13.1 NOAA'S OBSERVATIONAL REQUIREMENT COLLECTION PROCESS – MAKING A GLOBAL DIFFERENCE

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1. INTRODUCTION

With guidance from the National Oceanic and Atmospheric Administration (NOAA) Observing Systems Council, NOAA is developing well-defined, formalized process for identifying, documenting and updating its observational requirements. This paper provides an overview of the evolving observational requirements collection process that will lead to a comprehensive NOAA observational requirements document – the first-ever Consolidated Observational Requirements List (CORL).

The observational requirements collection Process and resulting CORL were created in direct response to the NOAA 2002 Program Review Team (PRT) recommendations (Appendix A). In particular, PRT recommendation #32, which addressed centrally planning and integrating NOAA observing systems, indicated a clear need for a NOAA-wide observing system architecture. In response, NOAA Headquarters directed development of a roadmap to ensure there is a rational, traceable, and efficient allocation for user requirements, and assigned NOAA National Environmental Satellite, Data, and Information Service's (NESDIS) Office of System Development (OSD) oversight of this task.

In support of PRT recommendation #32, the NOAA Observing Systems Council (NOSC) and the NOAA Observing Systems Architecture (NOSA) Office were established. The NOSC provides policy guidance for observing systems and data management. It also provides oversight of the NOSA Office. The NOSA Office is responsible for the development and maintenance of the observational architecture (Figure 1) that helps NOSA support NOAA's mission through fulfilling observing requirements, providing best possible cost/benefit value, avoiding unnecessary duplication of existing systems, and operating efficiently and in a cost-effective manner. The NOAA Enterprise Architecture is based on the mission goals and strategies espoused in the NOAA Strategic Plan, as well as the services and capabilities described in the Concept of Operations (CONOPS) For the National Oceanic and Atmospheric Administration (NOAA) in the 2010 – 2020 Timeframe (Dec 2003, Draft) document. How these services and capabilities are provided, whether through specific projects, systems, and integrated solutions developed to reduce or eliminate gaps (i.e., differences between current and target capabilities), will be defined in the NOSA activities. The NOSA process for developing a hierarchy of architectural entities and documents is shown in Figure 1.

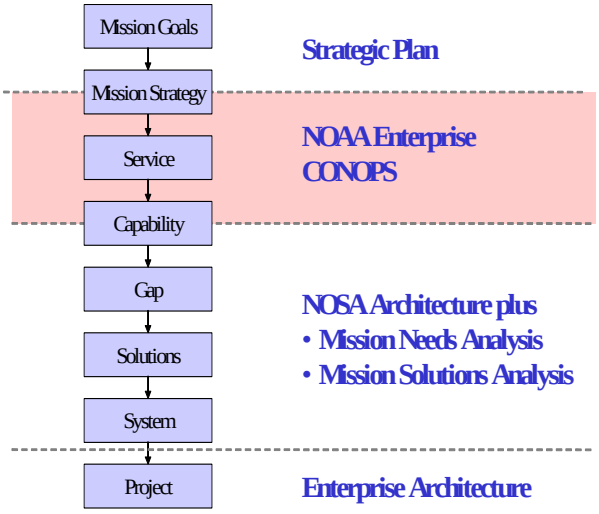

Figure 1. NOAA Observing Systems Architecture (NOSA) Entities and Documents

The comprehensive collection and documentation of all observational requirements will lead to the CORL and serve as the basis for the NOSA efforts.

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1.1 *Objectives*

The intent of the observational requirements collection is to develop a more formalized, well-defined process for identifying, collecting, documenting and updating requirements for observing systems. The goal is to help ensure current and future observing systems effectively support the NOAA mission and, where appropriate, the needs of the global user community. Figure 2 lists NOAA's four main Goal areas and the programs with observational requirements.

1.2. *Scope*

The observational requirements collections process focuses on supporting a NOAA-wide observing system architecture that allows central planning and integration of all observing systems. However, the plan is for this process to be extensible to fit within an integrated global environmental observation and data management system.

Ecosystem Goal
Habitat
Corals
Coastal and Marine Resources
Protected Species
Fisheries Management
Aquaculture
Enforcement
Ecosystem Research
Ecosystem Observations

Weather and Water Goal
Local Forecasts and Warnings
Space Weather
Hydrology
Air Quality
Environmental Modeling
Science, Technology, and Infusion
Coasts, Estuaries and Oceans

Climate Goal
Climate Observations & Analysis
Climate Forcing
Climate Predictions & Projections
Climate & Ecosystems
Regional Decision Support

Commerce and Transportation Goal
Marine Transportation Systems
Aviation Weather
Marine Weather
Geodesy
NOAA Emergency Response
Commercial and Remote Sensing Licensing
Surface Weather

Figure 2. NOAA Mission Goal Team (*Programs with Observational Requirements are in red italics*)

2. OBSERVATIONAL REQUIREMENTS COLLECTION PROCESS: DESCRIPTION

The observational requirements collection process is a seven-step process to identify, collect, standardize, prioritize, validate, consolidate, and update NOAA's environmental observing requirements. The validated requirements for environmental observations are then provided to the NOSA Team for allocation to programs and then to observational systems. The observational requirements collection process currently encompasses NOAA programs but future plans include incorporation of other Federal government, international, and commercial programs as well. The intent is to optimize the entire mix of observing systems against the total set of prioritized user requirements. This process will also help focus observational requirement and observing system research and technology initiatives on high-priority user requirements and aid the transition of these initiatives into operations.

At the direction of the NOSC, the seven-step requirements collection and management process aims to transition NOAA away from a stove-piped, technology-driven, platform-oriented process and move towards an integrated, user needs-driven, end-to-end systems oriented. The process will lead to the first-ever NOAA-wide consolidated observational requirements database called the CORL. When complete, the CORL will assist in linking observational requirements with current and planned observing systems; the planning, programming, budgeting and execution cycle; and NOAA Strategic and Program Plans. NOAA is on track to complete the first draft CORL in Spring 2005.

2.1 *Identification and Collection*

The first step in the process is to identify and collect the requirements. Each program or organization having environmental observing requirements designates a Requirements Point of Contact (ReqPOC) to the NOAA Requirements Integrated Program Team (ReqIPT). Working through the ReqPOCs, the ReqIPT assembles and reviews all of the program's related source documents concerning its observing requirements. Source documents include previously documented and validated platform-independent observing requirements, scientific discipline workshops, Program mission statements, and science and technology infusion programs, as well as system-

oriented specification documents. This review identifies the environmental parameters needed from observing systems along with derived products produced by data processing components. For each observational requirement, the ReqIPT identifies general characteristics related to the associated environmental domain (Atmosphere, Cryosphere, Ocean, Land, Space etc), geographic coverage (Global to Local scales), temporal needs (near real-time to decadal) and application (operational analysis and forecasting to climate and research).

The primary output of the Identification and Collection step is a preliminary set of Program Mission Observation Requirements Lists, or MORLs, specific to each NOAA Program's environmental parameters and their fundamental characteristics, collected from a variety of sources.

2.2 *Translation and Standardization*

The second step is to translate each program's related observational requirements listed in their MORL into specific NOAA Program observation requirements. The majority of this step encompasses translating observational requirements previously documented through the NOAA Line Office structure, and some observing system-level documentation, into the FY07 NOAA Goal Team and Program Structure (Figures 3 and 4) adopted in the CORL.

Standardization refers to creating a fixed, globally accepted, official format for all of the observational requirements. Standardization is critical to referencing and consolidating all the collected requirements, allowing NOAA to assess the ability of current and planned observing systems to meet user requirements, and to identify gaps or redundancies. Three levels of standardization were applied: (1) a parameter naming convention, using the NASA Global Change Master Directory (GCMD) as the guidon (i.e., the reference standard) for observational requirement titles. The ReqIPT made modifications for NOAA unique applications; (2) specific attribute specification usage and definitions; and (3) common quantification units for each attribute value.

The culmination of the Translation and Standardization step is a draft set of MORLs have been analyzed to reference each Program's mission specific, platform-independent, observation requirements with traceability back to the original requirements input and sources.

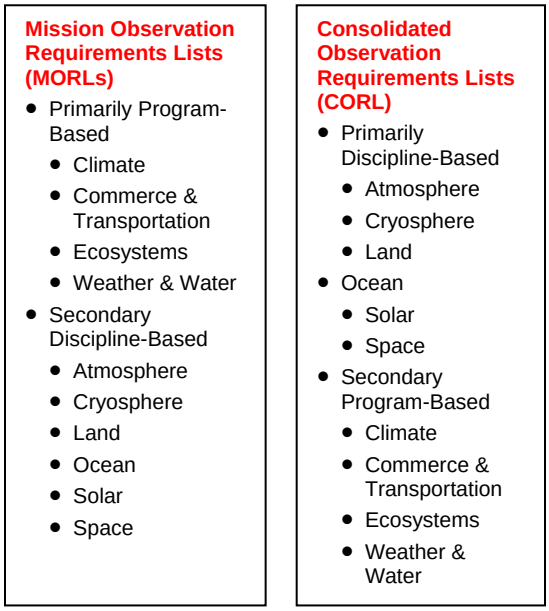

Figure 3. Comparison of MORLs to CORL

2.3 *Revision and Prioritization*

The third step is revision and prioritization of the initial observational requirements list (i.e., the draft MORL). Once the draft MORLs are produced, the ReqIPT and ReqPOCs conduct an organization-wide update includes categorization of each observational requirement by priority (Priority 1-Mission Critical, 2-Mission Optimal, 3-Mission Enhancing). To accomplish this, the ReqIPT first creates survey templates for the Priority 1 observational requirements and threshold specifications (spatial, temporal and measurements characteristics). A sample survey page is at Appendix B. Using the surveys, the ReqIPT works with each of the ReqPOCs to review their draft MORLS and to update the survey information. This approach allows an organization to review what has been documented and revise a comprehensive listing versus starting from scratch.

In this step, standardized naming conventions, associated definitions, attribute quantifications are all clarified and any new observation requirements are added. The observational requirements lists, observational requirements titles, and Threshold

(minimally acceptable) specifications for all Priority 1 observational requirements have been captured and revised (if appropriate). Work is in progress to categorize all Priorities 2 and 3 needs as well as to include the Threshold and Objective specification values for the observational requirements at all priority levels. In addition, the ReqPOCs will confirm all observational requirements attributes to ensure they are applicable and representative at both Threshold and Objective levels; any inappropriate parameters will be deleted. The ReqIPT will produce an updated draft MORL for each program in preparation for the Validation step.

The output of the Translation and Standardization step is an updated and verified draft MORL for each NOAA Program (Figures 3 and 4).

2.4 *Validation*

The fourth step is validation of each MORL. Efforts are underway to develop and implement an observational requirements validation process to be applied across all NOAA Programs. To date, in collecting Line Office requirements validation has consisted of organization-wide reviews of system specific requirements documents culminating with NOAA Assistant Administrator (AA) approval. The future validation process will also include a more thorough science-based justification of the importance and impact of the requirement to achieving NOAA's overall Mission Goals and specific Program outcomes and will be approved by all NOAA Program Managers and Goal Team Leads.

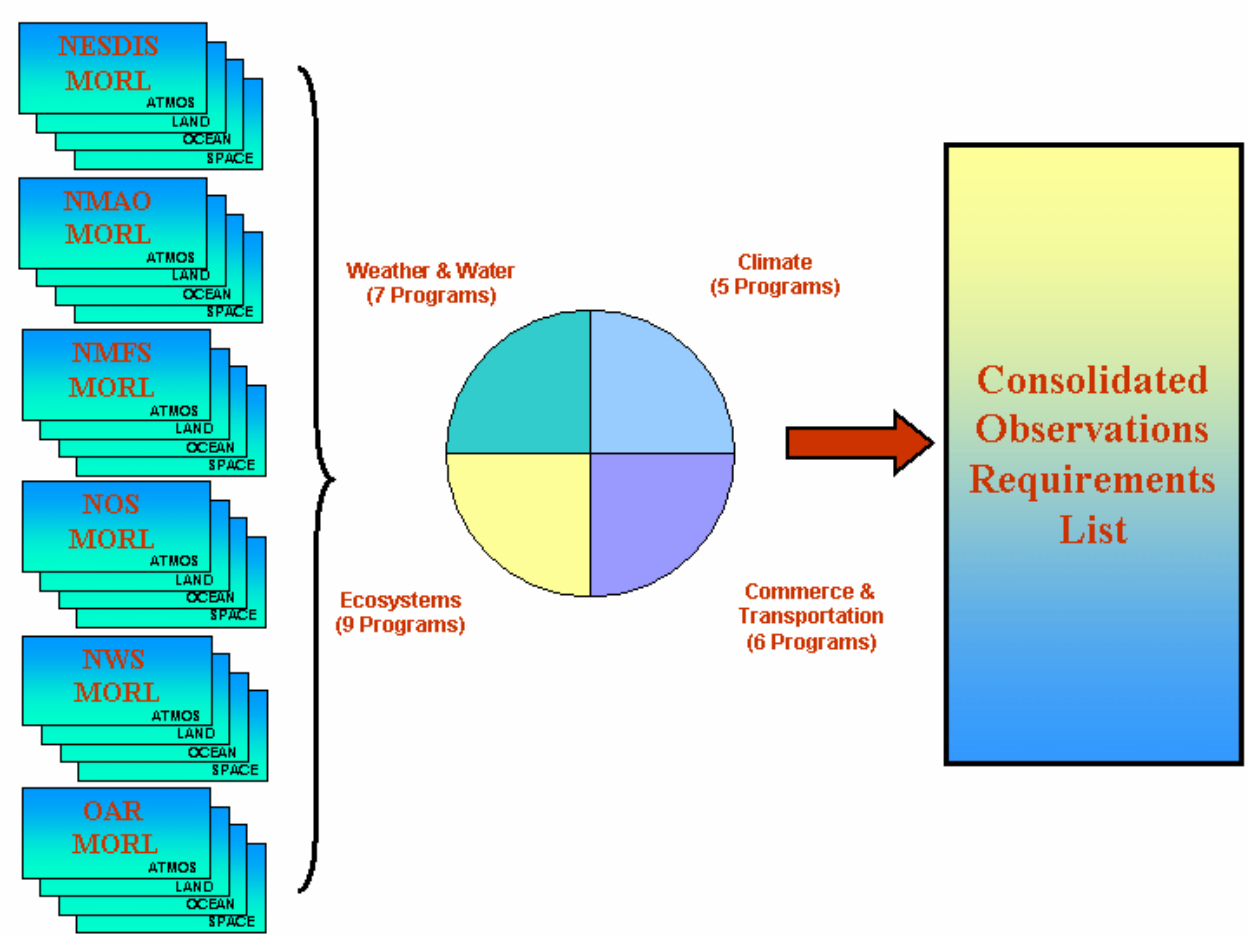

Figure 4. Consolidation of NOAA Line Office and Mission Goal

2.5 *Consolidation*

The fifth step is consolidation of a Program's individual validated MORL into the consolidated list (CORL). As depicted in Figure 4, the CORL provides a comprehensive listing of all of observational requirements, documented and sorted by domain, parameter, type, and timeline need rather than primarily by Program. This database represents the initial National Integrated Environmental Observation Requirements Repository planned to encompass all other Federal agency observational needs. The online relational database management tool for the CORL is called CasaNOSA.

Lists of Priority 1 observational requirements for the NOAA Programs and/or subcomponents are available from the NOSA web site: www.nosa.noaa.gov. Currently there are over 1300 observational requirements representing the needs of the NOAA Programs across the Goals of Ecosystems, Climate, Weather and Water and Commerce and Transportation**.** The lists of Priorities 2 and 3 observational requirements will be available by the end of calendar year 2004.

The outcome of the Consolidation step is inclusion of validated, individual, NOAA MORLs into the CORL. NOAA plans to complete the first, NOAA-only, CORL by February 2005 and release it for NOAA-wide review by April 2005.

2.6 *Stakeholder Interfaces*

The sixth step is fostering stakeholder interfaces. This is critical component of the observational requirements collection process is the active representation and participation of each of the NOAA Goal Teams and Programs, NOAA Line Offices, federal agencies, and, where appropriate, civil agency counterparts. As mentioned earlier, the ReqIPT and ReqPOC for each organization work closely to identify, help in the collection of, and then translate each user observation requirements into a standardized template, allowing NOAA to build agency unique MORLs. The first MORLs were integrated into the CORL, first using PC-based EXCEL spreadsheets, later integrated into the relational database, CasaNOSA. As a result, CasaNOSA enables each agency to document observing requirements, as well as information on all current and planned observing systems, greatly facilitating the linkage between user requirements and systems needed to build the NOSA. Current plans are to increase stakeholder access to CasaNOSA to allow their designated representatives to help add and validate new requirements, sustain the accuracy, depth, and breadth of the requirements database, and facilitate their involvement in determining how CasaNOSA can best help NOAA achieve a true global environmental requirements system.

The CORL database will annotate all requirements by Fiscal Year need, type (Biological, Chemical, Physical), and will link all requirements to NOAA Program Goal Outcomes. The plan is for CasaNOSA to allow for the cross analysis of the Program Baseline Assessments (PBAs), the observing systems, and the CORL observational requirements databases. This will allow for the cross-analysis of all of these databases.

2.7 *Maintaining Currency (Configuration Management)*

The last step in the process is maintaining observational requirements database currency through effective configuration management. Each NOAA Goal Team, Program, or other agency will responsible for maintaining the connection to their customers' requirements, updating their MORL, and working with the ReqIPT to integrate changes into the CORL. The ReqPOCs will be responsible for initiating the review of each Program's MORL in January of each year, as needed. This will provide annual updates for NOSA and for the Planning, Programming, Budgeting, and Execution System (PPBES). Future updates will be made via the online CasaNOSA CORL data management tool.

3. GLOBAL COOPERATION

NOAA Administrator, Vice Admiral (retired) Conrad C. Lautenbacher Jr., stated in the 2005-2010 Strategic Plan:

> *"No successful, societal response to environmental or ecological stress, however, has ever been accomplished by a single agency or organization. ... We must work with international institutions, state and federal agencies, tribes, local and regional governments, non-governmental organizations, educational institutions, and private businesses in all that we do, not only to succeed in providing information, products, and services, but also to ensure that agency, national, and international goals are achieved."*

The CORL represents an important element of this US interagency as well as international intergovernmental, implementation plan. In generation of the CORL, the ReqIPT coordinated with the U.S. Department of Defense (DoD), other US Federal Agencies, and the European environmental user community.

4. NEXT STEP

In building for the future network of systems, NOAA will work to develop global-to-local environmental observations and data management systems for comprehensive, continuous monitoring of ocean/atmosphere/land-coupled systems. As a part of the future network of systems, the NOSA and the CORL directly support NOAA's vision to move interactively into the 21st century scientifically and operationally, recognizing the link between the global economy and the planet's environment. The next step is to work with national and international partners and commercial entities to generate and release a truly comprehensive, integrated, global CORL.

5. CONCLUSION

NOAA is transitioning from a collection of "stovepipe" systems of space, air, ocean, and ground-based environmental sensors to an integrated observing and data management system. The current and planned network of observing systems will not be adequate to meet future needs in a changing environment unless the systems are integrated and managed on an enterprise-wide level. While some current systems are managed end-to-end, that is not enough: all of the systems need to be managed as a coherent whole.

In addition, the effective allocation of resources depends heavily on a clear understanding of prioritized observing requirements. The key to this is a well-defined requirements management process leading to a complete, consolidated database of observational environmental requirements. The NOSA, the CORL database, and the CasaNOSA data management tool will modernize access to the regional, national, and global environmental information. They will help to answer this critical question: how well do present, planned, and proposed observing systems meet user requirements for each program? The ultimate outcome is to ensure decision makers, researchers and operational users have the tools they need to meet their Mission Goals.

6. ACKNOWLEDGMENTS

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APPENDIX A

NOAA Program Review Team (PRT)
June 2002
Recommendation #32

(Full report available online at http://www.accessnoaa.noaa.gov/internal/)

32. The PRT recommends that NOAA centrally plan and acquire all observing systems, with responsibility assigned to NESDIS. Acquisition method and responsibility for operations and maintenance of systems will be determined on a case-by-case basis.

A. NESDIS should lead a crosscutting team to develop an observational architecture commencing immediately. This should capitalize on on-going efforts (e.g., coastal observations). This architecture should capture the state today as well as the future state (e.g., 10 to 20 years). With this architecture, NOAA would be able to assess current capabilities and identify short-term actions.
B. All prospective observing systems should be based on validated requirements, should be consistent with the developed target architecture, and should be presented with plans to address utilization of the data as well as long-term archive of the data.
C. Operation and maintenance of marine environmental buoys and floats (Argo, weather buoys, Tropical Atmosphere Ocean buoy network (TAO), and Coastal-Marine Automated Network (C-MAN) stations) and tide gauges should be consolidated with appropriate expertise into NOS. [See Appendix 3-3]

D. A crosscutting team led by NESDIS should conduct a systemic review of all other observing systems. The following factors should be considered for observing systems to determine the desirability of consolidating them:
• The required characteristics of the system (i.e., reliability, performance, maintainability)
• The number of and types of users of the system
• The estimated value of the capital asset and its recurring maintenance cost

32. I concur with the PRT recommendation that NOAA centrally plan and integrate all observing systems. I will assign this responsibility to a matrix management team, with NESDIS providing the program manager. I do not currently endorse the PRT recommendation to assign acquisition authority for all observing systems to NESDIS.

A. NESDIS should lead a crosscutting team to develop an observational architecture commencing immediately. This should capitalize on ongoing efforts (e.g., coastal observations). This architecture should capture the state today as well as the future state (e.g., 10 to 20 years). With this architecture, NOAA would be able to assess current capabilities and identify short-term actions.
B. All prospective observing systems should be based on validated requirements, should be consistent with the developed target architecture, and should be presented with plans to address utilization of the data as well as long-term archive of the data.
C. Operation and maintenance of marine environmental buoys (weather buoys, Tropical Atmosphere Ocean buoy network (TAO), and Coastal-Marine Automated Network (C-MAN) stations) should be consolidated. I support the ongoing transfer of the Tsunami buoy array from OAR to NWS/National Data Buoy Center and request that OAR and NWS develop a transition plan for the TAO array. Consolidation with other ocean observing systems (e.g., tide gauges) should also be considered. Further determination of the appropriate home for consolidated systems should be determined in coordination with the study directed in recommendation #31.

D. A crosscutting team led by NESDIS should conduct a systemic review of all other observing systems. The following factors should be considered for observing systems to determine the desirability of consolidating them:

- **The required characteristics of the system (i.e., reliability, performance, maintainability).**
- **The number of and types of users of the system.**
- **The estimated value of the capital asset and its recurring maintenance cost.**

APPENDIX B

NOAA Observing System Architecture (NOSA) Investment Analysis Evaluation Form

Program Name: Climate
Requirement Name: Air Temperature, Surface

Evaluator(s)_____

Date:_____

GCMD Description:

The degree of hotness or coldness as measured on some definite temperature scale by means of any of various types of thermometers.

NOAA Requirement Details:

User & Priority: CLIMATE-priority 1
Geo Cov (G,H,C,M) / Conditions: tbs
Vertical Range: tbs
Vertical Res: tbs
Horizontal Res: 100 km
Mapping Accuracy: tbs
Measurement Range: tbs
Measurement Accuracy: 0.5 K
Refresh Rate/Coverage Time: 12 hours
Data Latency: 48 hours
Long-term Stability: tbs

Source: 2AR, **GCOS,** PBA06

If the details of the requirement are incorrect or incomplete, or if you think the GCMC description is inconsistent with the NOAA requirement please note this information here:

Several current and potential observing systems are listed below. Please indicate how valuable or valueless you feel each system is to your ability to fully meet your established requirement(s) for measuring **Air Temperature, Surface** by circling a number beside it. If it is extremely valuable to you circle a number toward the right. If it is extremely valueless to you, then circle a number toward the left. If you think it's someplace in between, circle a number from the middle that indicates your opinion.

Investment Option	Scale									
	Extremely Valueless									Extremely Valuable
NWS-MDCRS	1	2	3	4	5	6	7	8	9	10
NWS-MDCRS Double Size of Program	1	2	3	4	5	6	7	8	9	10
NWS-MDCRS Double Size of Program	1	2	3	4	5	6	7	8	9	10
NWS-COOP-Observing	1	2	3	4	5	6	7	8	9	10
NWS-COOP-Observing Double Size of Program	1	2	3	4	5	6	7	8	9	10
NESDIS-CRN	1	2	3	4	5	6	7	8	9	10
NESDIS-CRN Double Size of Program	1	2	3	4	5	6	7	8	9	10
NESDIS-POES	1	2	3	4	5	6	7	8	9	10
NESDIS-NPOESS w/o Radar Altimeter	1	2	3	4	5	6	7	8	9	10
NESDIS-GOES	1	2	3	4	5	6	7	8	9	10
NESDIS-GOES-R 2 ABI	1	2	3	4	5	6	7	8	9	10
NESDIS-GOES-R 2 ABI, 2 HES	1	2	3	4	5	6	7	8	9	10
NESDIS-GOES-R 2 ABI	1	2	3	4	5	6	7	8	9	10
NESDIS-GOES-R 2 ABI, 1 HES, 1 Microwave Sounder	1	2	3	4	5	6	7	8	9	10
NESDIS-GOES-R 2 ABI, 2 HES, 1 Microwave Sounders	1	2	3	4	5	6	7	8	9	10
NESDIS-GOES-R 2 ABI, 2 Microwave Sounder	1	2	3	4	5	6	7	8	9	10
RAOB???	1	2	3	4	5	6	7	8	9	10
OAR-ETL-BAO	1	2	3	4	5	6	7	8	9	10

Investment Option	Scale									
	Extremely Valueless									Extremely Valuable
OAR-ETL-BAO Double Current Program OR OPERNLIZE?	1	2	3	4	5	6	7	8	9	10
OAR-ETL Marine Atmos. Boundary Layer Obs System	1	2	3	4	5	6	7	8	9	10
OAR-ETL Marine Atmos. Boundary Layer Obs Sys Double	1	2	3	4	5	6	7	8	9	10

APPENDIX C
Acronyms

AA	Assistant Administrator
CONOPS	Concept of Operations
CORL	Consolidated Observational Requirements List
DoD	Department of Defense
GCMD	Global Change Master Directory (NASA)
GPRD	GOES-R Program Requirements Document
MORL	Mission Observational Requirements List
NESDIS	National Environmental Satellite, Data, and Information Service
NOAA	National Oceanic and Atmospheric Administration
NOSA	NOAA Observing System Architecture
NOSC	NOAA Observing Systems Council
NPOESS	National Polar-orbiting Operational Environmental Satellite System
PPBES	Programming, Budgeting, and Execution System
PRT	Program Review Team
ReqIPT	Requirements Integrated Product Team
ReqPOC	Requirements Point of Contact