Abstract - As part of the Collaborative Adaptive Sensing of the Atmosphere (CASA) Engineering Research Center a testbed coordinated by students (SLT) has been proposed. The students belong to four different institutions: University of Massachusetts, University of Oklahoma, Colorado State University, and University of Puerto Rico at Mayagüez. They meet in a weekly basis via videoconferences to discuss details concerning their projects. This multicampus project has evolved in a multidisciplinary research initiative that includes areas from electrical engineering, computer engineering, meteorology, atmospheric sciences, and social sciences. The project consist in developing a network of high frequency, low power, and low range radars in Puerto Rico that will densely sample the lower atmosphere. In contrast with the other full system tested within the center, the students are leading this effort and they will find in Puerto Rico challenges in the mountainous topography and tropical climate of the Island.

Index Terms – Education, multicampus, multidisciplinary, partnerships, radar network.

INTRODUCTION

The National Science Foundation Engineering Research Center for Collaborative Adaptive Sensing of the Atmosphere (CASA) was established in the fall of 2003 to explore methods for improving observation, detection and prediction of atmospheric phenomena. The center is composed of four core universities, the University of Massachusetts, at Amherst, the University of Oklahoma, Colorado State University, and the University of Puerto Rico at Mayagüez. The center is focused on developing Distributed Collaborative Adaptive Sensing (DCAS) as a systems technology to improve our ability to monitor the earth’s lower troposphere. Improving today’s weather monitoring and forecasting requires an increase in both the resolution and volume coverage of observations in the lowest kilometers of the atmosphere. The DCAS system will be created with a network of X-band polarimetric radars with those previous conditions in mind.

Current approaches to sampling the lower atmosphere are physically limited in their ability to provide the required resolution and coverage. Current radars are used to cover distances up to 240km, introducing limitations due to the earth’s curvature and important atmospheric phenomena can go unobserved [1]. A proposed network of X-band radars located at closer range (~25 Km) will overcome this and other limitations related to long-range radars.

With DCAS, CASA proposes a method to complete the picture of the lower atmosphere. In order to achieve such a system, a series of technology and full-system testbeds are created and distributed throughout the four different partners. An innovative approach of the center is to integrate students from the four different campuses in a unique research experience under a Student Led Testbed (SLT). The SLT is a group of graduate and undergraduate students that belong to the four different partner institutions. The project follows the main idea proposed by CASA of creating a testbed similar to those proposed for Oklahoma and Houston, being the main difference that students are leading the Puerto Rico effort.

The Student Test Bed main goals are to establish a Quantitative Precipitation Estimation (QPE) sensing network starting at the western end of the island taking into consideration coverage gaps from the current weather radar, NEXRAD, which is located in the northeast section of the island. It is expected in the future, that with more coverage, and better resolution a significant improvement in precipitation estimates for western Puerto Rico will be achieved.

At this moment in UPRM, a modification of an X-Band 30 Km range Magnetron Radar is under development. In parallel, at UMass, the developing of an “Off-the-Grid” radar is on the way, and it is expected to have the first prototype completed by Fall 2005. The QPE algorithms are under development for Puerto Rico rainy characteristics, and students in University of Oklahoma will analyze the data gathered by the radars.

GEOLOGICAL SURVEY AND RADAR MODIFICATIONS

The Geological Survey for the radar node locations has been limited to UPRM land properties due to easy accessibility and permission requirements. The plan is still to use the sites suggested in [2] with separations of a few kilometers. The rooftop of the Electrical and Computer engineering (ECE) will host the first X-band radar. Arrangements have been made to allocate tower extensions donated from the the Arecibo Observatory to support a platform on ECE building and in a second site, farm La Montaña, in Aguadilla. Locations of these two sites are shown in figure 1.
As a first step in the creation of the full scale DCAS system, the University of Puerto Rico-Mayagüez (UPRM) students are modifying a marine radar for rain detection and attenuation studies. The radar under development is based on a 25 KW magnetron X-Band radar with single polarization. The magnetron works at a frequency of 9.41 GHz, and it can be modified for weather purposes. The marine radar is going to be station in the roof of the ECE building. Data from the radar is acquired with the data acquisition computer board that is currently under development at UMass. A scheme will be developed to transfers data from the data acquisition computer to the processing server computer, inside of the building. The algorithm in charge of this task is under development at the Colorado State University.

**OFF THE GRID ANTENNA**

Due to the orography of the Island and constrained power capabilities for high power radars, students at UMass came with the concept of “Off-The-Grid” (OTG) radar. The idea is to relax some systems design parameters and develop a self powered portable X-band radar [3]. The radar will be powered by batteries and a photovoltaic panel. The name “Off-the-grid” originates from off the grid from the main electrical grid system. The basic idea is to build a solid state radar with a range of 15 Km that will be reliable in severe weather conditions. Radar like this can be used in hurricanes or heavy rain that can bring down grid power. The design of the multi-layer antenna was performed following a design by Kadambala and Carver [4], the OTG antenna will have one patch for both polarizations. One of the polarizations will be feed from the top layer and the other from the bottom layer. The antenna for the OTG radar has been designed at UPRM. This antenna is a multi-layer flat panel printed circuit antenna that has a center frequency of 9.44GHz. The scanning will be made mechanically in both azimuth and elevation.

**REFERENCES**