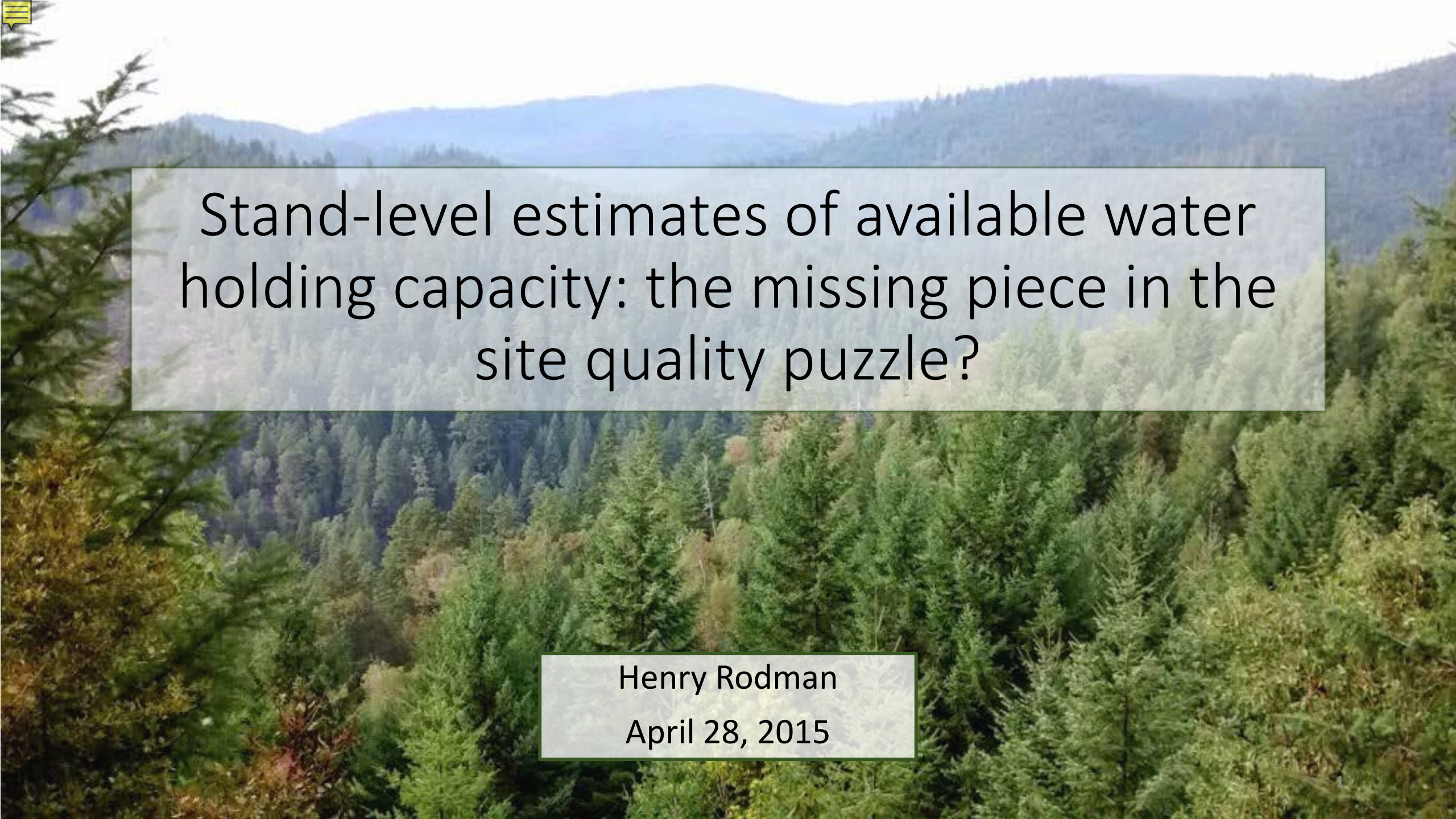


Stand-level estimates of available water holding capacity: the missing piece in the site quality puzzle?

Henry Rodman

April 28, 2015

Research directive

1. Identification of site factors that control **carrying capacity**

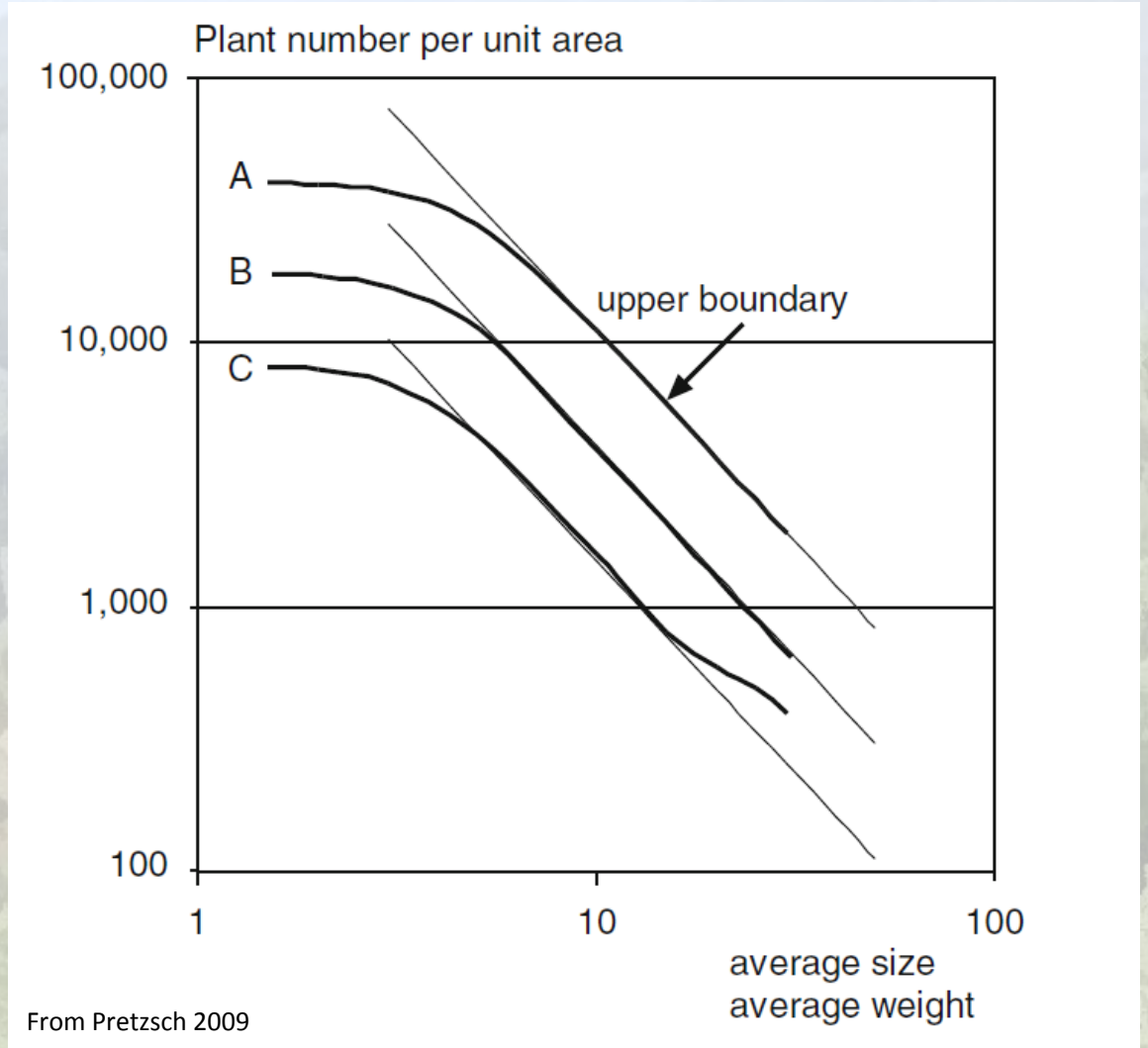
2. Integration of field sampling and remotely sensed information in assessments of **site productivity**

3. **Improve** estimates of site characteristics for use in silvicultural prescriptions and growth modeling

Research directive

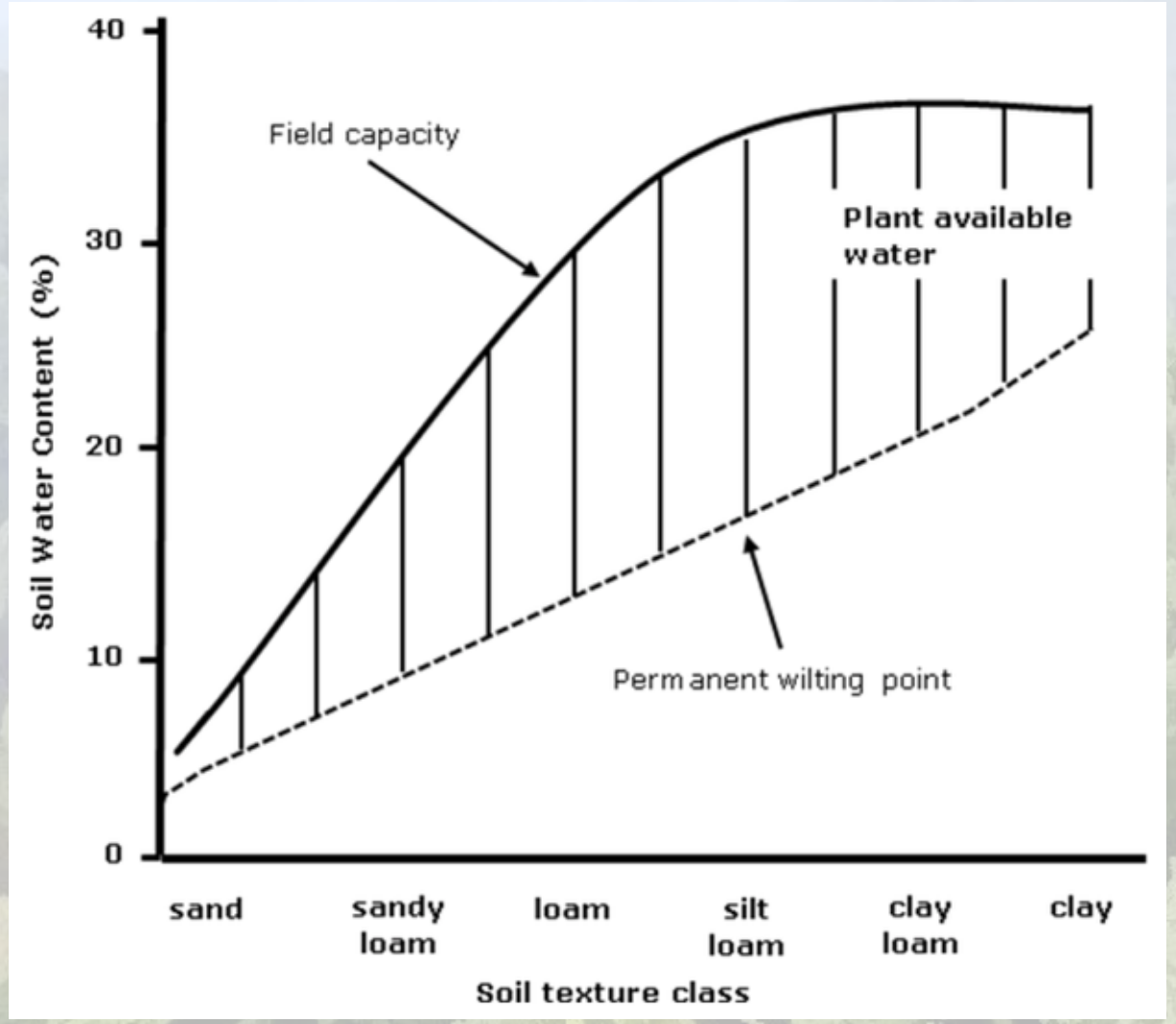
4. Development of a procedure for refining estimates of site quality that can be used by forestry practitioners

Carrying capacity



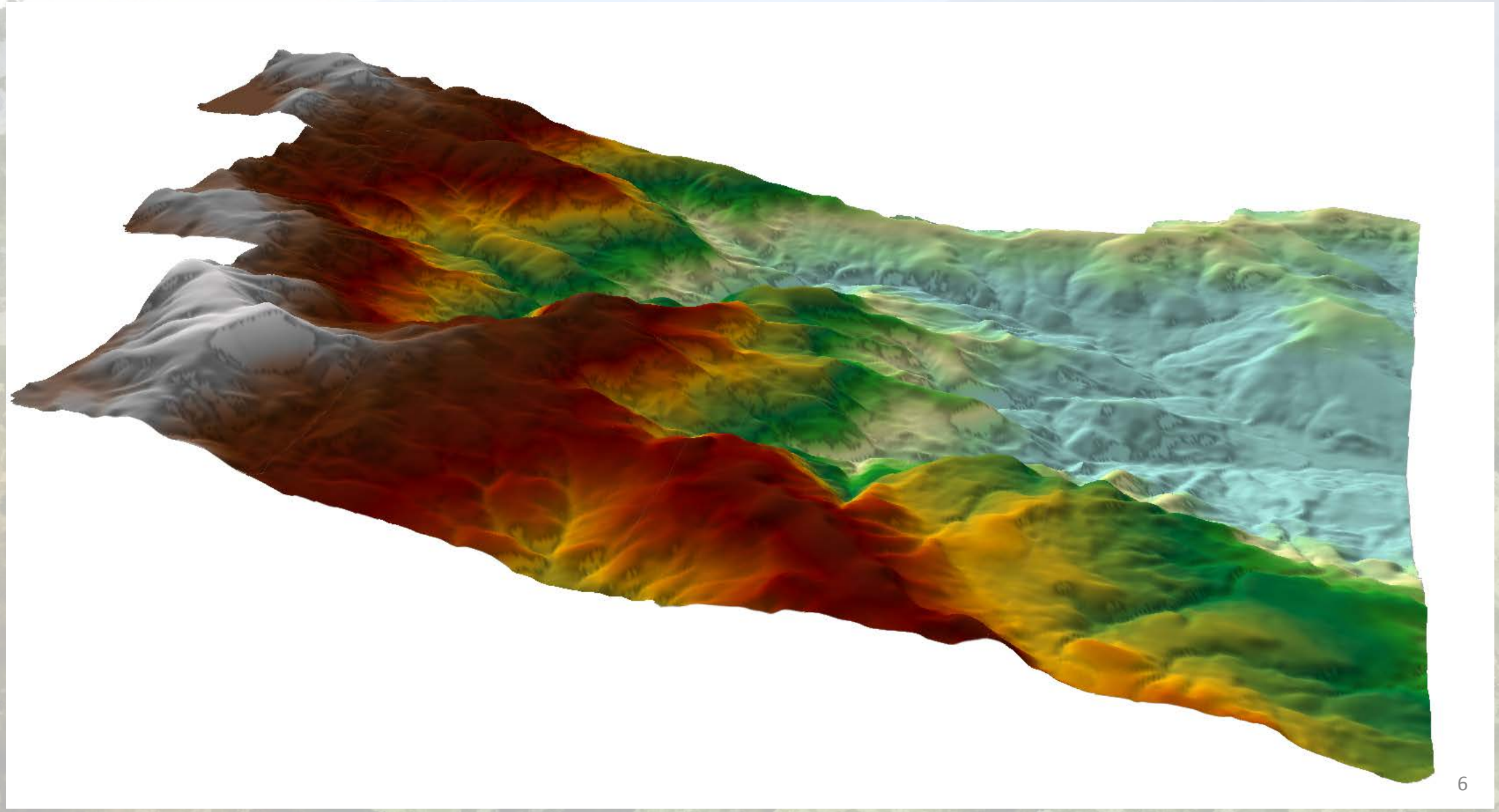
From Pretzsch 2009

Available water holding capacity (AWHC)



http://www.nature.com/scitable/content/ne0000/ne0000/ne0000/ne0000/59719652/1_2.png

Digital elevation model (DEM)



How does it all fit together?

Context for research: Silviculture

- Accurate stand descriptions are essential to management
  - Site characteristics are more difficult to describe
- Carrying capacity – maximum stand density index
  - Not necessarily correlated with site index
  - Varies from site to site
- A stand's response to silvicultural treatments may be dependent upon carrying capacity
  - Improved estimates of stand carrying capacity could inform stand density management decisions, fertilization treatments, etc.

Context for research: Silviculture

- In western Oregon tree growth is often water-limited
- A better understanding of limiting resources at a site will improve efficiency of silvicultural practices

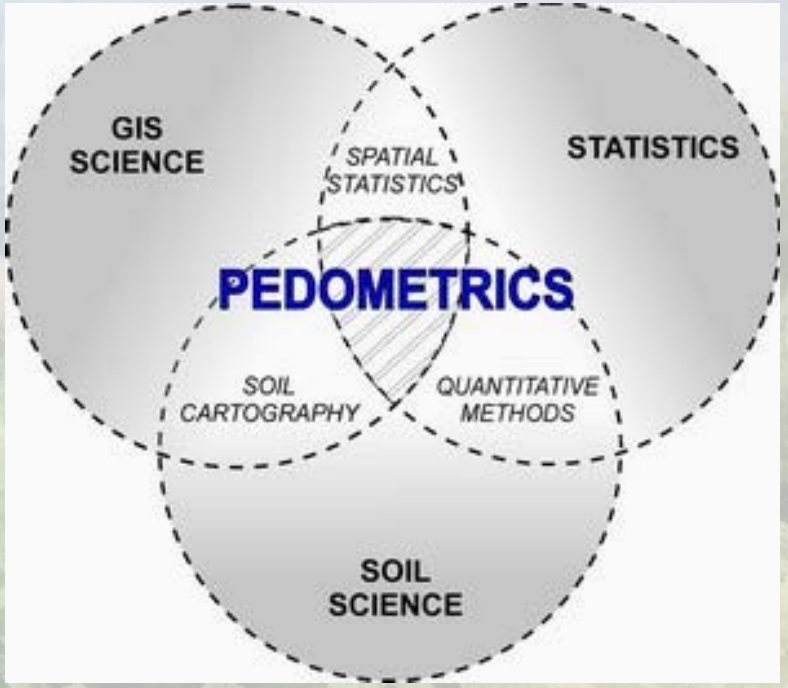
Context for research: Soil science

- AWHC is determined by soil texture, organic matter, coarse fragments
  - Pedotransfer functions use these attributes to estimate AWHC
- AWHC can be precisely measured by lab analysis
  - This is costly and takes time
- Field estimates of AWHC can be reliable
  - Lower precision than lab analysis
- Spatial variability of soil properties is high
  - Interpolation between sample points is necessary for mapping
  - Microsite variability

Context for research: Soil science

Pedometrics: the application of mathematical and statistical methods for the study of the distribution and genesis of soils.

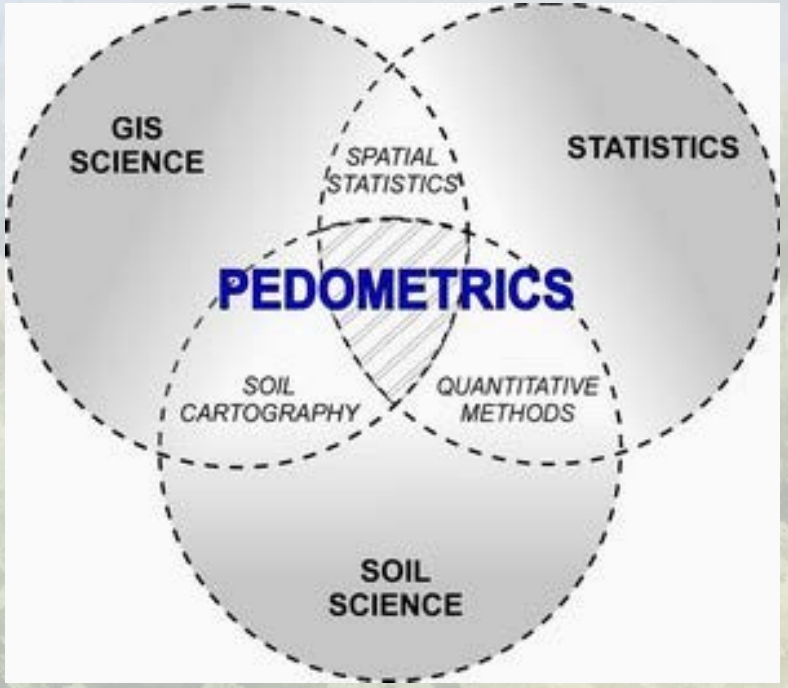
- official definition from the Pedometrics Commission



http://soils.ifas.ufl.edu/faculty/grunwald/research/what_is_pedometrics.shtml

Context for research: Soil science

- Topography is recognized as a soil-forming factor
  - digital terrain modeling
- High-resolution topographic data (LiDAR) is widely available

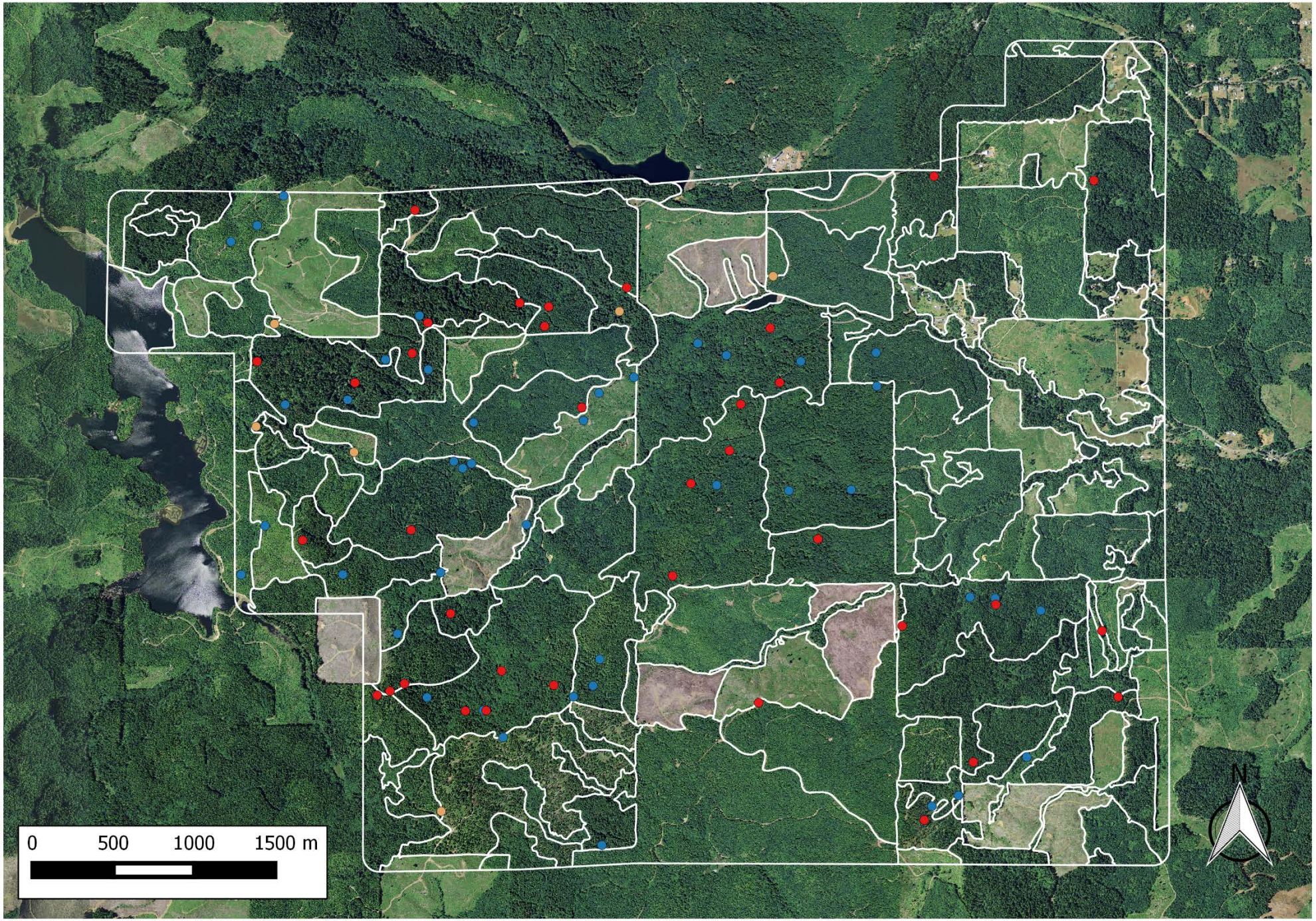


http://soils.ifas.ufl.edu/faculty/grunwald/research/what_is_pedometrics.shtml

Study area: Panther Creek Watershed

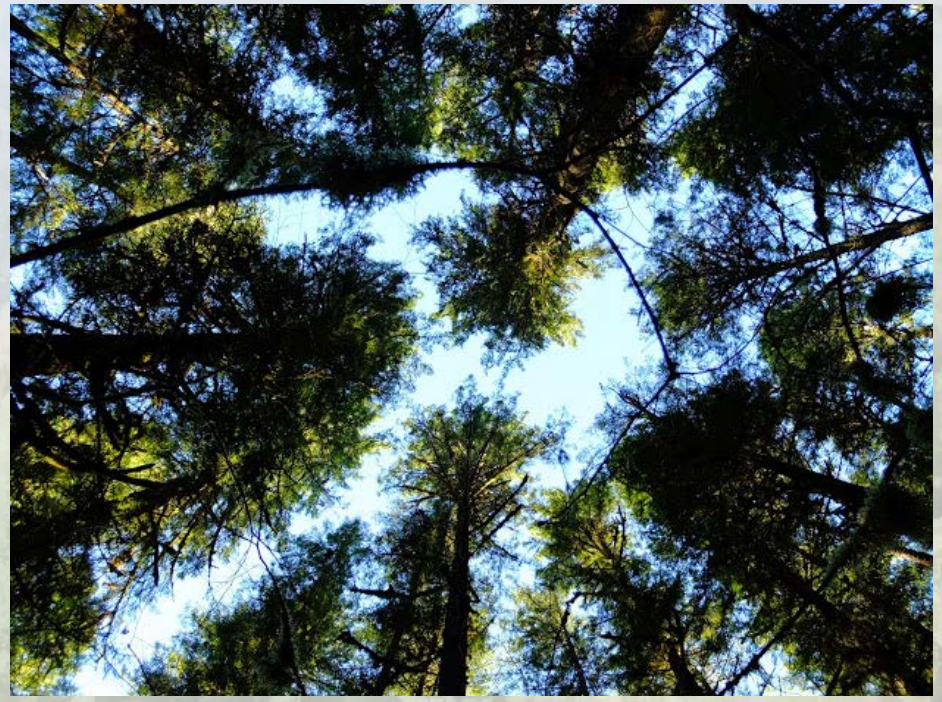
1. Cooperative study area
   i. Landowners: BLM, Weyerhaeuser Co.
   ii. 2,300 hectares

2. Data
   i. 84 permanent, 0.08-ha inventory plots
      a. Two measurements – 2009, 2012
   ii. 34 soil pits
   iii. Multiple LiDAR flights
   iv. Temperature and precipitation


0
500
1000
1500 m
N

Study objectives

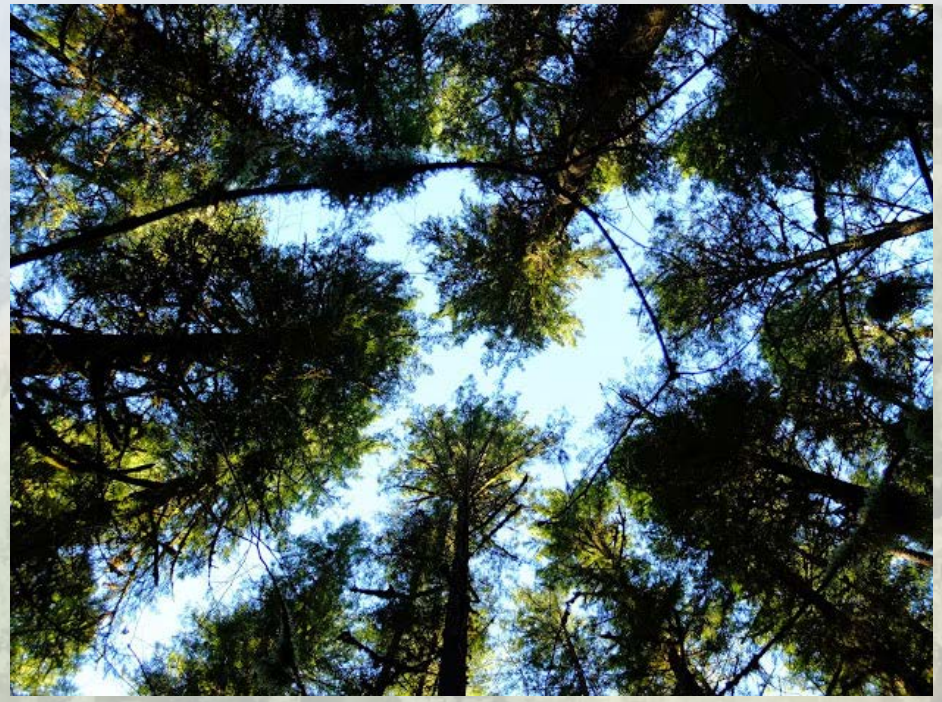
1. Process stand/tree growth, soils data
2. Perform terrain analysis using DEM
3. Expand soil sampling across study area



Study objectives

4. Fit plot growth model that includes topography/soils attributes as explanatory variables

5. Perform cost-benefit analysis of auxiliary data collection for stand growth prediction



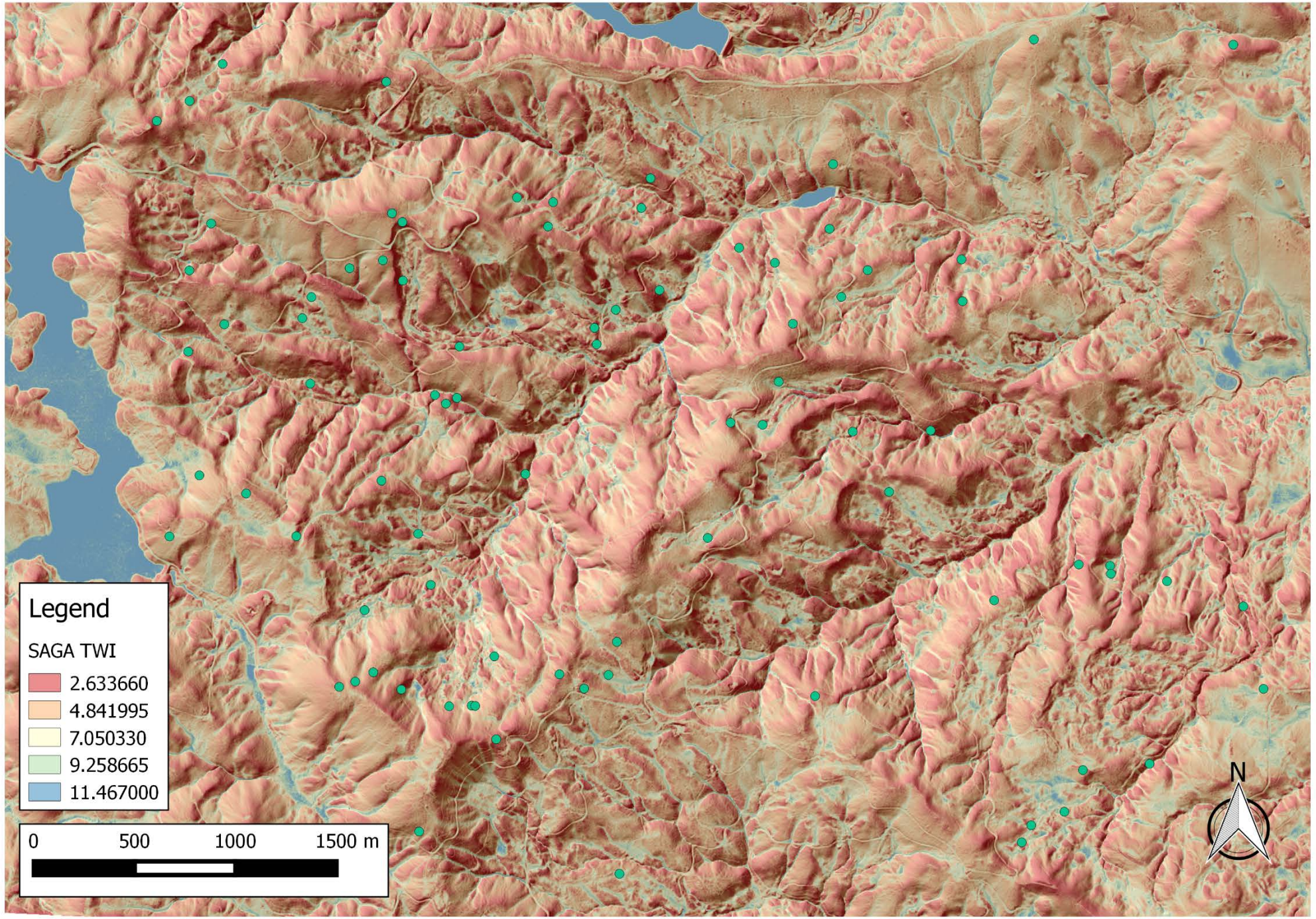
Methods

Methods: Terrain analysis – Spring 2015

1. Software:
   a. QGIS/SAGA
   b. ArcGIS

2. Terrain indices
   a) Slope, aspect
   b) Topographic wetness index (TWI)
   c) Topographic position incex (TPI)
   d) Terrain roughness
   e) Terrain curvature

These provide information about drainage, probability of moist soil conditions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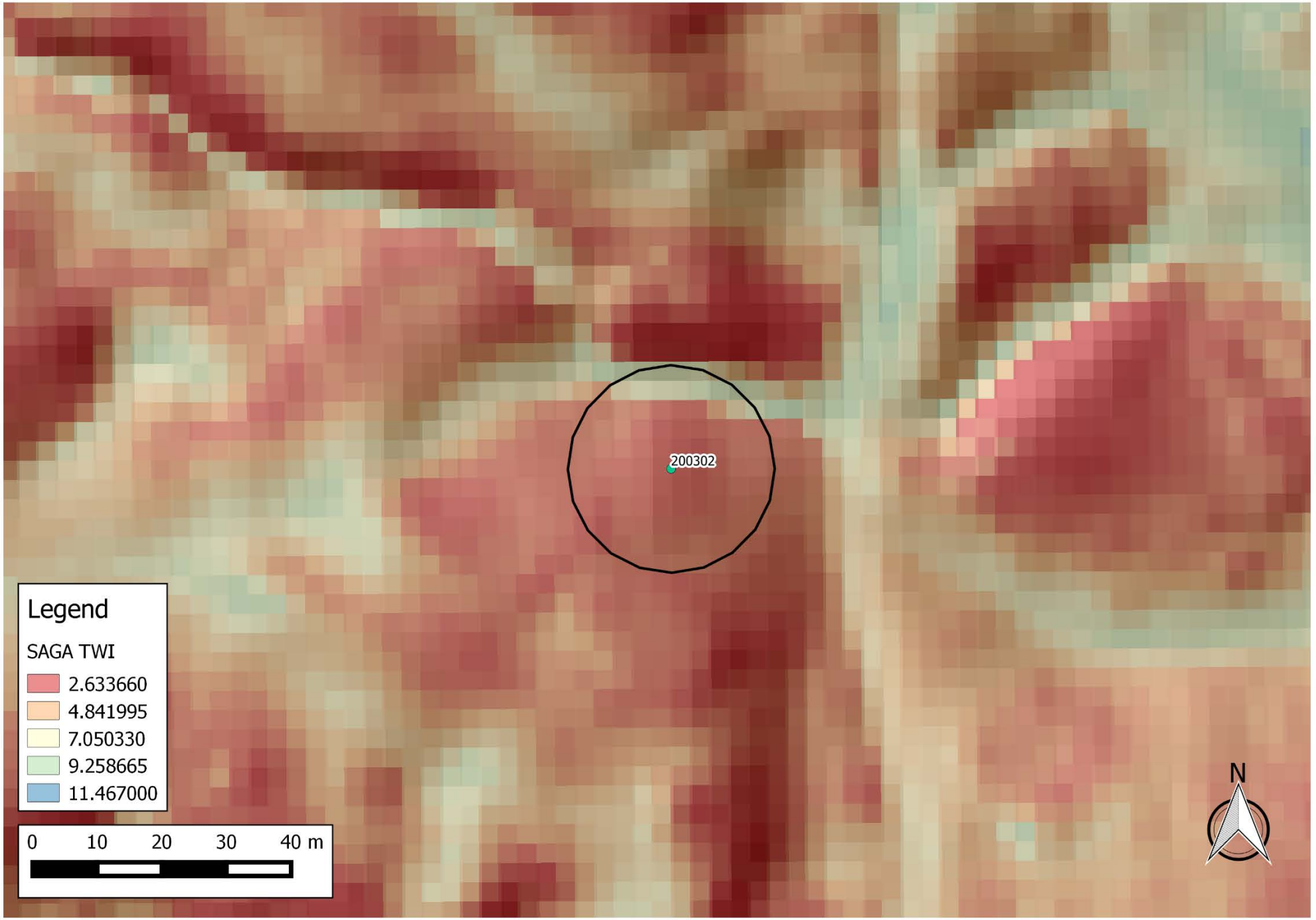
4.841995
7.050330
9.258665
11.467000
0
500
1000
1500 m
N


200302
Legend
SAGA TWI
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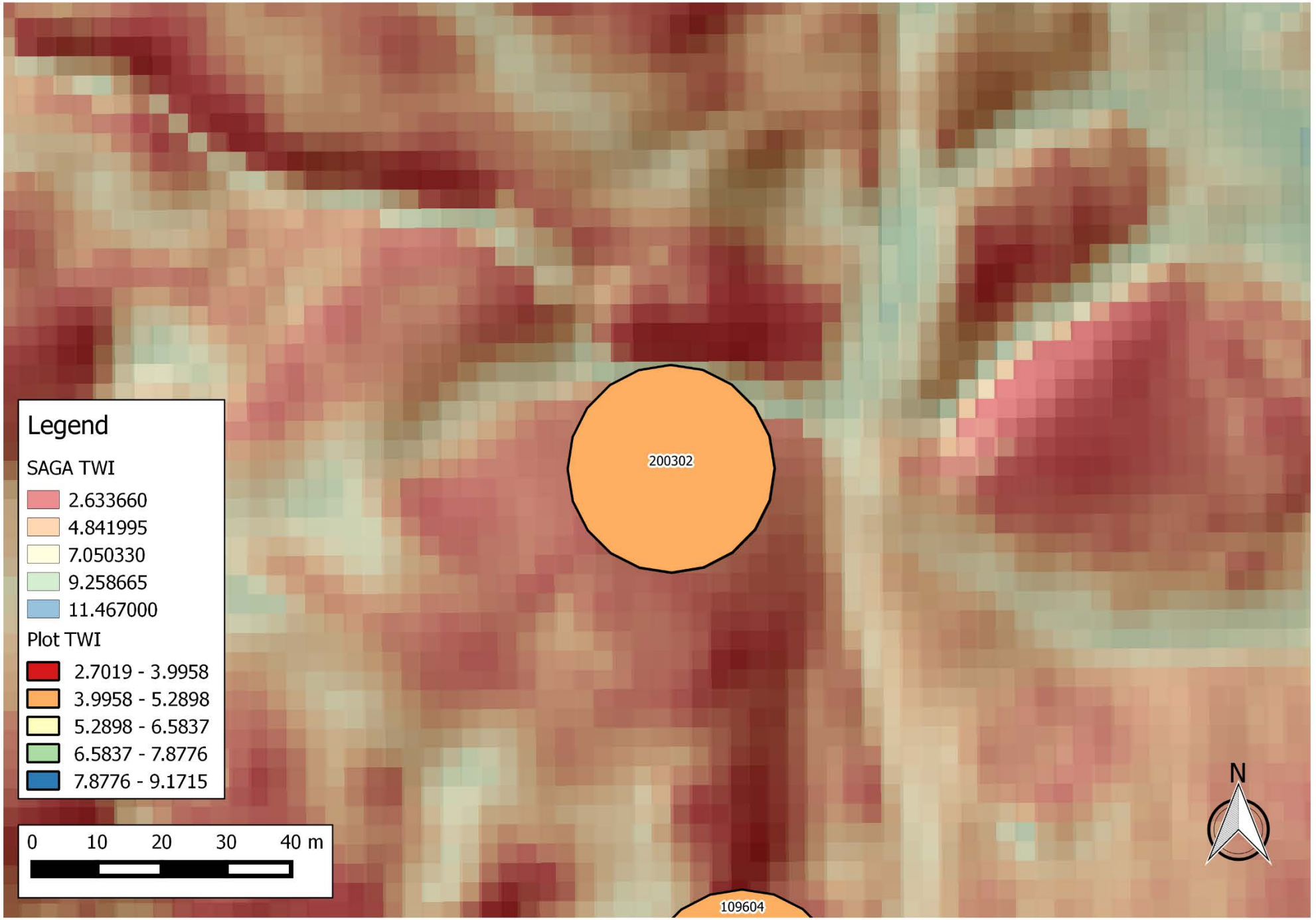
4.841995
7.050330
9.258665
11.467000
0
10
20
30
40 m
N


Legend
SAGA TWI
2.633660
4.841995
7.050330
9.258665
11.467000
Plot TWI
2.7019 - 3.9958
3.9958 - 5.2898
5.2898 - 6.5837
6.5837 - 7.8776
7.8776 - 9.1715
0
10
20
30
40 m
200302
109604
N

Methods: Soil sampling – Summer 2015

1. Visit study area for soil sampling during summer 2015

2. Sample soils down to 50 cm mineral soil depth
   a) Rooting zone

3. Observe texture, percent coarse content, organic component of each observed soil horizon

4. Precise location of soil samples will be recorded with a mapping-grade GPS device

http://oregonsoils.org/

Methods: Analysis

1. Calculate plot-level volume and basal area growth for 2009-2012

2. Fit plot growth model that includes topography and soils information as explanatory variables

3. Analyze the predictive power of remotely sensed topographic data and soils data collected in the field


Thank you
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