Plans for CERES on NPP and NPOESS

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Cloud and Earth Radiant Energy System (CERES)

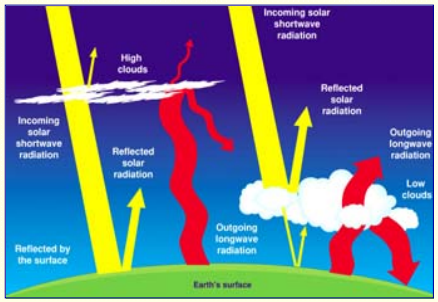
CERES measures the reflected shortwave and Earth emitted radiances. The Cloud and Earth Radiant Energy System (CERES) mission data will be provided by the Flight Model 5 instrument flying on the NPOESS Preparatory Project (NPP) and Flight Model 6 on the first National Polar-orbiting Operational Environmental Satellite System (NPOESS) satellite. The CERES measurements seek to develop and improve weather forecast and climate models prediction, to provide measurements of the space and time distribution of the Earth's Radiation Budget (ERB) components, and to develop a quantitative understanding of the links between the ERB and the properties of the atmosphere and surface that define that budget. CERES consists of three broadband radiometers that scan the earth from limb to limb. The three spectral channels cover the spectral regions of 0.3 to > 50 µm (total radiation channel), 8 µm to 12 µm (atmospheric window channel) and 0.3 µm to 5 µm (shortwave channel).

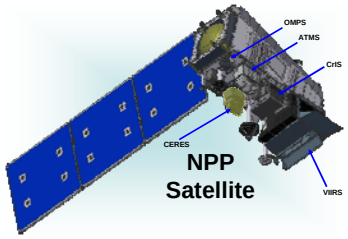
Mass, kg	57
Avg Power, W	50
Avg Data Rate, kbps	10.5

CERES on the NPOESS Preparatory Project (NPP)
- NPP is instrument risk reduction for NPOESS – planned for 2010 launch
  - Early delivery/instrument level test/system-level integration & test
  - Provides lessons learned and allows time for any required modifications before NPOESS first launch
- Continuity of data for NASA's EOS Terra/Aqua/Aura missions
- CERES FM-5 will fly on NPP
  - FM-5 was originally built for NASA's Earth Observation System
  - CERES instruments fly on NASA's Terra and Aqua missions
  - NASA Langley Research Center manages the CERES program and will lead the effort to prepare the instrument for flight
  - Northup Grumman Space Technologies built the original CERES and will do modifications on the instrument for NPP
- CERES FM-5 will continue a nearly 30-year record of Earth radiation budget measurements
  - Will operate in conjunction with the Visible/Infrared Imager/Radiometer Suite (VIIRS) on NPP to study changes to the Earth's energy balance and key changes in clouds and aerosols

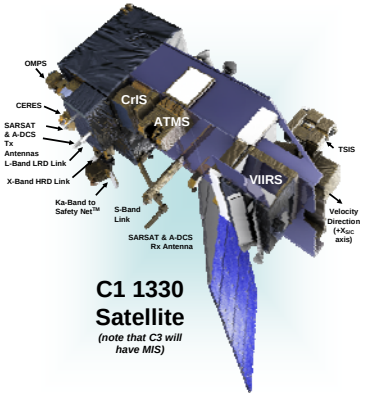
CERES on NPOESS
- Will continue Earth radiation budget measurements – planned for 2013 launch
- Northrop Grumman Space Technology (NGST) will procure CERES under the NPOESS program
- NASA Langley is part of the procurement team
  - Support sensor development, test and calibration pre-launch
  - Provide science support for algorithms, performance and Cal/Val
  - Provide ops development support, sensor loads and memory management
  - Utilize heritage LaRC CERES team for SDR to CDR processing
- NASA Langley will release all spare parts from FM5
  - Assumes ground data handling same as NPP FM5
- Joint study team determined most efficient point design is a FM "6"
  - Form, fit and function like FM5
  - Using spares left from earlier CERES builds (PC boards and long lead items)
  - One internal optics part must be built (Mirror Attenuator Mosaic)
- Additional enhancements recommended by the CERES Science Team based on operational lessons learned can be added at an extra cost
- Because FM6 is very similar to FM5, development risks are low

CERES Measures Earth's Radiant Energy Balance





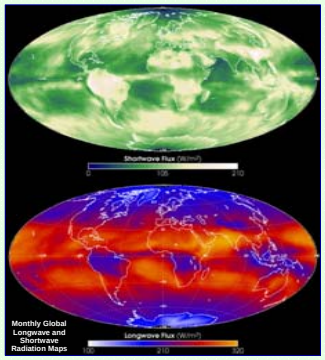
NPP Satellite



C1 1330 Satellite
(note that C3 will have MIS)

CERES Mission Objectives

- **Provides a consistent database of accurately known fields of Earth's reflected solar and Earth's emitted thermal radiation. Satisfies four NPOESS EDRs, in combination with other instruments:**
  - **Net Solar Radiation, Top of the Atmosphere**
  - **Downward Longwave Radiation at the Surface**
  - **Downward Shortwave Radiation at the Surface**
  - **Outgoing Longwave Radiation, Top of the Atmosphere**
- **The CERES EDRs are essential to understanding Earth weather & climate.**
  - **Measurement of clear sky fluxes aids in monitoring climate forcing and feedback mechanisms involving surface radiative characteristics.**
  - **These data are fundamental inputs to atmospheric and oceanic energetics.**
  - **They provide a basic input to extended range (10 day or longer) weather forecasting.**
  - **They provide a measure of the effect of clouds on the energy balance, one of the largest sources of uncertainty in our modeling of the climate.**



About This Image

These are the Terra mission's first global snapshots of the Earth's climate system composited over a one-month period. These measurements were acquired by NASA's Clouds and the Earth's Radiant Energy System (CERES) sensors during March 2000.

CERES measures the balance of solar energy received by the Earth and the energy reflected and emitted back into space. Understanding the energy coming into and out of the Earth system is critical for assessing whether scientists' models of global climate change are making accurate predictions. This pair of images is the Terra mission's first in what will be an ongoing series of such measurements of our planet's changing climate system.

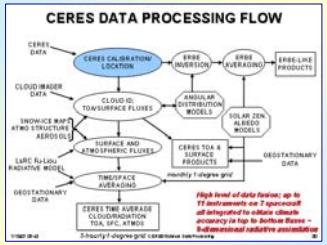
The top image shows shortwave radiation (sunlight) that is reflected back into space by our planet, averaged over the entire month. The white and tan pixels show where the Earth reflected more sunlight back into space during that month, either due to reflection by bright land surfaces such as deserts, or because of the presence of clouds. Green and bluish pixels show where less sunlight was reflected. The bottom image shows longwave radiation (heat) that is emitted by the Earth back into space. Orange and red pixels show where more heat was emitted back into space, while blue and whitish pixels show where less heat is escaping. The blue, cold, regions over Brazil, south central Africa, and Indonesian subcontinent, are due to the presence of high thick clouds in the tropical atmosphere. These same regions have enhanced shortwave reflection as a result of thick clouds, as seen in the upper image.

Courtesy, NASA LaRC CERES Project

The legacy to CERES builds on the highly successful ERBE (Earth Radiation Budget Experiment) Scanners flown on NOAA S/C CERES Sensors have flown on EOS .

ERBE Scanner circa 1984

CERES Flight Models 1999



Courtesy, NASA LaRC CERES Project

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