Presentation to the NRCS North Central Regional Work Planning Conference

Geospatial Applications for soil-landscape mapping and monitoring

Paul Gessler
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Dept. of Forest Resources, College of Natural Resources
University of Idaho

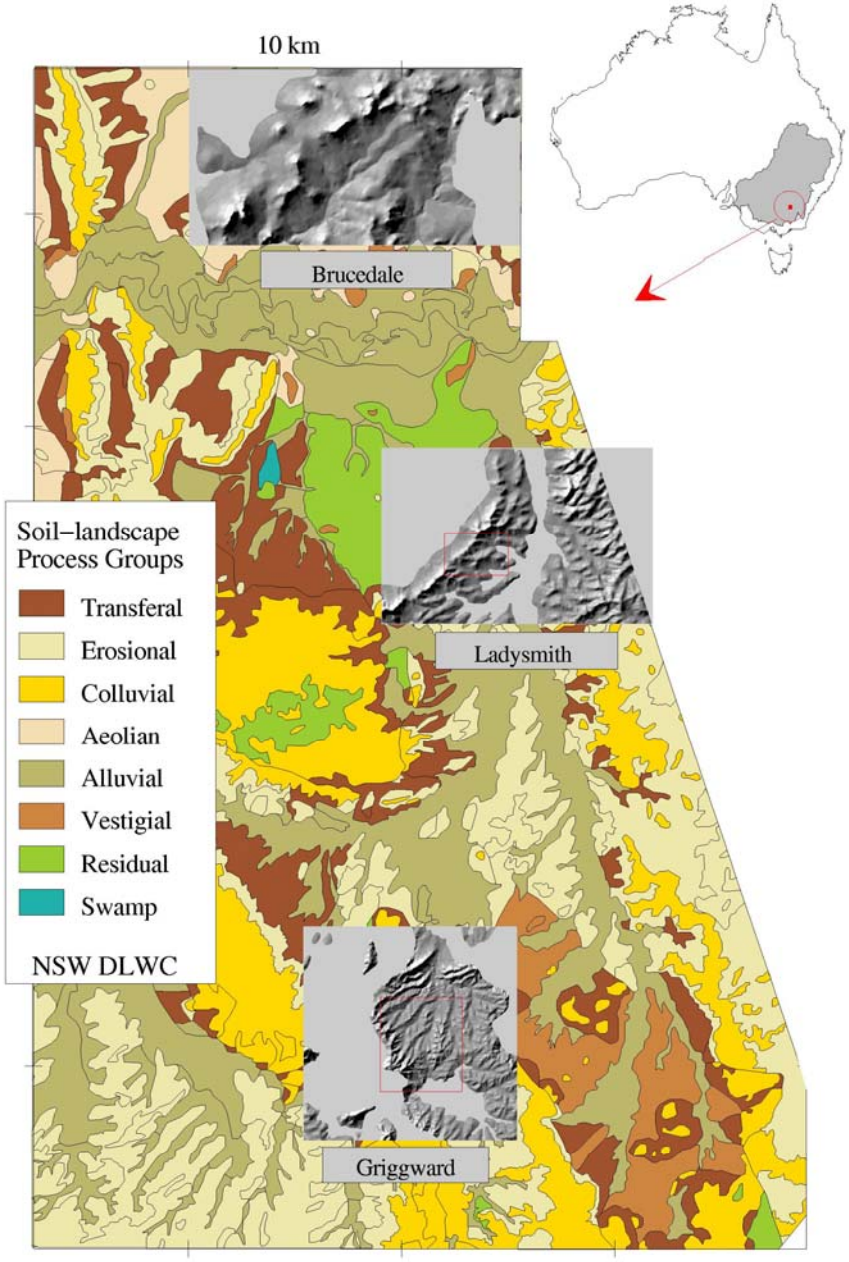
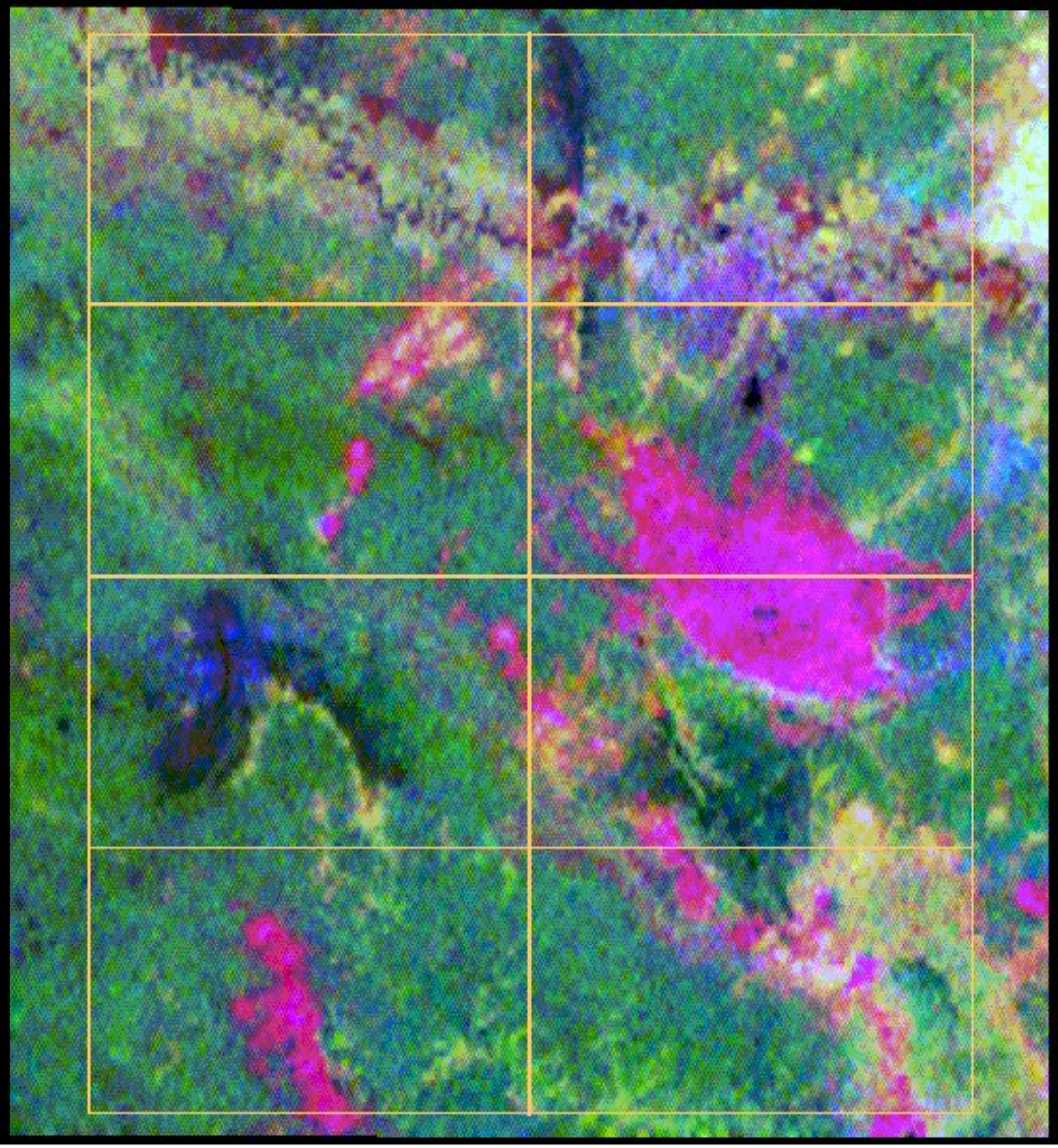


Figure 3.1 Study Area DEM Hillshades

WAGGA REGION - BMR Radiometric Image

May, 1992



N

50m pixels

R = K (1.35 - 1.57 MeV)

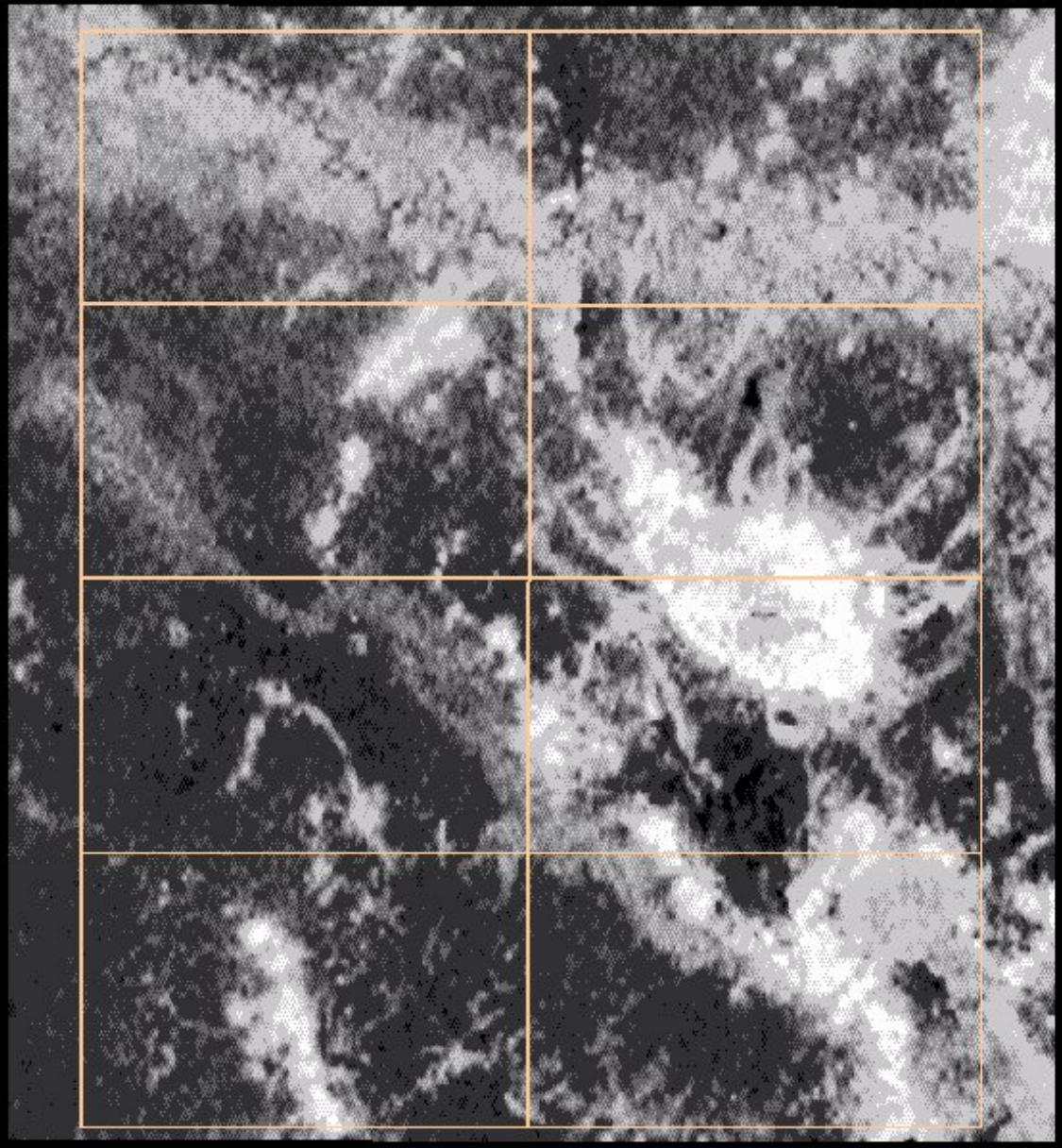
G = Th (2.42 - 2.82 MeV)

B = U (1.63 - 1.89 MeV)

25 km

WAGGA REGION - BMR Radiometric Image

May, 1992



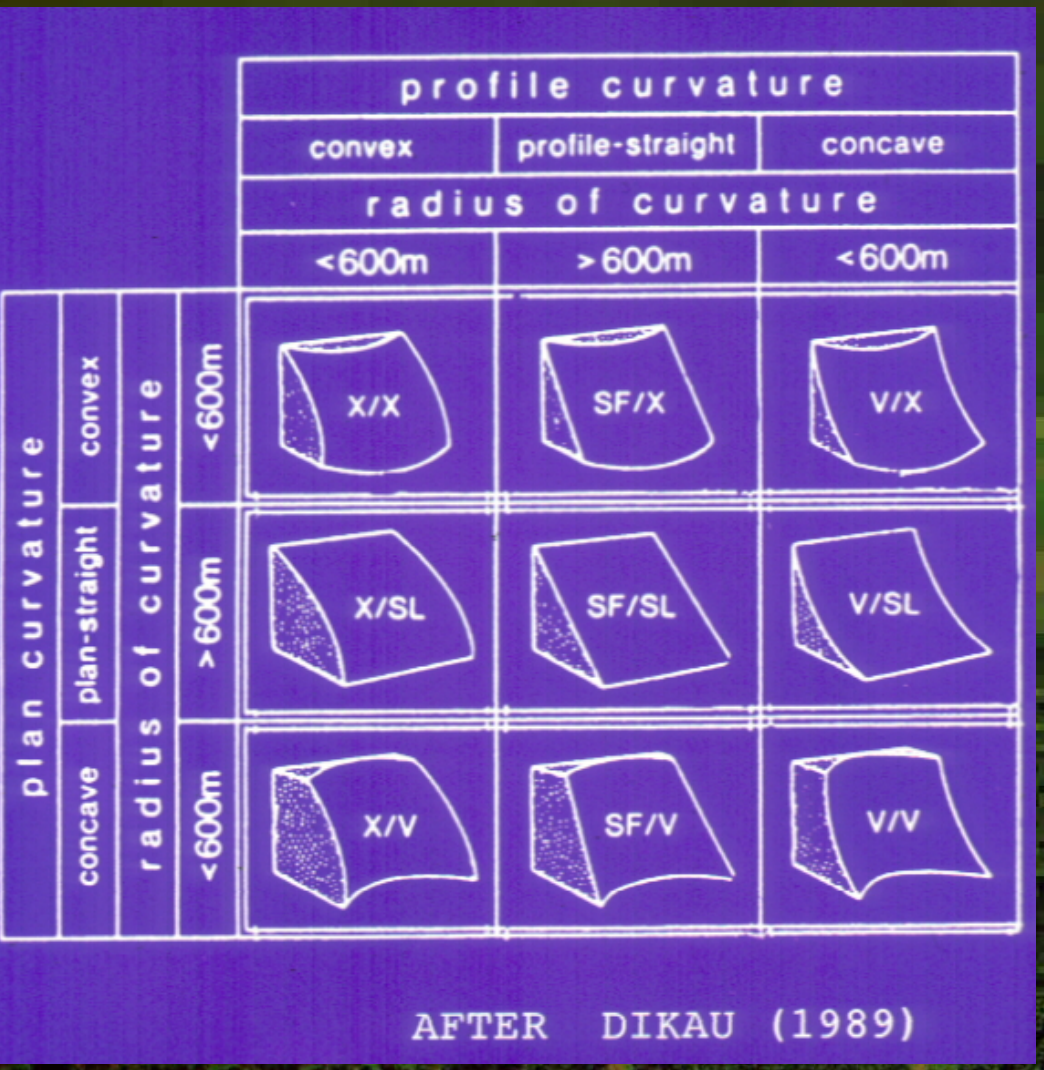
POTASSIUM
1.35 - 1.57 MeV

Areas of low K, enhanced

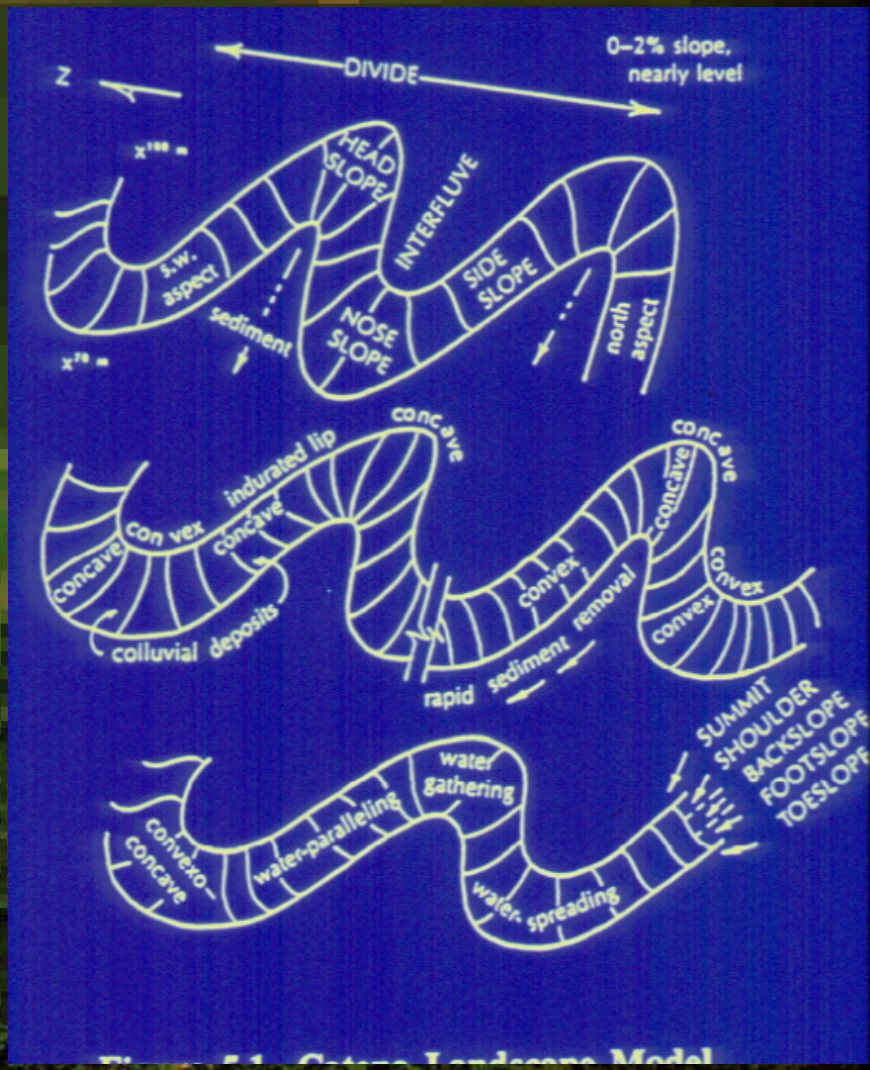
50m pixels

25km

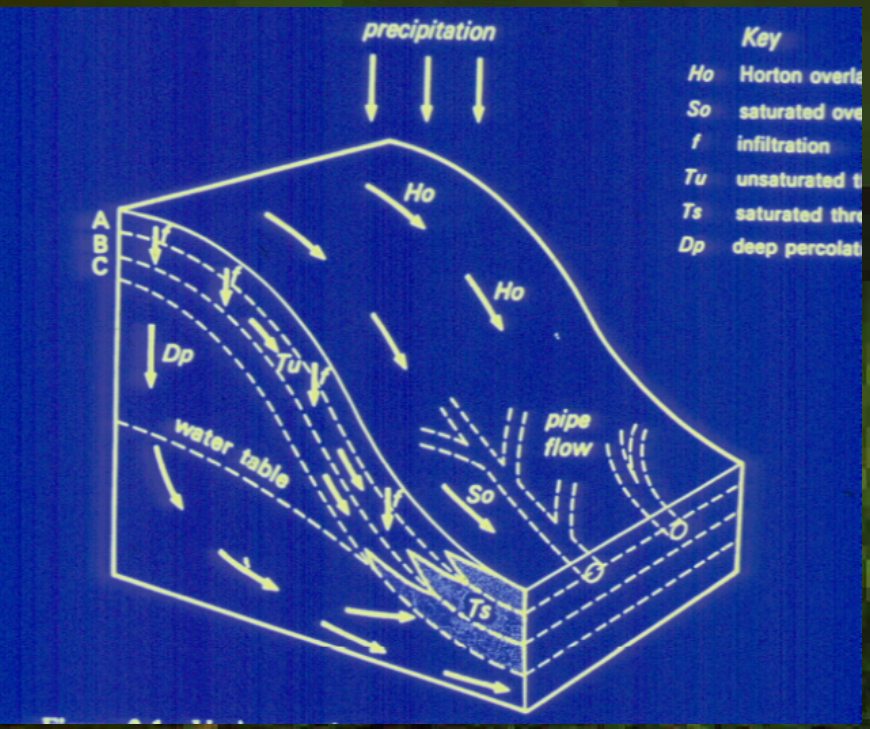
Quantitative Terrain Attributes - geomorphometry

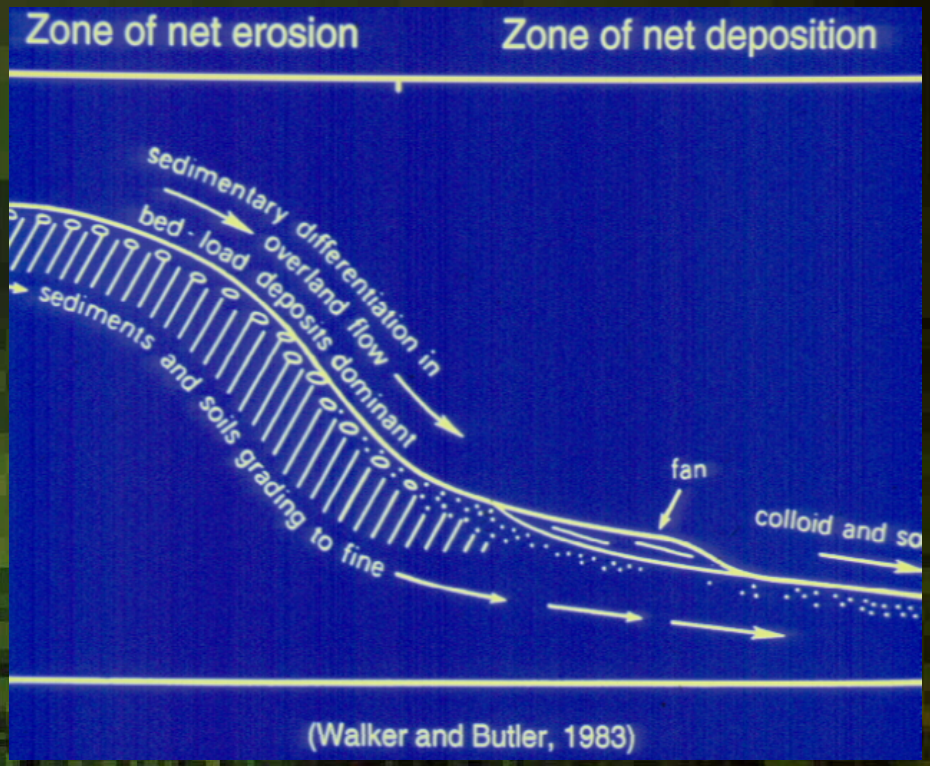


AFTER DIKAU (1989)

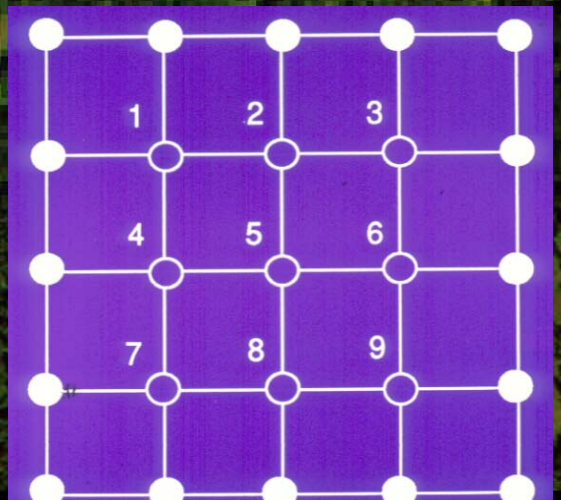


Quantitative Terrain Attributes - geomorphometry





(Walker and Butler, 1983)



Compound Topographic Index

(or steady-state wetness index)

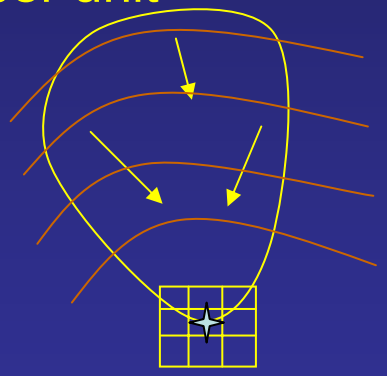
(Speight, 1974; Bevan & Kirkby, 1979; Moore et al. 1991; 1993)

$$CTI = \ln(A_s / \tan B)$$

where:

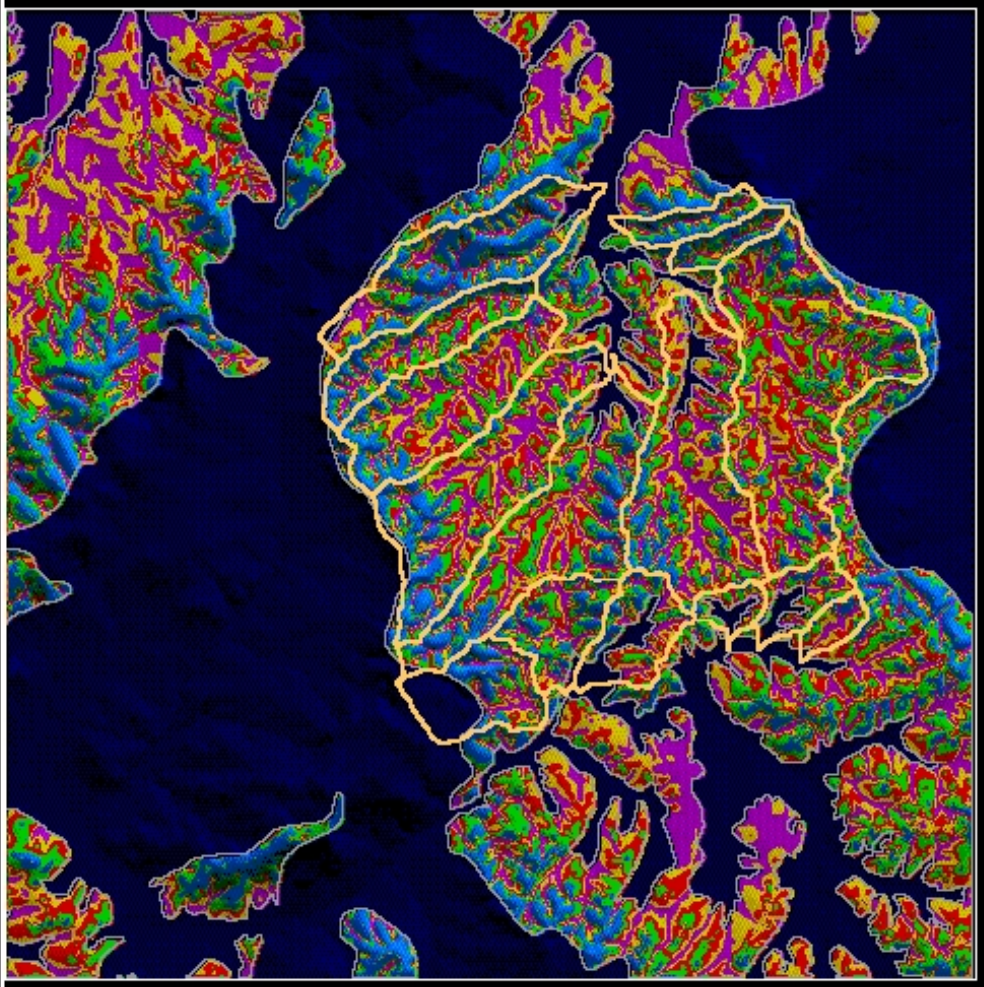
A_s is the specific catchment area (contributing area (m^2) per unit width of contour orthogonal to the flow direction)

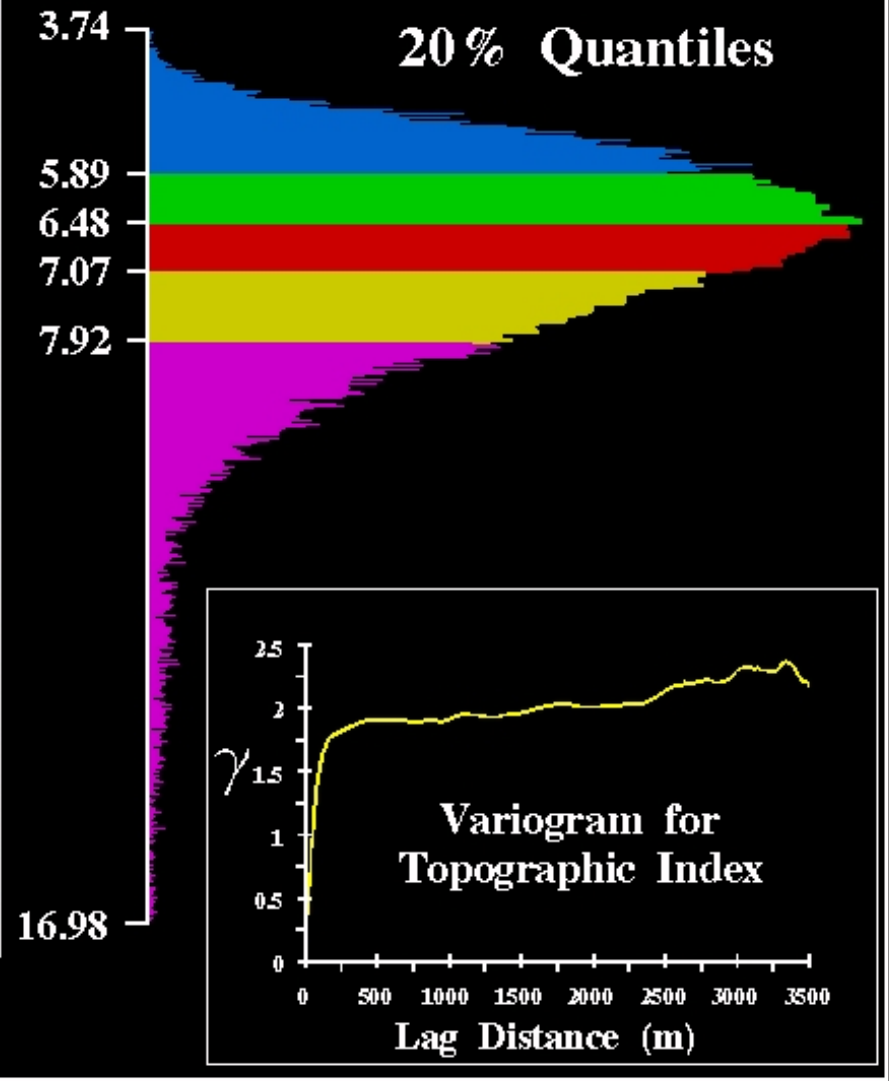
B is the slope angle in degrees



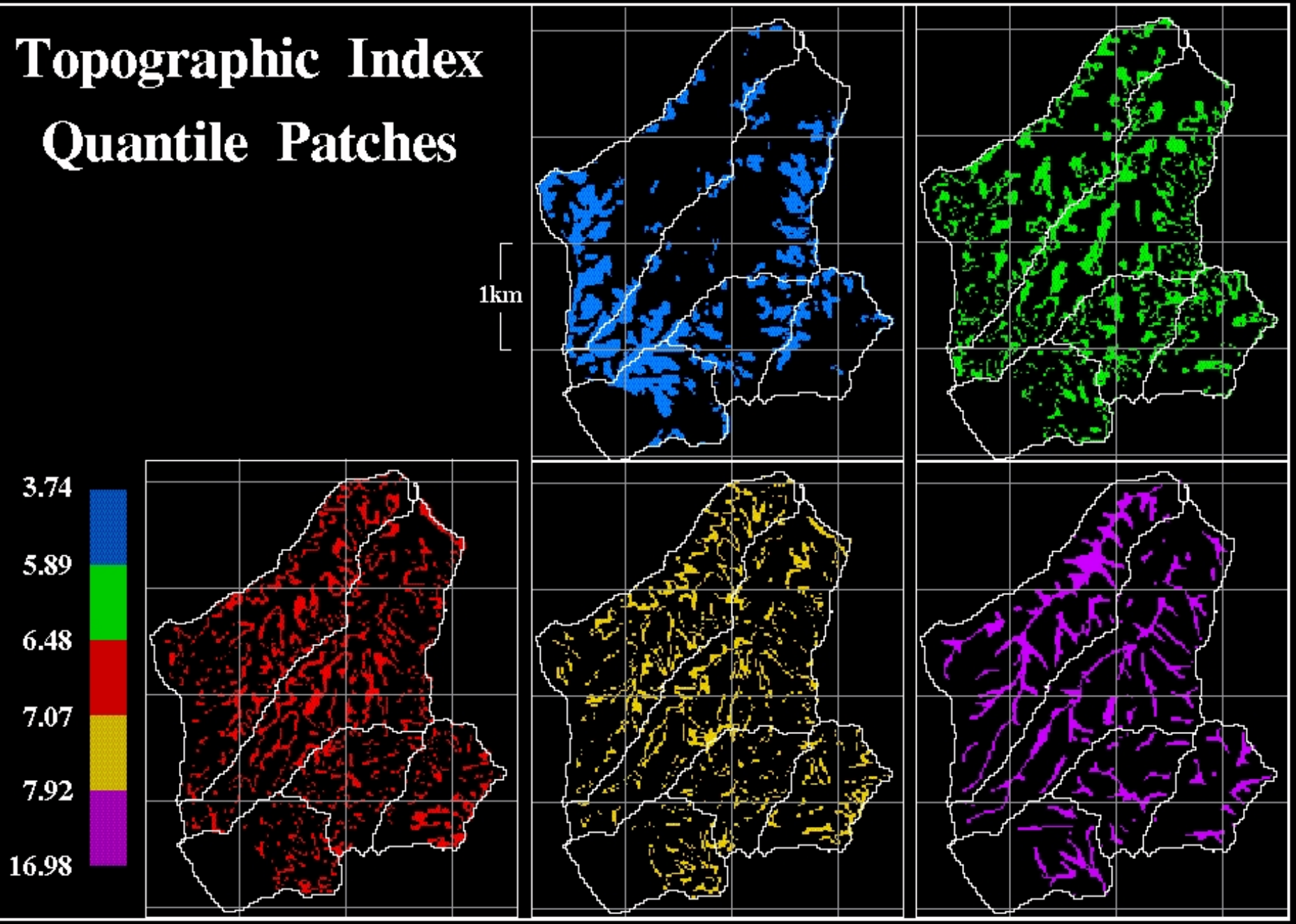
"a quantification of catenary landscape position"

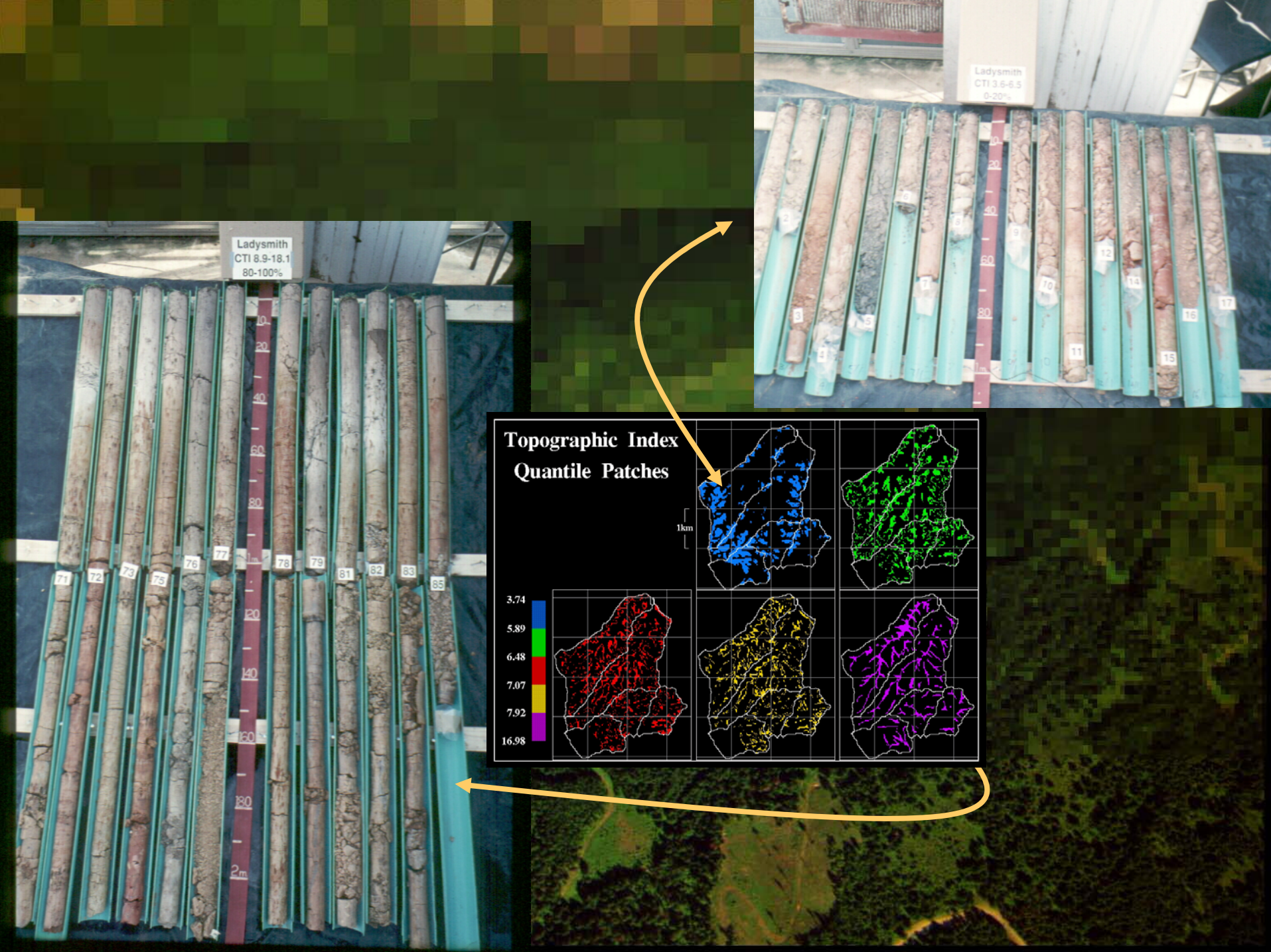
Topographic Index within the bounds of the Ordovician Metasediments





Topographic Index Quantile Patches




Ladysmith
CTI 8.9-18.1
80-100%
Ladysmith
CTI 3.6-6.5
0-20%
Topographic Index
Quantile Patches
1km
3.74
5.89
6.48
7.07
7.92
16.98

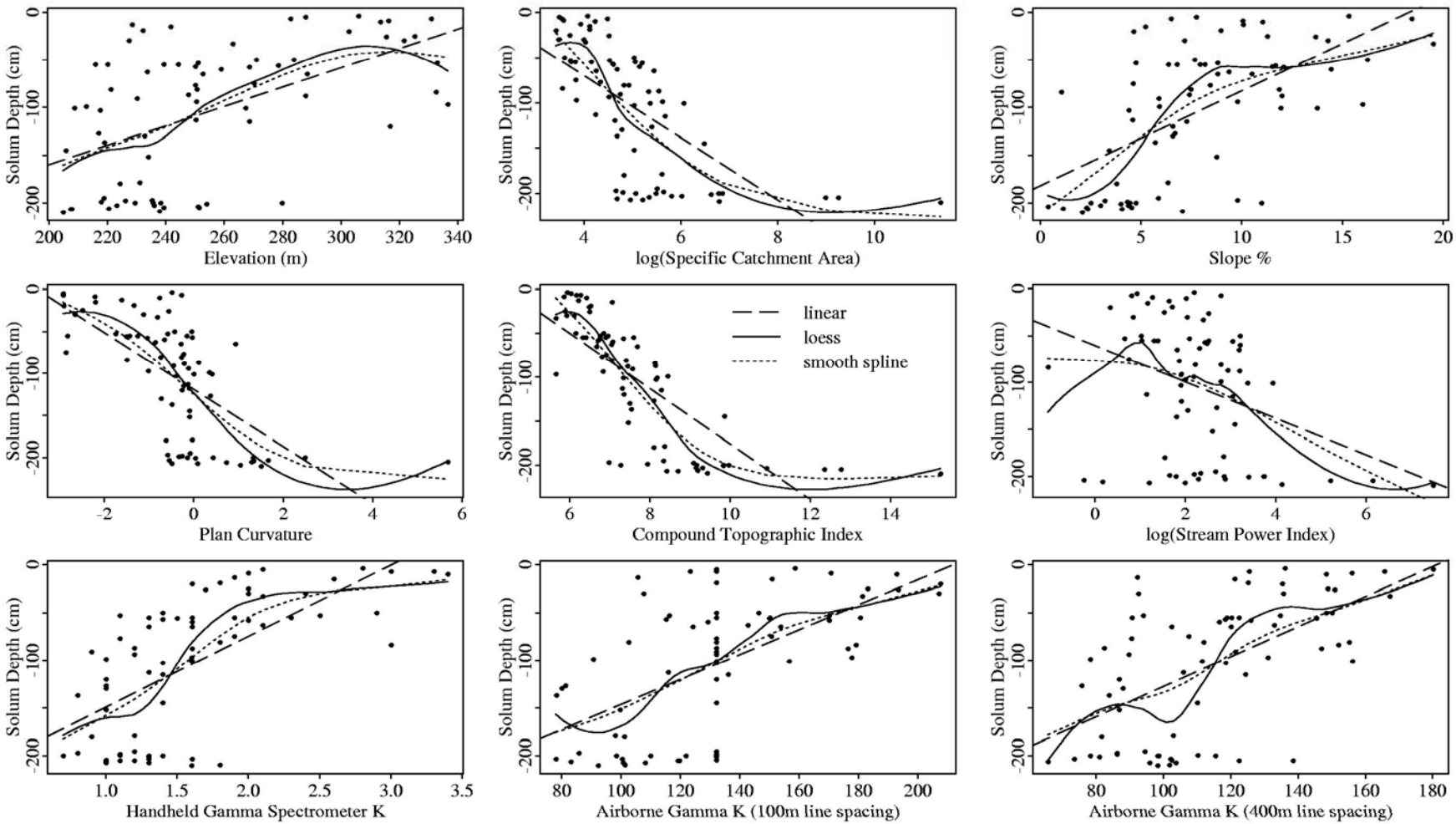


Figure 3.4 Environmental Attributes (Explanatory) vs. Solum Depth (Response)

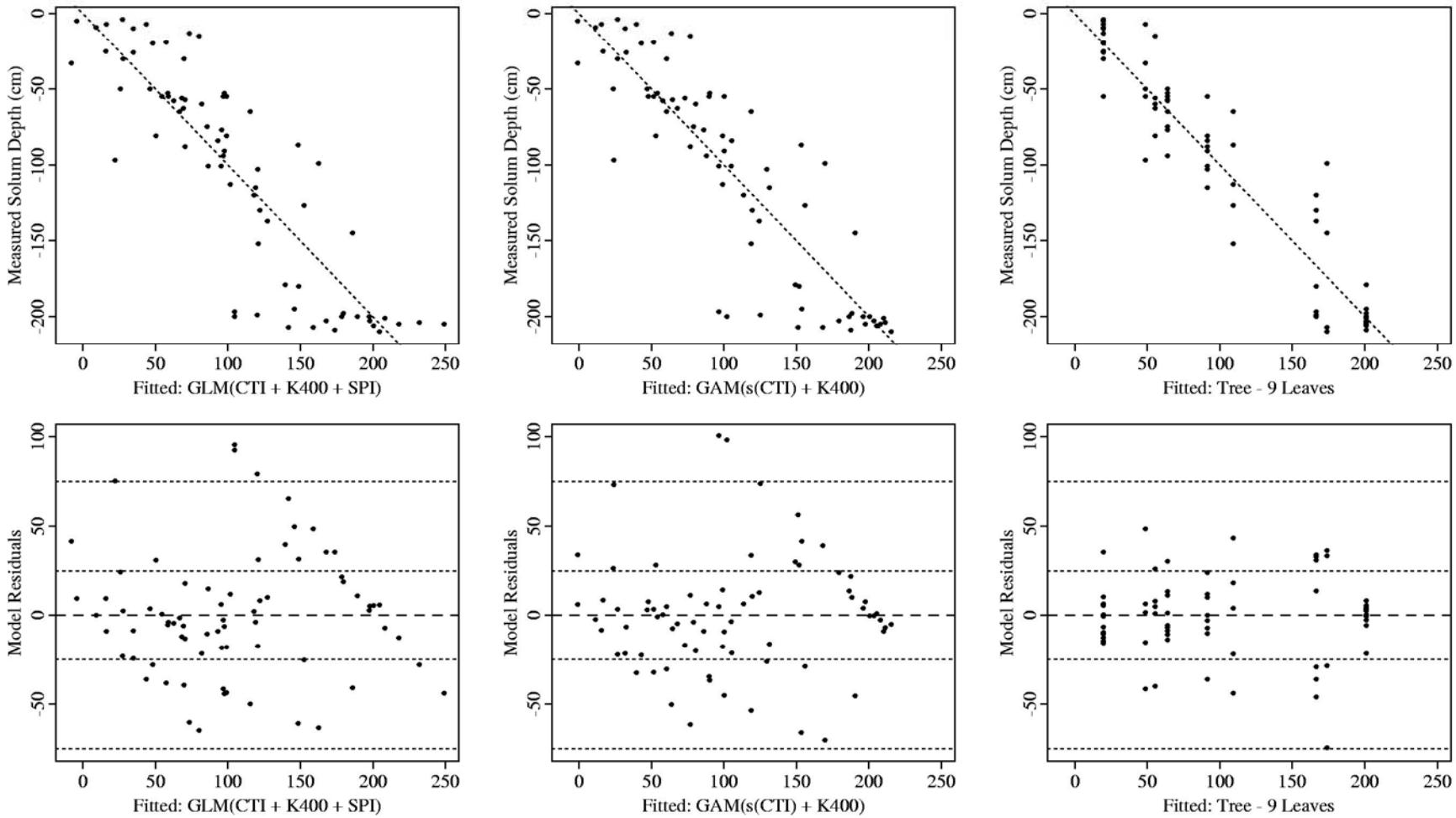


Figure 3.6 Fitted Solum Depth vs. Measured and Fitted Solum Depth vs. Residuals

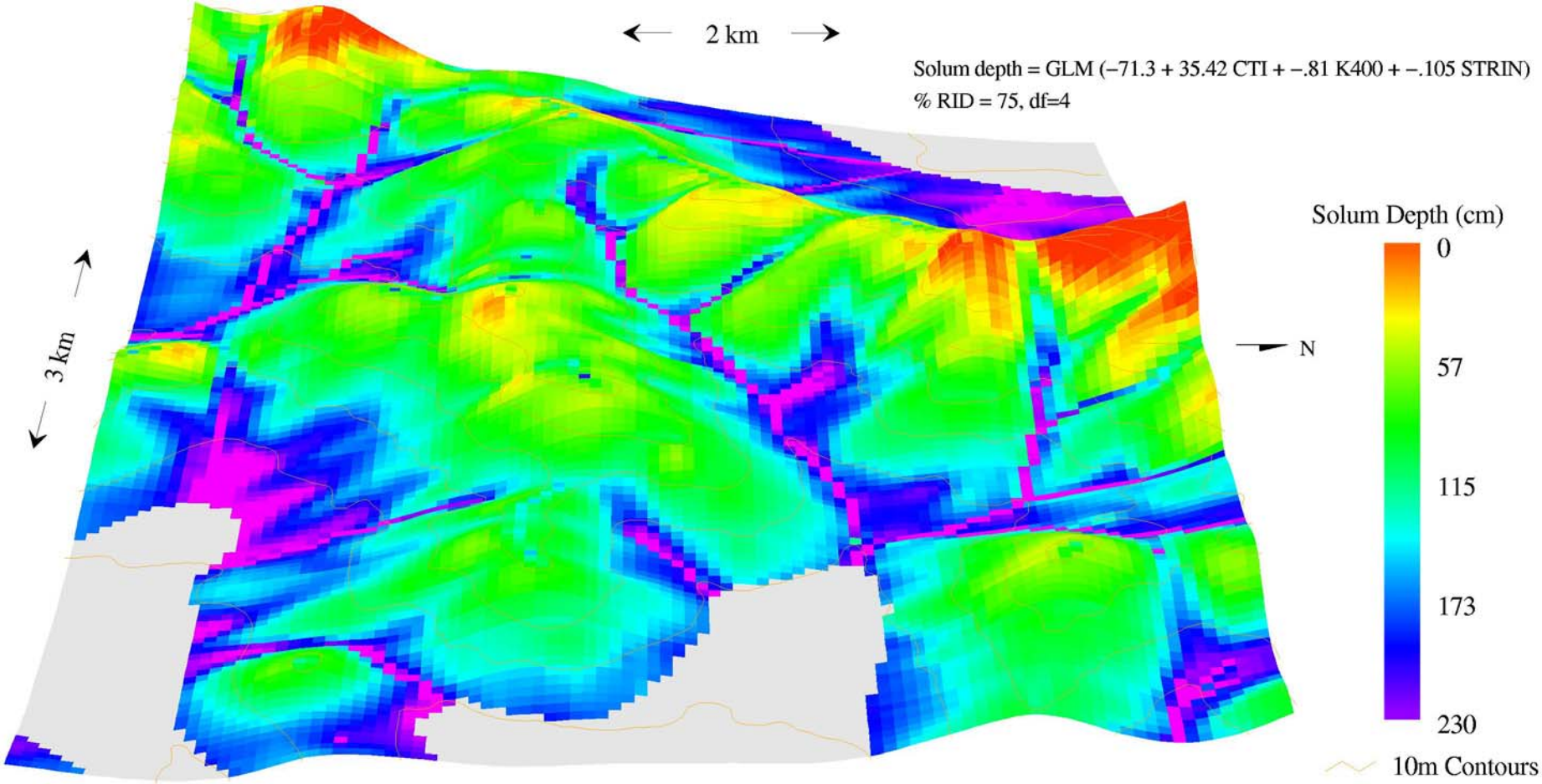
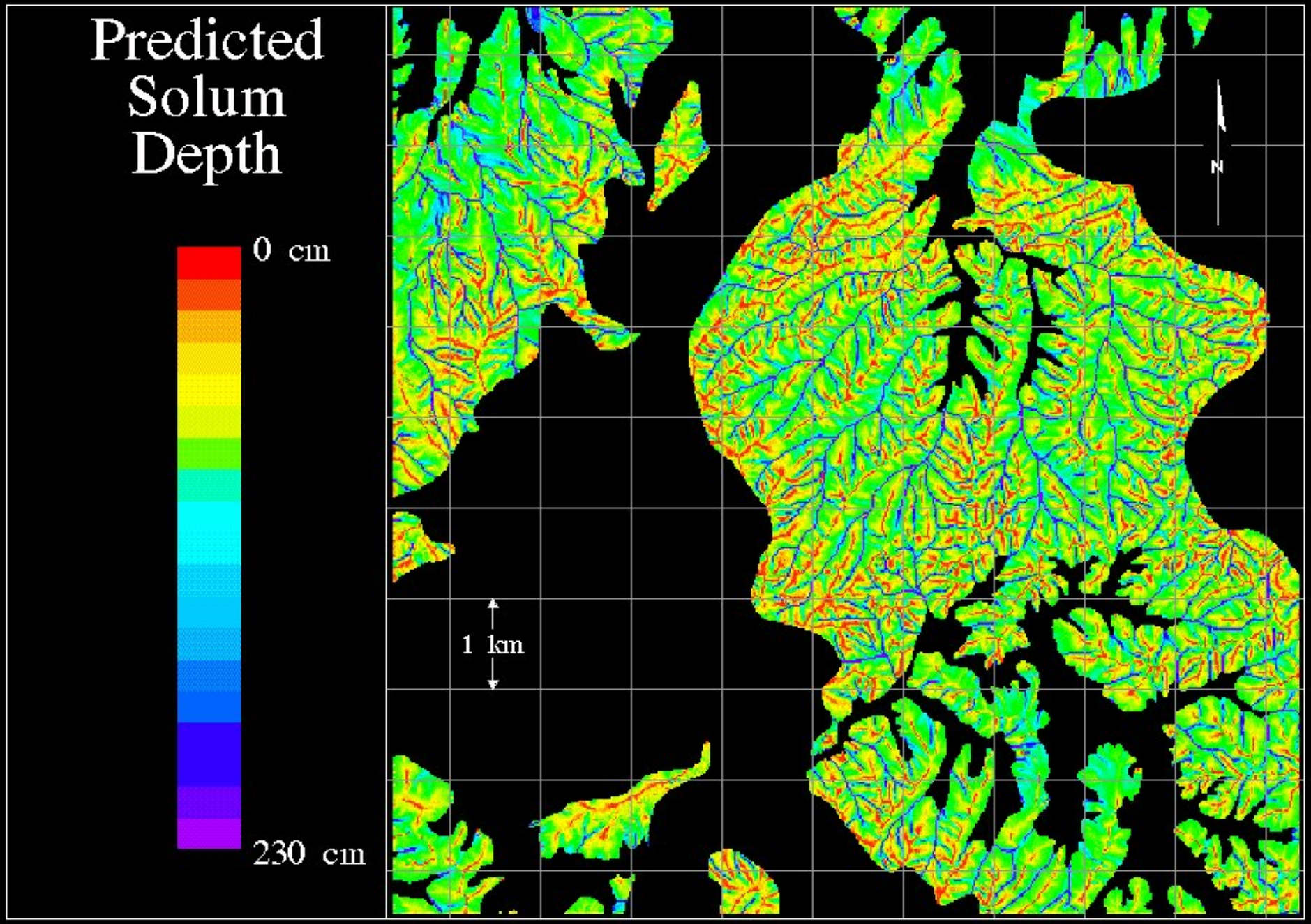


Figure 3.7 Drape of Predicted Solum Depth Using a GLM Model


Predicted
Solum
Depth
0 cm
230 cm
1 km
N

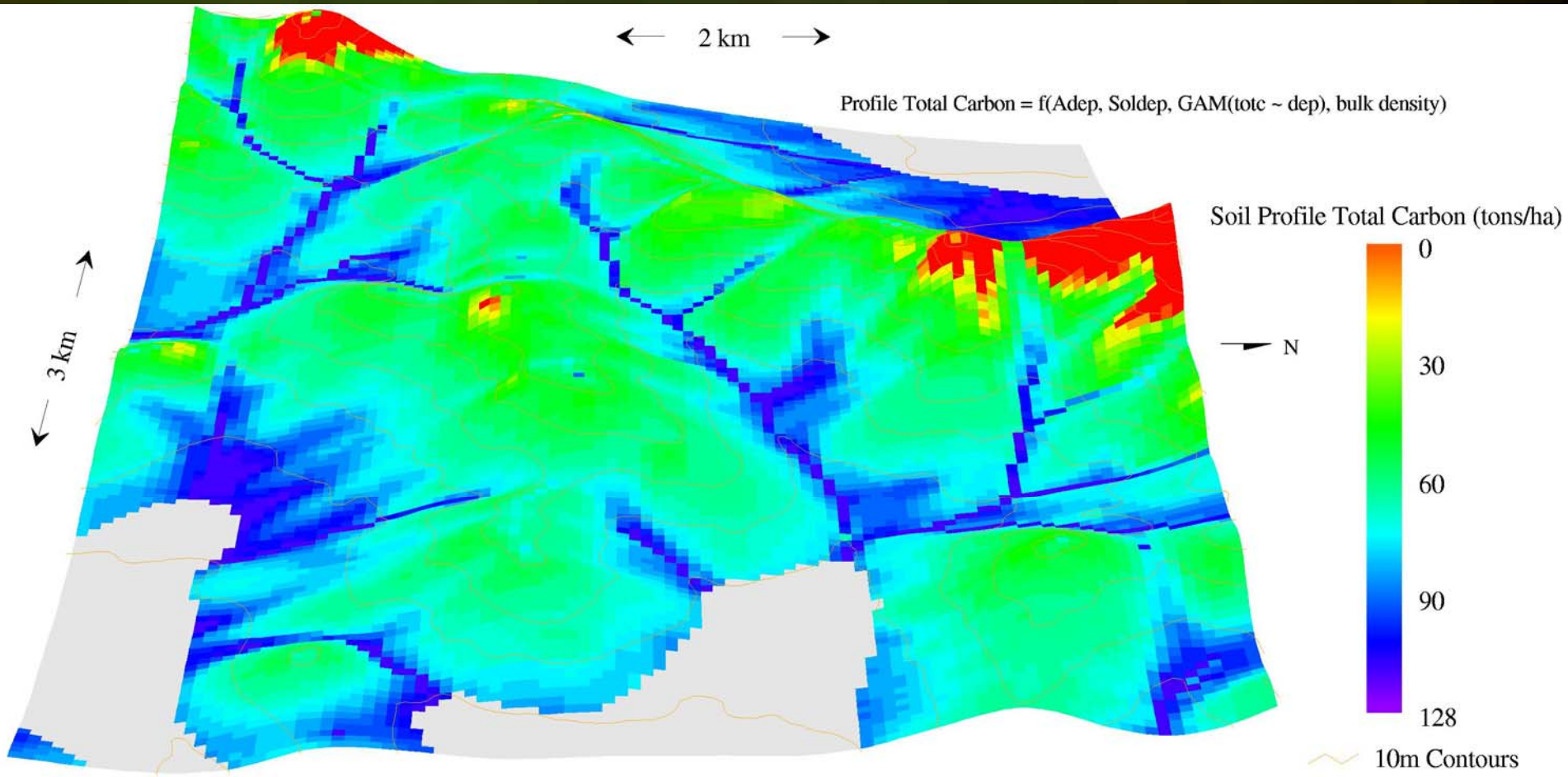
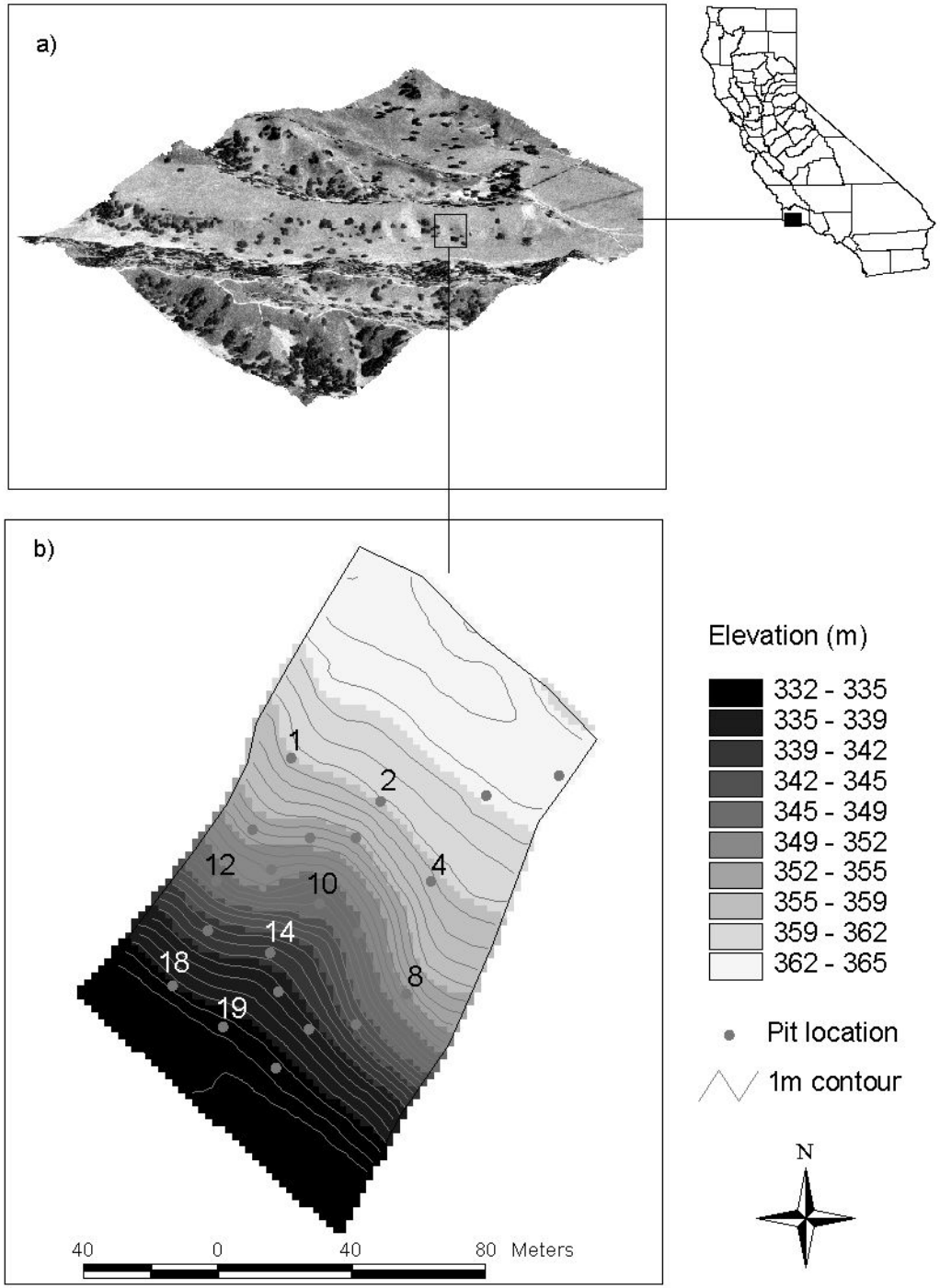
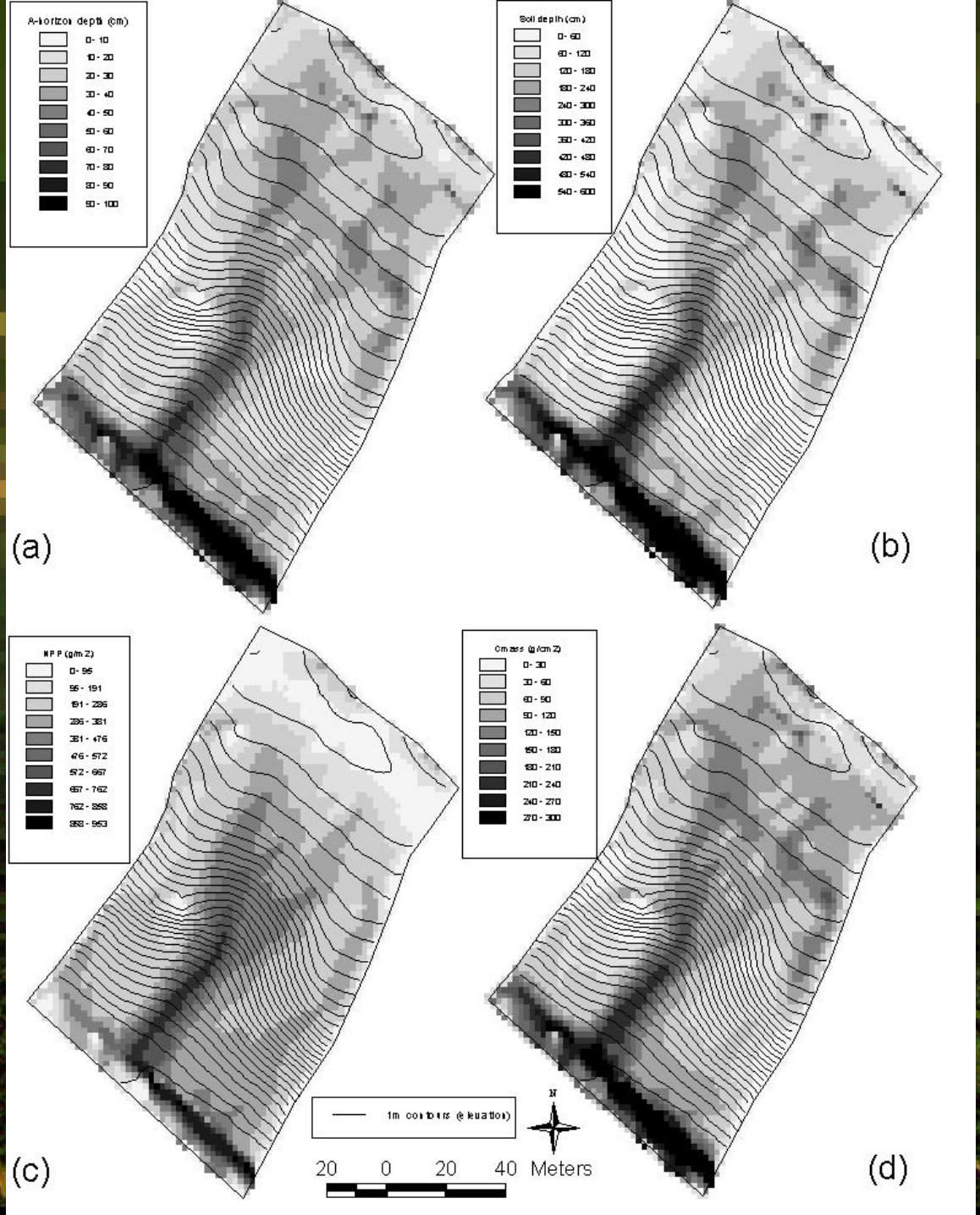


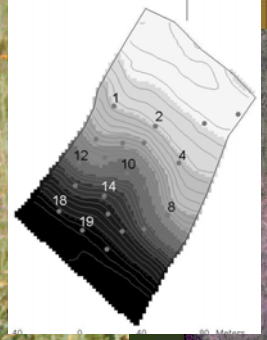
Figure 3.14 Drape of Predicted Soil Profile Total Carbon

S-L function


a)
b)
1
2
4
8
10
12
14
18
19
Elevation (m)
332 - 335
335 - 339
339 - 342
342 - 345
345 - 349
349 - 352
352 - 355
355 - 359
359 - 362
362 - 365
Pit location
1m contour
N
40
0
40
80
Meters

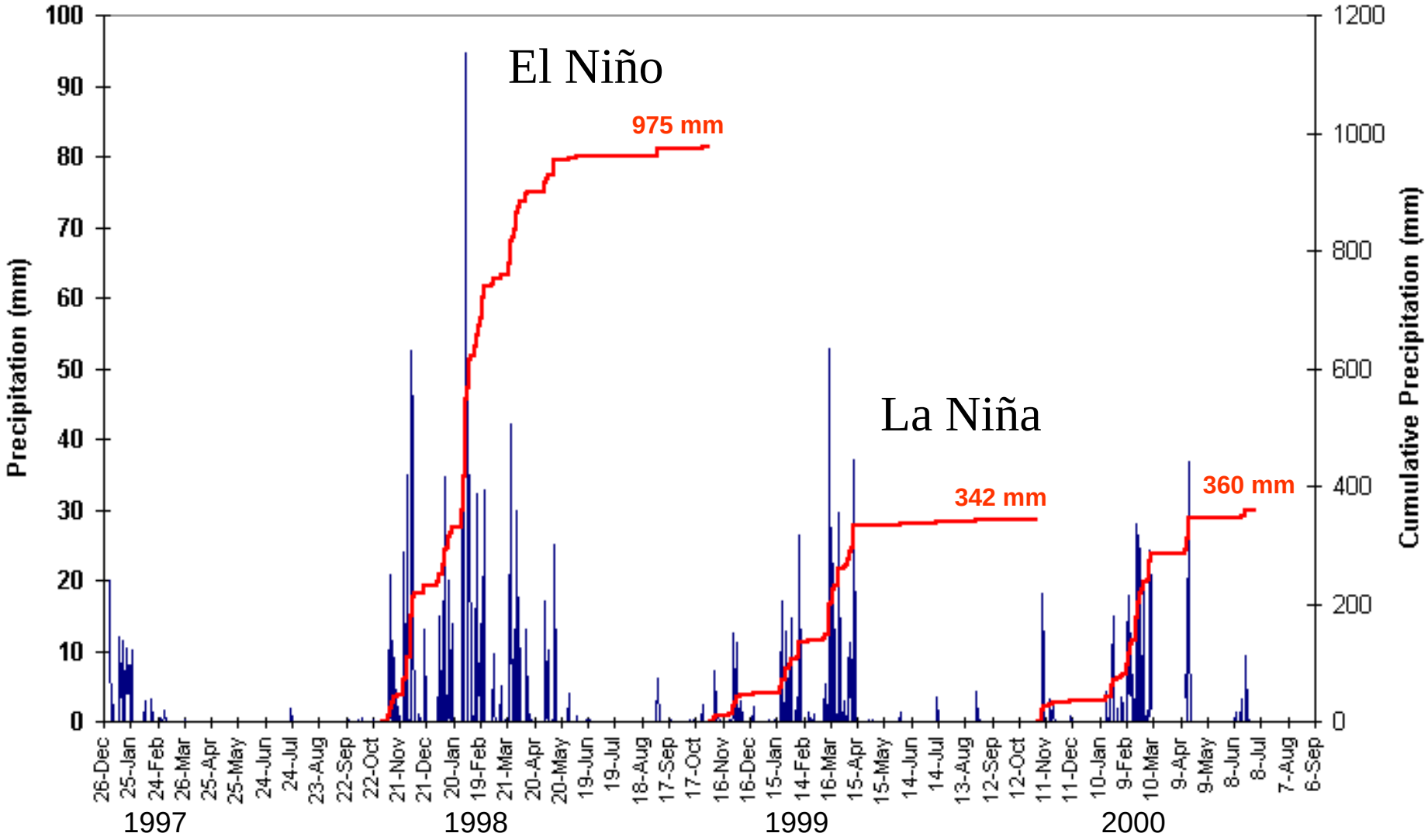

A-horizon depth (cm)
0 - 10
10 - 20
20 - 30
30 - 40
40 - 50
50 - 60
60 - 70
70 - 80
80 - 90
90 - 100
(a)
Soil depth (cm)
0 - 60
60 - 120
120 - 180
180 - 240
240 - 300
300 - 360
360 - 420
420 - 480
480 - 540
540 - 600
(b)
NPP (g/m2)
0 - 95
95 - 191
191 - 286
286 - 381
381 - 476
476 - 572
572 - 667
667 - 762
762 - 858
858 - 953
(c)
Cmass (g/cm2)
0 - 30
30 - 60
60 - 90
90 - 120
120 - 150
150 - 180
180 - 210
210 - 240
240 - 270
270 - 300
(d)
1m contours (elevation)
N
20 0 20 40 Meters

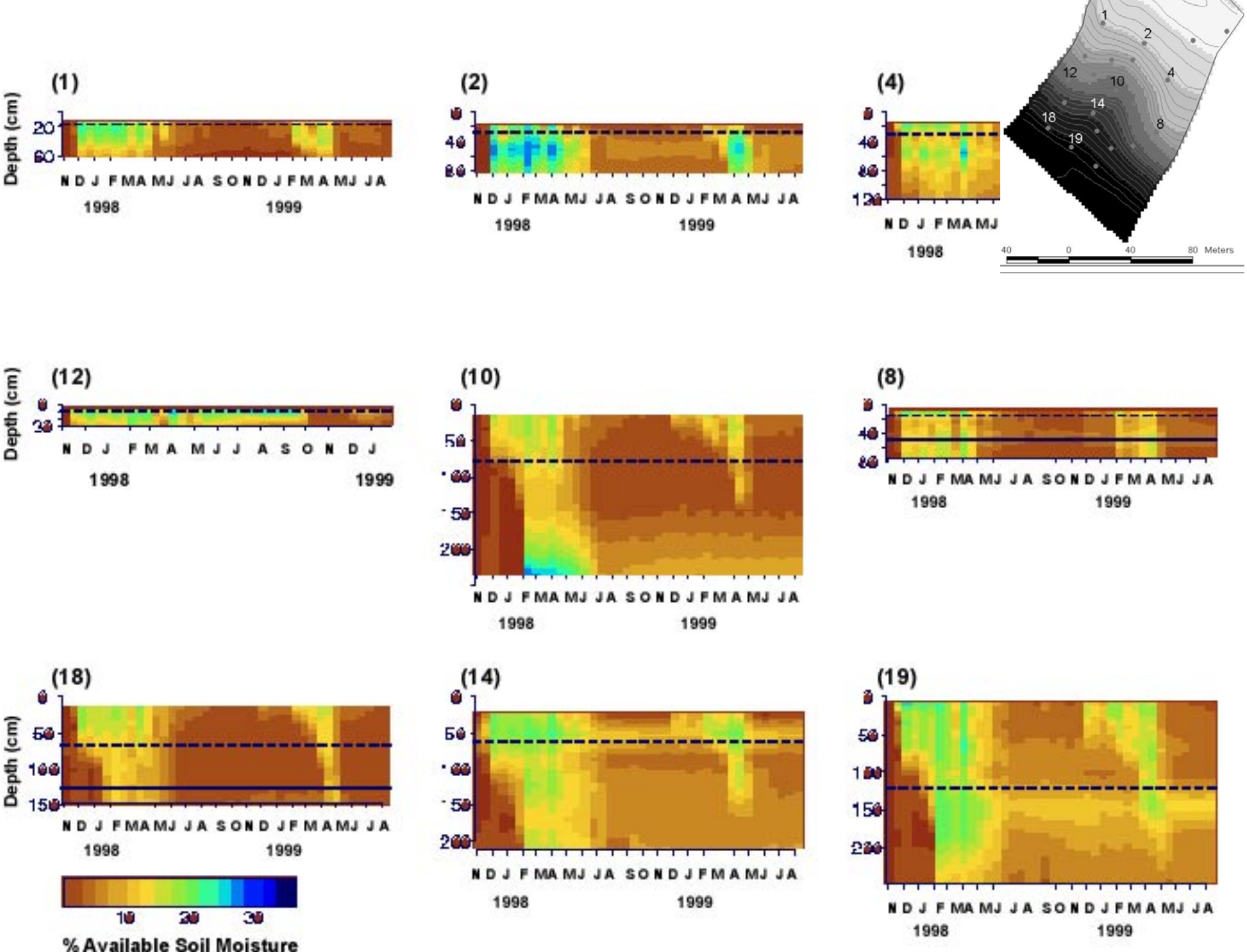
Sedgwick
Hillslope
#1
Soil Pit #1


1
2
12
10
4
14
18
8
19

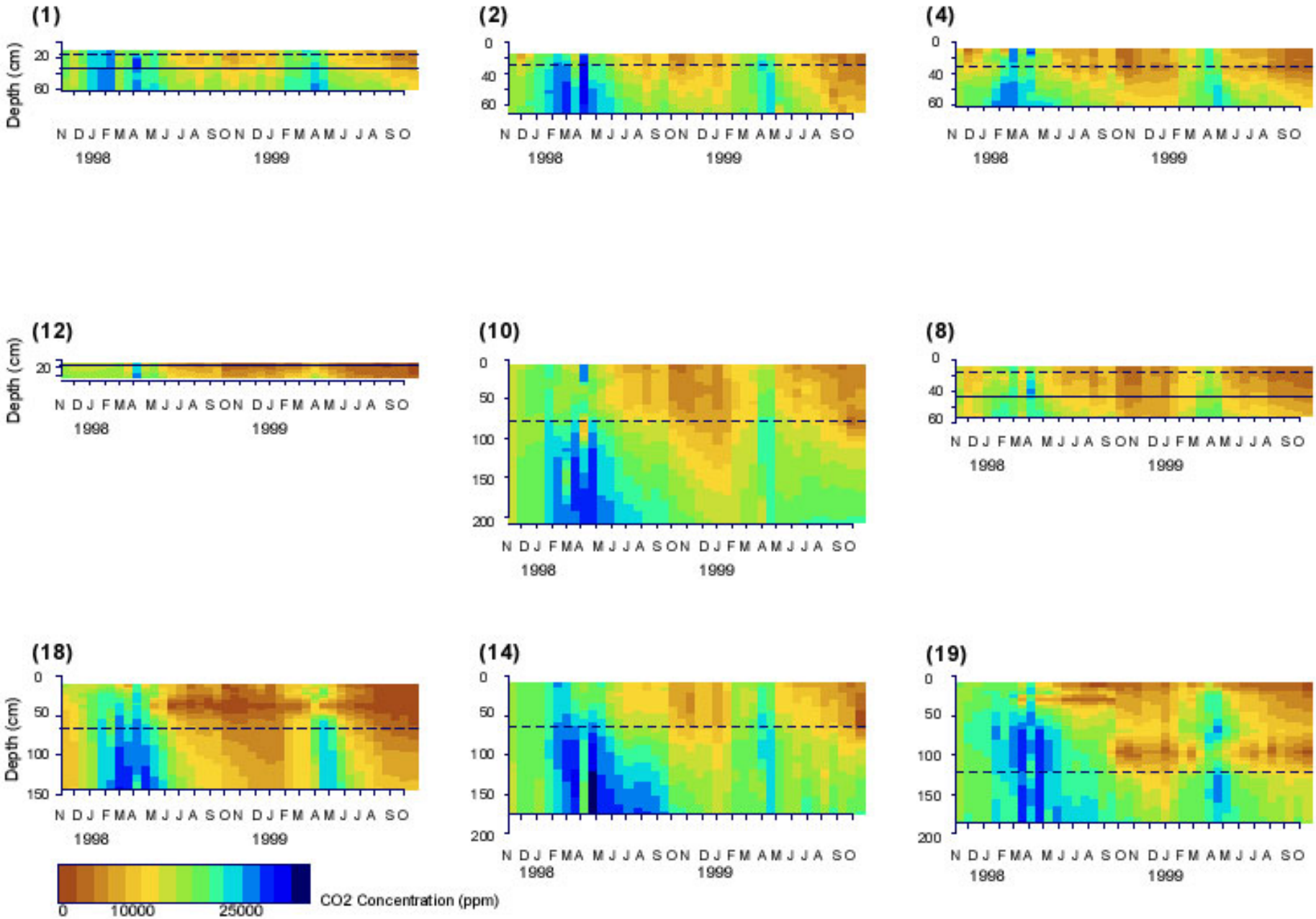
Sedgwick
Hillslope
#1
Soil Pit #19

Daily and cumulative values of precipitation for the Hillslope study site at Sedgwick Natural Reserve.




(1)
(2)
(4)
(12)
(10)
(8)
(18)
(14)
(19)
Depth (cm)
N D J F M A M J J A S O N D J F M A M J J A
1998
1999
1
2
4
8
10
12
14
18
19
40 0 40 80 Meters
% Available Soil Moisture

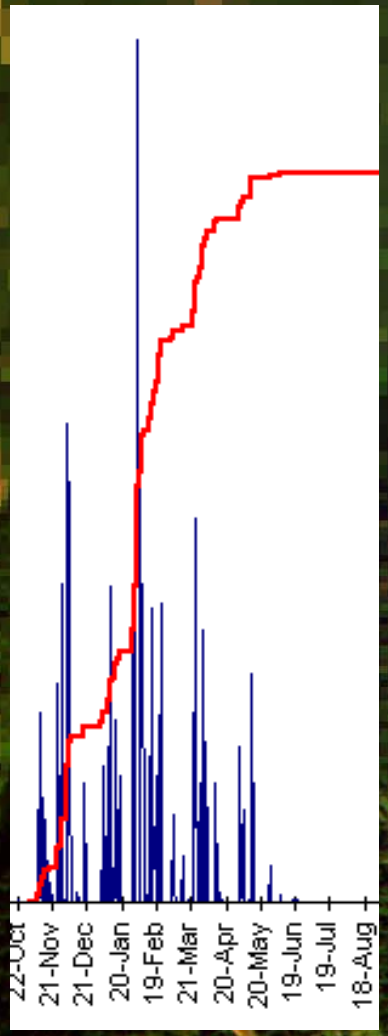
Log of soil CO2 Concentrations (ppm) for Hillslope1 Study Site - Sedgwick Natural Reserve

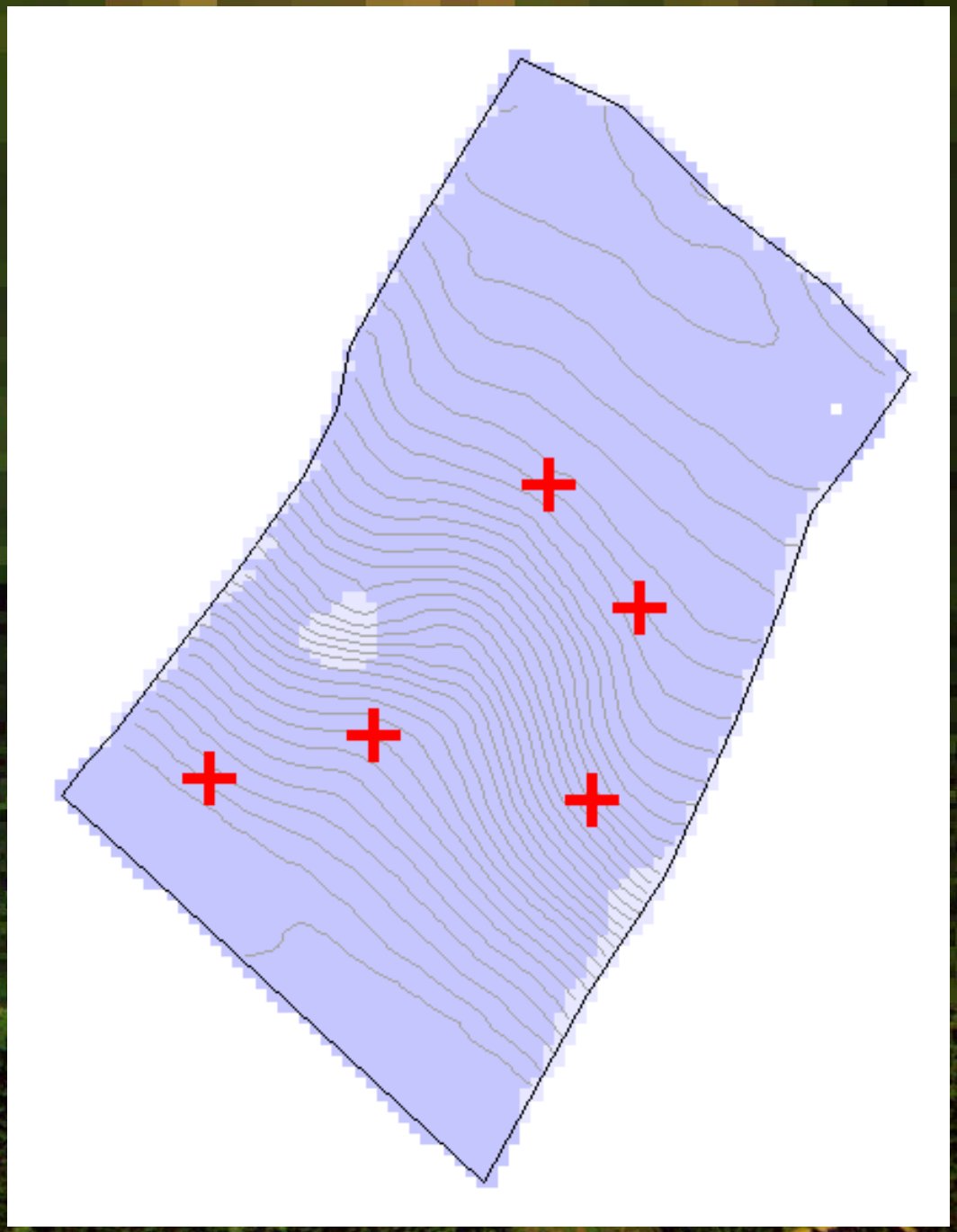


El Niño - 1998

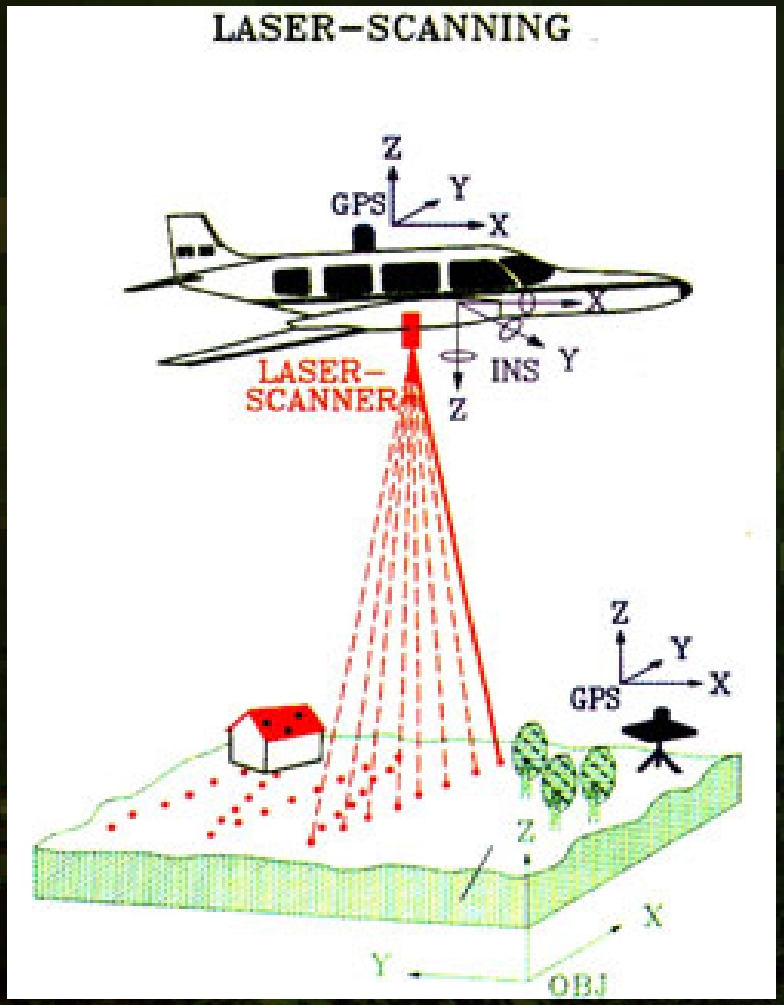
January to May weekly time steps

June to August monthly time steps





LIDAR



(Source: http://www.sbgmaps.com/lidar.htm)

- Lidar – Light Detection and Ranging
- 1st developed in 1960 by Hughes Aircraft inc.
- Modern computers and DGPS make it practical: requires extremely accurate timing
- Measures distance to surfaces by timing a laser pulse and it's corresponding return(s)
- Lidar data are the X, Y, Z positions of each return
- Typically used in very accurate mapping of topography

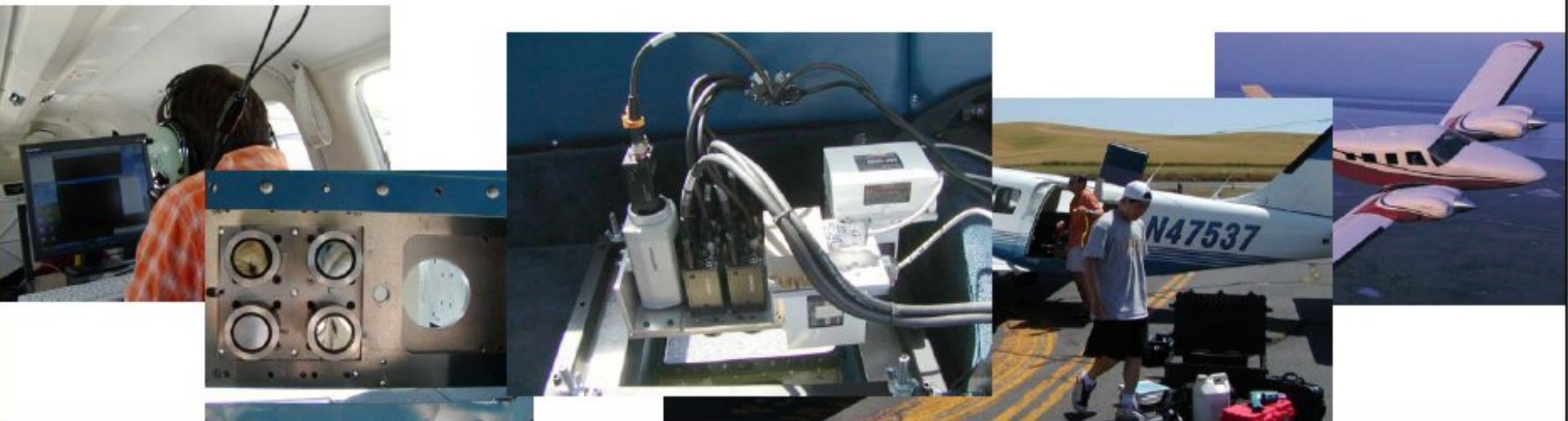
Advanced Photogrammetry and Digital Airborne Data Processing

Forest Resources 504, 2 credits

Offered spring 2006, Instructors: Paul Gessler et al.

This course will focus on the acquisition and processing of digital airborne imagery acquired with our own airborne hyperspectral and multispectral sensors. All aspects of data acquisition (including operation of the sensors while in-flight), geometric and radiometric pre-processing, and development of value-added products and maps from the data will be covered. The class will operate as an integrated team to develop a stream-lined processing flow from acquisition to application. Various datasets have been acquired and funds exist to acquire new data during the spring semester. These cover a broad range of application areas for natural resource management.

Permission of the instructor is required for enrollment. Students will be expected to have had basic and intermediate remote sensing and spatial analysis courses or extensive practical experience.
The meeting time and place for the course will be determined the first week of classes. Co-enrollment in "Advanced Methods in Remote Sensing" taught by Dr. Alistair Smith is encouraged.



116.jpg

108.jpg

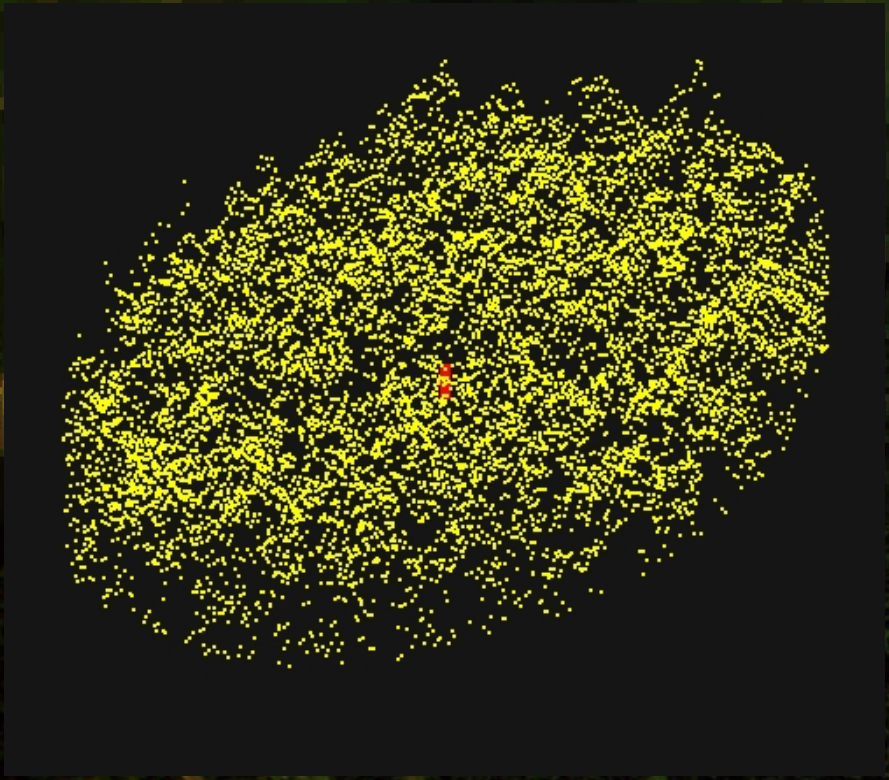
114.jpg

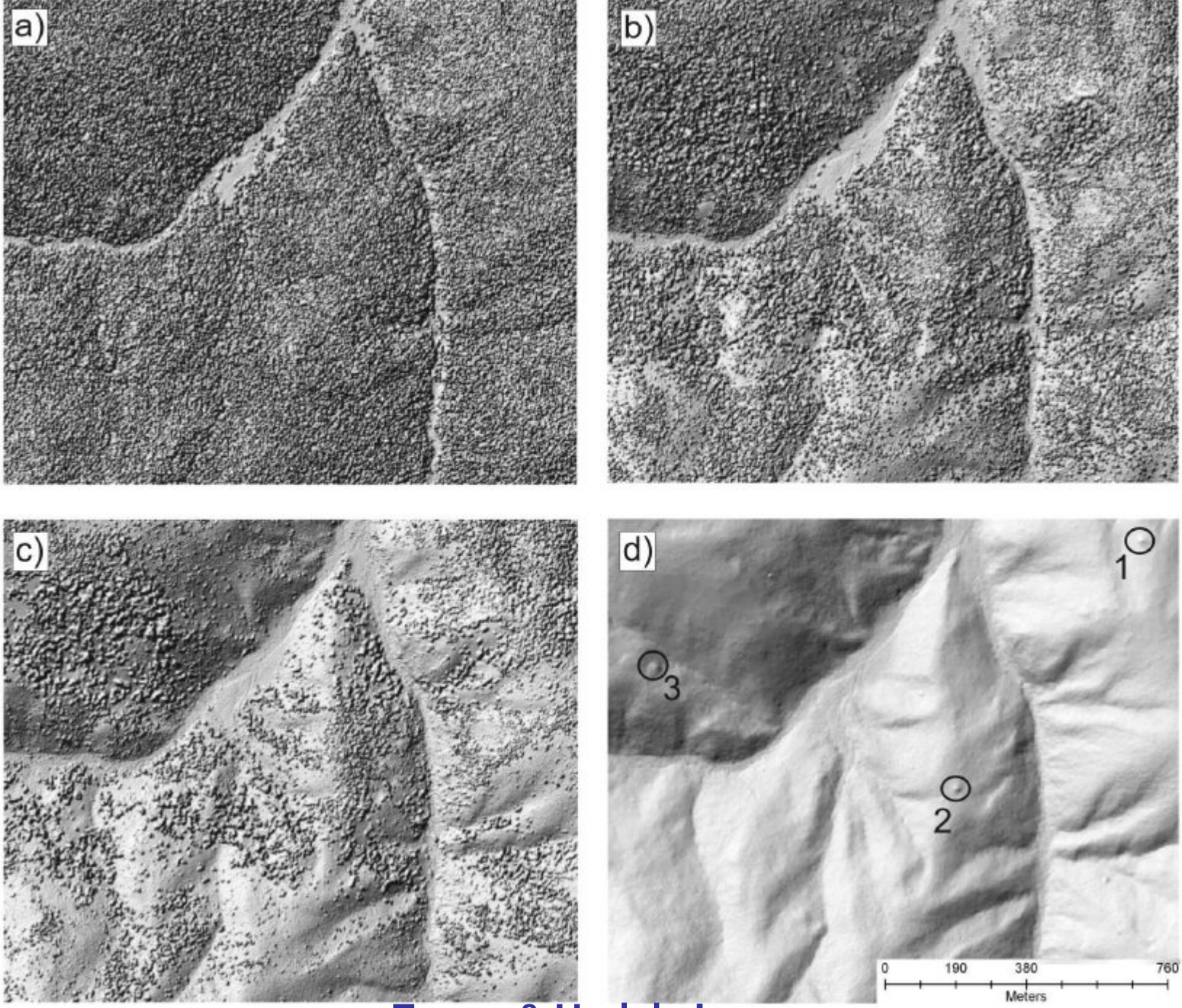
IDAHO
IDAHO

How much data do we need?

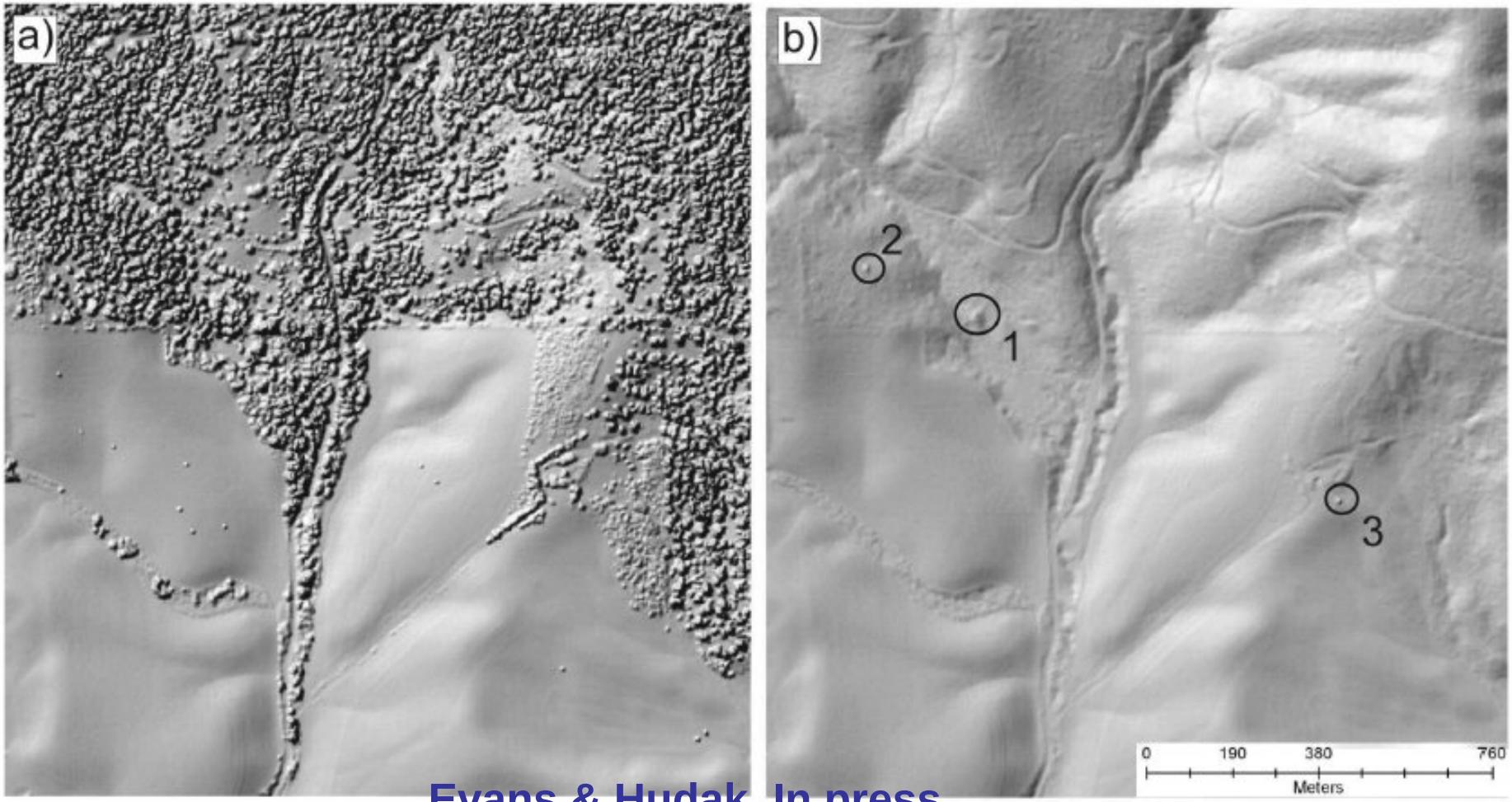
- PREF (4000 acres) = 38,000,000 lidar returns

100m circular buffer around plot 13 = 9960 returns

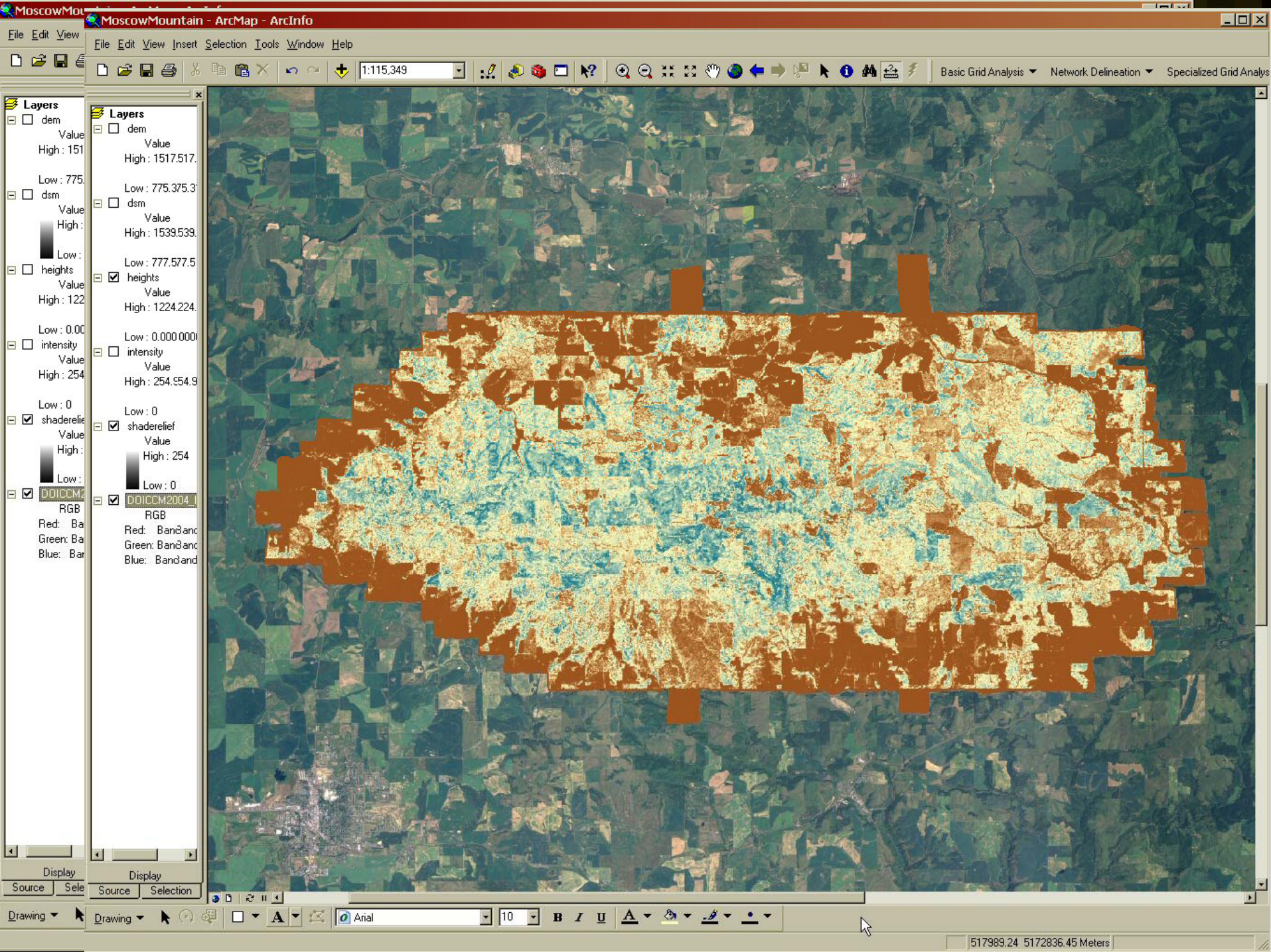




Evans & Hudak, In press



Evans & Hudak, In press


MoscowMountain - ArcMap - ArcInfo
File Edit View Insert Selection Tools Window Help
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Basic Grid Analysis
Network Delineation
Specialized Grid Analys
Layers
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Value
High : 1517.517.
Low : 775.375.3
dsm
Value
High : 1539.539.
Low : 777.577.5
heights
Value
High : 1224.224.
Low : 0.000 000
intensity
Value
High : 254.554.9
Low : 0
shaderelief
Value
High : 254
Low : 0
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Green: Band
Blue: Band
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Selection
Drawing
Arial
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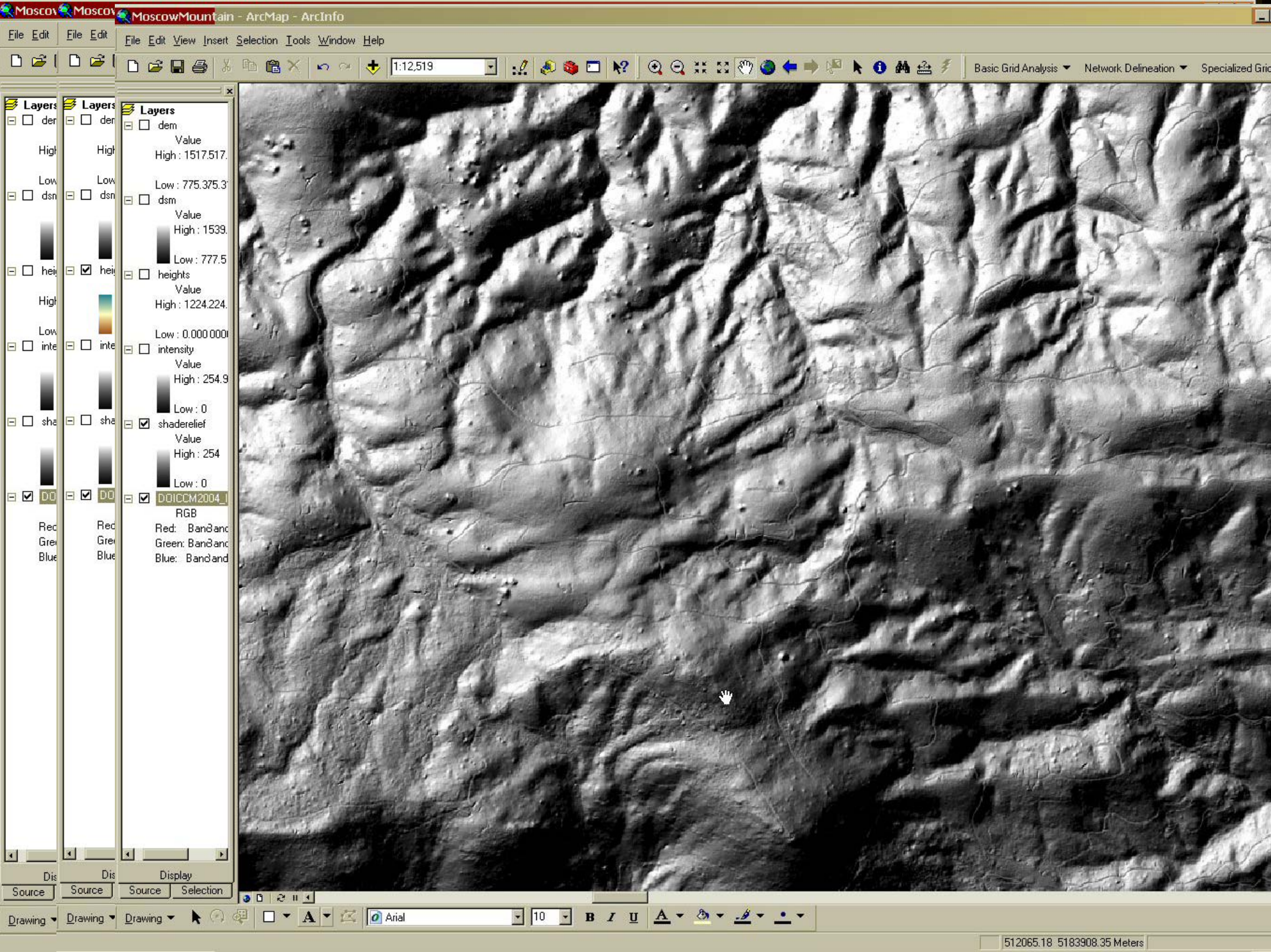
MoscowMountain - ArcMap - ArcInfo
File Edit View Insert Selection Tools Window Help
1:12,519
Basic Grid Analysis
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Low : 777.5
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High : 1224.224.
Low : 0.000 000
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Low : 0
shaderelief
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Low : 0
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RGB
Red: Band
Green: Band
Blue: Band
Source
Selection
Display
Drawing
Arial
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512065.18 5183908.35 Meters

GEOMORPHOMETRY.ORG

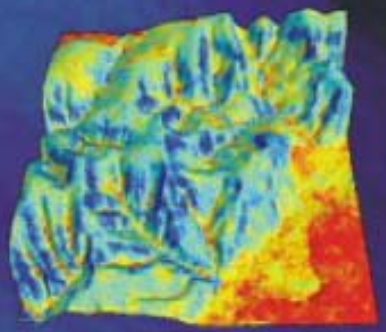
"All that you can extract out of a Digital Elevation Model…"

Geomorphometry is the science of quantitative land surface analysis. It gathers various mathematical, statistical and image processing techniques that can be used to quantify geomorphology of a land surface at various scales. In simple terms, the focus of geomorphometry is extraction of terrain parameters, which are then used to improve mapping and modelling of soils, vegetation, land use, geomorphological and geological features and similar.
With the rapid increase of sources of DEMs today (and especially due to the Shuttle topographic mission and LIDAR-based projects), extraction of terrain parameters is becoming more and more attractive to numerous fields ranging from precision agriculture, soil-landscape modelling, climatic and hydrological applications to urban planning, education and space research. The topography of almost all Earth has been today sampled or scanned, so that DEMs are available at resolutions of 100 m or better at global scale. Terrain parameters are today successfully used for both stochastic and process-based modelling, the only remaining issue being the level of detail and vertical accuracy of the DEM.

This book provides a practical guide to preparation of DEMs, extraction of terrain parameters in a variety of software and gives detailed instruction on how to use terrain parameters in various environmental and geosciences.

Includes detailed user guides to derive terrain parameters in:

ArcInfo ILWIS SaGa TAS
GRASS GIS IDL Landserf
LandMap RiverTools



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Geomorphometry: concepts, software, applications

GEOMORPHOMETRY

concepts, software, applications

Edited by
Tomislav Hengl
&
Hannes I. Reuter

Hengl T., Gessler P. & Evans I.S

What is terrain geomorphometry and how
evolved? Why is geomorphometry impo
and what are the most important applicat
What is the status of DEMs in the world
what can we expect in the coming years?
are terrain parameters and how are
extracted? What is a raster map and how
proce

1.1 What is Geomorphometry?

Geomorphometry is the science of quantitative
surface analysis (?). It gathers various mathema
statistical and (mainly) image processing technique
can be used to quantify morphological, hydrologica
logical and other aspects of a terrain. Commo
onyms for geomorphometry are geomorphological
ysis (Mark, 1975), terrain morphometry or terrain
ysis (Pike, 2004) and land surface analysis (Shary
2002). In simple terms, terrain parameterization
traction of terrain parameters using input digital
tion models and terrain parameterization software
tracted terrain parameters can then be used, for exa
to improve mapping and modelling of soils, veget
land use, geomorphological and geological feature
similar.

The basis of any geomorphometric analysis is exi
of a digital terrain model (Miller and Laflamme,
also referred to as the **Digital Elevation Model** (
— a digital representation of earth's topography. A

GEO MORPHOMETRY

ON LINE EDITORIAL SYSTEM

EUROPEAN COMMISSION
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GEOMORPHOMETRY: CONCEPTS, SOFTWARE, APPLICATIONS

Edited by: T. Hengl & H. I. Reuter

Action 2132 MOSES

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DEADLINES

Deadline for submission of invited chapters:
29 January 2006

Collection of all chapters for sponsored reviewers:
25 June 2006

Compilation of the book draft and submission for review:
16 July 2006

Results of the review - return to authors:
4 September 2006

Second revisions (if necessary):
2 October 2006

Professional English language editing:
12 November 2006

Final version for press:
26 November 2006

Official launch via the website:
December 2006

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INSTRUCTIONS

- General instructions
- General outline
- Document versions
- Templates and styles
- Writing tips
- Submission tips
- Glossary
- **WORKSHOP**
- Interesting facts

CHAPTER STATUS

- In proccess
- Revision needed
- Serious revision
- Accepted

DISCUSSION TOPICS

Discussion group

E-mail to all

QUESTION OF THE WEEK

What should be the purpose of software chapters?

- An user manual
- Scientific review of the software
- Scientific review without examples
- Combination manual/review

SORRY, BUT ONLY AUTHORS HAVE A PERMISSION TO VOTE

View results

Summary and Concluding Thoughts

US has a fantastic underlying resource of the NCSS – unequaled in the world – base for quantitative mapping, modeling and dynamic monitoring of soil-landscapes

Methods and tools for deriving high resolution DEM's, and derived terrain attributes now exist, as well as various forms of remote sensing (geophysical)

Much work still to do in merging soil survey with quantitative soil-landscape modeling and dynamic monitoring

Development of new tools, technologies does not eliminate the need for field soil scientist – however, it can/should influence what, where and how they sample in the landscape