

# **MODIS DATA STUDY TEAM PRESENTATION**

**August 24, 1990**

## **AGENDA**

1. MODIS Requirements for Platform Ancillary Data (McKay, Blaisdell)
2. MODIS Level-1 Context and Data Flow Diagrams (Preliminary) (Study Team)
  - Data Dictionary (Rough)
  - Interface Control Table (Rough)
3. Reprocessing Conditions and Data Flows in Level-1 (Riggs)

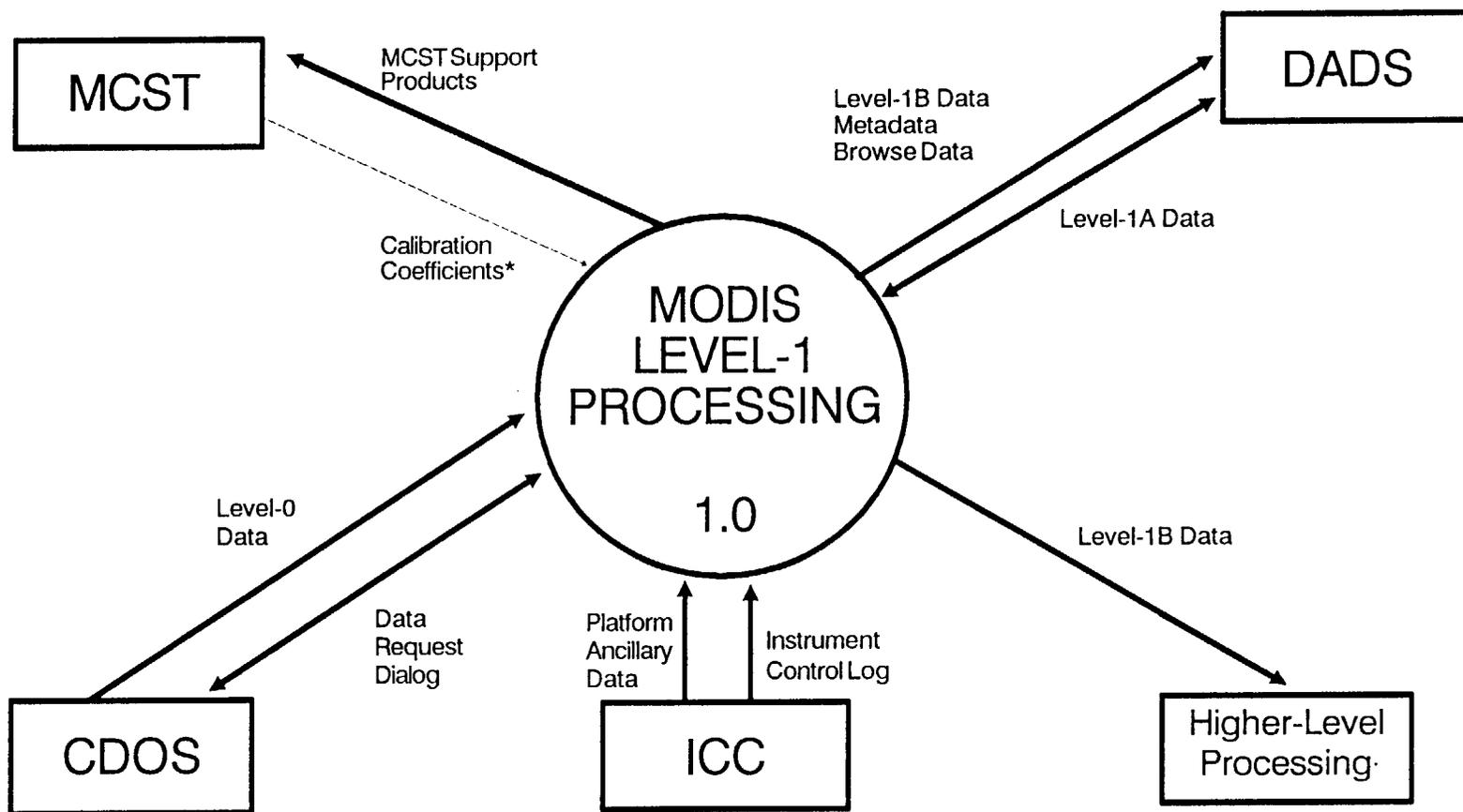
August 22, 1990

PLATFORM ANCILLARY DATA REQUIRED FOR MODIS DATA SYSTEM					
Data Item	Available Resolution	Required Resolution	Range	Bits Required	Bits Proposed <sup>1</sup>
Platform Position	TBS	1 m	$\pm 8000$ km		
X in GCI				24	32
Y in GCI				24	32
Z in GCI				24	32
Platform Velocity	TBS	0.1 m/sec	$\pm 10$ km/sec		
X-dot				18	32
Y-dot				18	32
Z-dot				18	32
Platform Attitude	0.05 arcsec	5 arcsec	TBD		
Pitch				18 (if 360° range)	12
Roll				18	12
Yaw				18	12
Times	$\sim 1 \mu\text{sec}$	0.1 msec	Mission length	64 more than adequate <sup>2</sup>	64
GPS to UTC Time Conversion		As needed to meet 0.1 msec requirement			
Solar array "currents"	TBD	0.1 W/m <sup>2</sup>	0 to 1600 W/m <sup>2</sup>	14	8

<sup>1</sup>General Instrument Interface Specification for the EOS Observatory, GE Astro Space [DRAFT], 15 January 1990.

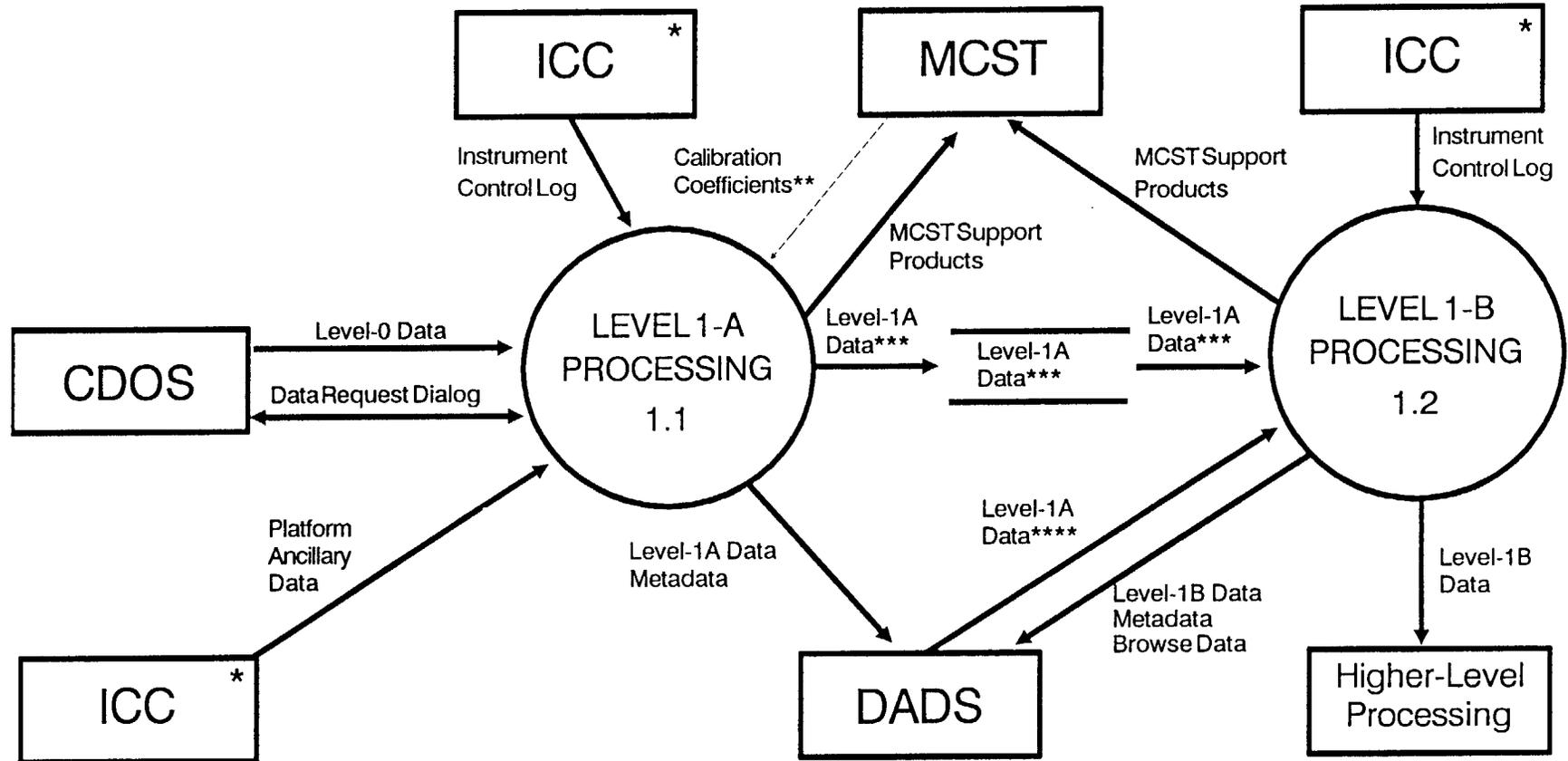
<sup>2</sup>Assuming count in seconds since launch, CCSDS formats may require more bits.

# MODIS LEVEL-1 PROCESSING CONTEXT DIAGRAM



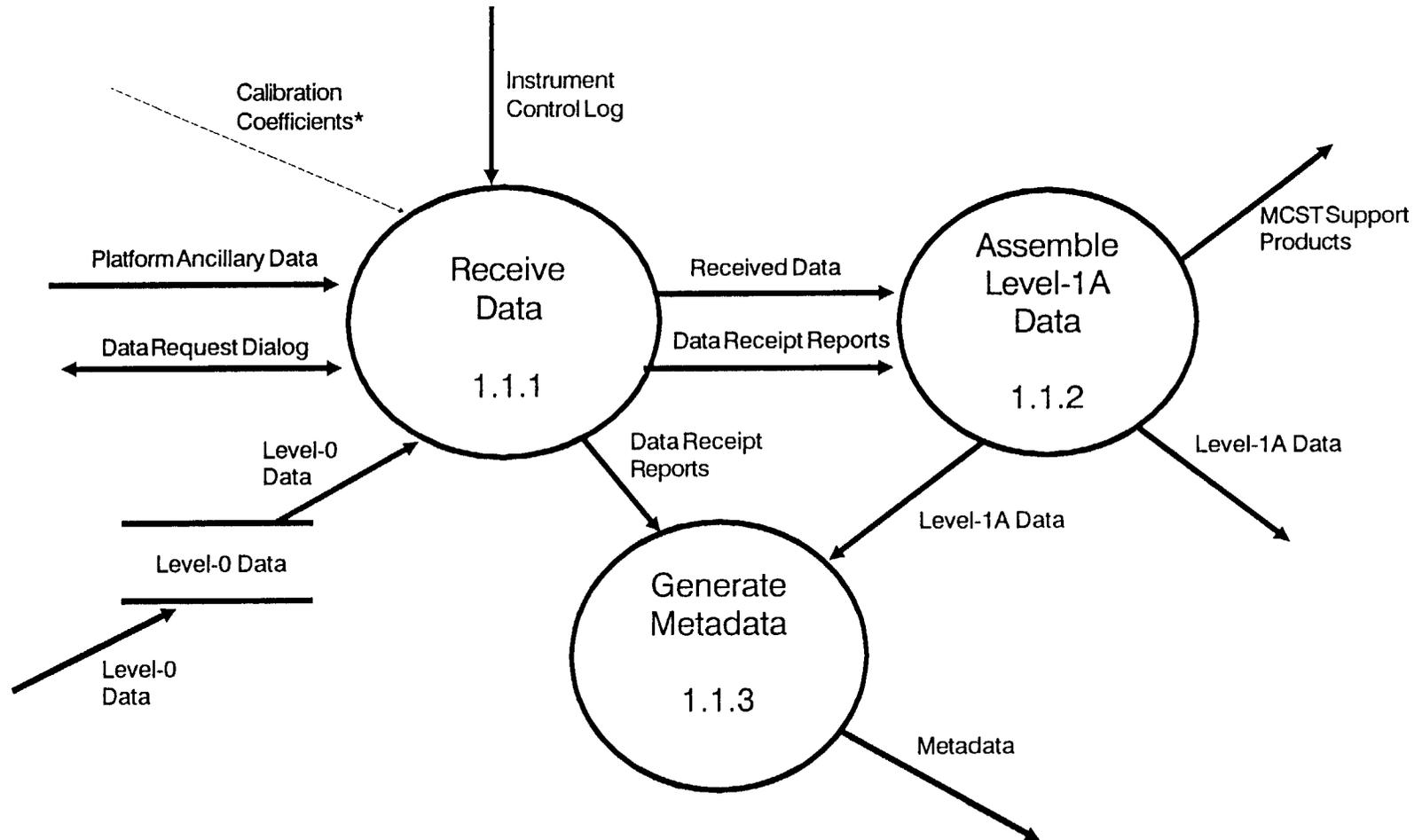
\*No present requirement; issue under discussion.

# MODIS LEVEL-1 PROCESSING DATA FLOW DIAGRAM (FUNCTION 1.0)



\*A single asterisk indicates that an item has been repeated on the same diagram. Items are repeated for readability.  
 \*\*No present requirement; issue under discussion.  
 \*\*\*Following Level-1A (re)processing only.  
 \*\*\*\*Reprocessing Level-1B (and higher) only.

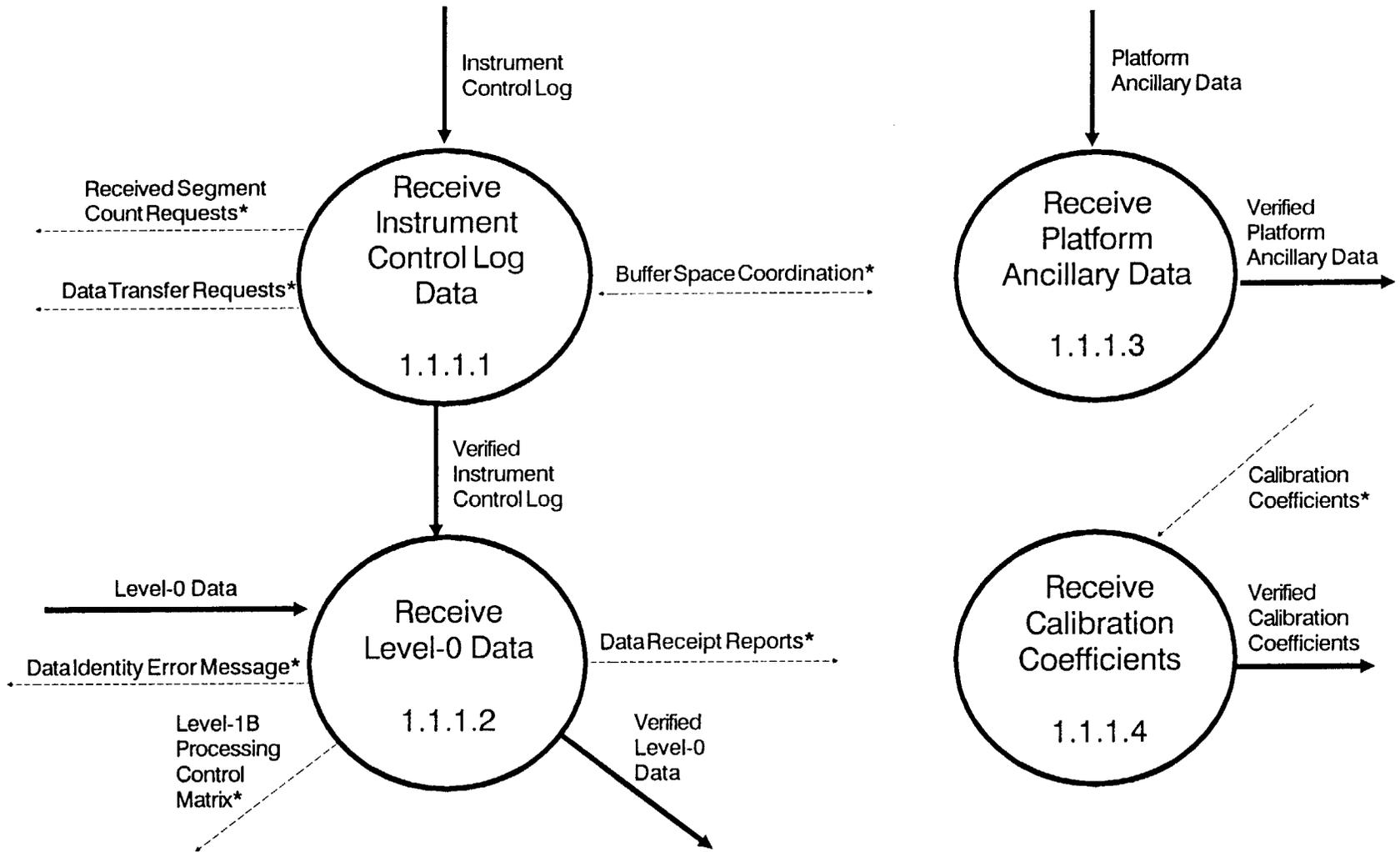
# MODIS LEVEL-1A PROCESSING DATA FLOW DIAGRAM (FUNCTION 1.1)



\*No present requirement; issue under discussion.

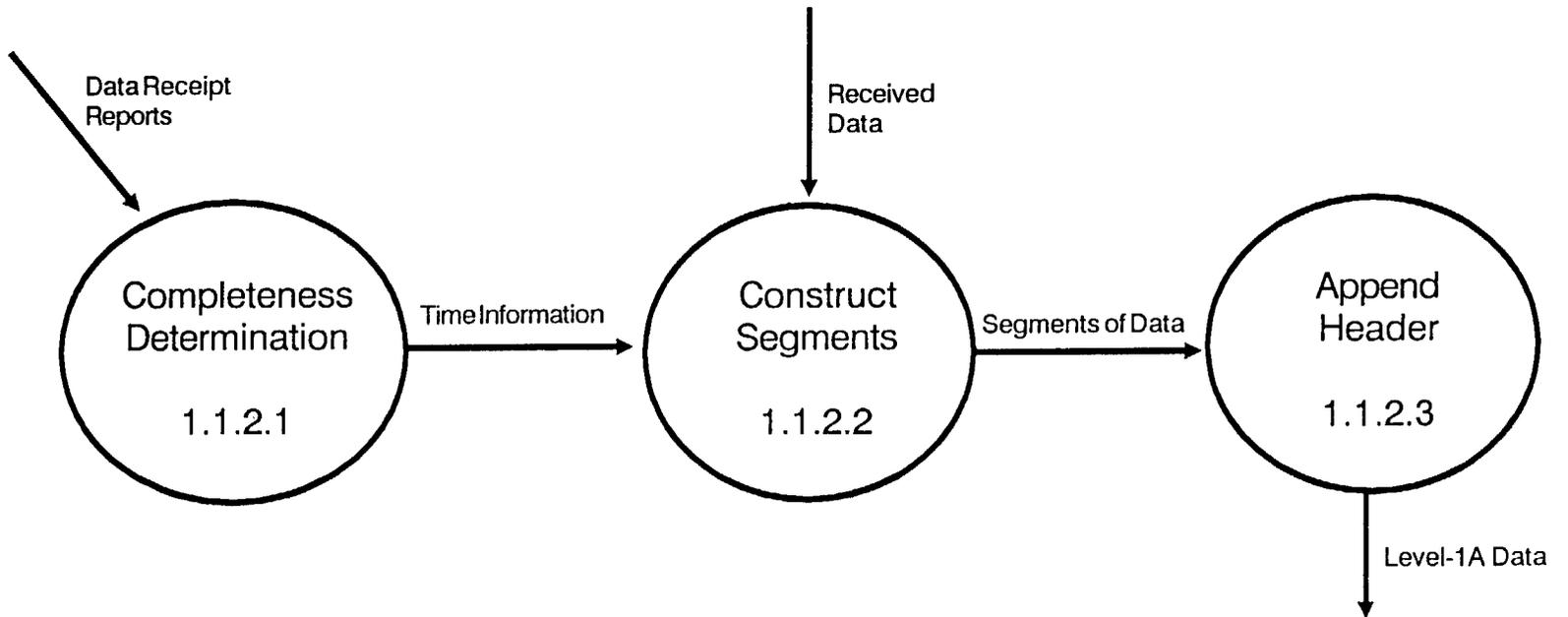
# RECEIVE DATA

## DATA FLOW DIAGRAM (FUNCTION 1.1.1)

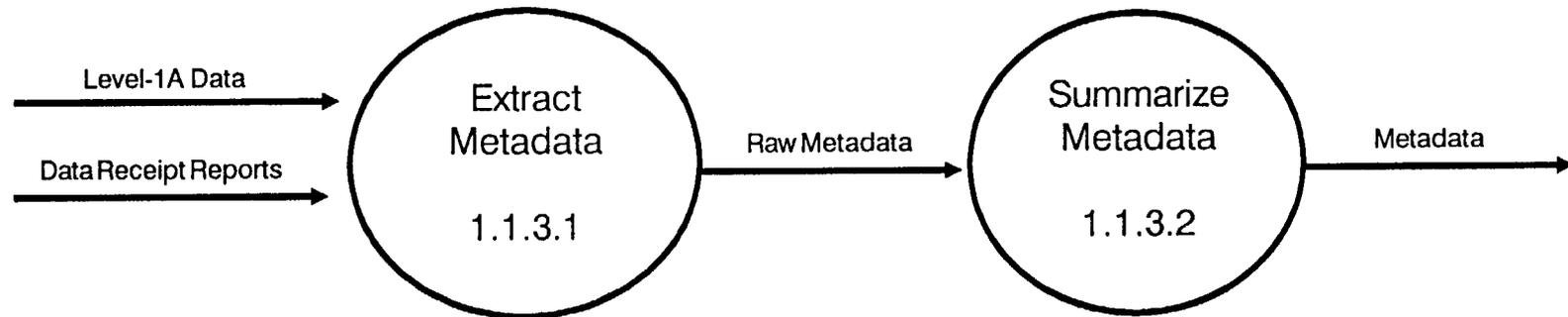


\*No present requirement; issue under discussion.

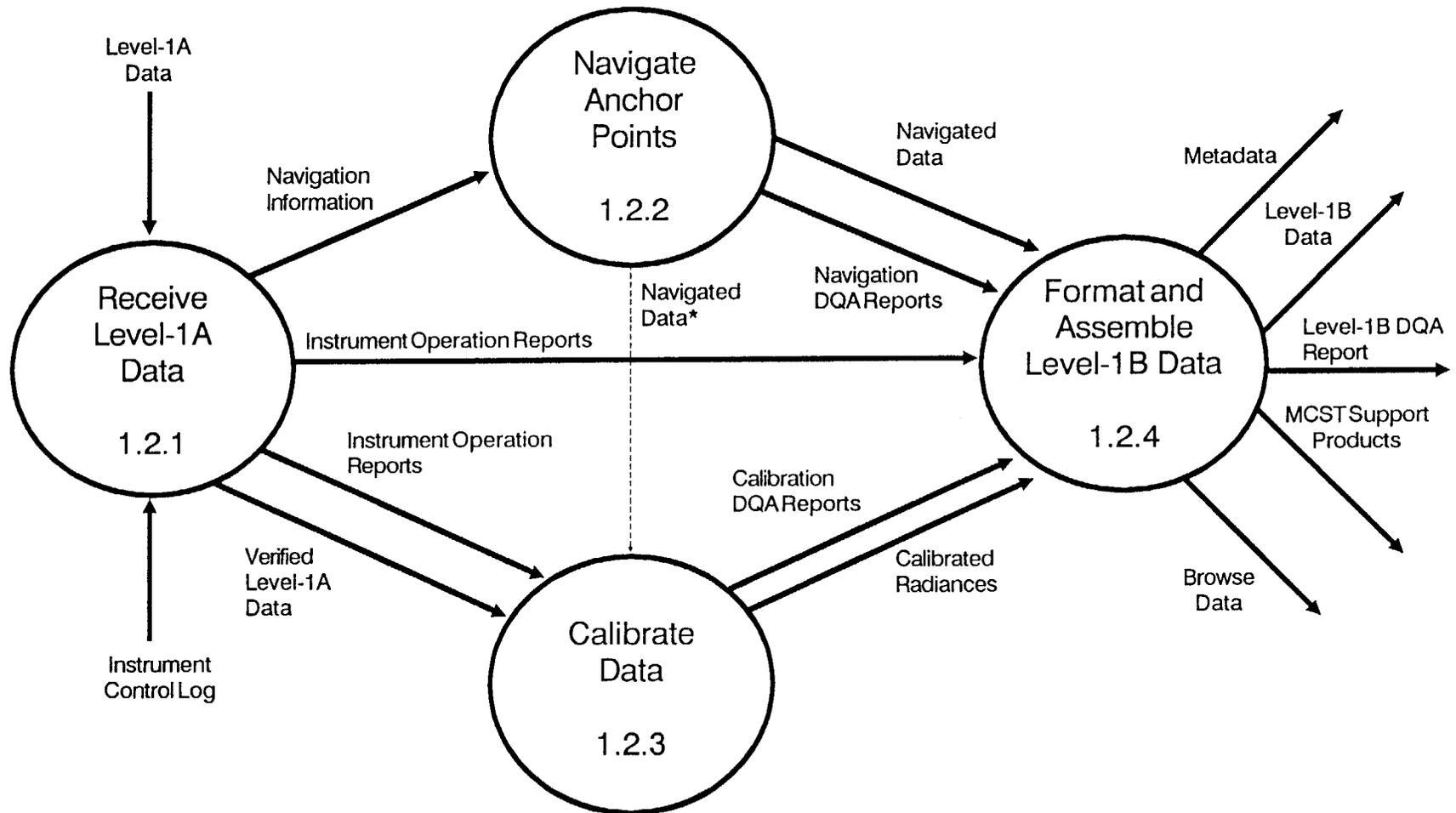
ASSEMBLE DATA  
DATAFLOW DIAGRAM (FUNCTION 1.1.2)



GENERATE LEVEL-1A METADATA  
DATA FLOW DIAGRAM (FUNCTION 1.1.3)

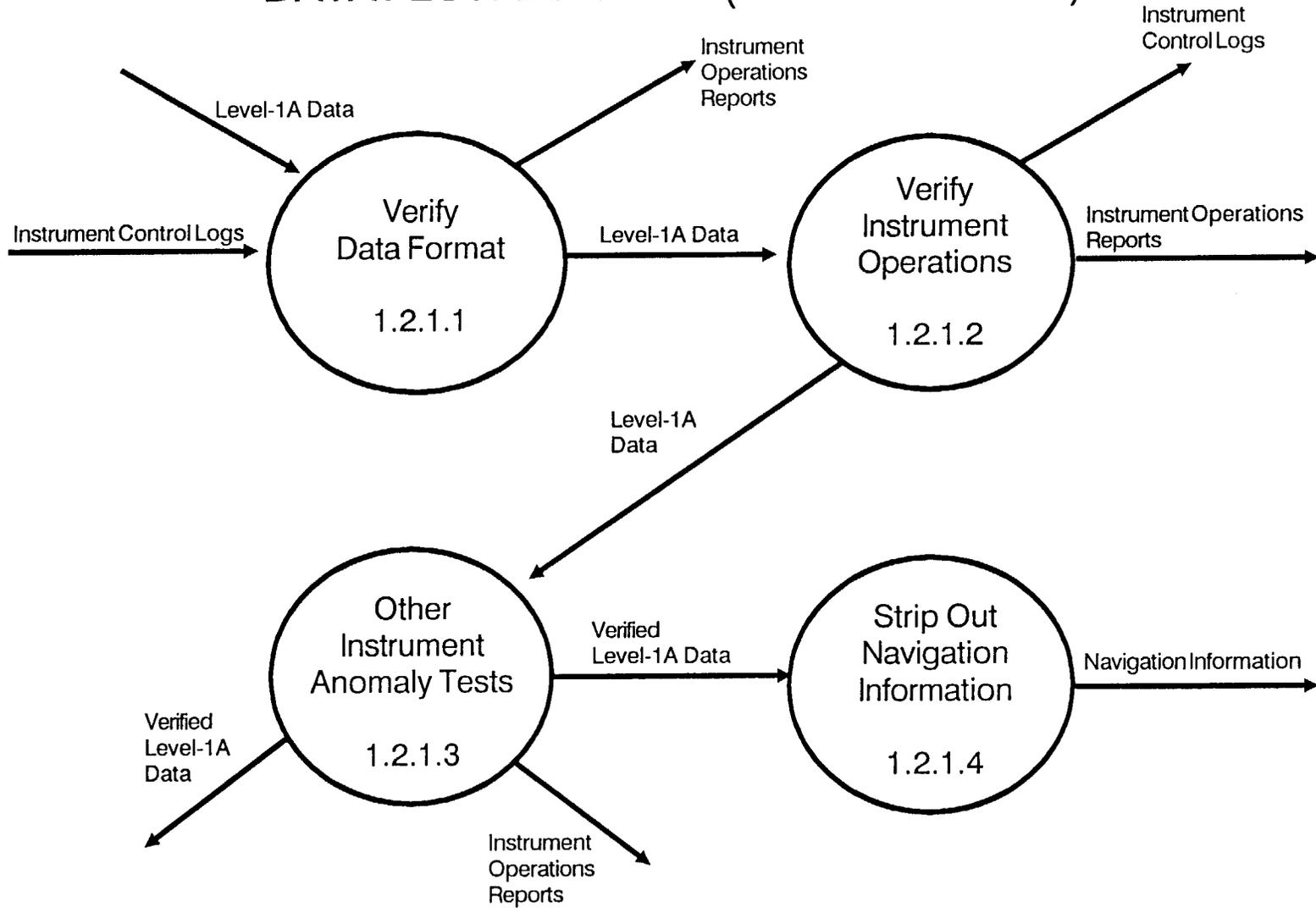


# MODIS LEVEL-1B PROCESSING DATA FLOW DIAGRAM (FUNCTION 1.2)



\*No present requirement; issue under discussion.

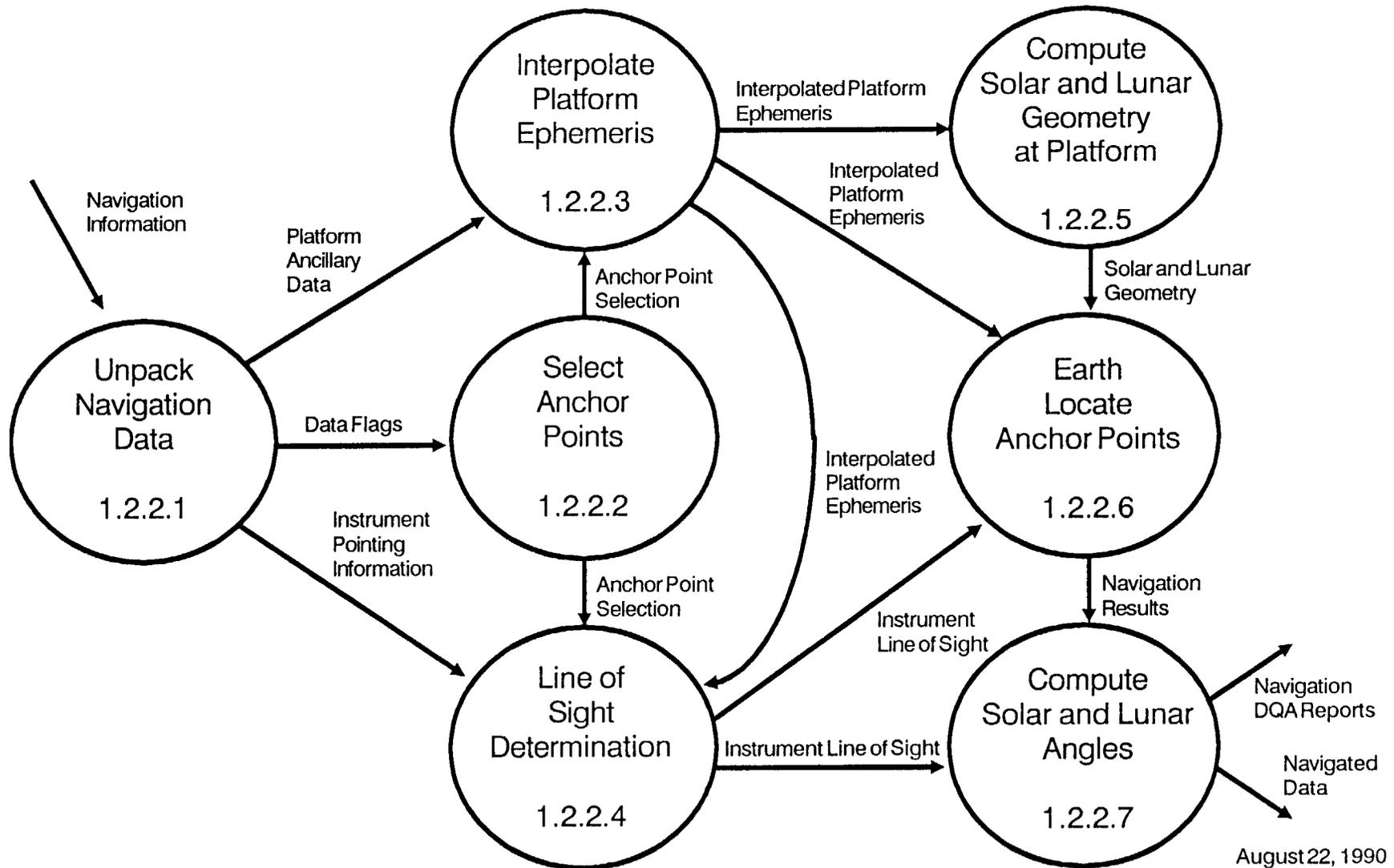
# RECEIVE LEVEL-1A DATA DATA FLOW DIAGRAM (FUNCTION 1.2.1)



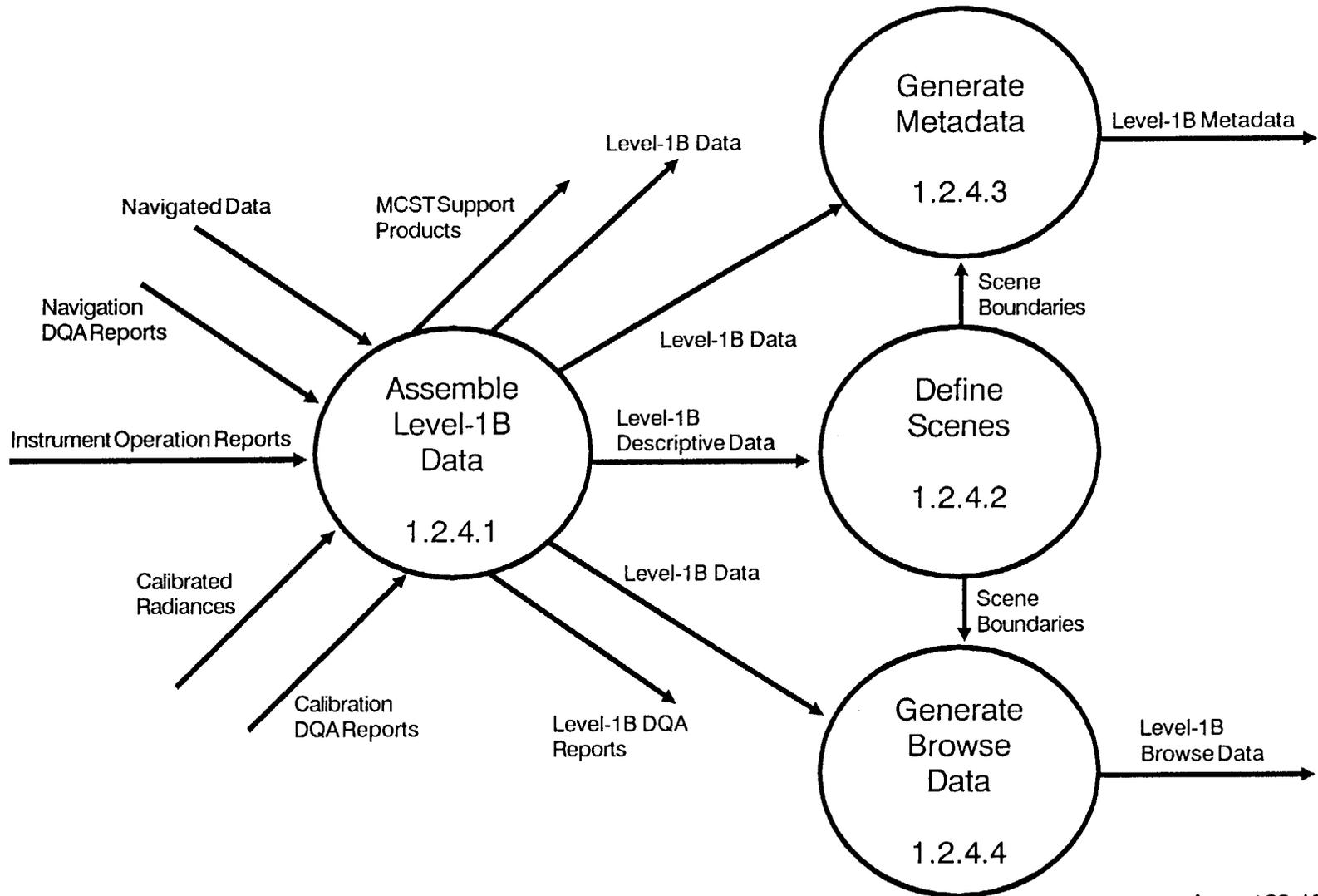
August 22, 1990

# NAVIGATE ANCHOR POINTS

## DATA FLOW DIAGRAM (FUNCTION 1.2.2)



# FORMAT AND ASSEMBLE LEVEL-1B DATA DATA FLOW DIAGRAM (FUNCTION 1.2.4)



August 22, 1990

<b>DICTIONARY DEFINING LEVELS OF PROCESSING OF MODIS DATA</b>	
<b>DATA ITEM</b>	<b>DATA DEFINITION</b>
Anchor Point Selection	
Browse Data	Reduced spatial, spectral, and dynamic resolution data products routinely generated during MODIS processing to assist the ultimate data user in selecting MODIS data products suited to his needs.
Buffer Space Coordination	
Calibrated Radiances	Integrated results of radiometric and navigation activities.
Calibration Coefficients <sup>1</sup>	Numerical coefficients, parameters, or thresholds needed to apply the MODIS radiometric calibration using a Calibration Model.
Calibration DQA Reports	
Calibration Model	An equation or set of equations and an algorithmic procedure used to convert instrument-generated digital counts to corresponding spectral radiances.
Data Flags	
Data Identity Error Message	
Data Receipt Reports	
Data Request Dialog	
Data Transfer Requests	

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<sup>1</sup>No present requirement; issue under discussion.

**DICTIONARY DEFINING LEVELS OF PROCESSING OF MODIS DATA**

DATA ITEM	DATA DEFINITION
Instrument Control Log	<p>A list of planned and actual events affecting the operational status of a MODIS instrument and associating a beginning time with each event. In the preliminary design of the MODIS Level-1 processing software, questions have arisen concerning a data flow labeled Instrument Control Log. Instrument Control Log information goes from the ICC to the IDPGF and provides information that the data processing system needs to assess received data completeness and the "quality" of MODIS observations.</p> <p>Specifically, MODIS Level-1A processing is concerned with assessing the completeness of received MODIS data. For Level-1A processing, Instrument Control Log information should enable the processing system to derive an answer to the following question:</p> <ol style="list-style-type: none"> <li>1. What data do we expect to be able to get? (If the log says the instrument is on and "taking data", Level-0 observation data should be available.)</li> </ol> <p>Level-1B processing is concerned with identifying fraudently labeled data (potentially caused by data transmission errors in packet identification fields) and identifying any departures from nominal instrument operation that could affect the type or quality of instrument observations. For Level-1B processing, Instrument Control Log information should permit the processing system to derive answers to the following questions:</p> <ol style="list-style-type: none"> <li>2. What should be the format of received MODIS data packets?</li> <li>3. What instrument status bits should be set?</li> <li>4. What are the instrument parameter limits (currents, voltages, temperatures, etc.) that correspond to acceptable, high-quality, instrument observations?</li> </ol> <p>As the instruments are built and checked out in preflight and operational configurations, additional Level-1B processing checks that reflect on the quality of instrument observations may also be devised. Instrument Control Log information on the intended operation of the MODIS instruments will likely be essential for such tests.</p>

<b>DICTIONARY DEFINING LEVELS OF PROCESSING OF MODIS DATA</b>	
<b>DATA ITEM</b>	<b>DATA DEFINITION</b>
Instrument Line of Sight	
Instrument Operation Reports	
Instrument Pointing Information	
Interpolated Platform Ephemeris	
Level-0	Instrument-Data at original resolution, time order restored, with duplicates removed.
Level-1A	Level-0 data which are reformatted, with Earth location, calibration data, and other ancillary data appended.
Level-1B	Level-1A data to which the radiometric calibration algorithms have been applied, to produce radiances or irradiances and to which the Earth-location and navigation algorithms have been applied.
Level-1B Browse Data	
Level-1B Descriptive Data	
Level-1B DQA Reports	
Level-1B Processing Control Matrix	
Level-1B Metadata	
MCST Support Products	A data set containing selected MODIS digital counts and radiance data fields, and other relevant information. This product is routinely generated at the behest of the MODIS Characterization Support Team (MCST) and contains requested data items <sup>2</sup> .

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<sup>2</sup>Is this product to be permanently retained? Should it be generated directly at the MCST without involving the Product Generation Facility? What operating modes will the MODIS instruments support? How many calibration modes are there? How will data from other instrument operating modes that do not include science data collection be stored? For example, will the instrument have an instrument test mode?

<b>DICTIONARY DEFINING LEVELS OF PROCESSING OF MODIS DATA</b>	
<b>DATA ITEM</b>	<b>DATA DEFINITION</b>
Metadata	Descriptive data developed during MODIS product generation to support user selection of MODIS data products using the facilities of the Information Management Center (IMC).
Navigated Data	Information specifying the computed Earth-location of MODIS pixels.
Navigation DQA Reports	
Navigation Information	
Navigation Results	
Platform Ancillary Data	Platform location and attitude data used to navigate and monitor MODIS pixel locations, and other platform housekeeping data needed for Level-1 and higher processing <sup>3</sup> .
Raw Metadata	
Received Data	A complete set of Level-0, Ancillary Platform, and Calibration Coefficient data that remains after data quality verification procedures are applied and inappropriate data are rejected. Received Level-0 data blocks have been entered in a Level-0 data receipt record.
Received Segment Count Requests	
Scene Boundaries	
Segments of Data	
Solar and Lunar Geometry	
Time Information	
Verified Calibration Coefficients	
Verified Instrument Control Log	

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<sup>3</sup>Will a chronology of platform events (maneuvers, service interruptions, etc.) be available? Where will the platform event chronology be developed? Should the platform chronology be integrated with the corresponding record for the MODIS instrument (Instrument Command and Response History)? Should a chronology of platform events be integrated into the mainstream of MODIS data (Level-1A)? Should status data from other payload instruments also be appended to MODIS Level-1A data? Are other platform data items needed in the MODIS Level-1A record?

<b>DICTIONARY DEFINING LEVELS OF PROCESSING OF MODIS DATA</b>	
<b>DATA ITEM</b>	<b>DATA DEFINITION</b>
Verified Platform Ancillary Data	

<b>INTERFACE CONTROL TABLE</b>		
<b>INTERFACE</b>	<b>DATA TYPE</b>	<b>COMMENTS</b>
CDOS	Data Request Dialog	
	Level-0 Data	
DADS	Level-1A Data	
	Level-1B Data	
	Metadata	
	Browse Data	
Ground Calibration Sites <sup>1</sup>	In-Situ Data	
Higher-Level Processing	Level-1B Data	
ICC	Instrument Control Log	
	Platform Ancillary Data	
MCST	Calibration Coefficients	
	MCST Support Products	

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<sup>1</sup>No present requirement; issue under discussion.

## REPROCESSING CONDITIONS AND DATA FLOWS IN LEVEL 1

Reprocessing may be requested for many reasons; we need to develop plans for reprocessing for any and all possible reasons. Reprocessing approaches may be of "brute force" or, they may be of surgical precision. Since severe computer resource limitations are not expected, brute force has an appeal in being simple and direct, simply reprocess all the data end to end in Level-1 rather than attempt to extract, correct, and rewrite small segments of the data for reprocessing in Level-1. The latter approach may require many I/O operations and programming control features to accomplish reprocessing, thus may result in a more complicated and difficult to integrate reprocessing data flow.

Reprocessing must be shown as a separate data processing flow distinct from the standard data processing flow diagram--even though the same Level-1 algorithms will be employed. A separate reprocessing flow diagram is required for clarity, to emphasize reprocessing demand on resources, and that reprocessing may begin at variable entry points in the Level-1 data processing flow. It is critical to demonstrate the impact that reprocessing will have on the data flow and resources required. The project anticipates reprocessing all data at least twice for the life time of the mission.

In the calibration processing we assume, until otherwise informed by Dr. Barker, that calibration is done in Level-1B with algorithms supplied by the MCST, i.e. there is no calibration data in Level-1A

To present separate MODIS Level-1 context and reprocessing flow diagrams is redundant to the extent that the same data processing algorithms will be used, the difference is that the data processing flow will be entered at different points for different reasons. What we need to illustrate at a high level are the entry points for reprocessing (Figure 1).

Several reasons for reprocessing listed in Table 1 (expect the number of reasons will increase) will dictate that reprocessing begin at one of two points in the Level-1 data processing flow, either at the very beginning, Level-1A or, at an intermediate point, Level-1B. In general, any corrections or revisions to the data received from external elements will necessitate reprocessing from Level-1A with the corrected/revised data written to the "data units"; reprocessing with revised calibration algorithms could begin from Level-1B with Level-1A data retrieved from the DADS.

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TABLE 1. Possible reasons for reprocessing and entry point into the Level-1 data processing flow to begin reprocessing.

Possible Reason	Entry Point
Revised calibration algorithms	Level-1B
Programming errors	Level-1A or -1B
Errors detected in platform ancillary data that have caused errors in navigation	Level-1A
Verify repeatability of algorithm(s) performance	Level-1A or -1B
New or updated Level-0 data received from CDOS subsequent to first processing	Level-1A

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MODIS LEVEL-1  
REPROCESSING ENTRY POINTS

**LEVEL-1A  
REPROCESSING ENTRY  
CAUSES FOR**

- UPDATED  
LEVEL-0 DATA
- CORRECTED ANCILLARY  
PLATFORM DATA
- REVISED INSTRUMENT  
CONTROL LOG
- PROGRAMMING ERRORS
- VERIFY ALGORITHM(S)  
PERFORMANCE



**LEVEL-1B  
REPROCESSING ENTRY  
CAUSES FOR**

- REVISED  
CALIBRATION  
PARAMETERS
- PROGRAMMING ERRORS
- VERIFY ALGORITHM(S)  
PERFORMANCE

