MODIS
SCIENCE DATA SUPPORT TEAM
PRESENTATION

January 24, 1992

AGENDA

1. Action Items
2. MODIS Airborne Simulator (MAS)
3. FY 1992 Work Plan Comments
4. Year-by-Year Data Volume (corrected)

ACTION ITEMS:

08/30/91 [Lloyd Carpenter and Team]: Draft a schedule of work for the next 12 months. Include primary events and milestones, documents to be produced, software development, MAS support, etc. (An updated draft version was included in the handout.) STATUS: Open. Due date 09/27/91.

12/06/91 [Liam Gumley]: Investigate a cataloguing scheme for the MAS data. Consider the Master Catalogue, PLDS and PCDS. STATUS: Open. Due date 02/14/92.

12/06/91 [Liam Gumley, Tom Goff, Ed Masuoka]: Develop a plan for storing and distributing MAS data. STATUS: Open. Due date 02/14/92.

01/03/92 [Ed Masuoka]: Check on the UCAR "copyright" as a first step in standardizing an SDST software copyright statement for code sharing. Check with legal. (Legal is developing the statement.) STATUS: Open. Due date 02/14/92.

01/03/92 [Team]: Check on the set of software engineering tools available in Code 530 to see if any of these would be of use to the SDST. STATUS: Open. Due date 02/14/92.

01/17/92 [Tom Goff]: Have a polished version (with peer review) of the file dump routine ready for the MODIS Science Team Meeting. STATUS: Open. Due date 04/01/92.

MODIS Airborne Simulator status (Liam Gumley)

Progress up to 23 January 1992

(1) MAS data distribution on Exabyte 8mm tape

Most of the week's activity has centered on resolving some difficulties experienced by Tom Arnold in reading the Exabyte tape supplied to him containing MAS Level-1B data.

The Exabyte tapes are currently created on a VAX/VMS system in LTPCF, and Tom is attempting to read them on a Silicon Graphics Iris in code 913. The aim was to create a "plain-vanilla" format tape containing the netCDF data files that would be transportable to any system. Whilst every effort was made to ensure that this was the case when the first tape was created on the VAX, it appears that several hitherto unknown problems have prevented the tape being read on the Iris. These are

(1) The VAX appears to have attached an 'ANSI' label at the beginning of the tape, which the Iris cannot handle,
(2) The Iris swaps the order of every pair of bytes read from tape unless explicitly requested.

The second problem is easily handled by using a different tape device driver. The first problem is taking a little longer to solve. Several methods of creating "plain-vanilla" tapes were investigated on the VAX, but it appears that none of these are compatible with the Iris. The best strategy appears to be to write 'ANSI-D' labelled tapes on the VAX, and to read these using the ansitape utility on the Iris. Investigation of this strategy is currently in progress.

(2) MAS data processing status

Flight Date	Area covered during flight	MAS data received	INS data received	Processing status
11/12/91	Ferry flight to Houston	yes (subset)	yes	Complete (1 track)
11/14/91	Coffeyville, Kansas	yes	yes	Complete (16 tracks)
11/18/91	Coffeyville, Kansas	yes	yes	
11/21/91	Coffeyville, Kansas	yes	yes	
11/22/91	Coffeyville, Kansas	yes	yes	
11/24/91	Gulf coast, Texas/Louisiana	yes	yes	
11/25/91	Coffeyville, Kansas	yes	yes	
11/26/91	Coffeyville, Kansas	yes	yes	
12/03/91	Gulf coast, Texas/Louisiana	yes	yes	
12/04/91	Gulf coast, Texas/Louisiana	yes	yes	
12/05/91	Coffeyville, Kansas	yes	yes	In progress
12/07/91	Coffeyville, Kansas	yes	yes	
11/16/91	Ground visible calibration	yes	-	
11/20/91	Ground visible calibration	yes	-	
11/23/91	Ground visible calibration	yes	-	

Mike King has indicated an interest in having the data from 12/05/91 processed next since this is being used as a case study by several investigators, and coincides with a satellite overpass. This flight is currently being processed.

(3) MAS data processing development

In the short term, a program will be designed that automatically determines which portions of a MAS data set are straight line flight tracks, based on examination of the INS data set. This will allow (in theory) the development of a MAS Level-1B processing system which requires no user intervention. Certain aspects of the code will need to be modified, but this may be a useful goal for version 2.0 (current version is 1.0).

Ken Brown has raised some issues concerning the quality of the MAS data, in particular the change in system sensitivity from ground to cruising altitude ("Engineering Evaluation of the MAS Remote Sensor performance during the FIRE Campaign", January 1992). The phenomena that require investigation are
(a) the change in thermal gain due to changing flight temperatures as detected by the blackbody references,
(b) the unknown behavior of the visible and shortwave IR channel gains due to changing flight temperatures,
(c) the coherent noise induced on the signal output of the detectors.

Ken has already made some investigations of the thermal gain changes, however more work is desirable. This would involve examining the change in thermal channel gain during the ascent phase of the mission for several flights, in order to characterize the change that occurs. This will aid in configuring the thermal gains before flight to obtain optimum sensitivity in the desired temperature ranges, and avoid over or under saturation.

The visible and near-IR channels are a more unknown quantity. No attempt has yet been made to characterize their gain change (if any) from the ground to cruising altitude. This is potentially a more important problem than for the thermal channels, as the visible/near-IR channels are only calibrated on the ground. Several methods of checking the gain change in these channels are possible.
(a) Comparing reflectance values at the same location(s) from the MAS and other imagers with similar spectral channels, under similar conditions (e.g. concurrent Landsat-TM or NOAA-AVHRR overpass).
(b) Comparing simulated MAS radiances over the ocean to those actually measured. This is applicable for the MAS near-IR channels, since the ocean is effectively dark (i.e. emits very small radiance) for wavelengths above 0.67 microns, compared to the radiance emitted in the visible part of the spectrum. Then the only process causing radiance to enter the sensor is scattering by molecules and aerosols in the atmosphere (assuming the sun glint pattern is not observed). If the molecular and aerosol scattering characteristics of the atmosphere can be estimated sufficiently accurately, then a simulated radiance for the MAS near-IR channels can be determined. This would then be compared to the radiance actually observed by the MAS in the same conditions. The difference in the simulated and measured radiance values will give an indication of the possible error (at altitude) in the visible/near-IR calibration.

Determination of the coherent noise characteristics of the data (especially the thermal channels) would aid in the removal of this noise. A first examination would include determining the noise characteristics in the frequency domain by the application of a two dimensional FFT. This would allow the isolation of the dominant frequencies of the noise signal, so that these could be removed from the frequency spectrum and the image data reconstructed. It may also point to a simpler noise-removal strategy such as a running-average of specified dimensions in either the along track or cross track direction (or both).

(4) MAS Atlantic Stratocumulus Transition Experiment (ASTEX) deployment

On 01/21/92 a meeting was held at GSFC for those participating in the MAS ASTEX deployment in June 1992. The experiment runs from June 1 to June 18 in the Azores Islands. The NASA Ames ER-2 and associated instrument teams will be located at the Lajes airfield on the island of Terceira. The MAS support team will include Mike King, Tom Arnold and Ken Brown. Chris Moeller from Wisconsin is also expected to be at the field site. The attendance of myself (Liam Gumley) is yet to be determined.

FY 1992 Work Plan Comments
Thomas E. Goff
23 January, 1992

TGoff on GSFC mail,
teg@LTPIRIS2.GSFC.NASA.GOV,
or (301) 982-3704

* **Anonymous FTP facilities** - The anonymous ftp account on the ltpiris2 computer has been updated into a group ownership to allow MODIS group users to post files to this area.

* **Science Code Portability** - FORTRAN has been installed on the ltpiris2 computer. Four of the five binary data sets have been converted on the IBM mainframe, ftp'd to the iris, subsequently converted to iris native floating point format and renamed to the iris FORTRAN default file I/O names. The fifth file has been decoded via my fdump facility and contains mixed integer and floating point. This file will be converted on the mainframe and ported to the iris next week.

* **Comments on the FY 1992 Work Plan** - (referring to last week's MODIS SDST handout)

  Section 2 - Add the development of general purpose utilities and the procurement/use of visualization tools such as image processing and graphics packages.

  Section 3 - How are CASE methodologies chosen? or a CASE environment?

  Section 6 - Add support for all the users who need help in obtaining and/or processing the MAS data.

  Section 9 - Purchase of books and recorded tutorials, etc.

  2.1 - Need the corresponding lists of ancillary data sets: in-situ requirements from TM experiments or archived in-place data (i.e. soil moisture or types) , other interdisciplinary instrument data: either historical or concurrent, and input to or output from models (i.e. circulation).

  2.2 - also implement the software development steps ala CM and auto indexing functions. Add COTS software acquisition.

  2.7 - Add simulation studies.

  3.1 - A CASE suite of tools: diagrammers, report generators, reverse engineering, quality assessment and metrics, debuggers, profilers, CASE environment, etc.

  3.2 - How about CASE environment instead of CASE tools?

  3.4 - Add CASE implementation (who will manage the repositories, where - what machines & network, when - time frame for this year's items vs next years)

4.1 - Will we be involved in setting, evaluating, or digesting the EOSDIS standards?

4.2 - How about the term: style guide? Interested in both mandatory rules/items in a check list form and optional guides. For which languages: C, FORTRAN, ADA, etc.

4.3 - All data will be self explanatory and self contained. We will derive, provide, and specify methods to accomplish this.

4.4 - A goal of self documented code. Derive techniques for auto documentation including key indexed software data bases.

5.0 - The calibration applies to instrument calibration, not at-ground radiances.

5.? - Incorporation of DEM data. Develop a data structure for DEM data. Begin the search for DEM data. Perform a parametric analysis on all obtained DEM data and implementation techniques. Add DEM corrected image registration while retaining non-DEM corrected information.

6.1 - The porting of MAS processing software and data sets to various machines as they become available.

6.? - User support. Subsampling, NetCDF to flat file formats to imaging package (i.e. Easi/PACE, Spyglass) formats.

6.? - Conversion of NetCDF ground location information to image system native formats. Conversion, specification, or incorporation of NetCDF into imaging packages. NetCDF is constantly being upgraded and we will have to be aware and/or implement changes as desirable or necessary.

7.? - Integration of off-site access to TLCF.

DISCUSSION ITEMS

* A library of the above mentioned subroutine functions should be generated or otherwise obtained to allow porting of routines among the various machine to be encountered in the MODIS time frame. A search is in progress to find copies if they exist.

* The file dumping utility (FDUMP) and the companion character replacement utility (REPLACE) will be placed on the MODIS anonymous ftp site as soon as some legalities are straightened out! This program would have been of great use on the IBM 3081 and I will endeavor to port it there for future use.

Year-by-Year Data Volume Estimates for MODIS-N

(GigaBytes)

Initial launch of first series (three consecutive 5-year missions) on June 30, 1998
Initial launch of second series on December 31, 2000

Year

Level	1996	1997	1998	1999	2000	2001	. . .	2012	2013	2014	2015	Total
0	69	480	12528	25056	25056	50112	. . .	50112	37584	25056	25056	725559
1A	72	504	13149	26298	26298	52596	. . .	52596	39447	26298	26298	789516
1B	122	851	22207	44414	44414	88829	. . .	88829	66622	44414	44414	1333408
2	56	395	10300	20600	20600	41200	. . .	41200	30900	20600	20600	618451
3 and above	20	140	3553	7305	7305	14610	. . .	14610	10958	7305	7305	219310
Total	339	2370	61837	123673	123673	247347	. . .	247347	185511	123673	123673	3712914

Notes: Daily volumes per MODIS-N instrument are:

Level-0:	68.6 gigabytes	Level-2:	56.4 gigabytes
Level-1A:	72.0 "	Level-3:	20.0 "
Level-1B:	121.6 "	and above	

Entries are computed as follows:

1996	1 day of data	2001 through 2012	24 months of data each year
1997	1 week of data	2013	18 months of data
1998	6 months of data	2014	12 months of data
1999	12 months of data	2015	12 months of data
2000	12 months of data		

MODIS
SCIENCE DATA SUPPORT TEAM
PRESENTATION

January 31, 1992

AGENDA

1. Action Items
2. MODIS Airborne Simulator (MAS)
3. Cloud Algorithm Porting
4. SDST Schedule

ACTION ITEMS:

08/30/91 [Lloyd Carpenter and Team]: Draft a schedule of work for the next 12 months. Include primary events and milestones, documents to be produced, software development, MAS support, etc. (An updated draft schedule is included in the handout.) STATUS: Open. Due date 09/27/91.

12/06/91 [Liam Gumley]: Investigate a cataloguing scheme for the MAS data. Consider the Master Catalogue, PLDS and PCDS. STATUS: Open. Due date 02/14/92.

12/06/91 [Liam Gumley, Tom Goff, Ed Masuoka]: Develop a plan for storing and distributing MAS data. STATUS: Open. Due date 02/14/92.

01/03/92 [Ed Masuoka]: Check on the UCAR "copyright" as a first step in standardizing an SDST software copyright statement for code sharing. Check with legal. (Legal is developing the statement.) STATUS: Open. Due date 02/14/92.

01/03/92 [Team]: Check on the set of software engineering tools available in Code 530 to see if any of these would be of use to the SDST. STATUS: Open. Due date 02/14/92.

01/17/92 [Tom Goff]: Have a polished version (with peer review) of the file dump routine ready for the MODIS Science Team Meeting. STATUS: Open. Due date 04/01/92.

MODIS Airborne Simulator status (Liam Gumley)

Progress up to 30 January 1992

(1) MAS data processing status

Most of this weeks effort has centered on processing the MAS data from the FIRE flight on December 5, 1991. Preliminary examination of channel 12 (12 micron) imagery and black body data indicates that coherent noise is present, with an amplitude maximum of approximately 20 counts. Chris Moeller at Wisconsin has also reported observing this noise.

Flight Date	Area covered during flight	MAS data received	INS data received	Processing status
11/12/91	Ferry flight to Houston	yes (subset)	yes	Complete (1 track)
11/14/91	Coffeyville, Kansas	yes	yes	Complete (16 tracks)
11/18/91	Coffeyville, Kansas	yes	yes	
11/21/91	Coffeyville, Kansas	yes	yes	
11/22/91	Coffeyville, Kansas	yes	yes	
11/24/91	Gulf coast, Texas/Louisiana	yes	yes	
11/25/91	Coffeyville, Kansas	yes	yes	
11/26/91	Coffeyville, Kansas	yes	yes	
12/03/91	Gulf coast, Texas/Louisiana	yes	yes	
12/04/91	Gulf coast, Texas/Louisiana	yes	yes	
12/05/91	Coffeyville, Kansas	yes	yes	13 of 29 tracks done
12/07/91	Coffeyville, Kansas	yes	yes	
11/16/91	Ground visible calibration	yes	-	
11/20/91	Ground visible calibration	yes	-	
11/23/91	Ground visible calibration	yes	-	

The processed data for 12/05/91 has been copied to the MAS anonymous FTP site, and Tom Arnold (913.0) has been notified they are ready for use. The FTP site now contains a subdirectory named "05dec91", which contains

(a) the netCDF MAS Level-1B flight track files,
(b) the corresponding INS data set,
(c) a brief document summarizing the flight mission.

(2) MAS processing software development

Design and implementation of a program that automatically determines straight line segments of an INS data file has commenced.

(3) Hard disk space requirements for MAS processing

In response to a request from Harold Geller (MCST), a brief estimate of hard disk space requirements for MAS Level-1 processing was generated, and is attached overleaf.

Estimate of hard disk space requirements for MODIS Airborne Simulator (MAS) processing.

Liam Gumley, RDC
30 January 1992

The processing of MAS data from Level-0 to Level-1B requires significant computing resources. The main requirement is for sufficient physical hard disk space to stage the input and output data sets, and the intermediate data sets and processing code. Also required are appropriate input and output devices for reading/storing the data (9 track 6250 bpi and Exabyte 8mm tape drives).

Currently, processing is carried out using both a DEC/VAX (VMS) and a Silicon Graphics Iris (Irix) in code 920. The VAX is used as a repository for the Level-0 data, and the Iris is used as a processing platform, and a repository for the Level-1B data. MAS data users are able to connect to the Iris and retrieve Level-1B data directly by FTP.

The minimum hard disk space requirements (in Megabytes) are as follows.

One file (tape) of MAS Level-0 input data	194.0 MB
One file of INS data (typical)	0.7 MB
Processing code and ancillary data	5.3 MB
Five MAS Level-1B output data files (75% of input data volume x 2)	291.0 MB
Ten MAS Level-1B output data files from previous flight (14-NOV-91)	564.0 MB
	1055.0 MB

It should be noted that these figures represent the figures for processing ONE MAS tape (9 track, 6250 bpi) only. Typical MAS missions (e.g. during FIRE, November/December 1991) generate between 3 and 7 tapes of MAS data. It is also assumed that BOTH 9 track 6250 bpi and Exabyte 8mm tape drives are available for archive and distribution purposes. The provision of a 1.2 Gigabyte disk drive would thus suffice in this limited case. For most efficient utilization of time and effort, 2 x 1.2 Gigabyte disk drives would be more desirable.

Overleaf is attached a message from Dr. Mike King (GSFC 913) regarding the number of MAS data channels. He states that in the near future it is possible the MAS will be upgraded to a 50 channel, 12 bits/channel data system. This will increase the storage required for MAS processing by a factor of 4 (approximately).

The transfer speed to and from the hard disk is also of importance. MAS processing speed is bound by the speed of disk I/O, and can slow down significantly if I/O speed is limited. This has been found to be the case when processing is performed on VAX/VMS cluster.

Thus it is recommended that AT LEAST a 1.2 Gigabyte disk drive be assigned exclusively for MAS Level-1B processing, with the addition of another 1.2 Gigabyte drive highly desirable. This will allow the delivery of quality MAS Level-1B products to the MODIS Science Team and others in a timely and efficient manner.

LG

From: SMTP%"@SCFVM.GSFC.NASA.GOV:king@climate.GSFC.NASA.GOV" 30-JAN-1992 11:56:17.64
To: gumley@ltp.gsfc.nasa.gov (Liam Gumley)
CC:
Subj: MAS Data System

Message-Id: <9201301656.AA03251@climate.gsfc.nasa.gov>
Date: Thu, 30 Jan 1992 12:01:47 -0500
To: gumley@ltp.gsfc.nasa.gov (Liam Gumley)
From: Michael King <king@climate.gsfc.nasa.gov>
Subject: MAS Data System

When the MAS is upgraded to 50 channels for the ASTEX mission, it will continue to have the current 12 channel data system. The tape recorder (Saber 80 analog drive) will be replaced by an exabyte (8500) drive, however. It is my hope that in the (near?) future we will be able to upgrade the data system to 12 bits and 50 channels, but that is still in the future.

Michael D. King | Tel : (301) 286-5909
Code 913 | Fax : (301) 286-4804
Goddard Space Flight Center | Internet: king@climate.gsfc.nasa.gov
Greenbelt, MD 20771, USA

Cloud Algorithm Porting
Thomas E. Goff
30 January, 1992

TGoff on GSFC mail,
teg@LTPIRIS2.GSFC.NASA.GOV,
or (301) 982-3704

* **Science Code Portability** - The fifth IBM binary file, associated with the cloud top program, that contains mixed integer and floating point has been converted on the mainframe and ported to the iris this week. A program to convert this data file into the native mixed integer and floating point is being written. This should have been an easy task, but I decided to do this in FORTRAN to match the IBM FORTRAN program. This would have avoided mistakes that might have been induced if a C program were written to perform this task. Instead, I have hit the wall of reading a mixed mode unformatted (binary) file on the ltpiris via a FORTRAN program. I have therefore decided to "bite the bullet" and create simple subroutines to perform this function. These will be similar to, but complimentary with, the IBM FTIO package.

* **Programming Style Guide** - I have been incorporating good suggestions for programming style into the existing utilities that I have previously written. A new book "C-Style Standards & Guidelines" by David Straker has just been released and contains much background information and examples that can be incorporated into our MODIS software project.

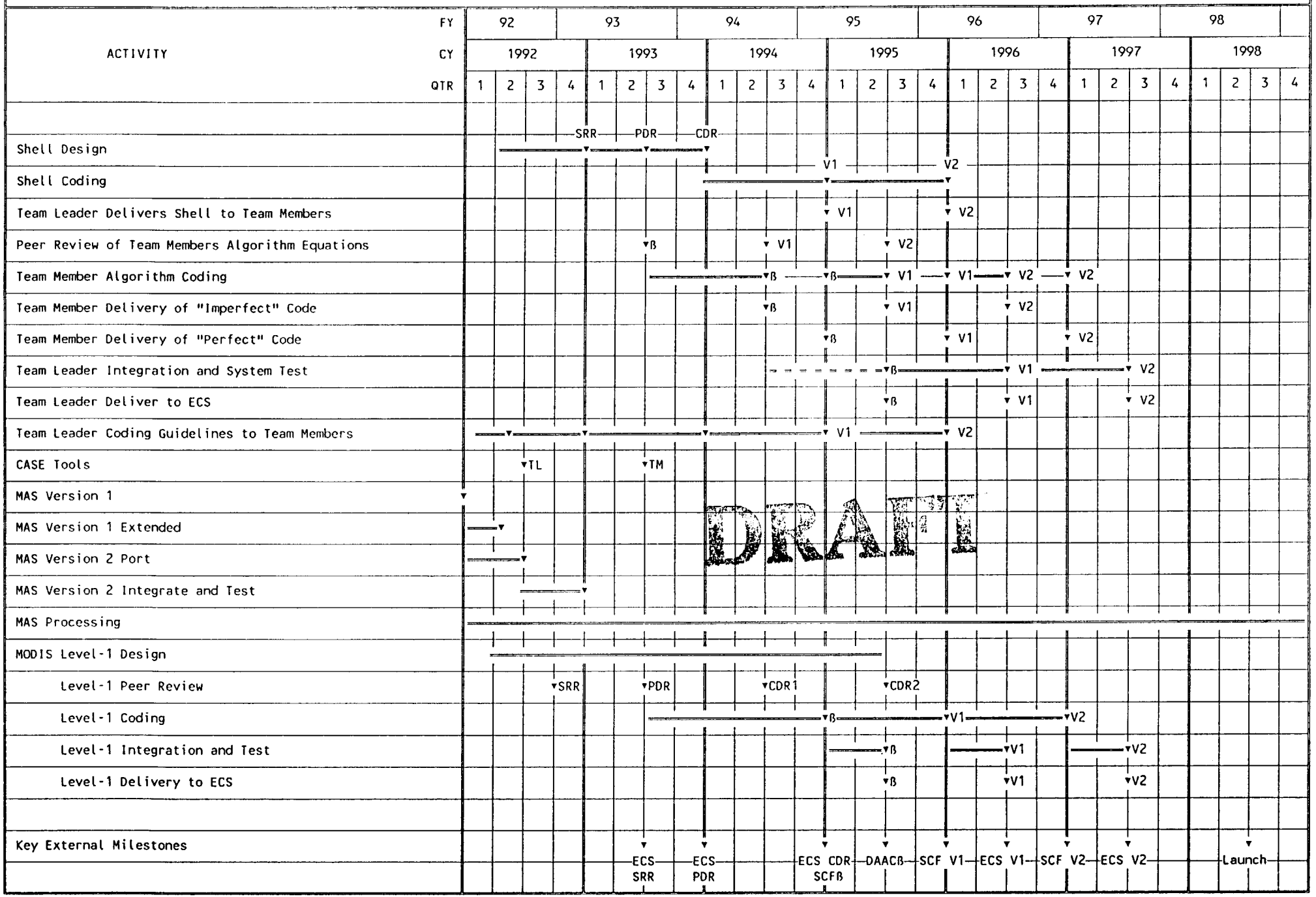
* **Automatic scripting language** - I would like to obtain the Perl language and manuals for evaluation as a tool to produce automatic documentation from source listings. The information I have been able to obtain suggests that this might be an industry standard, Public Domain, method to help automate documentation and configuration methodologies.

* **Remote communications to Goddard** - We at RDC have obtained the ncsa telnet program for PC's and a beta release of a slip protocol program to allow direct communications with the various machines at Goddard. The Goddard network people have been contacted to obtain an IP address for our PC's so we can test the feasibility of dial-up lines for more capability with screen editors, etc. This could lead to full X-window support via phone access. A political problem at Goddard exists because slip via a PC serial port has no interface card (hardware address), no rib manager (not connected to a rib), and no fixed location (dial up from anywhere). These are being worked out but will require a policy decision at GSFC networking to become reality. The wheels have been set in motion.

DISCUSSION ITEMS

* The file dumping utility (FDUMP) and the companion character replacement utility (REPLACE) will be placed on the MODIS anonymous ftp site as soon as the previously mentioned legalities are straightened out! Additional programs are available when this happens.

MODIS Science Data Suppor. Team (SDST) Schedule



MODIS Science Data Suppor. Team (SDST) Schedule

ACTIVITY	FY	92				93				94				95				96				97				98			
	CY	1992				1993				1994				1995				1996				1997				1998			
	QTR	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
MODIS Level-3 Develop Requirements																													
Level-3 Requirements Review																													
Design Level-3 Structure																													
Level-3 Design Review																													
Quality Control and Validation Tools																													
Identify																													
Design																													
Review																													
Implement																													
Iterate with Science Team																													
Utilities for Use with MAS or MODIS																													
Establish Utility/Subroutine Database																													
File Dump																													
Access																													
Selection																													
Browse																													
Display/Visualization/Graphing																													
Location																													
Data Conversion																													
Subsampling/Resampling																													
Lossy Compression																													
MetaData																													

MODIS Science Data Suppo. Team (SDST) Schedule

ACTIVITY	FY 92				93				94				95				96				97				98			
	CY 1992				1993				1994				1995				1996				1997				1998			
	QTR 1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
TLCF																												
Requirements Definition																												
Develop Evolution Strategy																												
Team Leader Computing Facility Plan																												
Design																												
Procurement																												
Utilities																												
Input Data																												
From Other Instruments																												
From MODIS Tests																												
From Simulations																												
For Development																												
Valid for Algorithm Examination																												
Defective for Algorithm Testing																												
For Validation/QC																												
Auxiliary for Processing																												
Output Formats																												
Establish Structures																												
Conversion Routines																												
Conventions																												
Simulated Data	———																											
Formats	———				▼SRR	——	▼PDR	——	▼CDR																			
Algorithm Specific (L-1B)					▼MAS/12 Channel								▼ß															
MODIS Generalized (L-1B)													———			▼ V1	———			▼ V2								
MODIS Level-0													▼MODIS-N Tests			▼ V1	———			▼ V2								