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Capturing multiple scales in geophysical applications by efficient adaptive mesh refinement

Jörn Behrens
University of Hamburg, Germany

Many geophysical phenomena feature an interaction of small and large scale behavior. Tsunami wave propagation in deep ocean is in general well describable by large scale gravity waves, while coastal complexity is driven by small scale topography and non-linear wave phenomena. An other example is the small scale mixing at cloud boundaries that drives the formation of the large scale cloud formation.
In order to capture these locally limited small scales within a large scale frame, adaptive mesh refinement methods have proved great potential. However, many adaptive implementation suffer from different efficiency weaknesses. We will shed light on different aspects of efficiency: numerical efficiency, computational efficiency and the efficiency of capturing the small scale behavior.