General comments:

--In the introduction part, several global emission inventories are mentioned. I propose to describe in more detail the problems with current inventories and the motivation of this work.

More detail has been added to the description of the motivation of this work as well as the limitation of current inventories. The last paragraph of the introduction has been changed as:

Here, a new global inventory of fuel-, vehicle type-, and age-specific CO_2 emissions from on-road vehicles for each country from 1970 to 2020 is developed with the global fleet turnover model, in which six types of fuel, five types of vehicles, and 231 countries are considered. Based on this inventory, we analyze the evolution of the global vehicle stock over 50 years; identify the dominant emission contributors by vehicle and fuel type; and further characterize the age distribution of on-road CO_2 emissions. Compared to the publicly available on-road CO_2 emissions from previous studies, CO_2 emissions in this study have more detailed source categories which are refined into vehicle and fuel type. And with the age distribution simulated by our fleet turnover model, CO_2 emissions offered in this study would better support the policy-making of emission mitigation.

--In this work, the database of fuel-, vehicle type-, and age-specific CO_2 emissions from global on-road vehicles from 1970 to 2020 is the key achievement. However, the data provided on FigShare is only in *.mat* format. To facilitate more readers to use this dataset, adding a non-proprietary format (e.g., the netCDF file) is recommend.

Data in the format of netCDF file has been provided on FigShare. The data are available as open data at https://doi.org/10.6084/m9.figshare.24548008

--If the air pollution inventory is to be output at the same time with the CO_2 emission inventory, will the fleet turnover model and the input data need to be adjusted significantly?

The air pollution inventory has been built recently and the fleet turnover model was not adjusted significantly. The developed modules as well as the input data remain unchanged, two new modules were added to the model to estimate emissions of air pollutants. One added module was judgment of emission standard, in which the output of age distribution simulation was used as input and the proportion of each emission standard stage by vehicle and fuel types in target year and country was output. The other added module was emission factor estimation, in which emission factors in running, start, and evaporation state of target emission standard stage, vehicle and fuel type was estimated. The output of emission factor estimation was the input of vehicular emission estimation.

Specific comments:

- Please align the text formatting, e.g. line spacing is not aligned.

  Text formatting has been aligned.

- Some of the references to figures and equations use abbreviations but some do not. For example, in line 83 using “(Eq. 5)”, in line 84 using “(Figure 1)”. Please check.

  References to figures and equations have been used uniformly.

- Line 85, “In summary,” --> ”Specifically,”

  Wording has been modified.

- Line 89, “Then,” --> “Third,”

  Wording has been modified.

- Figure 2, Figure S3-4, is there any interannual variation of the performance of the modeled vehicle stock and the age distribution during 1970-2020?

  In general, the performance of the modeled vehicle stock and the age distribution would be better in more recent years as more statistics were available. Taking United State as an example, the relative deviation ratios of vehicle stock ranges from 7% to 17% during 1970-1980, while the range of relative deviation ratios decreases to around $\pm 3\%$ after 1990. As the validation indicator of age distribution, the relative deviation between the simulated vehicle stock based on newly registered vehicles and survival rates and the vehicle stock for PLDVs in United States ranges from 11% to 17% during 1970-1980, while relative deviation ratios after 1990 are between -7% and 10%.

- Figure S12: why CO_2 emissions around 1990 are visibly higher than that in adjacent years in in rest of Europe?

  The higher CO_2 emissions around 1990 in rest of Europe were mainly from countries of the former Soviet Union. There's an abrupt jump in the national on-road fuel consumption of these countries derived from IEA around 1990, which leads to the visible higher CO_2 emissions. The mutation of IEA fuel consumption statistics around 1990 in countries of the former Soviet Union may have been influenced by the collapse of the Soviet Union.