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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Parametrization of convective transport in the boundary layer and its impact on the representation of diurnal cycle of wind and dust emissions" *by* F. Hourdin et al.

Anonymous Referee #2

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Overall this is a very interesting article that makes a nice contribution to our understanding of both surface wind simulations, as well as dust generation. I have a few minor comments on the paper, as well as many edits on the English in the paper, which needs some more work: because of the scientific quality of the work, and my interest in this area, I was willing to do the extra work to edit the text.

Minor comments: "The most uncertain dust-related process is emission which depends non linearly upon the friction velocity U_." I disagree. There are so many uncertain dust related processes, including dry and wet deposition! I would rephrase: "One of the important and uncertain dust related processes. . ."

Equation (1): I found this equation odd in the introduction. You could make the same point without including such a complicated equation: just cite the articles you cite already to make the point the extremes in the wind are really important.

"U*Th" I find the nomenclature of the Th in superscript disconcerting, and I kept misreading it as an exponent: I recommend a more standard placement of the Th in the subscript.

"We use here the version of the scheme described by Rio et al. (2010) and used in LMDZ5B (Hourdin et al., 2013b)." You can't say it's really important and then just send us off to another paper! We are full of suspense: give us a 1 sentence description of how to make this closure.

"Note that even the NP3 simulation underestimates the actual AOT as illustrated later on." Please specify where instead of 'later on'.

Section 4: comparison with observations: I think the description of the data should be in a methods section instead of in with the results. Please change the Section 2 "Model description and simulation setup" to be titled "Methods" and add a final section that describes the data you are using. At least the first paragraph of the section 4 should be instead in that section, plus probably some discussing how much we should trust this data, etc. I would argue that a really important point of this paper is value of the data, to compare to the model versions.

"Although the stations are not located in the emission area discussed above, model results show very similar diurnal variations of wind at these sites." I'm not sure I understand this sentence, could you clarify?

The authors switch between using NP to NP3 or NP48. For consistency, I think you should use the full case name in all cases (or tell us in the into what it means if you leave off the number)

Figure 5: missing the "obs ___" legend.

Top of P. 27439: you say that the results are the same whatever time period you look at, but presumably you only looked at a particular time period, so please indicate which years you analyzed this behavior for, even if this is in the methods.

“In particular, tuning of emission algorithms with overestimated winds from reanalyzes may lead to artificially underestimate the emissions when better winds are given to the emission module, as is the case here.” I think you are talking about certain groups which have done this in the past, and that this might not work? Maybe you want to point to these papers (e.g. Tegen et al., papers with the GISS model did this, but perhaps you are thinking of others?

“Significant conclusions may be drawn that do not depend on the particular model used for representation of dust” I agree that your conclusions are likely to be model independent, but you have not shown this. I would rewrite as“Significant conclusions may be drawn that are likely to be model independent”

“It clearly attributes the observed morning peak of near surface wind to the downward transport of momentum by the compensating subsidence of thermal plumes, at there first stage, when they reach the height of the low-level jet which develops during the night at a few hundred meters above the surface, when the wind is 5 decoupled from the surface” This is the result of analysis and model results, so I would write this less strongly and remove clearly.

“Of course many points could be investigated to try to understand the origin of this underestimation. Whatever those points, it does not alter the main result of the paper which is that an 15 accurate representation of the diurnal evolution of the boundary layer and transport of momentum by boundary layer convective cells must be taken into account for a good representation of winds, and that such a good representation is accessible now to the modeling community.” I found these sentences a bit vague and redundant. I would just say “Although there may be other errors in the model, our results suggest that the thermal plume model allows a more accurate representation

of the diurnal evolution of the boundary layer and transport of momentum by boundary layer convective cells and it improves the representation of wind and dust in models..”

I would also like to know what happens in your free running GCM: does it get similar diurnal cycle with and without the new scheme? Just a brief comment about this would help provide context for other modeling groups.

Edits for English (please do reread carefully, as I probably missed a few). Line 1: “boundary layer transport” should be ‘boundary layer’?

“It also reinforces dust emissions in better agreement with observations, but the aerosol optical thickness is 20 still significantly underestimated.” Replace “reinforces” with ‘generates’.

“Desert dust is a secondary but significant contributor to the atmospheric radiative transfer, with regional signature organized around desert area like Sahara, which is estimated to contribute to 25 to 50% of the global dust emissions” suggest replace with “Desert dust is secondary but significant contributor to atmospheric radiative transfer, with regional signatures dominated by desert areas like North Africa, which is estimated to contribute 25-50% of the global dust emissions.”

“that base the anticipation of future climate changes” replace with “on which future climate change estimates are based.”

“the importance of a good representation of the boundary layer transport, contrast between nocturnal turbulence in a stable atmosphere and convective transport during the..” replace with: “the importance of a good representation of the boundary layer transport, especially the contrast between nocturnal turbulence in a stable atmosphere and convective transport during the..” but this sentence is a bit long and probably could be cut into two.

“The counter-gradient term he proposed to reconcile the diffusive formulations with convection conditions was later on given a more explicit for20 mulation based on the

non local aspect of convective transport by Troen and Mahrt (1986) and by Holtslag and Boville (1993)." Replace "later on" with "later" (colloquialism)

"The present study aims at exploring the impact of those new parameterizations on the representation of dust emission and transport and anticipate". Replace 'those' with 'the above described', replace "anticipate' with 'anticipates'.

"Here air is assumed to enter the plume with the concentration of the large scale , which is equivalent to neglect the plume fraction" replace 'large scale' with 'large scale grid box', replace "neglect' with 'neglecting'.

"Coupling of LMDZ with the CHIMERE emission module follows the way CHIMERE is currently forced by regional climate models" replace with "The coupling of LMDZ with the CHIMERE emissions module is done similarly to the standard method used to couple CHIMERE by regional climate models."

"both computation5 giving very similar results." Replace computation with computations

"a Weibull parameterization is used to account for the effect of spatial inhomogeneities of wind speed within a grid mes" A weibull distribution, not parameterization, right?

"with a distribution following a logarithmic increase" replace with "with a lognormal distribution"

"by a mean mass median diameter, Dp" do you really want both mean and median in the same noun-phrase?

"the model is run with its zooming capability" →"the model simulations are conducted with the zooming capability." (run is a colloquialism)

"was described in details by Coindreau" replace 'details' with 'detail'

"The zoom consists in a refinement of the longitude and latitude discretization. Here, the zoom covers West Africa and the tropical Atlantic ocean." Should be 'consists of',

but these sentences are a little redundant, please combine to one sentence.

"the zoom was chosen so as to get a" replace to get with to obtain (colloquialism)

"A nearest neighbor method was retained instead that provides much better results." Replace 'retained' with 'implemented'.

"The LMDZ model is most commonly used in climate mode: integrated from an initial 5 state just imposing some boundary conditions such as insolation, sea surface temperature" replace "just imposing" with "with imposition of ".

"The longer the time constant the weakest the constraint by the analyzed wind fields." Replace "weakest" with "weaker" and 'by' with 'of'

"interactif" should be 'interactive'

"In order to interpret at process level the": should be 'at a process level'

"while the wind distribution for the NP version explores much larger values." 'explores' should be 'includes' "At the opposite, when the emissions are related to the daily-mean wind speed (right panel of Fig. 2) it appears that the wind explored are on average weaker in the NP than in the SP version.". many issues: recommend: "On the other hand, the relationship between daily mean wind speed and emissions (Figure 2b), suggest that the winds in the NP are smaller than SP, but emissions are larger for these lower wind speeds."

p. 27436 line 14 "reinforces" should be "increases"

"Consistently with Fig. 3,": should be "consistent with Fig. 3".

"it is for both stations the NP versions that give the best results" should be "it is the NP versions that give the better results for both stations."

"As for dust evaluation," should be "In order to evaluate the dust"

"This station is considered at first" should be "This station is considered first"

“A more systematic and synthetic comparison” should be “A more systematic and complete comparison” (synthetic means fake)

“We finally analyze” should be “Finally, we analyze”

“bias in the reanalyzes winds used for nudging. . .” should be “or bias in the reanlayses winds used for nudging.”

p.27439 “At the opposite,” should be “On the other hand”

p.27440 first line: there should be their

“driven by the unbalance between the Coriolis” unbalance should be imbalance

“The thermals still accelerates the surface layer” accelerate

“This conclusion goes beyond this particular model since many chemistry transport models rely on reanalyzes for the computation of near surface wind.” Should be “This conclusion is important for many chemical transport models which rely on reanlyses for the computation of near surface winds.”

“as large as 48 h the synoptic situation is still rather well constraint,” constraint should be constrained

“the model seriously underestimates the observed dust loading of the atmosphere,” remove seriously (seriously is a colloquialism, and in boring english science writing we rarely include adverbs)

Interactive comment on Atmos. Chem. Phys. Discuss., 14, 27425, 2014.