Global Distributed Fibre Optic Sensing recordings of the February 2023 Turkiye earthquake sequence

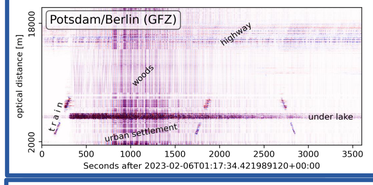
Philippe Jousset[1], Andreas Wuestefeld[2], Charlotte Krawczyk[1], Alan Baird[2], Gilda Currenti[3], Martin Landrø[4], Andy Nowacki[5], Zack Spica[6], Sandra Ruiz Barajas[7], Fabian Lindner[8], Özgün A. Konca[9], Pascal Edme[10], Voon Hui Lai[11], Vladimir Treshchikov[12], Lena Urmantseva[13], Jan Peter Morten[14], Werner Lienhart[15], Bradley Paul Lipovsky[16], Martin Schoenball[17], Kuo-Fong Ma[18], and the "DAS-month" team.

[1] GFZ Potsdam, Potsdam, Germany (philippe.jousset@gfz-potsdam.de);[2] NORSAR, Norway; [3] INGV, Italy; [4] NTNU, Norway; [5] The University of Leeds, UK; [6] University of Michigan, USA, [7] National Geographic Institute of Spain, Spain; [8] LMU Munich, Germany; [9] Bogazici University, Turkey; [10] ETHZ, Switzerland; [11] Australian National University, Australia; [12] T8 Sensor LLC, Russia; [13] AP Sensing, Germany; [14] Alcatel Submarine Network, Norway; [15] Graz University of Technology, Austria; [16] Department of Earth and Space Sciences, University of Washington, United States; [17] NAGRA, Switzerland; [18] Institute of Earth Sciences, Academia Sinica, Taiwan. The "DAS-month" team composition is listed on the abstract (https://doi.org/10.5194/egusphere-egu23-17618).

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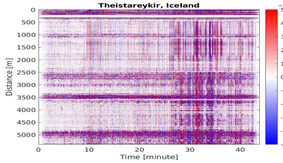
Potsdam (Germany)

A 20 km long telecommunication cable across Potsdam city and forest (Silixa iDAS)



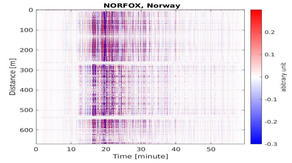
Theistareykir (Iceland)

A 30 km long telecommunication cable across geothermal area (Silixa iDAS) – shown 5.5 km.



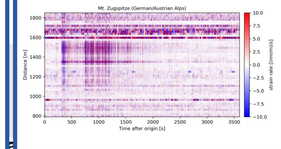
Svalbard and NORFOX (Norway)

- A 1.5 radius flower network of NORFOX (OptoDAS)
- A submarine cable of 150 km long (OptoDAS)



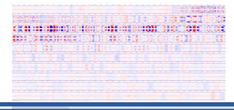
Mt. Zugpitze (Germany/Austria)

A dedicated 2 km long cable loosely placed on the ground of tunnels beneath ridge of Mt. Zugspitze (Germany/Austria). Topography effects may influences the recordings (Silixa iDAS).



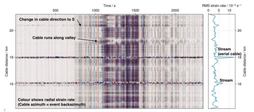
Graz (Austria)

A 0.6 km long telecommunication cable in the city center, in a double loop.



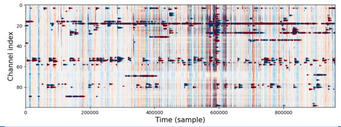
Eskdalemuir and North Sea (UK)

- A 90 km long submarine cable (OptoDAS)
- A dedicated cross network 5 km radius (Febus A1)



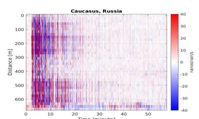
Seattle (USA)

An urban cable in Seattle interrogated by a Sintela Onyx v1.0 interrogator (see Lipovsky, 2023).



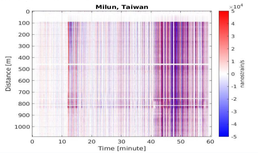
Kislovodsk (Caucasus, Russia)

A 0.7 km long cable from the Sternberg Astronomical Institute, Moscow State Univ. (DAS "Dunay", developed by T8 Sensor, LLC)



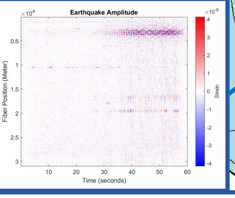
Milun (Taiwan)

A ~1 km long cable deployed at surface and behind casing in a borehole crossing an active fault (Silixa iDAS)



Madrid (Spain) .

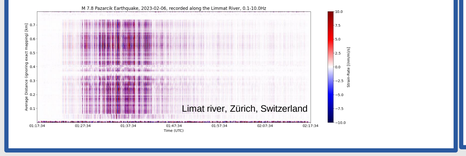
A 36 km long cable from ADIF (Administrador de Infraestructuras Ferroviarias of Spain), along high speed train track from Madrid-Valladolid, mostly in a tunnel tunnel across the Guadarrama mountain range (HDAS, Aragon Photonics).



Zürich, St Gallen (Switzerland)

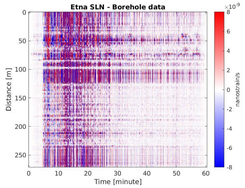
Various arrays in Switzerland:

- Glattfelden: a TBO STA3-1 cable in a vertical borehole near Stadel. Cased borehole (see report NAB 22-50 on nagra.ch). BRUsens T 190 C stainless-steel loose tube-in-tube sensing (Febus Optics A1-R).
- Nesslau-Neu St.Johann to St Gallen: a 44.5 km long cable along a railway (AP sensing).
- Zürich: a 800m long dark fiber in a duct running along the Limmat river in Zurich (1m channel spacing, 400Hz, gauge length of 10m, Silixa iDAS)



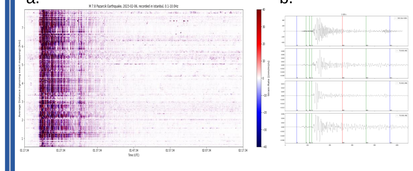
Etna volcano (Italy)

A dedicated 300 m long cable, 100 m at the surface and 200 m depth, 1 m channel spacing, 100 Hz (Silixa Carina)



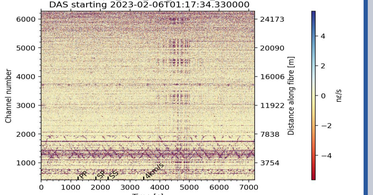
Istanbul (Turkiye)

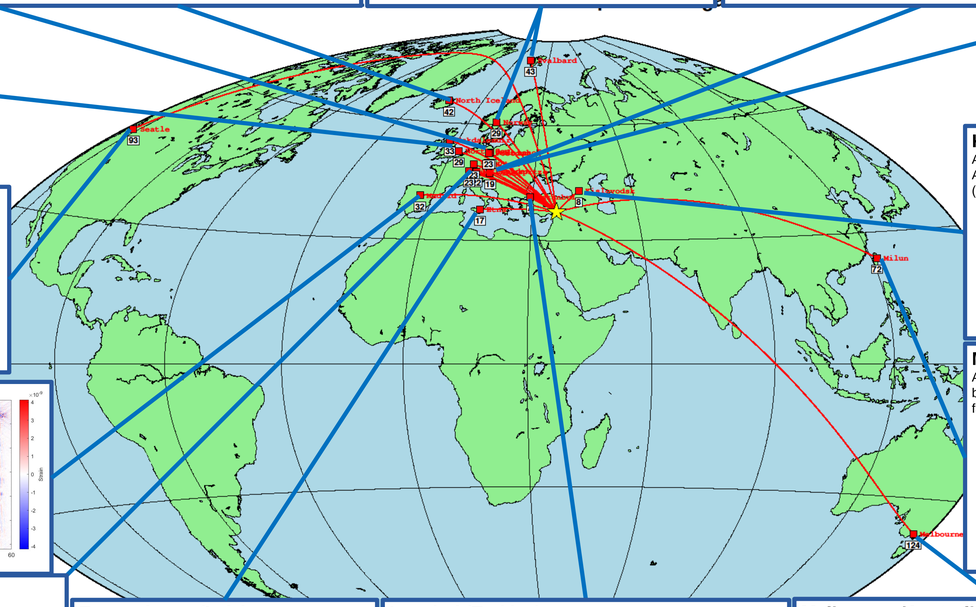
An urban dark fiber, along the coast of the sea of Marmara on the Asian side, 8 km long, 16m channel spacing, 100Hz (Silixa iDAS). **a.** Waterfall plot of the record. **b.** comparison of one of the trace strain rate with a closeby broadband seismometer.



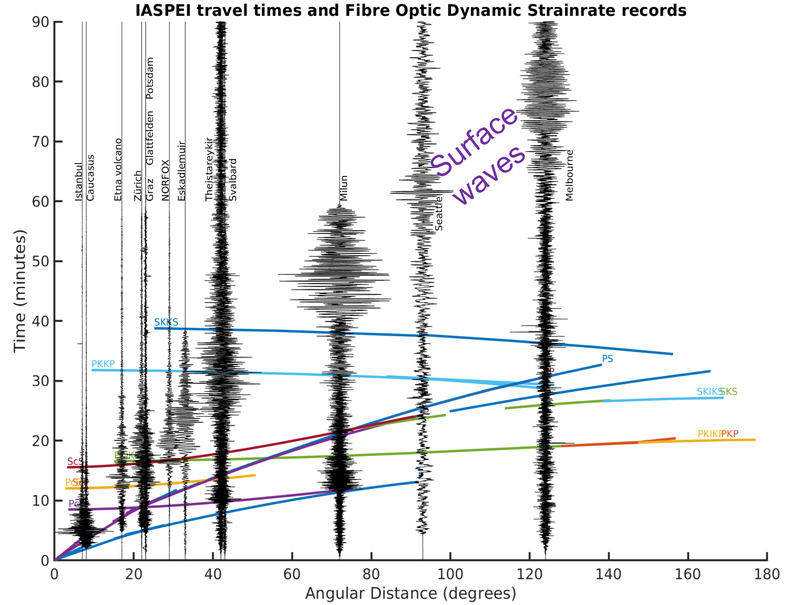
Melbourne (Australia)

A 25-km long telecommunication cable across urban Melbourne along major arterial roads and tram lines (Silixa iDAS).





IASPEI travel times and Fibre Optic Dynamic Strainrate records



Selected records of dynamic strain for 90 minutes after the Turkiye M7.8 earthquake (1:17:34) recorded by different interrogators deployed all over the world.
Theoretical arrival times computed from the matlab tool box (Knapmeyer, 2004) for various phases (P, S, ScS, PKiKP, SKS, etc). The records clearly show a good correspondance. All traces are filtered between 0.01 Hz and 0.5 Hz. The various records are not calibrated.

- **„DAS Month" initiative allowed to gather records of earthquakes for one month.**
- **The Turkiye earthquake sequence was recorded with many fibre optic interrogators all over the world. Data described is publicly available from PubDAS (Spica et al., 2023).**
- **We demonstrate that Fibre Optic Distributed Dynamic Strain sensing can provide complementary data for global seismology research, with strain (rate) observations.**
- **Local response highly dependent on site conditions and environmental noise.**

References:
Knapmeyer, M. (2004): TTBox: A MatLab Toolbox for the Computation of 1D Teleseismic Travel Times; Seis. Res. Lett., vol. 75, No. 6, 726-733
Spica et al., (2023). PubDAS: A PUBlic Distributed Acoustic Sensing Datasets Repository for Geosciences. Seis. Res. Lett 94 (2A): 983–998. https://doi.org/10.1785/0220220279
Lipovsky, B. P. (2023). *2023 Türkiye Earthquake*. University of Washington Photonic Sensing Facility. https://doi.org/10.6069/N3V7-5887
Wessel, P., Luis, J. F., Uieda, L., Scharroo, R., Wobbe, F., Smith, W. H. F., & Tian, D. (2019). The Generic Mapping Tools version 6. Geochemistry, Geophysics, Geosystems, 20, 5556-5564. https://doi.org/10.1029/2019GC008515