The tables in this document represent the complete set of findings and recommendations from the UCAR Review of the NCEP Environmental Modeling Center. The tables also include the EMC action plan in terms of specific actions, status and due dates. In June 2011, the Committee Chairs provided EMC management with a written evaluation of the action plan to date. The Committee evaluation of each recommendation and the EMC response is provided beneath each of the assessment categories. NOTE: yellow highlighted text represents updates since October 2011.

Community Review NCEP Assessment and Recommendations (Last modified 18 January 2012 WML)

Environmental Modeling Center (EMC)

Mission and Vision: Findings

Finding MV1: *The present mission statement for EMC,* **"Maintain, enhance and transition-to-operations numerical forecast systems for weather, ocean, climate, land surface and hydrology, hurricanes, and air quality for the Nation and the global community and for the protection of life and property and the enhancement of the economy."** *although adequate, is uninspiring because it begins with the word "maintain." A more effective approach would be something along the lines of "Provide the most effective numerical forecast systems…". This suggested wording implicitly includes development, enhancement, translation, and maintenance but avoids the term "advanced" because something that is advanced isn't necessarily most effective. Additionally, because hurricanes represent a weather phenomenon, including them in the list is redundant. Rather than listing specific phenomena or processes, which will never be complete, EMC might consider saying its forecast systems are used for atmospheric, oceanic, and environmental prediction from local to global scales and from minutes to years/decades. Finally, it is unclear whether EMC's mission is to protect life and property and enhance the economy on a global scale. The current mission statement is ambiguous in this regard because it places Nation and global community together.*

The vision statement, "With **our partners, to be the world's best and most trusted provider of numerical forecast systems for weather, ocean, climate, land-surface and hydrology, hurricanes and air quality."** *is much more compelling but is problematic in again providing an incomplete listing of weather phenomena and processes. Ultimately, EMC must determine whether it can indeed achieve the vision put forth. In contrast to ECMWF, which operates a single model and is structured far differently, EMC operates numerous models having different frameworks and purposes. Although EMC is moving toward a common model framework (the NOAA Environmental Modeling System, or NEMS), the sheer number of models supported, in comparison to the number of staff, may never allow it to be the "best in everything."*

Assessment Recommendation	Planned Action	Status	Due Date
Recommendation MV1: although adequate, is uninspiring because it begins with the word "maintain." A more effective approach would be something along the lines of "Provide the most effective numerical forecast systems…". Rather than listing specific phenomena or processes, which will never be complete, EMC might consider saying its forecast systems are used for atmospheric, oceanic, and environmental prediction from local to global scales and from minutes to years/decades. Finally, it is unclear whether EMC's mission is to protect life and property and enhance the economy on a global scale. The current mission statement is ambiguous in this regard because it places Nation and global community together.	**MV1.1:** EMC will revisit mission and vision statements	**MV1.1:** Internal discussion with EMC staff has started. Have modified EMC overview slides to emphasize the development and implementation aspects of the mission. Maintenance is downplayed but not ignored since is a non-trivial level of effort.	**MV1.1:** Q3FY12

Customers and Partners: Findings

Finding CP1: *The EMC has insufficient and ineffective interaction with the research community and with other NCEP centers. Although many successful research collaborations exist involving EMC and the external community (e.g., satellite data assimilation work with the JCSDA and university collaborators, the development of storm-scale numerical weather prediction systems with the University of Oklahoma, National Severe Storms Laboratory (NSSL) and SPC), EMC acknowledges that a long-standing perception persists of its lack of receptivity to innovations from outside its walls. The review panel believes this perception is reality. Evidence for this is manifest in the research community's lack of understanding of EMC's necessarily highly-regimented production suite schedule, which favors fast, efficient code over what may be considered operationally incompatible, state-of-the-science capabilities. In addition, inadequate facilities for hosting meetings and workshops, an inadequately funded visiting scientist program, and an overworked staff that is unable to visit peer institutions and universities because of production deadlines contributes to a dulling of the intellectual environment so vital to EMC's success. Discussions with other NCEP service centers reveal a similar lack of connectivity with EMC.*

Finding CP2: *The EMC has too many customers, products, and services for its budget. Unlike its peer operational centers around the world, EMC has extensive mission requirements with a large number of differing model elements composing its production suite. EMC management views each component of the "jigsaw puzzle" (production suite) as sacrosanct. Even with expected (modest) increases in computing capability, the projected development and deployment of a suite of forecast models being run at increasingly finer resolution will further strain limited resources.*

Assessment Recommendation	Planned Action	Status	Due Date
Recommendation CP1: The EMC must be proactive in reaching out to the community, including its sister NCEP centers, to assess needs and priorities and foster more effective understanding of activities and stimulate working relationships. In order for EMC's achievements to match its vision, it must ensure that its work is addressing community needs and priorities and working effectively with its sister NCEP centers. Further, it must be more effective in engaging the research community so as to take full advantage of research developments that can enhance its operational capabilities. Although EMC conducts the annual NPSR, wherein customers and partners are invited to provide input into EMC's requirements setting process, greater engagement with the community – particularly the research community – is needed. The World Meteorological Organization (WMO) programs, including the World Weather Research Programme (WWRP), the World Climate Research Programme (WCRP; inclusive of the Global Energy and Water	**CP1.1**: Increase collaborations on key scientific development. **(1)** Atmospheric Data Assimilation - Hybrid system, partners with ESRL, U. Oklahoma, GMAO **(2)** Climate process team (CPT) physics development with U. Washington, JPL, UCLA to improve shallow convection and stratus in global forecast model **(3)** Hold international workshop on CFS V.2 **(4)** Enhance collaboration with DTC (4.1) HWRF (4.2) GSI (4.3) NEMS (4.4) mesoscale ensemble systems **(5)** Enhance collaboration with GMAO, Navy, GFDL on Ocean Data Assimilation	**CP1.1:** **(1)** plan signed, code development proceeding, global operational implementation slated for Q3FY12. **(2)** Proposal accepted; coordinated project underway **(3)** Meeting held 8 March 2011. Meeting summary available on request. **(4.1)** HWRF tutorial and code repository **(4.2)** GSI tutorial and code repository **(4.3)** DTC placed software engineer at EMC to support NEMS development **(4.4a)** EMC supported DTC ensemble workshop (Sept 2009) and subsequent development of NOAA white paper on mesoscale ensembles **(4.4b)** EMC/DTC/DET collaborating on testing physics based component of SREF for FY12 operational implementation **(5)** Draft Ocean Data Assimilation plan developed (Dec 2010) joint between NCEP, GFDL, NASA and NAVY. NCEP considering adoption of NCODA for assimilation system for HYCOM and WWWIII.	**CP1.1:** **(1)** Plan completed and signed Feb 2010; development progressing well; pre-implementation results remain positive. **(2)** First CPT meeting held at NCEP in November 2010. Roles and responsibilities clearly defined. Work has started. Results presented at CFSv3 planning workshop Aug 2011. **(3)** Completed (4.1) completed (4.2) completed (4.3) completed (4.4a) completed (4.4b) ongoing- SREF implementation scheduled for Q2FY12 **(5)** Encountered programmatic issue with NAVY—Cummings vs Jacobs. Plan to be completed Q2FY12. NCEP OD now involved working with NUOPC mgmt

Cycle Experiment (GEWEX), Climate Variability and Predictability (CLIVAR), Stratospheric Processes and their Role in Climate (SPARC), and Climate and Cryosphere (CliC) programs), and the Working Group on Numerical Experimentation (WGNE) provide invaluable access to the international research community. The EMC has been historically underrepresented in these programs in comparison to its European, UK, Canadian, Australian, and Japanese counterparts. In order to be the world's leading environmental modeling center, EMC needs to foster a vibrant, intellectually stimulating research environment by increasing interactions with the national and international research communities. Although the move to a new building undoubtedly will provide the infrastructure and environment necessary to support meetings and workshops, especially with collaborators at the University of Maryland, a robust visiting scientist program and improved use of community test beds also is needed. Further, support for EMC staff members to visit peer operational centers, including all sister NCEP centers, for extended exchanges no doubt would enhance the intellectual vitality of all participating organizations. However, mechanistic changes such as visiting programs and new space are not sufficient; EMC needs to change its personality in working with the broader community and foster a culture of "EMC without walls" rather than the present framework in which activities are considered by all as either internal or external to EMC.	**(6)** Work with ESMF developers, Navy and AFWA to develop common model architecture **(7)** Work with JCSDA partners to use NPP data **(8)** US-EUROSIP climate products **(9)** Support EMC participation at professional meetings **(10)** Plan and execute CFSv3 planning workshop via CTB **(11)** Plan and execute joint DTC/EMC workshop on NWP physics **(12)** Site visit to NRL MRY to identify joint collaborative projects **CP1.2:** Meet periodically with other NCEP Center Directors to discuss how EMC can improve their products	**(6)** EMC active in NUOPC CMA and TTP Committees. ESMF developers visited EMC 5/18/2010. **(7)** FY10-11 work complete, including formatting CrIS and ATMS; JPSS IPO funding 2 FTE to support. EMC participating in interview process. EMC management now meets bi-weekly with NESDIS STAR management. **(8)** Providing NCEP GEFS products. Working jointly with CPC (lead Center on EUROSIP) **(9)** In 2010, EMC increased travel by 30% over FY09 budget. Staff attended 32 conferences in 15 countries. In 2011 there are plans to attend 39 conferences in 18 countries. See attached slide set listing international collaborations and participation in WMO/working groups. FY12 budget required a 25% reduction in travel. **(10)** CTB hosted a community based workshop to begin the planning process for CFSv3 development. Presentations and summary can be found at: To view the presentations in the meeting, go to :http://www.cpc.ncep.noaa.gov/products/ctb/ctb-home.shtml and then click "*The CFSv3 Planning Meeting on August 25-26, 2011 <http://www.cpc.ncep.noaa.gov/products/ctb/meetings/2011/CFSv3/>".* **(11)** A workshop organized by the DTC and NCEP/EMC was held at the World Weather Building in Camp Springs, Maryland on 26-28 July 2011. The goals of the two and a half day meeting were to find short-term opportunities for improving numerical weather prediction (NWP) models, and to establish a longer-term framework for closer collaboration between research and operations (R&O). **Please see meeting** web site for links to presentations: <http://www.dtcenter.org/events/workshops11/mm_phys_11/index.php> Plenary summaries and the final workshop summary <http://www.dtcenter.org/events/workshops11/mm_phys_11/Workshop_Summary_Final.pdf> under the "Agenda" tab. **(12)** EMC Acting Director was invited to visit NRL MRY Sept 12-13 to identify areas of alignment for enhancing EMC-NRL collaboration with intent to accelerate model development activities. Top two priority areas identified are development of semi-lagrangian advection capability within NAVGEM and GFS; (2) Land surface data assimilation; (3) application of ocean/wave data assimilation (NCODA) at NCEP. Note that EMC and NRL plan to have working meetings on the topics. Exact format TBD. EMC and NRL directors also agree to consider hosting visiting scientists to enhance collaboration. **CP1.2** Established meetings with NCO, HPC, SPC and CPC. Joint special projects with centers underway.	**(6)** Successful development of NUOPC layer in FY11. Ongoing commitment **(7)** Ongoing commitment. JCSDA only hired one new person due to budget constraints. **(8)** Ongoing commitment **(9)** Ongoing **(10)** Completed (11) Completed. Briefing NWS OS&T Director 21 September on workshop summary and recommendations. BAMS article accepted with revisions **(12)** Ongoing. NRL visit to NCEP for land surface modeling Dec 2011 **CP1.2** Ongoing commitment

Recommendation CP2: The EMC must streamline its portfolio of products and services. Through greater engagement of the community, EMC must re-prioritize its products and services to ensure that planned increases in resolution, sophistication of data assimilation and physics parameterizations, and increasing number of model executions via ensembles can be achieved with the highest value possible. One consideration toward achieving this goal is the adoption of a single (unified) multi-scale modeling approach capable of global, regional, and local prediction. Although this concept has long been debated, the clear message from other prediction centers around the world is that such a framework appears to be essential for meeting tomorrow's challenges in light of unavoidable limitations in funding and staffing.	**CP2.1**: Continue developing NEMS for both operational and research applications **CP2.2:** Unify global weather and seasonal climate analyses by introducing coupled atmosphere-ocean-land surface-sea ice system into GDAS and GENS **CP2.3:** Consolidate regional ensemble system (SREF) **Cross References:** **PS1.1:** Participate in NOAA Modeling strategic planning and budgetary processes. **PS1.2:** Establish a Scientific Advisory Committee to provide scientific assessment of operational modeling systems and future plans within FICA guidlines. Organizations that have operational systems running at NCEP will be subject to review (EMC, GSD, ARL, SWPC, PMEL, NOS). EMC will be primary beneficiary as it is responsible for the majority of the operational modeling systems.	**CP2.1:** NEMS development continues. First operational implementation of NEMS was FY12Q1 when the NNMB replaced the NMM in the NAM slot **CP2.2:** Testing GDAS with coupled system (GSI/GODAS). Results on weather prediction do not warrant operational implementation in FY12. Exploring coupled capability with HYCOM and/or GOLD ocean models. NCEP co-organizer of a WGNE meeting on coupled atm/ocean NWP meeting to be held in spring 2013 in DC area **CP2.3:** Four Eta model members replaced by WRF ARW members in Q1FY10 SREF upgrade. Q2FY12 SREF upgrade will eliminate all RSM and ETA members. Will be composed solely of NMM and ARW members.	**CP2.1:** completed **CP2.2:** Ongoing **CP2.3:** Q2FY12 Implementation. NOTE: this implementation is at risk due to limited operational computer capability.

***Evaluation of CP1*:** We are very encouraged by the many activities that are in concert with our rather long recommendation. Success of the hybrid data assimilation team effort is vital if NCEP is to keep up with peers. The response is somewhat minimal on engagement in the international programs mentioned in CP1, but the planned CFS Workshop is a good start. No response was made on the suggested two-way scientific visiting program, and recent progress on the NCWCP building suggests that a multi-partner planning effort on this program should begin.

EMC Response to CP1: Engagement with international programs is significant (see appendix A). Hybrid EnKF-3DVar GDAS top priority for NCEP in FY12 and pre-implementation testing on schedule for Q3FY12 implementation. EMC more proactive in developing and hosting targeted workshops with external community (see actions 10-13 for CP1 above). Visiting scientist program is very desirable and Acting Director working with NOAA leadership to find ways of funding it. It must be understood that EMC has little discretionary funding to self-invest in visiting scientists. EMC Acting Director is willing to set aside portion of overhead funding to fund post-doc positions within EMC. FY12 cuts in programmatic funding (CPO—reanalysis and ocean DA; HFIP, NWS AQ will not allow Director to acquire funds for new visiting scientists.

***Evaluation of CP2*:** Some good first steps have been taken, as the Eta and RSM models will be retired. We realize that unifying regional and global models is a longer and much more complicated task, and there are also good arguments for multi-model ensembles. However, we still encourage

efforts on a unified NEMS. It looks as if the use of NMMB for NAM has been decided, but the path to the next global system is unclear. The panel would like to see the plan for how this will proceed.

EMC Response to CP2: Strategy for a unified modeling capability for NCEP will take time to develop. EMC management is consulting with international centers which adopted such a strategy to determine pros and cons. The formation of a Scientific Advisory Board for EMC could be used to help develop such a plan. The NEMS is an infrastructure that provides flexibility for running multiple models and associated ensemble systems in an operational setting. It can be used for global and regional atmospheric models as well as ocean, land and ice. Moving nest capability has been developed and 2-way nesting as well. This development may allow the HWRF configuration to be integrated into the NEMS/NMMB system beyond FY12. The global model to beat operationally is the GFS. Current plans for the global system include development of the Semi-Lagrangian advection formulation within GFS with first opportunity for operational implementation in Q2-Q3 FY13. Preliminary testing is encouraging at T1148. It's obvious that NCEP must consider non-hydrostatic dynamics for higher resolution global system. Candidates include NMMB, GFDL Finite Volume, and MPAS. EMC-NCAR MMM working a joint project to put have NCEP become a MPAS friendly user in the spring of 2012 and EMC will put GFS physics into MPAS—Fanglin Yang to visit NCAR for a 3 week period to get MPAS training in spring.

Products and Services: Findings

Finding PS1: *The EMC is producing an enormous number of products and services that are viewed as valuable by the community. However, the growing model suite and diverging platforms of these implementations seem overbearing and potentially detrimental to future capabilities. The EMC has shown an ability to adapt and grow to fit user needs, and during the past decade, the EMC production suite has grown to include long-range and short-term ensemble products, increased resolution and forecast periods for short-range and long-range models, as 15*
well as inclusion of high-resolution mesoscale, air quality and global ocean modeling. It is commendable that EMC provides the global community with reliable, daily products; however, it is equally apparent that the current approach to development and ongoing support of these products probably is unsustainable, thus threatening achievement of EMC's vision. The EMC leadership has recognized the lack of resources needed to sustain its approach to numerical model development, including adoption of NEMS. However, the review panel did not see evidence of a strategic plan to organize available resources, both internally and across the user community, to streamline its production suite in a broader sense.

Finding PS2: *The EMC has created several valuable and noteworthy products that clearly demonstrate its ability to successfully cooperate and synthesize the community's needs into an operational product. Specifically, it has implemented a number of major new capabilities over the past five years that showcase its ability to serve a diverse user base. Some of these advances and implementations include:*

- *Data Assimilation Team: Unification of the Global, Regional, Real-time Mesoscale Analyses (RTMA) with the GSI system.*
- *Ensemble Team: Implementation of North American Ensemble Forecast System (NAEFS) with Canada.*
- *Climate Team: Implementation of the Climate Forecast System (2004) and its reforecast data base.*
- *Hurricane Team: Implementation of the Hurricane Weather Research and Forecast (WRF) system.*
- *Land Surface Team: Unification of the NOAA Land Surface Model (LSM) across Global Forecast System (GFS), WRF-NMM (Non-hydrostatic Mesoscale Model) and WRF-ARW (Advanced Research WRF model) applications.*
- *Global Branch: Implementations in 2005 that include use of the GSI analysis, addition of a hybrid sigma-pressure coordinate to improve representation of the stratosphere, and a rewritten and modernized radiation package.*
- *Mesoscale Branch: Implementation of explicit-convection High-Resolution Window Runs to support the SPC/NSSL Spring Program.*
- *Marine Branch: Adoption of the WAVEWATCH III wave model as the defacto community operational and research standard.*

The EMC leadership also recognizes they must increase the speed with which research outcomes are transitioned to operational implementation, using an improved approach that leverages resources within the external research and academic communities. EMC must take a leadership role in promoting its operational needs to foster a more effective, mutually beneficial relationships with the research community.

Finding PS3: *They understand the importance of meeting user requirements and providing high quality service.*

Assessment Recommendation	Planned Action	Status	Due Date
Recommendation PS1: The EMC must develop an approach to consolidate the vast number of numerical models currently being developed and supported. The EMC is to be commended for a 'can do' culture that seeks to meet expanding needs of internal and external user communities. However, EMC must find a balance between implementing new mandates, some of which are unfunded, and sustaining current mission needs. In order for EMC to push forward in what undoubtedly will be a resource-constrained environment for the foreseeable future, it must seek to eliminate the growing number of divergent numerical models currently under development or in	**PS1.1:** Participate in NOAA modeling strategic planning and budgetary processes. **PS1.2:** Establish a Scientific Advisory Committee to provide scientific assessment of operational modeling systems and future plans within FICA guidlines. Organizations that have	**PS1.1:** EMC has participated (is participating) in the following NOAA planning activities: (1) NOAA Environmental Modeling Program strategic plan (2) NOAA Science Workshop white paper entitled "Strengthening NOAA Science" (3) NWS OS&T Science and Technology roadmap (4) SEE budget planning for the Climate Service and Environmental Modeling Integration Program **PS1.2:** Committee formulation in the early stages. Must prepare a proposal for NCEP management.	**PS1.1:** Continuous commitment **PS1.2:** Proposal to NCEP management by 3/1/12. Stand up SAB Q1FY13

production. It also is apparent that the diversity of models today has placed a strain on the ability of EMC to support and quickly implement upgrades and enhancements to its production suite. In addition, inefficiencies inherently occur because some models produce similar, overlapping products, and this duplication consumes valuable staff time as well as computing resources. The EMC should develop a plan to migrate the current suite toward a more unified modeling approach that can leverage all resources currently available – from research and operations staff to computing capacity. This approach also will provide for a more suitable environment to effectively and efficiently transition visiting and on-site staff in and out of EMC.	operational systems running at NCEP will be subject to review (EMC, GSD, ARL, SWPC, PMEL, NOS). EMC will be primary beneficiary as it is responsible for the majority of the operational modeling systems. PS1.3:Develop a strategy for a unified modeling prediction capability for global and regional applications. Must be developed with NOAA EME participation.	PS1.3: Under consideration. Must address scope and ramifications of a unified approach on multi model ensemble systems.	PS1.3: Deliver strategy in Q3FY12
Recommendation PS2: The EMC must adopt a formal approach for consistently delivering full-resolution products (operational or experimental – requires clarification) to the entire user community. The EMC's vast array of products has created an equally large user community that relies upon them. Unfortunately, many of the products disseminated from EMC models are substantially degraded in both temporal and spatial resolution relative to their native frameworks and are limited in other ways (e.g., representing only certain fields). As a result, EMC should take a leadership position within NCEP – working with NCO and others, given the considerable information technology (IT) issues involved – to formalize and implement an approach for disseminating full-resolution, comprehensive information from its models. Doing so will leverage the creative, developmental and computational capacity of the global community, thus providing valuable feedback for future model improvement.	**PS2.1:** Use NOMADS to provide all products on public server in full resolution format. **PS2.2:** Keep NWS HQ informed on model resolution upgrades through formal NWS established processes **PS2.3:** Ensure CFSRR data gets to NCDC for distribution to public **PS2.4**: NCEP contributing to CMIP5	**PS2.1:** EMC now supports NCO quarterly upgrades to NOMADS. EMC developers provide new products for distribution via NOMADS based on customer requests. **PS2.2:** **(1)** EMC and NCO corroborate to produce Technical Information Notices in accordance with NWS regulations prior to all implementations. **(2)** EMC is not responsible for establishment of AWIPS and SBN priorities. **(3)** NCEP operational model grids available via NCEP FTP server or NWS TOC/NOMADS—NCO responsible center for dissemination of NCEP production suite products **PS2.3:** CFSRR data dissemination responsibility of NCDC. Data delivery plan completed. **PS2.4:** Data contributed to archive	**PS2.1:** NOMADS quarterly upgrades now part of the EMC/NCO AOP **PS2.2:** Completed **PS2.3:** Complete **PS2.4**: Ongoing
Recommendation PS3: The EMC must work closely with NCO to ensure continuation of the current high standard of product reliability without becoming too risk averse, which could slow the progress of enhancements and upgrades to the production suite. The process of transition from research to operations (R2O) is inappropriately informal and needs a terms of reference document to improve its effectiveness. This should be jointly developed between EMC and NCO and could be one mechanism to help alleviate the organizational	**PS3.1:** EMC working with NCO to review and revise the NCEP Implementation Process (IP)	**PS3.1:** (1) Chartered two projects designed to address issues and revise implementation process. (2) Team formed to execute project (3) EMC/NCO management provide NCEP Director with monthly updates on progress (4) Tolman and Magee leading team (5) First test implementation to be conducted in Q3FY11 using the WWIII upgrade (6) Expect to use new system during transition to new WCOSS in FY13	**PS3.1:** Ongoing

tensions noted elsewhere in this report.	**PS3.2:** EMC and NCO will revise the IP and execute prototypes to test procedure and demonstrate feasibility Cross references: **POC8.1:** NCO and EMC Directors set up regular meetings **POC8.3:** NCO and EMC will define projects to address improvements to the NCEP Production Suite Implementation Process (IP)	**PS3.2:** Project proceeding. Revised process for environmental equivalence developed and under testing with prototype implementation for wave model upgrade in Q1FY12.	**PS3.2:** Plan to extend to other implementations in FY12.

***Evaluation of PS1*:** The response indicates that moving to a unified system properly is a careful and deliberate process, and we encourage EMC to push forward. An UCAR Community Advisory Committee for NCEP has been created that will not require FACA guidelines. The UCACN will need to decide if it wants to take on this task or form a more specialized sub-committee to work with EMC and NCEP management on this issue.

EMC Response to PS1: Response to CP2 is repeated here: Strategy for a unified modeling capability for NCEP will take time to develop. EMC management is consulting with international centers which adopted such a strategy to determine pros and cons. The formation of a Scientific Advisory Board for EMC could be used to help develop such a plan. The NEMS is a infrastructure that provides flexibility for running multiple models and associated ensemble systems in an operational setting. It can be used for global and regional atmospheric models as well as ocean, land and ice. Moving nest capability has been developed and 2-way nesting as well. This development may allow the HWRF configuration to be integrated into the NEMS/NMMB system beyond FY12. The global model to beat operationally is the GFS. Current plans for the global system include development of the Semi-Lagrangian advection formulation within GFS with first opportunity for operational implementation in Q2-Q3 FY13. Preliminary testing is encouraging at T1148. It's obvious that NCEDP must consider non-hydrostatic dynamics for higher resolution global system. Candidates include NMMB, GFDL Finite Volume, and MPAS.

***Evaluation to PS2*:** Response to provide full-resolution data via NOMADS is excellent; not sure if it will be possible. [NOTE: NCO also received this recommendation, but confusion ensued re "native" vs "full-resolution" grids, the latter being what is desired. We encourage EMC to work with NCO toward the full-resolution goal.] Information about the CFSRR data is appreciated but it is noted that the promised date for availability of the reforecast data is now long past.

EMC Response to PS2: EMC, CPC and NCDC developing proposal for upper level management documenting costs associated with providing community with access to CFSRR hindcast dataset. Decisional authority resides at the NCEP and NCDC Director level.

Evaluation of PS3: We appreciate EMC's response to accept a more structured implementation process. As of this past fall/winter, though, the implementation rate had become slower, not faster, which was blamed on some unfilled senior production analysts positions. Will need an update to learn if this bottleneck has been alleviated.

EMC Response to PS3: The NCO PMB SPA office is fully staffed (8 SPA's). EMC and NCO have developed a modified implementation process using code management principles that is more efficient than the current process. Details were provided at the UCACN meeting in October.

Information Systems: Findings

Finding IS1: *High performance computing resources available at NCEP are far below those needed to achieve its goal of being the world's foremost weather and climate prediction enterprise. It has long been recognized that the lack of adequate high performance computing capability is a major factor in NCEP's less than desirable competitive position among world forecasting centers. Although computing power alone will not elevate NCEP to world leadership, failure to address this issue will continue to place NCEP at a notable disadvantage. The table below, provided by the EMC Director, demonstrates the notable advances that could be wrought with thoughtful investments in a much more capable HEC system.*

Finding IS2: *The EMC is severely lacking in non-HEC computing resources, particularly disk space, necessary to support its mission. A key limitation in the ability of EMC staff members to effectively accomplish their work is a severe lack of disk space on development systems managed by NCO. The imposed disk quotas limit not only the scale and scope of models that might be run, but they also limit the ability for developers to implement new models. Several EMC teams are experiencing this problem and it suggests a lack of effective communication regarding EMC needs and resource provisioning decisions by NCO.*

Finding IS3: *The EMC lacks a structured management process, of the type used in many organizations – especially those having complex structures – to ensure effective planning and resource allocation. The complete lack of formal project management is exacerbating many of the issues raised in this report.*

Assessment Recommendation	Planned Action	Status	Due Date
Recommendation IS1: The EMC must be provided with adequate computational resources for both operations and research. The EMC must request sufficient resources for substantially enhanced HEC capability, at the very least through the NOAA Planning, Programming, Budgeting and Execution System (PPBES) process, and leverage opportunities for using external computing resources whenever practical (e.g., from nationally available supercomputing facilities supported by the National Science Foundation (NSF) or other agencies). The computing resources needed to support a broad range of activities, from research and development to test beds to operations, must be balanced so that today's research can be implemented in tomorrow's production suite. An objective set of guidelines must be instituted to align research computing allocation decisions with the appropriate experts at EMC and NCO, but with shared goals in mind. Procurement of new systems must accommodate requirements across the NCEP family of centers.	**IS1.1**: Participate in NCEP HPC Resources Allocation Committee (HPCRAC) **IS1.2:** Convey EMC systems development plans to NCO and compare with available resources **IS1.3:** Plan resources allocation for NOAA R&D computer at Site A (ORNL) and Site B (West VA). **IS1.4:** Support NOAA Weather and Climate Operational Supercomputer Systems (WCOSS) acquisition plan development and execution	**IS1.1:** Ongoing. **IS1.2:** Provide computer resource requirements with emphasis on disk to NCO on a bi-yearly update cycle. **IS1.3:** Allocation process and definition agreed to by all NOAA line office representatives and DUS. Process executed to develop FY12 R&D compute allocations. Allocations approved by NOAA OCIO on 5 August 2011. EMC Acting Director is the committee chair. **IS1.4:** EMC supporting WCOSS acquisition plan development and acquisition in support of NCO and NOAA OCIO in the areas of requirements, benchmarks, evaluation factors, etc.	**IS1.1:** Continuous activity requiring EMC participation. **IS1.2** Provided monthly at HPCRAC **IS1.3:** Allocation process and FY12 allocation recommendations approved by NOAA OCIO and DUS. Committee now turns attention to process for monitoring/enforcing allocation usage. **IS1.4:** RFP released and closed. IBM selected vendor. Architecture to be announced in Q2FY12.

Recommendation IS2: The EMC should work with NCO to implement IT solutions (e.g., desktop resources and connectivity, software) to increase flexibility and capability. This should include development of a written agreement between EMC and NCO to clearly define lines demarcating the roles and responsibilities of both organizations. As it is apparent that NCO provides many IT support services to EMC and the NCEP service centers, EMC also must have a written service agreement with NCO to clearly define the responsibilities and service levels NCO is to provide. Clear metrics should be established (e.g. time to establish an account, problem escalation) and clear definitions made of rules and procedures governing hardware and software utilization. These clarifications will help ensure effective understanding and the setting of appropriate expectations	**IS2.1:** merge EMC Helpdesk with NCEP Helpdesk function **IS2.2:** Work with NCO on IT software standards	**IS2.1:** Merger accomplished **IS2.2:** Participate in NCEP IT Standards Process	**IS2.1:** Completed Q3FY10 **IS2.2:** document signed Q3FY11
Recommendation IS3: Many groups within EMC need to consider using external computing and other resources, e.g., at NSF or other centers. It is clear that considerable development and test work could be performed via access to external IS resources. Although the availability of resources identical to those used for the production suite is necessary for optimization and final implementation testing, much of the functional testing and impact analysis of model changes can be accomplished using external resources. Considerable resources are available to NOAA from the NSF TeraGrid, and access to them should be vigorously pursued. A side benefit of such utilization includes increased interaction with and visibility in the research community, particularly in the area of HEC, networking, and data stewardship.	**IS3.1:** Port model system benchmark to ORNL Cray **IS3.2:** Begin using ORNL Cray system **IS3.3:** Use NOAA R&D Site A computer for global modeling (S/I and ensemble emphasis) **IS3.4:** Conduct development of hybrid ensemble variational data assimilation system on HFIP computer resource in Boulder in concert with ESRL and University of Oklahoma investigators **IS3.5:** CFSv2 code provided to COLA in Q3FY11. **IS3.6:** Porting GDAS/GFS to NASA JCSDA	**IS3.1:** Benchmarks ported **IS3.2:** Plan and execute limited control runs **IS3.3:** Computer available Q1FY11. NCEP gained user access Q2FY11. Porting codes (GDAS/GFS) has been slow caused by black of documentation and slow comms. NCEP developing porting plan for GAEA and ZEUS. **IS3.4:** Primary development conducted at ESRL. Development progressing and nuances associated with ESRL computer environment are being documented. Code ported back to IBMP6 for pre-implementation testing. **IS3.5:** COLA has system running at NCAR (IBMP6) and NASA ARC (SGI). **IS3.6:** EMC hosted 2 NASA staff for a month to train them how to run GDAS/GFS on NCEP R&D system in support of transition to NASA JCSDA machine. EMC working with JCSDA to include JIBB in code porting strategy to reduce redundancies.	**IS3.1:** DoE never provided allocations despite constant NOAA requests. CLOSED **IS3.2:** See above. CLOSED **IS3.3:** Ongoing. EMC developed and implementing code transition plan to R&D systems. **IS3.4:** Work at ESRL completed. Pre-implementation testing now underway on transition IBM P6. Target implementation is April 2012. **IS3.5:** Completed: Q4FY10 **IS3.6:** EMC completed Hybrid parallel to JCSDA JIBB and S4 machines as requested.

Recommendation IS4: The EMC should institute formal project management practices, which will provide greater discipline and focus in planning, resource allocation, risk management and execution. Such practices will assist in balancing demands with available resources and in responding to unfunded mandates with well understood impacts and resource reallocation implications. Additionally, the planning phase of this structured process will produce clear requirements that also can feed into the planning processes of other NCEP centers	**IS4.1:** Plan EMC Scientific Project Office (ESPO) **IS4.2:** Institution of project management practices.	**IS4.1:** Established ESPO in revised EMC staffing plan **IS4.2:** Weekly meetings with NCO began; assigned EMC Executive Officer to manage. Application of project management practices to CCS disk and processor count allows for longer term planning associated with the NCEP production suite.	**IS4.1:** No funding to support plan **IS4.2:** Process established and executed

Evaluation of IS1: EMC is doing what is necessary to convey its computing needs "up the ladder", so most advice on this issue is for NCEP Director and higher. We believe that if the NOAA CIO (DoC CIO, OMB, etc.) requires a better "business case" for HPC investments, then NCEP should be very proactive in articulating this case. The external community, especially the private sector, should be provided with supporting data. In IS1.2, we are not sure what "emphasis on disk" means; while it is true that the research (backup) computer has insufficient disk space, emphasis needs to be on the proper balance between CPU power, storage and bandwidth.

EMC Response to IS1: Building the business case for NOAA operational compute capability is beyond the scope of EMC. We don't have the skill sets required to do the work and I'll argue that the business case must be developed at higher level in the agency. NOAA must build advocacy among the users of the operational products as stated in your evaluation of IS1.

***Evaluation of IS2*:** The actions above are a good start. Would need to poll staff as to whether clear lines of responsibility have been articulated, with NCO providing the IT security and hardware/software maintenance EMC needs, while allowing EMC to manage its in-house software. A similar comment was made in the evaluation of the NCO response to this issue.

EMC Response to IS2: The EMC IT system is now owned by NCO. The EMC IT helpdesk continues to support the 150+ staff and coordinates C&A and IT security with NCO. EMC Considers this recommendation response closed.

***Evaluation of IS3*:** These are excellent first steps. The next stage is to explore use of the Teragrid with NSF and Teragrid centers, perhaps in collaboration with universities.

EMC response to IS3: We are aggressively porting codes to NOAA R&D systems (GAEA and ZEUS) and the JCSDA JIBB and have a transition plan in place. We are not ready to consider how to use the Teragrid at this point in time.

***Evaluation of IS4*:** In the "Due Date" column following the create ESPO action, it was written that "No funding to support plan", which we assume means that ESPO was not enacted. However, since "underfunded mandates" continue to be a problem, some process must be developed to assess the resources required for new and ongoing projects, even if it needs to be done out-of-hide. The institution of project management practices is applauded.

EMC Response to IS4: EMC is considered a major IT investment by DoC entitled "Data Assimilation and Modeling" and is now being managed using project management principles. The Acting Director is the project manager and will become certified later in FY12. DoC requires monthly reporting on project status including milestone schedule, costs and risks.

***Evaluation of IS5*:** This recommendation is the same as IP1 in the NCO Review. The NCO provided a detailed response, on which we commented in their response document. In general, EMC and NCO collaboration is much better, but the systems engineering approach is still a work in progress.

EMC Response to IS5; EMC and NCO adopting more systematic approach to implementation process and scheduling.

Science and Technology: Findings

Finding ST1: *The EMC global model suite ranks 4th or 5th in the world, based upon objective skill scores, a rank that has deteriorated since the last review. It is patently unacceptable for the United States – given its extraordinary need for accurate weather and climate information across all sectors of society – to operate a global forecast system that lags well behind those of other nations and has continued to lose ground over the past several years. The reasons for this ranking are many and complex, ranging from inadequate computing resources to insufficient staffing levels, the latter driven by the support of too many modeling systems. This report offers specific findings and recommendations along those lines, but the review panel wishes to note here, with a clear and unequivocal statement, that EMC global model skill cannot be allowed to remain in such an embarrassing position in the world.*

Finding ST2: *The EMC is effective in supporting a limited number of students (funding, hosting) and this effort should be expanded with the move to the new building. The review panel is pleased to note that EMC hosts students and has been effective guiding their work on important scientific and technical problems related to prediction science. These students will become next-generation scientists, and their involvement in operational research will help promote the continued growth and development of EMC. Through these students, EMC also develops strong interactions with university faculty and researchers, allowing new ideas to be tested for operational implementation. We strongly encourage expansion of this program with the move to the new building, which will offer greater flexibility in office space.*

Finding ST3: *The EMC has an inadequate research visitor program. Although EMC has a significant number of visiting scientist appointments (e.g., via the SAIC contract), these positions are not truly visitor positions. Many visiting scientists have worked at EMC for a long period of time (i.e., longer than 10 years).Effectively, these long-term positions become surrogates of EMC staff, though without formal NOAA appointments. A common definition of a visitor is an individual who stays at the visiting institution not more than two years, with an intention to go back to his/her home institution. Using this standard, it is clear EMC does not have an adequate visitor program. With the need for EMC to be positioned at the cutting edge of science and technology, it is very important that a continuous flow of new ideas be maintained via a broadly inclusive visiting researcher program.*

Finding ST4: *The GFS performance "dropouts" represent a significant problem that must be addressed. It has been found that the NCEP GFS model experiences significant reductions in performance from time to time. A dropout is defined to occur when the five-day forecast 500 HPa anomaly correlation falls below 0.7. These occurrences are an important factor in explaining why NCEP global model forecast skill is not as high as that of ECMWF and UKMO, and thus eliminating dropouts is an important issue to help close the gap.*

Assessment Recommendation	Planned Action	Status	Due Date
Recommendation ST1: NOAA, NWS, NCEP and EMC leadership must vigorously address recommendations in this report, and take other necessary actions, to propel US operational global model skill to a leadership position in the world. It is vitally important that the organizations noted above understand the importance of, and take strong action to implement, the recommendations made in this report. The many challenges described herein are substantial, yet the opportunities are equally great. Failure to act with vigorous determination and leadership – at a time when the need for effective weather and climate prediction guidance are at unprecedented levels and science and technology are advancing at record paces – would be a grave disservice to the nation.	**ST1.1:** GFS Q4FY10 implementation: • Modify GFS shallow/deep convection and PBL • Detrainment from all levels (deep convection) • PBL diffusion in inversion layers reduced (decrease erosion of marine stratus) • GSI/GFS Resolution from T382 (~35km) to T574 (~28km) & 64L	**ST1.1:** Resulted in significant reduction in high QPF bias for precip amounts exceeding > 1.0" in 24h. Reduced tropical cyclone track and intensity error s for 2008 and 2009 hurricane seasons in Atlantic and East Pacific. Increased skill of 5-day 500mb AC in northern and southern hemispheres.	**ST1.1:** Complete Q4FY10
	ST1.2: Develop and execute plan for advanced global Hybrid Ensemble-Variational Data Assimilation System (HEVDAS) with NOAA ESRL, NASA GMAO, Univ of Oklahoma.	**ST1.2:** Plan developed and signed Q2FY10. System under development with preliminary tests showing positive impact on analysis and GFS forecasts at reduced resolution. Expected global implementation Q3FY12.	**ST1.2:** Ongoing. First potential operational implementation dependent on operational compute resources and development of semi-Lagrangian GFS formulation.
	ST1.3: Semi-Lagrangian formulation of GFS under development	**ST1.3:** Preliminary tests being conducted at T1148 (~16km) 64L on Tjet with goal of contributing to HFIP 2012 demo and FY13 implementation.	**ST1.3:** Ongoing. Would like to see potential operational implementation by Q4FY13. Transition to WCOSS creates moratorium Q4FY12-Q1FY13. Could be longer.

Recommendation ST2: NOAA, NWS, and NCEP leadership should assist EMC in developing a vibrant, intellectually stimulating research capability and strengthen interactions with the national and international research communities. With the constant demand of operating and maintaining a large number of prediction suites that consumes most of its resources, EMC has limited ability to develop and maintain a vibrant and intellectually stimulating research program. The lack of resources also prevents EMC from having strong interactions with the national and international research communities. The lack of such interaction directly limits the ability of EMC to translate the most effective science outcomes into practice, and also limits the ability of researchers outside EMC to engage challenging research problems directly beneficial to EMC. For example, an effective R2O transition requires investments in "operations to research" (O2R) by making the operational systems available to the research community. Doing so requires considerable resources beyond what the Developmental Test Bed Center (DTC) can provide. The review panel recommends that NOAA, NWS and NCEP leadership find ways of providing the resources and guidance necessary to transform EMC into an organization – recognized by the world – as the nexus of intellectually stimulating research and open interaction.	**ST2.1:** EMC participation in WMO activities **Cross References** CP1.1-4 (DTC) ST1.2 (HEVDAS) IS3.5 (COLA and CFSv2 porting) IS3.6: (GDAS/GFS porting to NASA JCSDA)	**ST2.1:** Participation includes: WGNE WWRP WCRP GEWEX CLIVAR GODAE GABLES	**ST2.1:** Ongoing
Recommendation ST3: NOAA, NWS, and NCEP leadership should assist EMC in developing a meaningful visiting scientist program, perhaps in conjunction with NSF, UCAR, and others. A robust visitor program would allow leading researchers from national and international research and operational institutions to visit and interact with EMC staff, resulting in promising new ideas to be tested for possible operational implementation. Such a visitor program would be an important component of achieving Recommendation ST1 above. We also recommend that 22 NOAA and NWS leadership work with NSF and UCAR to secure additional resources for such a program.	**ST3.1:** EMC transmit prototype VS program description to NWS/OST	**ST3.1:** Proposal submitted to NWS OS&T	**ST3.1:** No funding available. EMC Acting Director will continue to pursue opportunities for post-doc positions within the center.

Recommendation ST4: Accelerate the design of a flexible and adaptable modeling system that will lead to reductions in the number of individual models operated by EMC. As noted earlier in Recommendation PS1, EMC is operating and maintaining a large number of individual models, thus consuming a significant fraction of EMC resources and placing a strain on its ability to interact with the research community, pursue new initiatives, and meet unanticipated requirements. EMC must make a serious effort to reduce the number of individual models within its operational suite. A unified modeling approach, as that now being pursued with NEMS is needed to leverage available resources, both in terms of personnel as well as computational capacity. An excellent example of this recommendation in action is the GSI system, which is being used for global, regional and mesoscale data assimilation. No reason exists to continue the development of the Regional Spectral Model (RSM) and Eta models, knowing that the primary model framework to be used for regional and mesoscale prediction is WRF (NMM and ARW). We strongly encourage EMC to look seriously at all modeling systems and accelerate the design of NEMS that will lead to reductions in the number of individual models. In this context, EMC also should consider maintaining common physics suites for regional and global models. The recommended reduction in the number of individual models (and model components) would free existing EMC resources for other purposes, as noted above. This recommendation bears on issues such as the present capability and future plans of the Short Range Ensemble Forecast (SREF), which though valuable represents yet another arguably unnecessary challenge in managing a large portfolio of models. Finally, EMC should vigorously pursue a broad spectrum of approaches to data assimilation in the context of NEMS, especially hybrid ensemble-variational techniques as are now being developed jointly by EMC, the NOAA Earth System Research Laboratory (ESRL) and the National Aeronautics and Space Administration (NASA). The reasoning behind this recommendation is that, by the time a variational-only system would be implemented by EMC some 3 to 4 years from now – given	**Cross references:** **CP2.1**: Continue developing NEMS for both operational and research applications **CP2.2:** Unify global weather and seasonal climate analyses by introducing coupled atmosphere-ocean-land surface-sea ice system into GDAS and GENS **CP2.3:** Consolidate regional ensemble system (SREF)		

that ECMWF has been using this approach for many years – the gap between NCEP and ECMWF, and possibly other prediction centers, no doubt will have grown even wider.			
Recommendation ST5: The collaborative effort between NCO and EMC on GFS performance "dropouts" should be continued and strengthened. Solving the dropout problem requires close collaboration between NCO and EMC staff, and the review panel notes with satisfaction that a joint NCO-EMC team has been established to address dropouts and is making good progress. We strongly support continued emphasis on the dropout problem and encourage NCEP leadership to direct adequate resources to it, perhaps by engaging external researchers on a temporary basis. Specifically, because the monitoring and quality control processing of observations rests with NCO and could be contributing to dropouts, NCO should redouble its efforts to identify potential problems that might be associated with dropouts.	**ST5.1:** Correct upper air station dictionary **ST5.2:** Test changes to surface data processing to remove redundant data	**ST5.1:** Corrections implemented **ST5.2**: Changes tested (neutral impact); implementation planning on track	**ST5.1:** Complete **ST5.2:** May 2010 Implementation by September 2010

***Evaluation of ST1*:** We have noticed the improved GFS performance relative to its "competitors" during the past 9 months. On average, it appears that the GFS is at least 3rd best each month (to ECMWF and UKMET), with occasional "first place" finishes on some days. So, the gap has narrowed w.r.t. the ECMWF, but it is still significant. As noted above and earlier, improving the DA scheme is crucial. The new UCACN team will want to see the plan for how the new global model will be selected among the various competitors. Also, we noticed that the NAM appears to score last among the 6 models evaluated in precipitation skill in almost all categories (as shown on the STATS_vsdb web page). EMC should set a goal of producing the best QPF scores with its new regional model, at least over the CONUS area.

EMC Response to ST1: Excerpt from response to PS1: The global model to beat operationally is the GFS. Current plans for the global system include development of the Semi-Lagrangian advection formulation within GFS with first opportunity for operational implementation in Q2-Q3 FY13. Preliminary testing is encouraging at T878 and T1148. It's obvious that NCEDP must consider non-hydrostatic dynamics for higher resolution global system. Candidates include NMMB, GFDL Finite Volume, and MPAS. NAM about to be upgraded in October 2012 with 4km CONUS nest showing improved QPF performance over the current 12km operational NAM. A major challenge is to develop a high resolution NWP

system that provides high quality QPF forecasts and mode of convection for severe weather applications. EMC working closely with SPC, HPC and HWT to address this challenge.

***Evaluation of ST2*:** We are pleased with the ongoing and new international activities, and realize that this recommendation is redundant with earlier ones on U.S. collaborations. The over-arching goal is to improve the research culture and capabilities at EMC in order to attract top scientists to work or visit there.

EMC Response to ST2: Excerpt from response to CP1: " Engagement with international programs is significant (see appendix A)" Also linked with JCSDA and other NOAA testbeds. Working to build network with universities with programs in modeling to deal with work force succession planning. EMC culture is undergoing change. Working with operational deadlines requires a unique skill set not easily obtained. Working to recruit expertise.

***Evaluation of ST3*:** We are glad to see that a VS plan was developed. Although NWS/OS&T said no funding was available, there are many other ways to develop a VS program. Thus we encourage EMC to work with the NCEP OD and the UCACN to continue to develop a plan that can be vetted both internally in NOAA and to the external community.

EMC Response to ST3: Excerpt from CP1: **"**Visiting scientist program is very desirable and Acting Director working with NOAA leadership to find ways of funding it. It must be understood that EMC has little discretionary funding to self-invest in visiting scientists. EMC Acting Director is willing to set aside portion of overhead funding to fund post-doc positions within EMC.

***Evaluation of ST4*:** Agree that this recommendation is mostly repetitive, but certainly belongs in the S&T category. As noted above, actions so far have been excellent, with hopefully more to come.

EMC Response to ST4: EMC working to build a strategic plan and formation of a science advisory board. The strat plan must be coordinated across NOAA and this has been problematic in the past.

***Evaluation of ST5*:** **W**e presume that the above are but two of many actions to address this issue. Recent AC scores appear to show less frequent dropouts since the P6 implementation, but having a vigilant team to investigate serious model errors is always a good idea.

EMC Response to ST5: NCEP has formed a team to recommend a more robust model assessment capability similar in nature to that implemented at ECMWF. The purpose of the group is to assess model performance and provide feedback into the model development process. The plan is reformulate the dropout team to accomplish this goal. NASA GMAO has also developed a similar capability and EMC will meet with them to observe the process to prepare its own plan.

People and Organizational Culture: Findings

Finding POC1: *The EMC leadership and staff have created an organization that meets the day-to-day challenges of model development and numerical prediction and functions reasonably well. It was evident during the on-site review that the talented EMC staff members share a strong commitment to the EMC mission and enjoy a rewarding satisfaction in their accomplishments and contributions. The EMC Director has an impressive, detailed understanding of the tasks at hand and the challenges that must be met. The Director, Deputy Director, Branch Chiefs, and Team Leaders appear to work well together. The EMC staff members view the leadership team as strong advocates for employees and for the organization as a whole, although communication and guidance from the top of the organization to lower levels could be improved so that all employees understand both priorities and impediments to progress.*

Finding POC2: *The EMC accomplishments mask a number of serious stresses and strains that are likely to prevent it from attaining its vision as "best in the world". Some of the problems are internal to EMC, some a consequence of NOAA and federal personnel policies. The most significant internal challenge concerns the apparent lack of willingness on the part of EMC leadership to recognize the reality of insularity, work collaboratively with NCO to resolve important differences that are impeding progress, and be disciplined in scaling back and consolidating the number of models and related systems so as to achieve the EMC vision. The EMC staff members are overwhelmed with many projects and cannot focus on achievements that will lead to preeminence. Senior staff is working at an overload pace that cannot be sustained, and NCEP leadership does not seem to appreciate the severity of, or be willing to address, these challenges.*

Finding POC3: *The EMC organizational structures and workforce planning need attention. The EMC has responded to previous review recommendations by implementing a matrix management model. However, the main use of the model has been to staff projects funded with external resources and as a consequence, team leaders are drawn away from core responsibilities. The lack of a clear delineation of mission and responsibilities for EMC and NCO creates a difficult situation for both organizations and forces staff members into ad hoc arrangements in order to circumvent tension at higher levels. The longevity of the staff is an important advantage, though EMC is now facing considerable turnover and the loss of significant experience and knowledge. Although the federal Civil Service (CS) allows scientists to be promoted into senior ranks as scientists, NWS personnel policies seem to link promotion to acceptance of management responsibilities. Throughout EMC, ineffective and cumbersome government personnel practices work against the superior achievement evident in competing organizations that today are best in the world.*

Finding POC4: *The dependence on, and commitment to, outside funds stresses the EMC staff and deflects attention from the core tasks of the organization. NOAA provides EMC (in 2009) with direct funding of about $12M for the core mission and for 65 civil service employees. Some 30 other funding sources, including other NOAA organizations and other federal agencies, provide another $11M for a wide variety of tasks, many of them performed largely by employees of EMC contractor companies. This portfolio requires considerable attention of EMC executives and senior scientists and distracts them from core mission.*

Finding POC5: *The EMC seems to focus on day-to-day demands rather than on the bold and innovative advances required to achieve its vision. The EMC planning seems to be incremental and fails in setting clear and definitive priorities. The culture appears to be one of risk aversion and EMC seems to be a follower—at best—rather than a leader in the now global movement toward collaborative community numerical models and frameworks. The plethora of models EMC maintains consumes the strength of staff and requires duplication of scientific and programming effort.*

Finding POC6: *Although NextGen represents a potentially transformative activity for NCEP, little evidence exists that EMC recognizes the importance of NextGen and is planning effectively for it. The meteorological services required to support higher density, trajectory-based operations and integrative decision support frameworks in NextGen could radically transform how NCEP in general and EMC in particular do business. The review team saw little evidence of a thoughtful strategic plan, developed in close coordination with FAA and other relevant organizations, regarding NextGen.*

Assessment Recommendation	Planned Action	Status	Due Date
Recommendation POC1: The NCEP and EMC leadership need to create a new personality for the organization both internally and externally. Although a variety of technical or mechanistic solutions will be effective for addressing some of the recommendations made herein (e.g., implementation of a formal visiting scientist program, and more structured procedures for code changes), NCEP and EMC leadership must recognize that such changes alone will not solve some of the most important problems faced by EMC – problems relating to community perception regarding EMC values, EMC's willingness to consider alternative views and new ideas, and EMC's openness to collaboration. These factors are not mechanistic but rather reflect the personality of the organization, and the manner in which they are conveyed to the	**POC1.1:** EMC management improve manner in which EMC's mission, work plans and values are communicated internally and externally **Cross References:** **CP1.1**: Increase collaborations on key scientific development.	**POC1.1:** (1) EMC management and staff will listen to all ideas with respect (2) EMC management and staff to communicate development plans to all interested parties (3) EMC management and staff will provide insight into decision making process (i.e., increase transparency) (4) Team Building training for all GS14-15 was held 4-5 May 2011 (5) Several EMC management team members participated in a 360 feedback exercise	**POC1.1:** Continuous

community rests with the EMC director. The director sets the tone for the organization, and as noted in Finding POC1, the present director does an exceptional job dealing with technical issues. However, an organization rises and falls based upon other dimensions of leadership as well, as noted above, and considerable attention needs to be given to them if EMC hopes to achieve both its technical vision and its role as international leader.			
Recommendation POC2: The EMC must develop and implement a more formal process for defining core mission goals and setting priorities for those efforts required to achieve preeminence. The strategic planning necessary to streamline EMC activities and ensure success will be demanding, difficult work. It also must be collaborative and will require considerable dedication by the best minds in the organization. Some of EMC's goals and priorities will be dependent upon resources such as computer capability and staff talent and availability. EMC cannot continue to accept new tasks without new resources, expecting overloaded staff members to adapt to even more overload. The priorities developed must provide the resolve and motivation to say 'No!' to tasks that do not represent core mission goals, are not included in priorities, and are not supported with resources. Other core goals must be more cultural and long-lasting, including a dramatic revision in the posture of the organization toward change, toward community modeling initiatives, and toward acceptance of good ideas regardless of their source.	**Cross References:** **PS1.2:** Establish a Scientific Advisory Committee to provide scientific assessment of operational modeling systems and future plans within FICA guidelines. Organizations that have operational systems running at NCEP will be subject to review (EMC, GSD, ARL, SWPC, PMEL, NOS). EMC will be primary beneficiary as it is responsible for the majority of the operational modeling systems. **IS4.1:** Plan EMC Scientific Project Office (ESPO) **IS4.2:** Institution of project management practices.		
Recommendation POC3: The EMC must be bold, must take a long view, must focus on goals instead of tasks, and must put tomorrow ahead of today. Scientific understanding, computing and communications technology, observational capabilities, and demands for reliable environmental information are increasing at an accelerating pace. If EMC, NCEP, NWS and NOAA are to be relevant tomorrow, they all must start thinking very seriously *today* about tomorrow. They must start thinking about demands and opportunity brought by acceleration of change. EMC needs	**Cross References:** **IS4.1:** Plan EMC Scientific Project Office (ESPO) **PS1.1:** Participate in NOAA modeling strategic planning and budgetary processes. **PS1.2:** Establish a Scientific Advisory Committee to provide scientific assessment of operational modeling systems and future plans within FICA guidelines. Organizations that have operational systems running at NCEP will be subject to review (EMC, GSD, ARL, SWPC, PMEL, NOS). EMC will be primary	**POC3.1:** ESPO part of IS4	**POC3.1:** July 2010

to encourage bold, blue-sky thinking, it needs to stimulate ideas never before considered, and it must foster those outrageous ideas that reveal the key features of the future yet to come.	beneficiary as it is responsible for the majority of the operational modeling systems.		
Recommendation POC4: The EMC must seek enlightened and challenging external advice from leaders in the field and from an EMC component of an NCEP external advisory board created under the aegis of the NOAA Scientific Advisory Board. The essential task of the external advisers and the external advisory board will be to drive EMC to embrace and implement Recommendation POC2. Then EMC can look forward to the years ahead with verve and vigor; then it can march toward its vision with both courage and confidence.	**Cross Reference:** **PS1.2:** Establish a Scientific Advisory Committee to provide scientific assessment of operational modeling systems and future plans within FICA guidelines. Organizations that have operational systems running at NCEP will be subject to review (EMC, GSD, ARL, SWPC, PMEL, NOS). EMC will be primary beneficiary as it is responsible for the majority of the operational modeling systems.		
Recommendation POC5: All levels of NOAA must focus on ensuring that EMC has a sufficient number of sufficiently capable staff members to accomplish its core mission goals. Establishing adequate and flexible mechanisms for motivating, rewarding, and promoting talented scientists is essential to making EMC an attractive career choice. Success in developing and operating numerical models that give NCEP global preeminence requires financial, physical, computational, and human resources. Of these, human resources must be considered first and must be given highest priority. Computers cannot (yet) convert scientific principles into algorithms and convert algorithms into computer code. Working at the very heart of the U.S. weather prediction enterprise should be attractive and rewarding for many atmospheric scientists. It could be made more attractive than it is now with more flexible and more enlightened approaches to career opportunity and advancement that strike an appropriate balance among scientific management, creativity, knowledge production, and service. As an important step to improving the work environment, NCEP and EMC should create a formal orientation and mentoring program for new employees and visitors that stresses the goals, procedures, and rewards of the enterprise.	**POC5.1:** Create a staffing plan, differentiating between EMC Branches and Science Teams required to obtain adequate staffing level to support mission **POC5.2:** Brief EMC staffing plan to NCEP and NWS management **POC5.3:** Take a more proactive role in awarding EMC personnel when opportunities arise.	**POC5.1:** Staffing plan submitted to NCEP Leadership in Q4 FY10. **POC5.2:** Provided to NCEP OD **POC5.3:** Submitted numerous NOAA Employee of the Month, Dept of Commerce Gold, Silver and Bronze medal nominations in 2010. GFS 2010 upgrade awarded a gold medal. FY12 submissions were: CFSv2 (Gold); NAM (gold); HYCOM (Gold). NWSHQ Responses to nominations--NAM nomination was rejected, CFSv2 reduced to a silver nomination, and HYCOM accepted as Gold.	**POC5.1:** No action by NOAA leadership **POC5.2:** 15 June 2010 **POC5.3:** Ongoing. Rational for NAM gold nomination rejection not known.
Recommendation POC6: NOAA must act to reduce the EMC dependence on, and	**POC6.1:** Action required by NOAA Leadership to change programmatic funding model	**POC6.1:** Funding for core mission remains unchanged. Development areas at risk include land	POC6.1: Ongoing issue

commitment, to outside funds and projects. The first step is to increase the funding for civil service scientists who will contribute to the main mission. The second step should be to examine carefully whether the work supported by outside funds should be done by contract employees within EMC or whether it might be done by contract employees or private firms engaged by the agencies now transferring funds to EMC. The ratio of external to internal funds in EMC should be much smaller than it is now to ensure an adequate focus on being 'the world's best and most trusted provider' of numerical weather forecasts in the service of the nation.	**Cross references:** **POC5.1:** Create a staffing plan, differentiating between EMC Branches and Science Teams required to obtain adequate staffing level to support mission	surface modeling and climate due to uncertainty within NOAA Climate Program Office and the evolving Climate Service. Cuts in NOAA funding is pending in FY12—reanalysis, ocean DA, AQ, HFIP and HPCC at risk.	
Recommendation POC7: NOAA, NWS and NCEP leaders must significantly increase their role in planning for NextGen, especially with regard to EMC. This includes but is not limited to issues related to product and service planning, provision of necessary resources, development of effective communication strategies, and adequate frameworks for testing and evaluation.	**POC7.1:** Work with NWS HQ to define requirements and define funding **POC7.2:** Develop meta data for use in Real-Time Mesoscale Analysis, funded by NEXTGEN **POC7.3:** Institute quarterly upgrades to NOMADS data sets and consider software upgrades to "harden" system	**POC7.1:** Off-site strategic planning meeting was held in October 2010 with NCEP Directors to map NCEP Strategic Plan to NWS Strategic Plan and NEXGEN. **POC7.2:** hire contractor to perform work **POC7.3:** Quarterly upgrades scheduled by NCO and EMC assists in setting requirements and preparing data sets	**POC7.1:** Completed October 2010, however, this activity is ongoing **POC7.2:** Completed August 2010. NEXTGEN funding zeroed out in FY12. **POC7.3:** Completed March 2010
Recommendation POC8: The NCEP Director should work with the Directors of EMC and NCO to address some of the cultural and other challenges responsible for creating stress between the two organizations.	**POC8.1:** NCO and EMC Directors set up regular meetings **POC8.2:** NCO and EMC create collaborative summary of the stresses and how they will be addressed **POC8.3:** NCO and EMC will define projects to address improvements to the NCEP Production Suite Implementation Process (IP)	**POC8.1:** Weekly meetings have begun and are ongoing **POC8.2:** Create summary of NCO and EMC views and present to NCEP, NCO & EMC management **POC8.3:** The IP improvement project is being tracked at the NCEP Director level and being refined at the working level through a series of incremental projects. Thus far two projects have been completed (attempting to prototype improvements to job scheduling changes and instituting a strict version numbering protocol). (2) Weekly implementation meetings occur on Mondays at 10:30	**POC8.1:** Complete March 2010; meetings ongoing and have shown to be extremely valuable in resolving short and long term issues. **POC8.2:** Completed April 2010 **POC8.3:** Completed and activities ongoing

***Evaluation of POC1*:** We are gratified to see EMC leadership become more open to collaboration and improve internal transparency.

EMC Response to POC1: Lapenta still Acting Director. He has had three Acting Deputies in a 9 month period and needs a fourth in November. The extended uncertainty in leadership is being mitigated to the best of his ability.

***Evaluation of POC2*:** These earlier responses are certainly relevant here, and have been commented on. It is perhaps the role of the NCEP OD to develop an institution-wide policy that will bring structure and discipline to the process of deciding what NCEP can and can not do.

EMC Response to POC2: EMC needs a strategic plan for the development of the operational production suite. However, it can't be developed in isolation and must represent a larger NOAA wide effort. EMC working with NOAA Environmental Modeling Program (EMP) planning process. The EMP has planning and programming responsibility but no execution authority.

***Evaluation of POC3*:** The panel agrees with this response. Obviously this needs to be a team effort up the chain.

EMC Response to POC3: Same as response to POC2

***Evaluation of POC4*:** Same as before. Role of new UCACN will be much broader than above.

EMC Response to POC4: Establish a Scientific Advisory Committee to provide scientific assessment of operational modeling systems and future plans within FICA guidelines. Organizations that have operational systems running at NCEP will be subject to review (EMC, GSD, ARL, SWPC, PMEL, NOS). EMC will be primary beneficiary as it is responsible for the majority of the operational modeling systems.

***Evaluation of POC5*:** We support the response. We realize that OPM is not a paragon of flexibility, which often makes government employment unattractive. However, we encourage as much flexibility and creativity as is legal to hire, motivate and retain key employees. Strongly agree with nominating employees for awards.

EMC Response to POC5: EMC is working to expand recruiting network and aggressive workforce succession planning.

***Evaluation of POC6*:** Response adequate; problem needs NWS and NOAA attention.

EMC Response to POC6: No change since UCAR Review was held in July 2009.

***Evaluation of POC7*:** Response difficult to assess since don't know result of strategic planning meeting. Obtaining support for NEXGEN responsibilities will be important.

EMC Response to POC7: EMC participates in planning activities as much as possible.

***Evaluation of POC8*:** We view these actions as very good first steps, and hope they are having the desired result.

EMC Response to POC8: EMC/NCO relationship on a much more professional level—both at the management and worker levels. The best way for the review committee to determine progress would be independent verification by asking staff.

Business Processes: Findings

Finding BP1: *Linking science teams with branches in a matrix configuration responds to previous review recommendations .At the same time, most crosscutting projects appear to be externally (i.e., soft) funded, which may reduce their likelihood of completion. Some employees interviewed during the site visit recognized the pros (exposure to multiple projects) and cons (too little, too much, or conflicting direction) to matrix management. Some of the most productive staff members are diverted from core priorities by these efforts.*

Finding BP2: *The EMC planning lacks focus and prioritization. It is unclear how the next generation production suite will be developed. Although NPSR is the primary requirements process and is viewed favorably by NWS, EMC's role in its specification is vague, as is how NPSR integrates into NOAA's planning processes. Some concern was expressed during the site 27*
visit regarding EMC's isolation from prioritization of research in NOAA, and staff expressed a lack of clarity regarding the "right" level of research for EMC, vice development. In part because of the lack of focus and effective planning processes, EMC has accepted too many projects, diluting the talent required to complete core achievements that will lead to preeminence. Moreover, senior staff workload cannot be sustained. Some staff members have consistently long workweeks exceeding 55 hours, in addition to substantial travel commitments.

Finding BP3: *The EMC has serious stresses with NCO. It appears that lines demarcating the roles and responsibilities of EMC and NCO have blurred, with the perception that these two organizations compete for "turf", particularly in processes associated with approving and implementing production suite changes. Friction arises frequently because EMC and NCO do not share the same concerns or culture. Transition to the P6-based computing system, for example, has not been a smooth one, and the unavailability of systems has prevented progress in EMC's development activities. The "moratorium" on production suite upgrades due to the HEC transition lasted far too long, and the HEC system managed by NCO lacks balance due to a shortage of disk space, further reducing the pace of EMC's research. Further, management of IT infrastructure is rather confused, and lines demarcating the roles and responsibilities of EMC and NCO have blurred also. NCO handles many or even most approvals for items such as system accounts, email addresses, etc., and NCO appears very slow in responding, often taking 6+ months to provide approvals. This seriously impacts the value offered by visitors. NCO also has control over the approval of software and hardware usage on the network, which often places detrimental restrictions on staff. Although EMC has an Information Technology Help Desk, its staff members admittedly are not at all qualified to perform their IT security duties. All of these circumstances are complicated by the fluid nature of NOAA security policy.*

Finding BP4: *The EMC R2O is hampered by inadequate support for test beds and less than effective utilization. Test beds are one of the key avenues through which innovation enters the production suite. However, EMC does not always manage the test beds. For example, CPC runs the Climate Test Bed and uses it to improve CPC products, not EMC climate models.*

Finding BP5: *Federal laws, rules, and regulations impose numerous obstacles to recruiting, retaining, and promoting EMC employees, contractors, and visitors. The number of CS employees at EMC essentially is fixed and at capacity, despite a strong desire expressed by contractors and visitors to achieve a CS position, as well as funding now available to convert at least some of them. This leads to considerable difficulty in succession planning. Although some progress has been made in the CS/non-CS (or soft funded) staff ratio, the problem still remains and the current practice is unsustainable. During on-site interviews, some contractors expressed a sense of distance from decision-making – that they are treated the same as CS employees, but with little value attached to their input. Most NOAA staff awards can go to CS employees only. Although CS pay is relatively low compared to industry and academia, flexibility promotes an acceptable work-life balance. Because physical access to and account authorization on NCEP's National Critical Systems is strictly limited due to export restrictions, contractors, especially those without US citizenship, 28*
face a lengthy and difficult process, beyond EMC's control, to gain access to the computing resources they need. Travel requests must be made abnormally early, thus limiting the ability of staff members to participate in useful activities that have relatively short announcement lead times.

Finding BP6: *Unattractive and unsafe facilities impede recruitment and retention. The current EMC facilities are embarrassingly inadequate, both in terms of working office space and space for conferences and meetings. This is a long-standing problem that is exacerbated by the delay in moving to the new National Center for Weather and Climate Prediction at the University of Maryland.*

Assessment Recommendation	Planned Action	Status	Due Date

Recommendation BP1: The EMC should focus on core mission goals, including products and services, to prevent overextension, dilution and unnecessary activity. The EMC should assess its core competencies vis-à-vis its mission, and focus its human and computing resources on maximizing the use of those competencies toward meeting mission goals. The EMC also should integrate NOAA, NWS, and NCEP business processes, particularly PPBES planning activities, to streamline planning efforts and more effectively leverage the experience of EMC personnel. NCEP and/or EMC should have the ability to say "No!" to unfunded mandates and to the continuance of existing activities if they are not justified and core to the EMC mission. The complete lack of formal project management exacerbates many of the issues mentioned here. Implementing standard project management practices will help in many areas: planning execution, coordination and reporting. It also will help address the requirement of balancing demands with available resources and responding to unfunded requests with well understood impacts and resource re-allocation.	**BP1.1:** organize FY12 AOP around mission goals **Cross References:** **IS4.1:** Plan EMC Scientific Project Office (ESPO) **CP1.1**: Increase collaborations on key scientific development. **CP1.2:** Meet periodically with other NCEP Center Directors to discuss how EMC can improve their products **PS1.1:** Participate in NOAA Modeling strategic planning and budgetary processes. **PS1.2:** Establish a Scientific Advisory Committee to provide scientific assessment of operational modeling systems and future plans within FICA guidelines. Organizations that have operational systems running at NCEP will be subject to review (EMC, GSD, ARL, SWPC, PMEL, NOS). EMC will be primary beneficiary as it is responsible for the majority of the operational modeling systems. **IS1.1**: Participate in NCEP HPC Resources Allocation Committee (HPCRAC) **IS1.2:** Convey EMC systems development plans to NCO and compare with available resources **IS1.3:** Plan resources allocation for NOAA R&D computer at Site A (ORNL) and Site B (West VA). **IS1.4:** Support NOAA Weather and Climate Operational Supercomputer Systems (WCOSS) acquisition plan development and execution	**BP1.1:** FY12 AOP accepted by OD.	**BP1.1:** September 2011
Recommendation BP2: The EMC must be provided with adequate computational resources for both operations and research, along with a set of governance rules for these resources. EMC must request sufficient resources for substantially enhanced HEC capability, at the very least through the NOAA PPBES process, and leverage opportunities for using external computing resources whenever practical. The computing needed to support the broad range of EMC activities – from research and development to test beds to operations – must be balanced so that today's research can be implemented in tomorrow's production suite. An objective set of guidelines must be instituted to align research computing	**Cross References:** **IS1.1**: Participate in NCEP HPC Resources Allocation Committee (HPCRAC) **IS1.2:** Convey EMC systems development plans to NCO and compare with available resources **IS1.3:** Plan resources allocation for NOAA R&D computer at Site A (ORNL) and Site B (West VA). **IS1.4:** Support NOAA Weather and Climate Operational Supercomputer Systems (WCOSS) acquisition plan development and execution. **IS3.1:** Port model system benchmark to ORNL Cray		

decisions with the appropriate experts at EMC and NCO, but with shared goals in mind. Procurement of new systems must accommodate requirements across the NCEP family of centers. Often, considerable functional testing and impact analysis of model changes can be accomplished with the use of external resources. Such a strategy should be pursued to allow more focused use of limited NCEP resources.	**IS3.2:** Begin using ORNL Cray system **IS3.3:** Use NOAA R&D Site A computer for global modeling (S/I and ensemble emphasis) **IS3.4:** Conduct development of hybrid ensemble variational data assimilation system on HFIP computer resource in Boulder in concert with ESRL and University of Oklahoma investigators **IS3.5:** CFSv2 code provided to COLA in Q3FY11. **IS3.6:** Porting GDAS/GFS to NASA JCSDA		
Recommendation BP3: The EMC must be provided with adequate base funding consistent with its mission and vision, and adequate personnel and mechanisms for promoting, rewarding and motivating them. The ratio of CSto non-CS employees, which has long been an issue, needs to be addressed. Adequate base funding, with allowances for labor cost-of-living adjustments, will permit EMC to attack the key prediction problems that are keeping it from preeminence (e.g., drop-outs). Additional CS positions must be obtained so that qualified visitors and contractors can move into them and thereby provide EMC with capable future leadership. It is not practicable for EMC to continue with such a small ratio of CS to non-CS or soft money employees. When feasible, EMC should remove distinctions among CS, contract, and visiting staff to promote a single team approach to meeting EMC's mission. Streamlining processes for travel authorization and computer accounts also is essential.	BP3.1: see POC5 for Staffing plan	BP3.1: see POC5 for Staffing plan	BP3.1: see POC5 for Staffing plan
Recommendation BP4: Expeditious completion of the new building and NCEP's move to it are vital to the future of EMC. The NOAA, NWS and NCEP leadership should work collaboratively to ensure this move is completed in the most expeditious manner possible.	BP4.1: no EMC action required	BP4.1: no EMC action required	BP4.1: no EMC action required
Recommendation BP5: The NCEP Director should work with the Directors of EMC and NCO to address some of the cultural and other challenges responsible for creating stress between the two organizations.	See POC8 above	See POC8 above	See POC8 above

***Evaluation of BP1*:** Haven't seen 2010 AOP, so not sure if EMC was able to make any headway on right-sizing their mission. Other cross-referenced activities should all help. This obviously is an ongoing annual concern.

EMC Response to BP1: See cross references in table. FY12 AOP is reduced in scope to reflect risks associated with transition to new operational machine and near full capacity of current P6 system.

***Evaluation of BP2*:** As before, these responses are all appropriate. A larger effort is needed on making the business case for more computer resources.

EMC Response to BP2: Replicate response to IS1: Building the business case for NOAA operational compute capability is beyond the scope of EMC. We don't have the skill sets required to do the work and I'll argue that the business case must be developed at higher level in the agency. NOAA must build advocacy among the users of the operational products as stated in your evaluation of IS1.

***Evaluation of BP3*:** Response in POC5 good for hiring, motivating, retaining top employees. There are several other aspects to BP3 not addressed (teambuilding among all employees; streamlining, etc.)

EMC Response to BP3: EMC management aggressively promoting training. EMC Acting Director added training requirement to all management team staff in FY11. He conducted a professionally facilitated team building off-site training for all GS14-15's (26 people) in May 2011. He increased training budget from $8K to $50K. Proposed FY12 group training will be focused on conflict management (may be at risk due to budget cuts) . EMC management is empowering staff by assigning small team projects. Response has been very positive and staff receiving internal and public recognition for stepping up.

***Evaluation of BP4*:** Recent news on the NCWCP is good. We hope it facilitates progress on other topics mentioned in the review.

EMC Response to BP4: EMC expects move to be complete in late FY12. However, the building space requirements were developed in the 2007-2008 time period. Growth between 2009-2011 will result in limited seating for visiting scientists. Current telework policy may need to be extended to NCWCP era making room for more visiting scientists. Seating limitation for new visiting scientists may be mitigated by lack of funding for visiting scientists. EMC management hopes this is not the case.

***Evaluation of BP5*:** Same as for POC8.

EMC Response to BP5: EMC management responsive to meeting with other center leadership.

Comment: We note that the EMC review did not make any specific recommendations related to work being done in the Marine Modeling and Analysis Branch. However, both the OPC and TPC/NHC review reports had a significant number of recommendations that are relevant to this

branch, primarily in the modernization of its ocean, coastal and surge (inundation) modeling suite. We encourage EMC leadership to also consider these recommendations as it moves forward.

Final Comment: While many of our evaluations to the responses pointed out missing or not yet completed aspects, we want to emphasis that we are very pleased overall with the proactive and positive response to the review recommendations, many of which are not easily addressed. We encourage these efforts to continue, even in this bleak funding environment, so as to be well prepared for specific opportunities.

EMC Final Comment—The comments provided by the co-chairs are much appreciated. Many of the recommendations require a change in culture within the center and this has been the top priority of the Acting Director in the past 18 months. The next major challenge for EMC and NOAA is the development of a strategic plan for NOAA operational modeling. EMC alone can not implement change without the support of the other NOAA line offices where modeling expertise resides. Doing so will require NOAA leadership to put trust in the modeling labs and centers to work towards such a plan.