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Development of ground-motion prediction equations from a weighted mixture model with data-driven weights

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The steady increase of ground-motion data allows new possibilities but also comes with new challenges in ground-motion modelling and the development of ground-motion prediction equations.
One challenge is data selection - not all data can be processed equally - and we introduce an extension of the widely used mixed effect model, i.e. a model of fixed and random effects.
The extension incorporates data selection by assigning weights per event and model parameters are inferred by weighting the record data accordingly.
This advancement allows for the possibility of data classification beyond the more classical, expert-driven, binary classification based e.g. on the depth of the event, distance to the trench, style-of-faulting and dip angle of the fault plane.
We apply ACE - (A)ngular (C)lassification with (E)xpectation-maximization - a method to efficiently identify clusters of nodal planes from focal mechanisms to differentiate between interface and intraslab type events.
The classification is continuous, i.e. no event belongs completely to one class and classification uncertainty is then evaluated and taken into account in the ground-motion modelling.
As an example, we developed a ground-motion prediction equation from a database of approximately 2400 records from 319 events in the Chilean subduction zone.
Our ground-motion model with the data-driven and reproducible classification is comparable to the expert classification based model.
Furthermore, the models show temporal variations of the between-event residuals before and after large earthquakes in the region.