ISPRS Technical Commission I Symposium, Sustaining Land Imaging: UAVs to Satellites
17 – 20 November 2014, Denver, Colorado, USA, MTSTC1-85

HARMONIC REGRESSION OF MULTI-TEMPORAL LANDSAT DATA FOR FOREST BIOPHYSICAL PARAMETER ESTIMATION AND EXTRAPOLATION

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KEY WORDS: FIA, post-stratification, harmonic regression, hierarchical cluster analysis, site index, random forests

ABSTRACT:

We show research in two areas involving the combined use of Forest Inventory and Analysis (FIA) plot data with Landsat time series stacks. In the first area, we focus on improving the precision of dynamic forest parameter estimates such as growth, removal, and mortality using temporal trajectories derived from Landsat data. At the stand level, time series of Landsat images are ideally suited for producing stratum maps for use in post-stratification. In this study, we generate stratum maps based on trajectories of Landsat Thematic Mapper-based Normalized Difference Vegetation Index (NDVI) values and their derivatives, with a focus on post-disturbance recovery and recent measurements. These trajectories, from 1985-2011, are classified according to a hierarchical clustering algorithm from a training sample. The resulting stratum maps are then used to calculate the relative efficiencies of the methods for forest parameter estimation in an Alabama, USA study area. In particular, RE's around or above 1.2 were observed for each of the seven parameters being estimated, with different methods proving more effective for each dynamic parameter estimate. The second area of joint FIA-Landsat work involves the extrapolation of intensified experimental forest (EFRS) plot data to the surrounding region. In this work, we compute harmonic regression (HR) coefficients for a variety of spectral bands and indices over a timeframe matching the EFRS plot measurements, and we use these coefficients as inputs into a conditional random forests framework to predict biophysical values such as height, biomass, species group, and age. The model is fitted using three EFRS locations in the southeast US (Coweeta, Calhoun, and Santee experimental forests in North and South Carolina), then used to extrapolate across the transect between the three input EFRS sites, effectively covering the ground from the heights of the Appalachian Mountains to the Atlantic coast.