
COCONet EAR 1042906/9 Quarterly Report

September 2012 - November 2012 (FY2013-Q1)

SUMMARY

This quarterly report covers the COCONet project (EAR-1042906/EAR-1042909) activities for the time period September 2012 - November 2012. The COCONet grant was awarded to UNAVCO (EAR-1042906) with a collaborative grant (EAR-1042909) awarded to J. Braun, University Corporation for Atmospheric Research on September 14, 2010. The project is under the direction of M. Meghan Miller, as PI, with Co-PIs Eric Calais, Guoquan Wang, John Braun, Glen Mattioli, and Karl Feaux. Glen Mattioli is acting as Project Director in his role as Director of Geodetic Infrastructure at UNAVCO.

Most of the effort during this reporting period included reconnaissance, permitting, installation and maintenance activities related to the siting plan developed at the Port of Spain siting meeting in June 2011 and four siting committee meetings held during the past 18 months. Specifically, permitting in the Dominican Republic, station installations in Mexico and Colombia, and maintenance work in Jamaica and Nicaragua were the operations highlights during the last quarter. UNAVCO engineering personnel have performed site reconnaissance at 59 locations in 25 countries, submitted land use permits for 49 sites, permits accepted for 39 sites, and currently have 29 stations installed (Figure 1, red dots).

Dr. Alberto Lopez from the University of Puerto Rico, Mayaguez led planning efforts for the COCONet Data and Research Workshop which was held in Tulum, Mexico October 24-26, 2012 (See COCONet Highlight). This meeting was a critical project milestone, which was completed in FY2013-Q1.

Two significant geophysical events were captured by COCONet infrastructure during the period of performance of this report. A large Mw7.6 earthquake struck the Nicoya Peninsula in Costa Rica on September 5, 2012. For this earthquake, high-rate (1Hz) GPS observations were used to generate a geodetically determined finite fault model and coseismic displacementgram (See COCONet Highlight). Also, Hurricane Sandy, a particularly destructive hurricane for the eastern coast of the U.S., passed close to COCONet stations in Jamaica and the Bahamas before reaching the U.S. (See UCAR Update).

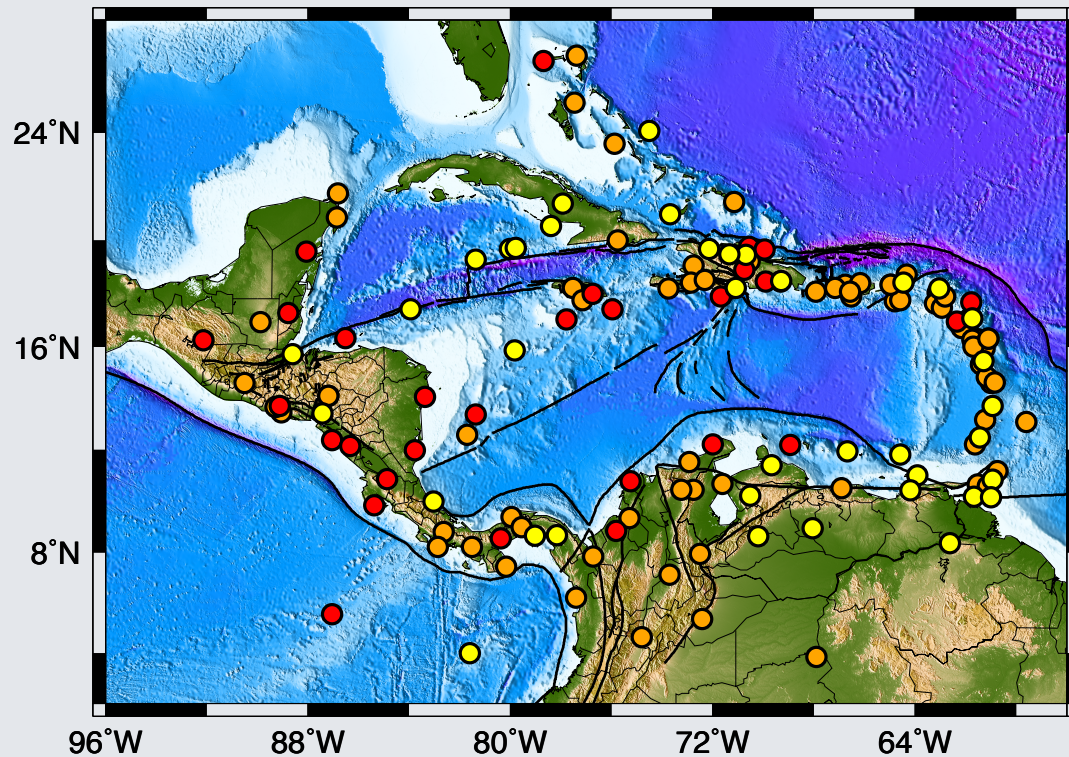


Figure 1. The current COCONet siting plan, the result of siting meetings in Puerto Rico and Trinidad, as well as four siting committee teleconferences during 2011 and 2012. Red dots represent the 29 completed COCONet stations (new or refurbished), yellow dots represent the 39 planned stations (new or refurbished), and the orange dots represent existing stations (61+) that will deliver data to the COCONet archive.

COCONET HIGHLIGHT: COCONET DATA AND RESEARCH WORKSHOP

The third COCONet workshop, held in Tulum, Mexico (October 24-26, 2012), was sponsored by the National Science Foundation and hosted by the National Autonomous University of Mexico (UNAM) and UNAVCO. The meeting was attended by 84 participants, representing 45 institutions from 19 countries (Figure 2). This third COCONet workshop focused primarily on long-term operations and maintenance for GPS stations installed in the Caribbean, GPS data processing, higher-level data products generation, and real-time GPS data distribution for enhanced science and broader societal benefits. Significant science advances and societal benefits that COCONet in its nascent stages has already accomplished were presented. In addition, there were presentations about the future potential and long-term sustainability of the network and the data. Plans were initiated to establish regional data centers for data archival and/or analysis/products to advance not only regional capacity, but the regional use and

impact of the data. A key result of the meeting was identifying several institutions that could potentially host a regional data center. Representatives from these institutions will be involved in a smaller meeting in the next 3-6 months to further develop plans for regional data centers. Other key objectives of the meeting were to explore new research and data product opportunities and to layout future goals and expanding directions for COCONet. There was great enthusiasm and energy at the workshop from all of the participants for developing regional data centers, plus advancing the research and education opportunities, the science and engineering workforce capacity, the international partnerships, and the societal benefits from COCONet. A draft of the 3rd workshop report has been prepared and is being reviewed by G. Mattioli; we anticipate that the final report will be completed before the end of December 2012.



Figure 2. COCONet 3rd Workshop participants, representing 45 institutions in the Caribbean region, shown here on field excursion to the ancient Mayan ruins in Tulum, Mexico.

COCONET HIGHLIGHT: NICOYA EARTHQUAKE

On Wednesday, September 5, 2012, at 14:42:07 UTC, a magnitude 7.6 earthquake struck roughly 40 km (25 miles) below the surface of the Earth, 10 km (6.2 miles) ESE of the city of Nicoya, Costa Rica. This earthquake occurred beneath the Nicoya Peninsula of Costa Rica as the result of thrust faulting on the plate interface between the subducting Cocos and overriding Caribbean plates. At this latitude, the Cocos plate moves north-northeast with respect to the Caribbean plate at approximately 77 mm/yr, and subducts beneath Central America at the Middle America Trench, as determined by GPS observations supported by UNAVCO and the COCONet project. Preliminary estimates show that approximately 3 meters of slip occurred on the interface between the two plates (e.g. Lujia and Newman, September 2012, personal communications). Two COCONet stations in Costa Rica, QSEC and VERA, were used in the analysis and UNAVCO engineers assisted NSF funded PIs (Dr. Andrew Newman, Dr. Timothy Dixon) and regional scientists (Dr. Marino Protti, OVSICORI) to ensure that COCONet and other stations in the region were returning data after the earthquake. UNAVCO support was part of a NSF RAPID award as well as part of COCONet O&M. High-rate (5Hz) data from some stations, including COCONet station QSEC, were processed to

produce baseline estimates relative to the station VERA (Figure 3).

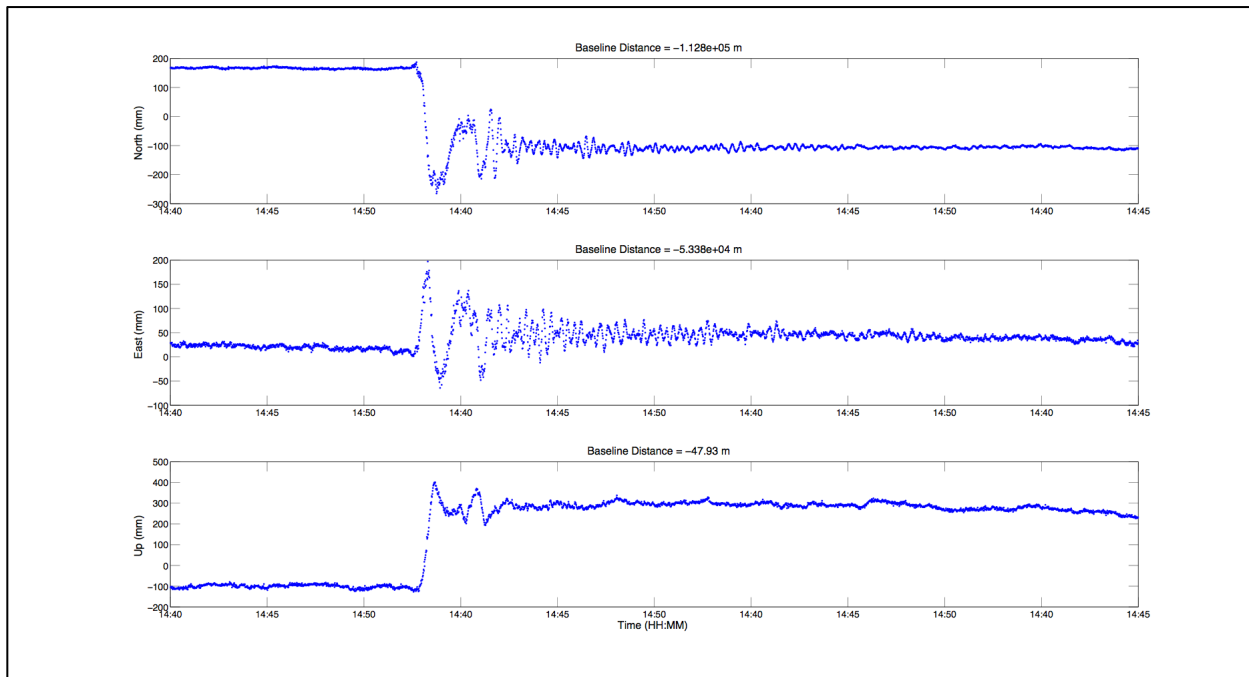


Figure 3. Time series of position estimates of COCONet station QSEC at Quebrada, Costa Rica during the dynamic rupture of the Mw7.6 Sept. 5th Nicoya earthquake. Raw GPS data were processed at 5Hz using TRACK (courtesy of Henry Berglund, UNAVCO). The COCONet site VERA, located **at Vera Cruz** ~124 km to the northeast, was held fixed to do this calculation.

PERMITTING SUMMARY

In FY2013-Q1, COCONet permitting activities focused on Panama, Haiti, the Dominican Republic, and Venezuela.

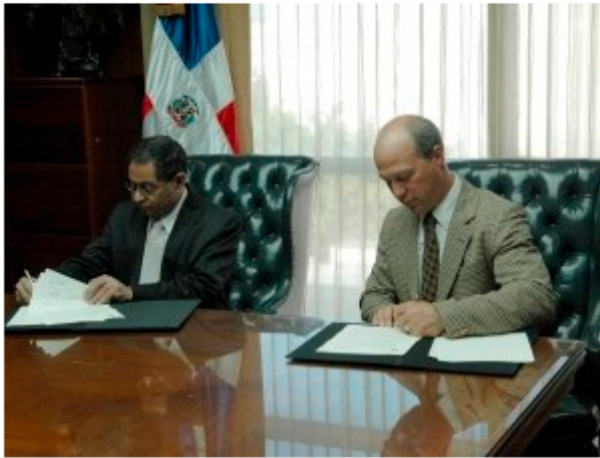
On November 28, 2012, UNAVCO entered into a Memorandum of Understanding with the Supreme Court Jurisdiccion Inmobiliaria (JI), the official government office for the maintenance of cadastral surveying records in the Dominican Republic. This MOU will allow COCONet to upgrade four existing GPS stations operated by the JI with modern NetR9 GPS receivers, choke ring antennas with radomes, and meteorological sensors. These stations will supplement the four new GPS stations built with the assistance of ONAMET, the official meteorological agency of the Dominican Republic.

In November, UNAVCO also entered into a Memorandum of Understanding with FUNVISIS, the Venezuelan national seismic program. This MOU will allow the construction of five new GPS sites in Venezuela.

ACUERDO

Poder Judicial y universidad de los EEUU firman convenio

28/11/2012 06:07 PM - REDACCIÓN



(Fuente Externa)

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El Poder Judicial y la University Navstar Consortium (UNAVCO) firmaron un acuerdo con el propósito de que la Jurisdicción Inmobiliaria participe en el proyecto COCONET, plan financiado por la Fundación Nacional de Ciencias de los Estados Unidos para aumentar la disponibilidad de datos meteorológicos y las mediciones de GPS en el área del Caribe.

El convenio fue rubricado por el presidente de la Suprema Corte de Justicia y del Consejo del Poder Judicial, Mariano Germán Mejía, y Kyle Bohnenstiehl, en representación de la UNAVCO, quienes destacaron la importancia del acuerdo, pues contribuye significativamente en la mejora del control de la información cartográfica y la medición de los terrenos del país, y por ende con el desarrollo económico de la República Dominicana.

"Este acuerdo que firmamos en el día de hoy es una prueba más de que los hombres diariamente vivimos buscando la unidad, la

concienciación y la tecnología, la cual nos permite seguir viviendo y avanzando. De manera, pues, que ante los desastres que causan los ciclones y otros fenómenos naturales, es necesarios que nosotros estemos preparados en el campo de la información para al final tener mejores resultados", apuntó Germán Mejía, a quien Kyle Bohnenstiehl manifestó estar muy feliz por tan importante convenio que aseguró traerá grandes beneficios al país.

El proyecto COCONET tiene como objetivo reducir los impactos de los desastres naturales, proporcionando una mejor previsión del clima tropical y la actividad sísmica, además del acceso al GPS en tiempo real que benefician a los grupos que utilizan este tipo de datos.

Figure 3. From November 11, 2012 online edition of El Caribe: UNAVCO Permit Coordinator, Kyle Bohnenstiehl, signing MOU agreement with Mariano German Mejia, the President of the Supreme Court of the Dominican Republic.

FIELD OPERATIONS SUMMARY

During the last three months, the following field operation milestones were completed:

- In early September, Sarah Doelger completed the installation of CN35 on Providencia Island, Colombia.
- In October, UNAVCO engineer John Sandru and Luis Salazar Tlaczani from the Institute of Geophysics, University National Autonomous, Mexico (UNAM) installed two new sites (CN24 and CN25) in Mexico. CN24 is located in Felipe Carrillo Puerto, Quintana Roo and CN25 is in Comitán De Domínguez, Chiapas. Both sites are rooftop monuments on buildings owned and operated by the Mexican Metrological Observatory.
- In October, Víctor González and Marin Protti (Observatorio Vulcanológico y Sismológico de Costa Rica, Universidad Nacional,) completed the construction and installation of one more COCONet CGPS station. The station name is Reserva Veragua Rainforest (VRAI), located in the northeast part of Costa Rica.
- COCONet engineers conducted station maintenance in Jamaica (Kingston, Pedro Caye, Morant Caye) and Nicaragua (Poneloya, Puerto Cabezas, Bluefields).

	Cumulative	Since Previous Quarter	Details From Current Quarter
Station Recons	59	1	CN16
Permits Submitted	49	1	CN16
Permits Accepted	39	2	Honduras (2)
Stations Installed New / Refurbished	24 new 5 refurbished	4 new	Mexico (2), VRAI, CN35
Data Flow	New/Refurbished 26 Existing: 39	New/Refurbished: 4	Mexico (2), VRAI, CN35
Maintenance Visits	6	3 stations in Jamaica 3 stations in Nicaragua	Costa Rica, Dominican Republic
Next Quarter Projection	Recons: 5, Permits: 5, New Installs: 6, Refurbishments: 4		

Table 1. COCONet Status: Tasks completed to date and in FY2013-Q1.

DATA SUMMARY

The Port-of-Spain planning meeting resulted in 50 target locations for new stations, 15 targets for refurbished stations, and 61 existing stations for integration into the COCONet network. Since the Port-of-Spain workshop, the COCONet siting committee has rejected the location of four new stations (St. Croix, Cayman Islands, Guanaja, Punta Cana) and approved the addition of 6 refurbished stations to the plan. The current siting plan calls for 46 new stations, 21

refurbished stations and at least 61 existing stations to be incorporated into the COCONet data archive. The COCONet data plan also calls for at least 10 stations to provide high-rate real-time GPS data streams.

COCONet is currently downloading mostly 15-second data (with some exceptions for BGAN sites) and processing daily position estimate from 26 of the 29 new and refurbished COCONet stations through the Plate Boundary Observatory (PBO) analysis centers. Data from 39 existing stations in the region are being archived.

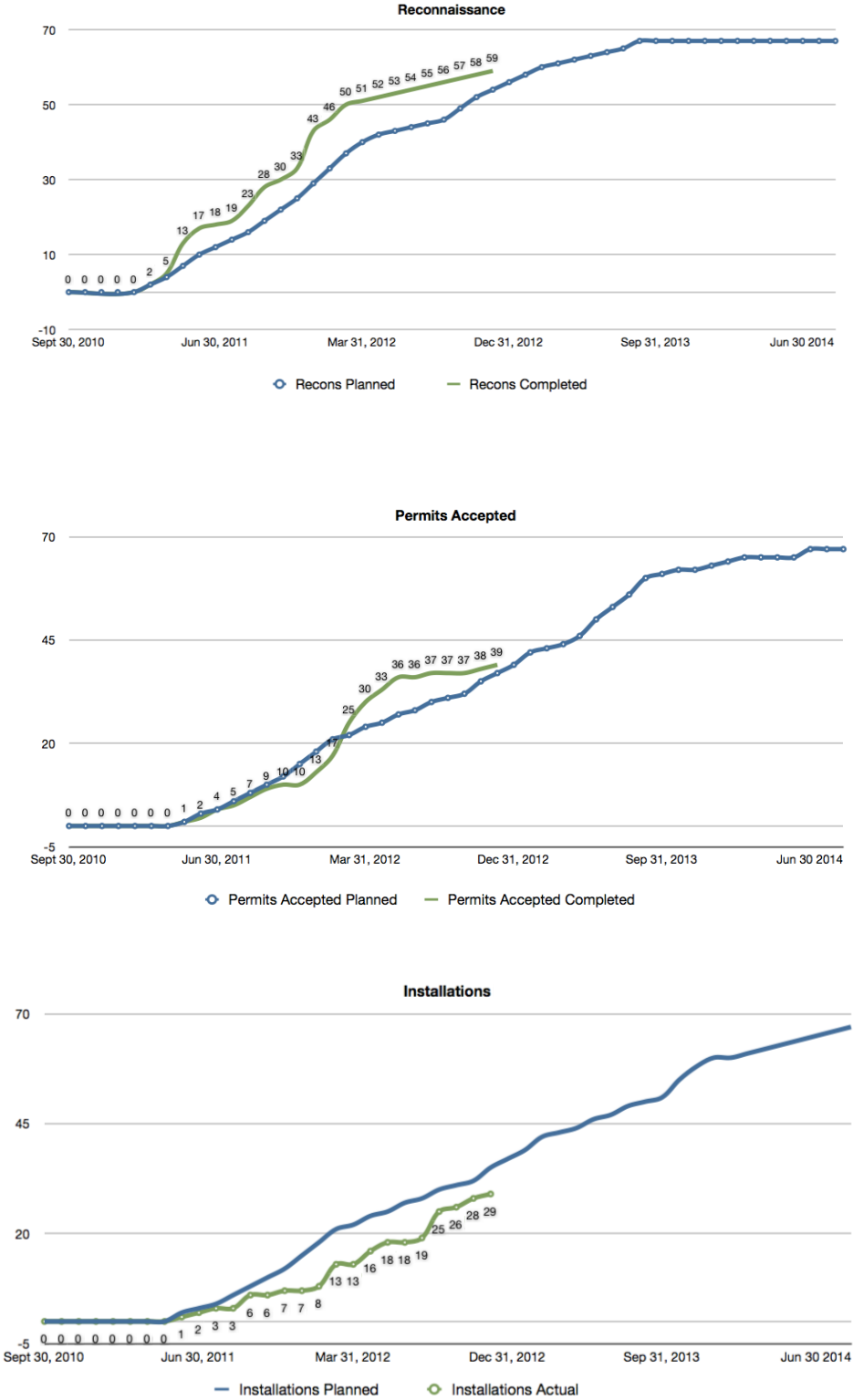
Processing of station data by the PBO GPS Analysis Centers is yielding high-quality time series. Table 2 shows the current data summary for stations identified as belonging to the COCONet network. See the discussion above related to the current status of PBO AC data processing and the plans for RT-GPS ingest and analysis at UNAVCO.

	New Stations	Refurbished Stations	Existing Stations	Notes
Standard data archived at UNAVCO	19 of 24 stations installed currently archiving 15-sec data 2 of 24 stations installed currently archiving 30-sec data (BGAN stations)	5 of 5 refurbished stations currently archiving 15 or 30-sec data	UNAVCO has received data from 49 existing stations. 39 currently online and operational	Known communications problems at CN06, CN22, CN29
Stations Streaming 1-Hz Data	(4) CN15, CN40, ISCO, CN12	(1) MANA	(2) NWBL, RCHY	

Table 2. COCONet data and archive summary.

SCHEDULE

The revised schedule includes 46 new station installations, 21 refurbished stations, and at least 61 existing stations. Refurbished stations are defined as stations that were operational in the past, but now require some equipment upgrades to become compatible with COCONet standards. Existing stations are assumed to require no additional hardware to be compatible with the COCONet network. The installation schedule was extended to four years, given the



Figures 4-6. COCONet Reconnaissance, Permitting, and Installations: Plan (blue line) vs Actual (green line).

delay in starting the field component of the project needed to refine the siting plan in light of new information that was not available at the time the proposal was developed.

Overall the project is ahead of schedule in reconnaissance and permitting and slightly behind schedule in station installations (Figures 4-6). The projection for the next quarter is at least 10 new/refurbished stations, which would put the project close to being back on schedule for installations.

OUTREACH: PUBLICATIONS, PRESENTATIONS, MEETINGS

The following publications, presentations, and/or meetings were either completed, submitted, or accepted for publication in FY2013-Q1:

Talk: Presented by Dr. Glen Mattioli

Mattioli, G. S., J. J. Braun, E. Calais, K. Dausz, K. Feaux, B. T. Friesen, M. M. Miller, J. Normandeau, E. Seider, and G. Wang, 2012, COCONet (Continuously Operating Caribbean GPS Observational Network): Goals, Network Status, Revised Scope, and Project Highlights, SIRGAS2012, Abstracts and Program SIRGAS Annual Mtg., Concepcion, Chile, Oct. 2012.

Poster: Presented by Dr. Glen Mattioli

Braun, J. J., K. Feaux, B. Friesen, G.S. Mattioli, M. M. Miller, J. Normandeau, E. Seider, and G. Wang, 2012, COCONet (Continuously Operating Caribbean GPS Observational Network): Infrastructure Enhancements To Improve Sea Level Monitoring, Paper No. 212178, Geological Society of America Abstracts with Programs. Vol. 44, No. 7, p.229.

Publication:

Protti, M., V. Gonzalez, J. Freymueller, S. Doelger, 2012, Isla del Coco, on Cocos Plate, converges with Isla de San Andrés, on the Caribbean Plate, at 78mm/yr, Rev. Biol. Trop. (Int. J. Trop. Biol. ISSN--0034--7744) Vol. 60 (Suppl. 3): 33--41.

UCAR UPDATE

The UCAR/COSMIC program is participating in COCONet through Collaborative Research under support from NSF grant (EAR- 1042909). UCAR produces continuous estimates of atmospheric precipitable water vapor (PW) using a heterogeneous network of GNSS stations, including those stations that are part of COCONet. These data are produced and distributed through the Suominet (www.suominet.ucar.edu) web portal as well as with the local data management (LDM) system. As of December 1, 2012 UCAR was including data from 44 new and existing COCONet sites into its processing system, and was preparing to ingest data from four other sites that are scheduled to begin producing sub-daily data streams for near real-time analysis. There are nineteen existing stations that are not currently being analyzed due to excessive latency and intermittent reliability of data arriving into the UNAVCO archive.

In an effort to maximize the availability of COCONet data, UCAR/COSMIC program is developing a software library to distribute PW data products in the Binary Universal Form for the Representation of meteorological data (BUFR) version 4 format. This format is the data standard for operational numerical weather prediction centers around the world. UCAR has finished the software development needed to produce BUFR format files and is in contact with the NOAA Data Distribution Service (DDS) to finalize the logistical requirements to push data into their distribution service. The production of atmospheric COCONet data products in BUFR format, and the distribution of this data through the Global Telecommunications System (GTS), should provide the operational meteorological community with broad access to COCONet data products.

COCONet PW data are shown in Figure 7 as the tropical disturbance that eventually became Hurricane Sandy develops in the central Caribbean. Hurricane Sandy, and Hurricane Isaac in August, are opportunities to use COCONet data to assess the distribution of water vapor in atmospheric analysis fields within and around hurricane systems. UCAR/COSMIC is now evaluating the differences in the Global Forecast System (GFS) analysis fields that are used to initialize numerical weather prediction models for forecasting.

UCAR/COSMIC has begun preparations for the Pan American Advanced Studies Institute (PASI) on Atmospheric Process of Latin American and the Caribbean: Observations, Analysis, and Impacts. The dates of this course have been finalized (May 27 – June 7, 2013), and a contract with a hotel in Cartagena, Colombia is in negotiation. The course web page (<http://www.cosmic.ucar.edu/pasi2013>) is accepting applications from perspective participants beginning on Dec 15, 2012.

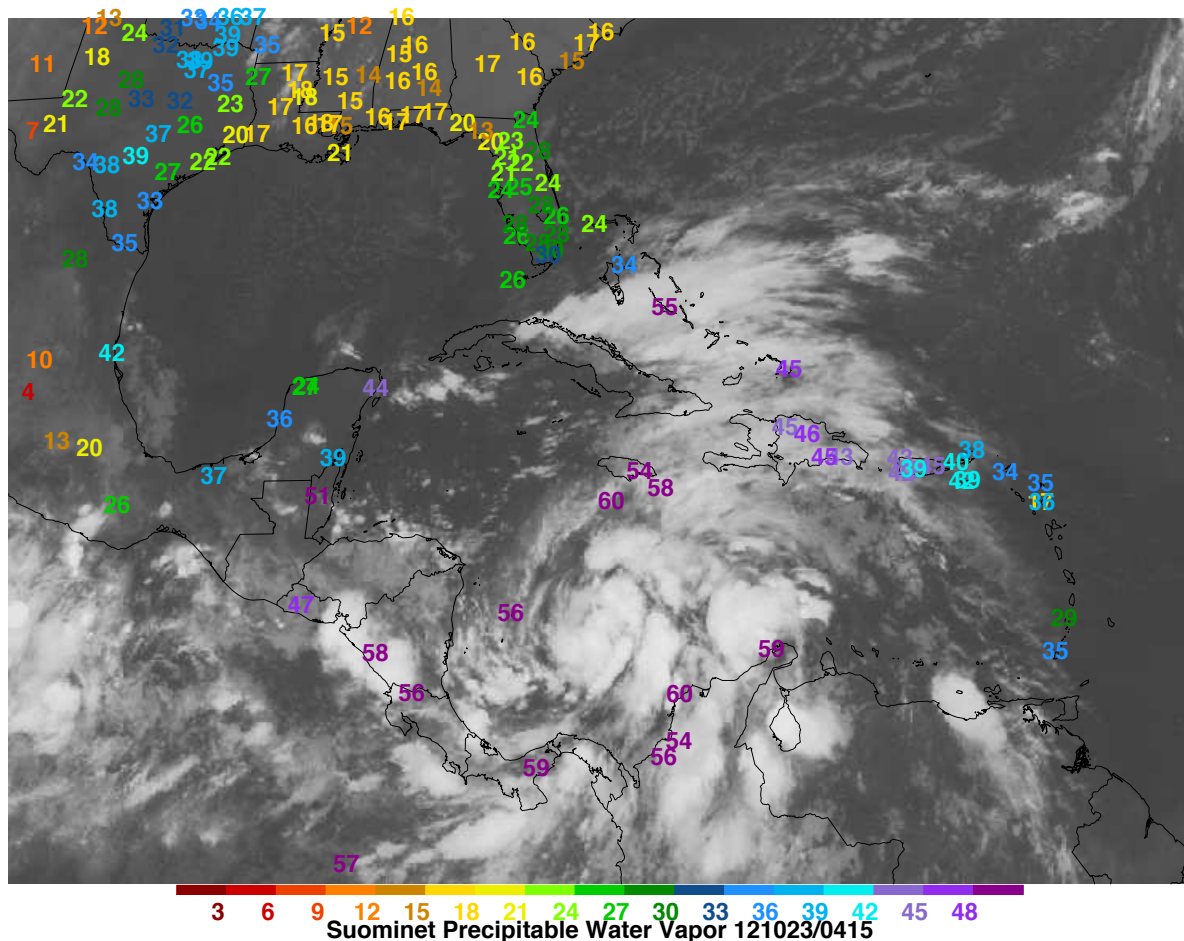


Figure 7. COCONet derived precipitable water vapor (PW) are overlaid upon a GOES-IR image taken on October 23, 2012 at 04:15 UTC. The storm system that would eventually evolve into Hurricane Sandy is visible in the central Caribbean.

EDUCATION AND OUTREACH HIGHLIGHT: DIVERSE WORKFORCE DEVELOPMENT SUPPORTED BY COCONET THROUGH RESESS

RESESS, or Research Experiences in the Solid Earth Sciences for Students, is a summer research internship program dedicated to increasing the diversity of undergraduate students entering the geoscience workforce. The RESESS program is supported by the National Science Foundation GEO-OEDG-0917474 award to UNAVCO. To date, the program has supported 37 undergraduates. Of those who have graduated from college, 70% are currently in graduate school.

RESESS intern Rachel Medina, a senior in geology at Fort Lewis College in Durango, Colorado, and President of the college's chapter for Engineers Without Borders, was supported by COCONet during the summer of 2012. In September, Rachel's abstract was accepted by AGU for the 2012 Fall Meeting, and selected for an oral presentation. In November, Rachel worked with her mentors Dr. Glen Mattioli of UNAVCO and Dr. John Braun of UCAR and her

professors at Fort Lewis College on updating and improving her presentation to be more accurate and polished. The focus of her work was on determining whether the tremendous vertical displacement (~2m) at Soufrière Hills Volcano, Montserrat, observed following the July 2003 volcano collapse can be explained in part by tropospheric interference by ash plumes. Rachel and her mentors inferred that moisture content associated with the ash plume cannot solely account for the apparent vertical displacement observed at the HERM site on Montserrat, and that a significant portion of the displacement is related to actual crustal motion during the collapse event.

PROJECT CONCERNS

Project Staffing – Two COCONet field engineers, Barrett Friesen and Emily Seider, have left the UNAVCO as full-time employees during this reporting period. We currently have an active search to fill these field engineering positions within the COCONet project and hope to have new staff hired as soon as possible. **Risk mitigation:** Field-engineering staff from the Plate Boundary Observatory in Alaska are available for assignment and charging to COCONet in support of installations in Jamaica, Panama, and other locations. Two new field-engineering positions have been announced and interviews will commence in January.