In this study, the authors examined the formation and evolution mechanisms of a haze event happened over Beijing–Tianjin–Hebei (BTH) in December 2015 using WRF-Chem model with a newly developed integrated process rate (IPR) analysis technique. They found that the $PM_{2.5}$ increase during aerosol accumulation stage was mainly attributed to strong production by aerosol chemistry process and weak removal by vertical mixing process, and the restrained vertical mixing could be the primary reason for near-surface $PM_{2.5}$ increase when aerosol radiative feedback was considered. This study is interesting, and the results are solid. IPR technique provides a fundamental information of the physical/chemical processes of aerosol change. The manuscript is well written. I would suggest publication after addressing my comments below.

Through IPR analysis, the authors found that $PM_{2.5}$ increase in the stage_1 was due to increased aerosol chemical production and decreased vertical mixing removal, but they did not explain why aerosol chemical production increased/vertical mixing removal decreased during this period. In Section 4.1, the authors used changes in synoptic conditions and atmospheric circulation to explain the aerosol variation, which seems not consistent with the IPR results. The specific humidity did not have a visible change during Dec.20-22, so the aerosol chemical production was not due to the humidity. Probably it was due to increases in aerosol precursors from regional transport.

Although the model reproduced well the $PM_{2.5}$ variation during the haze event, it strongly underestimated concentrations of most aerosols, but overestimated nitrate concentration (Figure 5). However, during stage_1, it looks that most PM2.5 increase is due to nitrate increase (Figure 8a). The authors need to discuss the potential influences of model biases on the results.

Minor comments:
Page 1 Line 23: Delete ‘happened’.

Page 1 Line 24 and following parts: Please change ‘outside transport’ to ‘regional transport’.

Page 3 Line 12: Delete ‘even’.

Page 4 Line 5: Change ‘contribution’ to ‘contributor’.

Page 4 Line 14: Recent studies found that black carbon-East Asian winter monsoon interactions and dust-wind interactions can also intensify winter haze in eastern China (e.g., Yang et al., 2017; Lou et al., 2019). The authors may would like to cite these studies.

Page 8 Line 19: What does emission source mean and how it affects aerosol variation with 24-hr (Figure 8). Does the model include diurnal variation of emission? Why contributions of EMIS are different between stage_1 and stage_2?

Page 9 Line 19: Change ‘closing’ to ‘turning off’.

Page 11 Line 4: How these matrices calculated?

Page 14 Line 14-22: Please rephrase this paragraph by illustrating absolute change first then percentage change (relative to what?). And what are the rest of contribution, from natural emission or emission outside the domain?

Page 15 Line 7: Please clarify that the dominant sources of surface-layer PM2.5 ‘variation’.

Figure 7: Change ‘special’ to ‘specific’ in caption and figure.

Figure 11: Change ‘18h’ to ‘20h’

References:

Yang, Y., L. M. Russell, S. Lou, H. Liao, J. Guo, Y. Liu, B. Singh, and S. J. Ghan, Dust-wind interactions can intensify aerosol pollution over eastern China, Nat. Commun., 8, 15333, doi:10.1038/ncomms15333, 2017.

Lou, S., Y. Yang, H. Wang, S. J. Smith, Y. Qian, and P. J. Rasch, Black carbon amplifies haze over the North China Plain by weakening the East Asian winter monsoon, Geophys. Res. Lett., 46, 452–460, doi:10.1029/2018GL080941, 2019.