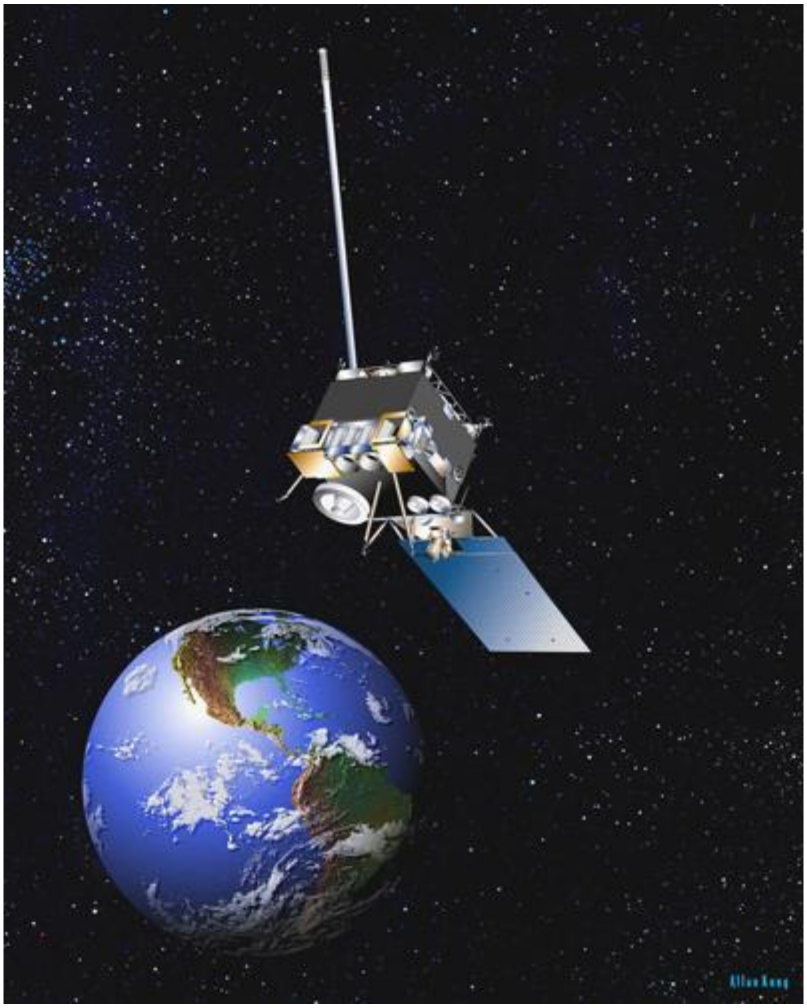
Good News Stories from the Field
Edition 1



Jon Wallace
U.S. Fish & Wildlife Service

During Hurricane Irma the National Key Deer remote automated weather station (Fire RAWS) on Big Pine Key, Florida continued to report reliably and accurately until the wind instruments came apart at around 130 MPH gusts. The satellite transmissions for the station never stopped during the event. The Weather channel used this station data for on-camera reporting during Hurricane Irma.

Post storm we were able to use the data coming from the station to depict the rapid drying that occurred and the subsequent rise in fire danger. Supported by this data we positioned extra firefighters in the area to augment those that were recovering from the storm.

I'm sure forecasters used the data coming from the station for different products but I am not aware of those.

Katie Landry
NOAA, National Weather Service

Back in 2017, Hurricane Harvey caused historical rainfall and catastrophic flooding across SE Texas. During this time, 33 of our 67 river forecast points reached record flooding. If it weren't for the GOES DCP data, we would not have had the information we needed to provide accurate and timely river forecasts, updates, and warnings that ultimately saved thousands of lives and allowed for people to protect their property. We did not have any issues during the event with regards to the GOES transmission. In comparison, our office also uses gauge data from an external partner that is not ingested via GOES DCPs; however, during Harvey, there was a hiccup with their system, which resulted in the loss of critical data during the peak of the heavy rainfall event. In addition to the seamless data flow from GOES, we were also able to ingest data from rapid deployment gauges that were quickly installed prior to landfall in high impact areas that did not have permanent gauging. This information was vital to collecting observations for future use. Without GOES data, we would not be able to fulfill our mission of saving lives and property.

Robbie Swofford
Bureau of Land Management

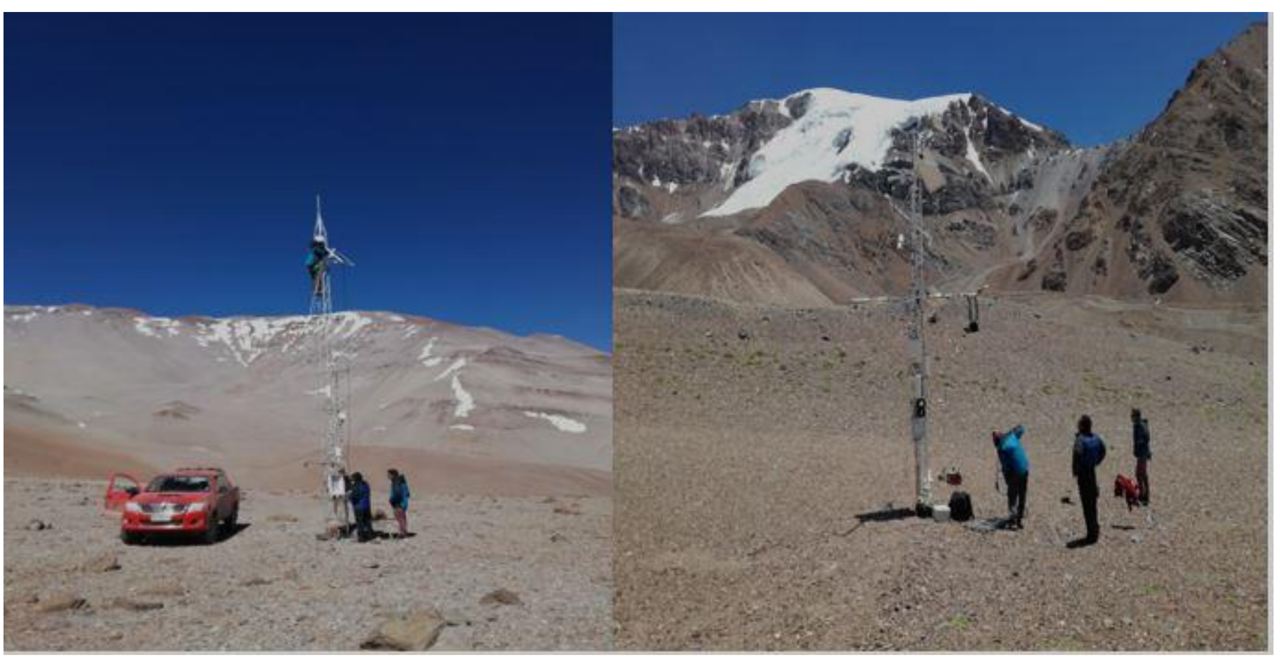
In 2018 we covered 52 fire incidents with our IRAWS (Incident Remote Automatic Weather Stations). 117 IRAWS were deployed on fire incidents. 23 IRAWS were deployed on the fires in California. I don't have a count of the portable RAWS stations that were deployed by the California Department of Forestry, but between the Federal and State agencies, there are 533 stations in the state of California.

Cristian Orrego Nelson
Center for Advanced Studies in Arid Zones

We are users of the GOES DCS for some time now, and are willing to share our experience. The Centro de Estudios Avanzados en Zonas Aridas (CEAZA) [Center for Advanced Studies in Arid Zones] is a scientific center in Chile, located in the Coquimbo Region that is focused on generating and providing scientific information both for publication and for decision makers. In particular the meteorology unit focuses on providing information for decision making with respect to extreme weather events and water shortages. In this context, hydrological and snowfall information is particularly important which is why CEAZA maintains a network (www.ceazamet.cl) of more than 50 AWS covering the entire region (aprox. 300x400km) ranging from the coast of the Pacific Ocean to the Andes.

Globally, there is a need for real-time snow data in high mountains areas, and in particular in zones like the Coquimbo Region where most of the water available to cities, agriculture and mining comes from the snow accumulated throughout winter. The Glaciology team within the center has been installing AWS in high areas of the Andes to understand snow mass balance processes and possible hydrological contribution, but these stations are also being used by the meteorology unit to provide data directly to the community via the online network.

In the Andean zones (+2500 m asl) 3G is not normally available, and so the only option to connect to these stations in real-time is via satellite link. Here's where the NOAA GOES DCS really helps, because for some years now (3-4) the normally "research-only offline weather stations" in the Andes can now be connected to the online network and provide weather and snowfall datasets throughout the year. This means that the local community can better assess water availability during the winter, which directly helps the assessment of summer river flows and with this enables decision makers to prepare 3 to 5 months ahead of time when the snow finally melts and can be used downstream. (Below are pictures of 2 of the AWS DCS connected stations.)



Leona Hyde
Govt of Newfoundland and Labrador

Floods are the most frequent natural hazard in Canada.

Flood damage is an increasing problem in the province of Newfoundland and Labrador because of increasing population density around water bodies and the higher values of water-front property. More than 267 communities in the province have been affected by flooding, causing over $262 million in damage over the past 64 years. Reducing exposure to flood risk is the only cost-effective way to minimize future compensation expenses and re-building expenditures.

Flooding has occurred on several occasions throughout Newfoundland and Labrador since the 1900's. As technology progressed the Government of Newfoundland and Labrador maintains and monitors several GOES DCS stations (hydrological, weather and water quality stations). We provide flood forecasting for three specific areas of our province. Last January of 2018 there was a weather anomaly and the town of Deer Lake and surrounding towns were dealing with a flood that threatened homes and lives. For over a week we were under alert and sending hourly levels from our GOES DCS monitoring stations and running our flood forecasting models to ensure first responder and residents were prepared for evacuations. https://www.cbc.ca/news/canada/newfoundland-labrador/deer-lake-water-levels-1.4490810

In our province we currently have 142 stations (hydrometric, weather, RAWS and water quality). GOES telemetry is first and foremost the base of the protection in Newfoundland and Labrador.

Sarah Jamison
NOAA Weather Service

I find it hard to emphasize the value of DCPs in operational forecasting and flood warnings. Since you ask for a specific example, I'll highlight a notable event I worked, Hurricane Florence in North Carolina.

Eastern North Carolina is no stranger to significant flood events from tropical cyclones (Matthew 2016, Irene 2011, Floyd 1999). Hurricane Florence, which made landfall near Wilmington on September 14, 2018, will be remembered as one of the most destructive hurricanes to ever strike North Carolina for its record-breaking rainfall and subsequent catastrophic flooding including storm surge. During the storm, numerous flash flooding events and road washouts occurred. After the storm, major to record river flooding was observed across inland Eastern NC. Real time rainfall and river gage readings were critical to warning services during this historic event. Coordination between agencies prior to, and during the storm, also allowed us to ingest rapidly deployment gages (RDGs) to supplement the normal observing network as many gages were overtopped by flood waters. Real time (hourly or higher frequency) rain gages are essential for the calibration of the Doppler Radar rainfall estimates. Dual Pol radar algorithms were "off the charts" in this event, making radar rainfall estimates suspect. Without valid reports from these automated gages, forecasters would have had more difficulty identifying flash flood trigger points. In all 20 flash flood warnings, with 3 flash flood emergencies were issued. Sadly, there were three known fatalities from the flash floods.

National attention was focused on the Carolina's during this event. NWS frequent public information statements on rainfall totals during the event were widely used by the media. In addition, volunteer COOP and Cocorahs observers were advised against taking rainfall measurements for their own safety. This reduced the number of rainfall reports the region was able to collect until the event was over, at which time most rain gages had overflowed.

Lakmal Ratnayake
Parks Canada

We at Parks Canada use the GOES DCS system for Wildfire Management in the summer and Avalanche Control in the winter. It is an essential information source in determining fire danger and responding to a wide variety of incidents throughout Parks Canada.

Kevin R. Kodama
NOAA/NWS Honolulu Forecast Office,
Hurricane Forecaster,
Central Pacific Hurricane Center

The GOES DCS feed is crucial to almost all aspects of our operations. From a hydrologic perspective, we receive water level and precipitation data via GOES from over 230 sites across the state of Hawaii. In addition to the scheduled hourly data, most of the USGS water level sites have random transmissions sent so that our forecast office receives the data in time to issue Flash Flood Warnings. Since most of our basins are small, flooding can occur within 30-60 minutes of intense rainfall onset so we can't wait for the normally scheduled hourly data.

A specific example comes from the Hanalei River basin on the island of Kauai. The river overflows several times a year and cuts off the only access road for the town of Hanalei and all communities to the west of it for several hours. The USGS has a water level gage upstream from the highway. We have a water level threshold to trigger an alarm in our office to prompt the issuance of a Flash Flood Warning. The warning provides about an hour of lead time before the road becomes impassable. It provides sufficient time to stage fire, ambulance, police, and American Red Cross units in Hanalei. The main school in the area is also in Hanalei, and the GOES-telemetered data are also used to send the school kids home early or not send them to school in the first place.

We also have 38 NWS real-time rain gages set to transmit on the random channel when rain rates exceed about 1 inch per hour. The additional data in between the hourly transmissions helps trigger internal alarms in support of flash flood monitoring. The number of our gages on GOES is increasing over time as we transition off of old landline communications. There are also several automated NWS rain gages on the island of Tutuila, American Samoa in the South Pacific. Tutuila has frequent heavy rain events and no weather radar. The GOES DCS telemetered rain gages provide rapid notification of heavy rains in different parts of the island.

Other stations, such as RAWS sites, provide hourly data across the state that greatly improves our view of the microclimates in our islands. Due to the complex island terrain, weather conditions can vary drastically over short distances and the data from 50+ RAWS stations sent via the NWS HADS feed help improve our situational awareness. As an example, we have internal alarms that are triggered on sustained wind and peak wind speed thresholds. These alarms help us issue wind advisories and warnings for the various forecast zones across the state.

Whenever I hear of potential encroachments or auctions of radio frequencies, I get nervous about impacts to our data collection capability.

Ronald Miller
National Weather Service

In the Spokane HSA, we make extensive use of GOES DCS DCPs to provide us real-time data from river gauges. One good example is Paradise Creek in Moscow, ID (PACI1). This creek is very flashy, rises rapidly to flood stage during heavy rain events. In March of 2017, we had advised our EM partners in Moscow of the potential for flooding on Paradise Creek. But there are no official forecasts for this creek. So our guidance to EM partners is more general, giving them time windows and flood potential. As the event unfolds, NWS staff are monitoring the data for PACI1 provided by the GOES DCS DCP on a continuous basis. When the incoming data show the beginnings of a sharp rise, we call the Moscow City Public Works to give them a heads up that the water is beginning to rise. We then continue with additional updates as the event progresses, evaluating the hydrograph, and giving our partners our best interpretation of what to expect.

Without the real-time data from this gauge supplied by the GOES DCS DCP, we would have no way to letting our customers know about the current flood situation. I've attached a few images from a March 2017 event.


ROAD
CLOSED

Tsunami MeasurementsTransmittied through the GOES Satellite System, by the mMexican Institute of Transportation

Noé F. Toledano V., José Alfredo López L., J. Miguel Montoya R., Rodolfo Ramírez X., David Segura Q.

The Mexican Institute of Transportation (IMT), operates the National Network of Oceanographic Stations (RENEOM) formed by autonomous equipment that measure wave characteristics, meteorological conditions and sea level variations in the main ports of Mexico. Due to the development of this RENEOM project, the IMT is a member of the National Tsunami Warning System (SINAT), and collaborates with institutions such as the Ministry of Navy, Ministry of Communications and Transportation, as well as the National University Autonomous of Mexico (UNAM) and the Center for Scientific Research and Higher

Education of Ensenada (CICESE). The objective of SINAT is to monitoring and warn of possible damages in Mexico, caused by a tsunami.

Figure 1. National Tsunami Warning System (SINAT)

Autonomous IMT stations that measure sea level have redundant transmission systems (VHF radio and satellite radio) to provide sea level information to SINAT continuously and in real time. The data is sent redundantly in two ways, the first is via VHF radio to the port Harbor Master, and the second way is through the GOES satellite system, with final destination at the IMT facilities and also at the facilities of Tsunami Warning Center (Operational part of the SINAT and directed by the Mexican Navy).

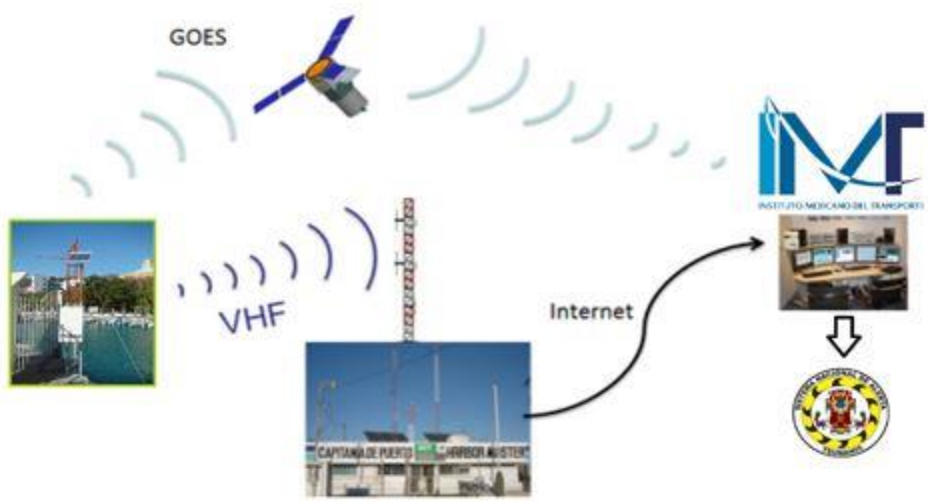


Figure 2. Transmission scheme.

On September 7, 2017, the National Seismological Service of Mexico (SSN) reported an earthquake measuring 8.2 on the Richter scale, located in the Gulf of Tehuantepec, Mexico, at 133 from Pijijiapan, Chiapas. The earthquake occurred at 23:49:17 hours (04.49 UTM), the coordinates of the epicenter are Latitude: 14.761 ° N and Longitude -94.103 ° W, at a depth of 45.9 km [1]. Due to the location of the epicenter of the earthquake, a Tsunami was generated in the Mexican Pacific off the coast of the state of Chiapas.

After the earthquake, a collateral effect was the lack of electrical power in the region where the Tsunami was generated (during and after the earthquake) [2]. Faced with this situation, the IMT tide stations sent data through the GOES satellite system without interruption, and the data was received in a timely manner at the facilities of the Tsunami Warning Center. The IMT data were used to determine the magnitude of the tsunami and apply the early warning protocols of the SINAT.

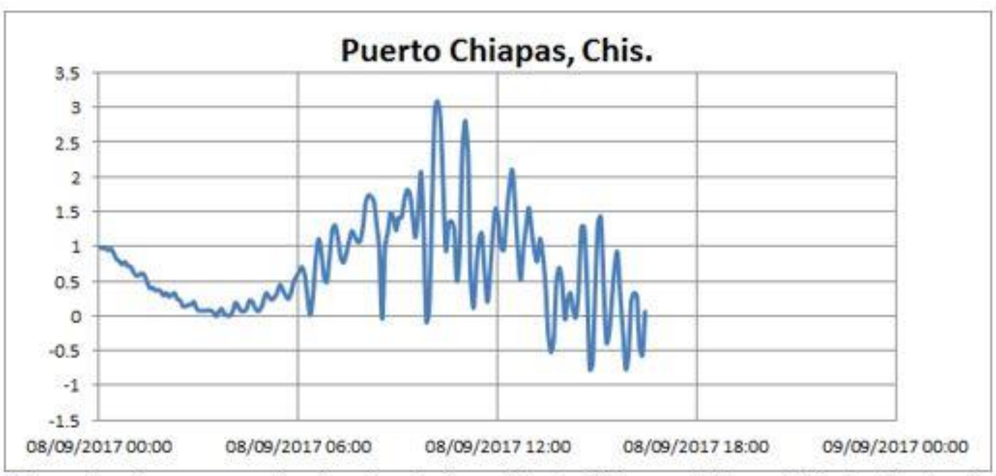


Figure 4.- Example of measures of sea level variations, Puerto Chiapas, Chiapas, Mexico, September 7, 2017.

Figure 5. Location of the gauge stations

Finally, we express our gratitude to Letecia Reeves and Stuart Weinstein who made possible our transmission slots through the GOES satellite system.

References

[1] Servicio Sismológico Nacional, “Reporte especial, Grupo de trabajo del servicio sismológico nacional, UNAM, Sismo de Tehuantepec (2017-09-07 23:49 Mw 8.2)”, Universidad Nacional Autónoma de México, México, 2017.

[2] https://cnnespanol.cnn.com/2017/09/12/los-5-estragos-que-dejo-el-terremoto-del-siglo-en-mexico

Paul Fajman
National Weather Service

The GOES DCS gages played and continues to play a vital role in decision making in the historical flooding that has taken place in Nebraska. In most locations, the GOES gages were the only ground truth available to the NWS OAX (National Weather Service Omaha). We got a lot of reports from law enforcement, emergency managers, and private citizens where they guesstimated how much the river had risen. Those guesses ranged greatly. The GOES DCS data told us exactly how much the river had risen. At certain levels, we know what the impacts will be for an area, 1' or 2' can be the difference between a road, bridge, or a levee being overtopped. The GOES gages were the only data we could get at night.

Decision makers, such as emergency managers, relied on GOES gages and forecasts (which were derived from the gage data) to make decisions on whether to evacuate. Even private citizens and communities who lived in vulnerable areas were familiar with the data, used them to decide whether they needed to evacuate or move their livestock to higher ground.

Of concern in our forecast area is the Cooper Nuclear station. They rely on the data from the BRON1 (CE7810AE), Missouri River at Brownville. If the river level gets to, or is forecasted to get to a certain level, they have to shut down the Nuclear station. The GOES data for that site are consistent, reliable, and doesn't require anybody go down to a dangerous river to get a river reading.

Without the GOES DCS data, our office would have essentially been blind as to the status of the rivers. More people would have died without consistent, reliable, and accurate data.

Octavio Gómez Ramos

Servicio Mareográfico Nacional Universidad Nacional Autónoma de México
(National Sea Level Service at the National Autonomous University of Mexico)

Renewed Sea Level network of the Mexican National Sea Level Service in near real time characterize the tsunami caused by the Pijijiapan earthquake. On September 8, 2017, at 4:49 UTC, an 8.2 Mw earthquake occurred on the south Pacific coast of Mexico, approximately 87 kilometers southeast of the town of Pijijiapan, Chiapas. This earthquake activated several Mexican and International warning systems, including the Mexican Seismic Warning System (SASMEX), and the National Tsunami Warning Center (SINAT).

The impact of this event on the sea level was registered in near real time and communicated to the Mexican warning systems and to the rest of the world thanks to the recently renewed Mexican sea level monitoring network (SMN, Servicio Mareográfico Nacional) at the Universidad Nacional Autónoma de México (UNAM). During the first minutes after the earthquake, the possibility of a catastrophic Tsunami was considered, and the shore observations recorded by the tide gauges of SMN gave the first confirmation of the arrival of the tsunami, as well a first estimate of its amplitude. The information transmitted contributed to the Mexican government's civil protection authorities to make informed decisions.

The renewal of the SMN began with two stations in the year of 2007, with the objective of achieving GLOSS quality stations, equipped with GOES transmission, radar, float and pressure sensors for the recording of sea level every minute, as well as meteorological sensors and high quality GNSS receivers. By 2017, the SMN had 11 stations in the Mexican Pacific that monitor the event. An important part of this renewal has been the inclusion of several stations equipped with GOES Data Collection System (DCS) that continue the transmission when the internet and conventional energy had a blackout. Figure 1. SMN sea level monitoring network. Figure 2. Huatulco sea level station equipped with GOES transmission, radar, bubble and pressure sea level sensors; meteorological sensors and permanent GPS. Regarding the event, the observations showed that the first station to record the event was Puerto Angel, 15 minutes after the earthquake, with an amplitude of a few centimeters. Later the wave was recorded in the Huatulco station, and then in the stations of Puerto Chiapas and Veracruz. The last station to register the event was La Paz, four hours after the earthquake. Figure 3. Map of arrival times and maximum registered amplitudes. Figure 4. Sea level record of the 11 stations of the SMN located on the coast of the Mexican Pacific. In conclusion, it can be said that the GOES Data Collection System has been fundamental in the process of sending data from sea level stations of the SMN, which has contributed significantly to the decision-making process in the face of risks by natural events, in this case tsunamis.