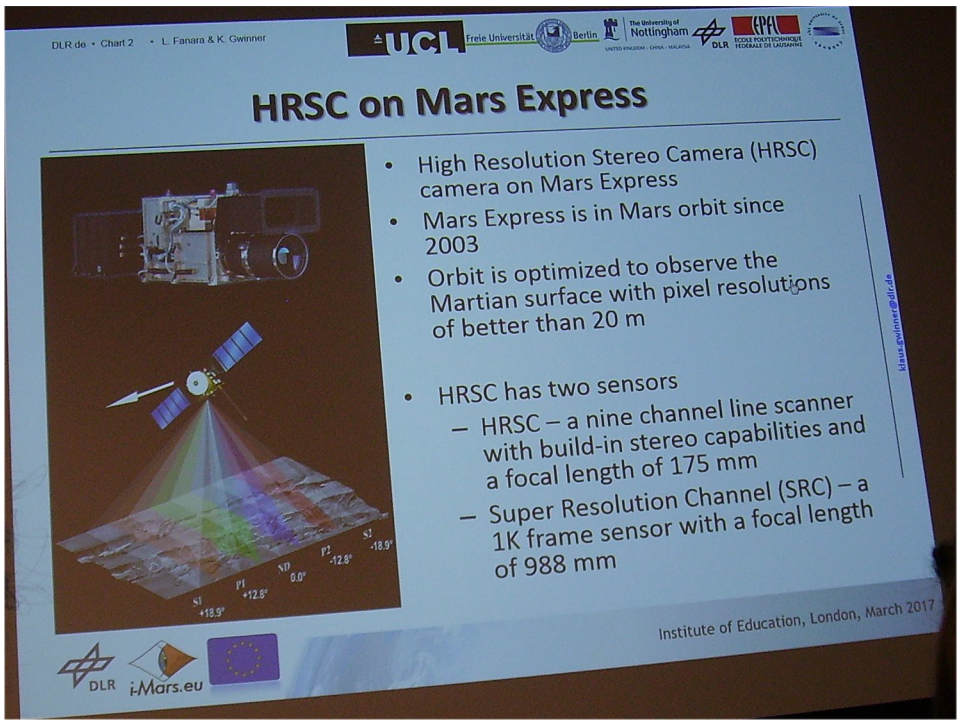
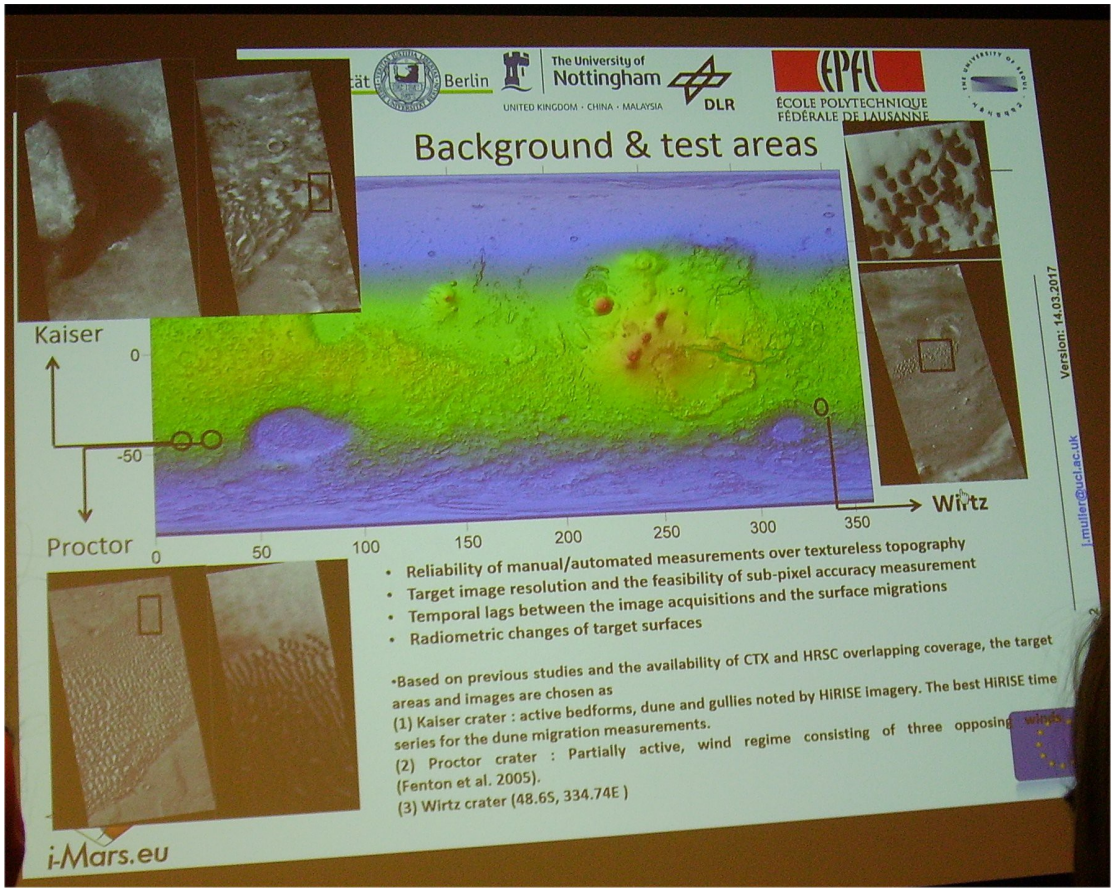
i-Mars event

On Tuesday 14th March 2017, Malcolm Smith and Ananda Sirisena attended the i-Mars event organised by UCL (University College London), part of the University of London. The speaker who introduced all the contributors was professor Jan Muller.

The accompanying slides are courtesy of Malcolm Smith and his camera. Readers may find these useful as they contain the website URLs for the i-Mars project.

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Background & test areas
Kaiser
0
-50
Proctor
0
50
100
150
200
250
300
350
Wirtz
• Reliability of manual/automated measurements over textureless topography
• Target image resolution and the feasibility of sub-pixel accuracy measurement
• Temporal lags between the image acquisitions and the surface migrations
• Radiometric changes of target surfaces
•Based on previous studies and the availability of CTX and HRSC overlapping coverage, the target areas and images are chosen as
(1) Kaiser crater : active bedforms, dune and gullies noted by HiRISE imagery. The best HiRISE time series for the dune migration measurements.
(2) Proctor crater : Partially active, wind regime consisting of three opposing winds
(Fenton et al. 2005).
(3) Wirtz crater (48.6S, 334.74E)
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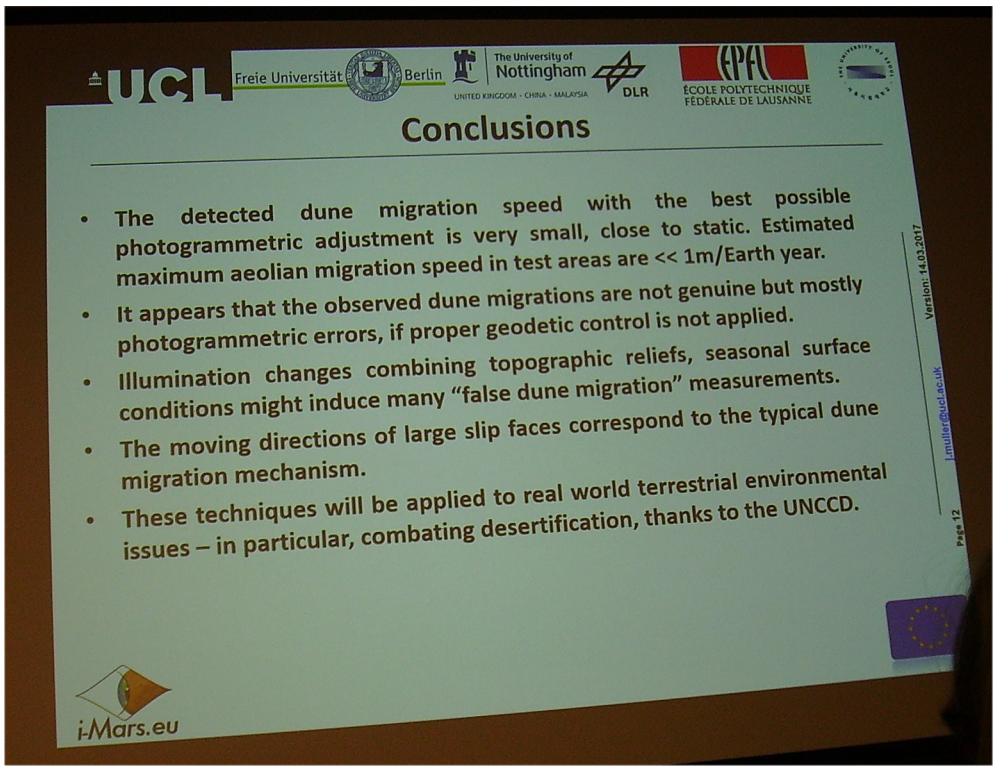
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Conclusions
• The detected dune migration speed with the best possible photogrammetric adjustment is very small, close to static. Estimated maximum aeolian migration speed in test areas are << 1m/Earth year.
• It appears that the observed dune migrations are not genuine but mostly photogrammetric errors, if proper geodetic control is not applied.
• Illumination changes combining topographic reliefs, seasonal surface conditions might induce many “false dune migration” measurements.
• The moving directions of large slip faces correspond to the typical dune migration mechanism.
• These techniques will be applied to real world terrestrial environmental issues – in particular, combating desertification, thanks to the UNCCD.
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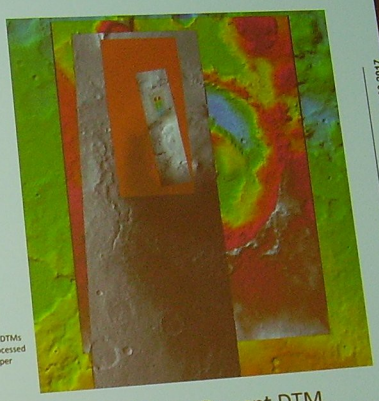
The need for South Polar Residual Cap 3D Products

Not enough HRSC DTM coverage
(Putri, et al., in-submission, 2017)



Scales for Current DTM compared to Current Resolution
(Gwinner and Willner, 2016)

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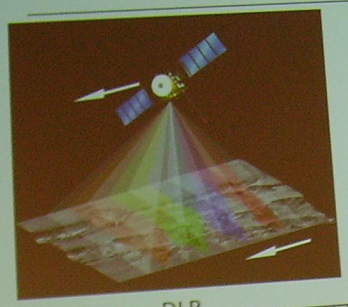
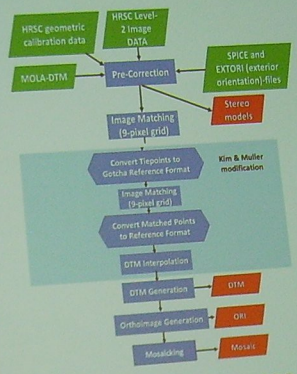
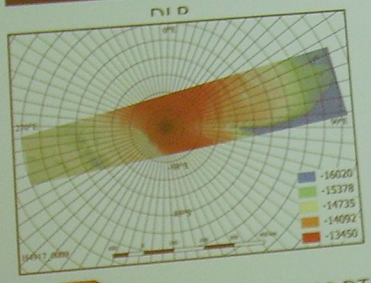
HRSC DTM Production





Kim and Muller, 2009

No seasonal effect for stereo processing
(courtesy of Calvin, et. al, 2016)



H4917_0000 DTM

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3D subsurface mapping and combining these with iMars 3D products

Federico Cantini

EPFL, École Polytechnique Fédérale de Lausanne, CH

The iMars project has received funding from the European Union's Seventh Framework programme for research, technological development and demonstration under grant agreement no. 607379

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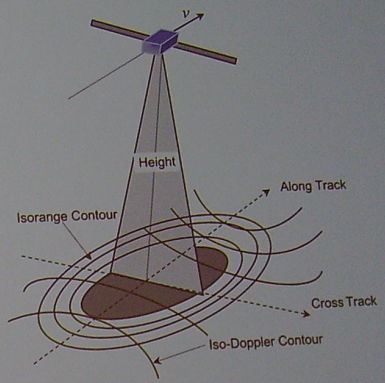
Planetary radars

MARSIS
Mars Advaced Radar for Ionosphere and Subsurface Sounding

ESA's Mars Express

SHARAD
SHAllow RADar

NASA's Mars Reconnaissance Orbiter



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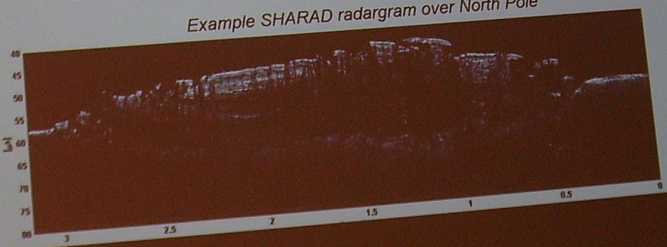
Background

- Planetary radar data for Mars (MARSIS and SHARAD) have been available in PDS and PSA archives
- No open source tools existed to analyze data jointly and interface with popular GIS systems
- The iMars project has invested in
  - Create a database of MARSIS and SHARAD data to allow access from any GIS system via standard protocols
  - Develop a tool for QGIS database to allow analysis of radar and imagery data together

Example SHARAD radargram over North Pole



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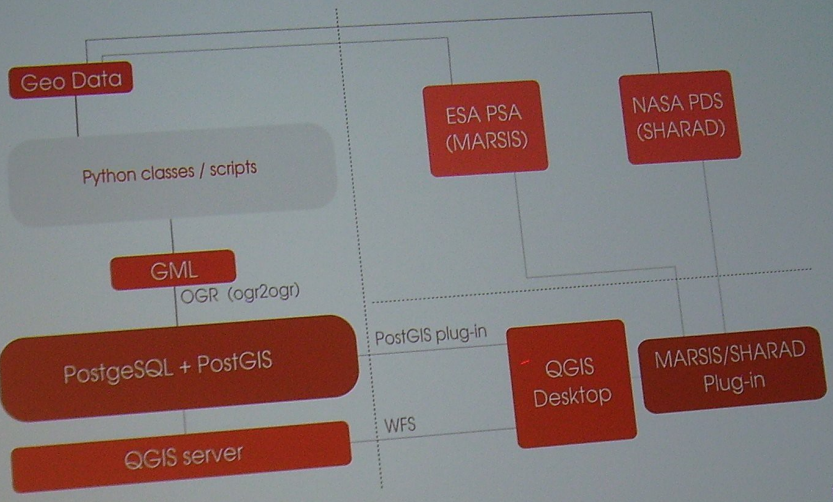
Data flow



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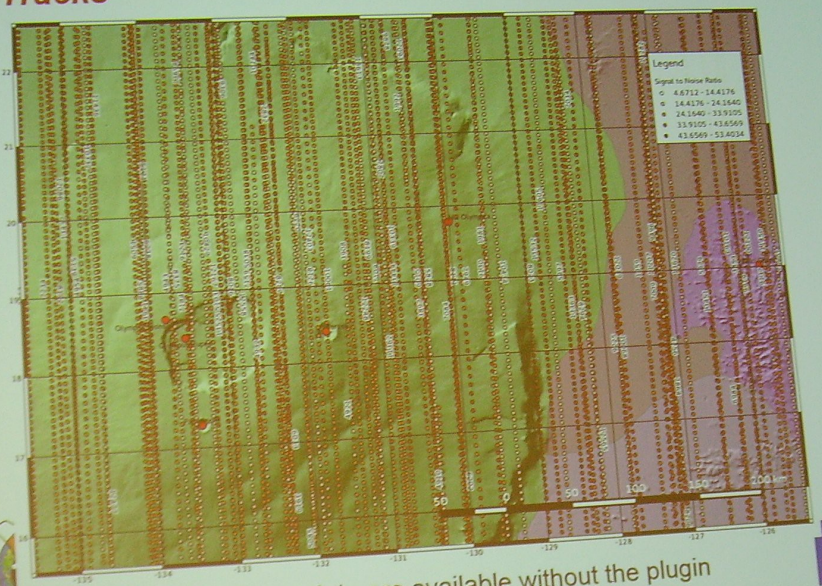
Orbit Tracks



These data are available without the plugin

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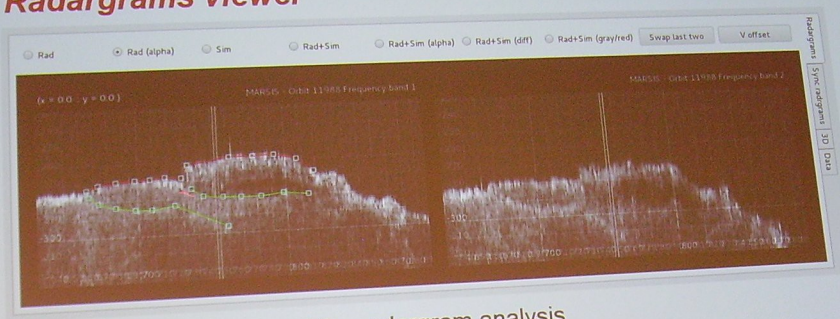
Radargrams viewer



Capabilities of the radargram analysis

- Selection of MARSIS and SHARAD data in a given area
- Assessment of data quality for MARSIS data
- Radar- and clutter-gram display for easy data analysis
- Access to radargrams hosted at PDS archives (MARSIS online access pending on latest release from MARSIS team)
- Time delay (depth) measurements on ragargrams
- Feedback mapping of radargram selection back to QGIS layer (selecting of interesting features)

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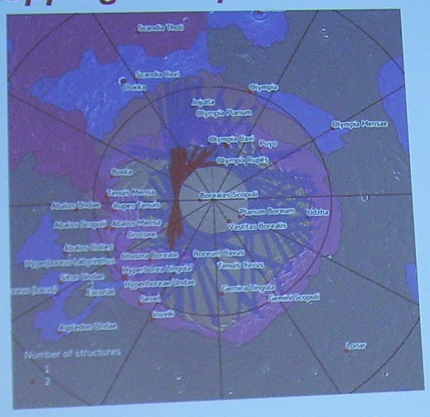
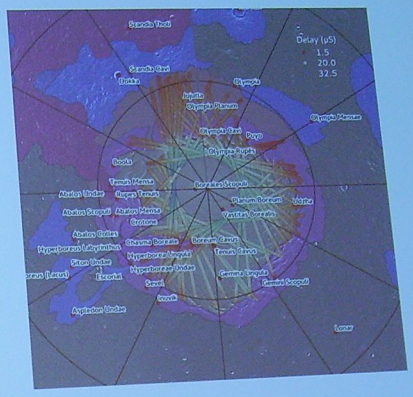
Mapping examples





Get the plugin from :

https://github.com/eSpaceEPFL/marsissharadviewer

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Change detection potential

- Large areas of Mars have been mapped repeatedly
  - Even if the input images are constrained according to season
- Batch-mode automatic change detection is possible using the available data
- "Manual" change detection becomes gradually obsolete due to the increasingly large data volume
- iMars objective:

automatically find multiple changes on the surface of Mars

Season	Mapped twice or more (10^6 km^2)	Mapped thrice or more (10^6 km^2)
NH Spring	48.3	20.1
NH Summer	25.3	8.8
NH Autumn	18.8	6.2
NH Winter	26.7	9.9
All Seasons	121.3	89.0

Asia: 44.5 M km2, Africa: 30.2 M km^2, N. America: 24.7 M km^2, S. America: 17.8 M km^2, Antarctica: 14M km^2, Europe: 10.2 M km^2, Oceania: 8.5 M km^2

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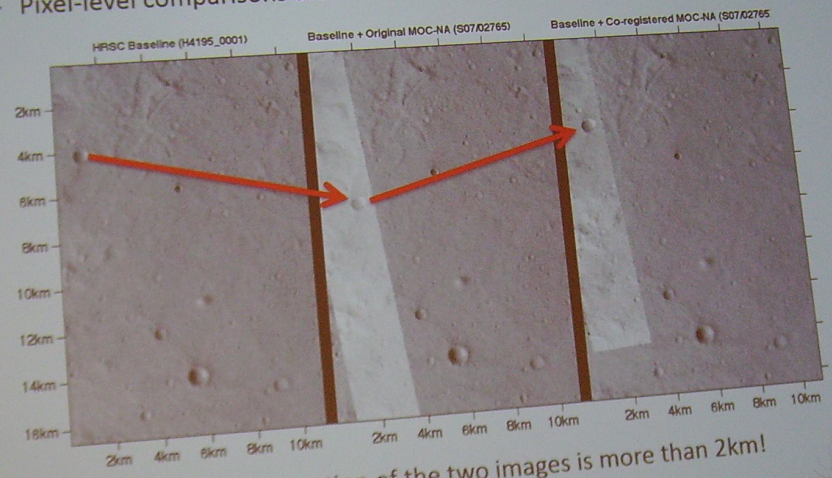
The need for co-registration and orthorectification

- Due to small position and orientation errors in the spacecraft location and pointing, each image is practically in its own coordinate system
  - Pixel-level comparisons are not feasible in these circumstances



The original mislocation of the two images is more than 2km!

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AGENDA

Time	Title and Presenter	Link
14.45 – 15.00	**Citizen science for training and verification of automated data mining for change detection** Jess Wardlaw, University of Nottingham	
15.00 – 15.10	**webGIS for visualisation of new global products from iMars** Sebastian Walter, Freie Universität Berlin	
15.10 – 15.25	**Use of web-based 3D digitisation tool for mapping sedimentary processes using iMars 3D products** Rob Barnes, Imperial College London	
15.25 – 15.35	**3D visualisations from iMars data products** Sebastian Walter, Freie Universität Berlin	
15.35 – 15.45	**Block falls near the North Polar cap - an example of Martian surface changes for iMars** Lida Fanara, DLR German Aerospace Centre	
15.45 – 16.00	**Visualising the role of catastrophic flooding on Mars using iMars datasets** Sanjeev Gupta, Imperial College London	
16.00	**End of the event**	

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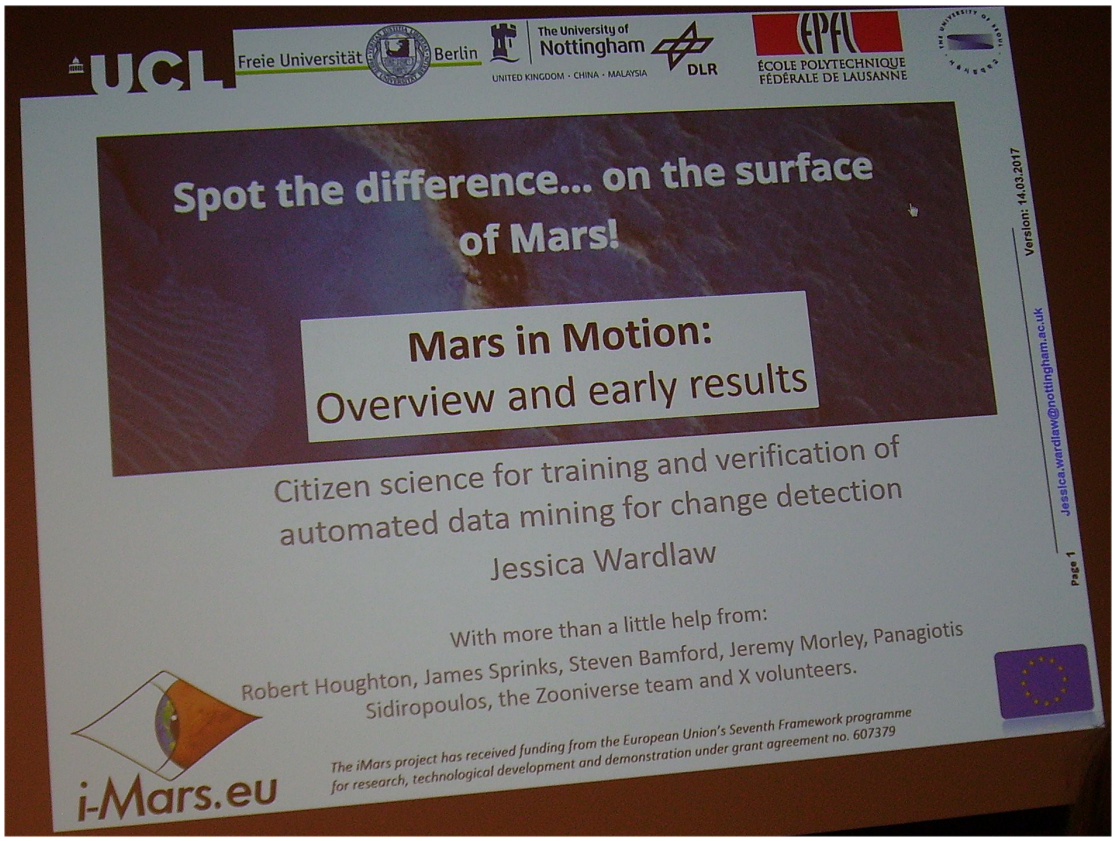
Professor Jan Muller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Spot the difference... on the surface of Mars!
Mars in Motion:
Overview and early results
Citizen science for training and verification of automated data mining for change detection
Jessica Wardlaw
With more than a little help from:
Robert Houghton, James Sprinks, Steven Bamford, Jeremy Morley, Panagiotis Sidiropoulos, the Zooniverse team and X volunteers.
The iMars project has received funding from the European Union's Seventh Framework programme for research, technological development and demonstration under grant agreement no. 607379
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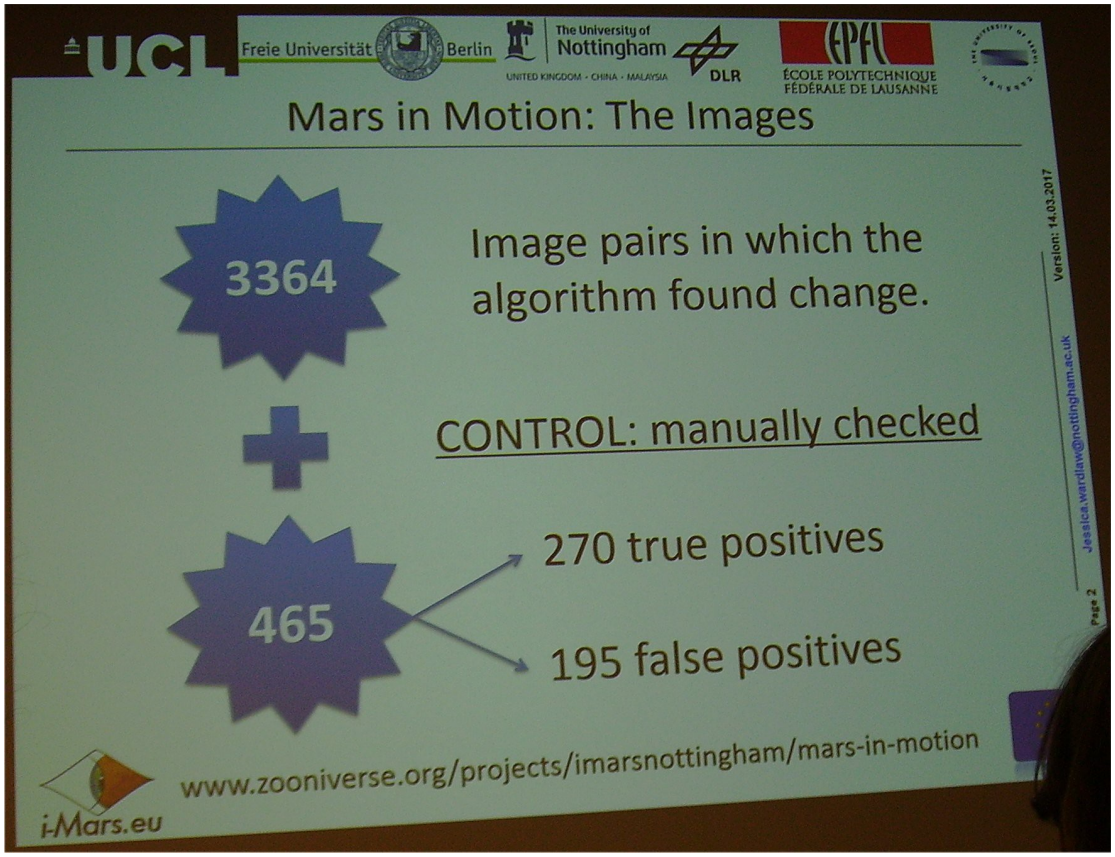
Page 1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Mars in Motion: The Images
3364
Image pairs in which the algorithm found change.
CONTROL: manually checked
465
270 true positives
195 false positives
www.zooniverse.org/projects/imarsnottingham/mars-in-motion
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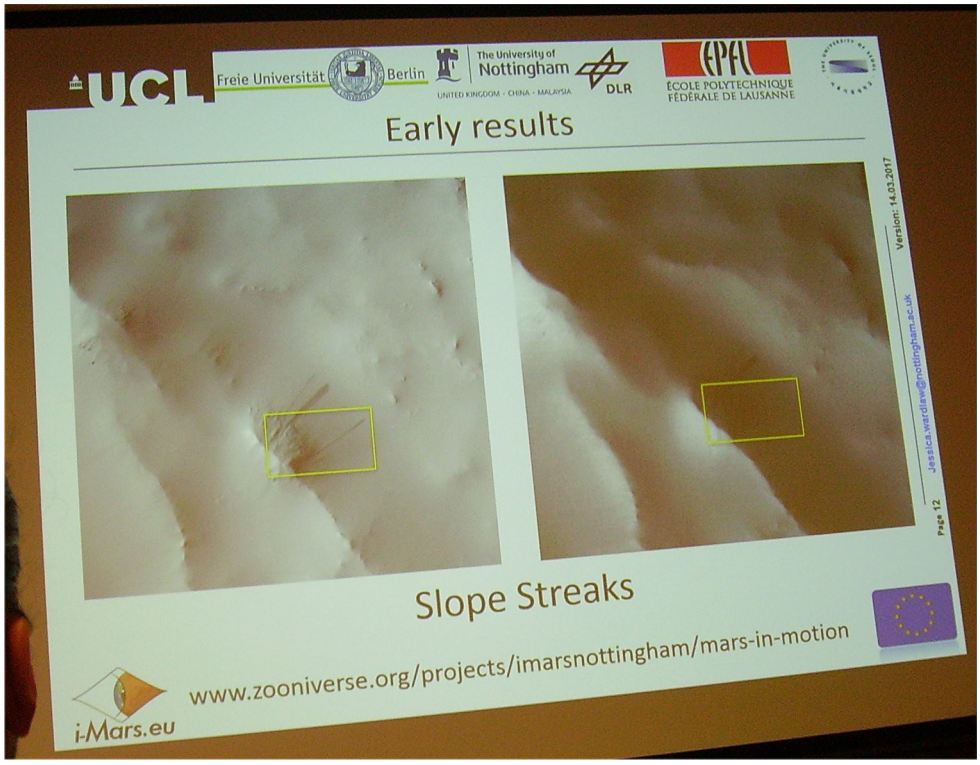
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Early results
Slope Streaks
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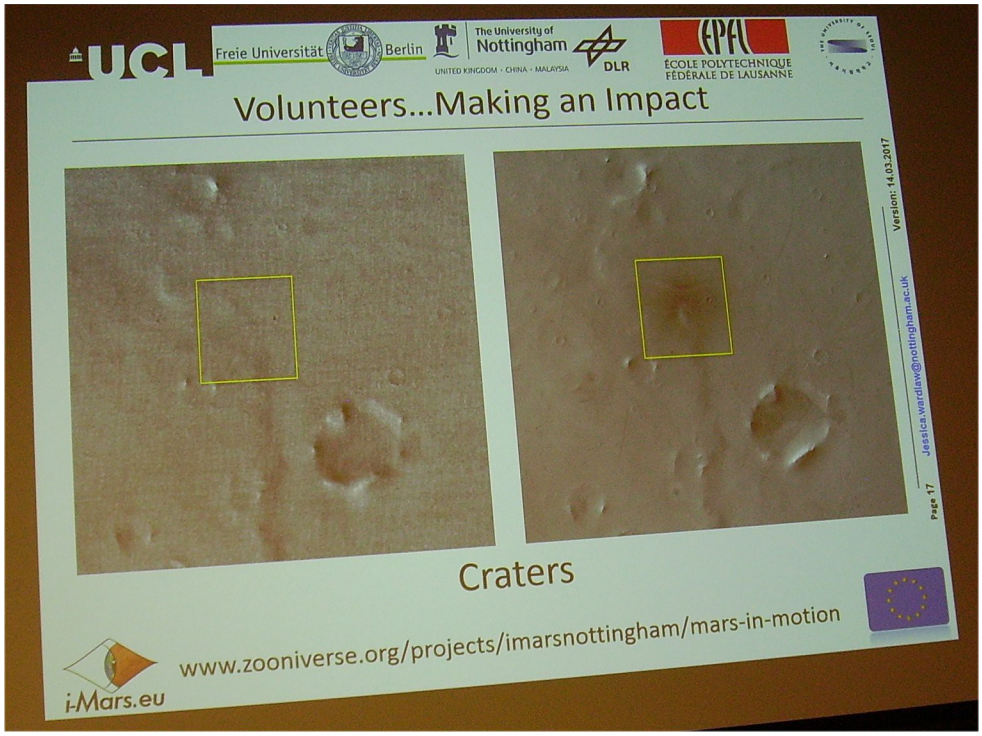
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Volunteers...Making an Impact
Craters
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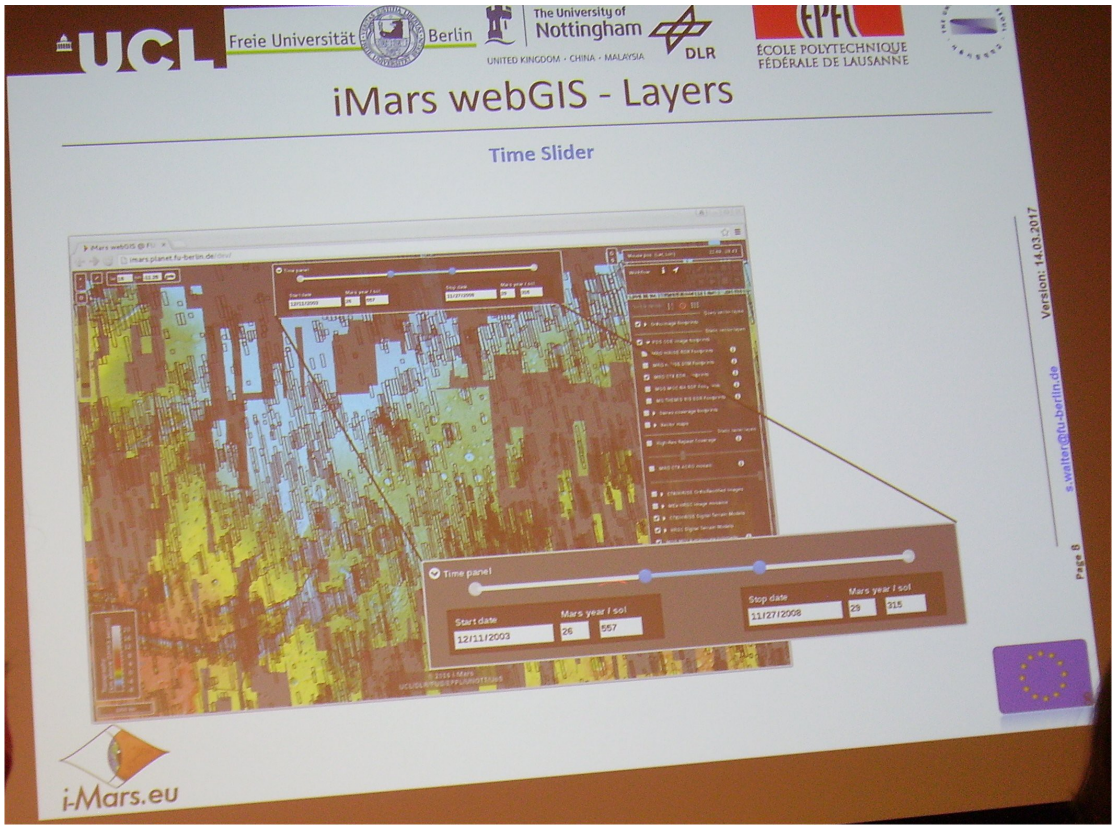
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iMars webGIS - Layers
Time Slider
Time panel
Start date
12/11/2003
Mars year / sol
26
557
Stop date
11/27/2008
29
215
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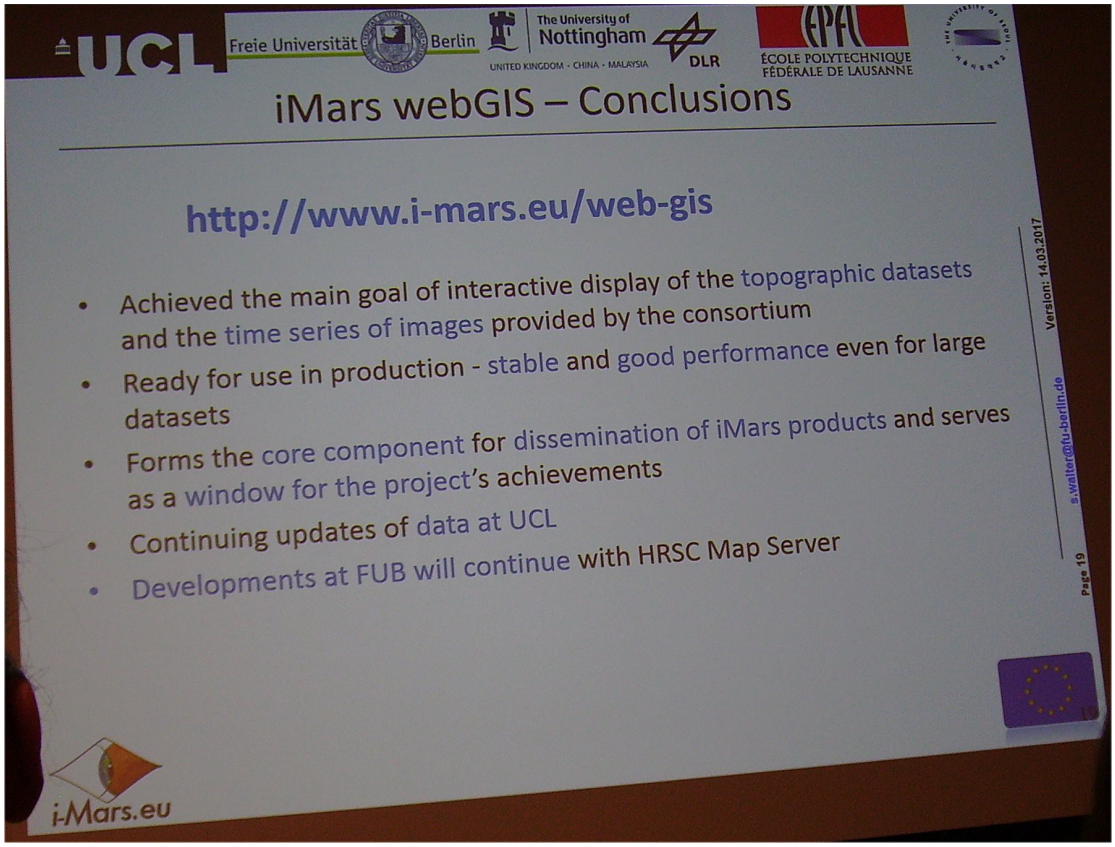
s.walter@tu-berlin.de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iMars webGIS – Conclusions
http://www.i-mars.eu/web-gis
Achieved the main goal of interactive display of the topographic datasets and the time series of images provided by the consortium
Ready for use in production - stable and good performance even for large datasets
Forms the core component for dissemination of iMars products and serves as a window for the project's achievements
Continuing updates of data at UCL
Developments at FUB will continue with HRSC Map Server
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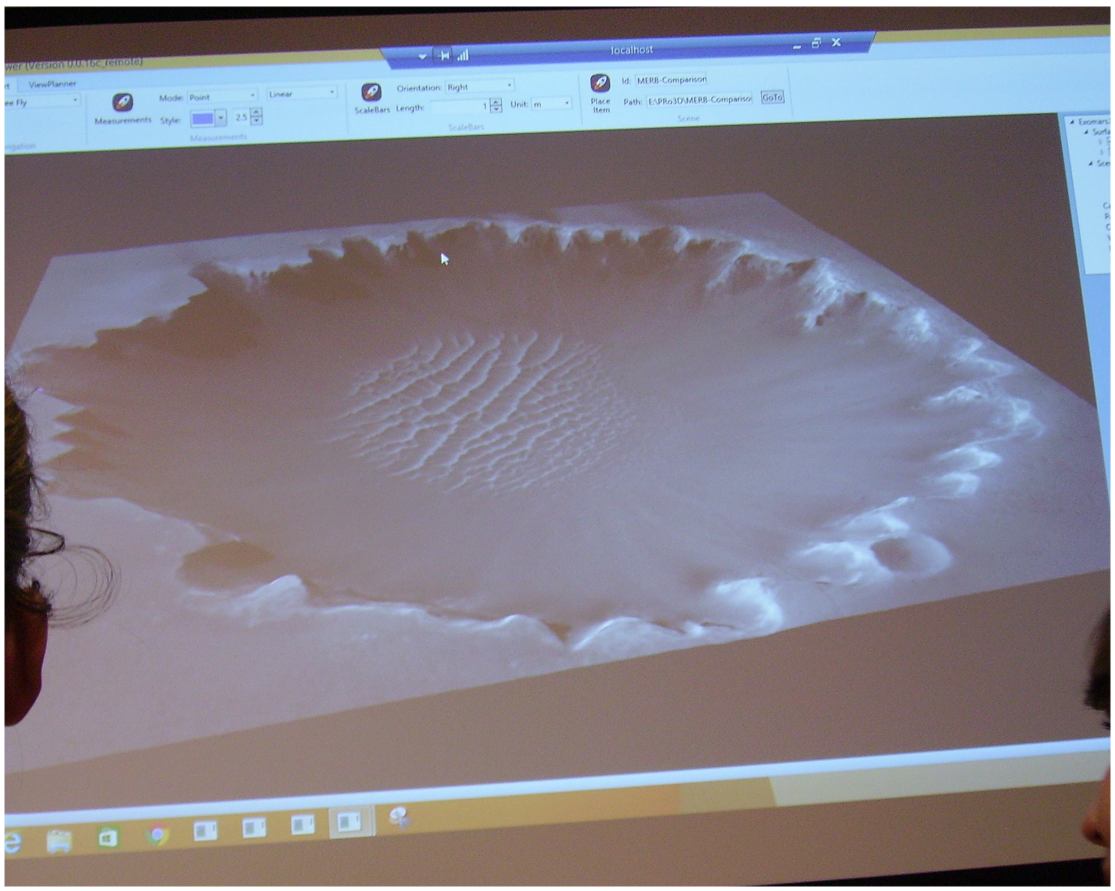
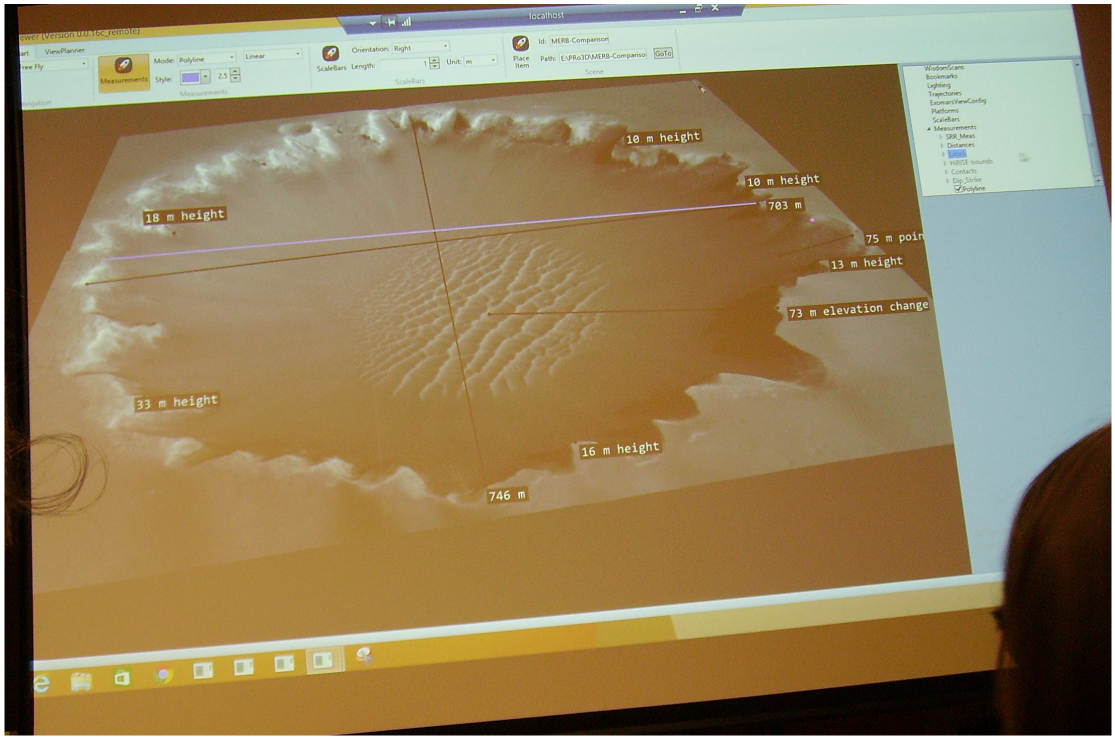
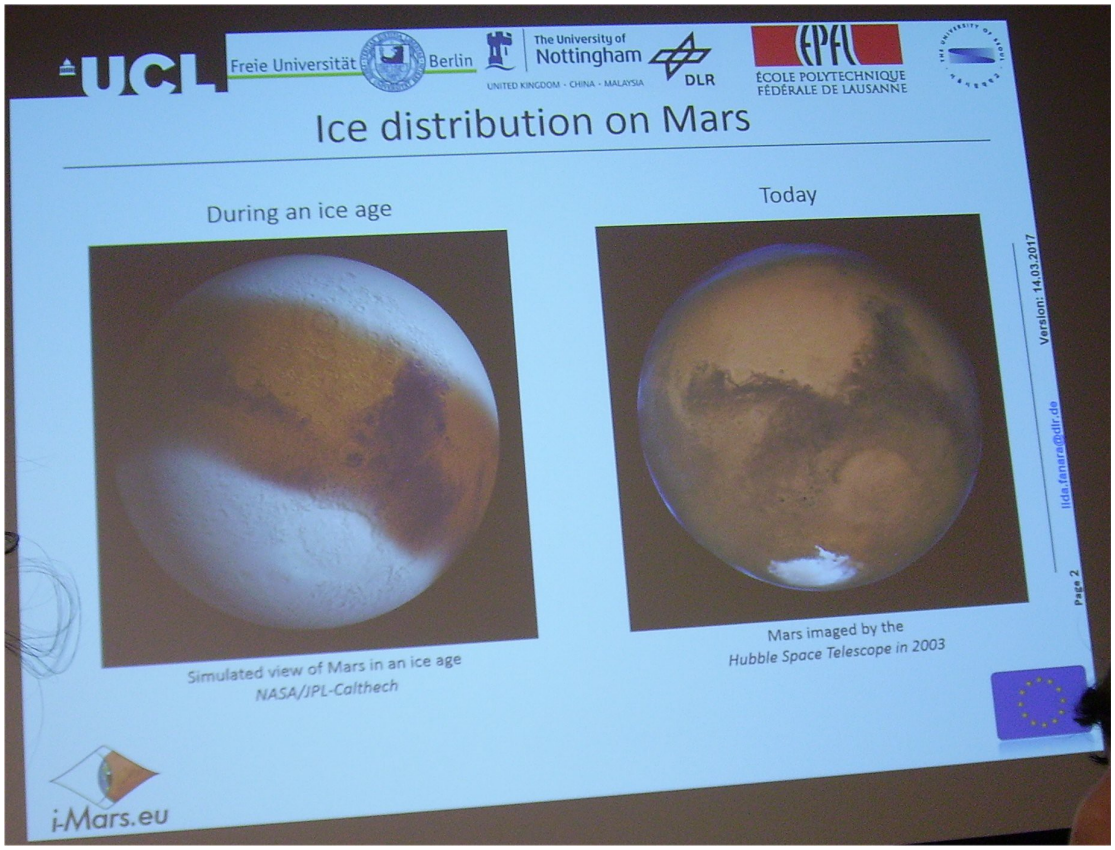

localhost


10 m height
10 m height
703 m
18 m height
75 m poin
13 m height
73 m elevation change
33 m height
16 m height
746 m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Ice distribution on Mars
During an ice age
Today
Simulated view of Mars in an ice age
NASA/JPL-Calthech
Mars imaged by the
Hubble Space Telescope in 2003
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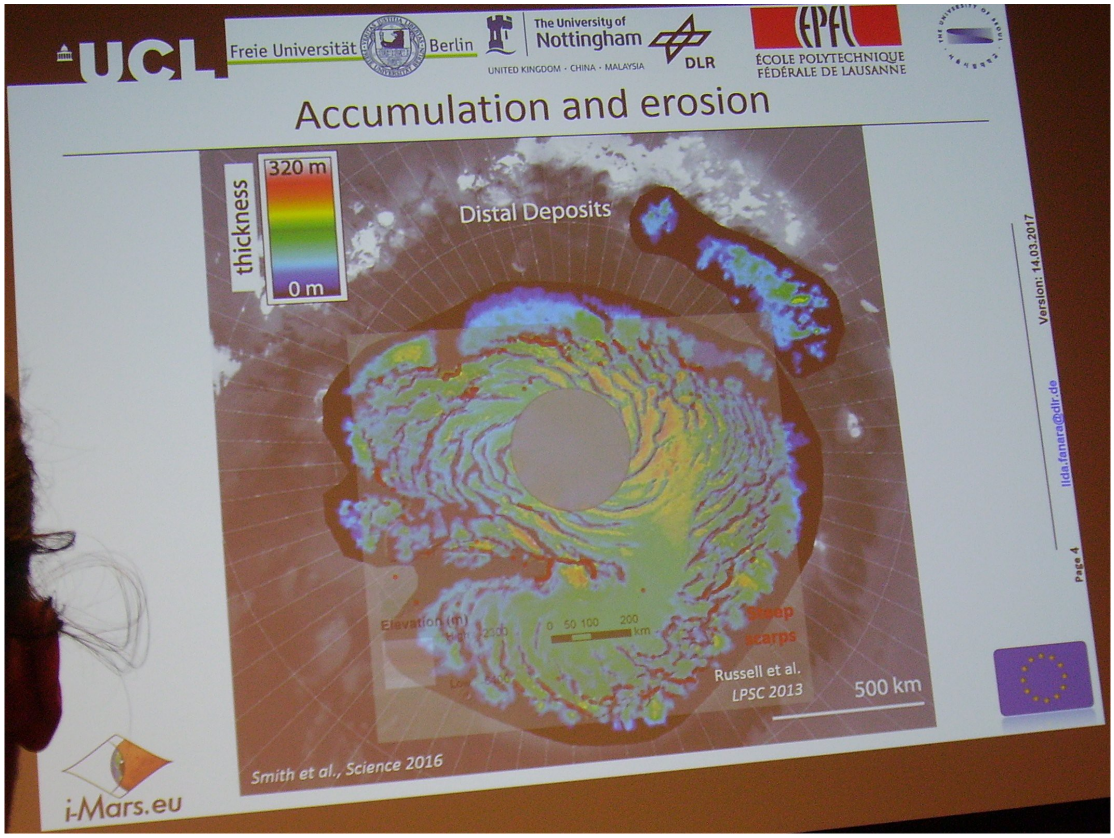
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Accumulation and erosion
thickness
320 m
0 m
Distal Deposits
Elevation (m)
0 50 100 200
km
Russell et al.
LPSC 2013
500 km
Smith et al., Science 2016
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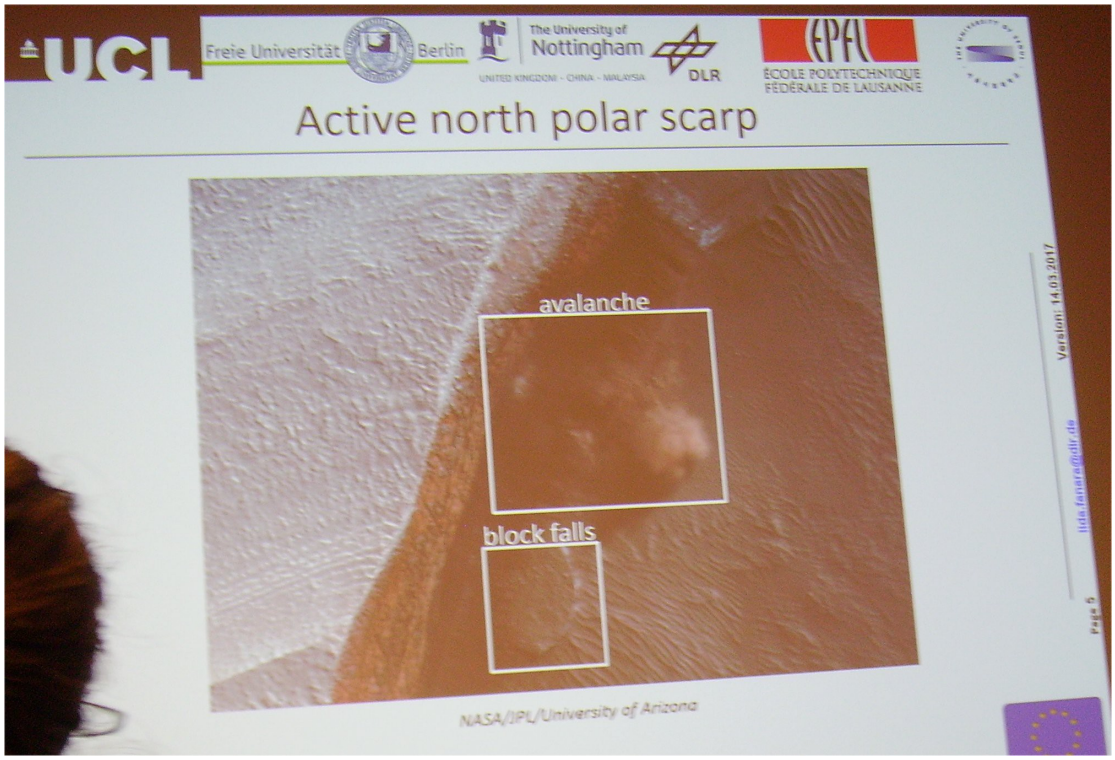
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Active north polar scarp
avalanche
block falls
NASA/JPL/University of Arizona
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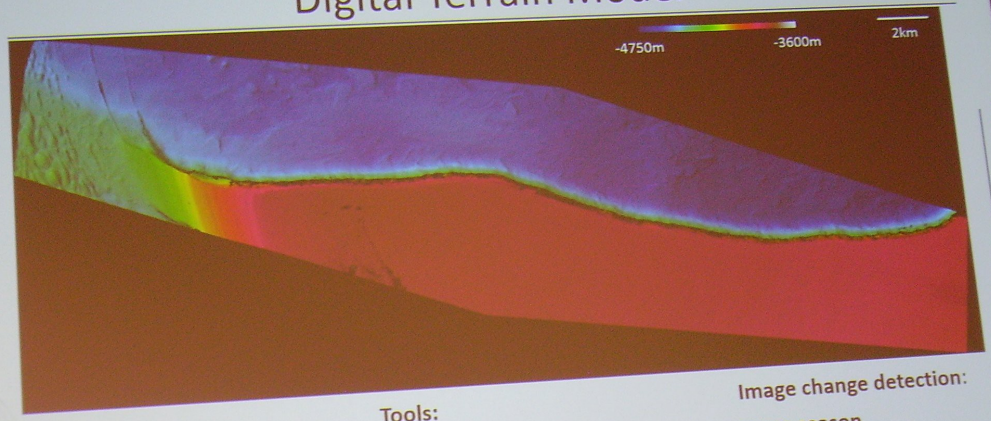
Digital Terrain Model



Stereo:

stereo angle: **10°-25°**
time interval: max. **30 days**

Tools:

USGS Integrated Software for Imagers and Spectrometers (**ISIS**)

NASA open source software Ames Stereo Pipeline (**ASP**)

Image change detection:

same **season**
resolution of **0.25 m**
same time of the day

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