# Towards the Implementation of Automated GIS Soil Mapping Techniques

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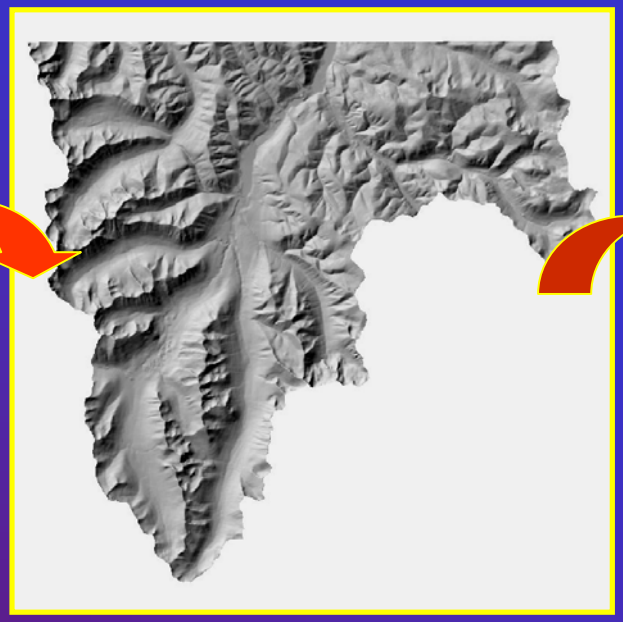
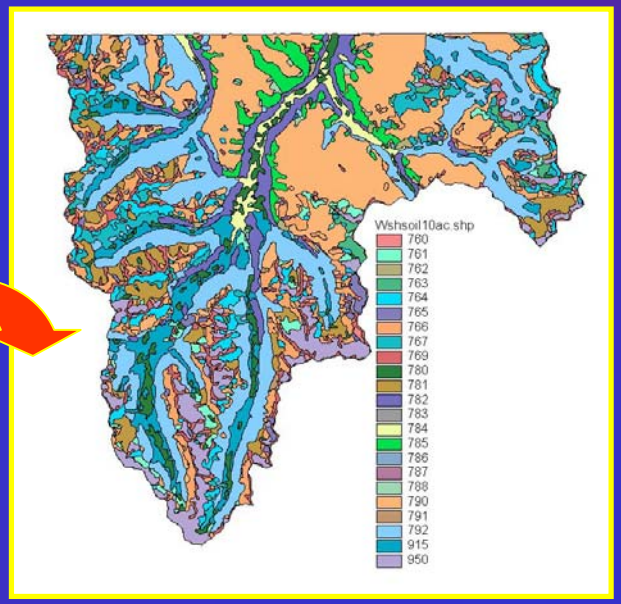
**Bruce Frazier, and Paul Gessler**



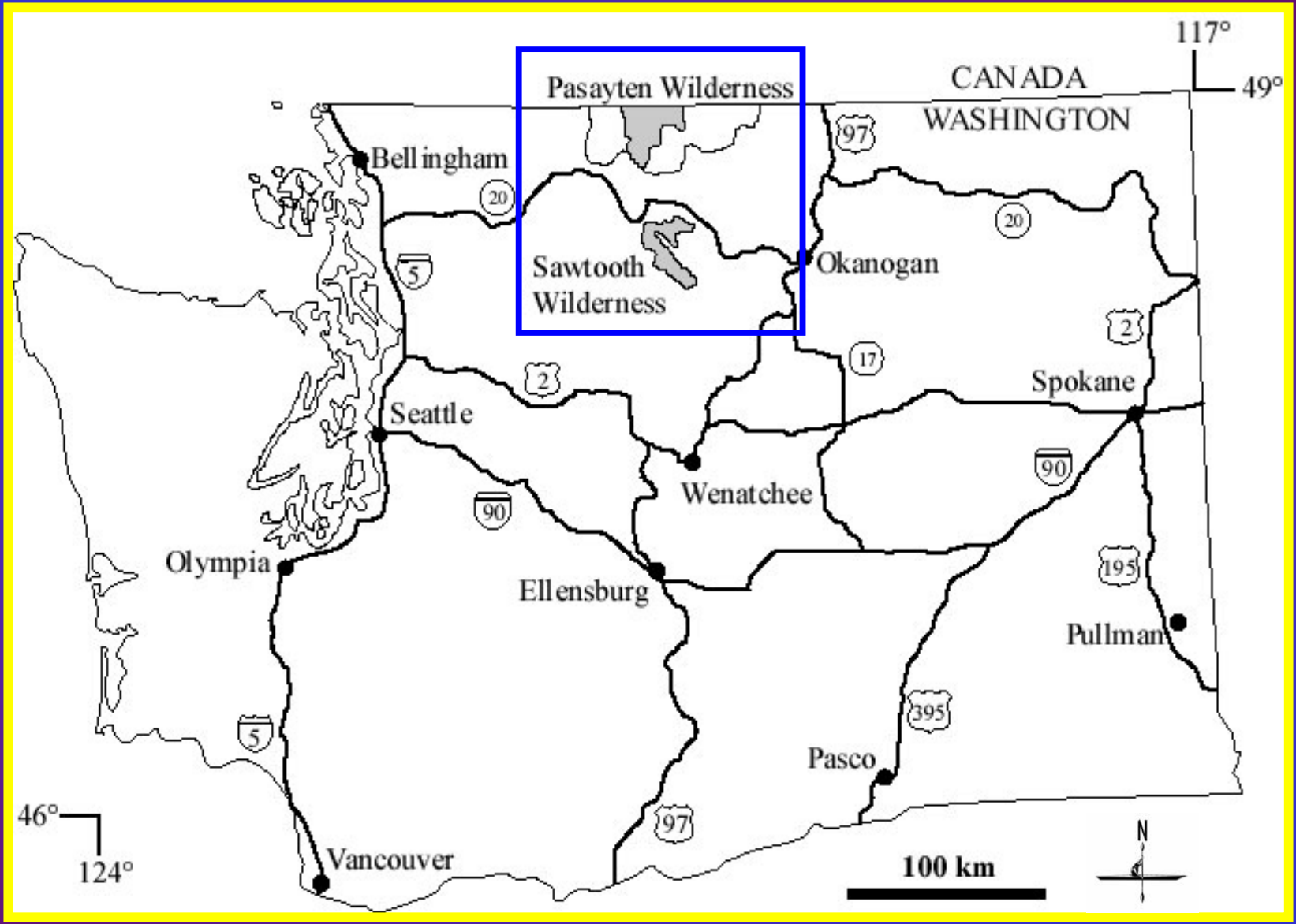


# Introduction

- Wilderness areas are seldom mapped
  - large investment of time and resources

- Geographic Information Systems (GIS) provide an efficient alternative

- Classic pedologic concepts incorporated within the framework of modeling platforms

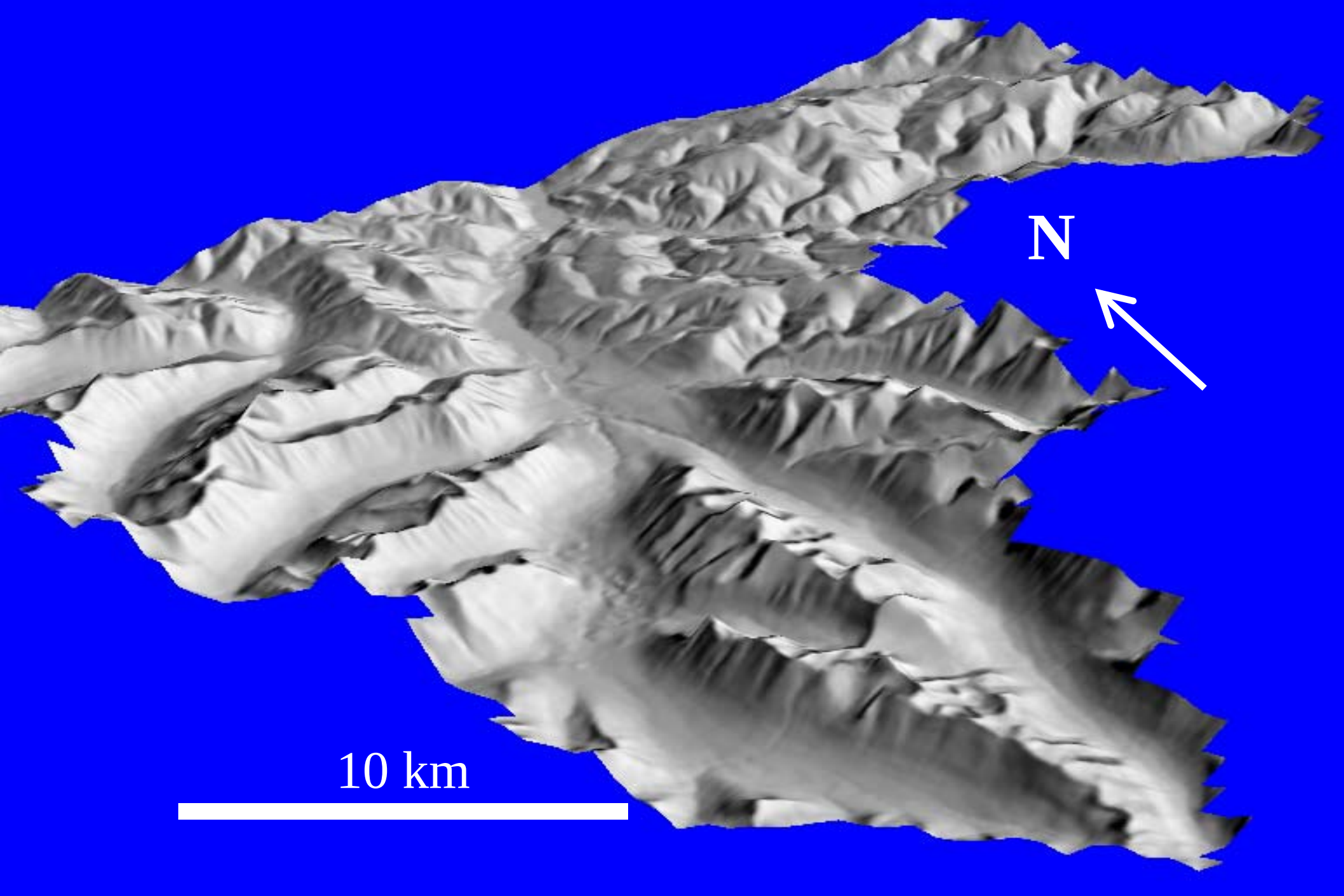



# Pasayten River Watershed Study Area

# Physiography

| Feature* | Sawtooth Wilderness | Pasayten Wilderness |
|---|---|---|
| Elevation (m) | 831 - 2693 | 588 - 2746 |
| Av. slope (%) | 53 | 46 |
| MAAT (°C) | -6.7 – 5.0 | -6.7 – 6.7 |
| MAP (mm) | 500 - 2300 | 500 - 2000 |

* Data derived from USFS GIS data layers


N
10 km

- GIS simplifies cartographic techniques
- Automates many traditional survey techniques
- Modeling procedures are documented
- Model is easily distributed and updated
- Results can be incorporated into existing resource management databases

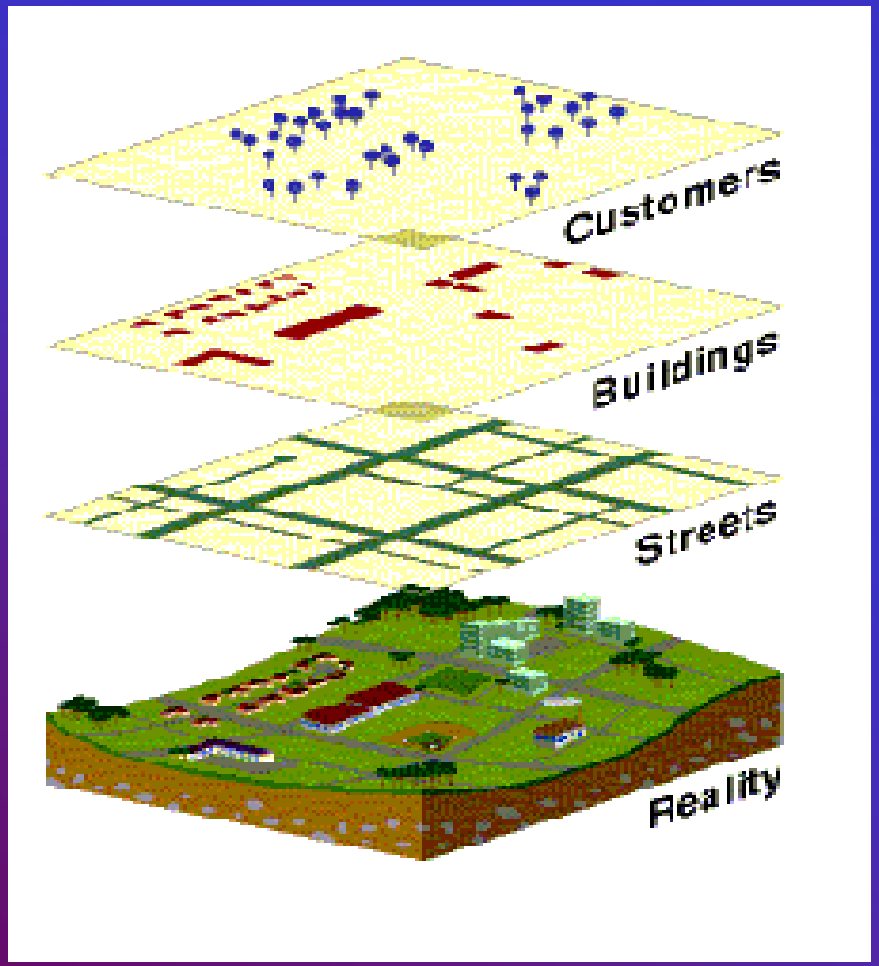
# Methods

- Visual inspection of aerial photographs
- > 200 site descriptions, located with Global Positioning Satellite (GPS) receiver
- Samples taken for documentation/lab analysis
- Model based on current GIS data layers and pedologic theories

Lithic Dystrocryepts-
Andic Dystrocryepts
Xeric Vitricryands-
Andic Eutrocryepts
Andic Haplocryods-
Typic Vitricryands
Humic Dystrocryepts-
Humic Vitricryands
Rock outcrop-Rubbleland

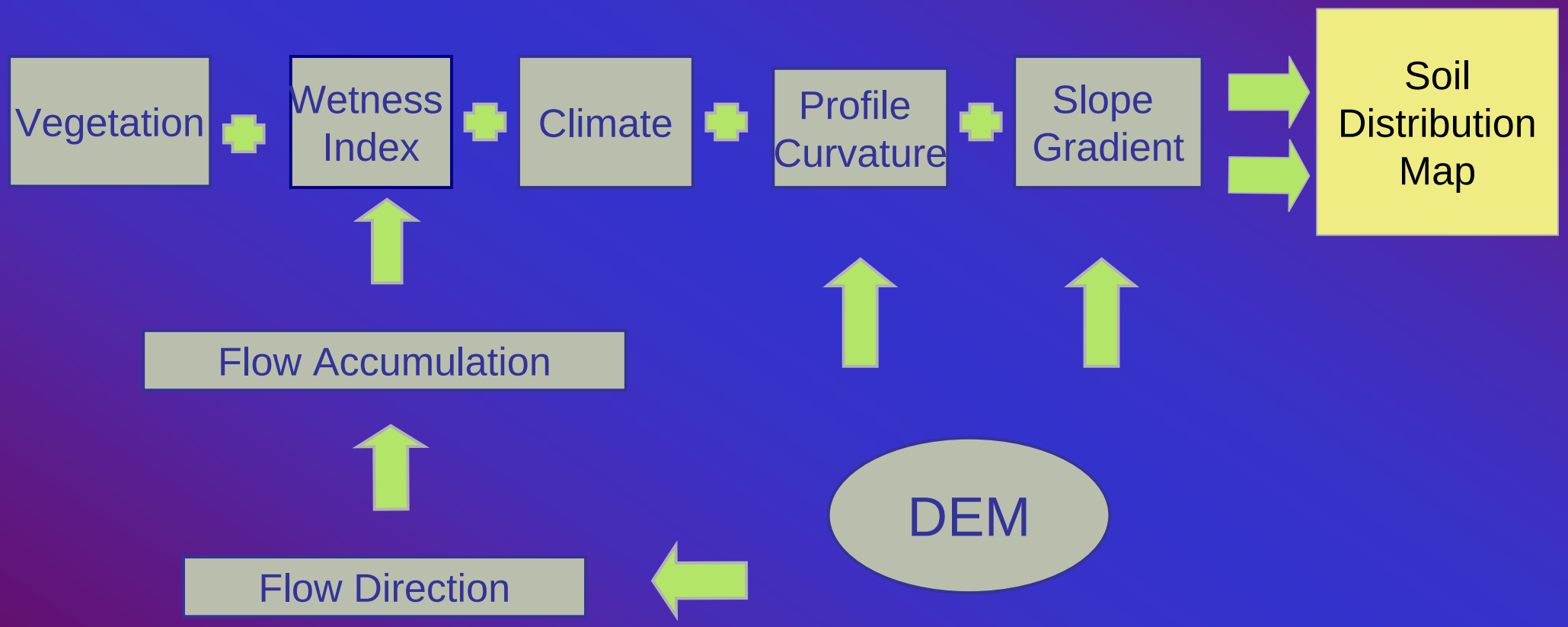
- Topographic analyses and data construction
  - 30 meter Digital Elevation Model (DEM)
  - primary and secondary terrain attributes
- Iterative process of layer compilation
  - wetness index
  - topographic shape
  - vegetation and landform maps
  - slope, aspect, and elevation

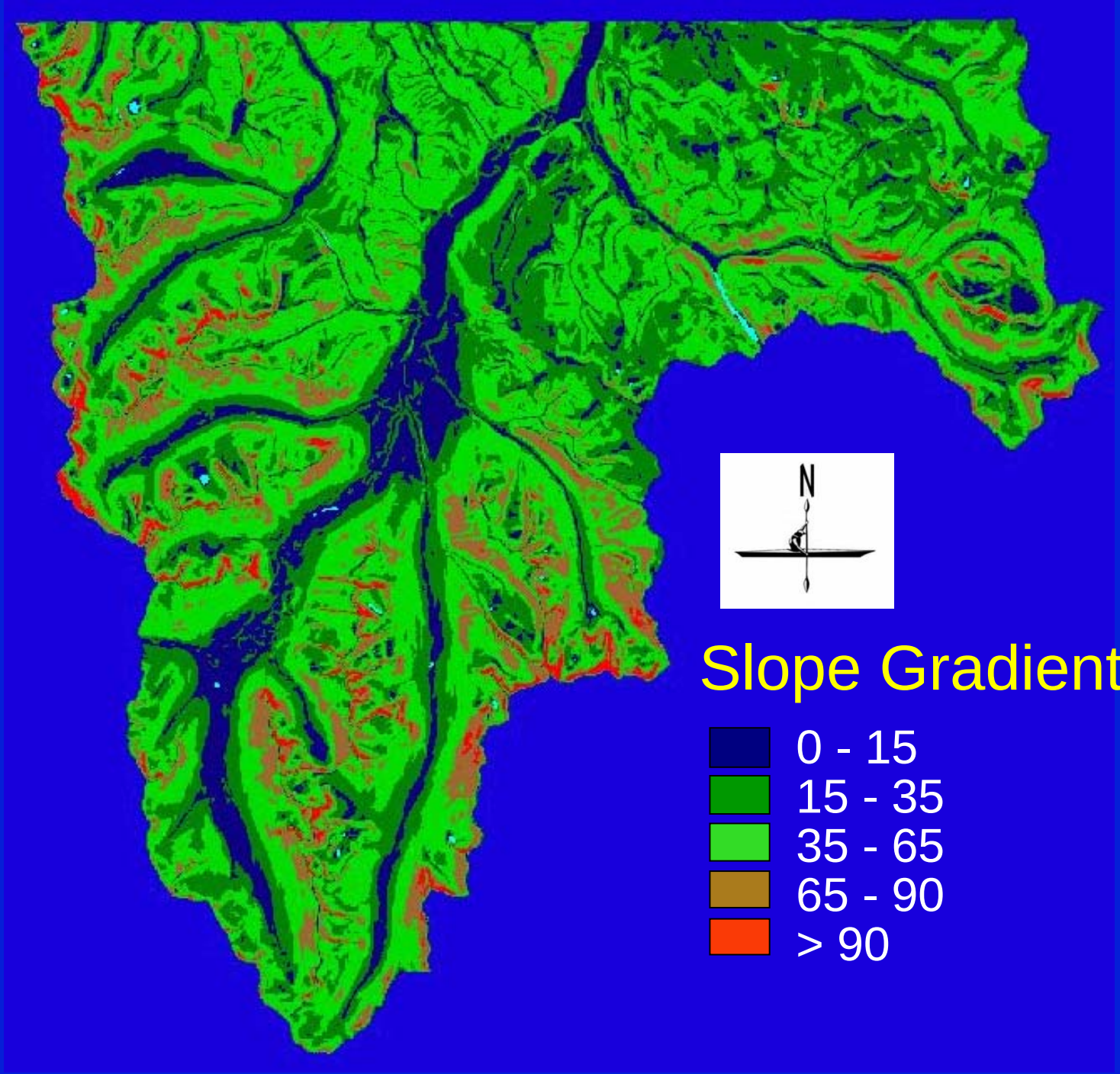
# Digital Data Layers Represent Reality

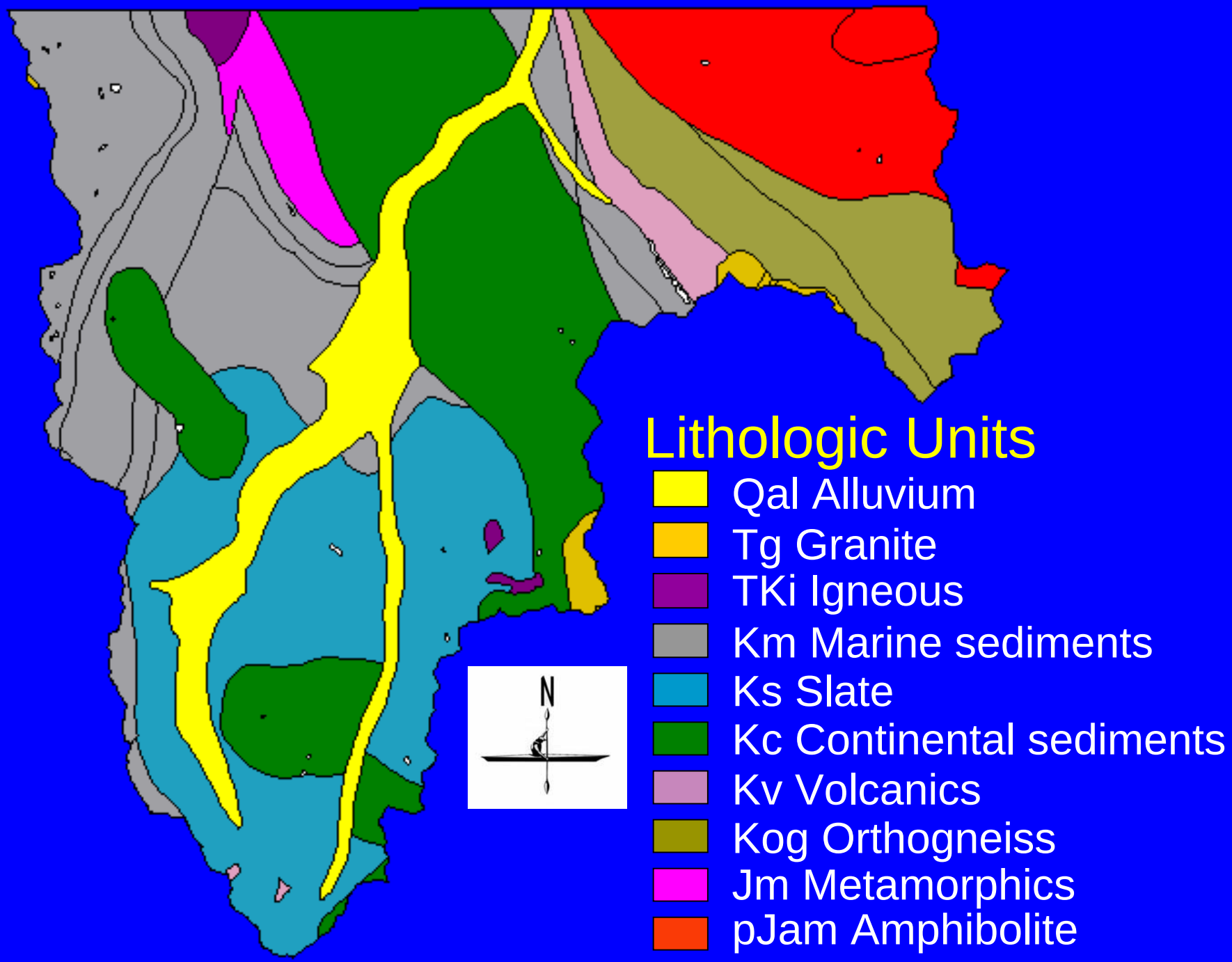



- Data is layered to create a digital representation of reality
- Relationships between the layers can be calculated on a cell by cell basis

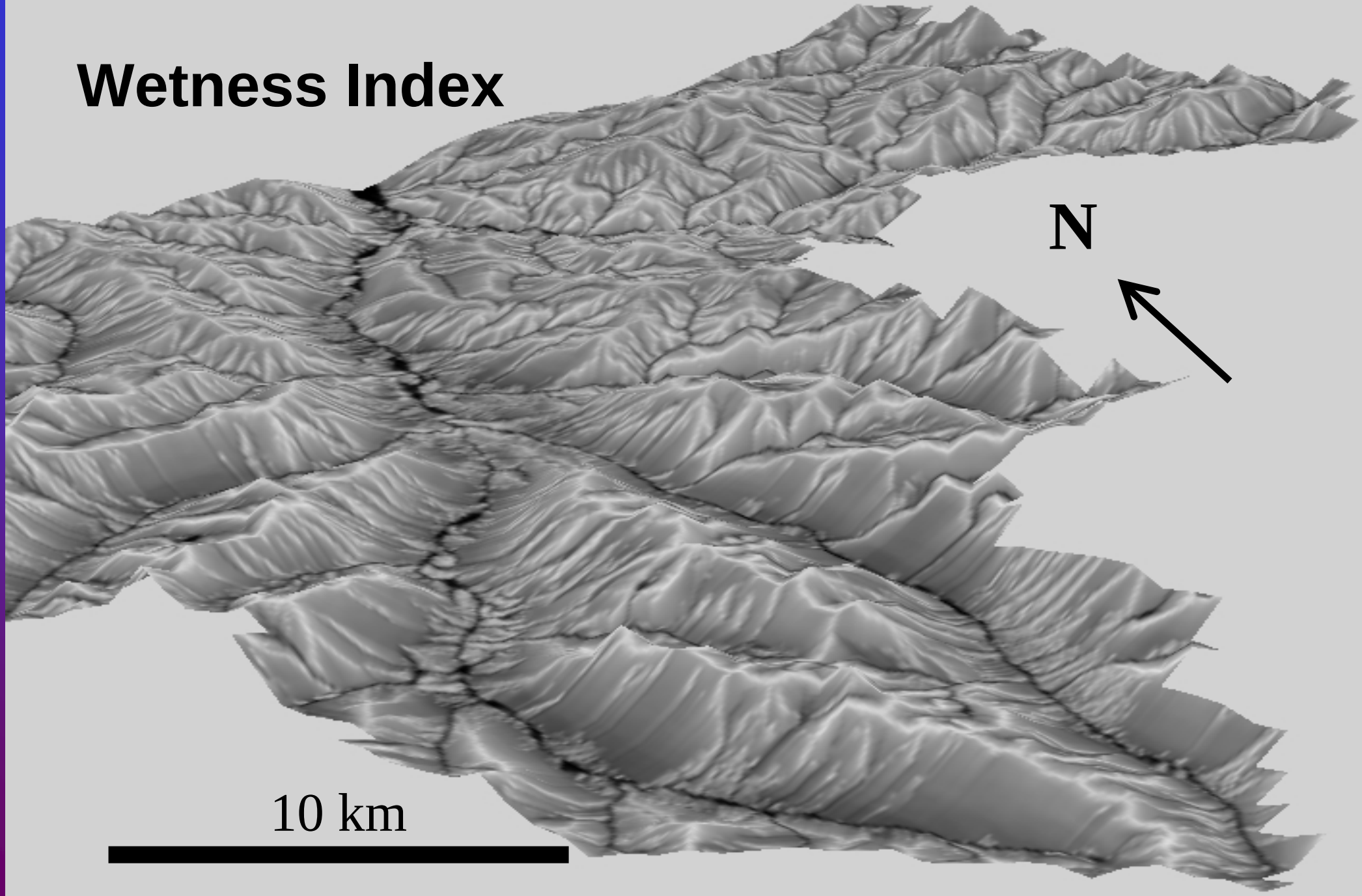
# Hierarchical, iterative layer compilation

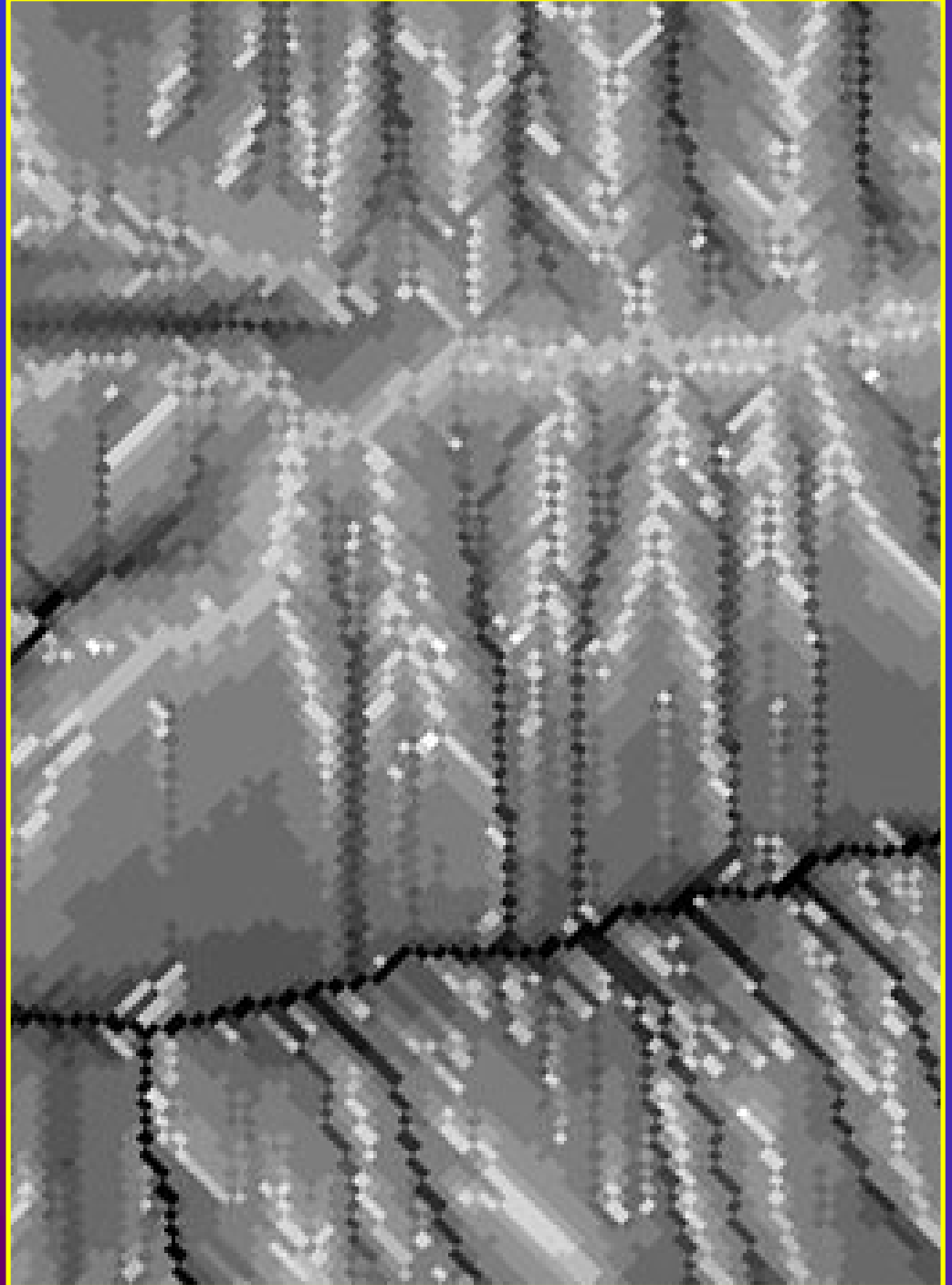



N
Slope Gradient (%)
0 - 15
15 - 35
35 - 65
65 - 90
> 90

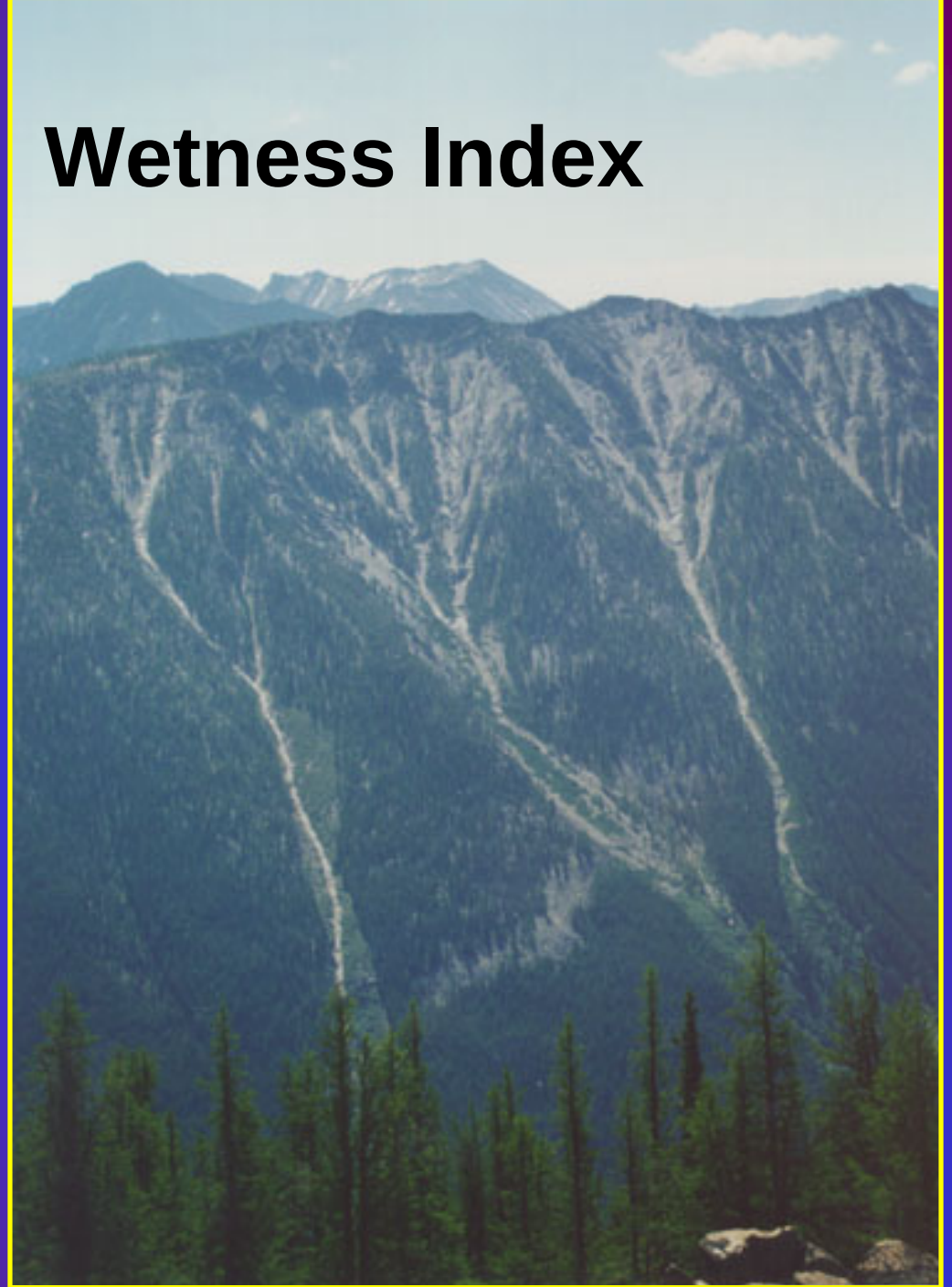

Lithologic Units
Qal Alluvium
Tg Granite
TKi Igneous
Km Marine sediments
Ks Slate
Kc Continental sediments
Kv Volcanics
Kog Orthogneiss
Jm Metamorphics
pJam Amphibolite
N

# Wetness Index





# Wetness Index



Cryaquepts

Interstratified tephra and fluvial sediments

# Interstratified tephra and fluvial sediments

Mixed overland wash 0.5 cm

MSH Wn tephra 0.3 cm

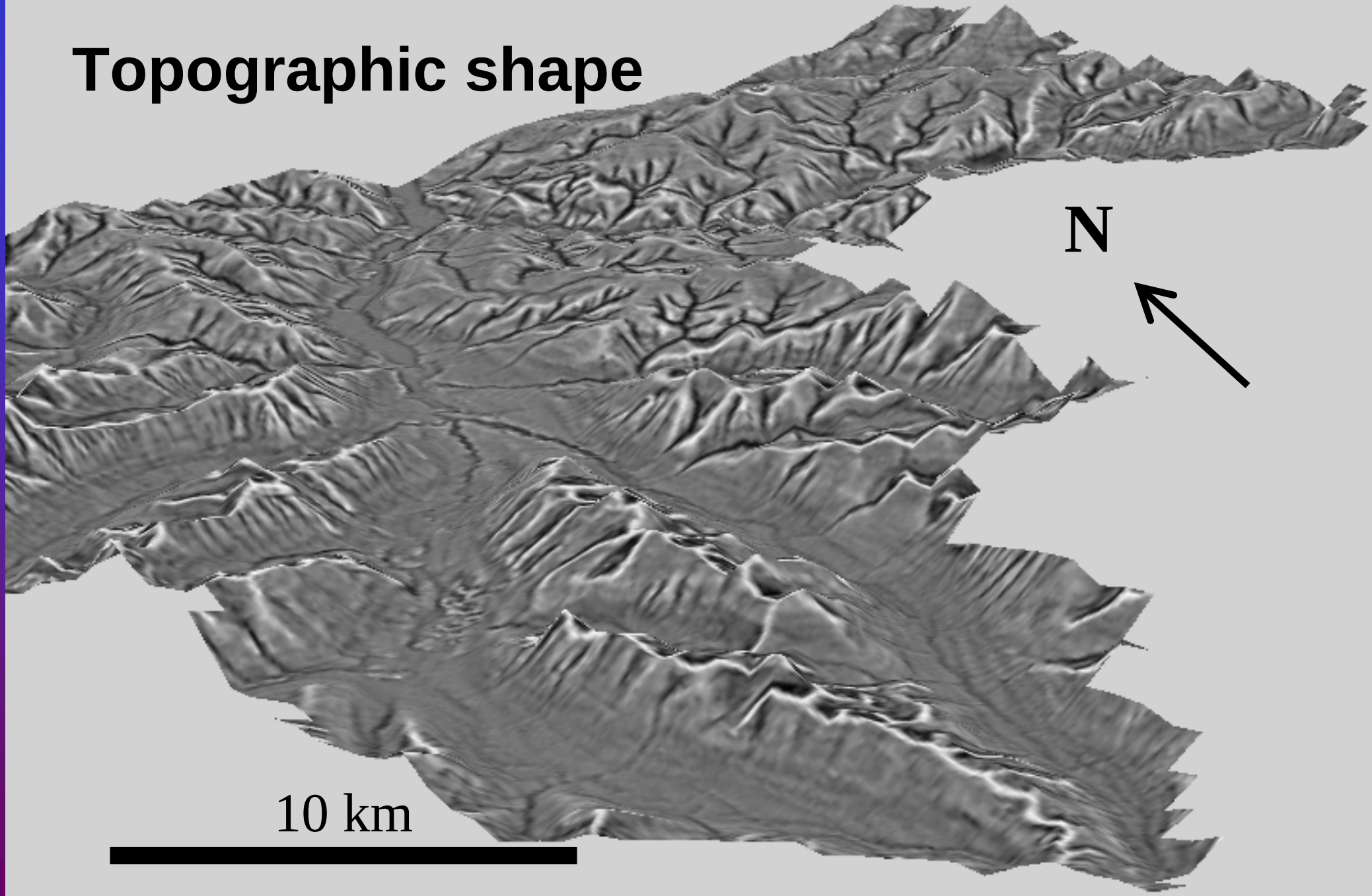
MSH Ye tephra 1 cm

Mazama tephra and silt 5 cm

Mazama tephra 7 cm

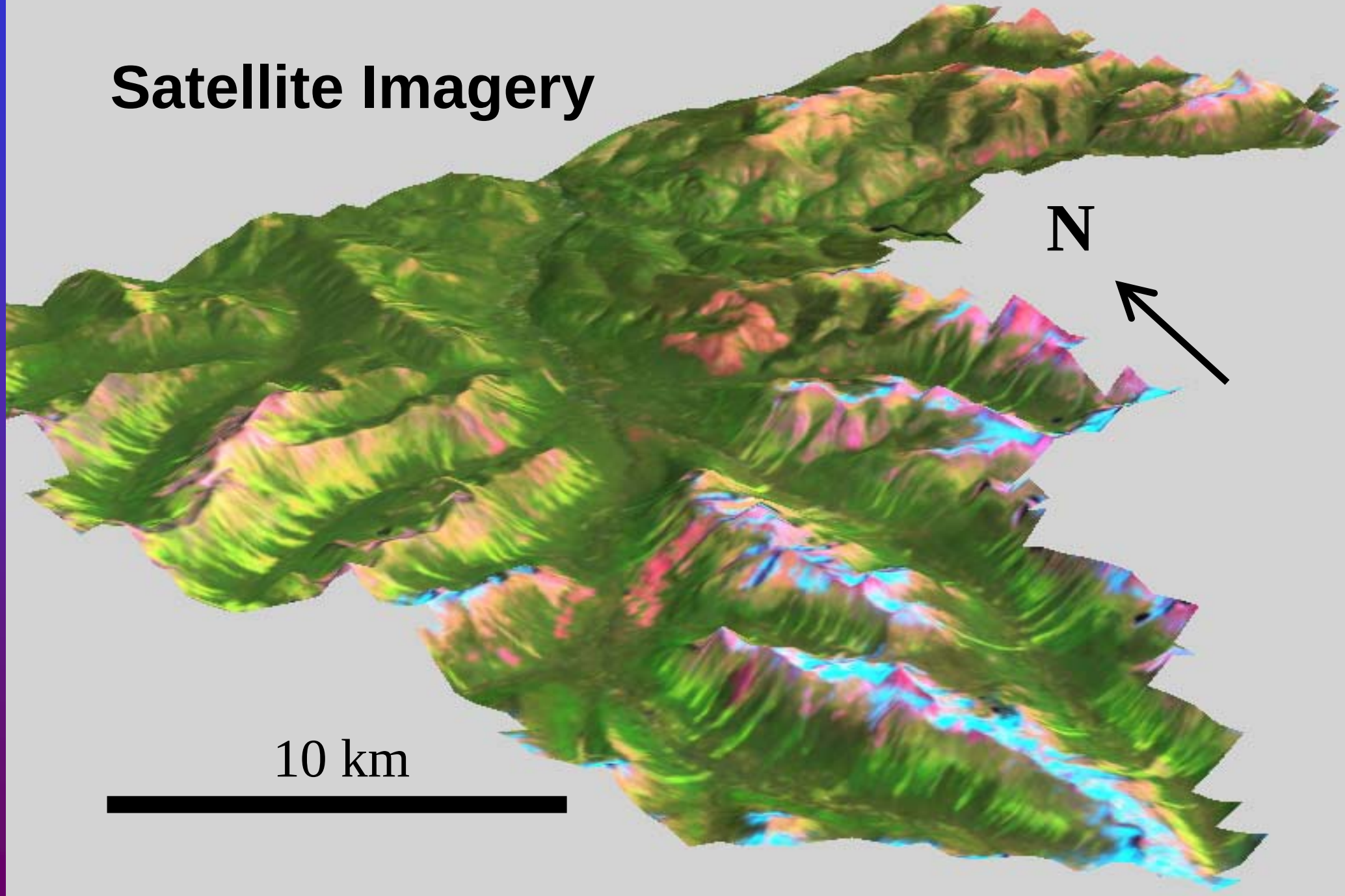
Fluvial sediments

# Topographic shape

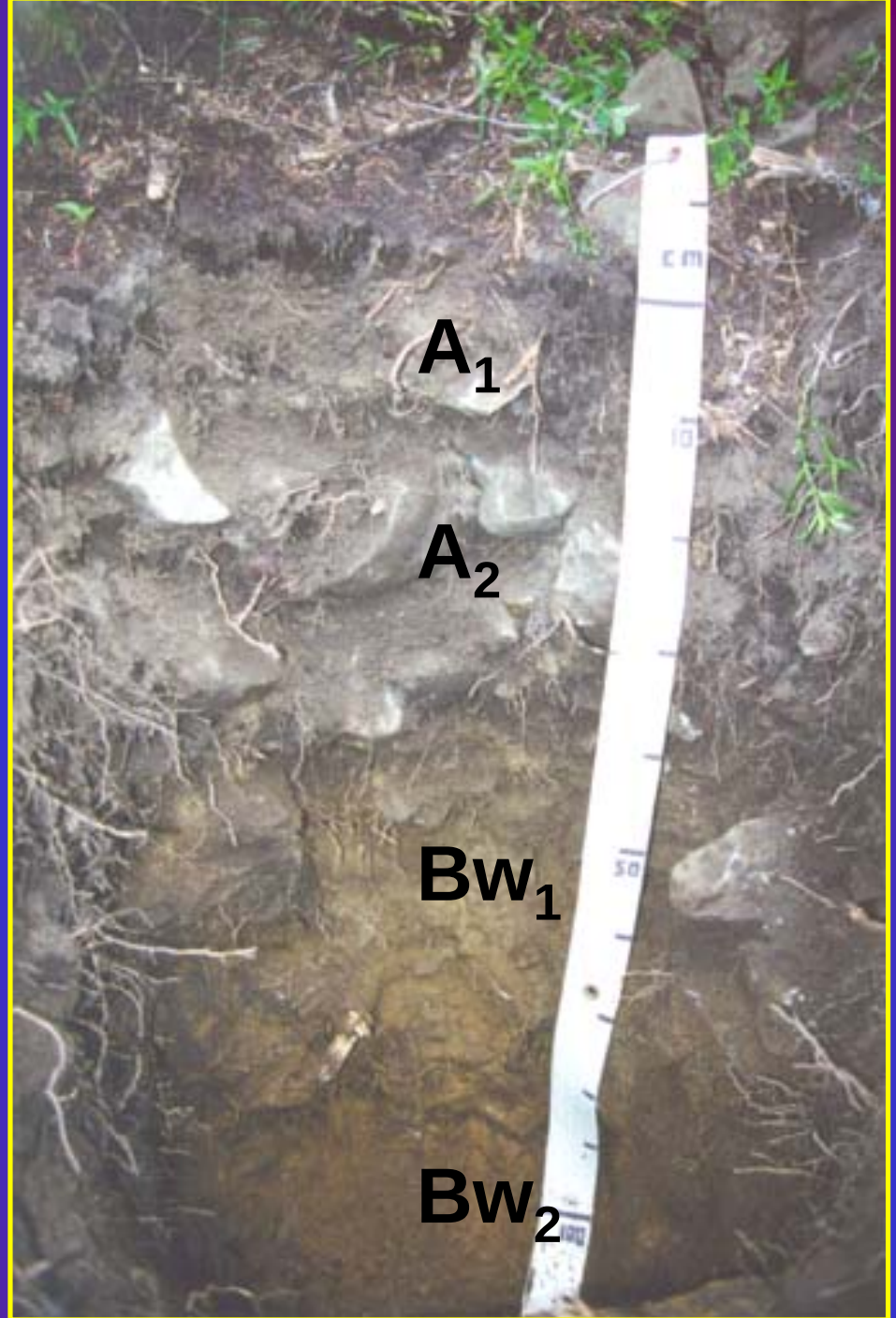


Rock outcrop-Lithic Dystrocryepts

# Satellite Imagery

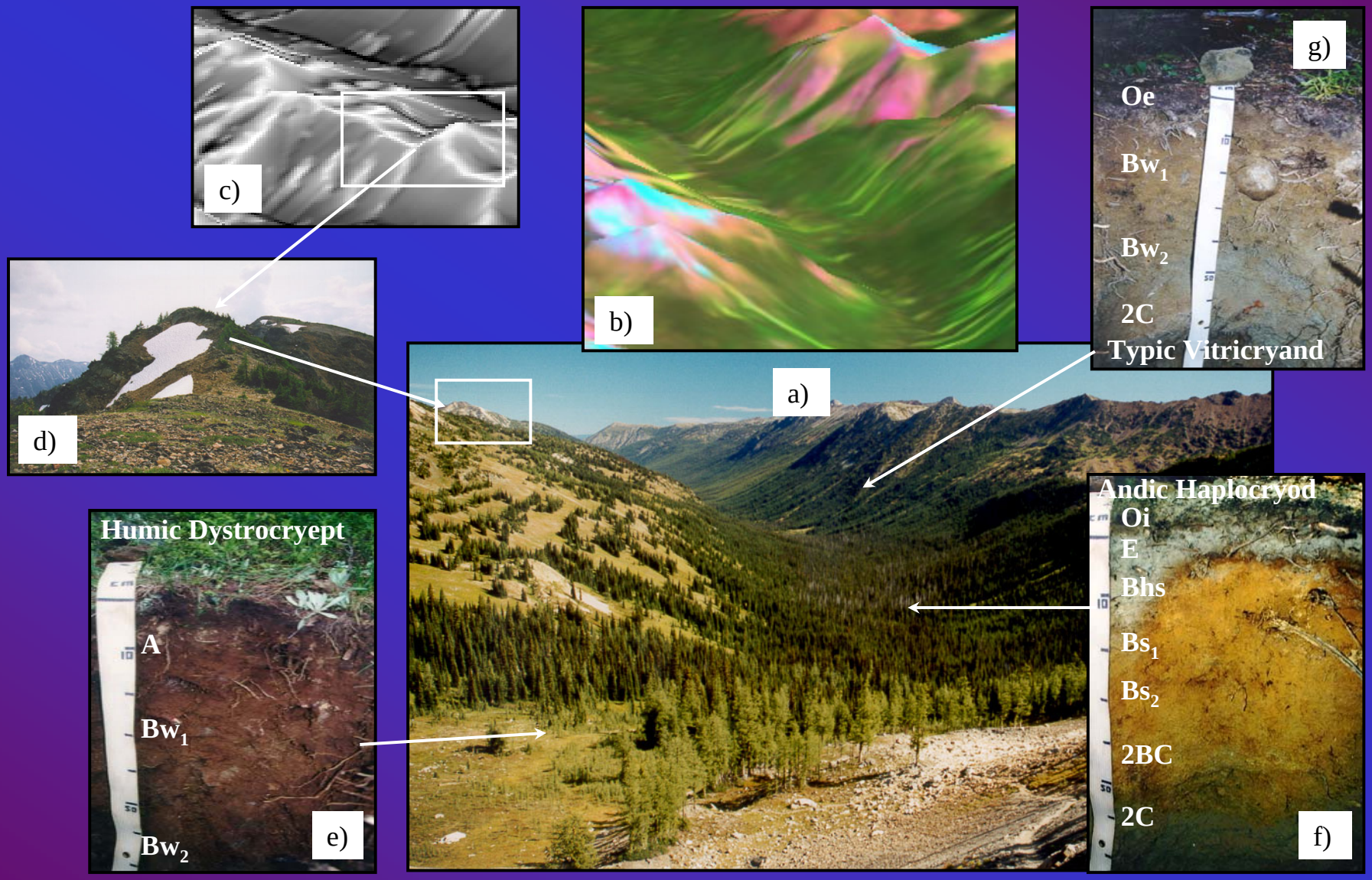


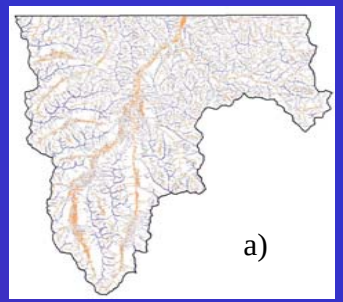
# Humic Vitricryand

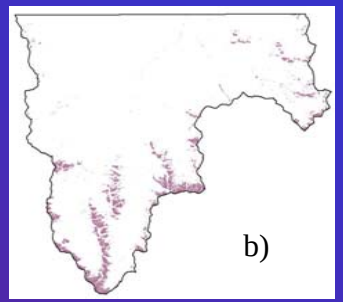


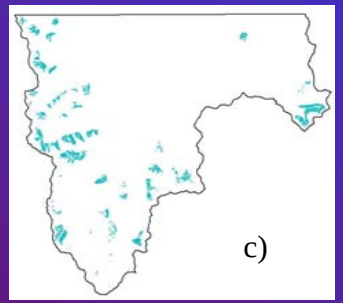
# Results

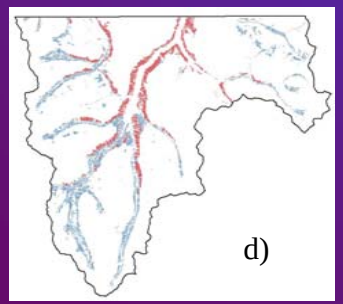
- Landform and soil delineations
- Soil data layer incorporated into current survey
- Remaining wilderness area also mapped
- 80 % agreement with field descriptions
- Mix of Andisols, Inceptisols, and Spodosols

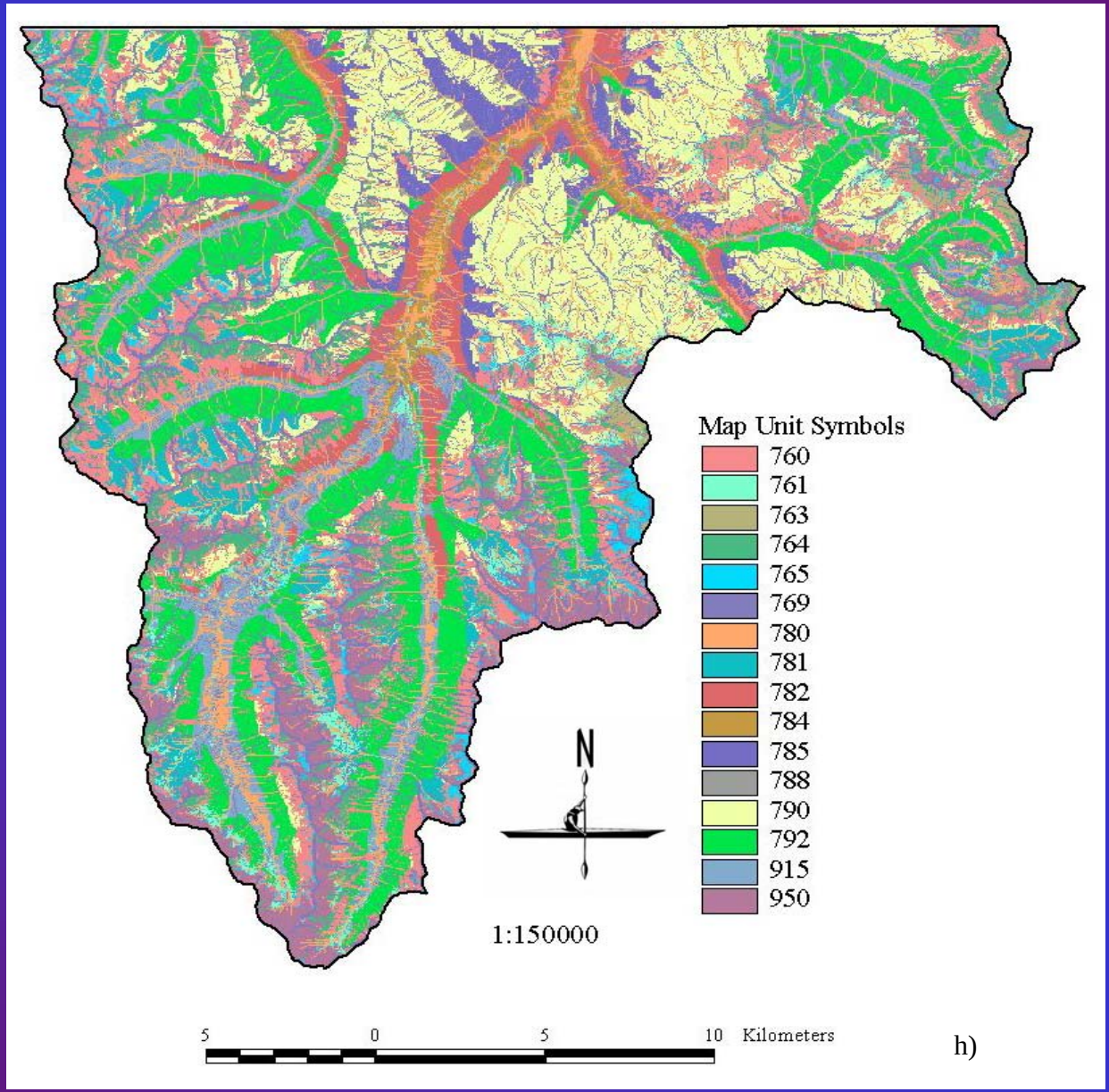

c)
b)
g)
Oe
Bw1
Bw2
2C
Typic Vitricryand
d)
a)
Humic Dystrocryept
A
Bw1
Bw2
e)
Andic Haplocryod
Oi
E
Bhs
Bs1
Bs2
2BC
2C
f)


a)


b)


c)


d)


Map Unit Symbols
760
761
763
764
765
769
780
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792
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950
N
1:150000
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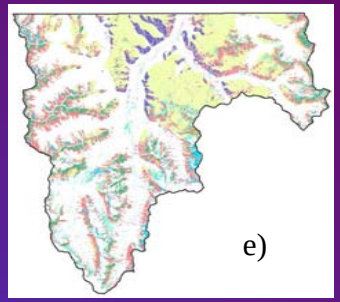
0
5
10
Kilometers
h)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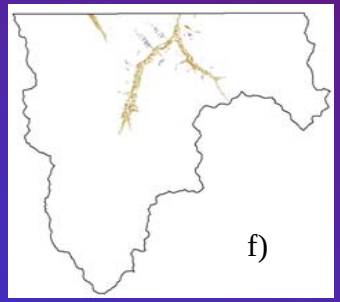
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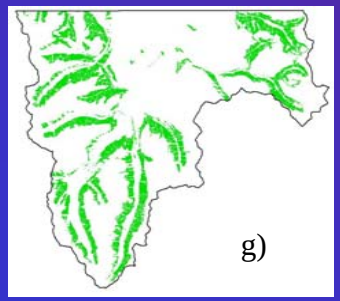
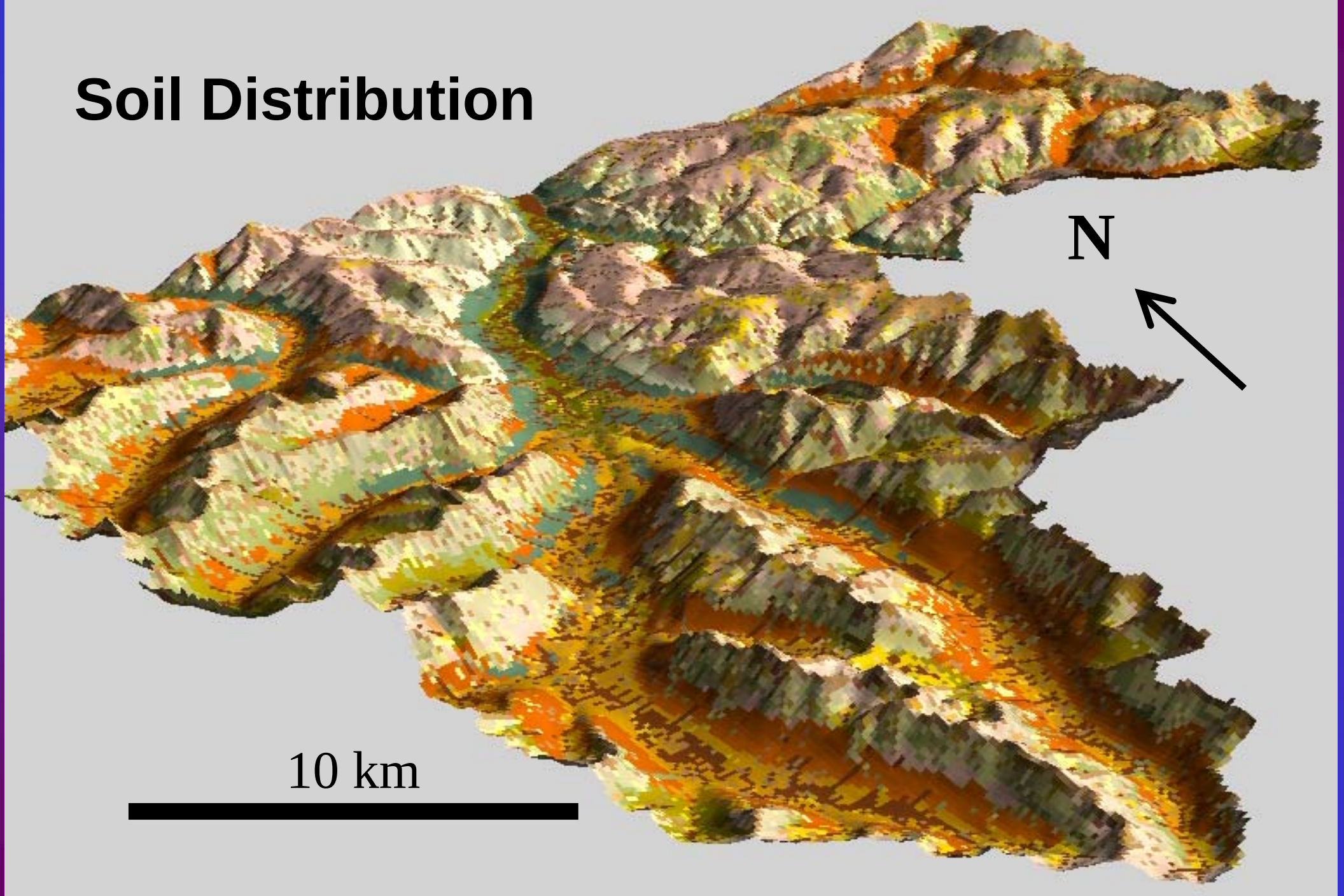
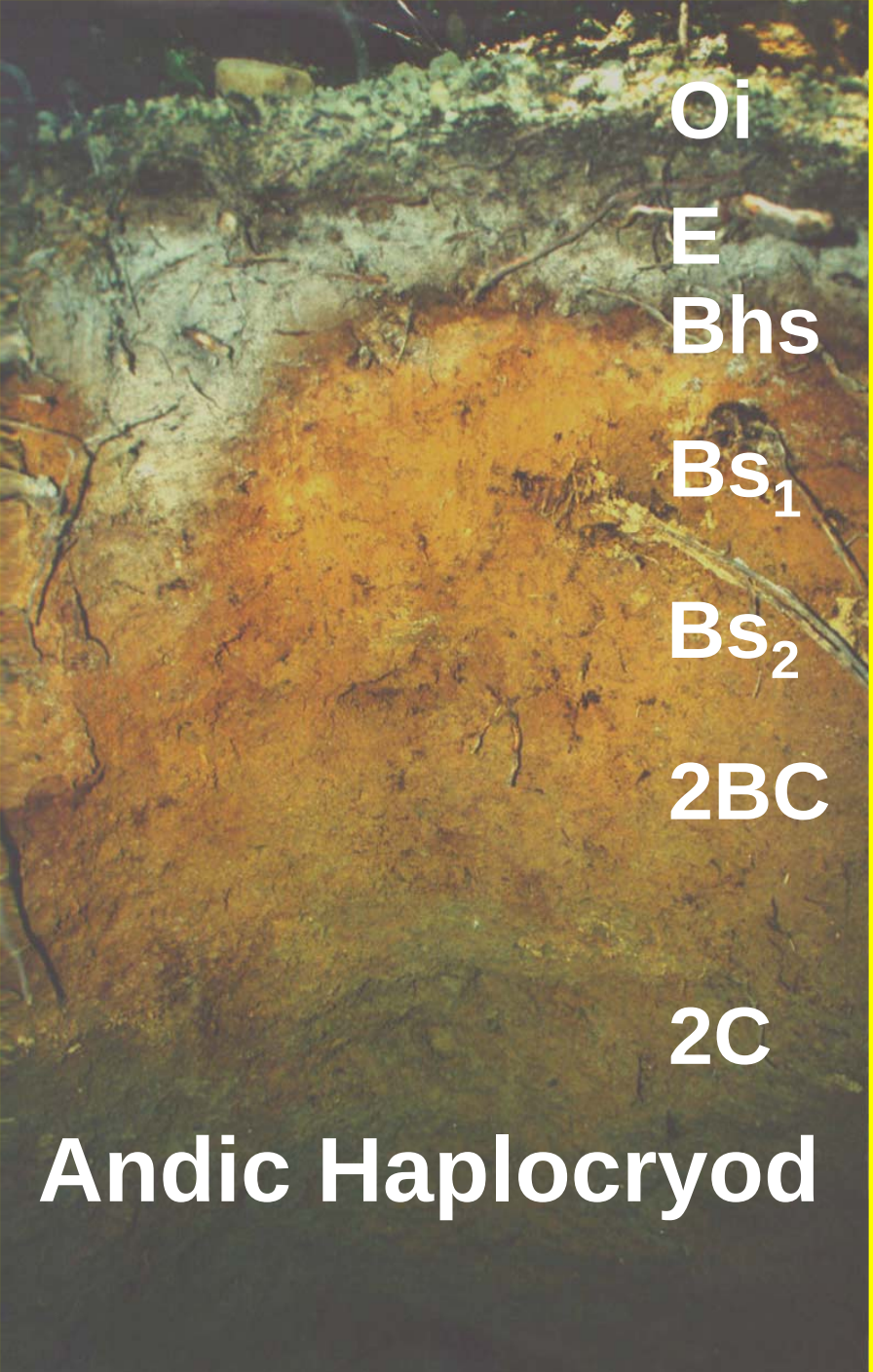
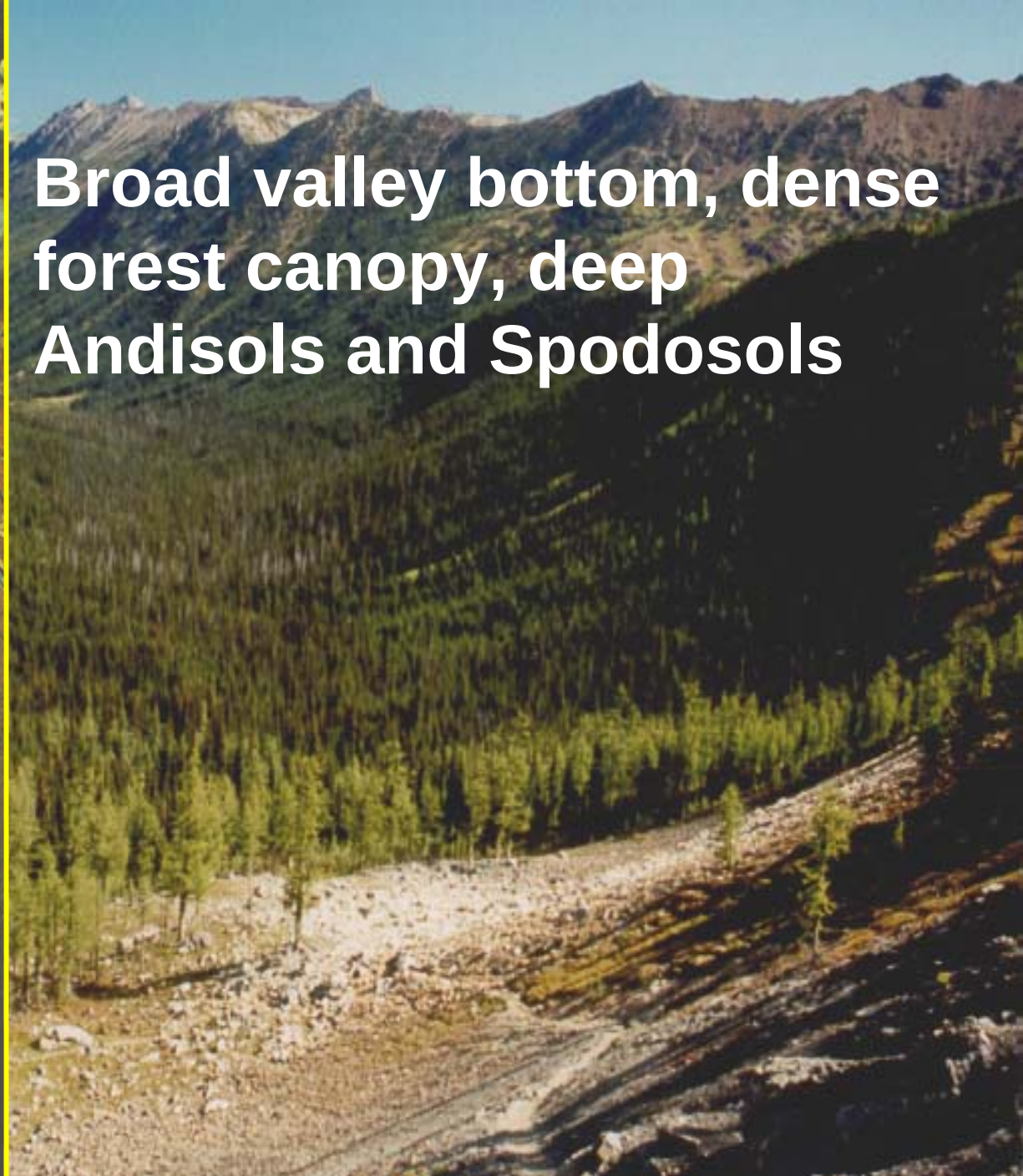
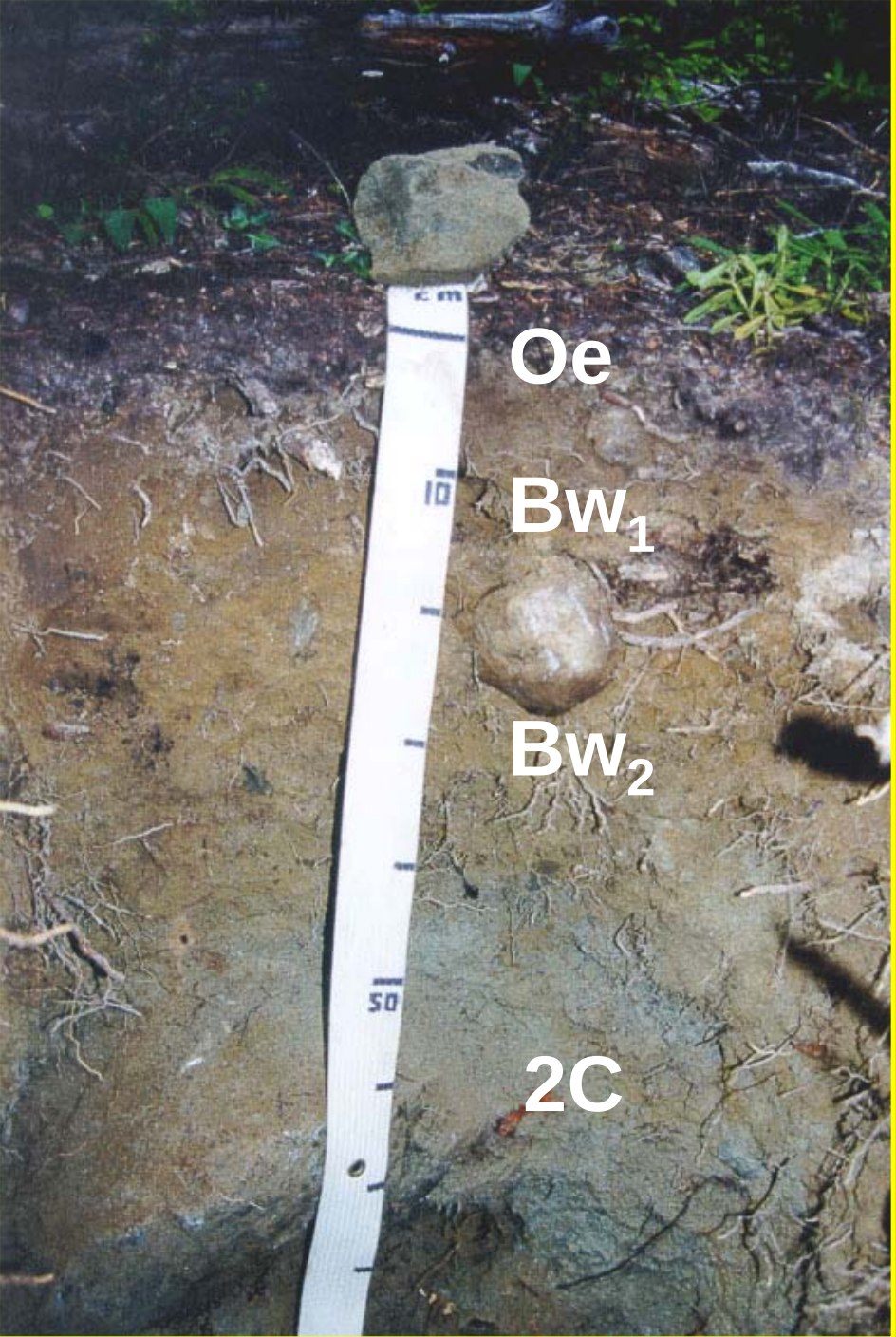

g)

# Soil Distribution



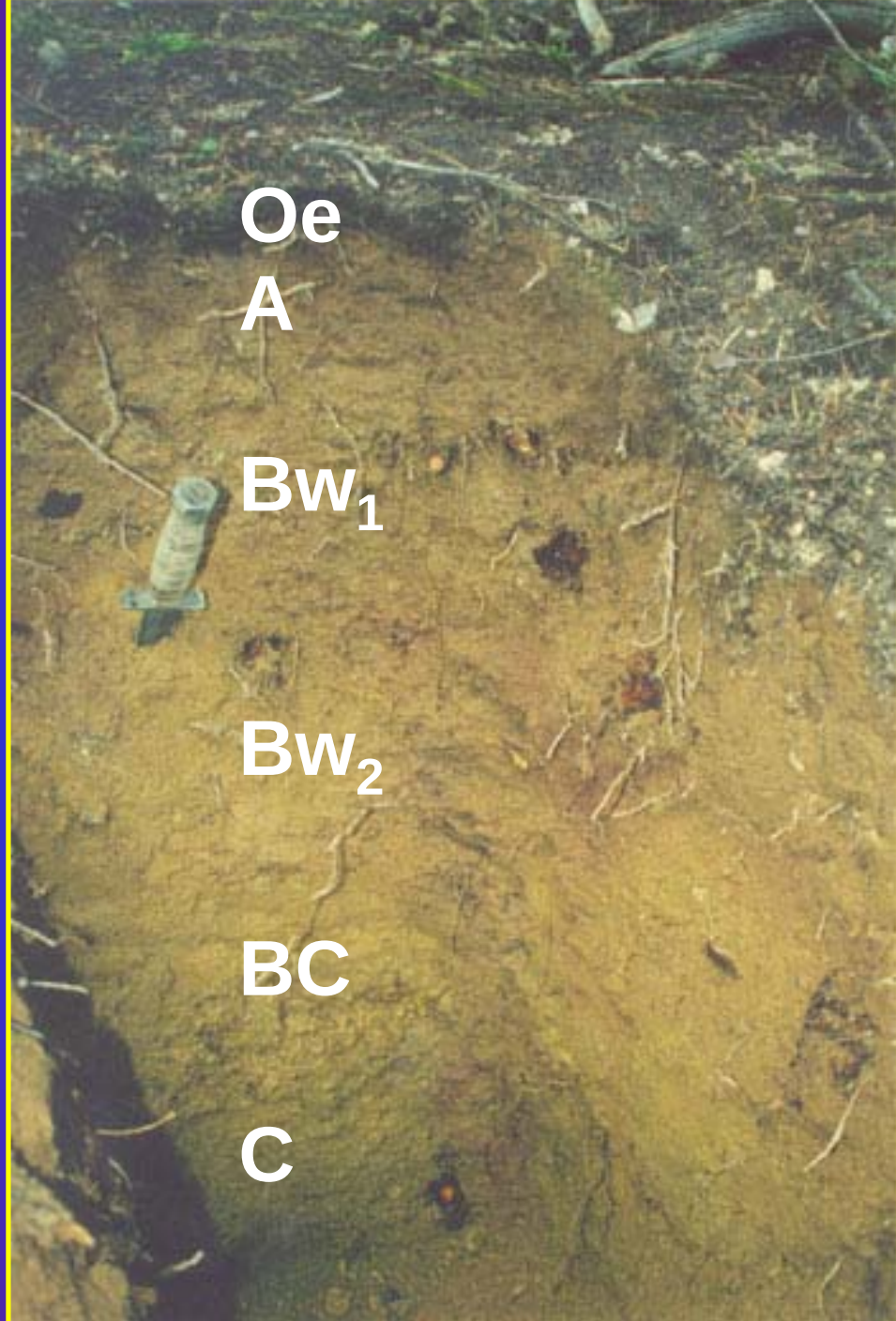

Oi
E
Bhs
$Bs_1$
$Bs_2$
2BC
2C
Andic Haplocryod


Broad valley bottom, dense forest canopy, deep Andisols and Spodosols



# Xeric Vitricryand

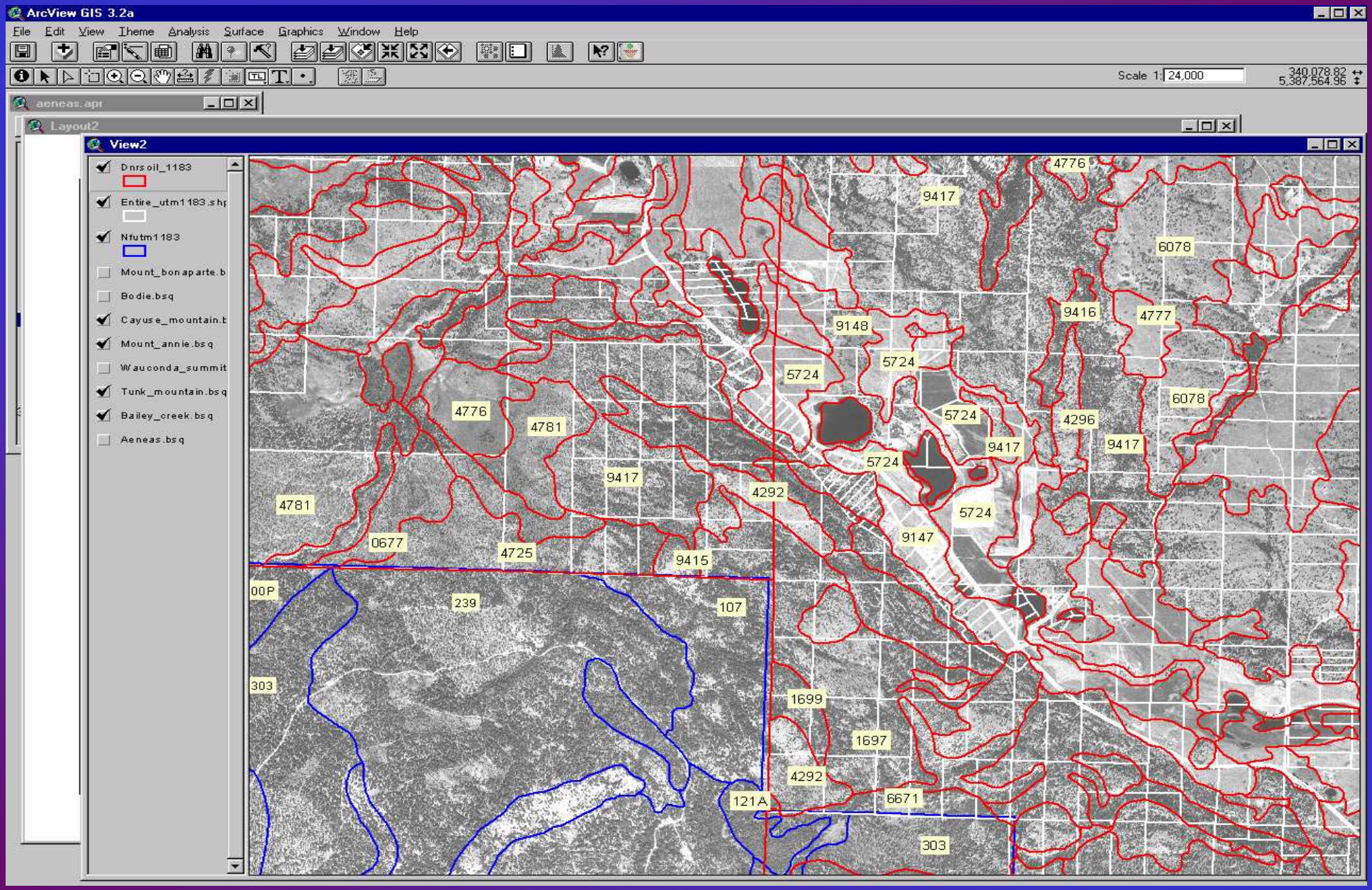
# Andic Haploxerept



# Conclusions

- GIS modeling very applicable in wilderness
- Modeling conserved time and resources
- Further refinement of input data layers will improve map unit delineations
- Expert supervised input extremely valuable

- Data is available for management applications
- Multidisciplinary spin-offs
- Highly useful in remote or sensitive areas
- Model is effective as a preliminary mapping tool
- Easily incorporated with traditional techniques


ArcView GIS 3.2a
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Nfutm1183
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Bodie.bsq
Cayuse_mountain.b
Mount_annie.bsq
Wauconda_summit
Tunk_mountain.bsq
Bailey_creek.bsq
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00P
239
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303
1699
1697
4292
121A
6671
303

# Recommendations

- Obtain higher resolution DEM’s
- Higher resolution satellite and climate data
- Correlate map units across survey boundaries
- Incorporate lithologic data
- Test application to other areas and scales

# Acknowledgements

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