

Landsat Radiometric Calibration: Towards a 20-Year Record of Calibrated Thematic Mapper Class Data for Carbon Cycle Studies

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The continuation of two existing efforts is proposed: (1) maintaining the radiometric calibration of the Landsat-7 ETM+ sensor by incorporating redundant vicarious calibration efforts that were previously funded as part of the Landsat-7 Science Team investigations; and (2) reconstructing the Landsat-4, 5 TM radiometric calibration records based on a combination of on-board, vicarious, and cross calibration with Landsat-7 methods. A new effort is also proposed to improve the usability of the single band of Landsat TM/ETM+ thermal data by developing an atmospheric correction routine based on generally available atmospheric data. The proposed Landsat-7 ETM+ calibration effort involves four vicarious calibration investigations: two for the reflective spectral bands of the ETM+ (by Helder and Thome), and two for the thermal band (by Palluconi and Schott). Each of these investigations predicts the radiance at the sensor aperture using a combination of ground- and/or aircraft-based reflectance, radiance or temperature measurements, coupled with measured and/or modeled atmospheric parameters. These results are then compared with the radiance predicted by the operational data processing system at the EROS Data Center (EDC). On-going investigations at NASA Goddard and EDC that are funded outside of this proposal will examine the behavior of the ETM+ instrument relative to its on-board calibration systems. These vicarious and on-board calibration results will be brought together per the radiometric calibration plan for Landsat-7 to provide the updated calibration results for the operational Landsat-7 data processing system. For the reconstruction of the Landsat-4/5 TM radiometric calibration records, a subset of the proposed investigators will: (1) analyze the radiometric calibration record of the Landsat-4/5 TM's relative to their internal calibrators; and (2) analyze historical Landsat-4/5 TM data of ground targets for which there is correlative data, or for cases where the ground data can be well estimated. Additional investigations will refine the cross calibration of the Landsat-5 TM to the Landsat-7 ETM+ based on near simultaneous data sets that were acquired early in the life of Landsat-7. The overall objective of the analysis is to provide a definitive 20+ year (1982 to end of Landsat-7 mission life) calibration record for the TM class of instruments. The goal is to understand the calibration of the reflective bands to $\pm 2\%$ for the Landsat-7 ETM+, and $\pm 5\%$ for the earlier Landsat TM's. For the thermal band, band 6, the goal is to achieve an uncertainty of $\pm 1\%$ for the Landsat-7 ETM+ instrument, and $\pm 2\%$ for Landsat-5 TM. These results will benefit any study that requires a consistent long-term record of observations of the Earth's surface, particularly attempts to characterize land cover for assessing terrestrial carbon stocks and to measure changes in the areal extent of sources and sinks of carbon. A consistently calibrated high-resolution data set is also critical for validating aquatic and terrestrial vegetation biophysical properties and vegetation indices derived from moderate resolution imaging systems, e.g., AVHRR, SeaWiFS, or MODIS.