

Community Review NCEP Assessment and Recommendations (Last modified 11 Jan 2012-Higgins)

Climate Prediction Center (CPC)

Mission and Vision: Findings

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Finding MV1: *The CPC continues to serve as a national and global asset for providing climate predictions, analyses and assessment products. CPC's products and services target time scales ranging from weeks to about one year and are vital for NOAA's stewardship of life, property, and the economy. The CPC is recognized as a global leader in climate monitoring, development and dissemination of reanalysis products and intra-seasonal prediction. The stakeholder survey (section 4) showed that they see CPC as an 'honest broker' of climate information. The CPC also maintains a world-class research and development program. The CPC has a successful track record in attracting extramural, competitive funding and its staff actively publishes in the peer-reviewed scientific literature. The vibrancy, commitment and talent of the staff are clearly evident and contribute to the productivity, value and relevance of CPC.*

Finding MV2: *The CPC has embraced strategic planning, and its implementation plan is consistent with the NCEP strategic plan. The shared strategic planning and vision is well-communicated at all levels of CPC staff and provides a consistent framework for the Center personnel to conduct its Mission. The panel applauds CPC for its five-year strategic plan. While the CPC mission is well-articulated in its strategic plan, its current portfolio of products and the development of desired future products and services within its budget will be a challenge. This finding about resource constraints is similar to that found in the 1998 review. As discussed in section 5.1, the panel found that CPC's mission is vital to the NOAA Climate Services (NCS) initiative, but that CPC appears to have a low priority in mission planning and budgetary allocation, perhaps because the NWS is primarily focused on short-term weather over seasonal climate, and NCS planning appears to focus more heavily on decadal-to-centennial projections and climate change adaptation over than on seasonal climate prediction and seasonal decision-making needs. From these issues, the panel found within the center prevailing uncertainty about its future mission and activities.*

Finding MV3: *As discussed above in section 5.2, there is an apparent lack of balanced, mutually respectful and productive relationships with some other NCEP centers that is impeding CPC from better executing its mission, developing more skillful products and transitioning developed products into operations.*

Finding MV4: *Increasing stakeholder demand for current and new CPC products and services, including the development of new products for any NCS initiative, may impede CPC's mission. Further, CPC's belief that external stakeholders will convey the importance of CPC products to NCEP and NOAA management is misdirected given the stakeholder survey results showing confusion in how CPC establishes new products and retires old products (see section 4.) The panel found that CPC's expectation that the external community will help establish a stronger role for CPC in the evolving NCS, may be overly optimistic. This finding is discussed further in subsequent sections.*

Finding MV5: *There is a need for seamless weather to climate forecast products during month 1 prediction. WMO, through the World Weather Research Program (WWRP) and WCRP activities, as well as all global operational weather centers are focusing on this need. This is reflected in responses to the panel's CPC stakeholder survey that identified the importance of CPC's sub-seasonal outlook (MJO, days 6-10 and 8-14), which are, arguably, medium range to extended range weather prediction. At this time scale, the products overlap with HPC's plans to enhance their week-2 forecast guidance. Additionally, there are stakeholder needs for weeks 3-4 seasonal predictions.*

Assessment Recommendation	Planned Action	Status	Due Date
<p>Recommendation MV1: The CPC must play a critical and essential role in any future CS. Ongoing CS planning must fully engage and involve CPC management, and ensure that CPC's mission objectives and expertise are represented, and that CPC stakeholders are served by future CS activities.</p>	<p>Provide support in defining NOAA Climate Services.</p> <p>Provide support for the development of the Climate.gov.</p> <p>Implement Action Plan to address staff concerns with the CS.</p> <p>Prepare Service Level Agreements between NWS and CS on product / service responsibility translated into budgeting.</p>	<p>Leading Societal Challenge Needs Assessment "Changes in Extremes of Wx and Cx" [FY11, FY12]</p> <p>Supporting a NOAA Weather and Climate Extremes Attribution Team [FY11, FY12]</p> <p>Supporting National Climate Predictions and Projections Platform [FY11, FY12]</p> <p>Developing NOAA strategy for ongoing reanalysis [FY12]</p>	<p>Ongoing</p>

<p>Recommendation MV2: The CPC must be enabled to obtain the necessary support from other NCEP centers, particularly from EMC in seasonal forecast model improvement and creating an effective NMME system and from NCO for R2O transitions of forecast products and services. By “enable” the review team means having an effective mechanism whereby EMC and NCO are resourced to engage CPC needs beyond what exists currently.</p>	<p>Develop strategy to reduce NCEP (CPC, EMC) and CSD dependence on CPO soft funding.</p>	<p>Working to develop R, T2O and O planning and funding strategy [FY11].</p>	<p>Ongoing; Discuss</p>
<p>Recommendation MV3: As part of CPC’s strategic plan and to preserve its mission and vision related to being the “world’s best and most trusted climate service center”, CPC needs to evaluate products in terms of their use and value, including plans for retiring old products and transitioning (R2O) new and enhanced climate products and services. It is recommended that CPC not depend on stakeholders to establish such evaluations. The stakeholder survey results indicated confusion regarding product development, transitions, retirements and evaluations (see section 4).</p>	<p>Develop lists of CPC forecast products/ tools with CSD that are (i) essential, (ii) can be retired, and (iii) need to be developed and transitioned to operations.</p>	<p>Retire products in conjunction with spin-up of new CPC Web Page [FY12]</p>	<p>Ongoing</p>
<p>Recommendation MV4: The CPC should modify its mission statement to reflect that it “delivers extended range weather and climate prediction, monitoring, and assessment products for time scales from week 2 to years”, that they work with HPC to develop collaborative activities and products for week 2, and that they extend sub-seasonal forecast products to include week 3-4 products as part of a month-1 seamless “weather-to-climate” forecast suite.</p>	<p>Review and update CPC mission statement:</p>	<p>Completed [FY11]</p>	<p>Completed</p>

Customers and Partners: Findings

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Finding CP1: Customer service and partnership building are vital functions for CPC’s mission and vision. The CPC received consistently positive ratings from stakeholders on customer service, staff accessibility, and product/service value (section 4). However, CPC must be positioned to strategically anticipate the current needs of its stakeholders, expand its customer base to non-traditional customers and fulfill their needs, while also adapting to emerging needs for both traditional and non-traditional customers. It is unclear what changes the NCS initiative, when implemented, will bring to CPC’s customer base. The current CPC web redesign is a promising development that will enhance customer service with stakeholders.

Finding CP2: The CPC is effective at partnership building and outreach. The panel found numerous examples of CPC’s proactive engagement in reaching out to and developing a broad stakeholder community that includes non-NCEP NWS partners, other NOAA partners and broader external communities through a variety of mechanisms that include climate focal points in Weather Forecast Offices (WFOs) and the Climate Prediction Applications Science Workshop (CPASW). Additionally, CPC proactively reaches out to RISA centers and other organizations to understand how climate services can be more effectively delivered through partnerships, and to the external research community by hosting the annual Climate Diagnostics and Prediction Workshop (CDPW). Since the last review, CPC has utilized the internet as the mechanism for delivering its products, which has been fully embraced by its stakeholders. CPC management recognizes that improved web services (e.g. website redesign and advanced protocols) will enhance stakeholder access and the delivery of products and services

Finding CP3: The CPC relies heavily on satisfaction-based performance metrics. However, as repeatedly documented by projects funded by the NOAA CPO (e.g., RISA, Sectoral Applications Research Program (SARP), International Research Institute for Climate and Society (IRI)), National Research Council reports, and Climate Change Science Program products (e.g., SAP 5.2 and 5.3)), the development of climate information, products, and services is best served by deep understanding of how users operate within their specific decision-making context. Asking users what products they would like, or whether they are satisfied with a product, is insufficient. The panel also heard that CPC expects their external stakeholders to convey the importance of CPC products to NCEP and NOAA management, which the panel believes doesn’t occur. The stakeholder survey results shows confusion in how CPC establishes new products and retires old products (see section 4.)

Finding CP4: As discussed in section 5, the CPC-HPC partnership is relatively healthy, but the panel noted deficiencies in CPC’s relationship with EMC and NCO. Such deficiencies create a level of intra-NCEP tension and more importantly, limit the potential effectiveness and/or efficiency of the relevant Centers.

Finding CP5: The panel found that CPC is not developing partnerships within the private sector and other federal sectors in proportion to the growing private-sector demand for climate products and service. CPC needs to enhance its strategy to be more effective in engaging with the private sector and for developing such partnerships. The panel recognizes the complexity of the issue where CPC must develop products that are open to all, while the private sector takes CPC information and develops value-added, proprietary products. The CPC needs to work with the private sector to assess and prioritize areas where their products and services can facilitate the private sector in their activities. The panel recognizes that building and sustaining effective partnerships takes years and dedicated staff attention that would be challenging to meet under present CPC staffing levels and expertise, yet such partnerships will be critical as NOAA moves into an NCS era.

Assessment Recommendation	Planned Action	Status	Due Date
<p>Recommendation CP1: The CPC must continue developing partnerships and fostering interaction with its stakeholders, including continued modernization of the delivery of its products through a content management system and web services (Web 2.0) automation. The CPC must work with NCO to automate and shift CPC mature products to NCO, and to track products through version control software. As noted in section 4, CPC needs to improve its stakeholder communications with regard to changes to (or development of) products and services, especially as the CS initiative evolves.</p>	<p>Enhance delivery of Climate Services.</p> <p>Partner with USDA on JAWF Improvement Plan.</p> <p>Enhance NCEP International Desks.</p>	<p>Improving Collaborative Forecast Process [FY11, FY12]</p> <p>Established an International Monsoon Forecaster Training Desk [FY11]</p> <p>Host / train 20 visitors to the NCEP International Desks (with HPC) [FY12]</p> <p>Lead International Climate Training Workshop in Costa Rica [FY12]</p>	<p>Ongoing</p>

Customers and Partners: Findings Cont.

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Assessment Recommendation	Planned Action	Status	Due Date
<p>Recommendation CP2: The CPC should develop a multi-dimensional approach for assessing jointly their products and services as well as their partners' and stakeholders' climate information needs, and the value of the products to their stakeholders' decisions. Information needs may include (for example) information on product skill. As such, this recommendation must be considered together with recommendations under section 6.3 (Products and Services) on products and services evaluation.</p>	<p>Develop process for CPC requirements based on user needs.</p>	<p>Leading Workshops (36th CDPW; CFSv2 Users Workshop) [FY12]</p> <p>Supporting NWS Climate Training Courses [FY11, FY12]</p>	<p>Ongoing</p>
<p>Recommendation CP3: The relationships between CPC and EMC and CPC and NCO need to be improved. Management from all centers and the NCEP Office of the Director should clearly define roles, mission priorities, and intra-center roles and responsibilities. Further, such roles and responsibilities should be clearly articulated to all levels of staff.</p>	<p>Continue bi-monthly CPC, CTB , EMC Mgmt Meetings.</p> <p>Coordinate with NCO on key projects (GIS-conversion, Compute Farm, IT Consolidation, etc.).</p>	<p>Implement NCEP backup system for CPC operational processes on Compute Farm [FY12]</p>	<p>Ongoing</p>
<p>Recommendation CP4: Both CPC and EMC would benefit by a true partnership for CFS development. The panel recommends activities such as CPC rotators in EMC and vice-versa.</p>	<p>Enhance EMC and CPC coordination on CFSv2, CFSRR and CFSv2 Lite Reanalysis.</p>	<p>Coordinated with EMC to complete CFSv2 Reanalysis & Reforecast Project [FY11]</p> <p>Implemented CFSv2 in CPC forecast operations [FY11]</p>	<p>Completed</p>

Customers and Partners: Findings Cont.

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Assessment Recommendation	Planned Action	Status	Due Date
<p>Recommendation CP5: The CPC must develop a strategy and mechanisms to understand the emerging needs of the private sector. Further, CPC should seek opportunities to interact with private sector stakeholders via virtual mediums and face-to-face ventures. Given its limited resources, CPC should partner with other programs (e.g., NWS Climate Services Division, NOAA CPO) or member organizations (e.g., American Meteorological Society, American Association of State Climatologists) that interact with the private sector, with an emphasis on multidisciplinary partnerships that include social scientists and decision research specialists.</p>	<p>Update “Climate Focal Point Directory” in coordination with CSD on an annual basis.</p>	<p>Continue on annual basis.</p>	<p>Completed</p>
<p>Recommendation CP6: The CPC needs to work more closely with the NWS Climate Services Division to enhance and expand outreach function and to understand potential new partners.</p>	<p>Provide a CPC Liaison to CSD. Participate in NWS Climate Training Courses.</p>	<p>Completed</p>	<p>Ongoing</p>
<p>Recommendation CP7: The CPC needs to clarify and publicize both within CPC and to their stakeholders their policy on interactions with the private sector (e.g., who/when they can talk with the private sector). Given their limited resources, CPC needs to strategically prioritize interactions and to ensure that interactions with a necessarily limited number of partners will have system-wide benefits without favoring specific private sector end-users or intermediaries.</p>	<p>Develop policy in coordination with NWS/NCEP leadership for NCEP Service Center interactions with the private sector.</p>	<p>Discuss</p>	<p>Discuss</p>

Products and Services: Findings

Finding PS1: *Generating climate information products and delivering these products to their partners and stakeholders (i.e. CPC’s service component) are the core activities of CPC and central to their mission. As discussed above and in section 5, CPC is dependent on other NCEP centers for vital components, and must address the needs of outside stakeholders, which they are doing well (see section 4). As part of their overall strategy, CPC management has expressed interest in expanding CPC capabilities to better contribute to NOAA’s efforts at developing a seamless prediction capability, and to better position CPC to contribute to the NOAA’s emerging strategy for NCS.*

Finding PS2: *The CPC product suite has traditionally focused on time scales ranging from two weeks to interannual. The near-term plans include improving drought monitoring and prediction, a greater emphasis on intraseasonal variability with a focus on week’s 3-4 and extreme events including seasonal hurricane outlooks, and increased emphasis on multi-model ensembles. The CPC has also expressed an interest in contributing to the emerging community effort to assess decadal predictability and prediction skill (Meehl et al., 2009; Bulletin of the American Meteorological Society). Nevertheless, CPC recognizes that the seasonal-to-interannual product suite (with a focus on ENSO) is one of their most popular products, and continued efforts must be made to improve those products.*

Finding PS3: *While ENSO is a critical component of CPC’s product suite, model improvements that could lead to major advances in ENSO prediction capabilities currently are, to a large extent, outside of CPC’s control.*

Finding PS4: *The CPC desires to contribute to efforts to assess decadal predictability and skill. While the scientific basis for decadal predictability is yet to be determined, long-term variability and trends are already an important component of CPC predictions, and there appears to be considerable demand for decadal prediction products. Efforts to address the decadal prediction problem could also play an important role in bridging CPC’s traditional focus on seasonal to interannual time scales and the intended focus of NCS on climate change.*

Finding PS5: *The CPC’s traditional focus on short-term climate (interannual and shorter time scales) doesn’t fully address NCEP’s strategic plan for seamless prediction out to decadal time scales. This also appears to be limiting CPC’s ability to advance prediction skill at time scales that are impacted by decadal variability and climate change (e.g., impact of trends on seasonal forecasts, decadal variability in ENSO predictability, and decadal variability in hurricane activity). Given the current discussion that NOAA’s climate service initiative will focus on such time scales, CPC needs to start developing a capability for products and services related to decadal predictions. The panel recognizes the challenges posed by developing such products and services, but feels that CPC is best positioned within NOAA to take the lead in these.*

Finding PS6: *The CPC and HPC products and services currently meet in the 1- to 2-week range. Week-2 prediction is a major challenge for techniques traditionally associated with deterministic weather prediction. Similarly, the probabilistic techniques traditionally employed by climate science contribute to forecast skill at week 2. Providing a consistent, unified week-2 product would be useful for both CPC and HPC stakeholders (as discussed in section 5.3). A joint HPC-CPC effort stands a far better chance to generate products and services of importance and relevance to a wide range of stakeholders in need of information at this range.*

Finding PS7: *There are other gaps in CPC’s climate products that include week 3-4 forecast products, which would be useful to their stakeholders.*

Finding PS8: *The CPC faces dual challenges in providing a large and growing number of climate information products. While users are often best served by providing a great variety of products, including multiple formats of the same product as well as information products for new variables (e.g., winds), non-atmospheric variables (e.g., vegetation stress) and non-standard products (e.g., climate event attribution), the plethora of products creates a daunting challenge for both CPC and users. For CPC, the increasing number of products (currently on the order of 15,000 per year) challenges CPC’s operational capacity to simply generate the products with current staffing levels. For users, the challenge is to identify the most appropriate products for their needs and to “connect the dots” across different types of products (e.g., historical climatologies, recent observations, forecasts).*

Finding PS9: *The CPC recognizes that climate information products require ancillary support, e.g., forecast discussions, descriptions of tools used in generating forecasts, and measures of forecast skill. However, ancillary support for users remains under-developed, especially in the areas of forecast evaluation in terms relevant to users, tutorials for interpretation, guidance in selecting products appropriate for different kinds of applications, and effectively connecting across products (e.g., use of consistent units between climatologies, observations, and forecasts).*

Finding PS10: *Users have multiple and diverse needs that are not optimally served by generic products. Rather, they need products that address the spatiotemporal coverage, lead times, and performance characteristics (e.g., forecast skill) of their specific decision processes, in forms compatible with their level of technical sophistication, and for the environmental variables used in their decision processes which are typically not those addressed in CPC products. However, CPC is sensitive to potential competition with the private sector and seems reluctant to embrace products that address unique needs of specific sectors.*

Finding PS11: *The CPC does not have sufficient internal expertise or staffing levels to identify, design, or implement the required decision-support capabilities to meet the widest spectrum of user and partner needs. Understanding those needs requires substantial time and skills in engagement, social science, decision making, and product design. Substantial progress in these areas has been made by external research groups and the private sector. Current CPC efforts are not sufficient for evaluating or incorporating that information into their services, but an approach that is more systematic and comprehensive would be.*

Assessment Recommendation	Planned Action	Status	Due Date
<p>Recommendation PS1: The CPC needs to be more actively engaged in both supporting and influencing the priorities of EMC’s development of CFS (also see sections 5.2 and 6.5). This engagement includes efforts to enhance forecast capabilities for weeks 3-4 and weather extremes (including seasonal hurricane forecasts) where it appears that major improvements to the product suite are possible.</p>	<p>Coordinate with EMC and NCO on upgrade of CFSv2 (Feb 2011) and complete CFSRR project. Continue CFSv1 as a parallel (non-operational) data stream for 6 months.</p> <p>Coordinate with EMC, NCO and CTB on plans for CFSv3 development cycle, including associated analysis and diagnostic modeling activities.</p>	<p>Coordinated with EMC and NCO on upgrade of CFSv2 [FY11]</p> <p>Continue analysis of CFSv2 and MME skill across timescales [FY12]</p> <p>Led CFSv3 planning workshop (25-26 Aug, 2011) to develop strategy for CFSv3 development cycle; Document outcome in white paper [FY12]</p>	<p>Completed</p> <p>Ongoing</p> <p>Ongoing</p>

Products and Services: Findings Cont.

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Assessment Recommendation	Planned Action	Status	Due Date
<p>Recommendation PS2: The panel supports NOAA’s goal of seamless predictions out to decadal time scales, and recommends that CPC should play a critical and essential role with a forecast product suite that includes decadal time scales, as the science supports it.</p>	<p>Establish Service Level Agreement between CS and NWS for coordinated modeling and prediction activities that include decadal timescales.</p>	<p>NCEP-COLA coordination on CFSv2 decadal prediction experiments [FY11]</p>	<p>Completed</p>
<p>Recommendation PS3: The CPC should develop a strategic whitepaper on the needs, opportunities and challenges of CPC providing decadal climate projection products and services. CPC should involve GFDL as the primary decadal-scale climate modeling center, hydrologic expertise from the NWS Hydrologic Development Laboratory (HDL) and other NWS entities, stakeholder groups identified by the NWS Climate Service Division, RISA centers, and regional climate centers, among other interested parties.</p>	<p>Establish Service Level Agreement between CS and NWS to develop strategic basis for decadal products.</p>	<p>See PS2</p>	<p>Completed</p>
<p>Recommendation PS4: The development of improved forecast skill at week 2 should be a high priority for NCEP. Thus, CPC and HPC should create a week-2 development team (W2DT) to develop and evaluate a unified (CPC-HPC) forecast product. As recognized by co-sponsorship of the International THORPEX Program by the WMO and WCRP, W2DT should apply the methodologies and metrics of the extended range weather community together with sub-seasonal predictions of the short-range climate community.</p>	<p>Convene an HPC-CPC working group to explore feasibility of a week-2 development team.</p> <p>Improve daily Weather and Climate briefings with HPC&NWS HQ.</p>	<p>Improved coordination of daily Wx & Cx briefs with HPC (11 am) & NWS HQ (7:30 am) [FY11]</p> <p>Implement separate 4-7 day and 8-14 day US Hazards Outlooks and provide to DHS (with OCWWS) [FY12]</p> <p>Coordinate with HPC on fall-winter outlook and winter weather desk [FY12]</p> <p>Coordinate with SPC on spring outlook and severe weather season(operations) [FY12]</p> <p>Coordinate with SPC on linkages between severe weather regimes and climate variability (research) [FY12]</p>	<p>Completed</p>
<p>Recommendation PS5: The CPC should establish the goal of providing a skillful week 3-4 forecast product to address the perceived gap at this lead-time range.</p>	<p>Develop experimental week 3-4 forecast product based on both empirical and dynamical model input.</p>	<p>Assess skill for weeks 3 and 4 in CFSv2 [FY12]</p> <p>Develop strategy for sub-seasonal (e.g. weeks 2-4) products in collaboration with HPC [FY12]</p>	<p>Ongoing</p>

Products and Services: Findings Cont.

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Assessment Recommendation	Planned Action	Status	Due Date
<p>Recommendation PS6: The CPC needs to develop product generation and delivery capabilities that provide flexibility and choice to users, with a high level of ancillary support, and includes developing a multi-dimensional approach for assessing their products, measures of forecast skill, and services that consider stakeholders' and partners' needs (section 6.2). The CPC product capabilities should include providing multiple formats for the same products, providing capabilities for users to customize products to suit their specific requirements (e.g., spatial aggregation), facilitating initial selection of appropriate products and formats, transitioning users to more appropriate products, helping users relate different products to each other, evaluating forecast performance characteristics in terms meaningful to users, facilitating recurring access to updated customized products, and providing tutorials and examples of product interpretation and application in different contexts. The CPC needs to work with NCO, the NWS Climate Services Division and CPO-supported groups like RISA centers in developing a plan for such enhanced generation and delivery of their products.</p>	<p>Implement next generation verification system for CPC's official outlooks.</p>	<p>Implement next generation verification system for CPC's official outlooks [FY11, FY12]</p>	<p>Ongoing</p>

Products and Services: Findings Cont.

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Assessment Recommendation	Planned Action	Status	Due Date
<p>Recommendation PS7: The CPC should develop a strategy for systematically engaging with the research and development community to comprehensively assess their product suite, identify options for improving CPC operational decision-support capabilities to meet user and partner needs, and prioritizing implementation of new products, tools, and processes. As part of this engagement, CPC needs to develop measures for assessing their products and services (e.g. forecast skill, economic and non-economic value in stakeholder decisions, and extent of use). The strategy should also address discontinuing some CPC products and transitioning users to new or more appropriate products, enhancing consistency (e.g., terminology, visualization) across internal and external products, and partnerships for sustainable distributed delivery of climate products as part of a research-to-CPC-operations transition or external delivery by others in the climate services enterprise.</p>	<p>Develop metrics that assess both the progress and value of CPC products.</p>	<p>Construct new metric based on CPC extended and long range outlooks [FY12]</p>	<p>Ongoing</p>

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Information Systems: Findings

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Finding IS1: The CPC has made commendable improvements in their product delivery systems (e.g., XML, GIS and KML outputs), and that will likely continue with their website redesign. However, more transformative improvements in product generation and delivery capabilities will require a more expansive paradigm in the design of products, the interface by which users access products, and the underlying technological systems for delivering products. The CPC does not have the internal capabilities to design or implement such systems without strong partnerships with NCO and the external community.

Finding IS2: The transition of research to operations for new products and tools is occurring, but at a scale and pace that is producing marginal improvements rather than the transformative improvements required by users and that is possible under current technological capacities. It was unclear to the panel the current activities in automating product generation or the potential to accelerate automation, as a strategy for improved transfer of products into operations. It was unclear to the panel the current status of the activities to automate product generation or of the potential to accelerate such automation, as automation is a potential strategy for improved transfer of products into operations. Products and tools are being developed by both the DB and OB, and it is unclear how they progress into operations (or alternatively, be are discontinued). External research groups have no guidance on what requirements must be met for new products or tools to be compatible with CPC operations (e.g., automation requirements) or information systems (e.g., coding standards, interoperability with operating systems or databases).

Finding IS3: The CPC Operations Branch is challenged in their ability to provide new products while continuing to support the present product mix. While additional automation of product generation will help, it is not sufficient to provide the increased staff effort needed to focus on entraining new products and tools.

Finding IS4: The NCEP hiring policies requires CPC to use operational forecasters and trained meteorologists as part-time software engineers to develop forecast and product information tools. This limits the CPC Operations Branch’s abilities to utilize externally developed software tools and procedures. While CPC staff is dedicated and works to learn new technologies, this is an insufficient and inefficient substitute for software engineering expertise in designing, implementing, and transitioning software code and information systems.

Finding IS5: In the operational implementation of new products, CPC has been largely opportunistic and limited in scope, in part because they have been self-sufficient and under served by NCO as discussed earlier. Nonetheless, CPC needs to strengthen its strategy and coordination for prioritizing operational implementation of new products that effectively leverages prior investments in product and tool development in the OB, DB, CTB, other NOAA units, or external efforts (e.g., academia, other federal research units).

Assessment Recommendation	Planned Action	Status	Due Date
<p>Recommendation IS1: The NCEP should establish policies, processes, and practices that will allow users to create customized interactions with CPC information systems, including dynamic process initiation, so that users can perform customized analysis and generate customized products on demand, user accounts and registration that allow maintenance of choices and portfolios across sessions, and implementation of new methods for providing information and engaging with users (e.g., podcasts, webinars).</p>	<p>Partner with NCO and EMC on centralized IT system.</p>	<p>Completed .</p>	<p>Completed</p>

Information Systems: Findings Cont.

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Assessment Recommendation	Planned Action	Status	Due Date
<p>Recommendation IS2: The NCEP should establish policies, processes, and practices that will foster interoperability among products and tools within CPC, NWS, NOAA, and beyond. This includes a process of active engagement with external groups that are developing new tools for users (public, academic, and private sector), and easy access to explicit technical information, e.g., meta-data. Engagement with the Earth Science Information Partners (ESIP) Federation, Earth Observing System Clearinghouse (ECHO), and similar groups is encouraged, with participation by CPC, NCO IT staff.</p>	<p>Form Tiger Team to develop recommendations on GIS activities.</p> <p>Identify and garner support for resources needed to facilitate interactions between CPC and external groups in the development and verification of forecast products and tools.</p>	<p>GIS@NCEP GIS Project Plan [FY11] and Implementation [FY12]</p> <p>Develop web services (CPC Website; Climate.gov) and partner with outside groups (e.g. RISA's; RCCs) to assess needs [FY12]</p> <p>Support transition of Climate.gov from prototype [FY11] to operational [FY12] status</p>	<p>Ongoing</p>
<p>Recommendation IS3: The NCEP and CPC should establish policies, processes, and practices that more effectively leverage OB, DB and external partner capabilities in designing and implementing new products and decision-support tools. This includes policies and processes for prioritizing R2O transitions, assessing whether a transition is best accomplished through adoption of externally developed code or internal redesign and implementation, moving code to CPC and training staff on both system operations and code extensions, and for ensuring continued access of research groups to the operational code base which facilitates continued development of additional capabilities. The latter includes formal mechanisms for collaborative software development, including version control, task tracking, code reviews, and development of design documents. CPC should work with NCO in the implementation of this recommendation (see section 5.2).</p>	<p>Develop activities to automate CPC product generation and compare / verify objective and subjective products.</p>	<p>Implement next generation forecast verification system for CPC seasonal outlooks [FY12]</p>	<p>Ongoing</p>
<p>Recommendation IS4: The NCEP should provide CPC with software engineering capabilities through changed policies that allow hiring outside the meteorologist classification or by assignment of NCEP NCO staff to CPC.</p>	<p>Coordinate with NCO (as appropriate) to support CPC's suite of operational hardware and software.</p> <p>Transition CPC codes to a version control system (CVS), develop documentation and provide training to facilitate transition.</p>	<p>Strengthen backup capabilities for CPC, HPC and OPC mission critical processes, including those on the Compute Farm. [FY11]</p> <p>Transition CPC codes to a version control system, develop documentation & provide training [FY11]</p>	<p>Completed</p>

Science and Technology: Findings

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Finding ST1: The principal science activities of CPC involve forecast tool development, climate monitoring and attribution, and model diagnostics and evaluation. The CPC scientists are very talented and committed people who are well versed with the current state of their science. Despite overall limited resources, CPC has in recent years had considerable success in attracting extramural, competitive funding, and CPC scientists have been active members of the research community as evidenced by the list of publications in peer-reviewed journals.

Finding ST2: The CPC has established itself as a leader in a number of science activities. In particular, the panel acknowledges CPC’s important leadership role in climate monitoring and assessment (especially drought). The CPC, in collaboration with EMC, is also taking a leading role in the development of new high-resolution CFS-based seasonal hurricane forecast products. The panel also applauds CPC’s pioneering role in the development and dissemination of reanalysis products for climate monitoring and analysis. CPC has a long history of proactively reaching out to the research community by hosting the annual CDPW.

Finding ST3: As part of their overall strategy, NCEP and CPO management have organized the CTB to accelerate CFS model improvements by infusing research results from the external community, to improve seasonal forecasting skill and for transitioning research to operations. The CPC has played an important leadership role in the CTB, and has been instrumental in some of its early successes, including the development of a consolidation tool that has helped considerably with seasonal prediction skill, and more recently performing hindcasts for the newly developed, high-resolution CFS-based seasonal hurricane outlooks, and in the development of a CTB seminar series. With the establishment of the CTB, CPC has played an increasingly important role in R2O activities. Nonetheless, as discussed in section 5.2, the CTB SAB has expressed concerns about the effectiveness of the CTB mission, which affects CPC science infusion activities, and particularly as it relates to the planning, development and evaluation of a NMME capability, which is further discussed below. The panel concurs with these concerns, particularly with the finding that CTB management and reporting isn’t well structured to meet the development goals for CFS, which are important for CPC’s strategic plans.

Finding ST4: The CTB faces a number of problems that threaten its viability, and limit the ability of CPC to influence science infusion and advance its product suite. Among these are a lack of transparency and coordination on CTB priorities, and funding levels that are insufficient to support a viable grants program, a grants program that is controlled by the CPO in OAR. The CTB has yet to develop a viable strategy for developing a NMME capability or for incorporating non-operational national models into a NMME system. While there have been improvements in the relationship and coordination between CPC and EMC (largely as a result of the CTB), CPC still does not seem to be a trusted partner in EMC’s development efforts, and therefore has limited ability to influence CFS development priorities. This is a serious issue for CPC because the ability of CPC to provide improved climate predictions is strongly tied to advances in the CFS model (e.g., improvements in the simulation of the MJO, land-atmosphere interactions, and ENSO, among others). The panel is concerned that CPC currently has limited influence on the development of CFS, and CTB lacks a strategy for developing a NMME capability that includes incorporating non-operational national models.

Finding ST5: The panel is supportive of CPC’s nascent attribution activity, and believes that it can play an important role in both enhancing climate monitoring and diagnosing model forecast performance.

Finding ST6: The panel applauds the fact that CPC has played an important role in CFS Reanalysis and Reforecasting (CFSRR) monitoring and evaluation, and that it has taken on the challenge of doing the 1948-1978 period reanalysis. The latter could potentially allow extending reforecasts back to 1948; thus providing a longer baseline for calibrating CFS forecasts and allowing an assessment of decadal and longer time scale variability. While this appears to be an important opportunity for CPC to take on this challenge, and to contribute to the development of an ongoing reanalysis activity both at NOAA and at the national level, CPC does not yet appear to have a strategy in place for how that will be done.

Finding ST7: The ability of CPC to make substantial progress on climate reanalysis, particularly on how best to bridge reanalysis across uneven data, is limited by the lack of an extended period reanalysis strategic plan. The plan should accommodate system developments that account for the evolution of the observing systems used in reanalysis and of time varying model bias. Such developments could contribute to research in data assimilation occurring at EMC and the Earth Systems Research Laboratory (ESRL).

Assessment Recommendation	Planned Action	Status	Due Date
<p>Recommendation ST1: NCEP and CPO should clarify the current structure of CTB to assure that it meets CPC’s science infusion goals. Science priorities should include CFS model development and improvements, the development of a NMME capability, and climate forecast product development. The CTB needs to work more effectively with its Science Advisory Board (SAB) to achieve the CTB’s envisioned goals when it was created. Additionally, the CTB should develop mechanisms for additional partnering with the external research communities and other research agencies (NSF, DOE, and NASA) that would bolster science infusion by leveraging resource</p>	<p>Finalize CTB Terms of Reference and engage Steering Committee.</p>	<p>Hired new CTB Director (Jin Huang) [FY11]</p> <p>Finalized CTB Terms of Reference and engaged Steering Committee [FY11]</p>	<p>Completed</p>

Science and Technology: Findings Cont.

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Assessment Recommendation	Planned Action	Status	Due Date
<p>Recommendation ST2: It is critical that the CTB receives sufficient funding for a viable grants program, that funding programs allow greater input by CPC and CTB in the competitive grants proposal review process, and that the funding programs do not constrain the scope of CTB activities.</p>	<p>CTB Annual Announcement of Opportunity.</p>	<p>Provide CTB Science Priorities to CPO on an annual basis [FY11, FY12]</p> <p>Worked to increase the number of CPO grants (currently 15) [FY11; FY12]</p>	<p>Completed</p>
<p>Recommendation ST3: CPC should move forward with plans to establish a model test facility (as a combined CTB, NCEP and CPO effort) that gives the external research community (and CPC) access to the CFS with the aim of influencing and accelerating improvements to CFS.</p>	<p>Establish Model Test Facility (MTF).</p>	<p>Ongoing discussion in FY12</p>	<p>Ongoing; Discuss</p>
<p>Recommendation ST4: The CTB should develop a viable strategy for incorporating non-operational national models into an operational NMME framework. While this will require strong leadership from EMC, it should be done in partnership with CPC to ensure that the system meets their needs, and it should leverage nationally-developed modeling resources such as the Earth System Modeling Framework (ESMF).</p>	<p>Develop strategy to improve IMME prediction system (e.g. with additional models).</p>	<p>Developed and tested IMME Seasonal Prediction System (CFS+EUROSIP) [FY11]</p> <p>Implement IMME Seasonal Prediction System and related graphical products (CFS+EUROSIP) [FY12]</p> <p>Implement Experimental NMME Seasonal Forecasts (CFS, GFDL, NASA, IRI, NCAR) [FY12]</p>	<p>Ongoing</p>

Science and Technology: Findings Cont.

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Assessment Recommendation	Planned Action	Status	Due Date
<p>Recommendation ST5: Given CPC’s critical dependence on CFS for many of its key products, and its unique role in CPC via EMC, it is to the benefit of both organizations that CPC play a more integral role in providing feedback to the development of CFS – this includes access to intermediate model versions and the computing resources necessary for assessing and diagnosing climate variability and predictability, and the capability to do sensitivity experiments that can provide feedback to EMC regarding model development priorities. For example, this could be done by an enhancement of CPC’s attribution activity to include notable forecast successes and failures that can lead to improved understanding of model performance. This could be facilitated by having CPC rotators in EMC.</p>	<p>Develop strategy (with EMC) for working with the community on CFSv3.</p> <p>Coordinate with EMC and NCO on implementation of CFSv2, CFSRR and real-time operational extension of CFSR with EMC and NCO.</p> <p>Convert CPC atmosphere-ocean-land monitoring products from CDAS based to CFSR based.</p> <p>Implement the CFSv2 Lite Reanalysis (1948-present) at model resolution (T126) .</p> <p>Complete yearly summary & assessment of the CFS forecast skill for SST, US surface temp and precip.</p> <p>Establish routine attribution meetings for operational assessments of climate variability.</p> <p>Incorporate CFSv2 into CPC forecast operations and verify model forecasts in real time.</p> <p>Coordinate with EMC and COLA on decadal prediction experiments for IPCC AR5.</p> <p>Assess GFS/CFS performance prior to upgrades.</p> <p>Focus CTB science priorities on accelerating improvements of CFSv3 and of MME prediction systems.</p>	<p>Assess GFS/CFS performance prior to upgrades [FY11, FY12]</p> <p>Incorporated CFSv2 into CPC forecast operations and verify model forecasts in real time [FY11]</p> <p>Complete yearly summary & assessment of the CFS forecast skill [FY11, FY12]</p> <p>Lead CFSv2 users workshop and document strategy in a White Paper [FY11, FY12]</p> <p>Provide monitoring of the CFSv2-Lite Reanalysis Project (1948-2010) [FY12]</p> <p>Complete evaluation of the CFSv2 Reanalysis for real-time climate monitoring and trends [FY12]</p> <p>Evaluate prediction skill for week2 to week4 in CFSv2 [FY12]</p> <p>Focus CTB science priorities on accelerating improvements of CFS [FY11; FY12]</p> <p>Provide high-resolution CFS seasonal forecasts for CPC’s Atlantic and Eastern Pacific Hurricane Seasonal Outlooks [FY11, FY12]</p> <p>Complete experiments to evaluate impact of TAO data on analyses/forecasts [FY12]</p>	<p>Ongoing</p>

<p>Recommendation ST6: The CTB efforts to develop new terms of reference for the CTB should be implemented quickly in order to provide greater coordination within CPC, and among CPC, EMC and NCO on R2O transition activities. This would create greater transparency and coordination in establishing CTB priorities.</p>	<p>Finalize CTB ToR.</p>	<p>Revised CTB Terms of Reference and established CTB Steering Committee [FY11]</p>	<p>Completed</p>
<p>Recommendation ST7: The CPC should develop a strategic plan for climate reanalysis and reforecasting that involves the CTB, other NCEP centers (esp. EMC), other NOAA groups (e.g. the National Climate Data Center (NCDC)), and coordinates with other reanalysis/forecasting activities (e.g. at the Global Modeling and Assimilation Office (GMAO) and ESRL). Any plan needs to consider how timely reanalysis/forecasting can be accomplished as CFS (and Global Forecast System (GFS)) model developments are implemented.</p>	<p>Complete a strategy document for climate reanalysis and reforecasting that coordinates all ongoing efforts across NOAA.</p>	<p>Formal Review of CFS-related reanalysis activities [FY12] Formal Review of ongoing NOAA-wide Reanalysis activities [FY12]</p>	<p>Ongoing</p>

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People and Organizational Culture: Findings

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Finding POC1: *The CPC has a talented and committed staff, well versed in the current state of the science. There is an extraordinary amount of activity and a passion for the mission of the Center. Under its current Director, CPC has gained an appreciation for the value of strategic planning, and has developed an implementation plan that is wholly consistent with the NCEP strategic plan. The staff understands CPC's importance to the mission of NCEP and appreciates the Center's effort to be fully responsive to it. CPC proactively reaches out to the RISA centers and other stakeholder organizations to understand how climate services can be more effectively delivered through partnerships.*

Finding POC2: *The development of new products and services occurs in both the DB and OB. The panel saw little evidence of coordination between the branches in the research and development activities, and there is the possibility of duplication and / or competition for research and development resources that weakens the overall enterprise. The panel also feels that the limited coordination and interaction between the branches is leading to less effective transitioning of R2O. A contributing factor may be CPC's organizational structure that relies heavily on contractors and "soft" money for the generation of its products and services. This reliance on contractors has ancillary effects that include pressure on CPC's mission and future contributions to NCS, strategies for science infusion and the development of new products and services, and the need to find contractor support.*

Finding POC3: *For its current mission, CPC's access to models and computer resources is woefully insufficient. This situation impacts their ability for diagnostic experimentation, for example limiting the opportunity to consider a strategy for real-time reforecasts such as is being done at the European Center for Medium Range Weather Forecasts (ECMWF). This situation impacts their ability for diagnostics experimentation, to produce in a timely manner seasonal reforecasts that would consider a strategy for real-time reforecasts such as being done at the European Center for Medium Range Weather Forecasts (ECMWF). It is unclear to the panel the extent of the problem (inadequate computer resources) across NCEP, or how NCEP management priorities impact CPC's access to computer resources. Nonetheless, the panel raises this as a significant concern.*

Finding POC4: *The CTB, while organizationally part of the DB, does not have an integrated relationship with its parent branch and is relatively autonomous without clear lines of authority as discussed earlier in section 5.2 and 6.5. The CTB and the DB can and should function in a harmonious and mutual reinforcing manner, with well-defined roles, including complementary activities, undertaken by design. The current structure of the CTB hinders CPC in developing a unified organizational culture needed to meet its mission and strategic plan goals.*

Assessment Recommendation	Planned Action	Status	Due Date
<p>Recommendation POC1: CPC needs to clarify the relative roles of the DB and OB in the research and development of new products and services. Mechanisms must be developed to identify needed research, new products and determine what should be transitioned. These mechanisms must include approaches for creating opportunities for enhanced interactions between the DB and OB personnel.</p>	<p>Establish routine Operations Branch and Development Branch Coordination Meetings.</p> <p>Establish CPC Staff Advisory Board with members from each branch.</p>	<p>Established routine OB and DB Coordination Meetings [FY11], inter-branch project charter [FY11] and partnership projects [FY11, FY12]</p> <p>Established CPC Staff Advisory Board with members from each branch [FY11]</p>	<p>Completed</p>
<p>Recommendation POC2: Mechanisms must be developed for reducing the reliance on contract personnel for product generation. One possible approach is by reducing the number of products (as called for in Recommendation PS7).</p>	<p>Develop strategy for decreasing NCEP reliance on soft funding.</p>	<p>Worked with NCEP OD and NWS HW to develop new R, T2O and O planning and funding strategy [FY11]</p>	<p>Ongoing</p>

People and Organizational Culture: Findings Cont.

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Assessment Recommendation	Planned Action	Status	Due Date
<p>Recommendation POC3: CPC management needs to carefully assess issues that are, or potentially will, adversely affect meeting its mission and strategic goals, and work on resolving issues that are detrimental to CPC and enhance activities that strengthen its organizational culture and support its mission. Getting access to sufficient computer resources is a central issue, as is effectively managing staff across CPC branches and its product and service suites. This recommendation cuts across many elements of the review (e.g. mission goals, products and services, science and technology) and the underlying issues are inter-center, requiring CPC management to work with other NCEP centers and the OD in addressing them. Strengthening CPC’s organizational culture is critical for CPC and NCEP so NCEP can contribute significantly to the CS activity.</p>	<p>Draft and socialize “CPC Needs Document” to establish additional support required to sustain and enhance CPC contributions to NWS mission.</p> <p>Implement CPC Action Tracker to address staff concerns with CS.</p>	<p>Implemented CPC Action Tracker to address staff concerns with CS [FY11, FY12]</p> <p>Drafted “CPC Needs Document” to establish support required to sustain and enhance CPC contributions to NWS and sent to NWS HQ [FY11]</p> <p>Led quarterly All Hands meetings to communicate CPC priorities to staff [FY11, FY12]</p> <p>Administered CPC Employee Survey & SES Workforce Management Survey [FY11]</p>	<p>Completed</p>

Business Processes: Findings

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Finding BP1: Under its current Director, CPC has gained an appreciation for the value of strategic planning, and has developed an implementation plan that is wholly consistent with NCEP strategic plan. As a result, the staff members understand their roles, and CPC's importance to the mission of NCEP and appreciate the Center's effort to be fully responsive to it.

Finding BP2: Considerable effort seems to have been made since the last review to provide appropriate metrics of service in order to give CPC staff proper credit for service. This includes performance awards such as "Cash-in-Your-Account", "Special Act / Service Awards", NOAA Gold/Silver/Bronze Medals, and Isaac Cline Awards.

Finding BP3: As discussed earlier, there are several issues (many outside of CPC's control) that significantly impact CPC's ability to encourage innovation, efficiency and accountability. These include limitations on hiring professional software engineers to develop internet services; lack of input on CFS development decisions (EMC and CTB issues); issues related to carrying out reanalyses and reforecasts in a timely manner; transition of products and services to operations (an NCO issue); an apparent lack of clarity about to whom and when staff can talk to the private sector (a CPC service issue); insufficient coordination and communication between CPC's development and operations branches; NWS conference travel restrictions; and a fixed number of promotion slots and the average GS level – a retention and workforce skill issue).

Assessment Recommendation	Planned Action	Status	Due Date
<p>Recommendation BP1: The CPC management needs to prioritize and work to resolve issues that affect CPC's innovation and efficiency, working with other center directors if the issues involve other NCEP centers. As an example, CPC management should further optimize the relationship between the DB and OB in order to promote efficiency and morale in both branches. Attention should be focused on ensuring that the DB solicits feedback from the OB on <i>post-mortem</i> forecast assessments, and on ensuring that the OB integrates products and tools from the DB as appropriate. Short-term exchanges of personnel or formalizing cross-branch partnerships (similar to RISA-CPC partnerships) are possible mechanisms to facilitate more effective relationships between the branches.</p>	<p>Develop strategy to improve innovation and efficiency and incorporate into CPC 5-yr plan and AOP.</p>	<p>Respond to recommendations from CPC external review [FY11; FY12]</p> <p>Managing expectations with respect to the new products by adhering to defensible scientific goals. [FY12]</p> <p>Managing product portfolio by assessing the value of existing products and eliminating products when new replacements are available [FY12]</p> <p>Support NOAA efforts to enhance climate services [FY11; FY12]</p> <p>Strengthen partnerships between CPC, other NCEP centers, and NWS regions and field [FY11, FY12]</p> <p>Develop Service Level Agreements between NCEP and other NOAA labs / centers on CPC product / service responsibility translated into budgeting [FY11; FY12]</p> <p>Provide clear guidance to CPC staff on goals and strategies [FY11; FY12]</p> <p>Focus on professional development of CPC staff [FY11; FY12]</p> <p>Exceed NCEP timeliness goals for on-time delivery of CPC products [FY11]</p> <p>Prepare and Execute CPC plan for move to NCWCP [FY11]</p> <p>Participate in National Climate Predictions and Projections (NCP) Platform activities [FY12]</p>	<p>Ongoing</p>

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