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Noise producing smooth surfaces with cut cells

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While with terrain following coordinates the orography follows a line of coordinates, with the cut cell discretisation the points on the lower boundary are positioned in an irregular way. This means that the fields near such mountains is expected also to be irregular. However, idealised test situations use a smooth and often well resolved boundary. When the mountain is also well resolved, we expect smooth meteorological solutions and these are obtained when using terrain following coordinates. When using the rather accurate cut cell discretisation, even for such smooth mountains rather noisy and inaccurate solutions are encountered. This phenomena is called “noise generating smooth surfaces” with cut cells. This means that the particular cut cell scheme is less accurate than expected. Examples and test calculations for this are presented. The mathematical reasons for this phenomena are analysed, the most important being the fact that for the advection process it is inappropriate to pose boundary values for the fluxes at the mountain surface. Examples for a corrected boundary scheme with cut cells are presented. The example of a cloud being transported using the cut cell discretisation is shown, being noise free. This means that the noise generation surface problem has a solution within the high order L-Galerkin formalism.

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