Comments on acp-2022-691

General comments

This manuscript presented a studying using CMAQ model with HDDM and PMF methods together to identify the contributions of VOCs to O3 at south part of Taiwan. The authors presented their efforts to conduct model simulations at 1km grid resolution to quantify the impacts of each VOC species from 8 different emission sectors, and also defined their own index to indicate the importance of each factor. Air pollution is always an critical issue for densely populated areas with intensive industrial facilities, and it's important to find the most economic-effective control strategy. This study made a contribution by providing in-depth investigation of O3 response to emissions changes, which could be an applicable suggestion for air quality management policy makers. The manuscript is well organized with solid method and data, and the results are presented and discussed thoroughly. Therefore I would recommend it to be published with minor revisions. My comments are listed as below.

Major Comment#1: The objective of this study was to identify the key VOC species and emission sectors to ozone abatement as the manuscript mentioned. So for the simulation period over a specific pollution event, is it able to represent typical ozone pollution conditions over southern Taiwan? Sec2.1 suggested the synoptic weather in fall usually favors ozone pollution due to less precipitation and weak vertical dispersion, but rest of the manuscript were mostly focused on impacts of emission. Therefore it is necessary to clarify if the conclusions of this study were applicable for fall ozone management only, as the driving factors and chemistry may differ in other seasons too. In addition, a brief description of ozone seasonality at southern Taiwan would be helpful to demonstrate how severe it is in fall season.

Major Comment#2: There was no description regarding chlorine emission in the manuscript, which could be a very important factor that may change the conclusion of this study, considering a vast part of simulation domain was over ocean. CMAQ was able to handle chlorine-related chemistry since earlier versions but usually it was applied over inland areas without too much attention devoted to oceanic chlorine emission. But for this study the emission from ocean may play an important role in ozone pollution over coastal cities in southern Taiwan.

Detailed comments:

(1). Did domain D03 simulation also applied HDDM and PMF? It would be interesting to reveal the differences between D03 and D04 due to grid resolution. 1km simulation is obviously too expensive for large domain, thus it would be helpful to see how well the 3km simulation can capture key factors to ozone formation.

(2). line145: Using 2016 TEDS emission is acceptable for 2018 simulation as there shall be no significant difference, but why not simulating a pollution in 2016 instead?

(3). Fig.10: Diurnal patterns of factor contribution are very different between sectors, for example, biogenic and motorcycle exhausts. Please provide a brief discussion.

(4). Was nudging turned on for WRF? Please clarify it in the manuscript.

(5). “DDM 3D” on line 47, “GCE” and “RRTM” on line 173 need clarifications.

(6). line 114-115 needs references.

(7). line112 “Oct” should be “Oct.”.

(8). line266: Please clarify how was the threshold 0.5 determined

(9). Please using consistent denotes for models. Line134 suggested using CMAQv5.2.1, while line219 indicated using v5.2.

(10). Was HDDM approach only used in the experiments S3~5 when considering higher order sensitivity, while DDM approach is used for the rest experiments and in conjunction with PMF analysis? If so, please clarify these details in the manuscript.

(11). The spatial contribution of the O3 sensitivity to each VOCs component is related to the spatial pattern of each VOCs emissions as discussed on 413-416. Please include the several plots to show the spatial pattern of VOC emissions in the supporting information.