Performance of SmartSolo Seismic Nodes in Seismological, Environmental and Geophysical research

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FUNDER belspo

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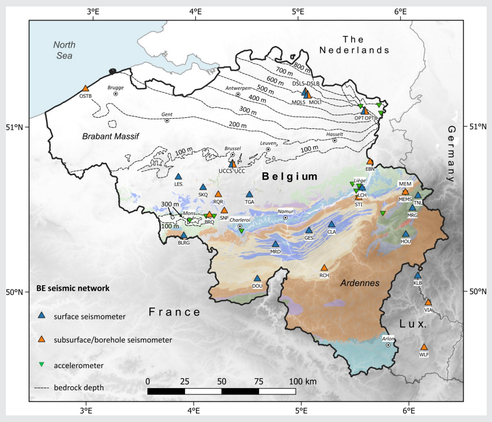
BSM2024 – British Seismology Meeting 25th-27th March, Reading, UK

SmartSolo (modular) IGU-16HR 3C and IGU-BD3C-5

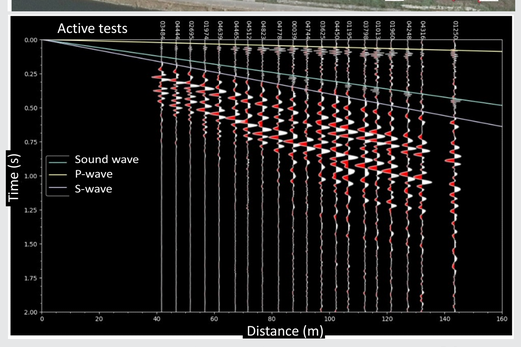
SmartSolo® IGU-16HR 3C connected to standard battery tripods during an urban seismology campaign in Brussels

SmartSolo® IGU-16HR and IGU-BD3C-5 seismic sensors used for geophysical prospection below a bridge in Halle (BE)

Site Characterisation of the Belgian Seismic Network with Nodes



Using a linear array for active shots and MASW

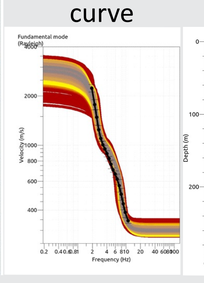


Using nodal arrays to provide station characteristic parameters in Orfeus

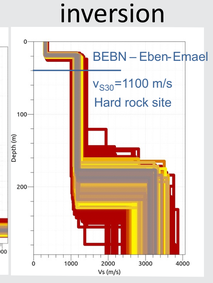
Orfeus STATION BOOK

Orfeus Stationbook parameters	CLA	EBN	GES	OPT	OPTB	RQR	SKQ	SNF	TGA	UCC	UCCB
Geological Unit	Limestone (Longpré formation)	Chalk (Upper Cretaceous, Maastrichtian)	Sandstone (Famennian, Ciney formation)	Fine sands (Mol formation)	Marine clays (Heers formation)	Slates (Brutia formation)	Mudstone - Siltstone (Steenkerque formation)	Limestone (Lives formation)	Shale (Mousty Formation)	Sands (Lede formation)	Quartzite/Slate (Tubize formation)
Morphology Class	T2	n/a	T1	T1	n/a	T1	T1	T1	T2	T1	n/a
Ground Type EC8	A (hard rock)	A (hard rock)	A (hard rock)	C (sedimentary deposits of hundreds of meters)	A (hard rock)	A (hard rock)	A (hard rock)	A (hard rock)	A (hard rock)	B (sedimentary deposits of tens of meters)	A (hard rock)
Groundwater Depth [m]	25 - 30	~ 20	~ 10		n/a	n/a	< 10	< 2	7	n.n.b.	n/a
vs_{30} [m/s]	2900	1100	982 +/- 32	362	846	> 800	1492 +/- 28	> 800	1188 +/- 170	280	1800
f_0 [Hz]	n/a	n/a	~ 50	0.28	n/a	n/a	n/a	n/a	n/a	0.90	n/a
Amp(f_0)	n/a	n/a	10	3.8	n/a		n/a		n/a	14	n/a
Basin Flag	False	False	False	True	n/a	False	False	False	False	True	n/a
Bedrock Depth [m]	0	0	0.3	356	0	0	0	0	0	115	0

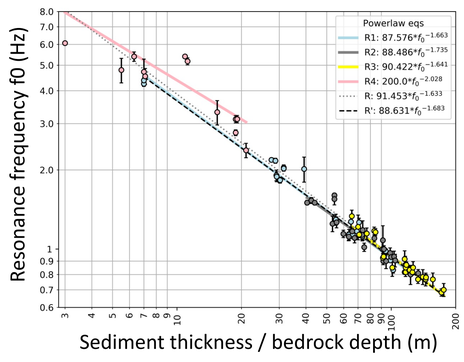
Dispersion curve



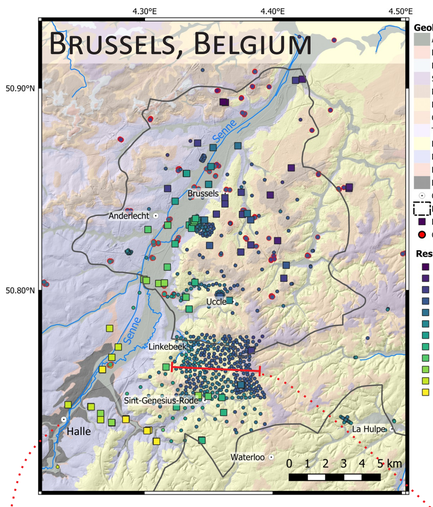
Vs profile inversion

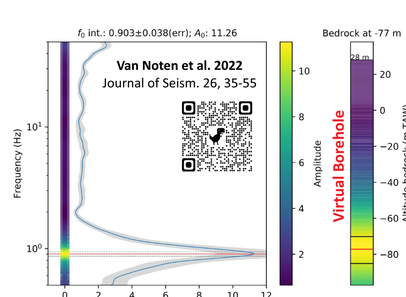


Urban Seismology and Bedrock depth prediction using H/V Spectral Ratio Imaging



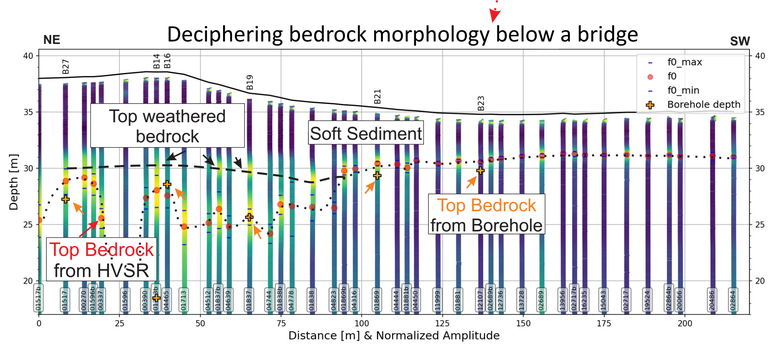
Get the f0 vs depth **powerlaw relation** from HVSR analysis of ambient noise above boreholes

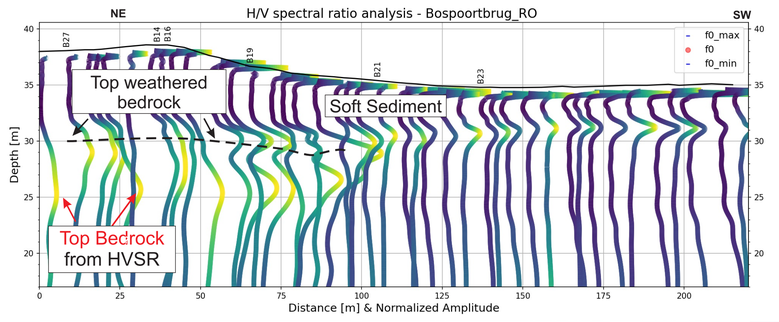


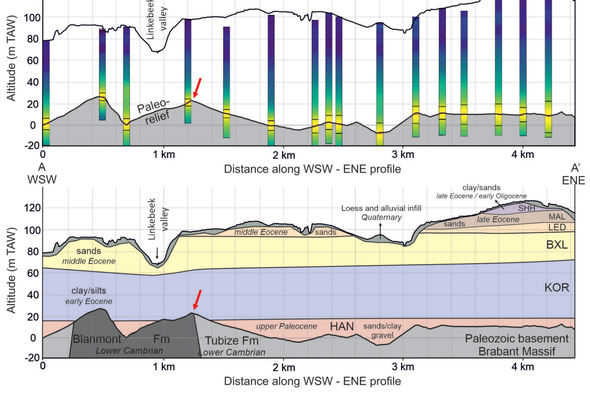


Apply the powerlaw on the HVSR curve to get a **VIRTUAL BOREHOLE**

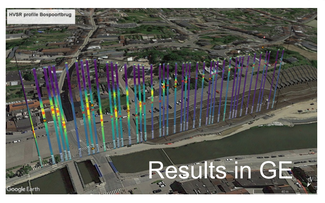
Deciphering bedrock morphology below a bridge

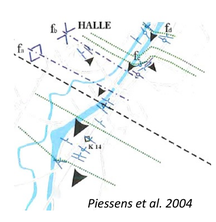


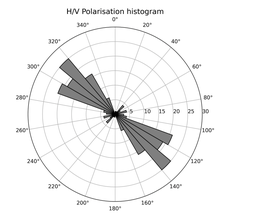




HVSR analysis of linear arrays & Virtual Borehole profiling to map bedrock paleotopography and orientation.

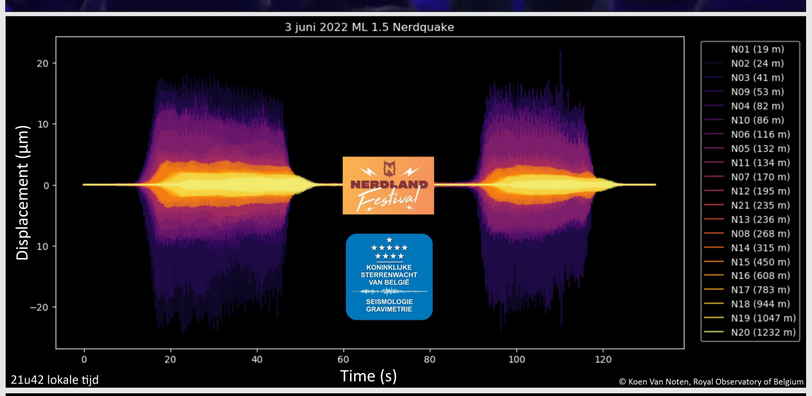


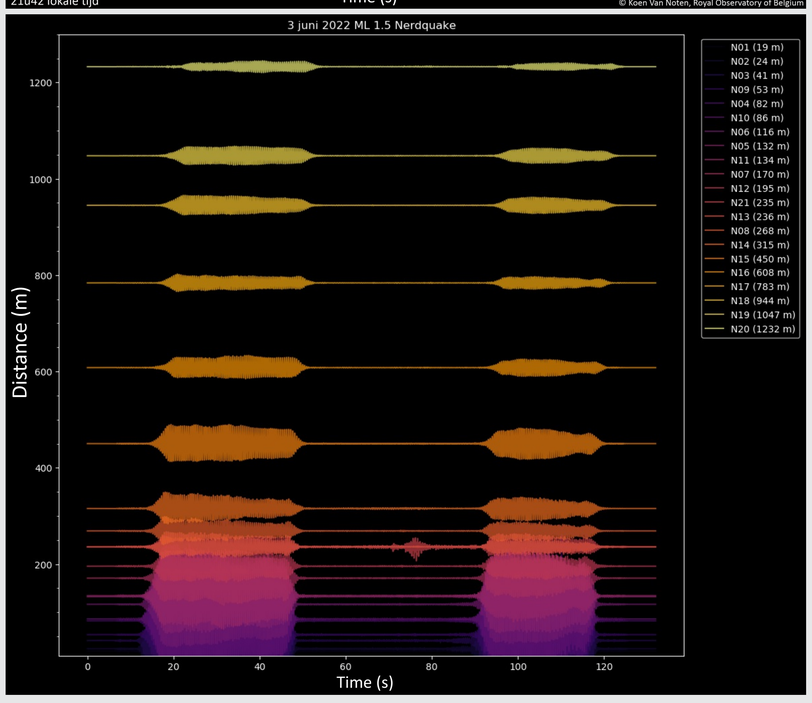




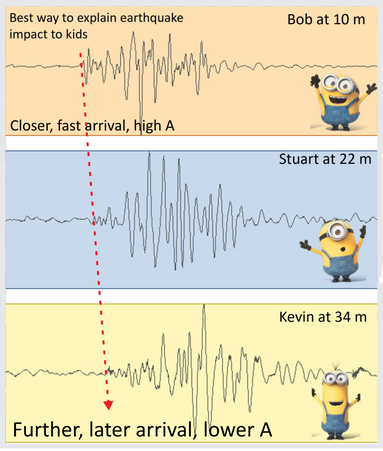
Outreach: ML 1.5 Nerdquake & Minions at School!

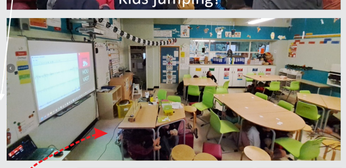
800 people jumping synchroneously during a science festival. 21 nodes up to 1.2 km from festival tent. Data restituted to displacement. Amplitude scaled to Belgian ML scale. **800 people jumping = ML 1.5 equivalent !**

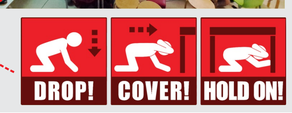




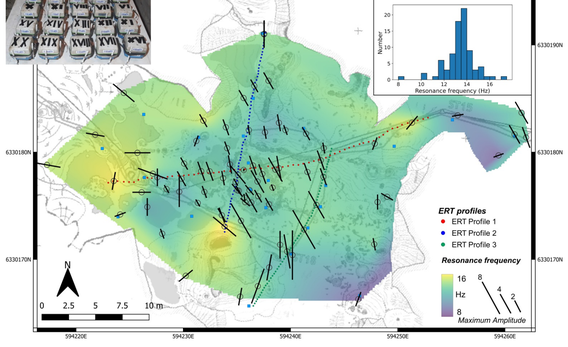
Three minions tracking ground motion decay of kids jumping. Great outreach tool!

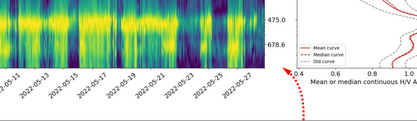






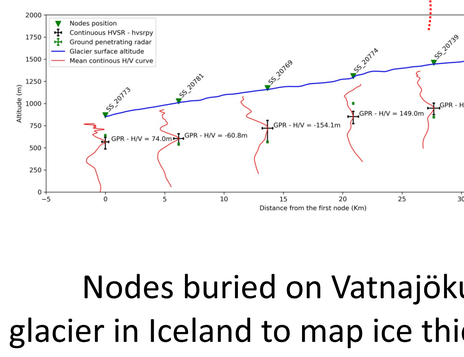
Bedrock below buildings with geothermal interest

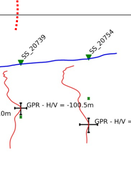




HVSR mapping around buildings

Continuous HVSR monitoring

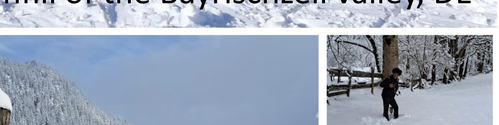




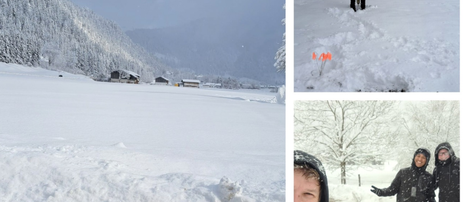
Solving Geological Problems

Is there a fault running beneath the Grohnde (DE) Nuclear Powerplant ?

Minions to the Rescue!



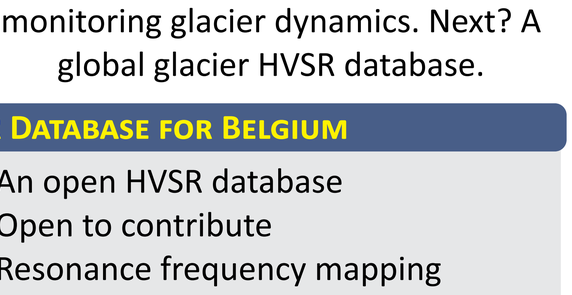
No fault! Thinning of Quaternary river terrace



HVSR & Cave infill Mapping (FR)

The H/V polarisation hints on structural geology. In this cave, H/V amplitude is maximal along limestone beds. Great tool for finding buried bedding orientation!

Nodes for Glacier thickness (IS)



Nodes buried on Vatnajökull glacier in Iceland to map ice thickness. Continuous HVSR is used for monitoring glacier dynamics. Next? A global glacier HVSR database.

Glacier Valley Infill & Tracking Skiers

HVSR profiling to map Quaternary infill of the Bayrischzell valley, DE

Ultimate Goal: The HVSR Database for Belgium

- ☑ An open HVSR database
- ☑ Open to contribute
- ☑ Resonance frequency mapping
- ☑ Useful for engineering purposes
- ☑ Useful for site effect modelling
- ☑ Added value for geological modelling

☑ What about the UK ?

During **SKIENCE2023 winterschool**, we placed nodes on the ski piste to track parallel skiers. Why ? Because we can :-)