How we could or could not catch the risk of Noto Peninsula Earthquake

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The Headquarters for Earthquake Research Promotion (HERP) of Japan continually publishes maps predicting the probability of occurrence of big earthquakes. They continually revised their maps, and the latest version was published in 2021 (HERP, 2021). HERP (2021) contains many maps, but, in general, the points indicating the high probability of occurrences of big quakes are scarce in Noto region, that is, the HERP maps failed to capture the risk of this region.

In contrast, our map of estimated rates of occurrences of intensity 6 plus earthquakes (ERO6+) marked the northern Noto peninsula as a high-risk region, we mean, the ERO6+ in most of the region is higher than once in 100 years (see the upper panel of the figure). Our method is based on Ikegami (1961), who found a linear relationship between log rate of occurrence of earthquakes (log10 r) and the intensity I,
$\log_{10} r = a + bI$
We improved his method by incorporating a correction for foreshocks aftershocks and swarms (FAS), by utilizing the distribution of inter-quake intervals, which in turn became possible, as the measurement and recording of seismic intensity is fully instrumental since 1996.
After the FAS correction, the intensity-rate of occurrence relationship is invariant before and after the big quakes. With this corrected intensity-rate of occurrence relationship, we extrapolated the regression or two-point lines and get the value at intensity 6.5. The value was used as ERO6+.
The details of the methods are available at SSS06-P03, in this meeting.

The lower panel of the figure shows the relationship between ERO6+ and observed intensity at 2024 January 1 earthquake, in Noto region. The cross symbols are results of stations which have corrected data only up to intensity 3 and are prone to large uncertainty. Thus, we calculated the correlation coefficients with and without these cross-symbol points, and the results were 0.401 and 0.366, respectively. Removing the large uncertainty points did not improve the correlation, but, whether with or without the cross-symbol points, the results shows that there is a weak correlation between our ERO6+ and observed intensities.

There might be a lot of discussion about how to interpret our results; however, we consider that our ERO6+ captures some of the characteristics of the risk of this region.
Our analyses are totally data analytic, and we consider this kind of approach can complement the full-fledged seismological predictions.

Ikegami, R (1961) Intensity-frequency relation for felt earthquakes in japan. Journal of the Seismological Societyof Japan 14, 94–101. in Japanese

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