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Reply on RC2

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Author comment on "Adapting potential evapotranspiration from climate stations to the urban canyon for hydrological models" by Merle Koelbing et al., Hydrol. Earth Syst. Sci. Discuss., https://doi.org/10.5194/hess-2021-24-AC2, 2021

Dear anonymous referee#2,

We appreciate the time for reading our paper and the effort that you have dedicated to provide your feedback on the manuscript. We are grateful for your comments that we like to reply to below:

a) Regarding the title:

We understand that the title might be misleading to readers with a climatologic scientific background. If we will be asked to submit a revised version of the manuscript and if the editor is supporting this, we will change the title so that the purpose of our presented method becomes clearer. The aim was to develop a method that allows to adapt input ETo for continuous urban hydrologic modelling to urban (built-up) areas. We chose two differently oriented street canyons with and without trees to represent these areas. The new title might be: Adapting potential evapotranspiration from climate stations to the urban canyon for hydrological models.

b) Regarding concept/frame, how people should modify (downscale) ETo for urban street conditions:

We show that modifying ETo (called E_p in our manuscript since it was adapted to incoming longwave radiation) by using the proportion of shading leads to very good results. Street size and building height are affecting mainly the shading situation in the canyon. So, when applying our method to a city with different street sizes und canyon widths, we expect that according to our results, differences in wind speed, air temperature, relative humidity and longwave radiation should play a minor role compared to differences in short wave radiation. The purpose of our method presented in our manuscript is to optimize input ETo for built-up areas of cities represented by an urban canyon. Our data shows that shading has the largest effect on urban ETo compared to the other climate variable. When focusing on urban green spaces, other approaches can be included or combined.

The idea presented in this paper has already been applied to the model RoGeR (Steinbrich et al., 2021):

“This physically-based model can map the processes of run-off generation, the groundwater balance and run-off concentration at high temporal and spatial resolution. RoGeR also takes account of processes that hydrological models often neglect, for instance infiltration and interflow through preferential flow paths, or infiltration of lateral run-off on its flow path." Among other things, RoGeR has been adapted to urban surfaces by using a digital elevation model including building height of the city of interest. Based on usual GIS tools (ArcGIS), the amount of available shortwave radiation can be calculated for each location in the city for each day of the year, dependent on the geographic location and the surrounding building structure. With the calculated GIS-based short-wave radiation we can determine δK□ and in combination with the parameters shown in Fig. 14 of our manuscript we can describe the change in E_p for each point in the city. For continuous modelling of a long-term water balance, the mean state around the equinox and winter/summer solstice can be used to safe computing time. We could provide an example of the resulting map of ETo for a selected neighborhood if this is of interest to the readers.

c) Regarding results in Table (3):

Table 3 shows E_p values which are all calculated for the reference station. It shows, whether the days that we chose for our measurements were representative for the whole period that the measurements were taken in per season. The measurement period begins at day 1 of the mobile measurements and ends at the last day of mobile measurement in each season (Table 2). Therefore, E_p estimations as shown in Table 3 are not reflecting conditions in the street canyons. We will clarify this in the revised version.

d) Regarding missing standard climate parameters:

Since we are focusing on ETo (E_p) and not the single observed climate variables, we presented Table 3 to provide reference E_p estimations for each seasonal observation period. Long-term means of precipitation and air temperature are provided in the method section (line 100). Fig. 9 gives an overview over the observed input variables during the measurement period, for both, streets and reference station. We will add the other variables in the method section.

e) Regarding abbreviations of street names & Costello et al. (2000)

If we are asked to submit a revised version of the manuscript, we will consider to change the abbreviations of the street names. In addition, we will discuss our results in the light of the results of Costello et al. (2000).

Literature not cited in the manuscript:

Steinbrich A, Leistert H, Weiler M (2021): RoGeR – ein bodenhydrologisches Modell für die Beantwortung einer Vielzahl hydrologischer Fragen. In Korrespondenz Wasserwirtschaft, 14. Jahrgang, Heft Nr. 2, Februar 2021. DOI: 10.3243/kwe2021.02.004