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ADAPTIVE MULTI-LEVEL MODELLING OF COUPLED MULTISCALE PHENOMENA WITH APPLICATIONS TO METHANE EVOLUTION IN SUBSURFACE

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Summary.
Many important problems in flow and transport phenomena with reactions and phase changes in subsurface can be modeled by a coupled system of PDEs in which the coefficients in the component equations vary by several orders of magnitude; this is for example common when different spatial and temporal scales are relevant for the problem. In such cases it is natural to use a fine computational grid for some components but only a coarse grid for some other components. The choice of the grids should be adaptive and tied to rigorous a-posteriori error estimators.

In this contribution we develop error estimates for a system of reaction–diffusion equations which are robust in parameters and therefore are applicable to degenerate cases. We show applications to models of methane evolution with kinetic exchange terms; these include multiscale and adsorption models relevant to Enhanced Coal Bed Methane recovery as well as kinetic phase transition models for evolution of methane hydrates.