High-resolution Satellite Data, Landcover, and Water Quality in the Southern Appalachian Mountains: Part I

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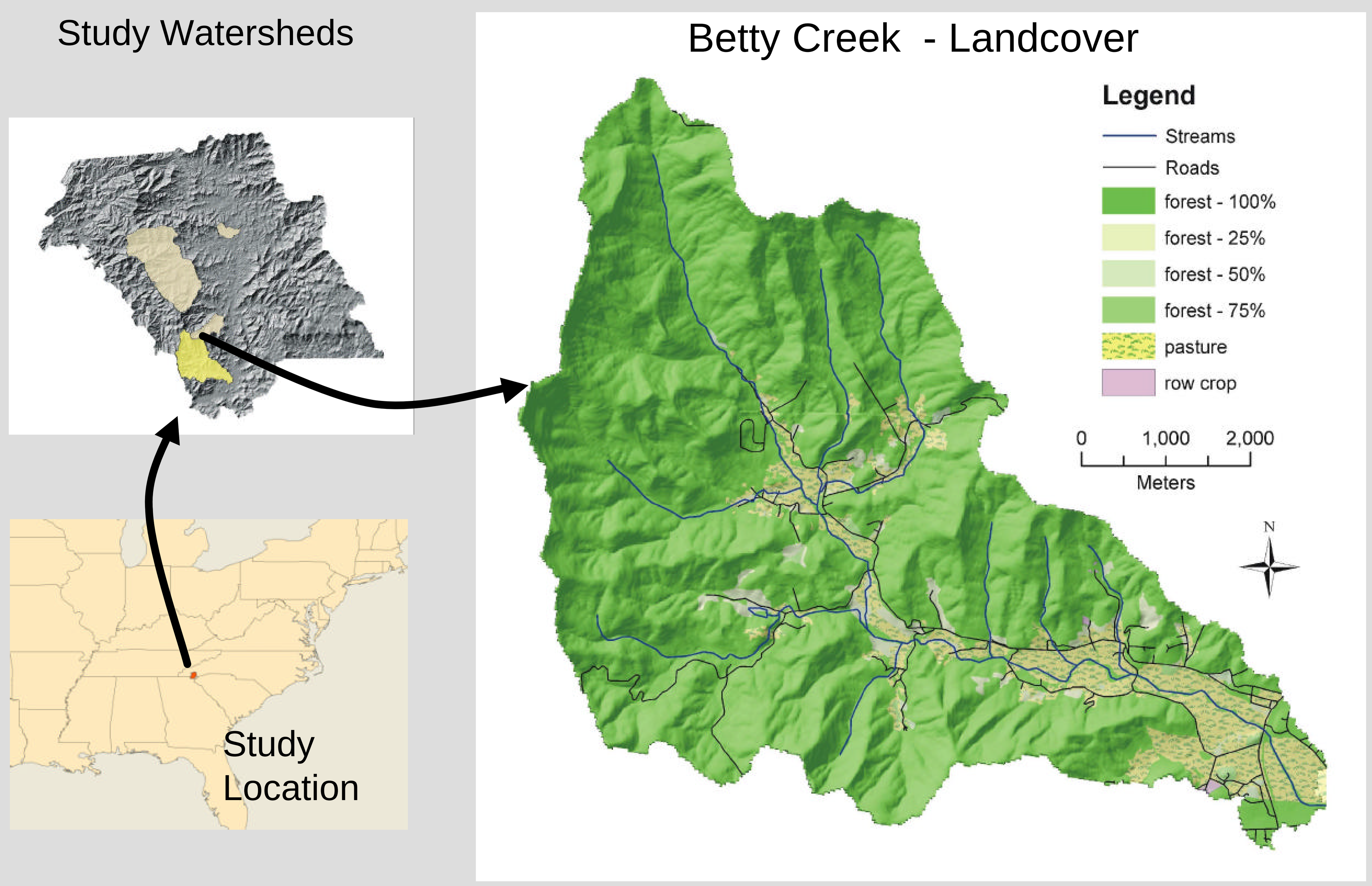
Figure 1. Measurement Watersheds – An Example



Study Area and Objectives

Landuse change in the southern Appalachian Mountains has been substantial over the past 500 years, and has accelerated during the past century. We are studying the impacts of landuse on water quantity and quality in two Appalachian watersheds: the Little Tennessee River and the upper Chatooga watersheds.

Our overall objections are to:

Quantify landuse impacts on water quality and quantity

Test process-based, spatially-explicit models of water quality

Identify the dependence of model accuracy on the spatial grain of inputs

Evaluate current high-resolution satellite systems as landcover inputs for spatially-explicit models of water quality.

Methods

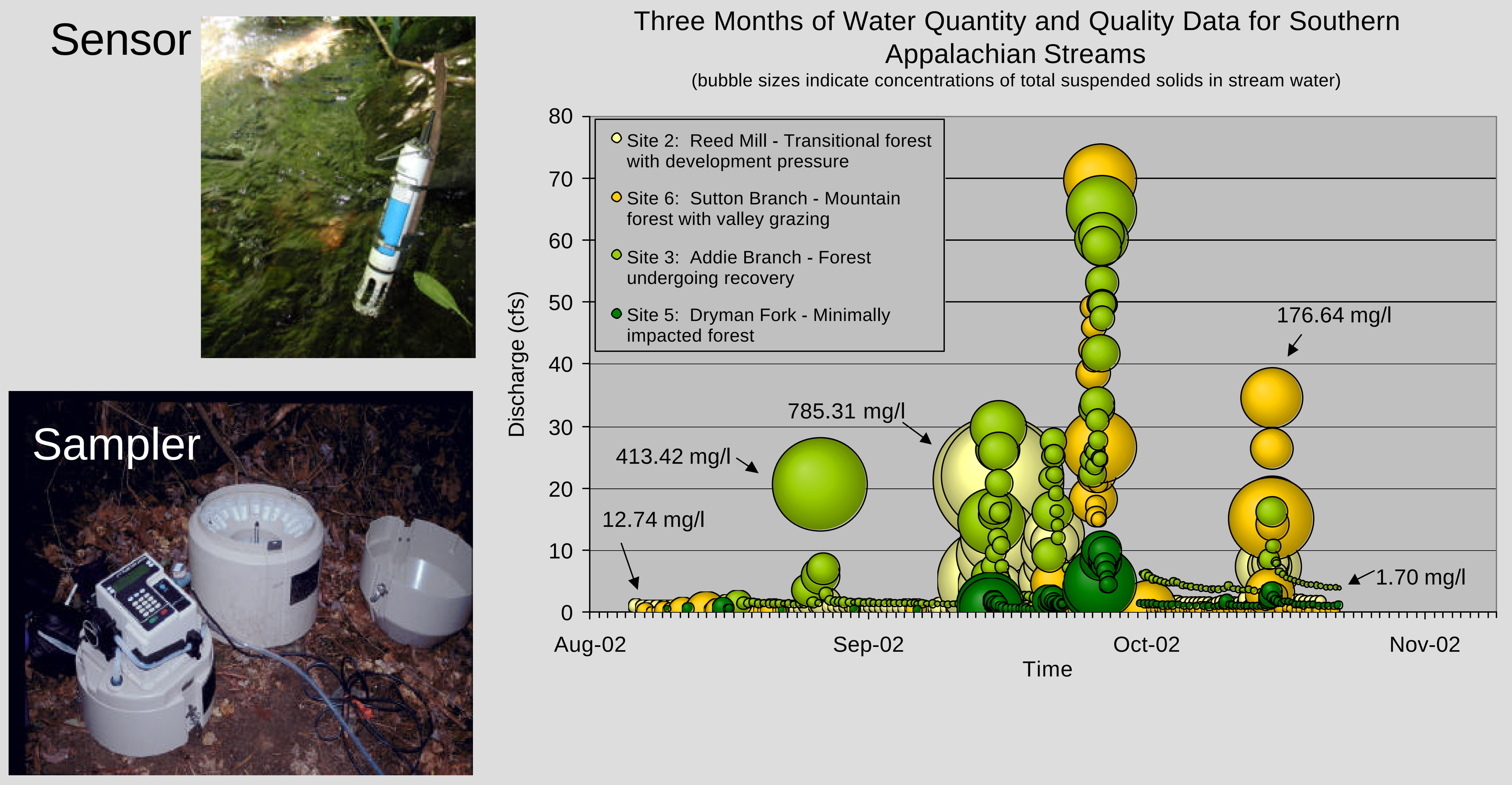
We apply three main research methods:

Measure water quality on eight study watersheds (example in Figure 1) in the Little Tennessee and Chatooga River Watersheds. To date we've collected over 50,000 stage/flow samples and over 600 water quality/chemistry samples. Example measurements are shown in Figure 2.

Develop ETM+, SPOT, Ikonos, and photo-based land use, permeability, and surface roughness data. We've gathered 182 photographs and 16 satellite images spanning 1950 through 2002, and have developed approximately ½ the landuse, roads, and building location data for these epochs.

Compare modeled and measured water quality across a range of grain sizes and data sources, and compare modeled sediment rates to historic and present landcover observations, and future landcover predictions.

Figure 2. Water Quality Measurements and Equipment.



Early Results

Landuse impacts on sediment yield most pronounced during stormflow.

Spatial grain size has large impact – model estimates change down to at least a 10 m DEM and landuse resolution.

Landuse changes through time have been large in near-stream areas, resulting in large differences in sediment input in both time and space. Improved spatial and categorical resolution in present-generation sensors results in substantially improved sediment entrainment, transport, and deposition estimates.

Figure 3: Water Quality Modeling

We are developing and adapting a process-based watershed model, WEPP, to estimate landcover impacts on water quality. Sediment is generated via landcover and soil-based sheer-stress calculations. Water velocity and quantity is predicted for a set of automatically delineated hillslopes (below, left). Sediment entrainment and deposition depends primarily on landcover, slope, and soil properties. This approach may improve on MUSLE methods more widely applied because it may be more easily generalized.