Thermal Instrument Concepts

presented by

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Current Scenario

- ASTER aboard Terra and the ETM+ aboard Landsat 7 currently provide moderate resolution (90 m and 60 m, respectively) thermal image data for science and applications
- No future missions currently include plans to acquire moderate resolution thermal image data
  - No current plans for an ASTER follow-on
  - LDCM Data Spec does not include requirements for thermal data
    - Thermal requirements determined to be system and cost driver for commercially operated system
  - VIIRS will acquire 750 m thermal data from NPP and NPOES satellites
- ASTER, ETM+, and VIIRS currently employ cryogenically cooled thermal detectors - cryogenic coolers increase power, mass, cost
  - Passively cooled thermal detector technology is evolving (e.g., microbolometers)
  - THEMIS aboard Mars Surveyor 2001 Orbiter currently employs microbolometers to acquire 100 m thermal images of Mars surface (PI: Phil Christensen; ASU)

Thermal Data Requirements

- Letter from Landsat Science Team to Dr. Asrar (2001) presented thermal data requirements for:
  - Quantifying surface energy and water fluxes
  - Material transport studies in aquatic systems
  - Soil moisture, canopy heat exchange, and crop health for agriculture
  - Mapping volcanic hazards
  - Urban heat island studies

- Workshop at Arizona State University, April, 2003, captured thermal data requirements for:
  - Urban studies
  - Lands surface fluxes
  - Lakes and coastal waters
  - Natural Hazards; volcanoes and glacial lakes

- Letters from University of Idaho and SEBAL North America to Dr. Asrar (April and May, 2003) described operational application of ETM+ thermal data to manage water resources, particularly irrigation rights, by the Idaho Department of Water Resources

Thermal Instrument Concepts & Status

- ASU workshop concept, a higher resolution (30 m) technology demonstration mission, had no place to go
  - Inappropriate for ESSP; no further NMP announcement planned
- JPL decided not to submit ESSP proposal for thermal mission with cryogenically cooled instrument
  - Conducted preliminary design study of a instrument affording a 30 m spatial resolution, 400 km swath, 6 TIR bands, from a 705 km altitude
- LDCM Project commissioned Instrument Synthesis and Analysis Lab (ISAL) study of microbolometer-based instrument
  - 120 m spatial resolution from 705 km altitude achievable with µbolometers
  - Cost of 2-band instrument with 185 km swath estimated at $26M
- GSFC conducted Instrument Incubator Program (IIP) study of a µbolometer-based Compact Visible and Infrared Imaging Radiometer (COVIR) in 2002; J. Spinhirne, PI
  - Intended for the observation of clouds with a 250 to 500 m resolution from LEO
  - COVIR is part of an ESSP proposal concept for Sub-mm Infrared Radiometer Ice Cloud Experiment (SIRICE)
- A µbolometer-based thermal instrument is one of many instrument concepts for a lunar reconnaissance mission

Concluding Remarks

- The future of thermal remote sensing of the Earth's land surface at moderate (circa 50 to 100 m) spatial resolution dependent on advocacy by Code YS and YO program managers

- Requirements for moderate resolution thermal data are not explicit in Road Maps
  - Some may consider the requirement implicit in the require for Landsat data continuity