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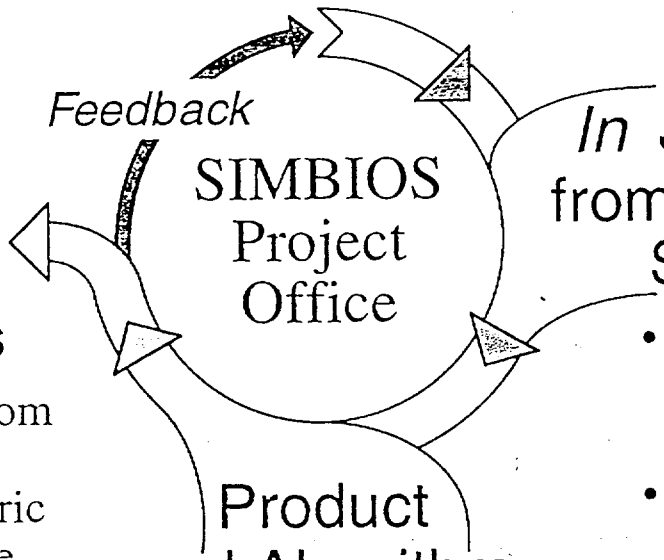
Ocean Color Product Evolution and Refinement

Mission Feedback

- Science community input.
- Comparison with other appropriate products.

Satellite Data from a Calibrated Sensor

- NIST-traceable laboratory characterization and calibration of the satellite sensor.
- Onboard (solar, lunar, lamps) calibrations.
- Vicarious calibration.



Improved Products and Algorithms

- New products from biogeochemical fields, atmospheric fields, alternative binning schemes, etc.
- Reprocessing due to new products, improvements in calibration, and product compatibility.
- DAAC interface.

In Situ Data from Calibrated Sources

- NIST-traceable *in situ* instrument calibration.
- Data collection in keeping with *Ocean Optics Protocols.*
- Data analysis in keeping with *Data Analysis Protocols.*
- Maintenance of an archive of calibrated *in situ* data.

Product and Algorithm Validation

- Atmospheric algorithm validation and development.
- Bio-optical algorithm validation and development.
- Satellite and *in situ* data binning and QC.
- Post-launch initialization.
- Access to an *in situ* archive of calibrated data.

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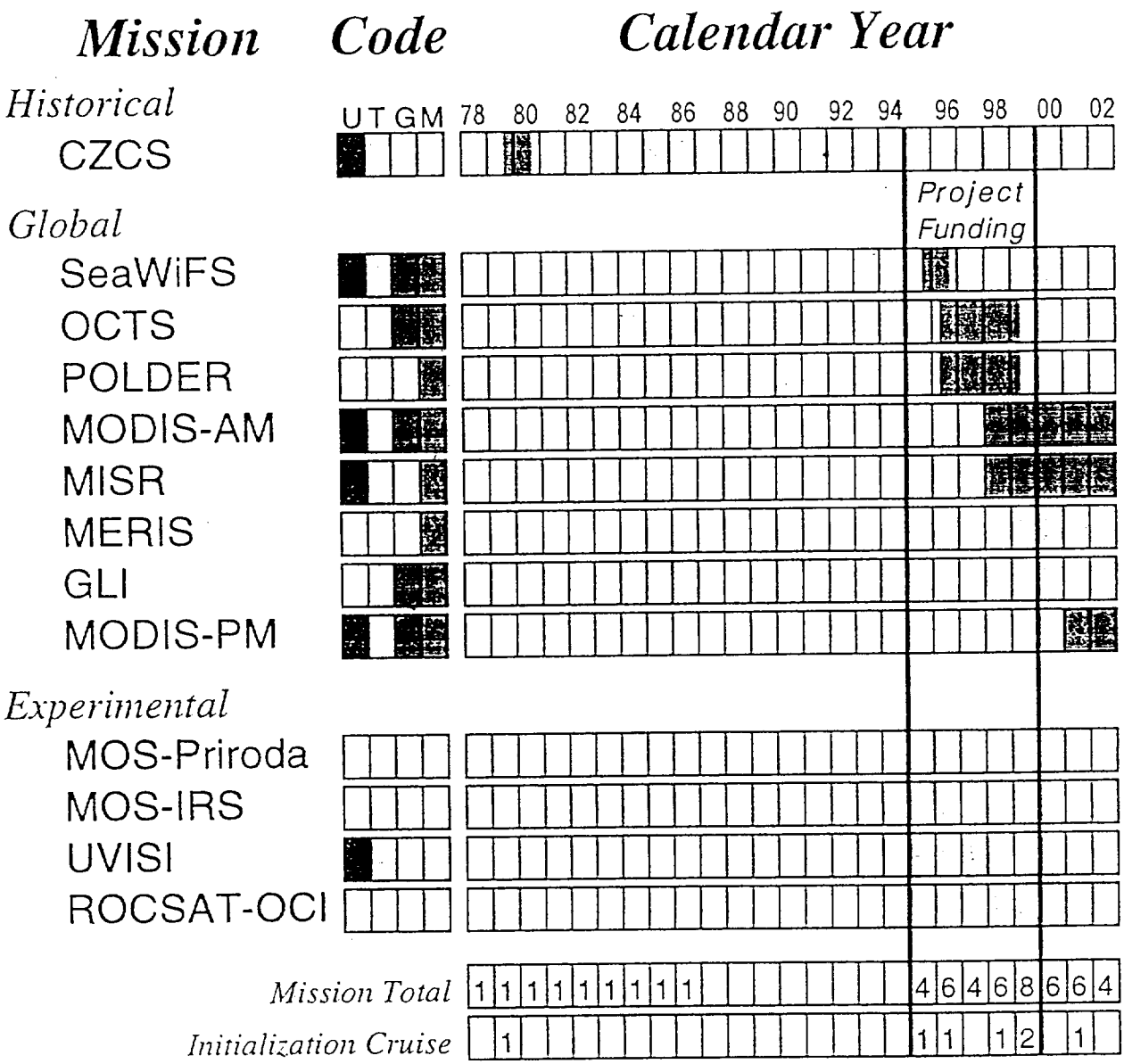
A Timeline of Ocean Color Missions



Code

- ■ ***U.S.*** *Mission*
- ***Tilted*** *Views*
- ■ ***Global*** *Coverage*
- ■ ***Meets*** *Cal/Val Paradigm*

Key

- ■ *Instrument and/or Science Team*
- *No Defined Team(s)*

SBH:10Mar95

SIMBIOS Budget
(Revised Plan; August 28, 1995)

Element Item							Comments
	Fiscal Year:	FY95	FY96	FY97	FY98	FY99	
SIMBIOS Project	(MP: C.S. = 5; Support = 12)						
Project Management (contractors/post-docs)							
Adm. Asst. (1/0)		55	55	55	55	55	
Equipment & supplies		25	25	25	25	25	
Meeting support		25	25	25	25	25	
TM Series (1/0)		70	70	70	70	70	
Calibration (1/1)		125	125	125	125	125	
Validation (2/1)		200	200	200	200	200	
~~Data Processing-staff (3/0)~~		~~250~~	~~50~~	~~50~~	~~50~~	~~50~~	
~~Data Processing-system~~		~~125~~	~~125~~	~~125~~	~~125~~	~~125~~	
Data Merger (1/1)		125	125	125	125	125	
~~On-site manpower costs~~		~~102~~	~~102~~	~~102~~	~~102~~	~~102~~	
	Subtotal	1192	992	992	1042	992	
					Total	5210	
Calibration							
Satellite Cal. Scale Tracability							
Round Robins (2/yr)		150	150	150	150	150	NIST
~~Stability Monitors~~		~~20~~	~~5~~	~~5~~	~~5~~	~~5~~	~~Contract~~
~~Community Calibration Support~~		~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~NRA~~
~~Special Studies~~		~~250~~	~~250~~	~~250~~	~~250~~	~~250~~	~~NRA~~
~~High Lat. Cal. & Val. Verific.~~		~~350~~	~~100~~	~~350~~	~~100~~	~~0~~	~~NRA~~
~~High Altitude Vicarious Cal.~~		~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~NRA~~
Common Atmos. Corr. Implement.		150	150	150	150	150	Contract
	Subtotal	920	655	905	655	555	
					Total	3690	
Validation							
~~Sun Photometer Support~~		~~30~~	~~30~~	~~30~~	~~30~~	~~30~~	~~NRA~~
Field Studies							
~~Productivity Time Series~~		~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~NRA~~
Augment. of U.S. Programs		400	400	400	400	400	NRA
~~PML/AMT~~		~~150~~	~~150~~	~~150~~	~~150~~	~~150~~	~~NRA~~
High Latitude Studies		Combined with Calibration line above					
~~Initializ. Cruises (augment)~~		~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~MODIS~~
~~N.W. Africa~~		~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~NRA~~
~~New Technology Exploitation~~		~~400~~	~~400~~	~~400~~	~~400~~	~~400~~	~~NRA~~
Optical drifter studies							
Automated towed systems							
Optical Mooring Augmentation							
	Subtotal	980	980	980	980	980	
					Total	4900	
Data Merger							
Algo. Dev. & Val. Studies		150	150	150	150	150	NRA
	Subtotal	150	150	150	150	150	
					Total	750	
	Total	3242	2777	3027	2827	2677	
					Grand Total	14550	

~~Deletions~~
~~Reductions~~

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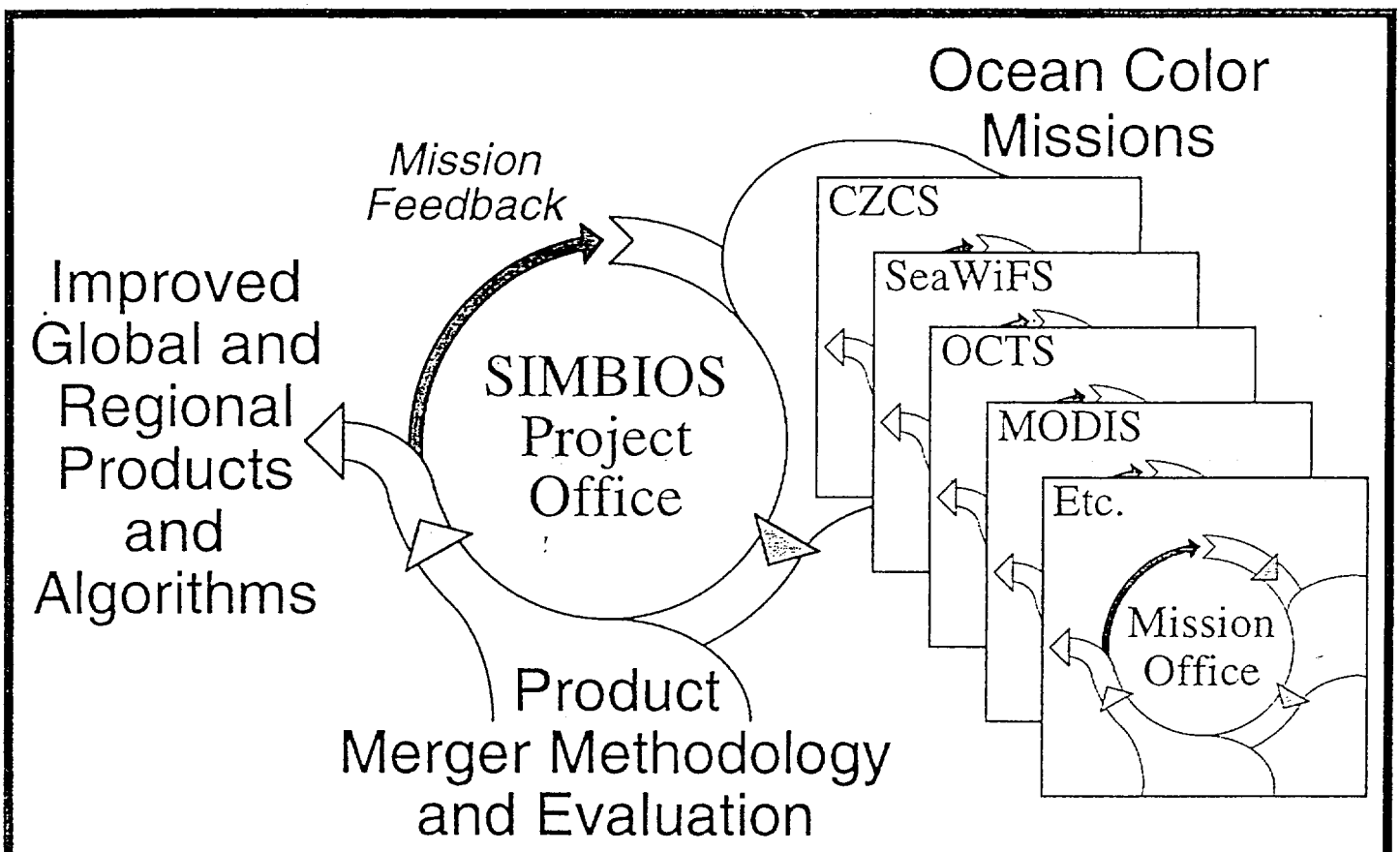
The Primary Components of SIMBIOS



SIMBIOS Project Office

Working Groups

- Calibration
- Bio-Optical Algorithms, Protocols, Data Merger
- Atmospheric Correction
- Primary Productivity
- Data Processing

- Project Management
- Project Elements:

  Calibration
  Validation
  Merger
  Processing
  International

- International Ocean Color Working Group
- NASA MTPE
- U.S. Interagency Coordination Group
- Ocean Biogeochemistry Science Advisory Panel

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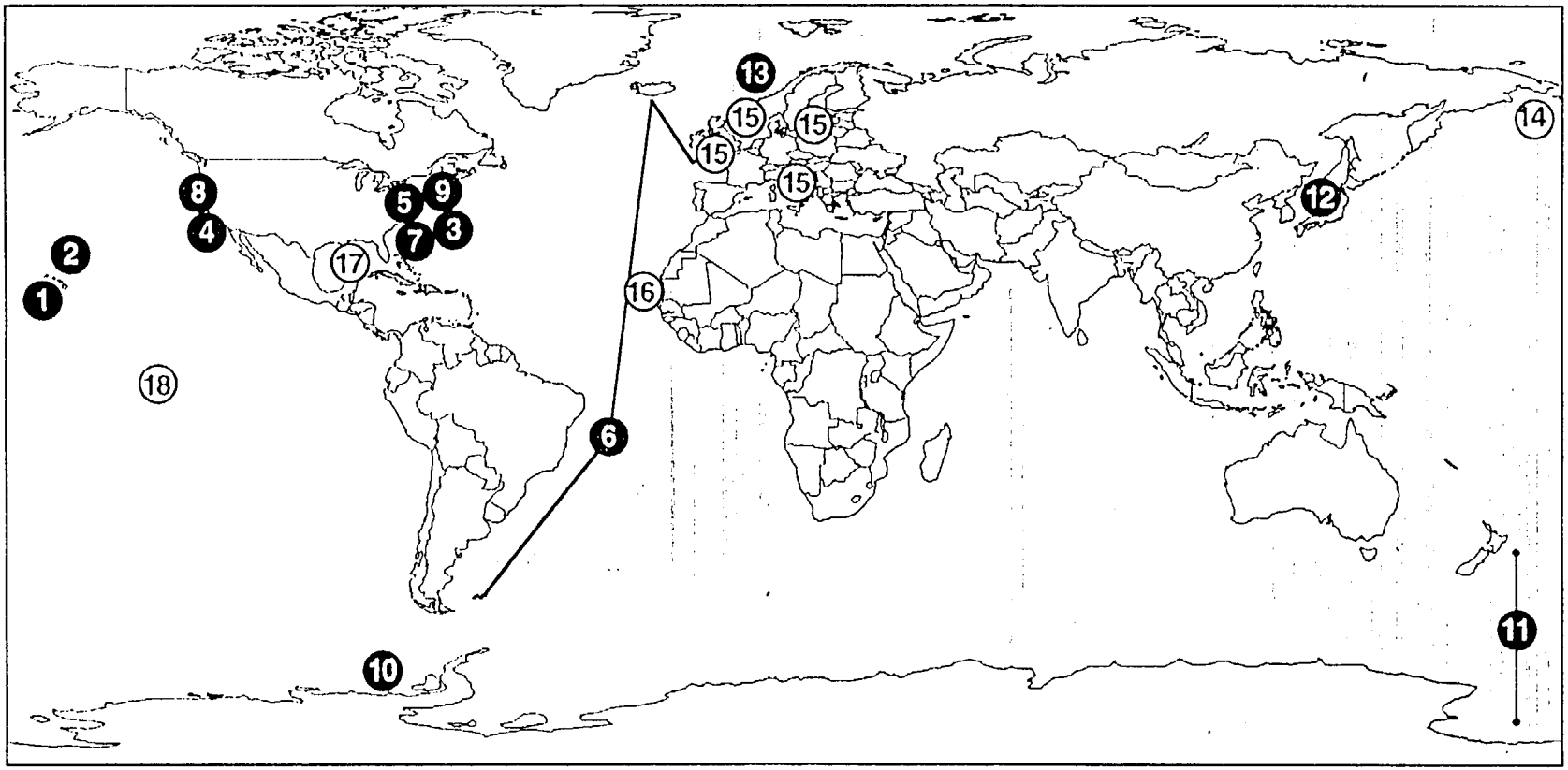
In-Water Validation Sites and Regions

○ *Proposed*



1. MOBY (NASA)
2. HOTS (NSF)
3. BATS (NSF)
4. CalCoFI (NOAA)
5. LMER (NSF)
6. PML/AMT (UK)
7. Ocean Margins Program (DOE)
8. Monterey Bay (MBARI)
9. Coastal Mixing & Optics (ONR)
10. LTER (NSF)
11. JGOFS (NSF)
12. YBOM (Japan)
13. Norwegian Studies
14. High Latitude (SIMBIOS)
15. PICASSO (European)
16. NW Africa (SIMBIOS)
17. Gulf of Mexico (NASA)
18. MBARI TAO (NASA)

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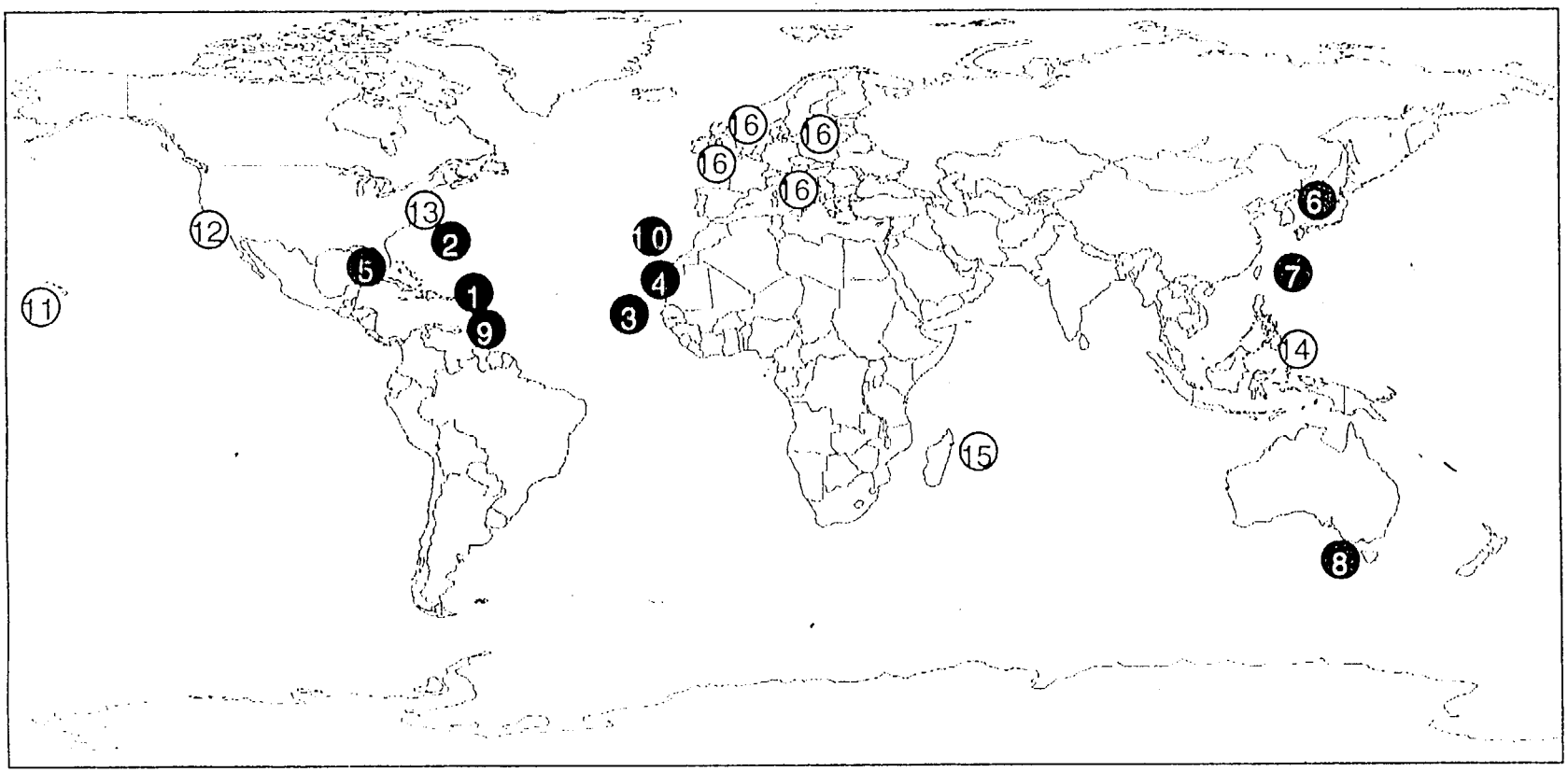
Coastal and Island Sun Photometer Sites



1. Barbados
2. Bermuda
3. Cape Verde
4. Dakar
5. Dry Tortugas
6. Niigata
7. Okinawa
8. Australia
9. Guadeloupe
10. Tenerife
11. Lanai (SIMBIOS)
12. La Jolla (SIMBIOS)
13. Wallops (SIMBIOS)
14. ARM
15. Reunion
16. PICASSO

○ *Proposed*

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A Synopsis of

SIMBIOS:
Sensor Intercomparison and Merging for Biological and Interdisciplinary Ocean Studies

Wayne Esaias, Chuck McClain
Nov. 13, 1995

In the next several years there will hopefully be multiple imaging sensors in orbit which will provide useful ocean color data on regional to global scales. A major benefit of this occurrance will be the increased spatial and temporal coverage of the highly dynamic ocean bio-optical system, in addition to the great decrease in risk of lack of any coverage due to a single failure. The SIMBIOS plan outlines a potential U.S. (mainly NASA) approach to enable scientific comparisons of the data produced from these missions.

While the principles of ocean color remote sensing are embraced by all the missions, no sensors are identical in terms of design, bands, swaths, viewing geometry, orbits, or equator crossing times, and differences will exist in the algorithms used by the various mission teams. Hopefully, these differences will result in only modest differences among the geophysical products both spatially and for regional averages. The differences will be in part random, and in part systematic, and will depend a great deal on the characteristics of data used to calibrate and validate the sensors and algorithms. Understanding these uncertainties, and separating potential instrument contributions from algorithm (atmospheric and bio-optical) and real geophysical variability, is necessary before data can be merged and assimilated into useful products. Additionally, these differences can be exploited to offer new insights into ocean processes, such as the occurance of diurnal and tidal effects.

The SIMBIOS plan recognizes five major areas which must be addressed in such an effort. These are:

1. Optical calibration and characterization of satellite sensors and validation sensors.
2. Validation of geophysical data products of individual and combined data.
3. Development of procedures for merging (assimilating) data obtained at different times and with different methodologies.
4. A data processing component beyond that associated with individual missions, for eventual routine assimilation of multisensor data, and associated DAAC activities.
5. Increased coordination, at the national and international levels, associated with the above, involving appropriate infrastructure beyond specific instrument missions.

The SIMBIOS plan was developed as a first approach toward these ends. While it resulted from a workshop with participation by 85 investigators associated with 5 missions, it was in response to a NASA program directive and therefore it is focused on specific implementation suggestions on the part of an intial NASA program. The proposed activities build upon those already planned by NASA as part of the SeaWiFS and MODIS efforts. It encompasses the activities proposed as joint activities between the U.S. and Japan for SeaWiFS/MODIS and OCTS intercomparison and validation, and encourages greater definition of these activities. It discusses and invites participation from ESA and the European Community. Most importantly, it encourages, among the larger international community, joint development of measurement protocols, calibration round-robins, sharing of at-sea and atmospheric validation data, and coordination of merging/assimilation data processing and distribution. Sharing of validation data collected by various national

programs, some of which are not directly associated with sponsoring a space mission, is extremely important in that these data are expensive to collect, and therefore difficult to obtain in wide-spread geographic regions.

Coordinating these efforts nationally and internationally will require a good bit of effort. The current SIMBIOS plan will undergo modification as the number of particpants and their degree of participation increase. Progress has been made in these areas both within the U.S., and on the international level. At the national level, two joint meetings with other ocean and ocean remote sensing agencies have been held, and broad consensus on the philosophy has been obtained. A primary concern is the ability of any agency to commit to joint plans during a period of down-sizing, but this also tends to force the issue for the sake of economy. A good mechanism to arrive at a consolidated US plan needs to be developed.

On the International level, the philosphy was strongly endorsed at an ad-hoc working group meeting on Ocean Color sponsored by the International Oceanographic Commission (IOC), in September, 1995. At their October meeting, the Committee on Earth Observing Satellites (CEOS) subsequently agreed to establish an Ocean Color Advisory Group, organized and administered by the IOC, with connections both to the Data Group and Calibration Group. This group will serve as a focus for planning joint calibration and validation activities. Already, the Joint Research Commission at Ispra has announced that they will sponsor an international calibration workshop this winter. The UK and NASA have begun an Atlantic Meridional Transect (AMT) program based on spring and fall cruises from 50-60 N to the Falklands. The US and Japan have held extensive discussions on joint utilization of the Hawaii MOBY site for OCTS calibration, and the YBOM site on Yamato Bank for joint validation of SeaWiFS, MODIS, and OCTS. Discussions are occurring with India with respect to access of data from the MOS sensor on IRS, and with DLR on MOS software.

Within NASA, we are still awaiting approval of plans for initial implementation. This plan calls for additional work beyond what was/is planned either for SeaWiFS and MODIS. For example, the optical mooring off Hawaii has been supported by MODIS and SeaWiFS, and is assumed by the SIMBIOS plan to continue as the primary ocean validation site for MODIS and SeaWiFS. The continuation of the SeaWiFS round-robins and the AMT, together with other proposed activities and NASA coordination, is proposed under the SIMBIOS program. Investigators to conduct these activities would be selected via an NRA in the spring of 1996. The SIMBIOS plan is available for review via the WWW at both the MODIS and SeaWiFS home pages.