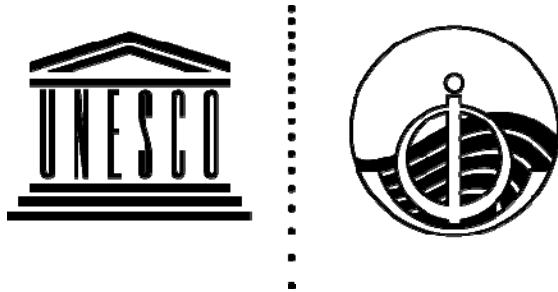


## **12 January 2010 Haiti Earthquake and Tsunami Event**

### **Post-Event Assessment of CARIBE EWS Performance**



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### **Post-Event Assessment of CARIBE EWS Performance**

**Tsunami and other Coastal Hazards Warning System for the  
Caribbean and Adjacent Regions (CARIBE EWS)**

**UNESCO 2010**



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**For bibliographic purposes, this document should be cited as follows:**

**12 January 2010 Haiti Earthquake and Tsunami Event Post-Event Assessment  
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*IOC Technical Series, 90.* UNESCO 2010 (English)

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## **Executive Summary**

The 26 December 2004 tsunami in the Indian Ocean killed over 230,000 people, displaced more than 1 million people and left a trail of destruction. Considering that the Caribbean is a region prone to tsunamis, and recognising the need for an early warning system, the Intergovernmental Coordination Group (ICG) for the Tsunami and other Coastal Hazards Warning System for the Caribbean and Adjacent Regions (CARIBE EWS) was established in 2005 as a subsidiary body of the IOC-UNESCO with the purpose of providing assistance to all Member States of the region to establish their own regional early warning system.

The main objective of the CARIBE EWS is to identify and mitigate the hazards posed by local and distant tsunamis. The goal is to create a fully integrated end-to-end warning system comprising four key components: hazard monitoring and detection; hazard assessment; warning dissemination; and community preparedness and response. The Pacific Tsunami Warning Centre (PTWC) in Hawaii is the interim tsunami warning service provider for the Caribbean. The West Coast and Alaska Tsunami Warning Centre (WC/ATWC) is providing tsunami warning service for the USA territories in the Caribbean region.

The magnitude 7.0 earthquake in Haiti on the 12 January 2010 was one of the most severe earthquakes that occurred in this country in the last 100 years. It caused a large number of casualties and material destruction. In addition, the earthquake generated a tsunami that caused a runup of 3m at both Jacmel and Petit Paradis, Haiti and 1m in Pedernales, Dominican Republic. Furthermore, it was recorded with an amplitude of 12 cm (peak to trough) at the Santo Domingo sea level station in the Dominican Republic. The arrival time was at 22:40 UTC, namely 47 minutes after the earthquake occurred. This tsunami recalled the need to effectively implement the CARIBE EWS to be prepared for future potentially destructive tsunamis in the region.

The event therefore presented an ideal opportunity to evaluate the performance of the CARIBE EWS to highlight both the strengths and weaknesses of the system, to identify areas that require further attention, and to provide a benchmark of the present status of the system. The UNESCO IOC Secretariat for the CARIBE EWS sent out a post-event survey questionnaire to Member States and territories that have identified their Tsunami Warning Focal Points (TWFP). Out of 28 questionnaires sent out, 23 responses were returned to the CARIBE EWS Secretariat in Paris. The objectives of the survey were to confirm that the NTWCs received bulletins from the interim advisory service in a timely manner, to determine what actions were taken by the NTWCs, and to find out if the Member States activated their emergency response plans based on the available information.

The survey was very useful to get an overview of the current status of the CARIBE EWS. Tsunami bulletins were received timely by most of the countries that answered the survey. On the other hand, it was identified that sea level was scarcely monitored during the event, and that some National Warning Centres (NWC) do not know how to access sea level data over the GTS or over the IOC Sea Level Observation Facility website. Most NWCs did not use any numerical models during the event. It was observed, as well, that countries placed in watch level were able to distribute warnings and even preventively evacuate some areas.

It is beyond the scope of this report to conduct a detailed interpretation of the results, and the survey results have been presented so that individual Member States and the ICG can draw conclusions from this exercise and decide on future action. Although progress has been made since 2005, it should be recognized that the CARIBE EWS is not yet fully implemented and much remains to be done to bring the system to full operational status. The ICG will continue to monitor the system to ensure continuous improvement during the development phase.

## Résumé exécutif

Le tsunami de l'océan Indien du 26 décembre 2004 a fait plus de 230 000 victimes, causé le déplacement de plus d'un million de personnes et apporté son lot de destructions. Compte tenu que les Caraïbes sont une région sujette aux tsunamis, et vu la nécessité d'un système d'alerte précoce, un Groupe intergouvernemental de coordination du Système d'alerte aux tsunamis et aux autres risques côtiers dans la mer des Caraïbes et les régions adjacentes (GIC/CARIBE-EWS) a été créé en 2005 en tant qu'organe subsidiaire de la COI de l'UNESCO, dans le but de prêter assistance à l'ensemble des États membres de la région pour qu'ils mettent en place un système régional d'alerte précoce.

Le CARIBE-EWS est principalement chargé d'identifier et de limiter les risques que font peser les tsunamis locaux et lointains. L'objectif est de créer un système d'alerte pleinement intégré de bout en bout, comprenant quatre composantes clés : surveillance et détection des risques ; évaluation des risques ; diffusion des alertes ; préparation et réponse des communautés. C'est le Centre d'alerte aux tsunamis dans le Pacifique (PTWC) de Hawaïi qui, à titre provisoire, fournit des services d'alerte aux tsunamis aux pays des Caraïbes, le Centre d'alerte aux tsunamis de la côte Ouest et de l'Alaska (WCATWC) offrant ses services d'alerte aux territoires des États-Unis dans la région.

Le séisme de magnitude 7 (Mw 7) survenu le 12 janvier 2010 en Haïti à 21 h 53 TU est l'un des plus graves qu'ait connu ce pays depuis un siècle. Il a fait un grand nombre de tués et de blessés et provoqué d'importants dégâts matériels. Par ailleurs, le séisme a donné lieu à un tsunami, produisant un « runup » de 3 m aussi bien à Jacmel qu'à Petit Paradis (Haïti) et d'1 m à Pedernales (République dominicaine). Le Centre d'alerte aux tsunamis dans le Pacifique (PTWC) à Hawaïi (États-Unis d'Amérique) a publié un avis d'alerte au tsunami pour Haïti, Cuba, les Bahamas et la République dominicaine à 22 h 03 TU (soit dix minutes après l'événement). L'amplitude du tsunami a été mesurée à 12 cm (du sommet au creux) à la station de surveillance du niveau de la mer de Saint-Domingue (République dominicaine), où il s'est produit à 22 h 40 TU, soit 47 minutes après le séisme. Il nous rappelle la nécessité d'améliorer l'efficacité du CARIBE-EWS, afin d'être préparés à de futurs tsunamis potentiellement destructeurs dans la région.

Cet événement a donc offert une occasion idéale d'évaluer la performance du CARIBE-EWS, afin de mettre en évidence les forces et les faiblesses du système, de repérer les domaines exigeant une attention supplémentaire et d'offrir un point de référence sur l'état actuel du système. La COI de l'UNESCO a adressé un questionnaire d'enquête sur les conséquences de la catastrophe aux États membres et aux territoires ayant désigné des Points focaux pour l'alerte aux tsunamis (TWFP). Sur les 28 questionnaires envoyés, le Secrétariat du CARIBE-EWS a reçu 23 réponses. L'objectif était de savoir si les Centres nationaux d'alerte aux tsunamis (NTWC) avaient reçu en temps opportun les bulletins du service consultatif intérimaire, quelles mesures les NTWC avaient prises, et si les États membres avaient mis en œuvre leurs plans de réponse à l'urgence à partir des informations transmises. Les principaux résultats sont les suivants (on trouvera le rapport complet dans le n° 90 de la Série technique de la COI, le résumé exécutif étant traduit dans les six langues officielles de l'UNESCO) : (1) Les bulletins relatifs aux tsunamis ont été reçus en temps opportun par la plupart des pays ayant répondu à l'enquête. (2) Le niveau de la mer n'a quasiment pas été surveillé pendant l'événement. (3) Certains Centres d'alerte nationaux (NWC) ne savent pas consulter les données concernant le niveau de la mer via le GTS ou le site Internet du Service d'observation du niveau de la mer de la COI. Le GIC du CARIBE-EWS prend des dispositions afin de remédier à ces lacunes. On a également observé que les pays placés en

état de veille ont été capables de donner l'alerte et même d'évacuer certaines zones à titre préventif.

Il n'entre pas dans le cadre du présent rapport d'offrir une interprétation détaillée des résultats de l'enquête, qui ont été présentés de façon à permettre aux États membres et au Groupe intergouvernemental de coordination (GIC) au niveau régional de tirer les conclusions de cet exercice et de décider de l'action future. Bien que des progrès aient été accomplis depuis 2005, il convient de reconnaître que le CARIBE-EWS présente encore des lacunes et que beaucoup reste à faire pour que le système soit pleinement opérationnel. Le GIC continuera de superviser ce dispositif et d'apporter des améliorations en permanence pendant la phase de mise en place.

## Resumen dispositivo

El tsunami ocurrido el 26 de diciembre de 2004 en el Océano Índico causó la muerte de más de 230.000 personas, produjo más un millón de refugiados y dejó una estela de devastación. Siendo el Caribe una región expuesta a los tsunamis y al reconocerse la necesidad de disponer de un sistema de alerta temprana, se creó en 2005 el Grupo Intergubernamental de Coordinación (ICG) del Sistema de Alerta contra los Tsunamis y otras Amenazas Costeras en el Caribe y Regiones Adyacentes (CARIBE-EWS), en calidad de órgano subsidiario de la Comisión Oceanográfica Intergubernamental (COI) de la UNESCO, con el fin de prestar asistencia a todos los Estados Miembros de la región para que crearan su propio sistema regional de alerta temprana.

El propósito fundamental del CARIBE-EWS consiste en detectar y atenuar los riesgos que entrañan los tsunamis, tanto locales como distantes. El objetivo es crear un sistema de alerta integral compuesto de cuatro elementos fundamentales: vigilancia y detección de riesgos, evaluación de riesgos, difusión de mensajes de alerta y preparación y respuesta comunitarias. El Centro de Alerta contra los Tsunamis en el Pacífico (PTWC) de Hawai presta con carácter provisional servicios de alerta contra tsunamis en el Caribe. El Centro de Alerta contra los Tsunamis de Alaska y la Costa Occidental (WC/ATWC) proporciona servicios de alerta contra los tsunamis a los territorios de los Estados Unidos de América situados en la región del Caribe.

El terremoto de magnitud 7,0 Mw que sacudió a Haití el 12 de enero de 2010 a las 21.53 horas UTC fue uno de los más intensos registrados en ese país en los últimos 100 años. El seísmo causó un gran número de víctimas e ingentes daños materiales. Además, el terremoto generó un tsunami que dio lugar a una altura de inundación de tres metros en Jacmel y Petit Paradis (Haití) y de un metro en Pedernales (República Dominicana). El Centro de Alerta contra los Tsunamis en el Pacífico (PTWC) de Hawai (Estados Unidos de América) emitió un aviso sobre tsunami para Haití, Cuba, Las Bahamas y la República Dominicana a las 22.03 UTC (10 minutos después del acontecimiento). El tsunami se registró una amplitud de 12 cm (entre valle y cresta) en la estación mareográfica de Santo Domingo (República Dominicana), donde la hora de llegada fue las 22.40 UTC, 47 minutos después de que sobreviniera el terremoto. Este tsunami puso una vez más de manifiesto la necesidad de organizar eficazmente el CARIBE-EWS, en previsión de futuros tsunamis que podrían tener un efecto devastador en la región.

Por lo tanto, este suceso ofreció una oportunidad ideal para evaluar el funcionamiento del CARIBE-EWS con el fin de resaltar tanto los puntos fuertes como las deficiencias del sistema, definir los aspectos que necesitan más atención y establecer su situación actual como punto de referencia para el futuro. La COI de la UNESCO envió un cuestionario sobre este tsunami a los Estados Miembros y territorios que habían designado a sus puntos focales de alerta contra los tsunamis (TWFP). De los 28 cuestionarios remitidos, se recibieron 23 respuestas en la Secretaría del CARIBE-EWS. Los objetivos de la encuesta eran confirmar que los Centros nacionales de alerta contra los tsunamis (NTWC) habían recibido a tiempo los boletines del servicio provisional de alerta, determinar qué medidas habían adoptado dichos Centros y averiguar si los Estados Miembros habían activado sus planes de respuesta de emergencia sobre la base de la información disponible. Los principales resultados (el informe completo figura en el N° 90 de la Colección técnica de la COI, cuyo resumen se tradujo a las 6 lenguas de trabajo de la UNESCO) son los siguientes: 1) la mayoría de los países que respondieron al cuestionario habían recibido oportunamente los boletines sobre el tsunami; 2) se constató que se había vigilado escasamente el nivel del mar durante el evento; 3) algunos de los centros nacionales de alerta no saben acceder a los datos relativos al nivel del mar mediante el Sistema Mundial de Telecomunicación (SMT) ni a través del sitio web del servicio de observación del nivel del mar de la COI. El GIC del CARIBE-EWS está tomando medidas para corregir estos tres puntos. Asimismo se pudo

observar que los países a los que se había alertado habían podido difundir avisos e incluso realizar evacuaciones preventivas en determinadas zonas.

La interpretación pormenorizada de los resultados de estas medidas excedería el marco del presente informe, y los resultados de la encuesta se han presentado a fin de que los Estados Miembros y el Grupo Intergubernamental de Coordinación (ICG) de la región puedan extraer conclusiones de la operación y adoptar decisiones acerca de la acción futura. Aunque desde 2005 se han realizado algunos progresos, hay que reconocer que el CARIBE-EWS todavía no se ha establecido íntegramente y queda mucho por hacer para que el sistema esté en condiciones de pleno funcionamiento. El ICG seguirá velando por su mejora permanente durante la fase de desarrollo.



## 执行概要

2004 年 12 月 26 日发生在印度洋的海啸夺走了 230,000 多人的生命，100 多万人流离失所，并造成了严重的毁坏。鉴于加勒比是一个容易遭受海啸侵袭的地区，并认识到该地区需要建立预警系统，2005 年成立了“加勒比海和周边地区海啸与其它沿海灾害警报系统”（CARIBE-EWS）政府间协调小组（ICG），将其作为教科文组织/政府间海洋学委员会的附属机构，其宗旨是为该地区的所有会员国提供帮助，以建立他们自己的地区预警系统。

加勒比海和周边地区海啸与其它沿海灾害警报系统（CARIBE-EWS）的主要目的是发现由当地或远处发生的海啸所导致的灾害，并减轻其造成的危害。具体目标是建立一个全面综合的端对端警报系统，该系统由四个主要部分组成：灾害的监测与发现；灾害的评估；警报的传播；社区的准备和应对。位于夏威夷的太平洋海啸预警中心（PTWC）是临时为加勒比地区提供服务的海啸预警系统。西海岸和阿拉斯加海啸预警中心（WC/ATWC）则向加勒比地区的美利坚合众国领土提供海啸预警服务。

2010 年 1 月 12 日世界标准时间 21:53 时发生在海地的强度为 7.0 级的地震是该国近 100 年来所遭遇的最为严重的地震之一。地震造成了大量的人员伤亡和物质损毁。此外，地震还引发了海啸，在海地的 Jacmel 和 Petit Paradis，海啸高达 3 米，在多米尼加共和国的 Pedernales，海啸高达 1 米。位于美国夏威夷的太平洋海啸预警中心在世界标准时间 22:03 时（地震发生后 10 分钟）发布了一份海地、古巴、巴拿马和多米尼加共和国的海啸警报。多米尼加共和国圣多明各海平面监测站记录到 12 cm 宽波幅（潮峰至潮谷）的海啸。海啸到达的时间是世界标准时间 22:40 时，即地震发生后 47 分钟。这次海啸的发生提醒了我们，需要为“加勒比海和周边地区海啸与其它沿海灾害警报系统”增加配套功能，以应对该地区今后有可能发生的灾难性海啸。

因此，这一事件为评估“加勒比海和周边地区海啸与其它沿海灾害警报系统”的功能提供了极好的机会，以发现这一系统的强项和不足之处，确定需要进一步关注的领域，并提供该系统目前状态下的基准。教科文组织/政府间海洋学委员会向已经确定了其海啸预警联络处（TWFP）的会员国和领土寄发了一份“事后调查问卷”。总共寄出了 28 份问卷，加勒比海和周边地区海啸与其它沿海灾害警报系统秘书处收到了 23 份回复。调查的目的是核实各国的国家海啸警报中心（NTWC）能否及时收到临时咨询服务机构提供的公告，从而确定国家海啸警报中心应采取的行动，并了解会员国是否根据获得的信息启动了应急计划。调查的主要结论（报告全文列入了《政府间海洋学委员会技术系列 90》，执行概要已翻译成教科文组织的 6 种工作语言）是：(1) 大部分作出回复的会员国都及时收到了关于海啸的公告，(2) 在灾难发生时，很少监测海平面数据，(3) 一些国家警报中心不知道如何从全球电讯系统或

从海洋学委员会海平面观察系统的网站获取有关海平面的数据。加勒比海和周边地区海啸与其它沿海灾害警报系统政府间协调小组正在采取行动以解决上述最后三个方面的问题。但我们也注意到被列入受观察一级的国家都能够传播警报，甚至预防性地从某些地区撤离。

本报告篇幅有限，无法详细地解读调查结果。提供调查结果是为了让会员国和地区政府间协调小组（ICG）能够从中得出结论，并决定今后的行动。虽然自 2005 年以来“加勒比海和周边地区海啸与其它沿海灾害警报系统”的工作已经取得了进展，但应当承认，该系统并没有得到充分的利用，要充分发挥该系统的作用还有许多工作要做。政府间协调小组将继续对系统进行监测，确保在开发阶段该系统能不断得到改进。

## ملخص تنفيذي

تسبب التسونامي الذي حدث في المحيط الهندي في 2004/12/26 في مقتل ما يزيد على 000 230 شخص وتشريد ما يربو على مليون، وخلف وراءه سلسلة من الدمار. ومراعاة لأن منطقة الكاريبي منطقة معرضة للتسونامي، وتسليماً بالحاجة إلى وجود نظام للإنذار المبكر، أنشئ في عام 2005 "فريق التنسيق الدولي الحكومي لنظام الإنذار بالتسونامي وغيره من الأخطار الساحلية في البحر الكاريبي والمناطق المتاخمة"، كهيئة فرعية للجنة اليونسكو الدولية الحكومية لعلوم المحيطات، بغرض تقديم المساعدة لجميع الدول الأعضاء في المنطقة لإنشاء نظمها الإقليمية الخاصة بها للإنذار المبكر.

والهدف الرئيسي من هذا النظام هو تحديد الأخطار الناشئة عن حالات التسونامي المحلية والبعيدة وتخفيف آثارها. والغاية من ذلك هي إيجاد نظام شامل ومتكامل للإنذار يضم أربعة مكونات أساسية هي: رصد الأخطار والكشف عنها؛ وتقييم الأخطار؛ ونشر الإنذارات؛ والتأهب والاستجابة على مستوى المجتمع المحلي. ومركز الإنذار بالتسونامي في المحيط الهادي في هاواي هو الذي يقدم بصفة مؤقتة خدمة الإنذار بالتسونامي في منطقة البحر الكاريبي. ويوفر مركز الإنذار بالتسونامي في الساحل الغربي وألاسكا خدمة الإنذار في أقاليم الولايات المتحدة الأمريكية الواقعة في منطقة البحر الكاريبي.

وكان الزلزال الذي وقع في هايتي في 2010/1/12 في الساعة 9.35 مساءً بالتوقيت العالمي المنسق وبلغت قوته 7 درجات على مقياس الشدة الآتية واحداً من أشد الزلازل التي حدثت في هذا البلد في المائة سنة الأخيرة. وتسبب في عدد كبير من الخسائر في الأرواح وقدر كبير من الدمار المادي. وبالإضافة إلى ذلك أدى الزلزال إلى تسونامي رفع منسوب سطح البحر بمقدار 3 أمتار في كل من "جاسمل" و "بيتي بارادي" في هايتي، و متر واحد في "بيديرناليس" في الجمهورية الدومينيكية. وقد أصدر مركز المحيط الهادي للإنذار بالتسونامي الواقع في هاواي بالولايات المتحدة إنذاراً باحتمال وقوع حالة تسونامي في هايتي وكوبا وجزر الباهاما والجمهورية الدومينيكية في الساعة 22.03 مساءً بالتوقيت العالمي المنسق (10 دقائق بعد الحدث). وبلغت قيمة الذروة لهذا التسونامي 12 سنتيمتراً (من الذروة إلى الغور) في محطة سانتياغو لقياس منسوب سطح البحر في الجمهورية الدومينيكية حيث وصل في الساعة 22.40 مساءً بالتوقيت العالمي المنسق، أي بعد 47 دقيقة من حدوث الزلزال. وذكر هذا التسونامي بالحاجة إلى تشغيل نظام الإنذار بالتسونامي في البحر الكاريبي والمناطق المتاخمة بشكل فعال للاستعداد لحالات التسونامي المدمرة المحتمل وقوعها في المنطقة.

ولهذا، أتاح هذا الحدث فرصة مثالية لتقييم أداء هذا النظام وإبراز ما فيه من أوجه قوة وضعف، وتحديد المناطق التي تتطلب المزيد من الاهتمام، وتوفير مقياس يسمح بتقييم الحالة الراهنه للنظام. ووجهت لجنة اليونسكو لعلوم المحيطات استبياناً استقصائياً إلى الدول الأعضاء والأقاليم التي حددت مراكزها المعنية بتنسيق شؤون الإنذار بالتسونامي. ومن بين الاستبيانات التي تم إرسالها والبالغ عددها 28 استبياناً، ورد إلى أمانة نظام الإنذار بالتسونامي في البحر الكاريبي 23 رداً. وكانت أهداف هذه الدراسة الاستقصائية هي التأكد من وصول البلاغات في الوقت المناسب إلى مراكز الإنذار الوطنية من الهيئة المؤقتة، وتحديد الإجراءات التي اتخذتها مراكز الإنذار الوطنية، ومعرفة ما إذا كانت الدول الأعضاء قد نفذت خطط الطوارئ الموجودة لديها على أساس المعلومات المتاحة. وترد فيما يلي الاستنتاجات الرئيسية (يأتي

التقرير الكامل في إطار "السلسلة الفنية رقم 90 للجنة الدولية الحكومية لعلوم المحيطات"، والملخص التنفيذي مترجم إلى لغات العمل الست في اليونسكو):

(1) وردت البلاغات المتعلقة بالتسونامي في الوقت المناسب إلى معظم البلدان التي ردت على الدراسة، (2) نادراً ما جرى رصد منسوب سطح البحر في أثناء التسونامي، (3) لا تعلم بعض مراكز الإنذار الوطنية كيف تحصل على بيانات منسوب سطح البحر من "النظام العالمي للاتصالات" (GTC) أو من موقع "هيئة رصد منسوب سطح البحر" التابعة للجنة علوم المحيطات. ويجري الآن اتخاذ الإجراءات اللازمة في إطار نظام الإنذار بالتسونامي في البحر الكاريبي لمعالجة هذه النقاط الثلاث. ولوحظ كذلك أن البلدان التي طلب منها أن تكون في حالة تأهب استطاعت أن توجه الإنذارات اللازمة، بل وأن تخلي بعض المناطق من سكانها كإجراء وقائي.

ولا يدخل في نطاق هذا التقرير إجراء تفسير مفصل للنتائج، وقُدمت نتائج الدراسة الاستقصائية حتى تتمكن الدول الأعضاء وفريق التنسيق الدولي الحكومي الإقليمي من الوصول إلى استنتاجاتها من هذه العملية وتقرير الإجراءات المطلوبة في المستقبل. ويجدر التسليم، رغم ما أحرز من تقدم منذ عام 2005، بأنه لم يستكمل بعد التنفيذ التام لنظام الإنذار بالتسونامي وغيره من الأخطار الساحلية في البحر الكاريبي والمناطق المتاخمة، وأنه لا يزال يتعين بذل الكثير من الجهود للوصول بالنظام إلى مرحلة التشغيل التام. وسيواصل فريق التنسيق الدولي الحكومي رصد النظام لكفالة استمرار تحسينه في مرحلة التطوير.

## **Рабочее резюме**

26 декабря 2004 г. цунами в Индийском океане унесло жизни более 230 000 человек, привело к переселению более одного миллиона человек и оставило за собой разрушительный след. Учитывая, что страны Карибского бассейна подвержены воздействию цунами, и признавая необходимость создания системы раннего предупреждения, в 2005 г. была учреждена Межправительственная координационная группа МОК (МКГ) по Системе предупреждения о цунами и опасности других бедствий в прибрежных районах Карибского бассейна и прилегающих регионов (КАРИБ-СРП) в качестве вспомогательного органа ЮНЕСКО/МОК в целях оказания помощи всем государствам – членам этого региона в создании собственной региональной системы раннего предупреждения.

Основная задача КАРИБ-СРП заключается в выявлении и смягчении последствий опасностей, возникающих в связи с местными и удаленными цунами. Целью является создание полностью интегрированной сквозной системы предупреждения, включающей четыре основных компонента: мониторинг и обнаружение опасности; оценка опасности; оповещение; обеспечение готовности общин и меры реагирования. Тихоокеанский центр предупреждения о цунами (ПТВЦ), расположенный на Гавайях, на временной основе предоставляет информацию о наблюдении за цунами странам Карибского бассейна. Центр предупреждения о цунами на западном побережье/Аляске (ЗП/АТВЦ) отвечает за предупреждения о цунами на территориях США в Карибском бассейне.

Землетрясение магнитудой 7 баллов, произошедшее на Гаити 12 января 2010 г. в 21.53 ВКВ (всемирное координированное время), было одним из сильнейших землетрясений в этой стране за последние сто лет. Оно сопровождалось многочисленными человеческими жертвами и материальными разрушениями. Помимо этого, землетрясение вызвало цунами с накатом волны, достигавшим трех метров у г. Жакмель и деревни Пти-Паради (Гаити) и одного метра в провинции Педерналес (Доминиканская Республика). Тихоокеанский центр предупреждения о цунами (ПТВЦ) на Гавайях (США) издал оповещение о цунами для Гаити, Кубы, Багамских Островов и Доминиканской Республики в 22.03 ВКВ (через 10 минут после события). Станция по измерению уровня моря Санто-Доминго в Доминиканской Республике зарегистрировала цунами амплитудой 12 см (между максимальным и минимальным значениями); приход цунами был зарегистрирован в 22.40 ВКВ, т.е. через 47 минут после начала землетрясения. Цунами напомнило о необходимости создания эффективной КАРИБ-СРП в целях подготовки к возможному разрушительному цунами в данном регионе.

Таким образом, это событие предоставляет идеальную возможность для оценки эффективности деятельности КАРИБ-СРП в целях выделения сильных сторон и недостатков системы, определения областей, требующих дополнительного внимания, и представления контрольных показателей нынешнего состояния системы. С целью проведения обследования ЮНЕСКО/МОК направила после этого события вопросник государствам-членам и территориям, которые определили свои координационные центры предупреждения о цунами (КПЦ). Секретариат КАРИБ-СРП получил 22 ответа на 28 направленных вопросников. Цели этого обследования состояли в том, чтобы подтвердить, что национальные центры предупреждения о цунами (НЦПЦ) своевременно получили бюллетени от центров предупреждения о цунами, временно отвечающих за этот регион, определить меры, принятые НЦПЦ, и выяснить, привели

ли в действие государства-члены свои планы реагирования в чрезвычайных ситуациях на основе предоставленной информации. Основные выводы (полный доклад № 90 в Серии технических докладов МОК и рабочее резюме, переведенное на шесть рабочих языков ЮНЕСКО) заключаются в следующем: (1) большинство стран, принявших участие в обследовании, вовремя получили бюллетени по цунами; (2) во время стихийного бедствия почти не проводился мониторинг уровня моря; (3) некоторые (НЦП) не знают, как получить доступ к данным об уровне моря через ГСТ или веб-сайт, посвященный механизму МОК по наблюдению за уровнем моря. МКГ/КАРИБ-СРП принимает меры для исправления положения в отношении трех последних пунктов. Было также отмечено, что страны, где был введен режим повышенной готовности, смогли распространить тревожные сообщения и даже в превентивном порядке эвакуировать жителей некоторых районов.

Подробная интерпретация полученных данных выходит за рамки настоящего доклада, однако результаты обследования представлены таким образом, что отдельные государства-члены и региональная Межправительственная координационная группа (МКГ) могут сделать выводы на его основании и принять решение о будущих мерах. Несмотря на прогресс, достигнутый после 2005 г., следует признать, что КАРИБ-СРП пока не реализована в полном объеме, и предстоит еще многое сделать для доведения этой системы до полного оперативного состояния. МКГ будет и далее осуществлять мониторинг системы в целях обеспечения ее постоянного совершенствования на этапе формирования.

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## 1. Introduction

### 1.1 Background

The 26 December 2004 tsunami killed over 230,000 people, displaced more than 1 million people and left a trail of destruction around the coasts of the Indian Ocean. Although the tsunami took over 2 hours to cross the Bay of Bengal, more than 50,000 in India, Sri Lanka, Maldives and East Africa lost their lives. An early warning system would have saved many thousands of lives, but none was in place at the time.

The Caribbean is an area of relatively high seismicity as it is surrounded by subduction zones that are potential sources of tsunamigenic earthquakes (e.g. McCann, 2006; Müller et al., 1999; NGI, 2009c). As a consequence, large zones of the Caribbean region are vulnerable to earthquake, volcano and landslide induced tsunamis. During the last 500 years, the Caribbean has experienced devastating tsunamis that have caused incalculable damage (NGI, 2009a). As an example, the tsunami in Dominican Republic in 1946 claimed over 1,500 lives.

Recognising the need for an early warning system specially after the lessons learnt from the 2004 Indian Ocean tsunami, the Intergovernmental Coordination Group for the Tsunami and other Coastal Hazards Warning System for the Caribbean and Adjacent Regions (ICG/CARIBE EWS) was established in 2005 as a subsidiary body of the IOC-UNESCO with the purpose of providing assistance to all Member States of the region to establish their own regional early warning system. The ICG/CARIBE EWS had its first meeting in Bridgetown, Barbados, in January 2006, and since then has met three more times. (Venezuela, 2007; Panama, 2008; and Martinique 2009).

The main objective of the CARIBE EWS is to identify and mitigate the hazards posed by local and distant tsunamis. The goal is to create a fully integrated end-to-end warning system comprising four key components: hazard monitoring and detection; hazard assessment; warning dissemination; and community preparedness and response.

The CARIBE EWS is owned by the Member States of the Caribbean Region and requires a high degree of international and multilateral cooperation, under the governance of IOC. It is designed according to well-defined operational standards which are uniformly implemented across the broad range of activities of the CARIBE EWS.

The Pacific Tsunami Warning Centre (PTWC) in Hawaii is the interim tsunami warning service provider for the Caribbean. The West Coast and Alaska Tsunami Warning Centre (WC/ATWC) is providing tsunami warning service for the USA territories in the Caribbean region. The tsunami warning duty should be assumed by the proposed Caribbean Tsunami Warning Centre (CTWC). The United States has introduced their phased approach to develop the CTWC, which establishes three planning phases, each with a discrete decision point that determines whether to proceed to the next phase.

Moreover, significant progress has also been made towards the establishment of the Caribbean Tsunami Information Centre (CTIC) in Barbados. The CTIC will be established thanks to a three-year funding agreement between UNDP Barbados and the OECS Subregional Office, the Government of Italy and the Government of Barbados, under the framework of the project “Enhancing Resilience to reduce vulnerability in the Caribbean”.



At the national level, each Member State is responsible for issuing warnings to its own citizens through their National Tsunami Warning Centres (NTWC) or the designated authorities. These warnings are based either on the NTWC's own analysis of the situation, on the advisory messages received from PTWC and WC/ATWC (and some other sources), or on a combination of both.

At the local level, coastal communities must be prepared to respond to warnings received through national dissemination channels. This is perhaps the greatest long term challenge facing the CARIBE EWS.

## **1.2 Status of CARIBE EWS as of 31 December 2009**

Since 2006 there has been considerable progress in the installation of vital earthquake and tsunami detection equipment. As of 31 December 2009, there are over 110 seismic stations with real-time seismic data exchange capabilities in the Caribbean region. These stations are operated by local, regional and global seismic networks. Earthworm and SeisComp are used for the real-time exchange of seismic data. Seismic data exchange for tsunami warning purposes is progressing well in the region. Results from the USGS Network Capability Modelling study indicate that the CARIBEEWS minimum performance criteria can be achieved with the 121 station core seismic network. Of the 121 stations, there are 10 stations for which funding has yet to be identified. Efforts are also underway to engage the network operators of existing core stations but for which there is no real time data exchange.

In addition, significant improvement has been achieved in terms of sea level monitoring coverage. 100 sea level stations, including 94 coastal gauges and 6 DART buoys have been identified as part of the CARIBEEWS core sea level network. The coastal stations have been divided into high and medium priority stations. Of the 100 stations, only 20 coastal stations, all in the north-eastern Caribbean, Bahamas and Bermuda, and the 6 DART buoys are providing data within 15 minutes, the requirement for stations within the Caribbean due to the very rapid travel time of tsunamis to coastal areas. The CARIBE-EWS has been coordinating with regional and global sea level initiatives like the CARICOM Caribbean Centre for Climate Change, which has upgraded 11 stations in the region and IOCARIBE-GOOS and GLOSS who have long standing projects in the region. The coordination with these efforts will support the multipurpose application of these sea level stations. The USA, with support of the University of Hawaii Sea Level Centre (UHSLC) and the Puerto Rico Seismic Network (PRSN), has offered to install 11 additional sea level stations in the region during 2009 and 2010.

The Puerto Rico Seismic Network (PRSN), located at the University of Puerto Rico, Mayaguez Campus, has become operational on a 24/7 basis and is providing earthquake and tsunami information and warning for Puerto Rico and the Virgin Islands as well as post-earthquake information for the Caribbean and adjacent regions.

## **1.3 12 January 2010 Haiti Tsunami – an Opportunity to Assess Performance**

One of the most severe earthquakes in more than 100 years hit the Caribbean country of Haiti at 21:53 UTC (16:53 local time). With a magnitude of Mw 7.0, a very shallow depth (10 km) and located close to the capital Port au Prince, it caused severe destruction and casualties. The tsunami warning system for the Caribbean CARIBE-EWS went into action, and first reports indicate that timely and adequate information was produced and disseminated.

The Pacific Tsunami Warning Center in Hawaii, responsible ad interim for the Caribbean, issued a Tsunami Message distributed to Tsunami Warning 24/7 focal points registered with UNESCO, 10 minutes after the earthquake (at 22:03 UTC) containing a Tsunami Watch for Haiti/Cuba/Bahamas/Dominican Republic. The tsunami watch was cancelled at 23:45 UTC after readings from real time sea level monitoring stations confirmed a tsunami measuring 12 cm crest-to-trough was recorded at Santo Domingo in the Dominican Republic and a tsunami less than 1 cm crest-to-trough was recorded on a deep ocean gauge in the East-central Caribbean.

This is the third reminder in the period of only three years that the Caribbean has a distinct potential to be affected by a tsunami. On 28 May 2009, an earthquake M 7.3 struck off Honduras at 2:25 AM local time with a depth of 10 Km. PTWC issued at that opportunity a Tsunami Watch for Honduras/Belize/Guatemala, 8 minutes after the earthquake. Local field surveys demonstrated later on that a small tsunami was generated, flooding some low-lying areas on the Guatemala/Honduras border. This occurred a year and a half after a similar event of magnitude Mw 7.4 happened on Thursday, 29 November 2007 at 15:00 local time UTC in the region of Martinique, French Antilles.

The event of 12 January therefore presented an ideal opportunity to evaluate the performance of the CARIBE EWS, to highlight both the strengths and weaknesses of the system, to identify areas that require further attention, and to provide a benchmark of the present status of the system.

A post-event survey questionnaire was sent out to the 28 Member States that have identified Tsunami Warning Focal Points (TWFP) and 23 responses were returned to the ICG/CARIBE EWS Secretariat. The objectives of the survey were to confirm that the NTWCs received bulletins from the interim advisory service in a timely manner, to determine what actions were taken by the NTWCs, and to find out if the Member States activated their emergency response plans.

This report is intended to be unbiased and constructive, and not to be in any way critical or judgemental. The intention is to provide an open and honest assessment of the performance of the CARIBE EWS on the 12 January 2010 and we are grateful to the Caribbean Member States who responded in this spirit to the survey questionnaire.

## 2. Event Characteristics

### 2.1 Earthquake Facts

At 21:53:10 UTC (16:53:10 Local time) on 12 January 2010, an earthquake of magnitude 7.0 occurred 25 km WSW off Port-au-Prince, Haiti. The earthquake parameters were as follows (from NEIC/USGS):

- Location: 18.457°N, 72.533°W
- Depth: 13 km
- Magnitude ( $M_w$ ): 7.0

The earthquake occurred in the boundary region separating the Caribbean plate and the North American plate. This plate boundary is dominated by left-lateral strike slip and compression, and accommodates about 20 mm/y slip, with the Caribbean plate moving eastward with respect to the North America plate.

The location and focal mechanism of the earthquake are consistent with the event having occurred as left-lateral strike slip faulting on the Enriquillo-Plaintain Garden fault system. This fault system accommodates about 7 mm/y, nearly half the overall motion between the Caribbean plate and North America plate.

The Enriquillo-Plaintain Garden fault system has not produced a major earthquake in recent decades. The Enriquillo-Plaintain Garden fault system is likely source of historical large earthquakes in 1860, 1770, 1761, 1751, 1684, 1673, and 1618, though none of these has been confirmed in the field as associated with this fault. (USGS)

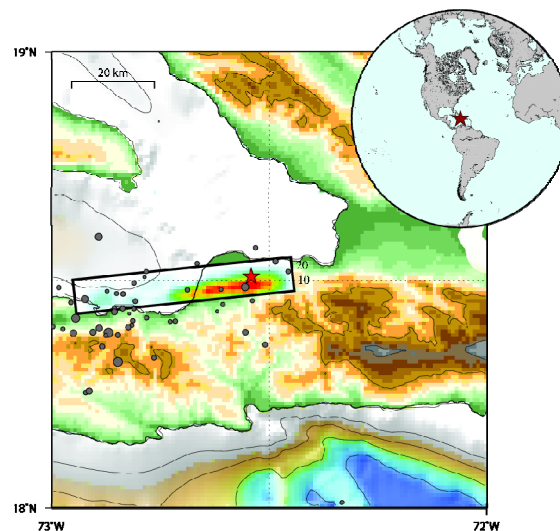


Figure 1. Surface projection of the slip distribution superimposed on ETOPO2. The dark gray circles indicate the location of ~20 hours of aftershocks. (USGS)

Figure 1 shows the location of the earthquake (red star), focal area (rectangular) and aftershocks (dark gray circles). The two largest aftershocks were magnitude 6.0 and 5.9. The M 6.0 aftershocks occurred 7 minutes after the main shock on 12 January and the M 5.9 event occurred at 11:03 UTC on 20 January. (USGS)

The United States Geological Survey (USGS) issued an “Assessment of Aftershock Hazards in Haiti on 21 January, 2010”. The summary of Aftershocks activity is as follows:

The aftershock sequence of the magnitude-7 earthquake will continue for months if not years in the affected area. The frequency of events will diminish with time, but damaging earthquakes will remain possible in the coming months. There is also small chance of subsequent earthquakes larger than the initial shock. The sequence from the Port-au-Prince earthquake continues to be very strong and active. Based on this activity and statistics of aftershock sequences, our estimate for aftershock activity during a 30-day period beginning 21 January 2010, is as follows:

- The probability of one or more earthquakes of magnitude 7 or greater is less than 3 percent.
- The probability of one or more earthquakes of magnitude 6 or greater is 25 percent.
- The probability of one or more earthquakes of magnitude 5 or greater is about 90 percent.
- Approximately 2 to 3 aftershocks of magnitude 5 or greater are expected this time period.

## 2.2 Tsunami Observations

Figure 2 shows the predicted tsunami travel time in the Caribbean sea using Tsunami travel Time software (TTT) developed by Paul Wessel, Geoware. As the location determined by NEIC is on land, this figure is calculated as 18.5N and 72.75W.

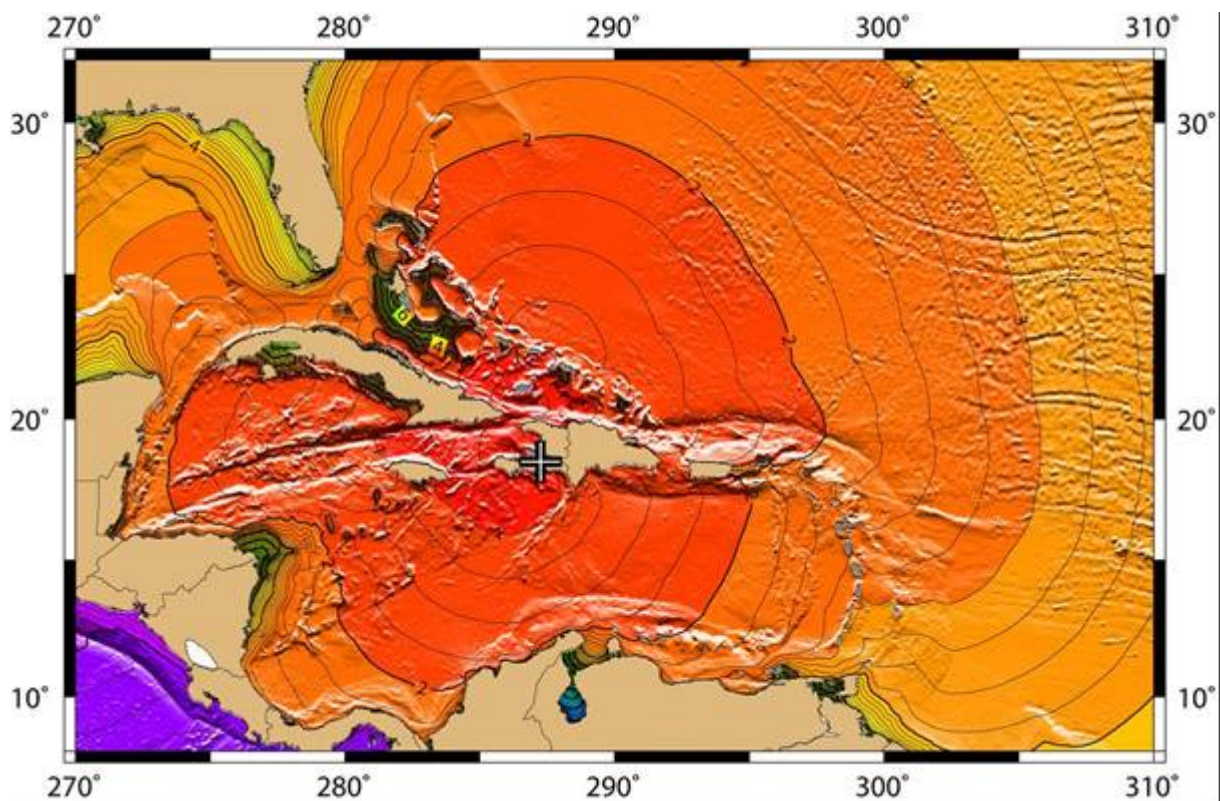


Figure 2 Tsunami Travel Time (15 minutes contours)

The earthquake generated a tsunami. Runup measurements of 3m at Jacmel and Petit Paradis, Haiti, and 1m in Pedernales, Dominican Republic are reported.<sup>1</sup>



Figure 3. High water mark in house (Photo: Hermann Fritz)

A 12 cm (peak to trough) tsunami was recorded at the Santo Domingo sea level station in the Dominican Republic. The Tsunami arrival time was at 22:40 UTC namely 47 minutes after the earthquake occurrence, and the initial motion of tsunami wave was a “rise”. Figure 2 shows the tsunami record in Santo Domingo. (Source: WC/ATWC)

The arrival time to Santo Domingo is 48 minutes earlier than the estimated initial tsunami wave arrival time of PTWC Bulletin #2, (23:28Z). The reason is not clear at the moment.



Figure 4. Tsunami record at Santo Domingo, Dominican Republic. The data sampling interval is 1 minute. The tsunami signal starts as a “rise” in sea level at 22:40 UTC and the amplitude of the oscillations gradually declined. The pulse around 2:30 UTC is noise.

A very small tsunami was also recorded at Mona Island in Puerto Rico (Figure 4) and Christiansted Harbor in the US Virgin Islands (Figure 5). Although the onsets of the tsunami time for both stations are not clear, they are around 23:25UTC and 23:00UTC respectively. (WC/ATWC)

<sup>1</sup> Pers. Comm. Hermann Fritz, Associate Professor, Georgia Institute of Technology, School of Civil and Environmental Engineering, USA



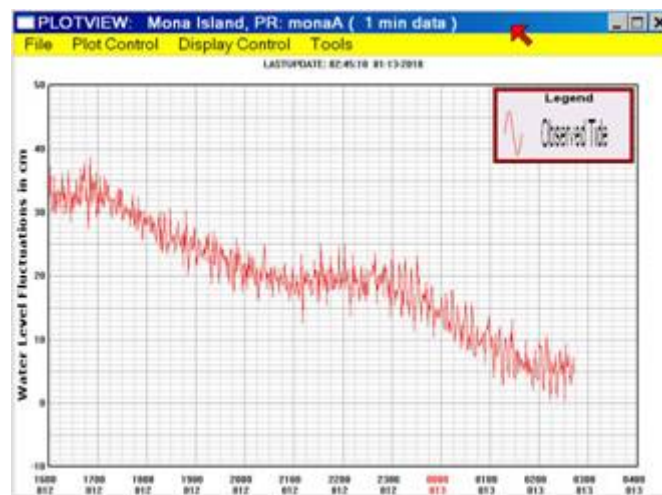


Figure 4. Tsunami record at Mona Island, Puerto Rico. The data sampling interval is 1 minute. Although the tsunami record is not clear, the tsunami arrival time will be around 23:00 UTC.



Figure 5. Tsunami record at Christiansted Harbor, US Virgin Island. The data sampling interval is 1 minute. Although tsunami record is not clear, tsunami arrival time will be around 23:25UTC.

### 2.3 PTWC and WC/ATWC

The Pacific Tsunami Warning Centre (PTWC) has responsibility to issue the interim tsunami warning to countries in the Caribbean Sea. The West Coast/Alaska Tsunami Warning Center (WC/ATWC) has the responsibility for Puerto Rico, the Virgin Islands and US East and Gulf of Mexico coasts.

Following the earthquake, PTWC and WC/ATWC issued bulletins at the following times (In chronological order UTC). Full bulletins are provided in Annex 1.

UTC Time

21:53 Earthquake occurs

22:03 PTWC Bulletin #1 M=7.3 “Tsunami Watch” for Haiti, Cuba, Bahamas and Dominican Rep

22:03 WC/ATWC Bulletin #1 M:7.3 “No Warning for Puerto Rico and the Virgin Island”

22:54 PTWC Bulletin #2 M:7.1 (Magnitude is reduced.)

23:45 PTWC Bulletin #3 “Tsunami Watch is cancelled” “A tsunami measuring 12 cm crest-to-trough was recorded at Santo Domingo in the Dominican Republic and tsunami less than 1 cm crest-to-trough was recorded on a deep ocean gauge in the east-central Caribbean.”



Figure 6. Sea level station (read circle) in Caucedo Harbor, Santo Domingo, Dominican Republic

### 3. Survey Questionnaire

The ICG/CARIBE EWS designed a questionnaire to obtain information from the Member States covering 4 main areas of interest:

- ***Interim Advisory Service***

The purpose of the questions in this section was to establish if and when the NTWCs had received the first and subsequent tsunami watch bulletins from PTWC and WC/ATWC, and if they had also received bulletins from other sources.

- ***National Actions***

In this section the purpose of the questions was to find out what actions were taken by the NTWCs, including independent analysis of the event, notification of relevant organisations, issuing and cancellation of warnings.

- ***National Response***

The purpose of the questions in this section was to find out what the national and local response was to the event after the tsunami warning had been issued by the NTWC, in particular if there were any evacuations.

- ***Monitoring and Modelling***

The last section of the questionnaire was intended to ascertain which Member States used numerical model scenarios and real time sea level data in their decision making.

The questionnaire is included in Annex 3. It was sent out to 28 TWFPs of IOC Member States and territories, not including Peru and Canada. Out of the 28 TWFPs, 23 responded with only Costa Rica, Guatemala, Mexico, Netherlands (Aruba), and Saint Lucia, failing to respond.

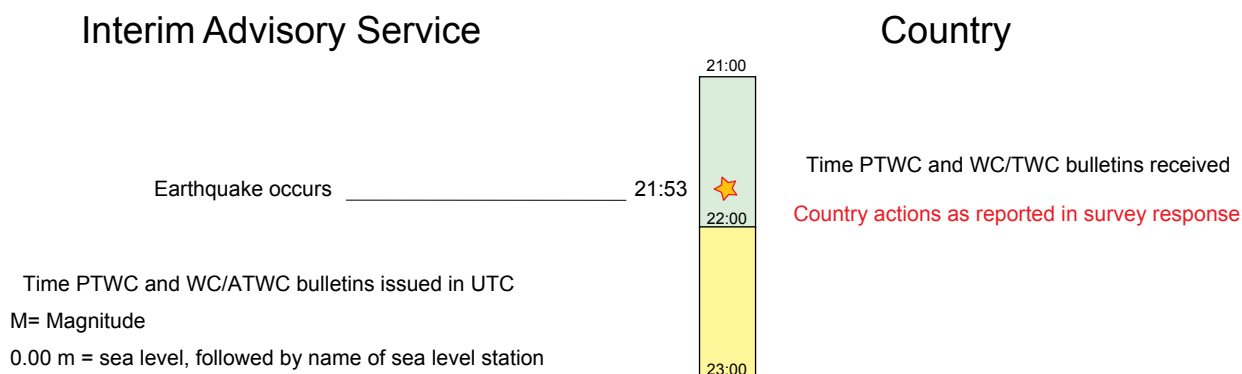
Member States were also encouraged to include additional information and comments and many of them took the opportunity to provide the Secretariat with national reports of the event and constructive suggestions for future surveys.



## 4. Country Reports

The following sections provide details of the response of individual countries, based on information provided in the questionnaires. Note that questionnaires were not returned by Costa Rica, Guatemala, Mexico, Netherlands (Aruba), and Saint Lucia.

The country reports are given in the form of a response timeline followed by a commentary based on information provided by the participating countries. Figure 4.1 shows the timeline legend.

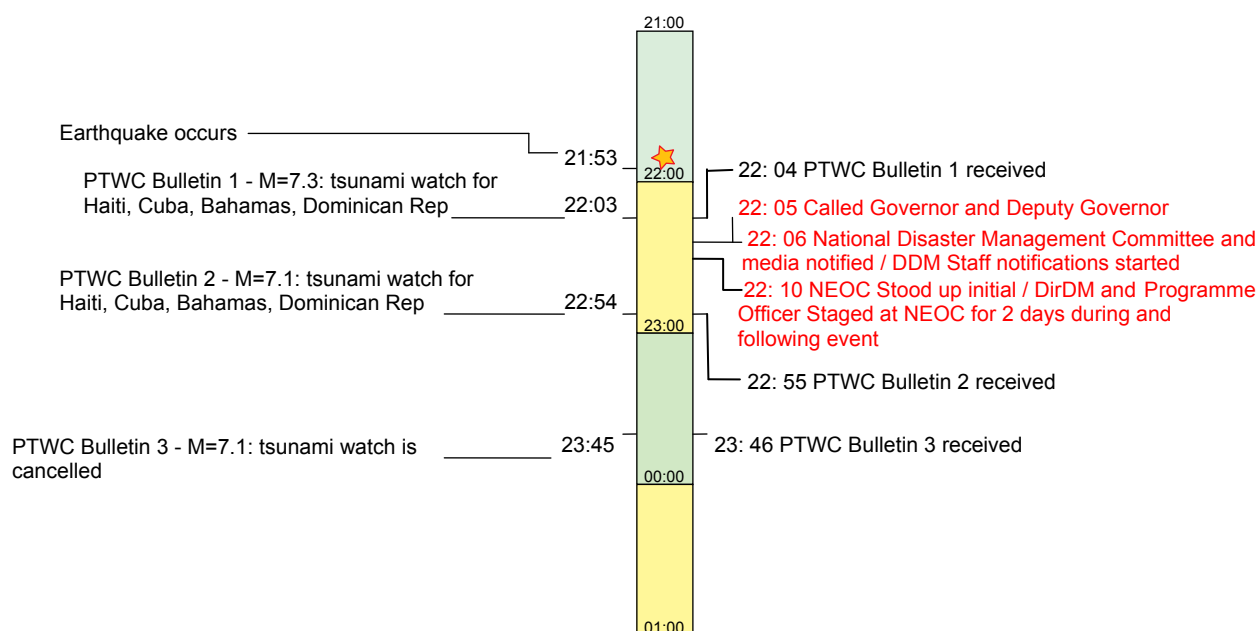


**Figure 4.1** Interim advisory service and country response timeline legend

The left side of the timelines lists the times at which bulletins were issued by the Interim Advisory Service (WC/ATWC and PTWC) and is the same for each timeline. Also shown on the left side is sea level information (sea level, gauge location and time of observation) issued in the WC/ATWC and PTWC bulletins. The information on the right side is provided by individual countries and lists the times at which the various bulletins were received from the Interim Advisory Service and the times at which country actions were taken, highlighted in red.

**Note that all times in this report are in Coordinated Universal Time (UTC).**

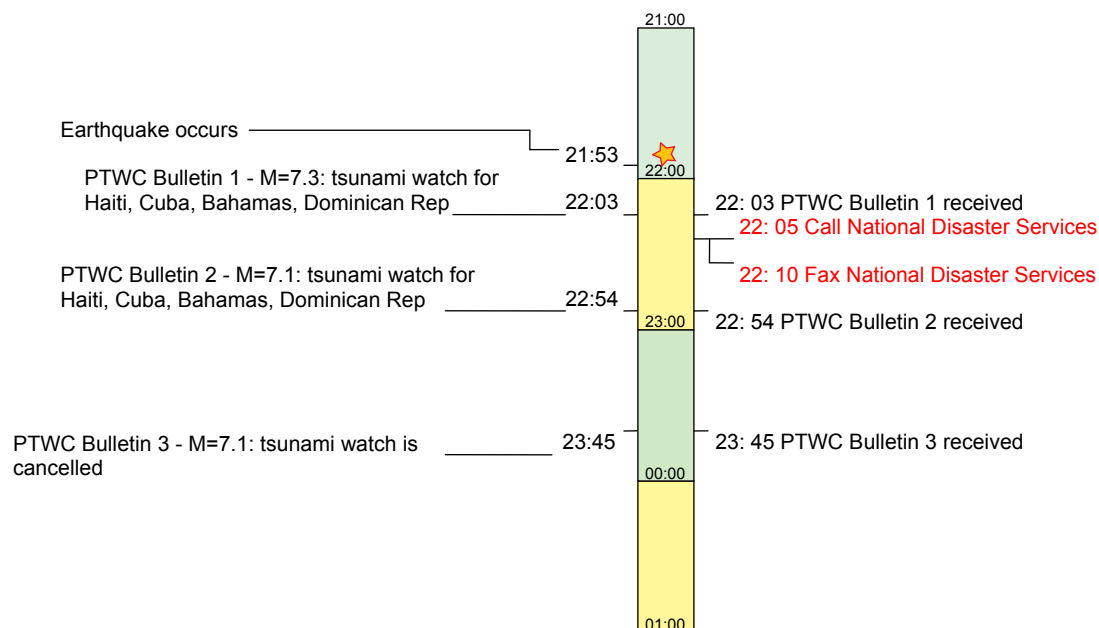
## 4.1 ANGUILLA (UK)



### Country Commentary

- Tsunami bulletins from the PTWC were received within 1 minute of being issued.
- PTWC tsunami bulletin 1 was received.
- Other sources of information: phone calls and via fax to RAPF.
- No warning was issued to the public and no areas were evacuated.
- Sea level data were monitored during the event through the following stations: Santo Domingo – dead; Mona Island PR – web; ArCibo PR - web and St Croix – web.
- National Warning Centre knows how to access sea level data over the IOC Sea Level Facility website but not over GTS.
- National Warning Centre did not use any numerical model scenarios during the event.
- Comment: Training has not occurred on monitoring systems as in-house expertise to adequately evaluate the information is not available. The Department of Disaster Management does not have GTS or EMWIN and Met is not 24x7. Police dispatchers who rotate quite frequently are used, so capacity is lost on monitoring.

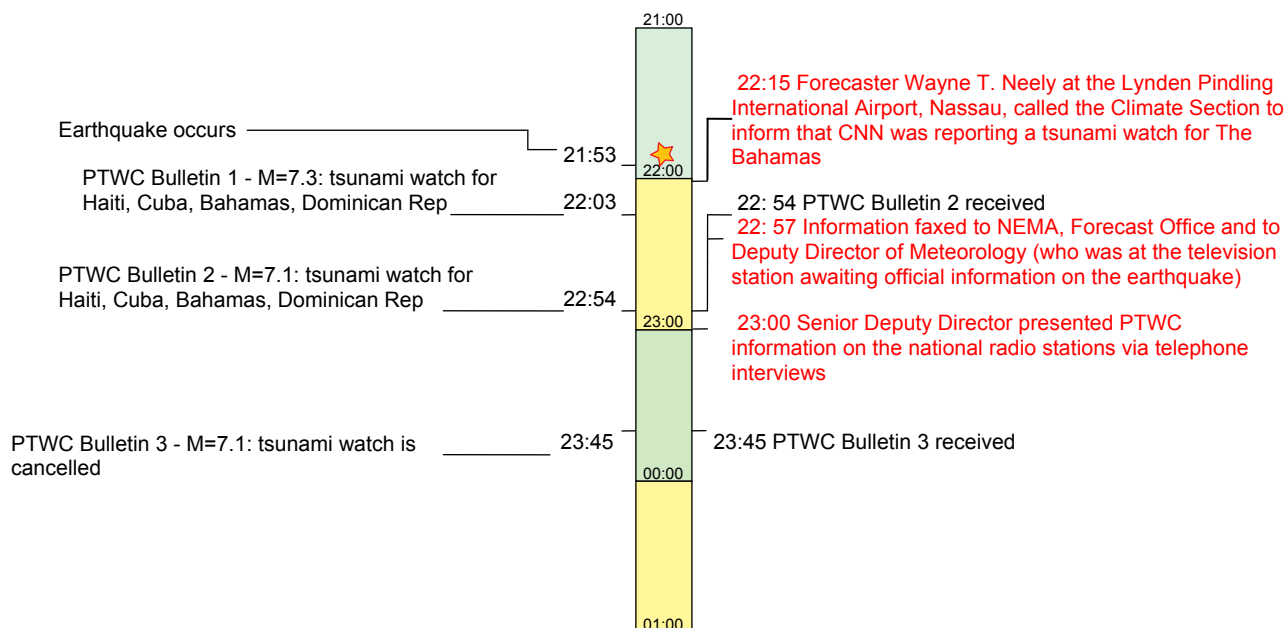
## 4.2 ANTIGUA & BARBUDA



### Country Commentary

- Tsunami bulletins from the PTWC were received at the same time of being issued.
- PTWC tsunami bulletin 1 was received by email and fax.
- Receipt of PTWC bulletin 1 was acknowledged.
- Other sources of information: CNN.
- No warning was issued to the public and no areas were evacuated.
- Sea level data were no monitored during the event.
- National Warning Centre does not know how to access sea level data over the GTS or on the IOC Sea Level Facility website.
- National Warning Centre did not use any numerical model scenarios during the event.
- Comment: Notification by personal cell phone by way of a short message service (text) would be useful.

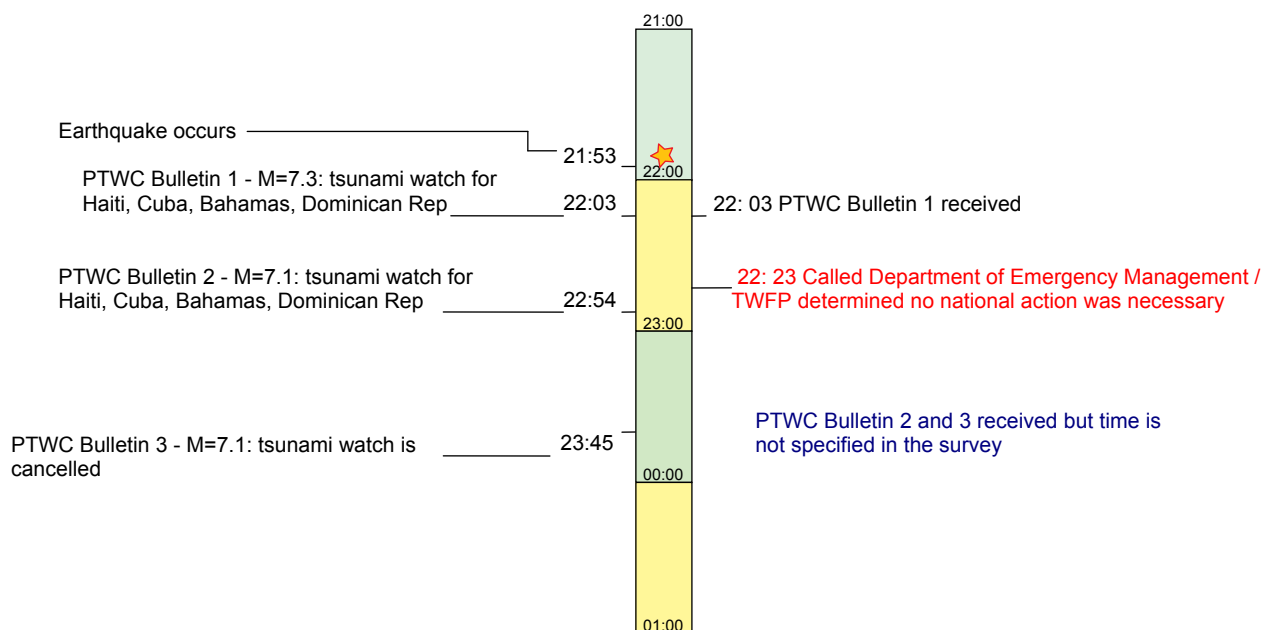
### 4.3 THE BAHAMAS



#### Country Commentary

- PTWC bulletin 1 was not received.
- PTWC bulletins 2 and 3 were received at the same time of being issued.
- Other sources of information: CNN.
- No warning was issued to the public and no areas were evacuated.
- No earthquake parameters were calculated at local level.
- Sea level data were monitored during the event over the IOC Sea Level Facility and the following stations: Great Inagua (GOES ID 941-0030; Nassau Harbour (GOES ID 941-0010); Lee Stocking Island (GOES ID 941 0020; Settlement Point, GBI (NDBC).
- It is not stated in the survey if National Warning Centre knows how to access data over GTS.
- National Warning Centre did not use any numerical model during the event.
- At 00:00 on 13 January a live press conference was held at NEMA; broadcast by ZNS-TV13, the national television network and national radio stations.

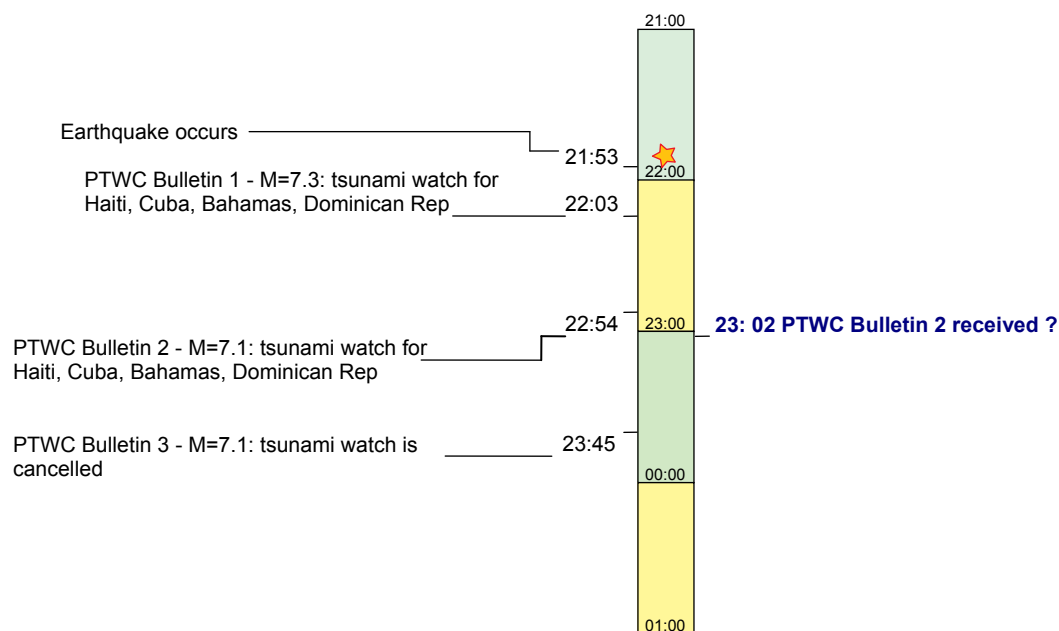
#### 4.4 BARBADOS



#### Country Commentary

- Tsunami bulletin from the PTWC 1 was received at the same time of being issued. Bulletins 2 and 3 were received. However, the time was not specified in the survey.
- PTWC tsunami bulletin 1 was received by email, fax and phone.
- Receipt of PTWC bulletin 1 was NOT acknowledged.
- Other sources of information: CNN and other international networks.
- No warning was issued to the public and no areas were evacuated.
- Sea level data were not monitored during the event.
- National Warning Centre (NWC) does not know how to access sea level data over the GTS. If the NWC knows how to access the data over the IOC Sea Level Facility website is not specified in the survey.
- National Warning Centre did not use any numerical model scenarios during the event.

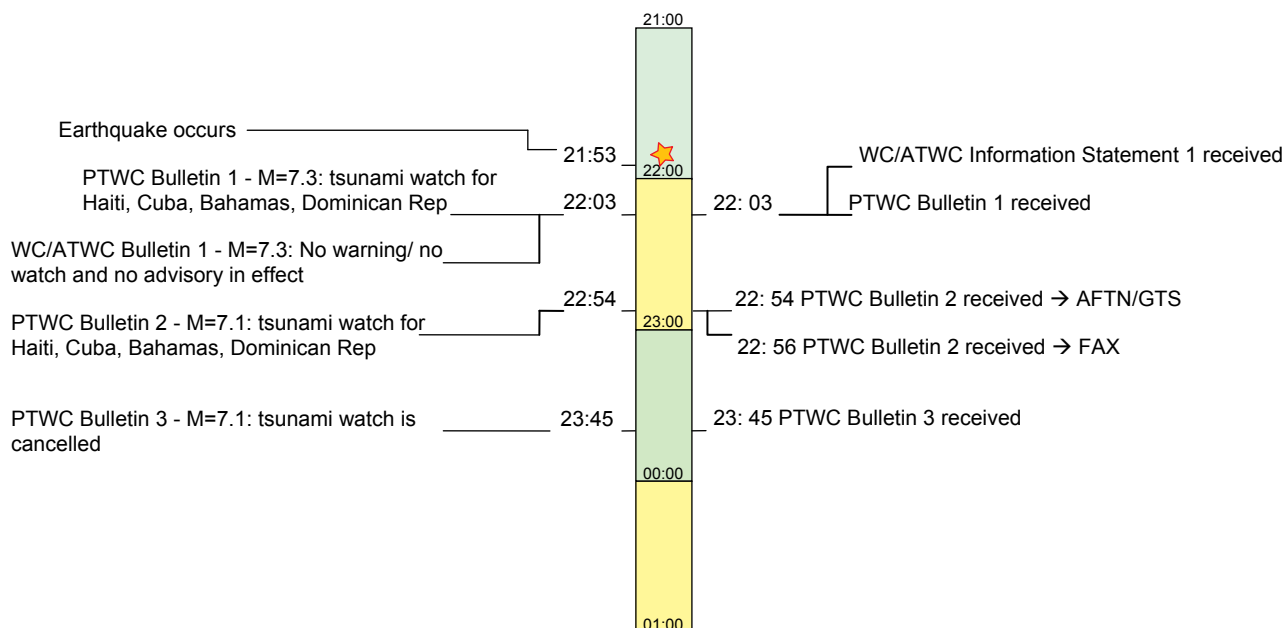
## 4.5 BELIZE



### Country Commentary

- Tsunami bulletin from the PTWC 1 was NOT received.
- Bulletin 2 was received 8 minutes after being issued.
- Other sources of information: Radio and TV.
- No earthquake parameters were calculated at national level.
- No warning was issued to the public and no areas were evacuated.
- Sea level data were no monitored during the event.
- National Warning Centre knows how to access sea level data over the GTS, but NOT over the IOC Seal Level Facility website.
- National Warning Centre did not use any numerical model scenarios during the event.

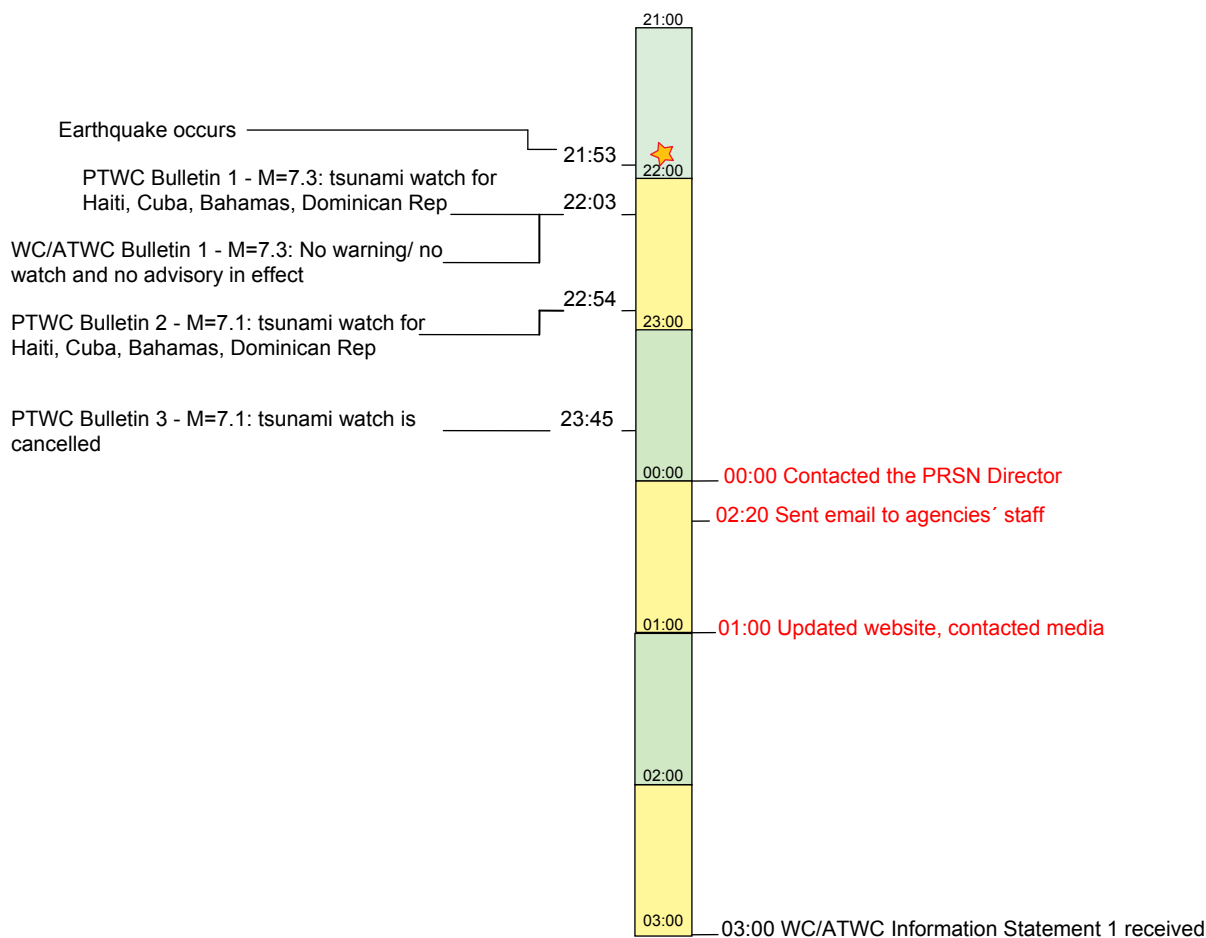
#### 4.6 BERMUDA (UK)



#### Country Commentary

- Tsunami bulletins from the PTWC were received at the same time of being issued.
- PTWC tsunami bulletin 1 was received by email, fax and GTS.
- Receipt of PTWC bulletin 1 was NOT acknowledged.
- Other sources of information: PTWC + WC/ATWC email alerts and Earth Alerts Software.
- No warning was issued to the public, no areas were evacuated and no earthquake parameters were calculated at national level.
- Sea level data were not monitored during the event.
- National Warning Centre does not know how to access sea level data over the GTS or IOC Seal Level Facility website. NOAA's National Data Buoy Website is mentioned.
- National Warning Centre did not use any numerical model scenarios during the event.

## 4.7 BRITISH VIRGIN ISLANDS (UK)

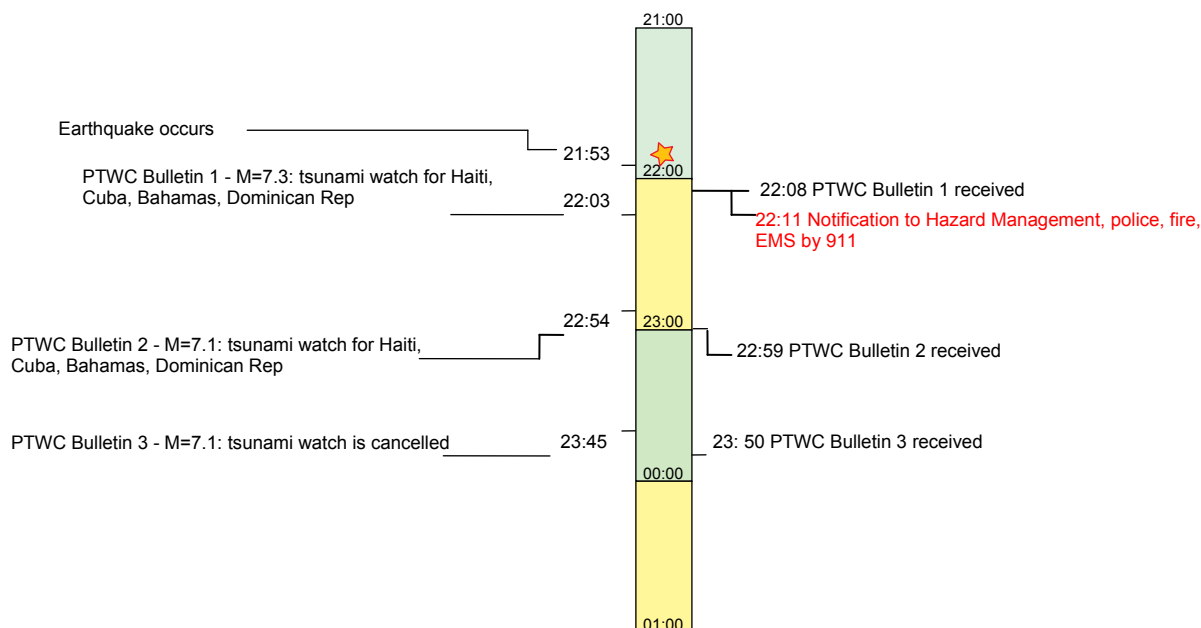


### Country Commentary

- Tsunami bulletins from the PTWC were NOT received.
- WC/ATWC bulletin was received by fax 5 hours after being issued.
- Other sources of information: USGS, PRSN.
- No warning was issued to the public and no areas were evacuated.
- No earthquake parameters were calculated at national level.
- Sea level data were not monitored during the event.
- National Warning Centre does not know how to access sea level data over the GTS or IOC Sea Level Facility website.
- National Warning Centre did not use any numerical model scenarios during the event.



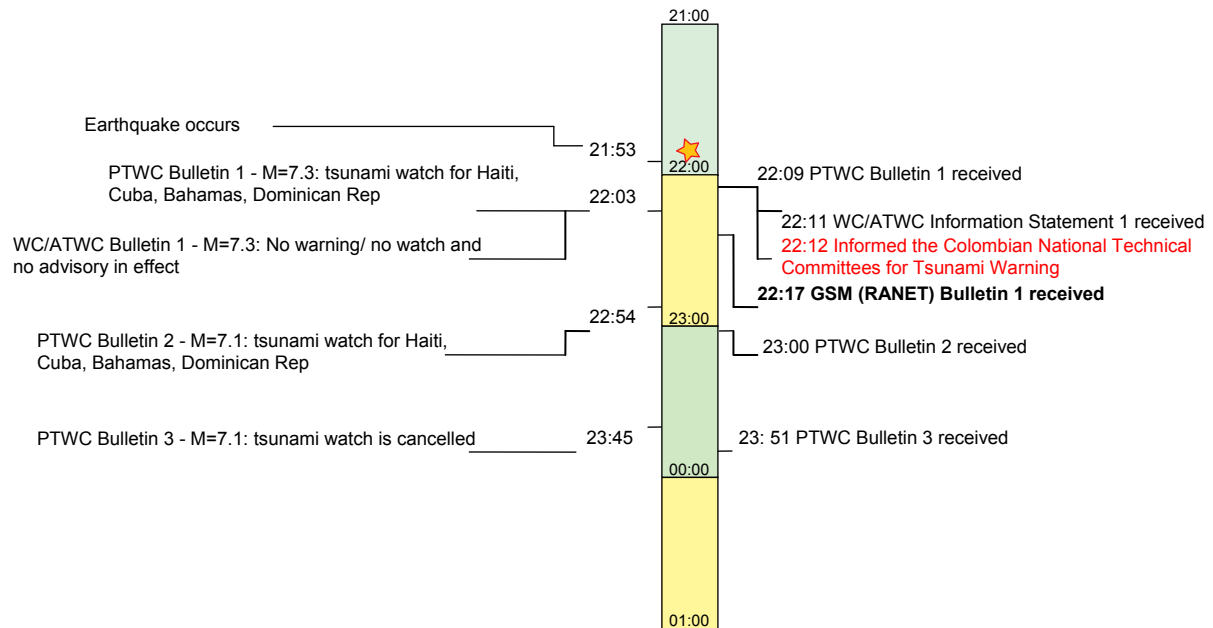
## 4.8 CAYMAN ISLANDS (UK)



### Country Commentary

- Tsunami bulletin from the PTWC 1 was received within 5 minutes of being issued. Bulletins 2 and 3 were received within 5 minutes of being issued.
- PTWC tsunami bulletin 1 was received by email, and fax.
- Receipt of PTWC bulletin 1 was NOT acknowledged.
- No warning was issued to the public and no areas were evacuated.
- Sea level data were not monitored during the event and no earthquake parameters were calculated.
- It was not stated if National Warning Centre knows how to access sea level data over the GTS or IOC Sea Level Facility website.
- National Warning Centre did not use any numerical model scenarios during the event.

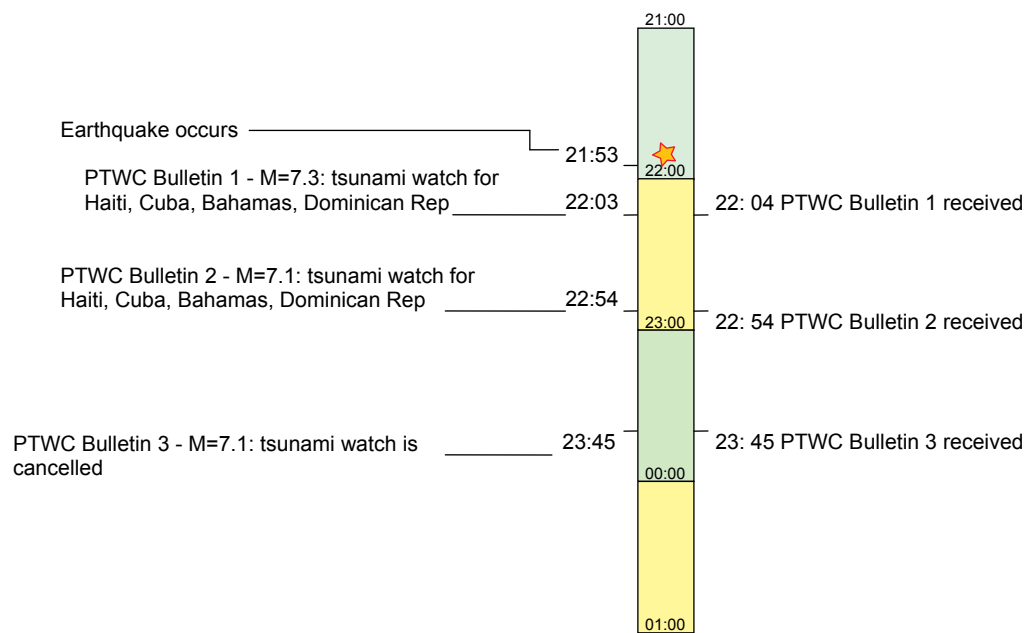
## 4.9 COLOMBIA



### Country Commentary

- Tsunami bulletin from the PTWC 1 was received 4 minutes after being issued. Bulletins 2 and 3 were received within 6 minutes of being issued.
- PTWC tsunami bulletin 1 was received by email, PTWC RANET SMS (GSM) and EMWIN.
- Receipt of PTWC bulletin 1 was NOT acknowledged.
- Other sources of information: Software CISN almost in real time. USGS information from the earthquake through Internet bulletins.
- No warning was issued to the public and no areas were evacuated.
- No earthquake parameters were calculated.
- Actions before receiving PTWC/WC/ATWC information were undertaken: (a) running the model Tsunami Travel Time (TTT). Search information from the Global Warning Centres; (b) start monitoring real time tide gauges in the area using the IOC Sea Level Monitoring Facility.
- Sea level data were monitored during the event: Mayaguez-PR Station (through IOC Sea Level Facility); Mona Island - PR Station (through IOC Sea Level Facility); 42407 Dart Buoy (other method – not specified in the survey).

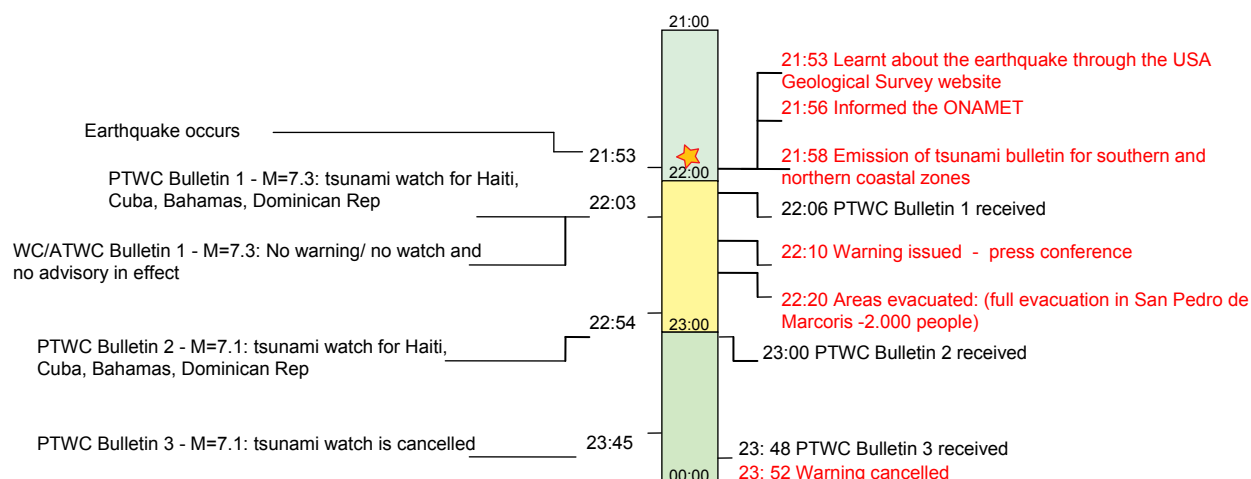
#### 4.10 DOMINICA



#### Country Commentary

- Tsunami bulletins from the PTWC were received at the same time of being issued.
- PTWC tsunami bulletin 1 was received by email and fax.
- Receipt of PTWC bulletin 1 was NOT acknowledged.
- Other sources of information: Media.
- No earthquake parameters were calculated at national level.
- No warning was issued to the public and no areas were evacuated.
- Sea level data were not monitored during the event.
- National Warning Centre does not know how to access sea level data over the GTS or IOC Sea Level Facility website.
- National Warning Centre did not use any numerical model scenarios during the event.

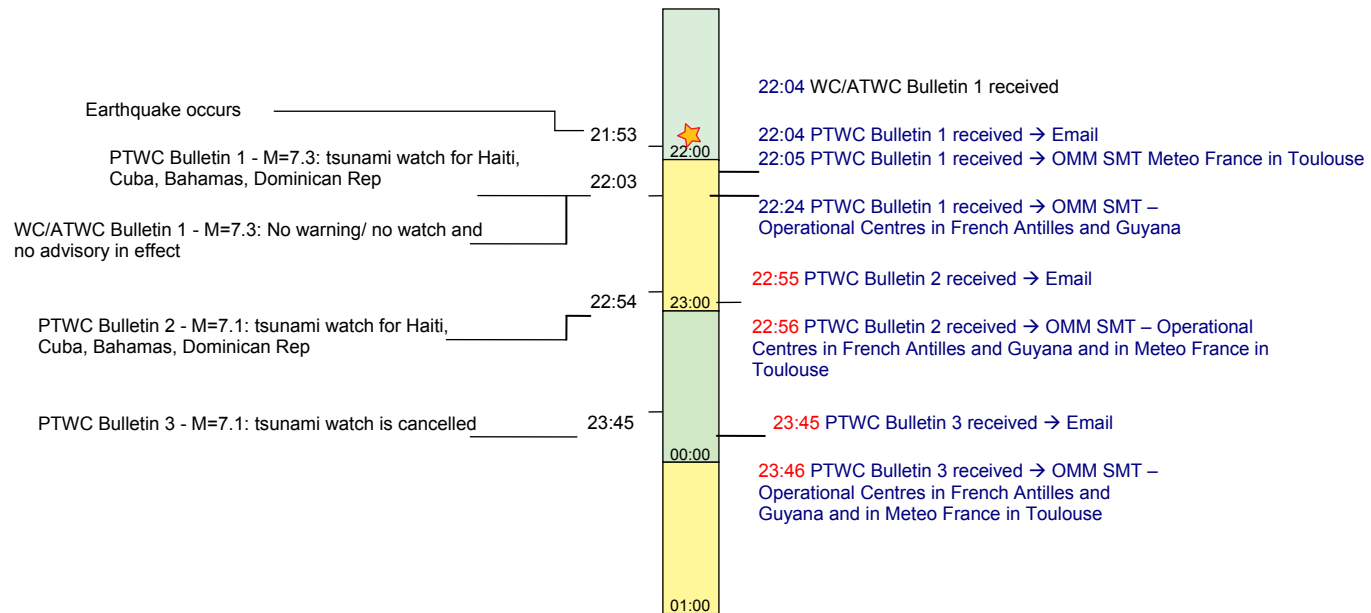
## 4.11 DOMINICAN REPUBLIC

Country Commentary

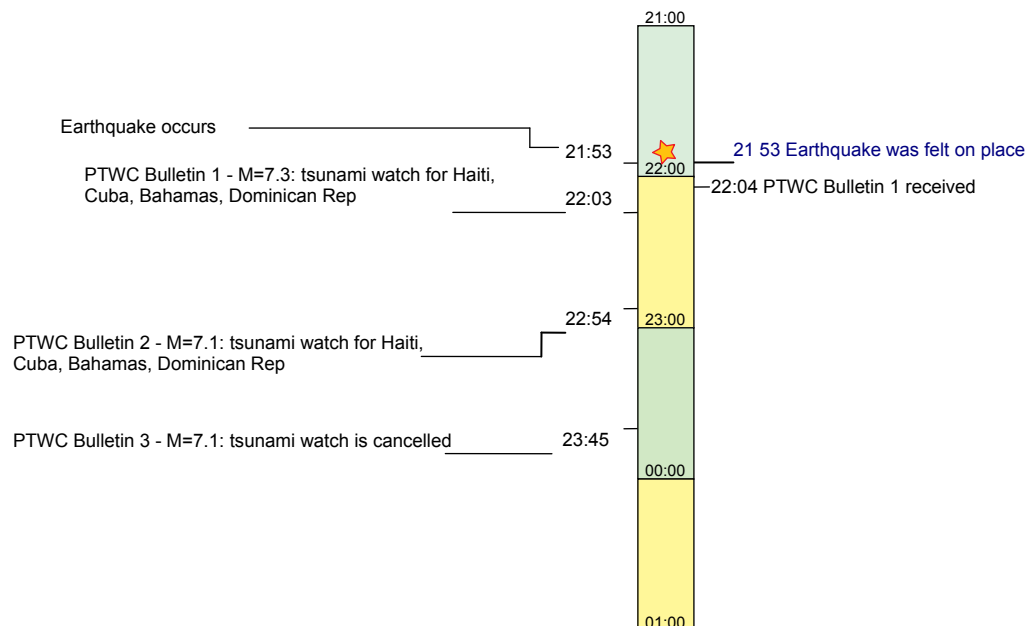
- The earthquake was felt and information was searched for on the website of the USA Geological Survey.
- Tsunami bulletin from the PTWC 1 was received within 3 minutes of being issued. Bulletins 2 and 3 were received within 6 and 3 minutes of being issued.
- PTWC tsunami bulletin 1 was received by email, and fax.
- Receipt of PTWC bulletin 1 was NOT acknowledged.
- Other sources: PRSN, PR Danis Client Data Base.
- Warning was issued; 2.000 persons in San Pedro de Macoris were evacuated (full evacuation). The areas of Pedernales, Boca Chica, Nagua and Puerto Plata were evacuated (number of people not specified in the survey).
- Sea level data were monitored during the event in the following stations: Santo Domingo, Dart Buoys 42407, Dart Buoys 41046.
- The National Warning Centre knows how to access sea level data over the IOC Sea Level Facility website, but not over the GTS.
- National Warning Centre did not use any numerical model scenarios during the event.
- A post-event assessment was conducted in the zones where a minitsunami was detected
- The warning was cancelled at 23:52 (7 minutes after the emission of the cancellation through the PTWC). The warning was cancelled based on the information received from the PTWC. The warning was cancelled by Internet.



## 4.12 FRANCE



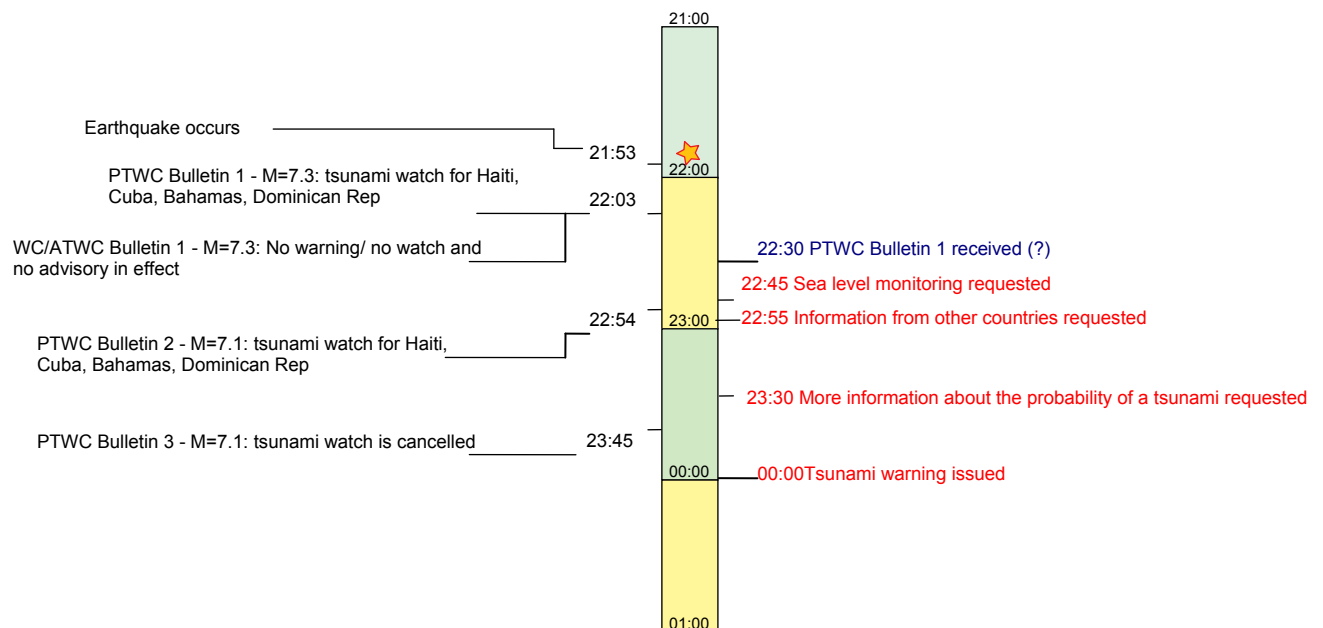
### 4.13 HAITI



#### Country Commentary

- PTWC Bulletin 1 was issued 10 minutes after the earthquake, but was only accessed by civil protection services in Haiti two days after the earthquake, due to the collapse of the power supply and the internet network. If the tsunami had been devastating, the populations would have been without any warning product.

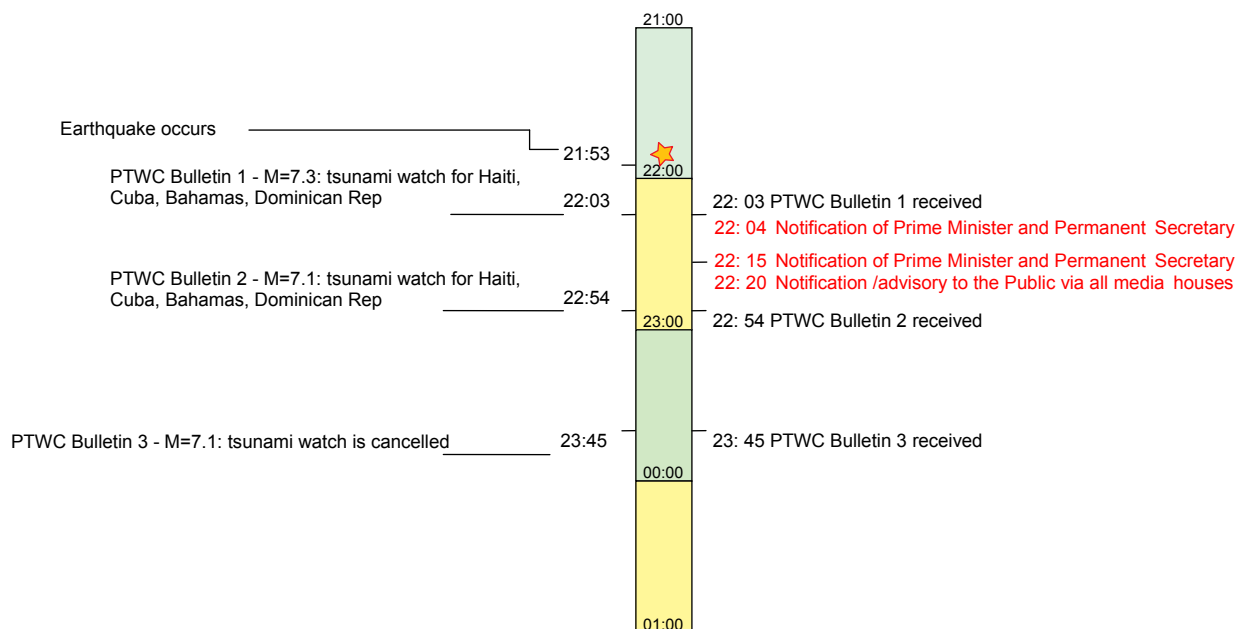
#### 4.14 HONDURAS



#### Country Commentary

- PTWC tsunami bulletin 1 was received at the same time of being issued. PTWC tsunami bulletins 2 and 3 were NOT received.
- PTWC tsunami bulletin 1 was received by email and fax.
- Receipt of PTWC bulletin 1 was NOT acknowledged.
- Other sources of information: INETER from Nicaragua and INSIVUMEH from Guatemala.
- A tsunami warning was issued to the public but no areas were evacuated.
- Sea level was monitored during the event but information about the stations is not provided in the survey.
- National Warning Centre does not know how to access sea level data over the GTS or IOC Seal Level Facility website.
- National Warning Centre used numerical model scenarios during the event.
- Before receiving PTWC bulletin 1, data were observed through seismographs located in different zones of the country.

## 4.15 JAMAICA

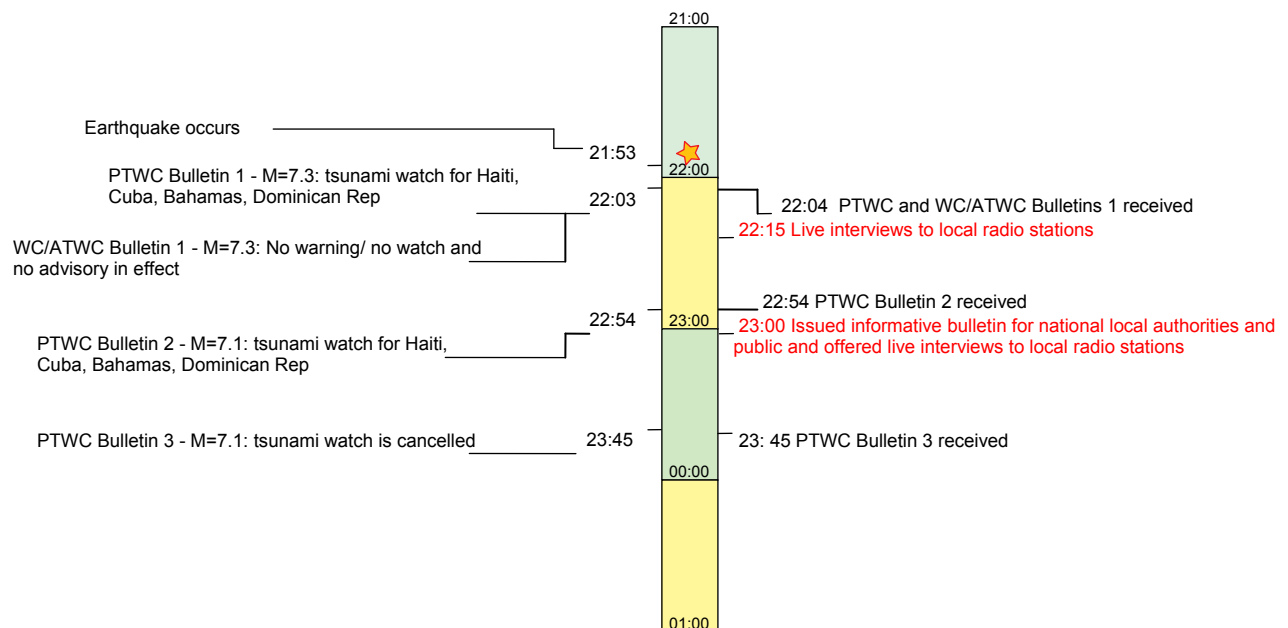


### Country Commentary

- PTWC tsunami bulletins were received at the same time of being issued.
- PTWC tsunami bulletin 1 was received by email.
- Receipt of PTWC bulletin 1 was NOT acknowledged.
- Other sources of information: Earthquake Unit UWI Jamaica and the Seismic Reserach Centre UWI T&T.
- Earthquake parameters were not calculated at a national level.
- A tsunami warning was not issued to the public and no areas were evacuated.
- It was not stated if sea level was monitored during the event.
- It was not stated if National Warning Centre knows how to access sea level data over the GTS or IOC Seal Level Facility website.
- It was not stated if National Warning Centre used numerical model scenarios during the event.



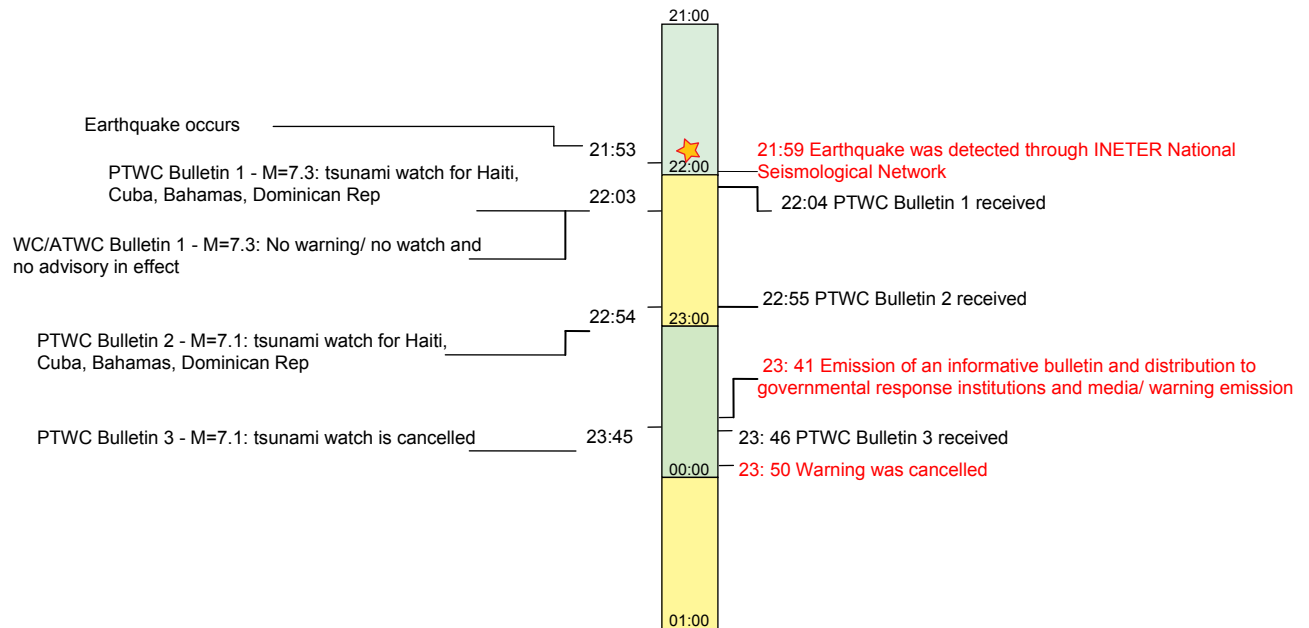
#### 4.16 NETHERLANDS (ANTILLES)



#### Country Commentary

- PTWC and WC/ATWC tsunami bulletins 1 were received 1 minute after being issued.
- PTWC tsunami bulletins 2 and 3 were received at the same time of being issued.
- PTWC and WC/ATWC were received by phone and AFTN.
- Receipt of PTWC and WC/ATWC bulletin 1 was NOT acknowledged.
- Other sources of information: USGS Website.
- No earthquake parameters were calculated at a national level.
- No tsunami warning was issued and no areas were evacuated.
- Sea level was not monitored during the event.
- National Warning Centre does not know how to access sea level data over the IOC Sea Level Facility website. It is not stated in the survey if they know how to do it over the GTS.
- National Warning Centre did not use numerical model scenarios during the event.

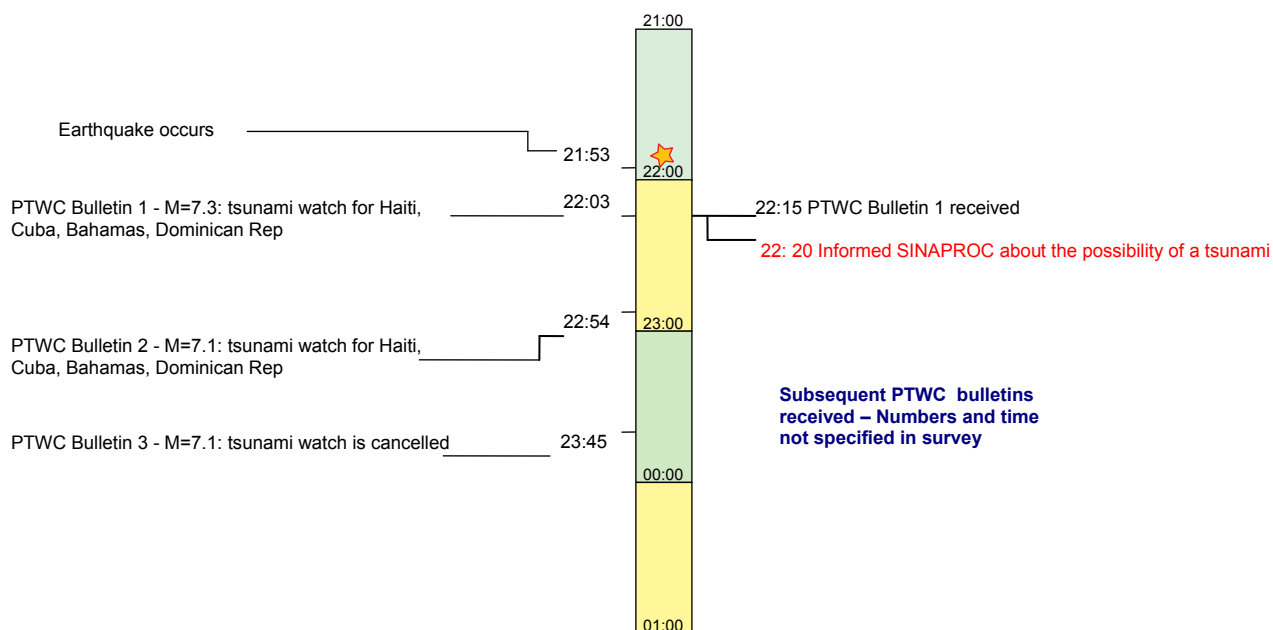
### 4.17 NICARAGUA



#### Country Commentary

- The earthquake was detected through the National Seismological Network monitored by INETER.
- Tsunami bulletin from the PTWC 1 was received within 1 minute of being issued.
- PTWC tsunami bulletin 1 was received by email and fax.
- Receipt of PTWC bulletin 1 was NOT acknowledged.
- Other sources: NEIC, GEOFON and news agencies.
- Earthquake parameters were calculated at the national level: Location: 18.8°N-71.8°W; Depth: 20 Km; Magnitude: 7.6; Type of Mag: mb.
- Warning was issued at 23:41 by the National Warning Centre. The warning was issued by phone, fax and email. No areas were evacuated.
- Sea level data were not monitored during the event.
- The National Warning Centre does not know how to access sea level data over the IOC Sea Level Facility website or over the GTS
- National Warning Centre did not use any numerical model scenarios during the event.
- The warning was cancelled at 23:50 by email, fax and radio. Reason for the cancellation: information received from the PTWC.

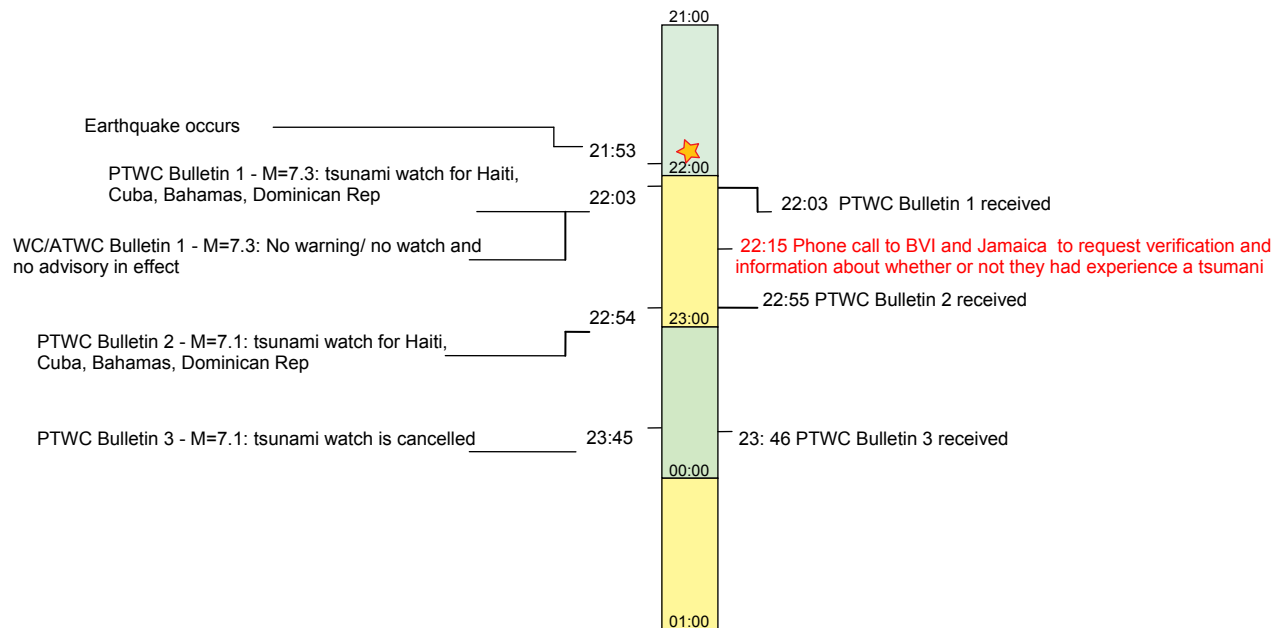
### 4.18 PANAMA



#### Country Commentary

- Tsunami bulletin from the PTWC 1 was received within 12 minutes of being issued.
- PTWC tsunami bulletin 1 was received by email.
- Receipt of PTWC bulletin 1 was acknowledged.
- Other sources of information: USGS, RED PUMA, CASC.
- Earthquake parameters were calculated at the national level: localization: 18.460° N, 72.530° W; Magnitude 7.1; Depth: 10 Km; Type of magnitude: Mw.
- No warning was issued and no areas were evacuated.
- Sea level data were not monitored during the event.
- It is not stated if the National Warning Centre knows how to access sea level data over the GTS or over the IOC Sea Level Facility website.
- It is not stated if National Warning Centre used numerical model scenarios during the event.

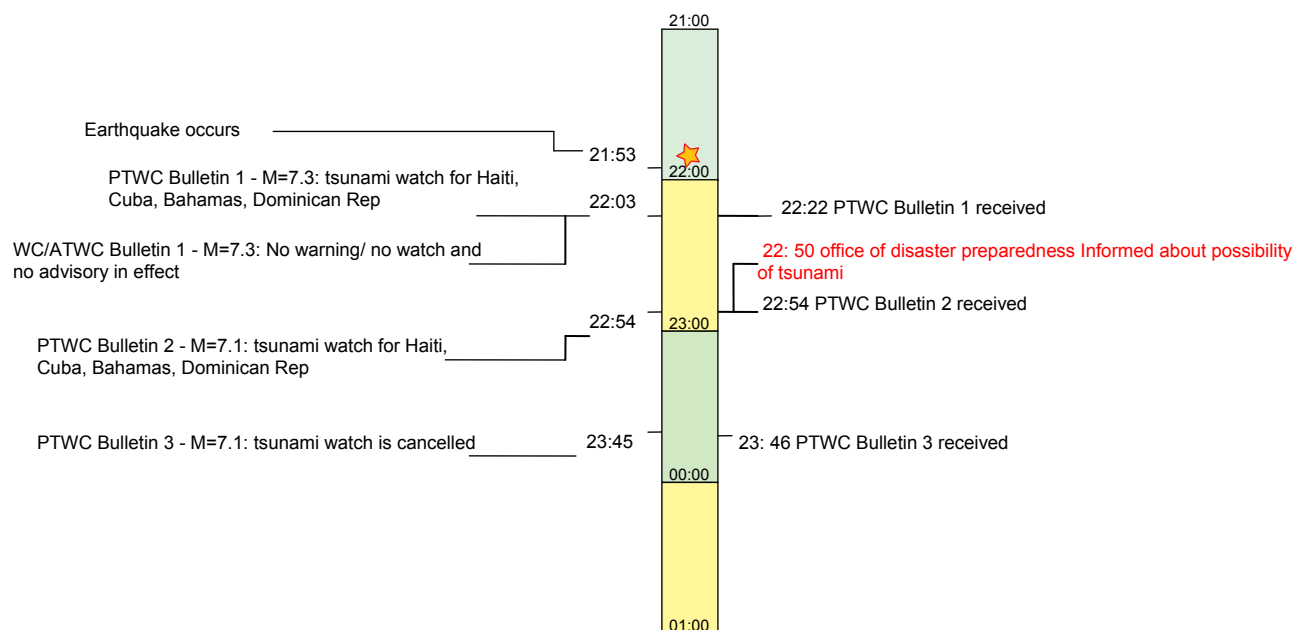
#### 4.19 SAINT VINCENT AND THE GRENADINES



#### Country Commentary

- Tsunami bulletins from the PTWC were received at the same time of being issued.
- PTWC tsunami bulletin 1 was received by fax and phone.
- Receipt of PTWC bulletin 1 was NOT acknowledged.
- Other sources: BVI Dept of Disaster Mgt.
- Earthquake parameters were not calculated at the national level.
- No warning was issued and no areas were evacuated.
- Sea level data were not monitored during the event.
- The National Warning Centre does not know how to access sea level data over the GTS or over the IOC Sea Level Facility website.
- National Warning Centre used numerical model scenarios during the event.

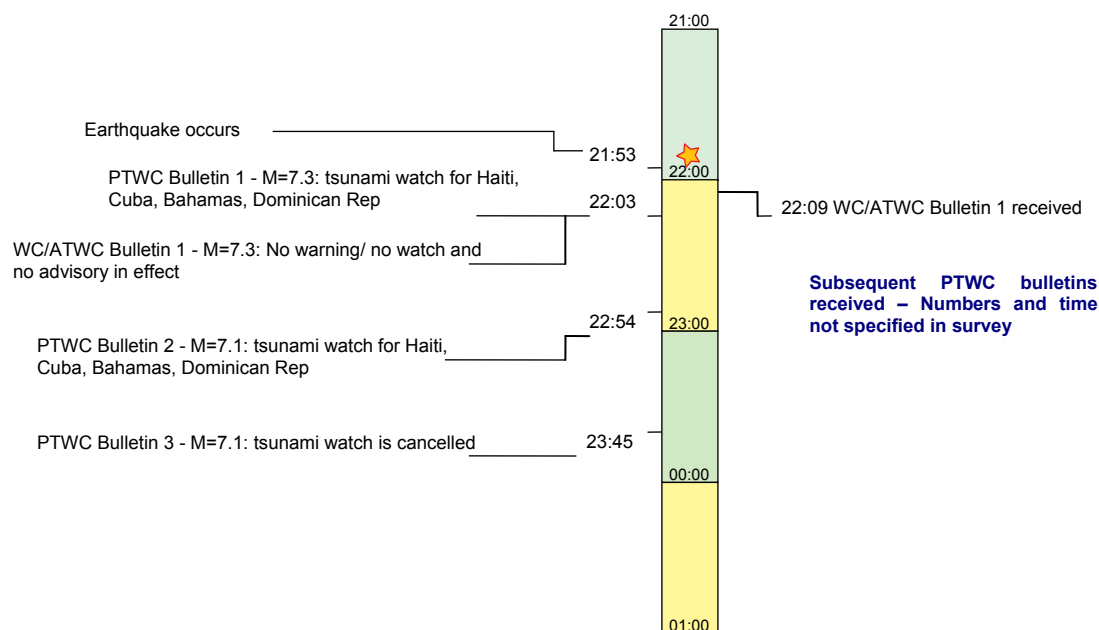
## 4.20 TRINIDAD AND TOBAGO



### Country Commentary

- Tsunami bulletin from the PTWC 1 was received within 19 minutes of being issued.
- PTWC tsunami bulletin 1 was received by fax and GTS.
- Receipt of PTWC bulletin 1 was NOT acknowledged.
- Other sources: University of the West Indies, Seismic Research Unit Website and media.
- Earthquake parameters were not calculated at the national level.
- No warning was issued and no areas were evacuated.
- Sea level data were not monitored during the event.
- The National Warning Centre knows how to access sea level data over the GTS but not over the IOC Sea Level Facility website.
- National Warning Centre used numerical model scenarios during the event.

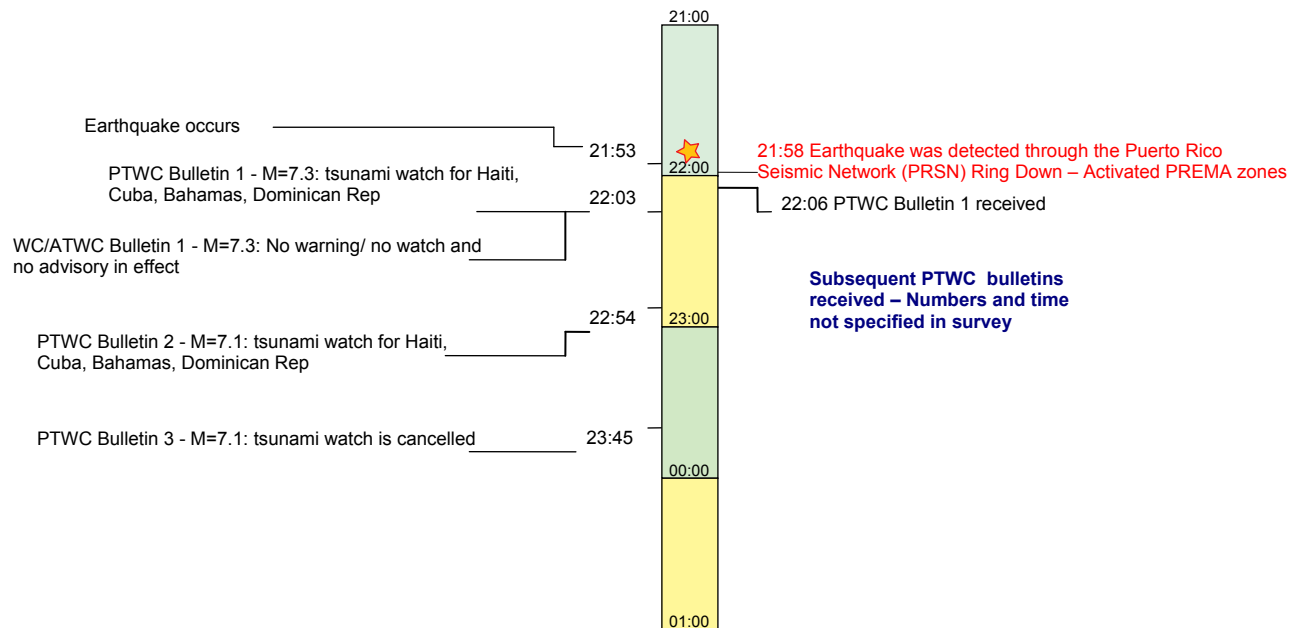
#### 4.21 UNITED STATES – VIRGIN ISLANDS



#### Country Commentary

- Tsunami bulletin from the WC/ATWC was received within 6 minutes of being issued.
- WC/ATWC tsunami bulletin was received by phone.
- Receipt of WC/ATWC bulletin was acknowledged.
- Other source of information: NWS.
- Earthquake parameters were calculated at the national level: localization: 18.457° N, 72.533° W; Magnitude 7.0; Depth: 13 Km;
- No warning was issued and no areas were evacuated.
- Sea level data were not monitored during the event.
- National Warning Centre does not know how to access sea level data over the GTS or over the IOC Seal Level Facility website.
- National Warning Centre did not use numerical model scenarios during the event.

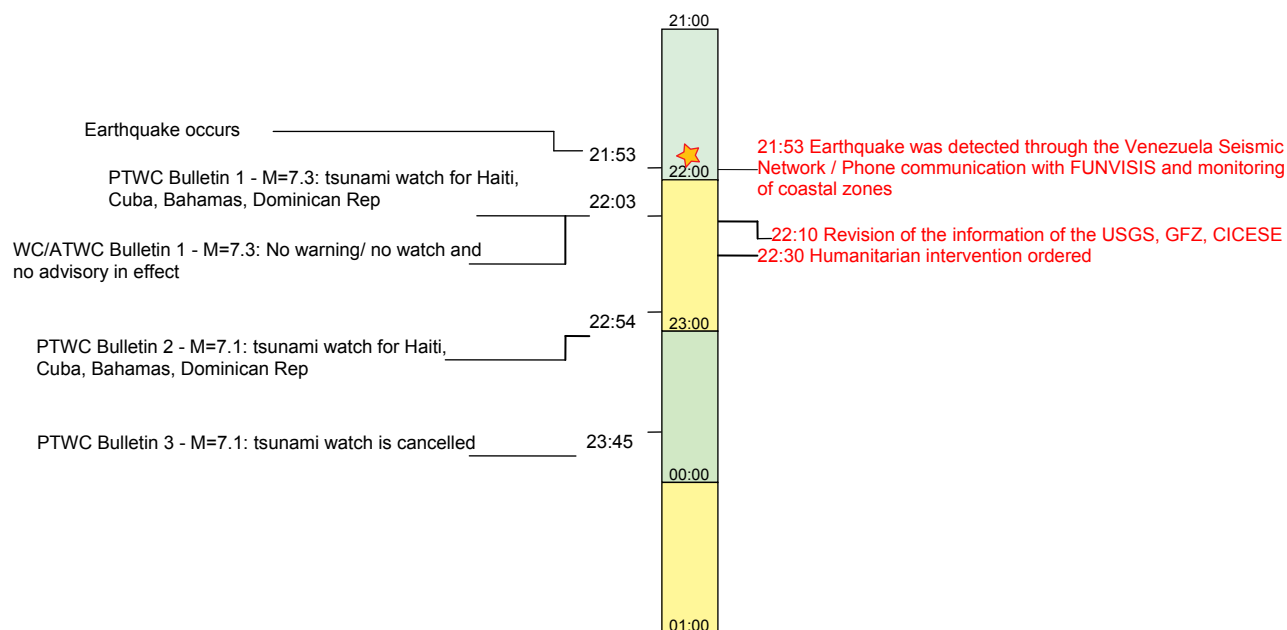
## 4.22 UNITED STATES – PUERTO RICO



### Country Commentary

- Tsunami bulletin from the PTWC 1 was received within 3 minutes of being issued.
- PTWC tsunami bulletin 1 was received by phone and NAWAS.
- Receipt of PTWC bulletin 1 was acknowledged.
- Earthquake parameters were calculated at the national level: localization: 18.45° N, 72.44° W; Magnitude 7.0; Depth: 10 Km; Type of magnitude: Mw.
- No warning was issued and no areas were evacuated.
- Sea level data were monitored during the event through the PRSN station.
- It was not stated if the National Warning Centre knows how to access sea level data over the GTS or over the IOC Seal Level Facility website.
- National Warning Centre did not use numerical model scenarios during the event.

### 4.23 VENEZUELA



#### Country Commentary

- Tsunami bulletins from the PTWC were not received.
- Earthquake parameters were calculated at the national level: localization: Lat 18.223 Lon, 72.4371 Magnitude was taken from the USGS; Depth: 47.7;
- No warning was issued and no areas were evacuated.
- Sea level data were not monitored during the event.
- National Warning Centre does not know how to access sea level data over the GTS. It was not stated if it knows how to do it over the IOC Sea Level Observation website.
- National Warning Centre used numerical model scenarios during the event.



## 5. Survey Results

The Member States' responses to the questions asked in the survey questionnaire have been compiled into tables and figures, as follows:

### **TABLES**

<b>Table 5.1</b>	Summary of responses by countries to “yes/no” questions. (Q2, 4, 5, 6, 7, 8, 9, 10, 12, 15, 17, 18, 19, 20, 22)
<b>Table 5.2</b>	Time of earthquake awareness by countries and means of notification. Time of receipt of first PTWC and WC/ATWC bulletins (Q1, 2)
<b>Table 5.3</b>	Time of receipt by countries of all PTWC and WC/ATWC bulletins. (Q5)
<b>Table 5.4</b>	Earthquake parameters calculated by countries. (Q7)
<b>Table 5.5</b>	Actions taken by countries before the first PTWC/ WC/ATWC bulletin was received. (Q8)
<b>Table 5.6</b>	Actions taken by countries after the first PTWC/ WC/ATWC bulletin was received. (Q9)
<b>Table 5.7</b>	Time of national warnings issued by countries. Time lapse between earthquake awareness and issuance of first warning. Source information on which the warning was based. (Q10, 11)
<b>Table 5.8</b>	Time of warning cancellation for those countries that issued warnings (UTC). Time period between warning issuance and cancellation (Q14)
<b>Table 5.9</b>	Actions taken by National Disaster Management Organisations. (Q16)
<b>Table 5.10</b>	Evacuations by countries. (Q17)
<b>Table 5.11</b>	Sea level stations monitored by countries. (Q20)

### **FIGURES**

<b>Figure 5.1</b>	Time of earthquake awareness expressed as lapsed time since earthquake.
<b>Figure 5.2</b>	Time of official tsunami warnings issued by countries and modelled tsunami travel times.
<b>Figure 5.3</b>	Time of warning cancellation for countries that issued warnings and modelled tsunami travel times.

	Country	ANG	ANT	BAH	BAR	BEL	BER	BR VIS	CAY	COL	DOM	DRE	FR	HAI	HON	JAM	NET A	NG	PAN	US PR	US VIS	SV&GR	TRI	VEN
INTERIM ADVISORY SERVICE	Received first bulletin from PTWC and/or WC/ATWC	●	●	○	●	○	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	○
	Acknowledged receipt of bulletin	NA	●	n/a	○	n/a	○	○	○	○	○	○	○	○	○	○	○	○	○	●	●	○	○	n/a
	Received subsequent PTWC/ WC/ATWC bulletin	●	●	●	●	●	●	○	●	●	●	●	●	○	○	●	●	●	●	●	●	●	●	○
	Received info from other sources	●	●	●	●	●	●	●	○	●	●	●	NA	●	●	●	●	●	●	○	●	●	●	●
NATIONAL ACTIONS	Calculated earthquake parameter	○	○	○	○	○	○	○	○	○	○	○	NA	●	○	○	○	●	●	●	●	○	○	●
	Action taken before bulletin	○	○	●	○	○	●	○	○	●	○	●	NA	○	●	○	○	○	●	○	○	○	○	●
	Action taken after bulletin	●	○	●	●	○	●	●	●	●	○	●	NA	○	●	●	●	●	●	●	○	●	●	n/a
	Issue national warning	○	○	○	○	○	○	○	○	○	○	●	NA	○	●	●	○	●	○	○	○	○	○	○
	Wave height forecasted	n/a	n/a	○	n/a	n/a	n/a	n/a	n/a	n/a	n/a	○	NA	n/a	○	n/a	n/a	○	n/a	n/a	n/a	n/a	n/a	n/a
	Communication Problem with warning	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	○	n/a	n/a	○	n/a	n/a	○	○	n/a	n/a	n/a	n/a	n/a
NATIONAL RESPONSE	Any area evacuated	○	○	○	○	○	○	○	○	○	○	●	NA	○	○	○	○	○	○	○	○	○	○	○
	Smooth evacuation	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	●	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Self evacuation	○	○	○	○	○	○	○	○	○	○	○	NA	○	○	○	n/a	○	○	○	○	○	○	○
MONITORING AND MODELLING	Monitored sea level	●	○	○	●	○	○	○	○	●	○	●	NA	○	●	NA	○	○	○	●	○	○	○	○
	- Accessed through GTS	○	n/a	n/a	○	n/a	n/a	n/a	n/a	○	n/a	○	NA	n/a	NA		n/a	n/a	n/a	○	n/a	n/a	n/a	n/a
	- Accessed through IOC Sea Level Observation Facility	●	n/a	n/a	●	n/a	n/a	n/a	n/a	●	n/a	●	NA	n/a	NA		n/a	n/a	n/a	○	n/a	n/a	n/a	n/a
	- Accessed through other systems	●	n/a	n/a	○	n/a	n/a	n/a	n/a	●	n/a	●	NA	n/a	NA		n/a	n/a	n/a	●	n/a	n/a	n/a	n/a
	Knowledge on accessing sea level data through GTS	○	○	○	NA	●	○	○	NA	NA	●	○	NA	NA	○	NA	NA	○	○	NA	○	○	●	○
	Knowledge on accessing sea level data through IOC Sea Level Observation Facility	●	○	○	●	○	○	○	NA	NA	●	●	NA	NA	○	NA	●	○	○	NA	○	○	○	NA
	Used numerical modelling	NA	○	○	○	○	○	○	○	●	○	○	NA	○	●	NA	○	○	NA	○	○	○	●	●

ANG = Anguilla (UK), AT=Antigua and Barbuda, BAH= The Bahamas, BAR= Barbados, BEL=Belize, BER=Bermuda BR VIS=British Virgin Islands  
CAY=Caiman Islands, COL=Colombia, DOM=Dominica, DRE=Dominican Republic, FR=France, HAI =Haiti; HON= Honduras, JAM= Jamaica, NETA= Netherlands (Antilles) NG=Nicaragua, PAN= Panama, UR PR= US Puerto Rico, US VIS=US Virgin Islands, SV&GR= St. Vincent and the Grenadines, TRI= Trinidad and Tobago, VEN= Venezuela

●= yes, ○= no, n/a= not applicable, NA= No answer provided

Table 5.1 Summary of responses by countries to “yes/no” questions.

Country	Time learnt	Means of Notification	PTWC	WC/ATWC
Dominican Republic	21:53	Through website of the US Geological Survey	22:06	
Venezuela	21:53	Venezuela Seismic Network		
Colombia	21:58	Through CISN Software (California Integrated Seismic Network)	22:09	22:11
US Puerto Rico	21:58	Through the Puerto Rico Seismic Network		22:06
Nicaragua	21:59	Through INETER national seismic network	22:04	
British Virgin Islands	22:00	Phone (Director)		03:00
Panama	22:00	Internet	22:15	
Antigua and Barbuda	22:03	Through PTWC bulletin 1 by email and fax	22:03	
Barbados	22:03	Through PTWC bulletin 1 by fax and SMS	22:03	
Bermuda	22:03	Through PTWC bulletin 1 by fax and AFTN (GTS)	22:03	
Jamaica	22:03	Through PTWC bulletin 1 by email.	22:03	
St. Vincent and the Grenadines	22:03	Through PTWC bulletin 1 by email and fax	22:03	
Anguilla (UK)	22:04	Through PTWC bulletin 1 by phone	22:04	
Dominica	22:04	Upon receiving the text from “tsunami information ioc@lists.unesco.org	22:04	
France	22:04	Through PTWC bulletin 1 by email, fax and SMT	22:04	22:04
Netherlands (Antilles)	22:04	Through PTWC bulletin 1 by SMS	22:04	22:04
US Virgin Islands	22:06	Through WC/ATWC bulletin 1 by phone		22:09
Caiman Islands	22:08	Through PTWC bulletin 1 by fax and email	22:08	
The Bahamas	22:15	Television (CNN)	-	
Trinidad and Tobago	22:22	Through PTWC bulletin 1 by fax and GTS	22:22	
Honduras	22:30	Tsunami Warning Monitoring and email	21:53	21:53
Belize	23:02	Through PTWC bulletin 2 by fax and SMS	23:02	

**Table 5.2** Time of earthquake awareness by countries and means of notification. Time of receipt of *first* PTWC and WC/ATWC bulletins. All times are in UTC. See also Figure 5.1.

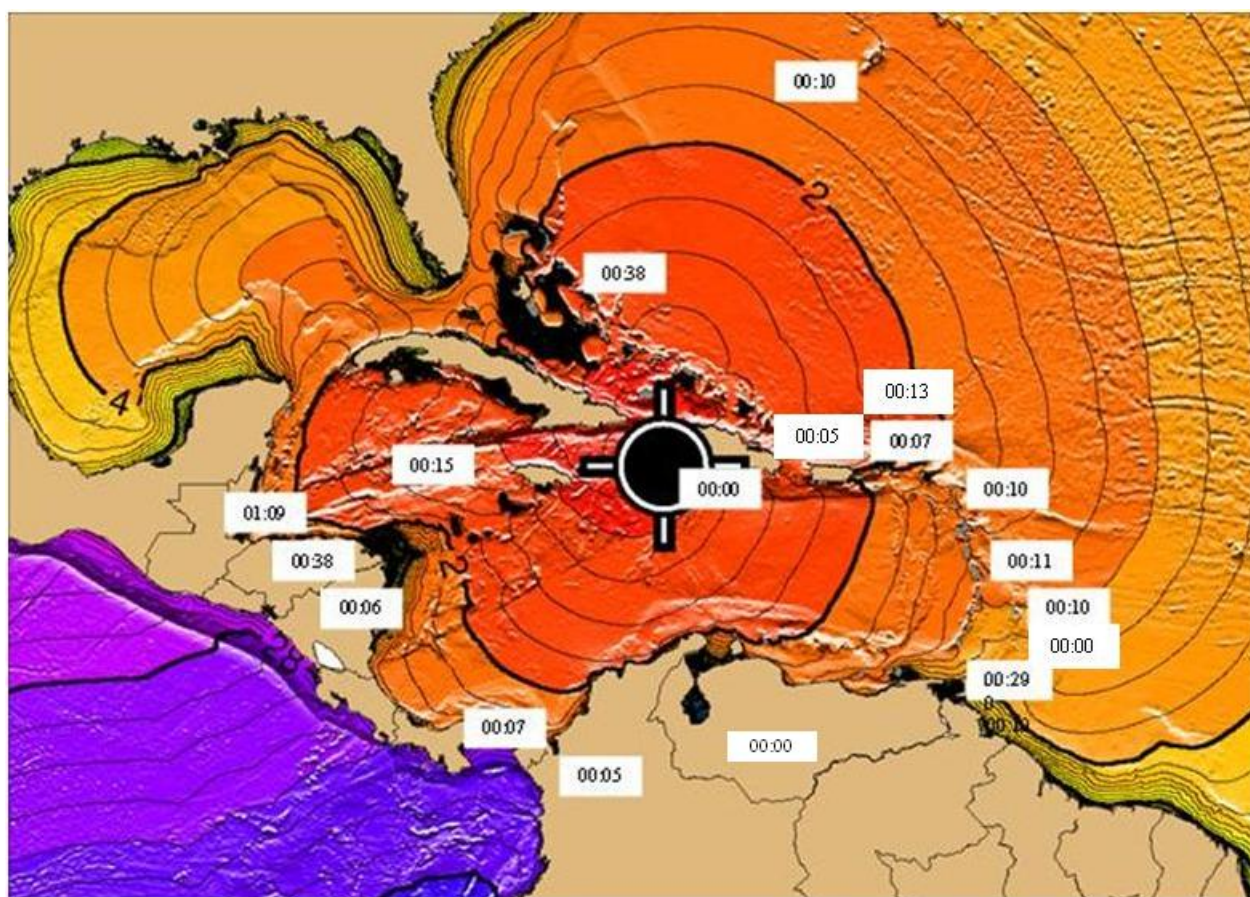


Figure 5.1 Time of earthquake awareness expressed as lapsed time since earthquake

Country	Agency	Bull. 1	Bull. 2	Bull. 3
Antigua and Barbuda	PTWC	22:03	22:54	23:45
Barbados	PTWC	22:03	NA	NA
Bermuda	PTWC	22:03	AFT/GTS: 22:54 Fax: 22:56	23:45
Honduras	PTWC	22 :03	Not received	Not received
St. Vincent and the Grenadines	PTWC	22:03	22:54	23:45
Dominica	PTWC	22:04	22:54	23:45
France	PTWC	22:04	22 :55	23 :45
	WC/ATWC	22 :04		
Haiti	PTWC	22:04		
Netherlands (Antilles)	PTWC	22:04	22:54	23:45
Nicaragua	PTWC	22:04	22:55	23:46
Dominican Republic	PTWC	22:06	23:00	23:48
US Puerto Rico	WC/ATWC	22:06		
Cayman Islands	PTWC	22:08	22:59	23:50
Colombia	PTWC	22:09	23:00	23:51
	WC/ATWC	22:11		
US Virgin Islands	WC/ATWC	22:09		
Panama	PTWC	22:15	NA	NA
Trinidad and Tobago	PTWC	22:22	22:53	23:46

<b>British Virgin Islands</b>	WC/ATWC	03:00	n/a	n/a
<b>The Bahamas</b>	PTWC	No received	22:54	23:45
<b>Belize</b>	PTWC	No received	23:02	No received
<b>Venezuela</b>	PTWC/ WC/ATWC	No received	No received	No received

- indicates bulletins received on 12 January except for British Virgin Islands

**Table 5.3** Time of receipt by countries of all PTWC and WC/ATWC bulletins.

Country	Latitude (S)	Longitude (E)	Depth (Km)	Magnitude	Scale
<b>Nicaragua</b>	18. 8 °	-71. 8 °	20 Km	7.6	mb
<b>Panama</b>	18. 460 °	- 72.530 °	10 Km	7.1	Mw
<b>US Puerto Rico</b>	18.45 °	-72.44 °	10 Km	7.0	Mw
<b>US Virgin Islands</b>	18.457 °	-72.533 °	13 Km	7.0	-
<b>Venezuela</b>	18.223	-72.4371	47,7 Km		

**Table 5.4** Earthquake parameters calculated by countries.

Country	Action details
<b>Colombia</b>	<ul style="list-style-type: none"> <li>• After knowing that an earthquake had been produced through CISM, started running the model Tsunami Travel Time</li> <li>• Searched information from the global warning centres</li> <li>• Started monitoring real time tide gauges in the area using the IOC Sea Level Observation Facility</li> </ul>
<b>Dominican Republic</b>	<ul style="list-style-type: none"> <li>• Issued tsunami warning</li> </ul>
<b>Honduras</b>	<ul style="list-style-type: none"> <li>• Observed data from seismographs located in different zones of the country</li> </ul>
<b>Panama</b>	<ul style="list-style-type: none"> <li>• Informed the National System of Civil Protection that an earthquake had been produced</li> </ul>
<b>Venezuela</b>	<ul style="list-style-type: none"> <li>• FUNVISIS emitted internal tsunami warnings to official institutions as Ministry of Science and Technology, Geographical Institut Simon Bolivar, Popular Ministry of Environment, Social Protection and Disaster Response, Direction of Hydrology and Navigation, and PDVSA</li> <li>• Prevision measures were undertaken in coastal zones</li> <li>• Information from USGS and CICESE was consulted</li> <li>• Constant communication by phone maintained</li> </ul>

**Table 5.5** Actions taken by countries before the first PTWC/ WC/ATWC bulletin was received

\*Venezuela did not received PTWC/WC/ATWC bulletins but undertook actions based on information from other sources

Country	Time	Details
Anguilla (UK)	22:05	Called Governor and Deputy Governor
	22:06	Notified National Disaster Management Committee and media
	22:06	Started DDM Staff Notifications
	22:10	NEOC Stood up initial
Antigua and Barbuda	22:05	Called national disaster services
	22:10	Faxed national disaster services

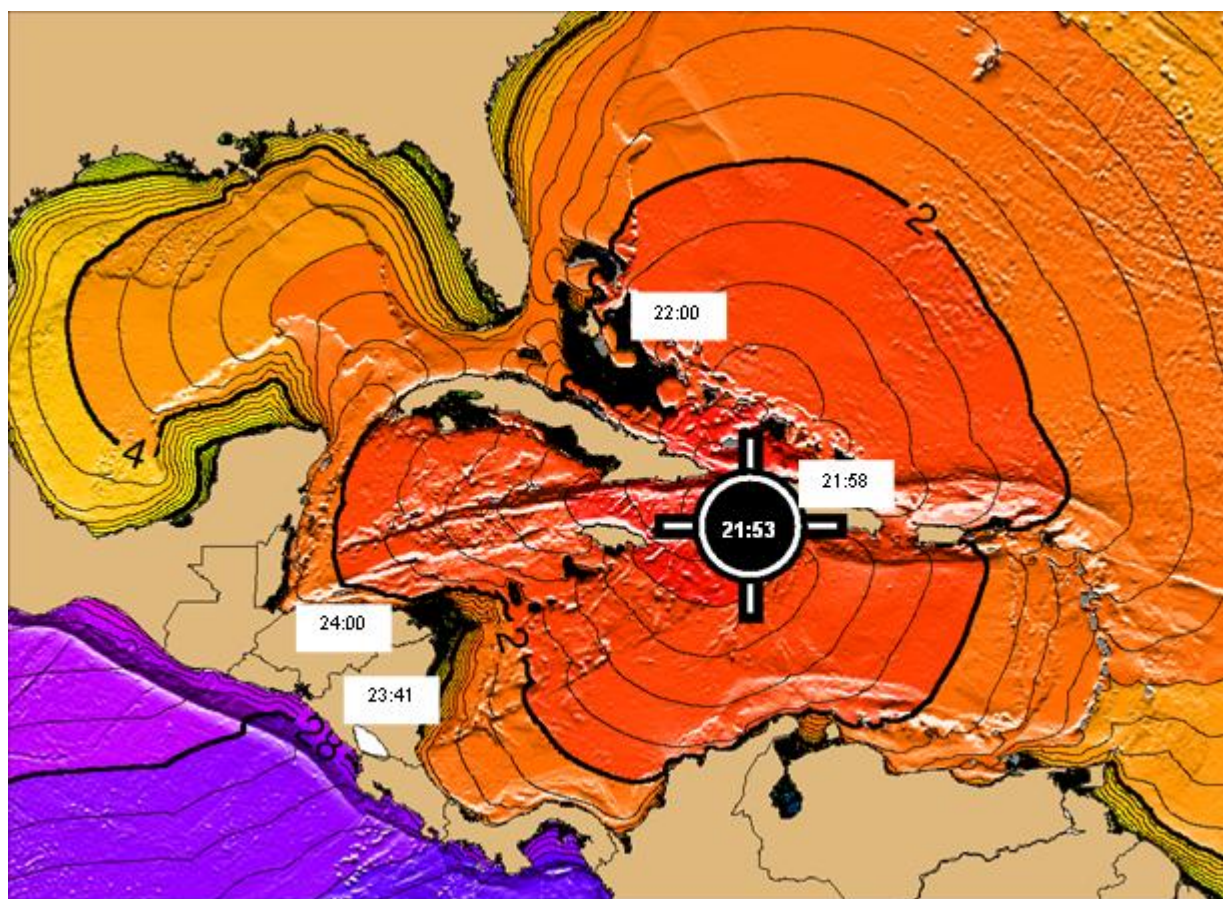
The Bahamas	22:57	PTWC information faxed to NEMA, Forecast Office and to Deputy Director of Meteorology, Mr Basil A. DEAN (who was at the television station awaiting official information on the earthquake)
	23:00	Senior Deputy Director, Mr Trevor M BASDEN presented PTWC information on the national radio stations via telephone interview.
Barbados	22:23	Called department of Emergency Management to confirm receipt of bulletin TWFP determined no national action was necessary at the time
British Virgin Islands	00:00	Contacted Director of PRSN
	00:20	Sent email to agencies, staff
	01:00	Updated website, contacted media
Cayman Islands	22:11	Informed Hazard Management, Police, fire, EMS by 911
Colombia	22:12	Informed the members of the Colombian National Technical Committee for Tsunamis Warning that a destructive tsunami threat did not exist. However, continued monitoring and informing this committee.
Dominican Republic	21:56	Informed Executive Committee of ONAMET via mobile phone
	21:58	Tsunami bulletin emitted to northern and southern coast of the country and Emergency Operations Centre
Honduras	22:45	Requested sea level monitoring
	22:55	Requested information from other countries
	23:30	Requested information about possibility of tsunami
Jamaica	22:04	Notification of Prime Minister and Permanent Secretary
	22:15	Notification of Prime Minister and Permanent Secretary
	22:20	Notification/advisory to the public via all media houses
The Netherlands (Antilles)	22:15	Live interviews to local radio stations
	23:00	Issued informative bulletin for national local authorities and public.
Nicaragua	23:41	Elaborated informative bulletin and distributed it to governmental disaster response agencies and media
Panama	22:20	Informed SINAPROC about possibility of tsunami
Trinidad and Tobago	22:50	Informed supervisors, and office of disaster preparedness
US Virgin Islands	-	Issued press advisories

**Table 5.6** Actions taken by countries after the first PTWC/WC/ATWC bulletin was received

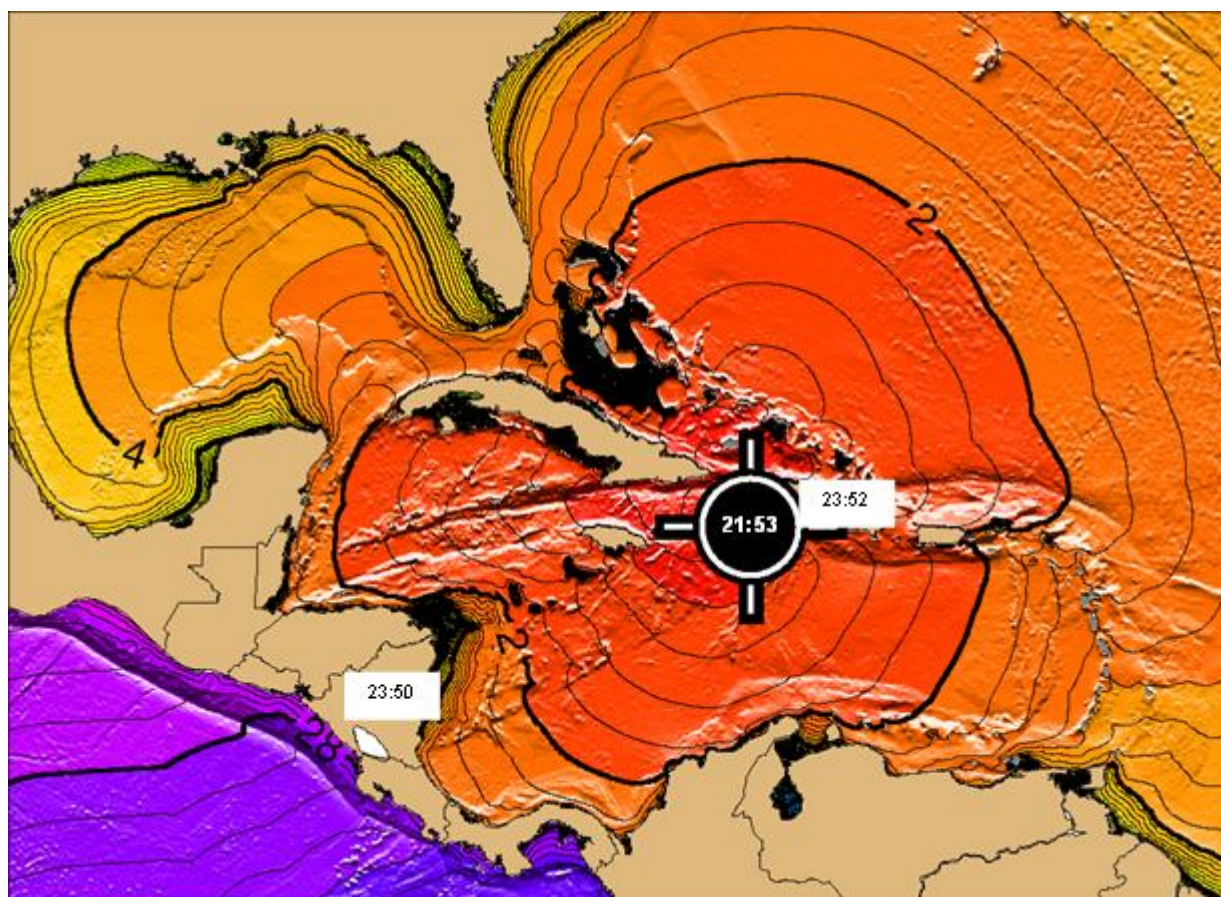
Country	Earthquake Notification	Warning issued	Time lapse (h:mm)	Information for warning
Bahamas	22:30	22:00	- 0:30	PTWC
Dominican Republic	21:53	21:58	0:05	National Warning Centre
Honduras	22:30	24:00	1:30	PTWC
Nicaragua	21:59	23:41	1:42	PTWC

**Table 5.7** Time of national warnings issued by countries (UTC). "Time lapse" is period between earthquake awareness and issuance of first warning. "Information for warning" is the source on which the warning was based. See also Figure 5.2





**Figure 5.2** Time of official tsunami warnings issued by countries and modelled tsunami travel times. All times in UTC.



**Figure 5.3** Time of warning cancellation for countries that issued warnings and modelled tsunami travel times. All times in UTC.

Country	Time of warning	Cancel time	Time on alert (hh:mm)	Reason for cancellation	Mode of cancellation
Bahamas	22:00	NA			
Dominican Republic	21:58	23:52	1:54	PTWC bulletin	Internet
Honduras	24:00	NA			
Nicaragua	23:41	23:50	0:09	PTWC bulletin	Email, fax, radio

**Table 5.8** Time of warning cancellation for those countries that issued warnings (UTC). Time on alert indicates the time between warning issuance and cancellation. See also Figure 5.3

Country	Time	Response
Bahamas	22:45	Contacted all relevant agencies and called a press conference
Honduras	24:00 – 12:00 (next day)	Monitored sea level
Nicaragua	23:41	Issued warning
St. Vincent and the Grenadines	22:15	Called BVI and Jamaica to request verification and information about whether or not they had experienced a tsunami

**Table 5.9** Actions taken by National Disaster Management Organisations.



Country	Warning Time	Evacuation Area	Evacuation Time	Number of people evacuated
<b>Dominican Republic</b>	21:58	San Pedro de Macoris,	22:20	2,000
		Pedernales, Boca Chica, Nagua, Puerto Plata	NA	

**Table 5.10** Evacuations by countries. All times in UTC.

Country	Sea Level Station	Monitoring method
The Bahamas	Great Inagua (GOES ID 941-0030)	IOC Sea level Observation Facility
	Nassau Harbour (GOES ID 941-0010)	IOC Sea level Observation Facility
	Lee Stocking Island (GOES ID 941-0020)	IOC Sea level Observation Facility
	Settlement Point, GBI (NDBC)	IOC Sea level Observation Facility
Colombia	Mayaguez PR Station	IOC Sea level Observation Facility
	Mona Island PR Station	IOC Sea level Observation Facility
	42407 Dart Buoy	Other
Dominican Republic	Santo Domingo	Other
	42407 Dart Buoy	Other
	41046 Dart Buoy	Other
US Puerto Rico	PRSN	Other

**Table 5.11** Sea level stations monitored by countries

## 6. Summary

The earthquake and tsunami event that occurred 25 km SW of Port-au-Prince, Haiti on 12 January 2010 presented an ideal opportunity to assess the performance of the CARIBE EWS. The UNESCO IOC Secretariat for the ICG/CARIBE EWS undertook a survey of Member States' responses to the event in order to collect information that can be used in a post-event assessment.

This report has been prepared by the Secretariat based on responses to a questionnaire sent out to 28 Member States and territories to which 23 responses were received. Factual details of the earthquake event and the tsunami are presented and the results of the survey are listed in tables and displayed as timelines and maps.

The survey has been very useful as an overview of the current status of the CARIBE EWS. Some gaps and weaknesses have also been identified, mainly regarding the knowledge of NTWCs on how to access sea level data over the GTS or the IOC Sea Level Observation Facility website.

It is beyond the scope of this report to conduct a detailed interpretation of the results, and the survey results have been presented so that individual Member States and the ICG can draw conclusions from this exercise and decide on future action. However, some highlights can be noted:

- 20 NTWCs received the first bulletins from PTWC/WC/ATWC
- 19 NTWCs received subsequent tsunami bulletins from PTWC
- 20 member states received information from other sources other than PTWC/WC/ATWC
- 7 member states and territories took some action before receiving the PTWC/WC/ATWC bulletin
- 16 took some action after receiving the PTWC/WC/ATWC bulletin
- 6 member states and territories monitored sea level
  - 4 by IOC Sea Level Observation Facility
  - 4 by other method
- A full evacuation was carried out in one Member State<sup>2</sup>.
- 3 member states did not receive the first PTWC/WC/ATWC bulletin
- 1 member state did not receive any PTWC/WC/ATWC bulletin
- 6 undertook their own earthquake analysis
- 4 member states used numerical models in their analysis
- 4 member states issued a tsunami warning
- 3 member states affirmed to have knowledge on how to access sea level data through GTS
- 5 member states affirmed to have knowledge on how to access sea level data through the IOC Sea Level Observation Facility website

Most of the shortcomings and weakness revealed by the survey can be addressed both by the ICG and at the national level through increased regional cooperation and training

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<sup>2</sup> Press Reports indicate that Cuba also performed a full evacuation of 30 000 habitants in Baracoa, Guantanamo (Secretariat note)

where needed. Post-event assessments can assist in this process by highlighting the strengths and weaknesses of the CARIBE EWS at regional, national and local levels and by raising the awareness of how Member States responded, both individually and collectively. The true value of such assessments is that it allows Member States to share information and experiences for the mutual benefit of improving the CARIBE EWS for all members. It is therefore recommended that the ICG/CARIBE EWS formalize this process and agree to a format and procedure for conducting surveys after every significant event in the Caribbean.

## **7. References**

USGS, 2010. United States Geological Survey Earthquake Hazards Program  
<http://earthquake.usgs.gov/earthquakes/recenteqsww/Quakes/us2010rja6.php>

Tsunami Travel Time Software. Geoware tsunami product list, 2007.  
<http://www.geoware-online.com/tsunami.html>

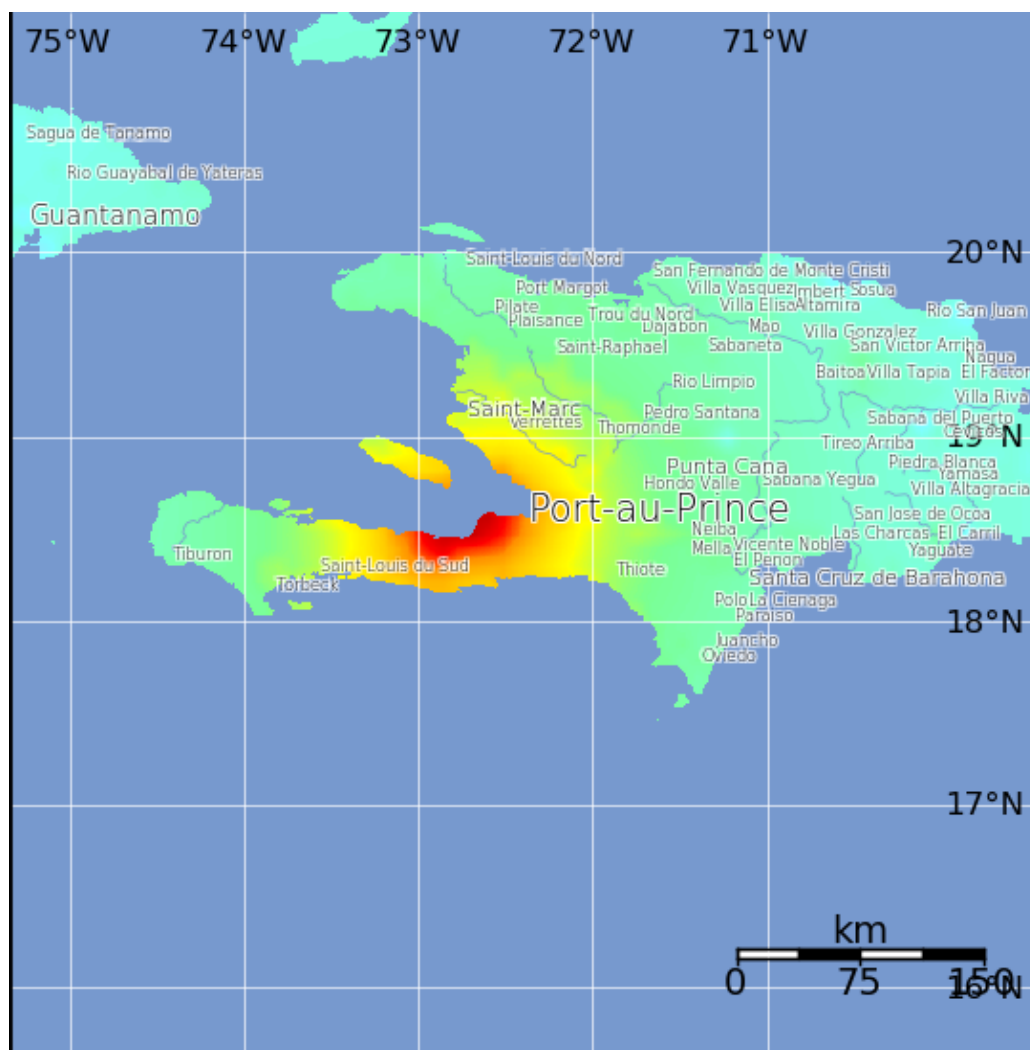
## Annex 1: Earthquake and tsunami event timeline

As of 13 Jan. 2010

12 Jan Haiti, 2010 (Earthquakes  $\geq 5.0$ )

	Elapse		Action
<b>21:53</b> 3 Jan UTC		NEIC	OT: 21:53:09 UTC (Local time: 16:53) 18.451N, 72.445W, Depth: 10km M:7.0 15km SW of Port-au-prince, Haiti
22:03	10	PTWC	Tsunami Watch for Haiti, Cuba, Bahamas, Dominican Rep. 18.5N, 72.5W, M:7.3 Estimated tsunami arrival times Jeremie, Haiti 22 :24 Port-au-prince, Haiti 22 :29 Cap-haiten, Haiti 22:55 Baracoa, Cuba 22:49 Great Inagua, Bahamas 22:46 Puerto Plata, Dominican Rep 23:04 Santo Domingo, Dominican Rep 23:37
22:03	10	WCATWC	No tsunami is expected for Puerto Rico, Virgin Islands, US Atlantic and Gulf of Mexico states and Eastern Canadian provinces.
22:54	1:01	PTWC	Tsunami Watch for Haiti, Cuba, Bahamas, Dominican Rep. 18.5N, 72.5W, M:7.1 Estimated tsunami arrival times Jeremie, Haiti 22 :15 Port-au-prince, Haiti 22 :28 Cap-haiten, Haiti 22:46 Baracoa, Cuba 22:40 Great Inagua, Bahamas 22:37 Puerto Plata, Dominican Rep 22:56 Santo Domingo, Dominican Rep 23:28 <i>(Note: M and tsunami arrival times are updated)</i>
23:45	1:52	PTWC	Tsunami Watch is cancelled Observed tsunami height <ul style="list-style-type: none"> <li>12cm (crest to trough) at Santo Domingo, Dominican Rep</li> <li>Less than 1 cm (crest to trough) at deep ocean gauge in the east-central Caribbean</li> </ul> Based on these data there could have been destructive tsunami waves near the earthquake epicenter but there is not a threat to coastal areas further away.
22:00			M: 5.9
22:12			M:5.5
23:12			M:5.1
13			M:5.0

JAN			
00:43			
00:59			M:5.2
01:16			M:5.1
01:32			M:5.3
01:36			M:5.5
01:55			M:5.0
01:57			M:5.4
05:02			M:5.7
05:18			M:5.2
07:23			M:5.0



## Annex 2: PTWC and WC/ATWC Bulletins

TSUNAMI MESSAGE NUMBER 1  
NWS PACIFIC TSUNAMI WARNING CENTER EWA BEACH HI  
2203 UTC TUE JAN 12 2010

THIS MESSAGE APPLIES TO COUNTRIES WITHIN AND BORDERING THE  
CARIBBEAN SEA...EXCEPT FOR PUERTO RICO AND THE VIRGIN ISLANDS.

... A LOCAL TSUNAMI WATCH IS IN EFFECT ...

A TSUNAMI WATCH IS IN EFFECT FOR

HAITI / CUBA / BAHAMAS / DOMINICAN REP

FOR OTHER AREAS OF THE CARIBBEAN COVERED BY THIS MESSAGE...IT IS  
FOR INFORMATION ONLY AT THIS TIME.

THIS BULLETIN IS ISSUED AS ADVICE TO GOVERNMENT AGENCIES. ONLY  
NATIONAL AND LOCAL GOVERNMENT AGENCIES HAVE THE AUTHORITY TO MAKE  
DECISIONS REGARDING THE OFFICIAL STATE OF ALERT IN THEIR AREA AND  
ANY ACTIONS TO BE TAKEN IN RESPONSE.

AN EARTHQUAKE HAS OCCURRED WITH THESE PRELIMINARY PARAMETERS

ORIGIN TIME - 2153Z 12 JAN 2010  
COORDINATES - 18.5 NORTH 72.5 WEST  
LOCATION - HAITI REGION  
MAGNITUDE - 7.3

### EVALUATION

A DESTRUCTIVE WIDESPREAD TSUNAMI THREAT DOES NOT EXIST BASED ON  
HISTORICAL EARTHQUAKE AND TSUNAMI DATA.

HOWEVER - THERE IS THE POSSIBILITY OF A LOCAL TSUNAMI THAT  
COULD AFFECT COASTS LOCATED USUALLY NO MORE THAN A HUNDRED  
KILOMETERS FROM THE EARTHQUAKE EPICENTER. AUTHORITIES FOR THE  
REGION NEAR THE EPICENTER SHOULD BE AWARE OF THIS POSSIBILITY.  
AREAS FURTHER FROM THE EPICENTER COULD EXPERIENCE SMALL SEA  
LEVEL CHANGES AND STRONG OR UNUSUAL COASTAL CURRENTS.

ESTIMATED INITIAL TSUNAMI WAVE ARRIVAL TIMES AT FORECAST POINTS  
WITHIN THE WARNING AND WATCH AREAS ARE GIVEN BELOW. ACTUAL  
ARRIVAL TIMES MAY DIFFER AND THE INITIAL WAVE MAY NOT BE THE  
LARGEST. A TSUNAMI IS A SERIES OF WAVES AND THE TIME BETWEEN  
SUCCESSIVE WAVES CAN BE FIVE MINUTES TO ONE HOUR.

LOCATION	FORECAST POINT	COORDINATES	ARRIVAL TIME
-----	-----	-----	-----
HAITI	JEREMIE	18.6N 74.1W	2224Z 12 JAN
	PORT-AU-PRINCE	18.5N 72.4W	2229Z 12 JAN
	CAP-HAITEN	19.8N 72.2W	2255Z 12 JAN
CUBA	BARACOA	20.4N 74.5W	2249Z 12 JAN
BAHAMAS	GREAT INAGUA	20.9N 73.7W	2246Z 12 JAN
DOMINICAN REP	PUERTO PLATA	19.8N 70.7W	2304Z 12 JAN
	SANTO DOMINGO	18.5N 69.9W	2337Z 12 JAN

ADDITIONAL BULLETINS WILL BE ISSUED BY THE PACIFIC TSUNAMI

WARNING CENTER FOR THIS EVENT AS MORE INFORMATION  
BECOMES AVAILABLE.



TSUNAMI MESSAGE NUMBER 2  
NWS PACIFIC TSUNAMI WARNING CENTER EWA BEACH HI  
2254 UTC TUE JAN 12 2010

THIS MESSAGE APPLIES TO COUNTRIES WITHIN AND BORDERING THE  
CARIBBEAN SEA...EXCEPT FOR PUERTO RICO AND THE VIRGIN ISLANDS.

... A LOCAL TSUNAMI WATCH IS IN EFFECT ...

A TSUNAMI WATCH IS IN EFFECT FOR

HAITI / CUBA / BAHAMAS / DOMINICAN REP

FOR OTHER AREAS OF THE CARIBBEAN COVERED BY THIS MESSAGE...IT IS  
FOR INFORMATION ONLY AT THIS TIME.

THIS BULLETIN IS ISSUED AS ADVICE TO GOVERNMENT AGENCIES. ONLY  
NATIONAL AND LOCAL GOVERNMENT AGENCIES HAVE THE AUTHORITY TO MAKE  
DECISIONS REGARDING THE OFFICIAL STATE OF ALERT IN THEIR AREA AND  
ANY ACTIONS TO BE TAKEN IN RESPONSE.

AN EARTHQUAKE HAS OCCURRED WITH THESE PRELIMINARY PARAMETERS

ORIGIN TIME - 2153Z 12 JAN 2010  
COORDINATES - 18.5 NORTH 72.5 WEST  
LOCATION - HAITI REGION  
MAGNITUDE - 7.1

NOTE: MAGNITUDE IS REDUCED FROM 7.3 TO 7.1

THERE ARE NO SEA LEVEL READINGS YET FOR THIS EVENT. READINGS  
FROM THE NEAREST GAUGES SHOULD BE RECEIVED WITHIN THE NEXT HOUR.

#### EVALUATION

A DESTRUCTIVE WIDESPREAD TSUNAMI THREAT DOES NOT EXIST BASED ON  
HISTORICAL EARTHQUAKE AND TSUNAMI DATA.

HOWEVER - THERE IS THE POSSIBILITY OF A LOCAL TSUNAMI THAT  
COULD AFFECT COASTS LOCATED USUALLY NO MORE THAN A HUNDRED  
KILOMETERS FROM THE EARTHQUAKE EPICENTER. AUTHORITIES FOR THE  
REGION NEAR THE EPICENTER SHOULD BE AWARE OF THIS POSSIBILITY.  
AREAS FURTHER FROM THE EPICENTER COULD EXPERIENCE SMALL SEA  
LEVEL CHANGES AND STRONG OR UNUSUAL COASTAL CURRENTS.

ESTIMATED INITIAL TSUNAMI WAVE ARRIVAL TIMES AT FORECAST POINTS  
WITHIN THE WARNING AND WATCH AREAS ARE GIVEN BELOW. ACTUAL  
ARRIVAL TIMES MAY DIFFER AND THE INITIAL WAVE MAY NOT BE THE  
LARGEST. A TSUNAMI IS A SERIES OF WAVES AND THE TIME BETWEEN  
SUCCESSIVE WAVES CAN BE FIVE MINUTES TO ONE HOUR.

LOCATION	FORECAST POINT	COORDINATES	ARRIVAL TIME
-----	-----	-----	-----
HAITI	JEREMIE	18.6N 74.1W	2215Z 12 JAN
	PORT-AU-PRINCE	18.5N 72.4W	2228Z 12 JAN
	CAP-HAITEN	19.8N 72.2W	2246Z 12 JAN
CUBA	BARACOA	20.4N 74.5W	2240Z 12 JAN
BAHAMAS	GREAT INAGUA	20.9N 73.7W	2237Z 12 JAN
DOMINICAN REP	PUERTO PLATA	19.8N 70.7W	2256Z 12 JAN
	SANTO DOMINGO	18.5N 69.9W	2328Z 12 JAN

ADDITIONAL BULLETINS WILL BE ISSUED BY THE PACIFIC TSUNAMI  
WARNING CENTER FOR THIS EVENT AS MORE INFORMATION  
BECOMES AVAILABLE.

TSUNAMI MESSAGE NUMBER 3  
NWS PACIFIC TSUNAMI WARNING CENTER EWA BEACH HI  
2345 UTC TUE JAN 12 2010

THIS MESSAGE APPLIES TO COUNTRIES WITHIN AND BORDERING THE  
CARIBBEAN SEA...EXCEPT FOR PUERTO RICO AND THE VIRGIN ISLANDS.

... THE TSUNAMI WATCH IS CANCELLED ...

THIS BULLETIN IS ISSUED AS ADVICE TO GOVERNMENT AGENCIES. ONLY  
NATIONAL AND LOCAL GOVERNMENT AGENCIES HAVE THE AUTHORITY TO MAKE  
DECISIONS REGARDING THE OFFICIAL STATE OF ALERT IN THEIR AREA AND  
ANY ACTIONS TO BE TAKEN IN RESPONSE.

AN EARTHQUAKE HAS OCCURRED WITH THESE PRELIMINARY PARAMETERS

ORIGIN TIME - 2153Z 12 JAN 2010  
COORDINATES - 18.5 NORTH 72.5 WEST  
LOCATION - HAITI REGION  
MAGNITUDE - 7.1

#### EVALUATION

A TSUNAMI MEASURING 12 CM CREST-TO-TROUGH WAS RECORDED AT SANTO  
DOMINGO IN THE DOMINICAN REPUBLIC AND A TSUNAMI LESS THAN 1 CM  
CREST-TO-TROUGH WAS RECORDED ON A DEEP OCEAN GAUGE IN THE  
EAST-CENTRAL CARIBBEAN. BASED ON THESE DATA THERE COULD HAVE  
BEEN DESTRUCTIVE TSUNAMI WAVES NEAR THE EARTHQUAKE EPICENTER  
BUT THERE IS NOT A THREAT TO COASTAL AREAS FURTHER AWAY.  
THEREFORE THE TSUNAMI WATCH ISSUED BY THIS CENTER IS NOW  
CANCELLED.

FOR ANY AFFECTED AREAS - WHEN NO MAJOR WAVES HAVE OCCURRED FOR AT  
LEAST TWO HOURS AFTER THE ESTIMATED ARRIVAL TIME OR DAMAGING WAVES  
HAVE NOT OCCURRED FOR AT LEAST TWO HOURS THEN LOCAL AUTHORITIES  
CAN ASSUME THE THREAT IS PASSED. DANGER TO BOATS AND COASTAL  
STRUCTURES CAN CONTINUE FOR SEVERAL HOURS DUE TO RAPID CURRENTS.  
AS LOCAL CONDITIONS CAN CAUSE A WIDE VARIATION IN TSUNAMI WAVE  
ACTION THE ALL CLEAR DETERMINATION MUST BE MADE BY LOCAL  
AUTHORITIES.

THIS WILL BE THE FINAL PRODUCT ISSUED BY THE PACIFIC TSUNAMI  
WARNING CENTER FOR THIS EVENT UNLESS ADDITIONAL INFORMATION  
BECOMES AVAILABLE.

WEXX22 PAAQ 122203  
TIBAT1

TSUNAMI INFORMATION STATEMENT NUMBER 1  
NWS WEST COAST/ALASKA TSUNAMI WARNING CENTER PALMER AK  
603 PM AST TUE JAN 12 2010

...THIS TSUNAMI INFORMATION STATEMENT IS FOR PUERTO RICO/  
THE VIRGIN ISLANDS/ THE U.S. ATLANTIC AND GULF OF  
MEXICO STATES/ AND EASTERN CANADIAN PROVINCES...

NO WARNING... NO WATCH AND NO ADVISORY IS IN EFFECT FOR  
THESE AREAS.

EVALUATION

BASED ON EARTHQUAKE DATA AND HISTORIC TSUNAMI RECORDS THE  
EARTHQUAKE WAS NOT SUFFICIENT TO GENERATE A TSUNAMI DAMAGING TO  
PUERTO RICO/ THE VIRGIN ISLANDS/ THE U.S. ATLANTIC AND GULF  
OF MEXICO COASTS/ AND EASTERN CANADA.

HOWEVER - EARTHQUAKES OF THIS SIZE SOMETIMES GENERATE  
TSUNAMIS THAT CAN BE DESTRUCTIVE ALONG COASTS LOCATED IN THE  
REGION OF THE EARTHQUAKE EPICENTER. AUTHORITIES IN THE REGION  
SHOULD BE AWARE OF THIS POSSIBILITY AND TAKE APPROPRIATE ACTION.

PRELIMINARY EARTHQUAKE PARAMETERS

MAGNITUDE - 7.3  
TIME - 1653 EST JAN 12 2010  
1753 AST JAN 12 2010  
2153 UTC JAN 12 2010  
LOCATION - 18.5 NORTH 72.5 WEST  
- HAITI REGION  
DEPTH - 21 MILES/33 KM

THE PACIFIC TSUNAMI WARNING CENTER IN EWA BEACH HAWAII WILL  
ISSUE MESSAGES FOR AREAS IN THE CARIBBEAN OUTSIDE PUERTO RICO  
AND THE VIRGIN ISLANDS.

THIS WILL BE THE ONLY STATEMENT ISSUED FOR THIS EVENT BY THE  
WEST COAST/ALASKA TSUNAMI WARNING CENTER UNLESS ADDITIONAL  
INFORMATION BECOMES AVAILABLE. REFER TO THE INTERNET SITE  
WCATWC.ARH.NOAA.GOV FOR MORE INFORMATION.

**Annex 3: Survey Questionnaire****12 JANUARY 2010 HAITI EARTHQUAKE AND TSUNAMI EVENT  
POST-EVENT ASSESSMENT QUESTIONNAIRE****COUNTRY:** \_\_\_\_\_**Contact Details**

Contact Name		
Name of Organisation		
Address		
Phone		Fax
Email		

**Instructions**

This is an electronic form which can be filled out in several ways:

- 1) If you use Microsoft Word software you can fill out the form electronically. To tick checkboxes (yes/no answers), you can either use the tab button or the mouse to move to the required answer. Written answers can be typed in the grey area next to the questions, and the area will expand to fit longer answers.
- 2) If the form fields don't work, then you can type your answers next to the relevant question.
- 3) Please give all times in UTC, not local time.
- 4) Please include as much information as possible in your answers. If there is not enough room on the questionnaire form, then please send extra information in a separate document.
- 5) Where multiple answers are possible, please feel free to tick more than one box.

**You may also print the questionnaire and fill out by hand, then scan/email or fax it back to us.**

**We may need to contact you to clarify your answers, so please include a contact phone number where we can reach you.**

## 12 JANUARY 2010 HAITI EARTHQUAKE AND TSUNAMI EVENT

### POST-EVENT ASSESSMENT QUESTIONNAIRE

#### SECTION A – INTERIM ADVISORY SERVICE

- 1) How and at what time (UTC) did you learn that a big earthquake had taken place?

How:

Time (UTC):

- 2) Did you receive the first tsunami watch bulletin from the PTWC and/or WC/ATWC?

Yes ☐

No ☐

If YES to either or both, at what time was the bulletin received(UTC)?

PTWC:

WC/ATWC:

- 3) How did you receive the bulletin (cross more than one box if appropriate)?

Email: ☐

Fax: ☐

GTS: ☐

Phone: ☐

Other (please specify):

- 4) Did you acknowledge receipt of the bulletin?

Yes ☐

No ☐

- 5) Were subsequent bulletins received from PTWC, WC/ATWC or another source?

Yes ☐

No ☐

If YES, please list the bulletin numbers and the time (UTC) you received them.

PTWC	Time UTC	WC/ATWC	Time UTC	Others	TimeUTC
No...		No...		No...	
No...		No...		No...	
No...		No...		No...	
No...		No...		No...	
No...		No...		No...	
No...		No...		No...	

(Add more rows if necessary)

**6) Was information about the earthquake received from other sources?**Yes ☐No ☐

If YES, please provide details:

**SECTION B – NATIONAL ACTIONS**

The purpose of this section is to find out what actions were taken by National Warning Centres, including independent analysis of the event, notification of relevant organisations, issuing and cancellation of warnings.

**7) Were any earthquake parameters calculated at the national level?**Yes ☐No ☐

If YES, please specify:

Location:

Depth:

Magnitude:

Type of Mag.:

**8) Was any action taken BEFORE receiving the PTWC/ WC/ATWC information?**Yes ☐No ☐

If YES, please give details:

**9) What action was taken after receiving the first bulletin? Please list times (UTC) as well as actions. Include details of organisations or government agencies contacted.**

Action Taken	Time (UTC)

(Add more rows if necessary)

**10) Did your National Warning Centre issue a tsunami warning to the public? If yes, what time was it issued (UTC)?**Yes: ☐

Time:

No: ☐**11) If a tsunami warning was issued to the public, was the warning based on bulletins from the PTWC and/or WC/ATWC, or on information determined by your National Warning Centre?**PTWC: ☐WC/ATWC: ☐National TWC: ☐

**12) If a tsunami warning was issued to the public, was a tsunami wave height forecast provided?**

Yes ☐

No ☐

If YES, please provide details:

**13) How was the warning issued? (eg phone, fax, email, sirens, police etc). Cross more than one box if appropriate.**

Phone: ☐

Fax: ☐

Email: ☐

sirens: ☐

Other (please specify)

**14) If a warning was issued, what time was the warning cancelled (UTC)? What was the reason for cancellation? How was this information communicated to the public?**

Time of Cancellation:

Reason for Cancellation:

Communication method:

**15) Were there any communication problems with distributing the tsunami warning or cancellation information? (eg mobile phone network overload, people not answering phones etc).**

Yes ☐

No ☐

If YES, please provide details:

### **SECTION C – NATIONAL RESPONSE**

The purpose of this section is to find out what the national and local response was to the event after the tsunami warning had been issued by the National Warning Centre.

**16) What actions were taken by the national disaster management organisation (or equivalent)?**

Action taken	Time (UTC)

(Add more rows if necessary)



**17) Were any areas evacuated?**Yes: ☐No: ☐

If YES, please provide details in the following table:

Area Evacuated	Time (UTC)	Estimated No. People Evacuated

(Add more rows if necessary)

**18) If an evacuation occurred, did the process happen smoothly?**Yes: ☐No: ☐

If NO, please provide details of problems encountered:

**19) Did people in some areas self-evacuate before a warning was issued?**Yes: ☐No: ☐

If YES, please provide details in the following table:

Area	Time (UTC)	Estimated No. People Evacuated

(Add more rows if necessary)

**SECTION D – MONITORING AND MODELLING****20) Were sea level data monitored during the event?**Yes ☐No ☐

If YES, which stations were monitored and how where they monitored?

Sea Level station	Monitoring method		
	GTS <input type="checkbox"/>	IOC Sea Level Facility <input type="checkbox"/>	Other <input type="checkbox"/>
	GTS <input type="checkbox"/>	IOC Sea Level Facility <input type="checkbox"/>	Other <input type="checkbox"/>
	GTS <input type="checkbox"/>	IOC Sea Level Facility <input type="checkbox"/>	Other <input type="checkbox"/>
	GTS <input type="checkbox"/>	IOC Sea Level Facility <input type="checkbox"/>	Other <input type="checkbox"/>
	GTS <input type="checkbox"/>	IOC Sea Level Facility <input type="checkbox"/>	Other <input type="checkbox"/>

(Add more rows if necessary)

**21) If the answer to question 20 is NO, does your National Warning Centre know how to access sea level data over the GTS or on the IOC Sea Level Facility website?**

GTS:

Yes ☐No ☐

IOC Sea Level Facility:

Yes ☐No ☐**22) Did your National Warning Centre use any numerical model scenarios during the event (deep ocean propagation and/or inundation model scenarios)?**Yes: ☐No: ☐**SECTION E – OTHER INFORMATION**

Please feel free to provide any further information you would like to be included in the report. This could include comments which you can type below, or attachments such as photographs, or any other documents you consider relevant. We would particularly welcome copies of any national post-event assessment reports that are available

# IOC Technical Series

No.	Title	Languages
1	Manual on International Oceanographic Data Exchange. 1965	(out of stock)
2	Intergovernmental Oceanographic Commission (Five years of work). 1966	(out of stock)
3	Radio Communication Requirements of Oceanography. 1967	(out of stock)
4	Manual on International Oceanographic Data Exchange - Second revised edition. 1967	(out of stock)
5	Legal Problems Associated with Ocean Data Acquisition Systems (ODAS). 1969	(out of stock)
6	Perspectives in Oceanography, 1968	(out of stock)
7	Comprehensive Outline of the Scope of the Long-term and Expanded Programme of Oceanic Exploration and Research. 1970	(out of stock)
8	IGOSS (Integrated Global Ocean Station System) - General Plan Implementation Programme for Phase I. 1971	(out of stock)
9	Manual on International Oceanographic Data Exchange - Third Revised Edition. 1973	(out of stock)
10	Bruun Memorial Lectures, 1971	E, F, S, R
11	Bruun Memorial Lectures, 1973	(out of stock)
12	Oceanographic Products and Methods of Analysis and Prediction. 1977	E only
13	International Decade of Ocean Exploration (IDOE), 1971-1980. 1974	(out of stock)
14	A Comprehensive Plan for the Global Investigation of Pollution in the Marine Environment and Baseline Study Guidelines. 1976	E, F, S, R
15	Bruun Memorial Lectures, 1975 - Co-operative Study of the Kuroshio and Adjacent Regions. 1976	(out of stock)
16	Integrated Ocean Global Station System (IGOSS) General Plan and Implementation Programme 1977-1982. 1977	E, F, S, R
17	Oceanographic Components of the Global Atmospheric Research Programme (GARP) . 1977	(out of stock)
18	Global Ocean Pollution: An Overview. 1977	(out of stock)
19	Bruun Memorial Lectures - The Importance and Application of Satellite and Remotely Sensed Data to Oceanography. 1977	(out of stock)
20	A Focus for Ocean Research: The Intergovernmental Oceanographic Commission - History, Functions, Achievements. 1979	(out of stock)
21	Bruun Memorial Lectures, 1979: Marine Environment and Ocean Resources. 1986	E, F, S, R
22	Scientific Report of the Interecalibration Exercise of the IOC-WMO-UNEP Pilot Project on Monitoring Background Levels of Selected Pollutants in Open Ocean Waters. 1982	(out of stock)
23	Operational Sea-Level Stations. 1983	E, F, S, R
24	Time-Series of Ocean Measurements. Vol.1. 1983	E, F, S, R
25	A Framework for the Implementation of the Comprehensive Plan for the Global Investigation of Pollution in the Marine Environment. 1984	(out of stock)
26	The Determination of Polychlorinated Biphenyls in Open-ocean Waters. 1984	E only
27	Ocean Observing System Development Programme. 1984	E, F, S, R
28	Bruun Memorial Lectures, 1982: Ocean Science for the Year 2000. 1984	E, F, S, R
29	Catalogue of Tide Gauges in the Pacific. 1985	E only
30	Time-Series of Ocean Measurements. Vol. 2. 1984	E only
31	Time-Series of Ocean Measurements. Vol. 3. 1986	E only
32	Summary of Radiometric Ages from the Pacific. 1987	E only
33	Time-Series of Ocean Measurements. Vol. 4. 1988	E only
34	Bruun Memorial Lectures, 1987: Recent Advances in Selected Areas of Ocean Sciences in the Regions of the Caribbean, Indian Ocean and the Western Pacific. 1988	Composite E, F, S

(continued)

No.	Title	Languages
35	Global Sea-Level Observing System (GLOSS) Implementation Plan. 1990	E only
36	Bruun Memorial Lectures 1989: Impact of New Technology on Marine Scientific Research. 1991	Composite E, F, S
37	Tsunami Glossary - A Glossary of Terms and Acronyms Used in the Tsunami Literature. 1991	E only
38	The Oceans and Climate: A Guide to Present Needs. 1991	E only
39	Bruun Memorial Lectures, 1991: Modelling and Prediction in Marine Science. 1992	E only
40	Oceanic Interdecadal Climate Variability. 1992	E only
41	Marine Debris: Solid Waste Management Action for the Wider Caribbean. 1994	E only
42	Calculation of New Depth Equations for Expendable Bathymetographs Using a Temperature-Error-Free Method (Application to Sippican/TSK T-7, T-6 and T-4 XBTs. 1994	E only
43	IGOSS Plan and Implementation Programme 1996-2003. 1996	E, F, S, R
44	Design and Implementation of some Harmful Algal Monitoring Systems. 1996	E only
45	Use of Standards and Reference Materials in the Measurement of Chlorinated Hydrocarbon Residues. 1996	E only
46	Equatorial Segment of the Mid-Atlantic Ridge. 1996	E only
47	Peace in the Oceans: Ocean Governance and the Agenda for Peace; the Proceedings of <i>Pacem in Maribus XXIII</i> , Costa Rica, 1995. 1997	E only
48	Neotectonics and fluid flow through seafloor sediments in the Eastern Mediterranean and Black Seas - Parts I and II. 1997	E only
49	Global Temperature Salinity Profile Programme: Overview and Future. 1998	E only
50	Global Sea-Level Observing System (GLOSS) Implementation Plan-1997. 1997	E only
51	L'état actuel de l'exploitation des pêcheries maritimes au Cameroun et leur gestion intégrée dans la sous-région du Golfe de Guinée ( <i>cancelled</i> )	F only
52	Cold water carbonate mounds and sediment transport on the Northeast Atlantic Margin. 1998	E only
53	The Baltic Floating University: Training Through Research in the Baltic, Barents and White Seas - 1997. 1998	E only
54	Geological Processes on the Northeast Atlantic Margin (8 <sup>th</sup> training-through-research cruise, June-August 1998). 1999	E only
55	Bruun Memorial Lectures, 1999: Ocean Predictability. 2000	E only
56	Multidisciplinary Study of Geological Processes on the North East Atlantic and Western Mediterranean Margins (9 <sup>th</sup> training-through-research cruise, June-July 1999). 2000	E only
57	Ad hoc Benthic Indicator Group - Results of Initial Planning Meeting, Paris, France, 6-9 December 1999. 2000	E only
58	Bruun Memorial Lectures, 2001: Operational Oceanography – a perspective from the private sector. 2001	E only
59	Monitoring and Management Strategies for Harmful Algal Blooms in Coastal Waters. 2001	E only
60	Interdisciplinary Approaches to Geoscience on the North East Atlantic Margin and Mid-Atlantic Ridge (10 <sup>th</sup> training-through-research cruise, July-August 2000). 2001	E only
61	Forecasting Ocean Science? Pros and Cons, Potsdam Lecture, 1999. 2002	E only
62	Geological Processes in the Mediterranean and Black Seas and North East Atlantic (11 <sup>th</sup> training-through-research cruise, July- September 2001). 2002	E only
63	Improved Global Bathymetry – Final Report of SCOR Working Group 107. 2002	E only
64	R. Revelle Memorial Lecture, 2006: Global Sea Levels, Past, Present and Future. 2007	E only

(continued)

No.	Title	Languages
65	Bruun Memorial Lectures, 2003: Gas Hydrates – a potential source of energy from the oceans. 2003	E only
66	Bruun Memorial Lectures, 2003: Energy from the Sea: the potential and realities of Ocean Thermal Energy Conversion (OTEC). 2003	E only
67	Interdisciplinary Geoscience Research on the North East Atlantic Margin, Mediterranean Sea and Mid-Atlantic Ridge (12 <sup>th</sup> training-through-research cruise, June-August 2002). 2003	E only
68	Interdisciplinary Studies of North Atlantic and Labrador Sea Margin Architecture and Sedimentary Processes (13 <sup>th</sup> training-through-research cruise, July-September 2003). 2004	E only
69	Biodiversity and Distribution of the Megafauna / Biodiversité et distribution de la mégafaune. 2006 Vol.1 The polymetallic nodule ecosystem of the Eastern Equatorial Pacific Ocean / Ecosystème de nodules polymétalliques de l'océan Pacifique Est équatorial Vol.2 Annotated photographic Atlas of the echinoderms of the Clarion-Clipperton fracture zone / Atlas photographique annoté des échinodermes de la zone de fractures de Clarion et de Clipperton	E F
70	Interdisciplinary geoscience studies of the Gulf of Cadiz and Western Mediterranean Basin (14 <sup>th</sup> training-through-research cruise, July-September 2004). 2006	E only
71	Indian Ocean Tsunami Warning and Mitigation System, IOTWS. Implementation Plan, July-August 2006. 2006	E only
72	Deep-water Cold Seeps, Sedimentary Environments and Ecosystems of the Black and Tyrrhenian Seas and the Gulf of Cadiz (15 <sup>th</sup> training-through-research cruise, June–August 2005). 2007	E only
73	Implementation Plan for the Tsunami Early Warning and Mitigation System in the North-Eastern Atlantic, the Mediterranean and Connected Seas (NEAMTWS), 2007–2011. 2007 ( <i>electronic only</i> )	E only
74	Bruun Memorial Lectures, 2005: The Ecology and Oceanography of Harmful Algal Blooms – Multidisciplinary approaches to research and management. 2007	E only
75	National Ocean Policy. The Basic Texts from: Australia, Brazil, Canada, China, Colombia, Japan, Norway, Portugal, Russian Federation, United States of America. (Also Law of Sea Dossier 1). 2008	E only
76	Deep-water Depositional Systems and Cold Seeps of the Western Mediterranean, Gulf of Cadiz and Norwegian Continental margins (16 <sup>th</sup> training-through-research cruise, May–July 2006). 2008	E only
77	Indian Ocean Tsunami Warning and Mitigation System (IOTWS) – 12 September 2007 Indian Ocean Tsunami Event. Post-Event Assessment of IOTWS Performance. 2008	E only
78	Tsunami and Other Coastal Hazards Warning System for the Caribbean and Adjacent Regions (CARIBE EWS) – Implementation Plan 2008. 2008	E only
79	Filling Gaps in Large Marine Ecosystem Nitrogen Loadings Forecast for 64 LMEs – GEF/LME global project Promoting Ecosystem-based Approaches to Fisheries Conservation and Large Marine Ecosystems. 2008	E only
80	Models of the World's Large Marine Ecosystems. GEF/LME Global Project Promoting Ecosystem-based Approaches to Fisheries Conservation and Large Marine Ecosystems. 2008	E only
81	Indian Ocean Tsunami Warning and Mitigation System (IOTWS) – Implementation Plan for Regional Tsunami Watch Providers (RTWP). 2008	E only
82	Exercise Pacific Wave 08 – A Pacific-wide Tsunami Warning and Communication Exercise, 28–30 October 2008. 2008	E only
83.	<i>Under preparation</i>	

(continued)

<b>No.</b>	<b>Title</b>	<b>Languages</b>
84.	Global Open Oceans and Deep Seabed (GOODS) Bio-geographic Classification. 2009	E only
85.	Tsunami Glossary	E, F, S
86.	Pacific Tsunami Warning System (PTWS) Implementation Plan <i>(under preparation)</i>	
87.	Operational Users Guide for the Pacific Tsunami Warning and Mitigation System (PTWS) – January 2009. 2009	E only
88.	Exercise Indian Ocean Wave 2009 (IOWave09) – An Indian Ocean-wide Tsunami Warning and Communication Exercise – 14 October 2009. 2009	E only
89.	Ship-based Repeat Hydrography: A Strategy for a Sustained Global Programme. 2009	E only
90.	12 January 2010 Haiti Earthquake and Tsunami Event Post-Event Assessment of CARIBE EWS Performance. 2010	E only