

# Monitoring seismic hazard in the Groningen gas field

## Abstract

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In this paper, we attempt to study induced earthquakes based on Groningen gas field seismicity data. The history of gas production from NAM and the catalogue of induced earthquake incidences in the region from KNMI are studied to construct a prediction model.

Poisson model for annual earthquakes count data, a logistic regression model for monthly incidence occurrence data and a Poisson point process model for the time of earthquake occurrence point pattern were fitted. Time and gas production values in specific periods were used as covariates in all three models. The former model with a non-homogeneous intensity function presents a good fit with a positive confidence interval for gas production parameter estimate and almost flat auto-correlation function, indicating independence of observations and a positive effect of gas production on the number of earthquakes. Switch to the monthly time discretization in the logistic regression model increases the number of observations for covariates. However, the shift from integer to binary response variable contributes to the loss of information. Finally, the point pattern model presents its challenges with time discretization, integral approximation, and intensity function choice. Nonetheless, the fitted model performs well in capturing the time-dependence of the data, and the estimated empirical pair-correlation function supports the Poisson process model.