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Stochastic Parametrization for the Impact of Neglected Variability Patterns

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An efficient description of the gravity wave variability and the related spontaneous emission processes requires an empirical stochastic closure for the impact of neglected variability patterns (subgridscales or SGS). In particular, we focus on the analysis of the IGW emission within a tangent linear model which requires a stochastic SGS parameterization for taking the self interaction of the ageostrophic flow components into account. For this purpose, we identify the best SGS model in terms of exactness and simplicity by deploying a wide range of different data-driven model classes, including standard stationary regression models, autoregression and artificial neuronal networks models – as well as the family of nonstationary models like FEM-BV-VARX model class (Finite Element based vector autoregressive time series analysis with bounded variation of the model parameters).
The models are used to investigate the main characteristics of the underlying dynamics and to explore the significant spatial and temporal neighbourhood dependencies. The best SGS model in terms of exactness and simplicity is obtained for the nonstationary FEM-BV-VARX setting, determining only direct spatial and temporal neighbourhood as significant – and allowing to drastically reduce the number of informations that are required for the optimal SGS. Additionally, the models are characterized by sets of vector- and matrix-valued parameters that must be inferred from big data sets provided by simulations - making it a task that can not be solved without deploying high-performance computing facilities (HPC).