iMars - Analysis of Mars multi-resolution images using auto-coregistration, data mining and crowd source techniques : processed results – a first look

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Overview

- iMars Objectives
- Martian imagery over the decades
- Examples of changes and their distribution
- iMars scientific context
- ESA/DLR/FU Berlin Global HRSC basemaps
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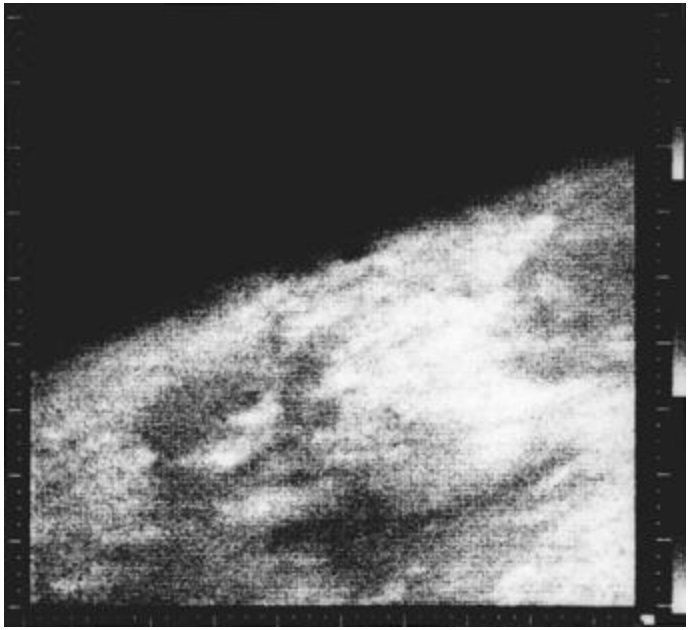
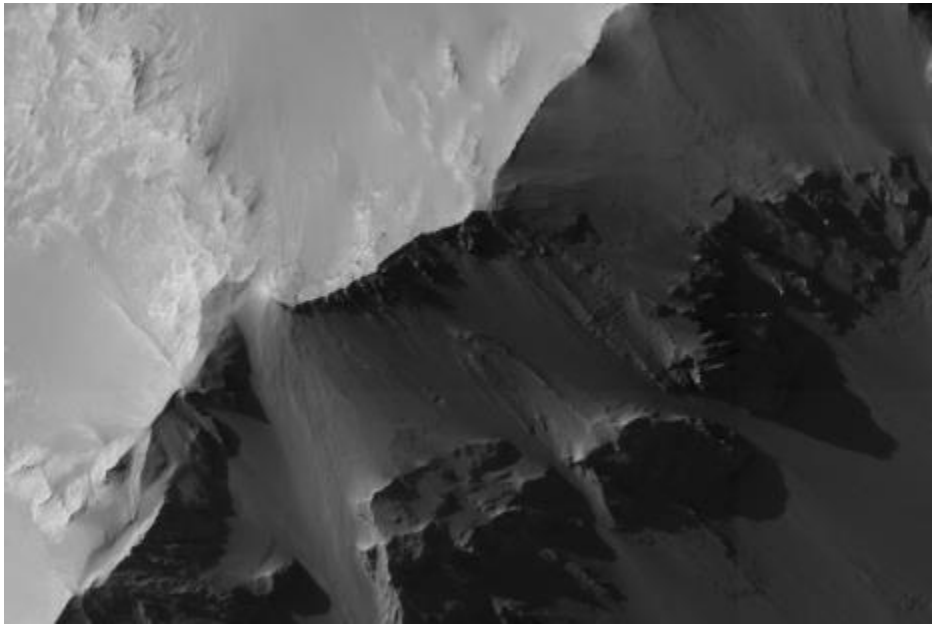
iMars Objectives

- To explore changes in the Martian surface for images <100m since the start of robotic exploration using automated data mining techniques and crowd-sourcing from
- HRSC OrthoRectified Images (ORIs) and Digital Terrain Models (DTMs) used as **base datasets** employing
- Automated co-registration of NASA orbital imagery together with higher resolution DTMs from CTX and HiRISE to these HRSC ORI/DTMs
- Applying data mining tools, stacks of co-registered data and automated data mining results verified by citizen scientists through an OGC-compliant webGIS to scientific collaborators of consortium members

Martian Imagery over the decades



First Mars fly-by image (15/7/1965): Mariner 4
Elysium Planitia: resolution – 5km/pixel



HiRISE imagery (2006-): MRO
Xainza Crater, 25cm/pixel

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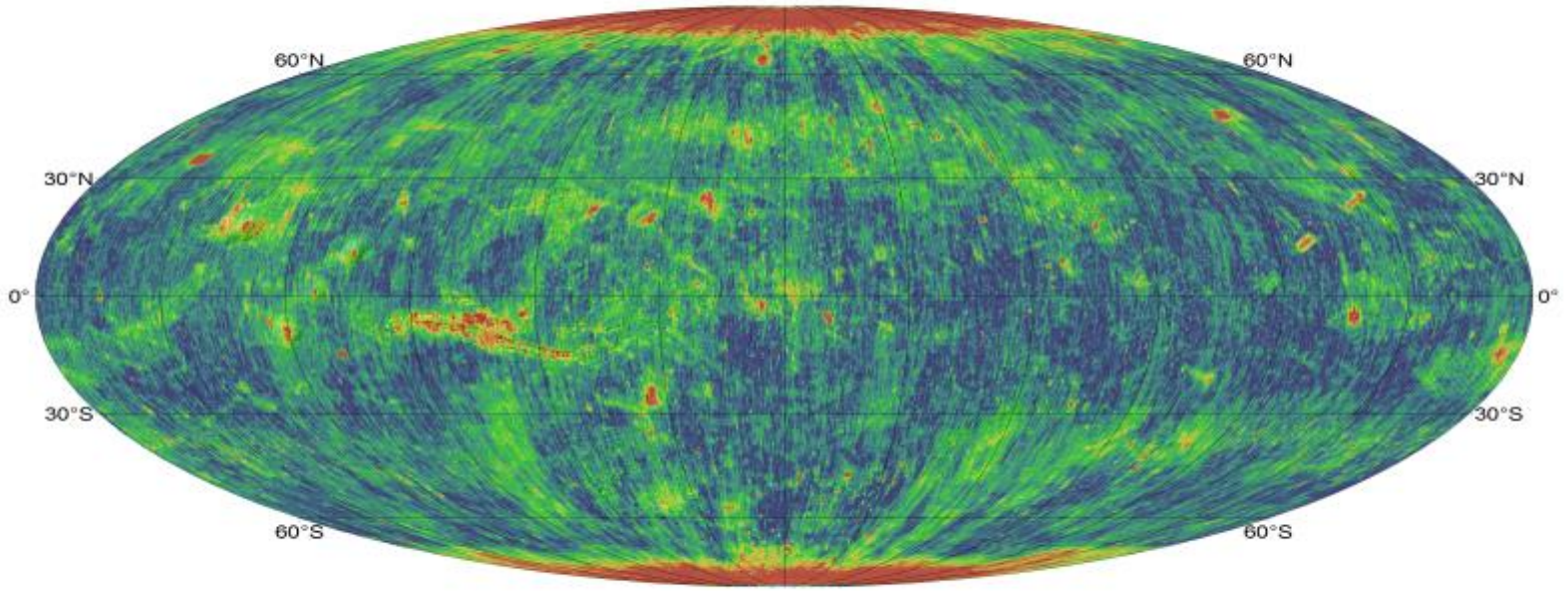
High-Resolution Mars REPEAT Coverage



Martian Surface Coverage, Res<100m, MY12-31 (1976-2013)

Greyscale shaded map: NASA/MOLA science team

Repeat
High : >19
Low : 1

P. Sidiropoulos and J. P. Muller, Planetary Space Science, 2015.

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High-resolution Mars image data

Significant increases in data volume

Cameras	Years	Resolution (m)	No. Images	Data
Viking Orbiter 1	1976-1980	8-1800	~32 000	29G
Viking Orbiter 2	1976-1978	8-1800	~15 000	
MGS MOC-NA	1997-2006	1.5-12	97 097	~350G
MO THEMIS	2002-	18-36	~205 000	~6T
MeX HRSC	2004-	12.5-25	~5000 (nadir)	~3T
MRO CTX	2006-	6	~79 000	~12T
MRO HiRISE	2006-	0.25-0.5	~90 000	~120T

Trivia: HiRISE acquires the same data volume every day that 2 VO missions acquired over 4 years

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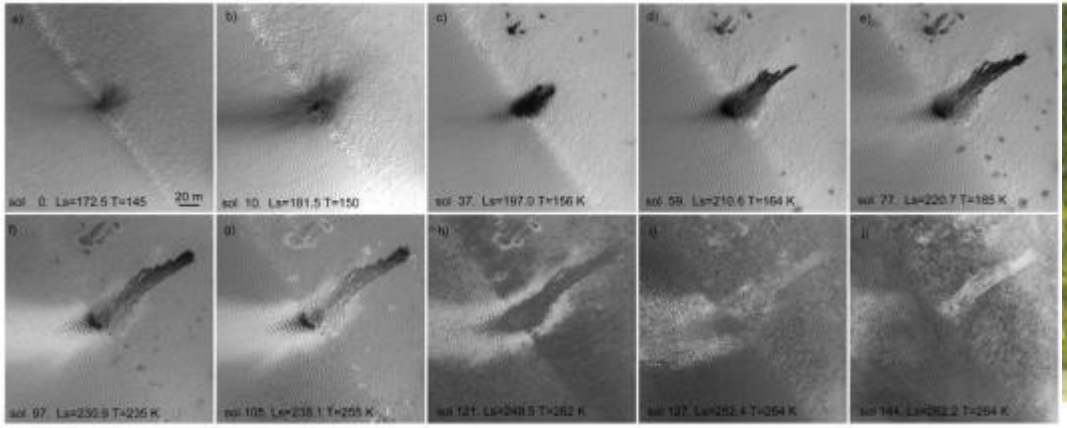
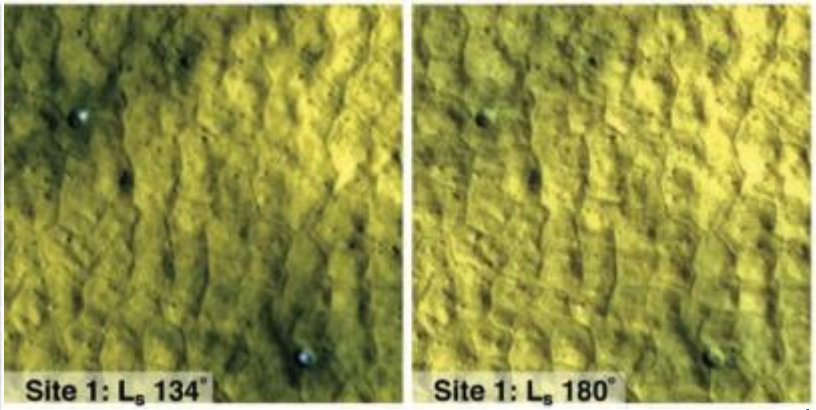
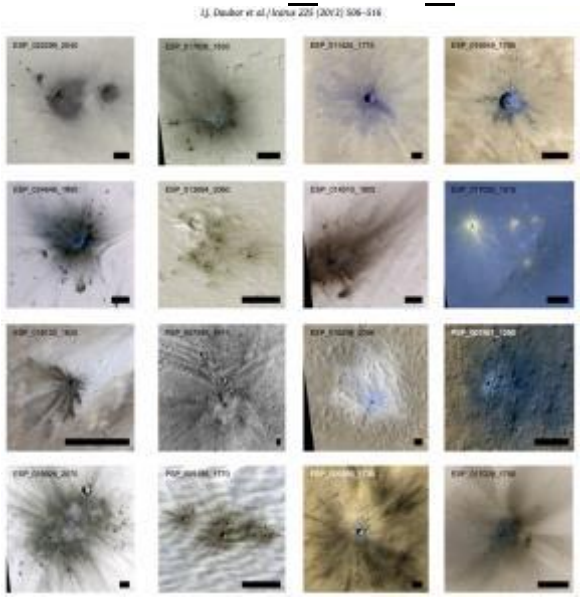
Examples of changes on the Martian surface



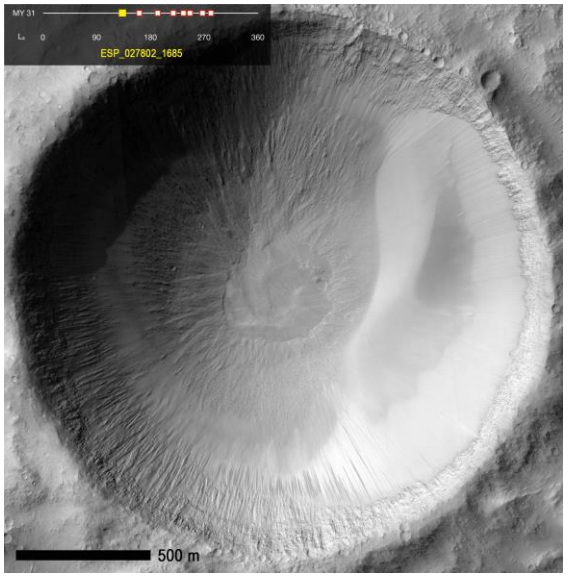


Kereszturi_etal_PSS11

Daubar et al., Icarus 2013



Bryne_etal_Science09



Courtesy of HiRISE team

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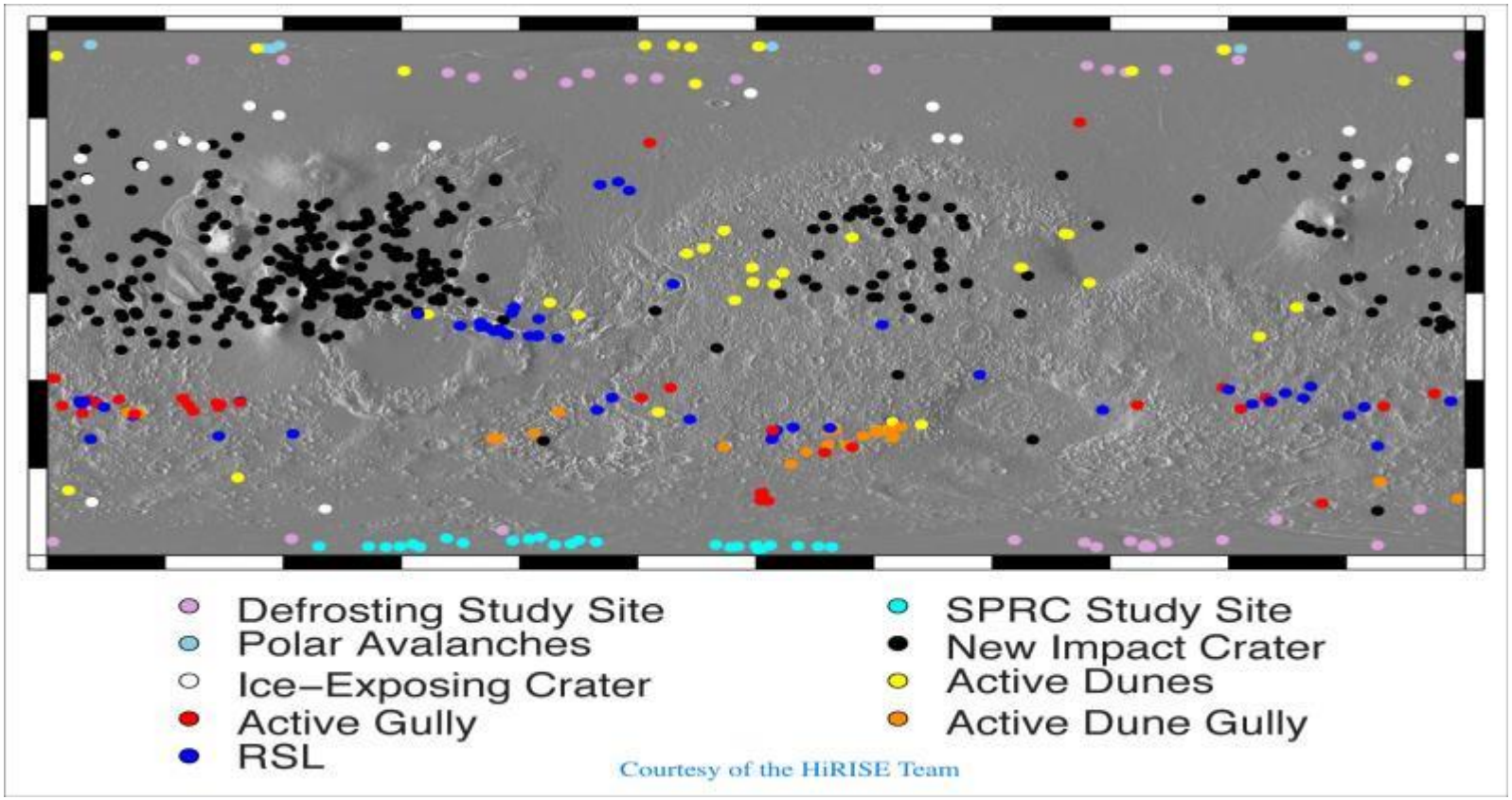
Changes manually confirmed using only HiRISE images



iMars Scientific Context

- The surface of Mars is NOT static, this is the lesson that was learnt from repeat observations from MOC and more recently from CTX and HiRISE
- There are now almost 40 years of repeat observations of the Martian surface
- These changes indicate that the surface is more active
- Most changes due to surface-atmosphere interactions

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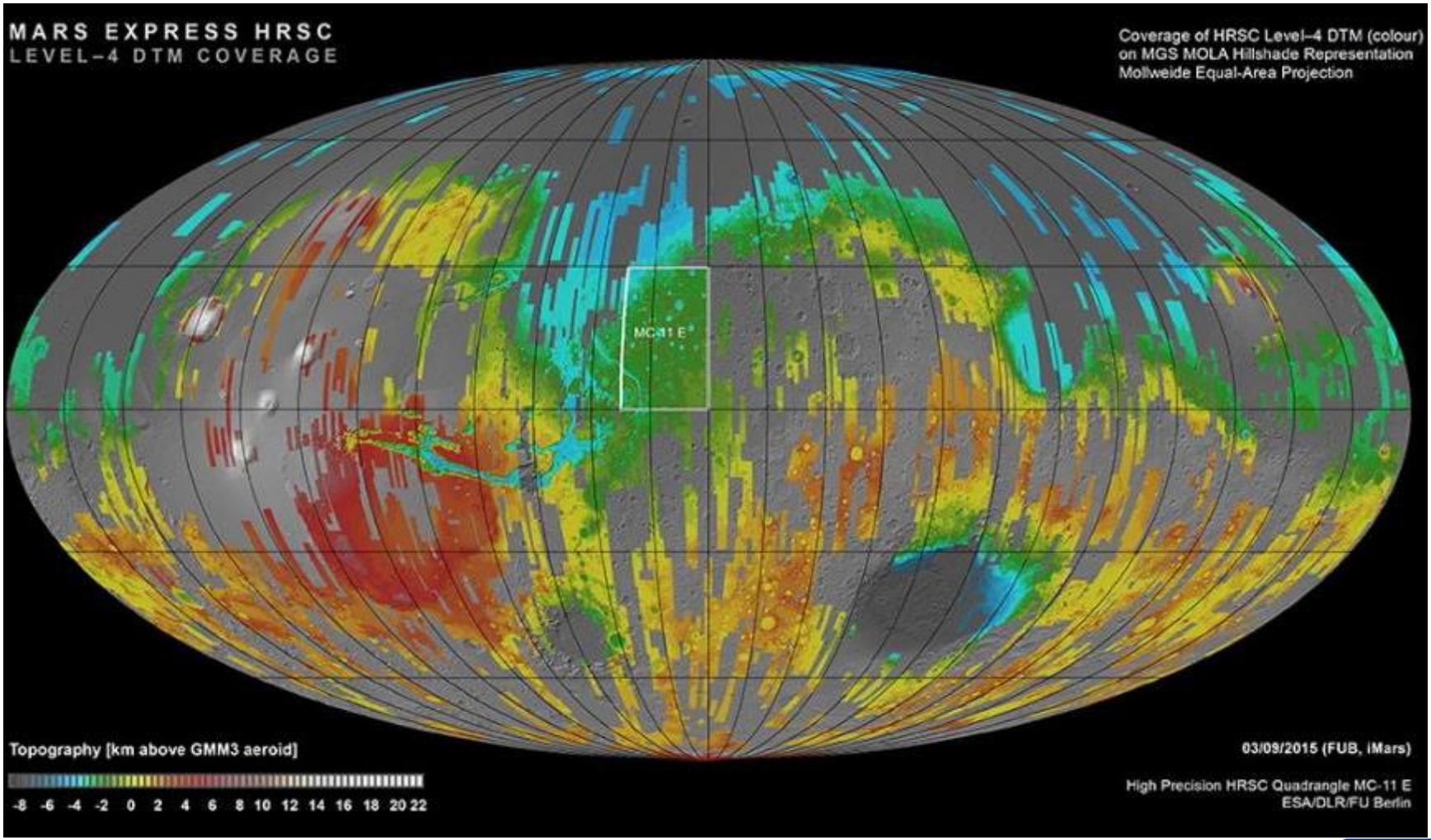
Global HRSC DTM+ORI coverage (DLR+FUB)



K. Gwinner, E. Hauber, R. Jaumann, G. Michael, H. Hoffmann, and C. Heipke, *EGU General Assembly*, Apr. 2015; EPSC15

iMars – Key Achievements

- First HRSC mosaiced DTM+ORI products (MC-11E+W) developed with further areas in the pipeline at DLR+FUB
- Automated co-registration/orthorectification (ACRO) processing chain developed and applied to ≈15,000 images (4,888 products for MC11E; 4397 for MC11W; ≈4400 over 44 single-strips and 1,200 over the South Pole)
- Automated CTX+HiRISE DTM processing chain (CASP-GO & UoS) developed, code ported to Microsoft Azure® cloud and used to produce ≈5,300 CTX and tens of HiRISE DTM + ORIs. ≈35 Tbytes to date of new products
- QGIS plugin for analysing and visualising sub-surface radargrams
- Citizen science interface and tools developed, expert scientists for SVM training samples, citizen science launch imminent
- Website including robust webGIS developed and online, can download PSA & PDS products
- Working with NASA PDS imaging node on release of ACRO & CASP-GO products in PDS4
- Until data is released through PDS (PSA for HRSC mosaics), products can be obtained via science collaborations with the producers of the datasets
- Long-term goal is to release UCL code as open access, starting with CASP-GO