REMOTE SENSING DRAFT RULES 17

1. DESCRIPTION: Participants will use remote sensing imagery, data, and computational process skills to complete tasks related to climate change processes in the Earth's system.
   A TEAM OF UP TO: 2 APPROXIMATE TIME: 50 minutes
2. EVENT PARAMERTERS: Each team may bring four 8.5"x11" sheets of paper that contain information on both sides in any form and from any source. The sheets may not be contained in sheet protectors but they may be laminated. Each participant may bring a metric ruler, a protractor, and a non-programmable, non-graphing calculator.

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's system. The test should be divided equally, approximately 25% on each across the following topic areas:
   a. Remote sensing instrumentation and physics: active vs. passive sensors; optical and infrared imagers; radiometers; LiDAR; radar altimetry; 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 the following satellites: Atmospheric and sea-surface temperature (GOES-16, ATMS and CRiS on NPP); global mean temperature; energy flux (CERES on NPP); optical, infrared and Doppler radar imagery of clouds and precipitation (MODIS, CALIPSO, CLOUD-SAT); CO_2 cycle (OCO- 2); aerosol scattering, absorption and optical depth (MODIS); detection of trace gas concentrations by satellites (OCO-2); aerosol scattering, absorption and optical depth (MODIS); detection of trace gas concentrations by satellites (OCO-2, AURA); sea level rise and surface waves (radar altimeters, especially Topex-Poseidon, JASON-1 and Jason- 3).
   c. Climate processes and climate change: greenhouse gasses (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 and applying and interpreting the output of small- scale models of planetary energy balance.
4. SAMPLE QUESTIONS/TASKS:
   a. Use a comparison 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. 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.
   d. Interpret a pair of radar altimeter returns to look at differences in significant wave height.
5. SCORING: Team with the highest score wins. Points will be awarded for the quality and accuracy of responses. Selected questions may be used as tiebreakers.