MODIS
SCIENCE DATA SUPPORT TEAM
PRESENTATION

September 18, 1992

AGENDA

Page

ACTION ITEMS:

04/24/92 [Lloyd Carpenter & Team] Develop a staffing plan for the accomplishment of the tasks shown on the schedule. (A draft version of the staffing plan has been developed and delivered.) STATUS: Open. Due Date: 06/12/92

06/12/92 [Tom Goff, Carroll Hood] Develop separate detailed schedules using Microsoft Project for Level-1A and -1B software design and development. (Updated results were discussed in the handout. STATUS: Open. Due Date: 07/10/92

07/31/92 [Tom Goff, Ed Masuoka, Al Fleig] Develop the purpose and requirements for a packet simulator. Get more information on the packet simulator being developed by SBRC. (An updated requirements specification was included in the handout on 09/04/92. Tom, Ed, and Al are to meet and discuss coordination with Jerry Hyde of SBRC.) STATUS: Open. Due Date: 09/04/92

MODIS Airborne Simulator (MAS) Status

Liam E. Gumley
Progress up to 17 September 1992

(1) Data processing

While the MAS operational processing is on hold, I decided to do some further investigation of the noise appearing in the MAS image data. I updated some existing code to provide noise estimates (in the form of signal to noise ratio) for a block of pixels for all MAS channels. I selected two dates that had significant cloud free ocean areas, so that the noise computations could be performed on a uniform scene. It should be noted that the infrared channels (3.7 micron and longer wavelengths) are of interest here since they are most affected by detector noise, 400 Hz pickup, and scanline striping noise. While Ames has attempted to improve some of these noise problems, quantitative noise estimates are required to see if any real improvement has occurred.

FIRE 31 October 1991

```
MAS Level-1B file name : 91304-03.cdf
Start record, # of records  : 1 50
Start pixel,  # of pixels   : 200 50
Scanline HHMMSSSS   Lat    Lon
   36894 20305500  35.82 -123.75
( 0.681 um) Radiance Mean=  41.88 W/m2/sr/um              RMS=   4.87 SNR=    8.6
( 1.617 um) Radiance Mean=  39.54 W/m2/sr/um              RMS=   0.00 SNR= ******
( 1.933 um) Radiance Mean=  15.43 W/m2/sr/um              RMS=   0.09 SNR=  180.8
( 2.088 um) Radiance Mean=  33.44 W/m2/sr/um              RMS=   0.00 SNR= ******
( 2.139 um) Radiance Mean=  39.76 W/m2/sr/um              RMS=   0.00 SNR= ******
( 4.695 um) Radiance Mean=   3.50 W/m2/sr/um (284.96 K) RMS=   0.90 SNR=    3.9
( 4.539 um) Radiance Mean=   2.02 W/m2/sr/um (276.30 K) RMS=   0.54 SNR=    3.7
( 8.800 um) Radiance Mean=  23.87 W/m2/sr/um (286.98 K) RMS=   0.18 SNR=  130.0
(10.950 um) Radiance Mean=  25.11 W/m2/sr/um (288.10 K) RMS=   0.15 SNR=  162.4
(11.950 um) Radiance Mean=  23.70 W/m2/sr/um (287.59 K) RMS=   0.24 SNR=   97.0
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ASTEX 23 June 1992

```
MAS Level-1B file name : 92175-05.cdf
Start record, # of records  : 1 50
Start pixel,  # of pixels   : 200 50
Scanline HHMMSSSS   Lat    Lon
   52393 16131200  36.56  -24.42
( 0.664 um) Radiance Mean=  17.60 W/m2/sr/um              RMS=   0.00 SNR= ******
( 0.875 um) Radiance Mean=  10.18 W/m2/sr/um              RMS=   0.27 SNR=   38.0
( 0.945 um) Radiance Mean=   3.81 W/m2/sr/um              RMS=   0.00 SNR= ******
( 1.621 um) Radiance Mean=  14.85 W/m2/sr/um              RMS=   0.67 SNR=   22.0
( 2.142 um) Radiance Mean=   5.97 W/m2/sr/um              RMS=   0.24 SNR=   24.5
( 3.725 um) Radiance Mean=   3.09 W/m2/sr/um (320.91 K) RMS=   0.15 SNR=   20.0
(13.952 um) Radiance Mean=  11.19 W/m2/sr/um (247.71 K) RMS=   1.96 SNR=    5.7
( 8.563 um) Radiance Mean=  22.73 W/m2/sr/um (285.65 K) RMS=   0.19 SNR=  118.5
(11.002 um) Radiance Mean=  24.85 W/m2/sr/um (287.56 K) RMS=   0.24 SNR=  105.7
(13.186 um) Radiance Mean=  17.47 W/m2/sr/um (272.61 K) RMS=   1.28 SNR=   13.6
(12.032 um) Radiance Mean=  23.43 W/m2/sr/um (287.17 K) RMS=   0.32 SNR=   72.8
```

Similar noise estimates will be computed for more MAS flights to establish a record of instrument noise performance. In the near future, it is planned to install a new lens on the far infrared detector port optics with improved transmission beyond 14 microns, as well as mounting the detectors on a cooled dewar. A set of noise estimates both before and after these modifications will help to establish the degree to which the instrument performance has improved.

(2) Software development

I received requests from Chris Moeller (Wisconsin) and Pat Grant (Ames) for copies of my PC based software which converts from MAS Exabyte format to Intermediate format. Intermediate format is currently used by both my software, and the Wisconsin MCIDAS software. Chris wants to have this capability available for TOGA/COARE in January so that he can analyze MAS data in the field using PC-MCIDAS. I uploaded a copy of the PC source and executable to the anonymous FTP site on ltpiris2, as well as test segments of Exabyte and Intermediate format MAS data.

(3) MAS prototype shell design

I spoke to Paul Menzel at Wisconsin regarding the possibility of obtaining his cloud top height code and applying it to the MAS data, for the purpose of helping to understand the construction and operation of the MODIS Level-2 shell design. Paul responded that while he would be happy to do so, the code had not been sufficiently tested yet to the point where he would feel comfortable about releasing it. The necessary MAS spectral channels at wavelengths of 13.2 and 13.8 microns have so far been too noisy. He intends to test the algorithm with some heavily filtered data in the near future.

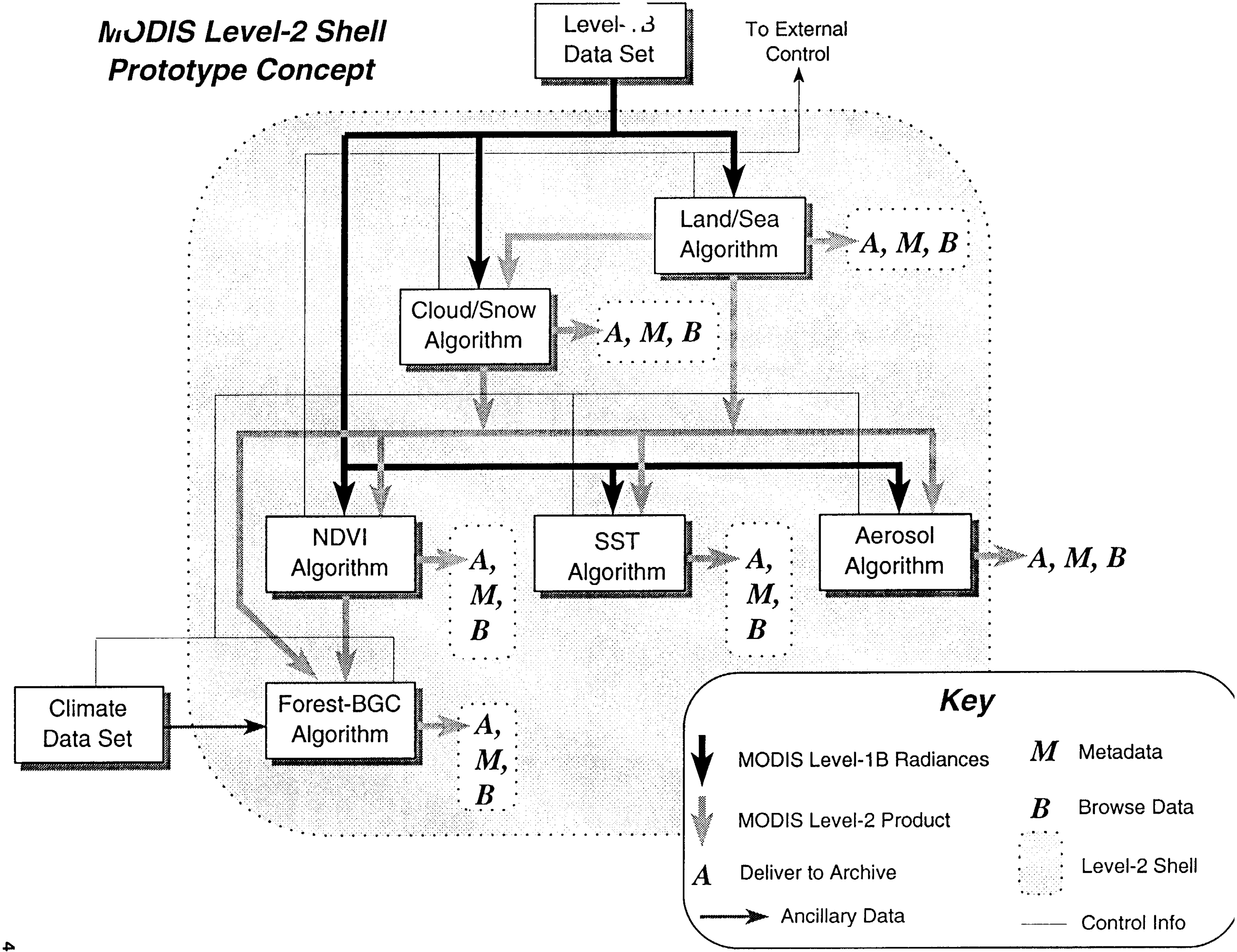
The purpose of a prototype shell would be to help understand the flow of data and the control mechanisms necessary for eventually handing MODIS data. It would not be necessary to generate accurate or valid scientific results; rather it would be the aim to integrate several different algorithms into one functional shell that explored some of the concepts we expect to encounter with MODIS.

There are several other more simple algorithms which could be used as part of a MAS prototype Level-2 processing shell. These would require almost no development time, as they are already well known and understood. Examples are

- Cloud detection (simple reflectance threshold test)
- Land/sea discrimination (use an existing land/sea topography database)
- NDVI (simple channel ratio)
- Sea surface temperature (dual channel split window with roughly estimated coefficients)
- Aerosol optical depth (simple single scattering computation over clear ocean only)
- Snow discrimination (simple threshold tests)

I estimate that each of these algorithms could be implemented in a simple fashion in less than 50 lines of FORTRAN code each. Although they are simple, they each require different input ancillary data (e.g. land/sea, cloud/clear, sunglint low/high, day/night, total ozone) that are common to MODIS algorithms as well.

MODIS Level-2 Shell Prototype Concept



Applying CASE Methodology using Microsoft Project

Thomas E. Goff
NASA/GSFC/MODIS/SDST/RDC
17 September 1992

I have applied the ECS and SDST milestone dates as constraints on the scheduling of the Level-1A Data Product Generator design. This has produced several interesting results as discussed below.

Resource Allocation - Microsoft Project 3.0 (MSProj) has a limitation when trying to juggle the relationship among the level of effort required to perform a task, the duration of the task, and the amount of resources required to perform the task. MSProj allows the user to fix the duration and solve for the level of effort given a specified amount of a resource, or to fix the level of effort and solve for the duration given a specified amount of a resource, but will not allow the level of effort and duration to be fixed and to solve for the amount of resource. Unfortunately, this is what we would like to be able to do. We know the level of effort required to execute a task by estimating the lines of code and multiplying by the standard rates (for example) and we are given the milestones for which a project must be finished and/or started. We would like MSProj to solve for the number of personnel required to perform this task. The only method currently available is to start with a large number of personnel, perform the leveling calculations, look at the resource histogram manually and decrease the number of personnel, level the task again, and repeat until an error occurs. Then back up to the previous guess and perform a leveling operation. This must be performed when any change is made, such as a new milestone or a redefinition of a milestone.

Relational Time Constraints - MSProj has no direct ability to allow a milestone date to be determined as a time offset from another milestone. For example, a program requires a specific amount of time to write after the delivery of the computer. This can be accomplished using the fixed task duration facilities in MSProj, but not with a milestone specifier directly.

Level-1A ß Version PDR - This date is currently set at 1 Feb., 1993. I have applied this constraint as a "Finish No Later Than" to the final task in the CASE design summary tasks. When this criteria is added, the final number of resources required to meet this date and criteria approaches five people. This is clearly a 'crunch' condition that can be alleviated by either slipping the milestone, or applying different criteria to the milestone. The remainder of the milestones (including versions 1 and 2) can be met with a one person effort terminating in middle 1994. This illustrates that a project design and implementation effort that is to be performed in a CASE environment incurs a large startup penalty with corresponding savings at the finish of the project, and requires rethinking of normal milestone criteria.

Executing a design in a CASE environment using current techniques utilizes five sequential models as defined in structured programming: the Environmental Model, the Behavioral Model, the Processor Model, the Task Model, and the Hierarchy Model. These models start from a global view of a project and sequentially 'home in' on the specifics of the design. When monitoring the performance of a design team in a CASE environment, it may be better to set the completion of these five models as milestones rather than the more common PDR, CDR, SRR milestones.

The first two models were followed in the alpha version of the design that was presented in the PDR held in April, 1991. This was accomplished using the PC based EasyCASE software. We are now ready to perform a repeat of these early models and to carry forth to the final program design using Cadre's Teamwork on a UNIX platform, and the beta version on the HP730 TLCF machine using the SoftBench integrated environment.

To better understand the five structured models I have included my 'hit list' of the items to be considered under each model phase:

Environmental Model

- Context Diagram
- Data Dictionary
- Event List
- Entity Relationship
- State Transition Diagram

Assumption/Tracking List

Concerns

Requirements Traceability

Behavioral Model

- Data Flow Diagram
- Functional Specifications
- Structured English
- Decision Tree
- Decision Tables
- Data Schema
- State Transition

Processor Model

- Cohesion Coupling
- Concurrency
- Cost
- Response Time
- User Interface
- Prototyping
- Simulations

Data Flow Diagram

Data Dictionary

Task Modeling

- Synchronization
- Sampling Rate
- Robustness
- Partitioning
- PDL

Hierarchy Model

- Documentation
- Assign Module Units
- Shared Memory, Capacities
- Communication Paths
- Structure Chart

MODIS DATA PRODUCTS LIST

The SPSO list of MODIS data products dated 08/24/92 has been modified by J.J. Pan to combine products with the same name but different resolutions. The revised list is given on the following pages.

Combining products in this way reduces the total number from 191 to 121. Of these 121 combined products, 30 contain products which were on the EOS Program Scientist's "selected" list. There were 33 products on the original "selected" list. The 3 missing ones are included in #2379, Level-2 Radiance, Land_leaving by Kaufman and Tanre, and #2338, Level-1B Radiance, MODIS <3 μm by Salomonson. (Perhaps #2340 should also be included in #2338!)

Product #	Product Name	Investigator	Temporal	zontal
2575	Chlorophyll Fluorescence Line Height	Abbott	1/day, 1/wk	1 km, 4 km
2566	Chlorophyll_a Conc (via Fluorescence)	Abbott	1/day, 1/wk	1 km, 4 km
2602	Ocean Productivity, Primary, Near_sfc (via Fluorescence)	Abbott	1/day, 1/wk	1 km, 4 km
2110	Land_sfc Emissivity	Barton	1/day, 1/wk	1 km, 50 km
2527	Sea_sfc Temperature (SST)	Brown, Barton	1/day, 1/wk, 1/mo	1 km, 4 km, 20 km, 50 km
2569	Chlorophyll_a Conc	Carder	1/day, 1/wk, 1/mo	1 km
2580	Organic Matter Conc, Dissolved	Carder	1/day, 1/wk, 1/mo	1 km, 20 km
3662	Organic Matter Degradation_Product Absorption Coef@415nm (DOM+Detritus)	Carder	1/day, 1/wk, 1/mo	1 km, 20 km
2571	Chlorophyll_a Conc	Clark	1/day, 1/wk, 1/mo	1 km, 20 km
2031	Ocean Water Attenuation Coef, PAR	Clark	1/day, 1/wk	1 km, 20 km
3206	Ocean Water Attenuation Coef@520nm, Beam	Clark	1/day, 1/wk	1 km, 20 km
2608	Organic Matter Conc, Particulate	Clark	1/day, 1/wk	1 km, 20 km
3085	Suspended-Solids Conc, Ocean Water	Clark	1/day, 1/wk, 1/mo	1 km, 20 km
2606	Ocean Productivity, Primary	Esaias	1/wk, 1/mo, 1/yr	20 km
2330	PAR	Esaias	1/day	N/A
3303	Calibration Data, MODIS	Evans	1/day, 1/wk, 1/mo	N/A
2295	Aerosol Angstrom Exponent	Gordon	1/day, 1/wk, 1/mo	1 km, 20 km
2344	Aerosol Radiance	Gordon	1/day, 1/wk, 1/mo	1 km, 20 km
2556	Coccolith Backscatter Coef	Gordon	1/day, 1/wk, 1/mo	1 km, 20 km
2254	Glint Field	Gordon	1/orbit(d)	1 km
2559	Ocean Water Backscatter Coef, Total	Gordon	1/day, 1/wk, 1/mo	1 km, 20 km
2266	PAR,Sfc (IPAR)	Gordon	1/day(d)	1 km
2555	Phytoplankton Backscatter Coef	Gordon	1/day, 1/wk, 1/mo	1 km, 20 km
1688	Wind Velocity, Sea_sfc Glint-Pattern	Gordon	1/orbit(d)	1 km
2416	Level-2 Radiance, Water-leaving	Gordon et al	1/day, 1/wk, 1/mo	1 km, 20 km
2577	Coccolith Conc, Detached	Gordon, Clark	1/day, 1/wk, 1/mo	1 km, 20 km

3199	an Water Attenuation Coef@490nm	Gordon, Clark	1/day, 1/wk, 1/mo	1 km km
2591	Pigment Conc	Gordon, Clark	1/day, 1/wk, 1/mo	1 km, 20 km
2574	Chlorophyll Fluorescence Line Curv	Hoge	1/day, 1/wk	1 km, 20 km
3317	Organic Matter Fluorescence Efficiency, Colored Dissolved (CDOM)	Hoge	1/day, 1/wk, 1/mo	1 km, 20 km
3319	Pigment Conc, Phycobillin (Phycoerythrin, etc.)	Hoge	1/day, 1/wk, 1/mo	1 km, 20 km
2593	Pigment Conc (via Spectral Curv)	Hoge, Esaias	1/day, 1/wk	1 km, 20 km
2537	Land_sfc Temperature-Difference, Day-Night	Huete	1/day	1 km
2286	Level-1B Radiance Mixture-Model, MODIS Spectral-spatial	Huete	1/day	pixel_size
2047	Soil Brightness Index	Huete	1/mo	1 km
2095	Soil Color Index	Huete	1/mo	1 km
3703	Vegetation Index Temporal Signal	Huete, Justice	1/yr (weekly points)	1 km
3701	Vegetation Index, Composited, Sfc	Huete, Justice	1/wk	1 km
3700	Vegetation Index, Hemispherical, Sfc	Huete, Justice	1/wk, 1/mo	1 km
3702	Vegetation Index, Integrated Annual	Huete, Justice	1/yr	1 km
3699	Vegetation Index-Directional Reflectances, Atmosphere-Corrected (O_3 and molecular scattering)	Huete, Justice	1/day	500 m
3704	Vegetation Index (Self_Atmospheric-Correcting, TOA)	Huete, Justice, Kaufman, Tanre	1/day	1 km
2659	Vegetation Growing_Season Duration	Justice	1/yr	1 km, 10 km
2749	Vegetation Index	Justice, Huete et al	1/day, 1/wk, 1/mo	0.5 km, 1 km, 10 km
3304	Data Characteristics, MODIS	Justice, Strahler	1/day	1 km, 10 km, 50 km
2068	Cloud Field Area	Kaufman	1/mo	1 dg
2092	Cloud Field Perimeter	Kaufman	1/mo	1 dg
2429	Land_sfc Reflectance, Directional	Kaufman et al	1/day	0.25 km, 0.5 km, 1 km
2711	Fire Class	Kaufman, Justice	1/day, 1/wk	10 km
2663	Fire Count	Kaufman, Justice	1/day, 1/wk	1 km, 10 km
2665	Fire Extent	Kaufman, Justice	1/day, 1/wk	1 km, 1 dg
2471	Fire Temperature	Kaufman, Justice	1/day, 1/wk	1 km

1017	osol Mass Loading	Kaufman, Tanre	1/day, 1/mo	0.5 d
2293	Aerosol Optical Depth, Spectral	Kaufman, Tanre	1/day, 1/mo	0.5 dg
2379	Level-2 Radiance, Land_leaving	Kaufman, Tanre	1/day, 1/mo	0.5 km, 1 km, 10
1874	Precipitable Water	Kaufman, Tanre	1/day, 1/mo	1 dg, 1 km, 5 km
2081	Cloud Cover	King	1/day, 2/day(d,n), 1/mo	1 dg, 5 km
2311	Cloud Optical Depth	King	1/day, 1/mo	1 dg, 5 km
1764	Cloud Drop Phase	King, Menzel	1/day, 1/mo	1 dg, 5 km
1780	Cloud Drop Size (Effective Radius)	King, Menzel	1/day, 1/mo	1 dg, 5 km
2094	Cloud JPDF	King, Menzel	1/day, 1/mo	1 dg
2126	Cloud Emissivity	Menzel	1/day, 2/day, 1/mo	1 dg, 5 km
1528	Cloud Pressure, Top	Menzel	1/day, 2/day, 1/mo	1 dg, 5 km
2466	Cloud Temperature, Top	Menzel	1/day, 2/day, 1/mo	1 dg, 5 km
1333	O_3 Total Burden	Menzel	1/day, 2/day, 1/mo	0.5 dg, 5 km
1875	Precipitable Water	Menzel	2/day	5 km
1559	Stability (Lifted Index), Atmospheric	Menzel	2/day, 1/mo	0.5 dg, 5 km
3668	Ground Control Points, Potential	Muller		0.3 pixels
2404	Land_sfc Radiance-Correction, Topographic	Muller	1/day	1 km, 10 km
3671	Photogrammetric Camera Model	Muller		N/A
3672	Simulated Data Sets, MODIS	Muller		0.25-1 km
3673	Simulated Scenes, MODIS, Monte Carlo Ray-Tracing	Muller		0.25-1 km
2001	Albedo, Spectral, TOA	Muller, Strahler	1/(3-8 day)	1 km
2434	Land_sfc Reflectance, Directional	Muller, Strahler	1/day	1 km
3665	Albedo, Spectral, Land_sfc	Muller, Strahler	1/day	1 km
3666	Albedo, Total (SW), Land_sfc	Muller, Strahler, Tanre	1/day	1 km
3667	Albedo, Total (SW), TOA	Muller, Strahler, Tanre	1/day	1 km
3669	Land_sfc Reflectance, Bidirectional (BRDF)	Muller, Strahler, Tanre	1/day	1 km

3670	d_sfc Roughness	Muller, Tanre	1/day	1 km
3216	Particulate Backscatter Coef	Parslow	1/day	1 km, 20 km
2582	Organic Matter Conc, Dissolved	Parslow et al	1/day, 1/wk, 1/mo	1 km, 20 km
2680	Vegetation Index, Leaf Area, (LAI)	Running	1/day, 1 wk	pixel_size
2703	Vegetation Productivity, Primary	Running	1/wk, 1/mo, 1/yr	1 km
2723	Vegetation Stress	Running, Huete	1/day, 1/wk	pixel_size
3641	Cloud Cover	Salomonson?	1/mo (day & night)	0.25 km
2282	Cloud Masking-shadowing	Salomonson	1/day	0.5 km, 1 km, 2
2338	Level-1B Radiance, MODIS <3 μm	Salomonson	1/day	0.25 km, 0.5 km km
2340	Level-1B Radiance, MODIS > 3 μm	Salomonson	1/day	1 km
3153	Sea_Ice Max Extent	Salomonson	1/day, 1/wk, 1/mo	1 km, 10 km
3020	Snow Cover	Salomonson	1/day, 1/wk	1 km, 10 km
3656	Geometric Error, MODIS Level-2	SalomonsonBarker		
3657	Geometric Error, MODIS Level-3	SalomonsonBarker		
3645	Instrument Characteristics, MODIS Level-1	Salomonson Barker		
3648	Instrument Model, MODIS Level-1	Salomonson Barker		
3652	Irradiance, Lunar, MODIS Level-2	Salomonson Barker		
3651	Irradiance, Solar, MODIS Level-2	Salomonson Barker		
3654	Radiance Error, MODIS Level-2	Salomonson Barker		
3646	Radiance, At-Satellite, MODIS Level-1	Salomonson Barker		
3650	Radiance, Lunar Reference, MODIS Level-1	Salomonson Barker		
3649	Radiance, Solar Diffuser, MODIS Level	Salomonson Barker		
3655	Reflectance Error, MODIS Level-2	Salomonson Barker		
3647	Reflectance, Exoatmospheric, MODIS Level-2	Salomonson Barker		
3653	Reflectance, Lunar, MODIS Level-2	Salomonson Barker		
3658	Texture, MODIS Level-2	Salomonson Barker		
3659	Texture, MODIS Level-3	Salomonson Barker		

3660	ssification Masks, Clouds/Snow/Land/Water, MODIS Level-2	Salomonson Barker (with Hall)		
3661	Classification Masks, Clouds/Snow/Land/Water, MODIS Level-2	Salomonson Barker (with Hall)		
2669	Land_Cover Type	Strahler, Huete et al	1/mo, 1/seas	1 km, 5 km
2671	Land_Cover Type-Change	Strahler, Huete et al	1/seas	1 km, 5 km
2268	PAR, Incident, (IPAR)	Tanre	1/day, 1/wk	1 km
2294	Aerosol Optical Depth, Spectral	Tanre, Kaufman	1/day, 1/mo	0.5 dg
1022	Aerosol Size-Distribution (Radius-Dispersion)	Tanre, Kaufman	1/day, 1/mo	0.5 dg
2003	Albedo, Aerosol	Tanre, Kaufman	1/day, 1/mo	0.5 dg
2015	Albedo, Land_sfc	Tanre, Muller	1/day, 1/wk	1 km, 10 km
2424	Land_sfc Reflectance, Bidirectional (BRDF)	Tanre, Muller	1/day, 1/wk	1 km, 10 km
1556	Land_sfc Roughness	Tanre, Muller	1/day, 1/wk	1 km, 10 km
3696	Land_sfc BRDF, Am-PM Asymmetry	Vanderbilt	1/day	250 m, 1 km
3697	Land_sfc BRDF, Am-PM Degree_of_Asymmetry	Vanderbilt	1/day	250 m, 1 km
2337	Vegetation Index, Polarization	Vanderbilt	1/day	pixel_size
3323	Land_sfc Emissivity	Wan	1/day, 1/wk	1 km, 10 km
2484	Land_sfc Temperature	Wan	1/day, 1/wk	1 km, 10 km

MODIS Level 1 Earth Navigation Software Evaluation

Paul A. Hubanks
18 September 1992

Objective

Locate any available software that performs navigation of satellite instrument data pixels.

Progress

I received a group of subroutines and functions that perform earth navigation of satellite pixel data and satellite orbit prediction from Fred Nagel (NESDIS, University of Wisconsin) on Monday. The software was written in High Level Fortran (HLF), a Fortran extension, and has been used only in on-site research projects. I was able to compile and run, using Microsoft FORTRAN version 5.1, the basic earth navigation routine after removing the HLF references.

The following is a list of the modules I received :

VTERRA - computes the ground coordinates which a scanning satellite views given the satellite position and scan angle. Done entirely in celestial coordinates.
VCOORD - converts between celestial and terrestrial coordinate systems.
VERNEQ - computes the longitude of the vernal equinox at a given time/day.
GEOCEN - computes geocentric latitude as a function of geodetic latitude.
GEODEN - (inverse of above).
DABTIM - computes Julian Day given the time in civil units.
TINVER - (inverse of above).
CELEM - Converts classical osculating orbital elements to Cartesian elements.
VBLMOD - Brouwer/Lyddane model for satellite prediction. Returns the 3-dimensional satellite position vector.
BROLYD - Brouwer/Lyddane orbit generator routine.
DKEPLR - Keplers Equation (relates position in orbit plane to time).

I finally made contact with the person who handles the USGS software for the geolocation of AHVRR data (Dan Etrhaim, EROS Data Center). These routines were written in the C language. He refused to send the code to my account on the LTP/VAX system over the network unless his supervisor (Randy Sunne) gave him the OK. I was told even though the software is public domain his job does not include acting as a clearing house for software distribution. I spoke with Randy Sunne on Thursday and he was going to call me back about the possibility of needing a formal written request for the software.