

2013 NBS Summer Mini-Grant Summary Report for Field Research in Ecuador, Venezuela, and Iceland

In June 2013, NBS Mini-Grant funds were used to purchase a high-fidelity, research grade microphone (G.R.A.S. 40 AZ) and preamplifier. The microphone package enabled field visits during July and August 2013 to measure the very low frequency sounds (*infrasound* [below the human threshold of hearing]) emitted from large waterfalls. This ongoing work is the pursuit of a new line of research, initiated during a 2012 university sabbatical, to investigate the physical geographic characteristics of the world's most powerful cataracts.

Ecuador

On July 7-11, 2013, the microphone, a data logger, and laptop computer were taken to Ecuador to measure the infrasound from San Rafael Falls, an impressive double plunge waterfall in the Ecuadorian rain forest (Figures 1 & 2). Unfortunately, this iconic fall—the largest waterfall of Ecuador—will effectively disappear in a national hydropower project slated to go online within the next 0-2 years. This made the audio measurements during the 2013 rainy season all the more precious.



Fig. 1. Field measurements in Ecuador. The small, ½” microphone is mounted on the tripod, and recordings are being written to the laptop computer.



Fig. 2. Microphone field-of-view of San Rafael Falls.

Venezuela

On July 15-19, 2013, I travelled by boat to the remote Amerindian (Yekwana) village of El Playon, on the broad Caura River of southern Venezuela. The Rio Caura is a major tributary to the great Orinoco River, and drains the south-central portion of Venezuela from the Brazilian border to its Orinoco confluence. El Playon was the launch point for a jungle trek to Las Pavas Falls (more commonly [but incorrectly] known as Pará Falls), which dramatically demarcate the Lower and Upper reaches of the Caura River. The remoteness of the mighty Las Pavas cataract makes it a seldom-visited feature; I was informally told that there are only one or two Americans who see the fall each year. Audio measurements were conducted at the base of the falls (Fig. 3), as well as 1-2 km downstream inside the Venezuelan rain forest (Fig. 4), to test the propagation/attenuation of its radiating infrasound signal.



Fig. 3. Audio measurements at the edge of Las Pavas Falls. The waterfall is broad (700 m), so only a portion of the total falls comprising the drop in the Rio Caura are visible.



Fig. 4. Infrasonic measurements within the Caura rain forest.

Iceland

On August 5 I returned to the field, to the dramatically different setting of Iceland. During a ten day tour, I dispatched the audio equipment at a diverse set of waterfalls on the rugged island. Most notable of these was the Dettifoss cataract (Fig. 5), the most powerful waterfall in Europe. Infrasound measurements were also conducted at upstream Sellfoss (Fig. 6), distant Skogafoss, and the famous Godafoss (Fig. 7) waterfalls.



Fig. 5. CSUDH alumna (and tourist) helping with audio recordings of thundering Dettifoss.

Summary

The audio equipment purchased from the NBS Mini-Grant has enabled an archive of infrasonic recordings from diverse, great waterfalls flowing during the peak of their annual runoff cycle (i.e., height of the rainy season in South America, and maximum glacial melt in Iceland). Each recording is approximately five minutes in duration. It remains an ongoing research task to perform the spectral analysis of the recordings to see what geophysical properties are revealed through the infrasonic data.



Fig. 6. Measurement site for the elongated Sellfoss waterfall.



Fig. 7. Measurement site for the picturesque Godafoss waterfall.

Despite the need for future laboratory (and field!) work, it should be noted that the summer 2013 funding has already enabled me to share field observations with students and the greater public. On November 15, I gave a well-received public lecture in Manhattan Beach, *Hydrographic Expeditions to South America*, which highlighted the July 2013 audio measurements performed in the remote and beautiful locations of these impressive waterfalls. Students in this spring's GEO 412 (Rivers and Streams) course will be further educated on the hydrographic settings and research methodologies.