# MODIS ANNUAL REPORT
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RSMAS/MPO

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CONTENTS

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## A. PERSONNEL

Personnel supported for the first half of 1999 include:

- B. Evans (Jan, Feb, Mar, Apr, May, Jun)
- V. Halliwell (Jan, Feb, Mar, Apr, May, Jun)
- K. Kilpatrick (Jan, Feb, Mar, Apr, May, Jun)
- A. Kroger (Jan, Feb, Mar, Apr, May, Jun)
- J. Jacob (Apr, May, Jun)
- A. Kumar (Jan, Feb, Mar, Apr, May, Jun)
- J. Splain (Jan, Feb, Mar, Apr, May, Jun)

S. Walsh (Jan, Feb, Mar, Apr, May, Jun)
R. Kolaczynski (Jan, Feb, Mar, Apr, May, Jun)
D. Wilson-Diaz (Jan, Feb, Mar, Apr, May, Jun)
J. Brown (Jan, Feb, Mar, Apr, May, Jun)
E. Kearns (Mar, Apr, May, Jun)
A. Li (Jan, Feb, Mar, Apr, May, Jun)

## B. NEAR TERM OBJECTIVES

### B.1 Processing Development

#### B.1.1 Pathfinder

B.1.1.1 Complete reprocessing the 1985-1998 AVHRR using version 4.2 algorithms for both the global day/night 9km fields and the new 4km fields.

B.1.1.2 Publish the comparison of MAERI SSTs with Pathfinder SSTs.

B.1.1.3 Reprocess NOAA7 data with new coefficients derived from Matchup analysis.

B.1.1.4 Continue climatological comparison of Pathfinder and Reynolds' SSTs, TOMS aerosol index, and SSM/I water vapor.

B.1.1.5 Continue the compilation of a 4km research archive of all Pathfinder v4.2 products.

B.1.1.6 Prepare additional fields needed to begin work on the next generation (v5.0) of Pathfinder.

B.1.1.7 Compile all available TOMS Aerosol Index data which are coincident with MAERI observations.

#### B.1.2 MODIS

B.1.2.1 Continue to refine Q/A procedures using test MODIS data.

B.1.2.2 Establish MOCEAN web site.

## B.2 Matchup Database

B.2.1 Complete correction of NOAA-7 decision discrepancies and produce new set of coefficients.  Identify the potential errors and biases associated with the early NOAA-7 AVHRR data.

B.2.2 Continue to develop new ocean color matchup database.

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# C. OVERVIEW OF PROGRESS FOR FIRST HALF  OF1999

## C.1 Processing Development

### C.1.1 Pathfinder processing

#### C.1.1.1 General

Use of the NASA/NOAA Ocean AVHRR Pathfinder continues to provide a basis with which to test the MODSST (MODIS Ocean SST L2 program) and the associated Q/A methods.   We are continuing work on the validation of the Pathfinder SST calculation and data quality test through comparison of the Pathfinder SST with available climatologies for analyses, the comparison of Pathfinder SST with the skin temperatures measured by the MAERI instrument, and the use of SeaWiFS data to identify those Pathfinder data which may be contaminated by aerosols.

Pathfinder processing continue to be used to implement MODIS-like product resolution.  Daily SST maps are produced globally using the current Pathfinder algorithm.

### C.1.2 Processing

During this time period, the 9km PFV42 dataset was completed.  The procedures were then modified to routinely produce 4km output, and the real-time data processing became closer to "true" real-time, albeit still with frequent interruptions.  Processing problems during the first half of 99 were similar to those  in the last half of 98, in that both hardware and software problems frequently  interrupted the processing stream.  The new disks and new machines required repeated service, modification and testing, often rendering the processing output used in the tests unusable. In addition, there were also problems with the DLT archive jukeboxes similar to last year, and these problems also resulted in the need to reprocess a large amount of data. In addition, two of the older alphas that serve the processing database (modis) and run the automatic processing system (orange) had occasional failures, which generally result in stalled or confused processing. Finally, a new problem occurred that caused a stall in the processing. A command called "sendevent" (which notifies the database of an action that needs to be taken) would at times stall on the event daemon's computer. When this happened, all processing would stop until the stalled command was killed.

There were only a few minor problems encountered due to the change-of-year, which was much more smooth than previous years. Changes made in the previous six months made the transition easier, and it is anticipated that the turn of the next year will also cause only minor problems in the Pathfinder processing. The conversion of filename from 2 to 4-digit years was made in 99.

It was determined that the single-year tree test for the first year of n14 (95) we not performing well. The year was then recalculated using the tree test for the succeeding years. This produced data that was more accurately cloud-masked. During this run, additional analysis fields (input sst, ch4-minus-ch5, satz) were also retained for the use of a colleague.

A problem in the n14 clock reset file required recalculation of the last part of 98. A small error was found in a file used by the orbit subroutines that caused minor errors in dataday calculations for 97365 and 98001. This was fixed. The other year changeover records were checked, but this was the only incorrect entry.

Global Data Processed:

- pfv42 9km: 85, 91-95, 97
- pfv42t 9km: 95 (tree test change)
- pfvrt 9km: 98-9901-9904 (switched to 4km)
- pfv42 4km: 9701-9746 (currently working on)
- pfrt 4km: 98, 9901 to 9926 (kept current)

By the end of this time period, the entire pfv42 9km dataset for 85 to 97 had been delivered to Jet Propulsion Laboratory, as well as the pfrt data for 98 and 99. (The pfrt data for 98 and 99 use the 97 coefficients.) An attempt was made to establish procedures allowing JPL to ftp the real-time processed data in a timely manner. Unfortunately, the JPL transfer was not satisfactory. The link was extremely slow, and frequently timed out. It was decided to send DAT tapes in the interim, while JPL works on its network. After pfv42 9km processing was completed, all of the processed daily files were retrieved from the archive, rearchived in a more efficient format, and mapped; both global and a number of regional sections were produced. In addition, a special set of weekly files were produced from the daily files. Dr. Richard Reynolds produces the Objective Interpolation files (NCEP analysis) that are used as input to the Pathfinder atmospheric correction algorithm. In the period 1981 to 1989, he used a Weds-to-Tues week, which was also adopted by Pathfinder. In 1990, he changed to a Sun-to-Sat week. He will be performing a reanalysis soon, and we have supplied him with a set of 1-degree weekly files, all using the Sun-to-Sat week, on which he will base his next analysis. A full set of weekly maps for the Gulf Stream were produced for comparison to model output. Two major programs (pathspc and pathfill) needed significant modification to handle the global 4km files. In particular, pathfill, which produces the cloud gap filled reference file, required significant modification to permit it to handle the larger arrays required by the 4km fields. A new capability was added to this program, allowing it to read an ice mask and "ignore" these areas. Currently, a single, very conservative mask is used. It is planned to produce weekly ice masks.

The ability to process regional data was made more flexible and convenient. This was used for several short-term regional projects, ranging from a few days maps around Australia to several months of Gulf Stream data from 1995. For one project, maps of cloud temperatures were produced, not SST. For another, a temperature scaling was produced that is more appropriate for tropical maps.

Command procedures were written to reformat the ice and aerosol data into formats that our programs can read. The procedures are complete, but the bulk of the data has yet to be converted. A new variable, 34p, was added to the suite of experimental variables that are used in our investigational runs. This compares observed with predicted 3.7um brightness temperature as a potential nighttime aerosol index. Finally, a new capability is being introduced into the Pathfinder processing here. For the first time, a web page has been used to disseminate Pathfinder data. The initial use was just the posting of individual images on a personal web page, allowing access to the products quickly and easily, but this has led to the construction of a permanent Pathfinder web page (which is still in development, and not yet available). The first implementation will probably make available weekly 36km fields for the entire dataset.

### C.1.3 Algorithm Development

The accuracy of Pathfinder SST retrievals has finally been quantified by using the high quality *in situ* infrared observations from the MAERI instrument from 6 different cruises. These MAERI/AVHRR (to be submitted for publication during the second half of 1999) in concert with AVHRR based assessments of near field cloud presence and AVHRR/SeaWiFS assessments of aerosol presence, provide a method to separate SST retrieval errors (instrument and algorithm) from data quality errors (clouds and aerosols). Future operational application of these findings will require development of an automated method to detect near field clouds and aerosol presence.

Detection of atmospheric aerosols is a more demanding challenge. We have utilized SeaWiFS visible channel observations to develop a method to detect presence of absorbing aerosols. This approach first calculates reflectance for two bands, one in the green (510nm) and one in the red to near ir region of the spectrum (670nm or 765nm). The ratio of the short to longer wavelength reflectances provides an indicator for certain types of aerosol (Saharan dust). The aerosol index provides a good indication of the presence of aerosol, but unfortunately only in areas away from sun glint. Sun glint and the limited swath width combine to limit coverage to approximately 25% of the daylight orbits. The limited coverage can not be minimized by combining data from adjacent days since the aerosol advection rate is large; these atmospheric features move by order 500 kilometers per day. We have instituted a similar procedure using channels 1 and 2 for the AVHRR sensor. The aerosol patterns detected by the AVHRR and SeaWiFS instruments agree. We thus have a preliminary method to diagnose aerosol presence, but as yet no method to spatially extend the observations to include the full IR spatial coverage. Test areas include the equatorial Atlantic, Mediterranean Sea and northern Arabian Sea. Basin scale time series that include reflectances, SST, observing geometry and meteorological observations have been generated. These fields are then analyzed to determine Q/A thresholds for data rejection.

During the second quarter we continued to pursue retrospective processing and extension of the data set to include NOAA-7 from 1982-1984. The N-7 time period is complicated due both to the use of a different set of wavebands from subsequent AVHRR instrument and to a very limited geographical distribution of *in situ* observations. A preliminary set of coefficients for the NLSST SST retrieval equation has been generated together with a data quality assessment tree. A similar coefficient/quality assessment set was generated for N-14 using an *in situ* data set resampled to coincide with the spatial/temporal distribution of the N-7 *in situ* distribution. We have explored monthly and yearly coefficients estimation using various windows ranging from 5 -12 months. The N-14 sampled results are then compared with the N-14 complete results to quantify the impact of the limited N-7 matchup database. Seasonal and hemispheric errors are larger than those obtained with the complete data set. Several different approaches, varying temporal intervals ranging from months to the entire N-7 period, have been analyzed to determine is an approach exists that significantly minimizes the error field. To date only minimal improvements have been found; a 0.2$^{o}$C cold bias in the Pathfinder SST value results, irrespective of the windowing method used to compute the coefficients

The evaluation of Pathfinder V4.2 algorithm results is continuing. The analysis makes use of the matchup database, daily and weekly GAC images , comparison to ship and buoy data (using Reynolds OI, AOML drifter, NOAA11 Matchups, and GOSTA plus climatologies), TOMS aerosols, and SSMI water vapor. Since the near-optimum accuracy of the Pathfinder SSTs has been estimated through comparisons with the MAERI instrument (and these estimates are favorable), the focus now is on the identification of gross errors in the Pathfinder algorithm in problematic regions of the ocean/atmosphere system. Comparing Pathfinder to the climatologies has shown that the location and magnitude of the residuals is highly variable and is dependent upon which climatology is used as a reference (these differences are caused mainly by the temporal/spatial sampling discrepancies in the data between each climatology). It is hoped that the errors associated with the highest residuals will be correlated with independent estimates of water vapor content and/or the presence of aerosols.

Results have been compiled from the comparison of the Pathfinder SSTs and the Marine Atmospheric Emitted Radiance Interferometer(MAERI). There were 6 separate cruises for which this analysis was undertaken; two cruises from 1996 and 1997 in the Pacific, three 1998 Atlantic cruises and one Arctic cruise in the second half of that year (Table 1). The “skin” SST measured at the sea surface by the MAERI was compared to that measured by the AVHRR at the same time and place in the ocean and subsequently rendered in the Pathfinder SST dataset. Only the highest quality Pathfinder data were used (quality flag=7, meaning no clouds, small satellite zenith angles and high homogeneity among the pixels in the scene).

The results for each cruise are plotted in Figure 1. The overall estimates of the accuracy of the Pathfinder for these coincident (within 40 minutes during the day and 120 minutes at night) and collocated (within 4km) data were 0.07 +/- 0.31 K exclusive of the Arctic data, and 0.14 +/- 0.36 K inclusive of the Arctic comparisons. These estimates are at least twice as good as any previous estimates. Since these comparisons were under the best possible conditions, efforts now will focus on the improvement of the Pathfinder SST data through the identification and eventual correction of anomalous oceanic and atmospheric conditions.

*Table 1: M-AERI cruise times and locations*

| **Cruise Name** | **Ship** | **Year** | **Begin Day** | **End Day** | **Area of Study** |
|---|---|---|---|---|---|
| Combined Sensor Program (CSP) | R/V Discoverer | 1996 | 78 | 103 | Equatorial Western Pacific |
| Hawaii-New Zealand transect (HNZ) | R/V Roger Revelle | 1997 | 272 | 286 | Central Pacific Meridional Section 24 $^{o}$N Section |
| Section 24 $^{o}$N Section (24N) | R/V Ronald H. Brown | 1998 | 8 | 55 | Zonal Section along 24 $^{o}$N in North Atlantic |
| GASEX (GSX) | R/V Ronald H. Brown | 1998 | 127 | 188 | Mid-latitude North Atlantic |
| Florida- Panama- | R/V Ronald H. | 1998 | 196 | 210 | Florida to |

| | | | | | |
|---|---|---|---|---|---|
| Oregon Transit (FPO) | Brown | | | | Panama to Oregon Transit |
| North Water Polynya study (NOW) | R/V Melville | 1998 | 150 | 203 | Baffin Bay, Arctic Polynya |

Some ancillary information was also assembled to aid in the interpretation of the comparison. For each pixel, daily Special Sensor Microwave Imager (SSM/I) water vapor values were averaged via bilinear interpolation to its location to provide some independent idea of the atmospheric water vapor content. Similarly, TOMS absorbing Aerosol Index (AI) data were compiled for the MAERI/Pathfinder matchups. Each research vessel's thermosalinograph (TSG) data, with SST computed every 30 seconds, provide a bulk estimate of the SST which can be compared via linear interpolation in time to the M-AERI SST along the whole cruise track, not just at coincident and contemporaneous Pathfinder points (these data are not yet available for the NOW98 cruise, necessitating that some statistics be quoted both inclusive and exclusive of this cruise). The values of the weekly Reynolds OISST were also extracted for each target pixel via bilinear interpolation from the 1º fields; these values can also be compared to M-AERI SST along the whole cruise track. The assembly of these other estimates for comparison with the M-AERI SSTs allows the M-AERI-Pathfinder comparisons to be placed in a more familiar context.

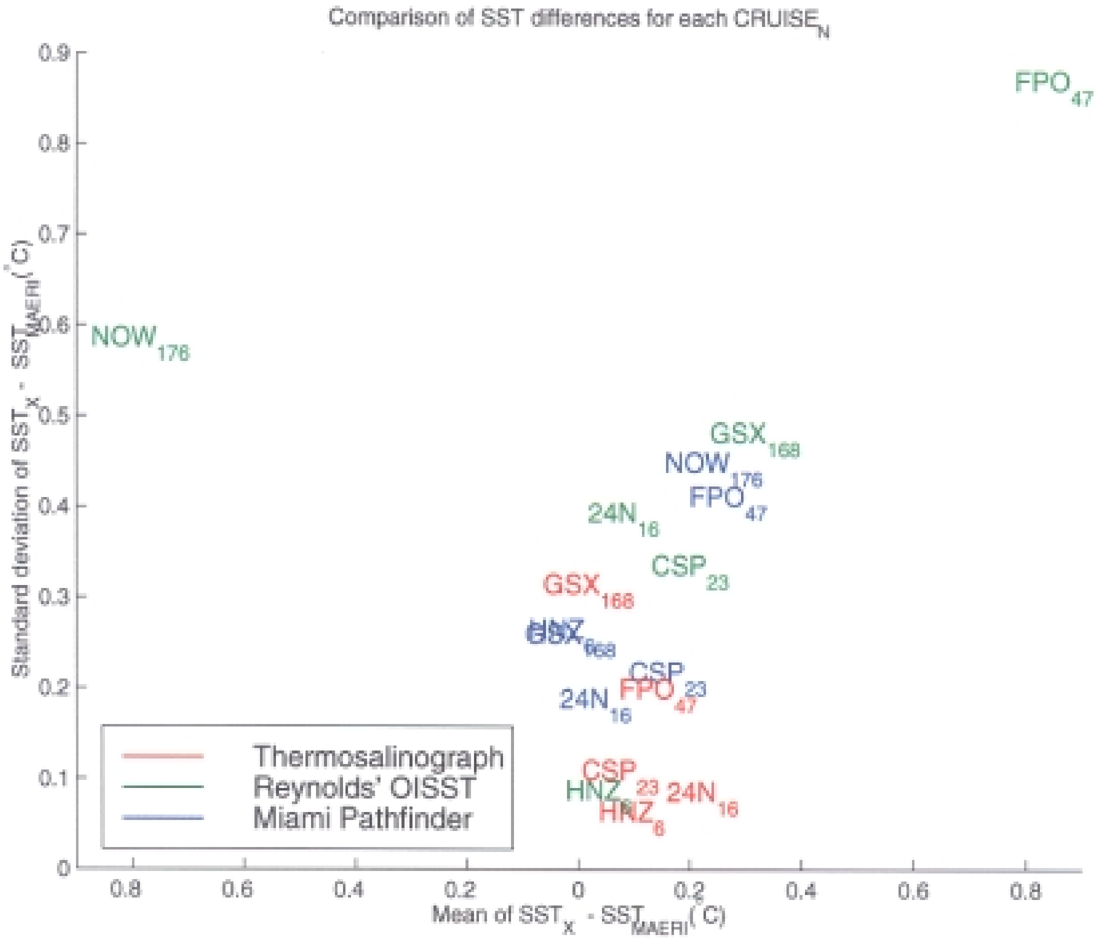



**Figure 1The mean (abscissa) and standard deviation (ordinate) of the difference of the various SST estimates from the reference MAERI SST. The cruise abbreviation (see Table X) is centered on the point with the number of observations for that cruise appearing as a subscript. The TSG data are generally most accurate, followed by Pathfinder SST and lastly Reynolds' OISST. The OISST outliers are the result of poor OISST boundary conditions in the Arctic (NOW) and along the west coast of North America (FPO).**

Although the number of M-AERI/Pathfinder points is relatively small, these results suggest that the Miami Pathfinder algorithm is much more accurate than has been estimated by previous studies - at least for those atmospheric and oceanic conditions sampled by these 6 cruises. The fact that Pathfinder SSTs are nearly as good as the research vessels thermosalinographs is very encouraging for global SST studies using AVHRR data. The larger error exhibited by the Reynolds' OISST fields gives a good indication of the minimum temperature difference necessary for meaningful interpretation of that difference when making Pathfinder SST vs. Reynolds' OISST comparisons, which is often done since the Reynolds' fields are global and are easily available.

The results of the comparisons from the Arctic NOW98 cruise have enhanced error for a number of reasons. The lack of the TSG data and a meaningful Reynolds' OISST field hindered the M-AERI quality control effort as MAERI outliers are more difficult to identify. More important than this is the fact that the Pathfinder algorithm may not perform well in the Arctic due to a lack of *in situ* buoy/drifter data in that latitude range with which to calculate the appropriate Pathfinder coefficients, a poor first guess field provided by the Reynolds' OISST average, and the nearby presence of sea ice may adversely affect the AVHRR retrievals (does the pixel include an IR contribution from ice, water, clouds, or all three?).

Given the small size of the current M-AERI dataset, the accurate portrayal of the effects of clouds, water vapor, and aerosols on the Pathfinder SST retrievals will have to wait for future M-AERI deployments in a greater range of atmospheric conditions. Nevertheless it is instructive to show a few of these relationships. Figure 2 shows the effect of water vapor for oblique scan angles. While all points are considered high quality with regard to the pixels' homogeneity, the Pathfinder/M-AERI difference versus the SSM/I water vapor estimate suggests a tendency for the large scan angle ($>45^{o}$ , quality level 6) to underestimate the SST with increasing integrated water vapor content. While there are not enough independent data to accurately model this relationship in this study, this effect has also been noted by Ajoy Kumar.
Figure 3 depicts the dependence of the Pathfinder/MAERI difference versus the TOMS AI for the Florida-Panama-Oregon cruise. This type of dependency of the Pathfinder/M-AERI difference versus absorbing aerosol content is similar to that which we have observed due to the Saharan dust present in the eastern North Atlantic and the Mediterranean.

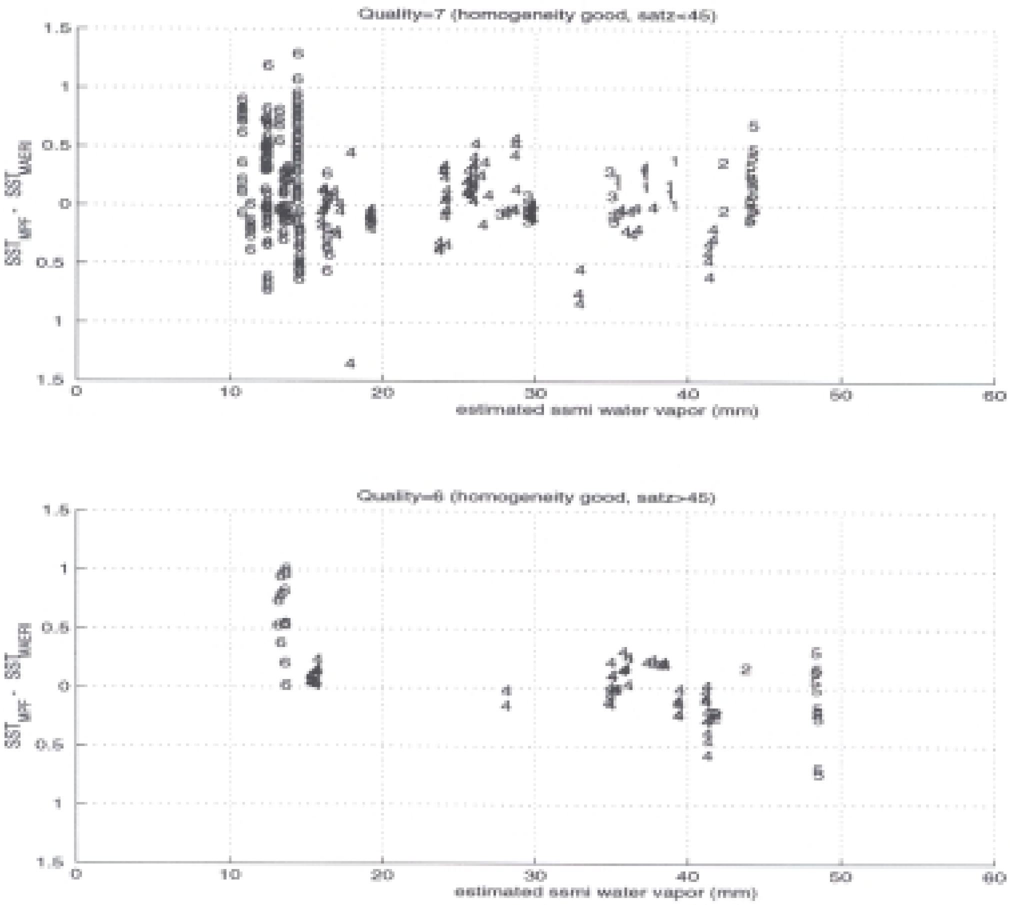



**Figure 1: The relationship between water vapor content as estimated from the SSM/I instrument versus the Pathfinder-MAERI difference for quality level 7 pixels [top panel] and quality level 6 pixels [bottom]. The level 6 pixels differ from the level 7 pixels only in that they are derived from observations with an oblique (>45 degrees) viewing angle. An oblique viewing angle leads to a longer path length through the atmosphere which makes the SST estimate more susceptible to the effects of atmospheric water vapor, resulting in a trend towards negative residuals with increasing water vapor for the level 6 pixels. The numbers in the plots are keyed to the cruises as follows: 1=CSP, 2=HNZ, 3=24N, 4=GSX, 5=FPO, 6=NOW.**

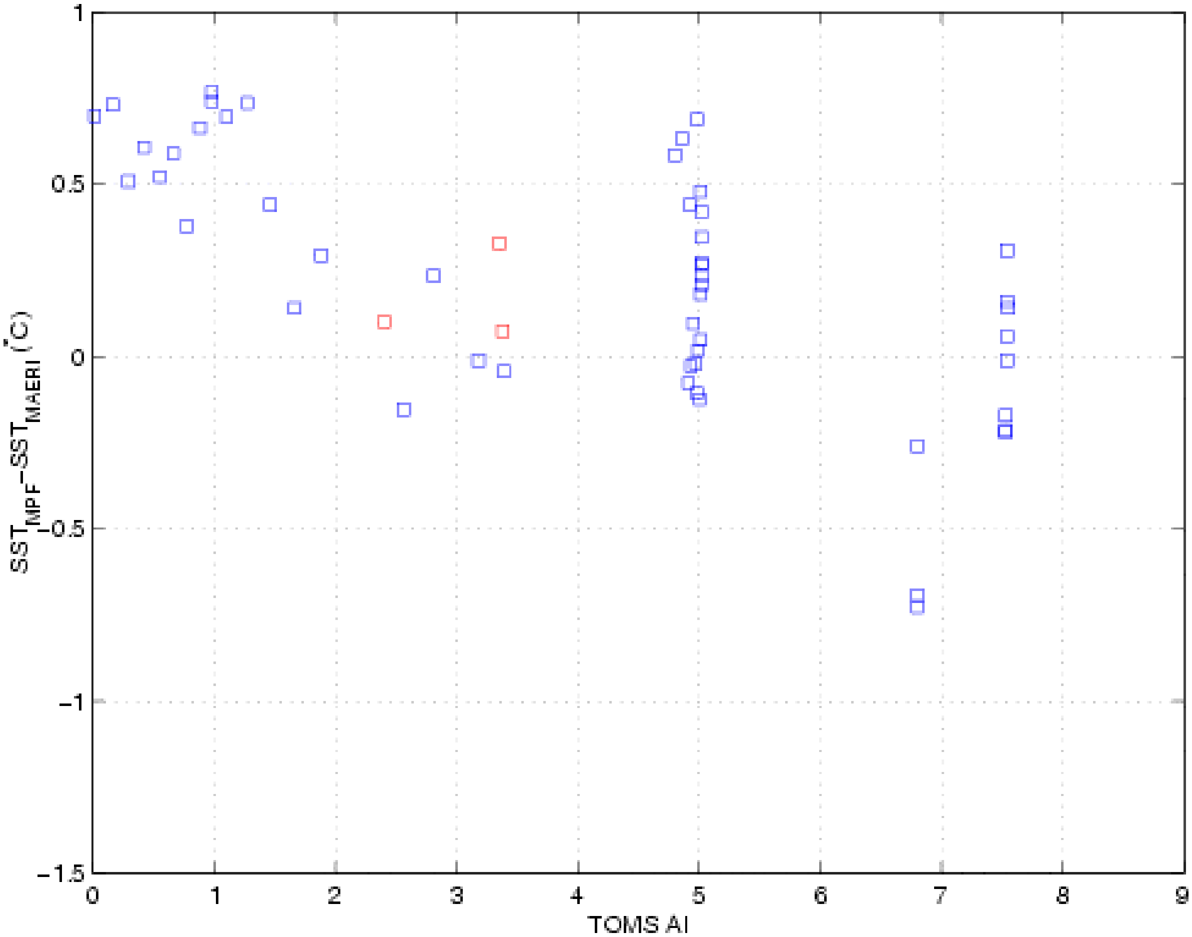



**Figure 3: The relationship between absorbing aerosol content as estimated from the TOMS instrument versus the Pathfinder-MAERI SST difference.**

Efforts are continuing to use aerosol products from the TOMS sensor and the AVHRR visible channels (PATMOS - L. Stowe) to begin to correlate SST anomaly patterns with ‘aerosol’ fields. The TOMS AI field monthly climatologies were found to correlate well with Pathfinder anomalies (v. Reynolds’ Optimally Interpolated SST fields) in the tropical Atlantic.

We continued to work on developing SST algorithm coefficients for NOAA7 and cloud detection tests. The limited temporal and geographical distribution of the in-situ data available during for NOAA7 makes it difficult to estimate coefficients resulting in unbiased SST values. We have explored monthly and yearly coefficients estimation using various windows ranging from 5 -12 months; all of which result in approximately a 0.2$^{o}$C cold bias in the Pathfinder SST value when the procedure is applied to NOAA14 matchups simulating the NOAA7 matchup data distribution. We continued to work on understanding the potential errors and biases associated with the early NOAA7 AVHRR data and have concluded that for the coefficient estimation a single set of yearly coefficients resulted in the least bias and encompassed the broadest geographic distribution available using this data set. A problem still remains in regard to developing an actual cloud detection test for NOAA-7. The NOAA-7 matchups geographical distribution is so limited that the database can not be used to develop tests using the binary decision tree method developed for Version 19 matchups. We must therefor return to the manual visual inspection of the NOAA-7 GAC images as was done in earlier Pathfinder versions.

## MODIS Algorithm Coefficient Modeling

We have developed new coefficients for the MODIS 11-12 um algorithm based on the latest version of the RAL model. The algorithm used is the following:

mpfsst = (( c2 * T31 ) + ( c3 * T3132 ) + ( c4 * secterm ) + c1 )

where

secterm = (( 1 / ( cos (( satz * pi ) / 180 ))) - 1 ) * T3132

and

T31 is the Band 31 brightness temperature (BT) (comparable to NOAA Ch4) and T3132 is the Band31-Band32 BT difference (comparable to NOAA Ch4-Ch5).

The coefficients obtained for two atmospheres(dry and wet) are shown in the table below.

| Coefficients | T3132 <= 0.7 | T3132 > 0.7 |
|---|---|---|
| C1 | -10.61831 | -34.97703 |
| C2 | 1.039315 | 1.120647 |
| C3 | 2.594784 | 3.781102 |
| C4 | 1.113795 | 2.018655 |

The above coefficients increased the accuracy of the SST estimates with an RMS 0.4670489. It was also found that the accuracies of the SST residuals improved if the satellite zenith angle was within 45 degrees of nadir.

### C.1.1.4 Documentation

We are continuing to work on the publication of a final document containing a detailed description of the processing used for Pathfinder GAC V4.0. We hope that his will be published in the peer-reviewed literature during 1999.

We are also working on an overview Web page which coordinates the various documents recently created in regard to Pathfinder SST developments at the University of Miami, including a web-based document which includes a detailed description of the Pathfinder V4.0 sea surface temperature algorithm .

As a consequence of the Atmospheric Radiation Measurement (ARM) work, a poster on the techniques and application of these high resolution SST AVHRR images was presented in San Antonio, Texas.

The latest results of the analysis of the existing Pathfinder Matchup Data Base was presented as a poster for the Joint Global Ocean Flux Study Symposium and Training Program in Bangalore, India. Later, the results were written as a paper titled "Analysis of Pathfinder SST Algorithm for Global and Regional Conditions" and communicated to Journal of Indian Academy of Science.

### C.1.1.5 Quality control

The MAERI instrument has been, and continues to be, used to provide reference temperature for QC and algorithm development. The MAERI instrument's SST data from 5 different mid-latitude cruises and one Arctic cruise have been used as a standard with which to compare Pathfinder (and other) SST estimates. The MAERI has been deployed during 1999 on one Pacific meridional transect and during a mid-Pacific sensor comparison cruise. The MAERI is very accurate (within 0.01 C) and provides a long time series on each cruise with which Pathfinder matchups can be made. This MAERI-Pathfinder comparison dataset will provide the opportunity to study those factors (aerosols, clouds, water vapor) which limit the Pathfinder SST estimate's accuracy. Previous attempts to perform these studies have been hampered by inaccuracies in the reference SST provided by buoy observations, VOSes, drifters, or composite datasets. Using such reference fields produce ambiguities in the comparisons that are often difficult to resolve.

TOMS aerosol indices are now available for the 1996-99 time period for which there are MAERI observations. It may now be possible to study the effect of aerosols on Pathfinder SST accuracy using the AI fields. In previous work, monthly Pathfinder SST data were averaged, as were TOMS aerosol index and Reynolds' OISST fields. Differences between the Pathfinder and Reynolds fields showed a strong correlation between the largest SST anomalies (about 2 degrees C) and the TOMS aerosol index over the southern North Atlantic ( Saharan dust from the African continent is well resolved in the TOMS aerosol index ). Problems with these averaged views may now be avoided with direct measurements of the SST residual and the independent estimate of absorbing aerosols.

## C.1.2 MODIS

### C.1.2.1 General

#### C.1.2.1.1 MODIS Version 2 (at-launch algorithms)

Updated versions of all ocean PGES were delivered to SDST in January for acceptance testing. This update included performance enhancements, integration of SDP Toolkit V5.2.3 and bug fixes for problems found during testing of earlier versions.

Several minor updates to individual programs have been resubmitted to SDST as problems are identified and fixed.

June/July deliveries incorporating the latest atmospheric correction, product algorithms, computational efficiency enhancements and general program corrections have been sent for I&T.

##### C.1.2.1.1.1 Metadata

##### C.1.2.1.1.2 Product File Specifications (EOS-HDF file format)

##### C.1.2.1.1.3 PGEs/ESDTs

Miami, SDST and ECS personnel participated in a teleconference on 2/26/99 to address the issues concerning the number of ocean ESDTs:

The participants were:

Miami: Bob Evans, Warner Baringer, Susan Walsh
GSC: Bob Woodward, Mike Linda
Landover/ECS: Art Cohen (Ingest), Lynne Case (Data Management), Mac McDonald (Architect's Office), Karin Loya, Michael Morahan, Jon Pals, ChuckThomas (all Science Office)

The following from Ed Masuoka summarizes the understanding that was reached by the participants:

> "We are proposing the following solution from the MODIS Data Processing System (MODAPS) point of view with regard to Ocean

ESDT reduction.  It is our understanding that to get from over 3,000 Ocean ESDTs down to 100 ESDTs that ECS will implement multigranule ESDTs. The multigranule ESDT correspond to attributes (mean, sample size, quality flags).  Each multigranule ESDT for Ocean Color products at Level 3, for instance,is a collection of all of the Ocean Color parameters (reflectance at 412nm ...) for that attribute.  If the attribute is the mean, then there is a multigranule ESDT which is made up of the  means for all Ocean color products, 36 in all.   The multigranule aspect of the ESDT is that the 36 means are contained in 36 separate files.  The ESDT shortname in the corresponding .met files (one .met file for each of the 36 files) is the field, which ties the components of the multigranule ESDT together.

On the MODAPS side of things, we will make each of the separate products as they currently exist now along with their corresponding .met files.  Before we ship the MODIS Ocean products to the GSFC DAAC we will modify the .met files so that files belonging to a multigranule ESDT all have the same ESDT shortname in the .met file.  Please note that we will not modify the ESDT shortname in the product itself. In order for this appraoch to work, when the ECS system ingests our products and inserts them into the data server/archive, if must use the information in the .met file and not the ESDT shortname metadata field in the HDF product file.  If this approach is OK, then it will avoid major changes to the MODAPS, a redelivery of all Ocean PGEs and a large schedule risk to us."

### C.1.2.2 Processing

The Miami Modis data processing procedures are being updated to include support for PGE40, PGE50 and PGE53. These PGEs create the weekly composites, the 3-week reference file and the declouded daily products. Three weeks of seawifs data (from june and july 97) were converted to Modis format and is being used to develop and test this process. These procedures will allow us to independently (from ECS or MODAPS) test the Modis code in a way that simulates a production environment

Jim Brown has worked on identifying bottlenecks in the L3B and L3M processing programs. Changes have been made to resolve these problems and increase performance.

Bug fixes and miscellaneous improvements have been made to the processing code.

The memory footprints of some of the processing programs have been drastically improved. This should lead to improved performance.

In support of the Atmospheric Radiation Measurement(ARM) project work, the processing, conversion and registering of images was automated so that a large number of images could be processed and stored at any given time. Also images were processed and registered for two specific regions, the Tropical Western Pacific region and the MANUS region in the Pacific. These regions were chosen to coincide with ground based measurements as per the requirement of the ARM investigators.

Revised Processing times for Level-2 and level-3 Ocean Products

The processing estimates presented in previous reports utilized a test data set that assumed no clouds or land. In addition, the at-sensor radiances/reflectances presently were not well matched to the atmospheric correction algorithms and consequently did not take advantage of provisions made in the codes to minimize processing time by utilizing pixel to pixel coherence in choice of potential atmospheric correction models. The previous Level-2 ocean color processing times were overstated by as much as a factor of three.

Revised processing estimates are currently based on Version 2 ocean color and SST PGEs executing on SGI Origin R10000 200Mhz processors using IRIX 6.5, EOS toolkit calls and HDF-EOS file structures and AVHRR or SeaWiFS->MODIS Level-1b input data. Granule processing times are averaged based on processing a week of real satellite observations and averaging to obtain processing times for a day's worth of granules. The Version 2 programs have integrated the lastest verions of the atmospheric correction and product algorithms supplied by the MODIS ocean team investigators.

Table 14 Processing times for L2 and L3 Oceans products

| **Process** | **CPU hours per data-day produced** | **number of processors** |
| --- | --- | --- |
| Ocean Color Level 2 and space binning | 20 | 8 |
| Sea Surface temperature Level 2 and space binning | 20 | 2 |
| Level 3 40 daily binned products and 3 map resolutions | 20 | 3 |
| De-cloud 40 daily products and creation of 3-week reference | 20 | 3 |

Our goal has been to improve processing capacity through a combination of algorithm efficiency improvements and upgraded hardware to achieve a capability to process reduced resolution (4km) MODIS observation at a rate that exceeds 10 data days/day. This capability will permit changes such as algorithm enhancements or updated calibration to be easily verified using long time series of global observations (> several years) prior to submitting the updates to the MODIS team for consideration In particular, if we can process high resolution global data at a rate of 1 data day/day, we will meet the goal to process 4km reduced resolution data at a rate > 10 data days/day. Finally the algorithms are continually reviewed to determine where computation efficiencies can be achieved.

Volumes and Loads:

Table 15 presents a list of the products that will be produced by the Level 2 and Level 3 PGEs for ocean color and SST and the latest estimates for file size. This table gives the maximum possible data load per day assuming all files listed are created and archived. The MOCEANS team has been investigating various options to reduce the daily volume load to match the at launch capability of the Goddard DAAC storage capacity.

Table 15. Summary of File sizes for SST and ocean color Archived products.

| | **Files/day** | **GB/file** | **GB/day** |
|---|---|---|---|
| Level 2 | | | |
| Level 2 OC QFlags | 144 | 0.19790 | 28.50 |
| Level 2 OC Data | 432 | 0.15667 | 67.68 |
| Level 2 SST Qflags | 288 | 0.12369 | 35.62 |
| Level 2 SST Data | 288 | 0.04398 | 12.67 |
| | | | |
| Level 3 Daily Binned 4.6 km | | | |
| Ocean Color 36 prods (mean, sd,n,qual, flags) | 36 | 0.62000 | 22.32 |
| SST (day, night, 4m, 11m) mean, sd,n,qual, flags) | 4 | 0.64000 | 2.56 |
| Level 3 Weekly Binned, 4.6 km | | | |
| Ocean Color | 5 | 0.62000 | 2.79 |
| SST | 1 | 0.64000 | 0.32 |
| MAPS EOS grid (**13 products x 8 fields and 27 products * 7 fields)** | | | |
| 4.6 daily | 293 | 0.13400 | 21.80 |
| 36 km daily | 293 | 0.00220 | 0.33 |
| 1 degree daily | 293 | 0.00030 | 0.05 |
| 4.6 km weekly | 37 | 0.13400 | 2.73 |
| 36 km weekly | 37 | 0.00220 | 0.05 |
| 1 degree weekly | 37 | 0.00030 | 0.01 |
| **Total** | **2186** | | **197** |

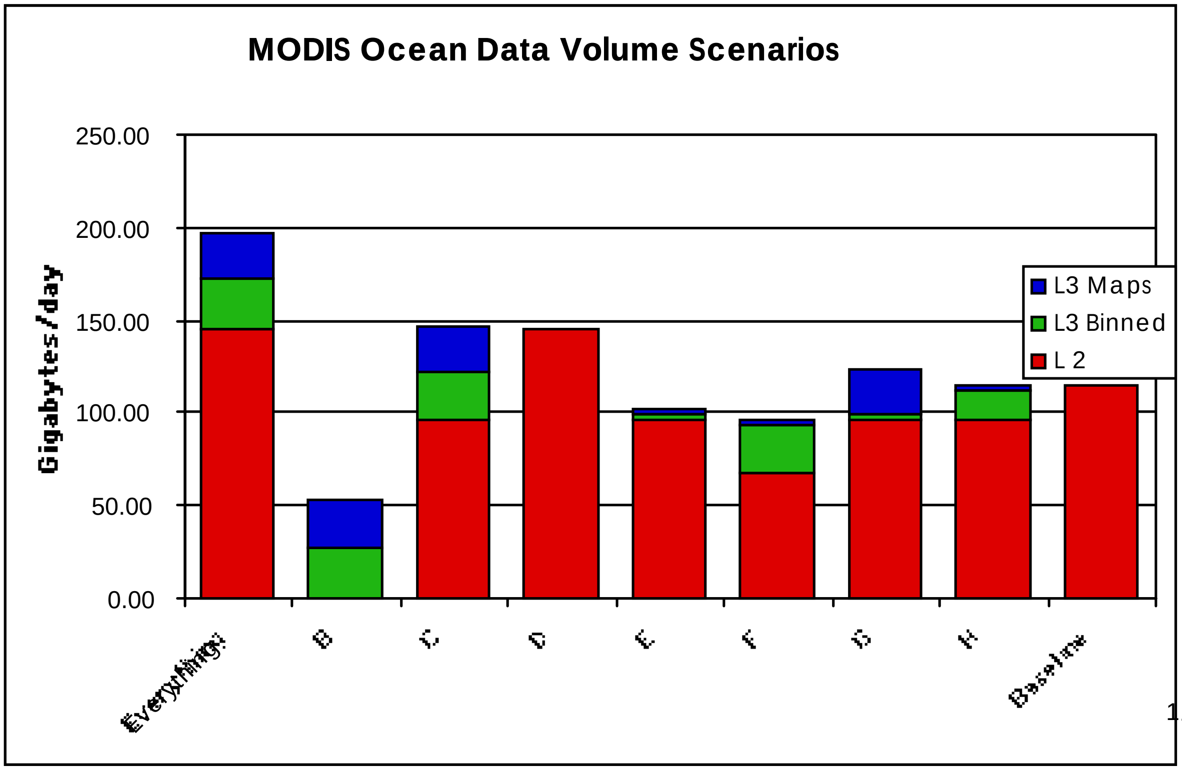
Total volume requirements will range between 30 and 100 gigabytes/day depending on available DAAC and MODAPS system services. The various options for limiting volumes are presented below.

| | Files /day | GB /file | GB /day | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | A | B | C | D | E | F | G | H | Base line |
| Level 2 OC QFlags | 144 | 0.20 | 28.50 | | 28.50 | 28.50 | 28.50 | | 28.50 | 28.50 | |
| Level 2 OC Data | 432 | 0.16 | 67.68 | | 67.68 | 67.68 | 67.68 | 67.68 | 67.68 | 67.68 | |
| Level 2 SST | 288 | 0.12 | 35.6 | | | 35.6 | | | | | |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Qflags | | | 2 | | | 2 | | | | | |
| Level 2 SST Data | 288 | 0.04 | 12.67 | | | 12.67 | | | | | |
| | | | | | | | | | | | |
| Level 3 Daily Binned 4.6 km | | | | | | | | | | | |
| Ocean Color 36 prods (mean, sd,n,qual, flags) | 36 | 0.62 | 22.32 | 22.32 | 22.32 | | | 22.32 | | 12.83 | |
| SST (day, night, 4m, 11m) mean, sd,n,qual, flags) | 4 | 0.64 | 2.56 | 2.56 | | | | | | | |
| Level 3 Weekly Binned, 4.6 km | | | | | | | | | | | |
| Ocean Color | 5 | 0.62 | 2.79 | 2.79 | 2.79 | | 2.79 | 2.79 | 2.79 | 2.79 | |
| SST | 1 | 0.64 | 0.32 | 0.32 | 0.32 | | 0.32 | 0.32 | 0.32 | 0.32 | |
| MAPS EOS grid 13 products x 8 fields and 27 products * 7 fields | | | | | | | | | | | |
| 4.6 daily | 293 | 0.13 | 21.80 | 21.80 | 21.80 | | | | 21.80 | | |
| 36 km daily | 293 | 0.00 | 0.33 | 0.33 | 0.33 | | 0.33 | 0.33 | 0.33 | 0.33 | |
| 1 degree daily | 293 | 0.00 | 0.05 | 0.05 | 0.05 | | | | | | |
| 4.6 km weekly | 37 | 0.13 | 2.73 | 2.73 | 2.73 | | 2.73 | 2.73 | 2.73 | 2.73 | |
| 36 km weekly | 37 | 0.00 | 0.05 | 0.05 | 0.05 | | 0.05 | 0.05 | 0.05 | 0.05 | |
| 1 degree weekly | 37 | 0.00 | 0.01 | 0.01 | 0.01 | | 0.01 | 0.01 | 0.01 | 0.01 | |
| Total | 2186 | | 197 | 53 | 147 | 144 | 102 | 96 | 124 | 115 | 115 |

| Scenario | Everythi | B | C | D | E | F | G | H | Baselin |
|---|---|---|---|---|---|---|---|---|---|

| | ng | | | | | | | | e |
|---|---|---|---|---|---|---|---|---|---|
| L 2 | 144.47 | 0.00 | 96.18 | 144.47 | 96.18 | 67.68 | 96.18 | 96.18 | 115.00 |
| L3 Binned | 27.99 | 27.99 | 25.43 | 0.00 | 3.11 | 25.43 | 3.11 | 15.94 | 0.00 |
| L3 Maps | 24.95 | 24.95 | 24.95 | 0.00 | 3.11 | 3.11 | 24.91 | 3.11 | 0.00 |




C.1.2.3 Algorithm development

As part of the ongoing improvement of the SST algorithm for the MODIS, the analysis of the existing Pathfinder Matchup Data Base was carried out. The latest results of these analysis was presented as a poster for the Joint Global Ocean Flux Study Symposium and Training Program in Bangalore, India.

Simulated MODIS IR Sea-surface temperature Matchups:
The MODIS will produce two SST products; a product using the 11 and 12um bands (SST) and a second product using the 3 and 4um bands (SST4). During the past 6 months in conjunction with Drs. Peter Minnett and Richard Sikorski we have created a simulated matchup database for the MODIS IR channels using radiosonde data, a modified Rutherford -

Apppleton IR-spectral model updated with recently supplied Clough continuum spectra for vapor optical properties, and the latests MODIS spectral response characteristics to produce channel data.  This simulated matchup database is being used to develop at-launch algorithm coefficients for the SST algorithm and evaluate current and alternative formulations of the SST algorithms in light of anticipated channel cross talk and calibration uncertainties.

The modified RAL was used with a global dataset of 761 marine and coastal radiosondes to simulate satellite-viewed brightness temperatures (BTs) for the currently available response functions (RSRs) for MODIS AM-1 3-micron and 4-micron IR bands (B20, B22, and B23).  New algorithms were developed for SST4 retrieval for a zenith viewing angle using the 3 and 4 um bands, and new relationships were observed for retrieval of total column water vapor.

We based the algorithm on a simple channel difference method.  We applied a seasonal correction (Figure 7), and a latitudinal band correction . Initial regressions showed a strong zenith angle dependence,  which may be included that in future algorithms.

Algorithm (equivalent to channel plus channel difference):
SST4= a + b * B22 + c * B23 + f(x)

(note: B23 may be replaced by B20 if warranted, using the appropriate set of coefficients.  At present the advantage of the B22:B23 pair over the B20:B22 pair is quite small.)

Seasonal term (based on solar declination):
f(x)= m *cos(2*3.14159*(x + n)/365) + p

Definitions:
a,b,c,m,n,p are coefficients estimated separately for each of 3 latitudinal bands based  distance from the equator.
x(northern hemisphere)=days after 173 (summer solstice)
x(southern hemisphere)=days after 357 (winter solstice)
B20 = MODIS Band 20
B22 = MODIS Band 22
B23 = MODIS Band 23
for leap years, standard year days = leap year days *365/366

Residuals (reference SST versus algorithm derived SST4) showed an RMS of 0.269 and 0.285 ,respectively for bands 22/23 and 20/22 formulations. Analyses during algorithm development revealed that certain band differences are a good proxy for total column water vapor. Plotting the regression residuals vs. radiosonde total vapor, the relationship is best for B20-B22 = 1 to -1 degrees versus 0 to 6 g/cm2 vapor. It is similar, but noisier (especially drier atmospheres), for B20-B23 = 2 to -0.5 degrees versus 0 to 6g /cm2 vapor. The B22-B23 difference shows virtually no slope vs. vapor load, and is noisy for drier atmospheres.

Figure 7 Seasonal correction function: modeled SST4 residuals versus day of year. Dots- simulated matchups residuals prior to addition of seasonal correction to the algorithm; Squares- fitted seasonal correction function is shown ,

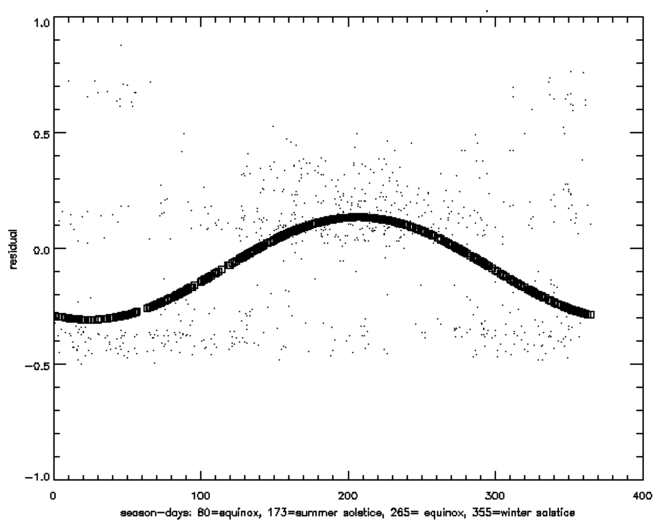
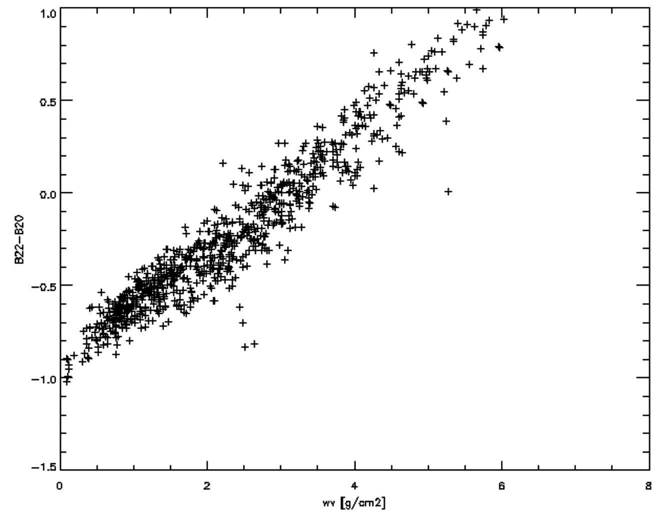



Figure 8 simulated Band 22 – Band 20 versus water vapor

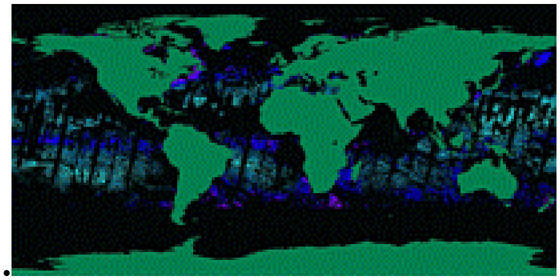



## ***Algorithm testing and code validation***

The sample images presented in Figure 21 panels A-L were produced from MODIS V2 at launch algorithms using SeaWiFS converted to MODIS level 1 data format. Two days of SeaWiFS data for July 2 and 3rd 1998 were processed to create these daily images. This has enabled us to test the complete MODIS oceans processing chain from Level 1b ->Level 2 calibrated parameters and space binning ->Level 3 time binned and mapped products. We are currently evaluating the ranges of values produced and the associated pixel level quality flags to verify the at launch algorithms. As a result of this testing and evaluation updates have been made to the various algorithms for each of the 36 ocean color products. We are now working on building climatologies from the converted Seawifs data for use in at launch quality control.

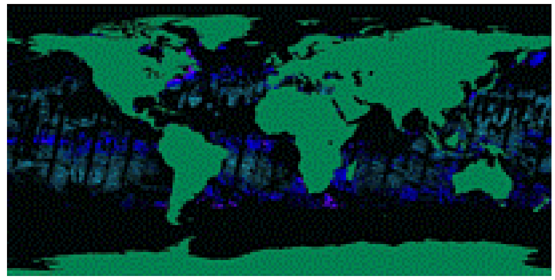
**Figure 21 panels A-L MODIS results for converted SeaWifs data July 2 and 3rd 1998**

**A.**



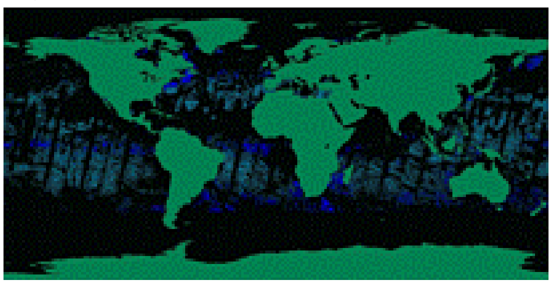
**nLw 412nm**

**B.**



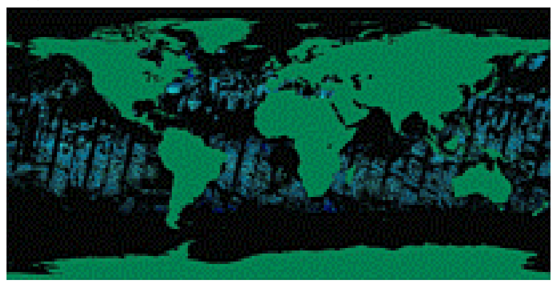
**nLw 443nm**

**C.**



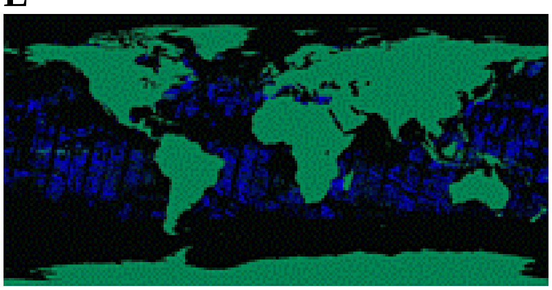
**nLw 488nm**

**D.**



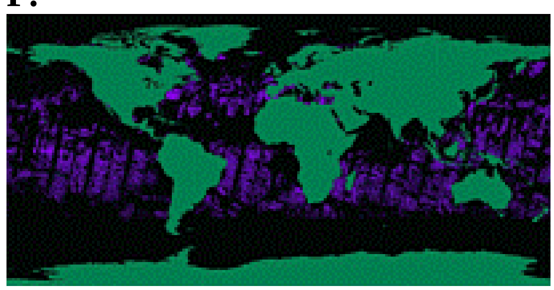
**nLw 531nm**

**E**



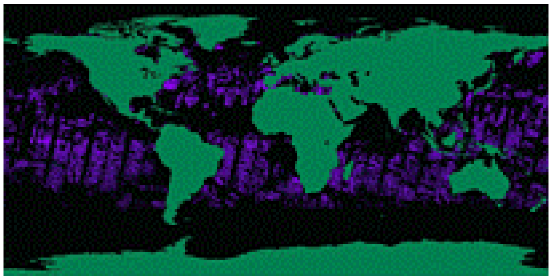
**nLw 551nm**

**F.**

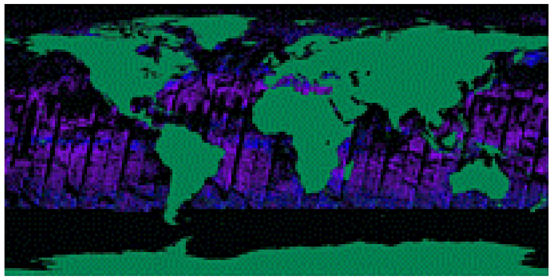


**nLw 667nm**

G.



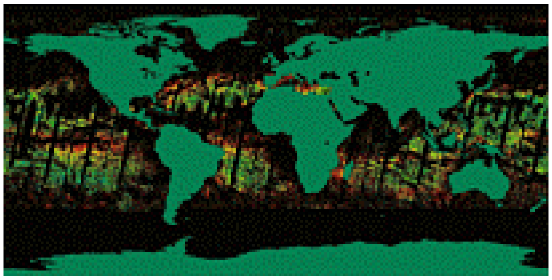
H.



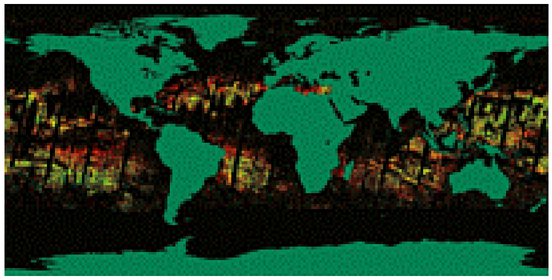
nLw 678nm

K490nm

I.



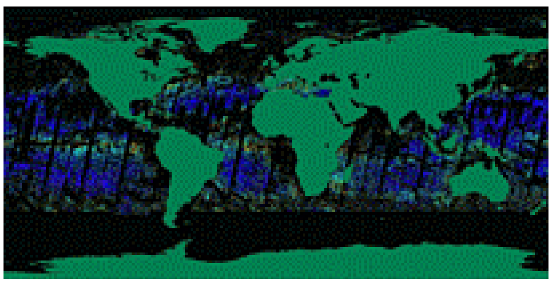
J.



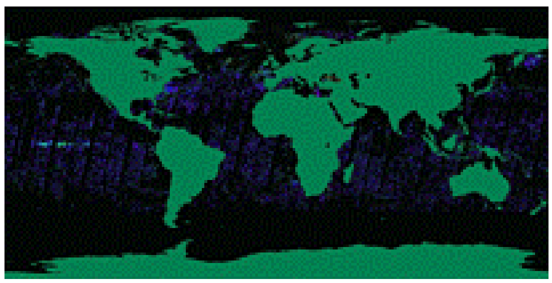
MODIS Chlorophyll

pigment_c1 total

K.



L.



Suspended solids

Coccolith Calcite concentration

Comparisons of similar fields obtained from SeaWiFS, AVHRR and MODIS are used in conjunction with ancillary data to identify locations and conditions where sensor and algorithm performance is satisfactory. Where not, the data sets will help identify potential sources of error. The creation of these reference datasets has been one of our prime activities during the last six months.

The MOCEANS strategy consists of two tiered QA of Oceans processing. The top level QA is done at the MOCEANS processing facility to detect the gross errors in processing. data products will be check for completeness of the level2 and level3 production by visual examination of the 40 level 3 daily products to determine if data is missing in the L3 file. The Q/A analyst must trace the problem to determine where in the processing stream the drop out occurred. Approximately 6 months post-launch activities are anticipated to move toward zero-order science QA tasks. These include: checks and trending performance of pixel level QA and metadata summary flag performance and values. Checks will be made to determine data consistency with climatology comparison/correlation with other MODIS products. These checks generally focus on verifying “reasonableness” of the data and identifying location of gross algorithm failure.

The second tier of the quality assurance plan is Post processing Science QA done at RSMAS SCF and MOCEAN team member institutions. Science QA procedures will examine both pixel and global context with the goal of understanding differences due to instrumental, code/algorithm, geophysical, and biological effects. Primary output of this effort will be revisions in the criteria and thresholds used to define and set run-time pixel level flags, and rules for using pixel flags at level 2 to control acceptability for binning level 2 pixels into level 3 fields and establishing the confidence flags.

The evaluation of the global MODIS SST fields requires that a standard global SST field be available for comparison. Without an accurate reference field, or at least a reference field with known limits in accuracy, it is not possible to make meaningful comparisons. Such comparisons are necessary to identify SST discrepencies and to compare with other fields (aerosols, water vapor) in order to make improvements in the SST algorithm. Below we present recent work in this area.

There are several global SST fields that are widely available for comparative purposes, including the Pathfinder, GOSTA, Reynolds OISST, and World Ocean Atlas 1994 (WOA94) datasets. A recent study by Casey and Cornillion 1999 compared a Pathfinder SST climatology with other SST climatologies to historical in situ surface SST measurements from research vessels which are found in the WOA94 database (Levitus 1994). They found that a climatolgy assembled from the 9 km Version 4.1 Pathfinder SST product had the lowest global standard deviation (1.45 C) as compared to the GIST 1 degree (1.55 C), Reynolds 1 degree (1.58 C), WOA94 1 degree climatology (1.58 C), and GOSTA 5 degree (2.07 C) products. Casey and Cornillon 1999 took these results to mean that the Pathfinder fields are more accurate than the fields used in the other climatologies. However, the use of global means and standard deviations, and even such statistics taken from zonal band ensembles, does not indicate those specific areas where a particular climatology may experience problems which cause it to deviate significantly from reality. Also, the use of monthly averages rather than annual means will be able to identify those processes which occur on some shorter frequencies.

The climatologies used in this study are listed in Table 17. The MPFSST, AOML, TOMS, and SSM/I climatologies were assembled and computed for this study; the other climatologies have been assembled by other researchers for other purposes. The Pathfinder Ascending (MPFSST--A) and Descending (MPFST--D) climatologies were produced by averaging the daily 1 degree resolution SST estimates for each month, for the years 1988 to 1993. The AOML climatology was assembled from the National Oceanic and Atmospheric Administration's Atlantic Oceanic and Meteorological Laboratory's database of surface drifters. The data were binned in 1 degree bins and a splined surface under tension was fit to average between the (usually) sparse measurements. The TOMS aerosol index fields for each month from these years were bilinearly interpolated to 1 degree from their original 1 by 1.25 degree resolution, but other than this subsampling procedure they were not spatially smoothed. The SSM/I fields were assembled by assembling a composite of the daytime and nightime values on a 1 degree grid.

| Name | Quantity | Source | Smoothed ? |
|---|---|---|---|
| MPFSST-A | SST | AVHRR | No |
| MPFSST-D | SST | AVHRR | No |
| GOSTA | SST | Ship Reports | Yes |
| AOML | SST | Surface Drifters | Yes |
| OISST | SST | Sips, Buoys, AVHRR | Yes |

| | | | |
|---|---|---|---|
| SuperObs Ship | SST | Ships | Yes |
| SuperObs Buoy | SST | Buoys | Yes |
| TOMS | Aerosol Index | TOMS | No |
| SSM/I | Water Vapor | SSM/I | No |

**Table 17. The climatologies assembled for inter-comparisons**.

The inter-comparisons of these monthly 1 degree climatologies revealed that the GOSTA, AOML, and both SuperObs fields cannot provide an adequate global reference field, mostly due to the (unconstrained) interpolation to vast undersampled areas. This problem is alleviated in the "blended" OISST fields by using AVHRR SSTs to constrain the fields between in situ observations.

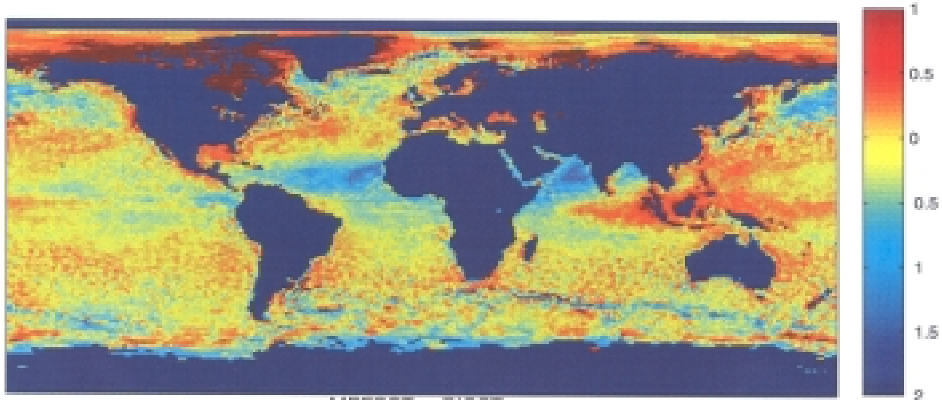
The OISST fields appear to be the most promising as a reference field for large scale climatological Pathfinder comparisons. However, the best comparisons were not accomplished through the differencing of the average fields, rather the most realistic comparisons are accomplished through the averaging of the differences between the fields. It is these "averages of MPFSST - OISST" that were used to compare to the aerosol and water vapor estimates.

Figure 15 depicts the average of the MPFSST - OISST differences for the month of July and the average TOMS aerosol index for the same month. The correlation between the high MPFSST-OISST difference and the high aerosol index in the southern North Atlantic and Arabian Sea is striking, and appears to be the result of Saharan dust which is often present in the atmosphere at that time of year. That the OISST fields are able to resolve the temperature deficit in that area despite relatively sparse observations and an AVHRR SST that was plagued by the same aerosols as the Pathfinder estimates is encouraging for future comparisons. Of course, of equal importance is why other areas (e.g. the western North Pacific) do not show as striking a correlation. Work is continuing on the comparisons of both the TOMS and the SSM/I water vapor fields with the MPFSST – OISST differences. The spatial correlations between these fields will be quantified in order to best identify those areas and conditions that produce errors in the Pathfinder SST fields.

Figure 15. The average ascending MPFSST minus Reynolds' OISST [top panel] and the average TOMS Aerosol Index [bottom] for the month of June over the years 1988-1993. Strong correlation between the fields exist over areas which

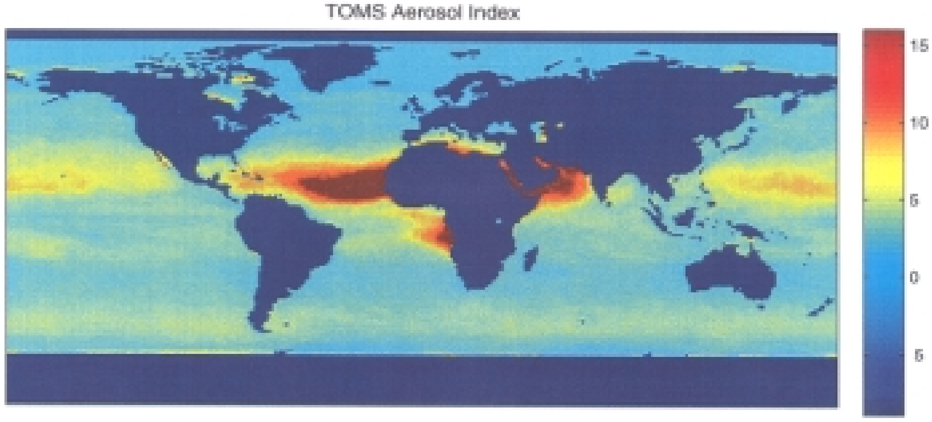
typically have Saharan dust in the atmosphere. Other areas with high Aerosol Index values do not always have a corresponding SST deficit.

1988 1993 Average for Month 06




MPFSST - OISST

TOMS Aerosol Index



### C.1.3 SeaWiFS

#### C.1.3.1 General

#### C.1.3.2 Processing

We continue to develop programs and procedures to support automated processing of seawifs data. During this reporting period we continued development of the seawifs metadata database.

A large raid 0 disk crash destroyed ~75 GB of level 1 seawifs data as it was being staged for reformatting. Some of this data is on DLT tape in Miami and some will need to be reordered from the GSFC DAAC.

#### C.1.3.3 Algorithm Development

Recent efforts have concentrated on developing absorbing aerosol models to complement the standard scattering aerosol models incorporated in the atmospheric correction scheme.

#### C.1.3.4 Absorbing aerosols

Work in conjunction with H Gordon and C Moulin produced an absorbing aerosol model based on aerosol spectral atmospheric reflectances observed in SeaWiFS images over the eastern tropical Atlantic. The model has been satisfactorily tested for a number of images in various ocean basins. This initial, exploratory effort has been encouraging and work is progressing. Results have been presented at the SeaWiFS workshop Monterrey.

### C.2 Matchup Database

#### C.2.1 Historical Matchup Database

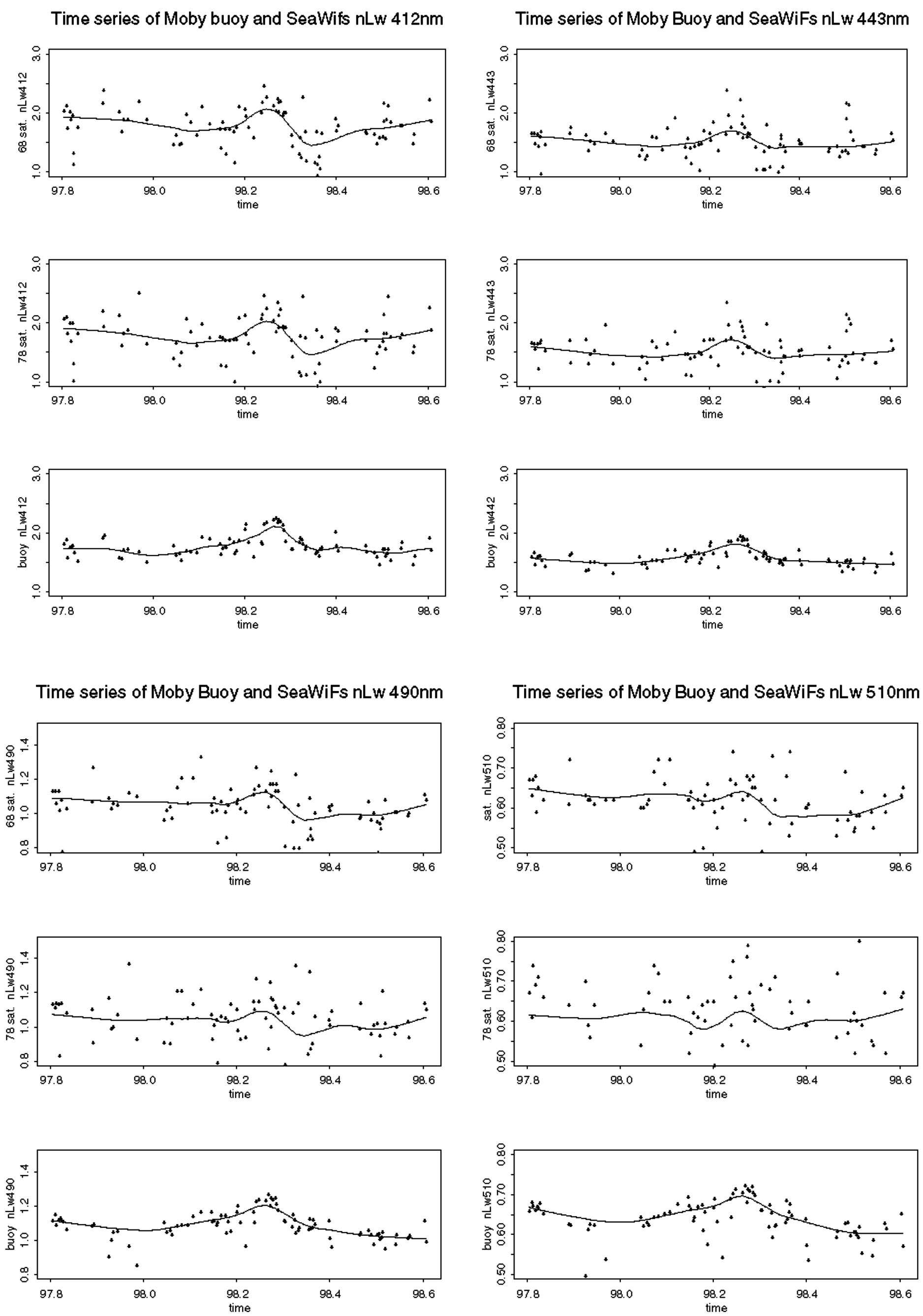
Received and assembled *in situ* buoy SST archive data for 1998. Currently extracting satellite quantities. These matchups will be used to determine archive coefficients and cloud test 1998. In addition this data will be used to asses the accuracy of the 1998 interium Pathfinder GAC Version 4.0 which is now routinely delivered by Miami in near real-time to the JPL-DAAC for distribution.

### C.2.2 Real-time Matchup Database

### C.2.3 Ocean Color Matchup Database

We continue to extend our current ocean-color matchup database developed from SeaWIFS satellite data and Dennis Clark's MOBY buoy. In this analysis changes were made to our local SeaWIFS processing stream to incorporate recent developments in calibration and atmospheric model selection in collaboration with Howard Gordon at the University of Miami Physics department. These changes included new calibration values in channels 1-7 (generally on the order of a 1% lower) and the addition of a new oceanic atmospheric model. This new atmospheric model assumes only a single mode of large particles associated with breaking waves. The current maritime atmospheric models contain two modes, big and small particles. We implemented the above changes in our processing stream and extracted the satellite information for a 3x3 km box located over the MOBY Hawaii location to examine the impact of these changes on the accuracy of the the atmospheric correction and nLw retrieval. We also evaluated the use of SeaWiFS bands 7 and 8 versus bands 6 and 8 for the atmospheric correction. Figure 9 shows the comparison of the retrieved satellite water leaving radiances is made using the MOBY buoy deployed by Dennis Clark off the island of Lanai, Hawaii. A time series of cloud free satellite retrievals for each of the SeaWiFS bands are presented for both the 6/8 and 7/8 band pair based atmospheric correction and for the buoy. The observations are color coded to reflect the observation pathlength; black 1-2, green 2-3, and yellow >3 atmospheres. Each line is a loess fit to the observations. There is less scatter for the 6/8 correction as well as lower scatter for the shorter pathlength observations.

Figure 9  Time series of SeaWiFS and MOBY buoy nLw’s  using both 6/8 and 7/8 Atmospheric correction Processing. The observations are color code to reflect the observation pathlength; black 1-2, green 2-3, and yellow >3 atmospheres.  Each line is a loess fit to the observations.



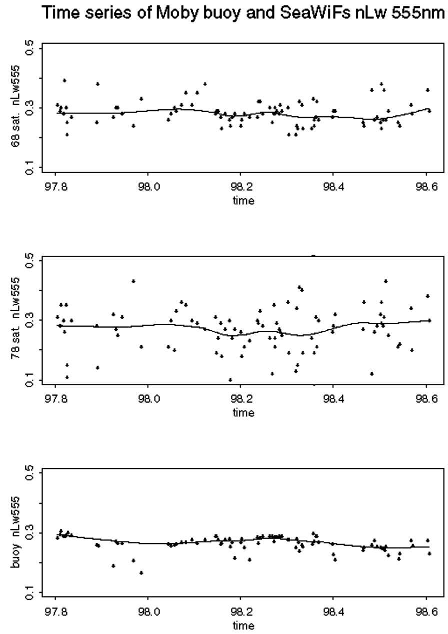



Table 13 presents the median and standard deviations for the 6/8 and 7/8 retrievals and buoy observations relative to the MOBY loess fit. The comparisons are similar to the MOCE initialization results; bias is order of 1% and standard deviation, 14%, is approximately twice that seen with the MOCE (ship based observations). The MOBY observations have order of 6% standard deviation relative to the loess fit to the MOBY observation.

Table 13 Percent difference of SeaWiFS – Buoy nLw's MOBY time series

| Band | | processing | | | median Moby nLw |
|---|---|---|---|---|---|
| | | 6/8 | 7/8 | buoy | |
| 555 nm | median | 3.7% | 5.6% | 0.1% | 0.268 |
| | std | 17.2% | 31.3% | 8.2% | |
| 510 nm | median | -3.6% | -2.6% | -0.3% | 0.643 |
| | std | 25.0% | 28.0% | 6.4% | |
| 490 nm | median | -4.2% | -4.4% | -0.8% | 1.088 |
| | std | 13.8% | 17.8% | 5.2% | |
| 442 nm | median | -3.3% | -4.6% | -1.0% | 1.555 |
| | std | 15.9% | 18.2% | 6.4% | |
| 412 nm | median | -0.6% | 0.2% | -1.3% | 1.731 |
| | std | 16.1% | 19.0% | 8.1% | |

## C.3 Systems Support

### C.3.1 Systems/COTS

Compatibility problems between the FC4400 OneOfUse Raid controllers and IRIX limited the performance of managed disks to 3-4 MBs. The vendor has been unable to correct the problems and we have removed two of the three controllers in favor of a software (xlv) striped volumes. This has had a substantial favorable impact on the wall clock time for Modis programs.

### C.3.2 Networking

The SOX/VBNS connection to GSFC has shown improvement since NIS routing changes in March. Testing indicates that potential data rate as high as 2000 KBs. However, the network is not consistent in supporting this rate and often drops well below 1000 KBs.

### C.3.3 Tape library and disk array

Tape library software vendor support is being reexamined due to the acquisition of DEC by Compaq and the subsequent shift in support of third party licenses. The disk fibre channel disk system will be augmented by the addition of 36 gigabyte drives and a change in vendor for the raid controllers. When the system software permits, the array will be shared across the Compaq machines.

### C.3.4 Software Support

#### C.3.4.1 Modifications/Additions to DSP

Change copyright date to 1999 in all files. Edits for new ARRSIZ - allow up to 8192 pixels per line. Add support for Solaris 7.

### C.3.4.2 PGE Problems Fixed

MODCOL: Add SeaWiFS chlorophyll algorithm. Modify macro to be more efficient. Add missing enddef after debugs. Add include needed by colorin1.h changes. Larger range in coccolith tables to account for values found in SeaWiFS imagery. DEC OSF builds need cc option -DOSF1_V3 Fix the modis prologs. Remove use of prohibited function: stop. Implement wider aerosol tables for MODIS (35 vs 26 entries). Use additional ancillary flagging detail to separate fatal from non-fatal errors. Summarize these flags in group 5 messages (bits 11-20). Correct calculation of midpix (Use IANCHR and not ANCHOR$1). Correct CFE comments and use of 6.023e23 in calculation. Read reference SST field for Carder NDT test. Update aerosol file names for new tables. Pass in neg_rrs_flag for ARP calculation. Don't compute ARP if neg_rrs_flag is 1 (bad rrs value). Disable diagnostic ARP calculations (ARP2 and ARP3). Fix SST reference image file present test. Move neg_rrs_flag test into CARDER_IPAR subroutine. Set all quals to 3 (bad) if UnProcessed bit in common flags is set. Change IPAR quality values. Separate IPAR and ARP qualities. Remove incorrect argument from REFread (lstr) -- only in REFwrite. Add documentation for calling arguments. Convert input MODIS radiances to SeaWiFS radiances. Don't test output values if input values failed tests. Make sure unused elements are zeroed (probably unnecessary).. Add DR1_QUAL flags to AnlyUpO routine. Add hdf-wrd.c and hdf_io_tools.c for reading hdf data fields. Add readndt.f to read Carder NDT reference field. Remove unused variable. Add Carder NDT threshold coefficients. Add binary file support for both Rayleigh and aerosol input files. Select binary format for both Rayleigh and aerosol files (much faster). Clean up error messages. Correct numerous errors in CFE and FLH calculations. Must output both DR1FLAGS and DR1QUAL with AnlyUpO. Add Carder NDT reference field support. Compute packaging value. Initial version of Carder version 1.4 delivery. Add argument required by Carder version 1.4 chlorophyll routine. Correct (unused) argument to AnlyUpO. Add two dr1 flags for Carder NDT packaging selector. Correct pk_val for packaged state. Set DR2 flag bits for NDT packaged / unpackaged states. Pass DR2 flags to FLH/CFE/ARP section (needed for quality checks). Remove redundant calculation of aphi. More corrections and improvements to FLH/CFE code. Set the *Ipararp_In flag. Add some debugging print statements. Change qual=3 test syntax to make it more like qual=2 tests. DR1 flags and quality arrays are really x4. This also solves another problem. Minor code cleanups.

Replace swf_chl-1.3.c with swf_chl-1.4.c. Add missing dr2_neg_rrs test for several products. Work around a problem with aph675 computed <= 0. Set lower limit of 1e-7. Add some debugging hooks (disabled). Change dr1 flags and quality from 3 to 4 byte arrays (to match output file and the way it was being read). Use inpixsiz for the width of the scan line (Not SCNLEN, MAGX2, etc). More corrections to FLH/BASELINE/CFE calculations. Make sure unprocessed pixels are flagged. Make sure FLH/BASELINE/CFE unprocessed pixels are flagged. m6..m8 are int so sav_m6..m8 should also be int. Return a four digit year to caller in XDATE. Use Reynolds OI data properly. Implement updated calibration equation [rad = slope*(count-intcp)]. Restore simpler Reynolds SST indexing calculation. Correct Reynolds array indexing. Change Clark diffuse attenuation calculation to SeaWiFS version/coefficients. Direct derivative of swf_chl-1.4.c tuned for MODIS. ARP no good if aph675 (aph/atot) inputs are bad. Increase input radiance limits. Change from swf_chl-1.4.c to modis_chl.1.c. Change diagnostic from humidity to precip. water. Add some debugging aids. Extrapolate epsilon values when only one aerosol model. Don't use 'blend' or 'default' flags for quality checks per Carder request. Fix up flag byte arrays (portability issue). Pass wind speed to atmospheric correction routine. Add wind speed interpolation to Rayleigh tables. Apply out of band water vapor correction to MODIS data. Extend out of band correction coefficients to all 9 bands. Correct MODIS central wavelengths. Switch to SeaWiFS based on input data. Read out of band correction coefficients from a file (READ_OUTOFBAND). Limit exponent of power function. Validate CHL value before using it as a divisor. Limit upper values for various power function evaluations. Limit magnitude of power function exponent. Add limit checks to find_newton routine to suppress bad values. Add limit checks to extrapolated epsilons to suppress bad values. Remove unused source file. Correct error handling for COCONS routine. Change clear water epsilon calculation to use a consistent set of inputs. One of the inputs was also incorrect. Don't use Carder's flags for now. Be more restrictive when inverting quartic using rho_a. Move these routines to binshr so they can be used by modsst and msbin also.

MODSST: New SST4 algorithm; band* and lat* inputs; use modsst_coeffs.dat instead of pathnlc_coeffs.dat. DEC OSF builds need cc option -DOSF1_V3 Use new routine AppendProcLog. Use new routine AppendProcLog. Change midpix to be same as modcol usage. Initial changes to support AVHRR input data. Add capability to use AVHRR as input data. readreyw.rat is now in atmcorshr. readreyw.rat is not in atmcorshr. Use modis band 26 instead of 27. Write image attributes to qc file so msbin will be able to bin qc products. Write "Data Sensor Type" image attribute (AVHRR or MODIS). Make quality values more like pathnlc. Fix metadata in QC file; fix mask bit info in header; use Reynolds OI the same way as in modcol. Add inputs to fake the tree test. Fix setting of sst4 qual. Split the coeffs into separate files for avhrr, sst, sst4. Don't read channel 6. Channel 26 is the first chunk of data in the input data buffer. Only write Verparm* PSAs for the data bands (not flags). Fix flag handling for machine compatability. Update SSTBANDS, NUMSST for current IR band usage. Use modcol's routines to handle the mask bit names.

MSBIN: Debugging constantly changes the pcf file. DEC OSF builds need cc option -DOSF1_V3 Minor changes to quality selection algorithm. Update for Toolkit 5.2.4. Fix splitting again - make it more like seawifs binner - use time of ascend/descend chunk to determine relation with dataday edges. AVHRR descending is night, MODIS descending is day. Add ability to bin qc files. IPAR and ARP have separate quality values. Initialize unused flag bytes to zero. Display error message if time conversion fails. Fix up flag byte arrays (portability issue). Only bin band if output files were specified in pcf file. Fix many small errors. Add more info to some error messages. Use modcol's routines to check mask bit names. Exit with DISPLAY_NOINTERSECT if no output files are created.

MTBIN: DEC OSF builds need cc option -DOSF1_V3 Change status variable name to irpcod. Check for valid data day inputs. Add ability to make month files. Fix Range... metadata fields. Fix use of BYTE variable in mice table. Exit with "display_nointersect" error status if none of the input files are within the specified time period. Allow output record size to be different from input record size (default: same). Include conditional compilation to build program either way. Resolve a few places where input size and output size variables were confused. Increasing record size solves a horrible HDF performance problem. Add some (disabled) debugging aids. Remove unnecessary include file (large memory footprint).

MFILL: DEC OSF builds need cc option -DOSF1_V3 Fix Range... metadata fields. Fix use of BYTE variables in mice table. Use BANDWIDTH instead of fixed 128. Remove unnecessary common blocks (excessive memory bloat). Use Jim's changes to pathfill to make mfill faster.

MCLOUD: DEC OSF builds need cc option -DOSF1_V3 Fix Range... metadata fields. Fix use of BYTE variables in mice table. Use BANDWIDTH instead of fixed 128. Remove unnecessary common blocks (extreme memory bloat).

MMAP: Allow for 4km (8192x4096) output. flagmask is really 4 bytes per pixel. Get calibration info from mmap_params_* file. Don't output error message for Standard Deviation output when input bin has only one value in it. Use -1.0 as invalid value for standard deviation. Fix flag byte index. Check for zero during standard deviation calculation. Fix standard deviation calculation to handle very small differences. DEC OSF builds need cc option -DOSF1_V3 Fix Range... metadata fields. Remove old pcf files. Fix use of BYTE variables in mice table. Use BANDWIDTH from bindefs.rat. Fix up flag byte arrays (portability issue). Remove unnecessary common block (excessive memory bloat).

L3M2MIA: Comment out old code. Fix use of CFLAGS.

ML3B2MIA: Allow for 8192 x 4096 images. Fix flag band bytes. Bound missing value to zero, instead of converting to byte value. Use proper HDF-EOS library.

MSPC: Fix Range... metadata fields. Fix use of BYTE variables in mice table. Use constants from include file. Remove unnecessary common blocks.

MODINC: miami.rat ocean_lun.f ocean_lun.h ocean_lun.rat shpsphcom.h: Fix zext macro. add sst level 3 product file luns.

MODINC: commoninout.rat ocean_lun.f ocean_lun.h ocean_lun.rat: Update flag bit definitions. Add new files (LUNs).

MODINC: commoninout.h commoninout.rat: PEB and PUB are absorption and not concentration. Spelling error fixed.

MSSTSHR5: Remove use of prohibited function: stop. Allow both AVHRR HRPT/LAC and AVHRR GAC as well as MODIS LAC.

MODISIO: Add debugging (currently disabled). Add support for AVHRR impersonating MODIS data. Merge in changes from MODIS project. Add ability to set metadata for Reynolds files. Display generated error messages. Support both old and new calibration information organization in L1B datasets.

MOCEAN: Add cacheing of band information for multiple open files (so it only has to be looked up once per band per file). Clean up sources. Remove unused variables. Optimize calls to support routines to minimize file access.

ATMCORSHR: Add prototypes for atmcorshr and mcolshr8 functions. Additional include files needed. Move sources to shared library area from MODSST. Two-digit/four-digit year corrections.

MCOLSHR8: Use prototypes from colorin1.h. Clean up local function usage. DEC OSF builds need cc option -DOSF1_V3 Change ancillary data flagging to provide more detail on the specific data failure to the calling routine. Add a second check for year range. Switch from relative humidity to total precip. water. Correct error reporting and enhance error logging.

BINSHR: DEC OSF builds need cc option -DOSF1_V3 Remove use of prohibited function: stop. Set Range* metadata fields. Increase limits on bands and files. Increase L3B record size from 128 to 4096. HDF library _very_ inefficient if large number of records in SDS. Use constants from bindefs.h. Add include file for common constants. Add functions to repair byte ordering. Fix comment in header. Add ice stuff for mfill. Modcol's versions of the routines to check the mask bit names.

ANLY8D: Disable some debug messages. Regularize output messages. Improve SetFlag2Bit macro. Include -DOSF1_V3 for DEC OSF builds with SeaWiFS toolkit. Add missing ENDDEF directive. Add routines for D. Antoine calculations. Add routines for D. Antoine calculations. Change taur, tauoz to per pixel quantities. Add new output file for D.Antoine subroutine results. Add code to support D.Antoine subroutine (output file 5). Minor cleanups. Corrections to D.Antoine parameter setups. Don't use values resulting from standard aerosol correction routine. Fix setting of lndmsk value. Use same YFLAGS values as anly6f (CZCS version). Add missing code to initialize slope/intercept for D.Antoine output file. Use ISSetFlagBit instead of ISSetMaskBit for

D.Antoine pixel classification. Add processing statistics on D.Antoine results. Clean up appends to proc_log (always end entry with a single |). Zero uninitialized output pixels at edges of scan lines. Mask out bad values for D.Antoine routine. Convert input files to host byte order while reading them. Initialize output values to zero in case calculation fails. Don't modify argument ylt, make a local copy (to modify). Rename first output file internal variables to include an explicit '1'. Include ozone absorbtion in D.Antoine Rayleigh. Add debugging, optimization changes. Resolve problems in David's routine. It didn't match what we were supposed to be using. Change ANCIL1 flag tests to detect certain specific problems with ancillary data input files. Add call for D.Antoine initialization routine. Add debugging outputs to D.Antoine's routine. Update polynomial coefficents. Improve testing of yflags so allow both yflags=1 and yflags=2 as good data. Increase chlor maximum value to 60. Add binary aerosol file support. Add aerosol binary file support. Default to using binary aerosol files. SeaWiFS only has 8 bands. Add input parameter 'usedust' with default value of 3 (try both dust models). Model 1 (usedust=1) is africa dust; Model 2 (usedust=2) is asia dust. Command line echoing was missing a |. Remove "-g3" compiler option. Fix includes to match the pathfinder changes. But still cheat with a copy here so we are still separate from dsp so we can easily give the package to seawifs without all of dsp. Remove unused include file. Change case 1/case 2 switch point to chlorophyll of 3.0 instead of 1.5.

LOCATE8D: Synchronize with anly8d I/O changes. Increase array size (NNBOX) to solve 'too many lines' problems. Disable some debug messages. Include -DOSF1_V3 for DEC OSF builds with SeaWiFS toolkit. Add include due to change in colorin1.h.

CALEPS8D: Save accumulated changes. Merge changes from anly8d/anly8dbl.rat into caleps8dbl.rat. Change limits on box start line and pixel from 2 to 1. Add out_refl option. Add new arguments to coloop(). Synchronize with anly8d. Change values being output. Dummy out anly8d logging routine. Add binary aerosol file support. Track changes to wang2m.f. Remove debug compiler options. COLORSHR: Add prototypes to colorin1.h for local routines. Make suitable changes to colorsub*.c to be in compliance. Use ffsign/ffmod prototypes from colorin1.h. Correct call to ffsign(). Add local prototypes to navigation routines. Add colorin1 include file to get removecommas_ definition.

COLORSHR5: Add prototypes to colorin1.h for local routines. Make suitable changes to colorsub*.c to be in compliance. Use ffsign/ffmod prototypes from colorin1.h. Correct call to ffsign(). Add local prototypes to navigation routines. Generalize calculation of IANCHR.

COLORSHR5F: Add prototypes to colorin1.h for local routines. Make suitable changes to colorsub*.c to be in compliance. Use ffsign/ffmod prototypes from colorin1.h. Correct call to ffsign(). Add local prototypes to navigation routines. Generalize calculation of IANCHR.

COLORSHR7: Add prototypes to colorin1.h for local routines. Make suitable changes to colorsub*.c to be in compliance. Use ffsign/ffmod prototypes from colorin1.h. Correct call to ffsign(). Add local prototypes to navigation routines. Include -DOSF1_V3 for DEC OSF builds with SeaWiFS toolkit. Generalize calculation of IANCHR. Force failing values to 0. Don't use "-g3" on Solaris

COLORSHR8: Add prototypes to colorin1.h for local routines. Make suitable changes to colorsub*.c to be in compliance. Use ffmod prototypes from colorin1.h. Add local prototypes for geolat. Provide Ozone and Rayleigh optical thickness as outputs from coloop(). Include colorin1.h. Generalize calculation of IANCHR. Set bits in qualflg based on various error possibilities to allow anly8d to make rational decisions on problems with ancillary data inputs. Don't use "-g3" on Solaris.

SSBIN-HDF: Include -DOSF1_V3 for DEC OSF builds with SeaWiFS toolkit. Add option to only bin good data from David Antoine's algorithm. Add 'inang' option to only keep the first best pixel for aer_model bands.

STBIN-HDF: Don't use -I for CFLAGS. Include -DOSF1_V3 for DEC OSF builds with SeaWiFS toolkit. Use include bin bin9km_def instead of bin9km_com. Add 'inang' option so aer_model bands are not summed.

SMAP9: Fix calibration documentation. Add ability to map QC products. Fix EOS in calibration name and units strings. Fix an error message. Add new keyword in_refl to specify input data is reflectance (not radiance). Change output scaling and calibration type based on in_refl. Update angle and ancillary data slopes and intercepts to be same as sremapnh/setupcal.rat. Minor change to SENSOR_Z slope. Include -DOSF1_V3 for DEC OSF builds with SeaWiFS toolkit. Add ability to map David Antoine's flag bands. Remove "-g3" option. Use include file bin9km_def instead of bin9km_com.

SEAWIFSNAV: Subset of SeaWiFS library used by sremapnh. Merge in recent changes to solve compiler warnings. Correct OSF symbol name. Source fixes in for test program navtest and associated routines. Correct multisegment calculations (don't need [y/z]offset). Remove unused arguments. Correct calls to tswf_* routines. Clean up code and minor corrections. Add more error checking. Clean up and simplify code. Clean up and simplify code. Add more error checking. More corrections to multiple tilt segment handling. Add more error checking. Some fixes for limiting conditions (one end of segment bug to be fixed). Additional simplifications. Fix last line of segment problem. Still have next to last line of segment problem.

SREMAPNH: Allow angles/ancillary data from ang file as well as QC file. New option use_qc (default use_qc=1) allows selecting ang vs QC input file. Use calibration info from command line; use ARRSIZ. Change slopes and intercepts for eps_78, and the ang versions of solar_a and sensor_a. Bound output values to 0 to 255.

SPACETIME: Increase number of parameters. Add overlap flag. Raise maximum data bands from 20 to 24 per file (actual usage appears to be 22). Add test in case number of data bands exceeds 24.

SMOS: Generalize makefile for bin routine.

GSFCBIN9: Increate maximum number of bins.

MOSAIC9: Increase maximum input bands from 20 to 24. Test input file for maximum number of bands. Add additional debugging output on open failure. Add cvs log. Fix up includes.

ANLY6F: Print summary of pixel flagging of processed pixels. Initialize output values in case no result is computed. Change pixel flagging to identify which tests are failing. Move input file open to anly6fda.rat. Open and use land/shallow water input files. Compute zbsorb(4) for D. Antoine's routine. Compute zabso3(4) in case it is needed. Modify CVTFLG* tables for extended flag codes. Force 4096 dimensions for D.Antoine arrays. Move NEW_WAY definition before first usage. Correct output scaling for Angstrom Exponent band. Correct handling of yflags (case 1 and 2). Extend chlor alg. range. Add la3 output. Add La550 output for outmode=1. Correct Delphi and La550 band names. Add range check on Act_Output variable (bound by MAX_OUTPUT). Coefficients 1-apr-1999. YFLAGS of 1 (deep water) and 2 (shallow water) are both good output values. Fix use of include files.

DCBIN9: Split 'if' statement into two so that array index is only used if valid. Increase number of output bands for La550. Bin if D.A. flags is 1 or 2. D. Antoine now has 4 extra bands -- increase input bands to 12. Add another summing band (LA550) for D. Antoine mode.

PATHNLC: Insert missing RATFOR directive (enddef) for RelDay debug block. Fix construction of radiance/temperature tables. Use Log10(radiance) instead of radiance in radiance/temperature tables. Add debugging code for MODSST debugging (DEBUG_MODSST). Add 34p product to allb=5. Add new routine. Add ability to specify which tree for noaa-14, instead of by date.

PATHBIN: Correct Fortran compiler option flags for 7.2 compilers. Move other defines into bin9km_def.rat from bin9km_com.rat. Add include for bin9km_def.rat where bin9km_com.rat is used. Add 34p product to allb=5.

PATHBINANG: Binary has to be pathbinan.

PATHBIN4K: Add constants to 4km version of this include file.

PATHBIN-HDF: Remove "-g3" option.

PATHFILL: Add ice mask input. Improve initial fill of missing data area. Improve smoothing calculation. Add more optimizations. Fix algorithm problems. Add bounding value test. Parameterize array declaration. Remove old (disabled) code. Increase default iteration limit (250 instead of 100). Add additional work arrays to speed up pixel smoothing. Add information message on iteration results. Increase maximum iteration limit. Improve iteration limit checks for early termination. Correct edge errors in *_grid routines. Optimize use of bin subroutines to lower overhead in *_grid routines. Add proper distance weighting to *_grid routines. Solaris Fortran compiler supports "byte" not "integer*1".

PATHSPC: Change from two-pass to one-pass algorithm. Save 50% on runtime. Change algorithm to allow 4km -> 9km conversion without huge memory footprint (requires reading input file twice). Added many error and consistency checks.

PATHCLOUD: Fix up includes.

PATHCOMP: Fix up includes.

PATHFLT: Fix up includes.

PATHMOS: Fix up includes.

PATHQUAL: Fix include files.

PATHTIME: Fix include files.

RATFOR: Warn for missing conditional directives.

RATF90: Warn for missing conditional directives.

MICE: Increase maximum table size to 150 entries.

DAYBOUNDS: Update fortran flags. DEC OSF builds need cc option -DOSF1_V3

IMG2HDFBIT: Update fortran flags. DEC OSF builds need cc option -DOSF1_V3

COCCO: Update for new coccolith tables.

SPHLIB: Change fields from char to byte datatype.

PLTDIM: Disable dash selector call.

QUORUM: Use new rawcal output calls. Remove duplicate lines. Fix up dependencies. Back out some of Jim's "fixes". Not everything was checked in that went along with the "fixes".

QRMPACK: Move alias line before init lines.

XYZ2MIA: Initial version.

SCRIPP: Portability change. Declare the function "ftrim". Declare "ftrim" as a function returning int.

WHERE: Allow where to dump pixel value info even if image has no navigation. Fix format statements so very large values will print properly.

INC: NEWNAMES.H: Correct the name of the token used to prevent multiple inclusion of this header file.

INC: IMGHEADER.H IMGSTDIO.RAT: Add definition of DATA_TYPE_CHAR.

INC: DISPLAY.DEF DISPLAY.H: Change ARRSIZ to 8192 on Unix.

HELPDS: Add missing "enddef".

DATADAY: Fix handling of date and time string quantities. Update compiler option flags.

READEM-SEA: Initial version.

REFORMAT-SEA: Initial version.

READAER-MOD: Initial version.

REFORMAT-MOD: Initial version.

SLD: Fix format statement for 4 digit year.

REFORMAT-NDT: Initial version.

DSP: Fix _TTY for unusual device names.

IO: evlcal: Limit floating point value to always be within valid integer range.

REFORMAT-MOD: First changes to support multiple wind speeds in Rayleigh tables. Fully support 5 Rayleigh files and the associated wind speed value for each one merged into a single output file.

WRKTLK: Fixed up mis-typed non-ANSI function declaration.

TIRPACK: Don't declare subroutines as functions.

PALMERREAD: Don't declare "append", it's not being used as a function.

BINLOC: Fix up includes.

IMG2BIT: Use bin9km_def_4km from anly8d.

IMG2PST: Fix up includes.

OA2PST: Fix up includes.

BIT2IMG: Fix up includes.

DIVC: Specify calibration info for output image.

## C.4 Team Interactions

Miami, SDST and ECS personnel participated in a teleconference on 2/26/99 to address the issues concerning the number of ocean ESDTs: The participants were Miami's Bob Evans, Warner Baringer, and Susan Walsh; GSC's Bob Woodward and Mike Linda; and Landover/ECS's Art Cohen (Ingest), Lynne Case (Data Management), Mac McDonald (Architect's Office), Karin Loya, Michael Morahan, Jon Pals, and ChuckThomas (all Science Office).

Jim Brown met with GSFC MOCEAN team members to discuss the latest delivery (In May 1999) and other issues.

Attended MODIS team meeting, presented papers at the SeaWiFS team meeting concerning identification and initial correction of absorbing aerosols.

Attended monthly PI processing meetings.

Worked with SDST to implement ocean processing, exchange experiences concerning hardware and system software, workarounds for toolkit limitations.

# D. FUTURE ACTIVITIES

## D.1 Processing Development

### D.1.1 Pathfinder

Search and display capabilities on the RSMAS Pathfinder AVHRR SST page will be enhanced over time to include selected-area movie loops and the ability to display SST at a selected quality level. This approach will be expanded to include MODIS products.

The SST retrieval algorithm will be modified to extend into higher water vapor concentrations.

Submit the Pathfinder algorithm paper for publication.

Submit the MAERI/Pathfinder comparison paper for publication.

Compare MAERI/Pathfinder comparisons to TOMS AI for 1996-1999.

### D.1.2 MODIS

Continue testing MODIS PGEs (using SeaWiFS input fields), interact with MOCEAN PIs to analyze product fields.

Continue the hardware integration.

Update the PGEs to reflect algorithm changes.

### D.1.3 SeaWiFS

Test the SeaWiFS La fields for correlation with the Pathfinder –Reynolds anomaly and TOMS AI fields.

## D.2 Matchup Database Future Work

Finalize the first version of SeaWiFS calibration derived from initialization cruise and MOBY mooring data.

D.3 Systems Support

Complete the integration of the fiber channel raid controller, the fiber channel system driver and the disk system.

E. Problems Encountered

Testing at MODAPS has validated the July PGE deliveries and the improved computational efficiency of these codes.  However, continued work is required to successfully integrate the ocean PGE's into the MODAPS framework. Interaction between SDST and Miami has permitted fast identification and correction of problems as they are encountered.