Athabasca University
ATHABASCA RIVER BASIN
RESEARCH INSTITUTE

A TOOL TO PREPROCESS THE NATIONAL SOIL DATABASE OF CANADA FOR SWAT2012

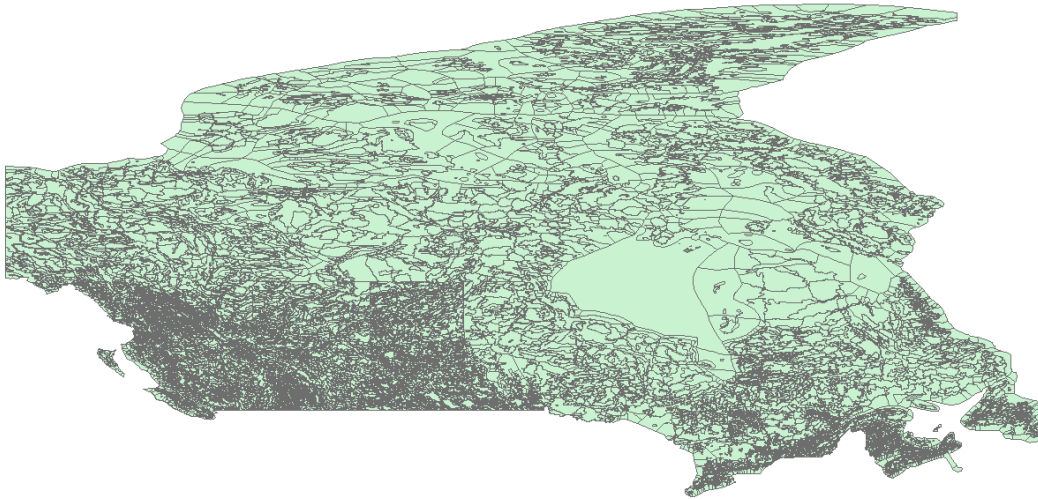Getnet Betrie, Baoqing Deng and Junye Wang

Presentation at 2015 SWAT Conference at Purdue University

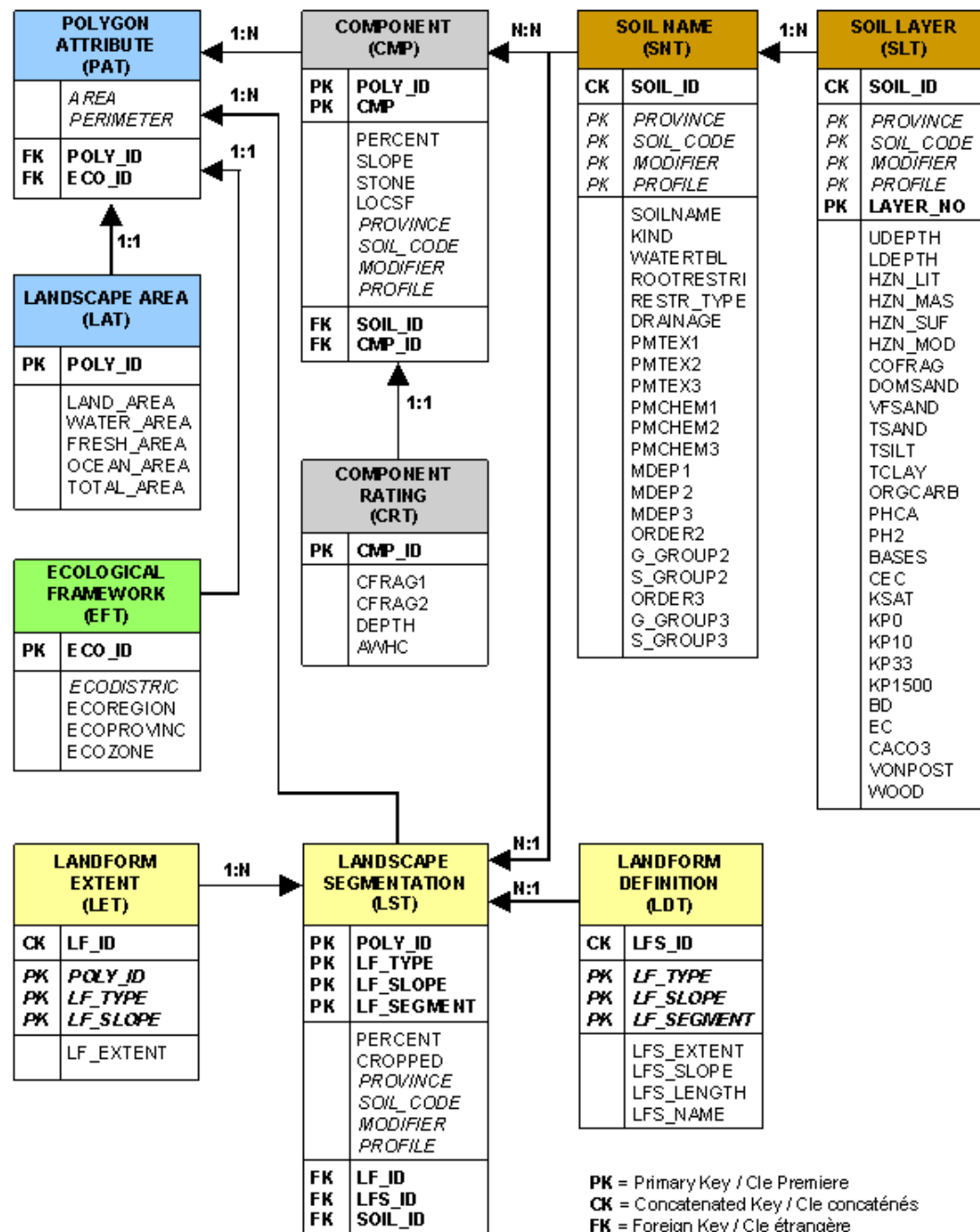October 14, 2015

Outline

- National soil database
- SWAT soil database
- Motivation and objective
- Tool development
- Case study

National Soil Database

- Covers the entire land mass of Canada
- 1:1 million scale

- Each polygon on the map represents a distinct soil type
- Contains major attributes for plant growth, land management and soil degradation

Source: Soil Landscapes of Canada Working Group (2010)

Description of the tables

- PAT: links geographic location of soils and their attributes in the associated tables
- CMP: links polygon and soil attributes in soil name table (SNT) and soil layer table (SLT)
- SNT: describe the general physical and chemical characteristics of soils in a polygon
- SLT: contains physical and chemical information vertically

SOIL LAYER (SLT)	
CK	SOIL_ID
PK	PROVINCE
PK	SOIL_CODE
PK	MODIFIER
PK	PROFILE
PK	LAYER_NO
	UDEPTH
	LDEPTH
	HZN_LIT
	HZN_MAS
	HZN_SUF
	HZN_MOD

Soil Database of SWAT

- SWAT distributed
  - Soil database (Swat_US_Soils.mdb)
  - Parameter database (SWAT2012.mdb)
- SWAT2012 contains usersoil table
- Contains component parameters and layer parameters

| Field Name	Definition
SNAME	Soil name
NLAYERS	Number of layers
SOL_ZMX	Max rooting depth
SOL_BD	Moist bulk density
SOL_AWC	Available water
SOL_CBN	Organic carbon content
CLAY	Clay content
SILT	Silt content
SAND	Sand content
ROCK	Rock content
USLE_K	Soil erodibility factor
SOL_EC	Electrical conductivity

Approaches to build usersoil
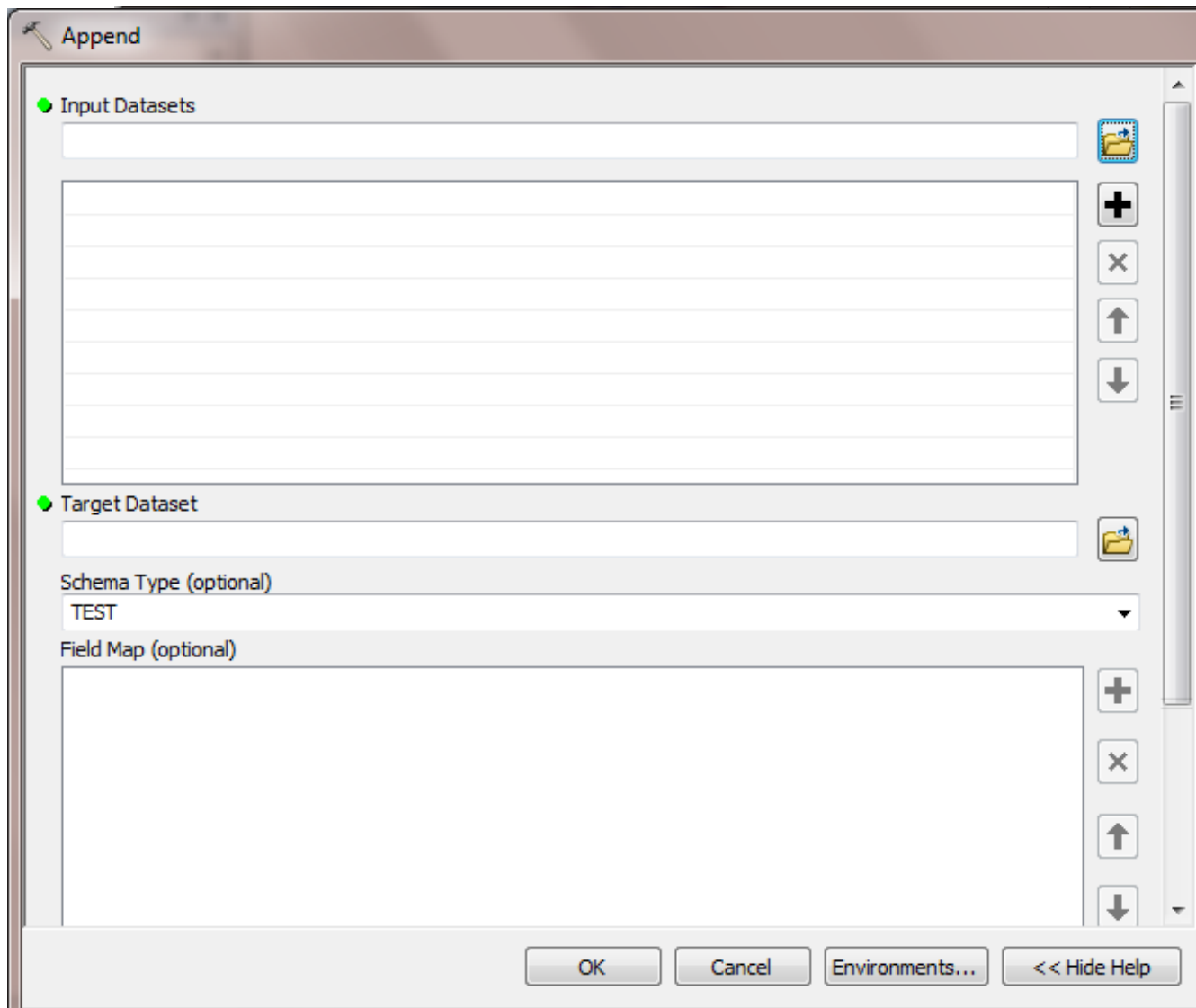
Motivation and objective

- Existing approaches:
  - Time intensive for large basins
  - Prone to errors
- Objective
  - To develop an ArcGIS tool that preprocesses the national soil database of Canada into usersoil database of SWAT

Algorithm
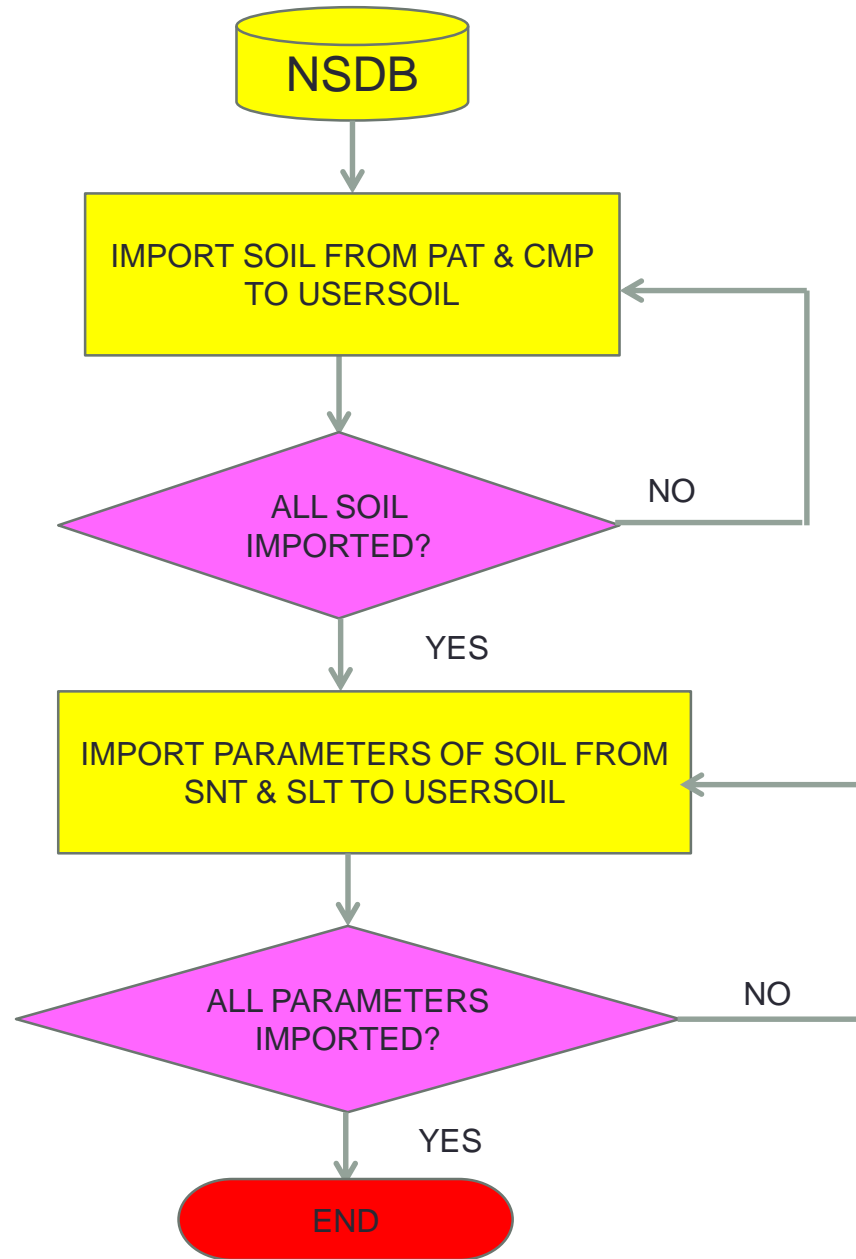
Tool development

- A Script written in Python language
- Arcpy and math modules used
- Cursor objects created to search, insert, and update tables

```
390         # create update cursor to write BD into usersoil
391    with arcpy.da.UpdateCursor("usersoil",("SNAM","SOL_BD1","SOL_BD2","SOL_BD3","SOL_BD4",
392                                            "SOL_BD5","SOL_BD6","SOL_BD7","SOL_BD8",
393                                            "SOL_BD9","SOL_BD10")) as cur_bd_updt:
394        # iterate through each soil in usersoil and write the soil BD (SOL_BDi)
395        for item in cur_bd_updt:
396            if item[0] == sol_nam[0]:
397                item[1] = bd_values.pop(0)
398                item[2] = bd_values.pop(0)
399                item[3] = bd_values.pop(0)
400                item[4] = bd_values.pop(0)
401                item[5] = bd_values.pop(0)
402                item[6] = bd_values.pop(0)
403                item[7] = bd_values.pop(0)
404                item[8] = bd_values.pop(0)
405                item[9] = bd_values.pop(0)
406                item[10] = bd_values.pop(0)
407                break
408        cur_bd_updt.updateRow(item)
```

Tool development

- The custom tool in ArcGIS 10.2 used to create a graphical user interface
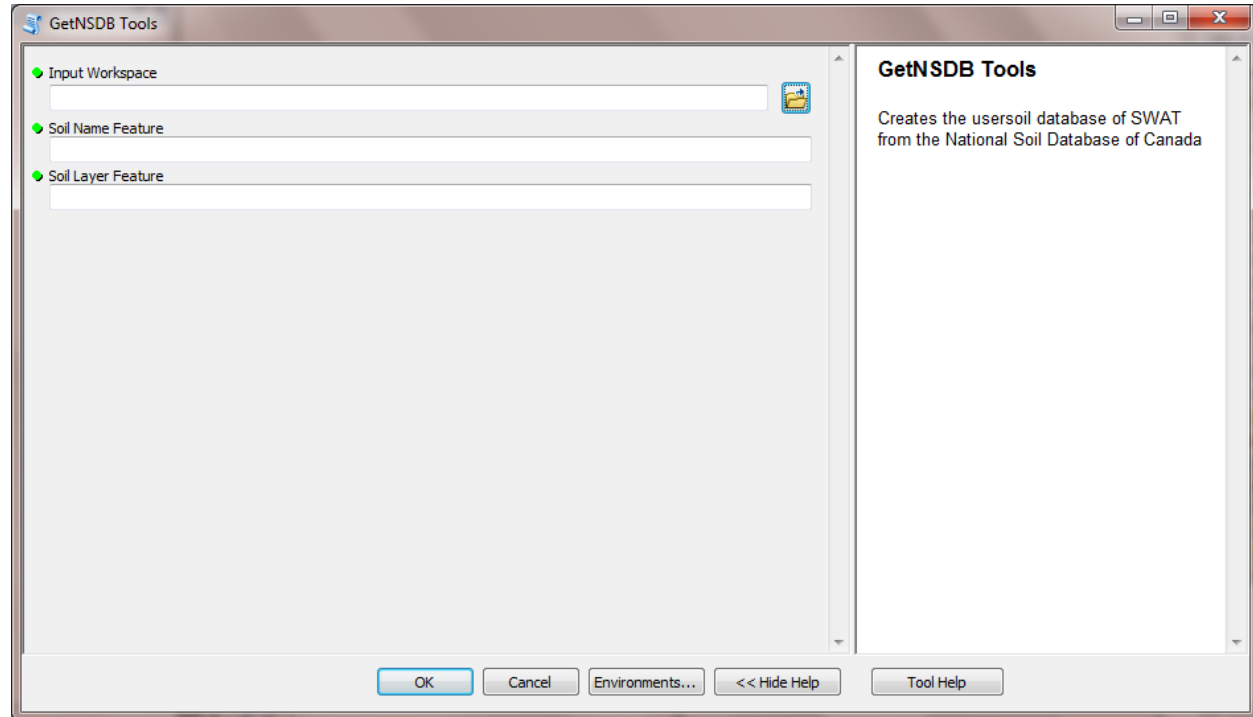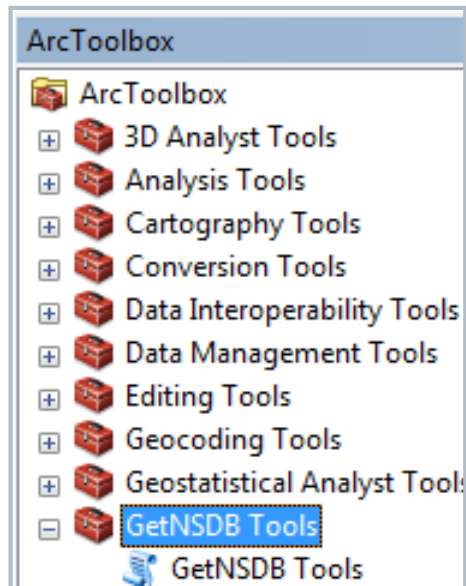
Case study

- The river begins from the Columbia Glacier and drains into Lake Athabasca
- Covers 138,000 km^2
- Landuse:
  - glacier
  - Agriculture
  - Forest
  - Wetlands
  - Urban centers
- The basin has 9 subasins
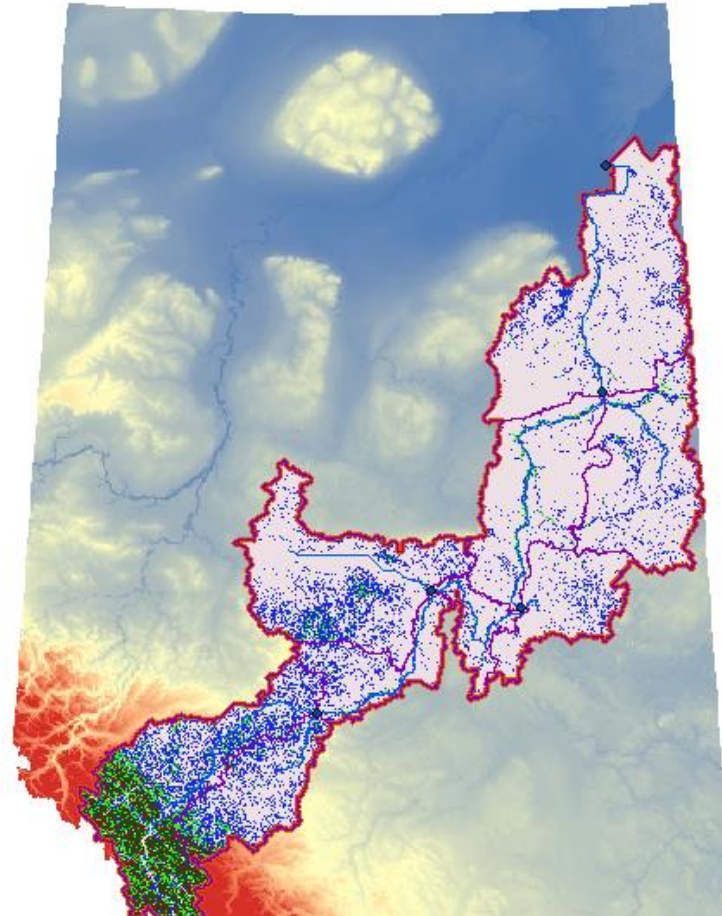
How to use the tool?

- Place NSDB, script and tool in one folder
- Load the tool into arctool box

How to use the tool

• Provide the input parameters

How to use the tool

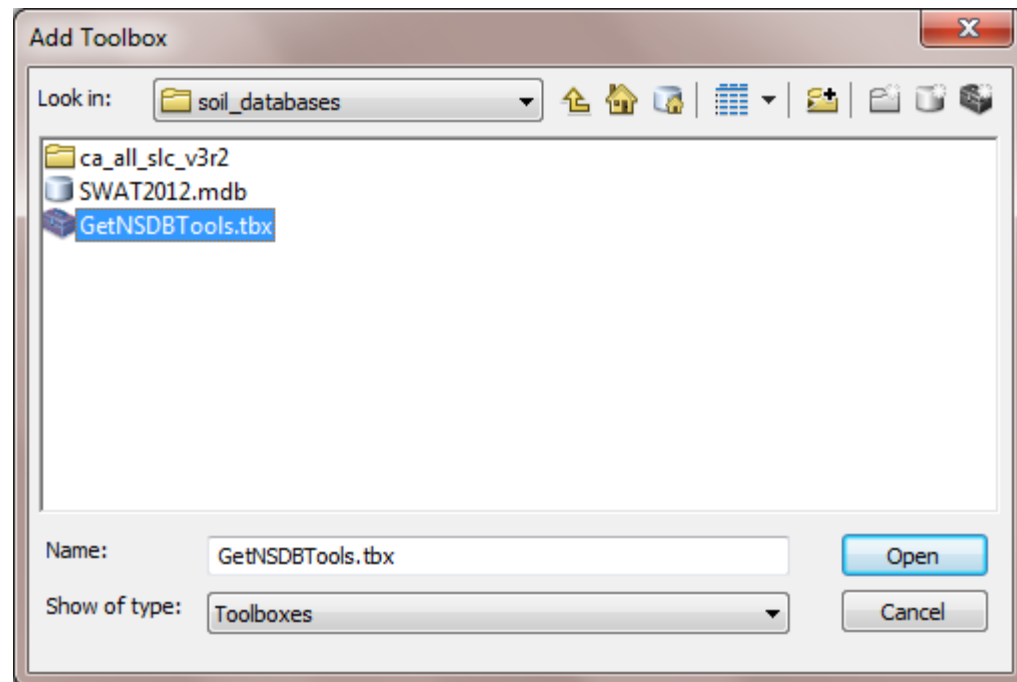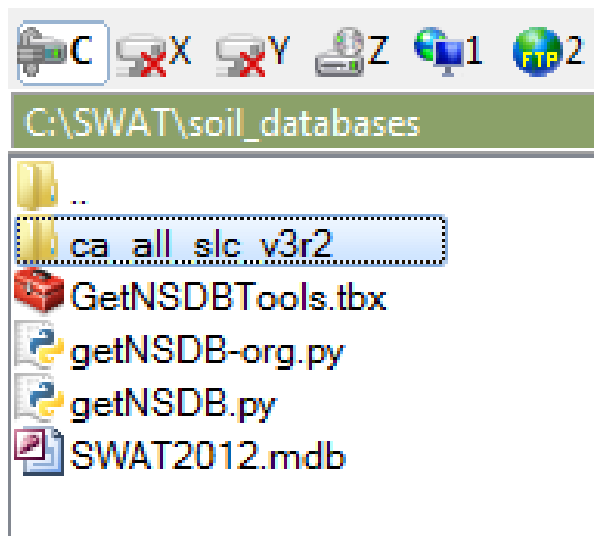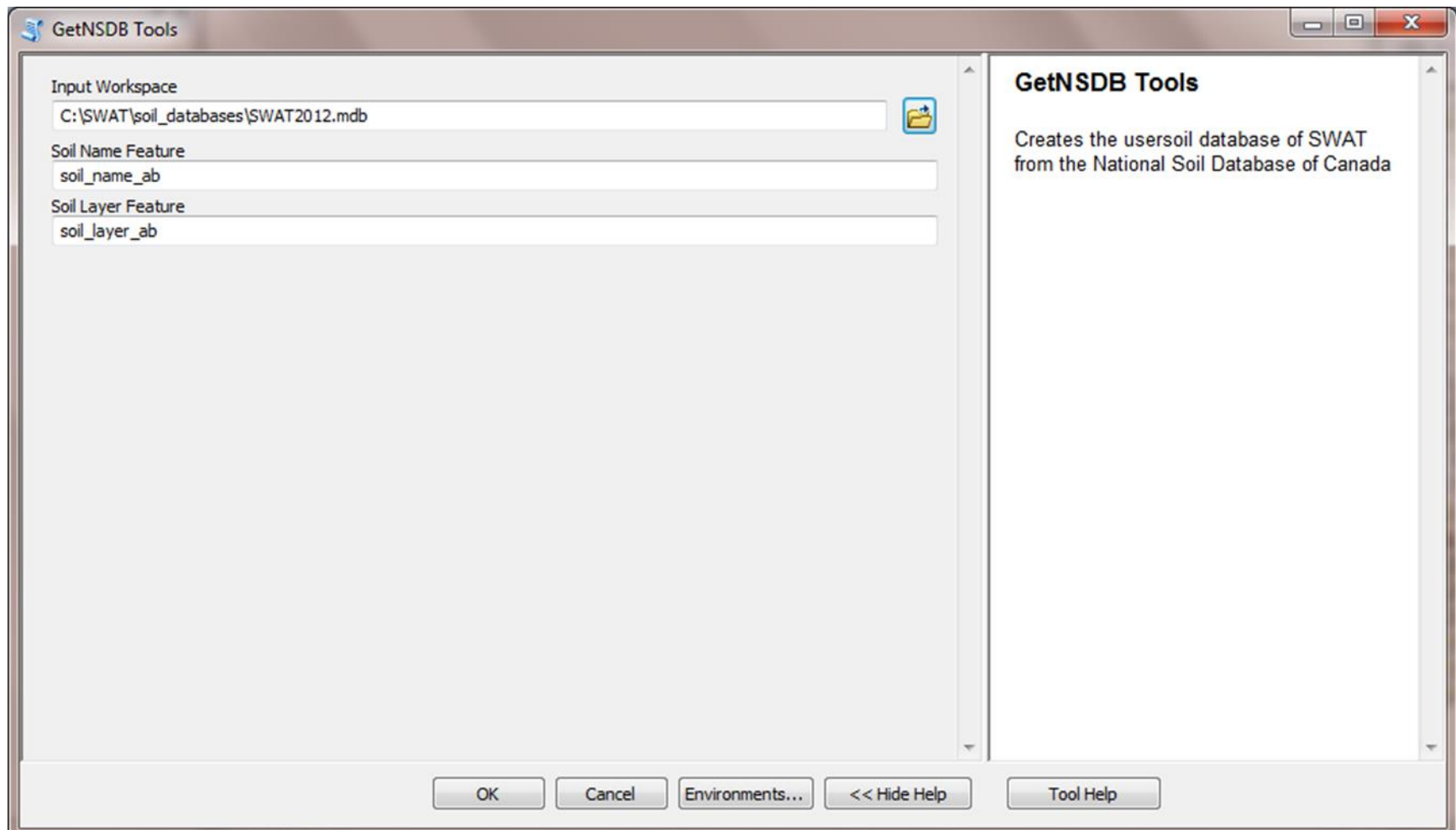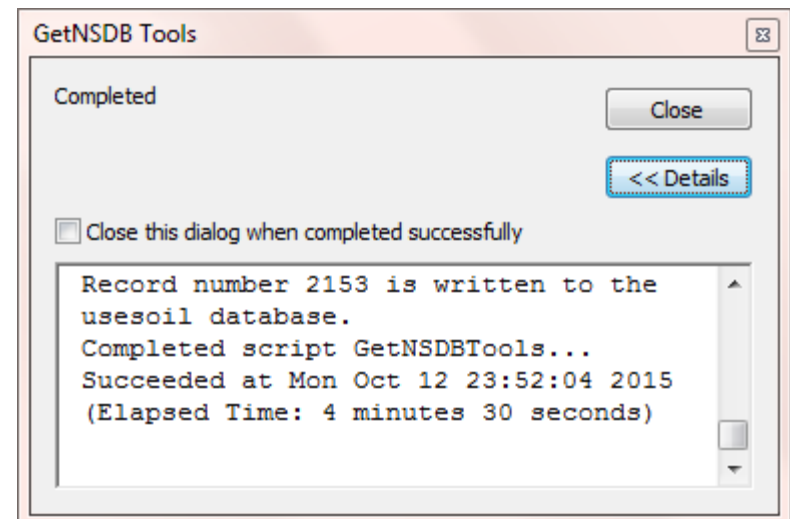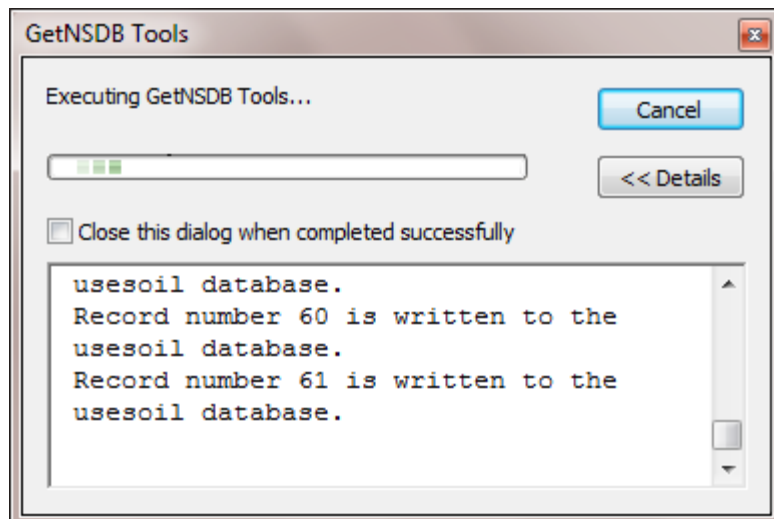| MUID *	SEQN	SNAM	S5ID *	CMPPCT	NLAYERS	HYDGRP	SOL_ZMX	ANION_EXCL	SOL_CRK	TEXTURE	SOL_Z1	SOL_BD1	SOL_AWC1	SOL_K1	SOL_CBN1
ABBER~~~~~N	1	BERLAND	AB	100	5	B	2250	0.5	0.5	VFS-LVFS-CSL-SL-FSL-GSL-CBSL-GFSL	0	0.1	20	300	40
ABBEVzz~~~A	1	BELLEVUE	AB	100	6	B	2510	0.5	0.5	VFSL-L-SIL-SI-GL-GSIL	150	1.25	11	100	2.5
ABBEVzz~~~N	1	BELLEVUE	AB	100	6	B	2470	0.5	0.5	VFSL-L-SIL-SI-GL-GSIL	110	1.15	11	100	3.3
ABBEV~~~~~A	1	BELLEVUE	AB	100	6	B	2510	0.5	0.5	VFSL-L-SIL-SI-GL-GSIL	150	1.25	10	100	2.5
ABBEV~~~~~N	1	BELLEVUE	AB	100	6	B	2470	0.5	0.5	VFSL-L-SIL-SI-GL-GSIL	110	1.15	9	300	3.3
ABBEZ~~~~~A	1	BEZANSON	AB	100	7	C	3150	0.5	0.5	SC-SIC-C-GSIC	130	1.25	15	100	3.7
ABADY~~~~~N	1	ACADEMY	AB	100	4	B	2680	0.5	0.5	SCL-FSCL-VFSCL-CL-SICL-GSCL-GL-CBCL	150	1	14	100	6.2
ABAGH~~~~~A	1	ALBRIGHT	AB	100	7	C	3150	0.5	0.5	SC-SIC-C-GSIC	130	1.25	15	100	3.7
ABAGH~~~~~N	1	ALBRIGHT	AB	100	8	C	3130	0.5	0.5	SC-SIC-C-GSIC	0	0.1	20	300	40
ABAGSer~~~A	1	ANGUS RIDGE	AB	100	5	B	2920	0.5	0.5	SCL-FSCL-VFSCL-CL-SICL-GSCL-GL-CBCL	100	1.25	13	100	3
ABAGSsa~~~A	1	ANGUS RIDGE	AB	100	5	C	1100	0.5	0.5	SCL-FSCL-VFSCL-CL-SICL-GSCL-GL-CBCL	170	1.25	13	100	4
ABAGSsc~~~A	1	ANGUS RIDGE	AB	100	5	B	1100	0.5	0.5	SCL-FSCL-VFSCL-CL-SICL-GSCL-GL-CBCL	170	1.25	13	100	4
ABAGSst~~~A	1	ANGUS RIDGE	AB	100	5	B	3300	0.5	0.5	SCL-FSCL-VFSCL-CL-SICL-GSCL-GL-CBCL	170	1.25	13	100	4
ABAGS~~~~~A	1	ANGUS RIDGE	AB	100	5	B	3300	0.5	0.5	SCL-FSCL-VFSCL-CL-SICL-GSCL-GL-CBCL	170	1.25	13	100	4
ABAGS~~~~~N	1	ANGUS RIDGE	AB	100	5	B	3300	0.5	0.5	SCL-FSCL-VFSCL-CL-SICL-GSCL-GL-CBCL	170	1.15	12	300	5.2
ABALCaaxp~A	1	ALCAN	AB	100	6	C	5640	0.5	0.5	SC-SIC-C-GSIC	140	1.15	13	100	1.5
ABALCco~~~A	1	ALCAN	AB	100	6	C	5640	0.5	0.5	SCL-FSCL-VFSCL-CL-SICL-GSCL-GL-CBCL	140	1.15	13	100	1.5
ABALC~~~~~N	1	ALCAN	AB	100	8	C	5720	0.5	0.5	SC-SIC-C-GSIC	0	0.1	20	300	34.6
ABALGxt~~~N	1	ALGAR LAKE	AB	100	7	D	3270	0.5	0.5	SC-SIC-C-GSIC	0	0.12	20	30	40
ABALG~~~~~N	1	ALGAR LAKE	AB	100	6	D	2520	0.5	0.5	SC-SIC-C-GSIC	0	0.12	20	30	40
ABALTsc~~~N	1	ALTARIO	AB	100	5	B	990	0.5	0.5	VFSL-L-SIL-SI-GL-GSIL	80	1.15	10	300	2.5
ABALT~~~~~A	1	ALTARIO	AB	100	5	B	3250	0.5	0.5	VFSL-L-SIL-SI-GL-GSIL	180	1.25	12	100	1.9
ABALT~~~~~N	1	ALTARIO	AB	100	5	B	3150	0.5	0.5	VFSL-L-SIL-SI-GL-GSIL	80	1.15	10	300	2.5
ABALX~~~~~N	1	ALTRUDE	AB	100	6	B	1950	0.5	0.5	FS-LCS-LS-LFS-GLS-CBLS	0	0.1	20	300	45.3
ABAMK~~~~~N	1	AMISK	AB	100	6	A	3670	0.5	0.5	VCS-CS-S-GS-CBS	0	0.1	20	300	30
ABAMT~~~~~N	1	AMITY	AB	100	5	B	2800	0.5	0.5	VFSL-L-SIL-SI-GL-GSIL	100	1.1	14	300	4.6
ABANOer~~~A	1	ANTONIO	AB	100	3	B	1580	0.5	0.5	VFS-LVFS-CSL-SL-FSL-GSL-CBSL-GFSL	150	1.4	8	100	0.6
ABANOgl~~~A	1	ANTONIO	AB	100	4	C	2030	0.5	0.5	VFS-LVFS-CSL-SL-FSL-GSL-CBSL-GFSL	120	1.35	10	100	1.5
ABANOst~~~A	1	ANTONIO	AB	100	4	B	2030	0.5	0.5	VFS-LVFS-CSL-SL-FSL-GSL-CBSL-GFSL	120	1.35	9	100	1.2
ABANO~~~~~A	1	ANTONIO	AB	100	4	B	2030	0.5	0.5	VFS-LVFS-CSL-SL-FSL-GSL-CBSL-GFSL	120	1.35	9	100	1.2
ABANO~~~~~N	1	ANTONIO	AB	100	5	B	2100	0.5	0.5	VFS-LVFS-CSL-SL-FSL-GSL-CBSL-GFSL	30	1.2	10	300	1.6
ABANR~~~~~A	1	ANTROSE	AB	100	6	C	3610	0.5	0.5	SCL-FSCL-VFSCL-CL-SICL-GSCL-GL-CBCL	180	1.15	14	100	3.7
ABANR~~~~~N	1	ANTROSE	AB	100	7	C	3560	0.5	0.5	SCL-FSCL-VFSCL-CL-SICL-GSCL-GL-CBCL	0	0.1	20	300	30
ABANZ~~~~~N	1	ANZAC	AB	100	4	D	1550	0.5	0.5	SCL-FSCL-VFSCL-CL-SICL-GSCL-GL-CBCL	0	0.12	20	30	40
ABARE~~~~~A	1	ARDENODE	AB	100	5	B	3150	0.5	0.5	VCS-CS-S-GS-CBS	150	1.4	6	300	1.6
ABARE~~~~~N	1	ARDENODE	AB	100	5	B	3150	0.5	0.5	VCS-CS-S-GS-CBS	150	1.3	6	600	2.1
ABARM~~~~~A	1	ARMENA	AB	100	6	C	840	0.5	0.5	VFSL-L-SIL-SI-GL-GSIL	180	1.15	14	100	3.5
ABARM~~~~~N	1	ARMENA	AB	100	5	C	660	0.5	0.5	VFSL-L-SIL-SI-GL-GSIL	300	1.1	13	300	4.6
ABARV~~~~~N	1	AMBER VALLEY	AB	100	4	D	1350	0.5	0.5	SCL-FSCL-VFSCL-CL-SICL-GSCL-GL-CBCL	0	0.12	20	30	40
ABASLaast~N	1	ANSELL	AB	100	7	B	2500	0.5	0.5	SCL-FSCL-VFSCL-CL-SICL-GSCL-GL-CBCL	0	0.1	20	300	40
ABASLaaxp~N	1	ANSELL	AB	100	8	B	3300	0.5	0.5	SCL-FSCL-VFSCL-CL-SICL-GSCL-GL-CBCL	0	0.1	20	300	40
ABASLaa~~~N	1	ANSELL	AB	100	7	B	2500	0.5	0.5	SCL-FSCL-VFSCL-CL-SICL-GSCL-GL-CBCL	0	0.1	20	300	40
ABASLst~~~N	1	ANSELL	AB	100	7	B	2500	0.5	0.5	SCL-FSCL-VFSCL-CL-SICL-GSCL-GL-CBCL	0	0.1	20	300	40
ABASLxp~~~N	1	ANSELL	AB	100	8	B	3300	0.5	0.5	SCL-FSCL-VFSCL-CL-SICL-GSCL-GL-CBCL	0	0.1	20	300	40
ABASL~~~~~N	1	ANSELL	AB	100	7	B	2500	0.5	0.5	SCL-FSCL-VFSCL-CL-SICL-GSCL-GL-CBCL	0	0.1	20	300	40
ABASPaa~~~N	1	ASPLUND CREEK	AB	100	9	C	1840	0.5	0.5	SC-SIC-C-GSIC	0	0.1	20	300	25
ABASPxt~~~N	1	ASPLUND CREEK	AB	100	9	C	1840	0.5	0.5	SC-SIC-C-GSIC	0	0.1	20	300	25
ABASP~~~~~N	1	ASPLUND CREEK	AB	100	9	C	1840	0.5	0.5	SC-SIC-C-GSIC	0	0.1	20	300	25
ABAST~~~~~N	1	ASPHALT	AB	100	2	D	1200	0.5	0.5		0	0.06	15	600	32.2
ABATLcr~~~N	1	ANTLER	AB	100	4	B	2550	0.5	0.5	SCL-FSCL-VFSCL-CL-SICL-GSCL-GL-CBCL	200	1.15	14	100	5.2
ABATLgl~~~N	1	ANTLER	AB	100	4	C	2550	0.5	0.5	SCL-FSCL-VFSCL-CL-SICL-GSCL-GL-CBCL	200	1.15	15	100	7.8
ABATLst~~~A	1	ANTLER	AB	100	4	B	2550	0.5	0.5	SCL-FSCL-VFSCL-CL-SICL-GSCL-GL-CBCL	200	1.25	15	100	4
ABATLxp~~~N	1	ANTLER	AB	100	5	B	2150	0.5	0.5	SCL-FSCL-VFSCL-CL-SICL-GSCL-GL-CBCL	150	1	14	300	6.2
ABATLzr~~~N	1	ANTLER	AB	100	4	B	2100	0.5	0.5	SCL-FSCL-VFSCL-CL-SICL-GSCL-GL-CBCL	200	1.15	14	100	3.9

Simulation results
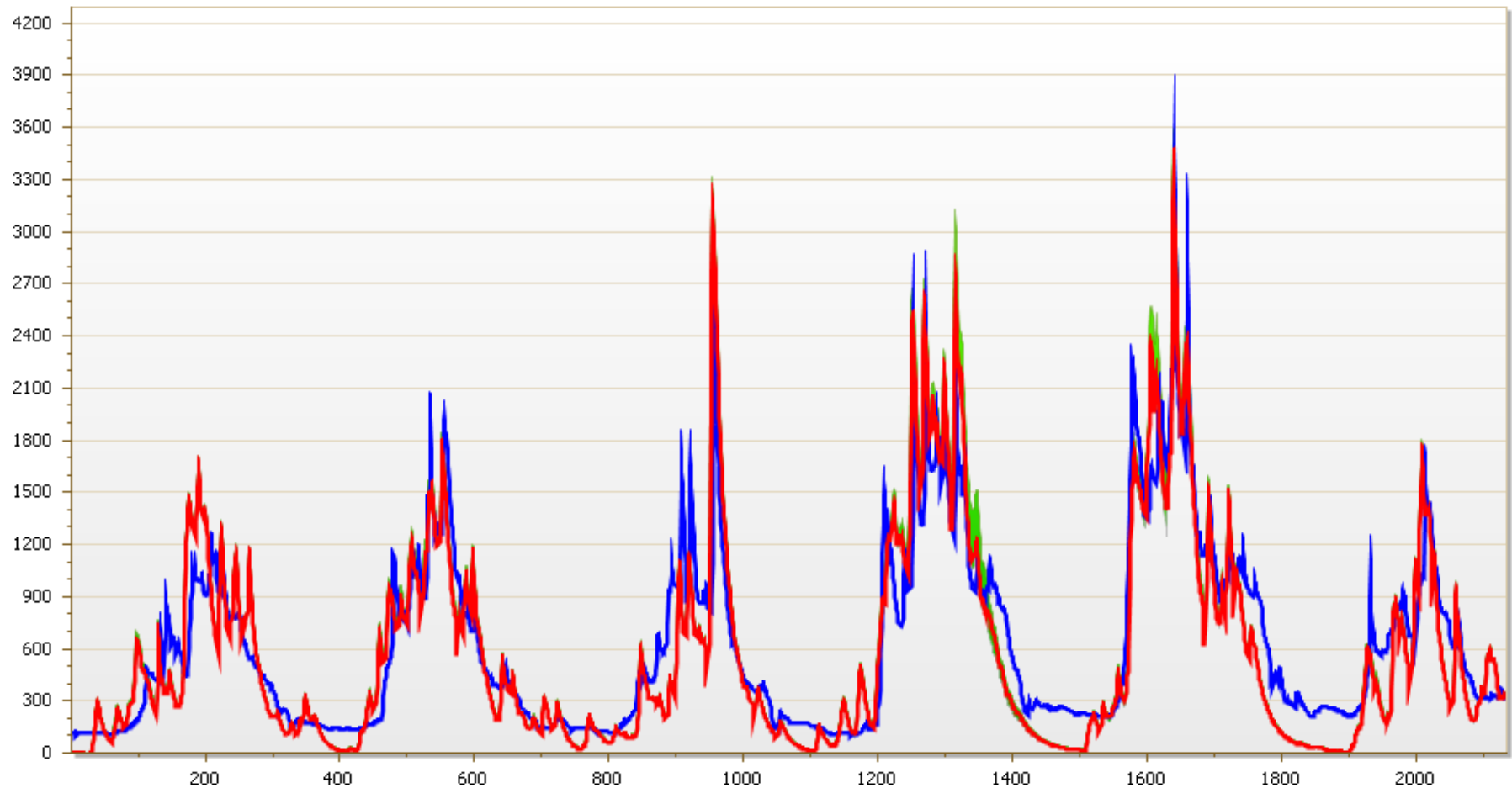
THANK YOU!

Questions/comments:
gbetrie@athabascau.ca and
junyew@athabascau.ca