From Flux Tower to Carbon Credit: Towards Robust and Accessible Measurement, Reporting and Verification

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Background/Objectives. At the 2021 Glasgow Climate Summit, the US committed to reducing its net greenhouse gas emissions by 50 to 52% below 2005 levels in 2030. In addition to decarbonizing the US economy, two principal carbon sequestration realms are envisioned for implementing this commitment: intensive abiotic sequestration such as Battelle's carbon capture, utilization and storage (CCUS) and extensive biotic sequestration such as nature-based climate solutions (NbCS). Measuring, reporting and verifying (MRV) the true climate benefits of these mitigation actions is a pivotal challenge that requires balancing robustness and accessibility. Here, we explore a dialogue between academia and industry in pursuit of an appropriately balanced MRV depending on mitigation project realm, scale, policy requirements, and the acceptable level of uncertainty. Key applications include: industry leak detection such as for CCUS; NbCS and precision agriculture; biophysical and permafrost feedbacks; emission inventory validation and urban air quality.

Approach/Activities. Eddy-covariance flux towers provide one of the few direct observations of net carbon, water, and heat exchanges between the earth's surface and its atmosphere. This feature has led to their advent as the de facto gold-standard for basic research in hectare-scale urban and natural settings such as at National Ecological Observatory Network sites. However, the rich information provided by flux towers is rarely applied to market-ready MRV, owing to cost and complexity in data interpretation. Here, we present progress towards a turnkey Emission Observation and Data Analysis System (EODAS) that overcomes these historical challenges through integrating flux towers with simultaneously available ground-based, airborne and spaceborne observations. These patent-pending, space- and time explicit systems and methods aim to harness the benefits and overcome the limitations of the individual observational assets.

Results/Lessons Learned. Flux tower EODAS produces carbon, water and heat flux maps at half-hourly and decameter resolutions over 1 km^2 to 100 km^2 mitigation project domains. The near-real time spatialization enables continuous MRV, precise problem tracking and resolution for underperforming locations, and ultimately provides robust information for mitigation action. An initial sensitivity study shows that flux tower EODAS can reduce the MRV cost per unit area by at least one order of magnitude compared to current industry practices. Implementing such cost savings can increase the accessibility and economic attractiveness of carbon sequestration, and accelerate widespread adoption. We expect to further specify strengths, weaknesses, opportunities and threats (SWOT) from applying EODAS to the CHEESEHEAD19 (https://doi.org/10.1175/BAMS-D-19-0346.1) 100 km^2 high-density dataset.