Volcanic Ash Soil Bulk Density Effects on Wood Density

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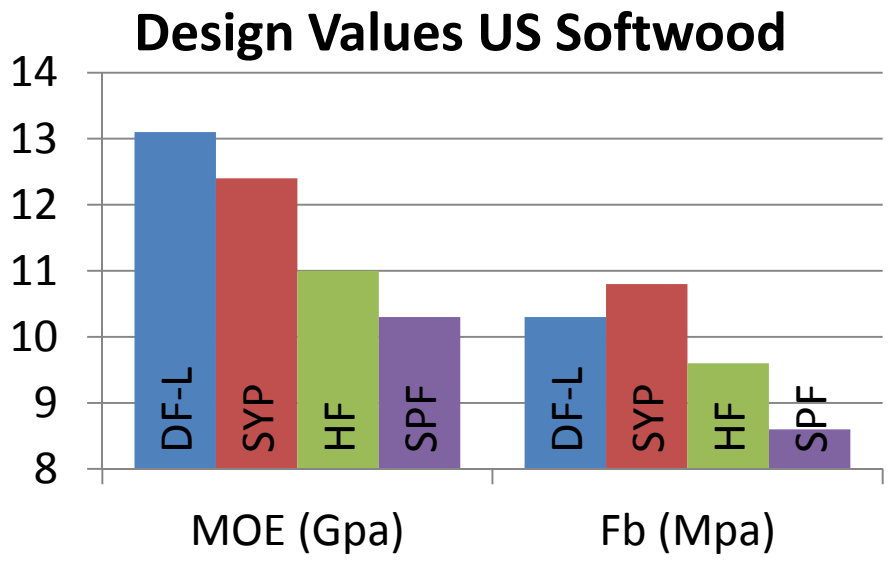
IFTNC Annual Meeting
April 1, 2014

College of Natural Resources

University of Idaho

Introduction

- Douglas-fir- valued for strength, stiffness, durability
  - Variability
    - Genetics
    - Silviculture
    - Stand/Site
    - Environment
  - Pre-harvest predictions
    - Maximize value

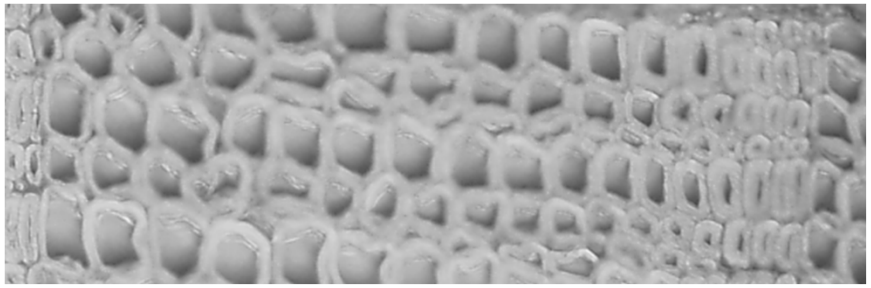


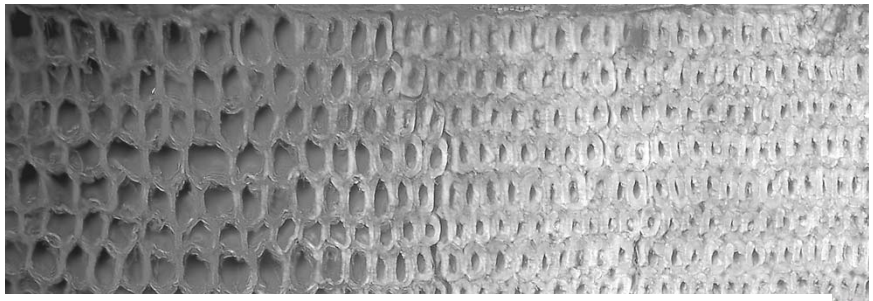
Introduction

- In 2007, non destructive testing of ≈ 300 small diameter Douglas-fir in Western MT
  - Significant differences in nondestructive MOE
    - Age (maturity)
    - Growth rate
    - **Soil Bulk Density (SBD)**
  - Increment cores indicated consistently higher Specific Gravity (SG) in trees on **low** bulk density soils

Introduction

- Annual rings
  - Historical record of tree-environment interaction
  - Latewood Percentage (LWP)
  - Timing of available moisture critical





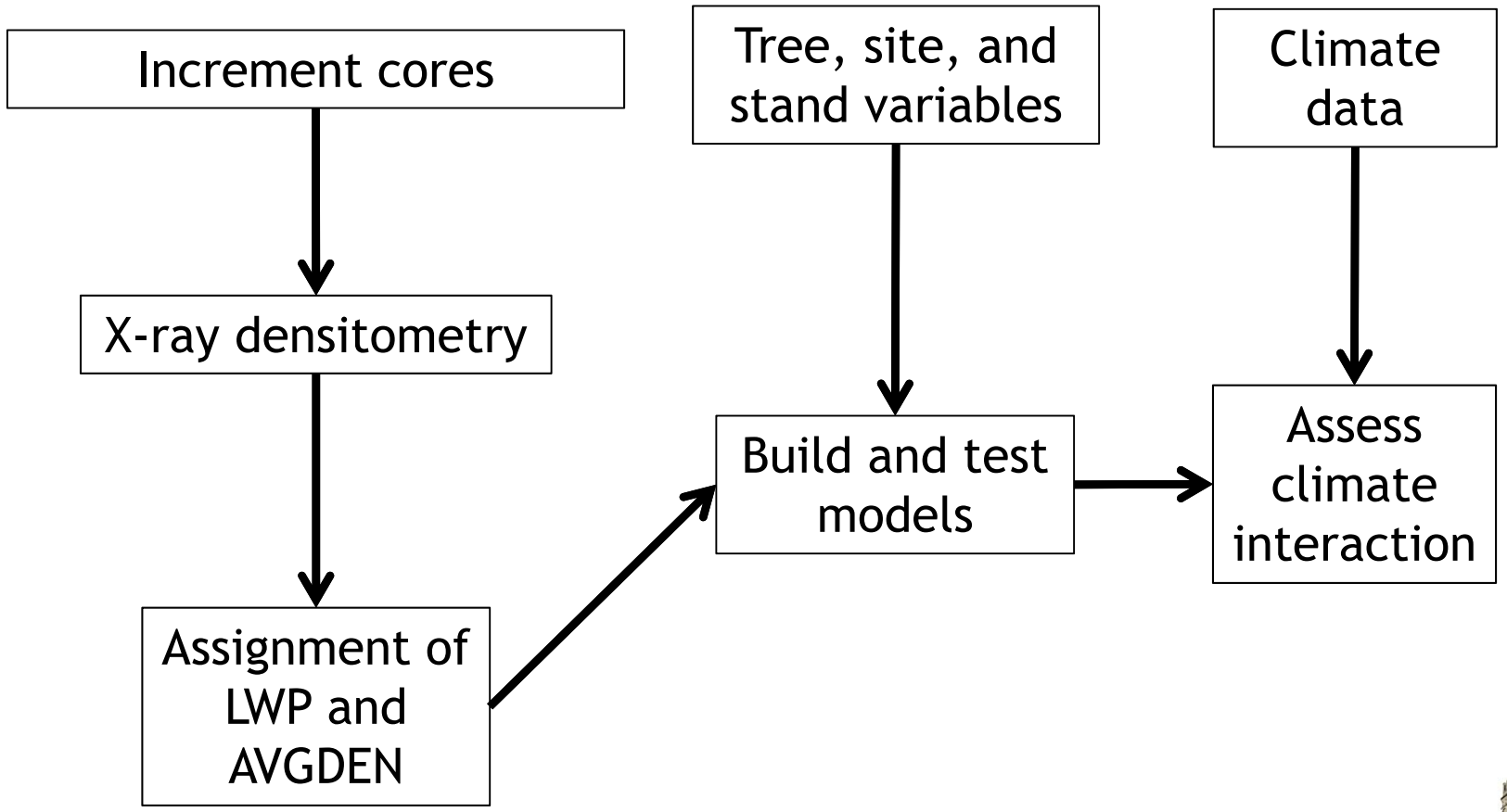
Introduction

- Hypothesis:

Interaction between climate and low bulk density soils → Provide available moisture later in the growing season → Results in higher average density and LWP on low bulk density soils

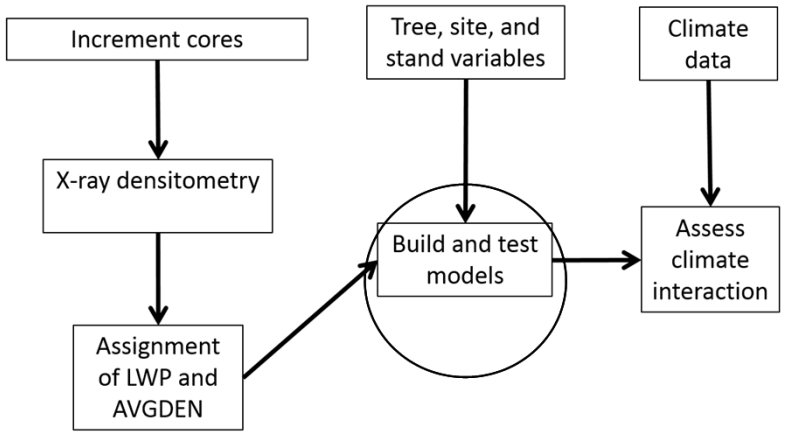
- Objectives
  - Determine differences in annual ring characteristics between trees grown on low and high bulk density soils
  - Assess climate interactions with soil bulk density

Methods- Project outline



Methods- Statistics

- Linear mixed models
  - Account for repeated measures
  - Fit models using data from 1976-1985
  - Test models using data from 1986-2005

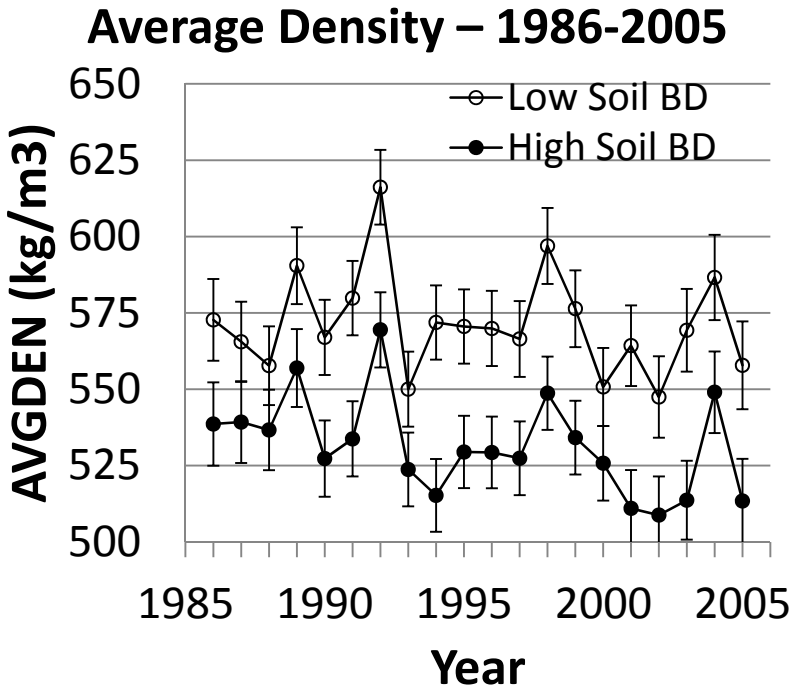


Possible covariates:

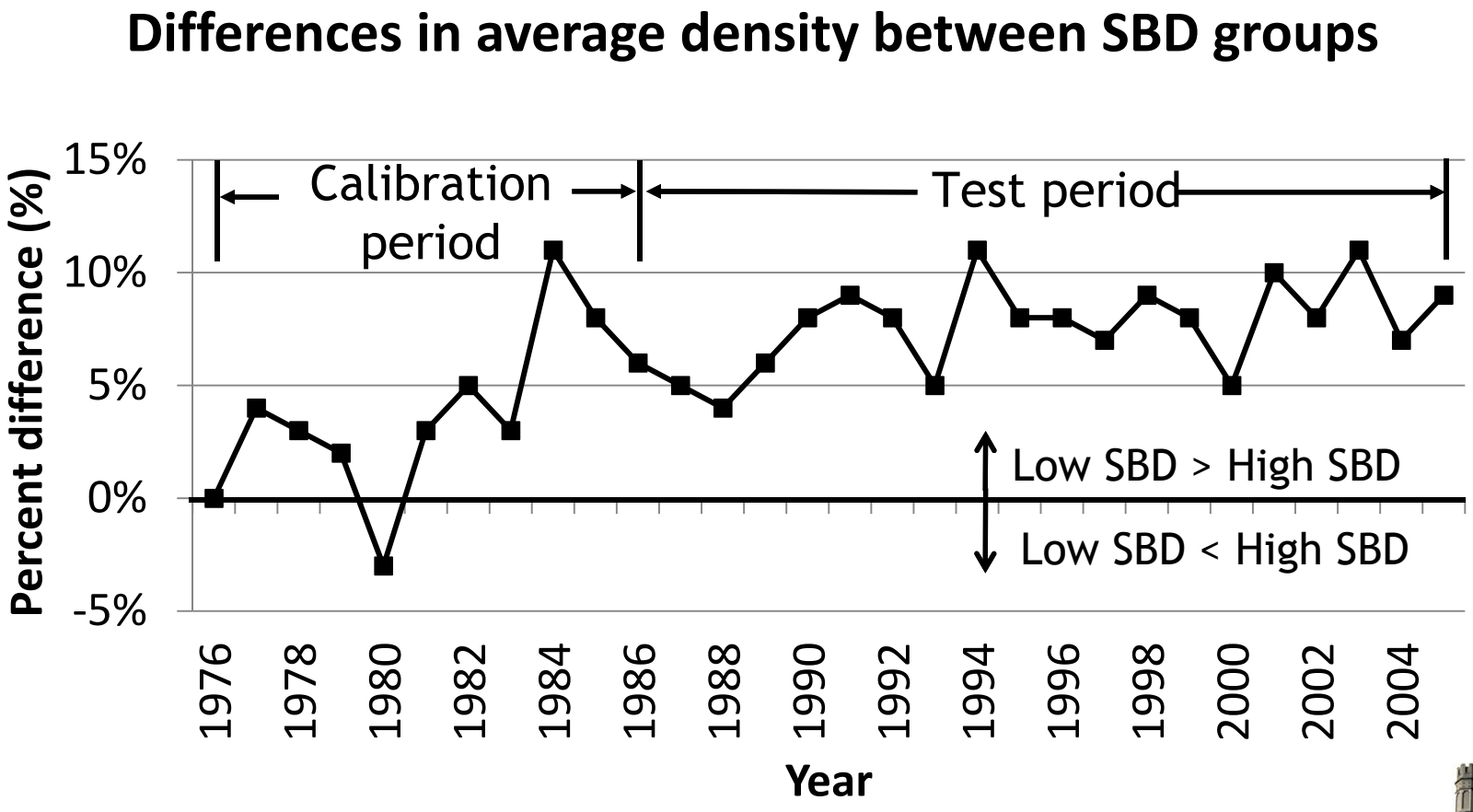
- Percent green canopy
- Basal area
- Percent closed canopy
- Stand density index
- Mean annual increment
- **Age at breast height**
- **Average ring length**
- **Elevation**

Results

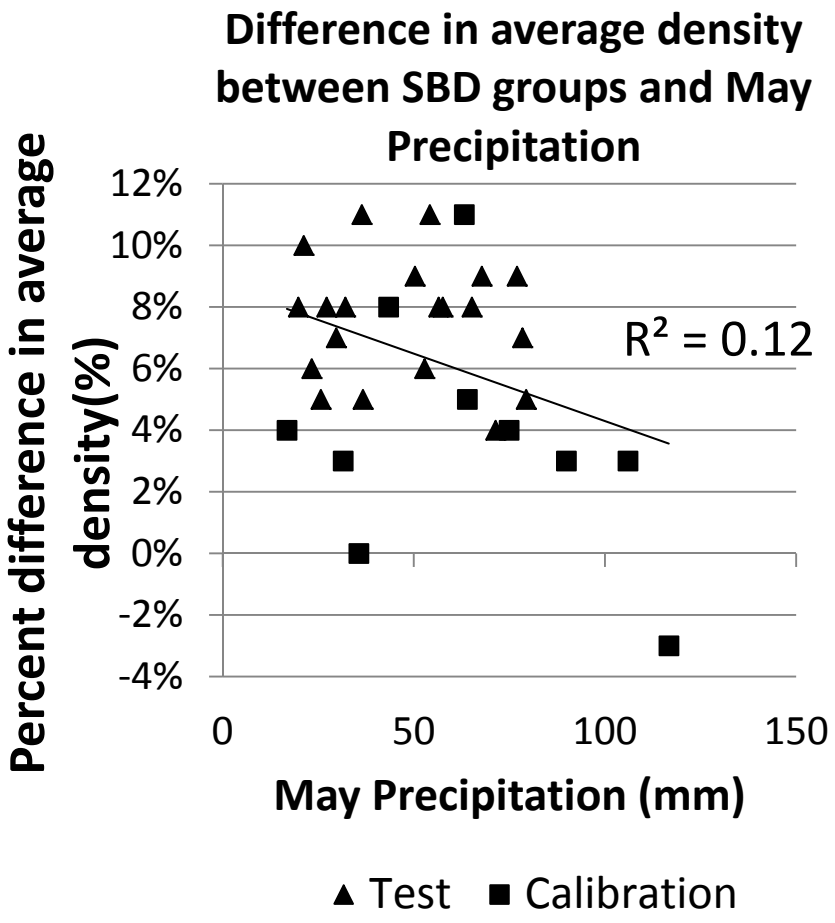
- 1976-1985 (Calibration)
  - Average ring density and latewood percentage
    - Significant interaction between SBD and Year
- 1986-2005 (Test)
  - No significant interaction between SBD and Year
  - Significant effect of low SBD regardless of year
    - 7% higher density and 14% more latewood

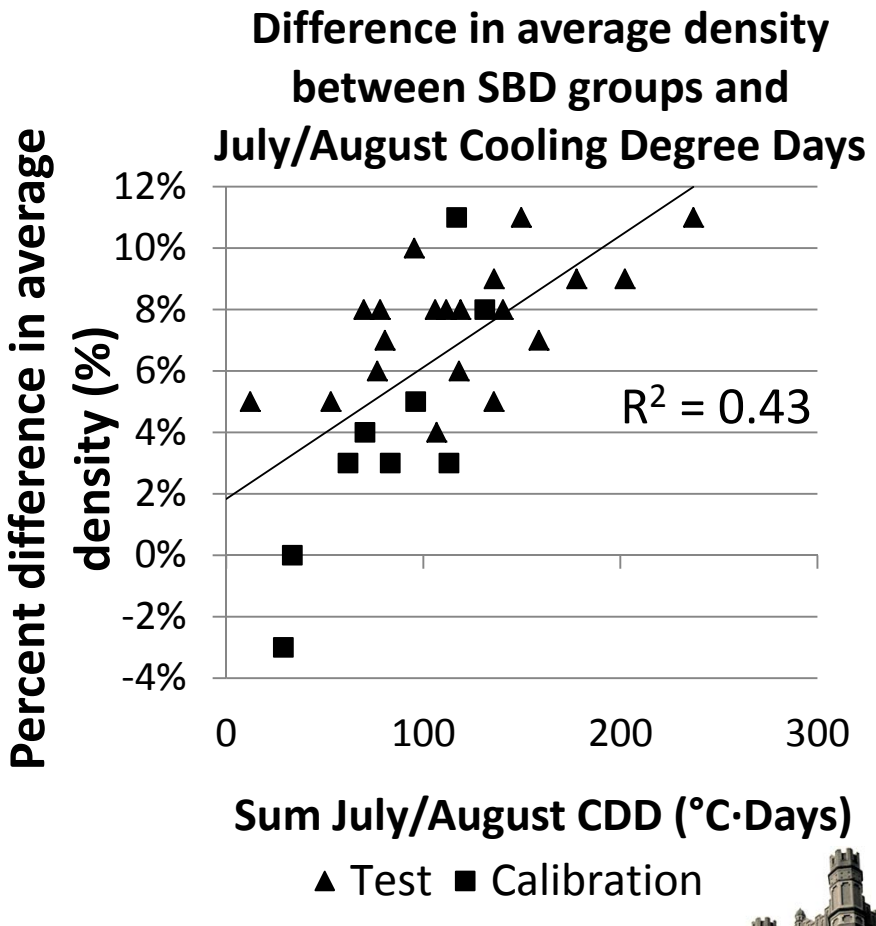


Results


Differences in average density between SBD groups
Percent difference (%)
15%
10%
5%
0%
-5%
Calibration period
Test period
Low SBD > High SBD
Low SBD < High SBD
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
Year

Results

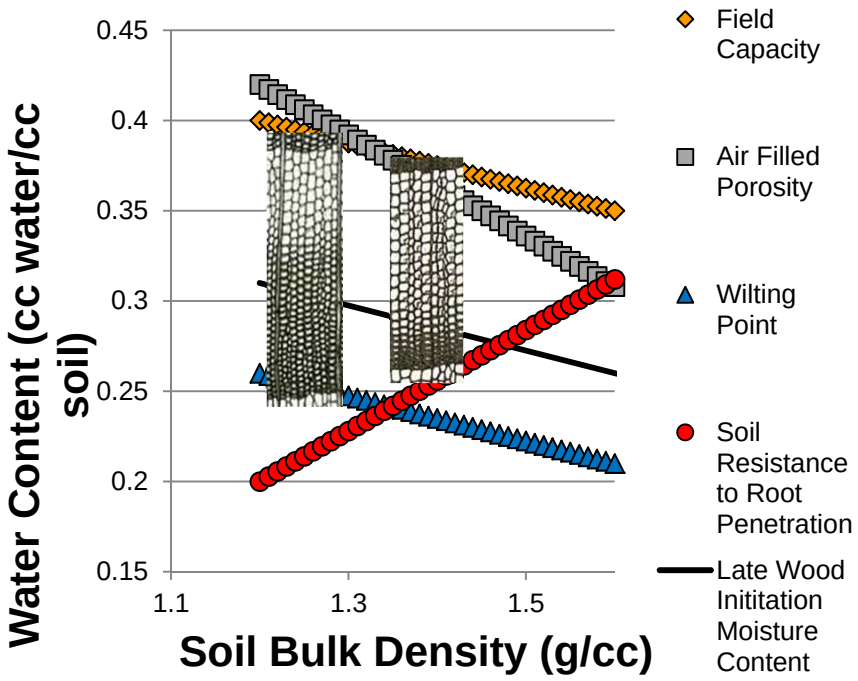

Difference in average density between SBD groups and May Precipitation
Percent difference in average density(%)
12%
10%
8%
6%
4%
2%
0%
-2%
-4%
0
50
100
150
$R^2 = 0.12$
May Precipitation (mm)
Test
Calibration


Difference in average density between SBD groups and July/August Cooling Degree Days
Percent difference in average density (%)
12%
10%
8%
6%
4%
2%
0%
-2%
-4%
0
100
200
300
$R^2 = 0.43$
Sum July/August CDD (°C·Days)
Test
Calibration

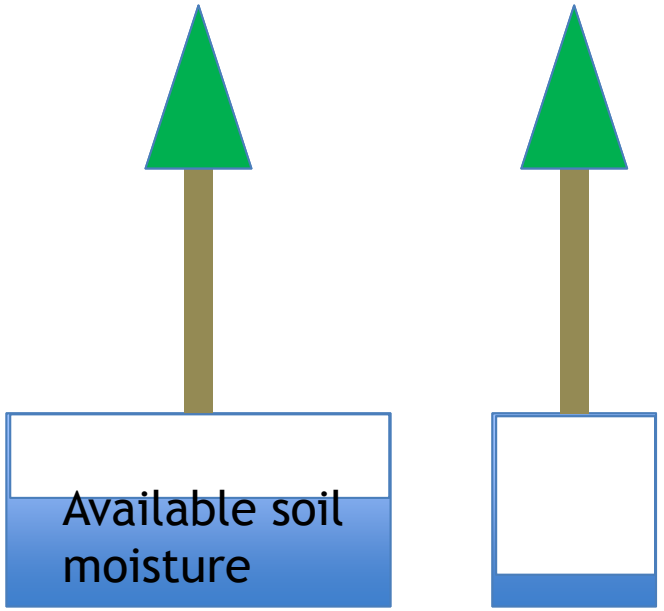
Discussion

- Soil bulk density's potential influence on average density:

Least limiting water range

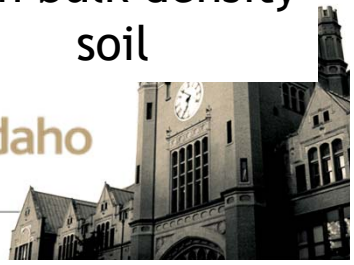


Ash parent material and slow growth



Low bulk density soil (Ash parent)

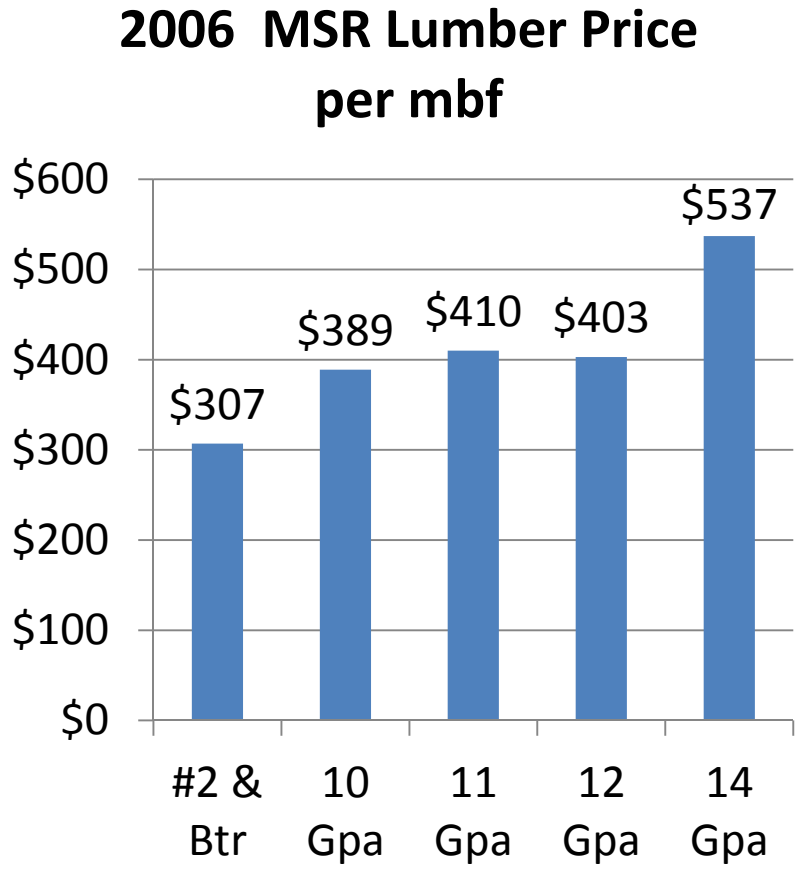
High bulk density soil



Discussion

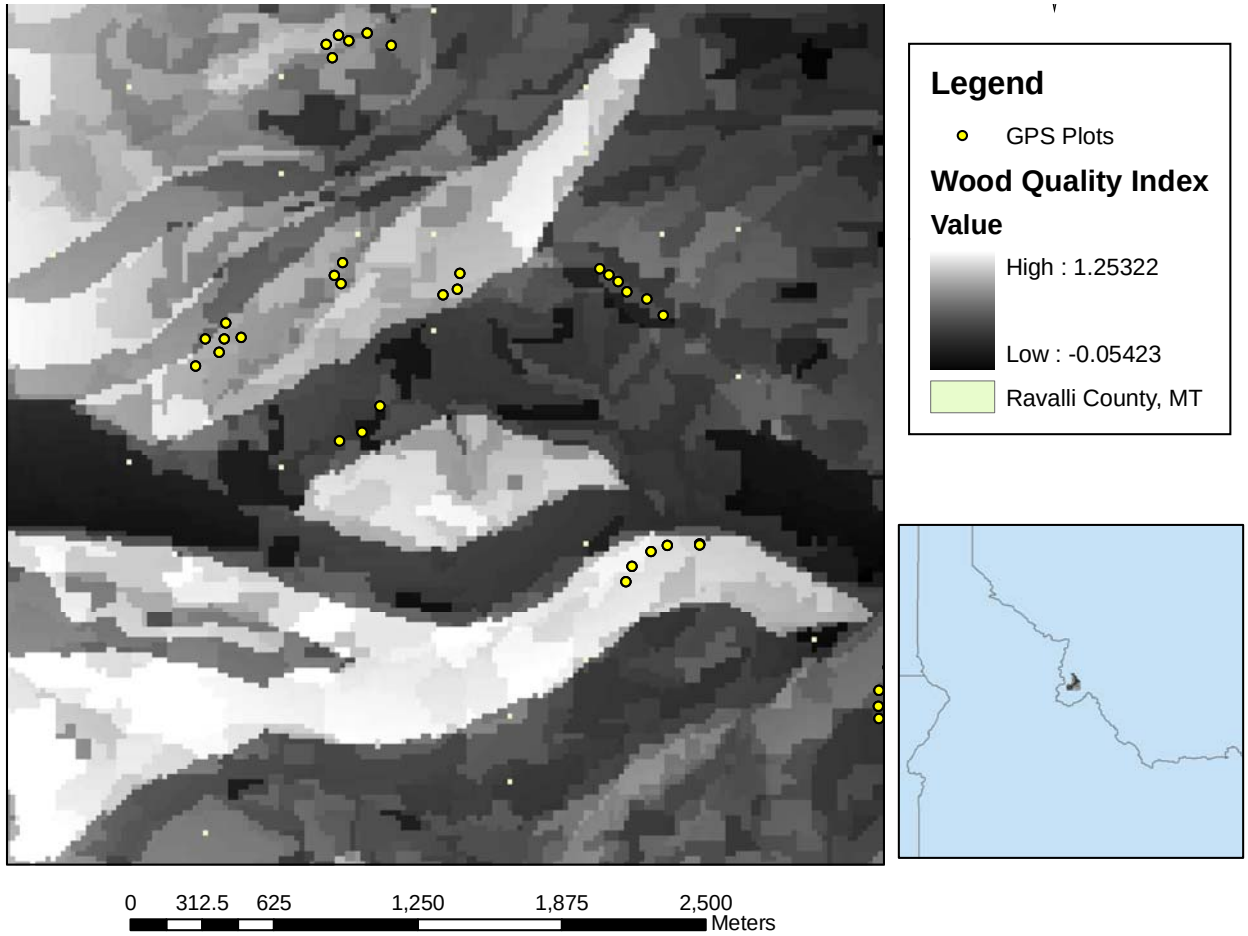
Significance:

- Machine Stress Rated (MSR) lumber
- Lumber from Low SBD sites expected to have 1Gpa greater MOE



Discussion

- Wood quality mapping
- Restoration activities



Conclusion

- Significant SBD effect for Low SBD trees
  - 7% additional latewood depending on measure (14% more latewood in Low SBD than High)
  - Low SBD trees 40 kg/m^3 denser (7.5% more dense)
    - SG_{LowSBD} =0.49 $SG_{HighSBD}$ = 0.45
- Differences between SBD groups changes with climate
  - Increased difference with July/August CDD
  - Decreased difference with extreme midseason precipitation events

Limitations and Future Work

- Experimental
  - Future work: monitor soil moisture, root growth, and xylem formation
- Confounding variables
  - Future work: Experimental design to better identify potential interactions
- Extent
  - Future work: expanded study area, better soil measurements

Acknowledgements

- Funding from the Coalition for Advanced Wood Structures, USDA-FS-FPL
- Faculty and Staff of the Department of Forest, Rangeland, and Fire Sciences

Thank You

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