

Interactive comment on “A user-orientated column modelling framework for efficient analyses of the Martian atmosphere” by Mark Paton et al.

Anonymous Referee #2

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This paper describes an implementation of the University of Helsinki/FMI column model of the Martian atmosphere that is intended for use as a tool to analyse and diagnose atmospheric structure observations on Mars. As the authors discuss, this is a useful approach in at least some situations that may allow some aspects of the atmospheric energy balance to be inferred from differences between model predictions and observations. The authors describe the basic software design and demonstrate the potential of the methodology by using a set of Mars Climate Sounder observed temperature profiles at a few particular locations on Mars. Further verification information is provided through comparisons with equivalent data from the GCM-based Mars Climate Database.

The tool being described is appropriate for the journal and the paper does a reason-

able job in presenting its key features and demonstrating its capabilities. There are, however, a number of places where some additional clarification would be helpful for the reader. Some of the choices of approach are not justified very clearly, and a few more details concerning the user experience would also be beneficial. I am surprised, for example, that the paper does not illustrate the GUI that is used to run the model and perform the observational fitting? The choice of comparison cases (based on VL1, VL2 and MSL sites) perhaps does not show off the diagnostic potential of this framework (especially the adiabatic warming capability) to the best possible extent. The VL sites are probably quite strongly affected by horizontal advection which is not represented in the column model - so inferring a vertical wind from temperature anomalies is actually misleading! Moreover, the adiabatic warming term does not seem to be necessary at the MSL site. Why not choose (in addition?) a couple of cases where adiabatic warming effects are likely to be substantial - such as at a high latitude site e.g. the Phoenix landing site at 68 degrees N? Perhaps this would show a better recovery of the vertical wind than at any of the locations chosen so far?

The paper overall should be publishable provided the authors address these and the other points listed below.

Line 24 “increasing”

Lines 33-34 What is meant by “lower sections” or “lower parts” of the atmosphere? Why restrict coverage to the lowest 30 km of the atmosphere? This should be explained, perhaps with references to the original model.

Line 41 “in the descending” instead of “of”

Line 69 What is a “frozen orbit”? Explain?

Line 85 Should be Figure 1. Perhaps also illustrate the GUI here or at some point?

Line 93 Should be Figure 2. Figure 2 is a bit sparse - not sure what it adds to the discussion?

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Line 99 “compute” or “predict” would be better than “provide”

Line 103 (Eq (1)) “Q” should be “T” (temperature) in “ $\partial Q / \partial t$ ”

Line 104 “t” should be upper case “T” in “ dt/dz ”

Lines 107-114 Why choose these particular functions for the fitted w for adiabatic warming? They look pretty arbitrary but presumably reflect the expected shape of w over the altitude range. But this should be discussed and justified.

Line 132 “within” instead of “with”

Line 133 Subscript S in L_S

Figures 3-6 Although there is a legend in Fig. 3(a) to indicate the column model and MCD data, it would be helpful to state which symbol represents which data in the figure caption.

Line 152 Why “perhaps” in this context? What else could it be?

Figure 7 caption - So does $w > 0$ imply downward motion? If so, is this consistent with Eq (1)?

Line 200 (and elsewhere?) Make clear the “adverted” means “horizontally advected” since the adiabatic warming term is also a (vertical) advection term.

Line 206 “periodicity”

Lines 208-213 Why show zonally averaged profiles when the observations are from particular longitudes? Also, are the sol averaged profiles shown here also taken from MCD? If so, please state.

Line 221 “an intense”

Line 235 “Again horizontal advection is probably playing. . .”

Line 238 “jet streams”?

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Line 316 Showman et al. reference is incomplete. Where is it published? (Presumably the University of Arizona Press book Comparative Climatology of Terrestrial Planets Edited by Stephen J. Mackwell, Amy A. Simon-Miller, Jerald W. Harder, and Mark A. Bullock?).

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