Real-Time Forecasting and Operational Control (RTFO) Module

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Science-informed Machine Learning to Accelerate Real Time (SMART) Decisions in Subsurface Applications

Summary

- **Objective:** Provide advanced, user-friendly tools for real-time decision support in CO_2 injection management.
- **Importance:** Addresses the critical need for accurate simulation and optimization of reservoir conditions for CO_2 sequestration to mitigate climate change.
- **Technology:**
  - Interface: Dynamic, browser based, built with Python and Plotly Dash.
  - Accessibility: Allows users to interact with reservoir simulation tools without needing to install software.
- **Capabilities:**
  - Integration: Combines forward models and history matching algorithms.
  - Data handling: Users can upload monitoring data, choose history matching algorithm, and run simulations.
- **Models:**
  - History Matching (HM): Uses the TAMU's history matching machine learning model for the Illinois Basin Decatur Project (IBDP) dataset.
  - Forecasting: Utilizes the University of Texas at Austin's Bureau of Economic Geology (UTBEG) model.
- **Optimization:** Aims to optimize storage and minimize pressure build-up.
- **Benefits:**
  - Real-Time adjustments: Facilitates real-time modification to operations and monitoring strategies.
  - Efficiency: Enhances the efficiency and effectiveness of CO_2 sequestration projects.

Features

- Provides real-time actionable decision support to improve operation and risk management strategies during geological carbon sequestration operations.
- Integrates history-matching ML models and visualizes them within the modern-looking graphical user interface.
- Forecasts future reservoir performance based on historical monitoring data.
- Optimizes storage efficiency by varying injection strategies.

Results

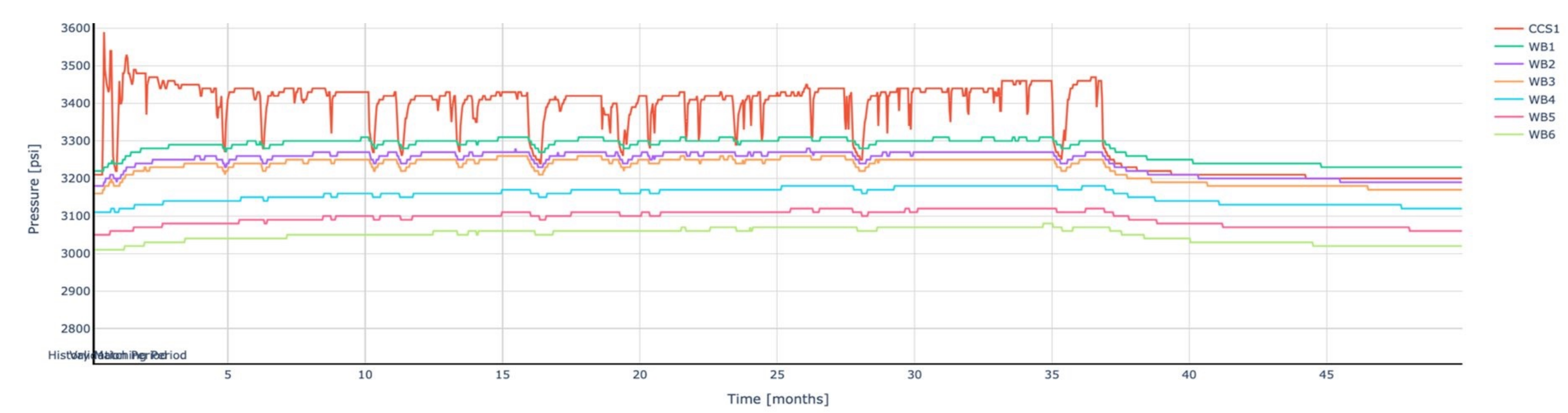

Figure 1. IBDP Bottom Hole Pressure

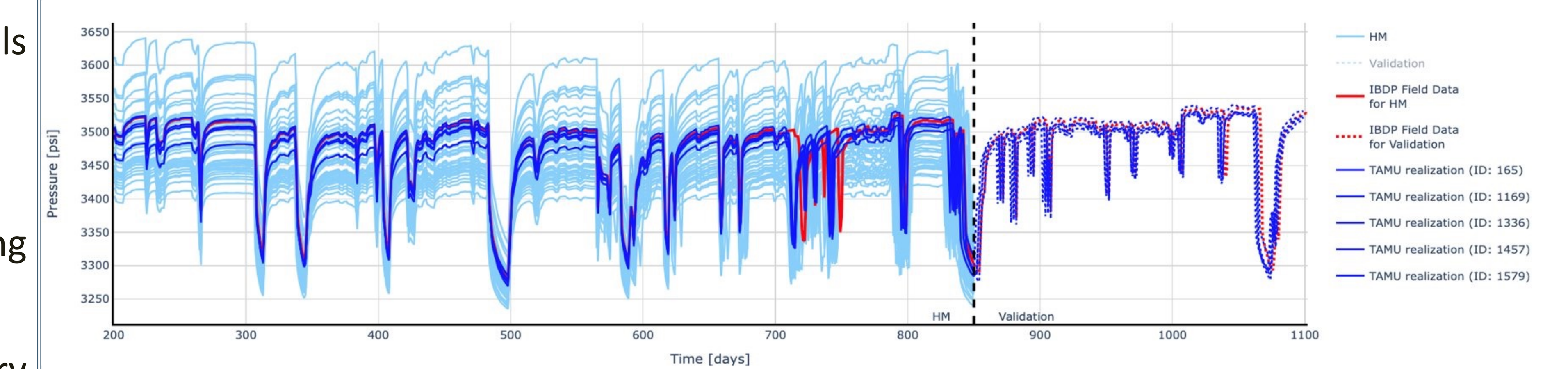

Figure 2. TAMU Pressure History Matching

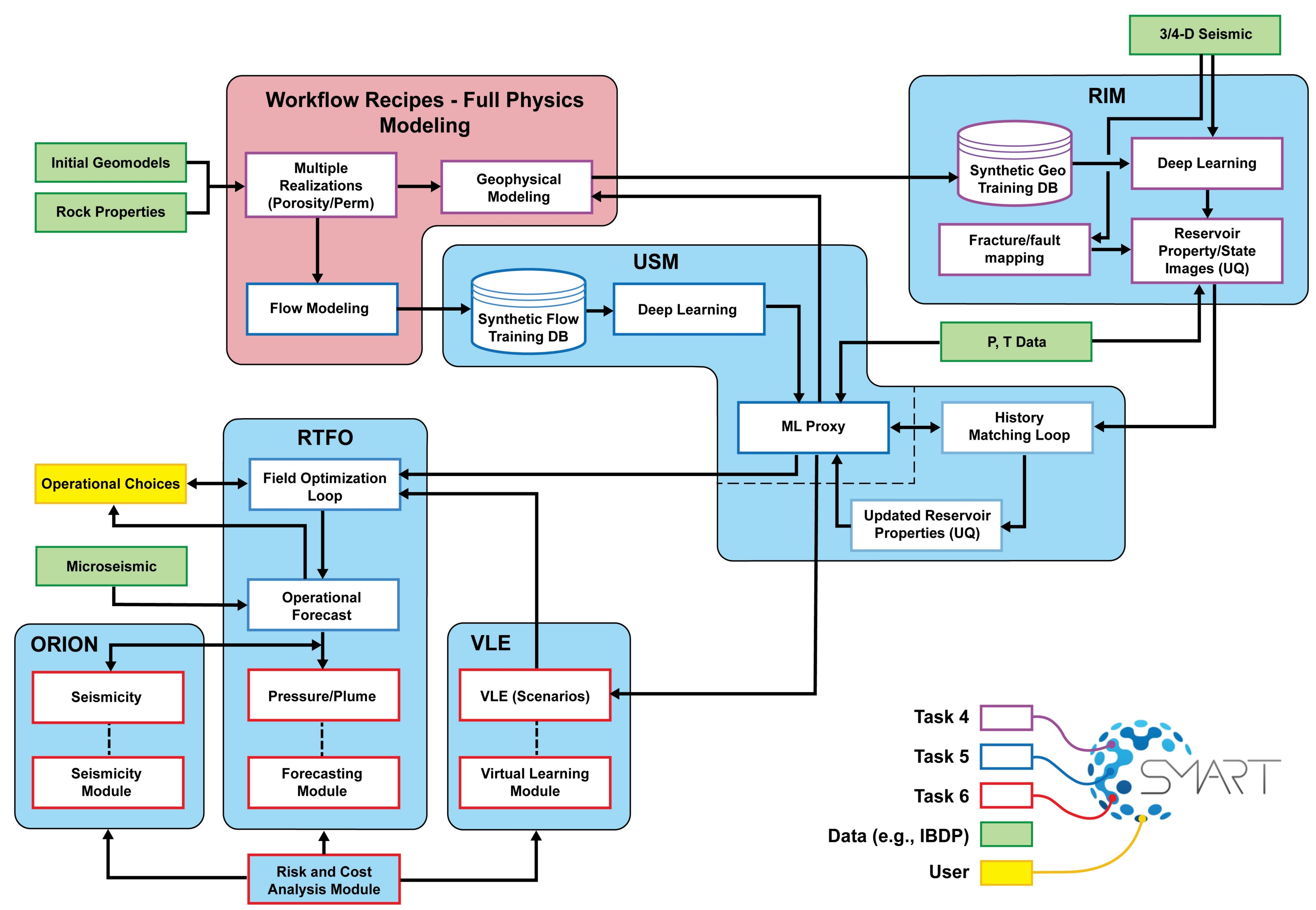

Figure 5: Workflow of SMART Modules

Conclusion

- The RTFO module utilizes machine learning-driven history matching to accurately constrain subsurface parameters, enhancing reservoir model precision.
- It enables the creation of optimized site operation plans despite uncertainties.

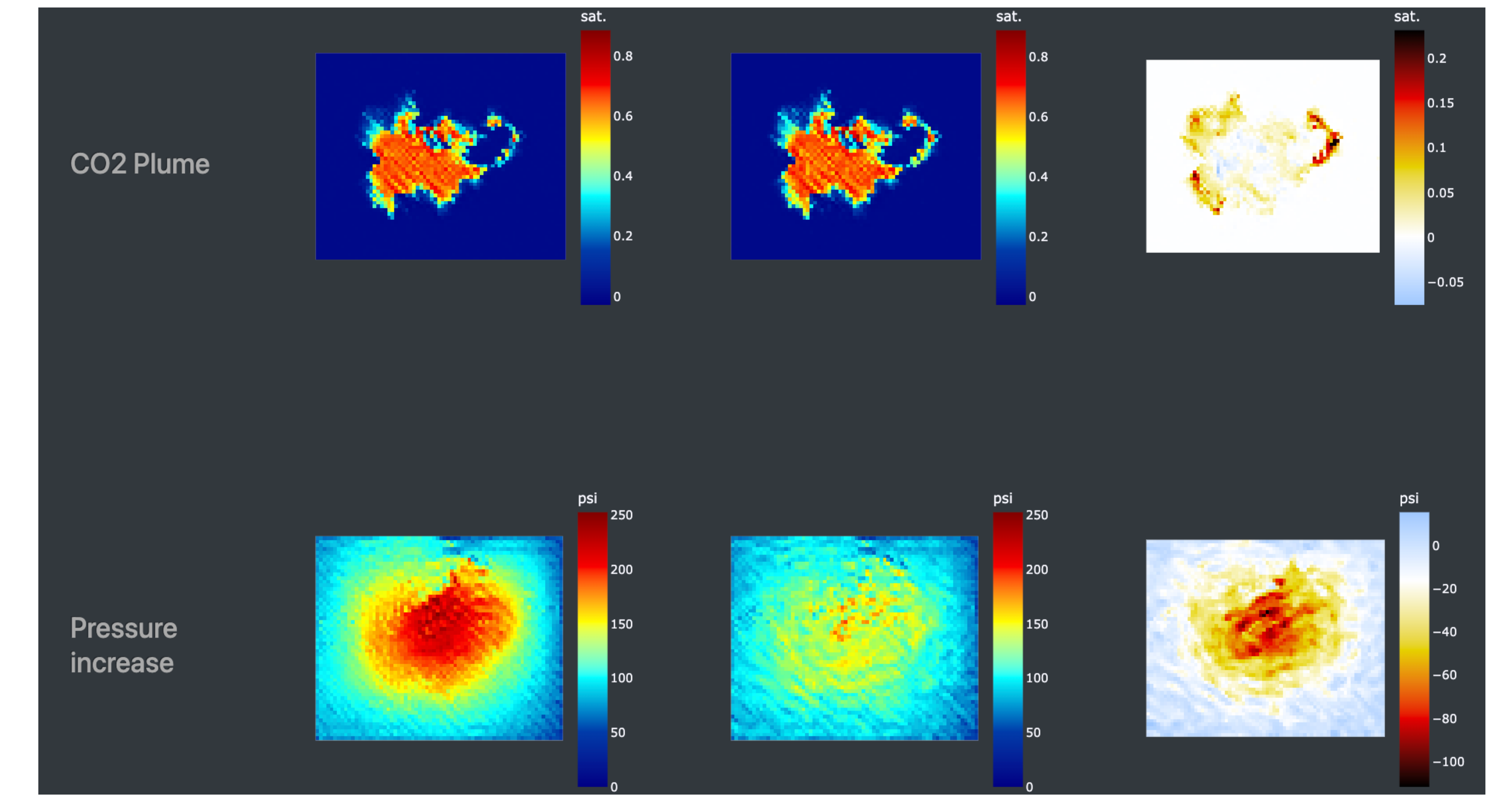

Figure 3: CO_2 saturation and pressure increase predicted by the Texas A&M model for scenarios with a base (left) and optimized (middle) injection rate. The difference between the two scenarios is shown on the right.

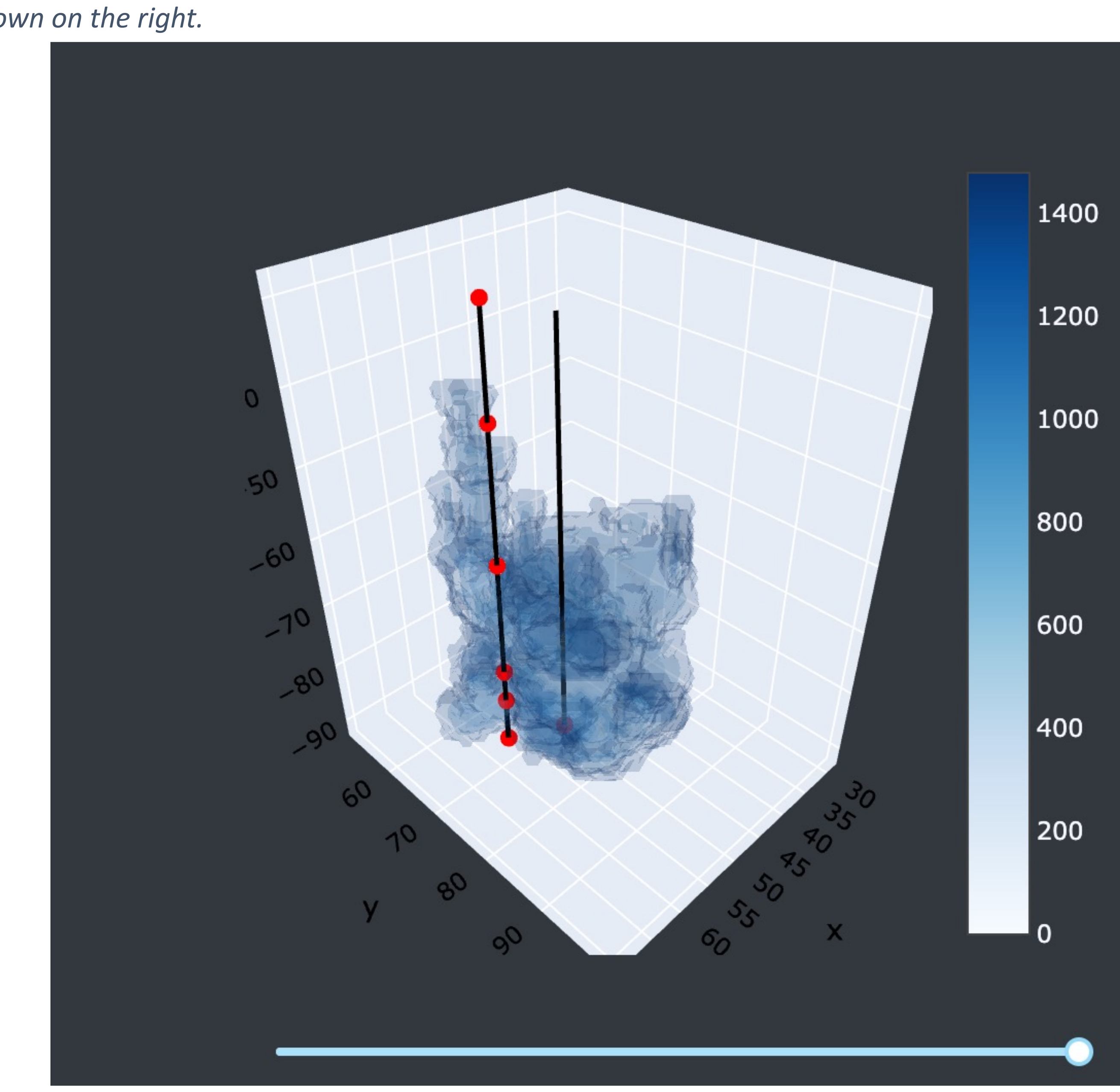

Figure 4: 3D representations of IBDP CO_2 Plume

Acknowledgement

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