Introduction





Experimental Design

Season: Summer (JA; July and August)

AME	Land Use Information	Anthropogenic heat release	Building aspect ratio Height : Width
976	1976	Not Considered	1:4
006	<u>2006</u>	Not Considered	1:4
06H	<u>2006</u>	Considered	1:4
06HR	<u>2006</u>	Considered	$3:4^{*1}$

*1 Aspect ratio was determined from GIS dataset in Tokyo Metropolis





Results EXP2006 – EXP1976 EXP2006H – EXP2006 EXP2006HR – EXP2006H Building aspect ratio change (radiation, turbulent fluxes) Land use fraction change Anthropogenic heat (roughness, wetness, albedo, thermal inertia, etc.) ms -0.4 -0.5 -0.6 $\Delta T = -0.725 \Delta U + 0.0692$ $\Delta T = 2.53 \Delta U + 0.0104$ $\Delta T = 2.58 \Delta U - 0.00464$ Cor. = 0.413Cor. = -0.227Cor. = 0.675Cor. = 0.6262.0 +2.0+ 2.0 -ΛT 1.0 ∆ T 1.0 ΛT 1.0 <u>-0.5</u> -0.25 0 0.25 0.5 -0.5 -0.25 0 0.25 0.5 -0.5 -0.25 0 0.25 0.5 0.25 0.5 ΔU ΔU $\Delta \mathbf{U}$ ms ms $\Delta T = -0.632 \Delta U + 0.0304$ $\Delta T = 1.51 \Delta U - 0.0501$ $\Delta T = 2.08 \Delta U + 0.0282$ Cor. = -0.389Cor. = 0.191Cor. = 0.542Cor. = -0.5612.0+ 2.0+ Λ T 1 1 **т** 1.0 AT 1.0

0.25 0.5

-0.5 -0.25

ΔU

0.25

0.5

-0.5 -0.25

ΔU

0.25 0.5

Summary

Total effect of land surface modification on surface air temperature and horizontal wind speed

Summer: Positive correlation

Negative correlation (but positive in the center of Tokyo) Winter: Weakening of wind caused by enlarged roughness length is remarkable in winter season when the average wind is originally stronger. Increase of wind speed can be seen in the center area of Tokyo.

Land use (EXP2006 – EXP1976: The changed parameters are roughness, wetness, thermal inertia, albedo, etc.)

Summer: Negative correlation

Winter: Negative correlation

> Temperature increase is caused by the Bowen ratio effect, effective in humid summer. Wind speed is weakened by the roughness change along the urbanized area.

Heat load (EXP2006H – EXP2006: No parameters changed except for the addition of anthropogenic heat)

ך Positive correlation Summer: destabilization effect? Positive correlation . Winter: Temperature increase is directly caused by the addition of anthropogenic heat. Wind speed increased in the area corresponding to the distribution of anthropogenic heat.



Building effect (The effects in terms of radiation and turbulent heat fluxes)

Summer: Positive correlation

Winter: Positive correlation

> Temperature increase is caused by the inhibition of radiative cooling, the decrease of effective albedo, increase of turbulent heat fluxes, etc. Wind speed increased in the area corresponding to the distribution of anthropogenic heat.

<u>Time-of-the-day dependency of regression coefficient</u> $\Delta T = \underline{R} \cdot \Delta U + X$



correlations between the urban warming trends and the wind speed trends in recent several tens of years from the quite careful analyses of observational datasets (e.g. Fujibe 2009). Further discussions are needed when we compare the simulation results in this study and the previous observational researches.

Fujibe, F., 2009: Relation between long-term temperature and wind speed trends at surface observation stations in japan, SOLA, 5, 81-84.

0.25 0.5

-0.25 0

ΔU

-0.5

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