Low-Rank Tensor Network Approximations for Large Scale Models

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Sensitivity analysis and model calibration studies for large scale models are challenged by both the large computational cost and large number of parameters typically associated with these models. These challenges are exacerbated by the non-linear input-output dependencies that limit the number of reduced-order techniques that could be leveraged in these studies. In this work we focus on the Energy Exascale Earth System Model (E3SM) land component, and we exploit its internal structure to construct low-rank tensor network surrogates that model the spatio-temporal dependencies for select quantities of interest. We present a set of functional representations and model fitting techniques to construct parsimonious approximations commensurate with the connectivities between various model components. We investigate the efficiency of this approach for uncertainty quantification studies at both regional and global scales.