Hurst exponents of surface geometry of the subducting Philippine Sea Plate estimated by the lifting scheme

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Seismic fault surfaces have complex geometries over a broad scale range. The Hurst exponent (*H*) is an important parameter characterizing the scale dependence of the geometric complexities. This exponent of seismic faults has only been estimated at outcrops and from surface traces of large earthquakes. This is because geometry data of subsurface faults usually have large uncertainties and many gaps in data. This study examined the applicability of the lifting scheme, one of the wavelet transform methods, to estimate *H* of irregularly sampled geometry of subsurface faults. We analyzed the surface geometry of the subducting Philippine Sea plate at the Nankai trough, Japan, which is part of the fault plane of interplate earthquakes. Seismic refraction and reflection surveys were integrated to estimate the geometries of the subducting plate along six survey lines. Two-way traveltimes of reflected waves from the plate surface, measured from seismic reflection data, were converted to depth using the velocity structure estimated by the refraction surveys. The intervals between sampled points were irregular because the reflected waves were obscured or invisible in some places. The Hurst exponents were estimated from the scale dependence of the wavelet coefficients that were derived by the lifting scheme without any interpolation for geometry data. Analyses of the synthetic data simulating the irregularly sampled plate geometries indicated that the lifting scheme yields stable but largely biased estimates of *H*, especially for small *H* (<0.5). We introduced the empirical bias correction to achieve an unbiased estimation of the exponent. The analysis of plate geometry at the Nankai trough was conducted at narrow scale ranges with consideration for accuracies of velocity structures. We concluded that *H* of 5 survey lines across the trough axis is >0.8, and that of a line along trough is >0.7. These estimated exponents had large uncertainties due to the narrow scale ranges, but these were close to the estimates in studies of the surface traces of large earthquakes.

