MUREP Small Business Technology Transfer (M-STTR) Planning Grants

Title: Imaging-non-Imaging Satellite-Airborne-Terrestrial Data for Dynamic Modeling: Impact Analyses of Climate Change on Natural Resources
Institution: Tennessee State University
City/State: Nashville, TN
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SUMMARY: The proposed M-STTR research will analyze and integrate NASA pertinent imaging and non-imaging satellite data to create models for quantifying impacts of climate change on natural resources including the vegetation. The factors impacting the vegetation: soil, water, topography/geology, land cover-land use, and surrounding environment will act as precursors to this research, and they will be included in the change analyses model(s). The research will standardize, process, and enhance the ICESat2, Sentinel2/Landsat8, GRACE-FO, airborne or UAS, and terrestrial data during the Phase I study.

The combined ICESat2 and GRACE-FO data will be used for modeling soil-water vegetation. The Phase I research will separate the ICESat-2 data into three different layers: (i) digital surface model (DSM), (ii) digital terrain model (DTM), and (iii) digital elevation model (DEM) after separating the four vegetation layers: emergent, canopy, understory, and forest floor which will assist in mapping vegetation structure as well as quantification of woody biomass and carbon stock across the landscape.

Anticipated products of the research will be following: (i) change detection using the biomass volume by creating time-series and dynamic geodatabase, (ii) tree height and total tree counts model, (iii) soil-water-vegetation nexus model(s) to predict forest fire likelihoods in the study area, and (iv) application packages developed utilizing Python/R in a free and open-source software such as QGIS. Patents will be filed on a need basis to the USPTO during the research period.

The significance of the proposed study area is characterized by diverse topography, land cover, and land use. The inclusion of the TSU campus area in the study site will further maximize the usage of the research products for developing new graduate-undergraduate curricula utilizing all pertinent NASA satellite data. The research products included in the curricula will enhance the production of STEM minority graduates that will meet the challenging requirements of the 21st-century workforce development, especially, related to climate change and conservation and management of natural resources for perpetuity.

Earth Mapping International will serve as a research product development partner that will commercialize the products developed to national and international clients through the United States Agency for International Development (USAID), the World Bank, direct sales to local-state-national governments, and commercial entities. The TSU-EMI Collaboration has developed a draft Cooperative Research Agreement (CRA); a duly signed CRA will be provided upon notification of award recommendation.

During the M-STTR planning period, the TSU-EMI team will develop strategic partnerships with other academic institutions: University of Notre Dame (UND), IN; University of Maryland Eastern Shore (UMES), MD; University of New Haven, CT; and the University of Georgia in Athens (UGA), GA for expanding internal research stakeholders. Various future patrons: federal-state-local government agencies: NASA, USDA (Forest Service and Agricultural Research Service), USAID, states, counties, the World Bank, and commercial entities will be interviewed during customer discovery. The summarized concerns of the stakeholders will be included in the Phase I research product development and commercialization proposal.

This NASA-M-STTR proposal is divided into four Phases: (i) Phase 0: research planning, research networking, customer discovery, and Phase I proposal writing; (ii) Phase I: feasibility of the research hypotheses, algorithms, and proposal writing for Phase II prototype development, (iii) Phase II: this phase will develop prototypes, and implement strategies for commercialization of the M-STTR research products, (iv) Phase III: in this phase, the research products will be rolled out to the domestic and international clients to meet the target markets.