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INFLUENCE OF SOLAR DISTURBANCE'S INITIAL PARAMETERS ON THE ARRIVAL OF THE ASSOCIATED INTERPLANETARY SHOCK AT EARTH AND THE SHOCK PROPAGATION MODELS

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Violent forms of solar activity, such as solar flares, coronal mass ejections (CMEs) and so on, are believed to be major sources of strong interplanetary (IP) disturbances and corresponding non-recurrent geomagnetic storms. Fast eruptions usually drive an IP shock ahead of them when they propagate outward in the heliosphere. Predicting the arrival times of solar disturbances and their related shock waves at Earth is an important aspect of space weather forecasting. Based on a large number of solar-IP disturbance events, this study investigates the influence of initial parameters of solar disturbances on the arrivals of the corresponding IP shocks at Earth. Then, the Shock Propagation Models with different versions are developed to predict the shock's arrival times. These models are based on an analytical solution to the propagation of blast waves in a moving, steady-state, medium with variable density. The inputs include the solar disturbance's initial parameters observed near the Sun. The outputs provide whether or not the shock will hit Earth and the corresponding arrival time if it does with enough lead time as models are analytic. For the latest version (SPM3), the prediction test based on 498 events of Solar Cycle 23 reveals that its prediction success rate is 70%–71%, and the prediction error of arrival time for the Earth-encountered shocks is within 9 hr (mean-absolute). Comparisons to other similar models also demonstrate that SPM3 has the highest success rate and best prediction performance.