Improving the Weather Network in the Western Pacific Ocean

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Recently, Typhoon Haiyan devastated the Philippines and the Western Pacific countries. Haiyan killed over 5000 people, but many of these deaths could have been prevented by implementing a new weather system in the Western Pacific.

The United States has three different types of weather observing sites, ASOS/AWOS, buoys and oil platform stations. Combining all of these sites, we have over 3000 individual stations that help record, forecast and predict major weather phenomenon. However, in the Western Pacific, no such organized system exists. A few countries have some sporadic stations but none as widespread and sophisticated as the United States.

My proposal is to add nearly 2000 weather observation stations across the Pacific Ocean and in the countries that border it. By adding a baseline of these stations over the course of a year and the rest in the time that follows, we can better predict where strong storms will go and will be able to know how strong they are before they come close to land. By combining all of this knowledge and information, we can help save lives both now and in the future.

Introduction

Here in the United States, we pride ourselves in the fact that we have a dense weather observing network. What we fail to often realize is how our network compares to other places in the world such as Asia and the Western Pacific areas. These areas tend to be more prone to strong weather phenomenon such as tsunamis, earthquakes and especially typhoons (Western Pacific hurricanes) than the United States. Even though weather systems in the Western Pacific tend to be stronger, due to the warmer ocean temperatures (Hurricane vs Typhoon), the weather network in that area is very weak. There are very few observing stations both on land and in water (National Buoy Data Center). This is disappointing because observing stations provide large advantages to not only the weather community but also to the general population. Weather observing stations that are located on buoys, can help determine strength and projected paths of hurricanes and typhoons before they hit land, which can protect valuable property and lives. To help protect people and infrastructure in the Western Pacific, we need a denser observing network in that area.

Proposal

My proposal is that we, as the United States, help begin a coalition of countries that border the Pacific Ocean and that we ultimately help the Western Pacific create a denser weather network to help them forecast and be better prepared for major weather phenomenon. This would hopefully be accomplished in a number of ways. By implementing the four concepts listed below, there would be additional lead time before major weather events impacted this region of the world, resulting in protection of life and property.

1. Add additional land-based observing stations to countries in the Western Pacific
2. Add additional buoys in the Western Pacific Ocean

3. Forming the Coalition of Pacific Countries for Weather Observing
4. Create a base network for countries based on the US weather system

Background Information about Weather Networking

The United States Weather Observing Network

The United States has nearly 2000 land based weather observing sites that go by the acronyms Automated Surface Observing System (ASOS) or Automated Weather Observing System (AWOS) (Surface Weather Observation Stations). These stations report data about several weather variables every minute 24 hours a day (Automated Surface Observing System). The ASOS/AWOS stations are most often housed at airports due to ease of identification and the intimacy of meteorology and aviation. Typically these stations record temperature, dew point and wind speed along with more complicated variables such as ceiling height and precipitation type.

A second type of observing station is one located on an oil platform. In addition to the 2000 land-based ASOS/AWOS sites, there are nearly 50 AWOS sites that are located on oil platforms off of the Gulf of Mexico (Gulf of Mexico AWOS). These stations function very similarly to the land-based sites taking many of the same measurements as ASOS/AWOS at less frequent intervals, typically ranging anywhere from every five minutes to every thirty minutes (Gulf of Mexico AWOS).

The third type of observing station is those located on buoys in the oceans. There are approximately 1000 of these buoys located along the coasts of the United States (National Buoy Data Center). These stations are tethered to the bottom of the ocean but are able to float and record the height of waves based on average sea level and the buoys (Weather Buoy). These buoys also record air temperature, wind speed and direction in addition to ocean depth, water temperature and wave direction (National Buoy Data Center).

For the most part, these station observations help meteorologists to make weather forecasts on a day to day basis, but during severe weather these instantaneous data points can be very useful. When a hurricane or typhoon is approaching, looking at the buoy data can give a meteorologist an idea of the relative strength of the hurricane or typhoon long before it is close to making landfall (Hurricane: Tracking & Researching Hurricanes). One can compare wave heights from minute to minute to calculate potential storm surge heights along with many other potential factors to find the ultimate strength of the hurricane or typhoon. By knowing the strength of the prospective hurricane or typhoon, meteorologists can evacuate people that may be in the path, saving even more lives.

The Western Pacific Weather Observing Network

When describing the Western Pacific, the countries typically included are Australia, Indonesia, Malaysia, Vietnam, Japan and the Philippines (Countries and Areas). Compared to the United States buoy system, which is shown in Figure 2 below, the Western Pacific buoy network depicted in Figure 1 is very sparse. Each of the yellow and red dots represent a buoy. The difference in color is based on when data was last taken. As you can see, there are only a handful of buoys in the open Pacific Ocean and almost none along coastlines except Japan. Although not shown, there are also land-based stations in the Western Pacific countries. These stations are also much sparser than in the United States. Many of these countries used to have weather observing networks but, as Kerry Emanuel, a climate scientist at the Massachusetts Institute of Technology says, “Budget cuts ended that decades ago.” (Harris) The only Pacific nation that has a weather network even comparable to the US is Japan and even they need more to be upgraded due to the fact that many sensors were lost in the Japanese earthquake of 2011.

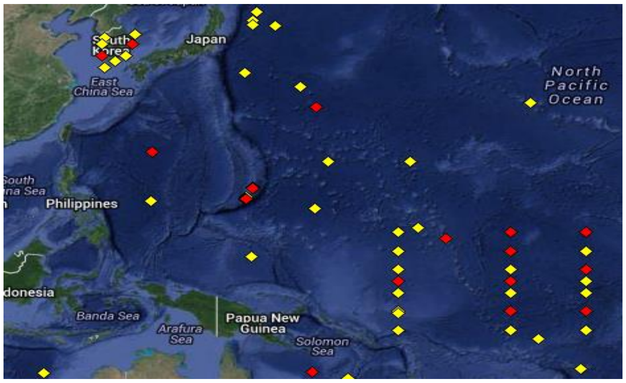

Fig. 1 W. Pacific Weather Observing Network

"National Buoy Data Center." *NDBC*. Web. 03 Dec 2013

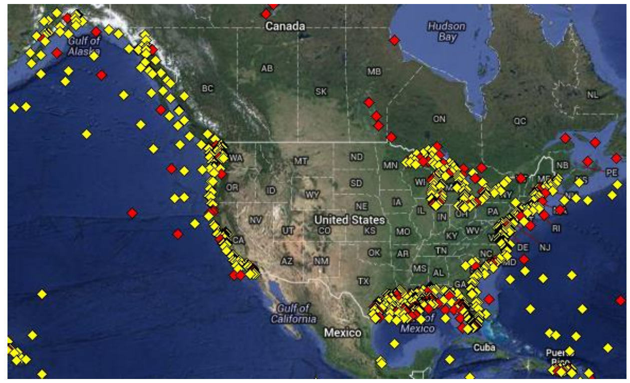

Fig. 2 United States Weather Observing Network

"National Buoy Data Center." *NDBC*. Web. 03 Dec 2013

Reflecting on Haiyan

Typhoon Haiyan hit the Western Pacific, primarily the Philippines, on November 8th 2013. As the projected track came closer and closer to hitting the Philippines, the hype about Haiyan began to increase across the globe. Before it ever made landfall, there were numerous reports that it would be a record breaking storm in many different aspects. There were many scientists that believed that it would have the lowest central pressure ever recorded, along with the fastest sustained winds ever and the fastest wind gust ever recorded. However, no direct wind speed measurements were taken due to the lack of observation sites and funding (Harris). Nearly 50 years ago, budget cuts were made in the US that no longer allowed planes to fly into Western Pacific hurricanes (Harris). According to as Kerry Emanuel, "Since then, we've had to rely on satellites, mostly, to estimate typhoon intensity. Satellites are very good at detecting the presence of typhoons but they're not so great when it comes to estimating how strong they are."

With no official measurements, it is nearly impossible to formally go down in the record books. The only thing that was able to be measured was the central pressure of 895 mb which was much weaker than the current record holder of Typhoon Tip, a central pressure of 870 mb (Typhoon Haiyan). While Haiyan will always be remembered as a violent storm that wreaked havoc on the Philippines, there is no way to put it in the history books with actual records that it may have achieved.

Looking Forward to the Future

While it is blatantly clear that these systems are needed to spare life and limb, designing the system and implementing it may not be so clear. My process relies on implementing two types of observing stations at a designated density across many of the Western Pacific nations.

In the United States, there are nearly 2000 ASOS/AWOS that are land-based. With the area of the US being 3,717,813 square miles, that means there is approximately one ASOS/AWOS every 1860 square miles, calculation shown below in Figure 3 (List of Countries). Using this density along with the areas of the countries listed, shown below in Figure 4, I calculated the number of land based stations that should ultimately be added to the Pacific.

Country	Land Area (sq. mi)	Number of Current Sensors	ASOS/AWOS Density (ASOS/sq. mi)
US	3,694,959	1987	1860

Figure 3.

Country	Land Area (sq. mi)	Number of Sensors to be Added
Philippines	120,000	65
Malaysia	127,724	69
Japan	145,920	78
Vietnam	127,882	69
Indonesia	735,358	395

Figure 4.

Data: “List of Countries and Dependencies” and “Automated Surface Observing System”

Similarly, the United States has approximately 133 thousand kilometers of coastline. With approximately 1000 buoys along the various US coastlines, that works out to be 1 buoy every 133 km which is approximately 80 miles. The calculation for this is shown in Figure 5. The sensor estimates for the Western Pacific countries are shown below in Figure 6.

Country	Coastline (km)	Number of Current Sensors	Buoy Density (Buoy/km)
US	133,312	~1000	133

Figure 5.

Country	Coastline (km)	Number of Sensors to be Added
Philippines	33,900	255
Malaysia	9,323	70
Japan	29,020	218
Vietnam	11,409	86
Indonesia	95,181	716

Figure 6.

Data: "List of Countries and Dependencies" and "Automated Surface Observing System"

With over 2000 sensors to ultimately be added, it is unlikely that they would all be able to be put into use all at once. The amount of labor and money that would have to put into the effort would be too much at all at once. To begin with, I propose that we first lay a base groundwork of sensors. First we would begin with approximately 100 buoys in the Western Pacific ocean with one buoy at least every 1,000 km or so. Also, I would put one land based station for every 10,000 square miles. The figures below show the number of baseline sensors to begin with.

Country	Land Area (sq mi)	Number of Sensors to be Added
Philippines	120,000	12
Malaysia	127,724	13
Japan	145,920	15
Vietnam	127,882	13
Indonesia	735,358	74

Figure 7.

Country	Coastline (km)	Number of Buoys to be Added
Philippines	33,900	34
Malaysia	9,323	9
Japan	29,020	29
Vietnam	11,409	11
Indonesia	95,181	95

Figure 8.

Data: "List of Countries and Dependencies" and "Automated Surface Observing System"

300 new observing sites is a much more reasonable number to begin with. My plan would be to try to implement these 300 sites within the first year and then as money came in, add additional sensors.

Ultimately with the implementation of these weather satellites across the Western Pacific, forecasting and response times for major weather phenomenon would be made better. The United States already has their network and now it’s time for the Western Pacific to have theirs.

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