Reviewer 1

This is a charming paper with very useful messages. The ability for stakeholders to quickly identify the air pollution situation in different cities is beneficial, as is the ability to see the chronology of air pollution in the cities and how this chronology can rapidly change when successful clean air action is implemented. The paper is novel in its approach and should be published once the following relatively small comments have been addressed.

We thank the reviewer for their kind comments and for the positive review.

The paper should acknowledge more fully that there are very few measurements of air pollution anywhere in the world before the 1950s and hence the model outputs are very unconstrained, especially before the satellite period.

We agree with the reviewer and we have made the following changes to the text in the revised manuscript:

Previous version:

Due to the scarcity of historical PM2.5 observations, evaluating the accuracy of this approximation is challenging. However, this method ensures that the historical trend in PM2.5 is guided by model simulations (informed by the emissions inventory), while absolute values are aligned with more recent satellite-derived observations with global coverage.

New Version:

Due to the scarcity of historical PM2.5 observations, evaluating the accuracy of this approximation is challenging. **Observations of PM2.5 did not become routine until after the 1990s, prior to that some measurements of "soot" exist, which can give some indirect indication of PM2.5 concentrations, but even these observations are sparse and do not have good temporal or geographical coverage. The concentration data pre 1998 is therefore unconstrained by measurements.** However, this method ensures that the historical trend in PM2.5 is guided by model simulations (informed by the emissions inventory), while absolute values are aligned with more recent satellite-derived observations with global coverage.

In lines 33-38, the role of production and loss terms of PM should be tightened up. Like all pollutants the concentration is governed by the relative importance of source and loss terms. The examples given are a little simplistic. The possible sources of PM should be expanded upon. The one example of the importance of meteorology – "while other urban locations are affected by strong onshore winds which can influence concentrations" should also be further expanded. All locations are going to be influenced by meteorology.

Previous Version

PM2.5 concentrations are influenced by factors such as industrial and agricultural activity, urbanization, air quality regulation, geographic location and meteorological conditions. In some places natural (or semi-natural) sources of PM2.5 such as mineral dust or black carbon from wildfires strongly influence concentrations (Reddington et al., 2014; Zhang et al., 2016; Graham et al., 2021; Pai et al., 2022), while other urban locations are affected by strong onshore winds which can influence concentrations (Pillai et al., 2002; Dall'Osto et al., 2010). PM2.5 has an atmospheric lifetime of a few weeks, allowing pollution to travel between nearby cities and countries, causing transboundary air pollution issues (Zhang et al., 2017; Chen et al., 2022). However, this relatively short lifetime means that concentrations respond quickly to effective clean air legislation (e.g. Silver et al. 2020).

New Version

The concentration of PM2.5 at any given location is governed by the balance between the magnitude of source terms (including direct emissions, secondary formation, and transport from other regions) and removal processes (such as deposition and atmospheric dispersion). Sources of PM2.5 are diverse and include combustion from vehicles, residential cooking and heating, industry, power generation, and agriculture, as well as secondary aerosol formation from gaseous precursors like SO_2, NO_x, and VOCs. Natural and semi-natural sources—such as mineral dust, sea salt, volcanic emissions, and black carbon from wildfires—can also contribute substantially to PM2.5 levels (Reddington et al., 2014; Zhang et al., 2016; Graham et al., 2021; Pai et al., 2022).

Meteorological conditions strongly modulate both source and removal terms. Temperature inversions, for instance, can suppress vertical mixing and trap pollutants near the surface, resulting in acute pollution episodes. Cities situated in valleys or at the foot of mountain ranges can experience higher concentrations due to restricted air movement (limiting the dispersion of pollutants), while some coastal cities are influenced by strong onshore winds that transport pollutants away (Pillai et al., 2002; Dall'Osto et al., 2010). Furthermore, PM2.5 also displays quite significant seasonal trends due to seasonal changes in meteorology and emission patterns.

PM2.5 has an atmospheric lifetime of approximately a few weeks, allowing pollution to be transported to nearby cities and countries, causing transboundary air pollution issues (Zhang et al., 2017; Chen et al., 2022). At the same time, it means that PM2.5 concentrations can respond relatively quickly - on the order of days to weeks - to effective emissions controls and clean air legislation (e.g., Silver et al., 2020), making policy interventions both impactful and measurable over short timescales.

Line 36 "…atmospheric lifetime of a few weeks,…" should be changed to "…atmospheric lifetime of approximately a few weeks,…"

Changed (please see above).