MCST Presentation on Cross Track Calibration

to the

Calibration Working Group

of the

MODIS Science Team

from

MCST (MODIS Characterization Support Team

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Attachment 3.11

Overview
of
MCST Presentation to Calibration Working Group on the MODIS Cross Track Calibration

Context of the Problem

Definition of the Problem

At what level of uniform or non-uniform contamination
will the radiometry of the MODIS bands be significantly affected?

Solutions to the Problem

If there is a significant Problem, what are the alternative approaches to dealing with it?

- Instrument-Based Monitoring/Correction
- Comparisons to Aircraft-Based Observations of Common Targets
- Time Series Analysis of MODIS Imagery over the same Target
- Yawing the Spacecraft to Acquire Along-Track Imagery

Context of the Problem

At what level of uniform or non-uniform contamination
will the radiometry of the MODIS bands be significantly affected?

Assumptions

The maximum contamination of the scan mirror is 19 angstroms of carbon.
19 A of C causes an 8% loss in mirror reflectance in the 700-900 nm region.
The maximum non-uniformity in contamination is 10%, or 2 A of C.
10% variation in contaminant thickness causes a 10% change in reflectance .
Scan mirror reflectance will vary form 89% to 90% across the mirror.

If any contamination is uniform on the scan mirror,
then the current on-board calibration system will correct for it,
and therefore **uniform contamination is only significant if it sufficiently darkens the mirror to reduce the system sensitivity below the required SNR, in which case, monitoring cannot solve the problem**

Non-Uniform Scan Mirror Contamination

Critical required MODIS instrument performance specifications
In-Orbit Reflectance Calibration Accuracy of 2% Relative to the Sun
Band 14 (681 nm) Required SNR of 1087,
implies a precision requirement of 0.1 % across the entire scan

Definition of the Problem

At what level of uniform or non-uniform contamination
will the radiometry of the MODIS bands be significantly affected?

A precision requirement of 0.1 % across the entire scan
implies a need to correct for any non-uniformity
in the contamination of the scan mirror
to an accuracy of 0.1%,
which further implies a need to measure the variation
to perhaps a factor of two better,
namely to an accuracy of 0.05%.

Measurement of scan mirror contamination
must be made with sufficient accuracy
to detect non-unifomities in contamination
that would lead to a variation in its reflectance of 0.1%.

A Question Regarding Uniformity of Deposition

Assuming a spatially uniform influx of contaminants, is it necessary also to assume that the velocity of the contaminants is fast relative to the spin rate of the mirror in order to get uniform deposition on the mirror?

Potential Solutions to the Problem

If there is a significant problem,
what are the alternative approaches to dealing with it?

Time Series Analysis of MODIS Imagery over the same Target

Implied Requirements

- Image Processing
  - Geometrically Rectified Resampled Pixels
- Target Characteristics
  - Large Area
  - Homogeneous
  - Lambertian

Expected Accuracy of this Methodology

- 5 to 20%

Potential Solutions to the Problem

If there is a significant problem,
what are the alternative approaches to dealing with it?

Yawing the Spacecraft to Acquire Along-Track Imagery

Expected Accuracy of this Methodology

2 to 5%

Highly desirable for cross-calibration of bidirectional reflectance measurements with MISR