# A Characteristic Discontinuous Galerkin Method for Tracer Advection in MPAS-Ocean
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## ABSTRACT

A new characteristic discontinuous Galerkin (CDG) advection scheme is presented. In contrast to standard discontinuous Galerkin schemes, the test functions themselves follow characteristics in order to ensure conservation and the edges of each element are also traced backwards along characteristics in order to create a swept region, which is integrated in order to determine the mass flux across the edge. Similar to semi-Lagrangian schemes, the accuracy and performance of the scheme are improved by the use of large CFL numbers and the scheme scales sublinearly with the number of tracers being advected. Using a modal Taylor series basis, the CDG scheme may be run to arbitrarily high order spatial accuracy and on unstructured grids. The scheme is being developed for implementation within the Model for Prediction Across Scales (MPAS) Ocean model, where it is applied on an unstructured Voronoi grid in the horizontal and a temporally evolving arbitrary Eulerian-Lagrangian grid in the vertical by way of operator splitting.

## REFERENCES

[1] D. Lee, R. Lowrie, M. Petersen, T. Ringler, M. Hecht "A high order characteristic discontinuous Galerkin scheme foradvection on unstructured meshes", *J. Comp. Phys.* Vol. **324**, pp. 289–302, (2016).