

Supporting Information for “4D Physics-Based Pore Pressure Monitoring Using Passive Image Interferometry”

Eldert Fokker¹², Elmer Ruigrok¹², Rhys Hawkins¹³, Jeannot Trampert¹

¹Department of Earth Sciences, Utrecht University, Princetonlaan 8a, 3584 CB, Utrecht, the Netherlands

²R&D Seismology and Acoustics, Royal Netherlands Meteorological Institute, Utrechtseweg 297, 3731 GA, De Bilt, the Netherlands

³Now at: School of Computing and Research School of Earth Sciences, Australian National University, Acton ACT 2601, Australia

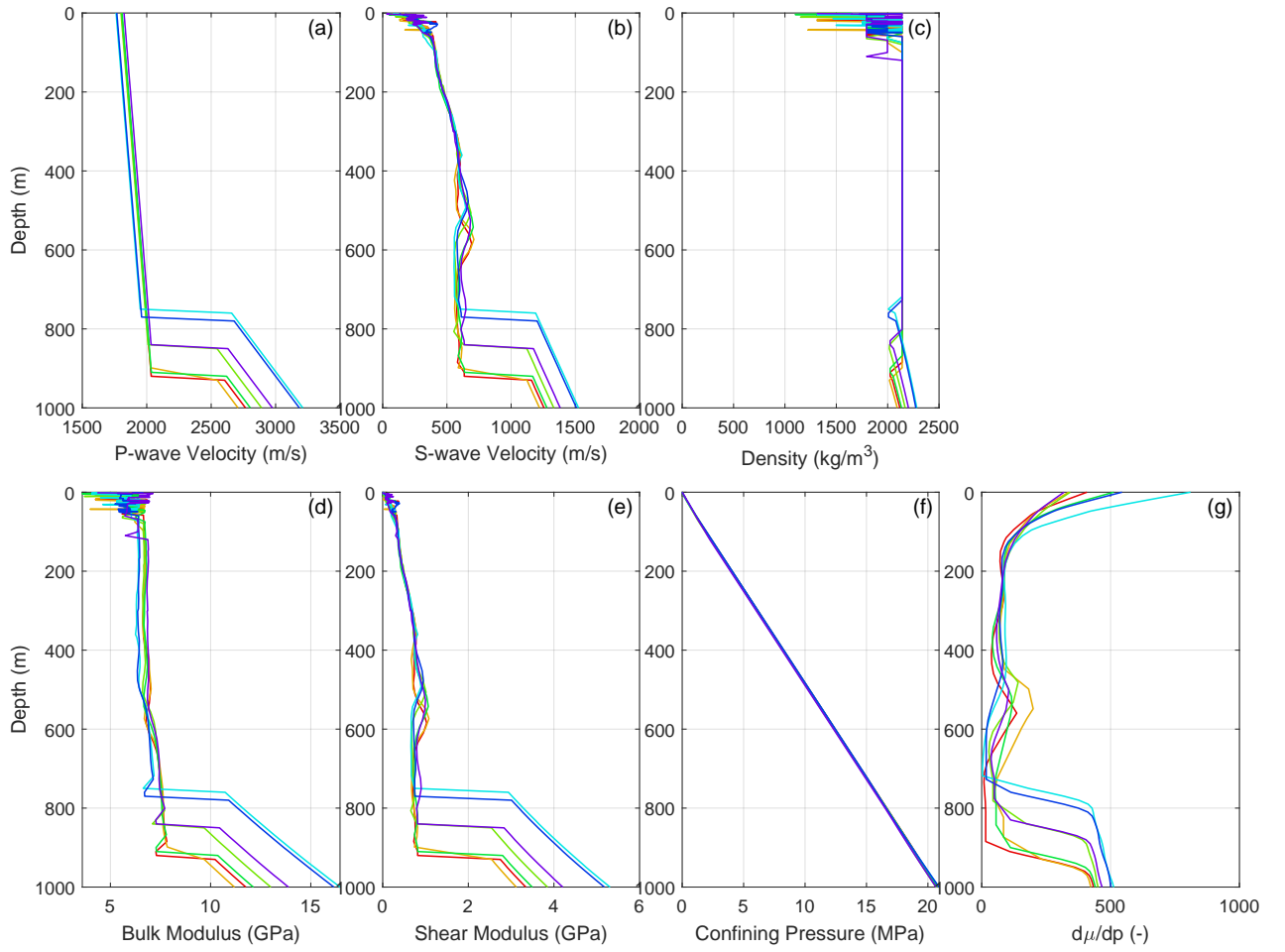


Figure S1. Elastic models for the regions indicated by the colored circles in Figure 1: (a) Compressional-wave velocity v_p , (b) shear-wave velocity v_s , (c) mass density ρ , (d) bulk modulus $\kappa = \rho v_p^2 - \frac{4}{3} \rho v_s^2$, (e) shear modulus $\mu = \rho v_s^2$, (f) confining pressure $P = \int_0^z \rho(z)g \, dz$, with g the gravitational acceleration and z the depth below surface, and (g) pressure derivative of the shear modulus $\mu' = d\mu/dp$, based on the smoothed derivative of the shear modulus with respect to confining pressure.

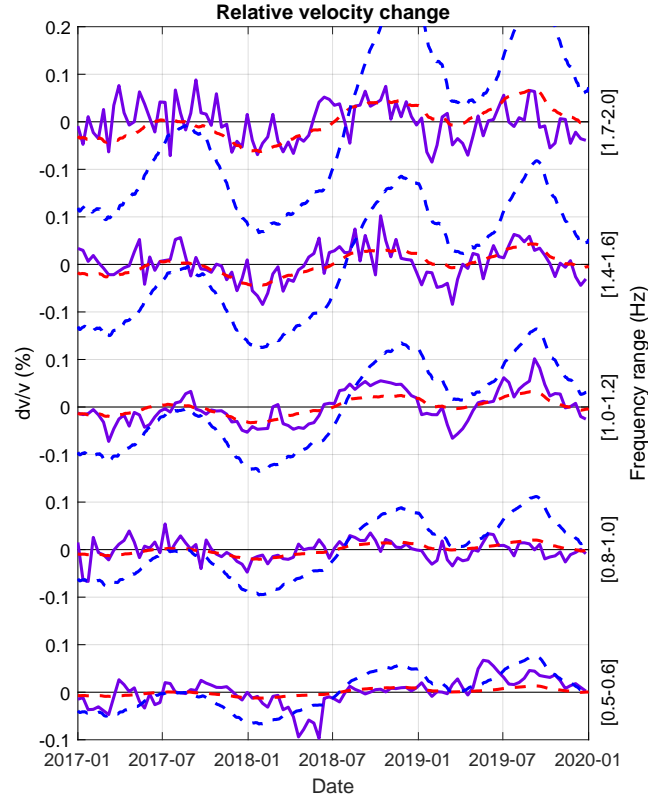


Figure S2. Models and observations of seismic velocity changes for the region indicated in Figure 1 in purple. The purple curves represent the velocity changes for six frequency ranges estimated using passive image interferometry (Sens-Schönfelder & Wegler, 2006) on the vertical components, while the red and the blue dashed curves show respectively the fundamental Rayleigh- and Love-wave velocity changes as modelled (Fokker et al., 2021) from pore pressure observations at the borehole piezometer (Fig. 1, blue point; Dinoloket, 2022).

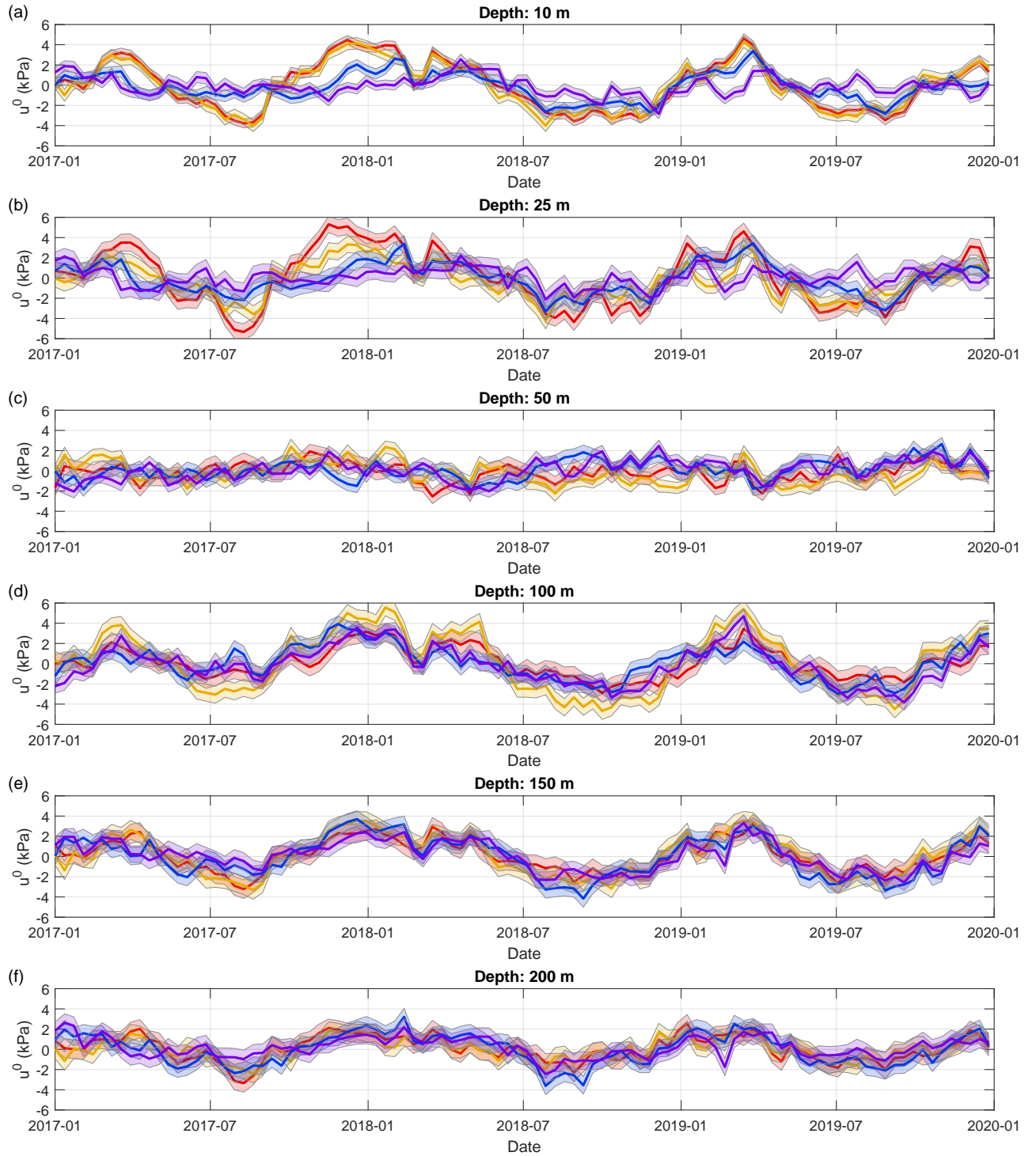


Figure S3. Comparison between pore pressure variations as modelled for different regions and depths. The pore pressure change has been modelled using Equations 12 and 7 (solid lines; colors correspond to regions in Fig. 1), while the uncertainty range was modelled using the squareroot of the diagonal of the posterior model covariance (Eq. 15; Fig. 3g). The uncertainty ranges of the shallow models in the northwest and the southeast do not overlap, indicating a significant difference. Lateral variations of deeper pore pressure models, however, fall within the uncertainty and can therefore not be classified as significant.

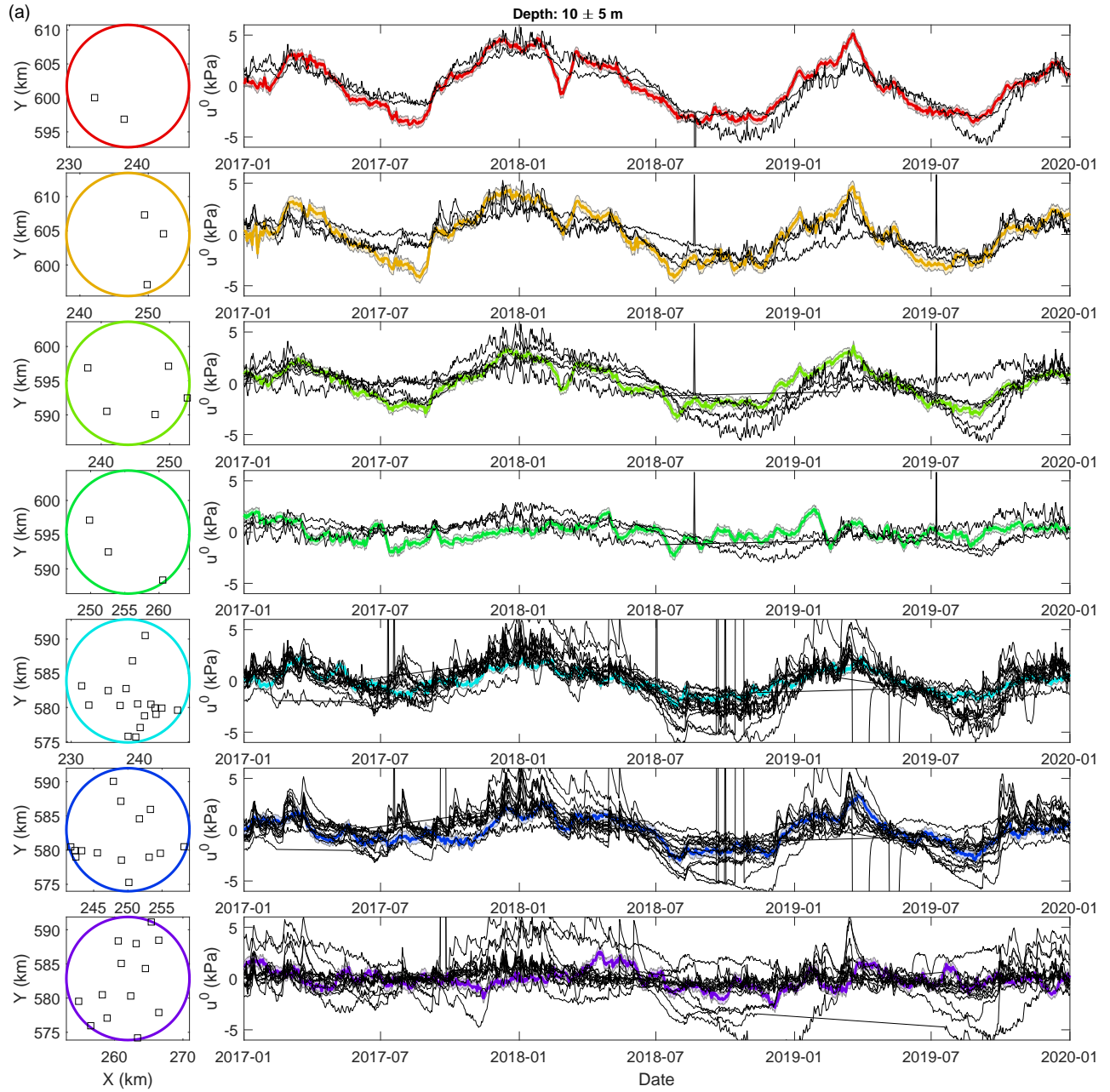


Figure S4. (cont.)

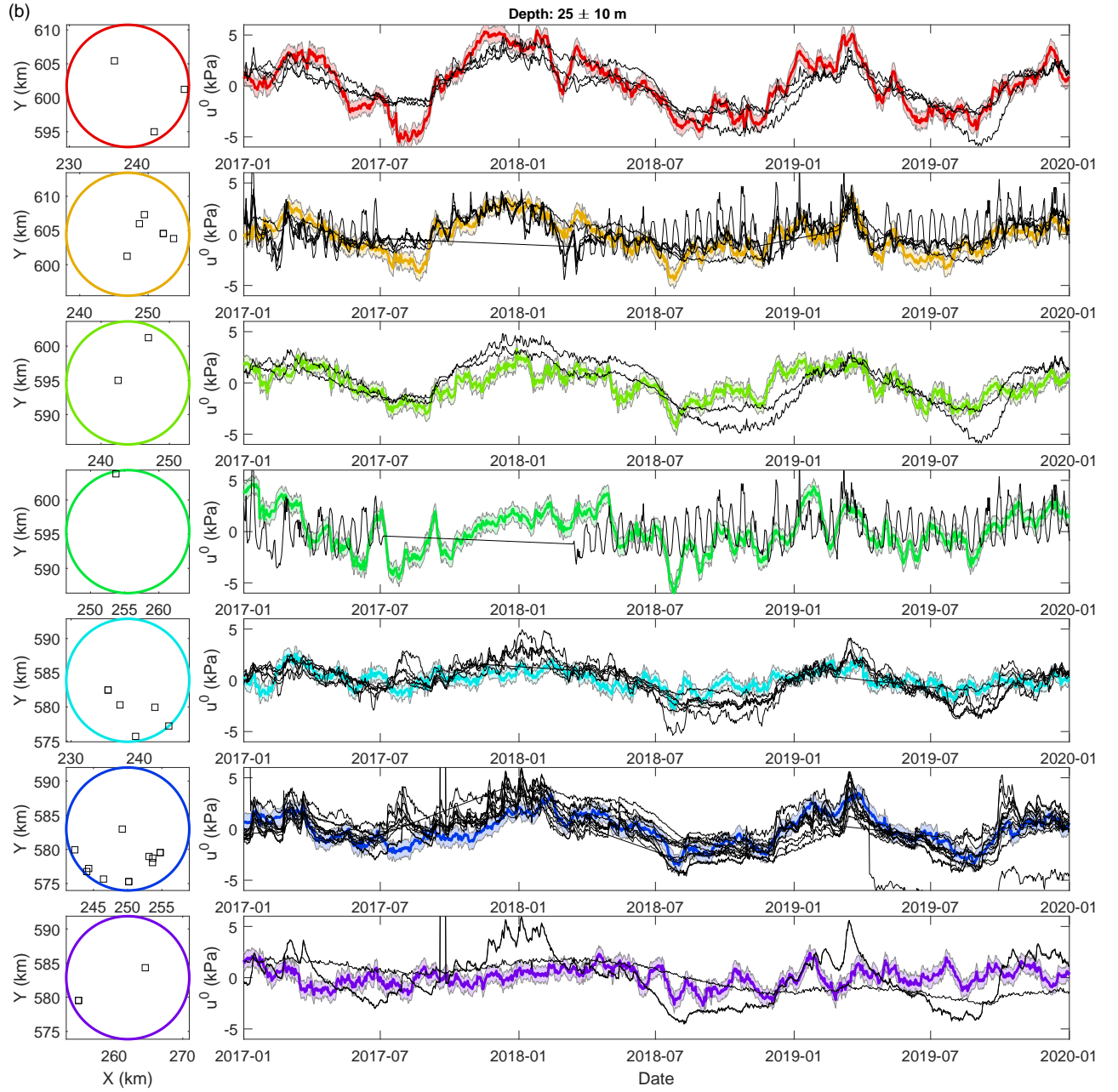


Figure S4. Comparison between pore pressure variations as modelled in this study and measured by local shallow piezometers (*Grondwatertools*, 2022). Left: Map views of separate regions in accordance with Figure 1, indicating locations of the piezometers as black squares. Right: Pore pressure variations as modelled in accordance with Section 5 for the region shown on the left, and measurements of pore pressure change (black) at the locations of the piezometers shown on the left. The pore pressure models are shown for depths of (a) 10 m and (b) 25 m, whereas the piezometric measurements are obtained (a) between 5 and 15 m depth and (b) between 15 and 35 m depth.

References

- Dinoloket. (2022). *Groundwater research; borehole identification B08C0952*. <https://dinoloket.nl/ondergrondgegevens>. (Last accessed: 7 September 2022)
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- Sens-Schönfelder, C., & Wegler, U. (2006). Passive image interferometry and seasonal variations of seismic velocities at Merapi Volcano, Indonesia. *Geophysical Research Letters*, 33(21).