A GNSS-Reflectometry Instrument for Wetland Extent and Dynamics

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We will present the key features of a new GNSS-reflectometry instrument designed primarily to monitor global wetland extent on weekly to monthly timescales. Wetlands represent the largest and most uncertain contribution to atmospheric methane as noted in the IPCC-AR5 report. Because methane is a powerful greenhouse gas ~25X more potent than CO2 on centennial timescales, monitoring its primary atmospheric source is needed to improve long-term climate models.

GNSS reflectometry, with its forward-scattering geometry and L-band wavelengths, has recently been shown to penetrate vegetation that typically overlays wetlands, to sense the extent of underlaying inundation. Our instrument will collect and process these GNSS signals-of-opportunity reflecting from the surface. For improved spatial and temporal sampling, our instrument is designed to simultaneously observe and process all GNSS and SBAS reflected signals in a small-sat configuration so that multiple receivers can be deployed on a single launch. To process the large number of simultaneous signals, including computing delay-Doppler maps of the reflected signals, is a key challenge. Novel solutions to this issue will be discussed.

We will also discuss other innovations planned for our instrument including our NASA ACT-developed front-end and the inclusion of JPL-developed Real-Time Gipsy (RTGx) for onboard navigation. The front end uses custom, 3-anntena-element ASICs having a 690 MHz bandwidth covering all GNSS signals, and requires only ~300 mW per input. This low power enables antenna arrays that can perform electronic beam steering, where the array is phased to provide high gain in the direction of each reflection simultaneously, resulting in longer observations and more data. For onboard positioning, navigation and timing (PNT), we leverage RTGx software to quickly add this functionality. RTGx is accurate at the decimeter level when using the transmitted ephemeris, and is good to the cm level when using transmitted ephemeris corrections. Finally, we will discuss other additional science measurements that this instrument can perform.