MODIS DATA STUDY
TEAM PRESENTATION

November 17, 1989

AGENDA

1. Analysis of Atmospheric Pressure Accuracy Required for MODIS-N and -T
2. Post-Launch Data Processing Scenario: Terrestrial
3. Post-Launch Data Processing Scenario: Atmospheric Sciences
4. Post-Launch Data Processing Scenario: Oceans and General
5. Post-Launch Data Processing Scenario: Product Integration

At a solar zenith angle 30° and spacecraft angle of 0° the viewing conditions are considered "favorable" (small atmospheric path length). The extra (or reduced) radiance incurred by pressure +15 mb and -15 mb from standard (±1.5%) was partially divided between aerosol radiance and water-leaving radiance, generating the errors shown in Figs. 2, 3, and 4. Note the Rayleigh-like shape of the errors in Figs. 2 and 3. The error in normalized water-leaving radiance produced errors in chlorophyll retrievals as depicted in Table 1.

Table 1. Percent error in estimated chlorophyll when atmospheric pressure is non-standard. Chlorophyll concentrations were computed using the CZCS algorithms from L_w computed at standard pressure. They differ from the concentrations used to compute the optical properties of the water because they represent an empirical relationship, rather than the model, which included only water and chlorophyll, and no other optically active substances.

Chlorophyll (mg m^{-3})	+ 15 mb	-15 mb
0.0328	6.7%	-7.3%
0.1332	-4.6%	5.9%
1.8002	-4.0%	5.1%
4.3047	-13.1%	19.9%
5.8452	-15.7%	24.0%

The errors in chlorophyll at low concentrations are probably acceptable but those at higher concentrations are not. Furthermore, the errors in $[L_w]_N$, at ± 0.07 mW cm^{-2} μm^{-1} sr^{-1} are too high for most MODIS applications requiring the blue wavelengths (e.g., gelbstoff concentrations, Case II chlorophyll). It should be noted that this error is within the digital count of the CZCS, and so was not important. However, atmospheric pressure is important for MODIS, with its higher radiometric sensitivity, and consequently must be accounted for. But at what resolution?

To get an idea of the atmospheric pressure accuracy required for MODIS, we examined the Preliminary Specifications Document for MODIS-N for September, 1989. In it were tabulated the minimum radiances detectable by MODIS-N (MODIS-T specifications were not available at the time of this report), which are plotted in Fig. 3, for those corresponding nearest the MODIS-T wavelengths. These may be considered baseline accuracy levels: if the error in $[L_w]_N$ due to incorrect atmospheric pressure are less than these minimum detectable radiances, then the error is negligible. In Fig. 4 we see that at P_o ± 15 mb the errors are clearly not negligible, even

Analysis of Atmospheric Pressure Accuracy Required for MODIS-N and T

Non-standard atmospheric pressure changes the Rayleigh optical thickness and thus affects the atmospheric correction required to obtain MODIS ocean data products. It has been recognized that surface atmospheric pressure observations are required to obtain accurate MODIS atmospheric corrections (Gordon, 1989). This is critical for ocean products because the atmosphere may contribute up to 90% of the total radiance signal received by the satellite.

Andre and Morel (1989) and Gordon et al. (1988a) examined this issue for the CZCS and found that expected variations in atmospheric pressure from standard conditions (1013.25 mb) were about ± 15 mb, considering that very low pressures are usually accompanied by clouds. Given this ± 1.5% variation in pressure, the CZCS did not require correction for atmospheric pressure because this error was of the same order as the CZCS digital count level (ranging from 0.09 to 0.02 mW cm^{-2} μm^{-1} sr^{-1}). However, they concluded that for ocean color sensors with higher radiometric sensitivity (e.g., MODIS), such a correction was necessary to keep the water-leaving radiance and chlorophyll retrievals within accuracy limits. They did not, however, specify at what accuracy the atmospheric pressure observations were required.

We attempted to assess the atmospheric pressure accuracy required for MODIS through a series of simulations of atmospheric corrections as proposed for MODIS by Gordon (1989). First the simulated standard total radiance viewed by the sensor was computed.

Optical properties of the water assuming five chlorophyll concentrations, 0.05, 0.5, 1.0, 5.0, and 10.0 mg m^{-3}, were obtained using the model of Sathyendranath and Platt (1988). These optical properties produced a spectral set of normalized water-leaving radiances for MODIS-T according to the model of Gordon et al. (1988b). Normalized water-leaving radiances $[L_w]_N$ are related to water-leaving radiances by

$$L_w = [L_w]_N \cos\theta_o \exp[-(\tau_r/2 + \tau_{oz})/\cos\theta_o] \qquad (1)$$

(λ-dependence has been suppressed) where θ_o is the solar zenith angle, τ_r is the Rayleigh optical thickness, and τ_{oz} is the ozone optical thickness. Normalized water-leaving radiances are thus the water-leaving radiance expected for a sun at nadir and with atmosphere removed.

Rayleigh radiance L_r at standard temperature and pressure was computed using a single scattering approximation (Gordon et al., 1983). Mean extraterrestrial irradiance was taken from Neckel and Labs (1984) as averages over the MODIS-T bands, and ozone absorption coefficients were taken from Bird and Riordan (1986). Aerosol radiance L_a was computed assuming an Angstrom exponent typical of maritime atmospheres (von Hoyningen-Huene and Raabe, 1987), with a radiance at 875 nm of 0.19 mW cm^{-2} μm^{-1} sr^{-1}.

Upon converting $[L_w]_N$ to L_w, the total radiance L_t could be computed at each wavelength by

$$L_t = L_r + L_a + tL_w \tag{2}$$

where t is the diffuse transmittance from the Earth to the satellite

$$t = \exp[-(\tau_r/2 + \tau_{oz})/\cos\theta] \tag{3}$$

where θ is the satellite zenith angle. The point here was to construct a spectral suite of realistic total radiances.

Given L_t, we then used the proposed atmospheric correction of Gordon (1989) to go back and retrieve L_r, L_a, and L_w, and then chlorophyll. In this method, Rayleigh is computed as before, assuming single scattering and standard pressure. Aerosol radiance is computed assuming L_w is zero at 875, 755, and 665 nm, and the Angstrom exponents determined at these wavelengths. The mean of the exponents at 755 and 665 nm was used to estimate the Angstrom exponents at smaller wavelengths, where L_w is not zero. By subtraction

$$tL_w = L_t - L_r - L_a \tag{4}$$

we could obtain the diffusely transmitted water-leaving radiance, and eventually the normalized water-leaving radiance by Eqn. 1. These results are shown in Fig. 1, where $[L_w]_N$ has been shown instead of L_w because it is this value that is used to compute chlorophyll.

These data formed the basis of the analysis, all of the computations having been performed at standard pressure.

Increasing or decreasing the atmospheric pressure changes the Rayleigh optical thickness. However, if standard pressure is assumed for the atmospheric correction, this change in optical thickness will be reflected in the total radiance, rather than the Rayleigh radiance, where it belongs. To simulate the errors associated with uncompensated pressure in the atmospheric correction algorithm, we added this radiance to the total radiance. We then went back through the atmospheric pressure assuming standard pressure. By comparing the results to those obtained when pressure actually was standard, we could estimate the error associated with non-standard pressure.

under these favorable viewing conditions.

The atmospheric correction algorithm was again run at different departures from standard pressure, for an unfavorable viewing geometry, to understand the maximum error and the minimum accuracy requirement. The solar and spacecraft viewing geometry is listed in Table 2.

Table 2. Solar and spacecraft angles used to determine atmospheric pressure requirements for unfavorable viewing conditions.

Solar zenith angle	60°
Solar azimuth angle	0°
Spacecraft zenith angle	50°
Spacecraft azimuth angle	120°

The spacecraft angles correspond to a 20° tilt, at the end of a swath. The solar angles correspond to northern hemisphere winter at 40° N latitude, at 1:30 PM (the MODIS equator-crossing time). The CZCS could not produce reliable data at greater winter solar zenith angles. Therefore these angles represent extreme viewing conditions. If the pressure accuracy meets these requirements, it should meet the vast majority of MODIS operational scenarios, and provides a good test of the accuracy required for pressure data.

The 410/415 nm bands on MODIS-T/N have the greatest error due to non-standard atmospheric pressure. Therefore, this band was used to assess the accuracy required to meet the minimum detectable radiance for MODIS-N. Table 3 shows the error in $[L_w]_N$ when pressure is known to various accuracies.

Table 3. Error in $[L_w]_N$ at 410 nm when atmospheric pressure is known to various levels. Minimum detectable radiance for MODIS-n at this band is 0.005 mW cm^{-2} μm^{-1} sr^{-1}. At unfavorable viewing conditions.

Error in $[L_w]_N$ mW cm^{-2} μm^{-1} sr^{-1}	Pressure mb
0.14	15
0.07	7.5
0.009	1
0.004	0.5

Thus, atmospheric pressure must be known to 0.5 mb to keep the error in $[L_w]_N$ below the minimum detectable radiance.

Unfortunately, 0.5 mb is probably an unrealistic expectation for the MODIS era. Wayman Baker of NOAA, however, suggested that 1 mb in NMC synoptic analyses is probably realistic for the MODIS time frame for the northern hemisphere. At 1 mb, the errors in $[L_w]_N$ are as shown in Figs. 5 and 6. The maximum error in $[L_w]_N$ is < 12% even under high chlorophyll, and < 4% elsewhere. Also, the absolute error in $[L_w]_N$ is within $\pm$ 2 times the minimum detectable radiance. Errors in chlorophyll at 1 mb are as shown in Table 4.

Table 4. Error in chlorophyll when atmospheric pressure is - 1 mb of standard pressure (+ 1 mb gives similar absolute percent errors, but reverse in sign).

Chlorophyll	Percent Error
0.03	-0.8%
0.13	0.7%
1.74	0.5%
4.19	1.9%
5.74	2.3%

Thus, given an accuracy of $\pm$ 1 mb, the residual error in $[L_w]_N$ and chlorophyll may be considered acceptable. It also appears that $\pm$ 1 mb is attainable, at least for the northern hemisphere. For the southern hemisphere, errors may be as large as several mb (Wayman Baker, personal communication), and thus the accuracy of radiance and chlorophyll retrievals will be less here. But the accuracy goal of $\pm$ 1 mb in atmospheric pressure appears at this time to be a reasonable and achievable standard.

If one assumes that pressure changes are of the order 1 mb per 100 km, then the above analysis suggests a requirement of 1° by 1° NMC synoptic atmospheric pressure analyses for the MODIS ocean processing scenario for atmospheric corrections.

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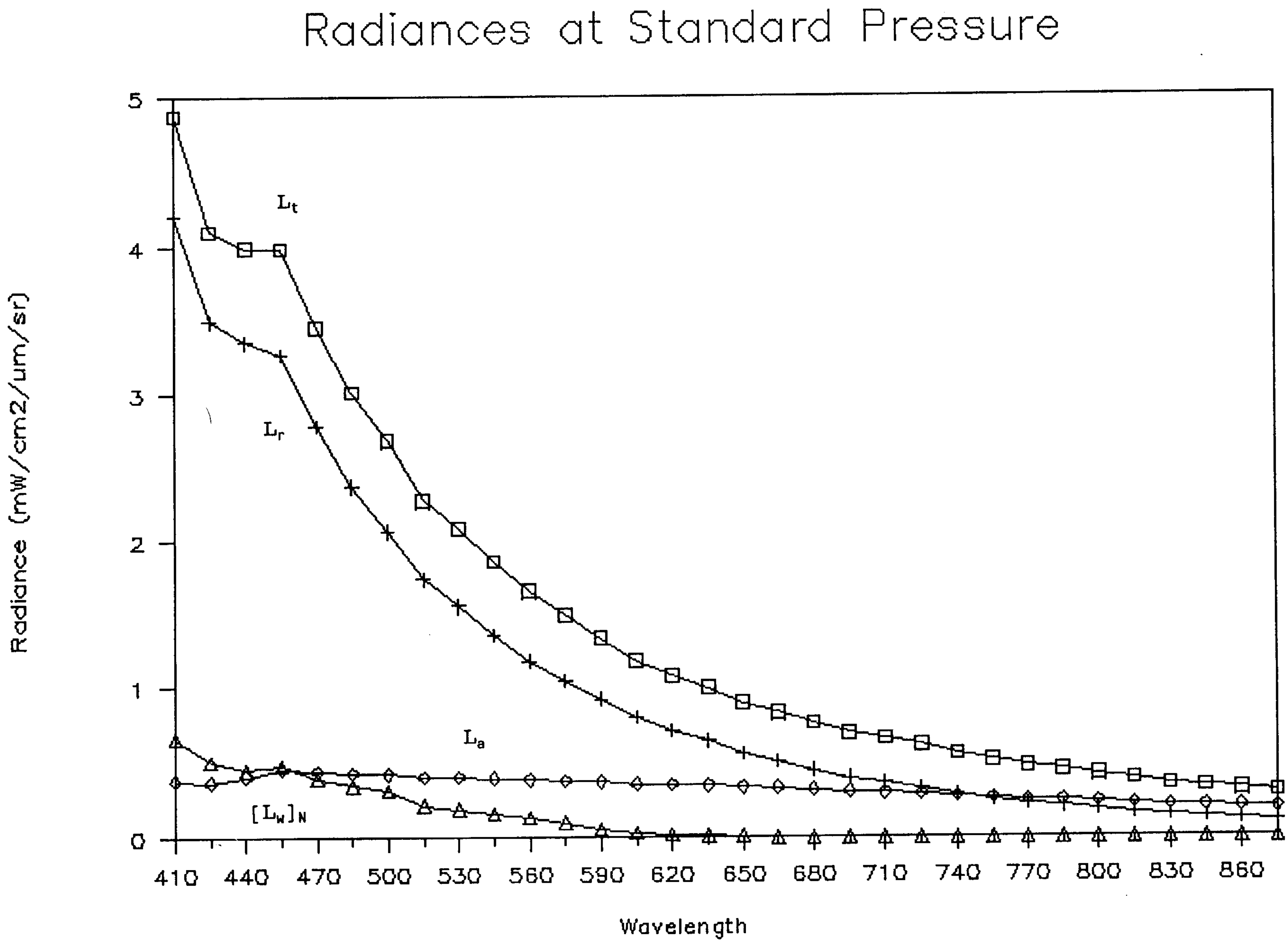


Fig. 1. Total (L_t), Rayleigh (L_r), aerosol (L_a) and normalized water-leaving radiances ($[L_w]_N$) at standard pressure and low chlorophyll ($C < 0.05$ mg m^{-3}).

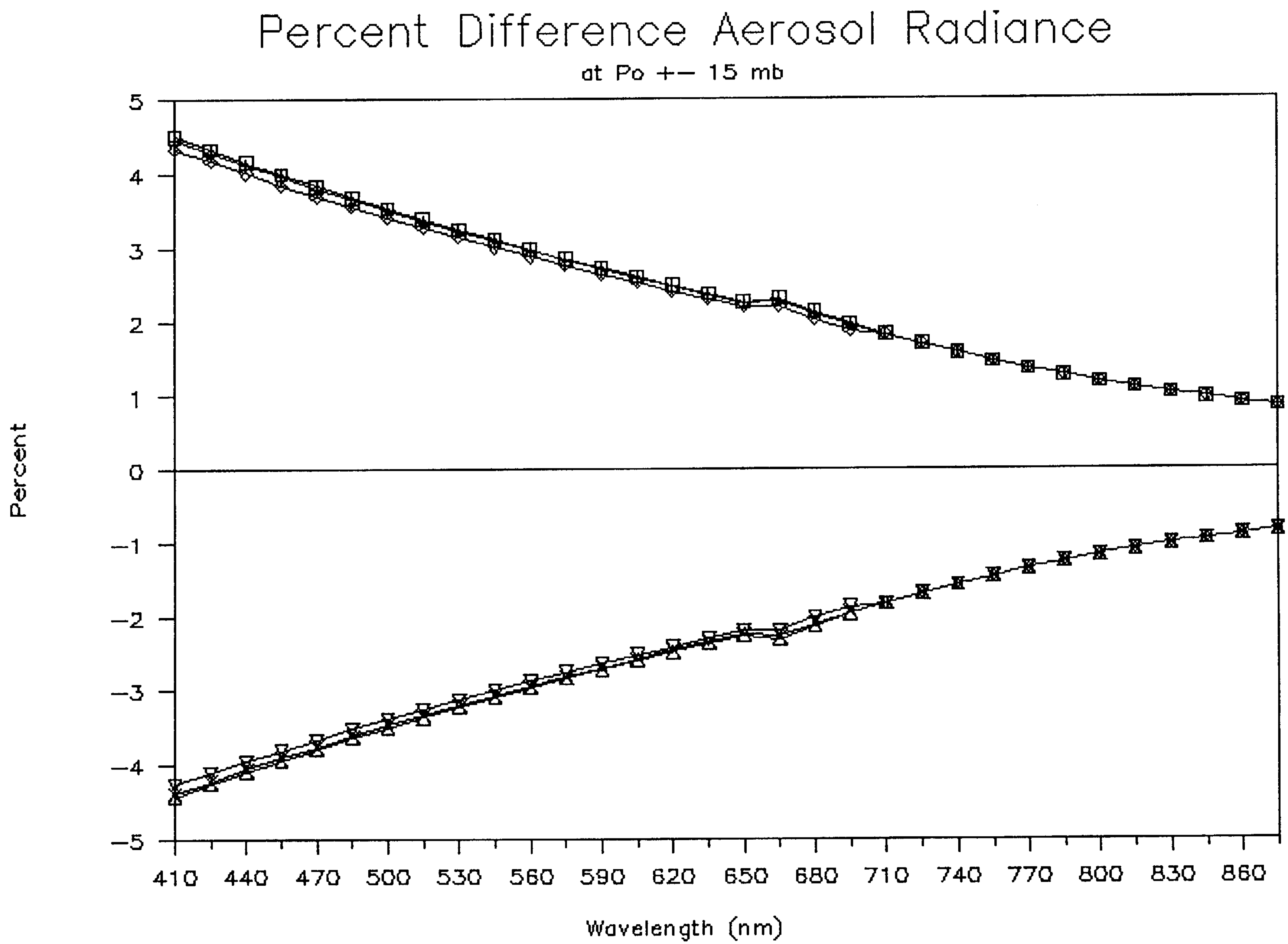


Fig. 2. Percent difference in aerosol radiances at $P_o \pm 15$ mb from those at P_o, if one performs atmospheric corrections assuming P_o. Three different chlorophyll concentrations (0.03, 1.0, and 5.0 mg m^{-3}) are shown, and the difference is insignificant.

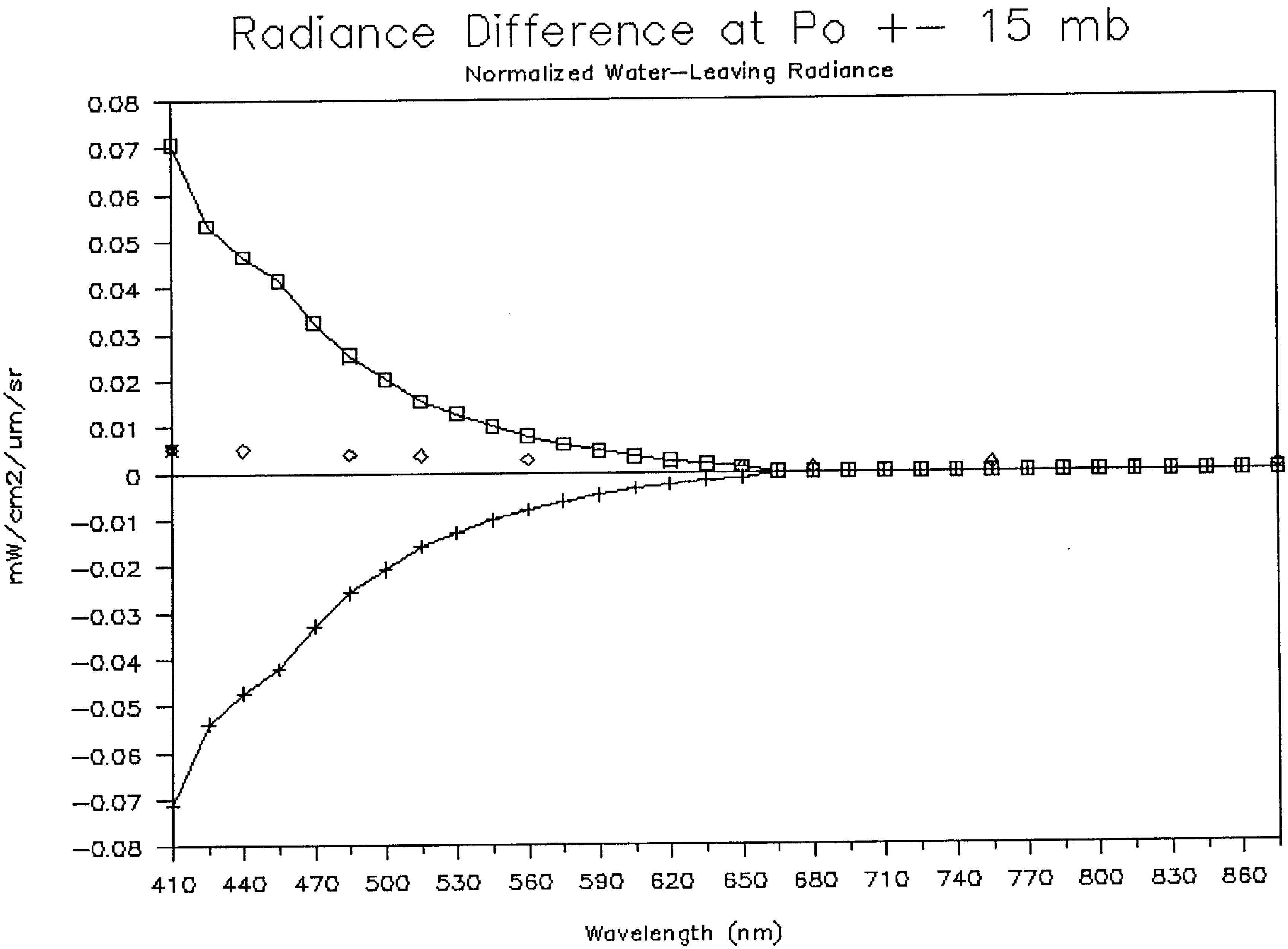


Fig. 3. Absolute difference in normalized water-leaving radiance when pressure is ± 15 mb, and atmospheric corrections are performed assuming P_o. Also shown are the MODIS-N minimum detectable radiance (diamonds) for wavelengths nearest the corresponding MODIS-T wavelengths.

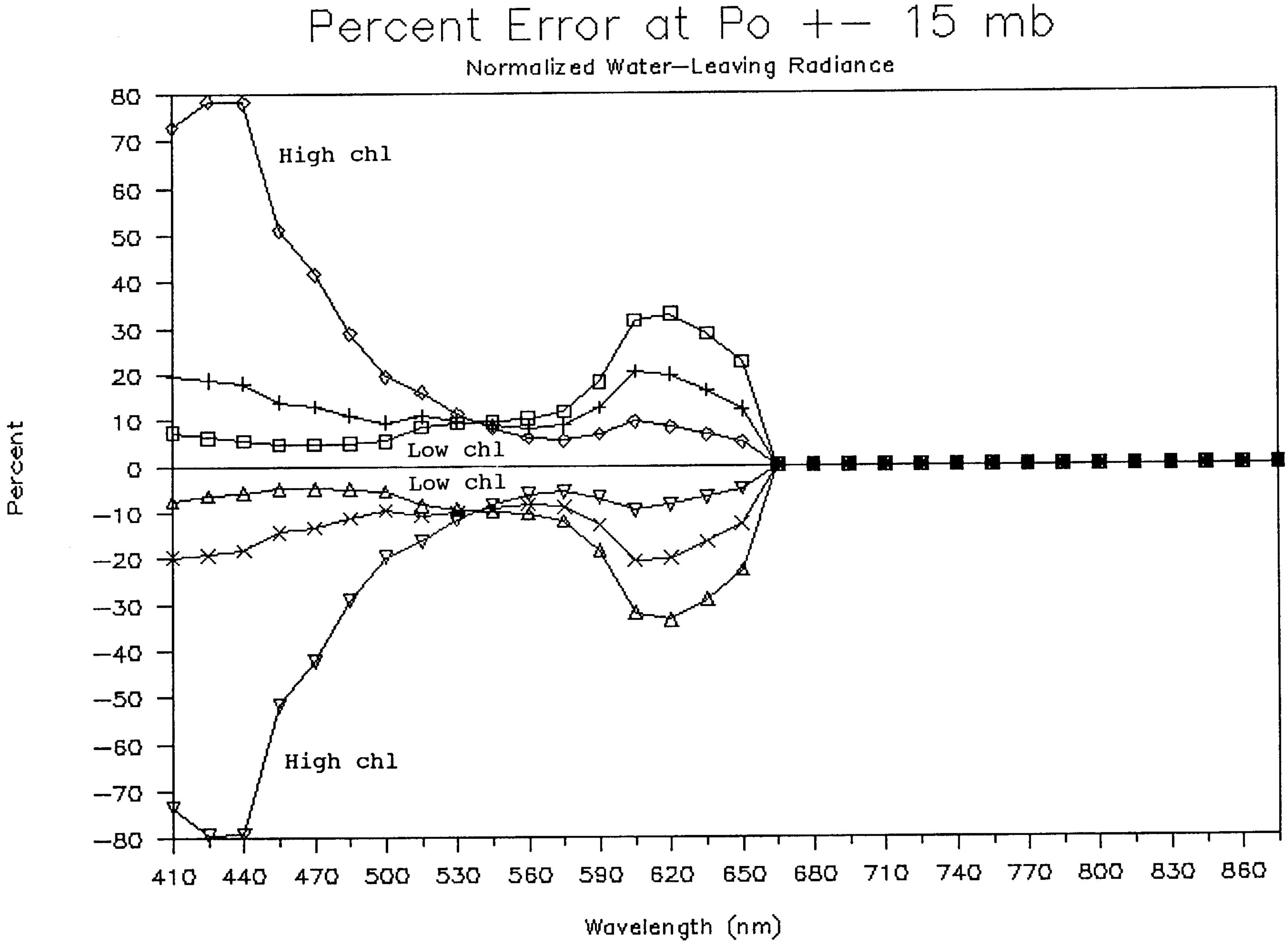


Fig. 4. Percent difference in normalized water-leaving radiance at ± 15 mb for three chlorophyll concentrations (< 0.03, 1.0, > 5.0 mg m^{-3}).

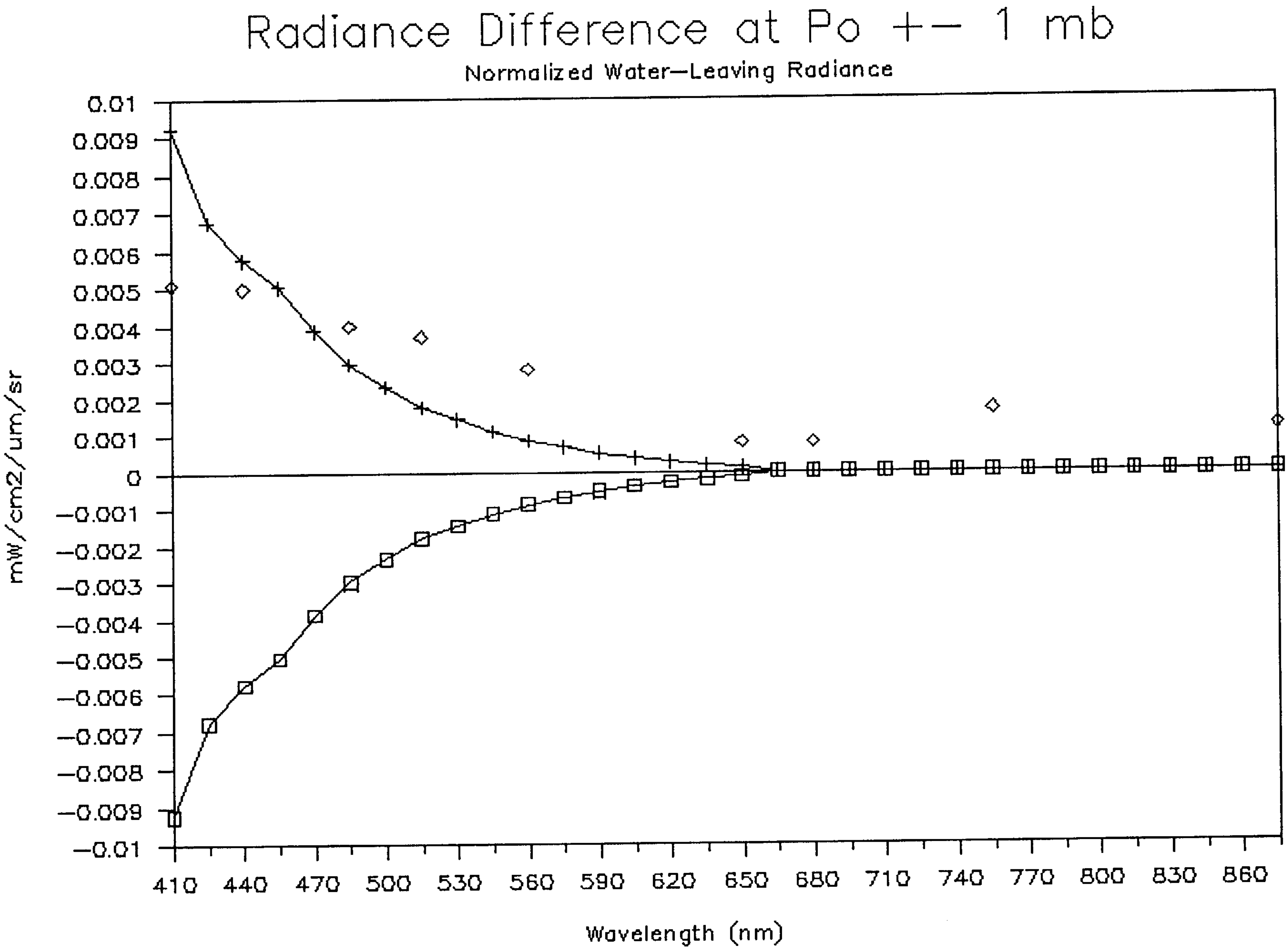


Fig. 5. Absolute difference in normalized water-leaving radiance when pressure is ± 1 mb, and atmospheric corrections are performed assuming P_o. Also shown are the MODIS-N minimum detectable radiance (diamonds) for wavelengths nearest the corresponding MODIS-T wavelengths.

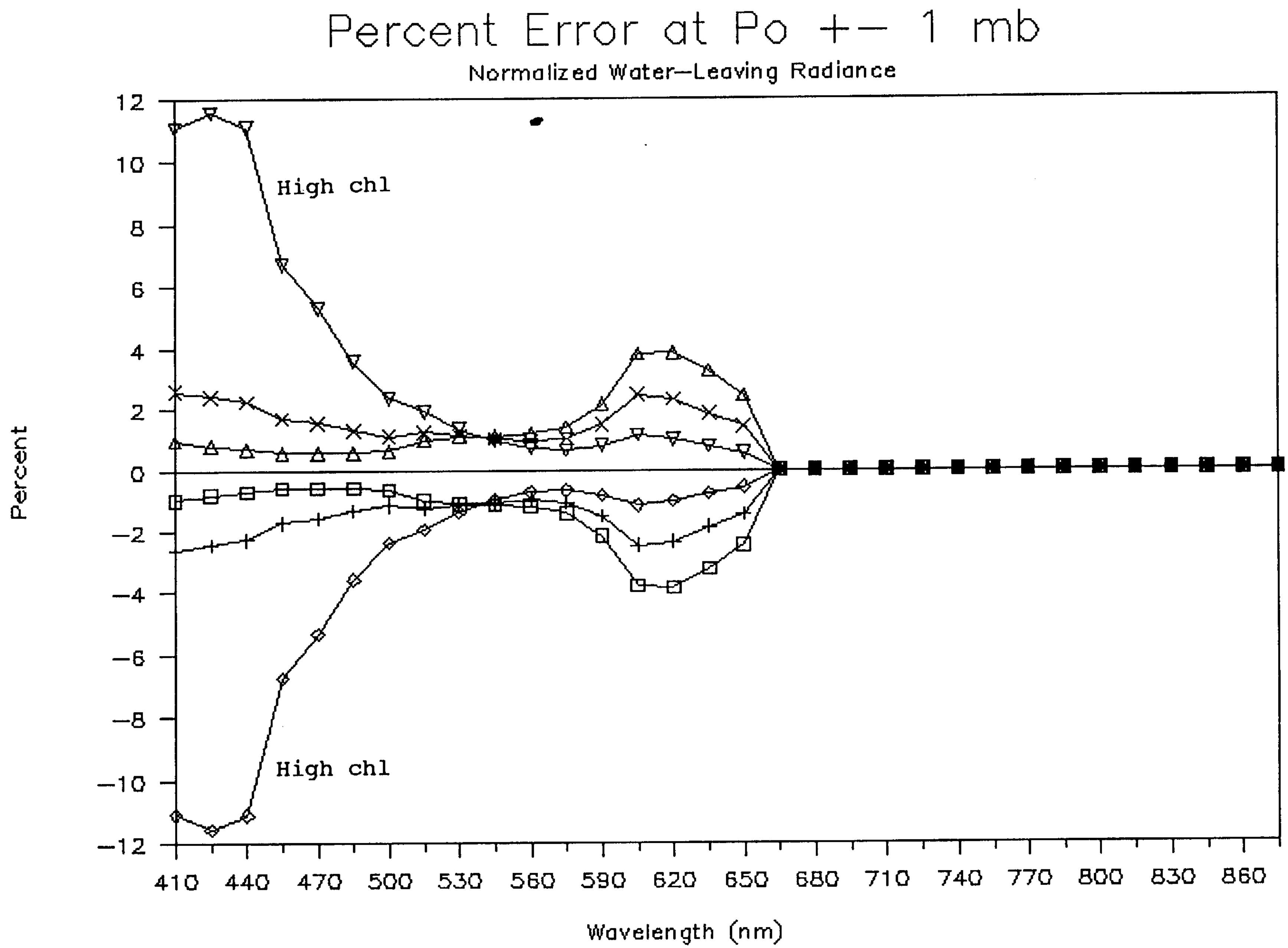


Fig. 6. Percent difference in normalized water-leaving radiance at ± 1 mb for three different chlorophyll concentrations (< 0.03, 1.0, > 5.0 mg m^{-3}).

Post-Launch Data Processing Scenario

TERRESTRIAL

A. Goal

To facilitate the selection and development of algorithims amoung MODIS team members for the production of standard data products for monitoring terrestrial change temporally and spatially.

b. Begining assumptions

That the TMCF will be initially supplied with Level 1 core products and will be producing Level 2,3 and 4 for the CDHF.

Algorithms for production of higher level data products, developed from simulalted MODIS sensor data and other sensors in the prelaunch phases, will be operational.

Inital input will only be from the MODIS team members. Input from the scientific community at large will be expected after an inital start up period.

C. Overview of post launch data processing

First processing will be to produce calibrated Level 1 products for TMCF's. Calibration will be a continual activity over the life of MODIS to check and verify sensor output. Calibrated data will then be delivered to TMCF's in the disciplines of; atmosphere, land, and oceans, where they will work on thier research and development products. TMCF's R&D products will then be sent to the CDHF for online production of standard data products to be available to the scientific community. The overview scenario is depicted in Figure 1. The disciplines of atmosphere, land, and oceans are presented as seperate research and development paths because, though they may be doing similar research, eg atmospheric corrections, they differ enough in methodology and objectives of reserch to require seperate, but, not isolated processing scenarios.

Data processing scenario for standard data products, LAND:

Overview: Algorithms used to produce the map products, with ancillary data sets if needed, that become standard data products produced by CDHF available to the scientific community. Depicted in Figure 2.

I. Algorithms

A. Algorithms developed at TMCF
1. Original code

    2. Revised editions of algorithm
    3. New algorithms
  B. Algorithms received at CDHF
    1. Re-coded or updated
    2. CDHF code output verified with TMCF code output
    3. Algorithm installed in a MODIS team members library

II. Map products produced at TMCF

  A. Delivered to CDHF
    1. Reproduced at CDHF from TMCF supplied algorithms

III. Ancillary data sets compiled at TMCF

  A. Delivered to TMCF
    1. Installed and linked to data products

IV. Standard data products from CDHF available to users

Anticipated Data Products from Team Members

Anticipated data products may be grouped into three categories; mapped products, data sets, and algorithms. Mapped products are expected to be in digital form and cover the extent of one or more MODIS images, as such they probably will be in essentially the same format as the Core Product received, perhaps with ancillary data. Data sets may be expected in the form of tabulated tables, and on various grid sizes of eg surface physical characteristics that were used to produce the mapped product. These data sets may be viewed as ancillary data and linked to a particular map product or algorithm. Algorithms, new and revised, may be expected from team members. Unless standard data formats and code have been implemented in pre-launch phases it is likely that the products coming into CDHF will be in a form unique to the TMCF and require re-coding to produce standard data products at the CDHF.

Transition to Standard Data Products at CDHF

Mapped products present, potentially the least intensive transitional effort as they should be in digital form and cover the same extent as the MODIS image(s) sent to the team member, it is expected that they will have a header file containing information on how the map was produced. For these digital maps to become standard data products they will need to be verified, produced in the same form at the CDHF as they were at the TMCF.

Data sets will probably come in the form of tabulated tables and at differing resolutions (grid sizes) containing information on surface physical parameters or atmospheric conditions. Whatever they contain it is likely that they will be specific to the team member's research, yet may be useable by others in data analysis or modeling even at different scales or resolutions. These data sets may come in a variety of forms from those that contain information for every pixel in an image to containing information at 1° grid cell size. These data sets may be considered as ancillary data used in the production of standard data products and should be linked to the data products in some manner as they would contain information on how the data product was created.

Algorithms developed or revised by team members present the greatest challenge in the effort to produce standard data products. Assuming the worse; that code for algorithms will arrive written in different languages and with machine specific features, a major effort will be required to recode and verify output at the CDHF before a standard product is released. And to further confuse the situation, several team members may be supplying algorithms to accomplish the same goal eg atmospheric corrections, and vegetation indices. It will be desirable for these differing algorithms to be available to all team members to compare and contrast their performance over different biomes.

A possibility for terrestrial ecology studies with Eos is the assembling of a group selected biome images to be used as standard data sets (images) for evaluating and contrasting team members algorithms for atmospheric corrections and vegetation indices. Team member proposals propose to develop vegetation indices, and other algorithms for producing information about the surface for the MODIS data over a wide range of biomes and a selected set of biome images would facilitate evaluating the performance of developed algorithms or analysis techniques over a wide range of terrestrial conditions before any one in particular algorithm or analysis technique is chosen to potentially produce a standard product at the CDHF.

FIGURE 1

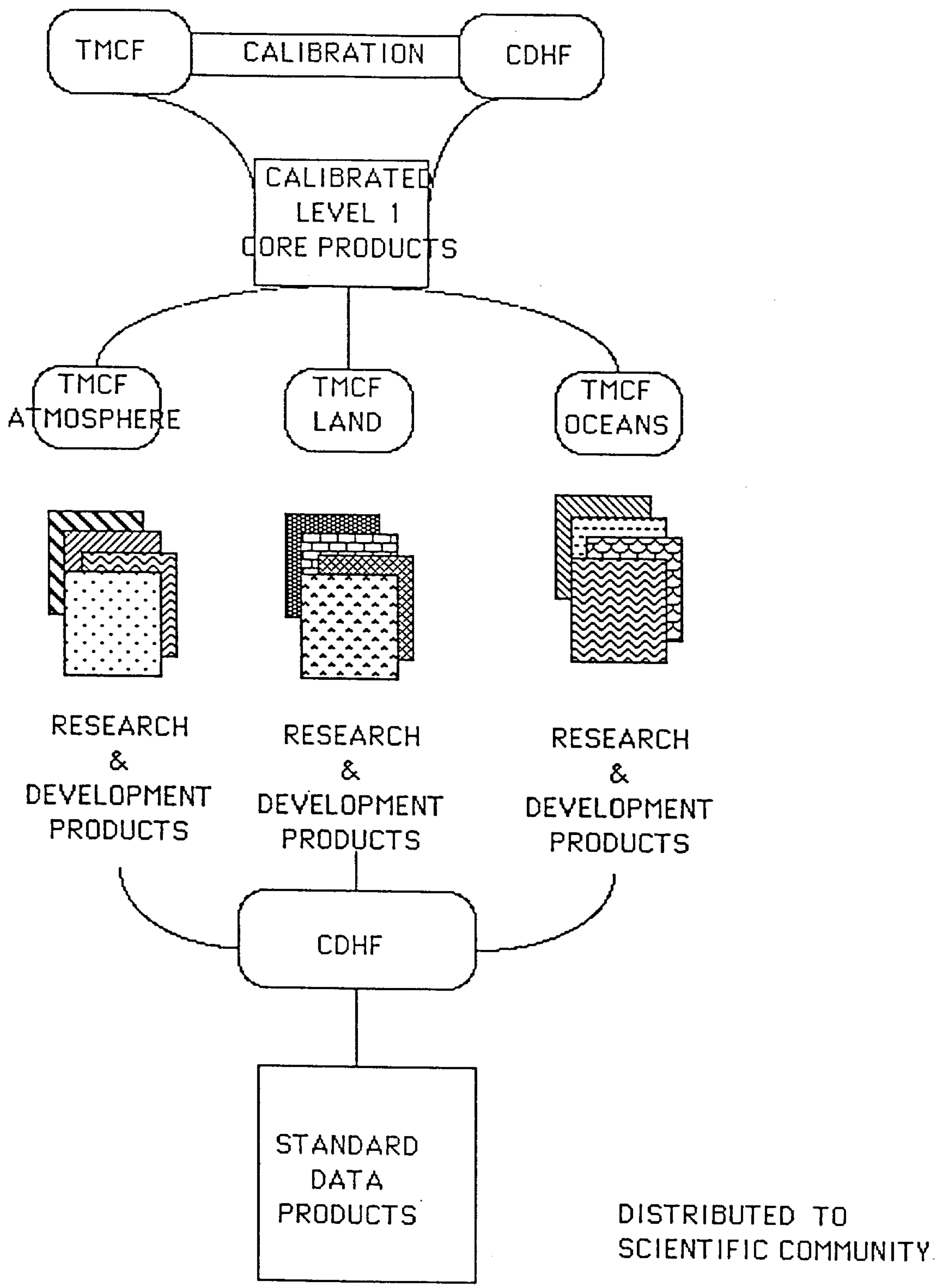
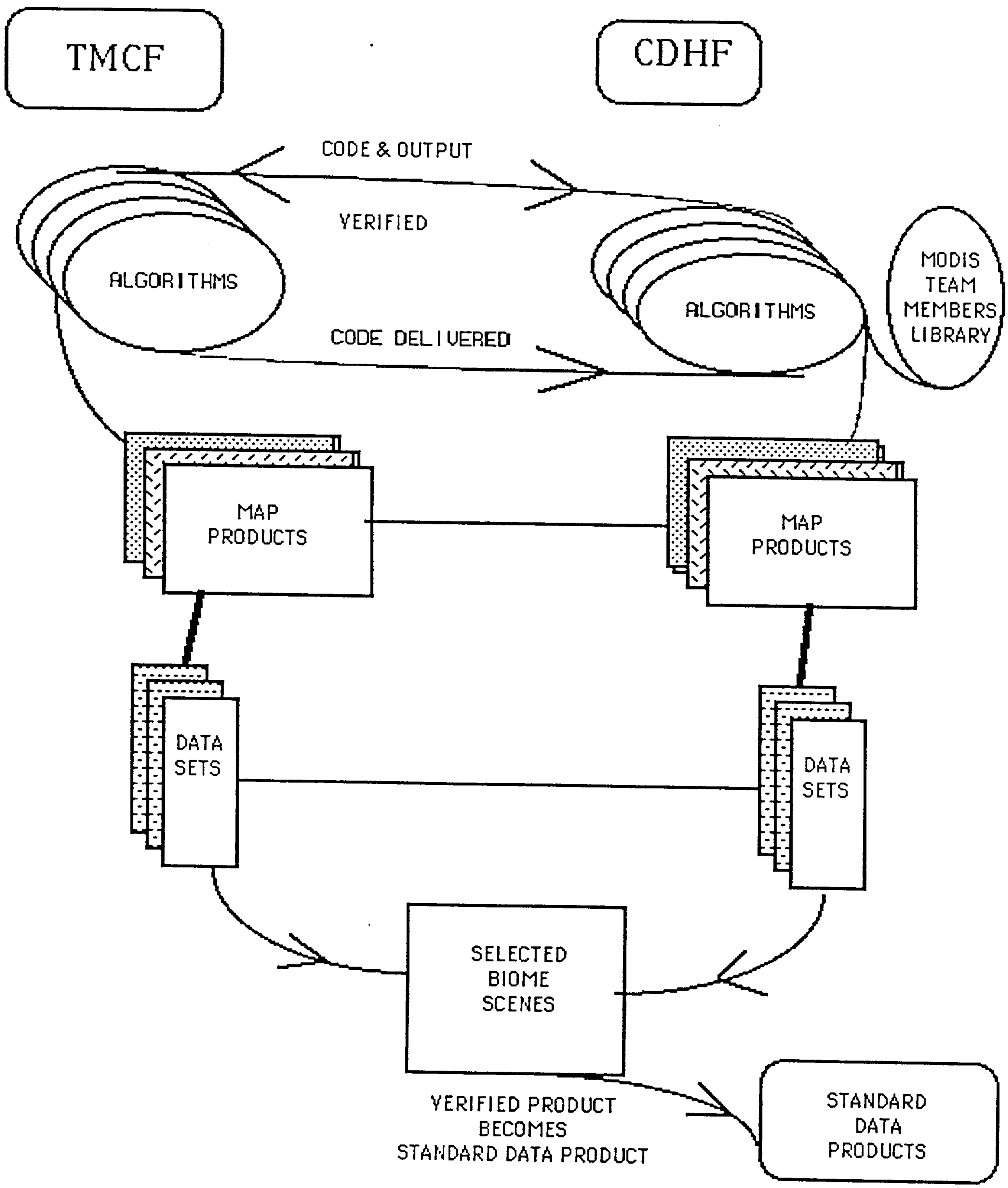

TMCF
CALIBRATION
CDHF
CALIBRATED
LEVEL 1
CORE PRODUCTS
TMCF
ATMOSPHERE
TMCF
LAND
TMCF
OCEANS
RESEARCH
&
DEVELOPMENT
PRODUCTS
RESEARCH
&
DEVELOPMENT
PRODUCTS
RESEARCH
&
DEVELOPMENT
PRODUCTS
CDHF
STANDARD
DATA
PRODUCTS
DISTRIBUTED TO
SCIENTIFIC COMMUNITY

FIGURE 2


TMCF
CDHF
CODE & OUTPUT
VERIFIED
ALGORITHMS
ALGORITHMS
MODIS TEAM MEMBERS LIBRARY
CODE DELIVERED
MAP PRODUCTS
MAP PRODUCTS
DATA SETS
DATA SETS
SELECTED BIOME SCENES
VERIFIED PRODUCT BECOMES STANDARD DATA PRODUCT
STANDARD DATA PRODUCTS

Post-Launch Data Processing Scenario

ATMOSPHERIC SCIENCES

The following is a proposed outline for section on post-launch processing scenarios for the atmospheric data products:

1) Introduction
2) Candidate data products proposed by team members
3) Potential data products from interdisciplinary investigators
4) Data processing flow charts with added data products
5) The role of spatially and/or temporally limited data products
6) Projected future growth in atmospheric data processing

Some atmospheric data products were proposed by team members, but did not become core data products. These research and development studies have the potential of becoming core data products sometime after launch. A list of these candidate future core data products is:

1) Aerosol transport processes
2) Aerosol effects on cloud albedo
3) Longwave cloud forcing studies
4) Precipitation studies
5) Cloud free albedo
6) Spectral bi-directional reflectance distribution using MODIS-T in stare mode
7) Atmospherically corrected imagery
8) Total column precipitable water within clouds

Interdisciplinary investigators and perhaps even members of the wider scientific community may wish MODIS to generate data products which are not now proposed as core data products. Until the interdisciplinary proposals are available, the exact nature of the requirements they may impose on the data processing will not be known. Some potential data products which may be proposed by Interdisciplinary Investigators and others are:

1) Surface radiation budget components
2) Top of the atmosphere radiation components (global?, regional?, temporally limited?)
3) Aerosol height distribution
4) Surface energy balance components such as sensible and latent heat fluxes
5) Teleconnection studies
6) Mesoscale model predictions
7) Global general circulation model studies
8) Wind speeds from cloud observations

The data processing scenarios will exercise the requirements as they are now understood. Some of the questions about data product integration that may be addressed are:

1) How will atmosphere core data processing flow charts be affected by implementation of each of above data products?

2) Will non-atmospheric core data products be affected?

3) What is the role of on-demand processing? Will CDHF handle it or is it a TMCF responsibility?

4) How will special, time or space limited studies, be handled, assuming TMCF resources are not adequate for the problem?

5) How will problems of different size grid resolutions be resolved? Will EosDIS require that MODIS geophysical parameters be stored at the highest spatial resolution so lower spatial resolution data products can be derived? When will the compatibility of grid resolutions within the three MODIS science disciplines be decided upon?

6) What is the expected yearly growth rate in atmospheric data processing?

7) How does a data product proposed by an interdisciplinary investigator become a core data product? What are the steps in this process?

8) What is the SDST role in the atmospheric sciences? (See section on Integration?)

Post-Launch Data Processing Scenario

OCEANS AND GENERAL

A. Sensor Calibration

The visible, near infrared and thermal infrared bands of MODIS-N and T must be continually monitored post-launch to ensure high consistency of the Level 1B calibrated radiances. This requires ongoing and continuous calibration procedures.

Question: Should these calibration data be stored at the Level-1 processing stage to allow investigators to perform their own checks?

B. Core Data Product Validation

At least for the first six months after launch, intensive core product validation efforts should take place to ensure the quality and validity of the core products. These validation efforts should be performed by the Science Team Member(s) responsible for the core product. Thus communication links between CDHF and the TMCF should be established and operational for the post-launch validation procedure.

Question: How will these communication links be established? Will they be direct electronic lines or is 9-track magnetic tape or optical disc acceptable?

In addition, in-situ ship observations and drifting buoy data will be used by one or more of the Science Team Members for validation.

Question: Should these in-situ data be made available to all members through the CDHF? If so, this will require Science Team Members to submit their in-situ data to CDHF for archival and distribution.

Validation efforts may continue after the first six months post launch, but it is undecided when and how often. Checks may be made on an annual basis to ensure data quality, or an in-situ network of buoys and ships of opportunity may be utilized in an ongoing, continuous validation exercise.

Question: Will these later checks will be performed by the Science Team Members or EosDIS internal to the processing scenario?

C. Research and Development (R&D) Products

In nearly all cases, Research and Development products for oceans are derived from Level-2 ocean core data products, and so do not impact the core data product processing scenario. Rather, they are additional products to the core data products, generated after most of the core products have been produced.

The exception to this scenario is with respect to Carder's R&D products (chlorophyll, suspended matter, gelbstoff, and detritus). Although Case II chlorophyll is listed as a core product, its inclusion in the R&D products reflects an expectation of substantial improvement given information on the distributions and abundances of suspended matter, gelbstoff, and detritus. These R&D products may then have substantial impact on the Case II chlorophyll products, and may also affect the Case II primary production core data products, since they depend upon knowledge of chlorophyll.

Question: In the case of R&D algorithms, how should they be sent to CDHF? Is a direct link required or is magnetic tape/optical disc acceptable? How will the algorithms be verified at CDHF? A suggestion is to require a benchmark data set to be submitted along with the algorithm to ensure proper operation of the algorithm.

Question: In the case of products such as Brown's and Barton's SST Quality Assessment Fields or Brown's Objectively Analyzed SST's, should these be delivered to CDHF for archival and subsequent distribution or may they be retained at TMCF?

D. Non-Team Member Access

Once MODIS is launched and the core data products validated, the data will be available for acquisition and use by members of the general scientific community. One may logically anticipate major use of these data and improvements in algorithms by these non-MODIS Science Team Members.

Question: How will it be decided which algorithms to use in the processing scenario? Will the Science Team decide on data product algorithms? Will there be a library of alternate algorithms for the same products available for users' choice?

Furthermore, one may anticipate that at least several new products will be developed by the general community.

Question: Will these new products enter the MODIS data processing scheme? If so, how will they enter and who will decide which to enter?

A decision team of TMCF & CDHF members to decide on reprocessing requests, algorithms used, revised, and out of the ordinary processing requests?

Once a standard data product(s) is agreed upon will the TMCF be producing it, or will CDHF produce all standard data products?

Should there be a SINGLE CDHF or MULTIPLE CDHF's, one for each discipline, or, SINGLE CDHF with resources partitioned among the disciplines?

E. Additional Questions

1. How are products validated at the CDHF? Does the Science team member supply bench marks to insure that the CDHF has properly implemented the algorithm? Who corrects errors?

2. How are results of field experiments incorporated into R&D products? Will all data at CDHF be available to all Science Team Members? all investigators?

3.How are changes incorporated into R&D products after they are running at the CDHF?

4. How does a non-STM get a MODIS product running at the CDHF? Is it a closed club? How about if a non_STM questions a product, how are changes made?

5. What happens when an R & D product conflicts with a core product output. What if regional SSTs differ from global maps?

6. Do regional products have to agree with global products for the same area? Will regional products be produced from regionally generated data? Will the same data be used for regional and global products? e.g., SSTs around Australia.

7. If regional products are produced by the STM in that region, how are the observations transferred to the TMCF?
How will processed data/products be transferred? Will regional products require regional data? Will they require special observational modes for MODIS?

8. Should all products be based on a common grid size. The analogy is to a digital map. When you draw a coastline map of the world you only use ever 100th point. When you draw a map of Chesapeake Bay, you use all of the points;i.e., (2048 X 4096, 1km, 4km, 10 km etc.) **Can map products be overlaid?**

9.Will regional products be routinely brought on line and processes at TMCF? Will products be transferred to other TMCF? If so, how? How are data and products transferred between TMCF and CDHF. Will there be any direct down loading of data from

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3.How are changes incorporated into R&D products after they are running at the CDHF?

4. How does a non-STM get a MODIS product running at the CDHF? Is it a closed club? How about if a non-STM questions a product, how are changes made?

5. What happens when an R & D product conflicts with a core product output. What if regional SSTs differ from global maps?

6. Do regional products have to agree with global products for the same area? Will regional products be produced from regionally generated data? Will the same data be used for regional and global products? e.g., SSTs around Australia.

7. If regional products are produced by the STM in that region, how are the observations transferred to the TMCF? How will processed data/products be transferred? Will regional products require regional data? Will they require special observational modes for MODIS?

8. Should all products be based on a common grid size. The analogy is to a digital map. When you draw a coastline map of the world you only use ever 100th point. When you draw a map of Chesapeake Bay, you use all of the points;i.e., (2048 X 4096, 1km, 4km, 10 km etc.) Can map products be overlaid?

9. Will regional products be routinely brought on line and processed at TMCF? Will products be transferred to other TMCF? If so, how? How are data and products transferred between TMCF and CDHF. Will there be any direct downloading of data from

TDRSS?

10. How are machine specific features in the implementing algorithm computer program handled? How are conflicting I/O requirements handled. What if an algorithm requires a MODIS-N product which isn't ready? computed?

11. How are conflicts resolved for products? for validation?

12. What specific languages will be available for implementationed of algorithms: FORTRAN, "C", UNIX ?

13. Will CDHF validate core products, R&D products?

14. How are R&D generated products updated? (only by originator?)

15. What happens if a STM leaves? Does a new individual become responsible for his products?

16. If the computer facility becomes size limited, how are products chosen for implementation?

17. How is a product removed from CDHF? Is quality, demand, validity, a consideration?

18. How are algorithm improvements implemented?

19. How shall algorithm efficiency be judged? By whom?

20. How are Case II waters flagged?

21. How are MODIS-N, T observations applied to regional products. Will there be data subsets?

22. How will non-MODIS data be integrated in a timely manner?

23. How much unique processing will be done to generate a regional product? Who says what is too much? What if an analysis program requires computational resources exceeding those available?

24. Will domestic and foreign STM operate under the same set of rules?

25. What will be the final determination as to how long Level-0 and Level-1 data remain on-line?

26. What quantity of Level-0 and Level-1 data will be transferred to any STM?

27. How much time will be available on CDHF for STM to get their algorithms running? How long before launch?

Post-Launch Data Processing Scenario

PRODUCT INTEGRATION

I. Definition of Product Integration

II. Goal of Product Integration

A. Minimize Use of Compute Resources
B. Facilitate Use of "Good" Scientific Procedures and Dissemination of "Good" Results (?)

III. Algorithm Design and Product Implementation Procedures to Facilitate Commonality Among Potential Products

A. At the TMCF

1. Data Available to Team Members in Single Common Format (Same as Used at CDHF)

2. Software Standards

B. At the CDHF

1. Peer Support and Review
2. Software Support Facilities

IV. Comparison of Redundant Products with Each Other and Validation Data.

QUESTIONS:

Why reduce system redundancy? Is the cost of redundancy primarily an increase in hardware requirements? Do increased software requirements just affect the implementing researchers? Or are software support personnel or other people affected? What about the ultimate data user, is he affected when multiple or inconsistent products exist?

What conduits for peer discussion will exist to help in the development of a common set of products?

How will Team Members who produce products become aware of the specific needs of those who will (or might) use their products?

What sorts of peer review will occur as new products are implemented on the CDHF? What sort of final approval will be needed?

How will available data processing resources be allocated among MODIS Science Team Members?

What sorts of software implementation support will be provided?

How will the data system support product comparisons?

Will intermediate results be available for comparison with results derived using other procedures?

How will common needs of several team members be identified? Who will respond to common data processing needs? How will a team member access information on products or software available from other team members or from the data support team?