A comparison between Tse&Rice and rdiation dumping method for the earthquake simulation

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Until now, we have simulated Tonankai-Nankai earthquake on the basis of rate-and state friction law with 5km meshes as well as with 10km meshes. In these simulations, we use Tse&Rice method (Tse and Rice, 1986) when the maximum velocity reaches 0.1 m/sec. This method adds stress around asperity area, and causes instability. So, we need to release stress around asperity. However the setting of this area is very sensitive to the result. Moreover, the tuning of the distribution of friction parameters is also sensitive. We hope these tuning become easer if mesh size is as small as 5 km, but unfortunately the size of 5 km is not small enough.

In Ruina(1993), he shows another simulation method that can deal with earthquake instability. He says the simulation goes well if we introduce a viscous radiation damping term. We try this method by applying various values of the factor for the radiation damping between 1 and 10 to the sixth power. Then we find this simulation works well when the factor is more than 10. The maximum velocity of meshes is found to reach 0.1m/sec which corresponds to the initial velocity of earthquake occurrence defined as the Tse&Rice method is applied.

The comparison of the results between two methods are as follows: In the Tse&Rice method, the slip of earthquake is about 7m, the recurrence time is about 170 years and the interval of Nankai and Tonankai earthquake is about 2 years. In radiation damping method, the slip of earthquake is about 2m to 3m, the recurrence time is about 30years to 40 years and the interval of Nankai and Tonankai earthquake is about 2 years. But, the interval is sometimes 30 years or 40 years.

The latter method is more suitable for investigating the relation of Tonankai and Nankai earthquake occurrence. This is because, for the latter method, there is no need to assume the rupture area in advance, the simulation is more stable against the change of friction parameters, and it is easier to tune the parameters. However, it should be noted that, in the latter method, the slip speed during the earthquake is suppressed and the duration time of earthquake sometimes became more than a year, and additionally the computational time is about 10 times or more longer than for the former method.

References

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