Modeling the interinfluence of fertilizer-induced NH₃ emission, nitrogen deposition, and aerosol radiative effects using modified CESM2

Ka Ming Fung^{1,a}, Maria Val Martin², Amos P. K. Tai^{1,3}

- ¹ Graduate Division of Earth and Atmospheric Sciences, The Chinese University of Hong Kong, Sha Tin, Hong Kong
 - ² Leverhulme Centre for Climate Change Mitigation, Department of Animal & Plant Sciences, University of Sheffield, Sheffield, UK
 - ³ Institute of Environment, Energy and Sustainability, and State Key Laboratory of Agrobiotechnology, The Chinese University of Hong Kong, Sha Tin, Hong Kong
 - ^a Now at: Department of Civil and Environmental Engineering, Massachusetts Institute of Technology, Cambridge, MA, USA

Correspondence to: Ka Ming Fung (kamingfung@mit.edu) & Amos P. K. Tai (amostai@cuhk.edu.hk)

15 Supplementary Figures



Figure S1. Contrasting annual-total fertilizer-induced NH₃ estimated by fully coupled CAM4-chem with online CLM5 NH₃ emission and NH_y deposition ([CAM4_CLM5]), and CAM4-chem with online CLM5 NH₃ and prescribed NH_y deposition ([CAM4_CLM5_CLIM]) at 2000-level fertilization. The prescribed NH_y map in [CAM4_CLM5_CLIM]) at 2000-level fertilization. The prescribed NH_y map in

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prescribed NH_y deposition ([CAM4_CLM5_CLIM]) at 2000-level fertilization. The prescribed NH_y map in [CAM4_CLM5_CLIM] is from the monthly average of [CAM4_CLM5] over 5 years. Panel (a) summarizes the regional differences of annual-total NH₃ emission between the two cases ([CAM4_CLM5]– [CAM4_CLM5] CLIM]). Panel (b) shows the spatial distribution of their differences.



Figure S2. Annual-mean atmospheric NH₃ estimated by fully coupled CAM4-chem with online CLM5 NH₃ emission and NH_y deposition ([CAM4_CLM5]), CAM4-chem with fertilizer-induced NH₃ emission from CMIP6 emission inventory and online NH_y deposition ([CAM4_CMIP6]), and CAM4-chem with online CLM5 NH₃ and

prescribed NH_y deposition ([CAM4_CLM5_CLIM]) at 2000-level fertilization. The prescribed NH_y map in [CAM4_CLM5_CLIM] is from the monthly average of [CAM4_CLM5] over 5 years. Panel (a) summarizes correlation analysis between the three cases and the IASI satellite retrievals. Panels (b) (c) (a) and (c) show the

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correlation analysis between the three cases and the IASI satellite retrievals. Panels (b), (c), (e), and (g) show the column NH_3 concentration of IASI and the three simulation cases correspondingly. Panels (d), (f) and (h) show concentration differences between each case and the IASI observations. Color scales are saturated at respective values, and ranges of values are shown in the legend titles.



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Figure S3. Contrasting the changes in NH_3 emission (Tg-N yr⁻¹) of [CAM4_CLM5_CLIM] and [CAM4_CLM5_NDEP] with respect to the fully coupled [CAM4_CLM5], when fertilizer application is increased by 30%.



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Figure S4. Contrasting the changes in plant nitrogen uptake (Tg-N yr⁻¹) of [CAM4_CLM5_CLIM] and [CAM4_CLM5_NDEP] with respect to the fully coupled [CAM4_CLM5], when fertilizer application is increased by 30%.



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Figure S5. Contrasting the changes in grain production (Tg yr⁻¹) of [CAM4_CLM5_CLIM] and [CAM4_CLM5_NDEP] with respect to the fully coupled [CAM4_CLM5], when fertilizer application is increased by 30%.

Change in Surface Temperature (annual-mean)



Figure S6. Contrasting the changes in annual-mean surface temperature (°C) of [CAM4_CLM5_CLIM] and [CAM4_CLM5_NDEP] with respect to the fully coupled [CAM4_CLM5], when fertilizer application is increased by 30%.



Change in Latent Heat Flux (annual-mean)

Figure S7. Contrasting the changes in annual-mean Latent Heat Flex (W m⁻²) of [CAM4_CLM5_CLIM] and [CAM4_CLM5_NDEP] with respect to the fully coupled [CAM4_CLM5], when fertilizer application is increased by 30%.

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Change in Sensible Heat Flux (annual-mean)



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Figure S8. Contrasting the changes in annual-mean Sensible Heat Flex (W m⁻²) of [CAM4_CLM5_CLIM] and [CAM4_CLM5_NDEP] with respect to the fully coupled [CAM4_CLM5], when fertilizer application is increased by 30%.