We would appreciate all the constructive comments by the anonymous referees. We have substantially revised the paper and improved the English expression. All the modification can be found in the revised manuscript. The responses in detail to RC1 are listed below.

Recent urbanization has been changing the regional climate significantly, and the urban irrigation and road sprinkling not only make the land surface processes more complex, but also influence the urban canopy temperature. Bin Liu et al. did a novel job to optimize the limited water supply between urban irrigation and road sprinkling to get the maximum cooling effects over the Beijing city. The authors introduced the urban irrigation and road sprinkling in the WRF model, estimated the cooling efficiency of urban irrigation and road sprinkling over the urban, suburban and rural areas, and developed an optimal water management scheme to get the largest cooling effects with limited water resource. However, there are still some issues should to be revised before its publication on the HESS journal. Major comments:

Q1: Is it appropriate to include the rural areas (outside the sixth ring road) in the analysis? Although the authors treat the "urban irrigation" as ecological and farmland irrigation, the farmland irrigation in the rural region seems only cools the rural temperature with little influence on the urban temperature.)

A : we think it is better to take rural areas into consideration because (1) total amount of water applied (including rural, suburb and city center) is one of known constraint conditions, and it is not easy to separate those water; (2) We take the whole city as an optimal objective, rural areas cannot be considered separately when applying optimization method; (3) the rural urban irrigation has influence to other parts of city, although smaller than non-rural area.

Q2:

- (1) the description of the experimental design is confusing. For example, the authors said "Three experiments were conducted to consider no water usage, urban irrigation and road sprinkling". Does it mean only one experiment was conducted with consideration of road sprinkling? If so, how can they separate the cooling effects of urban road sprinkling on the suburban and rural areas (Fig. 8a)?

A: They are three kinds of experiments actually, not only 3 experiments (total 1+21+27=49 experiments). they are (1) no water usage experiment includes no urban irrigation and no road sprinkling in city center, suburb and rural areas; (2) urban irrigation experiments include 21(7x3) individual experiments, they are 0.1 to 1.9 times (0.1, 0.4, 0.7, 1, 1.3, 1.6, 1.9) of the estimated urban irrigation among city center, suburb and rural areas separately. (3) Road sprinkling experiments include 27(9x3) individual experiments, they are road sprinkling in city center, suburb and rural areas separately, water amount ranged from 0.2 to 1 times (0.2, 0.3, 0.4, 0.5,0.6,0.7,0.8,0.9,1) of the maximum water-holding capacity. A new table added to detail this, see Table 2, L144.

Table 1. Descriptions of experiments designs

Experiments	Area	Water amount	Descriptions
Raw experiment	/	/	No urban irrigation and no road sprinkling
Urban irrigation experiments	City centers	0.1, 0.4, 0.7, 1, 1.3, 1.6 and 1.9 times of the estimated urban irrigation in each part of city	Urban irrigation in city center with different water amount
	Suburb areas		Urban irrigation in suburb areas with different water amount
	Rural areas		Urban irrigation in rural areas with different water amount
Road sprinkling experiments	City centers	0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9 and 1 times of the maximum water-holding capacity of impervious layer	Road sprinkling in city center with different water amount
	Suburb areas		Road sprinkling in suburb areas with different water amount
	Rural areas		Road sprinkling in rural areas with different water amount

Fig. 8a shows the cooling effect of city center in the condition of 0.5 times of the maximum water-holding capacity.

- (2) In addition, what does the "A climate summer time periods from 2000 to 2017 were averaged to 4 days which represent the climatic May, June, July and August. And the first day was considered as the spin up period. " mean? Does this mean for each month, only one day simulation forced by climatic boundary condition is performed?

A: Yes. Firstly, we found out all data for May from 2000 to 2017. Then, averaged all these data to one day which represented climatic May. At last, climatic June, July and August were got by repeating above two steps. We did this to save simulation time. Revised in L152-153.

Q3:

- The offline experiment using CLM4.5 model was used to "illustrate the cooling effect of urban irrigation and road sprinkling". Does the author also choose the CLM4.5 model in the WRF modeling?

A: The offline simulation is to validate the urban water usage scheme (urban irrigation and road sprinkling) , (here we just take CLM4.5 as an example). It proves that taking urban water usage scheme into land surface model is better (no matter which land surface model). In WRF model, we didn't use CLM4.5 because 1) WRF does not couple the complete CLM model 2) the plant function types are different between offline (CLM in CESM) and coupling model (WRF) , so we choose SLUCM in coupling simulation with the same urban water usage schemes (the same in CLM).

- (2) Moreover, the offline modeling shows that urban irrigation does not influence the latent/sensible heat significantly over the urban region (within the fifth ring road; Figs. 5a,5c), but the online modeling shows contrary result where clear influence of urban irrigation over urban region (Figs. 10a,10d). How to interpret this?

A: Urban irrigation has the influence, with little influence (even no) influence within the 3rd ring road, but the influence between 4th to 5th ring road (including some part of 3rd ring road) are strong.

The difference between offline and coupling model are (1) subgrid type of offline model within 3rd ring road are mostly urban and little pfts (plant function types), and impervious layers, walls and roofs are major parts in urban without evaporation. Besides, the estimated water amount within 3rd ring road are less, so influence of urban irrigation was not so significant (especially with 3rd ring road); (2) offline simulations had no interactive effect between atmosphere and land surface, but online simulation had which influence some variables over larger region.

Q4: Can the default USGS land use category in the WRF model represent the urban land use in the research region? As is shown in Figure 3, the land use type in the Beijing city is 12~14. But the urban land use type in USGS category is 1.

A: I recheck the data, they were MODIS-based Land Use Classifications, I mix them up in this manuscript. The cooling effect mostly driven by water use amount. The simulation with default land use type (not the land use type of 2000-2017) may bring some uncertainty; I have discussed the uncertainty in the last section. See L333-338.

Q5: The current optimization method does not consider the urban extension or land cover change in the future. The author should at least discuss the influence of this neglect on the result.

A: I discussed the uncertainty in the last section. See L333-338.

Minor comments:

Q1:L134, change “in-situ” to “In-situ”

A: Revised

Q2.I suggest the authors to give a short description of how to estimate the road sprinkling in section 2.3 and a plot of road sprinkling water use in Beijing in Figure 2.

A: Water amount of road sprinkling is proportional to the maximum water-holding capacity (Eq. 1) in road sprinkling scheme. So, spatial distribution of road area proportion was added in Figure 2(b).

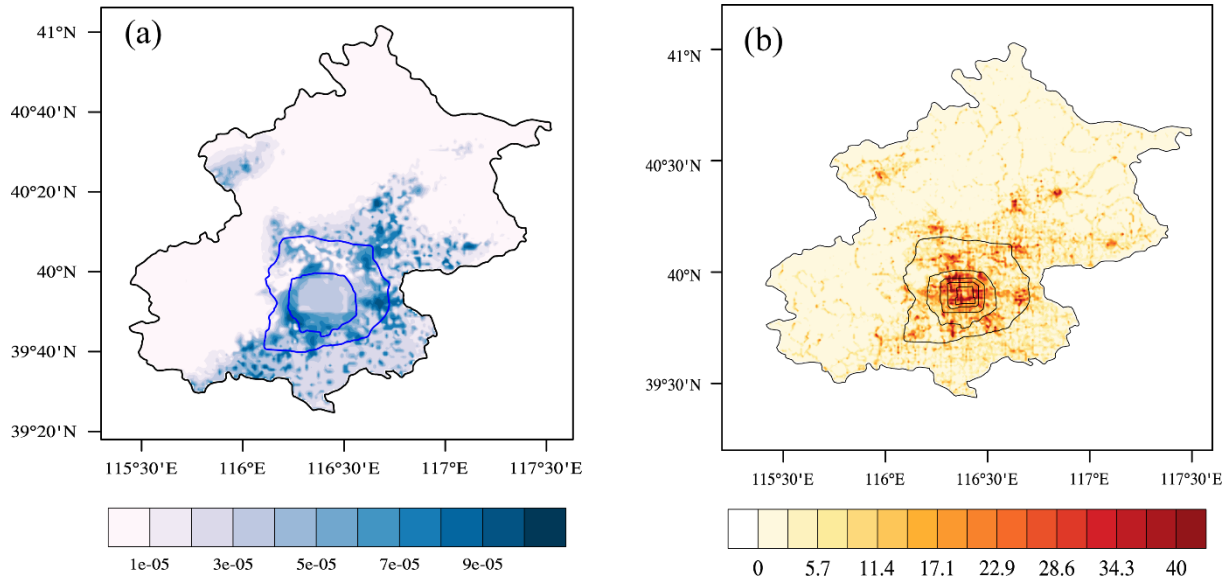

Figure 1. (a) Estimated urban irrigation water use in Beijing (mm/s), (b) spatial distribution of road area proportion (%).

Q3. In Table2, the land surface model option is "CLM/NOAH-MP", does this mean the authors performed ensemble simulation using different land surface models?
A: Revised. See Table 3

Q4."The simulation results showed that urban irrigation decreased the water table depth due to groundwater extraction " . Why does the water table depth decrease? If the water is extracted, the water table depth will increase (e.g., from 4m to 5m), and the difference is positive.
A: It's water table of ground not water table depth. The two variables are opposite. Revised in L165.

Q5.L205-L215. The author evaluate the WRF simulation by using CLDAS and observation. Does the WRF simulation used here consider the urban irrigation and road sprinkling? And will the incorporation of the above two processes have some improvements on the temperature simulations?
A: We validate the schemes in offline model (we take CLM as an example), it improves in sensible/latent heat flux (see Figure 6). In WRF simulation we drew the spatial distribution of correlation coefficients between simulation and CLDAS data in Figure 7.