

Interactive comment on “Characterization of the boundary layer at Dome C (East Antarctica) during the OPALE summer campaign” by H. Gallée et al.

Anonymous Referee #2

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Review of ACP manuscript

Characterization of the boundary layer at Dome C (East Antarctica) during the OPALE summer campaign

by Gallée and others

General assessment

This paper describes the performance of a mesoscale atmosphere model when applied to summertime conditions over Dome C, East Antarctica. In general a good agreement is found for wind speed and wind direction, but important deviations are found in simulated shortwave/longwave radiation components and near-surface temperatures. The

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paper is reasonably well written, but the English needs improving by the editorial staff. Here I only provide textual comments when a formulation may cause confusion. The figures are generally of good quality. The added value of the science requires better motivation. All in all the paper requires major revisions, see below.

Major comments

The introduction must be restructured and rewritten so as to include more specific information how mesoscale models like MAR can assist in the interpretation of the chemical composition of the Antarctic boundary layer. The current model does not have a chemical routine, so please explain explicitly how the current results are of value for OPALE. Can the results be used to drive an offline chemistry module? It must also become clear what this study adds to previous knowledge on the ABL structure over Dome C, since quite a number of observational studies have been published on that topic recently.

Page 33096: An elaborate description is given on the parameterizations of surface and surface layer processes, e.g. z_0 as a function of sastrugi formation and decay and the interaction of blowing snow with the vertical transport of radiation; disappointingly little of the influence of these elaborate parameterizations on the model results is found back in the discussion of the results. How important are these model adjustments for the final results at Dome C? For instance, it would be nice to discuss a time series of z_0 . Was blowing snow a common occurrence during the campaign? If so, was this simulated by the model? Etc.

Same page: how is the calibration (line 27) performed? How did MAR perform in terms of 3 m wind speed before this calibration was performed?

Table 1: It is remarkable that both LWd and SWd are underestimated. When cloud cover is underestimated in the model, as is suspected, one would expect SWd to be overestimated. Any thoughts?

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p. 33090, l. 24: the model used by Van As and others (2006) had very high vertical resolution, in the cm range near the surface; in terms of physics, it was not simpler, just 1D. How important are 3D (advection) effects over Dome C, in other words, what is the added effect of performing 3D simulations?

Another important difference between Van As and others (2006) and this study is that Kohnen is situated on a ridge with surface slope, generating a mixture of inertial oscillations and katabatic winds, while Dome C has no or very little slope, deleting the impact of katabatic forcing. This is supported by the absence of a nocturnal wind speed maximum. Please add a brief discussion along these lines (difference between climate of the ice shelves, the ice sheet slopes and the interior domes) in the introduction, and how these differences in e.g. daily cycles could impact the chemistry of the boundary later.

p. 33103, l. 3: "... while the pressure gradient force (PGF) still contributes to an increase of the wind speed after that time..." but the supergeostrophic wind speeds in the nocturnal jet are caused by a combination of (frictionless) inertia and the Coriolis effect, and do not require changes in the geostrophic wind speed.

Minor and textual comments

p. 33090, l. 17: preferably use 'evaluation' instead of 'validation' when it concerns models

p. 33090, l. 20: for -> in

p. 33090, l. 22: remove 'circulation'

p. 33090, l. 23: an approach ...done -> a study...performed

p. 33091, l. 13: able -> enable

p. 33092, l. 27: "...the low troposphere..." perhaps leave out 'low' for a site > 3000 m asl

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p. 33093, l. 26: the sensors used in the K&Z CNR1 are CG3 pyrgeometers and CM3 pyranometers (I may be wrong, please check). Please state their accuracy; if I remember well, measurement error maybe substantial for these sensors and may explain part of the obs-model bias.

p. 33095, l. 7: in the absence of a significant surface slope at Dome C and the fact that it is the highest point of the region, I do not expect drainage flow but rather radially diverging flow away from the dome, see major comment above.

Interactive comment on Atmos. Chem. Phys. Discuss., 14, 33089, 2014.

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