

研究论文

鼎湖山针阔叶混交林冠层下方CO₂通量及其环境响应

王春林^{1,2}, 周国逸^{1,*}, 王旭¹, 唐旭利¹, 周传艳¹, 于贵瑞³

1.中国科学院华南植物园, 广州 510650 2.广东省气候中心, 广州 510080 3.中国科学院地理科学与资源研究所, 北京 100101

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摘要 精确估算典型森林生态系统冠层下方CO₂通量(Fcb)对验证陆地生态系统碳平衡模型具有重要意义。采用开路涡度相关法对鼎湖山针阔叶混交林Fcb进行定位测定, 根据1周年数据分析Fcb及其对环境要素的响应特征, 结果表明: (1) 白天Fcb呈下降趋势表明地表植被全年具有光合能力, 但总体上地表植被和土壤表现为CO₂排放源; (2) Van't Hoff方程、Arrhenius方程和Lloyd-Taylor方程均可以较好反映土壤温度(Ts)与Fcb的关系, 其中仅Lloyd-Talor方程能够反映温度因子敏感性指标Q10随温度的变异性特征; (3) Lloyd-Talor方程模拟的Fcb完全由Ts控制, 而连乘模型由Ts和土壤水分(Ms)控制, 可以反映水热条件的综合影响, 对Fcb具有更强的拟合能力; (4)在Ms较大时连乘模型对Fcb的估算高于Lloyd-Talor方程, 反之在干旱时段连乘模型模拟结果低于Lloyd-Talor方程, 表明当存在水分胁迫时, Ms可以成为影响Fcb的主导因子; (5) 2003年鼎湖山针阔叶混交林Fcb总量((787.4±29 6.8)gCm⁻²a⁻¹)比静态箱-气相色谱法测得的土壤呼吸偏低17%。与箱式法相比, 涡度相关法通量测定结果普遍存在偏低估算现象。

关键词 鼎湖山; 冠层下方; CO₂通量; 涡度相关

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Below-canopy CO₂ flux and its environmental response characteristics in a coniferous and broad-leaved mixed forest in Dinghushan, China

WANG Chun-Lin^{1,2}, ZHOU Guo-Yi^{1,*}, WANG Xu¹, TANG Xu-Li¹, ZHOU Chuan-Yan¹, YU Gui-Rui³

1 South China Botanical Garden, CAS, Guangzhou 510650, China

2 Guangdong Climate Center, Guangzhou 510080, China

3 Institute of Geographical Science and Natural Resources Research, CAS, Beijing 100101, China

Abstract Accurate estimation of below-canopy CO₂ flux (Fcb) in typical forest ecosystems is of great importance to validate terrestrial carbon balance models. Continuous eddy covariance measurements of Fcb were conducted in a coniferous and broad-leaved mixed forest located in Dinghushan Nature Reserve of south China. Using a year-round data, Fcb dynamics and its environmental response were analyzed, results mainly showed that: (1) Fcb decreased during daytime which indicated that understory of the forest continued photosynthesis throughout the year, however, understory and soil acted as CO₂ source as a whole. (2) Using soil temperature (Ts) as a dependent variable, all of Van't Hoff equation, Arrhenius equation and Lyold-Talor equation can explain a considerable variation of Fcb, Among those three equations Lyold-Talor equation is the best to reflect the relationship between soil respiration and temperature for its ability in revealing the variation of Q10 with temperature; (3) Fcb derived from Lloyd-Talor equation is utterly determined by Ts, while Fcb derived from the multiplicative model is driven by Ts and soil moisture (Ms). The multiplicative model can reflect the synthetic effect of Ts and Ms, therefore it explains more Fcb variations than Lyold-Talor equation does; (4)Fcb derived from multiplicative model was high

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er than that from Lloyd-Talor equation when M_s was relatively high, on the contrary, F_{cb} derived from multiplicative model was lower than that from Lloyd-Talor equation when M_s was low, indicating that M_s might be a main factor affecting F_{cb} when the ecosystem is stressed by low-moisture. (5) Annual F_{cb} of the forest in 2003 was estimated as $787.4 \pm 296.8 \text{ gCm}^{-2}\text{a}^{-1}$, which was 17% lower than soil respiration measured by statistic chamber method. CO_2 flux measured by eddy covariance is often underestimated, further study therefore calls for emphasis on methods quantifying F_{cb} components of respiration of soil, as well as respiration and photosynthesis of understorey vegetations.

Key words [Dinghushan](#) _ [below-canopy](#) _ [CO₂ flux](#) _ [eddy covariance](#)

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通讯作者

周国逸

gyzhou@scib.ac.cn