Satellite Reflectance Validation based on BRDF Reconstructed Airborne Hyperspectral Data

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Abstract

In this paper, Pu'er City, Yunnan Province was selected as the research area to explore the method of using airborne hyperspectral reflectance data based on the Bidirectional Reflectance Distribution Function (BRDF) model to validate Gaofen-6 satellite reflectance data.

Introduction

Quantitative validation of satellite remote sensing reflectance data is crucial for assessing its suitability for quantitative remote sensing applications.

The use of airborne remote sensing data to verify the reflectance of satellite images has important research significance.

Data

•Gaofen-6: 2020-12-14 12:26

SZA = 47.0°, SAA = 164.9°

Blue Band (B1): 0.45μm to 0.52μm

Green Band (B2): 0.52μm to 0.60μm

Red Band (B3): 0.63μm to 0.69μm

NIR Band (B4): 0.76μm to 0.90μm

Spatial Resolution: 16 meters

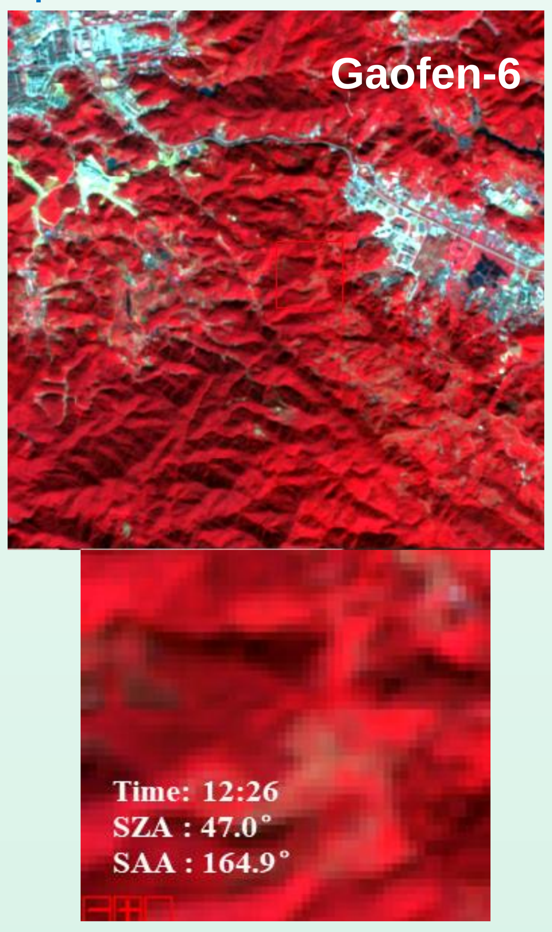
•Airborne HSI: 2020-12-13 13:47

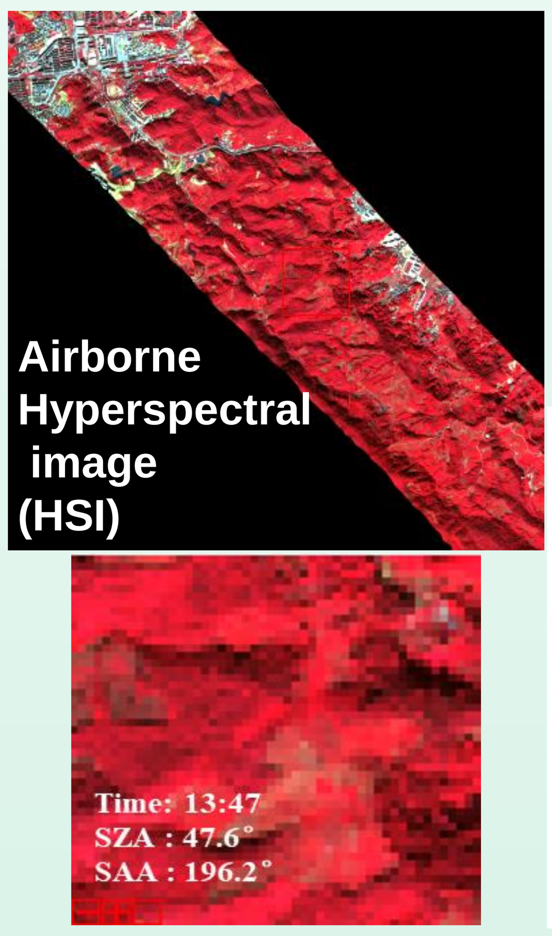
SZA = 47.6°, SAA = 196.2°

Spectral Range: 0.40μm~0.96μm

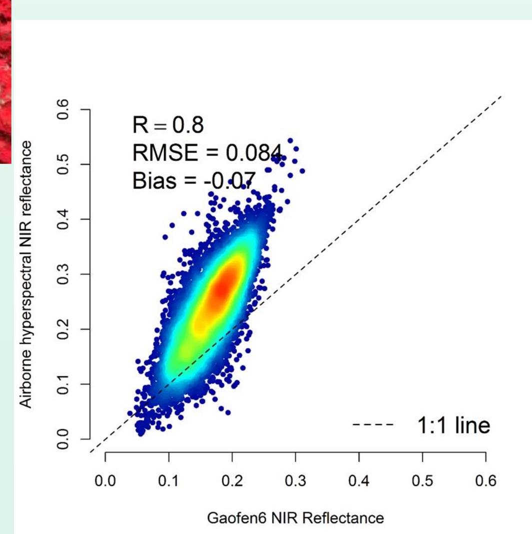
Spectral Resolution: 4.8 nm

Resample the airborne imagery's spatial resolution from 1 meter to match that of the Gaofen-6 imagery, which is 16 meters.



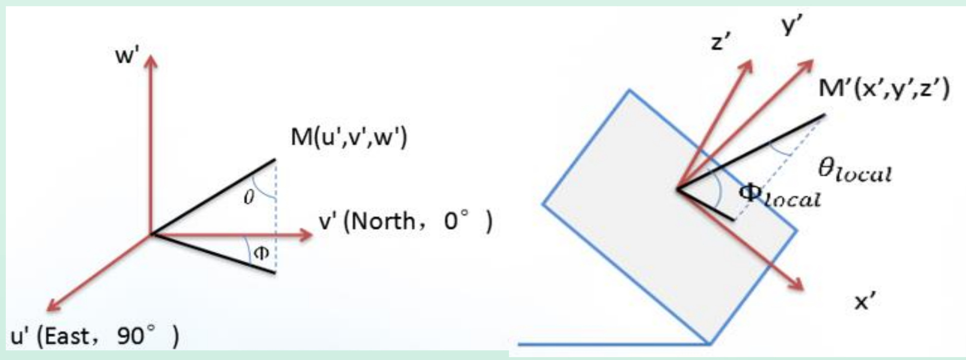


17,000 pixels selected for satellite reflectance validation.



Methods

A kernel-driven BRDF model for airborne hyperspectral imagery (Jia et al., 2020) over rugged terrain was utilized based on a linear combination of volumetric, geometric, and isotropic scattering.



$$\rho(\theta_v,\theta_s,\Delta\phi,c,\lambda) = f_{iso}(c,\lambda) + f_{vol}(c,\lambda)K_{vol}(\theta_v,\theta_s,\Delta\phi) + f_{geo}(c,\lambda)K_{geo}(\theta_v,\theta_s,\Delta\phi)$$

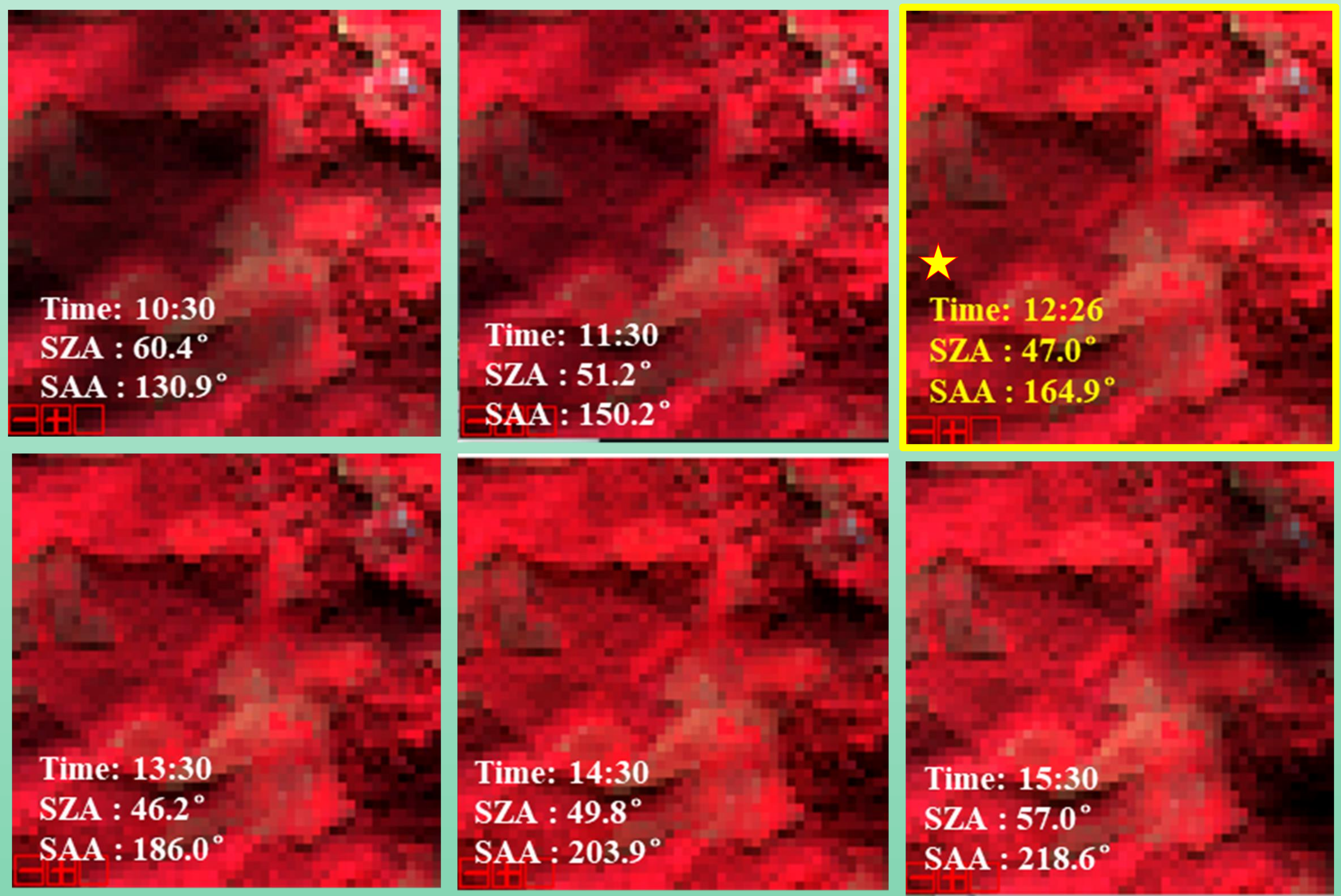
$$k_{vol} = \frac{(\pi/2-\xi)\cos(\xi)+\sin(\xi)}{\cos(\theta_s)+\cos(\theta_v)}\left(1+\left(1+\frac{\xi}{1.5}\right)^{-1}\right)-\frac{\pi}{4}$$

$$k_{Lispace} = O - \sec(\theta_s') - \sec(\theta_v') + \frac{1}{2}(1+\cos(\xi'))\sec(\theta_v')\sec(\theta_s')$$

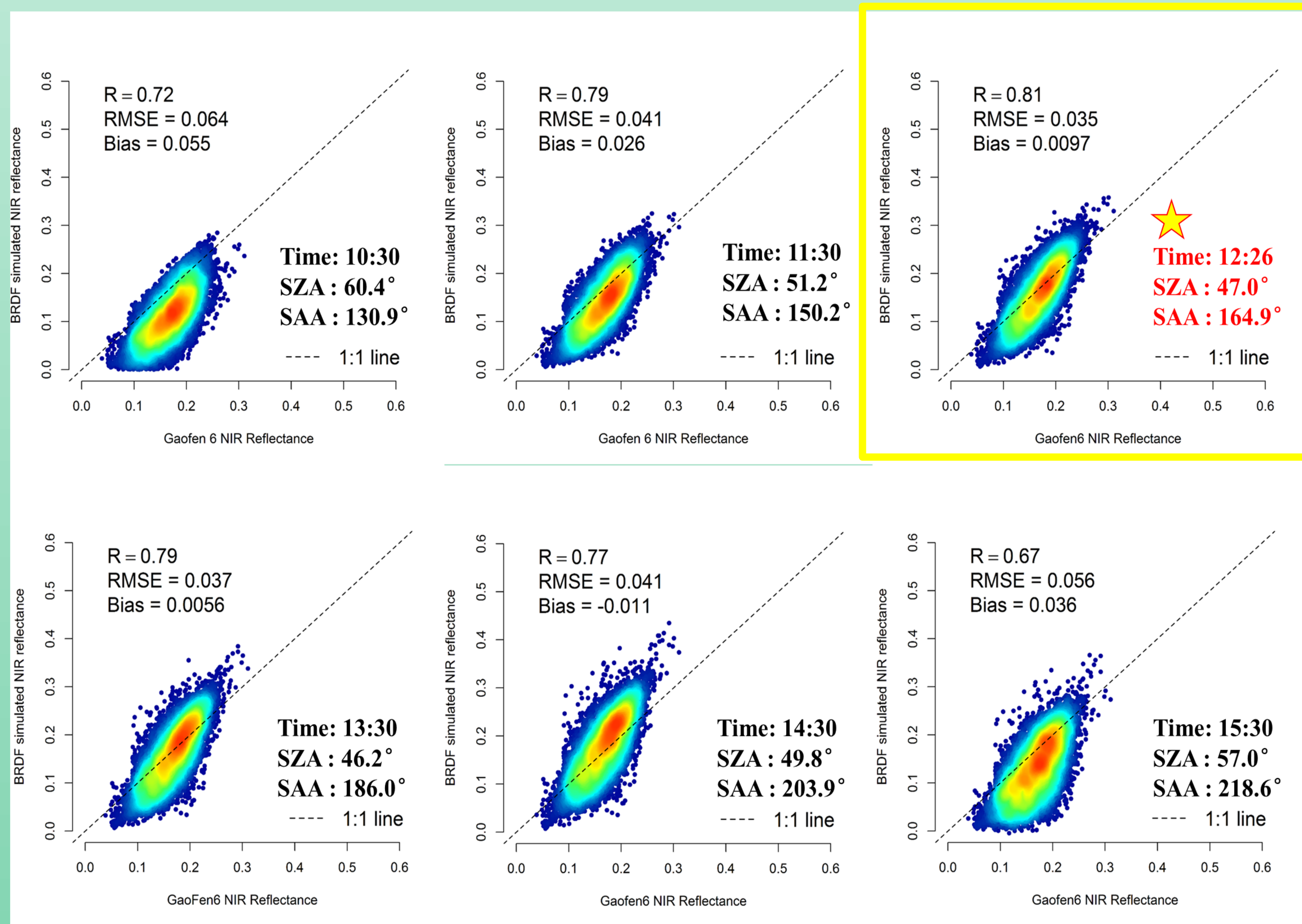
θ_v: local view zenith angle θ_s : local solar zenith angle $\Delta\phi$:relative azimuth angle between the sun and the observer c: class type λ: wavelength

Results

Reconstructed airborne reflectance data at different times



Validating GF-6 image NIR reflectance using reconstructed airborne imagery at different times



Conclusion

Instead of directly validating satellite data with airborne remote sensing data, the reconstructed airborne reflectance data (corresponding to the satellite imaging time) based on the BRDF model proves to be more efficient for verifying satellite reflectance images in complex forested terrains.

Reference

Jia, Wen, Yong Pang, Riccardo Tortini, Daniel Schläpfer, Zengyuan Li, and Jean-Louis Roujean. "A kernel-driven BRDF approach to correct airborne hyperspectral imagery over forested areas with rugged topography." Remote Sensing 12, no. 3 (2020): 432.