GLOBAL ANALYSIS OF UPPER MANTLE ANISOTROPY USING AUTOMATED SKS SPLITTING MEASUREMENTS

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We have developed an automated method to measure shear wave splitting and applied it to SKS phases archived by various data centers. Using an automated system we are able to process data in a quantity and with a consistency not possible with manual measurements. To date we have processed over 100,000 station/event combinations from over 200 stations distributed globally, although our stringent quality control measures mean that only approximately 2 percent produce reliable estimates of splitting.

When a polarized shear wave passes through an anisotropic medium, it is split into two perpendicular S-waves that are separated in time. In measuring splitting, we seek a polarization angle and time shift that removes the effect of the anisotropy, minimizing either the energy on the transverse component or the smaller of the two eigenvalues calculated from the covariance matrix. We report results from both methods, to allow consistency in comparisons with the results of other researchers and because we find consistent differences in results at some stations. Error estimates are calculated using both the methods of Silver and Chan (1991) and Sandvol and Hearn (1994).

Where it is possible to compare, we find that our automated results agree well with manual measurements. The quality of results at individual stations is variable, being influenced both by the volume of available data (determined by station deployment date and the distribution of natural seismicity), and the performance of the STA/LTA picker used to define the start of the SKS window. When we have reliable results from a range of back azimuths, we compare the distribution of results with those predicted from single and multiple layers of anisotropy. Where this is not possible we report the polarization angle and lag time for the most convincing splitting measurement. Where even this is not possible and where a sufficient number of events have been processed, a station is interpreted as a null, which may mean that it is underlain by an isotropic or transversely isotropic mantle. For stations suggesting either single layer anisotropy or where an individual splitting measurement has been used, we find an average lag value of 1.15 seconds. There seems to be some relation between splitting parameters and tectonic environment.

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