

## ***Interactive comment on “CALIOPE-Urban v1.0: Coupling R-LINE with a mesoscale air quality modelling system for urban air quality forecasts over Barcelona city (Spain)” by Jaime Benavides et al.***

### **Anonymous Referee #1**

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### **General comments**

The paper describes an interesting and innovative method for coupling the local air quality model R-LINE to a meso-scale air quality modelling system. It is generally clearly written and contains some useful analysis.

The analysis only considers NO<sub>2</sub> concentrations. NO<sub>2</sub> is a pollutant of active current interest for regulation and health effects, however it is challenging to model due to the interaction of dispersion and chemistry. Hence it is valuable to analyse modelled and

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measured NO<sub>x</sub> concentrations before considering NO<sub>2</sub>, to assist with distinguishing between uncertainties in emissions, dispersion and chemistry. The consideration of chemistry effects should also be included in the associated discussions of NO<sub>2</sub> results.

The method for taking into account the effects of a specific street canyon on dispersion described in Section 2.3.1 only considers flow channelling along the canyon. However, canyons are also known to cause recirculating flow across the canyon, which significantly alters the dispersion of road traffic emissions and hence the concentration variation with wind direction for receptors within the canyon. No analysis of the modelled or measured variation of concentrations with wind direction is presented, so it is difficult to assess the effectiveness of this formulation.

### **Specific comments**

Section 2.1: Please state explicitly the depth of the lowest model layer in WRF and CMAQ, which is alluded to in Section 2.3.1.

Section 2.3.2 and Figure 3: Please comment on the negative value of intercept, which may indicate that the Ciutadella site does not fully represent an appropriate urban background concentration for the Eixample traffic site.

Section 2.3.3: Is the background mixing correction applied uniformly to all pollutants? In particular, O<sub>3</sub> usually shows opposite behaviour to NO<sub>x</sub> and NO<sub>2</sub>, so this formulation may distort background concentrations used for chemistry calculations. Please also clarify how the background concentration is used within R-LINE, especially in regard to the chemistry calculations.

Section 2.4: Although the analytical model shows a significant reduction in execution time relative to the numerical local model, is 44 minutes execution time for 1 modelled hour realistic for use in an operational forecasting system?

Section 3.1: Please state the measurement height(s) for the official network sites.

Section 4: Please add an initial assessment of NO<sub>x</sub> modelled and measured concen-

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trations.

Section 4.1: The discussion relating to Figure 8 does not mention the varying influence of chemistry processes through the day, which can lead to inaccuracies in diurnal profiles.

Section 4.3: It is common for Gaussian-type models such as R-LINE to perform poorly in low wind speed conditions due to uncertainties about associated wind directions. They also do not take into account possible accumulation of pollutants between hours in low wind speed conditions, which is in contrast to the assumption in the background adjustment in this work of reduced mixing causing reduced surface background concentrations. Figure 10f) suggests that the unadjusted regional background could be more appropriate than the adjusted in the early morning hours, though not in the evening. Are there other differences (eg. wind direction) between these two periods?

Figure 10: for panels e) and f) why is the model background concentration an average over six sites, not also taken from the Ciutadella site?

Section 5: Again, the uncertainty in NO<sub>2</sub> resulting from chemistry processes should form part of the discussion.

#### Technical corrections

Abstract, p1 line 15: In this case, the coupled system **also** shows

Section 1, p3 line 8: subtract its result **from** the mesoscale model

Section 1, p3 line 30: please re-phrase 'over background roof-level concentrations' as the meaning is unclear

Section 1, p3 line 35 – p4 line 1: 5 traffic sites **and** 1 background

Section 1, p4 line 2: campaign that **deployed** 182 NO<sub>2</sub> passive dosimeters **across Barcelona** for two weeks...

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Section 2.3.3, p12 line 8: please re-phrase 'ends when the surface background gets over roof value for bd equals 0' as the meaning is unclear

Section 3.1, p15 line 8: centred **on** the measurement site

Section 4.1, p18 lines 9 and 11: unnecessary **the** before Appendix B

Figure 7: these plots look vertically distorted, as the target area is usually viewed as circular.

Figure 8: The vertical and horizontal axis scale labels are too small to read.

Section 4.1, p20 line 3: higher modelled traffic emissions, **resulting** in higher local pollutant concentrations...

Section 4.3, p23 lines 15-18: The first sentence says ten days of highest RMSE and ten days of lowest RMSE, whereas the following sentences suggest five days of high RMSE and five days of low RMSE. Please clarify how many days were selected and analysed.

Section 5, p27 line 11: ... gives surface concentrations **by** applying a vertical...

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