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A method to investigate the temporal variation of lakes on Titan using Cassini Synthetic Aperture Radar images

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The images obtained using the Cassini Synthetic Aperture Radar (SAR) revealed that Titan hosts a very complex surface curved with features [1; 2], which resemble Earth-like geomorphological structures [3, 4]. The Cassini/radar swaths counted in both north and south polar regions, above 50° N and 50° S respectively, more than 655 lake-like basins [5]. SAR imaging shows lake-like features separated into 3 classes; dark lakes, granular lakes, and bright lakes. Dark lakes are interpreted as liquid filled, while bright lakes are interpreted as empty basins and granular lakes are inferred as transitional between dark and bright lake features. From a geomorphologic aspect the lakes on Titan span the range of observed morphologies on Earth (5-7). They are rimmed features, from circular to irregular and some with distinct edges, steep margins and smooth surfaces [6] and exhibit from moderate to small sizes [6]. This study provides a qualitative method of recognition of lake-like features from Cassini SAR images. The intended goal is to label regions in an image into three classes (dark lakes, granular lakes and the local background). First, a filtering technique is applied to obtain the restored image [8]. Then, a method of supervised segmentation is used. The segmentation method based on the minimum Euclidean distance is used here. The temporal variation of the dark spots can provide information on the evolution of the lake system and consequently help us to better understand the methane cycle on Titan and therefore the mechanisms linked with the lake surface features, their origin and fate, through a global temporal and spatial coverage. The passage from qualitative to quantitative results, requires:
i. to apply the aforementioned method in the same regions of interest with the same observational characteristics at different time periods in order to measure the surface each time.
ii. to use a bathymetry model [e.g. 9] which will enable us to estimate the mean depth of any region of interest and to calculate its volume.
Using this temporal dataset will help us evaluate the volume variation through time and estimate the hydrocarbon loss rate, a critical parameter for the global methane cycle [10,11]. The proposed filtering and segmentation method would be a helpful tool in enhancing the return of the analysis of all SAR data acquired on Titan and other objects as well as in the exploitation of such data from future missions to Titan.

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