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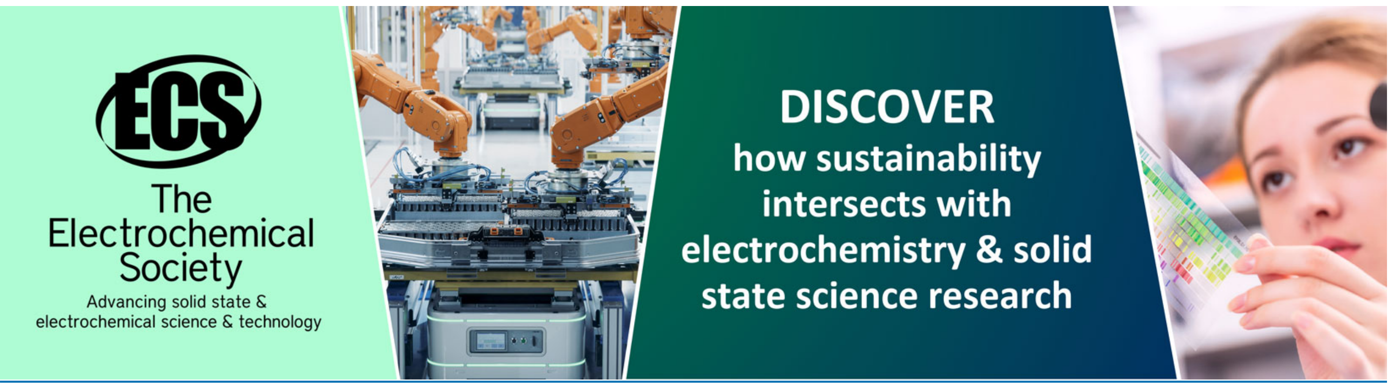

Strain Variation along Cimandiri Fault, West Java Based on Continuous and Campaign GPS Observation From 2006-2016

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Abstract. The Cimandiri fault which is running in the direction from Pelabuhan Ratu to Padalarang is the longest fault in West Java with several previous shallow earthquakes in the last 20 years. By using continues and campaign GPS observation from 2006-2016, we obtain the deformation pattern along the fault through the variation of strain tensor. We use the velocity vector of GPS station which is fixed in stable International Terrestrial Reference Frame 2008 to calculate horizontal strain tensor. Least Square Collocation is applied to produce widely dense distributed velocity vector and optimum scale factor for the Least Square Weighting matrix. We find that the strain tensor tend to change from dominantly contraction in the west to dominantly extension to the east of fault. Both the maximum shear strain and dilatation show positive value along the fault and increasing from the west to the east. The findings of strain tensor variation along Cimandiri Fault indicate the post seismic effect of the 2006 Java Earthquake.

Keywords: The Cimandiri Fault, GPS, Strain Tensor

1. Introduction

The convergent motion of the Australian and the Eurasia Plates results subduction at the Sunda Arc. This subduction zone process imposes tectonic stresses on the fore arc region offshore and on land of Java thus causes the formation of earthquake fault zones to accommodate the plate movement [1]. There are faults in-land Java to accommodate that plate movement; Cimandiri fault, Lembang fault, and Baribis fault.

The Cimandiri fault is located in Sukabumi, West Java, which runs in the direction from Pelabuhan Ratu, passing Sukabumi, Cianjur and Padalarang [1]. According to [2], Cimandiri is a sinistral strike-slip fault with the axial direction of some N150ºE trending folds in the southeast turn clockwise while those to the northwest turn anticlockwise (**Figure 1**). Geologic evidence indicates that Cimandiri fault is active fault. Several previous earthquakes such as Pelabuhan Ratu earthquake (1900), Cibadak earthquake (1973), Gandasoli earthquake (1982), Padalarang earthquake (1910), Tanjungsari earthquake (1972), Conggeang earthquake (1948), and Sukabumi earthquake (2001), occurred along the Cimandiri fault [1].

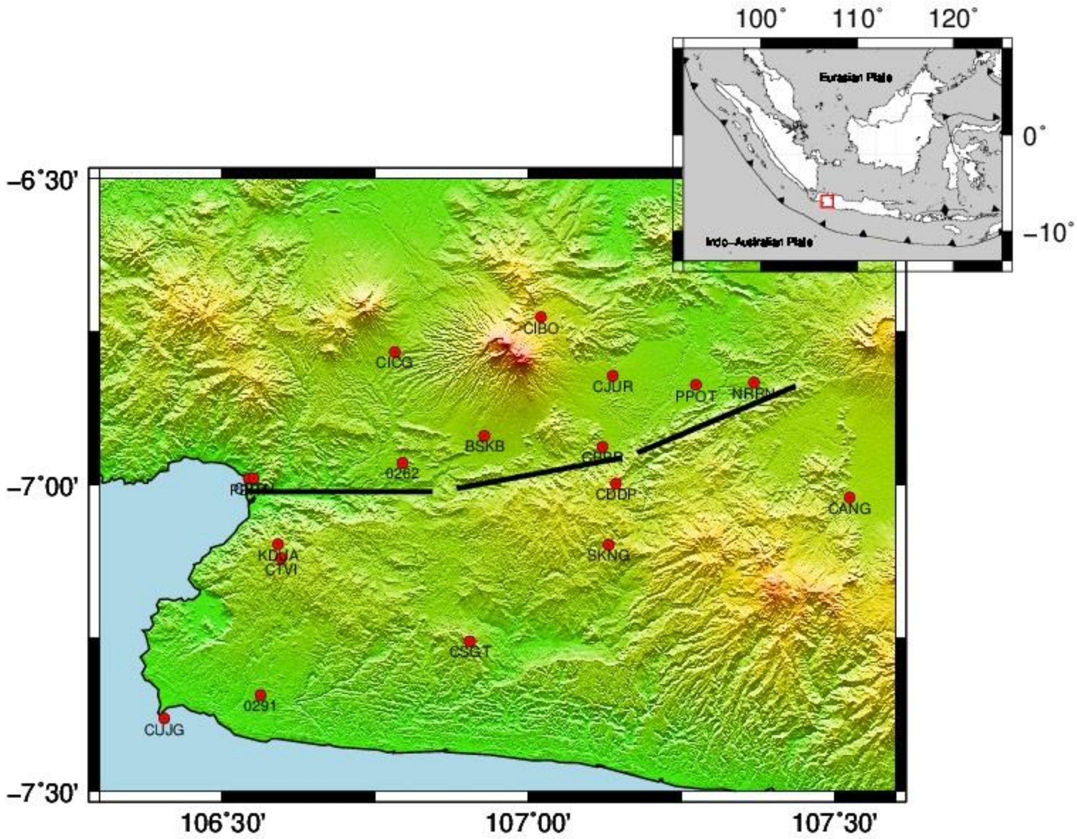

Figure 1. Location of Cimandiri Fault and the surrounding GPS stations indicates by red point. Solid black line indicates the main fault line.

By using continues Global Positioning System (GPS) and campaign GPS measurement, the strain is estimated along the Cimandiri fault. The surrounding GPS stations are very important to show the tectonic activities which influenced to the research area since the campaign GPS data was taken soon after the 2006 Java earthquake. The campaign GPS data were taken by Geodesy Research Division of Bandung Institute of Technology showed a significant signal of post seismic deformation of the 2006 Java earthquake [1]. According to Gunawan et al (2016), the post seismic of the 2006 Java earthquake also affected BAKO station which is located in distance about 440 km from the earthquake epicenter. Therefore, the aim of this research is to obtain the activity of the Cimandiri fault indicates by the strain pattern around the fault and the other tectonic activities which might influence the surrounding fault area.

2. Data and Method

This research combined two kinds of GPS monitoring. Continuous GPS stations cover entire fault zone which located in far distance of the fault. Campaign GPS stations cover area near fault line. The continuous GPS data are provided by Geospatial Information Agency of Indonesia (BIG) existing data from 2008 to 2015 whilst campaign GPS data were observed by Geodesy Research Group of Institute

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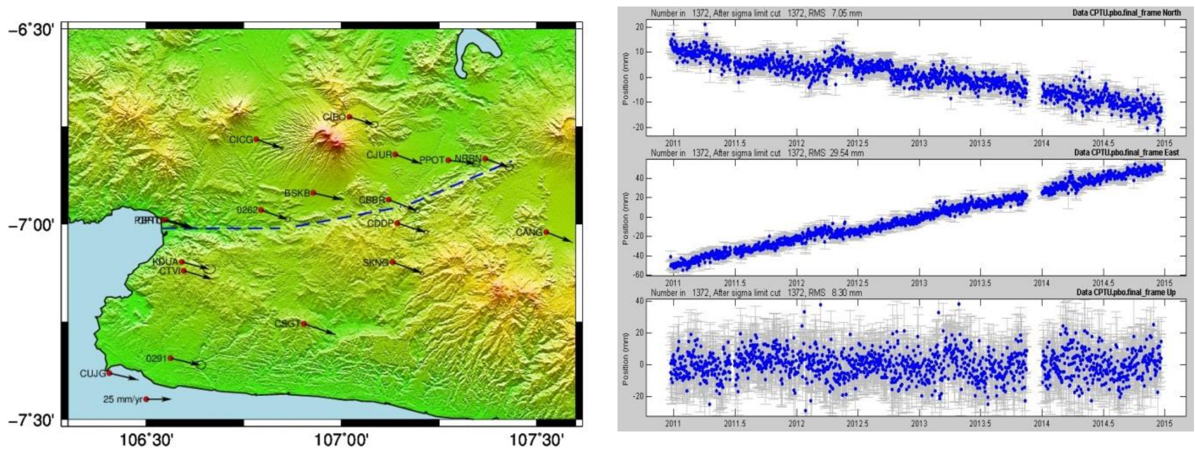
of Technology Bandung in collaboration with Center for Volcanology and Geological Hazard Mitigation in year 2006 to 2016.

The GPS data processing is done using GAMIT/GLOBK software [3, 4]. We used surrounding IGS stations around the research area to fix the preliminary coordinate results in ITRF2008 within 95% confidence level. Since the GPS stations located in Sundaland block, the effect of the Sundaland movement should be removed. We applied reference frame transformation from ITRF2008 to ITRF2000 using transformation parameters by [5]. The calculation of Sundaland block motion and rotation is applied by using parameters by [6].

The strain tensor is calculated within a GPS Delaunay triangulation which every triangle defined as discrete rigid body. The continuum model is applied into calculation to obtain the result of principal strain rate as the representation of tectonic activities within the area [7].

3. Results and Discussion

To produce the strain tensor within the area, we used the result of the velocity field of related GPS stations. The velocity field (**Figure 2**) clearly shows the movement of related GPS station to the southeast direction with varying magnitude around 25 to 30 mm/year which is fixed into stable reference ITRF2008. The result of the velocity field in ITRF2000 has the similar pattern of the velocity field which fixed in ITRF2008.

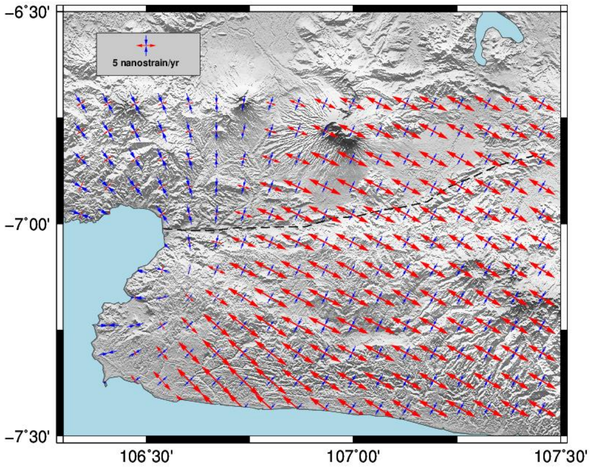


(a) (b)

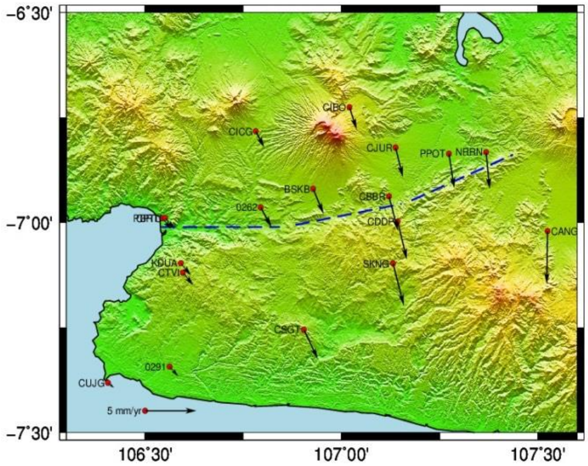
Figure 2. (a) Velocity field of surrounding GPS stations. The blue dash line indicates the Cimandiri fault. (b) The time series of one of GPS station (CPTU) breaks down into its component.

The strain tensor which is calculated from the velocity field shows through the principal strain rate in **Figure 3(a)** below. The principal strain indicates the significant extension movement from the west to the east. The west part of the research area tends to dominated by the shortening whilst in the east of the area the strain gradually changes into extension.

Our result of the principal strain rates indicates that the area dominantly influenced by the post seismic activity of the 2006 Java earthquake. The displacement of the post seismic displacement of the 2006 Java earthquake is also calculated according to afterslip model by [8] using STATIC 1D code analyzed in a layered, spherical earth model [9]. The post seismic displacement (**Figure 3(b)**) in each GPS station clearly shows the changes of the post seismic magnitude increasing from west to east which is agree with the result of the principal strain rates. The influence of the post seismic process get higher in east area since the east area located relatively near to the epicenter of the 2006 Java earthquake rather than the west area (**Figure 4**).



(a)



(b)

Figure 3. (a) Horizontal principal axes of strain rates. The red arrow indicates extension while the blue arrow indicates shortening. (b) Afterslip displacement in GPS stations.

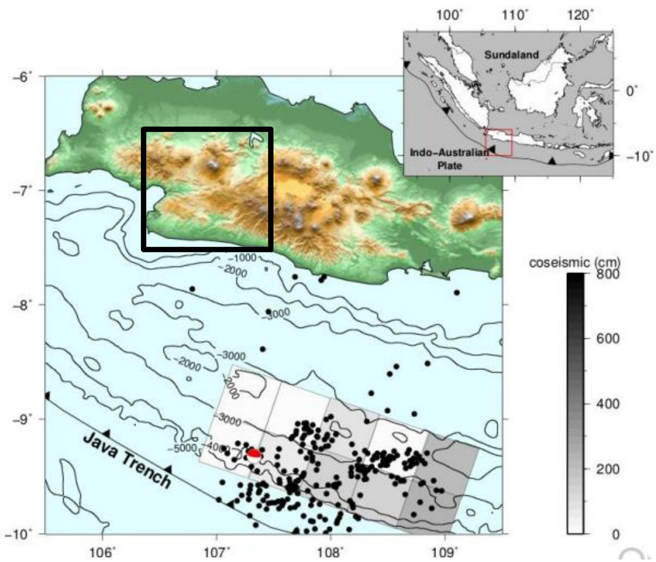


Figure 4. Location of research area indicated by black rectangular in Java map. The epicenter of the 2006 Java earthquake is about hundred kilometers away from GPS station which is used in this research (Modification from [10]).

4. Conclusion

We used combination of continues and campaign GPS data observed from 2006 to 2016 to produce the velocity field within the research area around the Cimandiri fault. The strain rates which is produced from the GPS velocity field indicates the dominant post seismic effect in the east area through the dominant patter of extension in the east whilst the shortening in the west area. These findings support the previous findings that the post seismic of the 2006 Java earthquake affect to the distance of 440 km away from the earthquake epicenter.

Acknowledgements
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