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Velocity field of GPS stations in the Taiwan area

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Abstract

The 131 stations of the 'Taiwan GPS Network' were surveyed 4–6 times from 1990 to 1995 with dual-frequency geodetic receivers. The standard deviation of an observed baseline length with its linear trend removed is in the range of 6–10 mm for a 3–120 km long baseline. The average rates of length change for all baselines of the network and those from nine continuously monitoring permanent stations are used in a least squares adjustment to estimate the velocities of the GPS stations relative to Paisha, Penghu, situated at the Chinese continental margin. To the south of Fengping, in the northern Coastal Range, the velocity vectors of stations in Lanhsu, Lutao, and the Coastal Range trend in the directions of 306°–322° with rates of 56–82 mm/yr. In contrast, there is a dramatic decrease in the rates to the north of Fengping. This may be caused by the motion along the NE–SW-trending thrusts which obliquely cut the northern Coastal Range. A discontinuity of about 30 mm/yr in the rates along with a remarkable change in the directions of station velocity is observed across the Longitudinal Valley, then the moving directions gradually shift to the west for the stations in the Western Foothills. In the Kaohsiung–Pingtung coastal area, the station velocities are even directed toward the southwest. To the north of the Peikang High, the velocity vectors of the stations change direction from the west gradually to the north and finally to the east and southeast. Significant NW–SE extensional deformation is found in the Ilan Plain and northern Taiwan. In general, the pattern of the velocity field for GPS stations in the Taiwan area is quite consistent with the directions of present-day tectonic stress.

Keywords: GPS survey; Velocity field; Crustal deformation; Active fault; Taiwan

1. Introduction

The satellite-based navigation system, the Global Positioning System (GPS), has a constellation of 24 satellites with orbits 20,000 km in altitude and orbital periods of about 12 h. It is operated by the U.S. Department of Defense and was originally designed for mainly military purposes. However, more and more civilian users have been applying this new technique in different fields. With the carrier phase signals from GPS satellites being received at two or more sites simultaneously and processing the observed data afterwards, the 3-dimensional relative positions of these sites can be precisely determined. Furthermore, the GPS survey does not require the line-of-sight intervisibility of geodetic stations. It is also much less affected by rugged topography and bad weather conditions. Thus, the GPS survey technique has become an efficient and powerful tool for studying active tectonics and plate motion (e.g. Dixon, 1991; Hager et al., 1991). Now it is possible

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