

# Calibration and Validation Plan for the NASA-ISRO Synthetic Aperture Radar (NISAR)

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The NASA ISRO SAR mission (NISAR) will be a dedicated U.S. and Indian SAR mission for studying hazards and global environmental change. Operating at both L-band and S-band wavelengths, NISAR will acquire data globally to address three mission science themes: The Earth's surface and interior; the Earth's cryosphere; and the Earth's ecosystems. NISAR is planned for launch in late 2021 or early 2022. The L-band SAR will have several modes up to and including fully polarimetric modes with most modes supporting a split spectrum to facilitate the correction of ionospheric delays; NISAR will support selectable bandwidths between 5 MHz and 80 MHz. The mission will be capable of acquiring SAR data every 12-day repeat orbit for both ascending and descending orbit directions over most if not all of the Earth's land surface during the nominal 3-year mission duration. Orbit tube repeatability for this left-looking SAR mission will be better than 500 m. In addition to the calibration of the sensor data, NISAR will have 13 science measurement requirements that will be validated after its launch.

The recently updated NASA Cal/Val plan ([https://nisar.jpl.nasa.gov/files/nisar/NISAR\\_Mission\\_CalVal\\_Plan\\_20180810.pdf](https://nisar.jpl.nasa.gov/files/nisar/NISAR_Mission_CalVal_Plan_20180810.pdf)) for NISAR will be discussed during this presentation. This updated Cal/Val plan describes in detail the calibration and validation approach for each NASA science requirement. This plan also describes a UAVSAR campaign that will produce a NISAR-like L-band time series of data products over ecosystem sites in the South East USA in 2019. The NISAR project has also recently released a NISAR science users handbook ([https://nisar.jpl.nasa.gov/files/nisar/NISAR\\_Science\\_Users\\_Handbook.pdf](https://nisar.jpl.nasa.gov/files/nisar/NISAR_Science_Users_Handbook.pdf)) that describes in detail the science objectives of this mission.

Image formation and performance requirements will be evaluated through an array of point targets deployed across the 240 km NISAR swath. The validation of NISAR solid earth deformation measurement requirements will include comparisons of NISAR results against continuous GPS (CGPS) measurements of ground displacements. Validation will be repeated annually in order to assess improvements with increased numbers of image acquisitions and to detect any potential degradation. The main validation approach for deformation of ice sheets and glacier velocity requirements will be to compare NISAR-derived velocity with points of known velocity. In particular, we will compare NISAR ice velocity products against stationary points (exposed bedrock) and with velocities measured with GPS stations deployed on moving sheets of ice. The NISAR biomass measurement requirement will be validated through comparison of NISAR-derived biomass products with biomass estimates from airborne LIDAR, which themselves will have been validated through allometry-based field measurements of biomass. High-resolution (cm to < 5 m resolution) optical data will be used to determine fractional forest canopy cover (FFCC) for 1 ha resolution cells at the beginning and end of a 12-month NISAR observation period for validation of the forest disturbance measurement requirement. Within the United States, Canada and Europe significant resources exist for validating the NISAR crop area metric, including the use of very high-resolution optical data. The measurement of open water extent by NISAR will be validated with data from optical sensors, limited only by cloud cover. A combination of measurements from ground transects, water level gauges, high-resolution multichannel optical data, and quad-pol airborne SAR data will be used to validate measurements of inundated vegetation.

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