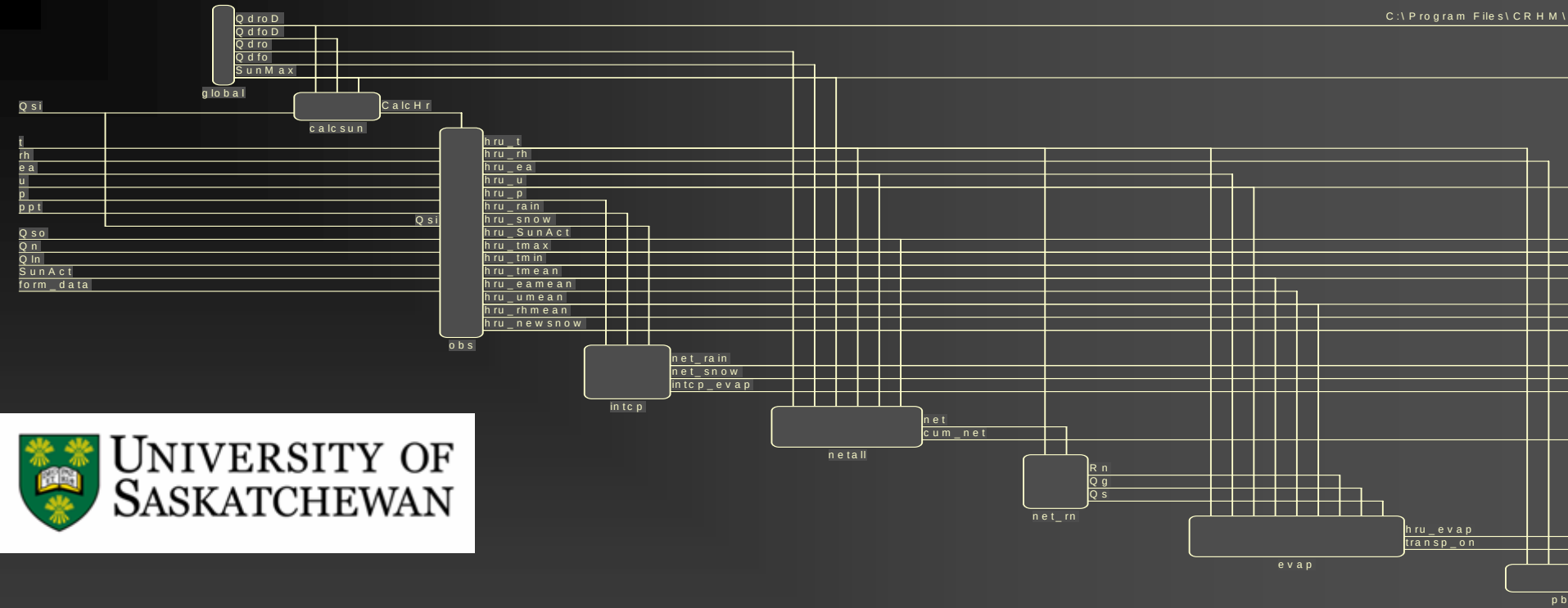



UNIVERSITY OF SASKATCHEWAN

# The Cold Regions Hydrological Model: A Simulation Platform for Physically Based Hydrology

CENTRE FOR HYDROLOGY

# Objective

**To develop a *hydrological cycle simulation system* that:**

- **is distributed such that the water balance for selected surface areas can be computed;**
- **is sensitive to the impacts of land use and climate change;**
- **does not require the presence of a stream in each land unit;**
- **is flexible: can be compiled in various forms for specific needs;**
- **is suitable for testing individual process algorithms.**
- DOES NOT REQUIRE CALIBRATION!

# Cold Regions Hydrological Model

## DATA COMPONENT

**Preparation of spatial and meteorological data.**

- **Spatial data (e.g. basin area, elevation, cover type) is analyzed using a Geographic Information System (GIS) interface that assists the user in basin delineation, characterization and parameterization of Hydrological Response Units (HRU).**
- **Time-series meteorological data include air temperature, humidity, wind speed, precipitation and radiation.**
- **Adjustments for elevation (lapse rate), snowfall versus rainfall, interpolation between input observations (stations)**
- **Unit conversions to consistent SI units**

# Cold Regions Hydrological Model

**MODEL COMPONENT**

- Utilizes Windows-based series of pull-down menus linked to the system features.
- **Modules**, or **process algorithms**, are selected from the library and grouped together by the CRHM processor.
- Modules have a set order of execution with a common set of variables and parameters.
- Modules are created in **C++** programming language.
- Macro modules can be created from within the model using a simple macro language.

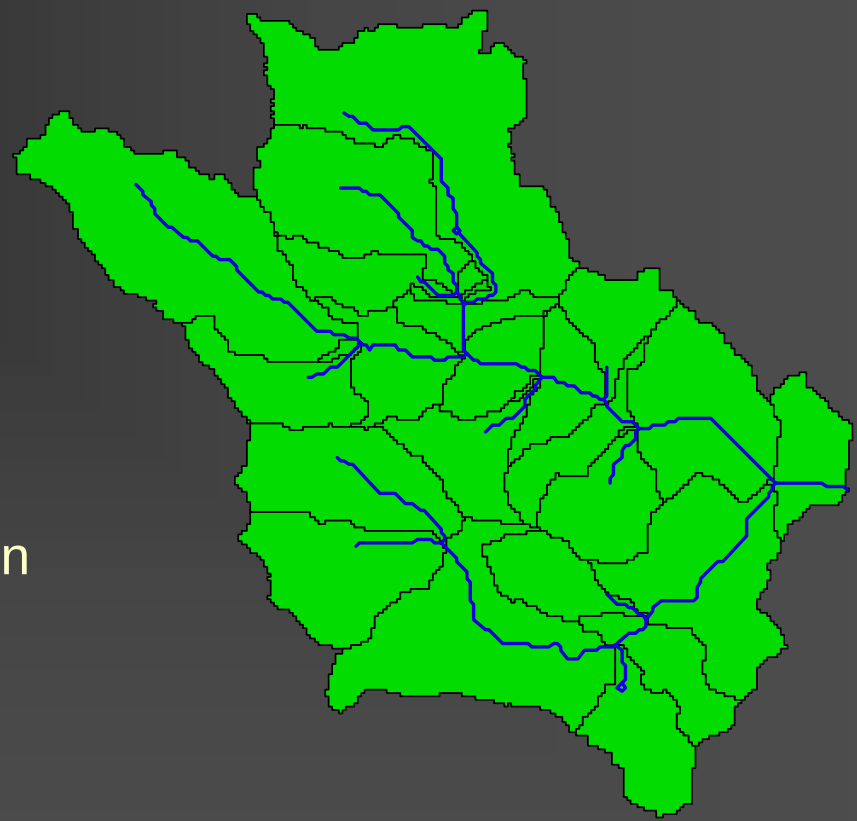
# Cold Regions Hydrological Model

## ANALYSIS COMPONENT

- Used to **display**, **analyze** and **export results (Excel, ASCII)**.
- **Statistical and graphical tools** are used to analyze model performance, allowing for decisions to be made on the best modelling approach.
- **Sensitivity-analysis tools** are provided to optimize selected model parameters and evaluate the effects of model parameters on simulation results.
- **Mapping tools** use ArcGIS files to map ouputs for geographical visualization.

# CRHM GIS Interface

- The interface automates the parameterization of CRHM.
- Uses TOPAZ and ARC/INFO AML coding to divide the watershed into sub-basins.
- Each sub-basin is defined as a polygon with drainage information, ID, and can be assigned other parameters.
- The next step is to link the sub-basin to other spatial information (land cover, fetch, etc.) in order to derive relevant HRU's.



# CRHM Module Development

## DATA ASSIMILATION

- Data from multiple sites
- Interpolation to the HRUs

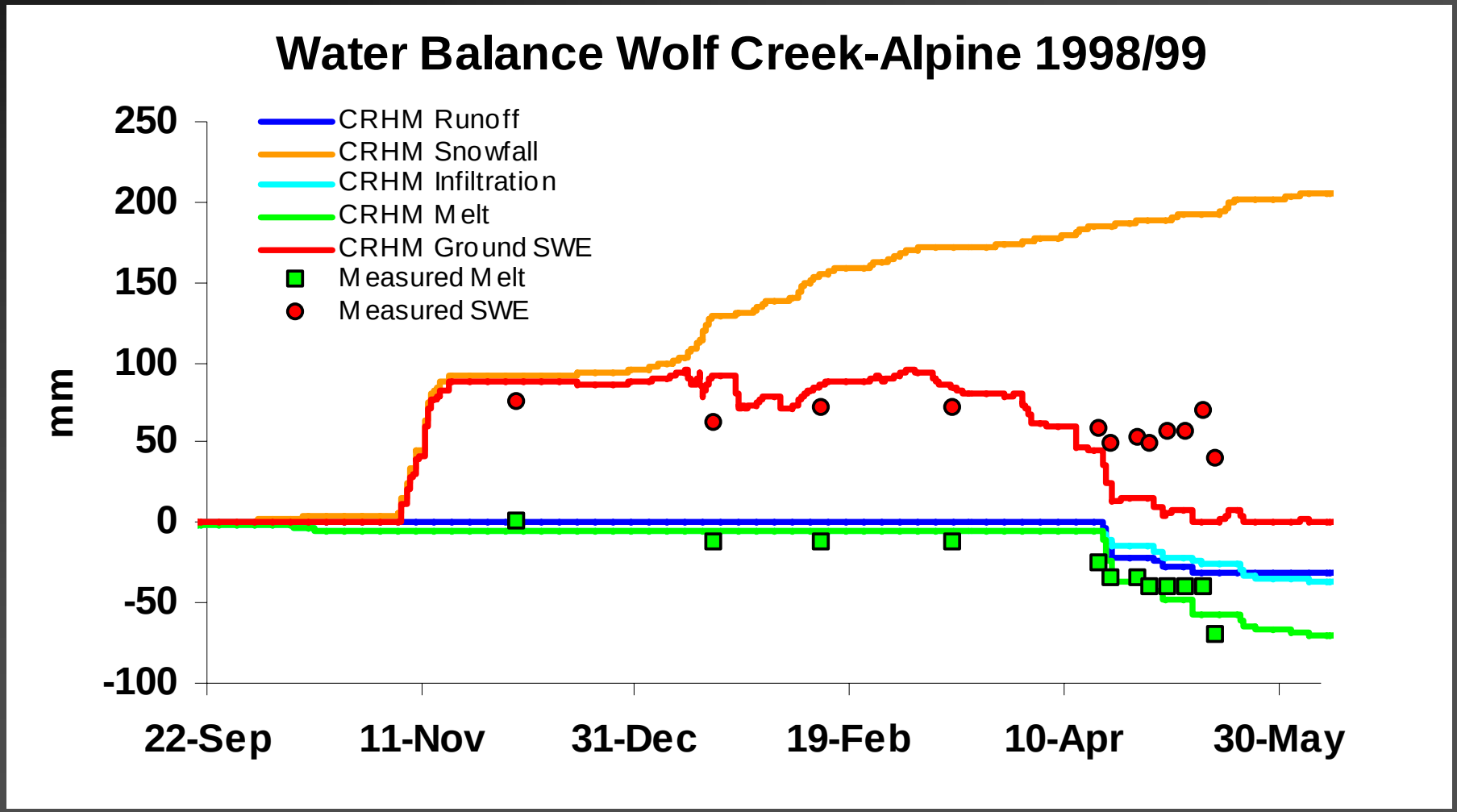
## SPATIAL PARAMETERS

- Basin and HRU parameters are set. (area, latitude, elevation, ground slope, aspect)

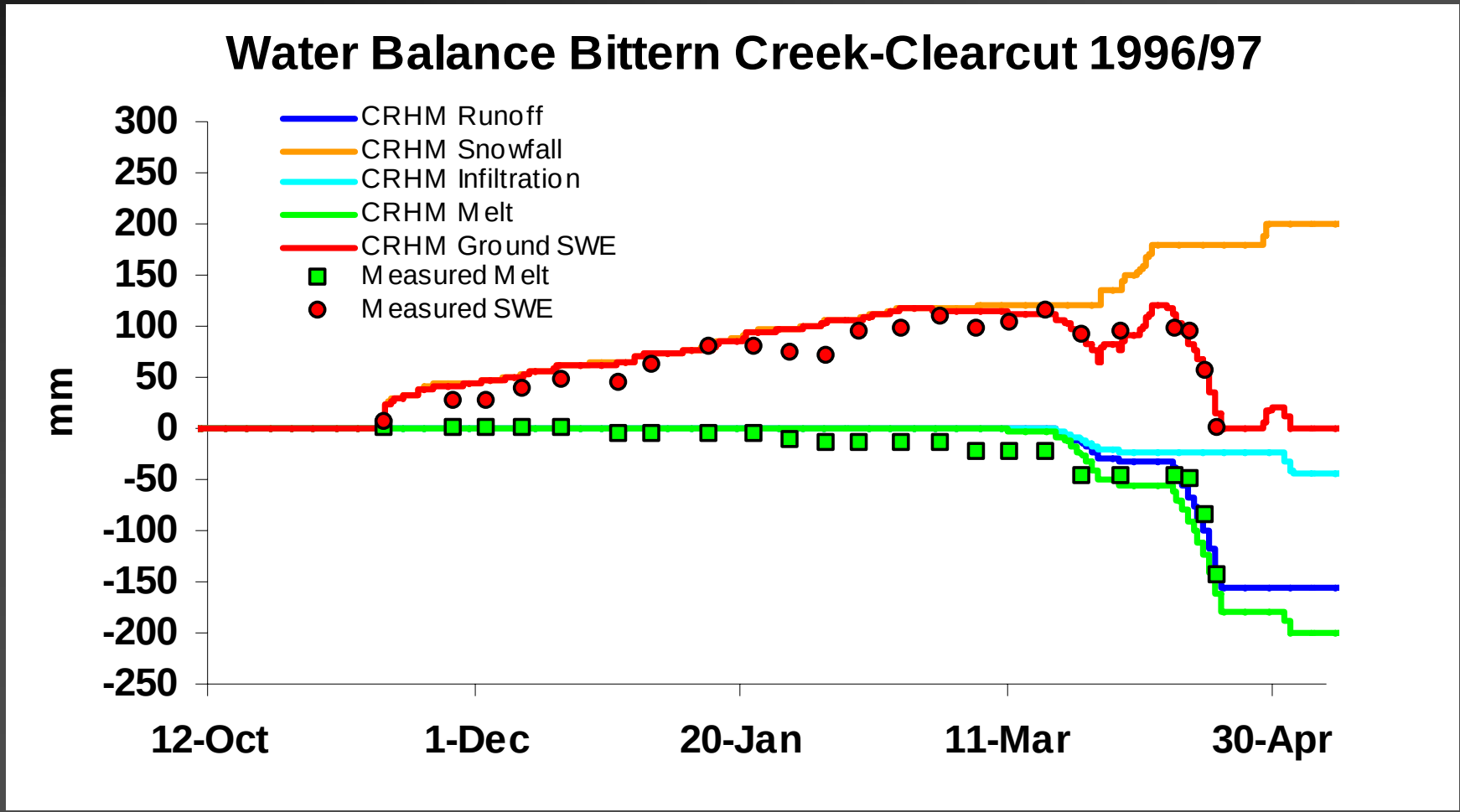
## PROCESSES

- Infiltration into soils (frozen and unfrozen)
- Snowmelt (prairie & forest)
- Radiation
- Wind flow over hills
- Evapotranspiration
- Snow transport
- Interception (snow & rain)
- Sublimation (dynamic & static)
- Soil moisture balance
- Runoff, interflow
- Routing (hillslope & channel)

# Sub-arctic alpine tundra



# Boreal forest clearing



# Prairie wheat field