

**Use of First-Principle Numerical Models to Enhance the Understanding of the
Operational Analysis of Space-Based Earth Radiation Budget Instruments**

by

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(ABSTRACT)

NASA's Clouds and the Earth's Radiant Energy System (CERES) program is a key component of the Earth Observing System (EOS). The CERES Proto-Flight Model (PFM) instrument is to be launched on NASA's Tropical Rainfall Measuring Mission (TRMM) spacecraft in November, 1997. Each CERES instrument will contain three scanning thermistor bolometer radiometers to monitor the longwave, 5.0 to $>100\ \mu\text{m}$, and shortwave, 0.3 to $5.0\ \mu\text{m}$, components of the Earth's radiative energy budget.

High-level, first-principle dynamic electrothermal models of the CERES radiometric channels have been completed under NASA sponsorship. These first-principle models consist of optical, thermal and electrical modules. Optical characterization of the channels is ensured by Monte-Carlo-based ray-traces. Accurate thermal and electrical characterization is assured by transient finite-difference formulations. This body of research presents the evolution of these models by outlining their development and validation. Validation of the models is accomplished by simulating the ground calibration process of the actual instruments and verifying that the models accurately predict instrument performance. The result of this agreement is a high confidence in the model to predict other aspects of instrument performance.

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