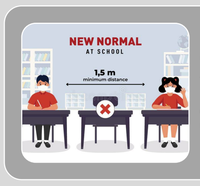
Analysis of gaseous and aerosol particle concentration in college classes during COVID-19 pandemic

C. Blanco-Alegre[1], A.I. Calvo[1] and R. Fraile[1]
[1]Department of Physics, University of León, 24071 León, Spain
Keywords: air quality, particle number size distribution, SMPS, ventilation, volatile organic compounds
Presenting author email: *aicalg@unileon.es*

INTRODUCTION

Nowadays, the indoor air quality (IAQ) is more important 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 their time. Thus, the study of the evolution of gaseous and particle number size distribution (PNSD) in indoor places (e.g. during class) it is important to evaluate 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 gaseous before (1 h), during and after (1 h) college classes**. The concentrations of particles by sizes -modes (nucleation: <30 nm; Aitken: 30-100 nm; accumulation: 100-1000 nm; coarse: >1000 nm) and gaseous concentrations (NO_2, SO_2, CO, CO_2 and VOCs) have been included.



20-40 students in the class.
Safety distance between seats of 1.5 m.

Students and teacher constantly wore mask.

The doors were constantly open while the windows were opened intermittently during class.

MATERIAL AND METHODS

6 April 2021 → 22 April 2021

Figure 1. Sampling at **Faculty of Biological and Environmental sciences** (University of León, Spain).

Figure 2. Sampling point (square) in the classroom.

High resolution nanoparticle sizer (SMPS Model 3938). Particles with diameters between 14 and 1000 nm in 104 channels were sampled.

An optical spectrometer PCASP-X to measure the aerosol concentration between 0.1 and 26.8 µm in 22 channels.

An automatic infrared monitor from Gray Wolf (WolfSense IQ-610) to register temperature, relative humidity, CO, CO_2 and volatile organic compounds (VOCs) concentrations.

Three portable gas sensors of Aeroqual series 500 to measure O_3, NO_2 and SO_2 concentrations.

RESULTS

Mean particle concentration by modes (cm^{-3})	Nucleation - 375	Aitken- 688	Accumulation 274	Coarse: 55

Preliminary results indicate that Aitken or accumulation mode concentration did not change during classes. However, a clear increase (Figure 3) during classes is observed for:

- **CO_2** concentration between before (**435 ppb**) and during class (**899 ppb**). The **maximum** registered was **1102 ppb** during class.
- **CO** concentration (**1.4 to 1.9 ppm**)
- **nucleation mode** concentration (mean increase of **46 %).**
- **VOCs** concentration (mean increase of **24 %**).

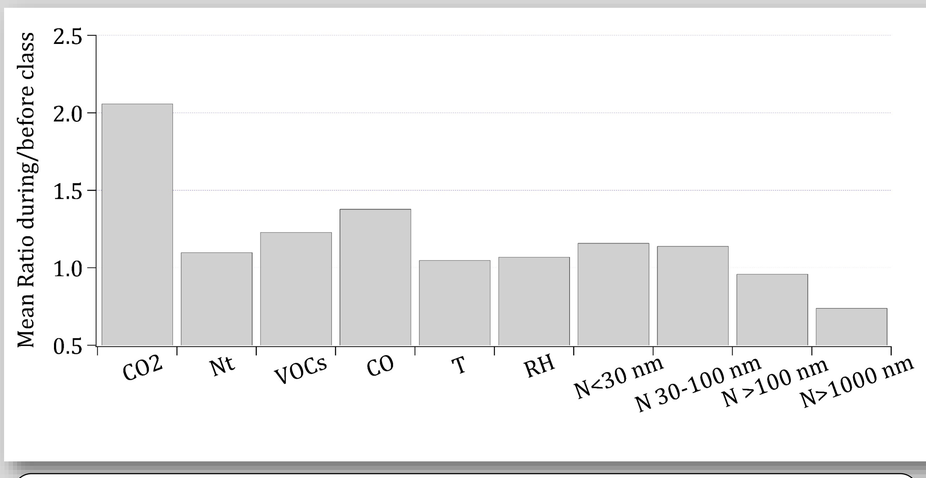


Figure 3. Mean ratio between variables registered during and before class.

Between classes, there was ventilation and cleaning of class with a sharp decrease of CO_2 concentration (Figure 4) and an increase of aerosol concentrations related with dry cleaning of floor and with the movement associated with students leaving the classroom.

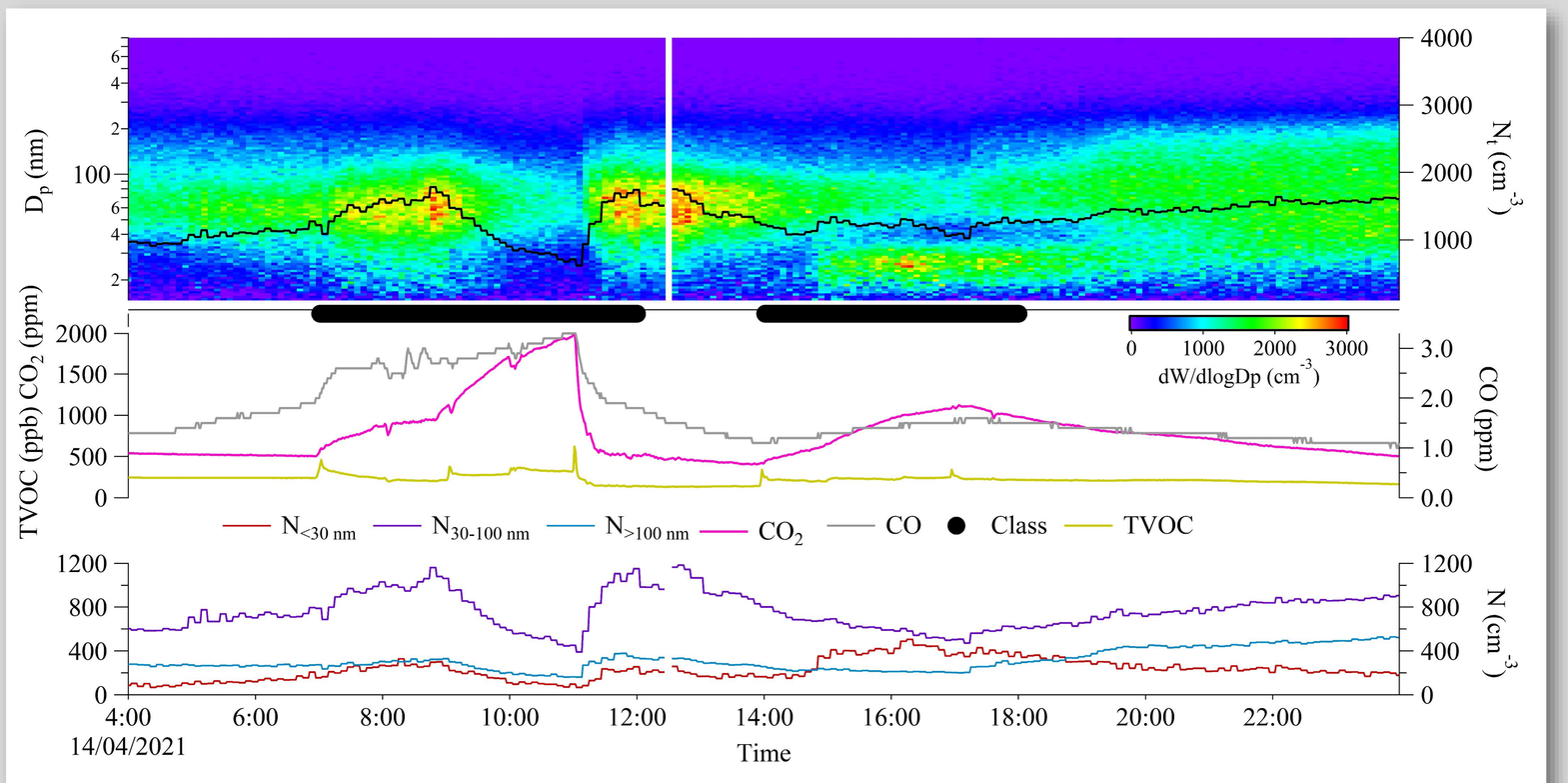


Figure 4. Evolution of particle number and gaseous concentration in the classroom at 14/04/2021. The thick black line indicates class periods.

CONCLUSION

An application of the analysis of the evolution of PNSD and gaseous compounds during the classes could be the study of virus transport through aerosols. This study should be completed with the determination of particulate matter composition, a complicated task given the noise of the particulate collectors. As observed, it is recommended wet instead dry cleaning of floors in order to reduce aerosol concentrations after class, as also noted Mainka et al. (2015) in nursery schools.

References

Blocken et al., 2021. Build. Environ. 193, 107659. doi:10.1016/j.buildenv.2021.107659
Mainka et al. 2015. Atmos. Pollut. Res. 6, 1098–1104. doi:10.1016/j.apr.2015.06.007

Acknowledgements

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) and the AEROHEALTH project (Ministry of Science and Innovation, Grant PID2019-106164RB-I00, co-financed with European FEDER funds). C. del Blanco Alegre acknowledges the grant FPU16/05764 from the Spanish Ministries of Education.