

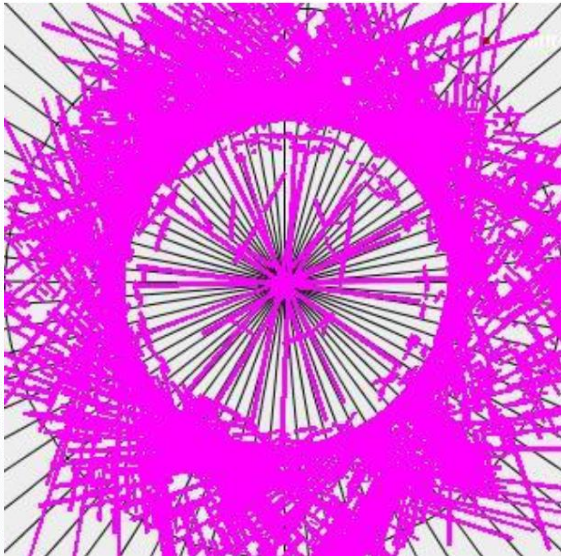
# HRSC 3D Image products of the North Polar Layered Terrain of Mars

**Alfiah Rizky Diana Putri, Yu Tao, and Jan-Peter Muller**

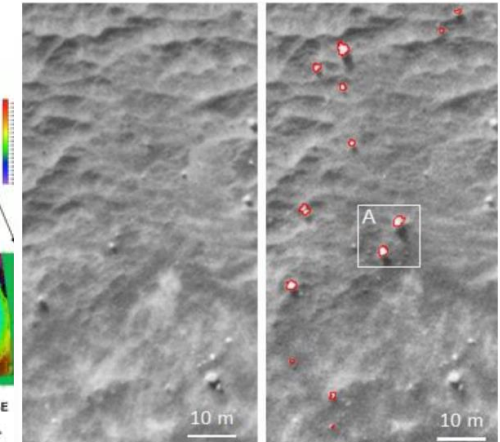
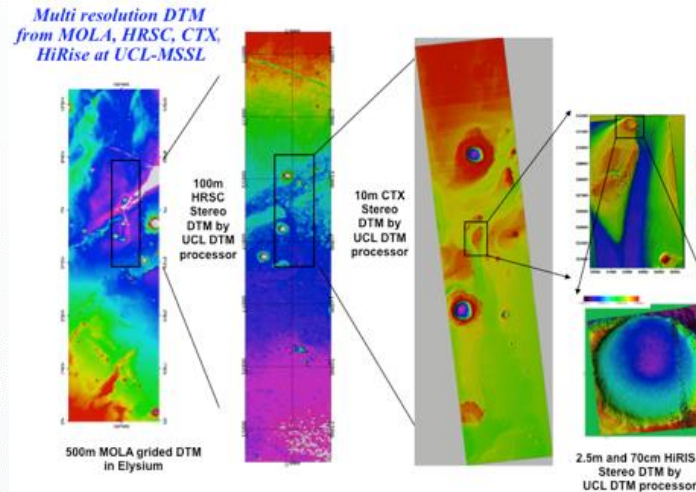
Imaging Group, Mullard Space Science Laboratory,  
University College London



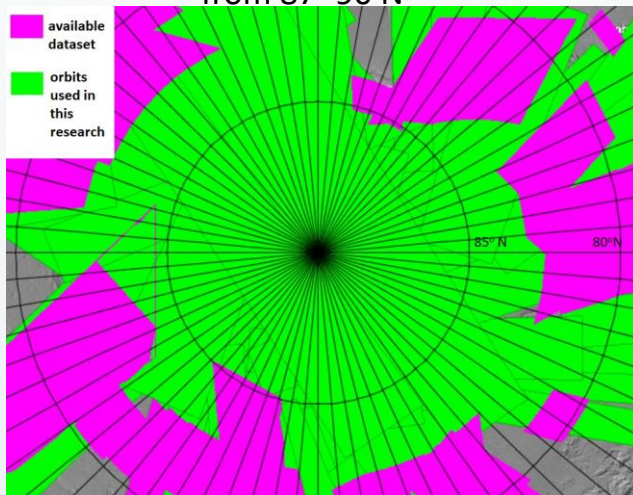
# Why we need HRSC 3D over the north pole



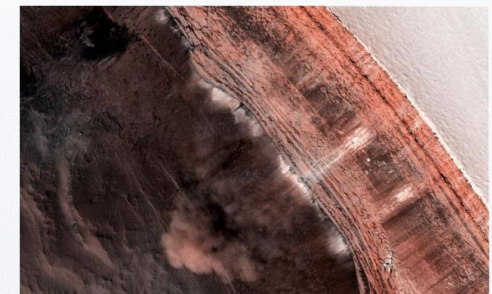
MOLA Data unavailable  
from 87°-90°N



HiRISE Block displacement  
(Fanara, et al., 2017)



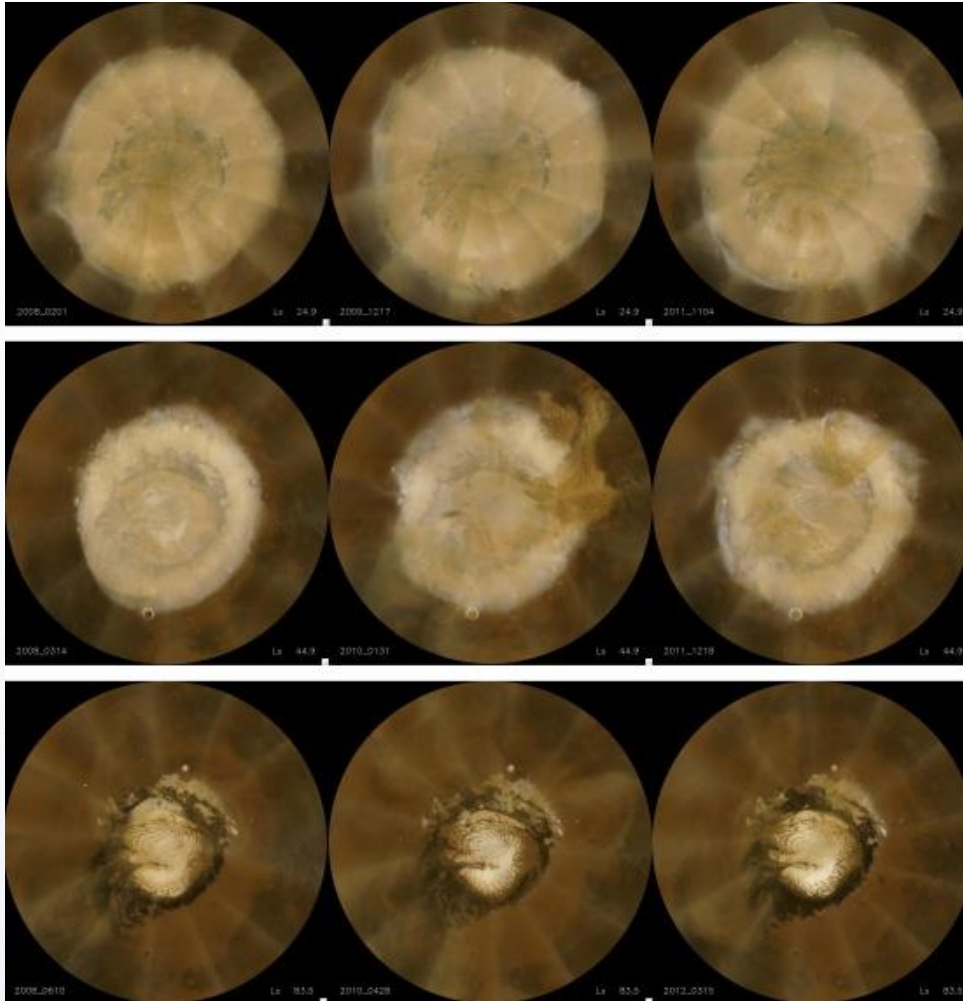
Multi-resolution DTMs compared  
to best available Resolution  
(from [Kim and Muller, PSS 2009](#))



HiRISE Avalanches  
(ESP\_025010\_2650)

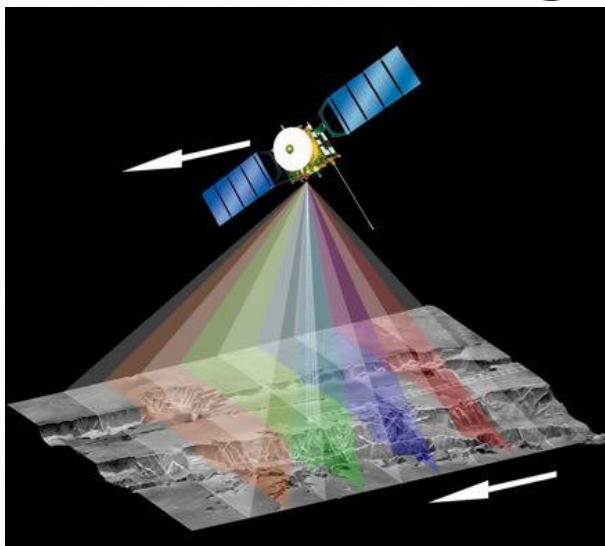


# Annual Cycle of polar changes

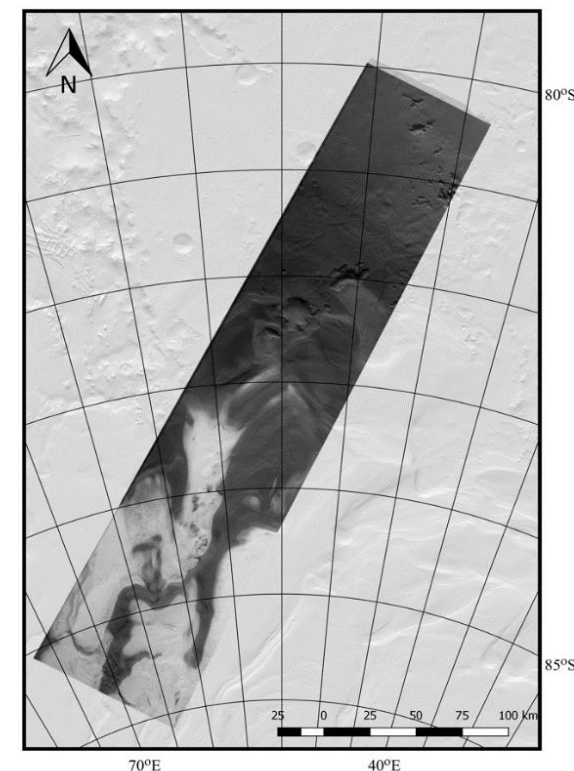
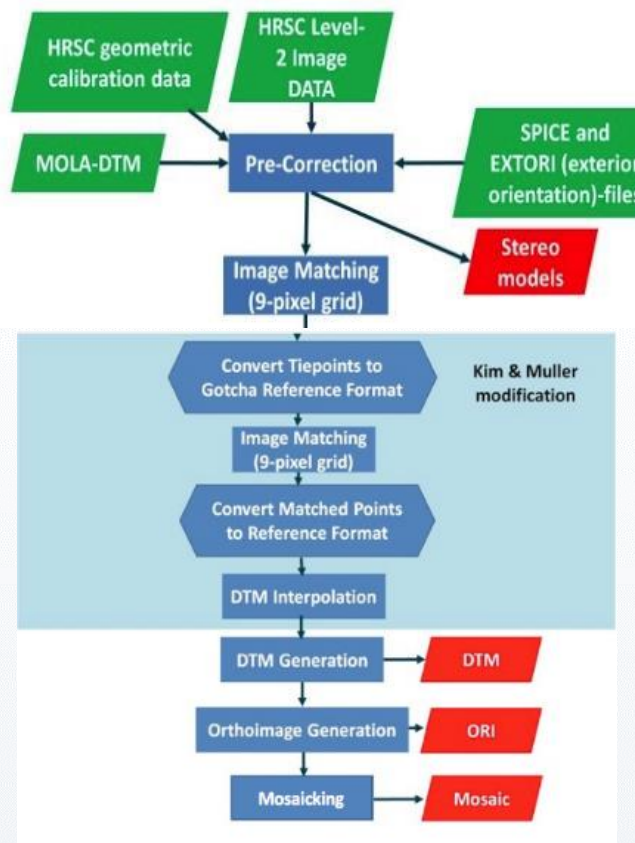


MARCI observation of MY29,30, and 31 of Ls 25 (top), 45 (middle) and 84 (bottom) ([Calvin, et. al, 2015](#)) (with video)

# Producing Base DTMs from HRSC



HRSC (ESA/DLR/FUB)

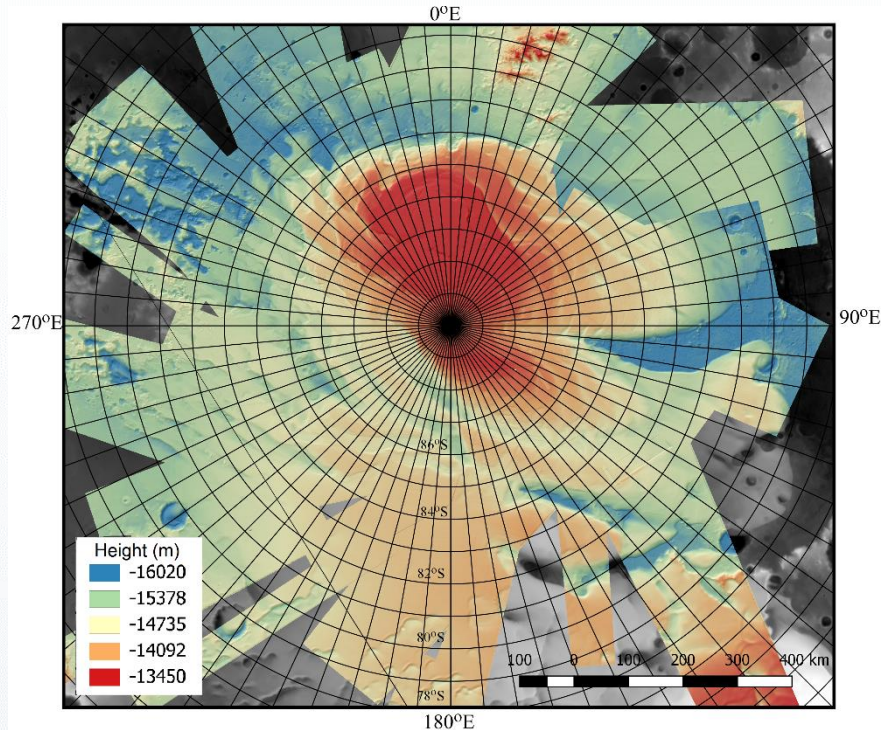


Example of orthorectified image (H2372\_0000)

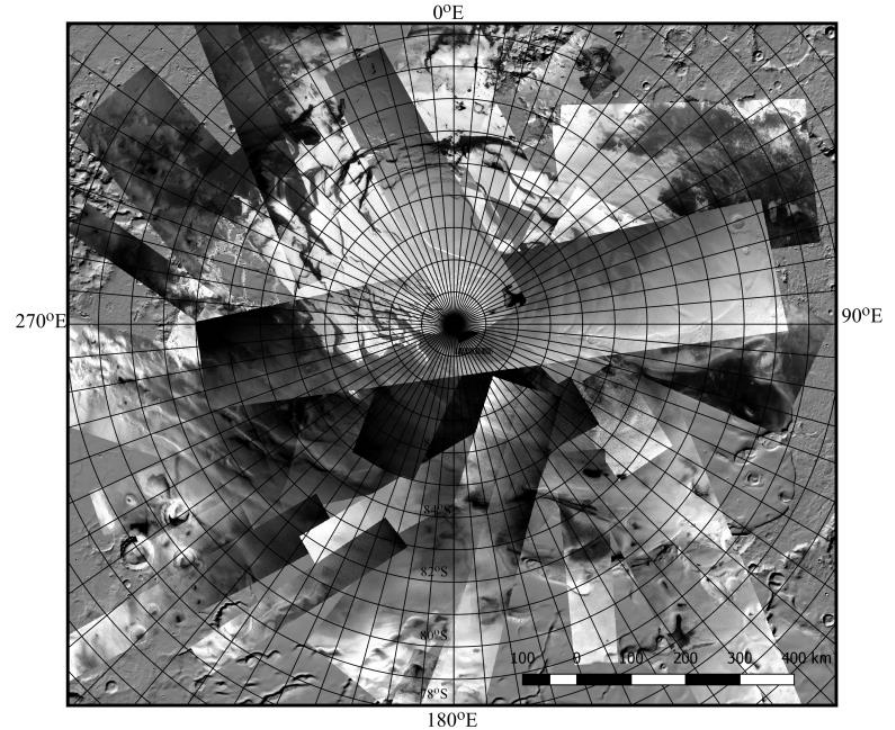
Kim and Muller, PSS  
2009



# Previous South Polar HRSC DTM Mosaic



HRSC DTMs produced for  
the SPRC  
[Putri et al., PSS 2019](#)

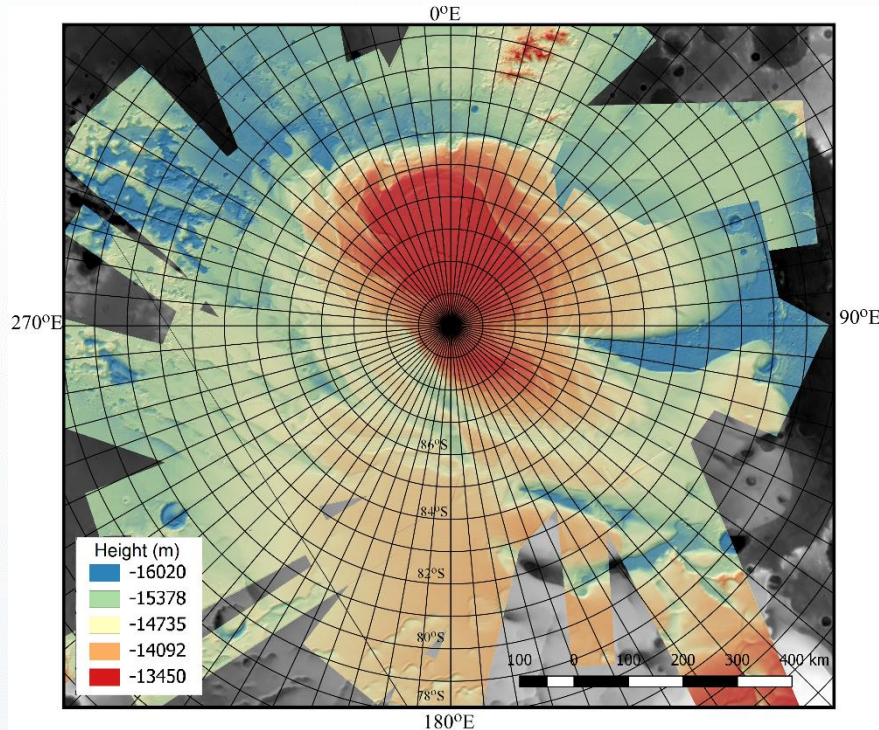


Mosaic of HRSC  
Orthorectified Images over  
the South Pole (before)

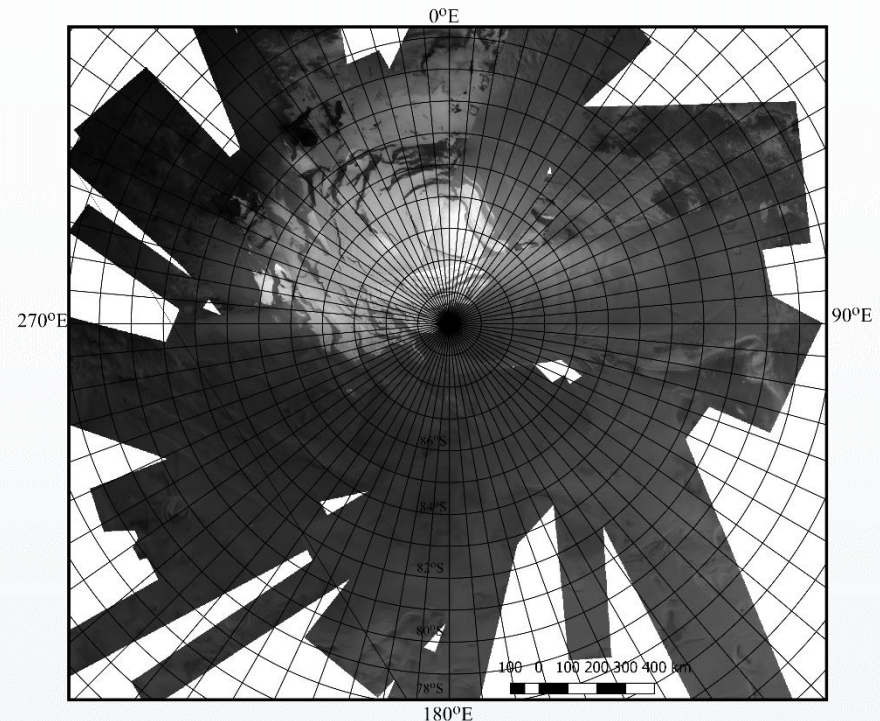
Can be accessed via ESA Guest Storage Facility (GSF) <https://doi.org/10.5270/esa-0j79yk8> or visualized through the iMars web GIS at <http://www.i-mars.eu/web-gis> ([Walter, Muller et al., ESS 2018](#)).



# Previous South Polar HRSC DTM Mosaic



HRSC DTMs produced for  
the SPRC  
[Putri et al., PSS 2019](#)

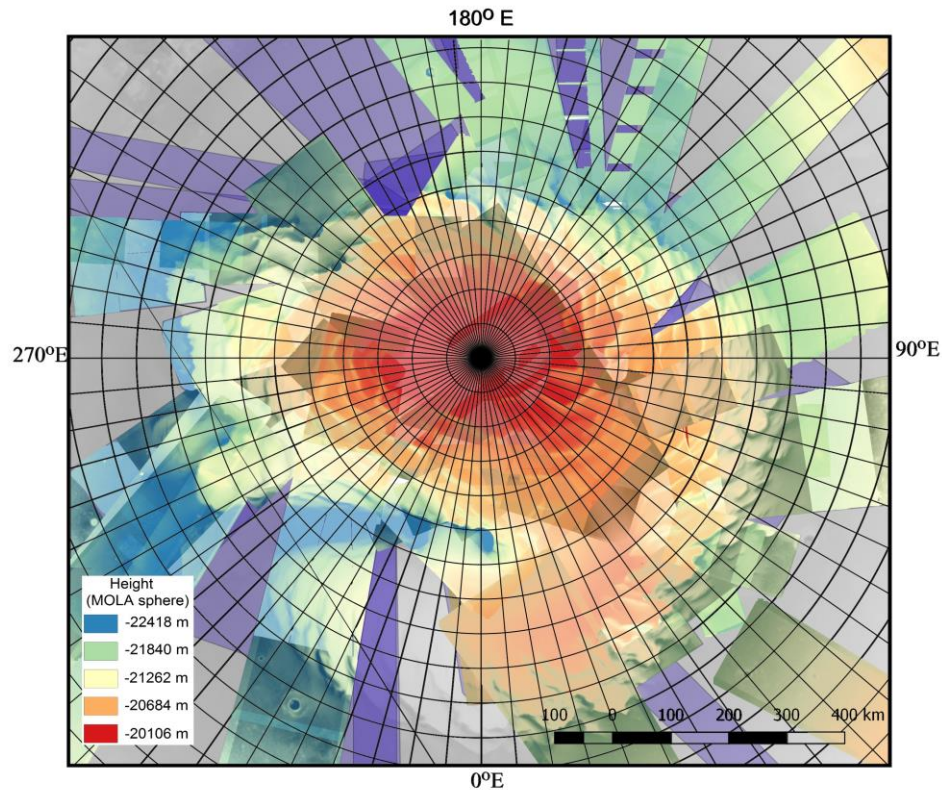


Mosaic of HRSC Orthorectified Images  
over the South Pole (courtesy of Greg  
Michael) ([Michael et al., 2016](#))

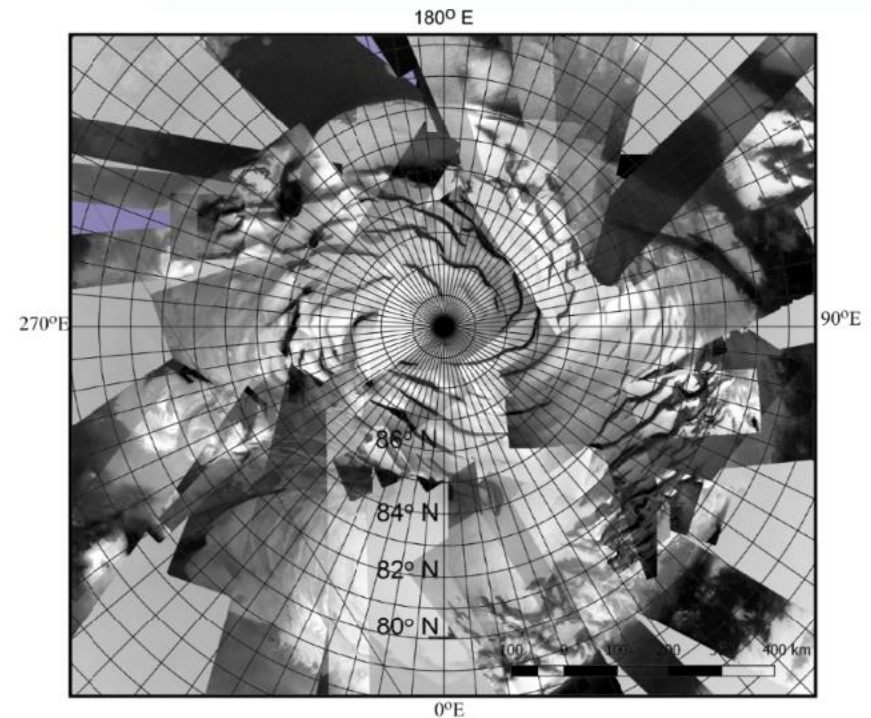
Can be accessed via ESA Guest Storage Facility (GSF) <https://doi.org/10.5270/esa-0j79yk8> or visualized through the iMars web GIS at <http://www.i-mars.eu/web-gis> ([Walter, Muller et al., ESS 2018](#)).



# North Polar DTMs & ORIs - current



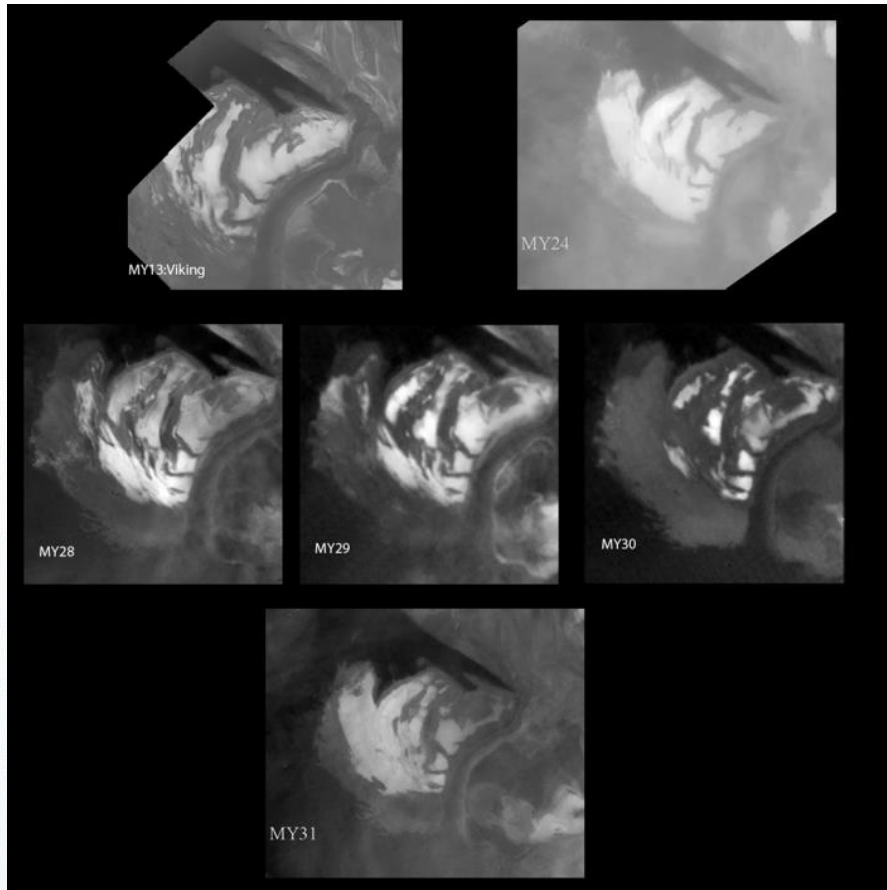
HRSC DTMs produced for the North Pole (Putri et al., unpublished)



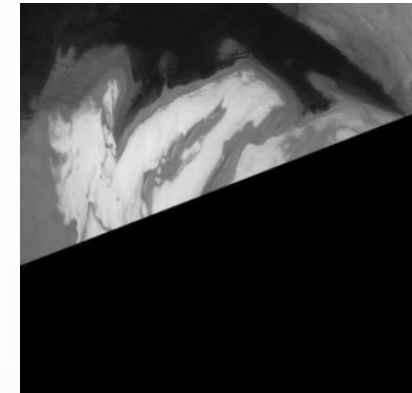
Mosaic of HRSC Orthorectified Images over the North Pole (before)

DTM mosaic will be finalised and ORI mosaic will be brightness-equalised

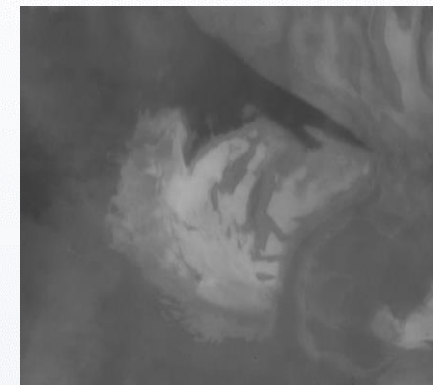
# Application Example



Abalos Mensa  
on MARCI (MY28-31) around Ls 137  
compared to Viking (MY13) and  
MOC (MY24) ([Calvin et al., 2015](#))



H1169\_0000 MY32 Ls 129.709

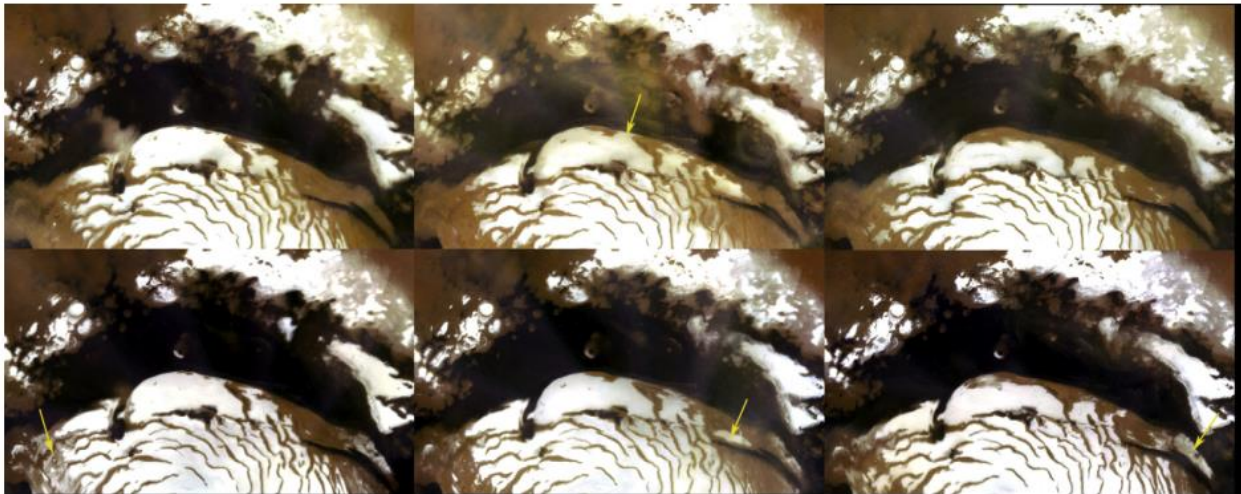


HD185\_0000  
MY32 Ls 133.1638

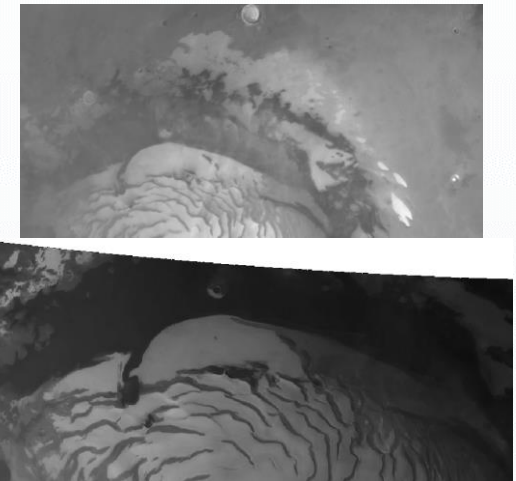
Abalos Mensa on HRSC



# Application Example



MARCI deposit change between MY29-31 at Ls 102 (top row) and Ls 132 (bottom row) in MARCI ([Calvin et al., 2015](#)).



The nearest HRSC  
HC85\_0000 MY27  
Ls 89.118 (top)  
HD185\_0000 MY32  
Ls 133.1638 (bottom)

(full coverage of MY27  
not available)

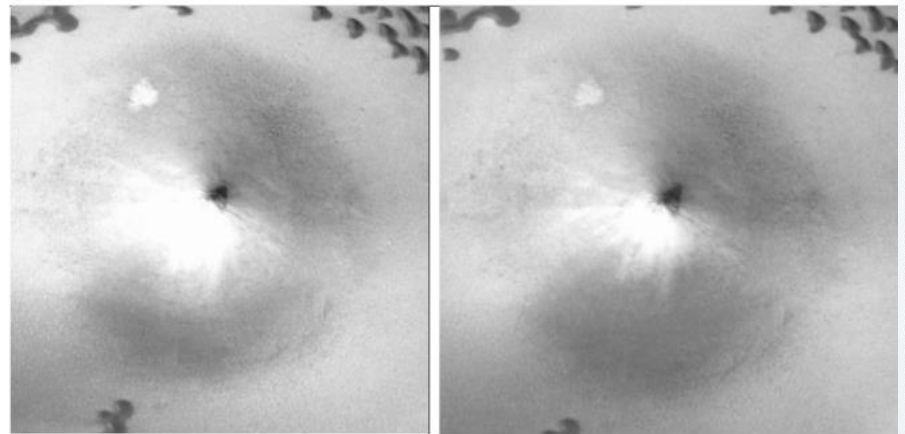


# Application Example – Rootless Volcanic Cones

- Volcanic landform characterised by the absence of magma conduit
- High-latitude volcanic cones in areas with ground ice
- Areas around H1169 0000, MY 27 Ls129.709 and H8160 0000, MY 30, Ls91.832
- Currently no observable changes

Left: P22 009631 2594 XN 79N084W,  
MY 27, Ls129.709

Right: D01 027538 2601 XN 80N084W,  
MY 31, Ls91.832

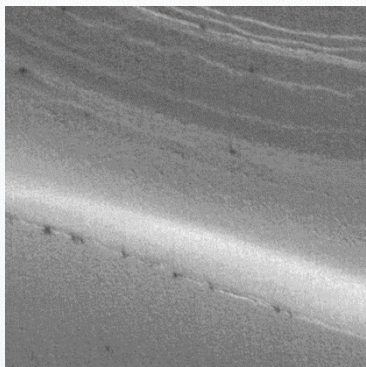




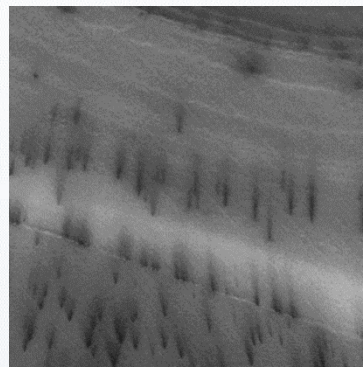
# Other possibilities of applications

Research that has been done previously utilising the published south polar dataset

Automatic change detection  
(Putri et al., GSW2019)

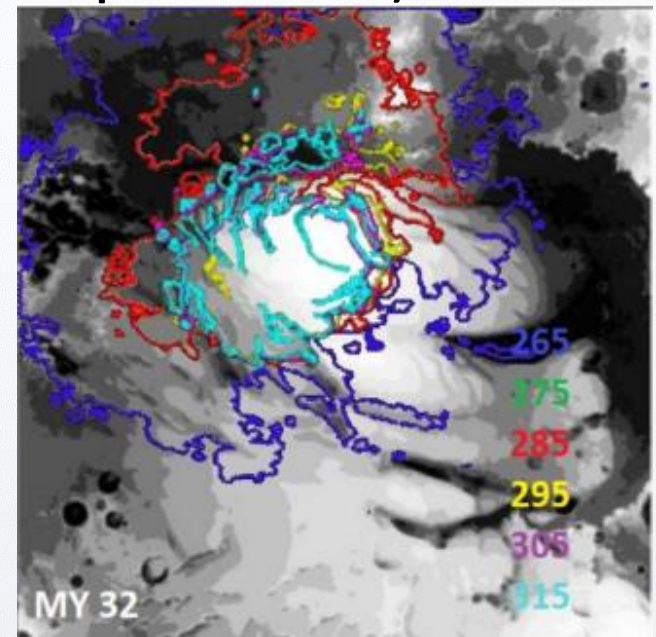


P04\_002532\_09  
40\_XI\_86S262W  
2007-02-09  
LS 181.11 MY28



B05\_011671\_0936  
\_XN\_86S261W  
2009-01-21  
LS 195.66 MY 29

automatic ice cap edge  
detection (Putri et al.,  
unpublished)

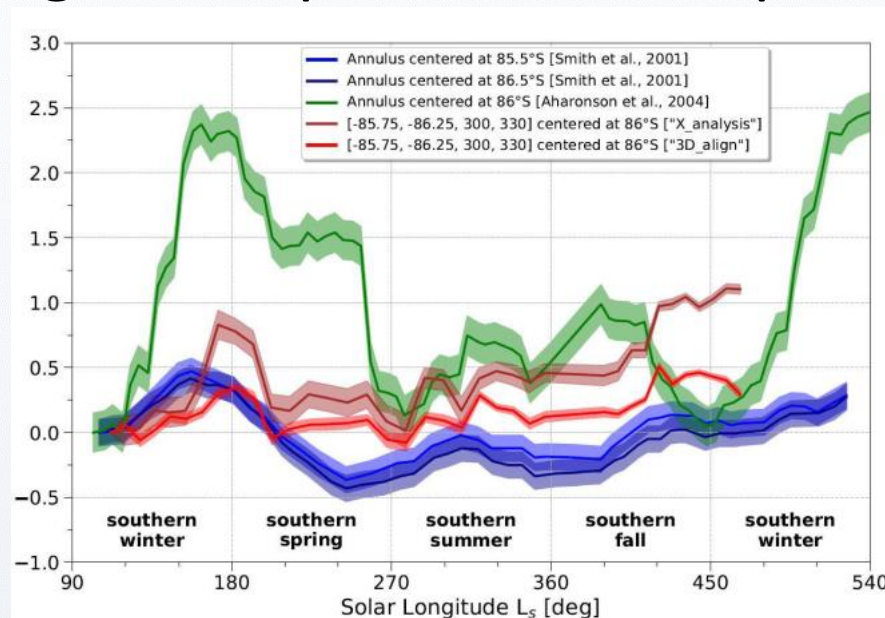




# Other possibilities of applications

Research that has been done using the published south polar dataset

Correcting MOLA points to ice cap changes



Xiao et al., EPSC/DPS 2019



# Conclusions and Future work

- HRSC 3D products (DTMs) and ORIs have been produced over the North Pole
- The dataset will be published at the ESA-GSF following the DTMs and ORIs over the South Pole
- Showed examples of published HRSC DTMs and ORIs produced over the South Pole used in different areas of research including change detection
- Possibilities of similar (or different) research using the North Polar dataset