MODIS ANNUAL REPORT
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Due to the interlocking nature of a number of projects, this and subsequent reports will contain coding to reflect the funding source. MODIS funded activities are designated with an M, SeaWiFS with an S, and Pathfinder with a P. There are several major sections within this report; Database, client/server, matchup database, and DSP support.

A. NEAR TERM OBJECTIVES

A.1 MODIS Objectives (M)

A.1.1. Continue to develop and expand the processing environment
- a. increase computational efficiency through concurrent operations
- b. determine and apply more efficient methods of data availability for processes

A.1.2. Continue extensive testing using global CZCS and AVHRR GAC data with database processing to test the following:
- a. algorithm capability
- b. machine and operating system stability
- c. functionality required for the processing and analysis environment

A.2 SeaWiFS Objectives (S)

A.2.1. Continue testing of processing methodology.

A.2.2. Continue to develop relationship between database and in-situ environment.

A.3 Pathfinder Objectives (P)

A.3.1. Expand matchup database as applicable.

A.3.2. Continue testing of methodology.

A.3.3 Train and integrate new personnel into Matchup Database processing scheme.

A.3..4 Use matchup database to examine the development and applicability of new algorithms

A.4 DSP Objectives (M)

A.4.1. Continue testing of processing methodology.

A.4.2. Continue to expand the number of sites supported.
A.4.3. Expand the supported hardware/software platforms

B. OVERVIEW OF CURRENT PROGRESS

B.1 Automatic Database Processing and Development (P)

B.1.1 Processing

B.1.1.1 January

A set of new processing machines was installed and used for the operational processing, which required frequent shutdowns of the processing to accommodate the new hardware and software used with the upgraded equipment.(These adjustments were needed to test/assimilate the use of ATM between machines, replacing the slower FDDI links).

The pf2b run noted earlier was run for weeks 9401 through 9321, then processing was paused while hardware and software was adjusted, and this run was analyzed.

B.1.1.2 February

The pfad version of the processing was performed on 1993. This version had both the pathfinder SST processing with slightly different coefficients from the last run (the 'pf'),plus the SST estimated from separate asc and dsc coefficients (the ad). Cloud-masking, product production and backup is still ether by had or the APServer system.

B.1.1.3 March

The pfad version of the processing was performed on the 1994/NOAA-11 files (through day 256). To further investigate the scan angle effects, a special run of for sets of two weeks of processing was performed, keeping the value for channel 4 minus channel 5 (ch4m5) for six ranges of scan angles: below 10, 10-20. 20-30. 30-40. 40-50. 50-69, and greater than 60.

B.1.1.4 April

The new pfv3 run started with 94001 through 94256 (the end of NOAA-11 data). Processing was slow due to the numerous adjustments that were required to operate in the new paradigm (alpha running the post-processing, and set-up on the automatic archiving procedures).

B.1.1.5 May

A re-run of pfv3 for 94001-94265 was made, and also the first pfv3 run for 1993 and late 92.

Several two-week runs were made of the scan angle files, both SST and ch4m5, but these files need further development.

B.1.1.6 June

Most of 91 and 92 were processed, as well as 88315-88365 (the beginning of the NOAA-11 data)/

B.1.1.7 July

A pfv3 version was processed for the last 7 weeks in 88, and all of 89 and 90.

A week's worth of binned files were provided to JPL for verification of processing.

A new set of scan-segregated files was produced.

B.1.1.8 August

A run of the new version, pfv4, was begun. A new "speed record" was established: 450 day's worth of GAC data was processed in five days without interruption.

Shortly after the period 87001 - 88315 was processed, electrical work at the school caused major problems in the DLT machines holding the input GAC data, requiring that the tapes be scanned for file content. This slowed the processing.

A new pfv4 was started, with new coefficients. The time period weeks 8601 to 8624 were calculated.

B.1.1.9 September

The new pfv4 run was continued, finishing 86, 87 and 88 through week 46 (the end of NOAA 9).

When calculations started on 85, it was discovered that the input GAC files on the DLT machine were not correct, and 85 will be read in again from laser disk. This proceeded through September.

B.1.1.10 October

In addition to the scan seg testing, the first run of PFV4 was calculated for 8501-8845 (NOAA 9), and also for 9401-9418 (N11).

B.1.1.11 November

The rest of N11 (9419-9437) was calculated for pfv4.

The scan-segregation runs were made for four two-week periods (8602-03, 8615-16, 8628-29, 8641-42).

B.1.1.12 December

The first runs of n14 were made using pfv4 procedures, covering the time period of 9503-9552.

B.1.2 Development Activities

B.1.2.1 January

APServer Development

The APServer system is, for all practical purposes, complete. All source and, command files have been checked into CVS, and the only anticipated changes that are needed are to the orbit scanner program(s), to better identify and cope with input file problems.

Processing was largely performed using the aps/autosys software. The APServer system was used as backup and to perform short processing jobs (a few days' worth of orbits at a time), so no additional work was needed for the APServer system. Note that the APServer system was used for producing daily files from the orbits, and for all cloud-masking and product production.

Pathfinder Development

In early January, it was discovered that the change in internal coefficient was resulting in an abnormally low temperature cutoff in the most recent Pathfinder processing, and would need to be reprocessed. (This reprocessing was already planned, due to further changes and testing concerning the pathfinder algorithm).

A new run was made termed "pf2b", and used not only the most current pathfinder coefficients, but also had a second SST estimate, calculated from a set of "experimental" coefficients determined separately for ascending and descending data. In this run, the value for channel 4 minus channel 5 was stored, and also segregated by scan angle, that is, the ch4m5 value was stored four times per pixel, once for scan angles less than 30 degrees, between 30 and 45 degrees, greater than 40 degrees, and one for all angles.

B.1.2.2 February

The APS/autosys software again controlled the basic processing, and now also the production of the daily files. Cloud-masking and product production either used the APServer system, or was done by hand. The APServer system was used quite a bit for short runs (2-3 days' worth of orbits at a time).

The orbit pre-scanner was modified slightly to attempt to better identify orbits containing missing or bad blocks of scan lines. These adjustments improved the ability of the scanner to catch the bad blocks, but some are still remaining in the final processing. The scanning and processing both need to better identify these blocks.

A new task to be performed is the ability to extract SST data, and other requested fields (quality, number of input points, etc.) from the binned data, and store it either as matchup data to a set of input points in space and time (x,y,t matchups) or as time series at a point (ts at x,y). A number of small tools will be needed for this, both to prepare the "query" ability, and to sort/assemble the output into the desired format.

B.1.2.3 March

Matchup/Time Series Extraction

A program was written to extract the count, quality and SST value from an input binned file for either a single bin, or a set of bins contained in an input file.

A file was created containing all in_situ data matchups for NOAA-11. This file contains the time, lat, lon, buoy/reference for all previously-identified satellite/buoy matchups.

A command file was written to separate this file into separate files for each year. Further work was carried out on the 1993 file.

A program was written to convert lat,lon into RSMAS or ISCCCP bin number for any resolution binned file.

A command file was written to add this bin number to the matchup file.

Another command file was written to separate the yearly file by day and ascending or descending time. This results in one ascending file and one descending file for each day. These files constitute the "SST query" files and will be used to extract matchup data from the ascending and descending daily binned files from the AVHRR/GAC processing. The output will be stored in corresponding extraction files, and will be recombined into a single matchup file for analysis.

To construct time series at a point, a file was created in "DIM" format (a DSP-recognized data format for lat/lon pairs), and the bin numbers associated with them.

A command file was written to extract these points from a set of binned files, and another was written to recombine these into time series files.

B.1.2.4 April

Another modification was made to the pahtnlc processing, see details elsewhere (Pete: see Sue's input). This version is to be the "official" version three, so processing will use the ssttype/extension pfv3.

All post-processing functions (daily file making, cloud masking, product production, archiving) was moved from the SGI, andrew, to an Alpha 2100, apricot.

The Autosys environment was modified to perform the daily job, and two weekly jobs. The first weekly job just makes a "pre-declouded" weekly file. The second weekly job take three-weeks' worth of these, produces a reference file for the middle week, uses the reference to cloud mask the daily files for that week, produces the various products (cloud-masked weekly files, and spatially-reduced daily files), and archives the daily and weekly files.

A command file was written to extract histogram data from a DSP history file, to be used for plotting.

B.1.2.5 May

A new test run of the six-scan angle was produced. It was found that one of the post-processing programs, pathspc, was not handling these files correctly, and was modified. The previous version kept the ch4m5 (channel 4 minus channel 5) information. A new version was written to keep SST as a function of scan angle.

B.1.2.6 June

The most recent version of the pathfinder software was made available to JPL.

The files used to track the ascending\descending nodes for each pass, and to define the data-days had previously been kept in files for each satellite for each year. These files were

further broken down to produce a separate file for each yearday, to eliminate lengthy reads of ASCII data to retrieve the information.

Halfway through the month, major changes in computer networking produced numerous problems for the processing. These have been overcome, but interfered with the processing and development.

B.1.2.7 July

The only development work this month were minor changes to command files. The most recent Pathfinder processing method was transferred to both JPL and the University of Rhode Island.

B.1.2.8 August

(Should be covered elsewhere) A new method of determining quality at the pathnlc level was tested for NO9. This version of the pathfinder algorithms to be called pfv4.

Usage of any files on the SGI machine, andrew was eliminated from the processing stream, and all input and out file locations were changed to disks mounted only on the DEC machines. (Due to a bug in the most recent XFS filesystem, use of some the Andrew's disks by the processing machines was causing the SGI to crash.)

B.1.2.9 September

Development this month centered on the post-processing procedures (producing maps and time series products form the binned files), as well as setting up a data extraction stream, that will retrieve processed files, make several maps, and extract point data for time series construction.

Modifications were begun on the data spooling procedures, to streamline them, increase their efficiency, and possibly use them to construct a scan database, but the changes are only preliminary.

B.1.2.10 October

In October, the analysis of SST by scan angle was continued. The pathnlc program was modified to store not just SST and ch4m5 (channel 4 minus channel 5), but also ch3m4 and ch3m5, and test runs were made of several weeks.

Post-processing analysis procedures were also developed for the new scan seg runs.

B.1.2.11 November

The pathnlc program was again modified to save further information as a function of scan angle, and more procedures were developed to handle and analyze test cases.

B.1.2.12 December

Changes to be made to the data-entry procedures were begun, but not yet implemented. The operational system was not changed. The new procedures will be more efficient, and will store more information about processed files. These changes will be covered when they are implemented.

B.2 Processing Systems Status (M)

B.2.1 MODIS Version 1

B.2.1.1 Processing Software

Version 1 science data processing software was delivered to SDST on Dec. 4th. This delivery supports production of sst and ocean color level 2 products and raw (not declouded) level 3 daily composites. The follow programs were included in this delivery: anly8dbl, modsst, mtbin, msbin. Major new features included in this delivery are support for ECS metadata and new L3 file formats which do not use HDF external data files (since external files will not be supported by the Rel B ECS data server).

B.2.1.2 Metadata

During this quarter new library routines were developed to support writing ECS metadata. ECS archive and inventory metadata fields are stored in a single HDF attribute (CoreMetadata.0), so in this context, writing means to a assign a value to an attribute field name using function calls to the ECS Science Data Processing Toolkit (SDPTK).

B.2.1.3 Version 1 HDF file formats

In October Sue Walsh and Warner Baringer attended the MODIS Algorithm Developers Meeting in Washington DC. At this time, we reviewed with SDST and ECS personnel the proposed level 3 file formats and reached agreement on the number and function of ocean PGEs.

The current design for ocean level 3 has one parameter per file. This allows global level 3 files at 1k resolution which are less that the maximum HDF file size of two GB without using external data elements. The consequences of this redesign: increased numbers of PGEs, PGE activations, ESDTs and documentation are understood by Hughes and SDST.

B.2.1.4 PGEs

The December delivery also included PCF files for the 36 PGEs that were formally PGE20 (time binner for interim composite). PGE20 serves as an example of how all level 3 PGEs must be decomposed to process individual parameters. It was agreed that for the sake of consistency with existing documentation, the new PGEs would have '.#' appended to the old names (PGE20.1, PGE20.2,...,PGE20.36).

Scripts were developed for PGE9 and PGE10 to combine processing level 1b with space binning (MOD_PR18 and MOD_PR18E). This reduces the number of PGE activations required by MODIS Ocean processing by 576 per day (number of level 1 granules/day x 2).

B.2.1.5 Build Procedures

At the request of SDST, MODIS make procedures were modified so that standard make macros used to set compiler parameters can be initialized outside of make. This allows DAAC specific compiler options to be easily configured.

B.2.1.6 Near Term Objectives

Develop PCF files for PGE59 (MOD_PR19E, interim weekly composite).

Integrate programs mbinfill and mbincloud with SDPTK and MOCEANIO libraries.

Develop scripts and template pcf files for PGE60 combining time binning of interim three week reference files (MOD_PR19G) and the execution of mbinfill to produce the standard three week reference (MOD_PR19H).

Develop scripts and template pcf files for PGE61 which executes mbincloud (MOD_PR21D) to produce a standard daily composite.

B.2.2 Systems/COTS

B.2.2.1 Autosys

Autosys was upgraded to Rel 3 of version 3.2.

B.2.2.2 Sybase

Sybase Rel 11 was installed on IRIX and Digital Unix. Verification and testing of Rel 11 with the Autosys and the automated processing is in progress.

B.2.2.3 ATM Local area networking

IP switching technology for ATM was evaluated during this quarter. IP switching replaces traditional IP routers with an IP switch controller which works in concert with the ATM switch. Each packet which enters the IP switch is examined and initially routed normally. When a consistent "flow" recognized, the controller sets up VCs to "cut-through" and the routers are effectively removed, allowing "routing" at rates limited only by the throughput of the switch. We were, however, unable to make use of IP switching on a wide basis due to lack of support for classical IP (1577).

Four additional host were added to the network this quarter bringing the total size of the network to twenty one nodes.

B.2.2.4 Library integration

Integration of the mocean IO library into the version 1 code base was completed and included in the 9/17 delivery to SDST. The library now supports reading and writing of MODIS ocean level 2 and level 3 files and the MODIS geolocation file.

Due to the size of the global L3 files, the library was enhanced to utilize HDF external data files. The current HDF version (4.0) supports single files up to a maximum of 2 GB. External data files provide a mechanism for distributing data across multiple files. Unfortunately, this type of HDF file will not be supported by the Release. B Data Server.

HDF-EOS V1 was successfully integrated into the mocean IO library. The library now supports reading and writing to HDF-EOS v1 swath structures.

B.2.2.5 Build Procedure Enhancements

The GSFC DAAC's comments and recommendations following the Beta software delivery were reviewed. Based on this feedback the following enhancements were made and included in Sept. 17th delivery:

- All code was delivered in the directory structure requested by DAAC and SDST.

- Only F90, F77 and C code was delivered (no rat FORTRAN or mice tables).

- The legacy libraries used by MODIS code were separated and stripped down to include only routines used by MODIS.

- Shared libraries (.so) were converted to standard archive files (.a).

- All of ocean's pmake files were rewritten in standard make.

- Conditional build logic for separate platforms (such as VMS) was removed.

B.2.3 Version 1 HDF file formats

B.2.3.1 Level 2 EOS Swath

The Sept. 17 delivery included level 2 files in EOS swath format which is now supported as one of the standard data formats in mocean IO library.

B.2.3.2 Level 3 File Formats

MODIS Ocean Level 3 files HDF file formats which utilized HDF external data elements were proposed and submitted to SDST in August. External data elements allow data to be separated into any number of physical files which appear as a single HDF file. Using this feature the 2 GB HDF file size limit was maintained. Unfortunately, this scheme presents problems to the Release. B Data Server and this has forced a redesign of level 3 file formats.

The present proposal calls for each MODIS Ocean product to be stored in a separate Level 3 file of approximately 500 MB. This design increases substantially the number of files managed by the Data Server. This issue has been submitted to ECS. If this design also proves problematic, another alternative is to divide the products among 12 files, instead of 36, in order to reduce Data Server overhead.

B.2.4 Near Term Objectives

Integrate SDP Toolkit metadata handling routines into the Nov. Version 1 delivery.

Resolve outstanding issues with level 3 files. Meetings with Hughes and SDST are scheduled around the MODIS Science Team meeting in October.

Write scripts for PGEs to combine level 2, ocean color and SST (MOD_PR18 and MOD_PR28), and level 3 space binning (MOD_PR18E). This will reduce the number of PGE activations required by MODIS Ocean processing by 576 per day (number of level 1 granules/day x 2).

B.2.5 AVHRR SST retrospective processing

B. 2.5.1 Near Term Objectives

Continue work on improving system stability by automating the process of redistributing work assigned to a machine that is no longer available to the processing system.

Bring the programs and procedures under control of a source code management system (CVS).

B.2.6 Systems/COTS

B. 2.6.1 Autosys

Platinum still has not certified it's client for IRIX 6.2. Platinum has asked us to participated in a beta software evaluation of the next client release for IRIX should we acquire a license for the SGI Challenge.

B. 2.6.2 Sybase

Sybase Release 10 is not compatible with Digital UNIX 4.0. We continue to run the dataserver at DIGITAL UNIX 3.2c for compatibility. Sybase has indicated certification of DIGITAL UNIX 4.0 is in progress for Release 11.

B.2.7. ATM Local area networking

Two additional hosts, monstera and ceriman (4 processor Alpha 4100s), were added to the ATM network.

B.3 Matchup Database - Year 1996

1. Matchup Compilation

During this year we continued the compilation of in situ sea surface temperature (SST) data from moored and drifting buoys in order to build a co-temporal, co-located set of in situ and AVHRR data. The “matchups” are being used to estimate SST algorithm coefficients and to characterize algorithm performance. We have now the following matchup data:

- NOAA-9: 1985–November 1988
- NOAA-11: November 1988–September 1994
- NOAA-9 gap: September 1994–February 1995
- NOAA-14: February–December 1995

As can be seen in the list, we now have a complete database of matchups for the entire lifetime of two AVHRR instruments: the one aboard NOAA-11 and the one on NOAA-9 (the operational phase, between 1985 and 1988). NOAA-9 data also were used to fill the gap between the demise of NOAA-11 and the beginning of NOAA-14’s operation.

Of the retrospective Pathfinder data, only matchups for NOAA-7 are missing to have continuous temporal coverage of the period 1981–1995. *In situ* data corresponding to the NOAA-7 period have already been assembled and a list of times and locations at which to extract NOAA-7 data has been generated. We have obtained optical disks for the period from mid 1981 through to the end of the 1984 NOAA-7 record. These platters have been copied and extraction lists generated through 1983. The remainder of 1983 and all of the NOAA-7 period ((January to October, 1984) will be copied and matchups produced. We have copied the 1995 AVHRR data to the TL820 tape jukebox

Beginning with the 1994 NOAA-11 matchups, we incorporated a new source of in situ SST data: moored buoys in the northeast Atlantic operated by the United Kingdom's Meteorological Office. These buoys provide much-needed data in high-latitude regimes, as the matchups are dominated by data from tropical and temperate regions. Also, a previously unavailable set of drifting buoy data for the Greenland-Iceland region has been obtained from NATO, and will be used in future matchup data bases.

The compilation of the initial distributed version (V. 18) of the matchup data base was documented. This document was made available through the World Wide Web. The documentation included a description of the fields included in the matchup files, matchup procedures, and preliminary cloud-flagging filters.

Towards the end of the period, significant effort was devoted towards producing a new version of the matchup database (V. 19). The main difference between this version and the matchups distributed earlier will be: (a) new cloud flagging procedures (see below), (b) ancillary data fields included (e.g., columnar water vapor estimates from SSM/I microwave radiometer), and (c) full inclusion of all individual pixel values in the 5x5 extraction box.

2. Matchup Cloud Flagging Procedures

During this year, there was a major revision of the way in which cloud-flagging tests for the matchups are handled. Previously, we had implemented a series of very restrictive tests, based on brightness temperature (BT) thresholds, spatial homogeneity constraints, and channel-to-channel BT differences. The filters fulfilled their main purpose: to ensure that only a limited amount of cloud-contaminated matchups were used in the estimation of SST algorithms.

Although the cloud tests were mainly developed for the matchup database, they were also temporarily implemented in the processing of Pathfinder image products, while a consensus Pathfinder cloud-flagging scheme was adopted. It was observed that the end result of the cloud tests in the image products was

that many pixels were being flagged as cloud-contaminated when in reality they were not.

At the time when we began to process the NOAA-9 matchups (1985–1988), we had to revise the thresholds for the filters. At this time, we tried an approach known as “classification trees”. In this procedure, we start with a training sample, for which whether a matchup is cloud-contaminated or not is supposed to be known. Using the training sample, a decision tree is “grown”, using various satellite quantities (e.g., differences between BTs among various channels). The tree procedure finds successive splits that maximize the separation between the two groups of matchups (“cloudy” and “not cloudy”).

Separate classification trees were implemented for all available matchup files. For the NOAA-9 main sequence (1985–1988), the result of the new approach was that 60% more matchups were retained than with the earlier filters, while at the same time the proportion of cloud-contaminated pixels that were flagged as good was similar to that obtained with the older filters.

3. Pathfinder SST Algorithm Development

During this period we experimented with numerous alternative formulations for a Pathfinder SST algorithm. One of our goals during the algorithm experimentation has been to minimize the amount of bias or systematic error in Pathfinder SST estimates throughout a wide range of environmental and sensor conditions (e.g., all latitudes, all satellite zenith angles). A final consensus was reached on a Pathfinder algorithm, and this formulation was recommended by the Science Working Group.

The consensus Pathfinder algorithm is based on the non-linear SST formulation (NLSST) originally proposed by C. Walton (NOAA-NESDIS). In order to minimize temporal trends detected in the residuals (defined as in situ minus satellite SST), the algorithm coefficients are estimated on a monthly basis, using matchups for a 5-month window centered on the month for which coefficients are being estimated. An exception is the NOAA-9 gap period, for which a single set of coefficients were estimated.

Another major change adopted during this year concerns the estimation of algorithm coefficients via multiple regression. We adopted an iterative procedure in which a robust regression procedure is first used. The robust regression is supposed to be very resistant to outlier points. The residuals from the robust regression are used as weights in a subsequent weighted linear regression step. The end result is that the values of the monthly coefficients are much more stable in time than they were using the previous approach (a simple multiple regression). Algorithm coefficients were estimated for all the matchup

databases available, and they are being used in the reprocessing of the global SST fields.

4. Transition to near-real time coefficient estimation

Until now, the compilation of in situ SST data to be used in developing the matchups has been based on historical data from archive centers (e.g., the National Oceanographic Data Center). In the last few months, we have been exploring a collaboration with the Naval Oceanographic Office to obtain near-real time SST data from multiple sources. This would allow a timely estimation of coefficients. This effort is just beginning and we expect to continue working on this topic in the near future. As initial steps, arrangements have been made with the Naval Oceanographic Office for routine transfer of near-real time daily in situ SST observations. We have examined the content of the daily files and developed scripts to perform initial quality checks, tabulate quality check results, and plot data distribution.

B.4 MODIS and DSP Program Support (M)

B.4.1 First and Second Quarter Activities

B.4.1.1 Testing:

None reported

B.4.1.2 Modifications/Additions to DSP:
Add MODIS prologs to source files.
Use "__unix__" when looking for UNIX systems.

B.4.1.3 PROBLEMS FIXED:
LIB/IO/UNPACK.C: Correct structure indexing (bp) when accessing a single band in a BIP record. Correct structure indexing (bp) when accessing a single band in a BIP record.
RATFOR: Clean up to make more portable.
Don't use getopt.c anymore, use the C runtime's.
STBIN-HDF: Fix setting of start and end orbits.
Fix use of proc_con, proc_log, and infiles.
ANLY8D: Correct type of FORTRAN function secnds. Remove minimum chlorophyll output value code. Account for cut line when interpolating APHI and APHI0 to ZPHI and ZPHI0. Add albedo to QC file temporarily as field 19.
Remove progress records from proc_log. Change ';' to '|' in proc_con.
Do not set Bad_Atmos or Bad_Lw if channel 6 <= 0.
Divide albedo by cos(theta0). Output albedo to QC file slot 19.
Set albedo to -1 if cos(theta0) is invalid (e.g. night).
Remove old version of Carder chlorophyll algorithm.
Implement latest chlorophyll algorithms from Ken Carder.
PATHNLC: Reference SST field was incorrectly interpolated (off by 0.5 deg in lat/lon). Add routines to read other coefficient files.
COLORSHR8/COLORSUB8.C: Move b00 (and c00) calculations to second loop where

they are used. Correct documentation for APHI, APHI0, ATHET0.
COLORSHR8/MAKEFILE: Add logic for VMS build
BINLOC: Convert lon,lat to bin number. Writes bin number to workspace variable WBIN.
CALLER: Re-enable code that reaps dead child processes.
LIB/VMSFORLIB: Change the check for __STDC__.
MAKE-BSD: Fix ^C handling on VMS. Use the C runtime's getopt.
LIB/WRKTLK,SPHLIB,SCREEN,SATELLITE,FB,DISPLYSHR/MAKEFILE: Include "make.arch" instead of "make.0", it's cleaner.
LIB/HDF: Change declaration of memcpy for Irix6.2
LIB/CDFIO,RTLIB,IO: Switch over to the new way of building shareable libraries.
VMSLIB: Move the RANLIB call to the main makefile for libraries.
MIA2HDF: Test for both __unix__ and unix keywords to be certain.
DSP: Fix month output for _GDAT. It never worked right.
INC/RPC-TYPES.H: Add conditionals for the DECC headers.
LIB/RTLIB,IO,CDFIO: VMS builds shared library directly
LIB/IO: DEC C emits a new global common area.
ORBITSHR: Only extract 'geolat' from goes library.
Move calling constant into local variable.
Normal version of dfloc for orbitshr, orbit uses special version.
Add test program, remove unused routines, pass FOPTS to other makes, use correct version of dfloc.f.
Add modules used by findpole to library: satasn, timadd, xyz2ll.
ORBIT: Convert timadd.f to timadd.rat. Improve algorithm to be more robust.
Change comment character to 'c'. Change include to "miami".
Correct typo in constant (from conversion).
Clean up source formatting.
FINDPOLES: Routine timadd.f converted to timadd.rat.
Use orbitshr library instead of individual source files.
Reverse change to makefile, findpoles must build like orbit.
SSBIN-HDF: Fix use of proc_con, proc_log, infiles. Add debugs for testing.
Make sure all command line parameters are written to proc_con; add debugs for testing.
Disable testing debugs; enable Mike Darzi's "invalid" messages.
SMAP9-HDF: Fix use of proc_con and proc_log.
SCRIPP: Fix calculation of length of ingested data for Dundee format data.
Check for unsupported combination of options.
Add byte stream input logic and global variable.
Create scripp.doc which explains the various input options.
Read Dundee files which have been ftp'd (disk files, not tapes).
EXAMIN: Change defaults to dump everything; add ability to show pathnlc version information.
PATHBIN: Let mask input be optional; Change grid spacing default to 8 (from 16); handle data by scan angle; pass pathnlc version information to output file; change use of flags for quality determination.
PATHTIME: Allow for more bands due to scan angle option; make sure all inputs have same pathnlc version number; write pathnlc version number to output file.
PATHMAP: Handle data by scan angle; allow input file which contains bin number for each output pixel to save calculation time.

AVHRRSHR5/MAKEFILE:
No longer need to build ephs, refrac, etc. They are in SPHLIB.
MCSST/MAKEFILE:
No longer need to build ephs, refrac, etc. They are in SPHLIB.

PATHBIN:
Fix to handle last box on line properly.
Fix REV2LF, which converts integer row,column to lon, lat.
Correct multiple bin per pixel use of scale and ndist.
Remove portability problems.

IMG2BIT:
Map input image to bins (pixel by pixel) instead of locating input pixel associated with each output bin. Also only set a bit if land found, don't clear the bit if water (array is pre-cleared to all water).
Enhance algorithm to make sure that all the data in the input image is represented in the output image and that all bins in the output image represent pixels in the input image.
Check for needed space in output array (output grid dependent).
Check for enough space for input image.
Reformat some declarations.

IMGTOFMT:
Remove declaration of Dsp_CalEvl.

QRMPACK/QRMPACK.RAT:
Remove declaration of variable APPEND.

RATF90:
Initial version. Derived from 'ratfor'.

CONVRT/CONVRTOP.RAT:
Fix typo with end of line character.

ORBITSHR/PCAPSUB.RAT:
Declare "scopy" as external, fix typo with end of line character.
Link with libsatellite and libgoe from DSP_LIB: instead of LIB_USER:.

PATHFILL/PATHFILL.MICE:
Remove calls to "secnds", they don't do anything.

INGEST/LIB/SCANBACK.RAT:
Fix loop bounds (previous fix was wrong).

MODSST:
MODIS version of PATHNLC.

LIB/SATELLITE/ISLEAP.RAT GREJUL.RAT JULGRE.RAT:
Use ISLEAP, a new function to determine if a year is a leap year, instead of in line code.

Third Quarter Activities.

B.4.2.1 Testing:
Tested and delivered V1 MODIS level 2 processing (modcol and modsst).

B.4.2.2 Modifications/Additions to DSP:
Change $NAMSIZ so that we have room for the MODIS path and file names.
Add prologs to MODIS source files.
Renamed programs and libraries so that the MODIS versions and the DSP versions have unique names.
Rearranged routines so that modules used by more than one program are in a library.
ATMCORSHR: New library which contains all of the routines and include files which are common to both modcol and modsst (except the routines which have to do with binning which are in binshr). Move splitandappend to binshr since it is now used by the binning routines also.

get_image_name wasn't being used. Changes to get rid of f90 compiler warnings. Fix MODIS headers. ifdef out DSP environment stuff.

BINSHR: New library which contains all of the binning routines and include files which the MODIS programs share. This also includes the routines which read the global land and shallow water masks. splitandappend moved from atmcorshr since the binners use it. parsefilestring is no longer used. Fix check for directory separator in splitandappend.

Put all include files which are used by more than one program in modinc.
MODIS executables have .exe extension.
Fix all makefiles to use MODIS environment variables.
Add -n32 support. Add f90 support.
Change pcf logical numbers to be in the 300,000 range for MODIS oceans.
Fix .pcf files for latest toolkit version.
Fix use of PGS_SMF_* toolkit error handling routines.
Clean up include files so they look ok in f90 files.

B.4.2.3 Problems fixed:

MODCOL: Include proper PGS error message file; output calibration information as band attributes; fix calculation of the time of the input scan. Implement complete algorithm for MOD31. Increase arrays to leave room for vagaries of input data. Correct string declaration. Scantime is now a single value (was two element vector before). l1b_bands_read is now an input from main program. Add secnds compatibility routine (for testing). Initial CFE/enhanced FLH code (Abbott). Output PEB and PUB to L2 file. Fix pel_* routines to work with SeaWiFS data converted to MODIS format. Add check for invalid input values. Take out old SeaWiFS and DSP stuff to make it easier to add MODIS prologues. Read HDF versions of bit masks using mocean routines instead of DSP files. Remove unused code. Scantime is an 8 byte real now. Get rid of blanks from the input mask/flag names. Change fold_arith_limit to 3134. Define Ftiltr and include string.h. Add attributes to output files to make the ncdump output look pretty. Fix MODIS error messages. Fix MODIS headers. Fix wang2.f to make f90 happy. Use swath file type.

MODSST: Get input files from .pcf file instead of assuming they are in $DSPROOT/cal. Include proper PGS error message file. Split is no longer in the mice table. Get input file name and path from pcf file. Start to add two more bands of input. Add another SST band to the output file. Allow short or real input pixels (using ifdef's); add second channel 5 uniformity check; add second SST output band; start to add two more input bands; a lot of little changes to do things more like modcol (and SeaWiFS) does; output other bands in QC file; write out band attributes; use pathfinder version 3 - 2 piece algorithm and coefficients. Adjust format statements to make radiance values readable. Add to documentation of USE_LAMBDA. Finish code for USE_LAMBDA (radiances in micro-meter vs cm^{-1}). Add more diagnostic printouts. Put radiation constants in a common block for etbpsub.rat. Add reftyp to specify type of reference file. New routine to read Reynolds weekly SST data directly instead of converting it to a DSP image. Use date of data to make sure correct reference file is being used. Add input of MODIS bands 21,22,23, and 27; write out raw and bright for bands 22 and 23 to the QC file; add option for another type of reference file - Reynolds weekly data (not converted to DSP).
Use swath type file organization. Increase FOPTS -Olimit. Fix format statements to output logicals as integers. Take out references to

ingest library. Fix attributes. Fix error messages. Don't allow DSP version of oi reference file. Add check for invalid input values.

MODLIB/MOCEAN: Added support for multi-file format (BSX_MF). Added support for HDF-EOS swath format (ESW_2D and ESW_MF). Use SMF routines instead of printing to stderr. Allow multiple bands to a single subordinate file.

OISST: Add option to read weekly file (formatted reals).

MSBIN: Fix debug ifdef. Get file organization from image open. Add attributes; fix close routine - add missing braces for if statement. Add long name attribute to output file; fix band number calculation. Read attributes from input file; fix maximum number of output bands; fix extraction of orbit number from input file; fix references to multi-dimensioned arrays. Change pcf logical numbers to be in 300,000 range for MODIS oceans; add attributes to output file; fix check for successful output file creation. Fix use of proc_con and proc_log. Take out DSP stuff. Fix attributes. Change pcf files to fix template pcf stuff, fix order of L3 output files, use 4km resolution.

MTBIN: Make things more standard for V1 delivery. Fix use of HDFLIB stuff; add rules to make writetest - Warner's test routine. Remove old and temporary files. Add option to subtract data in one file from the files being summed, but it is not completely tested yet. Fix routine which reads input data. Create output file names for subordinate files. Fix handling of flag bits. Add attributes; fix extraction of orbit number; fix referencing of multi-dimensioned arrays. Add attributes; fix string reference (use " instead of ' to make sure it is null terminated); fix format statement to make f90 happy; fix calculation of weight (wtpix) to make f90 happy. Add attributes; don't use subordinate files. Fix use of proc_con and proc_log. Fix attributes.

MMAP: Increase number of input bands; fix record read; get file organization from image open. Fix extraction of orbit number from input file. Fix use of encode to use EOS instead of 0. parsefilestring is now in binshr. Now have two pcf files for MOD28 instead of just one. Rename pcf files; fix use of proc_con and proc_log. Fix attributes in output file.

RATF90: Add trailing null character to strings that are expected to be null terminated. Some sources don't quite match what was last checked out.

MSSTSHR5: Only use trname for VMS. Remove all unused stuff. Get rid of relative paths. Remove old, unused stuff; don't reference routines which are in other libraries. Fix error messages. Move raygetpol.inc to $DSPROOT/inc because it is also used by modsst.

IMG2HDFBIT: new program to Convert DSP image mask into a bit mask hdf file. Used for land and shallow water masks. Add attributes to output file to make ncdump pretty.

MCOLSHR8: Get rid of unused stuff. len_str is now in atmcorshr. Routines from other libraries are no longer in this library. Move get_climatology.* from mcolshr7 which we no longer need. Update prolog to make checker happy.

B.4.3 Fourth Quarter Activities

B.4.3.1 Testing:

None mentioned

B.4.3.2 Modifications/Additions to DSP:

Lots of source files were modified to satisfy the F90 compiler:

Curly braces were added around one line body of DO's and IF's.
Commas were added to FORMAT statements.
"void" was added to the functions that do not return a value.
Added CONTINUE to naked line numbers.
ELSE IF needs to be on the same line.
Declare "merge" as external.
Change SNGL to FLOAT.
Add "status=" clause to OPEN statements. Add commas to FORMAT statements.
Change DATA staments to use "%" as radix character.
Change DATA initializers to use single quotes.
Add () to function without arguments.
Change "type" to "print".
Add support for Irix 64 bit systems.
Don't use .PATH variable in makefiles, use relative pathname instead.

B.4.3.3 Problems fixed:

PATHFILL: Add 'qual' data select argument and associated tests.
Add comments about number of input bands for successful run on andrew.
PATHBIN: Add allb = 7 and 8 options.
New quality tests (tree, and yuckiness); new bit 9 in quality band for yucky (used as extra qual info and used by pathqual); handle allb=9 and 10.
MSBIN: Changes for writing one band per file. (Still needs flag handling per band.) Write out total number of bins as an attribute. New routine, setuplog, to echo command line inputs and read in output file names. New pcf file to do all L2 files in one PGE. Update prologs. Update pcf files. Compute metadata values: corners, piece start time; change variable name 'of' to 'wf' to make it easier to search for it. Use toolkit metadata routines. Fix use of proc_log and proc_con; fix metadata. Fix use of mod_get_l1b_attr and fix error message. Fix attribute writes. Only echo filenames, not paths. New routine, maketime, to create a time string for metadata. Change SHORTNAME metadata.
RATF90: Add 'implicit none' after every function/subroutine/program record.
Fix multiple level breaks (not nexts) so they work in f90 context.
Wait for end of continued group before inserting 'implicit none'.
MAKE-BSD: Use the typedef "wait_t" instead of "union wait".
Fix error when breaking up long lines.
LIB/CDFIO: Don't hardcode the use of libnetcdf.a, we might have a shareable library available.
LIB/CDLIB: Recode arithmetic IF's. f90 doesn't allow a jump into a loop. Change "break 1" to "break".
LIB/DISPLYSHR: Add a reference to ASTPID to force the loading of common block KEYCOM.
LIB/GOELIB: Remove arithmetic IF's.
LIB/HDF: Fix up the comments.
XFBD: Remove old SGI 64bit support. XCopyArea is a void function, don't store return value.
PATHSST: Fix up structure references. Wrap code with same conditional used by referencing code.
TROUTC: Lower case variable types. Disable unused code.
SSTLOAD: Don't pass an INTEGER*2 to the float function.
SSTLC: Don't pass INTEGER*2 to float function.
OA2PST: Fix gridrows.
111111: Remove arithmetic IF's. Add CONTINUE to bare line numbers.

2CHAN: Remove "implicit none" from source.
Consolidate error code. Move branch target out of if-then block.
ANLY: Remove macro "ior".
BINOPR: Remove "xor" macro.
CONTENT: Declare "digits" as external.
CONTEXT: Declare "digits" as external.
CTBIN: Convert structure references to use the macros.
DBMAN: Add "status=" to FORTRAN open statements.
FILEEPS: Change "file=unknown" to "status=unknown".
GETCOM: Use the new form of "UNDEF".
IMGTOFMT: Add "int" to bare "reg" declarations.
MAPFORM: Change DFLOAT to FLOAT.
MAXSQR: Change "status=unknown" to "status=new"
MIA2CDF: Add "int" to bare "reg" declarations.
MIA2JPEG: Fix includes for VMS.
MIA2PICT: Add "unsigned" to declarations.
MIA2PS: Add missing "return" statement.
ORBIT: Recode arithmetic IF's.
ORBITSHR: Use six spaces instead of TAB for continuation. Recode arithmetic IF's.
PATHNLC: Fix up structure references. New satellite test (tree); allb=9 for new 4m5 coeff value; allb=10 for plus and minus satz.
SLD: Remove code from PWRITX call (??). Use logical NOT for test.
CZCS: Use character*4 instead of long for strings.
CZCSSCAN: Declare "merge" as an external function. Change "type=unknown" to "status=unknown".
SCRIPP: Fix up structure references.
CLR: Fix spelling of NAMSIZ.
PALIMPORT: Add a print option to display r/g/b values for each entry.
TRACE: Add third fractional digit to output record.
FLTR: Use DECL_STR for variable "string".
ORBIT: Move target code block out of if-then block.
COLORSHR/CALF0: Check for read/decode errors.
COLORSHR/CALGETEPS: Consolidate error code. Move branch target out of if-then block.
COLORSHR/CALGETOZONE: Consolidate error code. Move branch target out of if-then block.
AVHRRSHR5/AVHRRSUB5: Consolidate error code. Move branch target out of if-then block.
FINDPOLES: Move code outside if-then block.
JULIAN: Use rest of 'encode' arguments.
LPALROL: Move error checking up to where it is needed (inside if-then block).
MIA2PICT: Move argument types into call list (new style) instead of after the call list.
PULL: Move error code outside enclosing if-then block.
RPALROL: Move error code into block that uses it.
SHPNAV: Move error code outside if-then block.
VHRR: Move shared error code outside if-then block.
MTBIN: Update prologs. Update pcf files; write out filenames to metadata. Update pcf's; no longer need prologues for .rin files since we're giving modis the .f90's. Don't need start and end orbits for modis. Add setuplog, routine to echo input parameters. Fix attribute writes. Fix attribute and metadata handling. New routine, maketime, to create a time string for metadata. Use toolkit metadata routines.

LIB/MOCEAN: update prologs
FINDPOLES: Correct error message (writing 57 chars into string 50 long).
MODLIB/IO/EVLCAL: Use real constants (not integers).
LIB/MOCEAN: Add Mocean_GetFileID so we can use the toolkit metadata write routine.
BINSHR: Change array sizes to handle 4km; add pgsmetwrap - fortran wrappers for toolkit metadata routines; remove splitandappend; add stripandappend; add routines to set metadata - setmetafrominput, setmeta, timestamp, writemeta, and setmetal3; fix writecal to write out the correct units. Strip out base filename and append it to the blank separated output string, and optionally write it out as metadata. Fix use of toolkit metadata routines. Fix metadata; add maketime.
MCOLSHR8: Put function name in modis error messages; output all file names to metadata.
MCOLSHR8/RAYGETPOL: Fix error handling.
MMAP: Change for 4km; output filenames to metadata; changes for one band per file; update pcf files.
MODCOL: Update pcf files; use toolkit metadata routines; use solar constants to calculate level 1b radiances; change some debugs; check for bad input values; add use of mod_get_l1b_free. Comment out check for SGI since pmake complains about it. Add new parameter, scanmode, to modisio routine; write out flag info properly.
MODSST: Update pcf files; use toolkit metadata routines. Add new parameter, scanmode, to modisio routine; update pcf files.
MSSTSHR5/RAYGETPOL: Use toolkit metadata routines to write out ancillary file names to metadata. Fix error handling.
DAYBOUNDS: test program to calculate data day start time.
PATHQUAL: New version of pathcloud which uses both Reynolds and OA files.
ANLY8D: Change separator from space to comma. Add/change some comments. Only write "important" stuff to proc_log (for SeaWiFS). Add nav_flag argument to l1a_record and AnlyRdI interface. Modify for v5.0 distribution. Fix use of new HDFROOT for v5.0 SeaWiFS on SGI.
SSBIN-HDF: Only put "important" stuff in proc_log. Change debugs.
STBIN-HDF: Only put "important" stuff in proc_log. Fix use of infiles, use comma for separator.
SMAP9-HDF: Fix use of proc_con and proc_log for SeaWiFS.
B.5 Direct Project Support
B.5.1 MODIS (M)
MODIS

Richard Sikorski has been utilizing SCF elements to model possible errors in MODIS sensors due to uncertainties in the pre-launch characterization of the spectral sensitivity of thermal IR band sensitivity bands. RAL radiance model has been used with each generation of spectra to determine whether these filter functions allow the achievement of the level one goals of MODIS for SST

B.6 DOCUMENTATION ACTIVITIES

Modified and update all prologues for new science algorithms to satisfy requirements of the automated standards and guidelines checker utility used to verify coding standards of the version 1 code delivery. Created prologues for all subroutines and functions located in the heritage code libraries. Updated document containing all ancillary and output file

descriptions and version 1 packing list. Revised flow diagrams and volume and load estimates to reflect changes for version 1.

Matchup databases:
Continued processing matchups for 1994 and 1995 pathfinder sea surface temperature. Expanded the Pathfinder matchup database to include 1984 and 1985. Continuing to collect in-situ buoy data for 1996. Began exploring new techniques to identify cloud contaminated pixels in the GAC extractions contained in the matchup data base. This technique uses decision trees to develop new tests for flagging cloud contaminated satellite data for exclusion during coefficient estimation. These new tests should allow dramatic expansion of the matchup database while still maintaining stringent quality control of the data contained in the matchup records.

The preliminary design phase of two new matchup data bases processes was initiated. The first is a real-time matchup process for sea surface temperature. We began obtaining real-time in-situ buoy data from the Navy. This data was analyzed for quality and source of these datum for inclusion in the matchup process. Scripts were then developed to automate the quality checking and reformatting of the real time in-situ data. The initial design phase was begun to automate the extraction of real-time satellite data to be included in the "real-time" matchup process. The second database design is the ocean color matchups for use with MODIS. We are in the process of designing a querible relational database system which will contain in-situ ocean color data in both the vertical and horizontal and satellite extractions of L1 and L2 data for the time and space locations of the in-situ records. We have identified 21 in-situ measurements which should be included in this database and are presently soliciting input from MODIS team members and other potential users of this system during the Design phase.

B.6 Team Activities for September through December

SST activity focused on generating a consistent decade long time series using the NOAA AVHRR instruments from 1985 through 1995. An improved approach to determine retrieval equation coefficients and associated data quality filtering was implemented. Results of this effort was presented at the Fall AGU meeting at San Francisco.

Hajime Fukashima visited our laboratory to discuss OCTS algorithms and data exchange. A OCTS test tape will be used to develop input routines into the MODIS L2 program.

A group from Hughes visited to discuss implementation of portions of the ECS software at the MOCEAN SCF. The ECS replan activity prevented activation of this plan.

Attended the MODIS IR calibration meeting. Passed considerations to P. Minnett including IR channel cross-talk (spectral and spatial), mirror responsivity for long wavelength bands. stray light (internal and from space view), DA linearity, T/V limitations for calibration of wavelengths longer than 8 microns.

Met with H. Gordon concerning V2 implementation of his algorithms. Expecting delivery of updates for white caps, diffuse transmittance and polarization. Will need to rearrange tables to accommodate changing number of aerosol models for eventual inclusion of absorbing aerosol models.

Attended MODIS team meeting. Received further updates on instrument status.

Experimenting with a combination of SST Q/A approaches where both a running estimate of local SST and climatology is used to compare against the retrieved SST. Use of the climatology will provide a reference where the area has been cloudy for extended periods of time. An area about the pixel will be searched in the climatology field to allow for feature advection.

Attended ATBD review. Submitted updated ATBD for web posting.

Attended SPIE meeting in Halifax. C. McClain direction discussion of SeaWiFS algorithms. Community continues to weigh approaches to compute chlorophyll.

Attended MOCEAN meeting in Miami. K. Carder has updated his algorithm code and Q/A flags.

C. FUTURE ACTIVITIES

MODIS activities for 1997 will focus on integrating V2 algorithms and delivering revised code to the SDST. We also will continue to implement a near real time acquisition of in situ data and institute methods to compute contemporaneous SST retrieval equation coefficients. Disk and tape storage capabilities will be upgraded to support at launch sensor initialization an Q/A product generation. Initial tests will be run on SeaWiFS or OCTS data as they become available. The upgrade AVHRR sensor should also be launched during this year.

C.3 Pathfinder (P)

C.3.2 Continue algorithm tests and Pathfinder-Reynolds comparisons.

C.4 MODIS (M)
C.4.1. Delivery of prototype ocean code to MODIS team.
C.4.2. Work with team to update product algorithms.
C.4.3. Work with Hughes on processing rules/scenarios.

C.5 SeaWiFS (S)
C.5.1 Continue testing of Gordon's algorithms and its interaction with HDF ancillary routines.
C.5.2 Continue timing tests with CZCS and SeaWiFS algorithms.

D. PROBLEMS

D.1 Database Problems

None listed separately

D.2 Client/Server Problems

None listed separately

D.3 Matchup Database Problems

None listed separately

D.4 DSP Related Problems

None listed separately