New, innovative, high risk/high payoff approaches to miniaturized and low cost instrument systems are needed to enhance Earth science research capabilities. Sensor systems for a variety of platforms are desired, including those designed for remotely operated robotic aircraft, surface craft, submersible vehicles, balloon-based systems (tethered or free), and kites. Global deployment of numerous sensors is an important objective, therefore cost and platform adaptability are key factors.

Novel methods to minimize the operational labor requirements and improve reliability are desired. Long endurance (days/weeks/months) autonomous/unattended instruments with self/remote diagnostics, self/remote maintenance, capable of maintaining calibration for long periods, and remote control are important. Use of data systems that collect geospatial, inertial, temporal information, and synchronize multiple sensor platforms are also of interest.

Priorities include:

- Atmospheric measurements in the troposphere and lower stratosphere: Aerosol Optical and Microphysical Properties, Cloud Properties and Particles, Water, Chemical Composition, i.e.; Carbon Dioxide (\(1\text{2} \text{CO}_2\) and \(1\text{3} \text{CO}_2\)), Carbon Monoxide, Methane, Nitrogen Dioxide, Hydrogen Peroxide, Formaldehyde, Bromine Oxides, Ozone, and Three-dimensional Winds and Turbulence.

- Oceanic, coastal, and fresh water measurements including inherent and apparent optical properties, temperature, salinity, currents, chemical and particle composition, sediment, and biological components such as nutrient distribution, phytoplankton, harmful algal blooms, fish or aquatic plants.

- Instrument systems for hazardous environments such as volcanoes and severe storms, including measurements Sulfur Dioxide, Particles, and Precipitation.

- Land Surface characterization geopotential field sensors, such as gravity, geomagnetic, electric, and electromagnetic.
• Miniaturized instrument systems for submersible vehicles and tethered sub-surface observation systems for difficult to access water bodies associated with glaciers, including sub-glacial lakes, melt-water channels, and sub-ice shelf environments. Systems may be put down boreholes or placed on small submersibles and are required to map all aspects of cavity shape; determine sediment depth, composition, and spatial variability by acoustic or other methods; and measure water currents, temperature, thermal structure, and composition.

Instrument systems to support satellite measurement calibration and validation observations, as well as field studies of fundamental processes are of interest. A priority is applicability to NASA’s research activities such as the Atmospheric Composition and Radiation Sciences programs, including Airborne Science support thereof, as well as the Applied Sciences, and Ocean Biology and Biogeochemistry programs. Support of the Integrated Ocean Observing System (IOOS) and regional coastal research is also desired.