Physics-based model relating seismic velocity variation to groundwater and pore pressure fluctuation

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Previous studies examining the relationship between the groundwater table and seismic velocities have provided contradictory results, sometimes reporting positive and sometimes negative correlations between seismic velocity and groundwater table changes. Here we introduce a physics-based model relating fluctuation in the groundwater table and the pore pressure to seismic velocity variation through change in effective stress. This model can be used to explain the contradictory results of previous studies and justifies the use of seismic velocity variation for monitoring of the pore pressure and the groundwater table. It further results in a new field method to measure the pressure dependency of the shear modulus. Using data acquired in Groningen, the Netherlands, we demonstrate that measurements of seismic velocity variation can be used to monitor the pore pressure.