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Annales Geophysicae Discussions
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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 appreciate your positive and constructive comments.

We addressed all the grammatical errors you identified. We also added the missing citations as well correcting the issues with the Figures and Captions. In the following paragraphs, we address each of your remaining remarks.

Line 89: Your comment is correct, we modified the text to include a brief description for tau_f.

In last version the text read:

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"Additionally, u_1 is the in situ solar wind bulk speed and tau_f the rising phase duration (Zhang and Dere, 2006) of the associated solar flare."

Now the text reads:

"Additionally, u_1 is the in situ solar wind bulk speed and tau_f the rising phase, i.e. the period between the maximum and start times of the associated solar flare's X-ray flux (see Zhang and Dere, 2006, for further details on rising phase of solar flares)."

Line 145: Yes, there is a particular reason to use the events listed in our Table 1; these are the events that fulfill most of our piston-shock model assumptions. These "well behaved" events were selected from Table 1 of the previous work by Corona-Romero et.al. [2017]. Please see this reference for further detail on the events. In our draft, our criteria of selection included the error associated with computed travel times and arrival speeds of CMEs. Of all the cases, event 1 was the one with the lowest errors, and the reason for which we used it to demonstrate our methodology.

Line 155: We modified the text to clarify the parameters we are using as inputs.

In the previous version the text read:

"The values of L 0 and LÌĞ 0 we used were the reported initial position and speed by CME LASCO Catalog (Yashiro et al., 2004; Gopalswamy et al., 2009), respectively."

The text now reads:

"We used the initial position, at the first appearance in C2, and the linear speed reported by CME LASCO Catalog (Yashiro et al., 2004; Gopalswamy et al., 2009) as inputs for the values of L_0 and LÌĞ_0, respectively."

We do not state that initial position (L_0) and speed (LÌĞ_0) correspond to the CME leading edge position and speeds at in situ measurements for several reasons. First, at this point in the text, such a clarification may confuse the reader. Additionally, we believe it could be somehow repetitive, since in Section 2 we make it clear that L and

L_dot describe the position and speed of CME's leading edge. However, if the Referee feels that the text requires further clarification on this issue, we would gladly add few sentences to address it.

Line 181: According to Zurbuchen & Richardson [2006] (see Table 1), the enhancement (>8%) of alpha particles vs protons is the primary plasma-composition in-situ (at 1 AU) signature for CME detection. The authors agree that assuming an average value of 12% of alpha particles for all events might induce unnecessary uncertainties; nevertheless we believe that such a value does not invalidate our results. We have provided [attached to this letter] the in situ values of alpha particle rate during the in situ transit of the events studied, should the referee like to check the values for each one.

Line 673: Perhaps the authors did not adequately express their ideas in the Section 4.2. The equation (18) is not determined by one point, but by 10; which is the number of our analyzed events and, thus, the number of available data points. This also applies for the rest of the empirical relations.

Line 717: We agree, and have modified the text to address this. In previous version of the manuscript it read:

"The capability to simultaneously forecast in situ transits of CMEs, the geoeffectiveness, associated forward shocks, and plasma sheaths is of great interest for space weather purposes, since more intense geomagnetic storms are triggered by such phenomena (Ontiveros and Gonzalez-Esparza, 2010, and references therein). If this formalism is shown to be robust under a range of conditions, it can lead to an important operational tool for space weather, particularly for those scenarios when the response time is of importance, like early warning systems..."

The text now reads:

"The capability to simultaneously forecast in situ transits of CMEs, the geoeffectiveness, associated forward shocks, and plasma sheaths is of great interest for space weather purposes, since more intense geomagnetic storms are triggered by such phenomena (Ontiveros and Gonzalez-Esparza, 2010, and references therein). However, such a goal also requires additional information, such as the magnetic field within the sheath regions, which is not within the capabilities of such models yet. Nevertheless, if this formalism is shown to be robust under a range of conditions, it can lead to an important operational tool for space weather, particularly for those scenarios when the response time is of importance, such as early warning systems..."

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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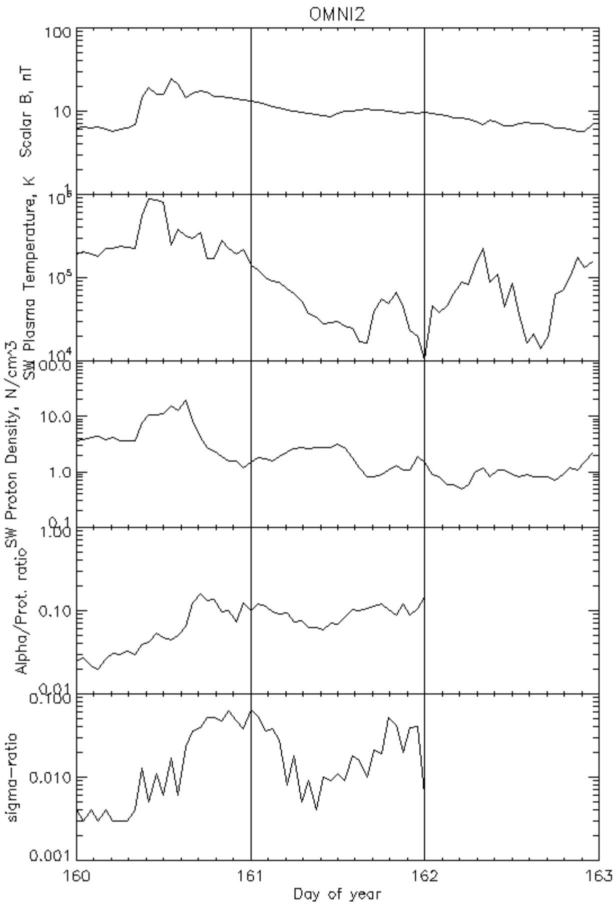

Fig. 1. Event 1

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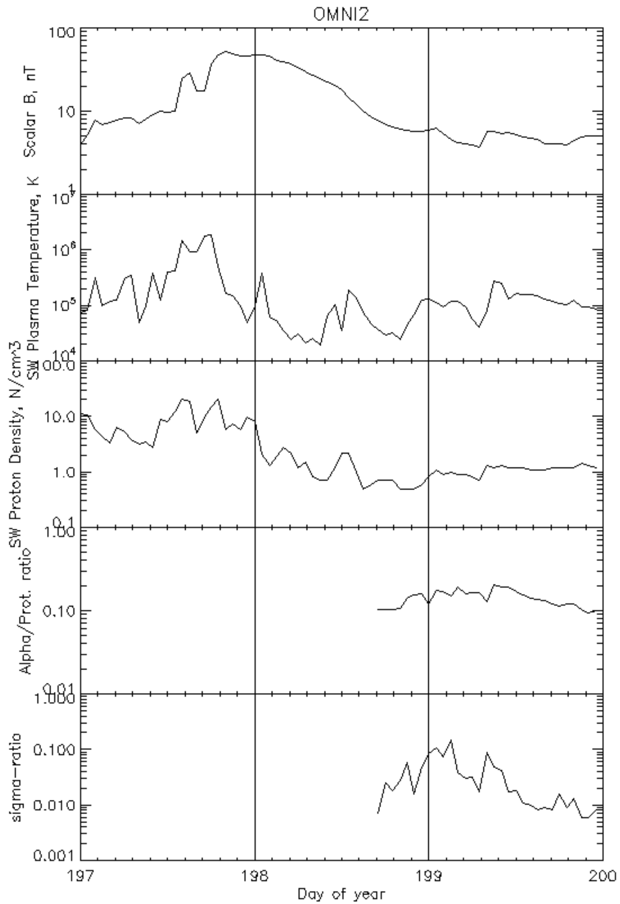
OMNI2
Scalar B, nT
SW Plasma Temperature, K
SW Proton Density, N/cm^3
Alpha/Prot. ratio
sigma-ratio
Day of year
197
198
199
200

Fig. 2. Event 2

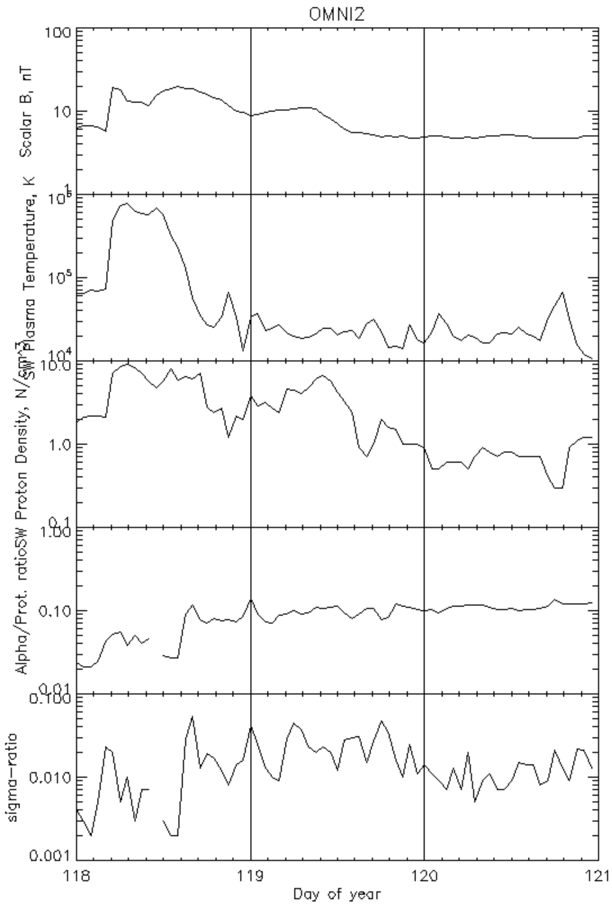
OMNI2
Scalar B, nT
SW Plasma Temperature, K
SW Proton Density, N/cm^3
Alpha/Prot. ratio
sigma-ratio
Day of year
118
119
120
121
100
10
1
10^6
10^5
10^4
10.0
1.0
0.1
1.00
0.10
0.01
0.100
0.010
0.001

Fig. 3. Event 3

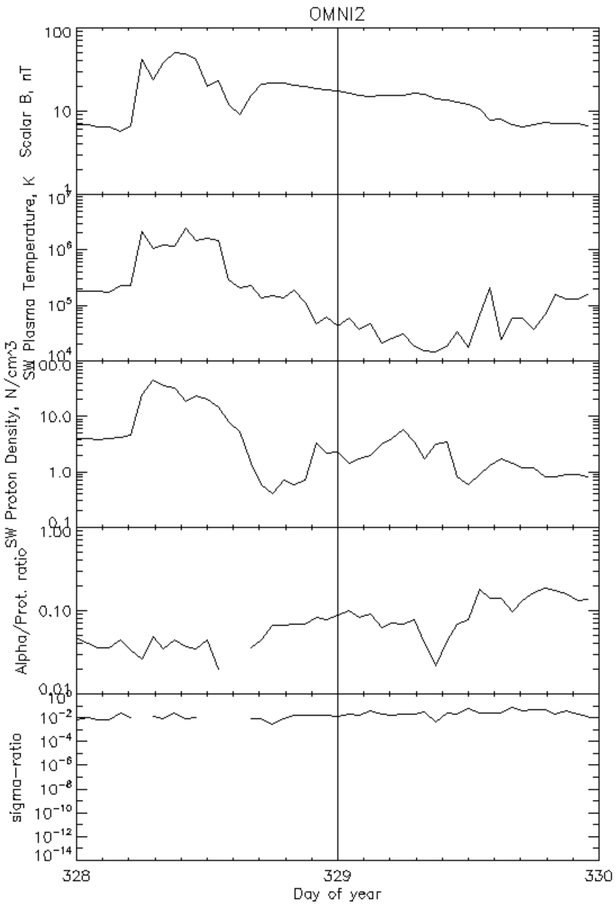
OMNI2
Scalar B, nT
SW Plasma Temperature, K
SW Proton Density, N/cm^3
Alpha/Prot. ratio
sigma-ratio
Day of year
328
329
330

Fig. 4. Event 4

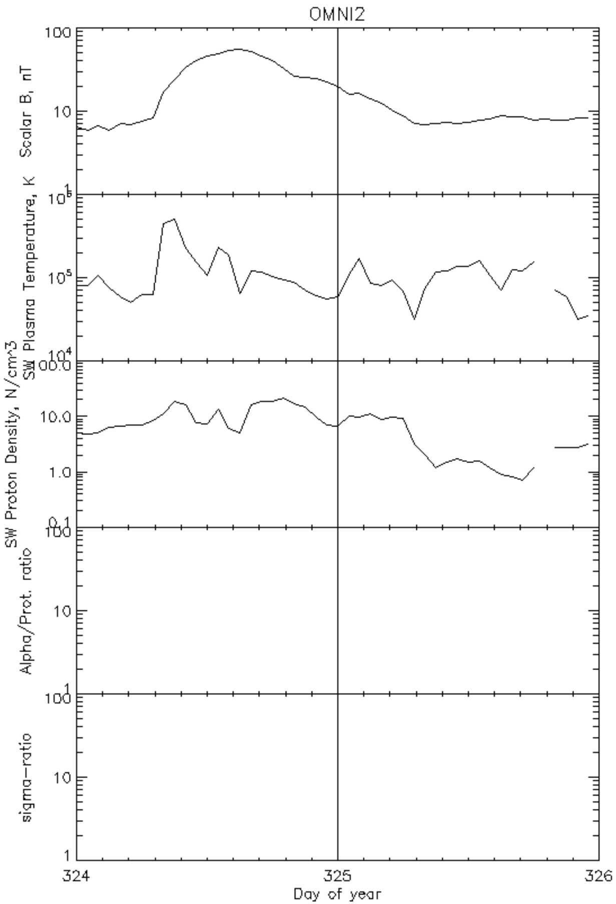
OMNI2
Scalar B, nT
SW Plasma Temperature, K
SW Proton Density, N/cm^3
Alpha/Prot. ratio
sigma-ratio
Day of year
324
325
326

Fig. 5. Event 5

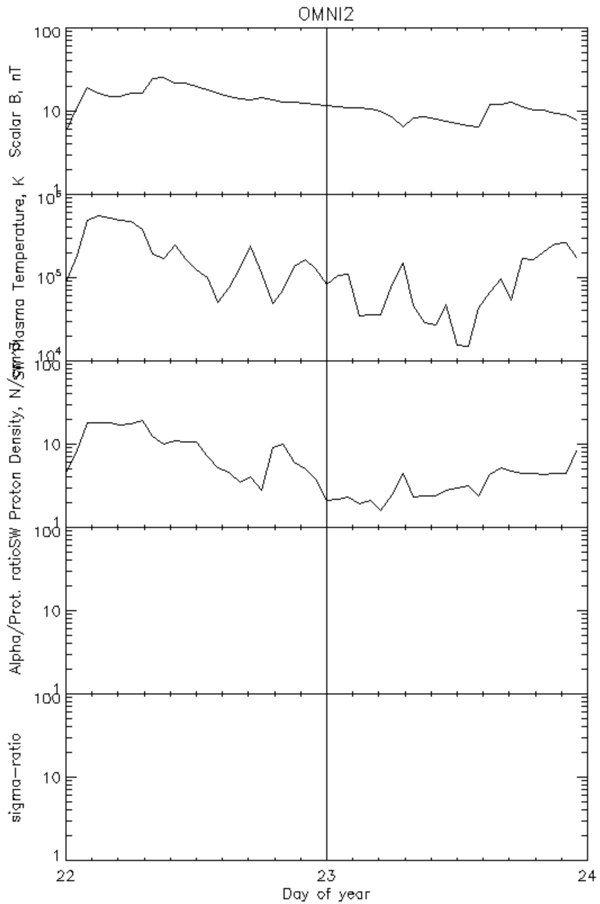

Fig. 6. Event 6

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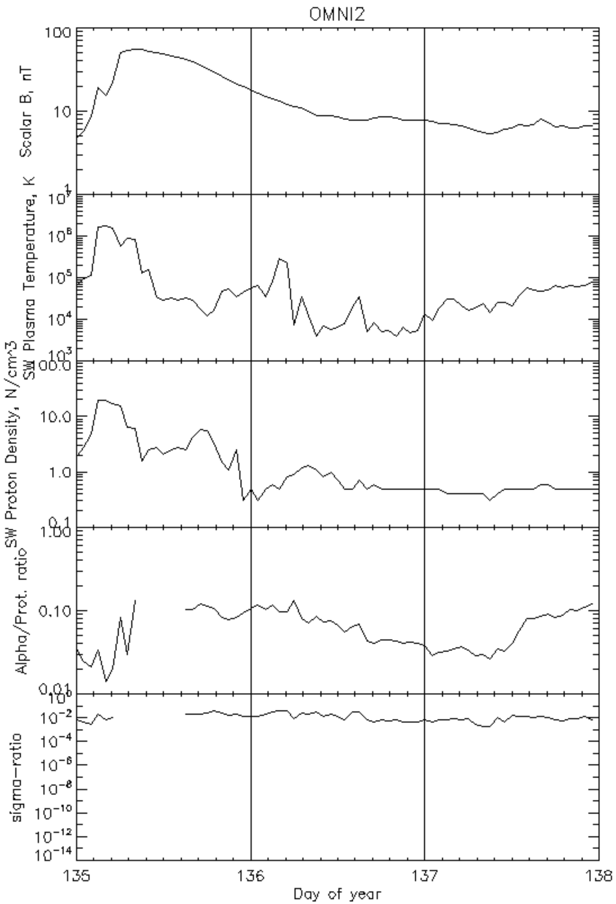

Fig. 7. Event 7

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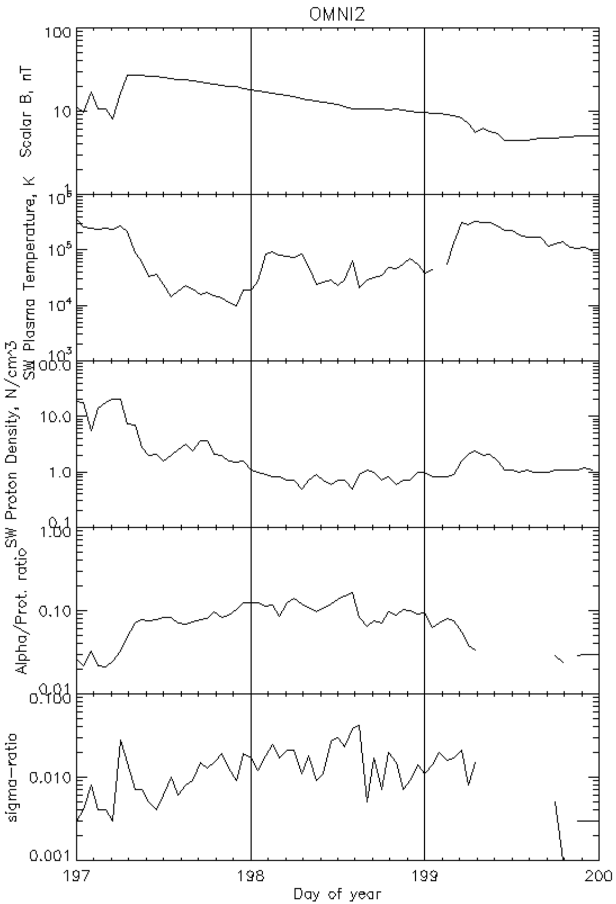
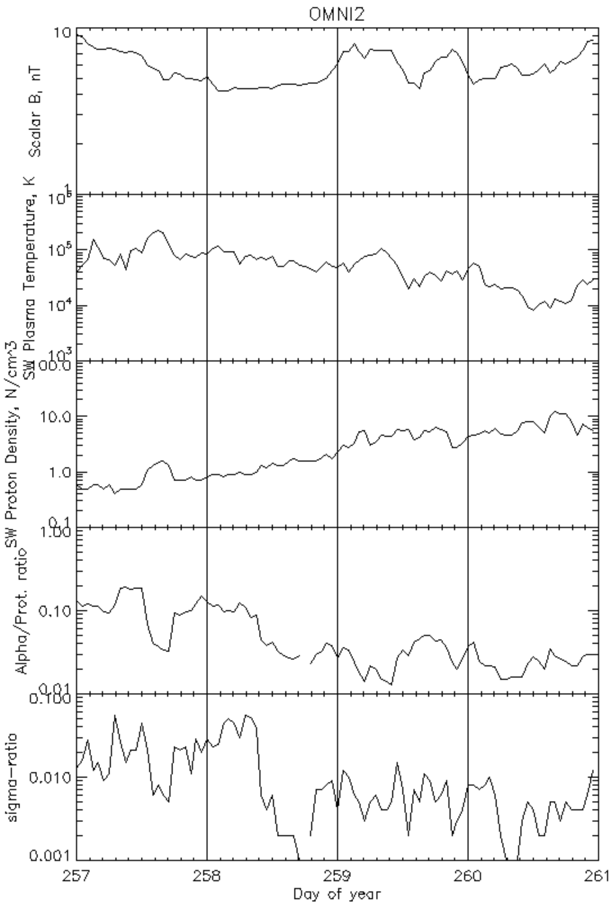

OMNI2
Scalar B, nT
SW Plasma Temperature, K
SW Proton Density, N/cm^3
Alpha/Prot. ratio
sigma-ratio
Day of year
197
198
199
200

Fig. 8. Event 8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Scalar B, nT
SW Plasma Temperature, K
SW Proton Density, N/cm^3
Alpha/Prot. ratio
sigma-ratio
Day of year
257
258
259
260
261

Fig. 9. Event 9