Surface wave phase velocity dispersion and azimuthal anisotropy model for constraining crust and upper mantle structure

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In order to complement our global datasets of surface wave group arrival times, we have adapted our cluster analysis method of group velocity measurement to measure phase velocity. (see Figure 1) When measuring phase, we are no longer working with waveform envelopes and we must be very careful to avoid cycle-skipping. The initial source phase is calculated using a second order approximation of the associated Legendre functions. We then correct for source phase and the predicted phase shift due to 3d structure by using a nominal phase velocity map. This latter step is important at periods shorter than 100 seconds but is not necessary at longer periods.

We have processed all the long period data from IRIS for earthquakes with magnitude greater than 5.5. Current dataset for Rayleigh wave is complete from 5mHz to 35mHz. More than 30% of our measurements since 2005 are from USArray data. This dense network allows us to obtain higher resolution dispersion model in North America than other parts of the world.

At long periods, there is a strong tradeoff between the isotropic part of the Rayleigh wave phase velocity and azimuthal anisotropy (e.g. Ekstrom, 2011). This effect is mainly confined to the Pacific basin where azimuthal anisotropy is coherent over large distances and results in significant signal. We include the effect of azimuthal anisotropy in our inversions in order to obtain a reliable isotropic part of the phase velocity. We will compare our azimuthal anisotropy model with other models, especially the ones obtained from ambient noise studies using USArray data.

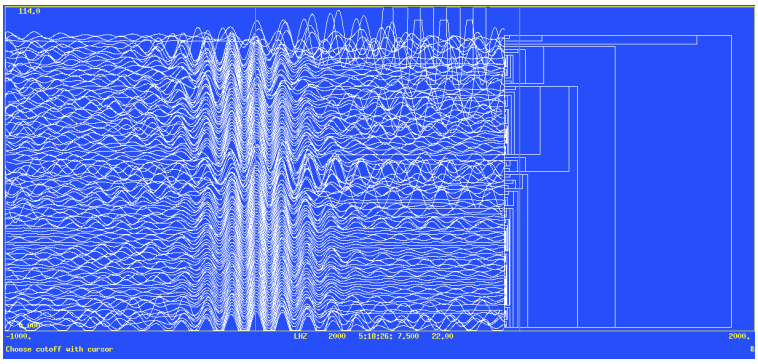

FIGURE 1. An example of clusters of waveforms shifted according to their relative travel times and the corresponding cluster tree. There are 114 waveforms in this example. Users can use their mouse to click on the cluster tree on the right to choose an appropriate cut off value. The vertical black line indicates a reasonable value for this example, which will generate three separate large clusters of clean records. Users can also easily identify distorted and noisy records.