Community Review NCEP Assessment and Recommendations – (Last modified 20 June 2012, 13 March 2013, 6 January 2014/ENR)			
NCEP National Hurricane Center (NHC)			
Mission and Vision			
Finding MV1: *NHC-TPC has earned high public visibility and respect, and thus good will, for its operational reliability. The NHC-TPC staff deserves praise for their job performance and dedication.*			
Assessment Recommendation	**Planned Action**	**Status**	**Due Date**
Recommendation MV1. NHC-TPC should continue to leverage its high public visibility and positive image to advocate for improved public preparation and mitigation of the negative effects of tropical storms and hurricanes, for the safety of lives and protection of property. The Review Panel discussed two NHC-TPC areas of responsibility for which its mission could be adjusted. During hurricane season (6.5 months), the TAFB is tasked with many additional duties in support of the HSU such as Dvorak estimates, rainfall guidance, forecast preparations, media support, etc., while still producing its usual suite of forecasts and products. Since many of the products (high seas, wind waves, peak waves, sea state, etc.) are ones in which the OPC has expertise, mission realignments are theoretically possible. The second area was the need for the NWS-operated Central Pacific Hurricane Center (CPHC) in Hawaii, which typically handles one land-threatening storm per year, but which has to be staffed throughout the season.	**NHC concurs with the recommendation in the first paragraph. NHC will continue its extensive outreach plan. No specific new action required.** **NHC Director will discuss with the OPC Director the recommendation in the second paragraph for mission realignment. NHC notes that most of the generating disturbances in its AOR (tropical cyclones, tropical waves and gap events) are different from those at higher latitudes, making NHC-OPC overlap of expertise only partial. TAFB operates a fourth desk during months of peak activity to spread workload to additional staff.** **NHC will forward recommendation regarding CPHC to NWS HQ.**	**F11 Budget reality reduced travel money by 20%** **FY13 travel budget facing potential 30% reduction from FY10 level** **Synergy team and NWSEO have for action** **Synergy team met in June 2012 and provided concurrence with Planned Actions** **Forwarded to NWS Director July 2010.**	**Closed**
Finding MV2: *The OPC and TAFB have similar forecasting tasking over the open ocean, with the TAFB having responsibility south of 31° N. The TAFB is required to augment the HSU during hurricane forecast periods. It would appear that the OPC could assume regional forecasting responsibilities during these periods of increased NHC-TPC stress.*			
Recommendation MV2. NHC-TPC**,** OPC and NCEP should assess the responsibilities and capabilities of the NHC–TPC,and OPC to develop a more cost-effective and beneficial distribution of duties. Possibilities to consider include OPC assuming regional forecasting responsibilities during the hurricane season, OPC taking over all TAFB high seas forecasts, etc. The TAFB could retain marine responsibility solely for the offshore marine forecasts. Such discussions should also ensure an improved continuity of operations among the centers.	**Per backup plan, OPC would need supplemental staffing to accomplish TAFB responsibilities. Recommendation would result in a single point of failure for NCEP High Seas Forecasts which opposes key objective from OPC-TAFB Synergy Team charter. Risks introducing inconsistencies between High Seas, Offshore Waters, and graphical marine forecasts over the same TAFB AOR.** **After the recommendations were made in 2009, the TAFB has implemented the Gridded Forecast Editor (GFE) system to produce gridded marine forecast. This process has expedited the production of several products, relieving some of the workload on TAFB during active periods…lessening the need**	**Synergy team will investigate depending on resources** **Synergy team met in June 2012 and provided concurrence with Planned Actions**	**Closed**

	for the recommendation. **Forward to OPC-TPC Synergy Team for consideration.**		
Recommendation MV3. Consider assigning all U.S. open-water hurricane responsibilities to the NHC-TPC, freeing up forecasters and reducing training requirements at the CPHC.	**NHC concurs. Concept brought to NWS HQ in a previous year. No known action taken by HQ. Will forward recommendation to HQ .**	**NHC Director briefed NWS Director**	**Closed (NHC action complete.)**
Customers and Partners			
Finding CP1: *Despite having the responsibility for a vast part of the ocean, the only oceanographic forecasts discussed were waves and storm surge. Other potential ocean products include currents, temperature, salinity, heat content, harmful algal blooms, etc. It is not clear, for the regions they are responsible, how NHC-TPC is coordinating with OPC, the Navy, and the National Ocean Service (NOS) on requests for these services.*			
Recommendation CP1. NHC-TPC needs to engage oceanographic expertise within NCEP, NOAA and the Navy to coordinate tasking for national oceanographic support; that is, to ensure marine, ocean and ecological forecasting southward of 31° N. Formal agreements with OPC (also see Recommendation MV-2), NOS and the Navy may be needed.	**NHC responds to user needs and has multiple venues for obtaining their input. NHC is not aware of a call for these products but will consider them if received, along with the necessary training, resources, collaborations, etc. as part of its annual planning process. No specific new action required.**	**NHC (TAFB and HSU) provided operational support of DWH response that was coordinated among NOAA line offices.** **TAFB has provided gridded forecasts and marine parameters as input to ecological dispersion models used by NOS and other decision support services agencies. TAFB is participating along with OPC in conference calls to improve services within the NWS Ecological Forecasting Team. An established Marine Advisory Committee (MAC) is ongoing to foster an exchange of ideas pertaining to services between TAFB and their user base. (Above reworded.) TAFB in collaboration with EMC Marine Modeling and Analysis Branch is initializing NWPS with gridded 10-m winds from AWIPS/GFE to provide enhanced gridded forecast guidance of significant wave heights to southern region WFOs.**	**Ongoing**
Finding CP2: *NHC-TPC recognizes that storm surge, inundation (SS&I) and flooding is a very important part of hurricane forecasting and safeguarding the nation's citizens. Its initiatives to improve forecasting and convey the dangers of SS&I to the public and its participation in the Storm Surge Roadmap are commendable. NHC-TPC has partnered with FEMA for funding this program. There are 3.5 people consisting of an NHC lead, 2 FEMA funded positions, and a ½-time NOAA Corps officer available for surge forecasting. Also, NOAA has committed to funding an additional person that will bring the total group to 4.5 full-time equivalents (FTE). These personnel make the scenario runs and real time runs of SLOSH. However, this past financial dependence is not assurance of future funding, which is required for the program to continue to meet NHC-TPC needs and requirements. Further, the financial dependence upon FEMA carries with it FEMA's perspective on what model architecture should be used and, since they do not have core in-house model competency, they rely on the Army Corps of Engineers (ACE) and the NWS Model Development Laboratory (MDL) for model guidance. While MDL, ACE and the Environmental Modeling Center (EMC) model guidance currently in use for storm surge prediction is computationally easy to apply, it is not physically complete nor fully four-dimensional.*			
Recommendation CP2: NHC-TPC should continue to partner with FEMA to support the needed storm surge, flood and inundation modeling but not be directed by FEMA on what models should be used for guidance. NHC-TPC should take advantage of advanced, tested, community models and also adopt a surge model ensemble forecast approach. Also, NHC-TPC should look for additional sources of funds to support this effort, and develop a contingency plan for the event that FEMA funds would decrease or be withdrawn.	**NHC will base its future storm surge activities on the NOAA Storm Surge Roadmap and, where not covered by the Roadmap, by requirements from key partners including FEMA.** **NHC will continue to search for scarce additional resources to conduct their storm surge activities. NHC is adding a new storm surge position with funds from NWS HQ in FY10 and is discussing ways to further strengthen support for the NHC surge program with HFIP leaders through their program.**	**Progress made through Roadmap. While advances have been made, none of the advanced community models for surge are operationally ready (Director discussions with model developers from UNC, UT and with MDL). Progress, but other models still not able to fulfill functions currently done with SLOSH. NHC evaluated the CEST and ADCIRC surge models in 2012, in part with HFIP sponsorship.** **NHC's participation in the recent NOAA IOOS multi-model testbed is a prime example of our**	**Ongoing**

		active partnership with the academic and research community. NHC, in partnership with MDL, has already taken several steps to address the findings of the testbed including: implementation of larger SLOSH grids/domains, adding the physics of breaking waves, increased grid resolution, and addition of tide. Moreover, NHC is working closely with NOS's CSDL on testing, and eventually transitioning, ADCIRC into an operational environment. Multi-model ensembles were tested informally within an operational environment during the 2012 and 2013 seasons. **NHC is now participating in a second testbed with a focus more on nearshore waves in island environments. As with the first testbed, a diverse group of researchers from both academia and government are participating. Another project was recently fundedby the Joint Hurricane Testbed which aims to transition visualization software into NHC ops. The software is designed to give NHC forecasters access to non-operational research models thus facilitating the evaluation of other modeling systems within an operational environment. These collective efforts are consistent with the NOAA Storm Surge modeling roadmap which calls for using multi-model approaches toward the prediction of total water level (i.e. surge, tide, waves, etc).**	
Finding CP3: *Close coordination with FEMA and DHS is vital to the success of the NHC-TPC mission, and we support the on-site presence of FEMA/DHS personnel. In addition, the emergency management community has requirements for increased training exercises, in which the NHC-TPC can play a role.*			
Recommendation CP3. NHC-TPC and NCEP OD should develop a National Level Exercise and Training Unit to help support FEMA and DHS needs for periodic readiness exercises. This group could also develop emergency action plans for NCEP offices, conduct internal exercises and ensure continuity of operations.	**While NHC supports National Level Exercises it isn't the facilitating agency. The NHC has for many years contributed to the development and execution of multiple annual table top exercises for national, state and local level decision makers. Will continue to support these exercises and offer expertise to better enhance overall decision support services. Additional efforts in this area by NHC staff, however, would take away from other important NHC tasks. Requires additional staff resources. Make issue known through NCEP OD.**	**COOP plans have undergone revision. Gaps identified. Resources to fill gaps have not. NHC committed to initiating actions commensurate with new resources.**	**Closed.**
Finding CP4: *A continuing concern exists between the 36/24 hr watch/warning lead time provided by NHC-TPC and the 72-120 hr lead time required by emergency management services to begin their evacuation staging, purchase logistical support, etc. Moreover, there is a requirement for probabilistic information that would enable emergency managers to provide citizens with higher probability, lowere risk shelter options closer to the evacuation warning areas. The CY10 goal to extend the times for watches and warnings from 36/24 hours to 48/36 hours is excellent.*			
Recommendation CP4: The 48/36 hr watch/warning time extension should be implemented. As forecast skill continues to improve, NHC-TPC should assess the merits of further extensions of watches and warnings.	**Because the matter isn't as simple as extending the lead time when a threshold of accuracy is achieved, the NHC will continue to assess this as part of its coordination with emergency management partners.**	**48/36h Watch warning extension implemented. A further extension of lead times may not be appropriate as it has the potential to dilute the message. In fact, a shorter-term warning is now being tested, in part to fill the void left by the current watch/warning times being so long. Extension discussion with Federal, state, and local**	**Closed.**

		evacuation decision makers indicates a preference to reduce, not extend evacuation decision timelines, thus they do not require a further extension of our watch and warning lead times.	
Products and Services			
Finding PS1: *Numerous requests come from Spanish-language media in the U.S., and from countries where the general population does not speak English. NHC-TPC's RA4 warning responsibilities, coupled with the growing U.S. Spanish speaking population, create a pressing need to provide an adequate Spanish language interface to the media. A Spanish language NHC-TPC media desk was created, and is managed by the NOAA Office of Communications. It is manned on a part-time basis, but only for U.S. land falling hurricanes and often by staff from the NOAA Office of Communications, not fully immersed in NHC-TPC operations.*			
Recommendation PS1: NHC-TPC should ramp-up efforts to efficiently communicate with the non-English-speaking population in the U.S. as well as countries or dependencies in Central and South America and the Caribbean. This communication could be strengthened by noting that their WMO Area of Responsibility (AOR) includes these areas and thus these languages are essential in that role. These efforts might include adding staff that can serve media requests in several languages, especially Spanish. The NHC-TPC Public Affairs office could have a trilingual (Spanish is essential, French is desirable) individual on staff who has excellent television (TV) and communications skills.	**NHC has an unusually large component of staff (~30%) that is bilingual. The NOAA Office of Communications plan supplements NHC staff with bilingual meteorologists as necessary. NHC can continue to indicate foreign language as a desirable skill in its vacancy announcements, but is prohibited from making it a requirement.** **The Public Affairs Office (part of NOAA Office of Communications) does not provide media interviews. They are done by NHC subject matter experts.**	**Cannot require candidates for positions to be fluent in language other than English (DUS, HR,OPM)** **Budget realities do not permit resources to add staff with these communication skills for the foreseeable future, if ever.** **In house, have provided Rosetta Stone learning system for Spanish and several staff are actively pursuing** **NHC committed to initiating actions commensurate with new resources.**	**Closed.**
Finding PS2: *Coordination with other countries in their area of responsibility is sometimes difficult. In addition to language issues, it appears that just getting timely information to the proper people can be impossible. Improved connections, possibly via more use of the Internet, should be investigated. In addition, the past requirements to read location, intensity, etc., values is time consuming and prone to errors. The plan to forward electronic pre-release worksheets to U.S. forecast offices is a good step forward.*			
Recommendation PS2: Convey tropical cyclone location data to local and international government customers electronically, allowing more time for discussion.	**Electronic pre-release of preliminary advisory information to NOAA and DOD recipients facilitates transfer of data and discussion of pre-decisional information by U.S. government agencies responsible for generating the tropical cyclone forecast.** **NHC will assess possibility of making electronic worksheet available to RA-IV meteorological services and, if appropriate, raise issue at the annual RA-IV Hurricane Committee in 2011. If accepted, NHC will begin the technical and administrative work required. IT security issues are potential impediment.**	**NHC assessing issue in advance of 2011 RA-IV Hurricane Committee meeting. NWS Chat was tried in FY11 and was unsuccessful. Revisit at 2012 RA-IV Hurricane Committee meeting.** **NHC will be trying in 2012 an alternate electronic chat system to communicate with international partners.** **NHC will revisit this with partners at 2013 RA-IV meeting.** **NHC experimented with use of electronic chat with international partners but technical issues did not allow it to become a reliable mechanism for exchanging forecast information. NHC continues to provide preliminary advisory information electronically to NOAA and DOD partners and will continue to exchange tropical cyclone forecast information with RA-IV countries via phone and e-mail, when requested.**	**Close**

Finding PS3: *Creating a designated webmaster in the Technical Support Branch has led to an excellent suite of web-based products. The creation of Graphical Information System (GIS) products is commended. The Graphical Forecast Editor (GFE) is impressive.*			
Recommendation PS3: Continue efforts in creating digital, graphical, and sophisticated web products responsive to customer requirements.	**NHC concurs. No specific new action required.**	**All graphical products to the web will be in GIS compatible format. NHC committed to initiating actions commensurate with new programming resources.**	**Closed.**
Finding PS4: *The amount of money that emergency management agencies in coastal states have to spend staging supplies and transportation, starting 3-4-days before hurricane landfall, is significant. The Navy also needs at least a 72-hour notice to get ships out of harm's way. The emergency management community typically issues life safety warning order guidance between 36 and 72 hours out (i.e. - before an official warning has been issued.) Despite this, FEMA post storm behavioral analyses indicate that the public does not heed evacuation protective guidance until "Warnings" have been issued. Thus emergency managers and coastal residents need longer lead times.* **Finding PS5:** *The growing disparity between the ever-increasing skill of track forecasts and the slow rate of improvement of intensity forecasts causes problems for the emergency management community, as they may not fully appreciate or understand the intensity forecast skill limitations. For example, early in the 2009 hurricane season the Monroe County (FL Keys) officials reported that they would no longer be issuing evacuation orders for systems classified as Category 1 or below. This presents the possibility of a nightmare scenario where a Category 1 storm spins up to Category 3 intensity overnight, as has happened in the recent past. A related problem is categorizing intensity only by wind speed, since huge rainfall totals and storm surge damage are not just functions of wind speed.*			
Recommendation PS4: In concert with Recommendation CP4, a study should begin on the pros and cons of a further extension beyond 48/36 hours that not only assesses whether this is justified by current forecast skill but also includes the emergency management community, media outlets, and social science and communication expertise. Increase education outreach on tropical cyclone forecast skill, storm surge and associated flooding, and involve the private sector. Consider expanding the warning criteria to include rainfall and other destructive conditions.	**As implied in the response to CP4, there are numerous and complex issues involved in deciding whether the temporal horizon of watches and warnings should be changed. NHC will continue to consider this possibility in discussion with its product users.** **As noted in CP3, additional outreach efforts by NHC staff (beyond its current extensive program) would take away from other important NHC tasks and would requires additional staff resources.** **NHC proposed in 2008 the establishment of separate storm surge watches/warnings associated with tropical cyclones. It believes, however, that existing watch/warning types are adequate for the rainfall threat and that making hurricane warnings dependent in part on rainfall would not be in the users' best interest. Hurricane and tropical storm warnings cover the wind threat. The NWS also issues explicit, quantitative forecasts for the threats. Scales are only a short hand for this information.**	**See CP4** **Budget realities preclude additional outreach activity at least thru FY12** **NHC working with NWS HQ and WFOs to develop experimental storm surge warning. Strong customer and partner support indicated in multiple social science surveys. NWS targeting 2015 for establishing storm surge warning.** **Warning criteria already exist for winds, tornado and rainfall flooding** **As noted in CP4, a further extension of lead times may not be appropriate as it has the potential to dilute the message. In fact, a shorter-term warning is now being tested, in part to fill the void left by the current watch/warning times being so long. Agree that any further change needs to consider customer and partner input.**	**ongoing**
Finding PS6: *It appears that product verification during the hurricane season is minimal, as NHC-TPC personnel said they do not have time to fully utilize available tools. Waiting until the end of the season to assess forecast skills does not allow for the possibility of important mid-stream corrections. Feedback to the model community is also important.*			
Recommendation PS5: Encourage a more deliberate use and tracking of a program that collects forecast skill indicators and feeds. The Hurricane Specialists do have and could use software that would provide real-time verification. These results could be used to improve use of model guidance and to determine where corrections in models or products are needed.	**As noted in the recommendation, forecasters have access to and use verification information in real-time, and have since at least as far back as the 1980s. Mid-year modifications to operational models do not usually occur for multiple reasons:** **(1) Operational experience indicates that model performance can vary significantly from run to run, from storm to storm and from season to season. This is why the NHC has used a "consensus" approach, even before one was available formally, as it has the ability to minimize the impact of performance outliers.** **(2) Diagnosing a potential deficiency in a model is much different than fixing it. Often, the latter can't be done. When it can, development and testing**	**"Guidance on guidance" retained in JHT 6th round announcement.** **To take greatest and quickest advantage of modeling advances in the research community, NHC conceived and has taken a leading role in HFIP's Stream 1.5 activity. In that program, potential enhancements to numerous research models are tested in the offseason on the past three years of storms (to obtain a robust sample of storms and environments). Top performers are then run on computing resources available only on research computers and provided to NHC in real-time. This moves forward by one or multiple years**	**Closed**

	occurs over an extended period, months to years. (3) Changes to operational models occur as part of a systematic annual process intended to provide upgrades shortly before the start of hurricane season. (4) Changes to models made mid-year are generally limited to urgent corrections (e.g., to repair a "bug") due to the risk incurred in making changes to complex operational systems without meeting rigorous test standards.	the positive impact of such research advances on operations.	
Finding PS7: *Storm surge is a very important part of hurricane forecasting and safeguarding the nation's citizens. The initiatives to improve forecasting and convey the dangers of surge to the public are to be commended. However, the existing models that drive NHC-TPC model output products may not represent the best available tools to reduce the loss of lives and property. Numerous advanced and tested community models are publicly available, suggesting the adoption of a surge and inundation model ensemble approach.*			
Recommendation PS6: NHC-TPC should take advantage of community modeling efforts and multi-model ensemble approaches to receive improved surge and inundation forecasts from tested, state-of-the-art models. Partners in this effort include EMC, NOS, ACE, Navy, FEMA and others. NHC-TPC should continue to actively participate in the national effort to improve public awareness of storm surge & inundation threats.	**NHC concurs. NHC has expanded its storm surge networking activities and will further do so through the NOAA storm surge roadmap and other initiatives. A storm surge section was introduced to NHC's webpage in 2010 to increase visibility of storm surge information.**	**Key aspect of Director's annual outreach talk has been and will continue to be presented at all State and regional EM conferences. NHC storm surge group is developing capability to use an ensemble-of-models approach** **NHC participating in IOOS Super-Regional Testbed. It has also developed an "auto-surge" ensemble capability to run SLOSH from multiple operational atmospheric models.** **NHC remains heavily involved and committed to these kinds of collaborations.**	**Closed.**
Finding PS8: *NHC-TPC has recognized and advocated the need to improve storm surge products and services, and management has supported the efforts of the storm surge team lead to participate in the Storm Surge Roadmap and engage with other NOAA components, agencies, and the academic community to identify and transition vital improvements. Specific initial improvements to address inundation and lead time are scheduled for the FY09 season and beyond. The panel applauds these efforts to bring visibility to this issue. Large inconsistencies still exist, however. During the review, NHC stated: "the greatest potential for loss of life related to a hurricane is from the storm surge," yet storm surge does not appear anywhere on the front of the NHC web page. In addition, storm surge is included in the official forecast in a very rudimentary way, and is handled by a skilled, but small storm surge team. This team is not given official forecaster status and may not be supported with the optimal suite of oceanographic and hydrodynamic/civil engineering expertise.*			
Recommendation PS7: Storm surge forecasts and products need more attention, visibility and support to enhance NHC-TPC's ability to effectively communicate actionable information on SS&I to a wide variety of customers to improve preparedness and decrease loss of life and property. Specific suggestions include: (i) playing a key role in the NOAA storm surge road map and interagency/ surge community plans currently in development; (ii) addressing storm surge requirements with JHT; (iii) exploring social science and media partnerships to improve public communication; (iv) investigate approaches to account for storm surge uncertainty similar to those used for hurricane track and intensity; and (v) establishing a formal plan to clarify relationships and roles with partners including agencies with related requirements, the academic and private sector.	**NHC concurs.** **(i) NHC is a major player in the NOAA storm surge roadmap.** **(ii) Storm surge has been listed as an NHC priority in JHT "announcements of opportunity". NHC will again indicate it as a priority for the upcoming JHT 6th round announcement.** **(iii) NHC (and its WFO partners) will continue to address this (e.g., through the NWS Storm Surge Team). NHC is working on issues with a social scientist and is involved in multiple NCAR projects on this topic. No specific new action required.** **(iv) NWS has several such approaches. "MEOWS" and "MOMS" have been available for many years. NHC began testing concept of a "mini-MEOW" in 2010. Two kinds of probabilistic storm surge products have been introduced in the past year or two. Additional options will be identified as they become technically feasible (e.g., with NOAA intention to couple a new storm surge model to an atmospheric model, circa 2012.) No specific new action required.** **(v) NHC has (e.g., at 2009 storm surge meeting in Tampa)**	**(i) Road map work progressing** **Also see CP2** **(ii) Improved storm surge input to forecasters listed in JHT 6th round announcement and will be in subsequent rounds.** **(iii) First study presented to NOAA by social scientists at NOAA Hurricane Conf 12/2010. HFIP Socio-Economic workgroup established in FY11. Workgroup continued in FY12, helped evaluate obtain feedback on surge inundation graphic product protoypes, based partly on probabilistic input, and on planned storm surge warnings.** **Efforts to continue as long as resources available.** **(iv) Probabilistic storm surge continues to be**	**(i) ongoing** **(ii) Closed** **(iii) Closed** **(iv) Closed** **(v) Ongoing**

	advocated and will continue to advocate for such a plan. No specific new action required.	**developed and implemented** **(v) roadmap should address** **Also see CP2**	
Information Systems			
Finding IS1: *Installation and maintenance of mandated security and other system updates are creating a drain on present personnel, at the expense of NHC-TPC core responsibilities. The relative roles of NHC-TPC IT staff and NCO security experts are not clear.*			
Recommendation IS1: NHC-TPC should team with NCEP NCO to come to agreements on NCO's role in supporting NHC-TPC in the areas of IT security, systems maintenance and upgrades, AWIPS2 support and other tasks that could be centralized.	**NHC concurs. Discussions with NCO are underway.**	**NHC awaiting outcome of related collaboration initiated between NCO and EMC (and other(s)) before reaching decision on proper course. 9/21/11 status: NCO and NHC tasked to develop plan for system owner consolidation and to identify potential productivity gains at NHC from such a consolidation.** **Deferred until at least FY13 due to budget implications and FY12 NCEP/NCO move to new building. Deferment continuing. NCO temporary assistance sought to help NHC through period of high number of vacancies in its TSB IT unit.** **NCO to become the System Owner of NHC's IT infrastructure in March 2014. Weekly NCO-NHC managment IT calls have commenced. Actions to further evolve the collaboration are in place.**	**Close**
Finding IS2: *The IT staff has a growing load of responsibilities. These include support of: (a) an increasing number of computer systems, (b) continuous new product and software additions without commensurate retirement of legacy programs, (c) continuing and new JHT projects as well as new HFIP research, and (d) AWIPS, NCEP Advanced Weather Inteactive Procesing Systems (NAWIPS) and the upcoming transition to AWIPS2.*			
Recommendation IS2: Increase IT support via a contractor approach, as is being done with HFIP funds. Work with Office of the Director and NCO to reduce required documentation. Perform an inventory of operational programs and look for possible elimination of legacy products.	**NHC agrees with the finding. NHC doesn't have funds to cover a contractor, but has made known (e.g., through the NOAA PPBES and NCEP Annual Operating Plan processes) of its TSB staff shortfall. Reduction of documentation is a component of IS1 above. Inventory of operational programs is a task to be completed as part of NHC's A&A activities.**	**NHC actions completed. Funding new positions not under NHC control.**	**Closed.**
Science and Technology			
Finding ST1*: The NHC-TPC has been and will continue to be extremely dependent on improvements in NWP products to improve tropical storm forecast skill. There are, however, significant hurdles to be overcome to realize this vision. A national effort to develop comprehensive observational, assimilation and modeling programs to address NHC-TPC needs for improved atmospheric, ocean, wave, surge and coastal forecasting is required. The review panel realizes this is a task beyond the scope of NHC-TPC's or even NCEP's mission.*			
Recommendation ST1: NHC-TPC and NCEP OD should promote the creation of a team involving NHC-TPC, EMC, OPC, NWS, NOS, DOD (specifically the Navy), the research community (both national and international), as well as selected stakeholders to develop a strategic plan for an advanced, collaborative	**NHC is working toward the goal through collaborations formed within the NOAA Storm Surge roadmap, the JHT and HFIP.**	**NHC involved indefinitely in leadership role on Storm Surge Roadmap, JHT and HFIP.**	**Closed**

approach to coastal, surge and ocean forecasting. Two-way, interactively coupled, state-of-the-science atmospheric, ocean, coastal ocean and land-surface models are needed.			
Finding ST2: NHC-TPC is to be commended for having already completed the research-to-operations transition for more than two dozen JHT projects. The rate of success has increased in recent years. The Review Panel is concerned that the JHT may have become too focused on funding only those projects which are nearly completed and for which only implementation stage of a new product at NHC-TPC is needed.			
Recommendation ST2: There should be a better balance between higher risk but potentially higher reward research projects in JHT that attempt, for instance, to incorporate recent theoretical findings on hurricane dynamics into intensity forecasting.	**NHC disagrees. The JHT was established specifically to facilitate and expedite the transfer of promising research into operations within a ~2-year time frame. This focus has not changed. Proposal review criteria do include risk vs. benefit analyses. More risky and longer-term (e.g. current theoretical findings) should remain the purview of HFIP and/or applied or basic research institutions.**	**2011 discussion between NCEP OD, NHC director and NWS director determined the JHT is not the proper vehicle for this research to operations transition function, but instead use HFIP to address.**	**Closed**
Recommendation ST3: As a corollary to ST2, ensure that NHC-TPC is a major participant in the HFIP process. The HFIP intensity forecast goals are very stringent and the NHC-TPC needs to be especially involved in assessments of research in that area and R2O transitions.	**NHC concurs. The NHC Director is on the HFIP Executive Oversight Board. The Deputy Director is the Operational Lead and a Co-Lead on one of eight HFIP teams. NHC staff is on several other HFIP teams.**	**NHC leadership and staff to remain involved indefinitely.**	**Closed**
Finding ST3: *HSU forecasters stated that there was no time to do case studies on poorly-forecasted hurricanes and to evaluate what went wrong (or, conversely, to examine why some forecasts were so successful).*			
Recommendation ST4: NHC–TPC operational forecasters and TSB personnel should be involved in close collaboration with EMC, the Hurricane Research Division in NOAA's Atlantic Oceanographic and Meteorological Laboratory (AOML) and perhaps other groups in studying "skill-dropout" (and successful) cases. This will result in a better understanding of data and model deficiencies and of NWP guidance, and permit an improved knowledge transfer across the center.	**Through HFIP, a contractor has been hired to work at NHC as a model diagnostician to undertake the work identified in the recommendation. The contractor started work in February 2010. He since been hired to a government position with TSB and will continue to do model diagnosis. The NHC has proposed to HFIP to backfill this position with another model analyst/developer. The HFIP backfill position is now filled, meaning one government employee and one contractor at NHC are doing model diagnostics.**	**Recommendation addressed.**	**Closed.**
Finding ST4: *The mechanism for the NHC-TPC to establish, submit, track, and transition requirements for product or capability improvement is poorly defined. It was not clear who is responsible for committing funds to Research & Development to specifically improve NHC-TPC forecasts, nor what the NHC-TPC role is in expressing their requirements to management, thereby ensuring research and developmentis working to meet their operational needs, monitoring progress, and completing the transition.*			
Recommendation ST5: Strengthen the requirements process and connection of NHC-TPC to larger programs through NCEP OD. Consider holding an annual exercise involving research, development and operational personnel to focus on key forecasting issues.	**NHC will continue to provide its R&D requirements to JHT and HFIP. NHC will also continue to make them known through such meetings as the AMS Conference on Hurricanes and Tropical Meteorology, the OFCM Interdepartmental Hurricane Conference, NHC's Annual Operating Plan, and the NOAA SEE process.** **NHC is seeking to formalize separate collaborative agreements with EMC and the Hurricane Research Division (HRD).**	**Signed director-level collaboration agreement with EMC. Two EMC-NHC applied research projects now underway. Similar agreement now in place with HRD to improve communication of requirements and capabilities.**	**Closed.**
Finding ST5: *The JHT is an effective vehicle to engage the research and development community. However, it was not clear that projects were based on requirements but rather were more likely a case of funding an investigator's interest with results that may or may not fit into the operational environment. Also, the good points of the JHT may not be used by the HFIP, with the inference that NHC-TPC may not have much influence on this program.*			
Recommendation ST6: NHC-TPC should continue to embrace partnerships with academia and the private sector in both the JHT and HFIP programs, guided by Recommendations ST1, ST2 and ST3 above.	**While NHC disputes the finding that JHT projects are not requirements-driven, it concurs with the recommendation to the extent noted in plans associated with ST1, ST2, and ST3.**	**see ST2 and ST3. NHC has lead positions in both JHT and HFIP and is making sure the latter is well-informed of the best practices of the former.**	**Closed**

Finding ST6: *The introduction of probability forecasting procedures at NHC-TPC is to be commended although more needs to be done in this area. They have also developed many ensemble products to assist forecasters, but most are simple averages of various model combinations.*			
Recommendation ST7: NHC-TPC should explore more sophisticated approaches to maximizing the information content from multi-model ensembles. This, in turn, will lead to new and/or improved probability forecast products.	**NHC concurs. It will participate in an HFIP workshop in April 2010 intended to identify ensemble-based model products that could be developed that would be useful to forecasters. HFIP leadership has committed to supporting the development of such new products.**	**Workshop conducted FY10 Q3. Will continue to mature ensemble research in FY11 and beyond.** **Applications of ensemble forecast guidance to deterministic forecast products remain lacking. Eventual use of ensembles to improve probabilistic products is more likely.** **NHC monitoring HFIP experimental work using ensembles to produce probabilistic tropical cyclone genesis forecasts.** **With HFIP funding NHC is hiring a new contractor to develop a NOAA version of the FSU Superensemble system. Also through HFIP, information from multi-model ensembles is being tested in an experimental version of NHC's wind speed probability program to determine if the statistically-generated error distributions used operationally can be improved by including input from dynamical model ensembles. Preliminary results indicate that the ensemble track forecasts contain comparable information relative to the statistically-generated errors, but the wind structure fields from the ensembles still have significant limitations.**	**ongoing**
Finding ST7: NHC-TPC's suite of watches and warnings and information services rely on extensive observational needs, which are also required to drive numerical forecast models. **Finding ST8.** Numerical model output of coastal storms and coastal processes, including physical and bio-geo-chemical models, has been shown to improve with the assimilation of in-situ and satellite data, and promises to improve coastal surge, inundation, flood and ecological modeling needed by NHC-TPC. **Finding ST9.** To meet its present and future forecast challenges NHC could benefit from enhanced in-situ atmospheric and oceanic observations (in terms of density of coverage, suite of sensors, and real-time data assimilation into forecast models) and modeling enhancements being explored in the scientific community. However, NHC-TPC's ability to consistently articulate these requirements to the appropriate NCEP (EMC) or NOAA (Integrated Ocean Observing System or IOOS, Global Ocean Observing System or GOOS, HFIP, Naval Ocean System Center or NOSC, etc) programs and to evaluate the success of new approaches seems limited.			
Recommendation ST8: In order to provide the information, products and services and to drive the storm surge, inundation, flood and ecological models needed, the observational requirements of NHC-TPC must be met. NHC-TPC, working with EMC, and then NCEP OD, NWS and NOAA, needs to identify existing observational gaps, both atmospheric and oceanic, and to determine the essential and optimal suite of observations that are needed. The goal is that this will lead to the enhancement and build-out of the present NDBC network, and possibly to a meaningful engagement with GOOS and IOOS.	**NHC concurs that additional observations are required, both for direct use by forecasters and to be assimilated by the operational numerical models (including existing observations in the latter case). The optimal observing network, while surely more comprehensive than what is in place today, is difficult to define, and has important cost-benefit considerations. NHC has documented the minimal network of buoys that will best meet its needs. While some of the network has been funded and deployed, several of those buoys (including some intercepted by tropical cyclones during the past few years) failed and were not operative during the storms due to budget shortfalls. NHC will elevate this recommendation to the NCEP OD.**	**NHC keeps NCEP OD current on observational shortfalls (e.g., replacement for QuikSCAT, P-3s as instrument testbeds, buoy network problems.) Challenging budget environment will make new observing systems or increasing in existing systems difficult to address.** **NHC identified its observational priorities in an extensive list of platforms in response to multiple NOAA data calls during FY12.** **NHC advocated strongly for P3 rewinging. NHC heavily involved in HFIP project to determine impact of airborne Doppler radar wind data on regional hurricane models.** **Options in place for communicating observational needs, but success dependent on budget and administrative issues at higher levels of organization.**	**Close**

People and Organizational Culture			
Finding POC1:. *NHC-TPC staff deserve high praise for their job performance and dedication.* **Finding POC2**: *There is a NOAA public affairs officer on site who has an education in meteorology and numerous years of on-camera expertise, and thus has expertise in communications. However, NHC-TPC does not have professional social sciences communications expertise on staff.*			
Recommendation POC1: NHC-TPC needs to more actively engage and incorporate internal and external communication and in particular, professional social science expertise in product design, web design and public communications, broadly defined, to improve forecast effectiveness and public understanding.	**NHC concurs. NHC obtains input on its products from the reference experts at conferences (e.g., National Hurricane Conference; AMS Broadcast conference) and through social science research. It will continue to do so. NHC is beginning a program to analyze expert and user input about product content and format provided through comments to NHC's webmaster and through a quarterly product-specific feedback process initiated in FY10. See, also, response to PS7.**	**Collection of web comments initiated.** **NHC has initiated in 2011 a social science team within HFIP. NHC Director is co-lead for the team and several staff members participate in team activities. Team includes representatives of social science, emergency management, WFO, and media. First in-person team meeting held.** **Prototype operational products (new and/or enhanced) are a goal of the team.** **A social science workshop track has been added to the National Hurricane Conference.** **New storm surge terminology based on social science input to be used in NHC public advisory product in 2012.** **Storm surge input received via interactions with social science community. Next phase, resources permitting, likely to look at wind products.** **NHC is working with the NOAA Coastal Services Center and social science experts to develop a storm surge marketing and outreach program, to be rolled out with the storm surge inundation graphic and storm surge warning.** **NHC has become increasingly active on social media with a Facebook page and three Twitter accounts. NHC also anticipates initiating a blog in 2014.**	**ongoing**
Finding POC3: *NHC-TPC does not have dynamical nor bio-geochemical oceanography expertise on staff.*			
Recommendation POC2. Determine NHC-TPC oceanography support requirements. Open communications with NOS, OPC, the Navy and other ocean support groups for mutual cooperation. Hire an oceanographer if required.	**It is not clear to NHC that it requires an oceanographer on staff to better meet its mission, nor where it could give up an existing position to add an oceanographer. NHC has over the years, and does today, have staff with oceanographic backgrounds (e.g., Horsfall, Spindler, Baig, Schauer). It hired in 2010 a contractor with a PhD in oceanography.**	**Navy liaison officer at NHC will serve as catalyst for collaboration with USN.** **NOAA Roadmap for storm surge serves as conduit with NOS.** **Synergy team provides liaison with OPC, as does daily coordination operationally.** **NHC storm surge group has hired an oceanographer (Forbes).** **An NHC staff member will be completing a graduate degree program in social science during 2014.**	**Closed.**

Finding POC4: *Adequate bi-lingual, technically competent, media-comfortable personnel on the NHC-TPC staff are needed to deal with NHC-TPC's WMO RA4 warning responsibilities along with the increasing U.S. Spanish speaking population. Spanish is essential and French is desirable.*			
Recommendation POC3. NOAA should consider hiring hurricane specialists who are bilingual or trilingual so as to better serve the media and public. At a minimum, the Office of Communications at NHC-TPC should be staffed by a bilingual or trilingual individual with excellent communications skills. Other alternate solutions might be explored although "flying-in" people without strong NHC knowledge of experience may not provide the needed communications.	**Addressed in response to Recommendation PS1.**	**see PS1**	**Closed.**
Finding POC6: *The Navy and NOAA officers both contribute to the NHC-TPC. The experience gained by young officers has to be invaluable. They also keep valuable lines of communication open with their respective organizations.*			
Recommendation POC4: NOAA and Navy billets are valuable and should be continued.	**NHC concurs. No specific new action required.**	**No milestone required.** **NOAA surge billet upgraded beginning with next incumbent (2012).**	**Closed.**
Finding POC7: *Significant positive steps taken since the 2007 Turner report on NHC have resulted in improved morale and openness, however, it was evident that a few cultural issues will need to be continually monitored to avoid similar challenges in the future. The importance of the NHC mission to the nation, and the substantial success and recognition they have received for their work seems to create a very deliberate approach to change, and a hierarchy across the branches. These perceptions can lead to NHC seeming like a somewhat closed system where not everyone feels free to speak their mind.*			
Recommendation POC5: NHC needs to continue to explore safe mechanisms for resolving employee issues quickly and hearing all employees' ideas and feedback. Providing a strong team culture and balanced access to all units will be important tools for ensuring continued success. External assistance may be required.	**NHC concurs. Being addressed through recommendations for outside experts and staff, as formalized in NHC's Annual Operating Plans (AOP) formed of staff input.**	**Meeting AOP goals. Team Training conducted. Employee morale survey conducted and areas for improvement noted. Diversity and team building training planned for FY12.** **Will be an ongoing process.**	**Closed.**
Business Processes			
Finding BP1: *NHC-TPC is clearly built to withstand strong winds, yet may be vulnerable to communication outages, flooding, or social/political hazards (noted little perimeter security). Although procedures for Continuity of Operations (COOP), fire drills, moving operations, etc, are clearly established, it did not appear that substantive full-scale COOP exercises were routinely conducted.*			
Recommendation BP1: As a vital national resource, NHC needs to continue to ensure they are optimally prepared to provide continuity of operations and safety and security of employees. NHC should conduct annual exercises with realistic scenarios to improve preparedness.	**The NHC conducts backup tests annually. Conducting full-scale exercises, where staff is relocated to Washington, D.C. are cost-prohibitive. NHC will need to investigate whether backup operations can only be done by volunteers and, if so, whether a sufficient number of volunteers to accomplish the mission can be expected.**	**COOP plans under development by senior staff and union steward with goal of training staff and initiating a back-up exercise within resource constraints in 2011.** **NHC initiated inquiry to HQ about reliance on volunteers for backup in FY10 Q4, but issue remains unresolved.** **New NHC director to take up issue with local union steward during summer of 2012. Needs renewed attention with new NHC director and union steward, new NCEP and NWS directors, and new**	**Ongoing.**

		regional level union representative. **Current staff shortage (four people) in TSB is a more immediate concern. COOP issues to be discussed with new (FY13) union steward. TSB staff shortage (currently two positions) remains a concern.**	
Finding BP2: *The current national response to hurricane threats may be misguided, i.e., a better response to land falling tropical storms may be weatherproof and surge-proof shelters near coastal cities rather than elaborate plans to evacuate large populations long distances inland. There is a growing concern that Emergency Management will not be able to adequately respond to rapidly intensifying storms just off the coast. Many operational time frames exceed H-120 hours; however, a significant number of storms are not predictable at this range.*			
Recommendation BP2: Use NHC-TPC's considerable influence as hurricane experts to improve the Emergency Management community's operational and evacuation timing considerations. Increase training opportunities to the emergency management community. Consider leading a collective effort to provide citizens with shelter options closer to the evacuation warning areas.	**NHC will continue to educate the emergency management community and others about the types, timing, potential impact, etc. of tropical weather threats. It will do so through its extensive outreach programs which include annual training workshops for emergency managers, the National Hurricane Conference, and the Interdepartmental Hurricane Conference. The issues cited, shelter options, for example, are outside both our jurisdiction and expertise.**	**NHC participated in every state and regional emergency management hurricane meeting for the 2010 and had similar broad-based attendance in 2011. While NHC supports efforts for improved sheltering, better building codes and land use policy, we do not have the jurisdictional authority to force such changes. Extensive outreach is a part of NHC's mission and it will continue indefinitely.**	**Closed.**
Finding BP3.: *The NHC-TPC warning coordination area covers not only the United States, but also many countries in the WMO RA4. Media outlets are the biggest and most important partners when it comes to the dissemination of life saving hurricane warnings.*			
Recommendation BP3: NHC-TPC needs to ramp up their services to Spanish media inside and outside of the U.S., and to French-speaking media for the Caribbean countries where that is the primary language.	**NHC's efforts in this area must remain constrained. It handles foreign radio interviews and requests from U.S. based Spanish-language television stations with existing staff, supplemented by the NOAA Communications plan as necessary. It is not clear what more it can "ramp up" from other nations as NHC has not received requests from television stations abroad and defers to its international partners for the dissemination of information to their own peoples. No new specific action required.**	**See PS 1**	**Closed.**
Finding BP4: National Wwather Service policy is that WFOs may and do provide weather services directly to the media on unscheduled significant weather. The NHC Director also provides frequent interviews and briefings for significant weather events. What is not done is the provision of routinely scheduled weathercasts, which is deemed a private sector only service, and NHC-TPC refers such requests to the private sector. In addition, NHC-TPC provides outreach and educational services to the media year round.			
Recommendation BP4. The NHC-TPC should, via web and in-person efforts, continue to educate its stakeholders on hurricane science, preparedness and response. In addition, NHC-TPC should include WFOs as preparedness/outreach focal points during hurricane threats. With the aim of establishing stronger bonds, the NHC-TPC partnerships with the media and private weather providers should continue to be strengthened, with respective roles clearly defined.	**The NHC will continue to use established mechanisms, like the annual National Hurricane Conference, and new approaches to strengthen these bonds.** **Through the NOAA Hurricane Conference, Awareness Tour and operational conference calls, NHC always involves the WFO MIC/WCM and staff regarding threats to their area**	**Conducted media training workshop at 2010 AMS Broadcast Conference as example of new approach.** **Director and staff gave dozens of presentations at various workshops in coastal areas and at professional society meetings in 2010 and again in 2011.** **NHC augmented its normal training regimen by providing training to partners in Puerto Rico and Louisiana in 2012. Also, presented webinars to media, EMs and public in 2012.** **Will be an ongoing activity.**	**Closed.**