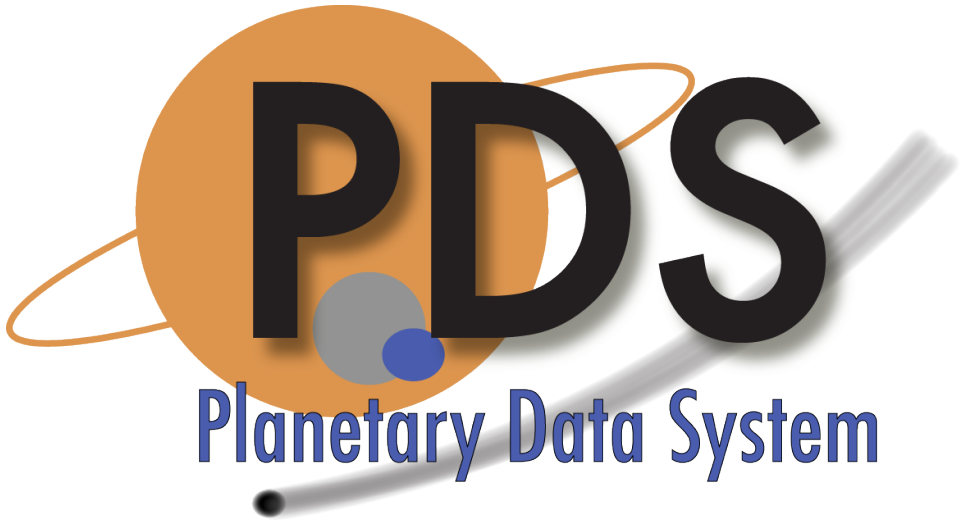


Atmospheres Node Report

Nancy Chanover
New Mexico State University

ATMOS Personnel

- No major changes (other than PI) from previous award period
  - Nancy Chanover (PI)
  - Reta Beebe (CoI)
  - Jim Murphy (CoI)
  - Lyle Huber (CoI)
  - Lynn Neakrase (CoI)
  - Joni Johnson (Staff)
  - Irma Trejo (Staff)
  - Shannon Rees (Staff)
  - Student employees
    - Saul Ramirez
    - Danae Hornung
- Contract to NMSU's Information and Communication Technologies division for server administration

Current PDS4 Involvement

- LADEE & MAVEN mission work (Lyle, Lynn, Reta)
- DDWG and Tiger Team development work (Lyle)
- CCB involvement (Lynn) – Chair until December
- Website End User Access development (Reta, Irma, Lynn, Jim, Nancy)
- Data Ingestion and Management (Lyle)
- Data backup and deep archiving (Irma, Joni)
- Data Provider proposal help and data submissions (Nancy, Jim, Lynn, Reta, Joni)
- PDS3 Data Migration (Shannon, Lynn, Lyle, Reta and students)

Advisory Group

- will serve as our conduit to the planetary atmospheres community at large and will:
  - give us feedback on specific aspects of the ongoing development of the archives
  - provide suggestions for peer review panels
  - address issues on web pages related to their areas of expertise
  - take part in an annual assessment
- Membership (others will be temporarily added as needed):

Name	Institution	Expertise
Brigette Hesman	U Maryland/GSFC	Outer planets, infrared spectroscopy
Melinda Kahre	NASA/ARC	Mars atmosphere, general circulation models
Rosemary Killen	NASA/GSFC	Moon and Mercury exospheres
Ralph Lorenz	JHU/APL	Titan atmosphere, Mars aeolian geomorphology, dust devil processes, extensive PDS experience
Mark Shirley	NASA/ARC	Moon UV spectroscopy, extensive PDS4 experience
Paul Withers	Boston University	Accelerometers, Radio Science, extensive PDS experience
Raffaella Noschese	ASI/ESA	Juno IR spectroscopy

PDS Planetary Data System ATMOS Data Holdings (current)

NM STATE UNIVERSITY

Target Body	Mission	Instrument/Data Set	Total Data Volume (Gb)
Mercury	MESSENGER	MASCS UV, VIRS spectra	616 current, 200 future
Venus	MESSENGER	MASCS UV, VIRS spectra	(see above)
	Venus Express	Radio science	14
	Magellan	Radio occultation	8
	Pioneer	OUVS and NMS	1
Moon	LADEE	Mass spectrometer, UVS spectra	72
Mars	MAVEN	accelerometer, mass spectrometer, UV spectrometer	645 current
	MSL	REMS	49 current, TBD future
	MRO	accelerometer, climate sounder, radio science	667 current, TBD future
	MER	accelerometer	1
	Mars Express	PFS, SPICAM	38
	Mars Odyssey	accelerometer	2
	MGS	science sampler, accelerometer, radio science, reduced P-T profiles	7
	Phoenix	LIDAR, MET, opacity, atmospheric structure, telltale winds	5
	Pathfinder	atmospheric structure	1
	Viking	atmospheric structure & winds, footpad & near surf. temps., daily avg. temps., water vapor, cloud distribution	1
	Mariner 9	IRIS cloud distribution	1

ATMOS Data Holdings (current)

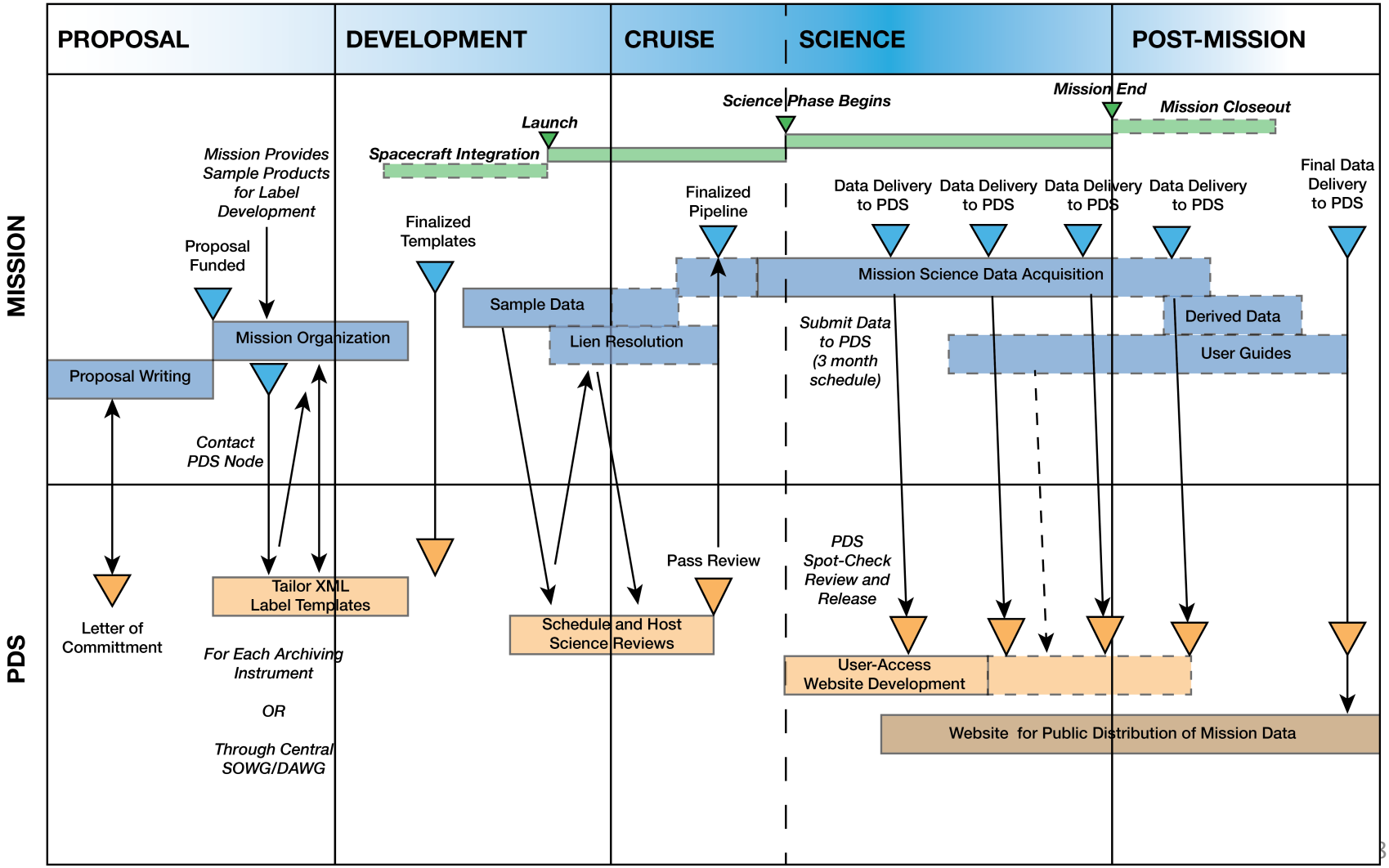
Target Body	Mission	Instrument/Data Set	Total Data Volume (Gb)
Jovin Planets & Titan	European Southern Observatory	ground-based spectrophotometry yielding full disk albedos, methane abs. coeff.	1
Jupiter	Cassini	CIRS spectra, UVIS spectral cubes	39
	Galileo Orbiter	PPR, UV & EUV spectra	3
	Galileo Probe	ASI, DWE, EPI, HAD, LRD, NEP, NFR, NMS	1
	Comet Shoemaker-Levy 9	HST/WFPC2, Anglo-Australian Telescope	3
	Voyager	IRIS N/S and Great Red Spot Maps of NH_3, Para/Ortho H_2, Opacity and Temperatures, UVIS North/South Brightness	3
Saturn & Titan	Cassini	CIRS IR Spectra, Radio Science, UVIS Cubes, Solar data and Spectral Products	1882 currently
	Voyager	IRIS N/S Maps of NH3, Para/Ortho H2, Opacity and Temperatures, UVIS North/South Brightness	3
Titan	Huygens Probe	Aerosols, Spectral Images, Trajectory, Doppler Wind, Gas Chromatography, Atmospheric Properties, Engineering Data	8
Uranus	Voyager	IRIS, UVS	1
Neptune	Voyager	IRIS, UVS, radio science for Triton	1
TOTAL			**> 4.2 Tb**

ATMOS Data Holdings (future)

Target Body	Mission	Instrument/Data Set	PDS Version	Total Data Volume (Gb)
Mars	MAVEN	accelerometer, mass spectrometer, UV spectrometer	PDS4	~2000
	InSight	Weather data	PDS4	TBD
	Mars 2020	MOXIE, MEDA	PDS4	TBD
Jupiter	Juno	JIRAM, MWR, UVS & Gravity	PDS3 (migrated to PDS4 upon receipt)	2500
Saturn & Titan	Cassini	CIRS IR Spectra, Radio Science, UVIS Cubes, Solar data and Spectral Products	PDS3	900
TBD	Discovery or New Frontiers missions	any selected Discovery and New Frontiers missions with atmospheric science data	PDS4	TBD
TBD	TBD	derived data sets from R & A programs such as PDART and DAPs	PDS4	TBD
TBD	Ground-based observations	contributed data sets from ground- based observers	PDS4	TBD
TOTAL				**> 5.5 Tb**

Working with Mission Data Providers

PDS-Mission Interaction Timeline



Working with Mission Data Providers – Early Steps

- Work with the mission to establish a timely process for development of a Data Management Plan. Establish a process for recovering a mission timeline.
- Upon early contact with the instrument teams, determine what formats and data structure the teams anticipate using. Work with them to formulate a PDS4 development plan (note: mission data center requirements can create huge obstacles).
- Help the teams to develop a bundle structure and develop sample label templates.
- Get the SIS and other documentation in place as early as possible.
- Iterate with providers to establish bundle structure and fleshed out labels.
- Define the delivery mechanism.

Working with Mission Data Providers-During & End of Mission

- Early in the mission - Establish a process for developing a data pipeline and setting up formal peer reviews.
- Agree on a schedule of deliveries, including derived products, and make sure the mission PI is committed to it.
- Validate the first delivery and establish a process to populate an accumulating data set. Begin development of a mission timeline.
- Determine nature of derived products and a schedule for their delivery.
- Stay in close contact with individual data suppliers, working around the science data center when necessary.
- Ensure that the final delivery is completed with enough time to evaluate and correct the final data set before funding runs out

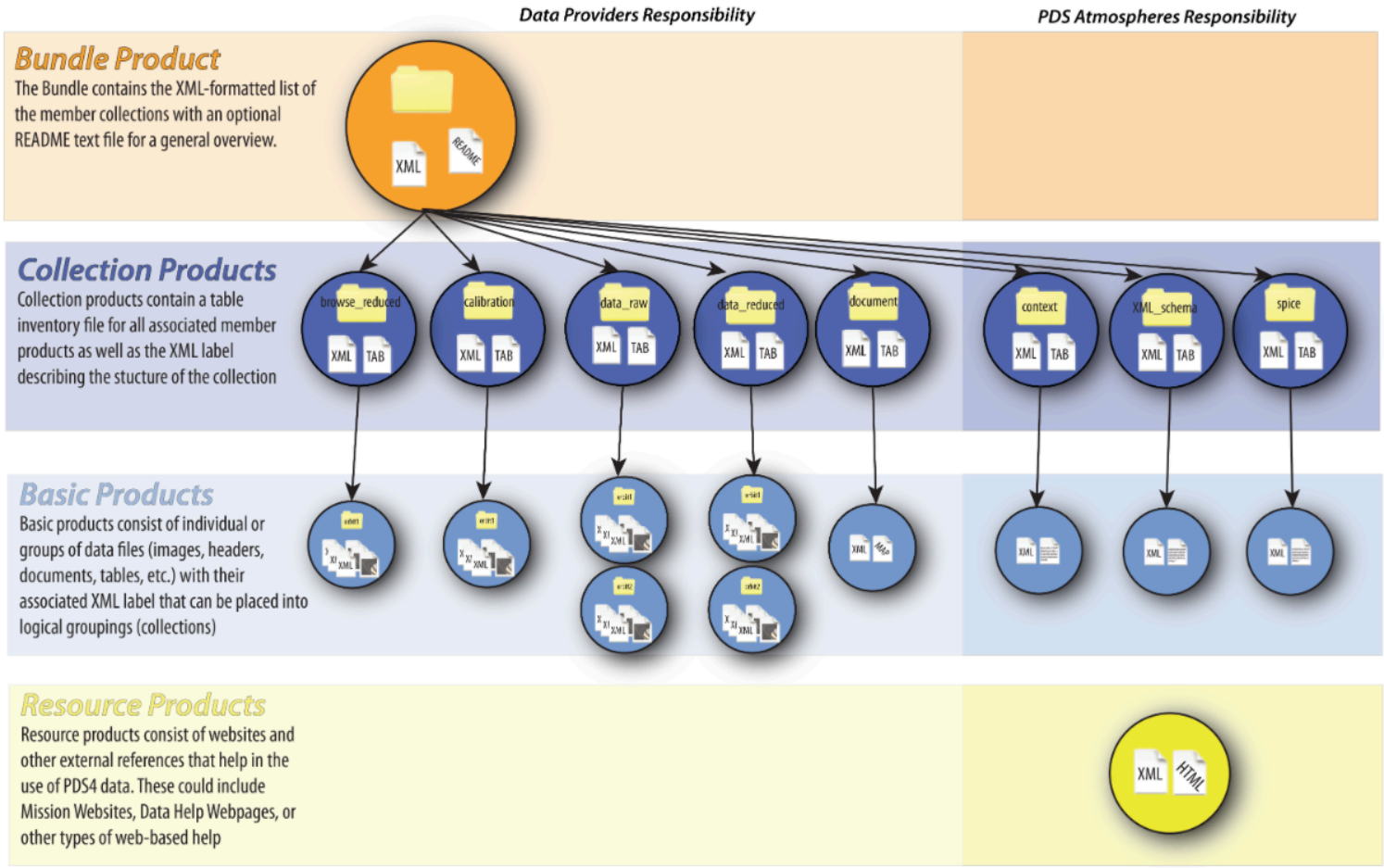
Working with Providers of Derived Data Products

- Development of steps to improve interactions with derived data providers
  - Aiding in cost assessment through understanding the responsibilities for node and provider
  - Learning the new layout of PDS4 hierarchy for data management plans
  - Improving communication from proposal to data archive

Working with Providers of Derived Data Products

- Resources on the ATMOS web site:
  - Responsibilities: http://pds-atmospheres.nmsu.edu/Archive_Responsibilities(PDART)V2.pdf
  - Process Planning: http://pds-atmospheres.nmsu.edu/pds4_comp.html
  - Generalized Bundle Examples: http://pds-atmospheres.nmsu.edu/bundle_diagram.html

Working with Providers of Derived Data Products



Working with Providers of Derived Data Products

RESPONSIBILITIES:

STEP	Data Provider	PDS Atmospheres Node
1	Contact the PDS Atmospheres Node to start a new archive. As a result of funding opportunities, some funding agencies will contact PDS. Always be proactive. Initial conversation should include mission information (if applicable), types of data products to be archived, estimated volume of data, and all contact personnel for completing the proposed work. Layout of the entire work effort begins in this step.	
2	Data Provider will establish a point of contact for the project to ensure completion of the archive in a timely fashion. Schedules for delivery of the archive to the PDS will be established during this phase of development and may be highly dependent on the type of data to be archived.	PDS Atmospheres Node will acknowledge the new project and request data samples representative to the proposed archive. Atmospheres node will request a copy of the funded proposal devoid of budget information to begin tailoring PDS4 XML label templates to be provided to the Data Provider.
3	After providing sample data and background information about the instruments or experiments, the Data Provider(s) will help refine all metadata to be captured in the labels for all products for the proposed archive. Basic PDS4 Bundle structures will be planned out at this time including proposed Collections (e.g., data, document, etc.).	PDS Atmospheres Node provides tailored XML label templates to be used by Data Provider in generation of the archive. This process is iterative with the Data Provider and is essential for capturing all important metadata for the future use of the proposed data archive.
4	Data Provider produces necessary Documentation including finalization of the Software Interface Specification (SIS) and any associated calibration information for each archive bundle.	PDS Atmospheres Node begins to set up review panel(s) for the peer review of the sample archive. Panel members may include external specific experts on similar data, and PDS personel.
5	Once the archive is accepted from the peer review process and all liens are resolved, the Data Provider will have a viable method for generation of all data products for the time allotted by the initial schedule for archive completion. Project scientists can aid PDS in designing and setting up websites to distribute the data once the archive is complete.	PDS Atmospheres Node will provide a website for distribution of the archive. In collaboration with the Data Provider, the website will be designed in a style determined by PDS for ease of distribution with input from the Data Provider.
6	Data produced over the span of the project will be reviewed for integrity and completeness at the end of the delivery period. The Data Provider will be expected to provide all data (all levels agreed upon in the initial setup) and all documentation to PDS. Certain pieces of the archive (XML Schema collections and Context collections) will largely be handled by PDS for final completion of the archive.	PDS Atmospheres will set up and conduct validation and completeness reviews of the final archive products upon delivery. After lien resolutions by the Data Provider, PDS will Certify the archive rendering it usable and accessible to other funding opportunities via the PDS web interfaces designed by the collaborative effort of PDS and the Data Provider. PDS will determine the need for additional reviews (e.g., multiple deliveries with different resultant products). In general there is one review before the first public data release.

Rationale for Atmospheres Access Focus

- the comparative nature of the research programs of many of our users
  - e.g. Withers utilizing radio science and probe entry data to understand effects of space weather and dust storms on planetary ionospheres and thermospheres
- the desire to maintain ease of access to seemingly disparate data sets related to planetary atmospheres (more about this shortly)
- the shift within NASA's Planetary Science Division to encourage interdisciplinary, comparative studies through a reorganization of the R & A programs based on crosscutting themes rather than target-based programs
  - e.g. Solar System Workings vs. Outer Planets Research Program

Typical Use Cases (1)

- Graduate students sent by their advisors to retrieve data on a particular topic and to determine whether the data exists in the PDS, and if so, did they retrieve it all.
- In response to this need we developed a set of Mars Orbiter and Lander matrices that reveal which *types* of data are available for each mission.
- See http://atmos.nmsu.edu/data_and_services/atmospheres_data/MARS/data_archive.html
- We can develop a desired list of derived data products listed on these pages to encourage suppliers to provide additional derived products.

Welcome to the Data Archive for Mars Orbiting Spacecraf

The following charts and linkages are meant to provide a summary of available atmospheric information. In addition, utilization of the sidebar will provide access. Suggestions for improvements or offers of data products to be included are invited. Please send them to Reta Beebe at rbeebe@nmsu.edu.

Orbiters

	Visible Derived		InfraRed Derived			Radio Occultation		Aerobraking	Mass Spectrometer	UV & IR	IR & V
	Aerosols/ H20 Vapor	Clouds	Ground Temperatures	Aerosol Clouds	T(P)	T(P)	Electron Density	Densities	Composition	Occultation	Spectra
Pre-Mariner 9	*The Node does not have any pre-Mariner 9 data. We recommend searching at http://adsabs.harvard.edu/abstract_service.html for publications on the Mariner 4 (1965) set the time gate to 01/1964 to 01/1967 and enter Mariner 4 in the abstract window. For Mariner 6 and 7 (1969) set the time gate to 01/1967 to 01/1970 with either Mariner 6 or 7.*										
Mariner 9		From images									IRIS
Viking Orbiter 1 & Orbiter 2	Atmospheric Water MAWD	From Images	Surface Temp & Albedo IRTM		Atmospheric Temperature IRTM						
Mars Global Surveyor (MGS)						Temperature vs Pressure RS	Electron Density RS	Density ACC			
Mars Odyssey								Density ACC			
Mars Express										IR & UV Spectra SPICAM	1.2-45 μ SPICAM
Mars Reconnaissance Orbiter (MRO)			Temperature MCS	Dust & Clouds MCS	Temperature vs Pressure MCS	Temperature vs Pressure RS		Density ACC			
								Density	Abundances	Spectra UV	

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Orbiters

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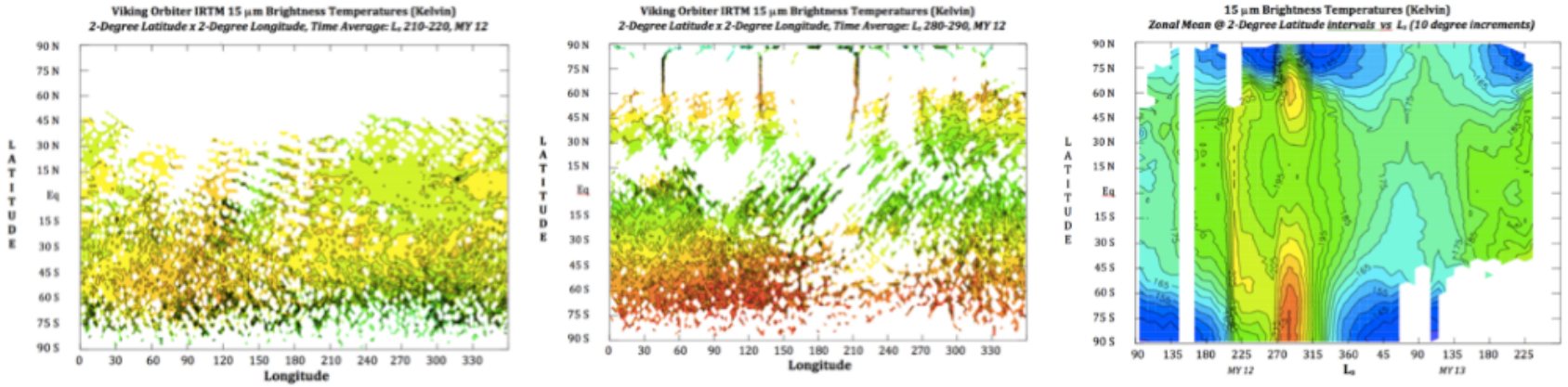
Mars Reconnaissance Orbiter (MRO)			Temperature MCS	Dust & Clouds MCS	Temperature vs Pressure MCS	Temperature vs Pressure RS		Density ACC			
								Density	Abundances	Spectra UV	

Welcome to the Viking 1 & 2 Orbiter Archive

InfraRed Thermal Mapper (IRTM) ATMOSPHERIC TEMPERATURE, "T15"

July 4, 1976 (Ls 90) to Feb 13, 1979 (Ls 230)



Atmospheric "T15" temperatures (15 μm brightness temperatures) were derived from Viking Orbiter IRTM measurements. The two maps on the left were averaged over 10 degrees of Ls, 210-220 and 280-290, MY 12 for 2-degree latitude by 2-degree longitude bins. A more seasonal representation of T15 in the form of zonally (longitudinally) averaged T15 over 10 degree Ls time increments for the duration of the Viking Orbiter mission, Ls 90 MY 12 through Ls 235 MY 13 is shown on the right. All available times of sol are included in these averaged temperature values, but sampling is not necessarily uniform, nor is the spatial coverage (as illustrated by the maps above).

Useful Mission Documents

- Description of data volume
- Mission Description
- Spacecraft Description
- Instrument Description
- References

Description of the DATA Document

The data contained within the Viking orbiter IRTM temperature archive provide the location (latitude, longitude), time (Ls and time-of-sol), and derived temperature and albedo values (and their standard deviations). They are in the form of averaged values spanning 10-degree Ls and 2-degree latitude by 2-degree longitude. In addition to the 15 μm atmospheric temperatures the archive also provides ground temperature (20 μm brightness temperature, T20) and differences between T20 and T7 (7 μm brightness

Typical Use Cases (2)

- A user who is familiar with a particular mission and data set wants to quickly retrieve bulk data.
- This highlights the need for
  - well-formulated mission timelines (like we got from the Cassini mission)
  - direct access to the instrument bundles and appropriate zip files
- we have an incomplete MAVEN timeline that we are developing; working with the MAVEN SDC to help us fill in the Notes column

Typical Use Cases (2)

Orbit No.	Time of Periapse UTC		Time of Apoapsis UCT		Solar Longitu	Solar Latitud	Spacecraft Lo	Spacecraft La	Altitude	Solar Distanc	Martian Year	Ls	Notes
2	2014 Sep 23	13:03:46	2014 Sep 24	6:34:36	262.36	-8.84	336.13	28.54	382.28	213043879	32	201	
3	2014 SEP 24	23:59:56	2014 SEP 25	17:25:37	112.38	-9.18	185.23	28.65	204.58	212828104	32	201.9	
4	2014 SEP 26	10:51:14	2014 SEP 27	4:14:04	323.6	-9.53	35.52	28.75	203.97	212615679	32	202.9	
5	2014 SEP 27	21:37:11	2014 SEP 28	0:20:12	176.11	-9.87	247.5	27.79	200.39	212406685	32	203.8	
108	2014 OCT 18	11:38:39	2014 OCT 18	13:57:13	165.12	-14.52	205.72	42.86	185.14	209779069	32	216.4	NGMS Comet Siding Springs Observations
109	2014 OCT 18	16:15:42	2014 OCT 18	18:34:16	97.72	-14.56	137.98	42.99	185.53	209757768	32	216.5	NGMS Comet Siding Springs Observations
110	2014 OCT 18	20:52:43	2014 OCT 18	23:11:16	30.34	-14.61	70.32	43.12	184.78	209736533	32	216.7	NGMS Comet Siding Springs Observations
111	2014 OCT 19	1:29:43	2014 OCT 19	3:48:18	322.96	-14.65	2.61	43.25	185.62	209715365	32	216.8	NGMS Comet Siding Springs Observations
112	2014 OCT 19	6:06:46	2014 OCT 19	8:25:19	255.56	-14.69	294.9	43.39	185.95	209694257	32	216.9	NGMS Comet Siding Springs Observations
113	2014 OCT 19	10:43:45	2014 OCT 19	13:02:19	188.18	-14.73	227.22	43.55	185.26	209673219	32	217	NGMS Comet Siding Springs Observations
114	2014 OCT 19	15:20:48	2014 OCT 19	17:39:21	120.79	-14.77	159.51	43.63	186.28	209652241	32	217.1	NGMS Comet Siding Springs Observations

Mission Issues

- Cassini: archiving is progressing smoothly and we are working with the mission to recover derived data sets
- LADEE: Derived products are in final stages and all the data from the mission will be complete by next month. We are implementing access at the product level.
- MAVEN: IUVS and NGIMS are current and we are implementing access at the product level
- Juno: on schedule and we are developing the skills needed to migrate the various types of data as they are submitted.

Directions for Year 1

- Develop a systematic approach to assist potential suppliers to realistically plan and estimate the amount of effort and development necessary to produce a PDS4 compliant atmospheres data set.

- Develop a process for guiding data suppliers to work with us from selection-to-delivery to optimize the quality of the metadata, assure PDS4 compliance while maximizing the efficiency of the supplier.

- Fully implement PDS4 capabilities into PDS4 help pages of LADEE, MAVEN and migrated data and to allow retrieval at the product level.

- Prepare to migrate Juno while the mission is in progress.