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An ultra light measurement system for monitoring of vertical profiles of meteorological parameters and particulate matter concentration using unmanned aerial vehicle.

Miroslaw Zimnoch (1), Piotr Sekula (1,2), Jakub Bartyzel (1), and Michal Kud (1)

(1) Faculty of Physics and Applied Computer Science, AGH University of Science and Technology, Krakow, Poland, (2) Institute of Meteorology and Water Management, National Research Institute, IMGW-PIB Branch of Krakow, Krakow, Poland

Better understanding of the atmospheric processes influencing the dynamics of the Planetary Boundary Layer (PBL) can contribute to advancement of atmospheric circulation models and improve the quality of numerical air quality forecasts. In particular, urban areas are important being responsible for intense air pollutants emissions, and on the other hand because of complicated topography and heterogenic land cover, making it difficult to reliably model the dynamics of the boundary layer over the city. Correct modeling of the boundary layer and wind field has a key impact on the obtained concentrations of air pollutants in the forecasts.

Here we present the airborne platform based on quadcopter equipped with set of sensors enabling to measure vertical profiles of air temperatures, relative humidity as well as three fractions of particulate matter (PM1, PM2.5 and PM10). The measurement system is based on Arduino platform [1] responsible for communication with the sensors and storing the measurements on the memory card. Temperature, relative humidity and atmospheric pressure is measured by combined digital humidity, pressure and temperature sensor BME280 manufactured by BOSCH [2]. The humidity sensor provides an extremely fast response allowing to complete 63% of step from RH=0% to 90% and reverse in 1s, the pressure sensor is an absolute barometric pressure sensor with extremely high relative accuracy (0.12hPa) and resolution (0.18Pa) and the integrated temperature sensor has been optimized for lowest noise (0.005 deg C) and highest resolution (0.01 deg C). Its output is used for temperature compensation of the pressure and humidity sensors as well as for measurement of the ambient temperature. For PM1, PM2.5 and PM10 measurements a PMS7003 low cost sensor manufactured by Plantower [3] based on light scattering method has been used. The accuracy of the sensor is equal to $\pm$10ug/m3 and single response time is equal to 1s. The measurement system is supplemented by NEO-7 GNSS module manufactured by Ublox company [4] allowing to monitor the horizontal and vertical position of the sensor with 1s resolution. The preliminary tests demonstrated the usefulness of the platform to perform vertical measurements of the temperature, relative humidity and PM concentrations in the range from ground level up to 100 m a.g.l., however the special flight plan is required allowing the temperature sensor to equilibrate at a certain heights. The upper height limit is a result of regulations for the area located inside the airport Controlled Traffic Region (CTR) zone. There are future plans to make higher measurements outside of the zone.

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