

# PDS Geosciences Node Virtual Open House

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Paul Byrne, Tom Stein, and the Geosciences Node team

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Dept. of Earth, Environmental, and Planetary Sciences  
McDonnell Center for the Space Sciences  
Washington University in St. Louis



# Agenda

- Welcome and Opening Remarks
- Node Overview and Mission
- Team and Organizational Update
- Mission Archiving
- Individual Data Providers
- PDS3-to-PDS4 Migration
- Data Tools: ODE, Spectral Library, Analyst's Notebook
- IT Infrastructure, Cloud Migration
- Coming Year Priorities
- Resources | Open Q&A | Closing



TOPICS 1–2

# NODE OVERVIEW AND MISSION

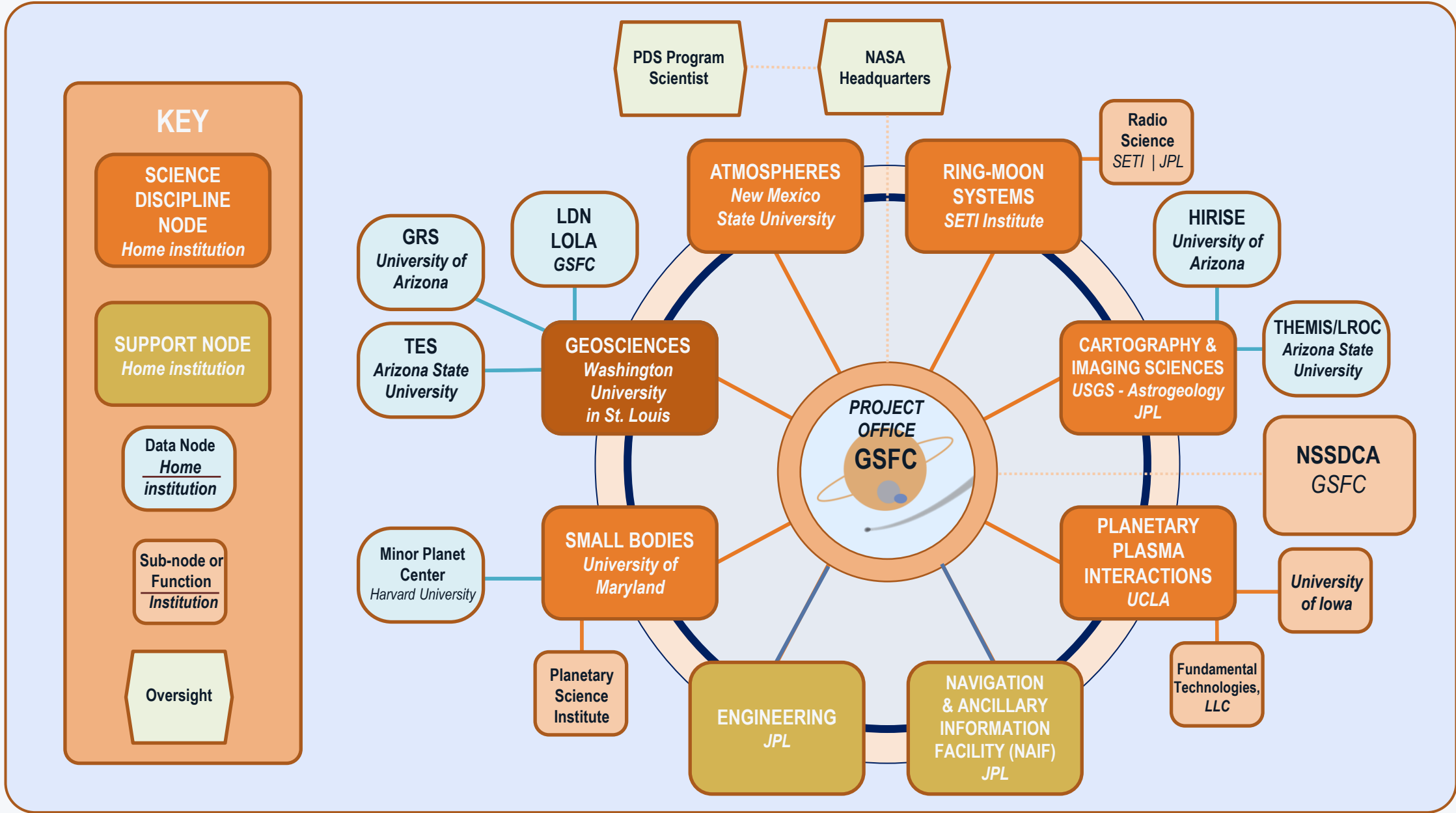
TOM STEIN

# What is the PDS Geosciences Node?

- Part of NASA's Planetary Data System, one of a federation of discipline nodes
- GEO is the long-term archive for geoscience data from NASA planetary missions and individual data providers
- Scope: ~400 TB of archive data (~60 million files) spanning multiple planetary bodies and mission eras
- Lead node for missions focused on surfaces and interiors of Mercury, Venus, Mars, and the Moon
- Hosted at Washington University in St. Louis

# GEO Activities at a Glance

- Preserving science data and fostering open science
- Community-facing tools
  - Orbital Data Explorer (ODE), Analyst's Notebook (AN), Spectral Library
- Supporting data providers via archive preparation, peer review, DOI assignment
- In-person and online community engagement and support
  - AGU/LPSC, workshops, user forum, email requests
- PDS-internal working groups
  - Data Design, Software, Editorial, Web Modernization, Change Control Board
- International Planetary Data Alliance – promoting PDS4 adoption globally
- PDS cloud migration



# PSD Data Services Program

- Data Services Program

- Established within Planetary Sciences Division in response to community findings and needs
- Provides means to lead and develop innovative and sustainable program through these goals:
  - Preserve planetary science data and make them discoverable and available to everyone following open science practices
  - Continuously evaluate and evolve planetary data and computing systems for accessibility, efficiency, sustainability, security, usability, transparency, and scientific innovation
  - Develop and implement the standards, policies, and capabilities needed to explore and use planetary data, foster partnerships, and enable innovative science and exploration
  - Enable the community to adopt and maintain an open science culture based on collaboration, coordination, integrity, and engagement

PSD  
Data  
Services  
Program

Infrastructure

Data Archives



Software and Tools

Discovery and Development

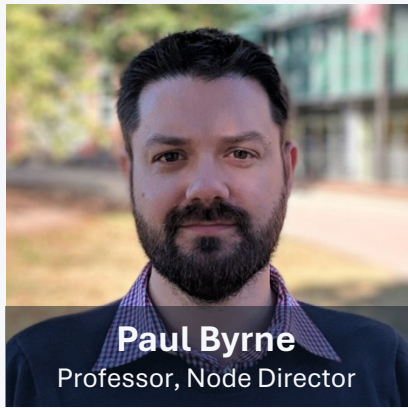
Standards and Policy



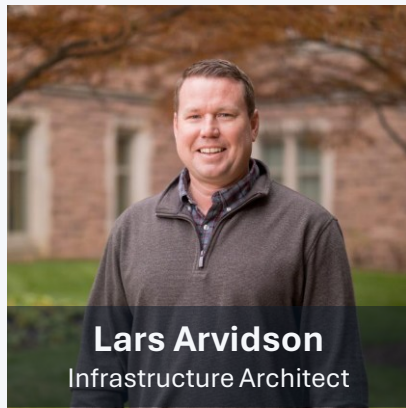
TOPIC 3

# TEAM AND ORGANIZATIONAL UPDATE

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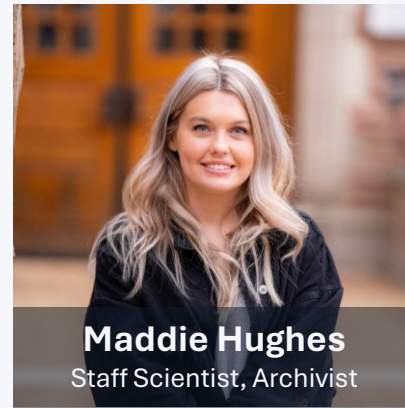
**Paul Byrne**  
Professor, Node Director



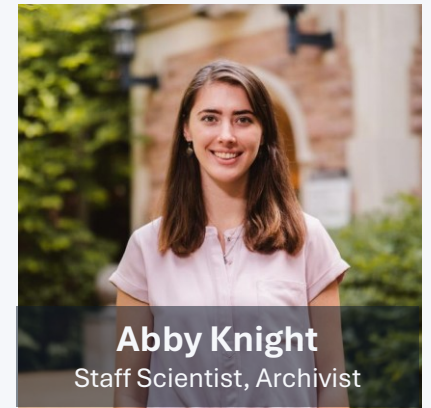
**Lars Arvidson**  
Infrastructure Architect



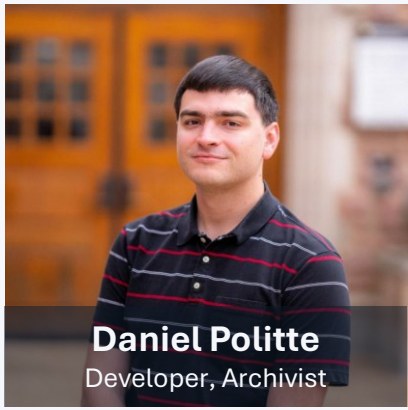
**John Christian**  
Postdoctoral Research Assoc



**Maddie Hughes**  
Staff Scientist, Archivist



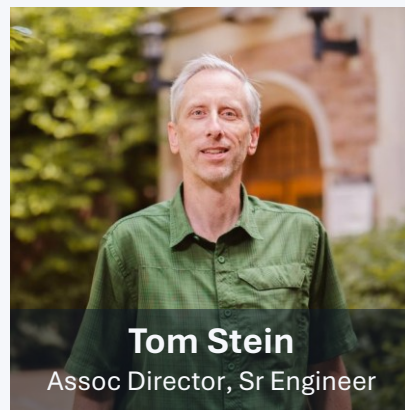
**Abby Knight**  
Staff Scientist, Archivist



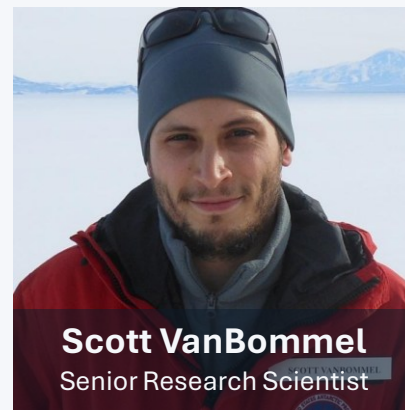
**Daniel Politte**  
Developer, Archivist



**Dan Scholes**  
Software Architect



**Tom Stein**  
Assoc Director, Sr Engineer



**Scott VanBommel**  
Senior Research Scientist



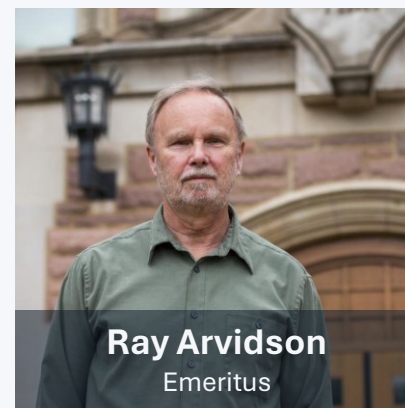
**June Wang**  
Mapping Scientist, Archivist



**Jennifer Ward**  
Senior Mission Archivist



**Feng Zhou**  
GIS Specialist, Developer



**Ray Arvidson**  
Emeritus



**Ed Guinness**  
Emeritus



# GEO Advisory Group

- Diana Blaney – Jet Propulsion Laboratory
- Lynn Carter – University of Arizona
- Abby Fraeman – Jet Propulsion Laboratory
- Trent Hare – US Geological Survey
- Erwan Mazarico – Goddard Space Flight Center
- Dave Williams – Arizona State University
- Ryan Zeigler – Johnson Space Center



TOPIC 4

# MISSION ARCHIVING

JENN WARD

# Node Archiving Responsibilities

- We collaborate primarily with NASA to create high-quality, well-documented, peer-reviewed mission archives
- Engage with mission teams early
  - Guiding archive preparation from the outset
- Full lifecycle
  - Archive Schedule > Archive Design > Products and Labels > Documentation > Peer Review > Scheduled Releases
- GEO is the lead PDS Node for missions studying surfaces and interiors of Mercury, Venus, Mars, and the Moon
  - Coordinate archiving across all PDS Nodes involved and manage relevant instruments
  - Lead regular Data and Archiving Working Group (DAWG) meetings

# Active Missions

## Active Missions

- Mars 2020
  - PIXL, RIMFAX, SHERLOC, SuperCam, Returned Sample Science (7 bundles)
- Mars Science Laboratory
  - APXS, ChemCam, CheMin, DAN, SAM (9 bundles)
- Mars Reconnaissance Orbiter
  - CRISM, SHARAD, Radio Science (14 datasets)
- Lunar Reconnaissance Orbiter
  - Diviner, LEND, LOLA, Mini-RF, Radio Science (11 bundles)
- Mars Odyssey
  - GRS Suite, Radio Science (9 bundles)
- Mars Express (ESA)
  - 8 instruments, 32 datasets

GEO is lead Node for all the above

# Developing Missions & Artemis

## Developing Missions

- Europa Clipper
  - MISE, REASON, Radio Science/Gravity (6 bundles)
- Dragonfly
  - DraMS/DrACO, DraGNS, DraGMet (3 bundles)
- EnVision (ESA) VenSAR, VERITAS (TBD)

## Artemis

- Artemis Program
  - GEO is lead Node for Artemis II, III, IV and V
  - Artemis III payload manifest TBD
- CLPS (30+ bundles)
  - Variety of payloads for lunar surface exploration; varying PDS requirements
  - Data Archive Support Service (DASS)
- Early engagement is key; contact us before CDR

TOPIC 6

# INDIVIDUAL DATA PROVIDERS

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# Individual Data Providers

- Currently working with ~30 individual data providers (PDART, MDAP, LDAP, SSW programs)
- Providers at various stages: initial consultation through peer review and public release
- Biannual status reporting to NASA Headquarters
- We accept datasets appropriate for GEO holdings with broad community appeal
- Recent releases:
  - Derived mission data: Phoenix TEGA mass spectrometer data, MSL ChemCam passive surface spectra
  - Laboratory spectral data: Frankenspectra spectral reflectance database, lunar simulant reflectance data
  - LIBS Reference Database (final stages)
- How to work with us: [pds-geosciences.wustl.edu/dataserv/proposerhelp.html](https://pds-geosciences.wustl.edu/dataserv/proposerhelp.html)



TOPIC 5

# PDS3-TO-PDS4 MIGRATION

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# PDS3-to-PDS4 Migration

- The PDS4 standard is a model-driven system that simplifies data formats and stores more extensive metadata in XML labels
- Community benefit through consistent data access, improved connections between data products, PDS API support, DOI citation
- Goal: complete migration of all PDS3 archives by FY2030 (most by FY2028)
- Active missions (LRO, MRO, MSL, Mars Odyssey) migrating — most work done by instrument teams
- Recent completions:
  - Magellan SCVDRs & Odyssey GRS Special Products (Jan 2026)
  - MRO CRISM DDRs and TRDRs (Oct–Nov 2025)
  - Apollo Datasets (Oct 2025); MRO SHARAD 3D Radargrams (Aug 2025)
- Near-term: Magellan F-BIDR/C-BIDR, MGS MOLA/TES, Phoenix MECA/TEGA
- Longer horizon: Viking Orbiter IRTM, individual data provider datasets (FY27–30)



TOPIC 7

# DATA TOOLS

DAN SCHOLLES • TOM STEIN

# Orbital Data Explorer (ODE)



[ode.rsl.wustl.edu](http://ode.rsl.wustl.edu)

- Search and download for orbital science products across planetary missions
- Recent improvements
  - PDS API integration
    - Additional source for ODE catalog updates
    - Outbound PDS API linking (from product detail pages)
  - Order confirmation email with link to monitor processing progress
  - Updated ODE help tutorial
  - Data updates: PDS3-PDS4 migrated data sets, ongoing mission data releases, new additions (MRO CRISM VNIR Hyperspectral RDR, Korea Pathfinder Lunar Orbiter – ShadowCam data)
- Upcoming
  - Updates to assist new users
  - Product detail page enhancements
  - Continue to add active mission data releases, PDS4-migrated data, and new derived PDS bundles



- Supports surface composition research across multiple spectral domains
- 2026Q2 updates
  - LIBS Reference Database PDS bundle (~305K Measurements)
  - Additional search filtering capabilities (atmosphere type, laser energy, specimen ancillary information)
  - Improved performance
- Future
  - Expanded Raman and Emission data
  - Enhanced search filters for new spectral types



- Integrated access to mission data, documentation, and context for landed missions to Mars and the Moon
  - MSL Curiosity, M20 Perseverance, InSight, MER Spirit and Opportunity, PHX, Apollo, LCROSS
- Recent updates
  - PDS Registry API integration for Mars 2020
  - PDS4 table viewer for Mars 2020 and InSight
  - File caching system
  - Map service updates
- Upcoming
  - Mars 2020 science target support in beta testing
  - Converting MSL to new PDS4 products

# Additional tools

- Geosciences Node
  - CRISM and OMEGA Analysis Tools
  - MakeLabels resource for data providers
- PDS-wide
  - PDS API
  - PDS Beta Site
  - Tool registry of additional tools

TOPIC 8

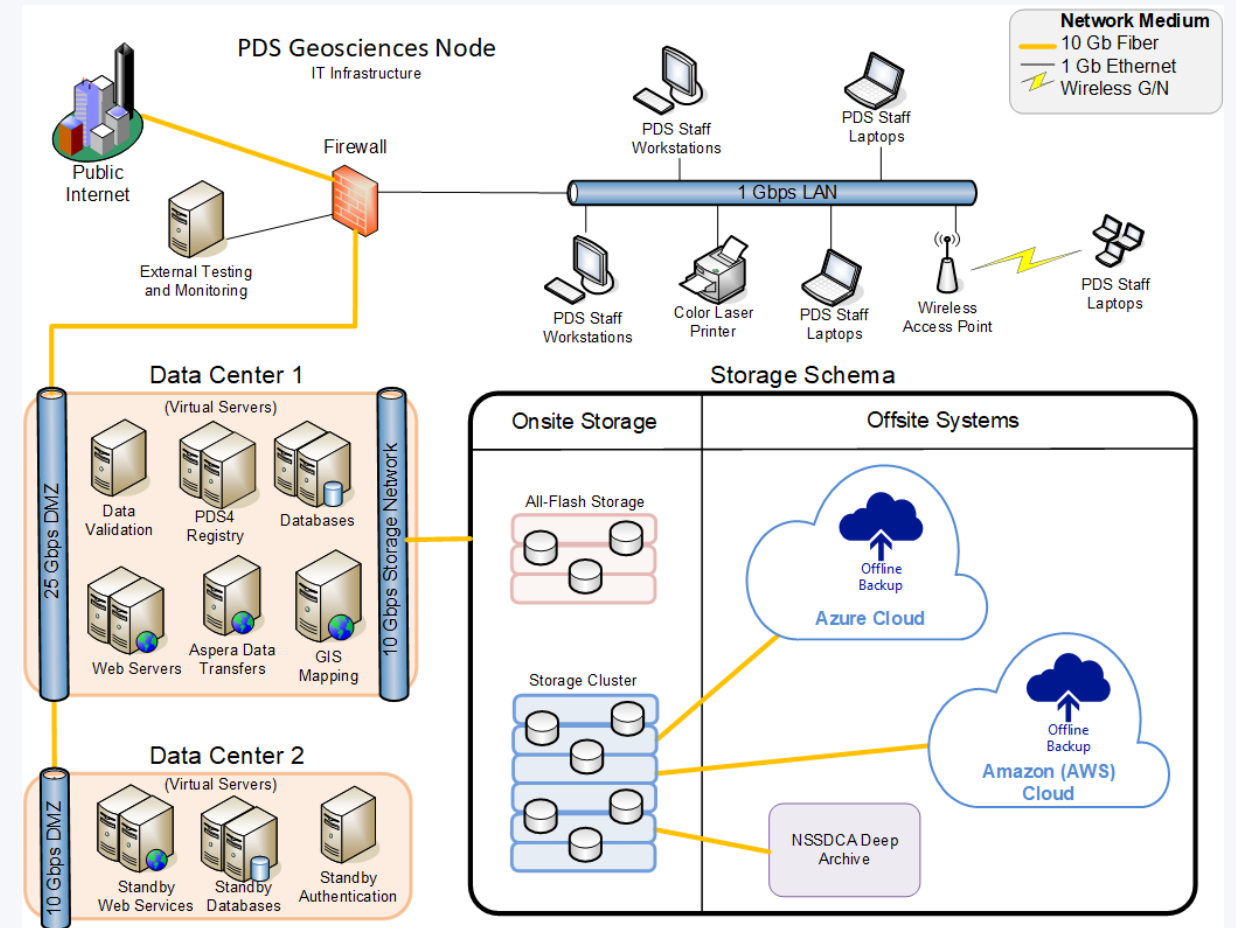
# IT INFRASTRUCTURE AND CLOUD MIGRATION

LARS ARVIDSON • TOM STEIN

# Current Infrastructure

## Overview

- Hybrid model of primary onsite IT + cloud integrations
- Three copies of archive:
  - Onsite (primary), AWS, Azure
  - Additional copy at NSSDCA
- ~400 TB archive data (60M files) + ~300 TB supporting files
- ~150 virtual servers
- NIST SP 800-53b compliant security controls



# Current Infrastructure

## Geosciences Node Cloud Integration

- Disaster recovery
  - **AWS Glacier Deep Archive:** ~1.5 PB full system backups
  - **Azure Archive:** ~600 TB PDS archive only backups
  - Archive-tier storage ~\$1/TB/month
- CRISM pilot
  - PDS data stored in Azure cloud storage
  - Access data from Azure compute instance
  - Investigate cloud computing while limiting data egress
- Historical PDS approach to cloud
  - Adoption guided by cost-benefit analysis

# PDS Cloud Migration

- NASA is now directing PDS to migrate archive data to the cloud as the primary copy
- Vision is unified, sustainable cloud platform ensuring long-term stewardship, open access, and scientific innovation
- What this means for users
  - Cloud-optimized access paths alongside traditional download; compute-to-data possible

## Strategic Pillars for Cloud Migration

Data Preservation First	Multi-tier storage (hot/warm/cold), automated lifecycle, quarterly integrity checks
Open and Equitable Access	Cloud-optimized formats, SPD-41a compliance
Cost Awareness and Optimization	Dashboards, soft quotas, anomaly detection
Security, Auditability, and Compliance	Identity and access management (IAM), auditing
Federated Operations	Nodes manage local usage; central CloudOps maintains guardrails
Policy-Driven Flexibility	Throttling, exemption workflows, hybrid access for diverse science use cases



TOPIC 9

# COMING YEAR PRIORITIES

PAUL BYRNE • TOM STEIN

# Coming Year Priorities

- Begin PDS Cloud Migration for select datasets in coordination with PDS Engineering Node
- Continue PDS3–PDS4 migration, on schedule toward FY2028/2030 goals
- Advance active mission data deliveries and new holdings
- AN, ODE, and Spectral Library enhancements as detailed
- Expand archiving support for Europa Clipper and Dragonfly
- Engage the community on data usability, including analysis-ready data, format compatibility, transformation tools
- Support PDS-wide actions like PDS4 standards evolution, web modernization rollout
- Explore cloud compute-to-data access opportunities for users

# Resources

Geosciences Node

[pds-geosciences.wustl.edu](https://pds-geosciences.wustl.edu)

User Forum

[geoweb.rsl.wustl.edu/community](https://geoweb.rsl.wustl.edu/community)

Orbital Data Explorer (ODE)

[ode.rsl.wustl.edu](https://ode.rsl.wustl.edu)

Analyst's Notebook

[an.rsl.wustl.edu](https://an.rsl.wustl.edu)

Spectral Library

[pds-speclib.rsl.wustl.edu](https://pds-speclib.rsl.wustl.edu)

Data Provider Help

[pds-geosciences.wustl.edu/dataserv/proposerhelp.html](https://pds-geosciences.wustl.edu/dataserv/proposerhelp.html)

Contact

[geosci@wunder.wustl.edu](mailto:geosci@wunder.wustl.edu)

PDS Beta Site

[pds.mcp.nasa.gov](https://pds.mcp.nasa.gov)



Q&A

# OPEN DISCUSSION

QUESTIONS, FEEDBACK, AND CONVERSATION WELCOME

# Thank You

 [pds-geosciences.wustl.edu](http://pds-geosciences.wustl.edu)

 [geosci@wunder.wustl.edu](mailto:geosci@wunder.wustl.edu)

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Daniel Politte • Dan Scholes • Scott VanBommel • June Wang • Jennifer Ward • Feng Zhou