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Atmospheric Chemistry and Physics Discussions

Interactive comment on "The impact of inhomogeneous emissions and topography on ozone photochemistry in the vicinity of the Hong Kong island" *by* Yuting Wang et al.

Anonymous Referee #1

Received and published: 27 October 2020

This study uses large-eddy simulations to investigate the impact of heterogenous emissions and topography on the segregation of chemical species in the mountain region of the Hong Long island. This is an important topic as global and regional chemical transport models typically cannot resolve subgrid-scale processes and therefore have difficulties accounting for the impact of segregation on chemical reaction rates within the boundary layer. The manuscript is generally well written. Experiments are carefully designed to include different emission, topography, and wind scenarios. Results are also clearly explained. However, a few major flaws need to be clarified before the manuscript can be published on ACP.

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Discussion paper

- The manuscript only provides a simple review of segregation caused by inhomogeneous emissions. First, please provide a more accurate descriptions of what these studies found. Second, a more thorough review of previous studies, including studies on the impact of terrain, is necessary. Why does this study focus on terrain? What is the role of terrain in regional scales? Third, it is recommended to include a brief description of the main results (e.g., segregation intensity) from previous studies, and elaborate on how the current study differs from previous ones.

- The study uses a flat outer domain, which could cause biases in simulated wind and other meteorological fields. The biases are then passed to the inner domain. If the WRF-LES is used, is it possible to provide more realistic simulations for both the outer and inner domains that apply meteorological fields, typography, emissions, etc from WRF?

- Segregation is important for fast reactions and determined by chemical and turbulent timescales. Therefore, turbulent turn over time and chemical lifetime of the species considered here need to be calculated based on the LES simulations and presented in this study. This study applies a simple chemical mechanism based on Brasseur and Jacob (2017), which implemented a rough categorization of primary anthropogenic and biogenic VOCs. Is this chemical mechanism suitable for the study of segregation? Are these VOCs all reactive? What are the criteria for reactivity in the current study? The lifetimes of VOCs in each category vary largely and are not all less or even comparable to turbulent turn over time. This rough categorization could induce large errors in segregation analysis. Please elaborate more on why this mechanism is selected. Also, please clarify what typical species are included in the anthropogenic and biogenic VOC groups and what the representative lifetimes are for these two groups.

- Because this study investigates segregation in the planetary boundary layer, the manuscript needs to include a paragraph to discuss boundary layer development. Please also elaborate on how terrain influences boundary layer height and whether/how it influences segregation.

- Although the LES is run in an idealized mode in the study, it would be more enlightening to perform some simulation-observation comparisons to assure things are generally consistent with the real world.

- In the result section, the manuscript needs to include a more detailed comparison of the results obtained in this study with those in previous studies. Although the results here are consistent with two studies, how about other studies? Please compare calculated segregation intensities and also justify the differences.

Others:

Lines 16-17: "However, in reality, these species are often segregated due to localized sources and the influence of the topography." It is unclear why topography is referred to here. Is it a finding from previous studies? If so, please add the citations to the introduction section.

Line 40: What are "organized turbulent flows?"

Lines 55-57: Other studies have already investigated the impact of inhomogeneous emissions. How does this study differ from previous ones?

Lines 59-60: What did Kim et al. (2016) find? Low and high NOx conditions could be similar to the mountain and urban regions in this study. Please provide more explanations here. Please fix the typo "NOX."

Lines 60-61: "resulted in?" Please rewrite this sentence with a better clarification. It now reads like it is recommended to remove aqueous-phase chemistry from the LES model. . . There are multiple obscure sentences in this manuscript. Please double check the writings to avoid misunderstanding.

Lines 65 and 80: Duplicate purposes?

Line 103: Eddies do not produce energy.

Lines 160-164: Please provide citations for the removal rate and the deposition veloci-

ties used in this study.

Line 212: Does this sentence make a paragraph?

Lines 232-234: Why is the simulated water vapor from LES higher than in the mesoscale model? Does it generate any or more clouds, which could then influence segregation aloft?

Line 236: Not all the species show similar profiles at hour 2 and 4. So this may not be used to justify chemical equilibrium. Or please elaborate more.

Lines 275-276: Do “hour 2” and “hour 4” represent 14LT and 16 LT? Please use local time instead of hour XX in the main context and the figures. What is “gradual mixing?” Or do the authors mean increased/enhanced mixing?

Line 373: “This is in consistent with ...” Please delete “in.”

Lines 373-375: Please rewrite this sentence. . .

Section 3.4: Are wind directions and speeds consistent and constant throughout the whole domain, both horizontally and vertically? Please clarify in this section. Based on the terrain map, north and south winds should be largely different from east and west winds. Please provide more explanations on this.

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