

Review of “A three-dimensional simulation and process analysis of tropospheric Ozone Depletion Events (ODEs) during the springtime of Arctic using CMAQ” by Li et al.

This topic is very interesting and getting more scientific attention these days. Modelling of ODEs are very difficult and the authors try to model ODEs here with a new additional chemical reaction step in a CTM, which needs to be appreciated. Therefore, the MS is interesting. However, a serious revision is needed in terms of its presentation quality and the science content in it. The main points are;

Major:

1. What are ODEs, is it driven by chemical or physical (meteorology for instance) process? You mix of both these in this study in explaining this. For example, In Abstract it sounds that it is a meteorological phenomenon, but it's a chemical process, as detailed in Introduction. Please state what ODE is and how you define it in your study.
2. In results, you said ODE1 is chemistry driven and ODE2 is meteorology driven and just opposite is said in Conclusions in lines 359-364. Please clarify.
3. A discussion on the model and measurement differences should be provided with respect to the new chemical reaction added, and also with the previous studies without that particular chemical reaction in the model. Improvements should be discussed.
4. The model domain and terrain maps are already provided in Figure 1. Then why do you want to repeat this in Figures 5-8 and 10?
5. Presentation quality has to be improved significantly.

Minor:

L2: In this study

L3 and elsewhere in the MS: 28 March, not March 28th

L4-5 rephrase “analysed thoroughly through process analysis” and state what process is analysed

L: “ozone lacking air” means no ozone in that air. It is not correct, there will be always some ozone.

L9: what is local chemistry here? Bromine?

L10-11: What is this ODE? Chemistry driven or Transport driven? Is it because of ozone lacking air transported from some other region? The entire abstract sounds that the ODEs are meteorological events, Is that so?

L19: an ozone depletion event or you mean “the ozone depletion event”?

L20-27; says ODE is chemical

L28: catalyst for what?

L57: Zeng et al., year is missing

L64, year missing with citation

L65: Marelle et al., year?

L68: Both studies

Figure 1 caption; write the name of that study region

L95: 9 km

L101; particulate matter or particulates or specify them

L105: Is this equation different from other CTMs in calculating the chemical tendencies”?

L110: “incorporated or implemented” not instrumented

L111: A complete list of

L126: “and if it is at a coastal area..”

Figure 2: I do not see any connection to the local meteorology and ODEs here. For instance, ODEs are found in both low and high temperatures/pressures/wind speeds. So what does this figure communicate?

L143: why don't you just write “Measurements” instead of observational data

L151, 225, 320: In the “Supplementary Information”, not in the “supplements”

L166: of the meteorology

L172-175: How can you say these are “accurate”?

Figure 3: write the parameter names, not “meteorological field”

Figure 4: Why the simulated ozone is about 13 ppb higher than that of the measurements? This suggests that the model has a problem in simulating the ODE. Also there is a 3-4 days lag in Bromine explosion and the associated decline in ozone or ODE

L189: 40%

L236: as shown in Fig. 7c

L239-240: What do you mean by “twisted” here?

L241-242: “At UTC 06 on March 30th, the sunset occurred.” Please rephrase this

L253: retarded?

L266: “These bromine atoms then consumed the surface ozone, forming BrO.” Please rephrase this. A similar sentence is also there in lines 314-315.

L269: “and the amount of HOBr is also increased ...”

L271-272: “Then, sun rose again. Br₂ photolyzed rapidly and BrO was formed again. Combine these sentences

L275: delete “occurring”

L361-363: In results section, L 321-322, you said it was not a chemical process. It's contradictory.
