Università degli Studi di Napoli Federico II

Dipartimento di **St**rutture per l'Ingegneria e l'Architettura
Via Claudio, 21, 80125, Naples, Italy.
Tel

Naples, April 6th 2017.

To: , **Inspector General of Mines, State Supervision of Mines, Ministry of Economic Affairs, Henri Faasdreef 312, 2492 JP, The Hague, NL.**

Subject: review of the report on recent earthquakes (Wirdum and Garsthuizen 2016).

The report discusses a recent cluster of events in the fields and tries to address whether it represent an anomaly with respect to the recent observed trend of seismicity in the area. A few points emerge from the review.

1. It is believed (as noted in the report) that the current measures of seismicity are affected by the improved sensitivity of the seismic network. It is especially important, when comparing recent observations with the past, to homogenize data (e.g., magnitude) with respect to the capabilities of detecting earthquakes available in the past.[1]

2. From the provided data, it results that fifteen earthquakes occurred in four months at nine different locations (table 2). In the Loppersum municipality they are eight. Table 3 reports twelve earthquakes in twenty-two months at that municipality (i.e., point estimate of rate equal to 0.54).[2]

3. Not all the analysis reported can be easily evaluated, for example figure 12 misses units. However, related to the analysis of the interarrival time, it is not clear how it can provide clear results for non-declustered data.

4. The following quantitative analyses foreseen by NAM should be targeted at quantitatively (i.e., statistically) establishing whether there is currently a deviation from the seismicity history. For example, this could be done with tools as the *Laplace test* (on declustered seismicity) or similar, yet more appropriate, statistical or tools.[3]

5. In general, it seems especially relevant for NAM to focus the research effort to try to build a quantitative model for a relationship (if existent) between production (i.e., the explanatory variable) and the seismicity rates (i.e., the observation). Without such a model, any analysis of the trend of seismicity, and consequently risk, seems at least difficult, and therefore any decision is hard to take.

Based on the above here are the replies to the questions posed by SODM to this reviewer:

---

[1] In this sense, I wonder whether the network has the ability to detect all earthquakes with M equal or larger than one (i.e., the value of the traffic-light threshold) and, if yes, since when.

[2] Under Poisson assumption, one could check the (for example) 95% confidence interval and see whether the current seismicity is anomalous. However, Poisson assumption may not apply in this context and data should be declustered.

[3] As per the previous test, a Laplace test on declustered data could help in detecting an anomalous trend in seismicity (if Poisson assumption applies).

Q1) *Do you (in your expert opinion) find the analyses and conclusions drawn scientifically sound?*

A1) The conclusions drawn seem not in contrast with observations. However, all the analyses conducted are generally qualitative and this is not sufficient to associate a (quantitative) significance level to the conclusions gathered.

Q2) *How (In your expert opinion) do you perceive the further development of the seismicity in the near and intermediate future?*

A2) Although the qualitative nature of the analyses provided in the report, it seems that there is not sufficient evidence to claim a systematic reprise of seismic activity in the considered area.

Q3) *Given that from a societal perspective new and further escalation of seismicity is unacceptable, do you deem it wise to further reduce the level of production?*

A3) Not based on these analyses alone.

Finally note that I'm relatively more familiar with probabilistic seismic hazard and risk analysis, which are both factually not touched in the report. Therefore, the comments above reflect the point of view from the side of my expertise.

Sincerely,

‹

_____

Professor of Earthquake Engineering and
Structural Dynamics
Dipartimento di Strutture per l'Ingegneria e l'Architettura
Università degli Studi di Napoli Federico II
Via Claudio 21, 80125 Naples - Italy
Tel:
Web-page - Google Scholar - Researchgate - Linkedin