Many NASA future Earth science remote sensing programs and missions require microwave to submillimeter wavelength antennas, transmitters, and receivers operating in the 1-cm to 100-μm wavelength range (or a frequency range of 30 GHz to 3 THz). General requirements for these instruments include large-aperture (possibly deployable) antenna systems with RMS surface accuracy of 200 μm. For these systems, advancement is needed in primarily three areas: 1) the development of frequency-stabilized, low phase noise, tunable, fundamental local oscillator sources covering frequencies between 160 GHz and 3 THz; 2) the development of submillimeter-wave mixers in the 300-3000 GHz spectral region with improved sensitivity, stability, and IF bandwidth capability; and 3) the development of higher-frequency and higher-output-power MMIC circuits.

Specific innovations or demonstrations are required in the following areas:

- Heterodyne receiver system integration at the circuit and/or chip level is needed to extend MMIC capability into the submillimeter regime. MMIC amplifier development for both power amplifiers and low noise amplifiers at frequencies up to several hundred GHz is solicited. Integration of a local oscillator multiplier chain, mixer, and intermediate frequency amplifier is one example. There is also a specific need to demonstrate array radiometer systems using MMIC radiometers from 60 GHz to approximately 500 GHz;

- Solid-state, phase-lockable, local-oscillator sources with flight-qualifiable design approaches are needed with >10 mW output power at 200 GHz and >100 μW at 1 THz; source line widths should be stable;

- Multi-channel spectrometers that analyze intermediate frequency signal bandwidths as large as 10 GHz with a frequency resolution of 1 GHz;

- Compact and reliable millimeter and submillimeter imaging instrumentation that produces images simultaneously in multiple spectral bands;

- Schottky mixers with high sensitivity at T = 100 K and above;

- Low noise superconducting HEB mixers and SIS mixers;

- Receivers using planar diode or alternative reliable local oscillator technologies in the 300-3000 GHz spectrum;

- Lightweight and compact radiometer calibration references covering 100-800 GHz frequency range;

- Lightweight, field portable, compact radiometer calibration references covering frequencies up to 200 GHz.
The reference must be temperature stable to within 1 K with a minimum of three temperature settings between 250 and 350 K;

- Low-cost, special purpose, ground-based receivers to detect signals radiated from active satellites that are in orbit for estimating rain rate, water vapor, and cloud liquid water; and

- Calibrated radiometer systems that can achieve accuracy and stability of 0.1 K.