OBJECT BASED IMAGE ANALYSIS FOR REMOTE SENSING OF PLANETARY SURFACES

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Introduction

Object based image analysis (OBIA) is an established Earth-based remote sensing method that processes images creating image-objects through user generated rulesets. Unlike traditional pixel-based analyses, OBIA looks at the image as a whole, checking homogeneity, shape, position, etc. in addition to brightness levels [1,2].

This study proposes incorporating the OBIA model into the study of other planetary surfaces by testing its validity on the Martian pits on the residual south polar cap. Then the evolution, structure, and distribution of features can then be easily and efficiently studied.

Methods

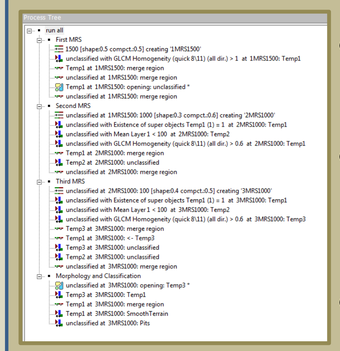


Figure 3 – *Above:* Ruleset dialogue used for Figure 1.

- HiRISE images of 'pits' in the Martian RSPC are analyzed [5].
- Rulesets are created in eCognition® OBIA software to classify morphological features.
- Conditions are used to create rules. Pits tend to be less homogenous and darker than the surrounding smooth terrain.
- GIS software is then used to process the images and their associated image-object classifications.
- Structure of rulesets followed the principles of:
  - Segmenting images (aggregating pixels)
  - Classifying objects
  - Merging regions (aggregating image-objects)
  - Morphology tools (smoothing out objects)
  - Iteration (repeating the above tools)
- Length, area, and width attributes are looked at to see how the features evolve.

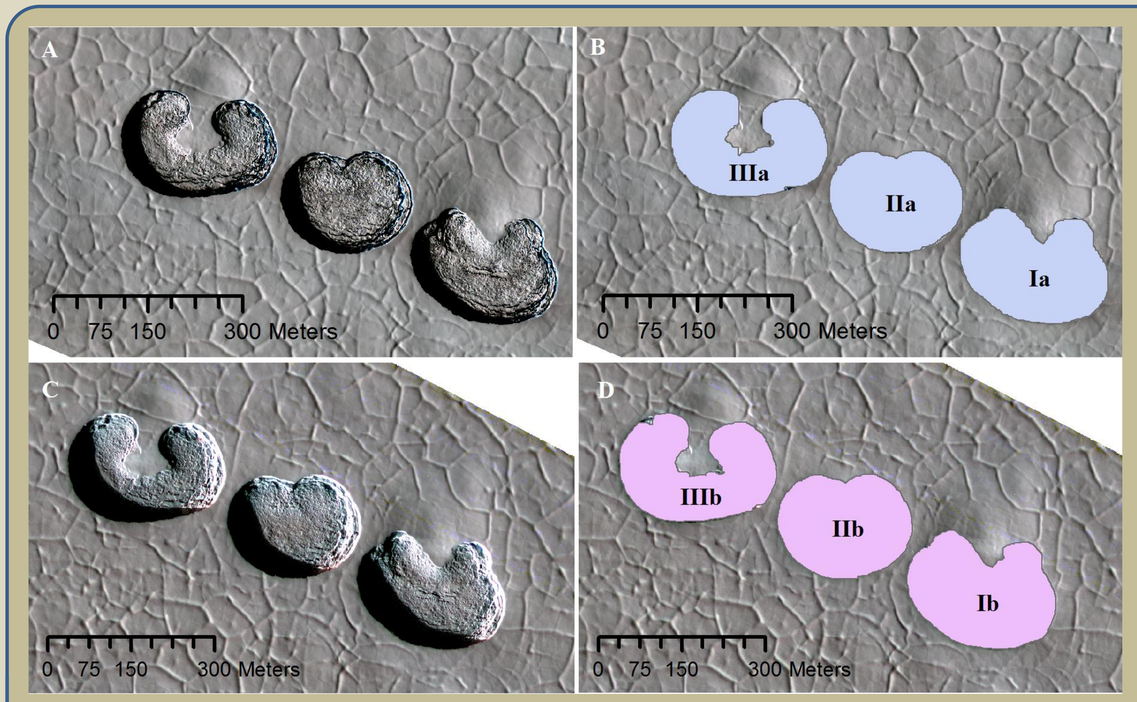
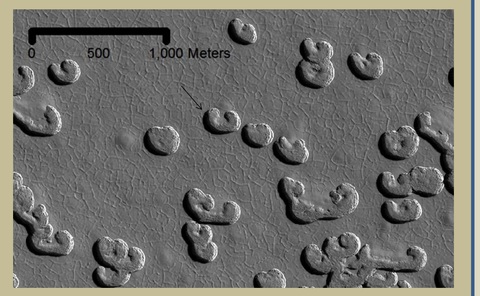


Figure 2 – *Lower Right:* HiRISE image of the characteristically pitted A1 terrain. | The three sampled pits are located in the center of the frame, arrow marks pit III. Photograph shows typical "swiss-cheese terrain" in the Martian residual South polar cap.

Results & Discussion

Figure 1 – *Left:* HiRISE images of the Mars residual South pole cap's unique pit features. | *A:* Three pits photographed in August 2009. *B*: Image *A* with the OBIA pit image objects overlaid in blue. *C:* Same three pits as *A/B* imaged in December 2010. *D*: Image *C* with the image objects overlaid in pink. Both analyses used the same OBIA ruleset. It is evident OBIA can readily recognize these objects.



- Pit lengths have grown at an average rate of 3.8 ± 0.9 m/♂y.
- Thomas et al. (2012) studied the growth and lifespans of these pits in the A1 layer of the RSPC. These features are expanding at an average rate of 3.6 ± 0.2 m/♂y [4].

Pit	2009 Length	Retreat Rate
I	265.0 m	4.6 m/♂y
II	239.5 m	4.1 m/♂y
III	281. 0 m	2.8 m/♂y
Average	**261.8 m**	**3.8 m/♂y**

- The OBIA retreat rates are within error and OBIA is shown to be a viable method.
- OBIA allows quick calculations to be made on high spatial and temporal data with ease.
- Rulesets can be easily adapted to fit different models and datasets.
- Future work should work on developing a rigorous ruleset for classifying multiple features on the Martian surface.
- Current work is being done to analyze the Venusian surface with Magellan data using OBIA software.

References

[1] Riggan Jr. N. D. and Weih Jr. R. C. (2009) *J. of the AR Acadamy of Sci.*, 63, 145–152. [2] Kamagata N. et al. (2005) *Proceedings of the 26th Asian Conf. on Remote Sensing*. [3] Thomas P. C. et al. (2005*) Icarus*, 174, 535–559. [4] Thomas P. C. et al. (2012*) Icarus,* Online. [5] McEwen A. S. et al. (2007) *JGR*, 112, 5.

Acknowledgments

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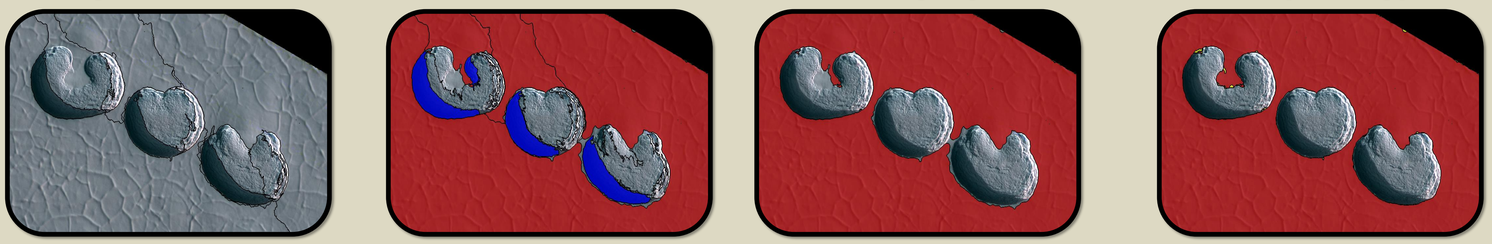

Figure 4 – *Left:* Methodology - Steps in OBIA | Typical steps of an OBIA: segmenting the image by aggregating pixels, classifying areas on their attributes, merging similar regions, and smoothing surfaces (morphology).