

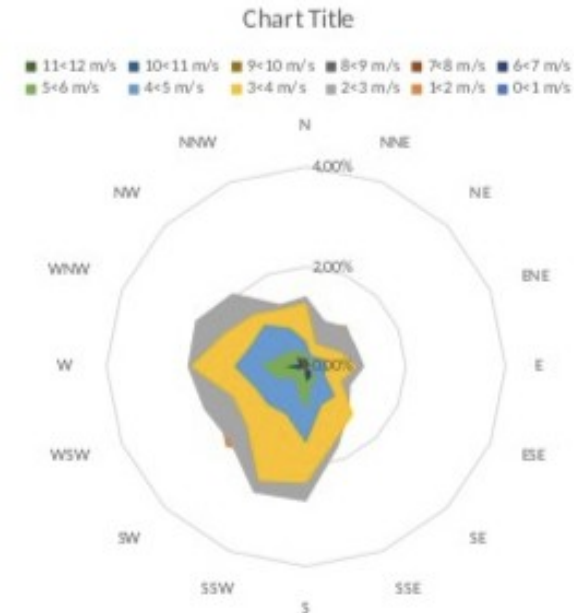
Wind Simulations Storängen/Huddinge February 2019- additional images

ARKITEKTUR+DEVELOPMENT
REPPEN WARTIAINEN

Metrological Data

	0<1 m/s	1<2 m/s	2<3 m/s	3<4 m/s	4<5 m/s	5<6 m/s	6<7 m/s	7<8 m/s	8<9 m/s	9<10 m/s	10<11 m/s	11<12 m/s	(blank)	Tot	Grand Total
N	0,23 %	0,92 %	1,42 %	1,28 %	0,51 %	0,21 %	0,17 %	0,06 %	0,01 %	0,00 %	0,00 %	0,00 %	0,00 %	0,00 %	4,81 %
NNE	0,30 %	0,88 %	0,99 %	0,49 %	0,25 %	0,17 %	0,09 %	0,00 %	0,00 %	0,00 %	0,00 %	0,00 %	0,00 %	0,00 %	3,17 %
NE	0,27 %	1,16 %	1,13 %	0,55 %	0,27 %	0,18 %	0,07 %	0,07 %	0,01 %	0,00 %	0,00 %	0,00 %	0,00 %	0,00 %	3,72 %
ENE	0,22 %	1,03 %	1,08 %	0,75 %	0,40 %	0,31 %	0,14 %	0,06 %	0,00 %	0,00 %	0,00 %	0,00 %	0,00 %	0,00 %	3,98 %
E	0,26 %	0,91 %	1,18 %	1,02 %	0,43 %	0,17 %	0,02 %	0,01 %	0,01 %	0,01 %	0,00 %	0,00 %	0,00 %	0,00 %	4,03 %
ESE	0,23 %	0,62 %	0,97 %	0,75 %	0,41 %	0,06 %	0,02 %	0,03 %	0,03 %	0,01 %	0,00 %	0,00 %	0,00 %	0,00 %	3,14 %
SE	0,23 %	1,05 %	1,23 %	1,35 %	0,83 %	0,38 %	0,16 %	0,11 %	0,08 %	0,03 %	0,00 %	0,00 %	0,00 %	0,00 %	5,46 %
SSE	0,27 %	0,97 %	1,72 %	1,58 %	0,83 %	0,32 %	0,24 %	0,07 %	0,06 %	0,02 %	0,02 %	0,02 %	0,00 %	0,00 %	6,13 %
S	0,35 %	1,62 %	2,71 %	2,33 %	1,54 %	0,91 %	0,30 %	0,02 %	0,06 %	0,07 %	0,02 %	0,05 %	0,00 %	0,00 %	9,98 %
SSW	0,45 %	1,92 %	2,74 %	2,48 %	1,04 %	0,46 %	0,07 %	0,00 %	0,00 %	0,00 %	0,00 %	0,00 %	0,00 %	0,00 %	9,14 %
SW	0,46 %	2,27 %	2,15 %	1,67 %	1,08 %	0,32 %	0,02 %	0,00 %	0,00 %	0,00 %	0,00 %	0,00 %	0,00 %	0,00 %	7,97 %
WSW	0,35 %	1,93 %	2,21 %	1,58 %	1,11 %	0,61 %	0,15 %	0,07 %	0,00 %	0,00 %	0,00 %	0,00 %	0,00 %	0,00 %	8,00 %
W	0,45 %	1,85 %	2,37 %	2,31 %	1,44 %	0,89 %	0,42 %	0,01 %	0,01 %	0,00 %	0,00 %	0,00 %	0,00 %	0,00 %	9,75 %
WNW	0,35 %	1,63 %	2,40 %	1,75 %	1,18 %	0,56 %	0,14 %	0,08 %	0,02 %	0,00 %	0,00 %	0,00 %	0,00 %	0,00 %	8,11 %
NW	0,30 %	1,47 %	2,09 %	1,47 %	1,19 %	0,43 %	0,29 %	0,14 %	0,01 %	0,00 %	0,00 %	0,00 %	0,00 %	0,00 %	7,39 %
NNW	0,14 %	0,79 %	1,36 %	1,24 %	0,84 %	0,37 %	0,15 %	0,23 %	0,07 %	0,05 %	0,00 %	0,00 %	0,00 %	0,00 %	5,23 %
Grand Tot	4,85 %	21,03 %	27,75 %	22,58 %	13,37 %	6,34 %	2,44 %	0,96 %	0,38 %	0,19 %	0,05 %	0,07 %	0,00 %	0,00 %	100,00 %

The presented wind rose is based on the year 2017 (<http://www.sveby.org/>) for 16 wind directions. The meteorological data was acquired from Stockholm- Bromma where the measuring station of the Swedish Meteorological and Hydrological Institute (SMHI) is located.



How the wind speed and its direction is distributed is visualized by a wind rose. Detailed data is compiled in the table. The wind direction is defined away from the origin e.g. if we liken the wind rose to a clock, a wind from south blows in the direction of midnight. The centered rings represents the percentage in time. For the simulations, four wind directions (S, SW, NW, W), were simulated and visualized with the dominant inflow wind speed 2.5 m/s (S, W, NW) and 1.5 M7s (SW).

Experience of wind speed by pedestrians

Table 1. Extended Land Beaufort Scale showing wind effects on people [76].

Beaufort Number	Description	Wind Speed at 1.75 m height (m/s)	Effect
0	Calm	0.0–0.1	
1	Light air	0.2–1.0	No noticeable wind
2	Light breeze	1.1–2.3	Wind felt on face
3	Gentle breeze	2.4–3.8	Hair disturbed, clothing flaps, newspaper difficult to read
4	Moderate breeze	3.9–5.5	Raises dust and loose paper, hair disarranged
5	Fresh breeze	5.6–7.5	Force of wind felt on body, danger of stumbling when entering a windy zone
6	Strong breeze	7.6–9.7	Umbrellas used with difficulty, hair blown straight, difficult to walk steadily, sideways wind force about equal to forwards walking force, wind noise on ears unpleasant
7	Near gale	9.8–12.0	Inconvenience felt when walking
8	Gale	12.1–14.5	Generally impedes progress, great difficulty with balance in gusts
9	Strong gale	14.6–17.1	People blown over

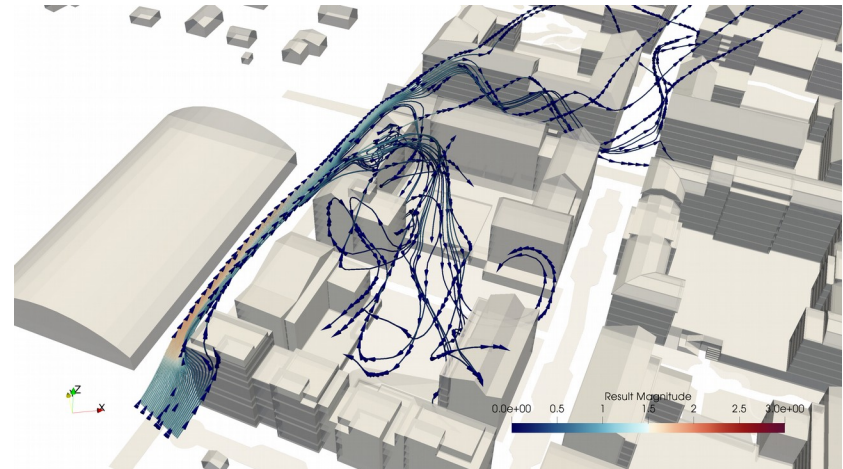
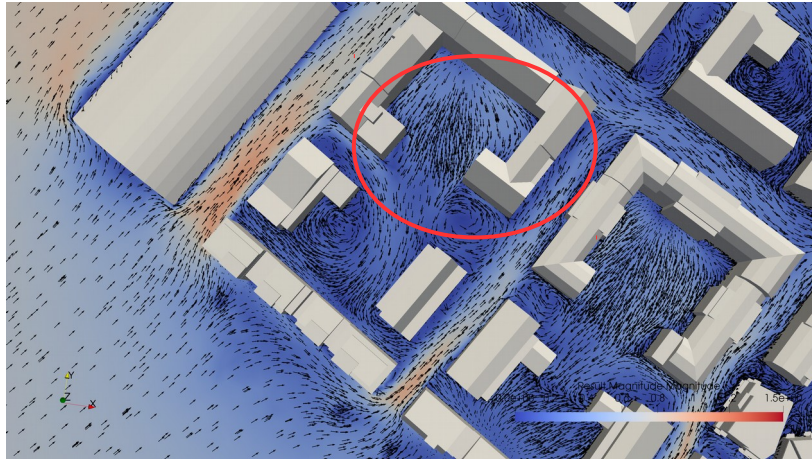
In order to illustrate, how the pedestrians experience wind, and to facilitate the understanding and analysis of the results of the numerical simulations compiled in this report, the wind speed is correlated to wind effects.

* T.V. Lawson and A. D. Penwarden. The effects of wind on people in the vicinity of buildings. Proceedings of the Fourth International Conference on Wind Effects on Buildings and Structures, pages 605–622, 1956

Some important explanations in order to understand the visualizations

- All velocities are actual velocities to make it easier to read (ie normalized velocities are converted)
- The color bars are adjusted to get a better visualization (ie min and max of the velocity can vary from direction to direction)
- Sometimes there are arrows showing away from buildings which might be not intuitive (image to left), but this is due the cut of the slice.

The image to the right shows the 3D dynamic of the flow, where we can see that the wind hits the building and is pushed down to the court yard. Since we make a cut on 5.5 m ,a level where the wind is pushed away, the arrows point away from the building

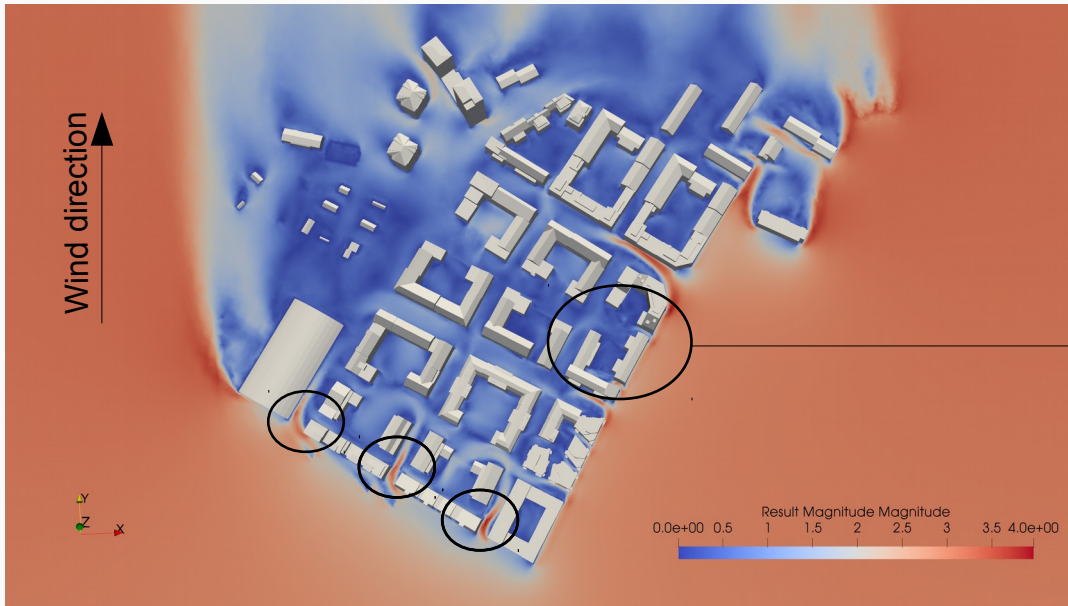


Visualizations



Wind Direction: South

These arrows pointing away from building arises since the wind hit the building and is pushed down to the court yard

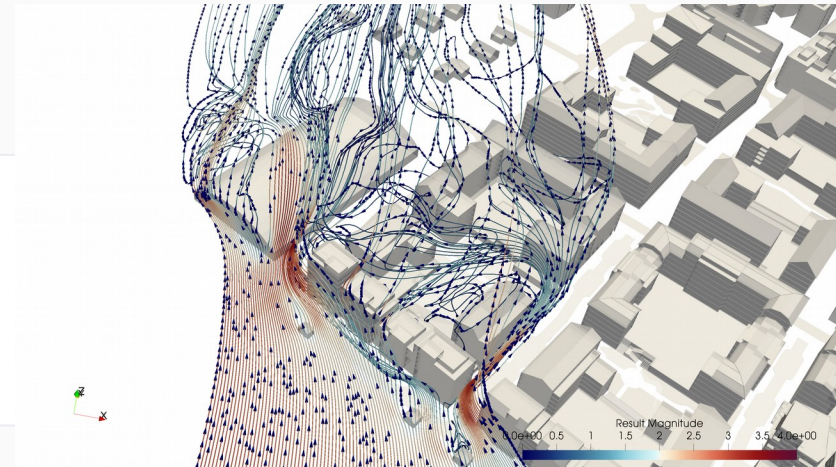
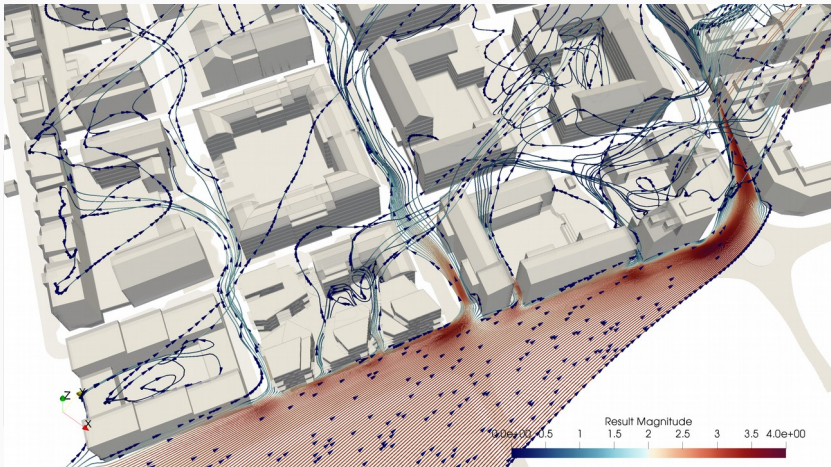
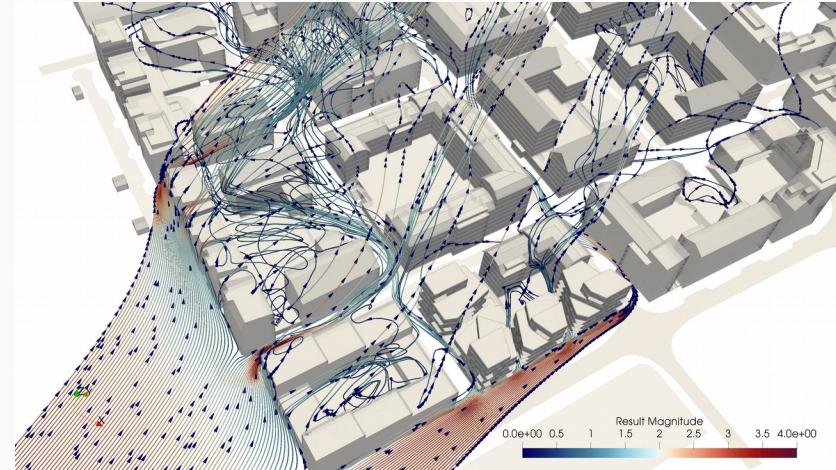
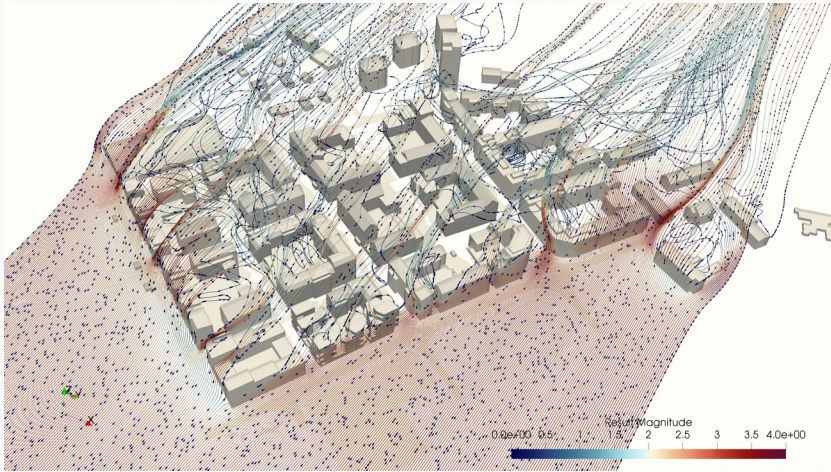


This slice shows the velocity magnitude on height 5.5 m/s. There are areas where the wind is accelerated at the corner and between buildings (marked with circles). The area with acceleration affecting a court yard is zoomed in on the image at the right hand side.

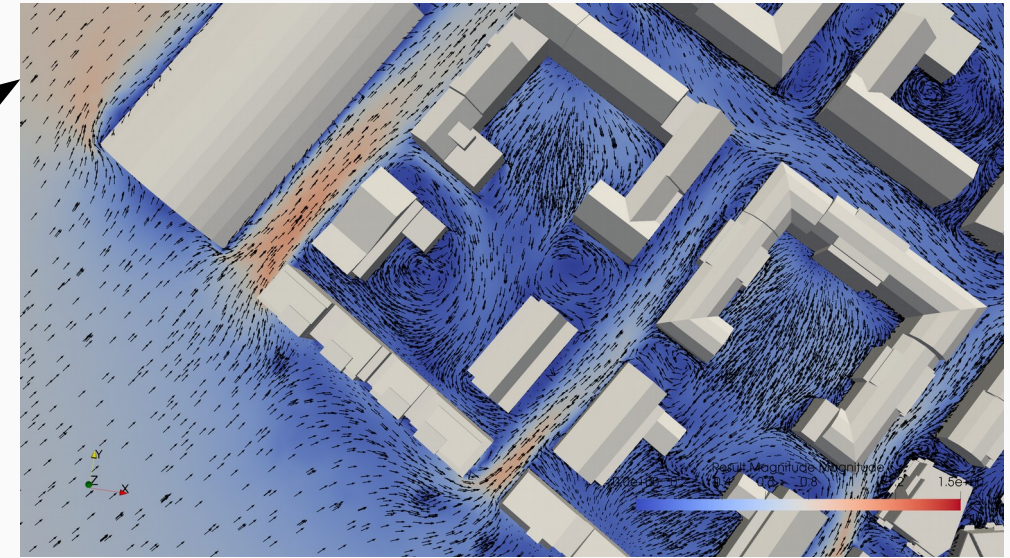
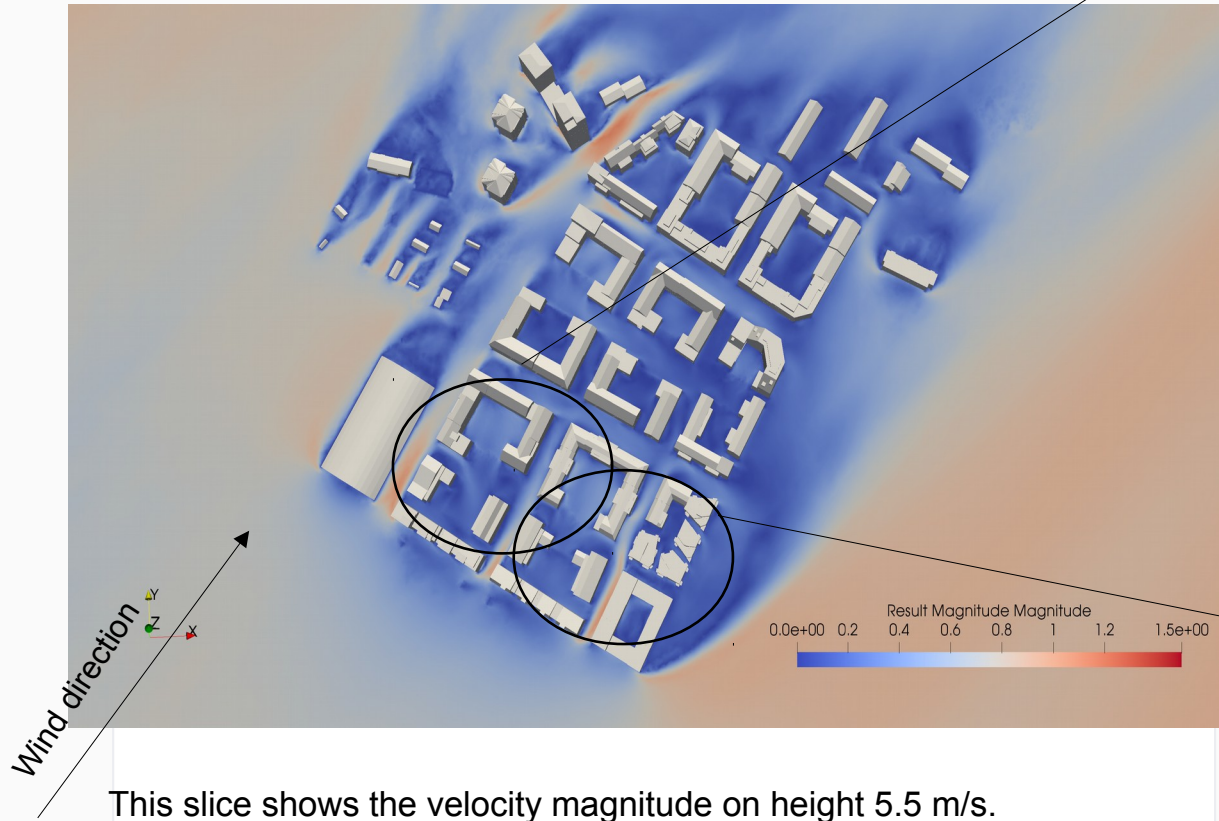


Velocity arrows are added to illustrate the flow direction. The same color bar as to the left is applied

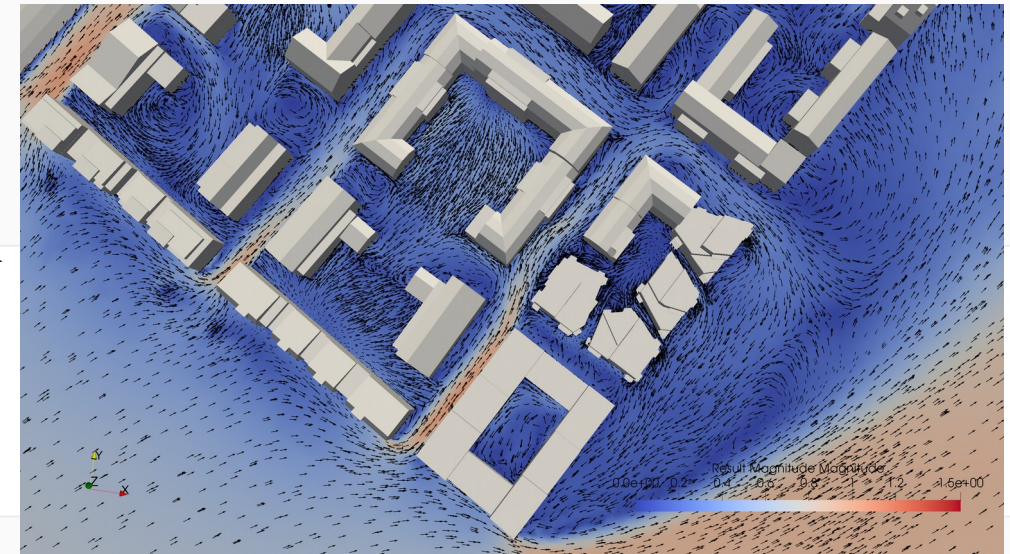
Wind Direction: South, stream lines to illustrate the wind dynamic



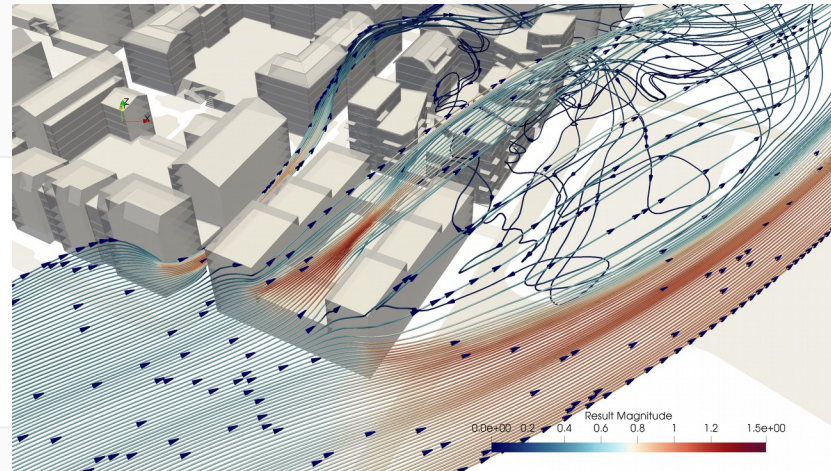
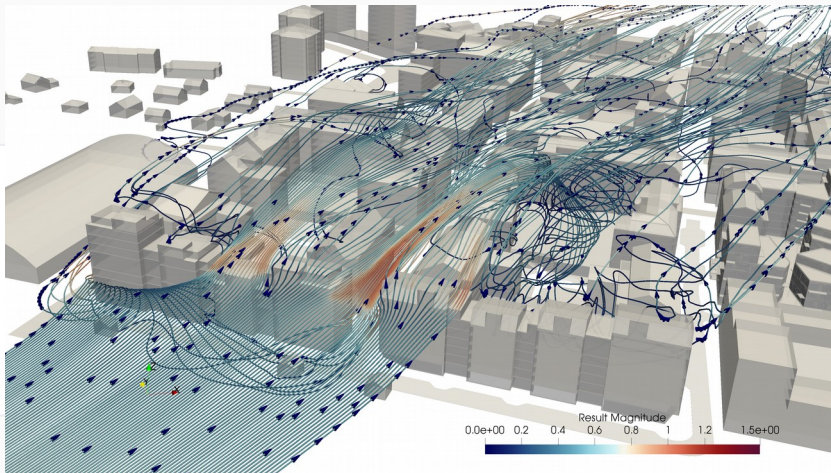
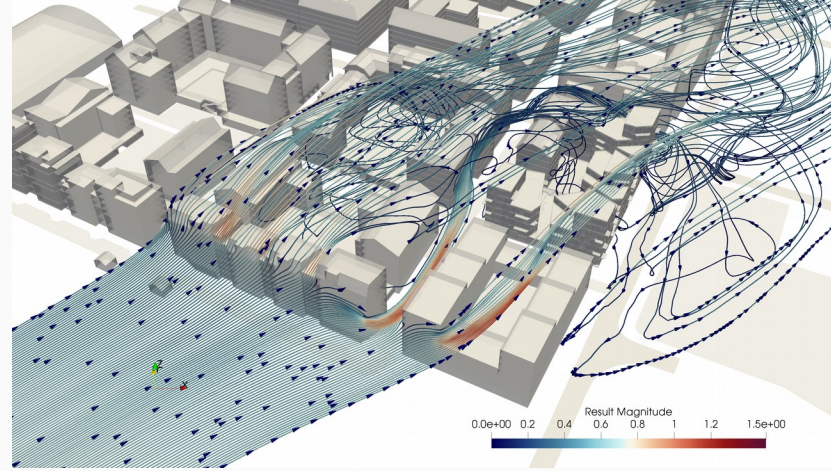
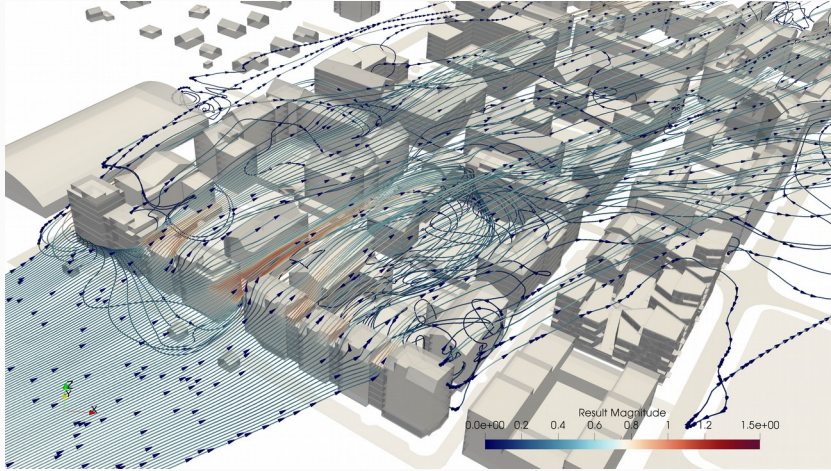
Wind Direction: South-West



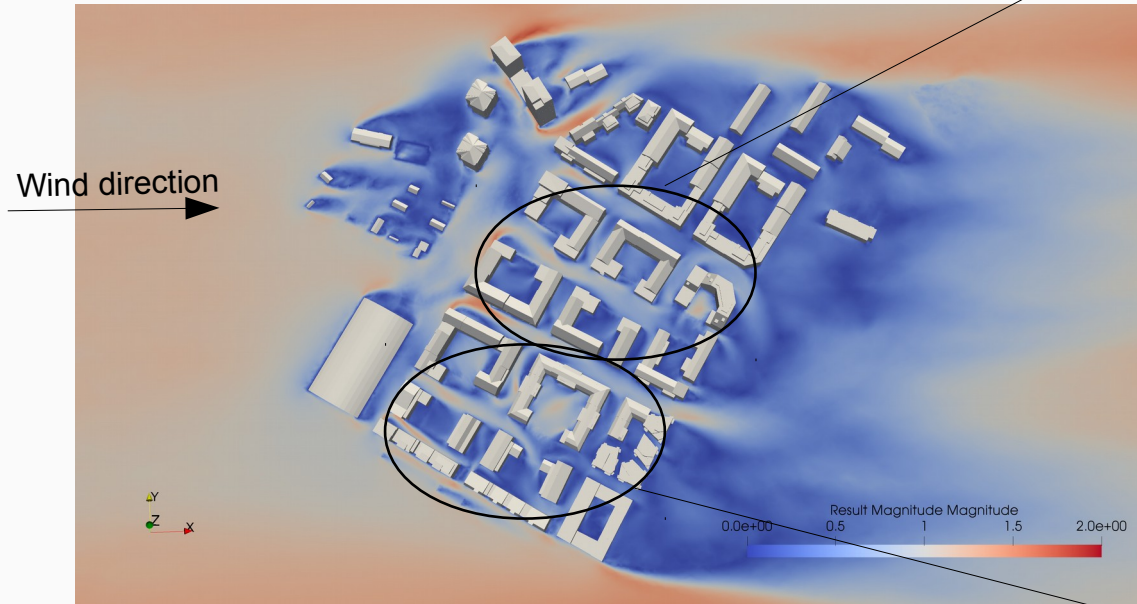
Velocity arrows are added to illustrate the flow direction.



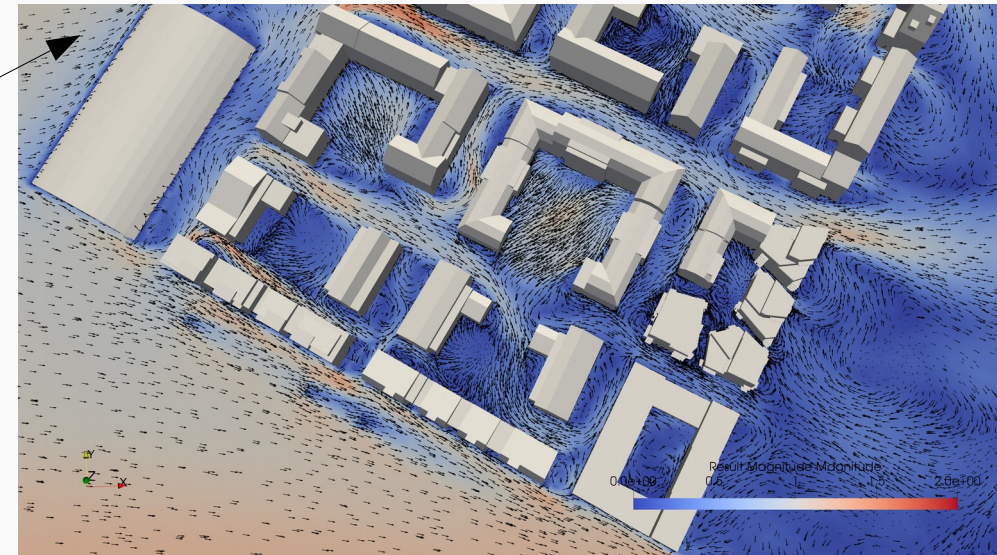
Wind Direction: South West, stream lines to illustrate the wind dynamic



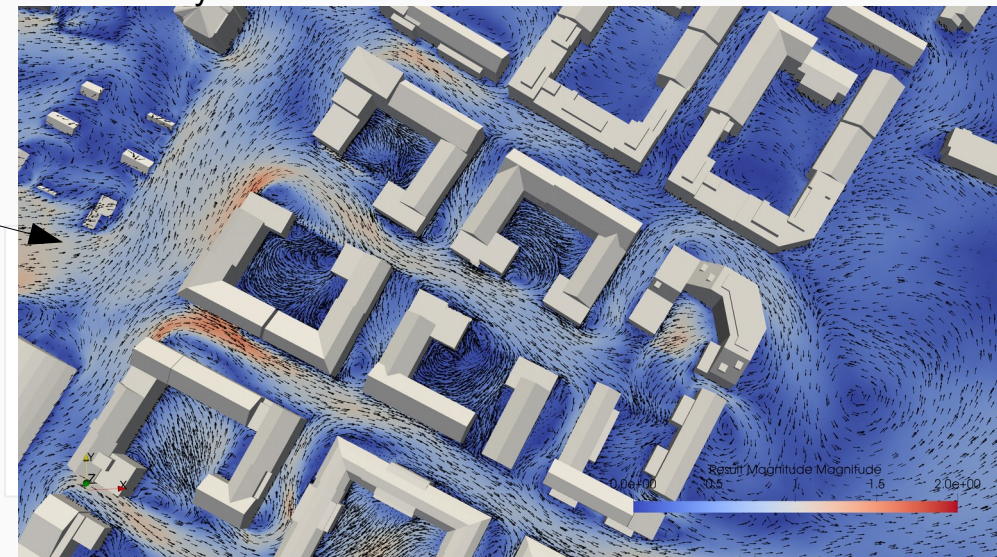
Wind Direction: West



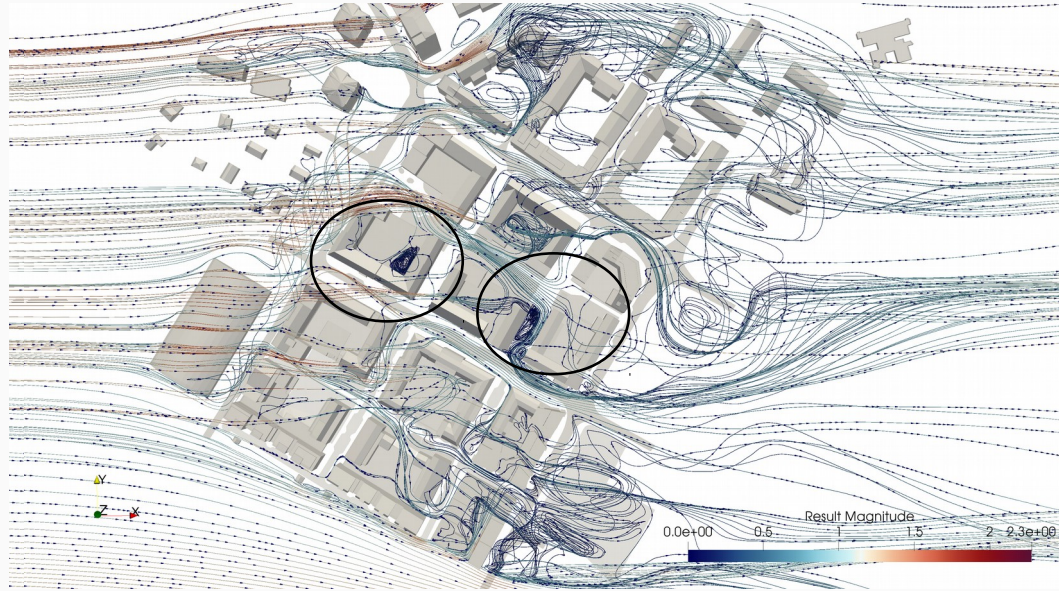
This slice shows the velocity magnitude on height 5.5 m



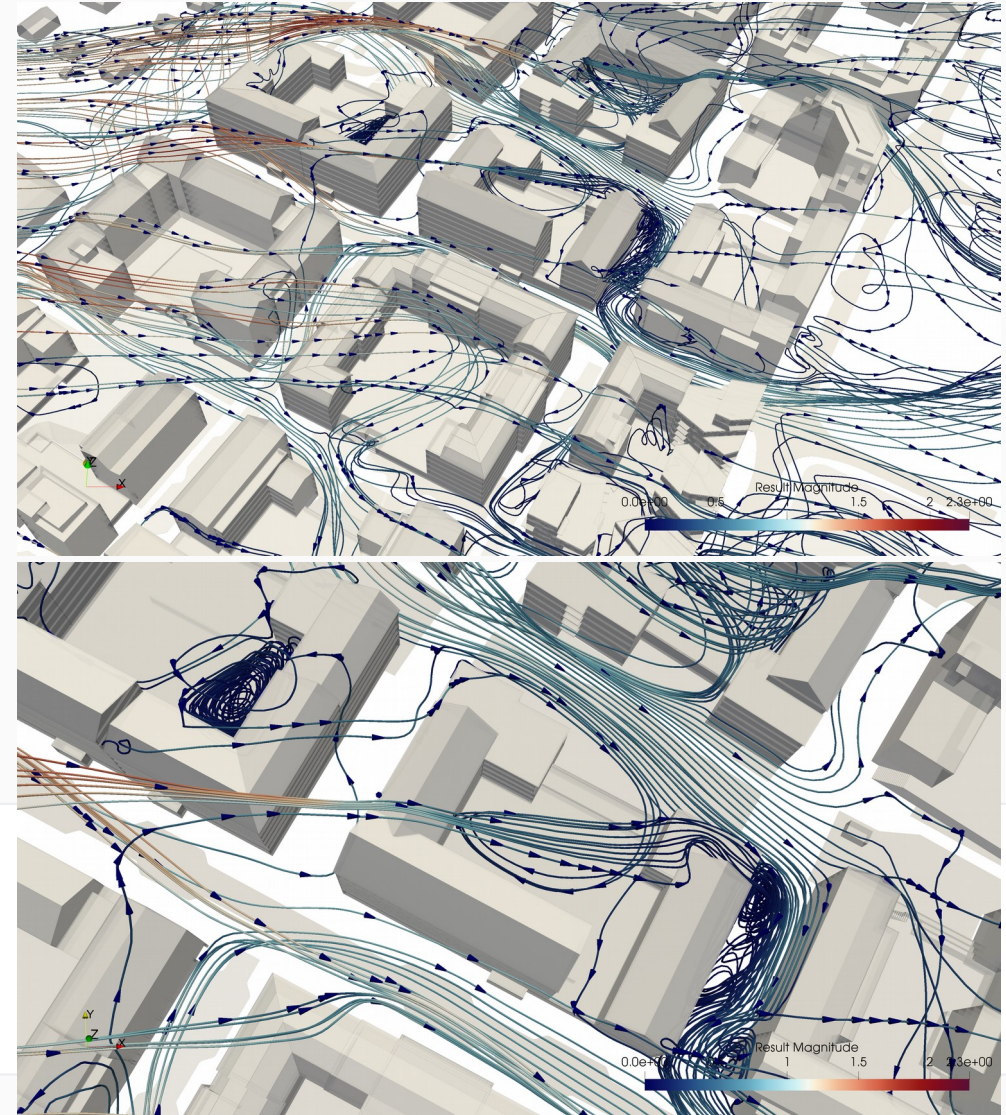
Velocity arrows are added to illustrate the flow direction.



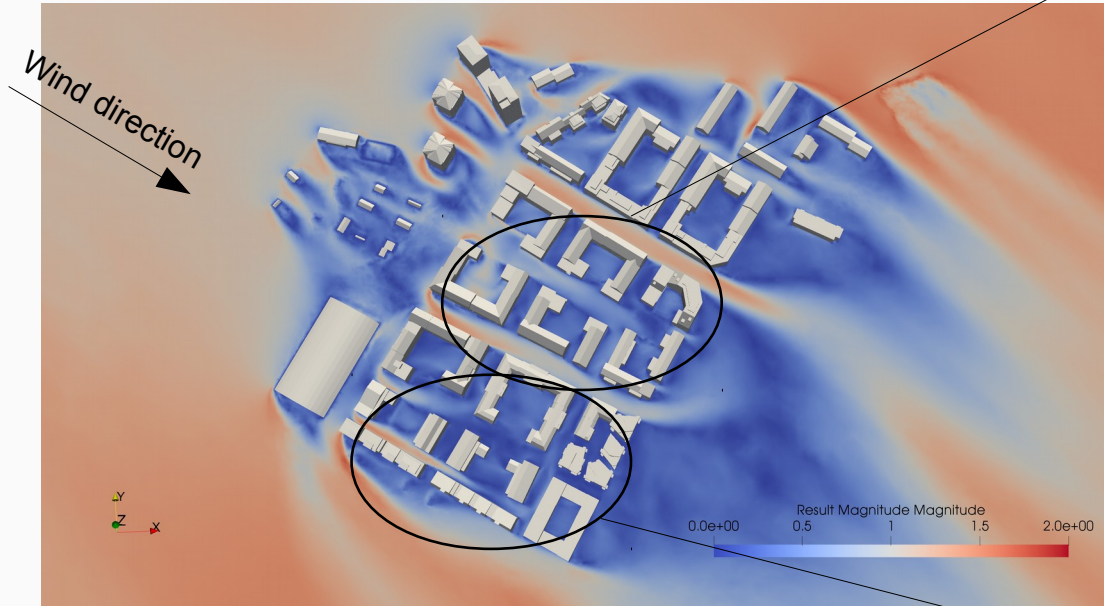
Wind Direction: West, stream lines to illustrate the wind dynamic



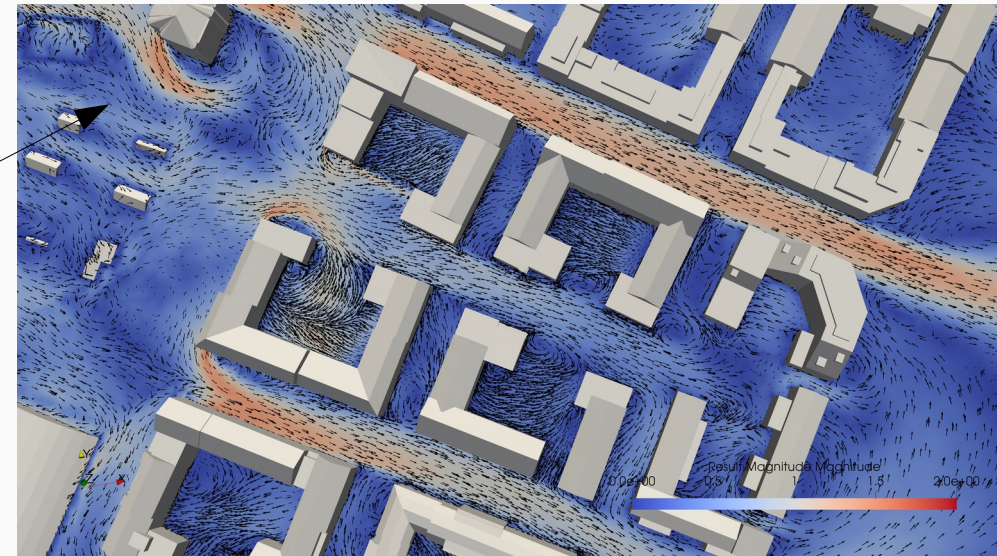
Interesting area: The wind is captured in the corner and the wall respectively and a vortex is created



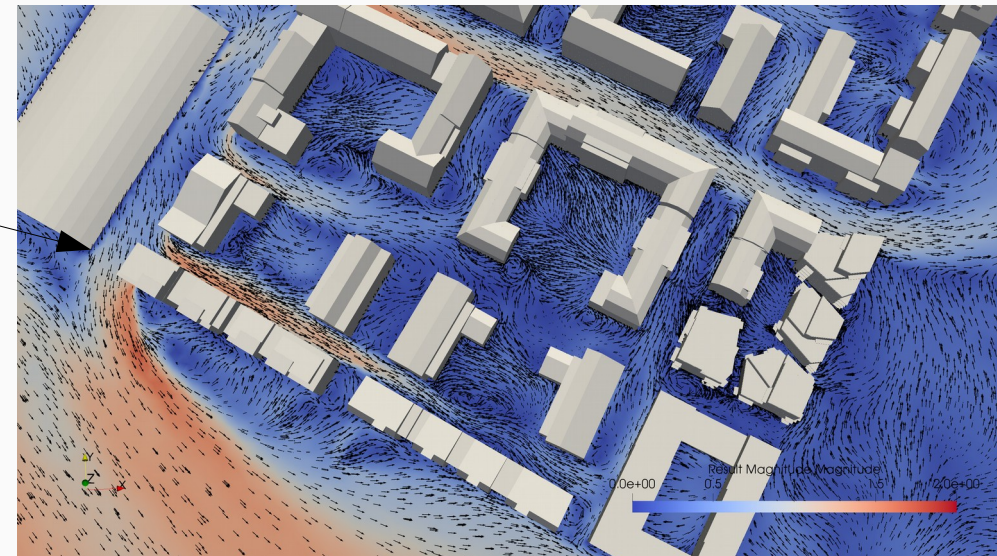
Wind Direction: North-West



This slice shows the velocity magnitude on height 5.5 m



Velocity arrows are added to illustrate the flow direction.



Wind Direction: North West, stream lines to illustrate the wind dynamic

