# Initial development of a citizen science-based river flood monitoring and forecasting for the Rimac River in Lima Peru

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**Abstract** The present study describes the initial efforts of building a citizen science-based monitoring river system for flood forecasting in the Rimac River located in Lima, Peru, a city that is severely affected by flooding during El Niño events. This system will be based on videos recorded of the Rimac River taken by regular citizens when the water rises , the videos will be processed to obtain useful results to alert the population in the case of flooding. Videos were recorded at three bridges along the Rimac River and were processed using Large Scale Particle Image Velocimetry (LSPIV) to obtain corresponding flowrates. Results were compared with official data from Hydrometric stations.

**Keywords:** LSPIV, citizen science, El Niño, Rimac River.

## Methods

1. **Field data collection**

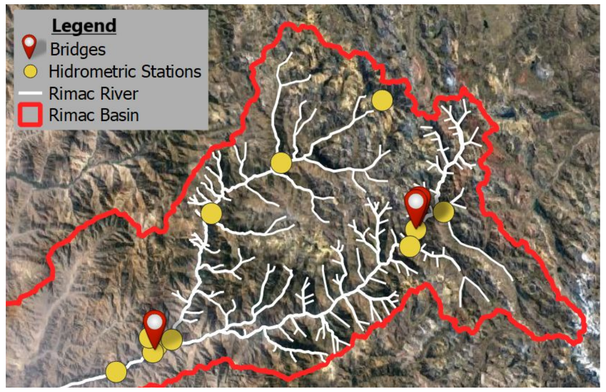


**Figure 1:** Study sites at Rimac basin

- Four equidistant control points in the river bank
- Addition of sawdust particles to enhance accuracy on the video processing.

**Figure 2**: San Mateo river with a) natural tracers and b) artificial tracers

2. **Data analyzing**

- Large Scale Particle Image Velocimetry (LSPIV) analysis of the recordings to extract mean velocity of the river.
- Application of a velocity index (0.85) to convert free surface velocity into mean velocity.

## Results

The flowrates obtained are shown in Table 1 and compared with the official values provided by a nearby hydrometric station managed by The National Water Authority (ANA, by its acronym in Spanish).

**Table 1**: Flowrates at each measurement point ($m^3/s$)

| Bridge | Natural tracers | Artificial tracers | Hydrometric value |
|---|---|---|---|
| San Mateo 1 | 9.49 | 10.93 | 11.62 |
| San Mateo 2 | 6.08 | * | 11.62 |
| Chosica | 25.34 | 16.70 | 22.00 |

**Table 2**: Error of the measured and hydrometic values

| Bridge | Absolute Error | | Relative Error (%) | |
|---|---|---|---|---|
| | Natural tracers | Artificial tracers | Natural tracers | Artificial tracers |
| San Mateo 1 | 2.13 | 0.69 | 18.3 | 5.94 |
| San Mateo 2 | 5.54 | * | 47.7 | * |
| Chosica | 3.34 | 5.30 | 15.2 | 24.1 |

*Video was not recorded because sawdust could not be thrown from the bridge.

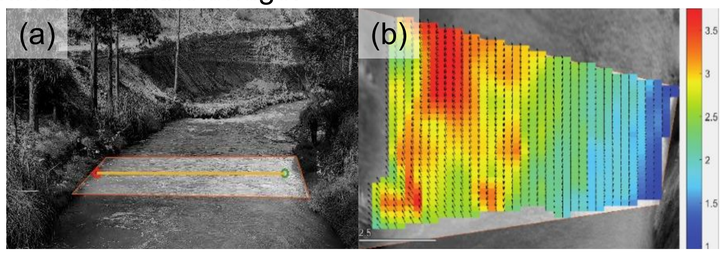


**Figure 3**: (a) Cross section of the original image (b) Vector and magnitude velocities of the rectified image.

## Conclusions

To create a system that is based on citizen participation, the communities that live along the Rimac River must be informed about their role on prevention. The system is accessible and practical and can be scaled to enrich the database. Another approach that will enhance the system is to install more LSPIV camera chambers. This will generate an interconnected network of all the data that can be correlated with other hydraulic and environmental attributes to validate the system with greater precision. As future research plans, a hydrodynamic model in HEC-RAS will be developed to predict flood propagation along the river network and estimate the most affected sections. Furthermore, the final aim is to develop an application that achieves the automatic processing of the videos to maintain an active response to the population needs.

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