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# Storage and streamflow generation in Canadian Shield basins

**IP3 Network Final Results Workshop**

**Saskatoon, SK**

**C. Spence**

**September 9, 2011**



Improved Processes & Parameterisation  
for Prediction in Cold Regions

# Acknowledgements

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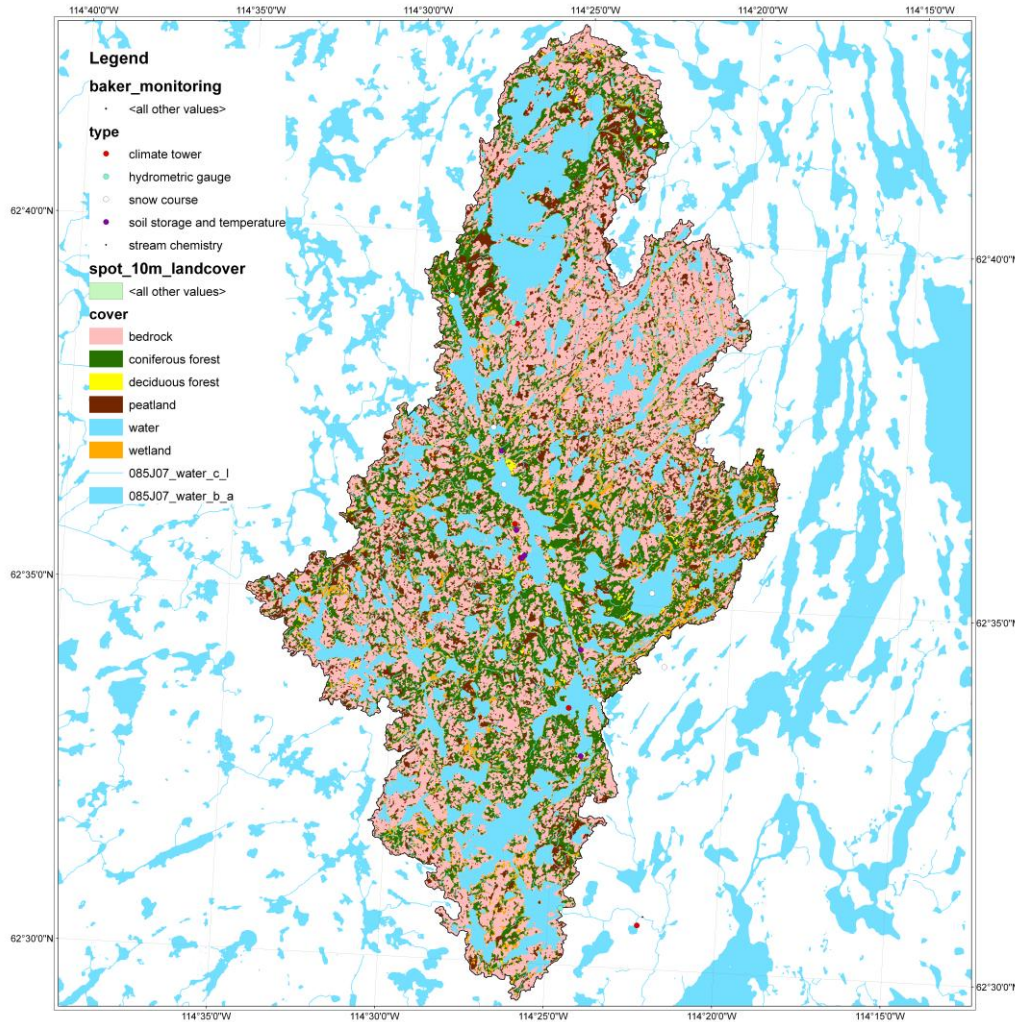
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# Objectives

- Prior to IP3, the influence of small scale storage processes on catchment scale runoff response had not been fully investigated.
- The objective of much of the IP3 effort on the subarctic Canadian Shield landscape was to determine how small scale processes upscaled, so as to develop new parameterizations that could improve prediction at the catchment scale.



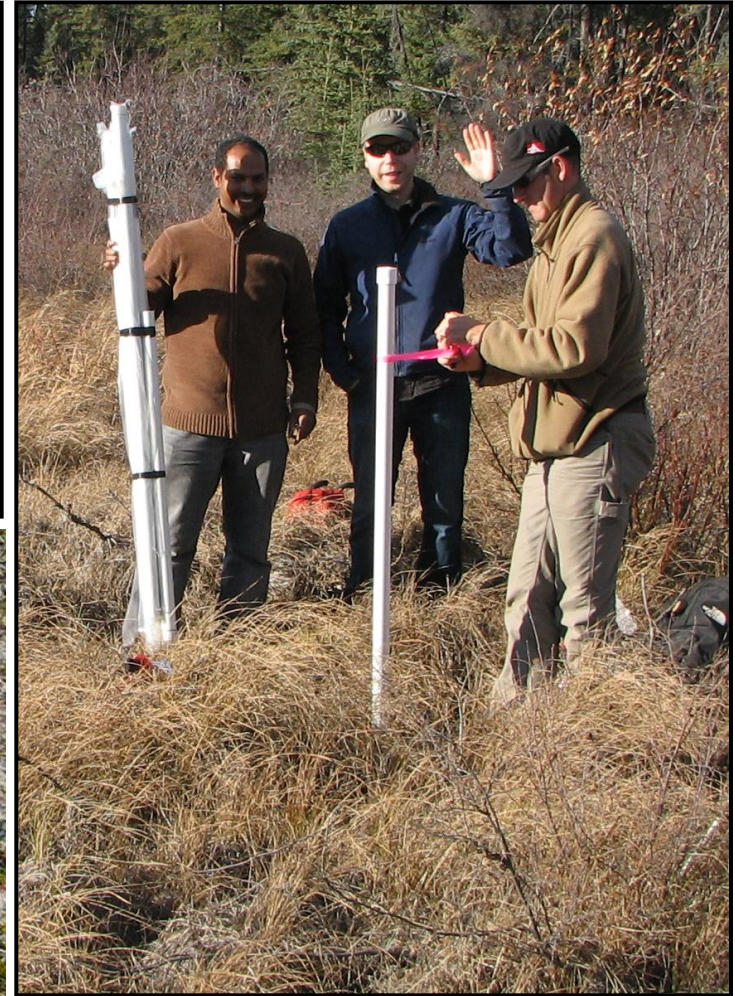
# Baker Creek



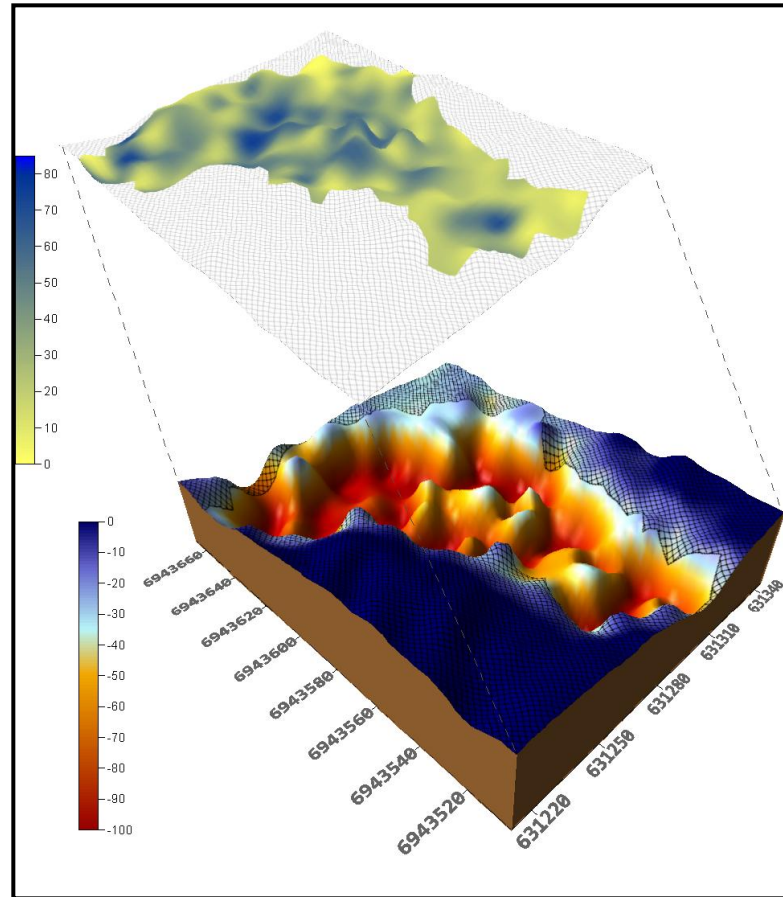
- The Baker Creek Research Basin drains runoff from ~155 km<sup>2</sup> (~170 km<sup>2</sup> at the mouth).
- It is located in the Great Slave High Boreal Ecoregion and Slave Structural Province of the Precambrian Canadian Shield.
- Land cover is dominated by exposed bedrock (40% of basin area) with substantial portions of wetlands (16%) and coniferous forest (21%).
- There are 349 lakes in the basin that occupy 23% of the area.
- Permafrost is discontinuous; absent from bedrock, well drained areas and water courses.



# Storage measurements



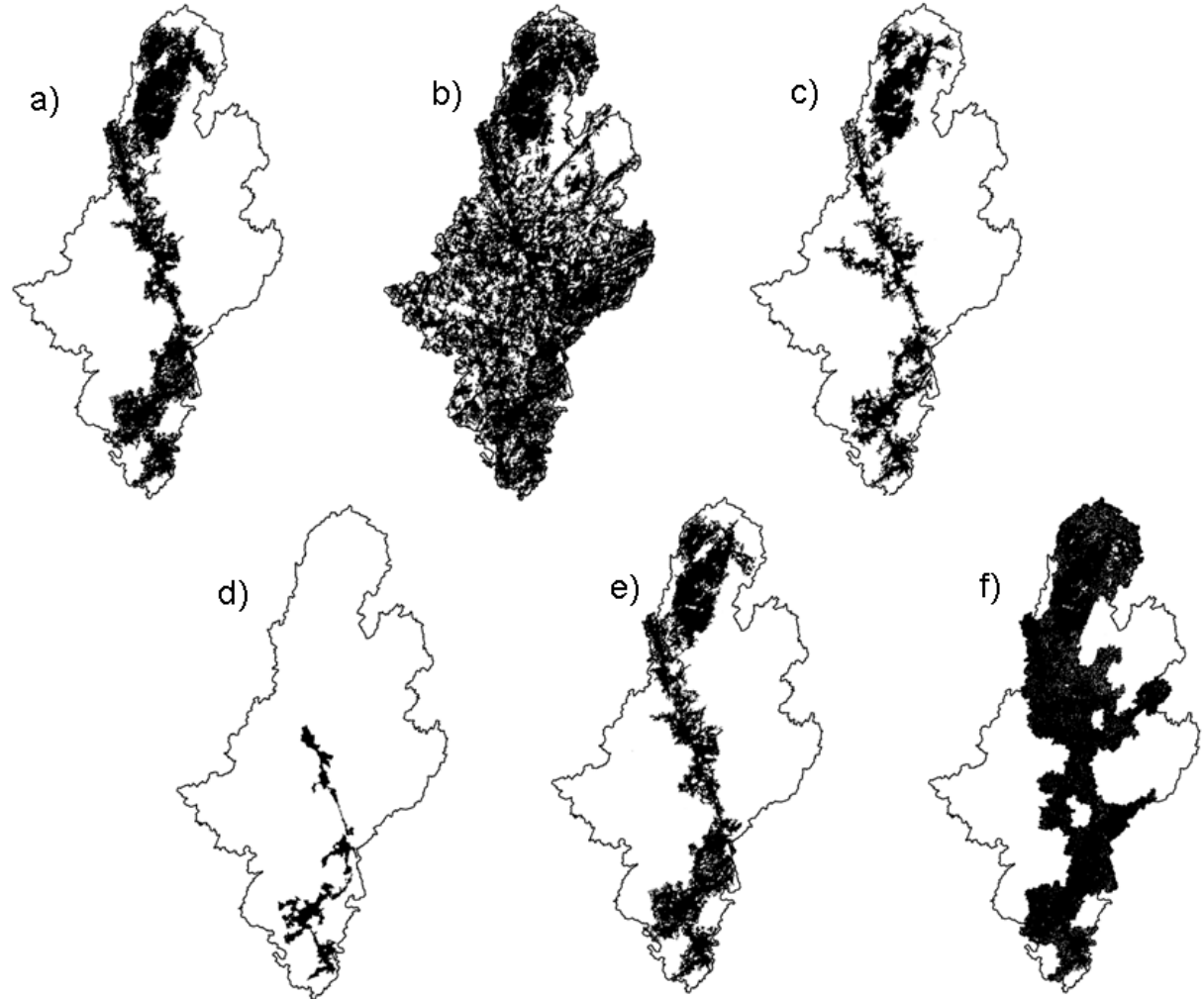
# Processes



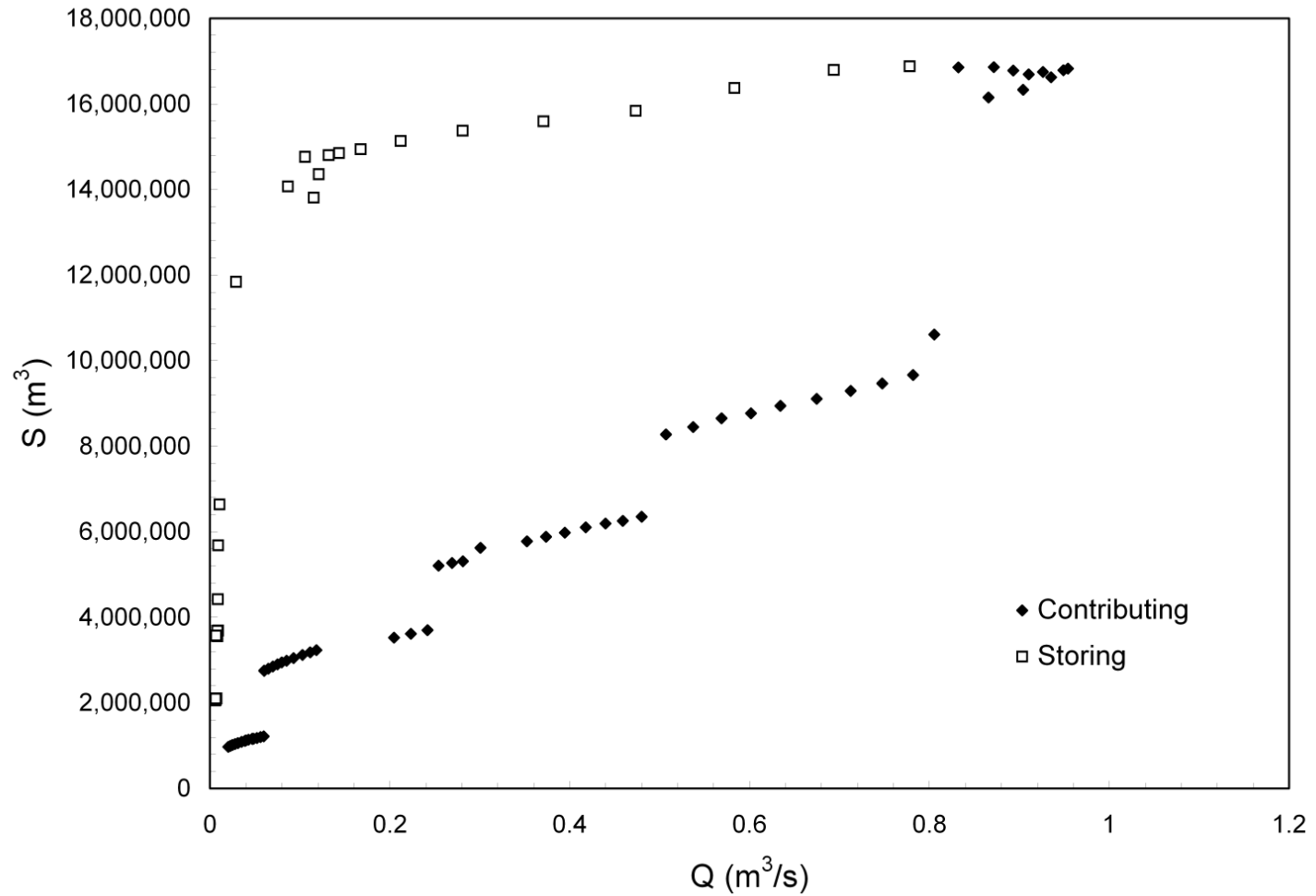
- Coincident locations of the wettest surface soils in spring and the deepest frost table depth in summer suggest strong feedbacks between soil moisture and ground thaw.
- Spatiotemporal soil moisture and ground thaw correlations change with the topology, topography and typology of response units, demonstrating that all soil filled areas cannot be treated similarly in hydrologic models.



# Processes

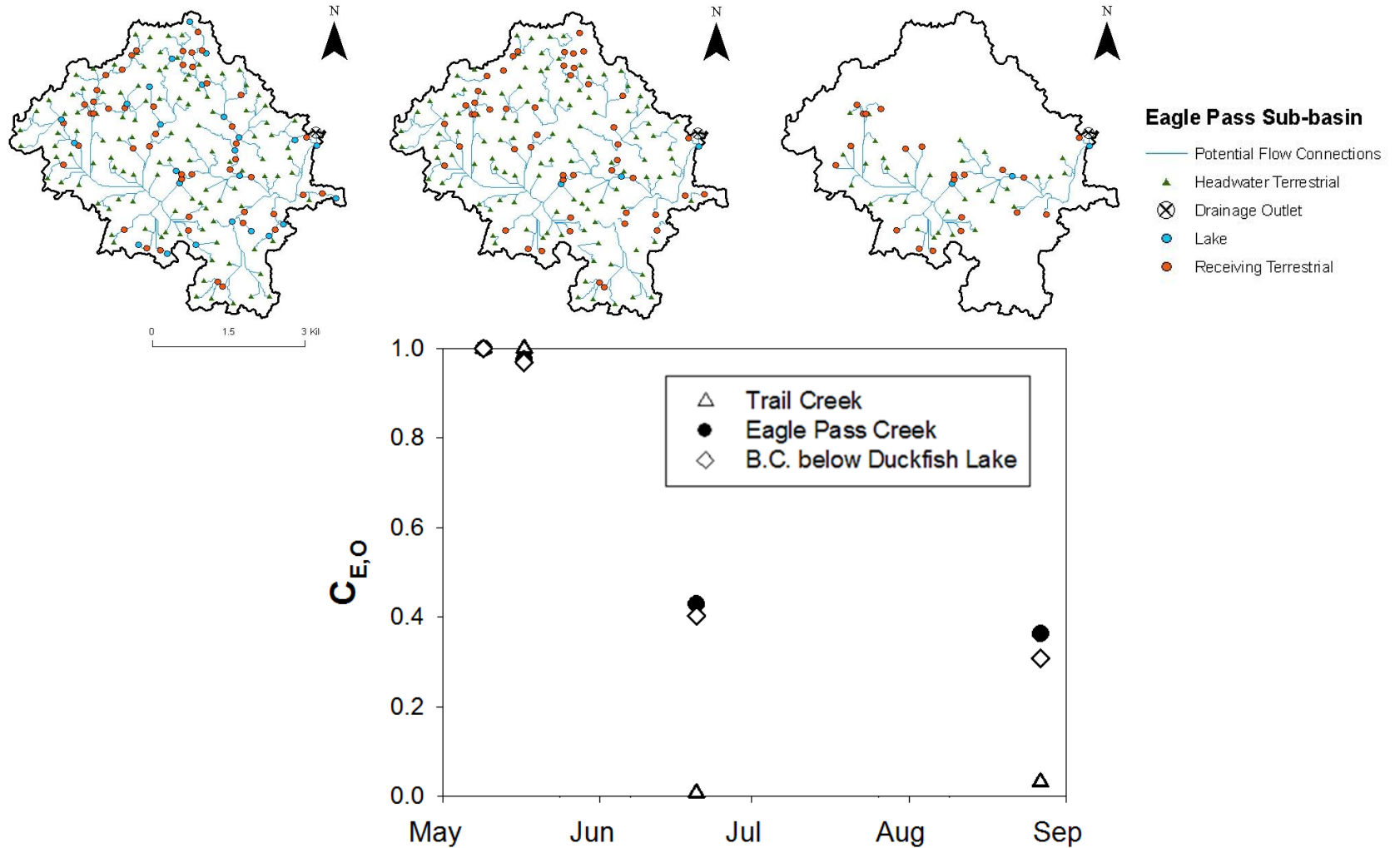


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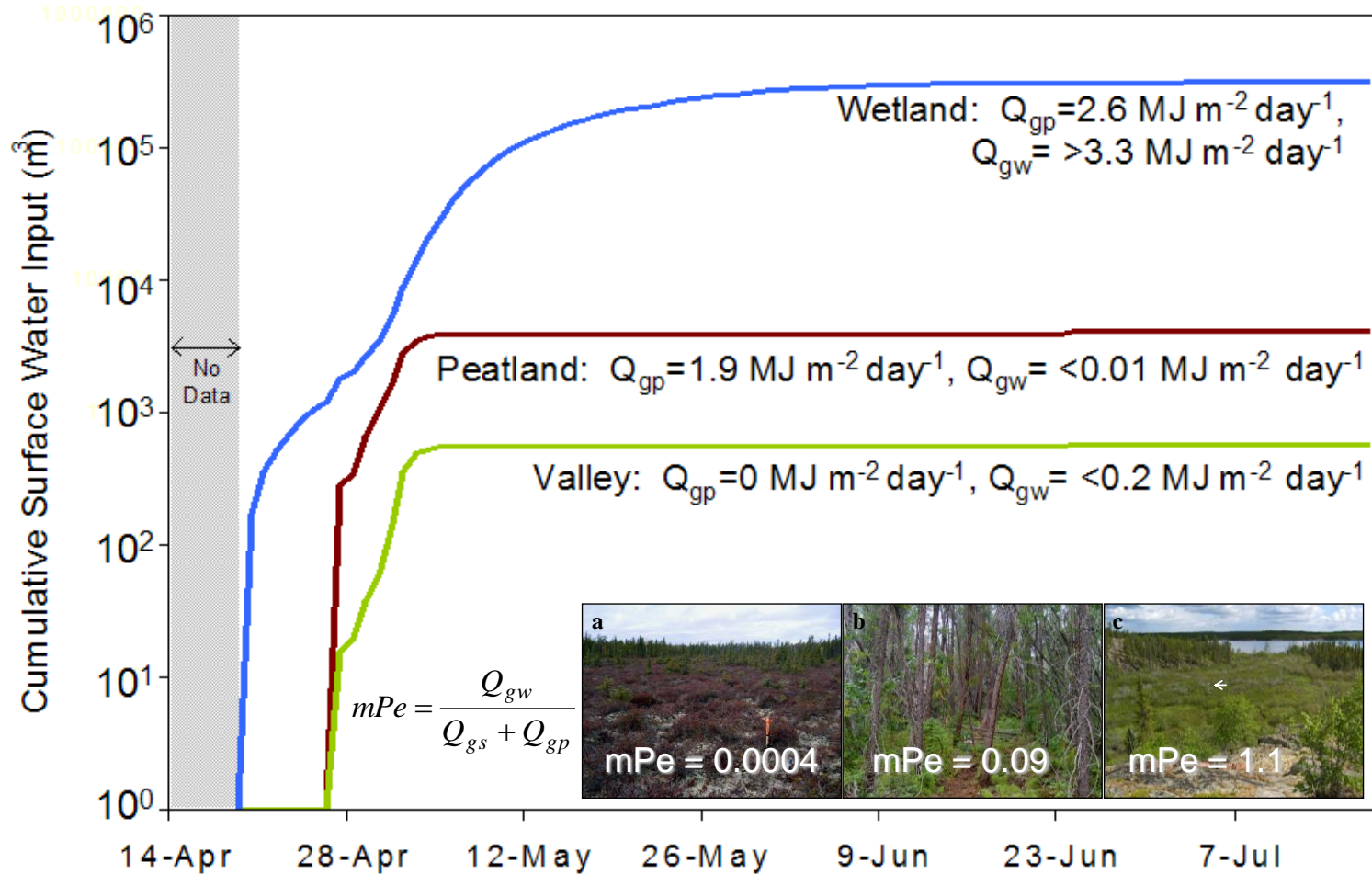




# Processes



# Parameterization



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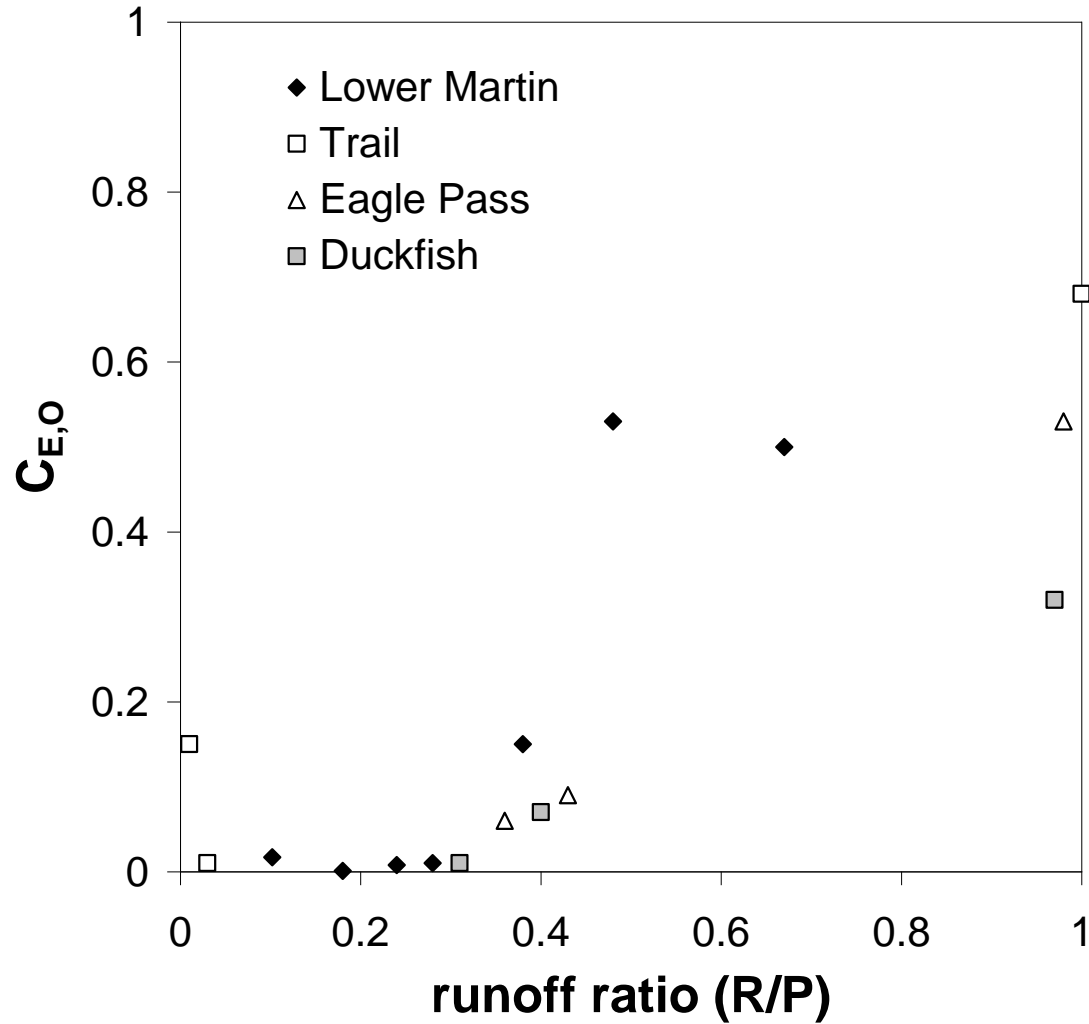


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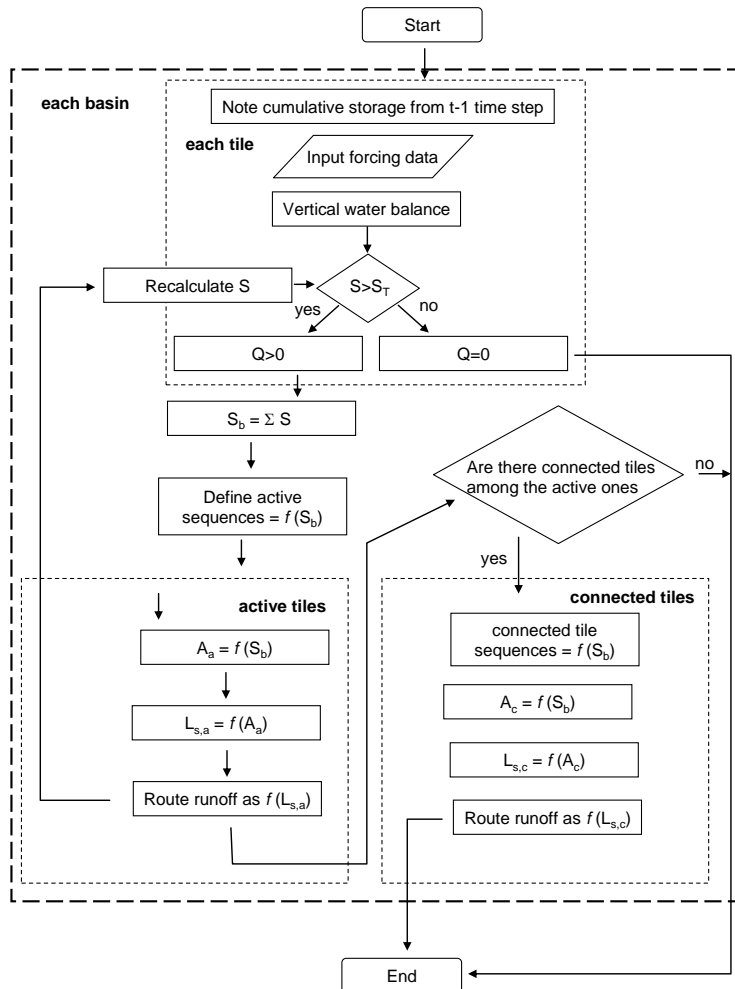
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# Parameterization

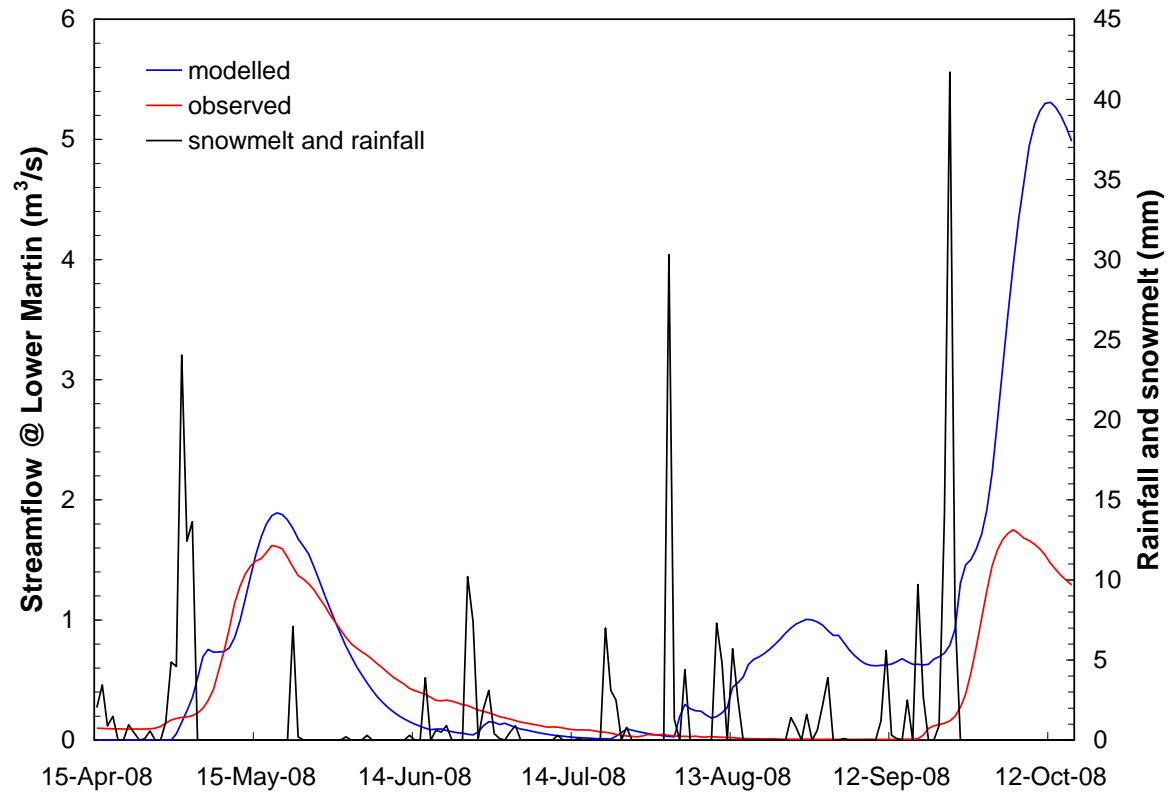
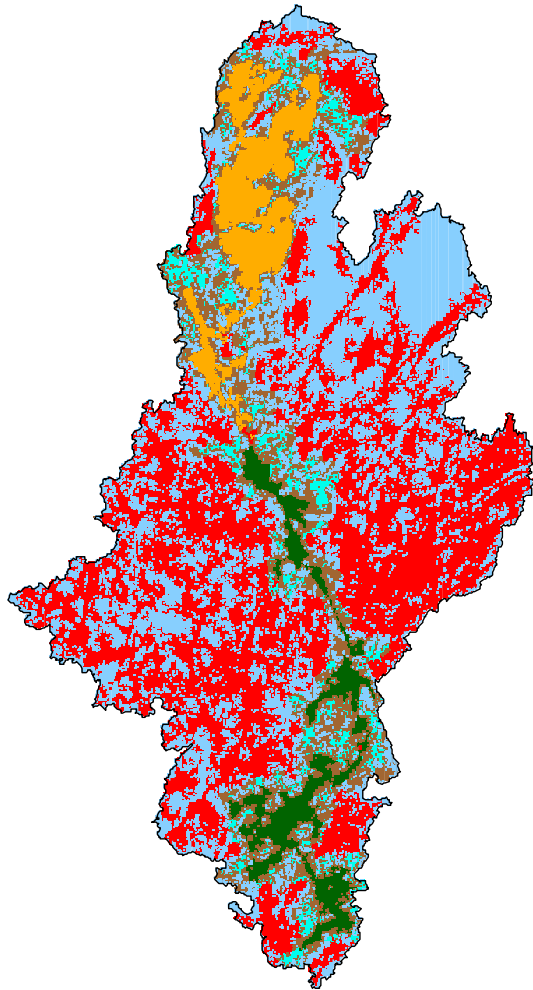


# Parameterization

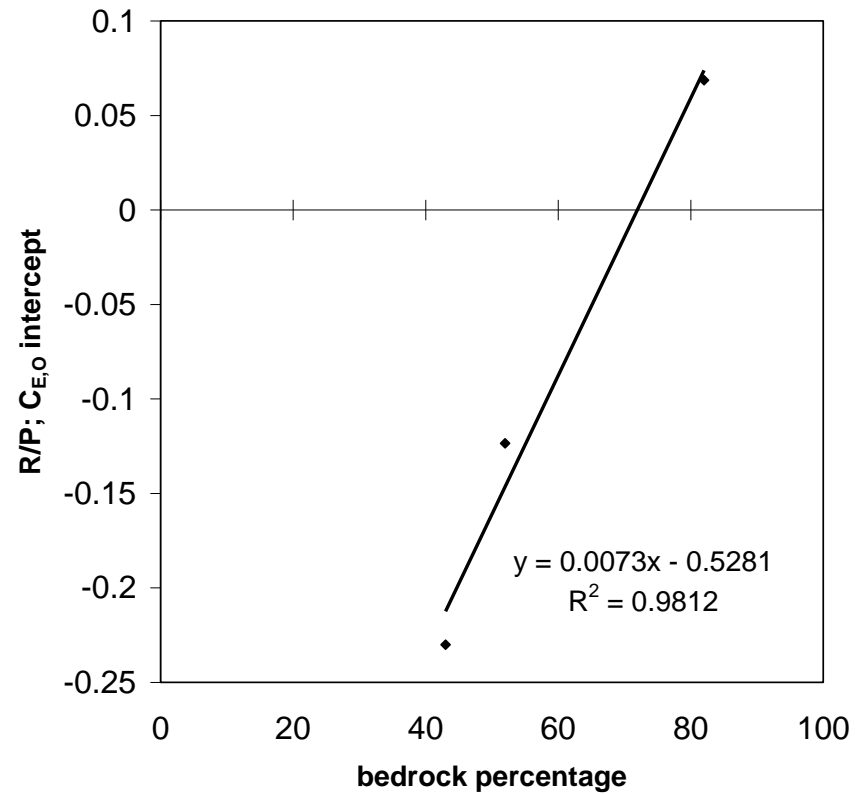
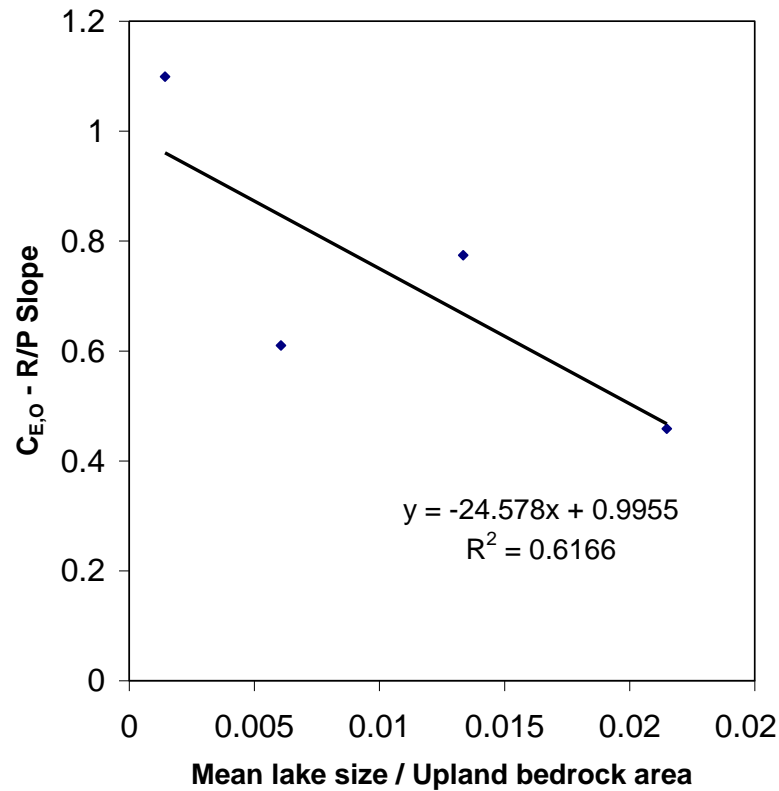


- A new tile connector scheme has been developed for MESH, but awaits coding and testing.

# Prediction



# Prediction



# Summary

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- There is a better understanding of hydrological processes, including the interplay between frozen ground / and surface wetness, the manifestation of contributing areas and hydrological connectivity.
- New parameterization:
  - 1) the “Guan” number incorporates the relative influence of topology and advective heat on frost table depth and, in turn, hillslope storage capacity.
  - 2) connectivity is related to streamflow and controls the runoff ratio and there is some indication connectivity signatures can be related to watershed attributes.
  - 3) characteristic catchment storage-discharge curves have been identified, and these have led to the design of a new tile connector scheme.
- We were unable to document a reduction in predictive uncertainty because parameterization schemes that are true to the processes and behaviour of hydrologic response units have not been fully tested.
- There is a legacy of data that was collected in a nested fashion; there is momentum towards a robust research catchment in the region; this could be a site that can be used to document biogeophysical state and change.

