LAND COVER MAPPING USING AN OBJECT-ORIENTED CLASSIFICATION OF PLÉIADES IMAGES : A CASE STUDY OF BOREAL FOREST RECOVERY AFTER SUMMER 2010 WILDFIRES IN MOSTA AREA (IVANOVO OBLAST, RUSSIA)

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ABSTRACT

In western part of Russia a high number of wildfires occurred in July-August, 2010 (almost 30,000 fires, with more than 1 million hectares burnt). Extreme heatwaves are made more likely by climate change, and the frequency of forest fires has increased 30-50% in the last 30 years. During 2016, 3.5 million hectares were burnt in Siberia (according to satellite imagery analysis), while government statistics claim only 669,000 hectares.

Mapping land-cover and monitoring boreal forest regrowth after 2010 fires using remote sensing imagery is the main objective of this study. The sudy area (**Plate 1a)** is located in Russia, 300km far from Moscow, near Mosta city in Ivanova oblast (latitude 42°10' N, longitude 56° 38' E). We used Pléiades images recorded on June 5, 2013, 3 years after forest fires. The appearance of the test area on Pleiades color composite imagery is shown at **Plate 1b**. In addition, we processed 2 Landsat ETM images,obtained before fire (2009) and 1 year after fire (2011). **Table 1** gives the characteristics of Pléiades and Landsat ETM sensors.

Ground checks have been done in July, 2013, including 106 sample plots for collecting information about vegetation structure and cover-abundance of dominant species using Braun-Blanquet scale (cf. **Table 2**).

Methodological approaches combine supervised and expertised classifications, implemented with ENVI Fx (Feature Extraction module) and eCognition, and using several algortihms (KNN, SVM, fuzzy logic). Methodological,schemes are similar and illustrated at **Plate 2** (ENVI) and **Plate 3** (eCognition).

First level of classification (4 classes : water, unburnt forest, forest burnt only 2010, forest burnt 2010 and before) is obtained from processing Landsat images and result is shown at **Plate 4**. In addition, bog delimtation has been done by manual digitization. Classification techniques are displayed at **Table 4**.

The second level of classifications involves segmentation of Pléiades images and object-oriented classifications. Original image and 2 levels of segmentation are illustrated at **Plate 5**. Training areas and control areas (cf. **Table 5**) have been selected to implement the supervised classification approach. The separability of thematic classes is evaluated through visualisation of 2-dimensional scattergrams of red and near infrared channels (**Plate 6a**), and of NDVI and brightness indices (**Plate 6b**). From the analysis of separabilty its is concluded that the best combination of input data is obtained when using 8 parameters: means in green, red and PIR spectral channels, NDVI, brightness index, standard-deviations in green, PIR and NDVI (cf. **Figure 1**).

Results of segmentation obtained in a burnt area and a forest area are displayed at **Plates 7a** and **7b** (ENVI Fx result) and at Plates **8a** and **8b** (eCognition result). Several classification methods have been used and compared (**Table 6**). The best classification results, obtained with supervised and expertised classification using eCognition, are displayed at **Plate 9** ; twelve thematic classes have been mapped : shadow, open water, water inside bog, bare soil, bog, herbaceous vegetation coniferous forest, broadleaf forest, mixed forest, and three levels of regeneration of burnt forest (low, medium and high). Ground photographs illustrating forest regeneration classes are shown at **Plate 10**. Evaluation of classification results is done through elaboration of confusion matrices with 67 control areas, and using producer's accuracy (**Table 7**), user's accuracy (**Table 8**) and

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Kappa index (0.81). With ENVI Fx, best classification accuracy is lower (Kappa = 0.70)

These results demonstrate the possible use of Pléiades images for mapping and monitoring land cover and boreal forest regrowth after fire.

KEYWORDS

Boreal forest, wildfires, forest regrowth, Pléiades images, Landsat images, object oriented classification, Russia

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