Active microwave sensors have proven to be ideal instruments for many Earth science applications. For global coverage and the long-term study of Earth’s eco-systems, space-based radar is of particular interest to Earth scientists. Radar instruments for Earth science measurements include Synthetic Aperture Radar (SAR), scatterometer, sounder, altimeter and atmospheric radar. The life-cycle cost of such radar missions has always been driven by the resources - power, mass, size, and data rate - required by the radar instrument, often making radar not cost competitive with other remote sensing instruments. Order-of-magnitude advancement in key sensor components will make the radar instrument more power efficient, much lighter weight and smaller in stow volume, leading to substantial savings in overall mission life-cycle cost by requiring smaller and less expensive spacecraft buses and launch vehicles. On-board processing techniques will reduce data rates sufficiently to enable global coverage. Technologies that may lead to advances in instrument design, architectures, hardware, and algorithms are the focused areas of this subtopic. In order to increase the radar remote sensing user community, this subtopic will also consider radar data applications and post processing techniques. Specific areas in which advances are needed include:

- L-band SAR for surface deformation, topography, soil moisture measurements:
  - Lightweight, electronically steerable, dual-polarized, L-band phased-array antennas;
  - Lightweight deployable antenna structures and deployment mechanisms suitable for very large aperture systems (e.g., 2x100m antennas);
  - Rad-hard, high-efficiency, low-cost, lightweight L-band T/R modules;
  - L-band MMIC single-chip T/R modules;
  - High-power L-band transmitters (2KW to 10KW);
  - Integrated (e.g., ASIC) arbitrary waveform generators;
  - High performance, low power, rad-hard, real-time SAR processors and SAR data processing algorithms and data reduction techniques;
Thin-film membrane compatible electronics. This includes: Reliable integration of electronics with the membrane, high performance (>1.2GHz) transistor fabrication on flex material including identifying new materials, process development and techniques that have potential to produce large area passive and active flexible antenna arrays.

- **Ku-band and Ka-band interferometers for snow cover measurement over land (Ku-band) and wetland and river monitoring (Ka-band):**
  - Large, stable, lightweight, deployable structures (10-50 meter interferometric baseline);
  - Phase-stable Ku-band and Ka-band electronically steered phased arrays and multi-beam antennas;
  - Lightweight deployable reflectors (Ku-band and Ka-band);
  - Phase stable Ku-band and Ka-band receive electronics and T/R modules;
  - High-power Ka-band transmitters (2KW to 10KW);
  - High performance, low power, rad-hard, real-time radar processors and SAR data processing algorithms and data reduction techniques.

- **X-band to W-band doppler radars for precipitation and cloud measurements:**
  - High efficiency RF power amplifier (Ku-, Ka-, and W-band);
  - Compact, low loss phase shifters (Ka- and W-band);
  - High power and low insertion loss transmit-receive switches (Ka-, W-band);
  - Wide dynamic range low noise amplifiers (Ka- and W-band);
  - Low sidelobe (-90 dB) pulse compression technology (W-band);
  - Compact frequency synthesizer (Ku- and Ka-band);
  - High power, low sidelobe, compact antennas for high altitudes (X-Ka-band).

- **Low Frequency (HF, VHF and UHF) airborne sounders:**
  - Technology for creating large Ground Penetrating Radar (GPR) baselines with wireless phase lock loops;
  - High Power (800W), linear amplifiers;
  - Innovations in system design or hardware improvements to minimize the effect of the transmit signal leakage into receiver.