SigNals of Opportunity: P-band Investigation (SNoOPI)
USNC-URSI National Radio Science Meeting

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Conventional P-band radar and radiometers are prone to RF spectrum access problems and require very large antennas to obtain sufficient signal-to-noise ratio and spatial resolution. Signals of Opportunity (SoOp) is a new technique that re-uses signals from existing telecommunications satellites as sources of illumination in a bistatic radar configuration.

SigNals of Opportunity: P-band Investigation (SNoOPI) will be the first on-orbit demonstration of SoOp in P-band (240-380 MHz). SNoOPI will demonstrate a novel instrument that shows promise for measuring root-zone soil moisture (RZSM) and snow water equivalent (SWE) from space. Accurate measurement of RZSM, identified as a priority target variable for technology development initiatives in the 2017-2027 Decadal Survey for Earth Science and Applications from Space (ESAS 2017), is of national importance and critical to food production. Observations at P-band are needed to penetrate into the root zone. Snow provides freshwater during spring and summer for a large portion of the world and plays a critical role in hydrology and water management. SoOp measurements of phase-delay are proportional to SWE, which was also recommended as a program element in ESAS 2017.

The primary objective of SNoOPI is in-space validation of the P-band SoOp technique through an instrument prototype. This is a necessary risk-reduction step on the path to a science mission and will verify important assumptions about reflected signal coherence, robustness to the RFI environment, and our ability to capture and process the transmitted signal from orbit. Our baseline mission design is driven by this objective, which will be met through demonstrating measurement of the complex reflection coefficient over various land surface conditions and showing that statistics of the reflection coefficient magnitude and phase retrieval meet the working requirements for a future RZSM and SWE mission.

The SNoOPI instrument consists of three subsystems: 1) The low noise front end (LNFE), developed from an airborne demonstration instrument and later redesigned in a CubeSat form factor; 2) The digital back end (DBE), a modification of the Cion instrument flying on CICERO that capitalizes on the extensive heritage of the Blackjack and TriG GPS receivers; and 3) an array of COTS antennas.

Success with SNoOPI will retire the critical risks associated with a P-band SoOp satellite instrument, with an exit at TRL-7. This instrument will enable direct measurements of RZSM and SWE that are not presently possible and will also be orders of magnitude lower in size weight, power and cost (SWaP-C) than comparable monostatic radars due to the re-utilization of powerful anthropogenic signals.