

# EXPLORING BLOCKCHAIN TO SUPPORT OPEN SCIENCE PRACTICES



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## 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

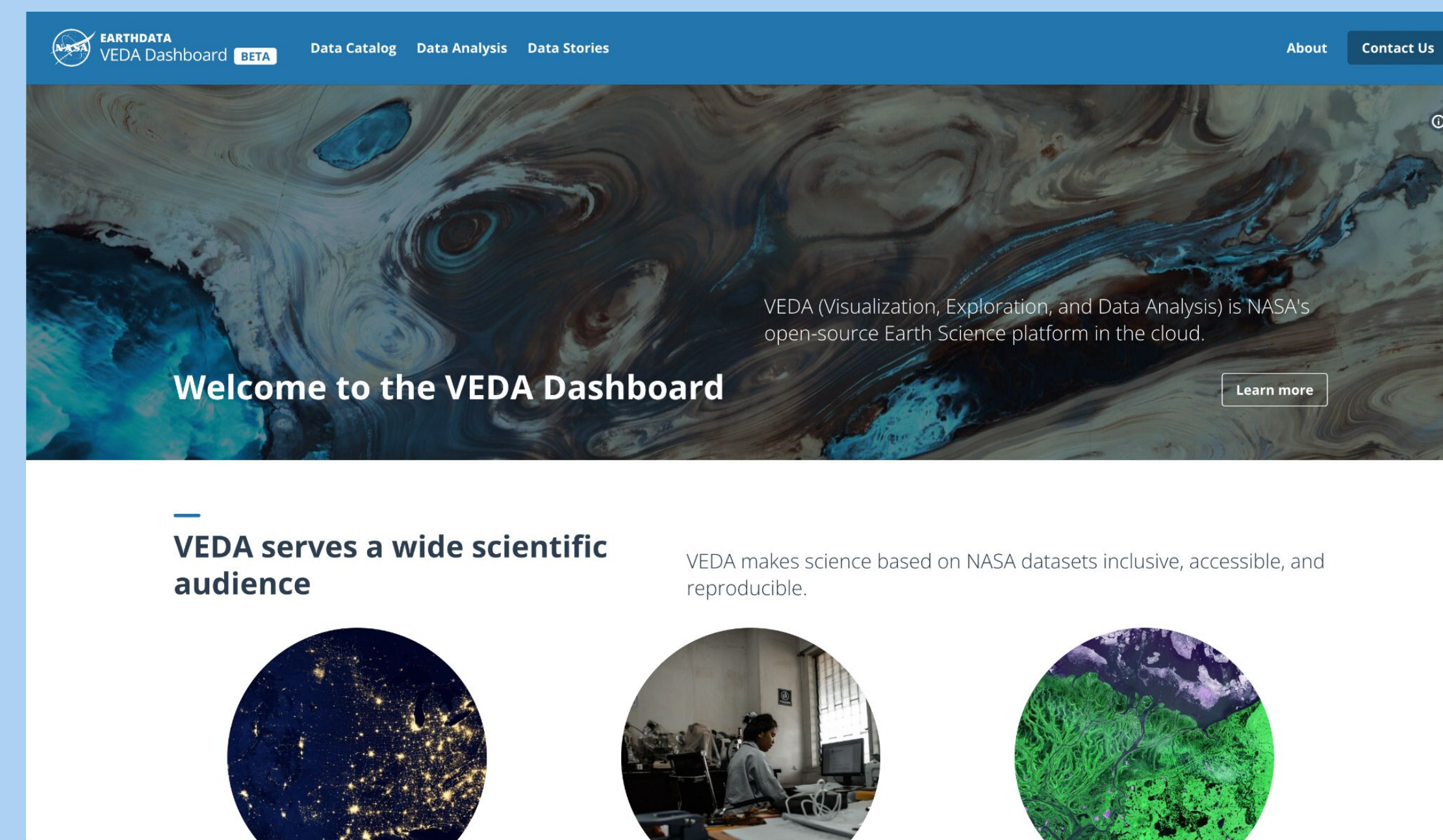
## Challenges

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

## Blockchain for Open Science

Challenges	Blockchain Characteristics
Management of scientific resources, data	Decentralization, Hashing, Consensus, Timestamping
Data verification	Decentralization, Hashing, Consensus, Timestamping
Proper attribution and Incentives	Timestamping, Decentralization, Tokens for incentives
Ensuring transparency throughout the research process	Decentralization, Consensus, Timestamping

## Use Cases



- 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.

- Amazon Web Services (AWS) managed Blockchain Used for the use cases.
- Elastic Container Service (ECS), and Application Load Balancer (ALB) used for hosting the API to interact with the network
- AWS Secrets Manager used to store the configuration.

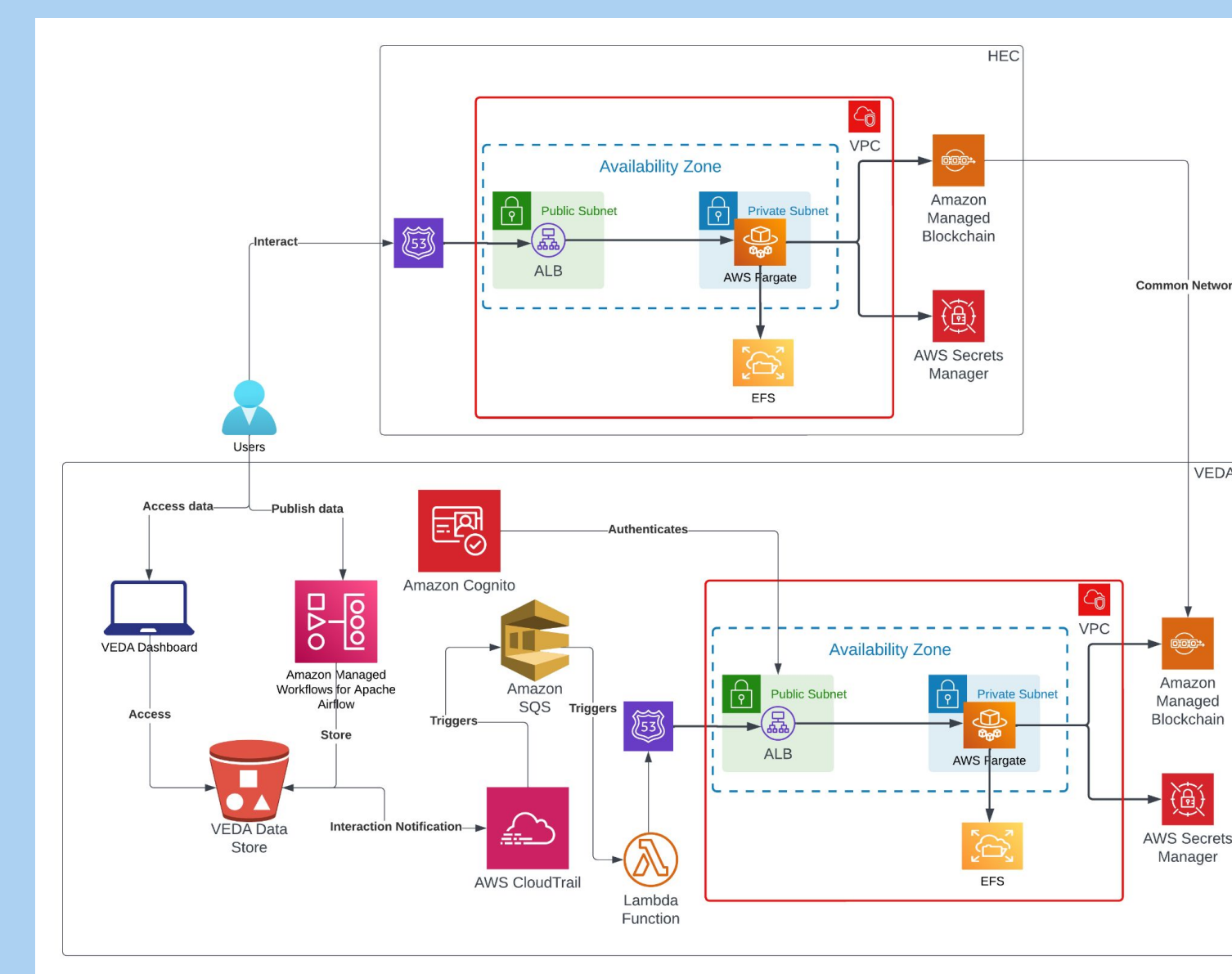


Fig: Architecture Diagram

## VEDA Use Cases

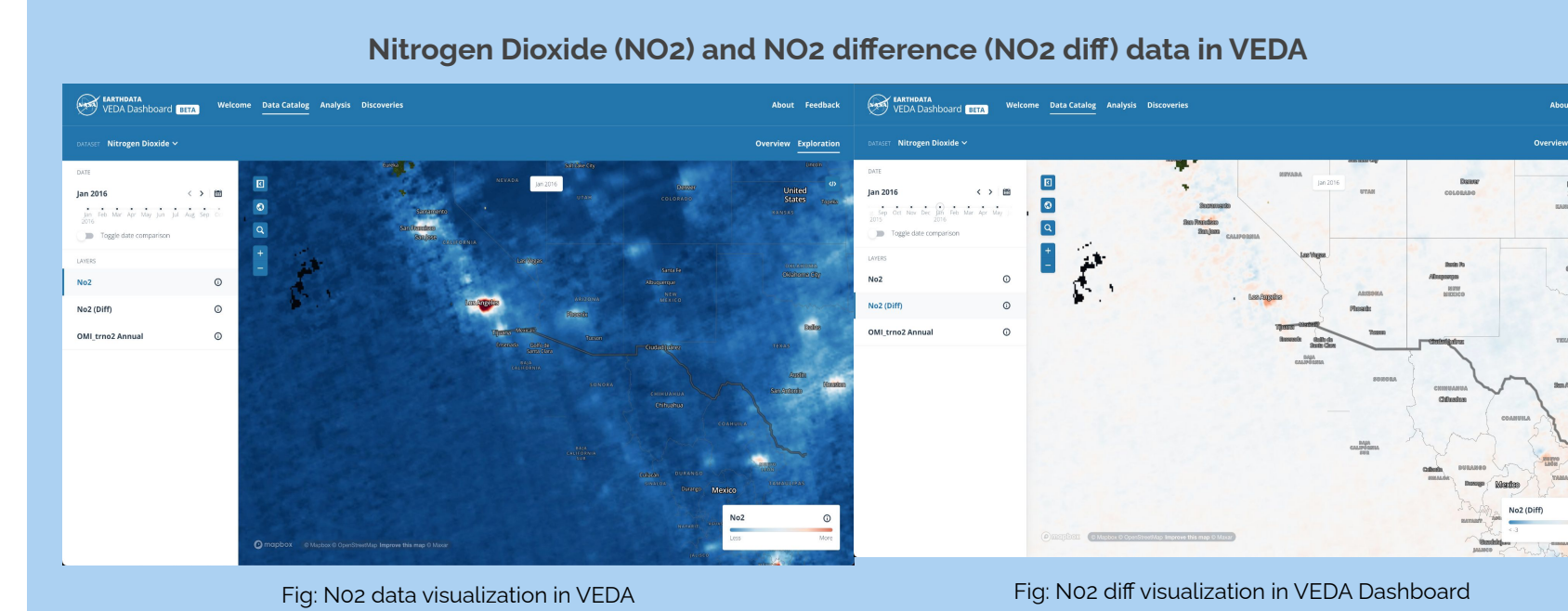
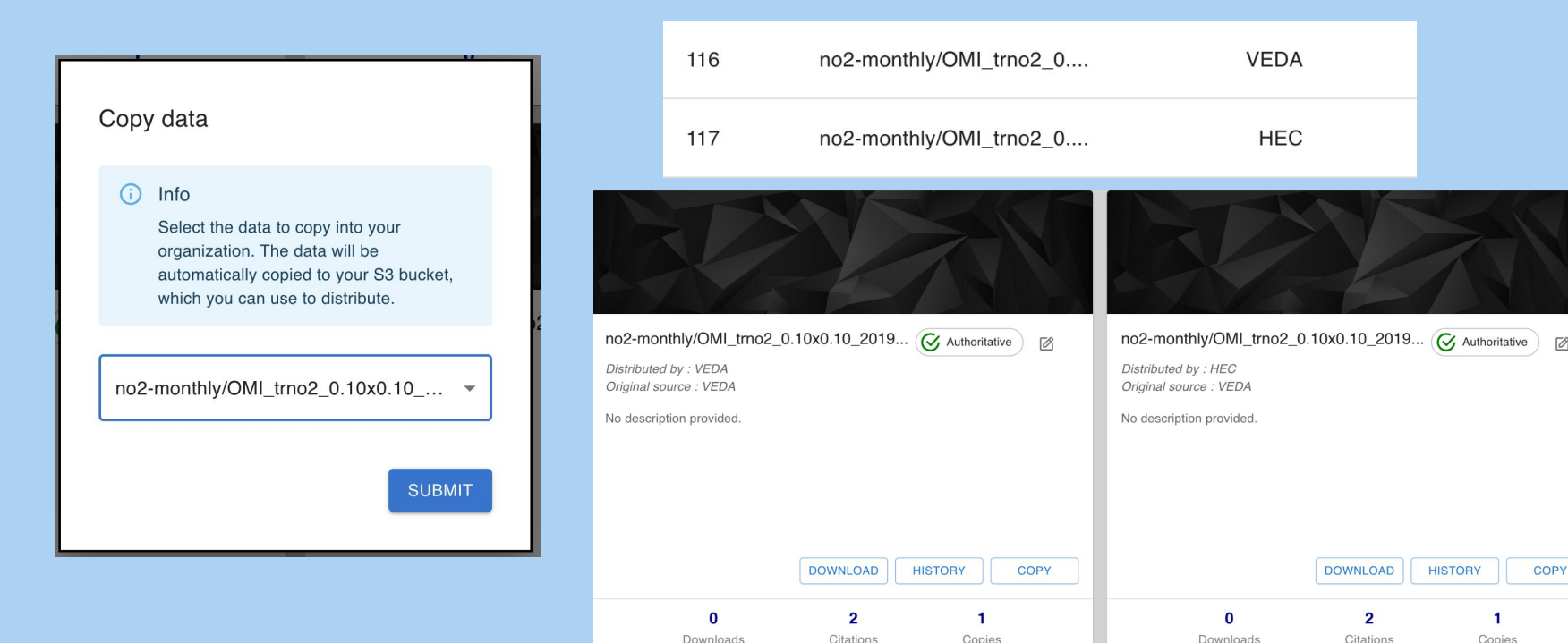
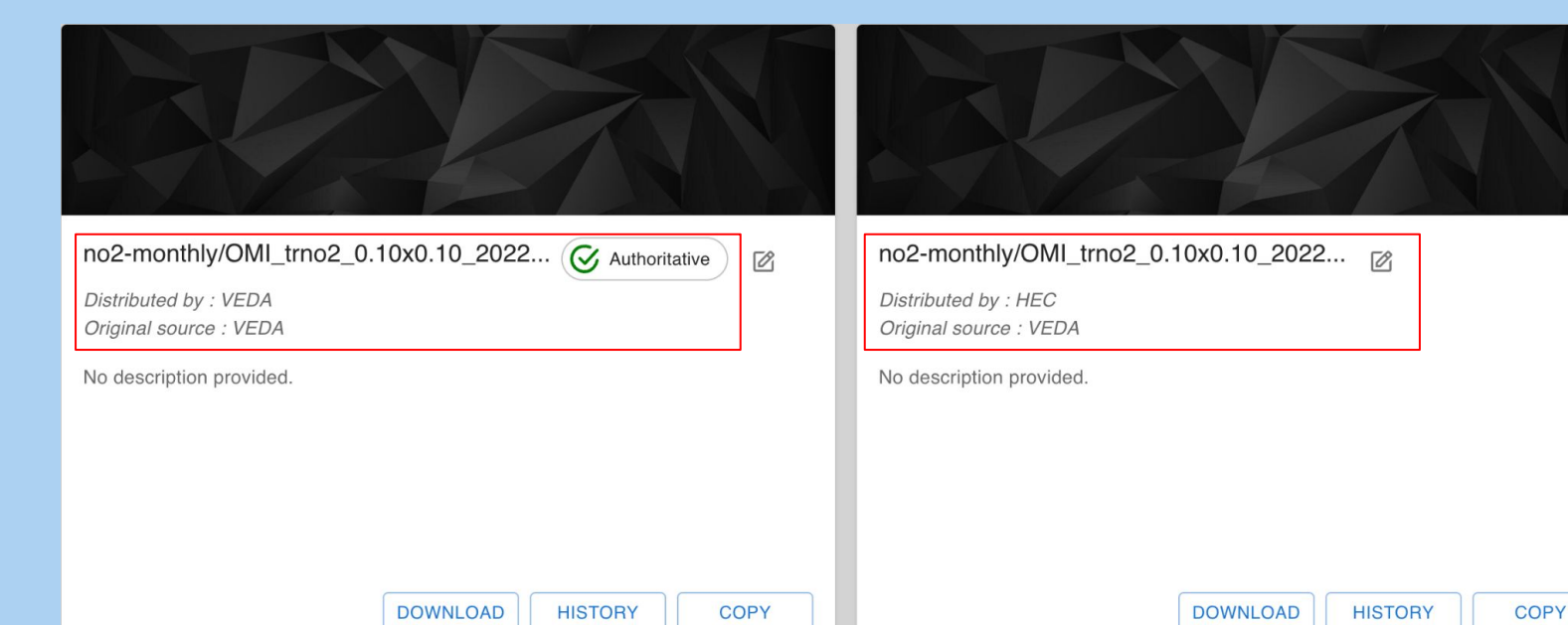


Fig NO2 data visualization in VEDA Dashboard  
Fig NO2 diff visualization in VEDA Dashboard

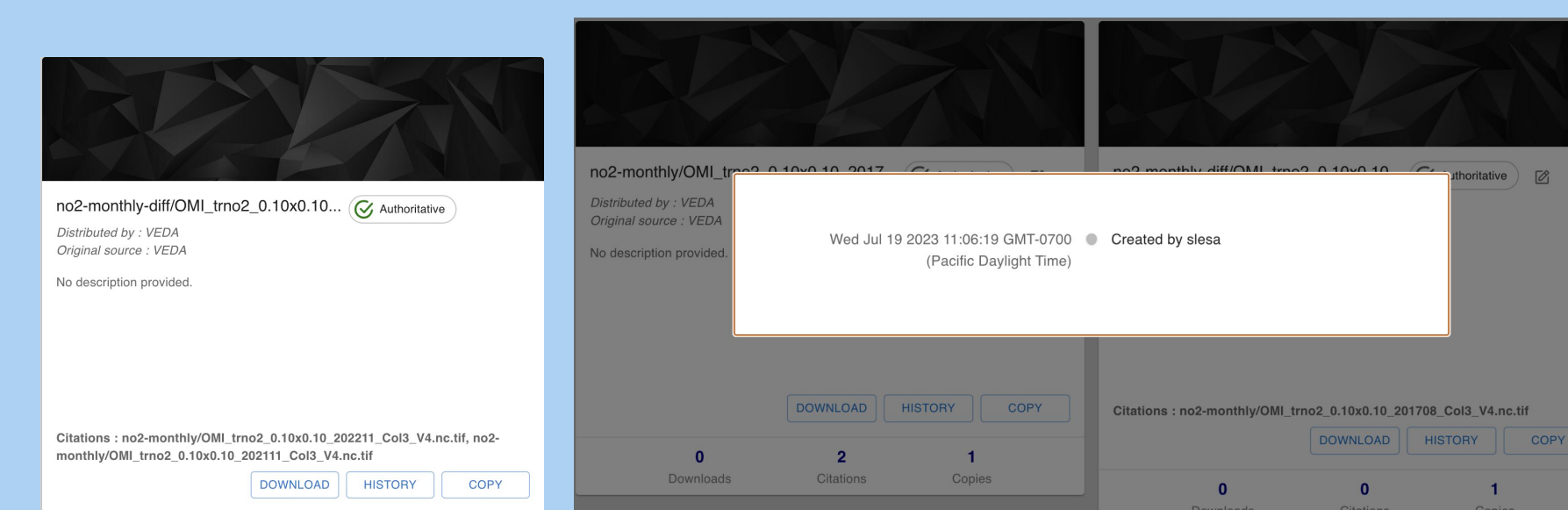
Use case 0: HEC Copies data from VEDA to become authoritative distributor of the data



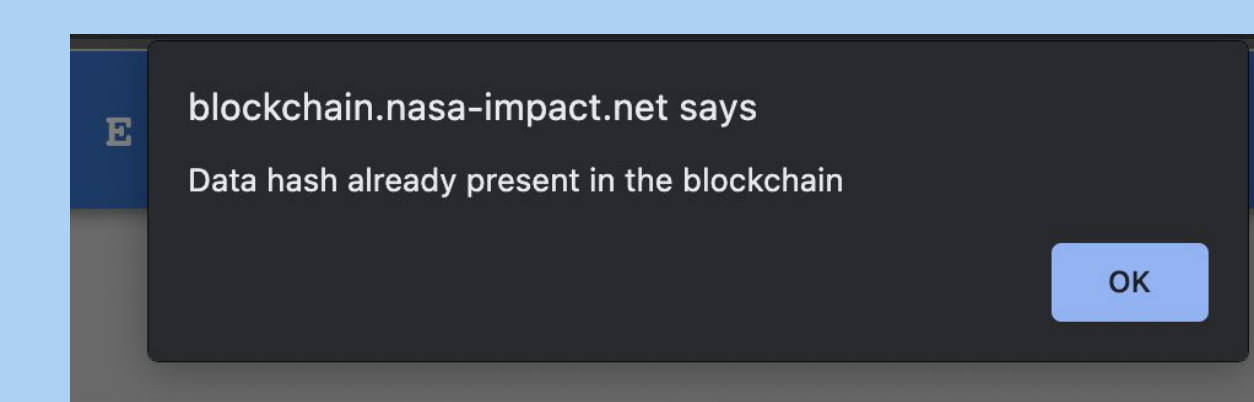
Use case 1: Differentiate between authoritative and non-authoritative data



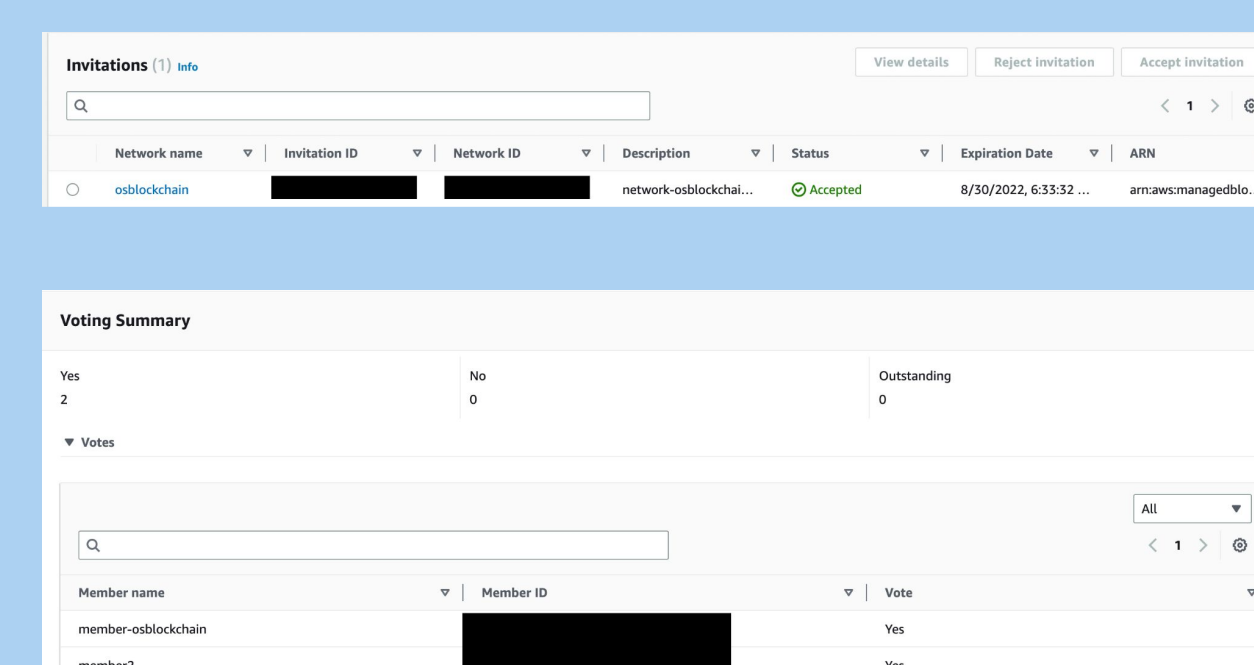
Use case 2: Citation is enabled to support open science



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



Use Case 4: Adding a new organization to the network



## Conclusion

- 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
  - Incentivization for contributing to *Open Science*
- Blockchain-based incentives foster collaboration and efficient research practices.

## Challenges for adaptation

- 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.

## Acknowledgements

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