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Tracking the momentum flux of a CME and quantifying its influence on geomagnetically induced currents at Earth

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We investigate a CME propagating towards Earth on 29 March 2011. This event is specifically chosen for its predominately northward directed magnetic field, so that the influence from the momentum flux onto Earth can be isolated. We focus our study on understanding how a small Earth-directed segment propagates. Mass images are created from the white-light cameras onboard STEREO which are also converted into mass height-time maps (mass J-maps). The mass tracks on these J-maps correspond to the sheath region between the CME and its associated shock front as detected by in situ measurements at L1. A time-series of mass measurements from the STEREO COR-2A instrument are made along the Earth propagation direction. Qualitatively, this mass time-series shows a remarkable resemblance to the L1 in situ density series. The in situ measurements are used as inputs into a 3D magnetospheric space weather simulation from CCMC. These simulations display a sudden compression of the magnetosphere from the large momentum flux at the leading edge of the CME and predictions are made for the time-derivative of the magnetic field (dB/dt) on the ground. The predicted dB/dt were then compared with observations from specific equatorially-located ground stations and show notable similarity. This study of the momentum of a CME from the Sun down to its influence on magnetic ground stations on Earth is presented as preliminary proof of concept, such that future attempts may try to use remote sensing to create density and velocity time-series as inputs to magnetospheric simulations.