Exploring Planetary Analogs: Environmental Monitoring and Lake Bottom Mapping at Planetary Lake Lander 2011. C. W. Haberle[1,2], N. A. Cabrol[2], and E. A. Grin[2], [1]Oregon State University (Christopher.W.Haberle@nasa.gov), [2]NASA Ames Space Science Division/SETI Carl Sagan Center, MS 245-3, Moffett Field, CA 94035-1000, (Nathalie.A.Cabrol@nasa.gov)

Introduction: Planetary Lake Lander is a project designed to study the impacts of deglaciation on lake ecology and habitat. It utilizes a floating 'Lake Lander' equipped with a payload capable of studying the physical, chemical, and biological state of the lake where it is located. Some of the technology derived and knowledge gained from this project will be applied to future missions that are being developed to land a probe in a lake on Saturn's moon Titan. Observation and investigations of this analog planetary environment were conducted to support the deployment of the Lake Lander proto-type. For the Lake Lander to be able to react to a changing environment, the meteorlogical conditions, variation in discharge from the glacier stream, and topography of the lake bottom where the Lake Lander will be deployed need to be characterized.

1. Laguna Verde and the Echaurren Glacier

Laguna Negra is located to the east of Santiago Chile in the central Andes (33° 38'38"S, 70° 7'32"W) and is fed by the Echaurren Glacier. It is a very large lake nearly 6 km long, 2 km wide and 300 m deep. Over the past decades, the glacier has been receding. The site was selected for the Planetary Lake Lander project because it provides an environment where the impact of deglaciation on lake ecology and biodiversity can help document the effect of climate change on Earth [1-3], and parallels may be drawn to environmental changes in Mars' past [4,5]. Results will therefore help us better understand where and how to seek evidence of past or present life on Mars in future missions. Technologically, the annual fluctuations of this glacier and lake system will allow the further development and training of adaptive systems for robots. The Lake Lander carries a payload analogous to that of the TiME mission for Titan, and will therefore test exploration strategies for planetary lake landers (see abstract by Cabrol et al., #2147).

2. Instrument Deployments

Although there is a meteorological station on the Lake Lander itself, it only charachterizes conditions where the Lander is at the time, which may be subject to local variation due to proximity to water or local topography.

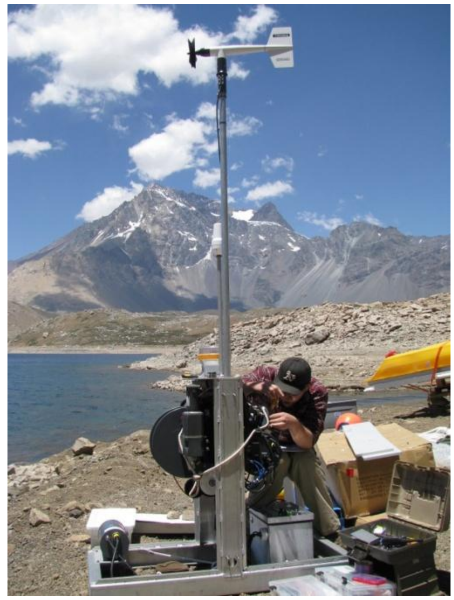

Figure 1: Installing the Lake Lander meteorological station.

For this reason a HOBO meteorlogical station was deployed in an area that is expected to be representative of the overall conditions. The HOBO met station is set to record the environmental conditions every 15 minutes for a year. This station is based upon a 2 meter tripod that is staked into the ground and grounded to prevent inclement weather from impacting its measurement cycle. Over the next year it will measure temperature, relative humidity, photosynthetically active radiation (400-700 nm), precipitation, wind speed, and wind direction. The data logging is done by a HOBO U30 monitoring station, which is powered by a rechargeable battery and a 6 W solar panel. The station was deployed nearly 200 m above the final mooring location of the Lake Lander in Echaurren Valley, in order to obtain representative data of the valley and glacier being investigated. This strategic placement should enable the station to collect data free of the turbulence and wall effects that the Lake Lander will encounter as it explores the deep glacial valley, and will allow a quantitative assessment of the changes in local conditions due to topography.

Figure 2: Meteorological station in Echaurren Valley.

In addition, a custom Greyline Stingray stream gauge was deployed in an outlet stream below a subglacial lake where the stream widens out and flow becomes laminar. It uses forward facing sonar to detect the velocity of the water as it flows over the sensor and upward facing sonar to detect the depth of the water above the sensor. The stream's discharge will be calculated from these two measured variables and knowledge of the channel's geometry. Seasonal and interannual discharge fluctuations will be documented.

Figure 3: Greyline stream gauge in the glacially-fed stream.

One of the critical datesets was obtained from the Eagle brand Fish Finder which was at all times attached to the boat used on the lake. This Fish Finder had the ability to geo-locate and log sonar data, which was then used to generate bathymetric maps of the lake using the software Dr. Depth. Since data was automatically preferentially collected at sampling sites, this allowed us to also generate higher resolution maps at these locations of interest. We focused the remainder of our work on the area that showed scientific interest for the deployment of Lake Lander: an area where glacial water from Echaurren cascades down into the lake. The Echaurren glacier has receded significantly and is now 4 km away from the lake, limiting its interaction with the lake water. The specific selection of the location for the Lake Lander was critical to study the remaining interaction between the melt water (its quantity, physical, and biological characteristics) and the lake water. It was also essential for engineering reasons such as the mooring depth of the Lake Lander and the depth reach of the winch system carrying the multisensor probe. The steep shoreline posed a problem because the mooring lines for the Lake Lander were not long enough to hold the Lake Lander in position only a short distance from the shore. The bathymetric data was instrumental for deciding on the final mooring location. Two landslides were mapped that entered the lake parallel to one another and at an acceptable depth and distance from each other to enable the placement of one mooring anchor on either far side of the slides. This placement ensures that when the prevailing winds would blow north-south the Lake Lander would have to drag its mooring anchors uphill either way making it difficult to move the Lander.

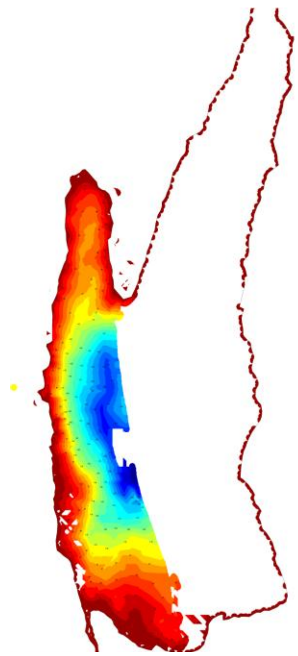

Figure 4: Partial bathymetric map of Laguna Negra

The collected meteorology, stream flow rate, and bathymetry datasets are an integral component of the Planetary Lake Lander deployment, and will evolve and grow with the coming field seasons. In the future we will add a twin met station to our HOBO station at a different locality, an eldonet UV dosimeter, and will complete the bathymetric map of the entire lake.

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