Release of MOM MENCA Data From 24th Sep 2017 to 23rd Sep 2020 to public On 12th Nov 2021

Mars Orbiter Mission (MOM), the maiden interplanetary mission of ISRO, launched on November 5, 2013 by PSLV-C25 got inserted into Martian orbit on September 24, 2014 in its first attempt by travelling 324days from lift off. MOM completes 2606 Earth days (85 earth months) in Martian orbit as on 12th Nov, 2021 and going on well beyond its designed mission life of six months. One earth day corresponds to 1day 0Hr 37mins Mars Sols (Martian Solar Day). 687 Earth days corresponds to 668 Mars Sols which is One Martian Year.

One orbit of MOM takes **66.5 Hrs around** Mars and MOM has completed **974 orbits till 12th Nov 2021.** From launch till now around **6 lakhs commands** has been uplinked to MOM

MOM is credited with many laurels like cost-effectiveness, short period of realization, economical mass-budget, miniaturization of five heterogeneous science payloads etc. Satellite is in good health and continues to work further. Scientific analysis of the data received from the Mars Orbiter spacecraft by PI teams and AO researchers is reflected in the publications appeared in journals.

The Mars Colour Camera, one of the scientific payloads onboard MOM, has produced more than 1100 images so far. Using early MCC images a Mars Atlas was prepared and made available on ISRO website.

As of **12th Nov 2021**, there are more than **7200 registered users**, approximately **28000** downloads of science data have been noticed.

The **25 new data sets** from the MENCA instrument of MOM have been added to online archive in this release and now MOM portal hosts **3112** data sets in total from **24-Sep-2014 to 23-Sep-2020**.

Highlights of Science Results published during 2017-2019 period

Scientific analysis of the data being received from the Mars Orbiter spacecraft is in progress. About thirty scientific papers have been published so far in peer reviewed journals. The Mars Colour Camera, one of the scientific payloads onboard MOM, has produced 1100+ images so far. Some of the processed images taken by MCC three of them after OM are shown below.



Global image of Mars taken on 8th Oct 2017 at an altitude of 70157 km



Sabaeusquadrangle of Mars imaged on 27th May 2017 at an altitude of 4406 km.

MENCA (Mars Exospheric Neutral Composition Analyser) experiment aboard the MOM has discovered the presence of suprathermal Argon atoms (Anil Bhardwaj, et al. 2017). The altitude variation of argon-40 (Ar) in the Martian exosphere are studied when MOM's periapsis altitude was the lowest during December 2014. An example of such an observation is shown in the following figure.



Fig. Temporal variation of the partial pressure of Argon-40 observed by MENCA. This corresponds to the observation on December 10, 2014 ($Ls=250^\circ$). The time in the x-axis is given in hours with respect to the time of the periapsis crossing. The black circles represent the observed amu 40 spectral data points. The red stars represent the data points after a smoothing. The mean background levels of the inbound and outbound legs are shown with pink dashed lines. The corresponding altitude variation is shown in the bottom panel (from Bhardwaj et al., 2017, Geophysical Research Letters).

The upper limit of Ar number density corresponding to this period is $\sim 5 \times 10^5$ cm⁻³ (250 km), and the typical scale height is ~16 km, corresponding to an exospheric temperature of ~275 K.

However, on two orbits, the scale height over this altitude region is found to increase significantly making the effective temperature >400 K (see the following figure).



Fig. Altitude variation of the number density of Ar corresponding to four different orbits.(a) 2014 December 10 and 13, (b) 2014 December 18 and 21. The error bars represent 40% uncertainty level. SH is the scale height and T is the exospheric temperature derived from scale height (from Bhardwaj et al., 2017, Geophysical Research Letters).

These observations indicate significant suprathermal Ar populations in the Martian exosphere. The finding has important implications in the context of understanding the energy deposition in the Martian upper atmosphere, and will help understand why the Martian atmospheric escape rates are higher than what was believed previously.

Another study (Guha B K et al, 2019) has been carried out by analysing of dust and water ice opacity and temperature profile before, during and after the dust storm period as observed by MCC and MARCIimages.Dust opacity is found to have increased drastically up to 20 km altitude. Anincrease of dustiness at the HATDM (High Altitude Tropical Dust Maximum) layer is seen, but with a temporal delay of 2° LS after the dust storm disappearance. The study implicates thevariation of convective boundary layer growth in the tenuous Martian atmosphere

during thedust storm scenario for this temporal delay in dust lifting. The dust lifting is found to be exclusively responsible for the increase in heating rate at this layer, not cloud radiative heating caused by water ice clouds.

Archive Release statement summary

- ISRO Science Data Archive (ISDA) LTA holds data sets acquired during Mars Orbiting Phase from 24-Sep-2014 to 23-Sep-2020 from all the five instruments namely MCC, TIS, MSM, LAP and MENCA. This release has Level-0 (CODMAC-2) and Level-1 (CODMAC-3) basic data sets prepared using PDS 3 standards. Multiple data releases will cover different mission durations, experiments, and observations.

- Data Clarifications will be provided by PI and Data Processing Teams on mission, experiment, Processing and science analysis aspects of these data sets, in addition to documents placed in archive.

Acknowledge the source of data, funding etc.

Researchers and common public who is downloading the Mars Orbiter Mission data sets, are required to acknowledge the ISRO for data, funding (if granted) and the research write ups taken from the archive.

1. When publishing a paper using the Mars Orbiter Mission data, there is a need to mention on "Mars Orbiter Mission (MOM)" in abstract and include the following statement in acknowledgement

"We acknowledge the use of data from the Mars Orbiter Mission (MOM), first interplanetary mission of the Indian Space Research Organization (ISRO), archived at the Indian Space Science Data Centre (ISSDC)"

2. If you are using the results of Mars Orbiter Mission which are already published and carrying out further interpretation or modeling, please include the following statement in acknowledgement -

"The research is based partially / to a significant extent (whichever is applicable) on the results obtained from the Mars Orbiter Mission (MOM), first inter-planetary mission of the Indian Space Research Organization (ISRO), archived at the Indian Space Science Data Centre (ISSDC