Assessing changing water quality in Peru due to glacial recession
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Abstract
As concerns over future access to fresh water are beginning to spread in the United States, other more vulnerable regions like western-draining Andean watersheds in Peru are already feeling the effects of climate change on drinking water. Here, the glacial peaks of the Andes buffer seasonal contrasts in stream runoff. However, these glaciers are now receding faster than ever before, and scientists have already recorded significant reductions in the water they supply to rivers. Furthermore, some streams have also been found to have adversely high acidity and potentially toxic concentrations of certain heavy metals. Many such streams are used in agricultural irrigation. To test the extent and source(s) of river water contamination in Peruvian glacier-fed streams, surveys were undertaken during three consecutive dry seasons (June-July). 2011-13, to analyze the concentrations of various dissolved metals and isotopes along the Santa River draining the Cordillera Blanca to the Pacific coast. I joined the sampling survey during three weeks of June-July 2013, and I am now measuring dissolved concentrations of 32 different metals from over 60 sample locations in the Santa River watershed. Other researchers in my group are measuring the metal concentrations within the suspended sediments, and at the bottom of the river bed. These results will be compiled and compared against two previous surveys (2011, 2012), with a focus on certain toxic heavy metals such as lead, cadmium, and arsenic, which are dangerous to human health if found above levels set by the World Health Organization. The goal of this research is to note any trends occurring in the concentrations of these metals. I hypothesize that the change in concentrations of metals will be correlated to their reactivity's and their atomic weights.

Methods
Water samples were taken in Peru during the 2013 field season using the “Clean Hands/Dirty Hands” technique. The samples were filtered into sterile 50 mL LDPE bottles. Sample contamination in the field was checked through the use of three “test” water samples. The concentrations were determined through inductively coupled plasma mass spectrometry (ICP-MS) at McGill University. Six standards of known concentration were used to determine the concentrations while accuracy was checked every 8th sample through a standard and blank test.

Results

Histogram detailing the distribution of specific metals
- Consists of toxic metals (As, Cd) and those most prevalent in the Rio Santa
- Average concentration of As and Cd are 6.7 ppb and 0.4 ppb (µg/L).
- The World Health Organization lists the maximum benign concentration of these metals as 10 ppb and 3 ppb, respectively.
- The metal concentrations trend upwards as there are no concentrations present at 1.5 or 2 standard deviations away from the mean

Pearson Correlation Coefficients
- The Pearson Correlation calculates a linear relationship between two variables
- Co and Ni have the strongest linear dependence, with an r value of 0.927.
- These metals are the most closely related in terms of both atomic weight and reactivity in the data set
- A pairing with a coefficient of at least 0.65 (linear variability of at least 42%) results in a significance of 95%.

Discussion
- The Pearson Correlation suggests that there may be a link between a metal’s weight, density, and its concentration trends. However, the data remains inconclusive.
- The lack of normal distribution of metal concentration displays the broad range of factors that affect metal concentration in a given point on the Santa River, and the remaining work to be done in this project to have a better understanding of these factors.
- Some of the factors which could not be accounted for within the scope of this project include changes in concentration due to additions to the river, changing composition of the river bed, and changes in properties of the water such as temperature and pH.
- There is no evidence of a general increase or decrease in metal concentrations as one moves further downstream. Further suggesting that there is a large influence on the metal concentrations by unexamined sources.

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References