Supplementary Materials

High-resolution net ecosystem productivity modeling reveals spatiotemporal heterogeneity of urban carbon metabolism

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Supplementary Text 1

Calculation of $FPAR$.

$FPAR(x,t)$ is the absorption ratio of vegetation layer to IPAR, which has a linear relationship with the Normalized Difference Vegetation Index (*NDVI*). It is calculated as follows[1]:

$$FPAR(x,t) = \frac{(NDVI(x,t) - NDVI_{i,\min})}{(NDVI_{i,\max} - NDVI_{i,\min})} \times (FPAR_{\max} - FPAR_{\min}) + FPAR_{\min} \quad (1)$$

$$NDVI = \frac{NIR - RED}{NIR + RED} \quad (2)$$

NDVI can be calculated from the near infrared band (*NIR*) and red band (*RED*) of the satellite multispectral images. Here we used the NDVI data of MOD13Q1 v061 product[2]. $NDVI_{i,\max}$ and $NDVI_{i,\min}$ are the maximum and minimum values of *NDVI* of the *i*-th vegetation type, usually 95% and 5% of the quantile of *NDVI*, $FPAR_{\max}$ is taken as 0.95, $FPAR_{\min}$ is taken as 0.001, and both are independent of vegetation type. There are also studies using the following equation for calculation:

$$FPAR(x,t) = \frac{SR(x,t) - SR_{i,\min}}{SR_{i,\max} - SR_{i,\min}} \times (FPAR_{\max} - FPAR_{\min}) + FPAR_{\min} \quad (3)$$

$$SR(x,t) = \frac{1 + NDVI(x,t)}{1 - NDVI(x,t)} \quad (4)$$

where $SR(x,t)$ is the Simple Ratio of vegetation, $SR_{i,\min}$ and $SR_{i,\max}$ are represented by $NDVI_{i,\min}$ and $NDVI_{i,\max}$. Research has shown that the *FPAR* estimated using equation (1) is higher than the measured value, while using equation (3) is lower than the measured value[3]. Therefore, we took the average of the two values to minimize the error.

Table 1. Annual results of NPP, R_H and NEP of PRD cities.

Province	City	Annual average ($gC \cdot m^{-2} \cdot a^{-1}$)			Annual total amount ($KtC \cdot a^{-1}$)		
		NPP	R_H	NEP	NPP	R_H	NEP
Guangdong	Dongguan	359.8	379.9	-20.1	892.4	942.2	-49.8
	Foshan	381.6	381.8	-0.2	1467.4	1468.1	-0.7
	Guangzhou	691.2	365.1	326.1	5063.9	2675	2388.9
	Huizhou	867.4	352	515.4	9964.0	4044.1	5919.9
	Jiangmen	858.7	373.7	485.0	8109.0	3529.2	4579.8
	Shenzhen	607.7	378.6	229.1	1196.1	745.2	450.9
	Zhaoqing	980.4	342.9	637.5	14854.3	5195.4	9658.9
	Zhongshan	350.1	390.4	-40.3	616.4	687.3	-70.9
	Zhuhai	484.9	395.6	89.3	774.3	631.7	142.6

References

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[2]Didan K. MODIS/Terra Vegetation Indices 16-Day L3 Global 250m SIN Grid V061 [Dataset]. 2021. https://doi.org/10.5067/MODIS/MOD13Q1.061

[3]Zhu W, Pan Y and Zhang J. Estimation of net primary productivity of chinese terrestrial vegetation based on remote sensing. *Zhiwu Shengtai Xuebao*. 2007; 31(3): 413-424. https://doi.org/10.17521/cjpe.2007.0050