NASA Workshop

VEG3D & BIOMASS Workshop
Science and Measurement Requirements for Future Spaceborne Missions

March 3-5, 2008

Proposed Questions, Challenges, and discussion topics to be addressed during the workshop.

MODELING

Mathematical models are important tools for diagnosing properties of ecosystems, quantifying their dynamics, and making testable predictions of the future. In terrestrial systems, ecologists have long recognized the importance of vegetation structure to defining the characteristics and dynamics of both plant communities and animal habitat. Tree height is a first-order variable used by historically foresters in in stand yield tables to index the quality of sites to grow trees. Canopy vertical structure strongly affects understory growing conditions (light) and is a central variable in forest gap models. Even the newest dynamic global vegetation models explicitly track the dynamics of vegetation structure. Given the importance of vegetation structure, new globally consistent data on vegetation structure promises to enable new fundamental scientific advances using models.

- What are the most important science questions that should be addressed by incorporating data on vegetation structure into models, and how can these be addressed?

What are above ground carbon stocks? Currently there are no globally consistent data-based estimates of global carbon stocks. Methods for estimating above ground carbon stocks vary by region and investigation, and range from extensive ground-based forest inventories employing allometric equations and statistical models, to highly aggregated model estimates. New globally consistent high-resolution data on vegetation structure could be used as a basis for new global estimates of biomass using new allometric models incorporating vegetation height and other characteristics of vegetation obtained from other sensors (vegetation type etc.). It could also be used as the basis for new data-initialized estimates of biomass in height-structured global land models.

How are ecosystem structure and above ground carbon stocks changing? Repeated estimates of above ground carbon stocks (above) can be differenced to estimate changes in above ground carbon stocks. Vegetation structure needs to be estimated with sufficiently high spatial and temporal resolution to capture fine-scale changes and to attribute mechanisms of change (e.g tree-fall, growth, selective logging, fire, landuse, hurricanes etc.), and for models to be able to relate patterns of vegetation structure with the underlying heterogeneity in edaphic and or topographic conditions that strongly influence predicted ecosystem dynamics. Measured changes in vegetation structure and carbon stocks can also be used to test global land model predictions of changes in these quantities.

What are the ecosystem impacts and carbon footprints of natural and anthropogenic disturbances (e.g. treefalls, fires, hurricanes, landuse, logging etc)? Large-scale fire models are substantially limited by a lack data on pre-burn biomass conditions and fire-consumption (i.e. fraction of biomass consumed, killed, damaged, etc.). Similarly estimates of tropical land-use and logging are highly sensitive to pre-disturbance stocks. Recent estimates of the impacts from hurricanes relied heavily on models that extrapolate statistical relationships between optical remote sensing data and measure field damage at a very limited number of sites. From fires to hurricanes to land use and logging, global studies of the impacts of anthropogenic and natural disturbances on ecosystems, and recovery rates, would benefit qualitatively from globally consistent data on pre- and post-disturbance vegetation structure and biomass. Empirically-based estimates of the impacts of these events in terms of measured changes in vegetation structure could be used to test and refine model estimates of these dynamics ultimately leading to improved Earth system models.

How will the new structural data lead model development of improve our predictive capability on a changing planet? The structural data produced by this mission will initially provide new and extensive model test-data for the structured ecosystem models that are currently under development. Vertical structure on forests appears to be an extremely important variable in our theroretical investigations to date. We can expect the potential for a creative era of model-improvement and model development with the availability of new three-dimensional structural data for forests. What evolutionary changes should we expect from our current set of ecosystems models with the influx of structural data? What revolutionary changes might occur? What are the payoffs in model improvement with different levels of measurement quality? What is lost with lower levels of measurement quality?