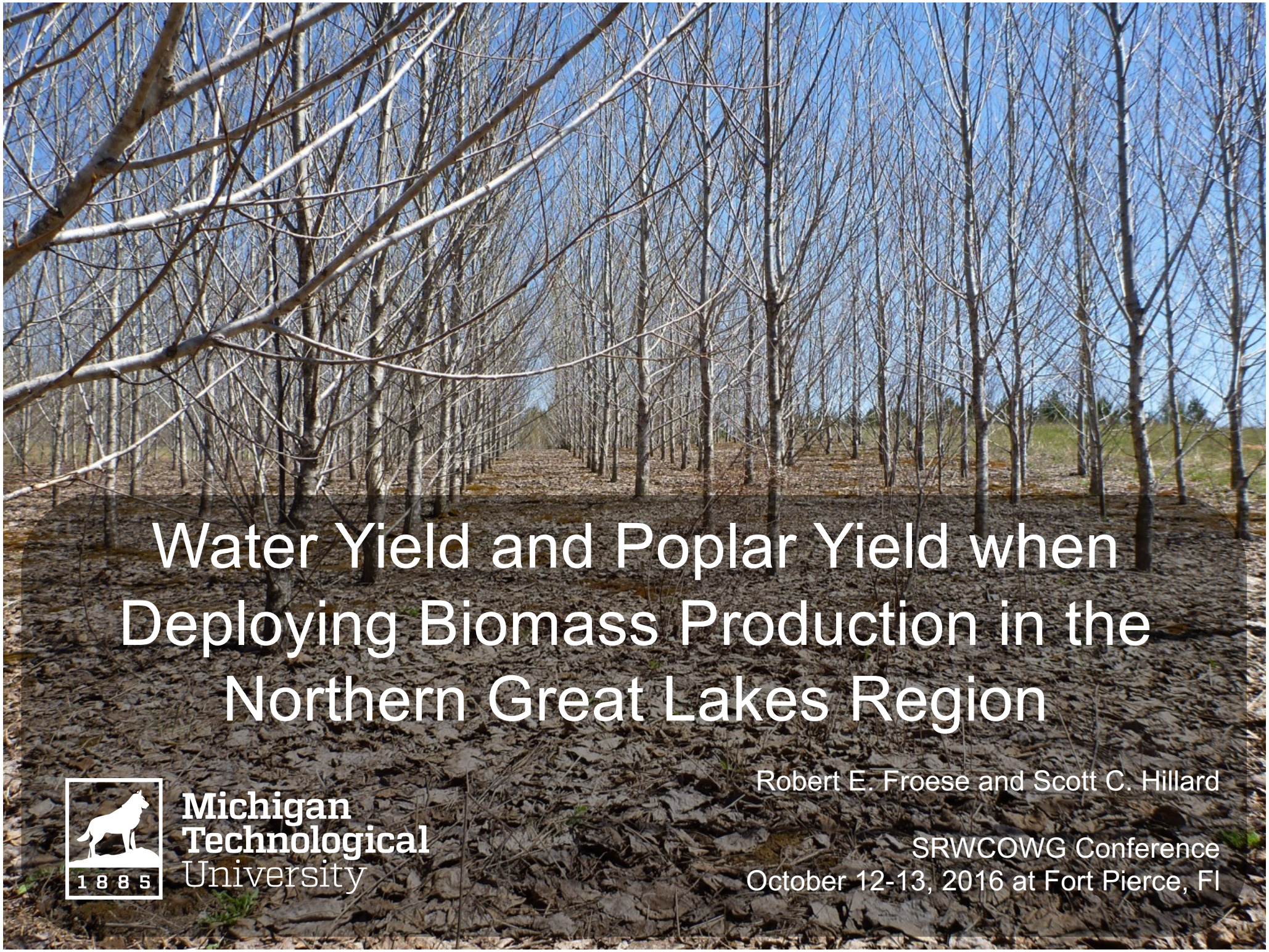

Water Yield and Poplar Yield when Deploying Biomass Production in the Northern Great Lakes Region

Robert E. Froese and Scott C. Hillard

Michigan Technological University

SRWCOWG Conference
October 12-13, 2016 at Fort Pierce, Fl

Poplar Network 2008 - present

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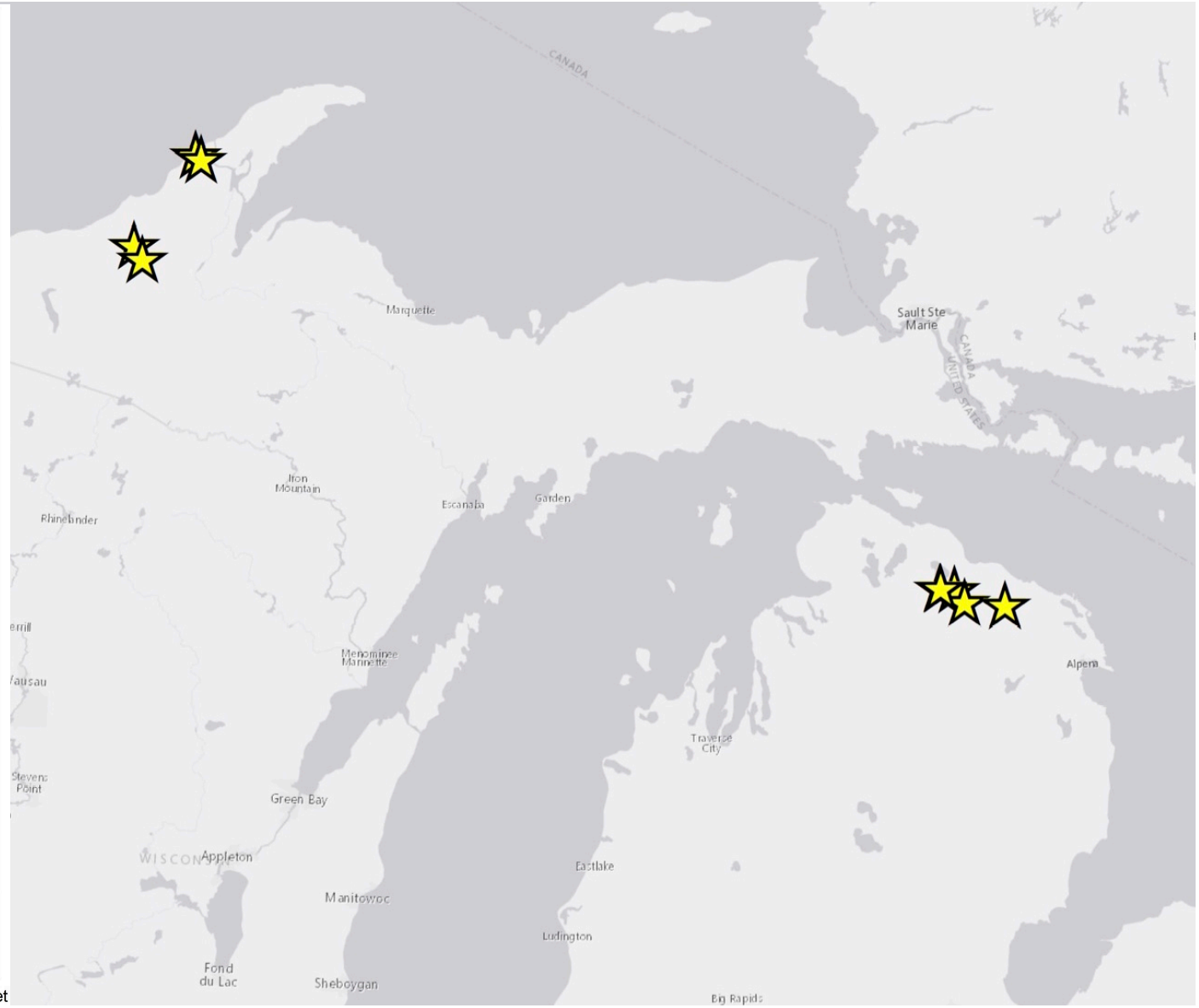
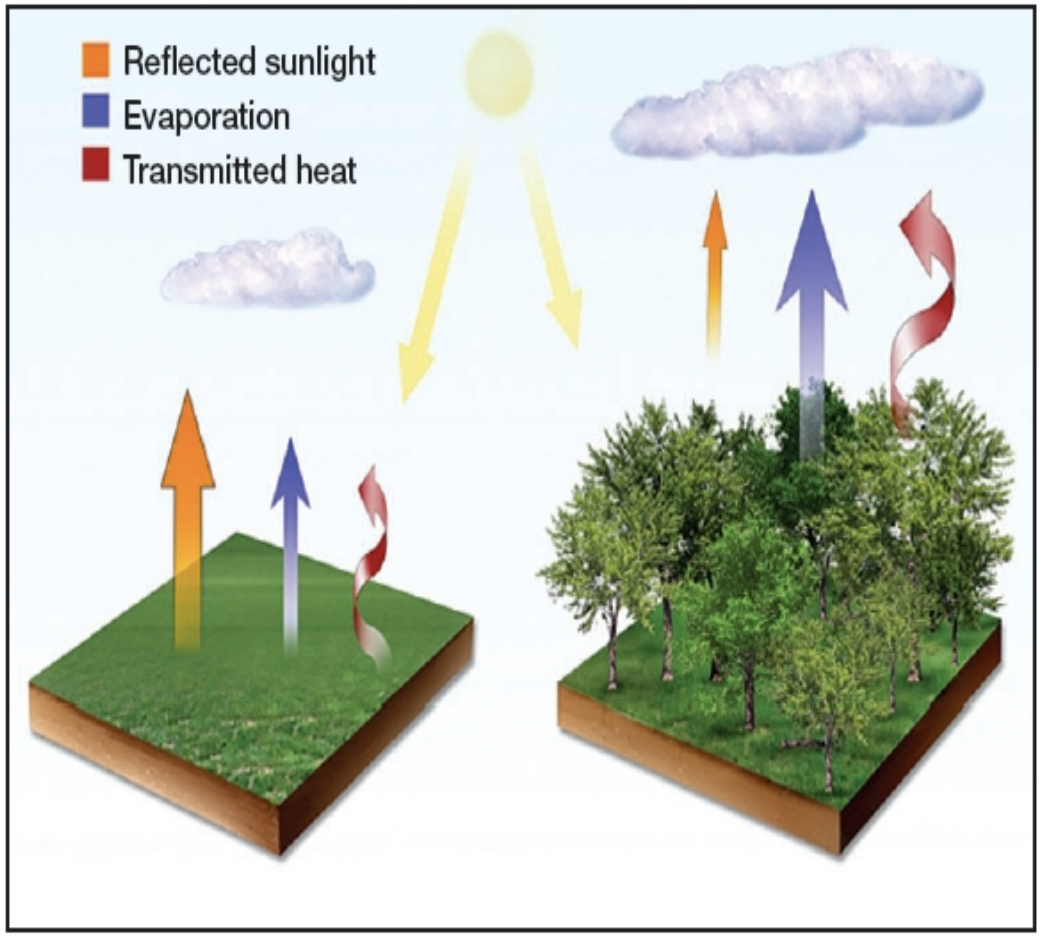


We know afforestation increases evapotranspiration



Papers frequently highlight the high water use of hybrid poplar at the stand level (Hinckley *et al* 1994. Zhang *et al.* 1999, Busch 2009, Jassal *et al.* 2013)

Many authors project disruptions to water resources if deployed on a large scale (Jackson *et al.* 2005, Wilske *et al.* 2009, Dimitriou 2009, Jassal *et al*. 2013, Watkins *et al.* 2014, Folch and Ferrer 2015)

We must get feedstock from *somewhere*.

This study had two goals

1. Come up with a credible estimate of the potential landbase in Michigan that does not compete with food or forest

2. Assess conversion scenarios on water quantity in selected watersheds that span the State

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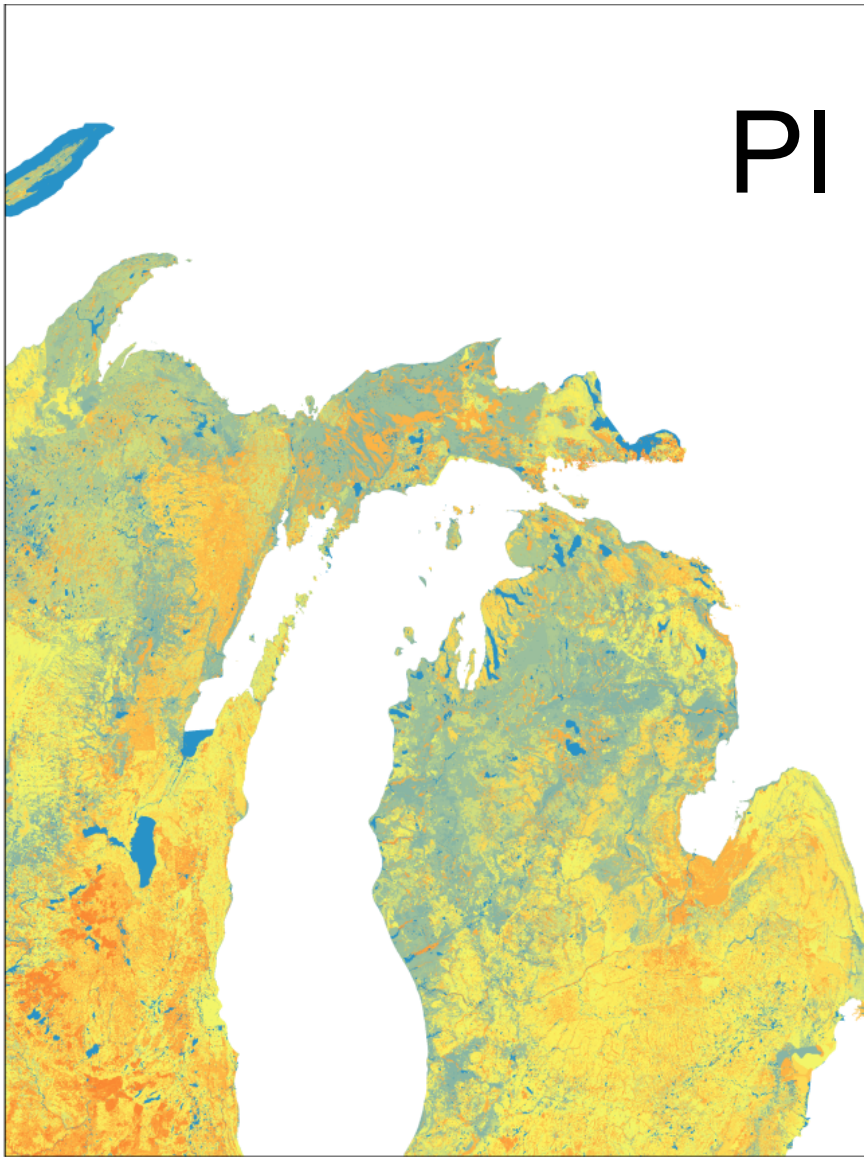
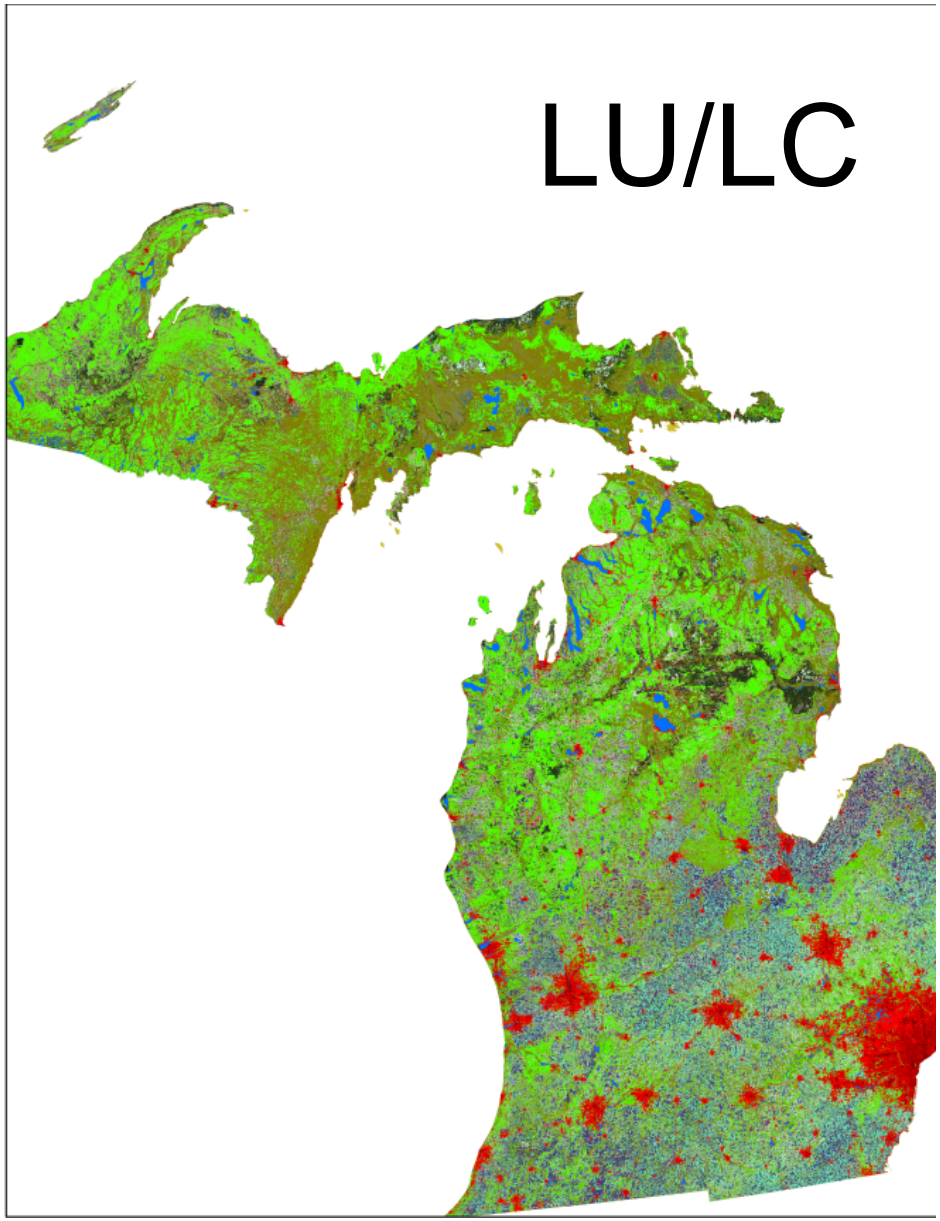
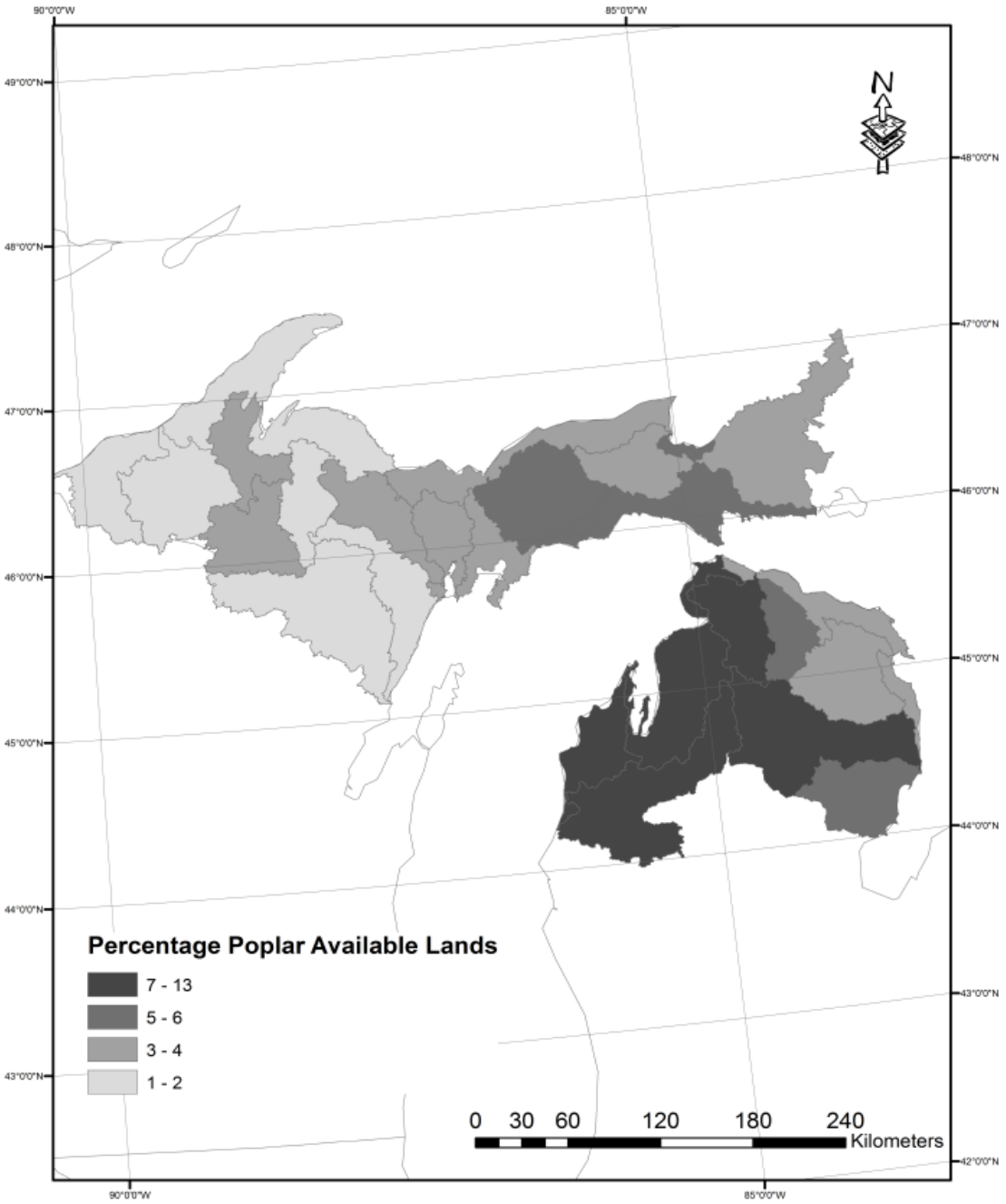
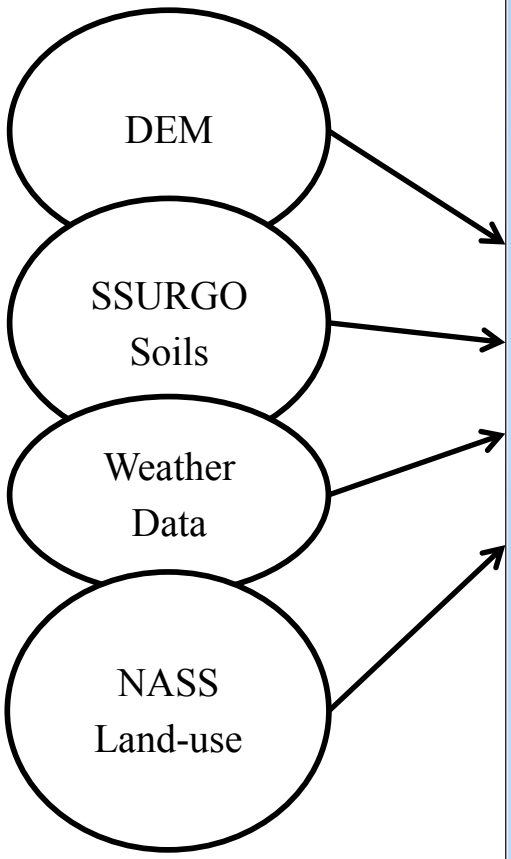
Simple landbase model depending on ordinal indices of site suitability

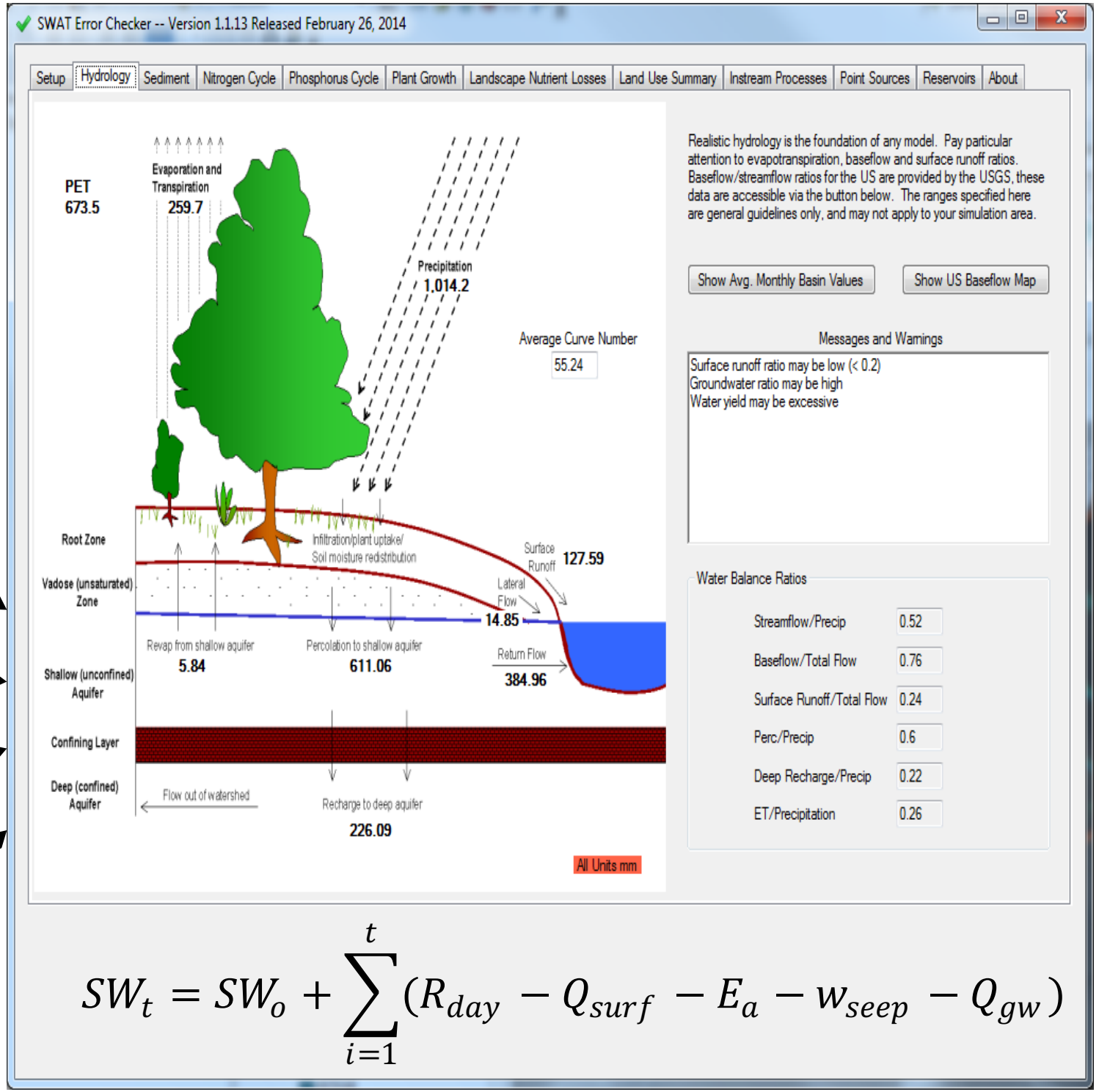



LU/LC


90°0'0"W
85°0'0"W
49°0'0"N
48°0'0"N
47°0'0"N
46°0'0"N
45°0'0"N
44°0'0"N
43°0'0"N
42°0'0"N
N
Percentage Poplar Available Lands
7 - 13
5 - 6
3 - 4
1 - 2
0 30 60 120 180 240
Kilometers

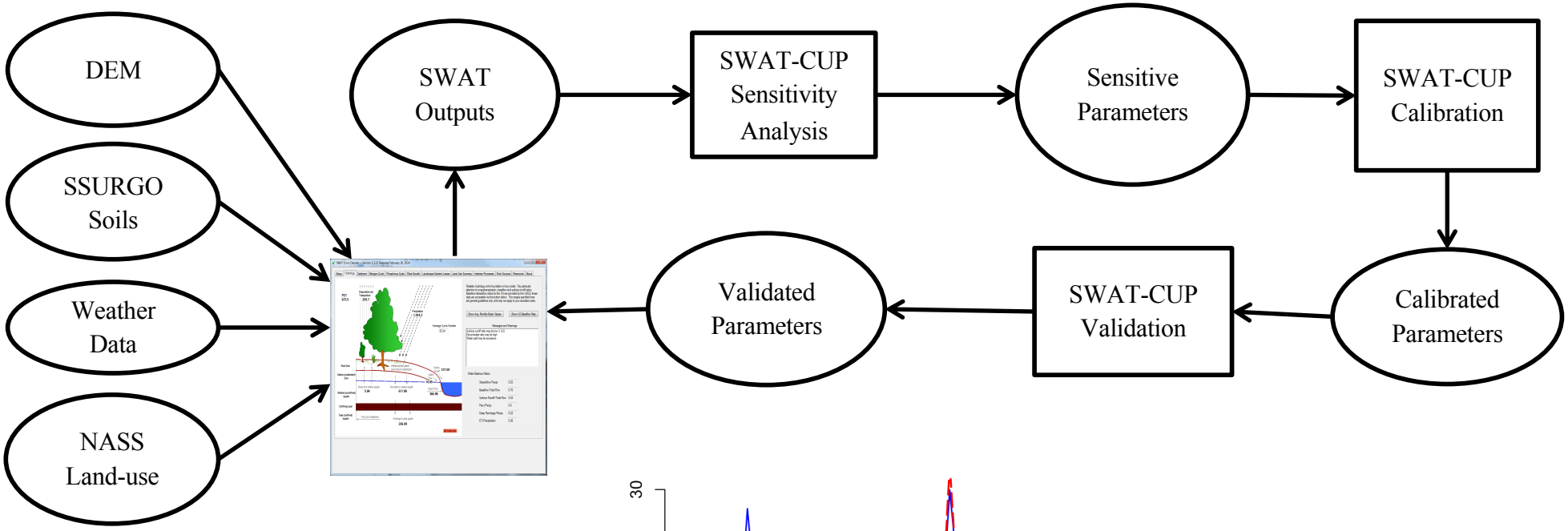
SWAT: Soil and Water Assessment Tool

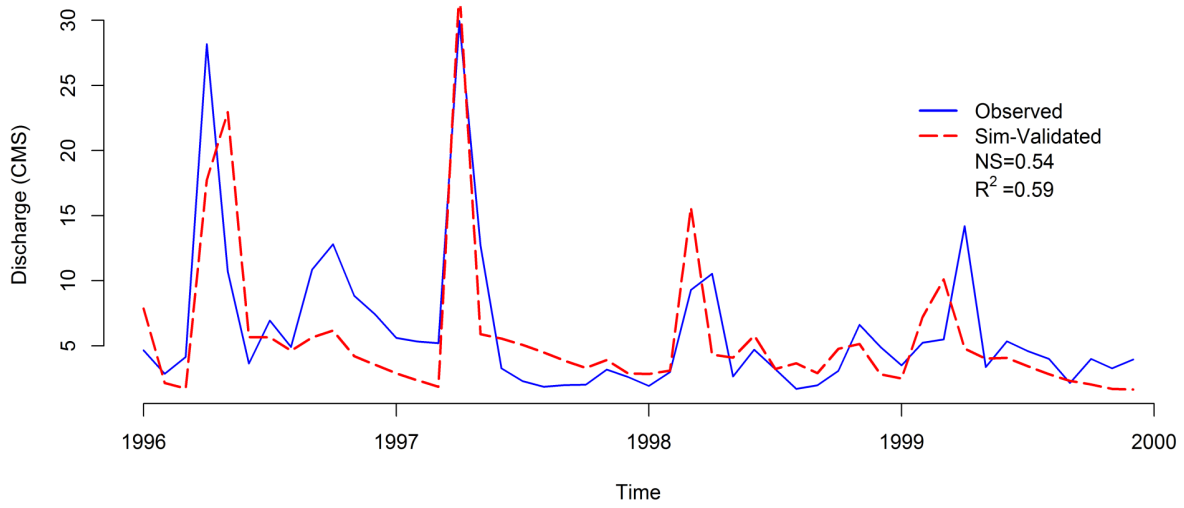




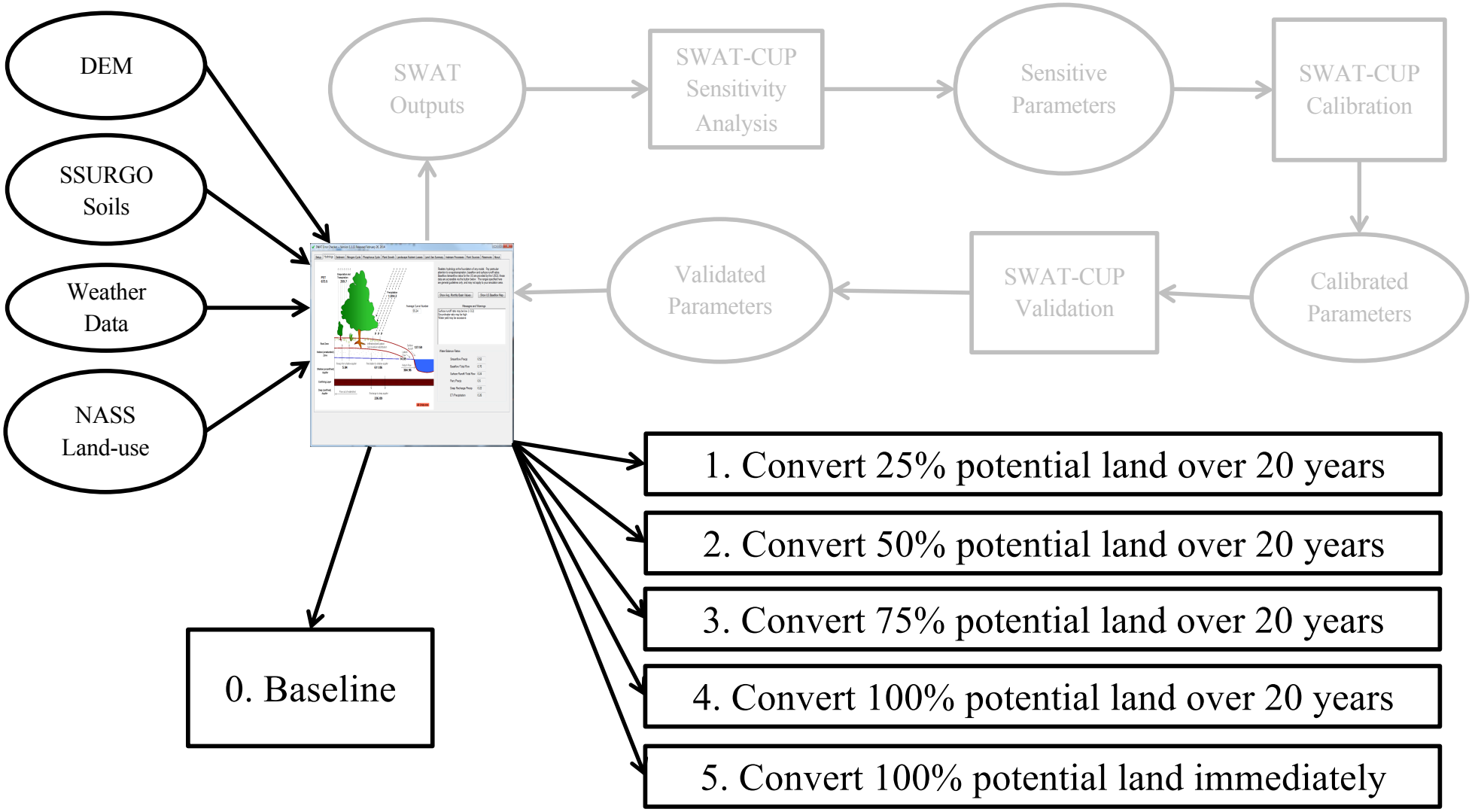
$$SW_t = SW_o + \sum_{i=1}^{t} (R_{day} - Q_{surf} - E_a - w_{seep} - Q_{gw})$$

SWAT is calibrated using stream data

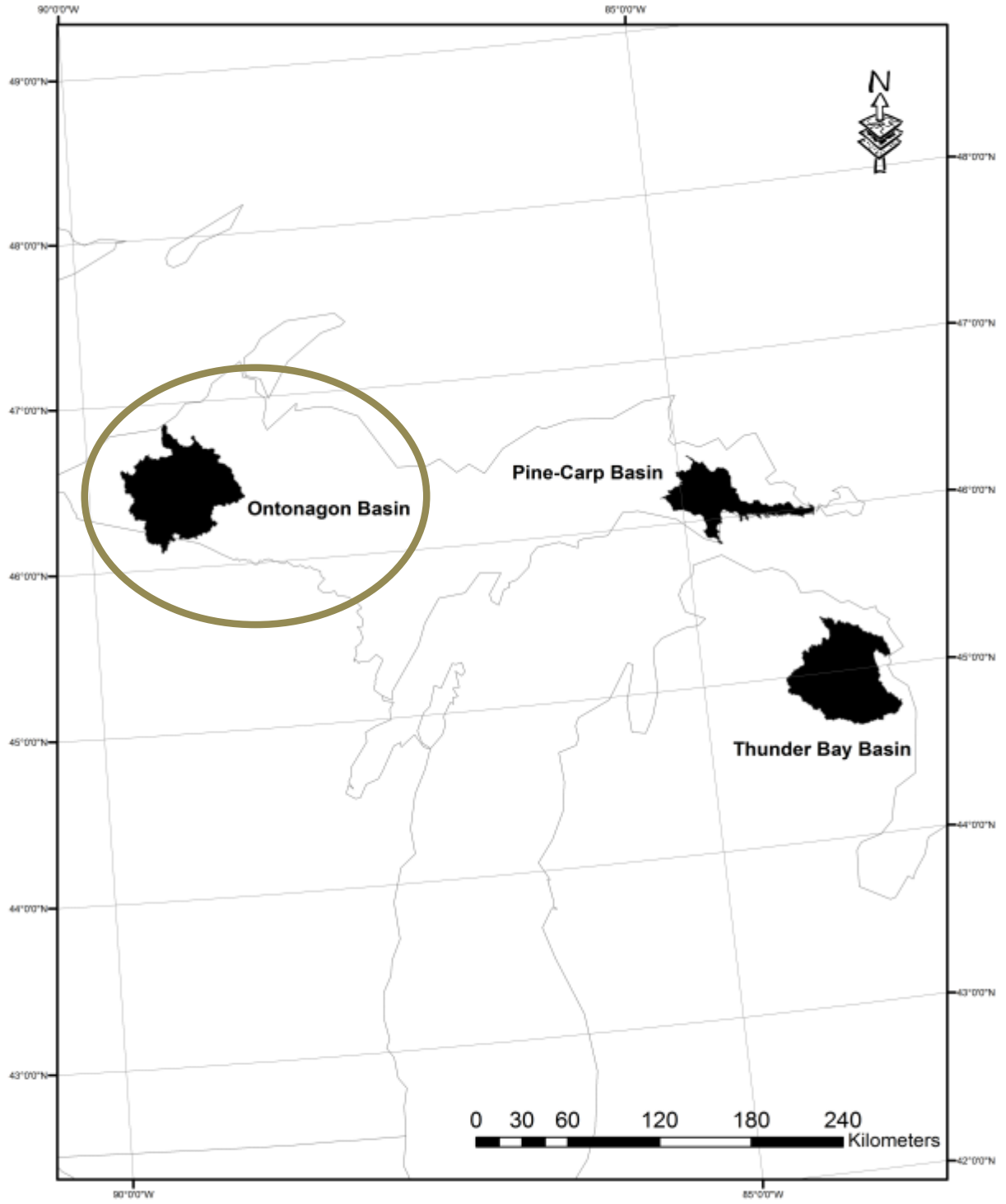




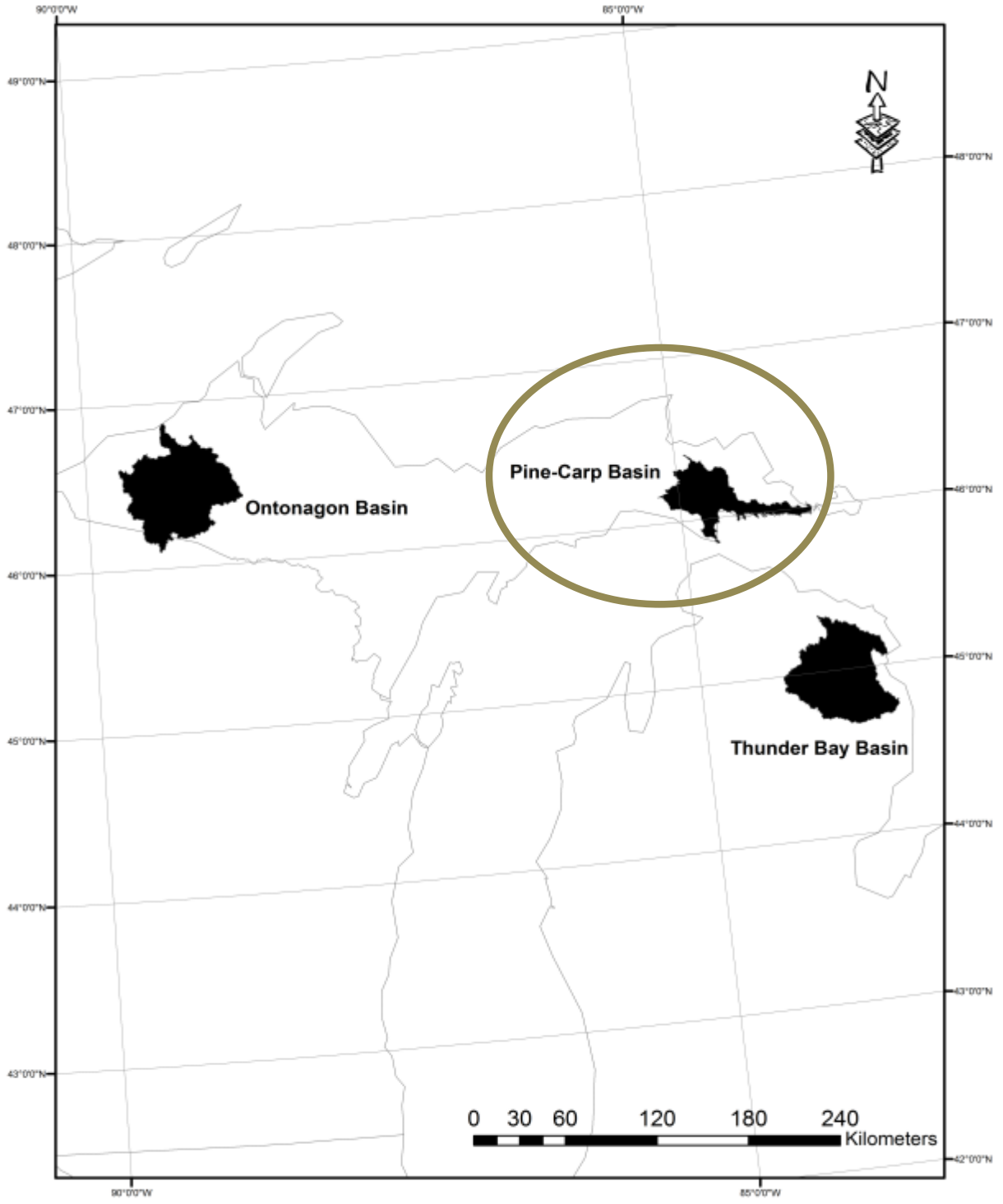
Then model conversion scenarios



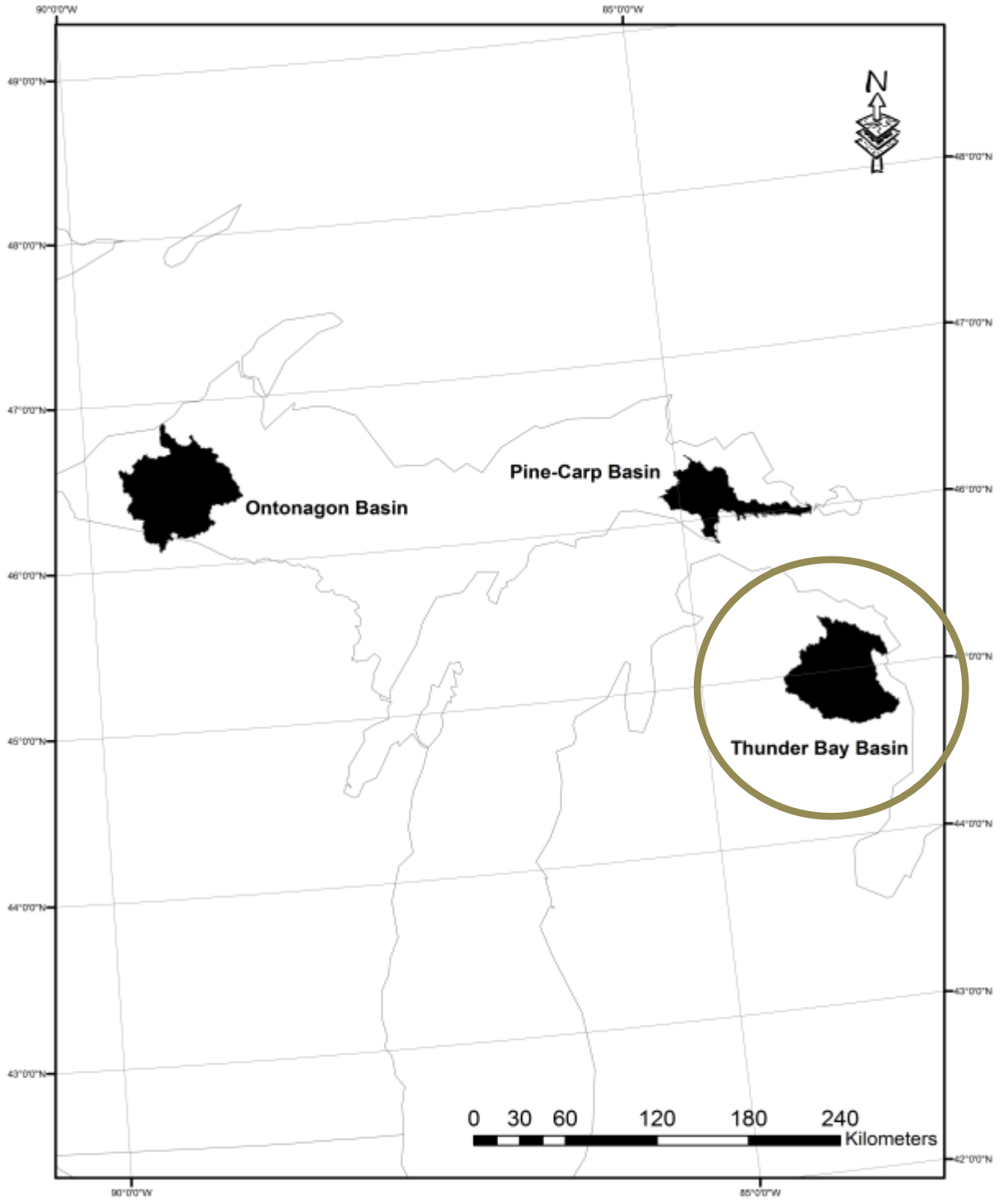
Basin	Ontonogan
Total Area	360,000 ha
Sub-Basin Area	138,900 ha
Poplar Landbase	2,500 ha
Proportion	2%



Basin	Pine
Total Area	171,700 ha
Sub-Basin Area	19,400 ha
Poplar Landbase	3,800 ha
Proportion	20%



Basin	Thunder Bay
Total Area	324,000 ha
Sub-Basin Area	74,900 ha
Poplar Landbase	7,900 ha
Proportion	11%



RESULTS

Yields averaged across the entire landbase in the watershed was 2-3 dry t/ha/year

This is a SWAT default poplar model estimate

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Scenario	Ground-water Yield % Change	Sediment Export % Change	Surface Runoff % Change	Water Yield % Change	ET % Change	Percolation % Change	River Discharge % Change
Base	0	0	0	0	0	0	0
25% Δ over 20 years	-0.05	1.74	-0.27	-0.09	0.27	-0.05	-0.09
50% Δ over 20 years	-0.09	3.09	-0.45	-0.16	0.47	-0.09	-0.16
75% Δ over 20 years	-0.12	4.06	-0.58	-0.21	0.60	-0.12	-0.21
100% Δ over 20 years	-0.14	4.74	-0.66	-0.24	0.69	-0.14	-0.23
100% Δ at year 10	-0.21	7.34	-0.97	-0.36	1.03	-0.22	-0.35

Comparisons among watersheds

Scenario	Sediment Export (Δ%)	ET (Δ%)	River Discharge (Δ%)	Landbase (% Poplar)
Base	0.00	0.00	0.00	0
Pine River	7.34	1.03	-0.35	20
Ontonogan	4.08	0.09	-0.08	2
Thunder Bay	63.32	0.30	-0.20	11

How do we reconcile consensus fear with these unremarkable results?

1. The results are wrong, of course
   - It's the grad student's fault
   - Seriously, all models are wrong

2. Converted areas are relatively small, so the very small impact is not surprising

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How do we reconcile consensus fear with these unremarkable results?

3. The results are averages over large areas – meaningful impacts occur at different scales

4. It's the yield model that's the problem

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Conclusions

- Much more work to do
  - Field hydrology at stand scale
  - Better models especially of poplar yield
- Still, impact is probably small for quantity
- Some significant potential impact on quality

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