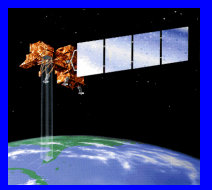
Landsat Radiometric Calibration: Towards a 20-Year Record of Calibrated Thematic Mapper Class Data for Carbon Cycle Studies

PI's:
Brian L. Markham, Dr. John L. Barker; NASA/GSFC

Co-I 's:
Dr.Dennis Helder; South Dakota State University,
Frank Palluconi; Jet Propulsion Laboratory
Dr. John Schott; Rochester Institute of Technology
Dr. Kurt Thome; University of Arizona

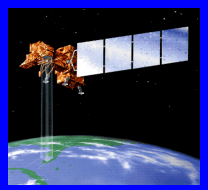
Collaborators:
Dr. Phil Teillet; Canada Center for Remote Sensing
Pat Scaramuzza; Eros Data Center
Dr. Simon Hook; Jet Propulsion Laboratory

http addresses:
http://ltpwww.gsfc.nasa.gov/IAS/handbook/handbook_htmls/chapter13/chapter13.html
http://landsat.gsfc.nasa.gov
http://Landsat7.usgs.gov/



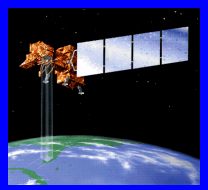
Introduction

- Questions
  - This investigation best fits under question a) what are the changes in land cover and/or land use (monitoring/mapping activities). Although the investigation is not considering land use or land cover change, it is developing techniques and parameters by which a Landsat data set can be generated that is devoid of sensor degradation effects and therefore more readily useable for detecting land use/land cover changes.
- Goals
  - Contribute to maintenance of Landsat-7 ETM+ and Landsat-5 TM radiometric calibration through vicarious calibration campaigns and regular meetings with Landsat-5/7 personnel
  - Reconstruct Landsat-5 (and 4) Thematic Mapper calibration based on analyses of on-board calibration system and historically acquired vicarious calibration data
- Approach
  - Supplement and complement USGS Image Assessment System (IAS) and NASA/GSFC Land Cover Project Science Office(LPSO) efforts
  - Conduct redundant multiple vicarious calibration campaigns for the Landsat-7 ETM+ (and Landsat-5 TM) reflective and thermal bands
  - Analyze historical internal calibrator and earth image data to reconstruct lifetime calibration records for L5 and L4 TM's
  - Share and integrate results with IAS and LPSO, updating processing algorithms and parameters to improve calibration



Results

- Most significant results
  - Improved operational calibration procedure implemented by EDC for Landsat-5 TM processing in May 2003 (SDSU)
  - Current Landsat-5 TM thermal band calibration generally consistent with vicarious calibration to ~2% (JPL, RIT)
  - Landsat-7 ETM+ stable to within 0.5%/year; calibration accurate to 5% (UAz)
  - Landsat-7 ETM+ thermal band calibration generally consistent with vicarious calibration to ~1% (JPL, RIT)
  - Thermal band atmospheric correction model implemented
- Future steps
  - Continue L5/L7 reflective and thermal band calibration campaigns
  - Complete L4 TM calibration history reconstruction/ cross calibration
  - Evaluate impact of SLC-off thermal regime change on Landsat-7 thermal band calibration
  - Resolve remaining Landsat-5 calibration issues
  - Refine/expand thermal atmospheric correction method



Conclusions

- Most important conclusions
  - L7 ETM+ continues to be well radiometrically calibrated and stable
    - Vicarious efforts contributing significantly to effort as on-board calibration systems have limitations
  - L5 TM calibration significantly improved, though some issues remain
    - Largely because L5 calibration was ignored for significant portions of its life
- Publications(selected)

  - Barsi, J.A., J.R. Schott, F.D. Palluconi, D.L. Helder, S.J. Hook, B.L. Markham, G. Chander and E.M. O'Donnell, Landsat TM and ETM+ thermal band calibration, Canadian Journal of Remote Sensing, 29: 141-153, 2003.
  - Chander, G. and B. L. Markham, Revised Landsat 5 TM radiometric calibration procedures and post-calibration dynamic ranges, IEEE Transactions on Geoscience,41,2674-2677, 2003.
  - Thome, K. J., S. F. Biggar, W. T. Wisniewski, Cross-comparison of EO-1 sensors and other Earth Resources Sensors to Landsat-7 ETM+ Using Railroad Valley Playa, IEEE Trans. On Geoscience and Remote Sensing, 41, pp. 1180-1188, 2003.
  - Teillet, P.M., D.L. Helder, T. Ruggles, R. Landry , F.J. Ahern , N.J. Higgs , J. Barsi , G. Chander , B.L. Markham , J.L. Barker, K.J. Thome , J.R. Schott , and F.D. Palluconi, A Definitive Calibration Record for the Landsat-5 Thematic Mapper Anchored to the Landsat-7 Radiometric Scale, Canadian Journal of Remote Sensing, in press
  - ~10 papers submitted to special Landsat performance issue of IEEE Trans. On Geoscience and Remote Sensing, currently scheduled for December 2004.