Specifics of pollutant dispersion in street canyons

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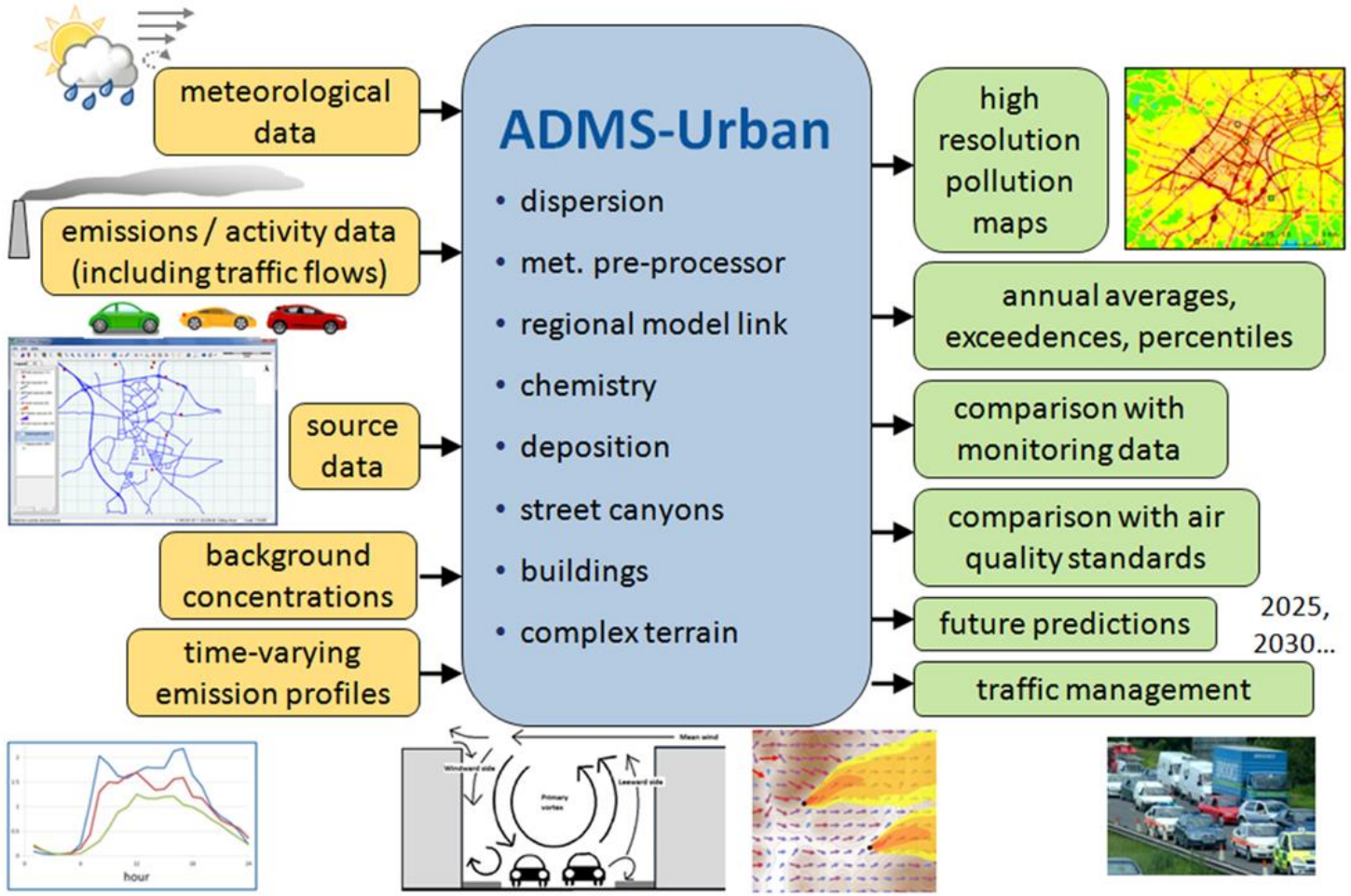
Brief description of ADMS-Urban

- local Gaussian dispersion model
- latest understanding of the boundary layer structure
- advanced algorithms for the height-dependence of wind speed, turbulence, and stability
- embedded Street canyon model
- photochemical model for NOx and O_3



Schematic representation of ADMS-Urban.

(**Source**: http://www.cerc.co.uk/environmental-software/ADMS-Urban-model.html)

Brief description of the Advanced street canyon module in ADMS-Urban

Table 1 Summary of component sources in the advanced street canyon module.

Component source		Canyon effect represented	Dispersion type	Wind direction	Region of influence
ID	Name				
1	Along-canyon	Channelling along canyon	Road source with wall reflections	Along canyon	Within canyon
2	Across-canyon	Direct dispersion across canyon by circulating flow	Simplified road source	Across canyon	Within canyon
3	Recirculation	Recirculation of pollution trapped within canyon	Well-mixed cells with vertical smoothing	n/a	Within canyon
4	Non-canyon	Dispersion through gaps between buildings	Road source	Upstream	Within and outside canyon
5	Canyon-top	Dispersion out of the top of the canyon	Volume source	Upstream	Outside canyon
6	Canyon-end	Dispersion out of the end of the canyon	Volume source	Upstream	Downstream of canyon

(**Source**: CERC_ADMS-Urban4.1_User_Guide)

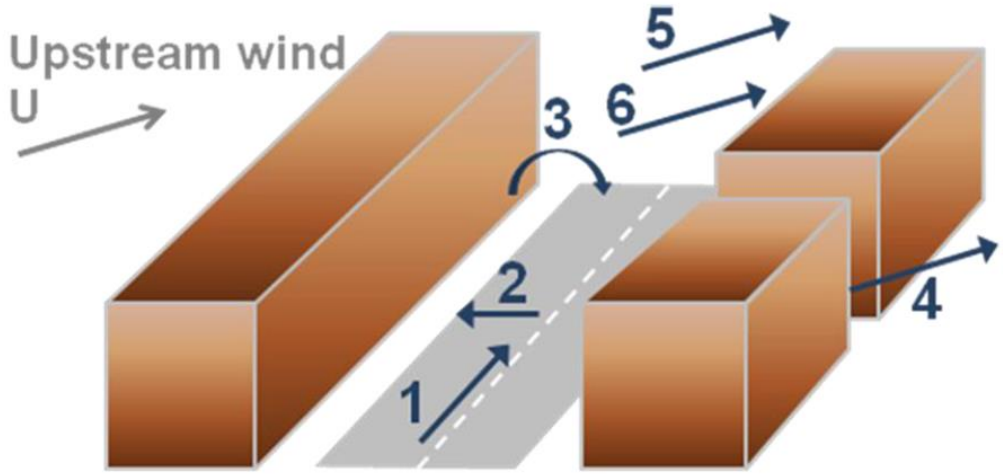


Diagram of the six component sources used in the advanced street canyon module.

(**Source**: CERC_ADMS-Urban4.1_User_Guide)

Model set – up and simulated cases

Table 2 Values of the aspect ratio H/W of the modelled canyons and values of the aspect ratio H/W corresponding to the different canonical flow regimes.

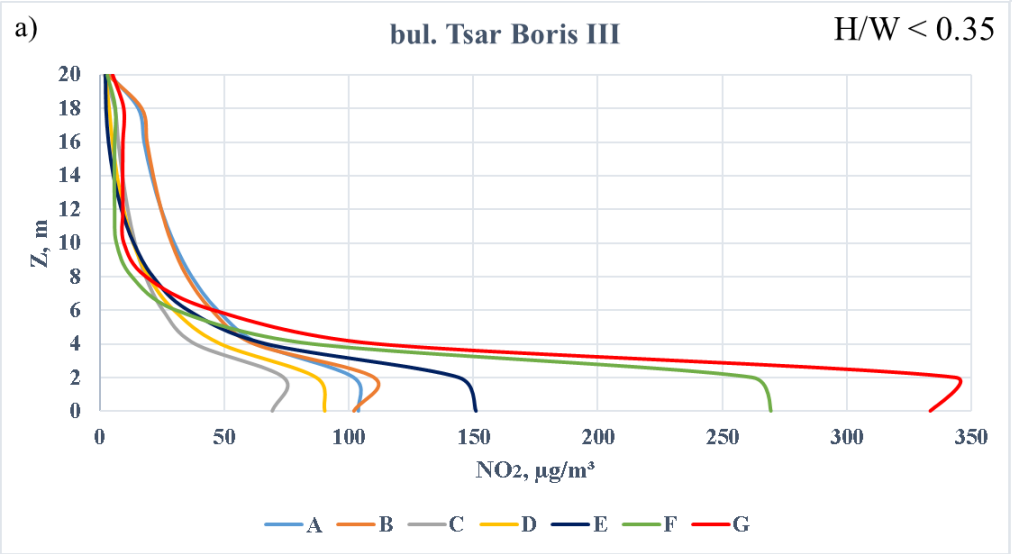
Boulevard/street	H/W	Oke,2017	Canonical flow regimes
bul. Tsar Boris III	0.28	H/W<0.35	Isolated roughness flow
bul. Todor Aleksandrov	0.45	0.35<H/W<0.65	Wake interference flow
G. Rakovski str.	2.21	H/W>0.65	Skimming flow

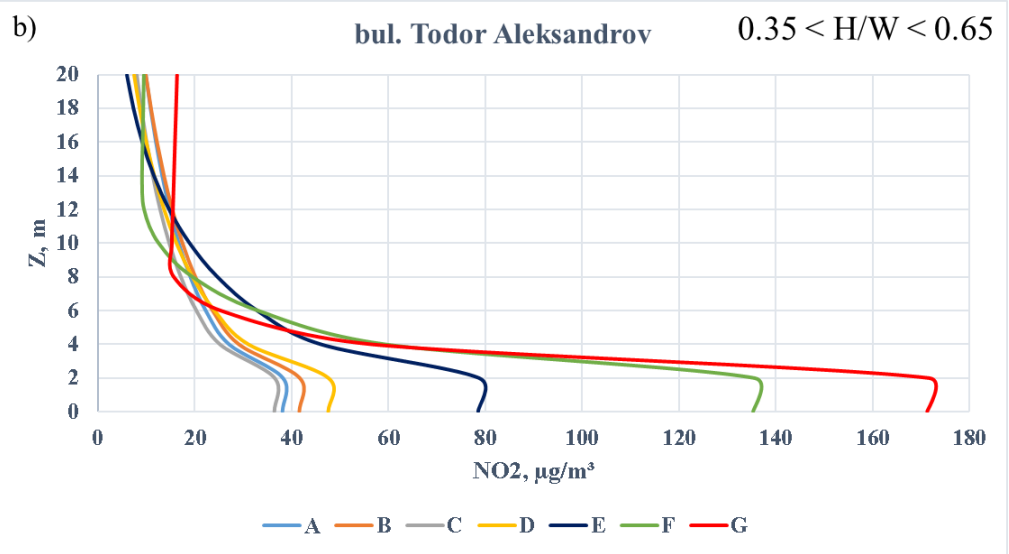
U (m/s)	L_{MO} (m)	$1/L_{MO}$ (m^{-1})	h (m)	h/L_{MO}	P-G Category
1	-2	-0.5	1300	-650	A
2	-10	-0.1	900	-90	B
5	-100	-0.01	850	-8.5	C
5	∞	0	800	0	D
3	100	0.01	400	4	E
2	20	0.05	100	5	F
1	5	0.2	100	20	G

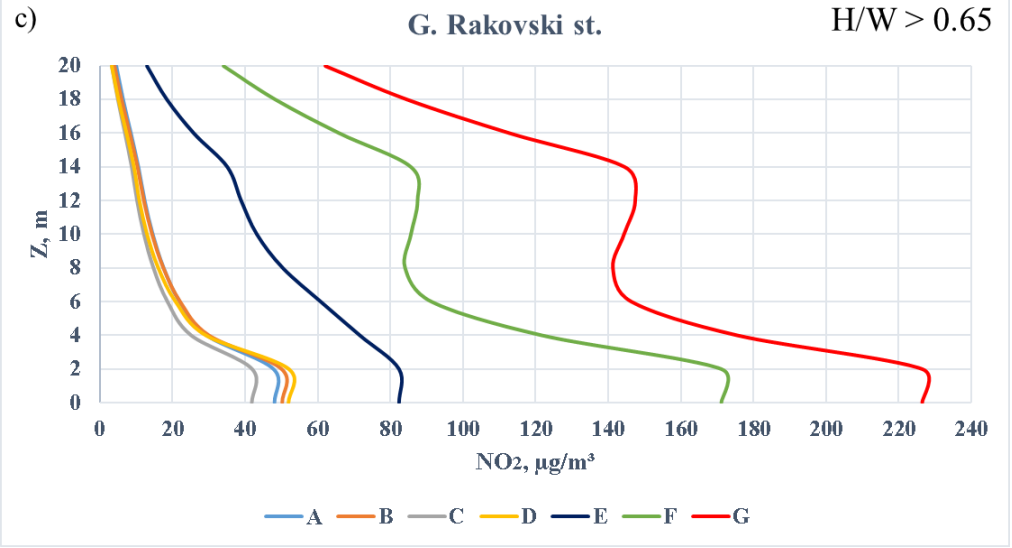
(**Source**: CERC_ADMS-Urban4.1_User_Guide)

Table 3 Values of wind speed, Monin – Obukhov length (L_{MO}) and boundary layer height (h), which may be used to represent Pasquill – Gifford categories A–G.

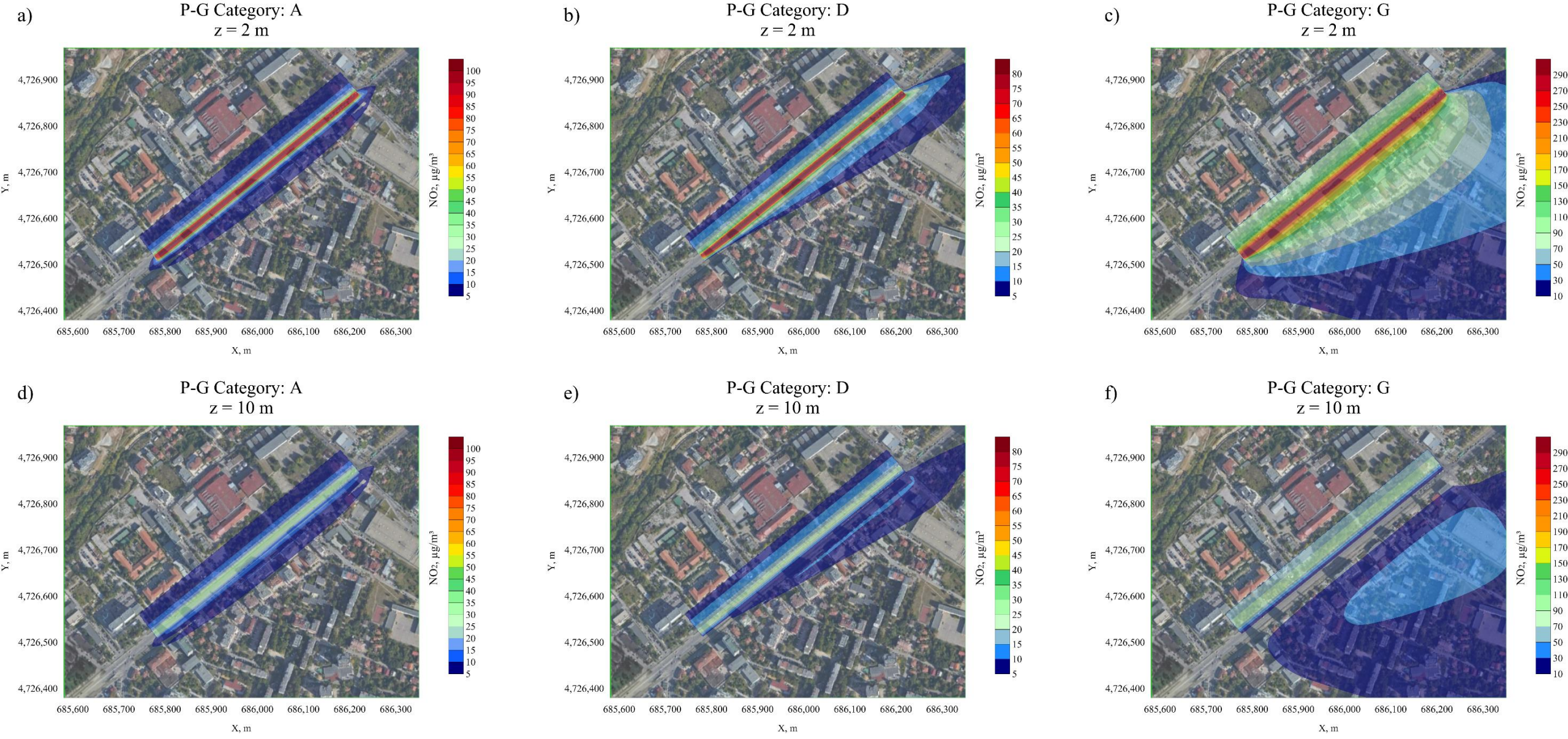
Pasquill – Gifford categories case results



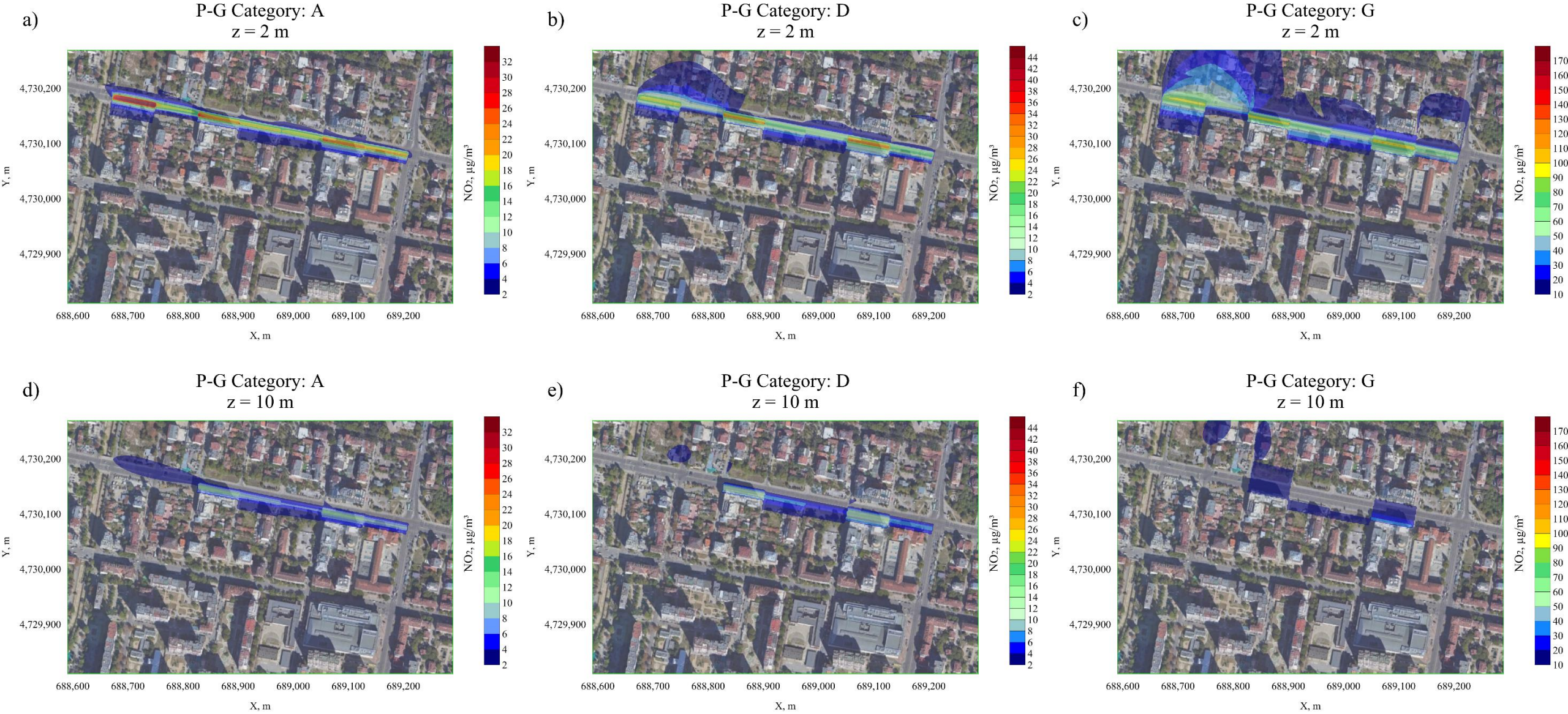




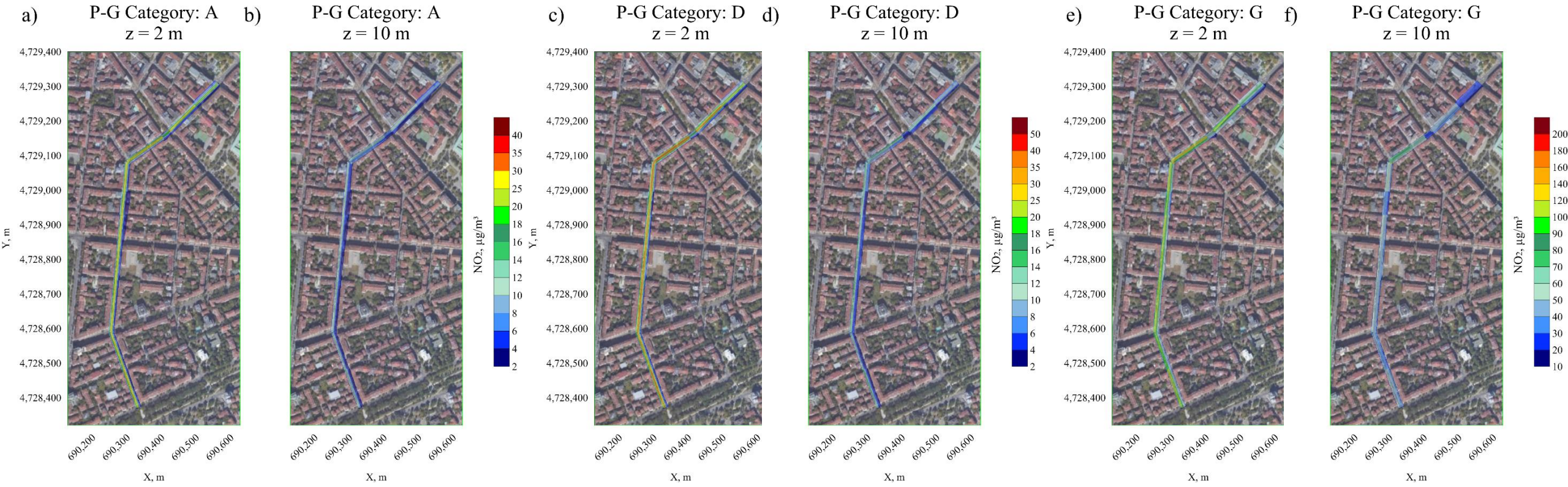
Vertical profiles of NO_2 concentration for the Pasquill – Gifford stability categories (A – G) for a) bul. Tsar Boris III, b) bul. Todor Aleksandrov and c) G. Rakovski str.



NO2 concentration field for A (left), D (center) and G (right) stability categories at 2 m – a), b), c) and at 10 m – d), e), f) height for bul. Tsar Boris III. (H/W < 0.35)

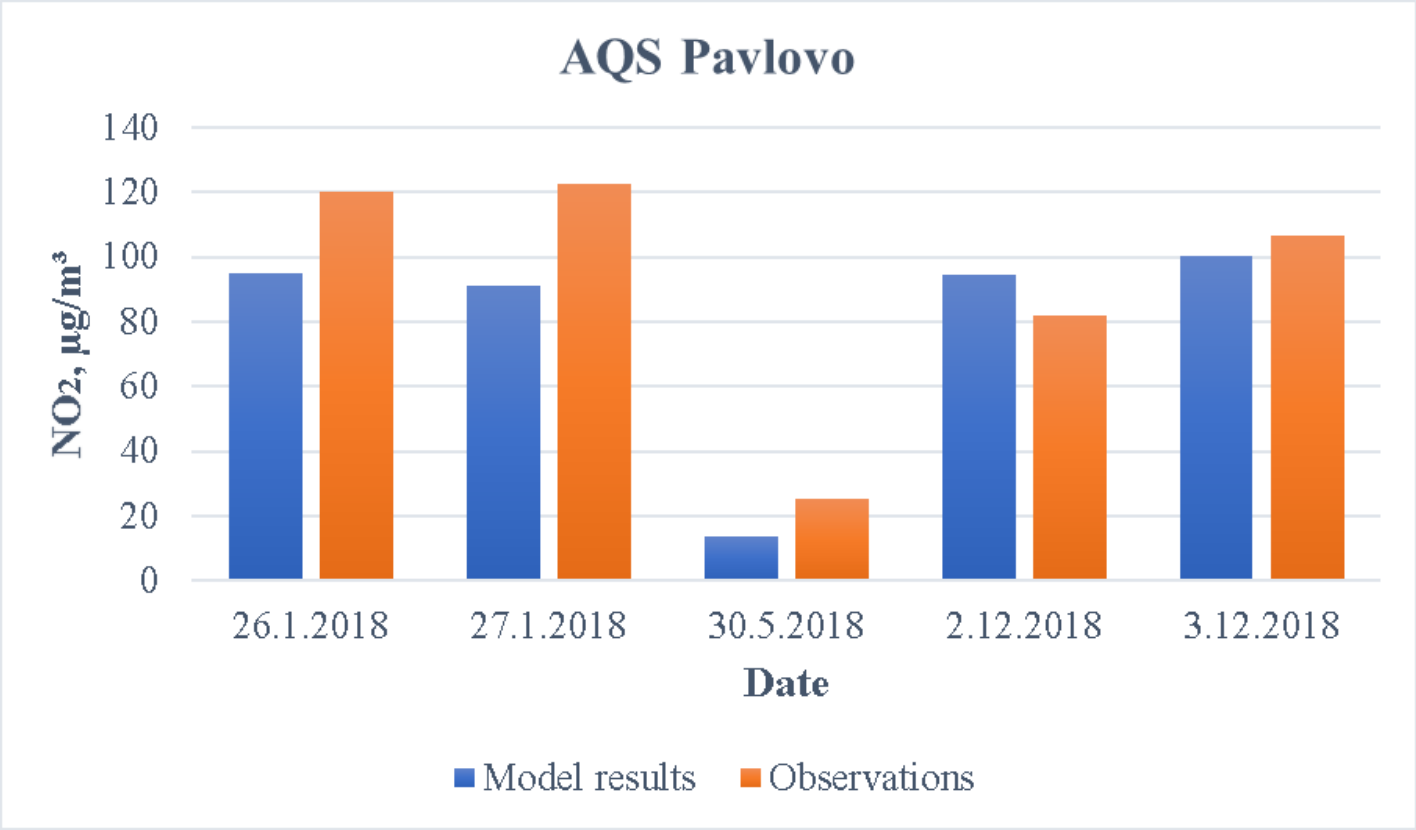


NO2 concentration field for A (left), D (center) and G (right) stability categories at 2 m – a), b), c) and at 10 m – d), e), f) height for bul. Todor Aleksandrov. (0.35 < H/W < 0.65)

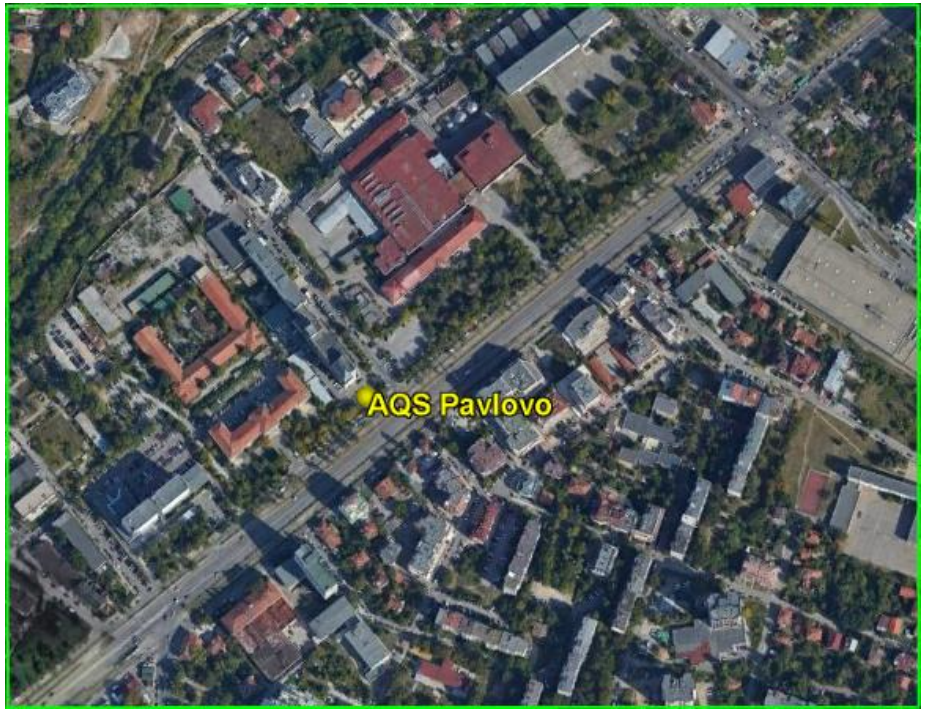


NO2 concentration field for A (left), D (center) and G (right) stability categories at 2 m – a), b), c) and at 10 m – d), e), f) height for G. Rakovski str. (H/W > 0.65)

Real meteorological conditions case results



Daily mean concentrations of NO_2 calculated by the model (blue) and measured at AQS Pavlovo (orange).



Area of the simulations and the measurement site location.

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Thank You for the attention!