MODIS DATA STUDY TEAM PRESENTATION

December 14, 1990

AGENDA

1. Action Items
2. Earth Shape Models for MODIS Level-1B Geolocation
3. TLCF Primary Functions: A Discussion Platform

ACTION ITEMS:

10/19/90 [Al McKay and Lloyd Carpenter]: Expand introductory material in Earth Model write-up to include broad discussion of MODIS geolocation and need for Earth model. Coordinate with Al Fleig to distribute report. STATUS: Open.

10/26/90 [Al McKay and Lloyd Carpenter]: Scope a brief error analysis and impact study on the merits of a geoid model as opposed to an ellipsoid. STATUS: Report in this week's handout. Open.

11/16/90 [Doug Hoyt]: Review MODIS Level-1 data flow diagrams and identify data items potentially provided by the MCST. Provide a list of instrument parameters required to Earth locate MODIS pixels (e.g. detector locations, electronic delays, mirror rotations, etc). STATUS: Presently available information insufficient to address item. Report due approximately one year from the assignment date. Open.

11/16/90 [Tom Goff and Al McKay]: Review the preliminary version (28 September 1990) of "Standards and Guidelines for Science Data Processing Software" and provide a list of questions and comments. STATUS: Report presented at 11/30/90 meeting. Closed.

11/30/90 [Team]: Develop a Software Validation Plan for MODIS. STATUS: Delivered to D. Han 12/4/90. Revised 12/5/90. Awaiting further revision.

12/7/90 [Watson Gregg]: Combine results of the anchor-point/interpolation accuracy studies presented on 11/30/90 and 12/7/90 into a single report and distribute to MODIS Science Team Members. STATUS: Delivered 12/14/90 for distribution. Open.

12/7/90 [Daesoo Han]: Arrange a meeting with appropriate EOSDIS civil service personnel to discuss data processing services to be provided on each side of the EOSDIS/MODIS interface and to set up communications structures to periodically review the needs and expectations of system developers working both sides of the interface. STATUS: Open.

Earth Shape Models for MODIS Level-1B Geolocation

The choice of an Earth model for use in geolocation of data from MODIS and other EOS instruments comes at distinct levels, corresponding to incremental improvements in accuracy.

The maximum deviation of the reference ellipsoid from the mean sphere of the Earth is of the order of 10 kilometers.

The maximum deviation of an accurate geoid (corrected for the rotation of the Earth) from the reference ellipsoid is approximately 100 meters. This geoid models the mean sea surface accurately, leaving effects due to tides, currents, etc. The standard deviation of these remaining effects is approximately 2 meters in the open oceans, and somewhat more in some coastal areas.

On the other hand, the maximum deviation of the Earth's land surface from any of these reference surfaces is several kilometers.

Over ocean areas, the geolocation of MODIS data can be determined in a straightforward manner with sufficient accuracy using the geoid. (In some cases the errors in the computed latitude and longitude will be magnified somewhat over the height errors because of the oblique angle of the observations.) The computational resources required will depend upon the required accuracy, the form of the geoid representation, and the efficiency of the algorithm. Proper selection of the degree and order for truncation of the spherical harmonic series will give the required accuracy without unnecessary additional computation. Recursive evaluation of the Legendre functions, and the use of multiple angle formulas for evaluating trigonometric functions, or alternative methods, can greatly improve the computing efficiency. An analysis of the required number of floating-point operations will provide a basis for estimating the impact of including the geoid in the model.

Over land areas the geolocation of MODIS data will require a much more detailed digital elevation model for improved accuracy. Variations in the land surface height above mean sea level (the geoid) are much greater in most areas than the variations in geoid height above the ellipsoid.

In the absence of a universally accepted Digital Elevation Model (DEM) for land areas, MODIS Level-1B processing may not, initially at least, account for specific terrestrial features. Instead, MODIS Level-1B Earth locations may be obtained with respect to an idealized, smooth Earth model that could serve as a reference to individual Earth investigators who, if needed, may apply their own individually derived terrestrial corrections in their regions of research interest.

Besides the MODIS investigators directly affected by the Earth model decision, the Earth model used could also affect other instrument and interdisciplinary investigators who access MODIS Level-1B and Level-2 data products. Similarly, the Earth model used to process EOS data for non-MODIS instruments may affect MODIS investigators who access this data and may need to achieve co-registration of MODIS and non-MODIS data fields.

Since the platform position will probably be specified in Cartesian coordinates and not as Earth coordinates (latitude and longitude) of the sub-satellite point[1] (which would depend on the particular Earth model used to determine the sub-satellite point), platform position as used in MODIS processing is not referenced to any particular Earth model, and the Earth model used in MODIS processing can be chosen independently of any Earth model that might be used in platform location. Specifically, it is expected that GPS will provide Cartesian platform coordinates and not an Earth-referenced sub-satellite point[2].

The differences in computed Earth location for the ellipsoid and geoid models depend on the satellite zenith angle for the observation in question. Assuming the absolute worst configuration (maximum Earth model discrepancy coincident with maximum MODIS scan angle), the offsets between ellipsoid and geoid referenced pixels are listed in Table 1.

Table 1

Maximum Offsets between Ellipsoid and Geoid Referenced Pixels

Instrument Configuration			Offset
MODIS-N	55° scan		228 m
MODIS-T	45° scan	0° tilt	132 m
MODIS-T	45° scan	50° tilt	740 m

[1] Personal communication, Dave Folta

[2] Personal communication, Dave Folta

TEAM LEADER COMPUTING FACILITY (TLCF)
PRIMARY FUNCTIONS:
DISCUSSION PLATFORM

Assumption: Algorithm development/validation effort at the University of Miami is part of the TLCF.

PRE-LAUNCH

I. Algorithm Development
   A. Team Leader's Level-2,3 algorithms
   B. All Level-1 algorithms (except perhaps calibration)
   C. Level-3 algorithms
   D. Team Members' Level-2 algorithms as requested
   E. Utility algorithms

II. Validation
   A. Team Leader's Level-2,3 algorithms
   B. All Level-1 algorithms (except perhaps calibration)
   C. Level-3 algorithms
   D. Team Members' Level-2 algorithms as requested
   E. Utility algorithms
   F. All software

III. Central Node for TMCF Network
   A. Communications
   B. Data/algorithm/software distribution

IV. Integration and Testing
   A. All software

V. ECS PGS Prototype for MODIS Data Processing

VI. Interface to ECS DADS/PGS/ATIS
   A. Facilitate transition of software/system to ECS

VII. Complete End-to-End Data system for Wildfire Data; build complete, working data system that will serve as a prototype for MODIS
   A. PGS functions, including
      1. Scheduling, control, and accounting
      2. Product generation
      3. Algorithm test and integration
      4. Product management
   B. DADS functions
   C. IMS functions

POST-LAUNCH

I. New Algorithm Development
   A. Team Leader's Level-2,3 algorithms
   B. All Level-1 algorithms (except perhaps calibration)
   C. Level-3 algorithms
   D. Team Members' Level-2 algorithms as requested
   E. Utility algorithms

II. Validation
   A. Team Leader's Level-2,3 algorithms
   B. All Level-1 algorithms (except perhaps calibration)
   C. Level-3 algorithms
   D. Team Members' Level-2 algorithms as requested
   E. Utility algorithms
   F. All software

III. Central Node for Team Member Computing Facility (TMCF) Network
   A. Communications
   B. Data/algorithm/software distribution

IV. Integration and Testing
   A. All software

V. Interface to ECS DADS/PGS/ATIS
   A. Facilitate transition of software/system to ECS
   B. Advisory role to ECS

ACRONYMS

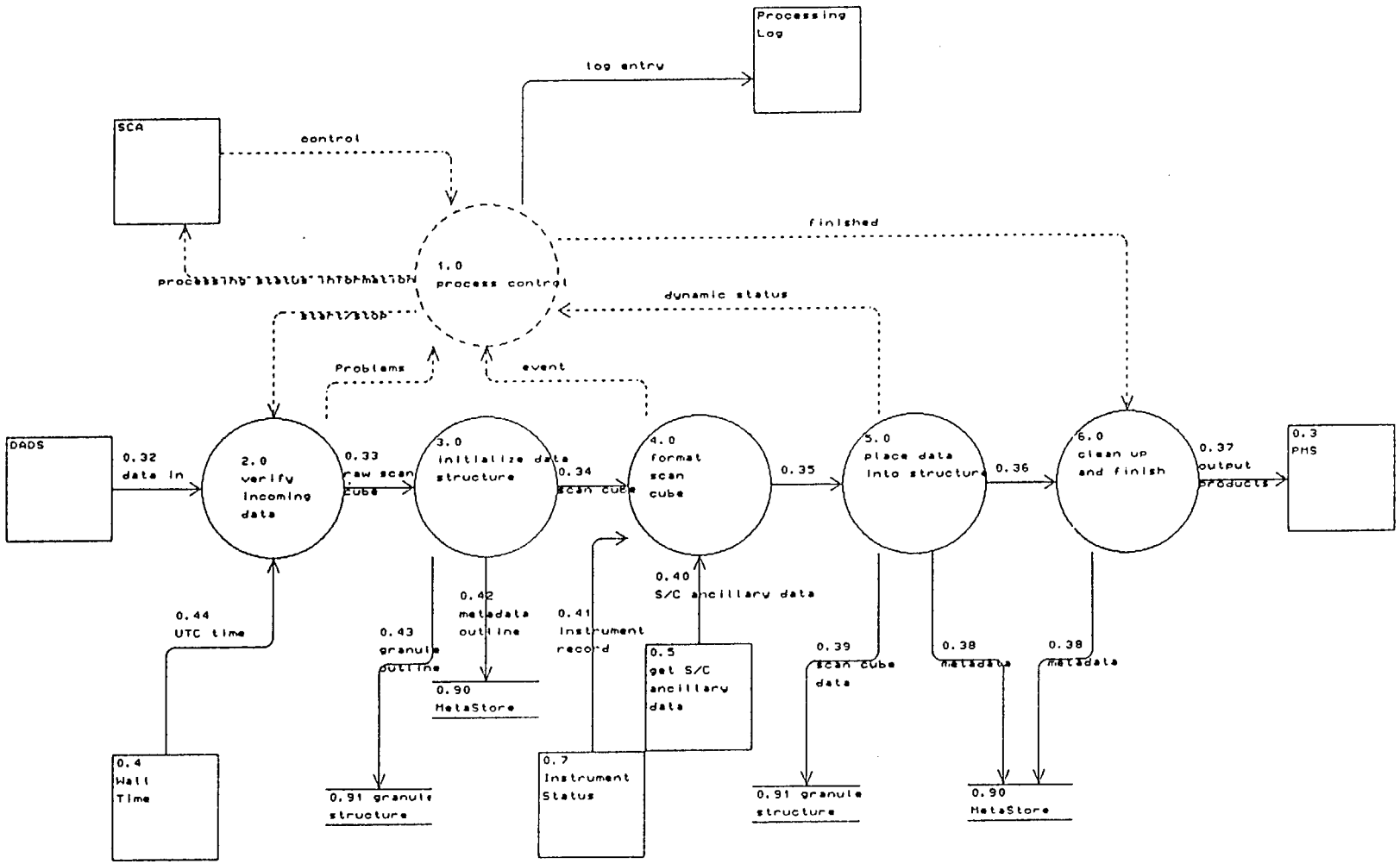
ATIS = Algorithm Testing and Integration Service
DADS = Data Archive and Distribution System
ECS = EOSDIS Core System
EOSDIS = Earth Observing System Data and Information Service
IMS = Information Management Service
MODIS = Moderate Resolution Imaging Spectrometer
PGS = Product Generation Service
TLCF = (MODIS) Team Leader Computing Facility
TMCF = (MODIS) Team Member Computing Facility

APPENDIX TO

MODIS DATA STUDY TEAM PRESENTATION

DECEMBER 14, 1990

Project : \ECPLUS\MODIS\
Chart : l1a0
Filename : l1a0.trg
Last Modified : 12-13-1998



oj : \ECPLUS\MODIS\

:ta Dictionary Entry Description Attribute Report for Object Type = All
- indicates deleted DDE)

)bject Identifier	Object Type	Description Attribute
).10	Control Flow	messages that inform the process which mode to operate in, to start, to suspend, to resume, to return status (dynamically or statically), and to request and verify the staging and/or destaging of data to/from the DADS
).11	Control Flow	information regarding the fault conditions and processing performance of the data processing system. Status or completion infromation from the MODIS process to the SCA.
).12	Control Flow	Starts the process with initialization parameters, panic stop executing.
).13	Control Flow	signals an end of data input, signals bad or inappropriate data, requests an alarm generation.
).14	Control Flow	Anomaly in instrument status between instrument record log and telemetered data.
).	Control Flow	Two way dialog asking for current dynamic status and returning this status information.
).16	Control Flow	Request graceful termination (post data), granule is filled up, terminate.
1.0	Control Transform	Handles the control functions of the processor
).31	Data Flow	A record to be posted in the processing log
).32	Data Flow	Level-0 data or quick look data.
).33	Data Flow	Packet data that has been placed into a cube type record containing across track pixels on the x-axis, along track pixels in the y-axis, and wavelength on the z-axis.
0.34	Data Flow	Cube of scan oriented data formatted to the data product specification.
).35	Data Flow	
0.36	Data Flow	
0.37	Data Flow	
0.38	Data Flow	
0.39	Data Flow	
0.40	Data Flow	
0.41	Data Flow	
0.42	Data Flow	
0.	Data Flow	
0.44	Data Flow	
2.0	Data Process	perform sanity checks on the raw packets
3.0	Data Process	setup the memory areas for the output products
4.0	Data Process	checks instrument status indicators,

		appends S/C platform ephemeris and attitude, updates packet accounting, optionally byte aligns data
.0	Data Process	determine proper location within the 1A data structure for this piece of data
.0	Data Process	perform final accounting, deallocate memory
.90	Data Store	
.91	Data Store	
.1	External Entity	Schedule, Control, Accounting
.2	External Entity	Data Archive and Distribution System
.3	External Entity	product management system - performs data management of processed data, adds further DQ info
.4	External Entity	
.5	External Entity	
.6	External Entity	Log of processing status records, time sequential events.
.7	External Entity	
.1a0	trg	

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37 Data Dictionary Entries Printed.

oject : \ECPLUS\MODIS\

E Attributes Report for Objects on TRG Chart File : l1a0.trg

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oject Name (ID): 0.2
oject Type : External Entity
oject Sub-Type :
oject Label : DADS
oject Explodes To, Type : Name :
oject Alias :
iscellaneous 1 :
iscellaneous 2 :
oject Definition :
oject Description : Data Archive and Distribution System

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oject Name (ID): 0.1
oject Type : External Entity
oject Sub-Type :
oject Label : SCA
oject Explodes To, Type : Name :
oject Alias :
iscellaneous 1 :
iscellaneous 2 :
oject Definition :
oject Description : Schedule, Control, Accounting

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oj(ame (ID): 0.4
oject Type : External Entity
oject Sub-Type :
oject Label : 0.4 Wall Time
oject Explodes To, Type : Name :
oject Alias :
iscellaneous 1 :
iscellaneous 2 :
oject Definition :
oject Description :

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oject Name (ID): 2.0
oject Type : Data Process
oject Sub-Type :
oject Label : 2.0 verify incoming data
oject Explodes To, Type : Name :
oject Alias :
iscellaneous 1 :
iscellaneous 2 :
oject Definition :
oject Description : perform sanity checks on the raw packets

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oject Name (ID): 0.91
oject Type : Data Store
oject Sub-Type :
oje abel : 0.91 granule structure
oje(xplodes To, Type : Name :
oject Alias :
iscellaneous 1 :
iscellaneous 2 :
oject Definition :

Object Description :

Object Name (ID): 1.0
Object Type : Control Transform
Object Sub-Type :
Object Label : 1.0 process control
Object Explodes To, Type : Name :
Object Alias :
Miscellaneous 1 :
Miscellaneous 2 :
Object Definition :
Object Description : Handles the control functions of the processor

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Object Name (ID): 3.0
Object Type : Data Process
Object Sub-Type :
Object Label : 3.0 initialize data structure
Object Explodes To, Type : Name :
Object Alias :
Miscellaneous 1 :
Miscellaneous 2 :
Object Definition :
Object Description : setup the memory areas for the output products

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Object Name (ID): 0.90
Object Type : Data Store
Object Sub-Type :
Object Label : 0.90 MetaStore
Object Explodes To, Type : Name :
Object Alias :
Miscellaneous 1 :
Miscellaneous 2 :
Object Definition :
Object Description :

Object Name (ID): 0.7
Object Type : External Entity
Object Sub-Type :
Object Label : 0.7 Instrument Status
Object Explodes To, Type : Name :
Object Alias :
Miscellaneous 1 :
Miscellaneous 2 :
Object Definition :
Object Description :

Object Name (ID): 4.0
Object Type : Data Process
Object Sub-Type :
Object Label : 4.0 format scan cube
Object Explodes To, Type : Name :
Object Alias :
Miscellaneous 1 :
Miscellaneous 2 :
Object Definition :
Object Description : checks instrument status indicators, appends S/C platform ephemeris and attitude, updates packet accounting, optionally byte aligns data