Forest cover change can cause strong local biophysical feedbacks on climate. Satellite observations of land surface temperature (T) and land cover distribution or forest cover change have been widely used to examine the effects of afforestation/deforestation on local surface temperature change (ΔT). However, different approaches were used by previous analyses to quantifying ΔT, and it remains unclear whether results of ΔT by these approaches are comparable. We identified three influential approaches to quantifying ΔT used by previous studies, namely the actual ΔT resulting from actual changes in forest coverage over time and accounting for changes in background climate (ΔT\textsubscript{a} proposed by Alkama and Cescatti, 2016), potential ΔT by hypothesizing potential shifts between non-forest and forest at given native spatial resolutions of satellite products (ΔT\textsubscript{p1} by Li et al., 2015), and potential ΔT, but using the singular value decomposition technique to derive ΔT by hypothesizing a shift between a 100% complete non-forest and 100% forest (ΔT\textsubscript{p2} by Duveiller et al., 2019). China realized large-scale afforestation making it a suitable test case to compare satellite-based approaches for estimating ΔT following afforestation. We hypothesize that (1) ΔT\textsubscript{a} depends on the fraction of ground area that’s been afforested (F\textsubscript{aff}). (2) The relative magnitude between different approaches should be: ΔT\textsubscript{a} < ΔT\textsubscript{p1} < ΔT\textsubscript{p2}. (3) When ΔT\textsubscript{a} is extended to a hypothetical case that F\textsubscript{aff} reaches 100%, it should be comparable to ΔT\textsubscript{p1} or ΔT\textsubscript{p2}. We used multiple satellite observation products to test these hypotheses. The results show that the magnitude of actual daytime surface cooling by afforestation (ΔT\textsubscript{a}) increases with F\textsubscript{aff}, and is significantly lower than ΔT\textsubscript{p1} and ΔT\textsubscript{p2}. But no significant difference was found between ΔT\textsubscript{p1} and ΔT\textsubscript{p2}. A linear regression model established between ΔT\textsubscript{a} and F\textsubscript{aff} extends the ΔT\textsubscript{a} when F\textsubscript{aff} reaches 100%, to a comparable magnitude than ΔT\textsubscript{p1} and ΔT\textsubscript{p2}. Our study thus highlights the importance to consider the actual surface cooling impact by afforestation projects in contrast to the potential effects, and provides a first study to reconcile different approaches to quantify the land surface temperature change due to afforestation.