

# Overview of North Korean Nuclear Tests Based on Data from Modernized Slovak National Network of Seismic Stations

Kysel<sup>1,2</sup>, R. (e-mail: robert.kysel@savba.sk), Csicsay<sup>1</sup>, K., Fojtíková<sup>1</sup>, L., Cipciar<sup>1,2</sup>, A., Chovanová<sup>1</sup>, Z.

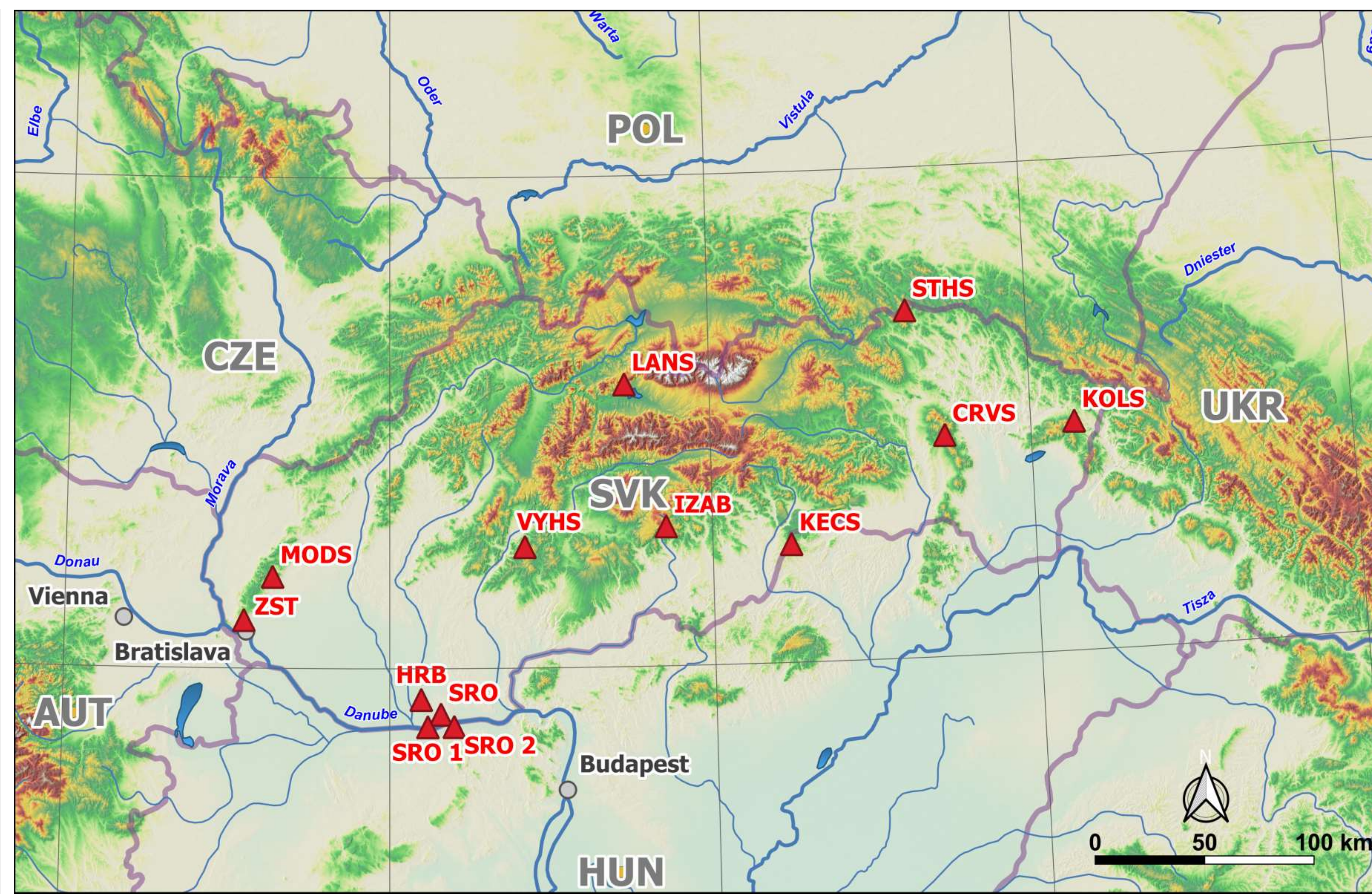
1 – Earth Science Institute of the Slovak Academy of Sciences, Bratislava, Slovakia 2 – Faculty of Mathematics, Physics and Informatics, Comenius University in Bratislava, Slovakia

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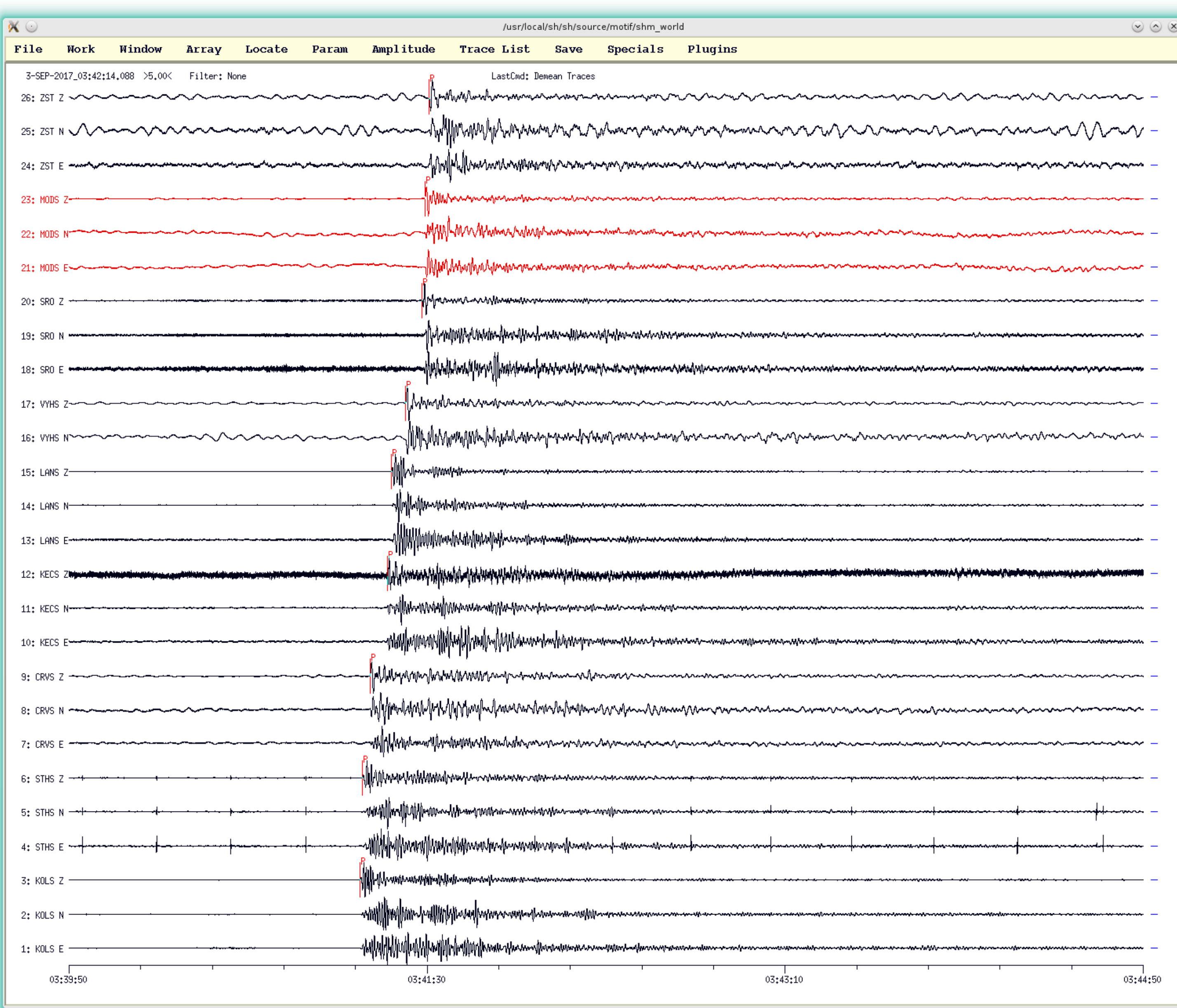
**Abstract**

The Slovak National Network of Seismic Stations (NNSS) has been considerably modernized and enhanced during the years 2001 - 2004. At the present, the NNSS represents the principal and the most important infrastructure designated for monitoring of seismic activity on our territory. The primary function of the NNSS is to monitor and localize earthquakes with macroseismic effects on the territory of Slovakia. Besides, the seismic stations of NNSS are also capable of recording weaker local and regional earthquakes as well as teleseismic earthquakes and nuclear explosions.

The NNSS fulfill its duties also within the framework of the technical cooperation between the Slovak Republic and CTBTO by providing seismological data to the Slovak Academy of Sciences (SAS), which has been designated as the Slovak National Data Centre (NDC) for CTBTO. Until today, the Democratic People's Republic of Korea (DPRK) has conducted six nuclear tests (in 2006, 2009, 2013, two in 2016, 2017). The ability of the NNSS to detect the seismic signal generated by the DPRK nuclear events and the estimates of locations and magnitudes of the events are presented. The results are compared to the International Data Centre estimations.



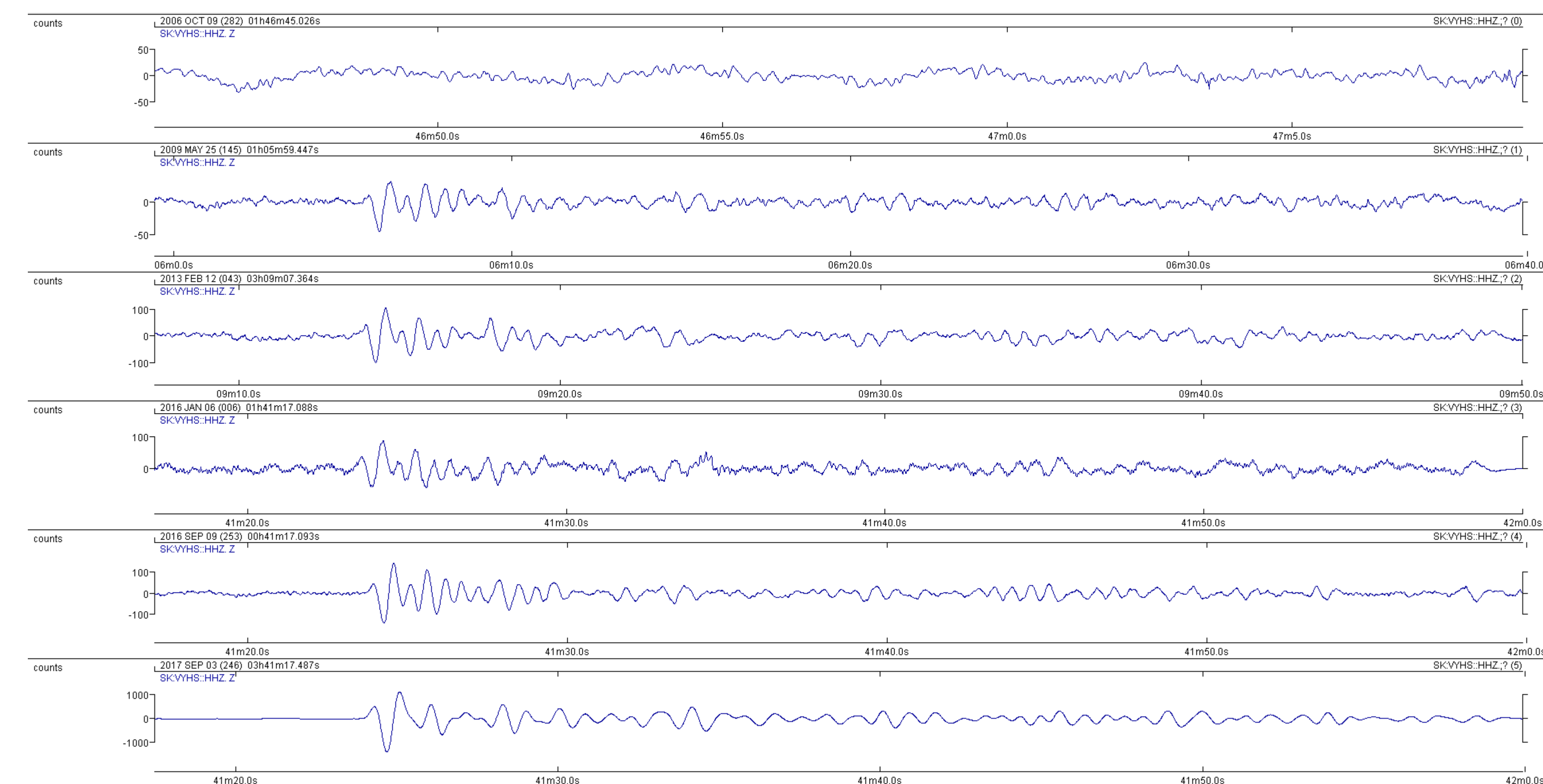
**Seismic signals on NNSS from the September 3, 2017 nuclear explosion**



| Agency | 09-10-2006<br>mb | 25-05-2009<br>mb | 12-02-2013<br>mb | 06-01-2016<br>mb | 09-09-2016<br>mb | 03-09-2017<br>mb |
|--------|------------------|------------------|------------------|------------------|------------------|------------------|
| NNSS   | undet.           | 4.9              | 5.1              | 5.2              | 5.6              | 6.5              |
| CTBTO  | 4.0              | 4.5              | 4.9              | 4.9              | 5.1              | 6.1              |
| NORSAR | 4.0              | 4.5              | 5.0              | 4.8              | 5.1              | 6.1              |
| USGS   | 4.3              | 4.7              | 5.1              | 5.1              | 5.3              | 6.3              |

| Seismic Station (ISC code) | Lat [°N]<br>Lon [°E] | Elev [m] | Onset time<br>09-10-2006 | Onset time<br>25-05-2009  | Onset time<br>12-02-2013  | Onset time<br>06-01-2016  | Onset time<br>09-09-2016 | Onset time<br>03-09-2017 |
|----------------------------|----------------------|----------|--------------------------|---------------------------|---------------------------|---------------------------|--------------------------|--------------------------|
| Červenica (CRVS)           | 48.9022<br>21.4614   | 476      | seismic signal           | 01:05:54.005<br>mb 4.5    |                           |                           |                          | 03:41:14.037<br>mb 6.6   |
| Izabela (IZAB)             | 48.5689<br>19.7126   | 482      |                          |                           |                           | 01:41:20.632<br>mb undet. |                          |                          |
| Kečovo (KECS)              | 48.4823<br>20.4856   | 345      |                          |                           |                           |                           |                          | 03:41:18.970<br>mb 6.2   |
| Kolonické sedlo (KOLS)     | 48.9333<br>22.2715   | 460      | seismic signal           | 01:05:53.039<br>mb 5.0    |                           |                           | 00:41:11.113<br>mb 6.1   | 03:41:11.226<br>mb 6.9   |
| Liptovská Anna (LANS)      | 49.1505<br>19.4678   | 705      |                          |                           | 03:09:09.805<br>mb undet. | 01:41:19.528<br>mb 5.1    | 00:41:19.705<br>mb 5.5   | 03:41:20.046<br>mb 6.4   |
| Modra (MODS)               | 48.3736<br>17.2774   | 520      |                          |                           | 03:09:19.121<br>mb 5.2    | 01:41:27.999<br>mb undet. | 00:41:29.030<br>mb 5.6   | 03:41:29.348<br>mb 6.7   |
| Smolenice (SMOL)           | 48.5139<br>17.4287   | 400      |                          | 01:06:10.126<br>mb undet. | 03:09:18.137<br>mb undet. |                           | 00:41:28.091<br>mb 5.3   | 03:41:28.510<br>mb 6.3   |
| Šrobárová (SRO)            | 47.8133<br>18.3133   | 150      |                          |                           |                           | 01:41:28.116<br>mb 5.4    |                          | 03:41:28.531<br>mb 6.6   |
| Moča (SRO 2)               | 47.7627<br>18.3940   | 109      |                          |                           |                           | 01:41:26.579<br>mb 5.4    |                          |                          |
| Stebnická Huta (STHS)      | 49.4167<br>21.2437   | 534      |                          |                           |                           |                           |                          | 03:41:11.937<br>mb 6.3   |
| Vyhne (VYHS)               | 48.4939<br>18.8360   | 450      | seismic signal           | 01:06:05.593<br>mb 4.4    | 03:09:13.688<br>mb 4.9    | 01:41:23.244<br>mb 5.0    | 00:41:23.753<br>mb 5.3   | 03:41:23.906<br>mb 6.3   |
| Železná Studnička (ZST)    | 48.1961<br>17.1025   | 250      |                          | 01:06:11.225<br>mb 4.6    |                           | 01:41:30.195<br>mb undet. | 00:41:30.501<br>mb 5.8   | 03:41:30.469<br>mb 6.7   |

**Comparison of seismic signals from DPRK nuclear explosions on Vyhne (VYHS) seismic station**



**Conclusions**

- Five from six North Korean nuclear explosions were recorded by the Slovak National Network of Seismic Stations. The presence of 2006 nuclear test in seismic signal needs further investigation.
- For 2009, 2013, 2016 (January and September) and 2017 events, the body-wave magnitudes mb were determined from the NNSS data. The magnitudes are higher up to half a degree in comparison to mb determined by CTBTO, NORSAR and USGS.
- The locations of events were taken from EMSC-CSEM bulletins. The analysis of teleseismic data by Slovak Academy of Sciences does not include determination of locations from NNSS data.
- For future work, we plan to compare the seismic signals from NNSS with the seismic data from other Central European agencies (e. g. From Hungary, Czech Republic and Poland).

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**Disclaimer:** The views expressed on this poster are those of the author and do not necessarily reflect the view of the CTBTO