Asperity map in the source region of the 1963 Kuril Islands earthquake

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Asperity distributions of the great earthquakes along subduction zones have been determined in previous studies, and comparisons of the asperities for two consecutive large earthquakes have also been done. According to these studies, it is found that the location of the asperity does not vary. However, it isn't found whether these observations could be applied to all the earthquakes along subduction zones, because only a few earthquakes have been examined. In this study, we analyze the asperity distribution of the 1963 Kuril Islands earthquake, and three earthquakes in the source region of this earthquake which are the December 22, 1991 (Mw=7.6), off-Urup Island, the December 3, 1995 (Mw=7.9), off-Etorofu Island, and the February 7, 1996 (Mw=7.1), off-Urup Island earthquakes, and we determine these relative positions of asperities.

We used long-period P-wave records observed at WWSSN stations for the 1963 Kuril Islands earthquake and broadband P-wave records observed at IRIS-DMC for the other earthquakes. In our analysis, we constructed the grid scheme for the fault plane by taking the initial break at the hypocenter. The fault strike and the dip were determined in the trial and error manner. We divided the fault plane into subfaults with a span of 10-30km, and the unknown parameters of slip rate function at each subfaults was expanded in a serious of 5-7 triangular functions with a rise time 1.0-2.0secs.

The results for four events are as follows: the 1963 event has three asperities, the 1991 events has two asperities, the 1995 event has two asperities, and the 1996 event has one asperity. If we take the hypocenter determined by USGS, some of these asperities are partly overlapped and the other asperities don't overlap each other. On the other hand, no asperities overlap each other if we take the hypocenter determined by Harada and Ishibashi (2001) which are determined by the method of modified joint hypocenter determination (Hurukawa and Imoto (1992)).Then we think it is possible that the 1991 event isn't the recurrent earthquake based our estimating the released moments of the 1963 and 1991 events and the accumulated moment for 1963-1991.

We also analyzed the earthquakes nearby the source region of the 1963 event. Thus three asperities of the 1963 event do not still fail.