MODIS DATA STUDY

TEAM PRESENTATION

April 26, 1991

AGENDA

1. Action Items
2. Updated Ancillary Data Requirements for Atmospheric Products
3. Ocean Science Proposals, Phase I: Esaias, Evans, Gordon, Hoge, and Parslow

ACTION ITEMS:

03/15/91 [Team]: Delete the requirement to append Instrument Status Information from Level-1A Processing System. STATUS: Revised Level-1A Processing System Report delivered 03/22/91. Further revision is required to eliminate status checking. Open.

03/22/91 [Team]: Organize a meeting with Yun-Chi Lu's and Locke Stuart's groups to coordinate efforts on categorizing data products for MODIS. Meeting held Friday, April 12, 1991. STATUS: Closed.

UPDATED ANCILLARY DATA REQUIREMENTS FOR ATMOSPHERIC PRODUCTS

Ancillary Data Requirements from Definition Phase Proposals (Atmospheric Products Only)

Surface Pressure	Menzel
Total Ozone	Tanre
Total Precipitable Water	Kaufman
Temperature Profiles	Menzel

Ancillary Data Requirements from Execution Phase Proposals (Atmospheric Products Only)

Pre-Launch

ASAS	Kaufman
AVHRR	Kaufman, Menzel, Tanre
AVIRIS	Kaufman
CAR	King
GOES	Kaufman
GOES I/M	Menzel
Ground truth measurements	Kaufman
HIS	Menzel
Landsat TM	Kaufman, Tanre
MAMS	Menzel
MODIS Simulator	King
Moisture at altitude (NMC)	Menzel
Pressure at altitude (NMC)	Menzel
SPOT	Kaufman
Surface reports (NMC)	Menzel
Temperature at altitude (NMC)	Menzel
TOVS	Menzel
VAS I/M	Menzel

Post-Launch

AIRS	Menzel
AVHRR	Kaufman, Menzel
CAR (Validation)	King
EOSP	Tanre
GOES[1]	Kaufman
GOES I/M	Menzel
Ground and aircraft observations	Kaufman
HIS	Menzel
HIRIS	Kaufman
LAWS	Menzel
MAMS	Menzel
MISR	Kaufman, Tanre
MODIS Simulator (Validation)	King
Moisture at altitude (NMC)	Menzel
Pressure at altitude (NMC)	Menzel
Surface reports (NMC)	Menzel
Temperature at altitude (NMC)	Menzel
TOVS	Menzel
VAS I/M	Menzel

[1]GOES I/M may be adequate.

MODIS Team Member Proposal
Data Requirements Form

Investigator: Esaias, Wayne E.

Output Product(s):
(1) Oceanic primary production.
(2) Water-Leaving Spectral Radiances
(3) Time Averaged Estimates of Marine Phytoplankton Biomass and Carbon Fixation page 4

Resolution (Time): Not Given
(Space): Not Given
Domain (Space): Not Given

At/Post-Launch: Pre and Post Launch

MODIS-N/T: Not Specified

Input Data: Not Specified
Spectral Bands Required:
Resolution (Time):
(Space):

Ancillary Data Required (Type and Source):

Pre-Launch: CZCS, SeaWiFS, OCTS, JGOFS (page 5) **Size (Mbytes):**
Post-Launch: **Size (Mbytes):**

Algorithm Complexity (floating point operations/scan):

Algorithm Memory Required (Mbytes):

Data Storage Required (Mbytes/scan):

Look-Up Tables Required:
Size (Mbytes):

Lines of Code:

Language Expected:

Accessory Output Products (e.g., field experiment data):
Pre-Launch: **Size (Mbytes):**
Post-Launch: **Size (Mbytes):**

Expected Need of SDST (Pre- or Post-Launch):
The MODIS Ocean Team (MOT) overview tables identify SDST support activities for each product, at-launch and post-launch. These include:

- product definition
- integrated processing system
- quality control process
- documentation
- utilities
- systems tests
- correction of problems

Post-Launch Expected Growth:

Quality Assessments:

Special Tilt Modes Required:

Notes: Specific products are identified in the proposal, but the requirements are not generally quantified to respond to this form.

The listed objectives include (page 4):

1. . . . provide definition of . . . data processing required to produce data useful for estimating **oceanic primary production and its global temporal/spatial variability** from satellite and ancillary observations.

2. . . . deliver working **integrated code** for production, quality control, and validation . . . for the **productivity and nLw data products.**

3. Develop appropriate temporally averaged estimates of **marine phytoplankton biomass and carbon fixation**, and time averaged anomalies from the CZCS, SeaWiFS, and MODIS observation periods.

Team Member Computing Facility needs are discussed on page 11.

MODIS Team Member Proposal
Data Requirements Form

Investigator: Evans, Robert H.

Note: Much of this proposal is devoted to discussion of the total role of the MODIS Ocean Team Computing Facility (MOTCF) which is seen as an expansion of the current RRSL. This form contains primarily Evans' requirements (Calibration, Validation and Quality Control)

Output Product(s): (1) Calibration, Validation and Quality Control of MODIS Ocean Visible Bands page 1,3

Resolution (Time): Monthly (view full moon) page 3
Daily to Weekly (short-term) page 4
Several Times per Year (long-term)
See Figures 1 & 2 (attached)

(Space):

Domain (Space):

At/Post-Launch: At-Launch page 1

MODIS-N/T: MODIS-N and MODIS-T: page 1,3

Input Data:

Spectral Bands Required: Level-1A and selected Level-1B Ocean Related Visible Channels page 1

Resolution (Time):

(Space):

Ancillary Data Required (Type and Source):

In-Situ Optical mooring and cruise data obtained by Clark. page 3,10

Visible Light Polarization (EOSP), Wind Speed (Scatterometer, Altimeter, or Model), Atmospheric Pressure (global models, ARGOS drifters), Equatorial Coverage (MISR) and Ozone (AIRS, AMSU, GOMR) at Resolutions from 20 to 200 km. page 6,9

Pre-Launch: **Size (Mbytes):**
Post-Launch: **Size (Mbytes):**

Algorithm Complexity (floating point operations/scan):

Algorithm Memory Required (Mbytes):

Data Storage Required (Mbytes/scan):

Approximately 10 gigabytes of data (total) are expected to be received and processed each day at the MOTCF. page 8

Look-Up Tables Required:
Size (Mbytes):

Lines of Code:

The current RRSL DSP system has 645K lines of code (see attached Table 4). For MODIS processing this is expected to increase by a factor of 4. page 9

Language Expected: Support Libraries for the Miami-Developed DSP system are coded in C. page 2

Accessory Output Products (e.g., field experiment data):

Global Level 3 products are expected to be produced at an 18 km resolution. High resolution Level 2 and Level 3 products will be produced for the in-situ observation sites and for selected special focus sites. Level 2 data will be computed on demand. Standard Level 2 products will be requested from EOSDIS as needed. page 8

Pre-Launch: **Size (Mbytes):**
Post-Launch: **Size (Mbytes):**

Expected Need of SDST (Pre- or Post-Launch):

The MODIS Ocean Team (MOT) overview tables identify SDST support activities for each product, at-launch and post-launch. These include:

- product definition
- integrated processing system
- quality control process
- documentation
- utilities
- systems tests
- correction of problems

The staff at RRSL will work with the MODIS SDST to port ocean product algorithms to the TLCF and/or CDHF environments as is appropriate. It is envisioned that the coding , standardization, and documentation activities will be shared by the RRSL and SDST and that compatible support tools such as a CASE environment will be utilized. The MOTCF staff will focus on developing an optimized algorithm implementation that produces the MOT products within a consistent framework and format. It is expected that the SDST then will port the MOTCF codes into the EOSDIS environment. page 7,8

Post-Launch Expected Growth:

Quality Assessments:

Special Tilt Modes Required:

Notes: It is anticipated that the MOTCF will be connected to the central facilities via a network link operating at 10-40 megabits/second. Connections to team members Gordon, Carder and Clark should operate at 1.5 megabits/second. page 2

In Evans' procedure, the full moon serves as a long term stability reference for calibration, the on-board diffuser plate gives short term instrument characterization, and in-situ measurements provide an overall calibration for the sensor and associated atmospheric correction algorithms. page 3

This proposal provides extensive description of the Rosentiel School of Marine and Atmospheric Science (RSMAS) Remote Sensing Laboratory (RRSL) DSP system. The MODIS ocean data processing requirements are viewed as being satisfied by the MOTCF as an extension of current RRSL DSP system capabilities. See Table 3 (attached) for the MOTCF implementation schedule. page 7,8,9

Fig. 1.

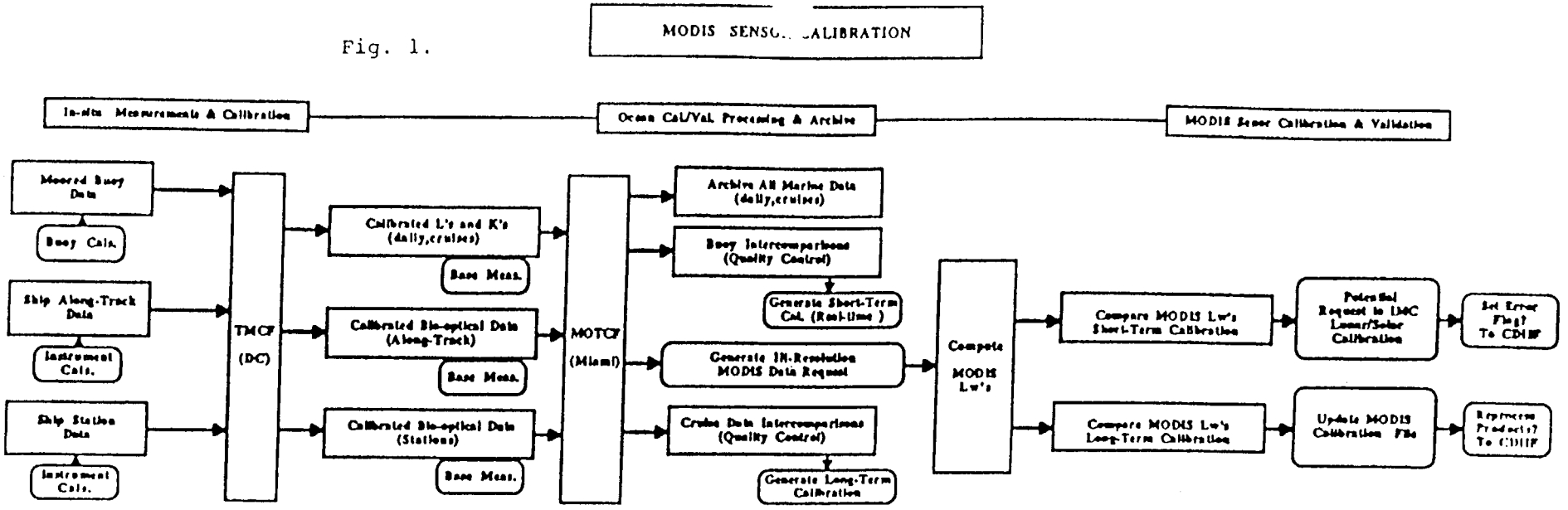
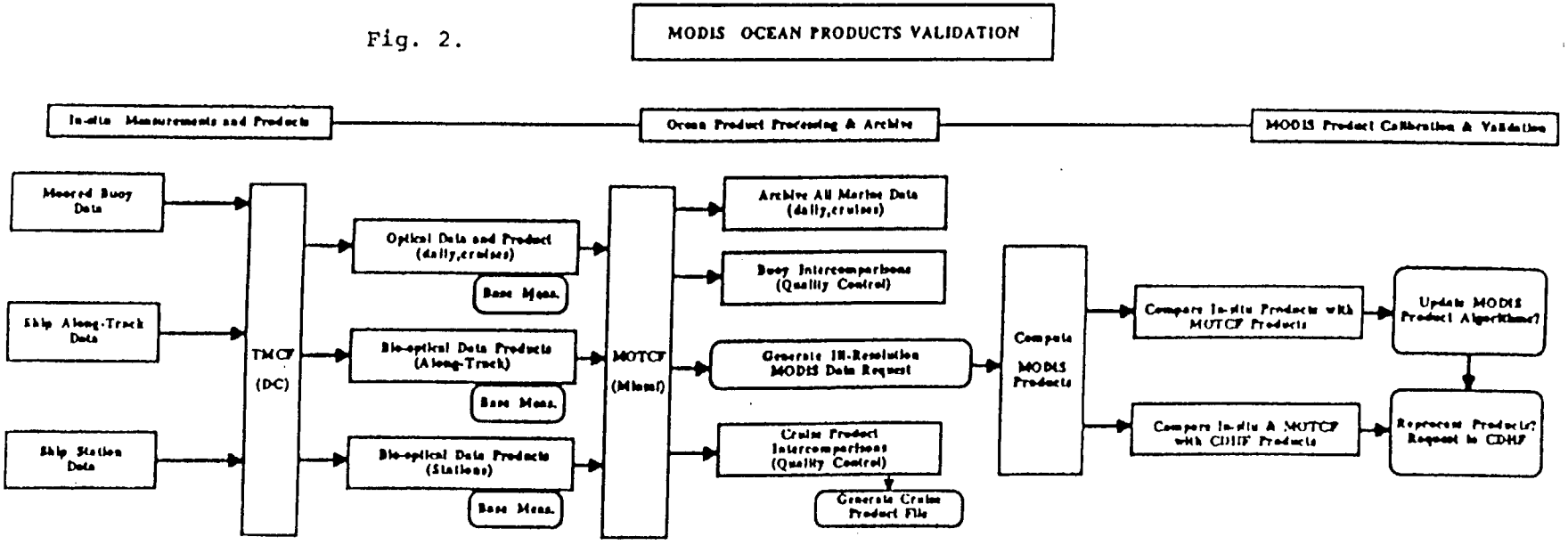
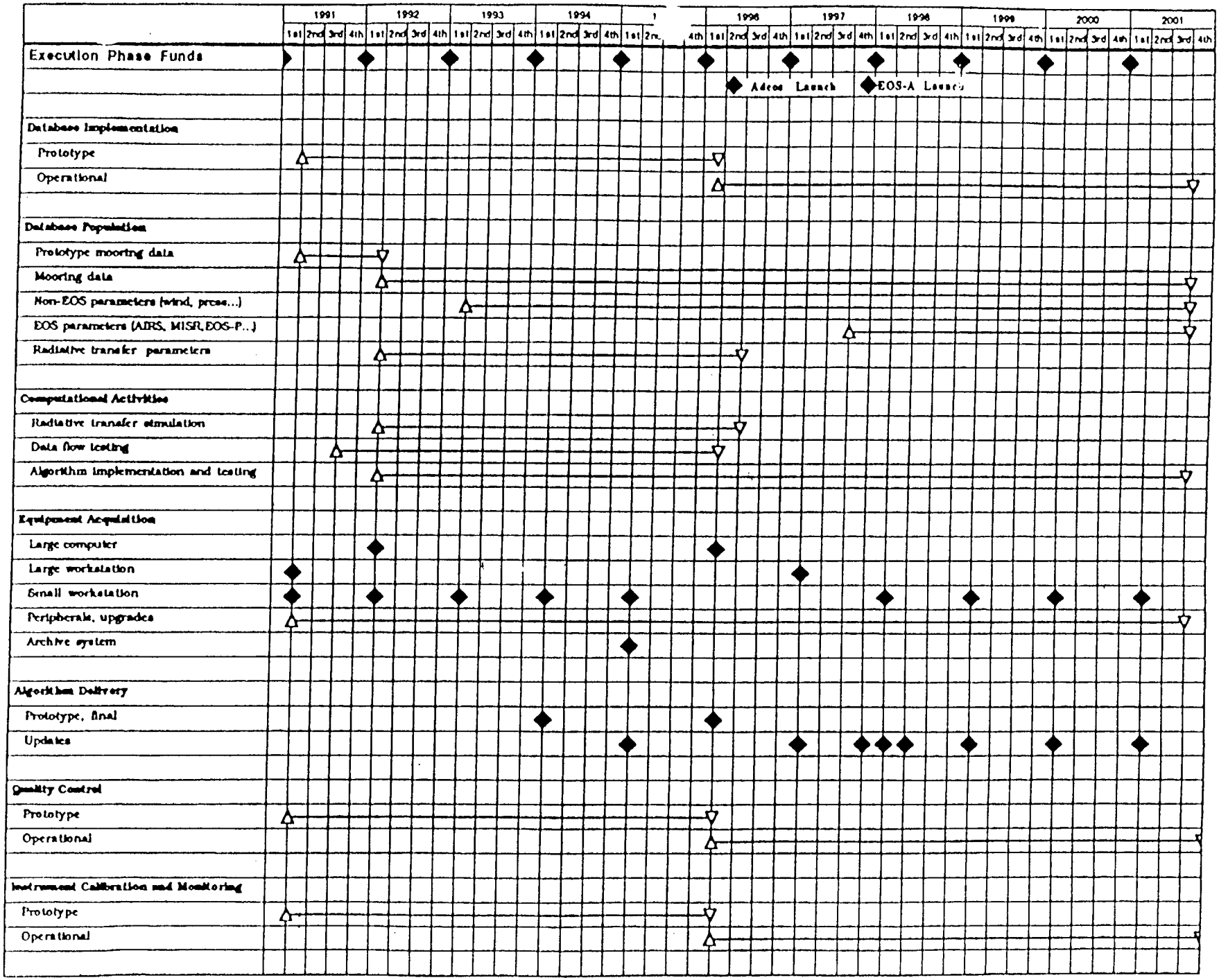

MODIS SENSO.. .ALIBRATION
In-situ Measurements & Calibration
Ocean Cal/Val Processing & Archive
MODIS Sensor Calibration & Validation
Moored Buoy Data
Buoy Cals.
Ship Along-Track Data
Instrument Cals.
Ship Station Data
Instrument Cals.
TMCF (DC)
Calibrated L's and K's (daily,cruises)
Base Meas.
Calibrated Bio-optical Data (Along-Track)
Base Meas.
Calibrated Bio-optical Data (Stations)
Base Meas.
MOTCF (Miami)
Archive All Marine Data (daily,cruises)
Buoy Intercomparisons (Quality Control)
Generate Short-Term Cal. (Real-time)
Generate IR-Resolution MODIS Data Request
Cruise Data Intercomparisons (Quality Control)
Generate Long-Term Calibration
Compute MODIS Lw's
Compare MODIS Lw's Short-Term Calibration
Potential Request to LMC Lunar/Solar Calibration
Set Error Flag? To CDHF
Compare MODIS Lw's Long-Term Calibration
Update MODIS Calibration File
Reprocess Products? To CDHF

Fig. 2.


MODIS OCEAN PRODUCTS VALIDATION
In-situ Measurements and Products
Ocean Product Processing & Archive
MODIS Product Calibration & Validation
Moored Buoy Data
Ship Along-Track Data
Ship Station Data
TMCF (DC)
Optical Data and Product (daily,cruises)
Base Meas.
Bio-optical Data Products (Along-Track)
Base Meas.
Bio-optical Data Products (Stations)
Base Meas.
MOTCF (Miami)
Archive All Marine Data (daily,cruises)
Buoy Intercomparisons (Quality Control)
Generate IR-Resolution MODIS Data Request
Cruise Product Intercomparisons (Quality Control)
Generate Cruise Product File
Compute MODIS Products
Compare In-situ Products with MOTCF Products
Update MODIS Product Algorithms?
Compare In-situ & MOTCF with CDHF Products
Reprocess Products? Request to CDHF


1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
1st 2nd 3rd 4th
Execution Phase Funds
Adeos Launch
EOS-A Launch
Database Implementation
Prototype
Operational
Database Population
Prototype mooring data
Mooring data
Non-EOS parameters (wind, press...)
EOS parameters (AIRS, MISR, EOS-P...)
Radiative transfer parameters
Computational Activities
Radiative transfer simulation
Data flow testing
Algorithm implementation and testing
Equipment Acquisition
Large computer
Large workstation
Small workstation
Peripherals, upgrades
Archive system
Algorithm Delivery
Prototype, final
Updates
Quality Control
Prototype
Operational
Instrument Calibration and Monitoring
Prototype
Operational

Code group	Lines of Code
Library	
Rayleigh	4k
I/O	20k
Navigation	5k
Core system	
Command interface, communication	300k
Data extraction, mapping	45k
Database access, archive	65k
Sea surface temp, ocean color	15k
Data manipulation, visualization	200k
Total lines of code	654k

Table 4. Lines of code for current DSP system

MODIS Team Member Proposal
Data Requirements Form

Investigator: Gordon, Howard R.

Output Product(s):

Primary Products:

(1) Algorithm for derivation of the nadir-viewing water-leaving radiance from the sensor radiance in Case 1 waters (atmospheric correction)
(2) Algorithm for estimation of the concentration of detached coccoliths
(3) Global-scale maps of the coccolith concentration

Secondary Products:

(4) CZCS pigments (provides link to CZCS global time series)
(5) Diffuse attenuation coefficient at 490 nm ($K_d(490)$)
(6) Single scattered aerosol radiance and Ångstrom exponent
(7) PAR incident on the sea surface

Interim Products (implicitly contained in other products):

(8) Sun glint field
(9) Winds derived from sun glitter pattern
(10) Total backscattering coefficient
(11) Coccolith backscattering
(12) Coarse description of phytoplankton backscattering

all on page 24

Resolution (Time):
(Space):
Domain (Space): (3) through (12) Global

At-Launch: (1) and (2)

Post-Launch: (3)

MODIS-N/T: MODIS-N and MODIS-T

Input Data:
Spectral Bands Required:
Resolution (Time):
(Space):

Ancillary Data Required (Type and Source):

Pre-Launch: **Size (Mbytes):**
Post-Launch: Surface atmospheric pressure, Atmospheric Ozone Concentration, Surface wind speed, and EOSP data (provided by EOSDIS) page 24 **Size (Mbytes):**

Algorithm Complexity (floating point operations/scan):

Algorithm Memory Required (Mbytes):

Data Storage Required (Mbytes/scan):

Look-Up Tables Required:
Size (Mbytes):

Lines of Code:

Language Expected:

Accessory Output Products (e.g., field experiment data):
Pre-Launch: **Size (Mbytes):**
Post-Launch: **Size (Mbytes):**

Expected Need of SDST (Pre- or Post-Launch):
The MODIS Ocean Team (MOT) overview tables identify SDST support activities for each product, at-launch and post-launch. These include:

- product definition
- integrated processing system
- quality control process
- documentation
- utilities
- systems tests
- correction of problems

Post-Launch Expected Growth:

Quality Assessments:

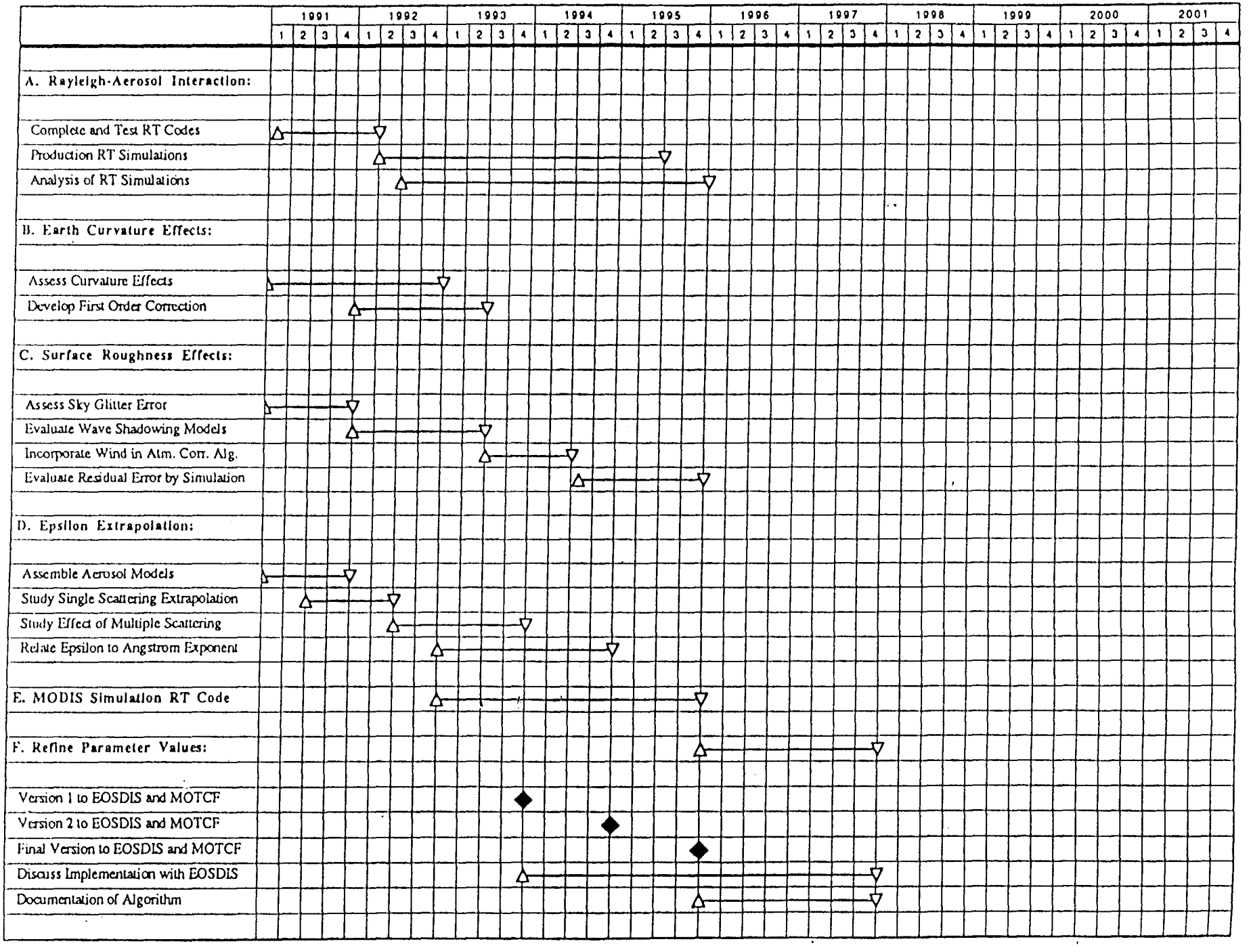
Special Tilt Modes Required:

Notes: The PI's primary involvement on the MODIS Team is to develop and maintain algorithms for the retrieval of the nadir-viewing water leaving radiance from MODIS data. His secondary involvement is to conduct a study of the global distribution of the concentration of detached coccoliths. Finally, as a by-product of the atmospheric correction, he will produce a radiance proportional to the concentration of aerosols in the atmosphere. page i

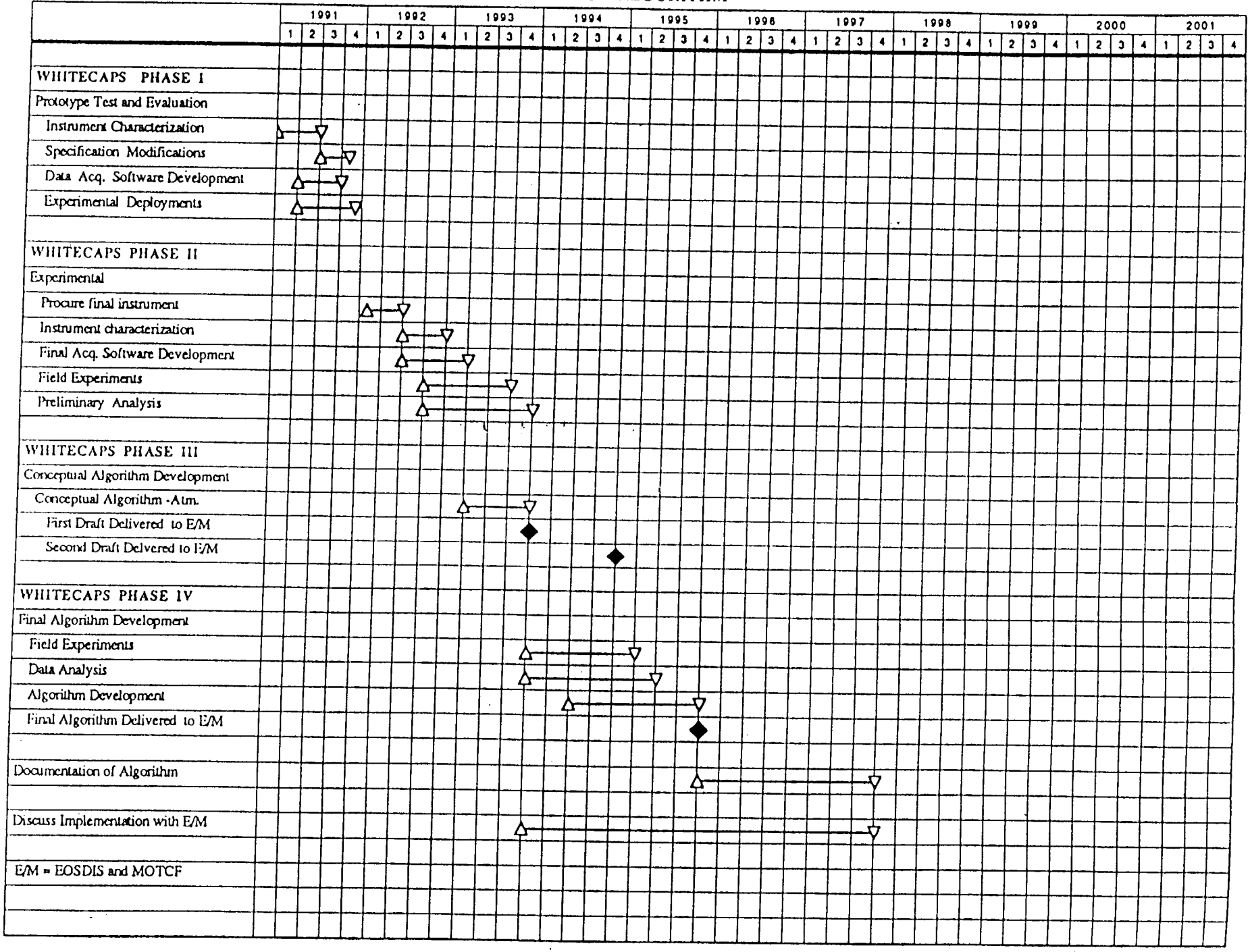
The bulk of the proposal provides the theoretical bases for the various components of the atmospheric correction, the global estimation of coccolith distribution, and miscellaneous studies.

The data plan (page 24) identifies the various data products for which the PI has responsibility. Schedules for the delivery of algorithms to the MOTCF and EOSDIS are provided in Schedules 1-9 (attached). The computer facilities plan (page 26) indicates the computer power (MIPS) required for the MOTCF and the TMCF processing.

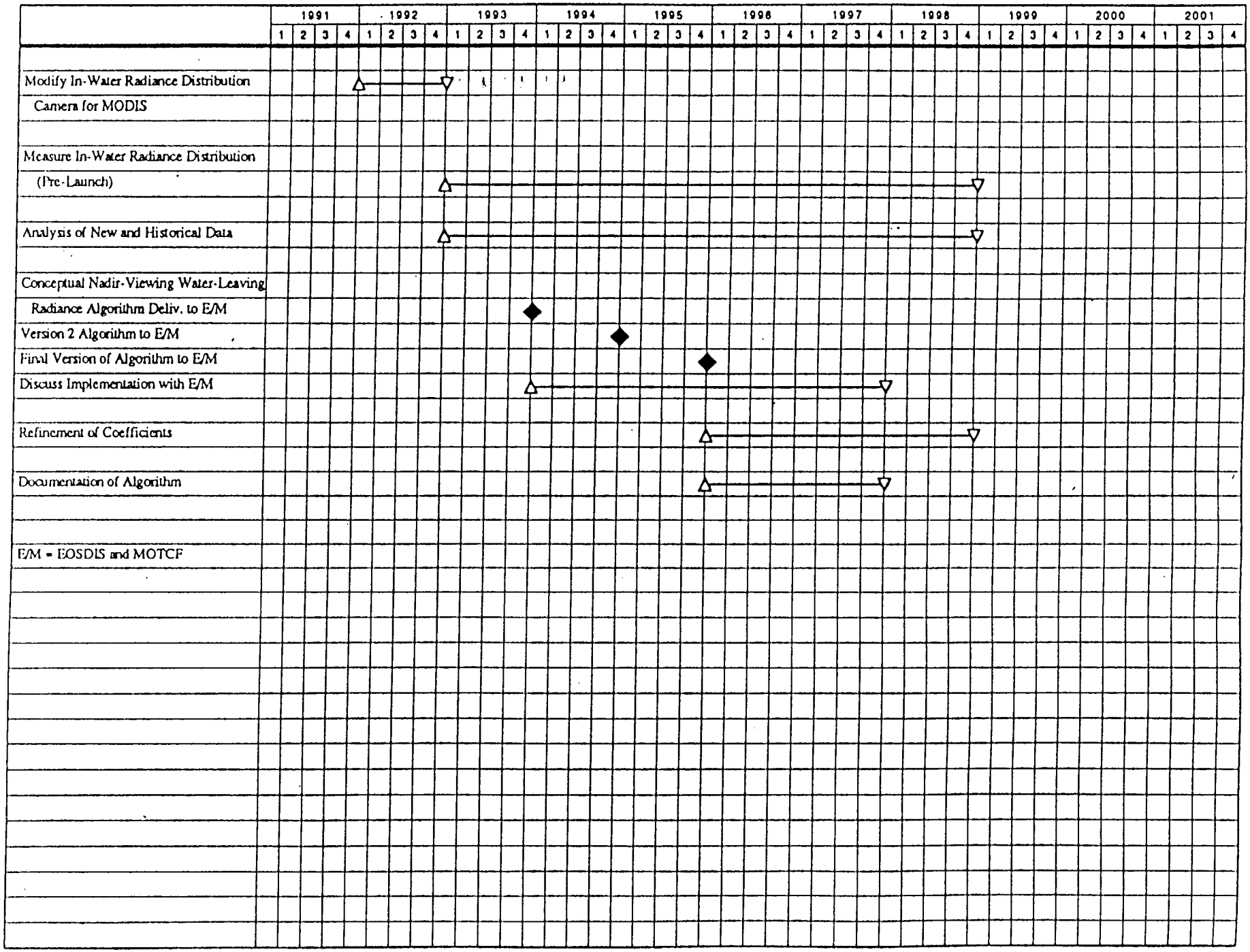
Schedule 1: ATMOSPHERIC CORRECTION ALGORITHM



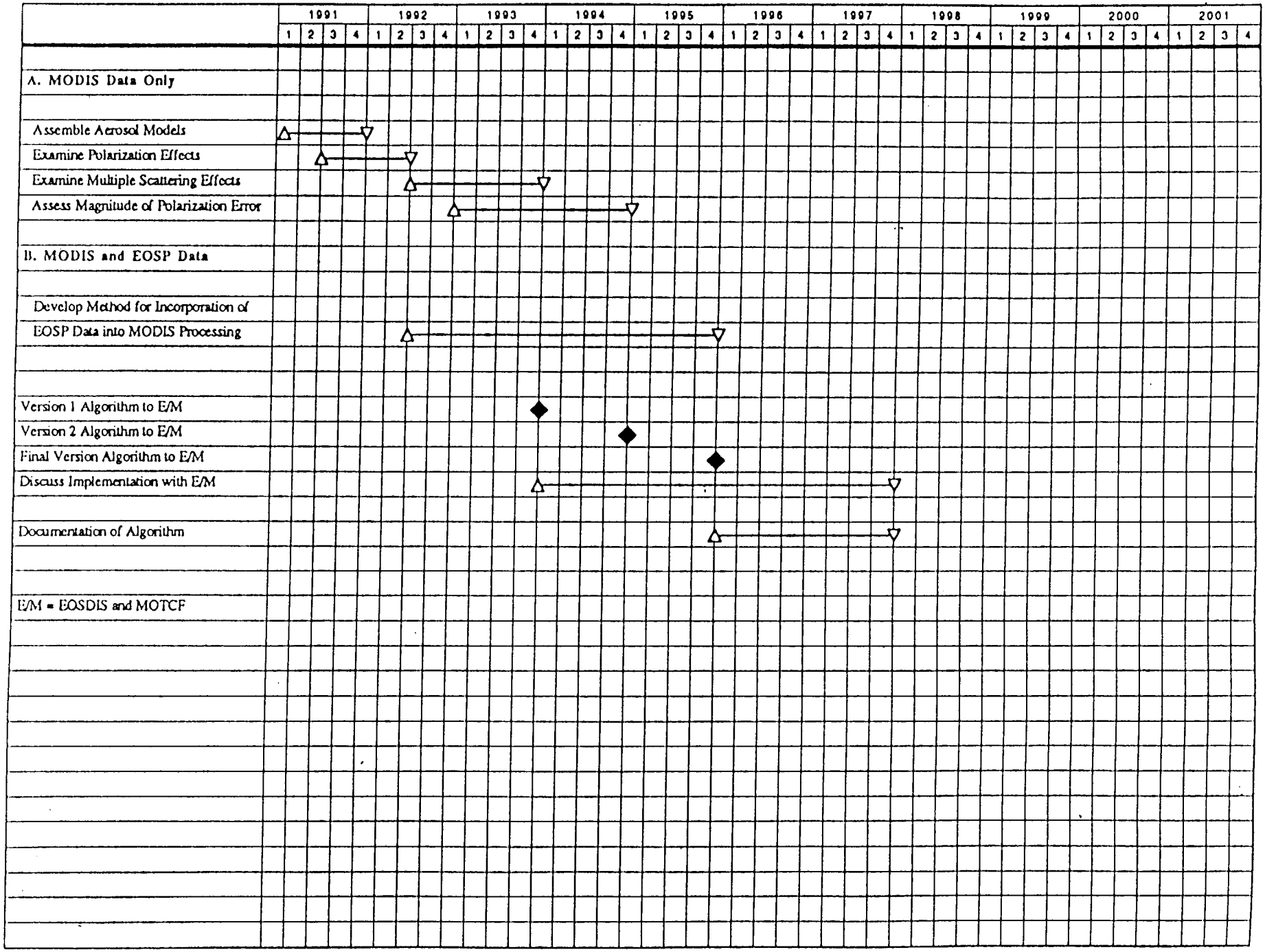
Schedule 2: WHITECAP CORRECTION ALGORITHM



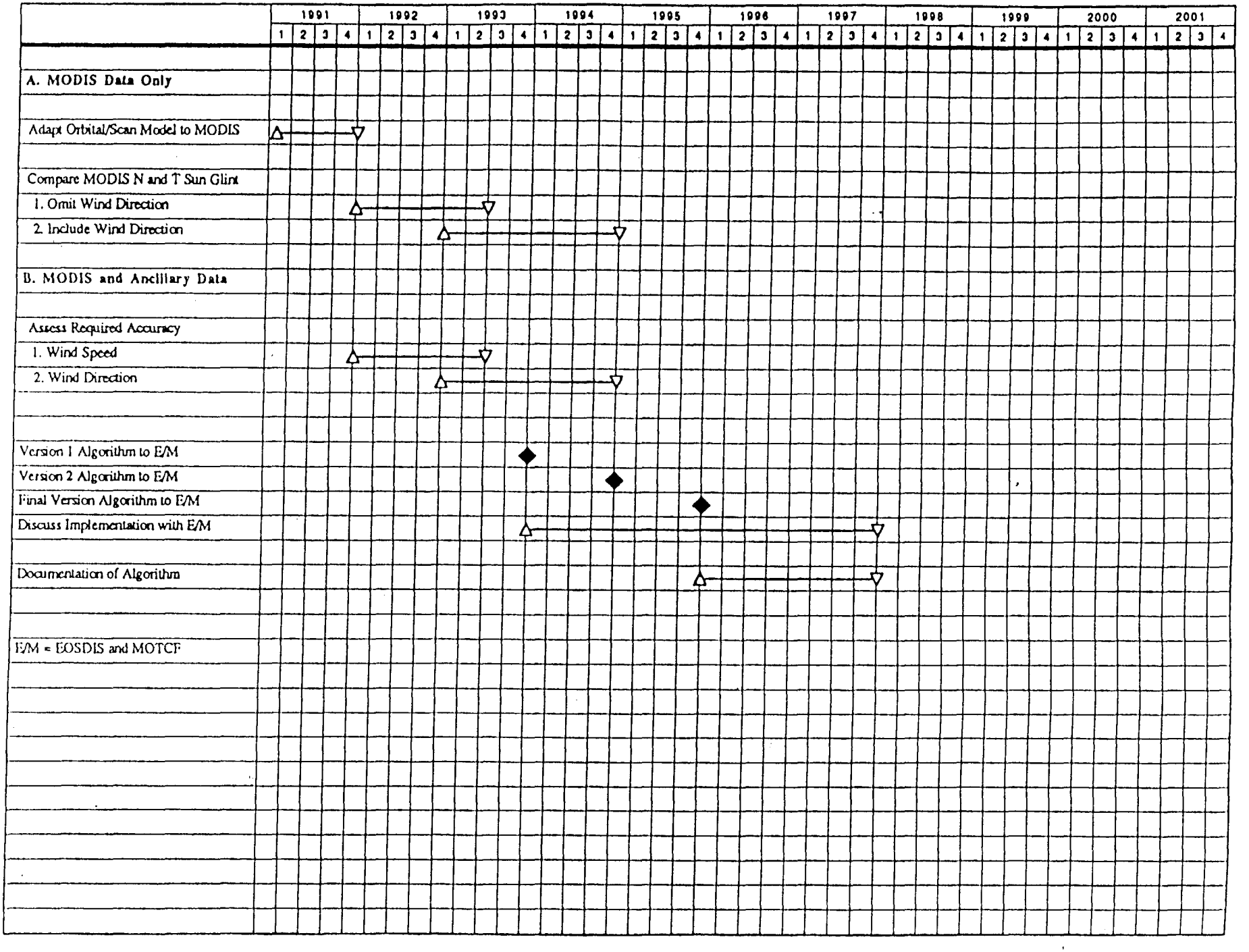
Schedule 3: IN-WATER RADIANCE DISTR. JTION



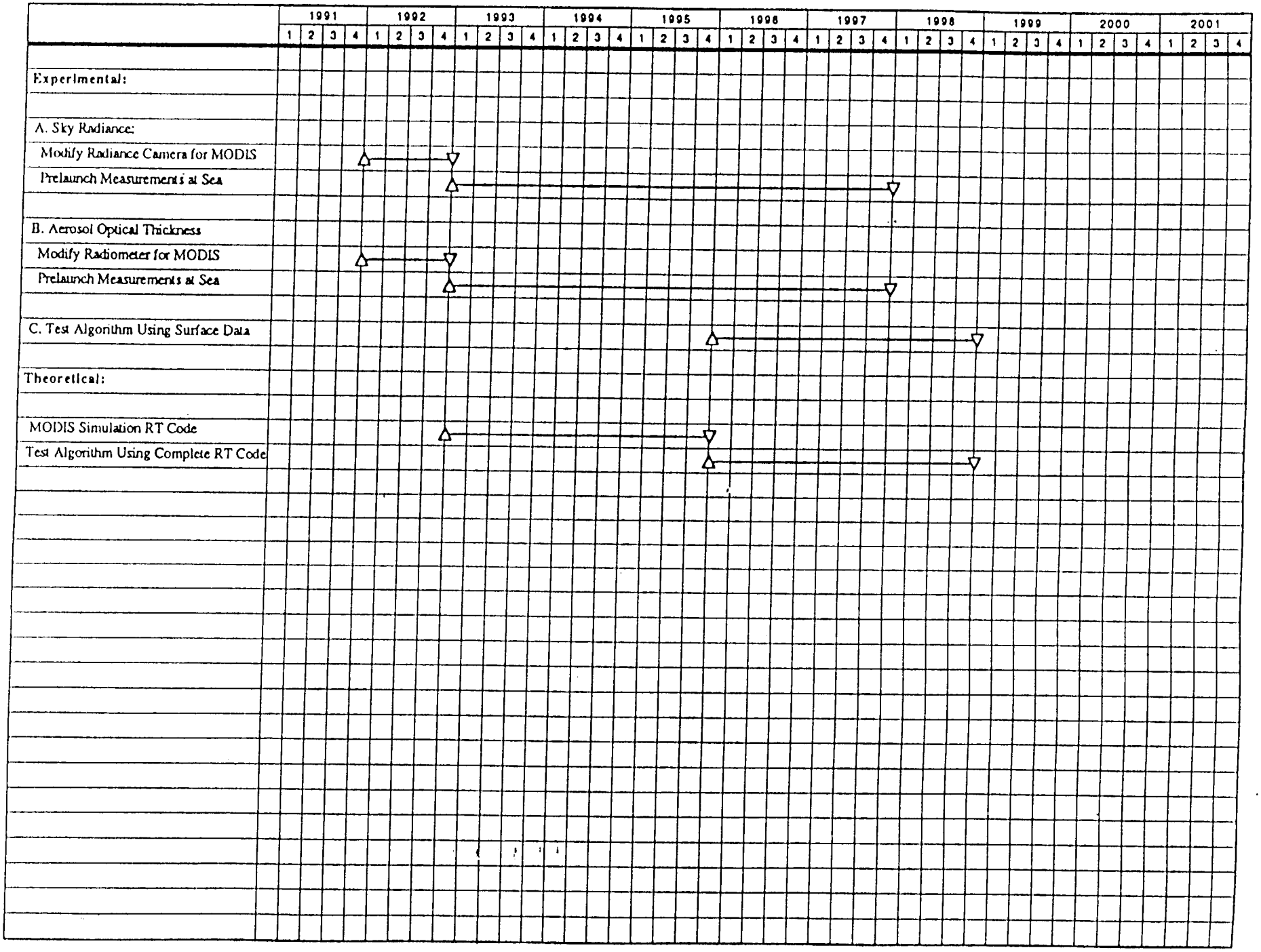
Schedule 4: RESIDUAL INSTRUMENT POLARIZATION CORRECTION ALGORITHM



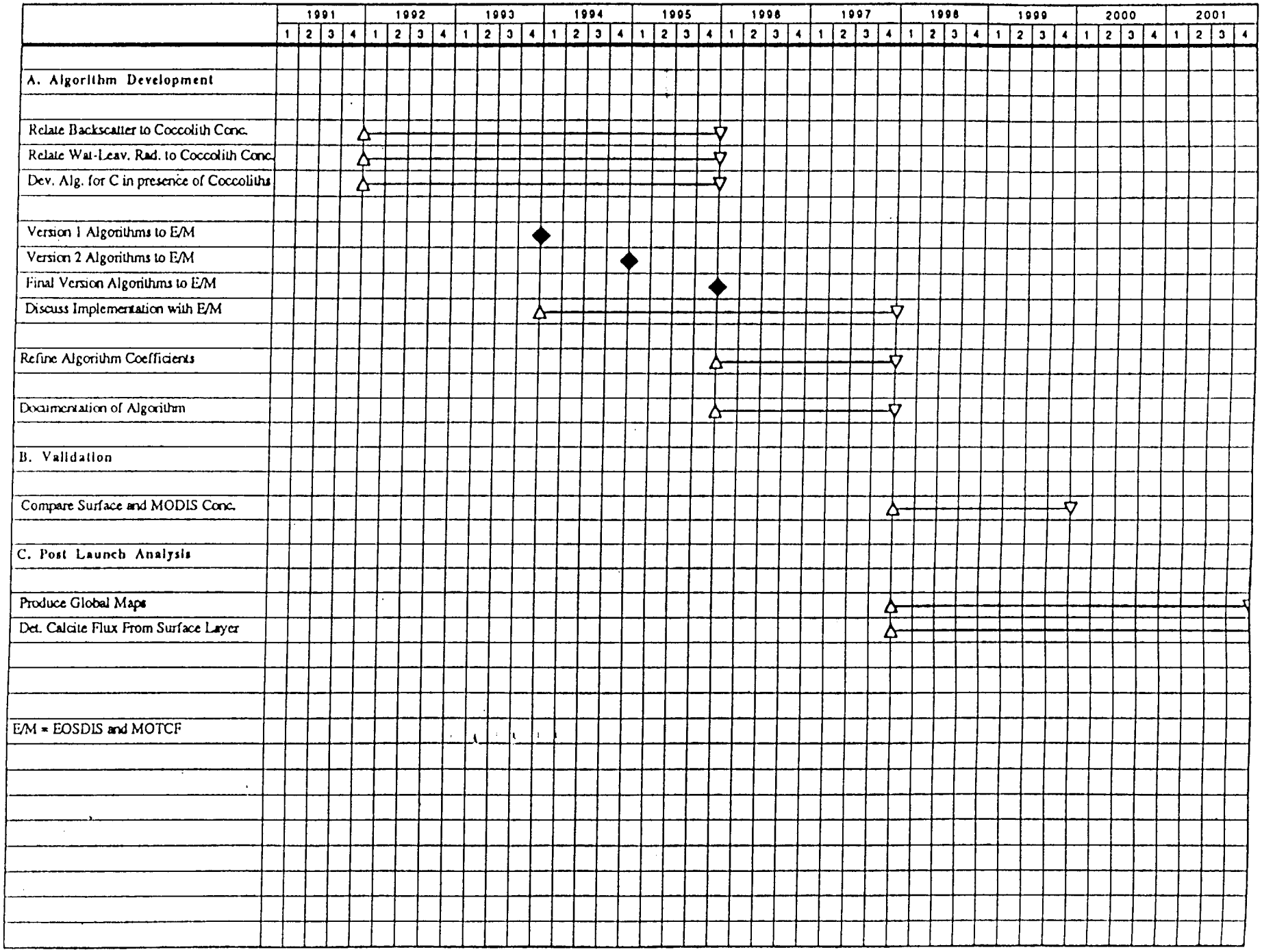
Schedule 5: DIRECT SUN GLINT CORRECTION ALGORITHM



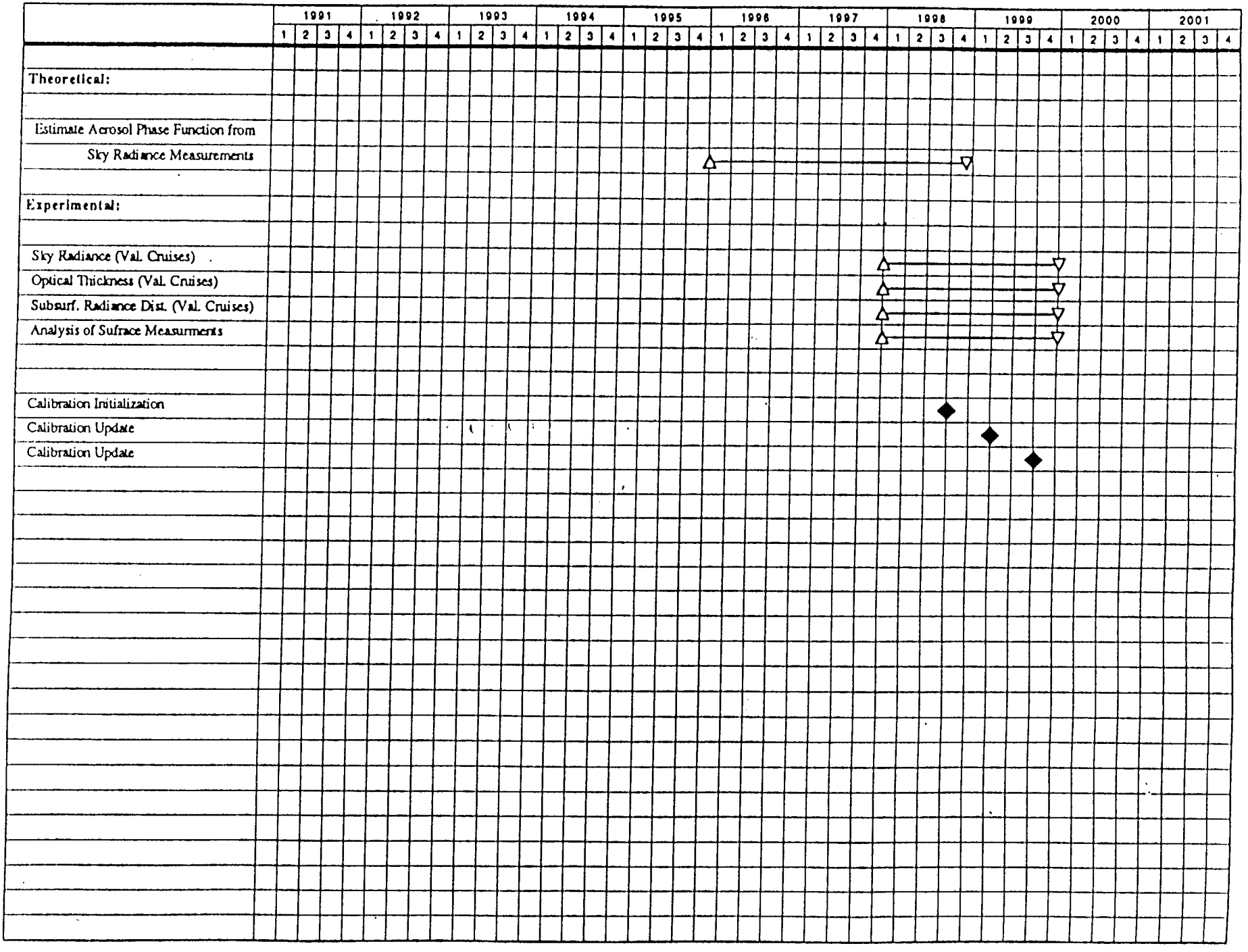
Schedule 6: ATMOSPHERIC CORRECTION VALIDATION



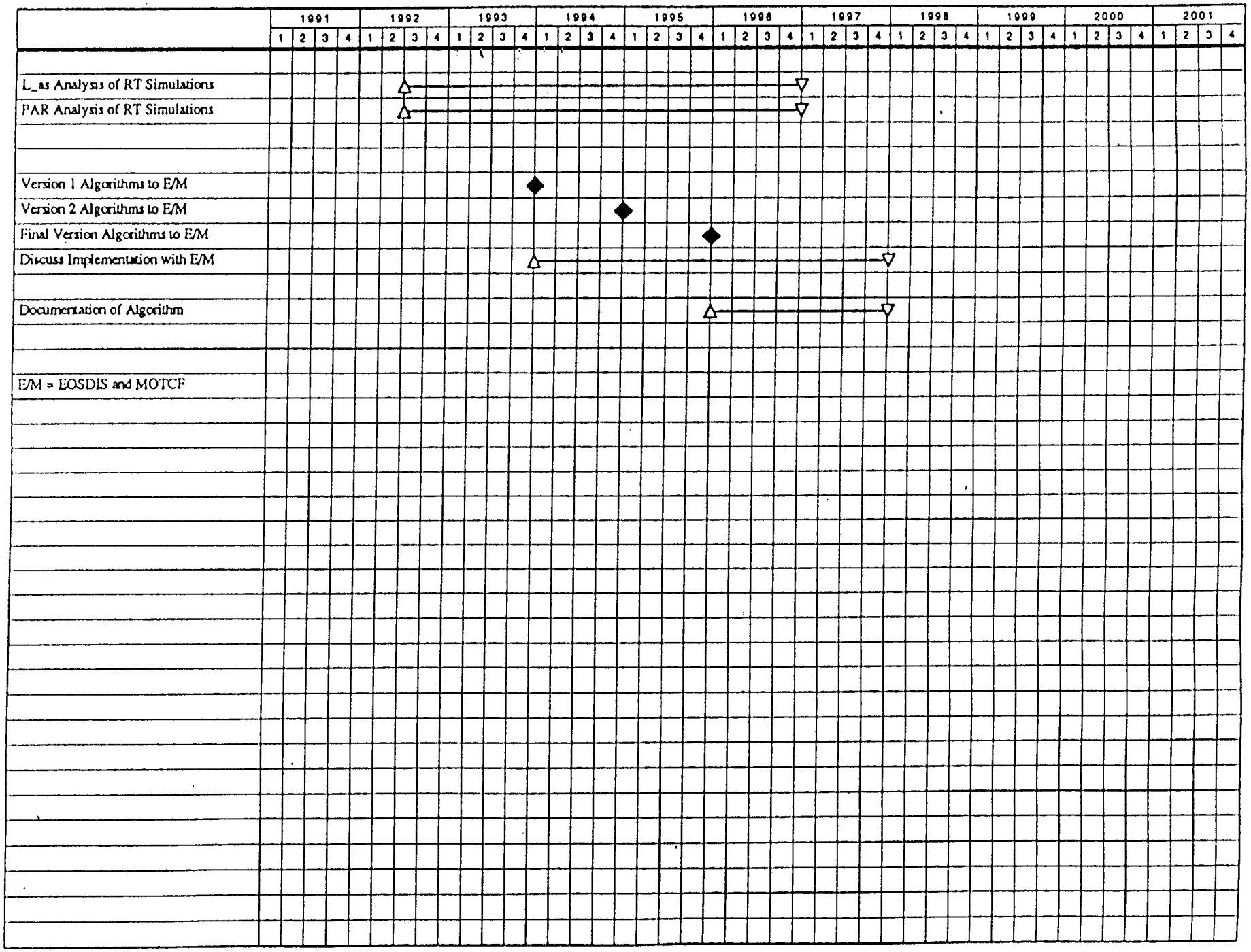
Schedule 7: PLAN FOR DETACHED COCCOLITH ALGORITHM AND POST LAUNCH STUDIES



Schedule 8: POST LAUNCH VICARIOUS CALIBRATION/INITIALIZATION



Schedule 9: SINGLE SCATTERED AEROSOL RADIANCE AND PAR ALGORITHM



MODIS Team Member Proposal
Data Requirements Form

Investigator: Hoge, Frank E.

Output Product(s):

(1) Phycoerythrin Algorithm
(2) Chlorophyll Fluorescence Algorithm
(3) Chlorophyll Algorithm for Case-II Waters
(4) Dissolved Organic Matter (DOM) Algorithm
(5) Species Diversity Imagery Algorithm
(6) Phycocyanin Concentration Algorithm
page 4,10,11,12,17
(7) Phycoerythrin Pigment Concentration
(8) Chlorophyll Fluorescence using Spectral Curvature Algorithm
(9) Chlorophyll in Case-II Waters using Spectral Curvature Algorithm
(10) Dissolved Organic Matter (DOM) using Spectral Curvature Algorithm
page 9,10

Note: Items (5) and (6) are research algorithms and products.

Resolution (Time):
(Space):
Domain (Space): Mid-Atlantic Bight and Global

At-Launch: (1),(2),(7),(8)
Post-**Launch:** (3),(4),(5),(6),(9),(10)

MODIS-N/T:

Input Data:

Corrected Level 2 imagery from each of the MODIS color bands and higher level products resulting from the algorithms developed by the MODIS Team members are requested during the full span of the proposed EOS/MODIS period within the mid-Atlantic test site. Imagery data will also be required from other oceanic areas covered by major field investigations (JGOFS and others). page 13,20

Spectral Bands Required:
Resolution (Time):
(Space):

Ancillary Data Required (Type and Source):
Sea surface temperature imagery from AVHRR or similar sensor. Ancillary information gathered from supporting ship and airborne observations acquired with the AOL page 13

Pre-Launch: **Size (Mbytes):**
Post-Launch: **Size (Mbytes):**

Algorithm Complexity (floating point operations/scan):

Algorithm Memory Required (Mbytes):

Data Storage Required (Mbytes/scan):

Look-Up Tables Required:
Size (Mbytes):

Lines of Code:

Language Expected:

Accessory Output Products (e.g., field experiment data):
Pre-Launch: **Size (Mbytes):**
Post-Launch: **Size (Mbytes):**

Expected Need of SDST (Pre- or Post-Launch):
The MODIS Ocean Team (MOT) overview tables identify SDST support activities for each product, at-launch and post-launch. These include:

- product definition
- integrated processing system
- quality control process
- documentation
- utilities
- systems tests
- correction of problems

Post-Launch Expected Growth:

Quality Assessments: MODIS results will be validated with overflights with the AOL and with observations from research vessels. page 17

Special Tilt Modes Required:

Notes: The algorithm development will be executed in large part by using the NASA Airborne Oceanographic Lidar (AOL) and research vessel measurements. The mid-Atlantic bight region is the primary test site to be used for algorithm development. page 12,13,14

It is anticipated that simulated MODIS data will be available to aid in the final development stages of the algorithms. page 17

If requested, the ancillary data collected in conjunction with this proposal will be submitted to the EOSDIS. The AOL data is described. Supporting shipboard measurements would be reformatted as appropriate. page 18

All software and algorithms developed in connection with EOS will be furnished to EOSDIS with full documentation. page 22

MODIS Team Member Proposal
Data Requirements Form

Investigator: Parslow, John

Output Product(s):

(1) Absorption coefficient (at 440 nm) due to eukaryotic phytoplankton
(2) Absorption coefficient (at 440 nm) due to gelbstoff
(3) Absorption coefficient (at 440 nm) due to non-chlorophyllous particulates
(4) Back-scatter coefficient (at 550 nm) for total particulates
(5) Angstrom coefficient for particulate backscatter page 5

Note: These products, and possibly others, are to be generated using the PI's multiple-constituent inverse modelling algorithm. page 1

Resolution (Time):
(Space):
Domain (Space): Global

At/Post-Launch: At-Launch with refinements Post-Launch page 4

MODIS-N/T: MODIS-N and MODIS-T

Input Data:

Spectral Bands Required:
Sub-surface spectral reflectance in the ocean channels from MODIS-N and in all channels (410 to 840nm) for MODIS-T at full spatial resolution page 5

Resolution (Time): Full
(Space): Full

Ancillary Data Required (Type and Source):
In-situ field data, Australian Ocean Color Scanner, imaging spectrometer, SEAWIFS, WOCE, JGOFS, simulated data products from EOSDIS for algorithm development and product validation page 5,6

Pre-Launch: **Size (Mbytes):**
Post-Launch: **Size (Mbytes):**

Algorithm Complexity (floating point operations/scan):

Algorithm Memory Required (Mbytes):

Data Storage Required (Mbytes/scan):

Look-Up Tables Required:
Size (Mbytes):

Lines of Code:

Language Expected: C

Accessory Output Products (e.g., field experiment data):
Pre-Launch: **Size (Mbytes):**
Post-Launch: **Size (Mbytes):**

Expected Need of SDST (Pre- or Post-Launch):
The MODIS Ocean Team (MOT) overview tables identify SDST support activities for each product, at-launch and post-launch. These include:

- product definition
- integrated processing system
- quality control process
- documentation
- utilities
- systems tests
- correction of problems

Post-Launch Expected Growth:

Quality Assessments:

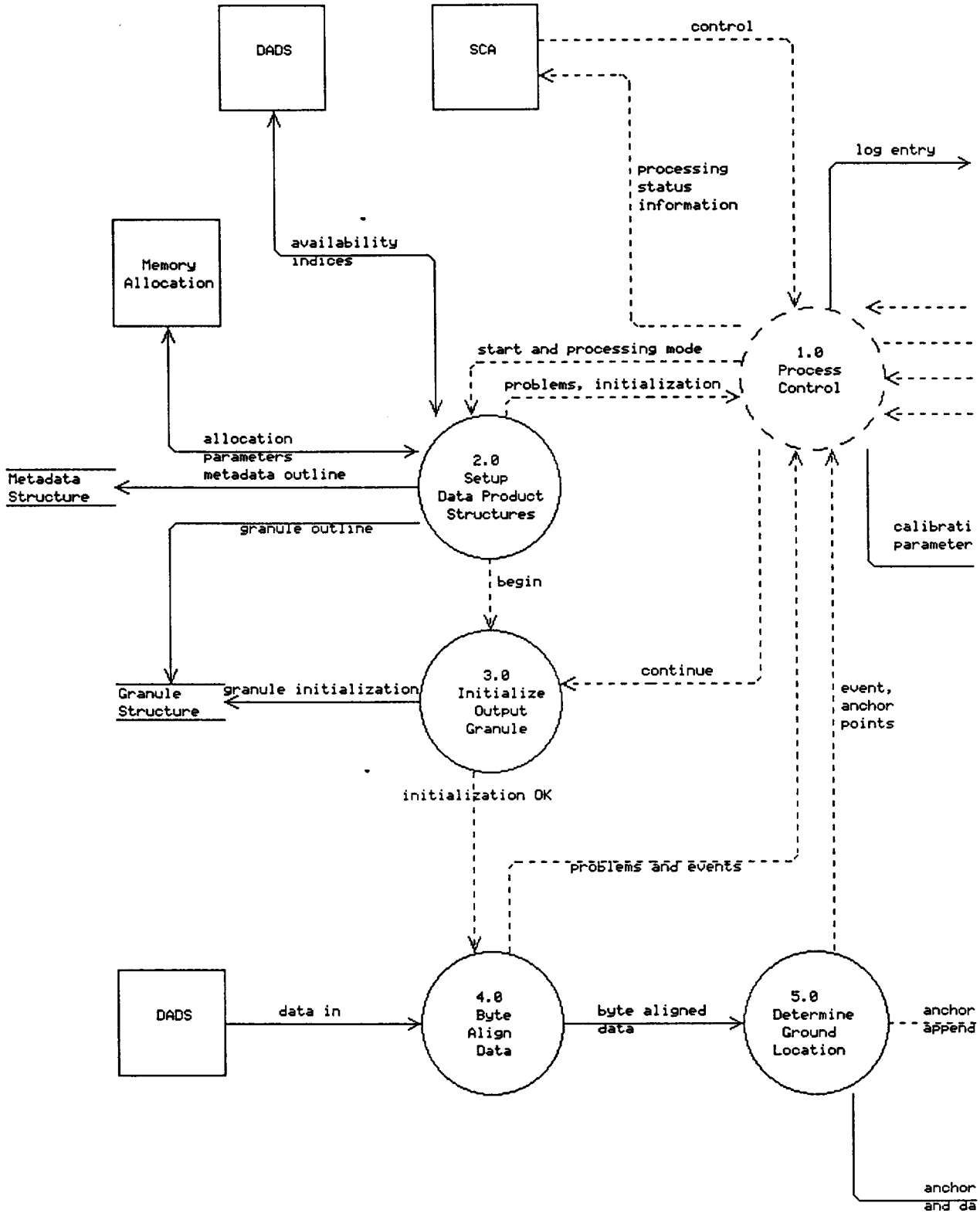
Special Tilt Modes Required:

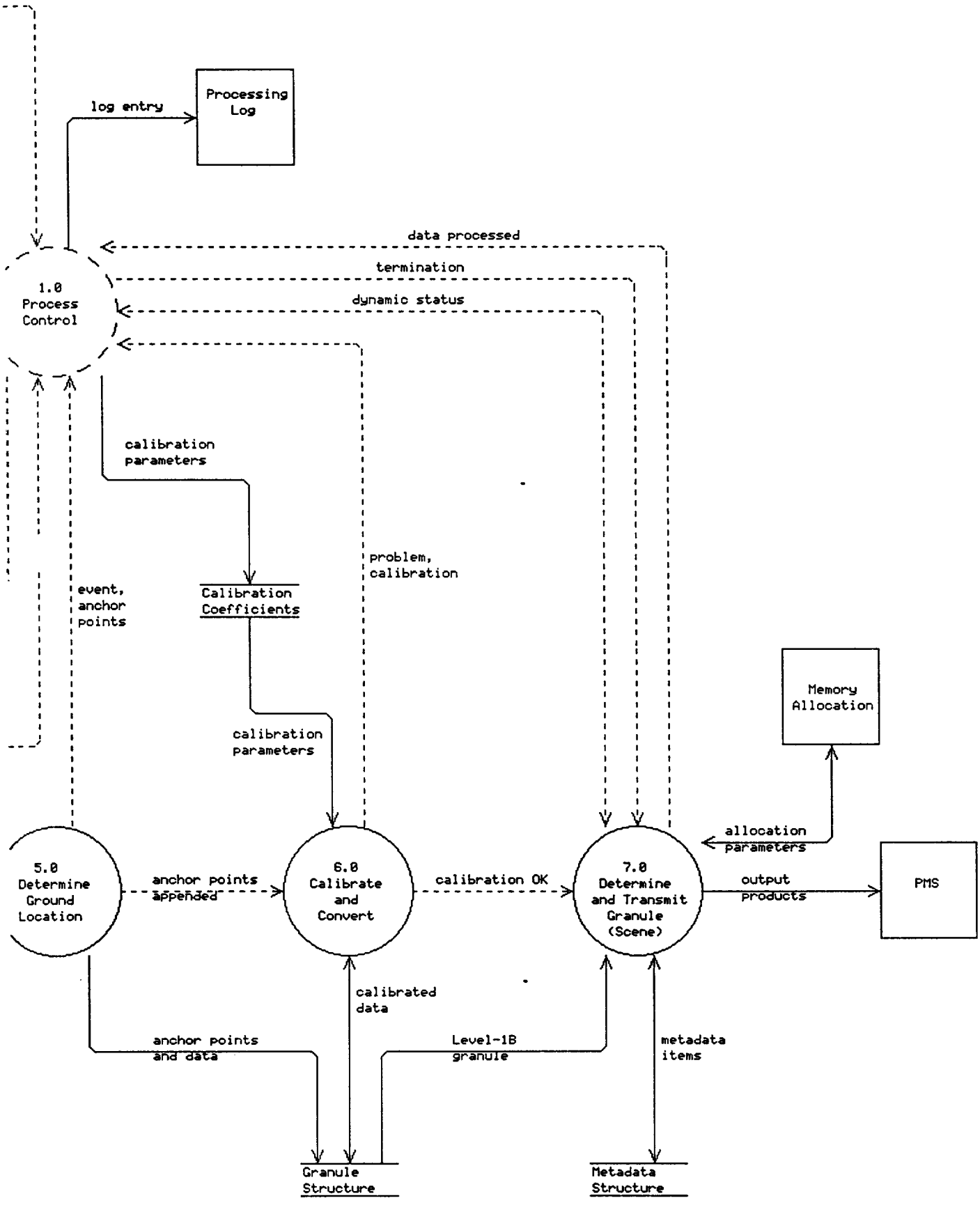
Notes: PI anticipates that the inverse modelling algorithm will be implemented and run on global data sets by EOSDIS.

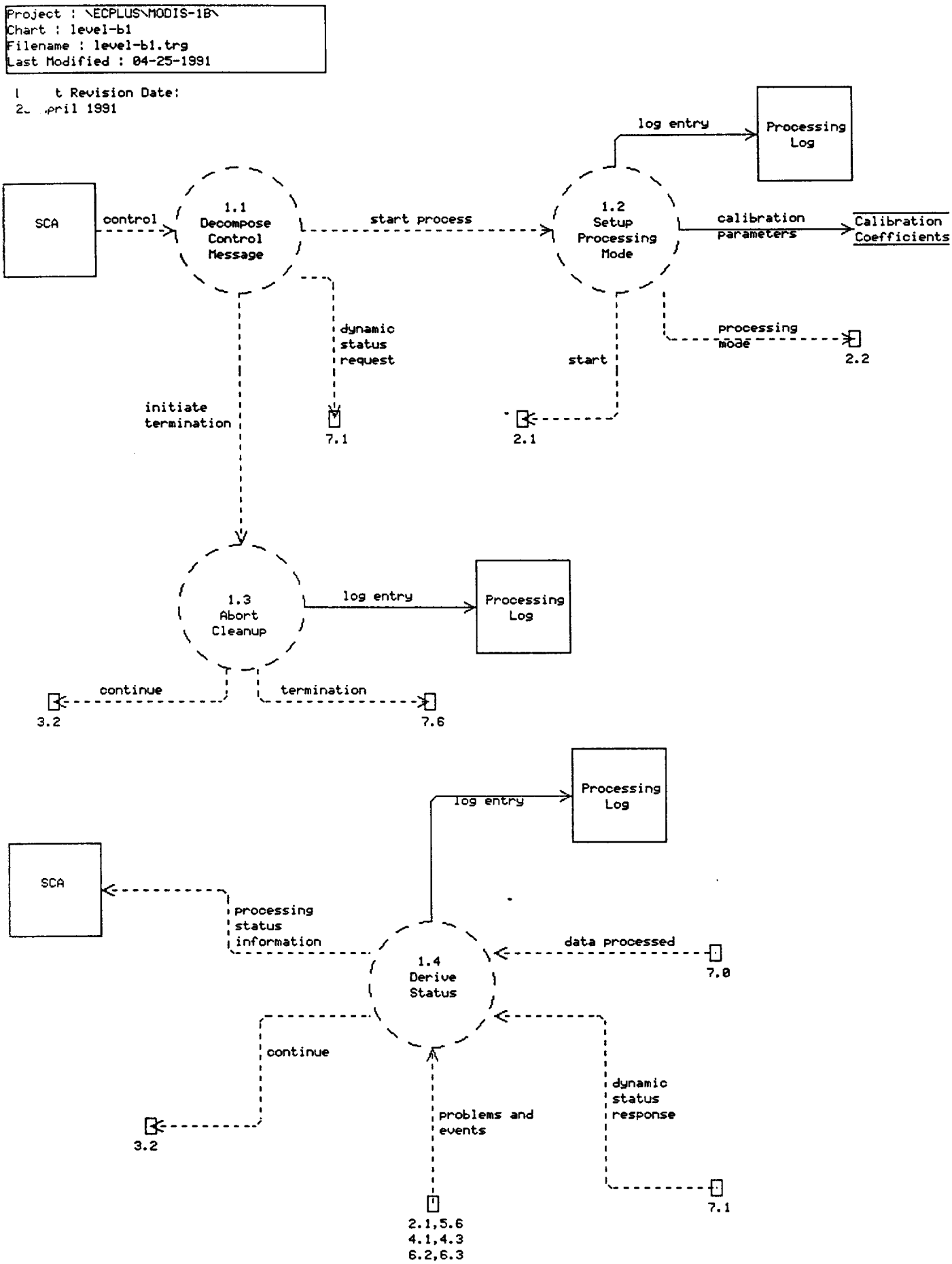
APPENDIX

Project : \ECPLUS\MODIS-1B\
Chart : level-a
Filename : level-a.trg
Last Modified : 04-25-1991

l t Revision Date:
24 April 1991

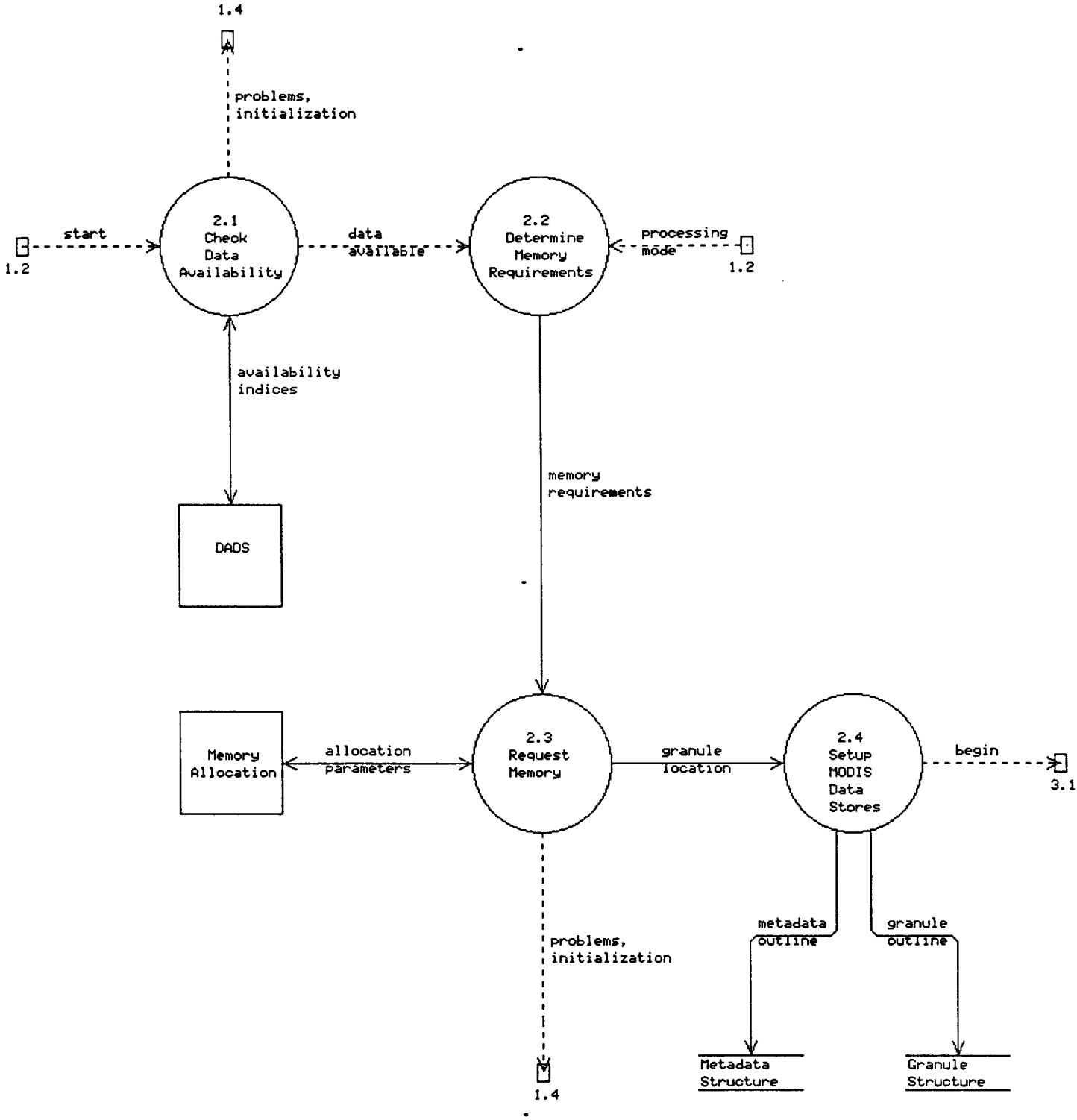



log entry
Processing Log
data processed
termination
1.0 Process Control
dynamic status
calibration parameters
problem, calibration
event, anchor points
Calibration Coefficients
calibration parameters
Memory Allocation
allocation parameters
5.0 Determine Ground Location
anchor points appended
6.0 Calibrate and Convert
calibration OK
7.0 Determine and Transmit Granule (Scene)
output products
PMS
calibrated data
anchor points and data
Level-1B granule
metadata items
Granule Structure
Metadata Structure


Project : \ECPLUS\MODIS-1B\
Chart : level-b1
Filename : level-b1.trg
Last Modified : 04-25-1991
t Revision Date:
April 1991
SCA
control
1.1
Decompose
Control
Message
start process
1.2
Setup
Processing
Mode
log entry
Processing
Log
calibration
parameters
Calibration
Coefficients
dynamic
status
request
7.1
start
2.1
processing
mode
2.2
initiate
termination
1.3
Abort
Cleanup
log entry
Processing
Log
continue
3.2
termination
7.6
Processing
Log
log entry
SCA
processing
status
information
1.4
Derive
Status
data processed
7.0
continue
3.2
problems and
events
2.1,5.6
4.1,4.3
6.2,6.3
dynamic
status
response
7.1

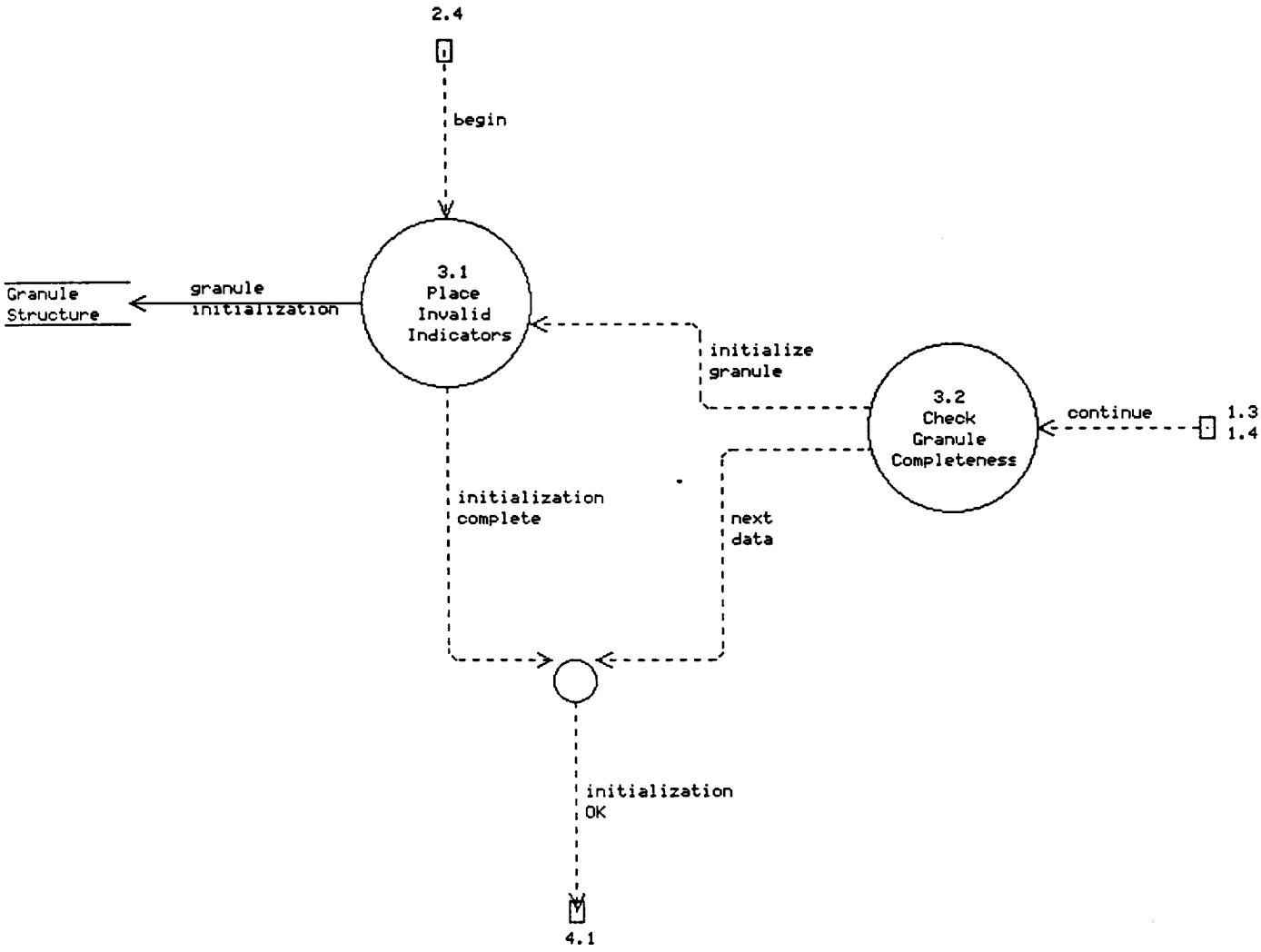
Project : \ECPLUS\MODIS-1B\
Chart : level-b2
Filename : level-b2.trg
Last Modified : 04-25-1991

l t Revision Date:
2. pril 1991



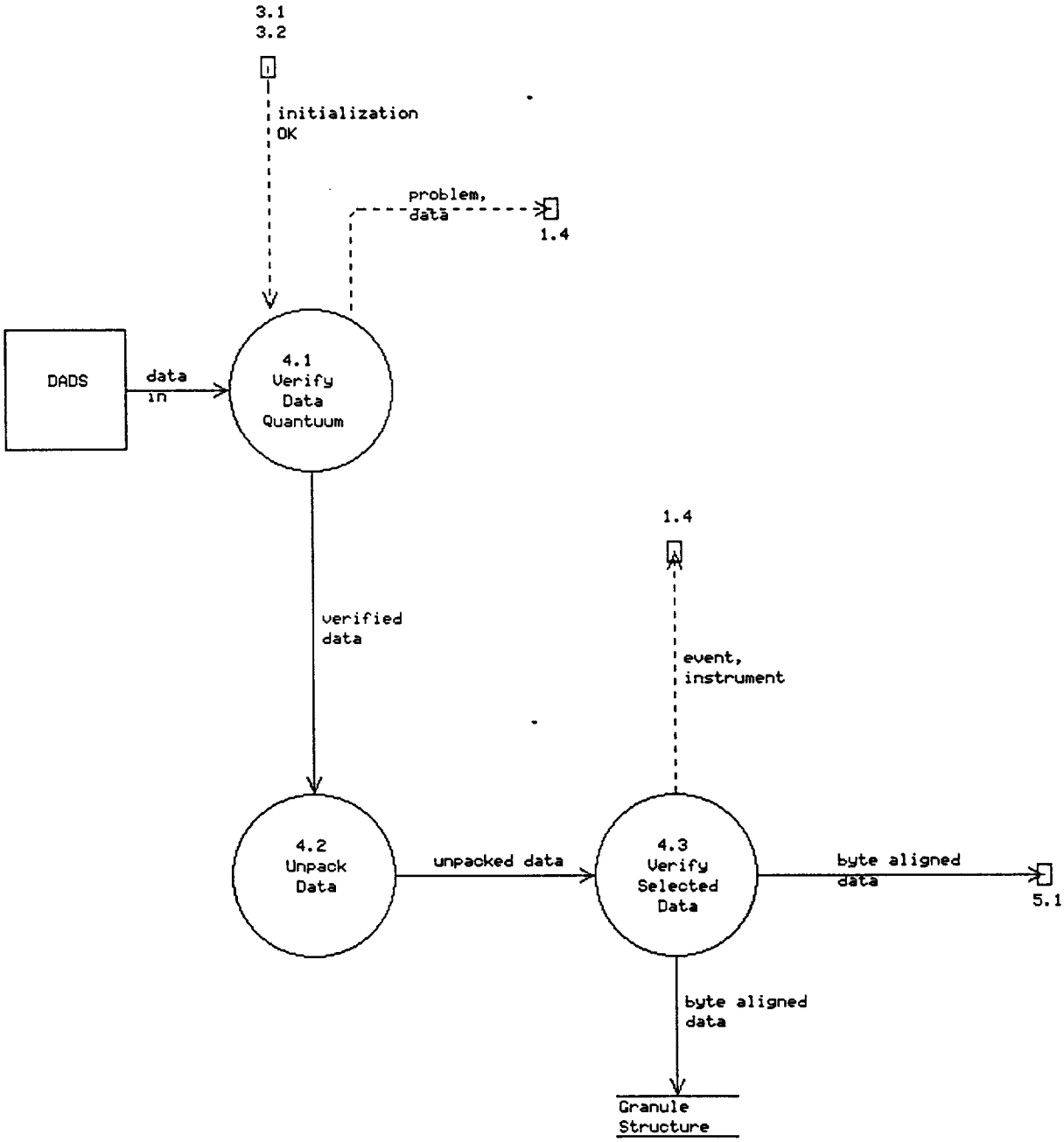
Project : \ECPLUS\MODIS-1B\
Chart : level-b3
Filename : level-b3.trg
Last Modified : 04-25-1991

l t Revision Date
2. pril 1991



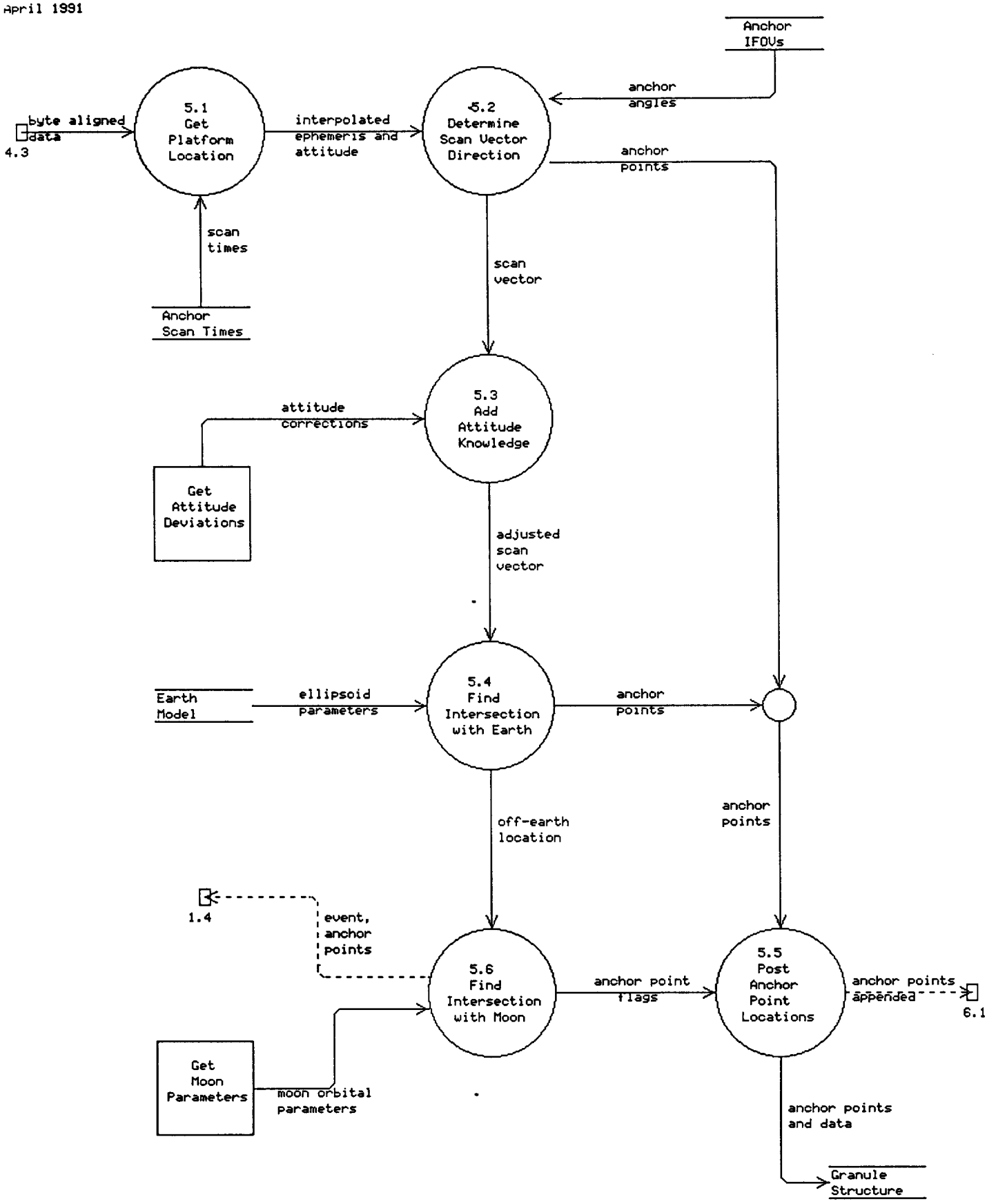
Project : \ECPLUS\MODIS-1B\
Chart : level-b4
Filename : level-b4.trg
Last Modified : 04-25-1991

st Revision Date:
April 1991



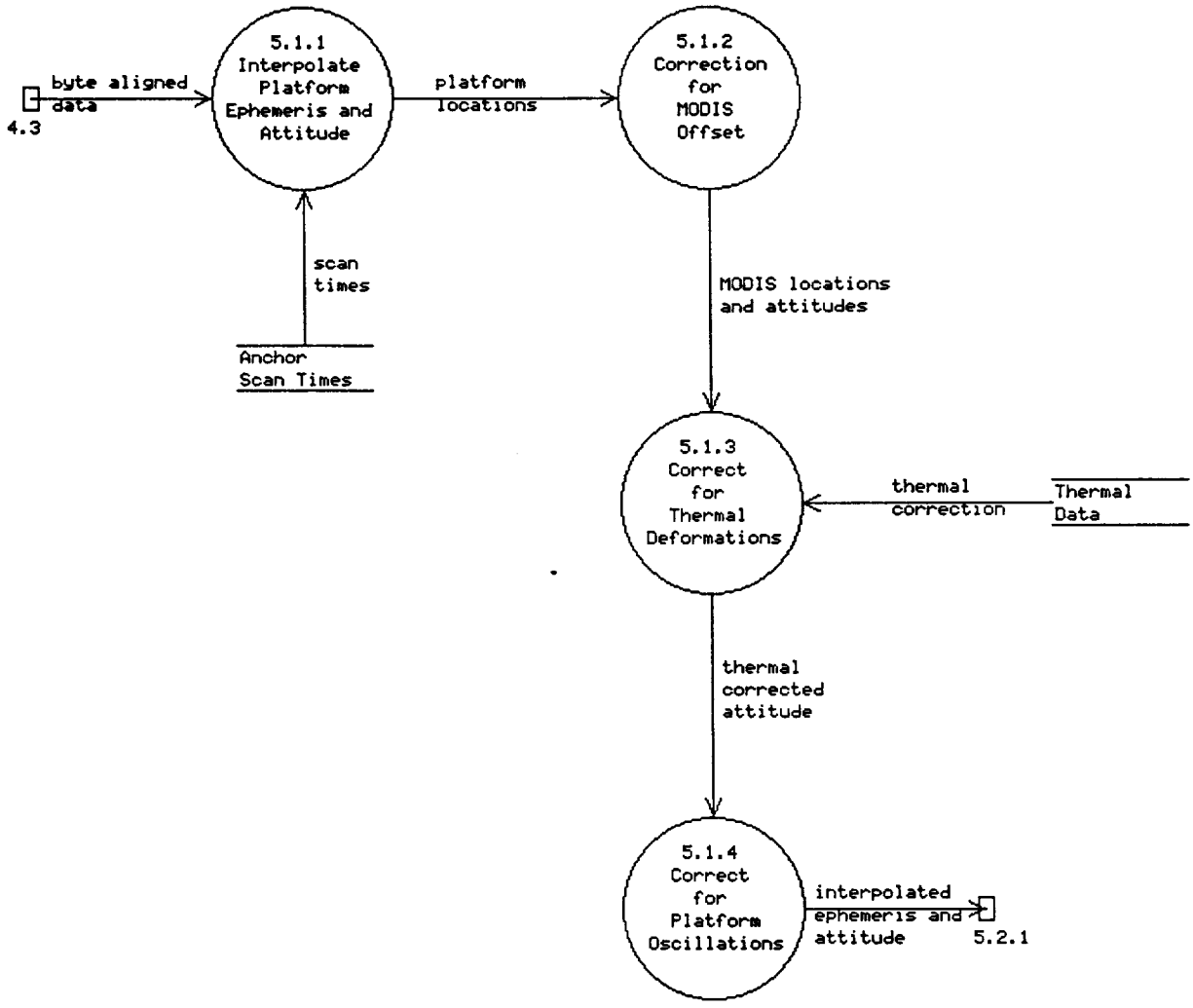
Project : \ECPLUS\MODIS-1B\
Chart : level-b5
Filename : level-b5.trg
Last Modified : 04-25-1991

st Revision Date:
April 1991



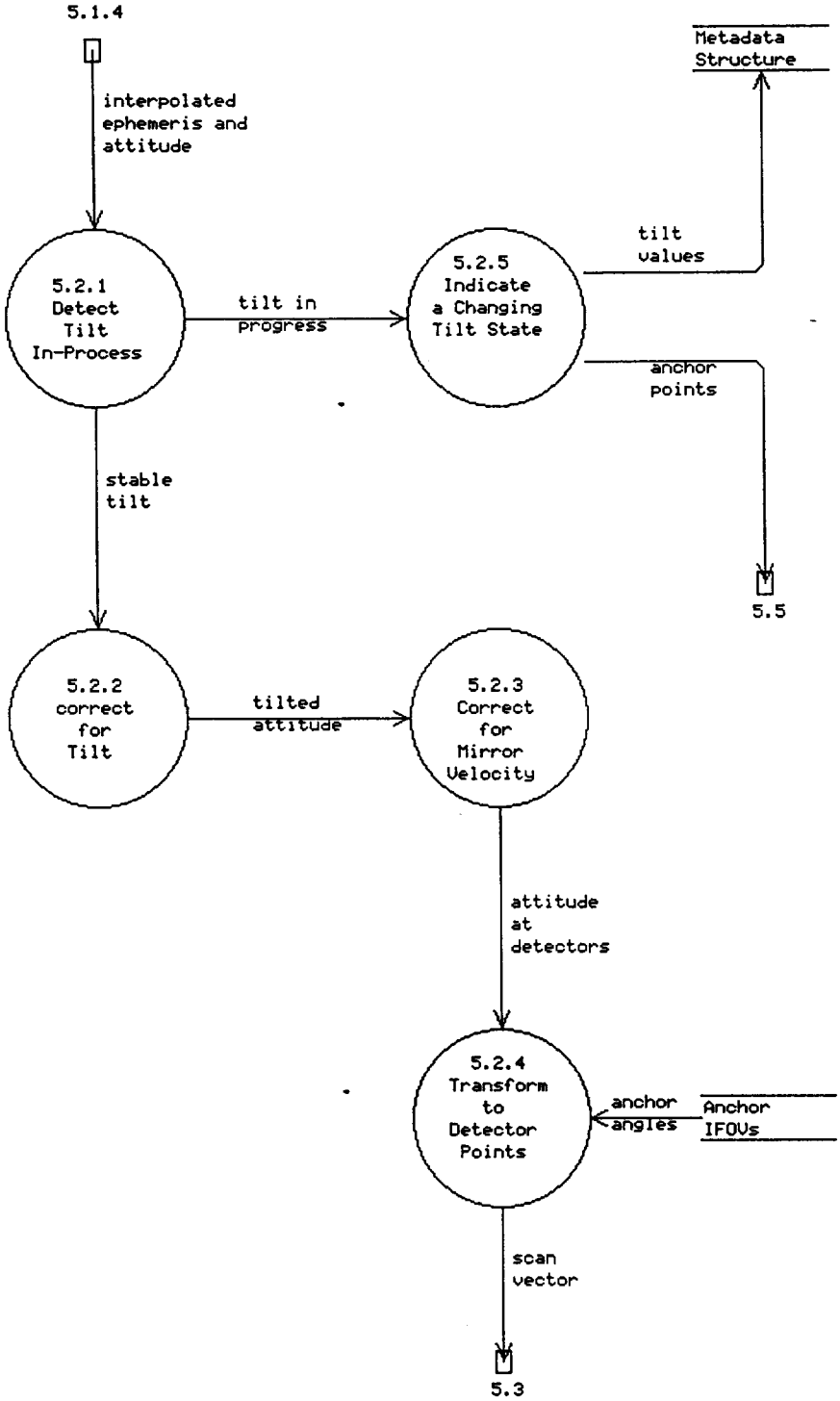
Project : \ECPLUS\MODIS-1B\
Chart : lvl-c51
Filename : lvl-c51.trg
Last Modified : 04-25-1991

1 t Revision Date:
2. pril 1991



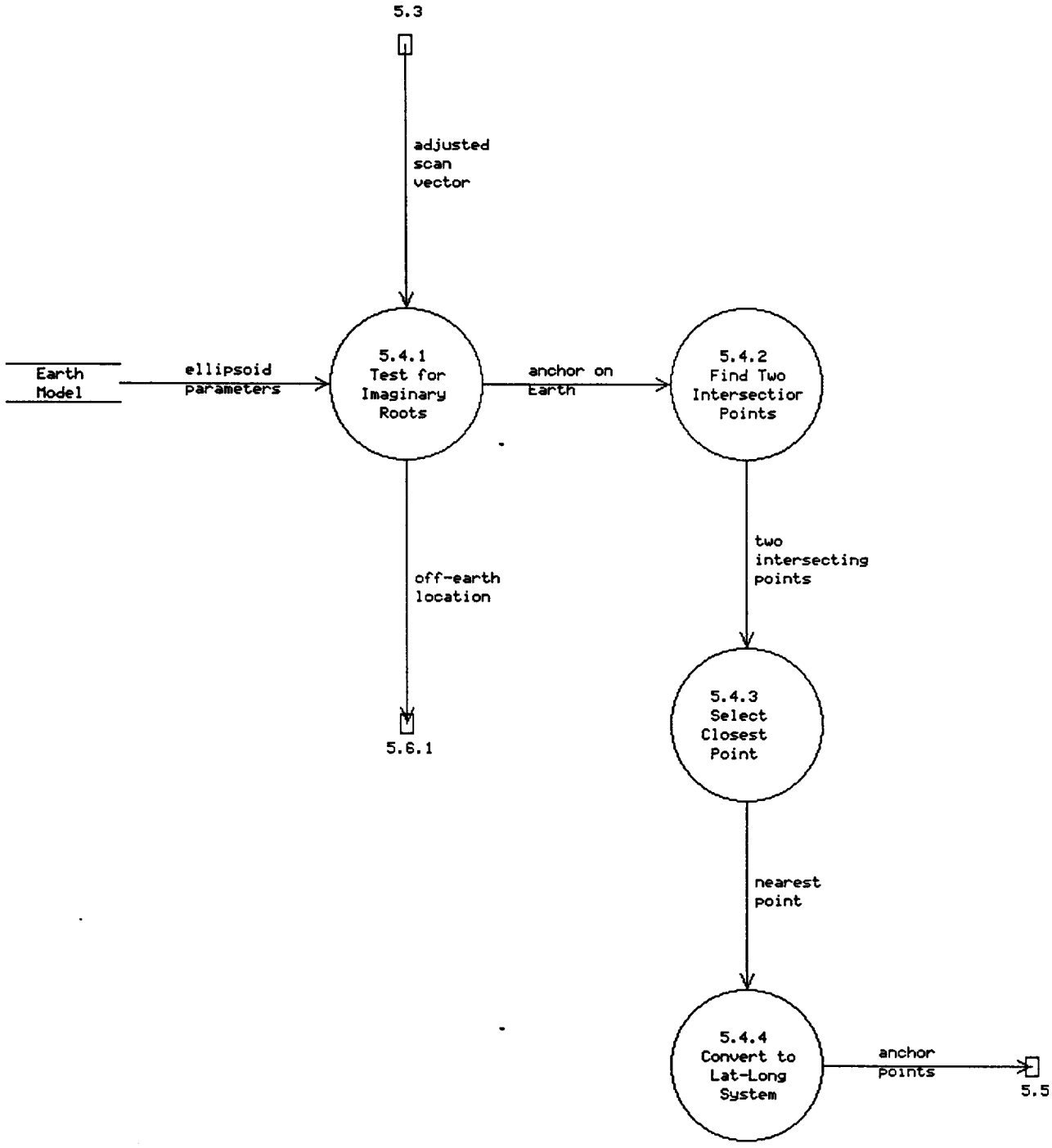
Project : \ECPLUS\MODIS-1B\
Chart : lvl-c52
Filename : lvl-c52.trg
Last Modified : 04-25-1991

st Revision Date:
April 1991



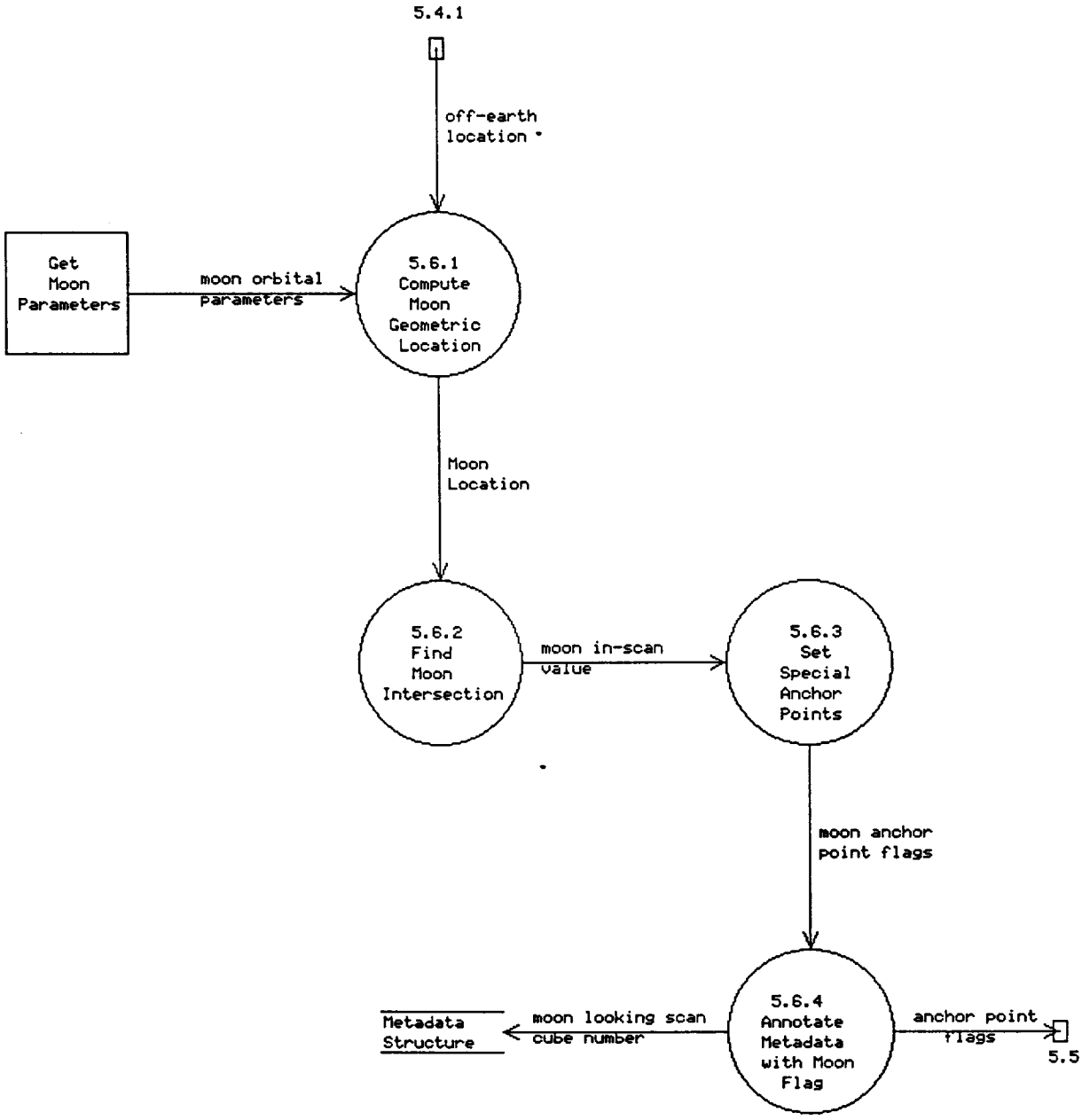
Project : \ECPLUS\MODIS-1B\
Chart : lvl-c54
Filename : lvl-c54.trg
Last Modified : 04-25-1991

l t Revision Date:
2. pril 1991



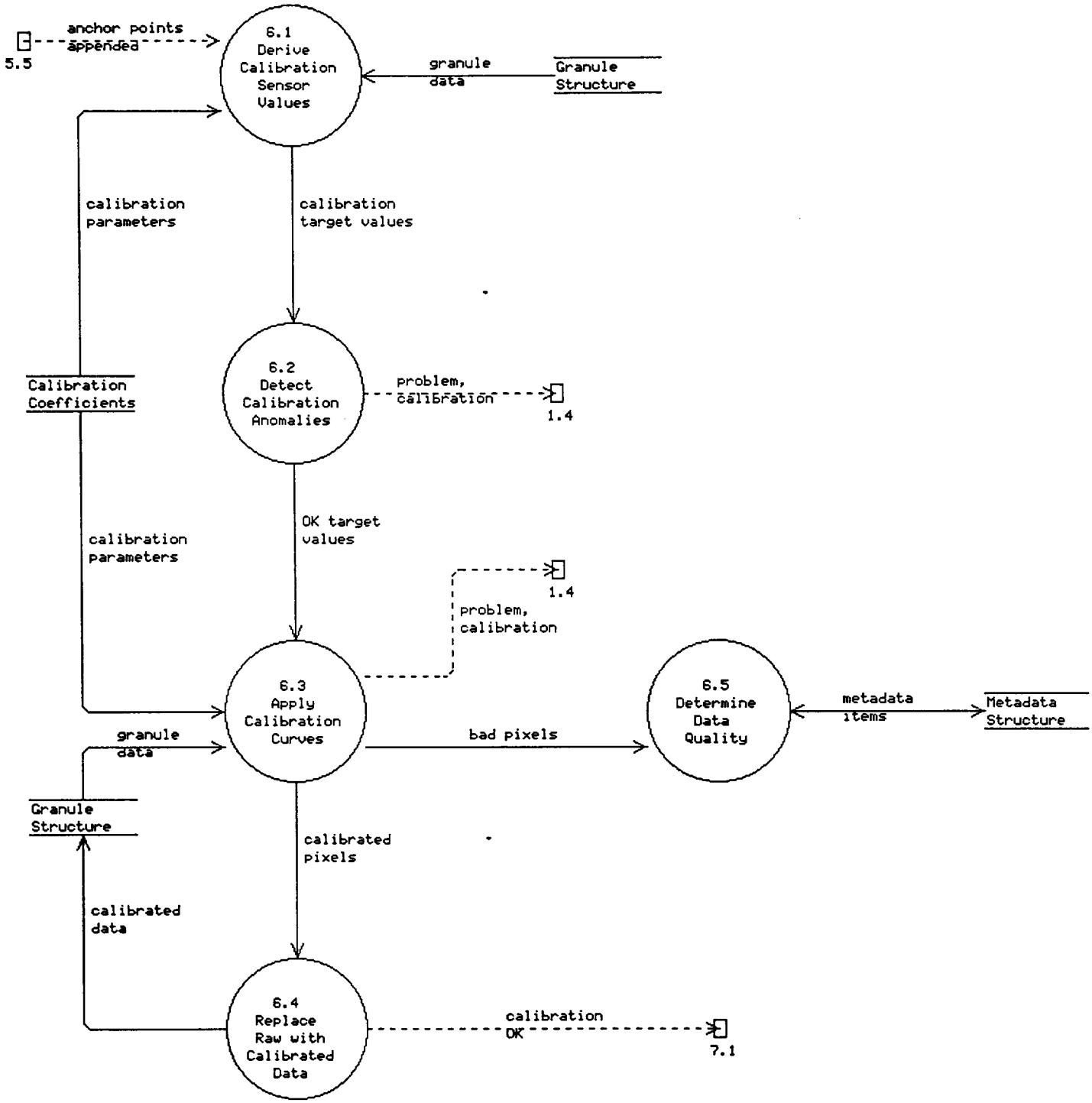
Project : \ECPLUS\MODIS-1B\
Chart : lvl-c56
Filename : lvl-c56.trg
Last Modified : 04-25-1991

L t Revision Date:
2. pril 1991



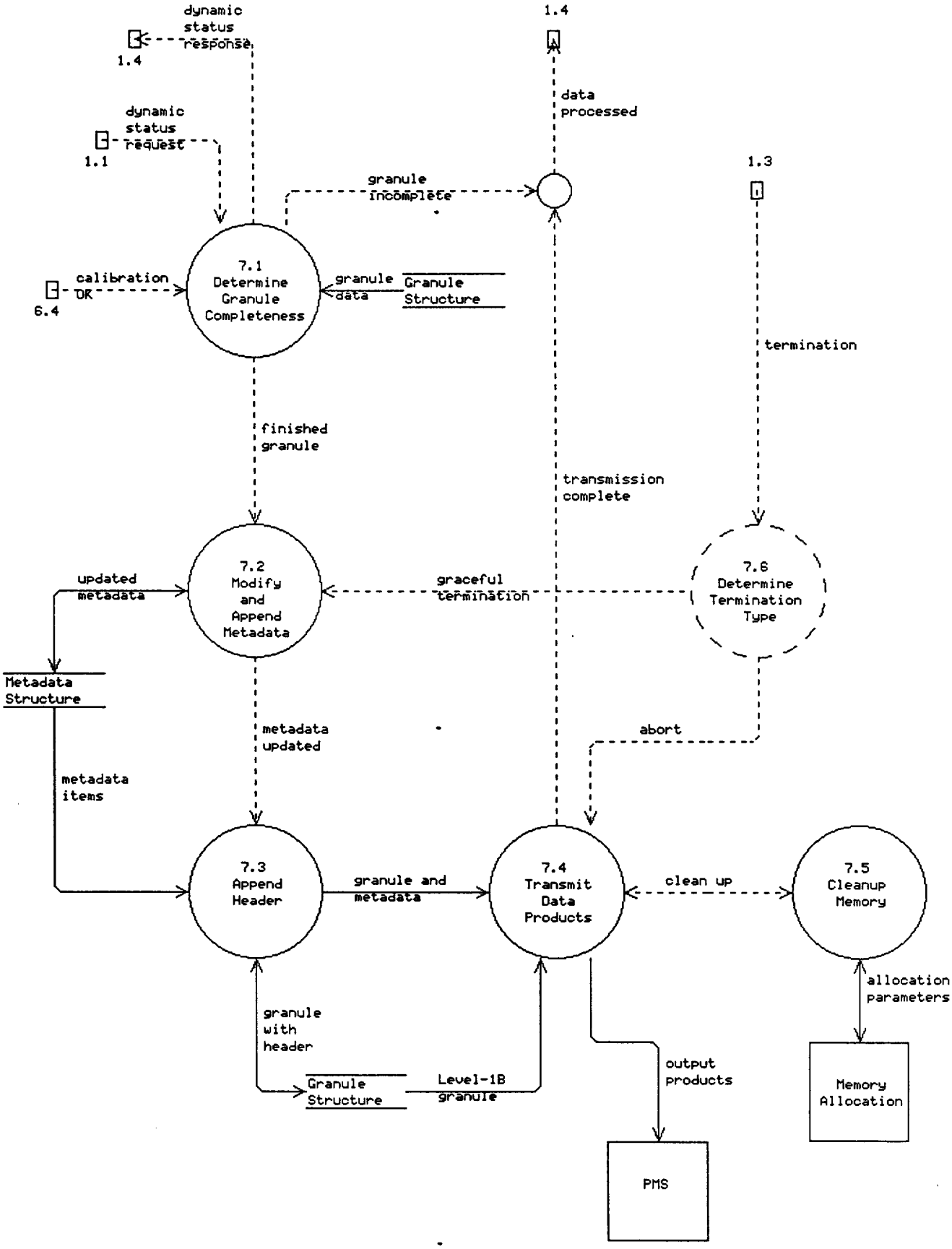
Project : \ECPLUS\MODIS-1B\
Chart : level-b6
Filename : level-b6.trg
Last Modified : 04-25-1991

l t Revision Date:
2. pril 1991



Project : \ECPLUS\MODIS-1B\
Chart : level-b7
Filename : level-b7.trg
Last Modified : 04-25-1991

1 t Revision Date:
2. pril 1991



Abort
Type: Control Flow
Location: 7.6, 7.4
An indication to perform an immediate abort by releasing system resources (memory and disk space). The program ultimately responds with a termination acknowledge message to the SCA.

Abort Cleanup
Type: Control Transform
Location: 1.3
Processes termination messages into the proper flow control items: either a graceful termination (all files written and closed) or abort-now condition (immediate termination without posting files). Posts an entry to the Processing Log.

Add Attitude Knowledge
Type: Data Process
Location: 5.3
Correct the computed instrument scan vector for any empirically derived anomalies. These may be derived from ground control point convolutions or other techniques and are contained in a periodically updated database. DEM and refraction may be added here.

Adjusted Scan Vector
Type: Data Flow
Location: 5.3, 5.4.1
The sensor scan vector corrected for any perturbations - derived or observed.

Allocation Parameters
Type: Data Flow
Location: Memory Allocation, 2.3, 7.5
A request to the operating system for storage allocation and a response with the storage parameters or alternately, an error message.

Anchor Angles
Type: Data Flow
Location: Anchor IFOVs, 5.2.4
The angular offsets from the instrument nadir vector for each of the anchor points.

Anchor IFOVs
Type: Data Store
Location: 5.2.4
A data store containing the scan definitions of the points for which ground anchor locations will be computed.

Anchor on Earth
Type: Data Flow
Location: 5.4.1, 5.4.2
A positive number indicating that the scan vector intersects the Earth.

Anchor Point Flags
Type: Data Flow
Location: 5.6.4, 5.5
Flags indicating the presence of a scan vector to Moon intersection. Pixel data and scan vector angles may be saved here for calibration and attitude purposes.

Anchor Points
Type: Data Flow
Location: 5.2.5, 5.4.4, 5.5
The location of the ground anchor points in Earth coordinates.

Anchor Points and Data
Type: Data Flow
Location: 5.5, Granule Structure
A quantum of level-1A data, byte aligned, with ground located anchor points and associated flags. This also includes the solar and satellite, azimuth and zenith angles.

Anchor Points Appended
Type: Control Flow
Location: 5.5, 6.1
An indication that the ground location anchor points have been appended to the granule (scene).

Anchor Scan Times
Type: Data Store
Location: 5.1.1
The spacecraft offset times from the reference scan cube time for each of the ground anchor points. This is a function of the instrument scan rates.

Annotate Metadata with Moon Flag
Type: Data Process
Location: 5.6.4
Update or create a metadata item that indicates the cube number and time of a Moon scan vector intersection.

Append Header
Type: Data Process
Location: 7.3
Create and append the granule header. This is a superset of the Metadata items.

Apply Calibration Curves
Type: Data Process
Location: 6.3
For every science pixel, apply the calibration equations taking the gain bit into consideration. Test for inconsistencies and generate SCA reports, invalid flags, and default values.

Attitude at Detectors
Type: Data Flow
Location: 5.2.3, 5.2.4
The scan cube with anchor points that have been corrected for the current location of the scan mirror.

Attitude Corrections
Type: Data Flow
Location: Get Attitude Deviations, 5.3
Small correction angles used to further improve the attitude information.

Availability Indices
Type: Data Flow
Location: 2.1, DADS
An enquiry to and a response from the external database containing a map of the data set sizes and completeness that is used to determine if the MODIS Level-1B processing can be properly performed.

Bad Pixels
Type: Data Flow
Location: 6.3, 6.5
Pixels of data that can not be calibrated properly. This is used for Data Quality Assessment. This function can be expanded to include data validation.

Begin
Type: Control Flow
Location: 2.4, 3.1
An indication to begin processing MODIS data.

Byte Align Data
Type: Data Process
Location: 4.0
Extract the data from the scan cube and byte/word align it. This places the data into a valid computer data type.

Byte Aligned Data
Type: Data Flow
Location: 4.3, 5.1.1, Granule Structure
MODIS data that has been placed into a valid computer data word type.

Calibrate and Convert
Type: Data Process
Location: 6.0
Convert the raw counts data to their physical measurements. Science data to albedo or energy values, engineering data to temperatures, positions, rates, etc.

Calibrated Data
Type: Data Flow
Location: 6.4, Granule Structure
The data contained in the granule subset (quantum or scan cube) that is converted from instrument digital counts to the proper science or engineering dimensional units.

Calibrated Pixels
Type: Data Flow
Location: 6.3, 6.4
Science data values that have been calibrated to at instrument radiances.

Calibration Coefficients
Type: Data Store
Location: 1.2, 6.1, 6.3
Parameters used to calibrate both the engineering and the science data from the instrument. This includes any instrument characterization information.

Calibration OK
Type: Control Flow
Location: 6.4, 7.1
An indication that the MODIS data has been calibrated and converted to its final Level-1B format.

Calibration Parameters
Type: Data Flow
Location: 1.2, 6.1, 6.3
Any data values or algorithms that are used to calibrate the instrument data.

Calibration Target Values
Type: Data Flow
Location: 6.1, 6.2
Data values that may be used to perform calibration on the science pixel values. This may include temperatures or non-Earth pointing data values.

Check Data Availability
Type: Data Process
Location: 2.1
Perform a verification that the data (MODIS Level-1B granule and Metadata) required to complete the output granule is available to this MODIS Level-1B program.

Check Granule Completeness
Type: Data Process
Location: 3.2
Determine if the computer output granule store has been posted to disk and enable this store initialization if true.

Clean Up
Type: Control Flow
Location: 7.4, 7.5
An indication to perform the final clean up of data stores, posting a post event record to the SCA via this program's control mechanism.

Cleanup Memory
Type: Data Process
Location: 7.5
Deallocate the computer memory and disk store areas.

Compute Moon Geometric Location
Type: Data Process
Location: 5.6.1
Given the orbital parameters of the Moon, calculate the current location of the Moon in the inertial coordinate system. This may be performed with an interpolated table lookup.

Continue
Type: Control Flow
Location: 1.3, 1.4, 3.2
An indication to continue the processing of MODIS data.

Control
Type: Control Flow
Location: SCA, 1.1
Messages from the EOSDIS scheduler containing start, finish, and requests for dynamic status.

Convert to Lat-Long System
Type: Data Process
Location: 5.4.4
Convert the nearest scan vector to Earth intersection point from the inertial coordinate system to the latitude longitude coordinate system.

Correct for Mirror Velocity
Type: Data Process
Location: 5.2.3
Correct the anchor point vectors for any anomalies in the position of the scan mirror as a function of time or mirror position.

Correct for Platform Oscillation
Type: Data Process
Location: 5.1.4
Correct the MODIS attitude (and position) for oscillations due to other instruments. This requires knowledge of the dynamics of other devices derived from the ancillary data stream attached to the MODIS level-1A data product.

Correct for Thermal Deformations
Type: Data Process
Location: 5.1.3
Correct the MODIS instrument attitude for platform thermal deformations. Thermal data is obtained from the telemetry stream and calibrated with thermistor curves.

Correct for Tilt
Type: Data Process
Location: 5.2.2
Correct the anchor points for the MODIS-T Tilt angle. Account for any instrument tilt settling dynamics.

Correction for MODIS Offset
Type: Data Process
Location: 5.1.2
Perform a coordinate transformation to correct the platform position and attitude to the MODIS position and attitude.

DADS
Type: External Entity
Location: 2.0 4.0
Data Archive and Distribution System. The EOSDIS core system program that manages the input and output product databases.

Data Available
Type: Control Flow
Location: 2.1, 2.2
An indication that the data sets required to process the output granule(s) are available from the external database storage. This is expected to be in the form of database indices.

Data In
Type: Data Flow
Location: DADS, 4.1
Level-1A data products generated by the MODIS Level-1A program. This consists of the Level-1A data granule and the Level-1A Metadata.

Data Processed
Type: Control Flow
Location: 7.1, 7.4, 1.4
An indication that data has been processed and more data is needed. This also indicates the completion of a granule (scene) of data.

Decompose Control Message
Type: Control Transform
Location: 1.1
Decomposes the incoming message to determine the type of message and where to send it.

Derive Calibration Sensor Values
Type: Data Process
Location: 6.1
Find the quantitative values for known calibration spots (truth values). This includes in-situ (on Earth), off Earth, and/or on-instrument spots. Also included are dark current and per sensor array element corrections.

Derive Status
Type: Control Transform
Location: 1.4
Handles problem (alarm) and event messages as well as data termination messages, posts entries to the Processing Log, and passes a Post Processing message to the SCA.

Detect Calibration Anomalies
Type: Data Process
Location: 6.2
Look for inconsistencies in the calibration targets defined in 6.1. Alert the SCA of any problems, assume default conditions, and flag the data as incompletely calibrated.

Detect Tilt In-Process
Type: Data Process
Location: 5.2.1
Compare the tilt angle before the scan cube with the tilt angle after the scan cube. This implies a tilt encoder reading before and after the immediate ground scan. Ground anchor points can not be determined if the tilt angle is changing.

Determine and Transmit Granule
Type: Data Process
Location: 7.0
Perform final accounting at the output granule (scene) level. Create the granule header. Update or generate the metadata items. Transmit the data to the PMS. Deallocate memory and disc stores.

Determine Data Quality
Type: Data Process
Location: 6.5
Derive any data quality indications for both the post processing record and the Metadata (and headers). These data quality indicators are TBD.

Determine Granule Completeness
Type: Data Process
Location: 7.1
Determines if an output granule (scene) has been completed. If so, pass the granule to further processing. If not, indicate to the control processes that more data needs to be processed.

Determine Ground Location
Type: Data Process
Location: 5.0
Determine the ground anchor points and append this data to the output granule.

Determine Memory Requirements
Type: Data Process
Location: 2.2
Calculate the memory and disk size requirements, knowing the processing mode, number of output granules, or other parameters.

Determine Scan Vector Direction
Type: Data Process
Location: 5.2
Using the spacecraft attitude and instrument geometry, determine the look angles for each anchor point. This includes instrument attitude corrections such as tilt, scan mirror velocities, and detector geometry.

Determine Termination Type
Type: Control Transform
Location: 7.6
Derive the abort or graceful termination type.

Dynamic Status
Type: Control Flow
Location: 1.0, 7.0
The request for and returning of dynamic status information.

Dynamic Status Request
Type: Control Flow
Location: 1.1, 7.1
A message originating via the SCA requesting that current processing information be posted into a return message. See Dynamic Status Response.

Dynamic Status Response
Type: Control Flow
Location: 7.1, 1.4
An internally generated message to be sent to the SCA that indicates the current status (accounting) of the data processing task. See also Dynamic Status Request.

Earth Model
Type: Data Store
Location: 5.4.1
The description of the Earth ellipsoid (actually an oblate spheroid).

Ellipsoid Parameters
Type: Data Flow
Location: Earth Model, 5.4.1
The parameters used in the Earth ellipsoid model

Event, Anchor Points
Type: Control Flow
Location: 5.6, 1.4
An anomaly has occurred in the calculation of the anchor points. This may indicate an off Earth point, Moon looking point, illegal point, or a numerical problem.

Event, Instrument
Type: Control Flow
Location: 4.3, 1.4
An indication that an instrument event has been detected with a description of that event.

Find Intersection with Earth
Type: Data Process
Location: 5.4
Perform an analytical computation to determine the intersection of the scan pointing vector and the Earth ellipsoid. Determine if this intersection exists. Also determine if this is a Moon looking scan. This is still in the inertial coordinate system.

Find Intersection with Moon
Type: Data Process
Location: 5.6
Calculate the intersection of the scan vector with the Moon. Set the Land Sea Moon Space flag accordingly. Pixels looking at the Moon can be used for calibration and scan angles at the Moon boundaries can be used for attitude correction.

Find Moon Intersection
Type: Data Process
Location: 5.6.2
Compute the intersection of the anchor point scan vector and an enlarged Moon. Determine if this intersection exists.

Find Two Intersection Points
Type: Data Process
Location: 5.4.2
Compute the locations of the two intersecting points between the scan vector and the elliptical Earth.

Finished Granule
Type: Control Flow
Location: 7.1, 7.2
An indication that a granule of output data has been completed.

Get Attitude Deviations
Type: External Entity
Location: 5.3
A process (currently external) that returns the small attitude corrections required to correct the attitude accuracy to an attitude knowledge specification. This may consist of platform and instrument deformations, and ground control point corrections.

Get Moon Parameters
Type: External Entity
Location: 5.6
A routine that returns the position and size of the Moon given a UTC time.

Get Platform Location
Type: Data Process
Location: 5.1
Obtain the spacecraft location and attitude in the inertial coordinate system coincident with the time of each ground anchor point scan. This includes MODIS platform offsets, thermal deformations, and oscillations due to other instruments.

Graceful Termination
Type: Control Flow
Location: 7.6, 7.2
An indication to perform a graceful, post data and update metadata, termination.

Granule and Metadata
Type: Data Flow
Location: 7.3, 7.4
The fully completed Level-1B data granule (scene) and its Metadata.

Granule Data
Type: Data Flow
Location: Granule Structure, 6.1, 6.3, 7.1
The data contained within the granule.

Granule Incomplete
Type: Control Flow
Location: 7.1, 1.4
An indication that a data granule is not complete and more data is needed. (A component of "Data Processed".)

Granule Initialization
Type: Data Flow
Location: 3.1, Granule Structure
Data values that initialize the internal granule store area to invalid data indicators.

Granule Location
Type: Data Flow
Location: 2.3, 2.4
The memory addresses and file names of the data stores.

Granule Outline
Type: Data Flow
Location: 2.4, Granule Structure
Address, sizes and types of the MODIS Level-1B granule store area. Initialization does not occur here.

Granule Structure
Type: Data Store
Location: 2.4, 3.1, 4.3, 5.5, 6.1, 6.3, 6.4, 7.1, 7.3,
The storage area for the data set granule (scene) containing a header with metadata values and instrument science and engineering data. Ancillary data such as calibration coefficients are also included.

Granule With Header
Type: Data Flow
Location: 7.3, Granule Structure
The data granule (scene) with header information attached.

Indicate a Changing Tilt State
Type: Data Process
Location: 5.2.5
Set the anchor point location values to a flag condition that indicates that ground locations can not be calculated due to a changing tilt angle. Set anchor point flags to an 'unknown' indication.

Initialization Complete
Type: Control Flow
Location: 3.1, 4.1
An indication that the output granule (scene) store has been initialized with invalid data indicators.

Initialization OK
Type: Control Flow
Location: 3.1, 3.2, 4.1
An indication that the internal granule storage area has been initialized with invalid data indicators.

Initialize Granule
Type: Control Flow
Location: 3.2, 3.1
An indication to place the invalid data indicators into the output granule (scene) store.

Initialize Output Granule
Type: Data Process
Location: 3.0
Place invalid value indications into the output granule (scene) storage area in preparation for the next granule processing.

Initiate Termination
Type: Control Flow
Location: 1.1, 1.3
An indicator to begin program execution termination. This may be either an abort-now (close files, deallocate memory) or graceful termination (post data before abort).

Input
Type: Data Flow
Location: Context Diagram
Consists of: Level-1A data or quick-look and locally maintained databases. (S/C ancillary data is included in the Level-1A data at this time.)

Interpolate Platform Ephm & Att.
Type: Data Process
Location: 5.1.1
Using the aligned data, interpolate the platform ephemeris and attitude for each ground anchor point.

Interpolated Ephemeris & Att.
Type: Data Flow
Location: 5.1.4, 5.2.1
The spacecraft platform ephemeris and attitude and the time of the ground anchor points.

Level-1B Granule
Type: Data Flow
Location: Granule Structure, 7.4
The final processed MODIS Level-1B data granule.

Log Entry
Type: Data Flow
Location: 1.2, 1.3, 1.4, Processing Log
A record to be posted in the EOSDIS (or other) master Processing Log. This provides an audit trail.

Memory Allocation
Type: External Entity
Location:
An operating system memory (and disk) allocation routine. A process requests storage allocation and the system returns error or location parameters.

Memory Requirements
Type: Data Flow
Location: 2.2, 2.3
The derived size of the Level-1B storage areas needed to process the output granules (scenes) of data.

Metadata Items
Type: Data Flow
Location: Metadata Structure, 6.5, 7.3
The items in the Metadata structure that are updated or derived in this MODIS Level-1B program.

Metadata Outline
Type: Data Flow
Location: 2.4, Metadata Structure
Addresses, sizes, and types of the metadata store allocation. These values determine the metadata memory area and initial Level-1A metadata values including predefined values representing invalid data.

Metadata Structure
Type: Data Store
Location: 2.4, 5.2.5, 5.6.4, 6.5, 7.2
The storage area for the MODIS Level-1B metadata values.

Metadata Updated
Type: Control Flow
Location: 7.2, 7.3
An indication that the Metadata has been successfully updated.

Modify and Append Metadata
Type: Data Process
Location: 7.2
Update any Metadata items and derive any new ones. This are placed into the enlarged Metadata store.

MODIS Locations and Attitudes
Type: Data Flow
Location: 5.1.2, 5.1.3
The anchor point data within the scan cube which has been corrected for the MODIS platform location and relative attitude.

MODIS-1B Product Generation
Type: Data Process
Location: Context Diagram
The processor of MODIS Level-1A data products into MODIS Level-1B data products.

Moon Anchor Point Flags
Type: Data Flow
Location: 5.6.3, 5.6.4
The flags to be placed into the anchor point lat-long locations indicating a Moon or off-Earth intersection.

Moon In-scan Value
Type: Data Flow
Location: 5.6.2, 5.6.3
An indication that the intersection of the anchor point scan vector with the Moon neighborhood does or does not exist.

Moon Location
Type: Data Flow
Location: 5.6.1, 5.6.2
The location of the Moon and its "zone of intersection" (size) in the inertial coordinate system.

Moon Looking Scan Cube Number
Type: Data Flow
Location: 5.6.4, Metadata Structure
An annotation to be placed in the metadata that indicates which scan cubes in this granule have Moon looking pixels.

Moon Orbital Parameters
Type: Data Flow
Location: Get Moon Parameters, 5.6.1
Given the UTC time, return the position and size of the moon at the specified time.

Nearest Point
Type: Data Flow
Location: 5.4.3, 5.4.4
The scan vector to Earth intersection point that is nearest to the satellite, in the inertial coordinate system.

Next Data
Type: Control Flow
Location: 3.2, 4.1
An indication that the MODIS Level-1B program is ready for the next quantum of input data.

Off-Earth Location
Type: Data Flow
Location: 5.4.1, 5.6.1
Scan vectors that are not pointing at the Earth.

OK Target Values
Type: Data Flow
Location: 6.2, 6.3
Data values that may be used for calibration that have passed quality checks. This includes bounds and other sanity checks.

Output
Type: Data Flow
Location: Context Diagram
Consists of Level-1B products, Processing Log entries, Metadata, Browse data, and/or quick-look products.

Output Products
Type: Data Flow
Location: 7.4, PMS
MODIS Level-1B Products consisting of the data granules (scenes), enlarged Metadata, and Browse data. The products may be standard, reprocessed, or quick-look. The products can be either file names or file contents.

Place Invalid Indicators
Type: Data Process
Location: 3.1
Put invalid data value indicators into the predefined output granule (scene) store in computer memory. This provides an indication of granule completeness in the data granule without accessing the Metadata.

Platform Locations
Type: Data Flow
Location: 5.1.1, 5.1.2
The interpolated platform location and attitude for each anchor point appended to the aligned scan cube data.

PMS
Type: External Entity
Location: 7.0
Product Management System. Performs management of processed data, adds further data quality (metadata) information before passing the data to the DADS.

Post Anchor Point Locations
Type: Data Process
Location: 5.5
Convert from inertial to Lat-Long coordinate system and post the anchor point data to the output granule (scene). Determine the solar and satellite, azimuth and elevation angles and append these to the output granule.

Problem, Calibration
Type: Control Flow
Location: 6.2, 6.3, 1.4
An alarm indicating a serious problem in the calibration of the instrument. This may be a loss of calibration parameters, numerical problems, or out of bounds condition.

Problem, Data
Type: Control Flow
Location: 4.1, 1.4
An alarm that indicates that invalid MODIS Level-1A data has been received from the DADS.

Problems and Events
Type: Control Flow
Location: 2.1, 2.3, 4.1, 4.3, 6.2, 6.3, 1.4
Any alarms or events that are to be detected at this Level-1B processing. This is probably a duplicate of the processing in the Level-1A program.

Problems, Initialization
Type: Control Flow
Location: 2.1, 2.3, 1.4
An alarm message indication that a serious problem has occurred in the initialization of required store areas. This could be computer memory or disk memory.

Process Control
Type: Control Flow
Location: Context Diagram
The SCA control of the initialization, dynamic status requesting, and termination of this program.

Process Control
Type: Control Transform
Location: 1.0
Handles the control functions of this program. Accepts and sends control information to/from the SCA.

Process Status
Type: Control Flow
Location: Context Diagram
The interface with the SCA consisting of Post Processing Status, Dynamic Status Response, Alarms, and Events.

Processing Log
Type: External Entity
Location: 1.0
Log of processing status records, time sequential events. This is not the current status, but a time based history of status events.

Processing Mode
Type: Control Flow
Location: 1.2, 2.2
The mode of processing (standard, reprocessing, quick-look) with any size parameters required.

Processing Status Information
Type: Control Flow
Location: 1.4, SCA
Information regarding the fault conditions and processing performance of this program. Status or completion information from the MODIS process to the SCA with abnormal, dynamic, or normal termination information.

Replace Raw with Calibrated Data
Type: Data Process
Location: 6.4
Place the calibrated data values into the proper output granule (scene) location.

Request Memory
Type: Data Process
Location: 2.3
Ask the operating system for system resources to allow the processing of this data set. This includes both computer memory and disk memory.

SCA
Type: External Entity
Location: 1.0
Schedule, Control, and Accounting. An EOSDIS core system process that performs scheduling, control, and accounting of the various Product Generation System (PGS) programs.

Scan Times
Type: Data Flow
Location: Anchor Scan Times, 5.1
The time offsets for each anchor point within the instrument scan.

Scan Vector
Type: Data Flow
Location: 5.2.4, 5.3
The pointing direction of the instrument field of view (IFOV) at the selected anchor point scan positions. This has been corrected for the detector physical positions.

Select Closest Point
Type: Data Process
Location: 5.4.3
Select the scan vector to Earth intersecting point that is closest to the satellite.

Set Special Anchor Points
Type: Data Process
Location: 5.6.3
If a Moon intersection has been found, set the corresponding anchor point to a special flag value. Set this anchor point to the off-Earth value otherwise.

Setup Data Product Structures
Type: Data Process
Location: 2.0
Setup the memory areas and the Output Data Product areas in computer memory and disk. Preallocate these data and metadata areas.

Setup MODIS Data Stores
Type: Data Process
Location: 2.4
Determine all data stores. Initialize the "yet to be determined" Metadata items to an invalid condition.

Setup Processing Mode
Type: Control Transform
Location: 1.2
Derives the processing mode and calibration parameters, posts an entry to the system Processing Log, and starts the show.

Stable Tilt
Type: Data Flow
Location: 5.2.1, 5.2.2
An indication that the tilt angle has not changed since the last scan cube was processed.

Start
Type: Control Flow
Location: 1.2, 2.1
An indication to start the processing of MODIS Level-1B data.

Start Process
Type: Control Flow
Location: 1.1, 1.2
The result of an "Initiate processing" message type being passed to this MODIS Level-1B program from the SCA.

Termination
Type: Control Flow
Location: 1.3, 7.6
An indication for the program to terminate immediately (abort) or gracefully (post remaining data). Either termination will cleanup and return any files or memory areas used to the operating system.

Test for Imaginary Roots
Type: Data Process
Location: 5.4.1
Solve for the value of the radical in the scan vector to Earth intersection equation. If this number is negative, then the intersection is off Earth.

Thermal Corrected Attitude
Type: Data Flow
Location: 5.1.3, 5.1.4
The anchor point data within the scan cube that has been corrected for and platform thermal deformations.

Thermal Correction
Type: Data Flow
Location: Thermal Data, 5.1.3
The parameters for the conversion from engineering counts to temperatures.

Thermal Data
Type: Data Store
Location: 5.1.3
Parameters for converting engineering data to temperatures.

Tilt in Progress
Type: Data Flow
Location: 5.2.1, 5.2.2
The MODIS-T instrument has changed the tilt angle since the previous cube has been processed.

Tilt Values
Type: Data Flow
Location: 5.2.5, Metadata Structure
Instrument tilt values for metadata purposes such as minimum and maximum tilts, tilt intervals, and percentage of data at each tilt angle.

Tilted Attitude
Type: Data Flow
Location: 5.2.2, 5.2.3
The scan cube with the interpolated positions and attitudes corrected for any MODIS-T tile angles.

Transform to Detector Points
Type: Data Process
Location: 5.2.4
Transform the anchor point attitudes to the detector positions for each anchor point field of view.

Transmission Complete
Type: Control Flow
Location: 7.4, 1.4
An indication that the Level-1B data products have been transmitted to the PMS. (A component of :Data Processed".)

Transmit Data Products
Type: Data Process
Location: 7.4
Transmit the Level-1B data products by either file name or records to the PMS

Two Intersecting Points
Type: Data Flow
Location: 5.4.2, 5.4.3
The intersections of the scan vector and the Earth ellipsoid.

Unpack Data
Type: Data Process
Location: 4.2
Unpack the 12 bits plus scaling bit into a computer recognizable data type. This is to be performed in place to minimize store area sizes.

Unpacked Data
Type: Data Flow
Location: 4.2, 4.3
The input data quantum in an unpacked (byte aligned) form.

Updated Metadata
Type: Data Flow
Location: 7.2, Metadata Structure
Items from the previous Level-1A Metadata that are to be updated and any new Metadata items for Level-1B.

Verified Data
Type: Data Flow
Location: 4.1, 4.2
A MODIS Level-1A data quantum that has passed verification checks.

Verify Data Quantum
Type: Data Process
Location: 4.1
Ask for a quantum of MODIS Level-1A data and verify that a piece of valid data has been received. Generate a problem alarm if invalid data has been detected.

Verify Selected Data
Type: Data Process
Location: 4.3
Perform any data value integrity tests. This may include items not visited in the Level-1A program in addition to newer items as defined during this processing level.