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Interactive comment on "Stress states and moment rates of a two-asperity fault in the presence of viscoelastic relaxation" *by* M. Dragoni and E. Lorenzano

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Response to the Referee's Comment

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We thank Dr. J. Freymueller for his comments on the first version of our paper. He considers some points that we discuss in the following.

1) The forces F_1 e F_2 are defined as the forces that act on the asperities *in the slip direction*: therefore they are valid for any source mechanism (strike-slip, dip-slip or other). Figures 1 in Dragoni and Santini (2012, 2014) are just a possible visualization of the model and do not represent it completely.

In the expressions of F_1 and F_2, the terms $-X$ and $-Y$ represent the tectonic loading of asperities 1 and 2 respectively and have the same sign for both asperities.

In the expression for F_1, the term αZ is the force applied to asperity 1 by the past

motions of asperities, in the presence of viscoelastic relaxation. Analogously, in the expression for F_2, the term $-\alpha Z$ is the force applied to asperity 2 by the past motions of asperities, in the presence of viscoelastic relaxation.

The two terms must have opposite signs so that, when asperity 1 slips by an amount U, there is a coseismic decrease αU in the term αZ of F_1 and a coseismic increase $-\alpha U$ in the term $-\alpha Z$ of F_2 (the forces F_1 and F_2 are always negative). And analogously when asperity 2 slips.

Afterwards, both terms relax viscoelastically according to equation (12). So, while the coseismic contributions to the forces have different signs for the two asperities, the subsequent viscoelastic relaxation has the same effect for both asperities, as correctly requested by the referee.

2) As to the events with a number n of modes greater than 2, a 3-mode event takes place if the state of the system at the beginning of the earthquake belongs to the subset R_1 (or R_2) of the face ACD (or BCD) of the sticking region (Fig. 4). A 3-mode event can result from four different sequences of modes: 10-11-10, 10-11-01, 01-11-10, 01-11-01. Each of these sequences starts with the failure of one asperity, continues with the simultaneous slip of both asperities and ends with the slip of a single asperity.

A real-world example has been considered in Dragoni and Santini (2014), where the 2010 Maule earthquake has been modeled as a sequence 10-11-01 on the basis of the slip history reported by Delouis et al. (2010).

3) Finally, we shall add with pleasure the more recent references on the 1964 Alaska earthquake suggested by the referee.