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Climate of the Past Discussions

Interactive comment on "Anthropogenic effects on subsurface temperature in Bangkok" *by* M. Taniguchi

Anonymous Referee #1

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1. General Comments

This manuscript outlines an attempt to attribute the rise in ground surface temperature in Bangkok as a result of both global climate change and urbanization. This is potentially a valuable contribution to the climate science community because it suggests that it may be possible to gain information on past climates from urban environments, which have traditionally been avoided in subsurface heat flow studies. However, there are several questions that should be answered to establish that the coupling between ground surface temperatures and surface air temperatures in the study area as these two measurements may or may not be well coupled (Gosnold et al., 1997; Mann and Schmidt, 2003; Nitoui and Beltrami, 2005; Beltrami et al., 2005). Many of these studies have focused on areas with significant snow accumulation or deforestation but they do

suggest the need to investigate the relationship between ground surface and surface air temperatures.

2. Specific Comments

P. 831, lines 20-25. Anthropogenic effects are clearly important to the temperature distributions beneath urban environments but it has not been established that the urban heat island effect is the same for above and below ground environments. The effect on surface air temperatures is generally considered the sum of microclimatic effects from changes in the radiative balance in built environments (Landsberg, 1981). These effects can be quite variable throughout a city and this could potentially cause sampling problems. Subsurface temperature changes can also be the result of heat losses from buildings (Lachenbruch, 1957; Ferguson and Woodbury, 2004), which will also be quite variable throughout an urban environment. Heat losses from buildings should be a much smaller issue in Thailand than in Canada as considered in the above-mentioned studies but it may still have some effect. Changes in surface cover (Nitoiu and Beltrami, 2005) will perhaps be a much larger issue, as soil temperatures can be altered as a result of land clearing or changing surface cover (e.g. conversion of grassland to pavement). Temperature increases from such changes in land cover can increase soil temperature by a few degrees Celsius over smaller areas and should be considered in this study.

p. 835, line 25-29. The depth by 0.1 C apart does provide an interesting metric of the importance of surface forcing on subsurface temperatures. However, it appears to be arbitrary and its use should be justified.

p. 835, lines 17 to 21 and Section 4 (pp. 836-837). The rapid development since WWII does suggest that this may be the overall onset of the urban heat island effect but the timing of this event may be significantly different than a linear increase for the entire city with different magnitudes of increase. Many of the effects related to changes in radiative balances and conductive heat flow from buildings will have immediate effects

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and behave more like a step function or exponential increase in early times rather than a linear increase (Ferguson and Woodbury, 2004; Nitoiu and Beltrami, 2005). Also, if areas at increasing distance from the city centre were developed at later times, the onset of warming related to urbanization should take place at a later time. This may also explain the exponential relationship between the distance from city centre and depth to 0.1 C apart in the borehole. Consideration of this idea could lead to the conclusion that the surface warming is greater in the fringe areas of the city than the analysis produce in this paper suggests. Rather than focusing on relationship of depth to 0.1 C apart from steady state and distance from city centre, this paper would make a much stronger argument if individual temperature profiles were considered. If attempts were made to model each profile using different magnitudes, rates and onsets of warming considered along with the statistical fits of these various models, the findings of this study would provide a more complete understanding of the usefulness of subsurface temperatures in urban environments.

References

Beltrami, H., Ferguson, G. and Harris, R. 2005. Long-term tracking of climate by underground temperatures. Geophysical Research Letters 32, L19707, doi:10.1029/2005GL023714.

Ferguson, G. and Woodbury, A.D. 2004. Subsurface Heat Flow in an Urban Environment. Journal of Geophysical Research - Solid Earth 109, B02402, doi:10.1029/2003JB002715.

Gosnold, W. D., Jr., P. E. Todhunter, and W. L. Schmidt, 1997. The borehole temperature record of climate warming in the mid-continent of North America, Global and Planetary Change 15: 33- 45.

Lachenbruch, A.H. 1957. Three-dimensional heat conduction in permafrost beneath heated buildings, U.S. Geol. Surv. Bull. 1052-B (1957) 51- 69.

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Landsberg, H. E. (1981), The Urban Climate, Int. Geophys. Ser., vol. 28, Academic, San Diego, Calif.

Nitoiu, D. and H. Beltrami. 2005. Subsurface thermal effects of land-use changes, Journal of Geophysical Research 110, F01005, 10:1029/2004JF000151.

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