4.3(b) Scaling of Hydrologic Models for MAGS

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1. Objectives

This project deals with hydrologic modelling of the four research areas identified by the GEWEX Science Committee and the macro-scale modelling of the entire MAGS area. These regions (Wolf Creek, Inuvik, Fort Simpson, and Yellowknife) have all been previously funded for a variety of process studies, which in many cases are still ongoing. This research project focuses on WATFLOOD and WATFLOOD/CLASS application in all of these regions, with particular emphasis on Wolf Creek in the first year. We proposed to evaluate and modify the TOPAZ model to test different techniques of basin discretization for the purposes of hydrologic modelling. This includes integrating both the landcover and digital elevation data for the Wolf Creek region, and generating the required physiographic files for WATFLOOD and WATFLOOD/CLASS. The purpose of this research is to assist with scaling issues through automated basin discretization. This research will contribute directly to all the meso-scale and macro-scale hydrologic modelling projects and contribute directly to the parameterization of the WATFLOOD and WATFLOOD/CLASS models through a synergistic combination of the TOPAZ and WATFLOOD models.

Another major restriction in successful model implementation is the insufficient availability of precipitation data. Additionally, it is necessary to obtain knowledge about the optimal utilization of the available precipitation information toward satisfactory modelling at different spatial scales. The research is intended to deal with this problem as well. A framework for spatial interpolation, cross validation and sub-area estimation for continuous daily time series of precipitation and other variables has already been developed integrating several conventional and geo-statistical methods. First results show improved flow simulations when using the geo-statistical interpolation methods, indicate the scale dependence of the results, and encourage the proposed data assimilation scheme (Haberlandt and Kite 1997). Also, an evaluation of different atmospheric models has shown their potential and limitations for hydrological modelling in the Mackenzie River Basin (Kite and Haberlandt 1997).

2. Progress and Collaborations

This multi-scale modelling project attempts to identify landscape based parameterization for the WATFLOOD and WATFLOOD/CLASS models in all the regions outlined above. This work will also provide the required tools for automated discretization of basin information leading to analysis of parameterization and scaling problems that will be critical to the overall success of MAGS.

The research will generally benefit the understanding of macro-scale hydrological processes and give better possibilities for investigating the climatic change impact on regional hydrology. Precipitation estimations in sparsely gauged regions for hydrological modelling are expected. The validation of numerical weather prediction models and general circulation models, as well as the coupling of those atmospheric models with hydrological models, will benefit from the results of this research.

Progress to date has been limited to the evaluation of the TOPAZ and Mapmaker models for the Wolf Creek and Yellowknife basins. These basins were chosen because they represent the extremes in terms of their hypsometry. We are currently operationalizing and testing TOPAZ to run on the Yellowknife Basin. It has been successfully applied to the Wolf Creek Basin. An evaluation of MapMaker, a computer program to generate the physiographic files required for the WATFLOOD square grid model was performed. Modification of the code was needed and variable grid size files needed for WATFLOOD were successfully produced with this automated procedure.

3. Scientific Results

This project began in May of 1998 and has resulted in some significant testing of the WATFLOOD algorithm for the Wolf Creek Basin. Preliminary results are shown in the appendix. The ability to transfer the software application to the Yellowknife Basin has so far yielded poor results. This is mainly due to the low relief in the area, and the difficulty in establishing flow pathways in such terrain.