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Validation of Rooftop Wind Measurements in the Urban Environment: Three-dimensional digital models of wind-tunnel configurations

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The National Research Council Canada (NRC) is engaged in a multi-year project with Transport Canada to characterize urban flow fields and to understand better the influence of typical urban flow structures on small Remotely Piloted Air Systems (sRPAS) operating in the urban environment. A study conducted in 2023 involved a field test and a wind-tunnel test of the same site in downtown Montréal, Canada (Barber, *et al.*, 2023). The goal of the study was to acquire urban airflow data in a real environment in order to validate urban airflow characteristics from model-scale testing. Sonic anemometers were installed on rooftops in Montréal and the wind measurements from three of these rooftop-anemometers were compared to wind-tunnel tests using a 1:300-scale model.

The supplementary material provided in this document includes three-dimensional (3D) digital models of the urban environment near the anemometers used for validation in the current study. The digital models of the surroundings of the Îlot Balmoral (BAL), Place Ville Marie Tower 1 (PVM-1) and Tower 3 (PVM-3) buildings are provided in Figures A.1 to A.3, respectively. The digital models are a representation of the wind tunnel model for each building site. The digital model was developed based on an open-access data-set that included terrain and 3D building models of Montreal from 2015 (Ville de Montréal, 2016). Twelve mid- to high-rise buildings were identified within the overall study area that were built after 2015. These buildings were modelled based on a combination of satellite images, Google Earth renderings, architectural drawings, and condominium floor plans and were added to the wind-tunnel model to represent the site as of the fall of 2023. The wind-tunnel models have a flat ground plane. The digital model for each building includes a representation of the turntable about which the model was rotated in the wind tunnel. The digital models are all at model scale (1:300), with dimensions in mm. A ring of compass directions is included in the digital model to represent the reference wind directions (0° is wind from the North).

Each digital model is provided as an interactive 3D PDF. The PDF files were generated as exports from *Rhino v6* using the *SimLab Plugin for Rhino*. The 3D PDFs have been confirmed to be compatible with PDF-XChange Editor, Adobe Acrobat Reader, and Foxit PDF Editor. A summary of the 3D controls for viewing the model is provided in the caption of each of the models below.

References

Barber, H., McTavish, S., Wall, A., 2024a. Airflow in the urban environment: RPAS use-case study (publicly available). Technical Report LTR-AL-2024-0014. National Research Council Canada. https://doi.org/10.4224/40003332.

Ville de Montréal, 2016. 3D Buildings 2016 (LOD2 model with textures). Service des Infrastructures du réseau routier-Division de la géomatique. URL: https://open.canada.ca/data/dataset/5eabd047-872e-425a-bbc2-3669e732a132

3D Model - Îlot Balmoral

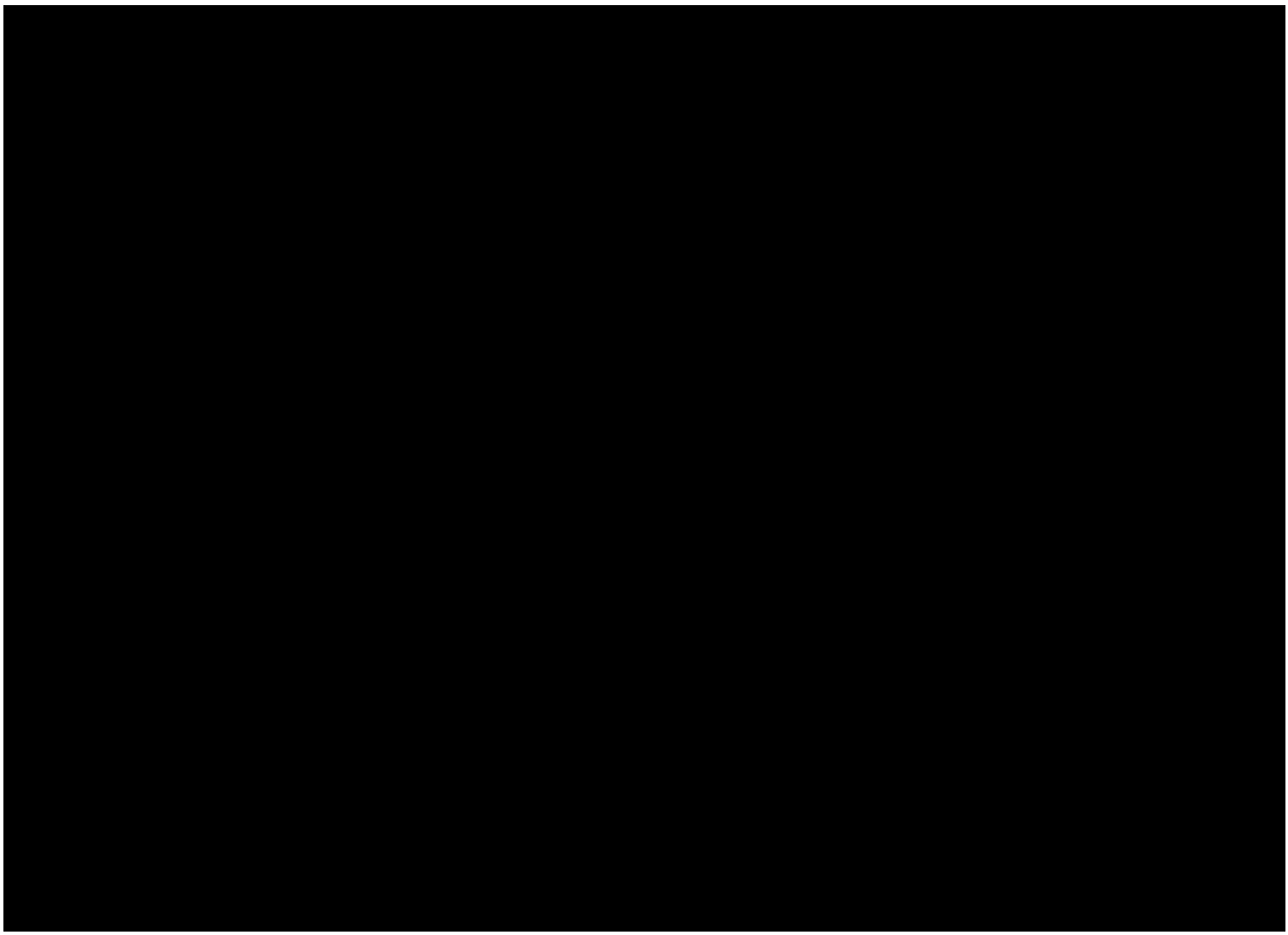

Figure A.1. Three-dimensional PDF model of the Îlot Balmoral (BAL) site. The model represents the buildings used in the wind tunnel study. Note that buildings overhanging the circular turntable area were removed when they caused interference with the wind tunnel walls. The compass directions are shown with orange arrows. Ilot Balmoral is located in the middle of the circular area and a representative, cyan-coloured post is shown at the location of the rooftop anemometer.

3D PDF Controls (may vary depending on the PDF viewer):

Pan: ctrl + left mouse click
Zoom: shift + left mouse click OR mouse wheel
Rotate: left mouse click

3D Model - Place Ville Marie Tower 1 (PVM-1)

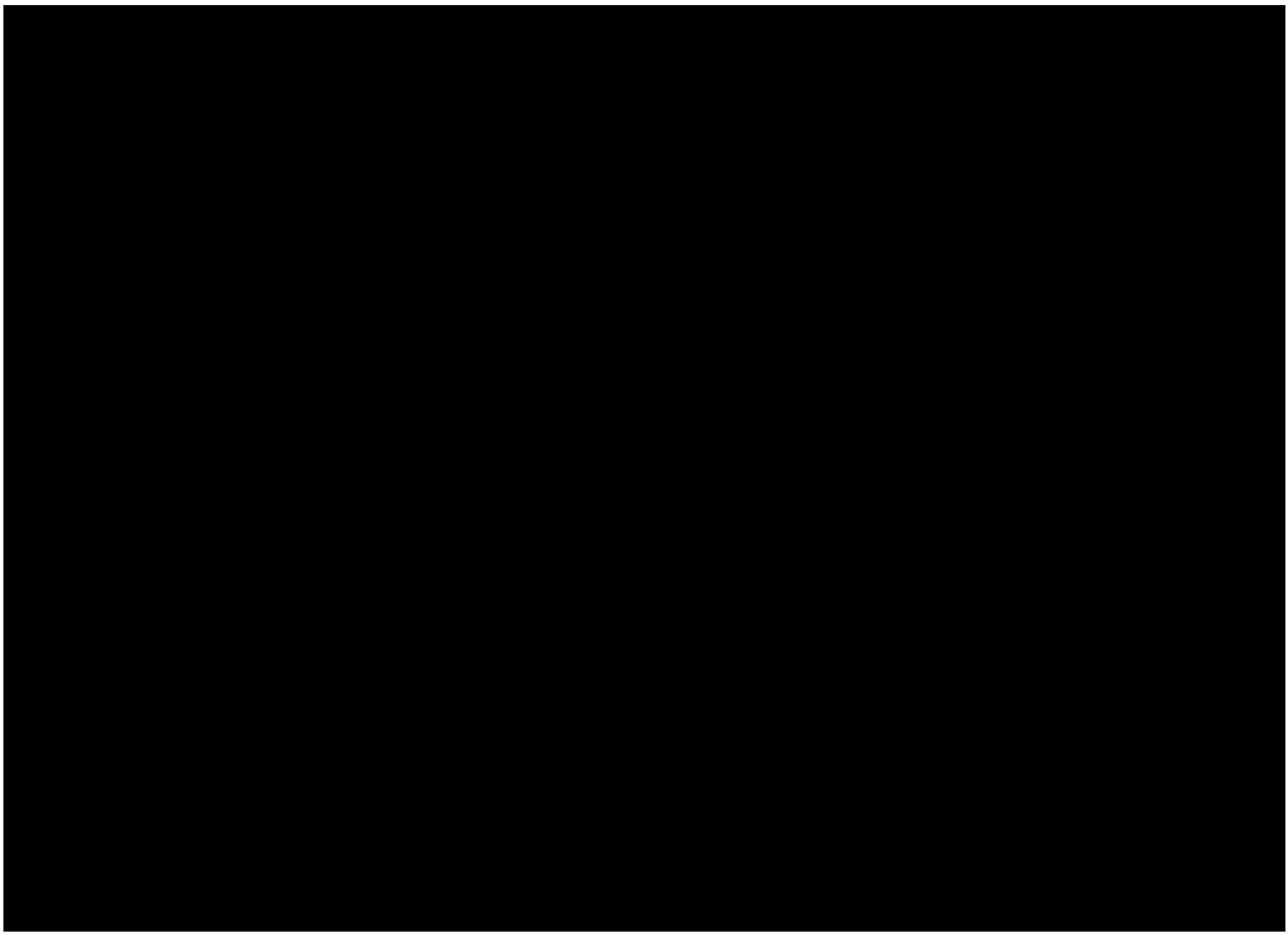

Figure A.2. Three-dimensional PDF model of the Place Ville Marie Tower 1 (PVM-1). The model represents the buildings used in the wind tunnel study. The compass directions are shown with orange arrows. PVM-1 is located in the middle of the circular area and a representative, cyan-coloured post is shown at the location of the rooftop anemometer mast.

3D PDF Controls (may vary depending on the PDF viewer):

- Pan: ctrl + left mouse click
- Zoom: shift + left mouse click OR mouse wheel
- Rotate: left mouse click

3D Model - Place Ville Marie Tower 3 (PVM-3)

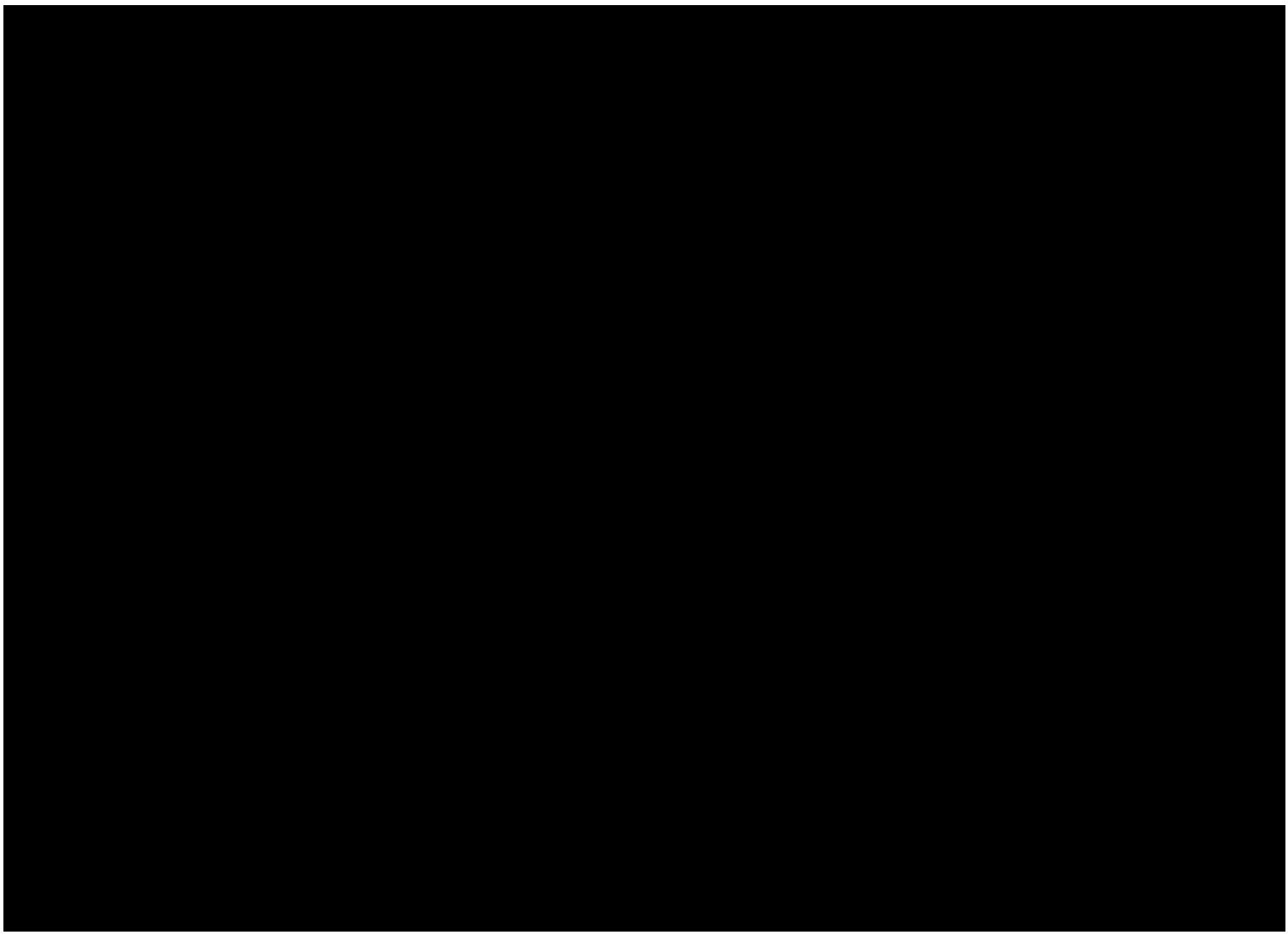

Figure A.3. Three-dimensional PDF model of the Place Ville Marie Tower 3 (PVM-3). The model represents the buildings used in the wind tunnel study. The compass directions are shown with orange arrows. PVM-3 is located in the middle of the circular area and a representative, cyan-coloured post is shown at the location of the rooftop anemometer mast.

3D PDF Controls (may vary depending on the PDF viewer):

- Pan: ctrl + left mouse click
- Zoom: shift + left mouse click OR mouse wheel
- Rotate: left mouse click