National Aeronautics and Space Administration

FY23 Strategic Initiatives Research and Technology Development (SRTD)

Improving UAVSAR PolInSAR and TomoSAR Processing and Analysis at L- and P-Bands to Address STV Observables

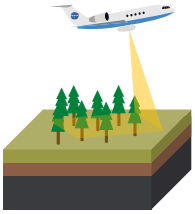
Principal Investigator: Michael Denbina (334)**; Co-Investigators:** Bryan Stiles (334), Richard Chen (334), Yunling Lou (334), Marc Simard (334)

Strategic Focus Area: Radar Advances to Accelerate Earth and Planetary Missions | **Strategic Initiative Leader:** Darmindra D Arumugam

1. Objectives:

Improve processing and perform analysis of data collected by JPL's Uninhabited Aerial Vehicle Synthetic Aperture Radar (UAVSAR) instrument in preparation for a future Surface Topography and Vegetation (STV) mission:

- Improve UAVSAR TomoSAR processing and calibration
- Analyze UAVSAR data collected at different frequencies (L- and P-band) over tall, dense forest
- Improve ground estimation algorithms
- Analyze ground-to-volume backscatter, comparing L- and P-band as a function of canopy height and vegetation density.



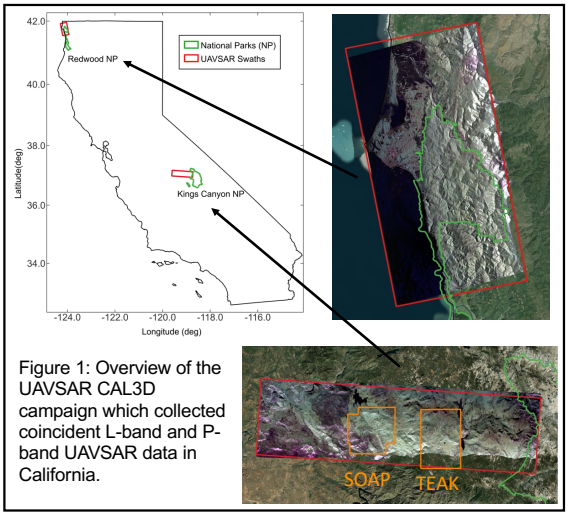


Figure 1: Overview of the UAVSAR CAL3D campaign which collected coincident L-band and P-band UAVSAR data in California.

2. Background:

- PolInSAR and TomoSAR techniques can be used to map vegetation structure and surface topography underneath vegetation.
- By assessing the performance of L-band and P-band data in a variety of forest types, this allows JPL to make better recommendations as to the preferred frequencies, baseline lengths, algorithms, and other parameters that should be incorporated into the future STV mission.

3. Approach and Results:

- CAL3D campaign collected coincident L-band and P-band UAVSAR data over tall, dense forests in California (Figure 1).
- Figure 2 shows examples of geocoded UAVSAR TomoSAR imagery at L- and P-bands for the CAL3D Kings Canyon study site.
- The ground-to-volume backscatter ratio of CAL3D campaign data demonstrates that P-band observes greater scattering from lower elevations closer to the ground, particularly for taller and denser forest, as shown in Figure 3.

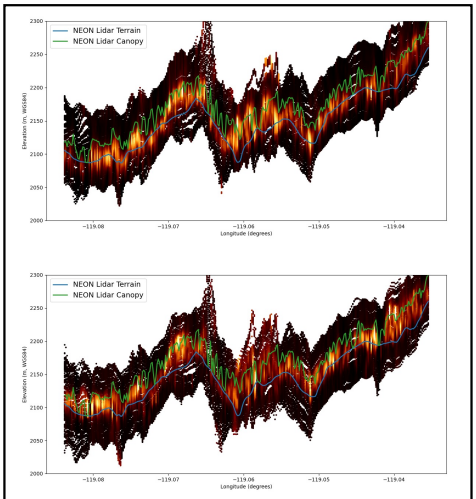


Figure 2: UAVSAR geocoded TomoSAR imagery at L-band (top) and P-band (bottom) collected over Sierra National Forest over varying topography.

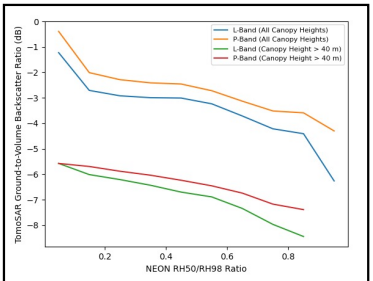


Figure 3: TomoSAR ground-to-volume ratio vs. lidar RH50/RH98 ratio, which is a proxy for canopy density.

4. Significance/Benefits to JPL and NASA:

- Position JPL to address STV observables using PolInSAR and TomoSAR techniques at multiple frequencies.
- Advance technology and reduce risks in formulating the STV mission.

National Aeronautics and Space Administration

Jet Propulsion Laboratory
California Institute of Technology
Pasadena, California

www.nasa.gov

Clearance Number: CL#00-0000
Poster Number: RPC#

PI/Task Mgr. Contact Information:
(818) 354-2551
michael.w.denbina@jpl.nasa.gov