Cold Regions Research Centre

IP3 Progress at Scotty Creek

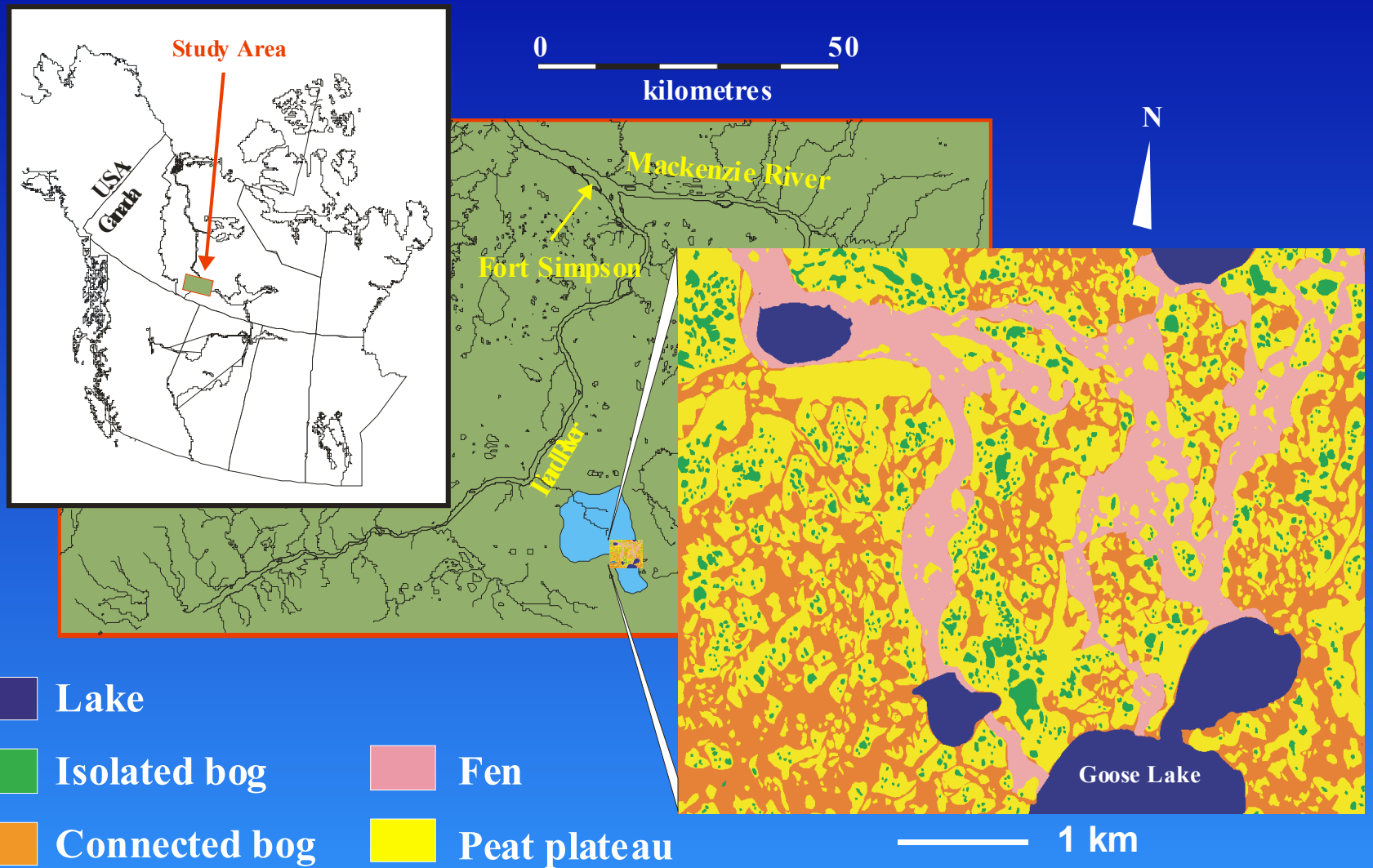
3rd Annual IP3 Workshop, Westmark Conference Centre, Whitehorse, Canada, 12-15 Nov., 2008

W. Quinton, M. Hayashi, N. Wright, L. Chasmer,
C. Hopkinson, R. Schincariol, F. Rezanezhad, R. Thorne,
A. Kenward, Y. Zhang, A. Verma, R. Petrone

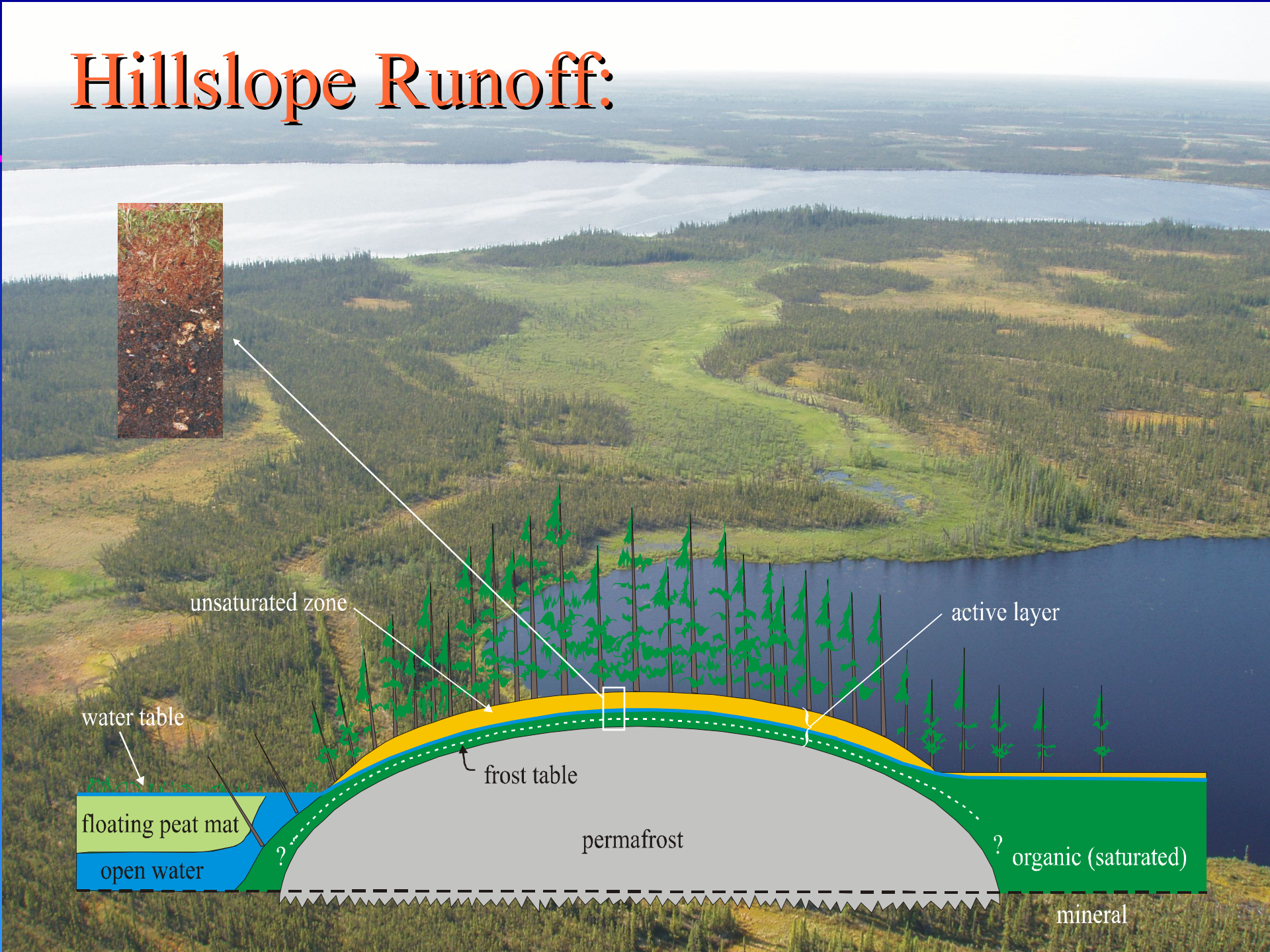
Wilfrid Laurier University

IP3
Improved Processes & Parameterisation for Prediction in Cold Regions

Scotty Creek, NWT, Canada:

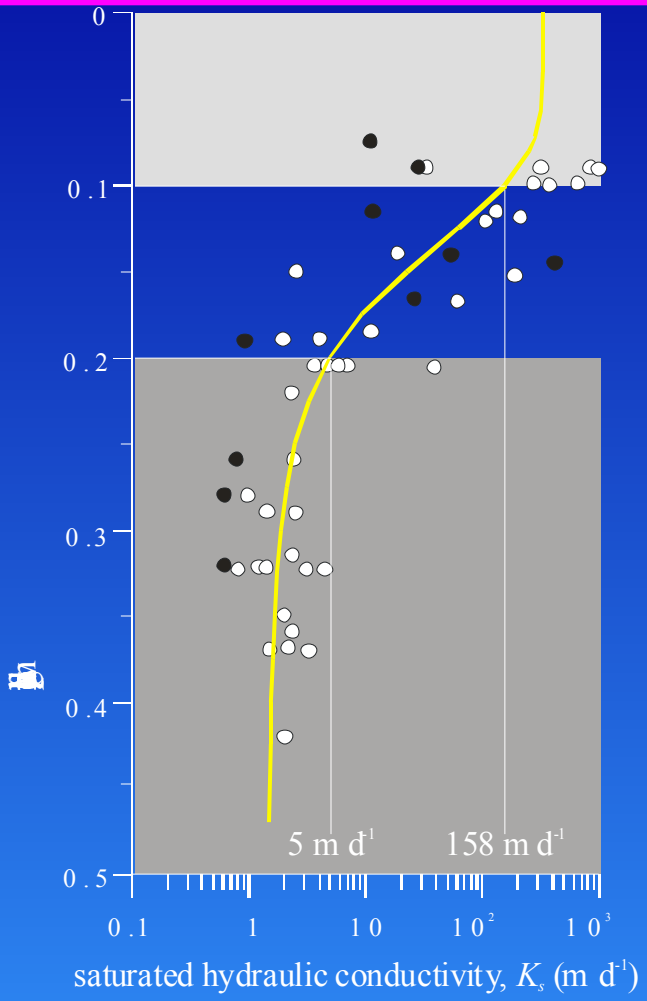


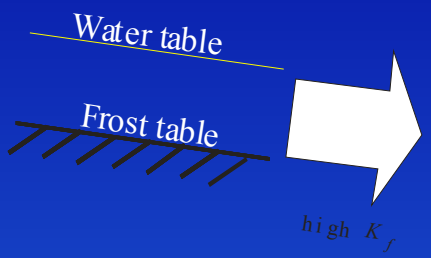
Hillslope Runoff:

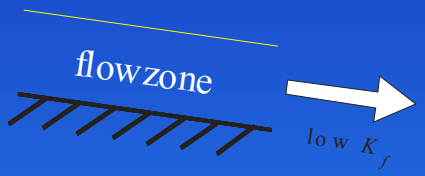


Hillslope Runoff:

Hydraulic conductivity profile:



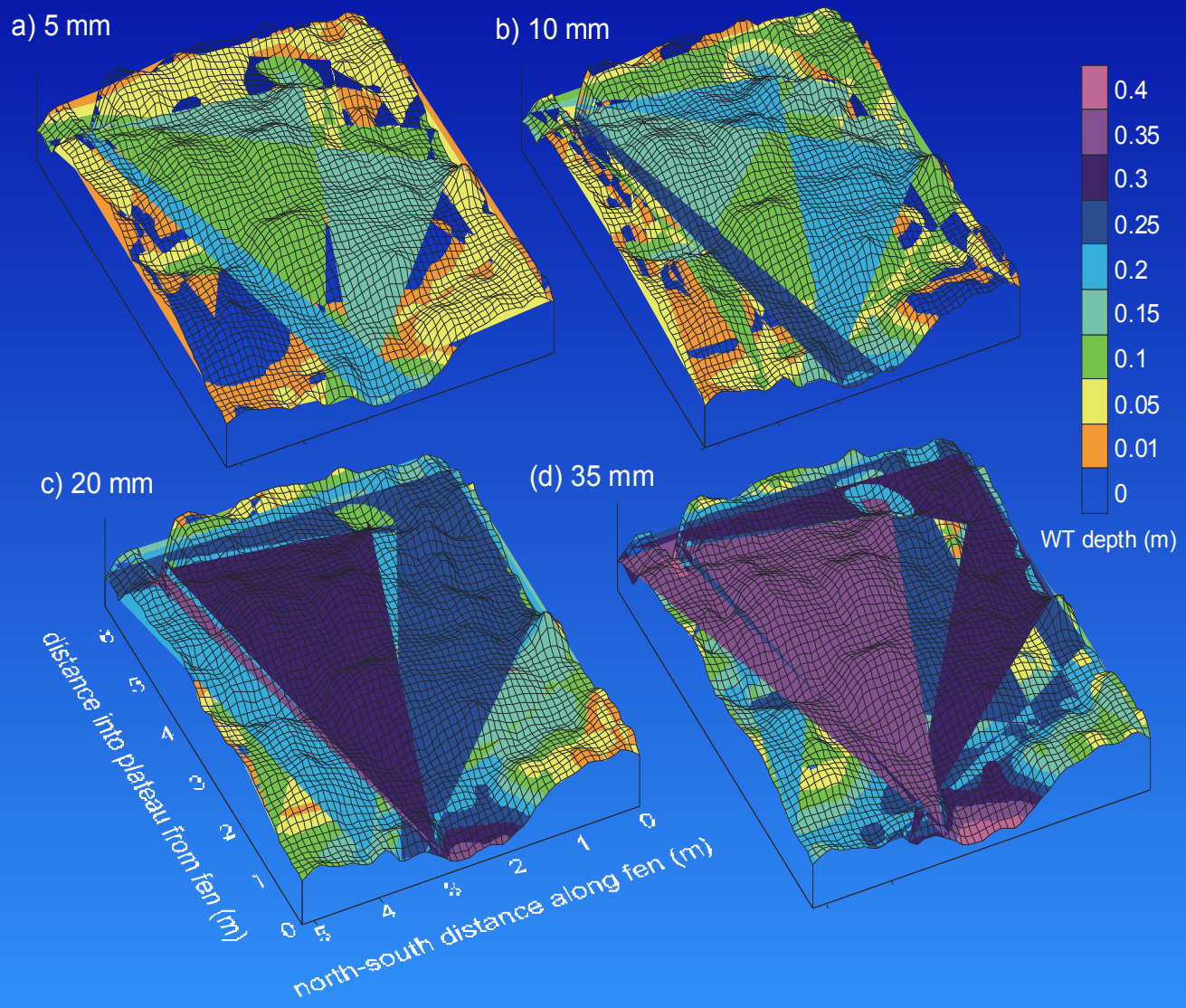




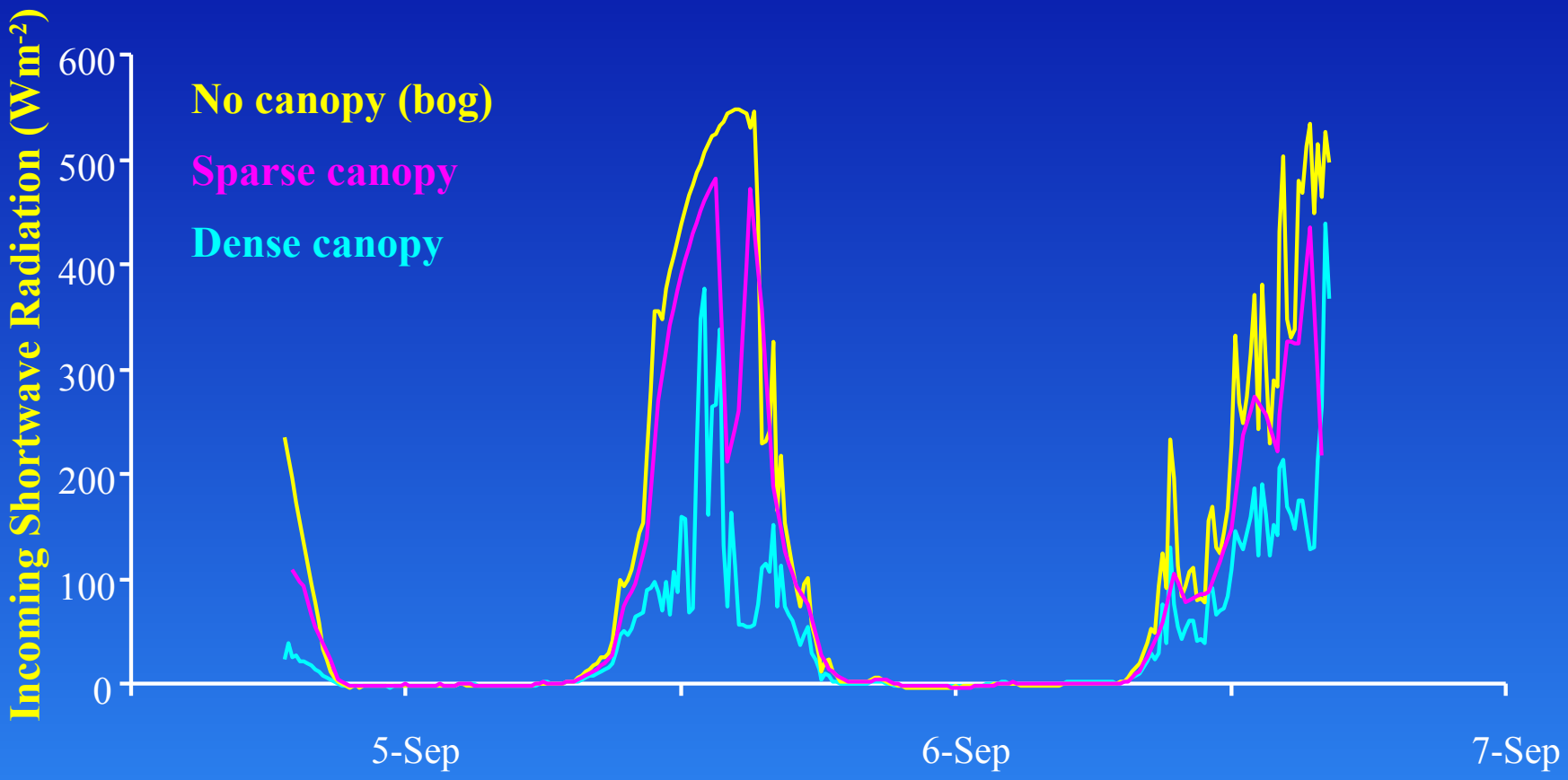
- Granger basin
- Other organic-covered, permafrost
- Uniformly high K_s
- Transitional K_s
- Uniformly low

$$\log K(z) = \frac{\log K_{bim} + (\log K_{top} - \log K_{bim})}{[1 + (z/z_{trn})^{n}]}$$

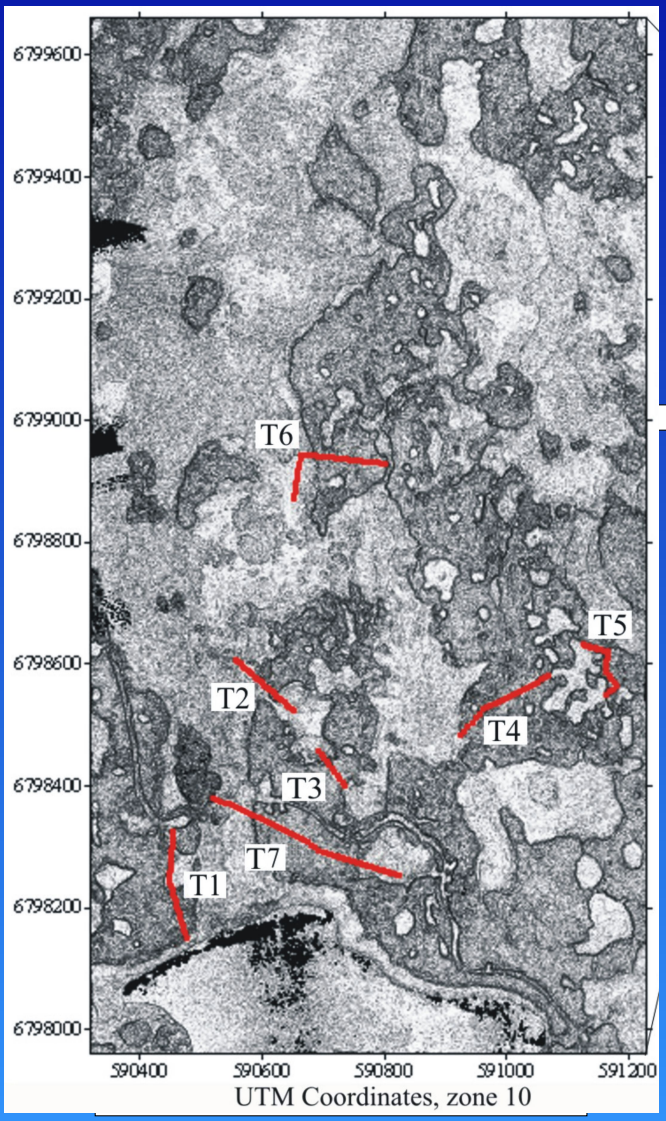
FT topography - runoff

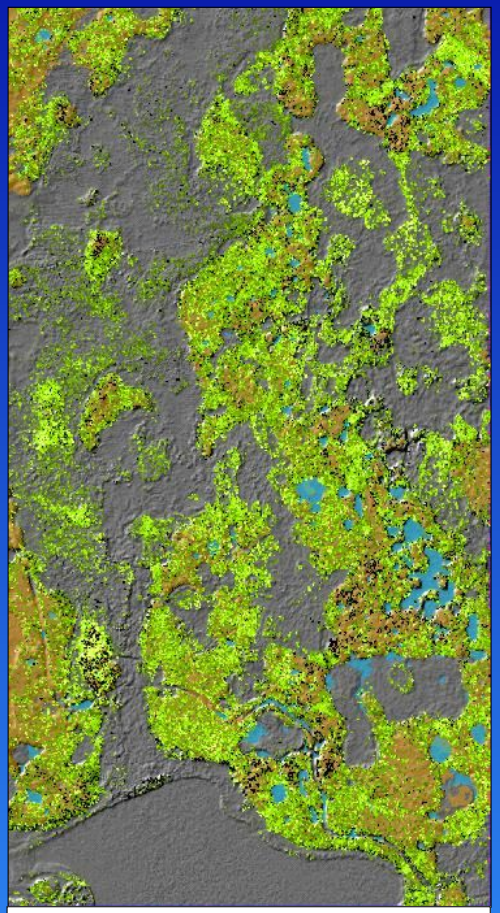


What controls FT depth distribution?

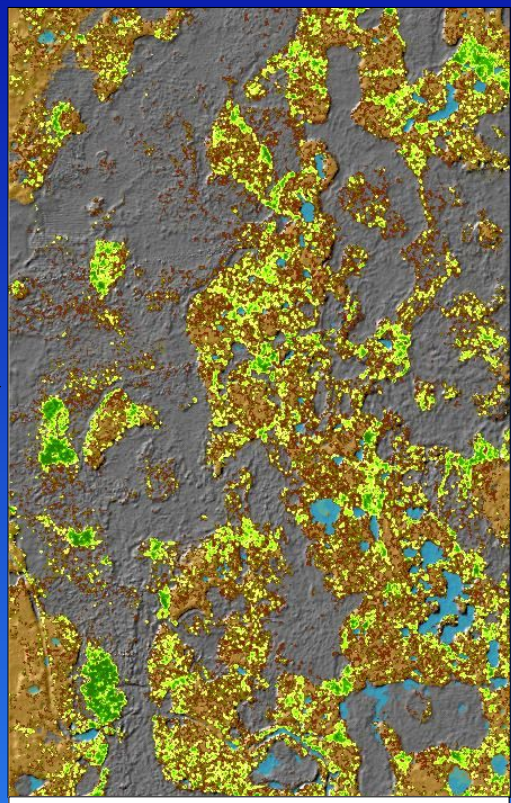


FT depth related to canopy:



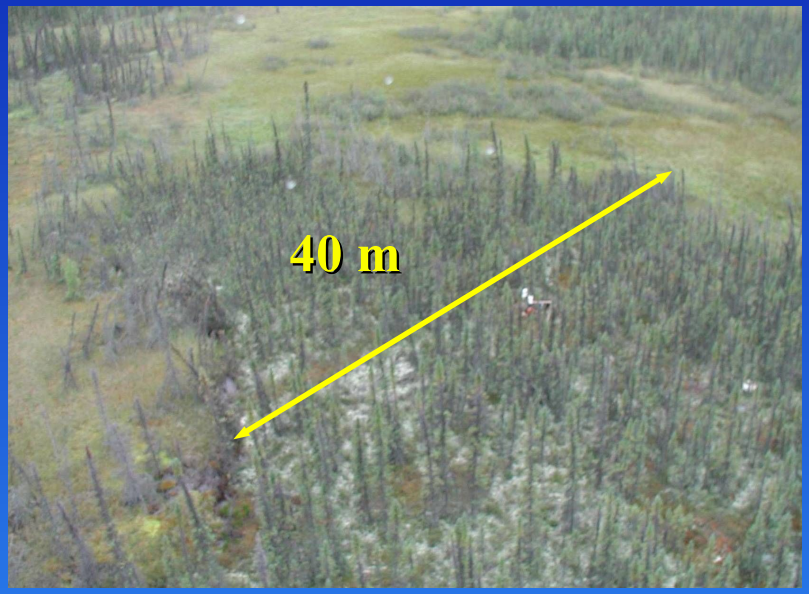


Lidar canopy height model: Shades of light to dark green =increasing canopy height from 0.7 m to 13 m



Shades of brown to green =increasing canopy fractional cover from 10%to 60%

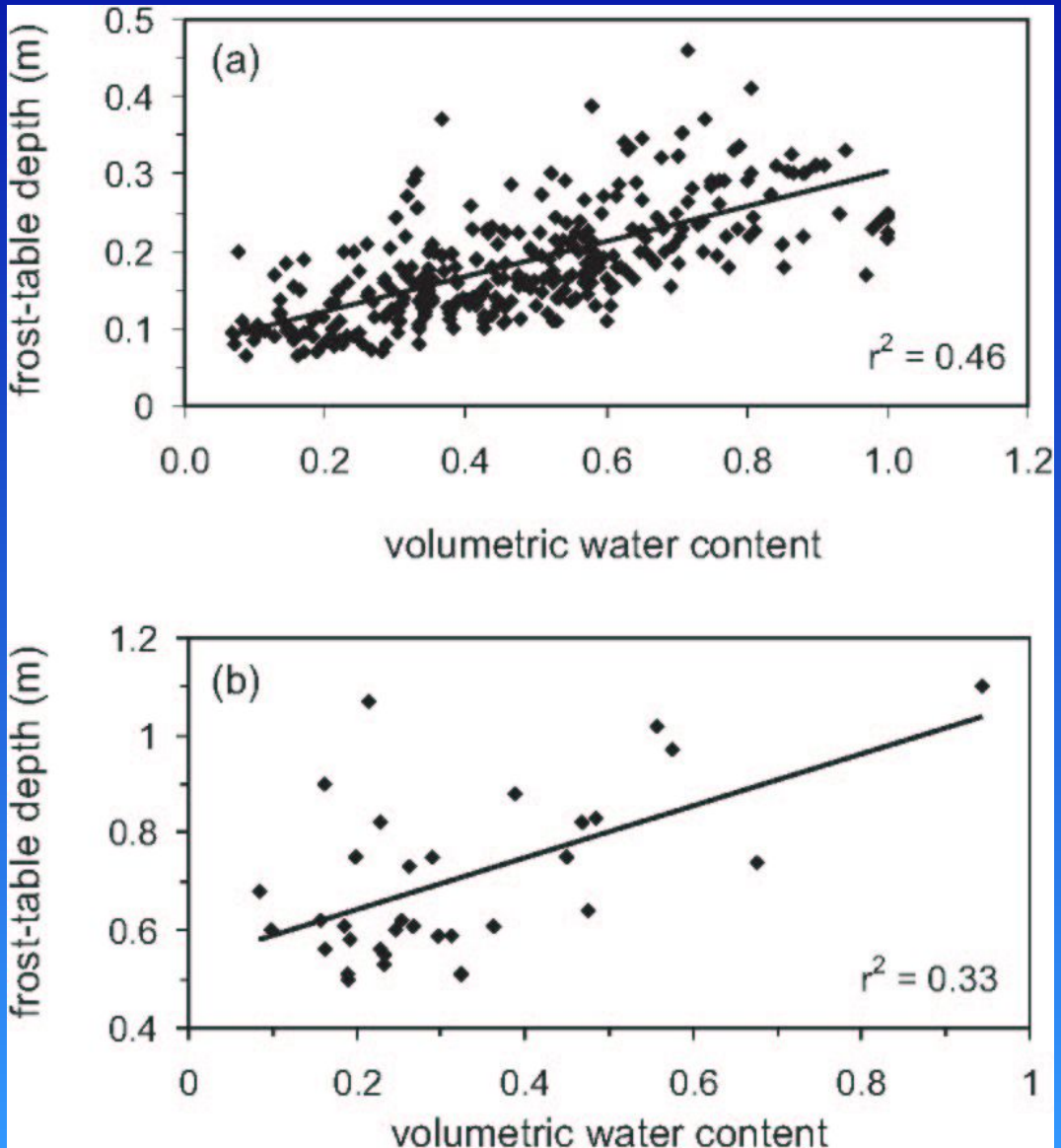
Ground surface albedo:



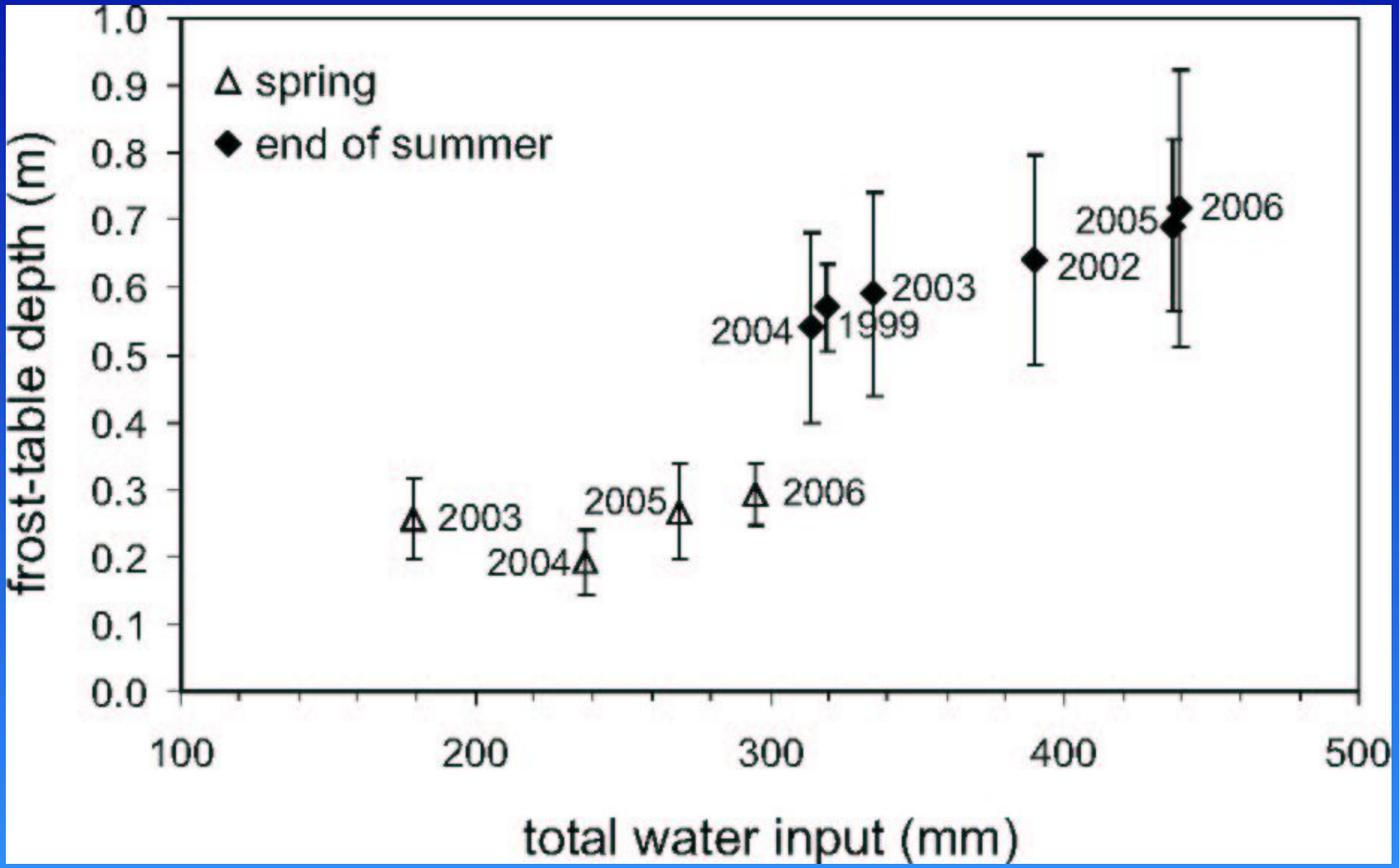
α = 0.19

α = 0.15

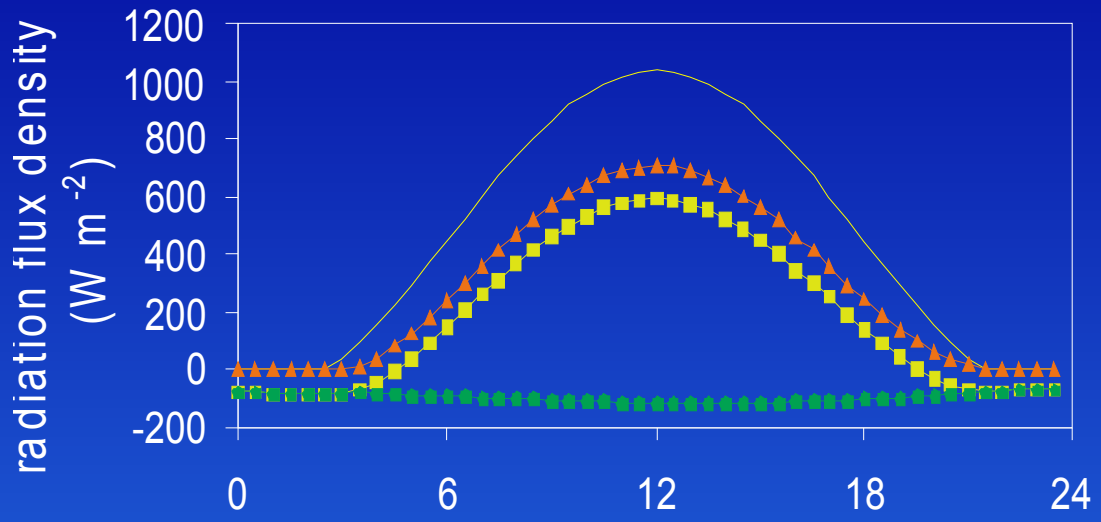
Soil moisture – FT depth:

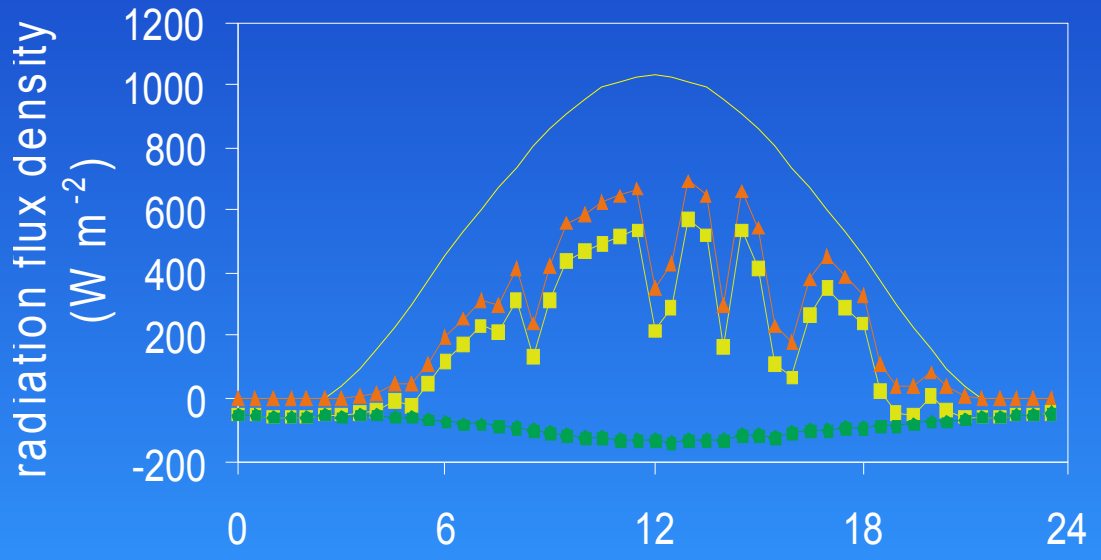


Seasonal moisture input:



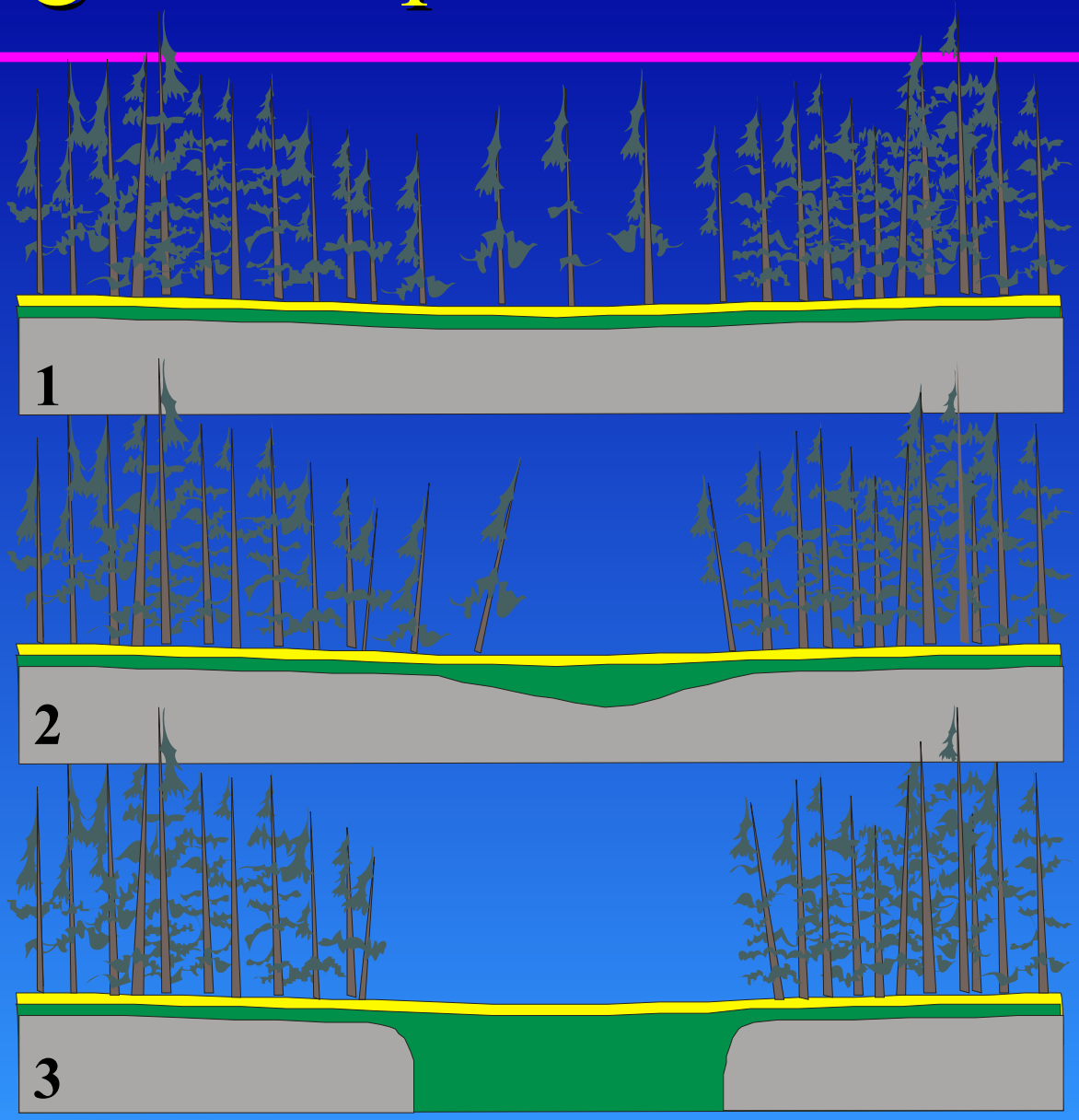
Sparse vs. no canopy surface RB:





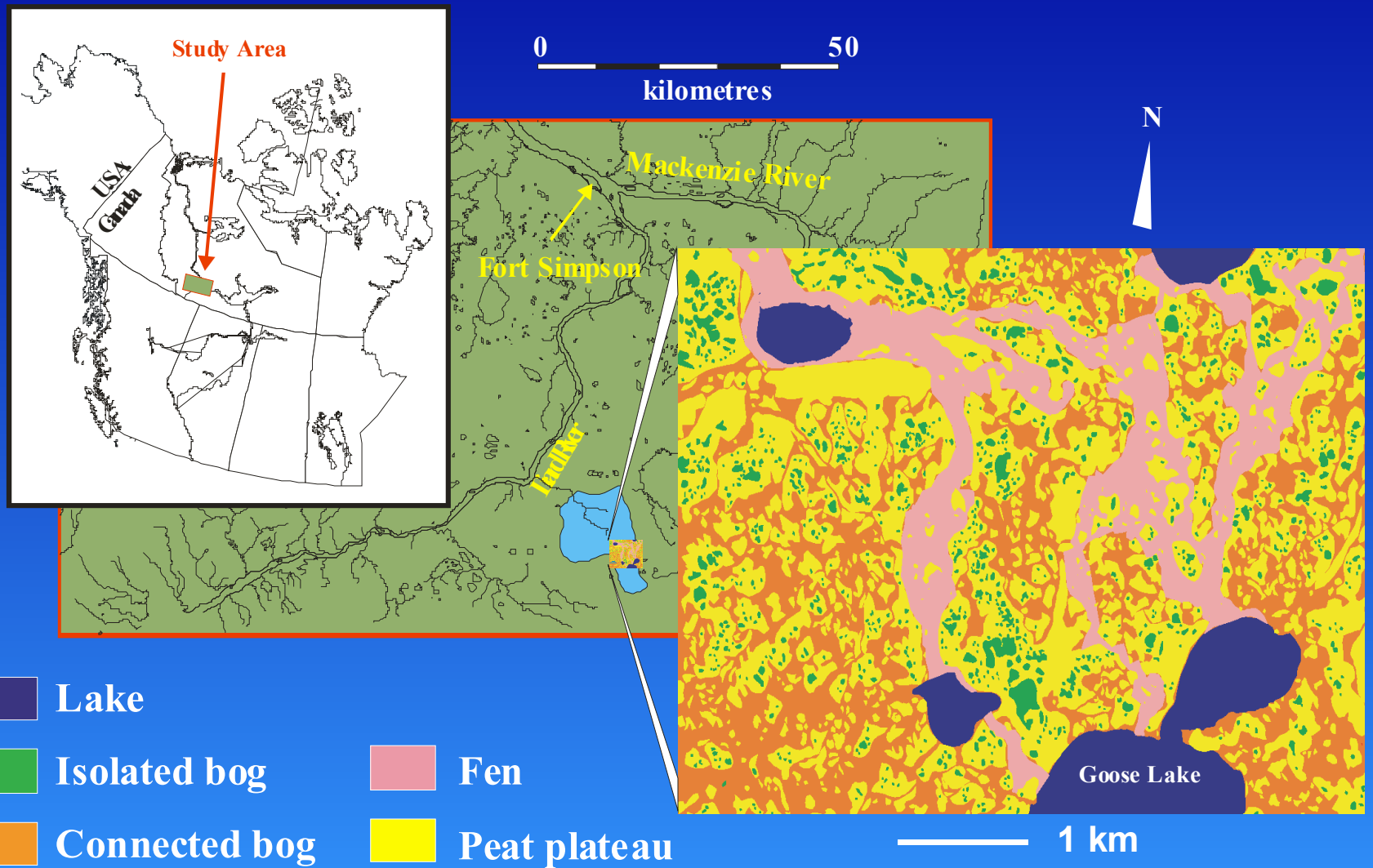
Kex K* Q* L*

Bog development - new model:

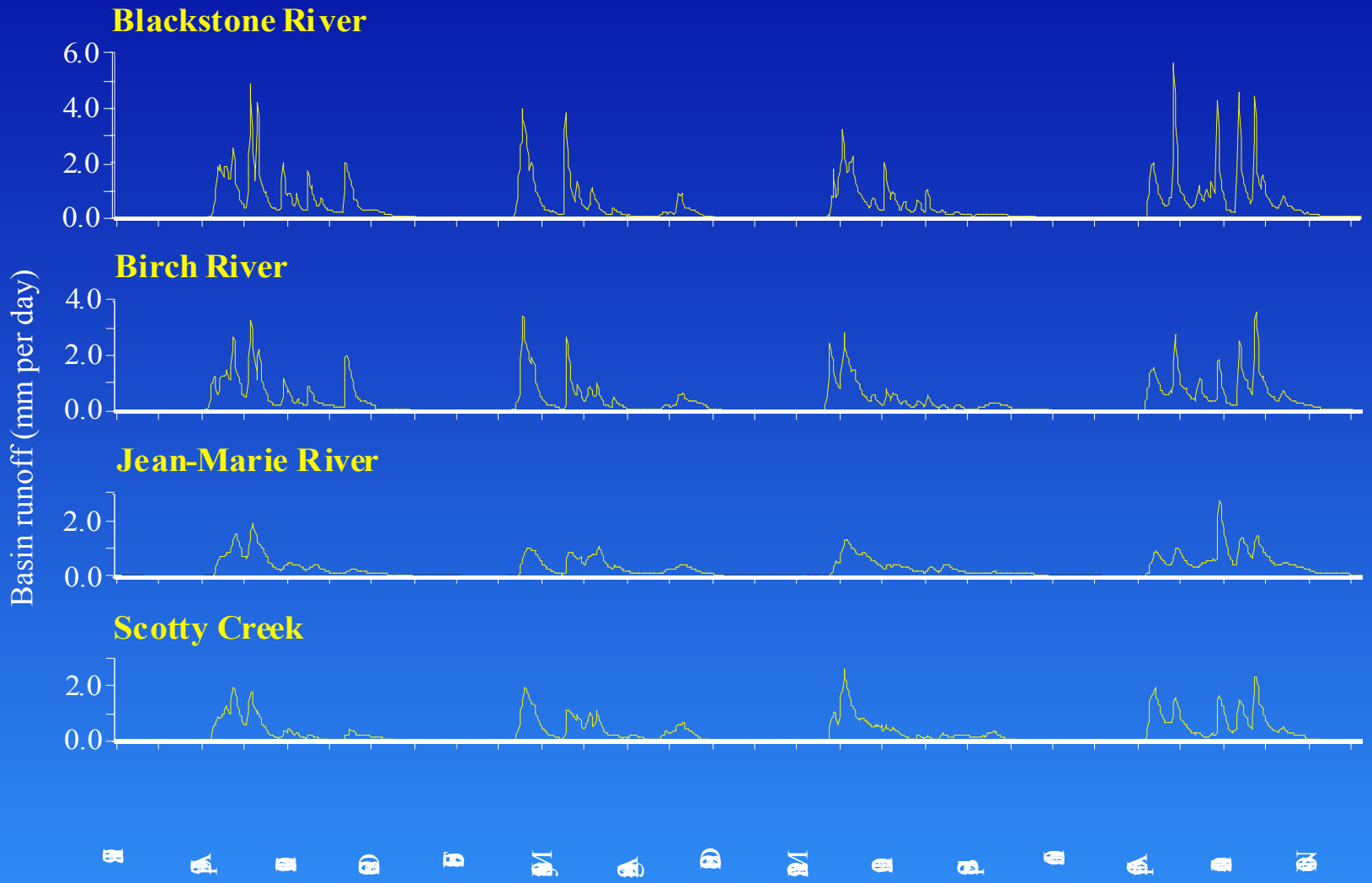


saturated, frozen
saturated, thawed
unsaturated, thawed

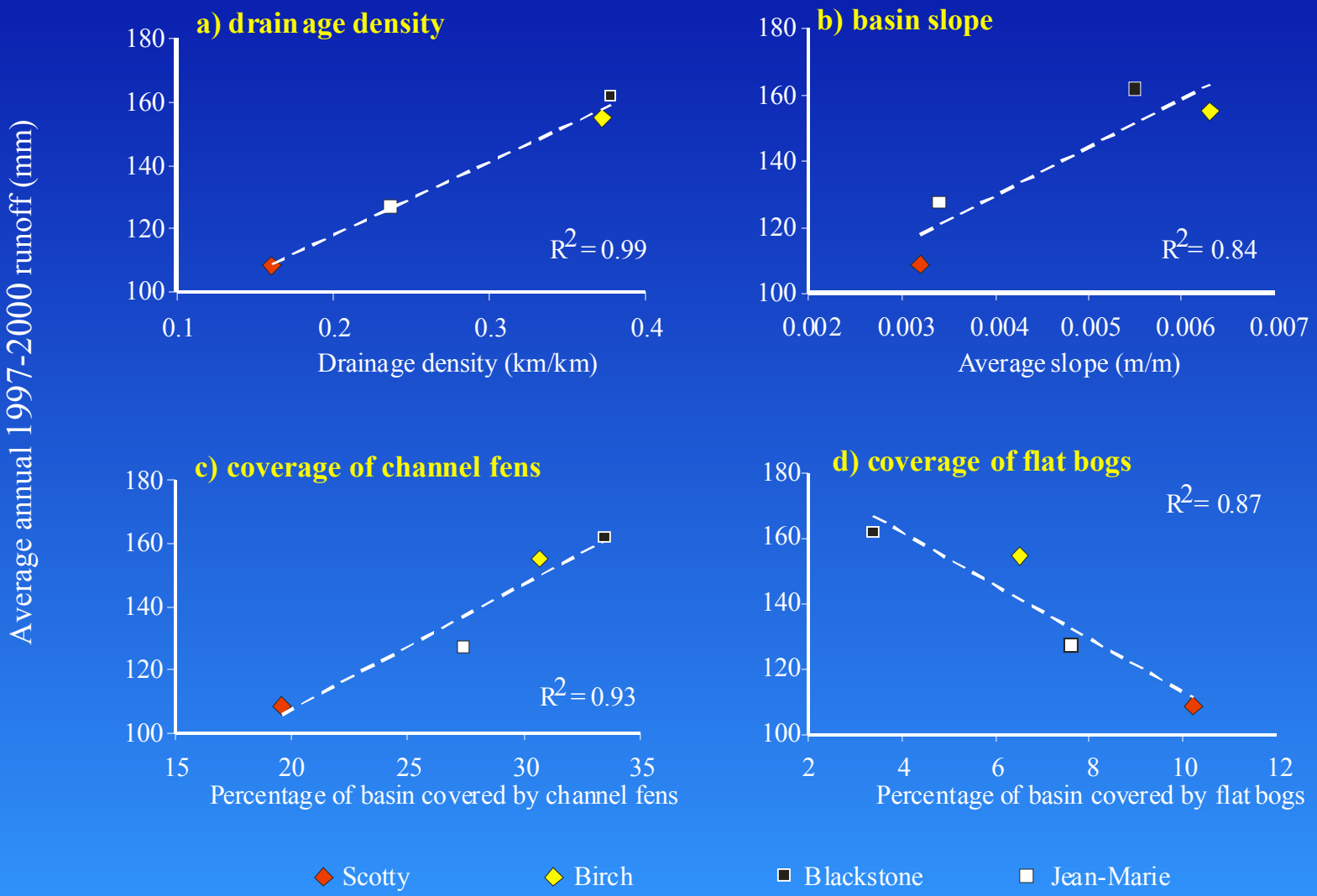
Ground cover - basin runoff:



Basin runoff in lower Liard valley:



Change cover = change runoff?



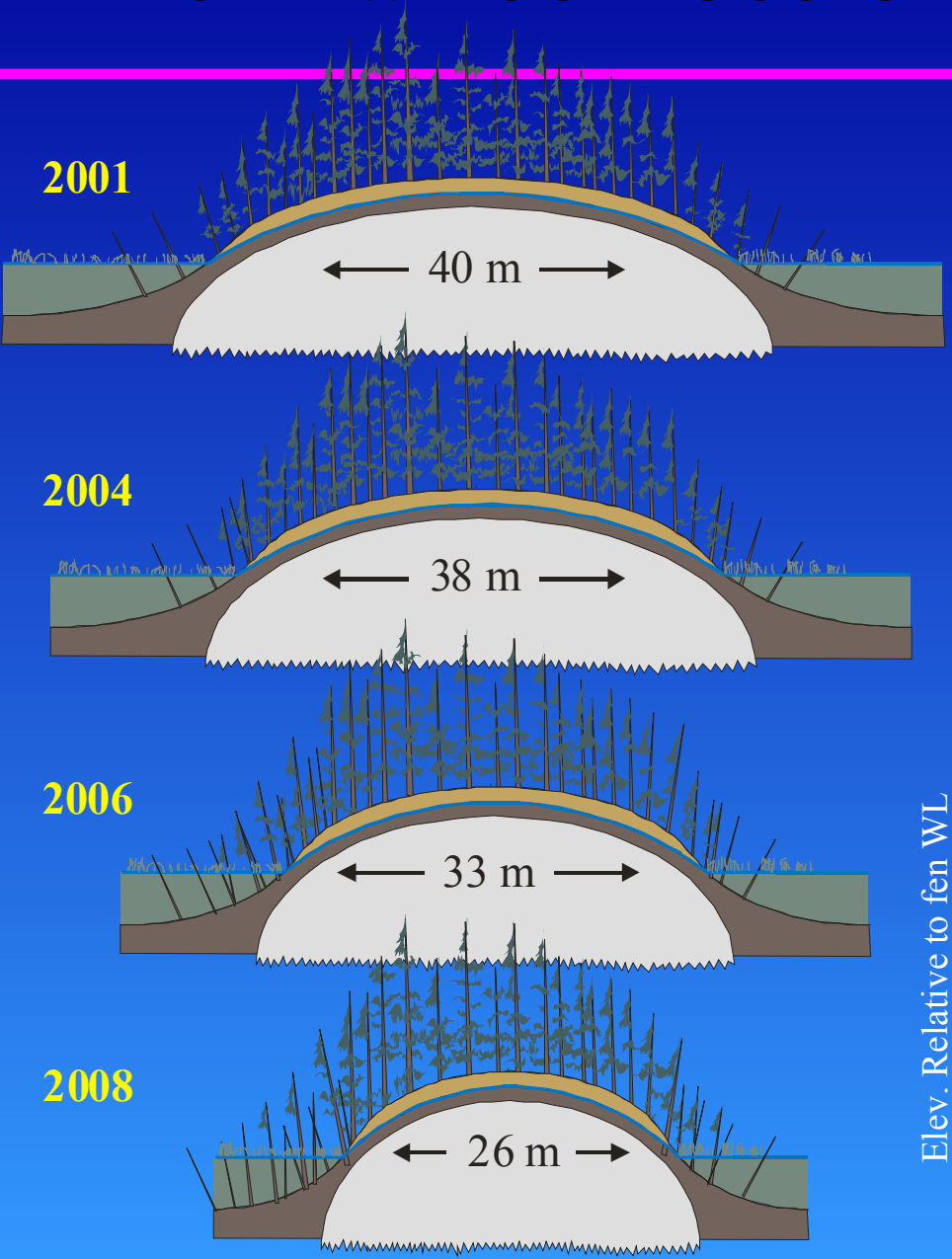
Shifting boundaries:

Shifting boundaries - rates:

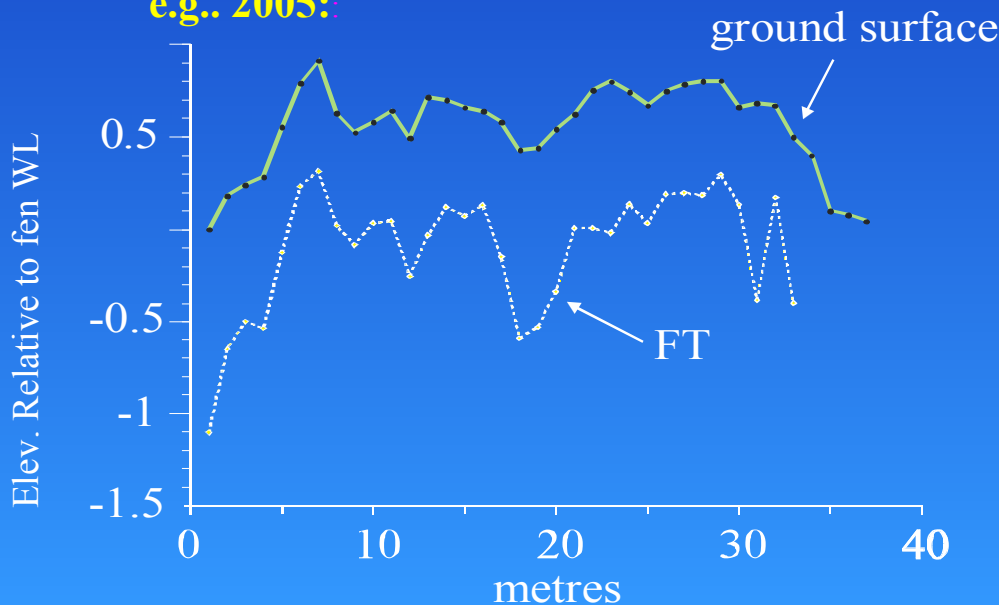
Peat profile warming:

2001	2002	2003	2004	2005	2006	2007	2008
Annual:							
- -	- -	0.58° (1.51°)	0.29° (0.62°)	1.82° (2.25°)	2.97° (3.08°)	2.68° (3.34)	- -
Beginning 25 August:							
0.75° (1.17°)	0.32° (0.40°)	0.61° (0.76°)	0.57° (-1.13°)	0.97° (0.33°)	2.32° (1.82°)	0.91° (0.81°)	- -
Ending 13 July:							
- -	-0.54° (-0.30°)	-0.80° (-0.11°)	-0.33° (0.16°)	0.7° (1.4°)	1.54° (1.7°)	2.07° (2.7°)	3.11° (2.7°)

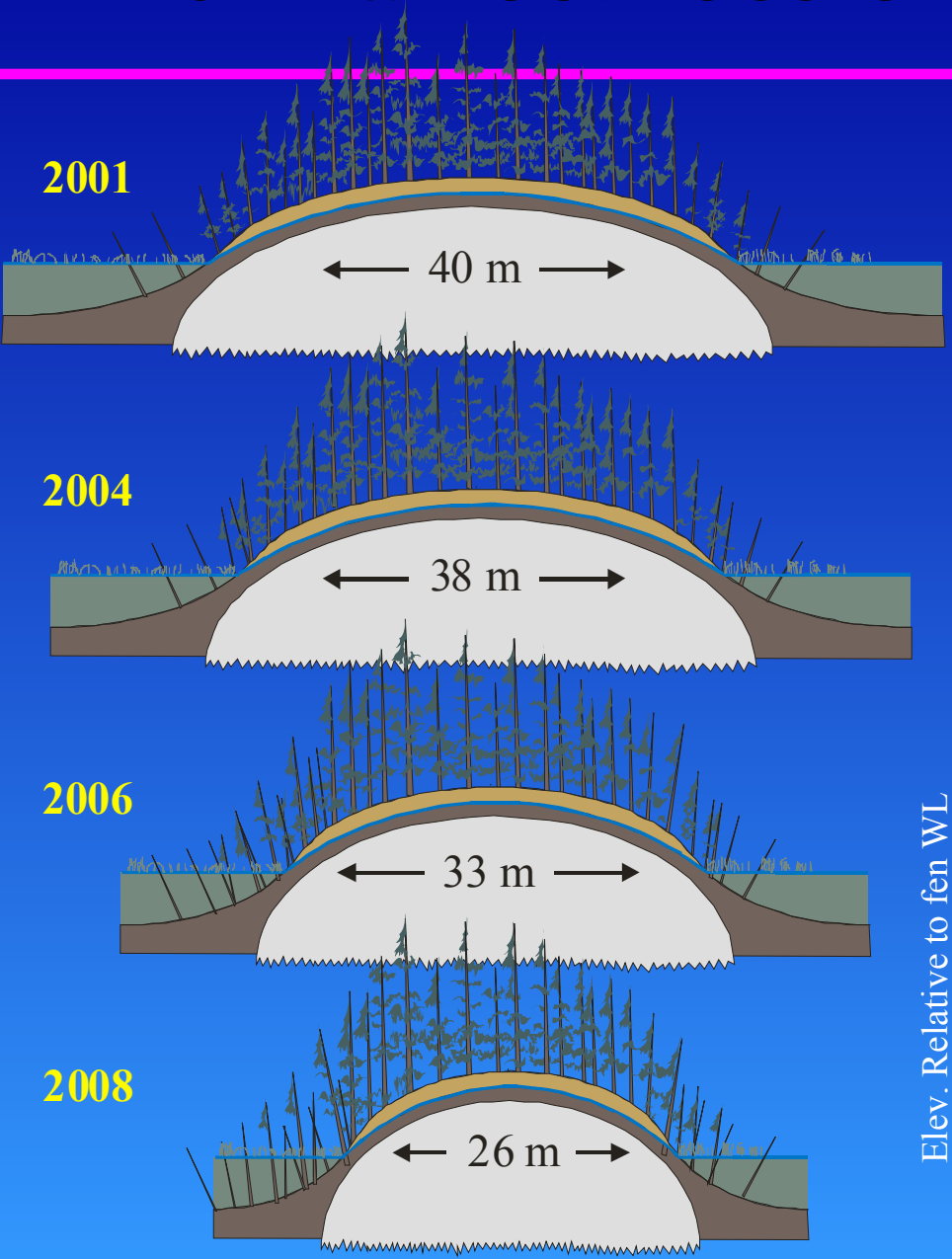
Permafrost loss on a plateau:



e.g.. 2005:

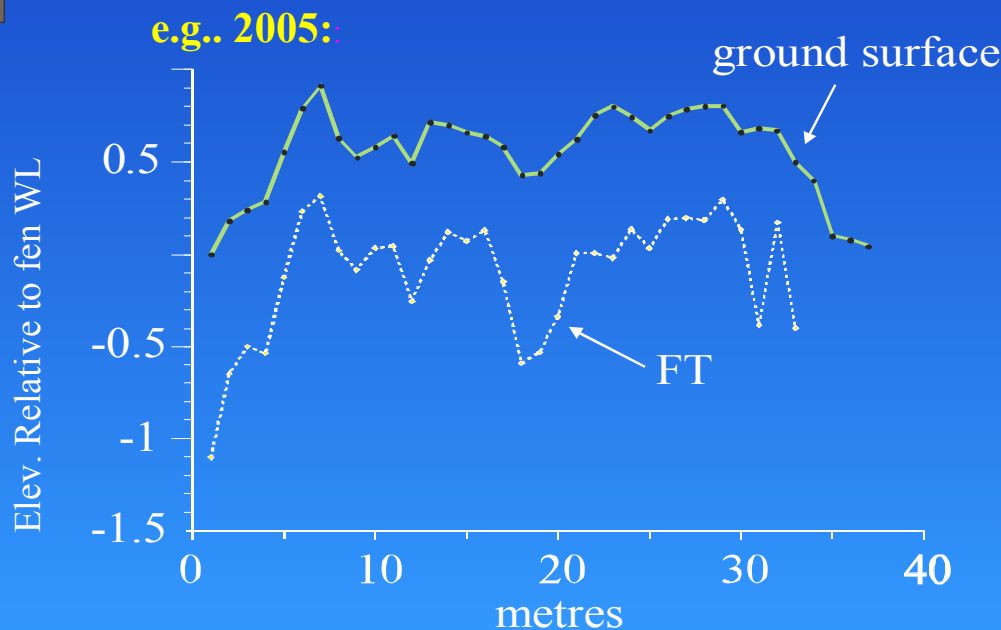


Permafrost loss on a plateau:

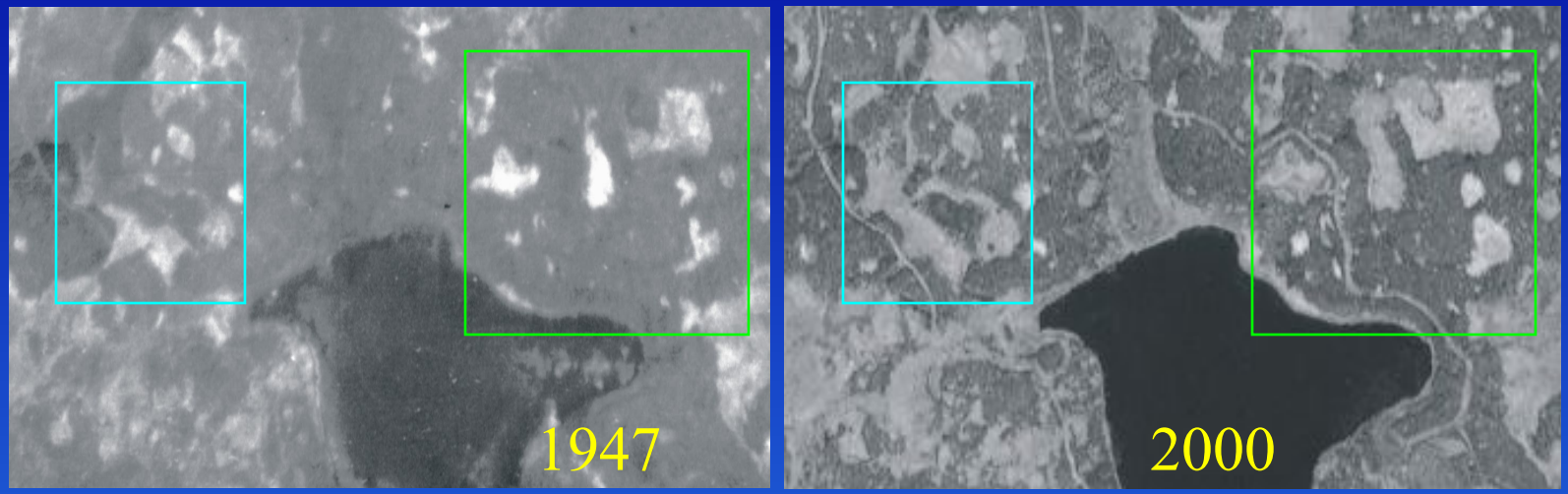


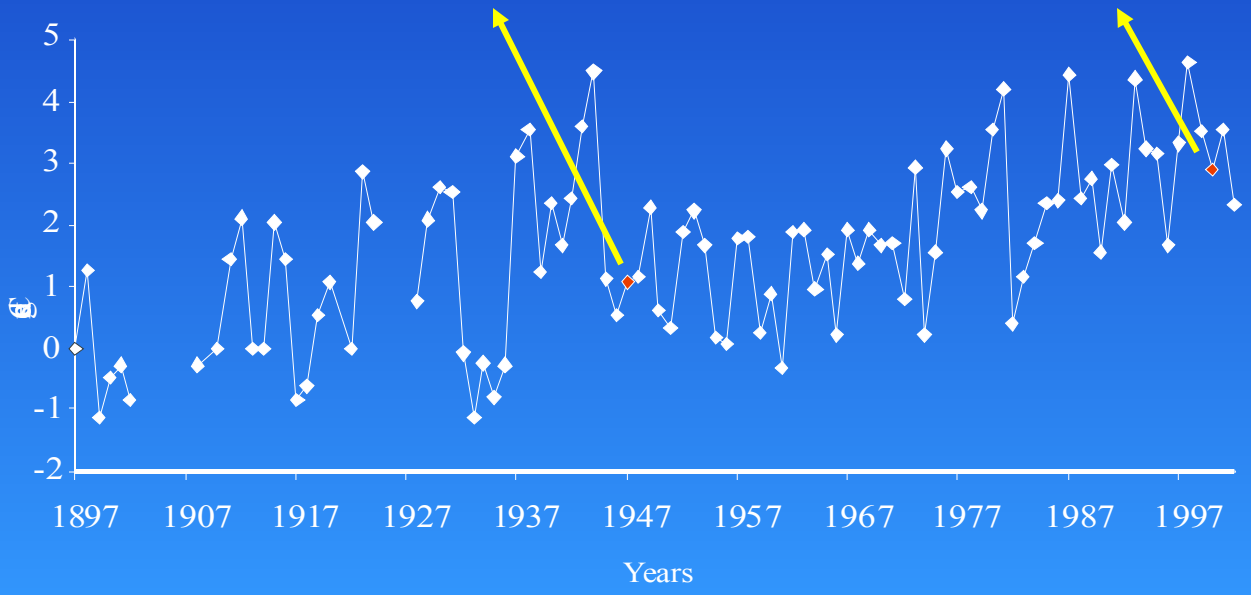
Changes since 1999:

- Decrease in plateau width = 15.8 m
- Loss on fen side = 10.7 m
- Avg. annual loss = 1.76 m
- Number of years remaining ~15

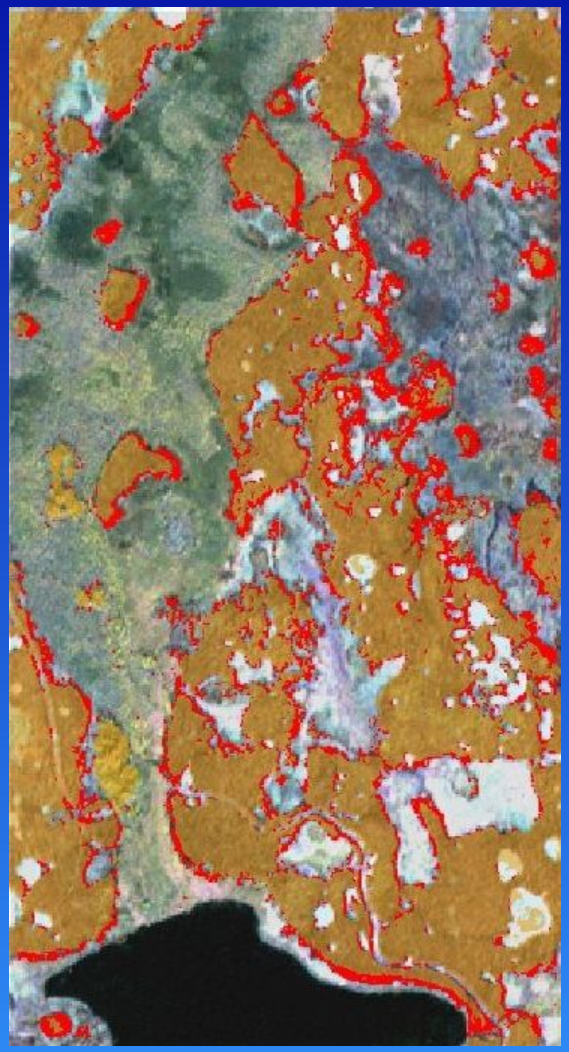


Permafrost melt:

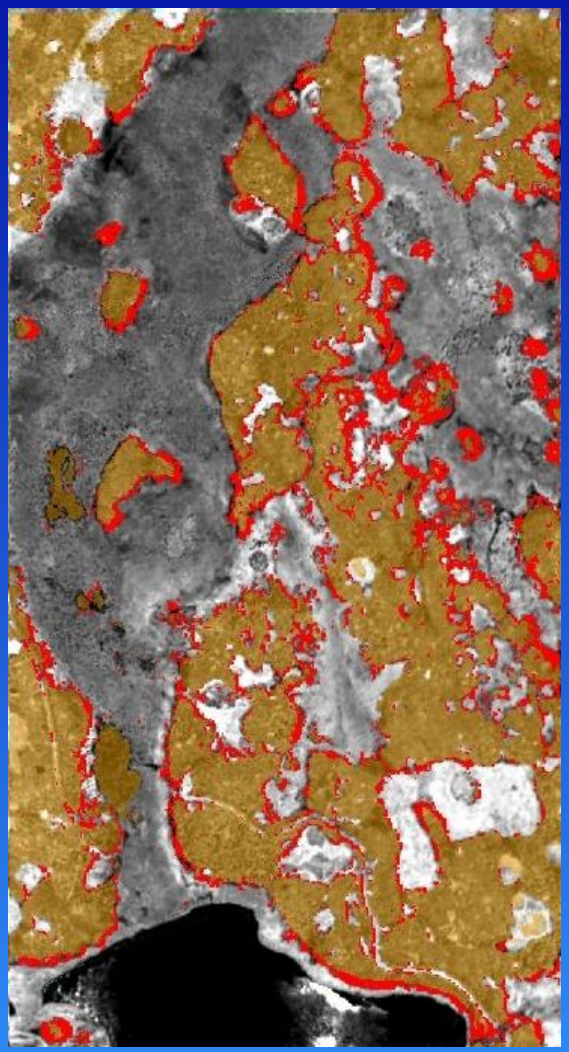




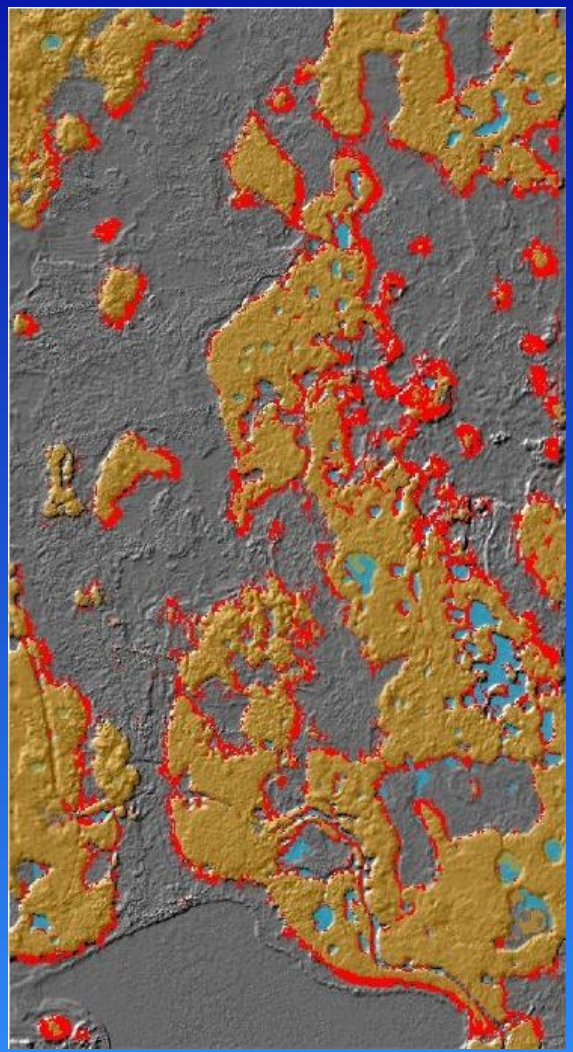
Permafrost loss 2000 – 2008:



IKONOS 2000 false colour composite with lidar-classified plateaus (brown). Red = retreat of permafrost since 2000.



Imagery includes laser pulse intensity. Split pulses are darker than single pulses except where absorbed by water.



Shaded lidar DEM with 2008 peat plateaus (brown) and disconnected sinks (blue). Red = permfrost loss since 2000.

Permafrost loss - summary:

- 1947 – 2000: ~30% permafrost loss. Approx 90 yrs. remaining.
- 2000 – 2008: 19% permafrost loss. Approx. 32 yrs. remaining.
- 1999 – 2008: 38% loss of permafrost. Approx. 15 yrs. remaining.

On-going IP3 activities include:

- Examine canopy influence on FT depth distribution
- Other influences on FT – examined at plots and transects
- Chamber studies – internal energy and water cycling
- CRHM modelling for a PP slope 2001 – 2008
- Runoff input from overall PP cover
- Contribute toward MESH runs for Scotty