TOWN PLANNING BOARD

TPB Paper No. 8972
for Consideration by the
Town Planning Board on 23.12.2011

Urban Climatic Map and Standards for Wind Environment Feasibility Study – Stakeholders Engagement

TPB Paper No. 8972
For Consideration by the
Town Planning Board
on 23.12.2011

URBAN CLIMATIC MAP AND STANDARDS FOR WIND ENVIRONMENT FEASIBILITY STUDY - STAKEHOLDERS ENGAGEMENT

PURPOSE

1. This paper is to :

   (a) brief Members on the findings and recommendations of the Urban Climatic Map and Standards for Wind Environment Feasibility Study (the UCM Study) which are also summarized in the attached Stakeholders Engagement Digest and leaflet; and

   (b) seek Members' views on the study recommendations.

BACKGROUND

2. Hong Kong is a high density city situated in the sub-tropical climate region with hot and humid summers. Owing to the dense concentration of buildings and urban activities, urban emissions, congested public spaces, insufficient greenery, etc., Hong Kong is suffering from the Urban Heat Island (UHI) effects. The urban temperature has been increasing while the wind speed has been decreasing in the past few decades. There is a need to better plan and design our city to improve the quality of urban living through promoting air ventilation and reducing thermal load in the built environment.

3. The air ventilation assessment (AVA) system was introduced in 2006 to guide public projects through the promulgation of Technical Circular No. 1/06 on Air Ventilation Assessments jointly issued by the then Housing, Planning and Lands Bureau and Environment, Transport and Works Bureau. In parallel, the Government commissioned the UCM Study to examine Hong Kong's urban climatic conditions and identify appropriate planning and design measures to achieve long-term improvement of the urban living environment.

4. In the Report on the Public Engagement Process on Building Design to Foster a Quality and Sustainable Built Environment, the Council for Sustainable Development recommends, amongst others, the Government to consider incorporating more scientific considerations in the planning process. The UC Maps serve this purpose.

FINDINGS AND RECOMMENDATIONS OF UCM STUDY

5. The technical investigations of the UCM Study are completed. Major findings and recommendations of the Study with regard to (i) Urban Climatic Planning Recommendation Map (UC-ReMap), (ii) wind performance criterion for AVAs, and (iii) refinements to the AVA system are summarized below :

Urban Climatic Planning Recommendation Map

6. UC-ReMap is formulated based on :

(i) an Urban Climatic Analysis Map which maps out the urban climatic characteristics in different parts of the territory based on an analysis and evaluation of the urban climatic factors and their effects on the thermal load[1] and dynamic potential[2] as well as impact on human thermal comfort[3]; and

(ii) a wind information layer to complement the Urban Climatic Analysis Map.

There are altogether five urban climatic planning zones (UCPZs) delineated on the UC-ReMap. The planning recommendations for each UCPZ are set out below.

---

[1] Thermal load measures the stored or emitted heat intensity of particular localities of urban areas. It has an effect on intra-urban air temperature increase depending on (a) the building volume (which has an impact on heat storage, and blocking the sky view slowing the city's cooling at night), (b) the topography and (c) the availability of green space.

[2] Dynamic Potential of an area depends mainly on its ground roughness which influences the air ventilation and air exchange of the areas. It is evaluated mainly based on (a) site coverage of buildings, (b) natural landscape and (c) proximity to surrounding openness.

[3] Human thermal comfort is indicated by Physiologically Equivalent Temperature (PET), the temperature of a reference environment based on a heat balance model that combines climatic and physiological variables including air temperature, relative humidity, solar radiation, air movement, clothing and metabolic rate. Based on the Users' Thermal Comfort Survey, under Hong Kong's summer conditions, the neutral PET is 28°C.

7. **UCPZ1** are mostly the natural areas at higher altitude, providing sources of cool air to their adjoining areas. These urban climatically valuable areas need to be preserved as far as practicable. Currently, the majority of this zone has already been subject to different statutory controls such as country parks and conservation related and non-development zones on statutory town plans. Essential small scale development is however possible.

8. **UCPZ2** are currently urban climatically "neutral' in terms of urban thermal comfort. They are mostly urban fringe or rural lowland. New low-density individual developments and comprehensive developments are possible subject to prudent planning and building design to avoid adverse impact on the urban climatic condition.

9. **UCPZ3** are currently subject to urban climatically "moderate" impact in terms of urban thermal comfort. They are mostly in the urban fringe or less dense development areas. Some mitigation actions are encouraged where possible.

10. **UCPZ4** and **UCPZ5** are the densely built areas, including most of the new town areas, the metro areas at the northern part of the Hong Kong Island, at the Kowloon Peninsula and at Tsuen Wan. The existing developments have already had a strong to very strong impact on thermal comfort. Mitigation actions are recommended and essential. Intensification of use/additional development is not recommended unless with adequate mitigation measures.

11. The UC-ReMap is a strategic and comprehensive urban climatic planning framework and information platform. At the strategic level, it helps identify areas in need of improvement, select suitable locations for new development areas as well as evaluate urban climatic effects of major planning and development proposals. For UCPZ1, preservation of the climatically valuable areas is the focus. For UCPZ3, 4 and 5, opportunities should be maximized to avoid intensification of the existing problems of high thermal load and poor air ventilation and to provide mitigation measures. If new additional development areas are contemplated, UCPZ2, in particular formed sites and spoiled rural areas, would be a more acceptable choice, subject to comprehensive planning and development to maintain the existing urban climatic characteristics and avoid adverse impacts on thermal comfort.

12. At the district level, the UC-ReMap helps understand the local urban climatic conditions, and hence identify appropriate planning measures such as

designation of air path, designation of non-building area, regulation of development intensity, preservation of greenery and open space, etc. for addressing urban climatic concerns during forward planning.

Wind Performance Criterion

13. The AVA system has been in force since 2006. AVAs have been undertaken for Government projects and relevant private sector projects requiring planning approval from the Board or Government approval. As there is no benchmark for AVA performance, it has been based on an option comparison and improvement approach. Based on the Users' Thermal Comfort Survey[4] (the optimum wind requirement) and the Wind Tunnel Benchmarking Studies[5] (the practical considerations of the existing built environment), a wind performance criterion for AVAs comprising the following two components are proposed for development sites requiring AVAs.

(a) Wind Performance Requirement

80% of all test points inside the assessment area as defined in the AVA Technical Circular have: **Annual median hourly mean wind speed >= 1 m/s** **AND** **Summer median hourly mean wind speed >= 1 m/s**
And
95% of all test points inside the assessment area as defined in the AVA Technical Circular have: **Annual median hourly mean wind speed >= 0.6 m/s** **AND** **Summer median hourly mean wind speed >= 0.6 m/s**

[4] Users' Thermal Comfort Survey was conducted as part of the UCM Study to understand the outdoor thermal comfort requirements of Hong Kong people and find out the range of comfortable wind environment from a human physiological point of view. A total of 2,702 interviews were completed. The survey results suggest that providing light air in the order of 0.9 – 1.3 m/s in summer is important and beneficial for the hot summer months of Hong Kong.

[5] The UCM Study has conducted wind tunnel benchmarking tests for 10 pairs of 20 areas with a view to investigating the existing wind environment of our city and comparing against the desirable urban air ventilation performance. It is found out that given the high urban density, narrow streets, tall and bulky buildings with large podium, the need for urban human thermal comfort as indicated in the Survey would be practically difficult to achieve, except in unobstructed areas nearer to the waterfront and exposed areas.

The requirement for 80% of all test points to achieve the wind speed of 1m/s is in recognition of some unavoidable isolated wake areas behind buildings. The requirement of 95% of all test points to achieve a minimum wind speed of 0.6m/s is to safeguard against a stagnant wind environment.

(b) Alternative (Prescriptive) Approach

14. Taking into account the practical constraints of some existing dense built environment to achieve the wind performance requirement, the studies on various parameters and their effectiveness to mitigate UHI effect, and the newly promulgated Practice Note for Authorized Persons, Registered Structural Engineers and Registered Geotechnical Engineers (PNAP) APP-152 on Sustainable Building Design Guidelines, the following mitigating design measures are required as an alternative to comply with the above wind performance requirement :

- ground coverage of no more than 65%;
- building (tower block) permeability as per PNAP APP-152;
- setback requirement as per PNAP APP-152; and
- greenery (preferably tree planting) of no less than 30% for sites larger than 1 ha and 20% for sites below 1 ha at lower levels preferably at grade. Sites smaller than 1,000m^2 are exempted.

Exemption

15. Developments with demonstrated functional requirements in terms of building length and/or ground coverage, such as infrastructural facilities, transport terminus, sports and civic facilities, may be exempted from the prescriptive design requirements, provided that all practical design improvement measures are incorporated in the development.

Refinements to the Air Ventilation Assessment System (AVA System)

16. Based on the Study findings and a review of all the completed AVAs on the AVA register[6], refinements to the AVA system are proposed. The major refinements include incorporating the proposed wind performance criterion as a quantitative yardstick to confirm acceptance of development proposal from

[6] AVA register keeps AVAs completed by government departments/bureaux to facilitate public inspection and review of the AVA process. Subject to the agreement of the private or quasi-government project proponents, non-public AVA projects may also be deposited in the AVA register.

the air ventilation view point, and extending the scope of application of AVA requirements to cover both public and private sector projects. There are also some technical refinements to the AVA System proposed.

WAY FORWARD AND IMPLEMENTATION

17. To carry forward the Study recommendations and improve the urban climate, concerted efforts of the public and the private sectors are required in the following areas :

By Government

- incorporate the UC-ReMap, the wind performance requirement and the planning and design measures to improve the built environment into the Hong Kong Planning Standards and Guidelines to guide both public and private development projects;

- suitably amend the joint Technical Circular No. 1/06 on AVA to reflect the refined methodology and wind performance criterion for AVA; and

- at district level, co-ordinate suitable planning measures to increase building permeability and reduce thermal load by regulating building density, building height and ground coverage, introducing breezeway/air path, connecting green and open space. PlanD, in this respect, has already been stipulating appropriate planning and building measures on statutory town plans where appropriate and during planning of new development areas such as Kai Tak development;

By Private Sector

- incorporate appropriate building design to ensure no adverse impact on the urban climatic environment; and

- demonstrate air ventilation acceptability when required in application for planning permission and lease modification or demonstration of compliance with the relevant requirement under the SBD Guidelines for applying for GFA concession.

18. Notwithstanding the above, it must be stressed that sustainable development is a matter of balancing environmental, social and economic needs. Urban climatic issue is only one of the important considerations in the planning and design process.

STAKEHOLDERS ENGAGEMENT

19. The Planning Department has commenced a stakeholders engagement to consult the trade, professional institutes, development and environment related statutory/advisory bodies, technical experts and academia as well as members of the public on the study findings/recommendations. The stakeholders engagement will last for 2 months until 15 February 2012.

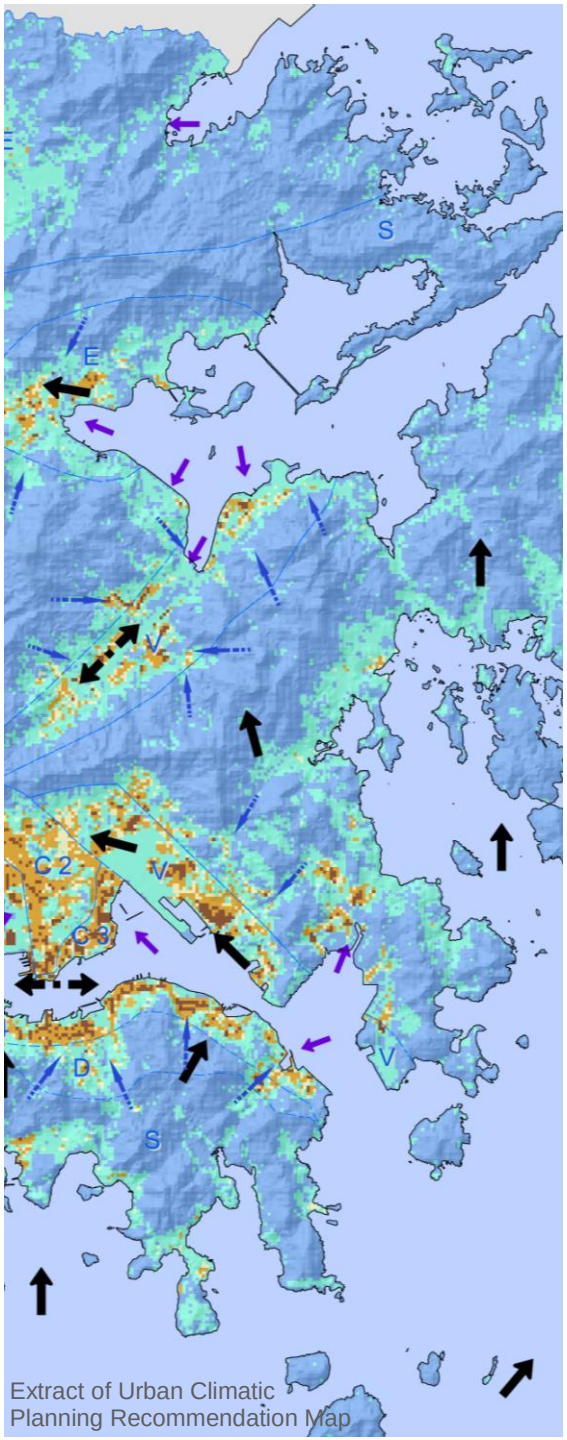
ADVICE SOUGHT

20. Members are invited to offer views on the findings and recommendations of the UCM Study.

ATTACHMENTS

Attachment 1: UCM Study – Stakeholders Engagement Digest
Attachment 2: UCM Study – Stakeholders Engagement Leaflet

Planning Department
December 2011



Extract of Urban Climatic Planning Recommendation Map

Planning Department

Urban Climatic Map and Standards for Wind Environment - Feasibility Study

Stakeholders Engagement Digest

December 2011

ARUP

香港科技大學 THE HONG KONG UNIVERSITY OF SCIENCE AND TECHNOLOGY

建築中大

PlanArch Consultants Ltd. 建港規劃顧問有限公司

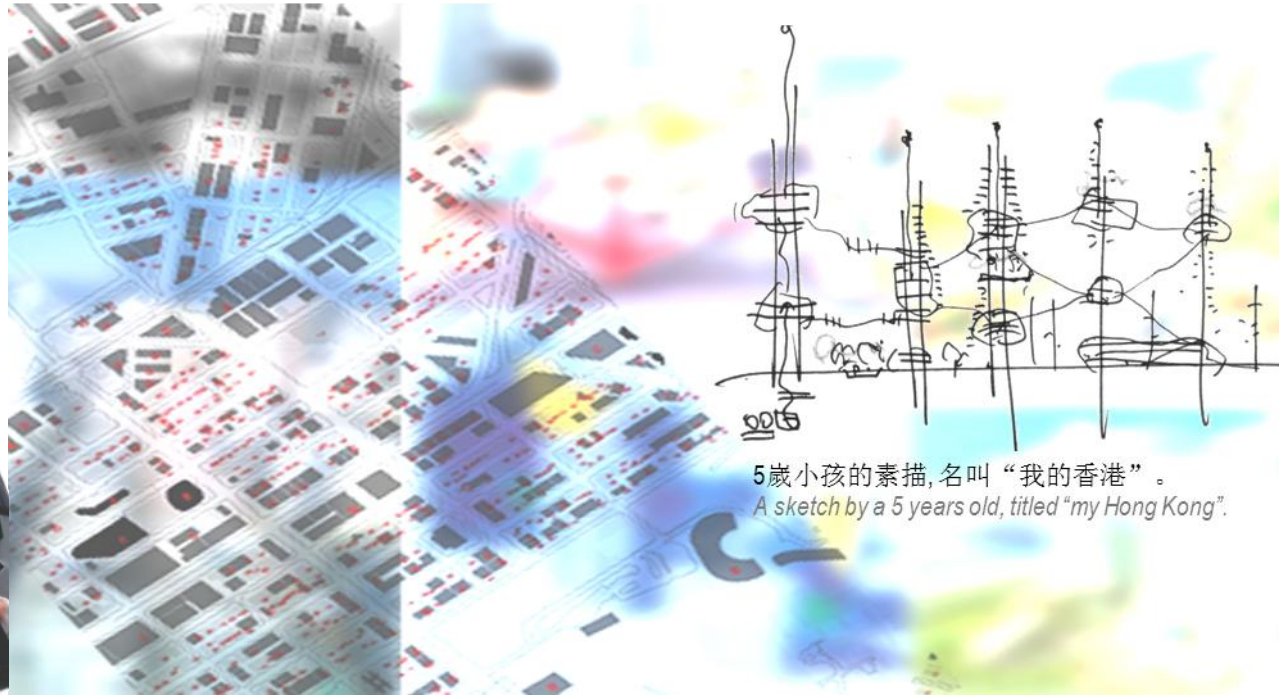
UNIKASSEL VERSITÄT


How should our future city be?

Our Vision

Towards quality urban living, for now and for the future

Better planning and building design to improve urban air ventilation and urban climate for healthier and more comfortable and sustainable urban living



5歲小孩的素描, 名叫“我的香港”。
A sketch by a 5 years old, titled “my Hong Kong”.

CONTENTS

1 **BACKGROUND, PURPOSES AND KEY ISSUES** 06

2 **URBAN CLIMATIC MAPS** 11

- Methodology
- Urban Climatic Analysis Map and Planning Recommendation Map
- Planning and Design Measures to Improve Urban Climate

3 **BEYOND URBAN CLIMATIC MAPS – AIR VENTILATION** 28

- Wind Performance Criterion
- Refinements to Air Ventilation Assessment System

4 **WAY FORWARD** 35

5 **SUGGESTIONS AND COMMENTS** 37

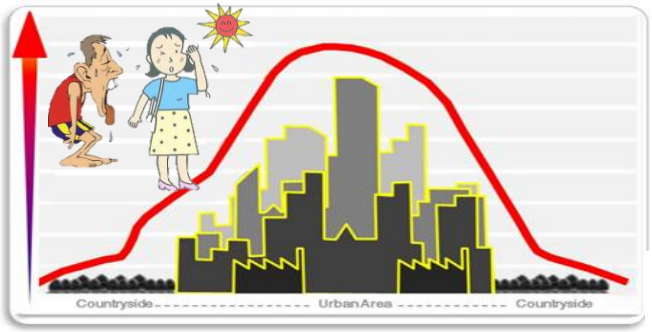
1 BACKGROUND, PURPOSES AND KEY ISSUES

High Density Sub-Tropical Urban Living

Hong Kong is a high density city situated in the sub-tropical climate region with hot and humid summers.

Due to our high density urban development, Hong Kong is suffering from the Urban Heat Island (UHI) effect. Our urban areas are significantly warmer than the rural surroundings. As a result of the UHI effect, the number of very hot days (maximum air temperature greater than 33°C) and very hot nights (minimum air temperature greater than 28°C) has increased dramatically. This leads to uncomfortable urban living, heat stress and related health problems, and increase in energy consumption. All in all, this has resulted in poorer urban living qualities.

There is a need to optimize the planning and design of our city to facilitate more wind penetration through the city fabric, and to attain a higher quality urban living environment with thermal relief and reduction of heat stress, especially in the public realm.



Urban Heat Island effect

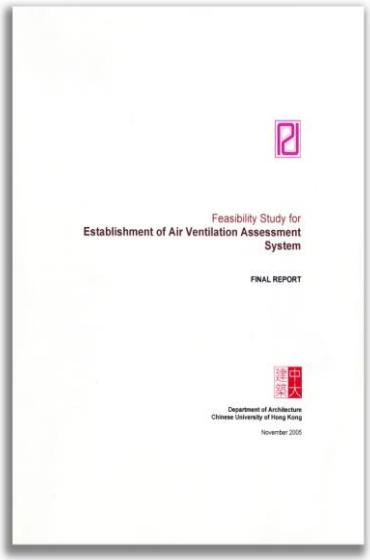
What Has Been Done

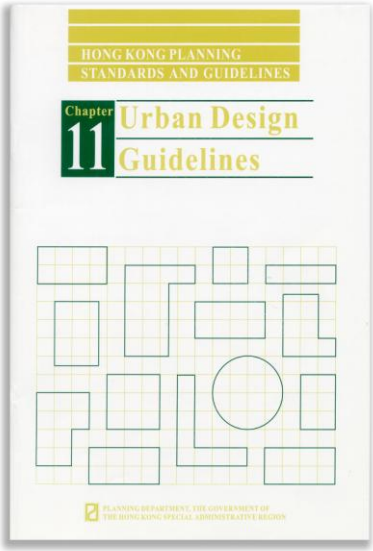
Based on the "Feasibility Study for Establishment of Air Ventilation Assessment (AVA) System" (AVAS Study) completed by the Planning Department in November 2005, a set of planning guidelines for promoting better air ventilation was added in Chapter 11 of the **Hong Kong Planning Standards and Guidelines** and promulgated in August 2006. In tandem, the then Housing, Planning and Lands Bureau and Environment, Transport and Works Bureau jointly issued a **Technical Circular No. 1/06** on **Air Ventilation Assessments**, setting out an advisory framework and requiring all major government projects to include AVA as one of the planning and design considerations. As there is no benchmark, the AVA System adopts an 'option-comparison-and-improvement' approach.

The AVAS Study suggested that apart from considering the urban air ventilation environment, a more holistic approach to reviewing Hong Kong's urban climatic conditions for better planning decision making at the territorial and district levels should be targeted.

In July 2006, the Planning Department commissioned a consultancy on the "**Urban Climatic Map and Standards for Wind Environment – Feasibility Study**" (the Study) to look for planning and design measures to achieve long-term improvement of the urban living environment.

Technical experts were consulted on the methodology of the Urban Climatic Analysis Map from February to March 2009. They generally supported the need to establish Urban Climatic Maps for Hong Kong and to integrate urban climatic considerations into the town planning process; and they raised no major methodological or fundamental issues with the Analysis Map. A report summarizing the views of technical experts and the consultants' responses has been prepared and uploaded onto the Planning Department's website for public information.
(*http://www.pland.gov.hk/pland_en/p_study/prog_s/ucmapweb/ucmap_project/content/reports/Technical_experts_engagement.pdf)*



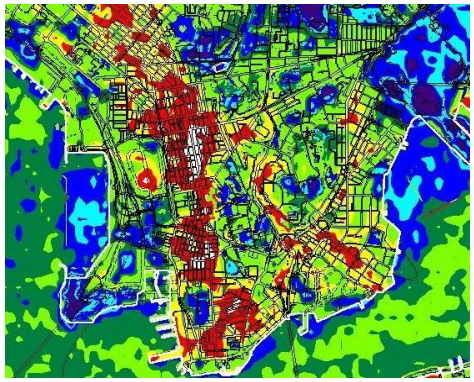


Recommendations in the Council for Sustainable Development's Report on "Building Design to Foster a Quality and Sustainable Built Environment"

In June 2010, subsequent to the Council for Sustainable Development's public engagement on "Building Design to Foster a Quality and Sustainable Built Environment", the Council submitted 51 recommendations to the Government; one of which is that it is important "to consider incorporating more scientific considerations in the planning process, e.g. Urban Climatic Map".

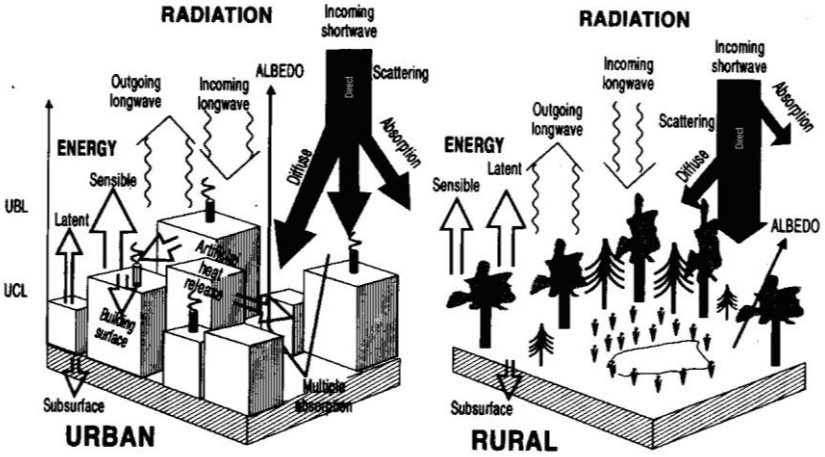
A Scientific Understanding

Urban Heat Island and Urban Climate



Urban Heat Island: A satellite image showing the high urban temperature areas, in red, in Mong Kok, Yau Ma Tei, Hung Hom and Tsim Sha Tsui.

Courtesy: Professor Janet Nichol, Hong Kong Polytechnic University



A schematic depiction of energy fluxes over an urban and a rural area.
Courtesy: Professor Tim Oke

A purpose of the Study is to formulate the **Hong Kong Urban Climatic Map** to identify climatically problematic and sensitive areas to assist planning decision making. In addition, the Study aims to establish a wind performance criterion for urban air ventilation in Hong Kong, as well as to refine the current AVA System.

Two urban climatic factors are important for town planning and urban design in Hong Kong. They are the focus and subject of the Study, namely **Wind** and **Urban Thermal Comfort**, particularly in relation to the Dynamic Potential and Thermal Load of the built environment.

Buildings in cities are mostly constructed of concrete and other manmade materials. They have higher thermal capacity than the natural environment, and therefore store a lot of heat during daytime. The heat they store will elevate urban temperature. At night, tall buildings block the urban area's sky view and hence limit their ability to release the heat back into the atmosphere, thus elevate the night time temperature. The residual heat carries forward to the next day and the viscous circle continues.

As a result of the buildings, paved surfaces and the complex building morphologies, the city has its own urban climatic conditions that are very different from the rural and natural areas.

Typically, urban area gains more heat than it loses, resulting in Urban Heat Island (UHI). Urban area has tall buildings and therefore high ground roughness. Wind will flow over it more slowly and urban air ventilation is weakened in addressing the UHI.

A Scientific Understanding

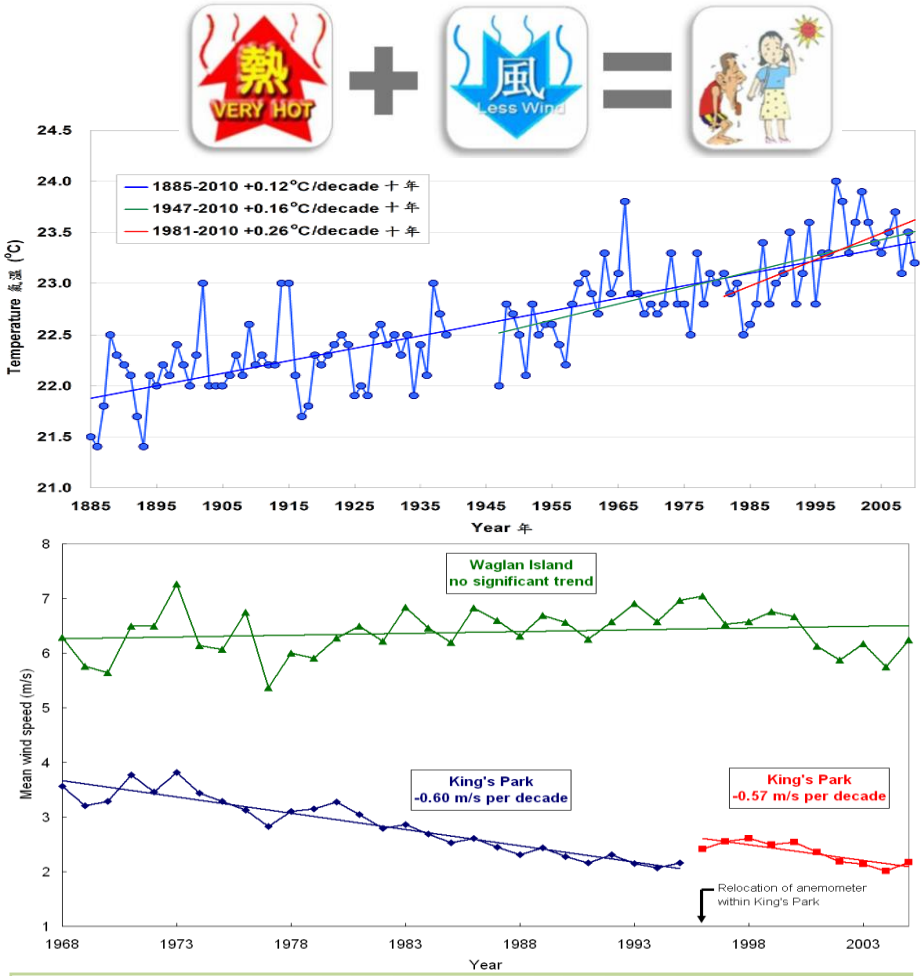
Thermal Stress and Wind for Thermal Comfort

The Hong Kong Observatory (HKO) has conducted studies and noted that Hong Kong's urban temperature has been increasing over the decades. The rate of increase in average temperature in Hong Kong between 1947 and 2010 was about 0.16°C per decade; during 1981 and 2010, the average increase amounted to 0.26°C per decade. Coupled with the UHI effect, the air temperature rise will further intensify. With an UHI intensity of 3°C, the yearly occurrence of very hot days and very hot nights in Hong Kong will increase from 10 days to over 90 days and from 20 nights to over 120 nights respectively.

Good urban air ventilation is an effective mitigation measure for the UHI effect. However, Hong Kong's urban wind environment is deteriorating due to intensive urban developments, which increase the surface roughness and block the free flow of air, leading to weaker urban air ventilation and higher urban thermal heat stress.

The human body senses our environment based on a range of environmental factors like air temperature, radiation and wind speed, etc. High air temperature and low wind speed lead to heat stress. Local public health researchers have found that heat stress is becoming an issue in urban Hong Kong. Higher temperature and weaker urban air ventilation can cause discomfort, thermal stress, and worse still, heat stress related health problems.

Higher air temperature and, more importantly, higher occurrence and longer duration of extreme weather, like heat waves, will have a severe impact on our urban living.



(**Top**) A graph showing the air temperature rise in Hong Kong over the last hundred years; note the acceleration in recent years (red line).

(**Bottom**) A graph showing the urban wind at King's Park as compared to the ambient wind at Waglan Island. Over the decades, the urban wind speed has nearly halved, mainly due to taller and bulkier buildings in our city.
Courtesy: Hong Kong Observatory

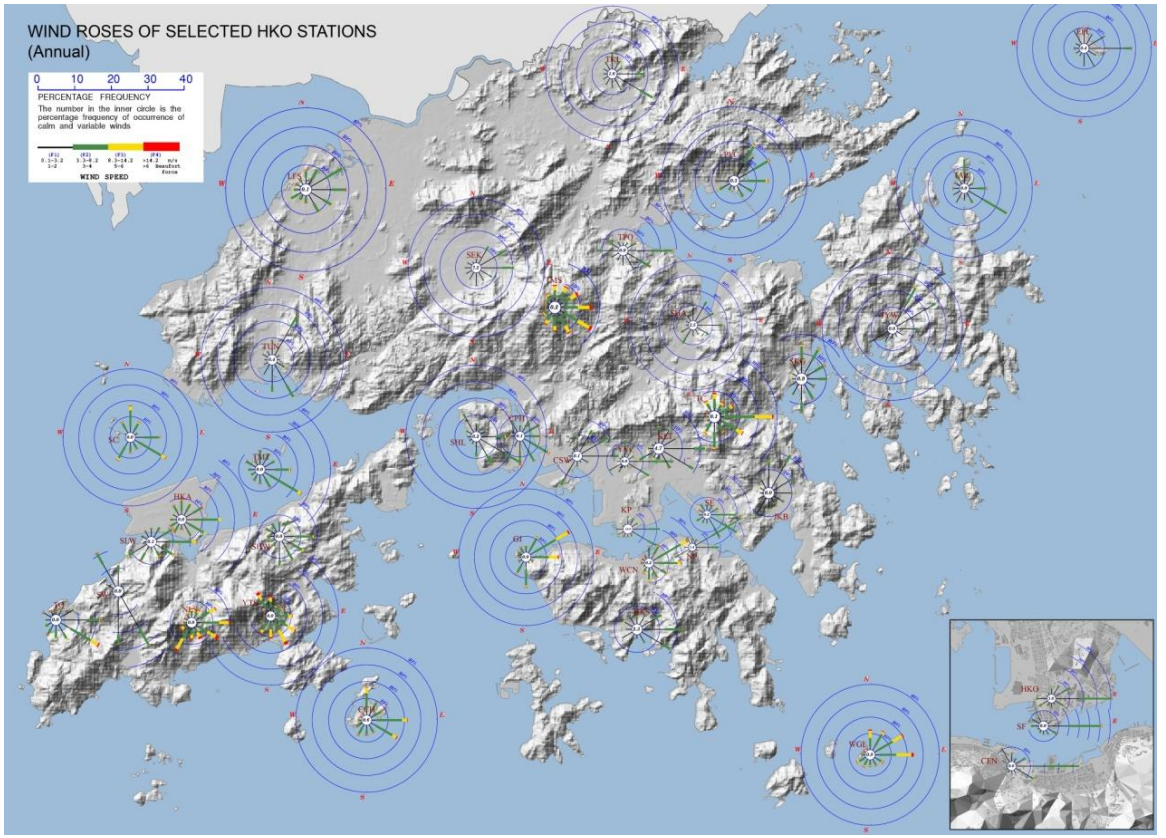
All in all, there is a need to plan and design our city to optimize the urban climatic condition and urban air ventilation based on a better understanding of the UHI phenomenon and the urban climate spatially.

We must find planning and design means to utilise Hong Kong's well-endowed wind environment, as well as to lower the urban air temperature when we further develop our city.

Hong Kong Observation Station Name	At pedestrian level hourly mean (m/s)
Hong Kong Observatory	1.57
Sha Tin	1.84
Tseung Kwan O	1.12
Sai Kung	2.09
Wong Chuk Hang	1.75
Tsing Yi Shell Oil Depot	1.66
Cheung Sha Wan	1.62
Kai Tak	2.51
Kowloon Star Ferry	2.44
North Point	2.24
Central Pier	2.27
Tuen Mun Government Offices	1.63

*The pedestrian level hourly mean wind speed is extrapolated based on the observations of selected HKO urban stations.

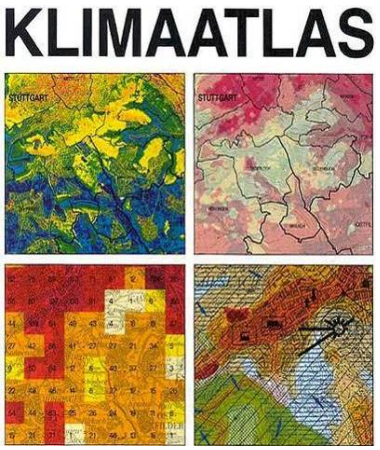
Hong Kong is well endowed with wind.
It only needs to be optimized by planners and designers with better designs.



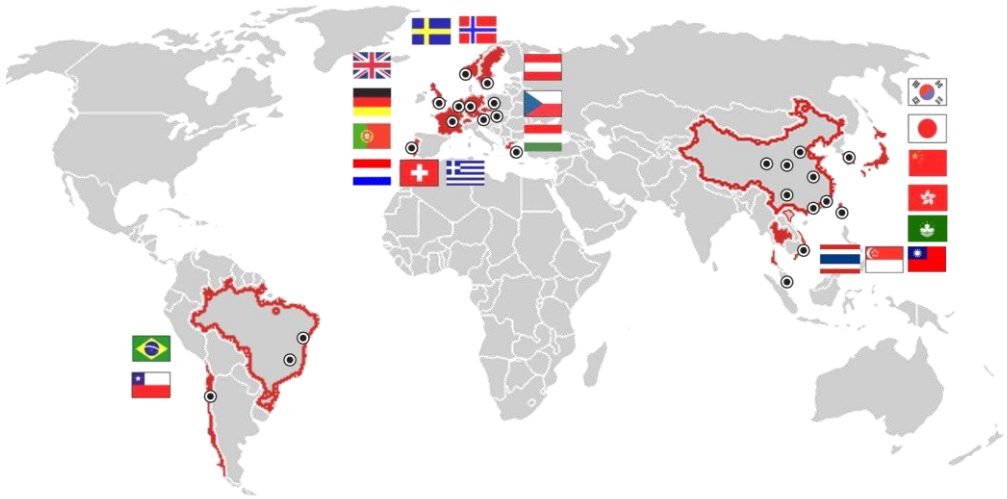
2 URBAN CLIMATIC MAPS

What is Urban Climatic Map?

Urban Climatic Map is an information and evaluation tool to integrate urban climatic factors and town planning considerations. Urban Climatic Map typically has two main components, *viz.* the **Urban Climatic Analysis Map** and the **Urban Climatic Planning Recommendation Map.**

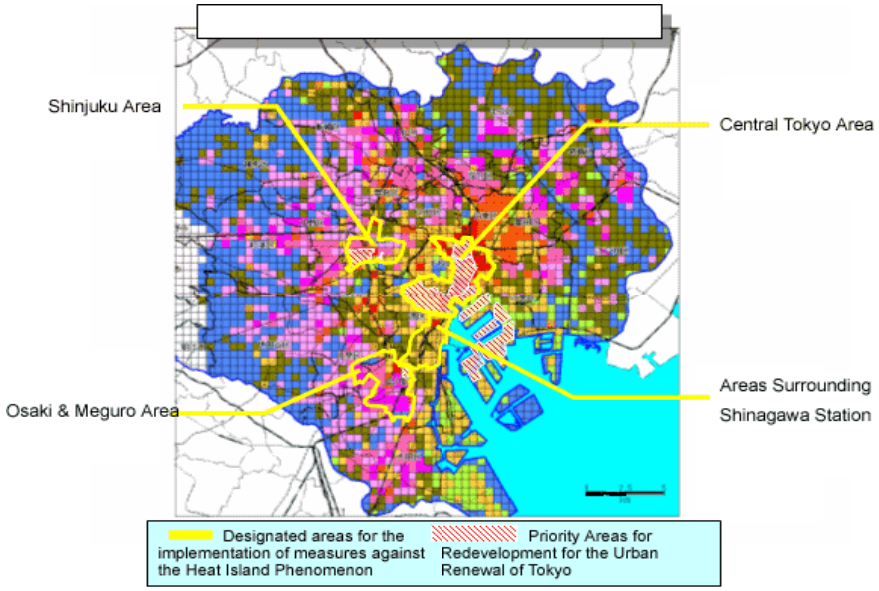


Climate Atlas produced by the Stuttgart Regional Federation



Countries that already have or will have their own urban climatic maps in assisting planning decisions

Ren, C., Ng, E. and Katzschner L. (2010) Urban Climatic Map Studies: a Review, International Journal of Climatology. DOI: 10.1002/joc.2237.



Urban Climatic Map Studies in Tokyo, Japan (2000 -)

Methodology and Classifications

The formulation of the **Hong Kong Urban Climatic Analysis Map** (UC-AnMap) has taken into account international experiences, including references to the Federal German Standard VDI-3787-Part1: Environmental Meteorology Climate and Air Pollution Maps for Cities and Regions, the Thermal Environmental Map studies of Japan and the unique climatic characteristics and urban morphologies of Hong Kong.

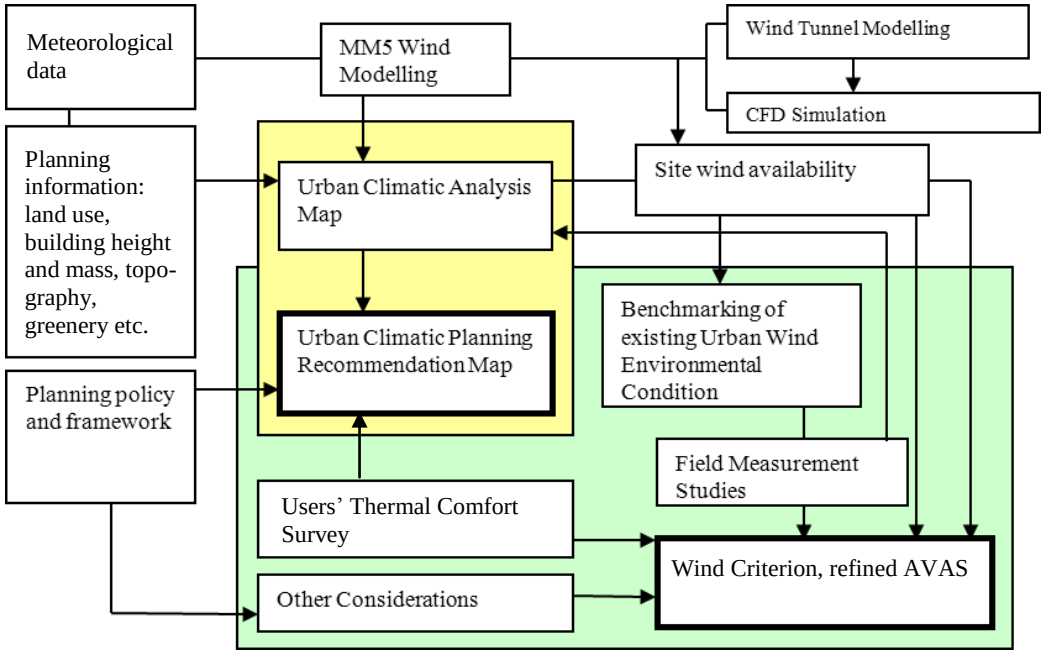
To start with, the urban climate of the city is analyzed based on a balanced consideration of **Thermal Load**[1] and **Dynamic Potential**[2] effects.

Thermal Load Analysis – the analysis focuses on the important variables contributing to the localized thermal loads. A major negative factor for the increase in thermal load is building volume, whilst topography and green space are positive factors contributing to a reduced thermal load.

Dynamic Potential Analysis – the analysis focuses on the important variables (ground roughness) affecting the wind environment. A major negative factor for the decrease in air ventilation is ground coverage, whilst natural landscape and proximity to openness are the main positive factors contributing to increased air movement.

Ng, E., (2010) Towards a Planning and Practical Understanding for the Need of Meteorological and Climatic Information for the Design of High Density Cities – a case based study of Hong Kong, International Journal of Climatology. DOI: 10.1002/joc.2292

Methodology of Formulating Urban Climatic Maps



1 Thermal Load measures the stored or emitted heat intensity of different localities of urban areas. It has an effect on intra-urban air temperature increase depending on (A) the building volume (which has an impact on heat storage, and blocking the sky view slowing the city's cooling at night), (B) the topography, and (C) the availability of green space.

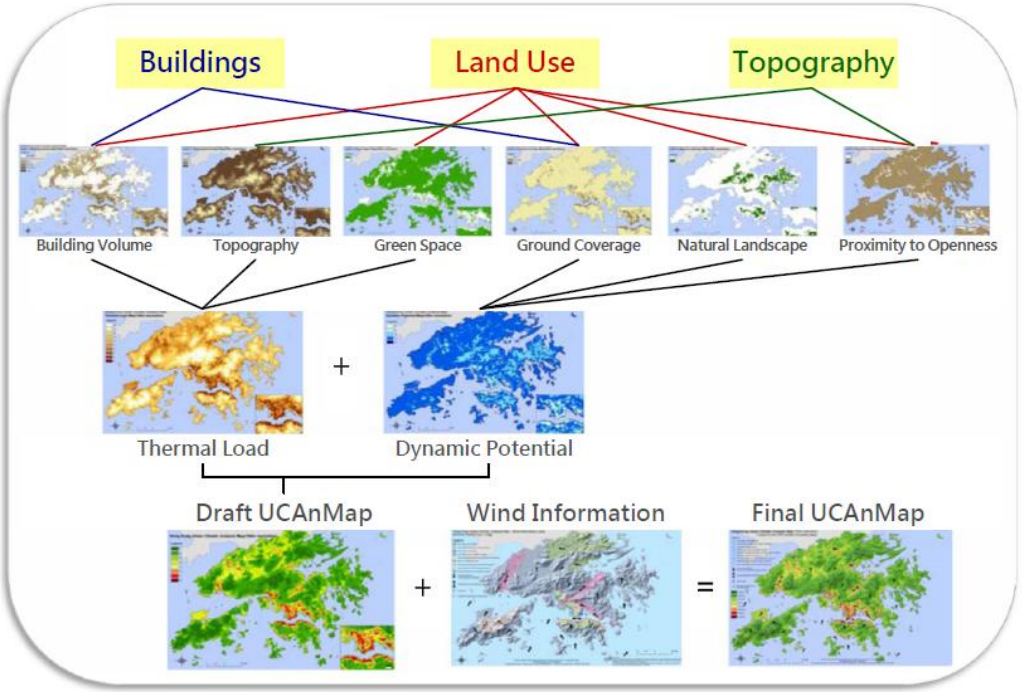
2 Dynamic Potential of an area depends mainly on its ground roughness which influences the air ventilation and air exchange of the areas. The main factors for evaluation include ground coverage of buildings, natural landscape and proximity to surrounding openness.

Urban climatic and geometric data with respect to the six thermal load and dynamic potential related factors are assembled. Physiological Equivalent Temperature (PET)[3], as a human urban thermal comfort indicator, is used to synergize and analyze all six factors according to their relationship and effects on wind and thermal comfort. Positive and negative classification values are assigned corresponding to gain or loss in thermal load and/or dynamic potential resulting from varying scales of each parameter. The resultant value denotes the net effect of the parameters on the urban climate.

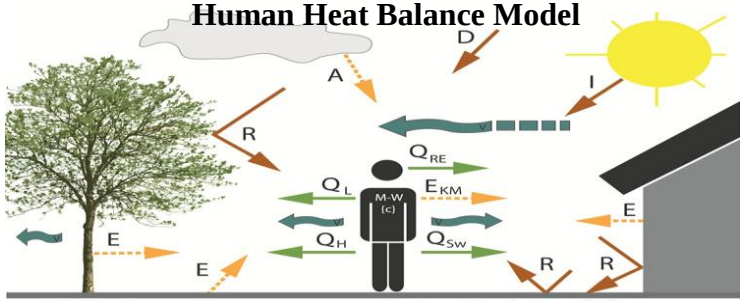
Based on the analysis and evaluation, the urban climatic factors are translated into eight different climatopes[4]/ classes in the form of the UC-AnMap.

Hong Kong is located in the sub-tropical climatic zone with hot summer months. To address urban thermal comfort, the UC-AnMap is developed to capture the most critical conditions in Hong Kong, i.e. the hot and humid summer months – June, July and August.

Urban Climatic Factors for Thermal Load & Dynamic Potential Analysis



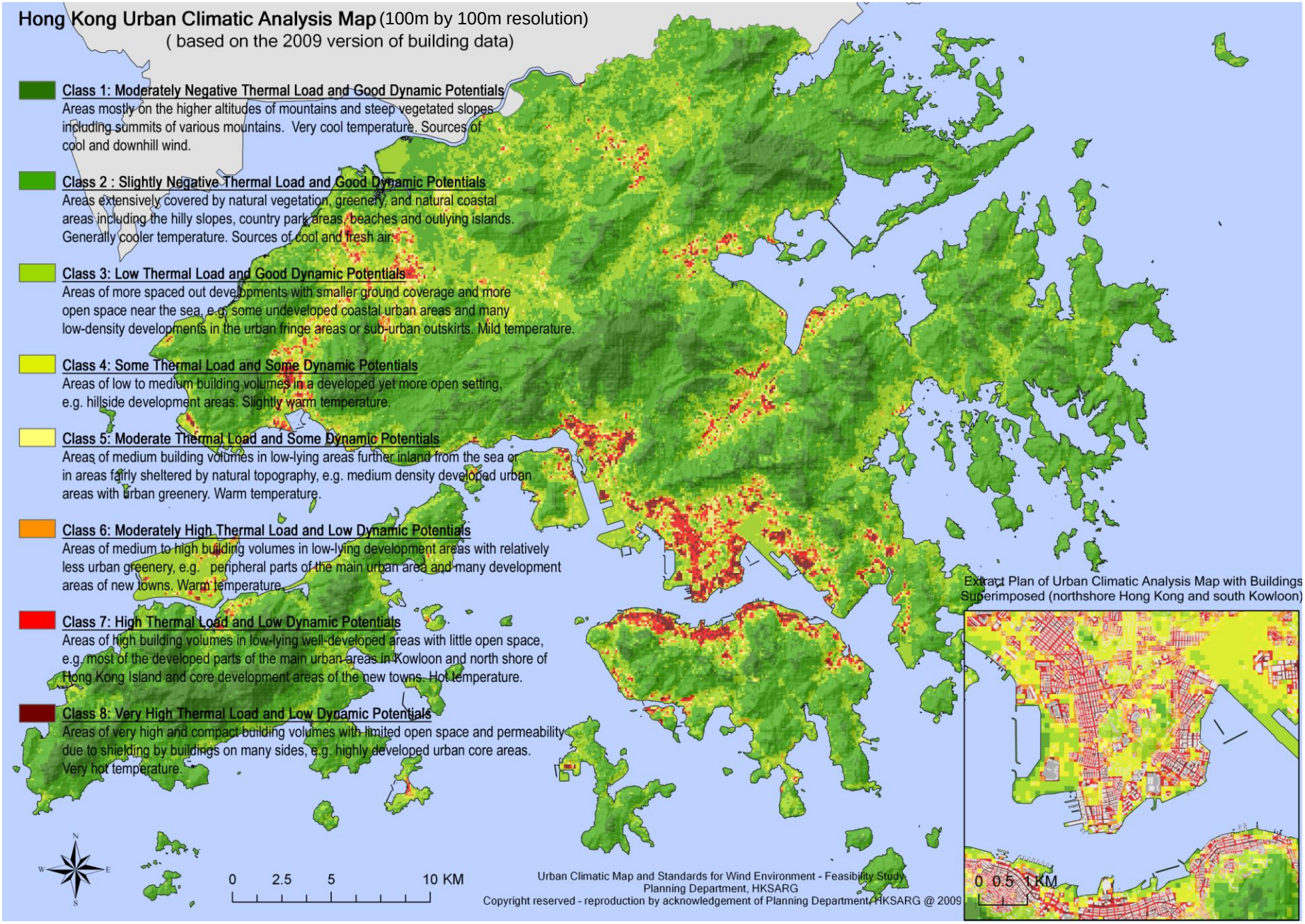
Human Heat Balance Model



M	metabolic rate	I	direct solar radiation
Q_H	turbulent sensible heat fluxes	D	diffuse solar radiation
Q_{SW}	turbulant latent heat fluxes	R	reflecting solar radiation
Q_L	latent heat fluxes by water vapour diffusion	A	atmospheric radiation
Q_{RE}	heat fluxes by respiration (sensible and latent	E	long-wave emission of the surrounding surface
V	wind speed	E_{KM}	infrared radiation of human surface
M-W	heat production by energy metabolism	{c}	thermal isolation of clothing

3 Physiological Equivalent Temperature (PET) is the temperature of a reference environment based on a heat balance model that combines various climatic and physiological variables including air temperature, relative humidity, solar radiation, air movement, clothing and metabolic rate to give a synergetic indicator of human thermal comfort. It is an index widely used to understand the thermal comfort environment of outdoor spaces.

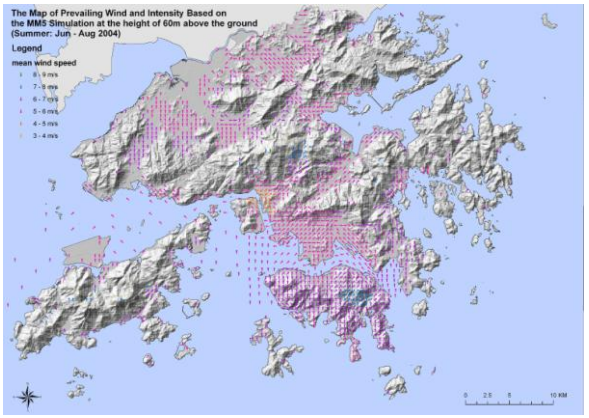
4 Climatopes are spatial units which exhibit relatively homogeneous urban climatic characteristics, for example open land, water or urban climatopes. Eight climatopes are identified for Hong Kong.

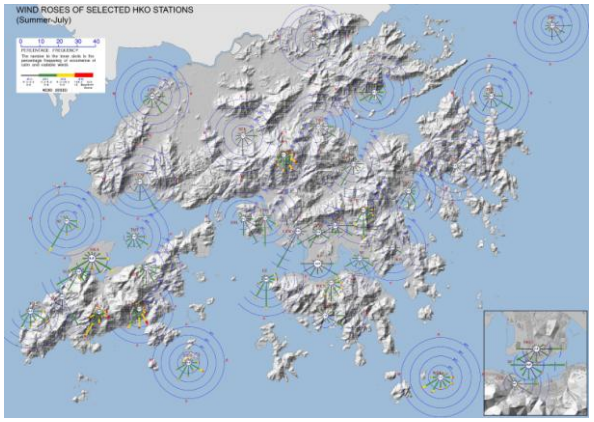


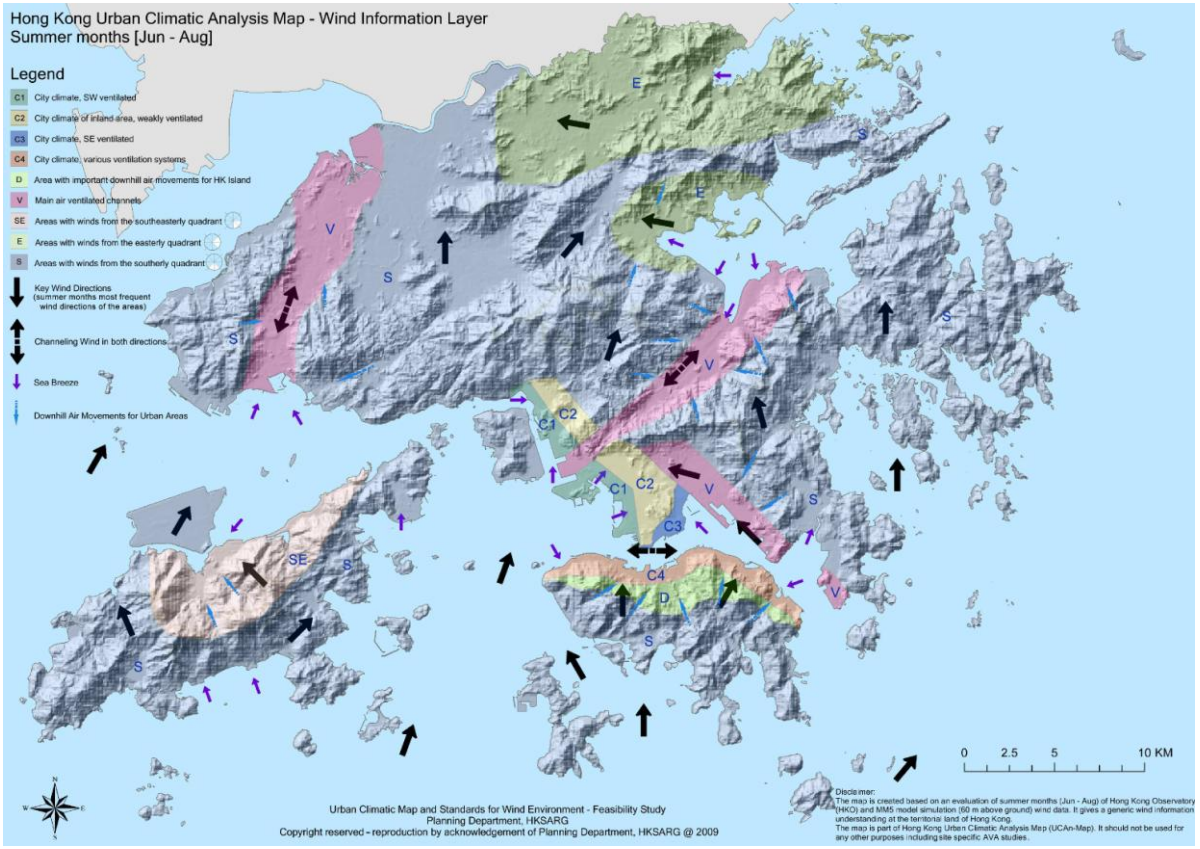
Wind Information Layer

A layer of wind information is prepared for Hong Kong based primarily on long term wind data collected at 40 Hong Kong Observatory stations (*figure: Top-left*), and supplemented with Hong Kong University of Science and Technology's MM5-CALMET modeled wind simulation data at 60m above ground [at roughly the average building height of urban Hong Kong] (*figure: Top-right*). Topography, greenery and ground roughness information are also referred to when the data are evaluated.

The wind data for the most critical summer months, i.e. June to August, of Hong Kong forms the basis of evaluation. The background wind including channeling effects due to topography, the localized land and sea breezes, as well as the downhill air movements are summarized in the wind information layer. Areas of similar characteristics are grouped into zones with their key characteristics and wind directions noted. The wind information layer (*figure: Bottom*) forms the basis of understanding, leading to the Hong Kong Urban Climatic Planning Recommendation Map (UC-ReMap).

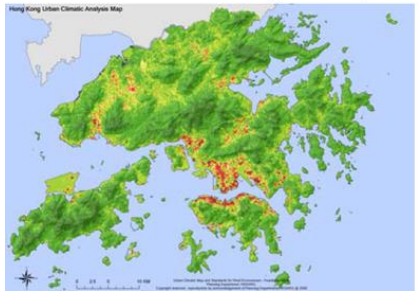




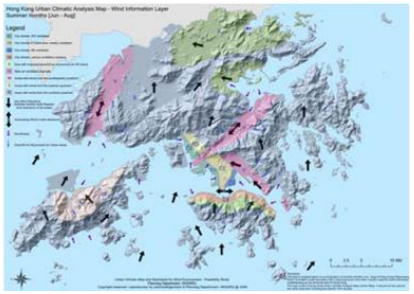


Urban Climatic Planning Recommendation Map

Urban Climatic Analysis Map



Wind Information Layer



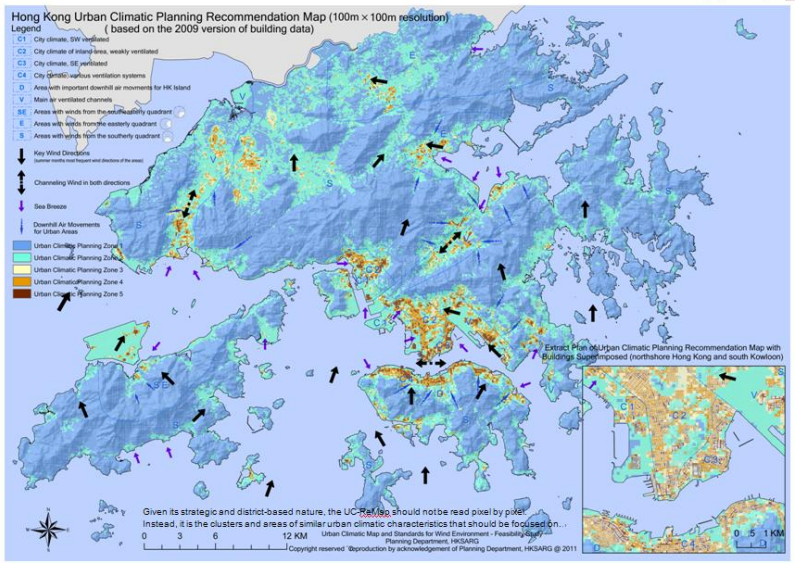
No	Urban Climatic Analysis Class	Impact on Thermal Comfort	Urban Climatic Planning Zone (UCPZ)
1	Moderate negative Thermal Load and Good Dynamics Potentials	●● Moderate	UCPZ 1 Urban climatically valuable area
2	Some negative Thermal Load and Good Dynamics Potentials	● Slight	
3	Low Thermal Load and Good Dynamics Potentials	- Neutral	UCPZ 2 Neutral urban climatically sensitive area
4	Some Thermal Load and Some Dynamics Potentials	● Slight	
5	Moderate Thermal Load and Some Dynamics Potentials	●● Moderate	UCPZ 3 Moderate urban climatically sensitive area
6	Moderately High Thermal Load and Low Dynamics Potentials	●●● Moderately strong	UCPZ 4 Highly urban climatically sensitive area
7	High Thermal Load and Low Dynamics Potentials	●●●● Strong	
8	Very High Thermal Load and Low Dynamics Potentials	●●●●● Very strong	UCPZ 5 Very highly urban climatically sensitive area

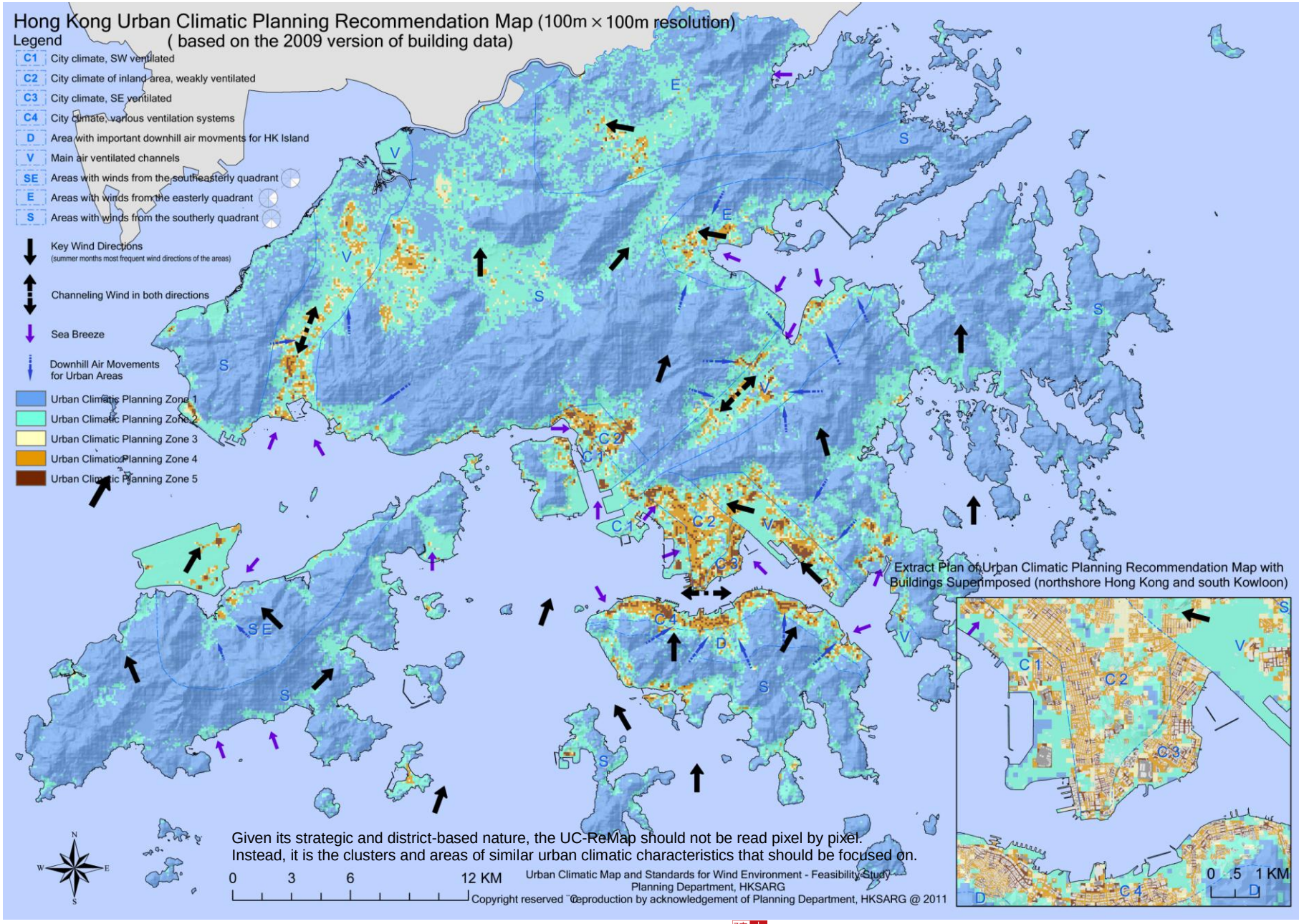
● negative (cooling) thermal impact ● positive (warming) thermal impact

In line with international practice, especially the experience gained by German and Japanese researchers, the urban climatic information collated in the form of the UC-AnMap with the Wind Information Layer superimposed are further evaluated and interpreted to formulate the **Urban Climatic Planning Recommendation Map** (UC-ReMap).

For clear and definable planning actions, the eight urban climatic classes of the UC-AnMap are consolidated into five **Urban Climatic Planning Zones** (UCPZ) of the UC-ReMap in accordance with their similar urban climatic characteristics with reference to the human thermal comfort and planning implications.

Planning recommendations are made with respect to each of the UCPZ to facilitate early consideration of urban climatic issues as one of the inputs in the strategic/district planning process.




Hong Kong Urban Climatic Planning Recommendation Map (100m × 100m resolution)
(based on the 2009 version of building data)
Legend
C1 City climate, SW ventilated
C2 City climate of inland area, weakly ventilated
C3 City climate, SE ventilated
C4 City climate, various ventilation systems
D Area with important downhill air movments for HK Island
V Main air ventilated channels
SE Areas with winds from the southeasterly quadrant
E Areas with winds from the easterly quadrant
S Areas with winds from the southerly quadrant
Key Wind Directions
(summer months most frequent wind directions of the areas)
Channeling Wind in both directions
Sea Breeze
Downhill Air Movements for Urban Areas
Urban Climatic Planning Zone 1
Urban Climatic Planning Zone 2
Urban Climatic Planning Zone 3
Urban Climatic Planning Zone 4
Urban Climatic Planning Zone 5
Extract Plan of Urban Climatic Planning Recommendation Map with Buildings Superimposed (northshore Hong Kong and south Kowloon)
Given its strategic and district-based nature, the UC-ReMap should not be read pixel by pixel.
Instead, it is the clusters and areas of similar urban climatic characteristics that should be focused on.
0 3 6 12 KM
Urban Climatic Map and Standards for Wind Environment - Feasibility Study
Planning Department, HKSARG
Copyright reserved ¨Ceproduction by acknowledgement of Planning Department, HKSARG @ 2011
0 .5 1 KM

Recommended Strategic Planning Actions

Based on the five UCPZs of the UC-ReMap, recommendations of "where" and "how" to develop our land can be made. This gives planners a reference when balancing urban climate with other planning considerations.

Urban Climatic Planning Zone (UCPZ) 1

These zones are extensively covered with natural vegetation, at higher altitude and with fewer obstructions to wind. They can provide a cooler and more conducive thermal comfort environment. Their cool air production capability can also be beneficial to nearby urban areas. Their urban climatic conditions should be preserved.

They are mostly country parks or non-development zones on statutory town plans. The broad strategic planning actions recommended are:

1 Natural areas especially sources of cold air production and drainage areas beneficial to other areas (e.g. vegetated hill slopes adjacent to urban areas) should be preserved. Sealing (covering of ground surface) or development should be discouraged.

2 In view of its urban climatic value, there is a general presumption against major development in this zone.

3 Small-scale and essential development may be allowed in areas other than in natural areas identified in 1 above subject to:

(a) careful planning and design of these developments to minimise any disruption to the existing urban climatic characteristics;

(b) maximising greenery and open areas; and

(c) minimising sealing (covering of ground surface).

Urban Climatic Planning Zone (UCPZ) 2

These zones are currently urban climatically “neutral’ in terms of urban thermal comfort. They are mostly urban fringe or rural lowland. It is important to maintain their urban climatic characteristics. The broad strategic planning actions recommended are:

1 General urban climatic characteristics such as lower building volume, open spaces and greenery should be maintained as far as possible.

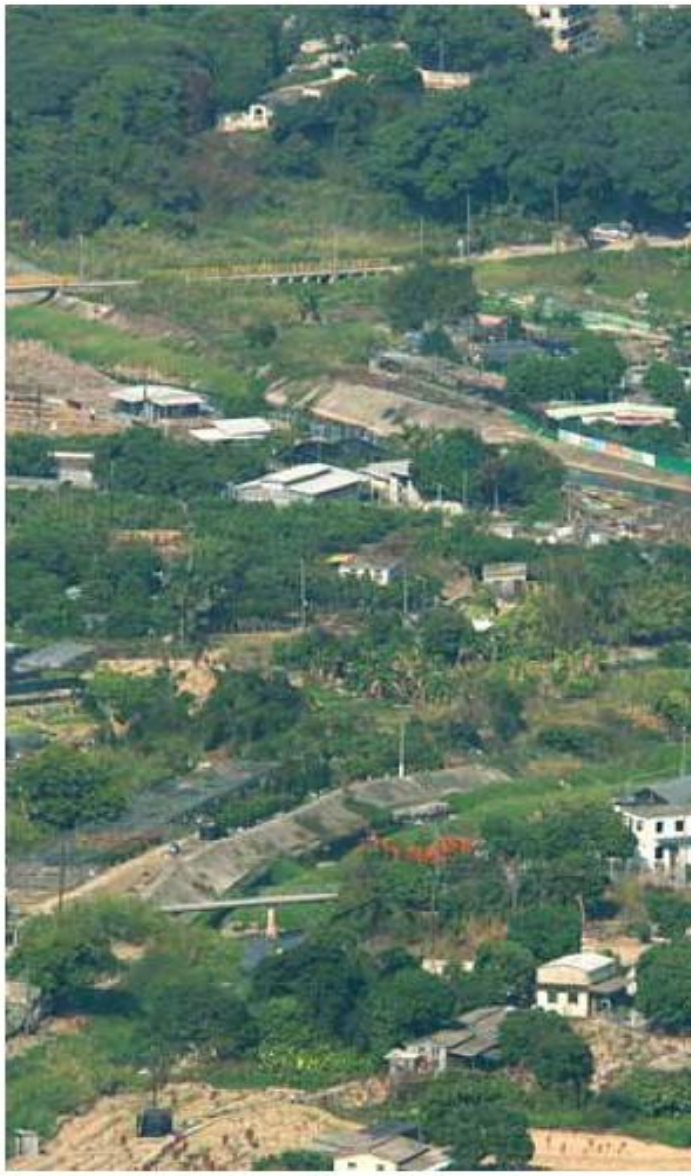
2 New low-density individual developments could be allowed subject to:

(a) a low building volume and a satisfactory disposition of buildings to align with the prevailing wind directions and preserve existing air paths;

(b) a low ground coverage in order not to impede air flow; and

(c) maximisation of greenery within development sites.

3 New comprehensive development is possible subject to thorough urban climatic consideration. Prudent planning and building design is necessary to avoid degrading the urban climatic condition. Breezeways and air paths must be carefully designed. Street grids and building disposition must respect prevailing wind directions. High building volume and ground coverage should be discouraged.



Urban Climatic Planning Zone (UCPZ) 3

These zones are currently subject to urban climatically “moderate” impact in terms of thermal comfort. Some mitigation actions are encouraged where possible. They are mostly in the urban fringe or less dense development areas. The broad strategic planning actions recommended are:

1 Additional development is permissible subject to:

(a) urban climatic evaluation in terms of building volume and green coverage;

(b) dispositioning of new buildings in line with the prevailing wind directions, to preserve/enhance existing air paths;

(c) reduction of ground coverage in order not to impede air movement; and

(d) maximisation of greening, particularly tree planting within development sites and adjoining streets.

2 Greening should be promoted in open areas as far as practicable.

Urban Climatic Planning Zone (UCPZ) 4

These zones are already densely built up. Thermal Load is high and Dynamic Potential is low. Some strong impact on thermal comfort is expected. Mitigation actions are recommended and necessary.

Isolated clusters of **UCPZ 4** can be found in the new towns in Tai Po, Ma On Shan, Yuen Long, Tin Shui Wai and Tung Chung, etc. These areas currently benefit from the surrounding extensive green areas (UCPZs 1 and 2), downhill air movements and valley winds. These green areas and natural ventilation systems should be preserved.

Other clusters of **UCPZ 4**, mixed with scattered **UCPZ 5**, can be found in Tseung Kwan O, Tuen Mun, Shatin and Aberdeen, etc. There are air paths and breezeways dividing the development clusters within these areas, which provide useful air ventilation reliefs.

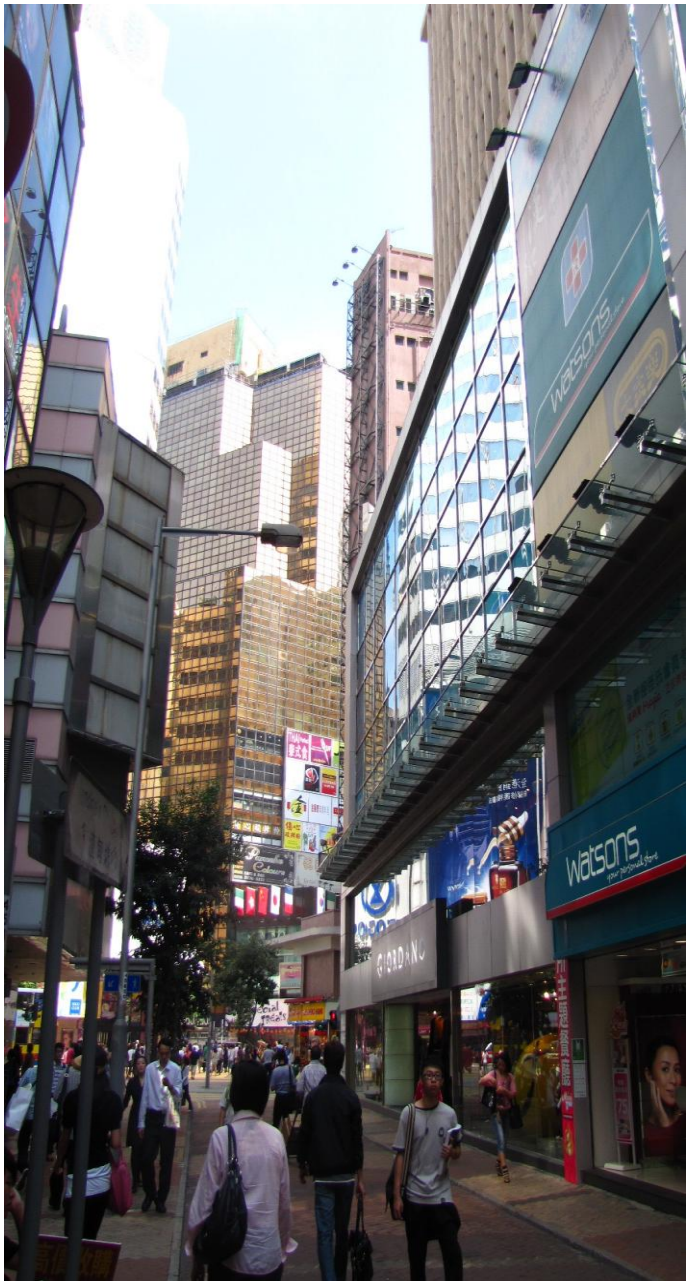
The broad strategic planning actions recommended are:

1 Air paths/breezeways, and low-rise, low-density 'Government, Institution or Community' (GIC) sites should be preserved as far as possible;

2 Greenery, particularly tree planting on streets and open areas, should be increased;

3 Additional development should not be allowed unless with appropriate mitigation measures, including:

   (a) reducing ground coverage to balance against any increase in building volume;
   (b) respecting existing air paths and introducing new ones, if feasible;
   (c) positioning buildings to align with the prevailing wind directions; and
   (d) maximizing greening within development sites.



Urban Climatic Planning Zone (UCPZ) 5

These zones are already very densely built. Thermal Load is very high and Dynamic Potential is low. Very strong impact on thermal comfort is expected. A high frequency of occurrence of thermal stress is anticipated. Mitigation actions are recommended and essential.

UCPZ 5, intermixed with UCPZ 4, are found in the metro areas of Hong Kong at the northern part of the Hong Kong Island, at the Kowloon Peninsula and at Tsuen Wan.

The broad strategic planning actions recommended are:

1 Intensification of GIC sites which serve as a relief to the existing condition should be avoided. Additional and intensified greening within the GIC sites is essential;

2 Additional greenery and tree planting on open areas and streets in this zone is essential and recommended. Intensified greening in “Open Space” zones is strongly recommended;

3 The existing urban environment should be improved by:

(a) identifying, respecting, widening and enhancing existing air paths;

(b) creating new air paths;

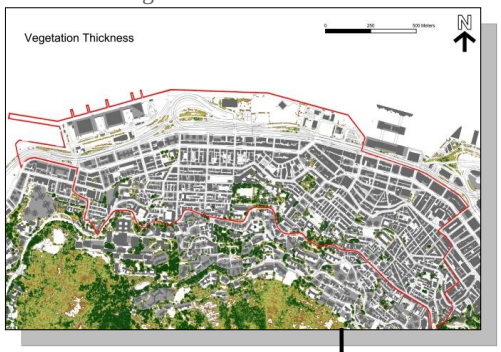
(c) reducing ground coverage, setting back building line along narrow streets, aligning the long frontage of building with prevailing wind directions; and

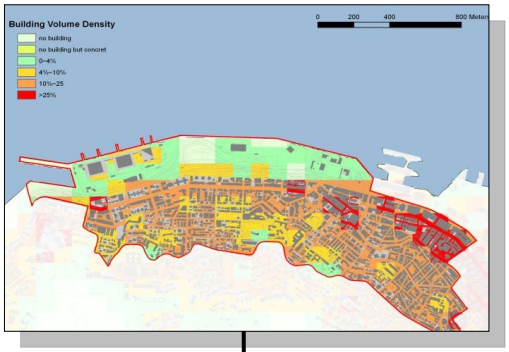
(d) maximizing on-site greening upon development /redevelopment;

4 Intensification of use, adding building volume and/or ground coverage are not recommended unless with strong justifications and appropriate mitigation measures.

Functions of the Urban Climatic Planning Recommendation Map

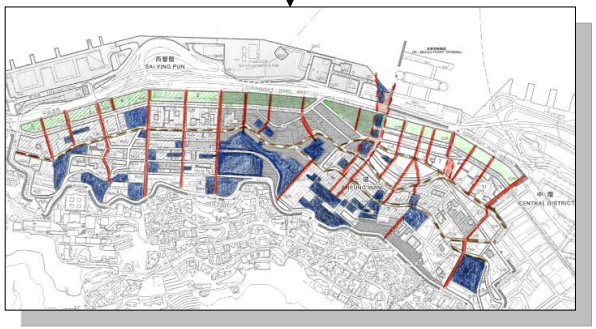
Case of Sheung Wan





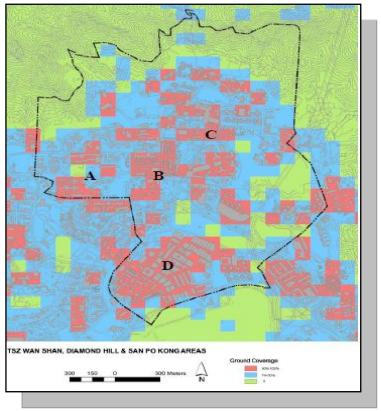
Understanding

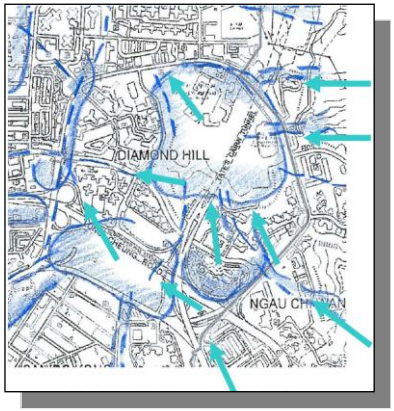
Analysis



Strategies

Case of San Po Kong





Issues

Solution

The UC-ReMap provides a strategic and comprehensive urban climatic planning framework and information platform for Hong Kong. It could serve the following forward planning functions:

- The UC-ReMap helps understand and identify appropriate planning and design measures for formulation of planning guidelines on matters related to urban climate.
- The UC-ReMap provides a strategic urban climatic information platform for guiding the planning and development process for future development, e.g. maximizing the mitigation opportunities within the UCPZs 3, 4 and 5, accommodating comprehensive new development areas in UCPZ 2 with prudent planning and building design measures.
- The UC-ReMap provides an urban climatic planning framework for reviewing OZPs and formulating suitable planning parameters.

The UC-ReMap is a broad-brush plan formulated based on urban climatic consideration. Planning proposals for specific sites have to take into account other planning considerations and the site context.

Planning and Design Measures to Improve Urban Climate

Based on the understanding of the Urban Climatic Maps, the following planning and design measures should thus be taken into account in project planning and formulation of development parameters. They could help improve the urban climate.

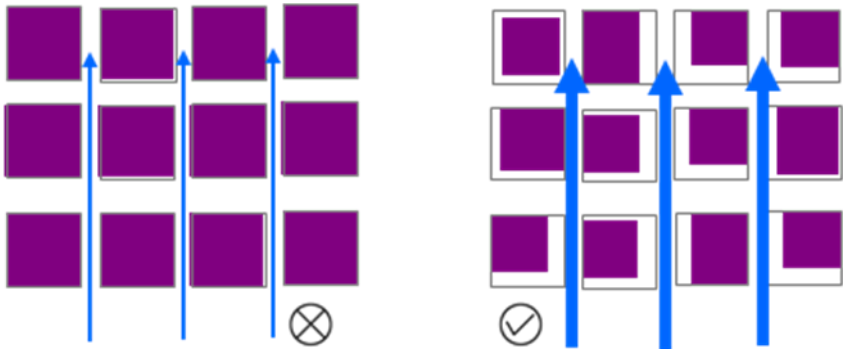
Green Spaces – *for lowering thermal load:*

- improve greenery, preferably tree planting at grade
- create urban green oasis
- establish network of connected green spaces
- roof top greening is desirable, however, not beneficial to thermal comfort at pedestrian level

Tree planting at grade is more effective than grass, shrubs and roof-top greening for providing human thermal comfort at the pedestrian level. Trees provide shades and reduce solar radiation. They also shade the ground and lower the paved surface's mean radiant temperature. The leafed tree crown creates an air volume with cooler air.

Ground Coverage –
for wind penetration:

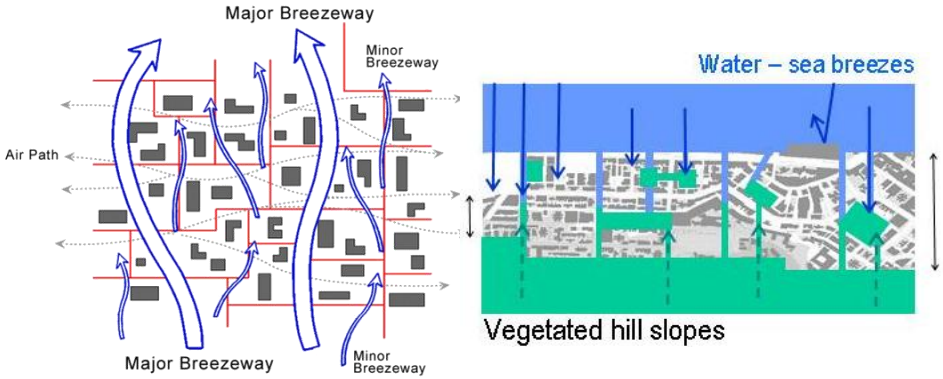
- reduce ground coverage
- encourage setback along narrow streets
- designate non-building area to allow air penetration
- reduce frontage areas of building to increase permeability

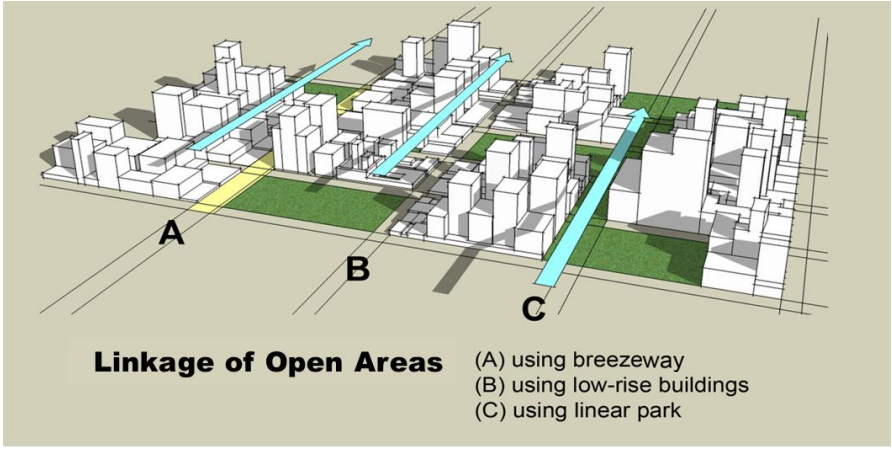


Ng, E., Yuan, C., Fung, J.C., Ren, C., & Chen, L., (2011) Improving the wind environment in high-density cities by understanding urban morphology and surface roughness: A study in Hong Kong, Landscape and Urban Planning 101 (1) 59-74.

Proximity to Openness & Connectivity –
for bringing air ventilation into the city:

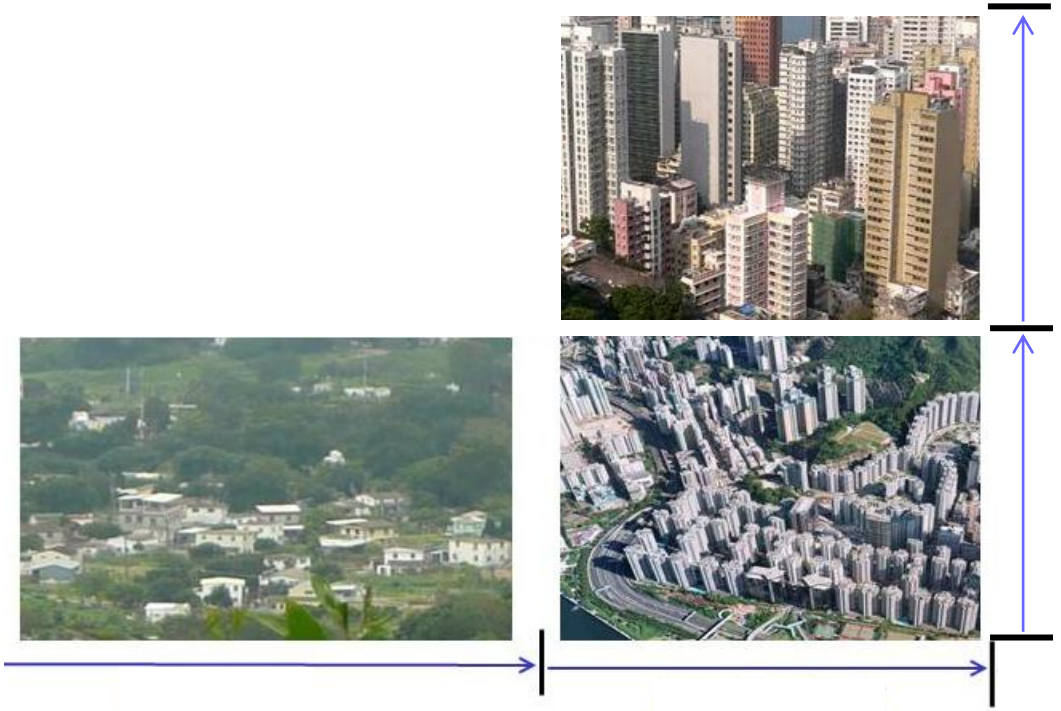
- preserve/create breezeways/air paths
- greening along breezeways provides cooler and cleaner air
- designate/orientate non-building areas perpendicular to waterfront and vegetated hill slopes
- connect green spaces through air paths





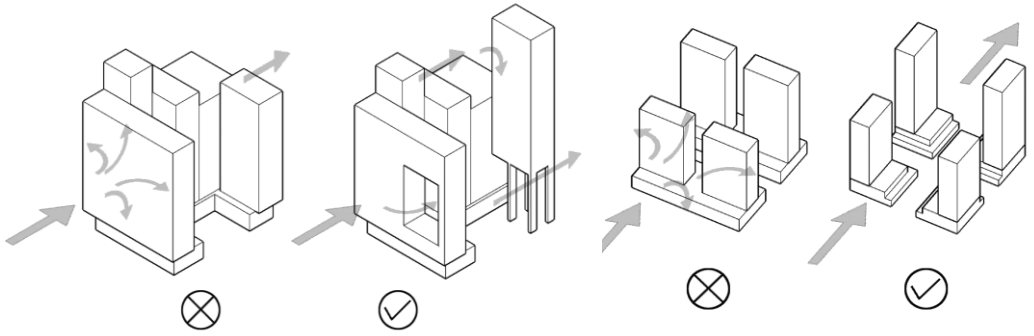
Building Volume – *for reducing thermal load and increasing urban cooling:*

- Scientifically, urban cooling depends on Sky View Factor, and thus the building volume
- The higher the building volume, the higher the thermal load as the localized heat capacity is increased whilst the radiative cooling effect in city at night is reduced
- In medium/high density areas, further development should be accompanied by appropriate building design to mitigate the increased thermal load



Building Permeability – *for wind penetration:*

- Closely packed buildings impede air flow
- Provide building gaps/separations. Making reference to the newly promulgated *Practice Note for Authorized Persons, Registered Structural Engineers and Registered Geotechnical Engineers* (PNAP) No. APP-152 on *Sustainable Building Design Guidelines* by the Buildings Department, building separation that provides a permeability equivalent to 20% to 33.3% of the total projected facades of the buildings is a good starting point for district planning and design.



Wong, M. S., Nichol, J.E., Ng, E., (2011) A study of the "wall effect" caused by proliferation of high-rise buildings in Hong Kong, using GIS techniques, Landscape and Urban Planning, 102, 245– 253.

Building Heights – *for urban ventilation:*

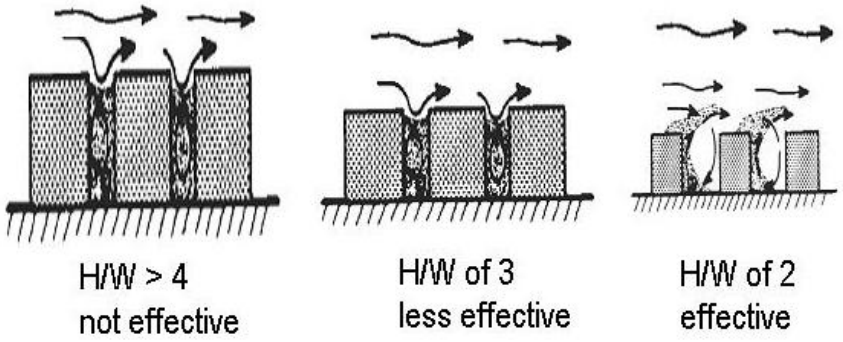
- In low/medium density areas with Building Height/Street Width (H/W) ratio of 2 or below, controlling building heights is effective in promoting air ventilation
- In medium/high density areas with H/W ratio of 3 or above, building height control alone may not be effective. Other parallel measures such as providing building separation, air paths, building setback and greenery, reducing ground coverage, etc. would be needed
- Given the same GFA, increase in floor-to-floor height will increase the building volume and thus thermal load. Thus, excessive floor-to-floor height should be avoided

Application

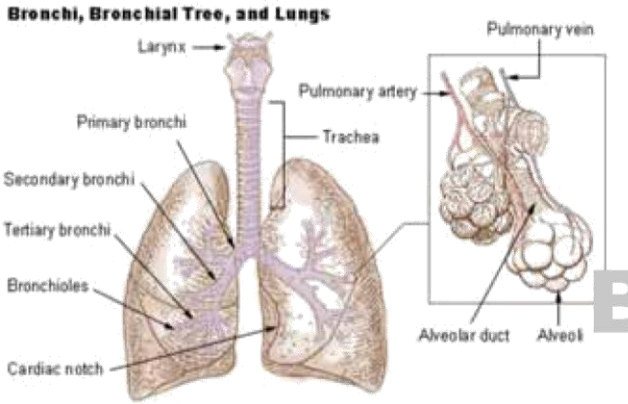
These planning and design measures are derived based on the urban climatic considerations with reference to the area average 100m by 100m grid understanding of the Urban Climatic Map and assuming urban homogeneity, they are not for direct application on individual site, but for guiding project planning and design at a district/area basis. In determining appropriate development parameters for individual sites, apart from these general planning measures, reference should also be made to other strategic and district planning considerations as well as individual site circumstances.

Chen, L., Ng, E., AN, X.P., Ren, C., He, J., Lee, M. Wang, U. and He, J. (2010) Sky View Factor Analysis of Street Canyons and its Implications for Intra-Urban Air Temperature Differentials in High-Rise, High-Density Urban Areas of Hong Kong: a GIS-Based Simulation Approach, International Journal of Climatology. DOI: 10.1002/joc.2243

Scientifically, urban air flow depends on Building Height/Street Width (H/W) ratio



3 BEYOND URBAN CLIMATIC MAPS – AIR VENTILATION



Planning Building

An analogy: the urban environment is akin to the human lung

For the lung to function properly, both the key bronchus (at the planning level) and the bronchioles and alveoli (at the building design level) must be free-flowing;

the two are inseparable.

Physiological Equivalent Temperature

Urban outdoor thermal comfort is important for people using outdoor spaces. The summer months are considered the most critical for urban thermal comfort in Hong Kong. Based on the Users' Thermal Comfort Survey, the neutral Physiological Equivalent Temperature (nPET) is 28^{o}C.

For the streets of Hong Kong, the mean radiant temperature under shading in the summer is typically 32 to 34°C, taking into account the average humidity and solar radiation. To achieve the nPET experienced by pedestrians, "light air" of 1 metre per second (m/s), as defined in the Beaufort scale, would be necessary.

Cheng, V., Ng, E., Chan, C. and Givoni, B., (2010) Outdoor Thermal Comfort Study in sub-Tropical Climate: a longitudinal study based in Hong Kong, International Journal of Biometeorology. DOI 10.1007/s00484-010-0396-z

Ng, E. and Cheng, V., (2011) Urban Human Thermal Comfort in Hot and Humid Hong Kong, Energy and Building. online 22 Sept 2011, ISSN 0378-7788, 10.1016/j.enbuild.2011.09.025.

Beaufort Number	Wind Speed (mph)	Seaman's Term		Effect on Land
0	<1	Calm		Calm smoke rises vertically
1	1-3	Light Air		Smoke drift indicates wind directions: vanes do not move
2	4-7	Light Breeze		Wind felt on face: leaves rustle; vanes begin to move
3	8-12	Gentle Breeze		Leaves, small twigs in constant motion; light flags extended;
4	13-18	Moderate Breeze		Dust, leaves and loose paper raised up; small branches move;
5	19-24	Fresh Breeze		Small trees begin to sway.
6	25-31	Strong Breeze		Large branches of trees in motion; whistling heard in wires.
7	32-38	Moderate Gale		Whole trees in motion; resistance felt in walking against the wind;
8	39-46	Fresh Gale		Twigs and small branches broken off trees.
9	47-54	Strong Gale		Slight structural damage occurs; slate blown from roofs.
10	55-63	Whole Gale		Seldom experienced on land; trees broken; structural damage occurs.
11	64-72	Storm		Very rarely experienced on land; usually with widespread damage.
12	>72	Hurricane Force		Violence and destruction.

** 1mph is equivalent to about 0.5m/s.*

Wind Performance Criterion

Balancing the optimum wind requirement and practical considerations of the existing built environment, a wind performance criterion comprising two components is proposed for development sites subject to Air Ventilation Assessment:

(A) Performance Requirement:

80% of all test points inside the assessment area as defined in the AVA Technical Circular should have:

Annual median hourly mean wind speed ≥ 1 m/s AND
Summer median hourly mean wind speed ≥ 1 m/s

95% of all test points inside the assessment area as defined in the AVA Technical Circular should have:

Annual median hourly mean wind speed ≥ 0.6 m/s AND
Summer median hourly mean wind speed ≥ 0.6 m/s

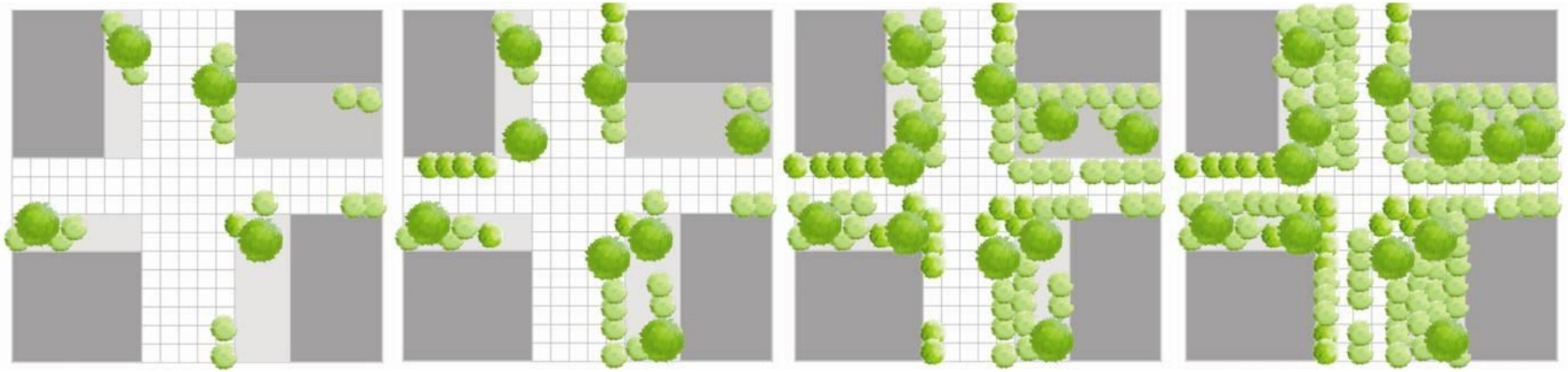
The requirement for 80% of all test points to achieve the wind speed of 1 m/s is in recognition of some unavoidable isolated wake areas behind buildings. The requirement of 95% of all test points to achieve a minimum wind speed of 0.6m/s is to safeguard against a stagnant wind environment.

(B) Alternative (Prescriptive) Approach:

The desirable light wind situation, especially in the summer months, may be difficult to achieve in some areas of Hong Kong due to the existing compact building morphology, such as high urban density, narrow streets, existing bulky buildings and large podia and hence the limited site wind available. For practicality consideration, an Alternative (Prescriptive) Approach is proposed to help mitigate the urban climatic impact arising from individual development.

Parametric studies have been carried out to test the effects of various mitigation measures. Tree planting and smaller ground coverage are found to be particularly useful in reducing the localized thermal load and contribute to increased air movement near ground level.

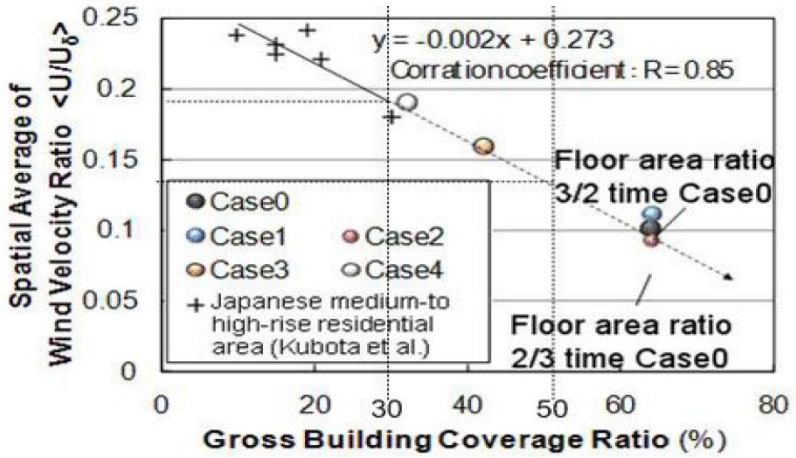
Local researchers have conducted studies using the micro-meteorological model ENVI-Met on effects of the amount, type and position of greening on pedestrian thermal comfort. The study has concluded that 30% greening (tree planting) may reduce urban temperature by 0.8ºC in the hot and humid summer daytime conditions of Hong Kong.



Tree Coverage	8%	10%	**30%**	50%
Temperature difference compared to base case	0.2ºC	0.4ºC	**0.8ºC**	1.3ºC

Ng, E., Liang, C., Wang, Y. N. and Yuan, C., (2011) A study on the Cooling Effects of Greening in High Density City: an experience from Hong Kong, Building and Environment, online 28 July 2011, ISSN 0360-1323, DOI: 10.1016/j.buildenv.2011.07.014.

Relationship between Spatial Average Velocity Ratio and Ground Coverage Ratio



Greenery lowers thermal load of the urban areas. On a district basis, about 1/3 of greened area may reduce thermal load by 1 urban climatic class hence reduce the reliance on urban air ventilation.

Local researchers have conducted studies using the wind tunnel test model on effects of the ground coverage ratio on the spatial average wind velocity ratio. The study has concluded that reducing ground coverage and increasing building permeability by about 1/3 can allow higher air volume near ground level and hence improve the dynamic potential of the urban areas in Hong Kong.

Ryuichiro Yoshie , Hideyuki Tanakaa and Taichi Shirasawa and Edward Ng, Experimental Study on Air Ventilation in a Built-up Area with Closely-Packed High-Rise Buildings, J. Environ. Eng., AIJ, Vol. 73 No. 627,661-667, May, 2008.

In January 2011, the Buildings Department issued a PNAP No. APP-152 to promote sustainable building design measures, which also target at the provision of building separation, setback and greenery. Taking into account the Study's analysis of various factors affecting urban climatic situation and the PNAP APP-152, an alternative (prescriptive) approach requiring the following mitigating design measures are formulated:

- ground coverage of no more than 65%;
- building (tower block) permeability as per PNAP No. APP-152;
- building setback requirement near narrow street as per PNAP No. APP-152; and
- greenery (preferably tree planting) of no less than 30% for sites larger than 1 ha, and 20% for sites below 1 ha at lower levels, preferably at grade. Sites smaller than 1,000m^2 are exempted.

Exemption

Developments with demonstrated functional requirements in terms of building length and/or ground coverage (e.g. infrastructural facilities, transport terminus, sports and civic facilities) may be exempted from the prescriptive design requirements, provided that the following measures are achieved:

- building separation requirement is fully complied with for other buildings on the same site or other parts of the building that are located above such special facilities being exempted, where applicable;

- an AVA be conducted to demonstrate that the design option with all practicable mitigation/improvement measures has been selected in comparing with different design options. No pedestrian areas will be subject to excessive wind speeds and no stagnant areas not flushed by breezes; and

- maximising greening and tree planting opportunities within the pedestrian zone, preferably at grade and at the part of the site not built over.

Refinements to Air Ventilation Assessment System

The AVA System has been in force since 2006. Based on the Study findings and a review of the completed AVAs, the following major refinements to the AVA System are proposed:

- Include the proposed wind performance criterion as a quantitative yardstick to confirm acceptance of design options.

- Extend the AVA requirements to cover both public and private sector projects.

- Include non-waterfront development sites with lot frontage over 140m in the category of projects requiring AVA, i.e. second part of item (i) as shown in the table to the right.

There are also some methodological and technical refinements to the AVA System as follows:

- Median hourly mean wind speed is added as an indicator to measure the wind performance.

- Summer thermal comfort is critical. The air ventilation impact of the proposal in summer months, apart from the prevailing situation, is to be analyzed as a study requirement.

- A set of standardized site wind availability data is recommended to improve the accuracy and ensure a consistent baseline condition for AVAs. The Planning Department is currently conducting a Consultancy Study on Establishment of Simulated Site Wind Availability Data for Air Ventilation Assessments in Hong Kong.

Category	List of projects requiring AVA
District-Based AVA	a) Planning studies for new development areas;
	b) Comprehensive land use restructuring schemes, including schemes that involve agglomeration of sites together with closure and building over of existing streets;
	c) Area-wide plot ratio and height control reviews;
Site-Based AVA	d) Developments on sites of over 2 hectares and with an overall plot ratio of 5 or above;
	e) Development proposals with total Gross Floor Area exceeding 100,000 sq. m;
	f) Developments with podium coverage extending over one hectare;
	g) Developments above public transport terminus;
	h) Buildings with height exceeding 15 meters within a public open space or breezeway designated on layout plans / outline development plans / outline zoning plans or proposed by planning studies;
	i) Developments on waterfront sites with lot frontage exceeding 100 meters in length or non-waterfront sites with lot frontage exceeding 140 meters in length;
	j) Extensive elevated structures of at least 3.5 meters wide, which abut or partially cover a pedestrian corridor along the entire length of a street block that has / allows development at plot ratio 5 or above on both sides; or which covers 30% of a public open space.

New addition

4 WAY FORWARD

Based on the UC-ReMap, it is clear that opportunities to mitigate the high thermal load and low dynamic potential within the UCPZs 3, 4 and 5 need to be maximized, whereas the long-term development needs may be accommodated in UCPZ 2 subject to prudent planning and building design measures. The Study recommends a package of measures, including the planning and design guidelines to improve the urban climatic environment, the wind performance criterion and the revised AVA System. These measures have to be implemented through concerted efforts by both the public and the private sectors.

By Government

- incorporate the UC-ReMap, the wind performance criterion and the planning and design measures to improve the built environment into the Hong Kong Planning Standards and Guidelines to guide both public and private development projects;

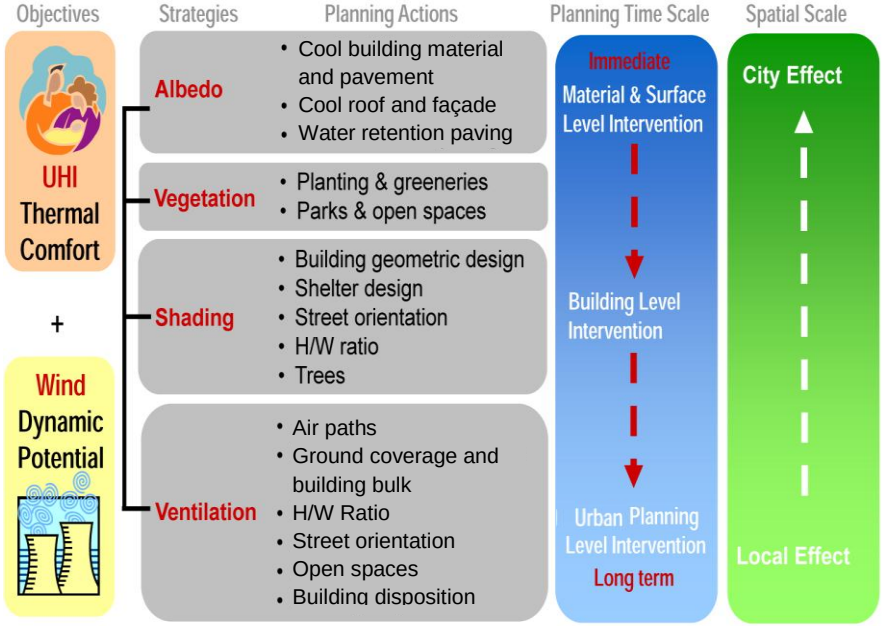
- suitably amend the joint Technical Circular No. 1/06 on AVA to reflect the refined methodology and wind performance criterion for AVA;

- at district level, coordinate suitable planning measures to increase permeability and reduce thermal load by regulating building density, building height and ground coverage, introducing breezeway/air path, connecting green and open space etc. The Planning Department, in this respect, has already been stipulating appropriate planning and building design measures on statutory town plans as appropriate and during the planning of new development areas such as the Kai Tak development;

- require public projects in their early planning and design stage to carry out AVAs in accordance with the revised Technical Circular and demonstrate acceptability from air ventilation point of view; and

- widely promote greenery, particularly tree planting, in the public realm and open spaces so as to improve the thermal comfort of the urban environment.

Strategies to Mitigate Thermal Load and Improve Dynamic Potential



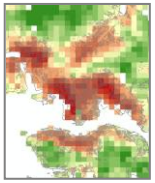
By Private Sector

- incorporate appropriate building design to ensure no adverse impact on the urban climatic environment; and

- demonstrate air ventilation acceptability when required in application for planning permission and lease modification or demonstration of compliance with the relevant requirement under the *Sustainable Building Design Guidelines* for applying for GFA concession.

Notwithstanding the above, it must be stressed that sustainable development is a matter of balancing environmental, social and economic needs. Urban climatic issue is but one of the important considerations in the planning and design process.

All in all, through the concerted efforts of the public and private sectors, the urban climatic condition and quality of the living environment in Hong Kong would gradually improve for the better, to the benefit of our future generations.



**The Planning Department of HKSAR Government acknowledges the kind assistance of Building Research Institute, Japan and the National Institute for Land and Infrastructure Management, Japan for producing the "heat map", using their Urban Climate Simulation System (UCSS) under the leadership of Dr Yasunobu Ashie, for incorporation into the Hong Kong Urban Climatic Analysis Map.*

5 SUGGESTIONS AND COMMENTS

1

Whether urban climatic issues should form part of the planning and design considerations?

2

Do you agree that actions should be taken to improve the urban climate of Hong Kong?

3

What are your views on the Draft Urban Climatic Planning Recommendation Map and the broad strategic planning actions to guide district planning?

4

What are your views on the proposed wind performance criterion including the wind performance requirement, the alternative approach and the exemption provision?

5

Do you agree that both the public and the private sectors have a role to play in addressing the urban climatic issues in Hong Kong?

6

Do you have any other views?

Thank You

Your views and comments are very important to us. They will form a valuable reference for finalizing the recommendations.

Please forward your views and comments **by 15 Feburary 2012** to

Urban Design and Landscape Section
Planning Department

Address:
15/F, North Point Government Offices,
333 Java Road, North Point,
Hong Kong

Tel: 2231-5067
Fax no.: 2116-0752
Email Address: ucm@pland.gov.hk

Disclaimer: A person or an organization providing any comments and views on the Urban Climatic Map and Standards for Wind Environment – Feasibility Study shall be deemed to have given consent to the Planning Department to wholly or partially publish the relevant comments and views (including the names of the individuals and organizations). If you do not agree with this arrangement, please state so when providing your comments and views.

Planning Department
December 2011

THE CONSULTANT TEAM

Project Director	**Prof. Edward Ng**	**(School of Architecture, The Chinese University of Hong Kong)**
Core Co-Investigators	Ms. Betty Ho	(PlanArch Consultant Company)
	Prof. Kenny Kwok	(CLP Power Wind/Wave Tunnel Facility, The Hong Kong University of Science and Technology)
	Prof. Lutz Katzschner	(Department of Architecture, Urban and Landscape Planning, University of Kassel)
	Dr. Raymond Yau	(Ove Arup & Partners HK Ltd.)

PlanArch Consultants Ltd. 建港規劃顧問有限公司 | 建築 中大 | ARUP | 香港科技大學 THE HONG KONG UNIVERSITY OF SCIENCE AND TECHNOLOGY | UNIKASSEL VERSITÄT

Key Team Experts and Advisors

Prof. Akashi Mochida
(Department of Architecture and Building Science, Tohoku University)

Prof. Alexis Lau
(Institute for the Environment, The Hong Kong University of Science and Technology)

Prof. Bernard Lim
(Department of Architecture, The Chinese University of Hong Kong)

Prof. Jimmy Fung
(Department of Mathematics, The Hong Kong University of Science and Technology)

Mr. Kam Sing Wong
(Department of Architecture, The Chinese University of Hong Kong)

Dr. Peter Hitchcock
(CLP Power Wind/Wave Tunnel Facility, The Hong Kong University of Science and Technology)

Prof. Ryuichiro Yoshie
(Department of Architecture, Tokyo Polytechnic University)

Dr. Nyuk Hien Wong
(Department of Building, National University of Singapore)

Prof. Baruch Givoni
(Department of Architecture, University of California, Los Angeles)

Dr Ing. Bernd Leitl
(Meteorological Institute, University of Hamburg)

Dr Marcus O Letzel
(PALM Group, Leibniz University of Hannover)

Dr. Vincent Cheng
(Ove Arup & Partners HK Ltd.)

Prof. Mat Santamouris
(Department of Applied Physics, University of Athens)

Prof. Phil Jones
(Welsh School of Architecture, Cardiff University)

Prof. See Chun Kot
(Department of Mechanical Engineering, The Hong Kong University of Science and Technology)

Prof. Shuzo Murakami
(Department of System Design Engineering, Keio University)

Prof. Stephen Belcher
(Ove Arup & Partners HK Ltd.)

Prof. Tze Wai Wong
(Deparment of Community and Family Medicine, The Chinese University of Hong Kong)

Prof. Edmund Choi
(Department of Building and Construction, City University of Hong Kong)

Prof. Janet Nichol
(Department of Land Surveying and Geo-informatics, The Hong Kong Polytechnic University)

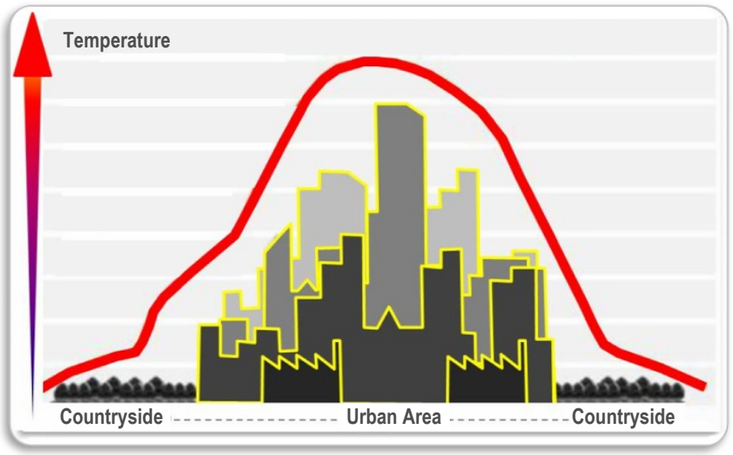
Prof. W K Chow
(Department of Building Services Engineering, The Hong Kong Polytechnic University)

Dr. Yasunobu Ashie
(National Institute for Land and Infrastructure Management, MLITT, Japan)

Urban Climatic Map and Standards for Wind Environment - Feasibility Study

FEELING THE INCREASING HEAT?

The **Urban Heat Island** (**UHI**) effect in Hong Kong is intensifying. The urban area is significantly warmer than its surrounding rural/natural areas due to a dense concentration of buildings and urban activities, urban emissions, congested public spaces and insufficient greenery, etc.



▲ Urban Heat Island (UHI) Effect

Increasing urban temperature and reducing urban wind lead to human thermal discomfort and heat stress.

ACTION REQUIRED?

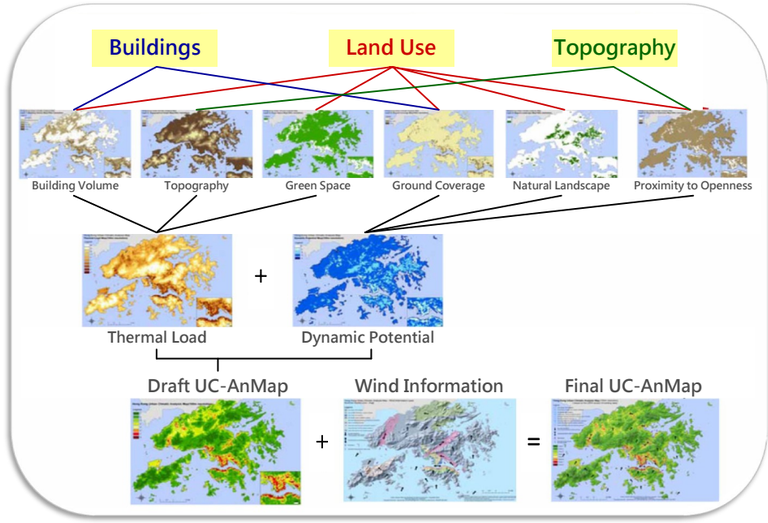
To help mitigate the UHI effect and improve quality of the living environment through better planning and urban design, we have launched the **Urban Climatic Map and Standards for Wind Environment - Feasibility Study** (**UCM Study**). It aims to examine the urban climatic characteristics of the territory and to make planning recommendations based on urban climatic considerations.

In the Report on the Public Engagement Process on *Building Design to Foster a Quality and Sustainable Built Environment*, the Council for Sustainable Development recommends, amongst others, the Government to consider incorporating more scientific considerations in the planning process. The Urban Climatic Map serves this purpose.

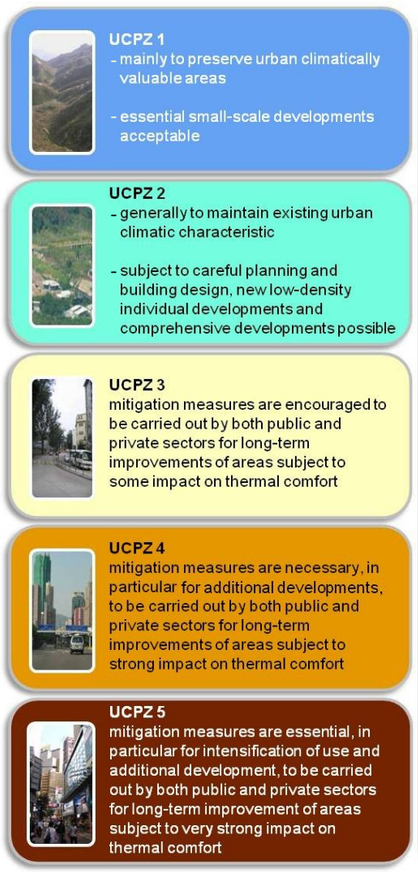
STUDY RECOMMENDATIONS

1 **Urban Climatic Analysis Map** (**UC-AnMap**) - Based on an analysis of 6 urban climatic factors which affect thermal load (heat gain capacity) and dynamic potential (air ventilation capacity) and hence have impact on human thermal comfort, 8 urban climatic classes of Hong Kong are mapped.

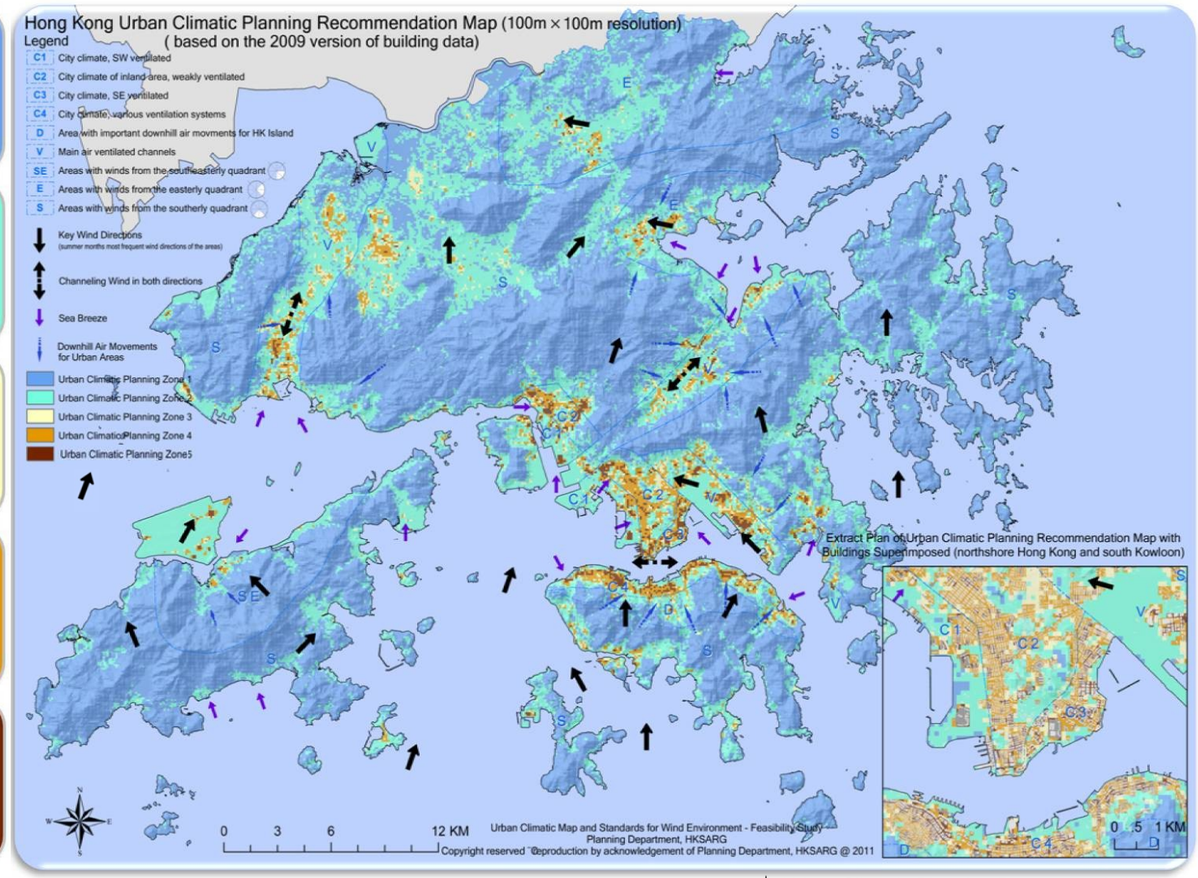
2 **Urban Climatic Planning Recommendation Map** (**UC-ReMap**) - The 8 urban climatic classes of the UC-AnMap are consolidated into 5 **Urban Climatic Planning Zones** (**UCPZs**) of similar human thermal comfort and planning implications. The UC-ReMap provides a strategic and comprehensive planning framework to guide broad strategic planning actions for each of the UCPZs.



▲ Analysis of Climatic Factors for Formulating the Urban Climatic Analysis Map

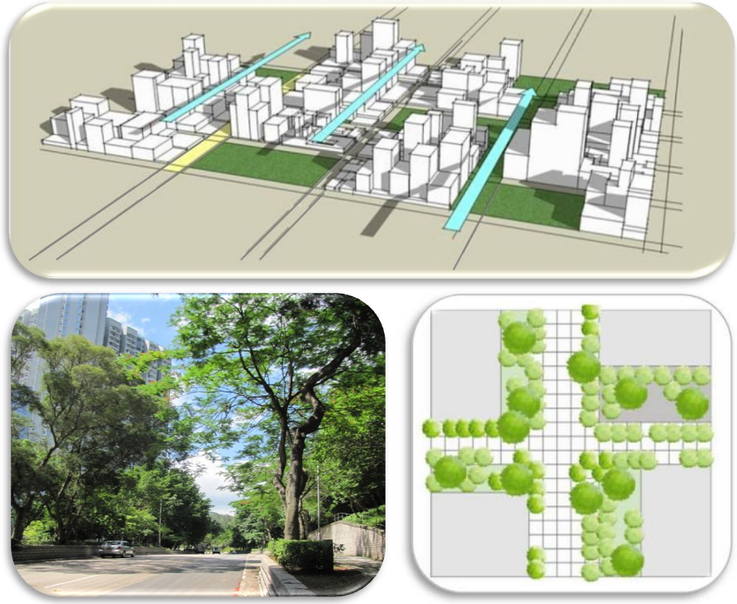


▲ Recommended Strategic Planning Actions



▲ Urban Climatic Planning Recommendation Map

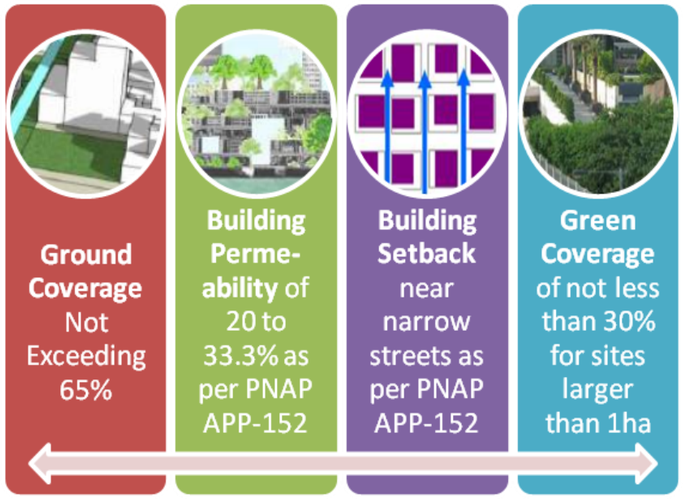
3 **Planning Guidelines** - Planning and design measures to improve the urban climate are proposed to guide project planning, formulation of development parameters and layout/ building design. They aim to lower thermal load through greening and to promote air ventilation through reducing ground coverage, improving building permeability and connecting low-rise developments/ open areas to create air paths, etc.



Planning and Building Design Measures to Improve Urban Climate

4 **Wind Performance Criterion for Air Ventilation Assessment (AVA)** - The AVA System has been in force since 2006. The Study proposes a minimum wind speed of 1 metre per second at street level to achieve pedestrian thermal comfort for projects requiring AVA. Due to the existing compact building morphology in some areas of Hong Kong, this may not be practically achievable. Therefore, the Study proposes an Alternative (Prescriptive) Approach comprising four mitigating design requirements detailed below, which has taken into account the recent Practice Note for Authorised Persons, Registered Structural Engineers and Registered Geotechnical Engineers (PNAP) No. APP-152 on *Sustainable Building Design Guidelines* issued by the Building Authority.

Exemptions - Developments with demonstrated functional requirements in terms of building length and/or ground coverage could be exempted, e.g. infrastructural facilities, transport terminus, sports and civic facilities, etc.



Requirements under Alternative (Prescriptive) Approach

5 **Refinements to the Air Ventilation Assessment System** - The AVA System is to be refined to incorporate the wind performance criterion, extend the scope of application to cover both public and private projects and include other methodological/ technical refinements.

OUR FUTURE

Through the implementation of the Study recommendations with concerted efforts of the public and private sectors, the urban climatic condition and quality of the living environment in Hong Kong would gradually improve for the better, to the benefit of our future generations.

A Quality Urban Environment for the Future

SUGGESTIONS AND COMMENTS

Your views and comments on the Study recommendations are very important to us. They will form a valuable reference for finalizing the way forward. If you wish to know more about the Study before forwarding your views, please visit our website at:

www.pland.gov.hk/pland_en/p_study/prog_s/ucmapweb/index.htm

You may forward your views and comments **by 15 February 2012** to

Urban Design and Landscape Section,
Planning Department
15/F, North Point Government Offices,
333 Java Road, North Point,
Hong Kong

Tel.: 2231-5067
Fax.: 2116-0752
Email Address:
ucm@pland.gov.hk

You are cordially invited to the stakeholder engagement forum to be held in early 2012. The detailed arrangements for the forum shall be announced on our website shortly.

THANK YOU

Planning Department
December 2011

PlanArch Consultants Ltd. 建港規劃顧問有限公司

Disclaimer: A person or organization providing any comments and views on the Urban Climatic Map and Standards for Wind Environment - Feasibility Study shall be deemed to have given consent to the Planning Department to wholly or partially publish the relevant comments and views (including the names of the individuals and organizations). If you do not agree with this arrangement, please state so when providing your comments and views.