Devito K, Creed I, Gan T, Mendoza C, Petrone R, Silins U, Smerdon B. 2005.

A framework for broad-scale classification of hydrologic response units on the boreal plain: is topography the last thing to consider?

Hydrological Processes 19: 1705-1714.

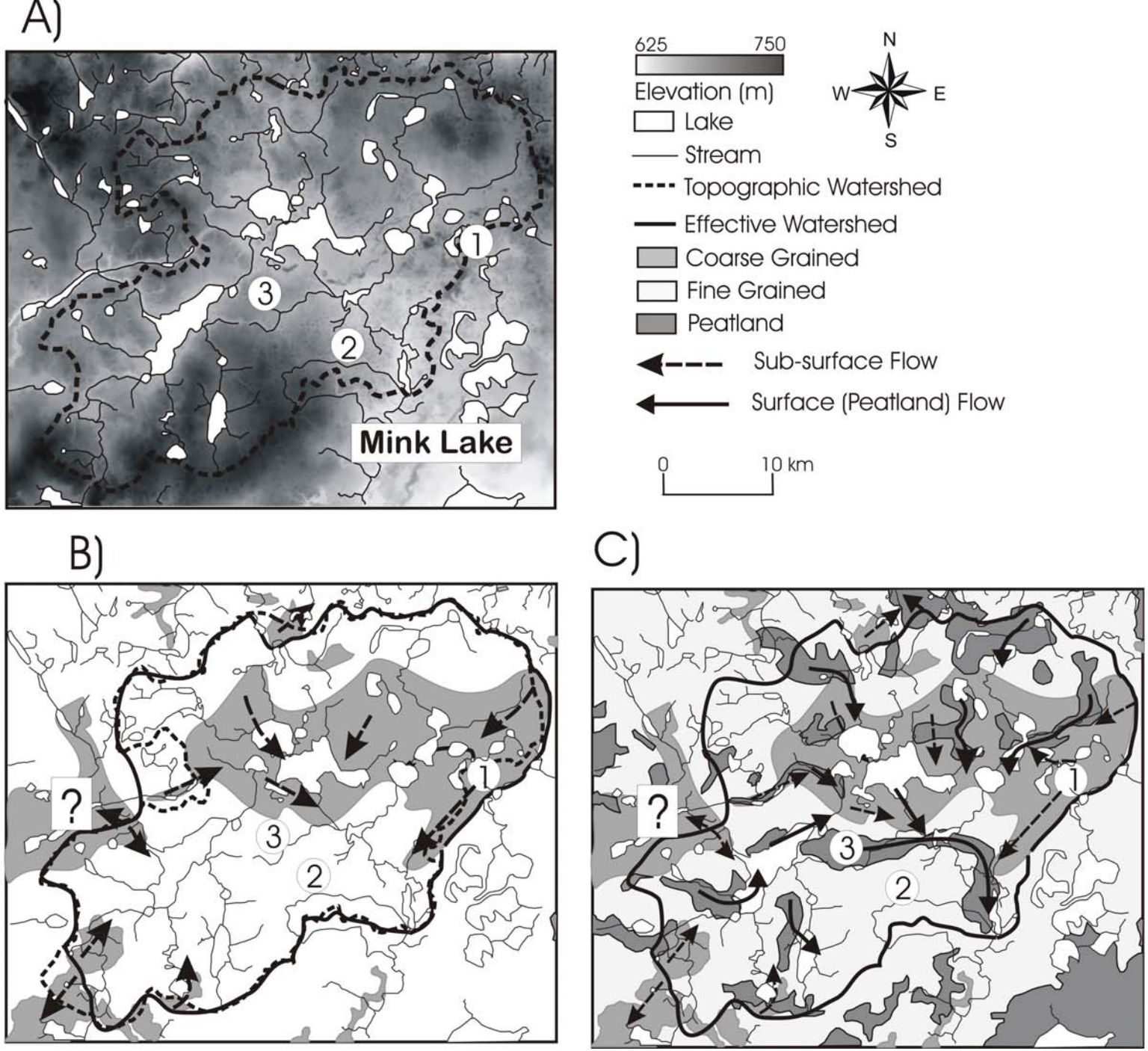
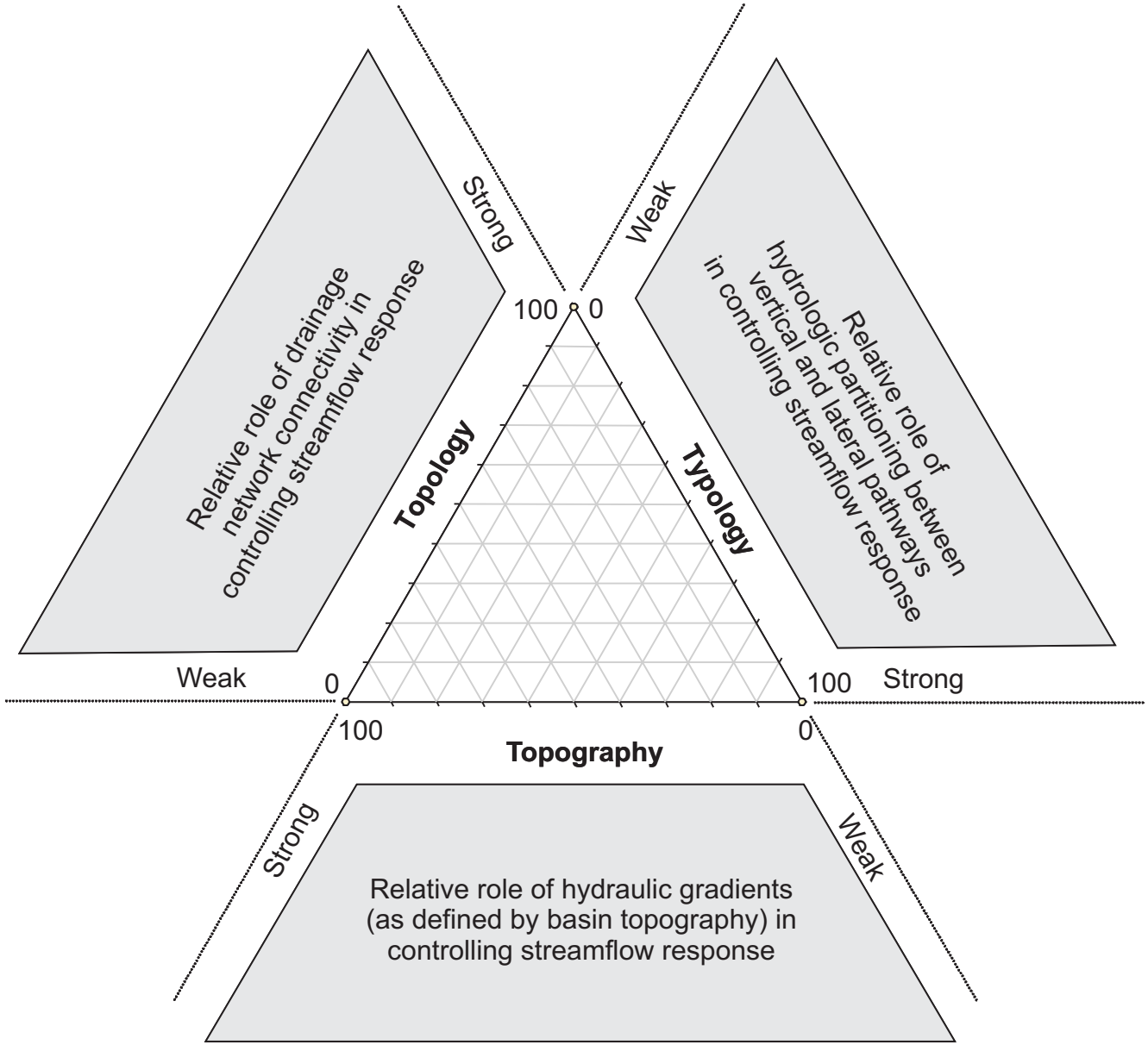
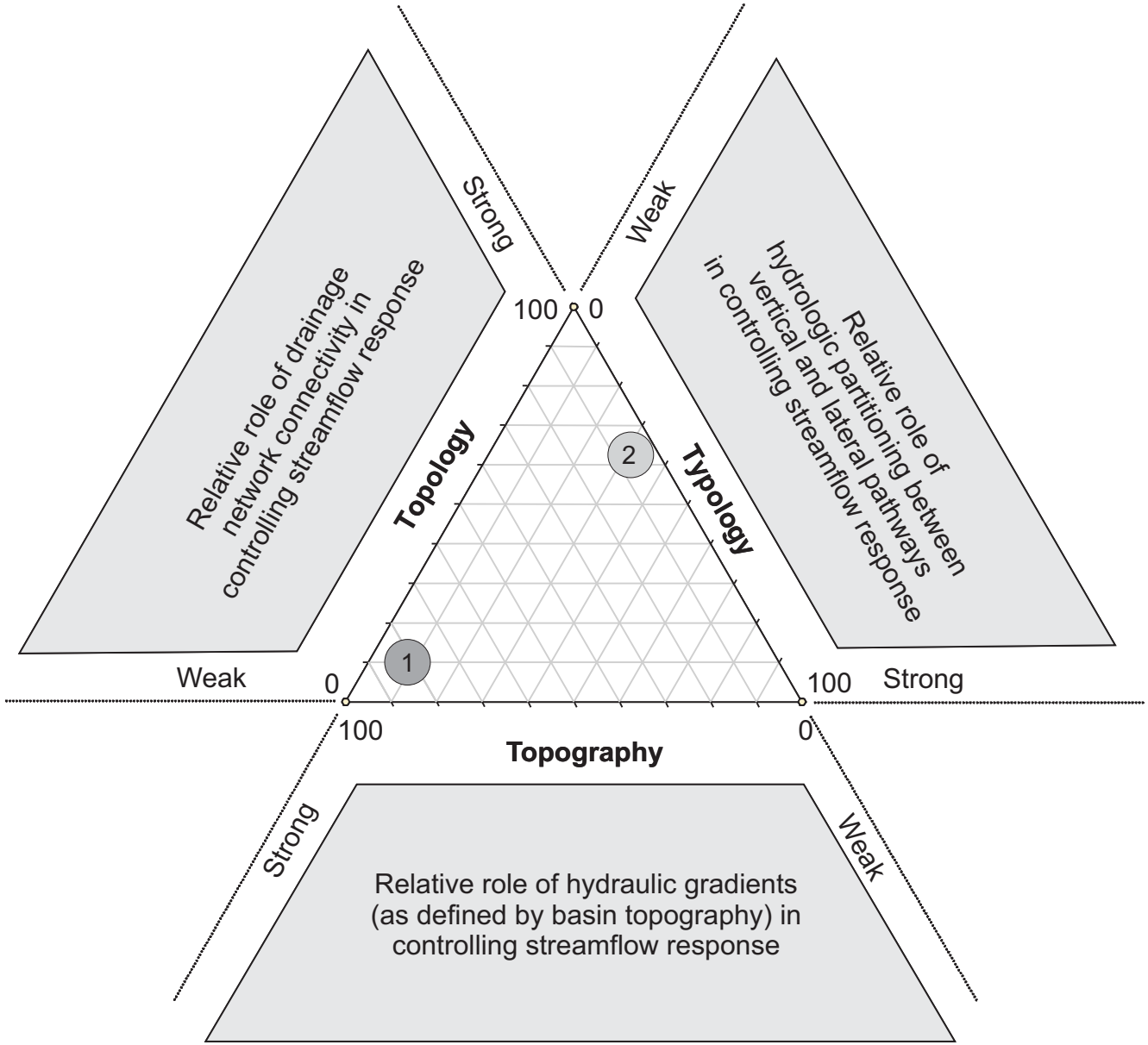

A)
625
750
Elevation (m)
Lake
Stream
Topographic Watershed
Effective Watershed
Coarse Grained
Fine Grained
Peatland
Sub-surface Flow
Surface (Peatland) Flow
0
10 km
N
W
E
S
Mink Lake
1
2
3
B)
C)
?

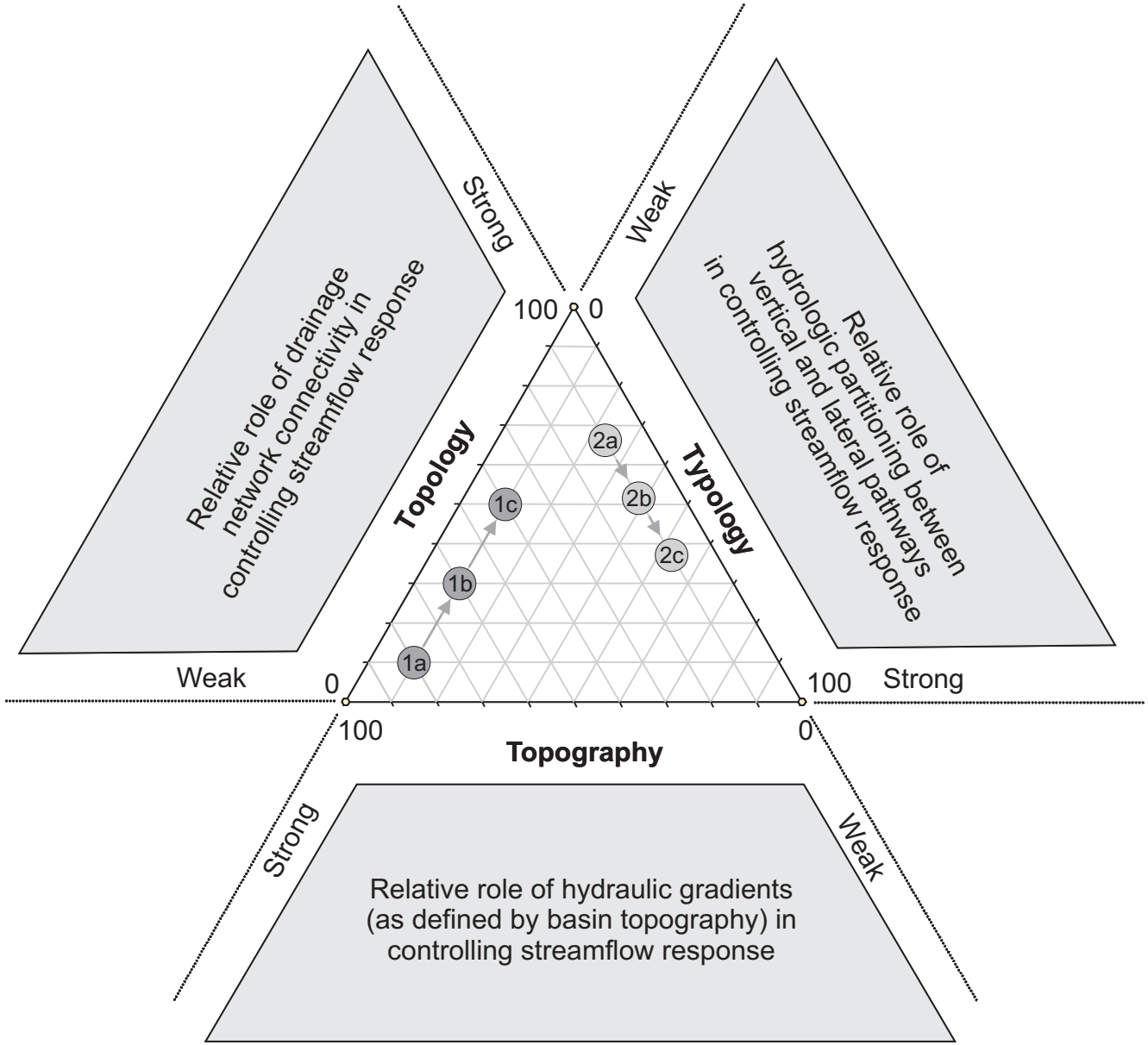
Table 1: Hierarchical classification to generalize the dominant controls on water cycling and indices to define effective hydrologic response units. The specified order (i.e., A. to E.) should be followed to develop a conceptual framework to determine the dominance of specific components of the hydrological cycle and to determine the scale of interaction (e.g., local to regional) that should be considered.

Factor		***Range of Factor***		***Scale***
A	**Climate**	**Dry, arid to sub-humid (P < PET)** -R poorly correlated with P -storage or uptake dominates -tendency for vertical flow	**Wet, humid (P > PET)** -R closely correlated with P -runoff dominates -tendency for lateral flow	**Continental to Local**
B	**Bedrock Geology**	**Permeable bedrock** •intermediate to regional flow systems •lack of topographic control on direction of local flow •vertical flow dominates in surface substrate **Bedrock slope perpendicular to land surface** -complex watershed boundaries -regional aquifer definition needed to determine flow direction	**Impermeable bedrock** •characterized by local to intermediate flow systems •topographic control on direction of local flow •lateral flow dominates in surface substrate **Bedrock slope parallel to land surface** -simple watershed boundaries	**Continental to Regional**
C	**Surficial Geology**	**Deep substrates** -intermediate to regional flow **Coarse texture** -vertical flow -deeper subsurface flow **Spatially heterogeneous deposits** -complex groundwater flow systems -groundwater flow modeling important	**Shallow substrates** -local flow most probable (but see bedrock geology) **Finer texture** -lateral flow -depression storage and/or surface and shallow subsurface flow **Spatially homogeneous deposits** -simple groundwater flow systems -surface flow modeling important	**Regional to Local**

Factor		*Range of Factor*		*Scale*
D	**Soil Type & Soil Depth**	**Upland mineral soils** •subsurface flow dominates •slow flow generation (matrix flow) **Storage** •deeper soils with large water storage potential **Transpiration** •deep roots access stored water •P ≈ AET during dry periods	**Lowland organic soils** •return flow and surface overland flow pathways dominate •quick flow generation (return flow, saturation overland flow) **Storage** •shallower soils with small water storage potential •lower specific yield of organic soils and compression leads to surface saturation **Transpiration** •shallower roots limit access to stored water •AET<PET during dry periods	**Local to Regional**
E	**Topography & Drainage Network**	**Gentle Slopes** •disorganized, inefficient drainage network •large groundwater recharge •small, variable runoff yield	**Steep Slopes** •organized, efficient drainage network •small groundwater recharge •large, uniform runoff yield	**Local to Regional**


Strong
Weak
100
0
Relative role of drainage network connectivity in controlling streamflow response
Relative role of hydrologic partitioning between vertical and lateral pathways in controlling streamflow response
Topology
Typology
Weak
0
100
Strong
100
0
Topography
Strong
Weak
Relative role of hydraulic gradients (as defined by basin topography) in controlling streamflow response


Strong
Weak
100
0
Relative role of drainage network connectivity in controlling streamflow response
Relative role of hydrologic partitioning between vertical and lateral pathways in controlling streamflow response
Topology
Typology
2
1
Weak
0
100
Strong
100
0
Topography
Strong
Weak
Relative role of hydraulic gradients (as defined by basin topography) in controlling streamflow response


Strong
Weak
100
0
Relative role of drainage network connectivity in controlling streamflow response
Relative role of hydrologic partitioning between vertical and lateral pathways in controlling streamflow response
Topology
Typology
1a
1b
1c
2a
2b
2c
Weak
0
100
Strong
100
0
Topography
Strong
Weak
Relative role of hydraulic gradients (as defined by basin topography) in controlling streamflow response