# CPS: Medium: Dig, Sip, Breathe: Automated Monitoring of Carbon and Water Cycles in Agriculture

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https://nimbus.unl.edu/projects

## Challenge:

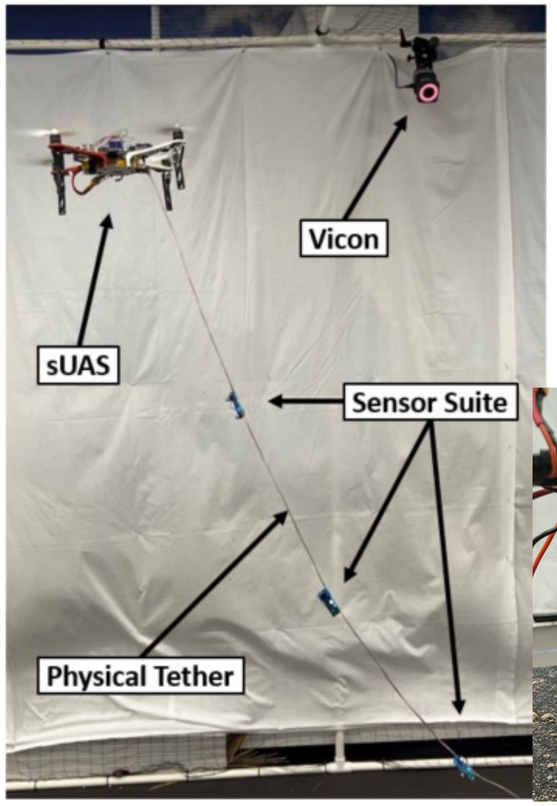
- Monitoring, reporting, and verification of soil water content (SWC) and soil organic content (SOC) is costly
- Automated monitoring requires breakthroughs in robotics, smart sampling, and the science of carbon sequestration

## Solution:

- UASs for soil water and carbon sampling, soil extraction, and tethered UAS for atmospheric monitoring
- Automated collection of high temporal and spatial resolution SWC and SOC data
- Smart sampling algorithms for use with multi-agent UAS system
- Smart sampling software to incorporate into existing USDA ESAP tool

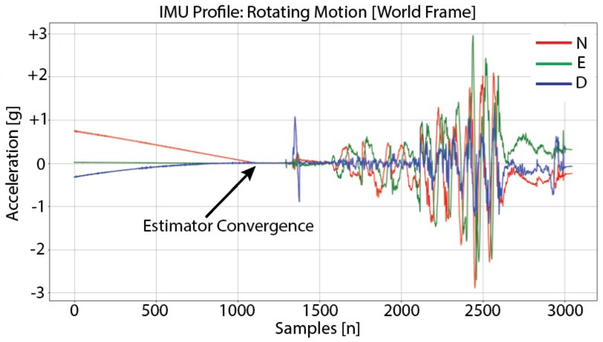
## Impact on Society:

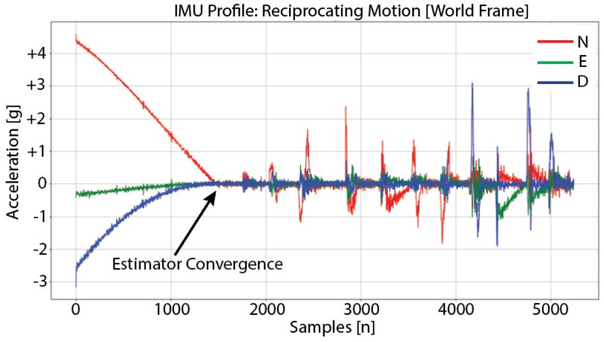
- Soil Sampling Optimization and Planning Tool (SSPOT) web application at USDA
- SSPOT 1.0 released Jan 2025 – 800k interactions in January
- Automated SOC, SWC sensing, and soil extraction via UAS




## Scientific Impact:

- Tethered UAS and “tetherbots” for localized, automated, optimal atmospheric monitoring
- Experiment using geochemical monitoring and modeling to estimate $CO_2$ sequestration
- Developed automated, UAS-based:
  - soil extraction and collection system
  - soil-water insertion probe



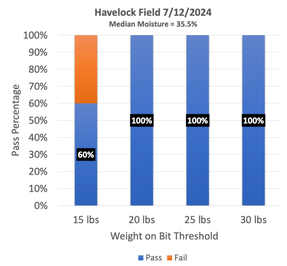



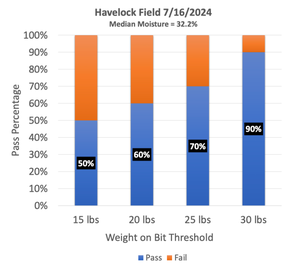

## Education and Outreach:

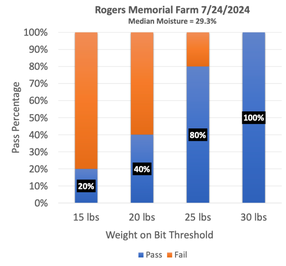
- Field day and demonstrations with farm management staff and local industry to showcase soil extraction UAS
- REU summer students help develop UAS-based soil-water insertion probe

## Quantified Impact:

- Fast soil-water probe insertion measurements
- Nearly 100% successful sensor reading if moisture >35%

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