Development of Automated SKS Splitting Measurement

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We have implemented an automated system to measure shear wave splitting in SKS and SKKS arrivals for stations and networks where waveform data are freely available and archived. Pending review by the Governing Council, the ISC plans to include these measurements in its On-line Bulletin as an aid to studies of anistropy in the Earth.

We intend to make automated measurements only for strong, clear signals, and at distances where there is no chance of contamination from S, ScS, Sdiff or other phases, as predicted by the IASP91 earth model. Phase onset will be more accurately identified using a simple STA/LTA picker, and suitable window lengths selected around this point. We find that for strong, clear signals, results are stable across window lengths differing by up to and exceeding 10 seconds, and intend to use this to discriminate between reliable and less reliable measurements. The window from which measurements are reported will be decided statistically, and thus far we have good agreement between these automated results and user made measurements. We find that narrow band filtering of noisy data does not create a clean signal useful for measuring splitting, but that applying a broader band pass filter between 0.01 and 0.3 Hz is useful to minimise the effect of local high frequency noise.

Typically investigators report the polarization angle and lag time that minimize either the energy on the transverse component, or the smaller eigenvalue in the covariance matrix. We find large differences between results from minimising either function to be rare, but for some stations such as EDM, (Edmonton, Canada), can be as large as 25 degrees and 0.7 seconds. Poor signal quality and lateral variations in the mantle or crust may contribute to differences, and we intend to publish results from both methods. Our measurements thus far have failed to distinguish significant differences between results in the (R,T,Z) and (L,Q,T) co-ordinate systems. We realise that this limitation occurs because we are using only SKS and SKKS phases with near-vertical ray paths in the upper mantle, and that splitting measuremnts in the (R,T,Z) co-ordinate system cannot be used to infer dipping anisotropy.

We find that error estimates following the method of Silver and Chan (1991), may understate the true uncertainty of the parameters determined by user review of the objective function over an entire grid. We find that bootstrapping error estimates as described by Sandvol and Hearn (1994), occasionally overstate the uncertainty estimates but effectively flag poor measurements. We prefer the bootstrapping error estimates to avoid accidental use of parameters that may be grossly in error, but intend to publish both uncertainties in order to allow compatability between our results and those of other researchers.