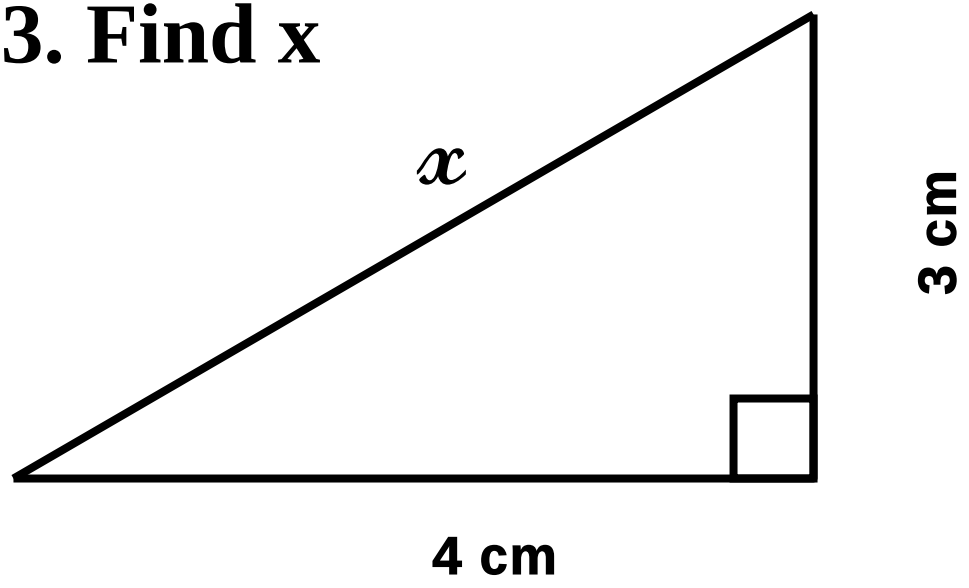
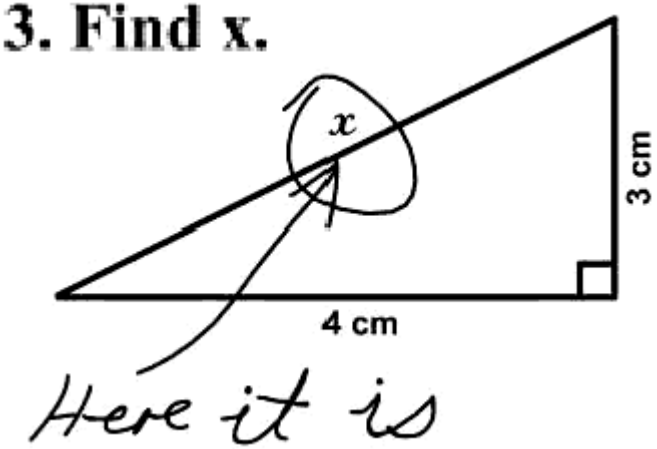
3. Find x

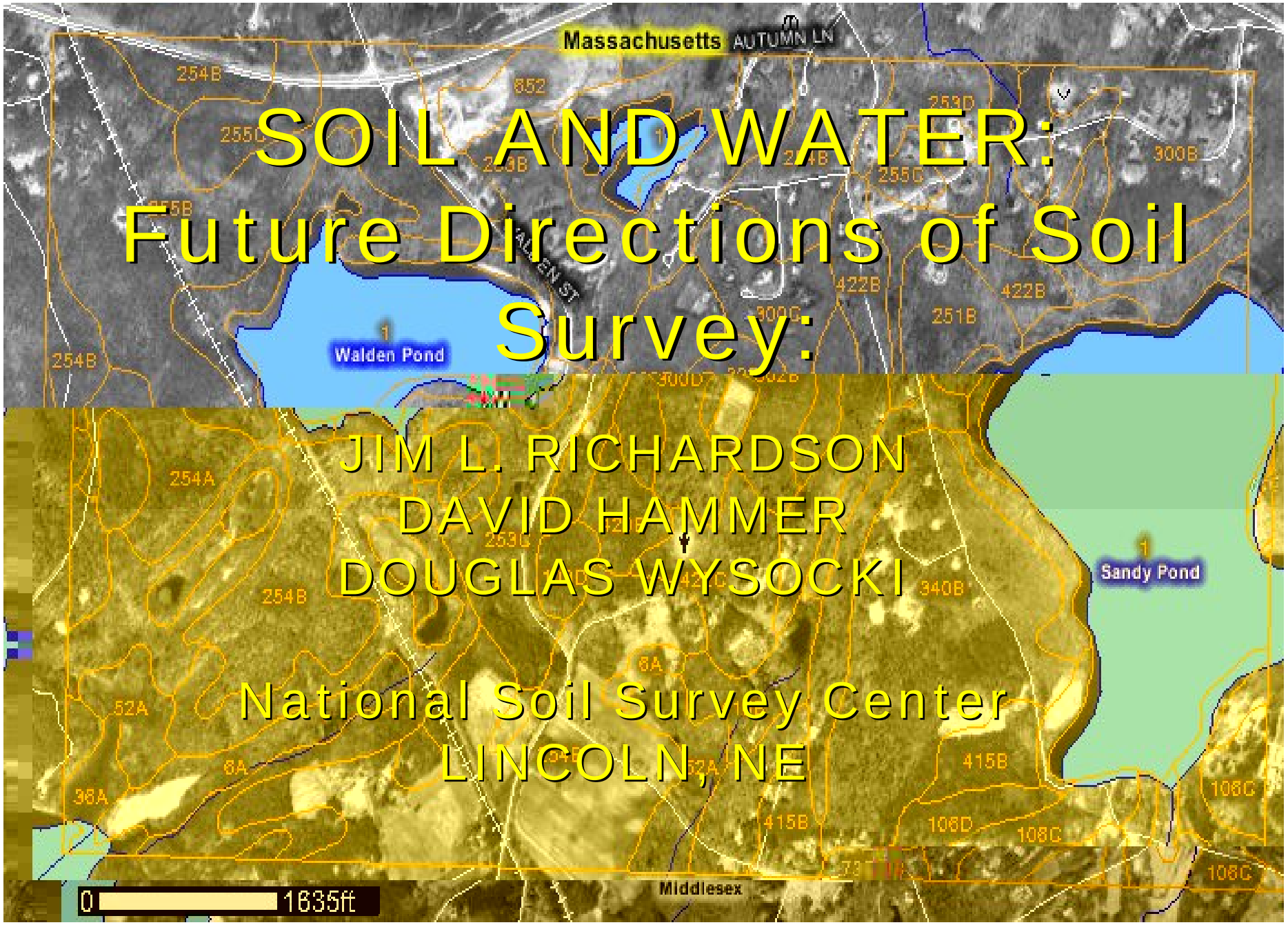


3. Find x.



If we think pragmatically about the kinds of data acquisition allowed by our resources (time, knowledge, skills, technologies, and budget) . . .

what are the most logical, economical, scientifically sound, and relevant things we can do to prepare for th widest spectrum of potential needs?



SOIL AND WATER: Future Directions of Soil Survey:

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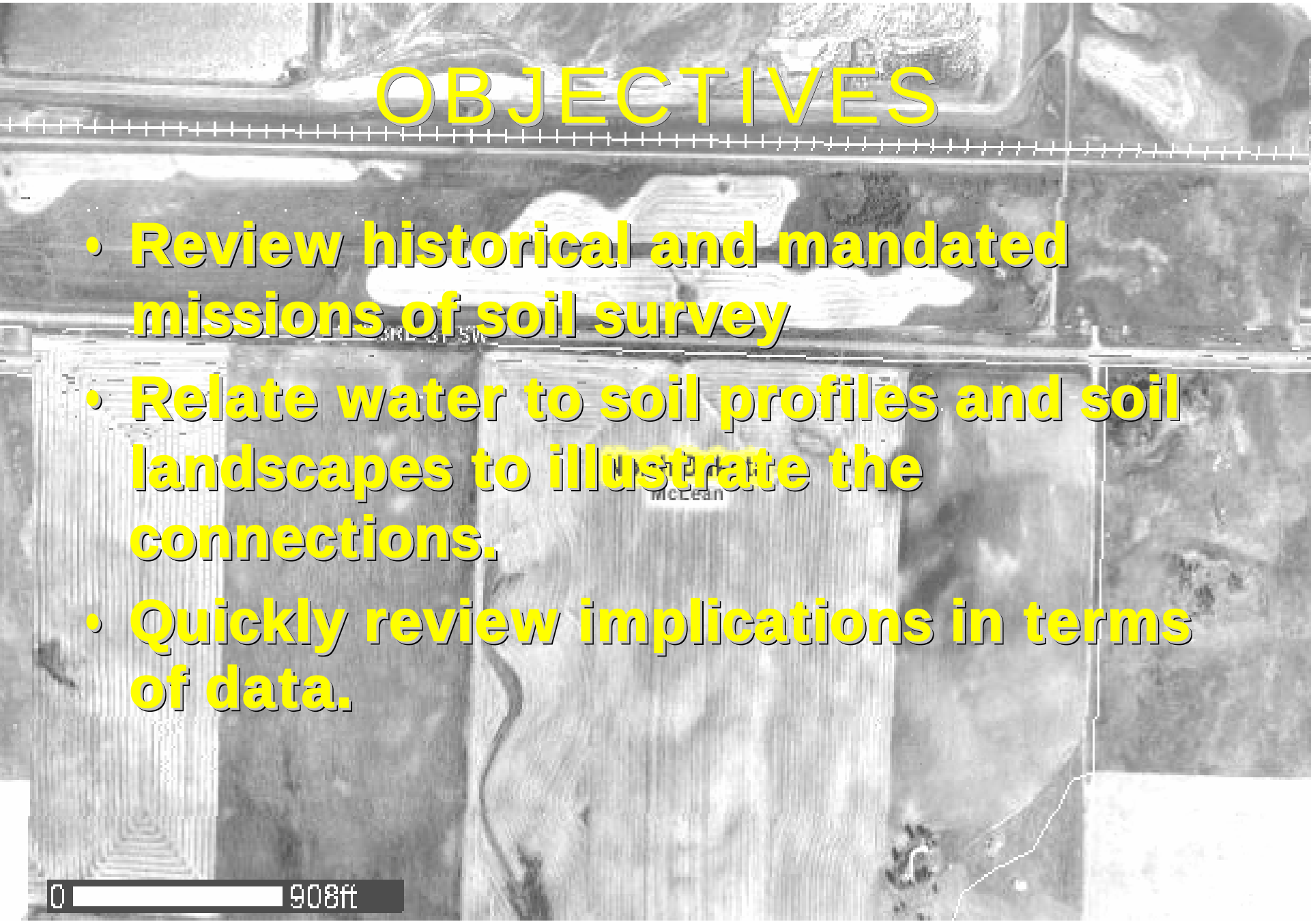
National Soil Survey Center
LINCOLN, NE

OBJECTIVES

- Review historical and mandated missions of soil survey
- Relate water to soil profiles and soil landscapes to illustrate the connections.
- Quickly review implications in terms of data.



The Purposes of Soil Survey

C.E. Kellogg (1951)

1. Map the distributions of soils.
2. Classify soils.
3. Develop interpretations of soils.
4. Gather relevant information about soils.
5. Provide information to people who need or request it.

The Mandated (Legislated) Soil Survey Missions

Survey Program in Public Law 89-560 (Soil Survey for Resource Planning and Development Act)

1. **Make an inventory of the soil resources of the United States;**
2. ***Keep the soil survey relevant to ever-changing needs;***
3. ***Interpret the information and make it available in a useful form; and***
4. ***Promote the soil survey and provide technical assistance in its use for a wide range of community planning and resource development issues related to non-farm and farm uses.***

UNIFYING PRINCIPLES

- **Temporal and spatial distributions of water create soil change (soil genesis) and drive most geomorphic processes.**
- **Water is the an integrating component between soils and their landscapes.**
- **Soil morphology is the reflection of hydrology and integrates soil development over time.**
- **Pedology is key to modeling and predicting water-related processes in landscapes.**

Operational Entities

- **Taxonomic unit**
- **Mapping unit**
- **Functional unit**

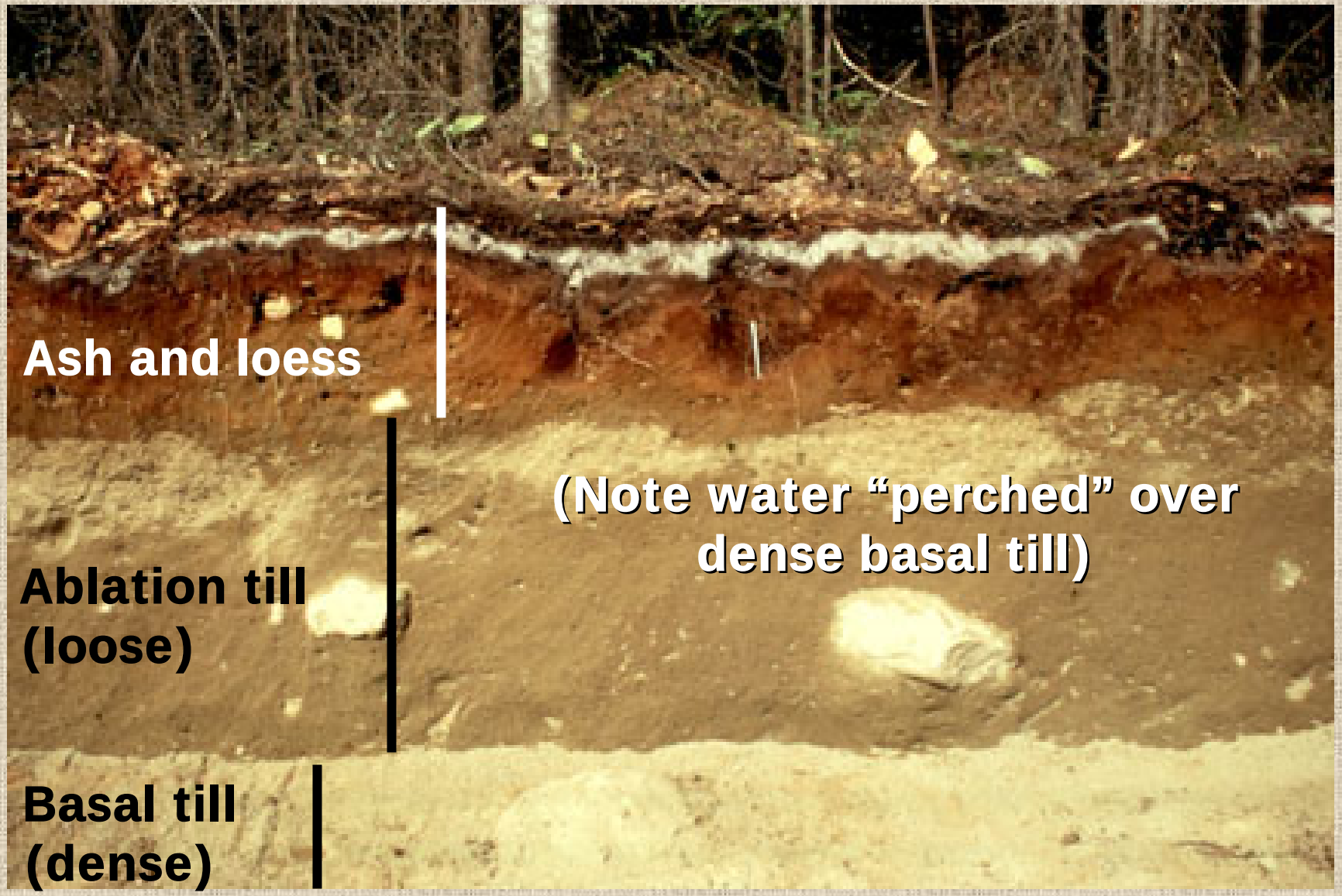
“Recognition that the soil profile is the historical record of the development of that soil is the most important discovery in pedology.”

D. H. Yaalon (1983)

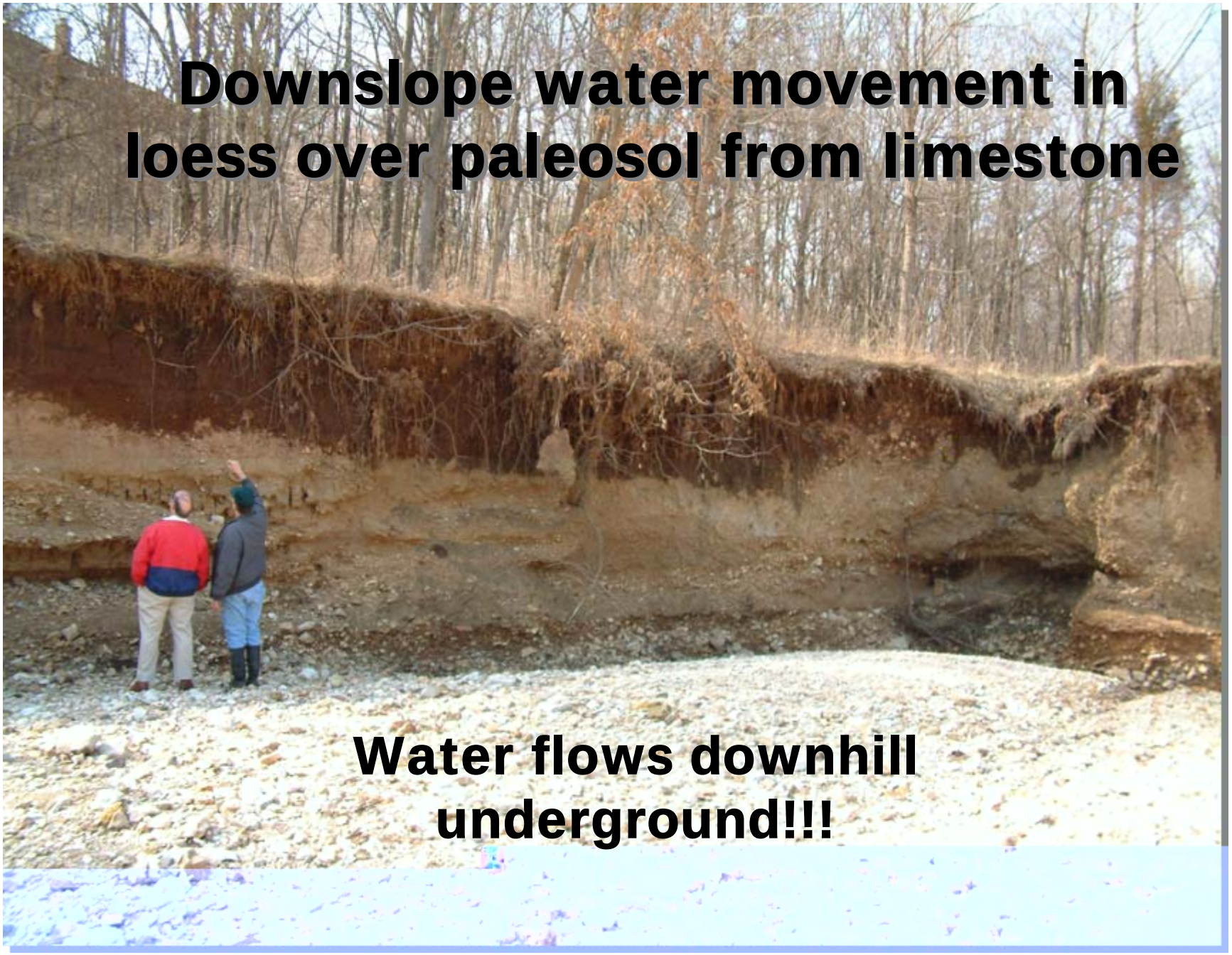
Complete soil profile descriptions, with associated chemical, physical and mineralogical data can be used with knowledge of soil water distributions to extrapolate from point sources to volumes.

These are fundamental, scale-independent data.

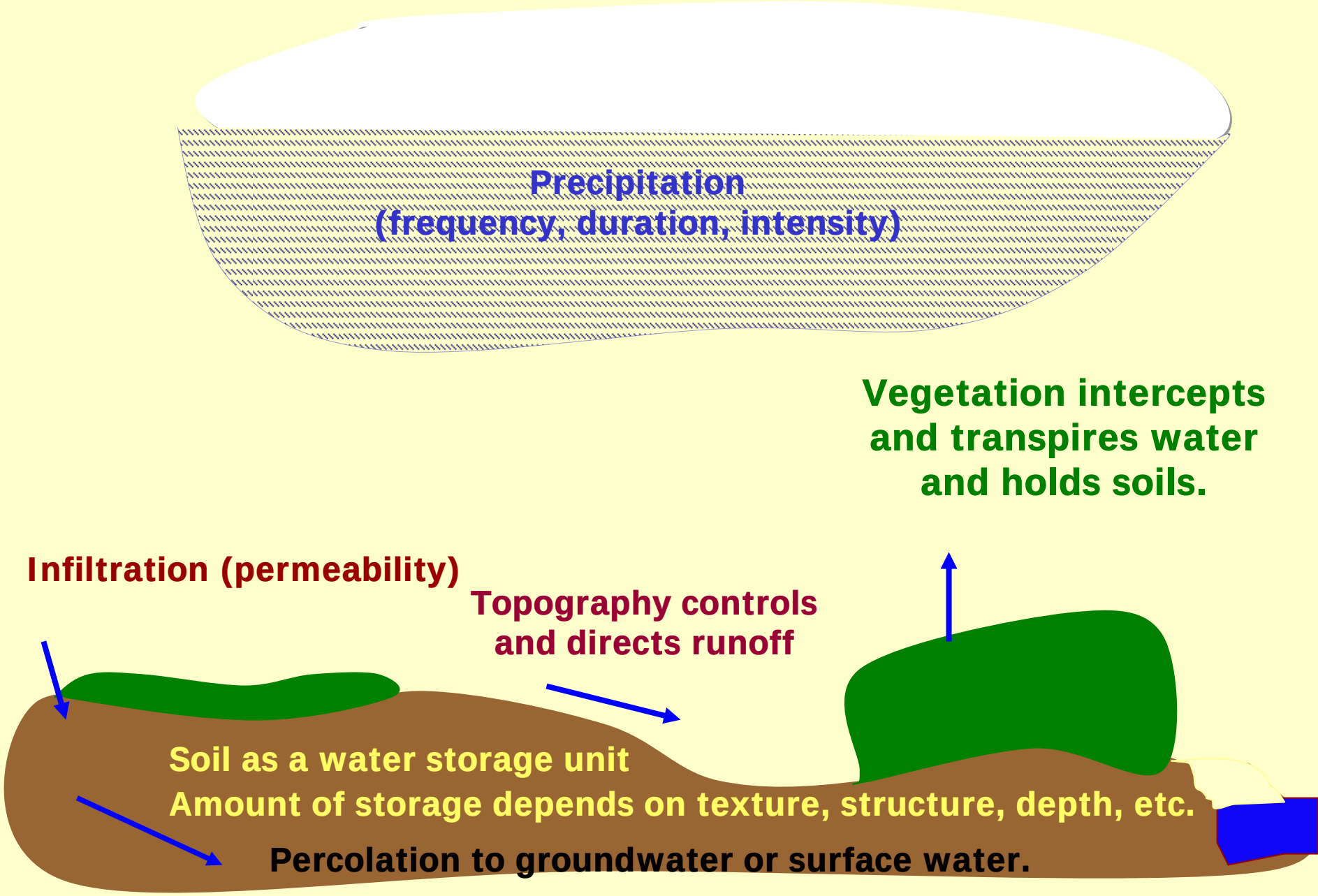
When the soil and water data are linked to allow an understanding of processes, the technological terrain attribute data have added value and relevance. . . they actually have quantitative applications beyond surficial attribute uses.



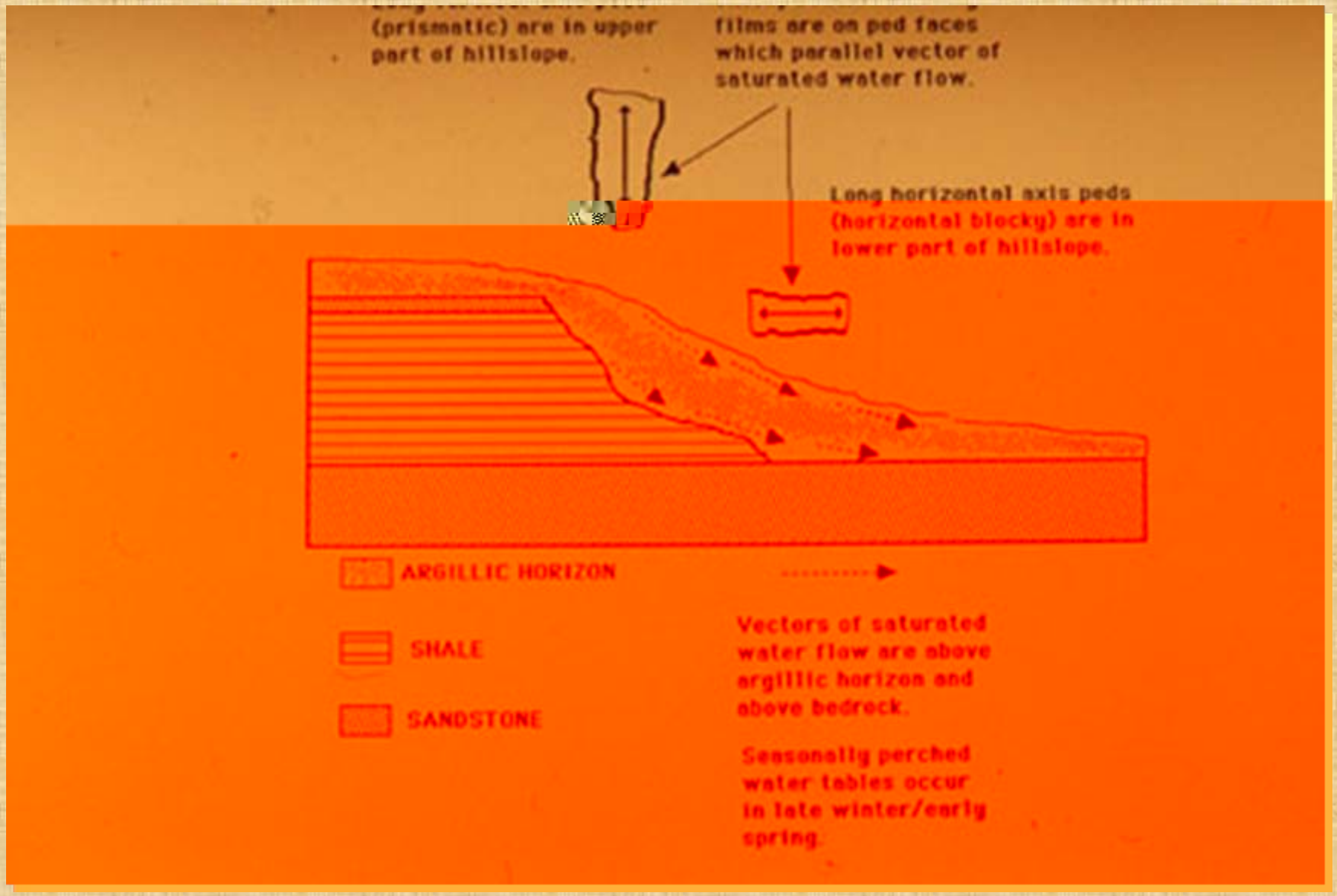
Pacific Northwest Spodosol in loess and ash over two kinds of glacial till.


Downslope water movement in loess over paleosol from limestone
Water flows downhill underground!!!

The Hydrologic Cycle



Primary, secondary and tertiary structure in forest soil. Note roots following structure.


(prismatic) are in upper part of hillslope.
films are on ped faces which parallel vector of saturated water flow.
Long horizontal axis peds (horizontal blocky) are in lower part of hillslope.
ARGILLIC HORIZON
SHALE
SANDSTONE
Vectors of saturated water flow are above argillic horizon and above bedrock.
Seasonalig perched water tables occur in late winter/earlg spring.

Loess over oxidized till over unoxidized till (central MO)

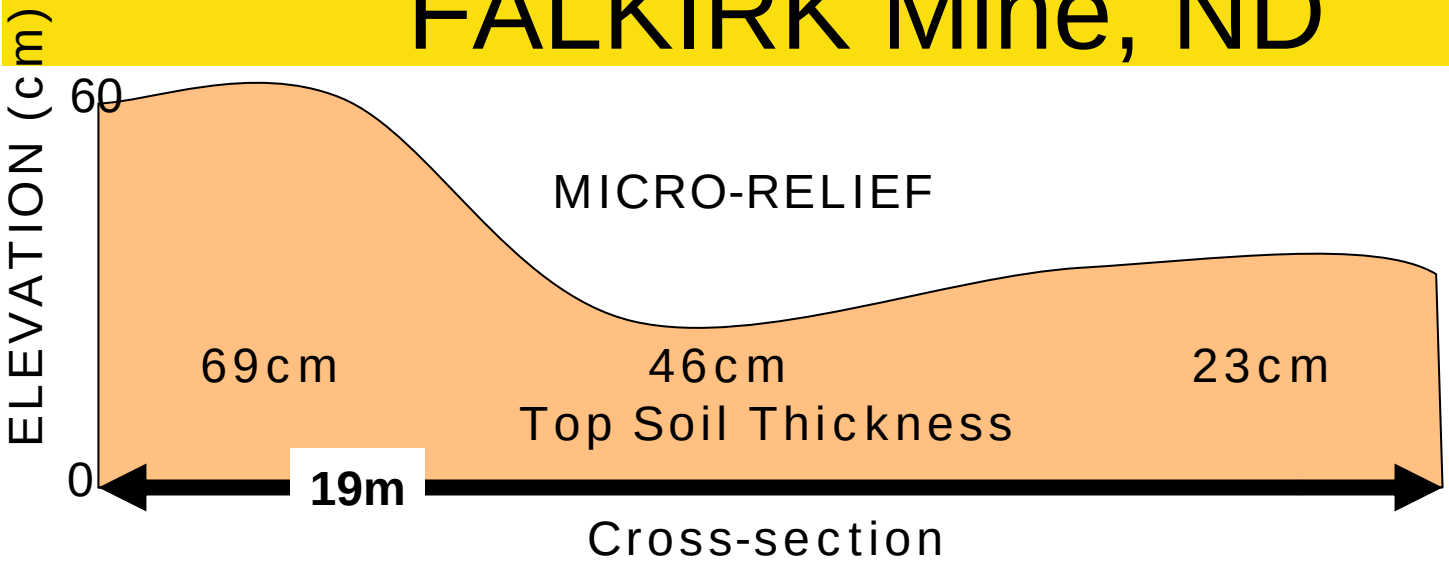
Till oxidizing "from the outside in" along deep ped faces.

Mn concretions

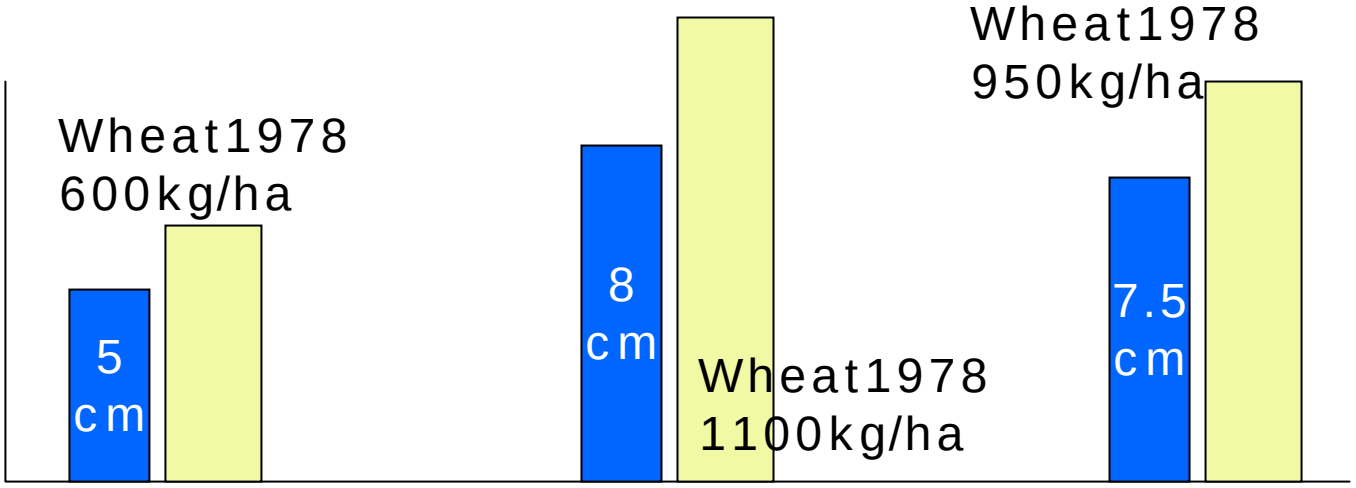
Fe concretions

Direction of water movement

Created Landscape & Soils
FALKIRK Mine, ND

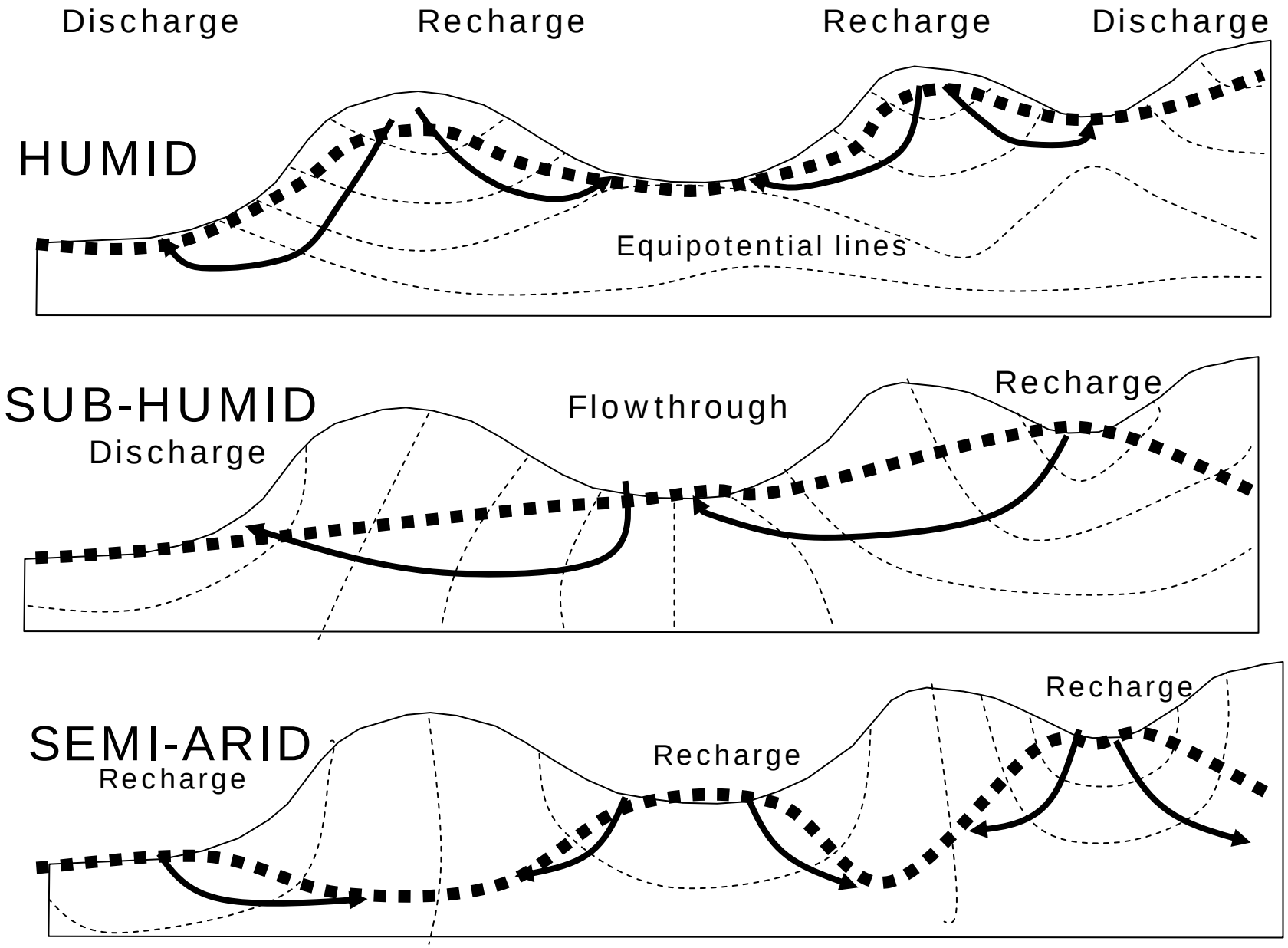


Na
15cm
Profile
based



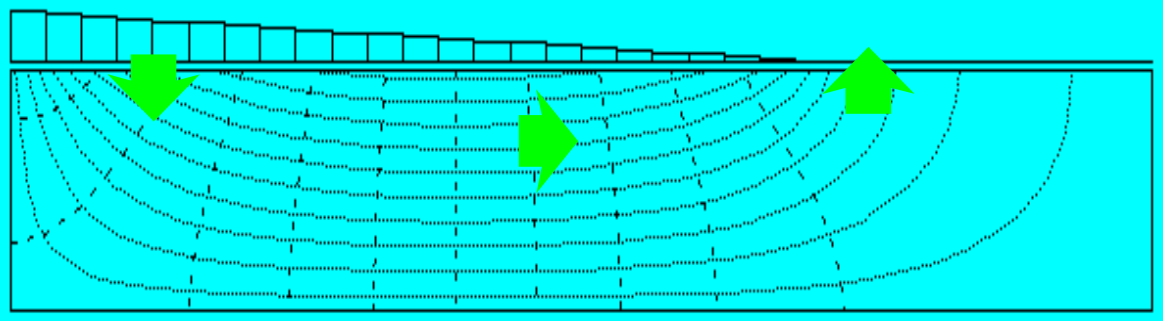
Wollenhaupt & Richardson,1982

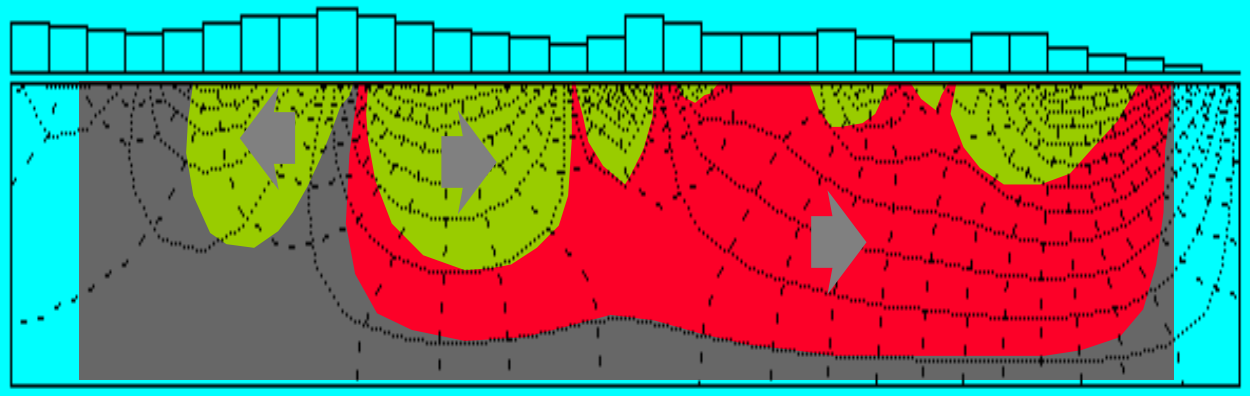
Climatic Influences on Water Tables



Richardson et al. 1991

Hummocky topography results in many local groundwater-flow systems.

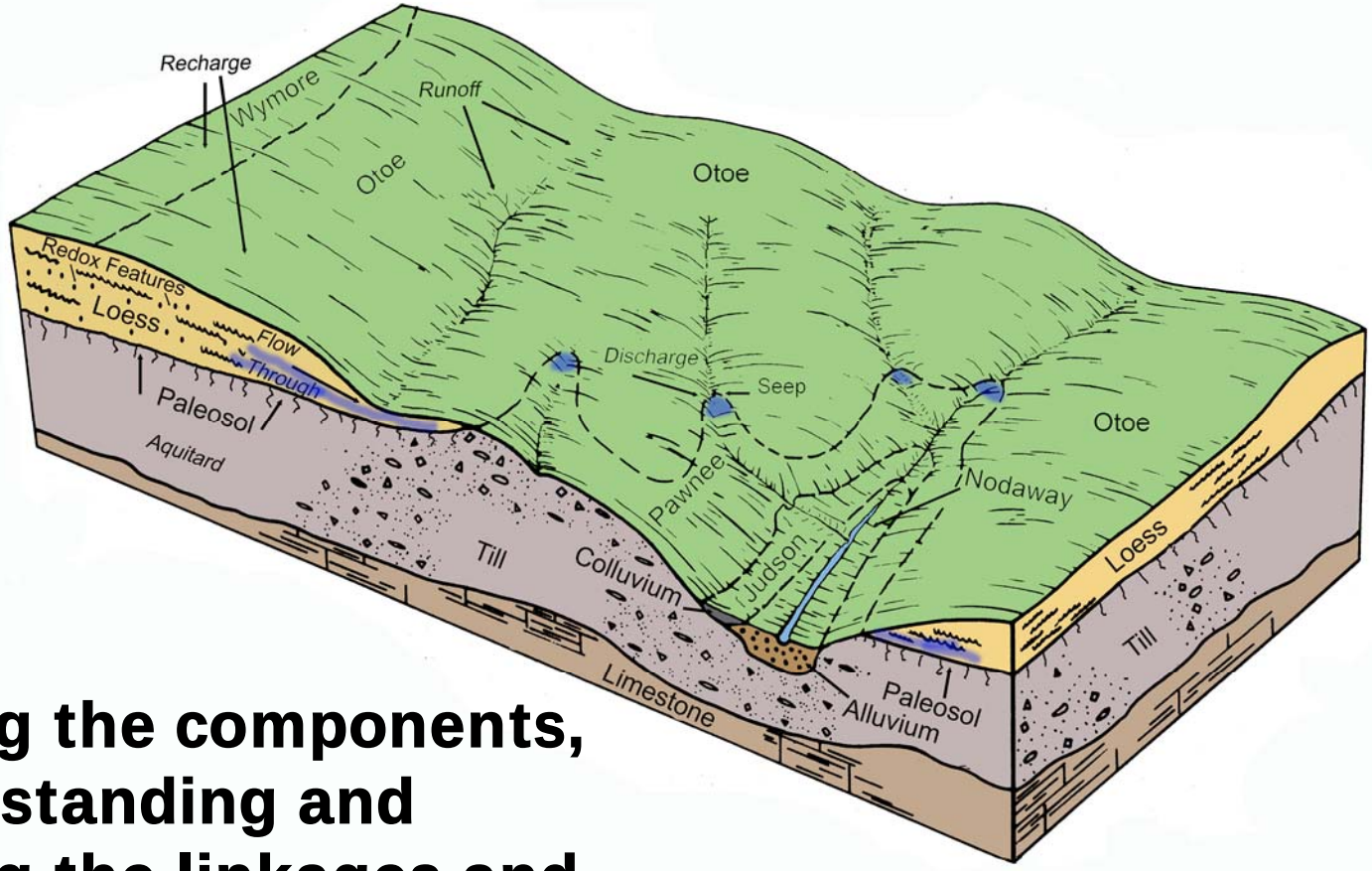




- Long, even slopes produce simple flow-systems Choppy slopes of high relief produce complex flow-systems

After Toth, and Winter

SOIL GEOMORPHIC INSTITUTE
Geomorphology, stratigraphy, pedology, and hydrology



Recognizing the components, understanding and interpreting the linkages and interactions

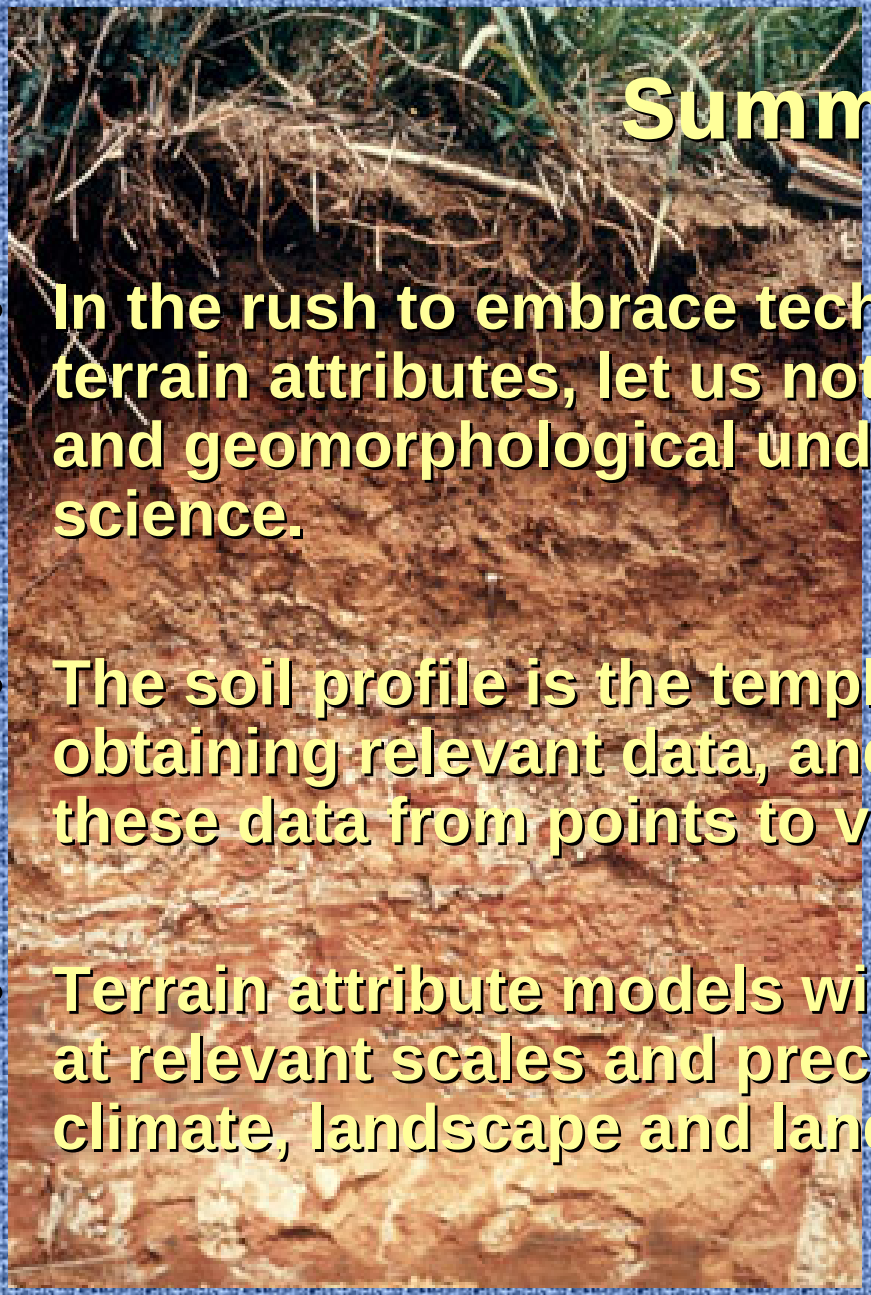
Wysocki et al. 2006

Fallacy

We are data rich and information poor.

Reality

We are data sporadic, correlations unknown, and "system process" uncertain.



Summary

- In the rush to embrace technology to model the terrain attributes, let us not forget the pedological and geomorphological underpinnings of soil science.
- The soil profile is the template for identifying and obtaining relevant data, and the key to extrapolating these data from points to volumes.
- Terrain attribute models will require field validation at relevant scales and precision, and must be climate, landscape and land-use specific.