Community Communications Update: Canada, Venezuela, Chile

MAP:GAC was represented at the 14th World Conference on Disaster Management in Toronto, Canada (June 20-23, 2004) in a booth hosted by Dr. Bert Struik, Manager of the Natural Hazards and Emergency Response Program, and Community Communications Sub-project Coordinator and Project Administrator Mr. Mike Ellerbeck. The theme of this year's conference was "The Changing Face Of Disaster Management – Are We Really Prepared?"

From June 14 to 18, 2004, Dr. Fernando Muñoz (Community Communications advisor) to work with the GeoSemantica Sub Project (see GeoSemantica Update below).

In July, Muñoz, Krauth, and Ellerbeck, along with Dr. Mark Stasiuk, will be in Chile to conduct the Community Communications Case Study workshop and Differential GPS short course.

Mr. Mike Ellerbeck

GeoSemantica Update

Community Communications and Geosemantica group capturing data during the field day trip to the case study area: Matucana, Peru.

The GeoSemantica team has started the development of the ".NET" application code named "Phoenix", scheduled to be delivered along with the servers in March 2005.

The GeoSemantica working group met in Bogotá, Colombia, June 21 – 25 to present on the implementation advances of GeoSemantica in member countries as well as to discuss security issues and future development of "Phoenix". The development team's presentation to the working group highlighted the new architecture and a proposal for securing the digital library.

Mr. Otto Krauth and Mr. Joost van Ulden conducted a workshop in support of the Community Communications Sub-project May 12 – 14 on the use of the application in Lima, Peru, and June 14 – 18th in Caracas and Mérida, Venezuela, to several organizations and partners such as civil defense and government agencies as well as personnel from INGEMMET. The workshop focused on the use of collaboration tools in the application to capture and share data. As a result of engaging other government agencies and partners in the project, the application has attracted a significant amount of traffic. Agencies have adopted the capability of saving and publishing digital maps from the digital library and serving them on their local web pages. Currently we have on register more than 450 custom maps that have been saved.

Mr. Otto Krauth

Landslide Hazard areas in Venezuela and Peru visited by GSC Scientists

View looking south of the rapidly urbanizing alluvial fan of Rio Montalban in the greater Merida area. Parts of the fan are subject to floods and debris flows. Expansion of development into higher parts of the fan and adjacent uplands potentially places homes and businesses in the path of landslides and debris flows.

Dr. Lionel Jackson and Ms. Monica Jaramillo (Geological Survey of Canada and MAP:GAC) recently visited MAP:GAC landslide hazard pilot study areas in Mérida, Venezuela, and Matucana, Peru.

These visits were intended to acquaint Jackson and Jaramillo with MAP:GAC colleagues and their pilot study areas in Venezuela and Peru. They spent May 5 at the INGEOMIN offices in Caracas, where they were introduced to staff and university colleagues by Ing. Elda Perdomo. Jackson and Jaramillo presented a seminar on debris flow hazard problems in Canada. Later that evening, they met with acting Vice Minister of Energy and Mines, Ing. Orlando Ortegano, and other senior government colleagues. On May 6, they flew to Mérida where they attended a meeting of INGEOMIN colleagues with representatives from local civil defense organizations. Their seminar on investigation of debris flow hazards was again well-received. During a field tour of the pilot project area, the increasingly urbanized Río Montalban basin, Jackson and Jaramillo examined deposits of prehistoric debris flood events in the area of the confluence of Río Chama and Río Montalban. Higher in the basin, their Venezuelan colleagues showed them extensive angular and bouldery deposits obscured by a young forest. This suggested to Jackson that a rock avalanche might have affected the upper basin in recent years. On May 8, both participated in a meeting (facilitated by Jaramillo) to chart the course of the pilot study over the coming year.

Jackson and Jaramillo continued on to Lima, Peru, on May 9, where they completed two days of field trips in the Andes Occidental east of Lima with Peruvian colleague Ing. Lionel Fídel of INGEMMET. The field party examined debris flow and other landslide hazards along Carratera Central and Ferrocarril Central, and toured the Matucana – Quebrada Payhua pilot study area. Of particular note was a visit to the abandoned mining village of Tambo de Viso east of Matucana, which was devastated by debris flows during the 1997–1998 El Niño. In the drainage basin of Quebrada Payhua, Jackson and Jaramillo were shown a large active landslide that could potentially block the course of Quebrada Payhua. Next, on May 13, they participated in a general field trip to the Matucana area that included engineers, social scientists, and civil defense workers. This was followed on May 14 by a planning meeting led by Fídel for the geoscience component of the pilot study.

Jackson and Jaramillo found the pilot study areas in both countries to be excellent choices for investigation of landslide hazard potential. The results should have extensive applicability in surrounding regions. Jackson and Jaramillo look forward to longer periods of collaborative fieldwork in August (Venezuela) and September (Peru).

Dr. Lionel Jackson

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Geoscience for Andean Communities

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Manager's Desk
July 2004

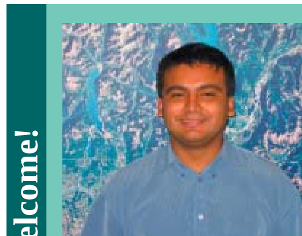
June for Canadians is the month we all start thinking about summer holidays – the days are finally getting to be long and hot (by Canadian standards!). One of the great things about MAP:GAC for Canadians is being able to experience summer in South America during our winter – but that still doesn't make up for a week or two of rest and relaxation. Summer in Canada (July and August) is a short, ephemeral time, so don't be surprised if some of us "disappear" for a couple of weeks, myself included.

As most of you already know, MAP:GAC staff have been rescheduling activities and reprofiling the budget. When you read this, the National Directors should have already received Report #9, which gives the revised budget and work plans. The other occupation for me this month has been reviewing, revising, and updating the Implementation Report. This report contains the philosophy of the project, guidelines for administration, and the roles and responsibilities of the participants. It was signed off in Lima, Peru, on September 24, 2002, but because of required changes to the Logical Framework Analysis, needs updating.

Now that the Implementation Report update is completed (in English) it will be sent for translation. After translation, circulation to the countries will begin, requesting input and comments of the National Directors, Project Leaders, and Coordinators. The most substantive changes are the addition of guidelines for the extraordinary travel funds, an expanded risk analysis, and a section on gender. Other changes reflect the new Logical Framework Analysis (LFA), such as a reworded section on the goal and clarification of purposes and outcomes. The Implementation Report will be used as the basis for the memoranda of agreement (MOUs) now being drawn up between CIDA and the participating countries. Also included in the MOUs will be revised work plans, based on what is currently in our project management system. Over the next six weeks, members of the Vancouver MAP:GAC team will be in touch with each of the country Project Leaders and Coordinators to ensure that the work plans correctly reflect what each country is doing and plans to do, and that you are satisfied with them as the basis for the official MOU between CIDA and your country.

Dr. Catherine Hickson

Welcome!



Mr. Oscar Cerritos

Mr. Oscar Cerritos, a physical geographer specializing in Spatial Information Systems (including GIS and remote sensing), has recently joined the Vancouver MAP:GAC team. He will be working in close support of Dr. Mark Stasiuk in remote sensing and differential GPS (dGPS), as well as seismic and geophysical studies. Cerritos has already accompanied Stasiuk on a MAP:GAC field assignment in Ecuador. We welcome him to the Project.

Natural Hazards in the Puente del Inca Region of Mendoza, Argentina

Figure 1: Location Map.

Introduction

The town of Puente del Inca, at 2719 m elevation in the midst of the Cordillera Principal, is located 195 km east of the city of Mendoza on the international highway that connects Argentina to Chile, also known as the bi-oceanic corridor. This small community's population increases in the summer months as merchants come to serve tourists and locals alike visiting Aconcagua and the 'natural bridge' (Puente del Inca) over the Cuevas River. Until 1965, the Puente del Inca Hotel & Spa was frequented by tourists from all over the world who came to the 'healing' hot springs.

Study Objectives

Historic records reveal that the Puente del Inca area has mainly been affected by snow avalanches and rockslides or falls, both products of the steep slopes of the valley. The best example occurred in August 1965 when a snow avalanche destroyed the Puente del Inca Hotel & Spa. Similarly, a snow avalanche in 1985, which originated in north Banderitas Norte, devastated two houses at the foot of the slope, killing five people trapped inside. These slides and rock falls on the north side of the valley are a concern for the Argentine Army, which maintains a local base at the toe of the slope.

Because the small amount of urban growth has occurred under provincial authorities, through the Ministry of Territorial Planning and Urban Development (DOADU), and has been developed to deal with urgent needs, it exhibits more of a random pattern than an organized land-use plan. The primary need is to find a definitive housing solution for families now living in the old Trans-Andean General Belgrano Railway buildings, before the line re-opens. The second priority is the relocation of the artisan stalls to improve access

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to and visibility of the natural monument. Thus it is necessary to analyze natural hazards that affect the area soon, so that appropriate locations for the construction of new structures can be identified before further development.

Geologic and Geomorphologic Framework and Active Geologic Processes

The town of Puente del Inca is situated in a glacially carved valley, now the course of the Cuevas River. According to Ramos and others, the local geology is characterized by three main stratigraphic sequences: pre-Jurassic basement, a Mesozoic sequence, and Cenozoic cover with associated volcanic rocks. The structural environment is that of a fold and thrust belt. Formation of the Cuevas River valley began during Miocene – Pliocene uplift as erosion acted on the rising mountains of the Cordillera.

During the Pleistocene there followed various glacial stages, each ending in a deglaciation and separated from one another by an interglacial period. Successive glaciers expanded and sculpted the characteristic deep U-shaped valley. The local relief, created by a mantle of ice that has since receded, has been modified only slightly by the processes of periglacial weathering, gravitational movement of debris, and running water. The latter effect has caused aggradation in the valley bottom as the Cuevas and Horcones rivers carry material from the receding glaciers, determining the glaciofluvial deposit levels.

Valleys like those of the Cuevas and Mendoza rivers provide limited areas of adequate accessible land situated at relatively low levels, as they are the natural passes across the Cordillera. Thus they are the locations of the most important highways and the few population centers in the mountains. Nevertheless, the steep valley walls create numerous natural hazards that affect the highways as well as the villages. In the case of Puente del Inca, the two main hazards are:

- Snow avalanches, which have caused fatalities and material damage to the village in the past century. The southern slope is less dangerous than the northern slope due to its greater exposure to the sun. Historic records show that the most destructive avalanches usually take place toward the end of winter.

- Rock falls and rockslides probably constitute one of the main mechanisms of erosion and transport on the slopes in the area of Puente del Inca. After snow avalanches, rock falls are one of the higher impact natural hazards, evident in the geomorphology and history of the area. These phenomena are favoured by the high relative relief, steep slopes with tectonically fragmented rocks, cliffs with intercalation of friable and resistant rocks, and cold climate conditions that favour cryogenic and/or cryoclastic erosional processes.

Other natural hazards that occur with less frequency, or which only indirectly affect the area, are considered less dangerous, but also should be analyzed, and include:

- The Horcones drift, defined by Pereyra and Gonzalez Diaz in the 1990's as rapid flow material originating in a landslide, or as a collapse of glacial deposits.
- Growth associated with the fracture of natural dykes produced by landslides above the Horcones River.
- High volume flows associated with lateral expansion in surrounding areas.

Figure 2: View of the locality of Puente del Inca and the natural bridge.

Figure 3: A groove produced by the recent fall of a block from a dacite cliff.

Work Completed

SEGEMAR has been working in the bi-oceanic corridor for several years; and work completed in the area includes the following:

- Map sheets at a 1:250,000 scale for Mendoza, Cerro Aconcagua, and Cerro Tupungato
- Map sheets for Potrerillos, Uspallata, and the geological map of the Aconcagua Region at a scale of 1:100,000
- Hazard map of Mendoza at a scale of 1:250,000
- A study of mass movements was carried out using the geologic map sheet of Potrerillos, and the results published in the *Contribucion Tecnica de SEGEMAR* in an article called "Rock avalanches associated with neotectonics in the Mendoza river valley and their associated geological hazards".

MAP:GAC supported all of this research, and the information was then transferred from the regional scale to focus on concrete problems of Andean communities. Within the Project the following has been done:

- Compilation of a geologic map of the bi-oceanic corridor at a scale of 1:100,000
- Preliminary mapping of the Puente del Inca area at a scale of 1:25,000. Within this framework, fieldwork has allowed for the creation of geomorphological, lithological, and structural maps of active processes at a scale of 1:25,000. Similarly, a study is now underway to define the areas and associated frequency of snow avalanches. Data from previously known and documented natural processes that have caused damage are being entered into a Hazards Database as part of the work of Argentina's Ministry of Environmental and Applied Geology. A detailed topographic base is being used with PCI, software that uses scanned aerial photographs and a grid of points located through a satellite positioning system, by means of two fixed base stations and one mobile station.

The superposition and combination of the different thematic maps will finally come together to create a natural hazards map for the area of Puente del Inca. This map will be a useful tool enabling specialists in land-use planning to define the type and location of new construction.

Future Work

The Argentine side of the bi-oceanic corridor is very extensive and there are many natural hazards along it. Because of this, the amount of work to be done is immense and must be prioritized by area within this large region. It is because of this that work thus far has focused on the area of Puente del Inca (at the request of the province of Mendoza) and on the avalanches to the south of Uspallata due to the high local hazard levels, and because studies there can be applied to a broader area. For the Puente del Inca locale, the final objective is to make a hazard zoning plan, for which the following tasks remain to be done:

- To take measurements of the heights of source areas of mass movements, and the mean angle of slope runouts to determine the extent of the areas to be protected from construction.
- To create a slope stability map.
- To compile a hazard zonation map that is also linked to snow avalanches.
- To define conclusively the problematic Horcones drift. This work requires radiometric, morphologic, and sedimentologic analyses to define the problem.
- To apply DAN-W to model the lateral expansion flow, using profiles taken from the 1:10,000 scale map, once it is complete.
- Finally, with all this information, a natural hazard map of Puente del Inca should be constructed.

In relation to the avalanches to the south of Uspallata, work is very advanced, and should be concluded with radiometric analyses in order to obtain paleoseismicity data (and dates) and determine the relationship between avalanches and climatic change. These should then be finalized by assigning an associated level of danger in the different areas.

Community Communication

The first community communication workshop took place in Mendoza in December 2003. This established the basis for future work with the local communities. Similarly, geologists carried out fieldwork in December 2003, and at the beginning of 2004 took personnel into the field from the VIII Mountain Infantry Regiment and the National Highway Administration, two groups who were supporting the work and who are very interested in the geological and hazard studies in the area.

Lic. Luis Fauqué, Ing. Mario Rosas, and Ing. Valérie Baumann

Further Reading:

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Irigoyen, M. V., Brown, R. L., and Ramos, V. A., (1993), The Central Andes active thrust front; Mendoza Province, Argentina, in Geological Association of Canada; Mineralogical Association of Canada; annual meeting; program with abstracts, Edmonton, AB, CAN, p. 47.

Pereyra, F.X., (1993), Geomorfología. en Geología de la región del Aconcagua. Subsecretaria de Minería de la Nación, Dirección Nacional del Servicio Geológico, Anales 24 (3): 423-443, Buenos Aires.

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MAP:GAC at NATO Landslide Dam Workshop in Kyrghyz Republic

MAP:GAC's Dr. Reginald Hermanns attended a NATO Advanced Research Workshop entitled "Security of Natural and Artificial Rockslide Dams" held in Bishkek, capital of Kyrghyzstan, June 8–13, 2004. It was the first international scientific meeting to bring together engineers working on blast-fill dam construction and geologists focusing on landslide research. A total of 48 of the leading specialists from NATO and former Soviet Union countries, as well as four neutral countries, discussed security issues of natural landslide dams and defined topics of future research in this field. A state-of-the-art book on this topic will be edited and published in 2005 within the NATO Science Series.

Dr. Stephen G. Evans of Canada's University of Waterloo (and formerly of the Geological Survey of Canada), the workshop co-director from NATO countries, highlighted in the opening session the enormous hazard associated with landslide damming and catastrophic dam breaching causing the world's largest landslide disasters. Although valley impoundments with a volume of 4x109 m^3 are frequent on a world-wide scale, with a rate of roughly 1 per 10 years, and outburst floods from natural lakes with a volume greater than 40x106 m^3 recur just about as often, awareness of this hazard is not given as much consideration as safety concerns and hazards related to breaching of artificial dams. Only 7 breaches of artificial dams having such large volumes occurred in the last century, three of which were related to military actions, thus placing the stability of artificial dams in the political forefront, compared to concerns about natural dams.

From the MAP:GAC team, Hermanns participated as independent co-director of the workshop, focusing with his contributions on the Argentine Andes. Landslide dams are frequent phenomena in Argentina, and giant outburst floods have occurred in historic and prehistoric time; the historic Río Barrancas outburst flood (1914) represents one of the world's largest historic water releases, with 1.5x109 m^3. In addition, case studies from the Argentine Andes indicate that the Andes represent an ideal natural laboratory for studying these phenomena, and that much can be learned on a world-wide scale from this unique mountain chain that crosses all climate zones. For example, from only few case studies from Argentina, it is evident that the landslide dam classification system used on a world-wide basis during the last 20 years has to be revised for a better understanding of dam/valley interrelations and morphology and their influence on landslide dam stability.

Dr. Reginald Hermanns

Further reading:

Hermanns, R.L., Naumann, R., Folguera, A., & Pagenkopf, A. 2004. Sedimentologic analyses of deposits of a historic landslide dam failure in Barrancas valley causing the catastrophic 1914 Río Colorado flood, northern Patagonia, Argentina. In: International Symposium on Landslides, in press. Rio de Janeiro.

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