Near-field strong motion on the hanging wall of low angle thrusting: a case of Hamaoka

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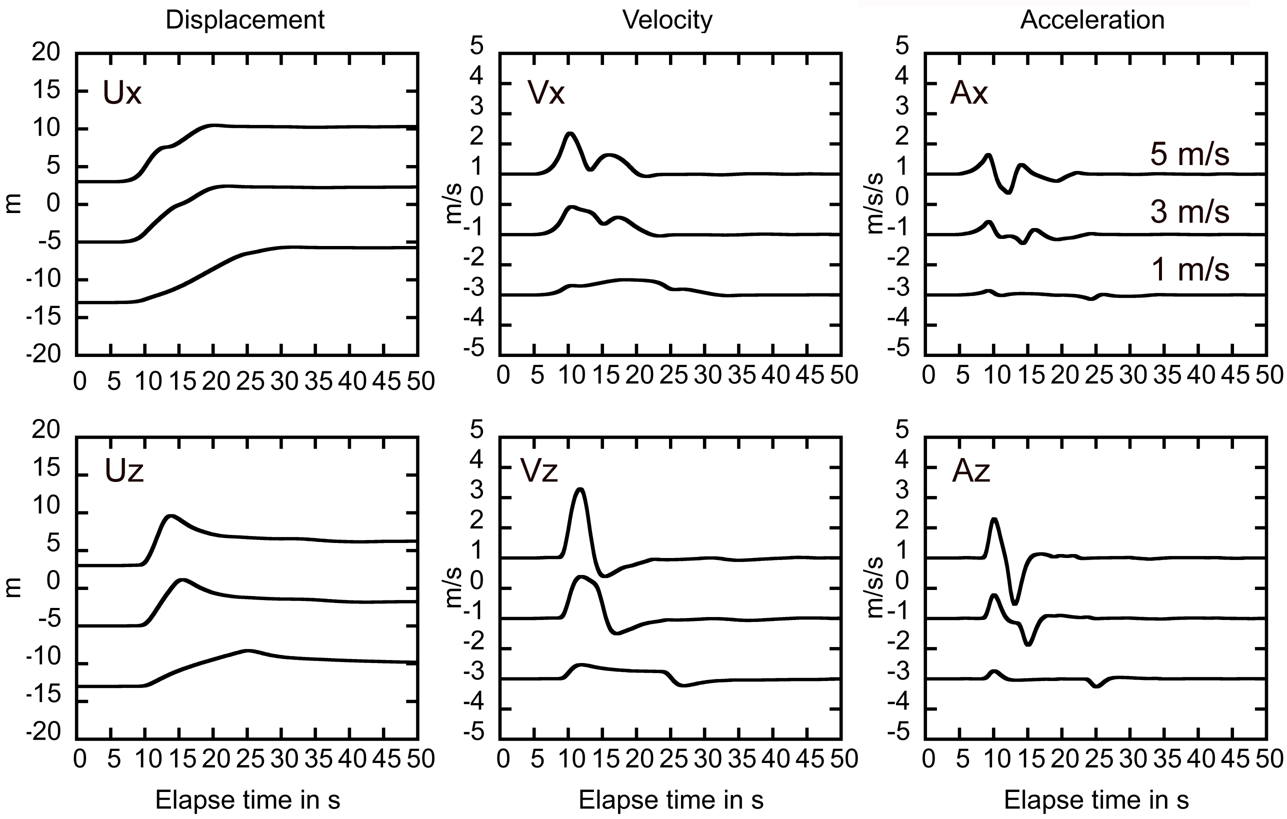
(1) We discuss the near-filed strong motion at Hamaoka on hanging wall of low angle thrusting. The key parameter is slip velocity.
(2) The high stress drop of 22 MPa has raised a problem on the evaluation of near-field strong motion. As fas as ever documented in Japan, stress drops of subduction zone earthquakes and average slip velocities were estimated to be around 3-5 MPa and 1 m/s, respectively. Following Starr (1928) for dip slip faulting, a stress drop Δσis proportional to Do/W, where Do is an average slip and W is a fault width. Following Brune (1970) and Ida and Aki (1972), an average slip velocity Do/to is proportional to earthquake generating stress σe, where to is a risetime. Assuming that σe is the same as Δσ, both Do and Do/to are proportional to σe, leading to the recognition that velocity and acceleration amplitude of synthetic strong motion are proportional to σe in the near-field to the first order.
(3) We move to a discussion of strong motion at Hamaoka. Assuming fault parameters as a fault length 100 km, W 50 km, and bilateral propagation in strike-parallel direction and unilateral propagation upward of rupture front from the center of the lower side, we obtain synthetic strong motion (Fig.1) at Hamaoka for three cases of Do/to of 1 m/s, 3 m/s and 5 m/s with a common Do of 15 m. Numerical computation is done by programs of Kawasaki et al. (1973) and Okada (1980). Velocity and acceleration are roughly proportional to Do/to. When Do/to is larger than 3 m/s, the maximum amplitude of acceleration is larger than g.
(4) We can not apply above discussion to shorter period strong motion because far-field term gets relatively predominant and physical attenuation and scattering become effective. However, on the following assumptions (a) and (b)
(a) velocity and acceleration of strong motion are proportional to slip velocity and earthquake generating stress in every scales of multi-scale rupturing phenomena,
(b) stress level of level 2 megathrust earthquake would be far higher than those of level 1 subduction zone earthquakes,
we can postulate that strong motions at Hamaoka during the coming level 2 class Mw9 Nankai trough earthquake would be far larger than those during level 1 class 1944 Tonankai and 1854 Ansei-Tokai earthquakes.
(5) Thus, reliable evaluation of near-field strong motion on the hanging wall of low angle thrusting seems to be not feasible at the present stage of seismology. The evaluation of regional tectonic stress on the hanging wall and the distribution of the strong asperity on the subduction interface are indispensable.
(6) Figure caption
Fig.1 Synthetic strong motions at Hamaoka for three cases of slip velocities of 1 m/s, 3 m/s and 5 m/s with a common slip Do of 15 m. Other fault parameters are given in the text. Left, middle and right panels are displacement (U), velocity (V) and acceleration (A), respectively. Upper and lower raw panels are those of fault perpendicular motion (subscript x) and vertical motion (z), respectively. A distance from Hamaoka to subduction interface is 10 km.

Keywords: near-field, low angle thrusting, earthquake generating stress, slip velocity, strong motion, Hamaoka


Displacement
Velocity
Acceleration
Ux
Vx
Ax
5 m/s
3 m/s
1 m/s
Uz
Vz
Az
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Elapse time in s