MODIS QUARTERLY REPORT
- March 1997-

UNIVERSITY OF MIAMI
RSMAS/MPO

DR. ROBERT H. EVANS

NAS5-31362

==========

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. Begin extensive testing using global color 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.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 Processing Database (P)

B.1.1 Processing -Pathfinder

During Jan-Mar 97, The "pfv4" processing was completed on these time periods/satellites:

8846 - late 94 - NOAA 11

late 94 - 9502 - NOAA 9

9503 - 9552 - NOAA 14

The only feature added to the automatic processing procedures was a timing feature, that allow individual computers to be added to re removed from the processing stream. This is for machines that are used interactively during the day, but available in the evening and overnight for processing.

In addition several special projects were also produced, including a special low-temperature run (for cloud investigation), several regional extractions over limited time spans, and a large run of scan-segregated files, running from Feb. to July of 91 through 95.

Four years of the Pathfinder PFV4 daily binned files were copied and sent to JPL, and copying continued. The years completed were:

8846 - late 94 - n11

late 94 - 9502 - no9

9503 - 9552 - n14

B.1.2 January APServer Development

Automatic Processing Development

The only feature added to the automatic processing procedures was a timing feature, that allow individual computers to be added or removed from the processing stream. This is for machines that are used interactively during the day, but available in the evening and overnight for processing.

Apr 97 Pathfinder Production

Data effort this month centered on transferring the pfv4 files to JPL, and making and distributing various products. A new method of making the archive tapes for JPL was not successful, so we will return to cloning of the archive tapes.

Procedures were developed and archive method tested to produce global 9 km maps from the binned data. A demon was written to run these procedures that retrieves the 9km daily binned files from the DLT tape archive one week at a time, and makes the 9km global maps, along with any other products that be needed. Remap characteristics for several regional products were developed,

Work was begun on an 11-year weekly climatology of the PFV4 data set. A demon was developed to retrieve a single week for each year from the DLT library, and calculate the 11 year mean and 11 anomaly files, and four weeks from each season were calculated.

The binned files currently contain both the interpolated Reynolds input values (bsst) and the Channel 4/5 difference (ch4m5). Since these are sometimes extraneous (in the reference files, for example), a program was written to strip out these data bands from the binned file.

The calculations of tau-1, which may occasionally been used as a diagnostic filed, were found to be incorrect, and will be corrected. this field has only actually been calculated for one special case, and even in this case was not used for analysis.

May 97 Pathfinder Production

The 11-year weekly climatology was completed, and compared to the climatology calculated from Arthur Mariano's objective analysis of the 18km 2-day filed.

A special run was made to compare two ways to calculate SST: the most current Pathfinder method, and Arthur Mariano's algorithms. Two weeks in each season of 1991 was calculated using the scan-segregated method (which separates data based on the scan angle of the AVHRR sensor).

Production of the global 9km maps continued.

Modifications were started to produce 4km binned data, in addition to the normal 9km bins.

Jun 97 Pathfinder Processing

A corrupted weekly file was identified in week 9224, and it was discovered that a number of file in the DLT archive had not backed up correctly. The corrupted files were replaced.

A series of zero-length files came off the DLT, and will need to be recalculated. This may represent the earliest calculations at the beginning of pfv4. They were backed up from a secondary disk, not the primary /AVHRR, and will need to be recalculated. They are: 8744 through 8751. It looks like the daily files for that time period are full size, so these will not need a full recalculation/

Cloning of all archive tapes for JPL is done.

Maps of the Mariano/Pathfinder run were made and the binned data archive on the DLT.

It was discovered that the most recent tree method of pixel selection was not used for the PFV4 version, and will need to be recalculated. Some changes were also made, and the entire set will be recalculated. Since these additional changes are not major, this run will be termed PFV41. Omission of the flag test primarily affects how each pixel is flagged, and not the value of the SST calculation itself.

Procedures will be implemented to extract the processed data that corresponds the pints contained in the Matchup Database.

Many adjustments were made to the processing procedures, to streamline them and make the process more efficient.

More adjusting to the processing had to be made to accommodate the 4km product production. The program that bins the scan data is highly memory-intensive, and the version that is large enough for an orbit piece at 4km can only run on our two biggest machines. Also as expected, these run are considerably slower than the normal 9km processing stream. However, this capability is now functional.

B.2 Processing Systems Status (M)

B.2.1 MODIS

B.2.1.1 MODIS Version 1

An addendum to the Version 1 science software delivery supporting production of level 3 declouded products was submitted to SDST on 1/23. This delivery included programs mfill (PGE50) and mcloud (PGE53)and associated scripts, PCF, MCF and test data files.

Version 1 science data processing software was delivered to SDST on 12/4. This delivery supports production of SST and ocean color level 2 products and raw (not declouded) level 3 daily composites. The following programs were included in this delivery: anly8dbl, modsst, mtbin, msbin. Major new features included in this delivery are support for ECS metadata and L3 file formats which do not use HDF external data files (since HDF external files will not be supported by the Rel B ECS data server).

B.2.1.1 MODIS Version 2 (at-launch algorithms)

MODIS Version 2 Science Computing Facility Software Delivery Guide (2/28/97)was reviewed and comments submitted to SDST.

B.2.1.1.1 Metadata

MODIS Ocean processing will require additional searchable metadata to support data processing. An outline of this requirement was requested and delivered to SDST prior the April Version 2 Metadata Workshop.

B.2.1.1.2 Product File Specifications (EOS-HDF file format)

Initial V2 product file specifications (HDF structure, content, size)were submitted to SDST in March. The current design for ocean level 3 products has one parameter per file. This allows global level 3 files at 1k resolution that are less that the maximum HDF file size of two GB without using HDF external data elements. The consequences of this redesign: increased numbers of PGEs, PGE activations, ESDTs and documentation are understood by Hughes and SDST.

B.2.1.1.3 PGEs/ESDTs

Due to the restructuring of Level 3 files, the number of ESDTs required for Oceans processing increased dramatically. A meeting attended by SDST, Hughes and Miami representatives was held at SDST in February to discuss options for reducing the number of MODIS ocean ESDTs. Three alternatives were presented. 1) Multi-type granules 2) A production rule which allows input specifications using metadata 3) One ESDT per parameter/per level (the way it is now). If option 1 or 2 above is supported in release B0, the numbers of ESDTs for level 3 ocean products can be reduced from 252 to 7.

B.2.1.1.4 Build Procedures

Version 1 build procedures will be used without modification in Version 2.

B.2.2 Networking

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 that works in concert with the ATM switch. Each packet that 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.

A version of IP switching which supports ATM over Classical IP (1577) was installed this quarter. We used the IP switches to route between fast Ethernet, FDDI and ATM LANs for a brief time. The technology worked well, however, our network topology is not well suited to IP switching which provides for very fast ATM to ATM subnet routing only.

We are participating in Beta testing of ATM for the SGI Origin under IRIX 6.4. Several open issues are now being worked. At the present time SVCs can only be established outbound from the Origin. All incoming call setup requests are failing. SGI is investigating the problem.

B.2.3 Systems/COTS

B.2.3.1 Autosys

Autosys was installed on the SGI Challenge machine (andrew) using a temporary license from Platinum.

B.2.3.2 Sybase

Verification and testing of System 11 with the Autosys and the automated processing was completed and our migration to System 11 is complete.

B.3 Matchup Database (P)

B.3.1 1st Quarter Matchup Database

The major effort during this period was concentrated on producing a new major release of the AVHRR Pathfinder Oceans Matchups Database. The new database involves not only a longer time span (1985–1995), but also major changes in the variables included in the database. Additional satellite variables include new geometric quantities that facilitate the identification of whether a daytime matchup is on the sun side of the AVHRR scan line (and, thus, if it can be potentially affected by sun glint). Furthermore, at the request of the SST Science Working Group, the matchups now include values for all five AVHRR channels for a 5x5 pixel box centered at the matchup. This offers the possibility of using textural metrics for cloud flagging purposes. Finally, a new set of ancillary variables was added to facilitate the use of the matchups. They include an ocean basin code, bottom depth (these two allow the separation of matchups by ocean and shallow/open ocean regimes), the Reynolds interpolated SST, and an estimate of columnar water vapor derived from the SSMC/I, a microwave radiometer.

In addition to the new quantities, there was a major change in the procedures used to identify potentially cloud-contaminated matchups. In previous versions of the matchups database, we had used a series of thresholds determined by interactive exploration of the data. The new version of the matchups involves a new series of tests based on a technique called “classification trees.” The new way of flagging clouds provides a larger number of usable matchups, while its ability to exclude cloud-contaminated matchups is similar to that of the previous procedure.

The new version of the matchup files have been completed and they are in the process of being transferred to JPL. A new version of the matchup documentation was produced and is available via the WWW.

B.4 DSP Support (M)

B.4.1 Testing:

None Described.

B.4.2 Modifications/Additions to DSP:
MFILL: MODIS version of program which fills in missing data in reference file, 3 week global binned data.
MCLOUD: Decloud MODIS data.

B.4.3 PROBLEMS FIXED:

SSBIN-HDF: Sum values instead of logs of values; change makefile to work with v5.0; use new nav_flag from get_l2_record.

STBIN-HDF: Update to work with SeaWiFS io v5.0; make string sizes consistent with the space binner.

SMAP9-HDF: Update to work with SeaWiFS io v5.0; use -9.1E6 for invalid values instead of zero; don't calculate median or mode; fix mean and std. dev. calculations because no longer summing logs.

MODCOL: Fix MODIS prologues. Increase fold_arith_limit. Add version to mod_get_l1b_open, and add data type to Mocean_WriteImageAttr. Fix metadata stuff. Fix status stuff; inputs and outputs are constantly changing. Use toolkit routines for messages.

BINSHR/*MASK.RAT: Use binning information from metadata instead of assuming 9km masks.

DAYBOUNDS: Fix status stuff; ins and outs are constantly changing.

IMG2HDFBIT: Link to modis and old libraries so we can read a DSP image file. Fix metadata.

MMAP: Fix status stuff; ins and outs are constantly changing for testing. Bad value is -9.1E6; sums are values not logs, fix mean and standard deviation calculations ala SeaWiFS; add data type to Mocean_WriteImageAttr; fix metadata handling.

MODSST: Fix status; ins and outs change for testing. Specify data type when write attributes; add version to mod_get_l1b_open; increase fold_arith_limit; change metadata; switch flag bands to match modcol. Fix headers; use LUN's for MODIS files from include file.9

MSBIN: Change status stuff; change quality type; ins and outs change for testing; add pcf for pge09 which does modcol and msbin. Change use of flags for quality determination just for now so we get some data, but not land; sum values, not logs of values; ad bin model to metadata; fix ShortName and LongName metadata; fix handling of SST output file names.

PATHREF: Add comment.

MTBIN: Move maketime to binshr.

MODLIB/MOCEAN: Rename variable stat to be status; change metadata names for the number of pixels per record, number of records in file, and number of bands; add data type to Mocean_WriteImageAttr and MoceanWriteAttr.

ANLY8D: Get binning characteristics from mask files instead of assuming 9km. Both land and shallow water masks must have been binned the same way. Size anly arrays for 4km masks. Change 'awhite' (and 'zwhite') to be per band. Adjust usage of zwhite. Correct use of 'navigation flag'. Use solar zenith and azimuth from input file. Generalize date handling (year 2000 bug-a-boo). We now use precip. water rather than relative humidity. Correct order of values written to QC file (did not match I/O library). Remove unused input parameter (i_index). Update to new Gordon atmospheric algorithms (remove linear_a_b and fourier_a_b and associated rho_sub_linear routines; add diffuse_transmittance and ff). Correct documentation of input/output variables. Add t_star (diffuse transmittance) for tLw -> Lw calculation. Add epsflg for QC output file. Remove multiline interpolation (not useable with SeaWiFS I/O). Generalize date handling (year 2000 bug-a-boo). Compute F0, f0corr every scan line (rather than once per scene). Correct order of values written to QC file. Correct turbidity equations (new results available). Simplify tests for negative Lw and bad Rayleigh corrections. Add explicit variables for La670 and Lt443 (for output files). Remove no longer used 2-d code and diagnostics. Remove more unused old code. Limit tau865 to 0. if invalid. Expand min/max epsilon limits for model search loop. Check floating point for <= 0 instead of == 0. Check for very small value (CC) instead of 0. Change min/max selection tests to remove equality test. Simplify usage of

Deg() and Rad() [were ASFs, now are RATFOR macros]. Remove leftover 2-d code.

QUORUM: Make consistent with scrlac behavior (same results with same input data). Symmetry in +/- line error checks. Change missing line algorithm to be more robust. Add missing logic (similar to scrlac.rat). Remove unnecessary condition on test. Improve negative gap handling.

SCRIPP: Make consistent with quolac behavior (same results with same input data). Clean up differences in source formatting. Symmetry in +/- line error checks. Change missing line algorithm to be more robust. Remove unnecessary condition on test. Improve negative gap handling (sometimes the positive gap is wrong).

COLORSHR8: Initial version. Add call to calwhite. Modify 'awhite' to be per channel. Change relative humidity to precip. water. Compute F0, f0var every scan line (not once per image). Use solar zenith and azimuth angles from input file. Generalize date handling (year 2000 bug-a-boo).

COLORSHR7: Change field name to precipitable water. Change build path for ancillary include files. Both precip. water and relative humidity are available in ancillary files. Restrict angle to +/- Pi.

MCOLSHR8: Add whitecap coefficient routine.

RATF90: Convert simple RATFOR defines into FORTRAN 90 parameter statements (e.g. define a 3). Attempt to determine the constants data type. Remove trailing whitespace from definitions. Clean up logic for outputting f90 format parameters vs. creating (internal) RATFOR define's. Capture comments on define (parameter to be) statements.

PATHNLC: Change the way products are binned by scan angle. Add ability to read weekly Reynolds file directly (along with weekly data from Reynolds annual files converted to DSP images). New routine to read Reynolds current weekly files. Add visible channel degradation for NOAA-14 (from NOAA/NESDIS, Mar 97).

PATHBIN: Handle satz band and binning by scan angle.

PATHCLOUD: Handle 32 bands. Decrement quality value if data is not within threshold of reference data.

PATHSPC: Remove badqual option. Allow inputs with 14 bands on andrew, but only 8 on other machines.

PATHCOMP: Add wq to command line. Add use of a reference image - don't include pixels which are not within threshold of reference value. Allow inputs with 32 bands.

PATHTIME: Check yuckiness before using pixel.

PATHSST: Use $COMSIZ instead of 80 in encode.

PATHLOAD: Directory /m5/dsp-master/src/bin/pathload added to the repository Convert pst files to loadable images.

COLORSHR5: Restrict delta phi to +/- PI.

B.5.2 MODIS (M)

MODIS

B.5.2.1 Jim Brown has been integrating the latest MODIS Ocean Team science algorithms into the processing package for the Oceans SCF.

Jim Brown has been integrating the MODIS I/O algorithms into the processing package for the Oceans SCF. To complete this effort, valid test data files must be received to be able to verify the routines.

B.5.2.2 In the first quarter of 1997, Richard Sikorski focused on testing and updating a VMS version of the RAL model, starting from a version originally supplied by the Rutherford Appleton Laboratory.

He used the model to translate the atmospheric attenuation data into ASCII for future portability, and compared that data to published emissivities to test code and data integrity. Our data matched the published data, with our data showing better resolution.

Initially, the model produced brightness temperatures that were significantly different from expected model results. We corrected three problems:

1) Channel filters were not applied correctly to NOAA-9 channel 3, and were not applied at all to NOAA-11 channel 3. We corrected the code.

2) The set of profiles in ALBIN.2 with the VMS code was truncated. We obtained a complete version.

3) The program for reading these profiles contained a default that removed all water-vapor data from the profiles. We removed that default.

Our current VMS version of the RAL model now successfully accomplished these goals:

1) It reproduces test results that were supplied with the original model code.

2) It calculates brightness temperatures:
   Using Bramson's emissivities.
   From radiosonde profiles or supplementary SST data.
   For channels 3, 4, & 5.
   For NOAA 9 and 11.
   For pathlengths of 1 to 2 air-masses.

In addition to work on the RAL model code, we have been systematically reviewing radiosonde datasets, instrumentation, and data handling strategies. We have identified some shortcomings and resources worth attention.

1) Radiosondes for marine atmospheres are sparse (compared to terrestrial data).
   This is particularly true in the southern hemisphere.

2) Sensor behavior is problematic under some conditions. e.g.
   The recovery-time of the humidity sensor from saturation, and the possible effects of insolation or evaporation on the temperature sensor is not well characterized and should be studied.

3) The standard methods for reducing radiosonde data remove some of the information needed to solve sensor and advection problems. Some non-reduced radiosondes are available, and should be used to address sensor questions.

4) Other techniques, such as GPS (UCAR/JPL) and Raman LIDAR (NASA), can deliver additional data on atmospheric composition and properties, and may develop into rich sources of profile data or corrections.

We have also located additional sources of atmospheric data that can be used with the RAL model, including:

1) The NASA/Goddard Distributed Active Archive Center
   The Assimilated 4-D Climate Data
   The Earth Science data sets e.g. TOGA/Coare Data
   The Interdisciplinary Data Collection e.g. NOAA/NASA

Pathfinder/TOVS

2) The NASA/Goddard Data Assimilation Office
The GEOS-1 Multiyear Assimilation
The Upper Atmosphere Research Satellite (UARS) Data Set
TOGA COARE Assimilations

3) The NASA/Langley Distributed Active Archive Center
The Liquid Water (lwp) data set
The Cloud Liquid Water (lwpcld) data set
The Water Vapor (pwc) data set

4) The NASA/Marshall Distributed Active Archive Center
The NASA Water Vapor Project (NVAP) Data Set

5) The NCAR Atmospheric Technology Division Research Data Program
The Tropical Ocean/Global Atmosphere (TOGA-COARE) data set

6) The NOAA Forecast Systems Laboratory (FSL) National RAOB database

7) The TIGR Radiosonde database

8) The University of Colorado
The Arctic Water Vapor Characteristics Data Set
The TOVS Pathfinder Path-P Arctic Atmospheric Data

B.6 Team Interactions

C. FUTURE ACTIVITIES

C.1 Database Future Work

C.2 Client/Server Future Work

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.
Continue with development of V2 code, implement PSA, work with SDST to determine how PSA and other searchable metadata can be utilized in production rules.
C.4.2. Work with team to update product algorithms.
Gather and exchange input/output requirements between ocean team members to achieve consistency in data flow. Variables must be of consistent type and units. V2 algorithms due next quarter.
C.4.3. Work with Hughes on processing rules/scenarios.
Work with SDST to determine how production rules will be implemented for ocean processing. How are data day and other control variables maintained and updated?

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

Need updates on PSA, how data day maintained.

ß

D.2 Client/Server Problems

None listed separately

D.3 Matchup Database Problems

None listed separately

D.4 DSP Related Problems

None listed separately