APPLYING THE THEMIS QUASI-SPECTRAL CHLORIDE INDEX TO THE MARTIAN SOUTHERN HIGHLANDS. J. R. Hill[1] and P. R. Christensen[1], [1]School of Earth and Space Exploration, Arizona State University, Tempe, AZ (jonathon.hill@asu.edu).

Introduction: Deposits of chloride minerals in the Martian southern highlands provide significant insight into the water cycle on Mars around the time of the Noachian-Hesperian boundary. The detection of chloride minerals has been difficult since they do not have spectral features in the wavelength ranges observed by current Mars-orbiting instruments. However, they can be indirectly identified by the slopes they introduce to thermal infrared spectra. In the past, they have been located by visual inspection of THEMIS [1] decorrelation-stretched (DCS) images, which enhance this spectral slope and give the chloride deposits characteristic colors. Using this method, Osterloo et al., (2010) [2] identified 642 chloride deposits, mostly in the southern highlands. However, the possibility exists that their survey may have missed deposits for various reasons. Also, because the number of available THEMIS observations has nearly doubled since the survey was conducted, an updated and more rigorous survey could yield important new detections.

Chloride Index: In order to conduct this updated search for chloride mineral deposits, a quasi-spectral index has been developed. The index is considered "quasi-spectral" because it is based on the band variations from the decorrelation-stretched data instead of the original radiance or emissivity data. This approach was chosen because initial attempts to develop a true spectral index for the chloride deposits were plagued by significant false-positive identifications.

The index utilizes the standard THEMIS DCS band combinations of 875, 964 and 642, which all highlight the chloride mineral deposits with unique colors (blue in DCS875, teal in DCS964 & yellow/orange in DCS642 [2]). The index itself is essentially composed of three tests, one for each of the standard DCS band combinations:

DCS875: $B > (R+1\sigma)$	Eq. 1
DCS964: $G > (R+1\sigma)$	Eq. 2
DCS642: $R > (B+½\sigma)$	Eq. 3

The index will return a detection for any pixels that satisfy all three of these tests.

From trial-and-error, we have found that the index occasionally results in false-positives in areas of high slope. However, since the exact positions of the false positive pixels are also dependant on the solar incidence

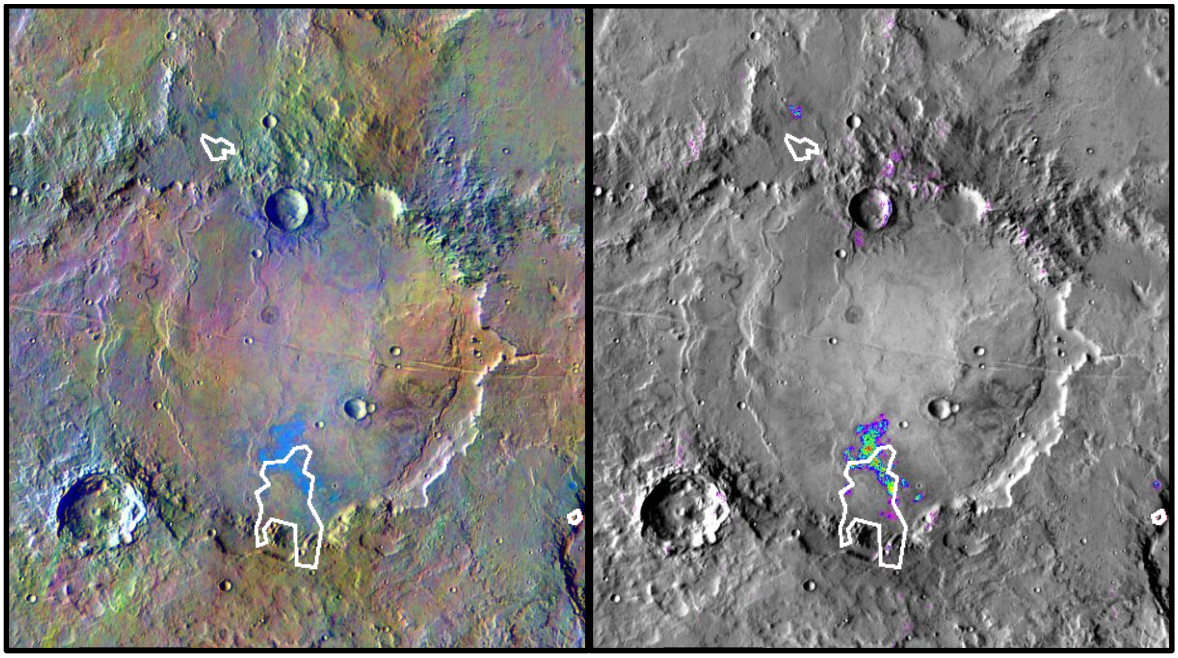

Figure 1: Unnamed Crater East of Ma'adim Vallis with Previously-Identified Chloride Deposits Outlined in White [1]: a) THEMIS DCS 875 Mosaic of the Crater, with the Chloride Deposit in Blue, b) Results of the Chloride Index with the Number of Detections Shown as a Heatmap (Only Detections ≥ 2 are Shown)

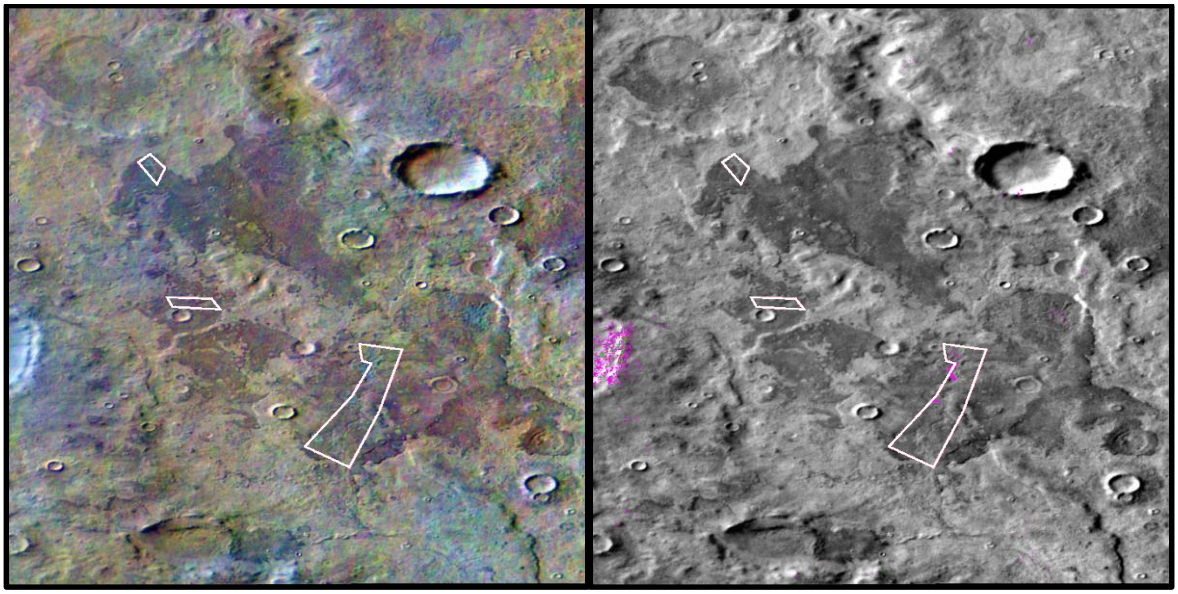

Figure 2: Unnamed Local Depression in Terra Sirenum with Previously-Identified Chloride Deposits Outlined in White [1]: a) THEMIS DCS 875 Mosaic of the Local Depression, with the Chloride Deposit in Blue, b) Results of the Chloride Index with the Number of Detections Shown as a Heatmap (Only Detections ≥ 2 are Shown)

angle, the solar azimuth angle and many other parameters, the false positives occur in slightly different places in different images. So to protect against false-positives, we only consider pixels that satify the index criteria in multiple THEMIS images.

Results: In order to verify the results of the chloride index, we applied it to all 642 previously-identified chloride sites [2]. Of those sites, 591 sites are positively identified by the chloride index. One such site is shown in Figure 1, with both a THEIS DCS875 mosaic and the results of the chloride index. (The exact position of the polygons from [2] are not well registered with the THEMIS global mosaic, resulting in slight offsets. This is most likely due to the original survey being conducted on individual images and not the THEMIS global mosaic, which has not been completed at that time.) The remaining 51 sites did not satisfy the chloride index criteria in multiple images. Two of these sites are shown in Figure 2 as the two left-most sites, while the right-most site in Figure 2 is properly identified by the chloride index.

In order to determine whether these negative confirmations were due to a problem with the chloride index or a mis-identification by the original survey, all 51 sites were manually analyzed using all three standard THEMIS DCS band combinations. The initial determination is that these 51 sites may have been overly-optimistic identifications in the original survey [2], however the analysis will continue in order to verify this interpretation.

Future Plans: Now that the chloride index has been validated against the known chloride mineral deposits, it is being applied to the entire southern hemisphere, one quadrangle at a time. Although the process of applying the chloride index to large areas is computationally intensive (THEMIS images must be processed into all three DCS band combinations, and then analyzed using the index criteria), the cluster at ASU's Mars Space Flight Facility is producing results at a rate of approximately one quadrangle per week. By the time of LPSC 2019, all of the southern hemisphere quadrangles will have been completed, which will enable the identification of previously unidentified chloride mineral deposits throughout the southern highlands.

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References: [1] Christensen et al. (2004) Space Sci Rev 110: 85-130. [2] Osterloo et al. (2010) J. Geophys. Res. Planets, 115, E10012.