

Comment on acp-2022-275

Anonymous Referee #1

Referee comment on "Radiative impact of improved global parameterisations of oceanic dry deposition of ozone and lightning-generated NO_x" by Ashok K. Luhar et al., Atmos. Chem. Phys. Discuss., <https://doi.org/10.5194/acp-2022-275-RC1>, 2022

This paper presents an analysis of the radiative impact associated with changes to two model parameterisations: oceanic ozone deposition and production of lightning-generated NO_x. The changes to the two parameterisation schemes and the impact on ozone distributions are described in previous papers while in this work the authors focus on a number of model experiments designed to evaluate changes in radiative fluxes and attribute them to changes in ozone and methane.

The topic of the paper and the methods used are sound and make it suitable for publication. In particular, the authors' findings that uncertainty in LNO emissions can have a large impact on global climate modelling has wide implications in the field. However, there is not a lot of analysis on the factors driving the changes in radiative fluxes.

One main concern is on the modelled changes to the shortwave radiation fluxes at the surface. This is an interesting and unexpected result, and therefore grants further investigation as it is not clear what causes this reduction when LiNO_x is increased (p15, l13-17 and Fig 2b, 3c and 4c). This is unlikely to be due to increased absorption by increased ozone concentrations (as suggested by the authors) because this is inconsistent with latitudes where changes in downward longwave radiation at the surface (fig 3b) due to increased ozone are largest. Also, most of the shortwave radiation in the wavelength spectrum that ozone can efficiently absorb is already removed by stratospheric ozone (with tropospheric ozone only accounting for 1-3 mW/m² in the shortwave (see Rap et al. 2015)). Based on what is shown here (including fig 4c), it seems to me that whilst changes in the longwave are consistent with increased ozone production, as suggested by the authors, changes in the shortwave could instead be driven by some other factors, possibly including some changes in cloud or aerosols between the perturbed parameterisation experiments and the base run. I suggest the authors look at differences in the cloud and aerosols fields between various runs and the base run to further understand what drives differences in the shortwave fluxes at the surface.

Other minor comments are below.

- replace non-tropics with extra-tropics and non-tropical with extra-tropical throughout the manuscript (including in Table 1 and various figure/table captions).

- p2, l5: replace 'A radiative forcing broadly refers to' with 'Radiative forcing is'.

- p2, l7: ')' is found but it is not preceded by a '('.

- p2, l15: add reference for estimated chemical lifetime of ozone.

- p3, l12-13: other authors in the literature have come up with different estimates for global LNOx emissions (see e.g. Martin et al. 2007 and more recently Nault et al. 2017); please add a sentence to recognise other work in this field, which further stresses the large uncertainty on the extent of LNOx emissions.

- p3, l14: please give more details about the methods used to estimate the direct energy dissipated from lightning.

- p6, l2: 'chemistry transport' should be 'chemistry transport models'.

- p6, l10: 'The upper troposphere is where O₃ is most potent as a greenhouse gas' should be rephrased including a description of ozone radiative kernel and adding a reference (see Rap et al. 2015).

- p7, l1: replace 'convective component' with 'convection parameterisation scheme'.

- p9, l25: replace 'this increase' to 'this change'. This is necessary as one of the explanations for 'this increase' in the sentence refers to 'CH₄ loss' but methane loss produces a decrease. Therefore it is better to describe this as a 'change'. The next sentence rightly explains the signs of the change in more details.

- p10, l16: 'The contrast in radiation changes over land *the* ocean...' should be '...land *and* ocean...'
- p17, l19: replace 'the this' with 'this'
- Fig 4 caption: there are two instances of b). One needs to be replaced with c)