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A fast and robust method for moment tensor and depth determination of shallow seismic events in CTBT related studies.

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International Data Center is required to conduct expert technical analysis and special studies to improve event parameters and assist State Parties in identifying the source of specific event according to the protocol to the Protocol to the Comprehensive Nuclear Test Ban Treaty. Determination of seismic event source mechanism and its depth is closely related to these tasks. It is typically done through a strategic linearized inversion of the waveforms for a complete or subset of source parameters, or similarly defined grid search through precomputed Greens Functions created for particular source models. In this presentation we demonstrate preliminary results obtained with the latter approach from an improved software design. In this development we tried to be compliant with different modes of CTBT monitoring regime and cover wide range of source-receiver distances (regional to teleseismic), resolve shallow source depths, provide full moment tensor solution based on body and surface waves recordings, be fast to satisfy both on-demand studies and automatic processing and properly incorporate observed waveforms and any uncertainties a priori as well as accurately estimate posteriori uncertainties. Posterior distributions of moment tensor parameters show narrow peaks where a significant number of reliable surface wave observations are available. For earthquake examples, fault orientation (strike, dip, and rake) posterior distributions also provide results consistent with published catalogues. Inclusion of observations on horizontal components will provide further constraints. In addition, the calculation of teleseismic P wave Green's Functions are improved through prior analysis to determine an appropriate attenuation parameter for each source-receiver path. Implemented HDF5 based Green's Functions pre-packaging allows much greater flexibility in utilizing different software packages and methods for computation. Further additions will have the rapid use of Instaseis/AXISEM full waveform synthetics added to a pre-computed GF archive. Along with traditional post processing analysis of waveform misfits through several objective functions and variance reduction, we follow a probabilistic approach to assess the robustness of moment tensor solution. In a course of this project full moment tensor and depth estimates are determined for DPRK events and shallow earthquakes using a new implementation of teleseismic P waves waveform fitting. A full grid search over the entire moment tensor space is used to appropriately sample all possible solutions. A recent method by Tape & Tape (2012) to discretize the complete moment tensor space from a geometric perspective is used. Probabilistic uncertainty estimates on the moment tensor parameters provide robustness to solution.