

PyGeoModel: A python package for integrating intelligent geographic model services into Jupyter's computing environment

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Abstract: Geoscientific modeling is essential for addressing urban sustainability challenges, yet the complexity of specialized models creates significant barriers for non-expert (Min Chen et al. 2020; Kai Xu 2024 et al.). Jupyter have revolutionized science research by providing an interactive environment that combines code execution, narrative text, and visualization in a single interface, enhancing workflow efficiency and reproducibility. However, despite these advantages, Jupyter still lack seamless integration with professional geographical models that are essential for sophisticated urban environmental analysis. This study introduces PyGeoModel, addressing this gap through two key aspects. First, we develop a graphical user interface within Jupyter that enables code-free access to over 3,000 professional geoscientific models spanning hydrology, climate science, and terrain analysis through a client-side service architecture. Second, we enhance usability through two intelligent services: a context-aware model recommendation function that analyzes notebook content to suggest appropriate models, and a knowledge-enhanced question-answering function that delivers domain-specific expertise during model configuration and interpretation. Both services leverage dynamically constructed contextual information and large language model reasoning capabilities. We demonstrate PyGeoModel's practical utility through a case study assessing urban rooftop photovoltaic potential in Nanjing, China, where it streamlines a traditionally complex workflow into an interactive, reproducible notebook. This integrated approach democratizes sophisticated modeling capabilities essential for urban environmental management while fostering collaborative research through improved accessibility and knowledge sharing.

REFERENCES

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