L-band High Resolution Soil Moisture Mapping Using a Small Unmanned Aerial System

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Soil moisture is of fundamental importance to many hydrological, biological and biogeochemical processes, plays an important role in the development and evolution of convective weather and precipitation, and impacts water resource management, agriculture, and flood runoff prediction. The launch of NASA's Soil Moisture Active/Passive (SMAP) mission in 2015 promises to provide global measurements of soil moisture and surface freeze/thaw state at fixed crossing times and spatial resolutions as low as 5 km for some products. However, there exists a need for measurements of soil moisture on much smaller spatial scales and arbitrary diurnal times for (e.g.) SMAP validation, precision agriculture, evaporation and transpiration studies of boundary layer moisture transport, tundra freeze/thaw science, and vehicle trafficability. The Lobe Differencing Correlation Radiometer (LDCR) provides a means of mapping soil moisture on spatial scales as small as several meters (i.e., the height of the platform). Compared with various other proposed methods of validation based on either *in situ* measurements or existing airborne sensors suitable for manned aircraft deployment, the integrated design of the LDCR on a lightweight small unmanned aerial system (sUAS) is capable of providing sub-watershed (~km scale) coverage at very high spatial resolution (~15 m) suitable for scaling scale studies. This sUAS, the Tempest, flies at very low operator cost compared to manned aircraft.

To demonstrate the LDCR several flights had been performed in the past two years during field experiments at the Canton Oklahoma Soilscape site, and Irrigation Research Foundation (IRF) Yuma, Colorado. During these experiments, the sUAS Tempest was flown at 20-50 m altitude to obtain differing spatial resolutions. The LDCR upwelling antenna temperature and soil moisture retrieving and mapping algorithm will be analyzed, and scientific comparisons between LDCR retrieved soil moisture and *in situ* measurements will be presented. The impact of irrigation and precipitation on soil moisture variation will be discussed based on high spatial resolution LDCR observations as well.