GRANDE
News Letter
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Building a water management system in La Paz, Bolivia

Climate change is a phenomenon that affects the entire world, but its impact on people differs depending on where they live. Some governments have few financial resources to prepare for this global challenge, to adapt to the changes it brings, or to recover from the damage it causes. It is important that all governments have access to the information and technical knowledge that will allow them to make appropriate decisions in dealing with climate change.

Bolivia and neighboring countries have recently suffered from several climate change impact, such as floods, droughts, and water shortages. Many Bolivians are vulnerable to the impacts of climate change, and their wellbeing continues to be at risk.

We need to understand the local impacts of global climate change, how best to tackle them, what decisions we must take to prepare for them, and how to respond when they occur. It is difficult for governments in developing countries to adapt to climate change. We believe that social research undertaken through the GRANDE project can contribute to mitigation of the effects of climate change in Bolivia and neighboring countries. The implementation of long-term planning on the basis of this work can make a valuable contribution to sustainable development for these nations.

The GRANDE project has identified the research needed to address the inevitable effects of climate change in Bolivia and provided direction for both the interpretation of data from that research and its future application. However, the availability of drinking water in the Bolivian cities of La Paz and El Alto is a current and critical problem. Water restrictions in these cities are greatly compromising the quality of life of the people living there. The Bolivian government must take steps to resolve this problem as soon as possible, but it lacks the research data necessary to make projections of the future supply of and demand for drinking water in La Paz and El Alto.

I believe that GRANDE is the first scientific research project that will provide tools and models appropriate to the Bolivian environment that will allow the government to make decisions about mitigation of future effects of climate change and, in particular, to address the availability of drinking water in La Paz and El Alto.

Angel Aliaga,
Professor, San Andres University
Bolivian Project Leader, GRANDE Project

Activity Report

Water quality measurement in Bolivia, Dr. Masago, Tohoku University

As a member of the GRANDE Management Group, I am responsible for quality assessment of current and future sources of drinking water.

Glaciers are a major source of drinking water for about two million people living in La Paz and El Alto, Bolivia. Much like forests, lakes and dams, glaciers can hold huge amounts of water (as snow and ice) for long periods without any deterioration of its quality. So glaciers are very important in water resource management. After the expected disappearance of glaciers during this century, we will need alternative sources for stable and safe water supplies. My task is to investigate existing and future alternative water sources and assess their quality for drinking and other purposes.

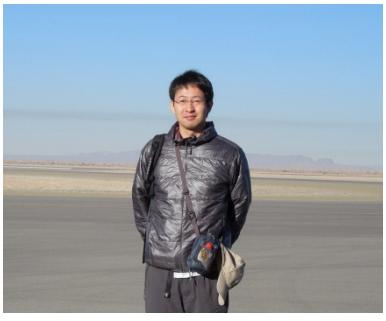
I visited Bolivia to conduct a field survey from 17 to 28 July this year. This was my second visit to Bolivia, so I arrived prepared with medication to combat altitude sickness, and found that I was a bit stronger in the thin air than on my earlier visit.

The purpose of this trip was to investigate the quality of glacial waters. During previous work on this project, we found high concentrations of heavy metals and arsenic in the watershed of the HuaynaPotosi West glacier and in groundwater in El Alto. Both of these are local sources of drinking water. On this visit, we still found arsenic in the watershed of the glacier, but concentrations did not exceed the drinking water quality standards of the government of Bolivia or of the World Health Organization.

We also visited the Choqueyapu River, the main river flowing through La Paz, where we investigated microbial water quality (total coliform and *Escherichia coli* contents). We found that the quality of the river water in La Paz was almost the same as that of wastewater flowing into the wastewater treatment plant in El Alto. Because there are no wastewater treatment facilities in La Paz, the river receives all wastewater generated in the city. The river water is unsuitable for human use of any kind. This means that this growing city must satisfy all of its water needs from sources other than the Choqueyapu River, including the nearby glaciers.

I took a student from my laboratory with me on this field trip. I think it was a great adventure for him because this was his first trip overseas. Unfortunately, he missed seeing the beautiful glaciers because he became ill and had to stay in the hotel during part of our stay. Nonetheless, I'm sure this trip will be a precious memory during his future career as a water resource professional.

Field survey of the Condoriri and the HuaynaPotosi catchment, Dr. Asaoka, Tohoku University



I was with Dr. Masago in Bolivia during the field survey from 17 to 28 July. Our first objective here is to show the remarkable retreat of the Condoriri glacier. The photo on the upper left of the following page was taken in May 2010 when the rock circled in red was in contact with the toe of the glacier. The photo on the upper right, taken during our survey in July, shows the same rock 8–10 m from the toe of the glacier. This amount of retreat of the glacier in the space of two years was a surprise to us. The Condoriri glacier appears to be shrinking faster than we expected. To properly understand

and project glacier retreat, we need to continue to take regular measurements that will to allow us to develop a model of glacial retreat based on scientific insight.

The task of the GRANDE snow and ice group is to improve an existing snowmelt model, which was originally developed on the basis of seasonal snow in Japan, to allow estimation of glacial retreat and melt for the Condoriri and HuaynaPotosi West glaciers. We plan to modify some of the components of the original model and add new components for the tropical glaciers. The purpose of our recent trip was (1) to use a spectral meter to measure albedo around the glacier, (2) to measure the properties of sediments collected from the glacial catchment, and (3) to use a GPS to monitor the retreat of both the Condoriri and HuaynaPotosi West glaciers. The results of our observations will be used to improve and validate the application of our model to tropical glaciers.

We were accompanied during the survey and sampling by Mr. Miyata (the lower left photo) and Mr. Morizawa (lower right photo), both students in the second year of their master course. Their master theses will be based on analysis of the survey data, and they will also submit peer-reviewed papers for publication. They have gained valuable experience by visiting the highest city in the world, encountering a society greatly different from that of Japan. I hope that they will have the opportunity to apply the knowledge they gained on this trip in their consideration of the future outlook for Japan.

Presentation to La Paz City Council and keynote lectures

Four members of the GRANDE project, Angel Aliaga, Edson Ramirez, Yuko Okamura, and Yoshihiro Asaoka, visited the La Paz City Council on 19 July to present a description of the GRANDE project. Javier Mendosa and Yoshihiro Asaoka also were also invited to present keynote lectures on the activities of the GRANDE project at a workshop titled “Adaptation to climate change and protection of water supply in La Paz” conducted by the La Paz City Council on 24 July. Interest in changing water resources in response to climate change is growing in Bolivia. Although there are many ongoing projects on water resources in Bolivia, GRANDE is the only one that considers the role of glaciers for present and future water resources there. Consequently, the GRANDE project is drawing considerable interest in La Paz.

GRANDE Students

Liu Tong, Ph. D student, Tokyo Institute of Technology

My name is Liu Tong and I was born and raised in China. In April 2010, I enrolled as a PhD student at the Tokyo Institute of Technology. Since then I’ve been fortunate to have this great opportunity to be involved in the GRANDE project with the support of JST and JICA through the SATREPS, which I gratefully acknowledge here. I’d like to express my deepest gratitude to my PhD supervisor, Dr. Tsuyoshi Kinouchi, who has given me the chance to pursue a doctoral degree in this important area of research. I’m also extremely grateful to other researchers of the GRANDE project, whose suggestions and encouragement have made an invaluable contribution to my study.

The title of my PhD thesis is “Glacio-hydrological analysis of tropical catchments in the Cordillera Real considering inhomogeneous glacier retreat.” The main objective of my study is to assess future water resources in the Bolivian Andes by means of monitoring glacier change, analyzing water balances, and applying hydrological modeling.

I have used remote sensing data to show that the rate of shrinkage of glaciers in the Cordillera Real increased between 1987 and 2010. Possible factors in this shrinkage include the role of glacier size and the influence of climate change. I defined a “change indicator” parameter to capture the effects of various factors on changes of glacier area. These factors include elevation, slope angle, and aspect. My analysis of the distribution of solar radiation and meteorological conditions at the HuaynaPotosi glacier showed that the period around September is critical, when both glacial melting and evaporation/sublimation are intensive.

Dr. Kinouchi and his laboratory students

I analyzed water balances in the study region and used them to validate some of the factors related to evaporation and glacial melting, which proved to be an accurate and efficient method of identifying deficiencies in the available data. Currently, I am applying a degree-day function based on temperature and solar radiation to calculate glacier melting, taking into consideration inhomogeneous glacier retreat (a key aspect of my PhD). I recently mapped solar radiation, incorporating atmospheric conditions and topographic effects through physics-based formulations and observed data. This method proved to be effective and applicable to tropical glaciers. Moreover, I found that taking into account atmospheric conditions when mapping solar radiation over glaciers and snow allows more accurate evaluation of the accumulation, ablation, melting, and refreezing processes.

My next step will be to use my results to modify a semi-distributed runoff model from a non-glaciated area that considers water storage (groundwater, wetland, and temporary surface storage). Then, my new model can be applied using a general circulation model (GCM) dataset to predict future changes to glaciers and runoff in the study area. These results will also help to differentiate the various components of local water resources, such as glacial meltwater, precipitation, and groundwater.

Japan is leading the way in the development of environmental science, and I now find myself working at the cutting edge of the field. I believe that the completion of my PhD study within the GRANDE project will allow me to turn my personal interests into a professional life, and also put me in a much better position to make a greater contribution as a real researcher in the top research institutes.

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