



Environment
Canada

Environnement
Canada



McGill



Canada

Short-term Hydrological Ensemble Prediction

Design and Preliminary Results

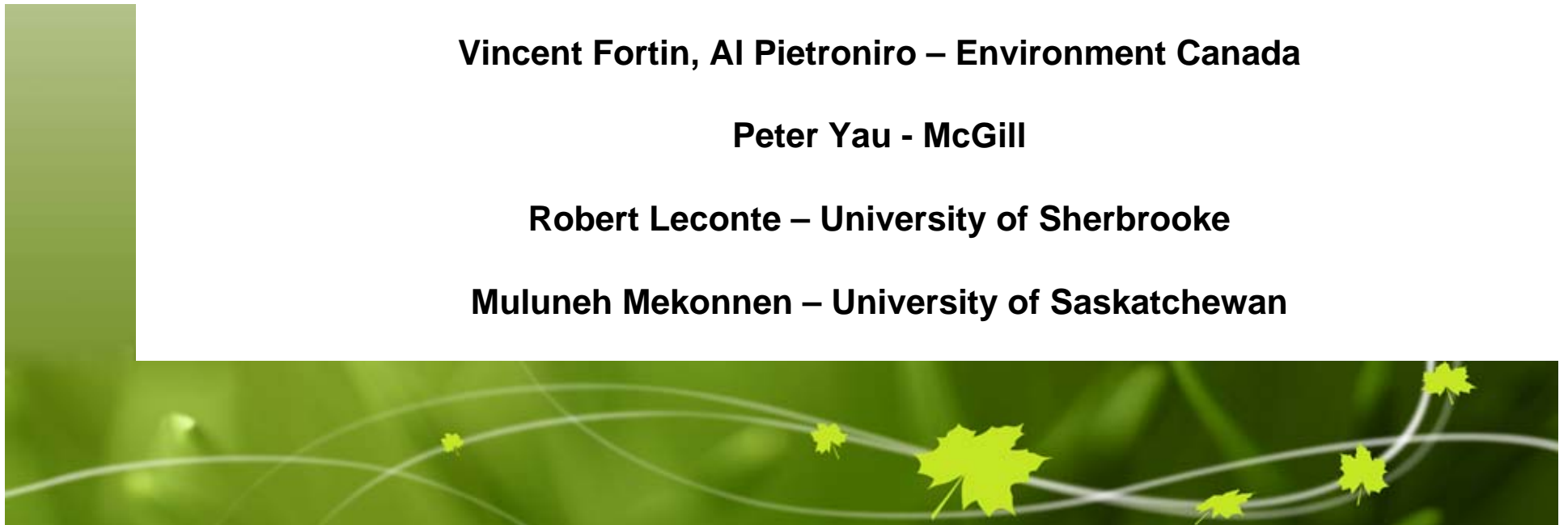
Bruce Davison - Environment Canada and McGill

Vincent Fortin, Al Pietroniro – Environment Canada

Peter Yau - McGill

Robert Leconte – University of Sherbrooke

Muluneh Mekonnen – University of Saskatchewan



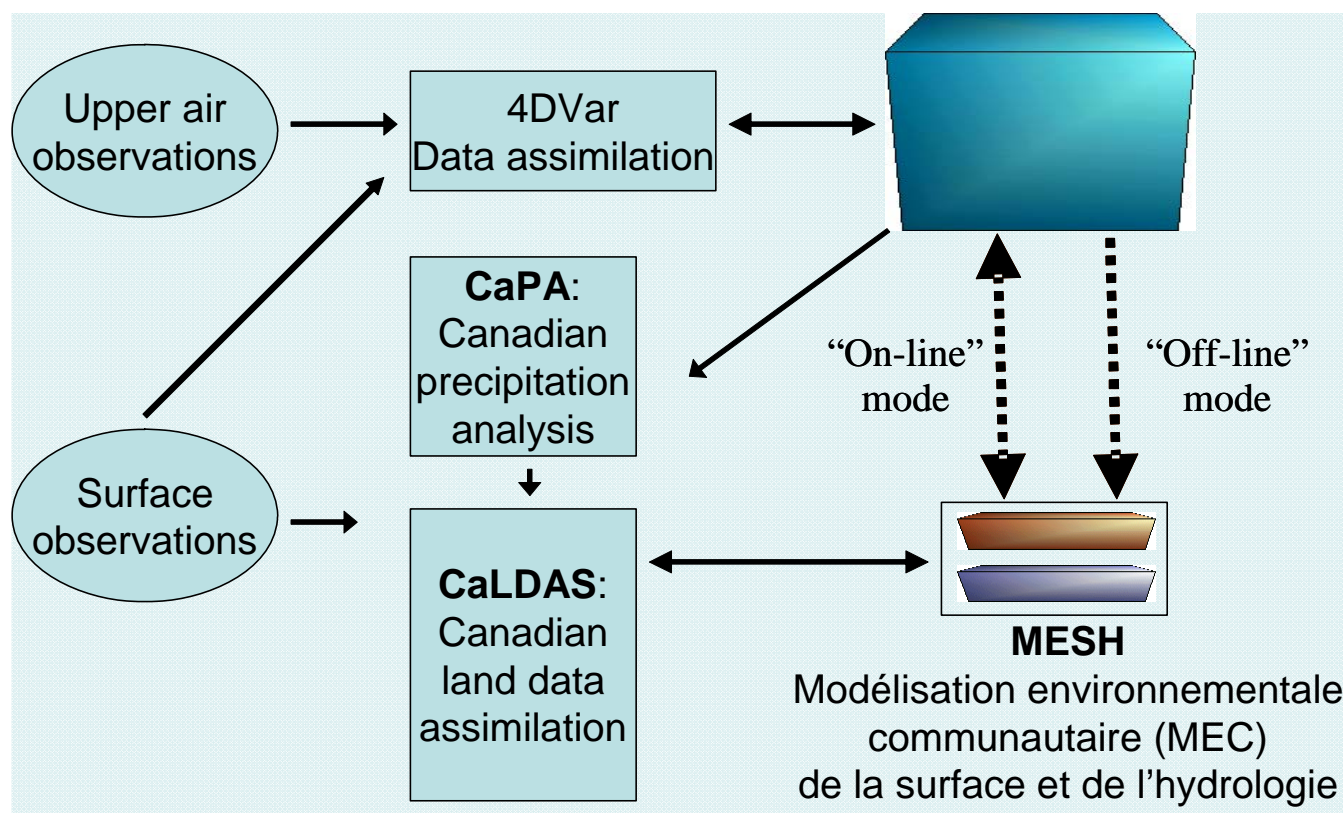
Outline



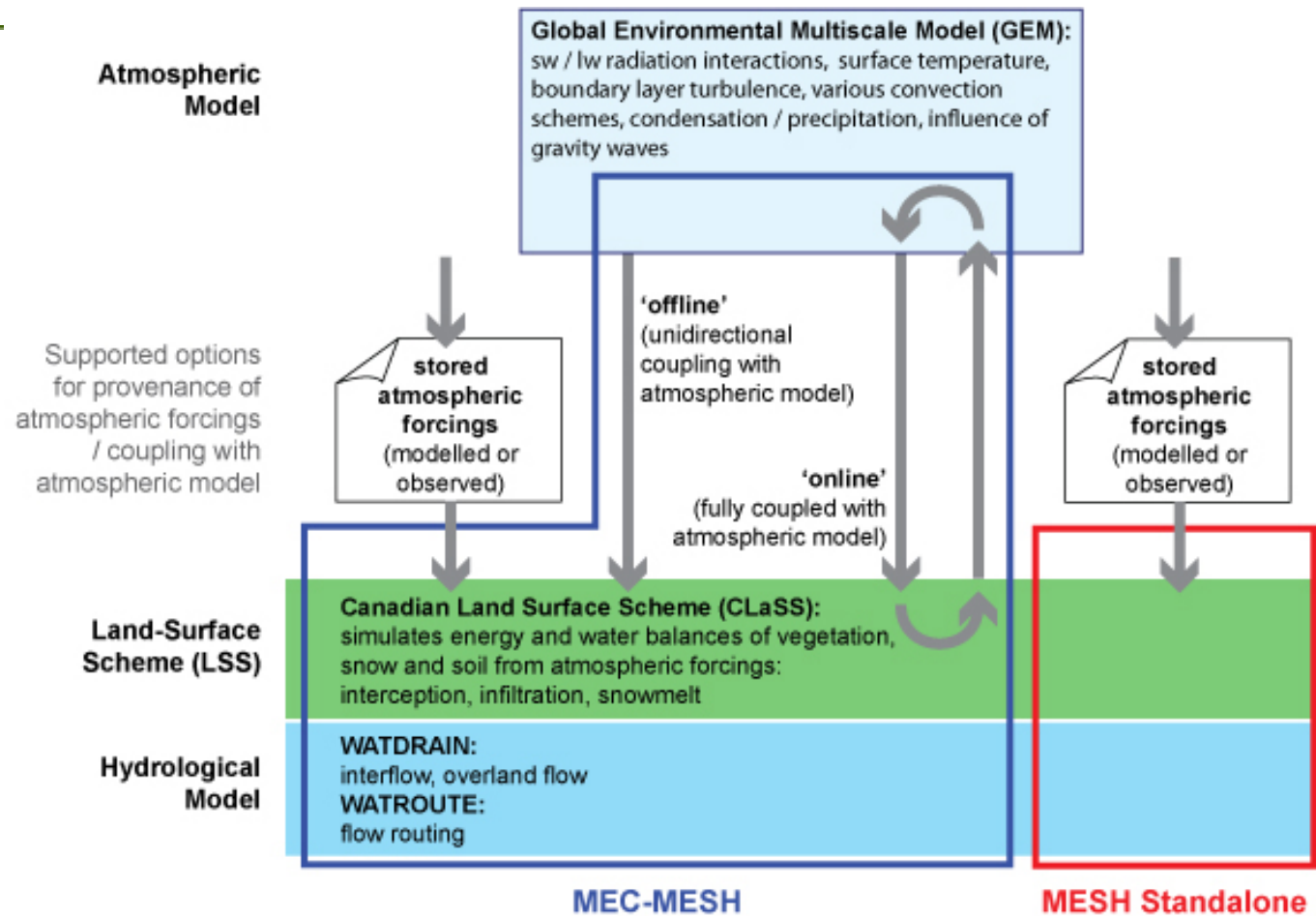
- The Modelling Platform
- Preliminary Deterministic Results
 - South Saskatchewan and Upper Assiniboine
 - Great Lakes
- H-EPS Design



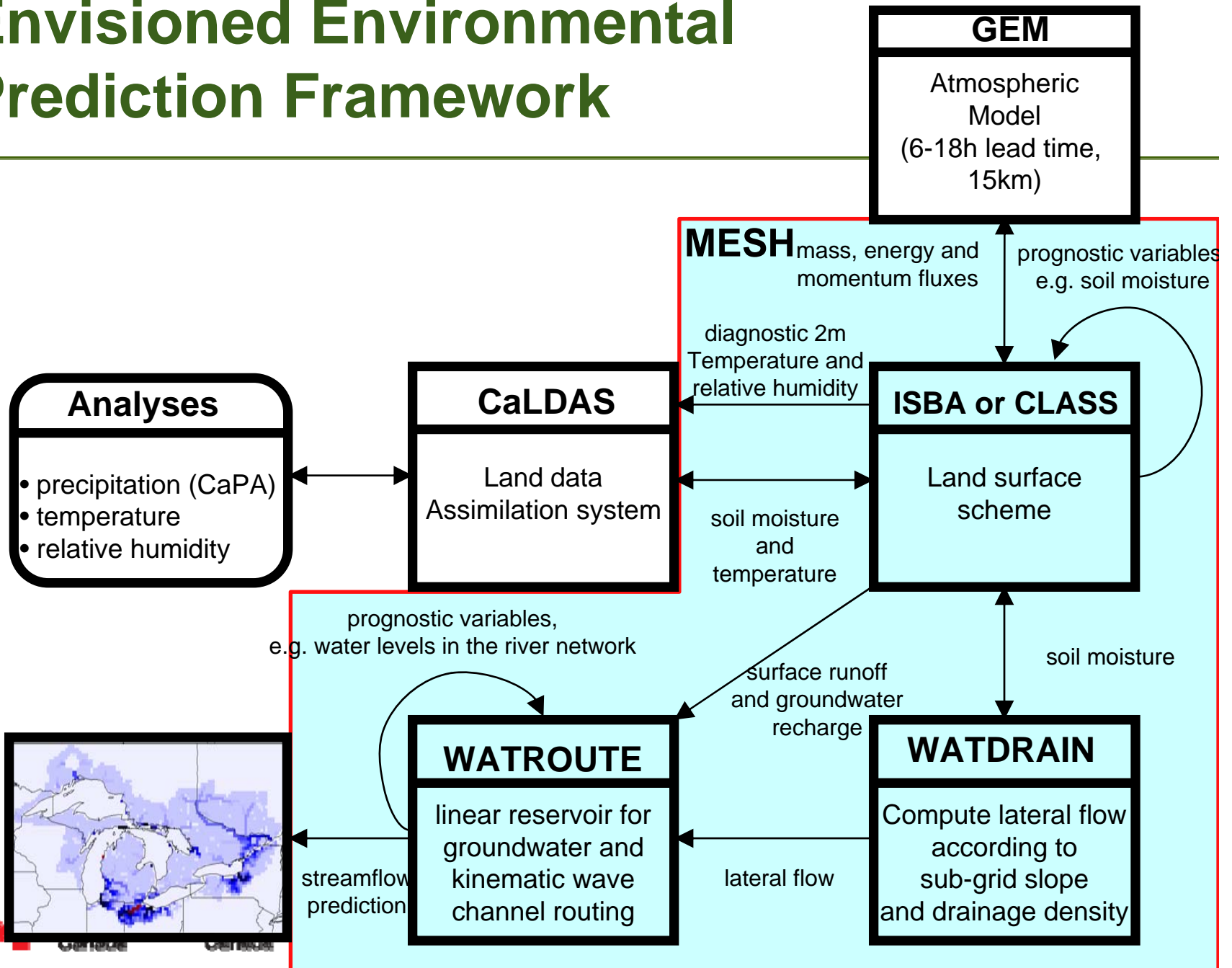
The Modelling Platform



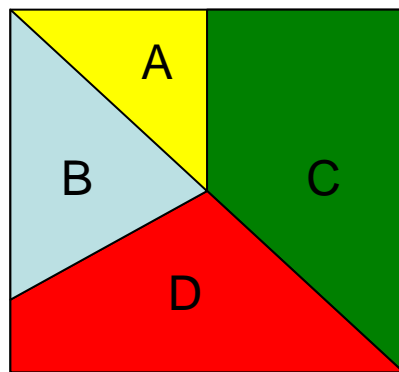
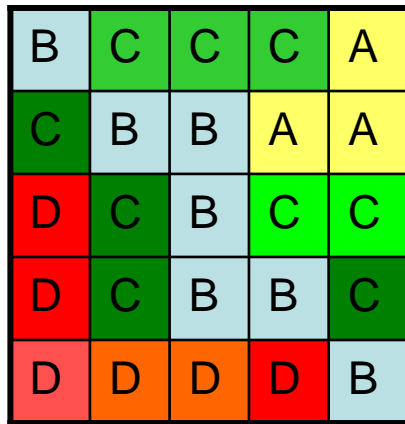
The Modelling Platform



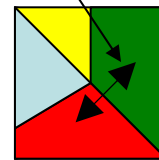
Envisioned Environmental Prediction Framework



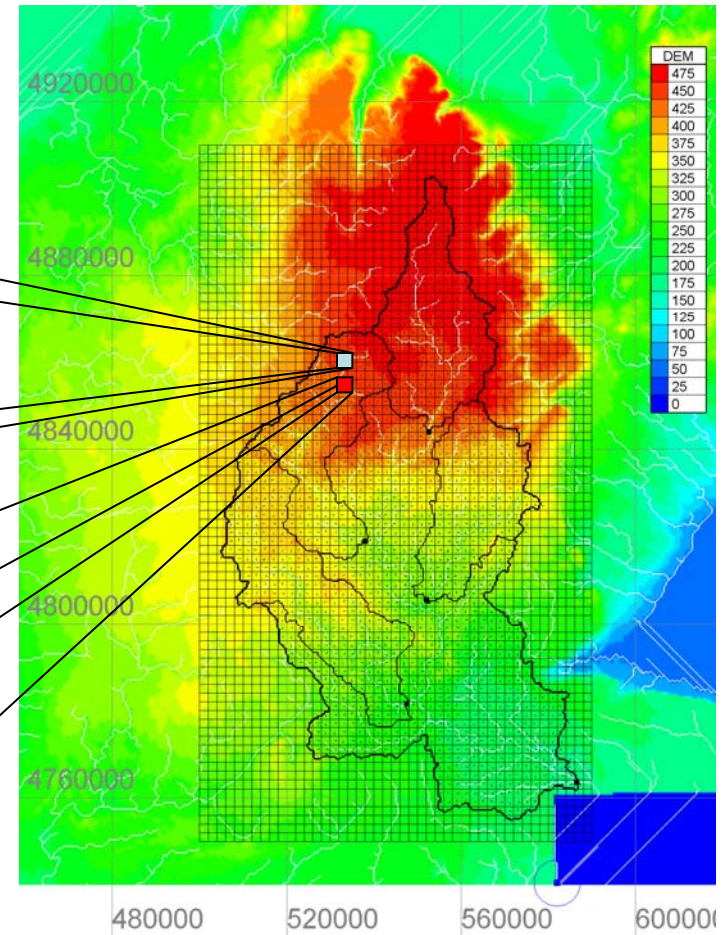
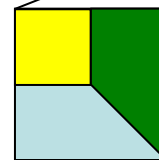
The Modelling Platform



Tile connector

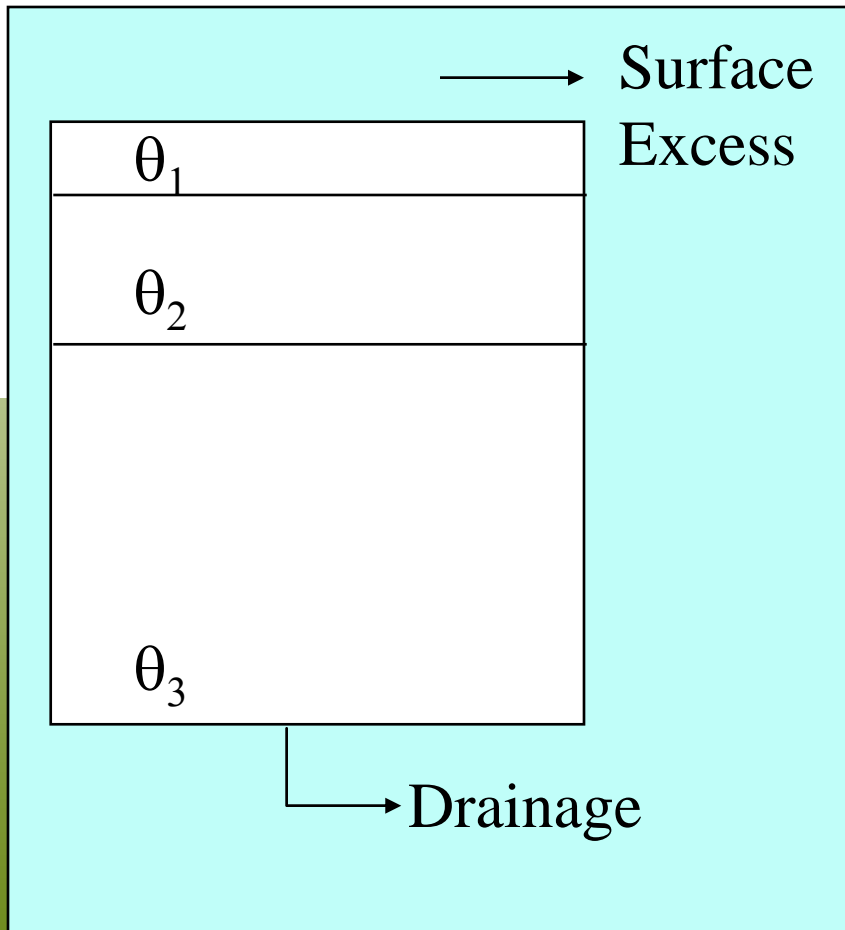


Grid connector

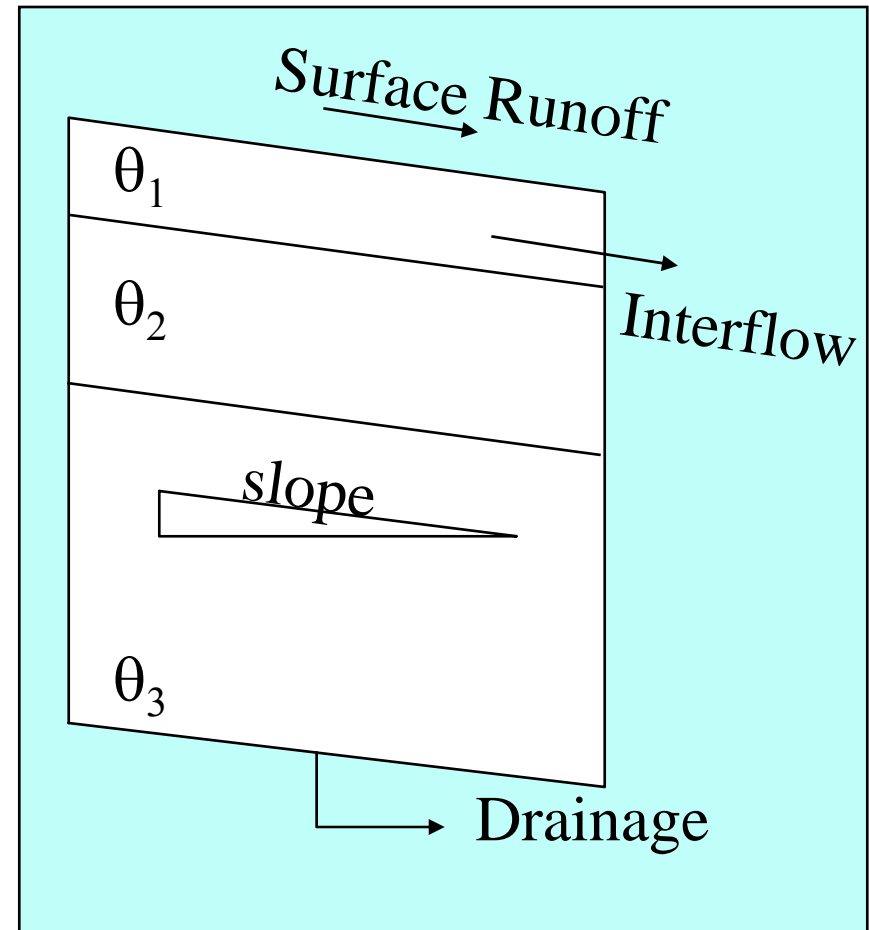


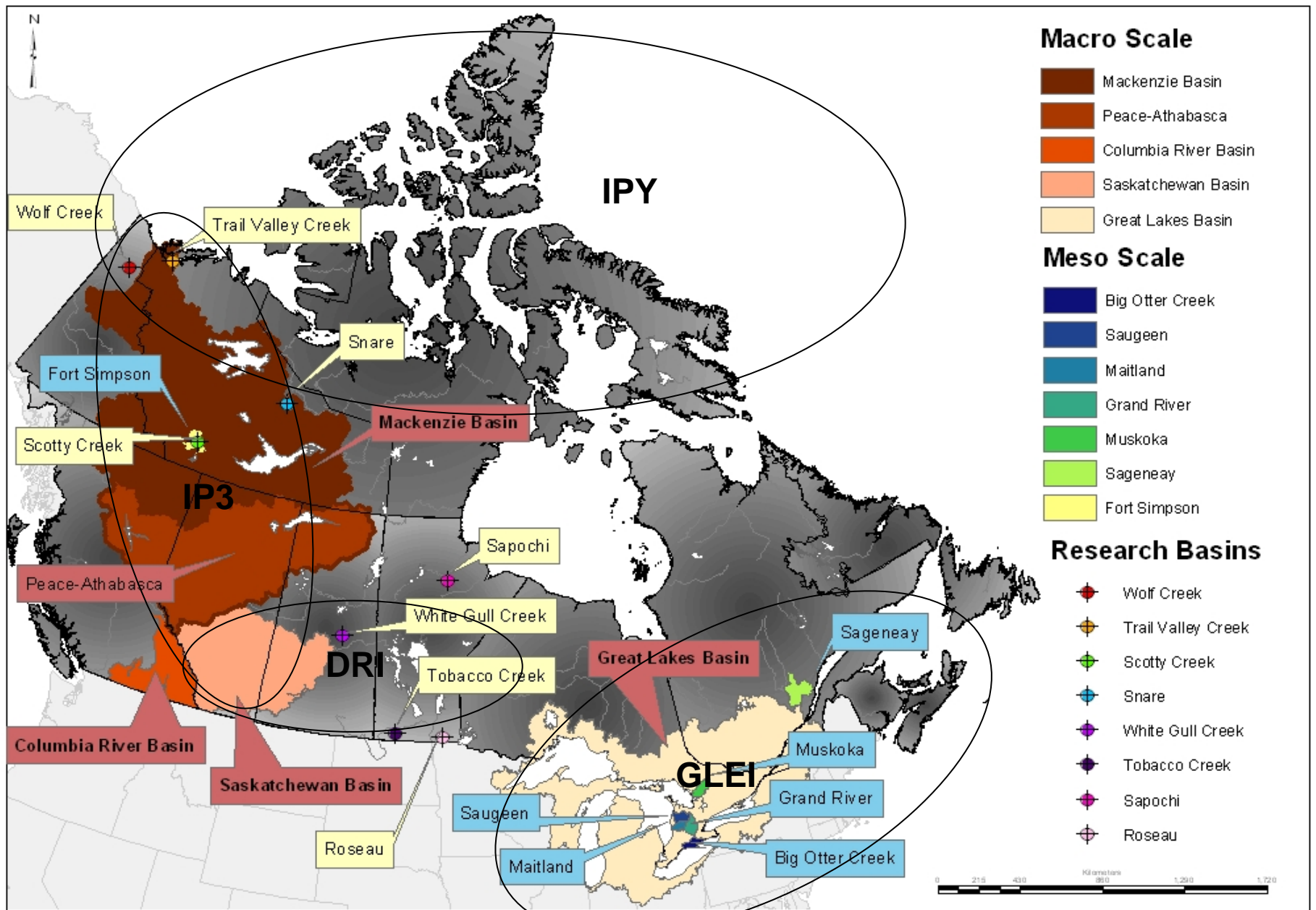
The Modelling Platform

Flat CLASS



Sloped CLASS





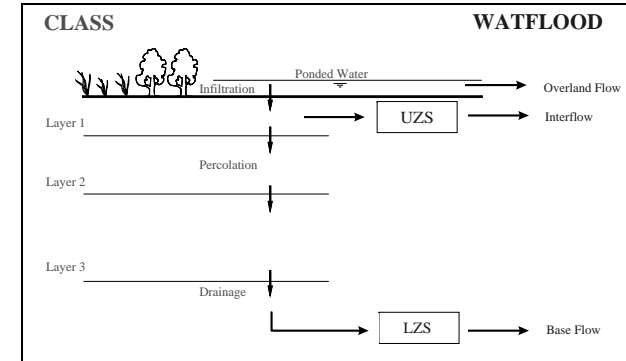
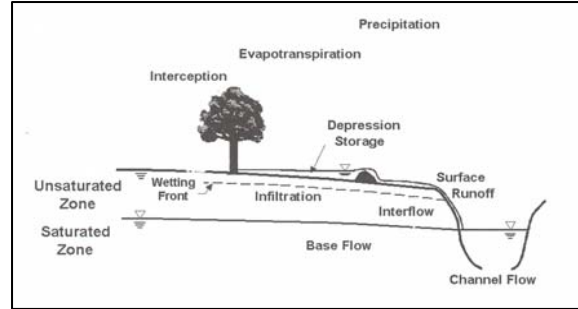
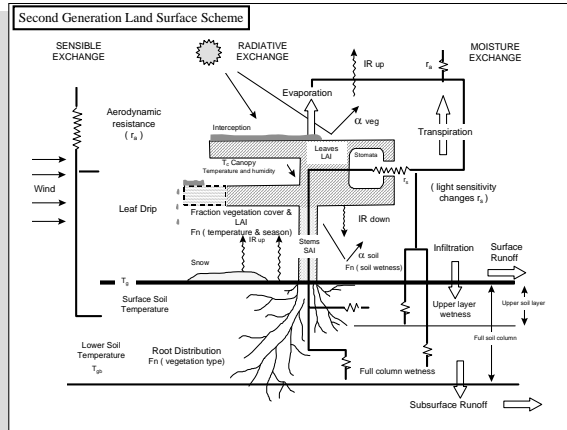
Map created by Jackie Bronson

Hydrological Modelling Framework

CLASS

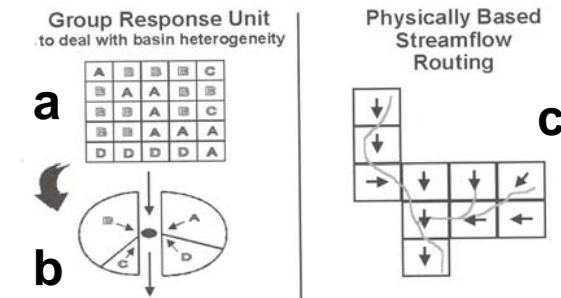
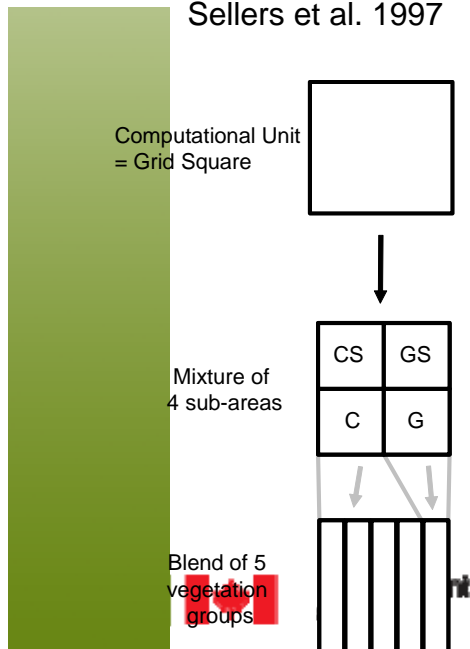
WATFLOOD

WATCLASS

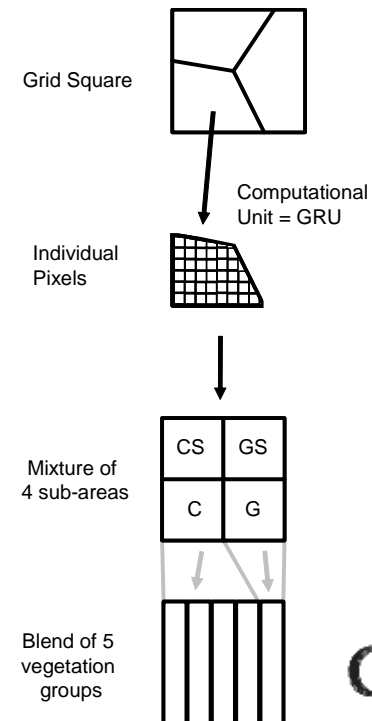


Sub-grid Variability

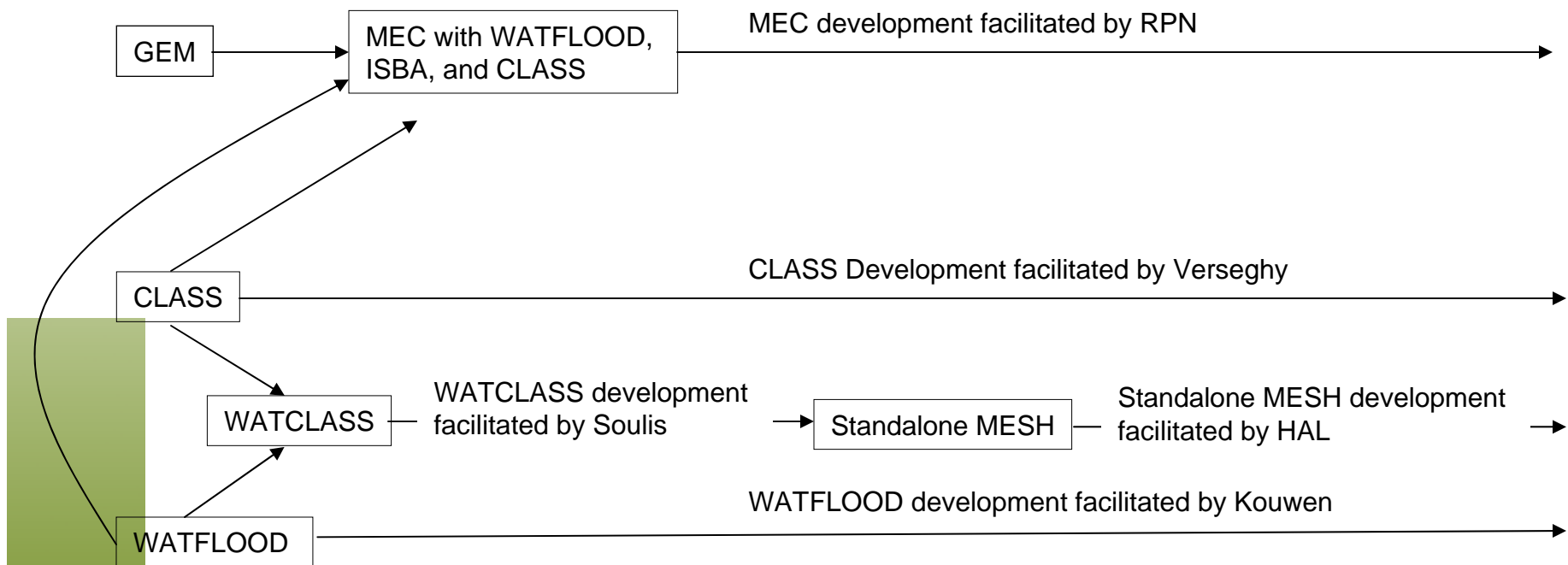
Sellers et al. 1997



Kouwen et al. 1993

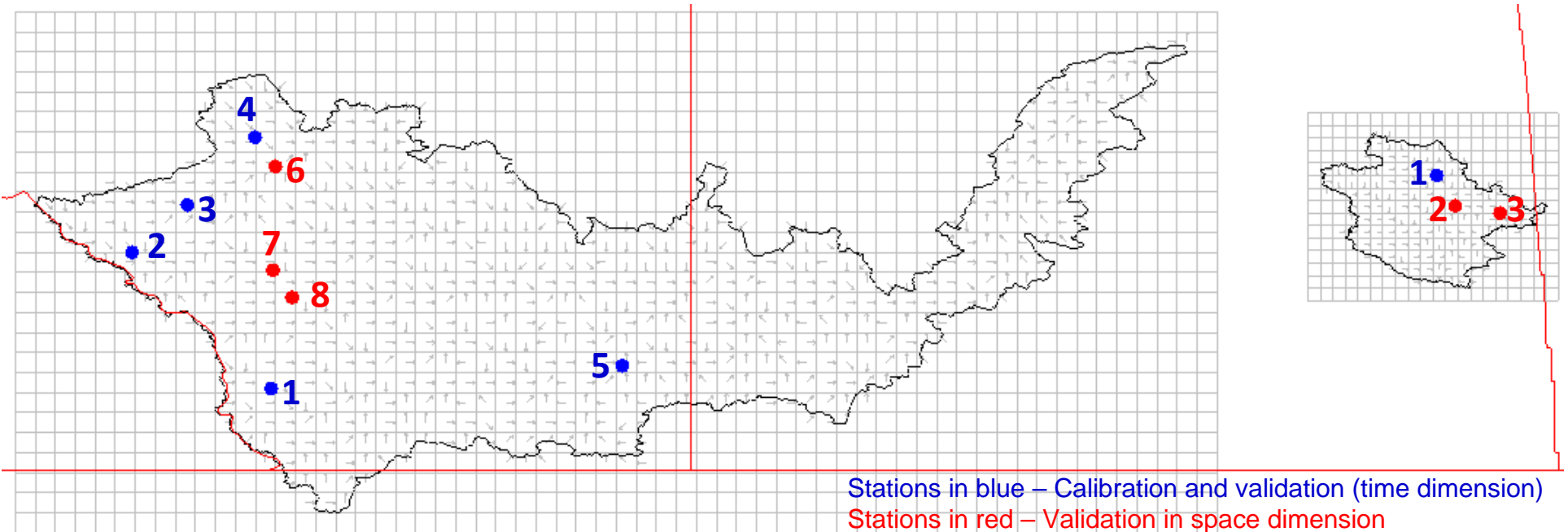


MESH History



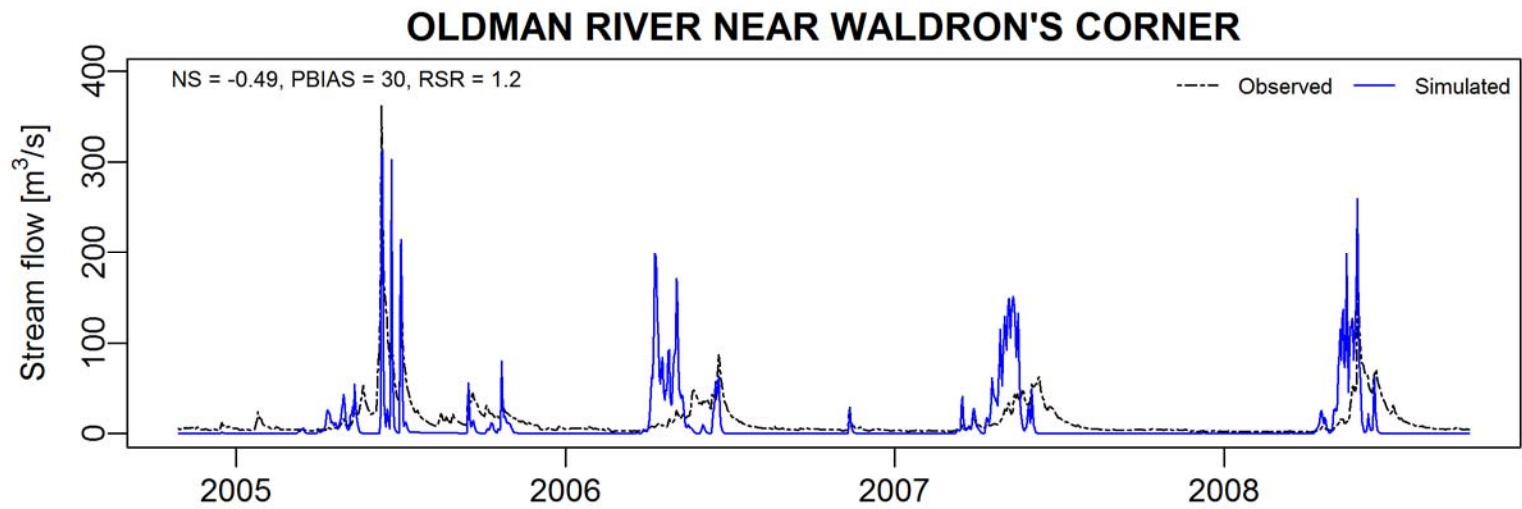
CASE STUDIES – SSRB and ASSINIBOINE

SSRB (60 x 26 - Grid size in degrees - 0.2 X 0.2)		ASSINIBOINE (20 x 15 - Grid size in degrees - 0.125 X 0.125)	
1	05AA023 - OLDMAN RIVER NEAR WALDRON'S CORNER	1	05MC001 - ASSINIBOINE RIVER AT STURGIS
2	05BB001 - BOW RIVER AT BANFF	2	05MB003 - WHITESAND RIVER NEAR CANORA
3	05CA009 - RED DEER RIVER BELOW BURNT TIMBER CREEK	3	05MD004 - ASSINIBOINE RIVER AT KAMSACK
4	05CC007 - MEDICINE RIVER NEAR ECKVILLE		
5	05AJ001 - SOUTH SASKATCHEWAN RIVER AT MEDICINE HAT		
6	05CB001 - LITTLE RED DEER RIVER NEAR THE MOUTH		
7	05BJ010 - ELBOW RIVER AT SARCEE BRIDGE		
8	05BL012 - SHEEP RIVER AT OKOTOKS		

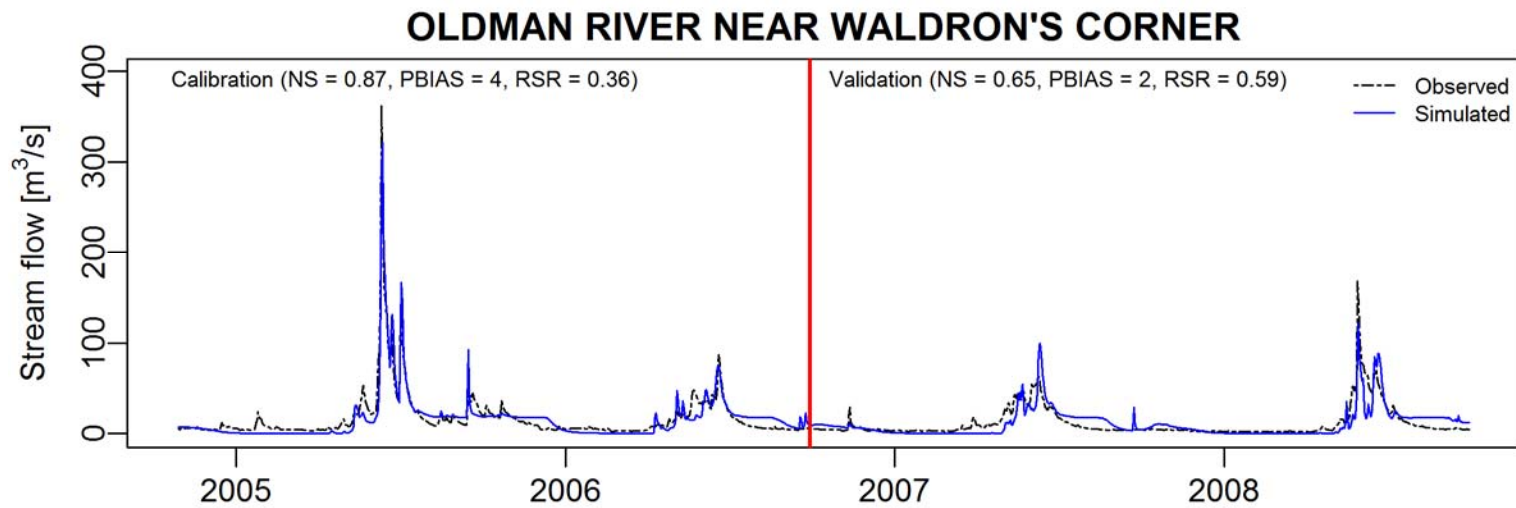


Stations in blue – Calibration and validation (time dimension)
 Stations in red – Validation in space dimension

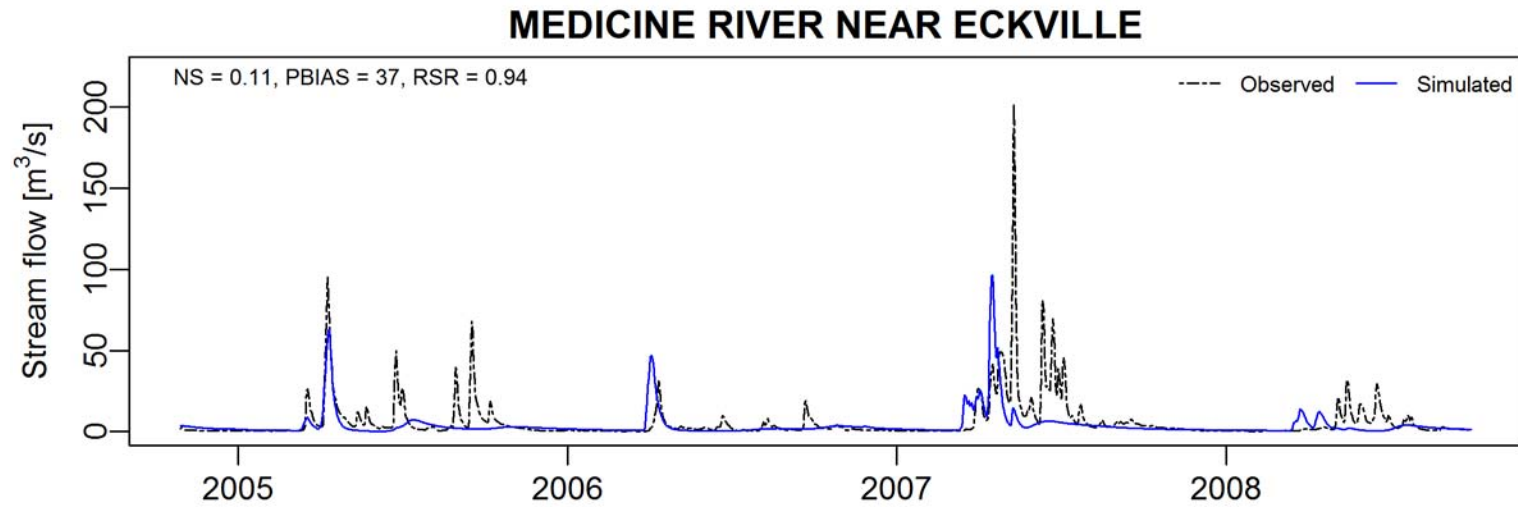
OUT-OF-THE-BOX



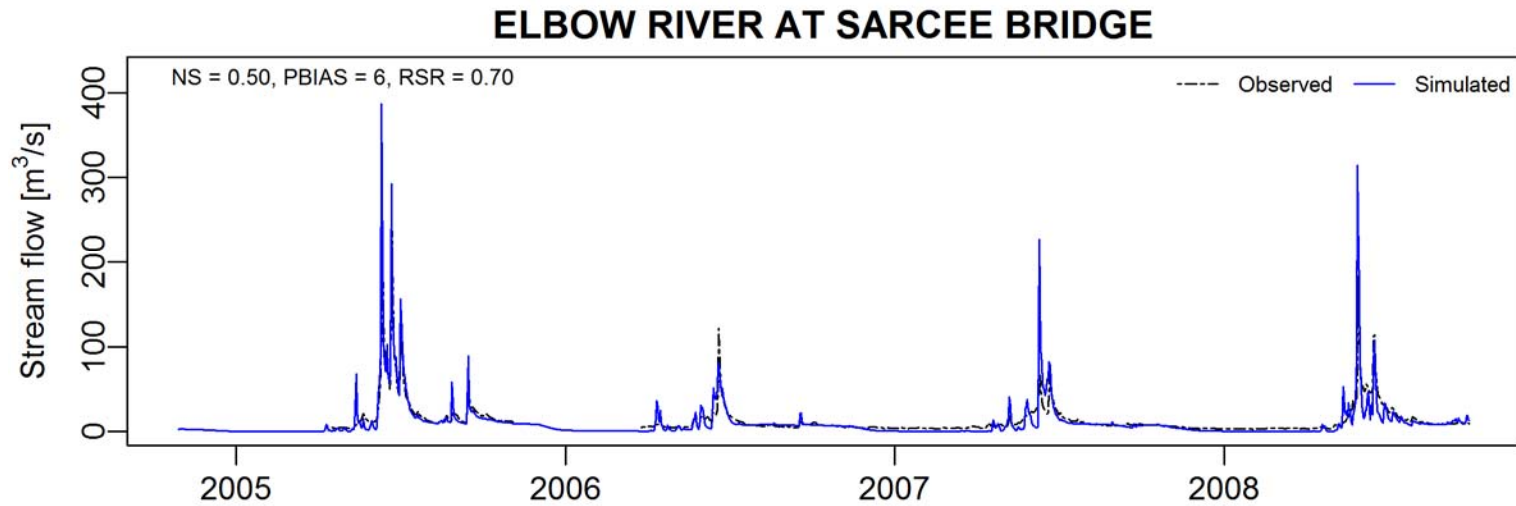
LATERAL FLOW PROCESSES INCLUDED



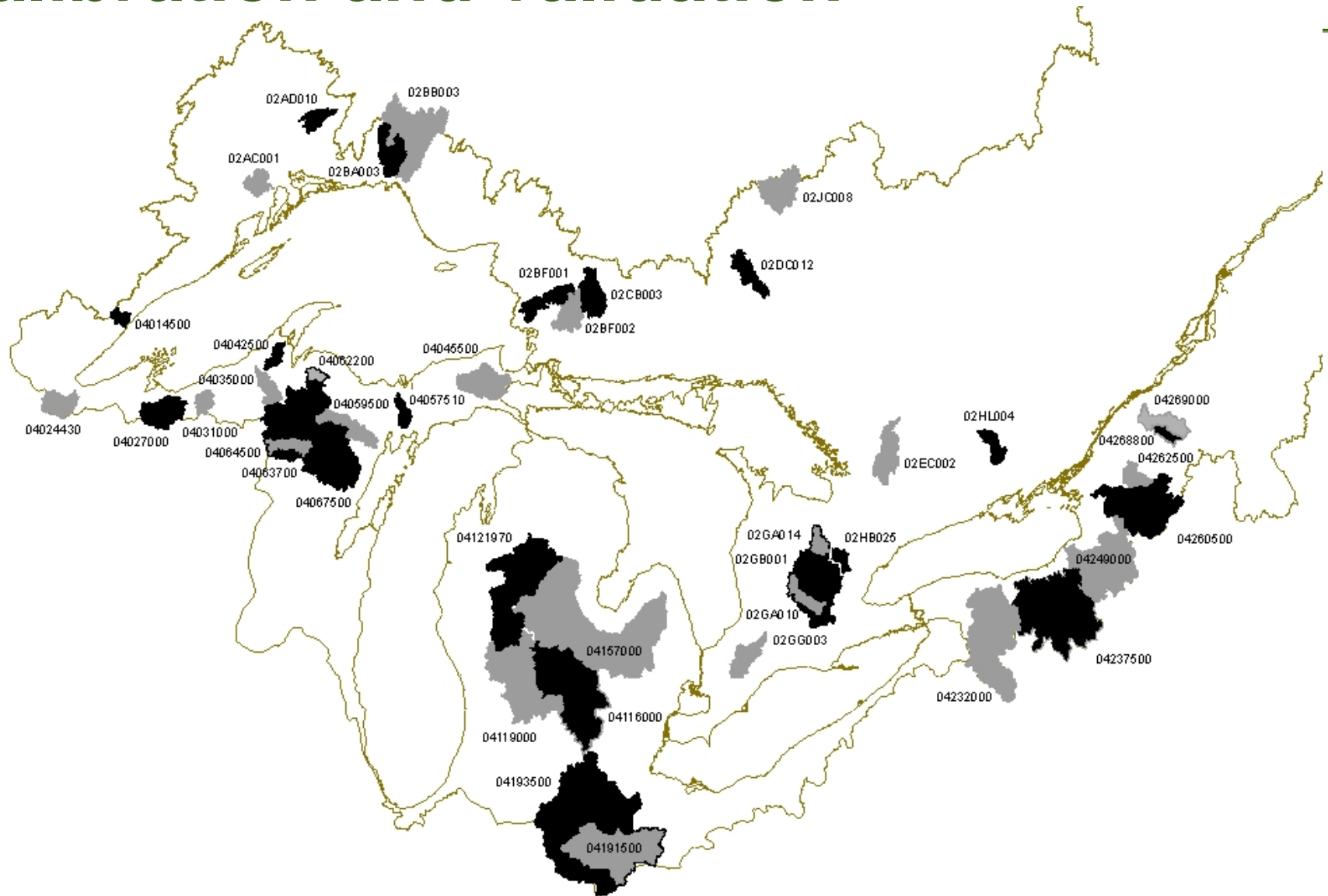
OUT-OF-THE-BOX



SPATIAL VALIDATION USING INDEPENDENT SUB-BASINS



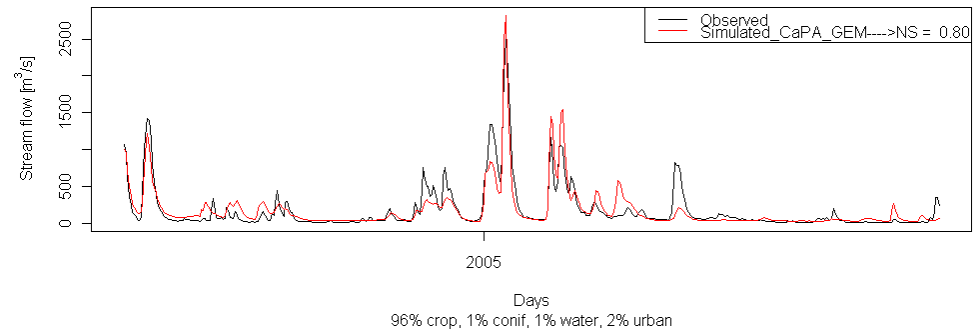
Potential Sub-basins for calibration and validation



Preliminary Great Lakes Results

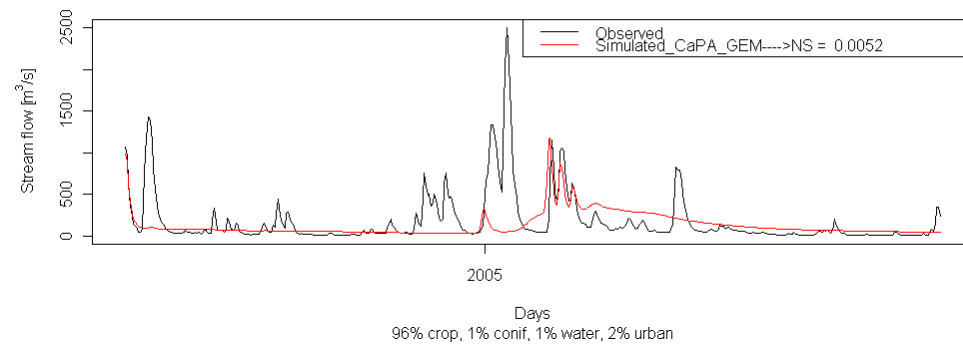
Standalone MESH
(sloped)

4193500: Maumee River at Waterville, OH (16,409 km²)



Standalone MESH
(flat)

4193500: Maumee River at Waterville, OH (16,409 km²)



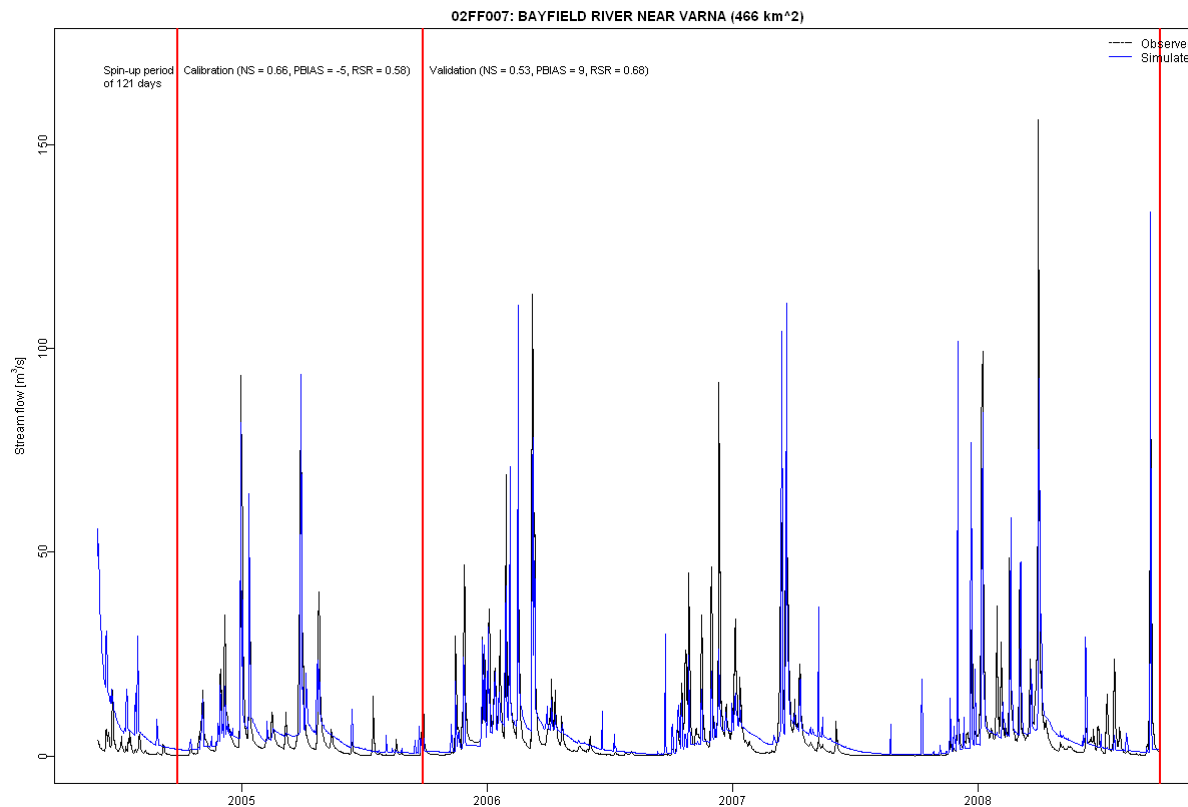
Preliminary Great Lakes Results

- MEC/MESH
- Manual Calibration
- Comparing ISBA and CLASS
- All other factors the same
- Map of sub-basins

Best CLASS runs vs. ISBA runs on the same basins

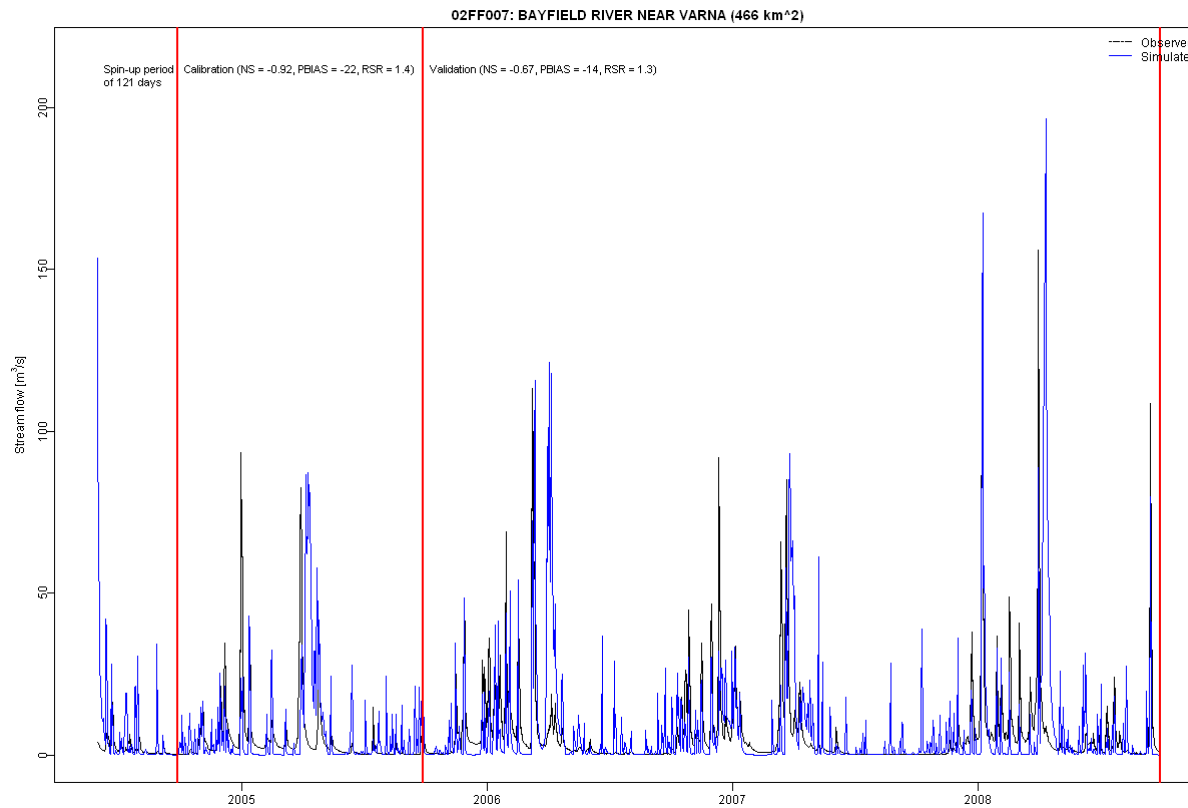
Preliminary Great Lakes Results

Best CLASS runs vs. ISBA runs on the same sub-basin



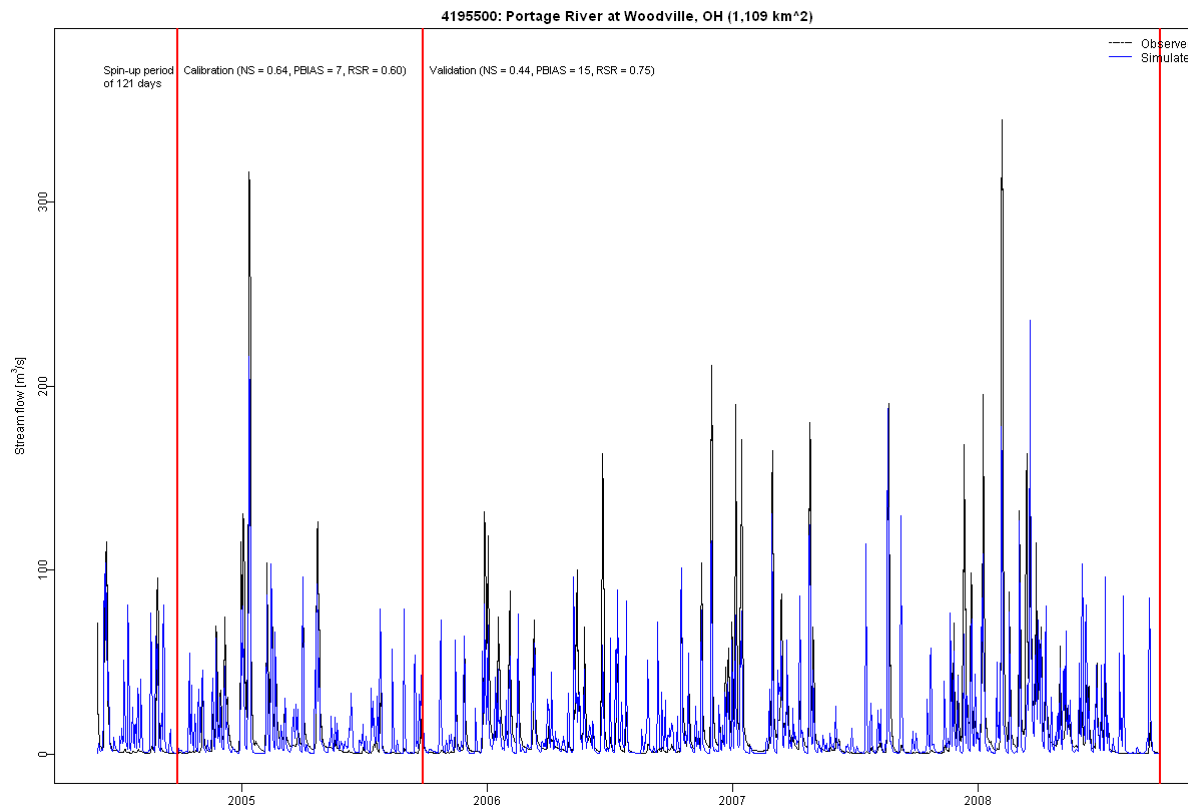
Preliminary Great Lakes Results

Best CLASS runs vs. ISBA runs on the same sub-basin



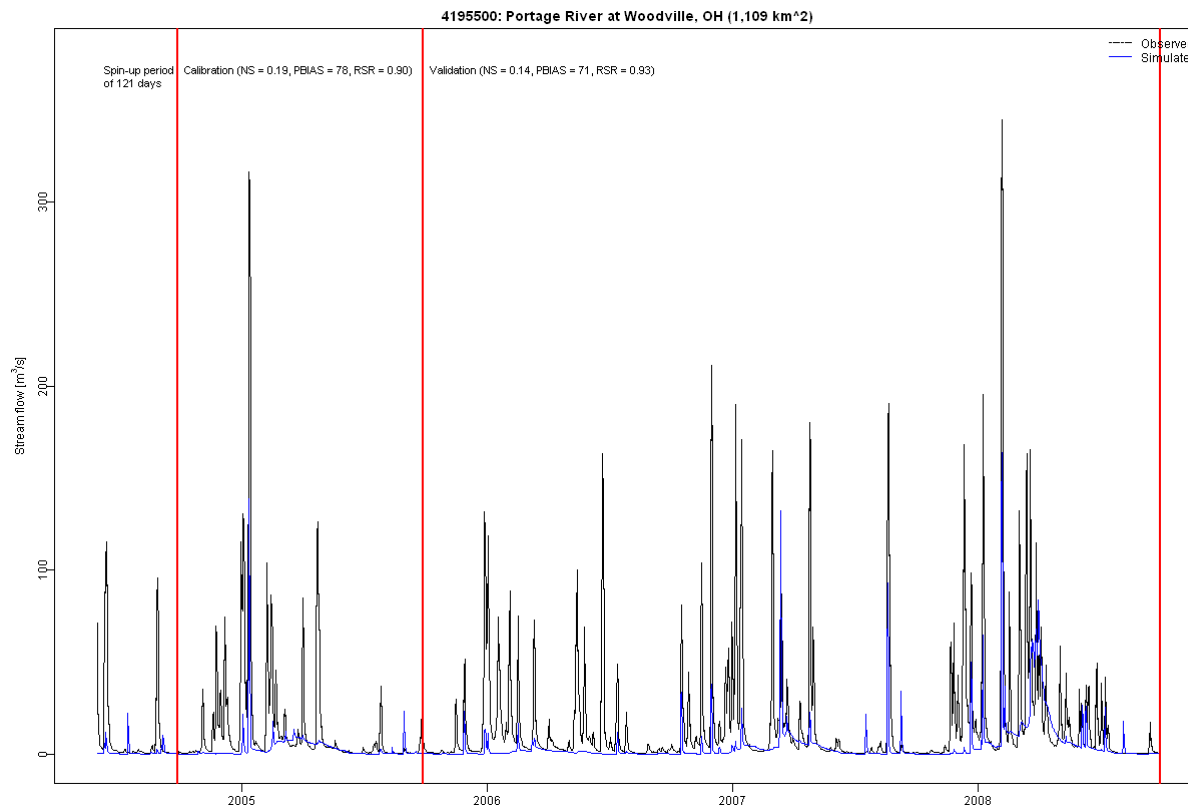
Preliminary Great Lakes Results

Best ISBA runs vs. CLASS runs on the same sub-basin

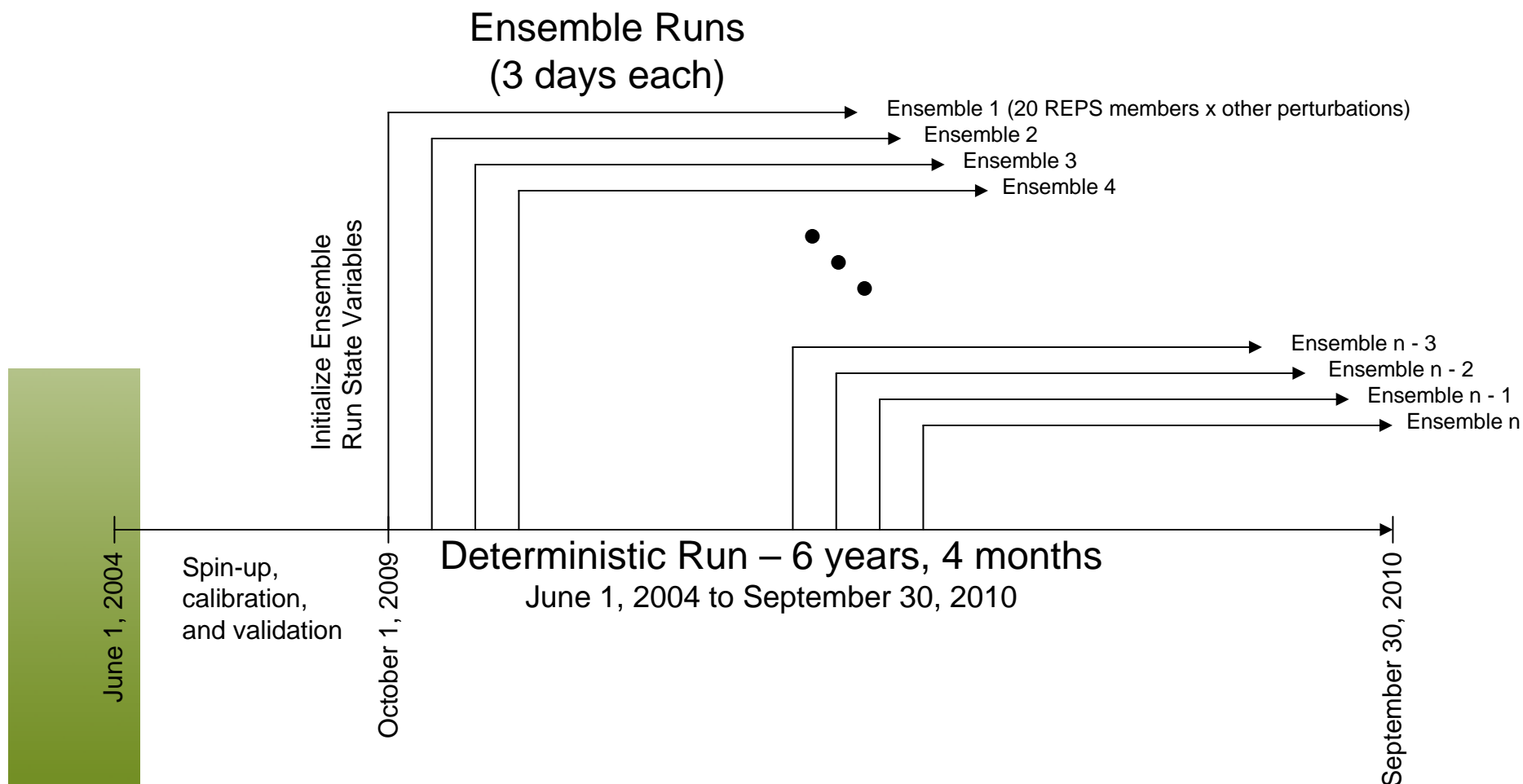


Preliminary Great Lakes Results

Best ISBA runs vs. CLASS runs on the same sub-basin



Model Run Plan – HEPS



Future Work

Enhanced H-EPS – Uncoupled from the Atmosphere

- Respectable model calibration
- CaPA for precipitation in the calibration run
(data assimilation of obs + climatological consistency of forcing fields)
- CLASS land surface scheme within MESH
- REPS forcing for H-EPS
- perturbation of surface initial conditions (soil moisture and temperature)
- perturbation of precipitation field using EnKF (Carrera et al., 2009)

Full Uncertainty H-EPS – Uncoupled from the Atmosphere

- Perturbations: Model forcing and initial conditions (as in previous step)
- Additional perturbations: Land surface schemes, physics and parameters

Full Uncertainty H-EPS – Coupled with the Atmosphere

- Hydrologic perturbations: models, initial conditions, physics and parameters
- Atmospheric perturbations: initial conditions, physics and parameters