OBSERVABLE CHANGES AT CTX TO HRSC-SCALE OVER THE SOUTH POLAR RESIDUAL CAP.

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Introduction: Research on changes over the South Polar Residual Cap have been previously performed using CRISM [1] and TES [2] images for the ice caps. OMEGA has mapped several water ice units adjacent to the caps [3]. A lot of research has also been done using MOC-NA, CTX, and HiRISE for various surface features and their changes in the region, from so-called “Swiss Cheese Terrain”[4] to “spiders” [5]. Also, interannual and seasonal changes over the Polar Cap have also been observed using MARCI[6]. With its coverage of 98% at 100 m/pixel or better resolution and 100% including lower resolution[7], the High Resolution Stereo Camera (HRSC) has mapped the South Polar region of Mars, including the South Polar Residual Cap (SPRC). With its near 100% coverage and its resolution (reaching 12.5 m/pixel) and its inherent characteristic as a stereo camera Digital Terrain Models can be processed for all the images opening up the possibility of mapping, changes over the SPRC including the use of HRSC images from other epochs. Results from the observable changes obtained at HRSC-scale are here compared to results obtained from other instruments.

HRSC Orthorectified Images: Digital Terrain Models have been produced from HRSC images over the South Polar region focused on the South Polar Residual Cap[8]. Digital Terrain Models are produced using open-source NASA-VICAR software environment with specialist programmes developed by DLR (*Deutsche Zentrum für Luft- und Raumfahrt*; German Aerospace Centre), modified by Kim and Muller using a script based on IDL[9]. This modification was done using an area based matcher based on the Gruen matcher (Adaptive Least Square Matching (ALSM)) and stereo region growing Gotcha algorithm [10]. Using the Digital Terrain Models at 50 m/pixel resolution, HRSC images are orthorectified to 12.5 m or 25 m to be used in this change detection research. Because of the block adjustment performed by colleagues at the Free University Berlin in producing exterior orientation information for producing the DTMs, co-registration between HRSC images produces very good results.

Diurnal CO2 Cycle: A diurnal CO_2 cycle over the South Polar region of Mars is observable from the existence of CO_2 ice layer on the surface over the South Polar region [11]. Because of the growth and recession of the ice layer, the appearance of the surface changes too rapidly, and is not suitable for change detection research. A similar surface appearance happens for images taken in the same solar longitude (Ls) range. Because of this, we employ HRSC co-registerted products for similar solar longitude ranges. If the diurnal CO_2 cycle is the point of interest, however, images taken in the same or different year with different solar longitude values may be selected.

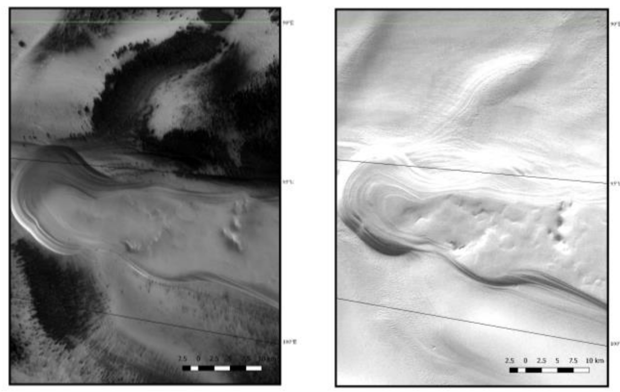


Figure 1 Changes over the South Polar Residual Cap in the same Martian Year caused by diurnal CO_2 cycle, (left: H4162_0000, 03-04-2007, MY 28, Ls 211.9, right: H4917_0009, 31-10-2007, MY 28, Ls 339.7)

Cap Edges: Because of the CO_2 ice layer being on top of the H_2O ice, there is a high albedo difference between the cap and the surrounding surface. Using an edge detection method, these edges caused by the albedo difference can be derived from HRSC images and mapped in regards of the pole. The edge values obtained can be compared with edge values obtained from other overlapping HRSC images from different epochs. The edge values obtained can be compared with cap edges derived from manual annotation or cap edges derived from CRISM or TES.

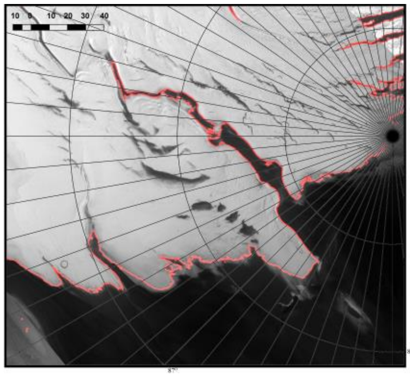
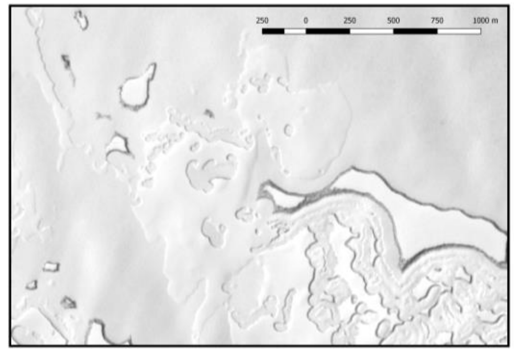
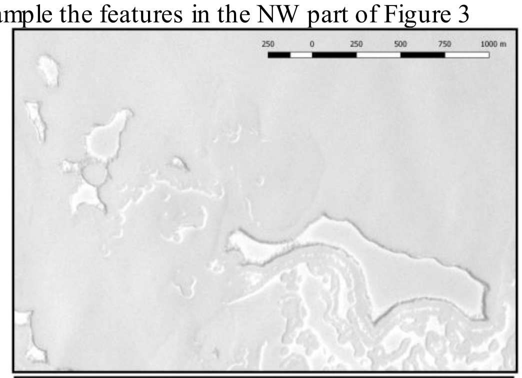


Figure 2 Cap edges pictured in HRSC image (H2189_0000, 27-09-2005, MY 27, Ls 296.052)

Surface Features: Because of the resolution of the original images and the scale of the surface features over the South Polar Residual Cap (SPRC), it is difficult to employ HRSC images to detect small changes due to CO2 sublimation. Instead we need to employ CTX at 6m/pixel to detect such small-scale changes, see for example the features in the NW part of Figure 3





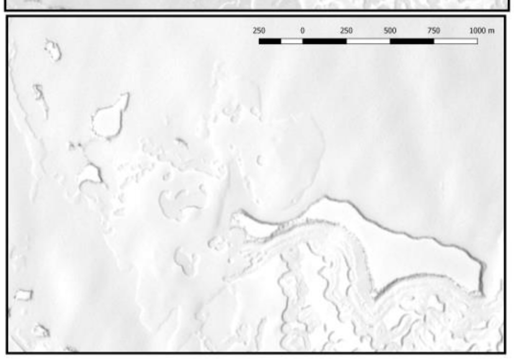


Figure 3 Observable Features from Figure 3 in CTX. Notice that the changes are distinguishable at this scale (top: P10_004765_0943_XI_85S357W, 02-08-2007, MY 28, Ls 288.22, middle: D10_031256_0942_XN_85S357W, 27-03-2013, MY 31, Ls 290.25, bottom: F12_040328_0942_XN_85S357W, 04-03-2015, MY 32, Ls 302.26)

Future Work: Changes observable at CTX to HRSC-scale and results of cap edge mapping will be presented at LPSC 2017. Research will also be extended to CTX time sequences using the HRSC orthorectified co-registered images as base images for autocoregistration and HRSC DTMs as base images for orthorectification, so that further change detection research can be done utilising Mars images at finer resolution.

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