

Analysis of concentration of gases and aerosol particles in university classes during the COVID-19 pandemic

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Keywords: air quality, particle number size distribution, SMPS, ventilation, volatile organic compounds.

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Nowadays, the importance of indoor air quality (IAQ) is higher than ever due to COVID-19 transmission in indoor environments. In these places, such as offices or classes environments, people spend more than 80 % of time away from home. Thus, the study of the evolution of gases and particle number size distribution (PNSD) in closed places (e.g. during class) is important to assess the possible transmission of viruses with different ventilation conditions (Blocken et al., 2021).

The main aim of this study is the analysis of PNSD and gases before (1 h), during and after (1 h) university classes. The concentrations of particles by sizes modes (nucleation: <30 nm; Aitken: 30-100 nm; accumulation: 100-1000 nm; coarse: >1000 nm) and gases (NO₂, SO₂, CO, CO₂ and VOCs) have been included.

In order to analyse IAQ in the classroom, the following equipment was used: i) a Scanning Mobility Particle Sizer spectrometer (TSI-SMPS Model 3938) to measure the aerosol concentration between 14 and 763 nm in 110 channels; ii) an optical spectrometer PCASP-X to measure the aerosol concentration between 0.1 and 26.8 μm; iii) an automatic infrared monitor from Gray Wolf (WolfSense IQ-610) to register temperature, relative humidity, CO, CO₂ and volatile organic compounds (VOCs); and iv) three portable gas sensors of Aeroqual series 500 to measure O₃, NO₂ and SO₂.

The students (about 20 to 40) and the professor constantly wore masks and the safety distance between seats of 1.5 m was respected, so there were no students less than that distance from the sampling point. The doors were constantly open while the windows were opened intermittently during class and always opened between classes.

Preliminary results indicate a clear increase of CO₂ concentration between before (435 pp) and during class (899 ppb), CO concentration (1.4 to 1.9 ppm) and nucleation mode concentration (mean increase of 46 %). Also noteworthy is the increase of VOCs during classes (24 %). The mean particle concentration recorded during class in the nucleation mode was 375 cm⁻³; Aitken, 688 cm⁻³; accumulation, 274 cm⁻³; coarse, 55 cm⁻³. Other parameters such as concentration in Aitken (before: 601 cm⁻³) or accumulation modes (before: 286 cm⁻³) did not change during classes. The maximum CO₂ concentration registered was 1102 ppb during class.

Between classes, the classroom was ventilated and cleaned with a sharp decrease of CO₂ concentration (Figure 1) and an increase of aerosol concentrations related with dry cleaning of floor and the exit of the students. Other study in nursery schools (Mainka et al., 2015) recommended wet instead dry cleaning of floors in order to reduce aerosol concentrations after class.

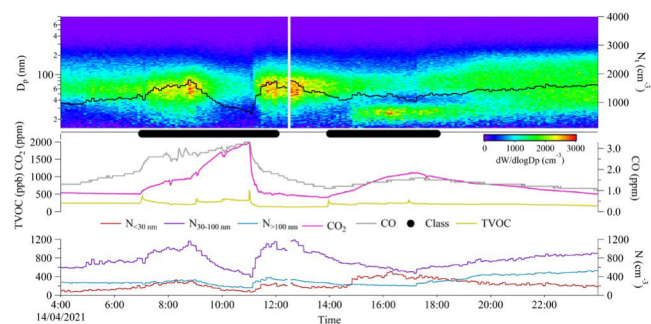


Figure 1. An example of the evolution of particle number and gaseous concentration in the classroom at 14/04/2021. The thick black line indicates class periods.

The study of the evolution of PNSD and gaseous compounds during the classes may allow us to analyze the possible transmission of viruses under different ventilation conditions. Unfortunately, the determination of particulate matter composition proved impossible, given the noise of the particulate collectors.

This study was partially supported by the Spanish Ministry of Science, Innovation and Universities (Grant RTI2018-098189-B-I00), the University of León (Programa Propio 2015/00054/001 and 2018/00203/001), the AEROHEALTH project (Ministry of Science and Innovation, Grant PID2019-106164RB-I00, co-financed with European FEDER funds) and by the Junta de Castilla y León co-financed with European FEDER funds (Grant LE025P20). C. del Blanco Alegre acknowledges the grant FPU16/05764 from the Spanish Ministry of Education.

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doi:10.1016/j.buildenv.2021.107659

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doi:10.1016/j.apr.2015.06.007