



## Urban Climate Map Application in High Density Cities: A Case Study of Macau

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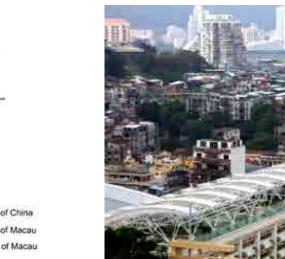
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## Background:

Macau Landuse for Recent 20 Years





Macau Cityscape



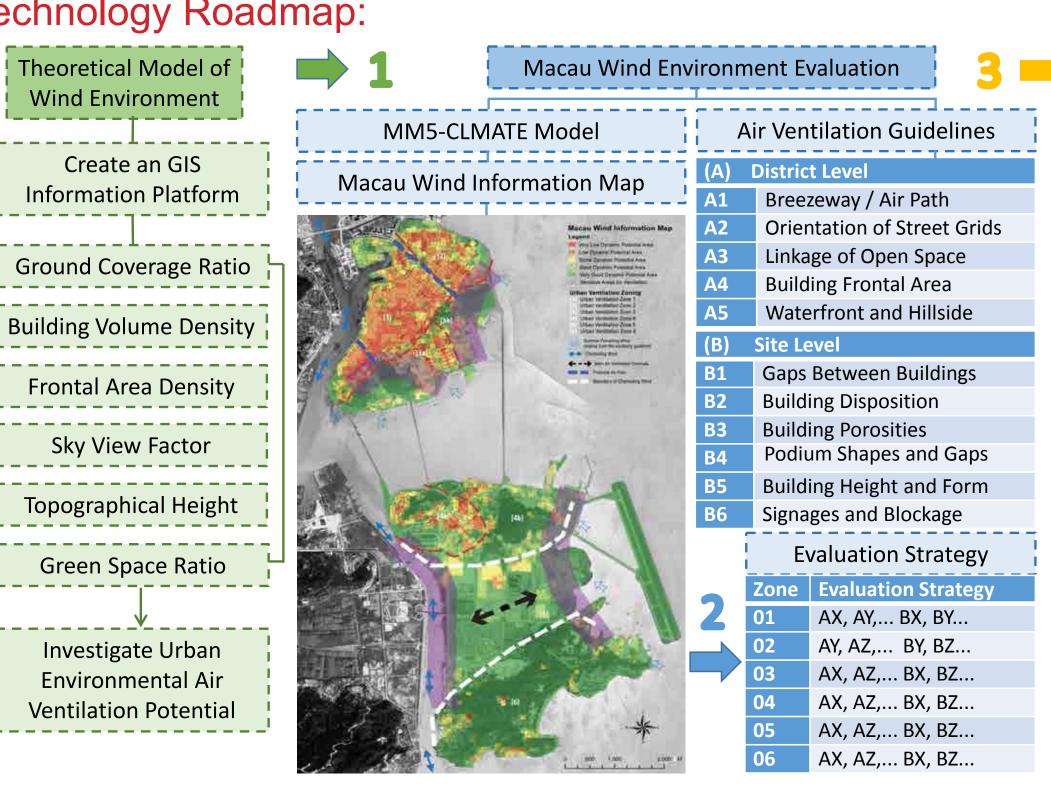


Macau, with an average population density of 21,000 people/km<sup>2</sup>, is ultra-high density urban environment;

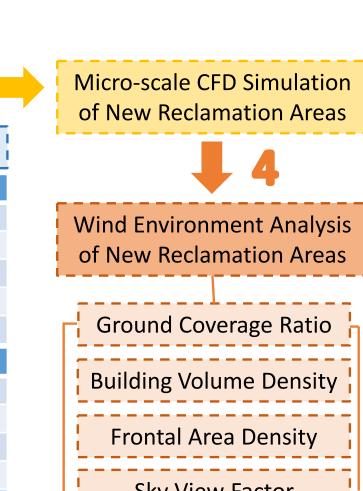
Its 30.3km² being home to an impressive 636,200 people, and more than 85.5% of residents are living in Macau Peninsula, which is merely 9.3km<sup>2</sup>;

New Reclamation Development Plan become the main way to develop urban space in Macau.

#### Technology Roadmap:



2. Wind Environment Evaluation of Macau Existing Condition:

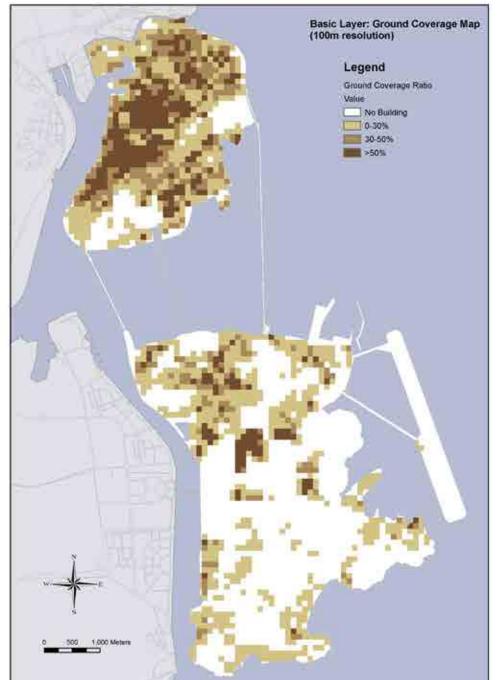


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	Evaluation Strategy			
Ì	Zone	Evalua	tion Strategy	
	Α	AX, AY,	, BX, BY	
	В	AX, AY,	, BX, BY	
	С	ΔΧ ΔΥ	RX RY	

## AX, AY,... BX, BY... AX, AY,... BX, BY...

AX, AY,... BX, BY...

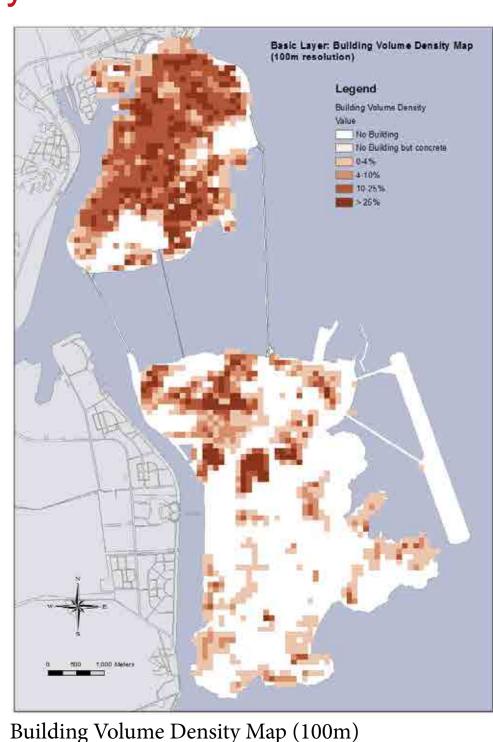
## 1. GIS-based Existing Analysis of Wind Environment:



Basic Layer: Sky View Factor Map

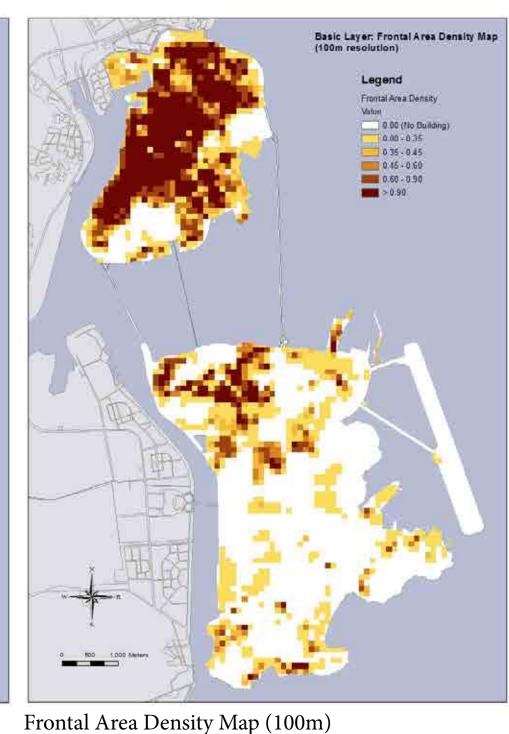
Ground Goverage Ratio Map (100m)

Sky View Factor Map (1m)



Basic Layer: Topography Map

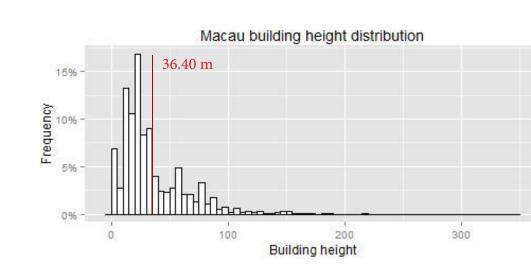
-0.3-50 mPD



Green Space Ratio Map (100m)

Basic Layer: Green Space Map

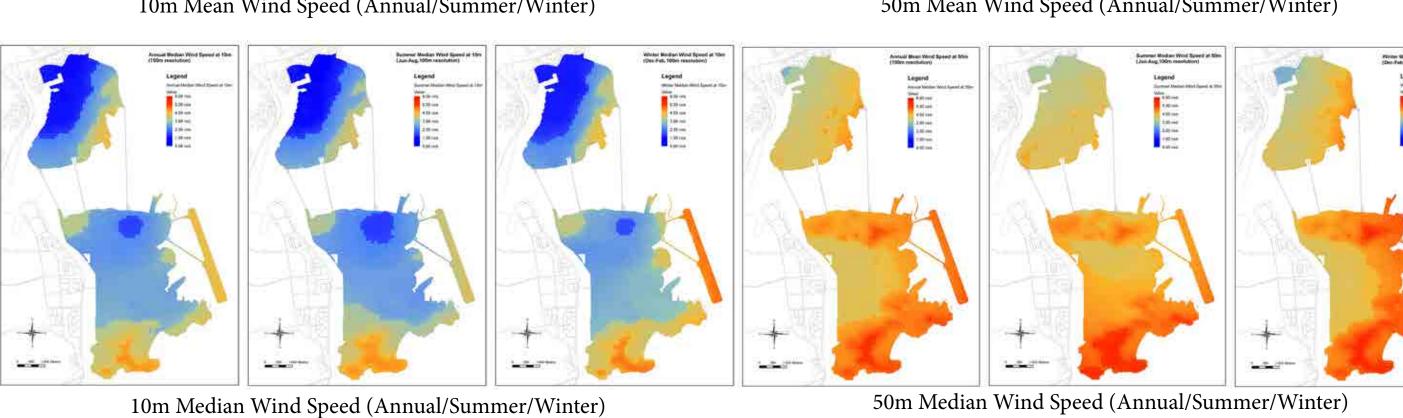
This study developed a web-based platform for interactive assessment of 10 years hourly wind information over the Macau area from 2000 to 2010. The Prognostic-Diagnostic Hybrid mode (WRF-CAL-MET) wind field downscaling is used for generating the very high resolution wind map (down to 100m resolution).

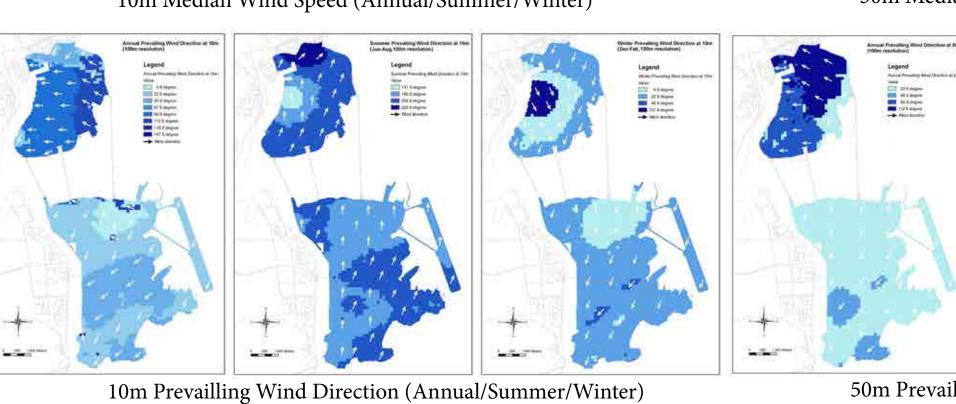


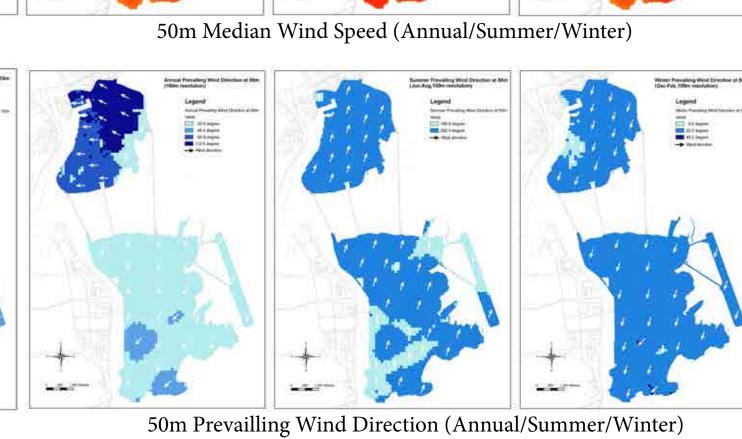
The mean building height of Macau is 36.40m based on the GIS database: Based on the result of MM5/CALMET Model to evluate the wind environ-

ment of Macau Existing Condition:

10m Mean Wind Speed (Annual/Summer/Winter) 50m Mean Wind Speed (Annual/Summer/Winter)



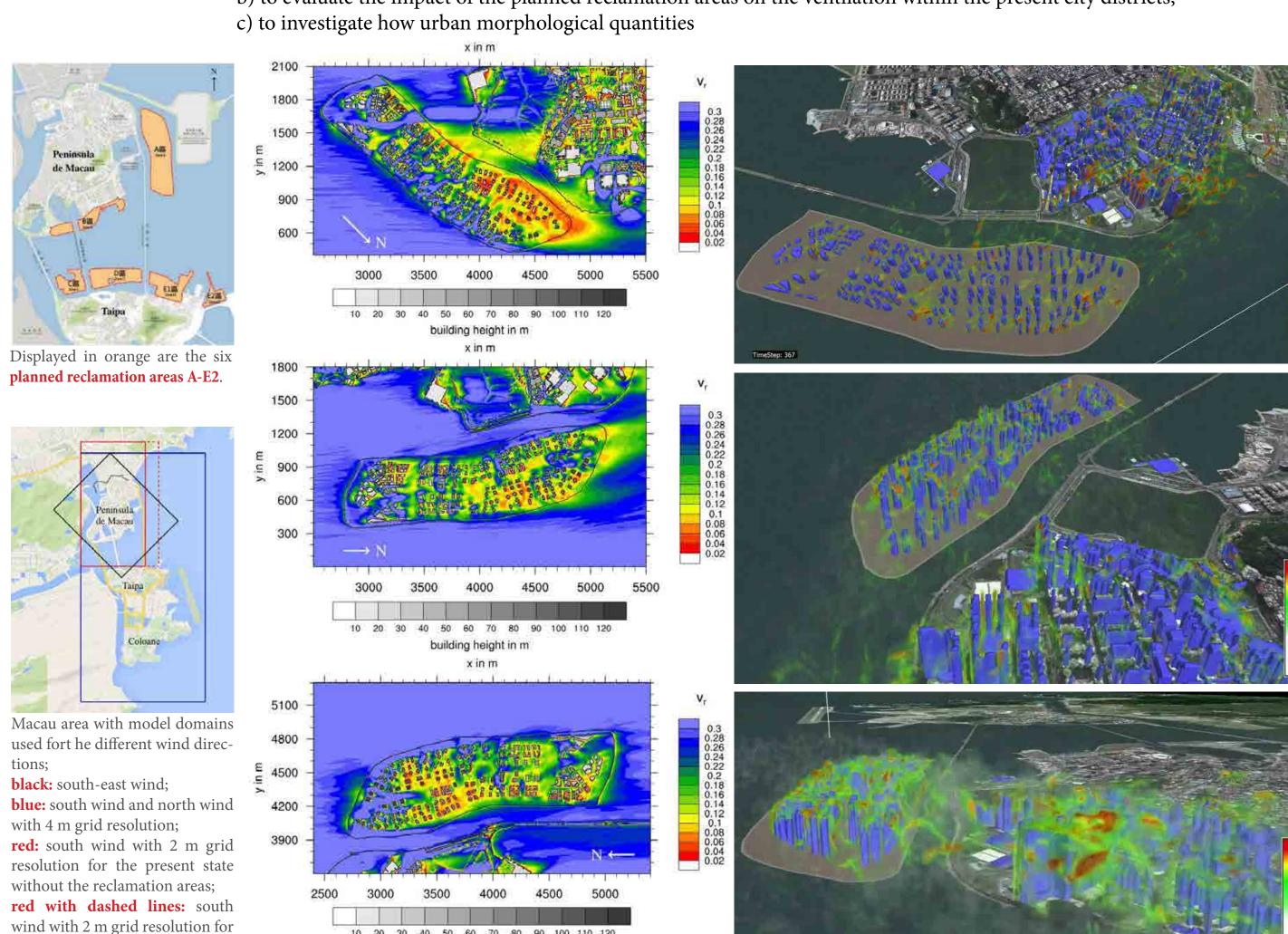




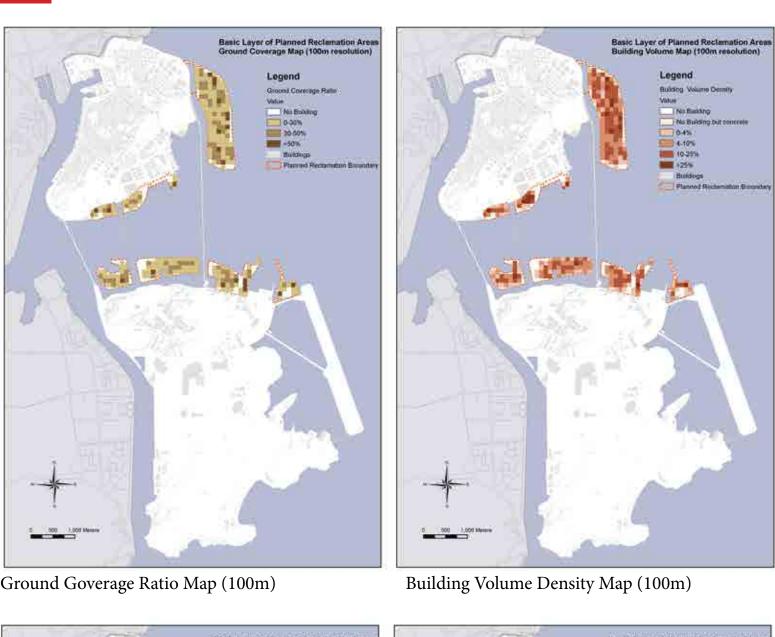
3. Micro-scale CFD Simulation of New Reclamation Areas:

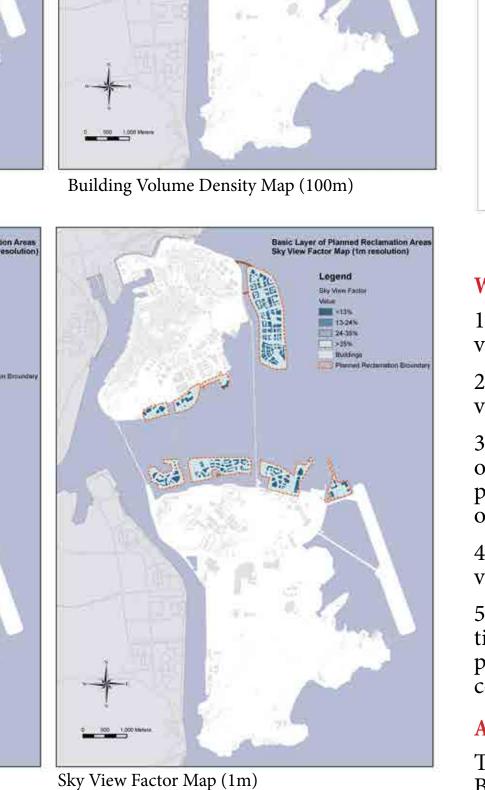
This study investigates the pedestrian level ventilation in Macau using the parallelized large-eddy simulation model PALM. The aims of the study are: a) to analyze the ventilation in Macau's present city districts and in the planned reclamation areas, b) to evaluate the impact of the planned reclamation areas on the ventilation within the present city districts, c) to investigate how urban morphological quantities

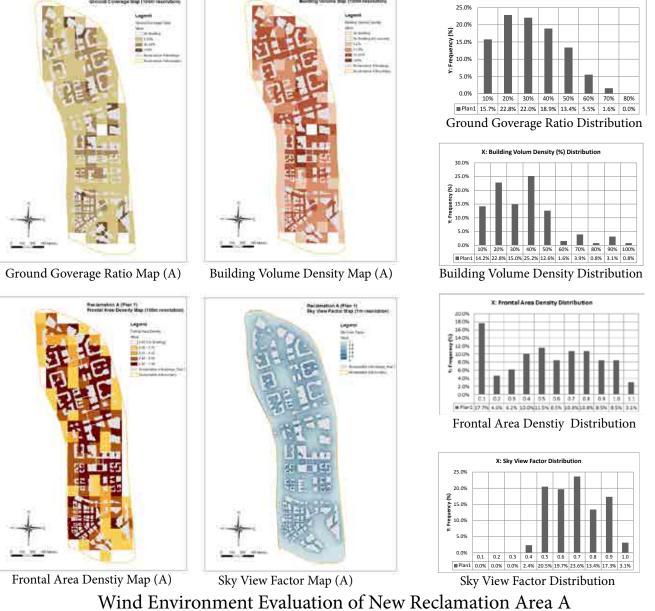
Topograpgy Map (100m)



# 4. Wind Environment Evaluation of New Reclamation Areas:







**Wind Environment Evoluation:** 

1. Planned reclamation areas A and B have the potential to affect the ventilation in the present city districts of the Peninsula de Macau;

2. In case of south-east wind, zone A and zone B cause decreased ventilation in few districts downstream;

3. In case of south wind, zone B has a strong impact on the ventilation of the peninsula, with better ventilation downstream of the western part of zone B and worse ventilation downstream of the eastern part of zone B;

4. In case of north wind, zones C, D and E1 significantly reduce the ventilation in many districts of Taipa;

5. Most of the planned reclamation areas themselves will be well-ventilated, regardless of the wind direction. Only in zone A will be some parts with bad to moderate ventilation due to the high value of ground coverage ratio and frontal area density.

## **Acknowledgement:**

The study is commission by The Land, Public Works and Transport Bureau (DSSOPT) of the Macau Government.



the future state with the reclama-



Velocity ratios in reclamation area A for a) south-east wind, b) south wind



Urban LES Model of Reclamation Area A

