

Involving Belgian citizens in earthquake monitoring and science

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12 January 2022






Did You Feel It?

Online crowdsourcing method using people's testimonies of earthquake experience

Goal

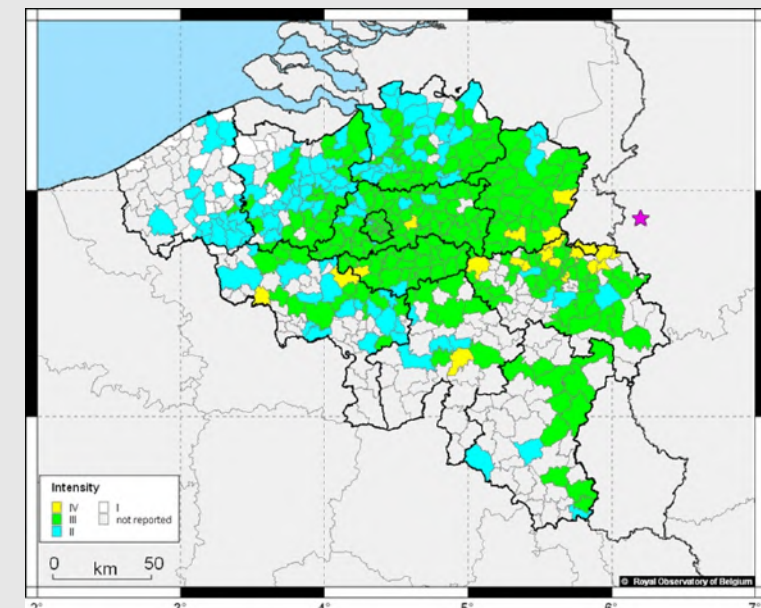
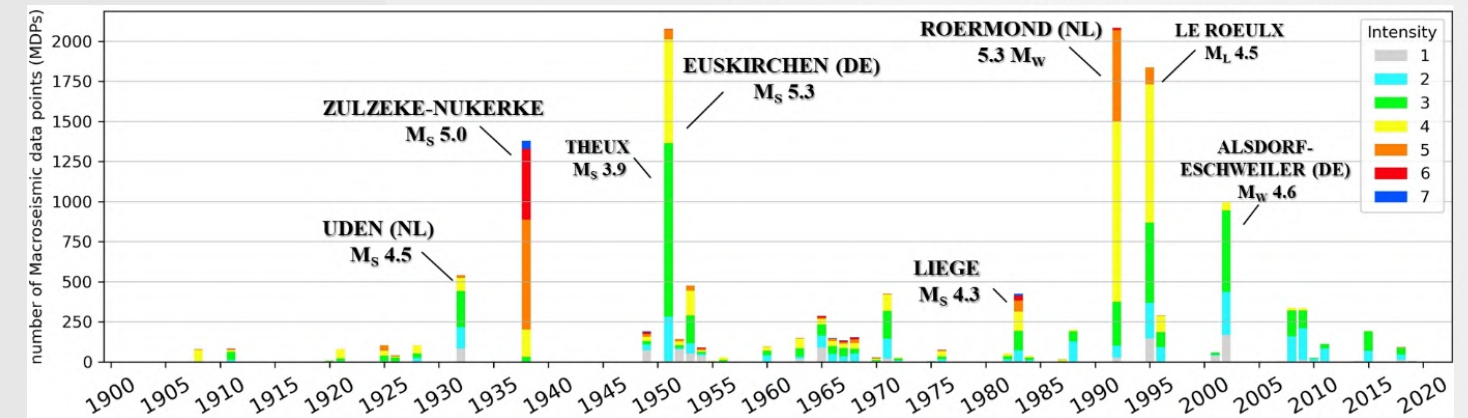
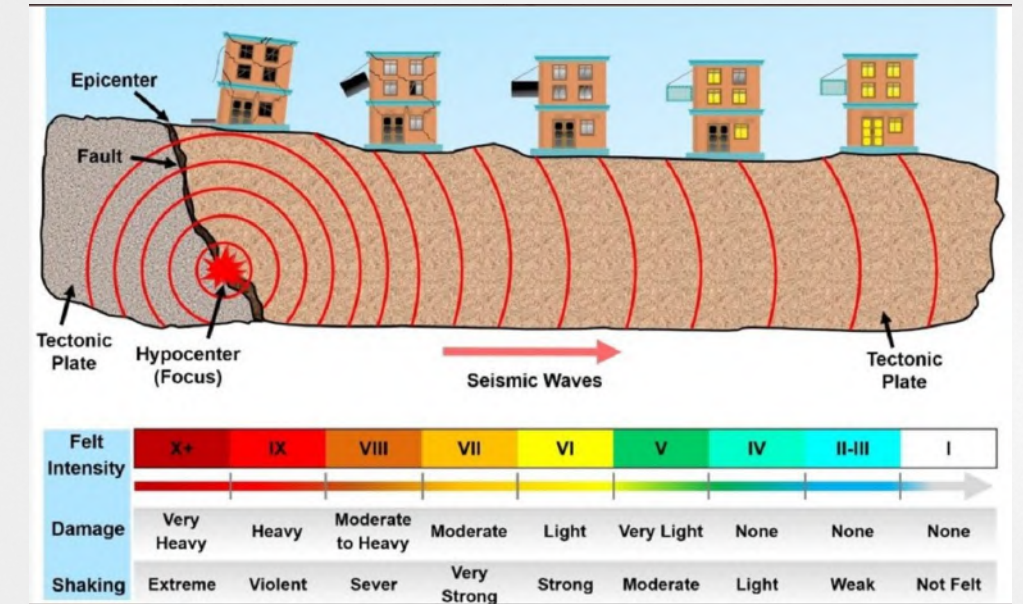
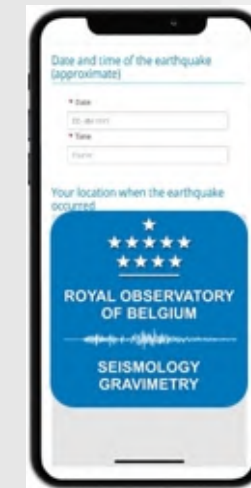
Dense **intensity** maps of earthquake shaking using geocoded reports

History of *Did You Feel It?*

-  1997 - First practice : Telephone earthquake reports (US)
-  1999 - Installation of *Did You Feel It ?* (US, David Wald)
-  2002 - First practice in Belgium → 2002 ML 4.9 Alsdorf earthquake
-  2011 - **Cross-border** collaboration with UCologne - BNS
-  2016 - Sharing data with France

Current practice

- ZIP-code or geolocated real-time intensity maps
- 29 262 responses in 5968 communes for 279 events



ROB macroseismic database
Neefs et al. 2022

Alsdorf 2022
> 6000 responses

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Did You Feel It? - Operational and real-time

- Part of **BE**lgian **E**arthquake **a**le**R**t **S**ystem - **BEERS**
- DYFI? activated by seismologist
- multiple choice **weighted** algorithm with fiability

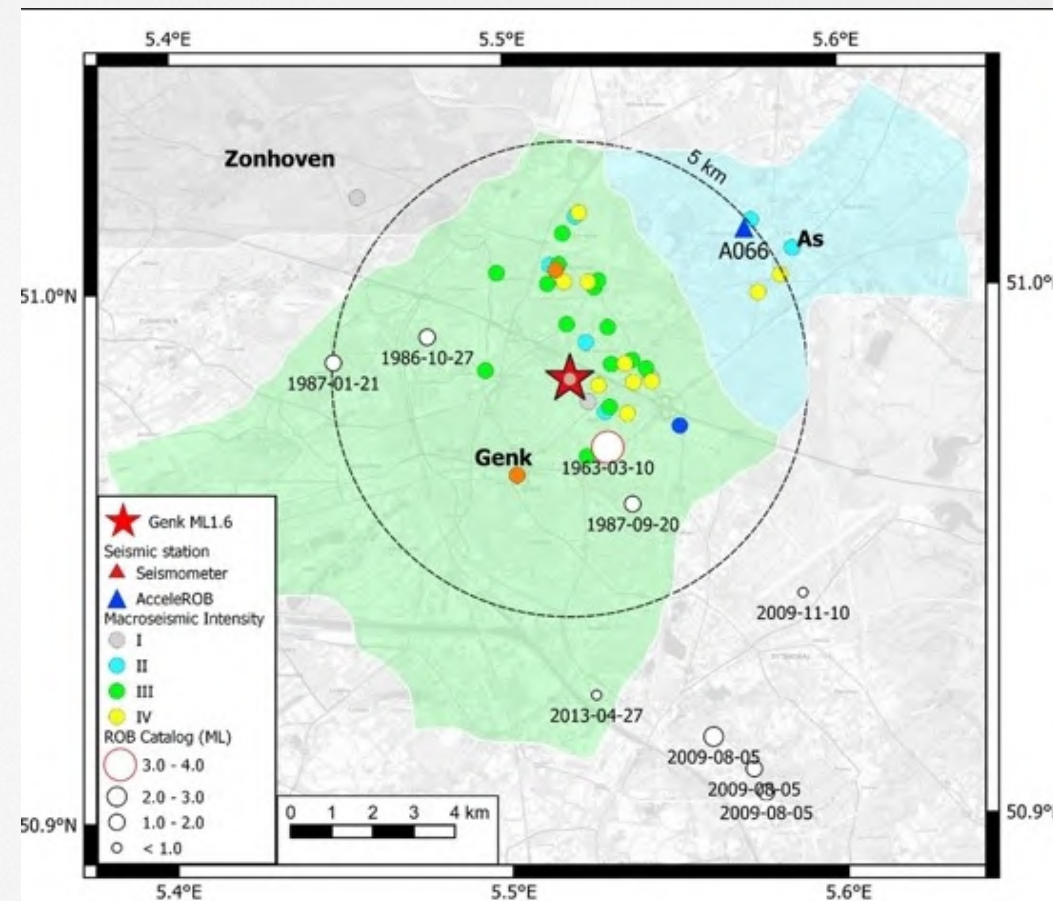
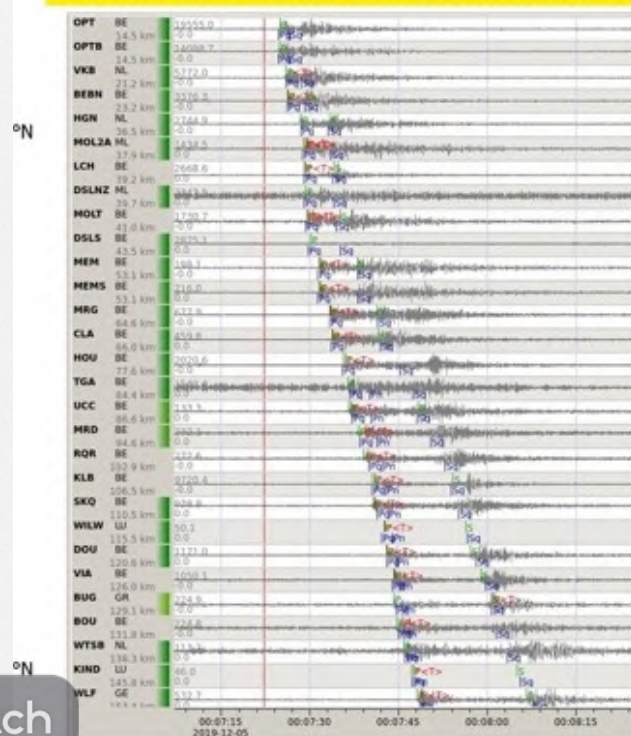
$$CWS = (5 \cdot \text{felt}) + (1 \cdot \text{motion}) + (1 \cdot \text{reaction}) + (2 \cdot \text{stand}) + (5 \cdot \text{shelf}) + (2 \cdot \text{picture}) + (3 \cdot \text{furniture}) + (5 \cdot \text{damage})$$

- initial guess of earthquake impact
- felt range
- potential damage degree →



National Crisis Center

Lichte aardbeving schudt tientallen Genkenaars rond middernacht wakker



FELT INDEX [weight = *5]

- **felt** (Did others nearby feel the earthquake?)
- 0=No [0]
- 1=Yes [1]

MOTION INDEX [weight = *1]

- **motion** (How would you best describe the ground shaking?)
- _=No description
- 0=Not felt [0]
- 1=Weak [1]
- 2=Mild [2]
- 3=Moderate [3]
- 4=Strong [4]
- 5=Violent [5]

REACTION INDEX [weight = *1]

- **reaction** (How would you best describe your reaction?)
- _=No answer / Don't remember
- 0=No reaction / Not felt [0]
- 1=Very little reaction [1]
- 2=Excitement [2]
- 3=Somewhat frightened [3]
- 4=Very frightened [4]
- 5=Extremely frightened [5]

STAND INDEX [weight = *2]

- **stand** (Was it difficult to stand or walk?)
- _=No answer / Did not try
- 0=No [0]
- 1=Yes, difficult to stand [1]
- 2=Yes, I was fallen [1]
- 3=Yes, I was forcibly thrown to the ground [1]

PICTURE INDEX [weight = *2]

- **picture** (Did pictures on walls move or get knocked askew?)
- _=No answer / No pictures
- A=No [0]
- B=Yes, but did not fall [1]
- C=Yes, and some fell [1]

FURNITURE INDEX [weight = *3]

- **furniture** (Did any furniture or appliances slide, tip over, or become displaced?)
- _=No answer / No furniture
- 0=No [0]
- 1=Yes [1]

DAMAGE INDEX [weight = *5] most impact on summary

- **d_text** (If you were inside, was there any damage to the building?)
- if selected, question is indicated with a *. Our order of questions is different than Wald. Only the largest checked question is taken for the damage index!*
- 1. No damage (d_text[0]=* if selected) [0]
- 2. Hairline cracks in walls (d_text[1]=* if selected) [0.5]
- 3. A few large cracks in walls (d_text[2]=* if selected) [0.75]
- 4. Many large cracks in walls (d_text[3]=* if selected) [1]
- 5. Ceiling tiles or lighting fixtures fell (d_text[4]=* if selected) [1]
- 6. Cracks in chimney (d_text[5]=* if selected) [1]
- 7. One or several cracked windows (d_text[6]=* if selected) [0.5]
- 8. Many windows cracked or some broken out (d_text[7]=* if selected) [2]
- 9. Masonry fell from block or brick wall(s) (d_text[8]=* if selected) [2]
- 10. Old chimney, major damage or fell down (d_text[9]=* if selected) [2]
- 11. Modern chimney, major damage or fell down (d_text[10]=* if selected) [3]
- 12. Outside wall(s) tilted over or collapsed completely (d_text[11]=* if selected) [3]
- 13. Separation of porch, balcony, or other addition from building (d_text[12]=* if selected) [3]
- 14. Building shifted over foundation (d_text[13]=* if selected) [3]

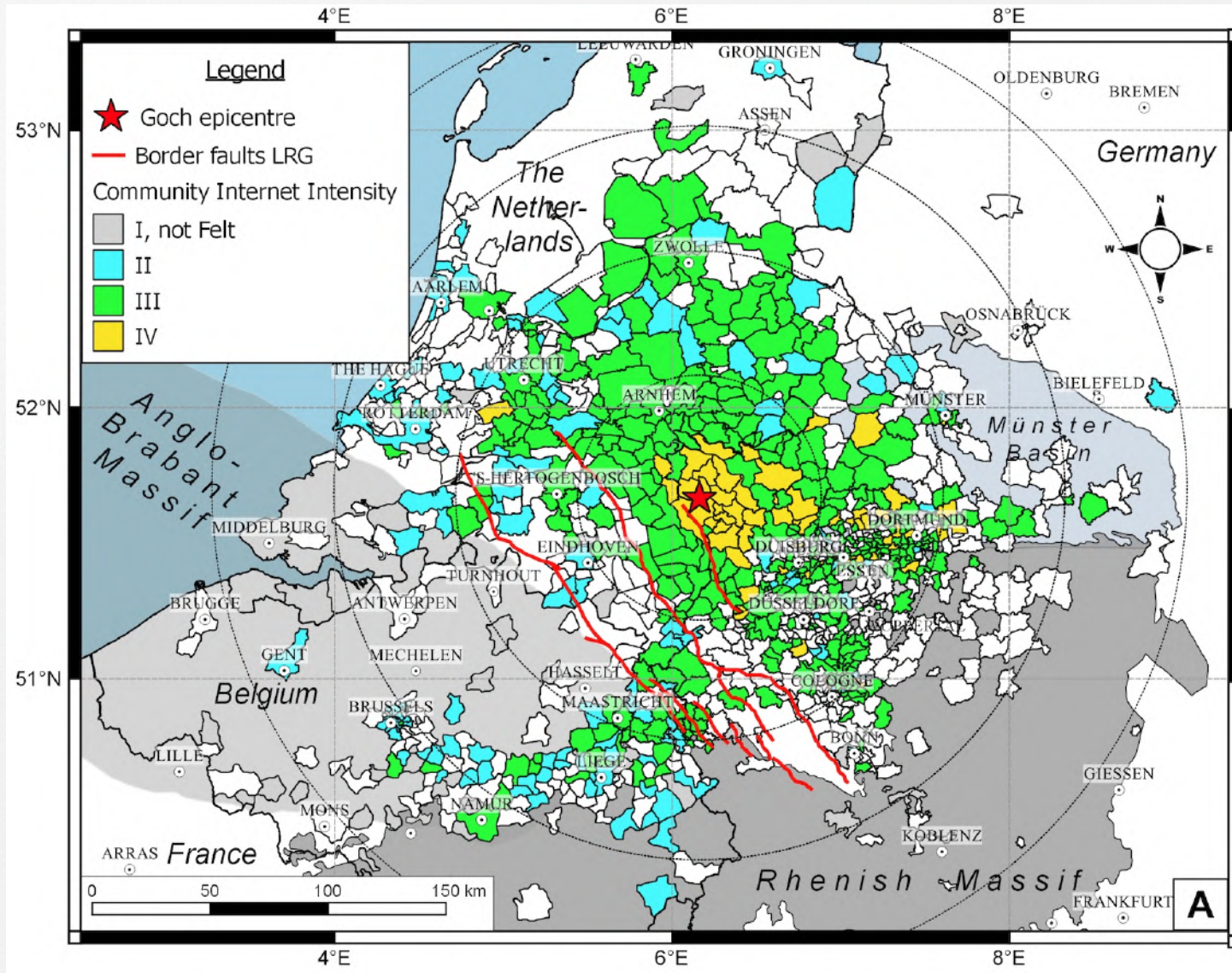
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Did You Feel It? - Scientific impact

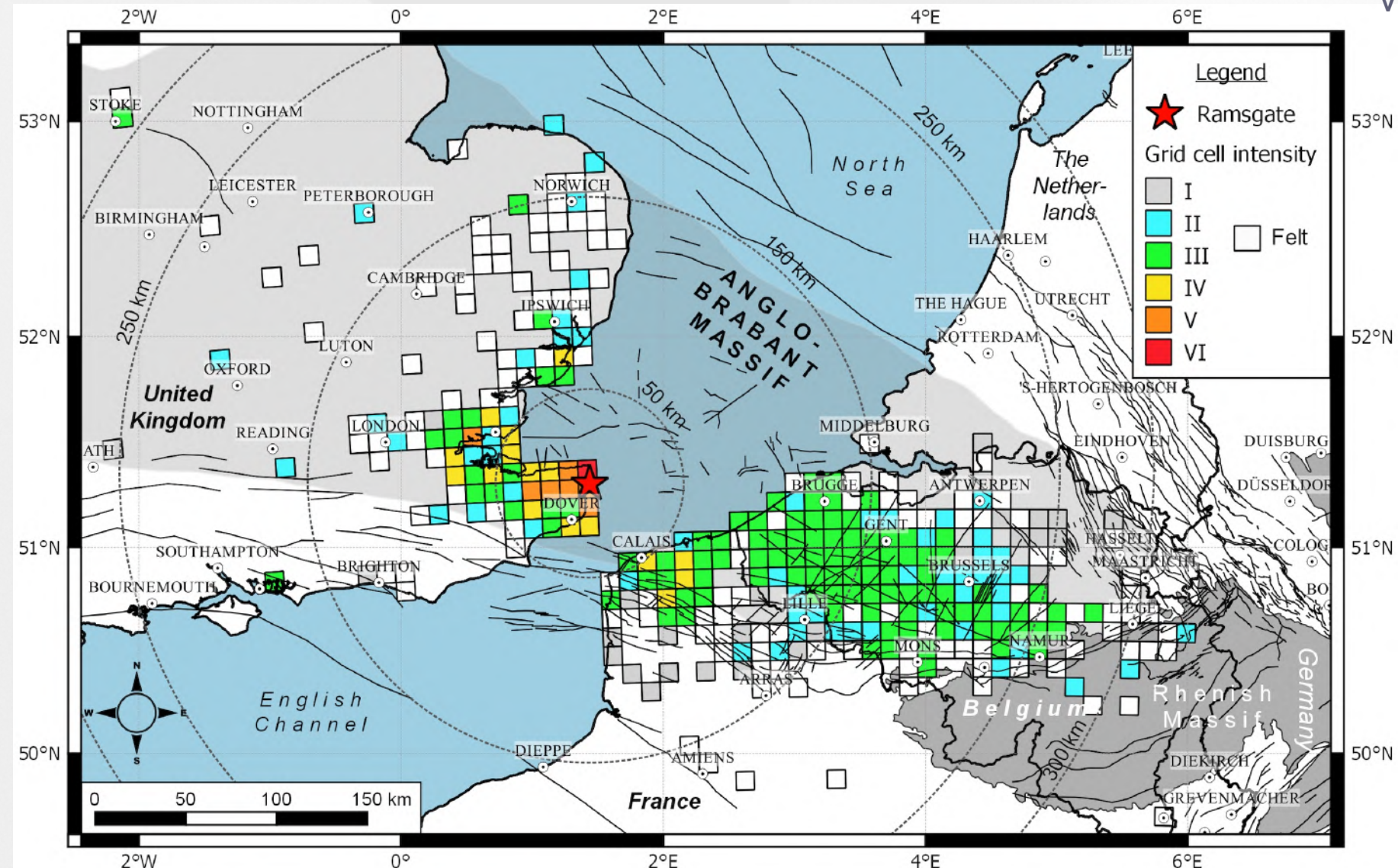
- Ground motion in BE not homogeneous: Flanders → site effect
- Database is an important source for simulating impact

Van Noten et al. 2017

Solid Earth 8



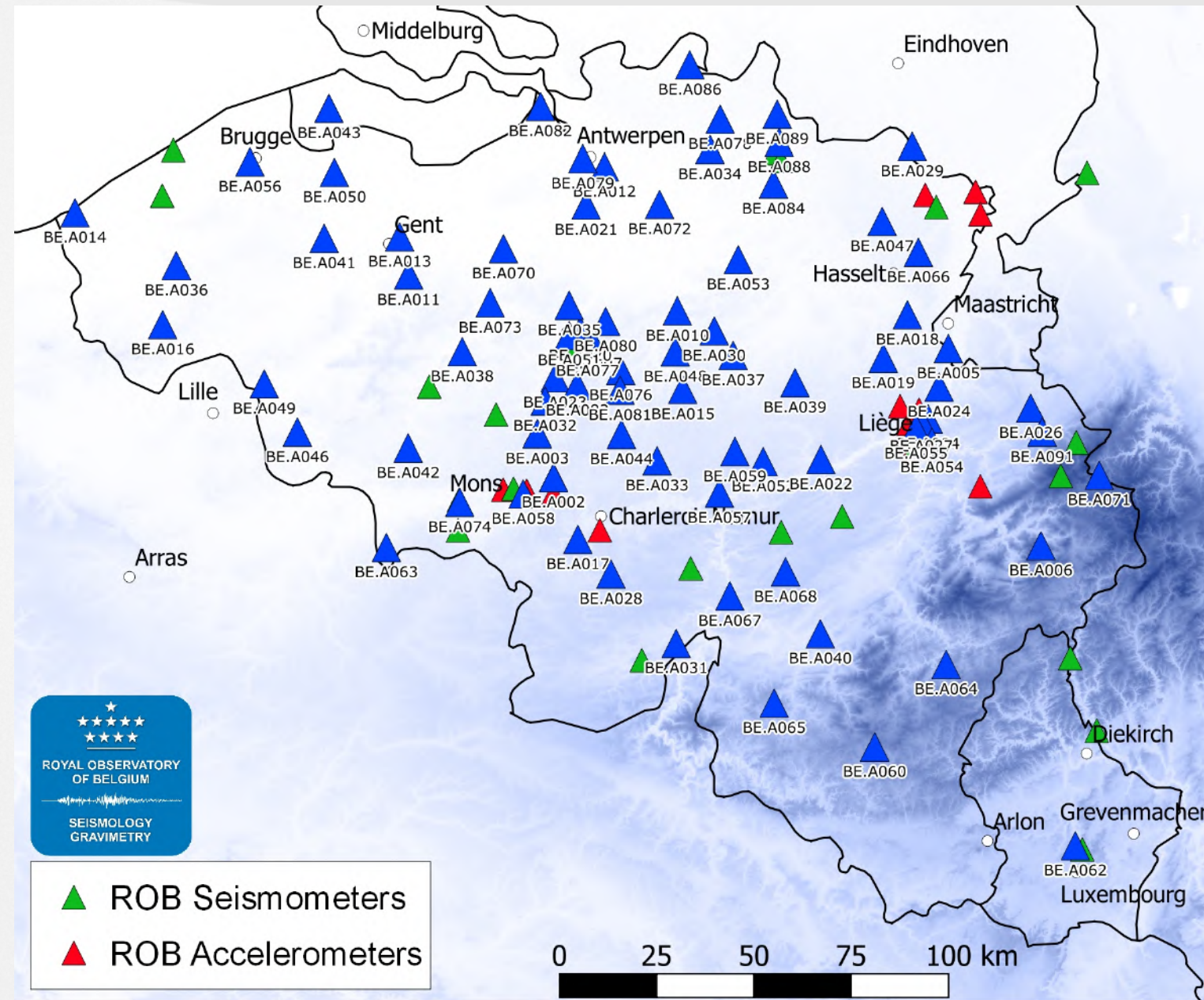
ML 4.3 Goch earthquake (2011)
> 10K reports, ~4K from ROB-BNS



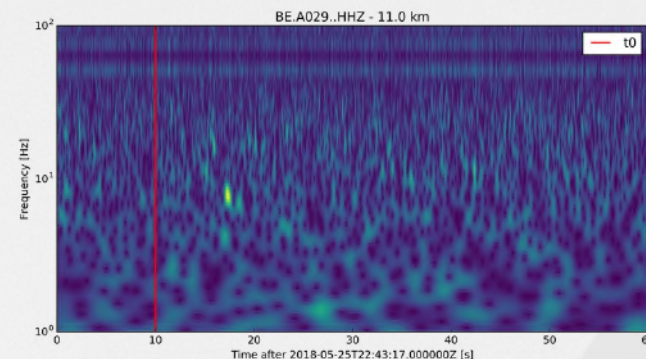
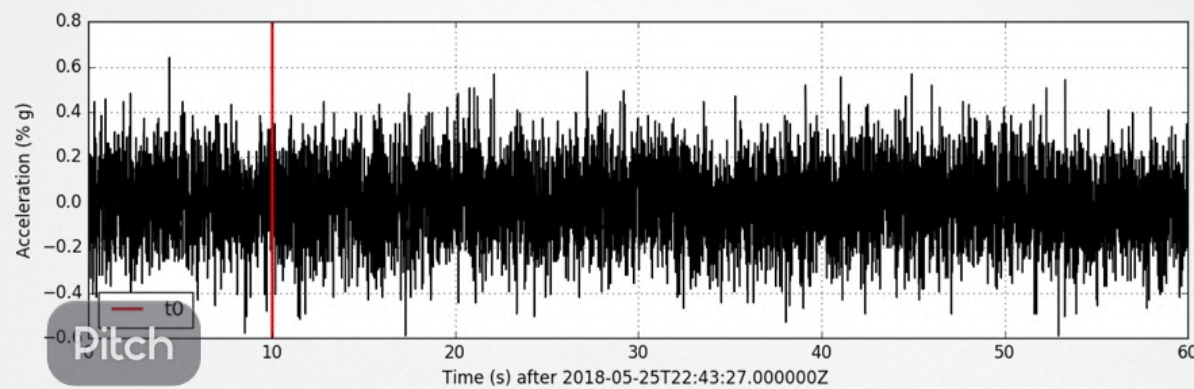
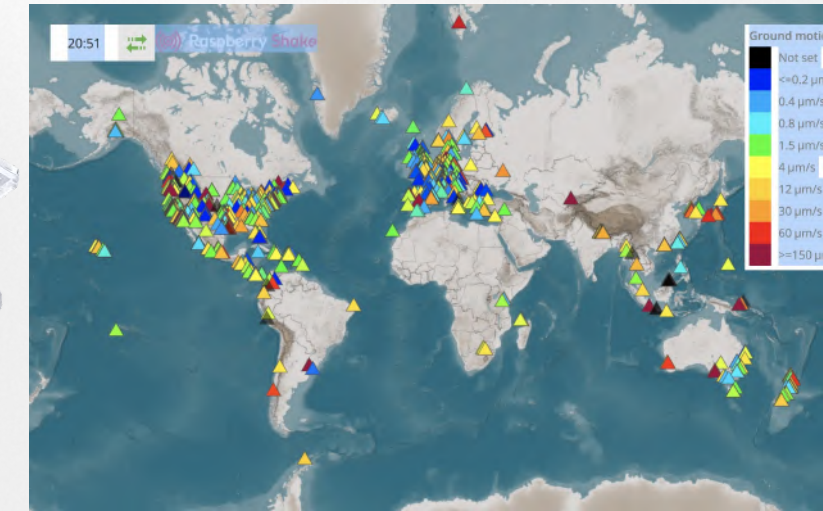
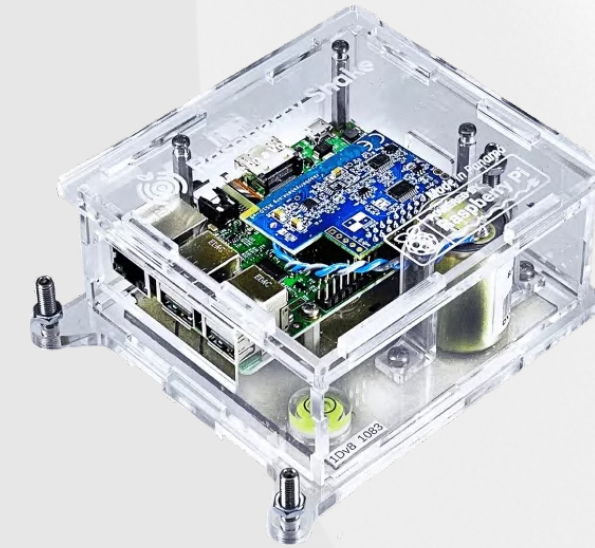
ML 4.1 Ramsgate earthquake (2015)
> 6K reports, ~2K from ROB-BNS

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AcceleROB: inhouse citizen science accelerometer



Future ?
Raspberry Shake
commercial solution



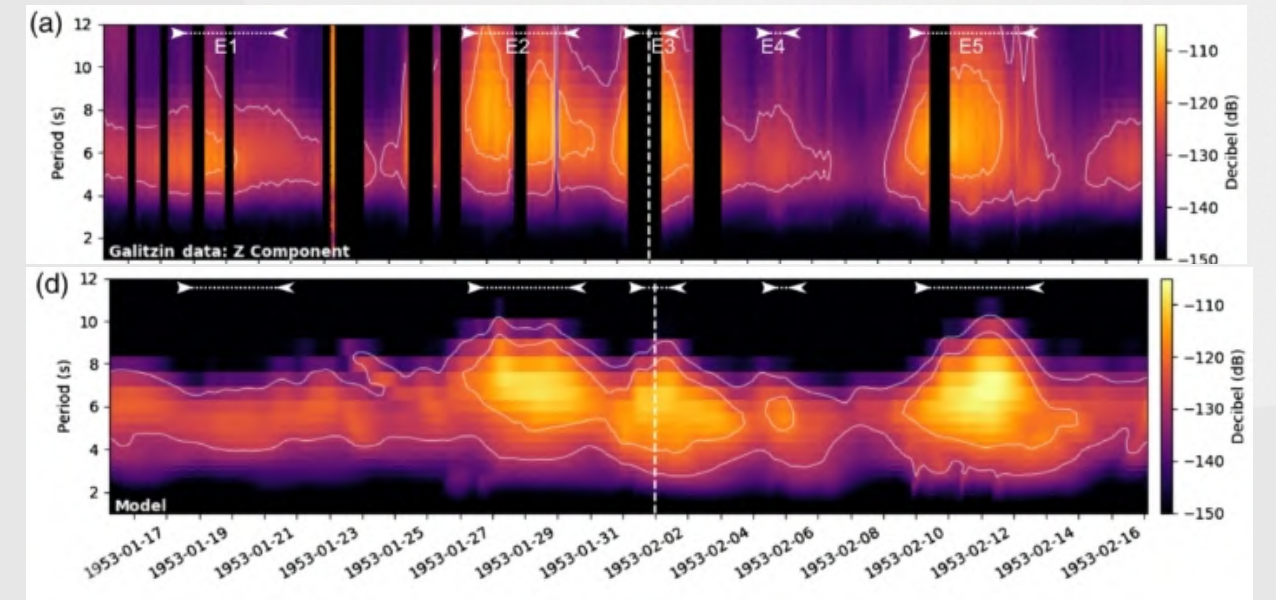
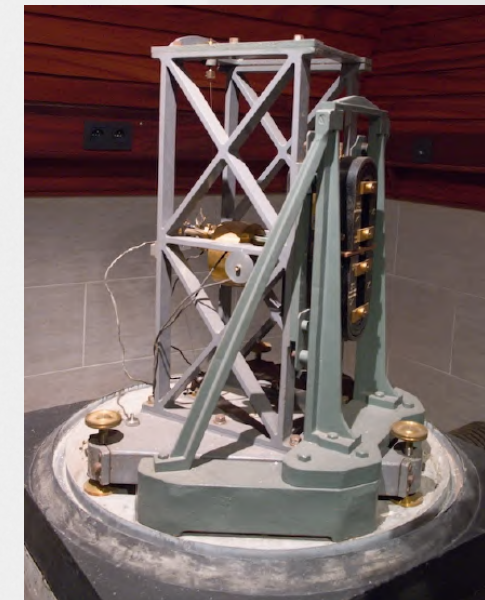
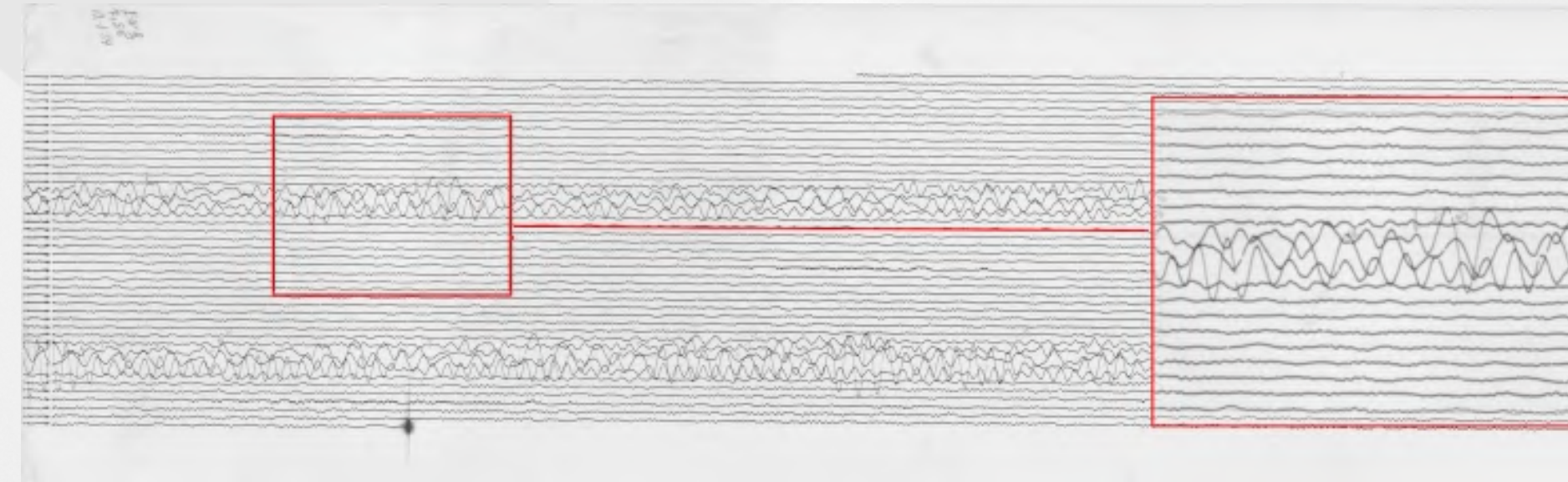
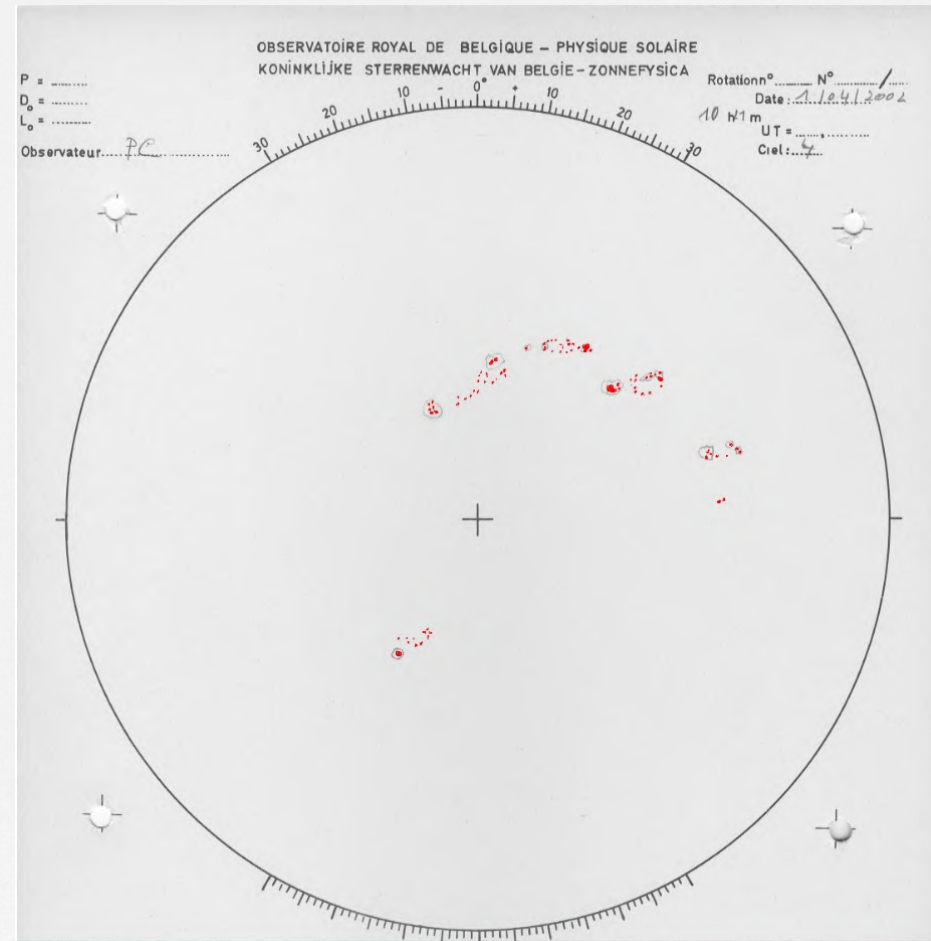
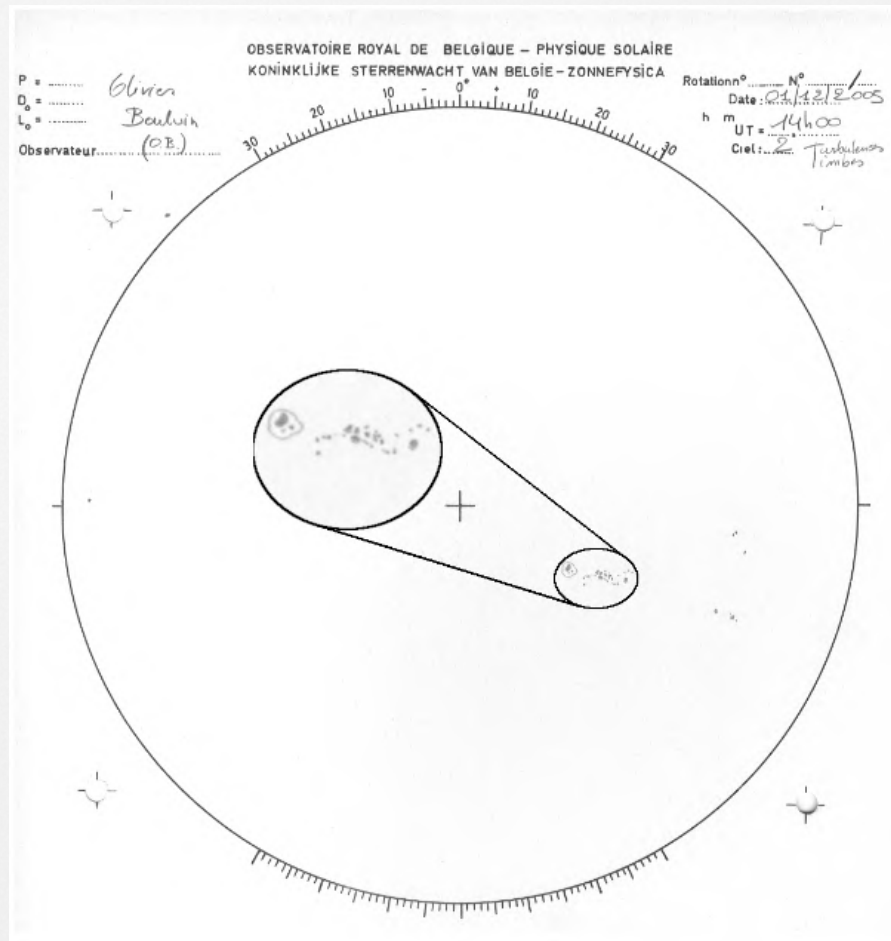
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Other ROB Citizen Science projects



Future ROB Citizen Science project

SEISMOSTORM BRAIN 2.0 2021-2023



Lecocq et al 2020, SRL

- Hand drawings of sun spots
- 80 yr of continuous solar activity
- Citizen science to count sunspots
- 774 analysed drawings
- 208 participants
- Still ongoing



- Scanned analog seismograms
- Algorithm detects wiggle shape
- Semi-automatic correction needed

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Past funding, problems and needs for funding citizen science

Past funding ?

- DYFI? operations, 1 PhD: internal ROB funds
- Valorisation project: FNRS postdoc (2014-2016)
- VAL-U-SUN: BRAIN.be Axis 3 & 6 (2017-2021)
- Other projects (FNRS: PhD; Belspo: AcceleROB) *not granted*



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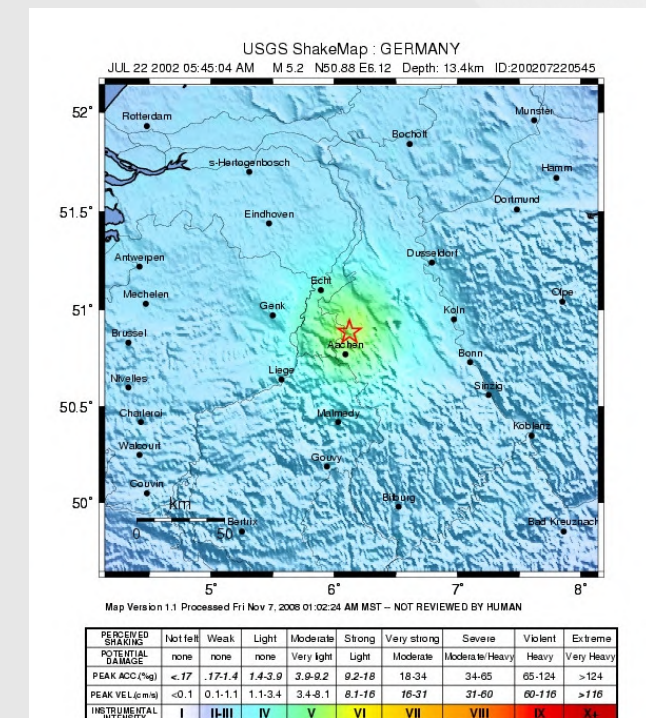


Needs ?

- Call for valorisation of crowdsourcing/citizen science
- Brain.be 2.0 Pillar 2 - Heritage science

Problems ?

- Earthquake impact simulation → beyond operational work
- Needed for local cross-border initiatives !
Federal institutes not able to participate to local (Interreg) initiatives



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References

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Wanna know more?

DYFI? <http://www.seismologie.be/en/research/seismology/macroseismology>

Val-U-Sun: <https://www.sidc.be/valusun/citizenscience/index.php>

SeismoStorm & legacy seismograms: <https://www.legacy-seismograms.eu/>

AcceleROB: <http://seismologie.be/accelerob/index.html>

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