GMDD 8, 4737–4779, 2015 Accounting for anthropic energy flux of traffic in winter urban road surface temperature simulations with TEB model

Review

General comments

This study presents the recent developments of the TEB model related to the implementation of anthropogenic heat sources coming from traffic and their impact on road surface temperatures.

This work is of great interest in terms of comprehension of processes as well as application for road network maintenance and road safety. However, this paper shows important weaknesses in its form and content. From my point of view, it requires a very important improvement work before considering any publication.

- The equations and the description of physical processes must be reviewed and improved or corrected. The equations and the description of physical processes must be reviewed and improved. There is a lot of inaccuracies and vagueness.
- The experimental study and the numerical experiments are very few described and developed. Many information are missing ; this makes comprehension and evaluation of this study more difficult.
- Regarding the evaluation of the TEB model, it seems to me crucial to evaluate first the model in the case without traffic ; so that, the authors may focus in the following step on the evaluation of the new parameterization.
- The bibliography seems to be very exhaustive. Indeed, the paper includes a lot of references but there are not discussed, thereby limiting the interest of such a bibliography.
- English needs to be improved.
- The figures are sometimes not clear (for instance Fig.4 is too small and not readable). Some figures are also redundant (Fig8a and Fig9a).

Specific comments

Abstract

"A forecast of the snowfall helps winter coordination operating services, reducing the cost of the maintenance actions, and the environmental impacts caused by an inappropriate use of de-icing." It is not clear in the abstract what you are talking about... You should specify that the issue is the road network maintenance.

"Physical numerical models provide such forecast, and do need an accurate description of theinfrastructure along with meteorological parameters."

The transition between context and objectives of the study must be improved.

P4738,L16

"During the winter period, precipitations could accumulate on pavement surface, with a specific danger in the case of snow and black ice since *it reduces* they reduce road grip and therefore *impacts* impact the road user's safety"

P4738,L18

"One of the roles of maintenance services during winter is to ensure the road network use,..."

P4739,L8

"Improvement of these models consisted in including a spatial component to incorporate the influence of both meteorological and geographical parameters." This sentence is not clear.

P4739,L14

"The flux heat(?) fluxes associated to 15 the traffic was investigated in details for their introduction into this model."

P4739,L15

"The modification in the energy balance caused by the presence of vehicles in the streets was then evaluated."

Section2,1st paragraph

You give a series of references for numerical models, but there is no details and no comments about the different models: which models? which processes? potential weakness or inaccuracy of these models, comparison between them?...

P4740,L2

You mention the different direct and indirect processes (related to the presence of vehicles) that emit heat and impact road temperature. Based on literature, could you provide a quantitative evaluation of the different impacts?

P4740,27

"Chapman et al. (2001) showed that traffic could cause up to 2°C difference between inside and outside the highways and that the identification of traffic impacts on RST is relatively difficult."

Does the 2°C difference refers to RST?

This part of the test is not clear (the link between the two parts of the sentence); why is it difficult to identify traffic impacts?

P4740,L27

"All the references quoted before are related to the winter season and shows show that the traffic has a significant effect on the RST..."

P4741,L1

"It consisted in integrating the theoretical traffic description into TEB numerical model dedicated to urban configuration to numerically quantify how much the traffic energy input affects the RST and on the basis of field experimental measurements and data (weather, traffic)."

This sentence is not clear, would you say: "It consisted in integrating the theoretical traffic description into TEB numerical model dedicated to urban configuration, and then to quantify how much the traffic energy input affects the RST both on the basis of experimental measurements (weather, traffic) and numerical experiments."?

P4741,L9

"urban atmospheric layer" should be replaced by "urban canopy".

P4741,L12

"or at higher resolution" should be replaced by "or few hundred meters".

P4741,L14

You mention different possible approaches to model traffic impact but do not give any details and explanations.

Section 3.1

The general approach and the physical processes of the TEB model are not correctly outlined here.

I really do not see the point of presenting all equations of TEB since they are already presented in details in previous paper (Masson 200 and Lemonsu et al. 2012). Besides, the description of the longwave radiation budget does not seem necessary here. You should include only equations that are relevant for understanding how traffic emissions are taken into account and how the model can be improved.

In Eq10 and 11: AC is the aerodynamic conductance = 1/R (Cp is missing in equations, check also Eq24 and 25)

I think the choice in names of variables in TEB equations is not always coherent with the previous papers (for instance Sa and L).

P4744,L16

"The values that were assigned to these two parameters are $QE_{traffic} = 0Wm-2$ and $QH_{traffic} = 20Wm-2$."

These fluxes are prescribed by users. They are not necessarily 0 and 20W/m2. Besides they are not constant but they follow a very simple diurnal cycle: fluxes are zero at nighttime and equal to the prescribed values at daytime.

P4744,L16

"The turbulent flow of urban canyon interacts with the road surface energy balance through the interactions radiative coefficient (LWx_to_y) defined previously." I do not understand this sentence.

Section 3.2

The parameterization for traffic was not implemented by Pigeon et al. (2008) and the fluxes are not constant even if their prescription is very simple (see my previous comment).

P4745,L24

"According to Guibet (Guibet, 1998), the NHC (Jkg^{-1})-is equal to 42700 J kg^{-1} for gasoline and 42600 J kg^{-1} for diesel. The fuel density ρ fuel (kgL^{-1}) is equal 0.775 kg L^{-1} for gasoline and 0.845 kg L^{-1} for diesel. The average fuel consumption FE (kmL^{-1}) depends on the type of fuel and on the type of traffic. In the study made by Colombert (Colombert, 2008)," Please, check the units in this section; I think they are not always consistent.

P4746,L11

Why do you prescribe a width of 10m for the streets?

Section 3.3

The equations must be presented here since it is the objective of the paper. The figure presenting the processes (Fig4) is not readable.

Again, you refer to many papers but without adding information since the references are not commented.

The explicit modelling of traffic effect induces a significant number of new input parameters for the model. They are listed in the text, but you do not explain how they are defined (for instance, how is computed the shield coefficient presented in Fig3?), and how they could be generalized to other urban sites or even for an entire city.

P4747,23

"This second approach of traffic integration in the TEB model based in the resolution of tow town surface energy balances."

Eq22 and Eq23

I guess there is a mistake in equations: (1-Cshield) should be replaced by Cshield The modifications of the radiation budget by including FIR_veh_inf and FIR_veh_sup are not clearly explained.

Eq24 and 25 How are computed AC* and ACwat* ??

Section 4.1

The experimental site and setup are not precisely described. For instance, what are the road parts with and without traffic? Are they comparable?

Section 4.2

Same comment for TEB simulation: The configuration of the simulation is not precisely explained, and it lacks many information regarding forcing data and input parameters for TEB. For instance:

- What is the forcing height for meteorological data? How do you deal with the fact that meteorological measurements are available at 2m above the ground and that TEB must be forced above the top of canopy?
- What is the building density ?

- How do you built radiative forcing for TEB including direct and scattered solar radiation, as well as infrared radiation? (are these data directly provided by the meteorological station?)
- TEB is forced by specific humidity instead relative humidity

P4751,L19

"There is a clear relationship between hourly variation of thermal traffic contribution (Fig. 3) and hourly RST variation too."

Please clarify this sentence.

Eq28

The equation is wrong. If road emissivity is unchanged for road with or without traffic, I think that the relationship should be:

$$RST = \sqrt[4]{\frac{1}{3}T_{Without}^4} + \frac{1}{3}T_{With}^4$$

Section 5.2

The first step in the evaluation of the TEB parameterization is to verify the ability of TEB to simulate the air canyon temperature for a street without traffic. If this comparison is good, then you can add the traffic effect and investigate the improvement brought by your new parameterizations.

Section 5.3

What is the traffic flux that is prescribed in TEB?? Is it the daily cycle presented in Fig.3 ? The flux is here expressed in W/m^2 ; is it W per m² of road or of town as it is specified in TEB ?

According to Fig8 or Fig9, it is shown that the 1st approach does not improve significantly the results in comparison to the default approach. RST increases a little bit but the daily cycle remains unchanged despite a better description of the heat release due to traffic. Can you comment this result?

Section 5.4

The results are significantly improved by the new parameterization (2nd approach). It would be especially interesting to evaluate the impact of the different processes that have been implemented. The modification of radiation terms probably plays the strongest role.

Fig.12

The comparison between the air temperature measured in the canyon and simulated by the default version of TEB seems different in Fig.8 and Fig.12.

Section 5.4.2

I do not find the sensitivity study really relevant. As said previously, I would find more interesting to evaluate the sensitivity of the results to the different terms of the new parameterization and of the input parameters.