FY 2010 Carbon Monitoring System Plan

The Fiscal Year 2010 Congressional Appropriation directed NASA to initiate work towards a Carbon Monitoring System (CMS). NASA's allocation of funding for these pre-phase A and pilot initiatives for the development of a carbon monitoring system reflects a bottoms-up agreement on products and work assignments across the NASA Centers, together with a programmatic focus on smaller-scale (e.g., local to regional) biomass products. The work to be conducted in this prototyping effort leverages the much larger investment currently made by NASA in satellite observations of carbon-related properties of the Earth, as well as in carbon cycle science and carbon management research. It also takes into account the efforts of other Federal agencies, especially as coordinated through the Carbon Cycle Interagency Working Group of the US Global Change Research Program.

The current focus is on two pilot products and a scoping study. A brief description of each of these follows:

Pilot Product Studies

The NASA plan has a primary focus on the near-term development of two pilot products – one on terrestrial biomass and one on integrated emission/uptake. A brief summary of each of these is as follows:

- ***Terrestrial biomass product*** – Will utilize satellite and *in situ* data to produce national quantitative estimates (and uncertainties) of aboveground terrestrial vegetation biomass. Will utilize satellite data, data from advanced airborne sensors, and new *in situ* field data to demonstrate an ability to produce improved quantitative estimates, with reduced uncertainties, of aboveground terrestrial vegetation biomass and carbon stocks at local to regional-scales (i.e., county/state) for selected regions. For both national and regional/local estimates, will develop and evaluate methodologies for aggregating to project, county, state, and federal levels and assess the ability of these results to meet the nation's need for monitoring carbon storage / sequestration. Will develop and evaluate a new model-data fusion approach to assess changes in carbon stocks over multi-year periods.
- ***Integrated emission/uptake (flux) product*** – Will combine satellite data with modeled atmospheric transport initiated by observationally-constrained terrestrial and oceanic models to tie the atmospheric observations to surface exchange processes and use the results to estimate the atmosphere-biosphere CO_2 exchange processes

These products will be produced at NASA Centers (i.e., Goddard Space Flight Center, Ames Research Center, and the Jet Propulsion Laboratory) working in close coordination. Details of NASA Center roles for each pilot product are included as Appendix 1.

Proposals Previously Qualified and Validation:

Work in this area emphasizes improving access to information that is needed to provide validation for the pilot products. It funds several highly ranked, previously declined proposals that could not be supported due to a lack of available funds at the time of selection. These tasks will increase our capability to validate the pilot products. There will also be some directed funding to improve our access to surface-

based measurement systems that can provide observations which can be compared to the pilot products in a direct way.

Scoping Study/Workshop:

The goal of the Scoping Study is to identify research, products, and analysis system evolutions required to support carbon policy and management as global observing capability increases. This will be a process involving significant community interaction. It was begun with a planning session held at the NASA Terrestrial Ecology Principal Investigators meeting in San Diego, CA, in March, 2010. A significant workshop was held in Boulder, CO on July 13-14, 2010. Approximately 70 people from around the United States were invited, representing a broad range of government agencies (NASA, NOAA, USDA, USGS, EPA, DOE laboratories) and academia. A second workshop is planned for January 10, 2011.

The Scoping Study will develop a plan for NASA to support carbon policy and carbon management decisions (e.g., treaty verification, adaptation information support at local and regional scales). The study will identify what products (with associated resolution and quality) can be provided over time (e.g. near-term and long-term). This effort will examine how modeling and assimilation programs can be best positioned to benefit from the new observing capability, what additional observations (in-situ, airborne, space) are needed to fill information gaps or support existing and planned capabilities, and what types of computational and data delivery systems are needed to fully capitalize on new observational capabilities. Also, the Scoping Study will use the NASA systems engineering, as well as NASA technology transfer mechanisms to fully utilize private sector capabilities.

Science Definition Team:

The Science Definition Team (SDT) will be the primary mechanism by which NASA engages the broader research community in the development and evaluation of the pilot products as they are prepared over the next 18 months. The SDT can provide insight as to how to choose among multiple approaches and/or approximations that will be required in the process of developing the products. They can also provide important thoughts about how to provide quantitative validation and characterize uncertainties of the products to be developed, and make connections to ongoing and newly developing activities among other entities (e.g., US federal agencies). The team will have two components: one each for the Biomass and Flux products. It is expected that each SDT component will consist of ~ 10 funded investigators, for up to 18 months of activity.

FY 2011 and beyond

NASA is developing plans to continue CMS activity in FY 2011 and beyond. The Administration's FY 2011 budget request, which involves a significant augmentation for NASA Earth Science over the 2011-2015 time period, has allowed NASA to plan for the CMS effort as a sustained one, with new competitive opportunities in 2011 and beyond. The scoping study activity will provide important guidance that NASA will use in finalizing its FY 2011 plans, as will lessons learned in the progress on the pilot products.

Appendix 1: Summary of Center Roles for Pilot Products

Center	Biomass Product Role	Flux Product Role
ARC	Assemble spatial data sets and remote sensing vegetation products	Organization and quality check of datasets
	Mapping distribution of biomass	Customized aggregation of data sets
	Validation, community participation	Generate and quality check disturbance products
	Plan for global biomass mapping	Quality check and aggregate data into model
		Conduct and review model runs with and without disturbance
		Data management and Evaluation
GSFC	Algorithms for active and passive satellite data for national mapping	Estimation of surface flux prior distributions
	Lead high resolution validation/ demonstration for local/regional mapping, including airborne lidar data, Landsat "data cubes," analysis, and evaluation	Configuration, use, and data management for atmospheric forward model runs
		Evaluation of atmospheric model results
	Plan for integrating and validating global biomass mapping efforts	
	Model-Data fusion approach for changes in carbon stocks	
JPL	Processing remote sensing data (radar, lidar)	Evaluation of Surface flux prior estimates
	Develop relationship for biomass model	Calculation of refined surface flux estimates
	Develop distribution of biomass	Evaluation of results
	Contribute to final national map and uncertainty analysis	