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Delineation of S-wave velocity profiles across the Himalayan Frontal Thrust (HFT) using metaheuristic approaches.

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The continent-continent collision between the Indian and Asian Plate formed a series of major faults from north to south along the Himalayan belt. Among these Himalayan Frontal Thrust (HFT) is the southernmost and youngest one and is tectonically very active. Any information on the shear wave velocity distribution across the fault is therefore very important. In this study, we have used the Wide Angle Multichannel Analysis of Surface Wave (WAMASW) to estimate the subsurface shear wave velocity profiles across HFT at Pawalgarh in Uttarakhand, India, using widely used stochastic global search Particle Swarm Optimization (PSO) and Grey wolf Optimization (GWO) algorithms. To gain confidence on the accuracy of the inversion results, we first generated an elastic synthetic seismic shot gather with ground rolls by using the forward modelling scheme of SOFI2D for a two-layer velocity depth model overlying a half-space. The generated gather was then processed in MATLAB to generate the experimental dispersion curve using the Phase shift method. We then extracted the fundamental mode for the gather and inverted it using the standard PSO and GWO algorithms and estimated 1D shear wave velocity profile. After getting acceptable results for the synthetic dataset, we then applied the PSO algorithm to generate the 1D S-wave velocity (Vs) profile across the Himalayan Frontal Thrust (HFT). In the study area, the Rayleigh wave phase velocity for the first shot varies from 444 to 743 m/s. We then obtained the 1D shear wave velocity profiles and a jump in Vs is observed across the HFT indicating variation in the sediment stiffness across the fault.

Keywords: WAMASW, dispersion, Meta- Heuristic, PSO, GWO, 1D Shear wave velocity