MODIS DATA STUDY TEAM PRESENTATION

May 12, 1989

AGENDA

1. Core MODIS Data Product Update
2. Revised MODIS Data Volume and Rate Estimates
3. Level-1 Processing Assumptions
4. Action Items

CORE MODIS DATA PRODUCTS

Revision A: April 14, 1989; Comments of Dr. Vince Salomonson incorporated.

Revision B: April 24, 1989; Comments of Dr. Michael King incorporated.

Revision C: May 9, 1989; Comments of Dr. Wayne Esaias incorporated.

1. INTRODUCTION

It is the intention of the MODIS science team to have in place and implemented on the Central Data Handling Facility (CDHF) at NASA/GSFC by launch of NPOP-1 a set of algorithms capable of producing a complete set of "core" MODIS data products. We define the term Core MODIS Data Product as a product that: (a) is of interest to the scientific community, particularly the members of the MODIS science team, other Eos instrument science teams, and the interdisciplinary investigations; (b) would be an important contribution towards meeting the scientific objectives of Eos; (c) can be produced using primarily, though not exclusively, MODIS data; and (d) is sufficiently well understood such that retrieval algorithms already exist or will be fully developed within the next several years using simulated MODIS data.

Standard products produced at the CDHF during the lifetime of the MODIS-N and MODIS-T instruments will consist of both the core products, which will be implemented and ready at launch, and other products which will be implemented after launch during the course of the mission. Thus, we expect that the number of standard MODIS data products will increase with time.

Special data product algorithms will also play a major role in the mission. These algorithms will reside at the various MODIS Team Member Computing Facilities (TMCFs). Many of these experimental algorithms may, in fact, also be in place (at the TMCF) at launch; however, they will generate experimental, non-standard, data products. Some of these special data product algorithms will later be implemented (months to years after launch) on the CDHF to generate the additional MODIS standard products.

This list of the core MODIS data products is being developed to fulfill several crucial requirements. First, the list will highlight the importance of the MODIS instrument (both MODIS-N and MODIS-T) when presented as a part of the upcoming nonadvocacy review. Second, the list will ensure that the MODIS instrument adequately supports the requirements of the Eos interdisciplinary investigations, many of which have very specific requirements for

MODIS data products. Third, emphasis on the processing, storage, and data requirements for these core MODIS products will provide accurate (initial) sizing estimates to be used in the specification of EosDIS components including the CDHF, DADS, and IMC.

2. RELEVANT ISSUES

The early identification of these core MODIS data products has identified some relevant issues which must be resolved before a final list of the data products, along with a complete set of their attributes, can be completed. The primary objective in resolving these issues is the identification, implementation, and generation of a set of core MODIS data products with the widest possible application and user community.

2.1 Data Product Domains

With its global and spectral coverage and relatively high spatial resolution, the MODIS instrument is a key component of the Eos. The MODIS science team is the largest of any facility instrument, and MODIS data will be used by the majority of the facility, PI, and interdisciplinary investigation teams. However, many of the MODIS science team members have proposed key data products to be produced only over very limited portions of the Earth. As core data products, it will be necessary to consider producing the MODIS products over expanded (and probably global) domains to satisfy the requirements of the general science community.

2.2 Selection of Standard Algorithms

There are a number of MODIS data products for which two or more members of the MODIS science team have proposed alternative algorithms based on somewhat different, radically different, or even unspecified (at this time) retrieval techniques. To gain wide acceptance by the general scientific community, and to be able to provide a "standard" core MODIS data product, it will be necessary for the MODIS science team to agree on a standard algorithm for each of the core products.

2.3 Compatibility with Requirements of Other Teams

At this time, certain interdisciplinary investigation and instrument teams are requesting calibrated Level-1 MODIS radiance data so that they can, in effect, generate "MODIS data products." In most and perhaps all cases, these alternative products (such as cloud coverage) replicate standard data products to be routinely produced by EosDIS for the MODIS science team. Though coordination with each of the other teams, and an understanding of the other teams' requirements with respect to timeliness, spatial resolution, algorithm compatibility, and other issues, it will be possible to reduce and perhaps eliminate these product redundancies.

2.4 Standard Grids

To optimize the utility of the MODIS data products, not only for the MODIS science team members but for other investigators as well, it is important to define a set of standard grids. These Level-3 grids should be common for many of the core products. There may be requirements to generate MODIS core products at more than one spatial resolution. In the science team members' proposals, there is a wide range of spatial resolutions with little consistency between the investigators.

Dr. Michael King has the following comment:

1. Some global data products be produced on Hammer projections of latitude and longitude, as in the ERBE data analysis displays. These global grids are equal area, thereby representing the area of the earth's ocean and land surface without distortion. The data products that go into this mapped product might be produced as averages on a 1° by 1° latitude-longitude grid.

Dr. Wayne Esaias has the following comment:

1. One standard grid for ocean data products should be a global 2,048 by 1,024 element grid, which varies linearly in latitude and longitude (0.18° per grid element). At the equator, the resolution of the grid is approximately 19.5 km. Data on this grid are easy to transform to other projections, and subsetting of the data into ASCII files is also simple.

3. TYPES OF PRODUCTS AND ALGORITHMS

The core MODIS data products and their corresponding algorithms may be allocated into six general areas: (1) Core MODIS "utility" algorithms; (2) Level-1 radiances at the top of the atmosphere and Level-2 radiances at the bottom of the atmosphere; (3) core terrestrial data products; (4) core oceanic data products; (5) core clear-sky data products; and (6) core cloud data products.

4. CORE MODIS "UTILITY" ALGORITHMS

There are a number of algorithms, over and above those required to produce the individual data products, which are essential to the reduction of the Level-0 MODIS data and the successful generation of higher-level products. These include standard: (1) calibration algorithms; (2) Earth location algorithms; (3) cloud identification algorithms; (4) atmospheric correction algorithms; (5) time and space averaging and rectifying/overlaying algorithms; and (6) display and processing algorithms.

4.1 Calibration Algorithms

Calibration algorithms will include: (1) instrument data monitoring algorithms; (2) analysis of internal calibration data; (3) analysis of instrument models; (4) comparison to in-situ and ground-truth data; (5) comparisons to other Eos and non-Eos instrument data; and (6) assignment of the MODIS calibration coefficients for production.

4.2 Earth Location Algorithms

Earth location algorithms will include: (1) navigation of the IFOV centers to the Earth geoid; (2) interpolation of the Earth locations from a sparse array of anchor points to each IFOV; and (3) a correction for surface topography.

4.3 Cloud Identification Algorithms

For the analysis and retrieval of data products at the Earth's surface, it will be necessary to identify the presence of clouds. In addition to cloud identification algorithms, it may also be necessary to delineate the cloud shadows as well.

4.4 Atmospheric Correction Algorithms

For the analysis and retrieval of data products at the Earth's surface, and particularly for oceanic products which provide only a small contribution to the total radiance signal as measured, it will be necessary to remove the atmospheric "contamination." The sources of contamination to be considered (for clear skies) include: (1) Rayleigh scattering; (2) aerosols; (3) ozone; and (4) total precipitable water.

4.5 Time and Space Averaging Algorithms

Other algorithms will be required to remove the effects of bidirectional anisotropy in the measured radiance field, limb darkening, and the dependence of albedo on solar zenith angle. In addition, standard algorithms averaging product data to standard MODIS grids may be required. It will be necessary to develop algorithms that can overlay observations taken from different viewing angles (side-to-side and fore-to-aft) with varying footprint sizes. Averaging to week, month, season, and year will be required for many Level-3 products.

4.6 Display and Processing Algorithms

Display algorithms will include land, ocean, and coastal region overlays, which can be used to extract desired data and to identify regions for a specific type of processing (e.g., generate a product at 1 km resolution for coastal regions, and 4 km for oceanic regions). Other algorithms in the category remain to be identified at this time.

5. CORE (LEVEL-1 AND LEVEL-2) RADIANCE DATA PRODUCTS

MODIS radiances will be taken over 104 different spectral bands spanning the shortwave, near-infrared, medium-infrared, and thermal-infrared spectral regions. The general science community has an interest in both the Level-1 radiances at the top of the atmosphere and the Level-2 radiances at the bottom of the atmosphere. This Eos-wide requirement for MODIS radiances is not fully known at this time, but is presumed to extend over most (if not all) of the spectral bands, include both the top and bottom of the atmosphere, and be for a range of spatial resolutions (from the instrument's IFOV to a variety of Level-3 meshes).

6. CORE TERRESTRIAL DATA PRODUCTS

The core terrestrial MODIS data products can be categorized into those which apply to all terrestrial surfaces (e.g., surface temperature or snowcover) and those which apply to the surface vegetation (e.g., vegetative index or net primary productivity). The candidate core terrestrial MODIS data products identified to date include:

6.1 Surface Emissivity

6.2 Surface Temperature

6.3 Surface Albedo

6.4 Surface Radiation Budget (SW up, SW down, LW up, and LW down)

6.5 Surface Snowcover

6.6 Normalized Difference Vegetative Index

6.7 Polarized Vegetative Index

6.8 Leaf Area Index

6.9 Absorbed Photosynthetically Active Radiation

6.10 Net Photosynthesis

6.11 Net Primary Productivity

6.12 Evapotranspiration

Following the review of these terrestrial core products with the MODIS science team leader, Dr. Vince Salomonson, the following revisions are suggested:

1. Of these candidate core products, it is likely that a surface effective blackbody temperature will be generated (the product of 6.1 and 6.2) as a core product.

2. Candidate products 6.3, 6.4, 6.8, 6.9, 6.10, 6.11, and 6.12 may not be generated as core products unless specific team members strongly advocate them.

3. Candidates 6.5, 6.6, and 6.7 are likely core products.

4. New candidate core products include:

6.13 Surface Effective Blackbody Temperature

6.14 Weekly/Seasonal Land-Cover (maps)

6.15 "Land-Leaving" Radiances (bidirectional, spectral radiance at the bottom of the atmosphere)

Dr. Michael King has the following comments:

5. 6.3 Surface Albedo - should be spectral surface albedo at best, as MODIS is not a broadband instrument like CERES.

6. 6.4 Surface Radiation Budget - estimating the longwave up and down fluxes at the surface is exceedingly difficult (because of clouds), and I would be hesitant to propose that we adopt this as a core data product.

7. CORE OCEANIC DATA PRODUCTS

The core oceanic MODIS data products can be categorized into those which are not directly related to biological activity (e.g., sea surface temperature and suspended sediment) and those which describe the biological activity (e.g., chlorophyll pigment and dissolved organic matter concentration). The candidate core oceanic MODIS data products identified to date include:

7.1 Sea Surface Temperature

7.2 Water-Leaving Radiances; Ocean Color (see Section 5 above)

7.3 Suspended Sediment Concentration

7.4 Chlorophyll Pigment Concentration

7.5 Phycoerythrin Pigment Concentration

7.6 Phycocyanin Pigment Concentration

7.7 Gelbstoffe Concentration

7.8 Detached Cocolith Concentration

7.9 Primary Productivity

7.10 Dissolved Organic Matter

7.11 Case II Waters Dissolved Marine Humus

7.12 Case II Waters Suspended Detritus

Following the review of these oceanic core products with the MODIS science team leader, Dr. Vince Salomonson, the following revisions are suggested:

1. Candidate products 7.3, 7.4, 7.5, 7.6, 7.7, 7.8, 7.9, 7.10, 7.11, and 7.12 may be generated if the team members strongly advocate them.

2. Candidates 7.1, and 7.2 are likely core products.

3. New candidate core products include:

7.13 Sea-Ice Coverage

Dr. Wayne Esaias has the following comments:

1. The number of core ocean data products that will be available at launch depends crucially on whether SeaWIFS is launched. Just as "at-launch" SeaWIFS data products will be generated using recoded Nimbus-7 CZCS algorithms, so many of the proposed MODIS core products will be generated using recoded algorithms that use the potential of the vastly more capable SeaWIFS instrument.

2. At least five water-leaving radiances are required in product 7.2; however, water-leaving radiances from most of the MODIS spectral regions will be required at the MODIS TMCFs for algorithm development work, particularly if SeaWIFS is not flown prior to the Eos. Also, more (longer) wavelengths may be required for this product for coastal regions than for the open ocean.

3. A core pigment product may replace chlorophyll and chlorophyll degradation products.

4. Product 7.4 should be renamed "Chlorophyll-A Concentration."

5. Product 7.5 should be renamed "Non Chlorophyll-A Absorptance (Gelbstoffe Concentration)."

6. Products 7.5 and 7.6 should be combined and termed "Accessory Pigments."

7. Product 7.9 will require: (1) the incident radiance integrated over the 0.40 to 0.70 micron spectral region; (2) the mixed layer depth; (3) K_{490} (new product 7.15) and K_{PAR} (new product 7.16); and (4) the sea surface temperature (7.1). The core primary productivity may be a simpler, but still desireable, version of a special product (at launch).

8. It may be possible to obtain core product 7.8 even without SeaWIFS data.

9. Products 7.1, 7.2, 7.4, 7.7, 7.8, 7.9 are definite core products, and probably 7.13.

10. Product 7.10 is the only really questionable product, even without SeaWIFS.

New candidate core products include:

7.14 Aerosol Radiances, total minus Rayleigh radiances for at least three spectral bands around 0.665, 0.765, and 0.865 microns.

7.15 K_{490}, the attenuation coefficient at 0.49 microns.

7.16 K_{PAR}, the spectrally integrated attenuation coefficient (both K_{490} and K_{PAR} are required for Primary Productivity)

7.17 Chlorophyll Fluorescence

8. CORE CLEAR-SKY DATA PRODUCTS

The core atmospheric MODIS data products can be divided into clear-sky and cloud products. The core clear-sky MODIS data products, in turn, can be categorized into those which apply to aerosols (e.g., single scattering albedo and optical depth) and those which do not apply to aerosols (e.g., degree of polarization and Rayleigh scattering). The candidate core clear-sky MODIS data products identified to date include:

8.1 Aerosol Single Scattering Albedo/Radiance

8.2 Aerosol Optical Depth

8.3 Aerosol Mass Loading

8.4 Aerosol Size Distribution

8.5 Polarization Over Oceans

8.6 Rayleigh Scattering Radiance

Following the review of these clear-sky core products with the MODIS science team leader, Dr. Vince Salomonson, the following revisions are suggested:

1. Candidate product 8.6 may not be generated as core products unless strongly advocated by a team member.

2. Candidates 8.1, 8.2, 8.3, 8.4, and 8.5 are likely core products.

3. No new candidate core products exist at this time.

Dr. Michael King has the following comments:

4. 8.1 Aerosol Single Scattering Albedo/Radiance - this is a difficult, and I believe, controversial product to produce everywhere. I propose that this be a core data product but I also realize that it may fail at some locations and be hard to validate everywhere.

5. 8.4 Aerosol Size Distribution - The size distribution describes the number of particles as a function of radius, and thus is an array for each pixel. It can best be determined by inversion of aerosol optical depth measurements as a function of wavelength from 0.4 - 1.6 micrometer in wavelength. I know that this is too complicated to do for each pixel, made even more complicated by the errors in the optical depths that will result due to uncertainties in the spectral surface albedo and single scattering albedo. This is an interesting research product that can probably be produced on some occasions, or in support of some research investigation, but should not be promised as a core data product. Perhaps an effective particle radius could be routinely estimated, as it represents some moment of the size distribution. It seems probable that a second moment such as a dimensionless effective variance can also be routinely retrieved. Perhaps these two parameters can be produced routinely and promised as core data products.

6. 8.6 Rayleigh Scattering Radiance - this can be calculated better than it can be measured, and is an ancillary piece of information in retrieving the aerosol component of the spectral reflected radiance.

7. 8.7 Number of fires, average fire size, and fire temperature - this could be a product of use in studying deforestation and environmental impact that is not

difficult to achieve and could thus be produced as a core, and I think useful, data product.

9. CORE CLOUD DATA PRODUCTS.

The candidate core MODIS cloud data products identified to date include:

9.1 Cloud Emissivity

9.2 Cloud Fractional Area

9.3 Cloud Optical Depth

9.4 Cloud Type

9.5 Cloud Area and Perimeter

9.6 Cloud Albedo/Brightness

9.7 Cloud-Water Thermodynamic Phase

9.8 Cloud-Droplet Effective Radius

9.9 Cloud-Top Pressure

9.10 Cloud-Top Temperature

9.11 Cloud-Radiative Forcing

Following the review of these cloud core products with the MODIS science team leader, Dr. Vince Salomonson, the following revisions are suggested:

1. Candidate product 9.1, 9.3, 9.4, and 9.11 may not be generated as core products unless strongly advocated by a team member.

2. Candidates 9.2, 9.5, 9.6, 9.7, 9.8, 9.9, and 9.10 are likely core products.

3. No new candidate core products exist at this time.

Dr. Michael King has the following comments:

4. 9.3 Cloud Optical Depth - this should be determined routinely for each cloudy pixel. I feel it is also extremely important, and not at all difficult, to produce a histogram of the probability distribution function for each gridded region (1 degree by 1 degree). Thus the meaning of cloud fractional area can be left to the user to define a critical cloud-no cloud optical depth

threshhold. The probability distribution function can be more useful in improving climate model simulations than most other parameters to be produced by MODIS.

5. 9.5 Cloud Area and Perimeter - statistics on cloud characteristics, such as albedo, area, and perimeter as a function of cloud size can be produced using an algorithm developed by Yoram Kaufman.

6. 9.6 Cloud Albedo/Brightness - this should be spectral albedo, not broadband albedo.

7. 9.11 Cloud-Radiative Forcing - this should be produced by the CERES team, and not the MODIS team, as this is a difference in broadband radiation budget with and without the clouds.

8. 9.1 and 9.3 should be produced as core data products.

9. 9.5 and 9.6 are questionable core data products in my mind, although statistics from 9.5 can be core products.

Dr. Wayne Esaias has the following comments:

1. The photosynthetically active incident radiance (I_0) at the ocean surface is required to compute primary productivity. I_0 will be required even on cloudy days. For this reason, products 9.2, 9.3, and 9.4 are required by the MODIS oceans scientists, and certainly products 9.3 and 9.4 are strongly advocated. Water vapor profiles (e.g., from AIRS) and haze/aerosol information may also be required.

10. ACTION ITEMS

10.1 Develop a table of core products stating proposed algorithms and proposing investigator(s). Consider mechanisms for developing trade-offs for identifying "standard" MODIS team algorithms from proposed alternatives.

10.2 Concisely list the MODIS team members (and other parties) strongly interested in the calibration of MODIS.

10.3 Provide a table relating core product, proposing investigator, and proposed grid resolutions (for the Level-3 core products).

10.4 Work with Jim Heirtzler to identify anticipated digital elevation data sets and sources for the MODIS Level-1 IFOV navigation.

10.5 Review the requirements of the Eos interdisciplinary investigations to ensure that MODIS meets them; begin discussions with the PI's for the investigations to converge to a common understanding of the role of the core MODIS data products.

Dr. Michael King has the following comments:

1. I concur with the action items, namely I would like to see a list of core data products, and algorithm, stating which investigators on the MODIS team have signed up to work on developing or implementing the different products. This summary should include a reference to published descriptions of the methodology, if available.

REVISED MODIS DATA VOLUME AND RATE ESTIMATES

ASSUMPTIONS

1. The dynamic resolution of MODIS-T, bits per sample, is 12.

2. The dynamic resolution of MODIS-N, bits per sample, is 12 for channels 1-25 and 10 for channels 26-40.

3. There are 1354 contiguous instantaneous field of views (IFOVs) per swath for MODIS-N at a 55° swath width, based on 1 IFOV = 0.081° or 0.0014 radians for a 1 km resolution.

4. There are 1591 contiguous IFOVs per swath for MODIS-N at a 55° swath width, based on 1 IFOV = 0.069° or 0.0012 radians for a 0.85 km resolution.

5. There are 1107 contiguous IFOVs per swath for MODIS-T at a 45° swath width, based on 1 IFOV = 0.081° or 0.0014 radians for a 1 km resolution.

6. All MODIS-T and MODIS-N (day) channels will be on for 50% of an orbit.

7. At night, only 15 channels will be on for MODIS-N (50% of an orbit); MODIS-T will be off.

8. The platform altitude will be 705 km.

9. The platform orbital period = 98.9 mins ($T = 2\pi(a^3/Gm)^{1/2}$.

10. The longitude between orbits is 24.73°.

11. The number of orbits per day is 14.56

12. MODIS-T # of samples per scan position = 4096 samples.

13. MODIS-N # of samples per scan position = 752 samples

    30 channels @ 8 km along track, 1 km resolution = 240 samples
    + 8 channels @ 8 km along track, 0.5 km resolution = 256 samples
    + 2 channels @ 8 km along track, 0.25 km resolution = 256 samples

14. MODIS-N (night) # of samples = 120 samples.

15. Each swath cube has physical dimensions of the following:

    2342 km x 8 (0.85 km or 1 km resolution) by number of channels for MODIS-N

    1502 km x 64 (1 km resolution) by 64 channels for MODIS-T.

16. The DHC will route selected MODIS science data to the ICC for monitoring purposes at data rates OF up to 150 Mbps, (the DHC may possibly buffer the data rate to approximately the real-time MODIS data rate).

DATA VOLUME

1. Computations of bits/swath cube.

bits/swath cube = (#scan positions/swath cube) (# sample/scan position) (bits/sample)

MODIS-T bits/swath cube = (1107)(4096)(12) = 54.41 Mb

MODIS-N bits/swath cube:

1.0 km channel (1354)(120)(12) = 1.95 Mb
1.0 km channel (1354)(120)(10) = 1.62 Mb
0.5 km channel (1354)(256)(12) = 4.16 Mb
0.25km channel (1354)(256)(12) = 4.16 Mb

TOTAL = 11.89 Mb
TOTAL w/o .25km = 7.73 Mb
TOTAL with.25km land only = 8.77 Mb

0.85 km channel (1591)(120)(12) = 2.29 Mb
0.85 km channel (1591)(120)(10) = 1.91 Mb
0.42 km channel (1591)(256((12) = 4.89 Mb
0.21 km channel (1591)(256)(12) = 4.89 Mb

TOTAL = 13.98 Mb
TOTAL w/o 0.21km = 9.09 Mb
TOTAL with 0.21km land only = 10.31 Mb

2. Computations of bits/swath cube for 4 channels

MODIS-T with 1 km resolution channels = (4/64)(54.41 Mb) = 3.4 Mb

MODIS-N (day) 1 km resolution channels = (4/30)(3.57 Mb) = 0.48 Mb

MODIS-N (night) 1 km resolution channels = (4/15)(1.62 Mb) = 0.43 Mb

MODIS-N (day) 0.85 km resolution channels = (4/30)(4.20 Mb) = 0.56 Mb

MODIS-N (night) 0.85 km resolution channels = (4/15)(1.91 Mb) = 0.51 Mb

3. Computation of total bits per orbit

A. Total for all instruments on 20 Mbps LAN, maximum.
Total = 20 mbps (98.9 mins./orbit)(60 sec/min) = 0.12 Tb

B. Total for MODIS only.

bits/orbit = (#swath cubes/orbit)(% orbit)(bits/swath cube)

MODIS-T = (626.17)(.50)(54.41 Mb) = 17.03 Gb

MODIS-N with 1., 0.5 and 0.25 km resolution channels:

All Channels (5009.38)(.50)(13.98 Mb) = 29.78 Gb
Without 0.25 km channel = 19.36 Gb
With 25% of 0.25 km channel = 21.97 Gb

Night, 1 km channels (5009.38)(.50)(1.62 Mb) = 4.06 Gb

MODIS-N with 0.85, 0.42, and 0.21km resolution channels:

All channels (5893.4)(.50)(13.98 Mb) = 41.19 Gb
Without 0.21 km channel = 26.79 Gb
With 25% of 0.21 km channel = 30.38 Gb

Night, 0.85 km channels (5893.4)(.50)(1.91) = 5.63 Gb

TOTAL T and N (1 km resolution) = 46.81 Gb
TOTAL T and N (0.85 km resolution) = 58.22 Gb

4. Computation of time to dump tape recorder (1/orbit) @ 150 Mbps

For all instruments = 0.12 Tb/150 Mbps = 791.2 secs = 13.19 Mins.
For MODIS data = 58.22 Gb/150 Mbps = 388 secs = 6.47 Mins.
For MODIS data = 46.81 Gb/150 Mbps = 275 secs = 4.58 Mins.

DATA RATES

Data Rate = (bits/orbit)/(instrument on time per orbit)

AVERAGE-ORBITAL DATA RATES (Mbps)

	1 KM	W/10% OVERHEAD	0.85KM
MODIS-T	5.74	---	---
MODIS-N (DAY W/'250' M)	10.04	11.04	13.88
MODIS-N (DAY W/O '250' M)	6.53	7.18	9.03
MODIS-N (DAY W/'250'M, LAND ONLY)	7.40	8.14	10.24
MODIS-N (NIGHT)	1.34	1.47	1.90

OTHER IMPACTS NOT INCLUDED IN ABOVE ANALYSIS

1. Impact of HIRIS on/off times during MODIS operations which may substantially decrease the amount of data collected by MODIS.

2. Impact of instrument design, mirror rotation rates for peak data rates.

LEVEL-1 PROCESSING ASSUMPTIONS

As a preliminary to the definition of MODIS Level-1 processing, several basic assumptions need to be examined because of their implications for the effort to follow. The issues examined here relate to the nature and extent of earth location processing included in Level-1 activities, the nature and quality of the input data received for MODIS processing, and redundancy and verification in instrument calibration activites.

Earth Location of MODIS Data Products

It will be assumed that MODIS Level-1 processing will include a complete and definitive location of instrument-generated pixels with respect to the earth. Level-3 activities will include the resampling of data to an earth referenced grid but will not include any activities that determine earth coordinates for individual pixels as originally observed by the instrument in the instrument-referenced observation grid. It is expected that independent earth location will not have to be applied to every MODIS pixel but that "anchor points" within the MODIS field of view can be designated for full earth location and satisfactory interpolation can be provided for pixels located between the "anchor points".

It will be assumed that pixel location uncertainties must meet stated requirements and will be on the order of or less than other uncertainties implicit in the platform and instrument design. Over land, terrain elevation corrections must be included to achieve this accuracy, and it will be assumed that these corrections are included in MODIS Level-1 processing. Although a similar height correction can be applied to cloud observations, we will not include this correction in our original Level-1 processing concept unless we are asked to.

Although the location of earth referenced "control points" from MODIS images is an activity that can improve and verify earth location activity, such activities are thought to be non-routine and not easily ammenable to software automation on the CDHF, and will not be included in the definition of "routine" Level-1 processing unless sufficient science team interest is expressed. It will be assumed that platform location (the platform state vector) is provided with all attainable accuracy from non-MODIS sources and MODIS Level-1 processing will not include any activities relating to the determination or refinement of platform locations or orientations. MODIS earth location activities will include all position determinations and refinements relating to the properties and characteristics of the MODIS instrument, its mounting on the orbiting platform, and apparent shifts in object positions associated with atmospheric refraction.

Input data assumptions

For purposes of the Level-1 processing design, it will be assumed that data returned by the MODIS instrument will require extensive quality verification. Data obtained from orbital databases, the MODIS or one of the other Eos DADS, or other internal sources should be verified in the original production facility; it will be assumed that data from internal sources requires only moderate (or perhaps little or no) verification as a part of MODIS processing.

It will be assumed that MODIS instrument data will not be returned from the instument in data packets suitably formatted for MODIS processing and storage. Packet reformatting to suitable EosDIS standards will be provided.

Calibration - Redundancy and Verification

It will be assumed that the MODIS instrument calibration provided at the CDHF is sufficiently accurate for all routine requirements. Large volumes of raw instrument data will not be routinely provided to any team member not directly associated with the Instrument Characterization Team (ICT). All routine instrument calibration activities will be handled by the ICT using their own computing facilities and those available at the CDHF. Other team members having special requirements involving limited data sets may wish to engage in independent instrument-calibration verification. Such activities will be supported so long as the data sets involved are small and data support requirements are not routine.

MODIS DATA SYSTEM STUDY TEAM

ACTION ITEM

Title (Subject) UARS Data System Lessons

Assigned to Dr. Daesoo Han Organization/Phone No. Code 636/286-9414

Action Item Identifier 5/5-1 Data Assigned 5/5/89 Date Due ______

Action Item Description:

Make initial contacts with Paul Hwang or Skip Reber to obtain materials on the UARS data system. Distribute materials, arrange meeting(s), or make other provisions so that the MODIS Data Study Team (or selected representatives) can understand the UARS data system and benefit from "lessons learned" during development of that system.

Action Item Response:

MODIS DATA SYSTEM STUDY TEAM

ACTION ITEM

Title (Subject) Review of the Data Acquisition and Processing Scenario Document

Assigned to Dr. Vince Salomonson Organization/Phone No. Code 600/286-8601

Action Item Identifier 5/5-2 Data Assigned 5/5/89 Date Due ________

Action Item Description:

Review the latest revision of the Data Acquisition and Processing Scenario Document and provide comments.

Action Item Response:

MODIS DATA SYSTEM STUDY TEAM

ACTION ITEM

Title (Subject) MODIS Core Data Products

Assigned to Dr. Philip Ardanuy Organization/Phone No. RDS/982-3714

Action Item Identifier 5/5-3 Data Assigned 5/5/89 Date Due 5/25/89

Action Item Description:

Revise the MODIS Core Data Product list in accordance with the recommendations made by Drs. Salomonson, King, Esaias, and Justice. Issue a revised chart illustrating the core data products and the related data flows.

Action Item Response:

MODIS DATA SYSTEM STUDY TEAM

ACTION ITEM STATUS

Action Item Identifier	Action Item Name	Responsible Organization/Person	Date Due	Date Assigned	Comments
5/5-1	UARS Data System Lessons	Dr. Daesoo Han/Code 636		5/5/89	
5/5-2	Review of the Data Acquisition & Processing Scenario Document	Dr. Vince Salomonson/Code 600		5/5/89	
5/5-3	MODIS Core Data Products	Dr. Philip Ardanuy	5/25/89	5/5/89	