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A. PERSONNEL

Personnel supported for 1998 include:

- B. Evans (Jul, Aug, Sep, Oct, Nov, Dec)
- V. Halliwell (Jul, Aug, Sep, Oct, Nov, Dec)
- K. Kilpatrick (Jul, Aug, Sep, Nov, Dec)
- A. Kroger (Jul, Aug, Sep, Oct, Nov, Dec)
- A. Kumar (Jul, Aug, Sep)
- J. Splain (Jul, Aug, Sep, Nov, Dec)
- S. Walsh (Jul, Aug, Sep, Nov, Dec)
- R. Kolaczynski (Jul, Oct, Nov, Dec)
- D. Wilson-Diaz (Jul, Sep, Oct, Nov, Dec)
- J. Brown (Sep, Nov, Dec)
- A. Li (Sep, Nov, Dec)

G. Podesta (Sep, Oct)

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 Complete initial comparison of MAERI SSTs with Pathfinder SSTs to improve QC, algorithm and/or cloud detection performance.

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

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

B.1.1.5 Start 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.1.2 MODIS

B.1.2.1 Establish Q/A procedures using test MODIS data.

B.1.2.2 Establish MOCEAN web site.

B.1.1.3 Make changes to MODCOL and rerun the July test SeaWiFS data.

B.1.1.4 Complete modifications to MODIS processing code to enable the processing of AVHRR data.

B.1.1.5 Get a new PGE to make 2-day maps of MODIS fields

B.1.1.6 Get a new PGE to perform the 3 weeks weighted Reynolds' SST average for MODIS as in Pathfinder.

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.

B.3 Systems Support

B.3.1 Complete the new FloridaNET network connection to GSFC.

B.3.2 Begin testing of data flow between RSMAS and EODIS and MODAP machines.

B.4 Team Interaction

B.4.1 QA testing using SeaWiFS/MODIS products

B.4.2 Host MODIS Ocean group meeting in April

C. OVERVIEW OF PROGRESS FOR 1998

C.1 Processing Development

C.1.1 Pathfinder processing

C.1.1.1 General

Use of the NASA/NOAA Ocean AVHRR Pathfinder programs is providing a basis to test the MODSST (MODIS Ocean SST L2 program) and the associated Q/A methods. Recent efforts have focused on 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.

As of the first quarter of 1998, near real-time 9km global SSTs derived from AVHRR are available via the RSMAS MPO/RRSL web page. Pathfinder products have also been expanded to include a 4km coastal day and night field.

Pathfinder processing is being used to implement MODIS-like product resolution. Daily SST maps are produced at 4km resolution within 800 km of the coasts using the current Pathfinder algorithm. Cloud masks are maintained separately from the data; masks can be applied at the quality level selected by the user when the images are presented at the web site. Twenty weeks of new coastal Pathfinder AVHRR SST 4km product were calculated in January. Produced scan segregated files for 1991 week 20 to 1992 week 30. The Arabian Sea 4km re-map was recalculated, and an Inter-American Sea/Gulf of Mexico 4km re-map was developed.

Vicki Halliwell has produced navigated and calibrated radiance and brightness temperatures for a sequence of NOAA-14 pass segments defined by W. Barnes for comparison with contemporaneous TRMM retrievals.

Progress is continuing on reprocessing the 1985-1998 AVHRR using the version 4.2 algorithms. Pathfinder v 4.2 SSTs were computed for 1994 and 1985. Version 4.2 pathfinder SSTs for 1996 were delivered to JPL in January. In March, Pathfinder v 4.2 SSTs were sent to JPL for the following years: 1994 through 1995, 1997 week 38 to 1997 week 47, and 1998 week 01 to 1998 week 09. 1985 was completed and sent to JPL for archiving during May.

The DLT tape archive used in the processing was moved from machine *apple* to *monstera* .

New clock drift correction factors for NOAA12, 14, and 15 were determined as a result of clock resets performed by the NOAA satellite operation center. These factors are used in navigation of the AVHRR data during image processing.

Reprocessed Pathfinder V4.1 GAC data were verified and released to the general scientific community. These data are available via the NASA JPL DAAC.

During May-July 1998, the MAERI was maintained aboard the R/V *Ronald H. Brown* to collect in situ data to compare with Pathfinder SSTs. Personnel involved in this effort included E. Kearns, A. Kumar, and R. Sikorsky. These data will be processed along with ancillary radiosonde and SSM/I data to identify any discrepancies between the MAERI and Pathfinder fields.

For the ARMS program in the second half of 1998, the AVHRR images for all ARMS regions were acquired at UM. The images were then processed by A. Kumar for the whole range of the IR spectrum, i.e. to include cloud, land and ocean temperatures. The steps involved in the processing include ingesting, sectoring, atmospheric correction (if needed), binning (if needed), and mapping. On a parallel basis, the whole AVHRR processing is also completed using TeraScan software. Routines were written to convert the AVHRR images processed in DSP software to TeraScan formats. In the end, the images are processed for all of the ARMS sites and will be delivered to Brookhaven laboratories on a regular basis.

C.1.2 Processing

Some improvements, big and small, to the Pathfinder processing have been made in 1998. We set up the automatic loading of real-time Pathfinder AVHRR SST files onto the local web site. The three jobs required for the real-time processing have now been combined, and can be done in one pass: the regular 9km global, the 4km coastal (new), and the 4km MAERI cruise sections.

Dual processing streams/double spoolers/double day processors were implemented and tested. Current versions of Autosys and auto-processing command files were put into CVS. Ran multiple SSTypes from the same Autosys jobs.

We processed daily scan-segregated files for days 140, 150, 160, 170, 175, 180, 185, 186, 187, 188, 189, and 190 of year 1991.

AVHRR data for 96 MAERI cruise were processed in May, and ship track trace extracted for a number of variables to enable along-track comparisons of Pathfinder and MAERI data.

Supplied 4km imagery for an investigation of Hurricane Opal.

Pathfinder data were supplied to WHOI in June, consisting of 9km data for the dates 9 Apr 98 through 24 Apr 98, for the region defined by the latitude range 5S -> 25 S and the longitude range 40 -> 15 W.

Extracted the median/minimum/maximum of the pixels surrounding the central pixel for channels 4 and 5 (for data that are coincident and contemporary with MAERI cruises).

In July, began to straighten out the 96-97 DLT GAC data.

Real-time Pathfinder (pfrt) processing is proceeding more smoothly, and is being used by some internal and external groups.

In the second half of 19998, these years were processed:
pfrt: 1997/all, 1998/weeks 01-35
pfv42: 1987/all, 1988/all, 1989/all, 1990/weeks 01-12

Dlt tapes of the pfrt data for 1997 and 1998 were copied for JPL, as well as the previously-calculated 1985.

It had been decided to copy the input data from the nsr save-set format to the nsr archive format, which we term reformatting. (We have been having problems recovering complete save sets.) The reformatting (still in progress) was done for 86-90(first half), half of 1993, 1996 and all of 1997-1998.

In addition to the "regular" global 9km processing, global 4km sst files were produced for 1997 and most of 1998. In addition to the regular sst fields, some experimental and analysis fields were also calculated at both 9km and 4km for regional projects. These fields were roughly categorized into four groups: "inp" or input fields (the five input channels and the interpolated Reynolds oi data), "dif" or various difference fields (channel difference, Reynolds-minus-Pathfinder sst, Reynolds-minus-channels), "hst" or homogeneity statistics (min/max/median over the homogeneity square) and "exp" or experimental fields (sat/sol zenith angle, tau, experimental coefficient ratios).

These four categories must be calculated in separate runs, due to disk space and program memory limitations. Full runs were made at 9km and 4km for several different regional area for time periods ranging from a few days to several months.

Adjustments were made to the processing of the real-time orbits. Previously, they were coped to a processing directory, processed, then moved to a different directory to be archived. However, the frequent stalls of the processing were preventing some orbits from being archived in a timely manner. The procedures now copy the new orbits directly to the archive directory, the put a copy on a different disk for processing.

When possible, dual processing streams were used to increase the throughput. That is, during times the processing is limited by the recover rate of the input data, a second processing stream can be started to process either the same type of data during a different time period, or to process a separate stream (perhaps the real-time or an experimental run).

Much of the processing has been run through automatic command files that supply information. A set of command files was developed to duplicate the processing without requiring the use of the automatic system.

Until recently, all processing has used "day-splitting" when space-binning an orbit. Under certain conditions, parts of an orbit to the east and west of the 180 degree meridian are assigned to different "data-days". However, under some circumstances, it is desirable to maintain the orbit intact. The binning procedure was modified to select or not select day splitting according to a new environmental variable from the automatic configuration files for each different run type.

Also, the more frequent use of regional masks (limiting the processing to a smaller geographic area) was made easier by the addition of a new environmental variable to the autoconfig files giving the name of the mask to use.

Three small perl command files were developed to make it easier to add, delete or modify environmental variables in the autoconfig files.

A number of small ascii files are used to define day-splitting, pole-crossing and week/day definitions. Modifications are being made to these to use either the present versions, which use a 2-digit year, or a new version of the files that uses a 4-digit year.

The 4km processing is being archived by day (instead of a weeks' worth of files at a time) due to their size. However, this was causing problems when multiple archive jobs would create severe problems with the tape jobs. A set of procedures was developed to archive these files one-at-a-time sequentially. As this worked well, the procedures were then adapted to make archive queues for both the reformatting of the GAC input data and the normal pfv42/pfrt processing streams.

C.1.3 Algorithm Development

Accuracy of AVHRR Pathfinder retrievals is strongly influenced by the ability to detect the presence of clouds and aerosols. Availability of high quality *in situ* infrared observations (MAERI temperature retrievals) finally permits an accurate assessment of the errors associated with satellite based surface temperature retrievals; the use of any existing climatologies has proven to be inadequate for this task. Combining the MAERI/AVHRR results with AVHRR based assessments of near field cloud presence and AVHRR/SeaWiFS assessments of aerosol presence has provided a method to separate SST retrieval errors (instrument and algorithm) from data quality errors induced by the misclassification of clear field conditions when in fact the pixel is affected by the presence of cloud or aerosol. Operational application of these findings will require development of an automated method to detect near field clouds and aerosol presence. The present methods are based on tool assisted analyst interpretation

For this exercise we have compared the SST fields with the ATLAS SST database and the Reynolds (CAC) weekly ship-satellite combined analysis. The initial intent was oriented to determine whether a bias existed in the Pathfinder fields due to the presence of large concentrations of water vapor. What was found instead was a situation where the anomaly field patterns defined at (climatology – Pathfinder) depended strongly on which climatology was used. Different climatologies resulted in very different anomaly fields. Further comparison using drifting buoys as a SST reference suggests that various errors are present in existing climatologies and that they should not be used to quantify error fields for the satellite derived SST.

A second approach has used the recently available MAERI infrared interferometer SST observations as a reference source for the Pathfinder SST. Comparison with a highly accurate radiometric SST shows the Pathfinder SST fields to have very small bias and low RMS when cloud contamination and atmospheric aerosols are not an issue

Detection of atmospheric aerosols is a more demanding challenge. We have utilized SeaWiFS visible channel observation 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 extent 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.

The initial phase of estimating coefficients for NOAA-7 (mid 1981 – 1984) was completed in the first quarter. A trial set of coefficients was developed that serves as a basis for generating a data quality acceptance tree. The tree can then be used to re-estimate coefficients. This procedure is iterated until the coefficients and quality tree are stable.

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

Extensive evaluation of Pathfinder V4.0 algorithm results is presently being undertaken in regards to understanding trends in the global Pathfinder fields. 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. Any trends which are discovered may be used in modifying the Pathfinder algorithm to minimize residuals in problematic regions of the ocean/atmosphere system. Comparing Pathfinder to the SST climatologies has shown that the location and magnitude of the residuals is highly variable and in a number of locations the sign of the anomaly is different depending on which climatology is used as a reference. These differences are caused mainly by the temporal/spatial sampling discrepancies in the data between each climatology. This conflict limits the ability to correlate SST anomalies with presence of varying water vapor or presence of aerosols. When using the buoy-satellite matchup database we see a tendency to under-compute SST when water vapor loading is high.

The Pathfinder algorithm was checked for sensitivity to inaccuracies in the relative spectral positions of the AVHRR bands 3,4, and 5. This experiment was driven by similar problems with the new MODIS instrument. After reprocessing NOAA-11 matchup data, no evidence of a significant discrepancy was discovered.

In continuation of the Pathfinder diagnostic analysis for the improvement of existing sea surface temperature residual accuracy, we looked at SST residual and difference between channel 4 and 5 temperatures for various SSMI water vapor conditions. We chose the Northern Indian Ocean as the study region as this region is known to experience a large seasonal water vapor variation due to the monsoons. Also this region was a site of a series of cruises as part of the JGOFS program. We chose five transects; three along each of the coast and one each along the equator and across the center of the Arabian sea. Along each of these transects we extracted and computed residuals (pathfinder - OIReynolds) SST, channeL4 - channel5(T45) and SSMI water vapor for 1995. We also extracted data along the JOGFS cruise track's for 1995. There were six cruises along the same cruise track and in this case we calculated the SST residual as the difference between pathfinder and the ships' thermosalinographs. The water vapor values range from about 10 to 70 mm in this region and is distributed seasonally. We observed that during periods of high water vapor (exceeding 45 mm) the error in the SST residuals tend to be negative, i.e. the satellite pathfinder data appears to underestimate the SST. The relative t45 values also appear to decrease.

We also analyzed GOES geostationary data for specific regions including Gulf of Mexico and Gulf of California. The main advantage of GOES is the higher frequency at which it samples compared to AVHRR and therefore more probability for cloud free data. We produced hovmuller diagrams for different time periods along many transects. The cloud free periods showed differential heating of the sea surface during the day and night. This diurnal signal was stronger near the coast and appears to decrease in strength offshore.

We also extracted a time series on a number of Tower Horn positions, expected to be fitted with the MAERI. The MAERI also measures sea surface radiances at very high spatial and temporal resolutions. The diurnal signal obtained from the GOES along with the MAERI will provide new and different aspect of sea surface temperature.

In continuation of the Pathfinder diagnostic analysis, we worked with residuals(satellite SST - in situ SST) greater than 0.5 C. Major observations include the large number of residuals that occur at scan angles greater than 30 degrees(nearly 80 percent). Although some residuals can be categorized in regions of high water vapor the major percentage of residuals always had a scan angle greater than 30. Other reasons for high residuals include the accuracy of in situ data collection(buoys) especially from AOML buoys. A notable observation is that the residual variations are evenly spread throughout the year. In general the residuals followed regions of greater data collection and hence the difference in the variation of different basins.

Pathfinder SSTs and ancillary data were extracted for locations where data were available from Marine Atmospheric Emitted Radiance Interferometer(MAERI). There have now been 6 separate cruises for which this analysis may be undertaken; Pathfinder data for cruises from 1996 and 1997 were extracted during the first half of 1998, and from three 1998 Atlantic cruises and one Arctic cruise in the second half of the year. The “skin” SST measured at the sea surface by the MAERI is compared to that measured by the AVHRR at the same time and place in the ocean and subsequently rendered in the Pathfinder SST dataset. Other satellite data sources, including SSM/I and TOMS, are being integrated into the analysis to enable some diagnoses to be made concerning the causes for any discrepancies between the two SST measurements. Preliminary results seem to confirm the effects of water vapor on SST retrievals, but also indicate that there may be remaining cloud-masking and cloud-contamination issues that must be dealt with as well.

Data quality issues that were a problem in the first half of 1998 were largely resolved n the second half of 1998, resulting in a clean MAERI dataset. With the continued analysis of the data and the completion of the digitization of the sky camera results, those remaining QC issues and more cloud contamination issues ought to be resolved. Comparison of the clean MAERI data with the ships' thermosalinographs, Reynolds' weekly Optimally Interpolated SST fields, and the Pathfinder SSTs has been helpful in evaluating their relative performances. Under optimal conditions (highest quality pixels), we find that the Pathfinder SSTs are agreeing well (0.06 +/- 0.29 C) with the MAERI skin temperature measurements. Continued analysis is necessary on this limited (in quantity) dataset.

Efforts are underway to use aerosol products from the TOMS sensor and the AVHRR visible channels (PATMOS - L. Stowe) to begin to correlate SST anomaly patterns with these '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.

In the second half of 1998, Ajoy Kumar has investigated GOES images in order to improve Pathfinder SST. Processed the GOES data to produce SST images; the coefficients for the SST algorithms were presently taken from Legecki's paper. Later, the coefficients will be derived from model simulations. A time series of SST images were processed from GOES data and is used to derive the diurnal cycle for various regions. Specific sites are planned for detail analysis of the hourly thermal fields. These fields will be later used to improve the accuracy of AVHRR images by increasing the number of matchup points between in situ and satellite data.

We have also recently updated our modified RAL atmospheric radiative transfer model to include newly available Clough continuums for water vapor optical properties. In order to apply this model to Pathfinder AVHRR matchups, we also incorporated the 11-12 micron channel spectral responses (channels 4 and 5) for the NOAA-15 satellite. The model was then used to simulate the brightness temperatures that would be viewed by NOAA-15 channel 4 and channel 5 from MAERI-measured SST's and ship-launched radiosondes from a 1996 cruise in the Pacific aboard the Discoverer. These brightness temperatures represent highly accurate matchups for AVHRR from a sea-going platform at a broad range of latitudes.

We determined new clock drift correction factors for NOAA12, 14,15 as a result of clock resets performed by the NOAA satellite operation center. These factors are used in navigation of the AVHRR data during image processing.

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 Version19 matchups. We must therefor return to the manual visual inspection of the NOAA-7 GAC images as was done in earlier Pathfinder versions.

C.1.1.4 Documentation

During the first half of 1998, we continued working on a final document containing a detailed description of the processing used for Pathfinder GAC V4.0. We began working on an overview Web page which will coordinate 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 .

During the second half of 1998, we completed this final document containing a detailed description of the processing used for Pathfinder

GAC V4.0. This document has been made available to users on our Pathfinder Web site. Work continues on an overview Web page which will coordinate the various documents created during the last year in regard to Pathfinder SST developments at the University of Miami.

C.1.1.5 Quality control

As mentioned earlier in Section C.1.1.4, the MAERI instrument is being used to provide reference temperature for QC and algorithm development. The MAERI instrument's SST data from 5 different mid-latitude cruises have been used as a standard with which to compare Pathfinder (and other) SST estimates. 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. By selecting the closest high quality (6 or 7 quality flag) pixel in the 4km Pathfinder product to a MAERI measurement within 4 km and 90 minutes of that measurement 260 valid matchups were collected. The Pathfinder – MAERI difference was found to be 0.06 +/- 0.29 C; this difference is smaller than previously estimated. In contrast, the Reynolds OISST difference for the same samples (matchups) was found to be 0.21 +/- 0.48 C, and the ships' thermosalinographs (TSG) reported SSTs that were different from MAERI by –0.43 +/- 0.26. Overall (10,000 samples) the MAERI and Reynolds' SSTs differences by 0.21 +/- 0.56 C, and the TSG and MAERI by 0.06 +/- 0.28 C. These comparisons indicate that the Pathfinder SSTs are about as good as the bulk SST estimates from research vessels, under good (homogenous) sky conditions.

The inclusion of a 6^{th} cruise, the NOW98 cruise to an Arctic polynia, adds an additional 176 MAERI-Pathfinder matchup points and modifies the difference statistics to be 0.13 +/- 0.37 C. This work is ongoing, and with the inclusion of the TSG data from the NOW98 cruise there may be improvements in the MAERI quality control methods that can improve these statistics (the presence of sea ice presents complications in the accurate measurement of SST by MAERI that were, of course, not present in the other 5 cruises).

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.

Since neither TOMS aerosol indices, nor (obviously) SeaWiFS observations, are currently available for the 1996-98 time period for which there are MAERI observations, in order to study the effect of aerosols on Pathfinder SST accuracy it was necessary to use older TOMS data and a less accurate reference field. 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. Apparently the Saharan dust from the African continent is well resolved in the TOMS aerosol index product and there are sufficient in situ observations in the Reynolds SuperObs from the area to provide a much difference reference from the Pathfinder AVHRR product. Note too that the 2 degree C difference is kept artificially low by the Pathfinder algorithm's use of the Reynolds' field to exclude those Pathfinder SSTs that differ by more than 2 deg from the OISST! This area of the ocean appears to be a good candidate for further study, as the SeaWiFS fields have proven useful (see section C.1.1.3 on estimating aerosol content).

C.1.2 MODIS

C.1.2.1 General

During the first quarter, a vBNS proposal to the NSF was submitted to establish FloridaNET that initially will include UF, FSU and Miami with an OC3 link from Gainesville to Georgia and DS3 links from FSU, Miami to UF. This network, when connected to vBNS and NREN, will provide network capability sufficient to exchange daily MODIS L1A and selected products between GSFC and UMiami. Discussions were held with NSI to provide an additional T1 to serve the EOS data requirement. An alternative high speed network option was explored via NREN at a cost of $27k/month for DS-3.

Processing and archival capability for the MOCEAN SCF were enhanced through addition of 3 DEC 4100 multi-processor computers in March; archival capability will be extended by addition of slave towers to the existing DLT jukeboxes. These units will be served by the existing 4100 computers due to the high I/O rates and the need to serve data to the remainder of the facility. The fiber channel disk arrays have arrived and will be interfaced to the 4100 computers. Integration of the new disks is dependent on receipt of a fiber channel raid controller and appropriate system drivers. Warner Baringer is experimenting with Hierarchical Storage Manager to better manage tapes in the DLT jukebox.

We updated the file format description document and prologs to reflect changes made to MOCEAN code during the second quarter.

The efforts of our group were focused on delivering V2 PGEs for testing and integration at the MODIS team and DAAC. All MOCEAN PGEs have been delivered and are undergoing initial testing with the initial focus on the two L2 PGEs (9 and 10). As part of the preparation, emphasis was placed on minimizing needed CPU resources. Substantial time is saved in the ocean color atmospheric correction through computation of various atmospheric correction parameters on a 4km by 4km grid and interpolating between these points. The atmospheric correction is then executed at each 1km pixel. Once a set of aerosol models is chosen, this model set is then tested at the next along scan pixel. If the selected models remain as the appropriate pair for the current pair, the model selection portion of the atmospheric correction code is bypassed and the correction process continues.

Testing of the ocean color algorithms utilizes two types of input data sets. The first is the synthetic MODIS L1B radiance file and associated meteorological, cloud and navigation files. This set is used only to test compliance with MODIS data flow due to compatibility problems between the radiance provided in the synthetic data and what is expected by the PGE. Science testing is performed using a L!B file converted from SeaWiFS observations and transformed into MODIS radiance units. The associated navigation information is also provided. Meteorological observations and ozone fields are obtained from the NOAA and TOMS analyzed fields using the ancillary data input routines. Resulting Lw outputs are then compared with the same radiance files processed through the SeaWiFS L2 program. Granules are collected for a “data day” and assembled into global files by product. Multiple data day files are then collected to provide fields for longer time periods. To date we have produced fields assembled with one, two and three days of data exercising the L2 and L3 PGEs.

During this period the ocean Q/A draft was circulated to the ocean team members, SDST, GDAAC and EOS Q/A personnel for comment. The Q/A document has been updated following various discussions. Miami will perform product science Q/A in conjunction with the team members responsible for their specific products while run time and an overview assessment will be performed at GSFC. Kay Kilpatrick is the Miami Q/A interface person and will utilize comparison of MODIS products to SeaWiFS and AVHRR derived fields and well as the *in situ* matchup data base to quantify this effort.

The automatic processing environment based on Autosys (production) and Networker (archiving) has been used to process AVHRR Pathfinder, SeaWiFS, and SeaWiFS/MODIS products. These products are being used to generate climatologies as well as test algorithm performance and quality assessment. Processing both real-time and retrospective fields for several projects is providing experience and reliability testing of the overall system. Some of the lessons arising from this exercise concern network stability and disk management. We are continuing to integrate the fiber channel raid disk array into the SGI and DEC environments and are working with the companies to isolate and remedy problems encountered with their respective device drivers. These systems should be operational in the next month or two. The DEC 4100 computers have proven to be very reliable and have been employed to compute an updated and expanded set of aerosol tables for the ocean color atmospheric correction.

We met the One-on-One group to discuss DAAC and networking issues related to ocean processing. Gordon Noble outlined discussions between NASA and NSF to interface NREN and NSI to vBNS. Miami has a NSF approved vBNS application for networking of EOS data between the university and NASA. The University of Miami connection to vBNS became operational in June although there are unresolved router issues. NREN must agree to support EOS data flows and become a conduit to vBNS; this issue remains to be finalized. Once the permission and routing issues are resolved, experiments will need to be conducted to understand how to effectively assess 15-20 megabits/sec of usable bandwidth. Discussed MOCEAN processing at the DAAC and outstanding issues relating to production rules and PGE testing. Implementation of the “data day” production rule is now scheduled towards year end.

The MOCEAN team met at GSFC to discuss Q/A and adaptive processing as well as team issues such as cruise activity, algorithm progress. A major result was discussion with C. McClain (SYMBIOS) to explore how MODIS can benefit from the experience gained from the SeaWiFS and SYMBIOS programs. This interface will be explored over the coming weeks. A role for Miami a part of "adaptive processing" was discussed. A desirable approach is for Miami to provide Q/A, special processing related to production of special assessment products, generation of climatologies and algorithm evolution and to act as a production backup to L2 and L3 processing at the MODIS team facility. Miami has the production capacity to provide either routine L2 and L3 processing or it can provide the functions listed above for the AM mission. It does not have the capacity to do both the evaluation processing (*e.g.* multiple passes though the data set for algorithm evaluation or calibration) and routine, daily processing in other than a backup mode or to handle the PM mission.

The following week, mid June, the EOSDIS panel met in Woods Hole to discuss adaptive processing and federation. It was interesting to hear how other teams planned to deal with processing. For example. The CERES team will use the LATIS system to do both processing and distribution and has no plans to utilize ECS functions. This is in contrast to MODIS where the team facilities will provide L2 and L3 products but will utilize the GDAAC for distribution. The impact and relationship of "adaptive processing" to the federation is unclear.

The following week provided an opportunity to meet with P. Cornillon to discuss progress and plans for DODS. His federation team is interested in providing community access to Pathfinder and MODIS products. I observed that they will need to provide a server for EOS-HDF products for this to be feasible as well as provide a web accessible interface (browser or JAVA based). They already have a capability to serve Pathfinder fields.

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

Current versions of PGE09 (ocean color), PGE10 (SST), PGE20 (L3 interim daily) were submitted to SDST on March 31 for acceptance testing. This delivery contained bug fixes, additional and improved diagnostic messages, and support for processing SeaWiFS data converted to MODIS format. PGE20 was expanded to include the production of global maps of each data product in HDF-EOS gridded format (GCTP Geographic projection) at 36km and 9km resolution. Also included with this delivery were programs and procedures developed to automate testing of level 3 processing.

Final versions of the L3 PGES (PGE20, PGE49, PGE50, PGE53, PGE54) were submitted to SDST on May 6th the for acceptance testing. Also included with this delivery were programs and procedures developed to automate testing of L3 processing.

Updated versions of L2 PGES (PGE09, PGE10) were also included. These versions contain only fixes for problems found during the testing of earlier versions. No new functionality is included. This represented the final scheduled V2 code delivery.

Updated versions of all ocean PGES were prepared for the January 1999 delivery to SDST 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. Section 3.4.2 provides details of PGE updates.

Sue Walsh has has been incorporating code fixes into the various MODIS Ocean PGEs in preparation for the Version 2 code delivery. She interfaces with the SDST ocean representative to receive code modifications to the PGEs such that the are MODIS and EOS compliant. In addition Sue incorporates algorithm updates as they are delivered by the ocean team members. Ken Carder has provided an updated version of his routines and Howard Gordon has supplied an expanded set of Rayleigh and Rayleigh/aerosol tables. Various computations also are included.

C.1.2.1.1.1 Metadata

The major metadata issue arising during 1998 in the metadata impact imposed by the redefinition of the MODIS Ocean ESDTs. The redefinition has generated a number of changes to the metadata of each PGE to reflect new LocalGranuleID, Long and SHORTESDT names. These changes will be incorporated in a Version @.1 delivery.

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

SDST requested separate ESDTs for each product and resolution due to the limited utility of product-specific metadata to discriminate between the various products and resolutions. These ESDT specifications have been delivered.

The MODIS Ocean hdf implementation was revisited since testing with the simulated and SeaWiFS data sets had demonstrated excessive i/o and subsequent low cpu utilization. A reanalysis of the hdf package revealed redundant calls to a calibration section. Removing the extraneous calls increased throughput by a factor of 2.

C.1.2.1.1.3 PGEs/ESDTs

Testing of the MODIS PGEs continued. During the first quarter, a 240 GB (2 days) data set of simulated MODIS data was generated using the L1A simulator developed by SDST, and archived to DLT tape. This data set was used for testing PGE49 (interim weekly/tbin) and PGE50 (reference file/mfill). We planned on creating a week of simulated data, but due to the processing time (over a week on the 16 processor SGI Origin to produce the 2 day dataset) and the storage requirements we created only two days. SeaWiFS data converted to MODIS L1B format was used for additional testing.

During the second quarter we continued to develop programs and procedures to support automated processing of synthetic MODIS data and expanded to include PGE20. These procedures manage the staging of synthetic level 1 data and ancillary data, the creation of PCF and MCF files, and the execution of the MODIS PGEs (PGE09/PGE10 and PGE20).

Previous ECS specification resulted in a large number of MODIS Ocean ESDTs. This issue was discussed at the PI processing meeting (December, 1998) by representatives of the GDAAC, SDST and the members of the PI processing group. Subsequently a series of teleconferences were held including ECS representatives where a solution discussed during Summer, 1998 was chosen as a viable approach. The selected approach will utilized the Additional Attribute metadata token to describe the name of a particular ocean product. An Ocean ESDT would then include all ocean products for a particular time interval and spatial resolution. This method reduces the number of ocean ESDTs from order 2000-3000 to order 100. The Oceans PGE presently include the Additional Attribute metadata. Continued coordination is required with GDAAC, Steve Kempler, STST, Bob Woodward, and ECS (Karen Loya, Chuck Thomas to validate this approach and to institute the corresponding changes into GDAAC/ECS for product ingest , archive, order and delivery and for MODAPS for processing and subsequent delivery to the DAAC using SIPS.

ECS has estimated that the Version 5B delivery to the GDDAC that will permit ESDT order by parameter will not be available during 1999. Prior to this date any order for Ocean products will results in the delivery of all parameters for the ESDT which will add cost and time delay to any order.

C.1.2.2 Processing

During the first quarter of 1998, Jim Brown developed a program, CALEPS, to compute Rayleigh, aerosol, and water leaving radiances for SeaWiFS and MODIS. This program permits the calculation of radiances from the matchup database L1 data for comparison with *in situ* observations. A separate program is now operational to extract L1 data at a specified (Lat, Lon, Time) location.

A SeaWiFS to MODIS L1 converter has been updated to work with MODIS V2 format files.

We updated the file format description document and prologs to reflect changes made to MOCEAN code during the first quarter. Began the task of documenting all OCEAN PGE error code messages listing the error code, associated string, source file or function, message meaning, and action to be taken by the DAAC. This document is required for PGE certification. Verified scaling and unit consistency for all 36 ocean color products. Units were traced through each of the routines which derive ocean color products to certify that the dimensions of the coefficients and scaling factors used within the routines were consistent. Several problems were detected and these have been corrected.

During the second quarter we continued to develop programs and procedures to support the automated processing of synthetic MODIS data as well as converted SeaWiFS data.

Several problems with the SeaWiFS to MODIS converter were identified and fixed during the third and fourth quarters. Changes were focused on consistent calibration and reproducing total radiances consistent SeaWiFS and AVHRR L1 files.

A week of SeaWiFS data was converted to MODIS format and processed with MODIS PGE09 and PGE20 to produce a daily map (no QC) of each of the 36 MODIS ocean parameters.

Web pages and cgi scripts were written to present the maps and allow for downloading of the hdf product files by MODIS ocean science team members.

C.1.2.3 Algorithm development

During the first quarter of 1998 it was discovered that the MODIS infrared channels have a problem with cross talk. In order to find the extent of this cross talk interfering with the actual signal, we analyzed a relatively clear AVHRR image of full swath width (2048 X 512) and included in it a 6 pixel noise at temperature of 290k and calculated a new channel 4 temperature that has a cross talk of 0.01 percent from channel 5. We analyzed the difference between the cross talk affected channel 4 temperature and the original channel 4 temperature. The results showed that the cross talk does introduce noise that effects channel 4 temperature.

Jim Brown has investigated improvements in PGS run times using SGI 7.2 compilers. Has encountered a number of bugs in new compiler, requested patches. Jim has implemented a number of science code efficiencies to reduce PGE run time requirements. These changes involve analysis the rate of change of various coefficients calculated and used within the atmospheric correction codes. Where these coefficients change slowly relative to the 1km MODIS pixel spacing, results are carried between pixels and recomputed as necessary. The present version of the code computes coefficients on a 5x5 grid assuming 1 km pixels. Another enhancement assumes the aerosol type is uniform over a local neighborhood. Before all possible aerosol types are tested, the choice made for the previous pixel is checked to determine if it remains valid. If this assumption is valid, only 2 aerosol models are needed for the pixel, otherwise the complete suite of models (currently 12) is examined. The run time for to produce a typical L2 granule is now about 27 minutes.

The SeaWiFS/MODIS converter is being used to process a series of days, 97-265 to 97-267 to check the MODIS PGE for L2 and L3 by comparison with equivalent SeaWiFS results. This includes both space and time binning programs. This capability will be used to generate reference fields for comparison to the same products derived using MODIS observations.

An agreement with H. Gordon has been reached to generate SeaWiFS sensor tables compatible with the MODIS MODCOL PGE. This will permit generation of MODIS color products, except for fluorescence related products, using the MODIS PGE, SeaWiFS radiances and full ancillary input data. The MODIS PGE will be modified to include SeaWiFS out-of-band and 765mn O_2 corrections. Generation of the new MODIS and MODIS/SeaWiFS tables requires the processing of approximately 200,000 radiative transfer simulations. These runs will be processed on the new DEC 4100 processors controlled by an AUTOSYS script authored by Warner Baringer and supervising data scripts produced by H. Gordon's group.

Ajoy Kumar did some further checking on the MODIS cross channel talk program during the second half of 1998. First, he simulated the problem using AVHRR data and analyzed the same for cross-talk problem. Results suggest that cross-talk is a problem at the cloud perimeter. These results were communicated in MODIS meetings.

Other efforts during this period have focused on the validation and testing of the MOCEANS code using SeaWiFS data. We currently have recently developed a converter allowing us to reformat the SeaWiFS radiance data to the MODIS format for input to the MODIS MOCEANS processing chain. We then evaluate the resulting MODIS product for reasonableness and then identify and resolve any coding or lookup table problems. A brief example of this is seen in our recent investigation of the coccolithophore algorithm. In this case we selected SeaWiFS data containing a known coccolithophore bloom in the Gulf of Alaska for which we had *in situ* data. After processing the SeaWiFS data in the MODIS oceans processing chain, the comparison of the results with the *in situ* data revealed several minor problems relating to the lookup tables. The analysis showed that a unit disparity existed with the lookup table. This was corrected and the processing repeated. The re-evaluation demonstrated that while the algorithm and code were operating correctly, the lookup table would need to be extended to cover a wider range of values since pixels in the center of the bloom were flagged as off-scale in the lookup table. The PIs H. Gordon and W. Balch were consulted and we are awaiting expanded tables which we will post to the MOCEANS code. We continue to process the SeaWiFS data through the MODIS chain to provide MOCEAN team members their products for coding and algorithm validation.

The MODIS will produce two SST products; a product using the 11 and 12um bands and a second product using the 3 and 4um bands. During the past 6 months in conjunction with Drs. Peter Minnett and Richard Sikorski we have created a new simulated matchup database for the MODIS IR channels using radiosonde data, a modified Appleton-Rutherford IR-spectral model, and the latest MODIS spectral response characteristics to produce channel data. This simulated matchup database is being used to develop at-launch algorithm coefficients and to evaluate current and alternative formulations of the SST algorithms in light of anticipated channel cross talk and calibration uncertainties.

Howard Gordon provided expanded SeaWiFS tables that include a larger range of satellite zenith angles in the Rayleigh and aerosol model tables increases the number of entries from 59 to 70, and the range of maximum angle was increased to 65 degrees. Additional aerosol models have been added to provide for weakly absorbing aerosols.

CPU usage has been improved by modifying the atmospheric correction scheme to include portions of the algorithm only when the geophysical setting has changed which can significantly reduce the needed calculation where the atmospheric length scales are long relative to the sensor FOV. Further increase in throughput was obtained by minimizing calls to certain HDF routines.

C.1.2.4 Documentation

Kay Kilpatrick developed a draft MOCEAN Q/A plan and delivered it to Wayne Esaias for comments during the second quarter of 1998. The document describes an initial version of the MODIS OCEANS (MOCEAN) quality assurance plan.

During the third and fourth quarters, the file format description document, prologs, and MOCEAN data volume were updated and load estimates to reflect changes were made to MOCEAN code during this quarter.

A scientific and financial work plan was developed for FY99: during FY 99 our efforts will focus on 4 major areas 1) Continued posting of MOCEAN algorithm changes and additional optimization of the MODIS code; 2) PI Processing of MOCEANS PGEs with MODAP and training of QA personnel; 3) Development of QA scripts and QA reference fields for QA of MOCEANS products by MODAT; 4) Production of Matchup databases, Q/A reference fields and validation of MOCEAN products and algorithms.

C.1.2.5 Mod_SST coefficients

New coefficients were developed for the short wavelength SST algorithm, 3.7 and 4um bands. These coefficients have been incorporated into the MODSST program.

C.1.2.5 Quality Control

The MODIS OCEANS quality assurance plan is still in a process of development. The plan is currently being reviewed by the MOCEANS science team. The plan incorporates experiences gained with run-time and post runtime QA for CZCS global processing, SeaWiFS , and AVHRR SST Pathfinder. This effort follows a meeting at GSFC with W. Esaias, Mike Jones, A. Fleig and others to discuss finalizing a MOCEAN Q/A plan. The Q/A activities will involve a combination of activities, near real-time tracking of PGE status at GSFC, comparison of L2 and L3 granules with a running climatology at UMiami and more detailed algorithm performance checks at the individual algorithm developer's SCF. Briefly, this work will include monitoring for failed PGEs, checks for whether all available granules have been processed and included in L3 and comparison of L3 product files with reference fields. The reference fields initially will computed using input from other sensors (SeaWiFS and AVHRR) with future comparisons including MODIS AM and PM.

MOCEAN QA procedures will be performed operationally during product generation at the MODIS Processing Center (run time science QA) and some period after product generation at the MOCEAN RSMAS SCF and team member institutions (post run time science and validation QA). A MODIS OCEAN QA facility (MODAT) will be formed to provide a coordination mechanism for MOCEAN's QA activities. The goal of MOCEAN QA activities is to understanding differences due to instrumental, code/algorithm, geophysical, and biological effects.

Run time science QA results will be derived within the product generation code by:

1) analysis of selected L2 granules
2) examination of the input data and its associated QA data
3) monitoring the computational stability of the code
4) documentation of the code processing history
5) science decision making performed within the code
6) application of computational analysis of the 40 daily L3 products
7) comparison of L3 products to climatologies when available.

Post run time science QA results will be derived by:

1) application of visualization and statistical analysis procedures to generated products
2) examination of run time QA results stored in generated data products

3) analysis of temporal, zonal, meridional, secular, and regional trends of L3 generated products.

Post run time validation QA results will be derived by:

1) comparison of L3 products to in-situ observations
2) long term trend analysis of the L3 products
3) cross validation studies with SeaWiFS and AVHRR data.

The results of QA procedures will be stored within the MOCEAN standard data products following a MOCEAN protocol described in Section 6.0 of the MOCEAN QA Plan. MOCEAN QA procedures will focus on analysis of pixel level QA which contain science and quality level information.

The QA protocol developed is adaptive enough to accommodate a changing QA data stream over the life of MOCEAN while satisfying the needs of the algorithm developers, personnel performing routine QA of generated products, and the data users. The protocol includes examination of both production information and pixel level QA results stored in science data sets (SDS) generated at the time of execution (non-searchable) to perform run-time processing and post run-time science QA. The status of QA results for a granule/product will be communicated by frequent updates to searchable granule/product level ECS QA metadata as a granule/product moves end-end through the QA procedures.

During the first quarter, progress started on the MOCEAN Strawman Test Plan for DAAC System Certification. In conjunction with Mike Jones at the Goddard DAAC, we worked on the test plan for MOCEAN system certification. This test plan covers 3-5 days in the life of MODIS Oceans and involves:

- 1.0 System certification plan
  - 1.1 System certification to test PGEs
  - 1.2 GSFC DAAC test production
  - 1.3 GSFC DAAC test production schedule
  - 1.4 Test data requirements
- 2.0 MOCEAN testing of ECS QA interfaces
  - 2.1 Data order / browse test schedule
  - 2.2 Subscription test schedule
- B. QA metadata update test schedule

During the second quarter, we continued working on final version of MOCEAN's quality control plan. Began discussions with Bob Lutz on MOCEAN's need to have the capability to automate the process for updating the QA metadata. The present design of the system has the QA metadata being updated manually using the QA Metadata Update Tool (QA MUT) and JEST to perform batch updates. The method of communicating updates is via e-mail and was not designed for the possibility of thousands of metadata updates that MOCEAN's is anticipating performing in the future. We have presented the following scenario for automated QA of MOCEAN's products:

1. A running climatology produced by MODIS/AVHRR/SEAWIFS will be compared to the respective MODIS granule. This activity is likely to be on the order of one month behind real-time to permit assembly of the needed climatology.
2. Where feasible, the MODIS granule will be compared with the expected vales and placed into a reasonable/unreasonable category. The range of conditions that can be tested is expected to increase with time. As we gain experience we should be able to characterize product/algorithm/sensor calibration and accuracy.
3. Since a large number of granules will be involved, we would like to be able to prepare a list of needed metadata updates and transmit this list from the SCF to the DAAC or appropriate party for insertion. This process need not be totally automatic but must be automated at a reasonable level to be feasible. Given this eventual scenario we are working with the parties involved to add this functionality in the future.

In conjunction with Mike Jones at the Goddard DAAC, we continued to work on revisions to the test plan for MOCEAN system certification tentatively scheduled for later this fall. This test plan covers 3-5 days in the life of MODIS Oceans. Clarified issues in regard to timing of files for data days and the need for attitude and ephemeris files in the schedule.

In conjunction with Richard Buss at the DAAC, SAC began working on test plan and resource requirements for testing the existing metadata update interface. This test is intended to verify that the Instrument teams and the Goddard DAAC can jointly perform QA checks and perform QA metadata updates to the MODIS data.

During the third and fourth quarters of 1998, further progress on defining the requirements of the MOCEANS QA plan with the move to PI processing was made. The MOCEANS strategy consists of two tiered QA of Oceans processing. The status, responsibilities and tools needed are outlined below.

Processing QA done at MODAPS by MOCEANS QA representative:

1. Analyze failed PGE to determine if the problem is with the code or a systems error. In the event of a failed PGE the representative will need to examine the logStatus and the logResult files which are created for each execution of the ocean PGEs. The QA representative will attempt to trace the problem and determine if the error is due to a code problem or a system problem. In the event of a suspected coding problem the RSMAS SCF needs to be notified and the logs, PCF files and input/outputs relating to the failed PGE should be assembled in a package to be pushed/pulled to the RSMAS-SCF for further analysis. A document which describes actions to be taken by the QA representative at MODaps for error messages reported in the log files has been created.

2. Check for completeness of the leveL2 and leveL3 production by visual examination of the 40 level 3 daily products. If data is missing in the L3 file, the representative must trace the problem to determine where in the processing stream the drop out occurred.

3. After six months of post-launch, moving toward zero-order science QA tasks is anticipated. These include checks and trending performance of pixel level QA and metadata summary flag performance and values, and checks of data consistency with climatology comparison/correlation with other MODIS products. These checks generally focus on verifying “reasonableness” of the data and identifying the locations of gross algorithm failure.

4. Update Quality flag of L3 granules will be examined, as well as suspect L2 granules, and problems will be communicated to the RSMAS-SCF.

5. tools needed at MEBS:

   a) Software to visualize the L3 files’ minimum requirements: ability to difference two files, and identify bounding boxes of problem areas in the L3 to aide in the location of the corresponding L2 granules.

   b) Method/channel to communicate QA results/problems to the RSMAS SCF. (E-mail, web page etc.)

c) System for communicating updates to the QA flag after data insertion at the DAAC.

Personnel required: 1 programmer/analyst at MEBS dedicated to tasks described above

B) Post processing Science QA done at RSMAS SCF and team member institutions

1) Investigate all data identified as resulting in a failed PGE as a result of science/code related problems and any other granules which the MODAT member of the processing center has identified as being suspect.

2) Post-run-time 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.

3) Final check on QA fidelity.

4) Coordination of end-to-end MOCEAN QA of all MOCEAN products will be performed periodically at common locations distributed across the globe This will be useful for resolving data dependency problems expected immediately after launch and after the algorithm is updated, and will provide a mechanism to verify that the configured algorithms behave in the same way as the scientific algorithms. Common locations will include those selected under the MOCEANS validation plan.

5) Long term validation and comparison with *in situ* observations in the Match-up database.

6) Bulk updates to QA flags with the goal of setting the QA flag and text explanation on all MOCEAN granules at the parameter level. Estimated to occur in 30 data-day groups resulting in 174000 updates/month.

- tools developed at RSMAS SCF:

1) visualization and statistical analysis tools – will us Miami DSP software to view and analyze data for QA. (currently in place)

2) Create reference data sets for Global context QA. (i.e. SeaWiFS data, AVHRR same day retrieval, last week MODIS products, SeaWiFS data processed through MODIS algorithms. These reference data-sets will be converted to Miami DSP format for use in analysis. The converters were completed during the past six months and we have begun creating the reference datasets.

3) Database to track QA results (under-construction).

4) Automated method for mass QA flag updates after insertion. We have been working with the GFSC DAAC to enable them to provide MOCEANS with this functionality .

C.1.2.6.1 Synthetic MODIS Data

Synthetic MODIS fields were received from SDST and processed at Miami using the MODCOL and MODSST programs. Comparison of the L2 water leaving radiances produced from processing the synthetic data fields with expected water leaving radiances obtained from processing similar observations obtained from the SeaWiFS sensor. The early version of the synthetic data had the following errors:

> Low Lw (zero on early passes), improved but still low by factor of 2. Also for SST, October test data for equatorial pacific were reasonable but low (23-25c at equator v. 28-30c in reality) while for granules over Antarctica the brightness temps range between –80 and 50c. October data has reversed azimuth angles.

A quantitative comparison of MODIS is provided by first using a converter program to transform SeaWiFS observations into MODIS Level L1B format. The converter recently has been improved to incorporate the latest SeaWiFS calibration. First a single day, 98187, was chosen, processed using the standard SeaWiFS programs and mapping the resulting water leaving radiances to a standard latitude, longitude grid. He same day was then converted to MODIS format and processed through the MODCOL PGE. Again the water leaving radiances were mapped to the same grid as used for the SeaWiFS processing. Channel by channel comparisons are then made by differencing the SeaWiFS and MODIS maps and computing histograms of the resulting channel differences. The SeaWiFS and MODIS fields agree on a pixel to pixel difference basis to within 1 count for all bands. This test has validated to MODIS processing for Level 2, Level 3 binning and Level 3 maps.

The actual comparisons are generated by converting the respective SeaWiFS and MODIS HDF files into the Miami DSP format. This permits the fields to be scaled to a common radiometric reference since the SeaWiFS fields are based on mwatts/cm**2/nm/sr and the MODIS units are w/m**2/nm/sr. This conversion also results in a common format for the two data sources. Standard DSP operators are then used to compare and quantify the results.

C.1.2.6.2 Reference Fields

After the SeaWiFS/MODIS processing path has been validated for each of the products, reference fields will be computed using one year of SeaWiFS global 4km (GAC) as input. These reference files will constitute the comparison fields to be used to establish whether the actual MODIS derived fields are within the expected ranges.

Quality assessment will be performed by computing residuals between SeaWiFS/MODIS and MODIS fields and looking for out-or-range data. These comparisons will be made using Level-3 mapped fields. Histograms will be produced to determine the spread of the residuals.

C.1.3 SeaWiFS

C.1.3.1 General

During the first quarter we continued to develop programs and procedures to support automated processing of SeaWiFS data and expanded processing to include the generation of daily maps. These procedures manage the transfer and archiving of files from the DAAC, staging of data and ancillary data and the execution of the SeaWiFS programs.

During May-July 1998, Jim Brown participated in a joint US-British cruise (AMT-6) on the RRS *James Clark Ross* with NASA scientist Stan Hooker. They deployed a number of optical instruments (including winch lowered profilers and free fall rockets) to collect daily optical profiles. They also deployed a hyperspectral instrument to collect instrument characterization data. Jim assisted in the design and development of the data acquisition systems, and also in the day-to-day collection of data from the various instruments. The data collected by these instruments will be used both in algorithm development and in SeaWiFS calibration.

C.1.3.2 Processing

The SDST SeaWiFS-to-MODIS L1A converter was added to the standard processing stream to generate additional test data for the MODIS PGES.

During the second quarter we continued to develop programs and procedures to support automated processing of SeaWiFS data. These procedures manage the transfer and archiving of files from the DAAC, staging of data and ancillary data and the execution of the SeaWiFS programs.

We continued to develop programs and procedures to support automated processing of SeaWiFS data in the second half of 19998. These procedures manage the transfer and archiving of files from the DAAC, staging of data and ancillary data and the execution of the SeaWiFS programs.

During this reporting period a prototype database (SYBASE) schema was developed to store a subset of SeaWiFS metadata and allow search and retrieval of archived data from the TL820 tape libraries.

C.1.3.3 Algorithm Development

Following the SeaWiFS Initialization cruise in January/February 1998, Dennis Clark provided normalized water leaving radiances for the SeaWiFS wavebands obtained from both the MOBY mooring and the MOCE cruise. Jim Brown developed an extraction program, CALEPS, for the SeaWiFS instrument based on the atmospheric correction program ANLY. This program computes water-leaving radiances for the available aerosol models which is then compared with the observed radiances. Differences between the radiances are used to compute adjustments to the sensor calibration.

Howard Gordon produced a calibration correction vector. Jim Brown in turn modified the SeaWiFS and SeaWiFS/MODIS L1 converter program to utilize the correction vector. Two geographical areas have been chosen to validate the correction vector, Hawaii and the Arabian Sea. For these areas, pseudo tracklines across scan, track directions and image features are used to extract sets of water leaving radiances (Lw 443, 510, 555), aerosol radiance (L_a 765), epsilon and the selected aerosol models. In addition, an option has been added to the ANLY program to based the atmospheric correction on either the $765/865_{nm}$ band pair (normal mode) or the $670/865_{nm}$ band pair (alternate mode). This addition allows comparison to be made to assess the relative band calibrations together with the O_2 correction to the 765_{nm} band.

Analysis performed to date suggests that the $765/865_{nm}$ band pair atmospheric correction produces relatively low values for epsilon and L_a765 which results in elevated Lw 555. Similar calculations using the alternate atmospheric correction mode produces a more consistent Lw 555 field. Discussions are underway to resolve these differences.

Scripts for extracting ocean color satellite quantities were developed during this report period and tested by creating an ocean color matchup database from SeaWiFS , MOBY buoy, and the MOCE initialization cruise. In this matchup database 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 include 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. In addition the satellite data was processed using both the channel 6/8 and 7/8 atmospheric correction. The nLw bands and associated QA data were then extracted for the buoy locations. Analysis of the residuals for both types of processing are given below and indicated that there is a significant decrease in the signal noise using 6/8 processing. Results from the analysis of this database were presented the Ocean Optics in November 1998.

Residuals SeaWiFS nLw - MOBY nLw				
Band		processing		median Moby nLw
		6/8	7/8	

555 nm	median	0.010	0.015	0.268
	std	0.046	0.084	
510 nm	median	-0.023	-0.017	0.643
	std	0.161	0.180	
490 nm	median	-0.046	-0.048	1.088
	std	0.150	0.194	
442 nm	median	-0.052	-0.072	1.555
	std	0.247	0.283	
412 nm	median	-0.010	0.003	1.731
	std	0.279	0.329	

C.1.3.4 Quality Control

Comparison of 1998 SeaWiFS data with ancillary (SST, aerosol) data and in situ measurements has produced methods of quality controlling the ocean color fields. Warner Baringer has acquired those SeaWiFS LAC data that correspond to the MOBY location. Joseph Prospero was able to provide TOMS aerosol indices for North Atlantic and Mediterranean comparisons. The difference between the Pathfinder SST and the Reynolds' SST estimates were found to provide an indicator of high aerosol content.

A monthly climatological view of the Atlantic Ocean's TOMS aerosol index and the Pathfinder/Reynolds difference revealed that a high TOMS aerosol index was collocated with the largest Pathfinder/Reynolds differences. The SST difference approaches 2C; even this relatively large limit is artificially reduced by the elimination in the course of standard processing of those Pathfinder data which differ from the Reynolds estimate by more than 3C. This testing is being extended to the eastern coast of the US, the Arabian Sea, and the Mediterranean Sea.

C.1.3.4.1 Absorbing aerosols

An absorbing aerosol test will be implemented by calculating the ratio of the reflectance for the 510nm and 670nm bands. For areas away from sun glint, a low value of this ratio is indicative of the presence of absorbing aerosols. Patterns of low reflectance ratio will be compared with the 550mn water leaving radiance residual. Low values in the two comparisons will be used to construct a mask that can be applied to the

Level 3 maps to indicate regions where the atmospheric correction for both the SST and ocean color is likely compromised.

New options have been added to the SeaWiFS code to permit the computation of the aerosol radiance + Rayleigh-aerosol interaction terms. These terms can be computed by two methods: 1) model results using the atmospheric correction code and extracting an intermediate result and 2)'measured' results where the water leaving radiance is assumed through use of the clear water assumption.

The aerosol terms obtained by the two methods will agree for scattering aerosols and differ for absorbing aerosols. This method is computationally involved but provides a check on the aerosol index mention in the preceding paragraph.

C.1.3.4.2 *In situ* comparisons and additional tests

Another option available in the SeaWiFS code is the ability to base atmospheric correction on either a band 765/865 combination or an alternative 670/865 combination. The latter provides a better signal to noise basis to determine the selection of appropriate aerosol models but is subject to error introduced by in water scatter at 670nm. The dual atmospheric correction approach will provide selective checks on the stability of the atmospheric correction for the ocean visible channels.

In addition, the satellite retrieved water leaving radiance for each of the channels between 410 and 550 nm will be compared with the direct observations obtained from the MOCE cruises and MOBY mooring. 'Track lines' will be established and water leaving radiances will be extracted to determine repeatability. The same approach will be applied to SST where MAERI and drifting buoys will provide comparison measurements.

C.2 Matchup Database

During 1998, the Miami SCF has produced matchups for AVHRR, SeaWiFS, and SeaWiFS as processed through the MODIS chain. These data sets are being used to undertake several case studies in areas where known problems in algorithm performance exist. Case Studies in ocean color ((in conjunction with Howard Gordon) include understanding aerosols signatures due to A) forest burning in Indonesia, Mexico, and Florida; B) dust particles from the Sahara, Sahel, Mediterranean basin, equatorial Atlantic, and W. Pacific , and C) continued development of QA strategies using matchups from the MOBY time series. Case studies in SST (in conjunction with Otis Brown, Peter Minnett, and Ed Kearns) include testing the robustness of the SST retrieval algorithm using matchup data assembled from the 1996-1998 MAERI instrument field campaigns and AVHRR NOAA-14. This SST case study, as previously outlined in section C.1.1.5, will start to examine the effects of both water vapor and aerosol loading on the SST algorithm. We also are using this case study and other matchups to continue the evaluation of the efficacy of the MODIS cloud mask and our current cloud flagging techniques developed with Pathfinder AVHRR.

C.2.1 Historical Matchup Database

During the first quarter, we continued to assemble near real time in situ buoy data from 1997 for the archive SST Matchups. Began analysis of NOAA-7 matchups to develop cloud tests. Decision trees developed using the same input parameters as NOAA-14, and NOAA-11 did not perform well (misclassified ~20%) for NOAA-7. We are exploring the use of other input parameters in NOAA-7 tree models and attempting to understand the differences in the response of this sensor.

During the second quarter, we assembled and processed all in situ data for the archive 1997 matchup database. Created 1997 extraction lists to obtain the associated co-spatial and temporal AVHRR data from NOAA-14. Extraction of the satellite quantities is currently in progress. Developed scripts and began collection of matchups for the recently launched AVHRR aboard NOAA15.

The second half of the year saw the creation of 1997 V19.0 archive matchups and their release to JPL for distribution. Analysis of the 1997 data indicated that sensor characteristics and the range of atmospheric conditions present in the NOAA-14 database had remained stable which verified continued use of the decision tree cloud tests developed from the previous years databases. Analysis of the 1997 pathfinder SST – buoy SST residuals by latitudinal band indicated a greater warm bias in the equatorial Atlantic during the period from July -September 1997 as compared to prior years. Further investigation demonstrated that this signal originated from a large number of new drifter buoys located off of Africa, in an atmospheric regime known to contain large quantities of dust. These African data clearly demonstrate an area of poor algorithm performance due to the atmospheric dust and the impact of the geographical distribution of the buoy data on analysis of Pathfinder residuals.

C.2.2 Real-time Matchup Database

Real-time matchup creation and analysis continued to operate smoothly. Continued collecting and monitoring real-time matchups for stability of coefficients being used in real time processing of the GAC pathfinder data.

In September 1998 we began the distribution of an interim real-time V4.2 GAC product to the JPL for public distribution. This interim Pathfinder product is processed in near-real-time and uses the previous year's archive coefficients for processing. With the release of 1999 archive coefficients and matchup database we were able to fully evaluate the beta 1997 interim product. Analysis of archive 1997 pathfinder SST-interim 1997 pathfinder SST demonstrated excellent agreement. We continue to collect and monitor real-time 1999 matchups for the stability of coefficients which are being used in the real time processing of the GAC Pathfinder data.

C.2.3 Ocean Color Matchup Database

Continued to collect in situ optical data from validation sites and develop scripts for the processing and analysis of in situ data. We are presently processing the SeaWiFS L1A LAC collected over the MOBY site in Hawaii with MODIS algorithms. When this is complete, a matchup data set with the in situ data from the MOBY buoy will be created and analyzed.

C.3 Systems Support

C.3.1 Systems/COTS

The 7000 DLT drives were updated with new firmware which has drastically reduced the number of leader failures.

Three Fiberchannel RAID controllers (FC4400 Oneofus) with 288GB capacity have been installed on the Origin and are operational. We tracked several compatibility problems with IRIX and with the current RAID firmware are not able to address multiple LUNs on an individual controller. The vendor has promised a solution in the near future.

C.3.1.1 Autosys

Added procedures to process SeaWiFS/MODIS and MODIS-simulated data sets.

C.3.2 Networking

Planning and preparations for the DS3 circuit to VBNS via FloridaNet are in progress. Cisco Lightstream ATM switch and 7507 router have been installed. An OC3 link between the campus ATM network and the Lightstream is up and communicating over PNNI-0 (IISP). We have started testing with LANE and RCF1577 ATM on the 7507.

At the end of the second quarter, DS3 circuit to VBNS via FloridaNet is up and in operation. We are in the process of testing the available bandwidth via this link to GSFC.

A second T1 to NSI was installed and is in operation.

The VBNS connection to GSFC has shown a consistent 2-5 mbs since the current routing topology (marshall-chi-gsfc) was implemented in mid November. Our understanding of NIS plans call for a new router in Chicago (peering with VBNS and eliminating the Marshall hop) going online by the end of January 1999.

A major problem has emerged with the delivery of IRIX 6.5 for the Challenge computers. A fundamental flaw exists within the system that causes Challenge type computers to crash if they contain SGI FDDI or ATM interfaces.

Local network capability enhancement is being investigated. The enhancement that is the most cost effective is incorporation of gigabit ethernet in high speed servers and use of 100 megabit ethernet in workstation level machine. Equipment from several vendors will be evaluated.

Network throughput between GSFC and Miami is periodically tested using ttcp. Problems area identified are the need to support expanded window size to accommodate the circuit delay between the two sites and GSFC net usage during the day that limits effective throughput. The first problem will require cooperation between DAAC, MODIS and Miami personnel to establish appropriate system parameters. The latter problem involves NSI/vBNS circuit configuration and is being addressed by the network providers. After change to route NSI/vBNS through Marshall, get consistent 200-300 kbytes/sec both direction, little day/night difference but limited transfer rates.

C.3.3 Tape library and disk array

The two original TL893 tape jukeboxes were moved from Alpha 200's to the 4100's in order to accommodate an additional two slave jukeboxes. Each master and slave combination will function as one virtual jukebox with a storage capacity of 20 TB.

During the second quarter, two additional TL893 tape slave jukeboxes have been installed the on the Alpha 4100 servers. Each master and slave combination functions as one virtual jukebox with a storage capacity of 20 TB.

We continue to have an unacceptably high number of failures with tape leaders on the new 7000 DLT drives and have escalated this issue with the vendor.

Problems with the Fiber Channel include no working DEC driver, that SGI uses special “microcode” and will not recognize Seagate drives, we must employ RAID controller to return SGI protocols, and that the DEC fiber channel effort dropped until OSF 5.x is available with standard fc support (which will require a fc switch). All fiber resources have been transferred to the Origin. The drives have been upgraded to 18GB from 9GB at no cost due to the disk firmware error.

During the last quarter, we received upgrades to the raid controller and the SGI FC support, and are now able to reliably use FC drives. Data rates are still limited, we are only seeing 50 MB via ultrascsi, 40 MB with fc stripped, and 10-20MB using RAID-5. The processing is very sensitive to the available i/o bandwidth when using multiple CPUs. We need to investigate needed i/o channels for both the Origin and DEC 4100.

C.3.4 Software Support

Angel Li is implementing EOS/HDF support for mapped L3 files, and will support Plate Carree projection.

Updated algorithms and coefficients files were received and integrated into the MOCEAN PGEs. Sue Walsh has tested the V2 PGEs using both simulated MODIS L1b (V2) data files and the converted SeaWiFS L1 data. The MODIS input is used to verify format compliance and the SeaWiFS data used to verify execution times and functionality of the various product algorithms. The V2 code base has been delivered to SDST.

A web page to view results of MODIS processing at Miami has been constructed, first by day for all products, hdf files then can be net delivered, later by product for range of days

C.3.4.1 Modifications/Additions to DSP

First half 1998:
MSPC: MODIS version of pathspc.
LOCATE8D: Determine scan/element for lat/lon (SeaWiFS).
CALEPS8D: Displays radiance info for given scan/element (SeaWiFS).
DIVC: New program to divide files using calibrated values.
Add support for Linux and f2c.
SREMAPN-HDF: Remap SeaWiFS level 2 files into dsp format.

Second half 1998:
ML3B2MIA: Convert MODIS binned data to dsp map.
COCCO: Initial version of MODIS coccolith routine which reads dsp maps of SeaWiFS L2 nlw_443 and nlw_555.
LGSOWG: New ingester to read decoded HDDT data.
LGSOWGPACK: New program to copy a decoded HDDT file from tape to disc.
AREAPACK: New ingester to read a Wisconsin AREA data file (assume AVHRR format).
COMPSEL: New program to select pixels using a mask created by compos.

C.3.4.2 PGE Problems Fixed

First half 1998:

BINSHR/STRIPANDAPPEND: Correct string constants (‘ ‘ should be “ “).

BINSHR/SETUPL3B: Fix size of level 3 bands (3 bytes of flags are really in a 4 byte field).
BINSHR/MAKETIME: Remove extra parameter. Fix time string.

Change date part of string to be yyyyddd. Make date part: yyyy-mm-dd

BINSHR/SETTBINMETA: Move routine from mtbin since all other level 3 programs use it. Change metadata value geolocation to Geolocation. Fix dataday string in metadata.

BINSHR/PGS-UTIL: Use version properly.

BINSHR/OPENMASK: Reference functions as functions.

BINSHR/L3IN,L3OUT,MAKEFILE,LEN_STR: Move len_str.f from atmcorshr. Change attribute "L2 Flag Usage" to "Common L2 Flag Usage". Change 3 byte flag fields to 4.

BINSHR/L3IN,L3OUT: Put both "L2 Flag Names" and "Common L2 Flag Names" attributes in all L3 files.
BINSHR/L3IN: Fix prologs. Put more info in error messages.
BINSHR/L3OUT: Don't write out 'orbit'.
BINSHR: Add quality bit flag descriptions. Remove orbit, just use start and end orbit numbers.
BINSHR: Move some constants from sum_structure to bindefs so sum_structure doesn't conflict with the mspc version.
BINSHR/BINDEFS: New include file for common constants so sum_structure doesn't have to be included in library routines.
BINSHR/BIN9KMF: Move common block initialization into block-data routine.
BINSHR/SUM_STRUCTURE: Some structure changes so msbin can bin all bands in a file at the same time.
MCLOUD: Use common level 3 i/o routines. Use parameter constants for pcf LUNs.Change program name from mSSTcloud to mcloud. Use commoninout include file. Remove unused variables. Use v2 metadata stuff. Fix prologs.Trim spaces from the end of the flag names. Fix use of PGS_SMF_*. Use both common and L2 flag strings. Fix check for end of file. Fix quality value change (MODIS values are backwards, 0 is good, not bad). Library hdfeos must be before Gctp. Fix use of orbit numbers. Correct string constants (change ' ' to " ").
MFILL: Use common level 3 i/o routines. Use parameter constants for pcf LUNs. Use commoninout include file. Remove unused variables. Use v2 metadata stuff. Add new flag bands. Comment out code that is ifdef'd out. Use WATBINS for assumed output size (global, water only). Fix use of PGS_SMF_*. Fix end of file handling; fix array parameters for forcheck. Library hdfeos must be before Gctp. Change input and output LUNs so can run in same PGE as mtbin. But mmap can't input mfill output (reference

image) in same PGE as mfill. Fix use of flag_names. Remove debugs.
MMAP: Use common level 3 input routines. Add calculation of missing pixels for QA metadata. Update metadata. Allow mapping of new flag bytes. Use commoninout include file. Remove unused variables. Add new flag bands. Comment out code that is ifdef'd out. Use proper pcf lun for input. Fix prologs and some little stuff for the fortran checker. Some silly changes to quiet the MODIS forcheck. Initialize file identifier. Only close file if it was opened. Use both common and L2 flag strings. Fix handling of lunin; and fix check for quality level. Fix use of orbit numbers. Use HDFEOS grid for output file type. Library hdfeos must be before Gctp. Fix use of LUNs so can run mmap in same PGE as mtbin and most other L3 programs (except mfill). Fix use of orbit numbers. Use temp file to find LUNs for input, output, and parameter files. Use parameter file to specify which value to output, and the pixel and line size of the output map. Don't scale the data (output reals instead of bytes) if the equation is zero. Fix sds name in output file; fix declaration of qualdesc. Output WQ.
MODCOL: Make sure the output to iaddr is defined as PTR. Change attribute name to "Common L2 Flag Usage". Properly reference the geolocation information. Call ascdscsub with the correct line number. Fix use of land/sea mask. Add code/input variables to allow pixels to be unprocessed (common flag bit 1). Add pixel subsampling code. Still have to fix FLH/CFE averaging section. Use PGS_SMF_* as functions not subroutines. Make cldmsk (MOD35) optional. Add comment indicating 'aersol' array is not used. Change MAX_INPUT to MAX_INPUT_L2 because of compiler complaint somewhere else. Use ftrim as a function, not a subroutine. Put Carder chlorophyll in DR2 file. Finish implementing value check when reading data file. Correct spelling of contributor. Implement changes to work with SGI F90 7.2. Correct parameter to PGS_IO_GEN_OPENF (recordlength) for formatted file. Correct internal reads. Move libanc into source tree. Modify options for F90 7.2. Correct error in calling PGS_IO_GEN_OPENF (must initialize RECORD_LENGTH). Move initialization of common block variables into BLOCK DATA module. OZONE2 and OZONE3 entries in mice table had incorrect OZONE#_LUN constants. Add flags3/flags4/flags5 pixel summary variables (for various debugging tests). Add saturated pixel test. Set bits in flags5 as needed. Disable setcolqual routine (not finished). Correct text in output messages. Change subroutine to function. Declare un-typed variables. Move input count tests earlier in sequence. Don't do aerosol calculations if 765 or 865 is invalid. Change way GOODLWX/GOODLWY are computed. Add more parameterization of array sizes/loop bounds on such arrays. Use f90 btest/ibset functions (if f90 compilation) instead of iand/ior. Fix initialization of some flag arrays (index variable wasn't being used in array reference .. was a constant

subscript). Remove or comment out unused code. Upgrade bit setting to use f90 functions. Use f90 bit set function. Set B_Lw_Counts_Lw when input counts are negative. Set all 3 B_*_Cloudy at the same time. Set B_Dr2_Carder_In. Use setcolqual to set quality values. Set B_Dr1_Base_In. Fix the L2_flag bit names for the Dr1 (MODOCL2A) file. Add Cloudy to dr1 and dr2. Pass a parameter to exit. Move local function declarations to remove C compiler warnings. Change cosd(x) to cos(rad(x)) to remove compiler warnings. Optimize rad(x)/ang(x) ASF functions. Make Aer_Model* names consistent between L2 and QC files. Change metadata value geolocation to Geolocation. Use constants for units - U_* from commoninout. Move LUNs to start of common area. Library hdfeos must be before Gctp. Change value of reprocessing metadata from "none" to "processed once". Correct calibration/units of output products. Correct conditionalization of bit testing. Detect SeaWiFS input file, pass flag to atmospheric correction. Correct FLH/CFE calculation (scaling problems). Added functions to correct SeaWiFS 765 data. Add SeaWiFS specific calculations enabled by input flag SeaWiFSinput. Use SeaWiFS aerosol files with SeaWiFS input data; MODIS with MODIS. Add additional diagnostic output for certain errors. Use SeaWiFS Rayleigh tables with SeaWiFS input data. Improve error messages. Add missing call arguments (SeaWiFSInput) to Rayleigh routines. Add additional diagnostic message. Add comments on 13L/13H and 14L/14H band order in L1A file. Correct string constants in calls ('.' should be "."). Correct a# string format in format statement (was too small). Remove part of a compiler work-around. It was only needed for f90. Don't print statistics if exiting due to error, just close files. Fix generic descriptions of units.
MODSST: Use PGS_SMF_* as subroutines, not functions. Change the attribute "L2 Flag Usage" to "Common L2 Flag Usage". Put bad pixel count into QA % missing data, instead of QA % out of bounds data. Fix use of land/sea mask. Fix calculation of ascending/descending lines. Add code to not process every other line and/or pixel. Make cldmsk (MOD35) optional. Use PGS_SMF_* as functions. Use list directed reads, and fix error message handling. Fix subroutines/functions and bit handling to satisfy forcheck. Fix a day/night check. Set the common flags B_Hi_Sat_Zen,B_Hi_Sol_Zen. Fix check for ok pixels. Fix setting of QA %'s. Fix record length for fortran formatted read. Pass a parameter to exit. Add subsample[xy] parameters. Add comment in mice table to show that subsample[xy] are taken from the mice table and not the params file. Change metadata value geolocation to Geolocation. Use constants for units - U_* from commoninout. Library hdfeos must be before Gctp. Add coefficients for SST4 product. Fix equation for SST4. Only check asc/desc at normal end (not after an error). Only output statistics at normal end. Add coeffs for SST4. Change reprocessing metadata from "none" to "processed once".

Change comment in mice table about parameter file and pcf. Check in routine to set the quality values. Fix bit checking and setting. Correct string constants (‘ ‘ should be “ “).
MSBIN: Change the attribute “L2 Flag Usage” to “Common L2 Flag Usage”. Remove output filenames from the mice table. Remove unused variables. Fix 3 byte flag fields, since they are actually stored in 4 bytes. Use PGS_SMF_* as subroutines, not functions. Convert %loc(x) to iaddr(x). Make sure iaddr and things receiving its value are declared as ‘PTR’. *.rin files shouldn’t be checked in. Fix size of flag bands. Try to fix dateline/pole/data-day splitting problem. Don’t declare subroutines. Remove some debug print statements. Fix subroutines to declare array parameters properly. Fix time string parsing. Fix looping problem to bin all bands correctly. Fix some old, incorrect changes in the grid calculations. Fix grid point calculations. Don’t bin ‘unprocessed’ pixels. Write pieces to correct output file. Reference functions correctly. Add more info to error messages. Fix loop bounds for reading L2_data. Make internal reads compatible with SGI 7.2 F90 compiler. Fix usage of RECLENGTH parameter in call to PGS_IO_GEN_OPENF. Fix integer*2/integer*4 problem. Fix compiler complaint. Move local declaration. Indicate variable is static. Work around bug in SGI F90 7.2 (can be restored later). Fixes so iand() call arguments are of same type (kind). Update for SGI F90 7.2. Fully optimize program. Handle variant input data for time. Improve checking for value sizes. Fix metadata for split pieces. Pass a parameter to exit. Bin all bands in a file at the same time. Fix string length logic. Cache last result (gets re-used several times). Check for put_L3b_recordf errors correctly. Fix use of sums array. Comment out some old ifdef’d out code. Put both “L2 Flag Names” and “Common L2 Flag Names” attributes in all L3 files. Change metadata value geolocation to Geolocation. Describe use of quality bits in output file. Change units for sum_squared band to show they’ve been squared. Library hdfeos must be before Gctp. Change metadata value for reprocessing from “none” to “processed once”. Fix bit handling; fix dataday stuff. Correct strings in certain calls (‘ ‘ should be “ “).
MTBIN: Use PGS_SMF_* as subroutines, not functions. Use common level 3 i/o routines. Fix C style comments. Fix format statement. Move settbinmeta.rat to binshr. Fix prolog (again?!?). Use temp file with output and input LUNs and versions. Fix 3 byte flag fields, since they are actually stored in 4 bytes. Remove unused variables. Fix QA % calculations. Convert %loc(x) to iaddr(x). Make sure iaddr and things receiving its value are declared as ‘PTR’. First attempt to read temporary list file with which inputs and output to use from pcf. Read temporary list file for input and output luns and versions. Reference functions properly. Convert ftrim to a function. Change read to list directed.

Correct reclength parameter value. Fix bit handling. Put both "L2 Flag Names" and "Common L2 Flag Names" attributes in all L3 files. Change input parameters for start and end datadays. Library hdfeos must be before Gctp. Fix use of orbit numbers. Add quality bit flag descriptions. Begin and end dataday are now strings, not integers. Update prolog. Use binning period for file start time. Fix use of single and double quotes. Input was changed from yyyymmdd to yyyyddd. Fix use of single and double quotes. Use $COMSIZ for the length of qualdesc.
SCRVERIFY: Handle end-of-year rollover.
IO/DSPLIB: Release memory allocated by MakeOneLine.
MODISIO/OCEANS_SMF_SetDynamicMsg: Use PGS_SMF_* as functions not subroutines.
MODISIO/L1B_Geo_Cld_Interface: Make MAPI optional (default without). Fix comment delimeter. Add check for error from Vend.
MODISIO/mod_get_L1b_attr_v2: Changed calculation of yearday and msec to account for leapsecs. Fix smsec and emsec calculation (they are int not short int).
MODISIO/V2_META: Changes to work with new mcf files. Add values to failure print statement. Fix string lengths to be long enough for any PSA name. Fix some metadata values. OrbitNumber is no longer in level 3 files.
Fix string for ReprocessingPlanned metadata, and update a comment.
MWRAP: Use PGS_SMF_* as functions not subroutines.
MOCEAN/MOCEANCLOSE: Fix spelling in comment.
MOCEAN/MOCEANREAD: Return unique error values.
MOCEAN: Add HDFEOS grid file type.
ANC/GETANC: Add clarifying error message. Return additional diagnostic information to caller in qc vector.
ANC/JULIAN: Change from f77 to f90. Use parens to emphasize result. Define variables, instead of relying on implicit statement. Put type declarations before data statement.
VMSFORLIB/EXIT: Upgrade makefile to conditionally compile module for SGI 7.2 compilers. Add parameter to exit, even though it isn't used, to satisfy MODIS fortran checker. Fix variable declaration.
MSPC: Use proper lun for output file. Fix use of pgs_smf_*. Change use of sx and sxx to be like binner. Library hdfeos must be before Gctp. Fix use of byte, short int, and integers. Use parameter file instead of pcf forcommand line variables. Use temp file to get input and output and parameter file LUNs and versions. Use $COMSIZ for the length of qualdesc.
Check for end of input file (don't process bin zero). Stop at last populated bin.
DAYBOUNDS: Fix lun for Reynolds file. Fix use of PGS_SMF_*. Pass a parameter to exit. Library hdfeos must be before Gctp.
MCOLSHR8/GET_CLIMATOLOGY: New version of hdfio/Anc_Files requires changes in get_ancillary parameters.

MCOLSHR8/COLORSUB8: Don’t call hmf8 routine. Results not used by caller of coloop. Keep good humidity values. Correct format of output value. Add diagnostic prints. Fix calculation of ianchr. Ifdef out debugs.
MCOLSHR8: Update location of ancillary include files.
MCOLSHR8: SGI F90 7.2 doesn’t like ‘,’ except in list context.
MCOLSHR8/CALLCW: Put return statment inside error test conditional.
ATMCORSHR: Don’t build hmf8.f. No longer used by colorsub8.c.
ATMCORSHR/COLORIN1: Restore pixel subsampling (MULT > 1).
ATMCORSHR/ACOSS,ASINN: Fix prologs.
MSSTSHR5/AVHRRSUB5: Remove subroutine hmf8. Stop using arrays AERSOL and AERMLT. Correct conditional compilation. Pass a parameter to exit.
MODINC/OCEAN_LUN*: Add more luns to include files. Parameters must be typed.
MODINC/COMMONINOUT: Change flag names to upper case. Use first common flag to mark unprocessed pixels. Change MAX_INPUT to MAX_INPUT_L2 because of
compiler complaints. Fix BD_Dr1_# comments. Add Cloudy flag in output files. Add size for cloud flag array. Add flag name for Dr1’s, L2_flags, Chl_a_in bit (B_Dr1_Chl_a_In). Make Aer_Model* names consistent between L2 and QC files.
MODINC/CVTCOMGOE: Add filler to common area to match other include file.
MODINC: Fix prologs. Save common areas.
PATHDR: Use correct type for variables holding an address.
Correct format of subimagepassdate value (YYYYMMDD instead of YYDDD).
L3M2MIA: Set the start time and dates in the subimage header and nav block.
MOSAIC9: Increase number of input bands.
PATHQUAL: Handle 3 bit quality values.
PATHREF: Handle 3 bit quality values.
PATHLOAD: Handle 3 bit quality values.
PATHNLC: Change bands for allb == 6. Fix tree test for noaa14.
Check in Arthur’s (old) stuff. Add -Nn option for SGI.
PATHBIN: Increase optimizer table size.
PATHBINANG: Add 3 bit quality values. Change some of the output bands for various allb’s.
STATS: Increase maximum lines in internal array (from 1024 to 2048).
PATHBIN4K: Larger value of AABINS for 4k binning.
PATHSPC4K: Larger value of AABINS for 4km binning. Use the include file from pathbin4k for all *4k programs so there is only one copy.
RATF90: Add blank between “include” and “’filestring’”. SGI f90 7.2 gets confused. Underscore is an allowed name character. Don’t split line inside an identifier.
RATFOR: Add whitespace between “include” and “’filename’”.

COLORSHR8/COLORSUB8: Correct prolog.

IMG2BIT: Update documentation.

MINMAXS: Correct program name.

STBIN-HDF: Correct SeaWiFS library paths.

SMAP9-HDF: Correct SeaWiFS library paths.

SSBIN-HDF: Update SeaWiFS library paths.

ANLY8D: New land mask support routines. Update SeaWiFS L1/L2 i/o interfaces.

Misc. corrections and changes. Replacement chlorophyll routines (replaces swf*.c). Merge newest parameter changes. Merge in newest functional changes. Fail pixels that have Lt-Lr <= 0. Flag any pixel with any corrected total radiances <= 0 with atmos corr fail. Change hightau1 default to match operational default. nLw670 was computed wrong (2 divides by tstar) this is fixed. Remove logic that sets the cloud flag if there is negative nLw and not shallow. Use the SeaBAM pigment instead of the older algorithm's pigment in determining the turbid regions. The change marginally increases the # of turbid flagged pixels in the data. 02Mar98 SeaWiFS project change. Use new diffuse transmittance files. Change sign of second parameter (sense different in new files).

RECLEN: Remove limit on record scanning.

CALEPS8D: Add logic to select area of interest. Fail points that have Lt - Lr <= 0. Add bit flags variable to mirror flags2_pc. Disable more output code. Add pixel summing variables. Disable more output code. Add initial tabular output. Add rms calculation. Revise output formatting. Add position and geometry data to output. Merge changes from anly8d: nLw670 was computed wrong (2 divides by tstar) this is fixed; Remove logic that sets the cloud flag if there is negative nLw and not shallow. Use operational default for hightau1. Output uncorrected L_t values. Exchange ZPHISA and ZPHI. Had them mixed up. Add comments to source. Use new diffuse transmittance files. Change sign of second parameter (sense different in new files).

TROUTC: Pass output image size to drawing routine (call VBUFSZ). Add new entry point VBUFSZ. Add code to check for line segment wrapping horizontally from right image edge to left image edge when start/end points are close to their respective edges. When this happens break the line into two pieces (start,first-edge) and (second-edge,end).

LOCATE8D: Took out too much. Restore sensor calibration file logic. Missed another initialization. Outputs more reasonable now. Enhance printouts. Additional debugging output. Construct matrix of closest points and determine relative weights. Solve for (fractional) line/pixel of specified location. Correct matrix filling. Add more fill cases. Test for too much data. Correct indexing for np>nl case in find_pct. Disable some outputs. Add result line. Script to generate extractions from images given

date/locations/images. Add test for no intersections (point not found). Add more output to shell script. Fix syntax error in echo command. Summarize output of generate.pl. Some images return 4 pairs of points. Clean up output. Test for error condition. Add missing header item. Add delta-phi calculation. Rename delphi to satphi. Compute delphi. Adjust precision of outputs to keep everything within 80 characters. Adapt to new output format from locate8d. input files moved.
IMG2HDFBIT: Library hdfeos must be before Gctp.
IO/VAX_EXTRACT: Solve problem with extract_float accessing data unaligned—use extract_long as a model of how to fetch input data.
VHRR: Set Variable INRDLY to TRUE for read-only input file (was wrong).
DISPLYSHR: Explicitly initialize note() signal handling routine from cc_comint.
CALLER: Improve diagnostic messages for process termination.
MAKE-BSD: Change status from wait_t to pid_t. Modify conditionalization. Fix entry for DEC OSF. Adjust include paths.
ANLY6F: Merge in appropriate pieces from other directories (the other source areas are diverging from what anly6f expects). Remove unnecessary items from makefile. Add sources from other directories so we have known versions. Add missing arguments to coloop calls (alon, alat).
MODCOL: Fix prologs. Use formatted writes for debugs. Correct L_a <= 0 error.
MCOLSHR8: Reduce whitecap reflectance by 75% (found by SeaWiFS project).
BINSHR: Fix metadata constants. Fix call to metadata routine. Declare extra bits in L2 flags as "Unavailable". Fix comments in prologs. Remove unused variables. Put all bit flag names in "L2 Flag Names".
MSBIN: Fix handling of pixels near the dateline. Declare extra bits in L2 flags as "Unavailable". Put pieces in the correct data-day. Add names of all 32 bits to "L2 Flag Names". Use "UNAVAILABLE" for the bits that don't exist in the L2 file.
MTBIN: Add checks to make sure input files have valid counts values. Fix handling of input file which is outside of binning period.
MFILL: MODIS quality values are the opposite of pathfinder.
MSPC: "wq" input parameter is in mice table, not param file. Variable was declared twice.
MMAP: Map specific quality value, not whole byte. Fix call to settbinmeta - remove orbit. Variable was declared twice.
MCLOUD: Put all messages in proc_log. Fix use of quality bits.
MICE: Add special case code for MODIS environment.
MODISIO: Fix offset to radiance bands. Fix error message. Fix prolog. Return with error value after errors.
MODINC/COMMONINOUT.*: Add U_* strings for products' units. Correct DR2 bit 13 output strings (high albedo). Add unit strings for

Conc_g, Conc, FLE. Eliminate duplicate field name. Fix Dr2 flag bit 13 for high 865.
MODINC/OCEAN_LUN.*: Add luns for mspc and mmap.

ANLY8D: Correct generation of diffuse transmittance file name.
Apply calibration correction factors [alpha(i)] to L_t [given by HRG].
Check for zero before divide. Add use670 input variable to select between 765/865 and 670/865 corrections. Add 670/865 version of rho_a_sub_quartic and logic to call it properly. Add debug printout for input calibration data. Add link libraries. Add missing variable declaration. Merge in SeaWiFS project changes for last few months.
CALEPS8D: Improve labels in output. Add ozone to L_w value.
Correct output item. Make file executable. Change output header. Remove HIGHLT1 option (warn, don't abort). Summarize output files. Add HRG alpha(i) calibration correction. Disable some aborts on bad pixel data.
COLORSHR8: Reduce interpolation grid size. Apply 0.25 multiplier (estimated) to whitecap calculation -- result too large.
L22MIA: Update to work with latest SeaWiFS stuff.
SREMAPN-HDF: Change calibration. Add ability to read bands from the qc file. Routine to set up the calibration info and validate the band name.
SSBIN-HDF: Yet another change to the dataday split algorithm.
L3M2MIA: Fix image date. Update to work with latest SeaWiFS stuff.

PATHSST: Fix f77 compiler options.
PATHNLC: Fix f77 optimization options. Add Noaa-15 support. Still need to add specific decision tree. Add allb=8: medians, mins, and maxes for channels 4 and 5.
PATHBINANG: Fix f77 optimization option.
Use "renamefile" instead of "rename" on Unix.
PATHBIN: Add allb=7. Fix handling of pixels on the seam. Put pieces in proper data day. Add support for f2c on Linux. Add allb=8: medians, mins, and maxes for channels 4 and 5.
PATHMAP: Add statistic U to output quality values as a bit mask.
PATHMAP4K: Use a larger value of AABINS for 4k binning.

ANLY6F: Add aerosol optical thickness output value (Tau670).
DCBIN9: Use allb=3 for files with Tau670. f2c doesn't support "-check". Use "renamefile" instead of "rename" on Unix.
COLORSHR: Reduce interpolation grid size.
COLORSHR7: Don't use calfixit.

UTILS/MAKE-BSD: Check in the correct version. Fix declaration of wait status.
Fix up directory reading code.
LIB/TABLE: Rename reference from "XtInheritFocusMovedProc" to "XmInheritFocusMovedProc".
INGEST/LIB: Add debugging.
SCRIPP: Process modified Noaa-15 calibration file format.
TIRPACK: Modify debugging output.
VHRR: Fix syntax error in makefile.
DATADAY: Change "type" to "print".
LOADDB: Move "data" statement after variable declarations.
IMG2PST: Use "renamefile" instead of "rename" on Unix.
OA2PST: Use "renamefile" instead of "rename" on Unix.
2CHAN: Add better check for AVHRR RESP. area.

Second half of 1998:

MODCOL: Convert radiances to match supplied coccolith tables. Allow MODIS and SeaWiFS to have different angular coverage for aerosol models. Expand THETAV initialization table for additional angles. Fix sun angle calculation (converted to integer too soon). Alter debugging support. Add SeaWiFS wavelengths in addition to MODIS wavelengths. Remove duplicate data statements for wavelength so all routines use the same set of values. Change (float) to (double) for extra precision in calculation. Enhance debug messages. Move per scanline date/time calculation from mod_get_L1b_recordf to nav_get to correct a problem with computing the time of a scan line. Make equivalent to SeaWiFS usage. Add explicit GAC support. Remove disabled code. Fix time at scan line calculation. Resolve differences with SeaWiFS anly8d results. Correct limit on iisun calculation. Revise second sun_max calculation to be same as first. Recompute Fresnel table if tilt (ATHETA(1)) changes [only a SeaWiFS problem]. Remove required flag from cloud filename table entry. Resolve some minor differences between MODIS and SeaWiFS sources: Use [+-]$PI instead of Rad([+-]180.). Include ZMU0 in albedo calculation. Update some comments. Add logic to update calculations more often for GAC input data. Disable GAC logic for now (3-4x slower .. harder to test). Remove some debugging code (KAI_DEBUG*). Simplify F_0 handling to be more like SeaWiFS (update F_0 every scan line). Modify debug printouts to locate some more problems. Finish changing variable names to track new usage of F0LN/F1LN. Use byte instead of char for 8-bit quantities. Add new input parameter (aermodsea) for SeaWiFS aerosol model selection. Update makefile compile/link options. Add new input parameter

(aermodsea) for SeaWiFS aerosol model selection. Add new input parameter (aermodsea) for SeaWiFS aerosol model selection. Update GAC support. Use byte instead of char for8-bit quantities.
MCOLSHR8: Change lcw, dob, white and f0 routines to use select either SeaWiFS or MODIS data files. Change solar constant correction to be same as SeaWiFS version. Return unmodified solar constants as well as adjusted solar constants. Return unmodified F_0. Compute updted F_0 for every call to COLOOP. Simplify code to be more like SeaWiFS. Remove/simplify more code related to old/new F_0 calculations.
MODSST: Fix error handling. Use byte instead of char for 8-bit quantities. Update makefile compile/link options.
ATMCORSHR: Make equivalent to SeaWiFS usage.
MSBIN: Exit with proper error values. Allow for larger number in 'Pixels output...' message. Update make options. Update copyright. Minor source changes for better compiler efficiency. Use byte instead of char for 8-bit quantities.
MTBIN: Fix error message. Use intended binning period for start and end datadays in MODIS metadata (as opposed to actual time covered by input files). Use byte instead of char for 8-bit quantities. Update makefile compile/link options.
MFILL: Use byte instead of char for 8-bit quantities.
Update makefile compile/link options.
MCLOUD: Update makefile compile/link options.
MSPC: Use byte instead of char for 8-bit quantities.
Update makefile compile/link options.
MMAP: Update makefile compile/link options. Use byte instead of char for 8-bit quantities. Remove some unused code.
MODINC/OCEAN_LUN.*: Add comment regarding mmap output file luns.
MODINC/MIAMI.RAT: Change byte datatype to integer*1 and fix zext() to work with
new byte type.
BINSHR: Use byte instead of char for 8-bit quantities.
MODLIB/ANC: Implement changes in SeaWiFS code base to ancillary read routines
vis lat/lon.
MODLIB/MODISIO: Satellite and sun angles are all unsigned quantities. Geolocation values are supposed to be int16 with range (0,180) or (-180,180).
MODLIB/MOCEAN: Add logic to cache the band name for a single output file write
call. Update write optimization to support multiple (MAX_MOCEAN_FILES)

output files. New shared data for mocean library routines.
Only declare MOceanData variables in one routine.
MICE: Add special case code for MODIS environment.
L3M2MIA: Fix XIMGDY (YYDDD).
ANLY8D: Use two/four digit conversion routine. Add clear water radiance
correction to Lt670 before atmospheric correction if using 670/865
algorithm. New files from SeaWiFS project. Add L_t-L_r-tL_cw calculation.
Merge in caleps8 changes so only need one version of wang2.f. Add Lcw670
back into Lw670 after atmospheric correction. Add/integrate routine to
read sensor adjustment values from disk file. Correct setting of
ALPHA_COEF from file/command line. Add pixel, scan to newatm() argument
list. Import MODIS versions of aerosol correction routines. Detect GAC
versus LAC input data. Do aerosol calculations at every pixel (GAC) or
every 4th pixel (LAC) (was every 5th pixel for either). Set TLCW for the
400 bands also. Add slopes and intercepts input parameters. Added
OUT_REFL option to output reflectance rather than radiance for out_modes 0,
10, and 11. New, wider, model tables. Fix internal read to work on alpha.
Trap overflow and underflow when using pow(10.,x). Fix usage of mskflg for
alpha. Add two additional output files to hold LAN and LAM values. Revise
debug output to be compatible with MODIS MODCOL program. Correct L_Ray()
macro. Use uncorrected solar constant when reading input data. Add
Ref_2_Rad() and Rad_2_Ref() macros to replace certain conversions. Eltb
values are supposed to be 1 biased (no effect on other calculations).
Merge in changes from SeaWiFS project:
Update defaults for SeaDAS algorithm;
Add out_mode = 3 (like mode 1 but keep La865, CZCS_pig and K_490 as is);
Modify K490 calculation to limit output to 6.4 for bad input value;
Remove test on sflags(2).
Remove tLcw670 from Lt670 before doing 6-8 atmospheric correction. Restore

tLcw670 to 'Lw670' after correction. Correct limit on iisun calculation.
Revise second sun_max calculation to be same as first. Add fourth
output
file including slope/intcp for angle/ancillary data. Configure fields in
fourth output file: solar, satellite geometry and various ancillary data
values. Add ozone ancillary value to fourth output file as parameter 10.
CALEPS8D: Merge in SeaWiFS project changes. Add 670/865 aerosol
correction
routine. Add clear water radiance correction to Lt670 before
atmospheric
correction if using 670/865 algorithm. Use anly8d/wang2.f instead of
private version. Update makefile to build all sources. Add new
ALPHA_COEF
logic and routines. MODIS model changes mirroring anly8d.
SREMAPNH: Add flag mapping; fix date. Call get_L2_record properly.
More
slope changes; some lan/lam stuff; put the R's back. Add out_refl
option.
No longer use o32. Set bit to avoid compiler complaining about "integer
conversion resulted in truncation". Move LAM and LAN 765 and 865
to chlor
and K bands. Use "Reflectance" for calibration units for reflectance
data.
SSBIN-HDF: Minor changes from SeaWiFS project (0.001 -> 0.0). Use
float() to
make alpha and sgi versions more similar. Use default minimum for
K_490
in the chlor/k_490 product if actual k_490 is zero or less. Read data
directly into input buffers. Yet another attempt to handle the poles.
Fix use of reals vs integers for alpha/sgi.
ANLY6F: The azimuth difference that is used when interpolating within
the f/Q
tables, and which should be 0 when the sensor is within the half part of
the sun vertical plane that does not contain the sun (i.e., in the
direction of specular reflexion), and 180 when the sensor is within the
half vertical plane that contains the sun (the direction of
backscattering). This indexing is actually the converse of the one
generally used to describe the "satellite geometry". Change the calling
DeltaPHI to be 180 - DeltaPHI_miami. A new version of subr_for_dsp.f
(for CZCS) which has been modified to account for the latest changes in
the bio-optical model. Add new parameter (outmode) to allow output
band selection. outmode=0 is standard behavior. outmode=1 adds three
geometry bands. Correct radiance units. Dec 17 changes from David

(updating algorithm, revert yphi calling value to original vs 180-original value). Remove store into unused array element.
DCBIN9: Add David A.'s angles.
COLORSHR8: Merge in latest SeaWiFS project changes. Make sources equivalent.
LOCATE8D: Improve parsing of output file. Allow more matching points to given Coordinate SMAP9-HDF: Pass calibration to output routine. Add entries for LAM_* and LAN_*. Use more reasonable scaling for nLw and La values. Pass
calibration to output routine. Replace K490 and CHLOR with La765 and La865 for LAN/LAM output files.
L22MIA: Don't need year check.
PATHNLC: Add allb=8: medians, mins, and maxes for channels 4 and 5. y2k. Yet another allb option. Correct radiance units. Yet another allb change. SGI f77 syntax has changed. Must initialize bandnums() for first band too so OffsetIn() is correct. Add debugging print statements (disabled). More allb changes for Vicki.
PATHBIN: Add allb=8: medians, mins, and maxes for channels 4 and 5. New definition for RENAME on unix. y2k. Yet another allb option. Yet another allb change. Four digit year changes. More allb changes for Vicki.
INC/SHPSPHCOM.H: Add closing comment to header.
INC/RTLIB.H: Update function prototypes to reflect actual functionality.
INC/NEWNAMES.*: Add year conversion functions.
INC/ARG.RAT,CALIBRATION.RAT,EXTSATREC.RAT,MIAMI.RAT,PALETTE.RAT: Use macro
to allow either F77 or F90 style structures and records.
INC/NETCDF.RAT: Version 3 netcdf definitions.
INC/*.H: Refine prototype declarations for externals (e.g. void instead of int).
INC/IMGTYPES.H,DSPLIB.H,COMDISPLY.H: Enhance conditionalization (64 bit, SVR4).
INC/COMCOM.H: Add unix domain sockets (for speed).
MIA2HDF: Add linux code.
CORRELATE: Initial version. Still needs work.
IO/UTILS.C: Improve error checking on year conversion.
ORBIT: Use two/four digit year conversion routines.
Initial Y2K changes. A bit more is left to do. Add Y2K functionality. Improve portability (use actual array dimensions).
ORBITSHR: Use two/four digit year conversion routines. Add Y2K functionality.
Add missing include file.
SPHLIB/SUNANG2: Add year 2000 logic.

SPHLIB/EPHS: Improve portability (use actual array dimensions).
VMSFORLIB/IDATE: Use two/four digit year conversion routines.
VHRR: Add two/four digit year conversion routines. Add Y2K compatibility.
JULIAN: Use two/four digit year conversion routines. Improve error messages.
EXAMIN: Fix a diagnostic printing problem between OSF and IRIX. Add info about EXTENSIVE option.
RATFOR: Add line numbers to traceback dump to aid in fixing source code errors. Improve formatting of traceback display.
IO/UTILS: Add two-digit <-> four-digit year conversion routines.
INC/DISPLAY.DEF: Use more general type PTR instead of machine specific types.
PST2OA: Add 3 bit quality. y2k. Fix quality check for good values.
SCRIPP: Day of year value is only 9-bits (not 10). Add logic to handle a pass that starts before midnight Dec 31 and ends on Jan 1 and the data extracted is all on Jan 1 (only from an archive file). Attempt to handle new version of Sea Space, Terrascan data. Fix use of Dsp_Date and 4 digit year. Make date string longer to hold 4 digit year. Fix portablility problem in scrcalib.rat. Disable new diagnostics.
QUORUM: Day of year value is only 9-bits (not 10). Add prototype input file. Fix Dsp_Date and 4 digit year.
AES: Day of year value is only 9-bits (not 10). Fix use of Dsp_Date and 4 digit years.
AES10: Day of year value is only 9-bits (not 10). Fix use of Dsp_Date and 4 digit years.
DLR: Day of year value is only 9-bits (not 10). Fix Dsp_Date and 4 digit year.
DSP: Clean up name clash (local version of pclose).
SATELLITE/SATTYPE: Make Y2K compliant. Also need to revise AVHRR.cal and noaaness.ids to change the ' 0' year entries to '-1'. Wait until next full rebuild.
111111: Add Y2K functionality.
DATADAY: Add Y2K functionality. Has to match changes in routine pcapsub.
SATPT: Verify Y2K functionality. Minor formatting changes. Add some info.
INGEST/LIB/READLEVEL1B: Change to allow variable length records (used by READLGSOWG module). Fix up EOF detection.
INGEST/LIB/READAREA: Fix a read problem.
INGEST/LIB/FFCSWITCH: Remove compiler warning by re-arranging source code. Fix syntax error.
INGEST/LIB/TIMETIR: Remove unused variables.

INGEST/LIB/TIMESCR: Add debugs. Fix mixes of reals and integers. Clean up print statements (remove trailing blanks).
READARCHIVE: Add big-endian support.
TIRPACK: Add big-endian support.
TIRREAD: Add big-endian support.
SCRREAD: Add big-endian support.
SCRVERIFY: Add big-endian support.
SCRPACK: Add big-endian support.
SETORBIT: Add big-endian support.
QRMPACK: Add big-endian support.
PALMERREAD: Add big-endian support.
XFBD: Lesstif doesn't set resources as Motif does.
IO/DSPLIB: Return 4-digit years in dsp_date, dsp_idate.
IO/UPDOLDNAV: Remove unused variables.
TRACE: Date limits in command lines need four digit years. Fix use of 2 digit and 4 digit years. Add variable precision to output value field.
PULL: Use two/four digit year conversion routines.
Don't cheat and reuse part of an array, declare a specific array.
MINMAX: Fix program name in makefile.
DBMAN: Fix for y2k.
MACE2: Fix for y2k.
MACE1: Fix for y2k.
PATHDR: Year 2060 compliant.
TRAVEC: Dates on comman line must have 4 digit years.
y2k. If color=0 then output vector length as graphic pixel value.
LIB/SATELLITE/SATTYPE: More Y2K fixes. Remove unused variable.
PLTDIM: pltdim lives again. Only works if you have access to the NCAR graphics package. Options have changed somewhat. We generate Postscript directly now instead of a CGM file. pltdim needs some work. The X windows display is quirky. Plotting to a Postscript file is better behaved. The dashing code doesn't seem to do anything useful. Change the color changing code to start at 0 instead of 3. This delays plotting yellow.
COMPOS: Add creation of mask to be used by compsel to 'composite' other bands of the same image by selecting the same pixels as compos did with it's band.
TIROS: Add logic to handle a pass that starts before midnight Dec 31 and ends on Jan 1 and the data extracted is all on Jan 1 (only from an archive file). Improve date checking for Y2K. Disable code probably on needed by SCRIPP. Fix Dsp_Date and 4 digit year.
L1A2MIA: Update to work with latest version of SeaWiFS (done a while ago, but never checked in).

LIB/HDF/DF: Remove compiler error on Solaris.
LIB/GOELIB/GETBET: Add exit status value.
LIB/GOELIB/SATEAR,SATPOS: Remove unused variable declarations.
LIB/ULIB/FITN,POLY: Improve portability (use actual array dimensions).
ANLY7D: Correct radiance units.
ANLY6D: Correct radiance units.
ANLY2D: Correct radiance units.
DMPHDR: Wider date field.
SHOCOM: Write out startx, starty symbols.
MAKE-BSD: Fixed nested C comment. Added missing "int" to declaration. Fix up comment after #endif.
LIB/DISPLYSHR/CC_COMINT: Add checks for EAGAIN and EWOULDBLOCK.
LIB/DISPLYSHR/CC_COMINT,NOTE: On recent SGI systems, we weren't gettting BSD signal semantics.
CALLER: Correct the grammar in a comment.
CSBIN: Add isccp code (a long time ago).
GRID: Don't use sglat before it is initialized.
GSFCBIN9: Add isccp option (a long time ago).
IMG2PST: isccp calculation added a long time ago.
PIXAREA: Fix a spelling mistake in a comment.
SLD: Make date array 2 bytes larger for 4 digit year.
SMAKE: (Changes from Dec. 95 and Apr 97). Use own version of maknavsub instead of the loadozone version.
CZCS: Fix Dsp_Date and 4 digit year.
LGSOWG,NMFS,RLREAD,SATMOS,SHARP,ZIP: Fix Dsp_Date and 4 digit year.
TWOLINE2PPTS: Fixed length integer decode wasn't working right -- do it another way. Strip trailing blanks from input lines. Trip trailing blanks from input lines (a little more agressively).
AVHRRSHR5: Improve readability of code. Preserve local variable across subroutine calls.
PATHSST: SGI f77 options have changed. Must initialize bandnums() for first band too so OffsetIn() is correct.
MCSST: SGI f77 options have changed. Must initialize bandnums() for first band too so OffsetIn() is correct.

C.4 Team Interactions

Attended SeaWiFS meeting Baltimore during the first quarter. Discussed upcoming SeaWiFS initialization cruise and subsequent calibration procedure.

Participated in Miami SST workshop. Observed calibration and comparison of radiometers and standards utilized by various laboratories.

Will be providing more Pathfinder SST data to William Barnes.

Started to set up procedures during 2nd quarter for the transfer of 4km data to Oregon State University - set up accounts and an easy transfer method.

Discussions with DAAC for SeaWiFS and MODIS data delivery via DLT tapes. GDAAC personnel agreed to distribute SeaWiFS L1 data to Miami via DLT tape for bulk reprocessing; ongoing data deliveries will utilize the NSI T1 link. Miami will copy and return the DLT tape to the GDAAC.

Miami staff (Warner Baringer) met with representatives from the ECS Architect's Office and SDST in Landover, MD June 17th to discuss open issues with ocean data processing. Steve Marley (ECS Architect's Office) proposed reducing the number of data types (ESDTs) by use of a granule-level measured parameter. The L3 ocean ESDTs would become a multi-granule ESDT with single-parameter granules. The L3 PGES would require code changes to set a granule-level parameter name attribute. The exact syntax for this will be specified by ECS in the near future.

Dennis Clark, H Gordon and R Evans met at NESDIS to discuss SeaWiFS initialization. Dennis provided station (MOCE) and buoy (MOBY) observations. C. McClain has arranged for the corresponding SeaWiFS LAC passes to be transferred to Miami. Jim Brown has developed an extraction procedure to acquire satellite pixels that correspond to the surface observations. Jim has created a program CALEPS that computes surface, Rayleigh and aerosol radiances for each of the aerosol models. These radiances are then compared to the surface observations to help determine sensor calibration adjustments.

Following discussions with MOCEAN team members and Ed Masuoka, we have defined required channels for ocean product processing based of L1A input. Discussed reduced number of channels for L1A data, will need 19 channels: 3, 4, 5, 6, 8, 9, 10, 11, 12, 13, 14, 15, 16, 20, 22, 23, 26, 30, 31. In addition, we will need PGEs to compute cloud mask, geolocation since is will be less expensive to recompute these fields as needed rather than archive on tape.

NOAA Ron Brown cross-Atlantic MAERI cruise along 24N during January was supported by computation of daily 4km SST fields for the subtropical Atlantic.

Set up exchange with Italy for Emanuele Bohm to work part time at RSMAS, Viva Bazon will work with H. Gordon and us to review ocean color products produced using CZCS and SeaWiFS data. The data sets will be processed using equivalent algorithms to produce a baseline time series. These fields will complement the MODIS fields produced using the SeaWiFS/MODIS converter.

Several presentations were made at various meetings the second quarter. Dick Reynolds chaired a session at a meeting at GFDL to analyze the implications of the accuracy of data fields used as either inputs or references for model predictions of coupled air-sea problems such as El Niño. One interesting outcome is the desire of the NOAA/CAC group to use Pathfinder SST fields as the input to the Reynolds' OI analyzed weekly, one degree SST fields. Since the Reynolds' fields serve both as the reference SST for the NLSST equation and as the comparison field to compute Pathfinder SST anomalies, the impact of this change will need to be analyzed.

A paper was presented at the Boston, AGU meeting comparing Pathfinder SST to various SST climatologies and MAERI skin temperature observations obtained 1996 during a Hawaii to western tropical Pacific cruise (P. Minnett).

Working with L. Stowe of NOAA to use his PATMOS aerosol estimates with UMiami Pathfinder SST to identify aerosol correction problems in the SST algorithms.

During the second quarter we met with the One-on-One group to discuss DAAC and networking issues related to ocean processing (including MOCEAN processing at the DAAC and outstanding issues relating to production rules and PGE testing).

In June, the MOCEAN team met at GSFC to discuss Q/A and adaptive processing as well as team issues. The following week, mid June, the EOSDIS panel met in Woods Hole to discuss adaptive processing and federation. The next week provided an opportunity to meet with P.

Cornillon to discuss progress and plans for DODS. The month ended with the MODIS team meeting.

R. Evans participated in the July Moby cruise – interactions included observing or participating in the following operations: moce, fiber profiles, satlantic, ctd, cell phone – internet connection to retrieve goes and SeaWiFS images Updates were installed in Dennis' shore based computers, irix 6.2

R. Evans attended the Sept. 21-27 Simbios meeting, San Diego. Discussions were held with C. Mcclain to integrate SeaWiFS/Simbios calval and similar MODIS efforts.

Jim Brown particpated in the AMT cruise, Portugal to Africa, Sept to Oct 18.

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.

D.1.2 MODIS

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

Submit the final version of MOCEAN Q/A plan.

Integrate the next generation ocean algorithms (from Carder and Gordon). The Carder algorithm utilizes SST to select absorption coefficients in the chlorophyll algorithm. The new Gordon algorithm includes code to discriminate between absorbing and scattering aerosols.

Make sample MODIS day, week fields, distribute them to MOCEAN PIs. Following confirmation from the PIs, generate a weekly climatology for a year. Test the QA exchange by delivering the MODIS fields to ocean PIs

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.

Process all available SeaWiFS L1 data through MODIS PGEs. Produce the first version of reference 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 startup of the FloridaNet/vBNS and startup of the second NSI T1 circuit.

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

E. Problems Encountered

E.1 Processing Development

E.1.1 Pathfinder

Equipment problems affected real-time data transfers in January.

Orbital elements have not be automatically updating (September-January), so real-time files were recalculated.

The determination of SST algorithm coefficients for NOAA7 and cloud detection tests has been hampered by the limited temporal and geographical distribution of the in situ data available during for NOAA7. It proved difficult to estimate coefficients that do not result in a biased SST estimate.

Experienced disk problems on processing machines, and a series of repeated disk crashes on the machine that runs the "event_demon" which controls the processing. Frequently, the event_demon would not start correctly after these crashed.

Had serious problems with indexing on the DLT machine. Also, the tapes for 1996 and 1997 include many duplicates and some omissions., and at least one tape that had to be dumped (because the nsr software could not access the files individually). A number of other tapes will mount, and then repeatedly run through the "verify" procedure.

Started to collect NOAA-15, and it caused multiple problems. We started to collect the orbits, which overloaded the disk resources assigned to archiving the GAC data.

During the last half of 98, a large amount of new equipment was installed and incorporated into the processing machines. However, much of this equipment was not functional, and the processing was frequently interrupted by problems. In the first three month, the new fiber-channel disks which were using on the DEC alpha processing machines turned out to be incompatible with the operating system, so experimentation with these disks consumed a large amount of the processing effort. Also, two new DLT juke boxes were installed, and hardware and software installed to allow two sets of the boxes to share their six drives. Again, hardware and software problems caused numerous problems. Frequently, the processing had to be halted for days until the juke boxes could be fixed. New tape drives that were installed frequently mishandled the tapes, and a number of tapes of processed data were corrupted, requiring that the data be reprocessed.

In addition to the hardware problems, occasional problems were encountered with corrupted coefficient files and a navigation database that occasionally was not updated correctly. These problems have now been cured, but did also require some reprocessing of data. The coefficient and navigation files have been corrected, and procedures put in place to insure that the navigation is being updated every night and notify operators is the update has not occurred.

There were a number of system problems that also interfered with the processing. Occasionally, a machine would exceed the maximum number of processes allowed to any "user". In addition, for a period of time, the system disk would briefly drop out, suspending active processes and requiring that machine be rebooted. Finally, in late December the disk that contained all software that runs all processing and archiving systems became corrupted. While nearly all of the files were recovered from various backups, there were a number of anomalies in file versions and even command and directory permissions that required a couple days to locate and correct.

E.1.2 MODIS

MODIS ocean processing as specified over 1700 L3 ESDTs. It is unclear whether the PDPS could handle this number of ESDTs. The DAAC also has concerns over maintaining such a large number. We have recognized from the start that such a large number of ESDTs might stress the system and are predisposed to respond favorably to changing the PGEs. However, until ECS provides concrete information on the use of single-parameter granules and demonstrates the capability to support it, we will concentrate our programming time on testing the PGEs for scientific validity, especially now that SeaWiFS data is available to serve as a geophysically relevant input.

The impact of a large number of ocean ESDTs on the ECS processing system continues to be raised as an area of concern. In June the ECS, SDST and Miami representatives agreed to move forward with a plan proposed by Steve Marley (ECS Architect's Office) to reduce the number of ESDTs by use of a 'granule-level measured parameter'. The recent reorganizations and the emergence of MEBS processing have contributed to uncertainty regarding his proposal. It will be increasingly difficult and present a greater risk to the schedule to make changes of this nature, so a decision should be made quickly.

Cross-talk problems with the MODIS IR channels continues to be a problem. Tests have shown that the cross talk will introduce noise into the Channel 4 temperature, especially near cloud edges.

A unit disparity with the MOCEANS lookup table was identified and corrected. The lookup table’s range was found to be inadequate to cover all possible oceanic scenarios.

Synthetic L2 data from SDST was shown to have low Lw, the SSTs in the equatorial Pacific were low, and the brightness temperatures over Antarctica were highly variable.

E.1.3 SeaWiFS

Problems with the scaling and unit consistency within the 36 ocean color products have been corrected.

The SeaWiFS to MODIS data converter experienced a number of problems which caused the L1 output to differ from SeaWiFS and AVHRR versions.

The 765/865 nm band pair atmospheric correction produced low values for epsilon La(765), resulting in elevated Lw(555).

E.2 Matchup Database

Decision trees developed using the same input parameters as NOAA-14 and NOAA-11 did not perform well for NOAA-7. Production of NOAA-7 coefficients is proving to be difficult due mostly to low matchups data density.

E.3 Software Support

Compatibility problems with IRIX and the RAID firmware have caused an individual controller to not be able to address multiple LUNs.

IRIX 6.5 causes SGI Challenge-series computers to crash with ATM or FDDI interfaces.

The new 7000 DLT drives are plagued with a high number of failures with tape leaders.

73.68421	0	1	1	0	1	1	1	1	1	1	1	1	1	0	1	0	0	0	1	1
89.47368	1	1	1	0	0	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1
84.21053	0	1	1	0	1	0	1	1	1	1	1	1	1	1	1	1	1	0	1	1
57.89474	0	0	0	1	1	1	1	1	1	0	1	0	1	1	1	0	0	0	1	0
57.89474	0	0	1	1	0	0	1	1	1	1	1	0	1	1	1	0	0	0	0	1
57.89474	0	0	1	0	1	0	1	1	1	1	1	1	1	1	1	0	0	0	0	0
84.21053	1	0	1	1	1	1	1	1	0	1	1	0	1	1	1	1	1	0	1	1
57.89474	1	0	1	0	1	1	1	0	1	0	0	0	1	0	0	1	1	0	1	1
73.68421	0	1	1	0	1	0	1	1	0	1	1	1	1	1	0	1	1	0	1	1
68.42105	0	1	1	0	0	1	1	1	1	1	1	0	1	1	1	1	1	0	0	0
84.21053	1	1	1	0	1	1	1	1	1	1	1	0	1	1	1	1	1	0	0	1
89.47368	1	1	1	0	1	0	1	1	1	1	1	1	1	1	1	1	1	0	1	1
94.73684	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1
68.42105	1	0	1	0	0	0	1	1	1	1	1	1	0	1	1	1	1	0	1	0
78.94737	1	0	1	0	1	1	1	1	1	0	1	0	1	1	1	1	1	0	1	1
89.47368	1	1	1	0	0	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1
73.68421	0	1	1	0	0	0	1	1	0	1	1	1	1	1	1	1	1	0	1	1
84.21053	1	1	0	0	1	1	1	1	1	1	0	1	1	1	1	1	1	0	1	1
84.21053	0	1	1	0	1	0	1	1	1	1	1	1	1	1	1	1	1	0	1	1
73.68421	0	1	1	0	1	0	1	1	1	1	1	1	1	1	1	1	0	0	0	1
73.68421	0	1	1	0	0	0	1	1	1	1	1	1	1	1	1	0	1	0	1	1
73.68421	0	1	1	0	0	0	1	1	1	1	1	1	1	1	1	0	1	0	1	1
76.07656	10	15	20	3	14	11	22	21	19	19	20	15	21	20	20	16	17	0	17	18