Sciences Faculty
Geography Department

Geometric Corrections of PRISMA Hyperspectral Satellite Images for Forest Ecosystem Monitoring: Errata Reporting

Master Thesis presented by: MICELI Florence

Geographic Sciences, Geomatics Orientation, Geodata Expert Finality

Academic Year: 2022 – 2023
Defence Date: 7 September 2023

Jury President: Prof. René WARNANT
Promoter: Prof. François JONARD
Co – promoter: Prof. Andrea NASCETTI
Reading Jury: Prof. Roland BILLEN,
Prof. René WARNANT

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1 Corrections of the chapters

1.1 Chapter 1 – Introduction

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1.2 Chapter 2 – Overview of Hyperspectral Remote Sensing

- Correction on line 40 (p.20): “from 400 to 2500 **nm”.**
- Correction on table 2.1 (p.21) on the 12th row: 920 - 2505 refers to the spectral range instead of referring to the spatial resolution.

1.3 Chapter 3 – The PRISMA Italian Hyperspectral Mission

- Correction on line 18 (p.24): “200 00**0** km^2”.
- Correction on line 15 (p.29): “the geocoded at-surface **reflectance** L2D product”.
- Correction on line 18 (p.29): “an orthorectified at-surface **reflectance** product”.
- Correction of figure 3.2 (p.29): “Level – 2D : Geocoded at-surface **reflectance**”.

1.4 Chapter 4 – Objectives

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1.5 Chapter 5 – Study Area and Datasets

- Corrections on lines 1 and 2 (p.38): deleted sentences.
- Correction on line 15 (p.38): “It provides a **10**m spatial resolution.”
- Correction on table 5.2 (p.38): **10**m spatial resolution.

1.6 Chapter 6 – Methodology

- Correction on table 6.1 (p.43) on the 7th row: ID of reference points - 5,10,21,22,**23**.

1.7 Chapter 7 – results

- Correction on line 5 (p.50): “The Sentinel – 2 reference map has a **10**m spatial resolution”.
- Correction one line 5 (p.52): “some hyperspectral images have geolocation **accuracy higher** than 200m”.
- Correction on table 7.7 (p.54) on the 3rd row: East shift: **1**20.70880.
- Addition of a section between page 55 and 56: 7.5 Assessment of the Orthorectification Process (see annexes of this document).

1.8 Chapter 8 – Discussion

- Correction on line 17 (p.56): “East shifts are more important than the **North** shifts”.
- Correction on table 8.2 (p.58):

Table 8.2: Maximum accuracy obtained by the rational polynomial function model on three test sites (Baiocchi *et al.*,2022).

Test Site	N. of polynomial coefficients estimated	N. of GCPs (N of CP)	East RMSE Value of CP discrepancies (m)	North RMSE Value of CP discrepancies (m)
Rome	6	6(54)	4.811	4.173
Fucino	6	6(54)	4.792	5.009
Ischia	5	5(55)	4.404	4.105

- Correction on lines 1-9 (p.59): deleted sentences.

1.9 Chapter 9 - Conclusion

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2 Correction of the Bibliography

- Missing references:

- Dolloff, J., & Carr, J. (n.d.). Computation of scalar accuracy metrics LE, CE, and SE as both predictive and sample- based statistics.
- Storch, T., Honold, H.-P., Chabrillat, S., Habermeyer, M., Tucker, P., Brell, M., Ohndorf, A., Wirth, K., Betz, M., Kuchler, M., Mühle, H., Carmona, E., Baur, S., Mücke, M., Löw, S., Schulze, D., Zimmermann, S., Lenzen, C., Wiesner, S., … Fischer, S. (2023). The EnMAP imaging spectroscopy mission towards operations. *Remote Sensing of Environment*, *294*, 113632.
- https://doi.org/10.1016/j.rse.2023.113632
- Tagliabue, G., Boschetti, M., Bramati, G., Candiani, G., Colombo, R., Nutini, F., Pompilio, L., Rivera-Caicedo, J. P., Rossi, M., Rossini, M., Verrelst, J., & Panigada, C. (2022). Hybrid retrieval of crop traits from multi-temporal PRISMA hyperspectral imagery. *ISPRS Journal of Photogrammetry and Remote Sensing*, *187*, 362–377. https://doi.org/10.1016/j.isprsjprs.2022.03.014

3 Annexes

Additional section on chapter 7 of the master thesis. The section 7.5 is described below.

7.5 Assessment of the orthorectification process

The objective of evaluating the proposed orthorectification process is to conduct a comparison between the geocoded PRISMA hyperspectral images and the PRISMA images corrected using the suggested methodology. Table 7.10 showcases the discrepancies observed in the North and East coordinate shifts, the RMSE values, and the geolocation accuracy when comparing the geocoded PRISMA hyperspectral images to the orthorectified PRISMA images.

Table 7.10: Discrepancies in North and East coordinates Shifts, RMSE values, and geolocation accuracy between the geocoded PRISMA hyperspectral images and the orthorectified PRISMA hyperspectral images.

ID of Hyperspectral Image	Number of GCPs used	North Coordinate Shift Difference (m)	East Coordinate Shift Difference (m)	North Direction RMSE Difference (m)	East Direction RMSE Difference (m)	CE90 difference (m)
1	15	-6,42112	+9,2584	+11,62269	-17.06841	-18.91602
2	6	-18,1747	-50,8824	-139.47364	-13.77345	-162.23748
3	14	-33,43378	+5,4678	+4.7977	-33.84777	-34.30231
4	14	-14,4425	-77,6152	-76.81817	-13.06337	-77.21128
5	11	-78,20795	-68,48374	-64.50239	-75.79958	-162.86842
6	10	-68,7343	-86,4700	-80.60154	-66.27319	-166.36915
7	5	+38,46446	-77,065	-72.38793	+39.17688	-157.275

According to the table 7.10, it can be observed that the shifts on the North coordinate decrease for all hyperspectral images except for the image 7. Similarly, the shifts on the East coordinate also decrease, except in two images. In some cases, the shifts have been greatly corrected such as the shift on the East coordinate of the hyperspectral image 6, which exhibited the highest correction in this direction.

In terms of RMSE values in the North direction, there is a decrease in most images, except for images 1 and 3. Moreover, the RMSE values in the East direction also decrease, except for image 7, where an increase can be observed.

The geolocation accuracy of all the hyperspectral images have been improved. However, it can be noted that there have been varying degrees of improvement in the geolocation accuracy of the hyperspectral images. By employing the suggested methodology, improvement up to 166.36915m can be achieved. Furthermore, improvements of 162.23748m and 157.2520 m have been achieved on the hyperspectral images with the highest cloud coverage.

Furthermore, it can be observed that there is no correlation between the number of GCPs used during the orthorectification process and the correction of the shifts and the improvement of the geolocation accuracy. In particular, employing a larger number of GCPs did not lead to greater enhancements.