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Modelling atmospheric flows on 3D hybrid unstructured meshes using high-order methods

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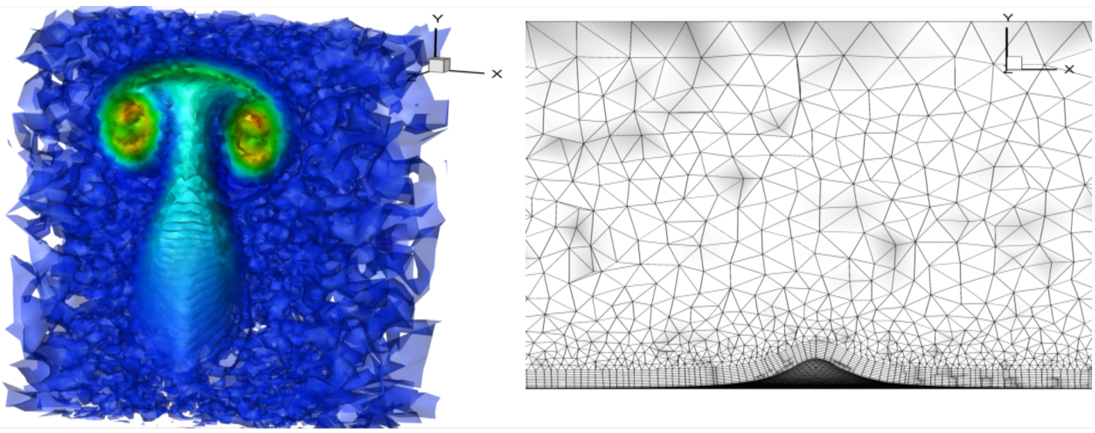
ABSTRACT

This paper presents an assessment of high-order finite-volume (up to 5th-order accurate) methods in conjunction with 3D hybrid unstructured meshes for atmospheric flows. Unstructured meshes consisting of various geometrical shapes such as tetrahedrals, pyramids, prisms and hexahedrals have the capability of representing complicated geometries in a more efficient and accurate manner compared to the structured curvilinear meshes. Therefore, unstructured meshes are perfect candidates for the demanding complicated topographies encountered in climate and weather forecasting.

Recently [1] a class of very high-order high-resolution finite volume methods have been developed that have demonstrated a very high-order of accuracy and the ability of handling smooth and strong-gradients types of problems. The present numerical schemes have been employed for the solution of the non-hydrostatic compressible 3D Euler equations in a conservative form for a rising thermal bubble, a Robert smooth bubble and the flow around a 3D non-linear mountain. The accuracy, efficiency and conservation properties to machine precision of various numerical schemes will be discussed.



(a) Potential temperature perturbations for Robert smooth bubble

(b) Hybrid unstructured mesh for non linear mountain

Figure 1: Test cases

References

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