REMOTE SENSING

See General Rules, Eye Protection & other Policies on www.soinc.org as they apply to every event.

1. **DESCRIPTION**: Participants will use remote sensing imagery, data, and computational process skills to complete tasks related to climate change processes in the Earth system.

A TEAM OF UP TO: 2 **APPROXIMATE TIME:** 50 minutes

2. **EVENT PARAMETERS**: Each participant may bring one 8.5" x 11" two-sided sheet of paper containing any information from any source. Each participant may bring a metric ruler, a protractor, and any kind of (non-graphing) calculator, but no other resources.

3. **THE COMPETITION**: The event will consist of questions and activities testing concepts related to the collection and use of remote sensing data to observe and study climate change processes in the Earth system. Each of the following topic areas should compose approximately 25% of the test:

   a. Remote sensing instrumentation and physics: active vs. passive sensors; optical and infrared imagers; radiometers; LiDAR; precipitation radar; blackbody radiation; Planck function, Wein's Law; Stefan-Boltzmann Law; beam attenuation; absorption and scattering by aerosols; refraction and refractive indices; scattering
   b. Interpretation of remote sensing images and data sets from NASA A-Train satellites: Atmospheric and sea-surface temperature (AMSR-E); global mean temperature; energy flux (CERES); optical, infrared and Doppler radar imagery of clouds and precipitation (MODIS, CALIPSO, CLOUD-SAT); CO_2 cycle (OCO-2); ocean color and ocean productivity (MODIS); aerosol scattering, absorption and optical depth (MODIS); detection of trace gas concentrations by satellites (OCO-2, AURA) and LiDAR
   c. Climate processes and climate change: greenhouse gases (concentrations and distribution) and trace gas concentrations; clouds and radiation; aerosol forcing; carbon cycle; surface albedo; comparison of remote sensing data with climate model data
   d. Using, applying and interpreting the output of small-scale models of planetary energy balance

4. **REPRESENTATIVE ACTIVITIES**:
   a. Compare visible and IR satellite images of clouds to interpret relationships between clouds and outgoing radiation, and to explain how clouds influence the Earth's radiative balance.
   b. Given information characterizing the extinction coefficient of a layer of dust in the atmosphere and the observed reduction in outgoing radiation, calculate the thickness of the dust layer.
   c. Use data from NASA's OCO-2 satellite to determine CO_2 concentrations in different latitudinal bands, modify a simple energy balance model to include an idealized greenhouse gas response to these CO_2 concentrations, and show how this affects global atmospheric temperature.

5. **SCORING**: Points will be awarded for the quality and accuracy of responses. Ties will be broken by the accuracy and/or quality of answers to selected questions.

Recommended Resources: All reference and training resources including the **Remote Sensing CD** and the **Bio/Earth CD** are available on the Official Science Olympiad Store or Website at www.soinc.org. Students are encouraged to explore these models of the Earth's energy to understand the earth's radiation budget and event supervisors are encouraged to use the output from these models in their exams to illustrate key concepts: climatemodels.uchicago.edu/modtran/, forecast.uchicago.edu/Projects/full_spectrum.html, www.shodor.org/master/environmental/general/energy/index.html