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Interactive comment on "Development of a formalism for computing in situ transits of Earth-directed CMEs. Towards a forecasting tool II" *by* Pedro Corona-Romero and Pete Riley

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The authors express thanks to the Referee for the constructive suggestions to our manuscript. We addressed all the "English language adjustments" as you requested and updated the Figures when necessary. Below, we describe our approach to address the technical issues that were raised.

Line 21: We include high-speed streams as source for space weather phenomena.

Line 153: We modified the text to clarify this point. Now it reads: "We mark the CME arrival time by a vertical dotted red line on the left side of the panels in Figure 2, and the

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corresponding TT would be the time lapse in between the arrival and detection times."

Figure 2: We modified the figure's caption to improve the description of the yellow and green lines.

In the original version we wrote:

"Green solid lines mark in situ solar wind used for calculations and solid yellow lines mark solar wind behind the CME (see Table 1)."

This now reads:

"The green solid lines, on the left side of all panels, mark the in situ solar wind values used as inputs for our calculations; and solid yellow lines, in |Vˆx| and N_p panels, mark speed and proton density values of the solar wind behind the CME (see Table 1)."

Line 226: We added a few sentences to briefly describe the way we calculate the accumulative magnetic flux. The new reads:

"In order to compute it, we integrate the (poloidal) magnetic field component, that is simultaneously perpendicular to the propagation direction and axial component, along the spacecraft transit inside the CME. For this purpose, we use the maximum variance technique to infer the reference frame of the CME magnetic field and use the magnetic coordinate of largest variance to calculate the accumulated magnetic flux as a function of time. It is important to note that this extremum gives an estimation for the time of closest approach to the magnetic center inside the CME."

Line 266: We added a short description for the "aging effect".

In the previous version the text read:

"It is important to note that all of our synthetic speed-profiles reproduce the speed-decreasing tendency called aging (Osherovich et al., 1993), commonly associated with the CME expansion. The aging effect is also present in the in situ data; however, it varies from one event to another; a condition that is easily observed in synthetic profiles...”

In our revised version the text reads:

“It is important to note that all of our synthetic speed-profiles reproduce the monotonic speed-decreasing tendency called aging (Osherovich et al., 1993), commonly associated with the CME expansion. The aging effect refers to the change in the CME characteristics seen in in situ measurements during the spacecraft transit across the CME structure; such a change is mainly due to CME expansion. The aging effect is also present in the in situ data; however, it varies from one event to another; a condition that is easily observed in synthetic profiles...”

Line 392: We expect that corrections relative to “Line 226” would help to clarify this point.

Finally, in your general description about the manuscript, you make two comments that are particularly interesting:

I) Section 2 is quite hard to go, and that II) the meaning of constants “a” and “c” may be confusing.

To address the first point, we propose to add the following sentences as a brief introduction to the model, at the beginning of Section 2.

Previously, the text read:

“The CME trajectories calculated by the piston-shock model have two phases: a short interval of constant speed followed by a period where the CME speed asymptotically approaches the speed of the solar wind. Previous studies suggested that the first phase ends around 30 R , hence the deceleration phase dominates CME propagation up to the orbit of the Earth (d âŁŢ = 1 AU) (Corona-Romero et al., 2013, 2015).”

The proposed change is:

“The piston-shock model is an analytical approach that assumes the CME as a piston, driving a shock wave during a finite lapse of time. The model simultaneously solves the CME leading edge (L_dot) and shock front positions. In order to calculate L_dot the model assumes conservation of both linear momentum and mass, in the interaction between the CME and surrounding solar wind. The CME trajectories calculated by the piston-shock model have two phases: a short interval of constant speed followed by a period where the CME speed asymptotically approaches the speed of the solar wind. The first phase occurs during its injection into the interplanetary medium, as long as the CME is provided with external energy. Once the external energy supply is exhausted, the interaction with the ambient solar wind decelerates the CME, which tends to equalize its surrounding solar wind speed. Previous studies have suggested that the first phase ends around 30 Ro , hence the deceleration phase dominates CME propagation up to the orbit of the Earth (dâŁŢ = 1 AU) (Corona-Romero et al., 2013, 2015)."

To address the second issue, we propose to add a new sentence when defining constant "a":

In the original version the text read:

"...while c is treated as a free parameter to match the calculated arrival time with its in situ registered counterpart."

In this new version the text reads:

"...while c is treated as a free parameter to match the calculated arrival time with its in situ counterpart. In the piston-shock model the constants "a" and "c" define the CME injection values of speed and density relative to the solar wind's values, respectively."

Again, we would like to thank the referee for their valuable and constructive comments. We appreciate them taking the time to review the manuscript so carefully.

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