esac

European Space Astronomy Centre (ESAC)
European Space Agency (ESA)
Camino Bajo del Castillo s/n
Urb. Villafranca del Castillo
28692 Villanueva de la Canada - Madrid
SPAIN

TEMPERATURE PROFILES AND SUSPENDED DUST AND ICE OPTICAL DEPTH OF THE MARTIAN ATMOSPHERE FROM PFS OBSERVATIONS

European Space Agency
Agence spatiale européenne

Prepared by **Paulina Wolkenberg and Marco Giuranna**
Date of Issue **22/10/2025**

CHANGE LOG

Reason for change	**Issue**	**Revision**	**Date**
Initial version	1	0	23/10/2025
Second version based on first experience	-	-	-

CHANGE RECORD

Issue 1	**Revision** 1		
Reason for change	**Date**	**Pages**	**Paragraph(s)**
Initial version	23/10/2025	All	All
Few global updates	-	-	-
Added one new section	-	-	-
Added additional inputs on the instructions to open products	-	-	-

Table of contents:

EXECUTIVE SUMMARY

Unbinned atmospheric temperature profiles, surface temperatures, and column-integrated dust and water ice retrievals by PFS-MEX. More than 2,500,000 spectra have been processed to build this dataset, covering the full range of season, latitude, longitude, and local time for more than six full Martian years. The current release contains retrievals from Ls=331.18° of MY 26 to Ls=218.66° of MY 35 (10 Jan 2004 - 12 June 2020). PFS performed observations at various local times. Atmospheric temperatures and aerosols opacity are also successfully retrieved over cold surface areas and in the polar regions, including the polar nights.

1. INTRODUCTION

The state of a planetary atmosphere can be described by the interdependence of the temperature, pressure and density as a function of the altitude. The knowledge of the vertical temperature profiles is essential for an understanding of the dynamical, thermodynamical, and chemical processes occurring in the atmosphere. In addition, suspended aerosols such as dust and water ice, which are very variable in the Martian atmosphere, strongly affect the radiative transfer, with significant impact on the atmospheric density and temperature, and influence on the large-scale dynamics.

PFS (Formisano et al., 2005) onboard MEx mission has been observing Mars since January 2004 (MY 26, Ls = 331.18°). It has now provided nearly continuous monitoring of conditions in the Martian atmosphere for over seven full Martian years, and it is still performing measurements at the time of writing. PFS LWC thermal infrared observations of the 15-μm CO_2 band have been used to retrieve atmospheric temperatures at different levels within the atmosphere by exploiting the variation in known optical depth as a function of wavelength across the band.

The dataset provided here consists of unbinned atmospheric temperature profiles, surface temperatures, and column-integrated dust and water ice retrievals by PFS. More than 2,500,000 spectra have been processed to build this dataset, covering the full range of season, latitude, longitude, and local time for more than six full Martian years. The current release contains retrievals from Ls=331.18° of MY 26 to Ls=218.66° of MY 35 (from 10 Jan 2004 to 12 June 2020; from MEx orbit 00010 to 20793). PFS performed observations at various local times. Atmospheric temperatures and aerosols opacity are also successfully retrieved over cold surface areas and in the polar regions, including the polar nights. The dataset is described in detail in Giuranna et al., 2021.

The above quantities have been retrieved using an optimal estimation method with a Bayesian approach (Rodgers, 2000) especially developed and optimized to process PFS LWC nadir spectra (Grassi et al., 2005; Wolkenberg et al., 2018). The column-integrated optical depth of dust is retrieved from the characteristic absorption band centred around 1075 cm^{-1} while the column-integrated optical depth of water ice is derived for the ice absorption band centred around 825 cm^{-1}. The surface temperature is retrieved from two different wavenumber ranges, centred around 300 cm^{-1} and 1200 cm^{-1}.

1.1 Instrument and Dataset

PFS is a double-pendulum infrared Fourier spectrometer optimized for atmospheric studies. It has two distinct spectral channels operating simultaneously and covering the wavenumber range between 200 and 2000 cm^{-1} (LWC) and 2000–8300 cm^{-1} (SWC). Both channels have a sampling step of 1 cm^{-1} and a spectral resolution of ~1.3 cm^{-1}, when no apodization function is applied, and ~1.8 cm^{-1} when Hamming function is applied to the measured interferograms (as in the case of the dataset presented here). The PFS IFOV is about 1.52° (FWHM) for the SWC and 2.69° (FWHM) for the LWC, which corresponds to a spatial resolution of, respectively, 6.5 and 11.5 km at the pericenter.

The file "PFS_dataset_20793_B.nc" (0.98 GB) contains unbinned quantities retrieved from PFS nadir-geometry spectra in NetCDF format. The current release contains retrievals from Ls=331.18° of MY 26 to Ls=218.66° of MY 35 (from MEx orbit 00010 to 20793).

Retrieved values using PFS nadir LWC spectra:

- surface temperature;
- atmospheric temperature (on a fixed pressure grid);
- integrated dust optical depth at 1075 cm^{-1};
- integrated ice optical depth at 825 cm^{-1}

The PFS temperature profiles are retrieved for the fixed pressure grid (61 levels) in Tab. 1

Tab.1. The pressure grid used in the retrieval process.

Levels	*Pressure [mb]*
1	*0.0101700*
2	*0.0133300*
3	*0.0172300*
4	*0.0219700*
5	*0.0276900*
6	*0.0345100*
7	*0.0425700*
8	*0.0520300*
9	*0.0630500*
10	*0.0757900*
11	*0.0904500*
12	*0.107200*
13	*0.126300*
14	*0.147800*
15	*0.172100*
16	*0.199400*
17	*0.229900*
18	*0.264000*
19	*0.301800*
20	*0.343600*
21	*0.389900*
22	*0.440900*
23	*0.496900*
24	*0.558500*
25	*0.625900*
26	*0.699600*
27	*0.780000*
28	*0.867700*
29	*0.963200*
30	*1.06700*
31	*1.18000*
32	*1.30200*
33	*1.43500*
34	*1.57800*
35	*1.73400*
36	*1.90200*
37	*2.08300*

38	*2.28000*
39	*2.49200*
40	*2.72100*
41	*2.96800*
42	*3.23500*
43	*3.52300*
44	*3.83400*
45	*4.17000*
46	*4.53200*
47	*4.92300*
48	*5.34600*
49	*5.80200*
50	*6.00000*
51	*6.29500*
52	*6.82700*
53	*7.40300*
54	*8.02600*
55	*8.70100*
56	*9.43100*
57	*10.2200*
58	*10.900*
59	*11.600*
60	*12.300*
61	*13.00*

Estimated uncertainty for retrieved quantities*:

Atmospheric temperatures: +/- 1 K for mid heights (10–30 km)
+/- 1-4 K for lower and higher heights

Dust optical depth:
“warm regime” (Tsurf >= 220 K): +/- 0.02–0.06
"cold regime" (Tsurf < 220 K): +/- 0.11

Ice optical depth:
“warm regime” (Tsurf >= 210 K): +/- 0.01
"cold regime" (Tsurf < 210 K): +/- 0.06

* from Giuranna et al., 2021. https://doi.org/10.1016/j.icarus.2019.113406

NOTE: This dataset only includes retrievals with QF = 1, meaning a chi-square between the model best-fit spectrum and the PFS observed spectrum less than 1.1. A more complete dataset including higher quality factors, which however may indicate questionable fits (chi-squares greater than 1.1), can be obtained by contacting the PI of the instrument, Marco Giuranna, at the following email address: marco.giuranna@inaf.it

1.2 Abbreviations and Acronyms

PFS – Planetary Fourier Spectrometer
MEx – Mars Express
MY – Mars Year
MCD – Mars Climate Database
LWC – Long-Wavelength Channel
SWC – Short-Wavelength Channel
IFOV – Instantaneous Field of View
FWHM – full width at half maximum
QF – Quality Factor
PI – Principal Investigator

1.3 Reference and Applicable Documents

M. Giuranna, V. Formisano, D. Biondi, A. Ekonomov, S. Fonti, D. Grassi, H. Hirsch, I. Khatuntsev, N. Ignatiev, M. Malgoska, A. Mattana, A. Maturilli, E. Mencarelli, F. Nespoli, R. Orfei, P. Orleanski, G. Piccioni, M. Rataj, B. Saggin, L. Zasova, Calibration of the Planetary Fourier Spectrometer long wavelength channel, Planetary and Space Science, Volume 53, Issue 10, 2005, Pages 993-1007, https://doi.org/10.1016/j.pss.2005.02.007

M. Giuranna, P. Wolkenberg, D. Grassi, A. Aronica, S Aoki, D. Scaccabarozzi, B. Saggin, V. Formisano, The current weather and climate of Mars: 12 years of atmospheric monitoring by the Planetary Fourier Spectrometer on Mars Express, Icarus, 353, 2021, 113406, https://doi.org/10.1016/j.icarus.2019.113406

Rodgers, C.D., 2000. Inverse Methods for Atmospheric Sounding: Theory and Practice. World Scientific, Singapore

D. Grassi, N.I. Ignatiev, L.V. Zasova, A. Maturilli, V. Formisano, G.A. Bianchini, M. Giuranna, Methods for the analysis of data from the Planetary Fourier Spectrometer on the Mars Express Mission, Planetary and Space Science, Volume 53, Issue 10, 2005, Pages 1017-1034, https://doi.org/10.1016/j.pss.2005.01.006

P. Wolkenberg, M. Giuranna, D. Grassi, A. Aronica, S. Aoki, D. Scaccabarozzi, B. Saggin, Characterization of dust activity on Mars from MY27 to MY32 by PFS-MEX observations *Icarus*, *310*, 2018, 32–47, https://doi.org/10.1016/j.icarus.2017.10.045

F. Forget, et al., Improved general circulation models of the Martian atmosphere from the surface to above 80 km, *J. Geophys. Res.*, 104 (E10), 1999, 24155–24175, doi:10.1029/1999JE001025

E. Millour et al., THE MARS CLIMATE DATABASE (VERSION 5.3), Scientific Workshop: "From Mars Express to ExoMars" 27–28 February 2018, ESAC Madrid, Spain

V. Formisano, F. Angrilli, G. Arnold, S. Atreya, G. Bianchini, D. Biondi, A. Blanco, M.I. Blecka, A. Coradini, L. Colangeli, A. Ekonomov, F. Esposito, S. Fonti, M. Giuranna, D. Grassi, V. Gnedykh, A. Grigoriev, G. Hansen, H. Hirsh, I. Khatuntsev, A. Kiselev, N. Ignatiev, A. Jurewicz,

E. Lellouch, J. Lopez Moreno, A. Marten, A. Mattana, A. Maturilli, E. Mencarelli, M. Michalska, V. Moroz, B. Moshkin, F. Nespoli, Y. Nikolsky, R. Orfei, P. Orleanski, V. Orofino, E. Palomba, D. Patsaev, G. Piccioni, M. Rataj, R. Rodrigo, J. Rodriguez, M. Rossi, B. Saggin, D. Titov, L. Zasova, The Planetary Fourier Spectrometer (PFS) onboard the European Mars Express mission, Planetary and Space Science, Volume 53, Issue 10, 2005, Pages 963-974, https://doi.org/10.1016/j.pss.2004.12.006

C. Leovy, Weather and climate on Mars, Nature, Volume 412, 2001, 245-249, https://doi.org/10.1038/35084192

P. Wolkenberg and M. Giuranna, Daily dust variation from the PFS MEx observations, Icarus, Volume 353, 2021, 113823, https://doi.org/10.1016/j.icarus.2020.113823

P. Wolkenberg, M. Giuranna, M.D. Smith, D. Grassi, M. Amoroso, Similarities and differences of global dust storms in MY 25, 28, and 34. *Journal of Geophysical Research: Planets*, *125*, 2020, e2019JE006104, https://doi.org/10.1029/2019JE006104

2. SCIENTIFIC OBJECTIVES

The data presented here span more than six Martian Years (from MY 26, Ls=331°, 10 January 2004 to MY 33, Ls=78°, 6 December 2015), allowing studies of the present weather and climate of Mars, the seasonal and latitudinal dependence of the retrieved atmospheric quantities for the relevant period, as well as an assessment of the interannual variability in the current Martian climate. The general effect of suspended dust on atmospheric temperatures can also be analysed, especially during the global dust storm of MY 28. Atmospheric temperatures and aerosol opacity are successfully retrieved over cold surface areas and in the polar regions, including the polar nights, and in the aphelion cloud belt, and can be used to study the climatology of the Martian water ice clouds as well as the seasonal extent, pattern and thickness of the North polar hoods, where most of the thickest clouds are observed. By exploiting PFS/MEx capability to perform observations at different local times, this dataset allows investigation of how dust and ice cloud optical depths vary throughout the day on Mars. With its relatively large spatial and temporal coverage, this dataset offers a new reference for the MYs complementary to those observed by previous orbiters (Giuranna et al., 2021).

The retrieved column-integrated dust optical depths allow us to study the dust cycle in the Martian atmosphere. The Martian year is divided into two intervals including dusty and non-dusty seasons. Dusty season usually begins from Ls = 180° to Ls = 360°. During this season more dust is suspended in the atmosphere than during non-dusty season. On average, the total column-integrated dust optical depth rises 0.5 – 0.6 during a typical dusty season, excluding global dust storms (Wolkenberg et al., 2018; Wolkenberg and Giuranna, 2021). High number of dust devils, local and regional dust storms occur during the second half of MY. Global dust storms are observed with still unknown periodicity, and the onset of three last ones corresponds to equinox or perihelion seasons (Wolkenberg et al., 2020).

The retrieved column-integrated water ice optical depths vary significantly during non-dusty season (aphelion season). Water ice clouds form in tropics during the first half of MY. The column-integrated water ice optical depths also vary with LT. The minimum of water ice content is observed during local noon while maxima are found in the morning at 7 LT and in the afternoon at 17 LT (Giuranna et al., 2021).

2.1 Acknowledgements

If this PFS dataset play a key role in the user's research project, then it would be appropriate to include the first author of this publication as a co-author on presentations or publications. If this PFS dataset plays a secondary or supporting role, then reference to the papers below, the DOI of the dataset, and perhaps an acknowledgement are sufficient.

Users are requested to acknowledge the dataset by mentioning its DOI and the following papers:

M. Giuranna, P. Wolkenberg, D. Grassi, A. Aronica, S Aoki, D. Scaccabarozzi, B. Saggin, V. Formisano, The current weather and climate of Mars: 12 years of atmospheric monitoring by the Planetary Fourier Spectrometer on Mars Express, Icarus, 353, 2021, 113406, https://doi.org/10.1016/j.icarus.2019.113406
(for temperature, dust, and ice retrievals)

P. Wolkenberg, M. Giuranna, D. Grassi, A. Aronica, S. Aoki, D. Scaccabarozzi, B. Saggin, Characterization of dust activity on Mars from MY27 to MY32 by PFS-MEX observations *Icarus*, *310*, 2018, 32–47, https://doi.org/10.1016/j.icarus.2017.10.045
(for dust retrieval, and updated retrieval algorithm)

D. Grassi, N.I. Ignatiev, L.V. Zasova, A. Maturilli, V. Formisano, G.A. Bianchini, M. Giuranna, Methods for the analysis of data from the Planetary Fourier Spectrometer on the Mars Express Mission, Planetary and Space Science, Volume 53, Issue 10, 2005, Pages 1017-1034, https://doi.org/10.1016/j.pss.2005.01.006

(for original retrieval algorithm)

The PFS experiment has been built at the "Istituto di Astrofisica e Planetologia Spaziali" (IAPS) of the "Istituto Nazionale di Astrofisica" (INAF) and is currently funded by the Italian Space Agency (ASI) in the context of the Italian participation to the ESA's Mars Express Mission (Grant ASI/INAF n. 2018-2-HH.0).

3. DATA PRODUCT GENERATION

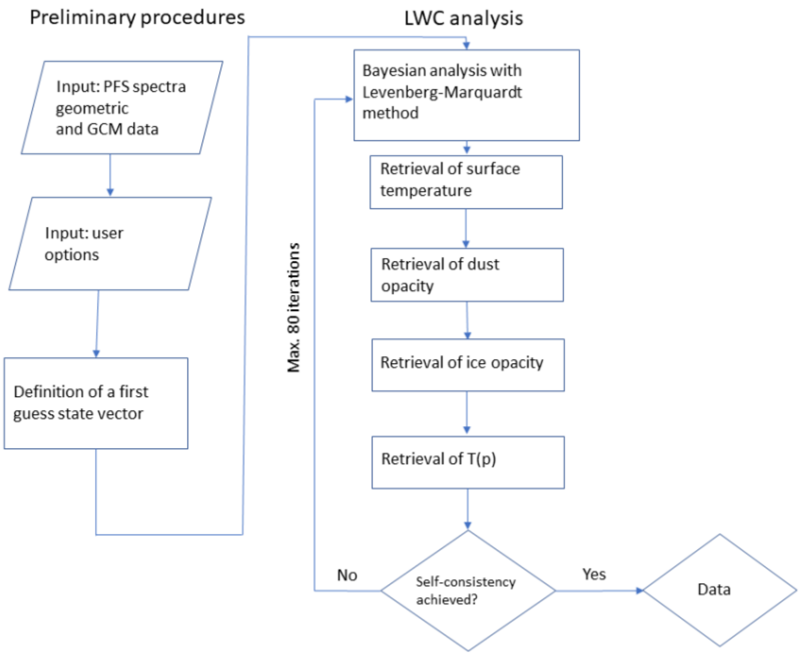


Fig.1. Scheme of retrieval steps for the PFS LWC.

The original version of the retrieval algorithm can be found in the paper by Grassi et al. (2005). The workflow of the retrieval algorithm is presented in Fig.1 for the PFS LWC. Calibrated spectra from nadir observations, geometry files and an 'a priori' covariance matrix are prepared as an input to the retrieval algorithm. The 'a priori' covariance matrix standard deviations are calculated from the MCD for each retrieved parameter.

The latest improvements to the algorithm (Wolkenberg et al., 2018) address the following: 1) an increased number of iterations up to maximum of 80 iterations, 2) an updated 'a priori' covariance matrix (the 'a priori' covariance matrix standard deviations are 10 K for atmospheric and surface temperatures and 2 for dust and water ice optical depths, unless MCD (Forget et al., 1999; Millour et al., 2018) foresees standard deviations smaller than these values), and 3) the Levenberg - Marquardt method applied to the Bayesian algorithm, with the γ-parameter value varying at each iteration. The last version of algorithm uses Wolff's optical properties for dust with a lognormal size distribution with r_{eff} = 1.65 μm and v_{eff} = 0.35 (Wolff et al., 2006). The water ice refractive indices are described by Warren et al. (1984). The lognormal size distribution is used for a spherical shape of water ice with r_{eff} = 3.5 μm and v_{eff} = 0.35.

Then, after the preparation of the 'a priori' covariance matrix, the initial state vector is prepared for the Bayesian analysis. The initial state vector x (x_1, x_2, x_3, ..., x_n) contains a first guess of atmospheric temperature profile on pressure grid given in Tab.1, surface temperature, total column-integrated dust and water ice optical depths. The problem of retrieval relies on finding the state vector x knowing measurements y (y_1, y_2, y_3, ..., y_m) as a measurement vector (radiances) described by equation (2.2) in Rodgers (2000). The inverse problem for temperature retrieval is nonlinear thus the Gauss-Newton iteration is necessary to apply. We also implement additionally the Levenberg-Marquardt method. The updated state vector x for the n+1-iteration is obtained from the equation (5.36) in Rodgers (2000). The parameter γ_n is chosen at each step of iteration to minimize the cost function given in the formula (8.3) written in Rodgers (2000). For each iteration the quality of fit (self-consistency) is checked using a chi-square. If the chi-square is less than 1.1 the iteration is stopped providing the final results (state vector x) which is flagged as a quality factor of 1. The presentation of state vector x and its seasonal variations can be found in the paper by Giuranna et al. (2021).

4. ARCHIVE FORMAT AND CONTENT

The results are given in the NetCDF format, often used by modellers. Below the user can find the description of PFS dataset content.

4.1 List of variables and attributes in the NetCDF file

PFS_dataset_20793.nc

dimensions: 2

Variables: 19

Global attributes: 9

The unlimited dimension is 1

Dimensions

0 Name: P_layer Size: 61

1 Name: N_Meas Size: 1590000

Global Attributes

0 Title: PFS MEX Retrievals (QF=1)

1 Version: v0.1

2 Mission: MARS-EXPRESS

3 Content: PFS unbinned retrievals from Ls=331.18° of MY 26 to Ls=218.66° of MY 35 (from MEx orbit 00010 to 20793)

4 Description: Please, read the accompanying file "PFS_Dataset_Description.txt" for a description of this dataset

5 Author: Marco Giuranna

6 email: marco.giuranna@inaf.it

7 Institution: INAF-IAPS

Variables and attributes

0 Temperature: FLOAT(61,1590000) = FLOAT(P_layer,N_Meas)

0 long_name: Retrieved atmospheric temperature profiles

1 short_name: T

2 notes: The atmospheric temperatures are retrieved on a fix Pressure grid. NaN values are used when pressure values correspond to altitudes "below" the surface

3 units: K

1 Pressures: FLOAT(61) = FLOAT(P_layer)

0 long_name: Pressure grid used in all retrievals

1 short_name: P

2 units: mbar

2 Altitude: FLOAT(61,1590000) = FLOAT(P_layer,N_Meas)

0 long_name: Altitude profiles of retrieved atmospheric temperatures

1 short_name: H

2 units: km

3 notes: From local surface -> min value = 0. Values of "-100" are used for altitudes "below" the surface

3 orbit_number: FLOAT(1590000) = FLOAT(N_Meas)

0 long_name: MEx orbit Number

1 short_name: Otbit

4 p_surf: FLOAT(1590000) = FLOAT(N_Meas)

0 long_name: Surface pressure

1 short_name: Psurf

2 units: mbar

3 notes: From MCD v5.2

5 T_surf: FLOAT(1590000) = FLOAT(N_Meas)

0 long_name: Retrieved Surface Temperature

1 short_name: Tsurf

2 units: K

6 h_surf: FLOAT(1590000) = FLOAT(N_Meas)

0 long_name: Surface altitude wrt Mars aeroid

1 short_name: Hsurf

2 units: m

3 notes: MOLA data uses an aeroid, or “sea level” measurement as a zero point, and the altitude data is measured up and down from that level

7 dust: FLOAT(1590000) = FLOAT(N_Meas)

0 long_name: Retrieved dust opacity (column)

1 short_name: tau_dust

2 notes: Coulmn dust optical depth at 1075 cm-1

8 dust_norm: FLOAT(1590000) = FLOAT(N_Meas)

0 long_name: Retrieved NORMALIZED dust opacity (column)

1 short_name: tau_dust_norm

2 notes: Coulmn dust optical depth at 1075 cm-1, normalised to Psurf = 6.1 mbar

9 ice: FLOAT(1590000) = FLOAT(N_Meas)

0 long_name: Retrieved ice opacity (column)

1 short_name: tau_ice

2 notes: Coulmn ice optical depth at 825 c

10 lat: FLOAT(1590000) = FLOAT(N_Meas)

0 long_name: Latitude

1 short_name: Lat

2 units: degrees

3 valid_range: -90.0000

3 valid_range: 90.0000

4 notes: [-90°, +90°]

11 lon: FLOAT(1590000) = FLOAT(N_Meas)

0 long_name: East Longitude

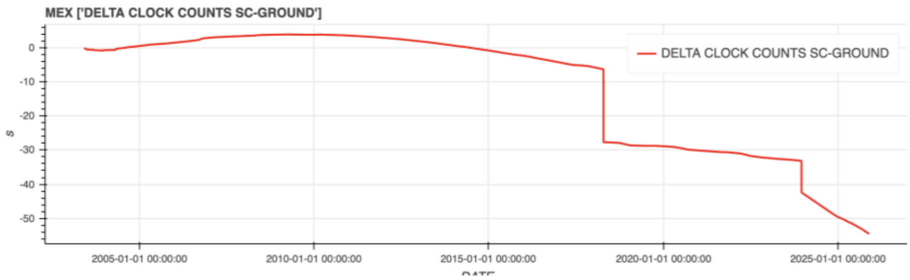
1 short_name: Lon
2 units: degrees
3 valid_range: -180.000
3 valid_range: 180.000
4 notes: East Longitude, [-180°, +180°]
12 loct: FLOAT(1590000) = FLOAT(N_Meas)
0 long_name: Local Solar Time
1 short_name: LST
2 units: hours
3 valid_range: 0.000000
3 valid_range: 24.0000
4 notes: Local Solar Time, [0h, 24h], at observed longitude and ephemeris epoch calculated through SPICE (CSPICE_ET2LST)
13 ls: FLOAT(1590000) = FLOAT(N_Meas)
0 long_name: Solar Longitude
1 short_name: Ls
2 units: degrees
3 valid_range: 0.000000
3 valid_range: 360.000
4 notes: Mars Solar Longitude (season), [0°, 360°]
14 ls_MY: FLOAT(1590000) = FLOAT(N_Meas)
0 long_name: Incremental Solar Longitude
1 short_name: Ls_MY
2 units: degrees
3 notes: 0-360 are from MY 26; 360-360*2 are from MY 27; ... ; 360*8-360*9 are from MY 34
15 incidence_angle: FLOAT(1590000) = FLOAT(N_Meas)
0 long_name: Solar Incidence Angle
1 short_name: IncAng
2 units: degree
3 valid_range: 0.000000
3 valid_range: 180.000
4 notes: This is the angle between the Sun and a "normal" drawn perpendicular to the surface of the planet
16 emission_angle: FLOAT(1590000) = FLOAT(N_Meas)
0 long_name: Emission Angle
1 short_name: EmAng
2 units: degree
3 valid_range: 0.000000
3 valid_range: 90.0000
4 notes: This is the angle between PFS boresight and a "normal" drawn perpendicular to surface of the planet. When PFS is looking straight down ("nadir"), the emission angle is 0°
17 SCET: FLOAT(1590000) = FLOAT(N_Meas)

o long_name: Unique ID to identify a specific PFS measurement
1 short_name: SCET
18 quality_factor: FLOAT(1590000) = FLOAT(N_Meas)
o long_name: Quality Factor
1 short_name: QF
2 notes: Quality Factor: 1 = good; 2 = warning (check manually); 3 = bad.

Only retrievals with QF = 1 are provided in this initial release. The full dataset including retrievals with QF =2 and QF =3 might be obtained by request. Please contact the PFS PI at the following address: marco.giuranna@inaf.it

Note that the time coordinate given in the netCDF file is Spacecraft Event Time (SCET).

To a first approximation, the SCET is the number of seconds elapsed since 00:00.000 UT on 5 March 2003. However, the spacecraft clock has drifted over the course of the mission, and occasional time corrections are made; the plot below shows that the error in SCET has reached up to 60 seconds. If more accuracy than this is needed then the user is advised to generate times using the SCLK SPICE kernel, available from https://www.cosmos.esa.int/web/spice/spice-for-mex.



4.2 Auxiliary files

The auxiliary file "PFS_Dataset_Description.txt" contains some additional information about the dataset, including the uncertainty for the retrieved quantities and the pressure grid to be used for the retrieved vertical profiles of temperature. The same pressure grid is used in all the retrievals.

5. KNOWN ISSUES

None at the moment.

6. SOFTWARE

NetCDF (Network Common Data Form) is a set of software libraries and machine-independent data formats that support the creation, access, and sharing of array-oriented scientific data. It is also a community standard for sharing scientific data.

For more information please check the following web pages:

Developer's homepage
Introduction to NetCDF
NetCDF User's Guide
NetCDF Libraries
Wikipedia