New Reforestation/Afforestation Protocol Background and Development

For future inclusion within the Second Nature Peer Review Offset Network, the Campus Forest Carbon Project has worked to modify the carbon quantification and verification sections of an existing reforestation protocol using innovative NASA Carbon Monitoring System (CMS) science. This student-led project is funded by the University of Maryland (UMD) Sustainability Fund and managed by the Department of Geographical Sciences Global Ecology Lab. The Sustainability Fund is an undergraduate-funded grant through UMD's Office of Sustainability that annually awards $330,000 dollars to sustainability projects on campus. It is currently funding the third year of the Campus Forest Carbon Project, which includes the development and review of this offset protocol. The project team is pursuing acceptance of this protocol by the Offset Network to support development of cost-effective and high-quality forest projects. The Offset Network's peer-review process and continual review requirements is appealing, and we were very much inspired by the Duke Urban Forestry Offset Protocol.

The process started by researching Forest Carbon Protocols certified under both Climate Action Reserve and Verra. As of July 2021, we found no afforestation/reforestation protocols under these two standards that ran on a voluntary market. We therefore began to look at the compliance market, where we found California's Compliance Offset Protocol for U.S. Forest Projects. This is more recent than the Regional Greenhouse Gas Initiative Compliance Offset Protocol for U.S. Forest Projects (CA was published in 2015, RGGI in 2013). It also includes language around reforestation projects, which the Climate Action Reserve Protocol for forest projects in the voluntary market does not. The protocol we chose focuses on reforestation, forest management and avoided conversion projects and has not been submitted to any other GHG program.

Specific changes to the protocol were made to leverage existing NASA CMS science. We changed the region from California to Maryland and removed all language surrounding Avoided Conversion Projects and Improved Management Projects, as our science currently supports required calculations for reforestation/afforestation projects. We updated the "Purpose and Definition" section of the protocol to match our own goals, and removed harvesting allowances and non-above ground biomass carbon pool requirements due to higher levels of uncertainty. We also changed the initial inventory and annual monitoring procedures from field sampling methodologies to remote sensing derived methodologies, and provided detail on how and where to acquire and process data for Maryland-based projects.

Unlike traditional offset protocols that use field based methods for monitoring, we are proposing a more time- and cost-effective remote sensing-based methodology for quantifying the carbon benefit of an offset project. We added our quantification methods based on the research the University of Maryland's Global Ecology Lab has conducted under NASA's Carbon Monitoring System. The application of NASA CMS science within this protocol has been applied to the uncertainty assessment, baseline inventory calculation, and monitoring approach for the annual reports. By decreasing the in-field labor requirements associated with field sampling and replacing them with remote sensed information at similar or lesser uncertainties levels, we are

reducing the costs associated with monitoring and verification and improving accessibility of this protocol for other universities.

The biggest changes to the original protocol involved the appendices, where we completely removed and re-wrote A-C and E. Currently, Appendix A represents the confidence deduction applied to each inventory. Appendix B outlines calculations to determine the initial carbon inventory of the proposed project area and the carbon sequestration potential of the project. Appendix C details the monitoring calculations used to update inventory methods for ongoing reporting requirements. Appendix D discusses the approach to reversal risk utilizing a buffer pool method, taken mostly from the original protocol. Appendix E is now a references section with all supporting papers.

Another indirect but crucial component of this protocol is that the quantification methodology uses the same suite of forest carbon products already adopted by the State of Maryland for state climate mitigation planning and inventorying. This makes the protocol particularly efficient and reliable for forest project development within the state. The University of Maryland, as a signatory to the Carbon Commitment, benefits because these offset projects are less costly to implement than traditional field-based protocols, potentially making purchase price of carbon credits also less costly. Project partners will benefit because our quantification and reporting process is much more efficient and less labor intensive. While this protocol is specifically amended to focus on projects in Maryland, this protocol can be leveraged for other universities where the underlying data is available. Doing so could promote peer-to-peer communication and collaboration between universities, furthering student education on reforestation offset protocols and quantification methods for land use change.

More information about NASA CMS can be found here: https://carbon.nasa.gov

More information about the UMD Carbon Forest Carbon project can be found here: https://geog.umd.edu/project/campus-forest-carbon-project

To keep the protocol at a high level and allow for the continual updating of the data used as it becomes available, this section regarding data access and pre-processing is here as a separate document. The protocol primarily uses a python script to output annual changes to forest carbon stock and loss within Maryland. The goal of this algorithm is to improve overall monitoring of annual changes to forest carbon within Maryland for a specified time period. Utilizing forest loss data from Global Forest Watch and Lidar-initialized outputs from the Ecosystem Demography model, annual carbon stocks, gains, losses, and fluxes can be calculated.

Access to the code can be found here:
https://github.com/UMDgel/Campus-Forest-Carbon-Project

(a) Prior to downloading the code users must:
    (i) Install the most recent, updated version of Jupyter Notebook or other program that can run Python scripts; and
    (ii) Download ArcGIS 10.8.1 or the most current release of ArcGIS
(b) To run the code users need to:
    (i) Specify specific monitoring years (e.g., 2011-2020)
    (ii) Identify geographic domains of interest within Maryland
(c) If using a Jupyter environment, download the code as a .ipynb file (recommended)
    (i) If using another coding environment, download and open the .py file