THE WOODS HOLE RESEARCH CENTER

149 Woods Hole Road · Falmouth, MA 02540-1644 USA
Telephone 508.540.9900 · Fax 508.540-9700 · www.whrc.org

Seeing the Trees for the Forest: WHRC Scientists Creating National Biomass and Carbon Dataset

Aug. 23, 2005

Scientists at the Woods Hole Research Center are producing a high-resolution "National Biomass and Carbon Dataset" for the year 2000 (NBCD2000), the first ever inventory of its kind. Through a combination of NASA satellite datasets, topographic survey data, land use/land cover data, and extensive forest inventory data collected by the U.S. Forest Service, this "millennium" dataset will serve as an invaluable baseline for carbon stock assessment and flux modeling in the United States.

The NBCD2000 project draws on vegetation canopy height estimated from digital elevation data collected during the 2000 Shuttle Radar Topography Mission, which mapped 80 percent of the Earth's land mass with a radar instrument, producing the most complete digital surface map of Earth. In combination with the National Land Cover Database 2001 (NLCD2001) and the National Elevation Dataset (NED), both generated by the U.S. Geological Survey, and forest survey data from the U.S. Forest Service, a high-resolution database of circa-2000 vegetation canopy height, aboveground biomass, and carbon stocks for the conterminous United States will be generated, providing an unprecedented baseline against which to compare data products from the next generation of advanced Earth observing remote sensing platforms.

Dr. Josef Kellndorfer, an associate scientist with the Woods Hole Research Center, is leading the project. He says, "The generation of this first-of-its-kind, high-resolution data set for the United States for the year 2000 will enable unprecedented quantification of biomass and carbon stocks, and will improve many more related studies ranging from carbon-climate interactions, forest fire mitigation, and wildlife habitat characterization, to national energy policy with respect to bio-fuel and renewable resources."

In the NBCD2000 initiative, data will be analyzed in 60 ecologically diverse regions, termed "mapping zones", which cover the entire conterminous United States. Within each mapping zone data from the space shuttle are combined with topographic survey data from the NED to form a radar-measured vegetation height map. Subsequently, this map is converted to estimates of actual vegetation height, biomass, and carbon stock using survey data from the U.S. Forest Service and ancillary data sets from the NLCD2001 project, which uses the same mapping zones. The NLCD2001 provides crucial input to the NBCD2000 project for stratification of the calibration/conversion process by providing land use/land cover and tree cover data sets.

In this context Dr. Kellndorfer states, "This project depends on the confluence of these national datasets, and the development of a complex set of models, each of which has its own accuracy characteristic. We are keen to see new global satellite missions which would provide much improved height, biomass, and carbon estimates more directly, e.g., through a fusion of lidar and interferometric radar technology."

Dr. Kellndorfer and his colleagues at the Woods Hole Research Center are beginning the first phase of the project, expected to conclude in early 2007. The first mapping zone targeted by the study is in central Utah, where the current production of the NLCD2001 is completed and where high quality NED data are available. Furthermore, central Utah is of high interest for the fire modeling community, which will benefit from the results as well. The first stage will be an iterative period devoted largely to algorithm development, testing, and subsequent refinement. An important outcome of this phase

will be an advanced understanding of the functional relationships between vegetation canopy height estimates and estimates of biomass and carbon stocks. Overall, work will be completed for several representative ecoregions totaling roughly 10 percent of the conterminous United States.

Knowledge and expertise gained during this phase will lay the groundwork for phase two, which is expected to last from 2007 into 2009 and which will extend the estimation strategy to the remainder of the conterminous United States.

To encourage use and further analysis of the proposed datasets within the scientific community, the results of this work be will be as transparent as possible. The following results and products will be delivered at the end of phase one for each of the six mapping zones:

1) An ArcGIS/FGDC compatible database with vector layers and an associated attribute table, the modeled mean estimates for height, aboveground biomass, and carbon stock, as well as spatial error and confidence measures which are based on the validation results.

2) Three 30 m-resolution raster layers corresponding to the modeled vegetation canopy height, aboveground biomass, and carbon stock, plus associated confidence layers for height and biomass.

3) A detailed metadata report containing the validation statistics together with all model statistics. The horizontal co-registration residuals and the "correction surface" used for vertical fitting of the SRTM and NED data sets will also be included.

4) A compilation of the final inversion models specific to each ecoregion (i.e., mapping zone), and vegetation structural group.

5) Various publications, presentations at the AGU and Carbon cycle science meetings.

In order to facilitate the transition to phase two of the project, a software archive and detailed documentation describing the prototype production processor developed during phase one will be delivered. Access to all final datasets and documentation will be given via a project website.

According to Dr. Kellndorfer, "The collaboration with the U.S. Forest Service is mutually beneficial. The Forest Service has a federal mandate to report on the state of U.S. forest land. To facilitate this reporting requirement, the Forest Service conducts surveys for over 75 years on some 300,000 permanent plots through the Forest Inventory and Analysis program (FIA). Information from these plots is used in the NBCD2000 project to generate models needed to derive the vegetation height, biomass, and carbon from the satellite measurements. Conversely, these spatially extensive measurements greatly enhance the Forest Service's capabilities to plan and conduct their survey and manage forest lands."

He adds,

"Overall, this project presents an opportunity to compile a more complete inventory of our national forest resource and to advance the science of accurately measuring and monitoring this resource globally with future satellite missions."

Funding for this project is provided by NASA's Terrestrial Ecology Program.