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Summary of EC Prediction System

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Environment Canada, NHRC



Monitoring, Prediction and Forecasting

- Hydrological processes are highly variable in space and time at all scales from centimeters to continents.
 - Data collection over such a range is difficult and expensive
 - Hydrological prediction fills the gap
 - Based on simple and homogenous models of nature
 - Range from deterministic to statistical/stochastic methods
 - Results are fair to good in well behaved basins
 - Scaling, pathways, dynamics, energy balance ... still to be resolved
- Significant advances are still made through observations
 - Environment Canada – Schisms between data collection and hydrological science
 - In the excitement of “glamorous science” the scientific community often lets data collection programs erode
 - All models are wrong some are useful



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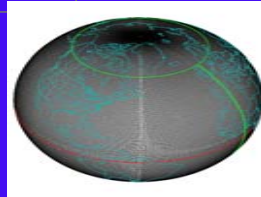
**Global Environmental Multiscale Forecasting & Modeling System
2002-2007**

Middle Atmosphere Model
&
Data assimilation

Multi- Seasonal Forecast

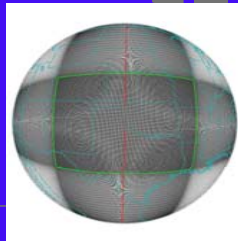
Monthly Forecast

Medium-range Forecast
(240 h 35-100 km)
&
Data assimilation



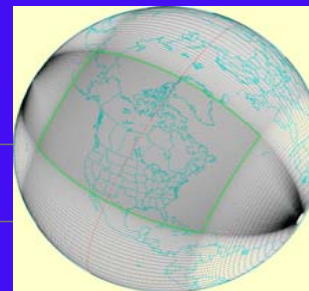
Ensemble Forecast

Regional and
Mesoscale Forecast
(24-48 h 10-24 km)
&
Data assimilation



Regional Climate Model

LAM
0-24h 1-4km



TIME SCALE

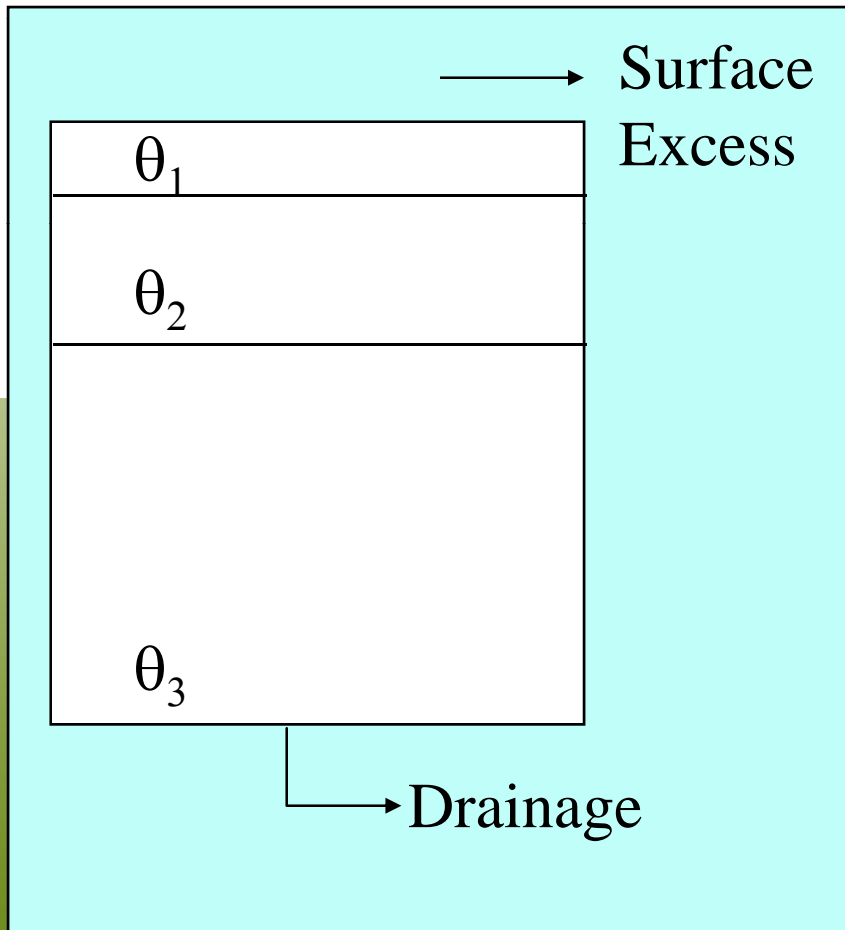
Uniform resolution
Variable resolution
Hydrostatic
Nonhydrostatic
Global
Limited-area
Distributed memory

3D Var Data Assimilation
4D Var Data Assimilation
Operational forecast
Emergency response
Volcanic ashes
Air quality
Stratospheric ozone
Wave model
Coupling to Hydrology
Coupling to Oceanology
Simulations
etc

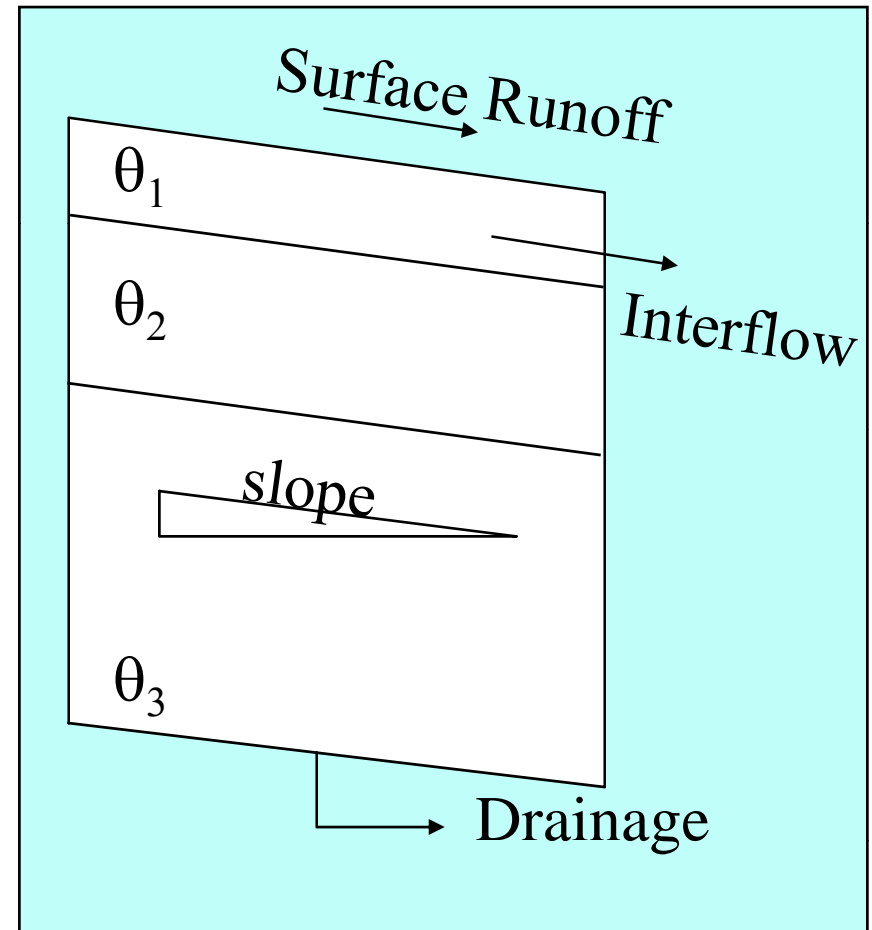
supercomputer (2003): 800 processors (IBM Power4)

Improved Soil Water Balance

CLASS 2.7 Model

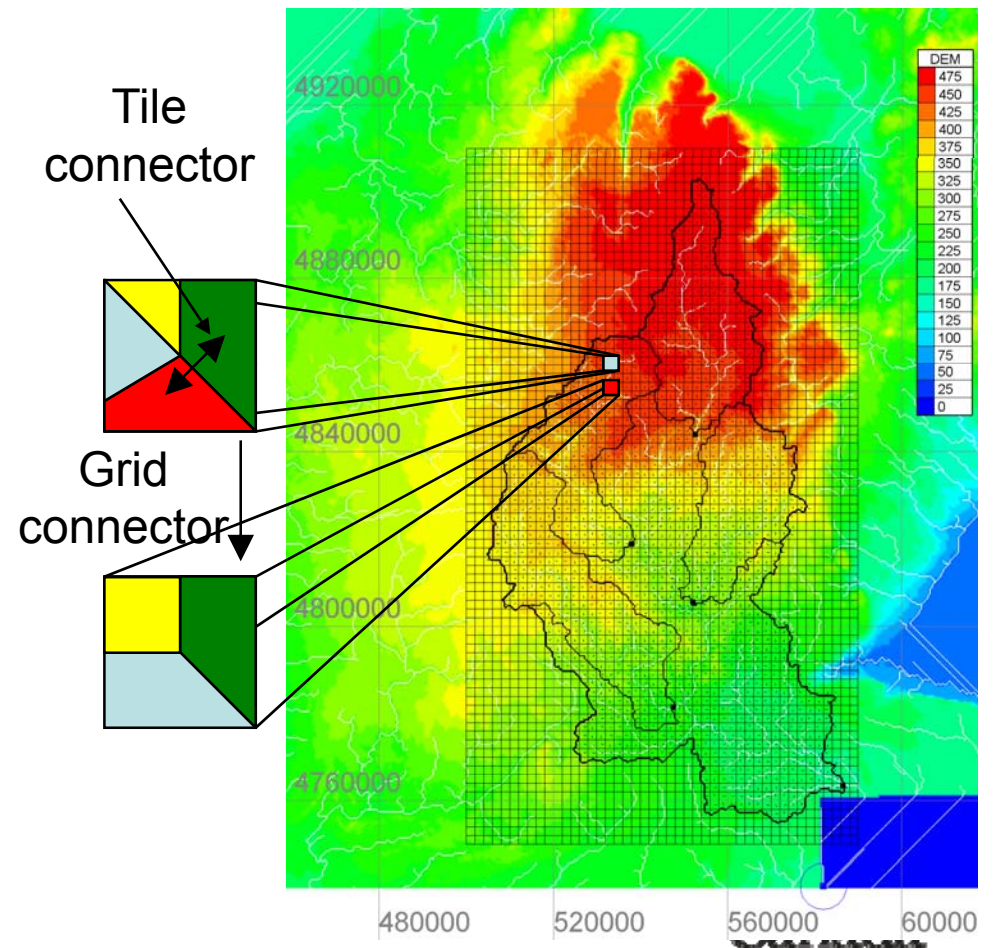


WatCLASS (class3.0)

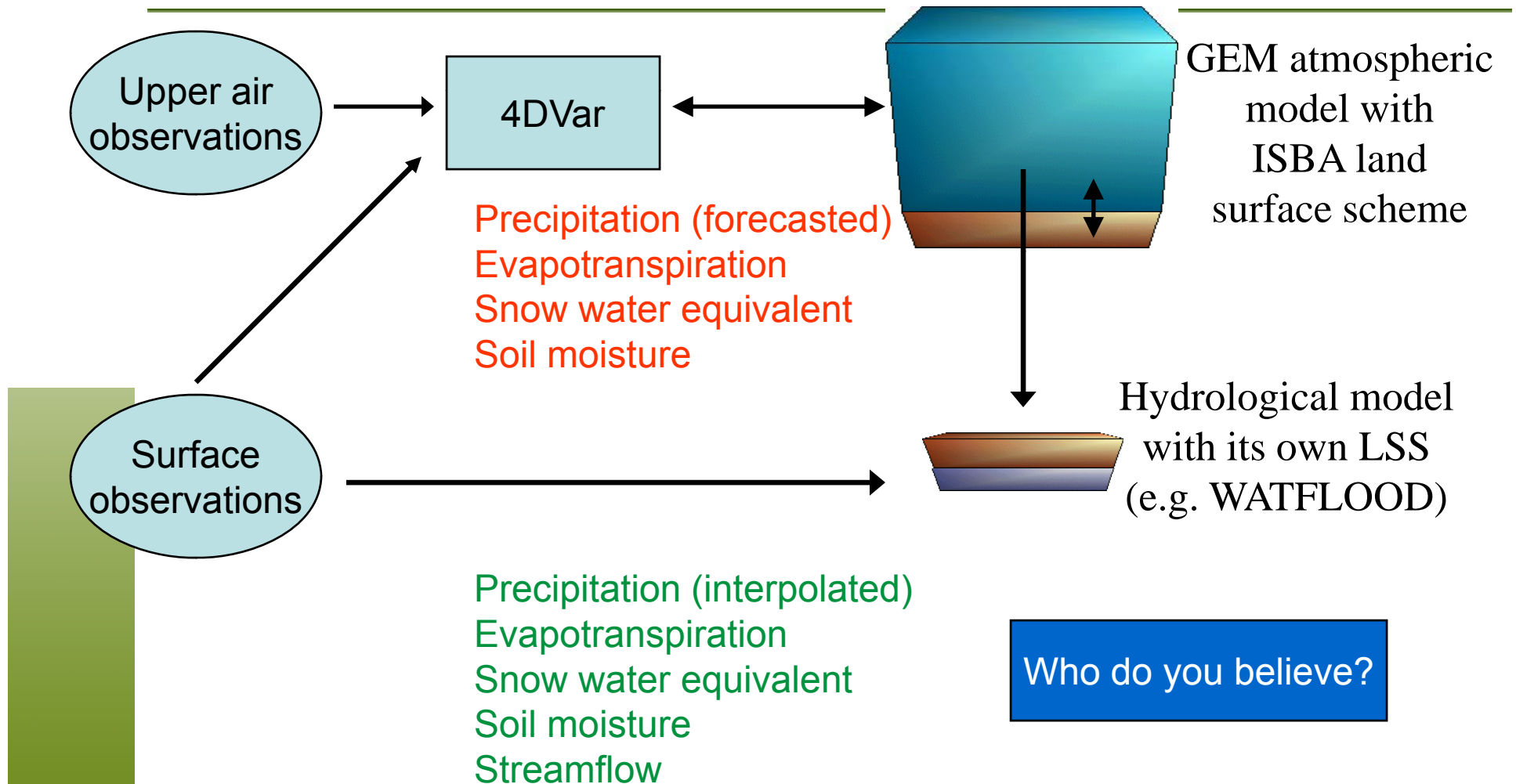


MESH: A MEC surface/hydrology configuration designed for regional hydrological modeling

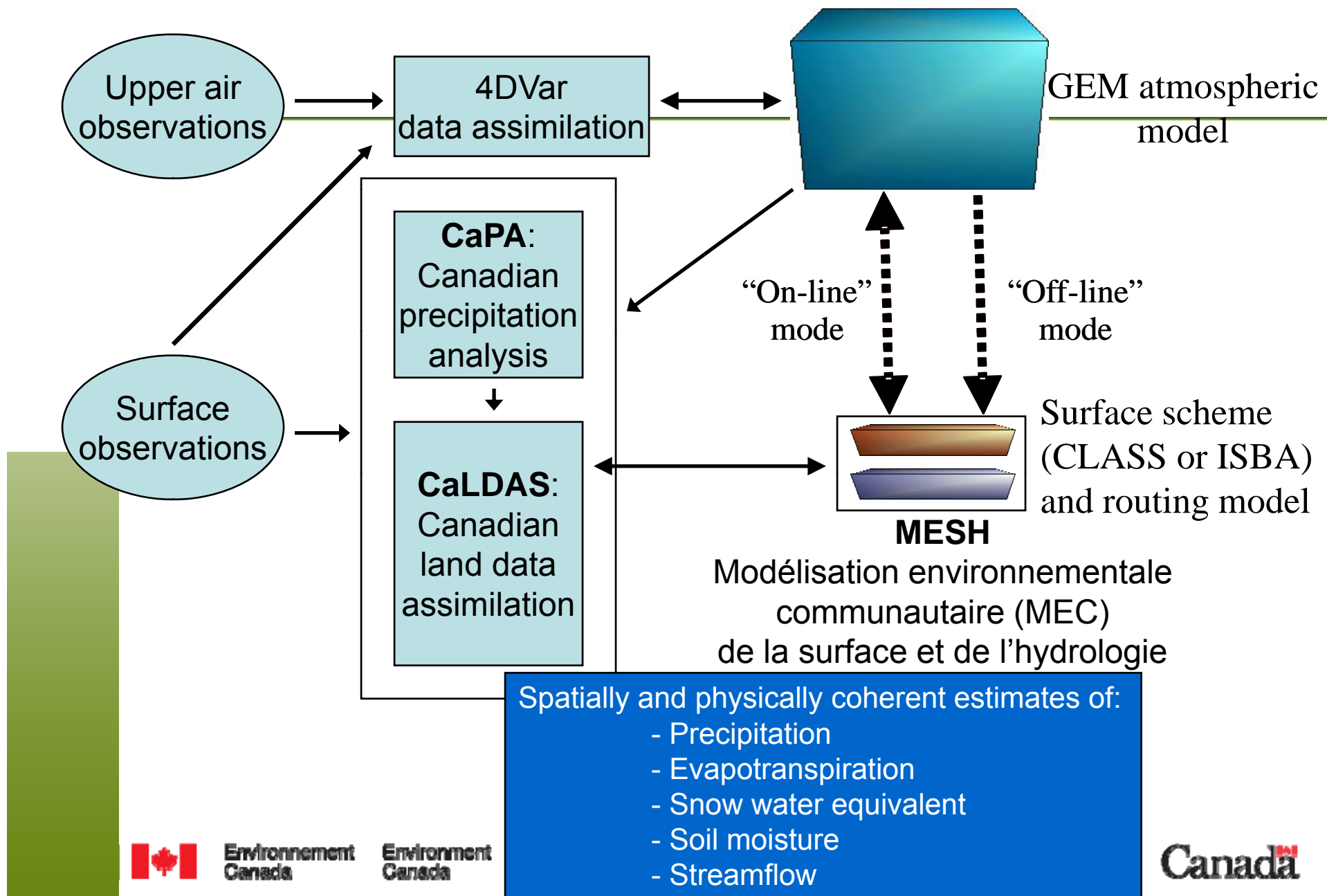
- The tile connector (1D, scalable) redistributes mass and energy between tiles in a grid cell
 - e.g. snow drift
- The grid connector (2D) is responsible for routing runoff
 - can still be parallelized by grouping grid cells by subwatershed



Hydrological Prediction Framework



Environmental Prediction Framework



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Community Model

- MEC is available for download:
 - As the current version of MEC is a subset of the GEM atmospheric model driver, go to:
<http://collaboration.cmc.ec.gc.ca/science/rpn.com/>
 - Then Click on « GEM »
 - Complete documentation for installing and running MEC available online

RPN.COMM: gem - Mozilla Firefox

File Edit View Go Bookmarks Tools Help

http://collaboration.cmc.ec.gc.ca/science/rpn.com/

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Trace: » gem
Trace: RPN.COMM wiki Home » gem

GEM : Global Environmental Multiscale NWP Model

The GEM Model (version 3.2.0) is now available for testing!
See below for download and installation.

GEM 3.2.0 documentation is now available!

Also you may be interested in the

- basic RPN documentation about GEM
- GEM V3 scientific documentation [PDF]

Test GEM3.2 + PHY4.2 Package

WARNING: This is a test version

Before installing the GEM model, you must have the ARMNLIB package installed and setup properly.

Download GEM3.2 + PHY4.2 for Linux

Installing the GEM package is as simple as doing

```
cd $ARMNLIB
tar: xzf modeles-gem3.2-phy4.2.tgz
```

gem.txt · Last modified: 2005/07/07 20:27 by stephane

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Environment Canada - MSC RPN.COMM Group Web Page

URL of this page: <http://collaboration.cmc.ec.gc.ca/science/rpn.com/> [Important Notices and Disclaimers]

Done



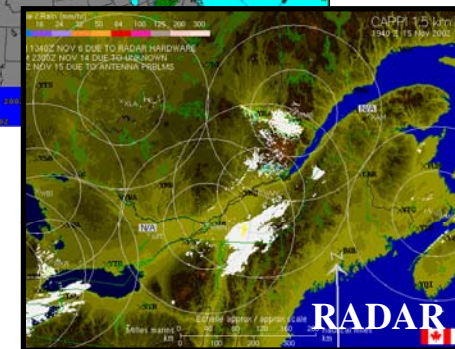
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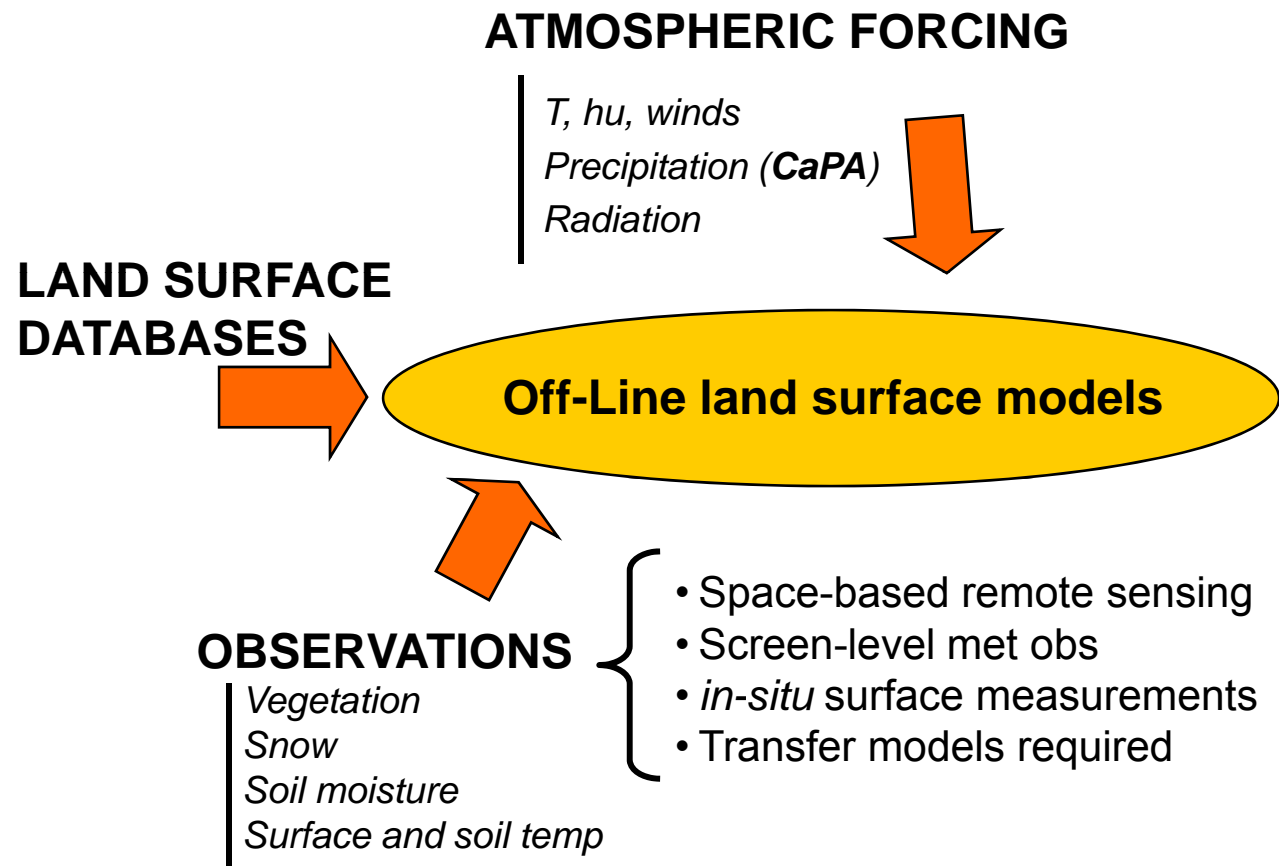
Precipitation analysis (CaPA)

- Combine different sources of information on precipitation into a single, near real-time analysis
 - Analysis of 6h accumulation of precipitation, covering all of North America on a 15km grid
 - Optimal interpolation technique to obtain our best estimate of precipitation



Land data assimilation (CaLDAS)

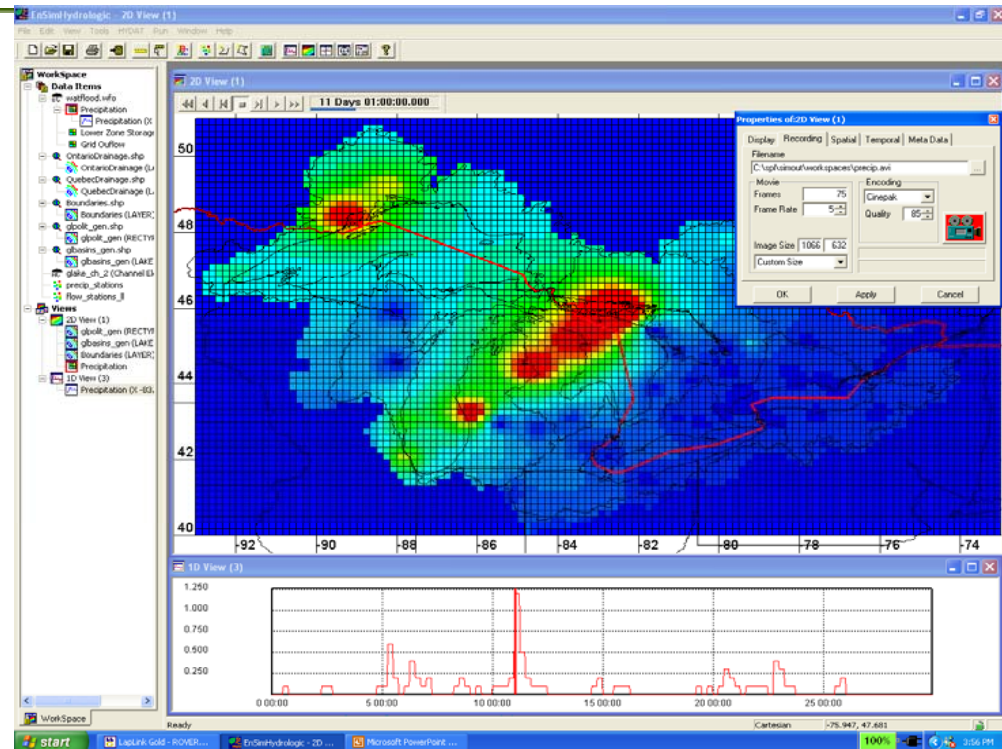
- Biases in energy and water storage can develop in coupled modeling systems due to incorrect representation of physical processes, atmospheric forcing, and surface characteristics.
- Land Data Assimilation Systems (LDAS) driven by observations and constrained by data assimilation have potential to more accurately depict land surface conditions



The Canadian EPS

Starting January 2006:

- 15 day runs twice per day
- 10 perturbed runs from each model
- Surface scheme:
 - 10 members with F-R
 - 10 members with ISBA



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Collaborative Studies

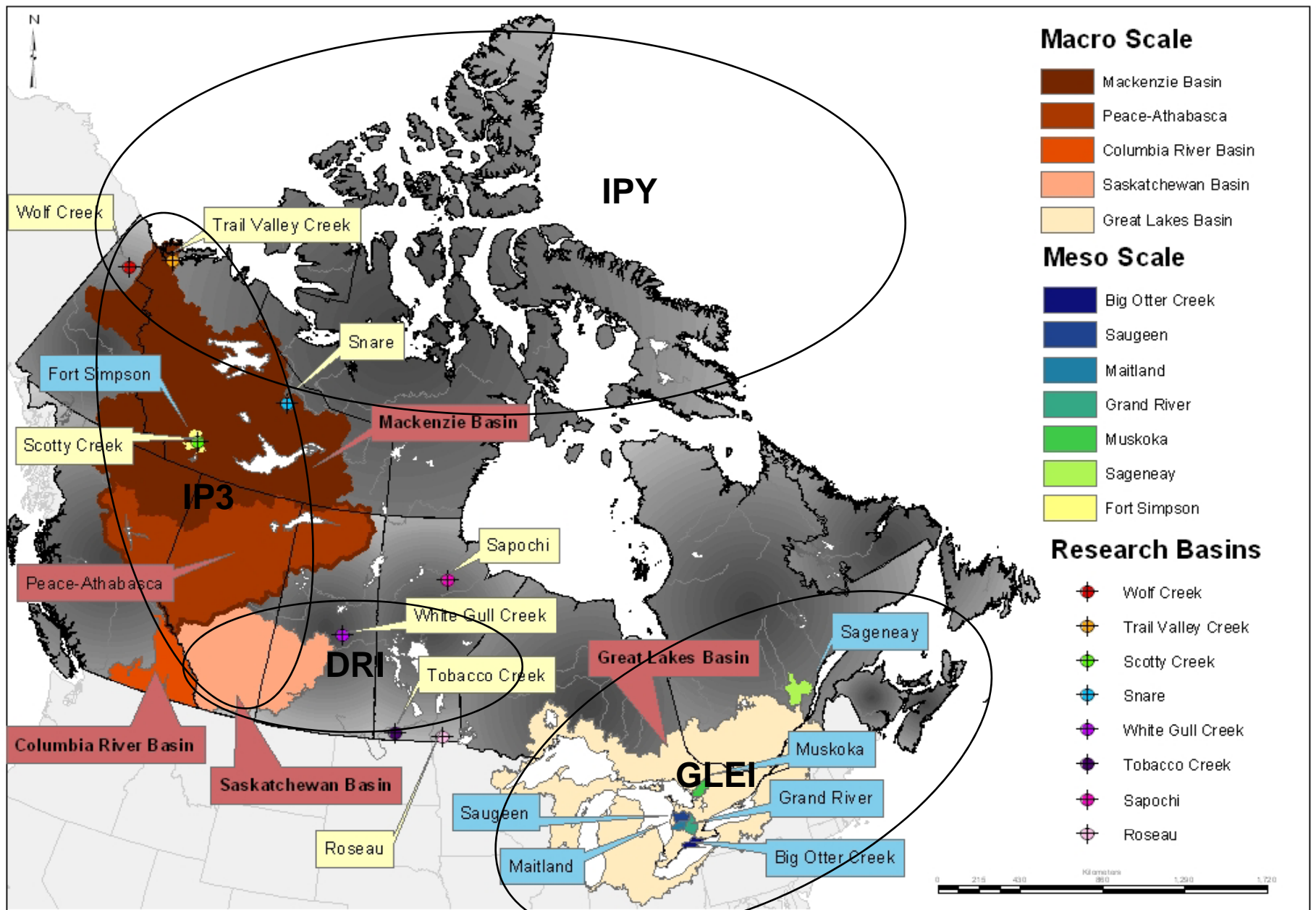
- Research – MESH testing
 - Canada DRI – Drought Research Initiative
 - IP3 – Process parameterization and Predictions –
 - IPY
 - Great Lakes Ensemble Modelling
 - Climate Change Assessments – SSRB



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Map created by Jackie Bronson

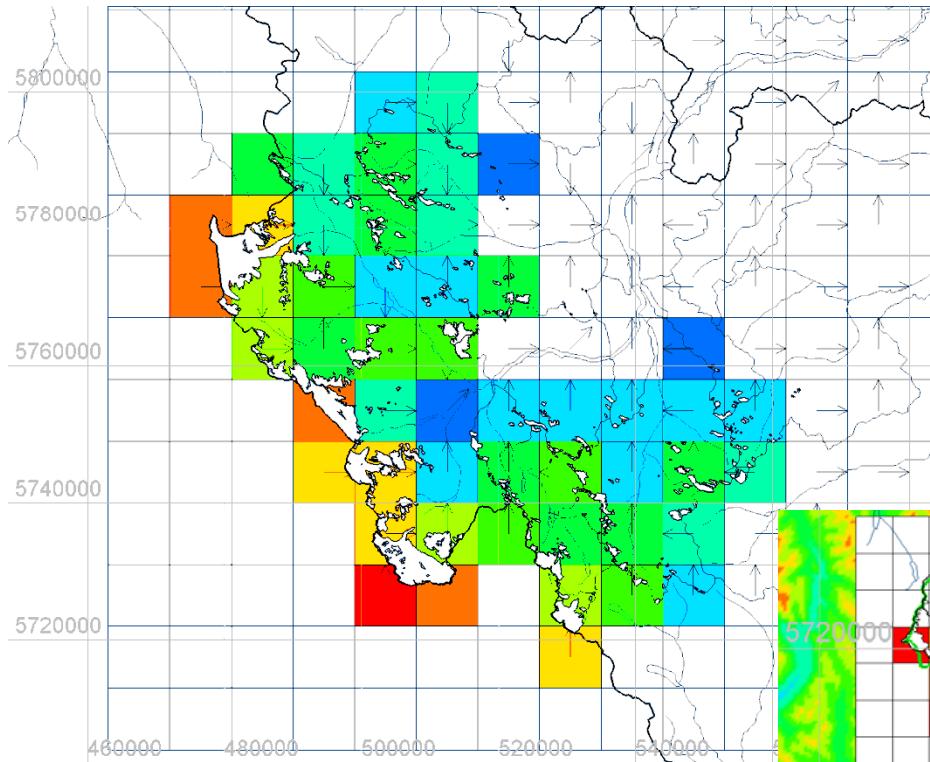
Glacier contribution to flow – IP3



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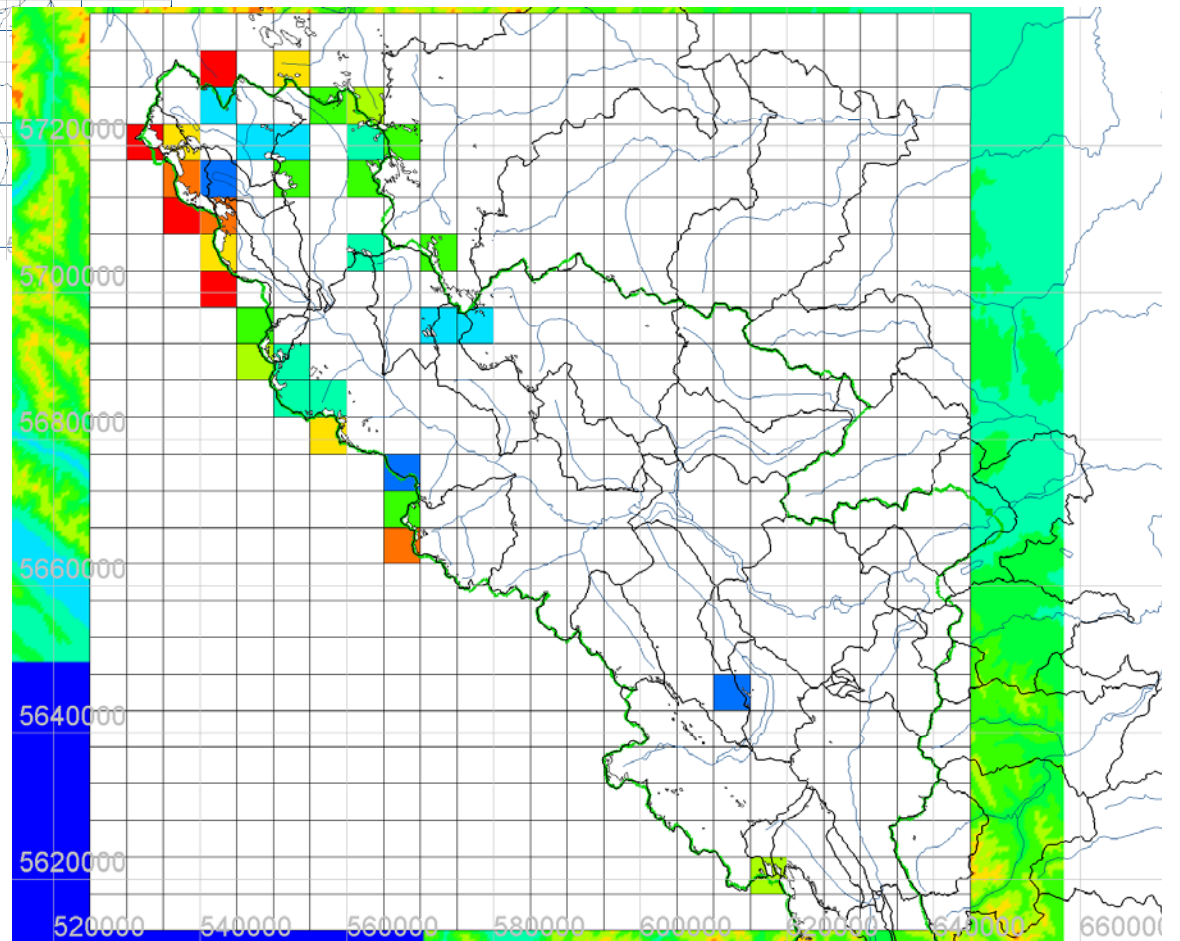
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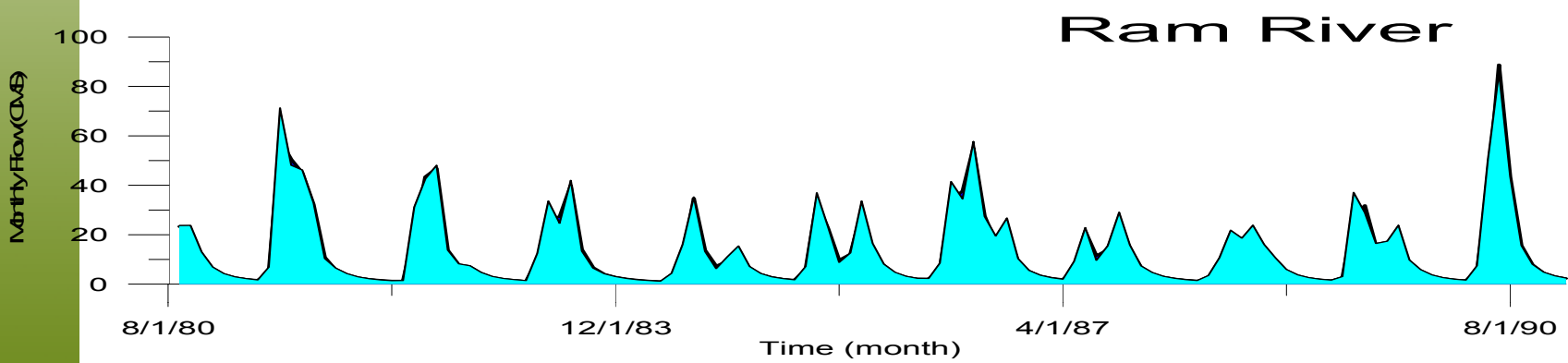
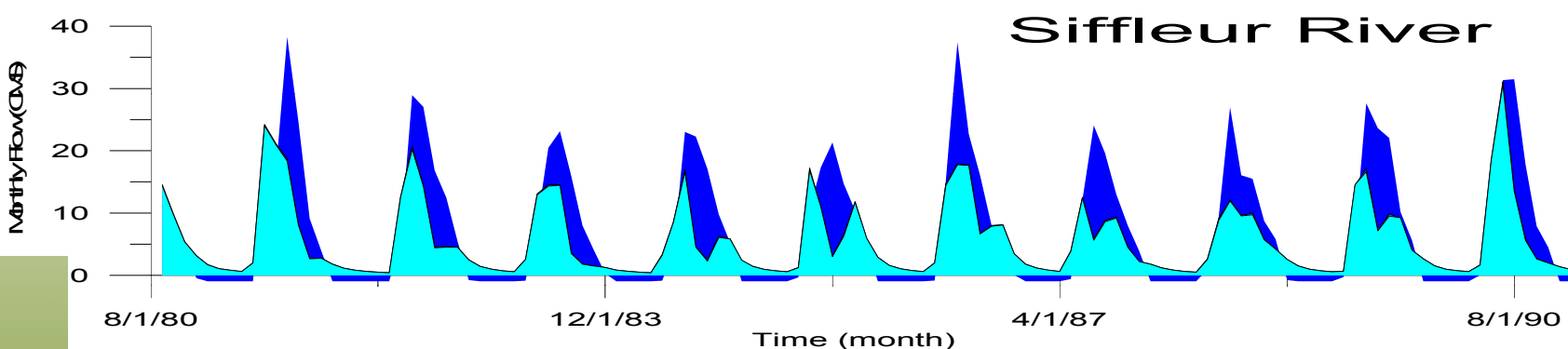
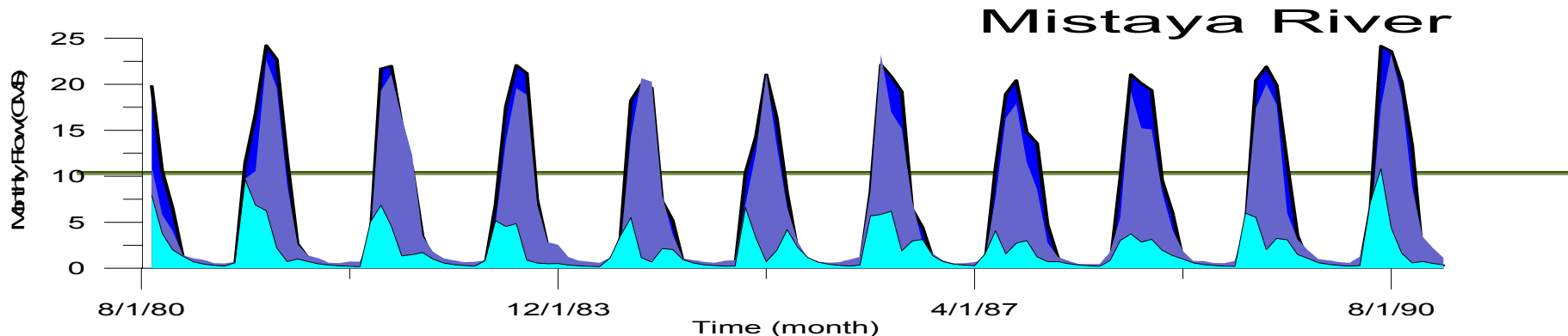
North Saskatchewan basin

South Saskatchewan basin



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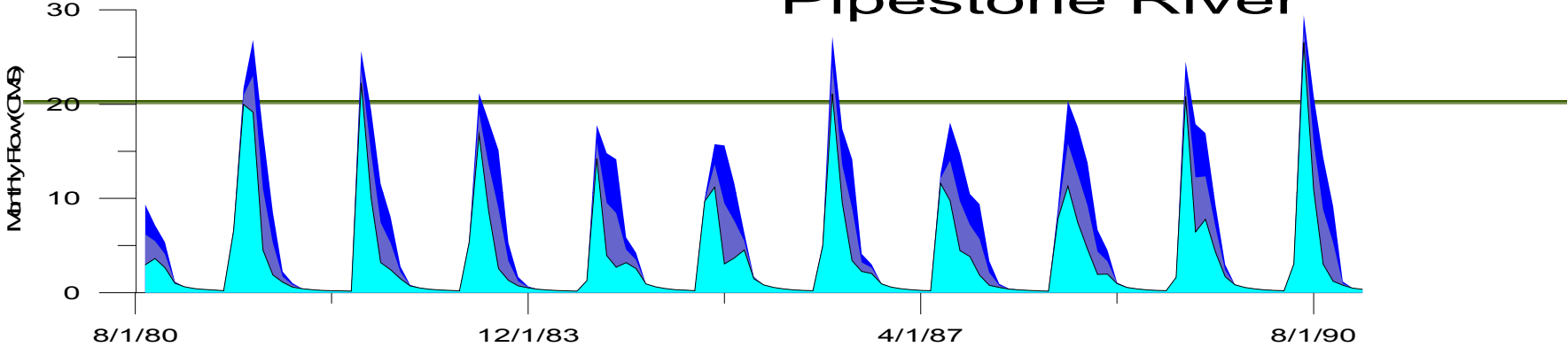
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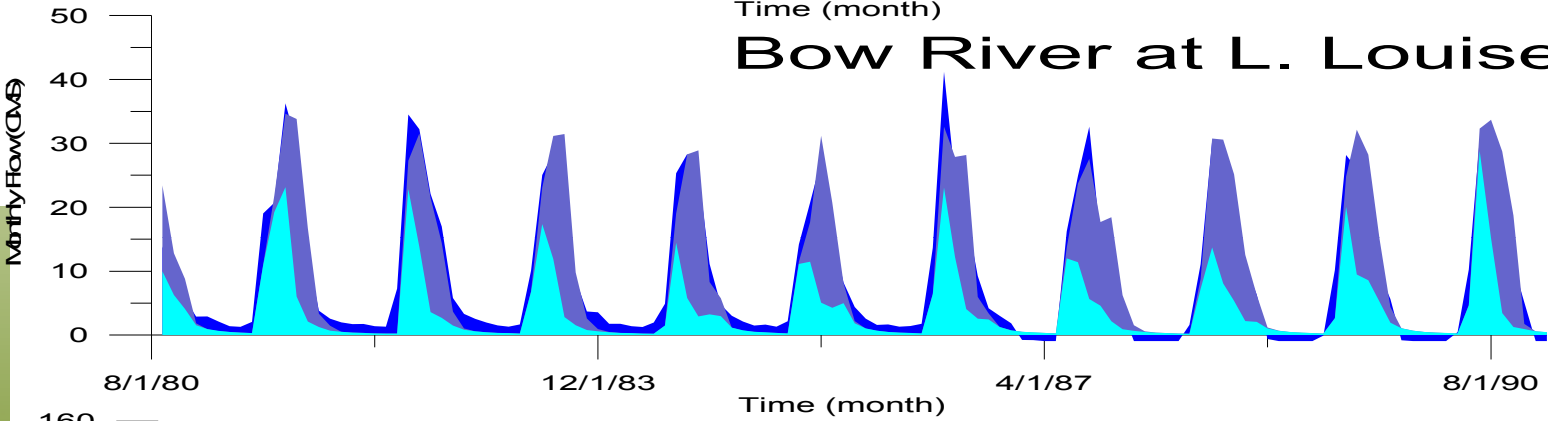
1998 extent
 1975 Extent
 None



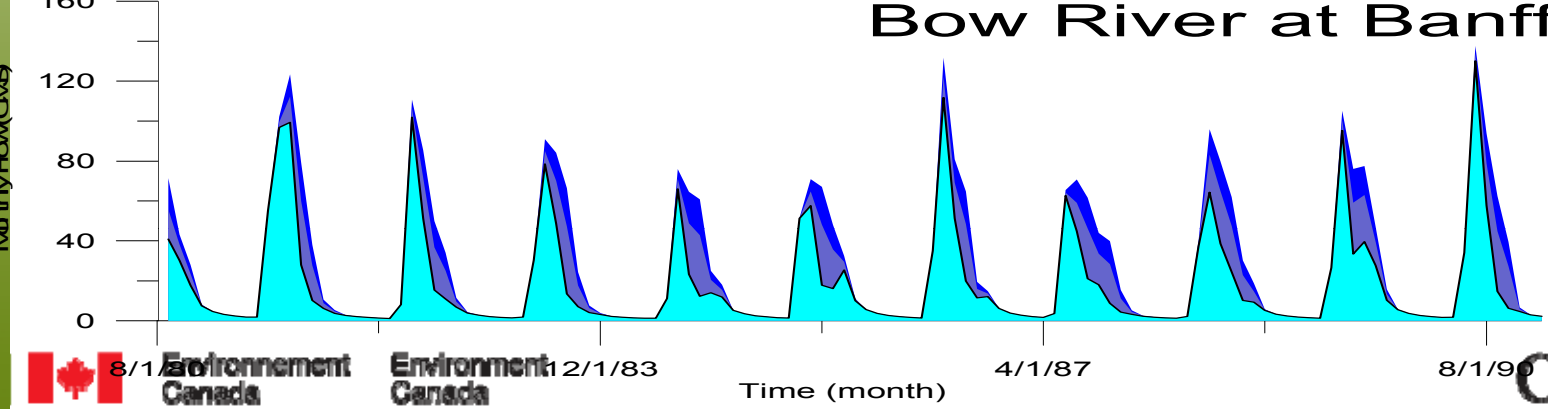

Pipestone River



Bow River at L. Louise



Bow River at Banff



The HEPEX Canada EPS

Multi-model ensemble (SEF + GEM)

- T149 for SEF, 1.2° for GEM
- A different parameterization is used for each member

Since June 2001:

- 10 day runs once a day
- 8 perturbed runs from each model
- Surface scheme:
 - force-restore

Starting January 2006:

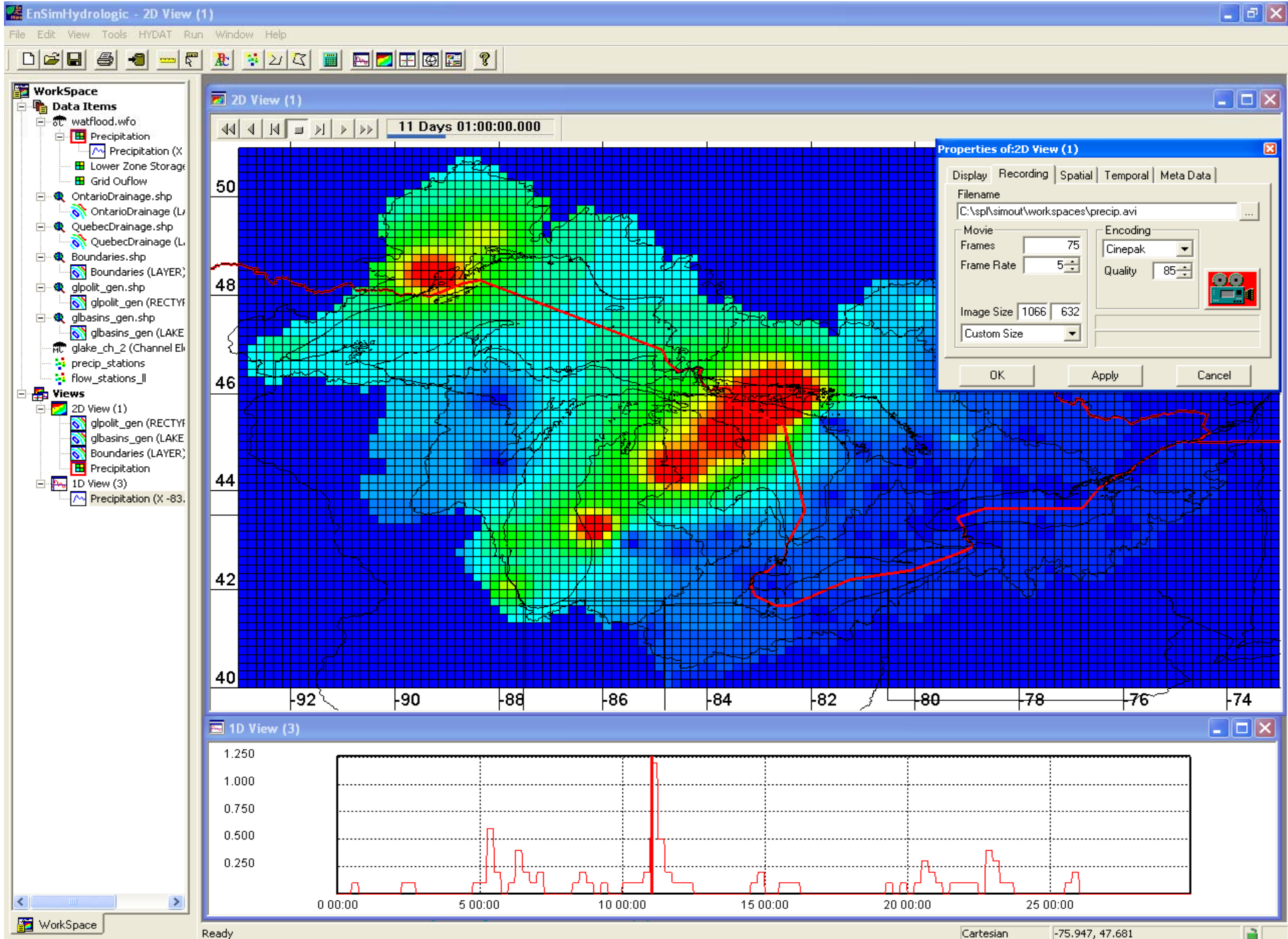
- 15 day runs twice per day
- 10 perturbed runs from each model
- Surface scheme:
 - 10 members with F-R
 - 10 members with ISBA



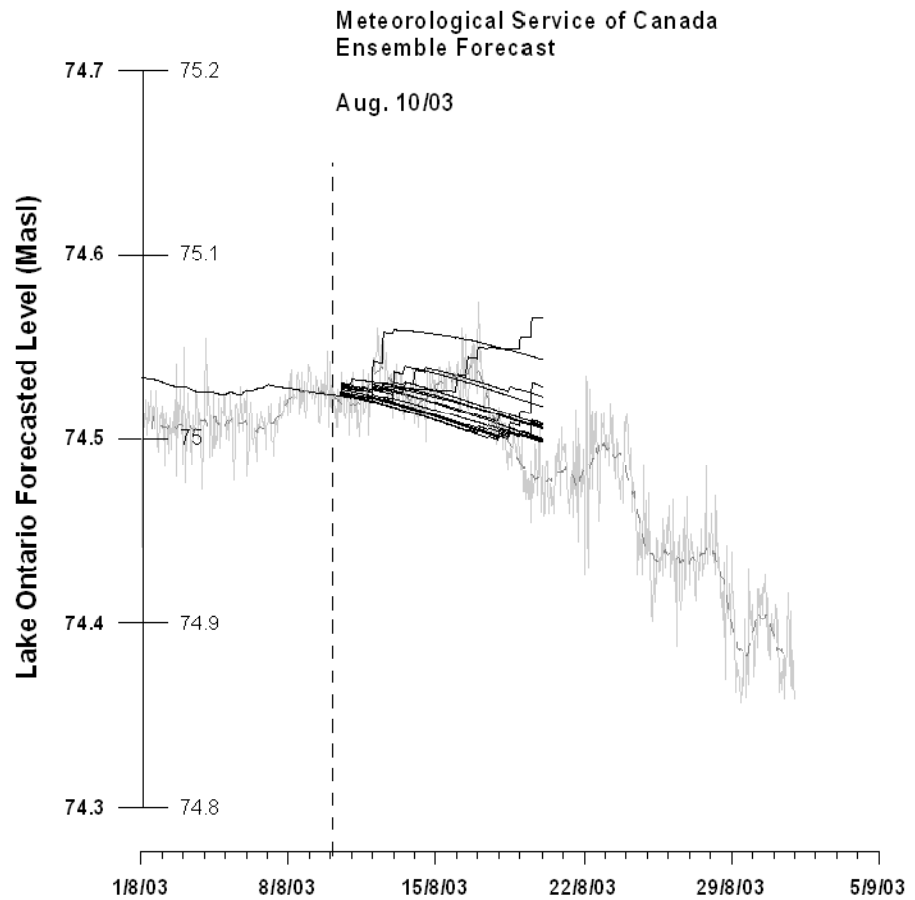
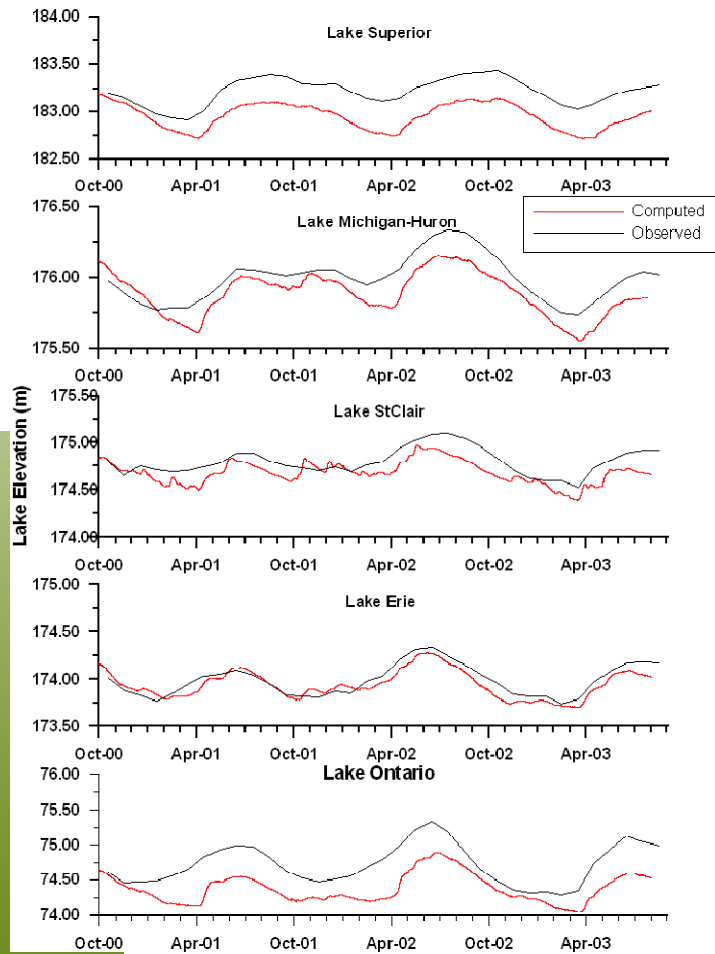
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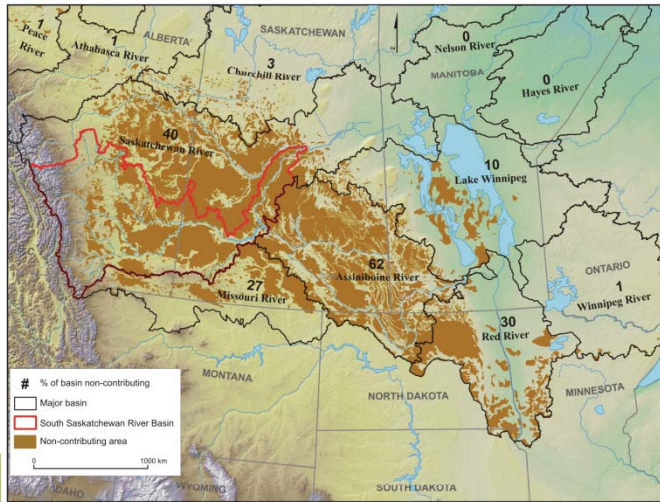
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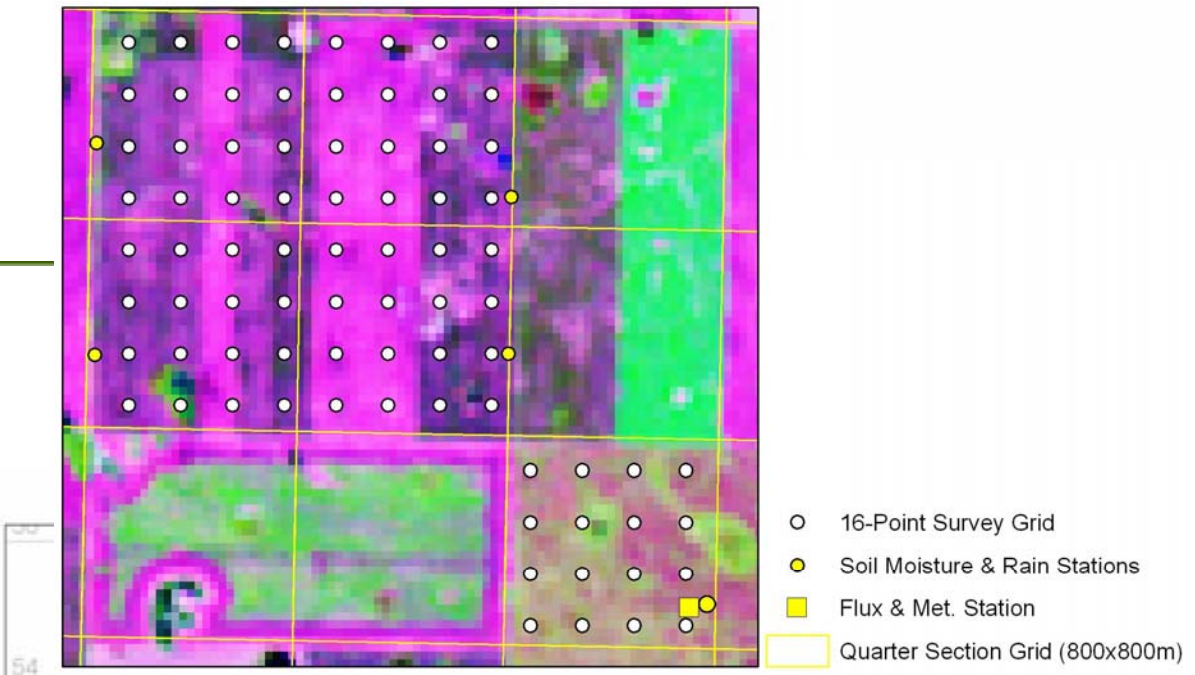
Forecasting



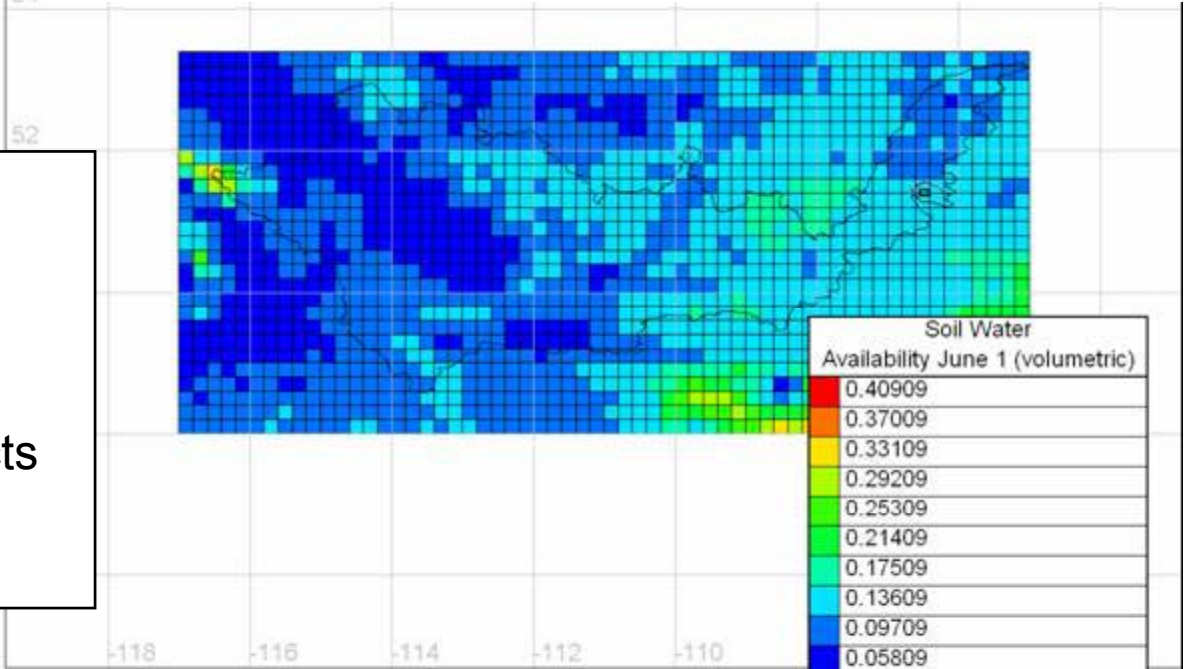
DR/NAESI



Map data source: Esri/DeLorme, GeoEye, Natural Resources Canada, Government of Canada. Map projection: Lambert Conformal Conic. Contour resolution: 100 m.



- 16-Point Survey Grid
- Soil Moisture & Rain Stations
- Flux & Met. Station
- Quarter Section Grid (800x800m)



- MESH development
- CaPA development
- CaLDAS development
- Assess the validity of MESH, CaPA and CaLDAS products
- Technology transfer



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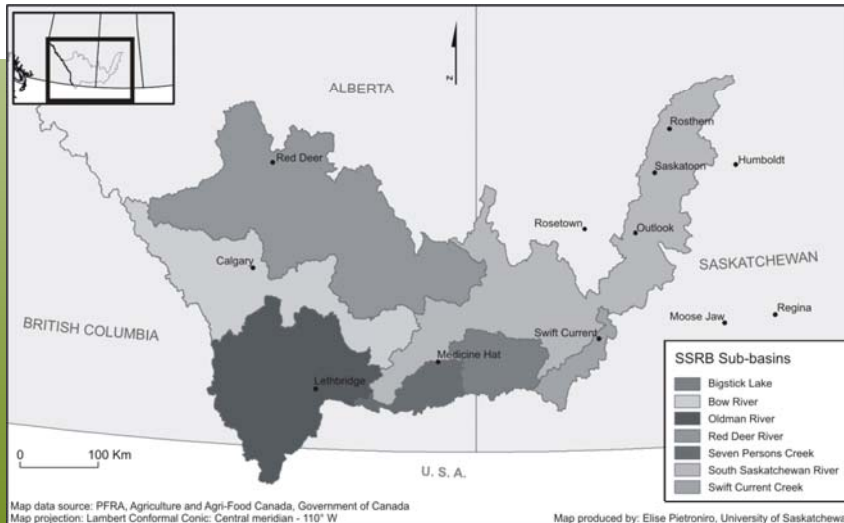
Two nested modelling domains

SSRB
xOrigin -117.0000
yOrigin 48.0000

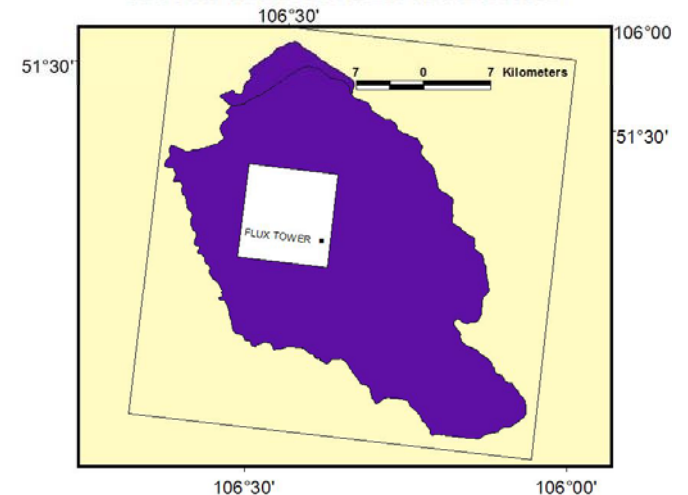
xCount 60
yCount 27
xDelta 0.2°
yDelta 0.2°



Brightwater Creek
xOrigin -106.6836
yOrigin 51.199
xCount 54
yCount 52
xDelta 800 m
yDelta 800 m



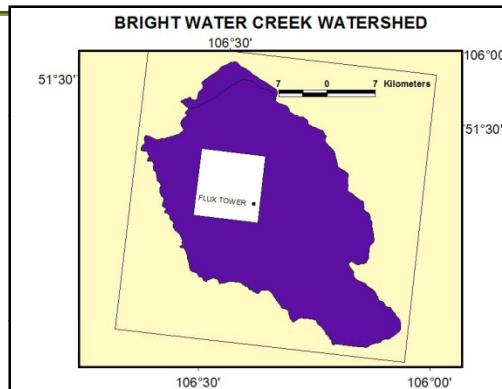
BRIGHT WATER CREEK WATERSHED



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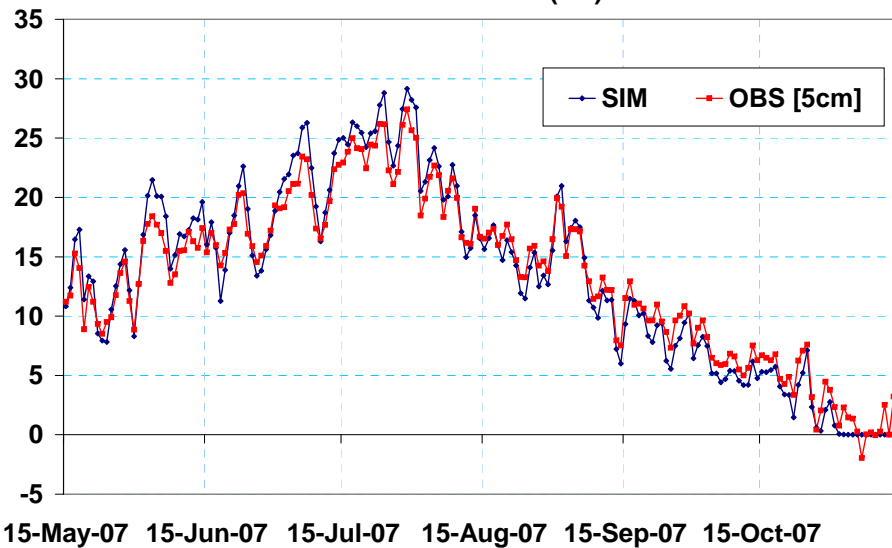
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Stand alone MESH

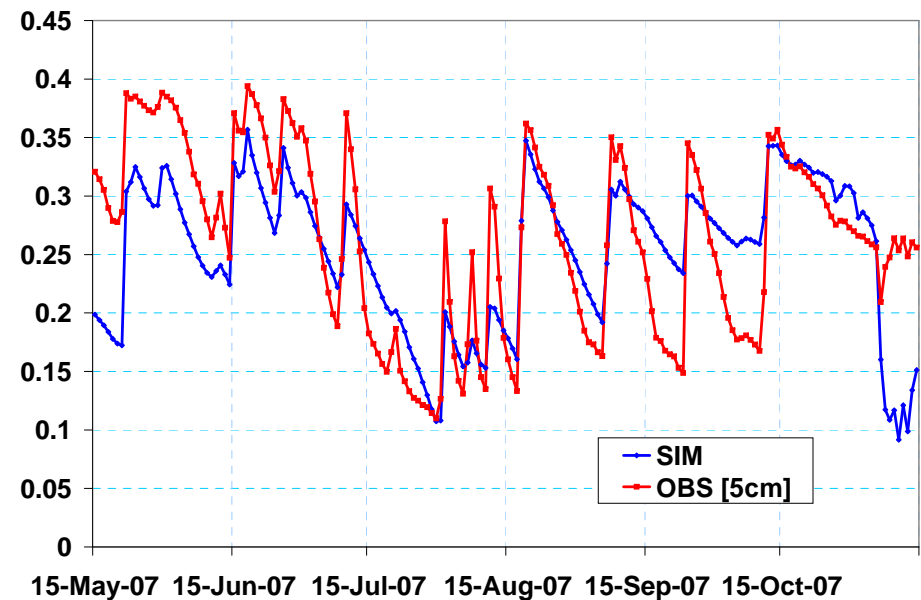


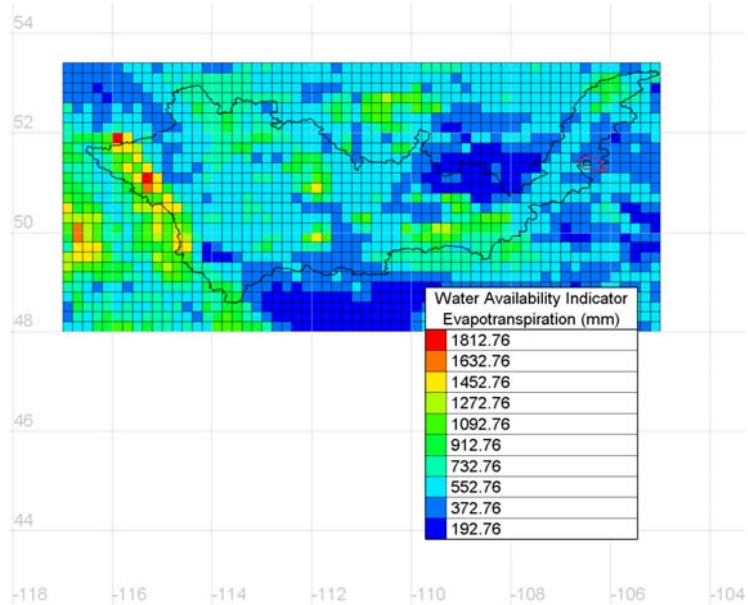
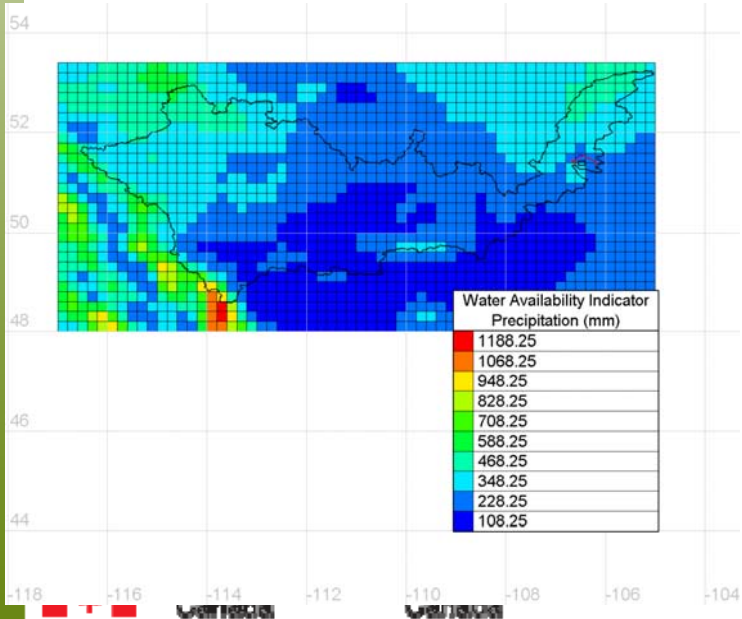
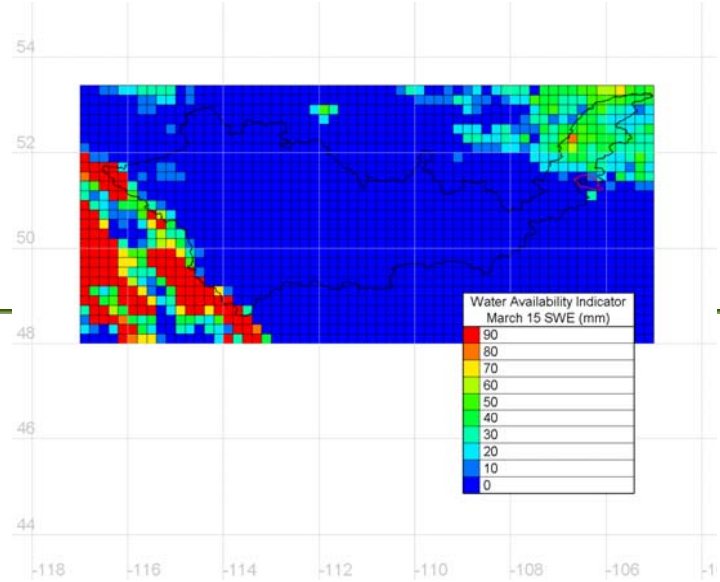
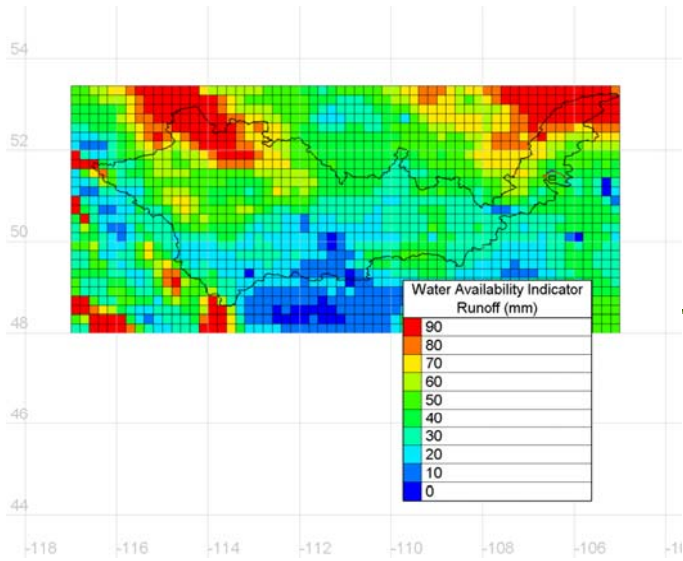
- **MESH model physics (CLASS LSS)**
 - with added routing based on Watroute
- **Forcing with met tower data**
 - Temp, precip, station pressure, specific humidity, wind, lw and sw radiation
- **May 15 to November, 2007, half hourly**

Soil Temperature - Layer 1 - Kenaston area - Flux Tower site (°C)



Soil Moisture - Kenaston area - Flux tower site [Fraction]





Summary and future considerations

- Stand alone MESH demonstrates that it is possible to reasonably replicate some water availability parameters.
- CaPa show some benefits to precipitation re-analysis. Will be operation this year.
- A first version of CalDAS has been tested with ISBA.
 - Future versions will
 - Assimilate soil moisture directly (if available)
 - Will be based on CLASS

MEC system is moving towards the same internal representation of the behavior of the stand-alone MESH and has the added benefit of the use of land surface data assimilation

- The goal is to provide calibration and verification from MEC and MESH and evaluate the system in an operation mode.
 - Further evaluation over the next 2 years.
 - Parameterizations and other changes to stand-alone MESH will be incorporated into the operational model.
- 10 Day forecasts
 - MEC/MESH can already provide 10 forecasts using deterministic and ensembles forecasts
 - All water availability indicators could be forecasted
 - Could be very useful for irrigation scheduling
- Seasonal Forecast
 - MEC/MESH will be incorporated into the Canadian Forecasting system
- Climate change
 - Force MESH standalone with RCM output
 - Run MEC in Climate Mode

