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Establishment of High Accuracy Permanent Global Positioning System (Gps) Station for Earthquake Studies at Multi-Parametric Geophysical Observatory (Mpgo), Imphal

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Abstract

The Earth has several major plates and dozens of minor plates. Plates are either ocean plates, composed of ocean seafloor, or lighter, thicker continental plates. Due to the spinning, rotation and lithosphere activities of the Earth, these plates are moving, which causes volcanoes, earthquakes, drift, landslides etc. The movement of the plates also affects the accuracy of maps for the region. So there are many advantages to understand movements in the plates and their consequential effects on the development in their own land. The north eastern part of India is known to be one of the most seismically active regions of the world. Thus the area is prone to natural calamities like earthquakes which lead to the crustal deformation in the region. The Global Positioning System (GPS) has been most useful to study the Earth's crustal movement [1,2]. A brief description of Permanent Global Positioning System (GPS) permanent continuously monitoring station in Multi-Parametric Geophysical Observatory (MPGO), Imphal of Manipur University, data processing and analysis and result as a case study are presented in this paper.

Keywords: GPS; Crustal deformation; Imphal valley; MPGO

GPS site, data processing and analysis

The continuously operating GPS permanent station at Multi-Parametric Geophysical Observatory (MPGO), Imphal (Figure 1) was installed in 2014. The station is located on a hill within the campus of Langthabal Khoupum, Imphal West. The station is located on a pillar approximately 7 m high and is rooted in the outcropping Disang formation. It is equipped with a Net R9 receiver and a Trimble Choke ring antenna. The Antenna is fixed on an 8 feet high RCC pillar and the receiver and battery are housed in a small nearby shed. The receiver is powered by the AC as well as through batteries which are charged using the solar panels (Figure 2) operational from September 2014.

The GPS data obtained from the site have been converted into RINEX observation files and quality check was performed using TEQC (Translation, Editing and Quality Checking Software). The quality check plots of all the GPS data were carefully examined and the data with high cycle clips, multipath and of duration with <18 hours observation were removed from the analysis.

Figure 1: Permanent GPS Station at Multi-Parametric Geophysical Observatory (MPGO), Imphal.

The processing of the GPS data from station is routinely performed at Department of Earth Sciences Manipur University using the GAMIT/GLOBK software [3-5]. Data from IGS (International GPS Service) sites, namely, BAHR, IISC, HYDE, LHAS, KIT3, KUNM and POL2. These data were processed on daily basis producing loosely constrained station coordinates and satellite orbits. These were further combined with loosely constrained solutions of globally distributed nearby IGS station data available from the Scripps Orbital and Positioning Analysis Centre (SOPAC; http:garner.ucsd.edu). Using the GLOBK software [3], position estimates and velocity stabilization in ITRF08 were achieved [6].

Results and Conclusion

Time series 2016-2018 of IMP1 site is shown in Figure 3. In the time series north component shows deformation 21.1±0.5 mm/yr, east component shows deformation 30.2±0.5 mm/yr.

In ITRF2008 reference frame the IMP1 site shows a velocity of 36.3 mm/year towards N55° (Figure 4). This velocity is significantly less than the velocity of Indian plate which is about 52 mm/year towards N52°. We use the Euler pole estimated by Banerjee [7] (2008) for representing the Indian plate motion. In Indian reference frame, the IMP1 site moves at a velocity of about 16.7 mm/year towards N222°, i.e. towards southwest (Figure 5).

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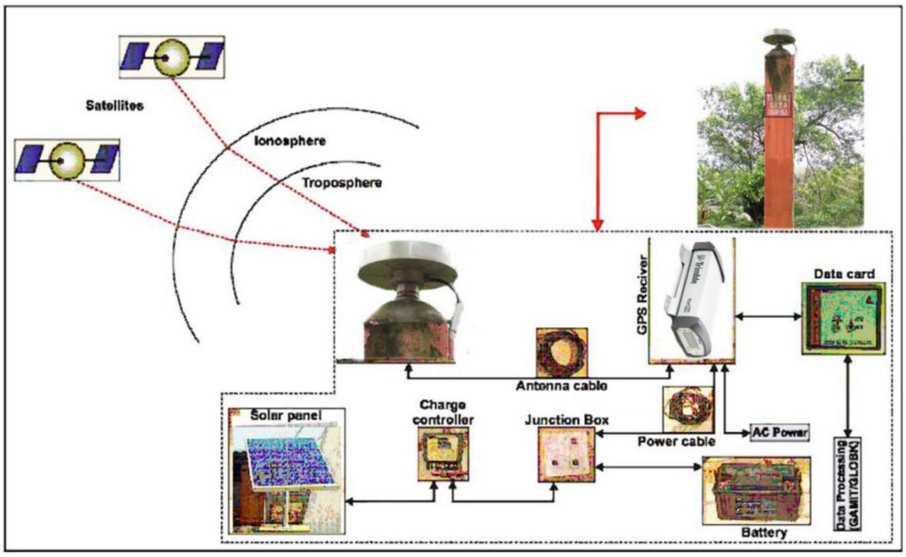

Figure 2: Schematic representation of GPS Permanent Station, GPS instrument and its associated flowchart.

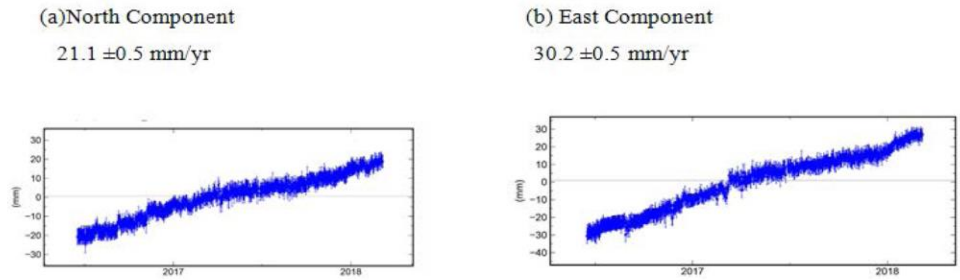

Figure 3: Time series at IMP1 in ITRF2008.

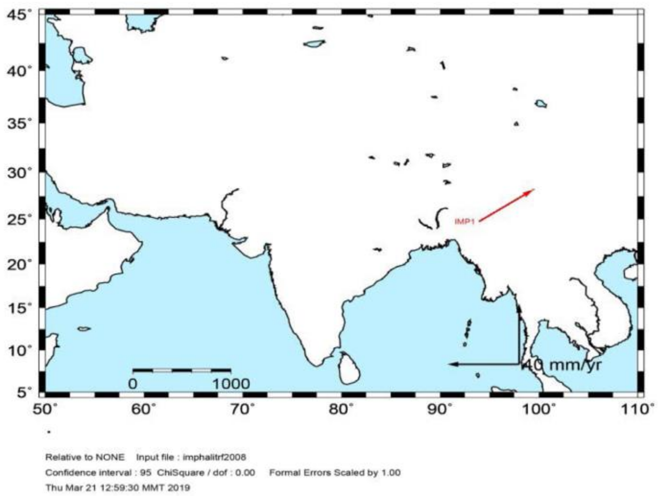

Figure 4: Velocity plot at IMP1 in ITRF2008.

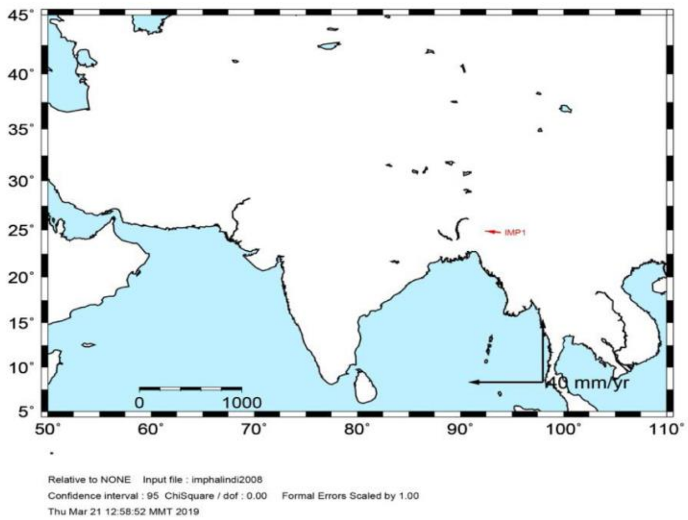

Figure 5: Velocity plot at IMP1 in Indian reference frame.

It implies that the difference in motion between the Indian plate and the IMP1 site is accommodated somewhere west of the IMP1 site. One of the immediate deductions from these results is that the site IMP1 is not located on the Indian plate. The site is actually located on the Burma plate and the velocity with reference to the Indian plate provides a constraint on the motion accommodated at the plate boundary fault located between the India and Burma plate [8].

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