Back-Up Charts
for
MCST Presentation
to the
MODIS Science Team
from
MCST (MODIS Characterization Support Team)

John L. Barker, Head
301/286-9498 or GSFCmail: JBarker
Joann M. K. Harnden
301/286-4133 or GSFCMail:JHarnden
Code 925 - Sensor Development and Characterization Branch
Steven G. Ungar
301/286-4007 or GSFCmail: SUngar
Brian L. Markham
301/286-5240 or GSFCmail: BMarkham
Code 923 - Biospheric Sciences Branch
NASA / Goddard Space Flight Center, Greenbelt, Maryland 20771
FAX: (301) 286-9200

Presented by:
John L. Barker
Contributions by
Harold Geller, Jon Burelbach, Barbara Grant, Doug Hoyt, Janie Nall
(301)286-9412 or (301)982-3700 GSFCmail:BGrant, JNall,
Research and Data Systems Corporation (RDC)
7855 Walker Drive, Greenbelt, MD, 20770
Fax: (301)286-9200 or (301)982-3749

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Attachment 1.14

Overview of MODIS/MCST & Calibration WG Report on Monday, April 13, 1992

MODIS Science Team Mtg Calib. WG Objectives
MCST Objectives, Priorities, People and Interfaces
MODIS/MCST Calibration Data Products
- Strategy
- Data Products
- Calibration Plan
- Calibration Handbook

SBRC/MCST Instrument Characterization Activities
- Instrument Delivery Schedule
- Math Model
- Proposed Calibration Scenarios

MCST Simulation Activities
MCST Bulletin Board
Open Action Items from October, 1991
- MCST
- Calibration WG

Actions Required by Calibration Working Group

MODIS/MCST & Calibration WG Appendix

MCST Interfaces

- EOS Project Science Personnel
  - EOSAM Algorithm and Facility Delivery Schedule
- SBRC MODIS Program Organization

MODIS/SBRC Instrument Information

- Cutaway and Cross Section
- In-Orbit Calibration Capability
- Instrument Concerns
- Instrument Layouts

MCST Information

- Papers and Responses
- Outline of MODIS Calibration Handbook
- Outline for MODIS Calibration/ Characterization Plan
- Completed Action Items from October, 1991
- MODIS-T Action Items Dropped by MCST
- Simulated MODIS Imagery from Landsat TM
- Key MCST Algorithm Milestones

Requested Feedback from Attendees

- MODIS/MCST Calibration Handbook and Plan

Overview of Part 1of

MCST Presentation to Land Working Group

on Tuesday, April 14, 1992

Land-Related MODIS Geometric Requirements

- MODIS Pointing Knowledge Requirement Memo
- Salomonson and Barker Georeferencing Talk
- MCST Simulated Band-to-Band Sensitivity
  - Mis-Registered Full-Scene Histograms
- MCST Simulated Scene/Pointing Sensitivity
- MODIS Pointing Knowledge Requirements
- MODIS Pointing Knowledge Goals

Back-Up Charts on Geometric Requirments

- Definitions Related to Geometric Requirements
- Error Budget from SBRC
  - Band-to-Band
  - Pointing Knowledge
- Salomonson and Barker Georeferencing Text

Overview of Part 2 of
MCST Presentation to Land Working Group
on Tuesday, April 14, 1992

Land-Related Science Team Objectives
MCST Priorities
MODIS/MCST Utility Data Products
- Texture Algorithm
  - Objectives and Approach
- Classification Overlay/Masking Algorithm
  - Objectives
  - Phased Development

MCST-Related MODIS Scene Simulation Activities
- Requirements, Properties and Approach
- Atmospheric Models
- Global Site Selection
- Simulated MODIS U. S. Land/Water Mask

Suggested MCST Land-Related WG Action

Overview of Back-up Charts
MCST Presentation to Land Working Group
on Tuesday, April 14, 1992

Geometric Requirments
- Definitions Related to Geometric Requirements
- Error Budgets from SBRC
  - Band-to-Band
  - Pointing Knowledge
- Salomonson and Barker Georeferencing Text

MODIS/MCST Utility Data Products
- Texture Algorithm
  - Comments on Development & Methodology
- Classification Overlay/Masking Algorithm
  - Scene Identification Fields and Masks

MCST-Related MODIS Scene Simulation Activities
- Procedure for Spatial Simulation of MODIS Data
- Chernobyl MODIS Results from TM Imagery
- Chugach, Alaska MODIS Results from TM

Land Science Objectives by Instrument

MCST Interfaces

MODIS Team Leader/900

MST	MODIS Science Team Members
MTT	MODIS Technical Team
MAST	MODIS Administrative Support Team
MSDST	MODIS Science Data Support Team
MCRP	MODIS Calibration Review Panel

EOS Project/420

AM Platform
- MODIS Instruments
- Non-MODIS Instruments

PM Platform
- MODIS Instruments
- Non-MODIS Instruments

EOSDIS/GSFC DAAC
- FOS/EOC (Flight Operations System / EOS Operations Center)
- DADS (Data Archive and Distribution System)

MODIS/MCST Calibration Plan

Objective

Provide a comprehensive review and integration of all methodologies
used to calibrate the MODIS instruments

Approach

Integrate calibration plans from all sources and for all phases of the mission:
pre-launch, in-orbit, and on-board
Eventually, provide an on-going structure of the methodologies used
to obtain the results in the MODIS Calibration Handbook
Include references to supporting and more detailed publications

Context

Provide an executive summary of methodologies
from both external peer reviewed articles on MODIS calibration and
internal NASA readiness review documents

Schedule

Provide up-dated versions at
MODIS Science Team Meetings, and
EOS Calibration/Validation Panel Meetings

For E-mail correspondence address GSFCmail:JBarker or BGrant.
For updates on the latest events and available documents, CHECK MCST.BB bulletin board on GSFCmail.

Outline for
MODIS Calibration/ Characterization Plan

1 Introduction
- 1.1 MCST Calibration/Characterization Plan Objectives
- 1.2 Document Overview
- 1.3 Applicable Documents
- 1.4 Overview of Instrument Design
- 1.5 Single Official Calibration Algorithm
- 1.6 Multiple Parallel Approaches
- 1.7 Mathematical Model Development
- 1.8 Comprehensive Documentation Trail

2 Pre-Launch Calibration/Characterization Methodology
- 2.1 Objectives/Rationale
- 2.2 Radiometric Calibration
- 2.2.1 Absolute Calibration
- 2.2.2 Relative Calibration
- 2.3 Geometric Characterization
- 2.4 Spectral Characterization

3 Instrument Cross-Calibration
- 3.1 Pre-Launch Cross-Calibration
- 3.1.1 Cross-Calibration Among MODIS Instruments
- 3.1.2 Cross-Calibration Between MODIS and Other Instruments
- 3.2 In-Orbit Cross-Calibration
- 3.2.1 Cross-Sensor/Within Platform
- 3.2.2 Cross-Platform/Among Sensors
- 3.2.3 Target Related/Aircraft

4 Transfer of Calibration/Characterization from Pre-Launch to In-Orbit using On-Board Calibrators
- 4.1 Objectives/Rationale
- 4.2 Radiometric Calibration
- 4.3 Geometric Characterization
- 4.4 Spectral Characterization

5 In-Orbit Radiometric Calibration/Characterization Methodology
- 5.1 Objectives/Rationale
- 5.2 Instrument-Based Calibration
  - 5.2.1 Internal Sources/Assemblies
    - 5.2.1.1 Spectroradiometric Calibration Assembly (SRCA)
    - 5.2.1.2 Blackbody
    - 5.2.1.3 Solar Diffuser Panel and Solar Diffuser Stability Monitor (SDSM)
  - 5.2.2 External Solar
  - 5.2.3 External Lunar
- 5.3 Target-Based Calibration
  - 5.3.1 Target Related/Ground Reflectance
  - 5.3.2 Bio-Optical Oceans
- 5.4 Image-Related
  - 5.4.1 External Image-Related Radiometric Rectification
  - 5.4.2 Class-Specific Scene Equalization

6 In-Orbit Geometric Characterization

7 In-Orbit Spectral Characterization

8 Official MODIS/MCST Calibration Algorithm
- 8.1 Objectives/Rationale
- 8.2 Minimization of Instrument Systematic Noise Sources
- 8.3 MCST Calibration Flow

9 MODIS/MCST Calibration Algorithm Validation and Upgrade
- 9.1 Algorithm Correction for Systematic Errors
- 9.2 Inclusion of In-Orbit Calibration Information
- 9.3 Creation of Calibration Error Images

10 Definitions and References
- 10.1 Data Dictionary/Glossary
- 10.2 Acronyms
- 10.3 Additional References

MODIS/MCST Calibration Handbook

Objective

Provide results of calibration and sufficient supporting information
to be able to scientifically use and interpret MODIS data.

Approach

Produce a stand-alone scientific user's guide containing all one needs to know
about calibration of MODIS data
throughout the lifetime of the EOS mission

Provide handbook in hard copy and electronic form,
initially from MODIS/MCST Bulletin Board, and
operationally from EOS DADS (Data Archive and Distribution System)

Provide notification of up-dated version
initially to MODIS Science Team members, and
operationally to EOS Science Office Mailing List

Include references to supporting and more detailed publications

Context

Provide an executive summary of results in this handbook
from both external peer reviewed articles on MODIS calibration and
internal NASA readiness review documents

Schedule

Provide up-dated versions at
MODIS Science Team Meetings, and
EOS Calibration/Validation Panel Meetings

MODIS/MCST Texture Utility Algorithm Objectives and Approach

Create un-resampled level-2 data products for the three MODIS spatial resolutions namely, 250, 500 and 1000 m

Three 16-Bit Texture Products

Develop spatial texture measure using 250m bands

Calculate geophysically based texture measures

perhaps standard deviation of NDVI

Three 1-Bit Texture "Pure Pixel" Masks

Label each pixel as "pure" or mixed

by thresholding of texture product

Classification Overlay/Masking Utility Algorithm Objectives and Priorities

Create un-resampled level-2 data products
as classification overlay masks
for the three MODIS spatial resolutions
namely, 250, 500 and 1000 m

The priority order for mask generation is

1. Clouds
2. Snow/Ice
   to provide the input for at-launch snow cover product
3. Water
4. Land, vegetated and non-vegetated
5. Image Terminator Line
   both observed by thresholding on imagery
   and by calculation of known Sun/Satellite positions
6. Cloud Shadows
   calculated from the cloud mask and cloud height

Classification Overlay/Masking Utility Algorithm Key Elements in Phased Developmental Approach

Pre-Launch Phase

- Level-2 Exoatmospheric Reflectance used as Input
- Texture Mask to identify Spectral Signatures from "Pure Pixels"
- Unsupervised Classification

Post-Launch Phase

- Reflectance-Based
  - after application of MODIS Atmsopheric Utility
    - Directional
    - Bidirectional
- Time-Dependent Classification Use of Prior Classifications
  - to Change A Priori Probablitites
  - to Provide Fitting Parameters for Predictive Models
- Regional Validation based on ASTER and Landsat TM Imagery
- Global Comparison to AVHRR Cover Maps

Global Calibration Site Selection Procedure

Objective

Locate potential MODIS calibration targets on the Earth's surface
that are radiometrically homogeneous on a scale of 3 by 3 Km.

Approach

Initially use annual NDVI biweekly datasets of 1 Km AVHRR data
in the continental United States in 1990
to search for radiometrically homogeneous regions
using the standard deviation of a traveling 3X3 pixel area
as a measure of heterogeneity.

Context

Use calibration sites within the MODIS imagery to provide for
1) every-pass calibration potential
using a modified "radiometric rectification" methodology,
2) aircraft under-flight calibration support, and
3) occasional support of ground field calibration experiments

Schedule

Initial results for 1990 dataset from EDC (EROS Data Center)
were reported at the Calibration Working Group session
of the April 13th MODIS Science Team Meeting

EDC Biweekly AVHRR NDVI Image for Period 6/ 8 to 6/ 21/ 90

Binary Land/ Water Mask

Key MCST Hardware Milestones

To Monitor MODIS Instrument-Level I & T

Ambient and thermal vacuum testing and calibration
about 6 months before delivery from SBRC/HAC to GE

October 1994	Engineering Model
December 1995	Prototype Model for EOS-AM1 Observatory
June 1997	Flight 1 Model for EOS-PM1 Observatory
December 1998	Flight 2 Model for EOS-AM2 Observatory

To Monitor MODIS Spacecraft-Level I & T

June 1996	Prototype Model for EOS-AM1 Observatory
December 1997	Flight 1 Model for EOS-PM1 Observatory
June 1999	Flight 2 Model for EOS-AM2 Observatory

MCST/EOC Workstation Delivery

Hardware up-grades on 3 year centers

January 1995	Prototype Model
January 1998	Operational Model 1 for EOS-AM1 EOC
June 2001	Operational Model 2 for EOS-PM1 EOC

Key MCST Software Milestones

To Monitor MODIS-N Instrument-Level I & T

October 1992	Concept Development of Engineering Model
April 1993	Code Engineering Model Software
October 1993	Test Engineering Model Software
April 1994	Deliver Engineering Model Software
June 1995	Prototype Model for EOS-AM1 Observatory
January 1997	Flight 1 Model for EOS-PM1 Observatory
June 1998	Flight 2 Model for EOS-AM2 Observatory

To Monitor MODIS-N Spacecraft-Level I & T

June 1996	Prototype Model for EOS-AM1 Observatory
December 1997	Flight 1 Model for EOS-PM1 Observatory
June 1999	Flight 2 Model for EOS-AM2 Observatory

MCST/EOC Workstation Software Delivery

Software up-grades on 1 year centers

January 1995	Prototype Model
January 1998	Operational Model 1 for EOS-AM1 ICC
June 2001	Operational Model 2 for EOS-PM1 ICC

Key MCST Algorithm Milestones

MCST Algorithm Deliveries

October 1992	Peer Review of Algorithms
January 1993	Version 0 Algorithms to MSDST
January 1994	Version 0 Algorithms for MSDST Integration
January 1994	**ECS PDR**
June 1995	Version 0 Algorithms for MSDST Test and Delivery
June 1995	Version 1 Algorithms to MSDST
January 1996	Version 1 Algorithms for MSDST Integration
June 1996	Version 1 Algorithms for MSDST Test and Delivery
June 1996	**ECS Version 1 Delivery**
October 1996	Version 2 Algorithms to MSDST
April 1997	Version 2 Algorithms for MSDST Integration
June 1997	Version 2 Algorithms for MSDST Test and Delivery
June 1997	End-to-End Software Test
June 1997	**ECS Version 2 Delivery**
January 1998	Post-Launch Algorithm Development
June 1998	**Launch of EOS-AM Platform**