Community Review NCEP Assessment and Recommendations – (Last modified 03JAN11/ACD)

NCEP Central Operations (NCO)

Mission and Vision

Finding MV1: *The present mission and vision statements, though well intentioned, do not reflect the true service nature of NCO and are insufficiently bold. For example, should not NCO seek to set the IT standard of excellence for operational weather/climate prediction centers around the world, not just within NWS? Additionally, although NCO certainly should be renowned, the latter part of the vision statement struck the review panel as somewhat odd in that success for NCO is predicated on its service role of ensuring the success of EMC and all NCEP service Centers.*

Assessment Recommendation	Planned Action	Status	Due Date
Recommendation MV1: We suggest a careful reevaluation of the mission and vision statements with due consideration given to all findings and recommendations reported herein.	MV 1.1: NCO will revisit mission and vision statements.	MV 1.1: Union engagement underway. Staff/management team forming.	Q2 FY12

Customers and Partners

Finding CP1: ***A commitment to on-time delivery and rigorous change management is important for NCEP.*** *NCO has demonstrated a genuine commitment to on-time daily product delivery. As of mid-July, 2009, NCO's performance metric of 99% of products produced with 15 minutes of the expected time has been regularly achieved since the goal was established in September, 2006. Monitoring the generation of products are key steps in product dissemination via AWIPS and NOAAPort, and NCO has indicated that average product latency to the NOAAPort Satellite Broadcast Network as been significantly reduced since 2002. NCO's latency goal of 12 minutes has been met since 2006.*

Because of a notably tight production suite schedule, both NCO and EMC are committed to ensuring that changes to production suite components are managed rigorously to ensure stability and predictable system behavior. Changes are tracked from testing to implementation, and NCO seeks to ensure that prior to implementation, stakeholders directly affected have an opportunity to review proposed changes.

Finding CP2: ***NCO lacks sufficient understanding of its customers and stakeholders and may not adequately appreciate that EMC is its first and foremost partner.*** *NCO views its interactions with customers within NCEP Centers and NWS regional offices as its greatest priority, while customers further removed from NCEP (e.g., NWS Family of Services users, universities) of lesser importance. NCO admits that it does not truly understand customer needs or the extent of its customer base, and attempted to remedy this circumstance by establishing an NWS-wide products, services, and customers tracking system. This tracking system was cancelled in 2008 has having insufficient priority for funding.*

NCO's vision statement is striking in that, as stated above, NCO does not appear to recognize that its interactions with EMC are of paramount importance in supporting the NWS/NCEP mission, particularly via furnishing products to support NWS field operations, the private sector, and other government agencies. The lack of a true partnership between NCO and EMC is further reflected in problematic collaborations, particularly with respect to development of effective change management implementation strategies. The review panel found both EMC and NCO supportive of the need for rigorous testing procedures in production suite management, but in disagreement on how to implement these strategies.

Finding CP3: ***The user community's desire for products, especially output at the resolution of model execution, is not being met and only will increase with time.*** *At present, major dissemination paths to public and private users of numerical weather prediction (NWP) model output are the NCEP FTP server at the NOAA Web Operations Center (WOC) and the NCEP FTP server at the NWS Telecommunications Gateway (TOC). Products with WMO headers are sent to TOC for worldwide dissemination. The CONDUIT (Cooperative Opportunity for NCEP Data Using Internet Data Delivery Technology) Local Data Manager (LDM) feed from WOC is a key source of model output to the university community. External users also can access NOAA real-time operational NWP model output through the NOAA Operational Model Archive Distribution System (NOMADS) server at WOC. These various systems are used by the private sector and academic communities to obtain analyses and forecasts as well as initial and boundary conditions for both products and experimental models run at higher resolution. Both communities have a requirement for NCEP model output at native resolution. At present, because of a combination of disk storage and bandwidth limitations, these products are not available.*

Finding CP4.: ***NCO has insufficient interaction with other operational or mission-critical IT processing centers (e.g., other national and international NWP centers, NSF supercomputing centers, commercial data centers) to the degree that would be advantageous****. Although NCO maintains close operational relationships with many meteorological agencies, these relationships appear to be primarily focused on data exchanges and data formats (e.g., NCEP/NCO being a member of the World Meteorological Organization's codes group). These interactions are, by NCO's admission, mostly reactive. Although such relationships are necessary for any global modeling center, they appear insufficient to advance NCO's ability to identify best practices that might aid in streamlining operations and assist the development of plans for continuity of operations in the event of catastrophic backup facility failures. NCO currently does not appear to be taking advantage of other supercomputing facilities and commercial data centers in ways that might alleviate disk storage needs and computational resource limitations caused by overburdened operational requirements. Additionally, NCO was not represented at the recent Computing in Atmospheric Sciences meeting despite a formal invitation to attend.*

Finding CP5: ***Working relationships and links between NCO and the NOAA National Climatic Data Center (NCDC) are not apparent.*** *In none of the review panel's discussion of partnerships or collaborations did the relationship between NCO and NCDC emerge. In light of NCEP's involvement in NOAA's NOMADS project, which provides archived access to high volume NWP model output and other information, the review panel believes that NCO's role in facilitating the exchange of data between NCEP and NCDC for this purpose would have been highlighted.*

Recommendation CP1: NCO should re-evaluate its chosen performance metrics and add to them with a view toward enhancing its overall performance measures. NCO's demonstrated ability to reach its own established metrics for on-time product generation and product dissemination is laudable. It is recommended, however, that NCO re-evaluate these metrics by either "setting the bar higher" regarding reliability or determining whether the metrics they have chosen are consistent with customer or partner needs. New metrics might include measures of the delivery of increasingly higher resolution model output, the breadth of the spectrum of products delivered, and customer satisfaction.	CP1.1: NCO will work with EMC and OD to propose shared performance metrics that balance reliability and rate of change	CP 1.1: New model implementation plans are included in Director's performance goals; model implementation and on-time delivery metrics are shared by NCO and EMC.	Complete
Recommendation CP2: NCO should continue to explore and implement strategies for delivering model output at native model resolution for university and private sector uses. NCO should work with its partners in the NOMADS data delivery system to work toward the goal of delivering all NCEP model output at native resolution, including all members of the NCEP's ensemble systems.	CP2.1: NCO is already pursuing greater customer access to NCEP products at desired resolution and will continue to meet with customers regularly. Early feedback indicates that the requirement for native resolution may be overstated.	CP2.1: A process to conduct detailed customer interviews has been implemented. Feedback indicates that the requirement for native resolution may be overstated.	Complete
Recommendation CP3: NCO should actively engage with other similar centers around the world and participate, to the extent possible, in internal forums on numerical prediction, high performance computing, and related topics. A key mechanism for both understanding and impacting directions in the international prediction and computing communities is active engagement in professional meetings, exchange visits, and sharing of best practices and tools. NCO should thoughtfully pursue these goals as part of its broader strategy to become the world leader in weather and climate prediction IT.	CP3.1: NCO will focus on attending supercomputing conferences, user group meetings and especially meetings hosted by other world centers. CP3.2: NCO will engage with engage with external high performance computing research efforts. CP3.3: NCO will establish an annual best-practices review with another world center for HPC	CP3.1: NCO personnel attended supercomputer conferences SC-09 and SC-10 and the ECMWF bi-annual conference on High Performance Computing in Meteorology. CP3.2: NCO has funded and participated in the NSF Industry/University Cooperative Research Center (I/UCRC) for Hybrid Multicore Productivity Research and chairs the Industry Advisory Board for the Center CP3.3: NCO and EMC management travelled to UKMET and ECMWF in August. • Single data center with adjacent isolated systems • Enforced 30-minute job granularity to enable failure recovery • Scheduling strategies to intersperse development around production jobs • Product on-time release strategies • Strategies for Production / Development allocations Follow-on meetings hosted by NCEP are being planned for this Spring with DoD modeling centers and UKMET has committed to an August visit.	Complete Complete Complete

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Products and Services			
Finding PS1: ***NCO demonstrates a commitment to on-time delivery of the products and services produced throughout NCEP.*** *NCO leadership and staff possess an understanding of the critical importance of on-time delivery and stability of the products and services they disseminate. On-time delivery metrics have been established and are continually referenced throughout the organization as a means for measuring success. This culture and approach is commended and should continue. Additional metrics to expand the breadth and impact of NCO should also be developed as described in Recommendation CP1.* **Finding PS2**: ***NCO has worked to embrace the adaptation of new technologies to achieve its mission and vision.*** *NCO leadership recognizes its role as 'the standard for information technology excellence for the NWS'. To achieve this portion of its vision statement, NCO has evaluated and implemented new technologies aimed at increasing the number and value of services it provides to NCEP. For example, NCO recently implemented a 'server virtualization' capability aimed at increasing computing power in a controlled resource environment. Continuing to foster and implement new technologies while sharing this capability with other NCEP Centers is a core responsibility of NCO. However, as noted elsewhere (see, for example, Recommendation IS4), NCO could be even more effective implementing new technologies and management practices, including for the support of service Center capabilities.* **Finding PS3**: ***NCO software development teams need additional and enhanced communication channels to the NCEP Centers they serve.*** *Although NCO leadership believes it has a direct understanding of NCEP service Center requirements, this feeling was not shared by those assigned to various projects within NCO. NCO should take a leadership position in creating communication channels between users of their products and services and NCO project teams charged with their development. This enhanced communication will lead to better project specification and a feeling of inclusion by the NCO development teams in the entire NCEP production process.*			
Recommendation PS1: NCO and EMC should develop metrics that measure the impact and rate of implementation of forecast models and use them to manage the pace of meaningful innovation. NCO has demonstrated the ability to adhere to an on-time metric that is required throughout the weather and climate enterprise. To further the missions of NCO, EMC and ultimately NCEP, it is imperative that additional metrics be developed jointly by NCO and EMC. These metrics should evaluate the rate of implementation matched with the value of the change being implemented within the EMC model suite. Additionally, the metrics should be created and adhered to jointly by EMC and NCO to ensure that both organizations show the same level of commitment to these new guiding metrics as is given to the extant on-time metric.	PS1: see CP1	PS1.2: see CP1	See CP1
Recommendation PS2: NCO should work closely with EMC to deliver NWP products at native resolution and forecast frequency. NCO must work closely with EMC to insure that IT capacity and capability exist to disseminate to the entire global user community all NWP products, at native temporal and spatial resolution, created within the NCEP model suite. This recommendation will require careful planning between NCO and EMC as data sets and product suites change and develop in the future. It is imperative for NCO to ensure appropriate budget allocation, planning and IT infrastructure innovation to help EMC in meeting this requirement.	PS2.1: see CP2	PS2.1: see CP2	See CP2
Information Systems			

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Finding IS1. High performance computing resources available at NCEP are significantly far behind 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 position among world forecasting centers. Although computing power alone will not elevate NCEP to world leadership, the existence of these resources is a necessary condition for NCEP to achieve the stated goal.* ***Finding IS2. Little evidence exists that EMC and NCO collaborate in an end-to-end process for HPC acquisition.*** *The review panel could find little evidence of an HPC acquisition requirements collection process that was inclusive of both NCO and EMC staff. Further, the analysis of identified needs and the specification and selection of resources fails to involve NCO's major customers.* ***Finding IS3. The delineation of IT responsibilities between NCO and NCEP service Centers is unclear.*** *The management of IT infrastructure is rather confused, and the lines demarcating roles and responsibilities of NCO and NCEP service Centers are poorly defined. This is particularly true in responses to security incidents.* ***Finding IS4: No formal continuity of operations plan exists for HYSPLIT or regional forecasts in the event of a complete Central Computing System (CCS) outage.*** *Should a complete outage occur at CCS (e.g. a wide-spread power outage on the U.S. eastern seaboard), HYSPLIT and regional forecasts will cease until repairs can be made. Although NCO is to be commended for its ability to switch operations from the primary to the backup system in a timely manner, significant exposure remains in the event both facilities become unavailable. Although such an occurrence may have seemed remote a decade ago, such is not the case in today's post 9/11 environment.* ***Finding IS5: EMC is severely lacking in computing resources, particularly disk space, to support its mission.*** *A key limitation in the ability of EMC staff 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 experiments 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.*			
Recommendation IS1: Working with stakeholders and partners including but not limited to NCEP service Centers, OFCM and NWS and NOAA leadership, NCO and EMC must develop a comprehensive strategic plan for an enhanced NCEP computing portfolio consisting of a balance of HPC, storage, bandwidth and processing tools. In achieving this goal, other partners such as NCAR, the NSF supercomputing centers and TeraGrid, and academic computing centers and informatics groups should be included.	IS1.1: NCO, in cooperation with all stakeholders, is driving balanced requirements into the FY12 PPBES process for the supercomputer contract. All related NOAA entities were invited to participate in this process.	IS1.1: Process currently active.	Complete
Recommendation IS2: NCO and EMC should design and implement a formal, collaborative process to document scientific and computational validity before implementing a new model or model change. This process should be implemented as part of a full systems engineering approach to evolving the production suite (see Recommendation IS4). The document describing the process should establish the need for implementation, assess impacts on other system components (data, models, products, IT operations), and articulate expected benefits.	**IS2.1:** NCO will work with EMC to propose a significant overhaul of the model implementation process aimed at enhancing both efficiency and reliability.	IS2.1: NCO will work with EMC to propose a significant overhaul of the model implementation process aimed at enhancing both efficiency and reliability. Started	Q4 FY12
Recommendation IS3: NCO should collaboratively identify and mitigate unnecessary duplication between NCO and NCEP organizations that it supports, e.g., IT support functions, forecast verification, customer survey. In reviewing both NCO and EMC, it became evident that several activities are unnecessarily duplicated between them. Given the somewhat overlapping missions of these Centers this is neither surprising nor negative. However, it is incumbent upon EMC and NCO to work effectively to identify unnecessary duplication and delineate responsibility to avoid loss of effort. Likewise, those activities for which both NCO and EMC believe duplication is necessary should be clearly justified and documented.	IS3.1: NCO will work with all centers and OD to develop a list of IT services that the centers would like NCO to provide.	IS3.1: Centralized IT support functions were discussed during the FY10 IT Planning Conference (Boulder, Apr10). Initial focus is on security services and AWIPS2 conversion support. OD will fund centralized IT Security staff (ISSO). All future IT Planning Conferences will address IT support de-duplication.	Complete

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Recommendation IS4: A comprehensive formal plan should be developed and implemented that provides for continuity of operations across key products and services. Current plans for maintaining operations in the event of outages or failures is not inclusive of all critical NCO functions. A formal plan that addresses a complete outage of CCS and ensures continuity of all critical services and products must be developed. The existing plans form a solid base upon which to build.	IS4.1: Plans for Alternative Processing Site (APS) will address most of the vulnerabilities. NCO will incorporate APS into a formal COOP plan that addresses vulnerabilities by providing at least one independent backup source for all critical functions. Will need to address the issue of where/how to accommodate physical space for personnel during long-term COOP scenarios.	IS4.1: The greatest thread to NCEP operations is the potential loss of the WWB. Plans for an Alternate Processing Site (APS) will address most vulnerabilities. NCO will incorporate the APS into a formal COOP plan that addresses vulnerabilities by providing at least one independent backup source for all critical functions. Will need to address the issue of where/how to accommodate physical space for personnel during long-term COOP scenarios.	Q4 FY13
Recommendation IS5: NCO and EMC should collaborate to implement a formal systems engineering approach to NCO-EMC processes which allows for coordination and, especially, planned evolution. Systems engineering focuses on how complex engineering projects should be designed and managed. It provides a structured approach not only for requirements-gathering, prioritization, assessment of technological capabilities, design, task planning, optimization, and testing and implementation, but also the orderly evolution of a design and its implementation. Though many elements of systems engineering are present in current NCO processes, a proper systems engineering implementation would provide structure and coordination of these processes and assist in better focusing of resources.	**IS5.1:** EMC and NCO have established a weekly series of meetings to address this and other inter-related issues. A tentative set of initiatives have been proposed: ▪ Overhaul Code movement and RFC process ▪ Develop a means to measure model suite efficiency ▪ Find a way to better measure HPCC effectiveness ▪ Measure and prioritize the value of different types of model input data	IS5.1: EMC and NCO have established a weekly series of meetings to address this and other inter-related issues. A set of initiatives are completed or underway: • Version numbering • Implementation metrics • Environment equivalence Next steps include: • Formalizing early implementation planning • Evaluating implementation metrics to identify the next implementation-related project	Q4 FY12
Recommendation IS6: A commitment to on-time delivery and rigorous change management is important for NCEP and should be continued. NCO's commitment to on-time delivery is exemplary and the formal change management process is to be commended. The latter should be properly incorporated into a full instantiation of project management practice. However, a key point here is that these practices must be conducted in support of advancing the NCEP mission, i.e. on-time delivery of products cannot lead to lack of progress in delivering important improved or new products.	IS6.1: No action required. See CP1	IS6.1: No action.	Complete
Science and Technology			
Finding ST1: ***The review panel endorses the proposed suite-based concept for testing model system changes on the backup HPC system.*** *Because NCEP modeling systems are closely coupled, changes made to one component frequently influence the performance of others, especially downstream in the prediction cycle. For example, a seemingly benign change in the Gridpoint Statistical Interpolation (GSI) data assimilation system could impact the performance of the Global Forecast System (GFS) forecast, subsequently impacting HWRF (which uses a GFS forecast as the initial and lateral boundary conditions). Therefore, before a specific model system change is implemented, the entire modeling suite must be tested to avoid undesirable results. The review panel commends NCO for making the backup HPC system available for suite-based testing of model system changes.* **Finding ST:** ***Uncertainty regarding the proposed NOAA National Climate Service (NCS) and Next Generation National Airspace System (NextGen) are adversely impacting NCO and EMC planning, e.g., the location of operational seasonal forecasting.*** *The proposed NCS and NextGen will require, respectively, operational seasonal prediction and high-resolution ensemble forecasting. The creation of these products will require computing resources far beyond NCO's current or even planned capability and thus will affect not only operations but also research. We strongly recommend that NOAA and NWS leadership provide assistance to NCO and EMC in dealing with these uncertainties and in developing effective plans for the future.* **Finding ST3:** ***GFS performance "dropouts" represent a significant problem that must be addressed.*** *It has been found that the NCEP GFS model evidences 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 NCPE global model forecast skill is not as high as that of ECMWF and UKMO, and thus eliminating dropouts is be important issue for helping close the gap.*			

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Recommendation ST1: The proposed suite-based concept for testing model system changes on the backup HPC system is good and should be developed and implemented in close collaboration with EMC. Although the concept of suite-based model testing is good, it requires a significant amount of computing and human resources. In order to optimize the use of resources for testing model system changes, it is important that NCO work closely with EMC to develop appropriate test procedures, and implement such procedures on the backup HPC system.	ST1.1: NCO is committed to working with EMC to establish a suite-based system for model testing and evaluation.	ST1.1: Suite-based testing and implementation was successfully executed as a pilot for the July GFS implementation. Visits to ECMWF and UKMO have validated this approach. NCEP will need to formally agree to the perceived resource cost associated with this approach. Project will proceed after completion of IS2.1.	Q4 FY12
Recommendation ST2: The collaborative effort between NCO and EMC on GFS performance "dropouts" should be continued and strengthened. It has been found that the NCEP GFS model evidences 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 NCPE global model forecast skill is not as high as that of ECMWF and UKMO, and thus eliminating dropouts is be important issue for helping close the gap. 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.	ST2.1: NCO and EMC have already reached out externally as part of dropout team activities (COPC, NRL, ECMWF). Will continue to reach out as required.	ST2.1: Dropout team active and ongoing	Complete
People and Organizational Culture			
Finding POC1: ***NCO leadership and staff are passionately committed to bringing the best and most effective contemporary principles and processes for managing complex computer production systems to the NCEP numerical forecast suite.*** *The management of complex computer systems for research and production has evolved into an exacting and demanding discipline through the experiences gained at a wide variety of public and private supercomputer operations. Certainly, NCO must take advantage of this accumulated experience to ensure that its own operations are as controlled and as effective as possible. The commitment to a demanding mission and effective operations is shared by NCO staff members, who are dedicated, understand their role, and are aligned with leadership. Although collegiality and esprit de corps were evident and refreshing, notable problems came to light during the site visit.* **Finding POC2:** ***The process and quality management perspective of NCO has not been adequately integrated with the research and numerical model development perspective of EMC, leading to seriously strained relations between NCO and EMC leadership.*** *The leaders of the two organizations are fairly zealous in protecting what they see as their prerogatives – to the point of imperiling the collaboration necessary for success. In some cases, new NCO procedures were implemented unilaterally and more rapidly than could be accommodated in the EMC research-oriented culture. Too much time is being spent in what one executive described as "fighting". Fortunately, NCO staff and EMC scientists are bypassing some of the tension by learning to work together through ad hoc approaches to implement new models and manage their operation over a complex life cycle of change and improvement.*			

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Finding POC3: ***NCO senior duty meteorologists (SDMs) are a key component of the NCEP operation and meet demanding responsibilities effectively.*** *Acting as the daily weather-eye for NCEP, SDMs ensure that NCEP operations are focused to meet the challenge of critical weather events occurring anywhere in the US. As a group, SDMs are highly engaged, dedicated, and effective. They have demanding responsibilities and meet them well, earning them respect throughout NCEP and NWS.* **Finding POC4:** ***Some members of the NCO team have the difficult challenge of working at the complex interface among contemporary supercomputer operations, information technology, and advancing atmospheric science. They are not now adequately supported in meeting this challenge.*** *Whatever their talents and accomplishments in the world of computing, NCO staff members must have some appreciation of the imperatives and aspirations of other worlds, including those of EMC, NCEP service Centers, and the diverse private and public entities that depend upon NCEP products for managing weather and climate risk and opportunity.*			
Recommendation POC1: NCEP, EMC, and NCO leaders must ensure that the EMC and NCO missions are appropriately defined and that the cultures are sufficiently integrated and adequately collaborative. It is axiomatic that NCO and EMC must cooperate. Their substantially different cultures must complement each other, not clash. Achieving this goal will require a more careful delineation of vision and mission. EMC is responsible for the development of numerical environmental prediction models and for their quality and skill in operations. NCO is responsible for the timely and reliable production of forecasts and concomitant products with those models and accessory software systems. Together they must create an effective forecast system scaled to available resources. Together they must foresee future scientific and technological trends and opportunities and seek the computational and human resources needed to take advantage of them. Together they are partners in progress, partners in change, and partners in a key national endeavor. Together they bear an awesome responsibility and they will only succeed by working together.	POC1.1: EMC and NCO must learn to work together on strategic issues. Both organizations acknowledge the history of dysfunction and the importance of fixing the issues.	POC1.1: EMC, NCO and OD have established a weekly senior management meeting to address cooperative efforts. Co-sponsored projects are drawing the organizations closer together.	Complete
Recommendation POC2: NCO staff members who work at the interfaces of technology and atmospheric science should be given more opportunity for professional development. NCO staff thus should attend a variety of relevant professional conferences, workshops, and short courses. They should visit NCEP service Centers, NWS forecast offices, and the weather and climate operations of other agencies and private firms for face-to-face conversations about present and future needs and requirements. Like a successful salesman, NCO staff members must know the territory.	POC2.1: All NCO employees are encouraged to visit other NCEP Centers and undergo training to keep pace with fast-changing IT standards and technologies.	POC2.1: Ongoing	Complete
Recommendation POC3: Senior Duty Meteorologists should be involved in data selection and denial experiments. One role of the SDM is to make decisions regarding the inclusion or denial of data in forecasts. To assist in this function, quantitative information about SDM decision impacts should be made	POC3.1: SDM will be assigned to the dropout team.	POC3.1: SDM Team Lead (Joe Carr) has been added to dropout team.	Complete

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available to SDMs, and they also should be involved in observing system experiments designed to better understand data impacts.			
Business Processes			
Finding BP1: ***NCO leadership is passionate about bringing a more systematic, process-oriented approach to achieving the NCEP mission and also is open to suggestions for improvement.*** *It has been noted elsewhere in this report that no formal software development process exists for NCEP models, a consequence of which is increased time required to move model and coding changes into the production suite. NCO is seeking to develop a joint process with EMC to improve the efficiency of the change process with emphasis on the development of plans for repeatable testing. Effective, although ad hoc, interaction appears to be occurring at the staff level between EMC and NCO in code development, testing, and operational implementation. However, some NCO procedural changes were implemented more rapidly than could be accommodated by the traditional research culture in EMC, and without sufficient engagement of EMC as a partner.* **Finding BP2:** ***NCO-managed high performance computing is not always responsive to requirements.*** *Current NCO leadership inherited a 10-year HPC contract/procurement that was not based upon a rigorous, systematic requirements analysis, further complicated by budget constraints. Uncertainty regarding the proposed NCS and NextGen are adversely impacting NCO and EMC planning (see Finding ST2), e.g., location of operational seasonal forecasting and its backup. Little evidence exists that EMC and NCO collaborate in an end-to-end process for HPC acquisition. Funding for operational HPC has not increased. Despite documenting the gap between current capability and need in the PPBES process, support from the broader NOAA community is lacking.* **Finding BP3:** ***Serious stresses and strains exist between NCO and EMC.*** *It appears that lines demarcating the roles and responsibilities of EMC and NCO are poorly defined, with the perception that these two organizations compete for "turf", particularly in processes associated with approving and implementing changes to the production suite. Friction can arise because EMC and NCO do not share the same concerns or culture. Transition to the P6-based computing system 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 resulting from an overly lengthy HPC transition process has been deleterious. Further, the HPC system managed by NCO lacks balance due to a shortage of disk space, thus reducing the pace of EMC's research.* *Additionally, the management of IT infrastructure within NCEP is rather confused, and lines demarcating the roles and responsibilities of EMC and NCO also are poorly defined. NCO handles many or even most approvals for items such as accounts on systems, 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, for example. NCO also has control over the approval of use of software and hardware on the network, which often places detrimental restrictions on staff. Although EMC has a Security Office, its staff members admittedly are not at all qualified to perform their duties. All of these circumstances are complicated by the fluid nature of NOAA security policy.*		
Recommendation BP1: NCO and EMC should align their processes so that the pathway from research to operational execution is visible to everyone. NCO and EMC should design and implement a formal, collaborative, documented process to establish scientific and computational validity before implementing a new model or model change. The document should establish the need for the implementation, assess impacts on other system components (data, models, products, IT operations), and articulate expected benefits. NCO and EMC also should collaborate in a broader systems engineering approach to shared processes (requirements-gathering, prioritization, assessing technological capabilities, defining tasking, optimization, testing, implementation, tempo control) that allows for coordination and, especially, planned evolution. Sharing standard project management practices should help in adopting this approach. Aligning 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: NCO will work with EMC to enhance the model implementation planning process to strengthen the scientific case for change and lengthen the planning horizon for IT asset consumption	BP1.1: Customer outreach to include NOAA HPC users in quarterly planning and implementation briefings is complete. Customer outreach has expanded to other Federal entities. DoD NWP center representatives have attended implementation briefings. Implementation briefings now include non-governmental attendees who are apprised of the model evaluation process and findings.	Complete

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Recommendation BP2: NCO should establish and document a process for collecting relevant requirements from all users of NCO-managed HPC systems and procure and manage systems that meet or exceed those requirements. NCO must work periodically with its HPC customers to establish requirements for current systems, system upgrades, and for the next procurement. NOAA's PPBES process can be used to document those requirements and request funding for HPC, but other NOAA programs must be engaged in supporting NCO's requests. Opportunities for using external computing resources should be leveraged whenever practical, e.g., from NSF-sponsored centers. The computing required to support a range of activities, from R&D 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 science and computing decisions with the appropriate experts at EMC and NCO, but with shared goals in mind.	BP2.1: Process is in place. No action required.	BP2.1: The NCEP Resource Allocation Council has established an HPC requirements-gathering process which is executed monthly. HPC acquisition (OD, NCO, EMC) is underway and on schedule. EMC is leading the functional requirements definition team for the acquisition.	Complete

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