

# JPL MARSIS processing activities and data products

Y. Gim

Jet Propulsion Laboratory

California Institute of Technology

May 15, 2018

# JPL's MARSIS processing activities

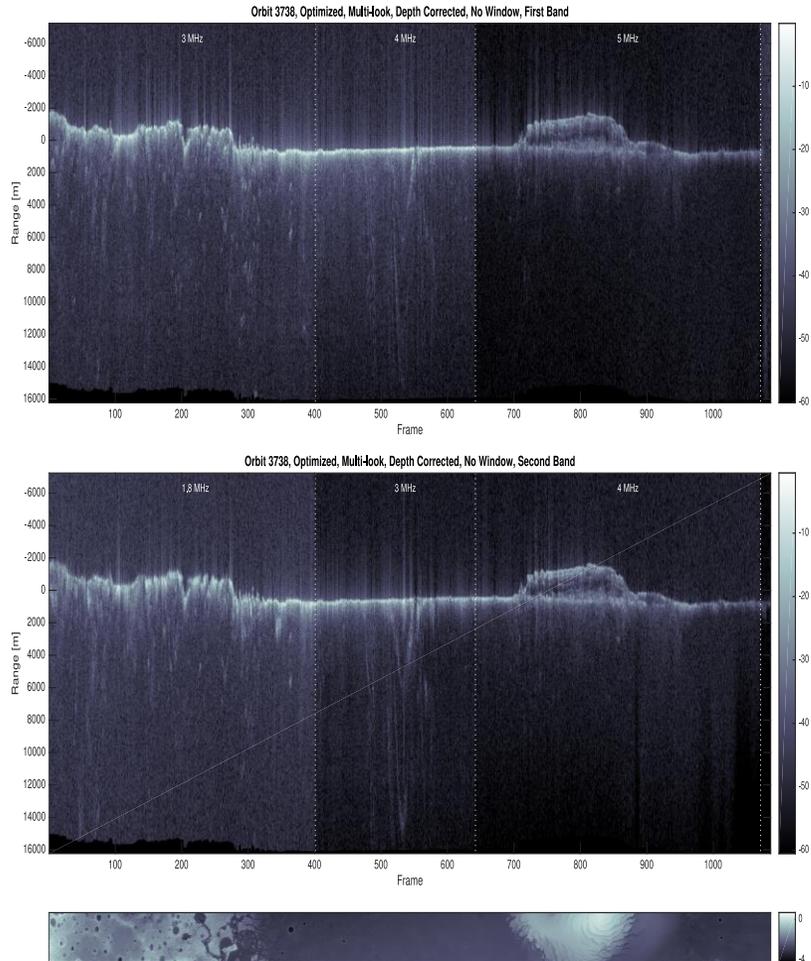
- Robust and computationally efficient MARSIS data processing
  - Autofocus algorithm to compensate for signal distortions caused by Mars ionosphere
    - Focus radar's surface response of each MARSIS frame by maximizing correlation with a simulated radargram
      - Joseph G. McMichael, Yonggyu Gim, Darmindra D. Arumugam, Jeffrey J. Plaut , “ Radar Autofocus Algorithm Incorporating Terrain Knowledge for Correction of Mars' Ionospheric Distortion in MARSIS Observations”, IEEE radar conference (2017)
- Streamlined processing: a single program capable of generating all the data products and corresponding images
  - Focused radargrams
    - With and w/o depth correction
    - With and w/o processing window
    - Single look and multi-look
  - Chapman model and optimized Total Electron Content (TEC)
  - Clutter simulation based on MOLA digital elevation model
- Computational efficiency via parallel processing
  - Single MAC with 12 cores capable of simultaneously processing 12 orbits
  - 7000+ orbits collected over 12 years can be re-processed within a week

# JPL's MARSIS processing activities (cont'd)

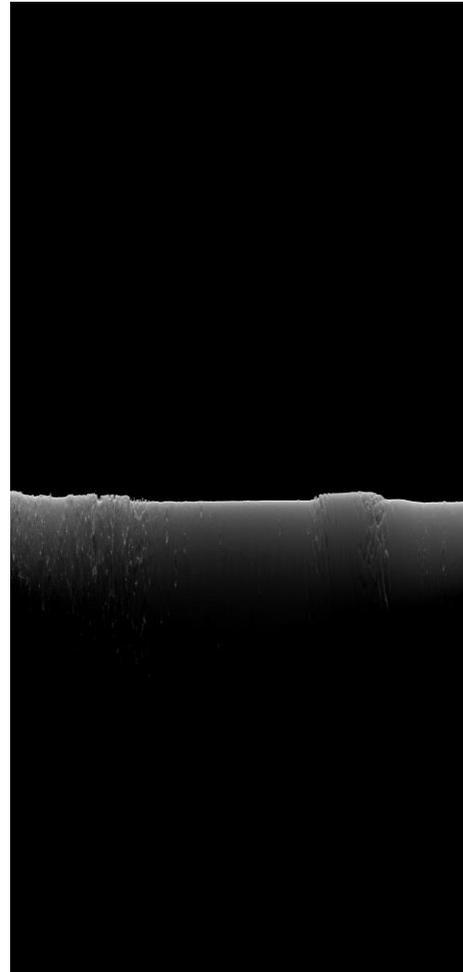
- 3D radar maps of Mars polar regions and archiving products
  - Performed by two summer students in 2017
  - Construct 3D radar maps of Mars North and South polar regions
    - Y. Gim, D. Bellutta, J. Plaut, "Construction of Marsis 3D radar maps of the martian polar regions", LPSC 2018
    - J. Plaut, D. Bellutta, Y. Gim, "New insights into the internal structure of the martial polar plateaus from Marsis 3D mapping", LPSC (2018)
- Archiving products
  - Data products generated by the autofocus algorithm
  - Image data only
    - Image format: PDF and PNG
    - Each image is paired with an ASCII label file

# Example of Archive products : MARSIS orbit 3738

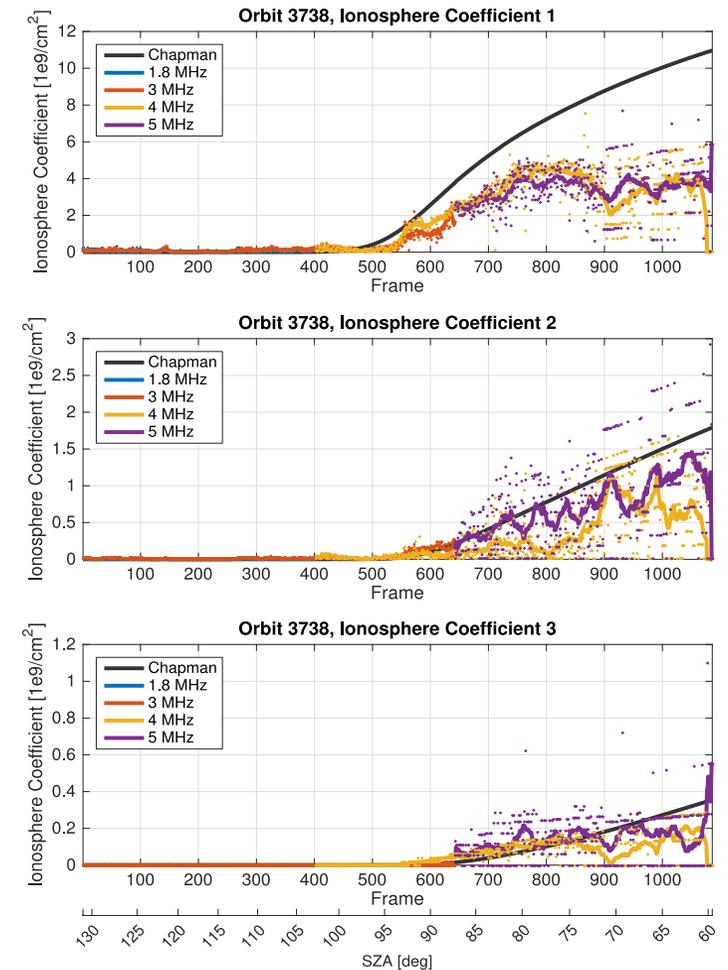
## Depth corrected radargram



## Surface clutter simulations

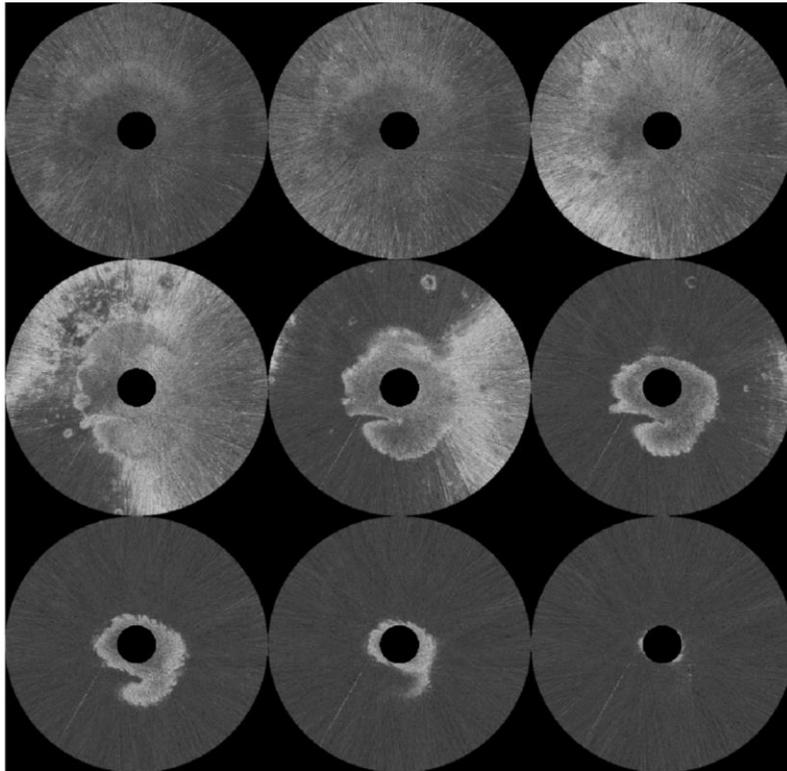


## Optimized TEC vs Chapman model

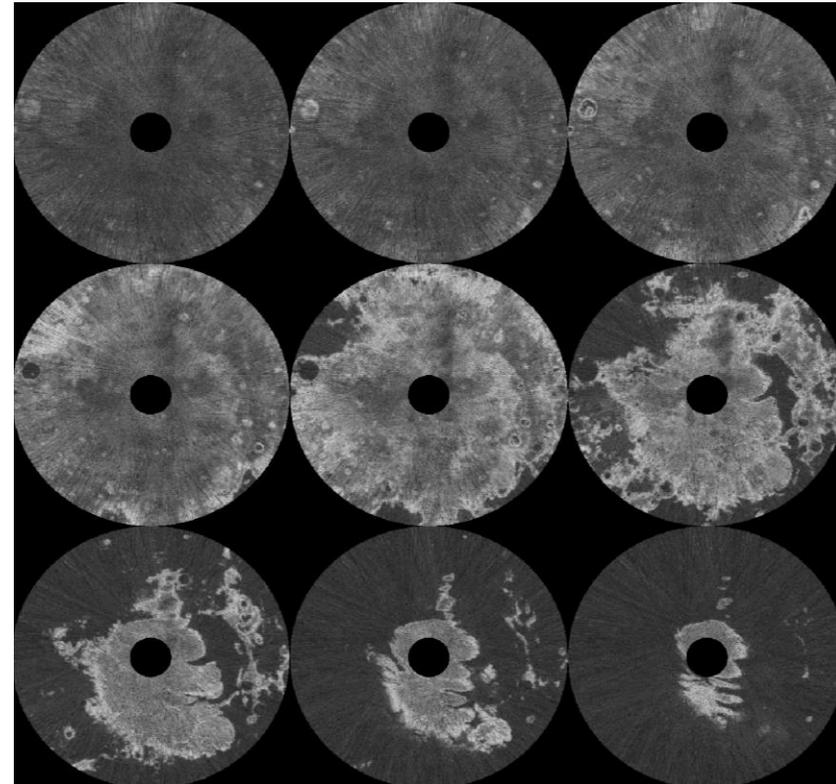


# Martian 3D radar maps

North pole

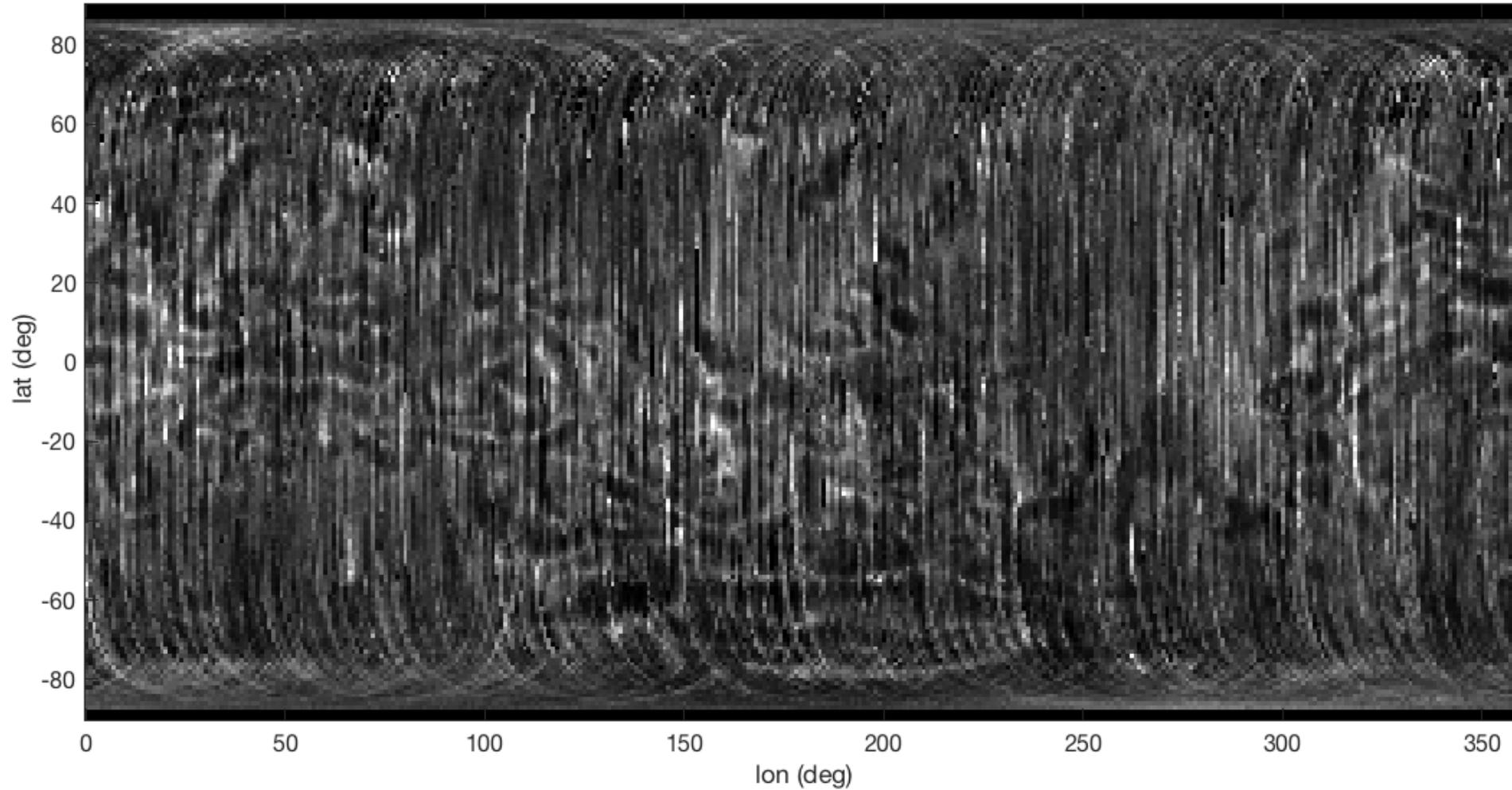


South pole



Each slice is a 2D cross-section of the 3D maps at different depths: from top-left (deep) to bottom-right (shallow) at every 500 m. The horizontal and vertical extents of each slice is approximately 2400 km at a pixel resolution of 1.5 km. Darker regions within each slice indicate very little radar reflection while bright features correspond to detectable radar echoes. 1965 and 2077 MARSIS tracks over Martian north and South polar regions, respectively are used to construct the 3D maps.

# Global Total Electron Content (TEC) map



The map is constructed by combining TEC values from night-time MARSIS orbits with solar zenith angle  $> 100$  deg. Some interesting patterns are observed in the mid latitudes. Work in progress to understand the pattern.