

Indoor and outdoor comparison of particulate matter monitoring systems aimed at the safeguard of cultural heritage

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Particulate matter (PM) is one of the many air pollutants that pose a significant threat to the conservation of cultural heritage [1]. Even though PM originates mainly from outdoor sources, numerous indoor activities can be responsible for the emission of particles, and penetration from the outdoors is also possible [2]. Various degradation phenomena may occur following the chemical-physical interaction between an artifact and suspended air particles which can be deposited on its surface; including, but not limited to, blackening, abrasion, and discoloration [3]. This interaction is influenced mainly by the chemical composition and size of the particles; the fine fraction being the one posing the greatest threat to the works of art [4].

To date, there is an absence of internationally-accepted regulations imposing limits on the concentrations of the main air pollutants. However, on a national level, different institutions indicate recommended values for the conservation of cultural heritage. These efforts prompted several museums to establish internal protocols focused on the enactment of monitoring campaigns to evaluate the levels of pollution in the environments surrounding the works of art, along with measures to contrast the presence of such dangerous species. There are however, sites other than museums (sanctuaries, churches, ...) which also host important artifacts, that remain essentially unmonitored.

The current study was conducted inside the *Santuario della Beata Vergine dei Miracoli*, which is a marian sanctuary located in the small town of Saronno (VA), in the Lombardy region of Northern Italy. Numerous frescoes, paintings and wooden sculptures created by the most important Lombard artists of the time can be found in this site. With the aim of safeguarding these precious works of art, three different particulate matter monitoring systems have been tested within the Sanctuary to evaluate the indoor concentrations of this dangerous pollutant. The first is an optical particle counter (P-Dust Monit, conTec Engineering Srl) that allows the dimensional speciation of the particles into seven different classes. The second is a real-time air quality monitoring system (Polludrone, Oizom Instruments), previously cross-validated by intercomparison with gravimetric data. The third instrument is a newly-developed air quality monitoring system (Sensy, Sense Square) which possesses several characteristics that would make it ideal for applications in the cultural heritage field: it is silent, of low visual impact, and easy to install.

Following the results of a first monitoring campaign carried out in 2021 with the only use of the P-Dust Monit, which highlighted critical issues regarding the indoor concentrations of PM in the Sanctuary, a second campaign was performed in 2022 with the use of the two additional instruments cited previously. The systems were placed in parallel both indoors and outdoors to evaluate the concentration of the particles and to carry out a comparison between them. Thanks to this campaign, a step towards the validation of the Sensy air quality monitoring system has been taken and hopefully these systems can be soon implemented for particulate matter monitoring in the cultural heritage field.

References

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