



EXPLORING BLOCKCHAIN TO SUPPORT OPEN SCIENCE PRACTICES

Iksha Gurung¹, Slesa Adhikari¹, Abdelhak Marouane¹,
Rajesh Pandey¹, Satkar Dhakal², Manil Maskey³

University of Alabama in Huntsville
Vanderbilt University
NASA Marshall Space Flight Center



Open Science

"Open-source science is a commitment to the open sharing of software, data, and knowledge (algorithms, papers, documents, ancillary information) as early as possible in the scientific process."

- Open-Source Science Initiative, NASA



OPEN (TRANSPARENT) SCIENCE
scientific process and results should be visible, accessible, and understandable



OPEN (INCLUSIVE) SCIENCE
process and participants should welcome participation by and collaboration with diverse people and organizations



OPEN (ACCESSIBLE) SCIENCE
data, tools, software, documentation, and publications should be accessible to all (FAIR)



OPEN (REPRODUCIBLE) SCIENCE
scientific process and results should be open such that they are reproducible by members of the community

Challenges:

- Management of scientific resources, data
- Data verification
- Proper attribution
- Ensuring transparency throughout the research process

Fig: Characteristics of Open Science, <https://science.nasa.gov/open-science-overview>

Blockchain for Open Science

	Open Science	Blockchain Characteristics					
		Decentralization	Cryptographic Hashing	Timestamping	Immutability (Append-Only)	Consensus Mechanism	Access and Governance System
Open Science Infrastructure Requirements	Collaborative Environment	X				X	X
	No censorship	X	X		X	X	
	Open Data		X				X
	Open Access		X				X
	Identity and reputation management	X	X			X	X
	Extensible system					X	
	Incentives for collaboration and sharing	X				X	X
	Equality of all participants	X				X	X
	Simple workflow integration					X	
	Data and content sharing	X	X			X	X
	Crowdfunding		X			X	X
	Trail of research (objects)	X	X	X	X	X	
	Citizen Science	X	X	X			X
	Open Source code and tools	X					X
	Resource sharing	X				X	X
	Metrics	X				X	X
	Connected systems						X

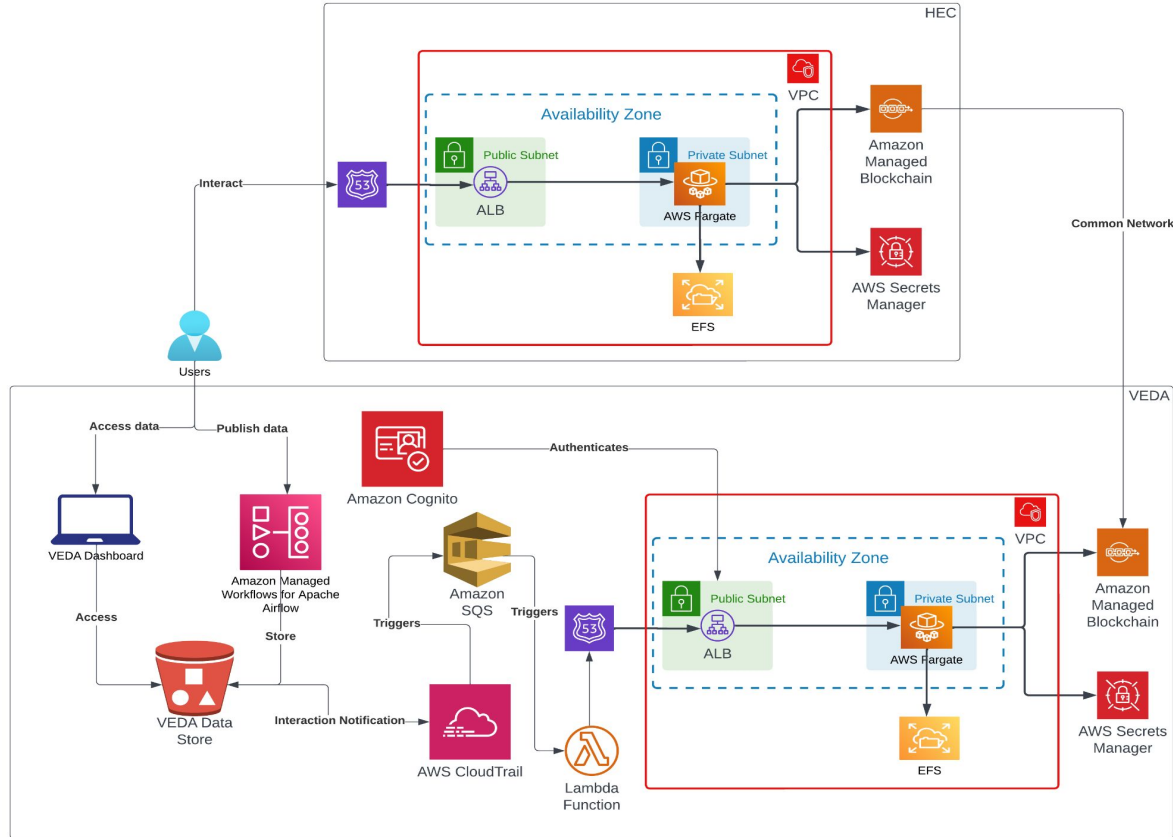
Fig : Open science infrastructure requirements and blockchain technology characteristics that are fulfilling them, Leible et.al

From : <https://doi.org/10.3389/fbloc.2019.00016>

Open Science Blockchain Use case

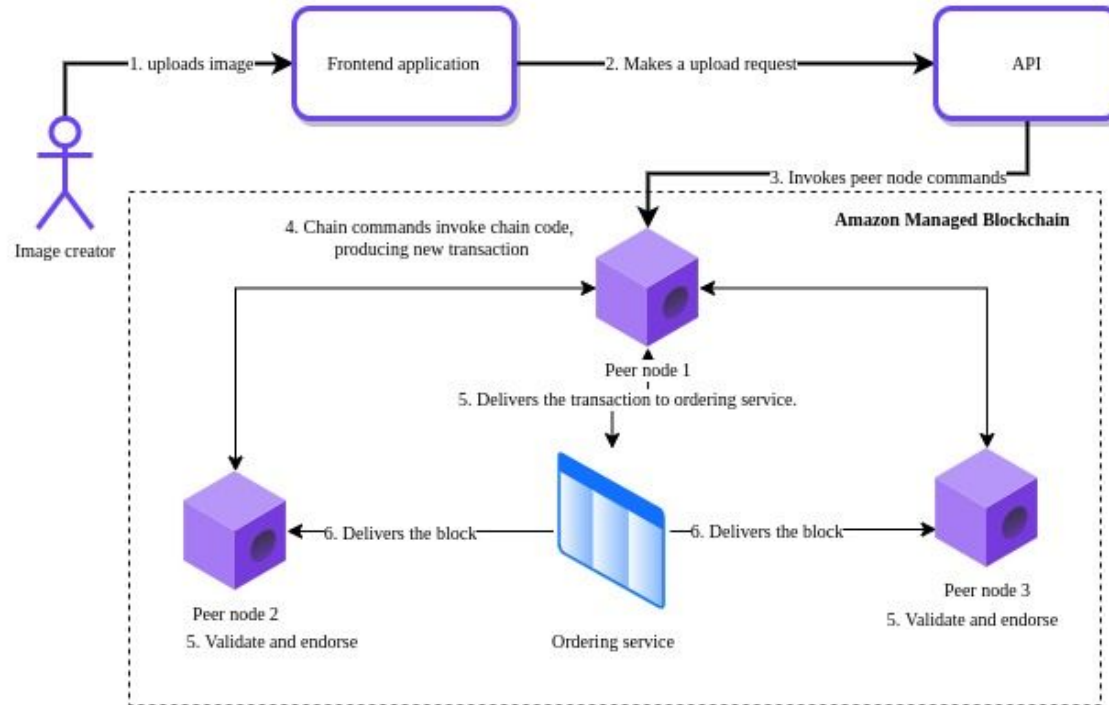
- Utilizing Visualization, Exploration, and Data Analysis (VEDA) project for the proof of concept.
- VEDA
 - utilizes open-source tools and resources to create an open-source science cyberinfrastructure for data processing and geographic information systems (GIS) capabilities
 - allows scientists from different organizations and teams to contribute datasets. These datasets are used to create discoveries or Data Stories to highlight multiple events
- VEDA's collaboration with High-End Computing program (HEC) used to demonstrate how Open Science Blockchain fosters Open Science.

Implementation



Architecture diagram

Implementation



Use cases

Nitrogen Dioxide (NO₂) and NO₂ difference (NO₂ diff) data in VEDA

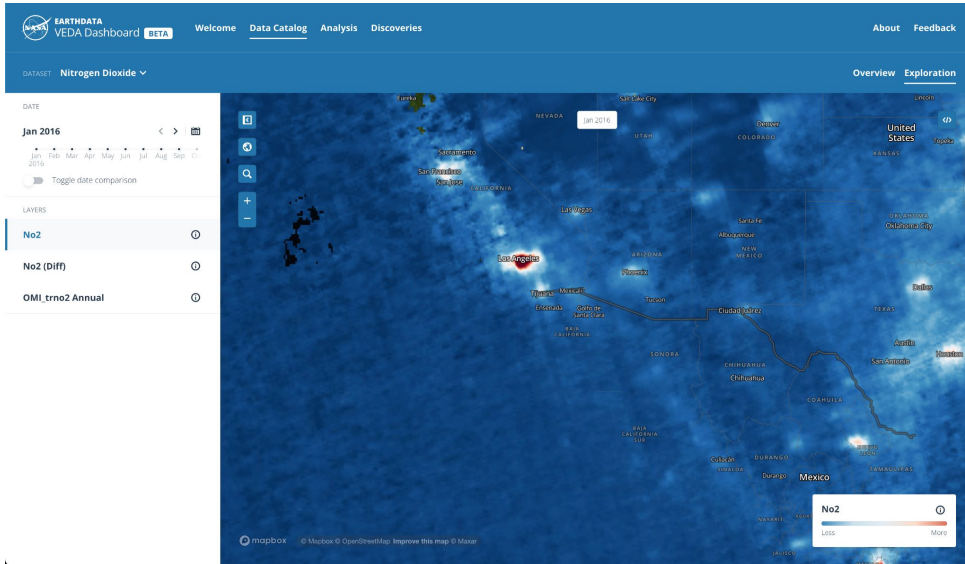


Fig: NO₂ data visualization in VEDA Dashboard

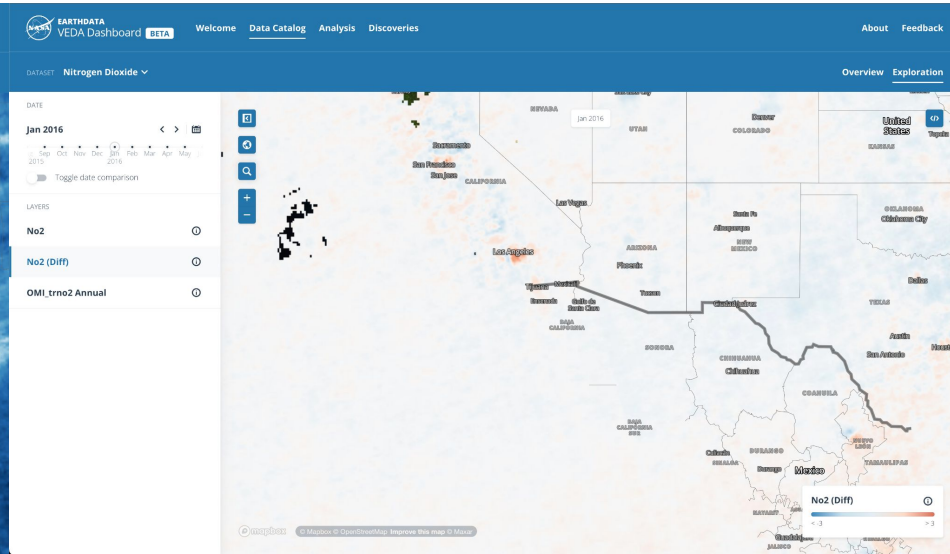


Fig: NO₂ diff visualization in VEDA Dashboard

Usecases

Use case 0: HEC Copies data from VEDA to become authoritative distributor of the data

Copy data

 Info

Select the data to copy into your organization. The data will be automatically copied to your S3 bucket, which you can use to distribute.

no2-monthly/OMI_trno2_0.10x0.10_... ▾

SUBMIT

116	no2-monthly/OMI_trno2_0....	VEDA
117	no2-monthly/OMI_trno2_0....	HEC



no2-monthly/OMI_trno2_0.10x0.10_2019...  Authoritative 

Distributed by : VEDA

Original source : VEDA

No description provided.

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no2-monthly/OMI_trno2_0.10x0.10_2019...  Authoritative 

Distributed by : HEC

Original source : VEDA

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Use cases

Use case 1: Differentiate between authoritative and non-authoritative data

no2-monthly/OMI_trno2_0.10x0.10_2022...  Authoritative 

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no2-monthly/OMI_trno2_0.10x0.10_2022... 

Distributed by : HEC
Original source : VEDA

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Use cases

Use case 2: Citation is enabled to support open science

no2-monthly-diff/OMI_trno2_0.10x0.10... Authoritative

Distributed by : VEDA
Original source : VEDA

No description provided.

Citations : no2-monthly/OMI_trno2_0.10x0.10_202211_Col3_V4.nc.tif, no2-monthly/OMI_trno2_0.10x0.10_202111_Col3_V4.nc.tif

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no2-monthly/OMI_trno2_0.10x0.10_2017... Authoritative

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Original source : VEDA

No description provided.

Wed Jul 19 2023 11:06:19 GMT-0700 (Pacific Daylight Time) Created by slesa

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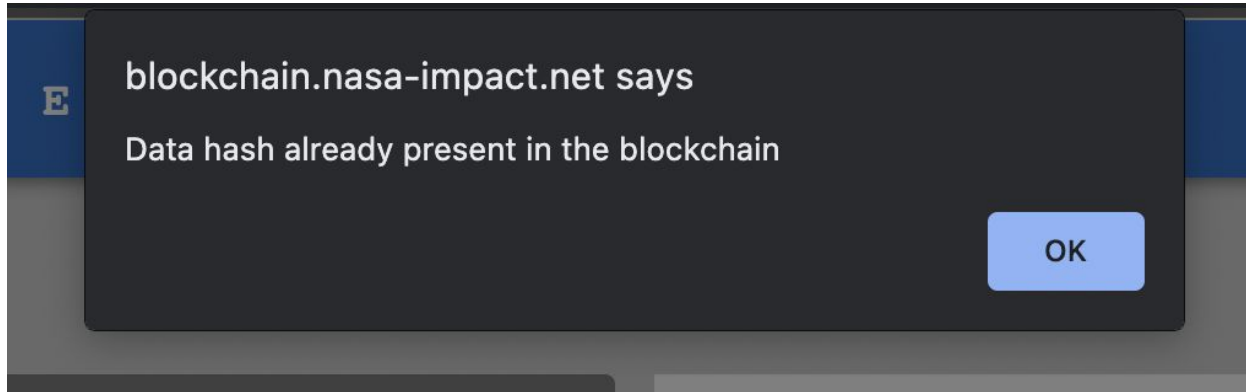
Citations : no2-monthly/OMI_trno2_0.10x0.10_201708_Col3_V4.nc.tif

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Use cases

Use case 3: Re-uploads to the network are not permitted



Use cases

Use Case 4: Adding a new organization to the network

Invitations (1) Info							
				View details		Reject invitation	Accept invitation
				< 1 >			
	Network name	Invitation ID	Network ID	Description	Status	Expiration Date	ARN
☐	osblockchain			network-osblockchai...	Accepted	8/30/2022, 6:33:32 ...	arn:aws:managedblo...

Voting Summary		
Yes	No	Outstanding
2	0	0
▼ Votes		
All ▼ < 1 >		
Member name	Member ID	Vote
member-osblockchain		Yes
member2		Yes

Conclusion

- The presented case study demonstrates practical implementation and contributes insights for further research.
- Blockchain technology offers solutions for:
 - Addressing challenges in open science
 - Promoting transparency, reproducibility, and accountability
 - Decentralized and secure sharing of authoritative data
 - Traceability of scientific resources and proper attribution
- Blockchain-based incentives foster collaboration and efficient research practices.
- Adoption of blockchain in open science requires:
 - Policy frameworks
 - Change in data management approaches
 - Cost considerations
- Full adoption of blockchain in open science will take time due to:
 - Policies around data citations and access
 - Additional cost of maintenance and development resources
 - Exploration of decentralized data storage and distribution for proper open science
 - Continued research is essential to unlock blockchain's full potential for advancing open science.

Contact

Iksha Gurung, ig0004@uah.edu