PROJECT ID: CAFS.20.83

YEAR: 1 of 2

PROJECT TITLE: Using predictive analytics to decompose site index

INVESTIGATOR(S): Jason Cross, University of Washington

Eric Turnblom, University of Washington

PROJECT DESCRIPTION:

Site Index (SI) is a heuristic device that describes the rate at which a location produces wood. It is the convolution of many and varied dimensions – elevation; topography; soil composition and depth; precipitation; daily/monthly/seasonal/annual temperature pattern; and seed source – into the expected height of (co-)dominant trees at a given base age. Site index likely differs by species at the same location, and differs by location for the same species; observed site index may vary for a species at the same site based on silvicultural decisions (e.g. planting density).

Increased quantities of atmospheric carbon dioxide are contributing to changes in the observed ranges of factors once thought to be fixed when index values were conceived (e.g., theoretical maximum photosynthesis rate, precipitation, minimum and maximum temperatures). At a given location, these changes may combine to effectively altering it (by increasing or decreasing site index from its historic value), and threatens the accuracy of the index, even though it may continue to be measured with sufficient precision. Accounting for the effects of climate change requires investigation into the decomposition of site index into its additive subcomponents.

HYPOTHESES or OBJECTIVES:

The objective of this project is to verify and validate (elements of) growth & yield models, and improve their parameterization. Both have been identified as priorities in the most recent CAFS/IAB member survey.

Updated Hypothesis: site quality measured as top height by breast-height age may be defined by a specific parameterized non-linear curve at a given base age. It is our hypothesis that one or more of the parameters can be modeled as a function of a set of constituent predictor variables with sufficient precision.

METHODS:

Using data from the Stand Management Cooperative's database, we have extracted 406 plot-level time series of data including breast-height age and top height, along with size, density, and physiographic attributes thought to affect site index. Each plot has been fit with a parameterized non-linear curve (modified Weibull) defined by three parameters: asymptote, rate, and shape. The analysis focuses on the intrinsic properties of each parameter and the interrelationships among them.

MAJOR FINDINGS:

- Constrained or fixed asymptotes result in normally-distributed rate parameters. Unconstrained asymptotes yield infeasible values and distort the distribution of rate parameters.
- Shape parameters are largely unaffected by the type of asymptote and rate parameter; the most independent parameter.
- The relationship between rate and shape parameters follows a Michaelis-Menten curve from biochemistry.
- Given a shape parameter, the $\log_{10}$-transformed rate parameter is a function of basal area, mean diameter, relative density, and relative spacing.

DELIVERABLES:

- Manuscript in preparation
- Model relating rate to shape that accounts for size and density

MEMBER COMPANY BENEFITS:

- Model allows for naïve estimation of site quality, and informed estimation requiring only a single stand measurement. Reduces requirement for time-series data to define a height/age curve.
- Model facilitates comparisons of silvicultural strategies to maximize observed site-index
- Site quality estimates can be updated as underlying data sets are updated; likely at shorter intervals than inventory is updated.