Earth System Research Laboratory
Physical Sciences Laboratory Review
Response and Implementation Plan Final Report

Science Review: March 9–12, 2010
Review Panel Report: July 7, 2010
Response and Implementation Plan: October 27, 2010
Final Report: May 20, 2011

This final report includes the original ESRL Physical Sciences Review Response and Implementation Plan with descriptions of the status of each action item annotated in blue. A brief summary of the status of each action item is also provided in a table that precedes the annotated Response and Implementation Plan.

Submitted by:

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Summary of Action Item Status				
	Action	**Target Date**	**Status**	**Actual Date**
2.1	Discuss the feasibility and methods of obtaining a better balance between base and external funding with OAR management.	12/15/2010	Completed	02/08/2011
2.3	1. Review postdoctoral staff assignments for each individual and make any needed tasking adjustments.	11/09/2010	Completed	11/09/2010
2.3	2. Implement mentoring through IDPs or equivalent mechanisms for junior staff.	02/08/2011	Completed	02/08/2011
2.3	2. Review annual appraisal and promotion processes for all employees with ESRL, CI, and contractor management to ensure that the goals of rewarding and retaining high-quality personnel are being met.	02/08/2011	Completed	2/8/2011
2.3	3. Emphasize intranet publications and contents to all personnel and update new hire checklists to remind managers to inform new personnel of the weekly intranet publications.	10/08/2010	Completed	10/08/2010
2.3	3. Revise intranet publications to promote increased readership.	02/08/2011	Completed	02/08/2011
2.3	3. Senior staff, mentors, technical leads, and project leads will be requested to provide monthly notices and reminders to postdoctoral and graduate student staff about participation in seminars offered.	10/01/2010	Completed	10/01/2010
2.3	3. ESRL management will coordinate with postdoctoral and graduate student staff to determine the frequency of informal seminars, and work through the ESRL Student Coordinator to provide more organized social events for the postdoctoral and graduate student staff.	10/05/2010	Completed	03/31/2010
2.3	3. ESRL management will highlight the availability of gathering areas throughout the building and approach the NOAA Boulder Directors Council to determine the feasibility of enhancements to building gathering areas.	12/07/2010	Completed	12/07/2010
2.3	1. 4. ESRL will document the current level of use of developmental and rotational assignments and, in areas of deficiency, managers will be directed to take an active role in determining the aspirations of their personnel, make use of IDPs as appropriate, provide for training, mentoring, and development opportunities, and to promote use of existing development programs and rotational assignments.	10/05/2010	Completed	10/05/2010
3.1	1. PSD will explore how best to advance its model diagnostics capability, perhaps in concert with the recently proposed Environmental Projection Center within the NCS.	03/31/2011	Ongoing	
3.1	2. Within 90 days of the formation of a NOAA Climate Service, PSD→PSL will discuss possible configurations for an enhanced and better-integrated Arctic program with NCS management.	03/31/2011	Deferred	Pending creation of an NCS
3.1	3. Within 90 days of the formation of a NOAA Climate Service, PSD→PSL will discuss possible avenues for elevating NOAA's leadership role in facilitating some broader international coordination for Arctic observations with NCS management.	03/31/2011	Deferred	Pending creation of an NCS
3.1	4. PSD will: (1) create a demographic profile of the personnel within the climate observations group, (2) develop projections of near-term and longer-term transitions by, (3) develop a list of personnel options (e.g., holding on to talented postdoctoral personnel, converting a few of our gifted CI people to federal status, or recruiting new Feds from University/Research Laboratories), and (4) develop and implement a long-term plan to transition key positions using the options identified above.	03/31/2011	Deferred	03/30/2012
3.2	3. Establish monthly reports published on the web to provide the skill from different versions of FIM vs. GFS.	10/05/2010	Completed	10/05/2010
3.2	4. Report significant transition projects in the Oar Project Database	01/30/2011	Completed	12/31/2010
3.2	5. Produce the first draft of the GSD 5-10 year strategic plan.	10/05/2010	Completed	09/08/2010
3.2	5. Initiate a coordination meeting on inline chemistry modeling and data	02/08/2011	Ongoing	

	assimilation with NWS and OAR colleagues and seek collaborative funding.			
3.2	6. Explore working more with the NESSI group.	02/08/2011	Completed	02/02/2011
3.3	1. If an NCS is created, PSD→PSL will work to codify its methods for implementing NCS metrics for transition of products to services.	03/31/2011	Deferred	Pending creation of a NCS
3.3	2. Within 90 days of the formation of a NOAA Climate Services that will also result in a final determination of CPC being either within or outside of the NCS line office, PSD→PSL will work with NCS management to develop either internal agreements or cross-line office MOAs to establish mechanisms to ensure the development and delivery of monitoring and prediction services across temporal and spatial scales that will be transparent to users.	03/31/2011	Deferred	Pending creation of a NCS
3.4	1. Review current evaluation practices of AWIPS-II and other possible methodologies for doing technology transfer evaluations and write a proposal to NWS for rapid prototyping work.	12/31/2010	Completed	12/08/2010
3.4	1. Investigate any opportunities to collaborate with IMAPP.	02/08/2011	Completed	02/07/2011
3.4	2. Establish a matrix of generalized quality, performance, and maintainability metrics.	02/08/2011	Ongoing	
3.4	3. Obtain and review the FAA REDAC report to determine elements with potential to improve transition of ESRL research to operations.	02/08/2011	Completed	02/08/2011
3.4	4. Organize a Task Team to explore the feasibility of engaging an economist or other experts (out-sourced) to assist with developing cost-benefit analyses of technologies transferred.	02/08/2011	Completed	01/13/2011
3.4	5. Examine multiple ways to disseminate forecasts in the electronically connected world in partnership with NWS and other stakeholders.	1/31/2011	Completed	02/07/2011
3.4	6. Develop a strategic plan for SOS.	02/08/2011	Completed	02/04/2011
3.4	7. Create a proposal for the Office of Education to evaluate the educational value of Virtual Worlds.	12/31/2010	Completed	12/27/2010
3.5 a	1. GSD will prepare a report on the use of extensions to WMO standards for RAOB verification.	02/08/2011	Completed	03/08/2011
3.5 a	2. Form a team for developing and implementing methods to quantify/estimate observational uncertainties for data assimilation and OSSEs, monitoring the quality of major remote and in-situ observing systems assimilated into operational and research models, and to assist in evaluating the impact on attaining NOAA performance objectives.	02/08/2011	Completed	01/20/2011
3.5 a	3. Prepare and submit satellite design and validation work proposals.	02/08/2011	Completed	01/20/2011
3.5 b	1. PSD will: (1) document the key observing system gaps related to PSD's science objectives (e.g., boundary layer processes, precipitation processes, air-sea fluxes), (2) assess opportunities to i) expand current capabilities to address unmet observation needs, ii) identify mutually beneficial strategic partnerships with other organizations, and iii) reduce current capabilities to eliminate low-impact technologies, (3) identify an ideal long-term (10-year) observing system profile that addresses key science needs and leverages existing and partner capabilities, (4) inventory the resources needed to sustain the current observing competency, and (5) develop and implement a long-term plan to adjust the current resource (people, funding, equipment) profile to accommodate long–term observational targets.	03/31/2011	Ongoing	
3.5 b	2. PSD will look into the possibility of hosting summer schools or similar events to maintain and build key observing system competencies, and will plan and implement an event in the summer of 2011.	03/31/2011	Deferred	Summer 2012
3.5 b	3. PSD will identify and explore other options for sustaining its observing system expertise through (1) targeted relationships with other institutions (academic, federal, commercial) which might be the source of required talent, (2) student internship programs to expose students to observing system	03/31/2011	Ongoing	

	science as a possible course of study and career path, and (3) planning for and engagement in observationally focused conferences.			

Earth System Research Laboratory
Physical Sciences Laboratory Review
March 9-12, 2010

Response to Review Recommendations and Implementation Plan (Annotated)

October 27, 2010

Submitted by:
Alexander E. MacDonald, Earth System Research Laboratory Director
William D. Neff, Physical Sciences Division Director
Steven E. Koch, Global Systems Division Director

Introduction

The Earth System Research Laboratory (ESRL) appreciates the positive findings and values the recommendations of the Review Panel from the Physical Sciences Laboratory Review conducted March 9–12, 2010.

The ESRL staff worked diligently to provide information about the broad range of physical sciences work being done within the Physical Sciences Division (PSD) and the Global Systems Division (GSD). We were aware that this laboratory review would be an intense event due to the breadth of our work. We are pleased that the dedication and enthusiasm of ESRL leadership and staff in contributing to the National Oceanic and Atmospheric Administration's (NOAA's) science mission was readily evident to the review panel throughout the event. Comments by the review panel such as "elements of both PSD and GSD should be considered national treasures" with our "top scientists being amongst the world elite," make us especially proud.

The remainder of this document addresses specific recommendations provided from the review panel to ESRL. We have engaged ESRL staff at all levels to address those recommendations. The section numbers that are provided follow the research theme numbers of the review and also correspond to the section numbers of the review panel report. A table at the end of this document provides the summary and schedule of ESRL actions that will be taken to achieve recommendations given by the review panel.

ESRL Response

2.1 General

Verbatim Review Panel Recommendation:
GSD's heavy reliance on external funding should be reduced to alleviate the risk that it may not be capable of achieving its NOAA mission. This will be especially important in the ongoing process of establishing a robust relationship with the National Centers for Environmental Prediction (NCEP).

Response:
During the review, perhaps we did not emphasize strongly how GSD leverages the work it engages in beyond NOAA to advance NOAA's mission. For example, information systems work with the Bureau of Meteorology in Australia and the Central Weather Bureau of Taiwan resulted in very significant dividends for development of the Advanced Weather Interactive Processing System (AWIPS), the Graphical Forecast Editor (GFE), and the Local Analysis and Prediction System (LAPS). This work was conducted and delivered under signed Interagency Agreements that added new capabilities to these systems. This type of leveraging gives mutual benefit to both GSD external customers and NOAA, and also applies to other research and development work within GSD in areas such as observing systems, information systems, weather and warning modeling, and data assimilation.

Nonetheless, GSD's significant reliance on external funding is an area that we will address with OAR management to determine the feasibility and method of obtaining a better balance between base and external funding. This would serve to alleviate risks in supporting the NOAA mission and allow us to hire junior staff who will be brought up through the ranks and take up the reins as seasoned staff members depart.

Actions and due dates:
By December 15, 2010, discuss the feasibility and methods of obtaining a better balance between base and external funding with the Office of Oceanic and Atmospheric Research (OAR) management.

GSD initiated a discussion that occurred on February 8, 2011 with OAR management including the Chief Financial Officer/Chief Administrative Officer and the Acting Deputy Assistant Administrator. PSD management also participated in this meeting. The recommendation from the Review Panel echoes that of the Acting Deputy Administrator in improving the level of base funds for all OAR laboratories. However, the economic realities at that time and further financial constraints imposed since that time certainly limit the opportunities to accomplish this worthy objective. OAR management noted that this objective is worth pursuing to any extent possible in the future, but for now, GSD will continue to rely significantly on external funding and continue providing high value work for the numerous sponsors being supported while leveraging that work to advance the NOAA mission.

2.3 The Workforce

Verbatim Review Panel Recommendations:

1. ESRL mentors and sponsors should ensure that Cooperative Institute (CI) and postdoctoral scientists are not tasked with too many projects.
2. ESRL management should ensure there is at least a modest level of mentoring of junior staff and nurturing of career pathways; ensure that the workforce encompassing CI scientists can be refreshed as needed; review the value of the annual appraisal and promotion processes.
3. ESRL should recognize the challenge of being part of a large workforce in a modern federal office building – web-based information about general procedures and resources (seminar announcements, availability of extra-curricular resources such as the gym, and so on) would help with communications that are especially important for the junior workforce. Having the postdocs arrange seminars, providing opportunities for postdocs to meet together, and creating natural gathering areas throughout the building would also help.
4. ESRL should start planning now for replacement of senior management, with a strong mentoring program for potential replacements.

Responses:

1. ESRL mentors and sponsors will be required to review Cooperative Institute (CI) and postdoctoral assignments for each individual to determine what tasking or tasking priority adjustments are needed. Tasking will be reflected in an annual work plan for each individual.

2. Mentoring of junior staff and nurturing their career pathways can help to ensure the success of individuals and all of the organizations involved. ESRL will work toward implementation of Individual Development Plans (IDPs) or equivalent mechanisms depending on the type of junior employee. We will coordinate with each CI and contract firm to encourage appropriate support of this endeavor through their organizations.

   As for replacing CI scientists, the CIs have readily and ably provided new or replacement personnel upon request and specification of duties and requirements. Since the CI workforce refresh need has not heretofore been a problem, no specific action will be implemented at this time.

   The annual appraisal and promotion processes are dependent on the type of employee. For government personnel, the appraisal process is defined by the Commerce Alternative Personnel System, a pay for performance mechanism that is separate from the older personnel system used in other parts of the federal government. The value of this system is greater flexibility to reward government employees with pay increases on a performance basis. Furthermore, federal employees can be considered for promotions above their current maximum level through a Performance Management and Awards Committee (PMAC) that meets up to three times per year and operates with straightforward guidelines to consider promotion submissions from supervisors. For CI and contractor staff, ESRL mentors and sponsors submit annual or more frequent performance input to their respective management for consideration of monetary awards and promotions. The annual appraisal and promotion processes will be reviewed by

ESRL, CI, and contractor management to ensure that the goal of rewarding and retaining high-quality personnel of all types is being met.

3. Seminar announcements and numerous other communications are already broadcast laboratory-wide multiple times via email. They are also posted throughout the laboratory on bulletin boards and published in weekly intranet publications. Senior staff, mentors, technical leads, and projects leads will be reminded to promote and encourage postdoctoral and graduate student staff participation in the numerous seminars offered.

   The weekly intranet publications include how-to articles, reference links, photos of events, announcements, and a feedback mechanism for the staff. Division-specific intranets provide a wide array of resources, information, and procedures. Wikis are available to personnel also via Division-specific intranets for content collaboration on items and topics of choice, and group-specific Wikis such as for Systems Administrators are used. These information and collaboration resources will be emphasized to all ESRL staff.

   To promote increased readership of intranet publications, we will: 1) Reorganize intranet publications by highlighting new or changed material, and 2) Move older articles to archive pages, establishing a single homepage with links to the archived articles.

   We will coordinate with postdoctoral and graduate student staff to set up regular seminars that are open building wide to all postdoctoral and graduate student staff. These seminars will be held in a casual, open, and inviting setting. We will coordinate with the postdoctoral staff to determine the acceptable frequency of holding these seminars. To help our postdoctoral staff and students at all levels to get to know each other, we will work through the ESRL Student Coordinator to provide more organized social events.

   Regarding natural gathering areas throughout the building, we will highlight what we have through various means and approach the NOAA Boulder Directors Council to determine the feasibility of any enhancements to existing gathering areas.

4. ESRL managers will be directed to talk with their personnel to determine the aspirations of individuals and the individual training needs to accomplish those aspirations. We expect that some personnel will be interested in maintaining scientific and technical tracks while others will be interested in pursuing management options. ESRL managers will be reminded to offer opportunities to individuals on their staff to take on additional responsibilities and to grant permission for individuals to represent their Division or ESRL at meetings, workshops, and seminars. Local mentoring and on-the-job training opportunities will also be implemented as a method of bringing junior employees up through the ranks. Furthermore, managers will be reminded to encourage the use of existing development programs, mentoring programs, and developmental/rotational assignments that are available in the OAR, NOAA, and Department ofCommerce (DOC), and other agencies.

Actions and due dates:

1. Review postdoctoral staff assignments for each individual as appropriate to their employment status and make any appropriate tasking adjustments by November 9, 2010. In particular, the Cooperative Institute for Research in Environmental Sciences (CIRES) staff supervision is by CIRES University employees and guided by the annual CIRES work plan which is developed in collaboration with NOAA: It is the responsibility of the CIRES supervisor (by law, a University employee) to make appropriate task assignments. This item, as it applies to CIRES, will be elevated to CIRES management by 1 January 2011. Most of our postdoctoral scientists come from and are funded by three external competitive programs that are based on a proposed research program and competitive review: these individuals have a great deal of independence and are not subject to tasking by ESRL.

   ESRL supports postdoctoral research associates through highly competitive programs sponsored by the National Research Council (NRC), the Cooperative Institute for Research in the Atmosphere (CIRA), the Cooperative Institute for Research in Environmental Sciences (CIRES) and the University Center for Atmospheric Research (UCAR). Successful candidates have submitted research proposals and work plans that have been carefully reviewed for appropriateness and the ability to be executed. These individuals have a great deal of independence and are not subject to tasking by ESRL management. However, tasking was reviewed for all Cooperative Institute personnel to ensure appropriateness. It was determined that tasking was appropriate for all individuals. No further action was necessary with management of the Cooperative Institutes.

2. Implement mentoring through IDPs or equivalent mechanisms depending on employee type for junior staff (those who began their appointment within the last two years at ESRL) by February 8, 2011, including attention to well-defined performance measures and appropriate performance awards. Review annual appraisal and promotion processes for all federal employees with ESRL managers. Raise the issue with CI, and contractor management to ensure that the goals of rewarding and retaining high-quality personnel are being met by February 8, 2011.

   PSD's federal workforce has no junior employees. In fact, the youngest PSD federal researchers are over 40 years of age and have over a decade of experience. Younger researchers typically enter the PSD federal workforce through initial associations with joint institute or formal postdoctoral programs. These programs already have mechanisms in place for developing staff through their own supervisory structures. By law, PSD federal managers cannot interfere with these processes.

   There is a well-defined appraisal and promotion process for ESRL federal employees. ESRL reviews these processes with supervisors twice annually in advance of the mid-term and year-end performance reviews. Cooperative Institute and contractor entities have their own processes in place. By law, ESRL federal management cannot interfere with Cooperative Institute and contractor appraisal and promotion processes, but only provide input about the accomplishments of individuals of these entities when requested by their management.

For GSD, IDPs were implemented for all federal employees while the management of Cooperative Institute and contractor entities were encouraged to appropriately focus on their similar mechanisms for individual personnel.

3. The available intranet resources will be emphasized to all employees by October 8, 2010. New hire checklists will be updated by October 8, 2010 to remind managers to inform new personnel of the intranet resources. Intranet publications will be revised to promote increased readership by February 8, 2011. ESRL management will coordinate with postdoctoral and graduate student staff to determine the frequency of holding informal seminars by October 5, 2010. ESRL management will work with the ESRL Student Coordinator by October 5, 2010 to facilitate social events for postdoctoral and graduate student staff. ESRL management will highlight the availability of gathering areas throughout the building by October 5, 2010 and approach the NOAA Boulder Directors Council by December 7, 2010 to determine the feasibility of enhancements to gathering areas within the building.

   GSD and PSD maintain extensive intranet sites for use by all staff that is updated regularly. It includes information and documentation related to the division's administrative functions, research facilities, Information Technology (IT) facilities, and science and other resources. GSD and PSD also distribute internal electronic publications: the PSD Weekly, which summarizes weekly PSD research activities and OAR and NOAA legislative actions, and the quarterly Communique which highlights a wide variety of items of interest across PSD, and weekly GSD Notes.

   PSD is currently working to establish an orientation process (e.g., a monthly orientation seminar and associated intranet link) for new and existing employees to familiarize them with PSD processes and procedures, and the intranet as a resource. GSD added information to the New Hire Checklist that is used for all types of personnel to serve as a guide for managers for informing new personnel about the intranet resources, encourage attendance at program reviews and technical seminars, and to take note of weekly publications.

   The ESRL postdoctoral and graduate personnel are fully integrated into research activities, including the presentation of both informal and formal seminars. ESRL broadly circulates seminar announcements to all staff, including follow-up reminders the day before and the day of scheduled talks.

   ESRL management met with postdocs to discuss any concerns they might have. Three issues emerged: (1) the need for better awareness and connectivity of postdocs across ESRL, (2) the need for better orientation of new employees to ESRL policies and procedures, and (3) the need for better awareness and connectivity of early career scientist within ESRL (not only postdocs). ESRL management has initiated several actions in response to these concerns: (1) The ESRL Student Coordinator has been contacted and has agreed to work with postdoctoral students to form a common postdoc community across ESRL, (2) senior PSD administrative staff have met and defined a way forward to establish monthly orientation seminars and generate associated materials, and

(3) the PSD Deputy Director will meet with interested staff to discuss the idea of forming a self-governing early career scientists group (pending).

By design, the DSRC has natural gathering areas throughout the building. The intent of these areas is to encourage informal interactions among employees. Their locations are self-evident and many are routinely used for regularly scheduled gatherings. In addition, GSD and PSD have internal facilities such as conference rooms, a coffee/tea/mail room, etc. that are also used for informal gatherings.

4. By October 8, 2010, ESRL will document the current level of use of developmental and rotational assignments and, in areas of deficiency, managers will be directed to take an active role in determining the aspirations of their personnel, make use of IDPs as appropriate, provide for training, mentoring, and development opportunities, and to promote use of existing development programs and rotational assignments.

   ESRL has a culture of providing a wide range of developmental opportunities for all levels of staff. These opportunities include: commercial seminars to enhance specific skills (e.g., IT, web/video communication, management skills), university coursework to develop new capabilities, full university programs to obtain advanced degrees, leadership programs such as the NOAA Leadership Candidate Development Program (LCDP), the Colorado Leadership Development Program (CLDP), the OAR Leadership Effectiveness and Advancement Program (LEAP) and the DOC Executive Leadership Development Program (ELDP), rotational assignments to expand skills and awareness across NOAA, and reassignments to provide new opportunities for those interested. ESRL managers have always taken active roles in encouraging the development of employees along pathways relevant to Division and NOAA priorities. Development opportunities are primarily implemented through annual work plans.

   Within the last four years, ESRL has supported four federal employees who took advantage of leadership development programs, including ELDP, LCDP, CLDP and LEAP spanning up to 18 months each. Five employees have also served in temporary assignments in other parts of NOAA ranging from four to nine months. Furthermore, four employees have completed Project Management Institute certification within the last year. Federal employees now have IDPs associated with their annual work plans and ESRL management has encouraged the management of Cooperative Institutes and contractors to use similar mechanisms for their personnel. Management of the Cooperative Institutes and contractors responded that they offer developmental opportunities in a number of ways though they do not all use an IDP. ESRL management encourages the use of all personnel development opportunities available, but relies on the aspirations of individuals to determine the selections of individuals for these opportunities.

3.1 Climate, Weather and Water Science

Verbatim Review Panel Recommendations:

1. PSD should attempt to get out in front with respect to climate model diagnostics. Like most groups, they are analyzing the last generation of climate models at a time when the

next generation of climate models have already been advanced and frozen for AR5. It would be helpful to short-circuit this feedback loop so as to not skip a generation of model development.

2. ESRL should establish a mini-Arctic program (a cross-division theme) to encourage dialogue and collaboration. The potential synergies between Arctic research efforts and model development/validation efforts should be exploited.
3. ESRL should position itself to become a leading hub for Arctic atmospheric research. NOAA should take a leadership role in facilitating some broader international coordination for Arctic observations. With the highlight given to the Arctic in the upcoming NOAA Strategic Plan, the time seems right for ESRL to exert itself in the Arctic. Perhaps the upcoming "Arctic Watch" will be one vehicle for broadening ESRL's visibility in the Arctic. Partnerships with CPC and GFDL on Arctic variability and predictability research would make NOAA more prominent in broader programs such as SEARCH (Study of Environmental Arctic Change).
4. ESRL management should have a plan for the sustenance of the scientific leadership of this group while planning how to identify, nurture, and groom the future leaders. The lack of Federal positions and the use of CI staff, who have little hope of moving to Federal positions, appears to provide challenges to sustaining ongoing excellence in science and science leadership.

Responses:

1. This recommendation raises an important issue of proactive vs. reactive diagnostic analyses, which is relevant not just within PSD but across multiple organizations and agencies. "To get out in front with respect to climate model diagnostics", especially with respect to an arbitrary Intergovernmental Panel on Climate Change (IPCC) clock, is easier said than done. Accomplishing and sustaining such an ambitious role for PSD will require: 1) Having not just NOAA, but multi-agency (and perhaps even international) support at the highest levels to perform proactive model diagnoses of the IPCC models as they are being developed, and 2) Having PSD play a more important role in the IPCC deliberations and assessments. Certainly, PSD staff members are both willing and able to perform these functions, but they will need formal recognition from NOAA headquarters to do so. One possibility is to advance model diagnostics capabilities within PSD, perhaps as a part of any proposals for a new NOAA Climate Projection Prototype, with crosscutting links to the other components of ESRL and GFDL.
2. PSD understands the importance and visibility of its polar research efforts and the potential for broader collaboration across ESRL. PSD has considered elevating Arctic activities to the status of a full Branch within PSD versus a research team within the Weather and Climate Physics Branch, and strengthening collaborations across ESRL. The FY11 President's Budget proposed an increase in support for Arctic activities that would support growth of PSD's Arctic program, but its future will depend on Congressional action. ESRL has defined several cross-division integrating themes. Although the Arctic is clearly relevant to many of these themes, it is not a theme unto itself as it perhaps should be. Given the imminent formation of a NOAA Climate Service, the exact configuration for a cross-division Arctic or polar program within ESRL is unclear.

3. This should be addressed in the immediate future by initiating a series of Arctic theme-related discussion groups in ESRL. An example of themes would be black carbon, surface fluxes and atmospheric transports. The groups should have an *a priori* mandate to identify actionable items and execute them. This should be tasked to the ESRL Management and Leadership Team (MLT). If ESRL should not exist after a NOAA reorganization, PSD (or PSL as it were) would provide the groundwork for this in a revised Strategic Plan. Ms. Uttal is also in discussion with the National Science Foundation (NSF) to have the International Arctic System for Observing the Atmosphere (IASOA) be officially adopted as an NSF funded program office. There is a possibility the director for this would be a CIRES appointment that would work within ESRL.
4. The issue of maintaining science expertise and scientific leadership is broadly relevant across ESRL. The climate observing group (Arctic, Air-sea, and future renewable energy) situation is a bit different because a significant amount of the national expertise is concentrated in PSD and there is a well-known trend of declining University strategic education in meteorological hardware. While PSD has had a healthy **influx** of talented postdoctoral personnel in the last decade, that has been balanced by an **outflux** of those individuals to attractive University faculty positions. If we look at scientists in the group with strong observing system credentials who are under age 50, there are a few CI people and no Federal employees. On the plus side, we have good connections with graduate students at the University of Colorado [CIRES and the Institute of Arctic and Alpine Research (INSTAAR)], although there are some very time consuming bureaucratic barriers. Right now, we don't have a decent concept of the best strategy. Developing talent from the grassroots student level may be reaching too deep. We believe this problem is solvable, but only in an ESRL (or maybe even a NOAA-wide) context. To some extent this maps onto the issue of "the NOAA and national context for sustaining climate observing competency..." In the short-term, we recommend creating a small task force to address the issue.

Actions and due dates:

1. By 03/31/2011 - (1) PSD will explore organization changes following decisions on a NOAA Climate Service. Should a Service should be created, PSD will look how to best organize to provide the appropriate bridging between our science enterprise and the needs of the Service. (2) The IPCC Fifth Assessment Report (AR5) process has begun already and both Drs. Perlwitz and Pulwarty of PSD are engaged as lead and convening lead authors respectively. PSD will continue to identify research avenues using AR5 model results to advance the science necessary for the IPCC and National assessments.

PSD is in the midst of acquiring an enterprise class data storage capability to better support next-generation climate diagnostics within the division. Part of this storage will be set aside for use by climate diagnosticians within PSD to make available locally subsets of the CMIP5 output that will be used in the IPCC Assessment Report 5 (AR5). This will be managed by the science staff using a community-based approach to determine what CMIP5 datasets need to be bought in house at any one moment, for use by the PSD community as a whole. PSD is planning to

purchase additional storage when funding becomes available.

As the CMIP5 data becomes available over the next 6 months, local access will be provide to selected monthly and daily averages of output from these next generation of climate models, thus enabling PSD "to get out in front with respect to climate model diagnostics". Diagnostic studies will focus on high priority issues such as the fidelity of high impact climate extremes simulated in 20th century control runs and a mechanistic understanding of how and why climate extreme events are projected to change over the next 100 years.

2. Within 90 days of the formation of a NOAA Climate Service, PSD→PSL (Physical Sciences Laboratory) will discuss possible configurations for an enhanced and better-integrated Arctic program with NCS management. If the NCS is not created, the ESRL Director's Office will initiate the development of a Polar Theme within 90 days of a final decision.

With the downsizing of the ESRL Director's Office, no staff are available to pursue development of a mini-Arctic program. Furthermore the ArcticWatch initiative did not survive the budget process so there has been no new funding. However, PSD has taken the initiative to advance polar interests for some time now. A first step has been the assignment of Dr. Intrieri to the Weather and Climate Physics (WCP) Branch to oversee the Polar Science team. A second step is the initiative of Dr. Neff with Dr. Steffan, CIRES Director to advance the concept of a virtual polar center in Boulder following initial meetings with CIRES, INSTARR, and NCAR. Unfortunately, because of the delay of Boulder's CI competition by a year, we need to wait until that process is completed. Meanwhile, staff have been added in WCP working on polar science, namely Drs Sandy Starkweather and Gijs DeBoer. Furthermore, Dr. Amy Solomon has formally joined the team as an expert in mixed phase cloud modeling and decadal variability..

3. Within 90 days of the formation of a NOAA Climate Service, PSD→PSL will discuss possible avenues for elevating NOAA's leadership role in facilitating some broader international coordination for Arctic observations with NCS management.

ESRLPSD's current Polar Observations and Processes Program:

http://www.esrl.noaa.gov/psd/arctic/

already has a strong international component through the International Arctic Systems for Observing the Atmosphere (IASOA) Program:

http://iasoa.org/iasoa/index.php?option=com_frontpage&Itemid=1,

and is also part of NOAA's Arctic Research Program:

http://www.arctic.noaa.gov/,

and the Interagency Study of Environmental Arctic Change (SEARCH) Program:

http://www.arcus.org/SEARCH/.

PSD will continue to work with NOAA leadership and a potential NCS as appropriate to elevate NOAA's leadership role in broadening international coordination of Arctic observations.

4. By 03/31/2011 - PSD will: (1) create a demographic profile of the personnel within the climate and the climate-weather interface observation groups, (2) develop projections of near-term and longer-term transitions, (3) develop a list of personnel options (e.g., holding on to talented postdoctoral personnel, converting a few of our gifted CI people to federal, or recruiting new Feds from University/Research Laboratories), and (4) develop and implement a long-term plan to transition key positions using the options identified above.

The PSD climate observations group (i.e., the PSD WCP Branch) has three primary components: a Polar Observations and Processes Team, a Boundary Layer Processes and Applications Team, and a Multiscale Interactions Team. It was expected that the polar team would be elevated to branch status within PSD, and that ESRL would develop a cross-cutting theme to support integrated efforts, but that has not happened for the reasons noted above. Regardless, PSD management remains committed to strengthening polar research within PSD, enhancing polar research across ESRL, and to integrating polar research across the Boulder community. The other two teams within WCP are relatively stable, and the thematic make-up of the branch will remain the same for the foreseeable future.

The action item above was developed in response to reviewer concerns about maintaining the scientific leadership of this group. Conversations with Dr. Fairall indicate that he will be remaining in his position for several more years. The same is true for the WCP team leads, so WCP leadership is stable for now. Regardless, Dr. Fairall has initiated discussions with colleagues outside of Boulder regarding finding new postdocs or assistant professor level scientists that could provide leadership in the future. Meanwhile, Dr. Intrieri, who was recently added to the WCP group is assuming more management level responsibility in the WCP Branch and is expected to pursue leadership training in the near future.

PSD remains very focused on and committed to maintaining the scientific integrity of this group. The adopted approach is more opportunistic and less directed than that noted in the action item above, which better suits the uncertainty of current times, both with respect to Arctic initiatives and the current budget outlook for NOAA research. PSD and WCP leadership have a sense of the future direction and needs of the group, and pursue new opportunities as they arise. If the budget environment stabilizes, PSD will consider a more methodical approach to future planning.

3.2 Modeling, Data Assimilation and Advanced Computing
Verbatim Review Panel Recommendations:

1. ESRL needs to set realistic expectations and understand the operational constraints of an operational NWP system, including computer efficiency of models.
2. ESRL's short- and long-term planning and technological transfer processes for NWP systems need to be improved and implemented in close collaboration with the National Centers for Environmental Prediction (NCEP). ESRL, NCEP, and stakeholders need to establish the requirements, roadmaps, and detailed implementation plan (e.g., including schedule, critical path, etc.) for NOAA's chain of innovation for NWP (research, development, operation, and service).
3. GSD should continue to monitor the skills of FIM forecasts. Care must be given to ensure FIM is using the same operational data stream (including QA/QC) to minimize any difference in the operational environments between ESRL and NCEP and to break down barriers to transition.
4. The status of key projects (e.g. RUC, Rapid Refresh, etc.) should be monitored and documented regularly by a formal technological transfer management and scientific committee that would review and document the performance of the existing and developing NWP systems, using agreed operational validation and verification methods and metrics with standard WMO recommended practices and metrics.
5. GSD should develop 5-year strategic and implementation plans, firmly embedded within a NOAA plan for environmental modeling and prediction, for its vision of a global coupled atmosphere-and-ocean-chemistry model. Such a plan should leverage off and contribute to and coordinate with existing efforts within NOAA, including GFDL.
6. In developing the EnKF, FIM and NIM, ESRL should establish stronger collaborations not only with other NOAA labs and operational entities but also with labs in other agencies. The use of the ESMF is absolutely critical to enhance these collaborations. It is recommended that ESRL commit to ESMF fully – not only at the superstructure level but also at the infrastructure level. The NOAA Global Interoperability Program has provided funding and direction and should be taken very seriously.

Responses:

1. For close to 20 years, GSD has worked with the Environmental Modeling Center (EMC) and other organizations and agencies relying on GSD for their weather forecast applications to ensure that proposed changes in analysis and forecast systems [e.g., Rapid Update Cycle (RUC), Rapid Refresh (RR), Flow-following Finite-volume Icosahedral Model (FIM), Local Analysis and Prediction System (LAPS), and Space-Time Multiscale Analysis System (STMAS)] are consistent with available resources, and we agree completely with this point. The granularity recently designed in the FIM model is an example of GSD's readiness to adjust to available computational resources. GSD has also worked with EMC, NCEP Central Operations (NCO), and consultant staff hired by NCEP to optimize models on NCEP computers. Yet another example of this is currently underway where GSD software engineers are working with NCEP and NCEP consultants to introduce OpenMP and other optimizations into the FIM model. ESRL already understands that the initial FIM implementation at NCEP will be as a member of the

Global Ensemble Forecast System (GEFS). The resources available have not yet been specified, but we expect the needed resolution to be between 50–80km and ESRL is prepared to tailor FIM resolution to available computational resources. ESRL also recently initiated, with NCEP engineers and consultants, a successful effort to greatly improve efficiency for the Weather Research and Forecasting-Advanced Research Weather Research and Forecasting Model (WRF-ARW) version on the NCEP Central Computer System (CCS) for the upcoming Rapid Refresh implementation, now planned for early 2011.

2. There seems to be confusion about how GSD makes decisions regarding model development priorities. Support for model development comes from NOAA (through both base funds and other NOAA support) and the Federal Aviation Administration (FAA). GSD leads development of a 7-year Model Development and Enhancement (MD&E) Plan with several other modeling groups each year as required by the FAA Aviation Weather Research Program. Thus, GSD plans are fully vetted with NCEP, the National Center for Atmospheric Research (NCAR), and the FAA before moving ahead. Since NCEP is also represented on the MD&E team, considerable coordination exists in planning and setting priorities. GSD also partakes in the annual NCEP review as a key participant, and there are many briefings given to the National Weather Service Office of Science and Technology (NWS/OST) and other parts of NWS including NCEP's Storm Prediction Center and the Aviation Weather Center. We regret that these extensive interactions with other parts of NOAA in planning, coordination, and execution were not made more apparent to the review panel.

   With contributions that are closely coordinated with NCEP and other parts of NWS, GSD plays a direct role in the orderly transition of various Numerical Weather Prediction (NWP) methods to the operational community. GSD has entered into Memorandums of Agreement (MOAs) with NCEP on model developments. GSD has also developed charters with detailed NCEP adoption and implementation plans for previous Rapid Update Cycle (RUC) changes, and is now revising one regularly regarding the Rapid Refresh (RR). The RR MOA includes a plan to merge the RR and North American Meso (NAM) model toward a North American Rapid Refresh Ensemble (NARRE) by 2013. NCEP/EMC and GSD also plan to use the NARRE to provide initial conditions for an ensemble version of the 3-km hourly High-Resolution Rapid Refresh (HRRR). ESRL has greatly increased its use of community code – WRF, Gridpoint Statistical Interpolation (GSI), unipost – for RR and HRRR, and this is also indicative of close collaboration with NCEP and the larger Numerical Weather and Environmental Prediction (NWEP) community. We also note GSD's increasing role in the Developmental Testbed Center (DTC). The DTC is supported through interagency collaboration and was established to improve research to operations and operations to research processes.

3. The skill of FIM, including different FIM versions versus each other and the Global Forecast System (GFS), is calculated daily and revised at least monthly by the FIM development group. These scores are calculated via an interactive verification application available under http://ruc.noaa.gov/stats. The software for calculation of

anomaly correlation coefficients in this application was provided by NCEP, and follows World Meteorological Organization (WMO) standards. GSD uses the operational GFS initial conditions in its primary real-time FIM run at 30-km horizontal grid spacing. The Ensemble Kalman Filter (EnKF) model uses the global prepbufr files, plus satellite data from NCEP, just as the Global Data Assimilation System does. Thanks to the use of the ESRL-developed Scalable Modeling System (SMS, a directive library for MPI parallelization), initial ports to NCEP computers for RUC and FIM have been quite routine. While transfers of NCEP models (e.g., GFS and NAM) have been problematic to non-IBM environments, transfers of ESRL-developed models into the NCEP IBM environment have been quick and without major problems. Note that the ESRL FIM testing environment is not fully "operational", although it is a real-time testbed environment. ESRL will establish monthly reports published on the web to provide the skill from different versions of FIM versus GFS. ESRL will continue to collaborate with NCEP on the implementation of FIM on NCEP's CCS, including application of NCEP verification software.

4. A formal process is followed at NCEP for all model changes, requiring approval by EMC and NCEP Central Operations (NCO) Directors, and ultimately, the NCEP Director as well. This process includes collaborative development of model change charters to identify requirements, testing processes, and points and dates of different stages of approval. This procedure is quite rigorous and is followed by ESRL for all changes to the RUC and Rapid Refresh.

   The NWS (via Regions and individual forecast offices), the NCEP National Centers [especially the Storm Prediction Center (SPC) and the Aviation Weather Center (AWC)], and other interested user groups serve as a *de facto* review committee advising the NCEP Director on the quality of new methods proposed for implementation. ESRL also responds to requirements articulated from NWS.

   GSD participates in many model monitoring and model development management activities at NCEP. One of them is participating with a presentation on the RUC and RR at the annual NCEP Production Suite Review. GSD has developed very powerful development verification capabilities, including online verification against radiosondes and surface observations for RUC, RR, FIM, NAM, and GFS. The GSD verification capabilities contribute strongly to improvements in Tropical Cyclone (TC) verification, including TC false alarm and demographic measures. GSD is developing an effective radar reflectivity and precipitation verification capability for 3-km scale HRRR and other model forecasts. For further information, please see:
   - NCEP verification web page for RUC, GFS, NAM – http://www.emc.ncep.noaa.gov/mmb/mmbpll/mmbverif
   - Verification web page for RUC, RR (multiple versions), NAM, GFS, and, FIM vs. RAOBS, GPS (under http://gpsmet.noaa.gov), surface obs

   - In addition, to improve monitoring and documenting, all significant transition projects will be tracked in the OAR Project Database and include key project status

information such as milestones, deliverables, timelines, and referenced transition agreements.

5. Development of a GSD Strategic Plan began with a two-day workshop held in Estes Park, Colorado during early July 2010, followed by development of a 10-year strategic plan proposal by each GSD Branch Chief in mid-August 2010. This plan was reviewed by the ESRL Director, ESRL Division Directors, OAR management, NWS/OST, NWS Office of Climate, Water and Weather Services (OCWWS) leadership, and NCEP [in particular, EMC, SPC, AWC, the Hydrometeorological Prediction Center (HPC), and the Climate Prediction Center (CPC)]. The first draft of the GSD Strategic Plan was complete by early October 2010 and the final was issued in March 2011.

   ESRL has been involved with National Unified Operational Prediction Capability (NUOPC) planning over the past two years and GSD will continue its current roles in NUOPC and the Earth System Prediction Capability (ESPC). ESRL took a leading role with the first ESPC meeting held September 7-9, 2010 that involved planning toward a common ESPC within the U.S.

   GSD has led the vision within NOAA for inline chemistry in atmospheric models for weather forecast time scales and for meso-spatial scales, as well as development of WRF-Chemistry, a multi-laboratory effort. WRF-Chemistry, in turn, has already been adapted to global application within the FIM, and is a candidate for the chemistry component of the NOAA Environmental Modeling System [NEMS, the Earth System Modeling Framework (ESMF) version at NCEP]. GSD's demonstrations of inline chemistry in WRF-Chemistry (for Texas Air Quality Study, HRRR-western U.S. and Alaska, and others) and now in FIM-Chemistry with real-time fire/smoke and volcanic ash forecasts are helping to create and accelerate a vision in NOAA, especially in OAR and NWS. Other drivers for inline chemistry or coupled model development include:
   - **Renewable energy (RE) – solar and winds (via Planetary Boundary Layer)**
   - Aviation (visibility, clouds)
   - Microphysics – aerosol interactions
   - **Improved general forecasts (e.g., 2-**m temperature, surface winds, etc.)
   - Arctic application
   - Great Lakes application

   GSD will initiate a coordination meeting on inline chemistry modeling and data assimilation with NWS and OAR colleagues within six months and seek funding to support FIM-Chemistry work with colleagues through collaborations with ESRL Divisions and others outside of NOAA.

   Other opportunities for improving chemistry forecasting using satellite data assimilation can directly improve aerosol initial conditions within the forecast models. In turn, better aerosol initial conditions can result in improved radiance assimilation within forecast models.

Regarding strategic and implementation plans embedded within a NOAA plan for environmental modeling, the NOAA Environmental Modeling Enterprise (EME) governance is currently in development. When the NOAA environmental modeling plan is developed and implemented, GSD will adhere to the requirements specified to develop and enhance capabilities in support of NOAA environmental modeling strategies and priorities.

6. ESRL is working closely with NCEP, the NASA Global Modeling and Assimilation Office, the U.S. Navy, and others toward multiple advanced modeling and data assimilation capabilities. We have incorporated the evolving NEMS architecture, based on ESMF, into ESRL model development for the FIM, and will do likewise for a 2012–13 version of the Rapid Refresh. ESRL collaborates on ESMF development with NCEP and has committed significant resources toward NEMS over the last several years. We have personnel on staff dedicated to the NOAA Global Interoperability Program and we have begun working with the new NOAA Environmental Software Infrastructure and Interoperability (NESII) group. Within the next six months, we will explore working even more with the NESII group.

Actions and due dates:

1. None.
2. None.
3. Establish monthly reports published on the web to provide the skill from different versions of FIM versus GFS by October 5, 2010.

   A web page showing monthly statistics for different versions of FIM versus GFS is available at http://fim.noaa.gov/fim_ac_stats/.

4. Report significant transition projects in the OAR Project Database by January 30, 2011.

   In December 2010, mature research projects ready or approaching readiness for transitioning to NWS operations were included in the OAR Project Database. Those projects included: Net-Enabled Verification Service (NEVS), Volcanic Ash Coordination Tool (VACT)/Weather Information Decision Aids (WIDA); GPS-Meteorology (GPS-Met), Rapid Refresh (RR) model, Flow-following finite-volume Icosahedral Model (FIM), Geo-Targeted Alerting System (GTAS), and AWIPS II Applications for Thin Client (FX-Net research system) and Collaboration (FX-Collaborate research system). Updates to the OAR Project Database will be provided when major progress is made or details about the transitions have changed.

5. Produce the first draft of the GSD 5–10 year strategic plan by October 5, 2010. Initiate a coordination meeting on inline chemistry modeling and data assimilation with NWS and OAR colleagues by February 8, 2011, and seek collaborative funding.

   The first draft of the GSD Strategic Plan was produced as of 09/08/2010. This document was distributed to other NOAA organizations for review and comment. The final version of the GSD Strategic Plan was issued as of March 10, 2011.

By mid January 2011, GSD initiated discussion with NWS and OAR on inline chemistry modeling and data assimilation. Discussions did not include ocean modeling. Further collaboration was delayed due to schedule conflicts and higher priorities within NWS. In April 2011, a meeting on this topic was held between representatives from NWS Office of Science and Technlogy, GSD, PSD, and CSD. Further meetings are needed on this topic and will occur, but are not yet scheduled.

6. Explore working more with the NESII group by February 8, 2011.

   GSD and the NESII group have an established, effective collaboration on modeling framework development and activities for the Earth System Modeling Framework (ESMF), the National Environmental Modeling System (NEMS), and the National Unified Operational Prediction Capability (NUOPC). The relationship between the teams is in terms of developer (NESII) and user (GSD) of the ESMF. GSD feeds information to the NESII group based on user experience. This includes reporting new development items, user experience with documentation, inconsistencies in the software, corrections or updates needed for the data standards and other issues. GSD relies on ESMF as a core technology for NEMS development by NCEP that GSD is using. Models that are being developed under the NEMS framework, as a requirement by NCEP to run models in operations, rely on the ESMF. As such, we must coordinate our activities and requirements to the NESII team. The technical interchange between GSD and NESII is rich and effective, resulting in work prioritization that supports the NOAA mission.

3.3 Climate, Weather and Water Services

Verbatim Review Panel Recommendations:

1. ESRL should look to define additional metrics (beyond publication count) on the transitions of products to operational services.
2. ESRL should have a stronger connection to CPC in its planning of climate service products. The unknown in this recommendation is the role of CPC in the NCS. Surprisingly, CPC, which has been a co-leader within NOAA (with CDC and then PSD) in developing climate products, is currently not planned to be part of the NCS.
3. There should be clearer roadmap plans for testbed activities, including transition to operations and/or maintenance of observational capabilities that have been identified as essential for particular applications.

Responses:

1. The CIRES Climate Diagnostics Center, and later the ESRL PSD Climate Analysis Branch, has been using two milestones that were developed to track the transition of research into operational services. The first metric "New experimental climate products and services developed" tracks the prototyping of new potential information streams that could support decision making. The second metric "Experimental research products introduced in operational setting" tracks the success in having operations adopt experimental climate products and services. Other ESRL metrics relevant in the tracking of transitions of products to operational services include "% skill score improvement in experimental U.S. Seasonal forecasts" and "Increase skill of medium-range forecasts of

tropical precipitation". Because the NCS planning teams are looking at performance metrics, PSD will monitor this activity so as to align it activities and metrics appropriately.

2. PSD works closely with Climate Prediction Center (CPC) on climate reanalysis, monitoring, attribution, and predictions. ESRL/PSD and CPC work together on strategic plans within the framework of the NOAA Climate Goal. While ESRL/PSD looks to CPC as the operational conduit for climate monitoring and prediction research findings, whether CPC will be in the NOAA Climate Service (NCS) is being debated, and will be decided, at a much higher level within NOAA Headquarters. Nevertheless, PSD and CPC are, and will continue, working together to develop mechanisms to ensure the development and delivery of monitoring and prediction services across temporal and spatial scales that will be transparent to users.

3. The Hydrometeorology Testbed (HMT) Implementation Plan (2009) provides a roadmap for activities in the major activity areas of Quantitative Precipitation Forecasting (QPF), Quantitative Precipitation Estimation (QPE), Snow Information, Hydrology, and Decision-Support Tools. The executive summary is available online at http://hmt.noaa.gov. The full plan can be requested from the HMT Project Manager.

Actions and due dates:

1. Dr. Webb has had responsibility for leading the development of the NCS Strategic Vision and Framework document, part of which deals with metrics for success. PSD will continue to be engaged in this process as the NCS generates more global metrics that will apply to this new Service. ESRL will contribute, as appropriate, to reporting transitions to applications for NOAA's Government Performance and Results Act (GPRA) new demonstration performance measure related to transitions during FY11.

   The NCS metrics for the transition of products to services has been slowed down by Congressional language in the appropriation bill: 'None of the funds made available ….may be used to implement, establish, or create a NOAA Climate Service as described in the ''Draft NOAA Climate Service Strategic Vision and Framework'' published at Federal Register 57739 (September 22, 2010) and updated on December 20, 2010." PSD will re-engage in this activity when a firm decision regarding the creation of a NOAA Climate Service has been made.

2. Within 90 days of the formation of a NOAA Climate Services that will also result in a final determination of CPC either within or outside of the NCS line office, PSD → PSL will work with NCS management to develop either internal agreements or cross-line office MOAs to establish mechanisms to ensure that the development and delivery of monitoring and prediction services across temporal and spatial scales that will be transparent to users.

   The development of formal linkages between PSD and CPC has been slowed down by Congressional language in the appropriation bill: 'None of the funds made available ….may be used to implement, establish, or create a NOAA Climate Service as described

in the "Draft NOAA Climate Service Strategic Vision and Framework" published at Federal Register 57739 (September 22, 2010) and updated on December 20, 2010." PSD will re-engage in this activity when a firm decision regarding the creation of a NOAA Climate Service has been made.

3. None

3.4 Technology Transfer and Outreach Activities

Verbatim Review Recommendations:

1. ESRL management should engage in discussion with the NWS AWIPS-II program. Collaboration with the NASA SPoRT center and IMAPP could help transition new technology to the NWS forecast offices.
2. GSD should work with NOAA and other US and or international science-oriented organizations, such as NASA, DARPA, or NSF to develop indices suitable for measuring the effectiveness and efficiency of technology transfer.
3. ESRL should obtain and review FAA's REDAC report on barriers to research transition into operations for lessons learned.
4. Technology transfer roadmaps that track investment in science to ultimate value in use should be developed.
5. ESRL should consider working with the private sector to rethink the ways forecast information might be created and disseminated in the new broadband-connected world.
6. A multi-year strategy for targeting outreach activities should be developed. The resources and outcomes achieved in this area should be assessed.
7. For major education and outreach efforts like virtual worlds and SOS, a formal evaluation process that includes educational value should be developed and implemented.

Responses:

1. GSD's role in AWIPS-II is different from its earlier role in AWIPS-I when GSD had the role of developing AWIPS-I. AWIPS-II development was outsourced to industry by NWS beginning in 2005. In AWIPS-I, Boulder, Colorado and Norman, Oklahoma Weather Forecast Offices (WFO) had testbeds running with real-time forecaster operational interaction. That is not the case at this point in the AWIPS-II development program. Rapid Prototyping was the method employed in the development of AWIPS-I, with quick feedback from WFO forecasters and thorough coordination with other government agencies throughout the development process. This is lacking in AWIPS-II. We propose the following actions if approved by NWS. We will use Rapid Prototyping for the AWIPS-II extended tasks assigned to GSD. For example, the Integrated Hazards Information Services (IHIS) project will begin forecaster prototype feedback in September 2010. While this does not directly address AWIPS-II proper, the extended projects will significantly enhance AWIPS-II capabilities once AWIPS-II is fielded. GSD will write a proposal to NWS for integrating more operational forecaster interaction and feedback into the AWIPS-II extended task development process, through a testbed environment or research and development proving ground shared by GSD and the NWS Boulder WFO. Included in this proposal will be travel funding to bring WFO forecasters from around the nation to Boulder for extended task feedback during the research and

development stage. This is vitally needed for tight integration among the various government entities involved in AWIPS-II.

ESRL scientists contribute to NASA Short-term Prediction Research and Transition Center (SPoRT) through participation on the Science Advisory Committee (Dr. Marty Ralph in PSD; 2007- present and Dr. John McGinley in GSD; 2003-2006). However, there is currently no direct ESRL role with SPoRT to transition new technology to NWS WFOs. SPoRT actively collaborates with 11 Weather Forecast Offices as well as the Spaceflight Meteorology Group from the Southern Region. Through ESRL's efforts in enhancing communication and collaboration across the NOAA testbeds, we have actively engaged with SPoRT to share information about our overlapping/coinciding research. For more information regarding NOAA's collaborations with SPoRT see: http://weather.msfc.nasa.gov/sport/. We currently have no direct collaboration with the NASA International MODIS/AIRS Processing Package (IMAPP) for transitioning new technology to NWS offices. We will investigate any opportunities to collaborate with IMAPP.

2. ESRL would welcome the implementation of such a formal process and believes it would be beneficial. Developing more suitable indices for measuring the effectiveness and efficiency of technology transfer can be done, but this is not trivial. Significant resources would have to be allocated to this task. Project funding has not been sufficient to cover the additional resources that would be required to establish and evaluate suitable indices for measuring the effectiveness and efficiency of technology transfer. Processes and indices would be different for each project since various stakeholders have different transition-to-operations protocols. For example, NWP projects do not rely on the NWS Operations and Services Improvement Process (OSIP) to determine the readiness of technology transfer. By February 8, 2011, we will establish a matrix of generalized, quality, performance, and maintainability metrics. This matrix will be populated with information obtained from performance measurement systems of various collaborators within NOAA and other organizations such as NASA, DARPA, NSF, and FAA.
The notion of measuring the efficiency and effectiveness of technology transfer has merit. However, as an alternative, resources may be better utilized by making the technology transfer process more efficient and effective. For the most part it seems to be *ad hoc*, differing from case to case. The approach for AWIPS-I used rapid prototyping followed by evaluations, and then refinements and adjustments were made to the system based on user feedback. The results proved very positive. Taking this type of approach might be a better investment.

3. We will obtain and review the FAA REDAC report to determine elements from this report with potential to improve transition of ESRL research to operations. This review will be completed by February 8, 2011.

4. GSD has been involved with other members of the scientific and development community in building a number of Science and Technology Roadmaps that include: Aviation Weather, Fire Weather, Hydrometeorology, Ensemble and Probabilistic Forecasting, and Numerical Modeling. Economic measures have been documented by

customers such as the Forest Service in fire weather applications and by the FAA for aviation weather analysis. ESRL research efforts are focused in areas that provide economic and societal benefit. By February 8, 2011, we will organize a Task Team to explore the feasibility of engaging an economist or other experts (out-sourced) to assist with developing cost-benefit analyses of technologies transferred.

5. GSD is currently developing new web-based technologies to disseminate integrated hazard information. GSD also partnered with social scientists in the academic community to explore new ways of communicating forecast uncertainty for improved decision-making. Private sector partners are engaged as advisors for input and feedback. The 4-D Data Cube/Weather Information Database (WIDB) is another technology to utilize broadband that empowers private industry to develop new value-added products. By November 15, 2010, we will examine the multiple ways currently used by industry to include mobile technology to disseminate forecasts in the new connected world in partnership with other stakeholders. This will include handheld technology. To develop new ways of creating and disseminating forecasts, we will explore scalability and access of technology provided by industry and being used or proposed for use by NWS and other national and international organizations.

6. GSD is actively engaged in a leadership role in the development of multi-year plans related to K–12 educational outreach activities directly linked with cutting-edge NOAA research in the area of satellite validation and numerical modeling of land surface and biosphere processes. Science On a Sphere® (SOS) is a conduit for educating all sectors on major issues facing the nation and the world, such as responding to climate change and balanced use of coastal and marine resources. Through collaborations with subject matter experts, innovative and relevant science continues to be presented on SOS in a variety of formats and forums. By February 8, 2011, GSD will develop a strategic plan for SOS with the goal of improving society's environmental literacy and to provide the ability to make better informed environmental decisions.

   For Virtual Worlds, a paper was prepared by OAR titled "Recommendations for NOAA Strategic Engagement" that demonstrates the utility of this technology and provides a recommended strategy for implementation. This paper is available at http://www.scribd.com/doc/34071454/Virtual-Worlds-and-Immersive-Internet-White-Paper. Specific steps to advance this new technology within NOAA are being evaluated.

7. Together with the NOAA Office of Education and the Institute for Learning and Innovation, the SOS users collaborative network is currently involved in a program-wide evaluation of the effectiveness of the exhibits of spherical display systems. In addition, all SOS installations that have been funded through the NOAA Environmental Literacy Grants must conduct formal evaluations of their SOS exhibits. Evaluation reports are available online at http://www.oesd.noaa.gov/network/SOS_evals/index.html.

   Since its inception, the Virtual Worlds program has carefully monitored visitor levels and interactions. This report is available at http://www.slideshare.net/hackshaven/noaa-in-second-life-traffic-report-year-2009-in-review. Several universities and other

government agencies have evaluated the effectiveness of Virtual Worlds in their programs. By October 31, 2010, we will create a proposal for the NOAA Office of Education to evaluate the educational value of Virtual Worlds.

Actions and due dates:

1. Review current evaluation practices of AWIPS-II and other possible methodologies for doing technology transfer evaluations and write a proposal to NWS for rapid prototyping work by December 31, 2010. Investigate any opportunities to collaborate with IMAPP by February 8, 2011.

   GSD's Information Systems Branch performed this evaluation and provided a proposal to the NWS to support AWIPS-II Operational Test and Evaluation during 2011. A multi-stage approach was presented that included subjective human-factor assessments and systematic component testing. GSD offered to assist in developing assessment metrics, test procedures, scheduling, and then to assist in execution of the final test plan.

   GSD investigated opportunities to collaborate with IMAPP. The findings revealed that the IMAPP approach is not aligned well with the regional and global forecasting system development work within GSD. GSD will continue to be mindful of IMAPP approaches for model analysis and forecast verification to determine if any collaborative linkage can be made.

2. Establish a matrix of generalized quality, performance, and maintainability metrics in collaboration with stakeholders by February 8, 2011.

   This action item is ongoing. The first draft of a technology transfer quality/performance matrix has been completed. The scope of the process has been defined and the definitions and explanations of the rating parameters are in process. So far, there are five general transfer criteria with six sub-category evaluation items for each. This output needs to be thoroughly reviewed internally within GSD and then with stakeholders (e.g., sponsors) to determine the suitability and robustness for a wide range of technology transfer items.

3. Obtain and review the FAA REDAC report by February 8, 2011 to determine elements with potential to improve transition of ESRL research to operations.

   The FAA REDAC report focuses on the transition of new Air Traffic Management (ATM) concepts from research through development to implementation. Two findings within the FAA REDAC report relate to GSD experiences with sponsors: 1) Government furnished information can be a useful resource; 2) Collaboration between industry and R&D teams is vital to success. The report confirms a collaborative approach with sponsors, their supporting staffs, and other industry and academic sources to achieve successful development and transition to operations. GSD will endeavor to maintain collaborative teamwork in working with other organizations, sponsors, and their respective supporters.

4. Organize a Task Team to explore the feasibility of engaging an economist or other experts (out-sourced) to assist with developing cost-benefit analyses of technologies transferred by February 8, 2011.

   GSD organized a Task Team and, since the ultimate customer is a real world decision-maker and in some cases outside NOAA, it was determined that assessment of socioeconomic benefit (vs. cost-benefit, which is done prior to technology transfer) will go hand-in-hand with the goal of delivering environmental information systems and decision-support services useful to the Nation's socioeconomic needs. In order to meet the goal of, for example, improving weather-decision services and then determining the overall value of weather information, GSD will have to find a way to assess weather forecast quality and value in the context of societal and economic impacts that threaten safety, health, efficiency, the environment, and economic productivity.

   Current funding constraints do not permit GSD to employ an economist. Therefore, GSD will continue this initiative by investigating the use of existing NOAA resources available to conduct socioeconomic benefit analyses of our research and development projects that have transferred to operations. This action may help GSD explore the socioeconomic benefits of new capabilities to be provided to stakeholders from GSD's research and development projects.

5. Examine multiple ways to disseminate forecasts in the new connected world in partnership with NWS and other stakeholders by January 31, 2011.

   GSD continues to be involved with the NWS, FAA, other stakeholders and research organizations on improving the way weather information is monitored, ingested, stored, processed, modeled, verified, integrated, and disseminated to end-users. As the information age continues to offer new and easily affordable ways to allow all citizens to have access to and share weather information, GSD, NWS, NOAA and their partners need to continue to refine, rethink, and rebuild the way weather information is shared between the research community, operations, and the public.

   As GSD continues to work with NWS and other partners to develop the next-generation weather information systems capabilities, we will be focused on the ability to have all areas of expertise collaborate and share information. Future development efforts will focus on the ability to collaborate with other NOAA offices, government agencies, the research community, and the public. The sharing of information needs to be a true integration of the data being presented. Operational users will need to be able to pose a question in the terms of thresholds and have the answer returned as a graphic tailored for their needs with a confidence level included (impact-based graphics). GSD work with NWS and other partners will enable data mining based on event type, information requested, geographic area and end-user devices, requiring an integrated device-tailored display capability. This will allow using a variety of information devices without inundating the users with menus or selections that are out of their areas of expertise or of no interest to them for the problem at hand. Instead of having stove-piped environments with unique data sets, GSD will be engineering a collaborative suite of tools that can be

used to share dissimilar data in real time for all users bringing their expertise to bear on the problem and the devices they use on a daily basis.

GSD examined and is currently in partnership with the NWS to develop ways for the NWS to disseminate more accurate forecasts in the ever-growing connected world. It should be noted that GSD's role is that of a research lab to design, prototype, and develop the tools necessary for the NWS to actually disseminate its products. GSD works with the NWS on a reimbursable basis to improve the way weather information is monitored, ingested, stored, processed, modeled, verified, integrated, and disseminated to end-users. As the information age continues to offer new and easily affordable ways to allow citizens access to weather information, GSD and the NWS need to continue to refine, rethink, and rebuild ways in which weather information is disseminated in a timely and efficient manner.

For private sector stakeholders, weather websites have surpassed search engine sites as the top sites accessed by users. This is due to the explosion of handheld devices, weather applications for those devices and the impact that weather has on all facets of society and the economy. The NWS maintains its own website for forecast dissemination and is deemed the official source by the U.S. government. GSD has examined non-traditional ways for agencies to disseminate forecasts when hazards offer an immediate threat to public safety. Under Federal Emergency Management Agency (FEMA) funding, GSD developed the Geo-Targeted Alerting System (GTAS) for chemical spills, biological agents, and volcanic ash with smoke and dust soon to be added. GTAS prototypes are deployed at NWS offices in several cities across the U.S. and their corresponding Emergency Operations Centers. Unfortunately, this project was cancelled in 2011 due to FEMA budget cuts.

6. By February 8, 2011, ESRL will develop a strategic plan for SOS.

A 2011–2015 SOS Strategic Plan was issued on 02/04/2011. The Executive Summary of this plan is included in paragraphs below.

> The vision for the Science On a Sphere® Program is to use this technology as a visualization system for educational purposes, providing audiences of all ages with a way to understand natural and potential human impacts on the environment. This approach maps directly into the NOAA Enterprise Engagement Objective to 'Improve society's environmental literacy and ability to make informed environmental decisions.'
>
> This Strategic Plan focuses on three areas of the Science On a Sphere® Program: Organizational Structure, Educational Focus/Data Development and Software Development/System Support.
>
> Due to the rapid and dynamic nature of this technology, the plan is split into two Phases. Phase I discusses activities to take place during 2011 and 2012, while

Phase II provides some insights for the technology for the years 2013 through 2015.

The key element of the Organizational Structure is the need to hire a full-time Program Manager for Science On a Sphere®. As the number of installations and the needs of the user community increase, it is clear that this Program Manager is required to prioritize the developing program, determine the best way to sustain the current activities and focus on those future features that will meet the NOAA mission and enhance the overall Science On a Sphere® program. An increase in the number of exhibits of Science On a Sphere® over the next few years is also anticipated.

Fundamental to the future of Science On a Sphere® is to enhance its educational value. This plan provides insights to a number of approaches to expanding its emphasis on informal education and also provides input for its connection to NOAA's Office of Education and formal education programs.

In the Software Development and System Support sections, activities are laid out that will enhance the ease of use of Science On a Sphere® and highlight the development of anticipated new features.

7. By December 31, 2010, we will create a proposal for the NOAA Office of Education to evaluate the educational value of Virtual Worlds.

   The recommended proposal was completed by 12/27/2010. The abstract of this proposal is inserted below.

   We proposed to evaluate the effectiveness of Virtual Worlds by comparing test results between more traditional educational methods and a trivia game solution based Virtual Worlds. To evaluate the Virtual Worlds trivia game, we proposed a traditional exam in a classroom setting to provide a baseline for comparison. Next, one group of students would be given access to the Virtual Worlds trivia game while another group would be taught using existing, traditional curriculum. At the end of the semester, a follow-up exam would gage retention between the two groups. It is expected that the group with access to the Virtual Worlds trivia game would perform better than the group using traditional methodologies, and if so, this would demonstrate the educational value of Virtual Worlds.

   NOAA's Office of Education has an immediate two-fold need for virtual worlds, games, and simulations as part of its strategic plan.

   First, before it is possible to effectively determine the value of a particular technology or pedagogical approach, it is important to take a step back and ask the question "What topics of knowledge are especially deficient within NOAA's educational sphere of influence?" For example, on average do students understand less about the carbon cycle or the ozone hole? Further, what underlying scientific

principles need focus as a result of deficiencies within a particular topic?

Therefore, part of this proposal is to perform a baseline needs assessment to determine what educational topics require special attention by NOAA in its science and technology curriculums.

This activity will be supported by creating a multi-player trivia game designed to increase an "under-21" user group's engagement to NOAA's educational material. The goal is to increase participation and ultimately the amount of data collected that could help drive NOAA's overall educational goals. By creating an activity that customers *want* to participate in (as compared to a traditional test) the hope is to increase the data available for NOAA Education to formulate future priorities.

Second, the success of the trivia game itself will be evaluated by comparing player scores in a trivia game setting to similar achievement scores from educational environments using more traditional pedagogical techniques. This evaluation should occur though an external collaborator.

Finally, it is important to note this activity is directly supported by the National Research Council's report on "Learning Science: Computer Games, Simulations, and Education." Specifically the report states, "*Academic researchers, developers and entrepreneurs from the gaming industry, and education practitioners and policy makers should form research and development partnerships to facilitate rich intellectual collaboration. These partnerships, which may be large or small, should coordinate and share information internally and with other partnerships. Government agencies and foundations may consider the potential benefits of providing sustained support for such partnerships.*"

Further, video games that are typically seen as mindless forms of entertainment have recently been shown to improve a player's speed, accuracy, vision, and multitasking capabilities. These improved skills are not just within the game, but translate back into the real world.

The projected cost of this proposal is $175K.

3.5a Weather Systems Observations and Analysis

Verbatim Review Recommendations:

1. The OSE activities should include standard WMO-recommended practices and metrics used by the majority of the NWP centers around the globe. Cost as well as benefit for new observation systems should be included in the assessment. ESRL should consider addressing geographic areas identified by the NRC report as challenges for network design, namely urban areas, coastal region, and mountainous terrain.

2. Given the extent of observational activities within ESRL, together with in-house modeling capabilities, ESRL should build a stronger effort in observing system evaluation and optimization.
3. ESRL should position itself as a ground validation resource for satellite data.

Responses:

1. GSD's Observing System Experiments (OSE) -related verification has used specifications consistent with the WMO RAOB verification algorithms documented under http://www.wmo.int/pages/prog/gcos/documents/gruanmanuals/GDPFS/WMO_485_Vol_I.pdf. GSD has described its extension to WMO mandatory-level-only RAOB verification in the Moninger et al. 2010 paper (http://ruc.noaa.gov/pdf/TAMDAR-WF-journal-6Oct09.pdf). We will learn yet more about the WMO practices, but we consider GSD extensions to have been extremely valuable in gaining physical understanding about data assimilation issues.

   Cost issues for possible future observing systems are the responsibility of the NWS. Future ESRL OSE efforts could be more formally coupled with NWS cost-related decision-making if needed.

2. GSD will seek new funding opportunities to support observing system evaluation and optimization. We will also form a team charged with developing and implementing methods to quantify/estimate observational uncertainties for data assimilation and Observing System Simulation Experiments (OSSEs), for monitoring the quality of major remote and in-situ observing systems assimilated into operational and research models, and to assist in evaluating the impact on attaining NOAA performance objectives. GSD will continue to participate in the establishment and development of the NOAA OSSE program to identify long-term interests and contributions, and will develop an OSSE strategic plan outlining long-term goals for implementing a comprehensive global OSSE system. This plan will study new observing systems and provide data supporting cost-benefit analyses.

3. GSD scientists have been contributing to ground validation of various satellite data and products in collaboration with the National Environmental Satellite, Data, and Information Service (NESDIS) and the Joint Center for Satellite Data Assimilation (JCSDA). We agree with the review panel that given GSD's expertise in ground-based GPS and other observing systems, there are further opportunities to be pursued.

Actions and due dates:

1. Based on the referenced paper by Moninger et al., GSD will prepare a report on the use of extensions to WMO standards for RAOB verification by February 8, 2011.

   The requested report is posted at http://ruc.noaa.gov/stats.

2. By February 8, 2011, GSD will form a team charged with developing and implementing methods to quantify/estimate observational uncertainties for data assimilation and

OSSEs, for monitoring the quality of major remote and in-situ observing systems assimilated into operational and research models, and to assist in evaluating the impact on attaining NOAA performance objectives.

While the focus of this action item has been and remains ongoing work within GSD, a new team was formed to specifically take a fresh look at the problem and to develop a cross-branch plan going forward to assess uncertainties in observations, analyses and short-range forecasts. The goal of this activity is (1) to develop objective, scientifically sound methods for the routine estimation of observation, analysis, and short-range forecast errors, and (2) demonstrate the use of such methods to continuously monitor the performance of observing, data assimilation, and Numerical Weather Prediction systems. Since observational, analysis, and forecast errors are all interlinked, it is anticipated that better estimates of observational errors will improve the performance of data assimilation and forecast systems that in turn may further reduce uncertainty in the estimates of observational errors. The scope of this work includes understanding and resolving random and systematic observing system errors, implementing better quality control methods and processes for observation systems, improved understanding of atmospheric conditions at various scales, analysis of forecast errors independent of assumptions used in data assimilation schemes, and greater utilization of OSSEs to provide the validation of analysis and reduce forecast errors.

Each GSD Branch has identified the areas where they are currently involved and where they would like to contribute to a coordinated GSD cross-branch team. Depending on available resources and considering other project requirements, the team is working to identify priority areas where significant progress can be made with the available resources. GSD will continue this work toward improvements in accuracy and timeliness of weather forecasting and in support of intra-seasonal climate prediction.

3. GSD will pursue broadening involvement with GOES-R, GPM, and other satellite system design and validation work via continued collaboration with NESDIS and JCSDA. Related research proposals will be prepared and submitted by February 8, 2011.

   The Forecast Applications Branch of GSD has been involved in collaborative work with NESDIS and JCSDA for a number of years. Over the past six months, GSD submitted a collaborative proposal to NESDIS to advance calibration/validation work for GOES-R using GPS-Met to diagnose satellite observation algorithms. However, while this proposal scored well, it was not funded. Other proposals submitted more recently have not yet been evaluated. GSD continues pressing forward in seeking collaborative opportunities with satellite system partners.

3.5b Climate Systems Observations and Analysis

Verbatim Review Recommendations:

1. ESRL should identify the NOAA and national context for sustaining their climate observing competency and excellence and thus the core expertise ESRL needs to maintain. A plan should then be developed to do so.

2. ESRL should consider hosting summer schools to sustain the core competency in key climate observing areas.

Responses:

1. PSD routinely develops and deploys state-of-the-art, ground-based, air- and ship-borne observing systems. These systems provide data needed to better understand key air-sea, Arctic and water cycle processes, which in turn leads to a more complete understanding and more refined modeling of the Earth's climate system. The expertise PSD maintains in these sub-disciplines is unique in the world and is an important component of broader local, regional, national, and international efforts to improve our understanding of climate and water processes and their representation in forecast and prediction models. All PSD efforts are guided by NOAA's Next Generation Strategic Plan, Strengthening NOAA Science document, NOAA's Arctic Vision and Strategy, and the NOAA HMT Implementation Plan (Section 3.3.3). National and international guiding documents include Observing Weather and Climate from the Ground Up (National Research Council), Integrating Multi-scale Observations of U.S. Waters (National Academies Press), Observations To Quantify Air-Sea Fluxes and Their Role In Climate Variability and Predictability (summary white paper – International OceanObs09 Conference), and planning documents associated with the Study for Environmental Arctic Change (SEARCH).
2. PSD, through CIRES, has agreed to host the 16th International Symposium for the Advancement of Boundary Layer Remote Sensing in 2012. We will be exploring the opportunity for short courses, especially those that might include hands-on experiences at the Boulder Atmospheric Observatory 300-m tower site.

Actions and due dates:

1. By 03/31/2011- PSD will: (1) document the key observing system gaps related to PSD's science objectives (e.g., boundary layer processes, precipitation processes, air-sea fluxes), (2) assess opportunities to i) expand current capabilities to address unmet observation needs, ii) identify mutually beneficial strategic partnerships with other organizations, and iii) reduce current capabilities to eliminate low-impact technologies, (3) identify an ideal long-term (10-year) observing system profile that addresses key science needs and leverages existing and partner capabilities, (4) inventory the resources needed to sustain the current observing competency, and (5) develop and implement a long-term plan to adjust the current resource (people, funding, equipment) profile to accommodate long–term observational targets.

PSD has relied on current NOAA Observing System Council (NOSC) efforts to inventory "systems of record" and prioritize them based on the most critical observational gaps included in NOAA's Consolidated Observing Requirements List (CORL). To fully address this action item, however, PSD is in the process of convening an internal Observing Systems Future group to focus on (1) identifying longer-term strategic directions related our observing system applications and development, (2) providing a national and NOAA context for our observational activities, and (3) identifying

approaches and resources for maintaining our current expertise and enhancing future observational capabilities. The resulting observing system strategy will be included in the PSD Strategic Plan developed in January of 2010, and will also help inform recent NOAA Observing System Analysis (NOSIA) efforts. A proposed completion date for this exercise is March 31, 2012.

2. PSD will look into the possibility of hosting summer schools or similar events to maintain and build key observing system competencies, and will plan and implement an event in the summer of 2011.

   Due to FY2011 budget uncertainties, PSD has no plans to host a summer school focused on developing key observing system competencies in the summer of FY2011. However, as noted above (3.5b, Responses, 2.), PSD, through CIRES, has agreed to host the 16th International Symposium for the Advancement of Boundary Layer Remote Sensing in the summer of 2012 and will be exploring the opportunity for short courses, especially those that might include hands-on experiences at the Boulder Atmospheric Observatory 300-m tower site.

3. By 03/31/2010 - PSD will identify and explore other options for sustaining its observing system expertise through (1) targeted relationships with other institutions (academic, federal, commercial) which might be the source of required talent, (2) student internship programs to expose students to observing system science as a possible course of study and career path, and (3) planning for and engagement in observationally focused conferences.

   1) PSD has a long history of collaboration for sustaining its observational capabilities. Examples include HMT and CalWater, which have strong links to several California agencies, our work with Arctic observatories, which relies on collaboration among many agencies and the Arctic countries, and our air-sea activities, which are embedded in national and international observational programs. (2) PSD often hires students of all levels to work with the development of observing systems and on observational campaigns. PSD will continue to look into advertising and couching these experiences in terms of a more formal Observation System Science internship. (3) When appropriate, PSD students, junior staff, and senior staff participate in a variety of observationally focused conferences and meetings. PSD will continue to encourage this activity.

   Recent efforts in this regard include a potential collaboration with the University of Colorado (CU) to jointly operate the 330-m tall instrumented Boulder Atmospheric Observatory (BAO) tower . ESRL currently administers the facility (http://www.esrl.noaa.gov/psd/technology/bao/), which sits on land owned by the Colorado State Land Board (CSLB). A committee comprising representatives from the CU Vice Chancellors Office, ESRL, and CIRES has been established to explore the possibility of purchasing the land from the CSLB, and expanding use of the site to include both research and educational activites. Also, as noted earlier, ESRL, through CIRES, has agreed to host the 16th International Symposium for the Advancement of Boundary Layer Remote Sensing in 2012. We will be exploring the

opportunity for short courses, especially those that might include hands-on experiences at the BAO

Table 1
Summary of Actions

Report/ Response Section	Action	Milestone
2.1	Discuss the feasibility and methods of obtaining a better balance between base and external funding with OAR management.	12/15/2010
2.3	1. Review postdoctoral staff assignments for each individual and make any needed tasking adjustments.	11/09/2010
2.3	2. Implement mentoring through IDPs or equivalent mechanisms for junior staff.	02/08/2011
2.3	2. Review annual appraisal and promotion processes for all employees with ESRL, CI, and contractor management to ensure that the goals of rewarding and retaining high quality personnel are being met.	02/08/2011
2.3	3. Emphasize intranet publications and contents to all personnel and update new hire checklists to remind managers to inform new personnel of the weekly intranet publications.	10/08/2010
2.3	3. Revise intranet publications to promote increased readership.	02/08/2011
2.3	3. Senior staff, mentors, technical leads, and project leads will be requested to provide monthly notices and reminders to postdoctoral and graduate student staff about participation in seminars offered.	10/01/2010
2.3	3. ESRL management will coordinate with postdoctoral and graduate student staff to determine the frequency of informal seminars, and work through the ESRL Student Coordinator to provide more organized social events for the postdoctoral and graduate student staff.	10/05/2010
2.3	3. ESRL management will highlight the availability of gathering areas throughout the building and approach the NOAA Boulder Directors Council to determine the feasibility of enhancements to building gathering areas.	12/07/2010
2.3	4. ESRL managers will be directed to take an active role determining the aspirations of their personnel, making use of IDPs and providing training, mentoring, and development opportunities.	10/05/2010
3.1	1. PSD will explore how best to advance its model diagnostics capability, perhaps in concert with the recently proposed Environmental Projection Center within the NCS.	03/31/2011
3.1	2. Within 90 days of the formation of a NOAA Climate Service. PSD→PSL will discuss possible configurations for an enhanced and better-integrated Arctic program with NCS management.	03/31/2011
3.1	3. Within 90 days of the formation of a NOAA Climate Service, PSD→PSL will discuss possible avenues for elevating NOAA's leadership role in facilitating some broader international coordination for Arctic observations with NCS management.	03/31/2011
3.1	4. PSD will: (1) create a demographic profile of the personnel within the climate observations group, (2) develop projections of near-term and longer-term transitions by, (3) develop a list of personnel options (e.g., holding on to talented postdoctoral personnel, converting a few of our gifted CI people to federal, or recruiting new Feds from University/Research Laboratories), and (4) develop and implement a long-term plan to transition key positions using the options identified above.	03/31/2011
3.2	3. Establish monthly reports published on the web to provide the skill from different versions of FIM vs. GFS.	10/05/2010
3.2	5. Produce the first draft of the GSD 5–10 year strategic plan.	10/05/2010
3.2	5. Initiate a coordination meeting on inline chemistry modeling and data assimilation with NWS and OAR colleagues and seek collaborative funding.	02/08/2011
3.2	6. Explore working more with the NESSI group.	02/08/2011
3.3	1. If an NCS is created, PSD→PSL will work to codify its methods for implementing NCS metrics for transition of products to services.	03/31/2011

3.3	2. Within 90 days of the formation of a NOAA Climate Services that will also result in a final determination of CPC being either within or outside of the NCS line office, PSD→PSL will work with NCS management to develop either internal agreements or cross line office MOAs to establish mechanisms to ensure the development and delivery of monitoring and prediction services across temporal and spatial scales that will be transparent to users.	03/31/2011
3.4	1. Review current evaluation practices of AWIPS-II and other possible methodologies for doing technology transfer evaluations and write a proposal to NWS for rapid prototyping work.	12/31/2010
3.4	1. Investigate any opportunities to collaborate with IMAPP.	02/08/2011
3.4	2. Establish a matrix of generalized quality, performance, and maintainability metrics.	02/08/2011
3.4	3. Obtain and review the FAA REDAC report to determine elements with potential to improve transition of ESRL research to operations.	02/08/2011
3.4	4. Organize a Task Team to explore the feasibility of engaging an economist or other experts (out-sourced) to assist with developing cost-benefit analyses of technologies transferred.	02/08/2011
3.4	5. Examine multiple ways to disseminate forecasts in the new connected world in partnership with NWS and other stakeholders.	1/31/2011
3.4	6. Develop a strategic plan for SOS.	02/08/2011
3.4	7. Create a proposal for the Office of Education to evaluate the educational value of Virtual Worlds.	12/31/2010
3.5a	1. GSD will prepare a report on the use of extensions to WMO standards for RAOB verification.	02/08/2011
3.5a	2. Form a team for developing and implementing methods to quantify/estimate observational uncertainties for data assimilation and OSSEs, monitoring the quality of major remote and in-situ observing systems assimilated into operational and research models, and to assist in evaluating the impact on attaining NOAA performance objectives	02/08/2011
3.5a	3. Prepare and submit satellite design and validation work proposals.	02/08/2011
3.5b	1. PSD will: (1) document the key observing system gaps related to PSD's science objectives (e.g., boundary layer processes, precipitation processes, air-sea fluxes), (2) assess opportunities to i) expand current capabilities to address unmet observation needs, ii) identify mutually beneficial strategic partnerships with other organizations, and iii) reduce current capabilities to eliminate low-impact technologies, (3) identify an ideal long-term (10-year) observing system profile that addresses key science needs and leverages existing and partner capabilities, (4) inventory the resources needed to sustain the current observing competency, and (5) develop and implement a long-term plan to adjust the current resource (people, funding, equipment) profile to accommodate long–term observational targets.	03/31/2011
3.5b	2. PSD will look into the possibility of hosting summer schools or similar events to maintain and build key observing system competencies, and will plan and implement an event in the summer of 2011.	03/31/2011
3.5b	2. PSD will identify and explore other options for sustaining its observing system expertise through (1) targeted relationships with other institutions (academic, federal, commercial) which might be the source of required talent, (2) student internship programs to expose students to observing system science as a possible course of study and career path, and (3) planning for and engagement in observationally focused conferences.	03/31/2011