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PROBABILISTIC ESTIMATION OF THE MAXIMUM EXPECTED MAGNITUDE M_T IN A TIME T FOR FLUID-INDUCED SEISMICITY

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The injections of fluids at depth is a well-known origin for the triggering of earthquake sequences. The growing number of projects related to enhanced geothermal systems, fracking and others has led to the question which maximum earthquake magnitude can be expected as a consequence of fluid injection. This question is addressed from the perspective of statistical analysis. For this aim, we extend the methodology introduced by Zöller *et al.* (2013;2014) to non-stationary seismicity; in particular, the earthquake rate becomes a function of time. Using additionally the common assumption that the number of fluid-induced earthquakes is proportional to the fluid injection rate, allows us to estimate the maximum expected magnitude M_T in a pre-defined time window T in the future. A case study of the fluid injection site at Paradox Valley, Colorado, USA (Ake *et al.*, 2005), demonstrates that the magnitude m=4.3 of the largest observed earthquake on 27 May 2000 was lying well within the expectation from past seismicity. The methodology can easily be adjusted to different fluid injection sites. Finally, it will be possible to calculate the volume of fluid that can be injected, if a given maximum magnitude must not be exceeded with a certain level of confidence.

REFERENCES

Ake, J., K. Mahrer, D. O'Connel, and L. Block (2005) "Deep-Injection and Closely Monitored Induced Seismicity at Paradox Valley, Colorado", *Bulletin of the Seismological Society of America* 95(2):664-683, doi: 10.1785/0120040072.

Zöller, G., M. Holschneider, and S. Hainzl (2013) "The maximum earthquake magnitude in a time horizon: theory and case studies", *Bulletin of the Seismological Society of America* 103(2a):860-875, doi 10.1785/0120120013.

Zöller, G., M. Holschneider, S. Hainzl, and J. Zhuang (2014) "The largest expected earthquake magnitudes in Japan: The statistical perspective", *Bulletin of the Seismological Society of America* 104(2):doi 10.1785/012013103.

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