Homework Session: Ultimate Tomography Bake-Off Challenge Using BHRS Data

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For this homework session, we propose to explore the use of two novel methodologies for the inversion of the BHRS crosshole and borehole-to-surface GPR and seismic traveltime data. First, we will investigate inverting the different data sets taking into account the possibility of angle- and source/receiver-position-dependent traveltime corrections (Figure 1). This relatively simple approach, proposed by Irving et al. (2007), has been shown in a number of cases to greatly improve the results of crosshole traveltime inversions and provide significantly better fits to collocated borehole log measurements. The approach has not yet been applied to seismic data. It will also be interesting to explore what types of static shifts may be necessary to properly assimilate the crosshole and borehole-to-surface geometries. The second methodology that we will investigate within the context of this homework problem is the characterization of uncertainty in the subsurface region through the use of a Bayesian Markov chain Monte Carlo inversion strategy. Here, we will utilize a facies-based parameterization approach in order to improve the computational tractability of the problem and generate multiple posterior realizations of subsurface geophysical parameters that fit the observed data.

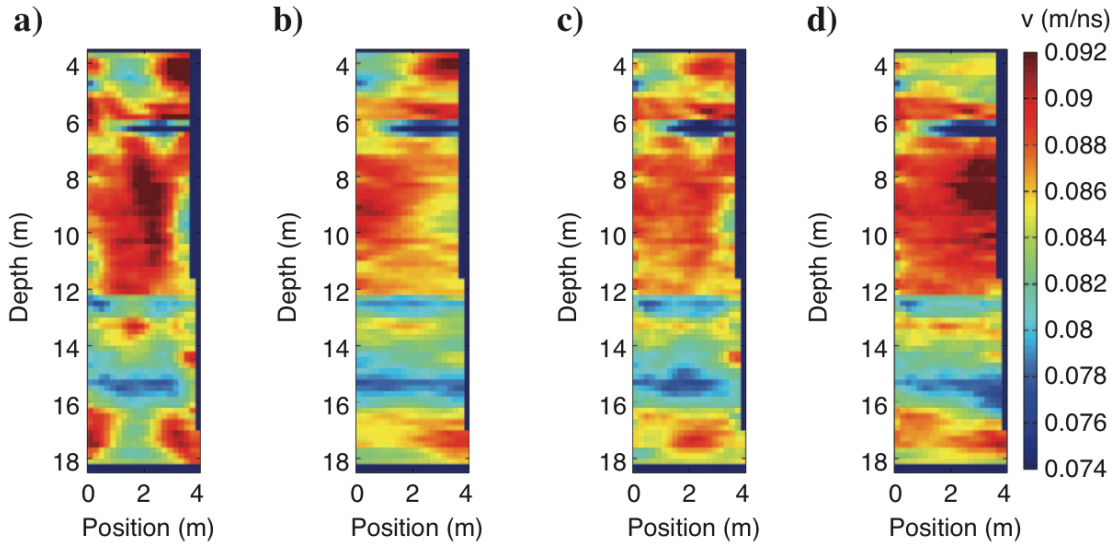

Figure 1: Traveltime inversion of BHRS crosshole GPR data collected between boreholes A1 and B2. (a) Result of applying the standard crosshole GPR inversion strategy to all available data; (b) result of applying the same standard inversion strategy to an aperture-limited (<30°) subset of the data; (c) result of allowing for an angle-dependent traveltime correction in the inversion of all available data; (d) result of allowing both angle- and receiver-position-dependent traveltime corrections in the inversion of all available data. From Irving et al., Geophysics, 2007.