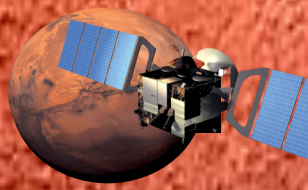
MARS EXPRESS



EGU 2020 Virtual Meeting

EGU2020-20093: New search capabilities based on observational geometry for Mars Express data in the ESA's Planetary Science Archive

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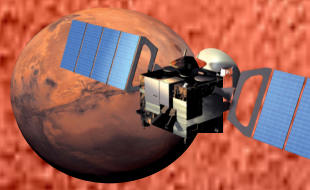
4 May 2020

Introduction



- The European Space Agency's (ESA) Planetary Science Archive (PSA) can be accessed at:

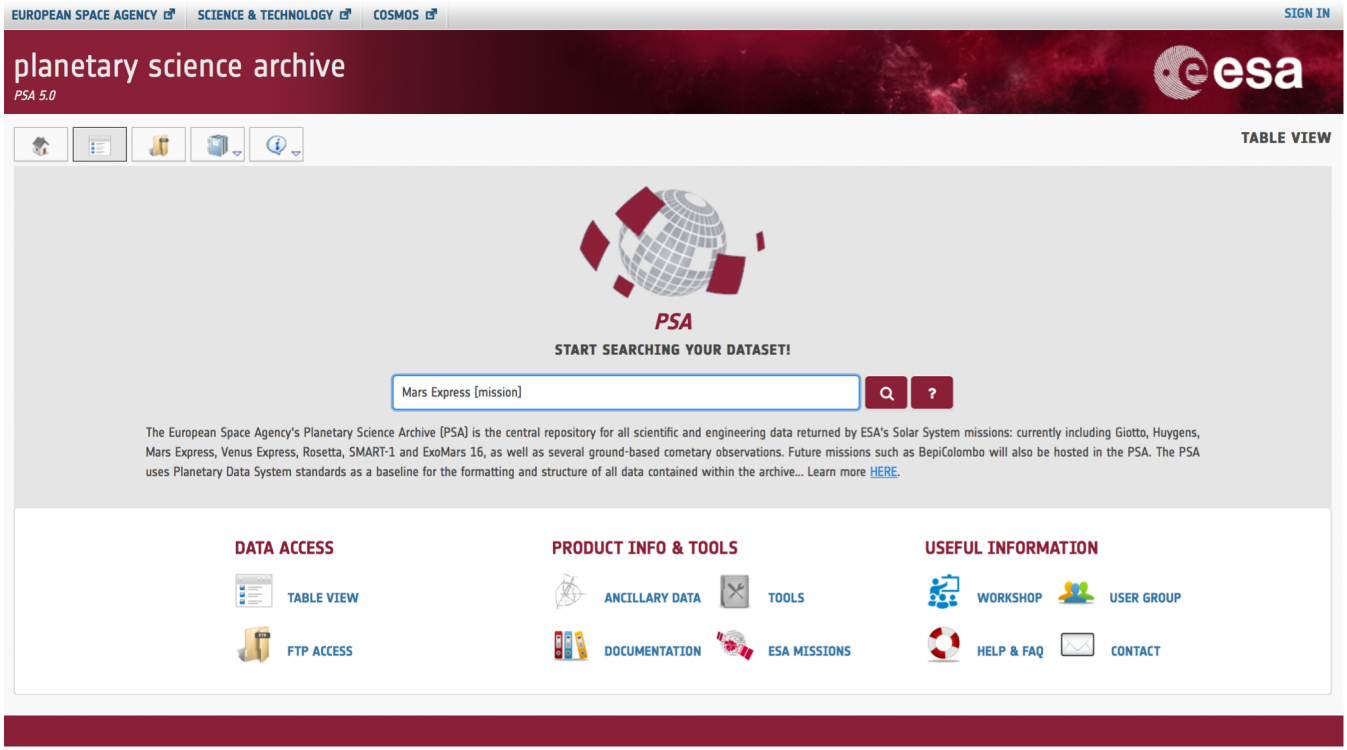
  http://psa.esa.int/

- The 918K+ Mars Express (MEX) data products stored in the PSA cover observations from 19 February 2003 through 30 June 2019 (and growing).

- That's 16 years of public data (MEX arrived at Mars Christmas 2003, but there were earlier instrument check-out observations and even some on-ground calibration) and the mission is still on-going and delivering data (with a proprietary period).

New PSA User Interface (UI)

- The re-designed UI (version 5.0) was launched on 16 Jan 2017[1].



- Starts with a home page, from which one could access the FTP and new Table View.

- Includes both PDS3 and PDS4 standard formatted data (previously only PDS3 was available, the newer missions from ExoMars onward use PDS4).

[1] Besse, S., Vallat, C., Barthelemy, M., Coia, D., Costa, M., De Marchi, G., Fraga, D., Grotheer, E., Heather, D., Lim, T., Martinez, S., Arviset, C., Barbarisi, I., Docosal, R., Macfarlane, A., Rios, C., Saiz, J., and Vallejo, F.: ESA's Planetary Science Archive: Preserve and present reliable scientific data sets, Planetary and Space Science, Vol. 150, pp. 131-140, 2018.

New PSA UI (2)

- An example of the Table View.

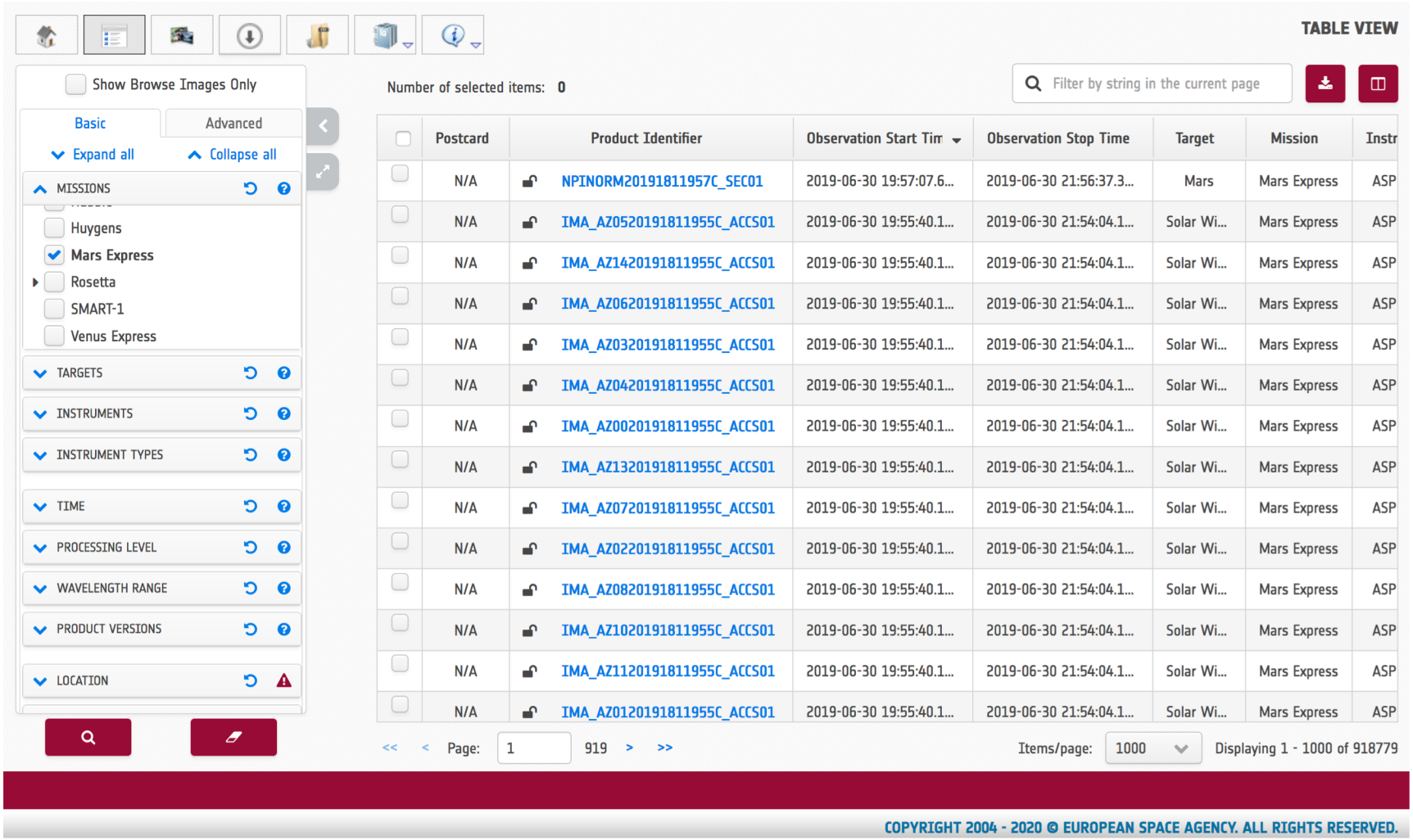
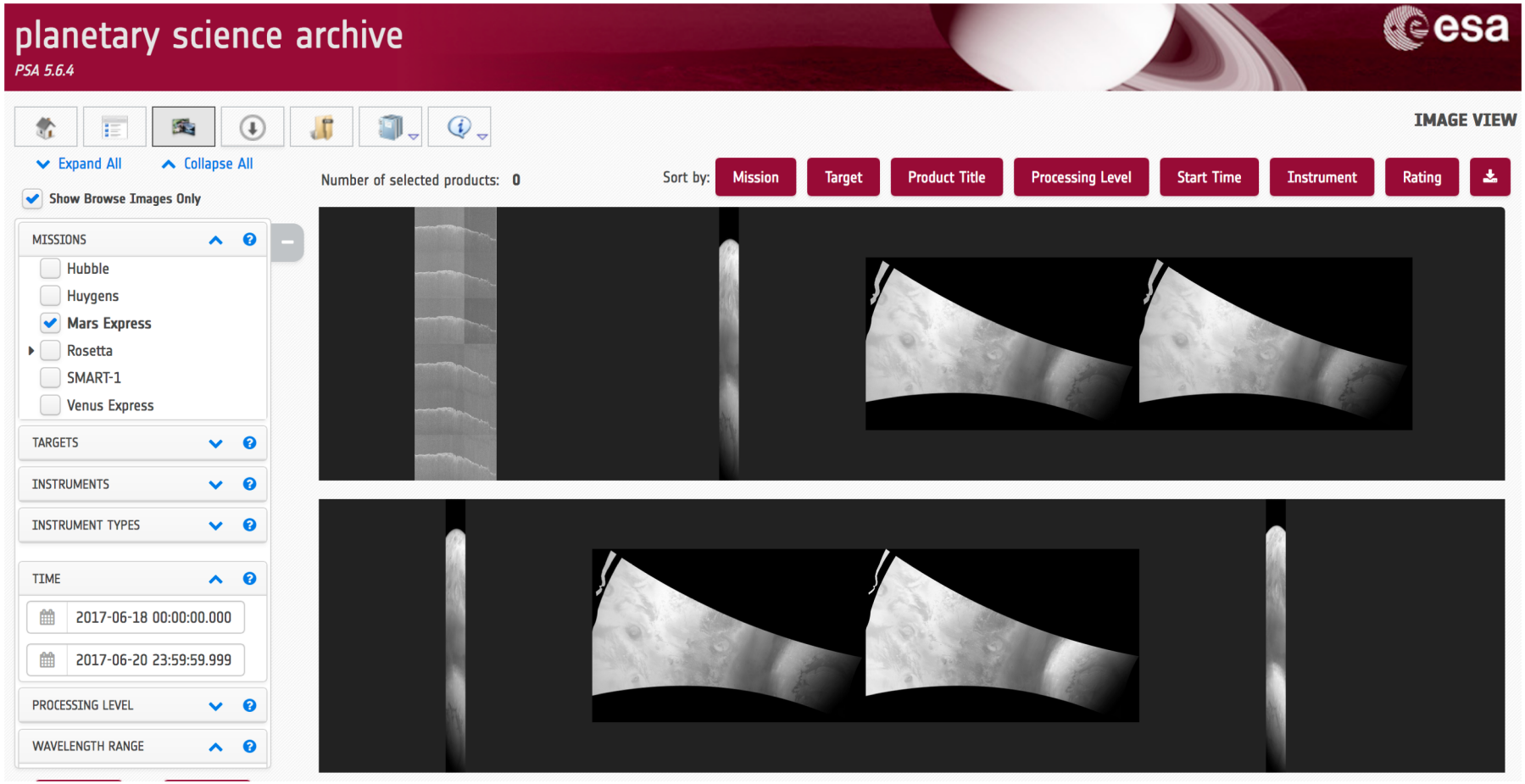


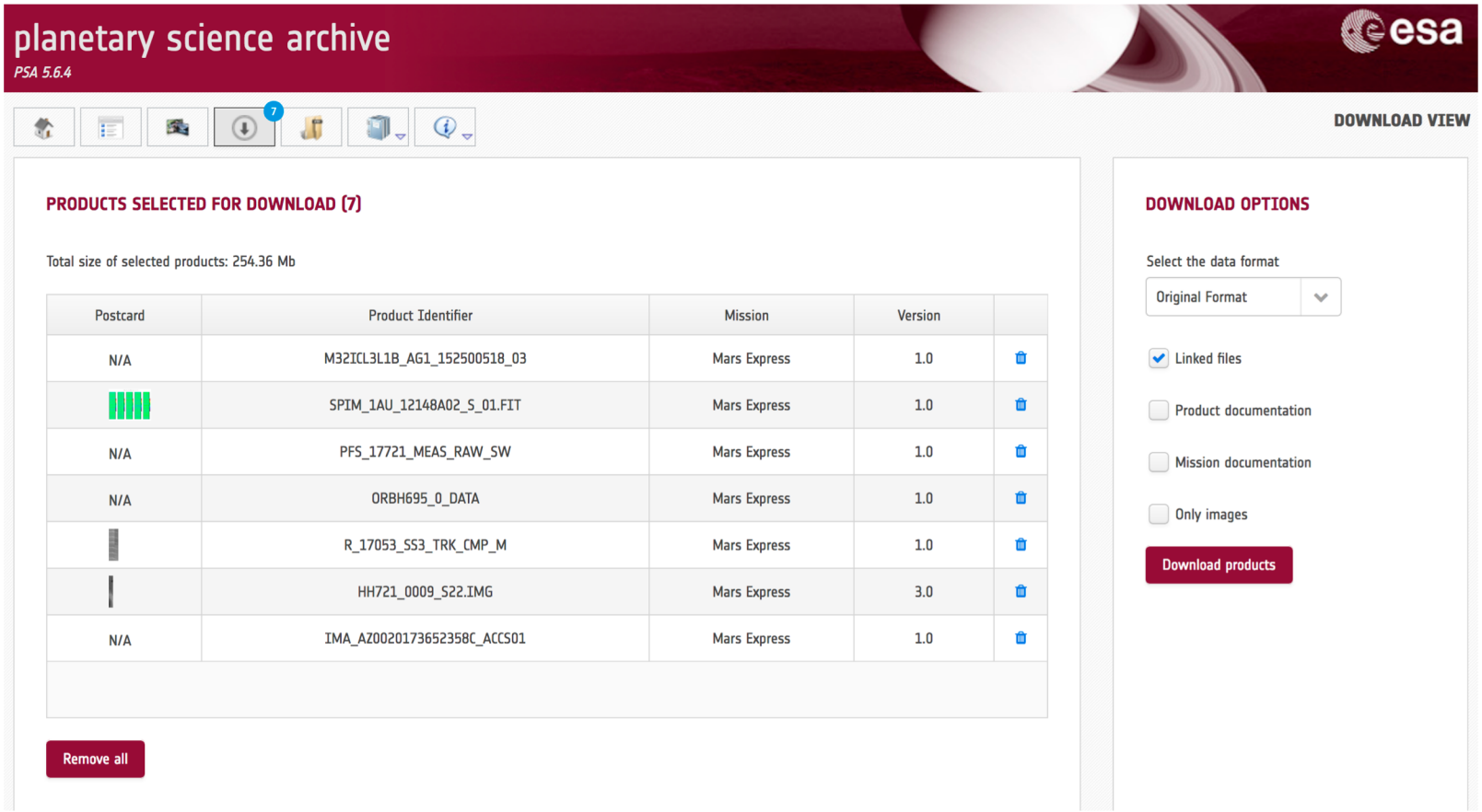
Image View

- With UI version 5.5, the Image View was released.
- This new View allows users to look through the data via the browse products (aka postcards).



Data Download Manager

- To gather assorted data products for a single download later, and decide what kind of ancillary information to include.

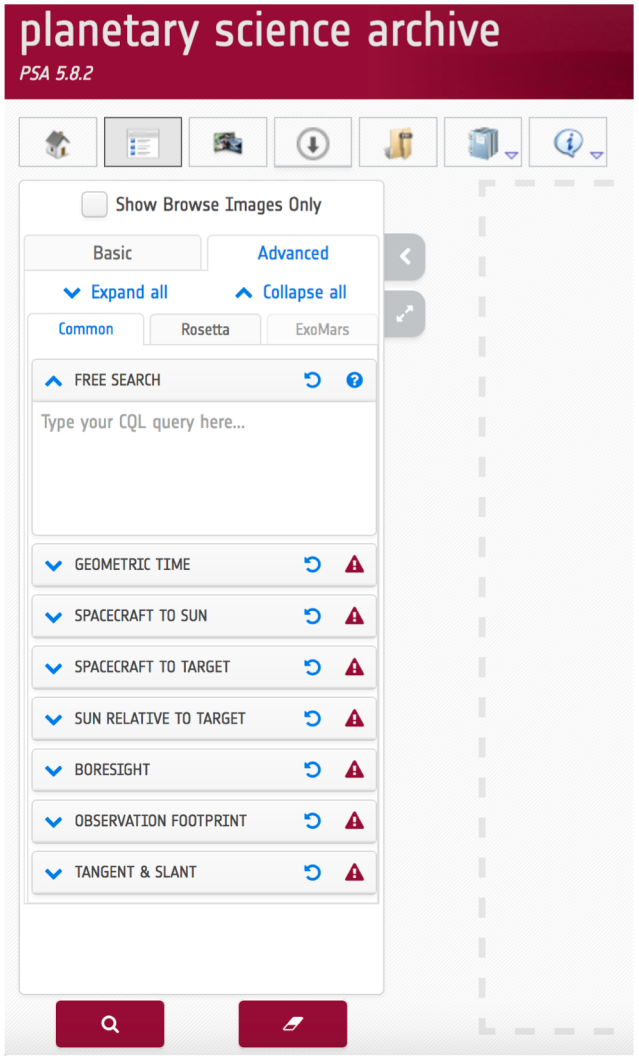


Geometrical searches

- Development of a new Map View is ongoing.

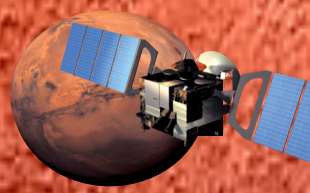
- As a first step, a common approach for calculating geometrical parameters was applied via the Geogen tool.

- These 47 new parameters can be accessed in the Table View's "Advanced" tab. More information can be found in the user manual's "Geogen parameters" section (see link below)



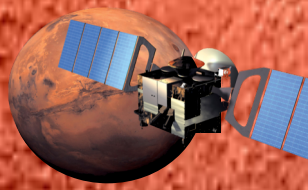
http://archives.esac.esa.int/psa/userguide/ESDC-PSA-MA-0001_v5.8.html

Geogen parameters (1/7)



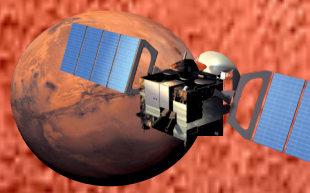
NAME	DESCRIPTION	EXAMPLE
geogen_center_latitude	Latitude of the observation footprint center point.	geogen_center_latitude = -39.45
geogen_center_longitude	Longitude of the observation footprint center point.	geogen_center_longitude = -46.03
geogen_westernmost_longitude	Westernmost observation longitude of the footprint.	geogen_westernmost_longitude BETWEEN -17.93 AND 120.71
geogen_easternmost_longitude	Easternmost observation longitude of the footprint.	geogen_easternmost_longitude = -174.38
geogen_minimum_latitude	Minimum observation latitude of the footprint.	geogen_minimum_latitude > -29.49
geogen_maximum_latitude	Maximum observation latitude of the footprint.	geogen_maximum_latitude = -52.44
geogen_local_true_solar_time	Local solar time for the surface point, evaluated at the reference time. The local solar time is the angle between the planetocentric longitude of the Sun, as viewed from the center of the target body, and the planetocentric longitude of the surface point, expressed on a "24 hour" clock.	geogen_local_true_solar_time = '00:16:38'
geogen_solar_longitude	Planetocentric longitude (Ls) of the sun for the target body at the reference time. The planetocentric longitude is the angle between the body-sun vector at the time of interest and the body-sun vector at the vernal equinox.	geogen_solar_longitude = 4.52

Geogen parameters (2/7)



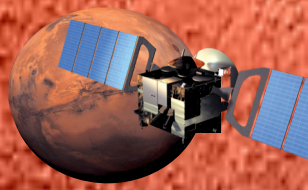
geogen_sub_solar_latitude	Latitude of the sub-solar point on the target body at the reference time. The sub-solar point is the point on a body's reference surface where a line from the body center to the sun center intersects that surface.	geogen_sub_solar_latitude = -18.57
geogen_sub_solar_longitude	Longitude of the sub-solar point on the target body at the reference time. The sub-solar point is the point on a body's reference surface where a line from the body center to the sun center intersects that surface.	geogen_sub_solar_longitude = 24.23
geogen_solar_distance	Distance from the center of the sun to the center of the target body at the reference time.	geogen_solar_distance < 206666750.311
geogen_spacecraft_solar_distance	Distance from the spacecraft to the center of the sun at the reference time.	geogen_spacecraft_solar_distance = 207353078.157
geogen_spacecraft_altitude	Distance from the spacecraft to the sub-spacecraft point on the target body at the reference time.	geogen_spacecraft_altitude = 326.891
geogen_target_center_distance	Distance from the spacecraft to the center of the target body at the reference time.	geogen_target_center_distance = 1334.922
geogen_sub_spacecraft_latitude	Latitude of the sub-spacecraft point on the target body at the reference time.	geogen_sub_spacecraft_latitude = -73.40
geogen_sub_spacecraft_longitude	Longitude of the sub-spacecraft point on the target body at the reference time. Solar zenith angle at the sub-spacecraft point on the target body surface at the reference time.	geogen_sub_spacecraft_longitude = -104.53

Geogen parameters (3/7)



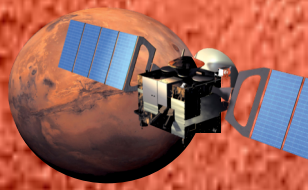
geogen_sub_spacecraft_solar_zenith_angle	The solar zenith angle is the angle subtended between the direction towards the Sun and the local normal at the surface.	geogen_sub_spacecraft_solar_zenith_angle = 29.4279
geogen_target_right_ascension	Right ascension of the position vector of the target body center as seen from the spacecraft in the Earth mean equator and equinox frame (J2000).	geogen_target_right_ascension < 0.0602
geogen_target_declination	Declination of the position vector of the target body center as seen from the spacecraft in the Earth mean equator and equinox frame (J2000).	geogen_target_declination = -17.0544
geogen_sun_right_ascension	Right ascension of the position vector of the Sun as seen from the spacecraft in the Earth mean equator and equinox frame (J2000).	geogen_sun_right_ascension = 21.0951
geogen_sun_declination	Declination of the position vector of the Sun as seen from the spacecraft in the Earth mean equator and equinox frame (J2000).	geogen_sun_declination = 53.6828
geogen_x_sc_sun_position	X component of the position vector from spacecraft to Sun, expressed in J2000 coordinates, and corrected for light time and stellar aberration, evaluated at the reference time.	geogen_x_sc_sun_position = -208028688.083
geogen_y_sc_sun_position	Y component of the position vector from spacecraft to Sun, expressed in J2000 coordinates, and corrected for light time and stellar aberration, evaluated at the reference time.	geogen_y_sc_sun_position = -214032850.577
geogen_z_sc_sun_position	Z component of the position vector from spacecraft to Sun, expressed in J2000 coordinates, and corrected for light time and stellar aberration, evaluated at the reference time.	geogen_z_sc_sun_position = -77268319.714

Geogen parameters (4/7)



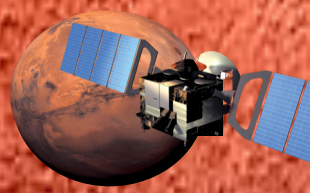
geogen_x_sc_sun_velocity	X component of the velocity vector of Sun relative to the spacecraft, expressed in J2000 coordinates, and corrected for light time and stellar aberration, evaluated at the reference time.	geogen_x_sc_sun_velocity = -27.81174
geogen_y_sc_sun_velocity	Y component of the velocity vector of Sun relative to the spacecraft, expressed in J2000 coordinates, and corrected for light time and stellar aberration, evaluated at the reference time.	geogen_y_sc_sun_velocity = -23.15454
geogen_z_sc_sun_velocity	Z component of the velocity vector of Sun relative to the spacecraft, expressed in J2000 coordinates, and corrected for light time and stellar aberration, evaluated at the reference time.	geogen_z_sc_sun_velocity = -13.49878
geogen_x_sc_target_position	X component of the position vector from the spacecraft to target body center, expressed in J2000 coordinates, and corrected for light time and stellar aberration, evaluated at the reference time.	geogen_x_sc_target_position = -3091.489
geogen_y_sc_target_position	Y component of the position vector from the spacecraft to target body center expressed in J2000 coordinates, and corrected for light time and stellar aberration, evaluated at the reference time.	geogen_y_sc_target_position = -1734.554
geogen_z_sc_target_position	Z component of the position vector from the spacecraft to target body center expressed in J2000 coordinates, and corrected for light time and stellar aberration, evaluated at the reference time.	geogen_z_sc_target_position = -745.707

Geogen parameters (5/7)



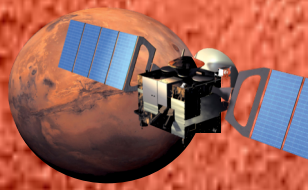
geogen_x_sc_target_velocity	X component of the velocity vector of the target body center relative to the spacecraft, expressed in J2000 coordinates, and corrected for light time and stellar aberration, evaluated at the reference time.	geogen_x_sc_target_velocity = 1.01425
geogen_y_sc_target_velocity	Y component of the velocity vector of the target body center relative to the spacecraft, expressed in J2000 coordinates, and corrected for light time and stellar aberration, evaluated at the reference time.	geogen_y_sc_target_velocity = -2.35642
geogen_z_sc_target_velocity	Z component of the velocity vector of the target body center relative to the spacecraft, expressed in J2000 coordinates, and corrected for light time and stellar aberration, evaluated at the reference time.	geogen_z_sc_target_velocity = -3.36229
geogen_min_incidence_angle	Minimum incidence angle. The incidence angle is the angle between the local vertical at a given surface point and the vector from the surface point to the sun.	geogen_min_incidence_angle BETWEEN 1.6275 and 5.6275
geogen_max_incidence_angle	Maximum incidence angle. The incidence angle is the angle between the local vertical at a given surface point and the vector from that the surface point to the sun.	geogen_max_incidence_angle BETWEEN 3.5575 and 7.2354

Geogen parameters (6/7)



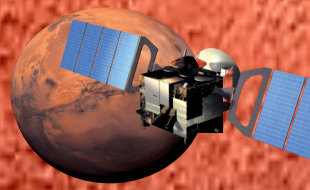
geogen_min_emission_angle	Minimum emission angle. The emission angle is the angle between the surface normal at a given surface point and the vector from the surface point to the spacecraft.	geogen_min_emission_angle = 3.2342
geogen_max_emission_angle	Maximum emission angle. The emission angle is the angle between the surface normal at a given surface point and the vector from the surface point to the spacecraft.	geogen_max_emission_angle = 15.5885
geogen_min_phase_angle	Minimum phase angle. The phase angle is the angle between the vectors from the surface point to the spacecraft and from the surface point to the Sun.	geogen_min_phase_angle > 0.0827
geogen_max_phase_angle	Maximum phase angle. The phase angle is the angle between the vectors from the surface point to the spacecraft and from the surface point to the Sun.	geogen_max_phase_angle < 3.5121
geogen_min_slant_distance	Minimum slant distance. The slant distance is the distance from the spacecraft to the nearest point on the detector line-of-sight to the target body surface.	geogen_min_slant_distance = 298.751
geogen_max_slant_distance	Maximum slant distance. The slant distance is the distance from the spacecraft to the nearest point on the detector line-of-sight to the target body surface.	geogen_max_slant_distance = 493.096

Geogen parameters (7/7)



geogen_min_tangent_altitude	Minimum tangent altitude. The tangent altitude is the distance from the target body surface nearest point to the detector line-of-sight.	geogen_min_tangent_altitude = 5.174
geogen_max_tangent_altitude	Maximum tangent altitude. The tangent altitude is the distance from the target body surface nearest point to the detector line-of-sight.	geogen_max_tangent_altitude = 113.808
geogen_boresight_right_ascension	Right ascension of the detector boresight vector, in the Earth mean equator and equinox frame (J2000), at the reference time.	geogen_boresight_right_ascension = 41.4073
geogen_boresight_declination	Declination of the detector boresight vector, in the Earth mean equator and equinox frame (J2000), at the reference time.	geogen_boresight_declination = -39.2410
geogen_boresight_target_angle	The separation angle between the detector line-of-sight (boresight) and the target body center as seen from the spacecraft, at the reference time.	geogen_boresight_target_angle = 2.9161
geogen_boresight_solar_elongation	Separation angle between the detector line-of-sight and the position vector of the Sun as seen from the spacecraft, at the reference time.	geogen_boresight_solar_elongation = 97.0743

New datasets by the PI teams

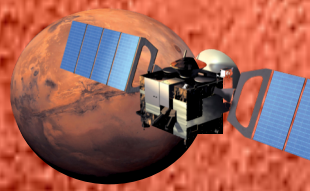


Over the last 5 years, additional datasets beyond the nominal ones have been delivered by the PI teams (not counting new versions/recalibrations); this includes the following:

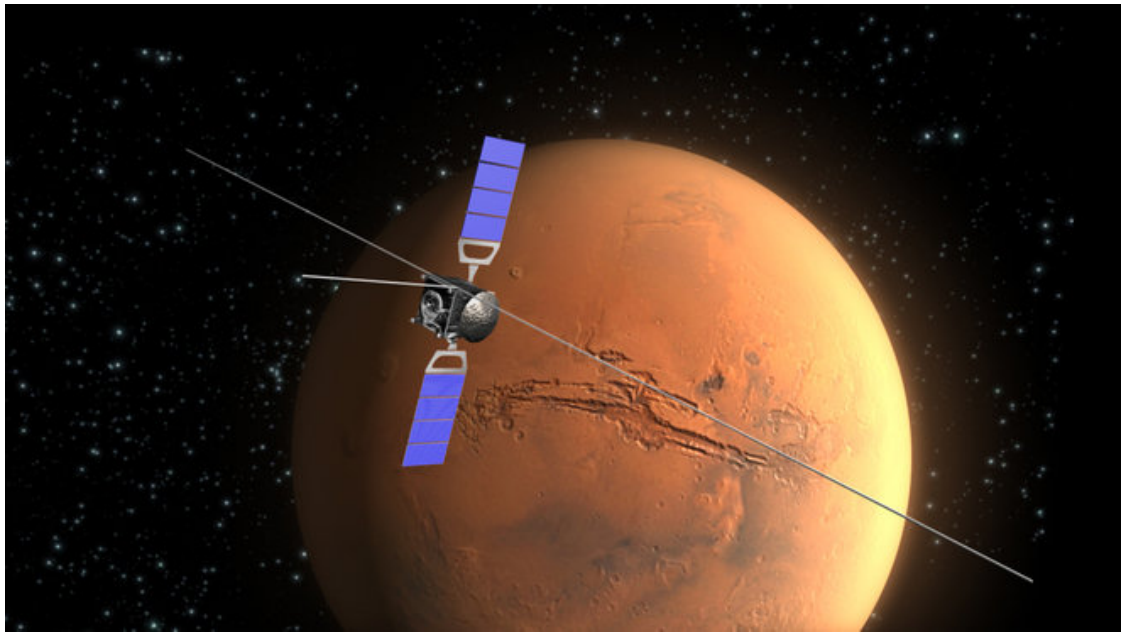
- ASPERA solar wind moments (also for VEX)
- HRSC Phobos data (including DTMs and mosaics)
- MARSIS AIS electron densities and magnetic field strengths

The Visual Monitoring Camera (VMC) has been repurposed as a scientific instrument as well, and the first 2 full datasets (raw and calibrated data) are currently undergoing review and will be published later in 2020.

Acknowledgements



Thank you to all the teams for your deliveries over the past 16 years, and thanks in advance for the many deliveries yet to be made in the future.

As with most endeavours in planetary science, this is a team effort.

Let's hope together we can reach 20+ years of MEX; and maybe exceed 1 million MEX data products in the archive.