2.6 RAINFALL MONITORING NETWORK IN THE AMAZONIAN JUNGLE

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1. INTRODUCTION

Our team has set up a network of a dozen rain gauges monitoring climatic change in rainfall (both natural and man-made) in a small region within the Amazon basin where deforestation is occurring (see Figure 1). Our hypothesis is that a reduction in vegetation should lower evapotranspiration rates, which would probably lead to a reduction in atmospheric water vapor. This in turn may lead to a measurable change in cloud and rainfall parameters. Our network of rain gauges have provided and are continuing to provide hard *in-situ* data which are utilized in conjunction with remote sensing measurements of cloud cover and rainfall that are being made with satellite instrumentation, notably from the Tropical Rainfall Measuring Mission (TRMM).

2. RIO BUGALAGRANDE

The rain gauges were set up on the Fundacion Rio Bugalagrande (FCB), 2300 hectares of private reserves interspersed in a mountainous region on approximately 40 kilometers by 20 kilometers of government-owned forest and private farms from the broad, low-lying valley (approximately 900m elevation) to the 3800m mountain tops (the treeline is at approximately 3500m). An elevation map of the Rio Bugalagrande watershed is shown in Figure 2. It is located near the village of Tulua, an hour north of Cali, Colombia and several hours from the coast (Latitude 4 degrees 5 minutes and 16 seconds North; Longitude 76 degrees 12 minutes and 0 seconds West). Most of this large watershed is natural forest, but small villages do exist in these mountains, and significant deforestation is occurring. The FCB is part of an effort to understand how Colombians are impacting their environment. Using private and public funds, the FCB has been purchasing deforested land and setting up reserves for reforestation. The FCB is also heavily involved in public outreach, teaching the farmers in the watershed about the appropriate crops to plant and about sustainable development of the area.

3. RAIN GAUGE MONITORING

Assistance in placing and monitoring these rain gauges was received from dozens of local inhabitants, including forest rangers, university students, several teachers at public schools, and several employees of various governmental agencies who either work or live in this region. Each of the team members travel to their assigned rain gauges on a daily basis to record the amount of rainfall, note any compromising effects which might have influenced the collection (particularly human disturbance and bird feces), and empty the rain gauges. They also make notations of where burning is occurring and to what extent. I ensured that the rain gauge network was properly placed (proper height, far from obstructions, adequate spacing, etc.) and that the data collection process is done properly. I also toured the region (to the extent allowed; guerilla activity is fierce in this region), to examine how virgin and dense the rainforest is (assists with estimating the extent of evapotranspiration), to study the topography of the region (upslopes enhance rainfall, hence topographical effects need to be subtracted to look for deforestation effects), to examine the rate and manner of burning going on (burning contributes to cloud condensation nuclei) and to examine the characteristics of the villages and the people within them (how extensive, how forested, etc.).

4. ELEVATION AND VEGETATION

The FCB provided detailed elevation and vegetation maps of the entire region, clearly showing the rivers and all the tributaries in the region, which is essential for comparison to satellite imagery because very few roads exist in the region for landmarks. These maps show not only the regions where deforestation has occurred, but also the type of vegetation in different parts of the watershed (essential for estimating evapotranspiration rates) and the ages (and hence heights) of regions where reforestation has begun (again essential for estimating evapotranspiration). Additionally, aerial photography shows the state of deforestation at the start of the project (see Figure 3), which will be useful when the project is completed.

5. OTHER NETWORKS

In addition, we receive cooperation from members of the governmental agencies Corpocuencas, CVC and EPSA; all of whom currently collect precipitation data in more inhabited areas around the Rio Bugalagrande watershed, utilizing excellent equipment and methodology. Corpocuencas is the national agency responsible for managing all of the watersheds in Colombia. CVC is the national agency responsible for natural resources, and EPSA is the national power-regulating agency. While none of these agencies have rain gauges in the Rio Bugalagrande watershed, all these agencies have collected data nearby for decades, allowing an examination of long-term change in the region.

Finally, several owners of some of the large ranches who have their own rain gauges in the wide valley below the Rio Bugalagrande watershed are providing their data to us. Some of these ranches have remarkably good equipment, which is understandable considering how important rainfall is to their livelihood. Again this data will be useful in examining the long-term data I will receive.

6. PARTNERS OF THE AMERICAS

Support for this project was also provided from the South Carolina Chapter of *Partners of the Americas* (POA), an international, nonprofit, volunteer nongovernmental organization based in Washington, D.C. Since 1972, the South Carolina chapter of POA has been a partner with Southwestern Colombia, seeking to improve relations between Americans and Latin Americans through privately sponsored projects for mutual social and economic development. The chapter offices in South Carolina, and in Cali, Colombia were both extremely helpful in setting up the necessary contacts as well as local travel arrangements. For more information of the national organization, consult: www.partners.net. For additional information on the local chapter, see: www.scswcolombia.org.

7. SATELLITE DATA ANALYSIS

In addition to the in-situ studies in South American jungles, satellite data analysis is taking place in the College of Charleston Weather Center. The College of Charleston Weather Center recently received a Unidata Software License, allowing access to a plethora of real-time NOAA satellite data. Data from the Tropical Rainfall Measurement Mission has been particularly useful.

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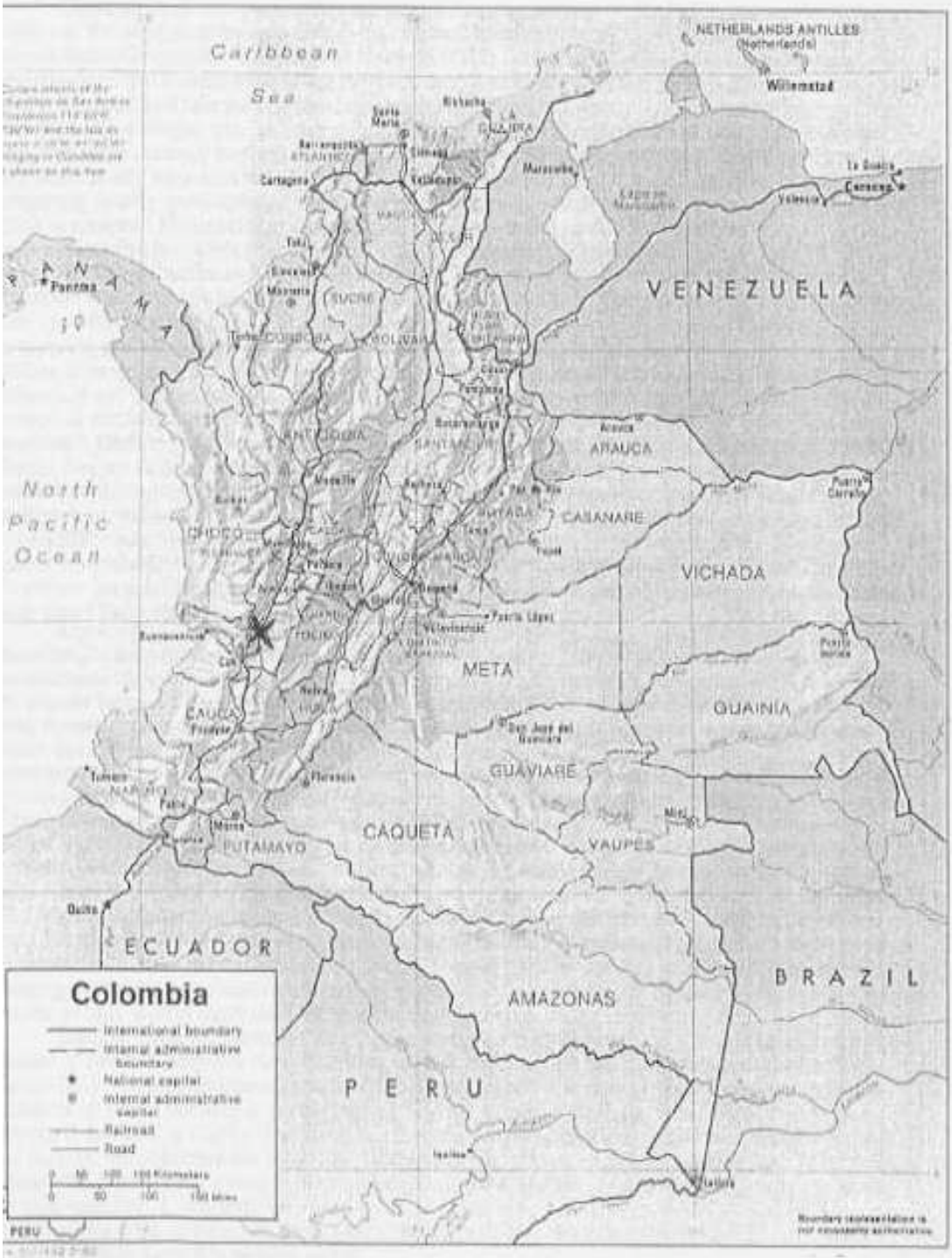

Figure 1 Geographical map of Colombia. The Andes mountain chain is indicated, running from the northern part of Colombia down to the southwestern part of Colombia. The Rio Bugalagrande watershed is indicated by an 'X', just north of Cali in the western part of Colombia.

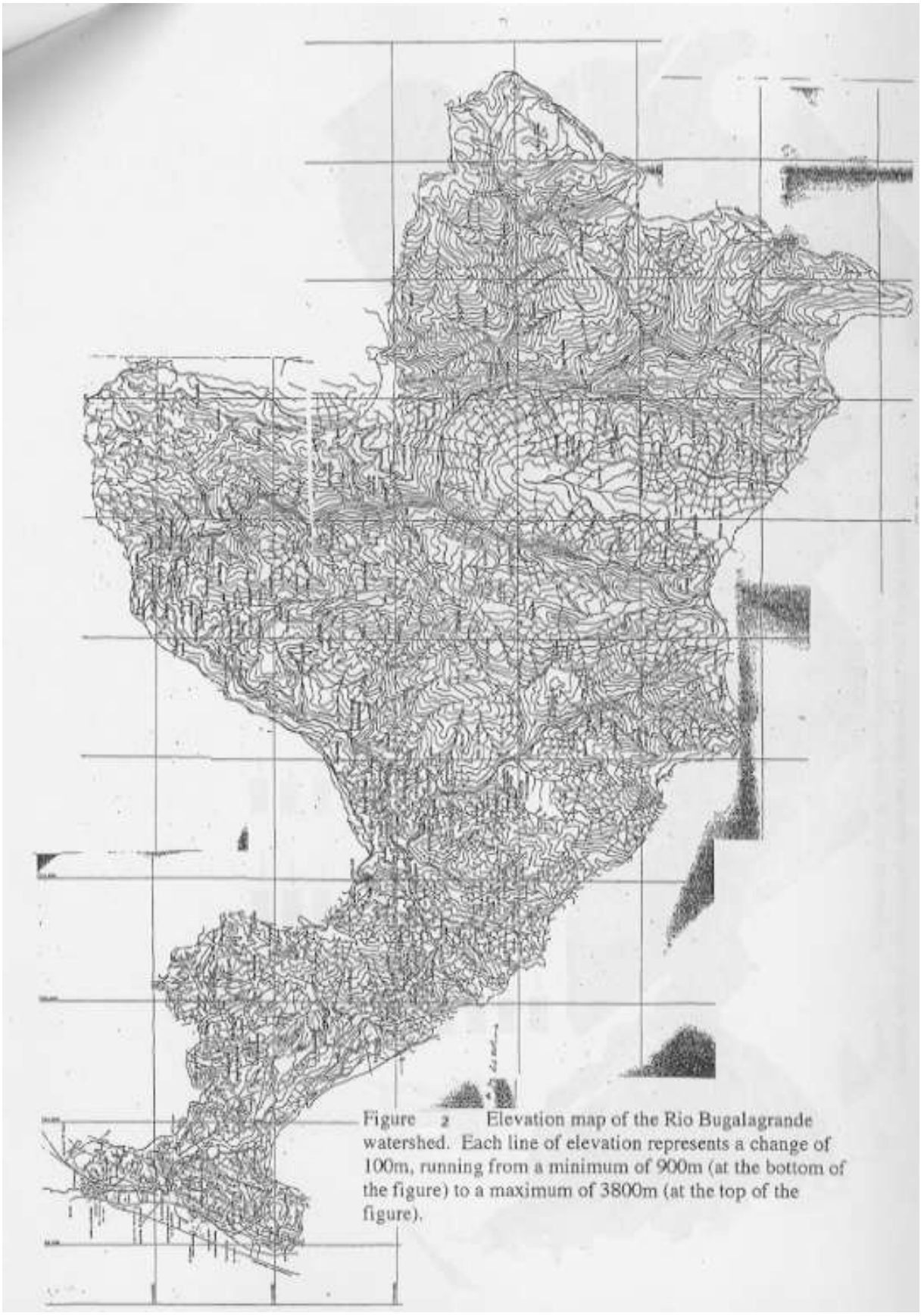

Figure 2 Elevation map of the Rio Bugalagrande watershed. Each line of elevation represents a change of 100m, running from a minimum of 900m (at the bottom of the figure) to a maximum of 3800m (at the top of the figure).

Figure 3. Sample aerial photograph of part of the Rio Bugalagrande watershed. The largest town in the watershed, Ceilan, is shown, as well as patches of forest and ranchland. In the originals individual homes and trees can be seen.