

Date 28-06-2019  
Our reference ES-KEM02-28062019  
Contact Prof. dr.  
Telephone +31 15  
+31 6  
E-mail @tudelft.nl  
Page 1/1



Delft University of Technology

---

Faculteit Civiele Techniek en  
Geowetenschappen  
Afdeling Engineering Structures

Bezoekadres  
Stevinweg 1  
2628 CN Delft

Postadres  
P.O. Box 5048  
2600 GA Delft

Subject: "Evaluation, validation and improvement of the site-amplification component of the Groningen Seismic Risk Model: A review of the KNMI procedures for the installation of the sensors and correction of the amplitudes implemented"

The documents listed below have been submitted to TU Delft for review:

1. Notes of the meeting KEM studies and KNMI on issues with records from B- and G-stations in the Groningen field, 13th February 2019;
2. KNMI presentation on "Groningen seismic network: Sensor orientation and amplitude differences over the network";
3. Paper submitted to the *Netherlands Journal of Geosciences — Geologie en Mijnbouw* |96 – 5 |s235–s245| 2017 entitled: Development of seismicity and probabilistic hazard assessment for the Groningen gas field;
4. Basic Network Information document composed by KNMI;
5. Report discussing the amplitudes prior and after correction composed by KNMI.

Upon reviewing the documents listed above, we concluded the following:

The investigation carried out by KNMI, as well as the corrections implemented once the problem manifested, are well thought-of and appropriate. Some additional information would be useful, namely, the frequency response functions of the slabs and concrete cubes (both in interaction with the ground) that the sensors are installed on. We are still somewhat confused by the fact that no resonances are observed in the observations that would be associated with the natural frequencies of the slab and the cubes (in interaction with the ground). Possibly this is caused by the fact that these frequencies are well below the lowest frequency of interest. In any case, it is clear that the setting error is definitely the dominant one and we fully agree with KNMI as to the way it was corrected.