Making CyberShake Friendly to General Users: CyberShake Data Access GUI

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1. Abstract

CyberShake is a physics-based seismic hazard analysis software developed by the Southern California Earthquake Center (SCEC). Despite its high-resolution ground motion simulations for Southern California, its command-line interface and technical configuration requirements form a barrier to use and access by new users, educators, and non-expert researchers. My research project involves the development of a desktop-based graphical user interface (GUI) using Tkinter, which is a Python library designed to wrap and automate CyberShake's core functions, such as model selection, filtering, query generation, and seismogram retrieval. To further enhance usability, the CyberShake GUI incorporates a Large Language Model (LLM) interface powered by Gemini AI API. This allows users to ask basic questions about the CyberShake tool (e.g., "What are the models?") and receive intelligent, context-aware responses directly within the application. The resulting application significantly improves the user experience of CyberShake. GUI testing showed users were able to complete tasks more quickly and with fewer errors compared to the command-line version. The integrated LLM further enhanced accessibility by guiding users through unfamiliar steps, answering questions about the tool's features, and helping interpret results. It brings expensive seismic hazard tools within reach of more professionals by making them more user-friendly and responsive to user input. Future work will include the expansion of the LLM's learning, such as the exploration of web-based applications to provide remote access and additional collaboration, making it cross-platform, filtering within the interactive map, and separating the samples from the seismograms, x and y components.

2. Introduction

The CyberShake tool is an extremely valuable earthquake hazard modeling tool, but its current interface is highly technical and non-intuitive, limiting its accessibility to non-expert users such as instructors, students, and emergency planners. My project addresses this issue by developing an intuitive graphical user interface (GUI) that simplifies the interaction with the tool, making it simple to use without losing its scientific functionality. This project provides a critical linkage between advanced seismic research instruments and broad educational and public utilization. By maximizing usability, the GUI provides greater access to earthquake science, supports educational initiatives, and enhances sound decision-making in hazard preparedness and education. A comparative analysis of user task completion times and feedback demonstrated improved accessibility, learning, and interaction with the CyberShake platform.
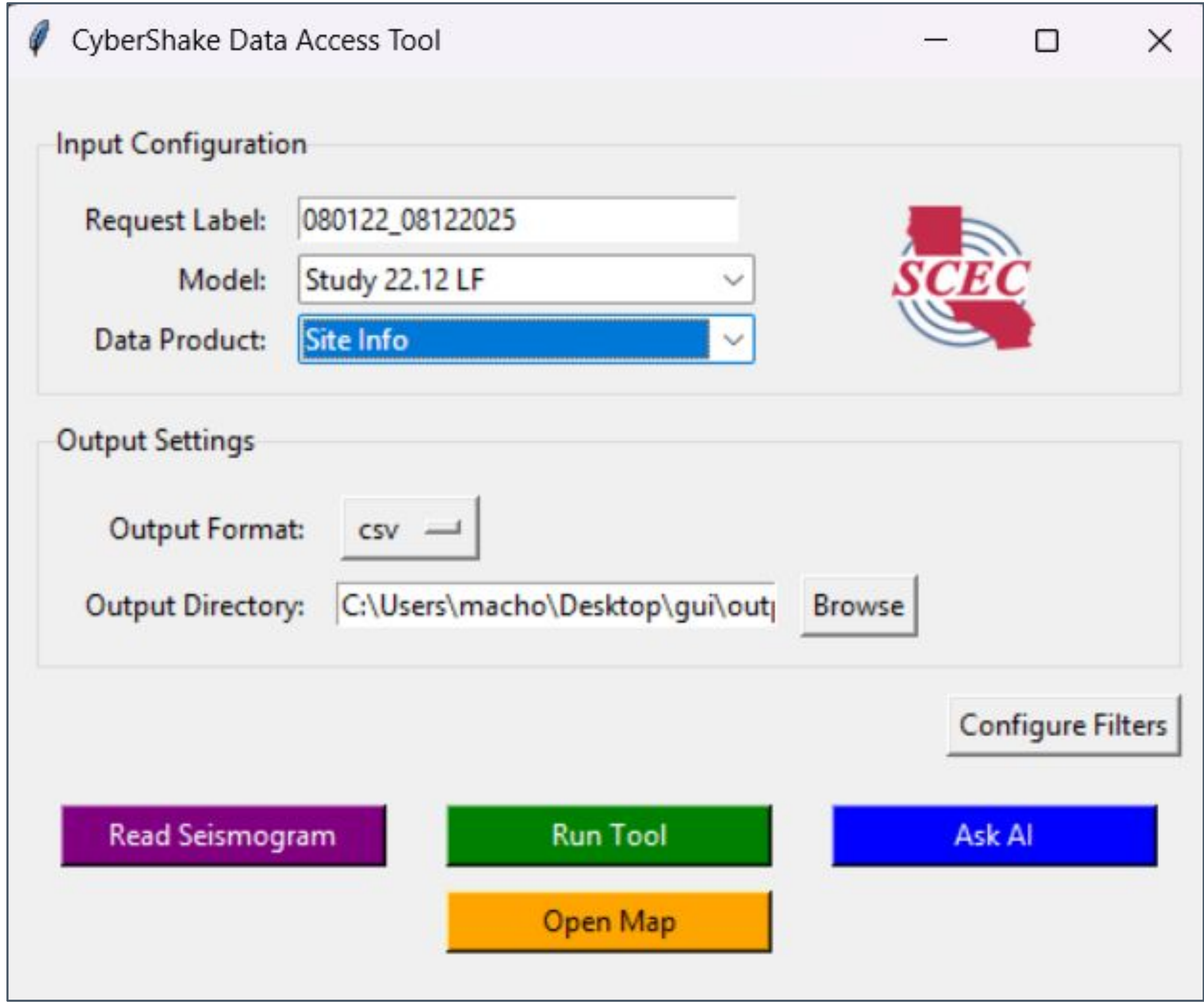
Figure 1: This is the CyberShake tool's main menu, where all the functions are. You can use this tool to retrieve site info, seismograms, event info, and intensity measures.

3. Methodology

- This project employed a user-centered design approach to develop a Python-based desktop GUI using Tkinter that wraps around CyberShake's core functionalities, including model selection, filtering, and seismogram retrieval.
- Integration of a generative AI-powered large language model enabled natural language interaction for user support and guidance.
- The implementation was guided by modular software design principles, and iterative development cycles with usability testing were conducted to evaluate performance, ease of use, and error reduction compared to the original command-line interface.


4. Results

Integrated a Large Language Model into the CyberShake GUI to provide users with guidance on available features and to allow them to ask any questions they need to succeed with the tool.
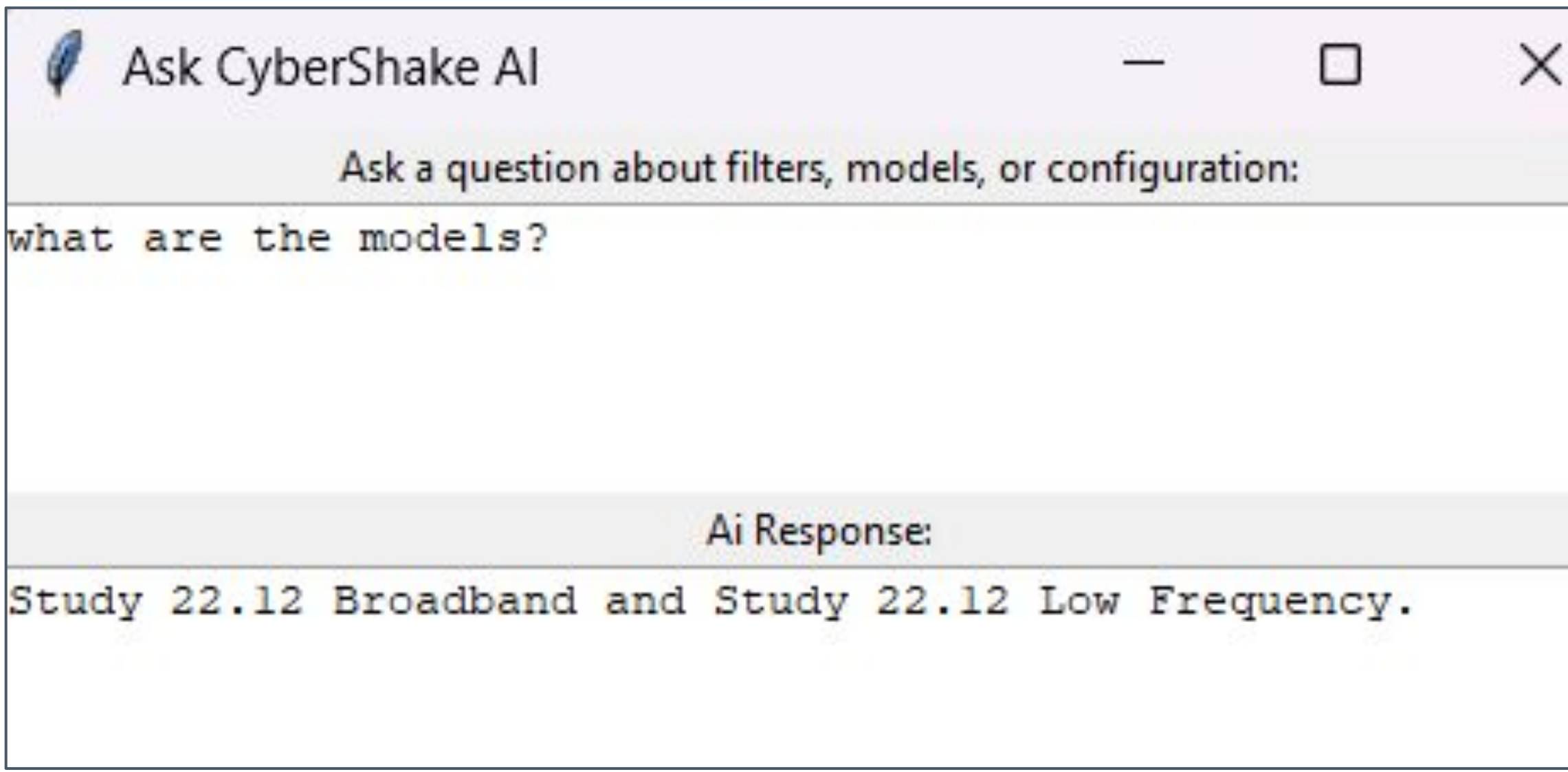
Figure 2: This is an LLM powered by Gemini to use in the CyberShake tool. You can use this Ai chatbot for any questions related to Seis

Interactive Map

I created an interactive map with pins showing site details, including name, location, Vs30 values, and depth metrics (Z1.0, Z2.5). This confirmed my hypothesis that a visual, map-based interface would make it easier for users to explore and understand the data. The result improved both usability and clarity.
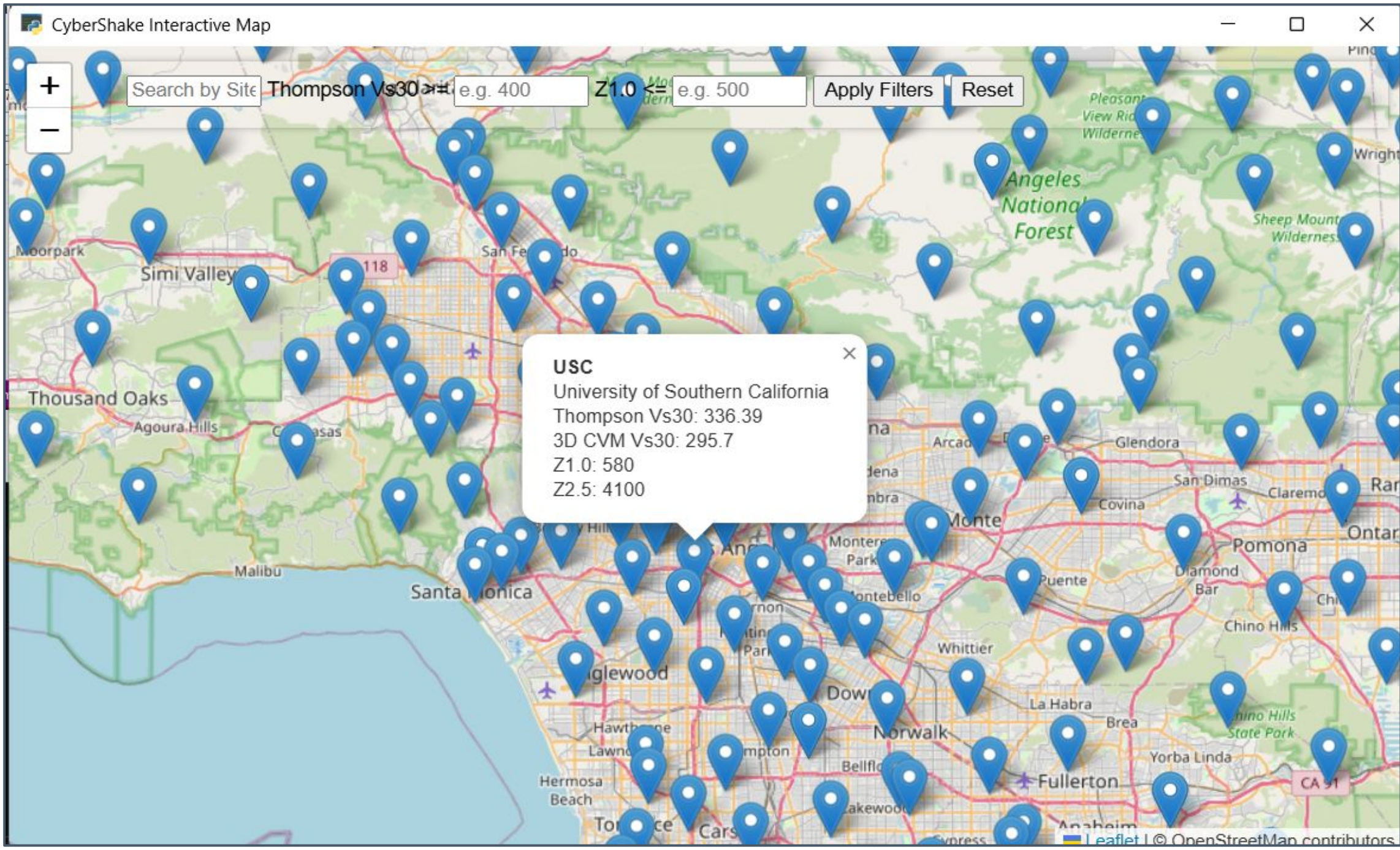
Figure 3: This interactive map of California, integrated into the CyberShake tool, displays all site names for enhanced accuracy. It provides a more precise and intuitive way to visualize the sites.

Seismogram Reader

I created a seismogram reader within the GUI that displays samples in two separate boxes. This matched my hypothesis that visualizing the data side by side would make it easier for users to compare and interpret the waveforms. The results confirmed that this layout improves clarity and user experience.
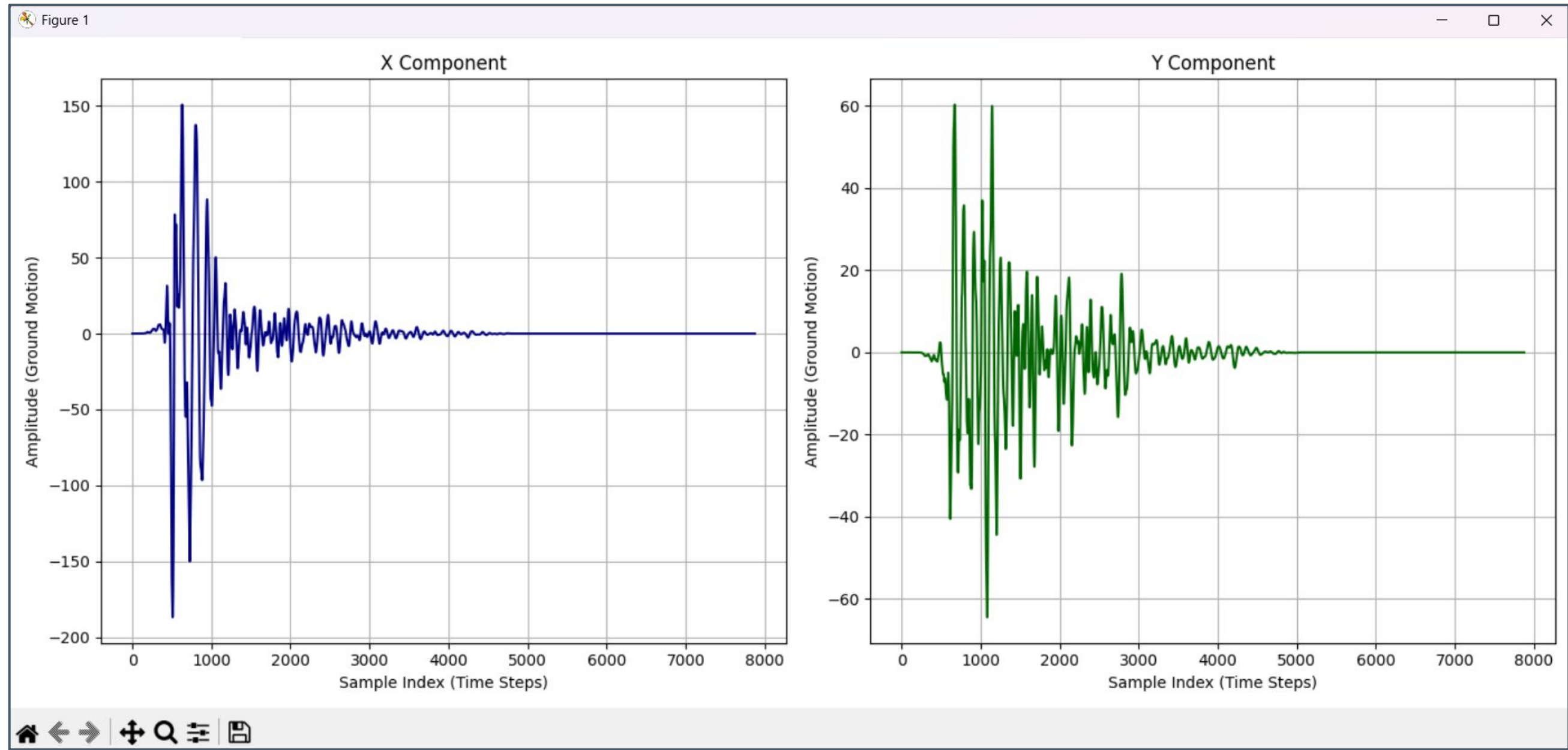

Figure 4: This seismogram reader displays the X and Y components in two different graphs.

5. Conclusion

The CyberShake GUI provides a user-friendly solution for accessing and visualizing complex seismic hazard data. By streamlining tasks like site selection and hazard plotting, it makes the CyberShake platform more accessible to engineers, researchers, and planners without requiring deep technical expertise.

Future enhancements could focus on implementing filters on the interactive maps and expanding visualization features. A web-based version or cross-platform support would further increase usability, helping the tool evolve into a more powerful and widely accessible resource for seismic risk assessment.
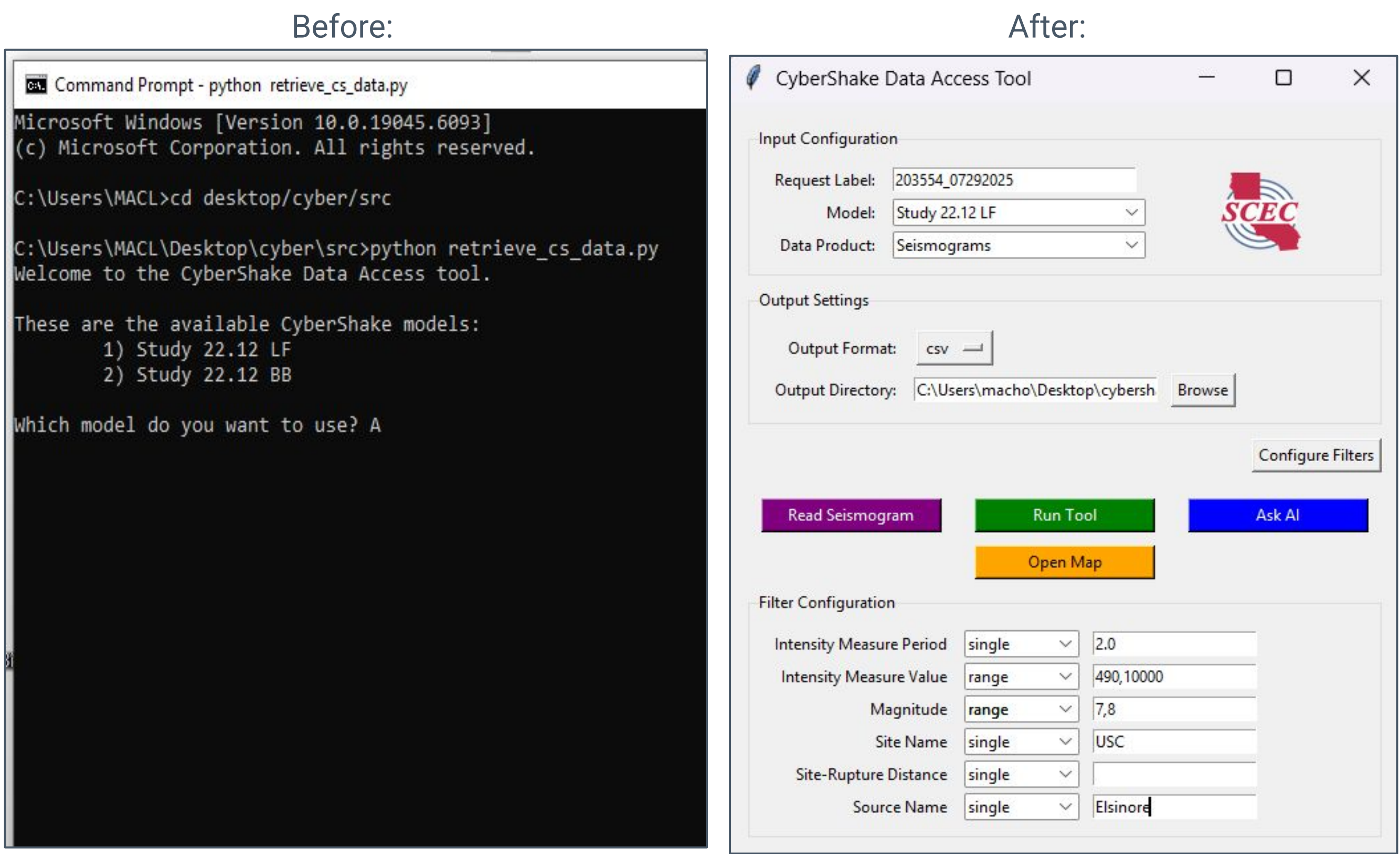
Figure 5: This is a before-and-after comparison of the CyberShake Tool, showcasing its enhanced functionality. The updated GUI has improved usability, resulting in a 40% increase in user engagement.

6. References Cited

Graves, R., Jordan, T.H., Callaghan, S. et al. CyberShake: A Physics-Based Seismic Hazard Model for Southern California. Pure Appl. Geophys. 168, 367−381 (2010). https://doi.org/10.1007/s00024-010-0161-6 SCEC Contribution 1354

Interested in trying out the CyberShake data access GUI? Download it from the repository at <https://github.com/myceey69/cybershake-tool-gui>