Whitegul Creek - the southern Boreal Forest in Saskatchewan

Andrew Ireson
Outline:

- Reflections on publishing models
- Conceptual model of the BPE
- Whitegul Creek
- Other modelling efforts: gaps and challenges
- CRHM @ Whitegul Creek
Reflections on publishing models

- **Why publish?**
- If your objective is “produce a model for watershed x” you may be in for trouble when it’s time to publish.
- You need a strong research question, which should determine your approach from day 1: a model without a question is an answer in search of a question.
- Do not try to “truthify” your model – no-one learns anything from this!
Publishing models

- What you did should be reproducible, solely on the basis of the information in your paper...
- ... this is almost never the case!
- Good and bad examples:
Hard-coded parameters

Water Resources Research

Are we unnecessarily constraining the agility of complex process-based models?

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The BPE
Climatic control on the BPE

The ecotone in western Canada is:
- Coincident with the P-PET isolines (CMI)
- Makes it sensitive to climate change.

CMI = P-PET
Climate Moisture Index (cm)
Precipitation
Pot. Evapotranspiration

Hogg, 1994
Soils:

Luvisol overlaying glacial till, with Aspen tree cover.

Brunisol overlaying coarse grained glacial deposits, with Jack Pine tree cover.
Water balance:
Hillslope-scale: Vegetation Pattern

Local topography and geology:
- Defines soil texture and drainage.
- Constrains the vegetation mosaic.

Ireson et al., 2015, Wires Water
Whitegul Creek

Davison et al., in press

www.usask.ca/water
Groundwater dominated in the east

Glaciofluvial deposits

**Upland**
- Coniferous canopy
- Shallow soil over sand
- High soil drainage to deep water table

**Lowland**
- Coniferous canopy
- GW feeds wetlands
- Wetlands may drain to stream network

Deep, fast, sustained GW flow
Groundwater model
Shallow, impermeable soils in the West

[Diagram]

- **Glacial till deposits**
  - High ET
  - Moderate ET
  - High ET

- **Upland**
  - Deciduous canopy
  - Clay rich soil with preferential flow paths
  - Shallow water table

- **Lowland**
  - Coniferous canopy
  - Precipitation feeds
  - Wetlands
  - Wetlands feed local GW

- **Fen/bog**

- Shallow GW with negligible flow
  - Potential transmissive zone with episodic lateral flow
Don’t forget the wetlands!
Don’t forget the wetlands!
Modelling @ Whitegul Creek

Bruce Davison: MESH

Davison et al., In press. What is Missing from the Prescription of Hydrology for Land Surface Schemes? CWRA Journal
Modelling @ Whitegul Creek

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![Box-Whisker Plots of Daily ET by Month](image)
CLASS-CTEM

**Objective:** Evaluate CTEM vegetation dynamics using flux tower data from BERMS aspen and pine and AB grassland

**Strategy:**
- Evaluate CTEM at site level
- Use CTEM to explore each PFT’s response to climate
- Evaluate CTEM’s ability to reproduce 20th century vegetation dynamics

**Team:** Andrew Ireson, Alan Barr, Omer Yetemen, Joe Melton, Andy Black, Mahtab Nazarbakhsh
Historical run at various BERMS Jack Pine sites:

![NEP vs Stand Age](chart.png)

- HJP02
- HJP94
- HJP75
- OJP
- CTEM

Legend:
- NEP (g C m²⁻¹)
- Stand Age (years)
Comparing Annual Fluxes
CLASS-CTEM versus Flux Tower

CTEM

Flux Tower

C Flux (g C m$^{-2}$ y$^{-1}$)

ET (mm y$^{-1}$)

Year


NEP = GPP - RE

ET
Forest: take-home points

- We are optimistic that CTEM is well suited to studies of vegetation dynamics
- CTEM represents the mean response well but overestimates inter-annual variability, related excess water stress
- In resolving this issue we face the problem of equifinality; water stress is affected by a host of soil and vegetation properties
- The C cycle responds much more sensitively than the water cycle to changes in climate or model parameters – it is therefore an excellent constraint for hydrological models
CRHM...