提高林冠照片分析林隙比例的准确度

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林窗对生物多样性维持意义重大

- 影响群落更新过程（更新生态位）
- 影响植物物种间的竞争关系。
- 影响不同鸟类的异性识别（光梯度假说）

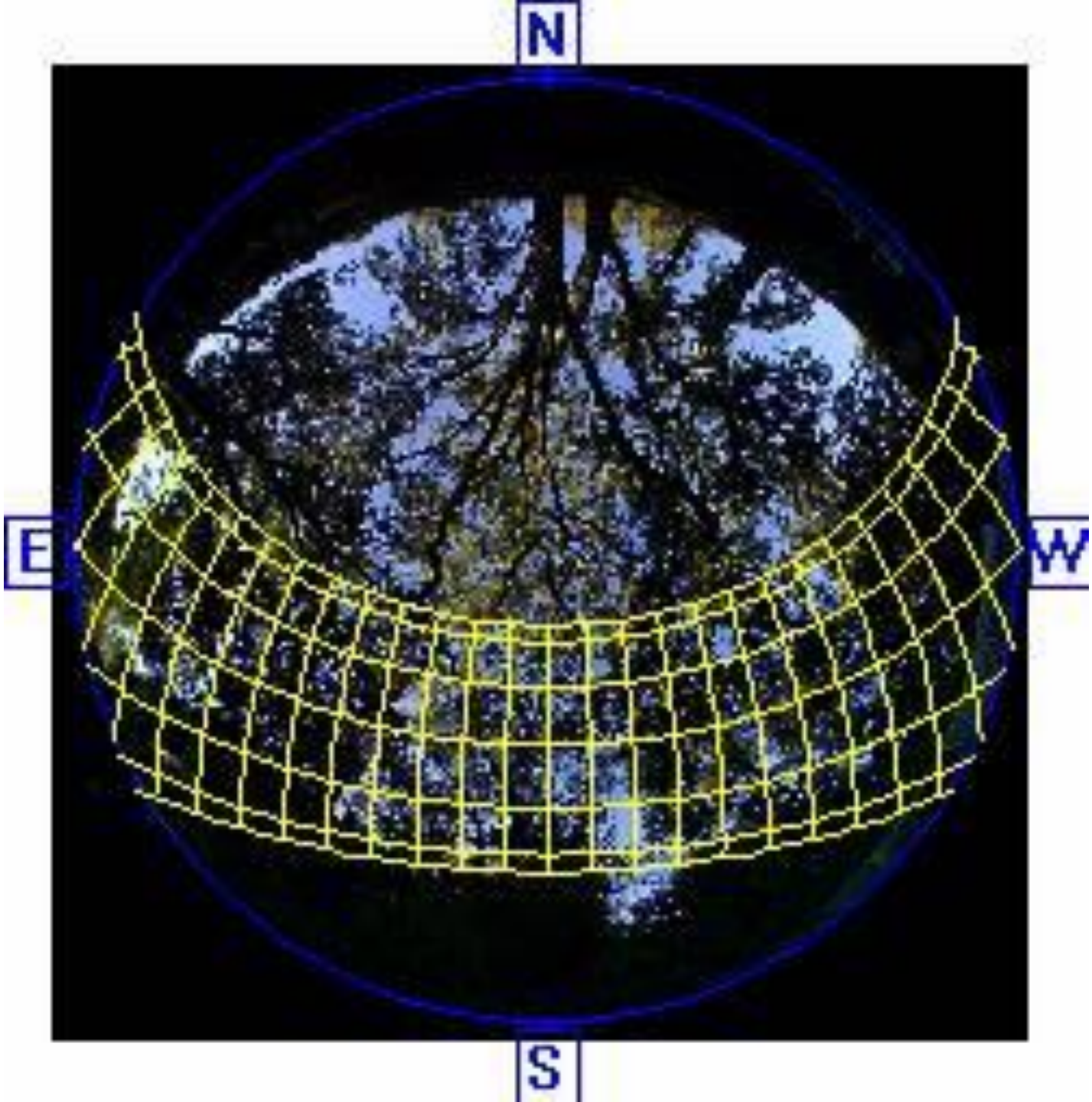
光梯度需量化

- 林窗、林下二分?
- 林隙比例的连续变化对群落的影响？？
- 量化光梯度的方法?

林冠照片何为?

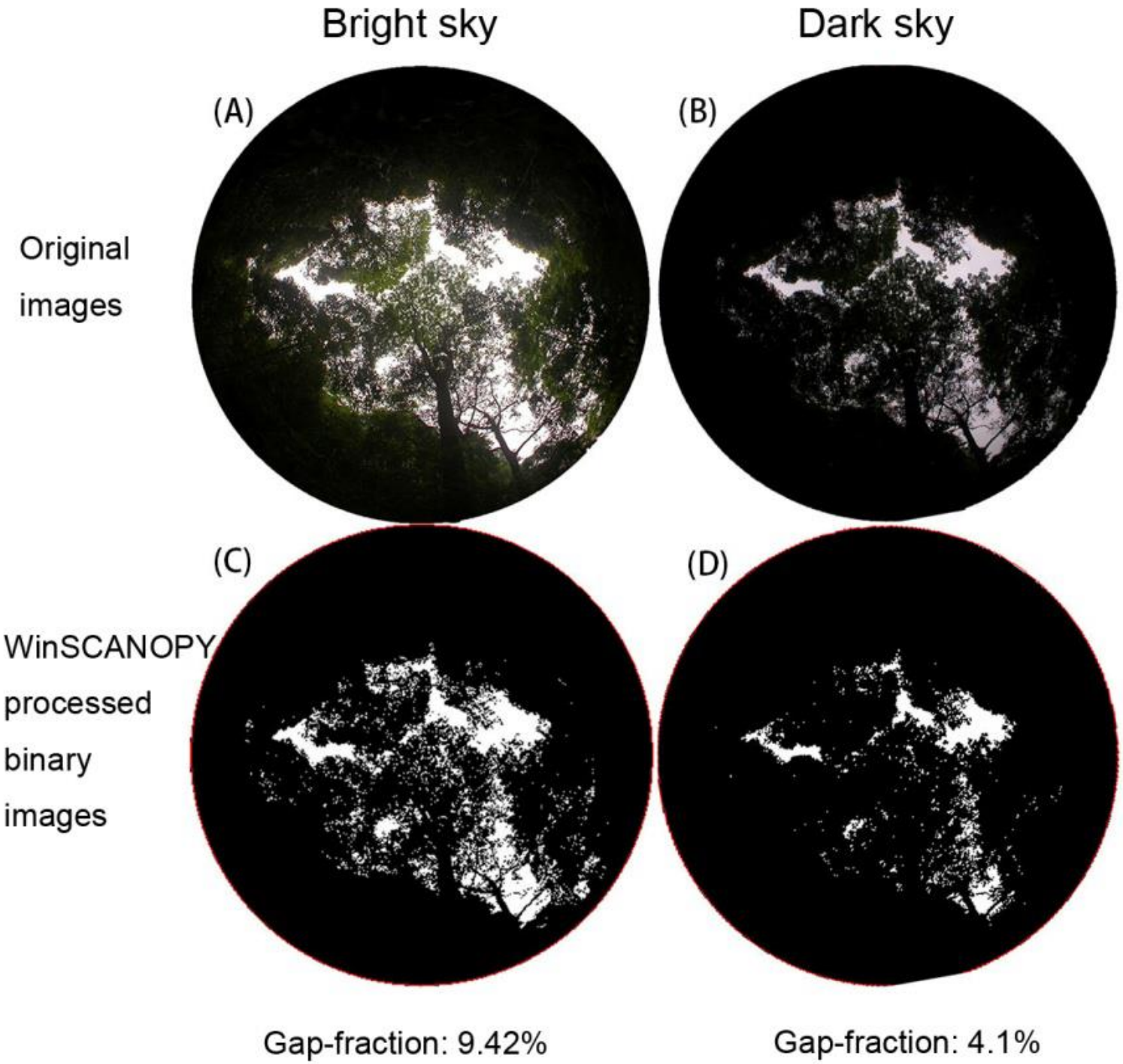
- 估计透光率
- 描绘林冠几何结构
- 估计林冠结构特征（比如叶面积指数）

优势
不可
替代



存在的问题

- 照片曝光情况影响分析结果


Bright sky
Dark sky
(A)
(B)
Original images
(C)
(D)
WinSCANOPY processed binary images
Gap-fraction: 9.42%
Gap-fraction: 4.1%

主要思路

- 根据天空亮度选择灰度阈值

推理过程

- $k = 1/(TS)$ （1）
- $Y = 260.542/(1+\exp(-X+1.422)/1.16)$ （2）
- $T_m/T=2^X$ （3）

$$Y = \frac{260.542}{1 + \exp[-\ln(T_m kS - 2) + 1.422]/1.160}$$

$K=1/(T_r*S_r)$

新方法的实现

- 1，传感器自动记录开阔地的光强（天空亮度）

- 2，根据天空亮度计算灰度阈值。

第一步

第二步

$$Y = \frac{260.542}{1 + \exp[-\ln(T_m kS - 2) + 1.422]/1.160}$$

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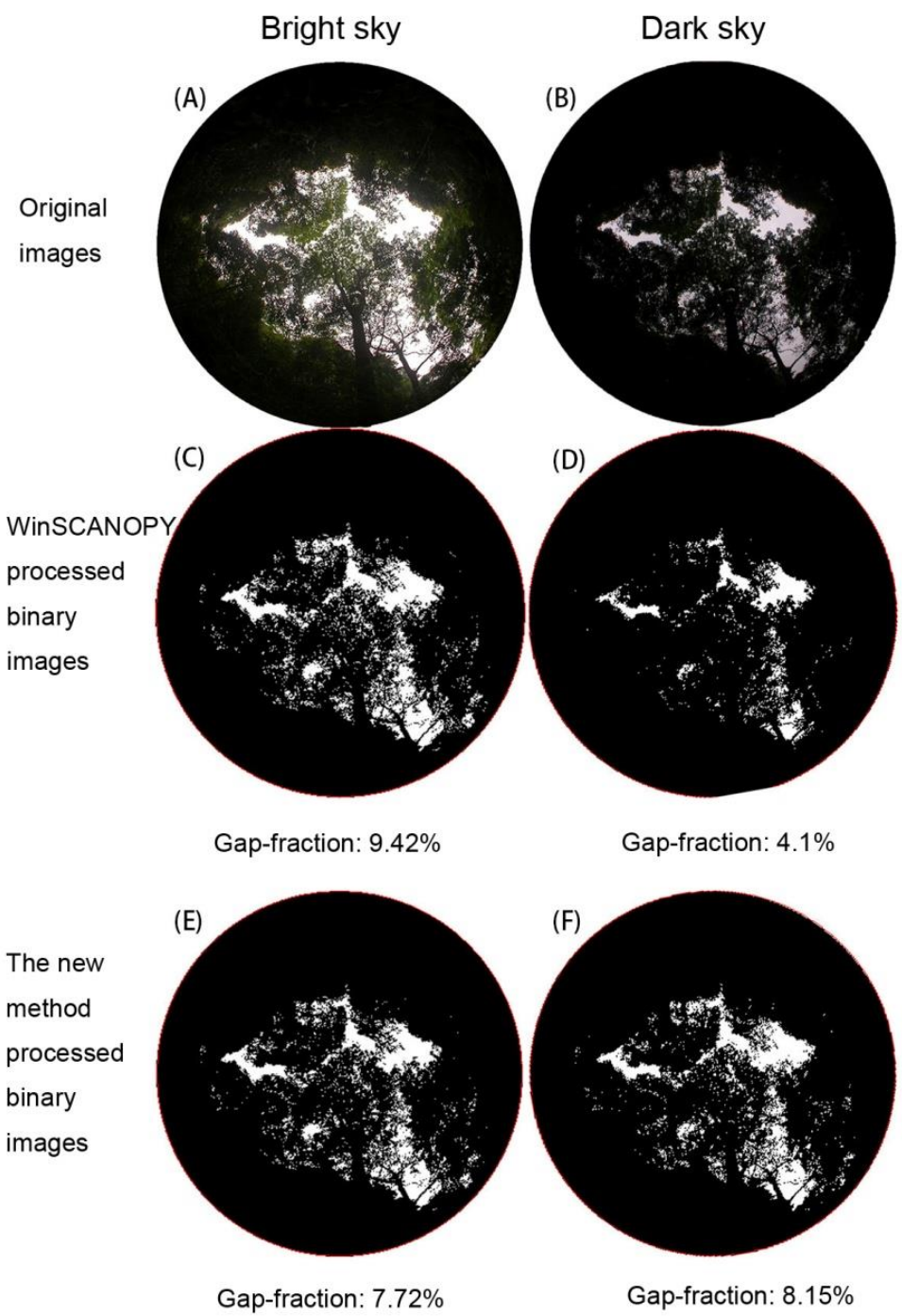
ARTICLE

Estimating light environment in forests with a new thresholding method for hemispherical photography

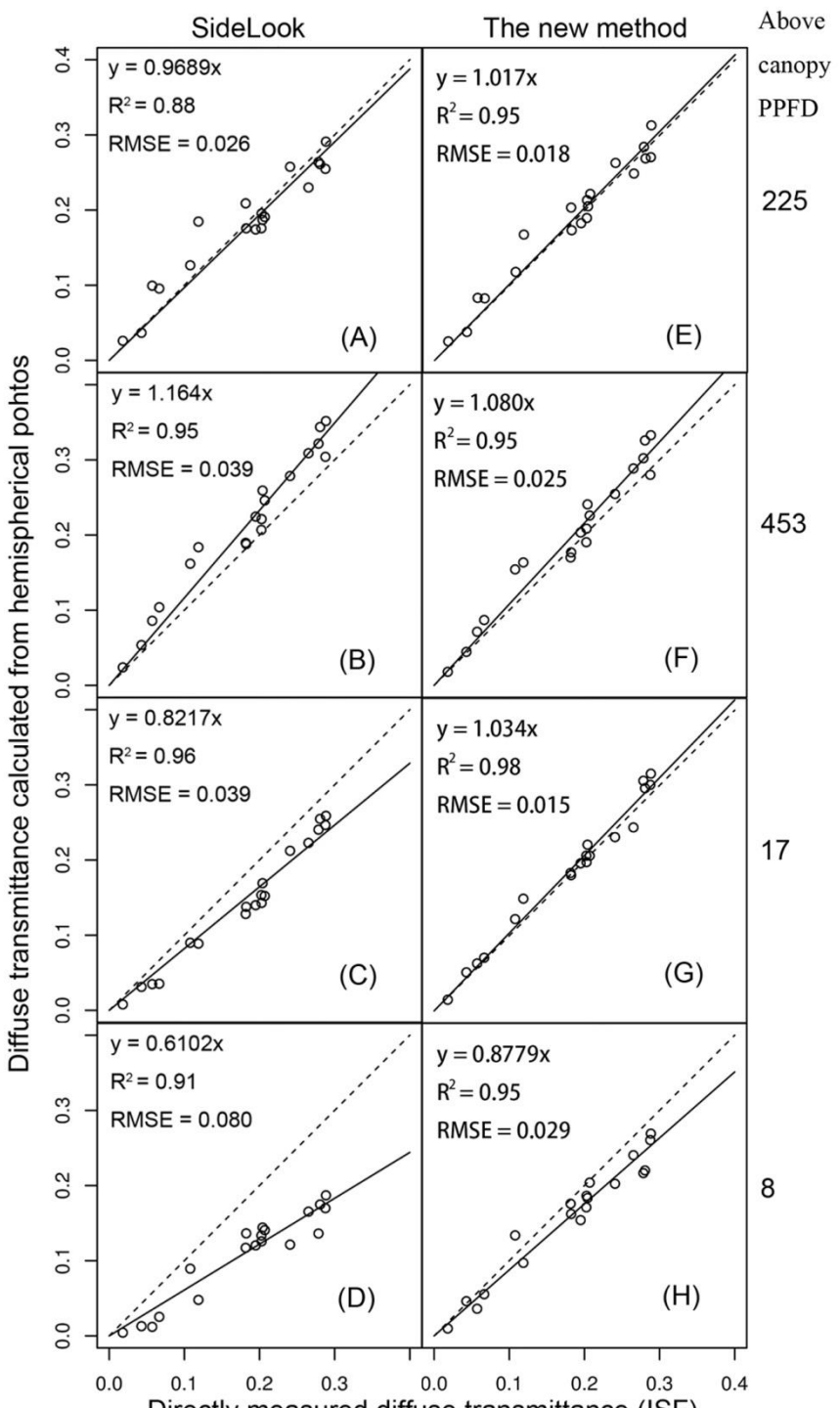
Kangning Zhao and Fangliang He

Abstract: Light environment estimates derived from hemispherical photography are known to be affected by variations in sky illumination. During photo acquisition, rapid changes in sky illumination can occur and will result in changes in detected canopy gap size and frequency. Any resulting problems in image consistency will become more serious with increased time lags between setting the reference exposure and hemispherical photograph acquisition. We showed that if the camera exposure setting was kept constant during photo acquisition, the estimated diffuse transmittance would be greatly influenced by sky illumination change. We developed a new pixel thresholding method that calculated the optimal threshold value for the separation of sky and plant pixels as a function of the above-canopy photosynthetic photon flux density (PPFD). We tested the performance of our method for estimating transmittance against two established methods that assume exposure to be held constant to two stops higher than the reference exposure. Our method compensates for changes in sky illumination, producing a smaller pixel threshold value when sky illumination decreases and a larger pixel threshold value when photographs are taken under increased sky illumination. The new method achieved accurate and reproducible results, even in situations where under- or over-exposure was caused by changes in sky illumination during photo acquisition.

Key words: sky illumination, gap fraction, light availability, indirect site factor, exposure.


Bright sky
Dark sky
(A)
(B)
Original images
(C)
(D)
WinSCANOPY processed binary images
Gap-fraction: 9.42%
Gap-fraction: 4.1%
(E)
(F)
The new method processed binary images
Gap-fraction: 7.72%
Gap-fraction: 8.15%

- 新方法在估计百分比透光率中的表现


SideLook
The new method
Above canopy PPFD
Diffuse transmittance calculated from hemispherical pohtos
Directly measured diffuse transmittance (ISF)
y = 0.9689x
R² = 0.88
RMSE = 0.026
(A)
y = 1.017x
R² = 0.95
RMSE = 0.018
(E)
225
y = 1.164x
R² = 0.95
RMSE = 0.039
(B)
y = 1.080x
R² = 0.95
RMSE = 0.025
(F)
453
y = 0.8217x
R² = 0.96
RMSE = 0.039
(C)
y = 1.034x
R² = 0.98
RMSE = 0.015
(G)
17
y = 0.6102x
R² = 0.91
RMSE = 0.080
(D)
y = 0.8779x
R² = 0.95
RMSE = 0.029
(H)
8
0.0
0.1
0.2
0.3
0.4

适合大样地

- A → B 光梯度

- A的林隙比例大？
- A拍的早，天比较亮

结论

- 根据天空亮度来计算灰度阈值，
- 更准确！
- 不受天空亮度变化影响！

- 更准确的林下光梯度的量化希望能够帮助我们发现更多问题、现象和规律。

- 感谢导师何芳良教授
  对我的工作的指导！

- 感谢您的聆听，请批评指正！