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Improved Process Understanding and Parameterization Methods but not yet Prediction on the Subarctic Canadian Shield

IP3 Annual Workshop

Lake Louise, AB

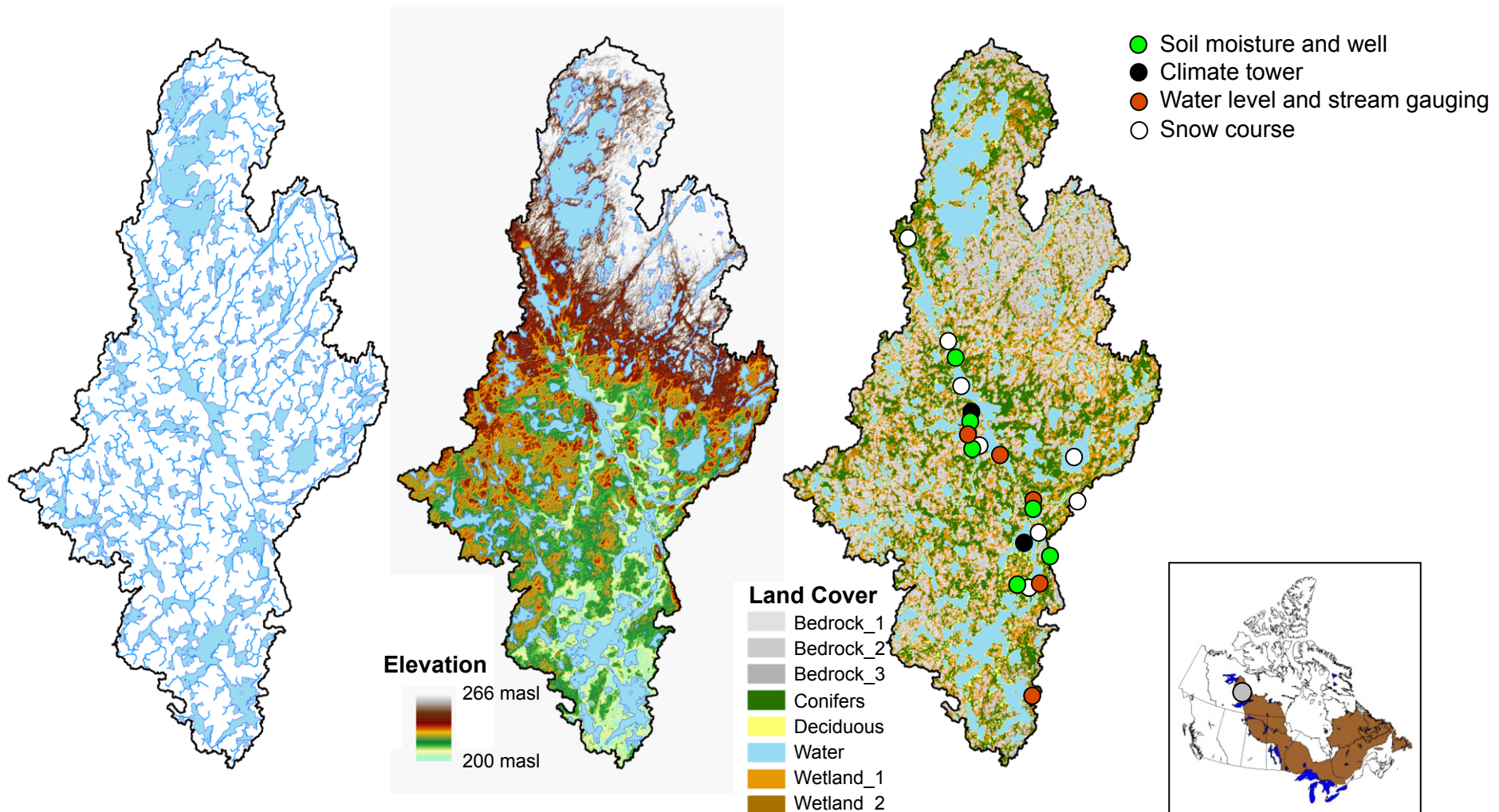
C. Spence, X.J. Guan, R. Phillips, N. Hedstrom and F. Seglenieks

October 14-16, 2009



Improved Processes & Parameterisation
for Prediction in Cold Regions

Baker Creek

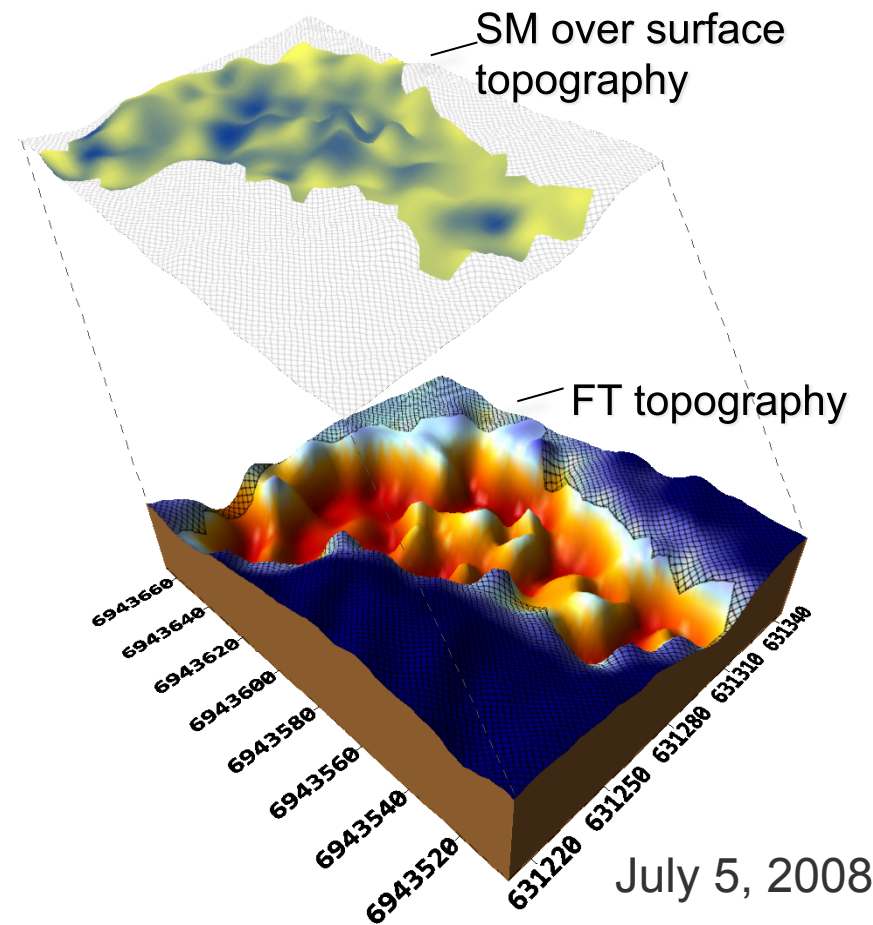
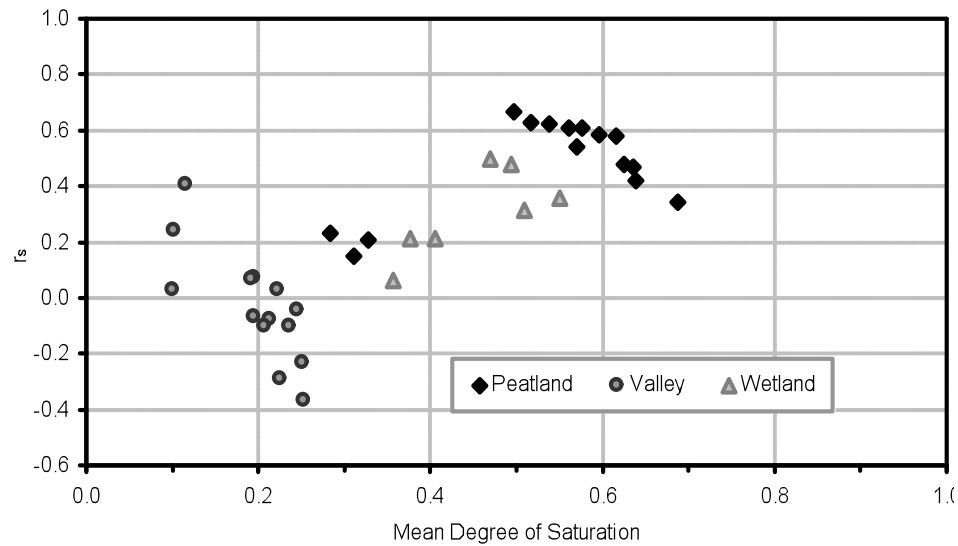


Hillslope scale

- Frost table depth and surface soil moisture was measured at a selection of soil-filled valleys.
- This was done to evaluate how the latter varies over space and time.
- This was evaluated because surface soil moisture status is indicative of a hillslope's ability to transfer water.



Hillslope scale



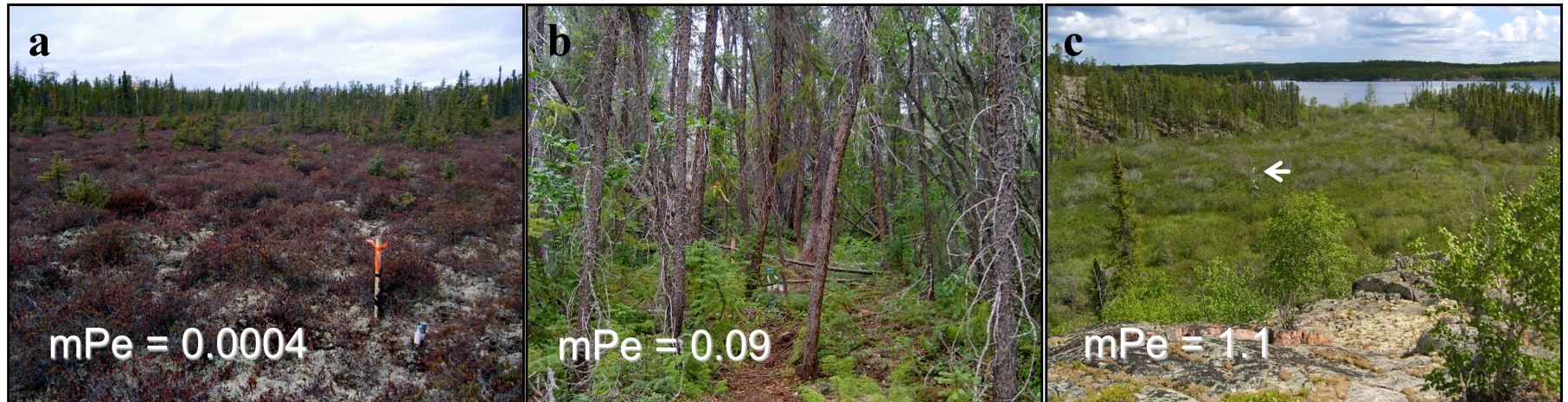
July 5, 2008



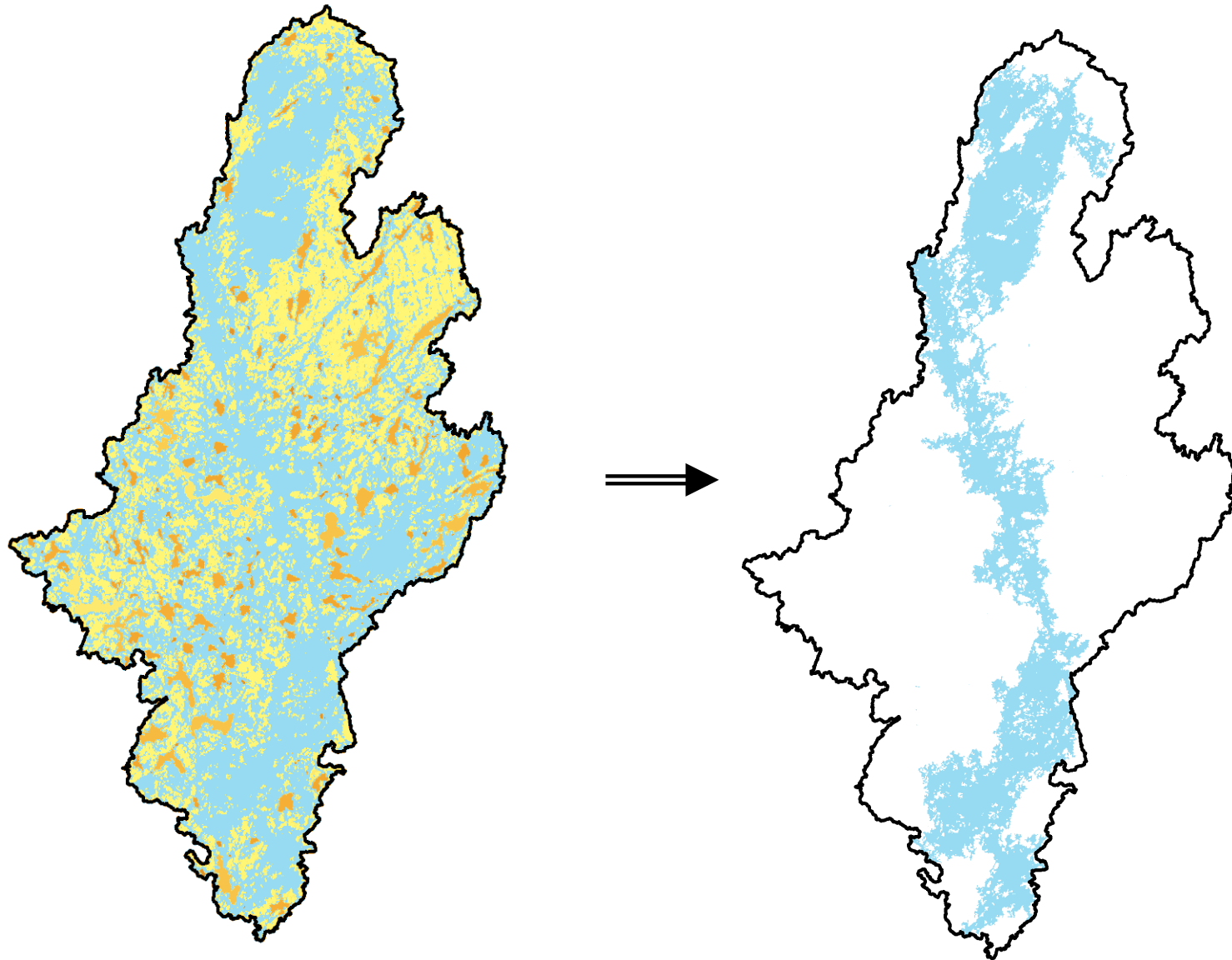
Hillslope scale

Modified Péclet Number for Northern Wetlands:

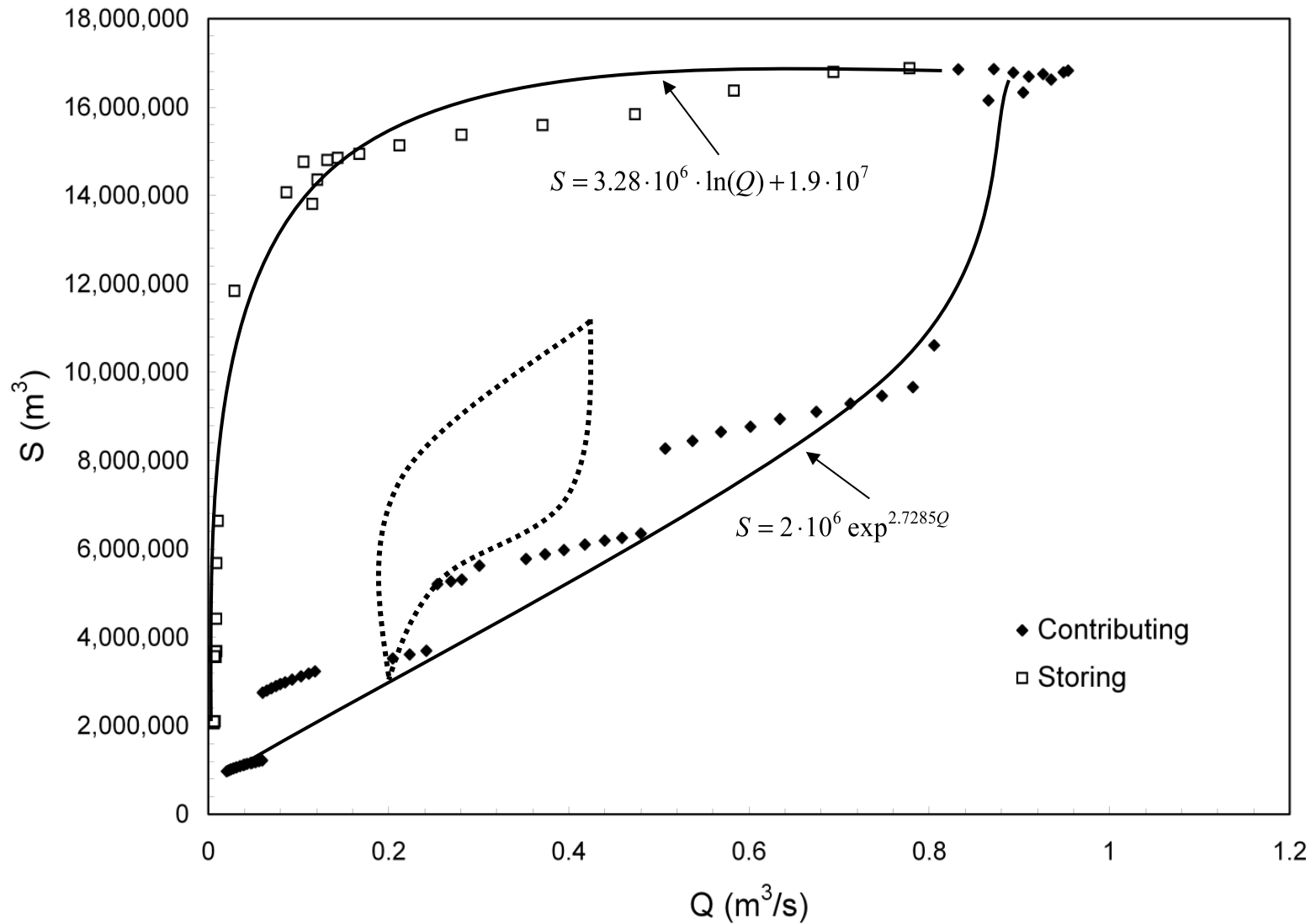
$$mPe = \frac{\sum Q_{gw}}{\sum Q_{gs} + \sum Q_{gp}}$$



Catchment scale



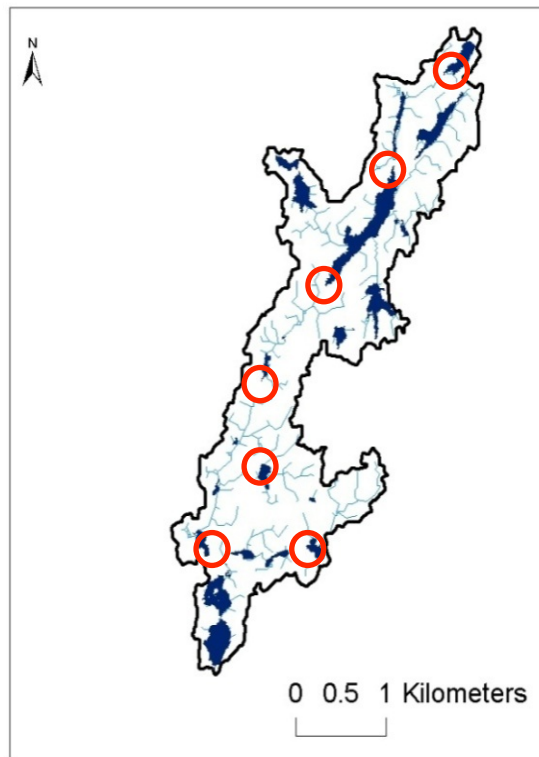
Characteristic S-Q catchment curves



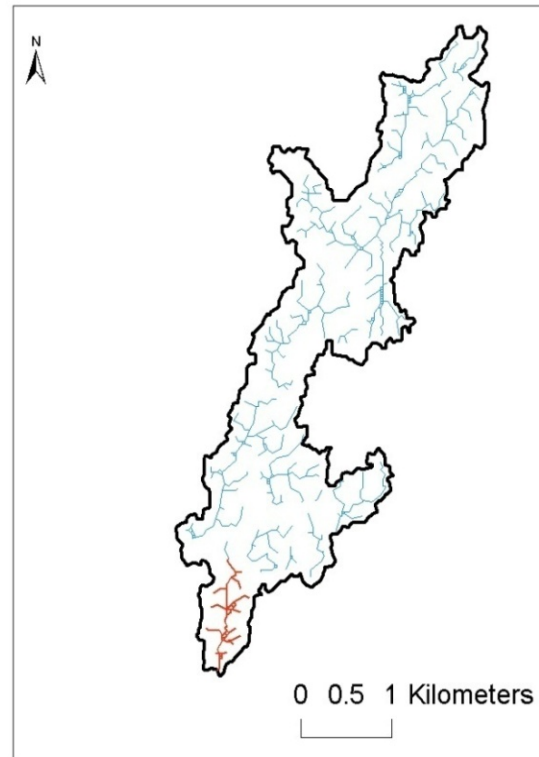
Catchment scale

- Contributing area and active stream network are always changing!

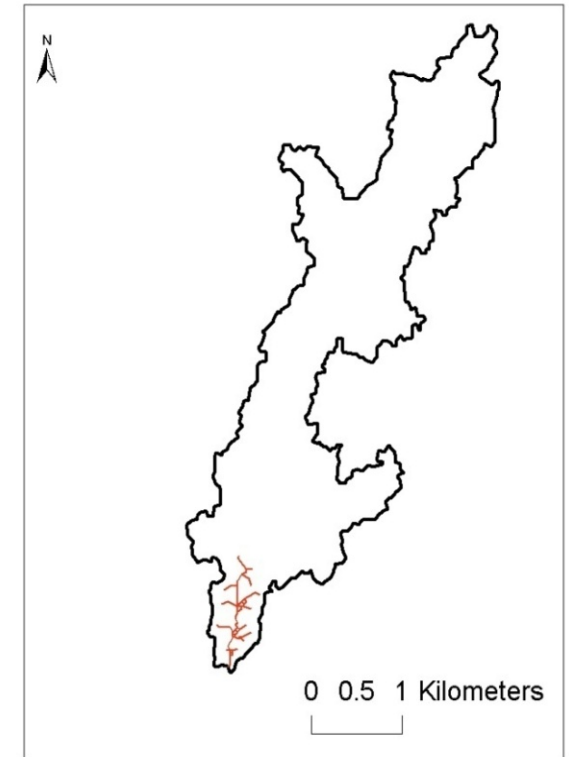
Stream Disconnection



Active Stream Network



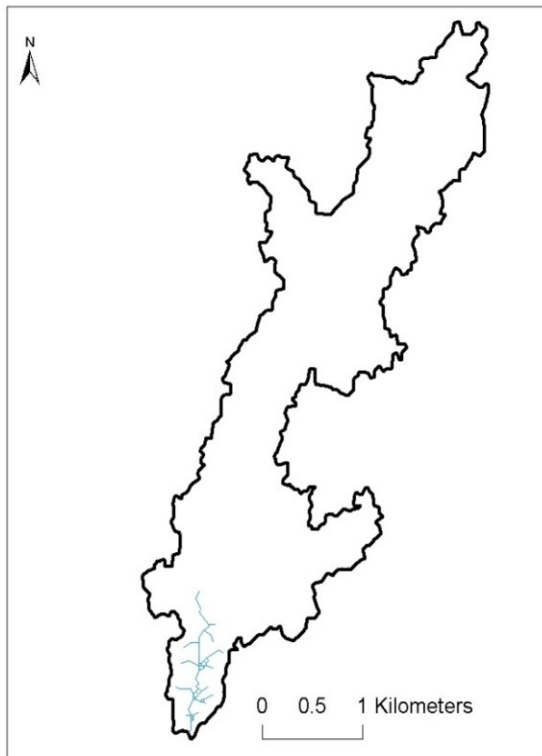
Contributing
Stream Network



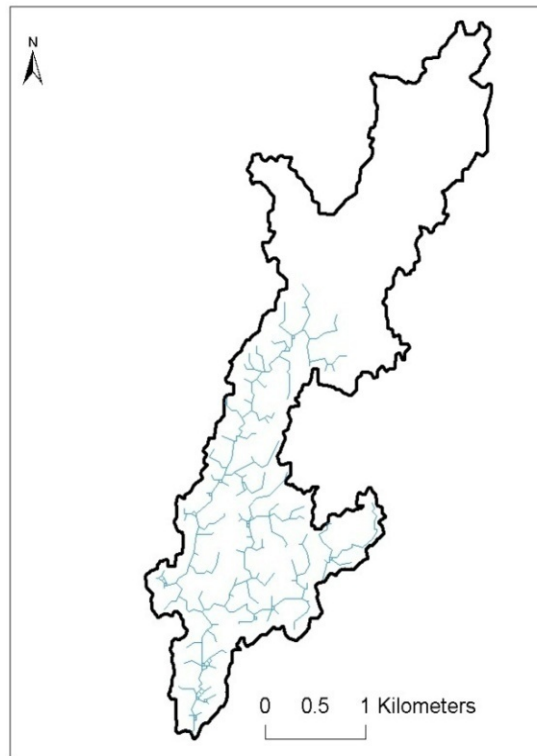
Connectivity

- How connected is the stream network?

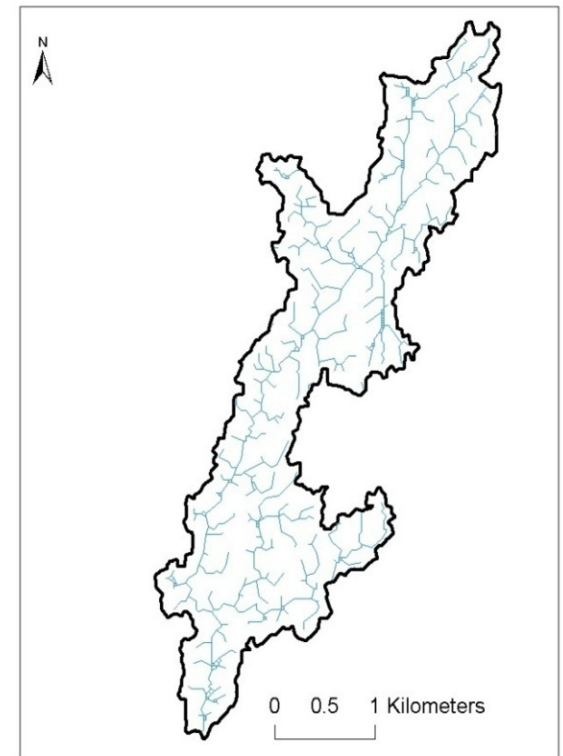
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Connectivity

- Connectivity Length

- Average weighted length between two connected points

$$C = \frac{\sum_{s=1}^m (n_s R_s)}{\sum_{s=1}^m n_s}$$

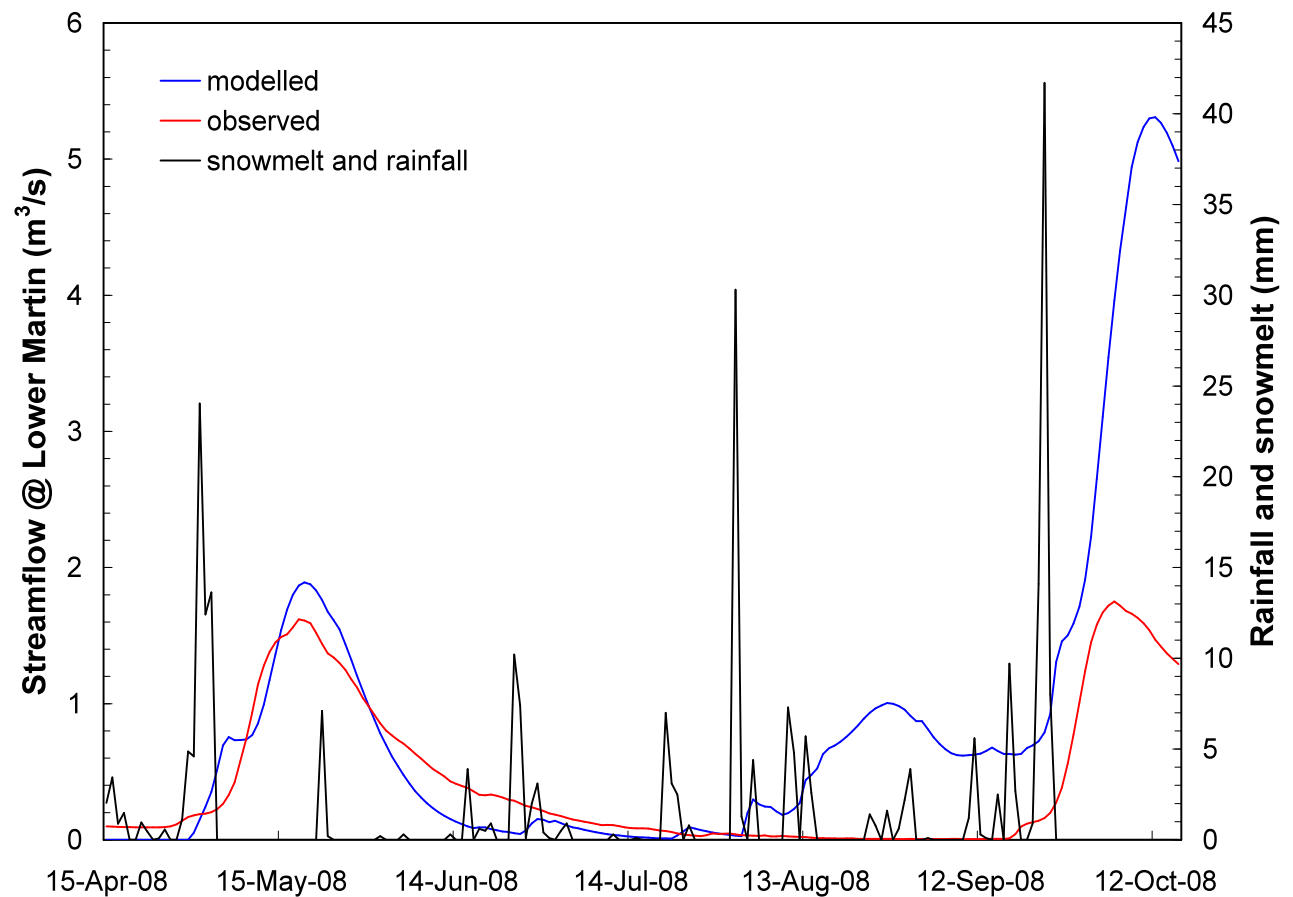
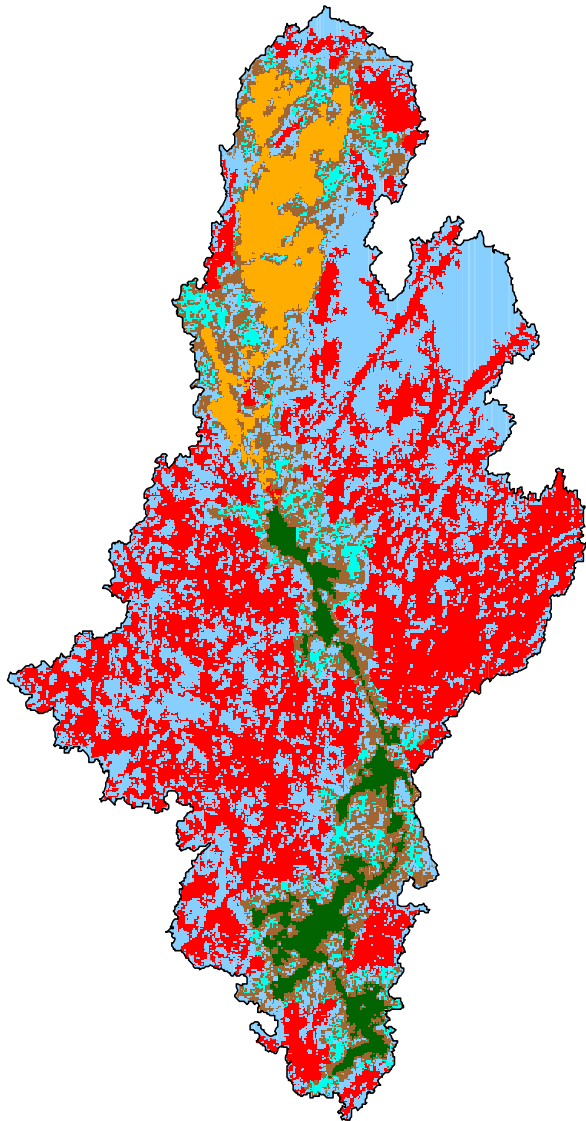
- Number of components in the network

- % Connection

$$\% \text{ Connection} = \frac{\text{Actual Connections}}{\text{Potential Connections}}$$

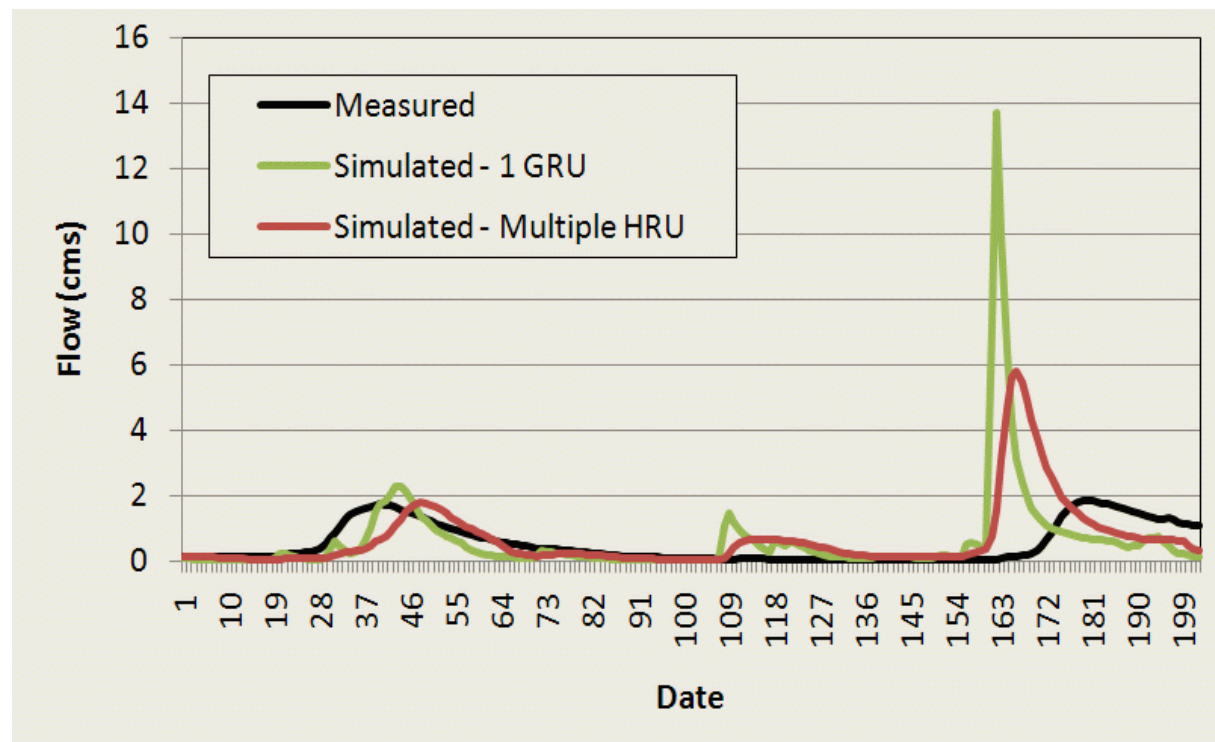


Prediction - CRHM



Prediction - MESH

- Quick initial test done with implementing HRU approach in MESH
- Comparison of 2007 streamflow using traditional GRU approach and 6 HRU approach



Summary

- New parameters to be tested:
 - 1) The “Guan” number incorporates the relative influence of topology, advective heat and conductive heat on frost table depth and, in turn, hillslope storage capacity.
 - 2) Characteristic storage-discharge catchment curves that could be used with connectivity measures.
- In the meantime, model testing continues with representations of response units reflective of observed sub-catchment hydrological behaviour.



