qgs: A flexible Python framework of reduced-order multiscale climate models

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In atmospheric and climate sciences, research and development is often first conducted with a simple idealized system like the Lorenz-$N$ models ($N \in \{63, 84, 96\}$) which are toy models of atmospheric variability. On the other hand, reduced-order spectral quasi-geostrophic models of the atmosphere with a sufficient number of modes offer a good representation of the dry atmospheric dynamics. They allow one to identify typical features of the atmospheric circulation, such as blocked and zonal circulation regimes, and low-frequency variability. However, these models are less often considered in literature, despite their demonstration of more realistic behavior.

qgs (Demaeyer et al., 2020) aims to popularize these systems by providing a fast and easy-to-use Python framework for researchers and teachers to integrate this kind of model. The documentation makes it clear and efficient to handle the model, by explaining the equations and parameters and linking these to the code.

The choice to use Python was specifically made to facilitate its use in Jupyter Notebooks and with the multiple recent machine learning libraries that are available in this language.

In this talk, we will present the modeling capabilities of qgs and show its usage in a varieties of didactical and research use cases.

Reference

Demaeyer, J., De Cruz, L., & Vannitsem, S. (2020). qgs: A flexible Python framework of reduced-order multiscale climate models. Journal of Open Source Software, 5(56), 2597, https://doi.org/10.21105/joss.02597.