

# Laser Ranging and GPS Measurements to Misti, Chachani, Pichu Pichu Volcanoes and Surrounding Hills, and Applications of Precise Positioning to Monitoring of Volcanic Deformation and Seismic Risk

P. R. Yanyachi<sup>1</sup> and D. R. McCormick<sup>2</sup>,

<sup>1</sup>TLRS-3 NASA/Universidad Nacional San Agustín – [raulpab@unsa.edu.pe](mailto:raulpab@unsa.edu.pe),

<sup>2</sup>GSFC NASA – [david.r.mccormick@nasa.gov](mailto:david.r.mccormick@nasa.gov).

San Francisco Hill w/n Characato Arequipa-Peru

Phone 51-54-448211, Fax 51-54-448418, e-mail [t3mgr@unsa.edu.pe](mailto:t3mgr@unsa.edu.pe)

**Introduction.** The city of Arequipa in Peru, site of the TLRS-3 SLR Station, is located in the valley of Arequipa, straddling the south slope of the Cordillera Occidental, and the north edge of the Arequipa depression, within a complex extensional and strike-slip faults in a tectonically active region associated with the subduction of the Nazca Plate under the South American plate. The nearby presence of Misti volcano, the most recently active edifice of a cluster of Pleistocene volcanoes, along with Chachani (dormant) and Pichu Pichu (extinct) has inspired numerous studies to monitor volcanological and seismic conditions in the area. The existence of a Satellite Laser Tracking station at the Observatory of Characato in Arequipa-Peru, operating under an Agreement of Scientific Cooperation between NASA and UNSA, allows us to envision the possibility of proposing a variety of local research projects involving academic institutions and research centers in Peru. Additionally, the existence of a zero order GPS station allows GPS positioning studies to take place. Since 1959, the various geodetic techniques at the site have evolved. Qualified staff currently running operations at the Satellites Laser Tracking station can significantly contribute with their participation in this mission. We are contemplating using a variety of geodetic techniques to obtain very accurate remote positioning measurements of the volcanoes in the area, and the surrounding hills. With help from NASA and their authorization to incorporate a few minor modifications into programming routines currently used by the TLRS-3 station in the screening process, and taking advantage of already planned upgrades to the current TLRS-3 system, monitoring selected points using laser ranging could be performed. Safety is an important consideration, since the line of sight to the selected points will involve elevations of up to 2 degrees for the surrounding hills, and up to 6 degrees for the volcanoes. Results of these monitoring efforts can be used to contribute to studies that aim to correct SLR observations for tectonic effects that may render them less useful for geodetic applications.

## References:

[1] *Transportable Laser Ranging System (TLRS-3/4) Technical Manual (1999) NASA Satellite Ranging Program, GSFC Greenbelt MARYLAND*