

NOAA Needs to Improve the Management of its Tsunami Warning Program

On February 20th, 2011 the Department of Commerce's Office of the Inspector General (IG) received a complaint (**Flawed Service Assessment: South Pacific Basin Tsunami – September 29-30, 2009**, hereafter referred to as the "Complaint") regarding mismanagement of the US's Tsunami Warning Program (TWP) by NOAA's National Weather Service's (NWS). The Complaint noted general problems with NOAA/NWS management of the TWP and specific problems with the NWS Service Assessment of its Pacific Region offices following the 2009 tsunami in American Samoa as well as its caustic follow-on visit and report directed solely at its Pacific Tsunami Warning Center (PTWC). While that assessment (NWS Service Assessment: South Pacific Basin Tsunami – Sept. 29-30, 2009, hereafter referred to as the "Assessment") and Follow-on Report contained some valid suggestions and criticisms, the assessment process and its published report (available online) are seriously flawed, prompting the Complaint to be submitted to the IG.

The IG agreed to investigate the Complaint in late February, 2011, and submitted a report to NOAA that required an official response. The IG finally received NOAA's formal response two years later in late March 2013 and it would be several more months before the Complaint's author received a copy. It can be found in the accompanying document "Memorandum for the Office of Special Investigations and Analysis," hereafter referred to as "NOAA's Response". It is not the intent here to go through NOAA's Response in great detail, but rather to highlight those statements in NOAA's Response that are either fundamentally flawed and at odds with reality or that are inconsistent with statements made by other NOAA personnel.

Three weeks after the IG received the Complaint the largest earthquake in the Pacific Ocean since 1964 occurred off of the coast of Japan on March 11, 2011, and generated a tsunami that caused damage and casualties across the Pacific Ocean. Unfortunately the primary message dissemination systems at PTWC's

sister TWC, the West Coast-Alaska Tsunami Warning Center (WC/ATWC), failed and for the first few hours after the earthquake the WC/ATWC had to resort to inefficient and less effective means (faxes, phone calls, etc.) of alerting their clients (Alaska, CONUS, and Canada) to the tsunami threat. The NWS gave these problems scant attention and the only document it produced (see AR assessment, unsigned by its authors) whitewashed the issues faced by the Alaska TWC duty scientists during this dangerous tsunami. Perhaps its anonymous authors wrote such a pro-forma, inadequate report because they did not want to repeat the mistakes of the botched Samoa service assessment and its follow-on activities at PTWC published back in 2010...or perhaps that is just charitable conjecture. This rebuttal will show that the NWS's issues with conducting its assessments are but symptoms of a much larger problem with NWS's management of the TWP.

The uneven treatment of the TWCs following damaging tsunamis is only the most glaring example of institutional favoritism of one TWC over the other. Other examples include the NWS's lack of attention to PTWC's infrastructure and its lack of, or at best muted, recognition of PTWC's service during the Chile 2010 and Japan 2011 tsunamis. Indeed, PTWC received far more recognition for its activities during the Chile tsunami from Chile (including a visit from the President of Chile, Sebastian Piñera) than from its own parent organization. Therefore this rebuttal will also highlight the historic differences in resources that the NWS provided the TWCs and other examples of favoritism possibly stemming from intra-agency politics and simple negligence.

The incompetent Assessment and its rancorous Follow-on report warped the relationship between the TWC's. The two TWCs need to work together and rely upon one another when tsunamis occur. But instead of fostering such cooperation, the Assessment and its Follow-on Report effectively twisted the TWCs' mission into a contest such that each TWC compete to be faster, creating a "race to the bottom" since (all things being equal) speed is gained at the expense of analytical accuracy. It also fostered a climate of fear such that problems were not brought to light for fear of repercussions, perhaps explaining why the staff of the WC/ATWC failed to coordinate with PTWC after their messaging software failed (see document Commentary by WC/ATWC Staff).

The recent renaming of the WC/ATWC to the “National tsunami Warning Center” (NTWC) is only NWS management’s latest blunder. It had been suggested that the WC/ATWC be renamed the “North American Tsunami Warning Center” as its “Area Of Responsibility” (AOR) includes all coasts of North America outside of Mexico. Their existing name was cumbersome and inaccurate, so such a renaming made sense. But renaming the WC/ATWC to the “NTWS” has led to stakeholder confusion. The public, the media, and emergency managers have all asked PTWC if tsunami information now needs to be obtained from the “NTWS.” When the federal government identifies one of its offices as “National” it creates the impression that such a facility is the authoritative agency and the go-to place for official information. Colleagues of PTWC’s staff repeatedly ask them “What is your role now?” If the NWS had competent management it would be difficult to fathom how it could not have foreseen this problem. It is precisely this disregard for consequences that damages the tsunami warning program and why the NWS should not remain stewards of the TWP.

Therefore this rebuttal will conclude with the recommendation that to ensure public safety the TWP should be made a line office within NOAA such that it can establish relationships with other NOAA organizations that the TWP cooperates with, such as OAR, NOS, etc., as equal partners and not as a program embedded within the NWS that does not fully comprehend (or even appreciate) the scope or nature of the TWP’s mission. The NWS neglected the TWP prior to the Indian Ocean tsunami of 2004 and mismanaged it thereafter.

The National Weather Service’s (mis-)Management of the NOAA Tsunami Program

The Complaint criticized the NWS’s overall management of the Tsunami program. Here are some of the statements in NOAA’s Response concerning NWS support of the TWCs and their handling of the Assessment.

NOAA Statement: “[The Complaint] also mentioned that the Pacific Region is more strapped for funding than the Alaska Region. A quick analysis shows PTWC spending more than WC/ATWC through 2008 and WC/ATWC exceeding PTWC after 2008 due to a \$1M earmark appropriation....” (p. 7, NOAA’s Response)

FACTS:

- The WC/ATWC has had a number of contractors and temporary employees to assist with software development, network and system administration, and even rotational duty.
- When PTWC asked for a comparable level of support to WC/ATWC the NWS Pacific Region Headquarters turned them down as it did not have or could not devote the resources to assist PTWC.
- PTWC finally got its own dedicated IT contractor thanks to tsunami program funding in June 2013 (even though a duty scientist position remains unfilled). Prior to then the responsibility for network and system administration, IT security, and software development all rested on the shoulders of PTWC science staff, none of whom are information technology (IT) professionals.
- PTWC is currently located on a large (172 acre) property requiring significant maintenance.

ANALYSIS: The Compliant raised the issue of an apparent inequality in access to resources between the two centers. One wonders whether NOAA’s “quick analysis” takes into account PTWC’s property maintenance costs and its significant IT requirements.

NOAA Statement: “In 2005, additional funds were appropriated to NWS to strengthen the Tsunami Warning Program. As part of these funds, NWS increased the staff at the TWCs to allow 24x7 coverage. PTWC chose to use one

of the additional staff to fill a Watchstander position rather than an Information Technology Officer (ITO) position”. (p. 7, NOAA’s Response)

FACTS:

- NOAA’s Response indicates that PTWC’s staffing profile was its own choice, but it in fact resulted from a national-level agreement between the NWS and its labor union, NWSEO (see document “Agreement”). Since PTWC’s ITO was required to be part of the duty rotation PTWC hired a scientist who could work part-time on IT issues.
- Just like duty scientists throughout the NWS, PTWC duty scientists do not possess all of the necessary skills and knowledge to provide IT support and security.
- Elsewhere in the NWS (including WC/ATWC) field offices include an ITO on staff who is a full-time IT professional, not a scientist in the duty rotation qualified for rotational duty.
- In 2005 the NWS never made PTWC aware of the extent of the IT security burden it would soon face.
- In 2005 the NWS increased PTWC’s Area of Responsibility (AOR) to include two additional ocean basins, the Indian Ocean and Caribbean Sea.

ANALYSIS: In view of PTWC’s much greater responsibilities than those of WC/ATWC, including dealing with dozens of different nations, why did the NWS staff the two centers almost identically in 2005? And if, as NOAA/NWS claims, that PTWC had a staffing choice why did it not warn PTWC of the future IT burdens that it would soon face?

NOAA Statement: **“Funding for the TWC’s is approximately equal, with some additional funds provided to the WC/ATWC at the direction of Senator Stevens.”**
(p. 7, NOAA’s Response)

FACTS:

- This statement would seem to contradict NWS DAA Laura Furgione's assertions during a conference call with the NOAA CIO Joe Klimavicz on Sept 5., 2013, during which she stated that WC/ATWC received no IT help from Steven's appropriation and that Alaska Region "repurposed" its personnel to assist the WC/ATWC.
- On this same call Mr. Klimavicz threatened to revoke PTWC's Authority to Operate (ATO) because of unaddressed IT concerns.
- As described above, until very recently NOAA/NWS provided inadequate IT support for PTWC thus making it impossible for PTWC to adequately address these IT concerns in the first place.
- On a previous call, Furgione suggested PTWC cut back on its international travel to pay for IT support.

ANALYSIS: In other words, funding is *not* equal between the NWS's two TWCs. Furthermore, the amount of money and time PTWC spends on travel to coordinate with other warning centers and national agencies, or to provide education and outreach (something that saved lives in Samoa in 2009), is negligible compared to what is required for PTWC to fully meet its IT obligations. PTWC's current IT contractor alone costs more than 100k per annum, far exceeding the 15k-20k PTWC spends on international travel. PTWC also receives funding for international travel from other agencies like UNDP or USAID and such funding is not part of PTWC's budget and cannot be "repurposed" for IT infrastructure.

The NWS appears to view PTWC's international obligations as a novelty only to be highlighted when it is convenient for the NWS to do so. Furgione's suggestion cannot be taken seriously and even if it was it would not free-up PTWC's finances to the extent that it could help resolve its IT issues. If PTWC eliminated international travel from its budget it could, at most, buy another enterprise-class computer server, but not all the professional IT help it needs. Furthermore, are we to believe that the \$1M Senator Stevens gave to NWS Alaska Region (the TWEAK Program) did not free up other resources to be "repurposed" by Alaska

Region Headquarters? Any claim that NOAA/NWS support for the TWCs is roughly equivalent is simply not credible.

NOAA Statement: **“The characterization of the website as “PTWC website” remains accurate, as it was used to communicate information on behalf of the PTWC.”** (p. 3, NOAA’s Response)

FACTS:

- The Assessment failed to mention that PTWC did not host its own web server, so the Complaint to the IG pointed out this fact. In 2009 the server in question was a single machine located at NWS Pacific Region Headquarters (a separate location from PTWC).
- During the 2009 Samoa tsunami the high number of hits to PTWC’s web site bogged down this single machine and it became very slow to respond.
- NOAA’s Response also blames the PTWC-authored “legacy code” used on the web server.
- NOAA and NWS management’s perception that issues with the website are PTWC’s fault continues to the current day. During the aforementioned conference call with the NOAA CIO regarding PTWC’s IT challenges on Sept. 5, 2013, an issue was made of the fact that “PTWC’s” website was hacked even though it continues to be hosted in another part of the NWS (now at the NWS’s national web server farm along with all of the NWS’s other web pages).

ANALYSIS: The Complaint raised this issue not to deny that the website in question communicated PTWC products, but rather that the maintenance and IT infrastructure supporting the PTWC website were out of the control of PTWC. Though it is not PTWC’s fault, it *is* PTWC’s problem if the NWS-provided system carrying PTWC information fails because of low network bandwidth, because of inadequacies with the server itself (yes, there was only one in 2009), and/or if the more modern—but still externally-hosted—system gets hacked.

The remark regarding *legacy code* is also gratuitous since the code had to be run on a *legacy* server.

NOAA Statement: “NOAA hired a GS-15 senior tsunami Program Manager in FY2011 to oversee the program.” (p. 6, NOAA’s Response)

FACTS:

- The Tsunami Program Manager was not hired until 2010.
- This Program Manager has limited authority and control over the TWP budget and is routinely overruled by his/her NWS superiors.

ANALYSIS: It took 6 years after the 2004 Indian Ocean tsunami for the NWS to create a GS-15 position to “oversee” the TWP. The TWP doesn’t need an overseer. It needs a *manager*.

To be sure, the NWS has done some positive things, such as the Tsunami IT Modernization Program (TIM) that will replace the current TWC scientist-authored software and scientist-maintained hardware at the TWCs with a professional, enterprise-class IT system in 2015 or 2016, 11-12 years after the Indian Ocean disaster. Meanwhile other nations, including developing nations (e.g., Indonesia, India and even Vanuatu), have managed to stand up fully-functional tsunami warning systems in only a few years.

The NWS Service Assessment of PTWC’s performance during the 2009 Samoa Tsunami

The Complaint’s fundamental issue with the service assessment’s discussion of problems faced by PTWC during the Samoa tsunami of 2009 is not that it discussed these issues but that it omitted important mitigating factors.

NOAA STATEMENT: "The difference in the software packages' time stamps provides an objective comparison of the differences in recorded time as well as the difference in the level of effort necessary to prepare a RWW versus a TIS." (p. 1, NOAA's Response)

FACTS:

- At the time of the Samoa earthquake the TWCs would coordinate by phone prior to issuing message products to ensure consistency between the two TWCs' products.
- PTWC had to send a Regional tsunami Watch/Warning (RWW) message that is more complicated than the Tsunami Information Statement (TIS) that WC/ATWC had to send.
- The TWC's bulletins use time stamps that are only accurate to the minute.
- The available evidence suggests the difference in time might actually have been more like one minute.

ANALYSIS: The Assessment expressed grave concern that the TWCs issued their first bulletins at different times following the coordination call (in effect making PTWC look incompetent for wasting time) but there was no way to precisely synchronize bulletin dissemination by the TWCs. Therefore the NWS should not be comparing the TWCs' performance using message and phone-call time stamps alone unless the time differences are of the order of several minutes or more. The NWS finally showed that they understood this truth when they dropped the requirement for a coordination call between the two TWCs before they both issue their official products. Now the TWC in whose area of responsibility (AOR) the earthquake occurs will issue their bulletin and the other TWC will extract the earthquake parameters from that bulletin and issue their own bulletin using those extracted parameters. This new procedure keeps the information in the official message products consistent while at the same time speeds up the messaging process because a coordination call is not required. However, it also ensures that the bulletins will *never* be issued simultaneously, which makes one wonder, why all the fuss in the first place?

NOAA STATEMENT: "The Service Assessment pointed out the fact that the earthquake parameters by the PTWC and WC/ATWC were provided at different times and with different accuracies." (p. 1, NOAA's Response)

FACTS:

- The Assessment took issue with differences in the initial parameters disseminated in the form of *unofficial* "observatory messages" by the TWCs (p. 7 of the Assessment). PTWC's initial estimation of the magnitude was deficient at 7.1, while the WC/ATWC had a much better measurement of 7.9 in their "observatory message."
- "Observatory messages" only contain basic earthquake parameter information and make no statement with respect to any tsunami threat or lack thereof. They simply present the duty scientists' first firm determination of the earthquake parameters.
- The TWCs have always cautioned that "observatory messages" are *only* to be used as a heads-up message, i.e., that a large earthquake has occurred and that an *official* bulletin may follow. PTWC does not in general advocate taking action on its "observatory messages." However, should PTWC's clients receive an observatory message regarding a large earthquake with $M \geq 6.8$ near their coastlines they may consider taking action without waiting for the official bulletin.
- The Assessment made no distinction between the *unofficial* "observatory messages" and the *official* message products (Watch, Warnings, and Advisories) that do convey tsunami threat information. NOAA's Response does admit that this is an omission (p. 2, NOAA's Response). Yet they go on...

NOAA Statement: "However, with the operational use of this observatory message leading to stakeholder confusion, it was a valid observation to include in the assessment". (p. 2, NOAA's Response)

FACTS:

- The issue raised in the Complaint was not whether the observation was valid, but that it omitted the fact that the *official* message product, the Regional Watch/Warning, used the better magnitude of 7.9.
- PTWC had no prior knowledge that the Weather Service Office (WSO) in Pago Pago would be using the threshold magnitude of 7.5 from PTWC's *unofficial* "observatory message" to issue a warning for American Samoa.
- PTWC was never involved in any discussions leading to the Pago Pago WSO's adoption of this 7.5 earthquake magnitude threshold for tsunami hazards. If they had been involved, PTWC would have argued for a much lower threshold such as the more conservative value they use for Hawaii: 6.9.
- PTWC issued its first official bulletin for the Samoa earthquake well within the Tsunami Program Strategic Plan goal (for 2009) of 20 minutes after the earthquake (actual time was 16 minutes). This fact is mentioned in the GAO report GAO-10-490 04/18/2010 but nowhere in the Assessment or its Follow-on Report.
- There is no statement in the Assessment that indicates PTWC fulfilled its primary mission requirements for the Samoa earthquake of Sept. 2009.

ANALYSIS: The TWCs strive to be as fast and accurate as possible and that goal requires a balancing act on the part of their duty scientists in their determination of earthquake parameters (i.e., speed vs. precision). An error in magnitude of this size is rare for either TWC yet it can happen when unusual earthquakes occur. For example, both TWCs initially underestimated the magnitude of Canada's Haida Gwaii earthquake of October 2012 by a similar amount (0.7 magnitude units). But upon further analysis over the next few minutes both TWCs determined the correct magnitude.

In their Assessment the NWS held PTWC to the higher standard of operations of a "local" TWC (see the introduction in the Complaint) for the Samoa Islands region, something that the NWS only required of PTWC for earthquakes that occur in Hawaiian waters (see NWS Tsunami Program Strategic Plan). In 2009 the NWS

required PTWC to treat American Samoa as it does all of its customers outside of Hawaii, and provided resources accordingly (“local” TWC operations need far more instrumentation than was—or still is—available in the Samoa region). This unrealistic expectation indicates a lack of communication within the NWS regarding policy in dealing with the tsunami threat. Had PTWC been involved in a discussion on how Samoa should use the *unofficial* “observatory message” the limitations of the service that PTWC *could* provide to Samoa would have been understood by all parties before the 2009 earthquake. In their Response NOAA indicates they still do not grasp this issue.

It is rare when any two seismic observatories perfectly agree on earthquake parameters even well after it occurs, let alone within just 5 to 10 minutes after it happens. Nevertheless the deficient magnitude in the *unofficial* “observatory message” rankled the NWS. The NWS should not be under the delusion that even if the TWCs had exactly the same systems they would issue observatory messages with identical parameters because the information the TWCs receive will not necessarily be the same or arrive in precisely the same order. Differences in information and the order in which it arrives affect the early determination of the location and magnitude of the earthquake when these determinations are based on the relatively small amount of data that is available within the first few minutes after the earthquake occurs. This is especially true in an area with sparse instrumentation and poor communication infrastructure such as the Samoa Islands region.

It is highly objectionable for the NWS to hold PTWC to what amounts to an *a posteriori* standard. The NWS effectively moved the goal posts after the game was over and other NWS field offices should take note. The requirements and goals the NWS spelled out in its Directives and Strategic Plans are irrelevant if the NWS can choose to ignore them whenever they like.

NOAA Statement: “He stated the first waves of the tsunami were not hazardous and he therefore infers that this fact was misleading. Despite the lack of hazard with the first waves it still marked the beginning of the event in Pago Pago, and

thus the NWS Service Assessment makes a factually correct statement.” (p. 3, NOAA’s Response)

FACTS:

- The Assessment took issue with the amount of time it took PTWC to issue its initial *official* international product, the Regional Watch/Warning bulletin, complaining that the first arriving waves reached Samoa at roughly the same time as when PTWC issued its bulletin.
- The Assessment does not state that PTWC fulfilled its Strategic Plan goals since the bulletin was issued within 20 minutes.

ANALYSIS: The Complaint stated that it is indeed *technically* correct that the first tsunami waves (just a few inches in height) arrived in Pago Pago harbor 17 minutes after the earthquake. The Complaint’s point is that the Assessment does not state that the *hazard* did not materialize for another 10 minutes, or 11 minutes after the PTWC issued its Warning. NOAA is defending an Assessment that misleads its readers by trying to show that PTWC’s actions had no benefit during the Samoa tsunami.

NOAA Statement: **“The statement here was related to Finding 20a, which gave the context and interpretation of the Fact as evidence that there was confusion among the public as to which tremor (the original earthquake of the subsequent aftershock) actually triggered the issuance of the tsunami warning.”** (p. 3, NOAA’s Response)

FACTS:

- Finding 20a in the Assessment states “The staff correctly issued the Tsunami Warning using the tsunami warning event code (TSW) over NWR at approximately 7:19 a.m., local time, but the tsunami had already struck the island. Because a large aftershock had also occurred by this time, the TSW created confusion and panic. People thought a second tsunami had been generated by the aftershock.”

- Tsunamis consist of a series of waves, and can threaten a coastal population for hours.

ANALYSIS: Finding 20a refers to actions taken by the staff of the WSO office in Pago Pago, not any actions taken by PTWC. Even so, the phrase “already struck the island” is misleading since it implies that any danger had passed by 7:19 am. PTWC did not cancel the RWW until approximately 4 hours after the Samoa earthquake precisely because a tsunami’s hazard lasts for hours. One can only wonder what Finding 20a has to do with PTWC and why NOAA brought it up in their Response. Furthermore, what actions would the Assessment team have preferred? Should the WSO *not* have issued an alarm for an extant threat?

NOAA Statement: “...asserted that the timing of the phone call from WC/ATWC informing PTWC of the missing watch/warning products occurred at the same time that the staff at PTWC became aware of the dissemination failure.” (p. 4, NOAA’s Response)

FACTS:

- The Assessment stated that the PTWC received a call from WC/ATWC regarding the failure of PTWC’s initial bulletin to appear on the AFTN/MET and NWW communication circuits (p.23 of the Assessment).
- The Complaint to the IG asserted that PTWC duty scientists were already aware of this problem.
- PTWC’s AFTN/MET circuit at the time was facilitated by a system running on a mid-1990s era personal computer that crashed on a regular basis.
- Like most emergency management offices PTWC uses multiple redundant communications pathways and the other communications circuits available to PTWC—GTS, EMWIN, RANET, etc.— successfully transmitted the same messages to PTWC’s customers.

ANALYSIS: The AFTN/MET is but one of several primary message dissemination pathways PTWC uses to communicate message products, and PTWC uses multiple pathways so it can carry out its mission in case a circuit fails. Other pathways include NOAA Weather Wire (NWW), EMWIN (Emergency Management Weather Information Network), GTS (Global Telecommunications Service) and RANET (Radio and Internet Technologies for the Communication of Hydro-Meteorological and Climate Information for Rural Development). The Complaint discussed this issue because the Assessment made it appear that PTWC duty scientists were completely oblivious to the issues with the AFTN and NWW circuits when that was not the case. It also neglected to state that the other primary messaging circuits were operational and conveyed the same information to PTWC's customers such that PTWC had carried out its mission.

The Assessment's "Follow-On Report":

A few months after NWS Service Assessment team visited NWS Pacific Region offices (including PTWC) the NWS sent a second team, headed by NWS Alaska Region headquarters' Carven Scott (currently Acting Meteorologist in Charge, WFO Anchorage), to make sure the issues identified by the Assessment were being addressed by NWS Pacific Region and PTWC. This second team also authored a "Follow-On Report" and the more objectionable parts of this Report are discussed below:

NOAA Statement: **"... raises training and facilities deficiencies as an issue related to the PTWC response to the event. NWS has identified training as an area needing improvement."** (p. 6, NOAA's Response)

FACTS:

- One of the follow-on report's principal suggestions was to replace PTWC software with those operated by the WC/ATWC (which, supposedly, could

better facilitate training at PTWC). These suggestions are listed, verbatim, below:

- Install WCATWC earthquake analysis system at PTWC in parallel (for risk reduction) with existing system
- Evaluate test results
- Move earthquake analysis system into operations if test results are favorable
- Move earthquake analysis system into operations if test results are favorable
- [Alternative:] Fastrack [sic] transfer of non-Hawaiian responsibilities to WC/ATWC
- WC/ATWC's messaging software failed and was inoperable for about three hours following the March 11, 2011 magnitude 9.0 Tohoku, Japan earthquake.

ANALYSIS: Had these recommendations been adopted then *both* TWCs would have failed during the Tohoku tsunami when a software failure at WC/ATWC would not let them send tsunami alert messages for the first few hours after the earthquake (see this Rebuttal's introduction). Alternatively, had the NWS transferred PTWC's international responsibilities to WC/ATWC then WC/ATWC would have been primarily responsible for mitigating this tsunami and also failed. Furthermore, the "deficiencies" obliquely referred to in this statement are neither defined nor explained as to how they may have arose in the first place, thus any suggested remedy is ill-informed.

The Complaint stated that nowhere in the Assessment or in the Follow-On Report were the issues and shortcomings of PTWC's facilities mentioned. NOAA's Response to that Complaint's issue:

NOAA Statement: **"NWS plans to ensure appropriate equipment and facilities are available in the new NOAA facility on Ford Island in Pearl Harbor for training, simulations, and test bed functions....[it] correctly states space and**

power/cooling requirements are less than desirable at the current PTWC facility at Ewa Beach.” (p. 6, NOAA Response)

FACTS:

- NOAA’s facility manager visited PTWC several times prior to the 2009 Samoa tsunami and identified its infrastructure problems.
- The PTWC’s cooling system failed during the fall of 2010.
- The NWS spent \$50k to upgrade PTWC’s cooling system only after it failed and after the resulting overheating damaged computer systems critical to tsunami warning operations.
- The expected date to move PTWC to its new facility keeps sliding into the future and as of this writing is not expected to move until May 2014.

ANALYSIS: The electrical infrastructure at PTWC was known to be inadequate for years and a major failure was simply a problem waiting to happen. When it finally did happen, PTWC had to resort to portable AC units that struggled to keep the temperature in PTWC’s combined server/operations room around 80F during the day for two months in the late fall. During this period computers, terminals, and disks all failed. Had the cooling systems failed during the summer it is unlikely that PTWC would have survived the time it took the NWS to fix the issues. NOAA/NWS’s promise of future upgrades is no excuse for ignoring the existing infrastructure problems of an operation charged with protecting lives and property from randomly-occurring disasters.

The Follow-On Report discusses the differences between how the PTWC and the WC/ATWC cover their 24x7 responsibilities without giving any context as to why this is a consideration. The only thing it cited was an NIH report regarding the difficulties people may face being awakened unexpectedly from their sleep. The Complaint cited the manner in which the NWS River Forecast Centers are staffed as baseline for showing how the NWS exploited the TWCs by understaffing them. NOAA’s response completely ignored the comparison made in the Complaint and the conclusions drawn from it.

NOAA Statement: **“The NWS is addressing the staffing models at both TWCs to ensure service to the Nation is the primary driver not individual TWC practices or preferences.”** (p. 6, NOAA Response)

FACTS:

- The NWS requires that two scientists be available at each TWC to respond to potentially tsunami-generating earthquakes at all times. At least one scientist must be of “senior” (GS-14) rank.
 - The WC/ATWC uses two scientists on shift at all times for 24x7 operations as is typical for most NWS field offices.
 - The PTWC uses one scientist on shift at all times plus a second scientist on standby (i.e., “on call” but restricted to the workplace, similar to a fire department) to ensure that two scientists are always available for 24x7 operations.
 - PTWC’s shift+standby duty rotation cuts in half the time each scientist must spend in shift status compared to their counterparts at WC/ATWC.
 - All PTWC scientists regardless of rank are authorized to issue initial tsunami bulletins.
- Neither TWC includes staff whose primary function is to perform outreach or scientific research as in typical NWS field offices even though NWS Directive 10-701 requires TWCs to perform these tasks.
- The Follow-On Report claims that the use of standby duty at PTWC lead to delayed responses, specifically citing Samoa as an example.
- The 2009 Samoa earthquake coincided with a shift change at PTWC, so two scientists (including a “senior” scientist) *on shift* responded to this event just as they did at WC/ATWC.

ANALYSIS: The Follow-On Report grasps at straws trying to make its case that PTWC’s standby duty is somehow harmful for TWC operations and treats the inconsistency in TWC operation styles as a problem to be solved. Furthermore, NOAA’s reply to the Complaint indicates that the agency believes that PTWC uses standby duty purely as a matter of “preference” and ignores reasons why using

standby duty might be optimal for a TWC's uniquely (for the NWS) purely event-driven operations and why such practices developed in the first place.

For each shift two scientists are always on duty. At PTWC one scientist must be "on shift" in full work status at a PTWC duty station while the other scientist is in "standby" status such that s/he is restricted to the PTWC property (including on-site quarters) and must be able to report to duty in 90 seconds. Both duty scientists must carry digital pagers that alert them when an earthquake occurs, typically within 1-2 minutes for earthquakes outside of Hawaii and within 10-15 seconds for an earthquake within Hawaii. Since at least one scientist is always awake and at a duty station, and since *any* PTWC duty scientist—even one who is not a "senior" scientist—can issue the first tsunami bulletin, any claim that standby duty delays PTWC's response is false.

PTWC's scientists do not just sit around 24x7 waiting for earthquakes to happen, and to require them to do so would be a waste of human resources. When not responding to earthquakes PTWC's scientists conduct scientific research and development (see end of this section) and perform outreach and education (as required by NWS Directive 10-701) even when in duty status. These mission-critical tasks save lives, and the flexibility in the duty schedule afforded by PTWC's shift+standby system maximizes the time that PTWC scientists can collaborate with their colleagues outside the duty rotation both within PTWC and at other institutions, whether they are university researchers, civil defense officials, or NWS personnel at other offices. Since the NWS saw fit to *not* provide the TWCs with specialists in these areas as they have at their other field offices, these tasks fall to PTWC's duty scientists just as the IT work has. Therefore PTWC hired the majority of its duty staff from the scientific research community, and has retained this talent thanks in part to its flexible duty schedule. By retaining this talent PTWC's scientists (even those who aren't "senior") have become very experienced at mitigating tsunamis, while the unnecessarily onerous duty schedule at WC/ATWC—even with staff augmentation by temporary and contract employees—seems to be at least partly responsible for its high turnover rate.

Instead of embracing this success story and recommending it as a solution for WC/ATWC's staffing woes, the Follow-On Report's authors (including the Director of WC/ATWC) try to paint PTWC's shift+standby system as a problem to be remedied. They suggest that a scientist coming into full duty status from sleep would be impaired, yet one could also argue that such a scientist will be better-rested and thus better suited to deal with a significant, complex, multi-hour event than a scientist who has been awake all night on a graveyard shift. They draw a speculative timetable as to how PTWC *might* respond to an earthquake in Hawaii, but they drew this timetable as if *only* standby is still used at PTWC (as both PTWC and WC/ATWC did prior to 2006), not the shift+standby system that PTWC actually uses such that the first responder will be the scientist on shift. These authors ignored well-documented actual response times for real earthquakes in Hawaii. They even go so far as to blame their perceived delay of PTWC's response to the Samoa tsunami on its standby duty, even though the first two scientists to respond (including a senior scientist) were in fact at their duty station since one was relieving the other of shift when the earthquake occurred.

One has to wonder why the Follow-On Report addresses PTWC's style of duty rotation at all since it played no role in its response to the Samoa tsunami. Perhaps its authors singled out PTWC's duty style simply because it is different from the other NWS offices that they are only familiar with, or perhaps blaming standby duty is more convenient than addressing some very real infrastructure problems discussed elsewhere in this Rebuttal. The Report certainly offers no valid reasons as to why PTWC's style of duty rotation should be a concern and only speculates about potential problems. Its authors' concern about operational consistency between the two TWCs—and favoring the one most like other NWS field offices—reveals their bureaucratic rather than operational mindset since they ignore how the TWCs are so different from other NWS field offices in the first place. At best, their unfounded criticism represents some of the clearest evidence that the NWS is targeting PTWC for “special treatment” not because of its performance deficiencies, but simply because it is different, and without regard to whether such operational differences are justified or not. At worst, this

criticism is evidence of a political agenda targeting PTWC that predates the Samoa tsunami.

Furthermore, as the Complaint points out:

The real issue isn't the manner in how the TWC's cover their 24x7 operations as claimed in the [Follow-On] report, but how the NWS has taken advantage of the TWC's in chronically understaffing them and has been ignoring or hiding this fact.

For comparison, the Complaint considered the staffing and duty style of the NWS's River Forecast Centers (RFCs):

The RFC's operate in a 16x7 mode; that is 16 hours per day, 7 days a week. The RFC's duty rotation uses 11 watchstanders, with 3 management personnel who can fill in as needed. The TWC's have 12 watchstanders for 24x7. AT PTWC, the 12 watchstanders are all trained scientists and include management. The TWC's if they are to operate with two watchstanders on shift, should have at least 1/3 more watchstanders than the RFC's as we operate 24x7 and not 16x7. That means the TWC's should be staffed with at least 14-15 watchstanders, plus three management positions.

NOAA's Response ignores this comparison and backs up a Report that favors eliminating standby duty without a commensurate staff augmentation to even come to parity with other NWS field operations. Of course, one of the Report's authors manages a TWC and is ignoring the staffing problems of his own office

NOAA's Response to the Complaint does acknowledge, at least, some of the problems with how the NWS handled its Assessment and Follow-On Report:

NOAA Statement: "The NWS is currently considering using more non-NWS individuals to help conduct assessments to ensure a non-biased analysis of NWS services." (p. 5, NOAA's Response)

FACTS:

- The Service Assessment team included two individuals from WC/ATWC and NWS Alaska Region
- Two of the four members of the Follow-On team were from WC/ATWC and NWS Alaska Region
- PTWC personnel have *never* served on a NWS service assessment of WC/ATWC or any other NWS office.
- WC/ATWC was subjected to a NWS Service Assessment in 2005 whose team included WC/ATWC staff and Alaska Region staff. Laura Furgione, the NWS Alaska Region Director at the time (and current Deputy Director of the NWS), served as its team leader.

ANALYSIS: “Using more non-NWS individuals to conduct assessments” should also cut down on intra-agency political issues and help avoid damage to *esprit de corps* within the NWS. Assessment teams should always include one member from the management staff of the unit that is being investigated such that the team can take mitigating factors into account, especially when the team is not familiar with the operation under scrutiny. Furthermore, the team leader should be impartial and not from a “rival” unit to the one being investigated, i.e., not from offices with which the unit under investigation must co-operate on a daily basis. These two recommendations simply represent sound ethics and should help ensure that hidden agendas are left at the door. Of course former NWS employees and outside experts should also be considered for team members as well as the role of team leader.

Final Remarks regarding the Samoa Assessment and Follow-on Report

One is struck by the glaring omission in the Assessment and Follow-On Report of any discussion as to how fast the TWCs can actually respond to earthquakes in the Samoa region. As noted previously in this document, the Samoa region has sparse seismic instrumentation (at least in terms of what is available to the TWCs) and poor communications infrastructure. Since the NWS did not bother to determine what was possible, PTWC scientists performed their own analysis and

presented it at a scientific conference in front of their peers. This scientific study determined that in a best-case scenario such that all instruments and communication networks are working perfectly it would not be possible for PTWC to give American Samoa more than 10 minutes warning for a tsunami after a nearby earthquake (Becker et al., 2010).

PTWC learned about existing and planned seismic networks in the Southwest Pacific during a seismic data sharing conference held in Vanuatu Oct. 19-20, 2009. PTWC told the NWS about these networks, but to date the NWS has made no plans to acquire additional data from networks in Tonga, Fiji, and Samoa. PTWC (with assistance from the International Tsunami Information Center) established relationships with seismic network operators in Vanuatu and New Caledonia so as to receive their data. PTWC incorporated these new data into its operations in much less time and at considerably less cost than was required to conduct the Service Assessment. This new influx of data enabled PTWC to issue a tsunami warning in about 6 minutes for the 8.0 magnitude Solomon Islands earthquake of February 6, 2013, or in half the time required to issue warnings for the nearby Vanuatu earthquakes of October 7, 2009.

Finally, as originally stated in the Complaint:

“The assessment, while a good idea in the sense that any tragedy should be analyzed, was botched by the NWS. It was ill-managed; the assessment team was poorly composed, its findings not fact checked, the esprit de corps within the tsunami warning system was damaged and the assessment unnecessarily called the credibility of the PTWC into question”

The unsigned NWS Alaska Region Assessment of WC/ATWC problems during the Japan 2011 tsunami can be found in the accompanying document “AR Assessment.” It is far from clear why WC/ATWC was treated so differently and with seeming deference relative to the PTWC. Even WC/ATWC staff wondered about this deferential treatment (see document Commentary by WC/ATWC Staff). Perhaps this latter, low-key Assessment resulted from intra-agency politics and

the problem of where to go for members of a new assessment team. Given the way the PTWC was treated during the follow-on report consultation, the NWS probably would find few volunteers amongst the PTWC staff or NWS Pacific Region for that matter. And if they did, one can only wonder what would have transpired. As mentioned earlier in this document, such a problem was foreseen in the Complaint submitted just three weeks before the great Tohoku earthquake.

Or perhaps this so-called “Assessment” was simply NWS Alaska Region management’s attempt to sweep these problems under the rug. The NWS may argue that there was not enough damage and/or deaths in the WC/ATWC’s AOR to warrant a more thorough assessment. If so, this reasoning offers little comfort to those impacted by this tsunami. It appears that the Alaska Region assessment was a whitewash that none of its authors dared to sign. This half-baked approach is troubling and those authors should be brought to account, particularly if they were also members of the Samoa Service Assessment or follow-on investigative teams.

The Complaint expressed more general concerns about a pattern of uneven treatment of the TWCs:

“A pattern of petty favoritism within the NWS started some time ago, continues unabated, and is simply too great to ignore. A number of PTWC staff were awarded NOAA Bronze Medals for their actions during the Sumatra tsunami. A number of ATWC staff were awarded NOAA Bronze Medals for expanding ATWC's AOR to include all of North America. Funny, we expanded our AOR to include another ocean basin (Indian), the South Atlantic and the Caribbean Sea. I would dare say that involved a much greater time and effort than what ATWC had to expend, but we don't seem to get any credit for that. Indeed, by May of 2005, PTWC had already put together a basin wide system in the Indian Ocean. It seems to us that the executive management of the NWS cares rather little about our international obligations now that it has obtained what it wanted by publicizing them.” (p. 24 of the Complaint)

Here are items that seem to relegate PTWC to second-class status:

- The Standby/Shift duty model seems to be an item of contention with the NWS even though there is no discernible effect on TWC performance.
- The lack of transparency during the Service Assessment and its Follow-On visit fueled ugly rumors throughout the NWS community:
 - that the PTWC Director would be removed and the WC/ATWC director put in charge of both TWCs
 - that the NWS would declare PTWC non-operational when the NWS finished their reports
- A threat in the Follow-On Report that WC/ATWC could take on all of PTWC's responsibilities outside of Hawaii if they did not adopt WC/ATWC's demonstrably error-prone software.
- A confidential memo proposing to consolidate PTWC with WC/ATWC in Palmer, Alaska, or in College Park, MD, that downplays the impending move of PTWC to the IRC (see the document "Confidential Memo").
- A lack of agency recognition and publicity following the visit of the President of Chile, Sebastian Piñera, to PTWC. Mr. Piñera visited PTWC to share his appreciation on behalf of Chile for actions taken by PTWC staff during the Chile tsunami of February 2010. PTWC is the only NOAA facility to ever receive a foreign head of state. PTWC staff themselves organized this affair with little support from the NWS (except some tents and picnic tables). No professional photographers were present at the behest of NOAA or its NWS.
- The NWS gave PTWC a "Unit Citation Award" in 2012. In addition to citing PTWC's performance during the 2011 Japan tsunami, this award includes PTWC's responses to the Samoa and Chile tsunamis. NOAA awarded Bronze Medals to PTWC for their performance during the Sumatra 2004 tsunami and to the WC/ATWC for expanding their AOR following the 2004 tsunami. So why not something comparable for the Japan tsunami? The

issue here is not the awards themselves, but the consistency of criteria for when they are awarded.

- Threats to revoke PTWC's authority-to-operate or declare it non-operational for IT security shortcomings even though WC/ATWC actually suffered an IT failure during a major tsunami and has not been met with a similar threat.
- The NWS changed the name change of WC/ATWC to the "National" TWC in October 2013. The NWS usually applies the term "National" to a unique or primary facility like NCEP facilities such as the National Hurricane Center. Ms. Furgione's letter (see document called "Letter") justifying the name change also downplays PTWC's domestic responsibilities by ignoring PTWC's obligations to the U.S. Defense and State Departments.

Concluding Remarks

Placing the US tsunami program under NOAA seems to make sense because tsunami hazards are oceanographic in nature, and putting the TWCs under the NWS seems to make sense because the NWS is the only NOAA unit that routinely deals with natural hazards in real time. Because the NWS is the only NOAA line office charged with protecting the lives and property of US citizens, it is also the only NOAA line office that continuously operates 24x7 and maintains good working relationships with emergency managers at the federal, state, and local levels as well as those in foreign governments. To accomplish its mission the NWS employs approximately 4000 staff who operate 122 Weather Forecast Offices (WFOs) for local weather forecasting, 21 Center Weather Service Units (CWSUs) for regional aviation weather forecasting, 13 River Forecast Centers (RFCs) for regional flood forecasting, 9 National Centers for Environmental Protection

(NCEP), and 11 National Specialized Centers for regional and national hazard forecasting (e.g. National Hurricane Center, Storm Prediction Center, etc.), plus 15 regional and national administrative offices.

Quite rightly the nation's weather enterprise is managed by people with weather know-how, and the NWS has a proven track record for effectively mitigating meteorological hazards. Having such expertise does not mean that it is equally capable of managing—or judging—a program built upon science and technology it does not understand. Precisely because the NWS is heavily geared towards forecasting weather and mitigating any hazards it may pose it is ill-suited to deal with tsunami threats, hazards generated by a very different mechanisms from weather and on very different timescales (the NWS is capable of predicting favorable conditions for tornado formation days in advance, while earthquakes have no known reliable precursor and no “season”). No one in the NWS's national leadership, including the tsunami program director, has ever worked at a TWC. No one in NWS's regional management with any authority over its TWCs has ever worked at a TWC either. The only people in NOAA who have ever had to make a life-or-death decision about tsunamis as they occur still work at the field-office level in the NWS.

The 4 tsunami field offices—PTWC, WC/ATWC, ITIC, and CPHC, plus the tsunami program manager and his staff in the NWS's National Headquarters—together make about 40 people or 1% of NWS personnel. By comparison, the National Hurricane Center alone employs over 60 people, not counting external support from other NCEP offices, NOAA's Hurricane Hunter aircraft unit, FEMA, the US Navy, etc. Such minimal staffing for the tsunami program is mind-boggling when considering a tsunami's potential impact: it is a natural hazard capable of hurricane-scale destruction but on tornado-like timescales but with an even shorter fuse.

PTWC's response to the Samoa tsunami was less than stellar and it did highlight problems that needed to be addressed. The subsequent NWS investigations were substantially less than stellar, however, but it is hard to imagine how it could have been otherwise given how poorly the NWS was already managing its tsunami

program. PTWC would have welcomed a fair assessment since it knows all too well how the NWS has historically neglected it in terms of support, whether it is adequate staffing (only five scientists at each TWC prior to 2005, and today still with fewer staff than a local WFO despite a TWC's global responsibilities), inadequate IT infrastructure (TWCs rely on constantly streaming, real-time data, and thus need greater network bandwidth than WFOs), and very different instruments than used at WFOs. The much-ballyhooed DART sensors, while useful and expensive, represent a small fraction of the total sensors that the TWCs rely on for operational data. In fact, the NWS does not own, and thus does not support, most of the instruments that the TWCs do rely on. The TWCs get most of their operational data from cooperative arrangements either with other NOAA agencies (i.e., NOS for coastal sea-level data), the US Geological Survey (its global seismic network), the Dept. of Defense (its seismic data for nuclear test monitoring), or instruments deployed primarily for academic earthquake or sea-level research (IRIS and UHSLC). Tsunami science is in its infancy compared to the much more mature meteorological sciences and is why TWCs are also centers for tsunami research. So far there is no equivalent to weather satellites or Doppler radar for tsunami hazard mitigation and that reality is why it is also so unfair for NWS meteorologists to judge TWC performance with their unrealistic expectations.

Currently the only way to speed up TWC response times to earthquakes is to install a dense, local-scale network of seismometers. In 2005 the NWS understood this truth when it began to install a dozen new seismometers in Hawaii to shorten its response time there, and why in 2009 NWS Directive 10-701 stated:

The PTWC serves as the operational center for the United Nations Educational, Scientific and Cultural Organization (UNESCO) Intergovernmental Oceanographic Commission's (IOC) Pacific Tsunami Warning and Mitigation System (PTWS). It has the primary responsibility for the detection and evaluation of tsunamis which threaten U.S. and foreign coasts throughout the Pacific Basin outside the WC/ATWC Pacific AOR. It

does not, however, have the capability nor responsibility to provide rapid local tsunami warnings outside of Hawaii.

In 2010, however, the NWS did not play by the rules it set for itself and the NWS's assessment teams criticized PTWC for not treating Samoa as it does Hawaii despite the lack of an equivalent density of instruments in the Samoa region, despite the lack of a reliable communication infrastructure in the region, despite the fact that the NWS office in Pago Pago made its own operational decisions regarding tsunamis without PTWC input, despite the fact that PTWC met the goals the NWS set for it, and despite the fact that the NWS did not even know what response time was technologically possible for this region. Instead, they chose to "compare and contrast" the performances of its two tsunami offices, with the Director of one of those offices and his immediate superiors participating in this exercise, and they acted "Shocked! Shocked!" that their own office—the office that has had greater support through the years—seemed to perform better that day. Furthermore, these NWS teams failed to understand basic facts about how a TWC operates: what an "observatory message" actually is, that PTWC was not (and still is not) responsible for maintaining its own web server, and worst of all, the nature of tsunami hazards in the first place. Such a disturbing level of ignorance and conflict of interest disqualifies them from passing any judgment on PTWC's performance. Such failings suggest managerial incompetence, but the fact that these teams even singled out PTWC's duty system for scrutiny—something that played no role in its response to the Samoa tsunami—suggests something far worse: an anti-PTWC agenda within the NWS that is all too consistent with the NWS's neglect of PTWC predating the Samoa tsunami. The recent name change of WC/ATWC to the "National" TWC and its implication that it is the superior TWC is only the most recent example of such favoritism.

The NWS also seems loath to give PTWC the public recognition it deserves. The very nature of the tsunami hazard means that PTWC frequently appears in the news media, yet neither NOAA nor its NWS seems to value PTWC for the high-profile asset that it is. The public and the government partners that PTWC serves seem grateful for its services, evidenced by personal staff interactions, "fan mail,"

positive feedback on PTWC's social media sites, and the only visit to a NOAA or NWS facility by a foreign head of state.

It would appear that the overall problems the NWS has with the TWP exist because it does not fully understand its responsibilities and systems of the TWP. The NWS has its hands full with the great variety of weather and weather-related hazards faced by the US territories. It cannot continue to manage the TWP as an afterthought or a satellite program. Elevating the TWP to a line office under NOAA would improve communication and cooperation with other NOAA line offices and allow the TWP to govern its own affairs. It would also relieve the NWS Pacific and Alaska regions the burden of having to support the TWP.

NOAA is made up of several “line” offices or organizational units:

<http://www.corporateservices.noaa.gov/public/lineoffices.html>

Creating a new tsunami line office within NOAA would be complicated at first and it will require a congressional mandate but it will be worth the effort. If the TWP was elevated to its own NOAA line office it could manage itself better; it could formulate its own policies and police itself with much more rigor and without the biases of the NWS, who fails repeatedly to understand the nuts and bolts of tsunami warning science and tsunami warning operations. Elevating the TWP to a line office within NOAA, of course, will require additional personnel for accounting, management, media, and other positions to coordinate with other NOAA line offices such the NWS, NOS etc., other government offices, and the public at large. It should be noted that any increase in operating costs for the TWP to make it a NOAA a line office would be relatively small compared to the resources already used by the TWP. The improvement in service and reliability: priceless.