COCONet EAR 1042906/9 Quarterly Report

December 2012 - February 2013 (FY2013-Q2)

SUMMARY

This quarterly report covers the COCONet project (EAR-1042906/EAR-1042909) activities for the time period December 2012 - February 2013. 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 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 21 months. Specifically, installations of refurbished stations in the Dominican Republic, station installations in Panama and the British Virgin Islands, and maintenance work in Jamaica 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 56 sites, permits accepted for 53 sites, and currently have 37 stations installed (Figure 1, red dots).

The final report for the COCONet Data and Research Workshop, which was held in Tulum, Mexico October 24-26, 2012, was submitted to the National Science Foundation in early February 2013 and was posted to the COCONet website simultaneously and can be viewed at: http://coconet.unavco.org/lib/downloads/COCONet-Tulum-Report.pdf. The completion of this document was a critical COCONet project milestone. Efforts are now underway to address the concerns and suggestions provided by the COCONet 3rd workshop participants.

The COCONet management team pursued hiring two replacement engineers during the last three months. Michael Fend, who worked as an intern for the Plate Boundary Observatory in Alaska, was hired as a COCONet field engineer in February 2013. In his short time working at UNAVCO, Michael has already made contributions to the project, including fieldwork during the installation of the COCONet station in Virgin Gorda, British Virgin Islands. The search for the second field engineer is still in-progress. Field engineers from throughout UNAVCO have been used to support various aspects of the project. Engineer John Sandru, hired in the summer of 2012, continues to provide excellent support to the COCONet project. Jim Normandeau, the UNAVCO Project Manager responsible to support NSF-EAR projects as the head of the Engineering Support, GLC, and Global Networks group within the Geodetic Infrastructure directorate, has been named the Engineering Project Manager for the COCONet project is now dedicating ~30% of his effort to this project.

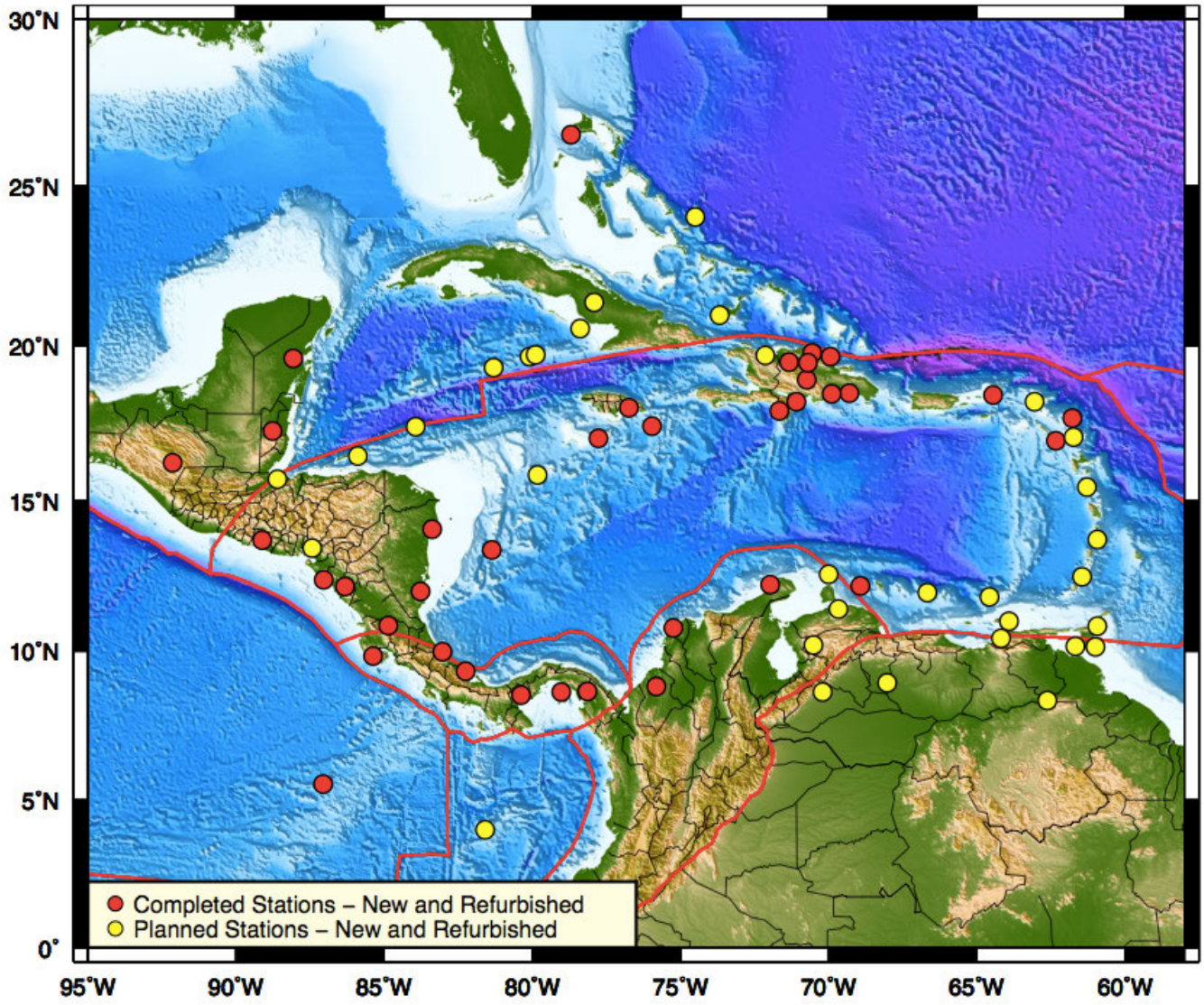


Figure 1. The current COCONet siting plan, the result of siting meetings in Puerto Rico and Trinidad, as well as four siting committee teleconferences during 2011 and 2012. Red dots represent the 37 completed COCONet stations (new and refurbished), yellow dots represent the 32 planned stations (new and refurbished). The existing stations (61+) that will deliver data to the COCONet archive and the 8 additional cGPS stations (locations TBD) associated with the tide gauge installations are not shown in this map.

COCONET HIGHLIGHT: DOMINICAN REPUBLIC INSTALLATIONS

In January of 2013, UNAVCO engineer John Sandru traveled to the Dominican Republic to install state of the art GPS equipment at four existing continuous GPS stations operated by the General Council of the Judiciary (Jurisdiccion Inmobiliaria). This equipment included a Trimble NetR9 receiver, Trimble choke ring antenna, and a Vaisala WXT520 meteorological instrument at each station. Additionally, each receiver was upgraded to provide RTK service to the

island's professional land surveyor community. This endeavour brings the total number of refurbished stations that COCONET has upgraded throughout the region to nine.

Figure 2. Refurbished COCONet station in Santiago de Rodriguez, Dominican Republic (SROD).

Field Operations Summary

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

- In February, field engineer John Sandru completed maintenance visits at CN07, CN06, CN08, and CN27 in the Dominican Republic and upgraded an additional four stations (BARA, SROD, SPED, LVEG) to COCONet standards.
- In February, field engineers Abe Morrison and Michael Fend completed the COCONet installation at Virgin Gorda (CN03).
- In late February-early March, field engineers Kyle Bohnenstiehl and Max Enders completed three installations in Panama (CN20, CN34, and CN28) and maintenance at CN33.
- In late-February, COCONet engineers conducted station maintenance in Jamaica (Morant Cay).

Additional details may be found in Table 1 below.

	Cumulative	**Since Previous Quarter**	**Details From Current Quarter**
Station Recons	59	0	
Permits Submitted	56	7	
Permits Accepted	53	14	
Stations Installed New / Refurbished	28 new 9 refurbished	4 new 4 refurbished (DR)	Panama (3), Virgin Gorda, Dominican

			Republic (4)
Data Flow	New/Refurbished 33 Existing: 39	New/Refurbished: 6	
Maintenance Visits	12	6	CN07, CN06, CN08, CN27 (DR), CN33 (Panama), CN10 (Jamaica)
Next Quarter Projection	Recons: 4, Permits: 4, New Installs: 6, Refurbishments: 4		

Table 1. COCONet Status: Tasks completed to date and in FY2013-Q2.

DATA SUMMARY

The Port-of-Spain, Trinidad 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, and Punta Cana) and approved the addition of 6 refurbished stations to the plan. In the last quarter, the COCONet Siting Committee approved two additional sites (Aruba and Panama). At this time, the current siting plan calls for 48 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, low-latency (1 Hz, <1 ms) or real-time GPS data streams.

UNAVCO currently provides a suite of geodetic data products from COCONet GPS stations. COCONet stations are mostly configured for 15-second hourly downloads, with some exceptions for sites that have BGAN satellite data communications infrastructure in place.

Level 0 and 1 GPS data products include quality checked RINEX files from all stations and real-time data from a subset of 7 stations. Level 2 GPS data products include station position solutions, station position time series, station position velocity estimates, and tropospheric delay parameters. These Level 2 products are produced by the Plate Boundary Observatory (PBO) Analysis Centers (AC's) and Analysis Center Coordinator (ACC), and are identical in format to their corresponding PBO data products. At the time of this report, Level 2 products are available from 72 (33 of the 37 completed new/refurbished and 39 existing stations); data products may not be available due to station communication issues or other reasons, such as the station being recently built. Table 2 below shows the current data summary for stations identified as belonging to the COCONet network. Seven stations are configured to deliver high-rate, low-latency (1 Hz, <1 ms) data streams in real-time via the Networked Transport of RTCM via Internet Protocol (NTRIP).

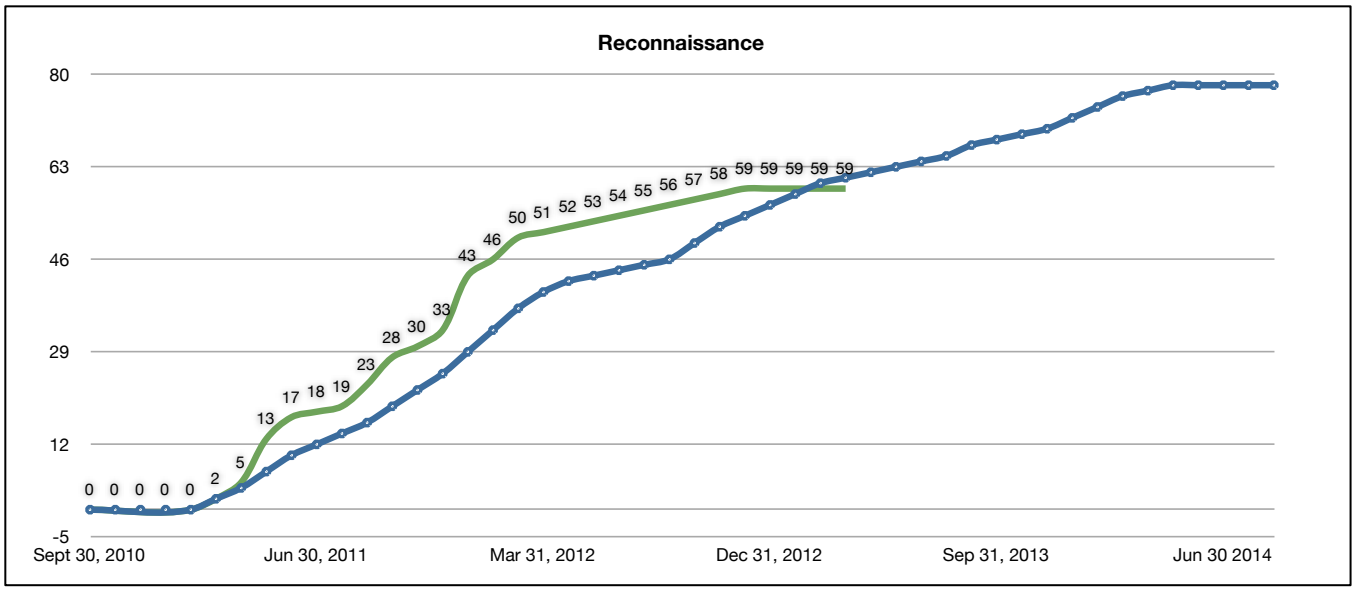
Table 2. COCONet site and data archive summary.

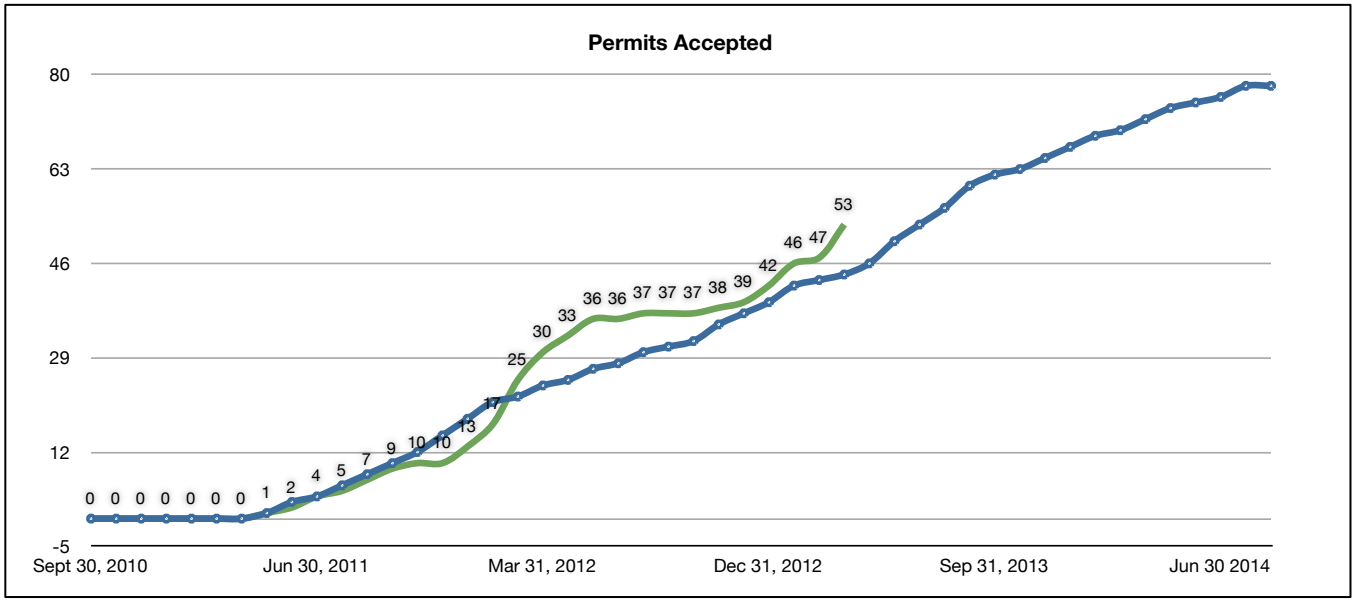
	New Stations	Refurbished Stations	Existing Stations	Notes
Standard data archived at UNAVCO	22 of 28 stations installed currently archiving 15-sec data 2 of 28 stations installed currently archiving 30-sec data (BGAN stations)	9 of 9 refurbished stations currently archiving 15 or 30-sec data	UNAVCO has received data from 50 existing stations. 39 currently online and operational	Known communications problems at CN06, CN29, CN34, CN15, CN11, CN08, CN22, QSEC
Stations Streaming 1-Hz Data	(4) CN15, CN40, ISCO, CN12	(1) MANA	(2) NWBL, RCHY	

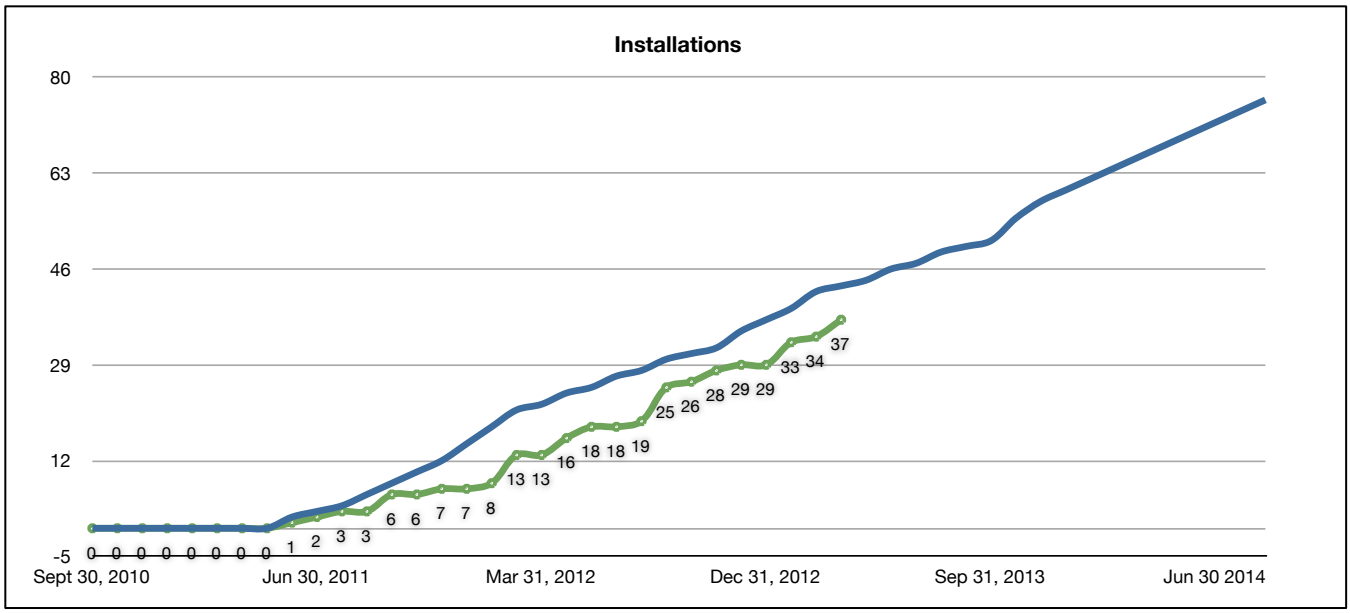
BUDGET AND SCHEDULE

The revised schedule includes 48 new station installations, 21 refurbished stations, and contribution of data from at least 61 existing stations. Refurbished stations are defined as stations that were operated by a regional partner and were working previously, 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 delay in starting the field component of the project, because of the need to refine the siting plan in light of new information that was not available at the time that the proposal was developed and submitted to NSF in 2010.

Overall the project is ahead of schedule in permitting and slightly behind schedule in reconnaissance and station installations (Figures 3-5). The projection for the next quarter is to install or upgrade at least 10 new/refurbished stations, which would put the project close to being back on schedule for installations.


Reconnaissance
80
63
46
29
12
-5
Sept 30, 2010
Jun 30, 2011
Mar 31, 2012
Dec 31, 2012
Sep 31, 2013
Jun 30 2014
0 0 0 0 0 2 5 13 17 18 19 23 28 30 33 43 46 50 51 52 53 54 55 56 57 58 59 59 59 59 59


Permits Accepted
80
63
46
29
12
-5
Sept 30, 2010
Jun 30, 2011
Mar 31, 2012
Dec 31, 2012
Sep 31, 2013
Jun 30 2014
0 0 0 0 0 0 0 1 2 4 5 7 9 10 10 13 17 25 30 33 36 36 37 37 37 38 39 42 46 47 53



Figures 3-5. COCONet Reconnaissance, Permitting, and Installations: Plan (blue line) vs. Actual (green line).

COCONet expenditures are now over $2.7M to date (Figure 6). The reasons for the discrepancy between the actual spending and the originally budgeted expenses include: (1) delayed invoicing from both the planned Purdue subaward as well as charges arising from data archiving/processing; (2) the initial decision to use Zephyr antennas instead of choke ring antennas, as planned and budgeted for in the original proposal; (3) lower data communications expenses, permitting fees, and shipping costs; and (4) fewer than planned installations that have been completed to date. A revised and more aggressive spend plan in the upcoming months designed to reduce this gap in FY2013-Q3 includes: (1) the purchase of Nanometrics Apollo Server software needed to connect to high-rate data streams at the Seismic Research Center in Port of Spain, Trinidad; (2) the purchase of choke ring antennas to replace all of the currently deployed Zephyr antennas as well as the additional cost to include choke rings for remaining Trimble NetR9 receiver purchases; (3) the installation of up to ten stations in the next 3 months; and (4) the purchase of additional met instruments to be deployed at existing stations. In the next month, our revised spend plan will be presented to the NSF Program Manager. This revised COCONet budget will include a PI-approved plan to re-scope the remaining $350K originally budgeted and allocated to Purdue as a subaward from UNAVCO. We note that former COCONet Co-PI, Dr. Eric Calais, Professor of Earth & Atmospheric Sciences at Purdue through December 2012, has left the US to accept a new position at Ecole Normale Superieure in Paris, France.

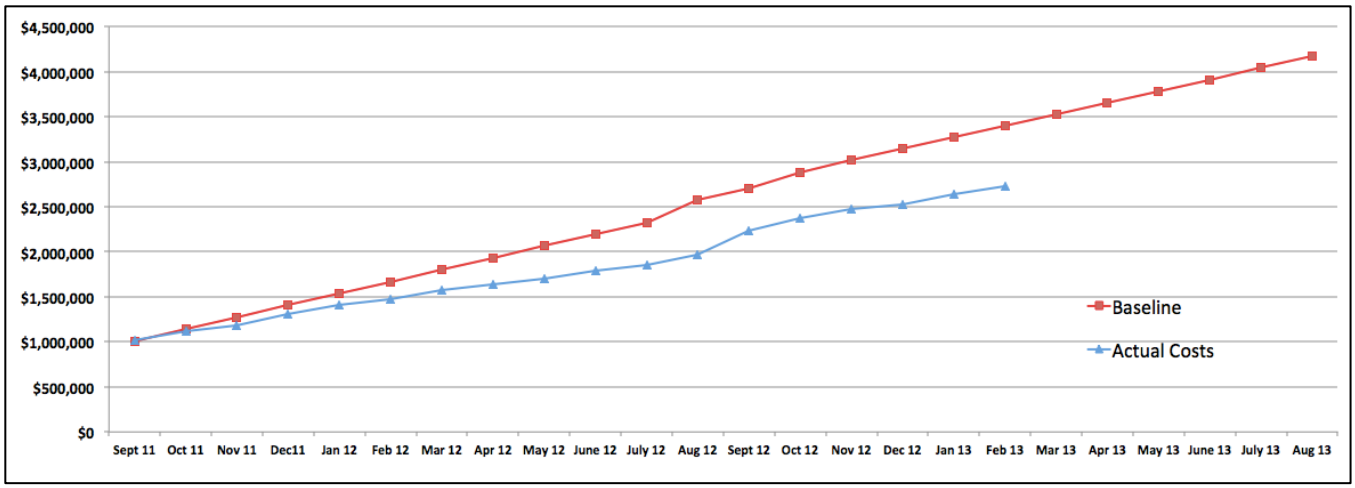


Figure 6. Total project actual costs vs. budget from September 30, 2011 – February 28, 2013. Red line is original NSF budget and blue line is actual UNAVCO expenditures.

Education, Outreach, and Community Engagement

The following publications and associated presentations at national and international meetings were completed in FY2013-Q2:

Poster: Presented by Mr. Karl Feaux and Mr. Jim Normandeau, UNAVCO
Feaux, K. F. and Normandeau, J., J. J. Braun, E. Calais, K. Dausz, B.T. Friesen, G.S. Mattioli, M. M. Miller, E. Seider, and G. Wang (2012), COCONet (Continuously Operating Caribbean GPS Observational Network): Network Status and Project Highlights, Abstract T41A-2556 presented at 2012 Fall Meeting, AGU, San Francisco, Calif., 3-7 Dec.

Poster: Presented by Dr. Christine M. Puskas, UNAVCO
Puskas, C. M., D.A. Phillips, G.S. Mattioli, C.M. Meertens, T. Herring, M.H. Murray, T. Melbourne, F.M. Boler, G. Blewitt, K. Larson, K. Feaux, J. Braun, E.E. Small (2012), UNAVCO Enhanced data products for the EarthScope Plate Boundary Observatory, COCONet, and other regional networks, Abstract G23B-0916 presented at 2012 Fall Meeting, AGU, San Francisco, Calif., 3-7 Dec.

Poster: Presented by Ms. Jamie Miller, UTA PhD candidate
Miller, J.A., G.S. Mattioli, and S.A. James, 2012, 2011-2012 Campaign GPS Geodetic Monitoring of Surface Deformation, Dominica, Lesser Antilles, Abstract G41A-0892 presented at 2012 Fall Meeting, AGU, San Francisco, Calif., 3-7 Dec. 2012.

Poster: Presented by Dr. John Braun, UCAR
Braun, J. J., T. Van Hove, The Application of COCONet to Determine Water Vapor Variability in the Caribbean; Poster, 93 Annual AMS Meeting, Austin, TX, AMS, Jan 8, 2013.

Talk: Presented by Dr. John Braun, UCAR
Braun, J.J., T.M. Van Hove (2012), The Application of COCONet to Determine Water Vapor Variability in the Caribbean (Invited), Abstract A53S-06 presented at 2012 Fall Meeting, AGU, San Francisco, Calif., 3-7 Dec.

Talk: Presented by Ms. Rachel Medina, UNAVCO RESESS intern
Medina, R.B., G.S. Mattioli, and J.J. Braun, 2012, An Analysis of GPS and Remote Sensing Data of Soufrière Hills Volcano, Montserrat, during the July 2003 Dome Collapse: Implications for Detection of Ash Plumes and Vertical Deformation, Abstract V33E-07 presented at 2012 Fall Meeting, AGU, San Francisco, Calif., 3-7 Dec. 2012.

Education and community engagement, which focused on recommendations from the COCONet Data and Research Workshop held in Tulum, include the following activities:

- Improvements to the COCONet webpage to address issues identified in Tulum. One of the key new features is a Project Management tab that provides information about key project management processes such as scope, schedule, and stakeholder issues. This is a work-in-progress and will be updated throughout the remainder of the project.
- As recommended in Tulum, a COCONet Facebook page was developed and is now live. Updates from the field will be posted on this page as a way to keep the COCONet community informed about the network construction progress of the project.
- A monthly news alert has been created to inform COCONet partners, collaborators and other stakeholders of actions, advances and opportunities. This recommended action should help to build a vibrant and sustainable community of scientists, engineers and others in the Americas and advance geoscience research for the benefit of society.
- Another key action item of the third workshop report was establishment of four working groups to advance some specific recommendations. The new *stakeholder management* page on the COCONet website lists the groups (Data Networks, Regional Data Centers, Scientific Training and Community Engagement and Outreach) and their goals. A UNAVCO staff member will act as a liaison to each of these groups. Additional volunteers are needed for each group and the groups are already beginning to work on their specific objectives.
- COCONet will sponsor three students from the Caribbean region to present at the COCONet session (T-06) at the upcoming AGU Meeting of the Americas in Cancun, Mexico.
- Continued COCONet support will be provided for RESESS intern Rachel Medina during the summer of 2013. Rachel will continue to work with Dr. Glen Mattioli and Dr. John Braun investigating the apparent large vertical displacement (~2m) at Soufrière Hills Volcano, Montserrat that occurred during the massive dome collapse of July 13, 2003.

UCAR UPDATE

The UCAR/COSMIC program is participating in COCONet under support from NSF grant (EAR- 1042909). UCAR/COSMIC 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. Of the 82 COCONet stations cataloged within the UNAVCO Data Archive Interface (DAI), 56 have reported data since Jan 30, 2013. Thirty of these stations are collocated with meteorology instruments. UCAR/COSMIC includes 45 of the 56 stations and 27 of the 30 stations with meteorology instrumentation into its routine processing. The remaining stations have either just become available through the archive (seven sites) or are excluded from the analysis because they are not yet producing sub-daily data files (four).

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.

In addition to these data processing efforts, UCAR/COSMIC is reviewing applications for the upcoming Pan American Advanced Studies Institute (PASI) on Atmospheric Process of Latin American and the Caribbean: Observations, Analysis, and Impacts. Response to this short-course announcement was exceptionally strong. There were 92 eligible applicants from 22 countries. The list of candidates is under a committee review. Approximately 26 candidates will be notified of their acceptance to the class by late March. Other logistics regarding the course are also undergoing preparation. The class will be hosted by the Almirante Padilla Naval Academy in Cartagena, Colombia with logistical support from the Colombian Geological Survey. Other elements of the course, including finalizing both a hotel contract and course syllabus are underway. Currently, the lecturers are conducting monthly teleconferences to focus on course content and organization.

PROJECT CONCERNS

Project Staffing – UNAVCO has filled only one of the two open COCONet field-engineering positions, which puts some constraints on the upcoming schedule for station installations. Engineering Project Management is now being handled by J. Normandeau in lieu of a dedicated COCONet Project Manager. **Risk mitigation**: Field-engineering staff from the Plate Boundary Observatory GPS Operations group and the Engineering Support, GLC, and Global Networks group in the Geodetic Infrastructure directorate at UNAVCO have been made

available for temporary assignments to the COCONet project in support of installations in Jamaica, Panama, Virgin Gorda, and other locations. When UNAVCO staff members, normally assigned to other projects, are used to support COCONet installations or site operations and maintenance, their time, travel, and field expenses are charged directly to the COCONet award.