Geosci. Instrum. Method. Data Syst. Discuss., 2, C307–C310, 2012
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Geoscientific Instrumentation Methods and Data Systems
Discussions

Interactive comment on "Martian atmospheric model with a high-fidelity subsurface thermal scheme" *by* M. D. Paton and A.-M. Harri

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Dear reviewer #2,

Thank you for your comments. We have considered them carefully and found them to be helpful. Please find below replies to the scientific and technical comments. At the end of the attached pdf document please find some new text and a new figure that have been added to the paper.

Reply to scientific comments

1. The ability of the model to use temperature dependent thermal properties is mentioned several times, but no examples are given (e.g. specific heat capacity and thermal conductivity).

We agree that this needs to be demonstrated so the reader can asses its importance and it is also a good test for the model

In section 2, Thermal properties of the Martian subsurface, we include some discussion of the temperature dependence of the thermal properties of the Martian subsurface with references

In section 5, Validation of the model, we include a figure comparing the surface temperatures produced by models with and without temperature dependent thermal properties

In section 5, we describe in detail the thermal properties and their relation to temperature and discuss the results, comparing the results to published work and discuss the results qualitatively in terms the expected behaviour of the models

2. As well as "slab" models, continuously varying physical properties with depth would also be of interest (e.g. allowing for a dust layer with increasing density with depth)

This is possible and this potential is hopefully made clear in additions to the text in the final section 6, Effects of layered material on the surface temperature

Further work planned and underway with this model would include further simulations that are relevant for specific investigations that could include the investigation of varying physical properties with depth

3. Ice and dust-ice layers are mentioned several times, but it is not clear how these would be included in such a model (and how this would affect the stability of the numerical method) – in particular sublimation/condensation processes – no mention of the volatile transport within the subsurface is mentioned – if the model can handle such cases this should be mentioned, or otherwise clarified – perhaps this just means expanding on the sentence “Surface sublimation is modeled using a constant soil moisture fraction.”?

Agreed, sentence has been expanded upon. Only sublimation/condensation at the surface is modelled.

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4. Thin "slabs" (i.e. a fine grid) are needed where the temperature gradient is steep, i.e. close to the surface or boundaries where sublimation/condensation might take place, but not everywhere. Could a variable (e.g. exponential) step size not have been used?

We use the finest grid spacing for all the levels. Sublimation/condensation only occurs at the surface (top layer). A variable step size could be used to perhaps save on computer processing time but at the moment the code is rather efficient and time management of running the simulations is not an issue.

Reply to technical comments

Please see attached pdf

Please also note the supplement to this comment:
http://www.geosci-instrum-method-data-syst-discuss.net/2/C307/2012/gid-2-C307-2012-supplement.pdf

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Interactive comment on Geosci. Instrum. Method. Data Syst. Discuss., 2, 737, 2012.

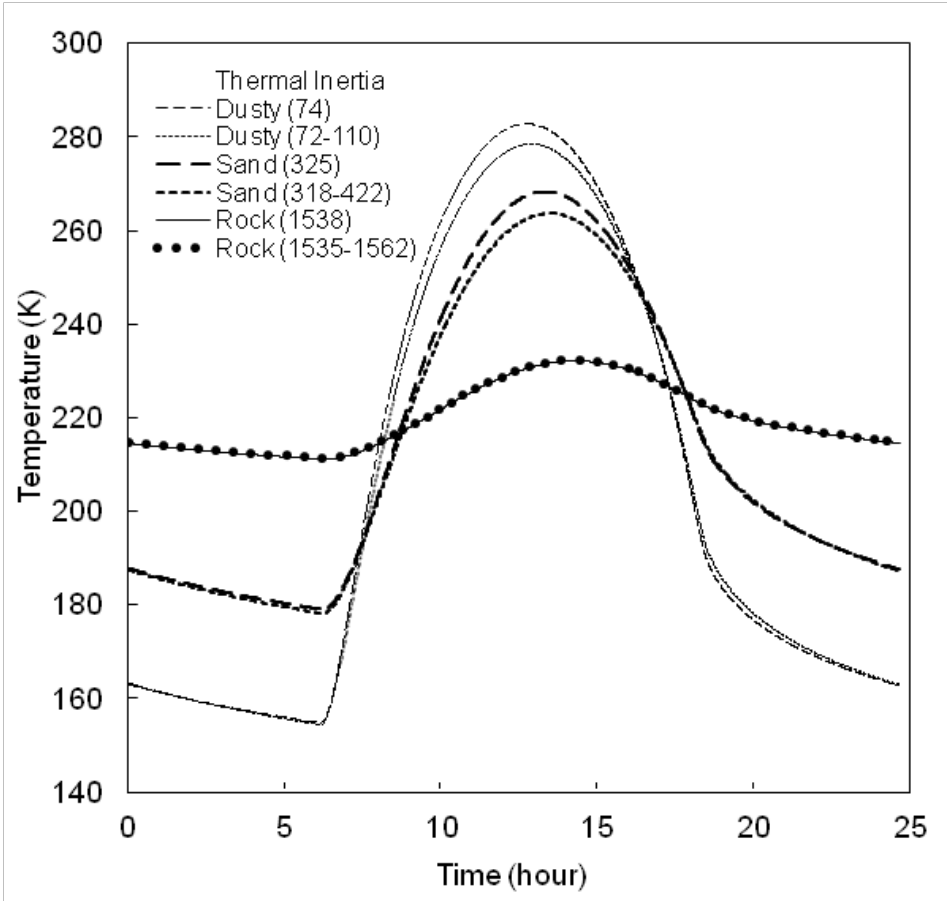

Fig. 1. Comparison of models with and without temperature dependent thermal properties. In the legend a temperature independent model has a single value of the thermal inertia.

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