Cooling Singapore 2.0

Singapore´s Digital Urban Climate Twin: Analysis of measures from island to neighborhood scale

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WORLD CITIES SUMMIT
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DIGITAL TWIN, URBAN CLIMATE, THERMAL COMFORT

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THE URBAN HEAT CHALLENGE

"The city is warmer than its surrounding – by up to 7˚C – due to the Urban Heat Island (UHI) effect."

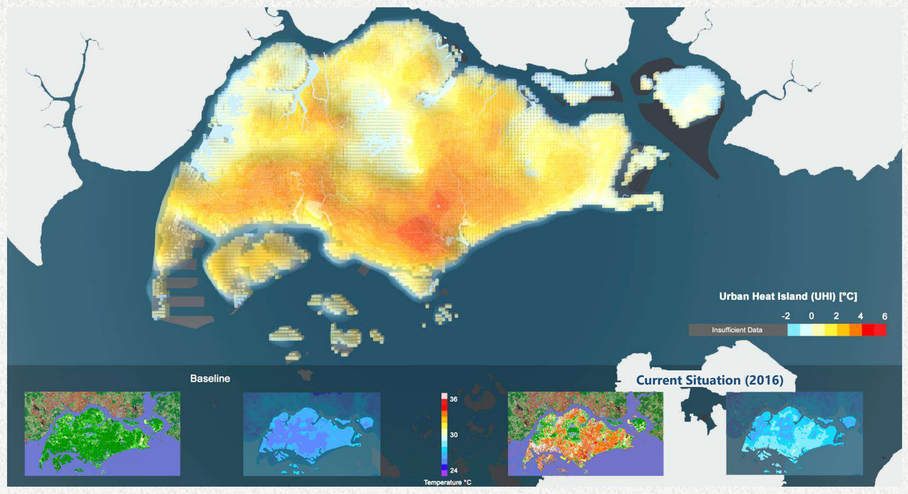


Figure 1: UHI representation from CS1.5 Final presentation 2021.

The Digital Urban Climate Twin (DUCT) is developed to allow Singapore to conduct comprehensive meso-scale and micro-scale urban climate simulations, facilitating the assessment of various what-if scenarios.

MULTISCALE ANALYSIS TOOL

The DUCT is accessible through the '**DUCT Explorer**', a user-friendly browser interface.

This allows systematic analysis of the UHI effect and Energy Efficiency under different future what-if scenarios, such as :

- Changes to traffic demand and electromobility
- Improvements in building properties, building geometries, energy efficiency and district cooling.
- Land use and vegetation change, such as placement of parks.

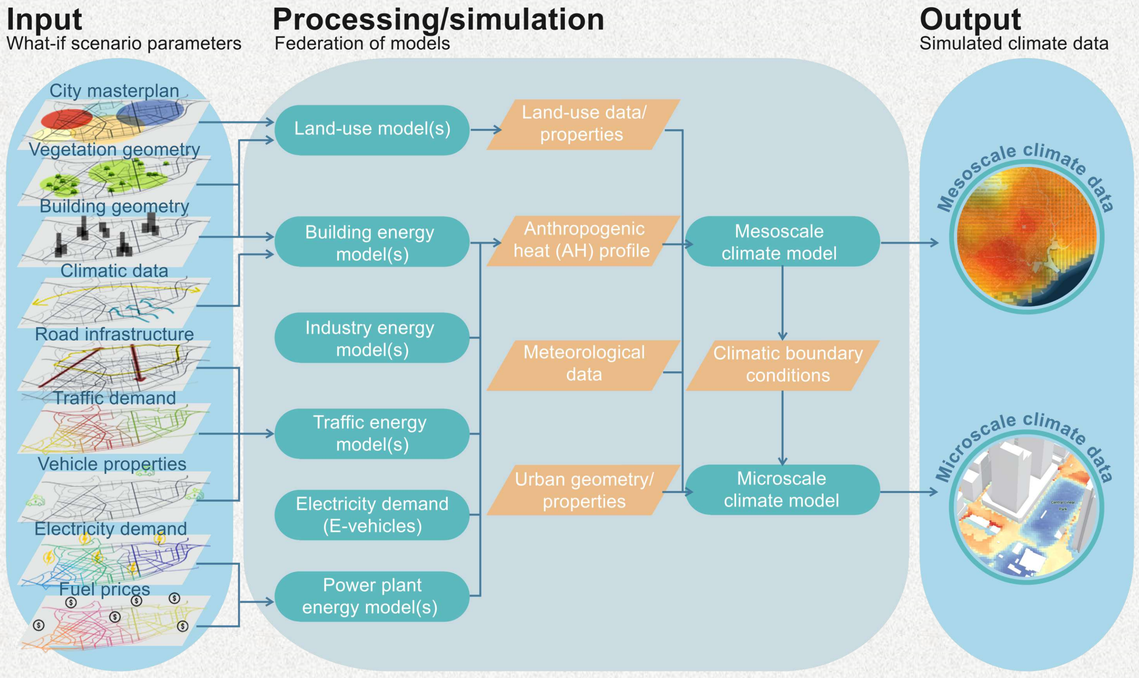


Figure 2: Digital Urban Climate Twin (DUCT) infrastructure.

SG 2030 GREEN PLAN

SG GREEN PLAN

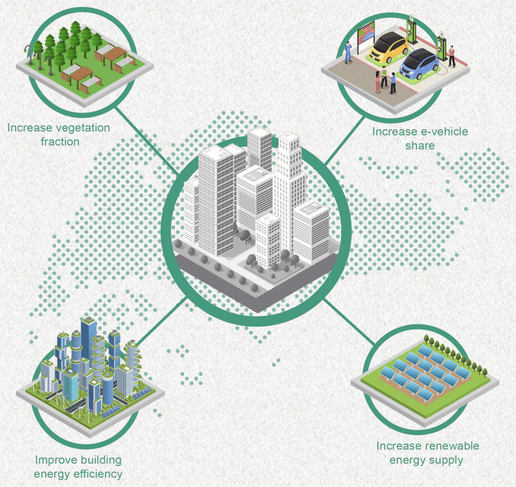


Figure 3: Singapore 2030 Green Plan scenario.

To demonstrate the capability of the DUCT, we simulate a potential 2030 scenario in Singapore. This scenario implements several measures from the Singapore 2030 Green Plan:

- Modified land use with new parks incorporated and increased urban vegetation fraction
- Improved building energy efficiencies
- 18% of electric vehicle share
- Increase import of energy supply (30%) and increase renewable energy supply (3%).

FINDINGS

- Results show a potential whole-island cooling effect of up to 0.13˚C, particularly during the peak morning hours from 0600 to 0800 hrs.
- However, the effectiveness of different strategies vary by district. The sensitivity of each district to various strategies must be carefully assessed to inform targeted policy decisions at the district level.

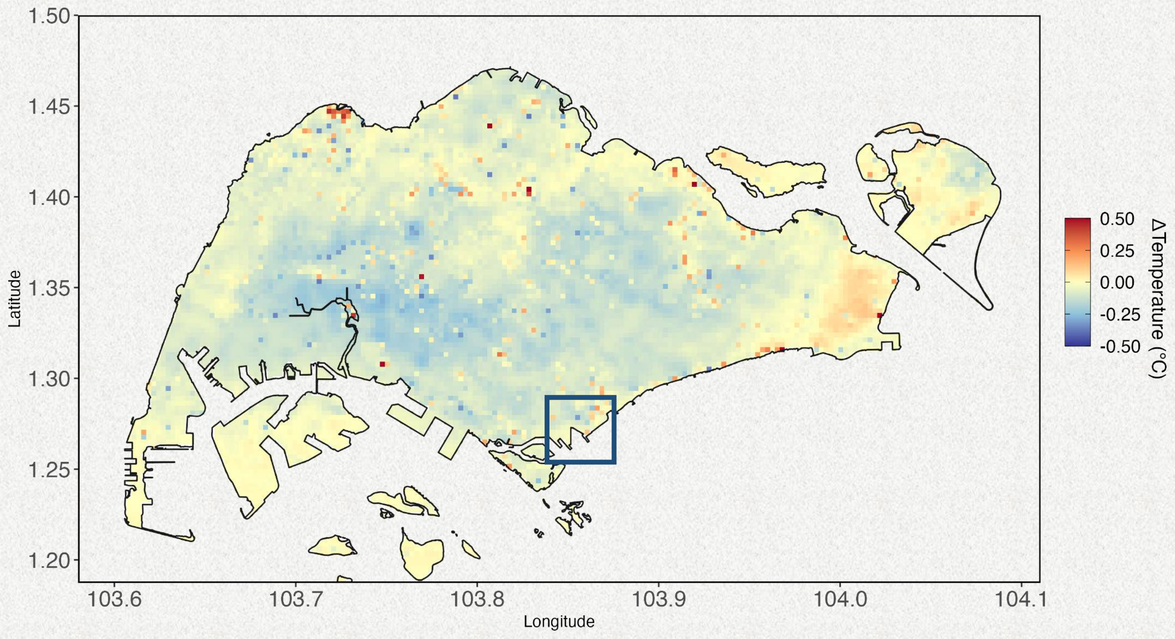


Figure 4: Change in the average 2m Temperature using an approximate Green Plan 2030 scenario on a heat-wave day.

CONCLUSION

The DUCT enables project stakeholders, urban planners and urban designers to:

- Evaluate what-if scenarios in a holistic manner.
- Visualize the implications of potential future developments and policies.

Future application:

The flexible setup of the DUCT allows for additional model onboarding and extension to other domains and could be **adapted for other cities or climatic regions** such as Zurich, Vienna or Jakarta, Indonesia.

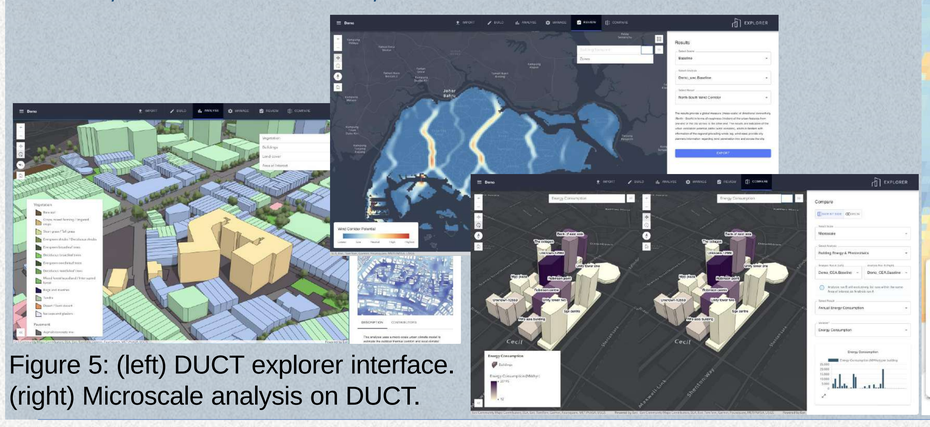
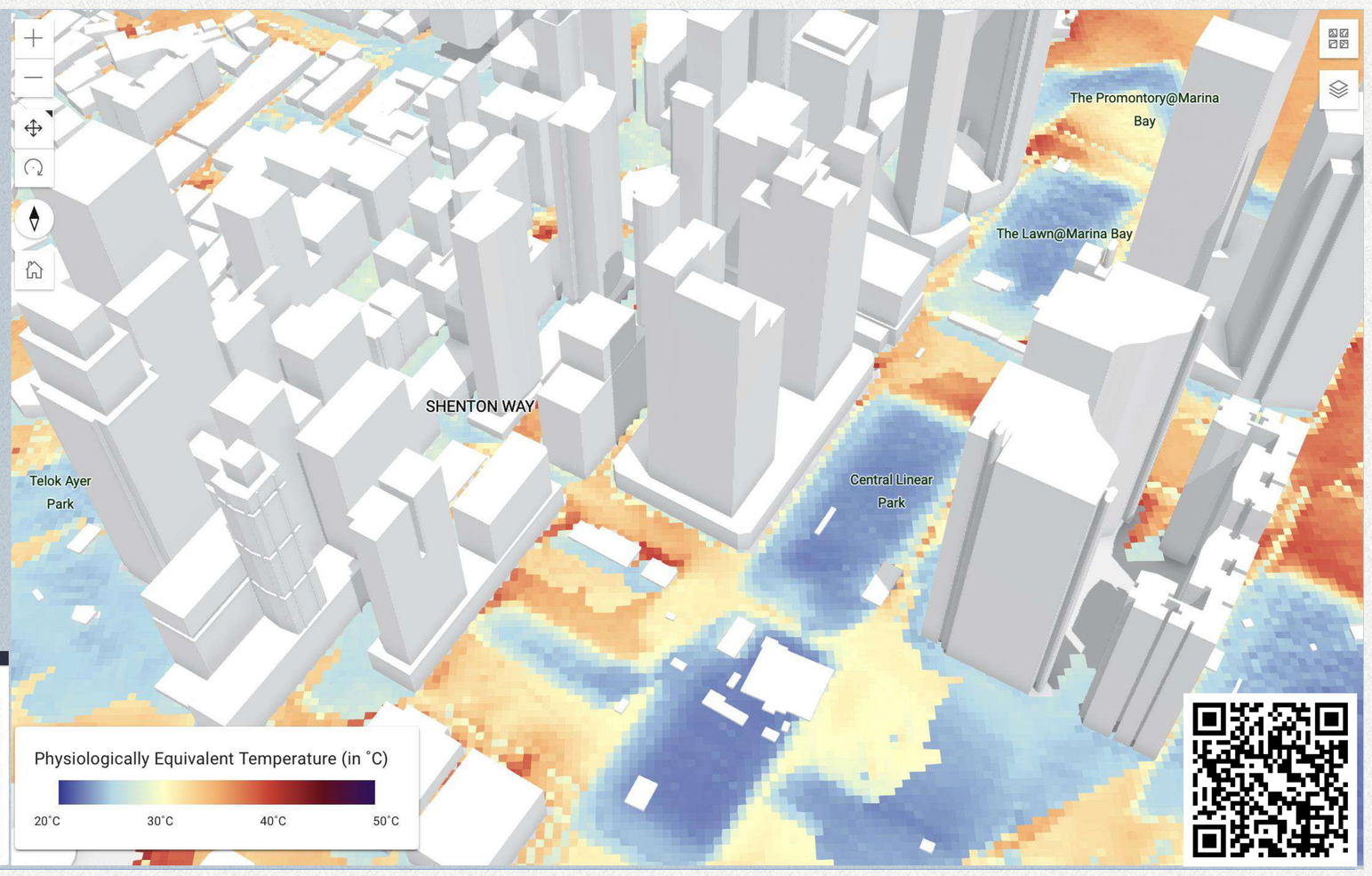


Figure 5: (left) DUCT explorer interface. (right) Microscale analysis on DUCT.



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Acknowledgements

Ministry of Sustainability and the Environment — SINGAPORE
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Funded by
NRF CREATE
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