Atmos. Chem. Phys. Discuss.,
https://doi.org/10.5194/acp-2020-411-RC1, 2020

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Urbanization-induced land and aerosol impacts on sea breeze circulation and convective precipitation" *by* Jiwen Fan et al.

Anonymous Referee #1

Received and published: 12 June 2020

This study investigates the effect of the city of Houston on a convective storm by means of regional numerical simulations. The authors use the WRF model coupled to a bin microphysics scheme and a land surface scheme. The city effect is decomposed into the land effect (the urban heat island effect) and the urban aerosol effect. The aerosol effect is further decomposed into the direct effect (aerosol-radiation interactions, ARI) and the indirect effect (aerosol-cloud interactions, ACI). It is shown that both effects (land and aerosol) drive increase in the convective intensity and precipitation, with the aerosol effect dominate. It is also shown that the interaction between the two effects causes a further intensification of the storm. The aerosol effect is shown to be dominated by the ACI rather than by the ARI. The two effects considered here (land and aerosol) affect the clouds at different stages and different levels in the atmosphere.

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Discussion paper

The mechanisms behind the different effects are explained. The paper address interesting questions and uses appropriate tools for answering them. I do have a few minor comments and suggestions for the authors:

L26: 15 m/s increase compared to what base-line? Maybe better to present it in percentage change.

L32: is 40 min change significant? Form the abstract the reader can't evaluate it.

L67: It will probably be good to explain what you mean here by: "indirect effect"

L147: what is the sizes of the domains? From Fig. 1 it looks like domain 2 is of the order of 200-250 km. Is it enough for spin-up of the clouds entering the domain from the lateral boundaries? As the boundary conditions are from MERRA-2 (and not from WRF simulations) I assume that the spin-up requires quite a long time after entering the domain. For a typical windspeed of $\sim$25-30 km/h (Fig. 12, for height below 1 km, and probably even higher windspeed above), the air will spend in the domain about 8-10 h. Is this enough for the spin-up? In other words, how can you eliminate the domain boundaries effect?

L220: are you only integrating liquid and no ice here? As you are simulating deep convective clouds, wouldn't it make more sense to include ice?

L233: you have twice "first".

L381: missing ")"

L405: what about the role of the slower fall speed of hydrometeors under polluted conditions? As it was shown before, smaller droplets, with lower effective terminal velocity, would be pushed higher into the atmosphere (even for a given vertical velocity) and hence invigorate the ice processes (in addition to the increased latent heating by condensation). Does that play a role here? In addition, in this section it might be a good opportunity to comment on a very relevant recent paper: https://journals.ametsoc.org/doi/pdf/10.1175/JAS-D-20-0012.1

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