Related articles

Volume 5, issue 6 | Copyright

Methods for assessment of models | 12 Dec 2012

How realistic are air quality hindcasts driven by forcings from climate model simulations?

G. Lacressonnière et al.

Received: 12 Jul 2012 – Discussion started: 31 Jul 2012 – Revised: 13 Nov 2012 – Accepted: 19 Nov 2012 – Published: 12 Dec 2012

Abstract. Predicting how European air quality could evolve over the next decades in the context of changing climate requires the use of climate models to produce results that can be averaged in a climatologically and statistically sound manner. This is a very different approach from the one that is generally used for air quality hindcasts for the present period; analysed meteorological fields are used to represent specifically each date and hour. Differences arise both from the fact that a climate model run results in a pure model output, with no influence from observations (which are useful to correct for a range of errors), and that in a "climate" set-up, simulations on a given day, month or even season cannot be related to any specific period of time (but can just be interpreted in a climatological sense). Hence, although an air quality model can be thoroughly validated in a "realistic" set-up using analysed meteorological fields, the question remains of how far its outputs can be interpreted in a "climate" set-up. For this purpose, we focus on Europe and on the current decade using three 5-yr simulations performed with the multiscale chemistry-transport model MOCAGE and use meteorological forcings either from operational meteorological analyses or from climate simulations. We investigate how statistical skill indicators compare in the different simulations, discriminating also the effects of meteorology on atmospheric fields (winds, temperature, humidity, pressure, etc.) and on the dependent emissions and deposition processes (volatile organic compound emissions, deposition velocities, etc.). Our results show in particular how differing boundary layer heights and deposition velocities affect horizontal and vertical distributions of species. When the model is driven by operational analyses, the simulation accurately reproduces the observed values of O_3, NO_x, SO_2 and, with some bias that can be explained by the set-up, PM_{10}. We study how the simulations driven by climate forcings differ, both due to the realism of the forcings (lack of data assimilated and lower resolution) and due to the lack of representation of the actual chronology of events. We conclude that the indicators such as mean bias, mean normalized bias, RMSE and deviation standards can be used to interpret the results with some confidence as well as the health-related indicators such as the number of days of exceedance of regulatory thresholds. These metrics are thus considered to be suitable for the interpretation of simulations of the future evolution of European air quality.

Download & links

- Article (PDF, 12679 KB)
- Supplement (39 KB)

How to cite: Lacressonnière, G., Peuch, V.-H., Arteta, J., Josse, B., Joly, M., Marécal, V., Saint Martin, D., Déqué, M., and Watson, L.: How realistic are air quality hindcasts driven by forcings from climate model simulations?, Geosci. Model Dev., 5, 1565-1587, https://doi.org/10.5194/gmd-5-1565-2012, 2012.