Planning Application for the Aylesbury Estate Regeneration

Plot 18 Reserved Matters Application

Pedestrian Wind Comfort Analysis Report

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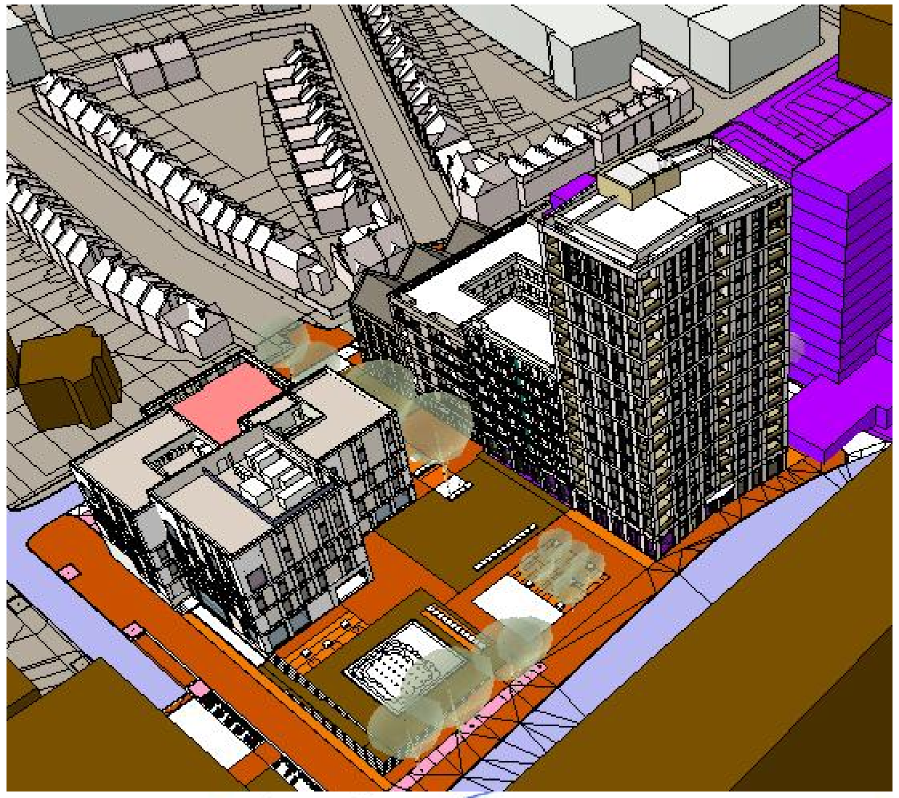
Plot 18
Pedestrian Wind Comfort Analysis Report



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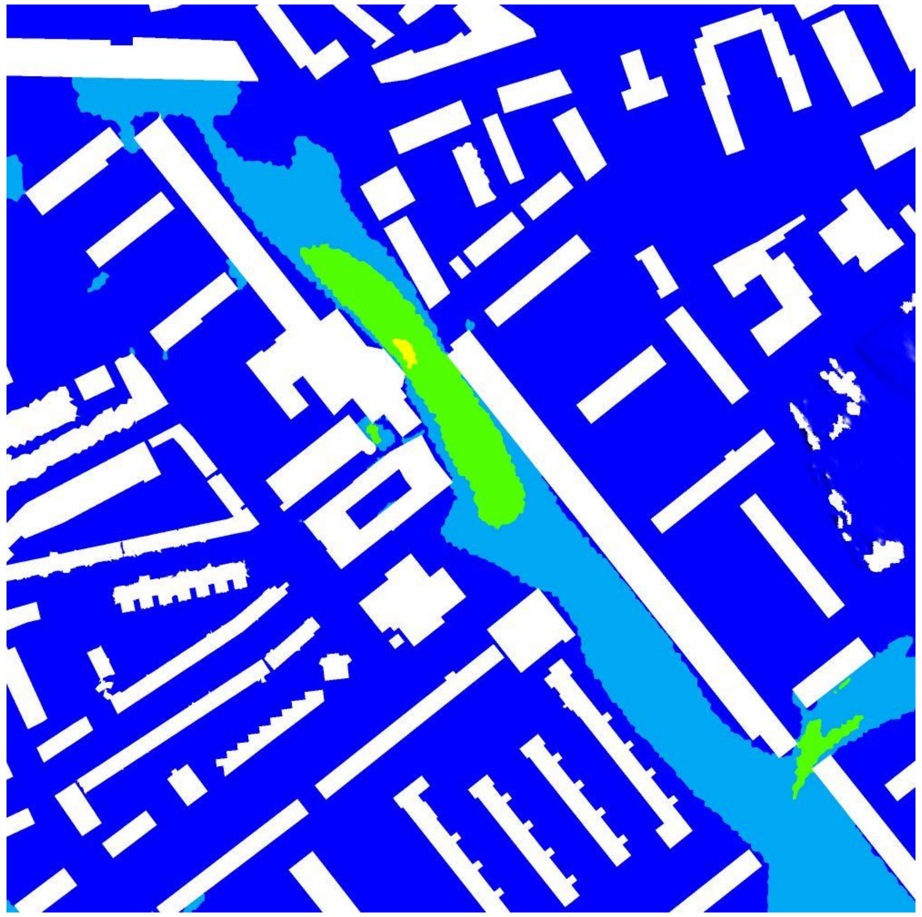
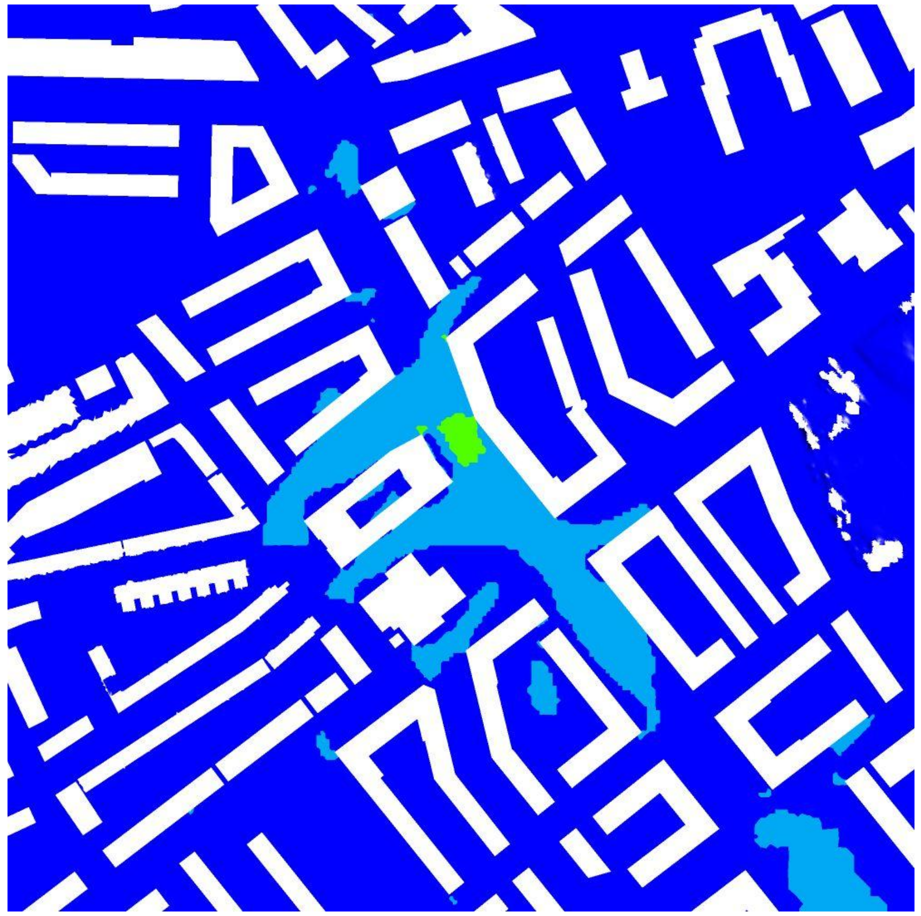
1 Table of Contents

2 Executive Summary

- A Computational Fluid Dynamics wind study has been performed for the proposed development at Plot 18 of the Aylesbury Estate Regeneration Scheme.
- Simulations have been performed with existing surrounding buildings and proposed surrounding buildings. The images to the right show simulated wind conditions for the existing surrounding buildings (left) and proposed surrounding buildings (right).
- No distressful conditions were found for "members of the general population".
- Two areas of distress for "Frail persons or cyclists" were found in the existing surrounding buildings case.
- One extremely small areas of minor distress for "Frail persons or cyclists" was found for the proposed buildings case.





Use according to the Lawson Criteria	Plot Colour
Long term sitting	
Standing or short term sitting	
Walking and strolling	
Business walking	
Unacceptable for pedestrian comfort	

3 Introduction

This assessment has been prepared by AECOM London to assess wind issues around two proposed buildings in the Aylesbury Estate regeneration area.

3.1 Outline of the Proposed Development

Development Parcel 18 or 'Plot 18' comprises two blocks, namely the 'North Block' located on subplot 18a and the 'South Block' located on subplot 18b. The North Block comprises residential, community and commercial uses and the South Block, a Health Centre and Early Years Facility.

A wind study has been carried out for the masterplan. This study addresses the detailed design of these buildings. This new wind microclimate analysis has been created to inform the approval of Reserved Matters pursuant to Outline Planning Permission ref. 14/AP/3844.

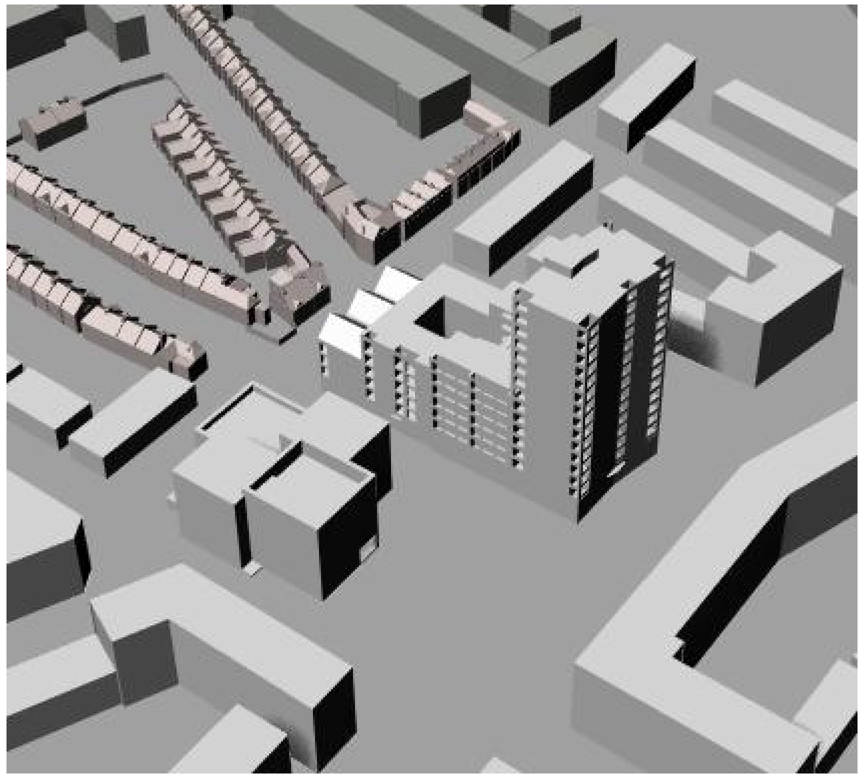


Figure 1 - Proposed Building Layout

3.2 Scope of the CFD Study

Simulations of the wind microclimate around the area of the proposed buildings were conducted to quantitatively assess the effect on pedestrian comfort levels in and around Plot 18.

The assessment was undertaken through computational wind engineering (CWE) which uses computational fluid dynamics (CFD) techniques to model a 'virtual wind tunnel' and simulate conditions around the site. This report contains the methodology and results from these simulations.

The aim of the simulations was to reproduce the macro level wind regime around the buildings. A total of 36 wind directions (every 10° around the compass) were analysed using a wind speed in the top decile applied to a full 3D model of the development within the local built environment.

Further analysis was also undertaken to assess compliance with Lawson Criteria (see Section 4.4 below) by interpolating steady state CFD simulations of the site to predict wind frequencies across the course of a typical year using annual weather data.

The purpose of this report is to demonstrate acceptable wind conditions as a result of the proposed development only.

3.3 Limitations of the CFD Study

The use of CFD for wind modelling is not an exact science. Although the software can be used to demonstrate an improvement (or otherwise) in the wind microclimate around a development, like any computational analysis technique, absolute improvements cannot be guaranteed. In particular, the CFD simulation does not explicitly quantify gusting wind, but the subsequent analysis does account for expected gust levels.

The results from CFD wind assessment should not be used for structural load analysis as these simulations assume steady state conditions, which do not explicitly quantify the effects of gusting wind.

4 Legislation and Policy

The following chapter outlines relevant legislation and policy related to pedestrian wind comfort.

4.1 National Planning Policy

There is no specific national legislation or policy in the National Planning Policy Framework dealing with microclimate. In general there is little guidance at national level on wind effects.

The National Planning Practice Guidance published online in March 2014 does not address these matters.

Paragraph 4.6(vi) of Historic England (previously English Heritage) Commission for Architecture and the Built Environment Guidance on Tall Buildings recommends that consideration be given to: "The effect on the local environment, including microclimate, overshadowing and night time appearance, vehicle movements and the environment and those in the vicinity of the building."

4.2 Regional Planning Policy

The London Plan, Spatial Development Strategy for Greater London (March 2015/16) [Reference 3] specifies the following:

- Policy 7.6 "Architecture", section B "Planning Decisions", Item d states that: *"Buildings and structures should not cause unacceptable harm to the amenity of surrounding land and buildings, particularly residential buildings, in relation to […], wind and microclimate. This is particularly important for tall buildings".*
- Policy 7.7 "Location and design of tall and large buildings", section A "Strategic" states that "*Tall and large buildings should not have an unacceptably harmful impact on their surroundings.*"
- Policy 7.7 "Location and design of tall and large buildings", section D "Tall Buildings", Item a states that: "*Tall Buildings should not affect their surroundings adversely in terms of microclimate…*"

4.3 Local Planning Policy

LB Southwark adopted its Core Strategy in April 2011. The Core Strategy does not explicitly refer to wind impact. However in the supporting text to Strategic Policy 12 Design and Conservation the supporting text at paragraph 5.112 that "*the height and scale of development is an important consideration in creating attractive and instinctive places. English Heritage and CABE have produced guidance on tall buildings, which has been endorsed by the Government. This advises that in the right place tall buildings can make positive contributions to places*." The text goes on to state that: "*However they need to be well designed so that they do not cause overshadowing, block views or create wind tunnels and they should help create more landscaped public spaces and enliven places*".

UDP Saved Policy 3.13 Urban Design states that consideration must be given to the site layout in terms of: "*Building location, public spaces, microclimate, and outlook, site access and servicing, permeability, safety and ease of movement including vehicular, pedestrians and cyclists*;."

4.4 The Lawson Criteria

The assessment of pedestrian level wind conditions requires a standard against which measured or expected wind velocities can be compared. The criteria used will be that described in "Building Aerodynamics" by T.V. Lawson as "The LDDC (London Docklands Development Corporation) Method" [Reference 2].

As well as comfort, this analysis uses the distress criteria of the "LDDC Method" as described in "Building Aerodynamics" by T.V. Lawson [Reference 2]. This specifies a limit of 0.025%, using wind speeds of 20m/s for "General Public", and 15m/s for "Frail Person Or Cyclist". A breach of these distress criteria requires a consideration of:

a) whether the location is "on a major route through the complex?"

and

b) whether there are "suitable alternate routes which are not "distressful"?"

Levels of pedestrian comfort strongly depend on individual activity. Therefore, the Lawson comfort criteria are defined for each activity in terms of a threshold wind speed which should not be exceeded for a given time throughout the year.

Pedestrian comfort criteria are assessed at 1.5m above ground level. Unless in extremely unusual circumstances, velocities at pedestrian level increase as you go higher from ground level. Therefore an assessment at 1.5m will be more onerous than one at, say 0.5m.

AECOM has developed a methodology to predict how often a given wind speed will occur each year over a specified area interpolating the results of steady state computational fluid dynamics simulations using weather data measured at an appropriate nearby location, in this case Heathrow airport.

Pedestrian activity alters between winter and summer months. The criteria assume that people will be suitably dressed for the time of year and individual activity. It is reasonable to assume, for instance, that areas designated for outdoor seating will not be used on the windiest days of the year.

5 Methodology

To identify the likely effect of the proposed development on the pedestrian level wind environment, a 3D CFD model of the development and surrounding site was created. This section describes the methodology for the creation of this model and the inputs used.

5.1 Computational Fluid Dynamics (CFD)

Simulations of the microclimate were conducted using ANSYS CFX CFD software. CFD simulation of likely wind patterns requires the generation of a three-dimensional computer model of the site and surrounding buildings.

A 3D Sketch up model of the buildings and site (*NHH-P18_HTA-A_3D_Detail_0_All blocks in context.skp*) was provided by the client. This was used, along with a 3D LIDAR model of the surrounding urban area to construct a 3D model using Rhinoceros 3D geometric modelling software.

The computational process involves the solution of fundamental equations of fluid motion within the CFD software. A computational 'mesh' was created to represent the geometry by dividing the domain into a large number of cell volumes. During the simulation, the values of each variable are determined in each cell of the mesh and so a comprehensive assessment of velocity and scalar variation within the calculation domain is obtained.

The dependent variables are as follows:

- Velocities in the three co-ordinate directions (U, V, W)
- Pressure (P)
- Turbulence Kinetic Energy (k)
- Turbulence Dissipation Rate (ε)
- Turbulence Specific Dissipation (ω)

To improve the resolution of the results, the mesh was concentrated in the areas of most interest (at pedestrian level around the proposed development) and around any significant small-scale flow features. This ensures greater accuracy of the variables under investigation.

5.2 Boundary Conditions

A cylindrical computational domain was used for the analysis (Figure 3). This allows the wind direction to be altered without changing the computational mesh. Around the perimeter of the wind tunnel, a profile for the velocity and turbulence parameters was specified to take into account how the wind speed changes with the height from the ground. Surfaces within the model were specified as having 'no slip'. This condition ensures that flow moving parallel to a surface is brought to rest at the point where it meets the surface.

5.3 Wind Boundary Layer Profile

Accurate specification of the boundary layer wind profile is crucial in correctly simulating the pedestrian level wind environment. For this reason, a logarithmic profile was assumed, which creates a wind boundary layer profile based on the assumption that wind speed increases proportionally with the natural logarithm of the height from the ground. The upstream logarithmic velocity profile has been applied for the simulations. This profile is for a wind in the highest decile of possible wind speeds, and is representative of all strong winds.

5.4 Building and Terrain Surfaces

All solid surfaces were represented as 'no slip' with an appropriate roughness height to account for small surface features.

5.4.1 Trees

Trees and low-level planting are already proposed for various locations within and around the development. The specific effect of this planting cannot be quantified within the scope of this analysis.

It is extremely difficult to quantify the effect of an individual tree on airflow. The porosity and resistance to flow is highly sensitive to many factors such as species, age, health, aspect, soil, season etc.

The highest wind speeds experienced in South East England tend to occur during winter, when deciduous trees are leafless. Although the presence of a particular tree might conceivably cause an acceleration of flow in one localised region under a specific scenario, its overall effect on the pedestrian environment will be to reduce the average velocity experienced. As a result, the omission of trees from the models around the proposed buildings may be considered to be an appropriate conservative measure.

Geometry data for trees, ground level and buildings far from the site have been taken from a LIDAR survey. This survey does not distinguish trees from ground or buildings, so for this far area trees have been represented in the CFD model where they are of sufficient density to be detected using LIDAR methods.

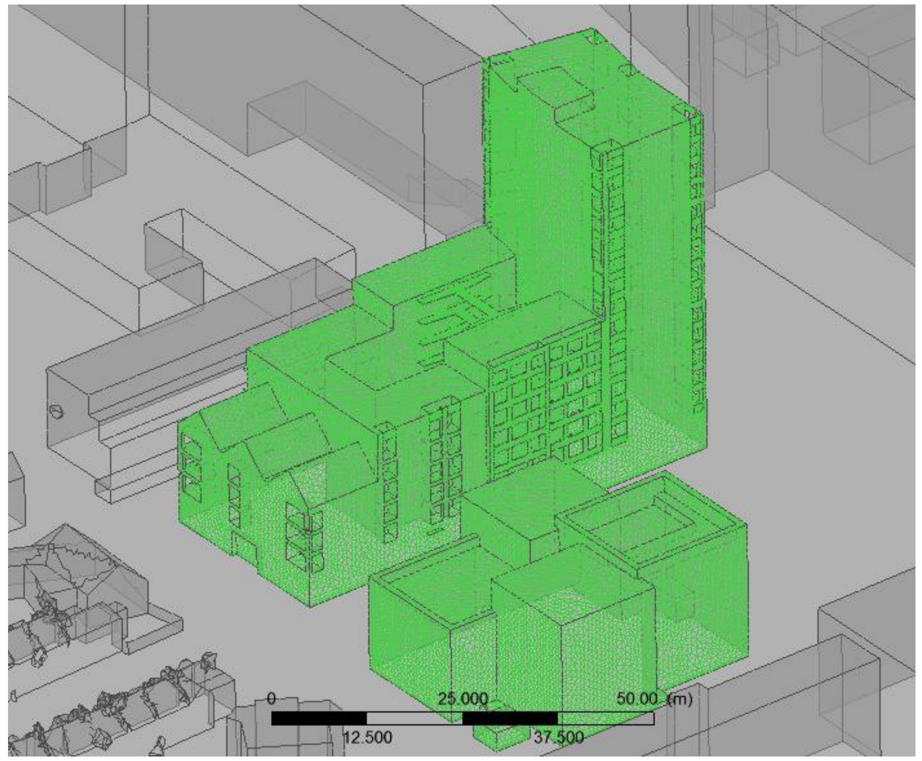


Figure 2 – Computational mesh of the proposed development (highlighted in green).

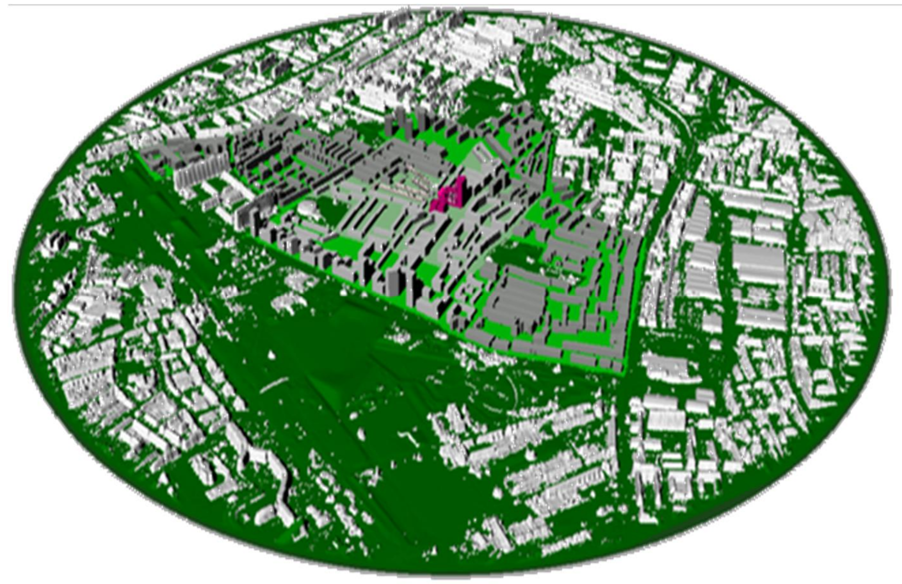


Figure 3 – Computational domain. The proposed development is highlighted in Purple. The ground in green.

6 Site Conditions

6.1 Site Location and Usage

The proposed development is located in the Aylesbury Estate regeneration area, in Walworth, South London.

Figure 4 - Google Earth aerial view of proposed location, with site showing proposed site

6.2 Wind Data Analysis

Wind microclimate studies require that wind speed data obtained from a measurement station be transposed to the site of interest.

The wind speed history, provided by weather centres such as the UK Met Office is reformatted into the number of observations of mean hourly wind speeds within each of several wind speed ranges, for each wind direction. A Weibull distribution is fitted to the wind speed distribution for each wind direction.

From the Weibull cumulative distribution, for a given wind direction, the probability a wind speed, V, will be exceeded is given by:

$$P = e^{-(\frac{V}{k})\wedge c}$$

where c is the dispersion parameter and k is the shape parameter.

The resulting weather centre wind data is transposed to a standard reference terrain category, ‘open country terrain’, at sea-level, accounting for upwind terrain, topography and altitude for the weather centre.

To these parameters is further added the probability, p, of each wind direction occurring. Thus the probability that a specified wind speed is exceeded for a specified wind direction may be calculated.

The resulting weather centre wind data is transposed to a standard reference terrain category, ‘open country terrain’, at sea-level, accounting for upwind terrain, topography and altitude for the weather centre.

The open country wind data is then transposed to reference height at the site of the proposed development, accounting for upwind terrain, topography and altitude for the target site.

Values of p, c and k for the Heathrow Airport Weather Centre, transposed to open-country terrain at 10m height above sea-level altitude are given in Table 1 - Weibull factors.

Direction	P	c	k
0	2.5%	3.39	1.80
10	2.8%	3.53	1.84
20	2.9%	3.77	1.92
30	2.8%	4.11	2.05
40	2.6%	4.52	2.20
50	2.2%	4.95	2.36
60	1.8%	5.34	2.51
70	1.4%	5.63	2.63
80	1.3%	5.79	2.72
90	1.2%	5.78	2.76
100	1.2%	5.63	2.76
110	1.1%	5.35	2.70
120	1.0%	5.01	2.60
130	0.9%	4.67	2.45
140	0.8%	4.39	2.27
150	0.8%	4.23	2.08
160	1.2%	4.22	1.93
170	2.0%	4.38	1.84
180	3.0%	4.67	1.82
190	4.1%	5.03	1.87
200	5.0%	5.40	1.97
210	5.8%	5.67	2.08
220	6.1%	5.79	2.16
230	6.0%	5.71	2.17
240	5.7%	5.46	2.10
250	5.2%	5.08	1.98
260	4.6%	4.63	1.83
270	4.1%	4.20	1.70
280	3.6%	3.85	1.61
290	3.1%	3.61	1.58
300	2.7%	3.47	1.61
310	2.4%	3.41	1.66
320	2.1%	3.38	1.71
330	2.0%	3.36	1.75
340	2.0%	3.34	1.77
350	2.2%	3.34	1.78

Table 1 - Weibull factors

6.3 Pedestrian Activity

Levels of pedestrian comfort strongly depend on individual activity. Therefore, the Lawson comfort criteria are defined for each activity in terms of a threshold wind speed which should not be exceeded for a given time throughout the year.

When considering the results of this study, the wind conditions predicted must be compared with the intended use for each space. The intended use described by the client is shown in Figure 5.

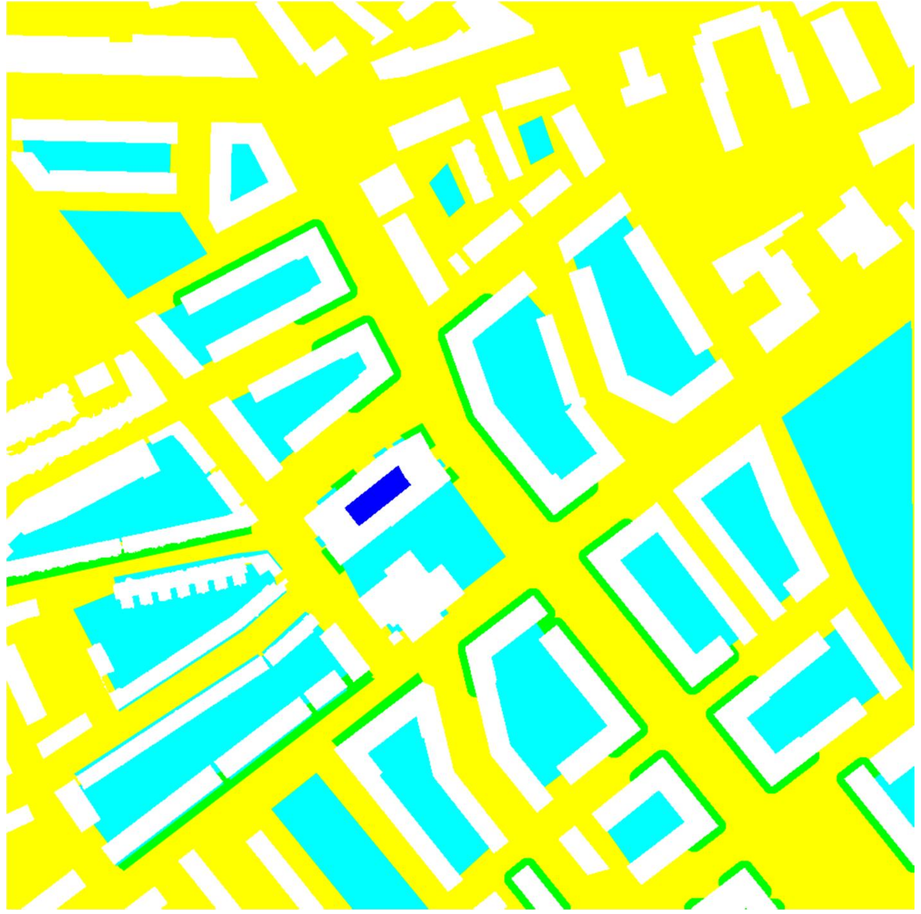


Figure 5 - Predicted Pedestrian Uses

Use according to the Lawson Criteria	Plot Colour
Long term sitting	
Standing or short term sitting	
Walking and strolling	
Business walking	
Unacceptable for pedestrian comfort	

Table 2 – Lawson Comfort Categories

7 Results

7.1 Introduction

Analysis has been undertaken to assess the wind microclimate around the proposed development for the 36 wind directions outlined previously in this document.

Further analysis has also been undertaken to assess the areas around the existing development against the Lawson Criteria. This specifies the level of activity at which pedestrians feel discomfort for a specified threshold wind speed and frequency of occurrence. The use categories specified by Lawson are shown in Table 3 below, along with the colour-key as used in the subsequent contour plots. As has been noted, AECOM has developed a methodology to predict how often a given wind speed will occur each year over a specified area interpolating the results of steady state computational fluid dynamics simulations using weather data measured at an appropriate nearby location. This allows predictions to be made of the suitability of the use of different areas across the site based on the different pedestrian activities outlined by Lawson.

Use according to the Lawson Criteria	Plot Colour
Long term sitting	
Standing or short term sitting	
Walking and strolling	
Business walking	
Unacceptable for pedestrian comfort	

Table 3 – Lawson Comfort Categories

7.2 Existing Surrounding Buildings

7.2.1 Lawson

Figure 6 - Lawson Existing Surrounding Buildings

Figure 6 above shows Lawson comfort categories over the wider urban area for the existing surrounding buildings case. The scale used is set out in Table 3.

As can be seen the general wind conditions range from “suitable for long term sitting” around areas of low level housing to “suitable for walking and strolling” in the more exposed areas of Burgess park.

The conditions along Thurlow Street, which runs from the park in the south past the east of the proposed buildings, are in general a category higher than the surrounding streets at “standing or short term sitting”. The cause of this windier environment is the large existing buildings on the east side of Thurlow Street. Prevailing westerly winds strike the western facades of these long tall buildings and are directed down to street level, where unable to escape around the long buildings, they flow along the axis of the street.

Figure 7 - Birds Eye View of Thurlow Street

Figure 7 above shows a bird’s eye view of the south side of Thurlow Street, showing the large exposed western façade of the buildings causing the downdraft. Wind is able to access this façade over the comparatively shorter buildings to the west of the street and across the park to the south. A diagrammatic representation of this mechanism is presented in Figure 8 below.

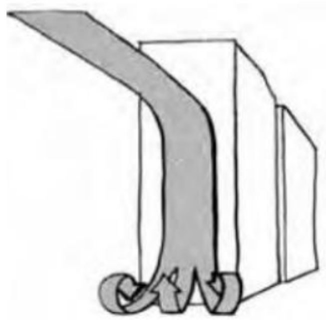


Figure 8 - Downwash Description

Figure 9 - Lawson Existing Surrounding Buildings Close

Figure 9 above shows the same information as Figure 6, and to the same colour scale. It shows the area around the proposed site in more detail. The light blue areas along Thurlow Street can be seen. At position A, wind is escaping between two of the existing high and long blocks to the east of Thurlow Street. At this position higher wind speeds are found.

Position B shows some areas of higher wind speed. Small areas are coloured yellow, and so are suitable for "business walking" only. The cause of these conditions is wind from the south west striking the exposed facades of the tall existing buildings along Thurlow Street to the south of the proposed site. Air is then moving North up Thurlow Street at low level. When it reaches the proposed site it is further channelled by the constriction formed by the proposed buildings and the existing tall building to the north of the proposed building.

The areas of higher wind at position B are currently close to both a zebra crossing and the entrance to the Aylesbury Medical Centre. It is likely that frail members of the population will use these, so thought should be given to the impact on these people.

This existing constriction is shown in Figure 10, with the proposed site to the centre of the picture.

Figure 10 - View of existing constriction from north

Figure 11 shown below is taken from Appendix 9.1 of the Masterplan Wind Microclimate Assessment by HTA. It is showing general agreement with the results presented in this study [note that this figure uses a different colour scale]. As the masterplan assessment picked points surrounding the development rather than presenting results across the entire ground, it may have missed particularly windy areas.

Point 33 and point 32 are shown as suitable for standing and sitting respectively. In the work to support this report these point would be shown as suitable for sitting and standing. However the much more windy area to the west of points 33 and 32 has not been measured.

Figure 11 - Masterplan Existing Study

This situation is caused by winds from a relatively narrow range of directions, as can be seen from Figure 12 to Figure 16 below. These show higher velocities as reds and yellows, and lower velocities as blues.

The black arrows at the corners of the plot show the wind direction. As can be seen from the narrow range of black arrows, and the sudden change in wind speed in the gap between the proposed building and the tall buildings to the eastern side of Thurlow Street there is a high degree of sensitivity to wind angle.

However when this situation does exist strong winds are channelled down to low level.

A full range of these images is presented in Appendix A.

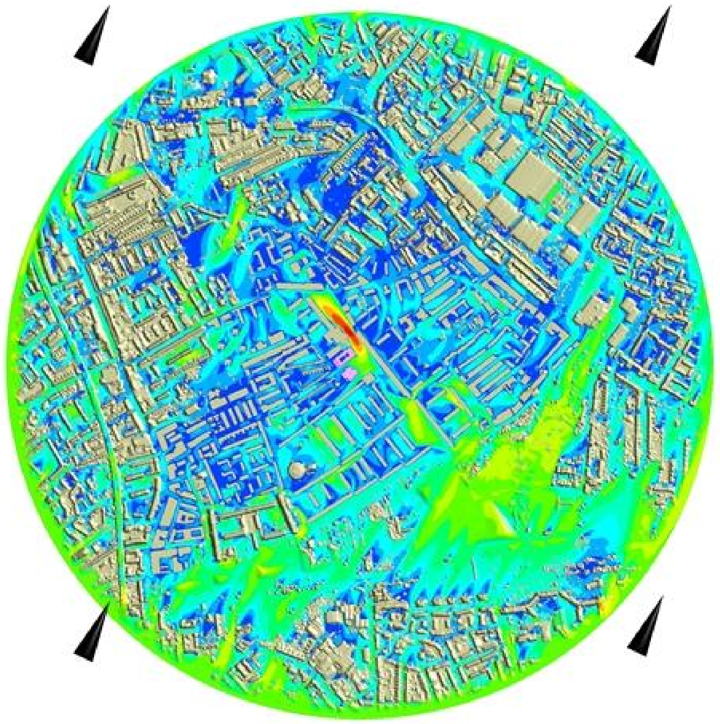


Figure 13 - Wind from 205 degrees

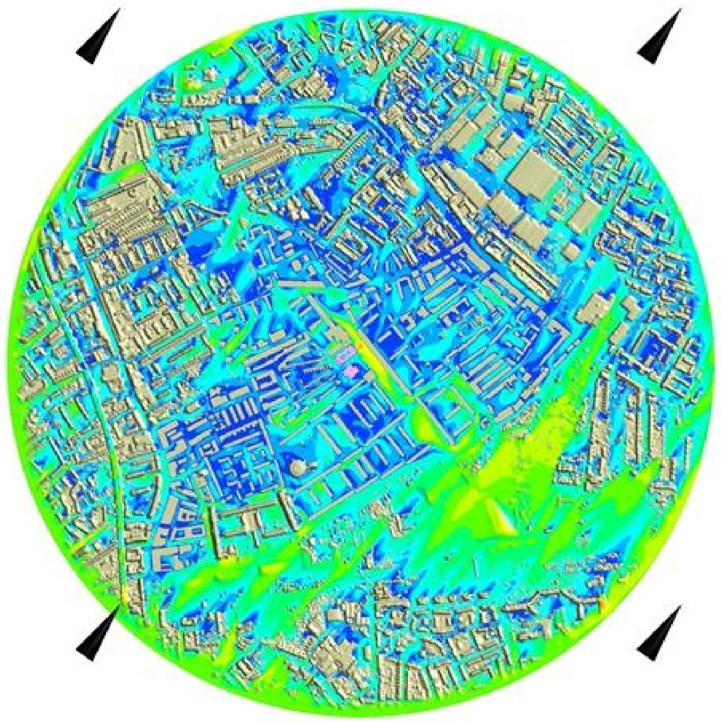


Figure 15 - Wind from 215 degrees

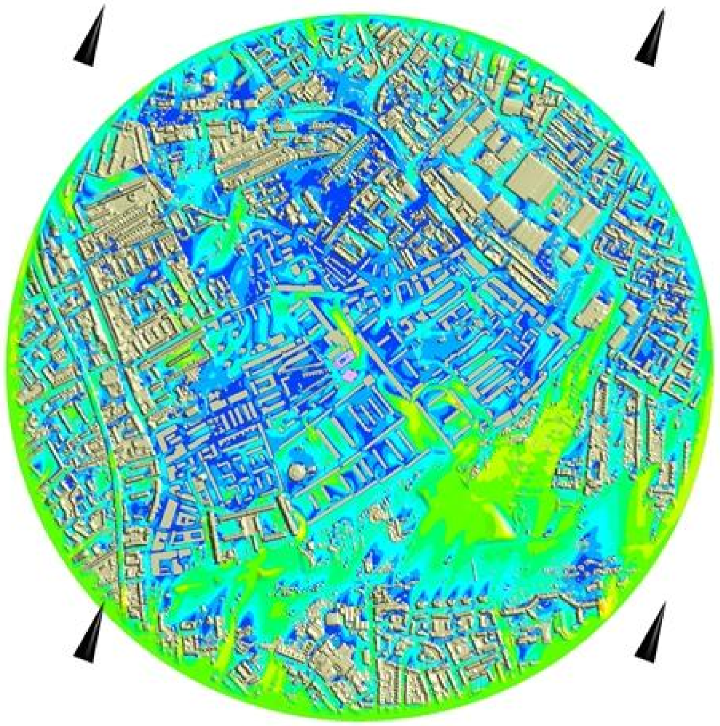


Figure 12 - Wind from 200 degrees

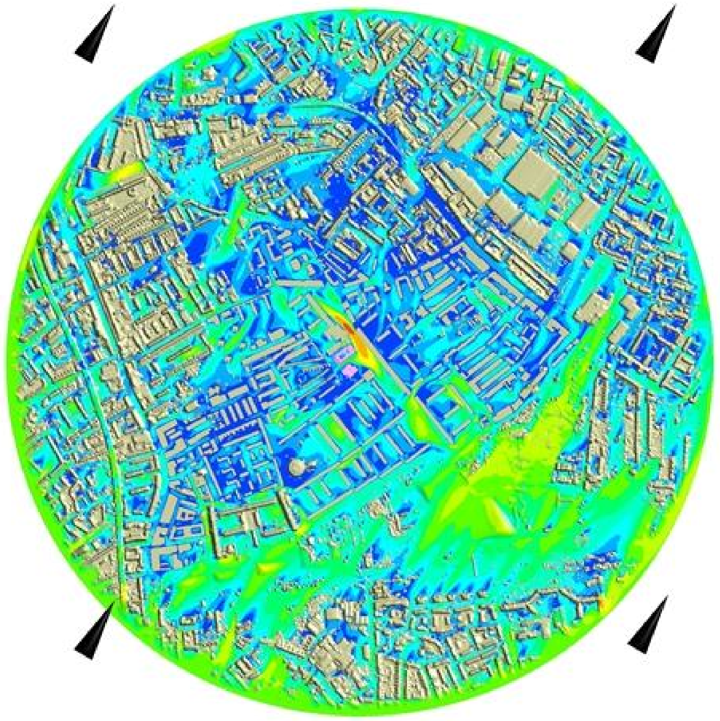


Figure 14 - Wind from 210 degrees

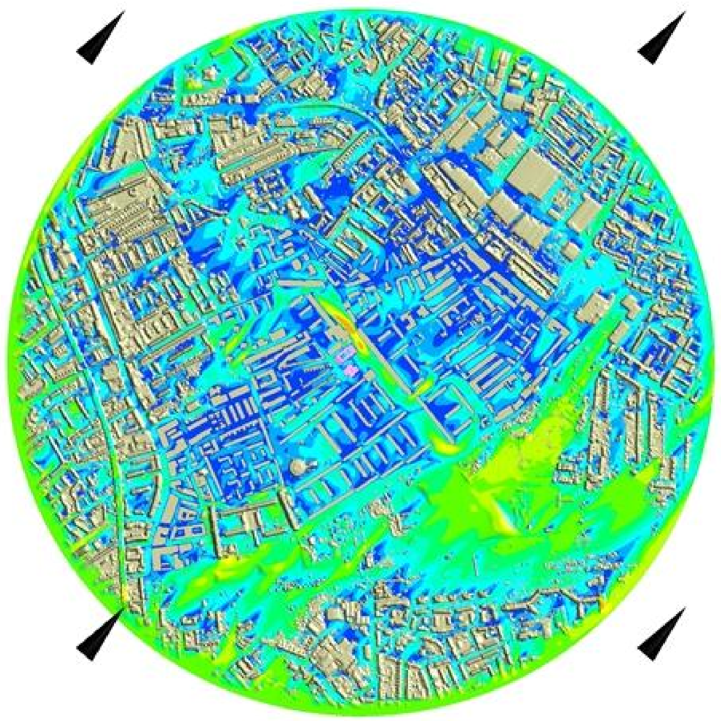


Figure 16 - Wind from 220 degrees

The graphs shown below in Figure 17 show the distribution of strong winds by angle at a point in the centre of this area of strong winds.

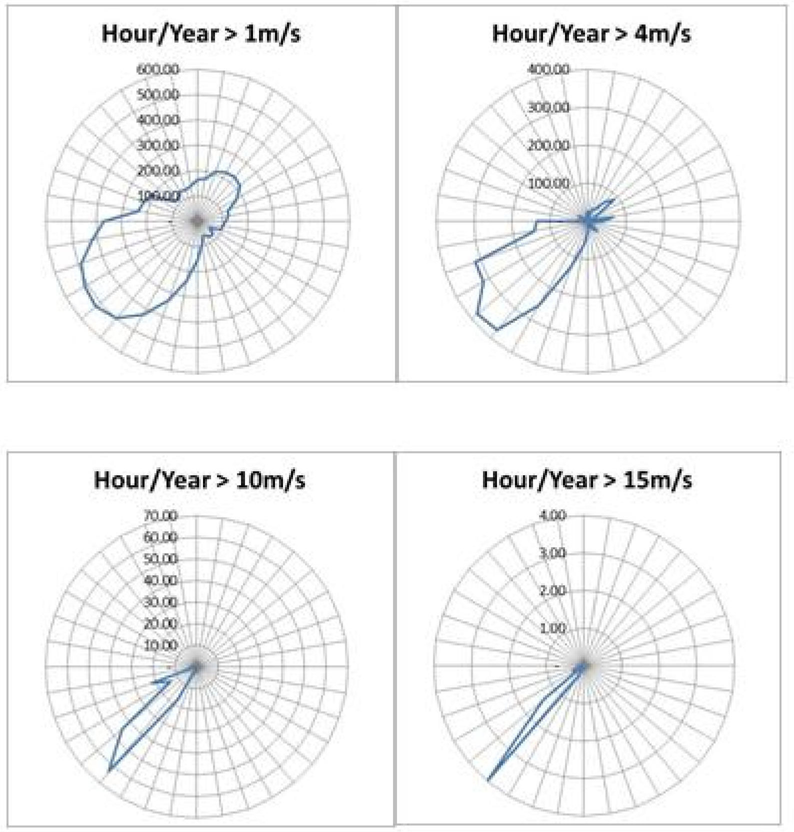


Figure 17 - Distribution of strong winds at pedestrian level

It can be seen that for light winds the distribution follows the general distribution of winds above the site.

For strong winds, those above 15m/s, these winds are generated almost exclusively by winds from 210 degrees from north.

The two figures below, Figure 18 and Figure 19, show streamlines of air which pass through the areas of highest wind at pedestrian level. The streamlines are coloured by velocity. The wind angle for these two images is 210 degrees.

From these two pictures it is clear that the mechanism for the high velocity air is as described in earlier sections. It is also clear that were these large existing buildings not present the mechanism would no longer appear.

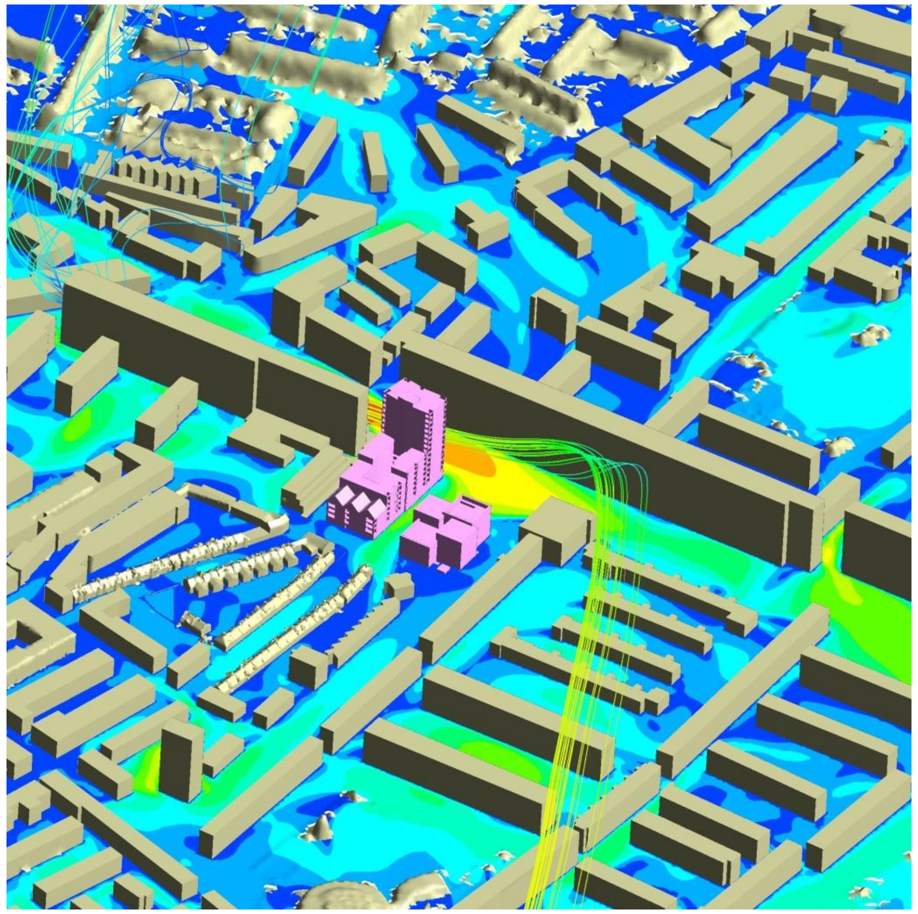


Figure 18 - Streamline through high velocity area, view from south

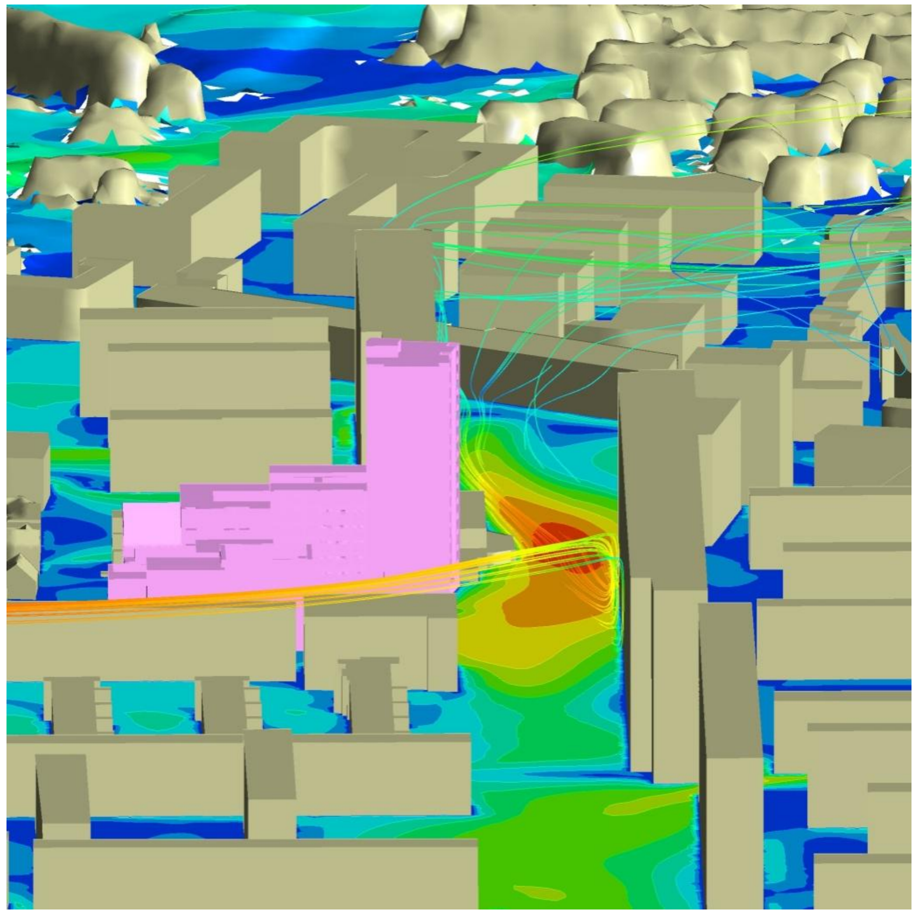


Figure 19 Streamline through high velocity area, view from south east

7.2.2 Distress

In addition to criteria for “discomfort” the Lawson method presents criteria for “distress”. The discomfort criteria focus on wind conditions which may be encountered for hundreds of hours per year. The distress criteria require higher wind speeds to be met, but focus on two hours per year. These are rare wind conditions but with the potential for injury rather than inconvenience.

The criteria for distress for a frail person or cyclist is 15m/s wind occurring at low level for more than two hours per year. Figure 20 below shows a plot of hours per year over 15m/s, ranging from zero hours in blue to two hours in red. As can be seen there are areas to the east of the proposed site where the wind is predicted to be over 15m/s for more than two hours per year.

The cause of these high winds is the rare but strong winds from 210 degrees as detailed in the previous section.

Figure 20 - Simulated Lawson “Distress” conditions – “Frail Person Or Cyclist”

Figure 21 below shows the same data as Figure 20. Areas close to the site are shown, and at a scale from 0 hours per year to 20 hours per year.

As can be seen from this image is it predicted that all areas will receive below 8 hours per year of wind at 15m/s. This is above the recommended level of 2 hours per year above 15m/s for a “Frail Person or Cyclist”.

Although the location is “*on a major route through the complex*”, there are “*suitable alternate routes which are not “distressful*” for many of the routes. Careful consideration should be given to additional significant local shelter in this region, and the provision of alternative routes.

The Lawson method encourages a probabilistic approach to risk. The surrounding buildings are planned for removal in the near future, and consideration should be given to the length of time that this increased incidence of risk will last, and if it is therefore acceptable.

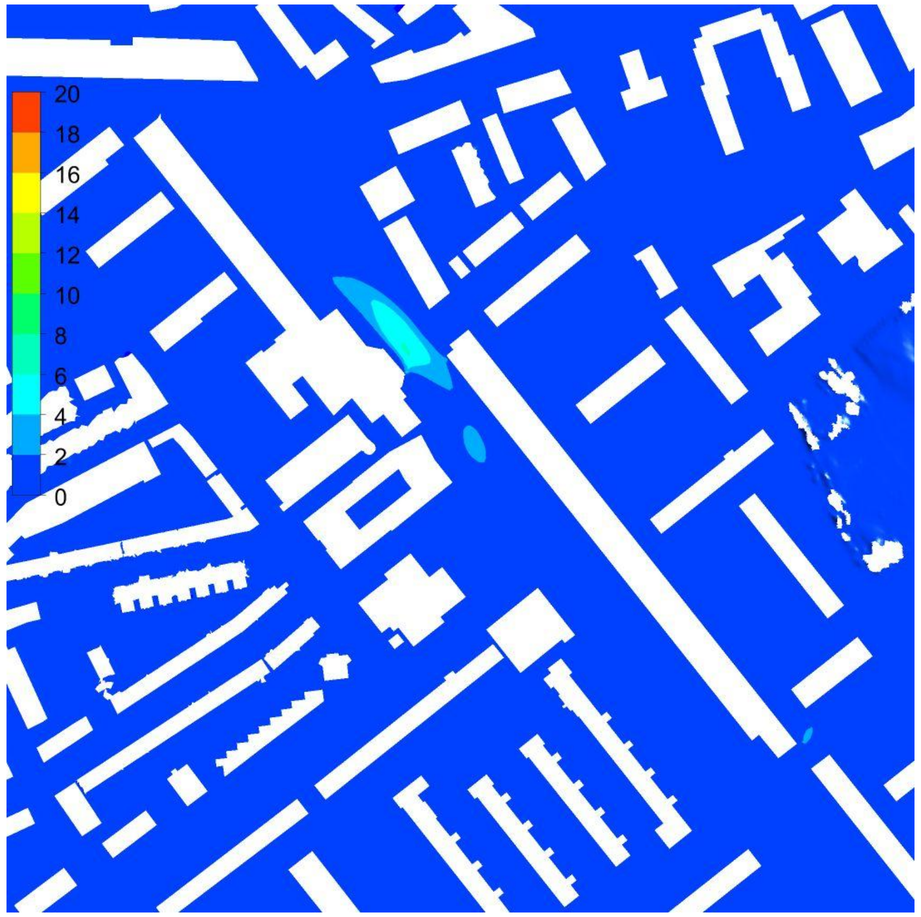


Figure 21 - Simulated Lawson “Distress” conditions around the proposed development and immediately adjacent buildings – “Frail Person Or Cyclist” Expanded Scale

The criteria for distress for a member of the general population is 20m/s wind occurring at low level for more than two hours per year. Figure 20 below shows a plot of hours per year over 20m/s, ranging from zero hours in blue to two hours in red. As can be seen there are no areas close to the proposed development where these conditions occur. These simulations show the site will not be distressful for members of the general population, as defined by the Lawson method.

Figure 22 - Simulated Lawson “Distress” conditions – “General Population”

7.3 Proposed Surrounding Buildings

The simulations shown in the previous section were repeated with the proposed buildings surrounded by the proposed masterplan.

7.3.1 Lawson

Figure 23 - Lawson Proposed Surrounding Buildings

Figure 23 above shows Lawson comfort categories over the wider urban area for the proposed surrounding buildings case. The colour scale used is set out in Table 3.

As can be seen the general wind conditions range from “suitable for long term sitting” around areas of low level housing to “suitable for walking and strolling” in the more exposed areas of Burgess park.

The previous conditions along Thurlow Street, which runs from the park in the south past the east of the proposed buildings, are now calmer than previously. This has been caused by the demolition of the tall long blocks to the east of Thurlow Street.

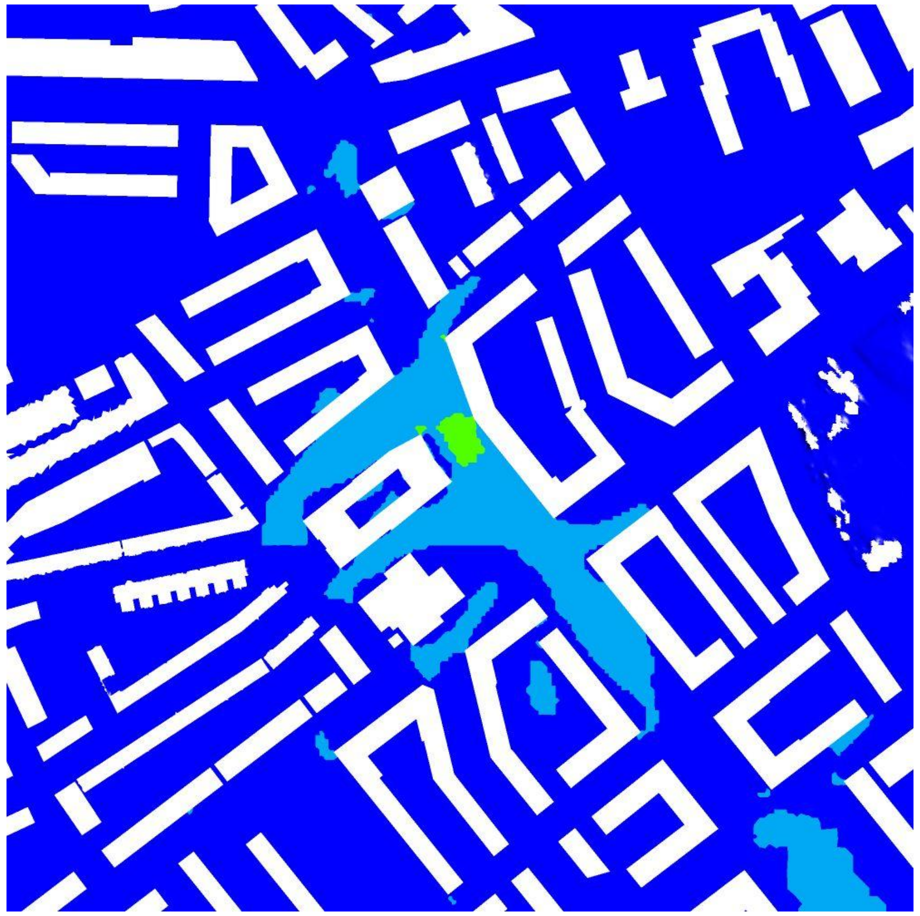


Figure 24 - Lawson Existing Surrounding Buildings Close

Figure 24 above shows the same information as Figure 23, and to the same scale. It shows the area around the proposed site in more detail. The light blue areas, suitable for standing, along Thurlow Street and surrounding the proposed development can be seen.

There is also a small green area. This area is suitable for strolling, but is unsuitable for buildings entrances. This area is caused by interaction between the taller of the proposed building’s north eastern façade and north easterly winds. This interaction causes downwash, in combination with the shorter building to the north east. Consideration should be given to the placement of the entrance of the shorter building to the North West.

Figure 25 shown below is taken from Appendix 9.1 of the Masterplan Wind Microclimate Assessment by HTA. It is showing general agreement with the results presented in this study [note that this figure uses a different colour scale]. As the masterplan assessment picked points surrounding the development rather than presenting results across the entire ground, it may have missed particularly windy areas.

Points 154 and 144 are shown as suitable for sitting and point 182 is shown as suitable for standing. In the work to support this report these points would be shown as suitable for sitting and standing. The slightly more windy area to the north west of the taller proposed building is shown in this work as suitable for walking or strolling. In the masterplan wind assessment no point was placed here so it is not possible to tell if similar results would have been predicted.

Figure 25 - Masterplan Proposed Study

7.3.2 Distress

The criteria for distress for a frail person or cyclist is 15m/s wind occurring at low level for more than two hours per year. Figure 26 below shows a plot of hours per year over 15m/s, ranging from zero hours in blue to two hours in red.

Figure 26 - Simulated Lawson “Distress” conditions – “Frail Person Or Cyclist”

Figure 27 below shows the same data as Figure 26, and focuses on the area around the development. Small areas are shown where wind speeds exceed 15m/s for a small number of hours per year. These areas are caused by downwash from the taller of the proposed buildings.

One area has a very small area where 15m/s is predicted for more than 2 hours per year.

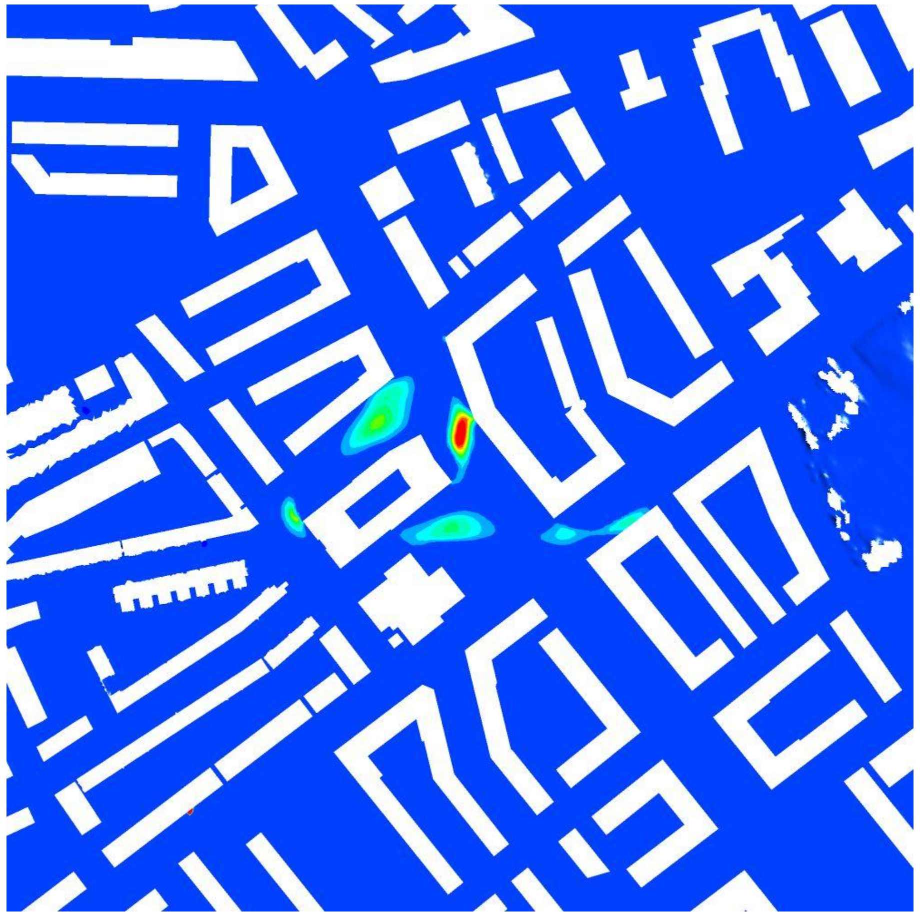


Figure 27 - Simulated Lawson “Distress” conditions around the proposed development and immediately adjacent buildings – “Frail Person Or Cyclist”

Figure 28 below shows the same data as Figure 27, but presented on a scale ranging from 0 to 20 hours per year rather than 0 to 2 hours per year. As can be seen from this image there is only an extremely small area predicted to have more than 2 hours per year over 15m/s and in this area the higher wind speeds are predicted for less than 4 hours per year.

Based on these findings the impact should be considered negligible.

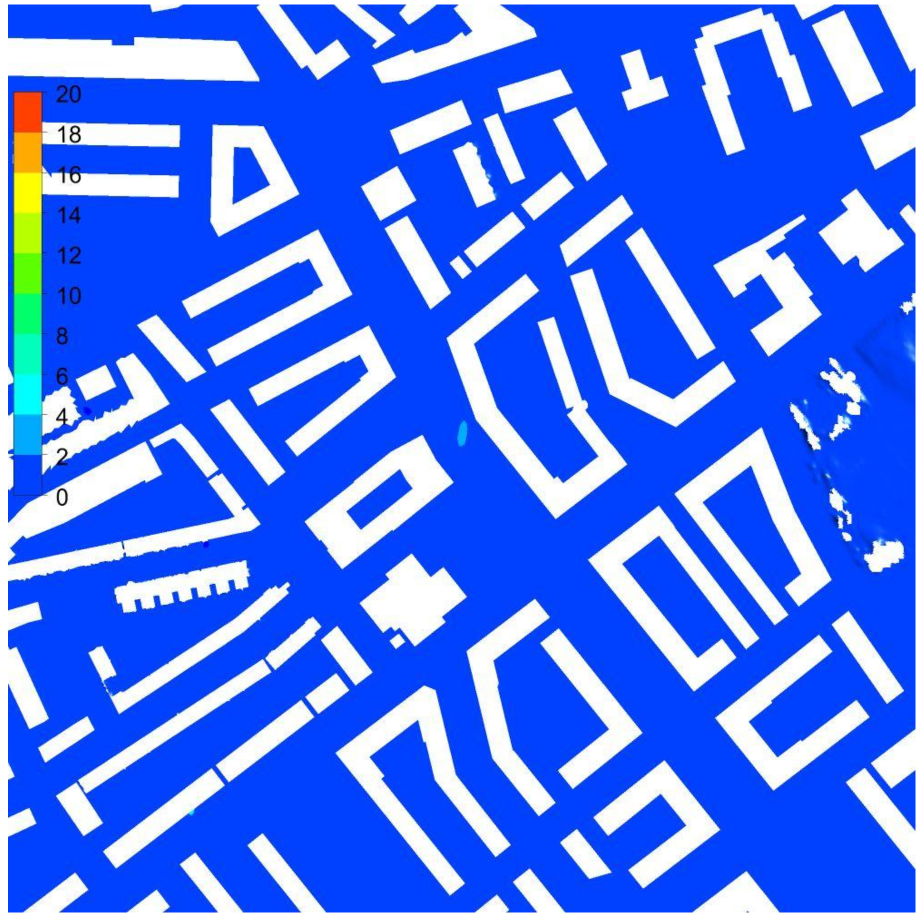


Figure 28 - Simulated Lawson “Distress” conditions around the proposed development and immediately adjacent buildings – “Frail Person Or Cyclist” Expanded Scale

The criteria for distress for a member of the general population is 20m/s wind occurring at low level for more than two hours per year. Figure 29 below shows a plot of hours per year over 20m/s, ranging from zero hours in blue to two hours in red. As can be seen there are no areas close to the proposed development where these conditions occur. These simulations show the site will not be distressful for members of the general population, as defined by the Lawson method.

Figure 29 - Simulated Lawson “Distress” conditions – “General Populationon”

7.4 Mitigation

Trees and low-level planting are already proposed for various locations within and around the development. Mature trees exist on the current development. The specific effect of this planting cannot be quantified within the scope of this analysis, but it is expected to provide additional benefit to the wind microclimate around the proposed development.

Images Figure 30 and Figure 31 below show the entrance to the medical centre, and the nearby zebra crossing.

Figure 30 - Entrance to the Medical Centre

Figure 31 - Zebra Crossing

The main entrance to the medical centre is from the road, and windy conditions are predicted to occur more frequently at this point.

Consideration could be given to shielding the entrance from winds coming from the south of Thurlow Street, and promoting access to the centre through the carpark.

Consideration could be given to the re-positioning of the crossing a little further to the north of Thurlow Street to allow frail pedestrians to cross in an area where strong winds occur less frequently.

8 References

Reference 1 DCLG (2012) National Planning Policy Framework

Reference 2 Building Aerodynamics, Tom Lawson FREng. Imperial College Press, 2001

Reference 3 The London Plan, Spatial Development Strategy for Greater London, (March 2015). http://www.london.gov.uk/priorities/planning/london-plan

Reference 4 EH/CABE (2007) Guidance on Tall Buildings, July 2007, 7pp

Reference 5 London Borough of Southwark (2011) *Core Strategy* DPD, 241pp

Reference 6 London Borough of Southwark (2011) *Unitary Development* Plan Saved Policies April 2011

9 Appendix A

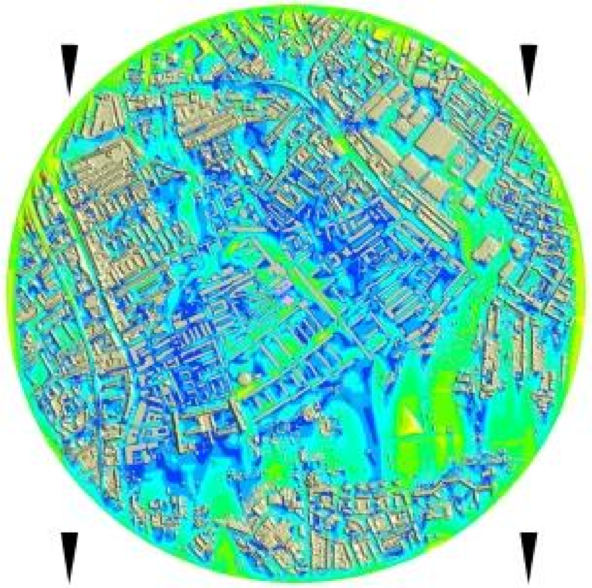


Figure 32: Existing Velocity Wind from 000

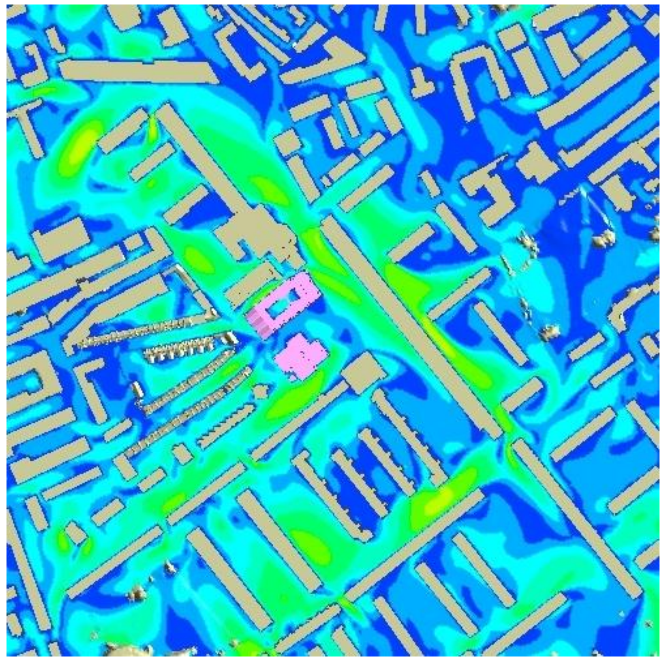


Figure 33: Existing Velocity Wind from 000

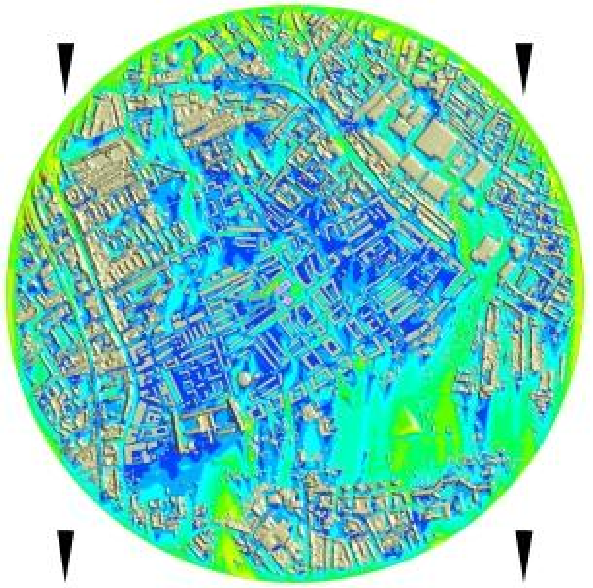
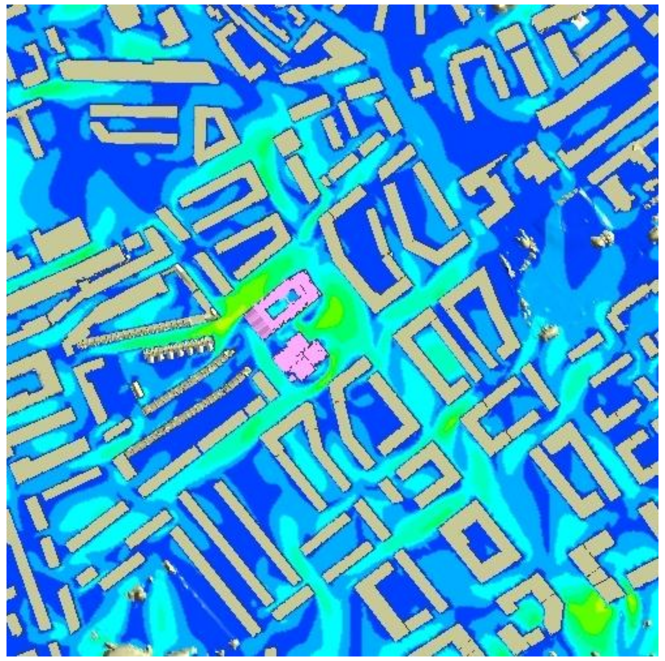


Figure 34: Proposed Velocity Wind from 000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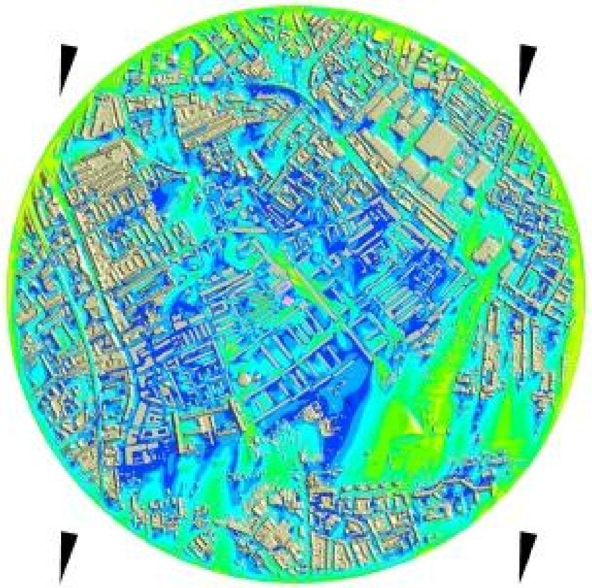


Figure 36: Existing Velocity Wind from 010

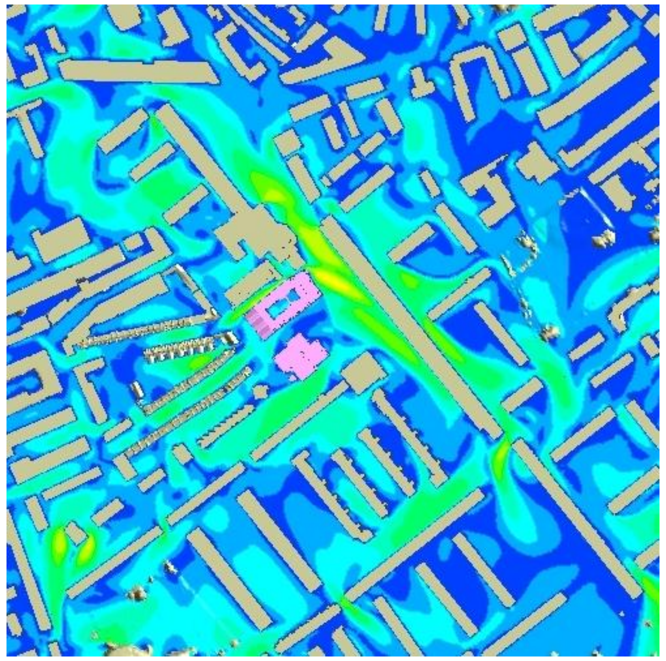


Figure 37: Existing Velocity Wind from 010

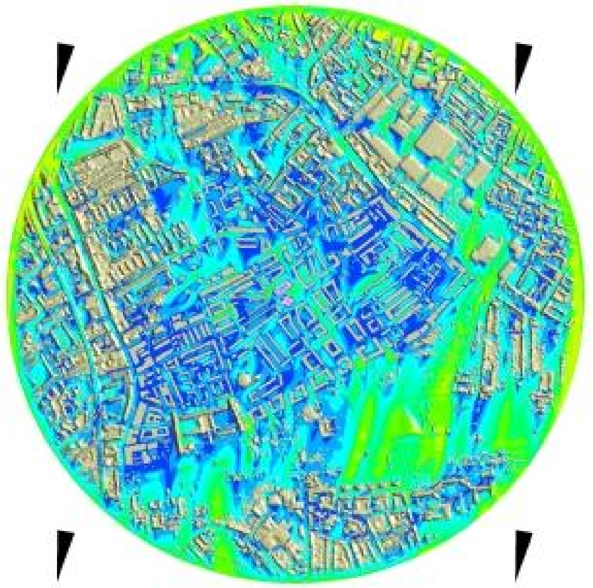


Figure 38: Proposed Velocity Wind from 010

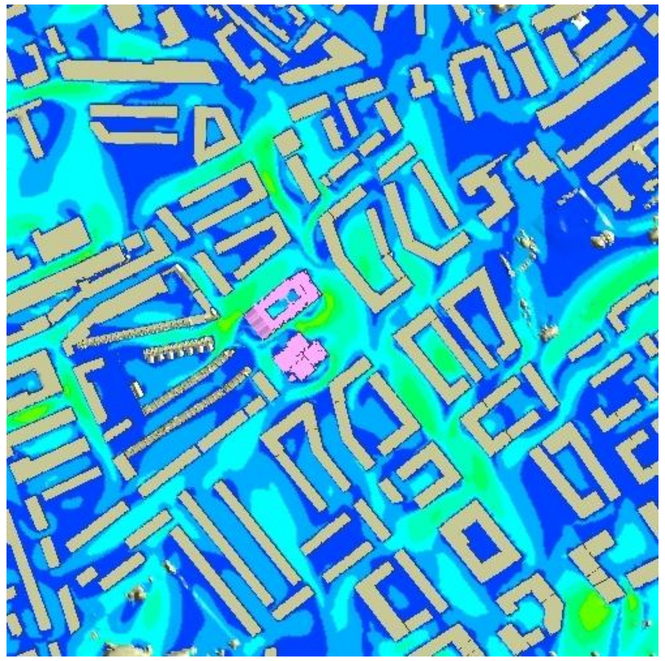


Figure 39: Proposed Velocity Wind from 010

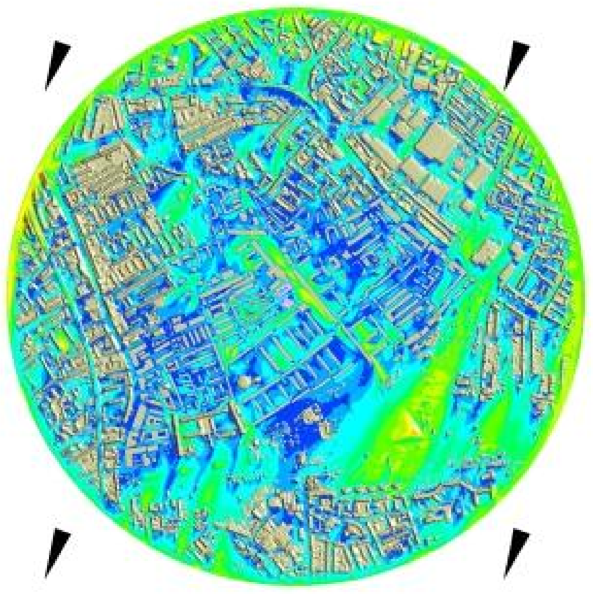


Figure 40: Existing Velocity Wind from 020

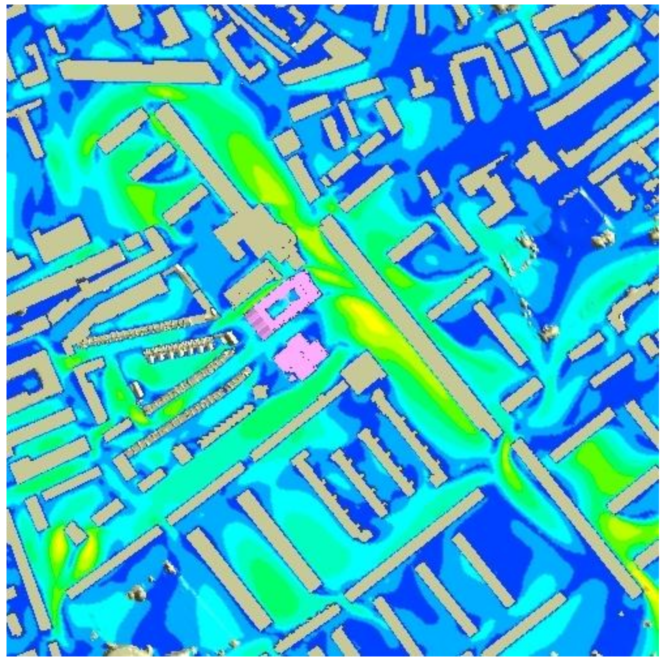


Figure 41: Existing Velocity Wind from 020

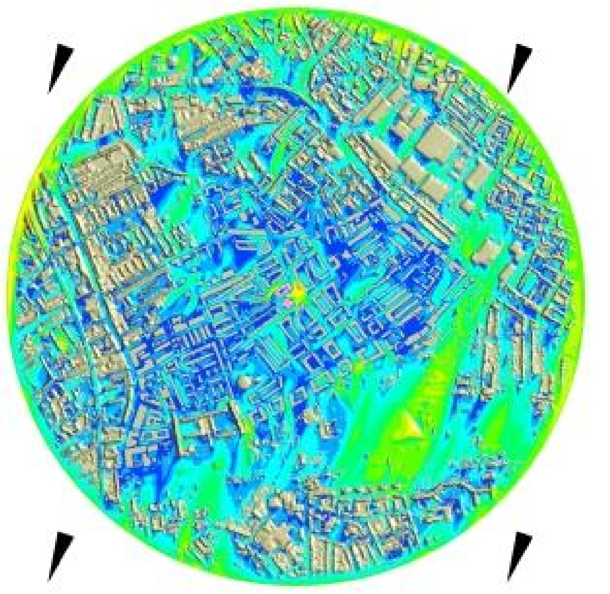


Figure 42: Proposed Velocity Wind from 020

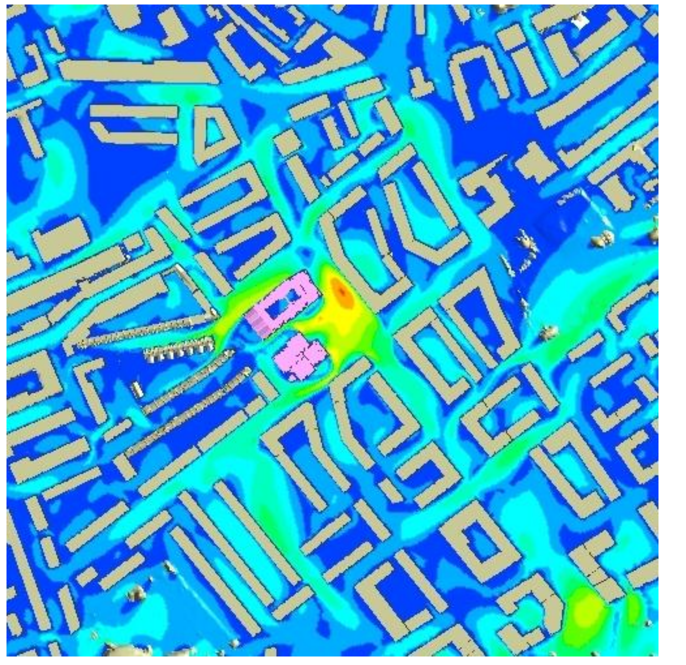


Figure 43: Proposed Velocity Wind from 020

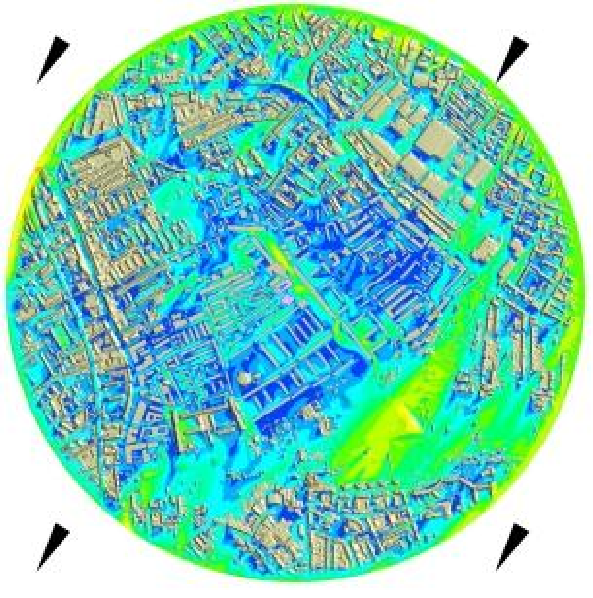


Figure 44: Existing Velocity Wind from 030

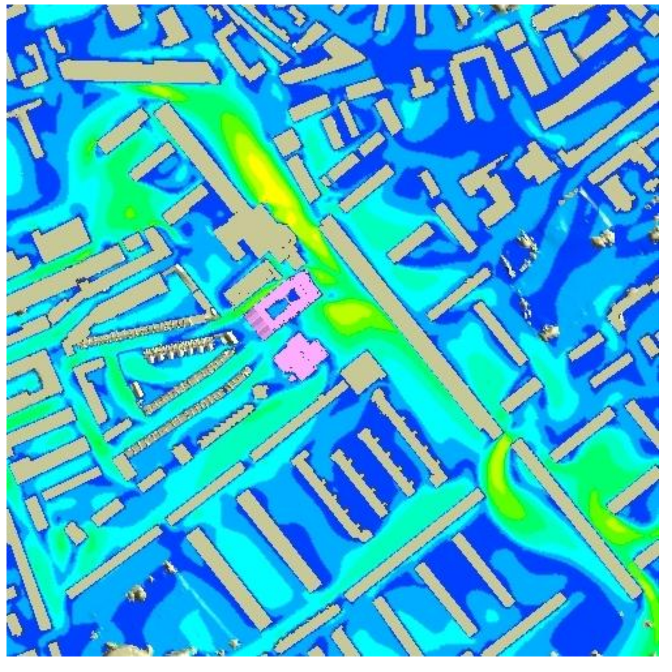


Figure 45: Existing Velocity Wind from 030

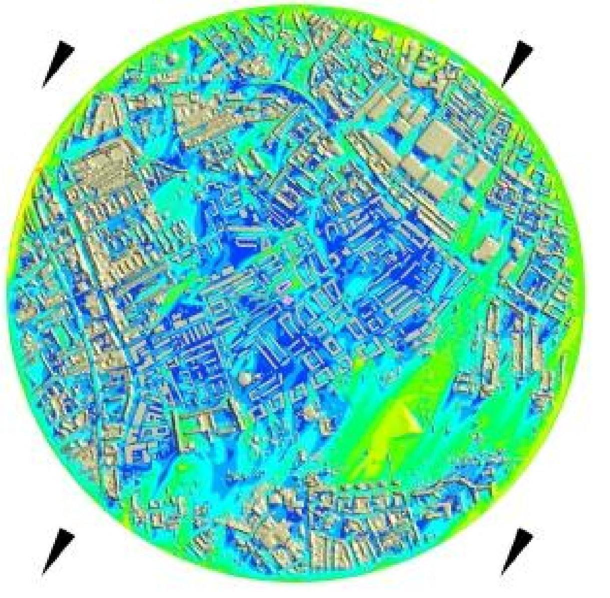


Figure 46: Proposed Velocity Wind from 030

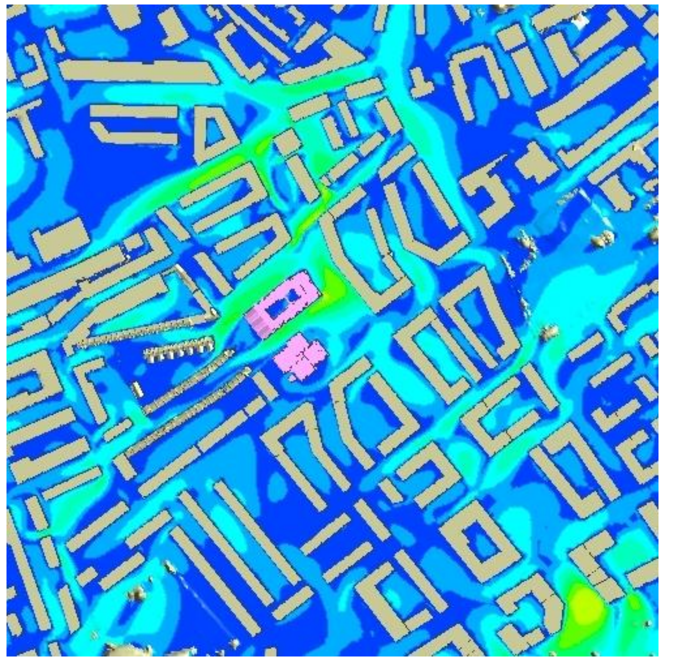


Figure 47: Proposed Velocity Wind from 030

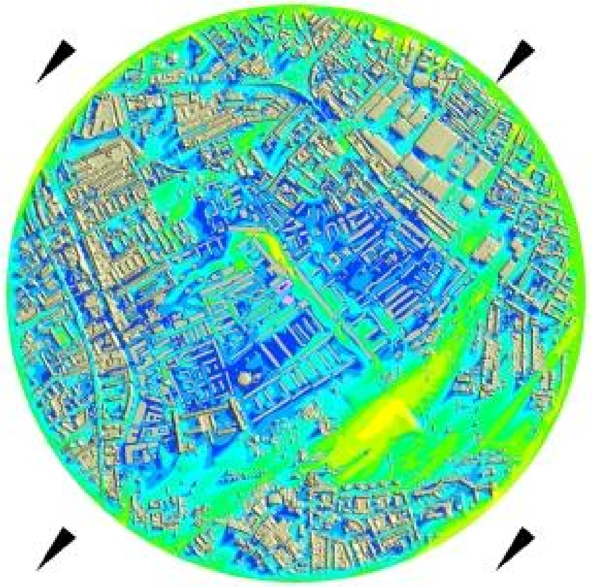


Figure 48: Existing Velocity Wind from 040

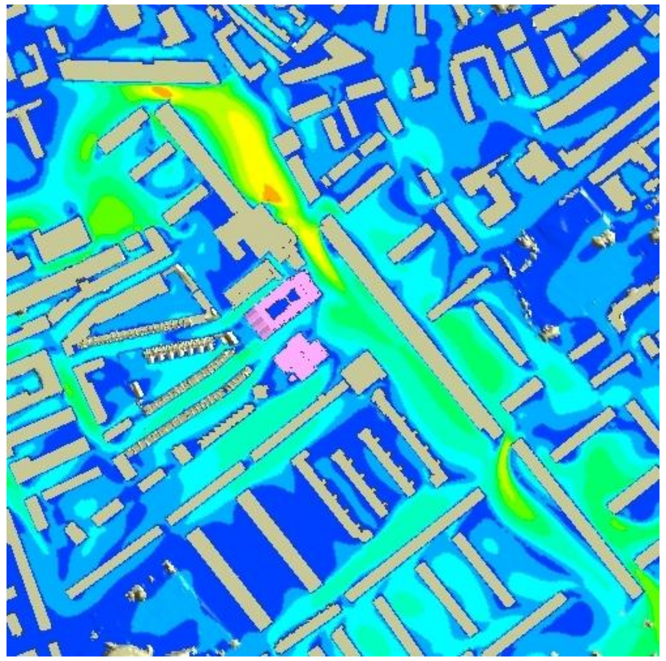
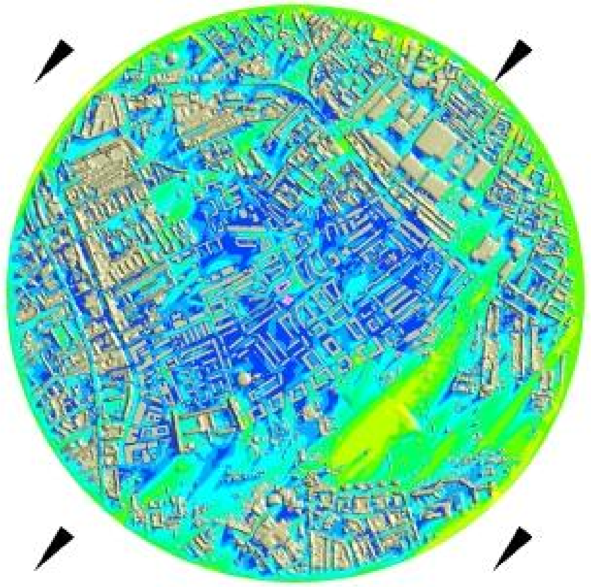


Figure 49: Existing Velocity Wind from 040



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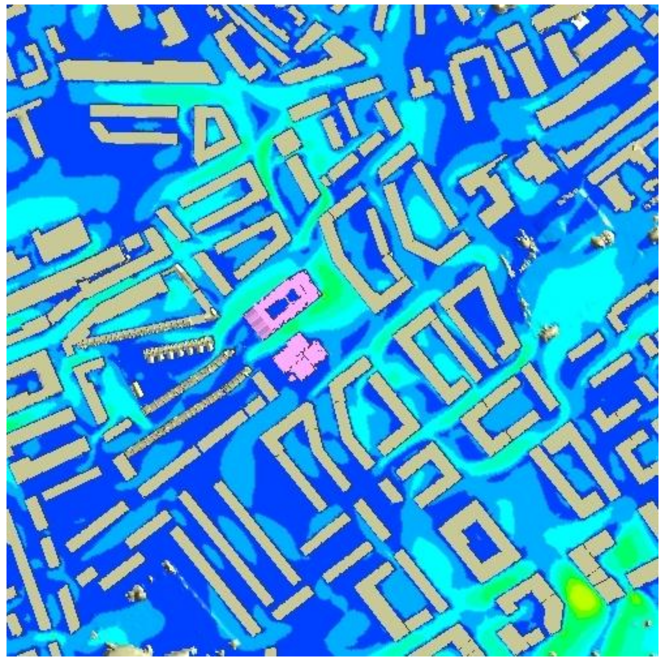

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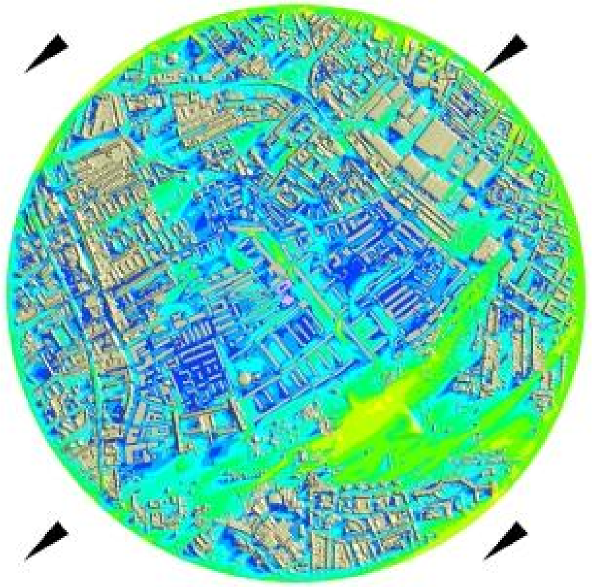
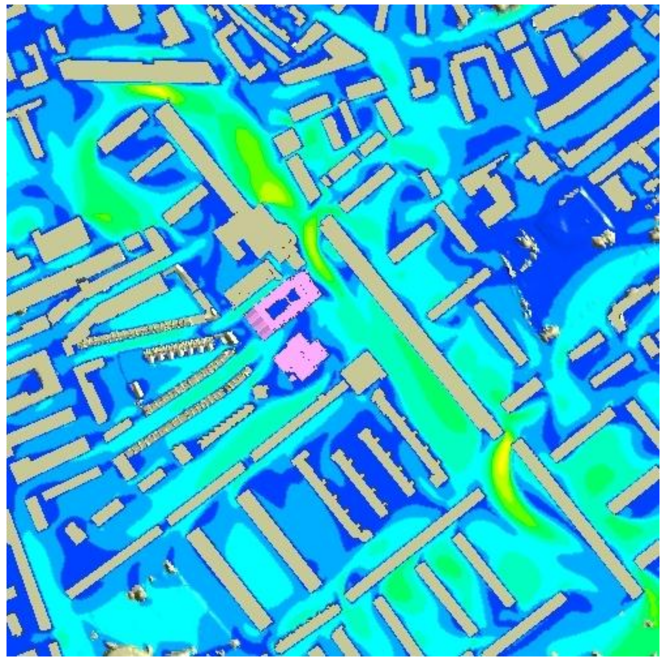


Figure 52: Existing Velocity Wind from 050



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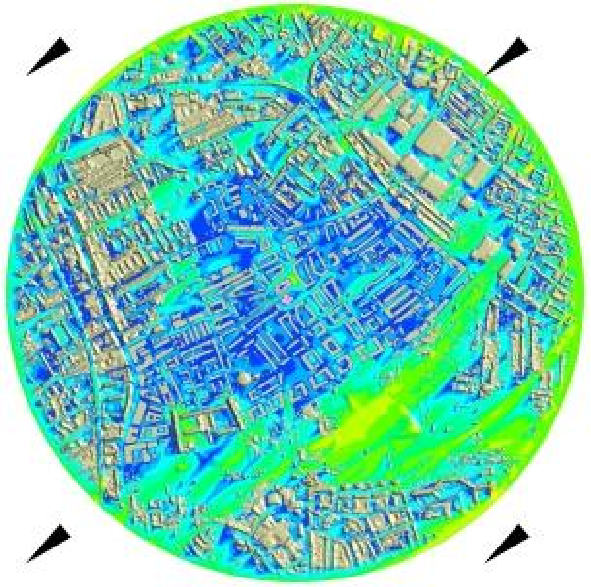
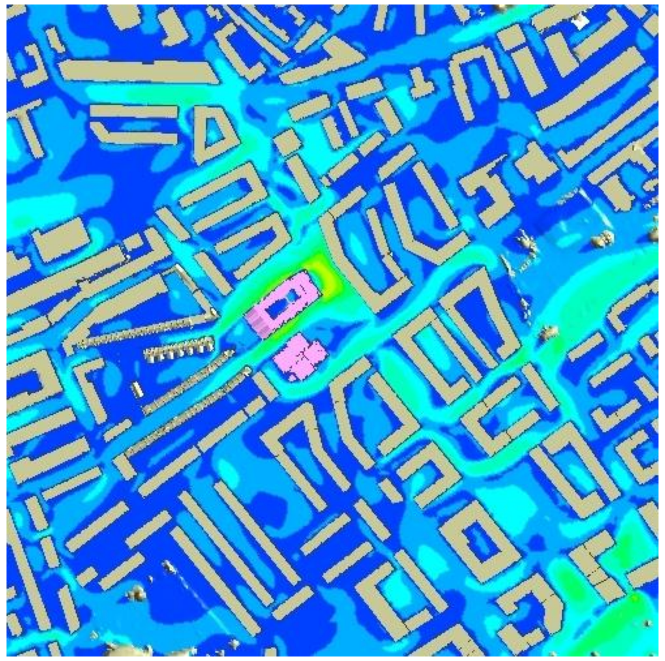


Figure 54: Proposed Velocity Wind from 050



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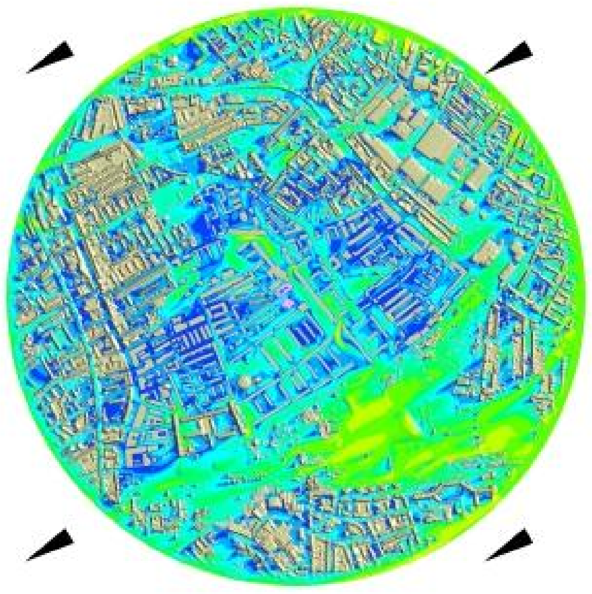

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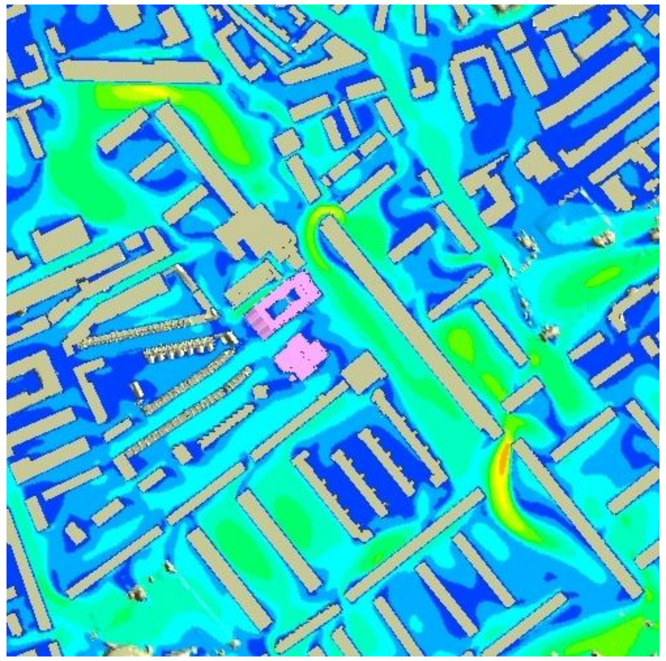

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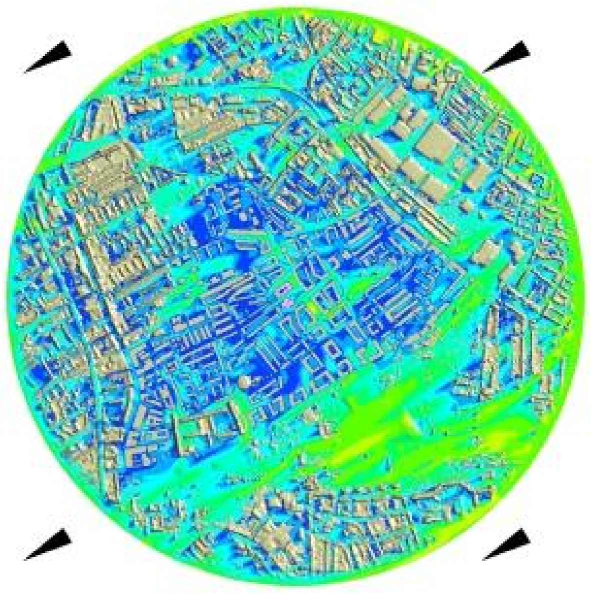


Figure 58: Proposed Velocity Wind from 060

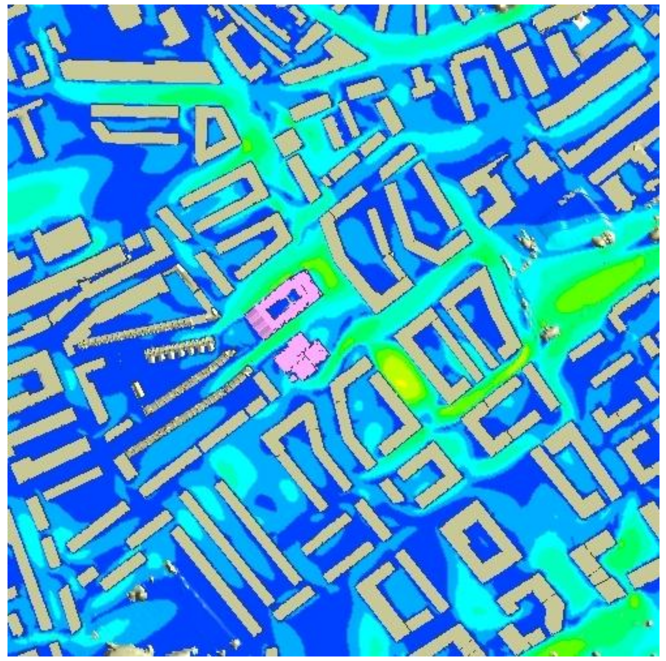


Figure 59: Proposed Velocity Wind from 060

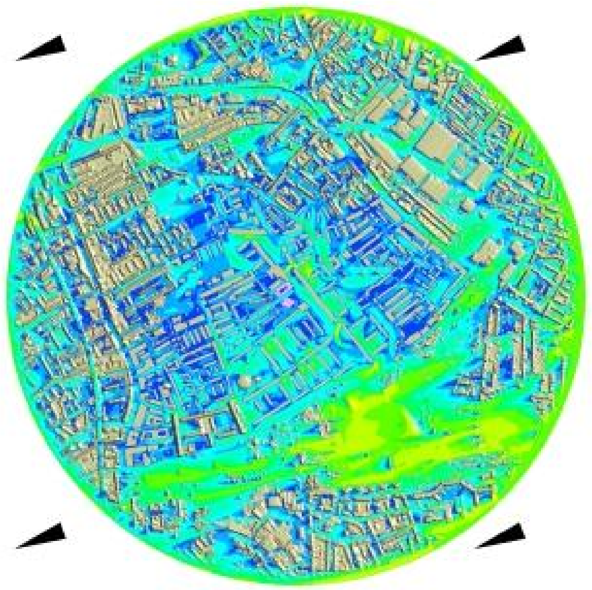


Figure 60: Existing Velocity Wind from 070

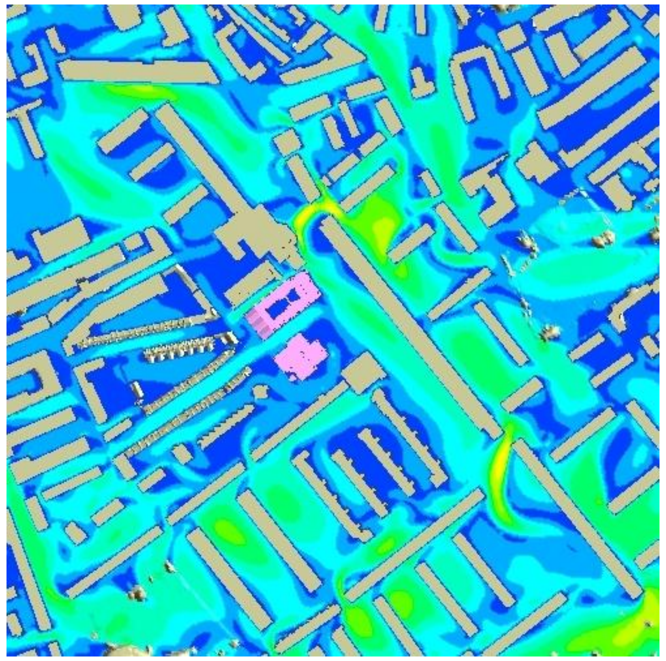


Figure 61: Existing Velocity Wind from 070

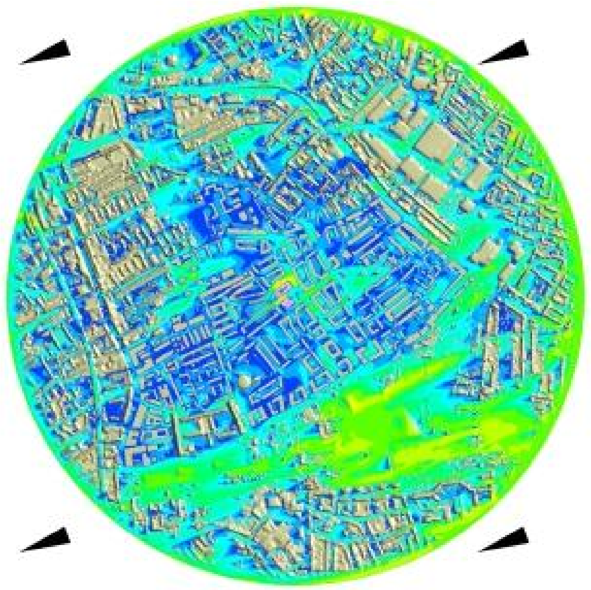


Figure 62: Proposed Velocity Wind from 070

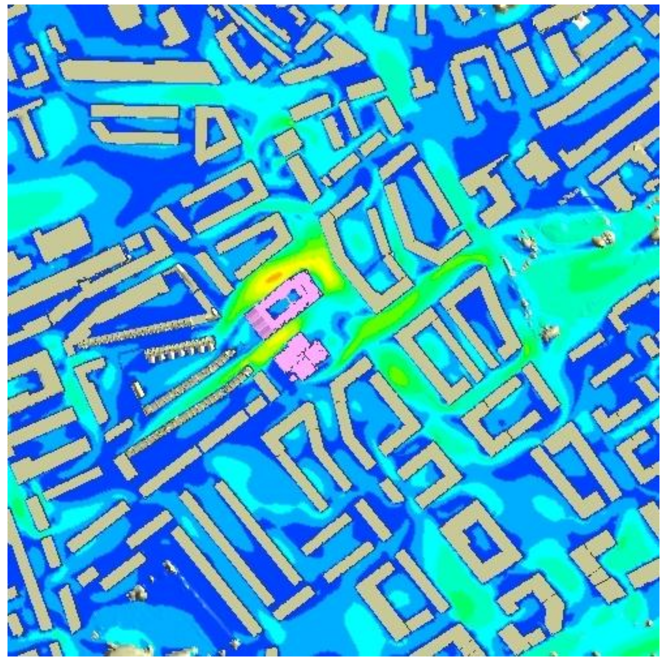


Figure 63: Proposed Velocity Wind from 070

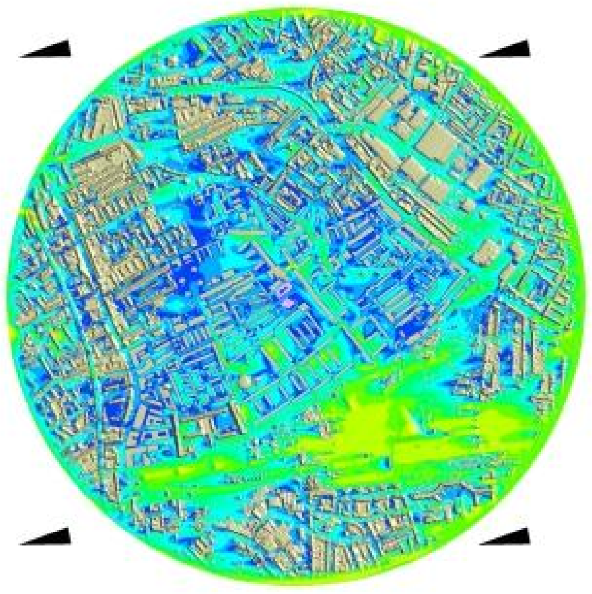


Figure 64: Existing Velocity Wind from 080

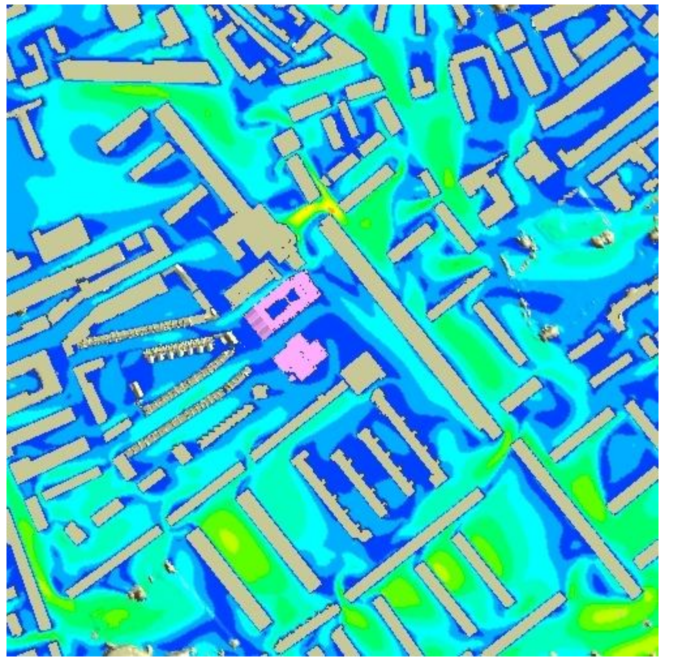


Figure 65: Existing Velocity Wind from 080

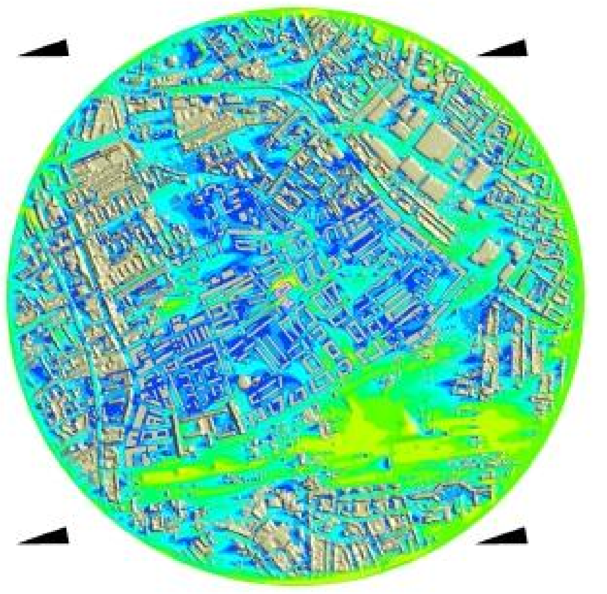


Figure 66: Proposed Velocity Wind from 080

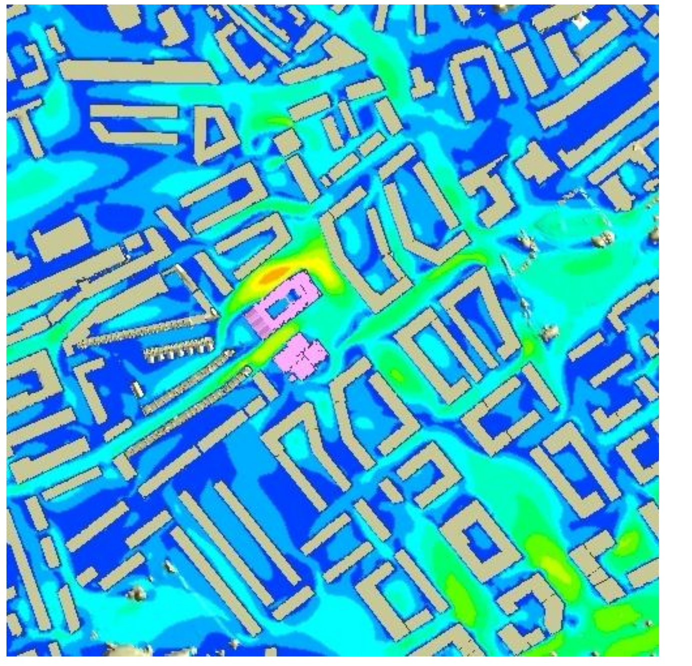


Figure 67: Proposed Velocity Wind from 080

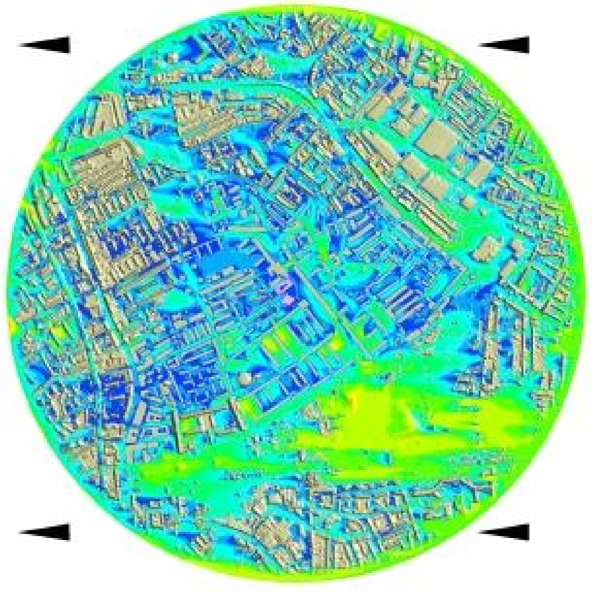


Figure 68: Existing Velocity Wind from 090

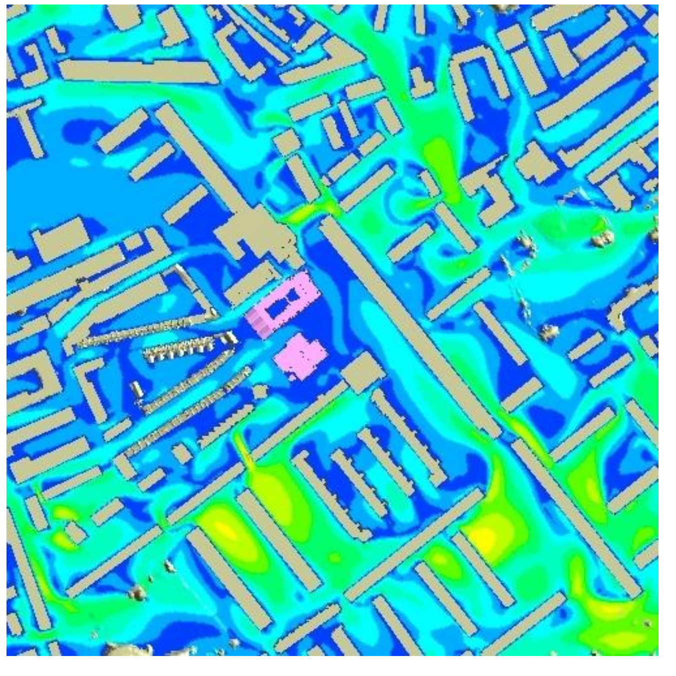


Figure 69: Existing Velocity Wind from 090

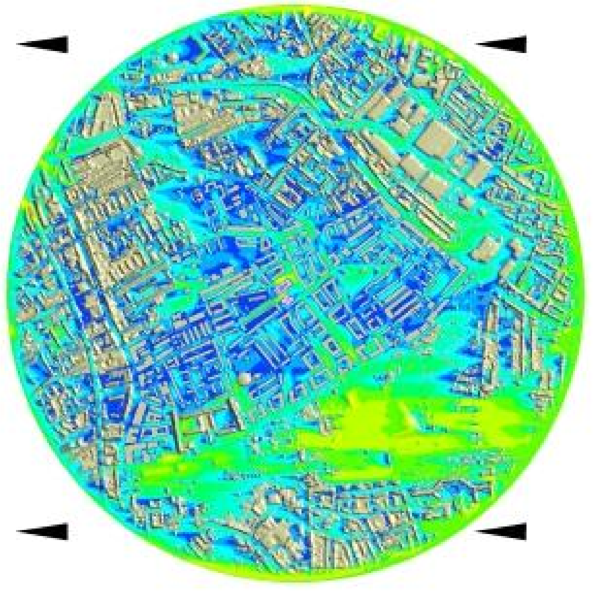


Figure 70: Proposed Velocity Wind from 090

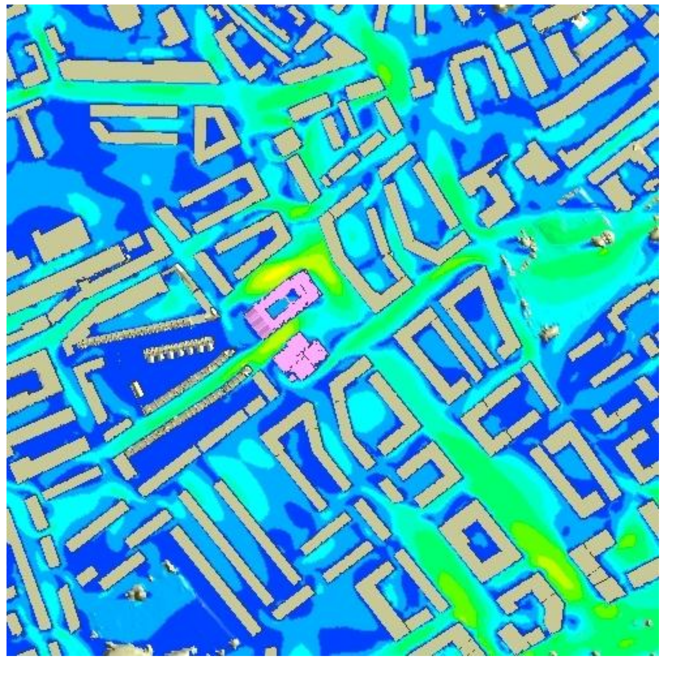


Figure 71: Proposed Velocity Wind from 090

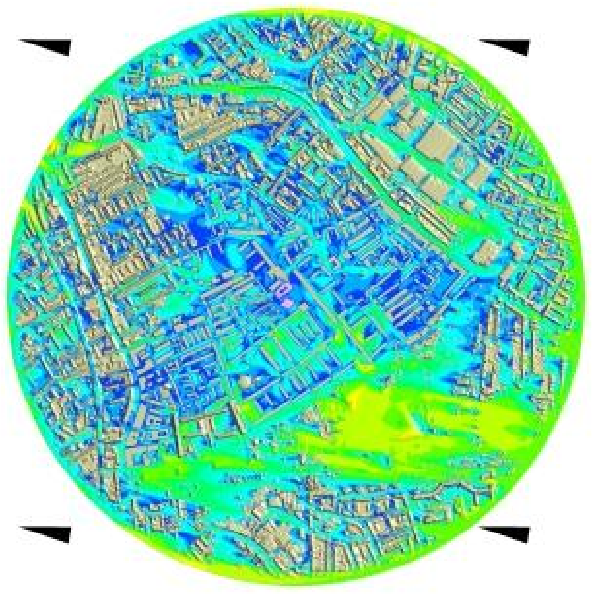
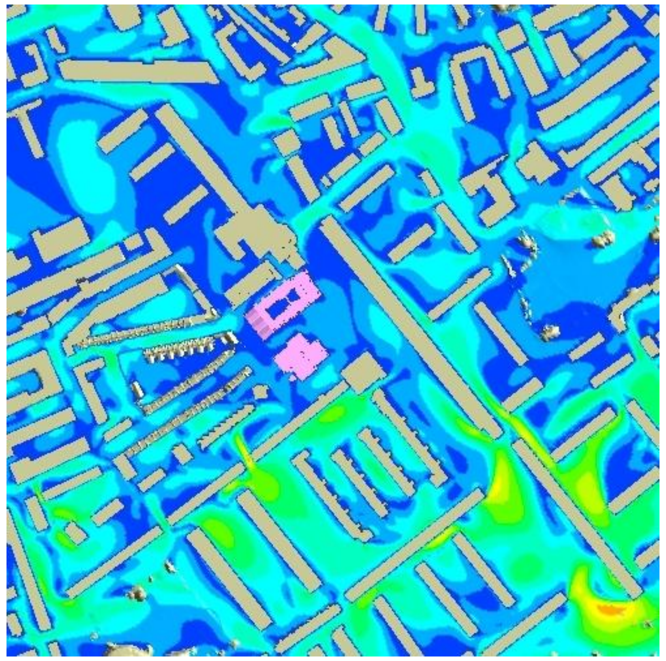


Figure 72: Existing Velocity Wind from 100



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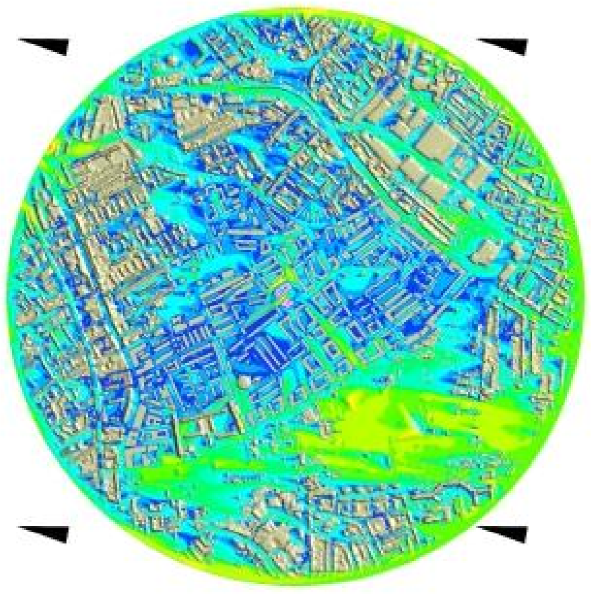


Figure 74: Proposed Velocity Wind from 100

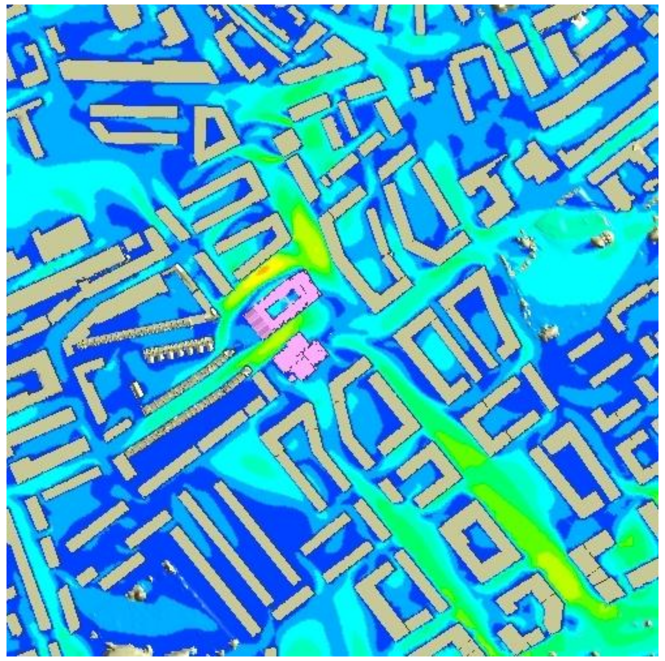


Figure 75: Proposed Velocity Wind from 100

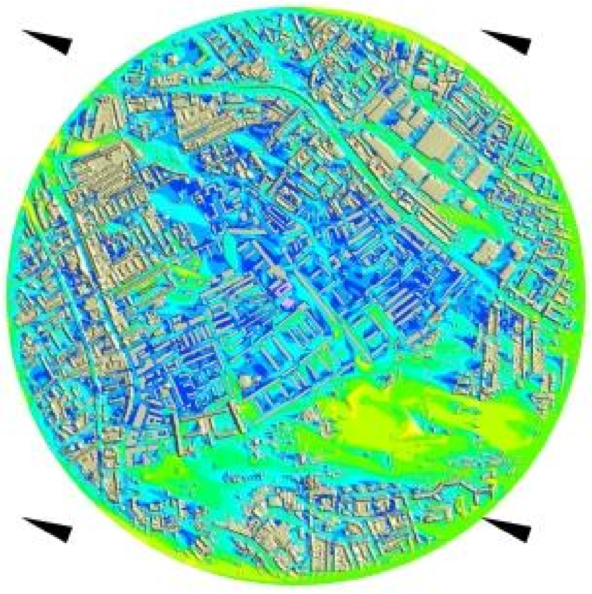
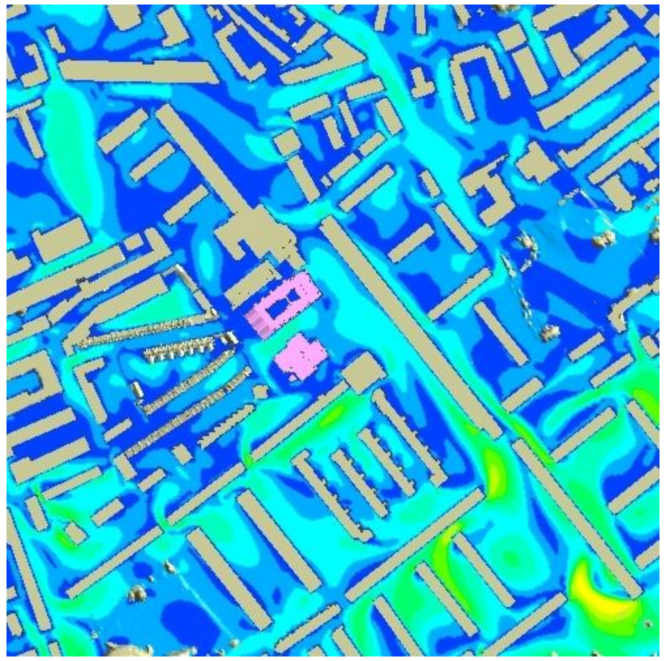


Figure 76: Existing Velocity Wind from 110



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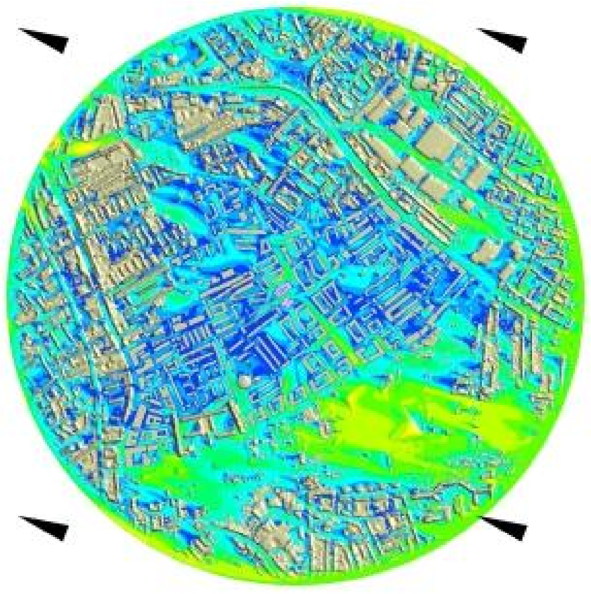

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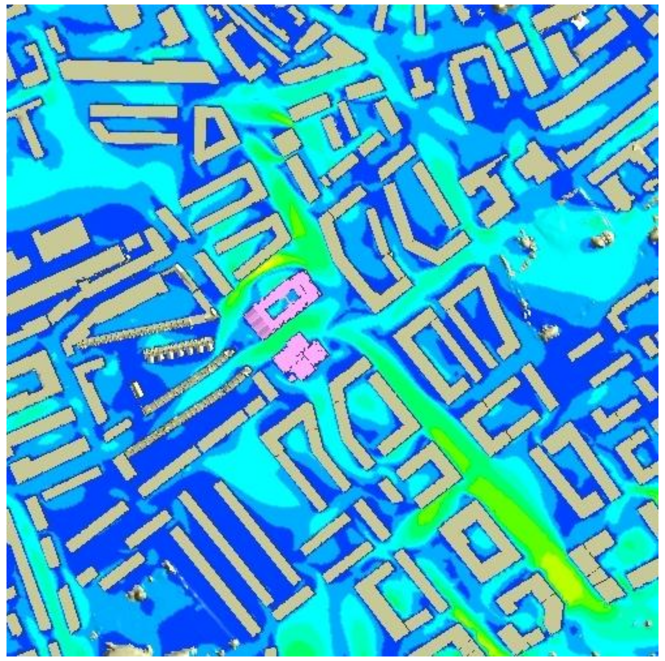

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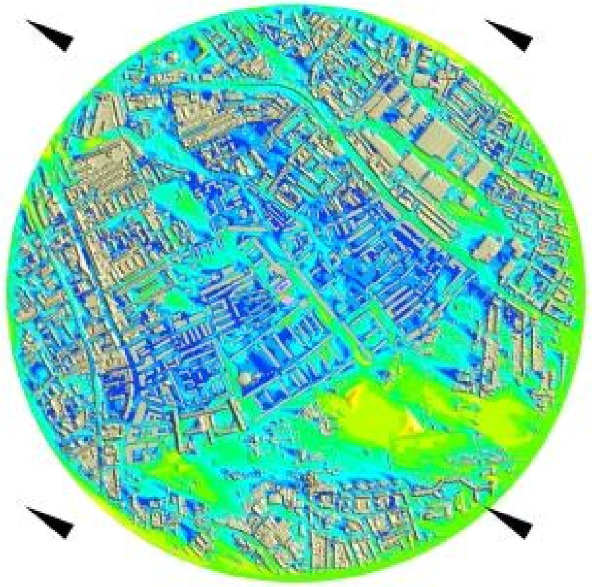


Figure 80: Existing Velocity Wind from 120

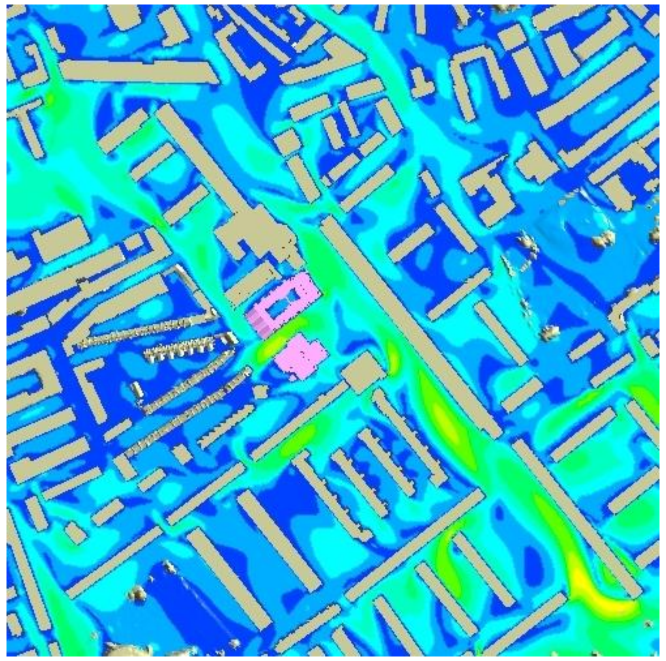


Figure 81: Existing Velocity Wind from 120

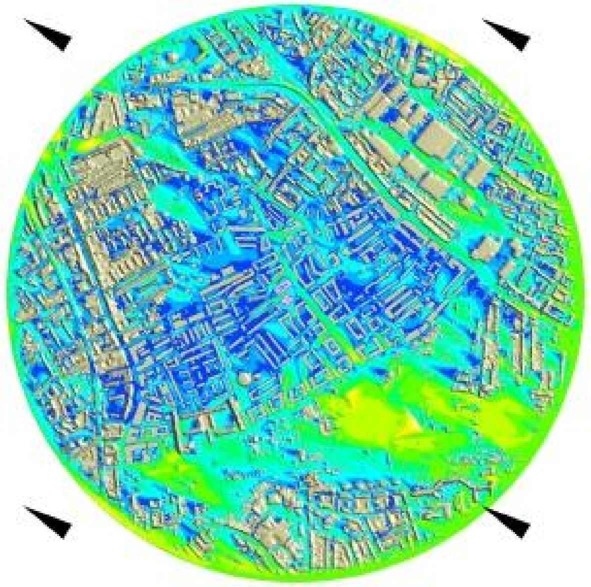


Figure 82: Proposed Velocity Wind from 120

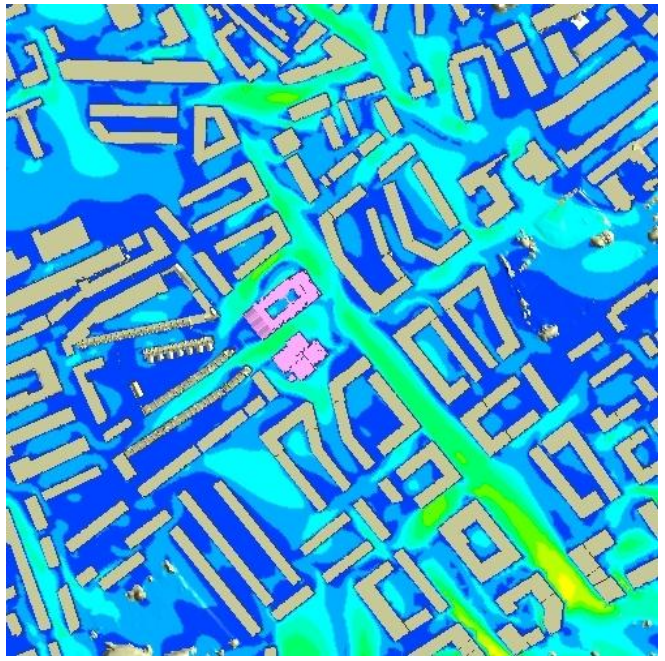


Figure 83: Proposed Velocity Wind from 120

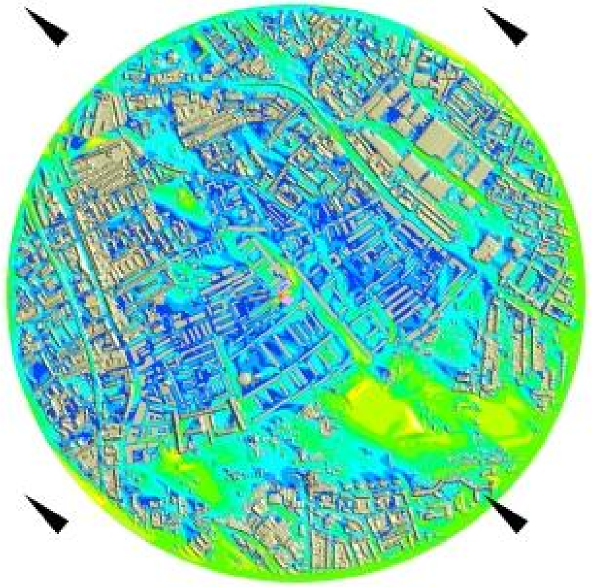


Figure 84: Existing Velocity Wind from 130

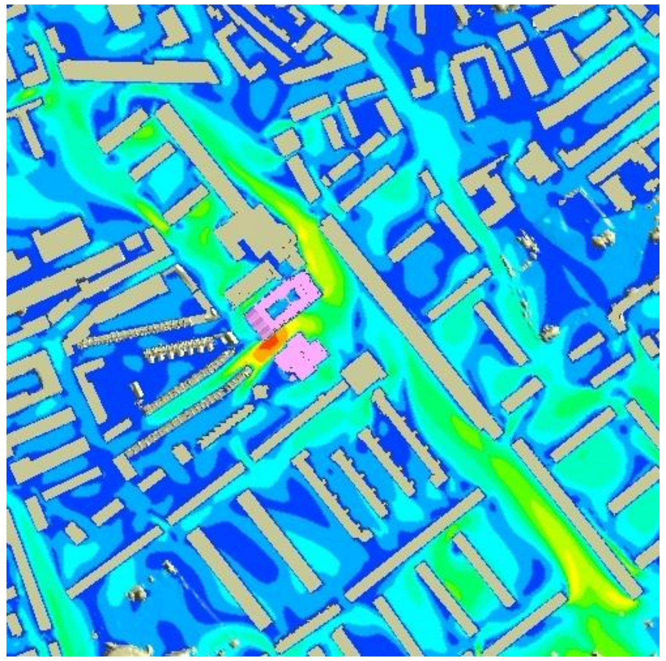


Figure 85: Existing Velocity Wind from 130

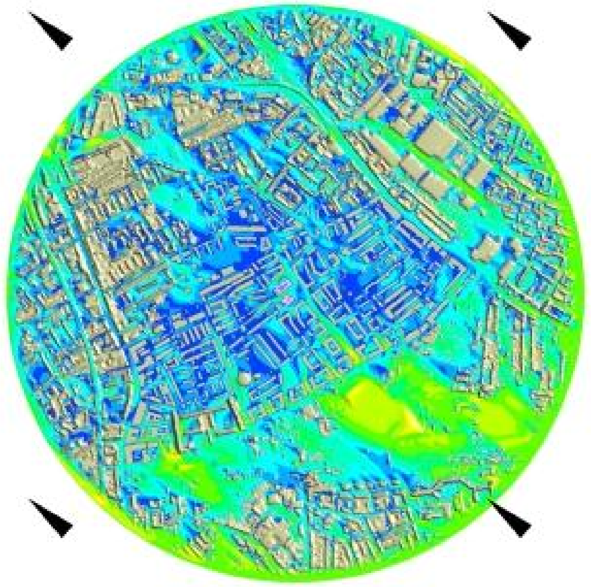


Figure 86: Proposed Velocity Wind from 130

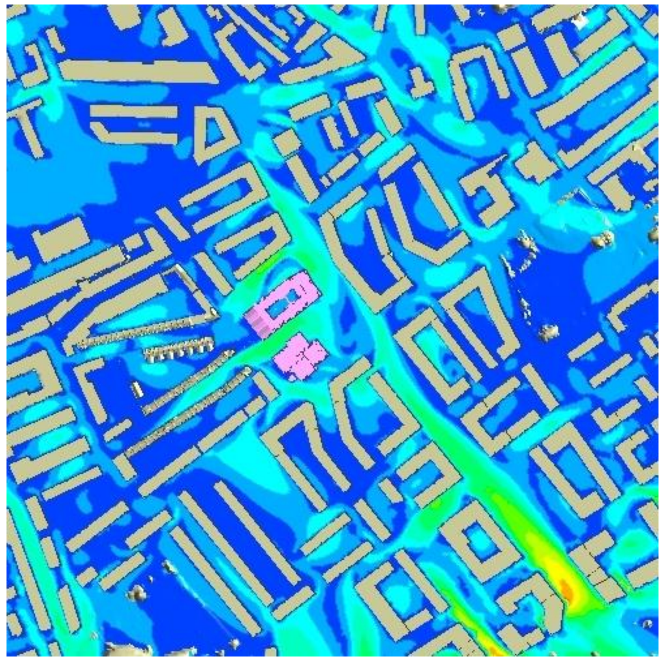


Figure 87: Proposed Velocity Wind from 130

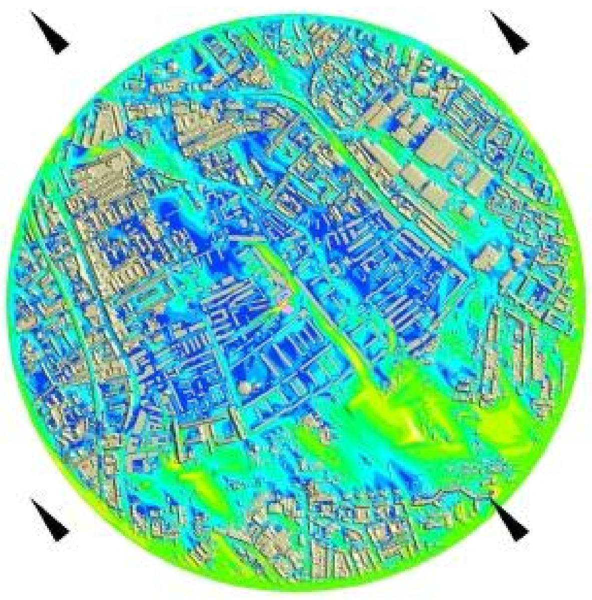


Figure 88: Existing Velocity Wind from 140

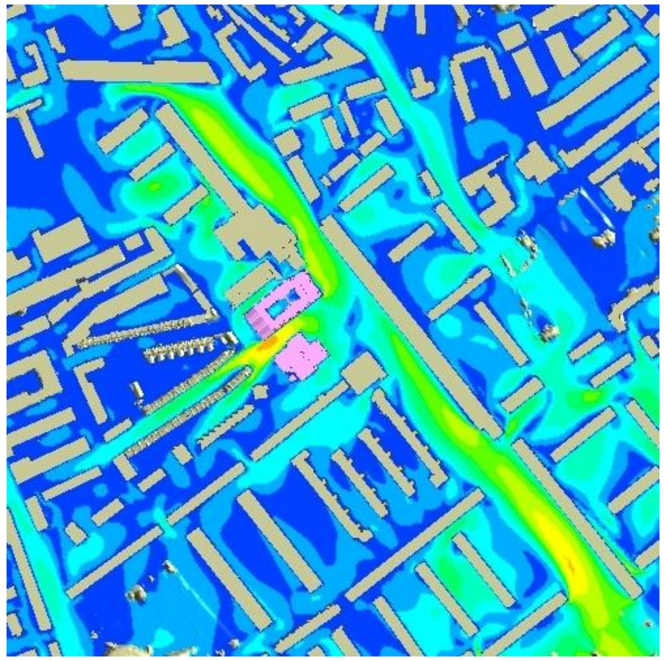


Figure 89: Existing Velocity Wind from 140

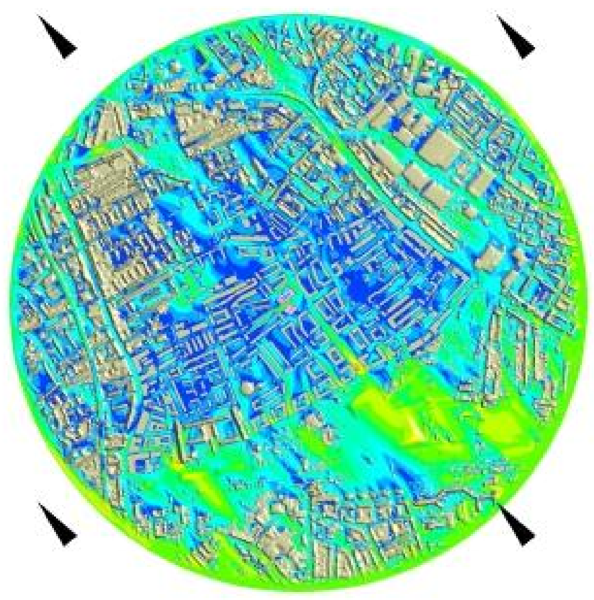


Figure 90: Proposed Velocity Wind from 140

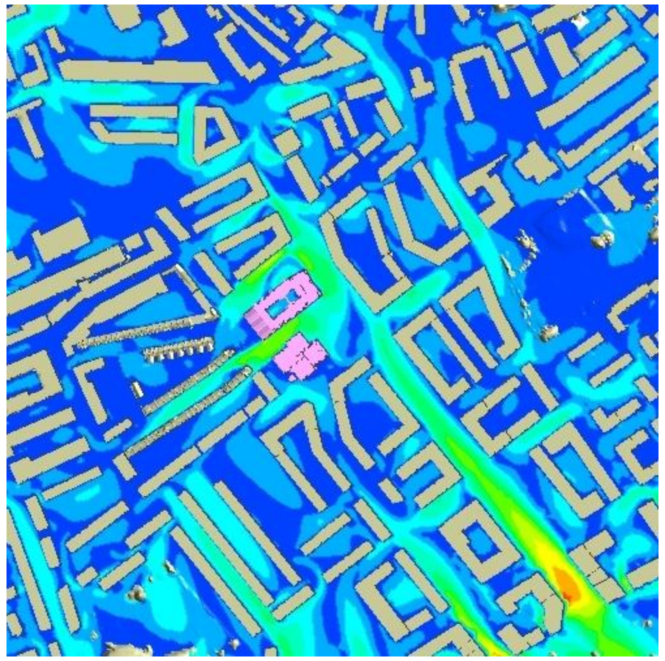


Figure 91: Proposed Velocity Wind from 140

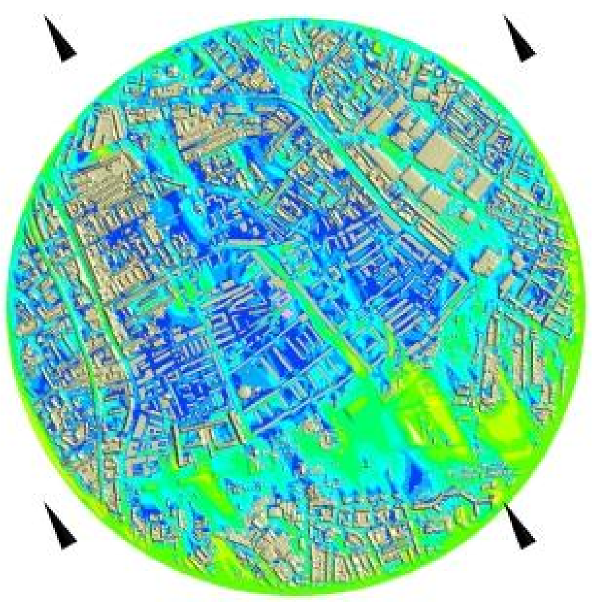


Figure 92: Existing Velocity Wind from 150

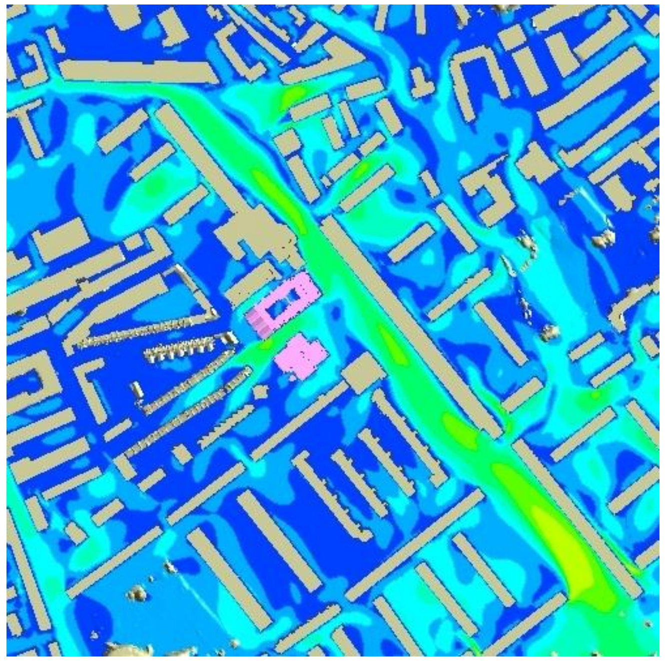


Figure 93: Existing Velocity Wind from 150

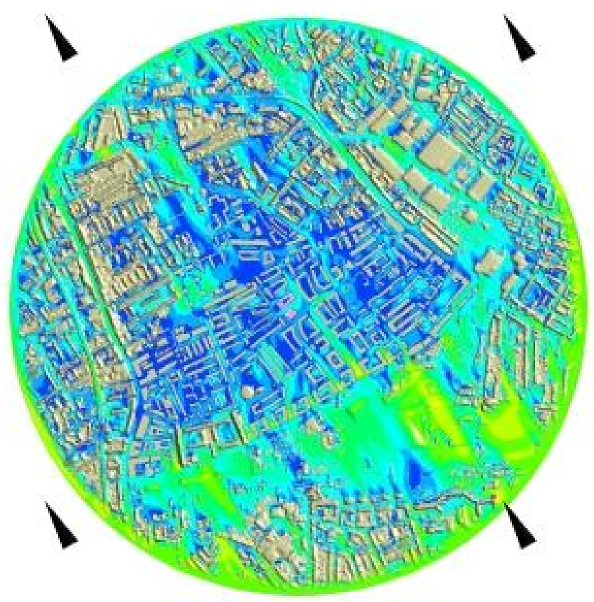


Figure 94: Proposed Velocity Wind from 150

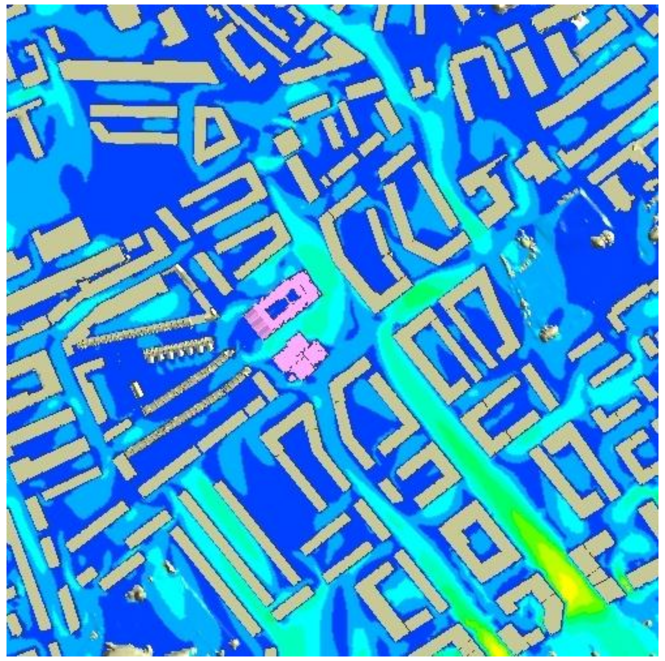


Figure 95: Proposed Velocity Wind from 150

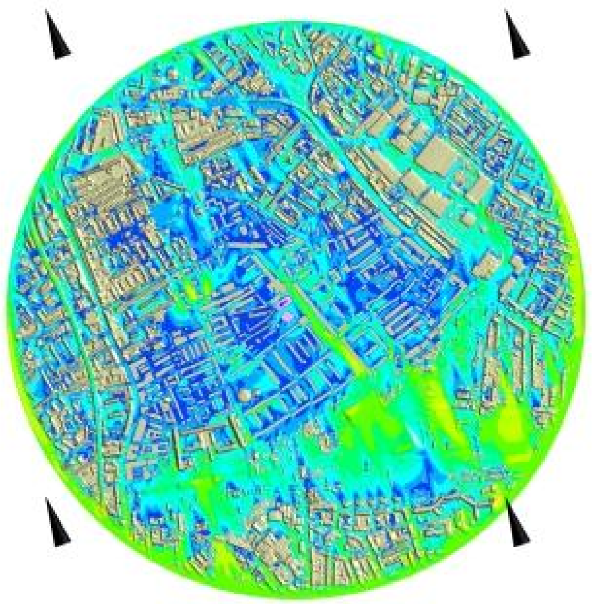


Figure 96: Existing Velocity Wind from 160

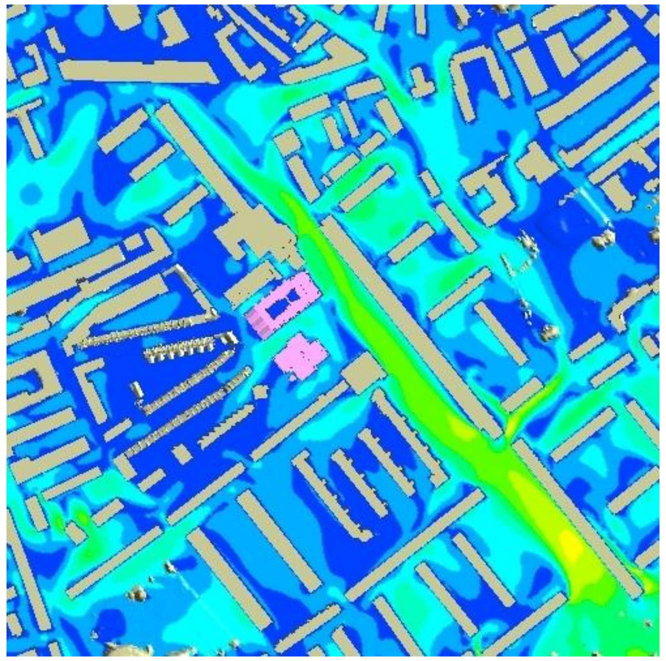


Figure 97: Existing Velocity Wind from 160

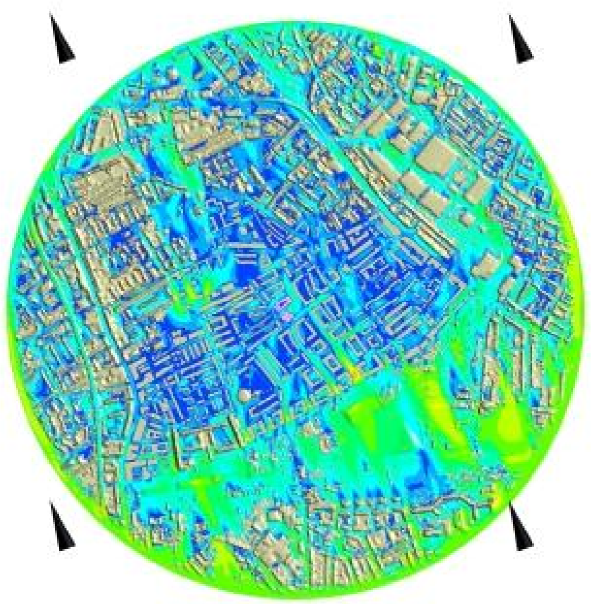


Figure 98: Proposed Velocity Wind from 160

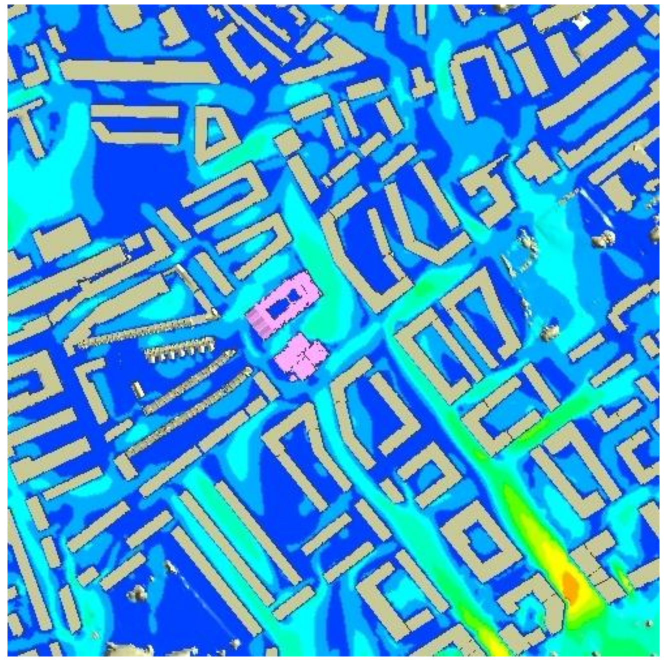


Figure 99: Proposed Velocity Wind from 160

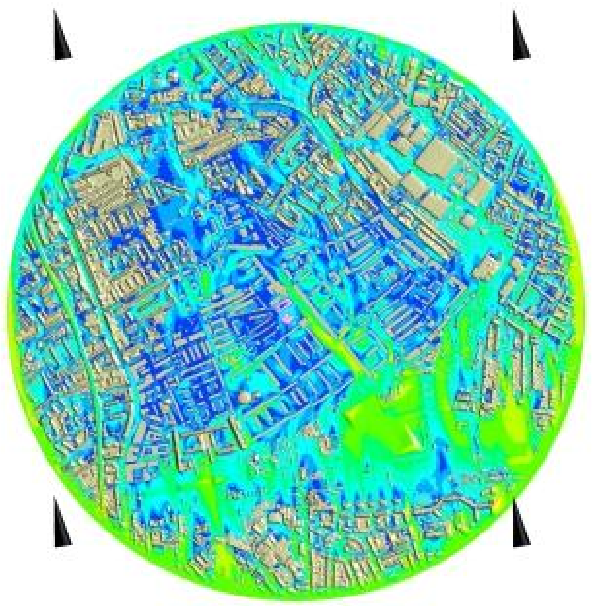


Figure 100: Existing Velocity Wind from 170

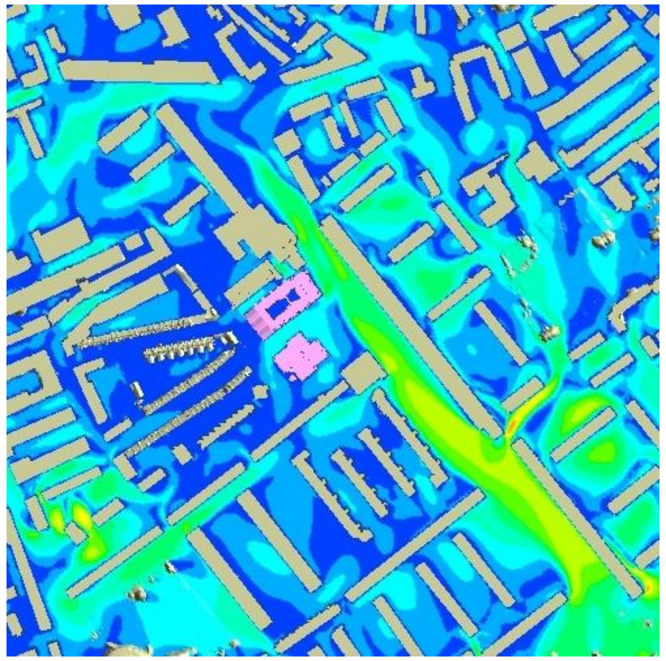


Figure 101: Existing Velocity Wind from 170

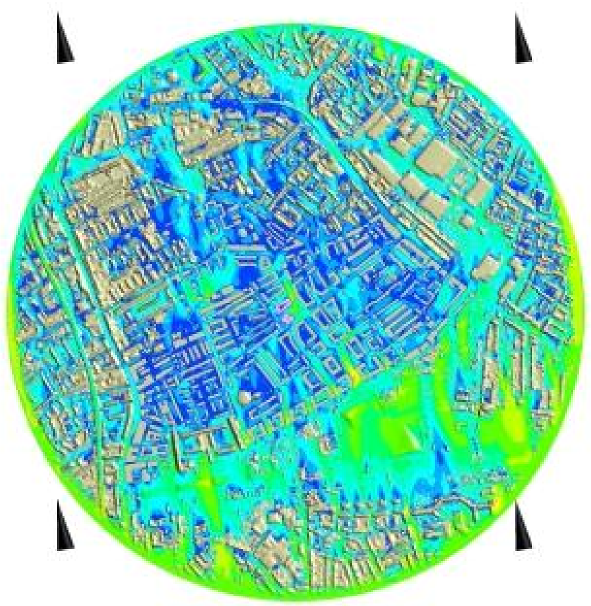


Figure 102: Proposed Velocity Wind from 170

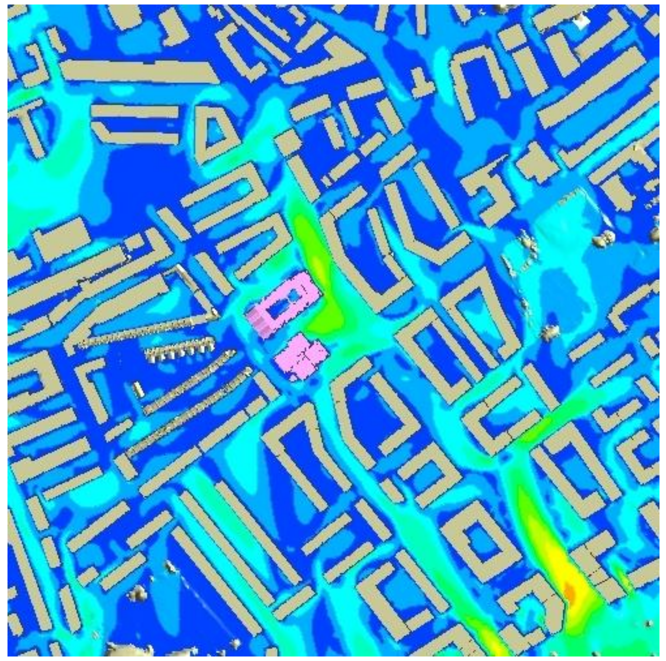


Figure 103: Proposed Velocity Wind from 170

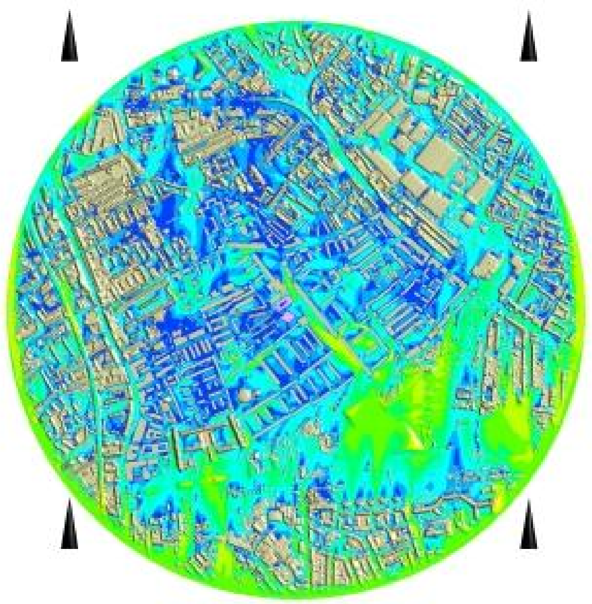


Figure 104: Existing Velocity Wind from 180

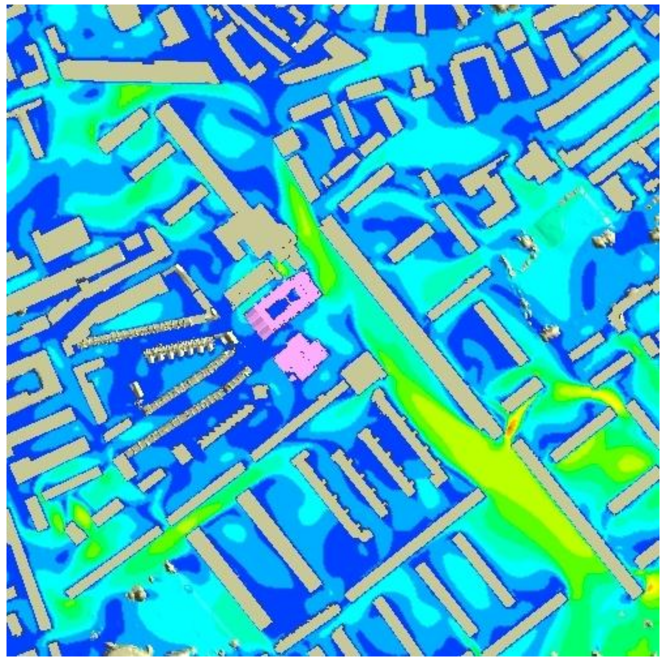


Figure 105: Existing Velocity Wind from 180

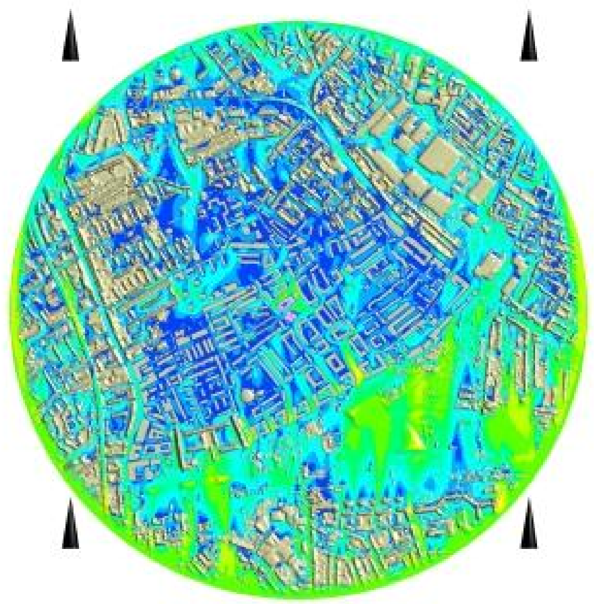


Figure 106: Proposed Velocity Wind from 180

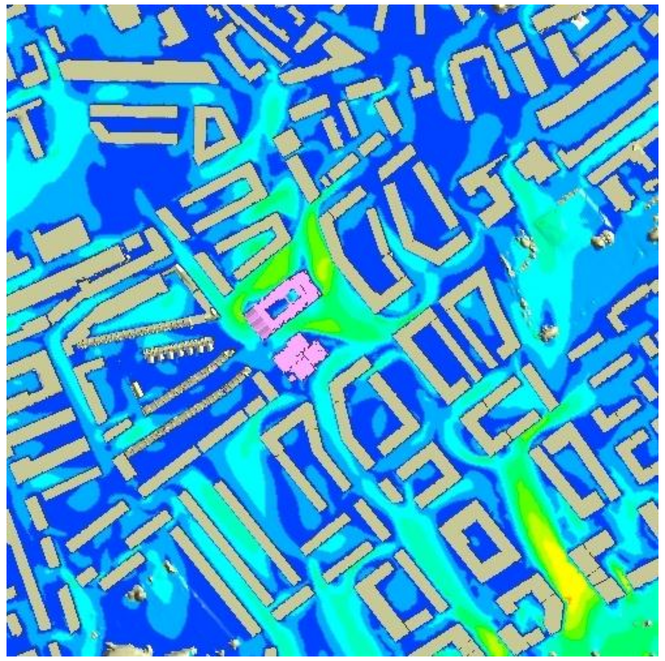


Figure 107: Proposed Velocity Wind from 180

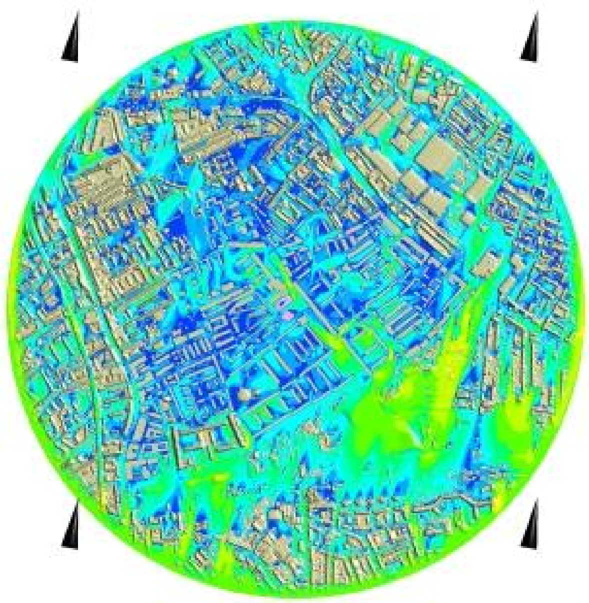


Figure 108: Existing Velocity Wind from 190

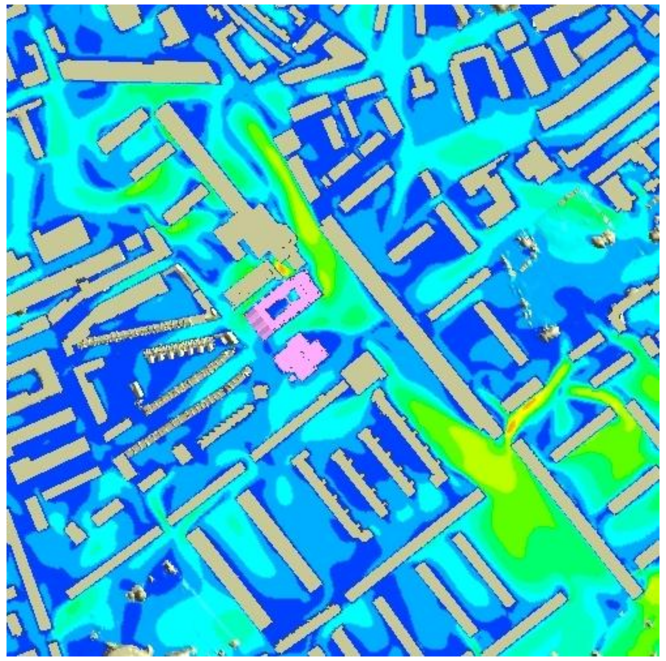


Figure 109: Existing Velocity Wind from 190

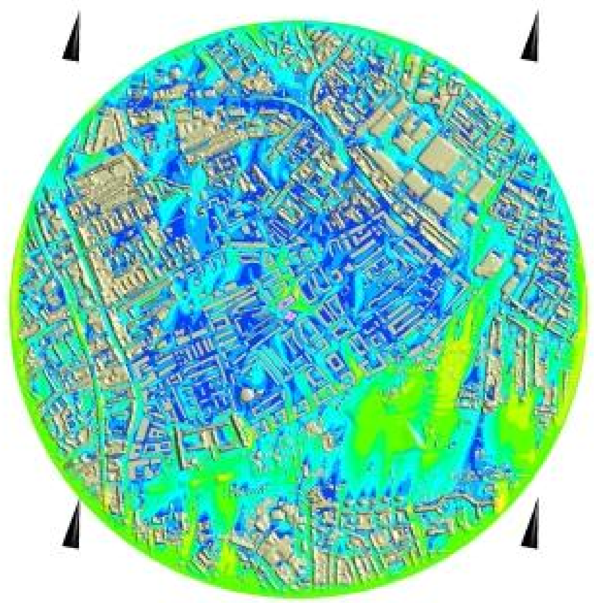


Figure 110: Proposed Velocity Wind from 190

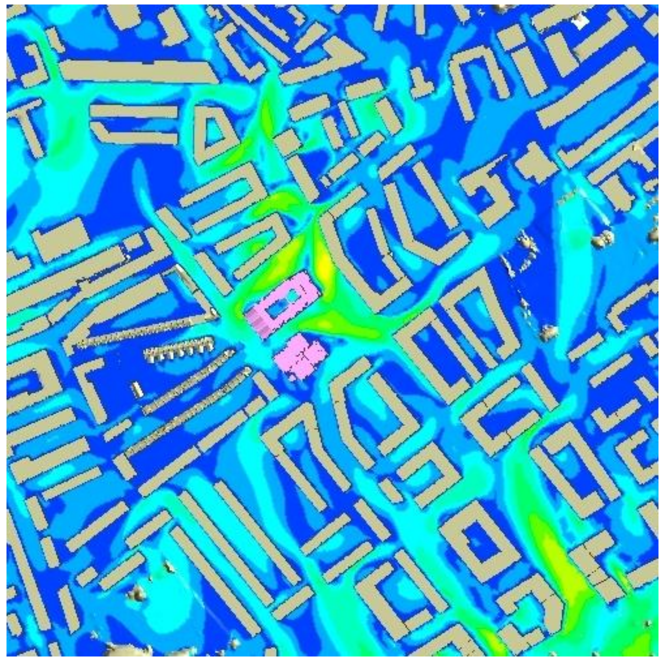


Figure 111: Proposed Velocity Wind from 190

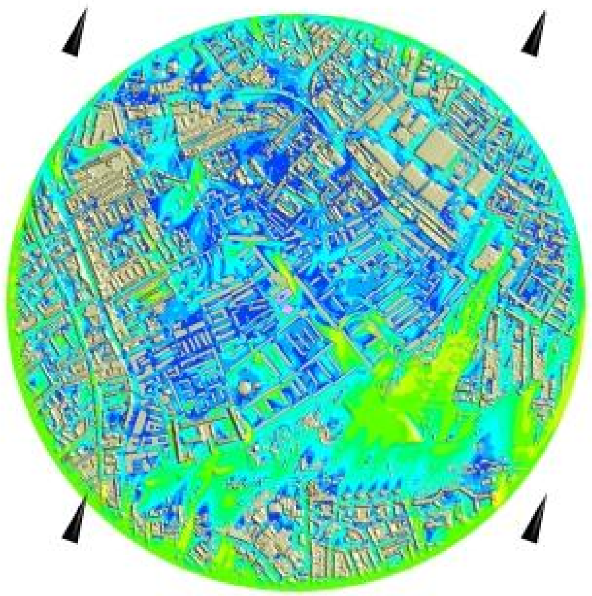


Figure 112: Existing Velocity Wind from 200

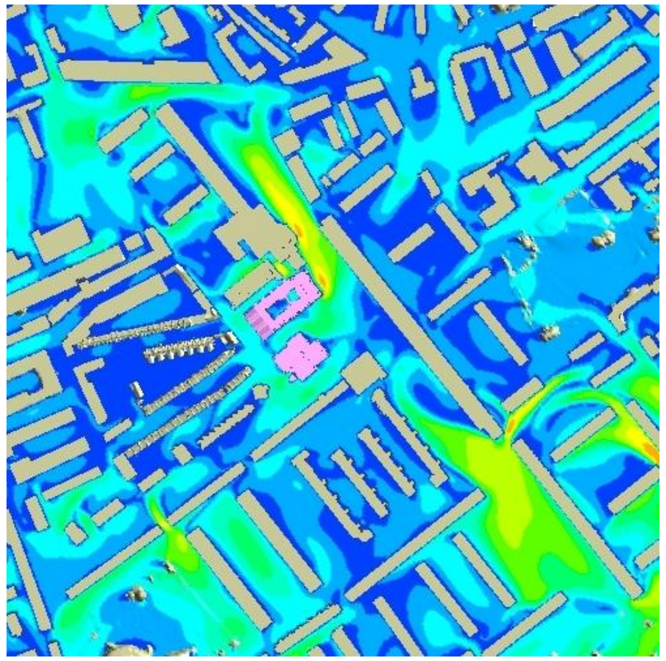


Figure 113: Existing Velocity Wind from 200

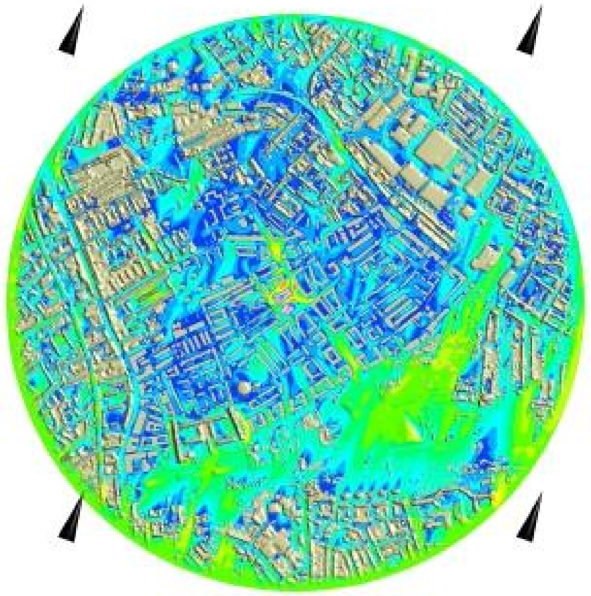


Figure 114: Proposed Velocity Wind from 200

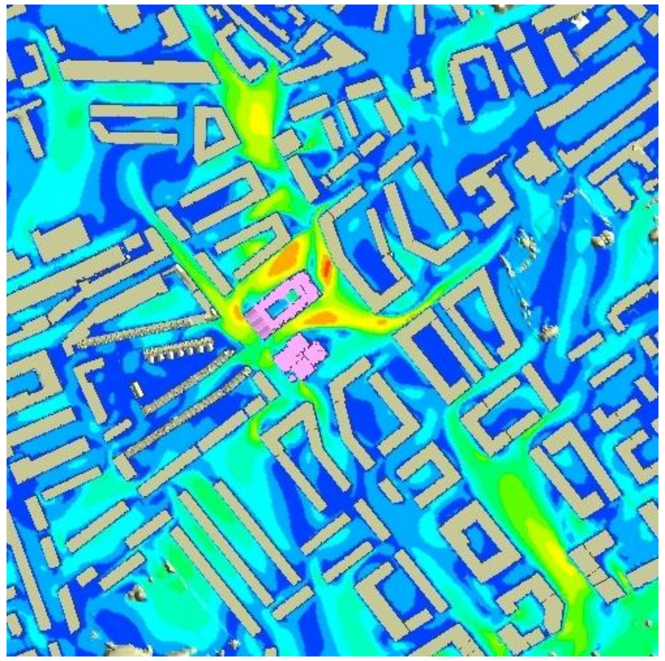


Figure 115: Proposed Velocity Wind from 200

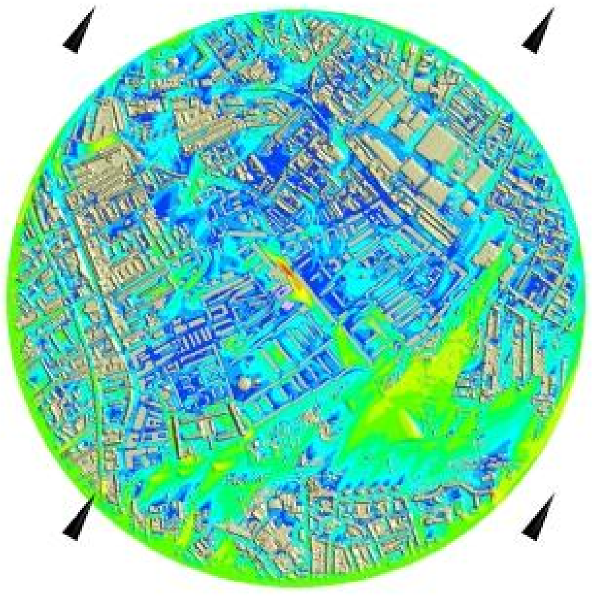


Figure 116: Existing Velocity Wind from 210

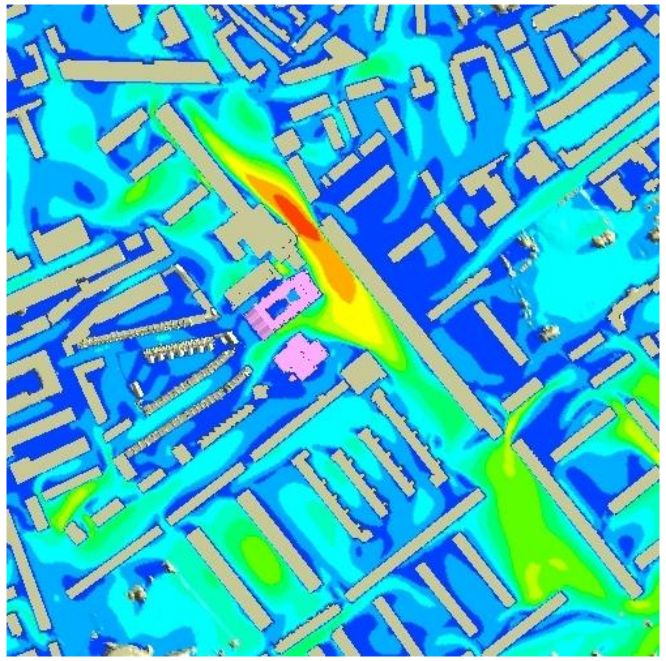


Figure 117: Existing Velocity Wind from 210

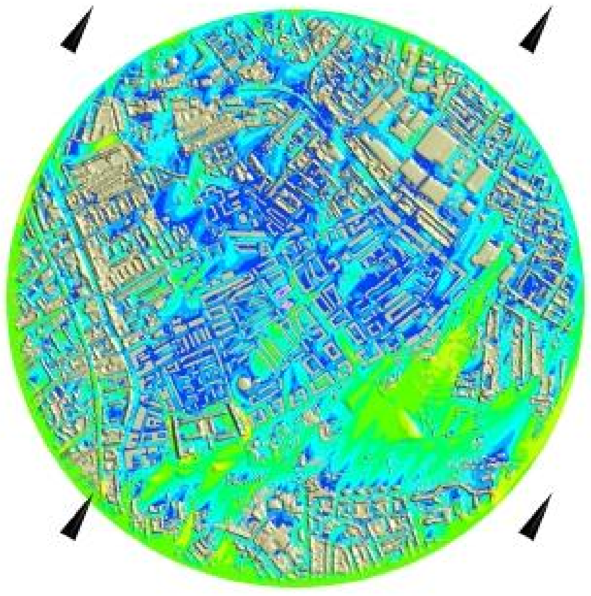
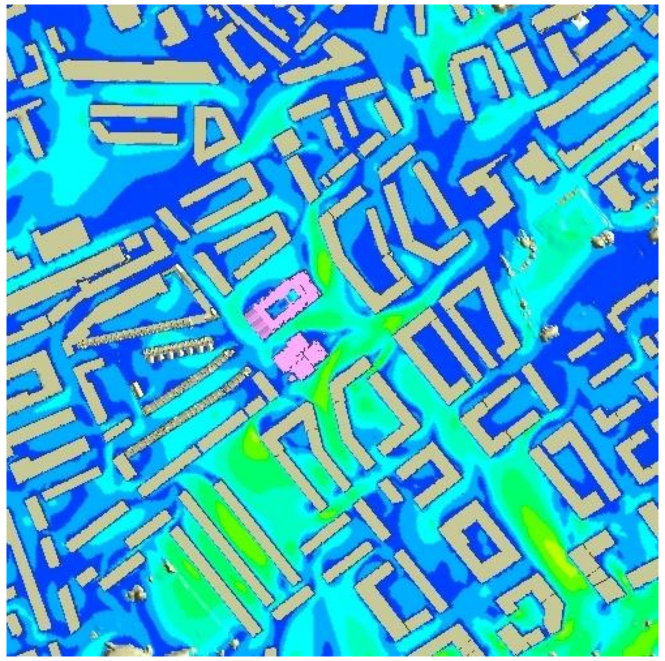


Figure 118: Proposed Velocity Wind from 210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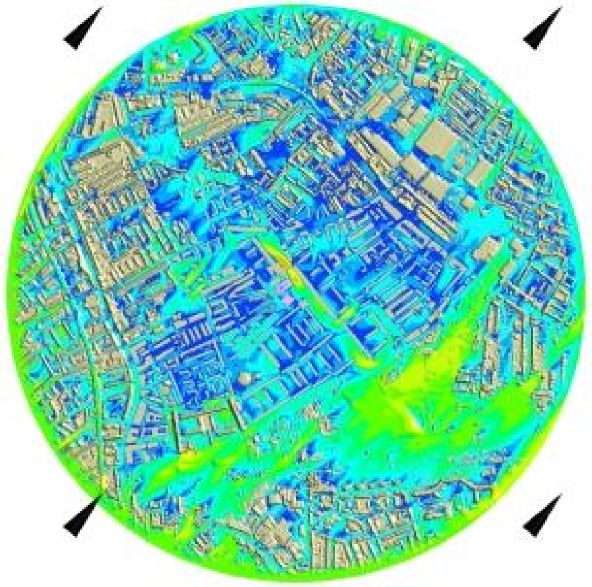


Figure 120: Existing Velocity Wind from 220

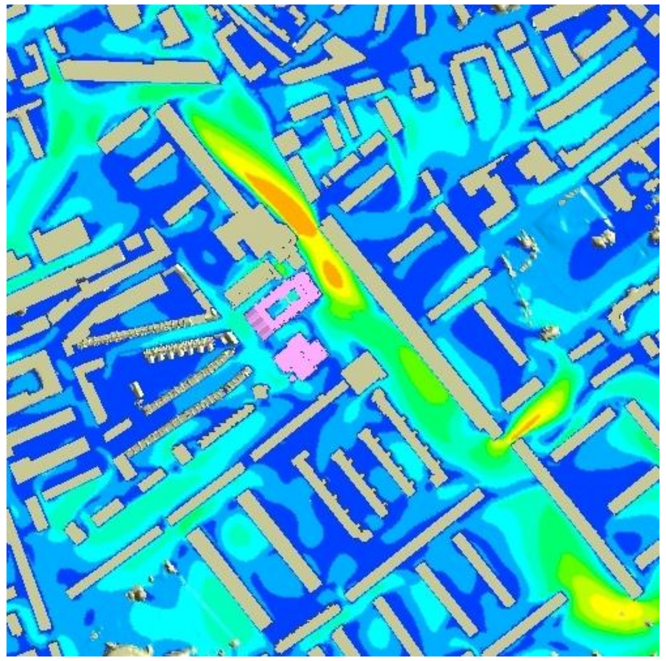


Figure 121: Existing Velocity Wind from 220

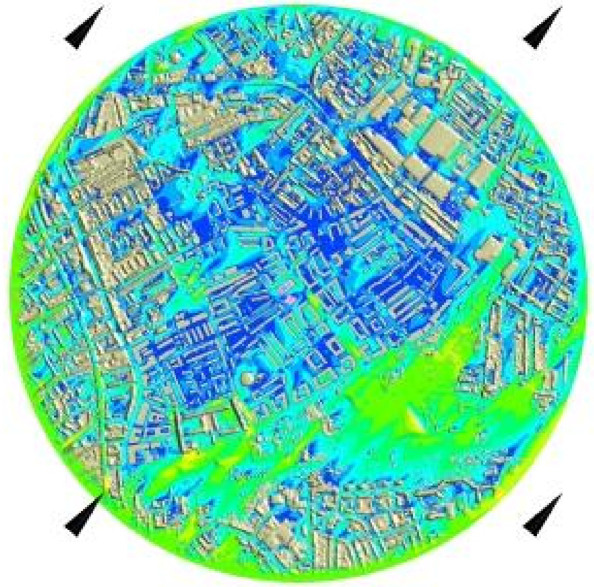
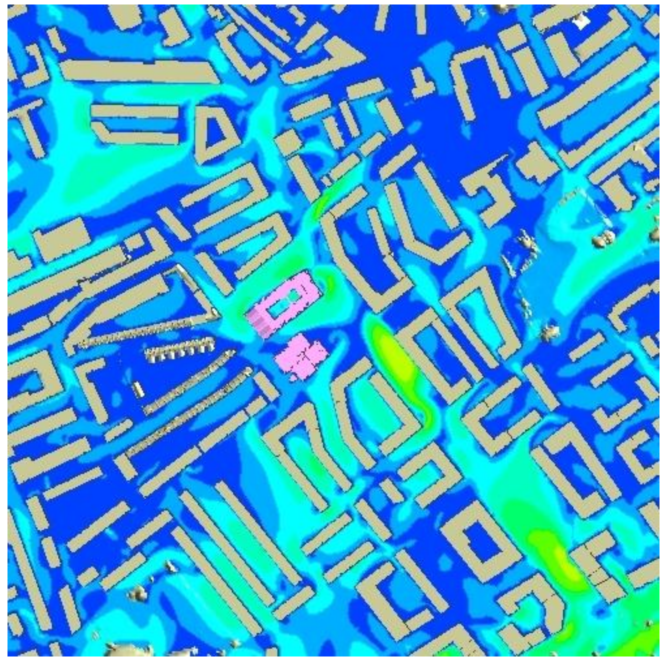


Figure 122: Proposed Velocity Wind from 220



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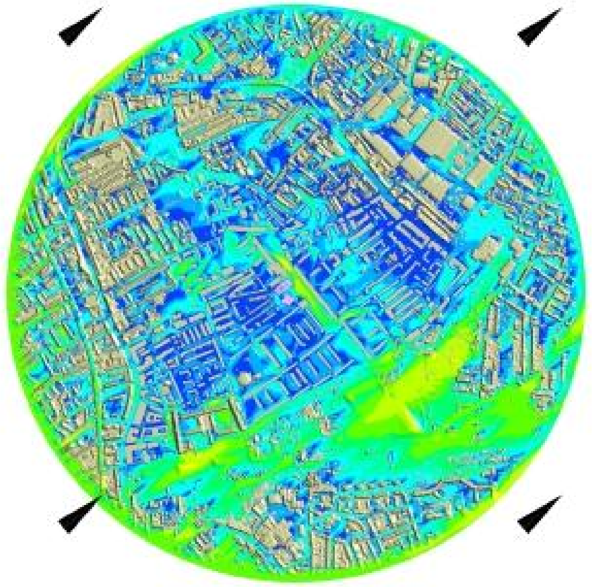

Figure 124: Existing Velocity Wind from 230

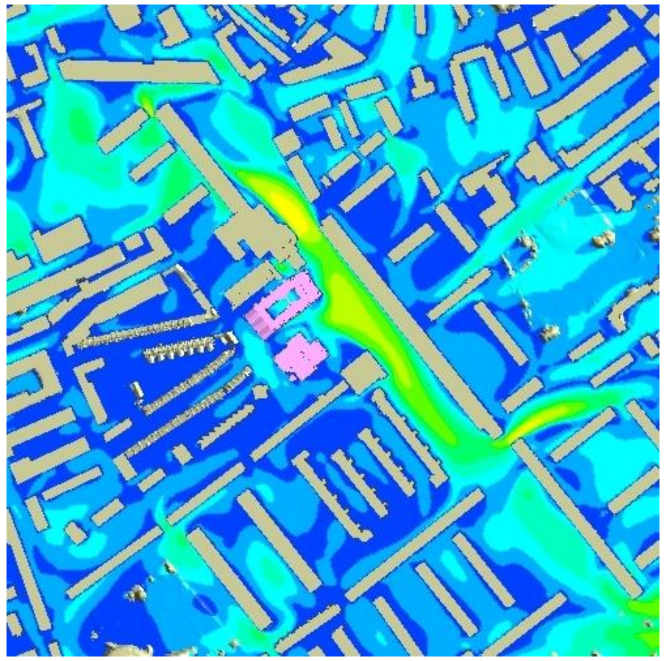

Figure 125: Existing Velocity Wind from 230

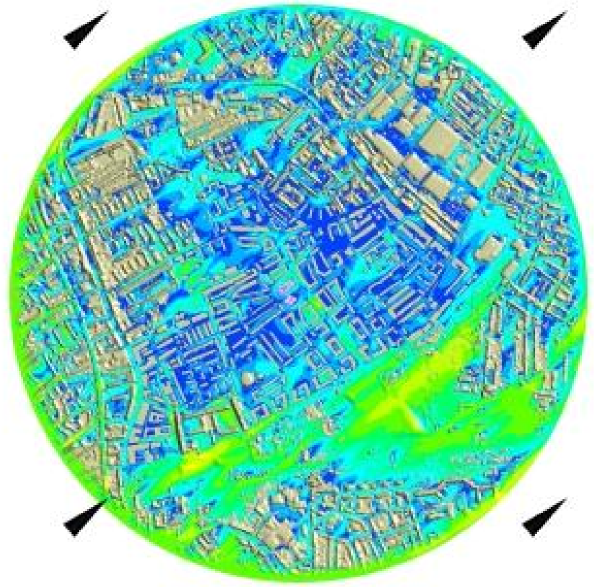

Figure 126: Proposed Velocity Wind from 230

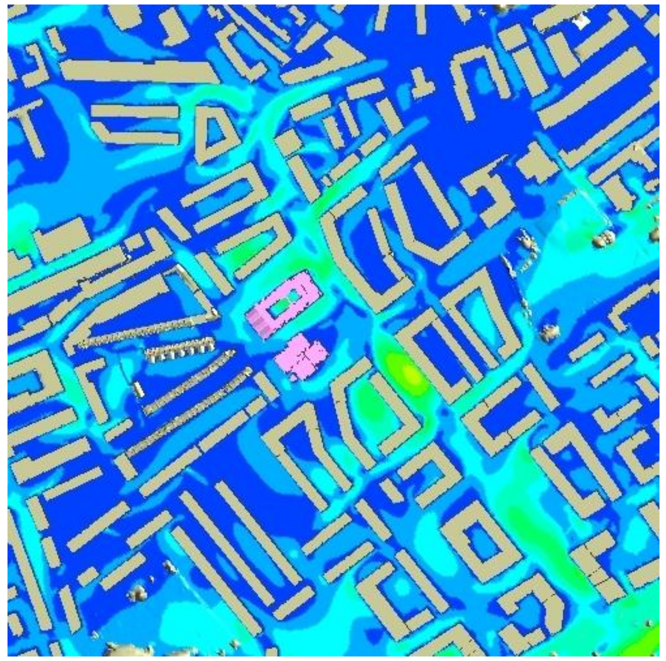

Figure 127: Proposed Velocity Wind from 230

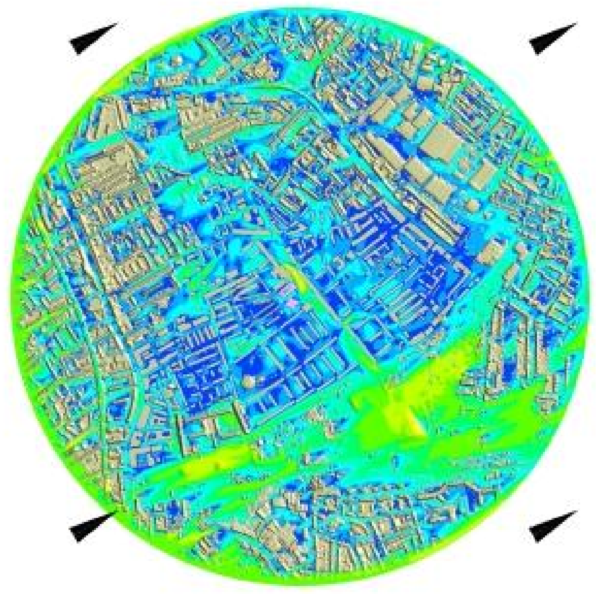

Figure 128: Existing Velocity Wind from 240

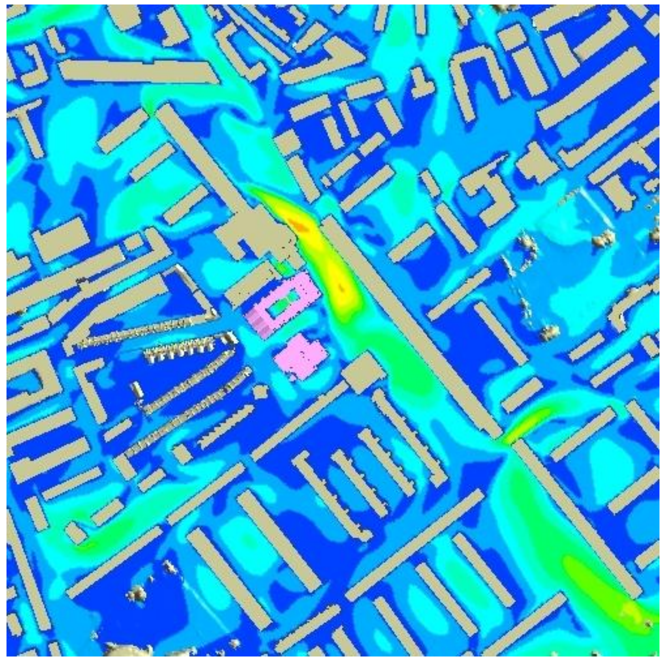

Figure 129: Existing Velocity Wind from 240

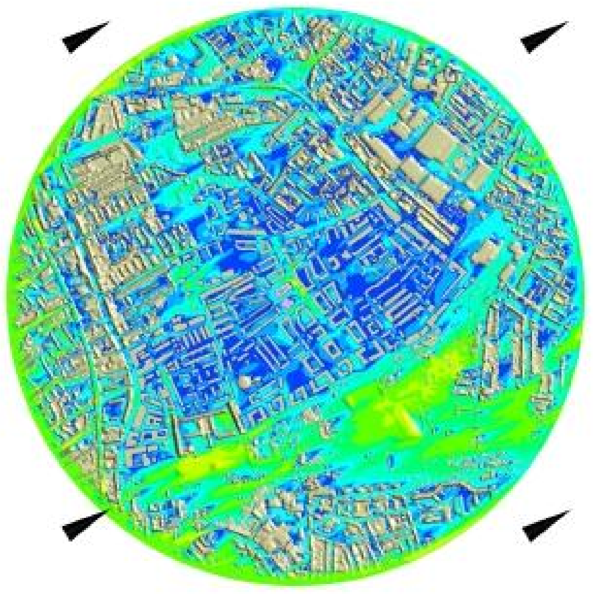

Figure 130: Proposed Velocity Wind from 240

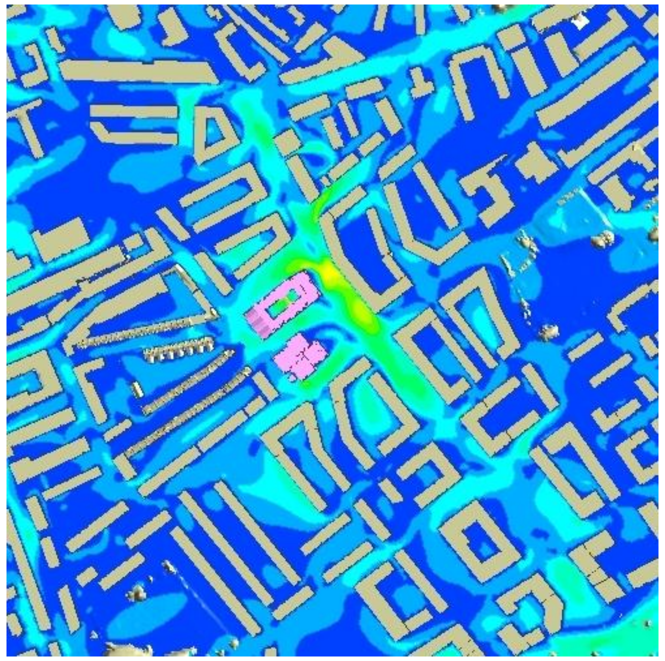

Figure 131: Proposed Velocity Wind from 240

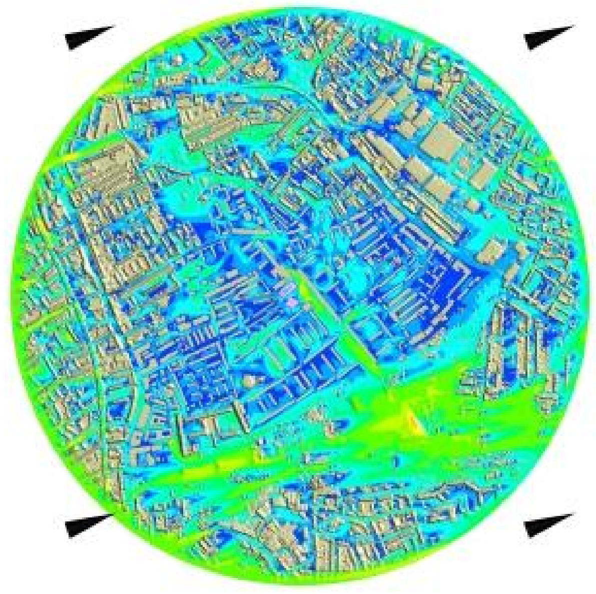

Figure 132: Existing Velocity Wind from 250

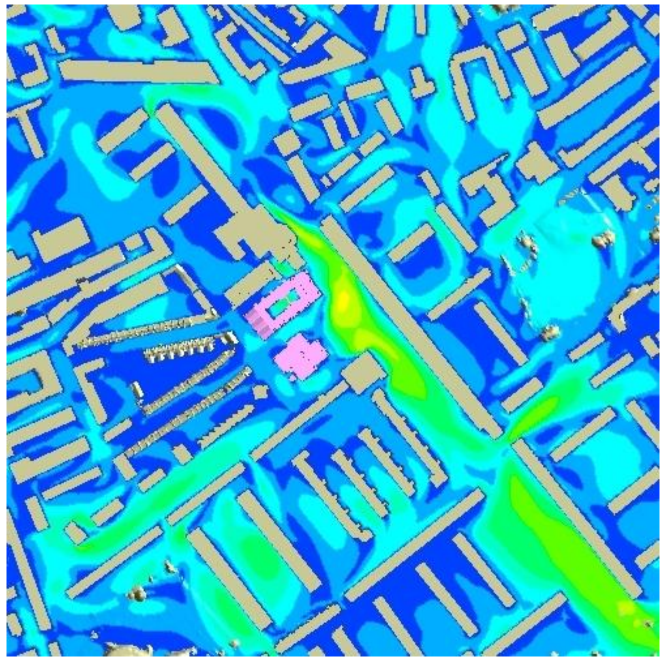

Figure 133: Existing Velocity Wind from 250

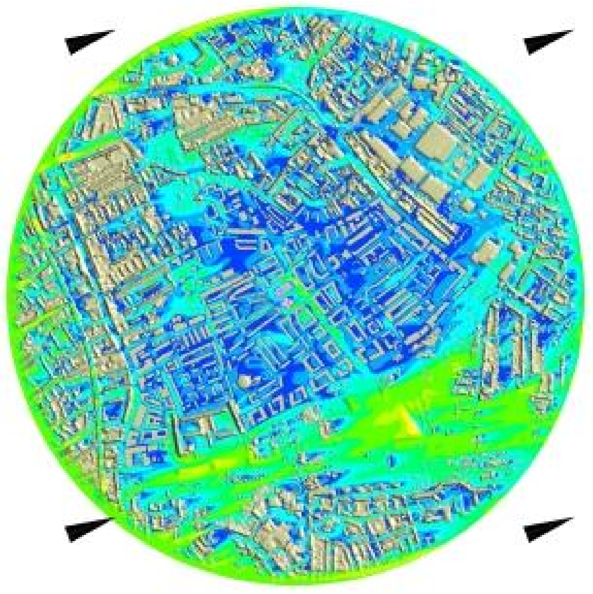

Figure 134: Proposed Velocity Wind from 250

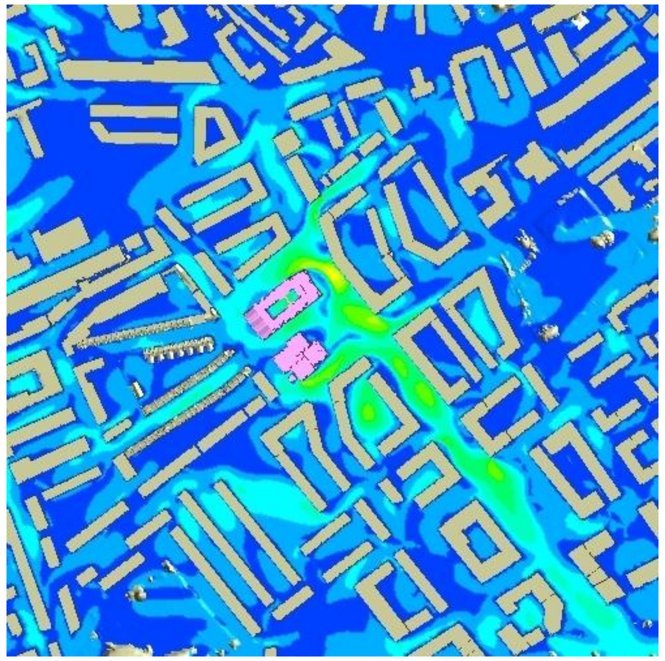

Figure 135: Proposed Velocity Wind from 250

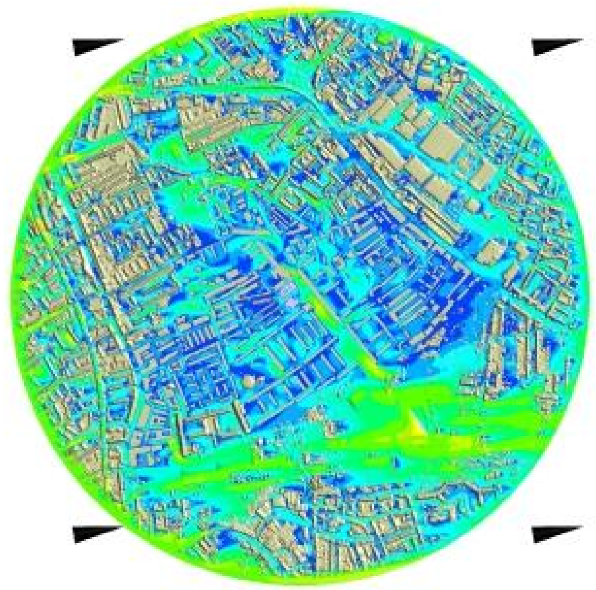
Figure 136: Existing Velocity Wind from 260

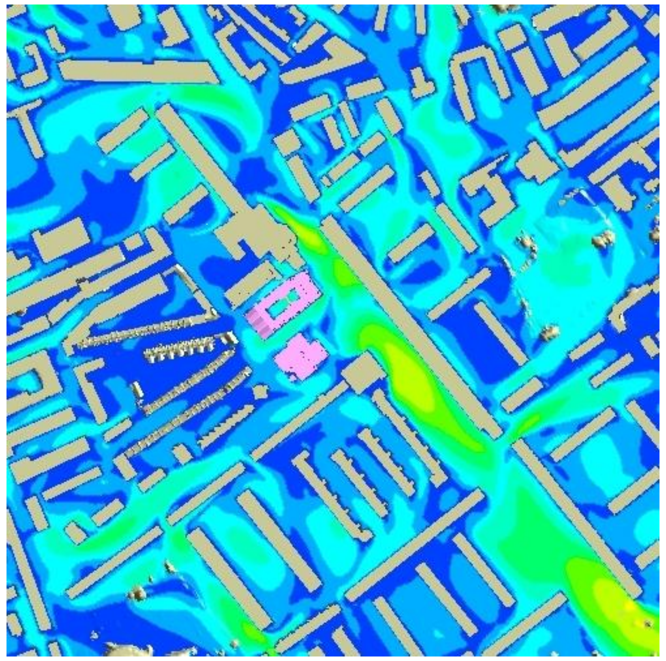
Figure 137: Existing Velocity Wind from 260

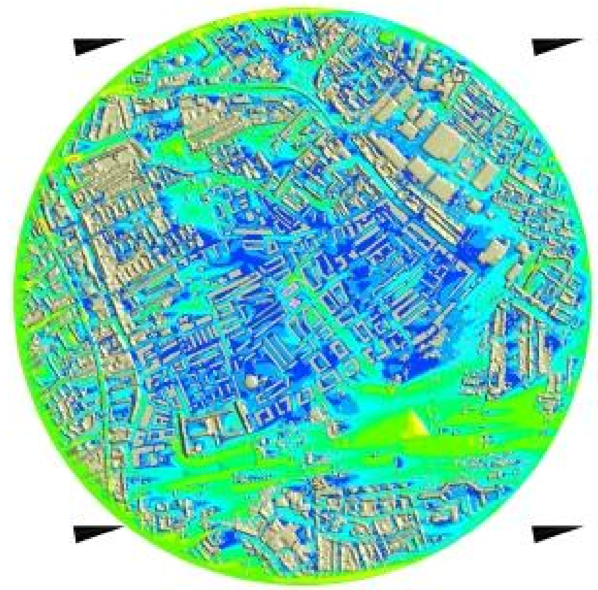
Figure 138: Proposed Velocity Wind from 260

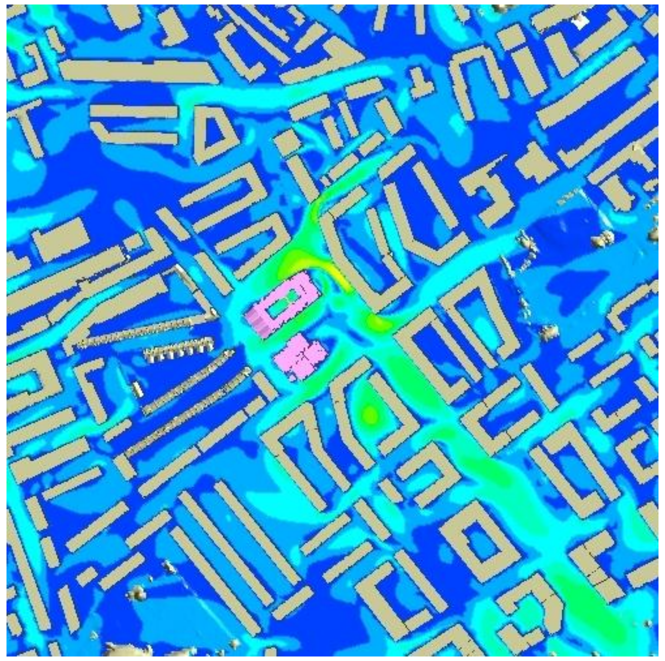
Figure 139: Proposed Velocity Wind from 260

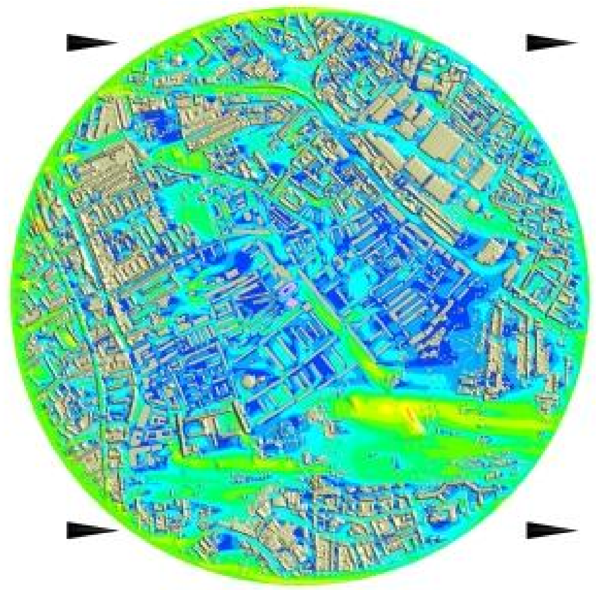
Figure 140: Existing Velocity Wind from 270

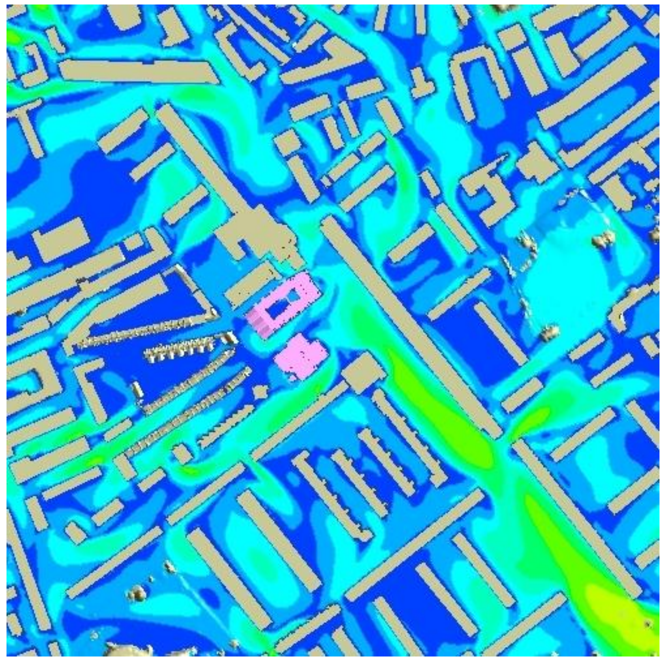
Figure 141: Existing Velocity Wind from 270

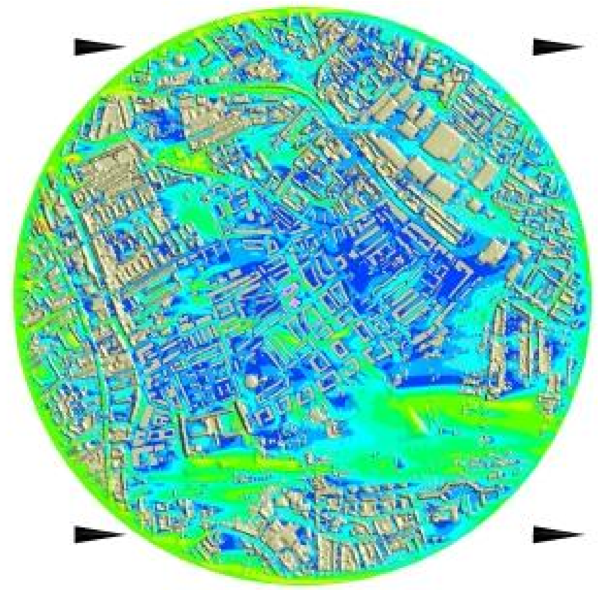
Figure 142: Proposed Velocity Wind from 270

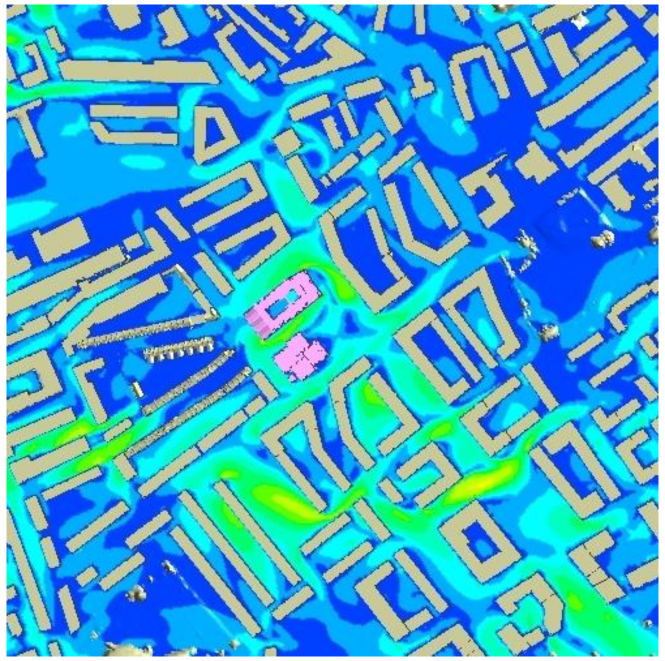
Figure 143: Proposed Velocity Wind from 270

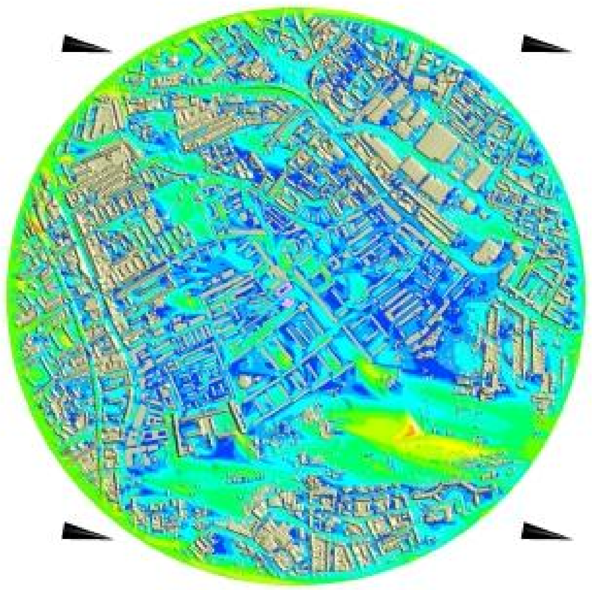

Figure 144: Existing Velocity Wind from 280

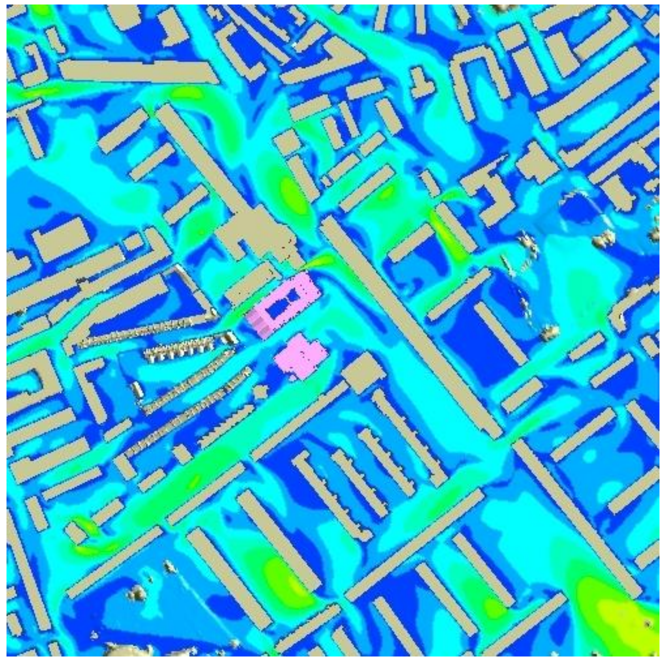

Figure 145: Existing Velocity Wind from 280

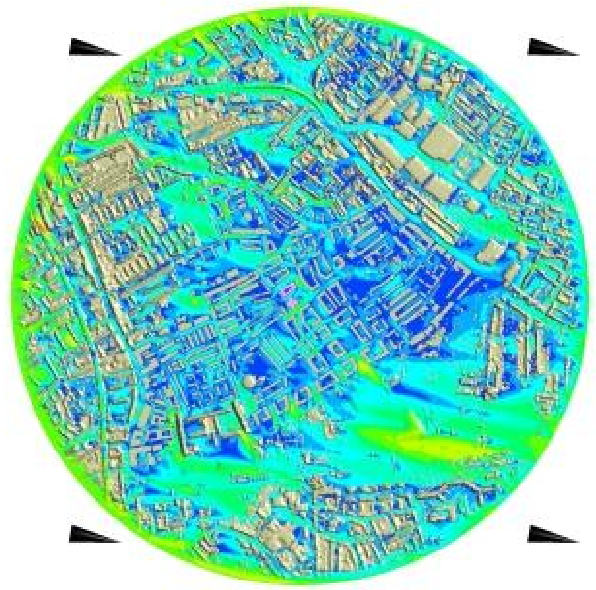

Figure 146: Proposed Velocity Wind from 280

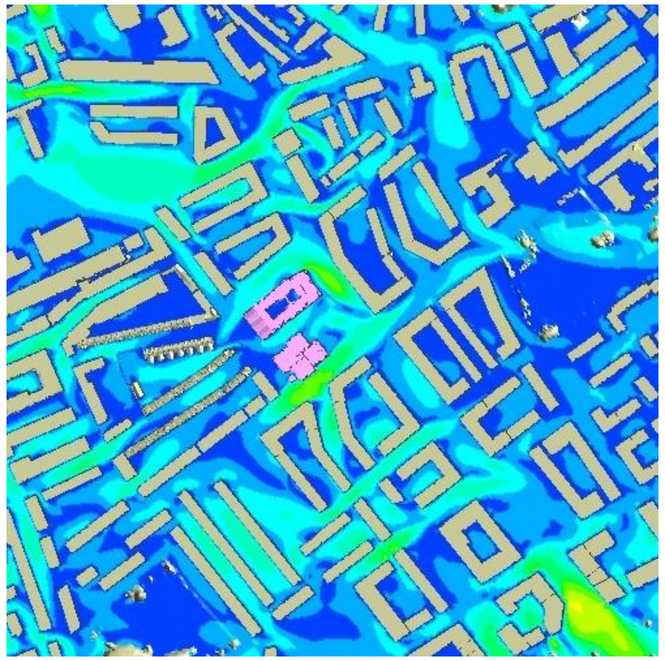

Figure 147: Proposed Velocity Wind from 280

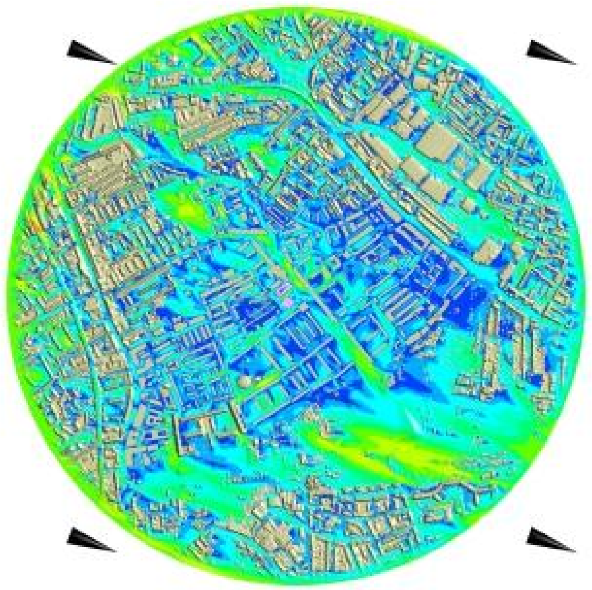

Figure 148: Existing Velocity Wind from 290

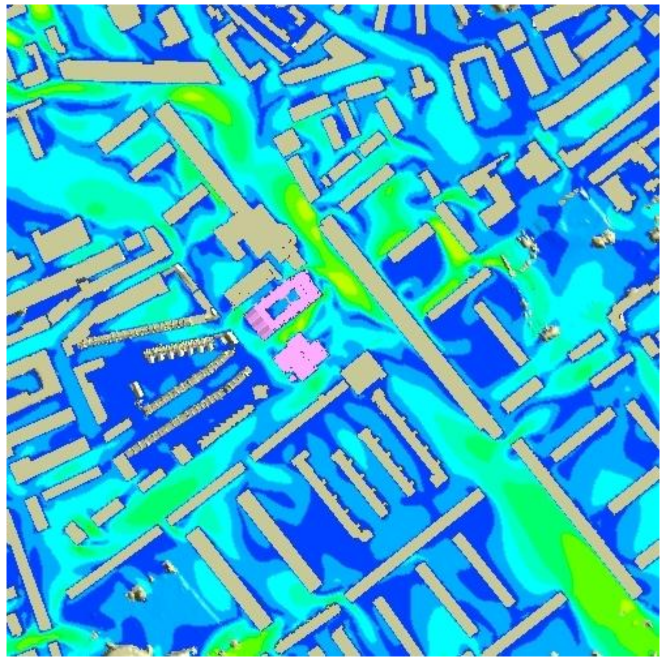

Figure 149: Existing Velocity Wind from 290

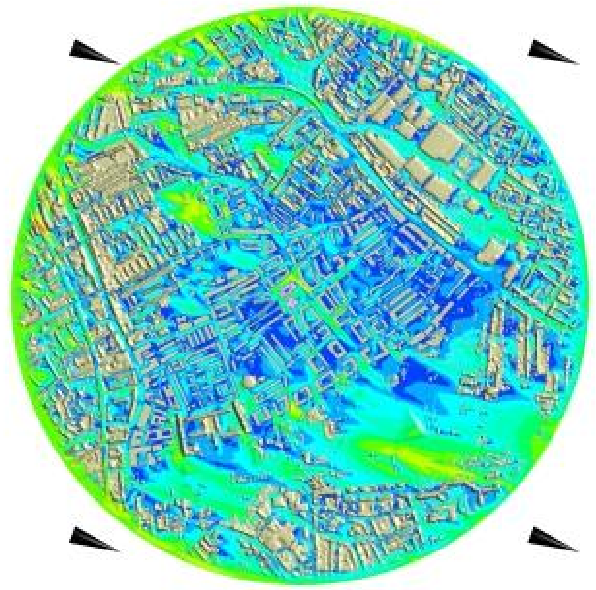

Figure 150: Proposed Velocity Wind from 290

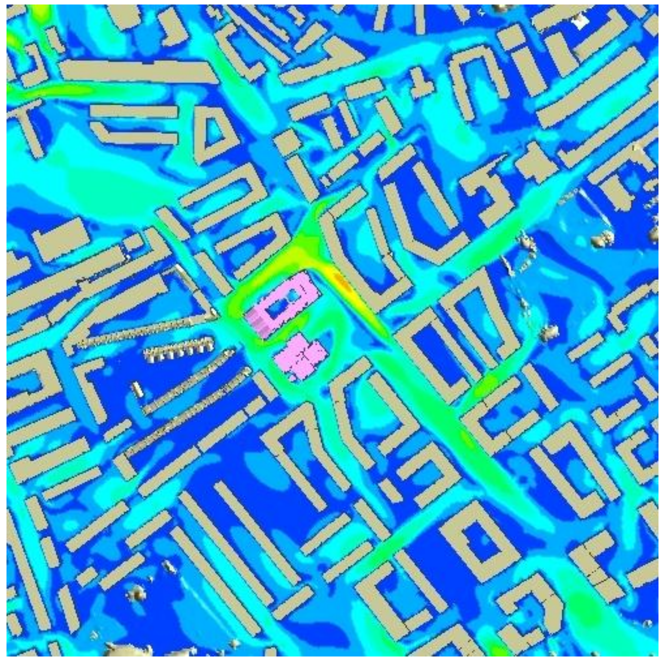

Figure 151: Proposed Velocity Wind from 290

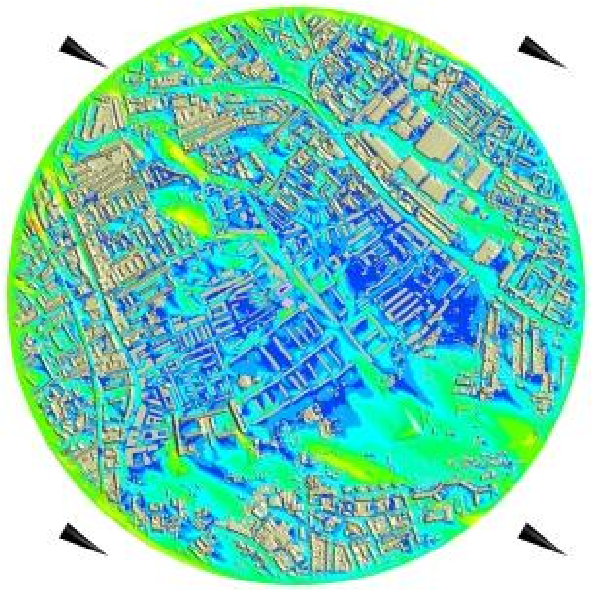

Figure 152: Existing Velocity Wind from 300

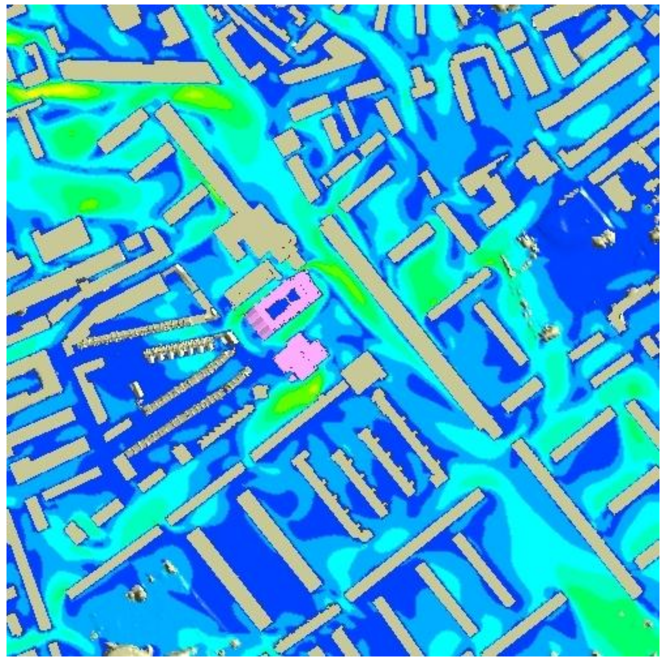

Figure 153: Existing Velocity Wind from 300

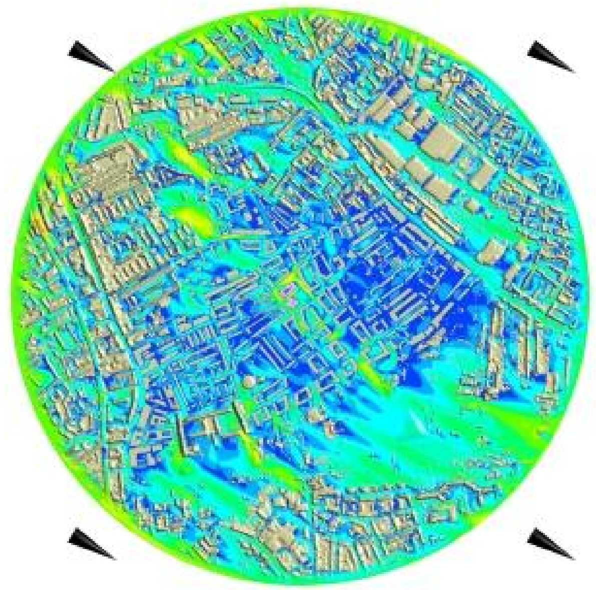

Figure 154: Proposed Velocity Wind from 300

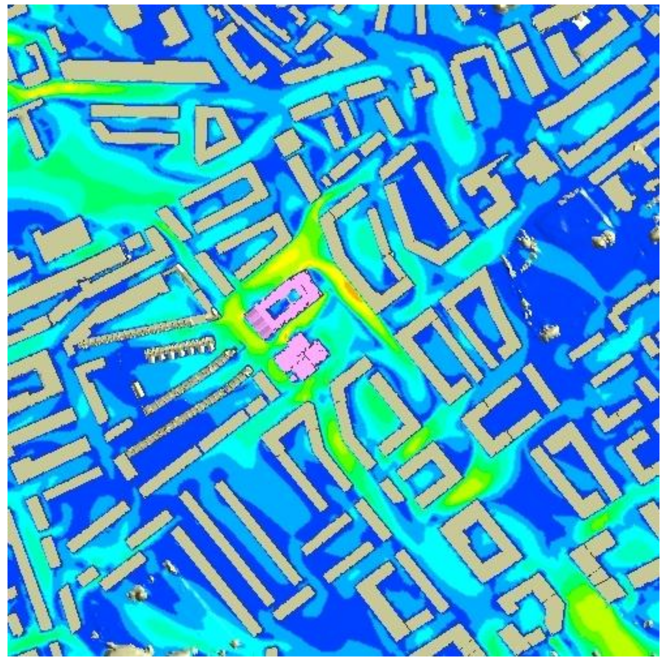

Figure 155: Proposed Velocity Wind from 300

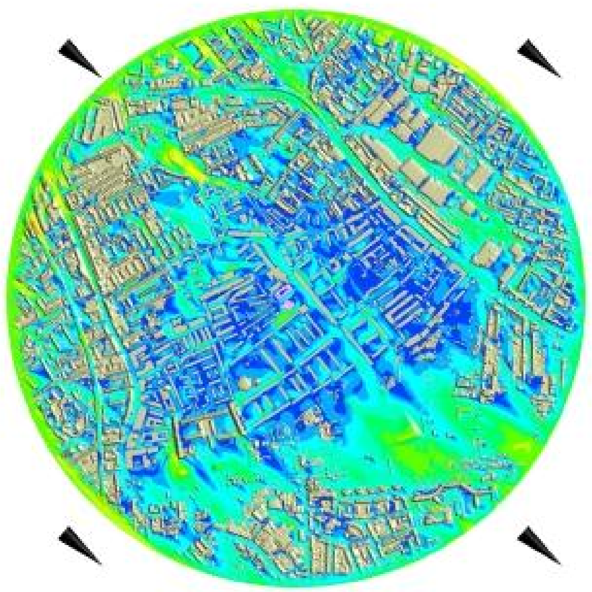

Figure 156: Existing Velocity Wind from 310

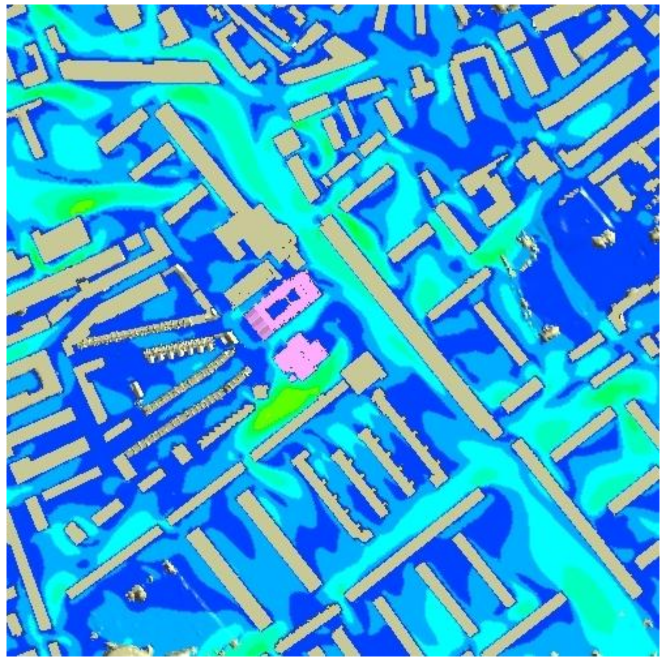

Figure 157: Existing Velocity Wind from 310

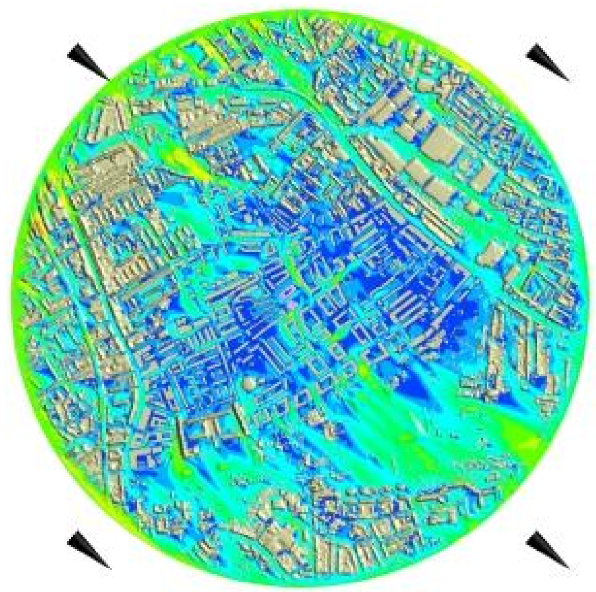

Figure 158: Proposed Velocity Wind from 310

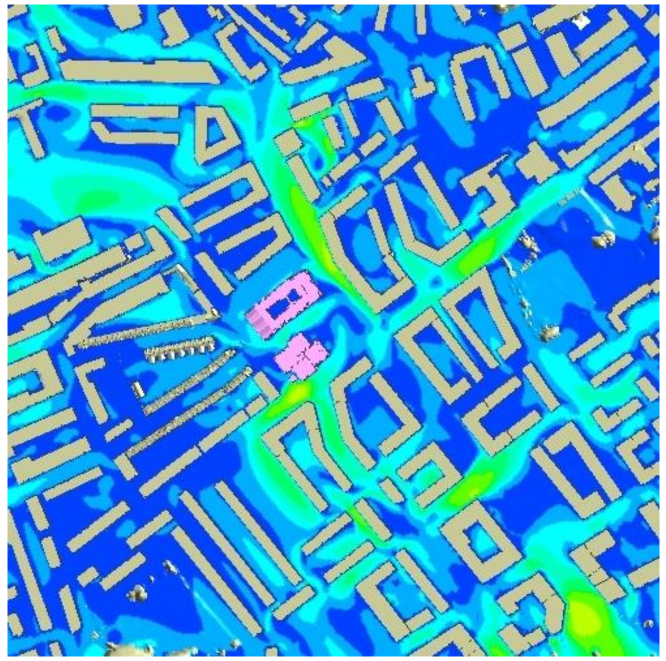

Figure 159: Proposed Velocity Wind from 310

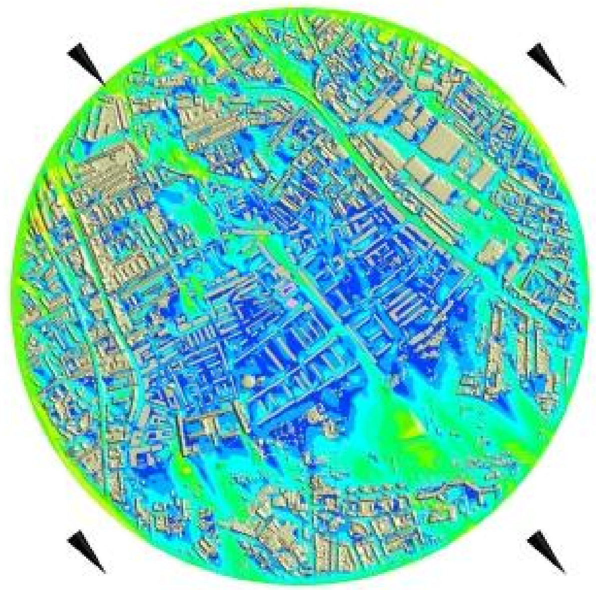

Figure 160: Existing Velocity Wind from 320

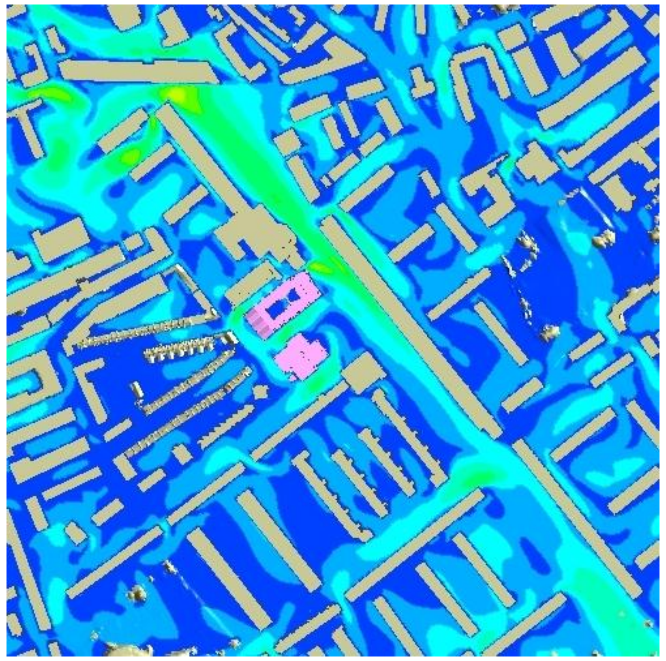

Figure 161: Existing Velocity Wind from 320

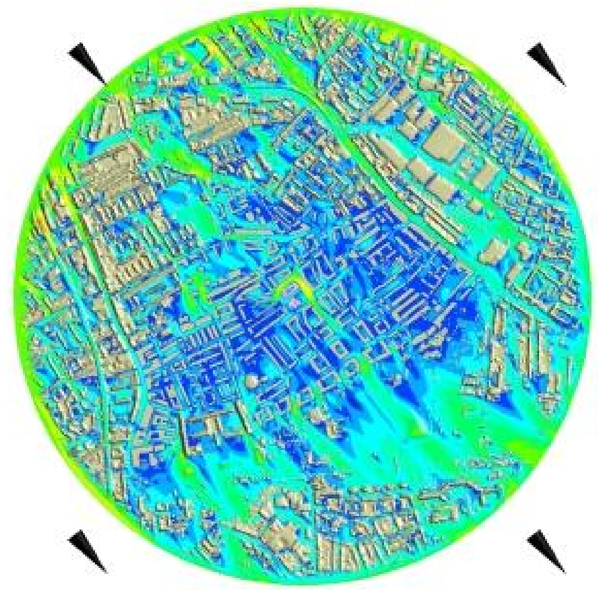

Figure 162: Proposed Velocity Wind from 320

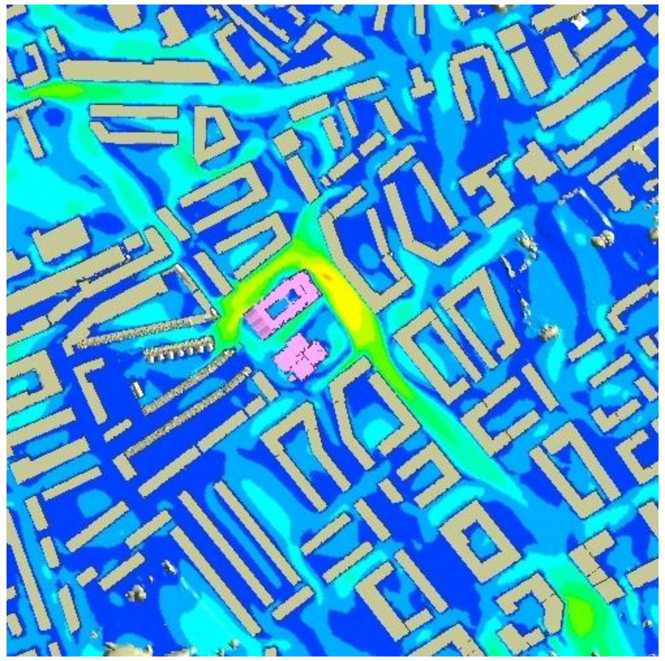

Figure 163: Proposed Velocity Wind from 320

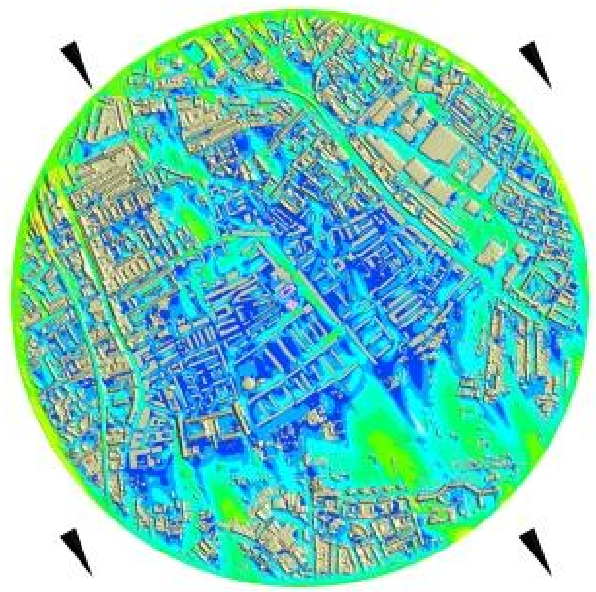

Figure 164: Existing Velocity Wind from 330

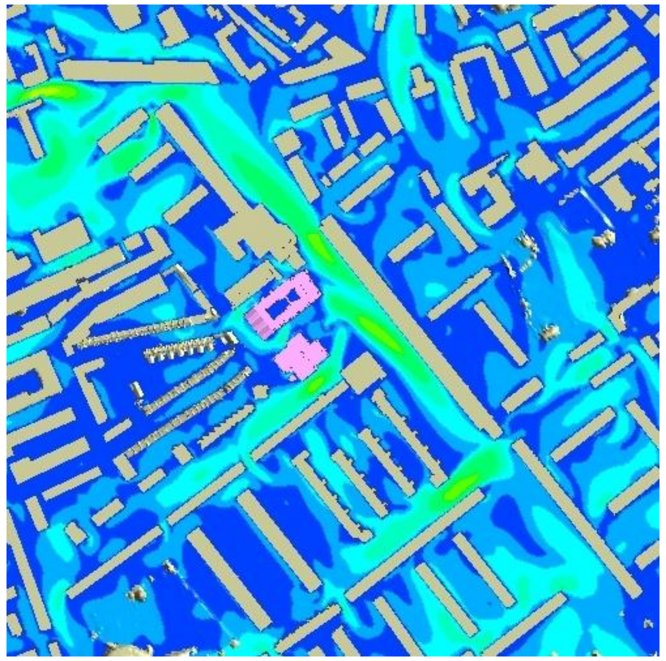

Figure 165: Existing Velocity Wind from 330

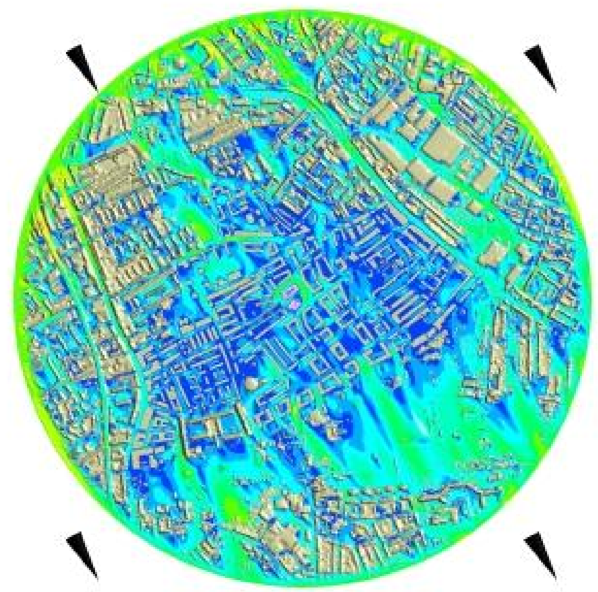

Figure 166: Proposed Velocity Wind from 330

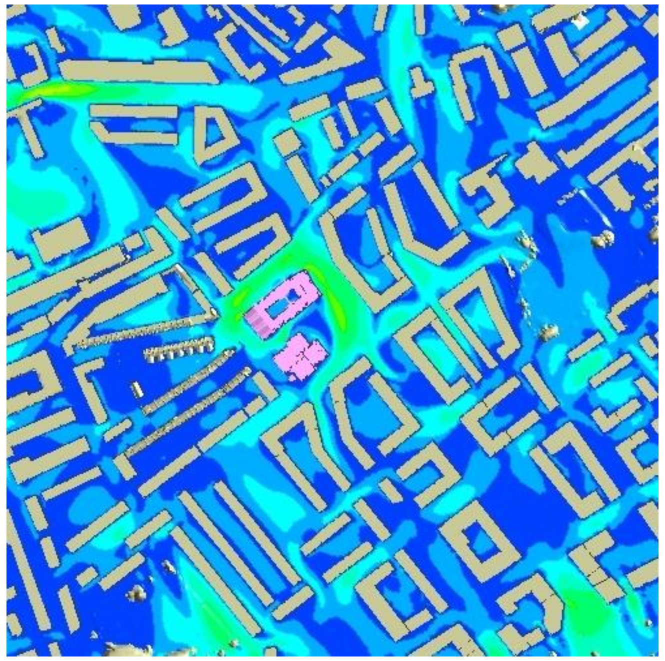

Figure 167: Proposed Velocity Wind from 330

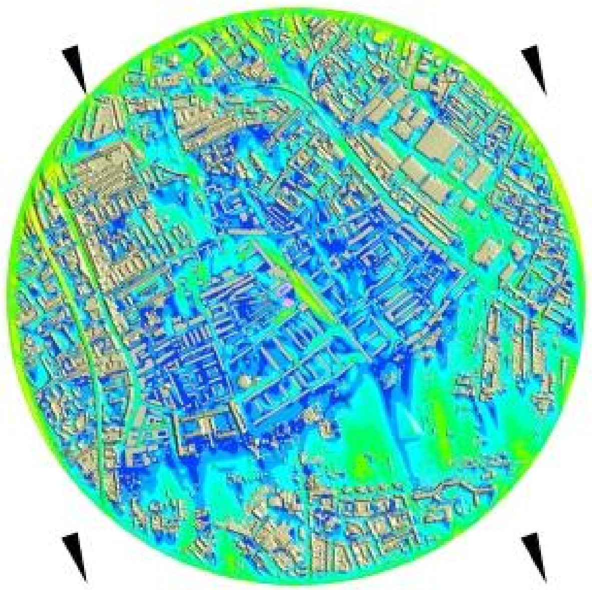
Figure 168: Existing Velocity Wind from 340

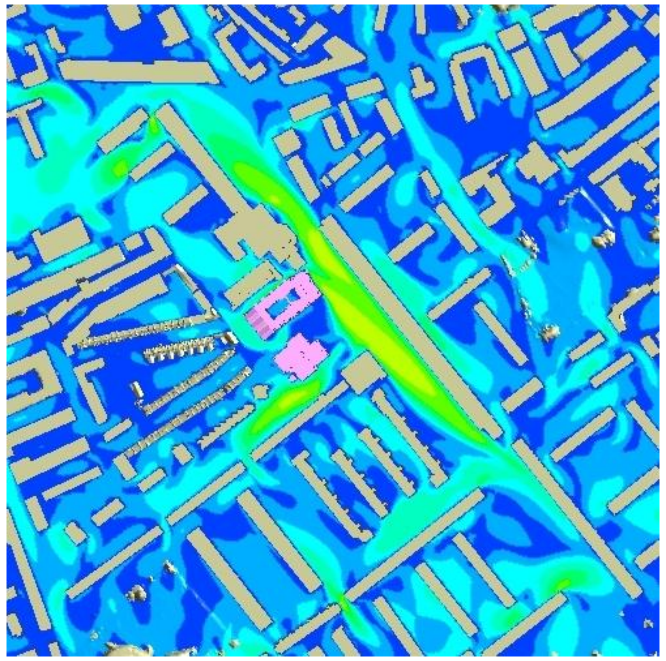
Figure 169: Existing Velocity Wind from 340

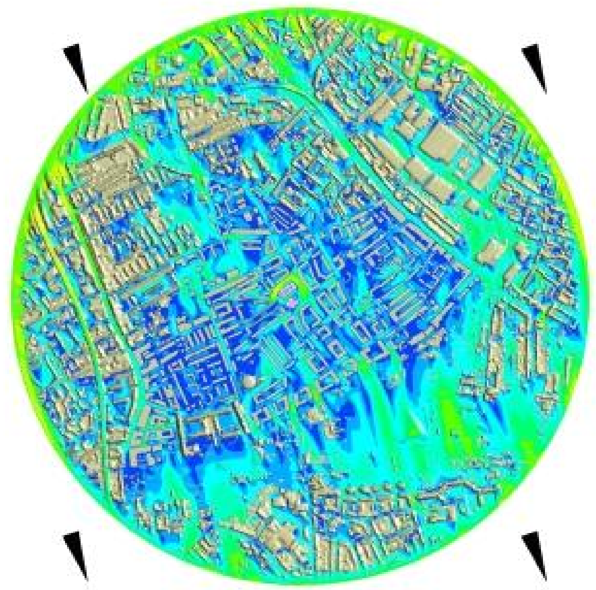
Figure 170: Proposed Velocity Wind from 340

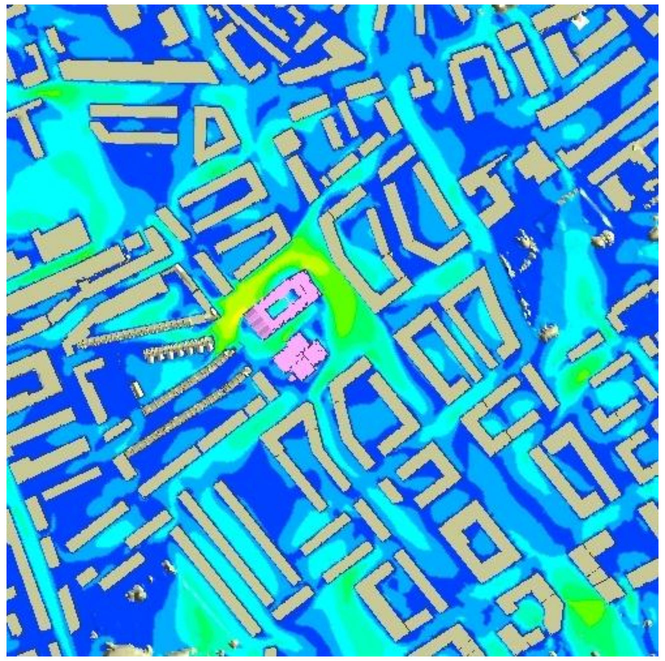
Figure 171: Proposed Velocity Wind from 340

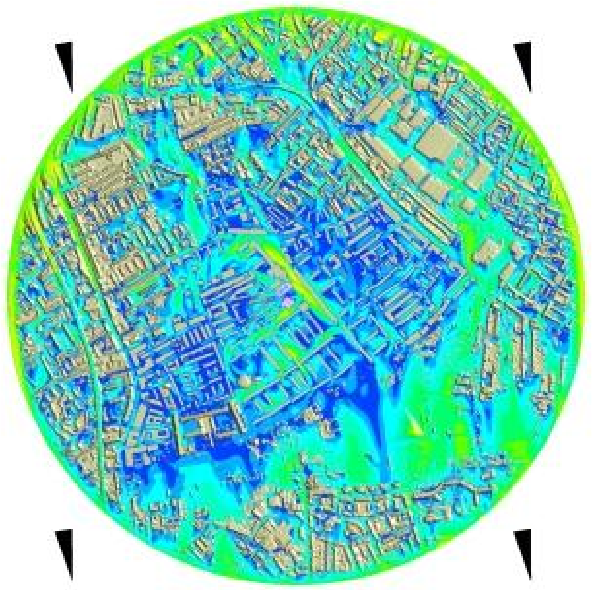
Figure 172: Existing Velocity Wind from 350

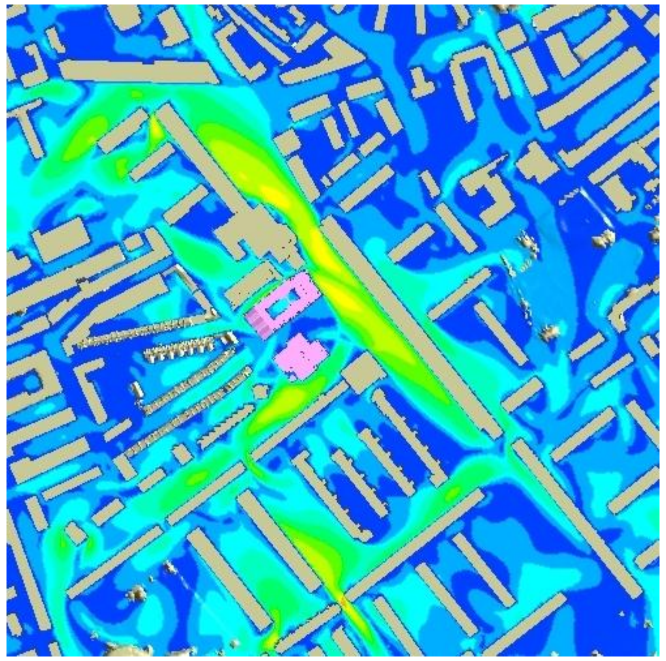
Figure 173: Existing Velocity Wind from 350

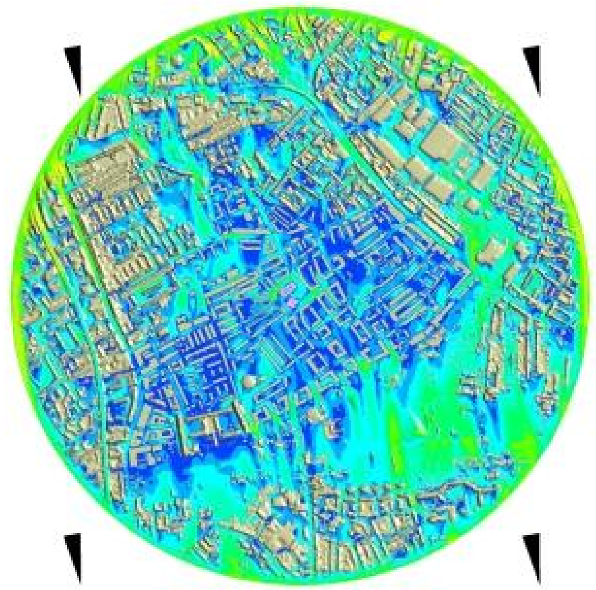
Figure 174: Proposed Velocity Wind from 350

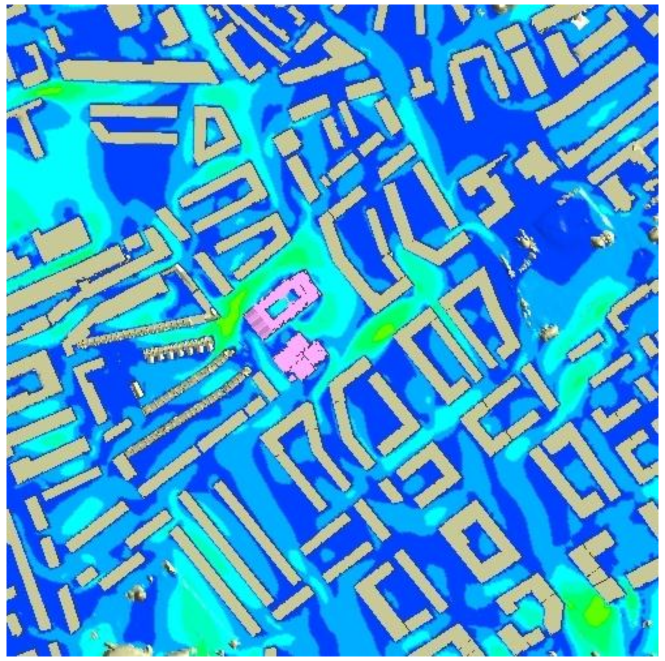
Figure 175: Proposed Velocity Wind from 350