Project Details

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Project Title:
Measurement and Modeling of Geoeffective Coronal Mass Ejections and Magnetic Clouds

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Summary:
We propose a three-year program to apply a numerical flux-rope model of coronal mass ejection (CME) events to Earth-directed "halo" and "partial halo" CME events, which are a class of geoeffective CMEs. This flux-rope model of CME events has been extremely successful in quantitatively reproducing the observed dynamics (size, position, velocity) of more than 15 "flux-rope CME" events and in quantitatively reproducing magnetic cloud properties in interplanetary space. To date, model results have not been compared to halo CME events which are both difficult to measure, because they tend to be faint, and difficult to interpret, because the velocity of the CME towards the observer cannot be measured directly. Two results from our previous data-model comparisons indicate the utility of extending these efforts to include Earth-directed CME events: 1. Synthetic coronagraph images of model flux-rope CMEs show that, when launched towards the observer, the model configuration reproduces the halo or partial halo often seen in CME observations. 2. The model shows that, as the underlying magnetic flux-rope structure of a typical flux-rope CME expands into interplanetary space, it matches typical magnetic cloud data in terms of size, density, temperature, and magnetic field configuration. In the present study, we will extend the methodology that was used in the quantitative modeling of limb events to address Earth-directed CME events. The result, for each event, will be a quantitative physics-based interpretation of the event and a prediction of the size, density, temperature, and magnetic field strength of the corresponding magnetic cloud. These predictions will be compared to magnetic cloud data. The overall purpose of this study is to aid in the interpretation of halo-CME event data and corresponding magnetic cloud data so as to better predict the geoeffectiveness of these events.

Publication References:

Summary: ''

Reference: Measurement and Modeling of Geoeffective Coronal Mass Ejections and Magnetic Clouds - Krall, Jonathan NRL