Geosci. Model Dev. Discuss.,
https://doi.org/10.5194/gmd-2020-301-RC1, 2020
© Author(s) 2020. This work is distributed under
the Creative Commons Attribution 4.0 License.

Geoscientific Model Development Discussions

Interactive comment on "A Model for Urban Biogenic CO_2 Fluxes: Solar-Induced Fluorescence for Modeling Urban biogenic Fluxes (SMUrF v1)" *by* Dien Wu et al.

Youngryel Ryu (Referee)

ryuyr77@gmail.com

Received and published: 22 November 2020

Dear Dien and all

I would like to congratulate you for this impressive manuscript. Incredibly comprehensive, in-depth analysis, great attentions to details and robust upscaling approach. I have to admit that I am not the expert in atmospheric transport model, where I didn't make any comment.

The authors developed a biogenic CO2 balance model which includes GPP, Reco, and NEE. They intended to develop this model for global cities, but actually it is applicable

to the global land. The basic idea came from linking SIF and GPP. They developed the slopes between GPP and SIF (CSIF products) across FLUXNET sites. After fine tuning (e.g. crops) in the slopes, they converted CSIF (0.05 degree) to GPP. As urban landscape is heterogeneous, they used very high resolution land cover maps to apply the slopes for the relevant land cover types then aggregated to 0.05 degree. Then the authors developed an Reco model using NN with GPP, Tair and Tsoil. To evaluate the model performance, the authors compiled FLUXNET, INFLUX dataset and rubanVPRM model. Then the authors combined fossil fuel emissions data, XCO2 data and an atmospheric transport model to tease out the contributions of biogenic CO2 fluxes in urban CO2 fluxes around the world.

The scope of this manuscript is vast but the authors didn't gloss over important details. Although some parts could be improved further, overall I see this is already too good. Though I would like to make some suggestions for furhter improvement.

First, evaluate SMUrF NEE directly against FLUXNET data like what you did for GPP and Reco in Fig 5. Good performance in GPP and Reco does not necessarily indicate good performance in NEE which is tiny signal compared to the other two fluxes. The authors reported Fig S10 for NEE evaluation, but I feel it is not enough. It is fine to report rather poor performance in NEE, which is quite well expected as machine learning based NEE (e.g. FLUXCOM) performed poorer than GPP and Reco. It would be an useful point about how to improve SMUrF later.

Second, the current evaluation focused on diurnal to seasonal scales. Could you provide some discussion on the model performance in interannual to trends? e.g. in case of LA, how NEE varied across dry and wet years? How does NEE/fossil fule CO2 varies across dry and wet years?

Third, I would like to recommend adding some discussions for including evaporation in SMUrF, not now but in v2. Your model already has most important components to compute evaporation. One approach would be to use Ball-Berry model to link

your GPP, canopy conductance and finally evaporation. I really enjoyed this paper (https://doi.org/10.1073/pnas.2005253117), which stressed the important linkage between irrigation and biogenic CO2 fluxes in LA. I think SMUrF can track this as well once evaporation module is included.

Followings include minor comments:

P4 L5-10: The previous paragraph criticized the limitation of simple Reco model, then this paragraph explained ML for SIF and land surface fluxes. I feel somewhat disconnected from the previous paragraph.

P9: pure temperature -> revise

P10 L30: I feel the assumption for no correlation between GPP and Reco is overly simplified. SMUrF model structure indicates GPP is a forcing to Reco (P6 L16).

P13 L6: What's GEE? Isn't it GPP?

P18 L12: what is QF?

P20 L3: spatial SIF -> revise

P20 L10-22: It is worth discussing complex SIF-GPP relationships reported in recent literature. Consistent, linear relationship disappears in some cases.

https://doi.org/10.1016/j.rse.2018.07.008 https://doi.org/10.1002/2017JG004180 https://doi.org/10.1038/s41598-018-32602-z

Again, this is a great manuscript. I really enjoyed reading it, and also learned a lot. Thanks- Youngryel

---

Interactive comment on Geosci. Model Dev. Discuss., https://doi.org/10.5194/gmd-2020-301, 2020.