COMPARISON OF SAM AND OBIA AS TOOLS FOR LAVA MORPHOLOGY CLASSIFICATION – A CASE STUDY IN KRAFLA, NE ICELAND

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(1) Introduction

Lava morphology is related to the characteristics of the surface morphology of a lava flow after solidification. The typical morphology of lava can be used as primary basis for the classification of lava flows when rheological properties cannot be directly observed during emplacement, and also for better understanding the behavior of lava flow models.

Although mapping of lava flows in the field is relatively accurate such traditional methods are time-consuming, especially when the lava covers large areas such as in Krafla, Iceland. **Semi-automatic mapping methods that make use of satellite remote sensing data allow for an efficient and fast mapping of lava morphology.**

(2) Objectives

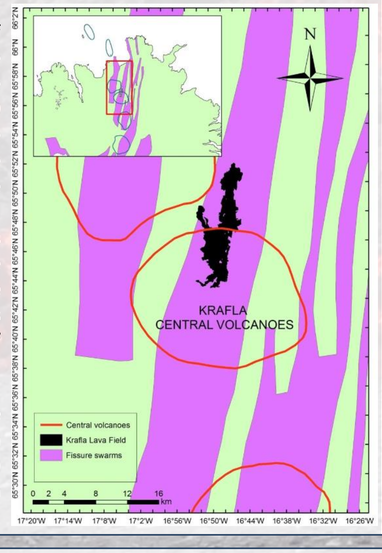
The morphology of an open channel lava flow in Krafla has previously been mapped by Rossi (1997), who recognized five flow facies:
(1) initial pahoehoe sheet,
(2) proximal slab pahoehoe and aa,
(3) shelly-type overflows from the channel,
(4) distal rubbly aa lava, and
(5) secondary outbreaks of toothpaste lava and cauliflower aa.

The study by Rossi (1997), who classified about 55% as aa, 32% as pahoehoe and 13% as main lava channel, was primarily based on field mapping, video recording and measuring pre-flow topography from aerial photographs. Therefore, a study by remote sensing is required as a complementary tool to traditional (field) investigations. **The aim of this study is to semi-automatically map and assess the surface morphology of the 1975-1984 Krafla lava field using satellite remote sensing.**

(3) Study Area & Data

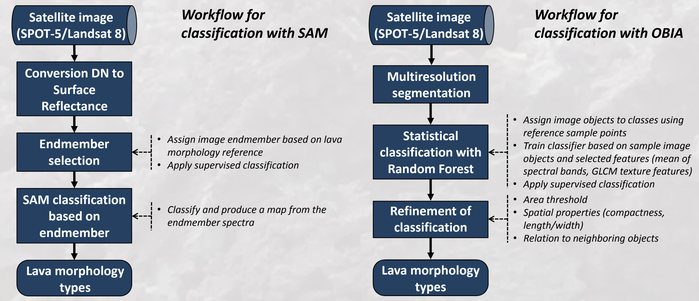
The Krafla volcanic system is part of the Icelandic North Volcanic Zone (NVZ). During Holocene, two eruptive events occurred in Krafla, 1724-1729 and 1975-1984. The last eruptive episode (1975-1984), known as the "Krafla Fires", resulted in nine volcanic eruption episodes. The total area covered by the lavas from this eruptive episode is 36 km^2 and the volume is about 0.25-0.3 km^3. **The Krafla lava field was chosen for this study since it is almost free of vegetation cover.**

Two optical satellite images were used: **(1) SPOT-5 (03/10/2002) with 10 m spatial resolution and (2) Landsat 8 OLI (28/08/2014) with 30 m spatial resolution.**

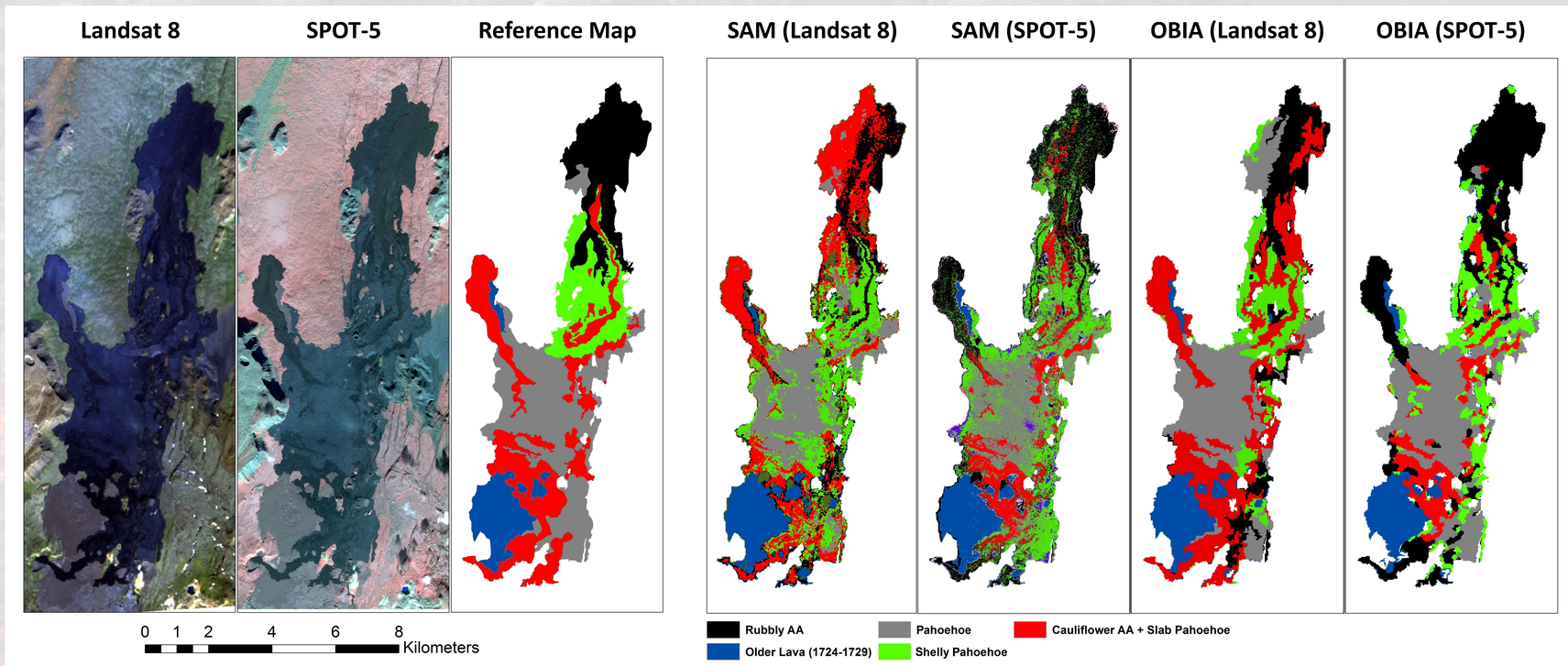


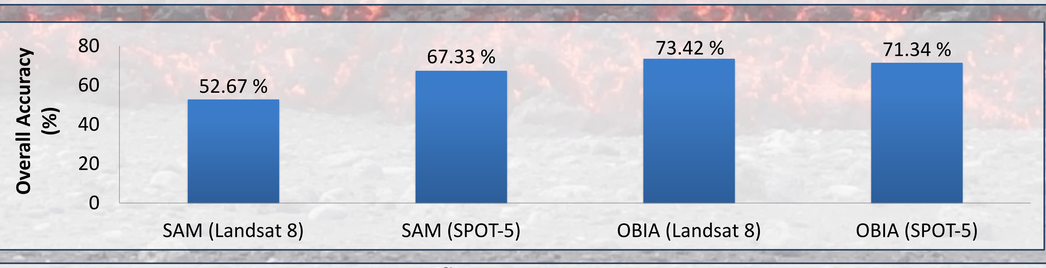
(4) Methods

In this study, **two semi-automatic methods for lava morphology classification are presented and compared** using Landsat 8 and SPOT-5 satellite images. For assessing the classification accuracy, the results from semi-automatic mapping were compared to the respective results from visual interpretation.
On the one hand, the **Spectral Angle Mapper (SAM) classification method using ENVI 5.3 software** was used. With this method an image is classified according to the spectral similarity between the image reflectance spectra and the reference reflectance spectra. On the other hand, we applied the **Random Forest (RF) classification method within an object-based image analysis (OBIA) framework using the eCognition (Trimble) software**. This statistical classifier uses a randomly selected subset of training samples to produce multiple decision trees. For final classification of pixels or – in the present case – image objects, the average of the class assignments probability predicted by the different decision trees was used. The lava morphology reference map was created by a combination of visual interpretation from very high resolution (VHR) aerial photographs (southern part) and of the classification by Rossi (1997) (northern part).



(5) Results





(6) Discussion & Conclusion

Both semi-automatic methods produced reasonable results in the Krafla lava field, however, higher accuracy values were achieved with the OBIA approach. In general, the identification and mapping of different pahoehoe and aa types of lava appeared to be difficult. The use of satellite remote sensing data shows a high potential for fast and efficient classification of lava morphology, particularly over large and inaccessible areas.

References

Rossi, M.J. 1997. Morphology of the 1984 open-channel lava flow at Krafla volcano, northern Iceland. *Geomorphology,* 20(1-2):95–112.

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