

Interactive comment on “MAX-DOAS measurements of tropospheric NO₂ and HCHO in Munich and the comparison to OMI and TROPOMI satellite observations” by Ka Lok Chan et al.

Anonymous Referee #2

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The paper is about the two-dimensionally (2D) scanning Multi-AXis Differential Optical Absorption Spectroscopy (MAX-DOAS) observations of nitrogen dioxide (NO₂) and formaldehyde (HCHO) in Munich. Vertical columns and vertical distribution profiles of aerosol extinction coefficient, NO₂ and HCHO are retrieved from the 2D MAX-DOAS observations. The retrieved surface aerosol extinction coefficients and NO₂ mixing ratios are compared to in situ monitoring data. The Pearson correlation coefficient (R) of surface NO₂ mixing ratios and in situ monitoring data is 0.91. The aerosols optical depths (AODs) show good agreement as well (R=0.80) when compared to sun-photometer measurements. Following these results the tropospheric vertical column densities (VCDs) of NO₂ and HCHO derived from the MAX-DOAS measurements are

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used to validate OMI and TROPOMI satellite observations. Monthly averaged data show high correlations. However, satellite observations are on average 30% lower than the MAX-DOAS measurements. Furthermore, the MAX-DOAS observations are used to investigate the spatio-temporal characteristic of NO₂ and HCHO in Munich. Analysis of the relations among aerosol, NO₂ and HCHO shows higher aerosol to HCHO ratios in winter and a longer atmospheric lifetime of aerosol and HCHO is concluded. It is suggested from this analysis that secondary aerosol formation is the major source of aerosols in Munich. General comments MAX-DOAS observations are one of the measurements methods to detect the carcinogenic atmospheric pollutant HCHO which is originated by a lot of sources. Also, satellite observations of HCHO are available so that MAX-DOAS is an ideal ground-truthing method which should be applied for this task worldwide. The paper addresses relevant scientific questions within the scope of AMT. It completes the knowledge about NO₂ and HCHO concentrations in urban area. The paper presents novel concepts, ideas and tools. The scientific methods and assumptions are valid and clearly outlined so that substantial conclusions are reached. The description of experiments and calculations are sufficiently complete and precise to allow their reproduction by fellow scientists. The quality and information of the figures is fine. The related work is well cited as well as the number and quality of references appropriate i.e. the authors give proper credit to related work and clearly indicate their own new/original contribution. The title and the abstract clearly reflects the contents of the paper. The overall presentation is well structured and clear. The language is fluent and precise. The mathematical formulae, symbols, abbreviations, and units are generally correctly defined. Specific Comments Please include at page 3, line 6 the name of the air quality monitoring station and a characterization of this station so that one can follow the analyses. Technical corrections Page 24, line : delete a dot.

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