

# **MODIS DATA STUDY TEAM PRESENTATION**

February 15, 1991

## **AGENDA**

1. Action Items
2. Plan for Assessing Hotspot Coverage by MODIS-T
3. Ocean Science Proposals, Phase I: Abbott
4. Atmosphere Science Proposals, Phase I: Menzel and Kaufman

#### ACTION ITEMS:

12/21/90 [Watson Gregg and Al McKay]: Combine Earth Model reports into single document. Pursue 2 additional questions: 1) how important is the geoid/spheroid difference over the oceans, and 2) how important is the difference over land, considering the types of DEM/DTM's likely to be used? Coordinate with Al Fleig to distribute report. STATUS: A conversation has been held with Bob Evans (oceans), who said he preferred the geoid. A discussion with Chris Justice (land) was also held. He requested a short write-up on the issue be sent to himself and Muller and Barnsley so they could form an informed opinion. A short write-up was delivered to Daesoo Han on 1/7/91. Open.

02/01/91 [Watson Gregg]: Review letter from Alan Strahler on MODIS-T tilt scenarios and estimate the time required to perform the tasks requested. Time to complete work estimated at 2-3 calendar months (1 - 1.5 man-months). Task requires input from Ocean Team on tilt scenarios. STATUS: Closed.

02/08/91 [Watson Gregg]: Develop plan for addressing Strahler's MODIS-T/Tilting issues. STATUS: Report in this week's handout.

PLAN FOR ASSESSING HOTSPOT COVERAGE  
BY MODIS-T

The hotspot is the area on the Earth where backscatter is maximum. It is defined in terms of the solar and viewing geometry. It is the location that satisfies the conditions that the spacecraft zenith angle  $\theta$  is equal to the solar zenith angle  $\theta_0$  and that the spacecraft azimuth angle  $\phi$  is equal to the solar azimuth angle  $\phi_0$ . Thus

$$\theta = \theta_0 \quad \text{and}$$

$$\phi = \phi_0$$

The primary purpose of this study is to assess the global coverage of the hotspot by MODIS-T. Secondly, the study attempts to determine the capability of MODIS-T to observe the bi-directional radiance distribution about, and near, the hotspot.

For the primary purpose, the plan is as follows.

- 1) Determine the location of the hotspot on the Earth given spacecraft position from the South Pole to the North Pole on ascending node. This will be done for a single ascending node pass, once each for an equinox, and the two solstices. This will allow visualization of the problem, which will aid in future analyses.
- 2) Determine the locations where MODIS-T can view the hotspot. Keep track of tilts required for each hotspot view. This will be a subset of 1) above, and will show the usefulness of MODIS-T in hotspot coverage. Do this over all Earth areas, land and ocean.
- 3) Sum the coverage in 1) for a 16-day repeat period, with the equinox/solstice centered within the period. This will show the total distribution of the hotspot due to the EOS orbit.
- 4) Sum the coverage in 2) for a 16-day repeat period, with the equinox/solstice centered within the period. This will show the total distribution of the viewable hotspot for MODIS-T. Do this for land and ocean, and for land only.
- 5) Compute the hotspot coverages in scenarios 2 and 4 above given the constraint that if ocean is viewable at nadir, then the land hotspot will not be observed. Again keep track of tilts required for viewing the hotspot, perhaps as a histogram for the 16-day coverage.
- 6) Perform 5) with the constraint of a reasonable ocean tilt mode.

For the secondary purpose, the distribution of reflectance at and near the hotspot, the plan is as follows.

1) Compute stare mode coverage over land areas under ocean-viewing priority for  $\pm 50^\circ$ ,  $\pm 40^\circ$ , and  $\pm 30^\circ$  tilts. Overlay on the coverage the viewable land hotspot coverage. (The hotspot  $\pm 8^\circ$  will be considered).

2) A few selected regions will be selected and the relative azimuth angles plotted on a polar plot, where azimuth is plotted in the azimuthal direction and zenith is plotted in the radial direction. In such a plot,  $0^\circ$  is the forward scattering direction (in the direction of light coming from the sun) and  $180^\circ$  is the backscattered direction (opposed to the direction of light coming from the sun). This will show the distribution of viewing and solar angles viewed by MODIS-T over a series of orbits and give an indication of the availability of angular distributions. This type of plot also conforms to those done by Barnsley and Morris (1990), and should be useful for comparisons.

#### Reference

Barnsley, M.J. and K.P. Morris, 1990. Assessing the BRDF sampling capabilities of various satellite sensors. IGARSS '90, 1369-1372.

**MODIS Team Member Proposal  
Data Requirements Form**

---

**Investigator:** Abbott, Mark R.

---

**Output Product(s):** (1) A measure of Fluorescence Line Height (FLH)  
(2) Chlorophyll concentration  
(3) Fluorescence efficiency  
(4) Primary productivity

**Resolution (Time):**

**(Space):** (1) MODIS-N at 1 km resolution  
MODIS-T at 4x4 km resolution

**Domain (Space):**

---

**At Launch:** (1)

**Post Launch:** (2), (3) and (4)

---

**MODIS-N/T:** Both N & T

---

**Input Data:**

**Spectral Bands Required:** Chlorophyll fluorescence channel (683nm, slipped to 681nm to avoid oxygen at 685.6nm) pg 2, 4  
(1) MODIS-N, 653nm (channel 13) and 750nm (channel 15) pg 4.

**Resolution (Time):**

**(Space):**

---

**Ancillary Data Required**

**(Type and Source):** Winds and currents (Other EOS instruments) page 4.  
FLH measurements from aircraft (Borstad and Gower). page 6.  
If MODIS-T is replaced with MERIS then he will need access to MERIS data. page 9  
Data from several field studies needed for algorithm development. pages 6, 7 and 8.

**Pre-Launch:**

**Size (Mbytes):**

**Post-Launch:**

**Size (Mbytes):**

---

**Algorithm Complexity (floating point operations/scan):**

---

**Algorithm Memory Required (Mbytes):**

---

**Data Storage Required (Mbytes/scan):** Rough estimate is 10GB high speed storage and 100GB of "slow" storage.  
page 16

---

**Look-Up Tables Required:**  
**Size (Mbytes):**

---

**Lines of Code:**

---

**Language Expected:**

---

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

<b>Pre-Launch:</b>	<b>Size (Mbytes):</b>
<b>Post-Launch:</b>	<b>Size (Mbytes):</b>

---

**Expected Need of SDST (Pre- or Post-Launch):** Will review SDST efforts with utilities, documentation, and problem correction. page 1.

Expects EOSDIS or SDST to provide a certain level of networking tools and management. Requires a T1-class link between OSU, Miami, and GSFC. EOSDIS responsible for network maintenance, interfacing, security etc., software development tools and data base tools. page 8.

EOSDIS or SDST should develop modules for navigation, format translation, file manipulation, etc. All these activities must be standards-driven. page 9.

He will assist the SDST and Robert Evans in systems design, utilities, integrated processing, quality control, maintenance and documentation. He expects to provide considerable support in the design and development of an integrated processing system. page 11.

---

**Post-Launch Expected Growth:** Will work on several "research" data products which may become standard products after launch including (pg 5, 6):

- Estimates of primary productivity
  - Estimates of light adaptation
  - Combined MODIS-N/MODIS-T data products
- 

**Quality Assessments:**

---

**Special Tilt Modes Required:**

---

**Notes:** Much of the algorithm development will need to take place in a networked environment such that various modules can be integrated together for eventual installation within EOSDIS. page 6

Some products cannot be generated without access to other data sets that may be located on remote machines. page 6

Several field studies are described and discussed. page 6,7 and 8

Advocates the "evolutionary" or "spiral" model of software development to avoid a massive failure after delivery. page 10

The Data Plan (pages 8 to 18) of this proposal contains extensive discussions of assumptions, the software development process, computer facilities, hardware and software.

MODIS Team Member Proposal  
Data Requirements Form

---

Investigator: Menzel

---

Output Product(s): (1) Cloud effective emissivity  
(2) Cloud top pressure  
(3) Cloud top temperature  
(4) Atmospheric stability (lifted index)  
(5) Total precipitable water  
(6) Total ozone content  
(7) MODIS-N infrared calibration

Resolution: Twice daily at 5 km instantaneous (1,2,3)  
Daily/monthly 1 degree x 1 degree (1,2,3)  
Twice daily at 5 km instantaneous (4,5,6)  
Daily 0.5 degree x 0.5 degree (4,5,6)

Domain (Space): Global

---

At/Post-Launch: At-Launch

---

MODIS-N/T: MODIS-N

---

Input Data:

Spectral Bands Required: Visible, 8.6, 9.6, 9.7, 11.0, 11.2,  
12.0, 13.3, 13.6, 13.9, 14.2, 15.0 microns

Resolution (Time):

(Space):

---

**Ancillary Data Required (Type and Source):**

**Pre-Launch:**

**Size (Mbytes):**

MAMS  
HIS  
VAS I/M  
GOES I/M  
TOVS  
AVHRR  
AIRS  
LAWS  
Temperature at altitude (NMC)  
Moisture at altitude (NMC)  
Pressure at altitude (NMC)  
Surface reports (NMC)

**Post-Launch:**

**Size (Mbytes):**

MAMS  
HIS  
VAS I/M  
GOES I/M  
TOVS  
AVHRR  
AIRS  
LAWS  
Temperature at altitude (NMC)  
Moisture at altitude (NMC)  
Pressure at altitude (NMC)  
Surface reports (NMC)

---

**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:** Fortran

---

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

<b>Pre-Launch:</b>	<b>Size (Mbytes):</b>
Case study data sets (ground truth and aircraft)	

<b>Post-Launch:</b>	<b>Size (Mbytes):</b>
---------------------	-----------------------

---

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

---

**Post-Launch Expected Growth:**

---

**Quality Assessments:**

---

**Special Tilt Modes Required:**

---

MODIS Team Member Proposal  
Data Requirements Form

---

Investigator: Menzel

---

Output Product(s): (1) Cloud emissivity  
(2) Cloud particle radius  
(3) Cloud extent  
(4) Cloud type

Resolution: Twice daily at 5 km instantaneous (1-4)  
Daily/monthly 1 degree x 1 degree (1-4)  
Monthly at 50 km (1,3,4)  
4 year cloud climatology at 50 km (1,3,4)

Domain (Space): Global

---

At/Post-Launch: Post-Launch

---

MODIS-N/T: MODIS-N

---

Input Data:

Spectral Bands Required: 8.6, 9.6, 9.7, 11.0, 11.2, 12.0, 13.3,  
13.6, 13.9, 14.2, 15.0

Resolution (Time):

(Space):

---

**Ancillary Data Required (Type and Source):**

**Pre-Launch:**

**Size (Mbytes):**

MAMS  
HIS  
VAS I/M  
GOES I/M  
TOVS  
AVHRR  
AIRS  
LAWS  
Temperature at altitude (NMC)  
Moisture at altitude (NMC)  
Pressure at altitude (NMC)  
Surface reports (NMC)

**Post-Launch:**

**Size (Mbytes):**

MAMS  
HIS  
VAS I/M  
GOES I/M  
TOVS  
AVHRR  
AIRS  
LAWS  
Temperature at altitude (NMC)  
Moisture at altitude (NMC)  
Pressure at altitude (NMC)  
Surface reports (NMC)

---

**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:** Fortran

---

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

<b>Pre-Launch:</b>	<b>Size (Mbytes):</b>
Case study data sets (ground truth and aircraft)	

<b>Post-Launch:</b>	<b>Size (Mbytes):</b>
---------------------	-----------------------

---

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

---

**Post-Launch Expected Growth:**

---

**Quality Assessments:**

---

**Special Tilt Modes Required:**

---

MODIS Team Member Proposal  
Data Requirements Form

---

Investigator: Kaufman

---

Output Product(s): (1) Thermal anomalies  
(2) Aerosol optical thickness  
(3) Aerosol mass loading  
(4) Total precipitable water  
(5) Surface spectral reflectance  
(6) Atmospherically-corrected NDVI

Resolution (Time):

(Space):

Domain (Space):

---

At/Post-Launch: At-Launch

---

MODIS-N/T: Both

---

Input Data:

Spectral Bands Required: MODIS-T 410-460 nm  
MODIS-N 413, 470, 665, 750-880, 905,  
935, 940 nm, 3.75, 11 microns

Resolution (Time):

(Space):

---

**Ancillary Data Required (Type and Source):**

<b>Pre-Launch:</b>	<b>Size (Mbytes):</b>
AVHRR	
SPOT	
Landsat TM	
GOES	
AVIRIS	
ASAS	
Ground truth measurements	

<b>Post-Launch:</b>	<b>Size (Mbytes):</b>
Ground and aircraft observations	
AVHRR	
GOES	
HIRIS	
MISR	

---

**Algorithm Complexity (floating point operations/scan):**

---

**Algorithm Memory Required (Mbytes):**

---

**Data Storage Required (Mbytes/scan):**

---

**Look-Up Tables Required:** Mie scattering

**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):**

---

**Post-Launch Expected Growth:**

---

**Quality Assessments:**

---

**Special Tilt Modes Required:**

---

MODIS Team Member Proposal  
Data Requirements Form

---

Investigator: Kaufman

---

Output Product(s): (1) Cloud area and perimeter

Resolution (Time):

(Space):

Domain (Space):

---

At/Post-Launch: Post-Launch

---

MODIS-N/T: Both

---

Input Data:

Spectral Bands Required: MODIS-T 410-460 nm  
MODIS-N 413, 470, 665, 750-880, 905,  
935, 940 nm, 3.75, 11 microns

Resolution (Time):

(Space):

---

**Ancillary Data Required (Type and Source):**

**Pre-Launch:**

AVHRR  
SPOT  
Landsat TM  
GOES  
AVIRIS  
ASAS  
Ground truth measurements

**Size (Mbytes):**

**Post-Launch:**

Ground and aircraft observations  
AVHRR  
GOES  
HIRIS  
MISR

**Size (Mbytes):**

---

**Algorithm Complexity (floating point operations/scan):**

---

**Algorithm Memory Required (Mbytes):**

---

**Data Storage Required (Mbytes/scan):**

---

**Look-Up Tables Required: Mie scattering**

**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):**

---

**Post-Launch Expected Growth:**

---

**Quality Assessments:**

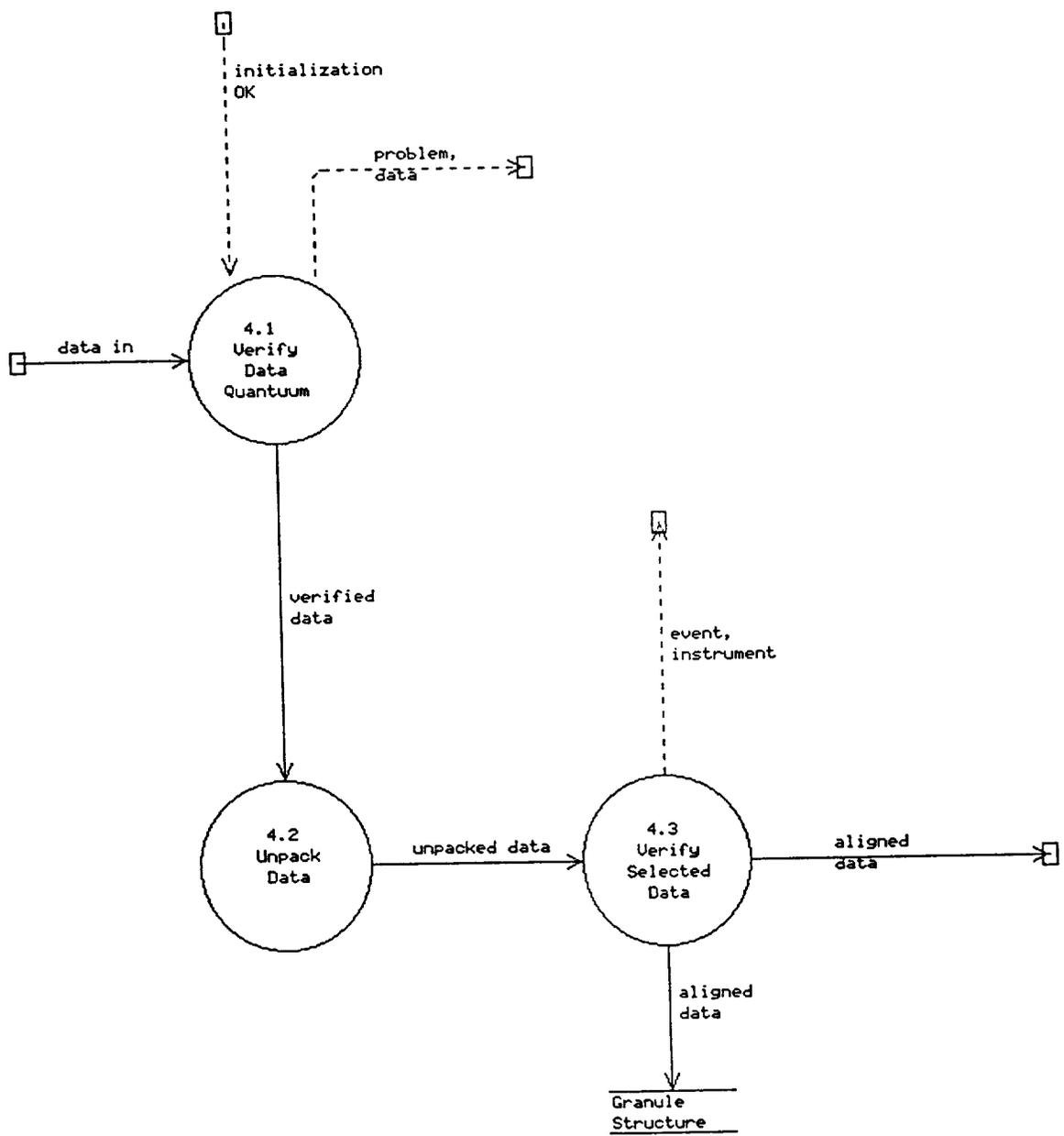
---

**Special Tilt Modes Required:**

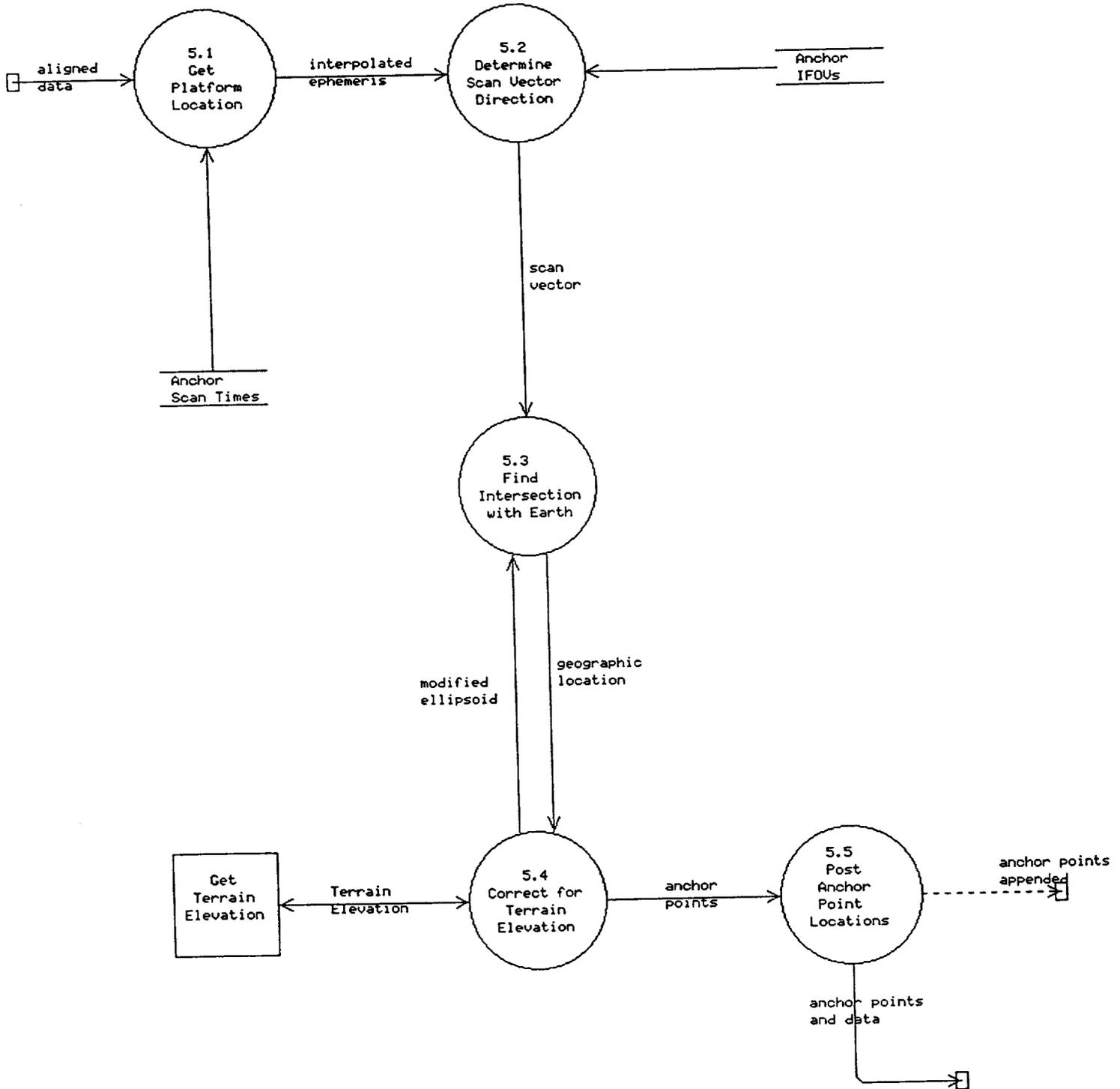
---

## APPENDIX

Project : \ECPLUS\MODIS-1B\  
Chart : level-b4  
Filename : level-b4.trg  
Last Modified : 02-14-1991



Project : \ECPLUS\MODIS-1B\  
Chart : level-b5  
Filename : level-b5.trg  
Last Modified : 02-14-1991



Project : \EPLUS\MODIS-1B\  
Chart : level-b6  
Filename : level-b6.trg  
Last Modified : 02-14-1991

