

Analysis of Mars Color Camera (MCC) of Mars Orbiter Mission (MOM)

STRUCTURE

Introduction:

About Mars Color Camera

Part:1

- " Browsing of Mars Color Camera (MCC) data in Long Term Data Archive (LTA)
- " Downloading of MCC data
- " Getting meta-data information about MCC data

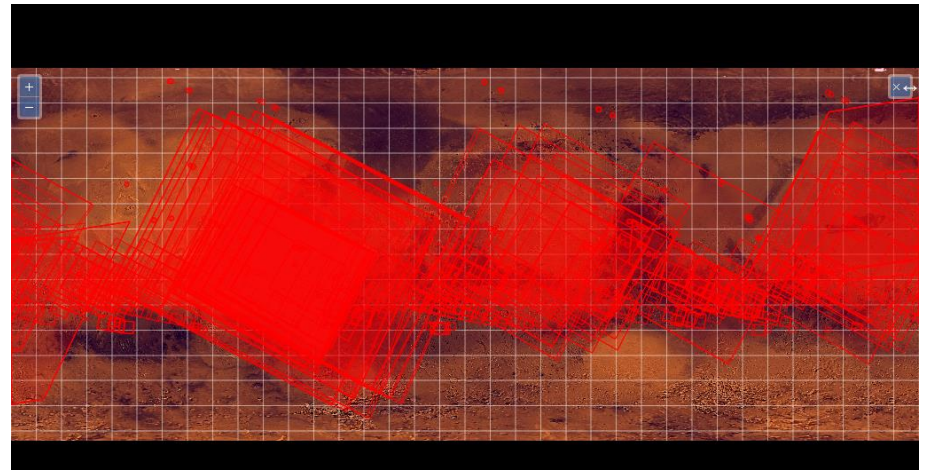
Part:2

- " Loading MOLA global topography data as contextual information
- " Loading of MCC data sets in GIS Software
- " Loading of Mars Nomenclature
- " Loading of other Global data sets(MDIM-2.1, MOC-WA) as contextual information
- " Mapping of various morphological features

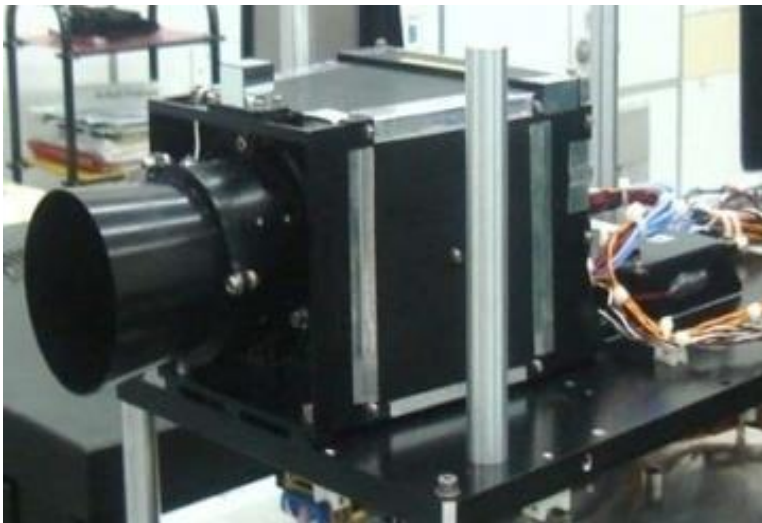
About Mars Color Camera (MCC)

Orbit of MOM: 443 x 71149 km
Exposure time (ms) - Total 16 ground programmable exposures ranging from 34 ms to 490 ms
Spectral region (micrometer) = 0.4-0.7

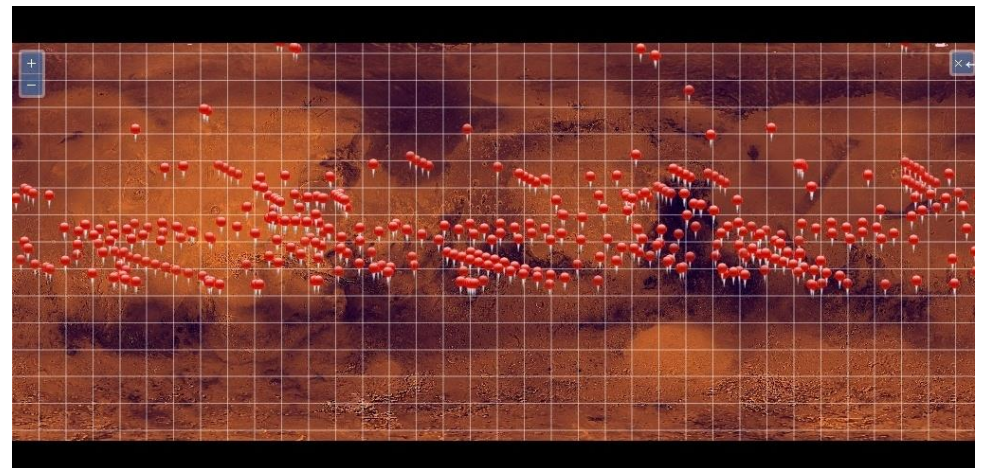
Coverage of MCC as on 09-05-2015



Foot prints of MCC shown as polygons



Mars Colour Camera



Foot prints of MCC shown as Pin/Point

Browsing MCC data in Long Term Data Archive (LTA)



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*** DATA ACCESS ONLY FOR REGISTERED USERS. ***

[MAP SEARCH is available now...](#)

Please Log In

Username *	<input type="text" value="Username"/>
Password *	<input type="password" value="Password"/>
	<input type="button" value="Login"/>
	Forgot password?

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Map View
Table View
Level 0 Tar

S. No.	Product ID	Start Date	Stop Date	Altitude	Integratio	Orbit No.	OD	Location	Images	Label	
1	MCC_MRD_20150509T161123625_D_D32	2015-05-09 16:11:23.0	2015-05-09	534.67145	0.8 ms	000105	PRE				<input type="checkbox"/>
2	MCC_MRD_20150509T161123625_D_D32	2015-05-09 16:11:23.0	2015-05-09	534.67145	0.8 ms	000105	POST				<input type="checkbox"/>
3	MCC_MRD_20150509T160922623_D_D32	2015-05-09 16:09:22.0	2015-05-09	617.12915	0.8 ms	000105	PRE				<input type="checkbox"/>
4	MCC_MRD_20150509T160922623_D_D32	2015-05-09 16:09:22.0	2015-05-09	617.12915	0.8 ms	000105	POST				<input type="checkbox"/>
5	MCC_MRD_20150509T160721620_D_D32	2015-05-09 16:07:21.0	2015-05-09	732.0839	0.8 ms	000105	PRE				<input type="checkbox"/>

5 (1 of 148) No. of products : 737

[Export as XLS](#) [Custom View](#) [View Selected Products on map](#)

Product Type : RAW ONLY RAD ONLY RAD + AREO*

Type this :

*AREO is valid for available MCC datasets only.

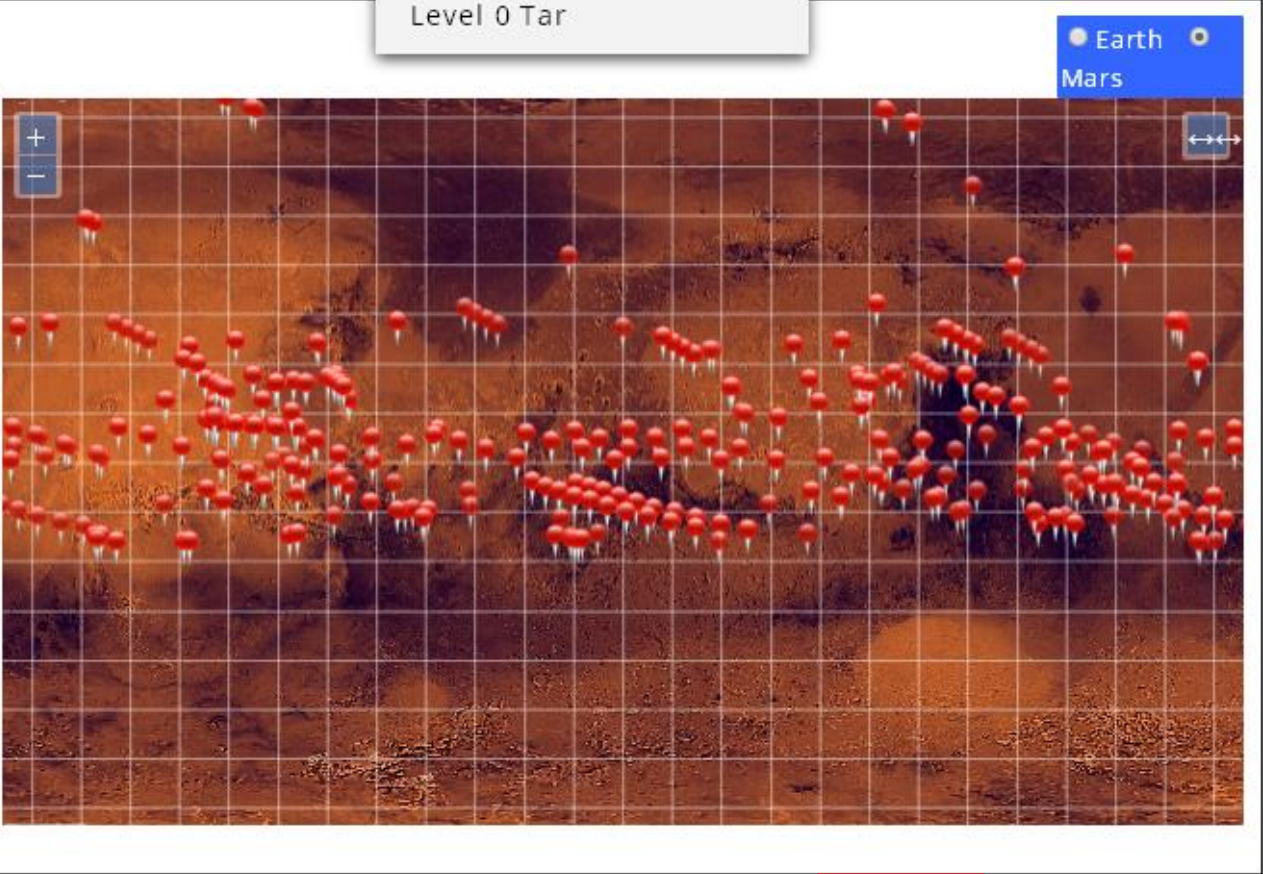
MAP view of MCC data coverage : Pin view

← → ↻ 10.61.141.90/MOMLTA/protected/map_pin.xhtml 🔍 ☆

HOME SEARCH **BROWSE** GALLERIES DOWNLOADS HELP WELCOME ARYA

*** DATA ACCESS *** **Map View** MAP SEARCH is available now...
Table View
Level 0 Tar

● Earth ○ Mars



Move your cursor on any product to view its information and click on the product to view more options.

MCC MSM TIS LAP Grid **Pin View** Polygon View KML

↑

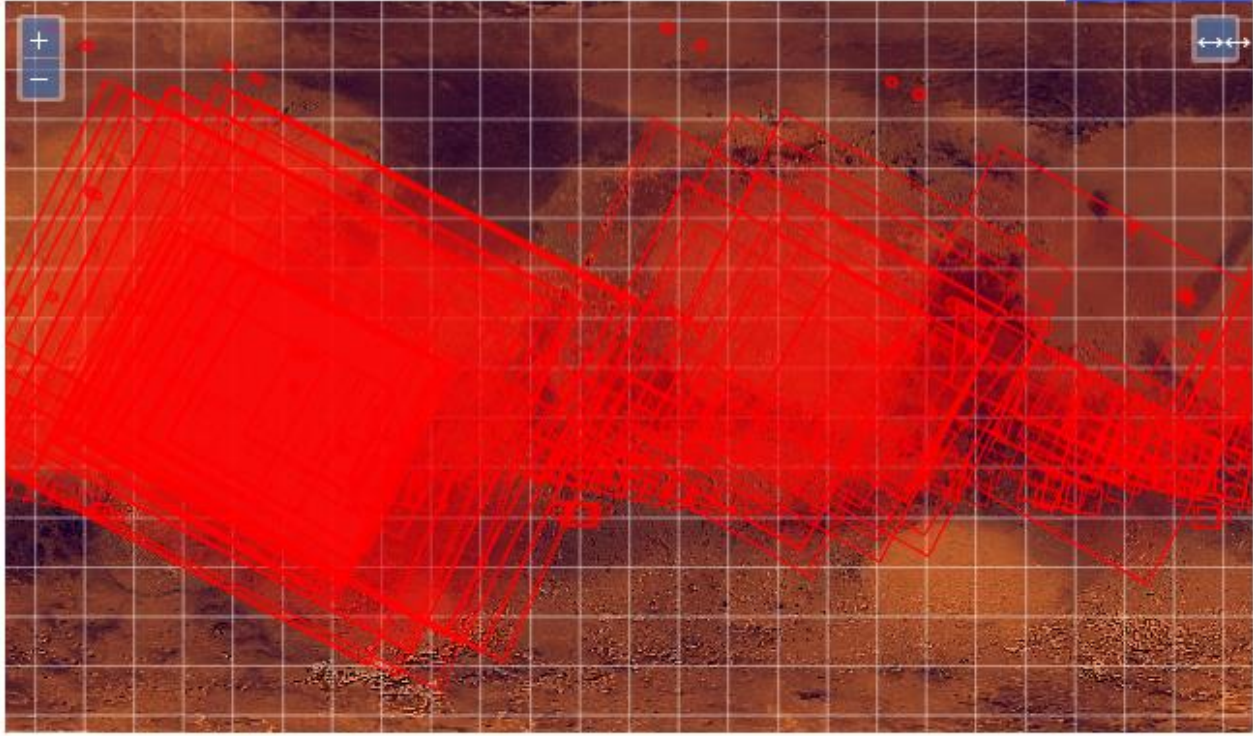
MAP view of MCC data coverage : Polygon view

10.61.141.90/MOMLTA/protected/map_polygon.xhtml

HOME SEARCH **BROWSE** GALLERIES DOWNLOADS HELP WELCOME ARYA

*** DATA ACCESS *** **Map View** MAP SEARCH is available now...
Table View
Level 0 Tar

Earth Mars



Move your cursor on any product to view its information and click on the product to view more options.

MCC MSM TIS LAP Grid Pin View **Polygon View** KML

MCC data search by Date

HOME SEARCH BROWSE GALLERIES DOWNLOADS

HELP ▾ WELCOME ARYA

*** DATA ACC... MAP SEARCH is available now...

Map
Date
Lat-Lon

Start Date: YYYY-MM-DD Stop Date: YYYY-MM-DD

Start Time: Stop Time:

Instrument : ALL Orbit Determination : ALL

Submit Reset

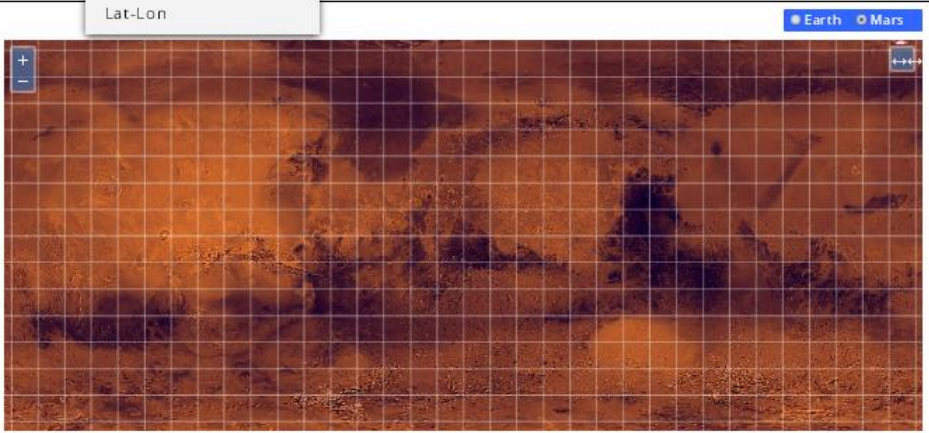
MCC data browse using Map search

Case study: Ophir Catena from Valles Marineris region

HOME SEARCH BROWSE GALLERIES DOWNLOADS HELP

ONLY FOR REGISTERED USERS. ***

Map
Date
Lat-Lon

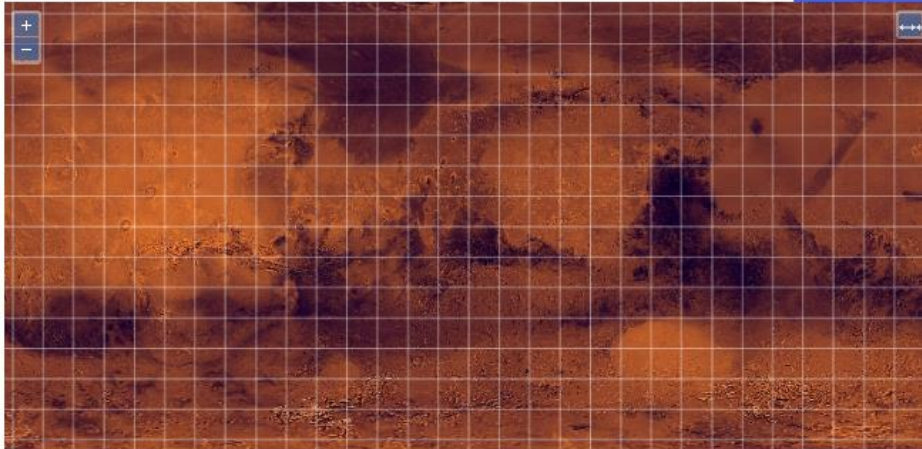


Hold SHIFT key and drag to draw search area on the map.

MCC MSM TIS LAP KML Grid

This screenshot shows the initial state of the MCC data browse interface. The 'SEARCH' tab is active, and a dropdown menu is open over the 'Map' button. The map displays a grid over the Martian surface. A search area is highlighted in red on the map. The interface includes navigation controls (zoom in/out, pan) and a toolbar with icons for MCC, MSM, TIS, LAP, KML, and Grid.

Earth Mars



Hold SHIFT key and drag to draw search area on the map.

MCC MSM TIS LAP KML Grid

This screenshot shows a zoomed-in view of the search area on the map. The 'Earth' and 'Mars' buttons are visible in the top right corner. The map shows a detailed view of the Martian surface with a grid overlay. The search area is highlighted in red. The interface includes navigation controls and a toolbar with icons for MCC, MSM, TIS, LAP, KML, and Grid.

Feature Name Based Search

Feature Name :

Extent :

Search

This form is used for searching for features based on their name. The 'Feature Name' field is currently set to 'None', and the 'Extent' field is set to 'Range(0-100) in degrees'. A 'Search' button is located at the bottom right of the form.

Feature Name Based Search

Feature Name :

Extent :

Search

This form is used for searching for features based on their name. The 'Feature Name' field is currently set to 'Ophir Catenae', and the 'Extent' field is set to '2.0'. A 'Search' button is located at the bottom right of the form.

MCC data browse using Map search

Case study: Ophir Catena from Valles Marineris region

Earth Mars

S. No.	Product ID	Color	Colc
1	MCC_MRD_20150501T114650178_D_D32		<input checked="" type="checkbox"/>
2	MCC_MRD_20150501T114650178_D_D32		<input checked="" type="checkbox"/>
3	MCC_MRD_20150423T072306117_D_D32		<input checked="" type="checkbox"/>

(1-3 of 3)

Draw All

Custom View
Export as XLS

Product Type: RAW ONLY RAD ONLY RAD + AREO*

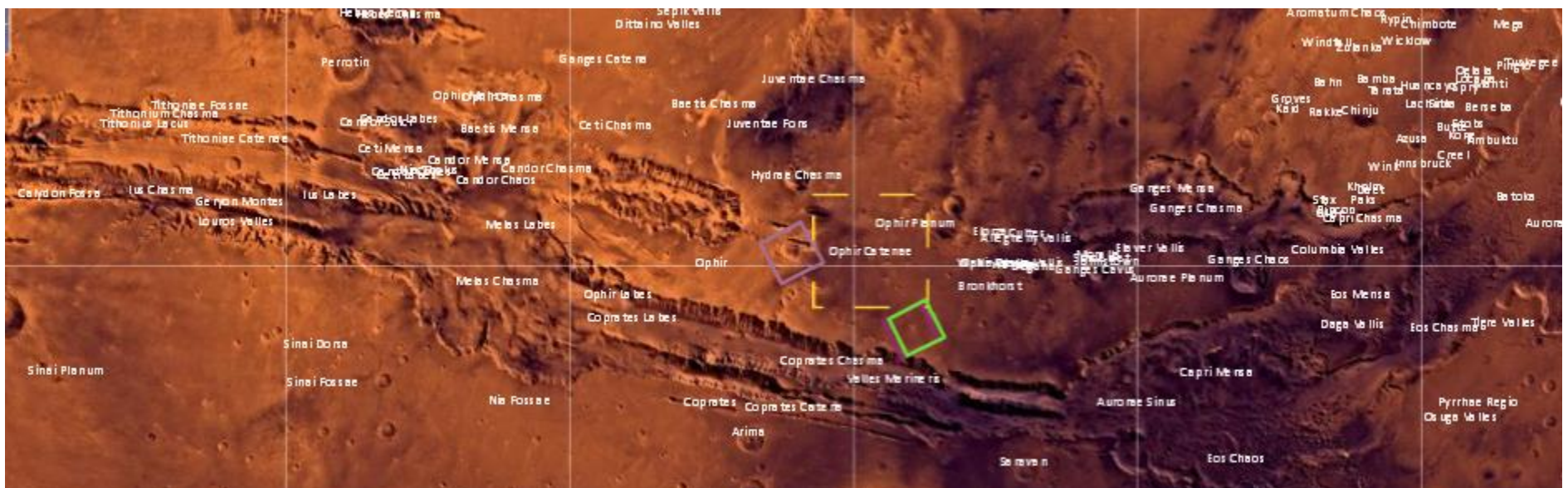
Type:

*AREO is valid for available MCC datasets only.

Download

-52.48, -16.61

Hold SHIFT key and drag to draw search area on the map.



MCC data search by giving Longitude and Latitude extent of Region of Interest

Case study: Pital crater from Valles Marineris region

HOME SEARCH BROWSE GALLERIES DOWNLOADS HELP

WELCOME ARYA

ED USERS. *** MAP SEARCH is available now...

Map
Date
Lat-Lon

Reticle points Latitude Longitude

Upper Left:	<input type="text" value="-8.35"/>	<input type="text" value="-63.43"/>	Upper Right:	<input type="text" value="-8.35"/>	<input type="text" value="-60.97"/>
Lower Left:	<input type="text" value="-10.77"/>	<input type="text" value="-63.43"/>	Lower Right:	<input type="text" value="-10.77"/>	<input type="text" value="-60.97"/>

Instrument Name

Submit Reset

Lat-Lon Query Results										
S. No.	Product ID	Upper Left (Upper Right	Lower Left	Lower Right	Altitude	Location	Images	Label	<input type="checkbox"/>
1	MCC_MRD_20150423T072306117_D_D32	-9.189713 ,	-8.433133 ,	-10.618603	-9.864509 ,	852.4337				<input type="checkbox"/>
2	MCC_MRD_20141110T172436240_D_GDS	5.791166 , -	-4.6945224	-13.399525	-24.449337	11992.824				<input type="checkbox"/>
3	MCC_MRD_20141110T172436240_D_GDS	5.9195805 ,	-4.5663285	-13.27576 ,	-24.314198	11990.726				<input type="checkbox"/>

No. of products : 3

[Export as XLS](#) [Custom View](#) [View Selected Products on map](#)

Product Type : RAW ONLY RAD ONLY RAD + AREO*

Type this :

*AREO is valid for available MCC datasets only.

Select Post OD (1)

→ 10.61.141.90/MOMLTA/protected/customView.xhtml

Available Fields

- Product ID
- Instrument
- Station No
- Stop Date
- Target
- Dataset ID
- Job ID

Selected Fields

- Start Date
- Spacecraft Altitude
- MCC Horizontal Pixel
- Scale
- Version
- OD
- Integration Time

Generate

Custom View Products											
S. No	Start Date	Space	MCC Ho	Version	OD	Integration	Mr1 Ex	Product Creation Time	Location	Images	Label
1	2014-11-10 17:24:36.0	11992	623.7402	V1	0	0.4 ms	3	2016-01-20 17:09:40.0			
2	2014-11-10 17:24:36.0	11990	623.6311	V2	1	0.4 ms	3	2016-01-20 18:40:52.0			
3	2015-04-23 07:23:06.0	852.43	44.33461	V2	1	0.8 ms	4	2016-01-19 21:37:10.0			

No. of products : 3

[Export as XLS](#) [View Selected Products on map](#)

Product Type : RAW ONLY

RAD ONLY RAD + AREO*

Type this :









Custom View Products										
S. No	Start Date	Spac	MCC Ho	Version	OD	Integration	Mr1 Ex	Product Creation Time	Location	Images
1	2014-11-10 17:24:36.0	11990	623.631	V2	1	0.4 ms	3	2016-01-20 18:40:52.0		
2	2015-04-23 07:23:06.0	852.4	44.3346	V2	1	0.8 ms	4	2016-01-19 21:37:10.0		

No. of products : 2

[Export as XLS](#) [View Selected Products on map](#)

Product Type : RAW ONLY

RAD ONLY RAD + AREO*

Custom View Products												
S. No	Start Date ▲	Space	MCC H	Version	OD	Integration	Mr1 Ex	Product Creation Time	Location	Images	Label	✓
1	2014-11-10 17:24:36.0	11990	623.63	V2	1	0.4 ms	3	2016-01-20 18:40:52.0				
2	2015-04-23 07:23:06.0	852.43	44.334	V2	1	0.8 ms	4	2016-01-19 21:37:10.0				

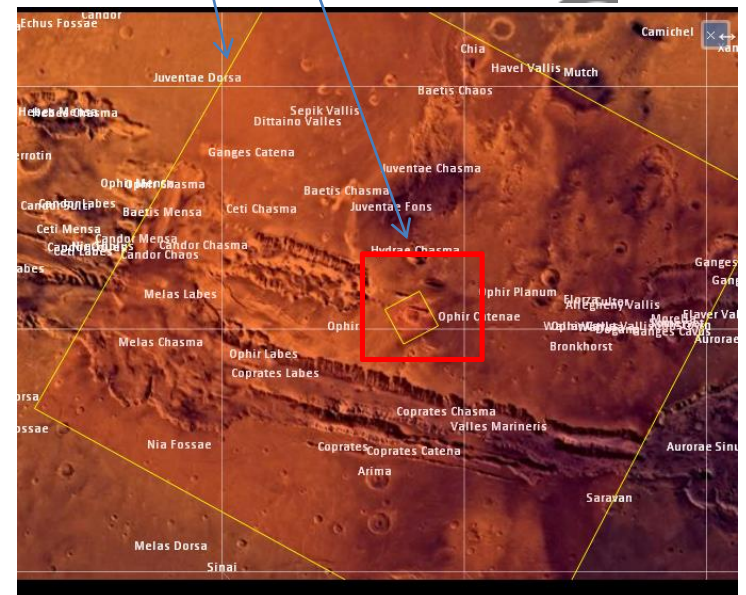
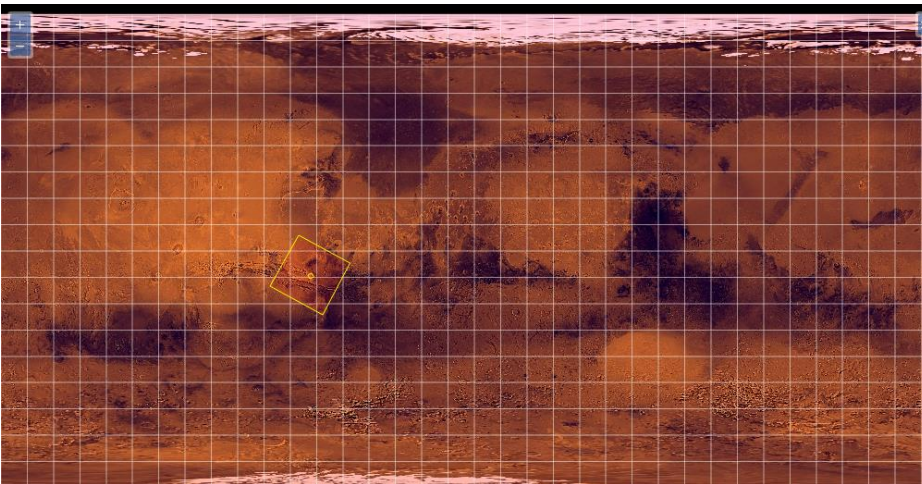
No. of products : 2

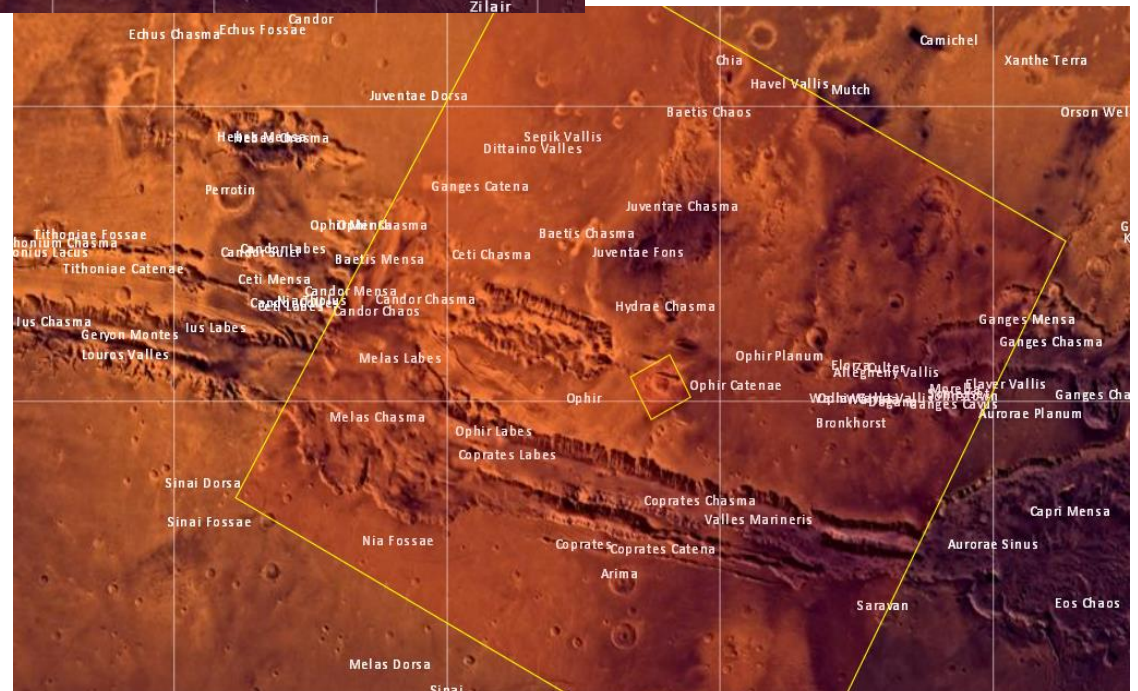
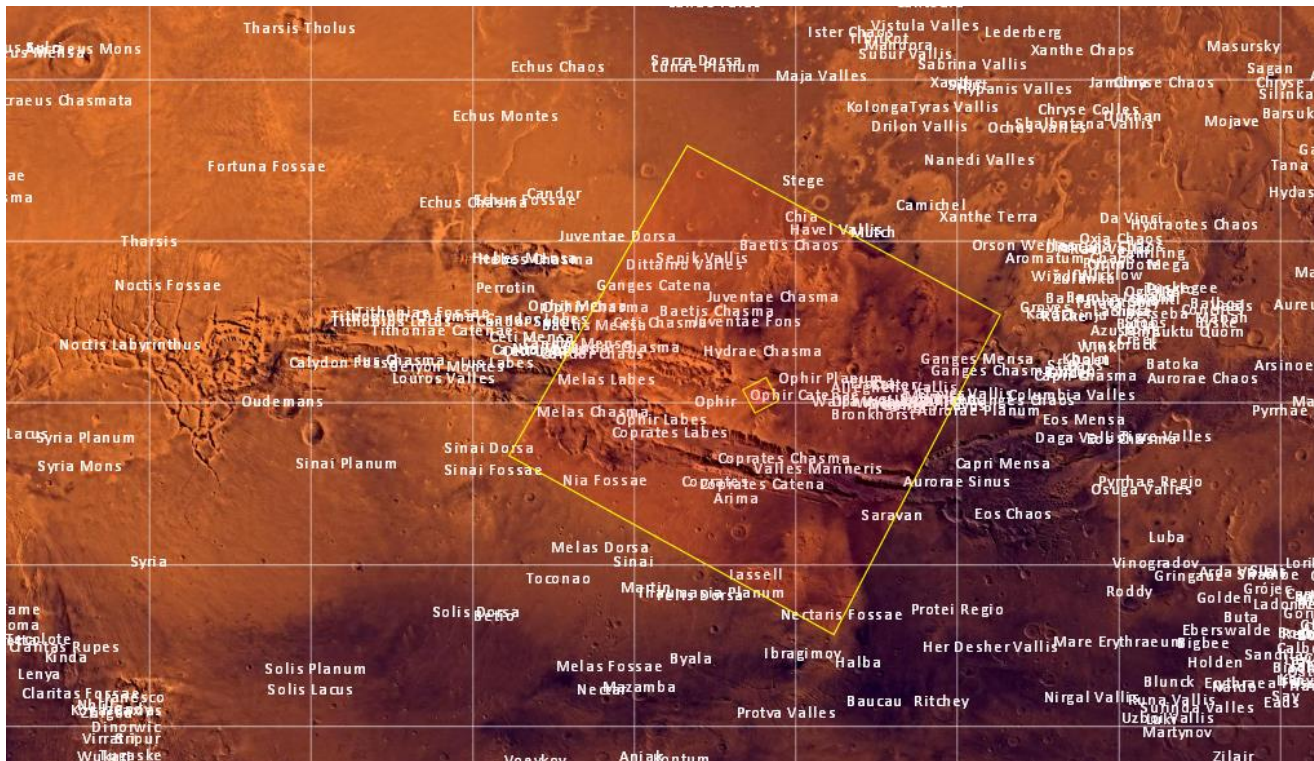
[Export as XLS](#) [View Selected Products on map](#)

Product Type :

RAD ONLY RAD + AREO* RAW ONLY

Type this :





Footprints of Mars Color Camera data sets over **Pital crater** in ophir planum region

This region having both high and coarse resolution data sets of MCC

Custom View Products												
S. No	Start Date ▲	Space	MCC H	Version	OD	Integration	Mr1 Ex	Product Creation Time	Location	Images	Label	<input checked="" type="checkbox"/>
1	2014-11-10 17:24:36.0	11990	623.63	V2	1	0.4 ms	3	2016-01-20 18:40:52.0				<input checked="" type="checkbox"/>
2	2015-04-23 07:23:06.0	852.43	44.334	V2	1	0.8 ms	4	2016-01-19 21:37:10.0				<input checked="" type="checkbox"/>

No. of products : 2

[Export as XLS](#) [View Selected Products on map](#)

Product Type :

RAW ONLY

10.61.141.90/MCMLIA/protected/map_product.xhtml

MCC_MRD_20150423T072306117_D_D32_V2_POST

Brightness 0 Contrast 0

Grid KML

MCC_MRD_20141110T172436240_D_GDS_V2_POST

Brightness 0 Contrast 0

Grid KML

Custom View Products												
S. No	Start Date ^	Space	MCC H	Version	OD <	Integration	Mr1 Ex	Product Creation Time <	Location	Images	Label	
1	2014-11-10 17:24:36.0	11990	623.63	V2	1	0.4 ms	3	2016-01-20 18:40:52.0				<input checked="" type="checkbox"/>
2	2015-04-23 07:23:06.0	852.43	44.334	V2	1	0.8 ms	4	2016-01-19 21:37:10.0				<input checked="" type="checkbox"/>

Meta information about data: Details about mission phase, start time and Exposure ID, integration time

MCC_MRD_20141110T172436240_D_GDS_V2_POST

```

PDS_VERSION_ID          = PDS3
LABEL_REVISION_NOTE     = "2013-04-22, MR1-ISRO-SAC-DP-TEAM"
/* FILE CHARACTERISTICS */
FILE_NAME                = "MCC_MRD_20141110T172436240_D_GDS.IMG"
RECORD_TYPE              = FIXED_LENGTH
RECORD_BYTES            = 8192
FILE_RECORDS            = 2048
/* POINTERS TO DATA OBJECTS */
*IMAGE                   = "MCC_MRD_20141110T172436240_D_GDS.IMG"
/* IDENTIFICATION DATA ELEMENTS */
RELEASE_ID               = 1
DATA_SET_ID              = "MR1ORB-M-MCC-3-MOP-RDR-RAD-V1.0"
DATA_SET_NAME            = "MR1 ORBITER MARS MCC 3 MOP RDR RAD V1.0"
PRODUCT_ID               = MCC_MRD_20141110T172436240_D_GDS
PRODUCT_TYPE             = "RDR"
PRODUCER_ID              = "MR1-ISRO-SAC-DP-TEAM"
PRODUCT_CREATION_TIME    = 2016-01-20T18:40:52.052
PRODUCER_FULL_NAME      = "MARS 1 ISRO SAC DATA PROCESSING TEAM"
PRODUCER_INSTITUTION_NAME = "
SPACE APPLICATIONS CENTRE ISRO, AHMEDABAD INDIA
"
PROCESSING_LEVEL_ID      = "3"
PROCESSING_LEVEL_DESC    = "2 Experiment Data Record,
3 Reduced Data Record"
MISSION_ID                = "MR1"
MISSION_NAME              = "MARS 1"
MISSION_PHASE_NAME       = "MARS ORBITAL PHASE"
SPACECRAFT_ORIENTATION   = 0
SPACECRAFT_ORIENTATION_DESC = "0 means descending,
1 means ascending"
SPACECRAFT_POINTING_MODE = NULL

```

MCC_MRD_20141110T172436240_D_GDS_V2_POST

```

INSTRUMENT_HOST_ID      = "MR1ORB"
INSTRUMENT_HOST_NAME    = "MR1 ORBITER"
TARGET_NAME              = "MARS"
TARGET_TYPE              = "PLANET"
DSN_STATION_NUMBER      = GDS
START_TIME               = 2014-11-10T17:24:36.240
STOP_TIME                = 2014-11-10T17:24:36.240
START_ORBIT_NUMBER       = 000039
STOP_ORBIT_NUMBER        = 000039
IMAGE_OBSERVATION_TYPE   = "REGULAR"
/* DESCRIPTIVE DATA ELEMENTS */
INSTRUMENT_ID            = "MCC"
INSTRUMENT_NAME          = "MARS COLOUR CAMERA"
INSTRUMENT_TYPE          = "IMAGING CAMERA"
INSTRUMENT_PARAMETER_NAME = "RADIANCE"
INSTRUMENT_PARAMETER_UNIT = "
MILLIWATT_CENTIMETER**-2_STERADIAN**-1_MICROMETER**-1
"
INST_CMPRS_NAME          = "ISRO PROPRIETRY"
FILTER_NAME              = "BAYER FILTER"
FILTER_NUMBER            = "3"
FILTER_TEMPERATURE       = "N/A"
FILTER_TYPE              = "ORGANIC"
CENTER_FILTER_WAVELENGTH = "N/A"
MR1_EXPOSURE_ID         = 3
LINE_EXPOSURE_DURATION   = "0.4 <ms>"
FOCAL_PLANE_TEMPERATURE = "N/A"
DETECTOR_ID              = "CMV4000"
DETECTOR_DESC            = "
CMV4000 - a high resolution, high speed snapshot colour CMOS image sensor
"
DETECTOR_TYPE            = "CMOS IMAGE SENSOR"

```

Continue....

Custom View Products												
S. No	Start Date	Space	MCC H	Version	OD	Integration	Mr 1 Ex	Product Creation Time	Location	Images	Label	
1	2014-11-10 17:24:36.0	11990	623.63	V2	1	0.4 ms	3	2016-01-20 18:40:52.0				<input checked="" type="checkbox"/>
2	2015-04-23 07:23:06.0	852.43	44.334	V2	1	0.8 ms	4	2016-01-19 21:37:10.0				<input checked="" type="checkbox"/>

.....Continue

MCC_MRD_20141110T172436240_D_GDS_V2_POST

/* GEOMETRY DATA ELEMENTS */
SPACECRAFT_ALTITUDE = 11990.7257890625

NOTE = Mars Colour Camera (MCC) is a Bayer Array RGB camera operating in the visible range (0.4-0.7) is a medium resolution camera flown on the Mars Orbiter Mission. It captures images of topography of Martian surface. It observes and helps in furthering our understanding of events like dust storms, dust devils etc. Moving in an elliptical orbit of 372km x 80000km around mars, the camera produces visible images of Mars and its environs. The highly elliptical orbit chosen for the Mars mission allow imaging of localized scenes at high spatial resolution as well as providing a synoptic view of the full globe. from apogee position of the orbit. This instrument is from Space Applications Centre, Ahmedabad, India

Information about S/C Altitude in km

MCC_MRD_20141110T172436240_D_GDS_V2_POST

Scientific Objective :-
 1. To map various morphological features on Mars with varying resolution and scales using the unique elliptical orbit.
 2. To map the geological setting around sites of Methane emission source.
 3. To provide context information for other science payloads.
 Sensor Configuration :-
 MCC uses a multi-element lens assembly and a 2Kx2K area array detector with RGB Bayer pattern to take images. The f/4 lens has a focal length of 105mm with a circularly symmetric field of view of plusminus4.4deg.
 The detector has 2048 x 2048 elements on a pixel pitch of 5.5 microns
 Salient Features:-
 1. Spacecraft Altitude (km) - 372x80000
 2. Resolution (m) - 19.5@Periareion
 3. Frame Size (km) - 40x40@Periareion (Full Mars disc from 63000km Apoareion)
 4. Spectral region (micrometer) - 0.4-0.7
 5. Frame rate - 1s (frame selection at 1s, 8s or 15s period by BDH through ground commanding)
 6. Exposure time (ms) - Total 16 ground programmable exposures ranging from 34 ms to 490 ms
 7. Data volume/frame (Mb) - 48
 8. System MTF@46 LP/mm (-) - greater than 15
 SNR @9. Near Saturation - greater than 50"

Information about Sensor parameters

Downloading of selected data sets

Custom View Products												
S. No	Start Date ^	Space	MCC H	Version	OD <	Integration	Mr1 Ex	Product Creation Time <	Location	Images	Label	<input checked="" type="checkbox"/>
1	2014-11-10 17:24:36.0	11990	623.63	V2	1	0.4 ms	3	2016-01-20 18:40:52.0				<input checked="" type="checkbox"/>
2	2015-04-23 07:23:06.0	852.43	44.334	V2	1	0.8 ms	4	2016-01-19 21:37:10.0				<input checked="" type="checkbox"/>

No. of products : 2

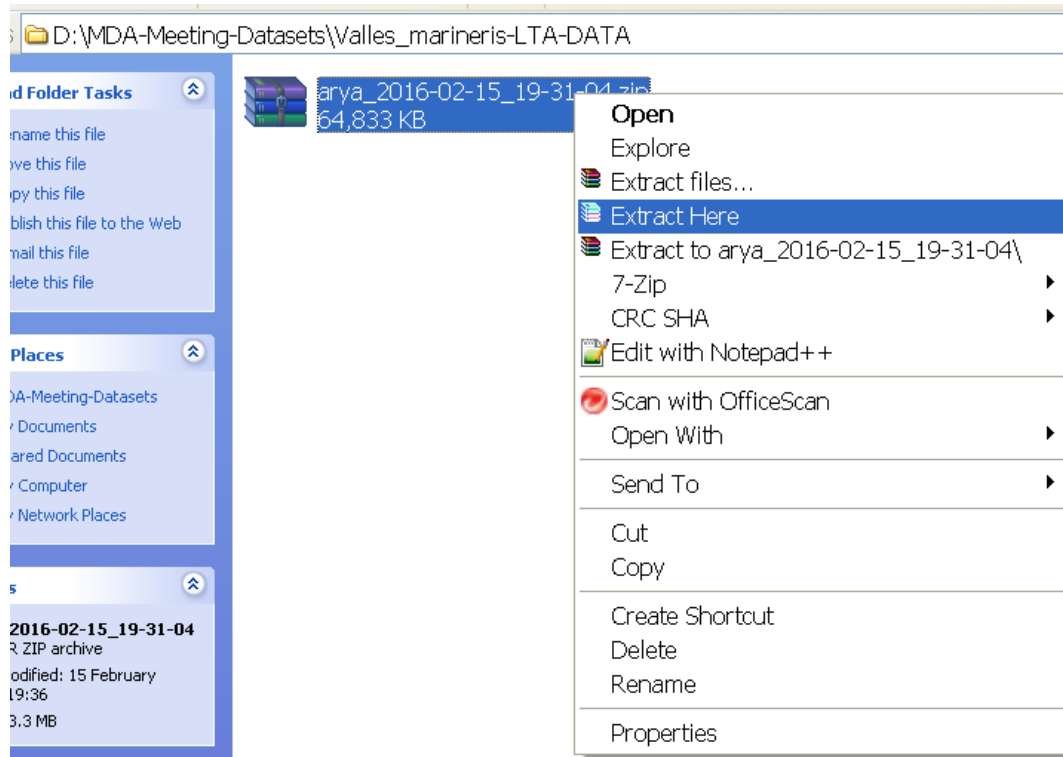
[Export as XLS](#) [View Selected Products on map](#)

Product Type : RAW ONLY

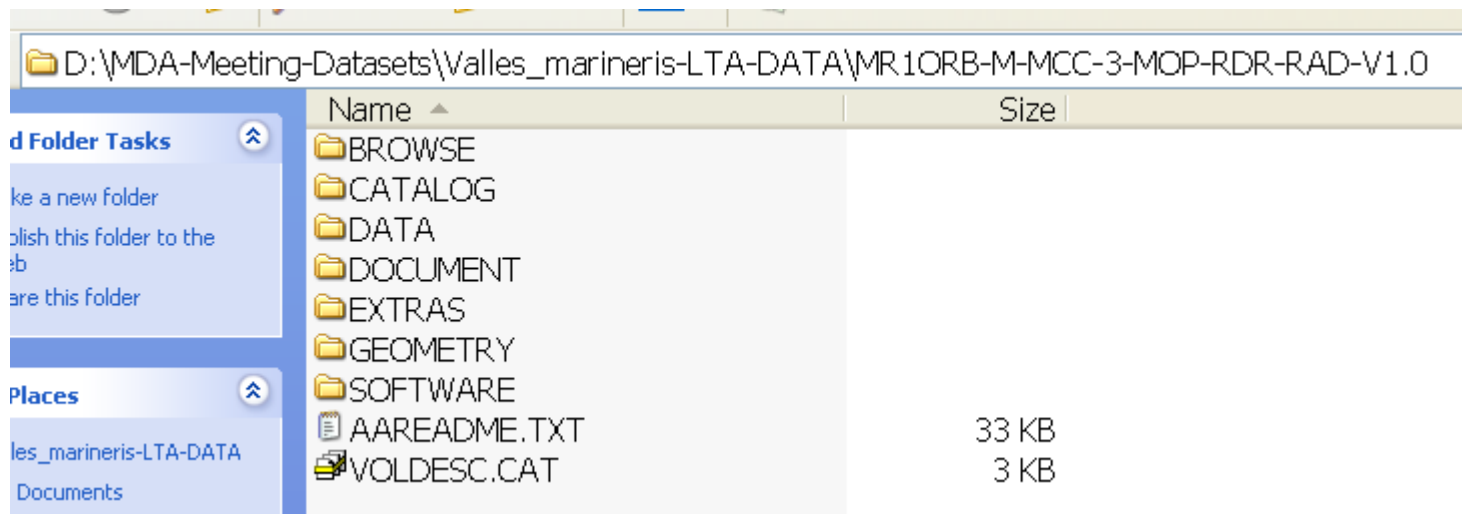
RAD ONLY RAD + AREO*

Type this :

*AREO is valid for available MCC datasets only.



Extracting MCC data from *.tar file



- BROWSE**
- CATALOG
- DATA
- DOCUMENT
- EXTRAS
- GEOMETRY
- SOFTWARE
- AAREADME.TXT
- VOLDESC.CAT



Preview of *.PNG file in **BROWSE** folder



Windows Explorer window showing the directory structure of a dataset. The left pane shows a tree view with folders: BROWSE, CATALOG, DATA, DOCUMENT, EXTRAS, GEOMETRY, SOFTWARE, AAREADME.TXT, and VOLDESC.CAT. The CATALOG folder is highlighted with a red box. The main pane shows the contents of the CATALOG folder, which includes several .CAT files. A blue arrow points to the right pane.

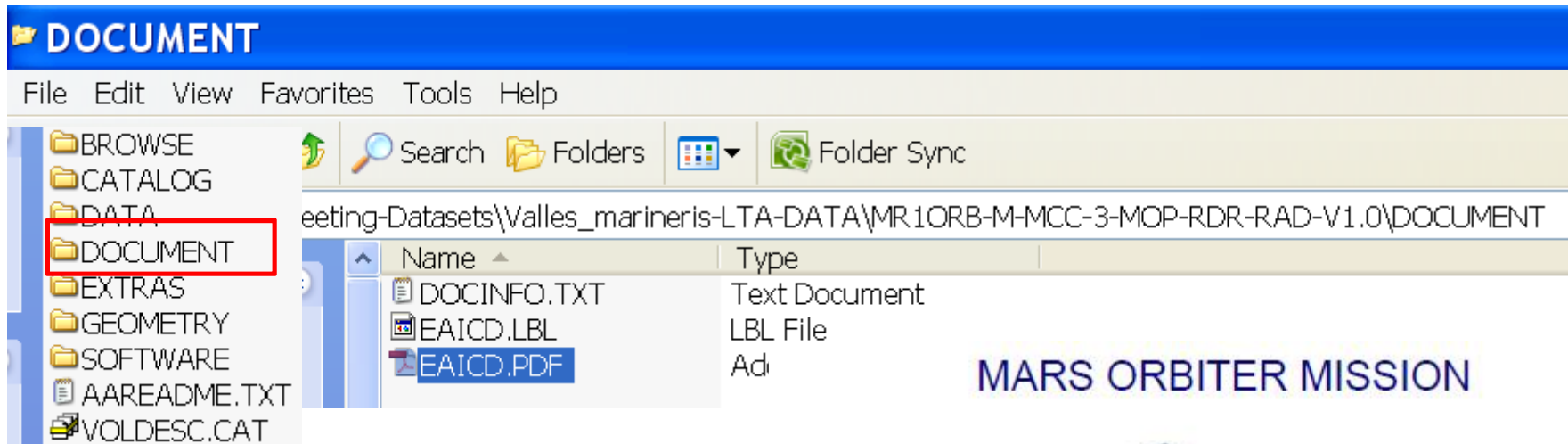
Name	Date Modified
DATASET.CAT	15/02/2016 19:31
INST.CAT	15/02/2016 19:31
INSTHOST.CAT	15/02/2016 19:31
MISSION.CAT	15/02/2016 19:31
PERSON.CAT	15/02/2016 19:31
REF.CAT	15/02/2016 19:31

***.CAT files of CATALOG folder
Provides meta information
about data, instrument,
institution, person, references
related to data set**

Windows Explorer window showing the contents of the DATA folder. The left pane shows a tree view with folders: BROWSE, CATALOG, DATA, DOCUMENT, EXTRAS, GEOMETRY, SOFTWARE, AAREADME.TXT, and VOLDESC.CAT. The DATA folder is highlighted with a red box. The main pane shows the contents of the DATA folder, which includes four files. Two files are highlighted with blue boxes.

Name	Type
MCC_MRD_20141110T172436240_D_GDS.LBL	LBL File
MCC_MRD_20141110T172436240_D_GDS.IMG	IMG File
MCC_MRC_20141110T172436240_D_GDS.LBL	LBL File
MCC_MRC_20141110T172436240_D_GDS.IMG	IMG File

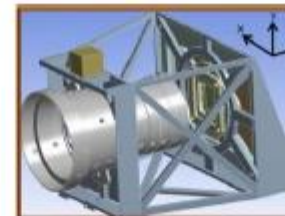
**DATA folder contains Count and
Radiance images of MCC –set-1
In this study**



MARS ORBITER MISSION

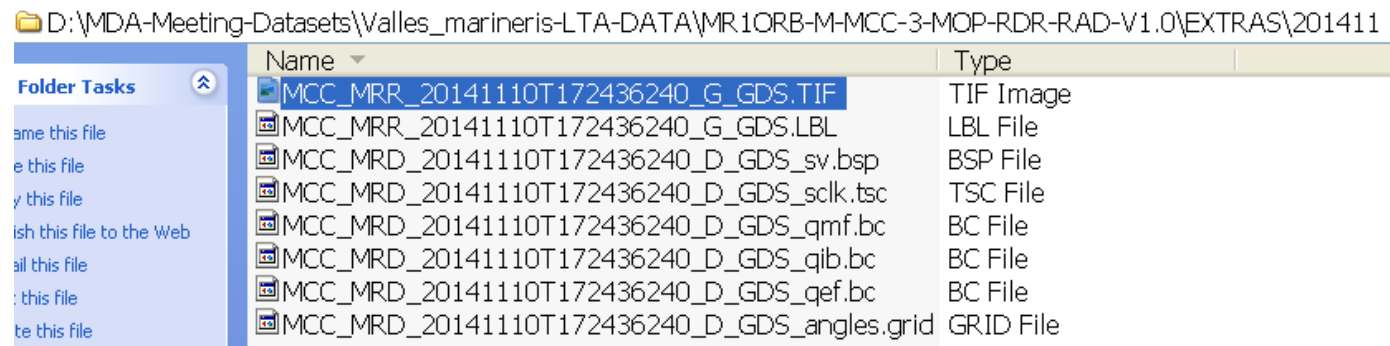
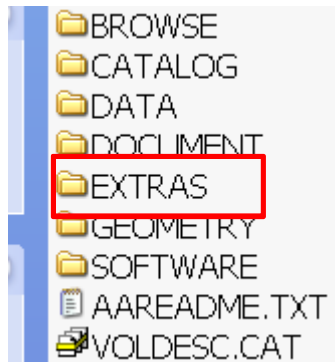


Mars Colour Camera (MCC)



Experimenter to Archive Interface Control Document [EAICD]

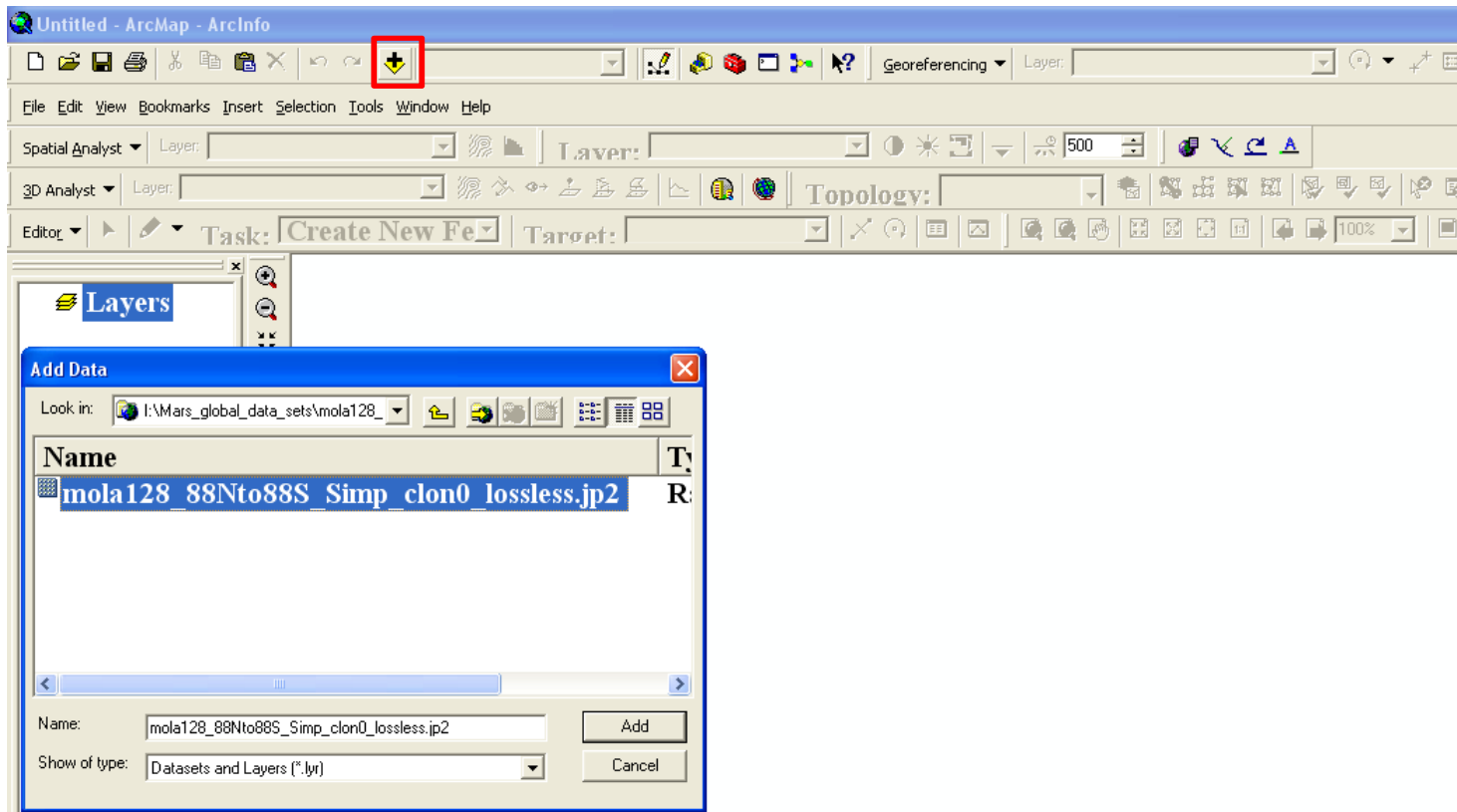
ISRO Science Data Archive



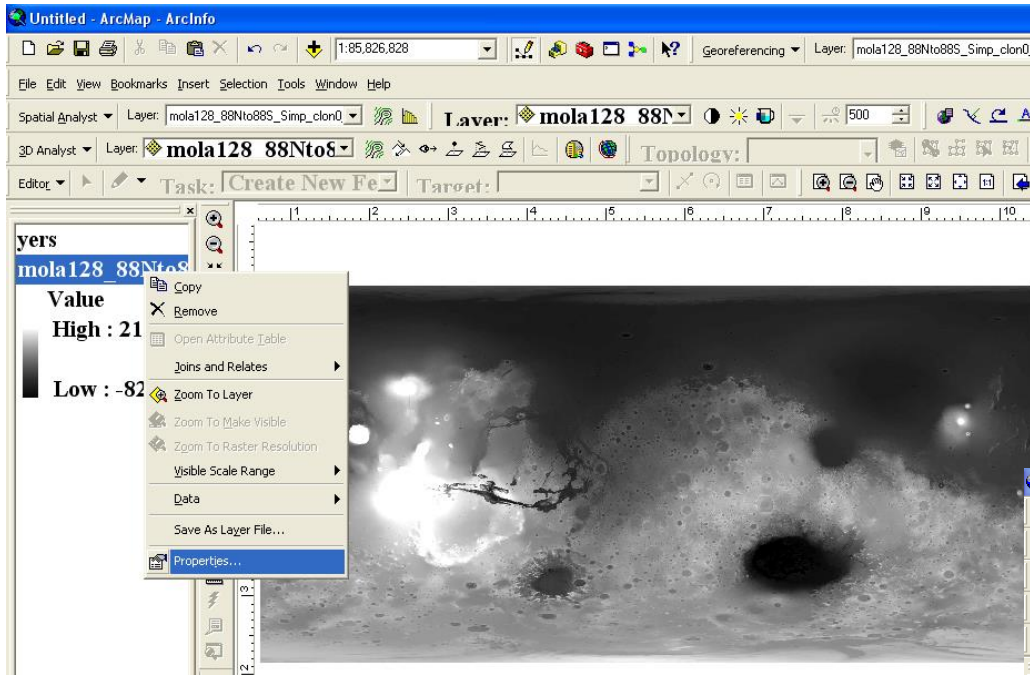
EXTRAS folder consists of **areo-refenced image (*.TIF) and SPICE related parameters for set-1 in this study**

Base map Preparation in ARC GIS software

- 1) Loading of global MOLA topography data using Add Data button
(for Seamless compatibility over various data source)

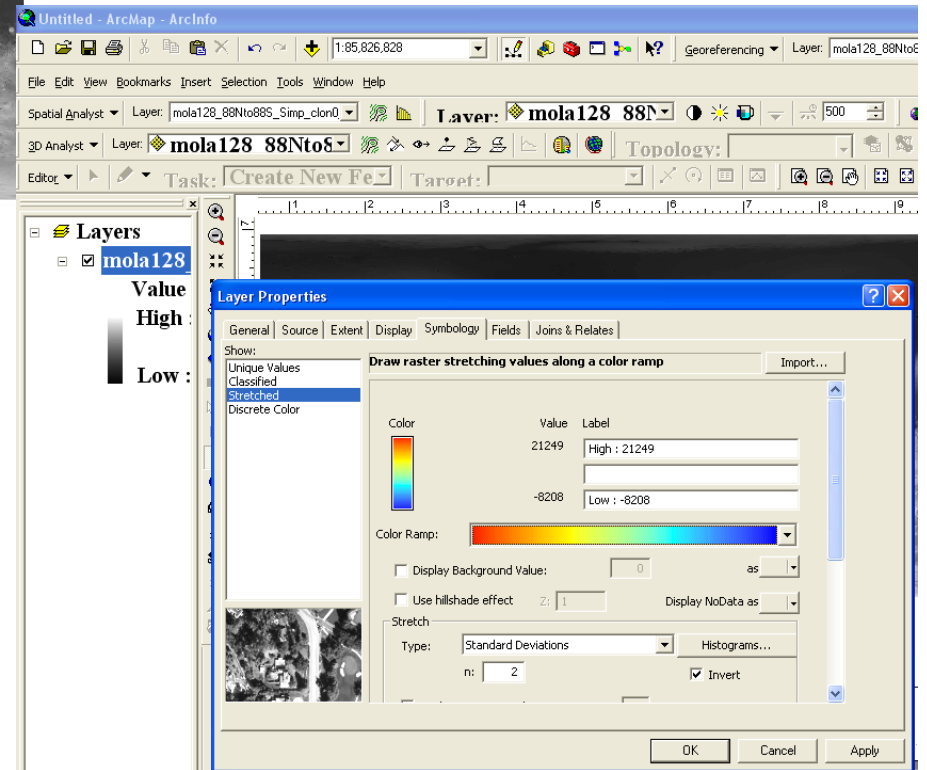


2) Changing color palette of topography map

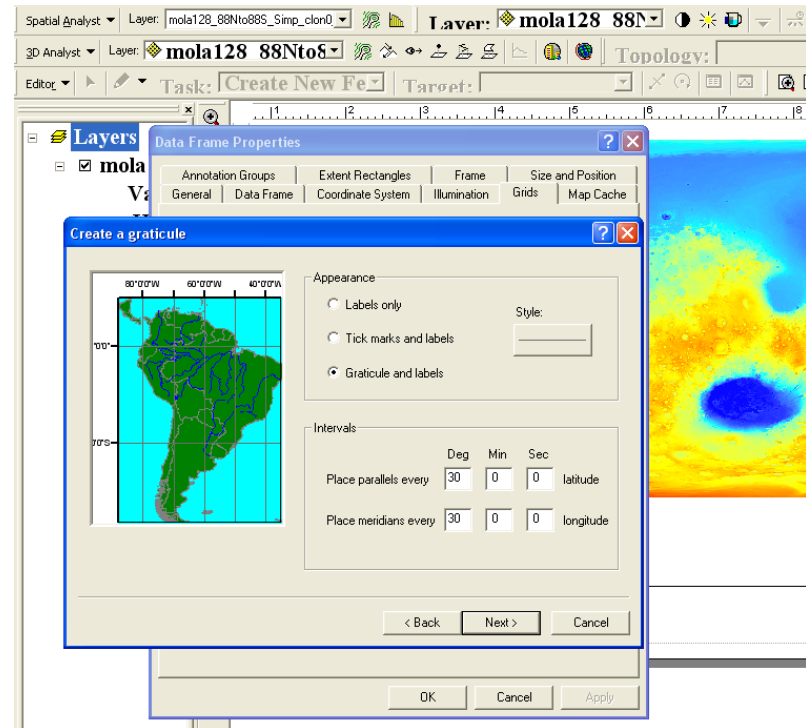
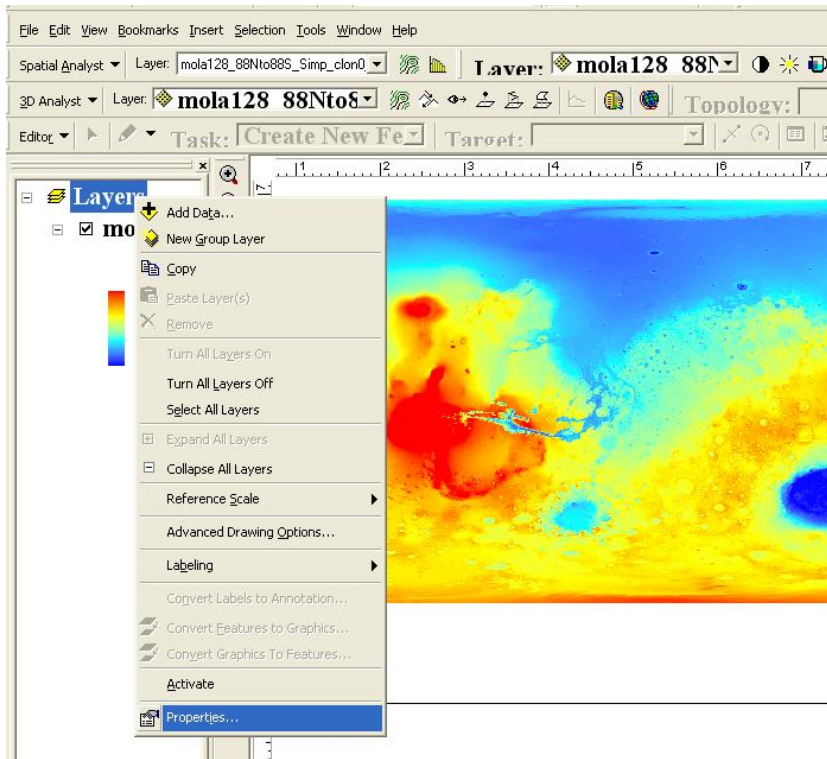


Right click on "MOLA topography" layer

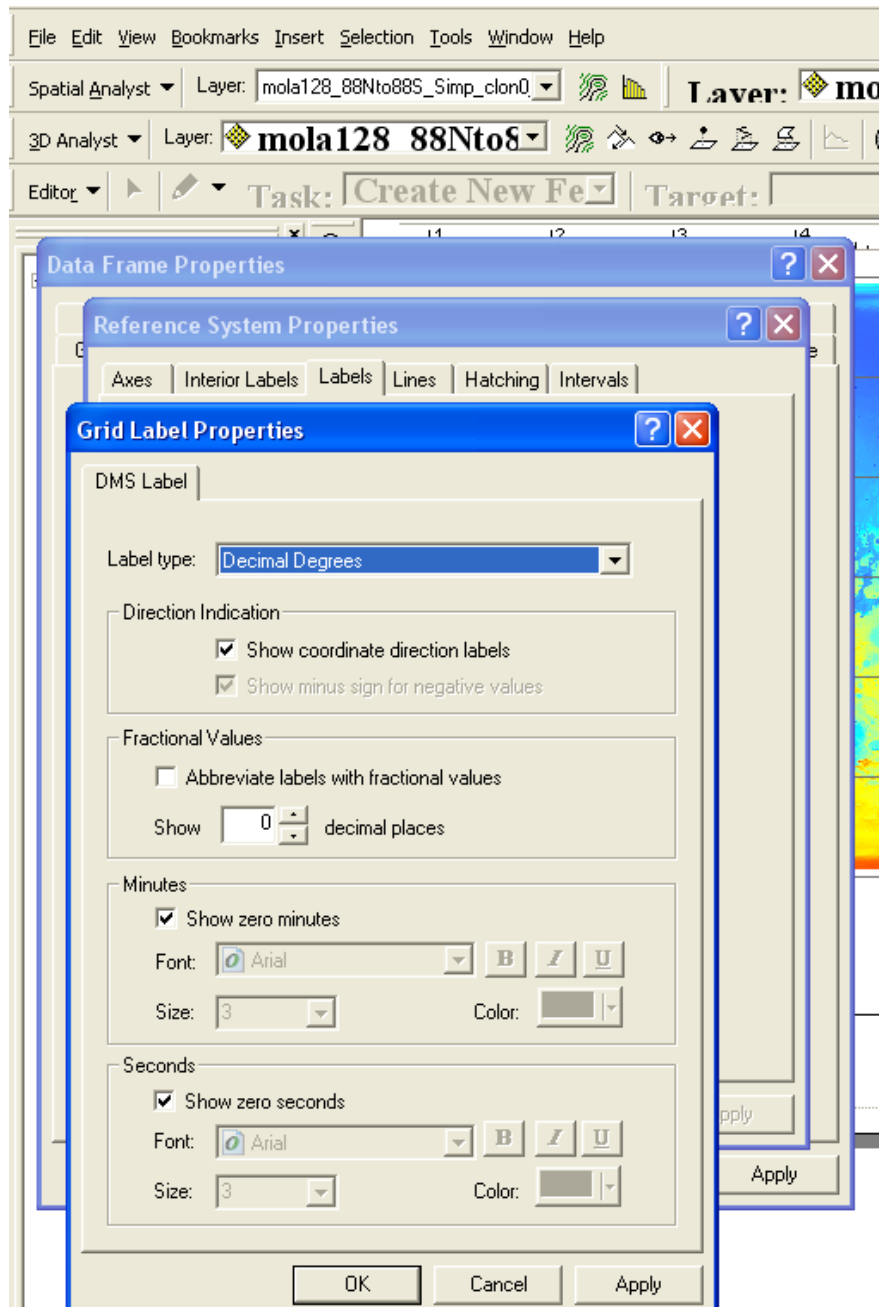
Select the color palette



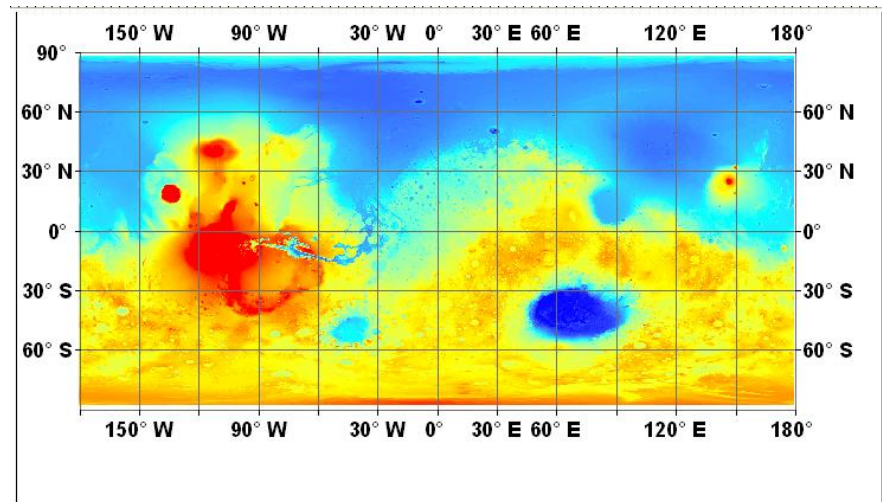
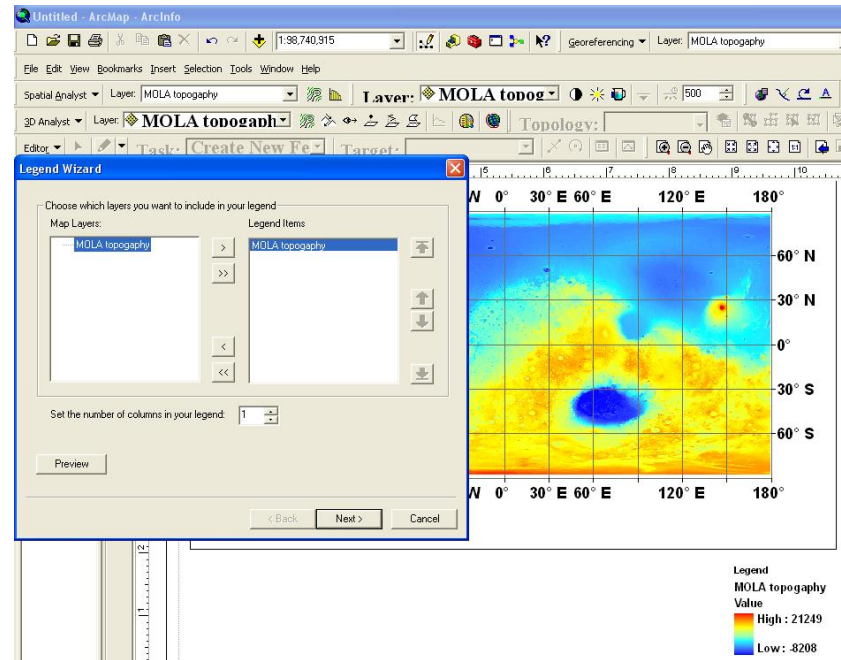
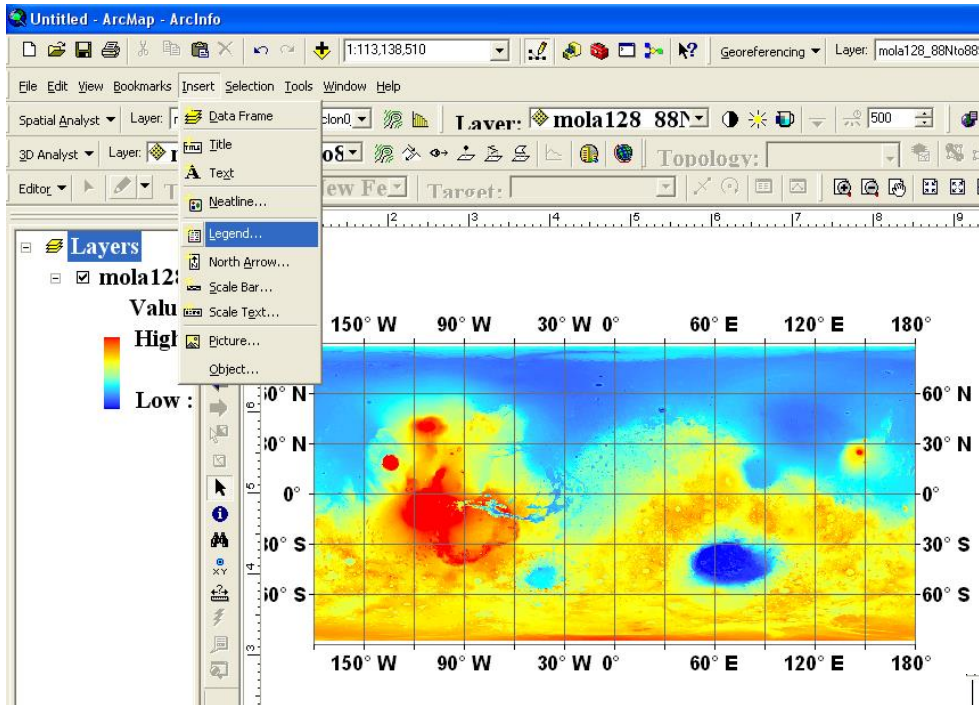
3) Adding Grid lines and annotations to map



Changing the style of annotations/Labels of map



Adding Legend to map



Adding MCC data set-1 to map

Table of Contents

- Layers
 - ☑ mola128 88Nto88S Simp clon0 lossless.ip2

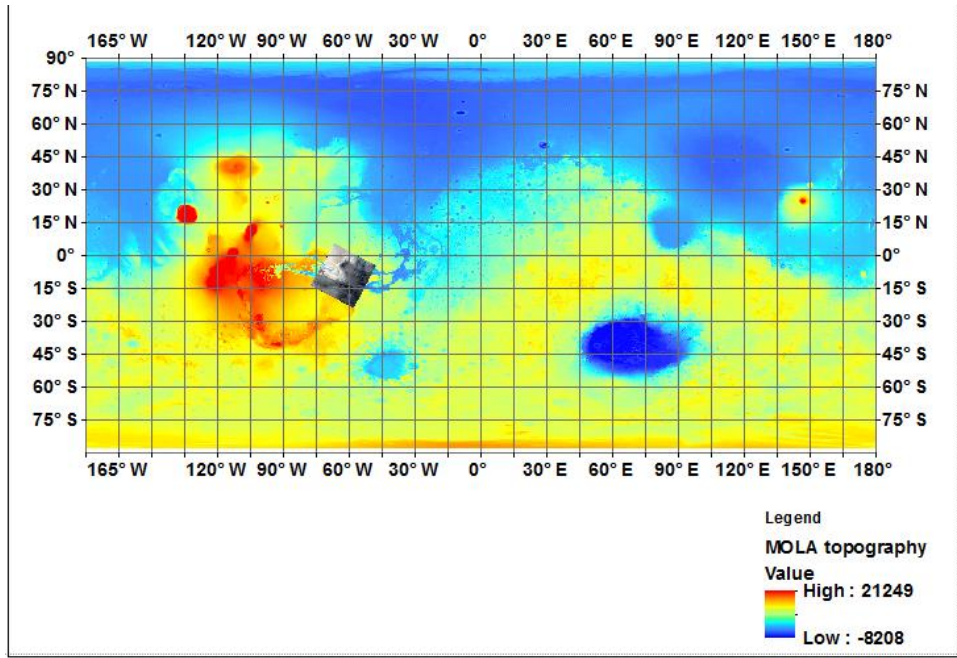
Add Data

Look in: 201411

- MCC_MRR_20141110T172436240_G_GDS.LBL
- MCC_MRR_20141110T172436240_G_GDS.TIF

Name: MCC_MRR_20141110T172436240_G_GDS.TIF Add

Show of type: Datasets, Layers and Results Cancel



Layer Properties

General Source Key Metadata Extent Display Symbology

Show: Vector Field Stretched RGB Composite

Draw raster as an RGB composite

Channel	Band
<input checked="" type="checkbox"/> Red	Band_1
<input checked="" type="checkbox"/> Green	Band_2
<input checked="" type="checkbox"/> Blue	Band_3
<input type="checkbox"/> Alpha	1

Display Background Value: (R, G, B) 0 0 0 as []

Display NoData as []

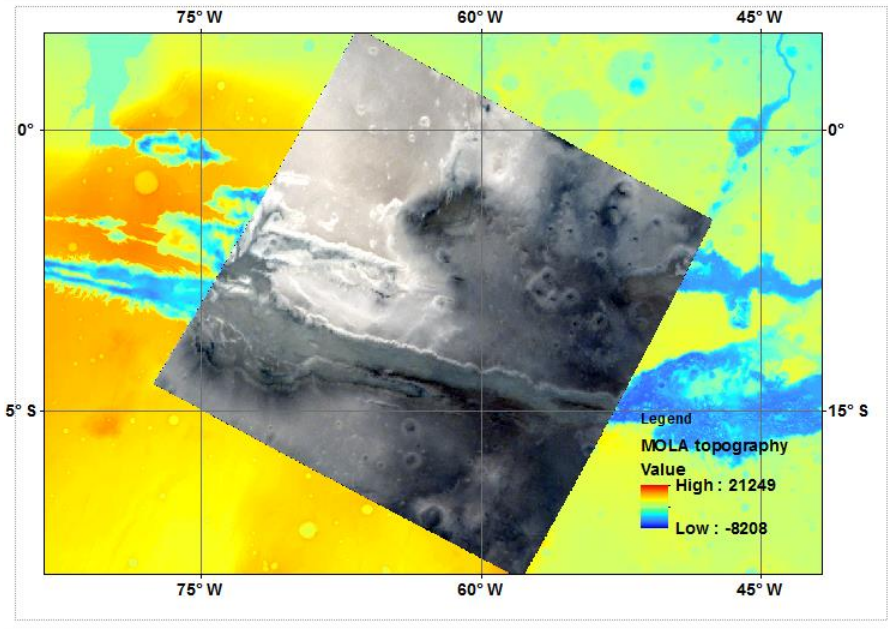
Stretch Type: Standard Deviations Histograms...

n: 2.5 Invert

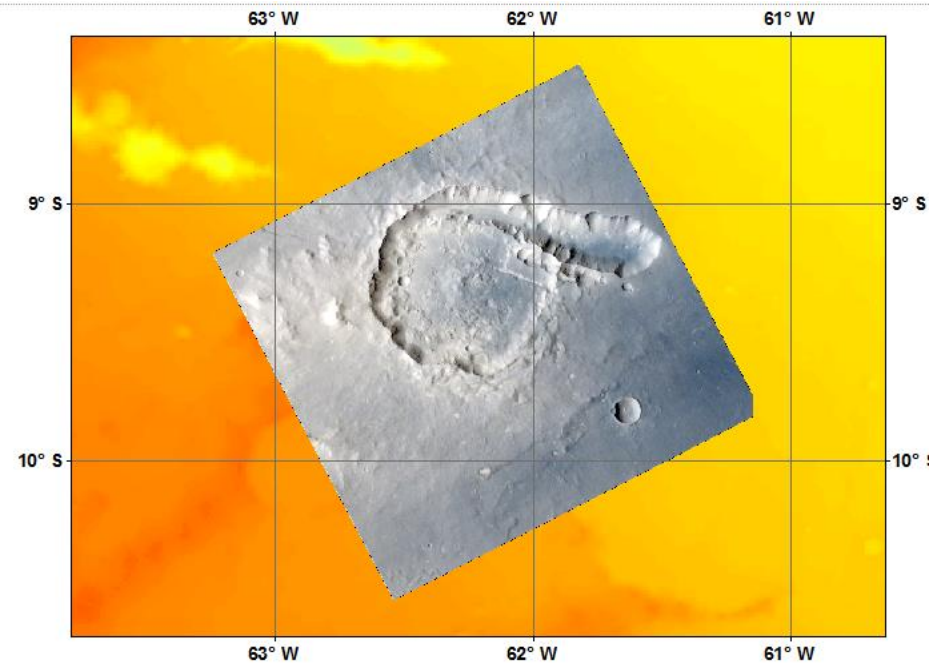
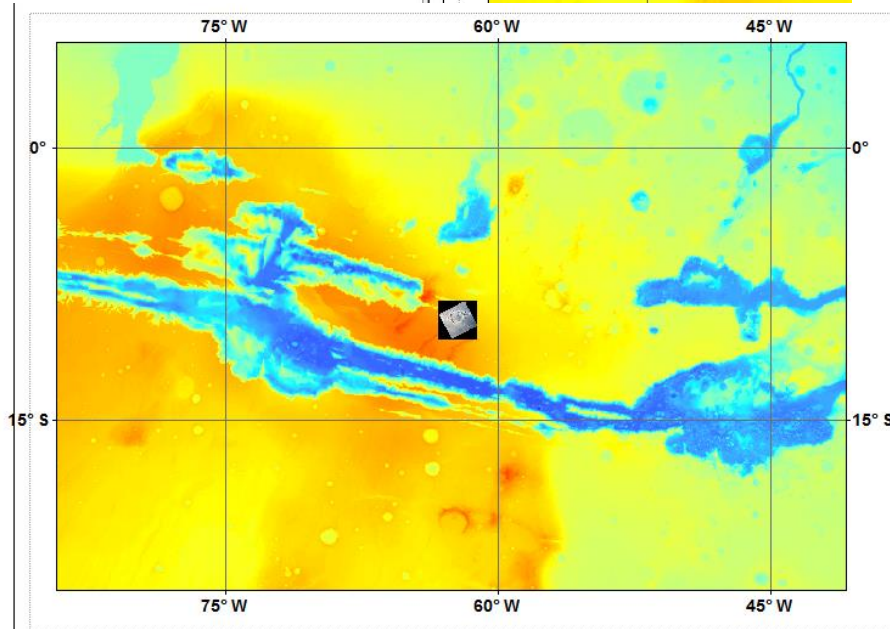
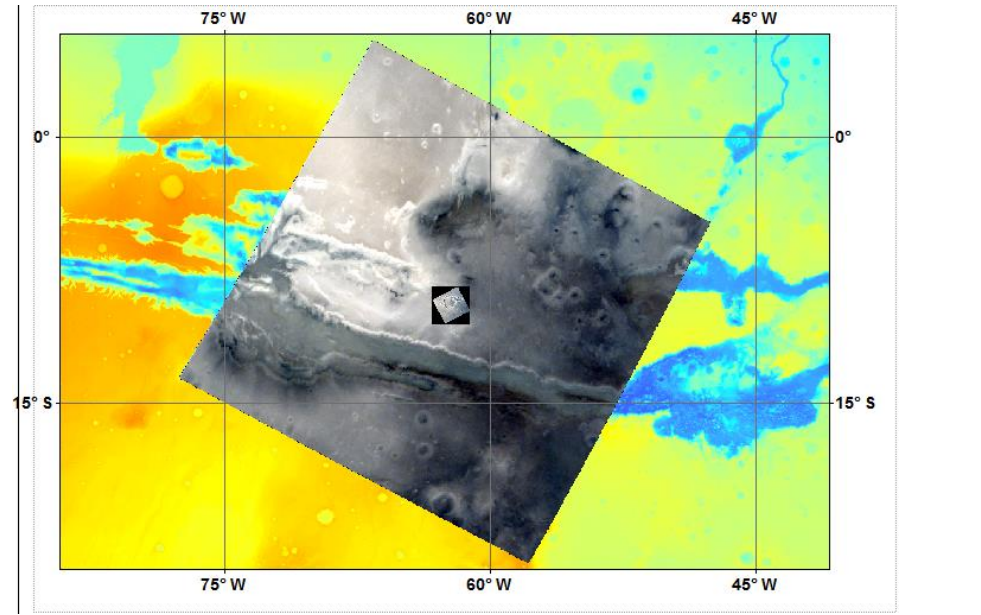
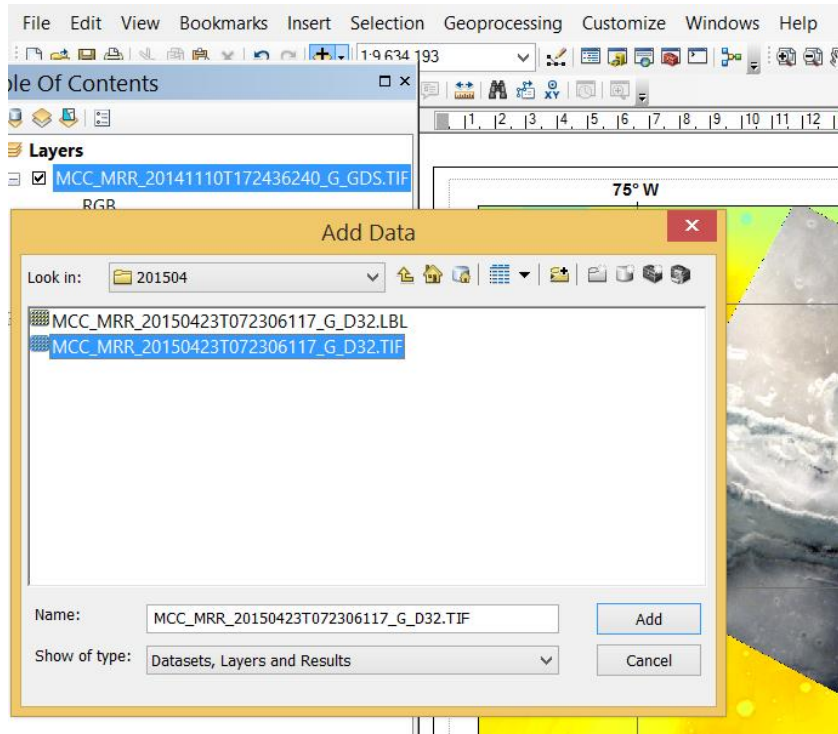
Apply Gamma Stretch: 1.37672 1.37672 1.37672

Statistics: From Each Raster Dataset

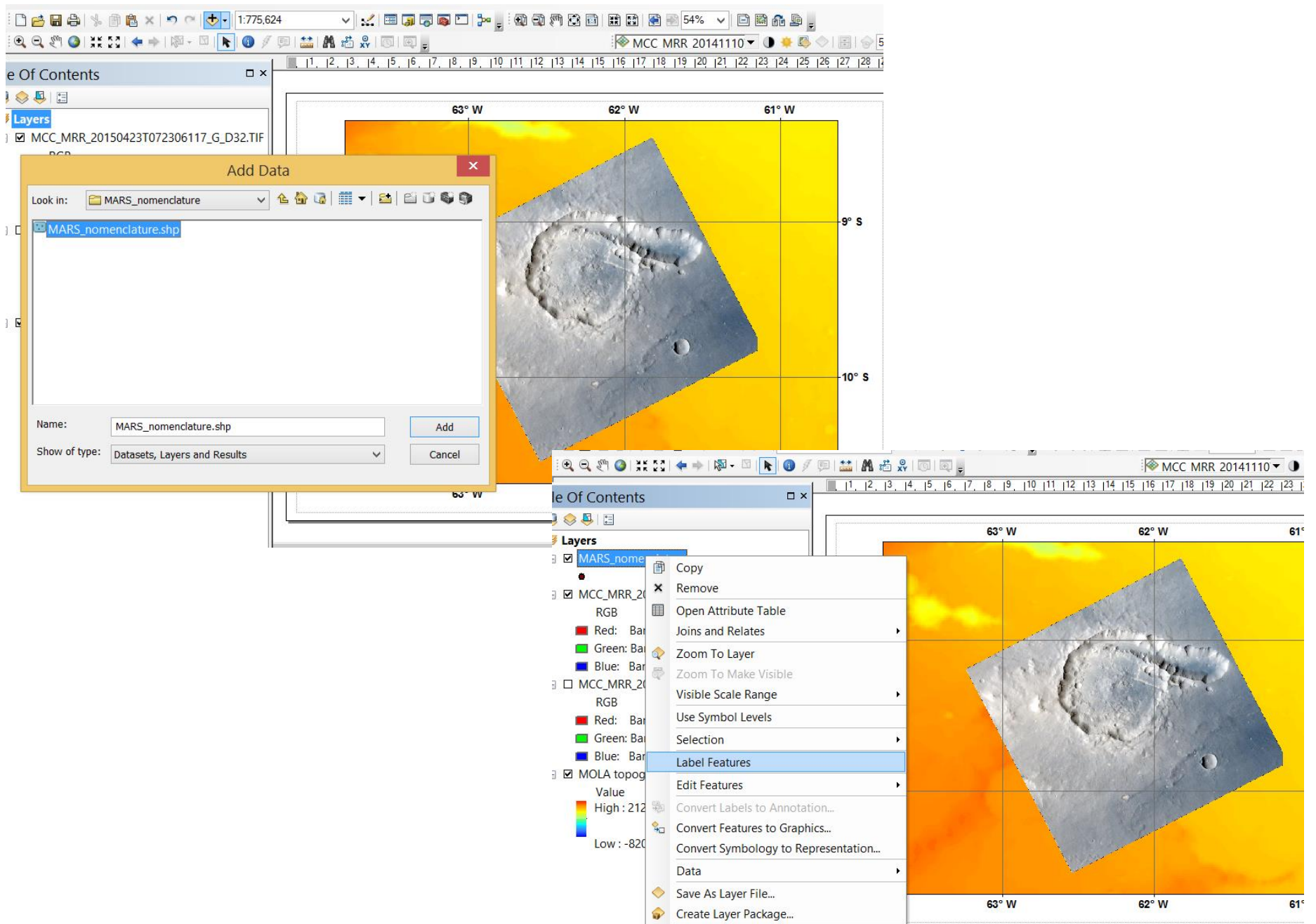
Red Green Blue



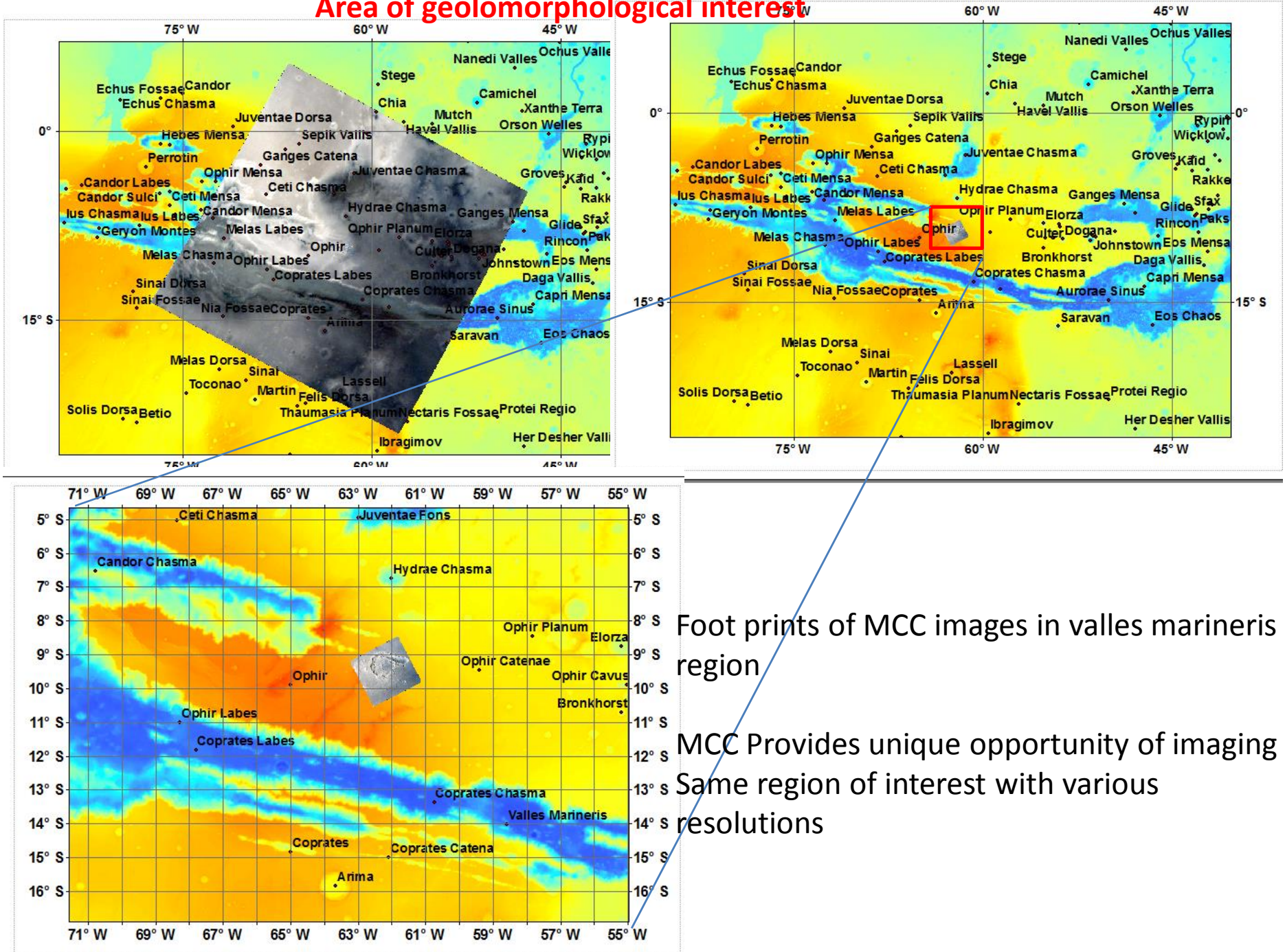
Adding MCC data set-2 of high spatial resolution



Adding Mars Nomenclature file to map



Area of geomorphological interest



Foot prints of MCC images in valles marineris region

MCC Provides unique opportunity of imaging Same region of interest with various resolutions

MARS_nomenclature
 MCC_MRR_20150423T072306117_G_D32.TIF
 MCC_MRR_20141110T172436240_G_GDS.TIF
 RGR

Layer Properties
 General Source Key Metadata Extent Display Symbology

Show MapTips
 Display raster resolution in table of contents
 Allow interactive display for Effects toolbar

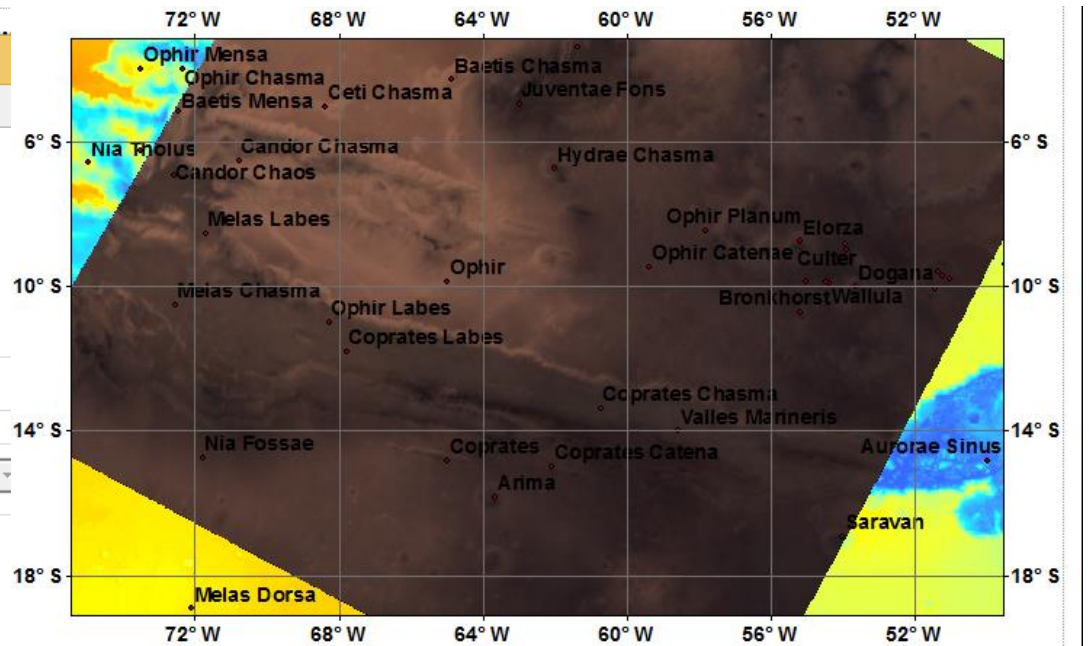
Resample during display using:
 Nearest Neighbor (for discrete data)

Contrast: %
 Brightness: %
 Transparency: %

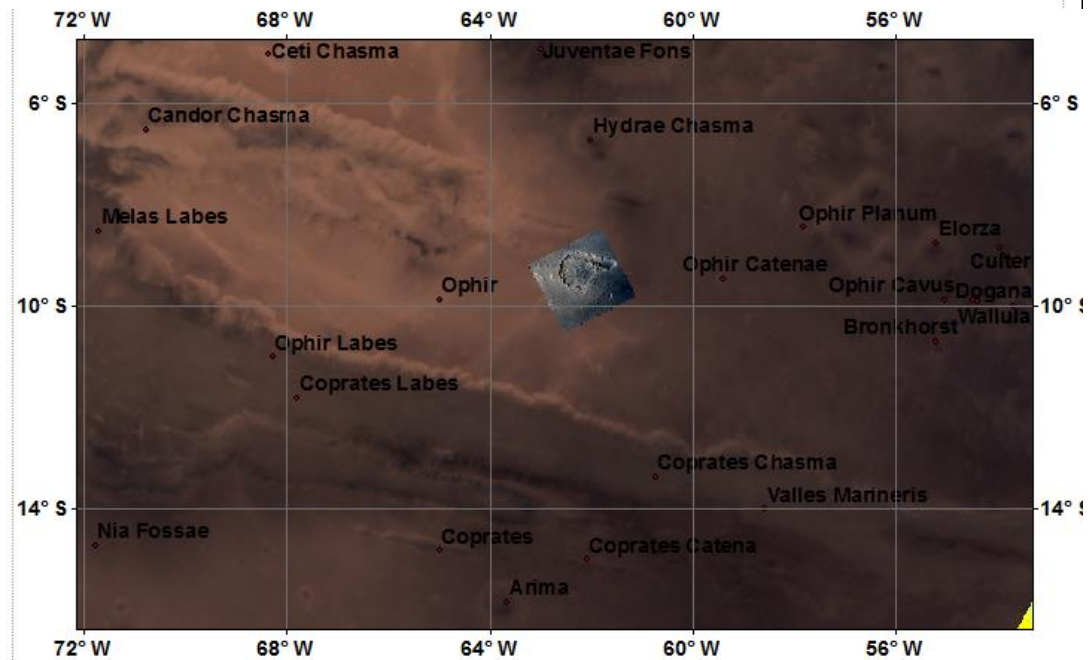
Display Quality
 Coarse Medium Normal

Orthorectification
 Orthorectification using elevation
 Constant elevation:
 DEM:

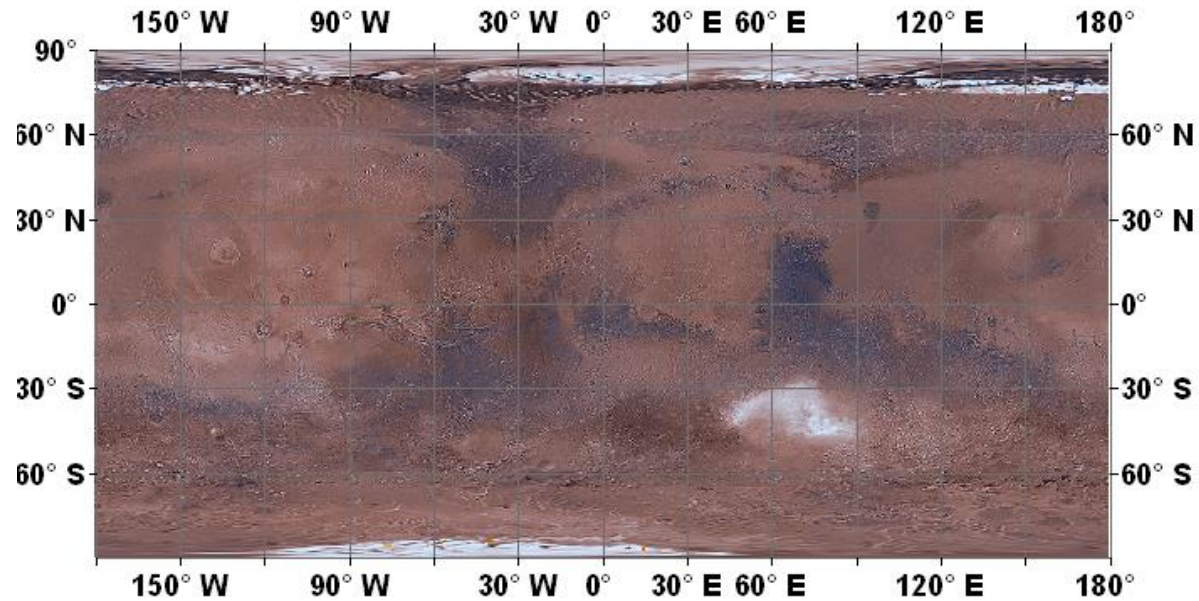
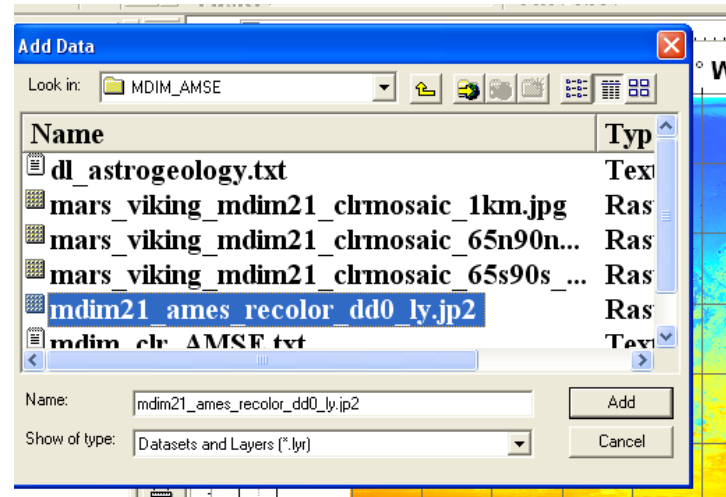
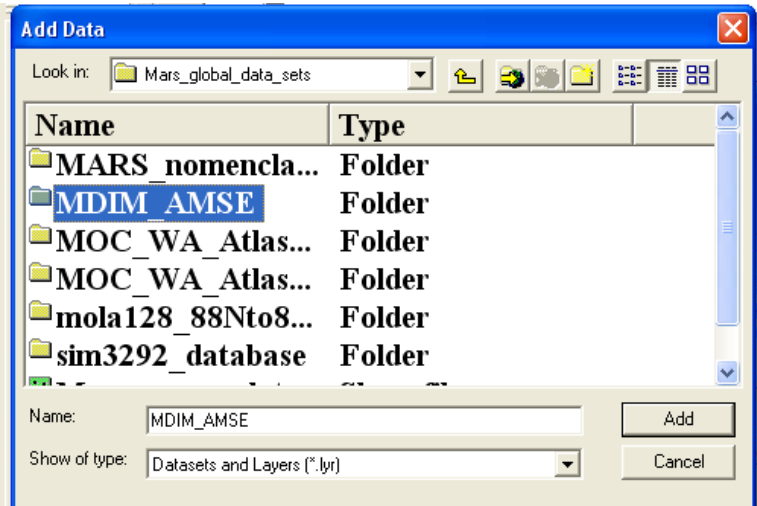
Elevation adjustment
 Z factor:
 Z offset:
 Geoid:



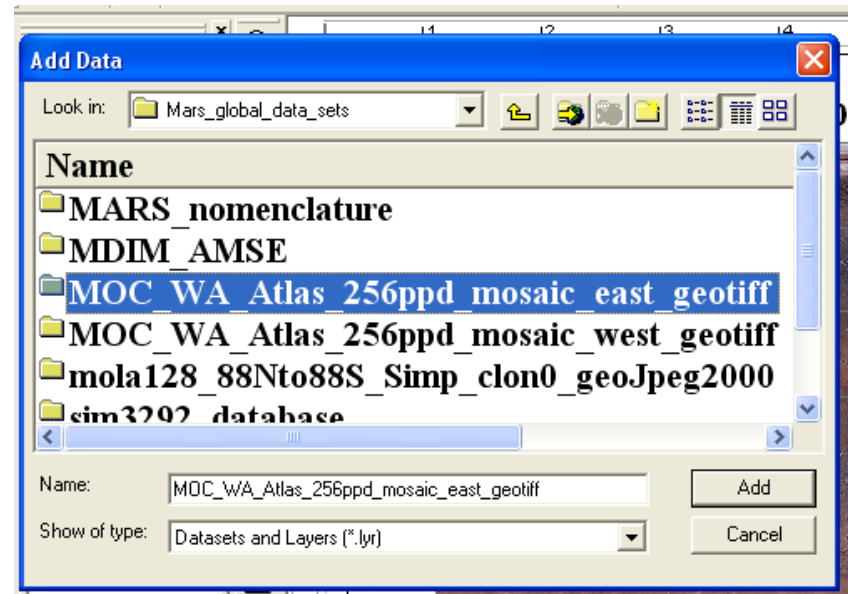
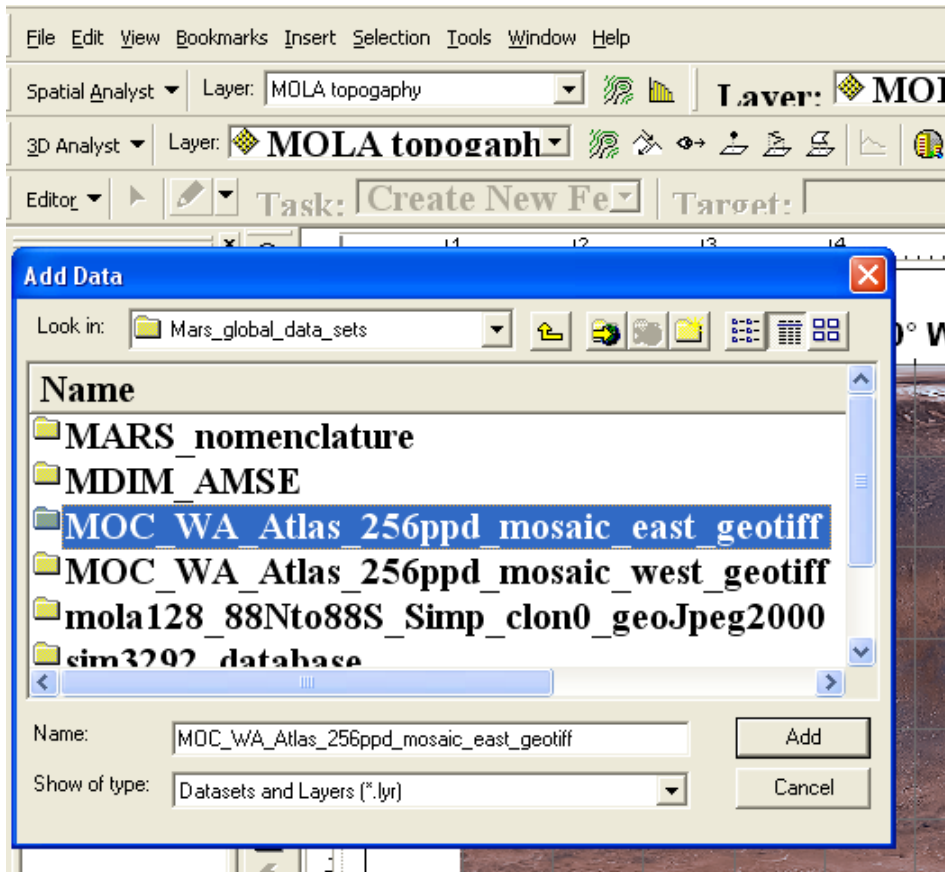
Enhance / Contrast controls

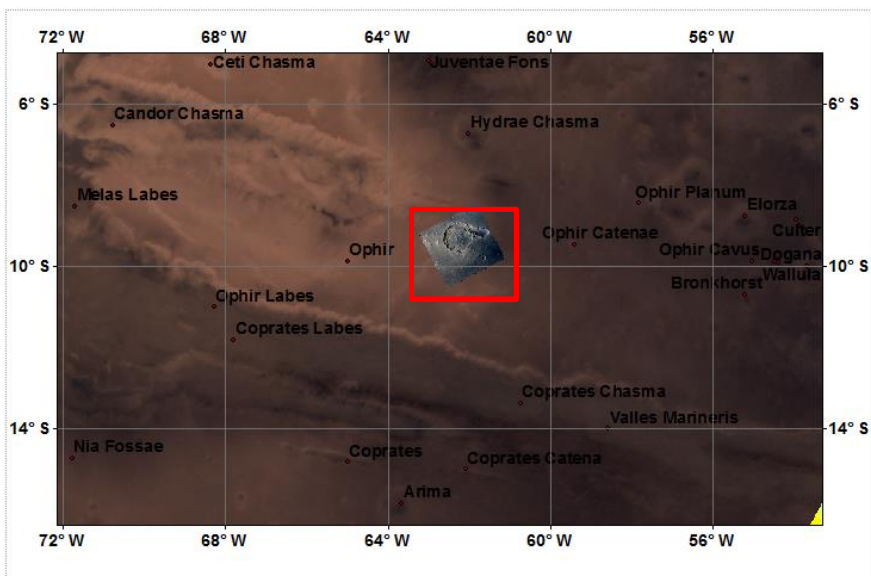


Adding “Mars Digital Image Mosaic” (MDIM-2.1) as a reference image

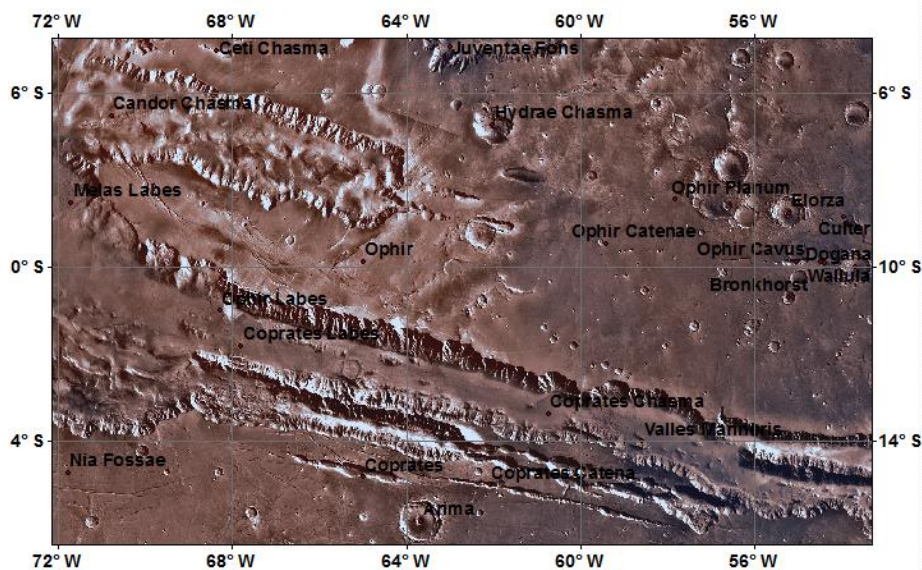


Loading MOC-WA data in ARCMAP as a reference image

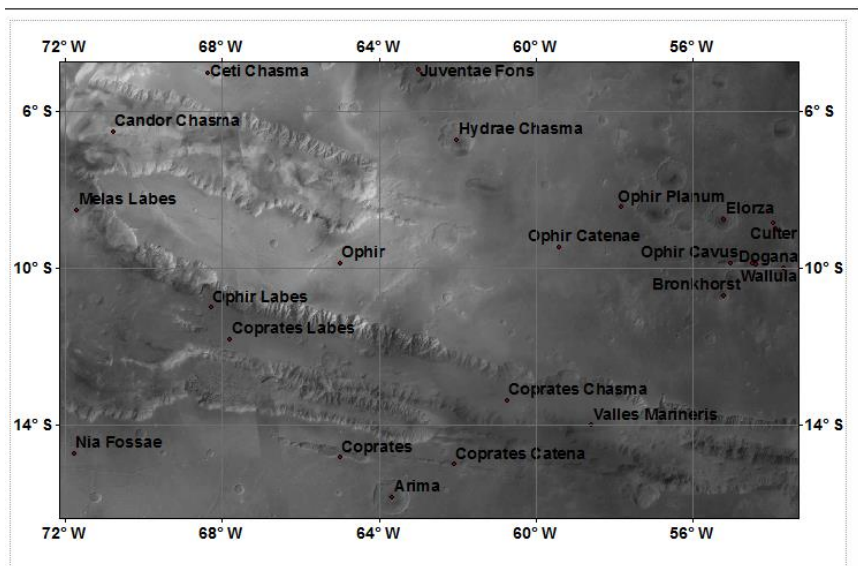




MCC: 623 meter, 44 m/pixel



MDIM: 231 m/pixel



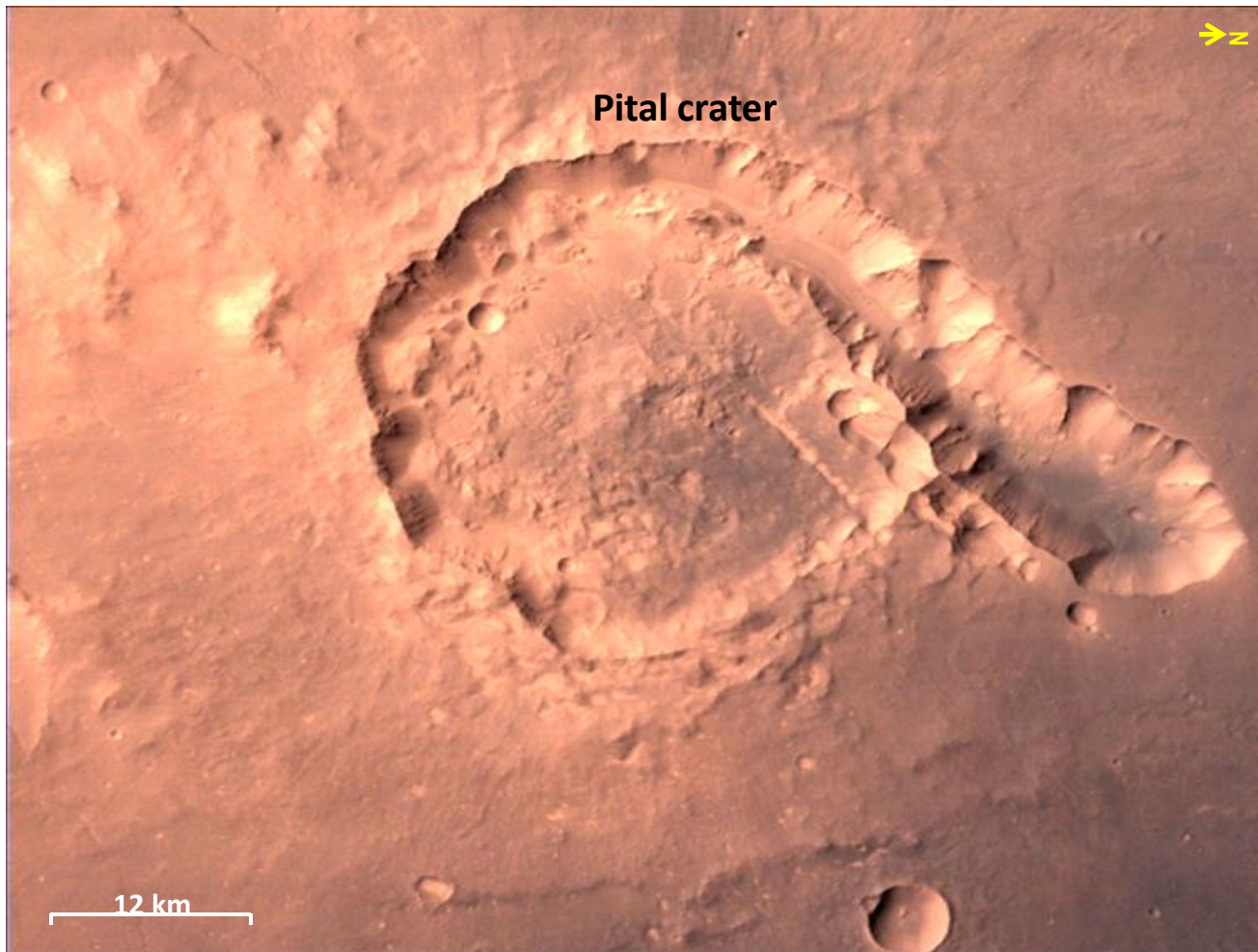
MOC: resolution 231 meters

Creating shapefiles (Polygons) for digitization of areas from MCC, MOC, MDIM images using Arc catalogue

The image illustrates the workflow for creating shapefiles in ArcGIS:

- Arc Catalogue:** Shows a project workspace with a folder named 'Gale-MCC-LTA-DATA'. A red box highlights the 'New' button in the toolbar.
- Create New Shapefile Dialog:** The 'Name' is 'MCC_roi' and the 'Feature Type' is 'Polygon'. The 'Spatial Reference' is currently 'Unknown Coordinate System'.
- Spatial Reference Properties Dialog:** Shows the 'XY Coordinate System' set to 'Unknown'. The 'Details' section is empty. The 'Import...' button is highlighted with a red arrow.
- Browse for Dataset Dialog:** Shows a list of datasets. The dataset 'mola128_68Nto88S_Simp_clon0_0' is selected.
- Create New Shapefile Dialog (MOC):** The 'Name' is 'MOC_roi' and the 'Feature Type' is 'Polygon'. The 'Spatial Reference' is 'Unknown Coordinate System'.
- Spatial Reference Properties Dialog (MOC):** Shows the 'XY Coordinate System' set to 'Mars2000_equicylindrical_clon0'. The 'Details' section contains projection parameters: 'Projection: Plate_Carree', 'false_easting: 0.000000', 'false_northing: 0.000000', 'central_meridian: 0.000000', 'latitude_of_origin: 0.000000', 'Linear Unit: Meter (1:000000)'. The 'Import...' button is highlighted with a red arrow.
- Create New Shapefile Dialog (MDIM):** The 'Name' is 'MDIM_roi' and the 'Feature Type' is 'Polygon'. The 'Spatial Reference' is 'Projected Coordinate System'. The 'Description' section contains: 'Projected Coordinate System: Name: Mars2000_equicylindrical_clon0' and 'Geographic Coordinate System: Name: GCS Name = GCS_Mars_2000_Sphere/Datum = M'. The 'Import...' button is highlighted with a red arrow.

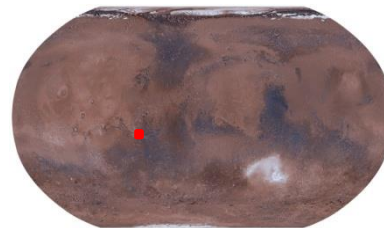
High resolution image of Pital crater in Ophir Planum region



Pital crater is an impact crater having a diameter of ~40 km and located at 9°S, 62°W.

Wall of the crater and chain of small impact craters are clearly seen in this image.

Date of Acquisition: 23-04-2015
Space craft Altitude: 800 km
Spatial resolution: 44m.



High resolution images of Impact crater SE of Bernard crater in Terra Sirenum region

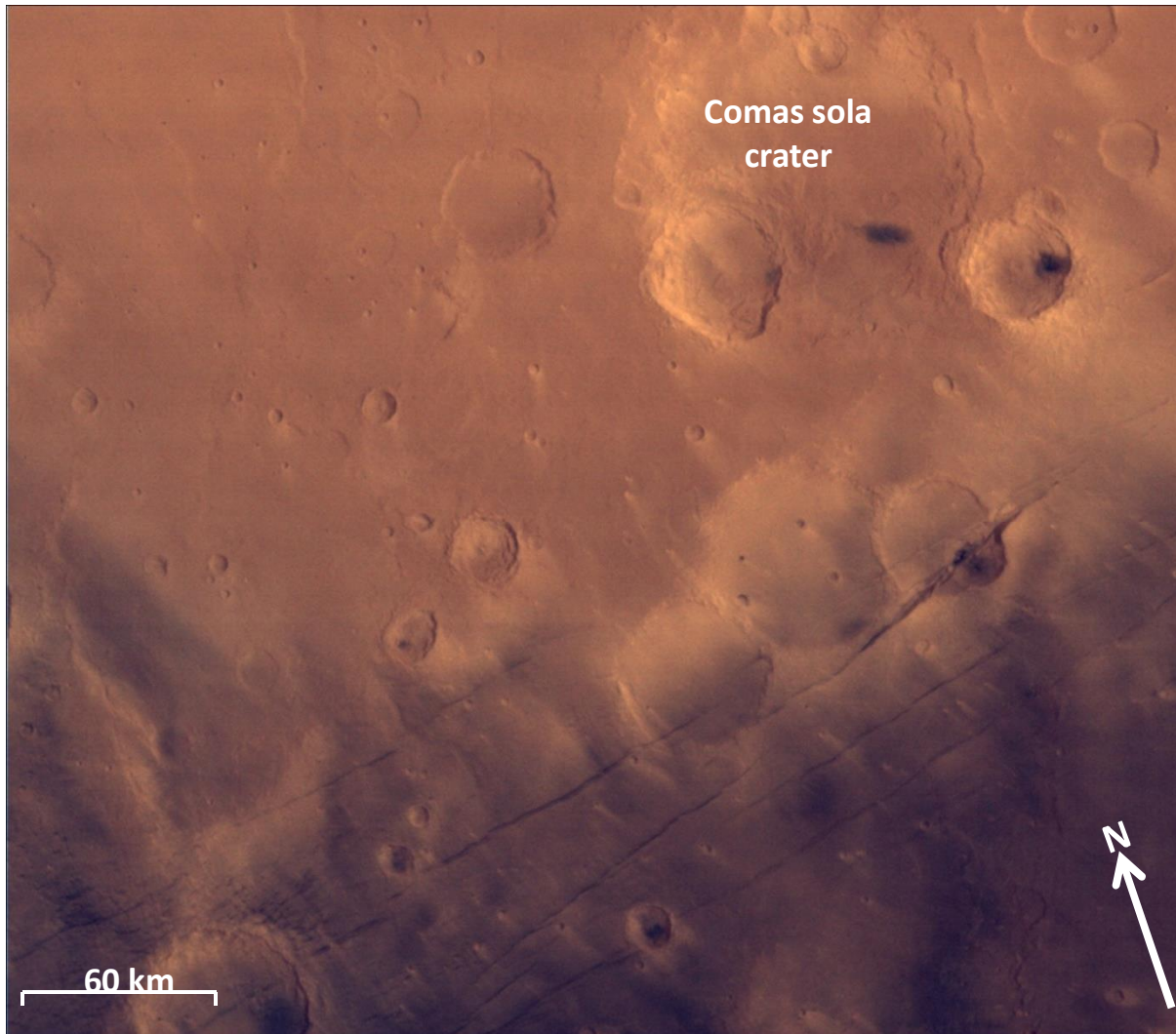


A concentric crater (1) super imposed over graben is also seen in this high resolution image. The relative position of this crater with respect to graben indicates that crater is younger than graben system. Larger crater having the diameter of 6 km. Three NE-SW trending grabens, and craters of various dimensions are clearly seen in this image. Part of regional graben system (2) of length 600 km is seen in this image.

Date of Acquisition: 13-03-2015
Space craft Altitude: 442 km
Spatial resolution: 23m.

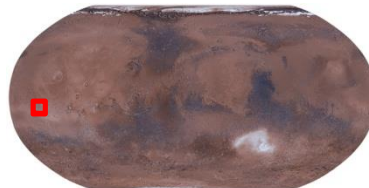


Tectonic features: Regional faults cutting across craters in the Region around Comas Sola crater

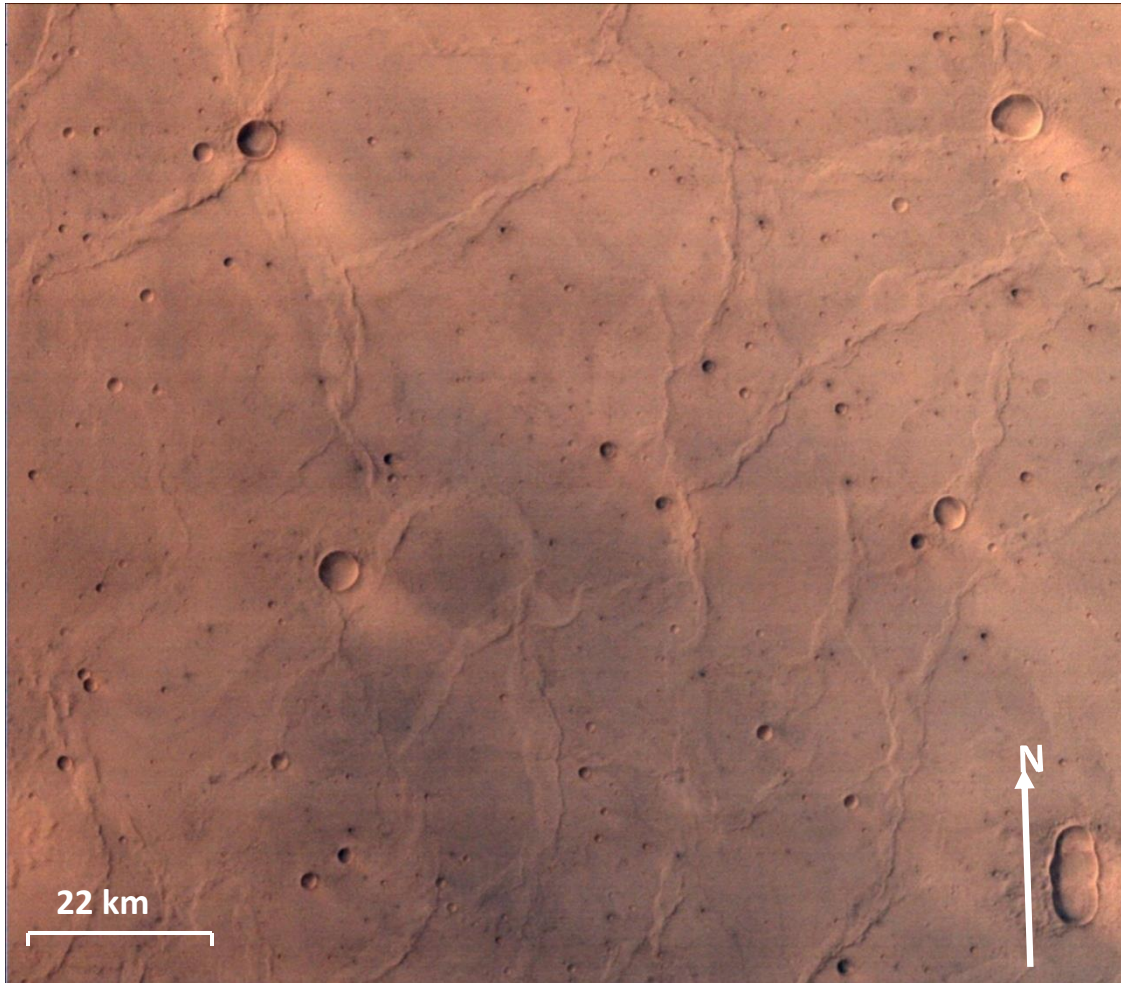


A set of regional faults cutting across various craters, south of Comas sola crater are seen clearly in this image. Craters of various dimensions and wind streaks in bottom right side portion of the image are also clearly seen.

Date of Acquisition: 13-03-2015
Space craft Altitude: 3453 km
Spatial resolution: 179 m



Tectonic features: Wrinkle ridges Hesperia Planum region

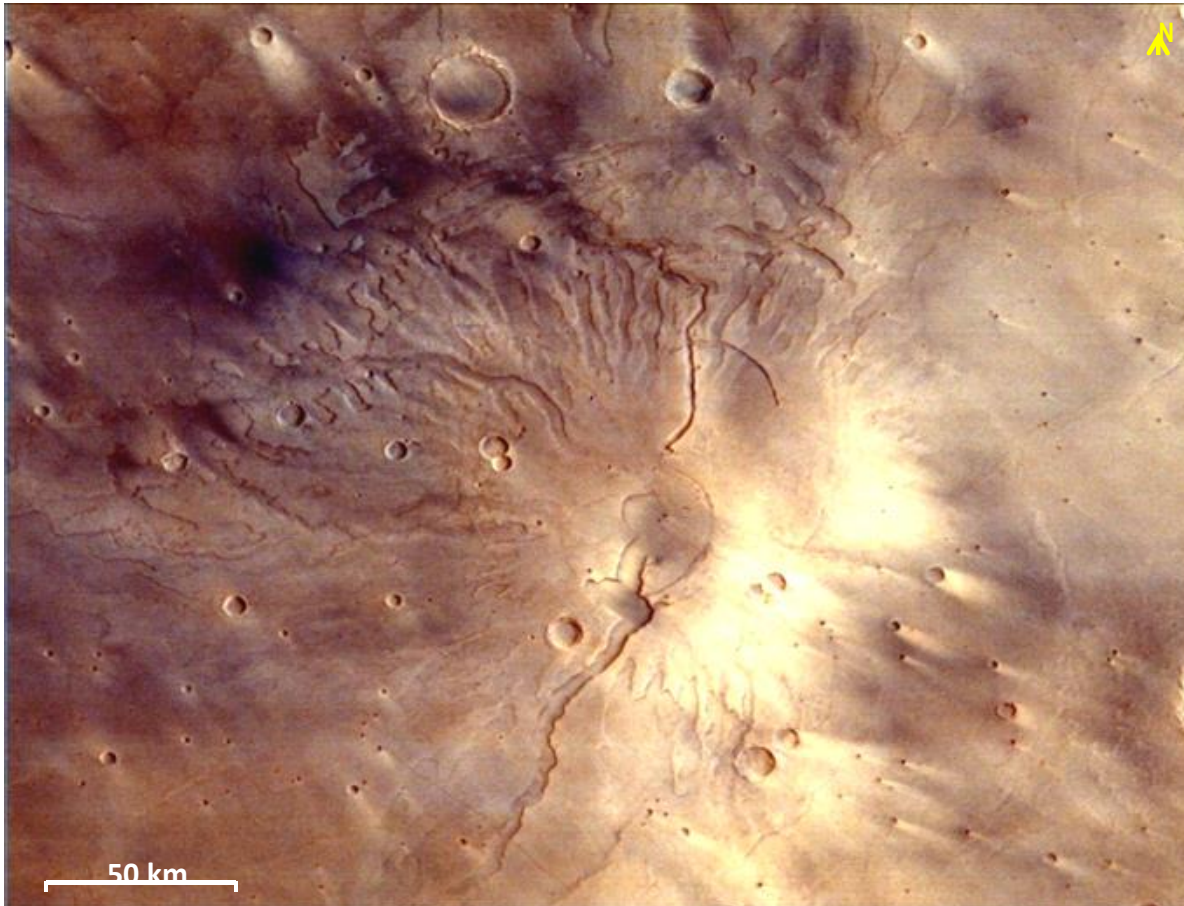


Wrinkle ridges and craters of smaller diameters are clearly seen in this image. Wrinkle ridges on planetary surface are formed due to compressional stress regime. Ridge means linear/ curvilinear elongated raised structure.

Date of Acquisition: 31-01-2015
Space craft Altitude: 1132km.
Spatial resolution: 58m



Volcanic features: Tyrrhenus Mons Hesperia Planum region



Tyrrhenus Mons is a volcano present in the Hesperia planum, located at $\sim 21^{\circ}\text{S}$, 106°E on Mars. Tyrrhenus Mons is having base diameter $\sim 269\text{ km}$.]

Volcanism in Tyrrhenus Mons region occurred around ~ 3.9 billion years ago. Concentric fractures systems seen in the MCC images are possibly formed by extensional stresses within the surface of Mars.

Impressions of wind streaks can also be seen in this image.

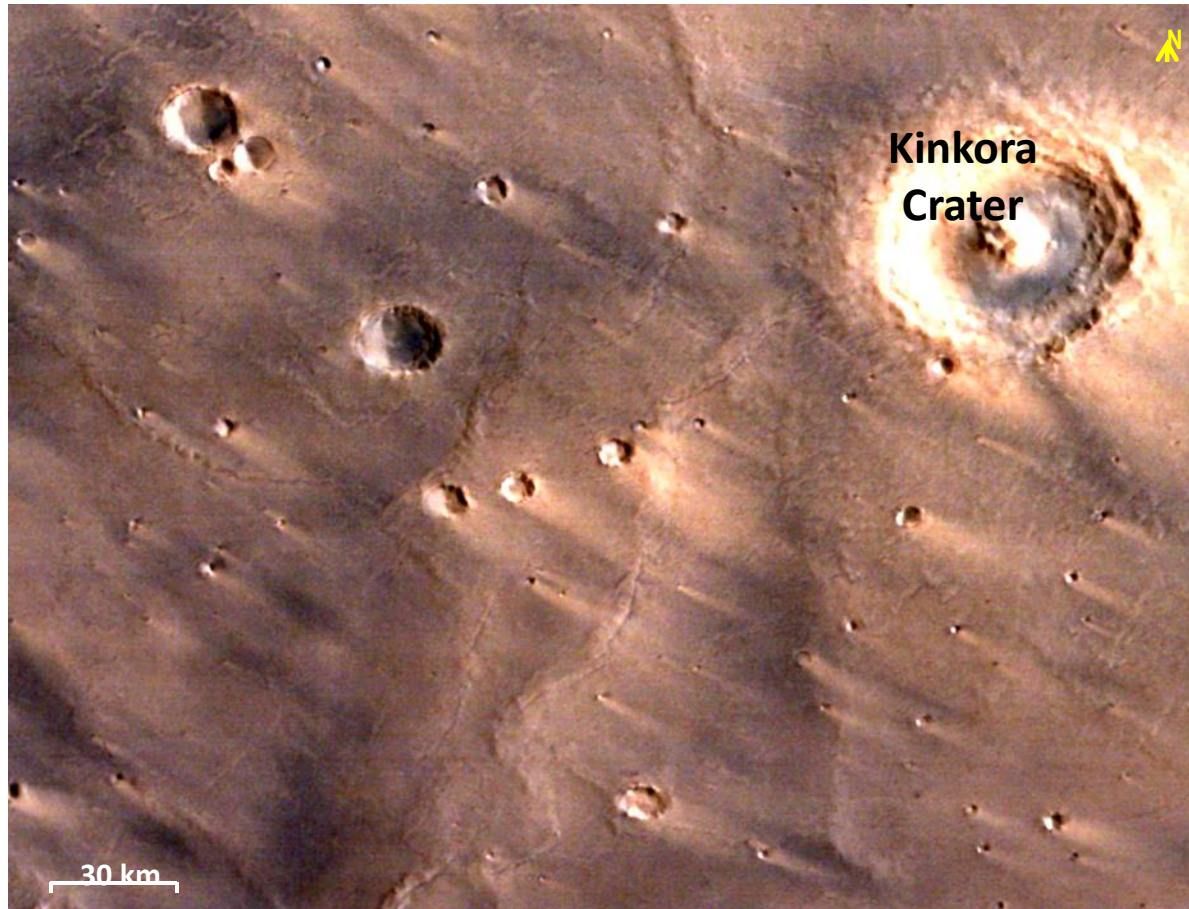
Date of Acquisition: 25-02-2015

Space craft Altitude: 3192 km.

Spatial resolution: 166 m



Image of Wind streaks near to Kinkora crater observed by MCC

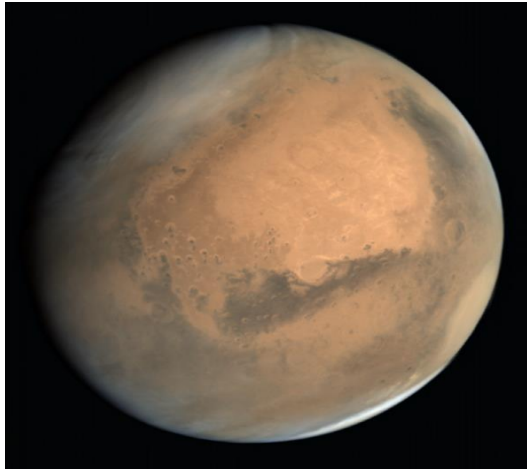


Wind streaks aligned along NW-SE direction are seen in this image. NE-SW aligned wrinkle ridge system to the west of Kinkora crater is also seen in this image.

Date of Acquisition: 16-02-2015
Space craft Altitude: 2286 km
Spatial resolution: 119 m
Location: 25⁰S, 112⁰ E.



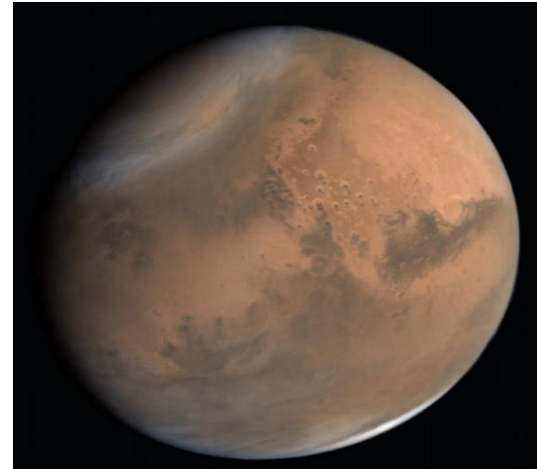
Global views of Mars captured during apo-imaging



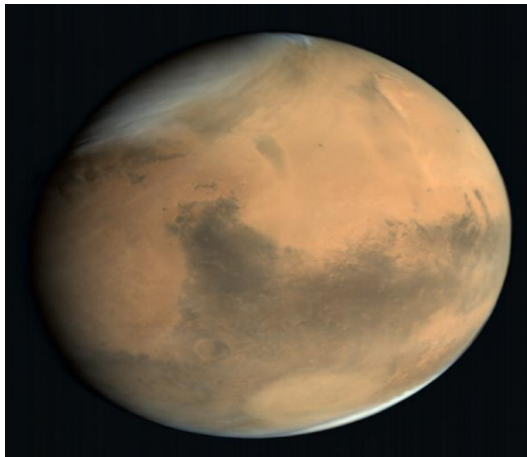
28-09-2014



30-09-2014



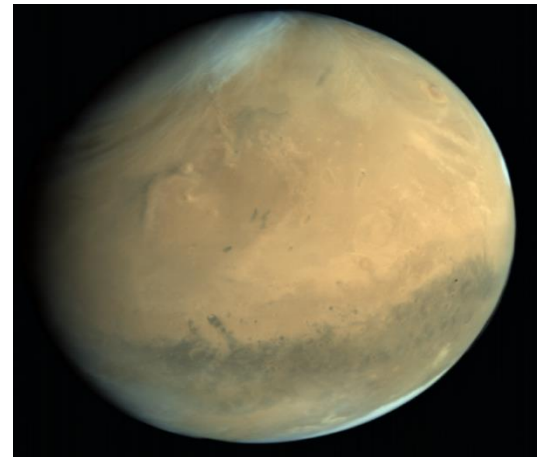
1-10-2014



4-10-2014



4-10-2014



7-10-2014

Thank You

Remote sensing data sets of Mars

sno	Instrument	horizontal resolution	DEM vertical resolution	Satellite/Mission	Mission launch date	Martian orbit	Coverage
1	Mars Orbiter Laser Altimeter	128 pixel per degree (460 m) for equatorial regions	1m	Mars Global Surveyor	07-Nov-96	March,1999-june30,2001)	Full globe coverage
2	Viking Orbiter 1,2 Digital image mosaics	925 meters/pixel		Viking Orbiter		1976-1980	part of the globe
3	Mars Orbiter Camera (MOC) Wide angle camera	red and blue wide angle cameras for context (240 m per pixel)		Mars Global Surveyor	07-NOV-96	September 1997 and November 2006	Full globe coverage
3	Mars Orbiter Camera (MOC) Narrow angle camera	grayscale (black-and-white) high resolution images (typically 1.5 to 12 m per pixel)		Mars Global Surveyor	07-NOV-96	September 1997 and November 2006	Full globe coverage
4	High resolution Stereo Camera (HRSC) Digital Elevation Model (DEM)	Ortho images:12.5/25/50m; DTM: 50m/75m/100m	1 m	Mars Express	02-07-2003	December,2003 to till date	part of the globe
5	High resolution Imaging Science Experiment (HiRISE)	images:25-30 cm/pixel DTM: 50m/pixel	1m	Mars Reconnaissance Orbiter	12-Aug-05	Dec. 7, 2006 till date	part of the globe
6	Compact Reconnaissance Imaging Spectrometer from Mars (CRISM)	18m/pixel		Mars Reconnaissance Orbiter	12-Aug-05	Dec. 7, 2006 till date	Part of the Globe

Viking MDIM2.1 Colorized Global Mosaic 232m

This global image map of Mars has a resolution of 256 pixels/degree (scale approximately 231 m/pixel at the equator). The colorized mosaic was completed by NASA AMES which warped the original Viking colorized mosaic and blended over the latest black/white mosaic (MDIM 2.1). The positional accuracy of features in MDIM 2.1 is estimated to be roughly one pixel (200 m), compared to 3 km for MDIM 2.0 released in 2001 and >6 km for MDIM 1.0 released in 1991

Details of Global data sets of Mars

MGS MOC WA Atlas Mosaic (MSSS)

This mosaic was generated by MSSS and ASU using Mars Global Surveyor (MGS) Mars Orbiter Camera (MOC) Wide Angle red images.

For more details see:

ftp://pdsimage2.wr.usgs.gov/pub/pigpen/mars/moc/msss_atlas_ocentric/MOC_WA_Atlas_256ppd_readme.txt

Data Source:

<ftp://pdsimage2.wr.usgs.gov/pub/pigpen/mars/moc/>

MGS MOLA Shaded Relief

This is a shaded relief map from Mars Global Surveyor (MGS) MOLA instrument.

Data Source:

ftp://pdsimage2.wr.usgs.gov/pub/pigpen/mars/mola/Colorshade_global_megt128ppd_merged64ppd/

MGS MOLA Topography (Goddard)

This basemap layer was generated from Mars Global Surveyor (MGS) MOLA instrument data. For more details see:

ftp://pdsimage2.wr.usgs.gov/pub/pigpen/mars/mola/mola128_88Nto88S_Simp_clon0.txt

Data Source:

ftp://pdsimage2.wr.usgs.gov/pub/pigpen/mars/mola/mola128_88Nto88S_Simp_clon0.zip

MGS TES Global Albedo

This basemap layer is a Mars Global Surveyor (MGS) TES bolometric albedo global map by Christensen.

For more details see:

ftp://pdsimage2.wr.usgs.gov/pub/pigpen/mars/tes/tes_global_albedo_simp0.txt

Data Source:

ftp://pdsimage2.wr.usgs.gov/pub/pigpen/mars/tes/tes_global_albedo_simp0.zip

MGS TES Thermal Inertia Day (Putzig et al.)

This basemap users thermal inertia maps derived from Mars Global Surveyor (MGS) Thermal Emission Spectrometer (TES) observations of the surface temperatures of Mars taken over three Mars-years from orbit 1583 to 24346. The maps were produced by Nathaniel E. Putzig at University of Colorado.

For more details see:

ftp://pdsimage2.wr.usgs.gov/pub/pigpen/mars/tes/putzig_thermal_inertia/TES_Thermal_Inertia_Putzig2007_Readme.txt

Data Source:

ftp://pdsimage2.wr.usgs.gov/pub/pigpen/mars/tes/putzig_thermal_inertia/

Odyssey THEMIS Day IR Global Mosaic

This global mosaic was generated by THEMIS team/ASU using Mars Odyssey THEMIS IR data.

ftp://pdsimage2.wr.usgs.gov/pub/pigpen/mars/themis/themis_ir_global_mosaic/Global_IRday_512ppd/PGM_THEMIS_IRday_clon0_worldfiles_README.txt

Data Source:

ftp://pdsimage2.wr.usgs.gov/pub/pigpen/mars/themis/themis_ir_global_mosaic/Global_IRday_512ppd/

MOC_WA_Atlas_256ppd_mosaic_west_geotiff

Original MSSS Text:

This mosaic was assembled from Wide Angle red images (primarily those acquired in May-June 1999) from the Mars Orbiter Camera.

The mosaic has been produced at 64 and 256 pixels/degree. All quadrangles are complete except for the polar regions (MC-01 and MC-30) and areas on quads MC-24 through MC-29 south of 60S; these should be completed by early 2002.

Processing Flow

This mosaic is built entirely from MOC images, most acquired during the Geodesy Campaign (mapping cycle M01) and some in mapping cycles M00, M02, and M03. Where possible, nadir-looking images were used; some remaining gaps needed to be filled with off-nadir images. South polar coverage is provided by images taken in mapping cycles M10-M11. Additional south polar coverage will be acquired during the 2002 summer solstice.

Each image was systematically processed by removing pixel-to-pixel variation and matching brightness to a low-resolution base map built by hand from MOC daily global map swaths. It was then map-projected, using the MOLA Digital Terrain Model to provide "orthophoto" topographic control (control sampling of 16 pixel/degree). Images with downlink data loss or corruption were processed with and without all corrupted fragments replaced by black, and the versions with errors present added to the mosaic only at the end.

Mosaicking was performed in two steps. In the first step, large barely-overlapping image swaths were mosaicked using linear blending of the overlap regions to reduce the visual impact of the seam. In the second step, smaller fill images were added only in regions without coverage from the first step.

Finally, the small gaps between adjacent swaths caused by slight timing mismatches between the end of one image and the start of the next on the same orbit were filled by linear interpolation.

All of this processing was performed automatically by software written at MSSS. Once the images were selected, processing required less than 48 hours on a Sun SunBlade 1000 system with dual 750-Mhz UltraSPARC III processors and 4 GB of RAM.