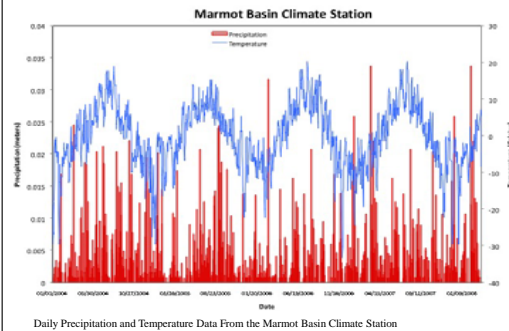
DHSVM calculates the full water and energy balance for every pixel and for every time step. This level of complexity is necessary to capture the highly dynamic processes affecting snow accumulation and ablation in a snow-dominated system (Storck, et al., 1994).



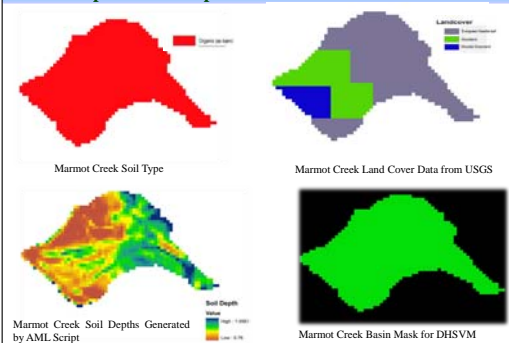
Meteorologic Inputs

Climate data were taken from the Environment Canada and IP3. DHSVM requires the following climate data:

- Precipitation (m)
- Longwave Radiation (W/m²)
- Wind Speed (m/s)
- Shortwave Radiation (W/m²)
- Relative Humidity (%)
- Temperature (°C)

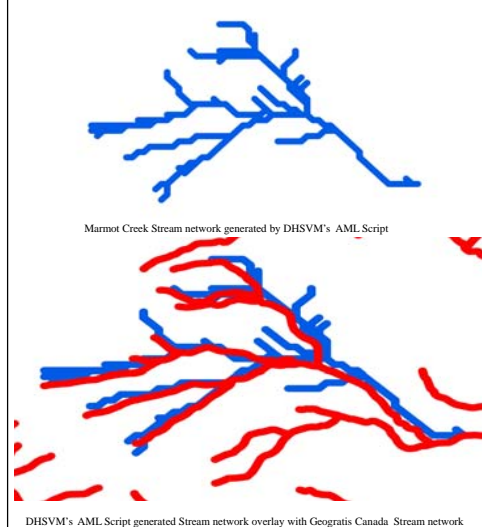


DHSVM Spatial Data input



Each raster map must be the same spatial resolution. A watershed boundary mask is used to extract values of interest from the input grids.

Verification of Stream Network produce by DHSVM

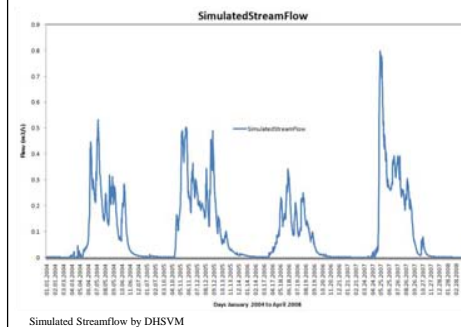


DHSVM's AML Script generated Stream network overlay with Geogratis Canada Stream network. DHSVM's AML script was used to generate the stream network of Marmot Creek from the SRTM digital elevation model. It was found that the Stream network was almost identical to the published Stream network from Geogratis Canada.

Preliminary Results

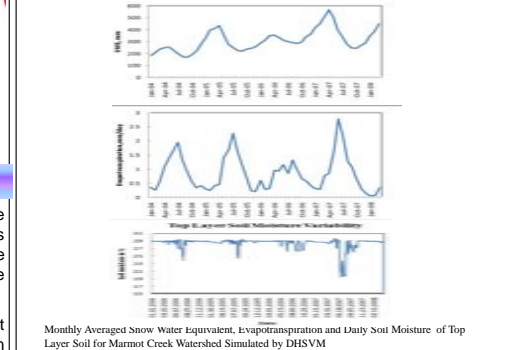
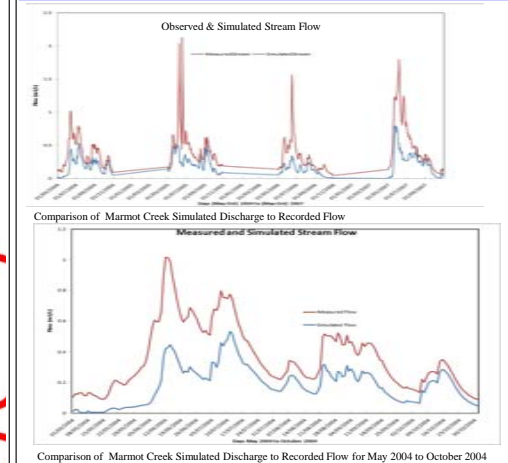
Although we want to calibrate the model, we are satisfied with the preliminary results. The model is capturing the timing of peaks reasonably well, but it is under estimating the volumes. We believe the under estimates are attributed to one or more of the following:

- > Unsatisfactory precipitation lapse rate predictions. Point precipitation is distributed through the watershed via algorithms in DHSVM.
- > Inadequate soil data. We used only one type of soil.
- > Inaccurate solar radiation inputs may be influencing transpiration and soil storage.



Simulated Streamflow by DHSVM

Preliminary Results



Monthly Averaged Snow Water Equivalent, Evapotranspiration and Duty Soil Moisture of Top Layer Soil for Marmot Creek Watershed Simulated by DHSVM

Future Work

Our preliminary results are encouraging. We are confident that we will accurately calibrate DHSVM by refining the basin characteristics and meteorological inputs. Once calibrated, the model will be used to explore hydrologic fluxes over the watershed such as soil moisture and evapotranspiration. We will assess the increasing snow storage in the model and finally, we will determine the effect of using different resolution DEM like hydrologically modified DEM generated by ANUDEM on streamflow.

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Pomeroy, J.W., R.L.H. Essery and B. Toth, 2004. Implications of spatial distributions of snow mass and melt rate on snow-cover depletion: observations in a subarctic mountain catchment. *Annals of Glaciology*, 38, 195-201.

Acknowledgments

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